

SEMINAR AM 23. OKTOBER 2024 IN NÜRNBERG

Agenda

- 09:00 – 09:10 Uhr Begrüßung
- 09:10 – 10:30 Uhr **Funkmodulintegration in der Praxis - Würth Elektronik (Michael Lang)**
- 10:30 – 11:00 Uhr Kaffeepause
- 11:00 – 11:45 Uhr **Marktzugang von Produkten mit Funkmodulen – (Bureau Veritas)**
- 11:45 – 13:15 Uhr Mittagspause
- 13:15 – 14:00 Uhr **Filtern und Abblocken – (Thomas Eichstetter emv-wissen.de)**
- 14:00 – 14:30 Uhr **Cyber Security – (Bureau Veritas)**
- 14:30 – 15:00 Uhr **Redexpert - Auswahl und Simulationstool – Würth Elektronik (Markus Schubert)**
- 15:00 – 15:30 Uhr Kaffeepause und Fußmarsch [10min] zum Bureau Veritas
- ab 15:30 Uhr **Optional: Führung durch das EMV-Labor von Bureau Veritas**





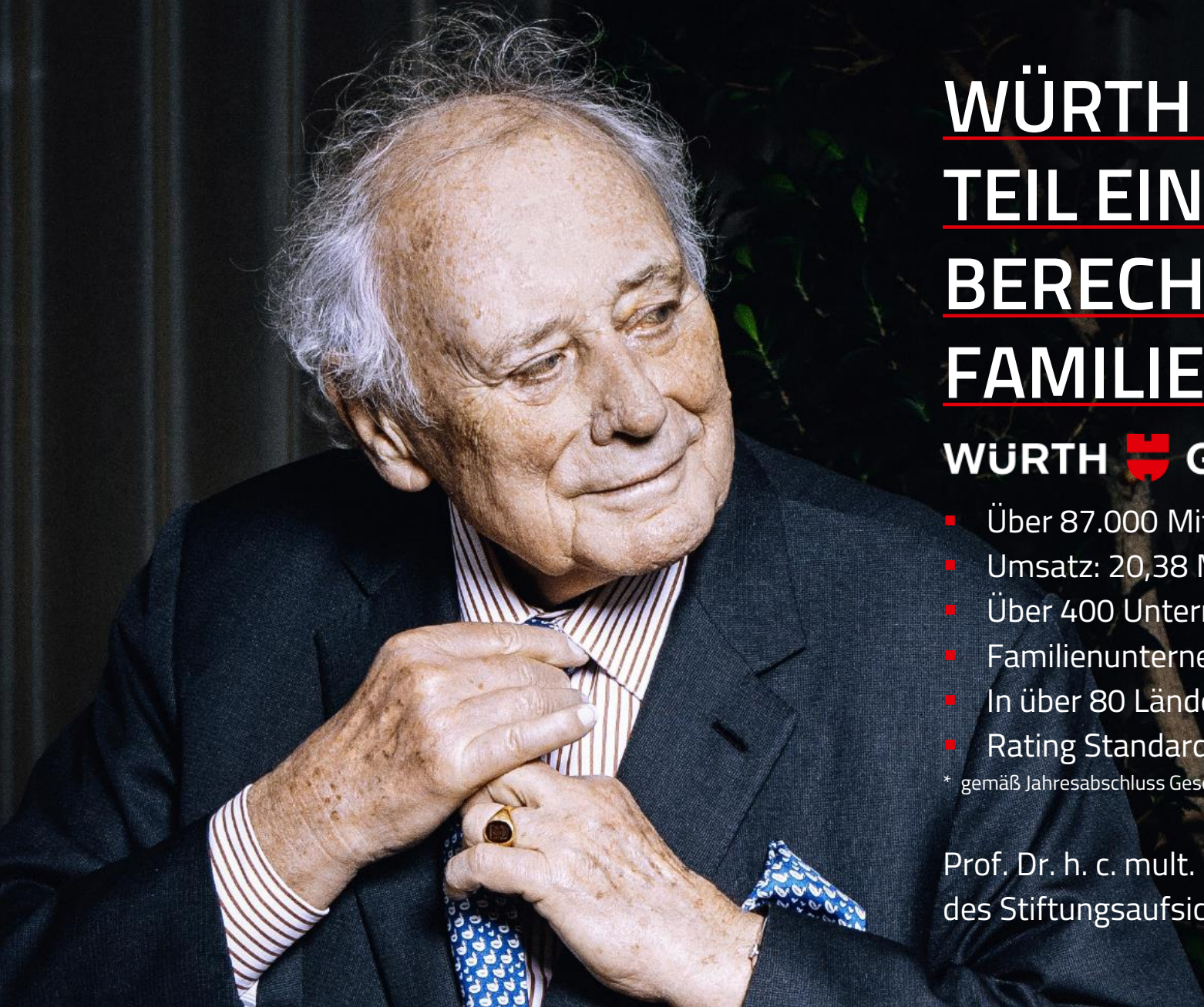
+



**WÜRTH
ELEKTRONIK**
MORE THAN
YOU EXPECT

KURZE VORSTELLUNG

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT



WÜRTH ELEKTRONIK eiSos: TEIL EINES STARKEN & BERECHENBAREN FAMILIENUNTERNEHMENS

WÜRTH  GROUP

- Über 87.000 Mitarbeitende*
- Umsatz: 20,38 Milliarden Euro*
- Über 400 Unternehmen
- Familienunternehmen
- In über 80 Ländern
- Rating Standard & Poor's: A/stable

* gemäß Jahresabschluss Geschäftsjahr 2023

Prof. Dr. h. c. mult. Reinhold Würth Vorsitzender
des Stiftungsaufsichtsrats der Würth-Gruppe

DIE WÜRTH ELEKTRONIK GRUPPE



1,33 Mrd. €

Umsatz



15

Quality &
Design Centers



8.200

Mitarbeitende



23

Produktionsstandorte



50

Länder



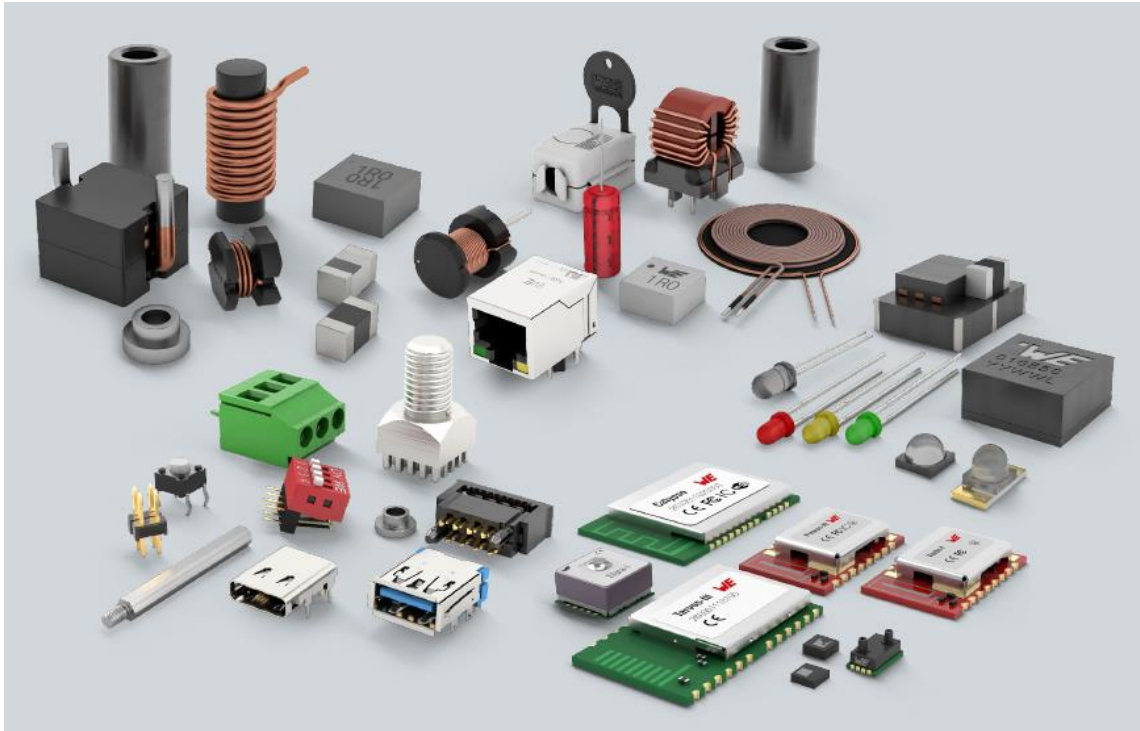
13

Lager- und
Logistikstandorte



DIE WÜRTH ELEKTRONIK GRUPPE

Würth Elektronik eiSos Elektronische & Elektromechanische Bauelemente



Würth Elektronik CBT Leiterplatten

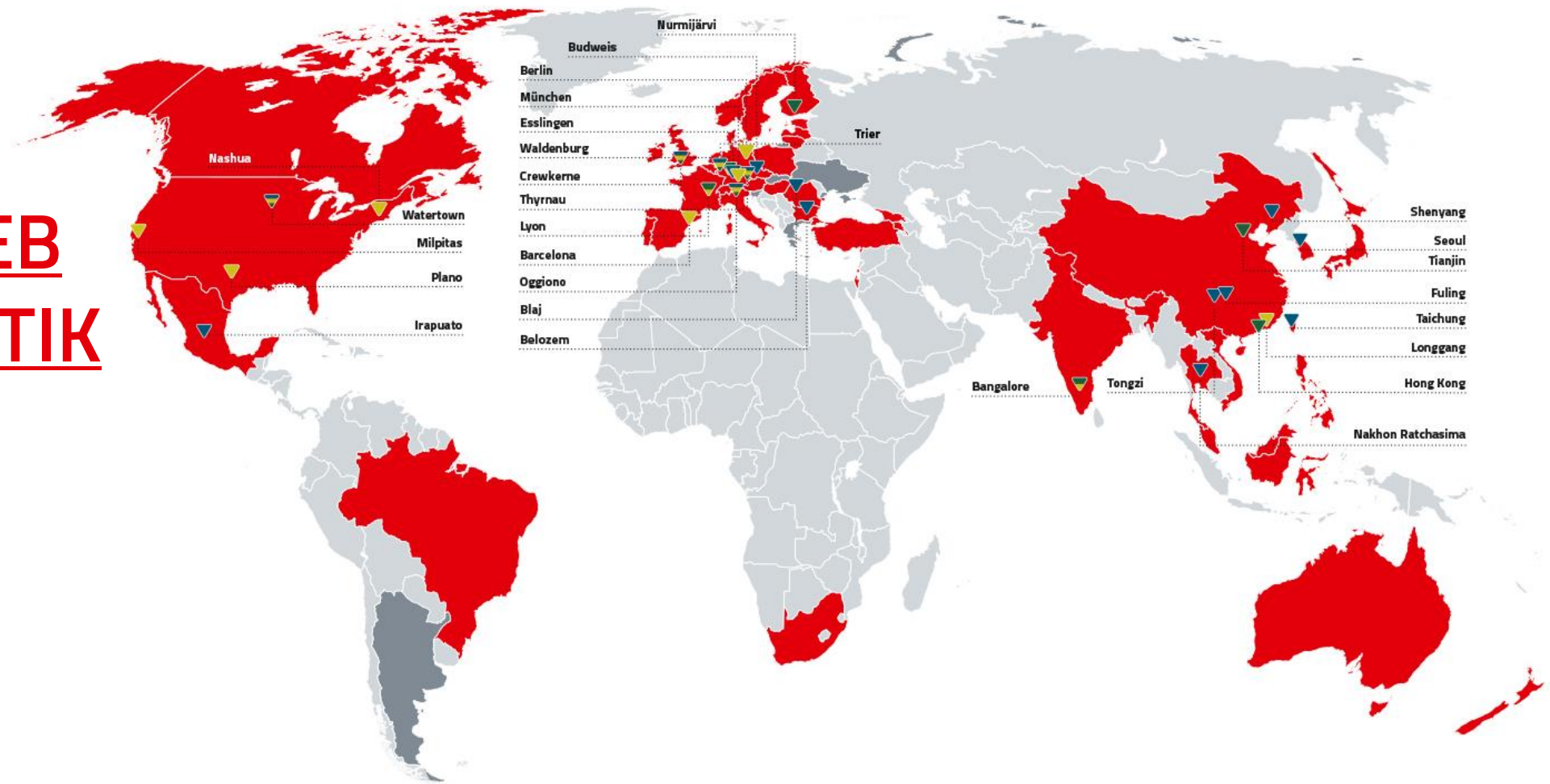


Würth Elektronik ICS Intelligente Power- und Steuerungssysteme



VERTRIEB & LOGISTIK

DIREKTVERTRIEB
PRODUKTION
DISTRIBUTION
QUALITY &
DESIGN CENTER
LAGER



GLOBAL VERFÜGBAR. LOKAL PRÄSENT.

DIE WÜRTH ELEKTRONIK eiSos GRUPPE



HIGHTECH INNOVATION CENTER MÜNCHEN



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FUNKMODULINTEGRATION IN DER PRAXIS – *HOW TO GET STARTED WITH WIRELESS CONNECTIVITY*

Michael Lang, Business Development Wireless Connectivity
23.10.2024



HOW TO GET STARTED WITH WIRELESS CONNECTIVITY

Michael Lang, Business Development Manager
23.10.2024

HINTERGRUNDINFORMATIONEN

Wireless Connectivity & Sensors Product Guide

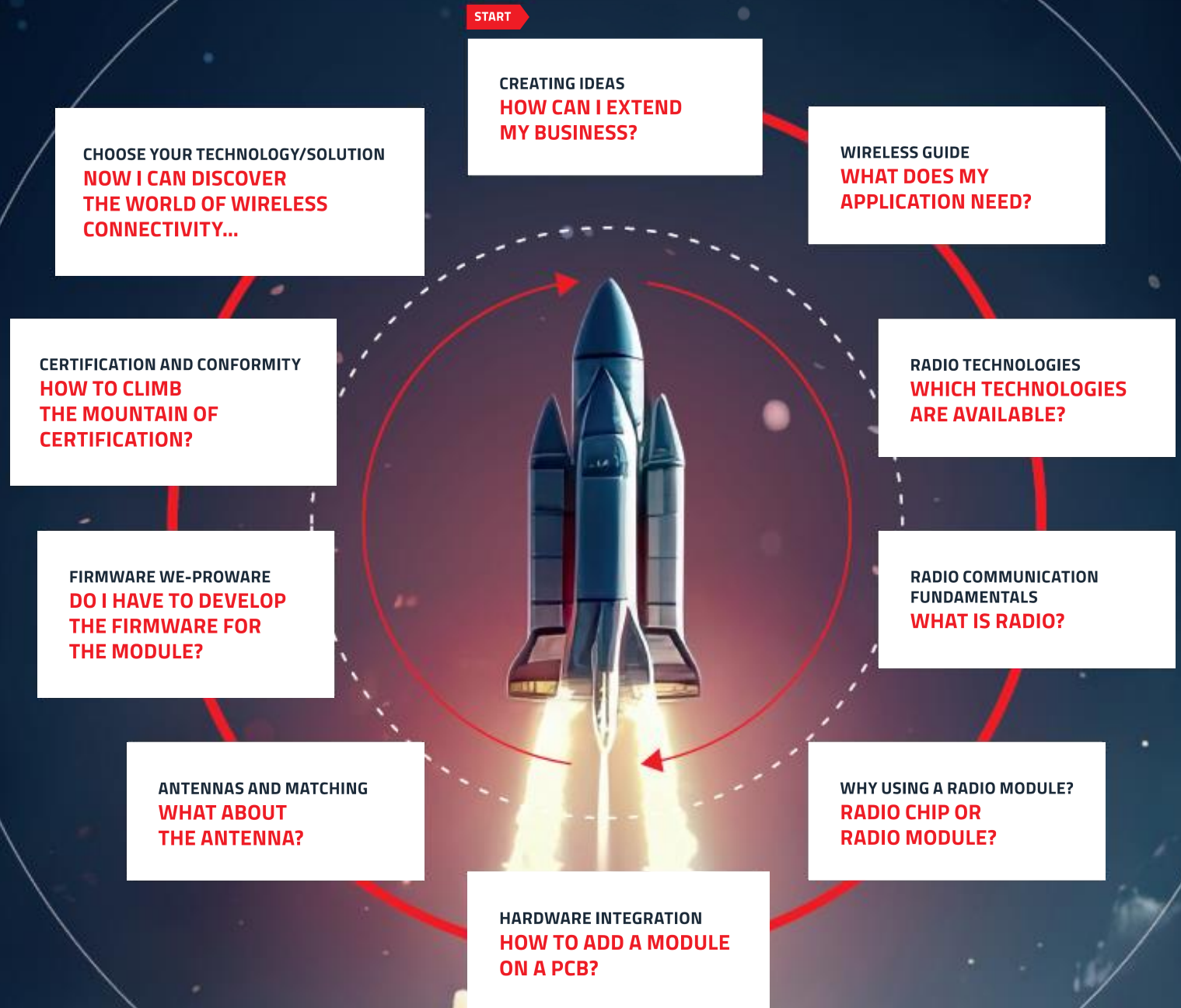


www.we-online.com/wcs-product-guide

HOW TO GET STARTED WITH WIRELESS CONNECTIVITY



HOW TO GET STARTED WITH WIRELESS CONNECTIVITY



START

CREATING IDEAS
HOW CAN I EXTEND
MY BUSINESS?

ION

WI
W
AP

A man and a woman are shown in profile, looking towards the right. The man is in the foreground, wearing a blue shirt, and the woman is slightly behind him. They appear to be looking at a screen in a dark room. A bright light flare is visible in the bottom right corner. The background is dark and out of focus.

CREATING IDEAS

SEMINAR AM 23. OKTOBER 2024 IN NÜRNBERG
EXTERNAL | MICHAEL LANG | 10/2024



TURN
UPSIDE DOWN



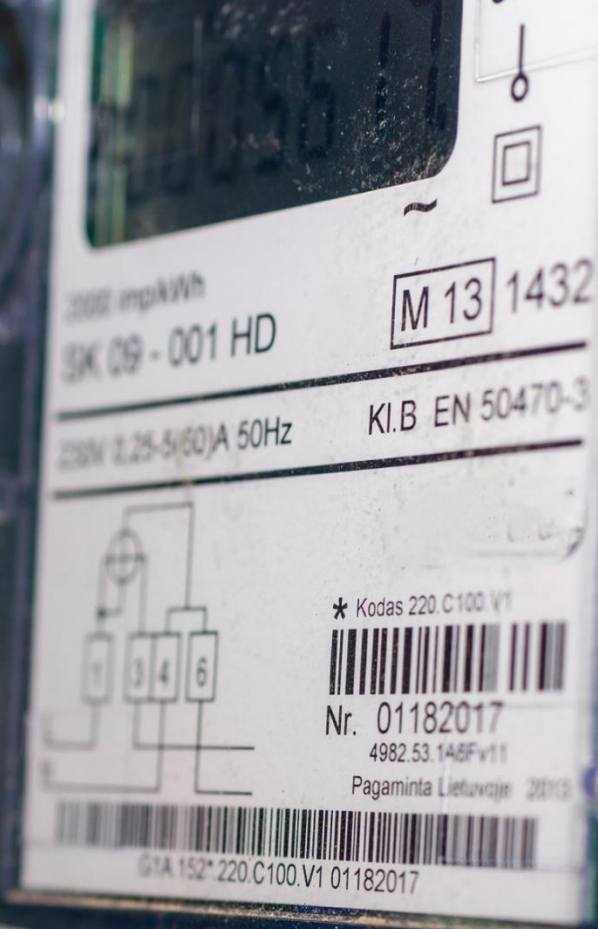
TURN
UPSIDE DOWN

REPLACING LC DISPLAYS

PESTICIDE MONITORING



SMART METERING





INTELLIGENT COFFEE MACHINE

START

CREATING IDEAS
HOW CAN I EXTEND
MY BUSINESS?

ION

WI
W
AP

WIRELESS GUIDE
**WHAT DOES MY
APPLICATION NEED?**

WICHTIGE FRAGEN

Wireless Guide

1. Region



In which region will the application run or should be used in the future?

- ☐ Europe
- ☐ North America
- ☐ South America
- ☐ Asia
- ☐ worldwide
- ☐ other: _____

2. Range



What range do you need to cover in your application?

- ☐ 0 - 15 m
- ☐ 15 - 50 m
- ☐ 50 - 100 m
- ☐ 100 - 500 m
- ☐ 500 m - 2 km
- ☐ 2 km - 10 km
- ☐ >10 km

3. Environment



In which environment will your application be used?

- ☐ Indoor
- ☐ Outdoor
- ☐ Industrial
- ☐ Home Automation
- ☐ other: _____

WICHTIGE FRAGEN

Wireless Guide

4. Data

001101
010100
101101

How much data has to be transmitted? Which data rate is required?

