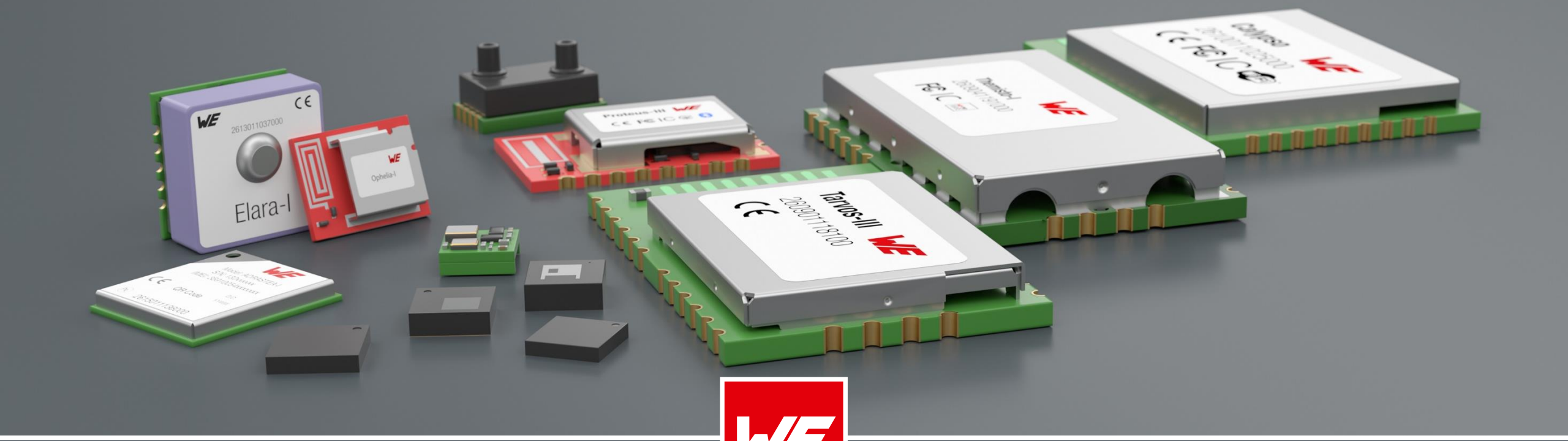


BEST PRACTICES FUNKENTWICKLUNG

Oliver Krause
Business Development Manager

KURZE VORSTELLUNG

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

EINFÜHRUNG FUNK

Was ist das Ziel?

- Viele Aspekte müssen vorab betrachtet werden
- Viele Fehler entstehen schon vor der Entwicklung
- Ziel dieser Präsentation:
  - Komplexität einer Funkentwicklung aufzeigen
  - Wichtige Fragen vor Beginn einer Entwicklung mit an die Hand zu geben
  - Tipps und Lösungen

Funkapplikationen sind komplex,
aber mit der richtigen Strategie und den richtigen Partnern
auch keine Zauberei


I PROMISE, IT'S ALL SCIENCE, NOT MAGIC!

EINFÜHRUNG IN DIE FUNKENTWICKLUNG

1. Wo wollen Sie ihr Produkt einsetzen?

1. Region

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

- [ ] Europe
- [ ] North America
- [ ] South America
- [ ] Asia
- [ ] worldwide
- [ ] other: _____

	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

EINFÜHRUNG IN DIE FUNKENTWICKLUNG

2. & 3. Welche Reichweite benötigen Sie und in welcher Umgebung wird gefunkt?

2. Range

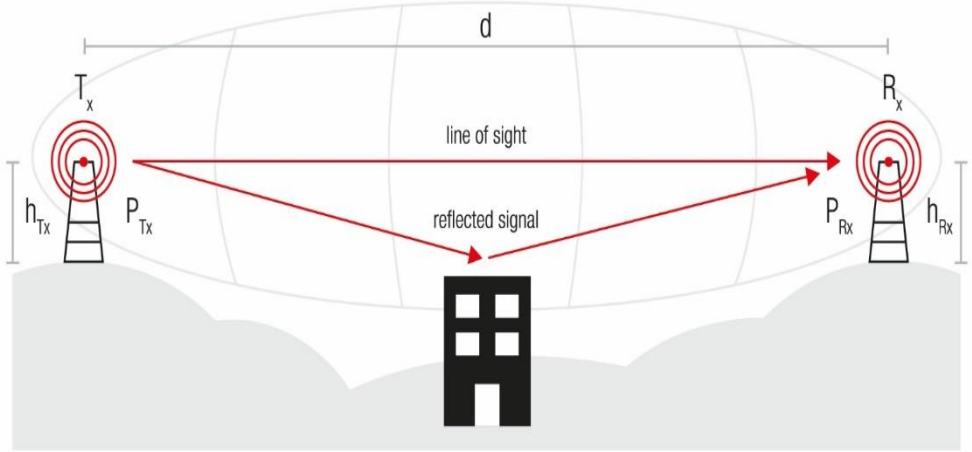
What range do you need to cover in your application?

- ☐ 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:_____



EINFÜHRUNG IN DIE FUNKENTWICKLUNG

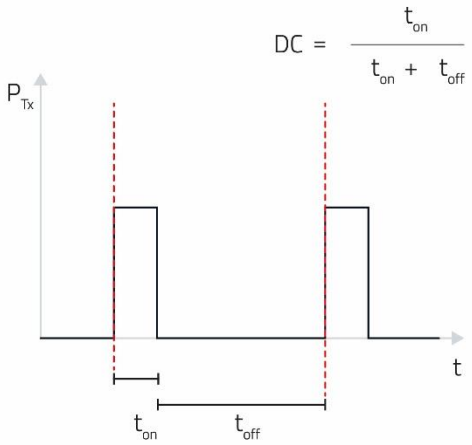
4. Wie viele Daten müssen Sie übertragen?

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)



Frequency [MHz]	Band	TX Power [dBm]	TX Power [mW]	Duty cycle	max. occupied BW*	Notes
169.400 - 169.475	D	+ 27	500	≤ 1 %	50	For metering devices: 10 % DC;
169.400 - 169.4875	E	+ 10	10	≤ 0.1 %	whole band	
169.4875 - 169.5875	F	+ 10	10	≤ 0,001 %	whole band	0,1 % DC during 0:00 and 6:00 local time; Equipment that concentrates or multiplexes individual equipment is excluded.
169.5875 - 169.8125	G	+ 10	10	≤ 0,1 %	whole band	
433.050 - 434.790	H	+ 10	10	10 %	whole band	
433.050 - 434.790	I	0	1	no limits	whole band	-13 dBm / 10kHz PSD when bw > 250 kHz, audio/video applications are excluded
433.050 - 434.790	J	+ 10	10	no limits	25	audio/video applications are excluded
863.0 - 865.0	K	+ 14	25	≤ 0.1 % or psa**	whole band	OBW restictions except audio & video limited to 300 kHz
865.0 - 868.0	L	+ 14	25	≤ 1 % or psa**	whole band	
868.0 - 868.6	M	+ 14	25	≤ 1 % or psa**	whole band	
868.7 - 869.2	N	+ 14	25	≤ 0.1 % or psa**	whole band	
869.4 - 869.65	P	+ 27	500	≤ 10 % or psa**	whole band	
869.7 - 870.0	Q	+ 7	5		whole band	audio / video applications are excluded
869.7 - 870.0	R	+ 14	25	≤ 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

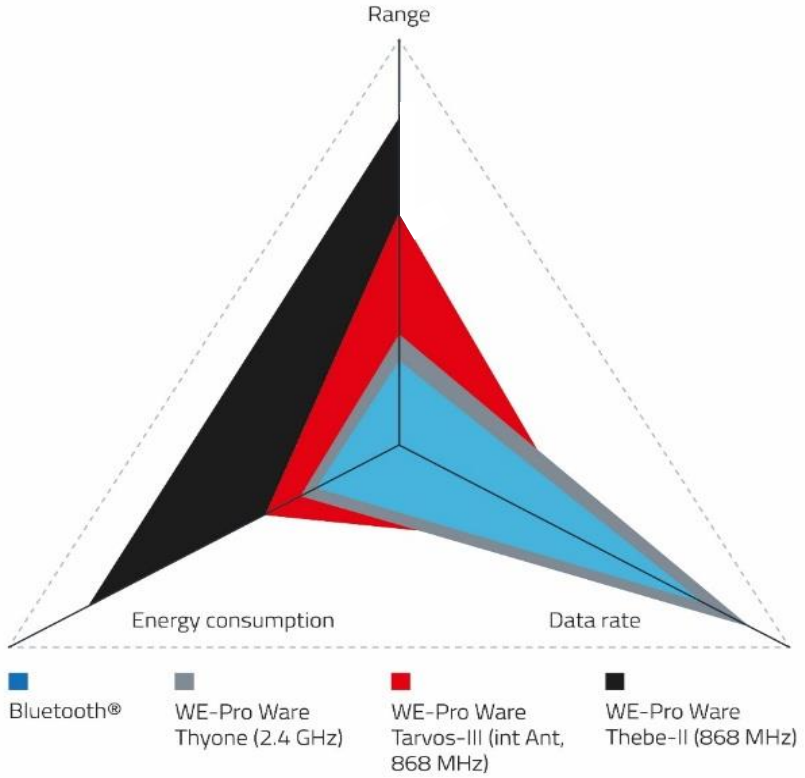
EINFÜHRUNG IN DIE FUNKENTWICKLUNG

5. Welcher Stromverbrauch ist akzeptabel?

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: _____



EINFÜHRUNG IN DIE FUNKENTWICKLUNG

6. Mit welchem Gerät wollen Sie kommunizieren?

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: _____

Bluetooth®

- Bluetooth® classic, Basic Rate (BR), Enhanced Data Rate (EDR), High Speed (HS)
- Standardized connection to smart devices
- High data rates possible
- Esp. audio connections

Wi Fi CERTIFIED

- Actually Wireless Local Are Network (WLAN)
- Wi-Fi is a marketing name
- Standard of IEEE-802.11
- High data rates possible
- Worldwide standardized in use

Bluetooth® LE

- Bluetooth® Low Energy
- Standardized, simple connection to smart devices
- Low energy requirements
- Low data rates, typically for parameterization, service interfaces, remote displays, etc.

