Product Service

Choose certainty.
Add value.

20 May 2016

Prüfbericht / *Test Report* Nr. / *No.* 486871-82655-4e (Edition 1)

Auftraggeber *Applicant*	PRÜFTECHNIK Condition Monitoring GmbH
Geräteart *Type of equipment*	laser-optical measuring-system
Typenbezeichnung *Type designation*	RS5 BT
Seriennummer / *Serial number*	3901 0224
Auftragsnummer / *Order No.*	---
Prüfgrundlage *Test standards*	EN 300 328 V1.9.1 (partly)

TÜV SÜD Product Service GmbH
Äußere Frühlingstraße 45
94315 Straubing
Germany

Phone: +49 9421 5522-0
Fax: +49 9421 5522-99
Web: www.tuev-sued.de

Summary

Prüfergebnisse / *Test Results*	Auftragsnummer / *Order No.* **---**

Die Prüfungen wurden nach folgenden Vorschriften durchgeführt:
Tests were performed according to:
EN 300 328 V1.9.1 (partly)

Durchgeführte Prüfung ***Test performed***	**Prüfergebnis** ***Test result***			
	Erfüllt *Passed*	Nicht erfüllt *Not Passed*	Nicht zutreffend *Not applicable*	Nicht durchgeführt *Not performed*
Sendeleistung / *RF output power*	☒	☐	☐	☐
Spektrale Leistungsdichte / *Power Spectral Density*	☐	☐	☒	☐
Betriebszyklus, Sendesequenz, Sendepause / *Duty Cycle, TX-sequence, TX-gap*	☐	☐	☒	☐
Verweilzeit, MinimaleFrequenzbelegung, Hopping-Sequenz / *Dwell time, Minimum Frequency Occupation, Hopping Sequence*	☒	☐	☐	☐
Hopping-Frequenz-Abstand / *Hopping Frequency Separation*	☒	☐	☐	☐
MU-Faktor / *Medium Utilisation (MU) factor*	☐	☐	☒	☐
Adaptivität / *Adaptivity*	☐	☐	☐	☒
Belegte Bandbreite / *Occupied Bandwidth*	☒	☐	☐	☐
Sender Nebenbandaussendungen / *Transmitter unwanted emissions in the out-of-band domain*	☒	☐	☐	☐
Sender Nebenaussendungen / Transmitter unwanted emissions in the spurious domain	☒	☐	☐	☐
Empfänger Nebenaussendungen / *Receiver spurious emissions*	☒	☐	☐	☐
Empfänger Blockieren / *Receiver blocking.*	☐	☐	☐	☒

Bemerkungen / *Remarks:*
According to applicant's request only a spot check was performed following the standard appropriate to the equipment but in reduced extend. Therefore the tests do not cover the whole range as defined by this standard.

Datum / *Date*	Geprüft von / *Tested by*	Freigabe durch / *Checked by*
2016-05-20	Steindl Martin Martin Steindl Responsible for testing	Johann Roidt Laboratory manager

Prüfergebnis / *Test Result*
☒ **Erfüllt / *Passed***
☐ **Nicht erfüllt / *Not passed***

Table of Contents

1 Administrative Data 4
2 Details about the Test Laboratory 5
3 Description of the Equipment Under Test 6
4 Operation Mode and Configuration of EUT 8
5 Referenced Regulations 9
6 Measurement Uncertainty Values 10
7 Test Results 14
7.1 RF output power 16
7.2 Accumulated Transmit Time, Frequency Occupation and Hopping Sequence 18
7.3 Hopping Frequency Separation 21
7.4 Occupied Channel Bandwidth 25
7.5 Transmitter unwanted emissions in the out-of-band domain 29
7.6 Transmitter unwanted emissions in the spurious domain 34
7.7 Receiver spurious radiation 41
8 Application form for testing 48
9 Additional informations 49
10 Revision History 50

1 Administrative Data

Application details	
Applicant:	PRÜFTECHNIK Condition Monitoring GmbH Oskar-Messter-Straße 19 – 21 85737 Ismaning Germany
Contact person:	Mr. Bernhard Glaser
Intercompany contact:	TÜV SÜD Product Service Ridlerstraße 65 80339 München / Munich Germany Ms. Susanne Frank
Order number:	---
Receipt of EUT:	2016-05-06
Return of EUT:	
Date(s) of test:	2016-05-06 to 2016-05-18
Note(s):	
Responsible for testing:	Mr. Martin Steindl
Responsible for test report:	Mr. Martin Steindl
Test report checked by:	Mr. Johann Roidt

Report details	
Report number:	486871-82655-4e
Edition:	1
Issue date:	2016-05-20

2 Details about the Test Laboratory

Details about the Test Laboratory	
Company name:	TÜV SÜD Product Service GmbH
Address:	Äußere Frühlingstraße 45 D-94315 Straubing Germany
Laboratory accreditation:	DAkkS Registration No. D-PL-11321-11-01
Contact:	Mr. Johann Roidt Phone: +49 9421 5522-0 Fax: +49 9421 5522-99

3 Description of the Equipment Under Test

Equipment characteristics	
Type designation:	RS5 BT
Parts of the system:	
Options and accessories:	
Type of equipment:	laser-optical measuring-system
Serial number:	3901 0224
Manufacturer:	PRÜFTECHNIK Condition Monitoring GmbH
Application [1]:	Wideband Data Transmission Systems
Equipment class:	Equipment for portable use
Kind of equipment:	Transceiver
Frequency band [1]:	3a (2400.0 – 2483.5 MHz)
Frequency range:	2401 MHz – 24080 MHz
Operating Frequency:	2401 MHz – 24080 MHz
Rated Carrier Power:	12 dBm; 8 dBm (BT low energy)
Antenna Gain (declared):	-5 dBi
Channel spacing	Wideband
Number of RF-channels:	79; 40 (BT low energy)
Antenna type:	Integrated antenna
Antenna size:	N/A
Standby mode:	Not Applicable
Temperature Range:	-40 °C to +85 °C
Nominal Temperature:	+20 °C
Power supply:	Battery supply (lithium) Nominal: 3.7 V
Version of EUT:	As received – Version 1.0

[1] Classification according to CEPT/ERC Recommendation 70-03

Information as required by clause 5.3.1 for Testing Process		
Nominal RF Power / dBm	12 dBm 8 dBm	Classic mode Low energy mode
Antenna Gain / dBi	-5 dBi	
Beamforming Gain / dB	---	If applicable
Number of Transmit Chains	1	
Operating Frequency Max. Channel Frequency Min. Channel Frequency	 2402 MHz 2480 MHz	
Type of Modulation:	FHSS	
FHSS equipment: Hopping Frequency separation	1 MHz 2 MHz	Classic mode Low energy mode
FHSS equipment: Nominal Number of Hopping Frequencies	79 40	Classic mode Low energy mode
FHSS equipment: Minimum Number of Hopping Frequencies	N/A	
FHSS equipment: Maximum Number of Hopping Frequencies	N/A	
FHSS equipment: Avarage Dwell Time	N/A	
Nominal Channel Bandwidth	1 MHz 2 MHz	Classic mode Low energy mode
Adaptive / non-adaptive equipment	adaptive	Adaptive Equipment without the possibility to switch to a nonadaptive mode.
Adaptive equipment: Channel Occupancy Time	N/A	
Adaptive equipment: LBT based DAA	N/A	
Adaptive equipment: CCA duration	N/A	
Adaptive and FHSS equipment: Avarage Dwell Time	N/A	
Frame based Load based	Frame based	
Environmental operating Temperature Nominal: Extreme Conditions Maximum: Minimum:	20 °C N/A	

4 Operation Mode and Configuration of EUT

Operation Mode(s)
The applicant provided test software for transmitting and receiving in “classic mode” and “low power mode”. Tests on “classic mode” were performed with active hopping sequence; tests in “low power mode” were performed on lowest and highest channel.

List of transmitting operation modes				
No.	*Number of transmit chains*	*Power distribution*	*Number of receive chains*	*Beam forming implementation*
1	1		1	No

List of ports and cables				
No.	*Description*	*Classification*[2]	*Cable type*	*Cable length*
S1	USB interface port	signal/control port	Shielded	≤ 1 m
S2	Temporary RS-232-interface	signal/control port	Unshielded	≤ 1 m

List of devices connected to EUT				
No.	*Description*	*Type designation*	*Serial no. or ID*	*Manufacturer*
1	USB-RS-232-interface convertor			

List of support devices				
No.	*Description*	*Type designation*	*Serial no. or ID*	*Manufacturer*
	---			

[2] Ports shall be classified as ac power, dc power or signal/control port.

5 Referenced Regulations

European publication	*International publication*	*Title*
EN 300 328 V1.9.1	---	Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonized EN covering the essential requirmenets of article 3.2 of the R&TTE Directive

6 Measurement Uncertainty Values

Radio Testing			
Test	k_p	*Expanded Uncertainty*	*Note*
RF-Frequency error	1.96	$\pm 1 \cdot 10^{-7}$	7
RF-Power, conducted carrier	1.96	+0.077 dB / -0.078 dB	7
RF-Power uncertainty for given BER	1.96	+0.94 dB / -1.05	7
RF power, conducted, spurious emissions	1.96	+1.4 dB / -1.6 dB	7
RF power, radiated			
25 MHz – 4 GHz	1.96	+3.6 dB / -5.2 dB	8
1 GHz – 18 GHz	1.96	+3.8 dB / -5.6 dB	8
18 GHz – 26.5 GHz	1.96	+3.5 dB / -4.5 dB	8
26.5 GHz – 66 GHz	1.96	+4.0 dB / -6.5 dB	8
Spectral Power Density, conducted	1.96	+1.4 dB / -1.6 dB	5
Maximum frequency deviation			
300 Hz – 6 kHz	2	±2,89 %	2
6 kHz – 25 kHz	2	±0.2 dB	2
Maximum frequency deviation for FM	2	±2,89 %	2
Adjacent channel power 25 MHz – 1 Ghz	2	±2.31 %	2
Temperature	2	±0.39 K	4
(Relative) Humidity	2	±2.28 %	2
DC- and low frequency AC voltage			
DC voltage	2	±0.01 %	2
AC voltage up to 1 kHz	2	±1.2 %	2
Time	2	±0.6 %	2