- ☐ Very low data rate (up to 1 kbps)
- ☐ Middle data rate (up to 100 kbps)
- ☐ High data rate (>100 kbps)
- ☐ Very high data rate (>500 kbps)

5. Energy



What about power consumption? How much energy is available? How long should a battery last?

- ☐ Long term battery powered
- ☐ Battery powered
- ☐ Main powered
- ☐ other: _____

6. Interface



Communication to...?

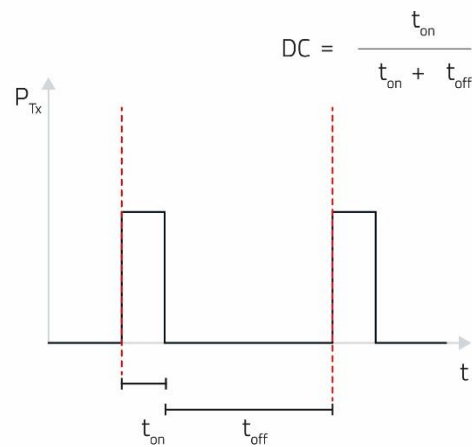
- ☐ Smart Device (Mobile, Tablet)
- ☐ PC, Server, etc.
- ☐ Device of own development
- ☐ Special communication interface (Wirepas, wM-Bus, CAN-Bus, ...)
- ☐ Mesh (Wirepas, Bluetooth® Mesh, Closed Mesh)
- ☐ other: _____

WIRELESS GUIDE
**WHAT DOES MY
APPLICATION NEED?**

RADIO TECHNOLOGIES
WHICH TECHNOLOGIES
ARE AVAILABLE?

	LIZENZFREIE ISM-BÄNDER (INDUSTRIAL SCIENTIFIC MEDICAL)							LIZENZIERTE MOBILFUNK-BÄNDER					
Frequenz [MHz]	169	433	868	915	1500	2400	5000	700	900	1800	2100	2600	3500
Wellenlänge [cm]	178	69	35	33	20	13	6	43	33	17	14	12	9
Funkprotokoll	 		       	       	   	       IEEE 802.15.4 		 	   				
Reichweite	mittel	mittel	hoch	hoch	hoch	niedrig	niedrig	hoch	hoch				
Datenrate	niedrig	niedrig	mittel	mittel	niedrig	hoch	hoch	hoch	niedrig				
Würth Elektronik Antennen		 	 	 	 	 		 	 				

DUTY CYCLE



Frequency [MHz]	TX Power [dBm]	TX Power [mW]	Duty cycle	max. occupied BW* [kHz]	Notes
169.400 - 169.475	+ 27	500	$\leq 1 \%$	50	For metering devices: 10 % DC
169.400 - 169.4875	+ 10	10	$\leq 0.1 \%$	whole band	
169.4875 - 169.5875	+ 10	10	$\leq 0,001 \%$	whole band	0,1 % DC during 0:00 and 6:00 local time
169.5875 - 169.8125	+ 10	10	$\leq 0,1 \%$	whole band	
433.050 - 434.790	+ 10	10	10 %	whole band	
433.050 - 434.790	0	1	no limits	whole band	-13 dBm / 10kHz PSD when bw > 250 kHz, audio/video applications are excluded
434.040 - 434.790	+ 10	10	no limits	25	audio/video applications are excluded
863.0 - 865.0	+ 14	25	$\leq 0.1 \%$ or PSA**	whole band	OBW restrictions except audio & video limited to 300 kHz
865.0 - 868.0	+ 14	25	$\leq 1 \%$ or PSA**	whole band	
868.0 - 868.6	+ 14	25	$\leq 1 \%$ or PSA**	whole band	
868.7 - 869.2	+ 14	25	$\leq 0.1 \%$ or PSA**	whole band	
869.4 - 869.65	+ 27	500	$\leq 10 \%$ or PSA**	whole band	
869.7 - 870.0	+ 7	5		whole band	audio / video applications are excluded
869.7 - 870.0	+ 14	25	$\leq 1 \%$ or PSA**	whole band	analogue audio / video are excluded
2400.0 - 2483.5	+ 10	10	no limits	whole band	non specific short range devices
2400.0 - 2483.5	+ 14	25	no limits	whole band	radio determination devices (radar, RFID,...)
2446.0 - 2454.0		500 / 4000		whole band	RFID only

* BW = Band width

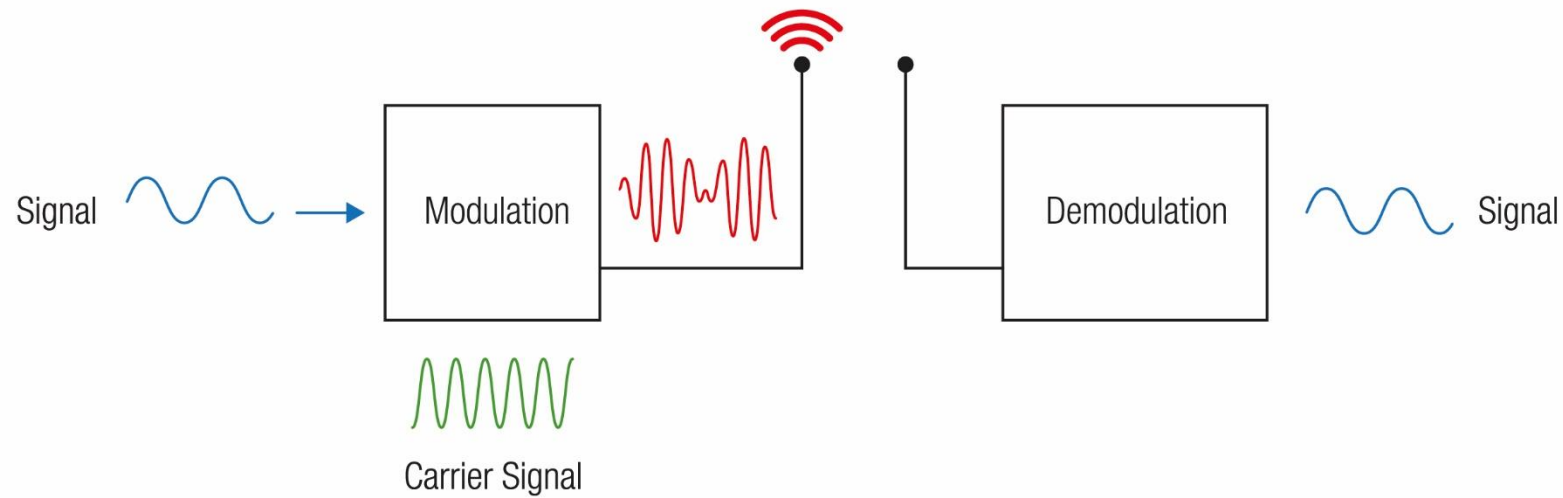
** PSA = Polite Spectrum Access, allows up to 100s sending per 1 hour observation time, so a duty cycle of up to 2.77%

RADIO TECHNOLOGIES
WHICH TECHNOLOGIES
ARE AVAILABLE?

RADIO COMMUNICATION FUNDAMENTALS

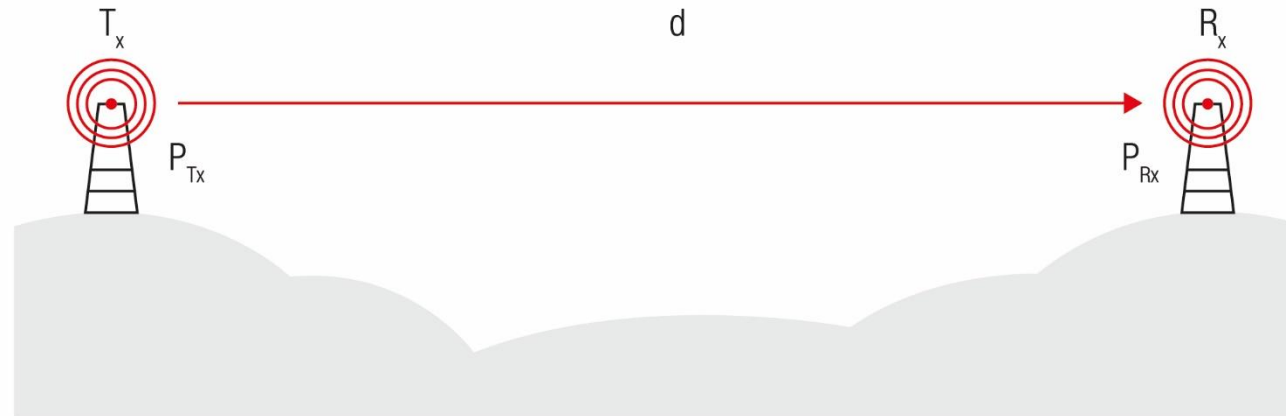
WHAT IS RADIO?

FUNKSYSTEM



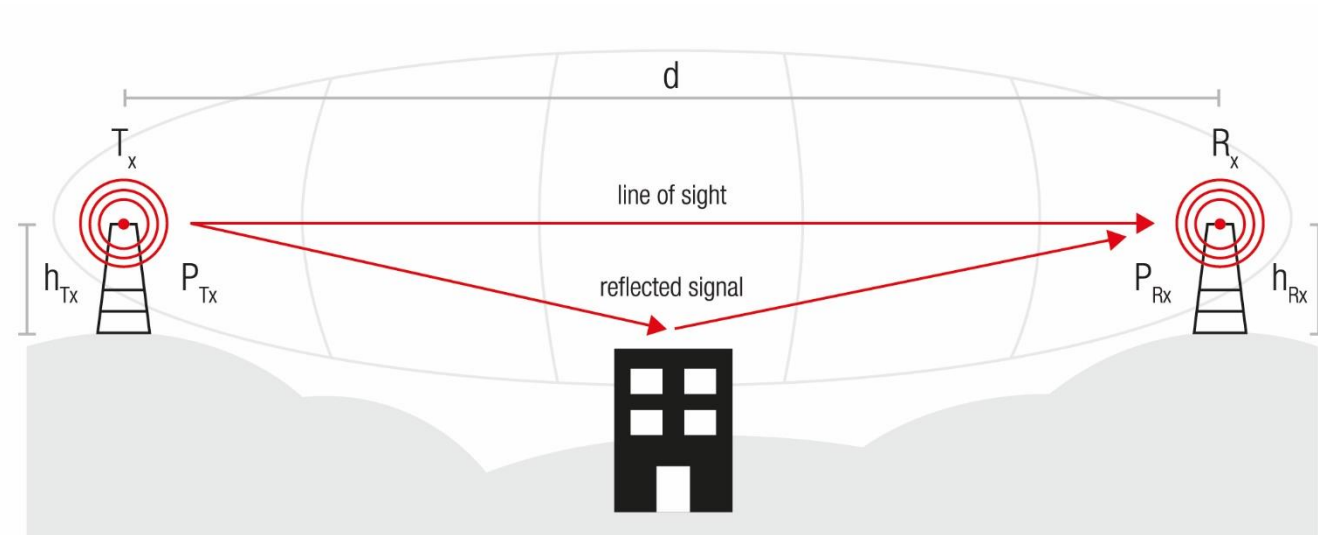
REICHWEITEN ABSCHÄTZUNG

Model 1: Friis Transmission for Free Space



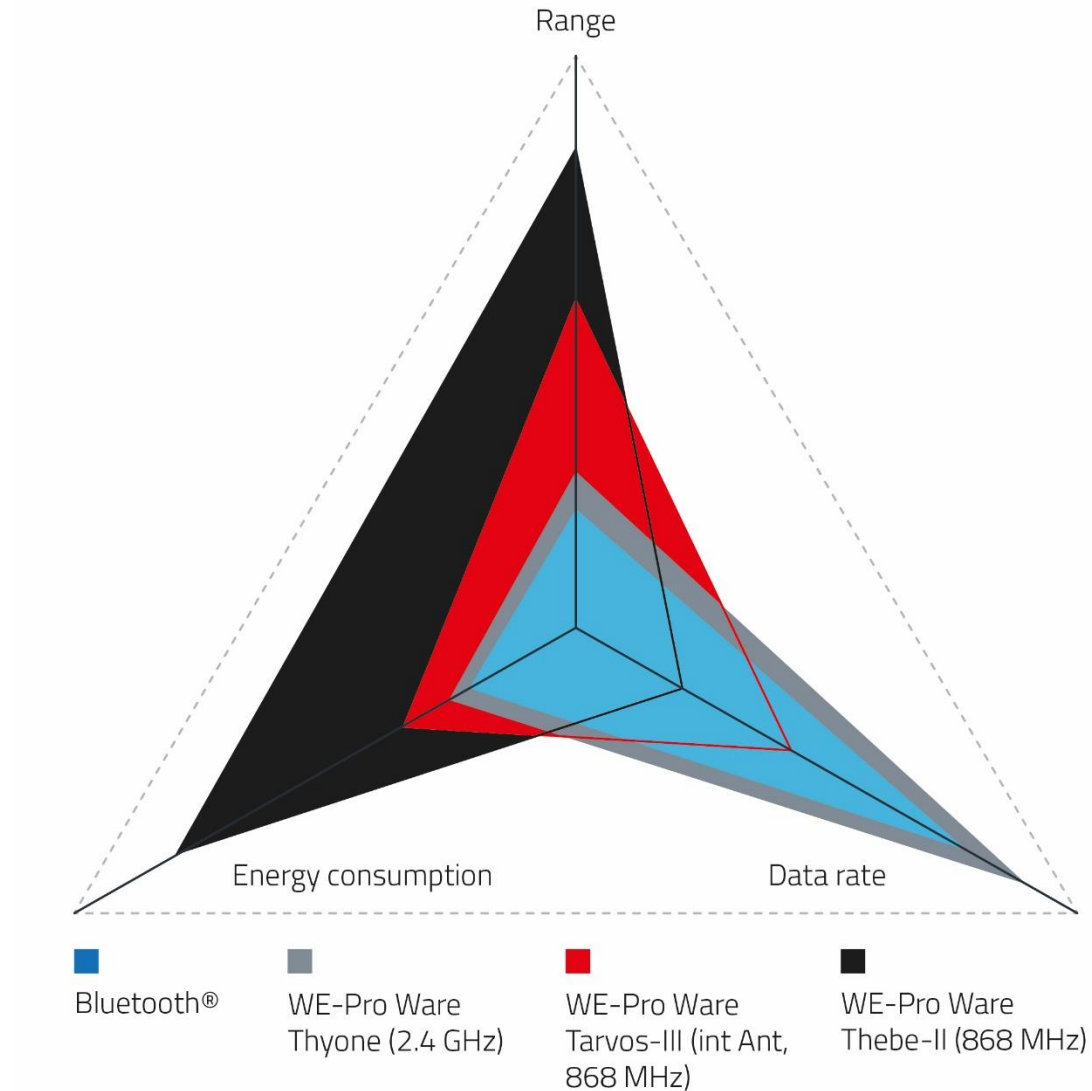
RANGE ESTIMATION

Model 2: Two-ray Ground Reflection

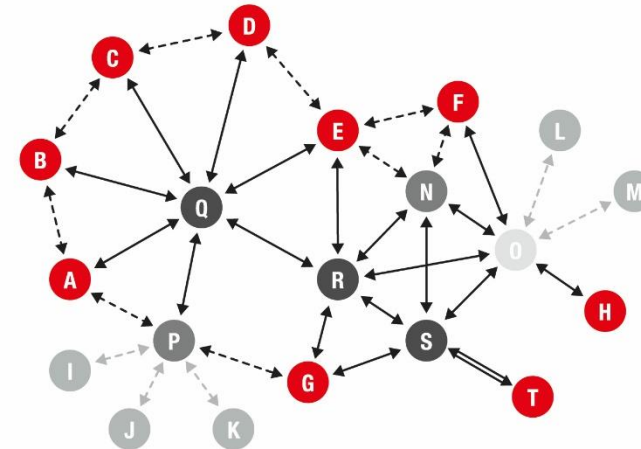
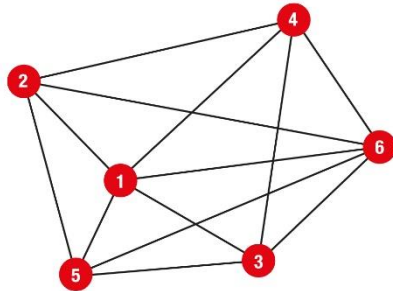
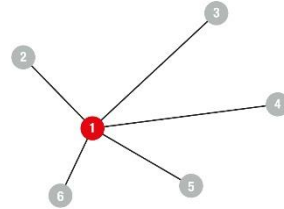


REICHWEITE – DATENRATE – ENERGIEVERBRAUCH

Immer ein Kompromiss



NETZWERK TOPOLOGIEN



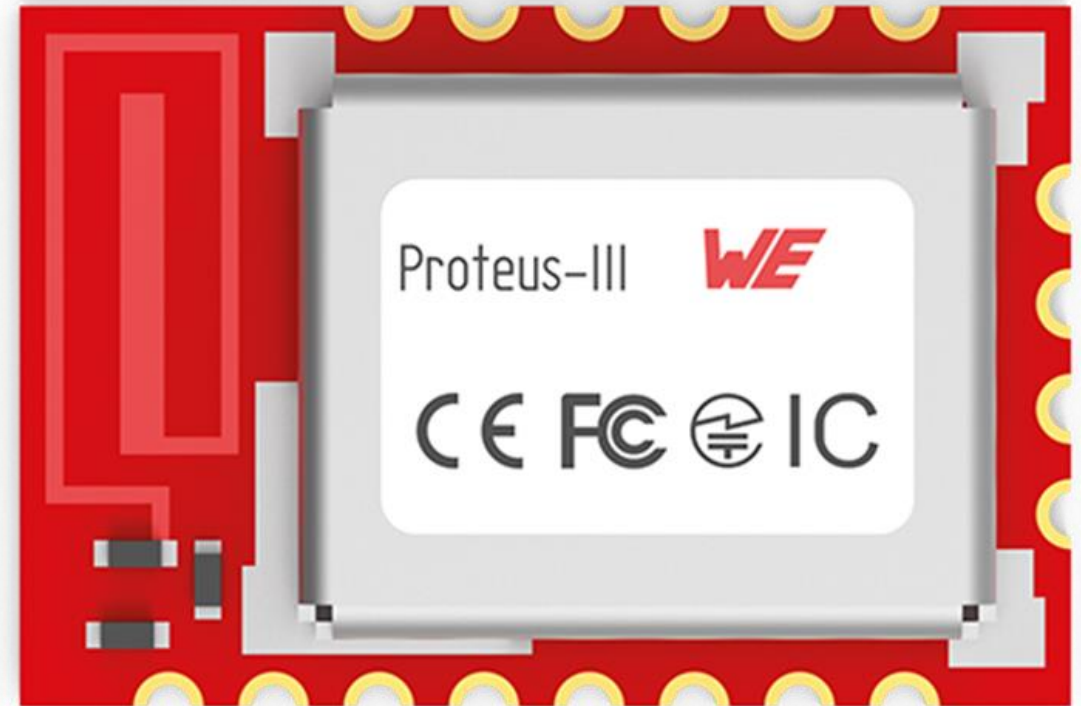
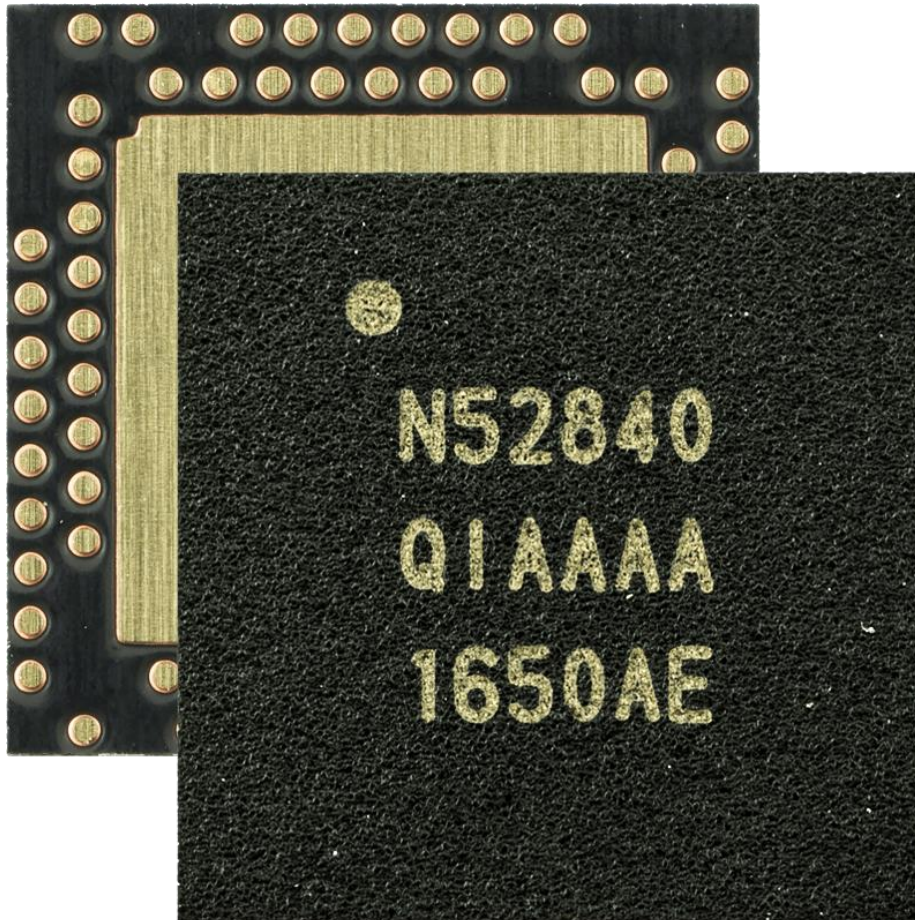
RADIO COMMUNICATION FUNDAMENTALS

WHAT IS RADIO?