LoRa

- Managed by LoRa Alliance
- LoRaWAN® widely deployed LPWAN (Low Power Wide Area Network)
- Low power consumption and high range
- Open networks can be shared if available

	LIZENZFREIE ISM-BÄNDER (INDUSTRIAL SCIENTIFIC MEDICAL)							LIZENZIERTE MOBILFUNK-BÄNDER					
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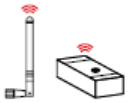
Wellenlänge [cm]	178	69	35	33	20	13	6	43	33	17	14	12	9
Funkprotokoll	WE-PRO WARE M-Bus wireless	WE-PRO WARE	WE-PRO WARE M-Bus wireless LoRa sigfox zigbee Z-WAVE enocean mioty	WE-PRO WARE M-Bus wireless LoRa sigfox zigbee Z-WAVE enocean	NAVSTAR GPS GLONASS GALILEO BEIDOU	WE-PRO WARE Bluetooth Wi Fi zigbee matter THREAD Wirepas IEEE 802.15.4 ANT+	Wi Fi	lte 5G			NB-IoT LTE-M GSM UMTS		
Reichweite	mittel	mittel	hoch	hoch	hoch	niedrig	niedrig	hoch			hoch		
Datenrate	niedrig	niedrig	mittel	mittel	niedrig	hoch	hoch	hoch			niedrig		
Würth Elektronik Antennen													

EINFÜHRUNG IN DIE FUNKENTWICKLUNG

7. Welche zusätzlichen Kosten fallen an?

7. Additional costs

Are there any additional costs for using my preferred rf-standard?

Quelle: Silicon Labs techtalks sessions

MATTER

Matter mit Thread: Anforderungen

- Listing Bluetooth bei der Bluetooth SIG
- Zertifizierung Thread bei der Thread Group
- Zertifizierung Matter bei der CSA

Quelle: Silicon Labs techtalks sessions

	Associate	Adopter*	Participant*	Promoter*
New Certification (by Testing)				
Application fee	N/A	3,000	2,000	2,000
Authorized Test Provider Fee	Based on Test Provider			
Certification by Similarity (CbS)				
Application fee	N/A	2,500	1,500	1,500
Certification Transfer Program				
Application fee	2,500	2,500	1,500	1,500
CTP listing (annually)**	500	FREE	FREE	FREE
Family Certification Program				
New family application fee	N/A	8,000	4,000	4,000
Recertification (family update) application fee	N/A	8,000	4,000	4,000
Family extension (adding variants) application fee	N/A	1,000	500	500

Normal Certification

Certification by Similarity (CbS)

Family Certification

** Includes a yearly fee starting at 7000 USD/year*
*** CTP listing fees for any existing certified products are immediately removed upon upgrade to Adopter or a higher level membership.*
**** All fees are listed in US Dollars (USD).*

Quelle: Silicon Labs techtalks sessions

- Quelle: Silicon Labs techtalks sessions

	Bluetooth SIG	Thread Group	Wi-Fi Alliance
Alliance Membership Levels			
Membership Fees	Adopter - $0		
	Associate* – $9000	Implementer - $7500	Implementer*** - $6000 (2024)
	Associate** – $42000	Contributor - $15000	Contributor - $20000 (2024)
Authorized Test Labs			
Testing Fee	Varies based on ATL	Varies based on ATL****	Varies based on ATL
Product Certifications			
Certification Fees (per Product).	Declaration Fee (Adopter) - $11040	Inheritance (Implementer) - $1500	FlexTrack (Contributor)- $5000
	Declaration Fee (Associate) - $4800	Inheritance (Contributor) - $1000	QuickTrack (Contributor)- $7500
		Certification at ATL**** - $2500	Derivative (Contributor)- $600
			Derivative (Implementer) - $4000

NOTE: *The above info is for guidance only. Visit the respective alliance's website for the most up-to-date information and fees.*
**For companies with annual revenue < $100M*
***For companies with annual revenue >$100M*
****Wi-Fi Alliance Implementer is for companies that are using unmodified Wi-Fi modules certified by another company and want to use the Wi-Fi Certified brand*
***** If using an uncertified thread stack or an altered certified thread component*

Quelle: Silicon Labs techtalks sessions

BLUETOOTH LISTING

- Die Bluetooth SIG entwickelt die Standards (z.B. BT LE 5.2) und bestimmt auch die Laufzeiten der einzelnen Versionen.
- Es gibt 3 mögliche Stadien in der sich eine Version befinden kann

- 1. Adopted/Active (aktiv: neue Qualification können erfolgen)
- 2. Deprecated (veraltet: der Standard bekommt keine Updates mehr
- 3. Withdrawn (zurückgezogen: keine Qualifizierung bzw. Aktualisierung der Qualification mehr/es dürfen nur bestehende Einträge weiterproduziert werden)

Document Name ▲	Version/Revision	Type	Status	Deprecation	Withdrawal
Core Specification (amended)	5.4	Specification	Adopted	*1 Feb 2033**	*1 Feb 2038**
Core Specification (amended)	5.3	Specification	Adopted	*1 Feb 2032**	*1 Feb 2037**
Core Specification (amended)	5.2	Specification	Adopted	*1 Feb 2030**	*1 Feb 2035**
Core Specification (amended)	5.1	Specification	Adopted	*1 Feb 2029**	*1 Feb 2034**
Core Specification (amended)	5.0	Specification	Adopted	1 Feb 2027	1 Feb 2032
Core Specification (amended)	4.2	Specification	Adopted	1 Feb 2026	1 Feb 2031

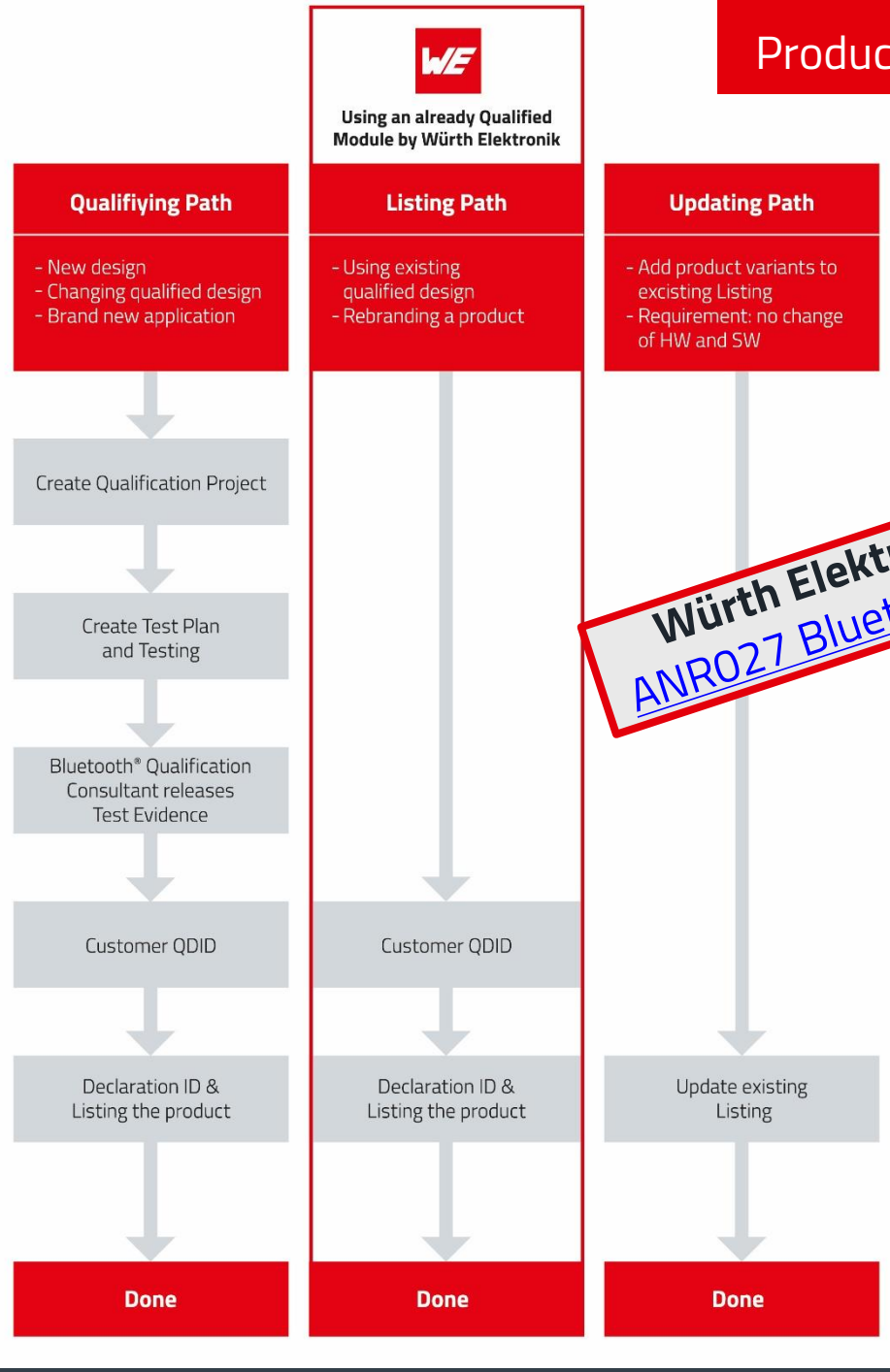
BLUETOOTH®

Qualification Prozess

- besteht aus Test und Declaration
  - Test Prozess
    = Funktionalität und Konformität zu Spezifikationen (Testpläne und Messungen)
  - Declaration = Keine Pläne oder Messungen nötig (nur “Paperwork” und Bares)

- 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



Würth Elektronik AppNote:
ANR027 Bluetooth Listing Guide

BLUETOOTH SIG

BLUETOOTH TRADEMARK ENFORCEMENT

Big Brother is watching you!