Radio Interference Emission Testing			
Test	k_p	*Expanded Uncertainty*	*Note*
Conducted Voltage Emission			
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB	1
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB	1
100 kHz to 200 MHz (50Ω/5µH AMN)	2	± 3.6 dB	1
Discontinuous Conducted Emission			
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB	1
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB	1
Conducted Current Emission			
9 kHz to 200 MHz	2	± 3.5 dB	1
Magnetic Fieldstrength			
9 kHz to 30 MHz (with loop antenna)	2	± 3.9 dB	1
9 kHz to 30 MHz (large-loop antenna 2 m)	2	± 3.5 dB	1
Radiated Emission			
Test distance 1 m (ALSE)			
9 kHz to 150 kHz	2	± 4.6 dB	1
150 kHz to 30 MHz	2	± 4.1 dB	1
30 MHz to 200 MHz	2	± 5.2 dB	1
200 MHz to 2 GHz	2	± 4.4 dB	1
2 GHz to 3 GHz	2	± 4.6 dB	1
Test distance 3 m			
30 MHz to 300 MHz	2	± 4.9 dB	1
300 MHz to 1 GHz	2	± 5.0 dB	1
1 GHz to 6 GHz	2	± 4.6 dB	1
Test distance 10 m			
30 MHz to 300 MHz	2	± 4.9 dB	1
300 MHz to 1 GHz	2	± 4.9 dB	1

Radio Interference Emission Testing (continued)			
Test	k_p	*Expanded Uncertainty*	*Note*
Radio Interference Power			
30 MHz to 300 MHz	2	± 3.5 dB	1
Harmonic Current Emissions			4
Voltage Changes, Voltage Fluctuations and Flicker			4

Immunity Testing			
Test	k_p	*Expanded Uncertainty*	*Note*
Electrostatic Discharges			4
Radiated RF-Field			
Pre-calibrated field level	2	+32.2 / -24.3 %	5
Dynamic feedback field level	2.05	+21.2 / -17.5 %	3
Electrical Fast Transients (EFT) / Bursts			4
Surges			4
Conducted Disturbances, induced by RF-Fields			
via CDN	2	+15.1 / -13.1 %	6
via EM clamp	2	+42.6 / -29.9 %	6
via current clamp	2	+43.9 / -30.5 %	6
Power Frequency Magnetic Field	2	+20.7 / -17.1 %	2
Pulse Magnetic Field			4
Voltage Dips, Short Interruptions and Voltage Variations			4
Oscillatory Waves			4
Conducted Low Frequency Disturbances			
Voltage setting	2	± 0.9 %	2
Frequency setting	2	± 0.1 %	2
Electrical Transient Transmission in Road Vehicles			4

Note 1:
The expanded uncertainty reported according to CISPR 16-4-2:2003-11 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%

Note 2:
The expanded uncertainty reported according to UKAS Lab 34 (Edition 1, 2002-08) is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%

Note 3:
The expanded uncertainty reported according to UKAS Lab 34 (Edition 1, 2002-08) is based on a standard uncertainty multiplied by a coverage factor of kp = 2.05, providing a level of confidence of p = 95.45%

Note 4:
It has been demonstrated that the used test equipment meets the specified requirements in the standard with at least a 95%confidence.

Note 5:
The expanded uncertainty reported according to IEC 61000-4-3 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%

Note 6:
The expanded uncertainty reported according to IEC 61000-4-6 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%

Note 7:
The expanded uncertainty reported according ETSI TR 100 028 V1.4.1 (all parts) to is based on a standard uncertainty multiplied by a coverage factor of k_p = 1.96, providing a level of confidence of p = 95.45%

Note 8:
The expanded uncertainty reported according to ETSI TR 102 273 V1.2.1 (all parts) is based on a standard uncertainty multiplied by a coverage factor of kp = 1.96, providing a level of confidence of p = 95.45%

7 Test Results

Frequency Hopping Equipment

EN 300 328 V1.9.1			
Section(s)	*Test performed*	*Page*	*Test Result*
4.3.1.2	RF output power	17	Test passed
4.3.1.3	Duty Cycle, TX-sequence, TX-gap	---	Not applicable [3]
4.3.1.4	Accumulated Transmit Time, Frequency Occupation and Hopping Sequence		Not applicable
4.3.1.5	Hopping Frequency Separation	22	Test passed
4.3.1.6	Medium Utilisation (MU) factor	---	Not applicable [3]
4.3.1.7	Adaptivity		
4.3.1.7.2	Adaptive Frequencys Hopping using LBT based DDA	---	Not performed
4.3.1.7.3	Adaptive Frequencys Hopping using other forms of DDA	---	Not applicable
4.3.1.7.4	Short Control Signalling Transmissions	---	Not applicable
4.3.1.8	Occupied Channel Bandwidth	26	Test passed
4.3.1.9	Transmitter unwanted emissions in the out-of-band domain	30	Test passed
4.3.1.10	Transmitter unwanted emissions in the spurious domain		
	- Conducted measurement	35	Test passed
	- Radiated measurement	38	Test passed
4.3.1.11	Receiver spurious emissions		
	- Conducted measurement	42	Test passed
	- Radiated measurement	45	Test passed
4.3.1.12	Receiver Blocking	---	Not performed
4.3.1.13	Geo-location capability	---	Not applicable

[3] Test is applicable for non-adaptive equipment, only.

Equipment with other types of Wide Band Modulation

EN 300 328 V1.9.1			
Section(s)	*Test performed*	*Page*	*Test Result*
4.3.2.2	RF output power	---	Not applicable
4.3.2.3	Power Spectral Density	---	Not applicable
4.3.2.4	Duty Cycle, TX-sequence, TX-gap	---	Not applicable
4.3.2.5	Medium Utilisation (MU) factor	---	Not applicable
4.3.2.6	Adaptivity		
4.3.2.6.2	Non-LBT based Detect and Avoid	---	Not applicable
4.3.2.6.3	LBT based Detect and Avoid	---	Not applicable
4.3.2.6.4	Short Control Signalling Transmissions	---	Not applicable
4.3.2.7	Occupied Channel Bandwidth	---	Not applicable
4.3.2.8	Transmitter unwanted emissions in the out-of-band domain	---	Not applicable
4.3.2.9	Transmitter unwanted emissions in the spurious domain	---	Not applicable
4.3.2.10	Receiver spurious emissions	---	Not applicable
4.3.2.11	Receiver Blocking	---	Not applicable
4.3.2.12	Geo-location capability	---	Not applicable

7.1 RF output power

7.1.1 Test Equipment List

	Type	*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☒	Test system 2.4 and 5 GHz band	TS8997	20251	1520.9504.20-101329-BB	Rohde & Schwarz
☐	Signal Generator	SMB100A	19887	100112	Rohde & Schwarz
☐	Vector Signal Generator	SMBV100A	20238	1407.6004K02-261570-du	Rohde & Schwarz
☐	Signal and Spectrum Analysator	FSV40	20219	101448	Rohde & Schwarz
☒	Switching device and power sensors	OSP120 for TS8997	20248	101534	Rohde & Schwarz

7.1.2 Test Results

Results for RF output power test are documented as listed below.

RF output power – Conducted measurement

Prüfdatum / *Date of test:*	2016-05-02
Prüfer / *Operator:*	Martin Steindl
Messplatz / *Test site:*	Non shielded room

Prüfergebnis / *Test Result*
☒ **Erfüllt / *Passed***
☐ **Nicht erfüllt / *Not passed***

Luftdruck / *Barometric pressure:*	981 hPa
Relative Luftfeuchtigkeit / *Relative humidity:*	33 %
Temperatur / *Ambient temperature:*	24 °C

Anforderung / *Requirement:*	EN 300 328 V1.9.1, Section 4.3.1.2
Prüfgrundlage / *Specifications:*	EN 300 328 V1.9.1, Section 5.3.2.2.1
Nominelle Sendeleistung / *Rated carrier power*	12 dBm; 8 dBm (BT low energy)
Antennengewinn / *Antenna gain:*	-5 dBi
Modulation / *Modulation:*	Carrier Modulated
Betriebsart / *Operation mode:*	Transmitting continuously with classic BT.
Kommentar / *Comment:*	This test was performed at nominal test conditions, only.

Test conditions		RF Output Power			
		Max. Conducted power	Max. EIRP	Limit	Margin
Classic BT mode, hopping		(dBm)	(dBm)	(dBm)	(dB)
T_{nom} +20°C	V_{nom} 3.7V	2.3	-2.7	20.0	22.7

Grenzwert / *Limit*
The maximum RF output power for adaptive Frequency Hopping equipment and adaptive equipment using wide band modulations other than FHSS shall be equal to or less than 20 dBm. The maximum RF output power for non-adaptive Frequency Hopping equipment and non-adaptive equipment using wide band modulations other than FHSS shall be declared by the supplier. The maximum RF output power for this equipment shall be equal to or less than the value declared by the supplier. This declared value shall be equal or less than 20 dBm. This limits shall apply for any combination of power level and intended antenna assembly.

7.2 Accumulated Transmit Time, Frequency Occupation and Hopping Sequence

7.2.1 Test Equipment List

	Type	*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☒	Test system 2.4 and 5 GHz band	TS8997	20251	1520.9504.20-101329-BB	Rohde & Schwarz
☐	Signal Generator	SMB100A	19887	100112	Rohde & Schwarz
☐	Vector Signal Generator	SMBV100A	20238	1407.6004K02-261570-du	Rohde & Schwarz
☐	Signal and Spectrum Analysator	FSV40	20219	101448	Rohde & Schwarz
☒	Switching device and power sensors	OSP120 for TS8997	20248	101534	Rohde & Schwarz

7.2.2 Test Results

Results for dwell time, minimum frequency occupation and hopping sequence test are documented as listed below.