WHY USING A RADIO MODULE?
RADIO CHIP OR
RADIO MODULE?

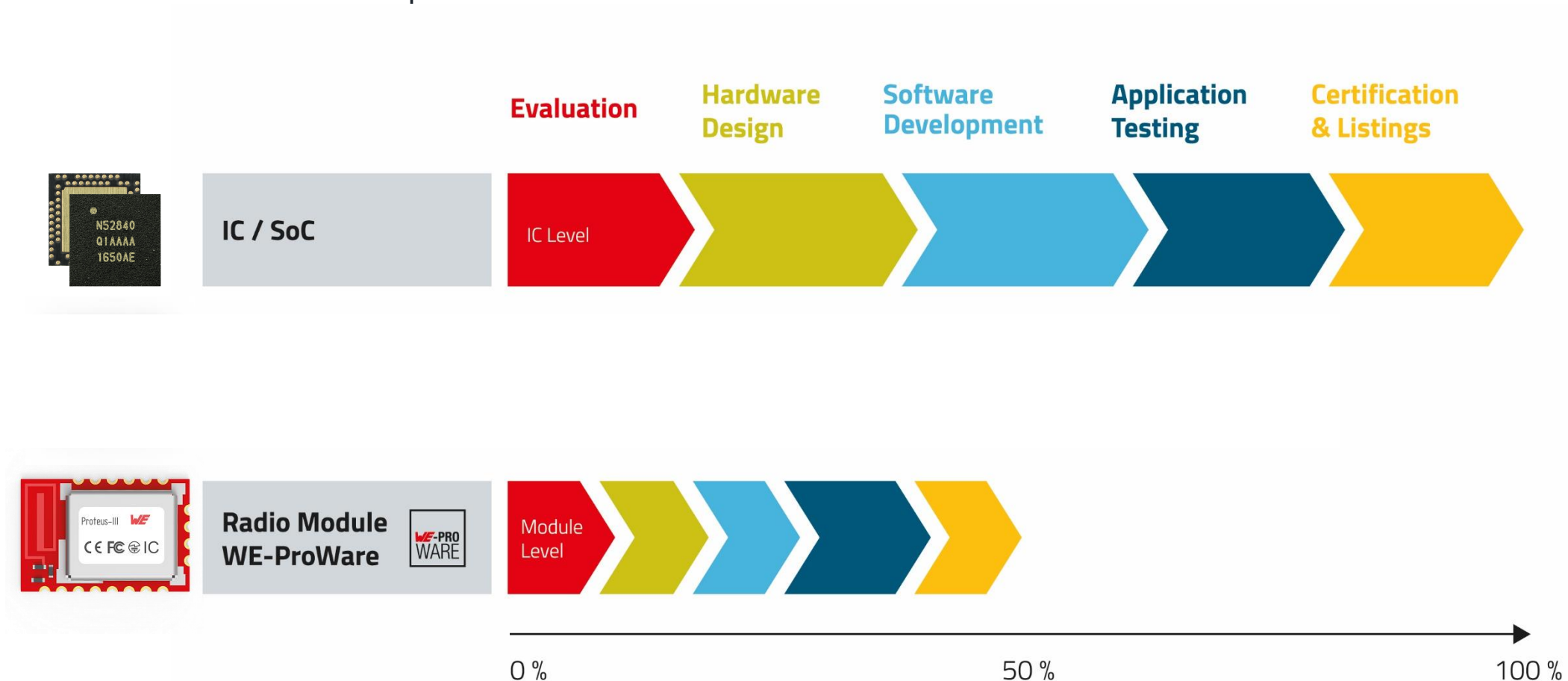
FUNK-CHIP VS. FUNK-MODUL

2 Möglichkeiten

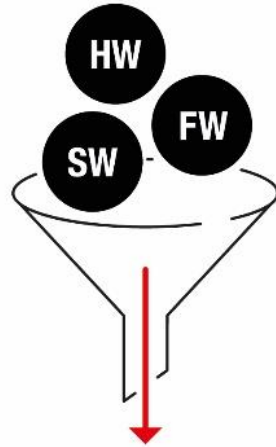


HARDWARE

Funkmodul oder Funkchip



WAS IST EIGENTLICH EIN FUNKMODUL?



Radio module



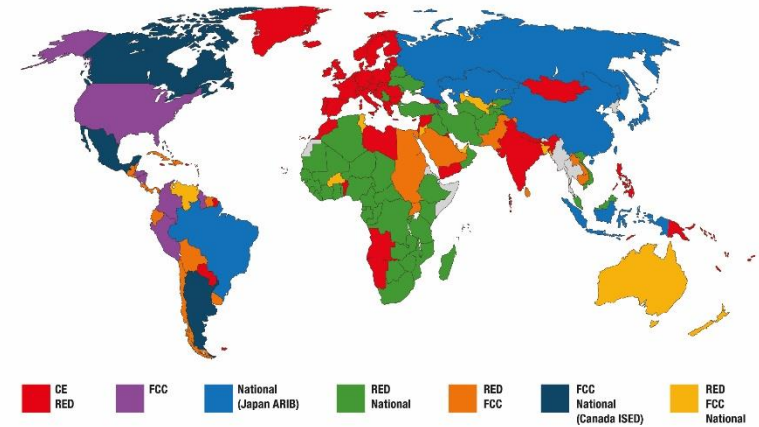
Hardware



Firmware



Software



Certification



EU DECLARATION OF CONFORMITY

Radio equipment: 2011011024000

The manufacturer: Würth Elektronik eGmbH & Co. KG
Max-Eyth-Strasse 1
74638 Waldenbuch

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

Object of the declaration: 2011011024000

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

EN 300 328 V2.1.1 (2016-11)
EN 301 489-1 V2.1.1 (2017-02)
EN 301 489-17 V3.1.1 (2017-02)
EN 62366-1:2014 + AC:2015 + A11:2019



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

Due to the size of the Proteus-III label, the certification label of the Proteus-III is not placed onto the module label.

2011011024000:



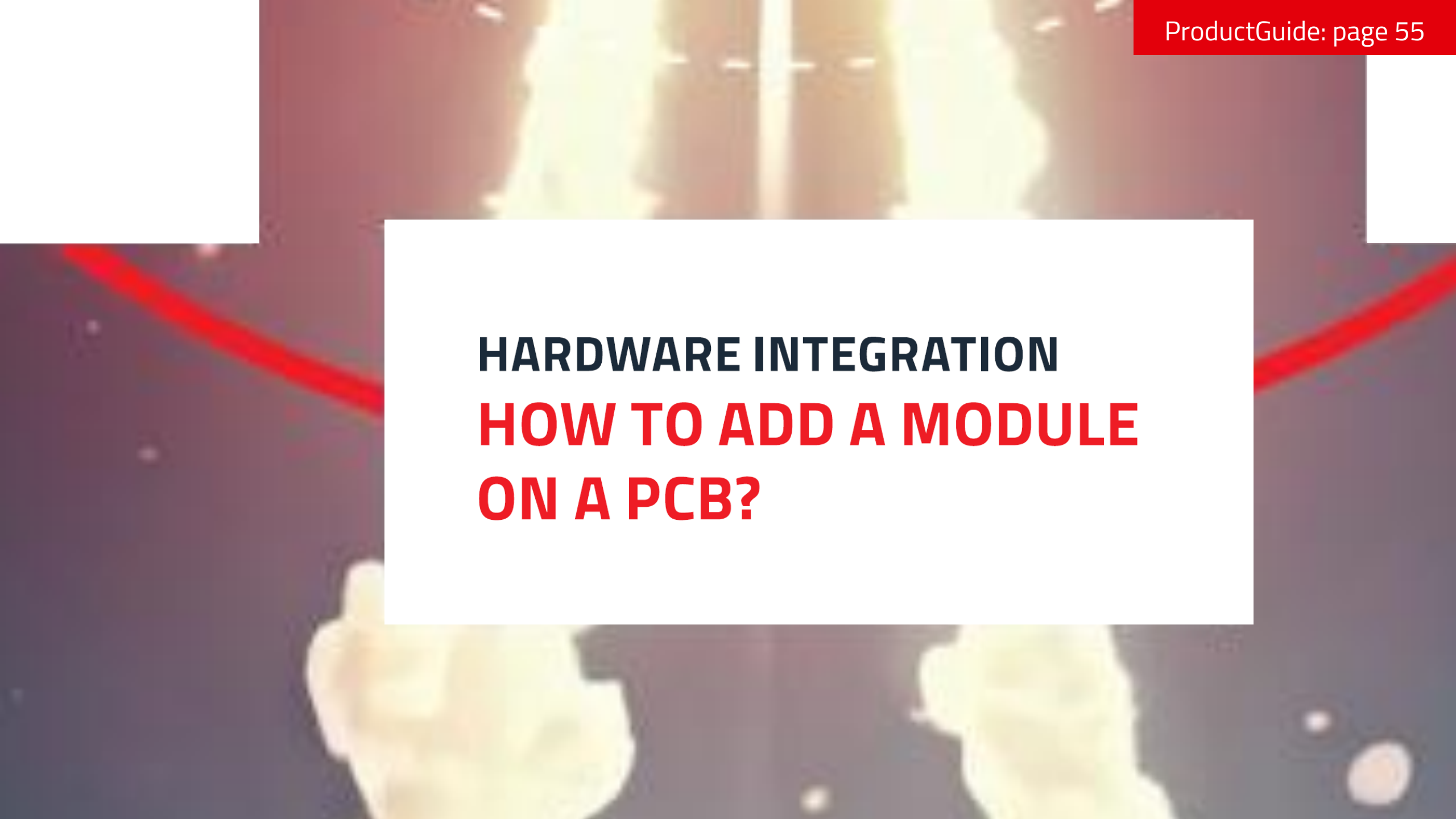
KOSTENVERGLEICH– CHIP VS. MODULE

1. FIXED COSTS	What is necessary to consider?	
	Würth Elektronik "Off-the-Shelf" radio module	Customer "Build-Your-Own-Device"
Module Buy-Price The buying price of the radio module should compare apples by apples. A Würth Elektronik Module always comes with in a package of Hardware (radio module), Firmware (µC & RF stack) and the needed Software for evaluation. One price includes all features. "Building-Your-Own Device" needs to consider ADDITIONALLY the following investments.	€€	€
Hardware Development The hardware costs are more than just the Bill of Materials for like Microcontroller, IC, Oscillator, Antenna, PCB, LNA, and more. It needs to be taken into account the development itself, the necessary rework during the prototype-to-series phases, the antenna design and possible revisions while the device is already in the market. Using an "Off-the-shelf" solution makes all this mainly unnecessary, as Würth Elektronik is taking care of that for you.		€
Firmware Development The Firmware running on a radio modules is an accumulation of the one-time software development costs, the recurring costs for software maintenance and required updates and don't forget the necessary documentation. This can simply sum up in a 6-digit Euro investment and following needs to be broken down to each single radio module. Würth Elektronik eiSos modules require a minimum of configuration like communication between module and host microcontroller into the end application from the system designer. A budget of a few days is realistic.		€€
Required Measurement Equipment The final step while taking the radio module into operation is the necessity of measuring all electrical parameters. Therefore it requires to have measurement tools like a Signal Generator, Spectrum & Signal Analyzer and Oscilloscope available, which represent another 6-digit investment, unless those have already been purchased before.		€€

COST COMPARISON – CHIP VS. MODULE

	What is necessary to consider?	
	Würth Elektronik "Off-the-Shelf" radio module	Customer "Build-Your-Own-Device"
2. VARIABLE & FIXED COSTS Certifications, Conformity, Declaration A product that is to be launched globally must meet the certification or conformity criteria of each country it is to be marketed in. It can be compared with the typical iceberg model, where the measurements, the official certificate or the official stamp only represents the tip. For a "Build-Your-Own-Device" solution it requires a comprehensive knowledge of all those regulations in each country and following a huge time investment, also for the documentation. Würth Elektronik radio modules come along with the Declaration of Conformity following the Radio Equipment Directive for Europe and on top with a variety of different certifications complying to regulations in the United States, Canada, Japan and some even with the Chinese law. To be on the safe side with the end device, Würth Elektronik recommends a simple and very low cost delta measurement in the final device, as all the documentation will be provided to the customers test lab. Using a USB radio stick from Würth Elektronik makes it even easier – Plug & Play, ready to operate at lowest possible costs.	€	€€
3. OPPORTUNITY COSTS Avoid Delayed Market Entry and loose Money Last but not least, deciding for a "Build Your Own Device" solution will set you back several month in most of the cases. Simply, it is missing sales in the market. Instead, using an "Off-the-shelf" radio module solution from Würth Elektronik and starting to sell the end device earlier will accelerate the market release of the end device. It is like gaining time and early profit.		€

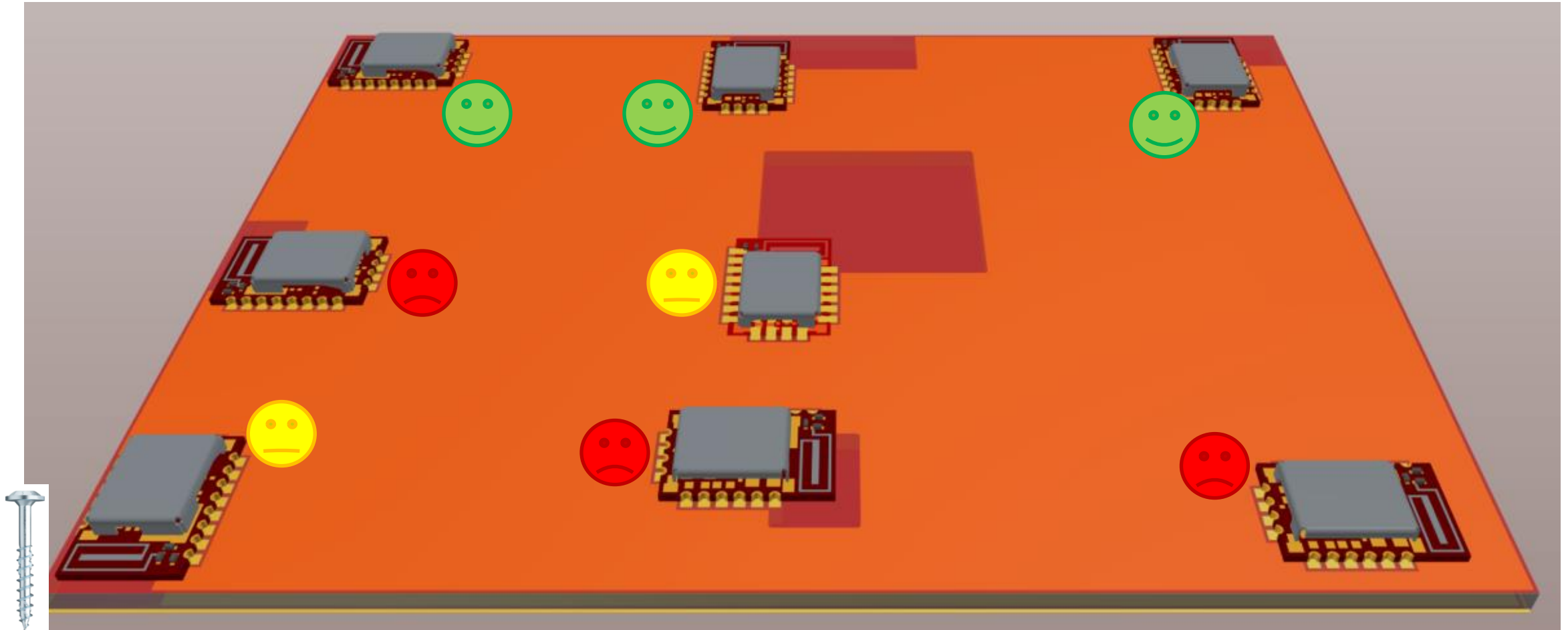
WHY USING A RADIO MODULE?
RADIO CHIP OR
RADIO MODULE?

The background of the slide is a close-up photograph of a printed circuit board (PCB). It features a dark, textured surface with various electronic components and traces. A prominent red laser line is visible, running diagonally across the frame from the upper left towards the lower right. The text is overlaid on a white rectangular area in the center of the image.

HARDWARE INTEGRATION

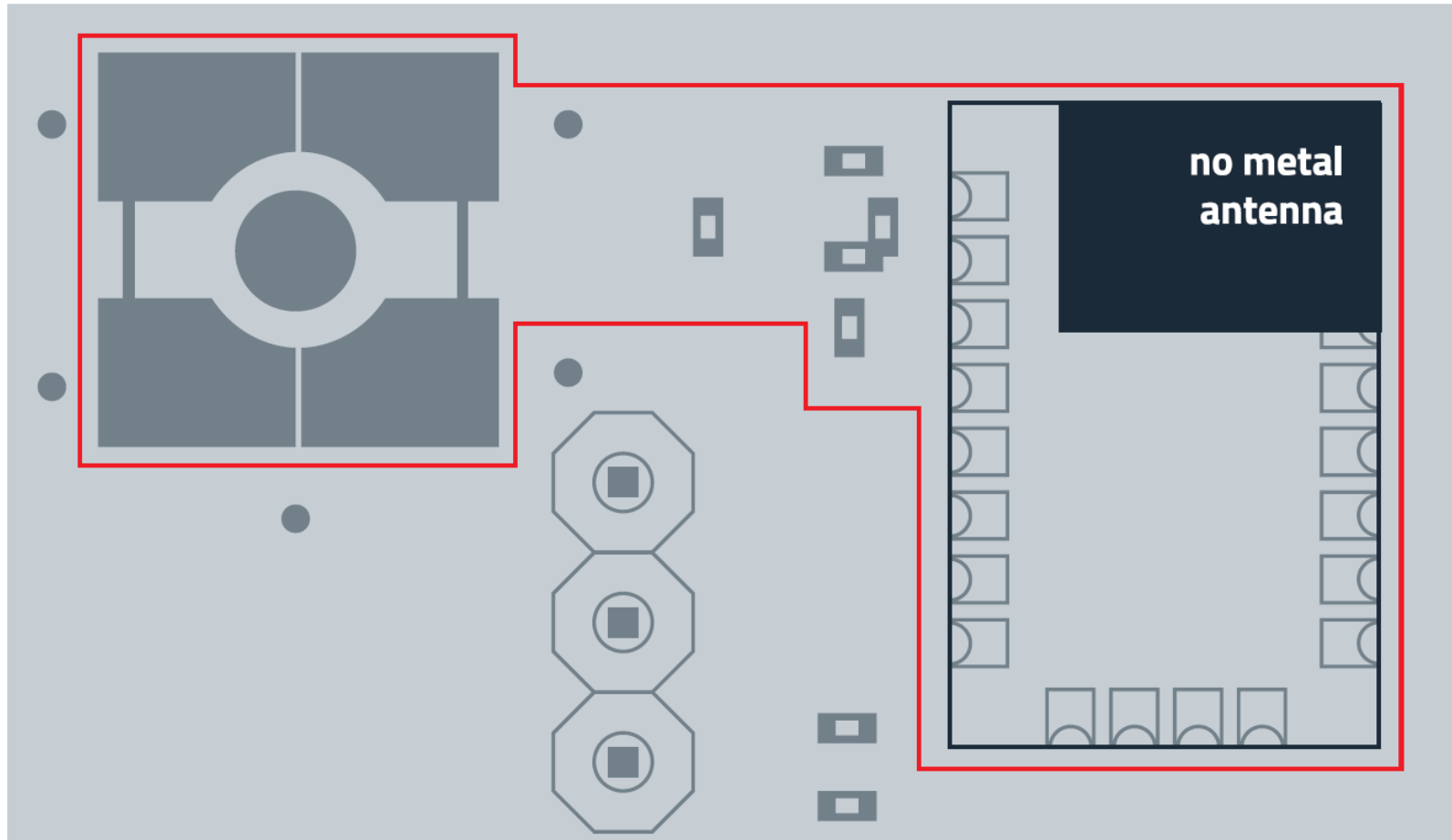
HOW TO ADD A MODULE ON A PCB?