- **Monitoring der Bluetooth SIG**
  - Die SIG überwacht den Markt und kontaktiert Hersteller, welche ihr Produkt nicht qualifiziert haben
- **Monitoring der SIG Mitglieder**
  - Mitglieder sind angehalten, nicht qualifizierte Produkte von Mitbewerbern zu melden
- **Monitoring der Zollbehörden**
  - Die Zollbehörden dürfen nicht qualifizierte Produkte beschlagnahmen und zerstören

BLUETOOTH® SIG SCHEDULE OF DUES AND FEES

Seit dem 01. Juli 2024

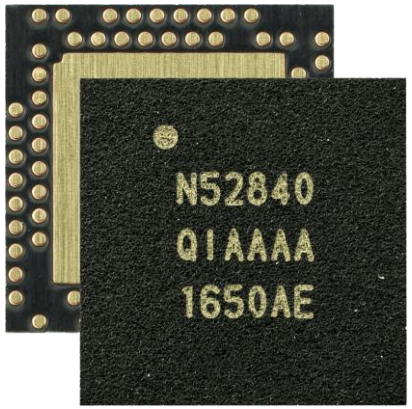
Description	Current Fees
Membership Dues	
Adopter Membership Dues – Annual	$0
Associate (Large) Membership Dues – Annual	$48,300
Associate (Small) Membership Dues – Annual	$10,350
Qualification Fees	
Product Qualification Fee – Associate Members[1]	$5,520
Product Qualification Fee – Adopter Members[1]	$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/

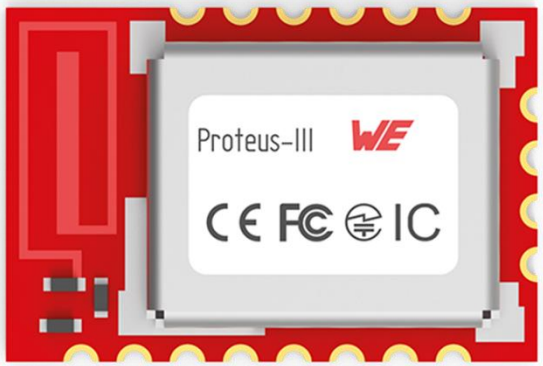
ENTWICKLUNGSANSÄTZE FÜR FUNKANWENDUNGEN

Es gibt 3 Möglichkeiten eine Funkentwicklung zu starten



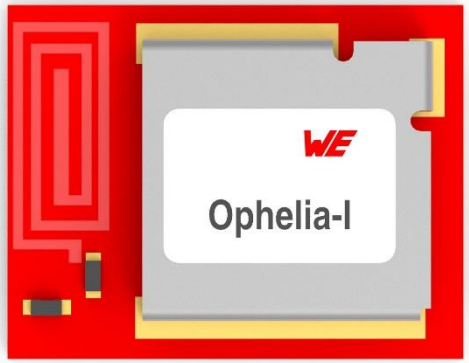
Funkchip

VS.



Funkmodul mit Software

VS.

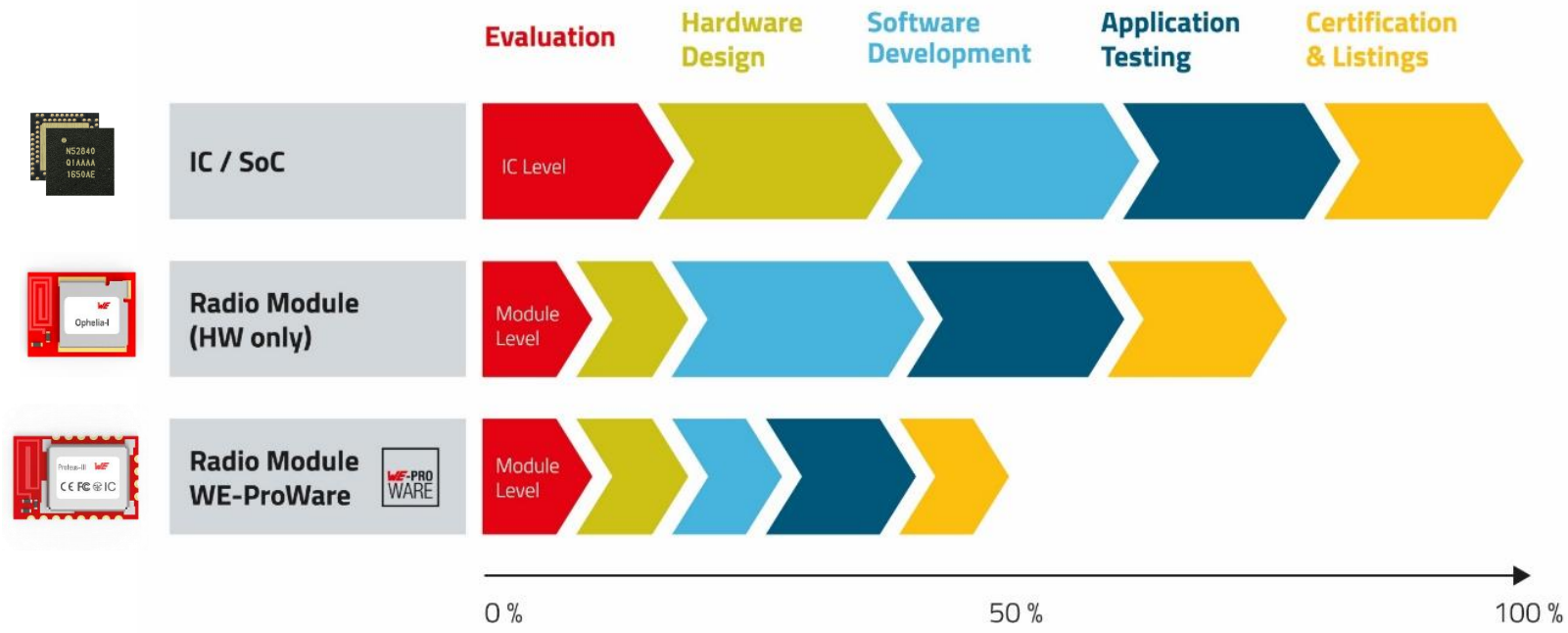


Funkmodul ohne Software BYOF

EINFÜHRUNG IN DIE FUNKENTWICKLUNG

8. Welcher Ansatz macht Sinn?

- Stückzahlen
- Laborausstattung
- Know-how im Unternehmen
- Zertifizierungskosten