TÜV SÜD Product Service GmbH
Äußere Frühlingstraße 45
94315 Straubing
Germany

Phone: +49 9421 5522-0
Fax: +49 9421 5522-99
Web: www.tuev-sued.de

Accumulated Transmit Time, Frequency Occupation and Hopping Sequence – Conducted Measurement

Prüfdatum / *Date of test:*	2016-05-02
Prüfer / *Operator:*	Martin Steindl
Messplatz / *Test site:*	Fully anechoic room, cabin no. 2

Prüfergebnis / *Test Result*

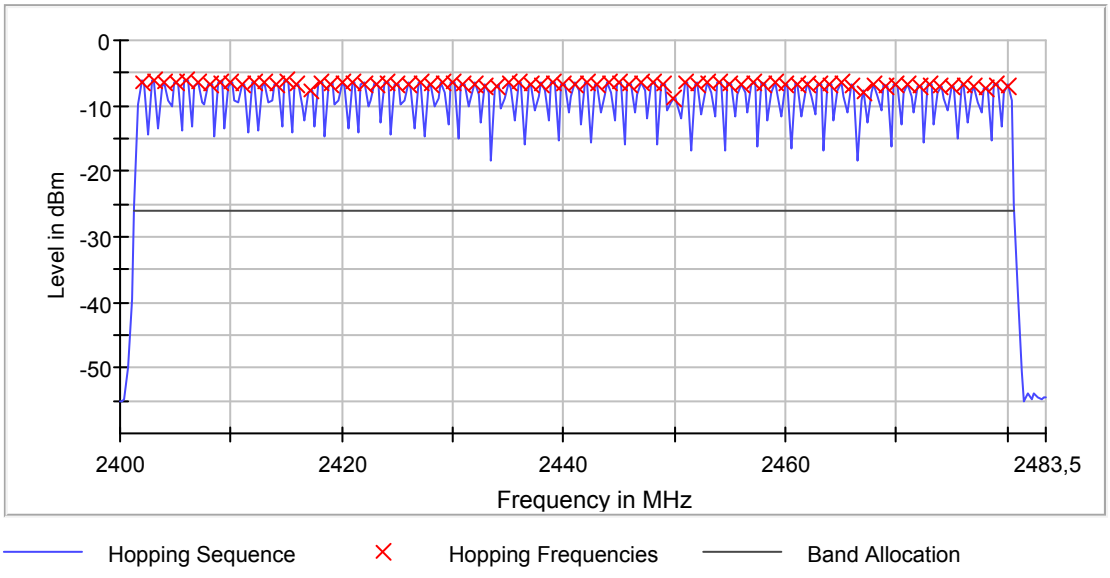
☒ **Erfüllt / *Passed***

☐ **Nicht erfüllt / *Not passed***

Luftdruck / *Barometric pressure:*	981 hPa
Relative Luftfeuchtigkeit / *Relative humidity:*	33 %
Temperatur / *Ambient temperature:*	24 °C

Anforderung / *Requirement:*	EN 300 328 V1.9.1, Section 4.3.1.3
Prüfgrundlage / *Specifications:*	EN 300 328 V1.9.1, Section 5.3.4.2.1
Nominelle Sendeleistung / *Rated carrier power*	12 dBm; 8 dBm (BT low energy)
Modulation / *Modulation:*	Carrier Modulated
Betriebsart / *Operation mode:* Kommentar / *Comment:*	Transmitting continuously with classic BT mode and hopping.

Test conditions	Hopping Sequence	
	Measured value	Limit
Number of Hopping Frequencies	79	≤ 16
Band	95.0	≥ 70.0



Grenzwert / *Limit*
Non-adaptive Frequency Hopping equipment The Accumulated Transmit Time on any hopping frequency shall not be greater than 15 ms within any observation period of 15 ms multiplied by the minimum number of hopping frequencies (N) that have to be used. Non-adaptive medical devices requiring reverse compatibility with other medical devices placed on the market that are compliant with version 1.7.1 or earlier versions of ETSI EN 300 328, are allowed to have an operating mode in which the maximum Accumulated Transmit Time is 400 ms within any observation period of 400 ms multiplied by the minimum number of hopping frequencies (N) that have to be used, only when communicating to these legacy devices already placed on the market. In order for the equipment to comply with the Frequency Occupation requirement, it shall meet either of the following two options: Option 1: Each hopping frequency of the hopping sequence shall be occupied at least once within a period not exceeding four times the product of the dwell time and the number of hopping frequencies in use. Option 2: The occupation probability for each frequency shall be between ((1 / U) × 25 %) and 77 % where U is the number of hopping frequencies in use. The hopping sequence(s) shall contain at least N hopping frequencies where N is 15 or 15 divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater. *Adaptive Frequency Hopping equipment* Adaptive Frequency Hopping equipment shall be capable of operating over a minimum of 70 % of the band specified in clause 1. The Accumulated Transmit Time on any hopping frequency shall not be greater than 400 ms within any observation period of 400 ms multiplied by the minimum number of hopping frequencies (N) that have to be used. In order for the equipment to comply with the Frequency Occupation requirement, it shall meet either of the following two options: Option 1: Each hopping frequency of the hopping sequence shall be occupied at least once within a period not exceeding four times the product of the dwell time and the number of hopping frequencies in use. Option 2: The occupation probability for each frequency shall be between ((1 / U) × 25 %) and 77 % where U is the number of hopping frequencies in use. The hopping sequence(s) shall contain at least N hopping frequencies at all times, where N is 15 or 15 divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater.

7.3 Hopping Frequency Separation

7.3.1 Test Equipment List

	Type	*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☒	Test system 2.4 and 5 GHz band	TS8997	20251	1520.9504.20-101329-BB	Rohde & Schwarz
☐	Signal Generator	SMB100A	19887	100112	Rohde & Schwarz
☐	Vector Signal Generator	SMBV100A	20238	1407.6004K02-261570-du	Rohde & Schwarz
☒	Signal and Spectrum Analysator	FSV40	20219	101448	Rohde & Schwarz
☐	Switching device and power sensors	OSP120 for TS8997	20248	101534	Rohde & Schwarz

7.3.2 Test Results

Results for hopping frequency separation test are documented as listed below.

Hopping Frequency Separation - Conducted measurement

Prüfdatum / *Date of test:*	2016-05-02
Prüfer / *Operator:*	Martin Steindl
Messplatz / *Test site:*	Fully anechoic room, cabin no. 2

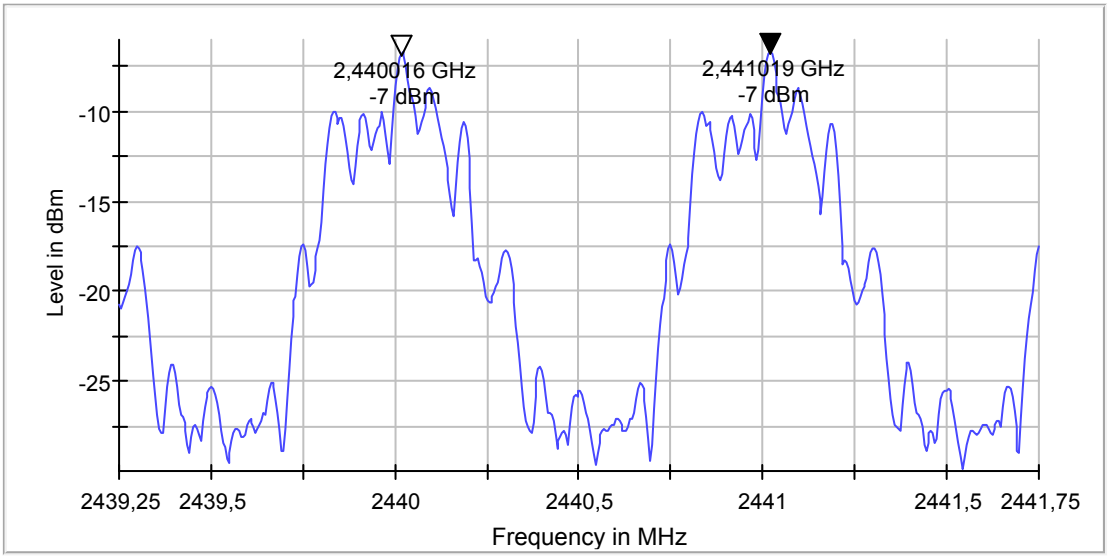
Prüfergebnis / *Test Result*

☒ **Erfüllt / *Passed***

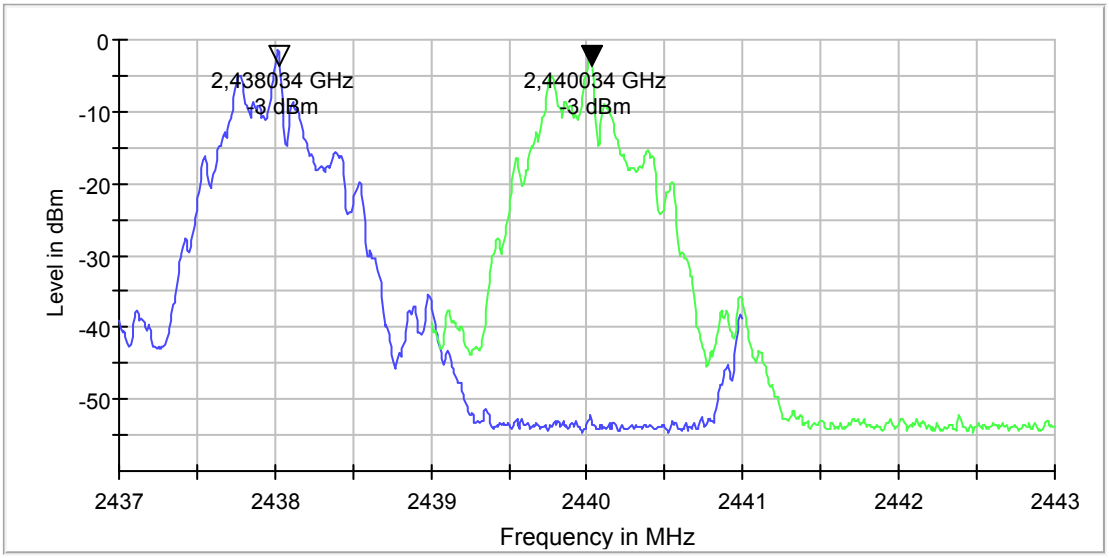
☐ **Nicht erfüllt / *Not passed***

Luftdruck / *Barometric pressure:*	981 hPa
Relative Luftfeuchtigkeit / *Relative humidity:*	33 %
Temperatur / *Ambient temperature:*	24 °C

Anforderung / *Requirement:*	EN 300 328 V1.9.1, Section 4.3.1.5
Prüfgrundlage / *Specifications:*	EN 300 328 V1.9.1, Sections 5.3.5.2.1
Nominelle Sendeleistung / *Rated carrier power*	12 dBm; 8 dBm (BT low energy)
Modulation / *Modulation:*	Carrier Modulated
Betriebsart / *Operation mode:* Kommentar / *Comment:*	Transmitting continuously with classic BT mode and hopping and BT low power mode.



classic BT mode



BT low energy mode

Grenzwert / *Limit*
Non-adaptive Frequency Hopping equipment For non-adaptive Frequency Hopping equipment the Hopping Frequency Separation shall be equal or greater than the Occupied Channel Bandwidth, with a minimum of 100 kHz. For equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for non-adaptive Frequency Hopping equipment operating in a mode where the RF Output power is less than 10 dBm e.i.r.p. only the minimum Hopping Frequency Spearation of 100 kHz applies. *Adaptive Frequency Hopping equipment* For adaptive Frequency Hopping equipment, the minimum Hopping Frequency Separation shall be 100 kHz. Adaptive Frequency Hopping equipment, which for one or more hopping frequencies, has switched to a non-adaptive mode because interference was detected on all these hopping positions with a level above the threshold level defined in clause 4.3.1.7.2.2 or clause 4.3.1.7.3.2, is allowed to continue to operate with a minimum Hopping Frequency Separation of 100 kHz on these hopping frequencies as long as the interference is present on these frequencies. The equipment shall continue to operate in any adaptive mode on other hopping frequencies. Adaptive Frequency Hopping equipment which decided to operate in a non-adaptive mode on one or more hopping frequencies without the presence of interference, shall comply with the limit in clause 4.3.1.5.3.1 for these hopping frequencies as well as with all other requirements applicable to non-adaptive frequency hopping equipment.