MODULPLATZIERUNG

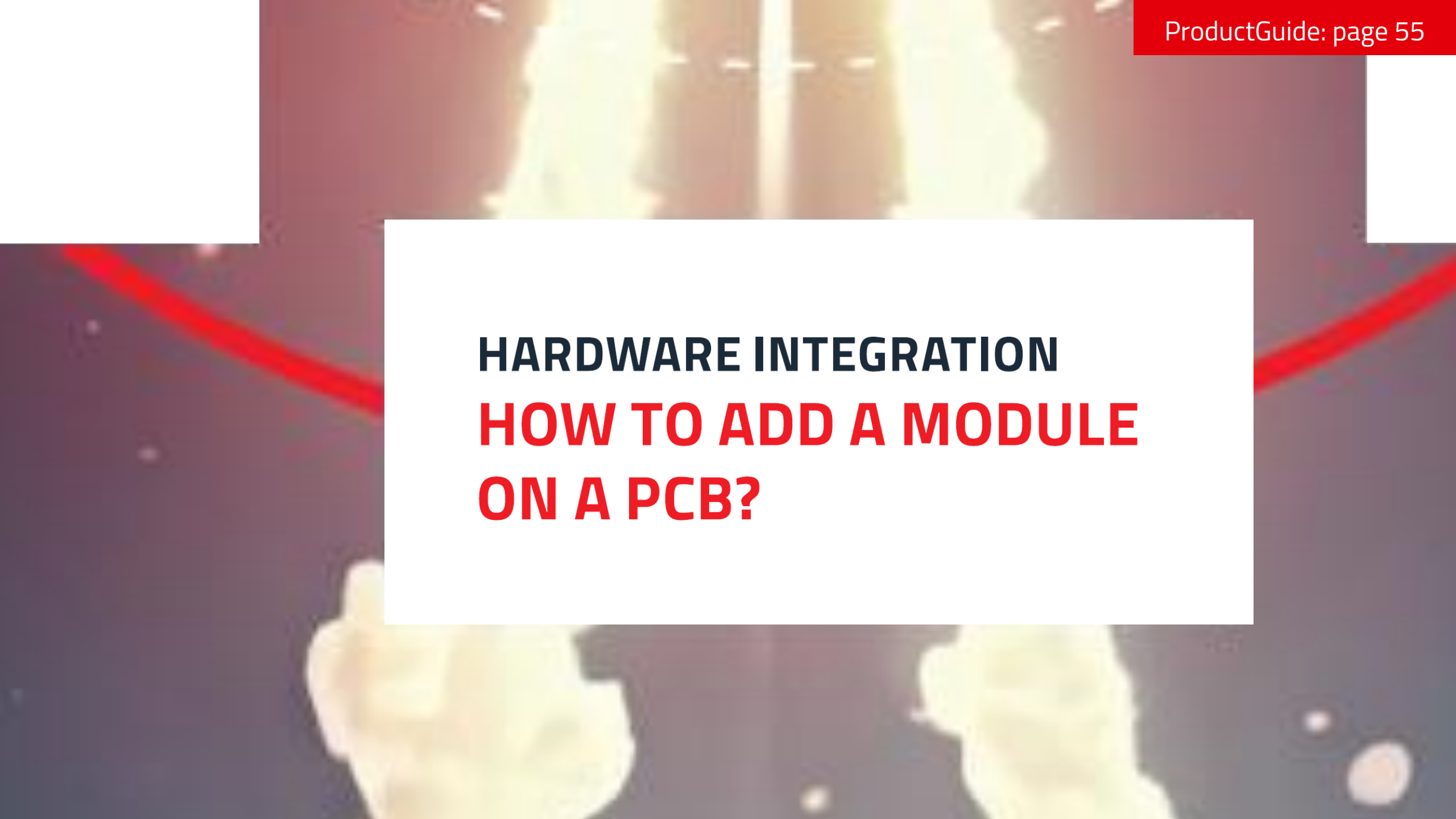


HARDWARE DESIGN

Trace Design



„DAS IST DOCH NUR DER EMPFÄNGER“

The background of the slide is a close-up photograph of a printed circuit board (PCB). It features a dark, textured surface with various electronic components and traces. A prominent red laser line is visible, running diagonally across the frame. The text is overlaid on a white rectangular area in the center.

HARDWARE INTEGRATION

HOW TO ADD A MODULE ON A PCB?

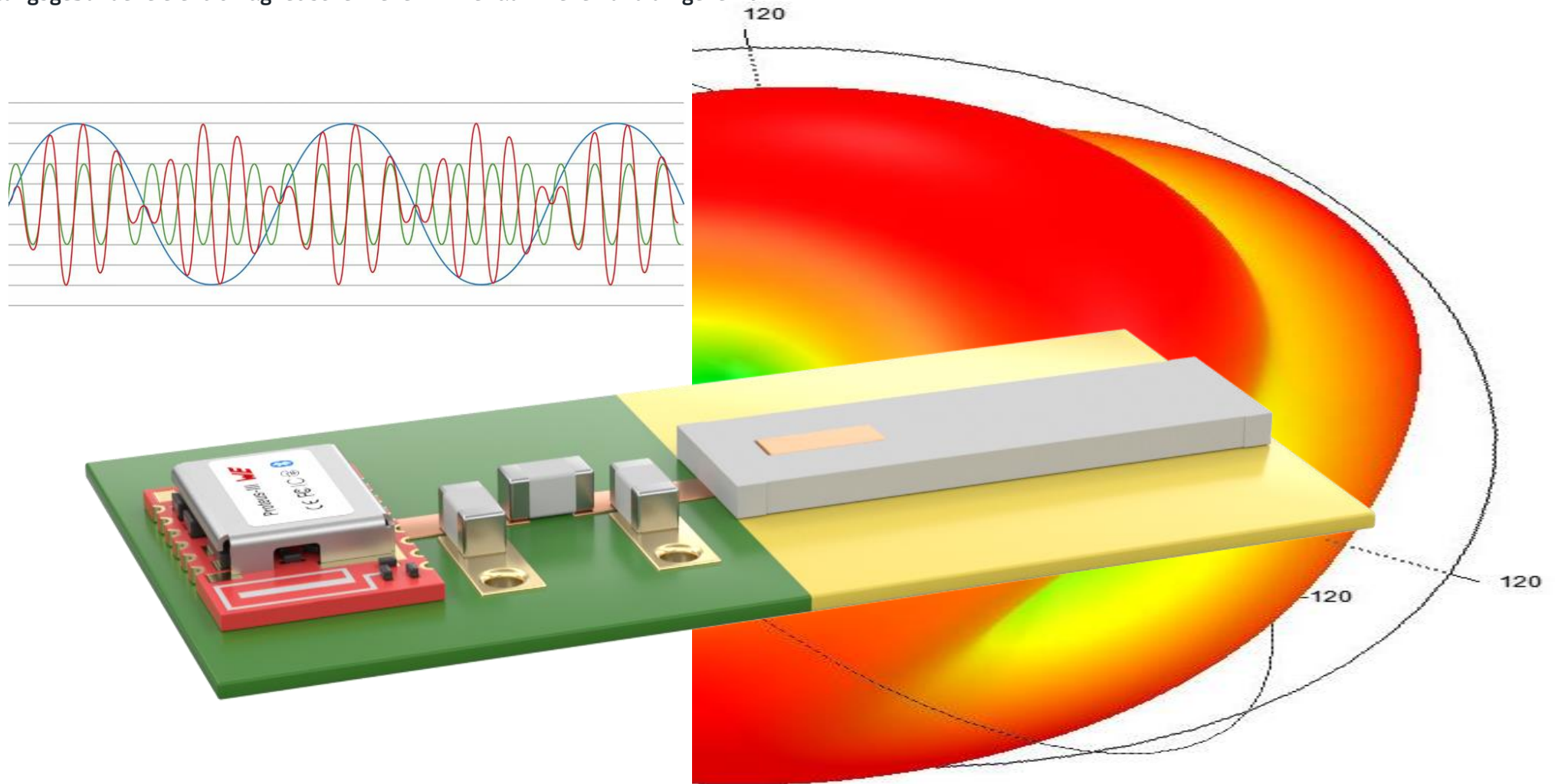
ANTENNAS AND MATCHING

WHAT ABOUT THE ANTENNA?

DAS WICHTIGSTE BAUTEIL FÜR DIE FUNKPERFORMANCE:

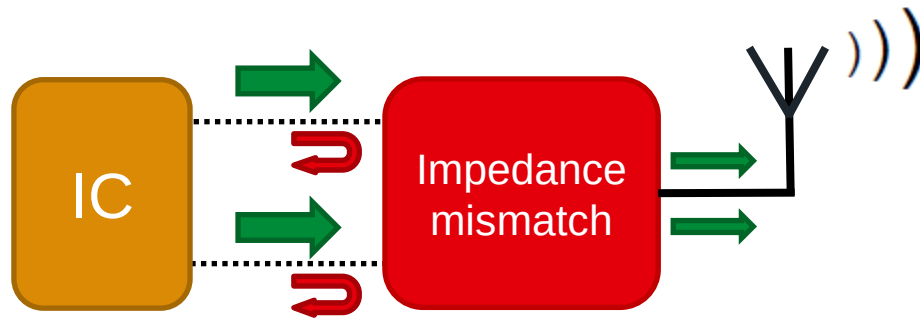
Die Antenne...

... wandelt Leitungsgebundene elektromagnetische Wellen in Freiraumwellen und umgekehrt.

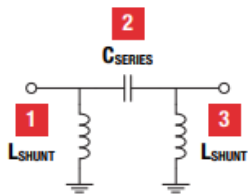
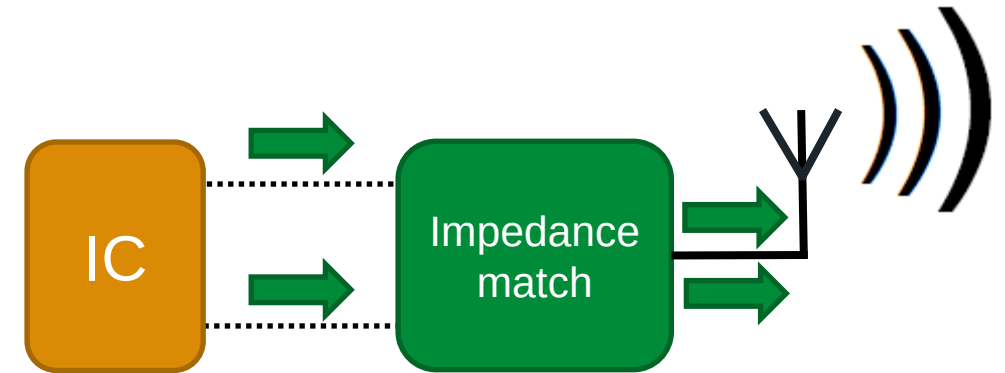
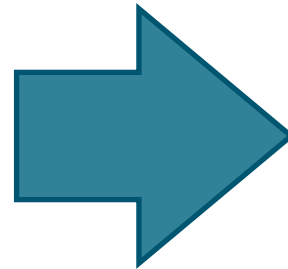


ANTENNA MATCHING

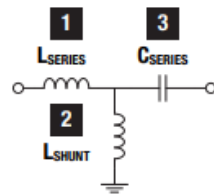
Warum?



Impedance
Matching circuit



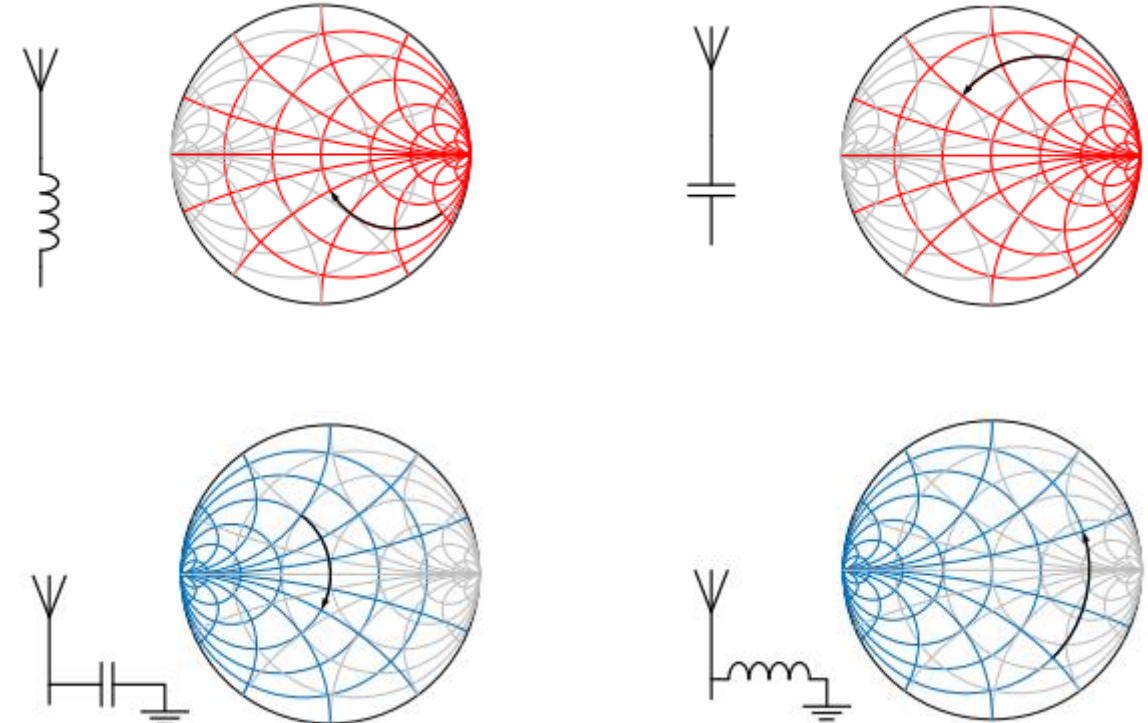
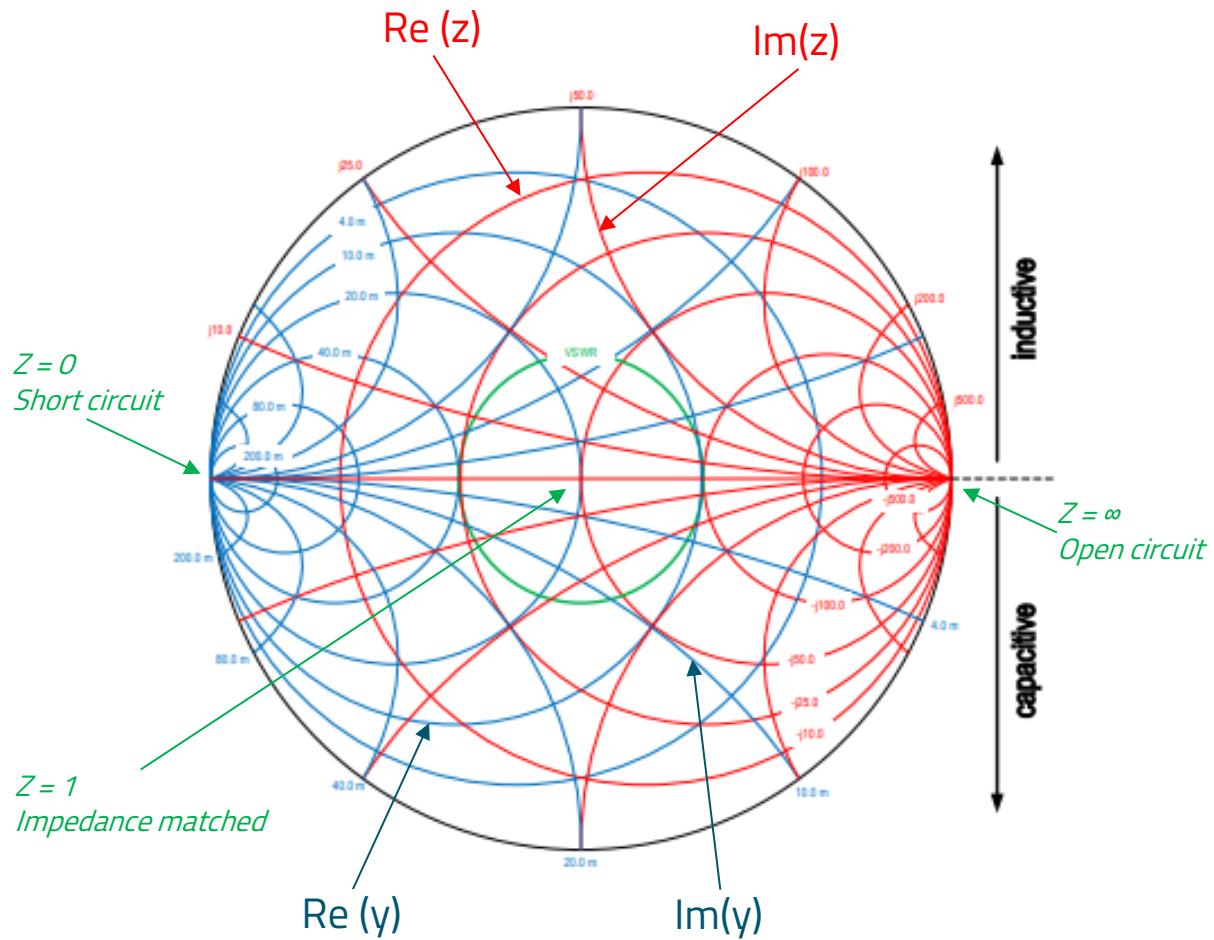
Pi matching for Point A



T matching for Point B

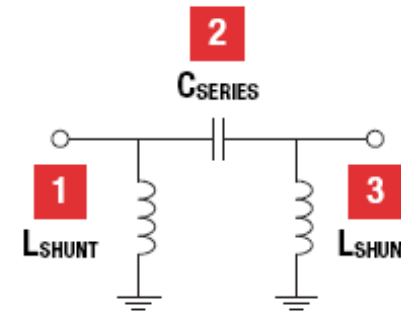
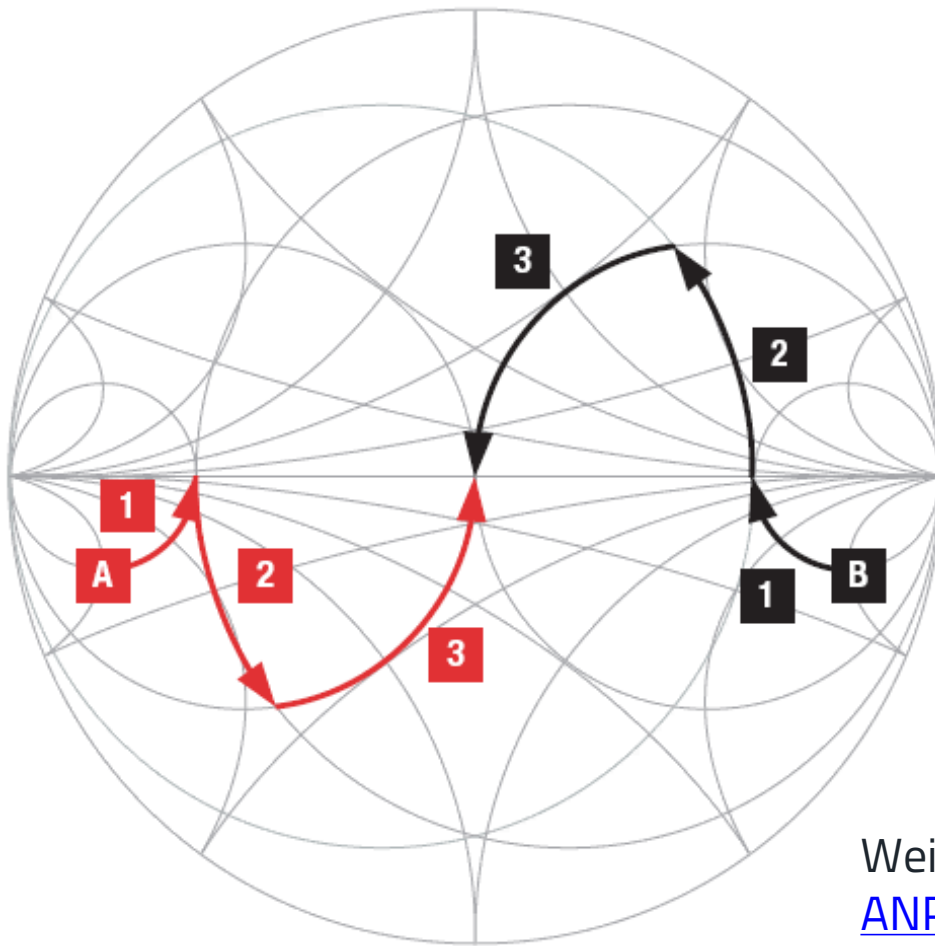
ANTENNA MATCHING

Wie?