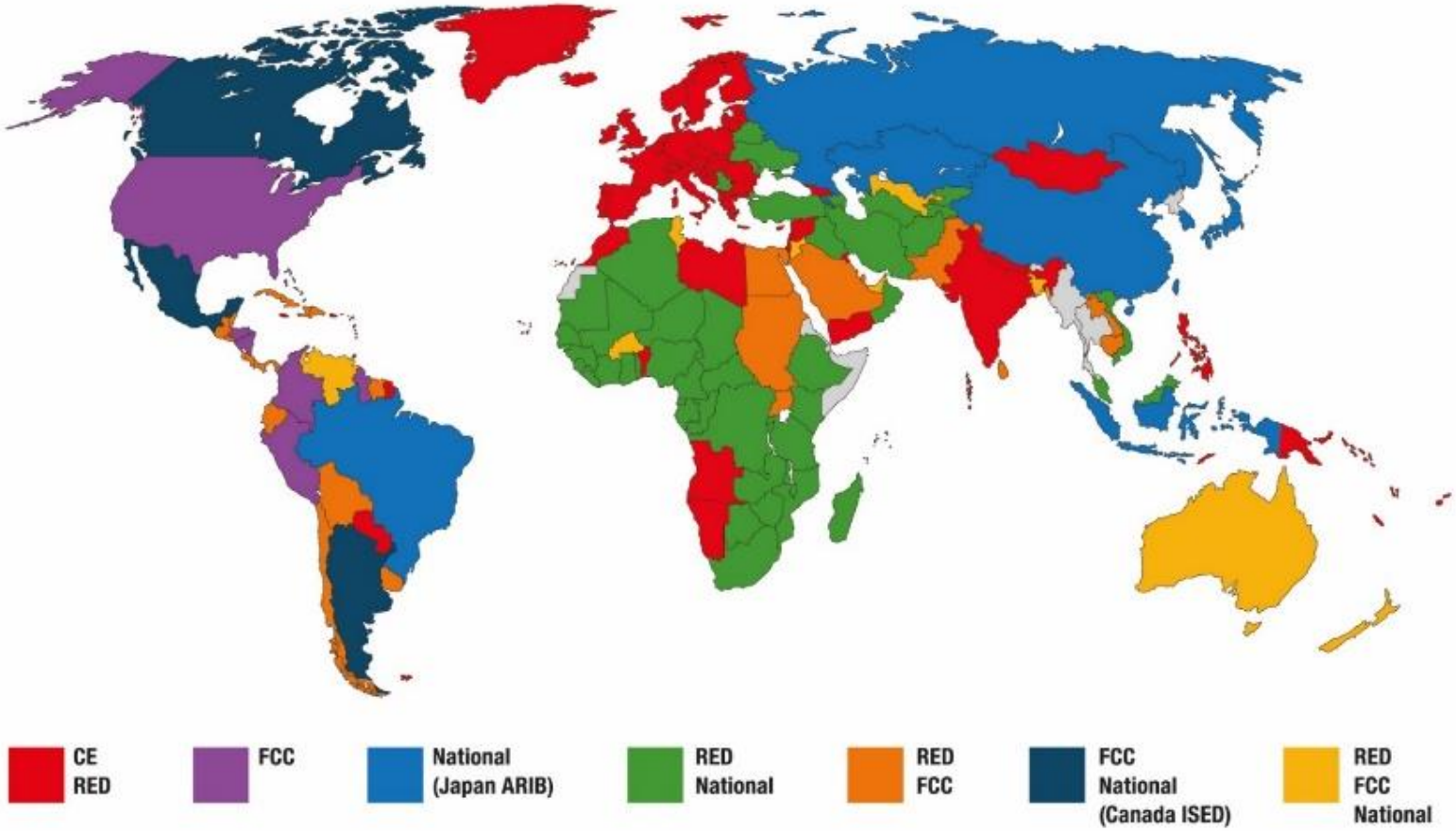


EINFÜHRUNG IN DIE FUNKENTWICKLUNG

8. Welche Zertifizierungen benötige ich?

8. Certification

Certification and Conformity –
CE, FCC, IC & Telec



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	SRRC China	WPC India	Australia	Brazil	Other countries
2615011136000	Adrastea-I	800-1800 / 1560-1610	WIRL-CLTI	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 U.FL 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	Calypso	2400	WIRL-WIFS	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	Calypso 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	Telesto-I	915	WIRL-PRO9	915 MHz proprietary module with RF pad	no	yes	yes	no	no	modified	modified	possible	on request
2607021191010	Telesto-II	915	WIRL-PRO9	915 MHz proprietary module with RF pad	no	yes	yes	no	no	modified	modified	possible	on request
2609011091000	Telesto-III	915	WIRL-PRO9	915 MHz proprietary module with integrated antenna	no	yes	yes	modified	modified	modified	modified	possible	on request
2609011191000	Telesto-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 fullfils national requirements, testing, certification and/or self declarations are done. Module fullfills 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 countrys.
- **Receiver only modules** are exempted from radio conformity approach in some countrys.

No

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

Possible

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

Modified

Module is not fullfilling 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 (fillings 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

BEISPIEL FCC

Neue Regeln seit Februar 2023

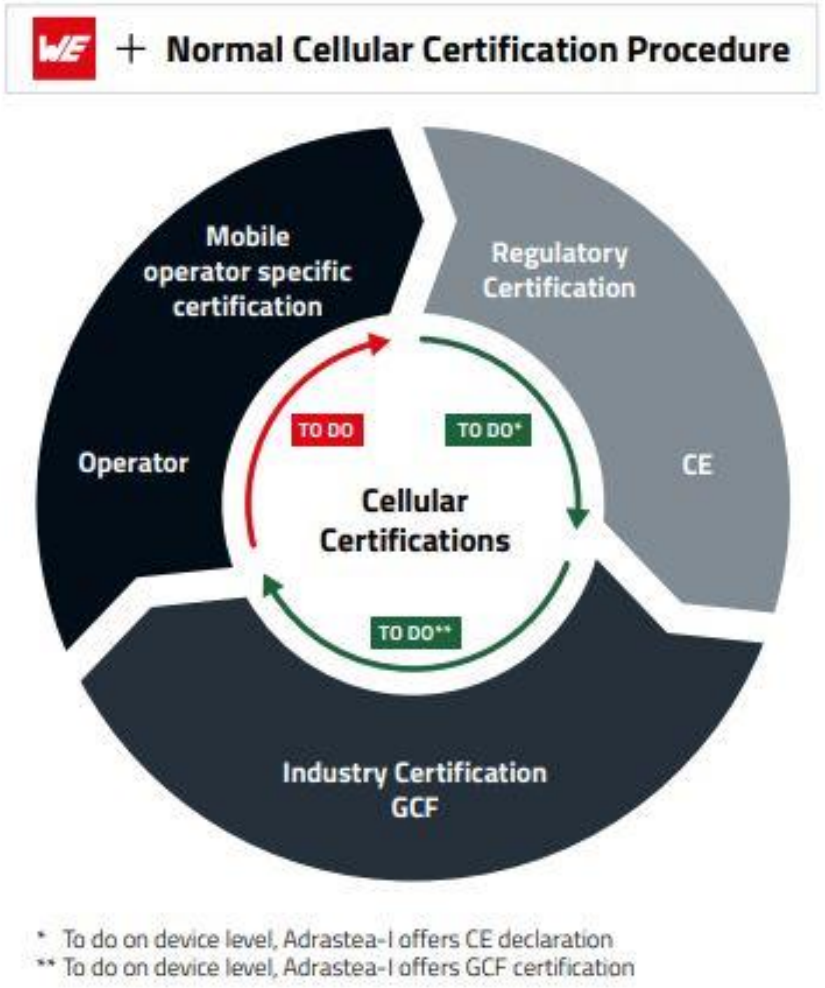
- **Responsible party**
  - Die Responsible Party ist die Person oder Organisation, die für die Einhaltung der FCC-Vorschriften verantwortlich ist. Dies kann der Hersteller, Importeur oder der Einzelhändler sein.
  - Diese Partei muss sicherstellen, dass das Produkt alle relevanten FCC-Anforderungen erfüllt und dass alle notwendigen Dokumentationen und Prüfungen durchgeführt wurden.
  - Die Responsible Party ist auch dafür verantwortlich, dass das Produkt korrekt gekennzeichnet ist und dass alle erforderlichen Informationen und Anleitungen für den Endverbraucher bereitgestellt werden
- **Local agent**
  - Local Agent ist eine in den USA ansässige Person oder Organisation, die berechtigt ist, im Namen des Herstellers oder Importeurs rechtliche Mitteilungen und andere offizielle Dokumente entgegenzunehmen.
  - Diese Rolle ist besonders wichtig, da die FCC sicherstellen möchte, dass es einen Ansprechpartner innerhalb der USA gibt, der für die Kommunikation und die Einhaltung der Vorschriften verantwortlich ist

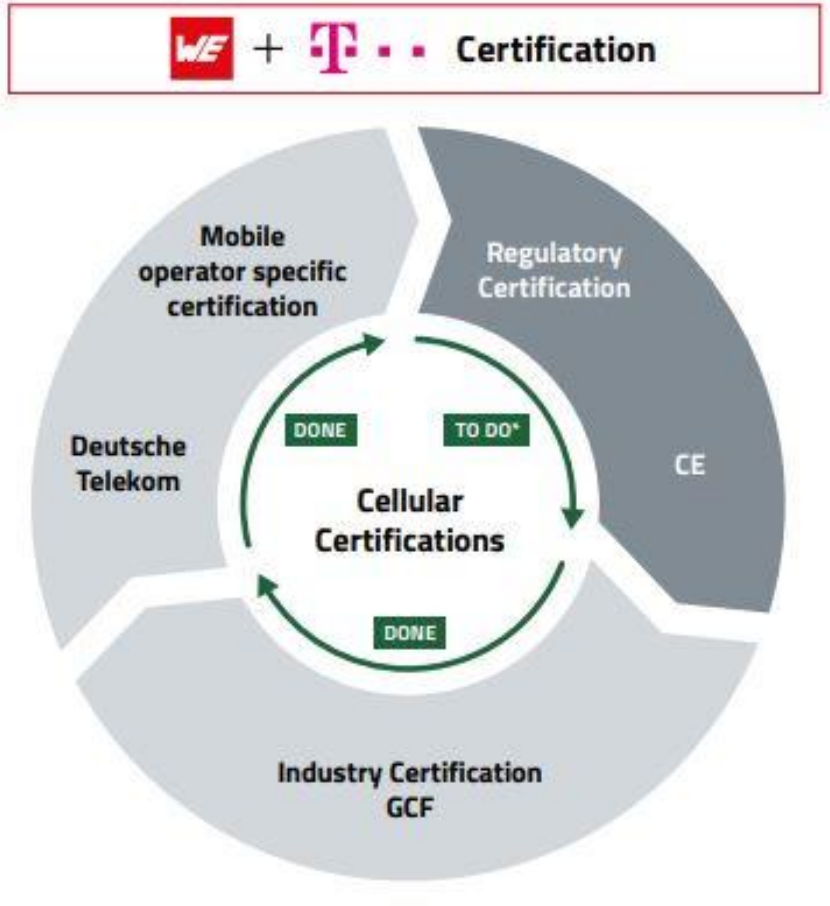
SDOC VS FCC ZERTIFIZIERUNG

- FCC-Zertifizierung:
  - Mitgliedschaft ist Pflicht
  - Kennzeichnung und Information zur Position der Kennzeichnung (Produkt-Label)
  - Blockdiagramm
  - Funktionsbeschreibung
  - Schaltbild (Schaltplan, PCB Anordnung)
  - Benutzerhandbuch (einschließlich regulatorischer Hinweise für den Benutzer)
  - …

- sDoc Verfahren nutzt vorzertifiziertes Modul
  - Keine FCC-Mitgliedschaft bei Einhaltung der Vorschriften §15.101 nötig
  - Nachmessungen sind in einem FCC-zertifizierten Labor Pflicht
  - Hinweise zum Ablauf (Kennzeichnungspflicht etc.) finden Sie im Manual

MOBILFUNKZERTIFIZIERUNG





MOBILFUNKZERTIFIZIERUNG

Regulatory Certification: Country specific to comply with country's regulations. Testing covers safety aspects, RF emissions do not interfere with other wireless equipment's (e.g. RF transmitter and receiver tests, EMC, electrical safety and environmental).