7.4 Occupied Channel Bandwidth

7.4.1 Test Equipment List

	Type	*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☒	Test system 2.4 and 5 GHz band	TS8997	20251	1520.9504.20-101329-BB	Rohde & Schwarz
☐	Signal Generator	SMB100A	19887	100112	Rohde & Schwarz
☐	Vector Signal Generator	SMBV100A	20238	1407.6004K02-261570-du	Rohde & Schwarz
☒	Signal and Spectrum Analysator	FSV40	20219	101448	Rohde & Schwarz
☐	Switching device and power sensors	OSP120 for TS8997	20248	101534	Rohde & Schwarz

7.4.2 Test Results

Results for occupied channel bandwidth test are documented as listed below.

Occupied Channel Bandwidth

Prüfdatum / *Date of test:*	2016-05-02
Prüfer / *Operator:*	Martin Steindl
Messplatz / *Test site:*	Fully anechoic room, cabin no. 2

Prüfergebnis / *Test Result*

☒ **Erfüllt / *Passed***

☐ **Nicht erfüllt / *Not passed***

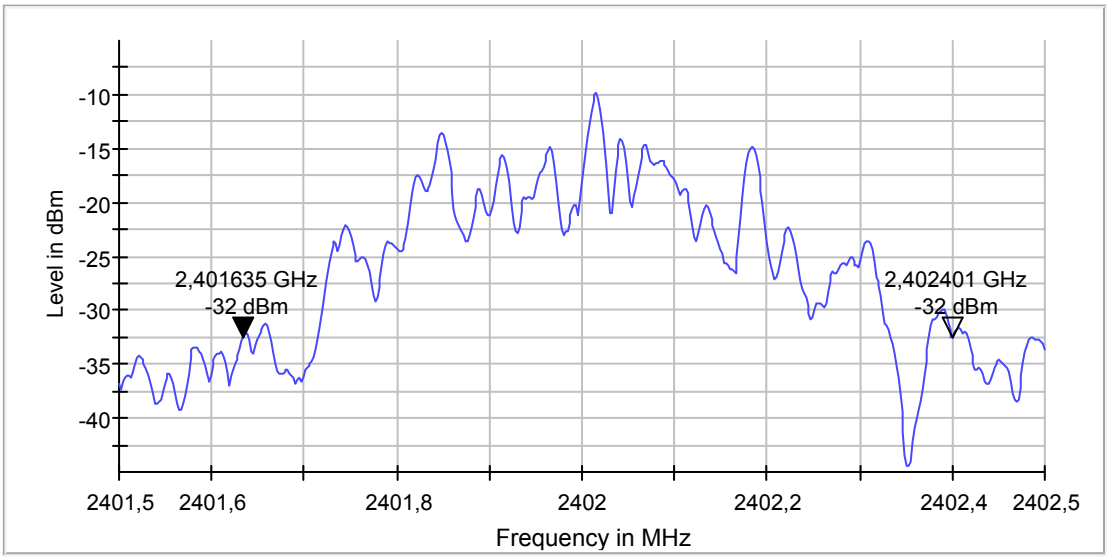
Luftdruck / *Barometric pressure:*	981 hPa
Relative Luftfeuchtigkeit / *Relative humidity:*	33 %
Temperatur / *Ambient temperature:*	24 °C

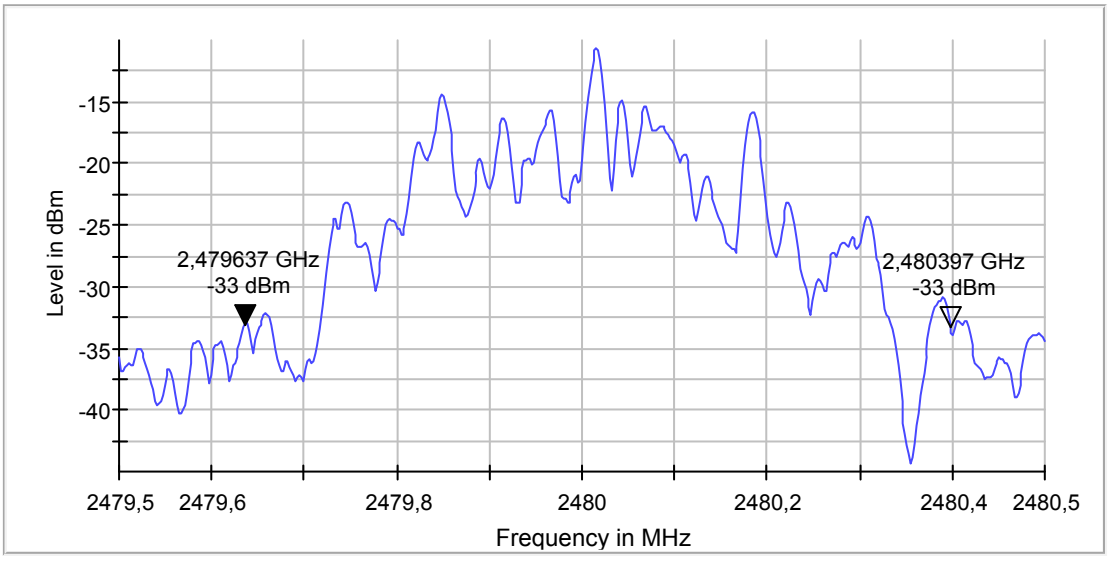
Anforderung / *Requirement:*	EN 300 328 V1.9.1, Section 4.3.1.8
Prüfgrundlage / *Specifications:*	EN 300 328 V1.9.1, Section 5.3.8
Nominelle Sendeleistung / *Rated carrier power*	12 dBm; 8 dBm (BT low energy)
Messbezug / *Reference:*	ERP
Betriebsart / *Operation mode:* Kommentar / *Comment:*	Transmitting on channel

Test conditions		Measured Frequency (MHz)
Classic BT, lowest channel	F_L	2401.635
	F_H	2402.401
Classic BT, highest channel	F_L	2479.637
	F_H	2480.497
BT low energy, lowest channel	F_L	2401.525
	F_H	2402.535
BT low energy, highest channel	F_L	2479.521
	F_H	2480.539
Where:	F_L	Lowest frequency of 99 % of the bandwidth, each
	F_H	Highest frequency of 99 % of the bandwidth, each

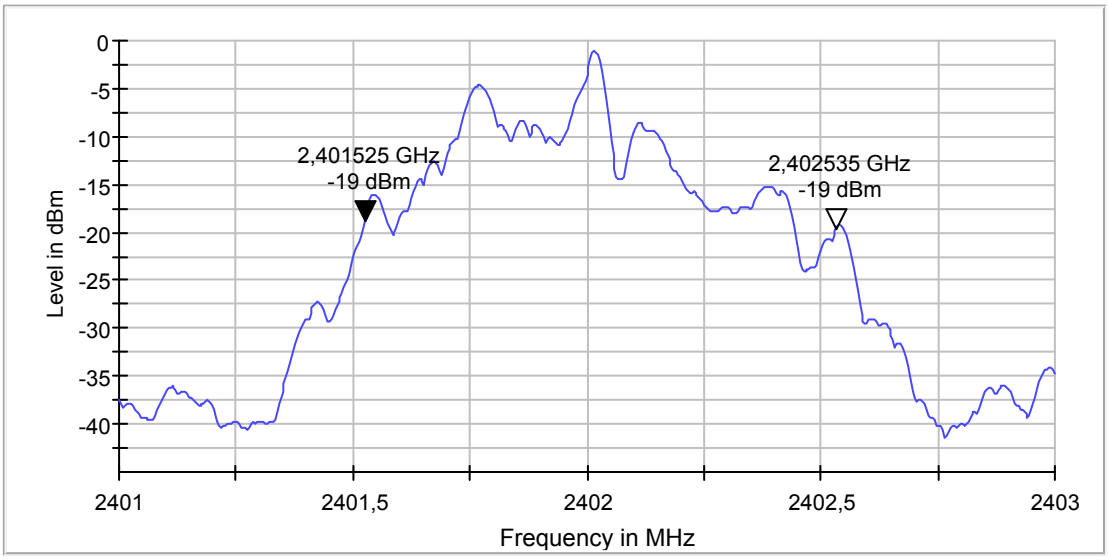
Grenzwert / *Limit*
The occupied channel bandwidth for each hopping frequency / channel shall fall completely within the band 2400.0 MHz – 2483.5 MHz. For non-adaptive Frequency Hopping equipment with e.i.r.p greater than 10 dBm, the Occupied Channel Bandwidth for every occupied hopping frequency shall be equal to or less than the Nominal Channel Bandwidth declared by the supplier. This declared value shall not be greater than 5 MHz.

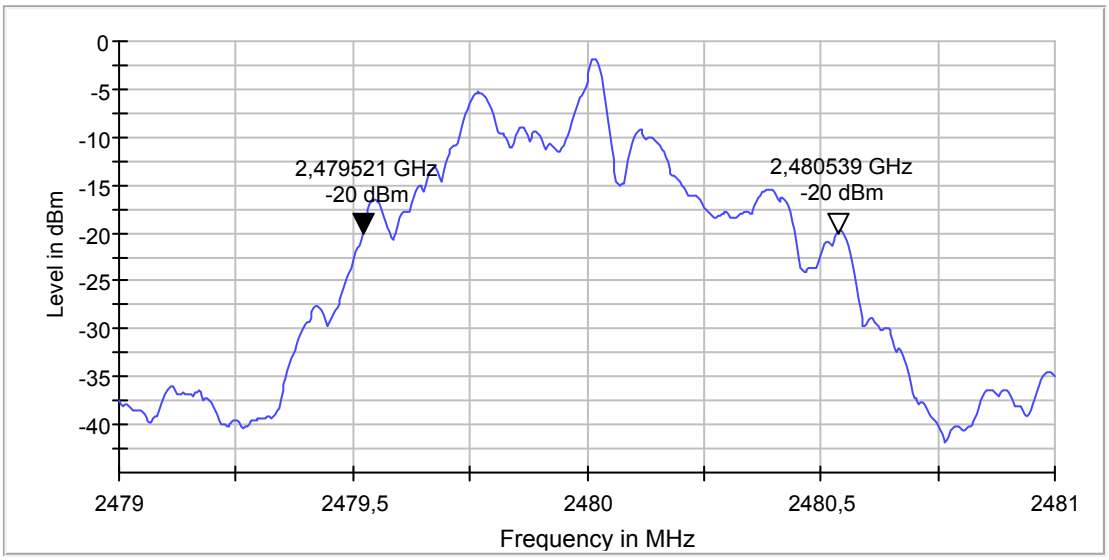
Plots for occupied bandwidth for “BT classic mode”





Plots for occupied bandwidth for “BT low energy mode”





7.5 Transmitter unwanted emissions in the out-of-band domain

7.5.1 Test Equipment List

	Type	*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☒	Test system 2.4 and 5 GHz band	TS8997	20251	1520.9504.20-101329-BB	Rohde & Schwarz
☐	Signal Generator	SMB100A	19887	100112	Rohde & Schwarz
☐	Vector Signal Generator	SMBV100A	20238	1407.6004K02-261570-du	Rohde & Schwarz
☒	Signal and Spectrum Analysator	FSV40	20219	101448	Rohde & Schwarz
☐	Switching device and power sensors	OSP120 for TS8997	20248	101534	Rohde & Schwarz

7.5.2 Test Results

Results for transmitter unwanted emissions in the out-of-band domain factor test are documented as listed below.