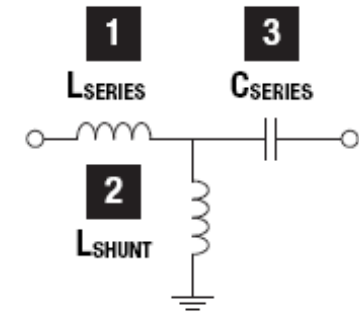


ANTENNA MATCHING

Wie?



Pi matching for Point A



T matching for Point B

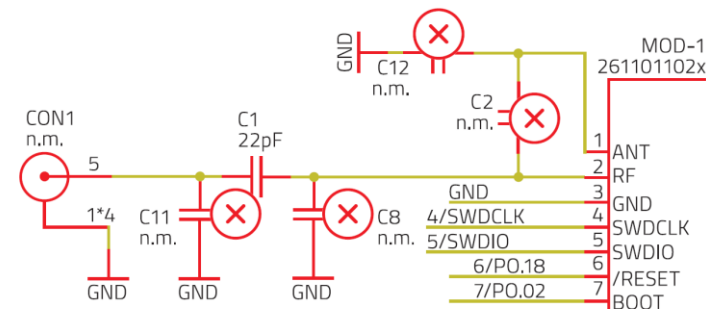
Weitere Information:

[ANP057WE-MCA Multilayer-Chipantenne Platzierung und Anpassung](#)

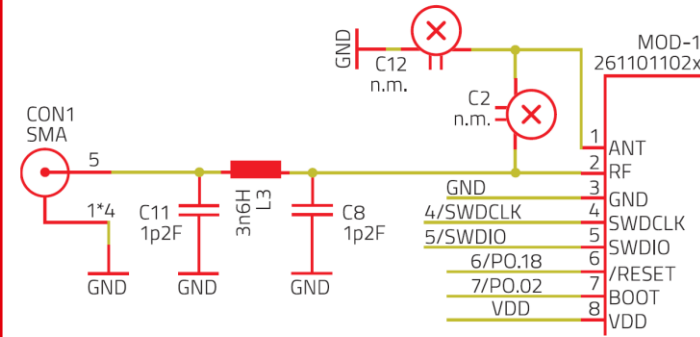
SMART ANTENNA SELECTION

ANTENNA MATCHING

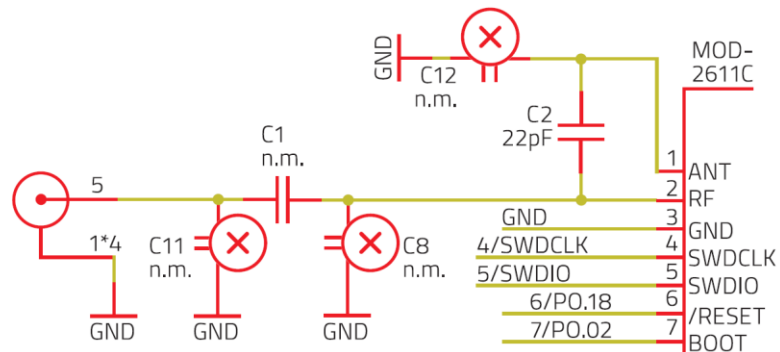
Coaxial connector w/o filter or matching



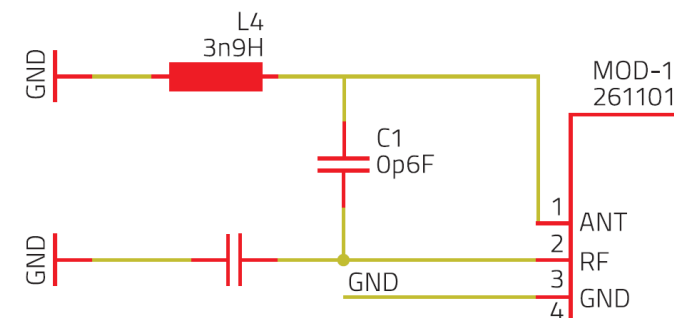
Pi-Filter: i.e. lowpass with cut-off frequency 2.5 GHz and ripple of 0.1 dB, (Chebyshev) adapted to 50 Ohm network



Internal antenna w/o filter or matching



Rematching: i.e. 15-j102 back to 50 Ω

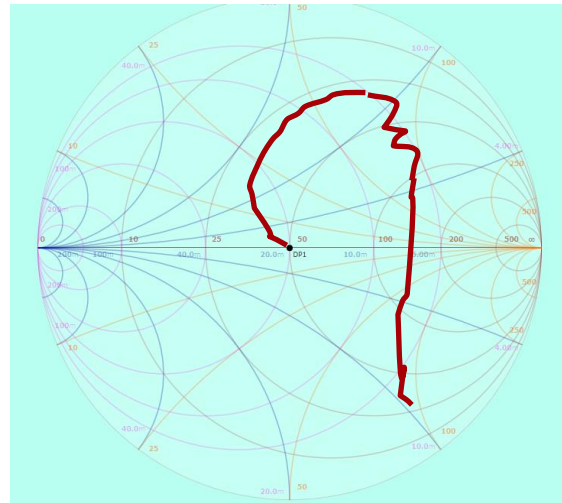


SMART ANTENNA CONNECTION

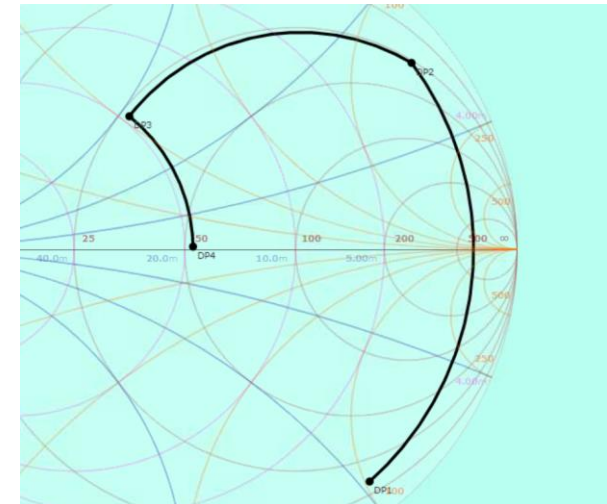
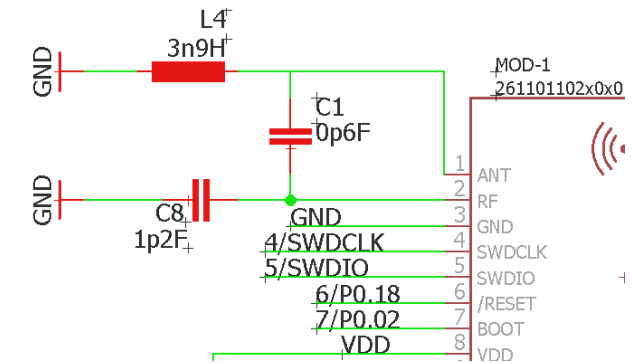
Was ist eigentlich mit Feintuning oder Rematching gemeint?



Antenne wird durch die Integration in die Anwendung verstimmt.



Rematching, z.B. von 15-j102 zurück auf 50 Ohm



DESIGN AND SOLUTIONS

ANTENNA MATCHING SERVICE



Antenna matching:
www.we-online.com/antennamatching

Service Process

Our process enables transparent integration into your project plan. If you have any questions about the process or general questions about antenna matching, our service is also available to you.

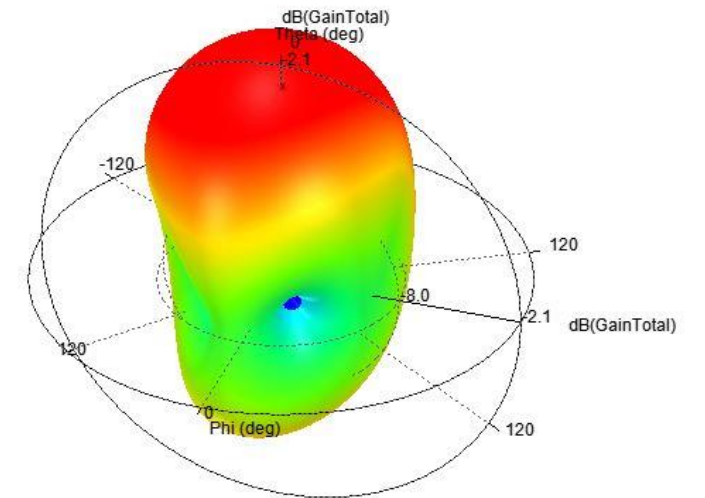
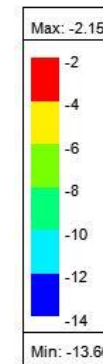
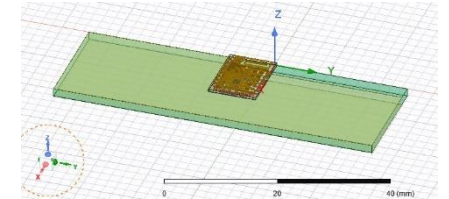
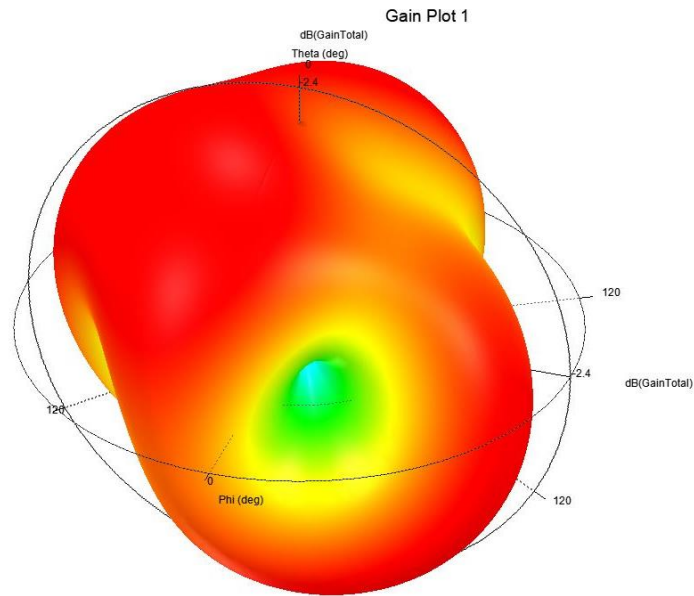
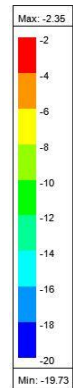
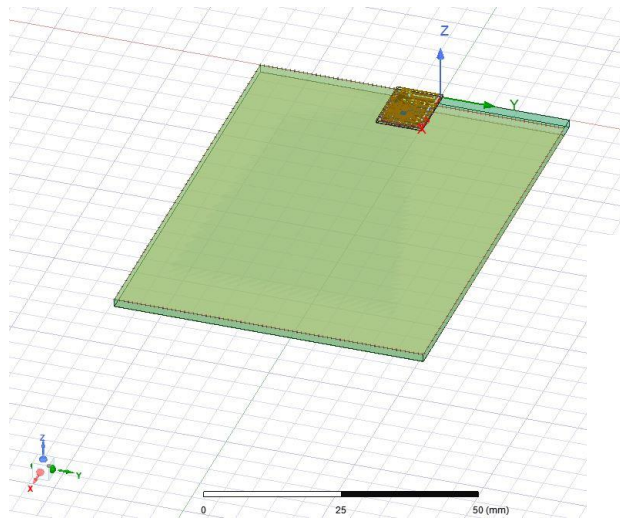
- Get in touch with us via the online contact form on our website we-online.com/antennamatching
- We review your information and get back to you.
- Please have the following data ready for analysis:
 - **Antenna:** Order code, required operating frequency range, required transmission range
 - **Radio Module:** Order code
 - **PCB:** BOM, circuit diagram, layout, layer structure, layer material
 - **Application:** casing information, immediate environment, environment
- We analyze your data and advise you.
- After successful analysis, the following materials will be required for antenna matching:
 - Complete application with housing and battery/accumulator
 - Two fully assembled PCBs on which the antenna is placed
- We match your antenna and send you a report.
- Your material will be returned.

SERVICES

- ✓ Advice on antenna selection
- ✓ Advice on antenna placement
- ✓ Advice on selection of the matching circuit for the antenna with RF-inductors and -capacitors
- ✓ Measurement of antenna S11 parameters: return loss (RL), voltage standing wave ratio (VSWR) and RL efficiency
- ✓ Antenna simulation models

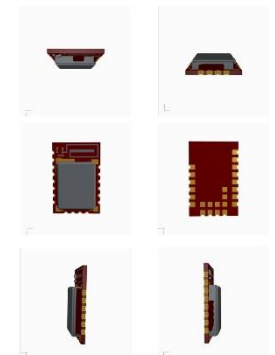
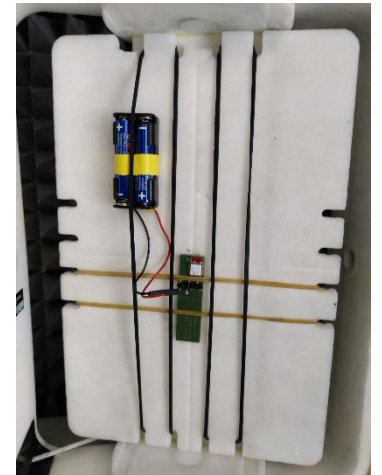
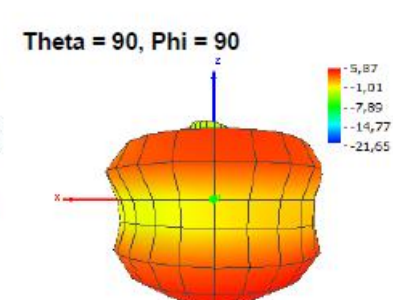
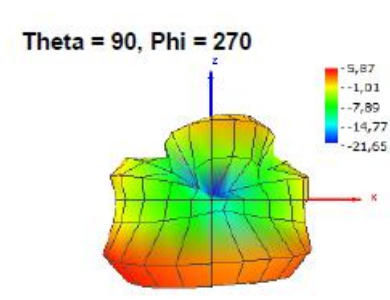
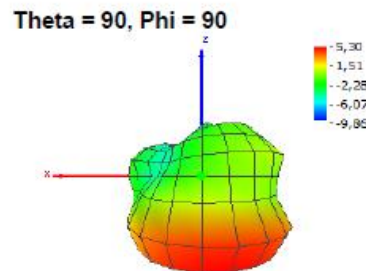
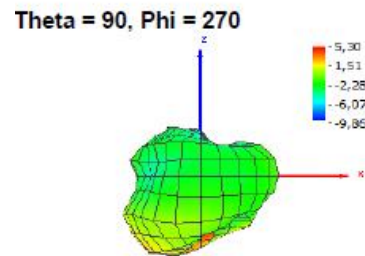
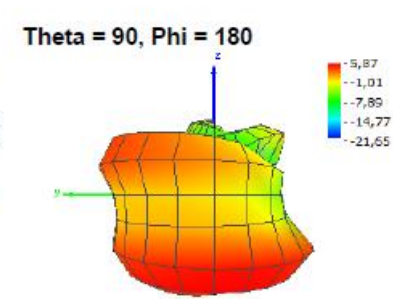
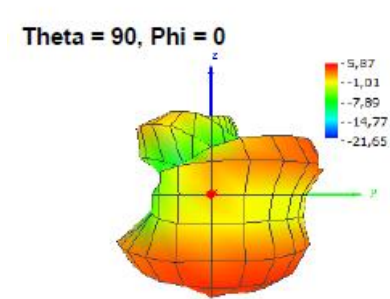
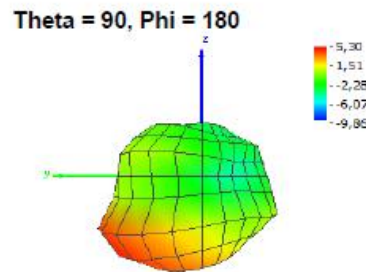
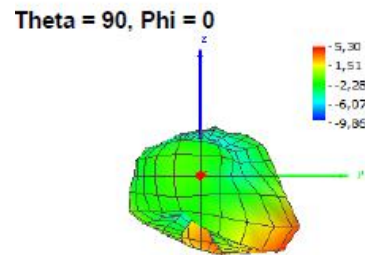
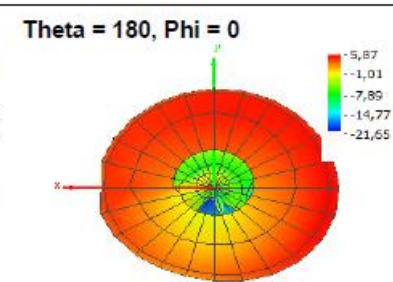
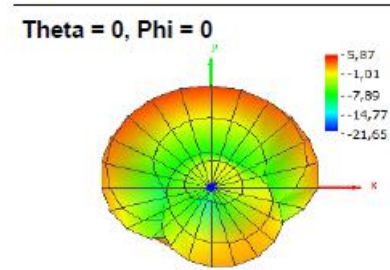
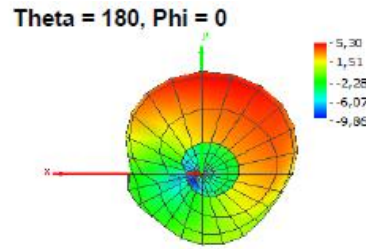
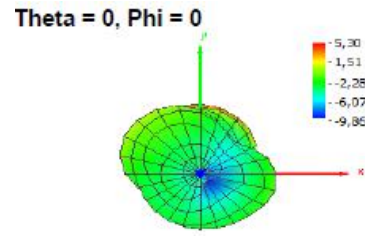
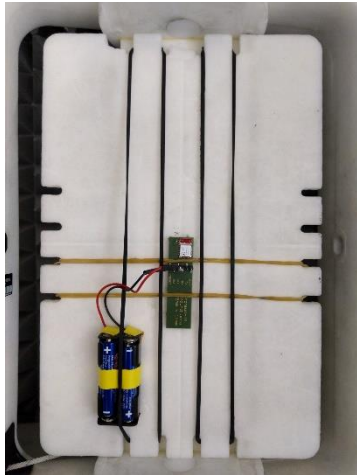
BEEINFLUSSUNG DER ANTENNENCHARAKTERISTIK DURCH DIE UMGEBUNG

Massefläche



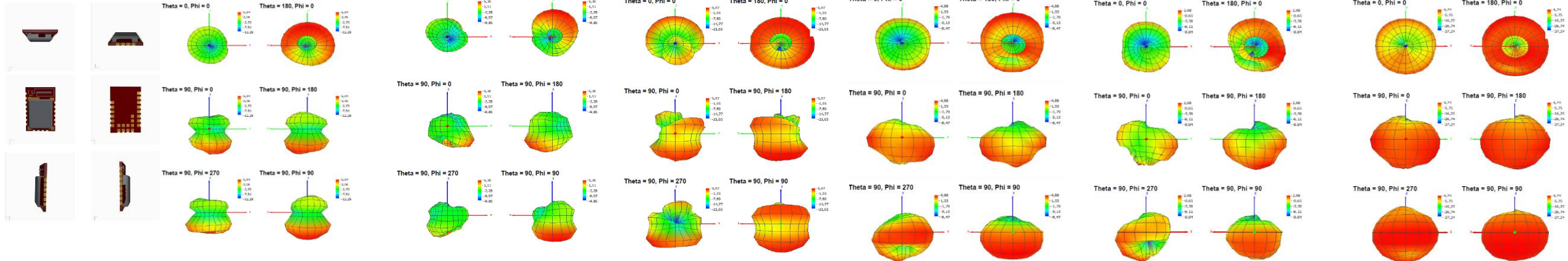
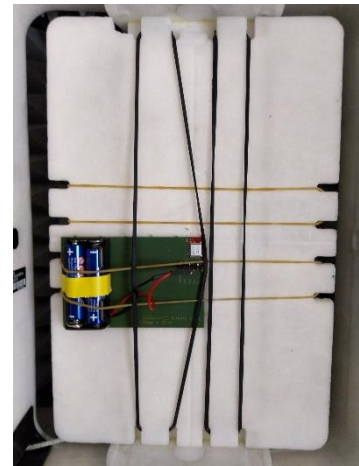
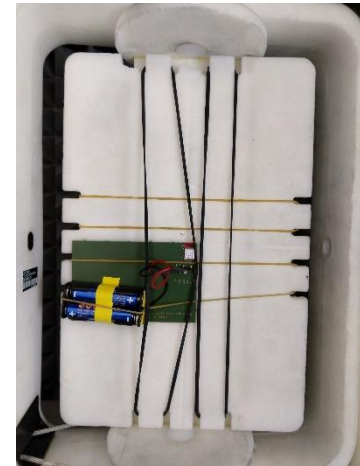
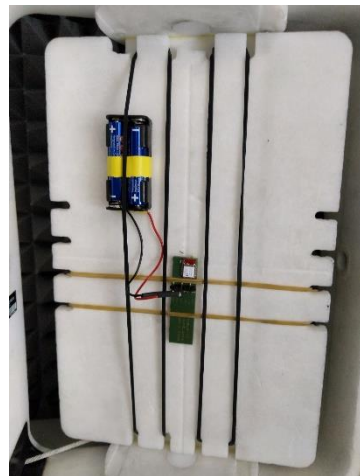
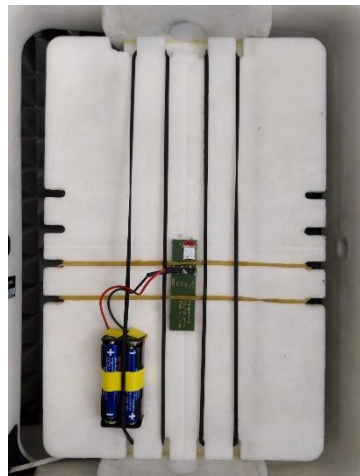
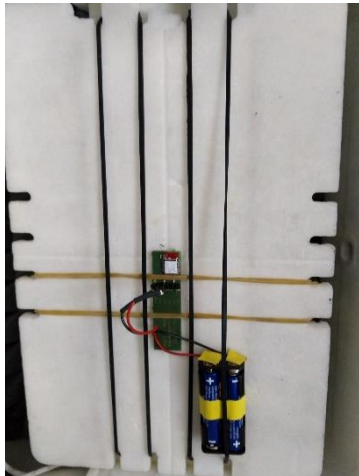
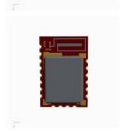
BEEINFLUSSUNG DER ANTENNENCHARAKTERISTIK DURCH DIE UMGEBUNG