Industry Certification: The Global Certification Forum (GCF) is a certification organization in which manufacturers, operators and test laboratories deal with the compliance of devices in mobile networks with 3GPP standards and specifications.

Mobile operator specific certification: Testing specific to their network configuration and network parameter settings. This testing is focusing on field performance of the devices, such as radio sensitivity, data throughput.

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	☒	☐	☐	☐	-/-
5.4.10	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 (bald)

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

EINFÜHRUNG IN DIE FUNKENTWICKLUNG

9. Werde ich Unterstützung benötigen?

9. Support

Technical Support –
Talk from Engineer to Engineer

MORE THAN YOU EXPECT

Unser Support unterscheidet uns von den Mitbewerbern!

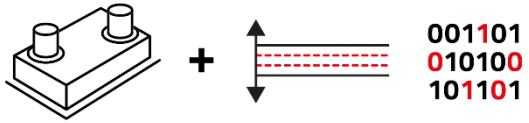
Full Service Products
Hardware + Firmware

page: 20

APIs and Software
Development Kits

Software Individualization and
Custom Sensor Charaterization

page: 30
page: 140



Configurable User Settings
with our Firmware
WE-ProWare

page: 28

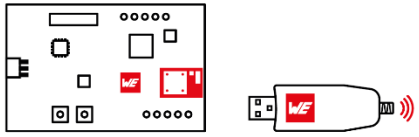
Free of Charge PC-Software
and Mobile Apps

page: 146

Technical Support –
Talk from Engineer to Engineer

Evaluations Kits
and USB Radio Sticks

page: 150



Certification and Conformity –
CE, FCC, IC & Telec

page: 18

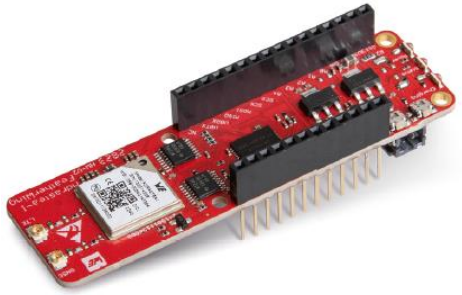
Long Term Availability

EVALUATION TOOLS

WIRELESS CONNECTIVITY

Evaluation Kit

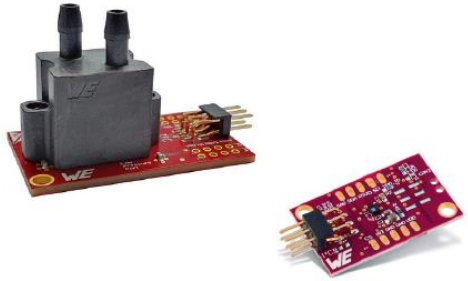
Mini/Family– Evaluation Board



FeatherWings

USB Radio Stick

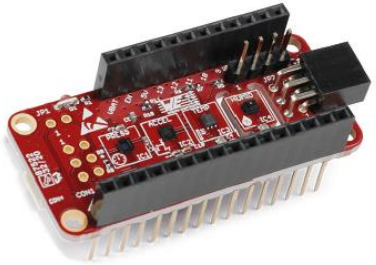
SENSORS



Evaluation Board

Sensor Node

Sensor Shield for Arduino

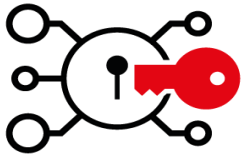


FeatherWing

EINFÜHRUNG IN DIE FUNKENTWICKLUNG

10. Welches Sicherheitslevel benötigt meine Applikation + Cyber Resilience Act ?

10. Security



Welche Security Features / Encryption wird benötigt?

- Unterstützt das gewählte Modul diese?

CRYPTO QUANTIQUE

Use data

Evaluate data

Display data

Collect data

Transfer data

Capture data

CRA UND EN18031

- Die Cyber Resilience Act der EU hat die RED (Richtlinie über Funkanlagen) um Anforderungen an die Cybersicherheit erweitert und die EN18031 wird ab dem 01. August 2025 verpflichtend.

- Einige wichtige Punkt daraus:
  - „Security by design & Secure by default“
  - Sicherheitsüberlegungen von Anfang an in das Design einbeziehen
  - Etablierte Methoden verwenden, um End-to-End-Sicherheit zu gewährleisten
  - Zero Trust by default: „niemals vertrauen, immer verifizieren“
  - Ihr System unterstützt die Installation von Software-Updates für sich selbst und seine Komponenten, verhindert jedoch das Zurücksetzen auf alte, anfällige Versionen
  - Fehlerberichtsmechanismen einbeziehen
  - Eine Risikobewertung für das Endsystem hilft, Schwachstellen zu identifizieren

Ist ihre Anwendung sicher?

Keine Panik. Wir haben da mal was vorbereitet.

- **Die Würth Elektronik eiSos GmbH & Co. KG & Phoenix Testlab laden Sie herzlich zum Hybriden Seminar Cybersecurity am 21. November 2024 in München ein.**
- Das Seminar wurde von Ingenieuren und Technikern konzipiert und richtet sich an Personen, die an praxisorientierten Inhalten interessiert sind, um Unterstützung bei der Entwicklung fehlerfreier Elektronik und Geräte zu erhalten.

- **Themenschwerpunkte:**
- ▪ Cybersecurity nach EN 18031
- ▪ Anwendung der EN 18031 mit dem Würth Elektronik Funkmodul Cordelia

- **Seminarort:**
- Hightech Innovation Center
- Clarita-Bernhard-Straße 9
- 81249 München
- **Donnerstag, den 21.11.2024 von 08:30 Uhr – 14:00 Uhr**
- Anmeldung Teilnahme vor Ort:
- www.we-online.com/seminarregistration
- Anmeldung Teilnahme Online:
- www.we-online.com/Online-Anmeldung

Cyberkriminalität hat im Jahr 2023 einen geschätzten globalen Schaden von fast 148 Milliarden Euro verursacht.
In der EU wird die EN18031 ab August 2025 in Kraft treten und für alle Geräte mit drahtloser Konnektivität gelten, um dieser wachsenden Bedrohung zu begegnen.

Gute Neuigkeiten!!!
Das Cordelia WiFi-Modul 2610011025010 wird eines der ersten Produkte auf dem Markt sein, das die EN18031 Norm erfüllt. Ein besonderes Merkmal ist der Ansatz des Zero-Touch-Provisioning, welcher das Risiko einer Kompromittierung in jeder Phase der Lieferkette minimiert..

Verpassen Sie nicht unser Seminar

Save your spot now

EINFÜHRUNG IN DIE FUNKENTWICKLUNG

11. Debugging

Von Beginn an:
Projekt und SW so auslegen, dass später Fehler leichter gefunden und analysiert werden können

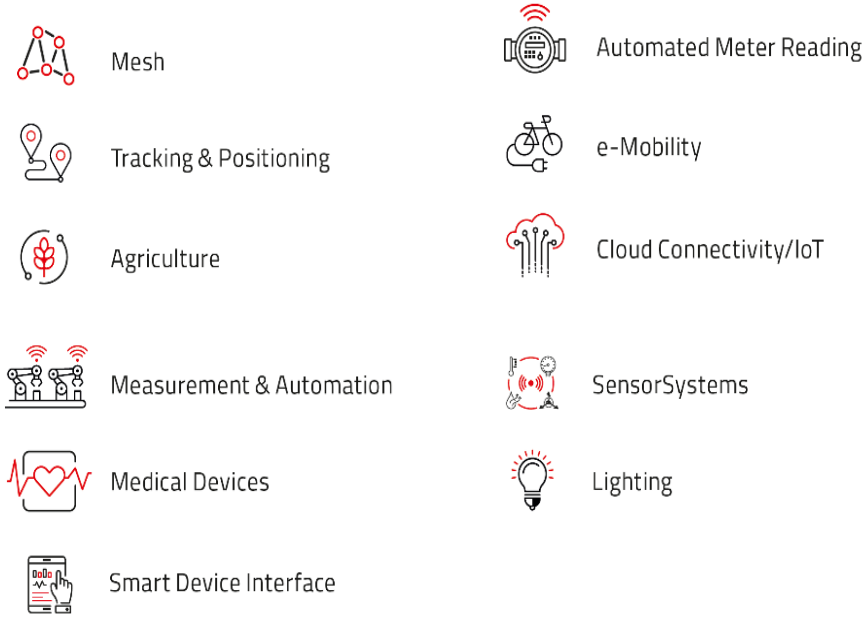
EINFÜHRUNG IN DIE FUNKENTWICKLUNG

12. Ist meine Applikation auf einen Funkausfall ausgelegt?

12. Paket loss

Datenverlust kommt immer vor
Wie kann ich dem begegnen?