Unwanted emissions – Out-of-band-domain – Conducted measurement

Prüfdatum / *Date of test:*	2016-05-02
Prüfer / *Operator:*	Unknown
Messplatz / *Test site:*	Fully anechoic room, cabin no. 2

Prüfergebnis / *Test Result*

☒ **Erfüllt / *Passed***

☐ **Nicht erfüllt / *Not passed***

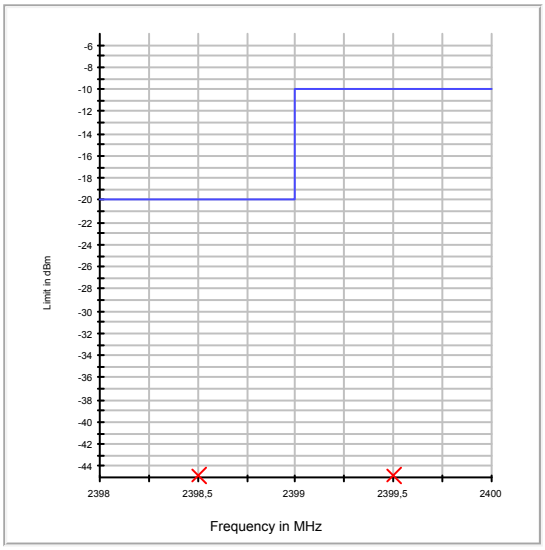
Luftdruck / *Barometric pressure:*	981 hPa
Relative Luftfeuchtigkeit / *Relative humidity:*	33 %
Temperatur / *Ambient temperature:*	24 °C

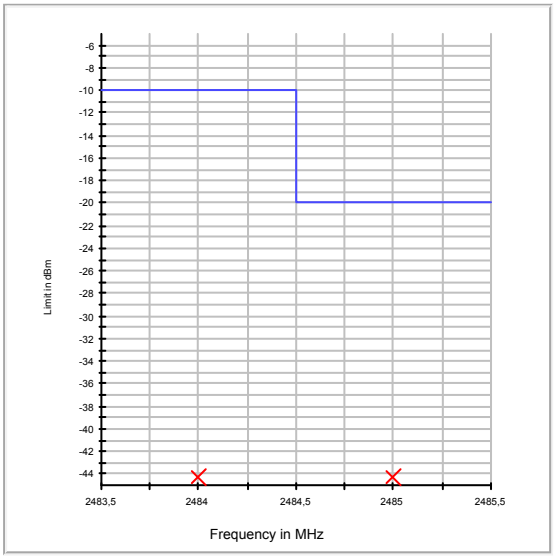
Anforderung / *Requirement:*	EN 300 328 V1.9.1, Section 4.3.1.9
Prüfgrundlage / *Specifications:*	EN 300 328 V1.9.1, Section 5.3.9
Nominelle Sendeleistung / *Rated carrier power* Antennengewinn / *Antenna gain:*	12 dBm; 8 dBm (BT low energy) -5 dBi
Modulation / *Modulation:*	Carrier Modulated
Betriebsart / *Operation mode:* Kommentar / *Comment:*	Transmitting continuously with classic BT mode and hopping and low energy BT on lowest and highest channel.

Grenzwert / *Limit*	
2400.0 MHz - 2 BW to 2400.0 MHz – BW	*-10 dBm/MHz e.i.r.p.*
2400.0 MHz - 2 BW to 2400.0 MHz - BW	*-20 dBm/MHz e.i.r.p.*
2483.5 MHz + BW t0 2483.5 MHz + 2 BW	*-20 dBm/MHz e.i.r.p.*
2483.5 MHz + BW t0 2483.5 MHz + 2 BW	*-10 dBm/MHz e.i.r.p.*
Note: BW is the Occupied bandwidth	

Classic BT mode

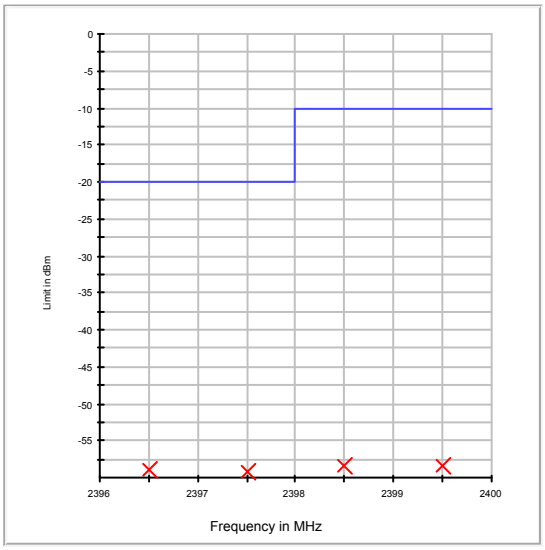
Frequency (MHz)	Emission level (dBm)	Limit (dBm)	Margin (dB)
2398.5	-44.8	-20.0	-24.8
2399.5	-44.8	-10.0	-34.8
2484.0	-44.2	-10.0	-34.2
2485.0	-44.2	-20.0	-24.2

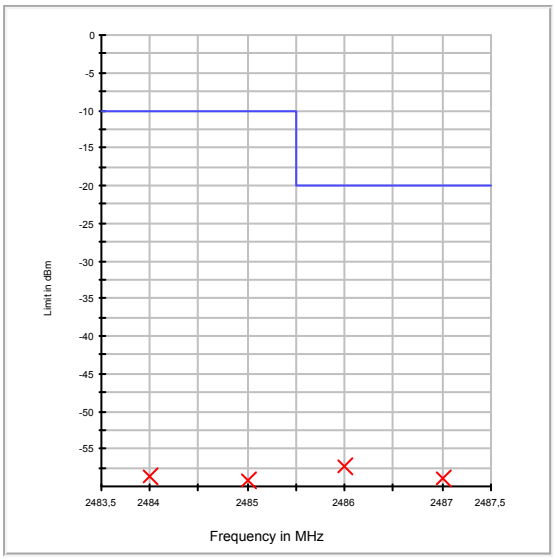




BT low energy mode on lowest channel

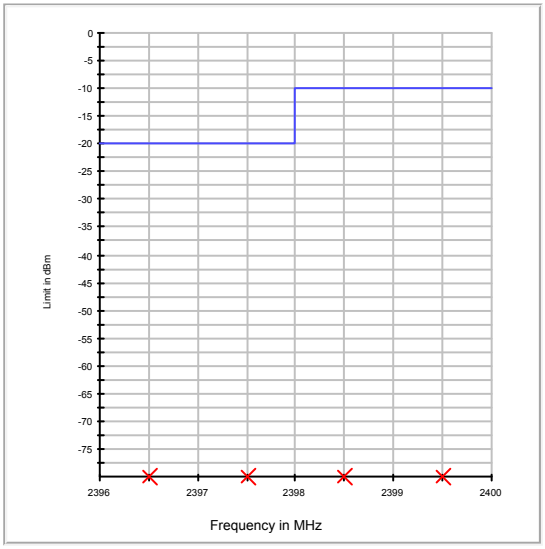
Frequency (MHz)	Emission level (dBm)	Limit (dBm)	Margin (dB)
2396.5	-59.1	-20.0	39.1
2397.5	-59.2	-20.0	39.2
2398.5	-58.5	-10.0	48.5
2399.5	-58.5	-10.0	48.5
2484.0	-58.6	-10.0	48.6
2485.0	-59.1	-10.0	59.1
2486.0	-57.3	-20.0	37.3
2487.0	-59.0	-20.0	39.0

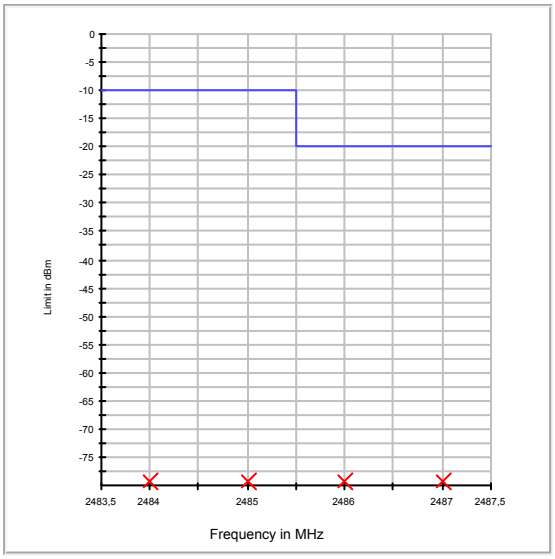




BT low energy mode on highest channel

Frequency (MHz)	Emission level (dBm)	Limit (dBm)	Margin (dB)
2396.5	-79.9	-20.0	59.9
2397.5	-79.9	-20.0	59.9
2398.5	-79.9	-10.0	69.9
2399.5	-79.9	-10.0	69.9
2484.0	-79.4	-10.0	69.4
2485.0	-79.3	-10.0	69.3
2486.0	-79.3	-20.0	59.3
2487.0	-79.4	-20.0	59.4