Batterie



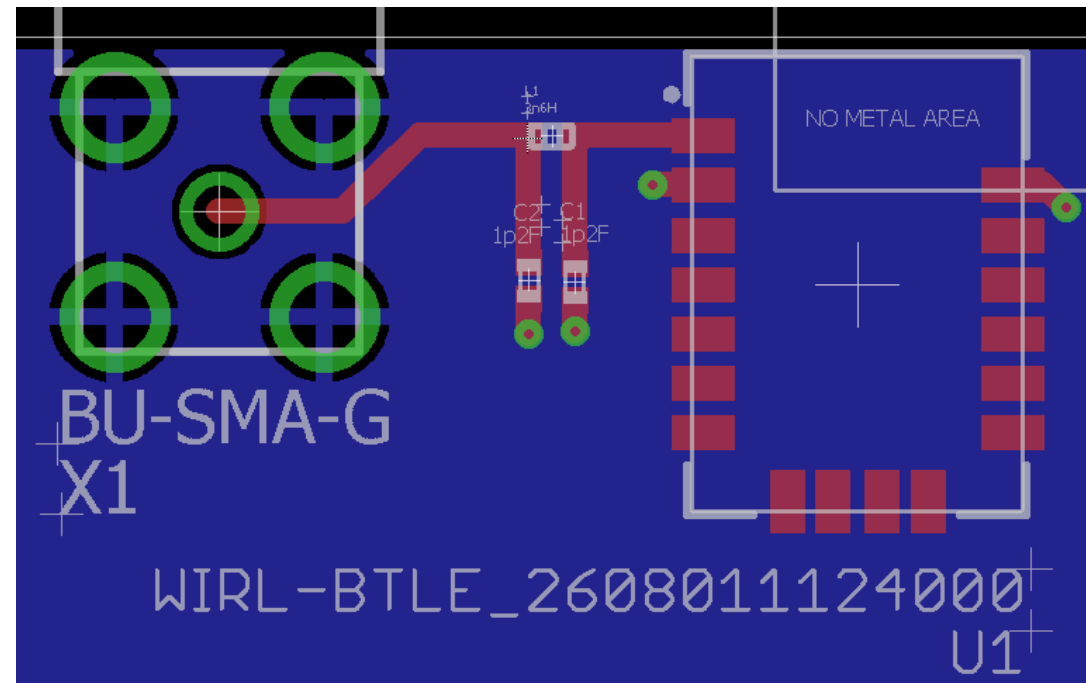
DESIGN-IN:

Umgebungseinflüsse am Beispiel der Platzierung der Batterie



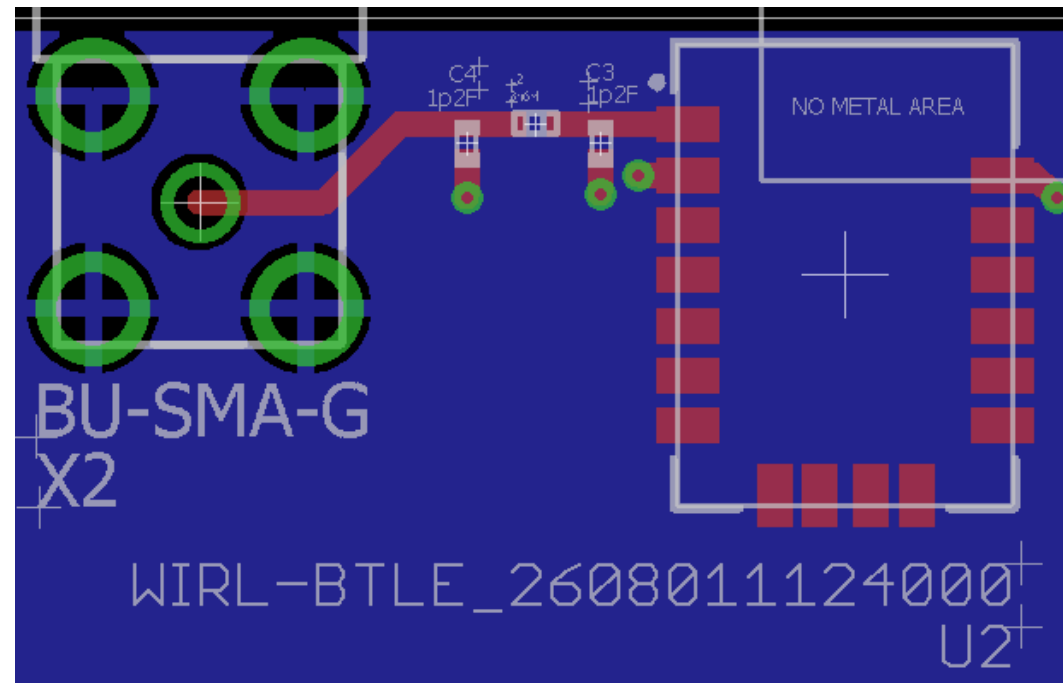
LAYOUT TIPS

- Filter- und Abblockkondensatoren direkt in die Zuleitung platzieren
- leerlaufende Stichleitungen vermeiden
- Anpassungselemente für die Antenne möglichst nah an der Antenne oder dem Steckverbinder platzieren
- Abblockkondensatoren möglichst nah am Module.



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- Abblockkondensatoren möglichst nah am Module.
- Masseanbindung für Modul und Kondensatoren so kurz wie möglich und mit mindestens einer Durchkontaktierung auf die Masselage
- ESD Schutz möglichst nah zu der ausgesetzten/berührungsgefährdeten Stelle platzieren

ANTENNAS AND MATCHING

WHAT ABOUT THE ANTENNA?

FIRMWARE WE-PROWARE
DO I HAVE TO DEVELOP
THE FIRMWARE FOR
THE MODULE?

FIRMWARE OPTIONEN

STANDARD FIRMWARE

- RF Module comes with a standardized firmware
- RF Module is subject to further firmware development
- 100% verified, electrical tested and validated
- update functionality given (UART, FOTA, ...)
- packaged in Tape & Reel, ESD und MSL conform



FIRMWARE FREEZE

A firmware freeze guarantees a static behaviour of the module and no change in the module at all.

- RF Module comes with a standardized firmware
- RF Module is NOT subject to further firmware development
- RF Module will have a fixed revision of the firmware e.g. 1.3.1
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INDIVIDUALIZED ADAPTION (USER SETTINGS)

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CUSTOM

A fully customized product with your dedicated application implemented on the module. This might require Würth Elektronik to offer design consultancy services and the product is not available ex stock.

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- we can upload your Firmware in our production process to the WE Hardware

Thread

MIOTY

Zigbee

RS485 / CAN

Bluetooth® Mesh

Application on the module

SPI / I²C

Switch status

Sensor measuring

...

BUILD YOUR OWN FIRMWARE

Get every module without WE Firmware to bring your own solution on it.

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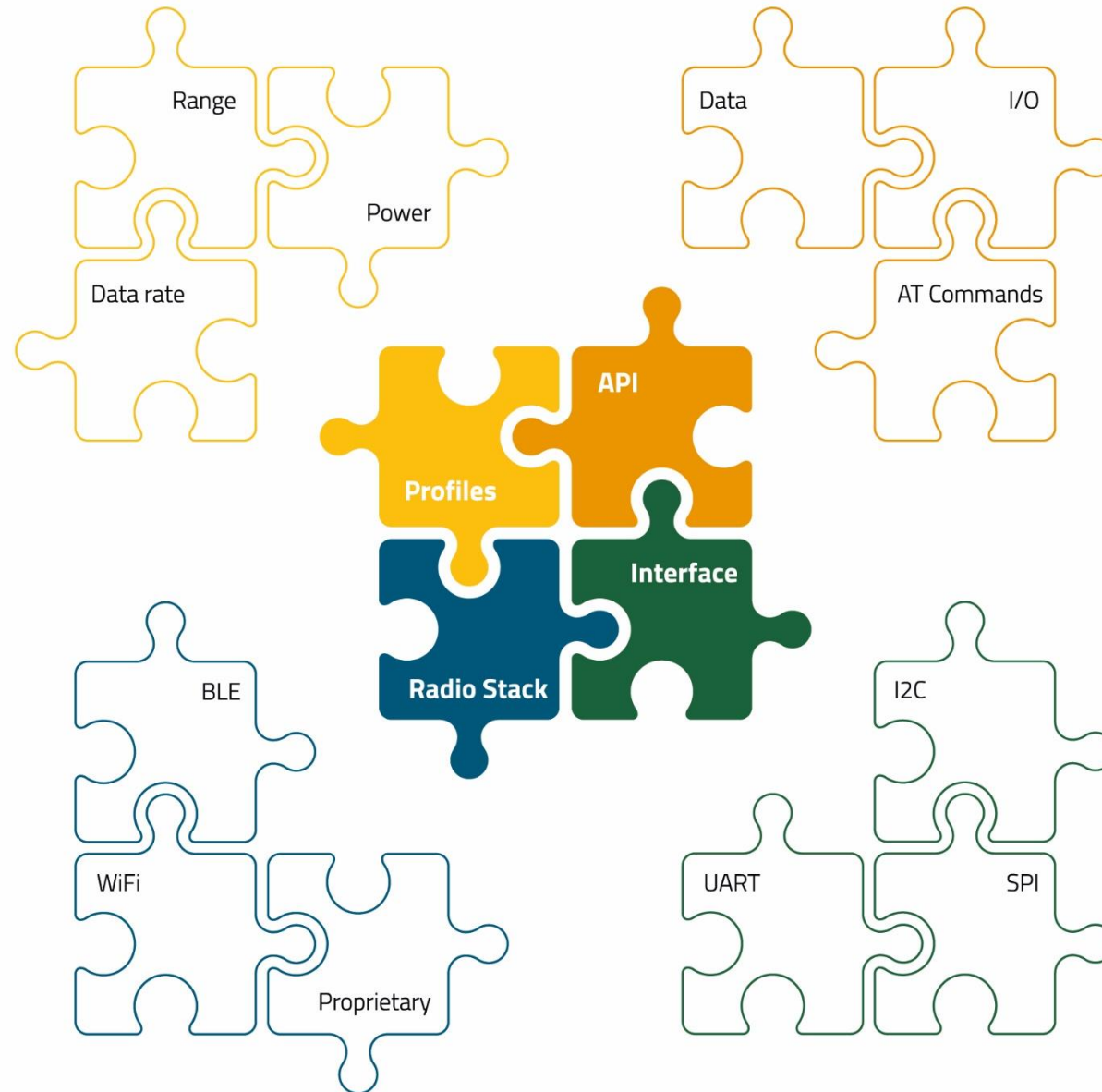


page: 114

Ophelia-I

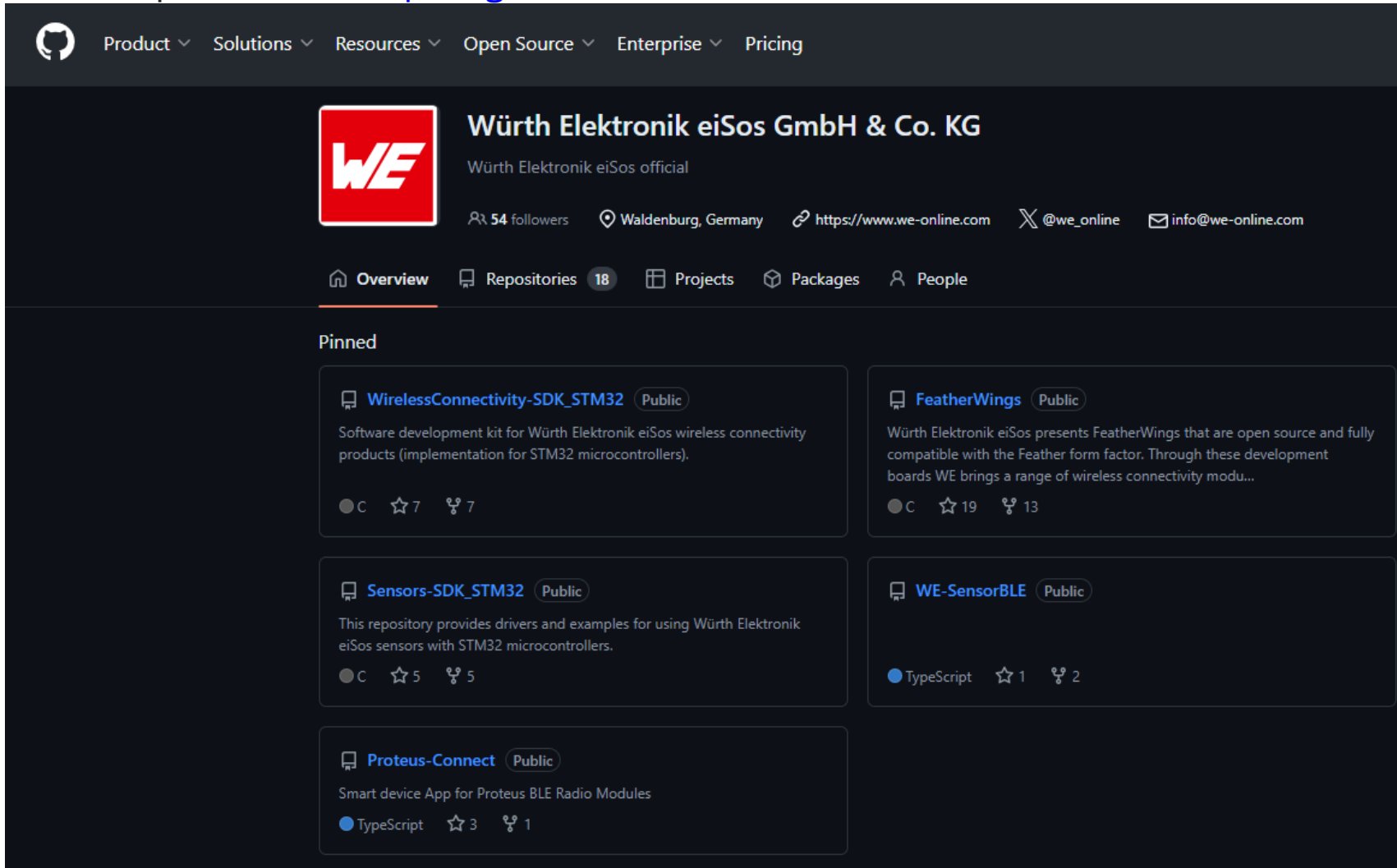
Hardware-only module based on Nordic nRF52805 radio chipset

SDK



SOFTWARE DEVELOPMENT

Github repositories - <https://github.com/WurthElektronik>

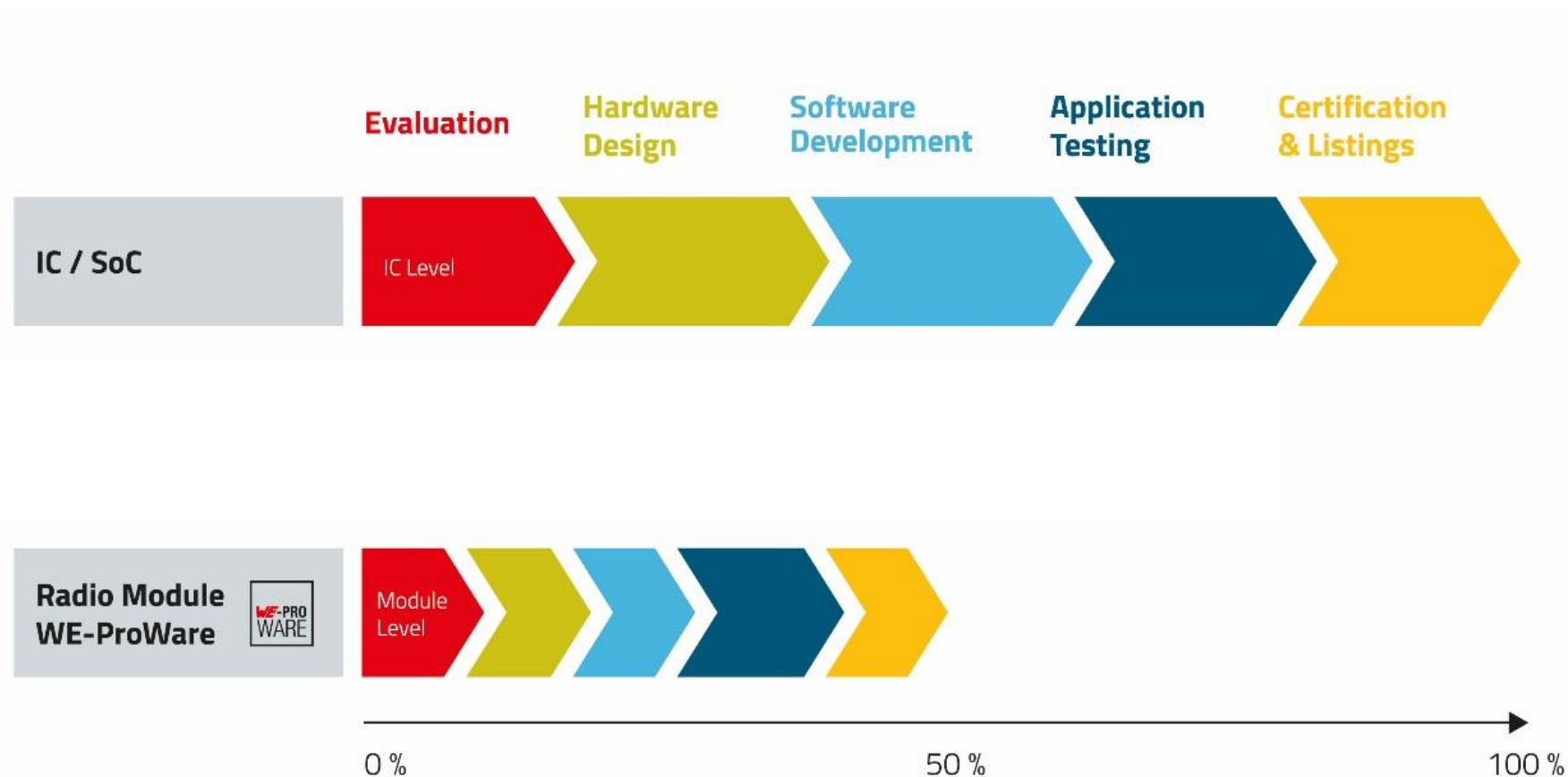


The screenshot shows the GitHub profile page for Würth Elektronik eiSos GmbH & Co. KG. The profile includes a red square logo with the white letters 'WE'. The company name is 'Würth Elektronik eiSos GmbH & Co. KG' with the subtitle 'Würth Elektronik eiSos official'. It shows 54 followers, a location in Waldenburg, Germany, and links to the company website, X (@we_online), and email (info@we-online.com). The navigation bar highlights 'Overview' and 'Repositories' (18). The 'Pinned' section displays five repositories:

- WirelessConnectivity-SDK_STM32** (Public): Software development kit for Würth Elektronik eiSos wireless connectivity products (implementation for STM32 microcontrollers). 7 stars, 7 forks.
- FeatherWings** (Public): Würth Elektronik eiSos presents FeatherWings that are open source and fully compatible with the Feather form factor. Through these development boards WE brings a range of wireless connectivity modu... 19 stars, 13 forks.
- Sensors-SDK_STM32** (Public): This repository provides drivers and examples for using Würth Elektronik eiSos sensors with STM32 microcontrollers. 5 stars, 5 forks.
- WE-SensorBLE** (Public): TypeScript, 1 star, 2 forks.
- Proteus-Connect** (Public): Smart device App for Proteus BLE Radio Modules. TypeScript, 3 stars, 1 fork.