Applications



EINFÜHRUNG IN DIE FUNKENTWICKLUNG

13. Ist mein Design auf Funk abgestimmt?

14. RF design

Retrofitting/ Neuentwicklung

Unterschiedliche Herausforderungen ans Design In

15.2. Dimensioning of the micro strip antenna line

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

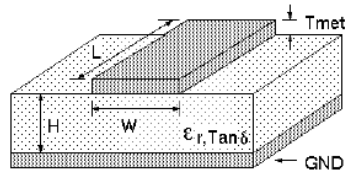
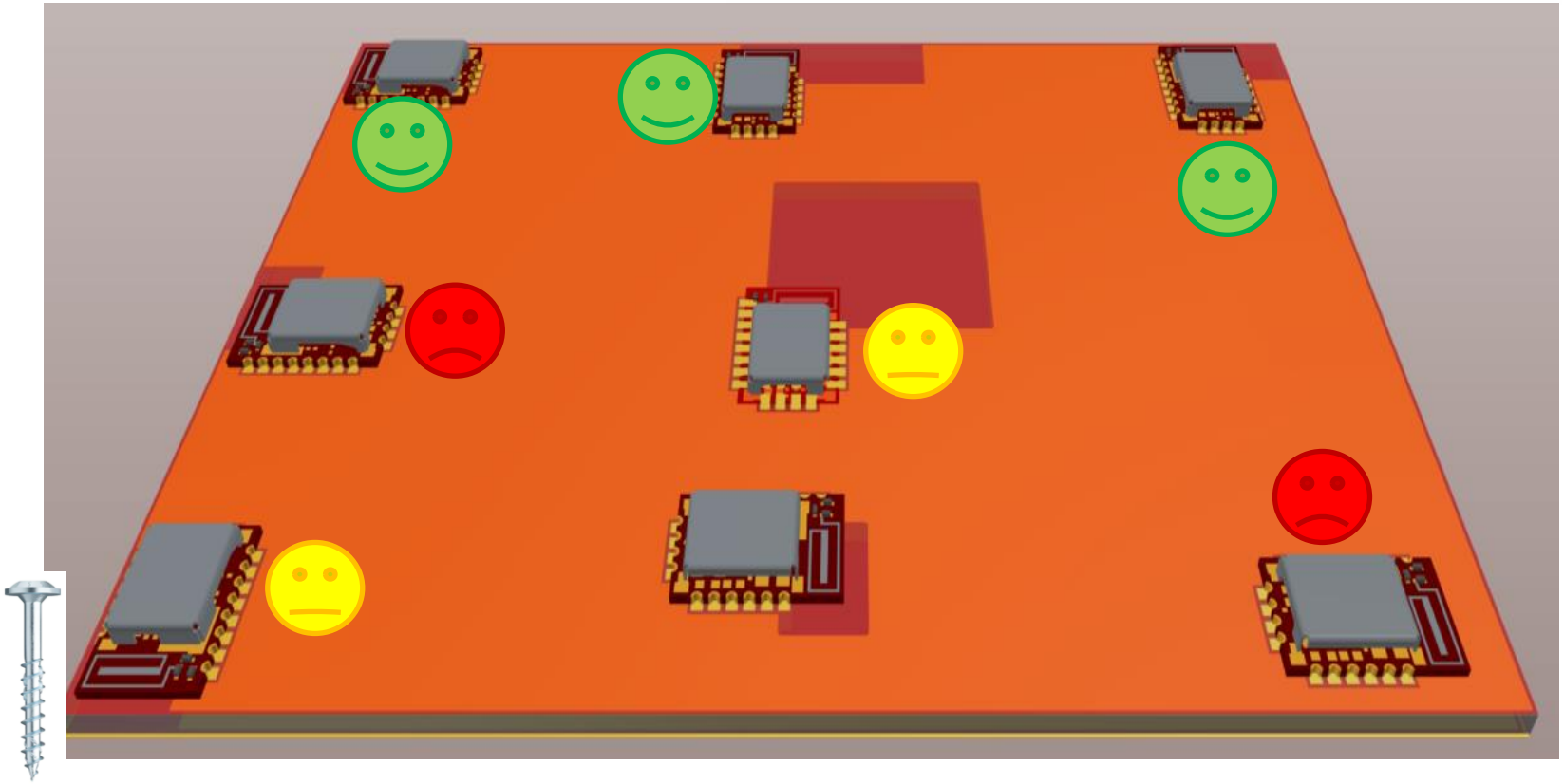
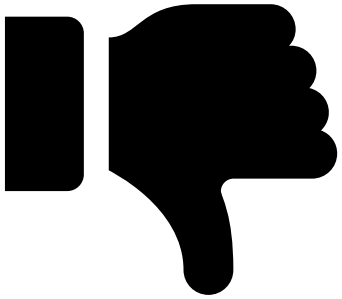


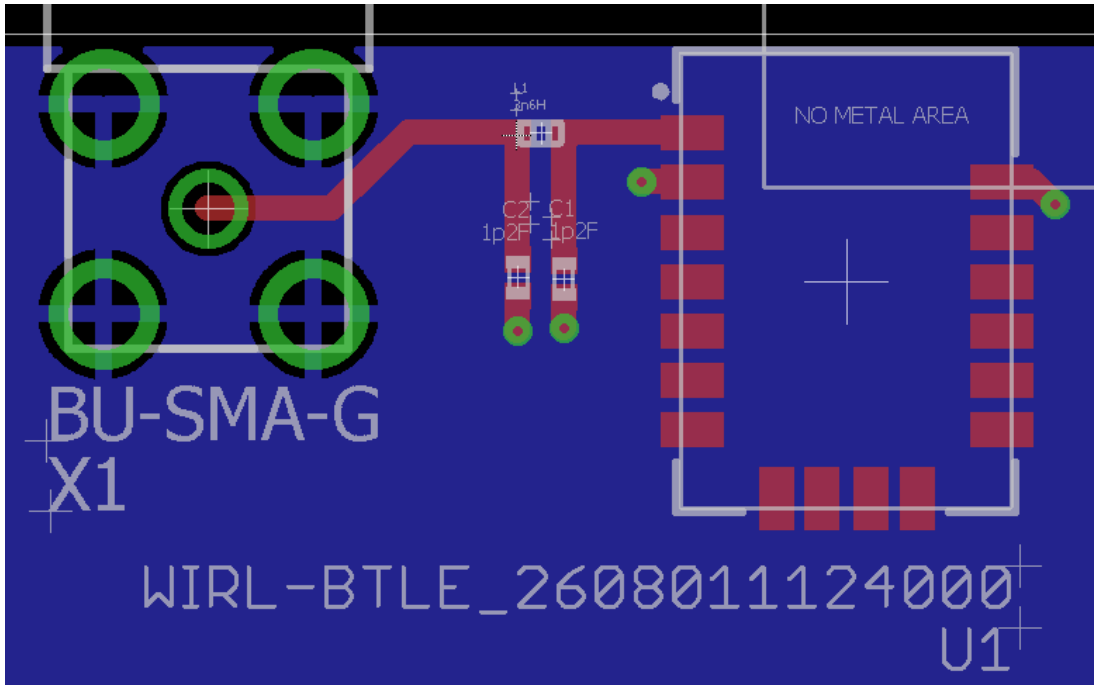
Figure 10: Dimensioning the antenna feed line as micro strip