7.6 Transmitter unwanted emissions in the spurious domain

7.6.1 Test Equipment List

	Type		Designation	Inv.-no.	Serial No. or ID	Manufacturer
☒	Spectrum analyzer		FSP30	1666	100036	Rohde & Schwarz
☐	EMI test receiver	Cabin no. 3	ESPI7	2010	101018	Rohde & Schwarz
☐	EMI test receiver		ESU8	2044	100232	Rohde & Schwarz
☐	EMI test receiver		ESMI	1569	839379/013 839587/006	Rohde & Schwarz
☒	Test system 2.4 and 5 GHz band		TS8997	20251	1520.9504.20-101329-BB	Rohde & Schwarz
☐	Signal Generator		SMB100A	19887	100112	Rohde & Schwarz
☐	Vector Signal Generator		SMBV100A	20238	1407.6004K02-261570-du	Rohde & Schwarz
☒	Signal and Spectrum Analysator		FSV40	20219	101448	Rohde & Schwarz
☐	Switching device and power sensors		OSP120 for TS8997	20248	101534	Rohde & Schwarz
☐	Attenuator		4776-10	1638	9412	Narda
☐	Attenuator		4776-20	1639	9503	Narda
☐	DC-block		7006	1636	A2798	Weinschel
☒	Preamplifier	Cabin no. 2	CPA9231A	1716	3557	Schaffner
☐	Preamplifier		R14601	1142	13120026	Advantest
☒	Preamplifier (1 - 8 GHz)		AFS3-00100800-32-LN	1684	847743	Miteq
☐	Preamplifier (0.5 - 8 GHz)		AMF-4D-005080-25-13P	1685	860149	Miteq
☒	Preamplifier (8 - 18 GHz)		ACO/180-3530	1484	32641	CTT
☐	Trilog antenna	Cabin no. 2	VULB 9163	2058	9163-408	Schwarzbeck
☐	Trilog antenna	Cabin no. 8	VULB 9163	1802	9163-214	Schwarzbeck
☒	Trilog antenna	Cabin no. 2	VULB 9162	2256	9162-048	Schwarzbeck
☒	Horn antenna		3115	1516	9508-4553	EMCO
☐	Horn antenna		HF907	2073	100154	Rohde & Schwarz
☐	Horn antenna		3160-03	1010	9112-1003	EMCO
☐	Horn antenna		3160-04	1011	9112-1001	EMCO
☐	Horn antenna		3160-05	1012	9112-1001	EMCO
☐	Horn antenna		3160-06	1013	9112-1001	EMCO
☐	Horn antenna		3160-07	1014	9112-1001	EMCO
☐	Horn antenna		3160-08	1015	9112-1001	EMCO
☒	Fully anechoic room		No. 2	1452	---	Albatross
☐	Semi anechoic room		No. 3	1453	---	Siemens
☐	Semi anechoic room		No. 8	2057	---	Albatross

7.6.2 Test Results

Results for transmitter unwanted emissions in the spurious domain test are documented as listed below.

Transmitter unwanted emissions in the spurious domain – Conducted

Prüfdatum / *Date of test:*	2016-05-02
Prüfer / *Operator:*	Martin Steindl
Messplatz / *Test site:*	Fully anechoic room, cabin no. 2

Prüfergebnis / *Test Result*
☒ **Erfüllt / *Passed***
☐ **Nicht erfüllt / *Not passed***

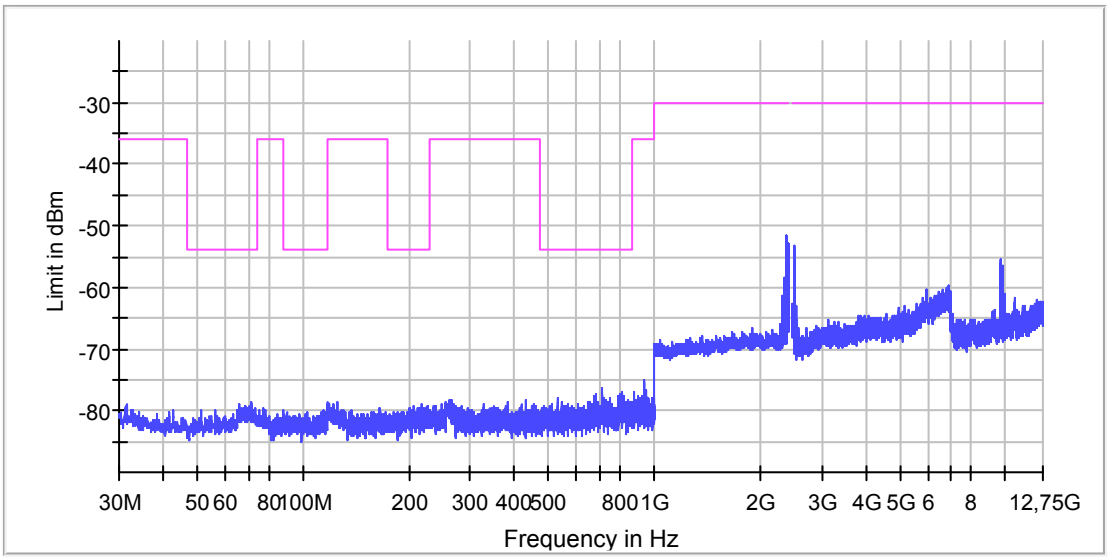
Luftdruck / *Barometric pressure:*	981 hPa
Relative Luftfeuchtigkeit / *Relative humidity:*	33 %
Temperatur / *Ambient temperature:*	24 °C

Anforderung / *Requirement:*	EN 300 328 V1.9.1, Section 4.3.1.10
Prüfgrundlage / *Specifications:*	EN 300 328 V1.9.1, Section 5.3.10
Nominelle Sendeleistung / *Rated carrier power*	12 dBm; 8 dBm (BT low energy)
Messbezug / *Reference:*	ERP
Betriebsart / *Operation mode:* Kommentar / *Comment:*	Transmitting continuously with classic BT mode and hopping.

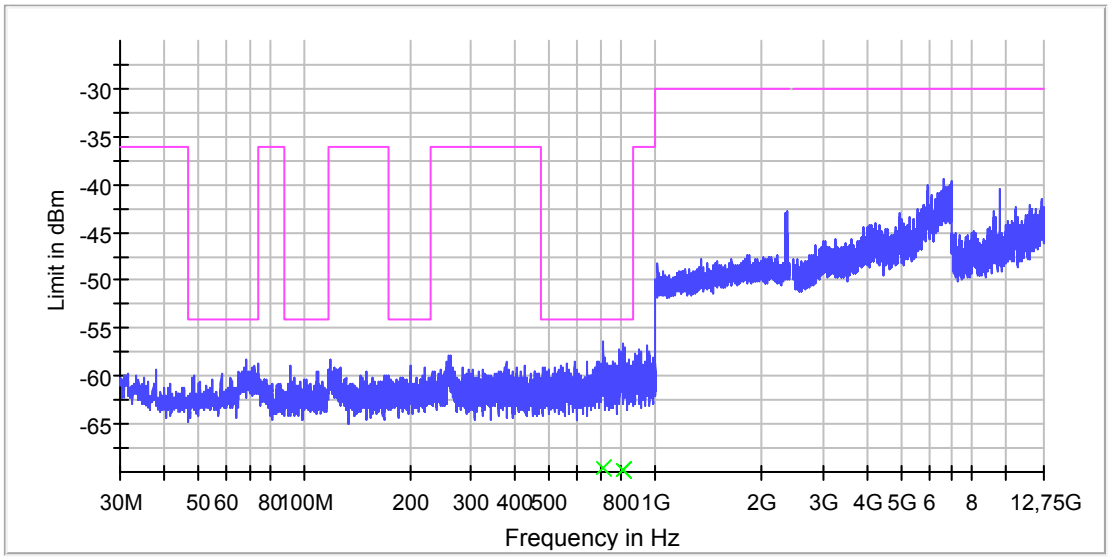
Frequency (MHz)	Resolutionbandwidth (kHz)	Spurious emission level (dBm)	Limit (dBm)	Margin (dB)
Classic mode - hopping				
All emissions show more than 20 dB margin to the limit				
Low energy mode – lowest channel				
706.425	100	-69.6	-54.0	15.6
810.325	100	-69.8	-54.0	15.8
813.825	100	-69.7	-54.0	15.7
Low energy mode – highest channel				
708.275	100	-69.7	-54.0	15.7
794.375	100	-69.9	-54.0	15.9
810.925	100	-69.8	-54.0	15.8

Grenzwert / *Limit*		
47 MHz to 74 MHz *87.5 MHz to 118 MHz* *174 MHz to 230 MHz* *470 MHz to 862 MHz*	*Other frequencies* *≤ 1000 MHz*	*Frequencies > 1000 MHz*
4 nW (-54 dBm)	250 nW (-36 dBm)	1 µW (-30 dBm)

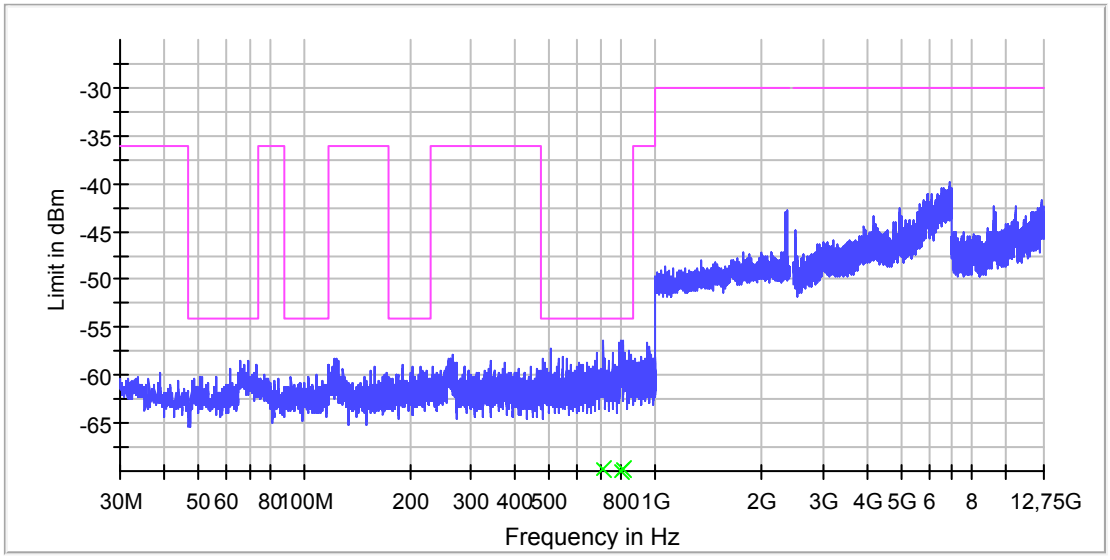
Plots for occupied bandwidth for “BT classic mode”



Plots for occupied bandwidth for “BT low energy mode”



Lowest channel



Highest channel

Transmitter unwanted emissions in the spurious domain – Radiated – Transmitter operating

Prüfdatum / *Date of test:*	2016-05-04
Prüfer / *Operator:*	Martin Steindl
Messplatz / *Test site:*	Fully anechoic room, cabin no. 2