DESIGN-IN

Vergleich Funkchip vs. Funkmodul



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Thread

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Zigbee

RS485 / CAN

Bluetooth® Mesh

Application on the module

SPI / I²C

Switch status

Sensor measuring

...

BUILD YOUR OWN FIRMWARE

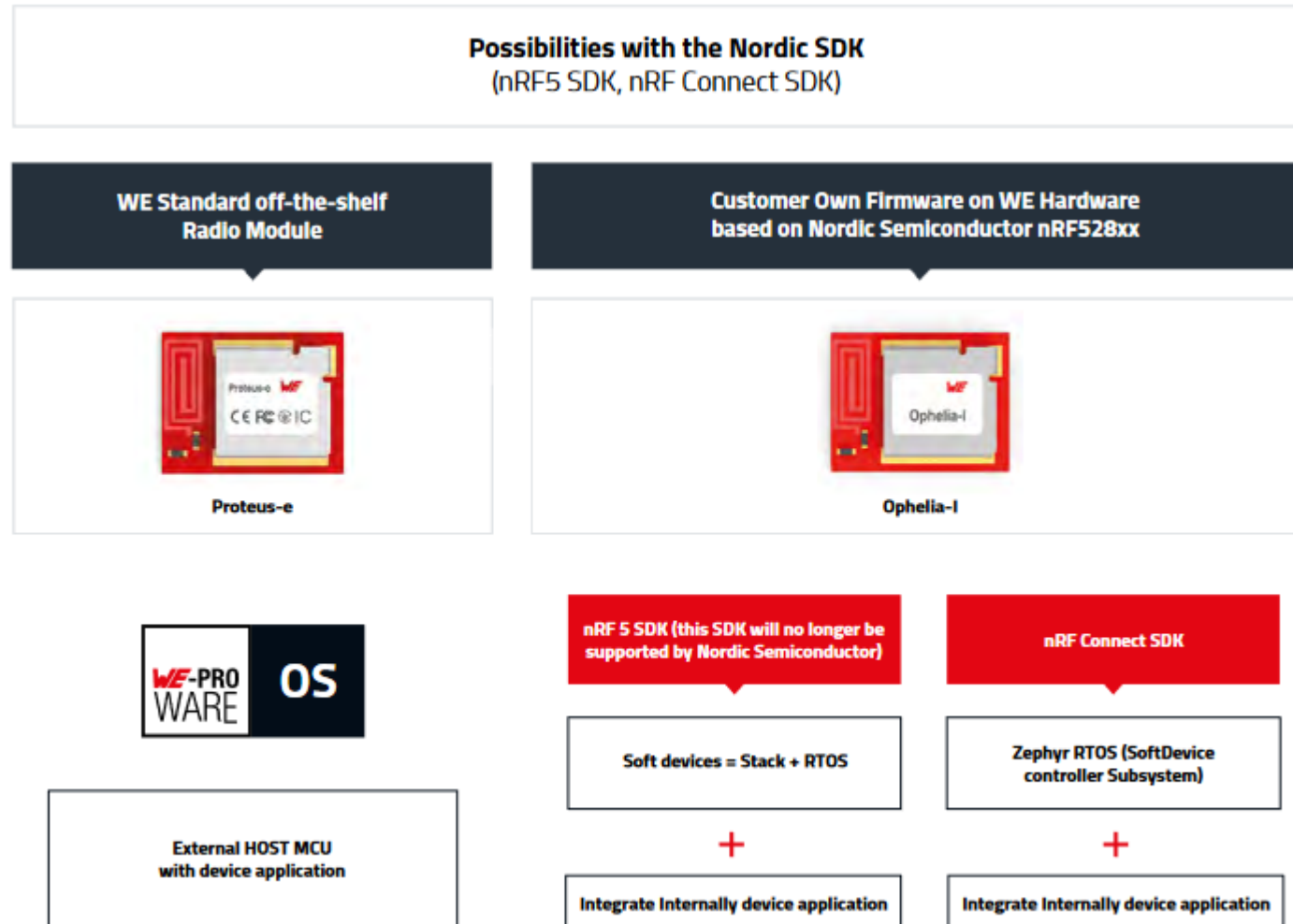
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NRF CONNECT SDK & WE-PROWARE OS + SDK

WC & S
SDK



BYOF – build
your own
firmware

CERTIFICATION OF CUSTOM MODULE

How can the certification of the standard module be re-used for the custom module?

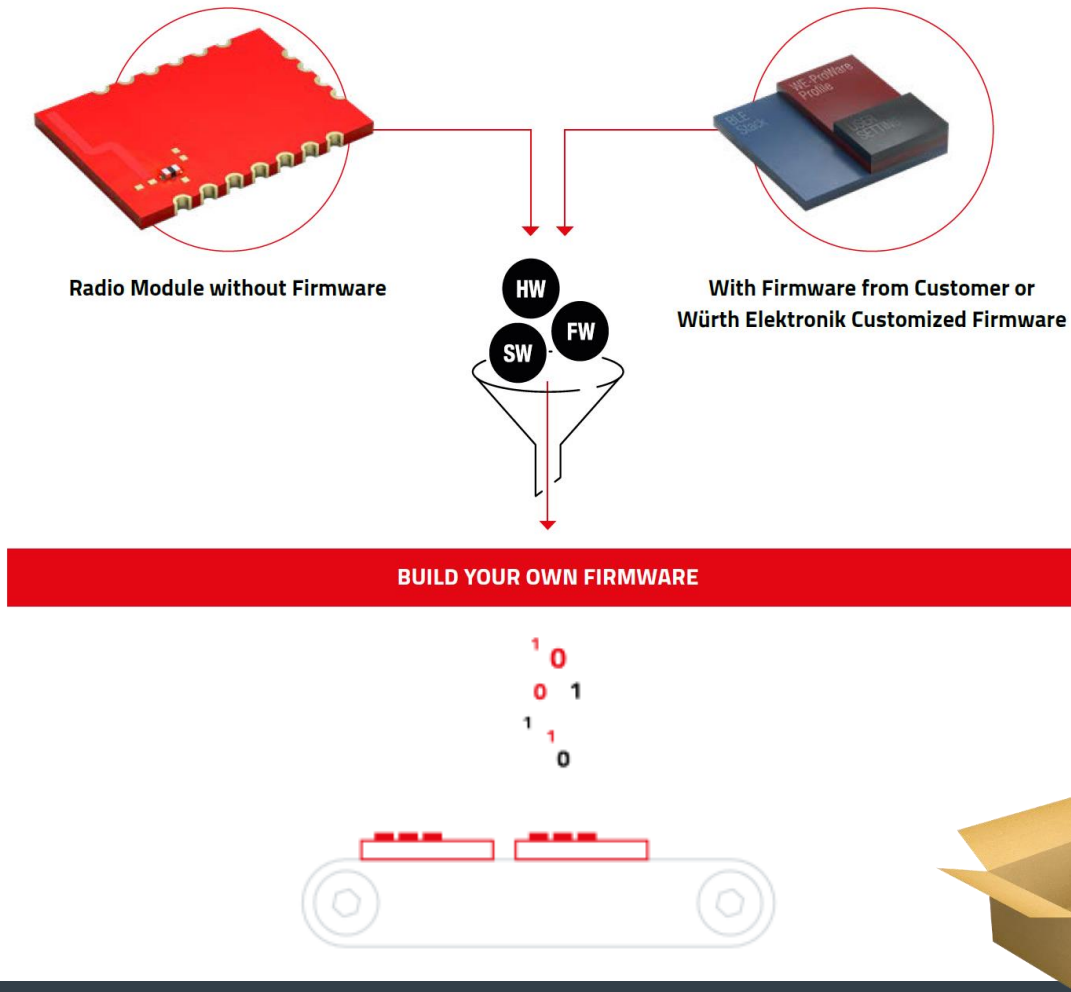
- For **RED (Europe), FCC (USA), IC (Canada), UKCA (Great Britain)** a **declaration of identity** must be done in case the custom module is **radio identical** to the standard module.
- TELEC (Japan) does not provide this opportunity.
- **Radio identical**: Radio of the custom module must respect the maximum TX power and radio profiles (Bluetooth LE 1 Mbit for example) as specified in the ANR031.

Proteus-III, Proteus-III- SPI, Setebos-I, Ophelia-III	• Using Bluetooth® LE radio of the nRF52840 • Using 1 MBit, 2 MBit or LE-Coded phy • Output power register of the radio chip set to maximum 8 dBm • Using Bluetooth® LE stack Nordic Semiconductor S140 Version 7.0.1¹ or nRFConnect SDK [1]
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Würth Elektronik AppNote:
[ANR031 Certification of custom modules](#)

FLASHING SERVICE

custom modules

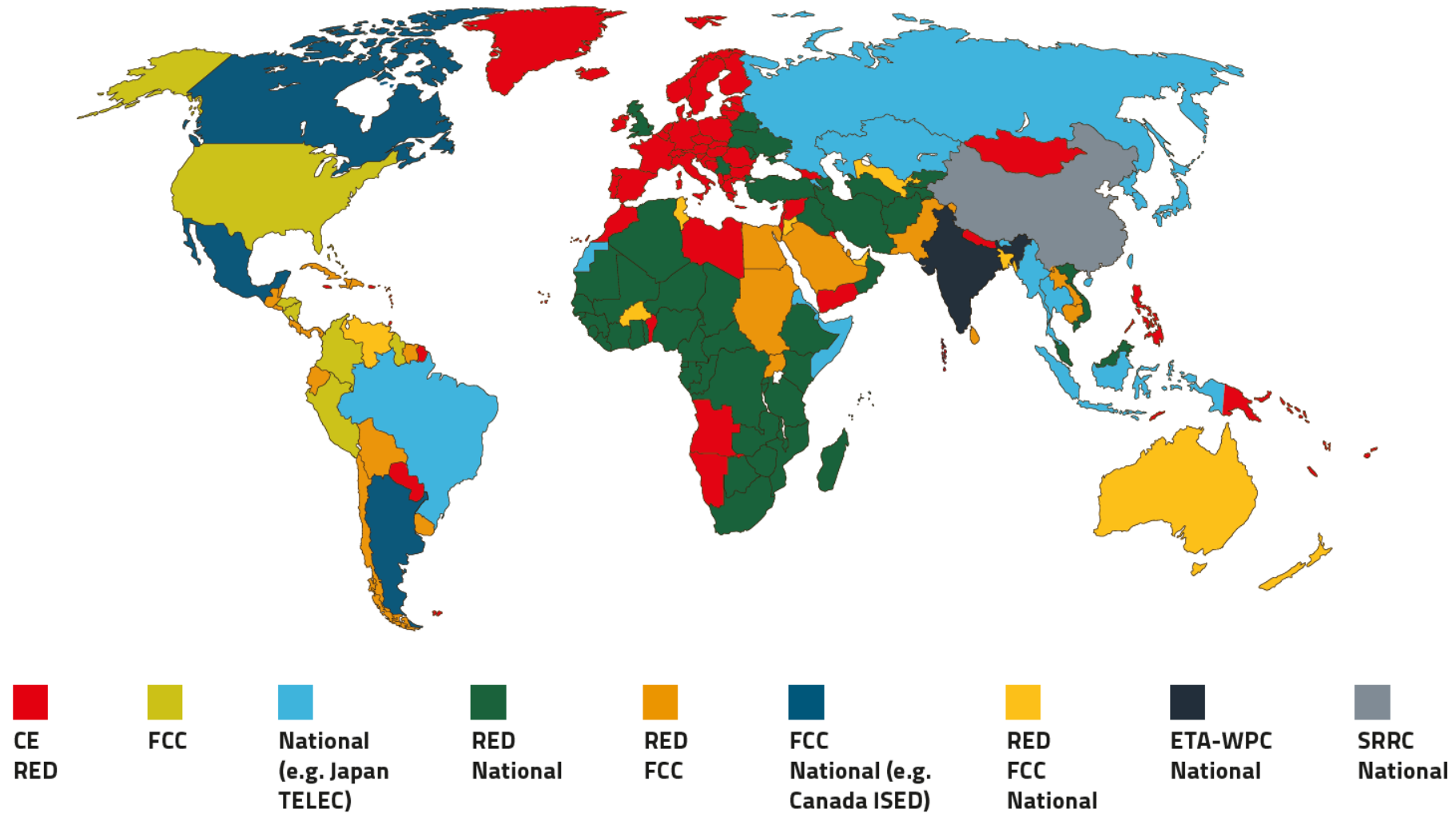


- Kundeneigene FW kann im Fertigungsprozess bei Würth Elektronik eiSos™ geflasht werden
- Spezifische Prüfroutine kann festgelegt werden
- Kundenspezifische Artikelnummer wird hierfür angelegt
- Bestellungen auch von EMS etc. möglich

FIRMWARE WE-PROWARE
DO I HAVE TO DEVELOP
THE FIRMWARE FOR
THE MODULE?

CERTIFICATION AND CONFORMITY
HOW TO CLIMB
THE MOUNTAIN OF
CERTIFICATION?

REGULARIEN WELTWEIT



NATIONAL REQUIREMENTS MATRIX

Order Code (part number)	Product Name	Frequency [MHz]	Match code (Product Series)	Product Information (Article Description)	CE EU	FCC USA	IC Canada	TELEC Japan	SRRCC China	WPC India	Australia	Brazil	Other countries
2615011136000	Adrastea-I	800-1800 / 1560-1610	WIRL-CLT1	LTE-M / NB-IoT Cellular module with GNSS	yes	possible	possible	no	possible	on request	on request	possible	on request
2612011022000	Ophelia-I	2400	WIRL-NFW2	2.4 GHz radio module without firmware	yes	yes	yes	yes	yes	yes	yes	possible	on request
2617011025000	Stephano-I	2400	WIRL-COMB	Bluetooth® Low Energy 5.0 & IEEE 802.11 b/g/n 2.4 GHz	yes	yes	yes	yes	possible	possible	possible	possible	on request
2608011024000	Proteus-I	2400	WIRL-BTLE	Bluetooth® LE 4.2 with integrated antenna	yes	yes	yes	yes	yes	possible	possible	possible	on request
2608011124000	Proteus-I	2400	WIRL-BTLE	Bluetooth® LE 4.2 with RF pad	yes	yes	yes	yes	no	possible	possible	possible	on request
2606031021000	Thalassa	2400	WIRL-PRO2	2.4 GHz proprietary module with integrated antenna	yes	yes	yes	no	no	possible	possible	possible	on request
2606031121000	Thalassa	2400	WIRL-PRO2	2.4 GHz proprietary module with RF pad	yes	yes	yes	no	no	possible	possible	possible	on request
2606031321000	Thalassa	2400	WIRL-PRO2	2.4 GHz proprietary module with UFL connector	yes	yes	yes	no	no	possible	possible	possible	on request
2611011024020	Setebos-I	2400	WIRL-PRO2	2.4 GHz radio module with proprietary and Bluetooth® LE 5.1 radio protocol	yes	yes	yes	possible	possible	yes	possible	possible	on request
2608011024010	Proteus-II	2400	WIRL-BTLE	Bluetooth® LE 5.0 with integrated antenna	yes	yes	yes	yes	possible	yes	possible	possible	on request
2611011024000	Proteus-III	2400	WIRL-BTLE	Bluetooth® LE 5.1 with smart antenna selection	yes	yes	yes	yes	yes	yes	possible	possible	on request
2611011024010	Proteus-III- SPI	2400	WIRL-BTLE	Bluetooth® LE 5.1 with SPI interface	yes	yes	yes	yes	possible	yes	possible	possible	on request
2611011020000	Ophelia-III	2400	WIRL-NFW2	2.4 GHz	yes	yes	yes	yes	yes	yes	yes	possible	on request
2612011024000	Proteus-e	2400	WIRL-BTLE	Bluetooth® LE 5.1 module	yes	yes	yes	yes	possible	yes	possible	possible	on request
2610011025000	Calypto	2400	WIRL-WIFI5	2.4 GHz WiFi module	yes	yes	yes	possible	possible	yes	possible	possible	on request
2611011021000	Thyone-I	2400	WIRL-PRO2	2.4 GHz proprietary module; smart antenna selection	yes	yes	yes	yes	possible	yes	possible	possible	on request
2612011021000	Thyone-e	2400	WIRL-PRO2	2.4 GHz proprietary module; smart antenna selection	yes	yes	yes	possible	possible	possible	possible	possible	on request
2611011021010	Thetis-I	2400	WIRL-PRO2	2.4 GHz Wirepas Mesh module	yes	yes	yes	possible	possible	yes	possible	possible	on request
2608011124010	Proteus-II	2400	WIRL-BTLE	Bluetooth® LE 5.0 with RF pad	yes	yes	yes	yes	on request	yes	on request	possible	on request
2603011021000	Triton	2400	WIRL-PRO2	2.4 GHz proprietary module with integrated antenna	yes	yes	yes	possible	possible	yes	possible	possible	on request
2603011121000	Triton	2400	WIRL-PRO2	2.4 GHz proprietary module with RF pad	yes	yes	yes	possible	possible	yes	possible	possible	on request
2611059021001	Thyone-I FeatherWing	2400	WIRL-EVAL	Proprietary 2.4 GHz RF-Module Connection	yes	yes	yes	possible	yes	on request	on request	possible	on request
2610039025001	Calypto FeatherWing	2400	WIRL-EVAL	WiFi-Connection 2.4 GHz	yes	yes	yes	possible	yes	on request	on request	possible	on request
2609041191000	Themisto-I	915	WIRL-PRO9	915 MHz proprietary module with RF pad	no	yes	yes	modified	no	no	modified	possible	on request
2607021191000	Telesio-I	915	WIRL-PRO9	915 MHz proprietary module with RF pad	no	yes	yes	no	no	modified	modified	possible	on request
2607021191010	Telesio-II	915	WIRL-PRO9	915 MHz proprietary module with RF pad	no	yes	yes	no	no	modified	modified	possible	on request
2609011091000	Telesio-III	915	WIRL-PRO9	915 MHz proprietary module with integrated antenna	no	yes	yes	modified	modified	modified	modified	possible	on request
2609011191000	Telesio-III	915	WIRL-PRO9	915 MHz proprietary module with RF pad	no	yes	yes	modified	modified	modified	modified	possible	on request
2609031181000	Thebe-II	869	WIRL-PRO8	868 MHz proprietary module with RF pad	yes	no	no	no	no	no	no	no	on request
2605041183000	Metis-I	868	WIRL-WMB8	868 MHz wM-BUS module	yes	no	no	no	no	no	no	no	on request
2607021183000	Metis-II	868	WIRL-WMB8	868 MHz wM-BUS module	yes	no	no	no	no	no	no	no	on request
2607056283011	Metis-II	868	WIRL-WMB8	868 MHz wM-BUS radio simulation USB-Stick	yes	no	no	no	no	no	no	no	on request
2607057283011	Metis- Analyzer Tool	868	WIRL-WMB8	868 MHz wM-BUS radio Analyzer USB-Stick	yes	no	no	no	no	no	no	no	on request
2605041181000	Tarvos-I	868	WIRL-PRO8	868 MHz proprietary module with RF pad	yes	no	no	no	no	modified	no	no	on request
2607021181000	Tarvos-II	868	WIRL-PRO8	868 MHz proprietary module with RF pad	yes	no	no	no	no	modified	no	no	on request
2609011081000	Tarvos-III	868	WIRL-PRO8	868 MHz proprietary module with integrated antenna	yes	no	no	no	modified	modified	no	no	on request
2609011181000	Tarvos-III	868	WIRL-PRO8	868 MHz proprietary module with RF pad	yes	no	no	no	modified	modified	no	no	on request
2618011181000	Daphnis-I	868	WIRL-LoRa®	868 MHz Long-Range-WAN module with RF pad	yes	modified	modified	on request	on request	on request	on request	no	on request
2605031141000	Thadeus	434	WIRL-PRO4	434 MHz proprietary module with RF pad	yes	no	no	no	no	no	possible	no	on request
2607011111000	Titania	169	WIRL-PRO2	169 MHz proprietary module with RF pad	yes	no	no	no	no	possible	on request	no	on request
2607011113000	Mimas-I	169	WIRL-WMB1	169 MHz wM-BUS module	yes	no	no	no	no	possible	on request	no	on request

Yes

Module fulfills national requirements, testing, certification and/or self declarations are done. Module fulfills national requirements. If required testing, certification and/or declaration of conformity are done.

Yes also includes products that have not been tested, certified or declared to be conform in case of not required.

Some examples:

- **Evaluation boards** are excluded from radio conformity approach in many countries.
- **Receiver only modules** are exempted from radio conformity approach in some countries.