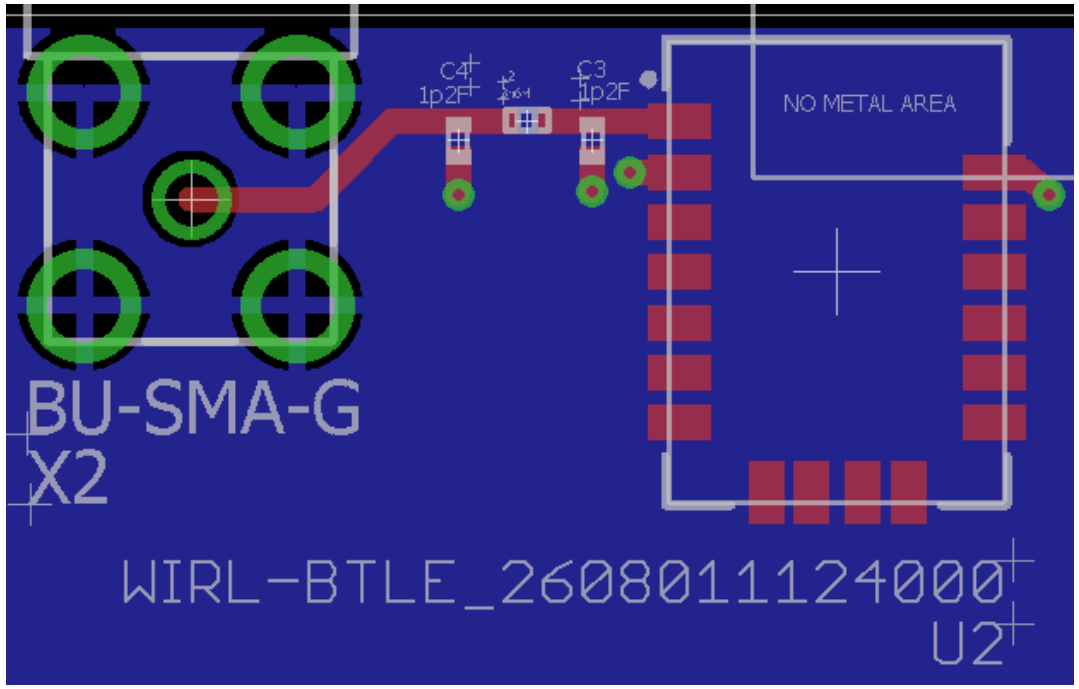
LAYOUT TIPS

Trace Design ist wichtig





LAYOUT TIPS

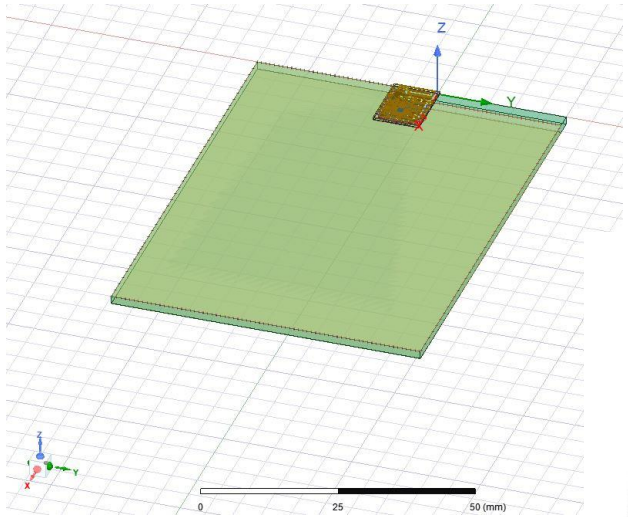

C4
1p2F
C3
1p2F
NO METAL AREA
BU-SMA-G
X2
WIRL-BTLE_2608011124000
U2

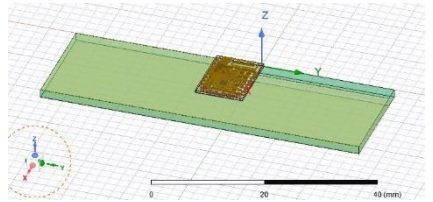
LAYOUT TIPS

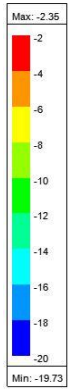
- Filter- und Abblockkondensatoren direkt in die Zuleitung platzieren
- leerlaufende Stichleitungen vermeiden
- Anpassungselemente für die Antenne möglichst nah an der Antenne oder dem Steckverbinder platzieren
- Abblockkondensatoren möglichst nah am Module.
- Masseanbindung für Modul und Kondensatoren so kurz wie möglich und mit mindestens einer Durchkontaktierung auf die Masselage
- ESD Schutz möglichst nah zu der ausgesetzten/berührungsgefährdeten Stelle platzieren

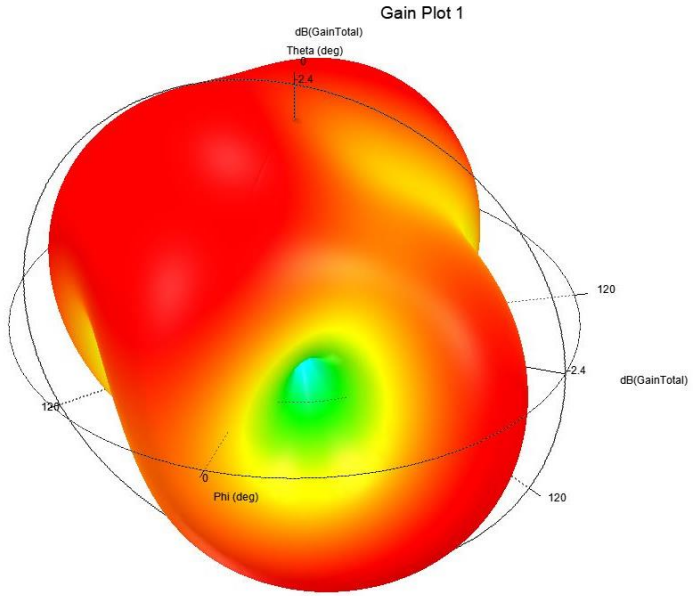
BEEINFLUSSUNG DER ANTENNENCHARAKTERISTIK DURCH DIE UMGEBUNG

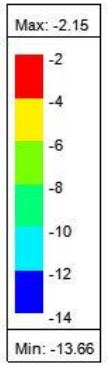
Massefläche

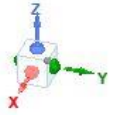


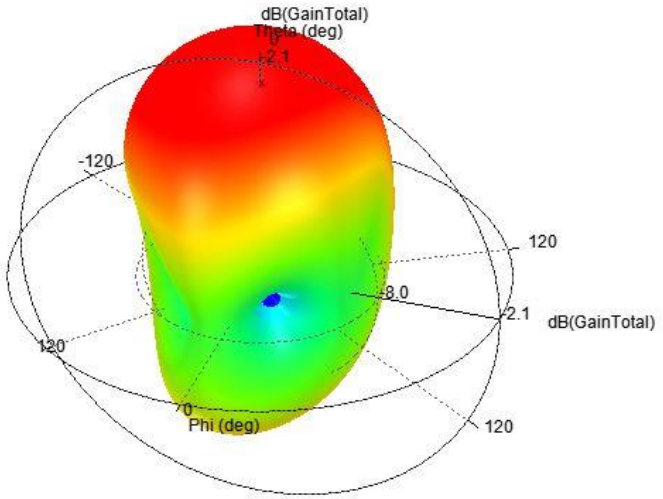






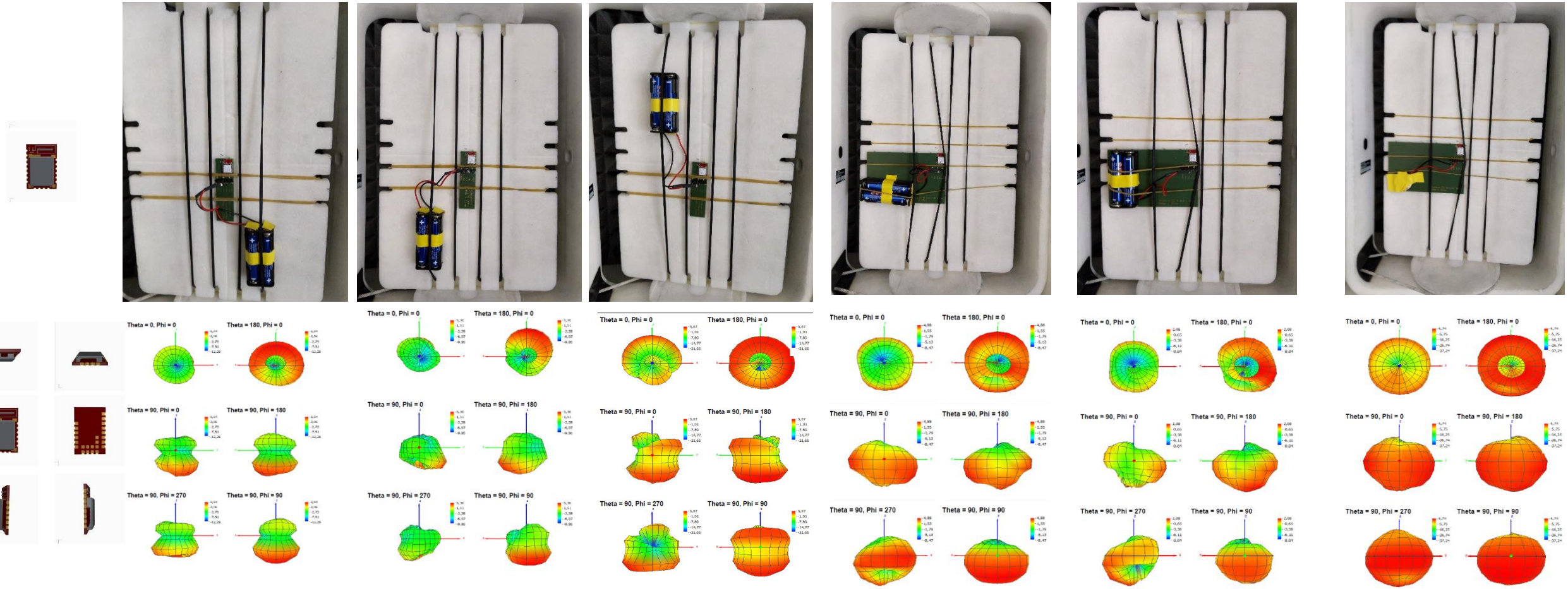






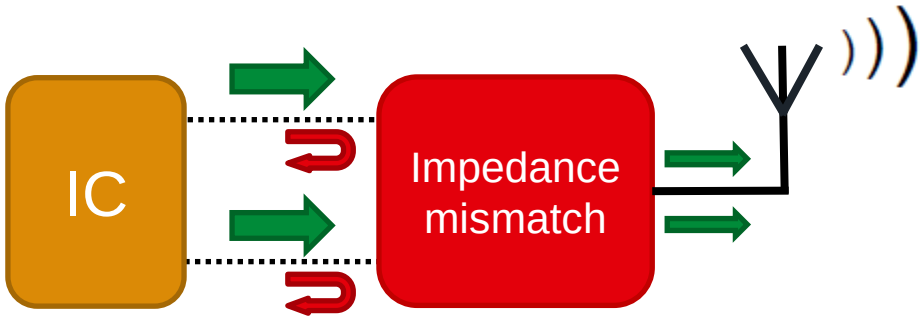
DESIGN-IN:

Umgebungseinflüsse am Beispiel der Platzierung der Batterie

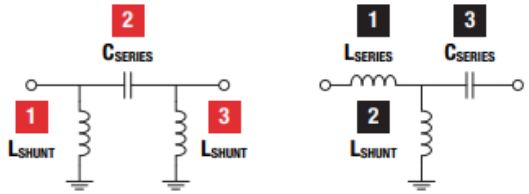


ANTENNA MATCHING

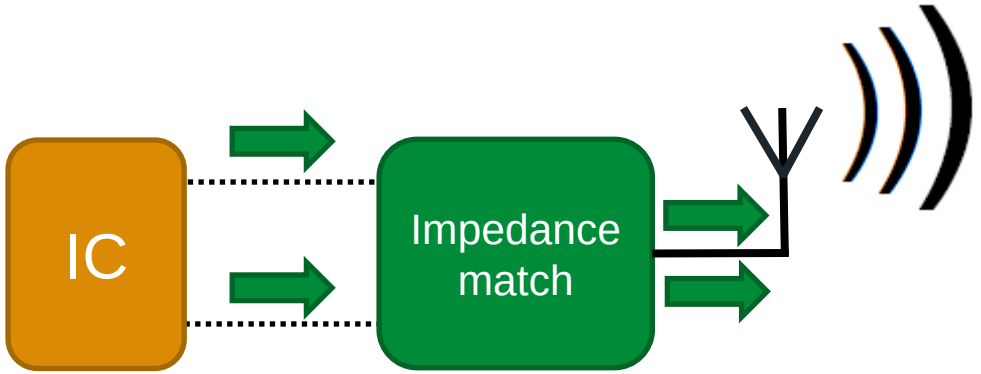
Warum?



Impedance
Matching circuit



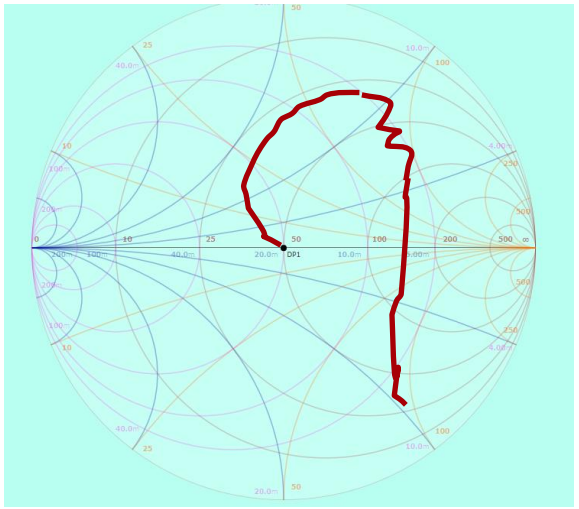
Pi matching for Point A *T matching for Point B*



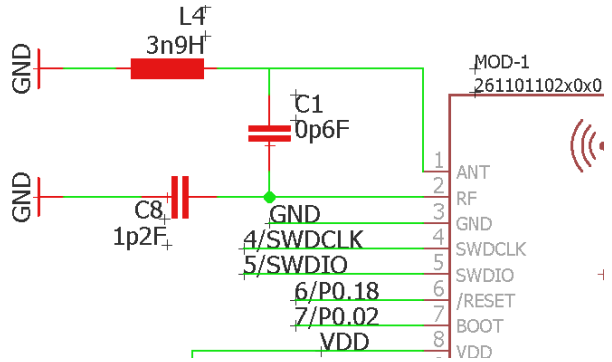
REMATCHING

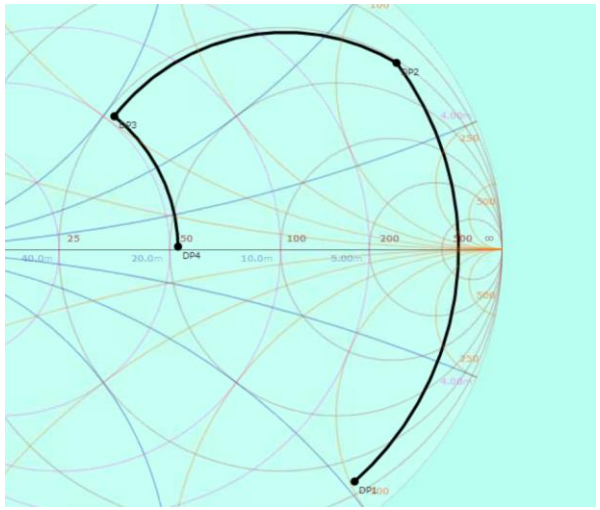
Was ist eigentlich mit Feintuning oder Rematching gemeint?

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

ZUSAMMENFASSUNG

- Funk ist komplex
- Bei Neuentwicklung einer Applikation mit Funk, sollte der Funkteil von Anfang an im Fokus stehen
  - Form follows function
  - Bietet die Möglichkeit beste Performance/Reichweite zu erreichen
- Retrofitting hat eigene Herausforderungen
  - Function follows Form
  - Performance/Reichweite wird hier immer Kompromiss sein

- Starke Partner bieten bei fehlendem Know-how große Vorteile
  - Zertifizierungen
  - Design In
  - Messlabore
  - Security

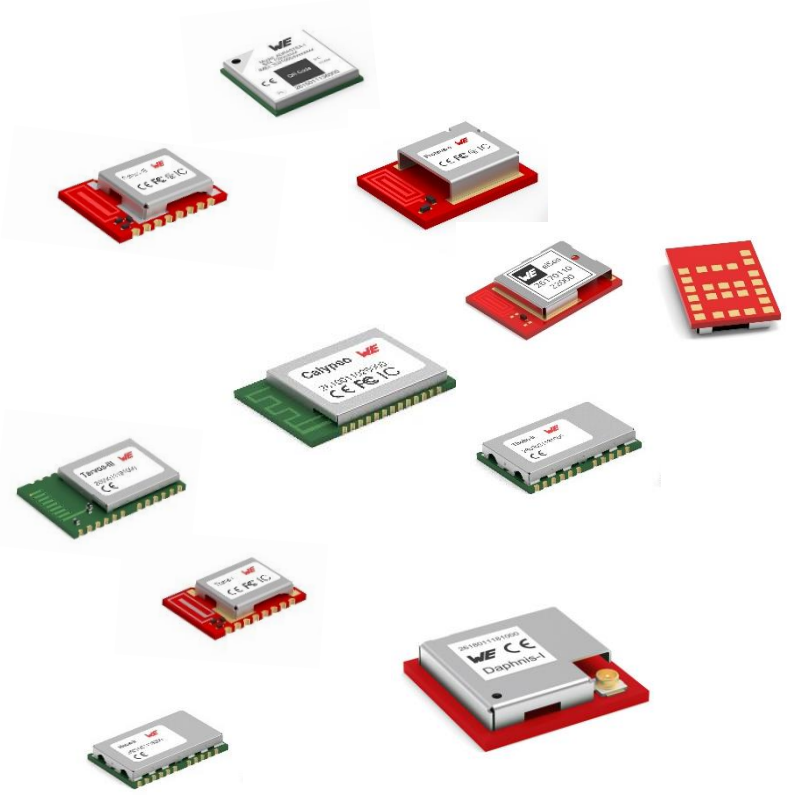
PRODUKTÜBERSICHT

WC&S
OLIVER KRAUSE - BDM

PRODUKTÜBERSICHT

WIRELESS CONNECTIVITY

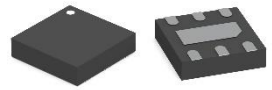
LTE-M NB-IoT	Connect Machine Globally	**Cellular**
Bluetooth	Connect Machine to Mobile Device	**Bluetooth®**
Wi Fi CERTIFIED	Connect Machine to Internet	**WiFi**
Long-Range	Connect Device to Gateway	**Long-Range-WAN**
WE PROWARE	Connect Machine to Machine	**Proprietary**
WE PROWARE Bluetooth WiFi	Connect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

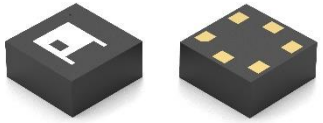


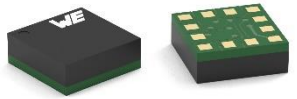
PRODUKTÜBERSICHT

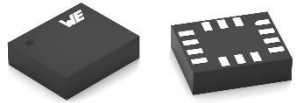
SENSORS

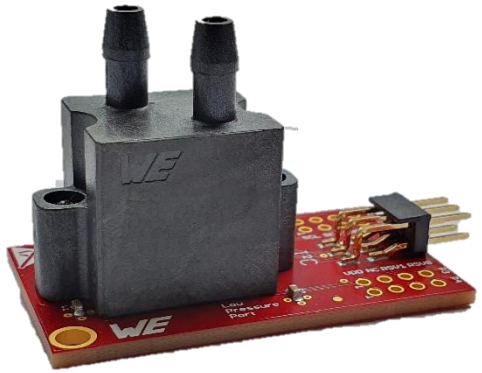
- Motion Sensors
- Environmental Sensors
- Pressure Sensors
- Current Sensors

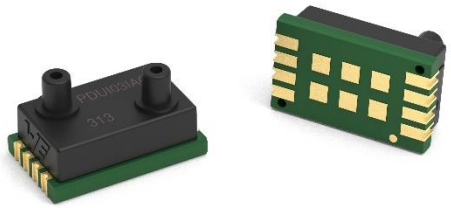


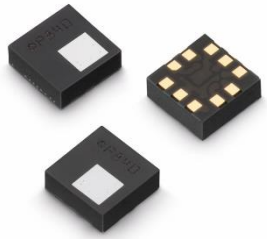












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