Prüfergebnis / *Test Result*

☐ **Erfüllt / *Passed***

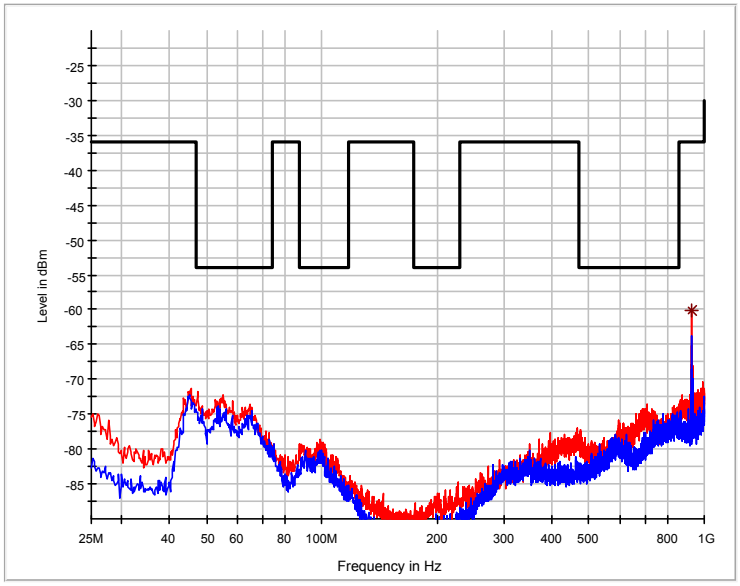
☐ **Nicht erfüllt / *Not passed***

Luftdruck / *Barometric pressure:*	987 hPa
Relative Luftfeuchtigkeit / *Relative humidity:*	31 %
Temperatur / *Ambient temperature:*	25 °C

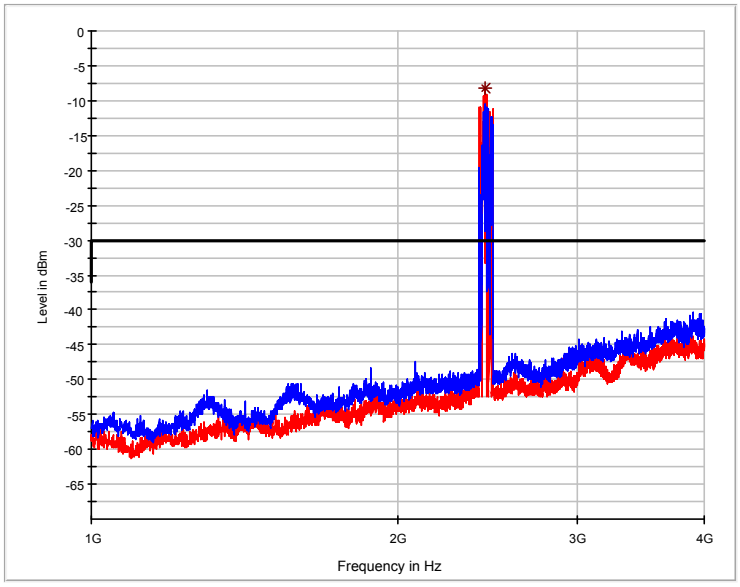
Anforderung / *Requirement:*	EN 300 328 V1.9.1, Section 4.3.1.10
Prüfgrundlage / *Specifications:*	EN 300 328 V1.9.1, Section 5.3.10
Nominelle Sendeleistung / *Rated carrier power*	12 dBm; 8 dBm (BT low energy)
Messbezug / *Reference:*	ERP
Betriebsart / *Operation mode:* Kommentar / *Comment:*	Transmitting continuously with classic BT mode and hopping.

Frequency (MHz)	Resolutionbandwidth (kHz)	Spurious emission level (dBm)	Limit (dBm)	Margin (dB)
929.8	100	-60.1	-36.0	24.1

Grenzwert / *Limit*		
47 MHz to 74 MHz *87.5 MHz to 118 MHz* *174 MHz to 230 MHz* *470 MHz to 862 MHz*	*Other frequencies* *≤ 1000 MHz*	*Frequencies > 1000 MHz*
4 nW (-54 dBm)	250 nW (-36 dBm)	1 µW (-30 dBm)

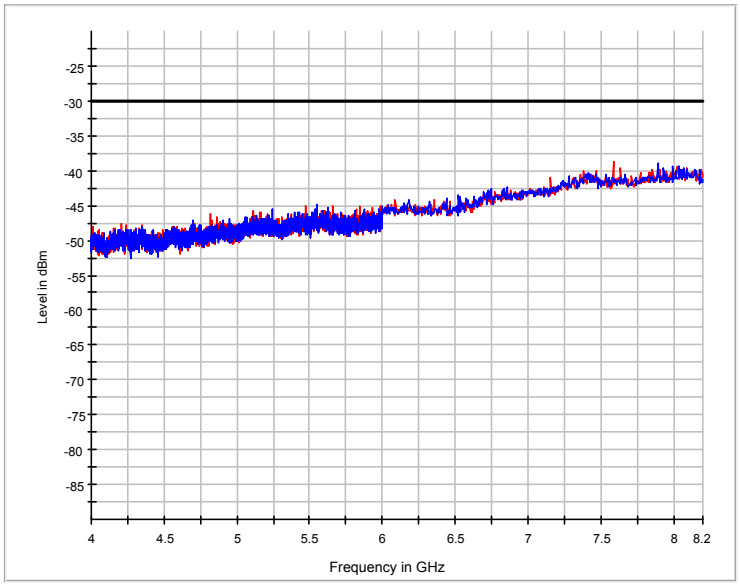


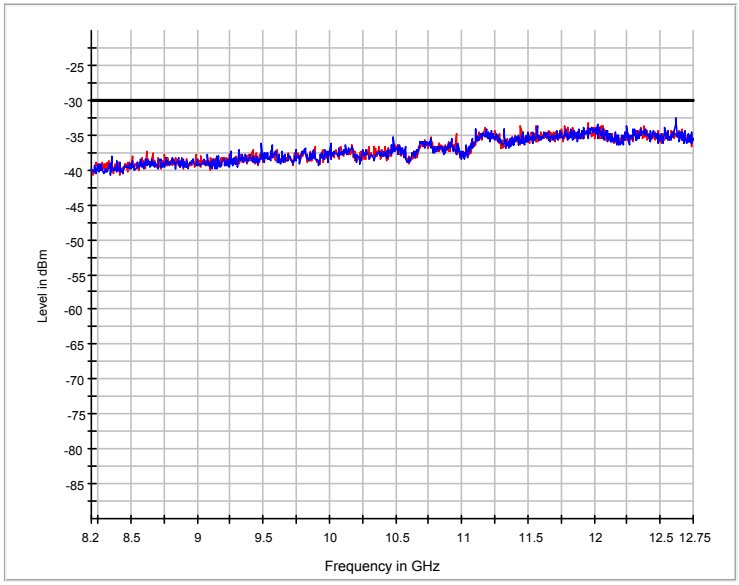
Preview Result 1H-PK+
EN 300 XXX TX
Preview Result 1V-PK+
Final_Result PK+



Preview Result 1H-PK+
EN 300 XXX TX
Preview Result 1V-PK+
Final_Result PK+

Carrier not evaluated to spurious emissions limit


-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
-75
-80
-85
Level in dBm
4
4.5
5
5.5
6
6.5
7
7.5
8
8.2
Frequency in GHz
Preview Result 1H-PK+
EN 300 XXX TX
Preview Result 1V-PK+
Final_Result PK+


-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
-75
-80
-85
Level in dBm
8.2
8.5
9
9.5
10
10.5
11
11.5
12
12.5
12.75
Frequency in GHz
Preview Result 1H-PK+
EN 300 XXX TX
Preview Result 1V-PK+
Final_Result PK+

7.7 Receiver spurious radiation

7.7.1 Test Equipment List

	Type		*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☒	Spectrum analyzer		FSP30	1666	100036	Rohde & Schwarz
☐	EMI test receiver	Cabin no. 3	ESPI7	2010	101018	Rohde & Schwarz
☐	EMI test receiver		ESU8	2044	100232	Rohde & Schwarz
☐	EMI test receiver		ESMI	1569	839379/013 839587/006	Rohde & Schwarz
☒	Test system 2.4 and 5 GHz band		TS8997	20251	1520.9504.20-101329-BB	Rohde & Schwarz
☐	Signal Generator		SMB100A	19887	100112	Rohde & Schwarz
☐	Vector Signal Generator		SMBV100A	20238	1407.6004K02-261570-du	Rohde & Schwarz
☒	Signal and Spectrum Analysator		FSV40	20219	101448	Rohde & Schwarz
☐	Switching device and power sensors		OSP120 for TS8997	20248	101534	Rohde & Schwarz
☐	Attenuator		4776-10	1638	9412	Narda
☐	Attenuator		4776-20	1639	9503	Narda
☐	DC-block		7006	1636	A2798	Weinschel
☒	Preamplifier	Cabin no. 2	CPA9231A	1716	3557	Schaffner
☐	Preamplifier		R14601	1142	13120026	Advantest
☒	Preamplifier (1 - 8 GHz)		AFS3-00100800-32-LN	1684	847743	Miteq
☐	Preamplifier (0.5 - 8 GHz)		AMF-4D-005080-25-13P	1685	860149	Miteq
☒	Preamplifier (8 - 18 GHz)		ACO/180-3530	1484	32641	CTT
☐	Trilog antenna	Cabin no. 2	VULB 9163	2058	9163-408	Schwarzbeck
☐	Trilog antenna	Cabin no. 8	VULB 9163	1802	9163-214	Schwarzbeck
☒	Trilog antenna	Cabin no. 2	VULB 9162	2256	9162-048	Schwarzbeck
☒	Horn antenna		3115	1516	9508-4553	EMCO
☐	Horn antenna		HF907	2073	100154	Rohde & Schwarz
☐	Horn antenna		3160-03	1010	9112-1003	EMCO
☐	Horn antenna		3160-04	1011	9112-1001	EMCO
☐	Horn antenna		3160-05	1012	9112-1001	EMCO
☐	Horn antenna		3160-06	1013	9112-1001	EMCO
☐	Horn antenna		3160-07	1014	9112-1001	EMCO
☐	Horn antenna		3160-08	1015	9112-1001	EMCO
☒	Fully anechoic room		No. 2	1452	---	Albatross
☐	Semi anechoic room		No. 3	1453	---	Siemens
☐	Semi anechoic room		No. 8	2057	---	Albatross

7.7.2 Test Results

Results for receiver spurious emissions in test are documented as listed below.