No

Module is not suitable to fulfill national requirements, e.g.: frequency range, transmitter on time, output power, hopping, bandwidth.

Possible

Module is expected to fulfill national requirements, but no testing, no certification and/or no self declaration was done.

Modified

Module is not fulfilling national requirements but is suitable to do with some modifications that can only be implemented in a new or custom product.

On Request

The requirements must be checked depending on the project.

Brazil

Certification in Brazil is valid two years. Therefore we decided to not certify modules. We support customers with exchange to the authority (filings and confidential docs).

United Kingdom (UKCA)

With the intention of the British government to legislate in spring 2024 the indefinitely recognition of EU requirements, including CE marking for 21 product regulations, amongst others the Radio Equipment Regulations no further conformity prove or marking than CE is needed.
<https://www.gov.uk/guidance/using-the-ukca-marking>

DURCHFÜHRUNG DER ZULASSUNG

mit einem zertifizierten Funkmodul – WE Testreport

7 Summary of measurement results

☒	No deviations from the technical specifications were ascertained
☐	There were deviations from the technical specifications ascertained
☐	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC identifier	Description	verdict	date	Remark
RF-Testing	ETSI EN 300 328 V2.1.1 (2016-11)	See table!	2017-01-11	-/-

Test specification clause	Test case	temperature conditions	power source voltages	Mode	C	NC	NA	NP	Remark
5.4.2	RF output power	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
		Low	Nominal	GFSK	☒	☐	☐	☐	
		High	Nominal	GFSK	☒	☐	☐	☐	
5.4.2	Duty cycle, Tx-sequence, Tx-gap, medium utilization	Nominal	Nominal	-/-	☐	☐	☒	☐	-/-
5.4.3	Power spectral density	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
5.4.4	Accumulated transmit time, freq. occupation and hopping sequence	Nominal	Nominal	-/-	☐	☐	☒	☐	-/-
5.4.5	Hopping frequency separation	Nominal	Nominal	-/-	☐	☐	☒	☐	-/-
5.4.6	Adaptivity	Nominal	Nominal	-/-	☐	☐	☒	☐	-/-
5.4.7	Occupied channel bandwidth	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
5.4.8	Transmitter unwanted emissions in the out-of-band domain	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
5.4.9	Transmitter unwanted emissions in the spurious domain (cond. + rad.)	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
5.4.9	Transmitter unwanted emissions in the spurious domain (cond. + rad.)	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
5.4.10	Receiver spurious emissions (cond. + rad.)	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
5.4.11	Receiver blocking	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-

Note: C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

- Testreports der bestandenen Funkprüfung verfügbar
- Reduziert den Testaufwand des Endprodukts deutlich
- Module mit spezieller Test-FW möglich
- Pre-Tests im Labor in Waldenburg möglich

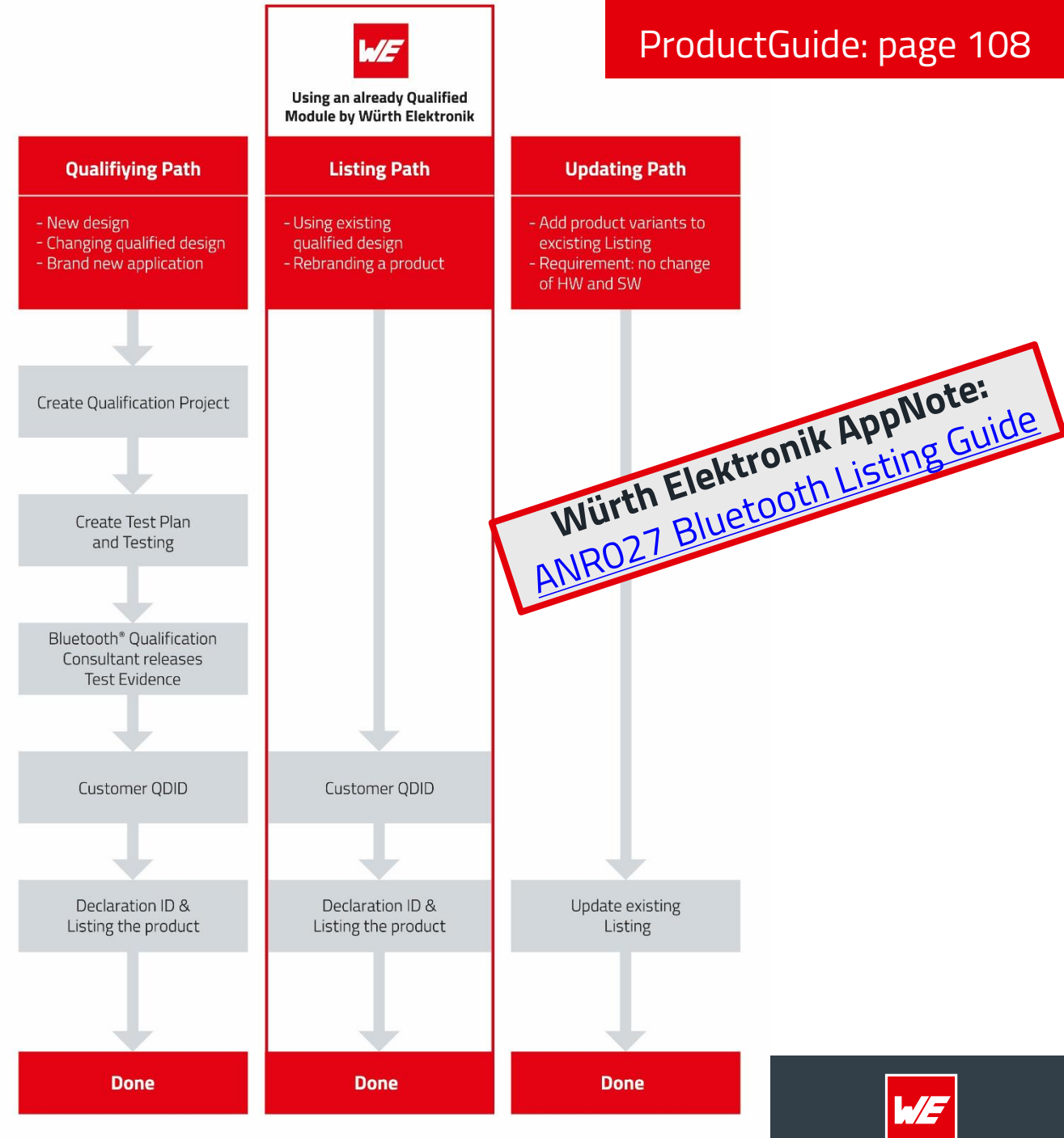
5.4.6	Adaptivity	Nominal	Nominal	-/-	☐	☐	☒	☐	-/-
5.4.7	Occupied channel bandwidth	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
5.4.8	Transmitter unwanted emissions in the out-of-band domain	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
5.4.9	Transmitter unwanted emissions in the spurious domain (cond. + rad.)	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
5.4.10	Receiver spurious emissions (cond. + rad.)	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
5.4.11	Receiver blocking	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-

Note: C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

BLUETOOTH®

Listing Prozess

- Besteht aus qualification und declaration
 - qualification Prozess
 - = Funktionalität und Konformität zu Spezifikationen (inkl. Tests und Messungen)
 - Declaration = Keine Tests oder Messungen, Ausschließlich verwaltungsaufwand (nur "paperwork"; und declaration fee)
- Der Inverkehrbringer ist für das Vorhandensein eines Listing verantwortlich
- Möglichkeit eines Updates eines vorhandenen Listing
 - identische Bluetooth HW und SW
 - Identischer Inverkehrbringer
 - → keine zusätzlichen Listing-Kosten entstehen



BLUETOOTH® SIG SCHEDULE OF DUES AND FEES

Updated 01 July 2024

Description	Current Fees
Membership Dues	
Adopter Membership Dues – Annual	\$0
Associate (Large) Membership Dues – Annual	\$48,300
Associate (Small) Membership Dues – Annual	\$10,350
Qualification Fees	
Product Qualification Fee – Associate Members ¹	\$5,520
Product Qualification Fee – Adopter Members ¹	\$11,040
Bluetooth Qualification Test Facility (BQTF) Recognition Fee – Annual	\$11,040
Bluetooth Recognized Test Facility (BRTF) Recognition Fee – Annual	\$2,760
Bluetooth Qualification Consultant (BQC) Exam Fee	\$828

Trademark Enforcement Cost Recovery Fees	
First Audit Failure (time to resolution)	
Day 0 to 45	\$0
Day 46 to Suspension	\$5,520
After Suspension	\$11,040
Each Additional Audit Failure (time to resolution)	
Day 0 to 45	\$2,300
Day 46 to Suspension	\$7,820
After Suspension	\$13,340
Other Fees	
16-bit UUID – Members	\$3,450

<https://www.bluetooth.com/fee-schedule/>

CERTIFICATION AND CONFORMITY
HOW TO CLIMB
THE MOUNTAIN OF
CERTIFICATION?

CHOOSE YOUR TECHNOLOGY/SOLUTION
NOW I CAN DISCOVER
THE WORLD OF WIRELESS
CONNECTIVITY...

HOW TO GET STARTED WITH WIRELESS CONNECTIVITY



BUT ONE MORE THING ...



RADIO NEEDS
TO GET
THE RULER
IN YOUR
APPLICATION



001101
010100
101101



Development
time

Development
cost

Hardware
dimensions

Housing
materials

Antenna
design

Wireless
connectivity

Software
development

Security
level

Energy
consumption

Target
market

Test
effort



RADIO NEEDS
TO GET
THE RULER
IN YOUR
APPLICATION

ONE MODULE
TO RULE THEM ALL...

HOW TO GET STARTED WITH WIRELESS CONNECTIVITY



PRODUKTÜBERSICHT



MORE THAN YOU EXPECT

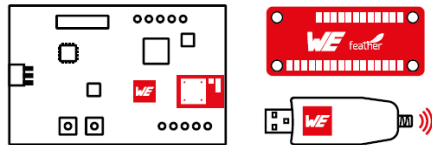
Full Service Products Hardware + Firmware



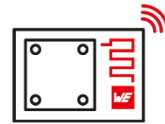
Certification and Conformity – CE, UKCA, FCC, IC, Telec , SRRC, NCC & ETA-WPC



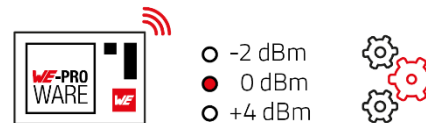
Evaluation Tools



Proven High Frequency PCB-Design & Proven Antenna Characteristics



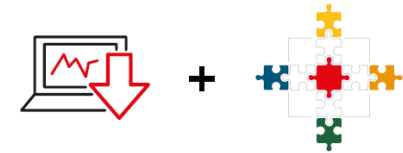
Configurable User Settings with our Firmware WE-ProWare



Technical Support – Talk from Engineer to Engineer



Software Toolkit: APIs and Software Development Kits (SDKs)



Free of Charge PC-Software and Mobile Apps



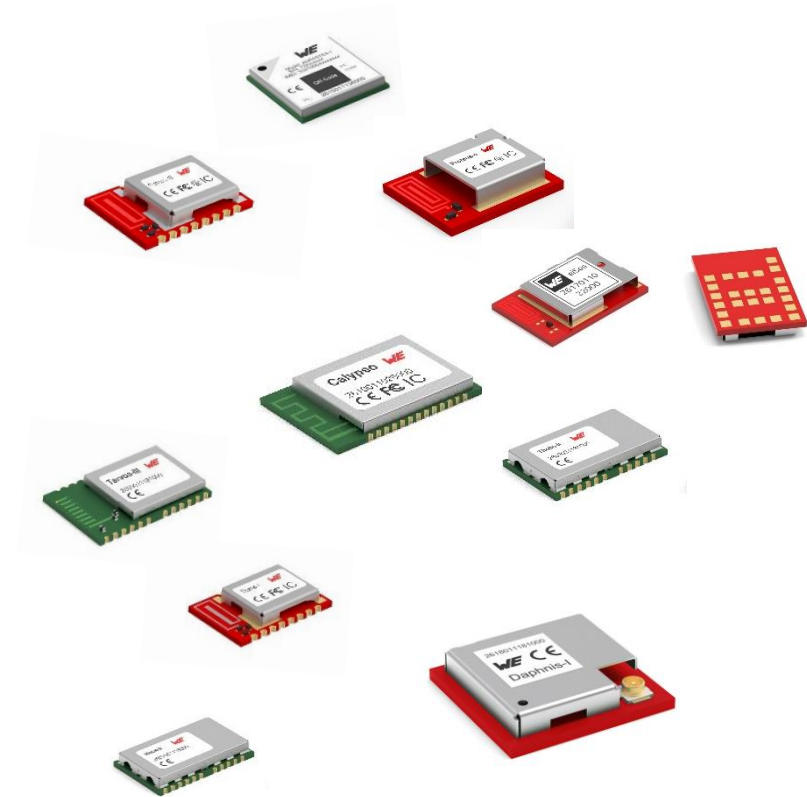
Long Term Availability



PRODUKTÜBERSICHT

WIRELESS CONNECTIVITY

LTE-M 	Connect Machine Globally	Cellular
 Bluetooth®	Connect Machine to Mobile Device	Bluetooth®
 WiFi CERTIFIED	Connect Machine to Internet	WiFi
Long-Range	Connect Device to Gateway	Long-Range-WAN
	Connect Machine to Machine	Proprietary
  Bluetooth® WiFi	Connect M2M & Mobile Device	Combined
  Wirepas	Connect all together	Mesh
	Connect Smart Meter	Wireless M-Bus
	Open Module/No Firmware	Build Your Own Firmware



SECURITY?

Cloud connectivity need to be secure



Hackers exploit casino's smart thermometer to steal database info

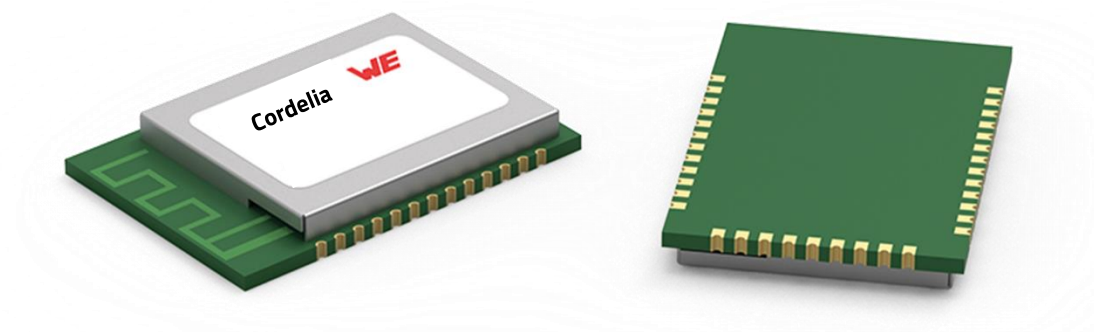
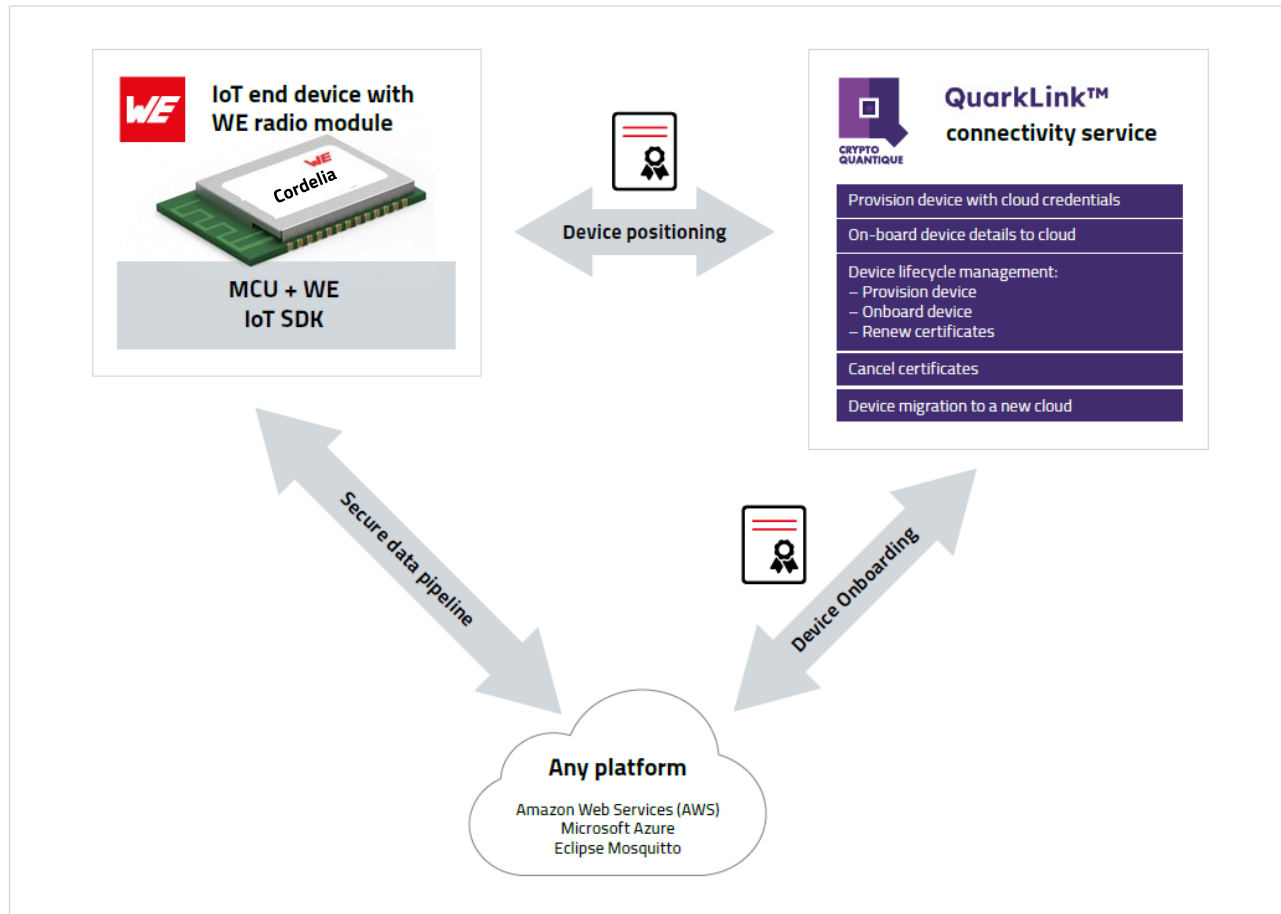
Nothing is safe.

By [Kellen Beck](#) on April 15, 2018



Coming soon – Cordelia-I

Secure cloud connectivity module - Cybersecurity in a module



PRODUKTÜBERSICHT

SENSORS



Motion Sensors



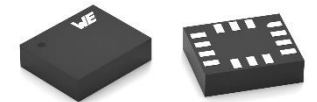
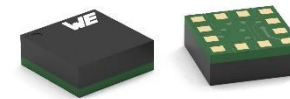
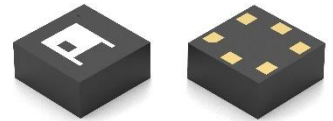
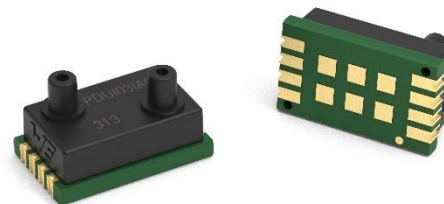
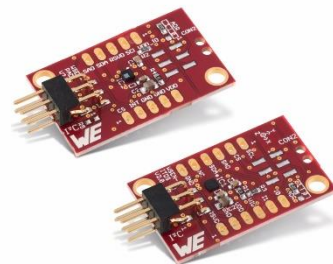
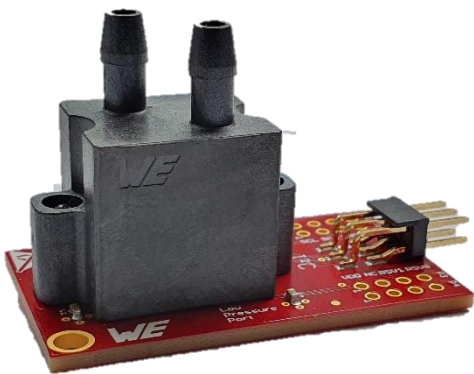
Environmental Sensors



Pressure Sensors



Current Sensors



WEITERE INFORMATIONEN HIER:

WWW.WE-ONLINE.DE/KATALOG/WCO

WWW.WE-ONLINE.COM/WCS-PRODUCT-GUIDE

HINTERGRUNDINFORMATIONEN

Wireless Connectivity & Sensors Product Guide



www.we-online.com/wcs-product-guide

VIELEN DANK!

NOCH FRAGEN?



Bei Fragen immer gerne melden!



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