Receiver spurious radiation – Conducted

Prüfdatum / *Date of test:*	2016-05-02
Prüfer / *Operator:*	Martin Steindl
Messplatz / *Test site:*	Fully anechoic room, cabin no. 2

Prüfergebnis / *Test Result*

☒ **Erfüllt / *Passed***

☐ **Nicht erfüllt / *Not passed***

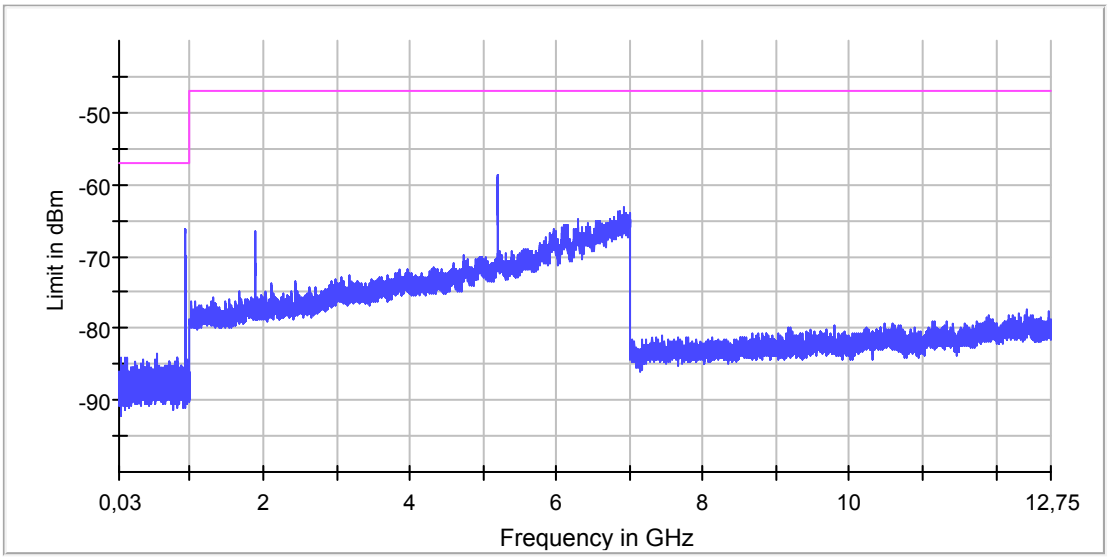
Luftdruck / *Barometric pressure:*	981 hPa
Relative Luftfeuchtigkeit / *Relative humidity:*	33 %
Temperatur / *Ambient temperature:*	24 °C

Anforderung / *Requirement:*	EN 300 328 V1.9.1, Section 4.3.1.11
Prüfgrundlage / *Specifications:*	EN 300 328 V1.9.1, Section 5.3.11
Betriebsart / *Operation mode:*	Transmitting continuously with receiving.
Kommentar / *Comment:*	

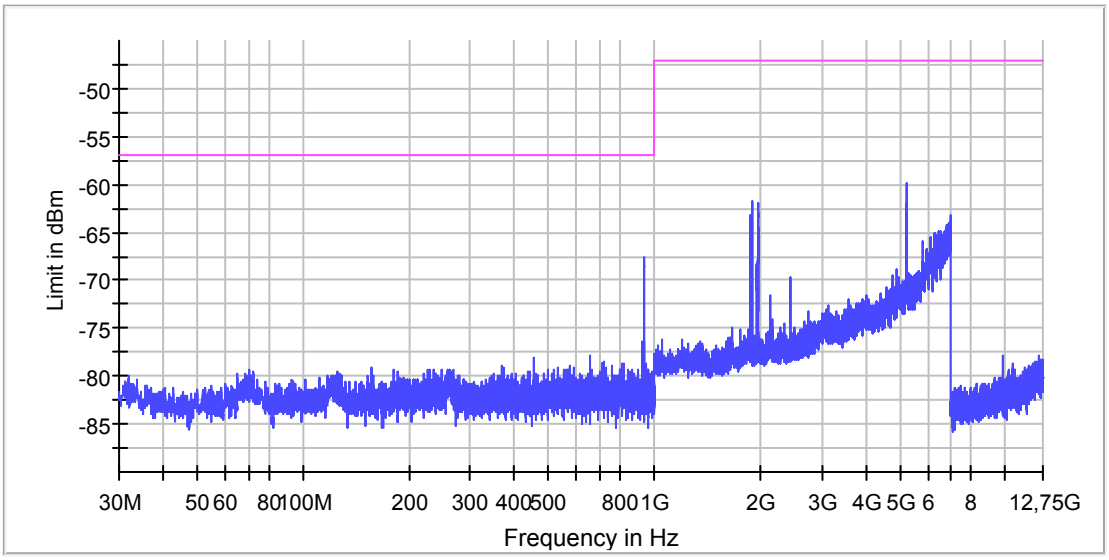
Frequency (MHz)	Resolutionbandwidth (kHz)	Spurious emission level (dBm)	Limit (dBm)	Margin (dB)
Classic mode - hopping				
All emissions show more than 10 dB margin to the limit				
Low energy mode – lowest channel				
All emissions show more than 10 dB margin to the limit				
Low energy mode – highest channel				
All emissions show more than 10 dB margin to the limit				

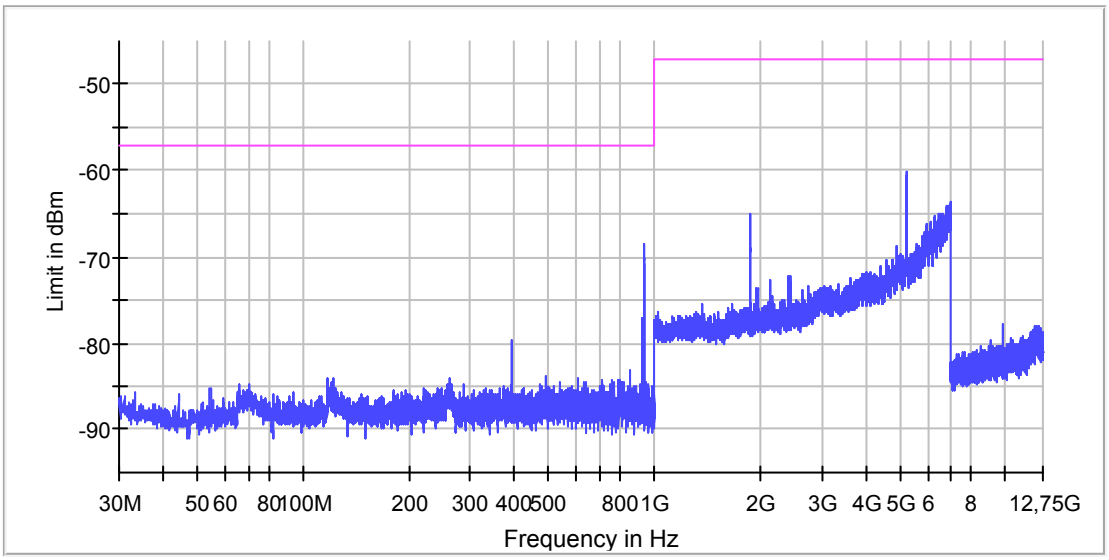
Grenzwert / *Limit*	
Frequencies ≤ 1000 MHz	*Frequencies > 1000 MHz*
2 nW (-57 dBm)	20 nW (-47 dBm)

Plots for occupied bandwidth for “BT classic mode”



Plots for occupied bandwidth for “BT low energy mode”





Receiver spurious radiation – Radiated

Prüfdatum / *Date of test:*	2016-05-04
Prüfer / *Operator:*	Unknown
Messplatz / *Test site:*	Fully anechoic room, cabin no. 2

Prüfergebnis / *Test Result*

☒ **Erfüllt / *Passed***

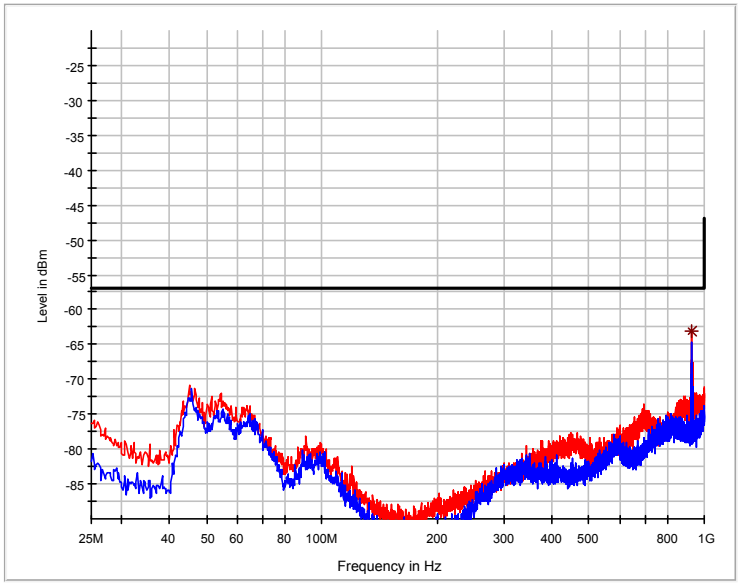
☐ **Nicht erfüllt / *Not passed***

Luftdruck / *Barometric pressure:*	987 hPa
Relative Luftfeuchtigkeit / *Relative humidity:*	31 %
Temperatur / *Ambient temperature:*	25 °C

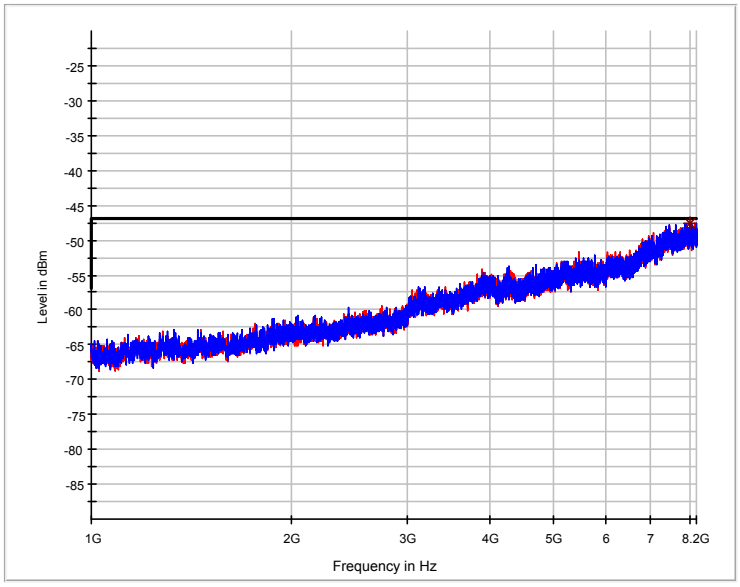
Anforderung / *Requirement:*	EN 300 328 V1.9.1, Section 4.3.1.11
Prüfgrundlage / *Specifications:*	EN 300 328 V1.9.1, Section 5.3.11
Betriebsart / *Operation mode:*	Transmitting continuously receiving.
Kommentar / *Comment:*	

Frequency (MHz)	Resolutionbandwidth (kHz)	Spurious emission level (dBm)	Limit (dBm)	Margin (dB)
929.605	100	-63.0	-57.0	6.0
8000.2	1000	-47.6	-47.0	0.6
12565.462	1000	-51.0	-47.0	4.0

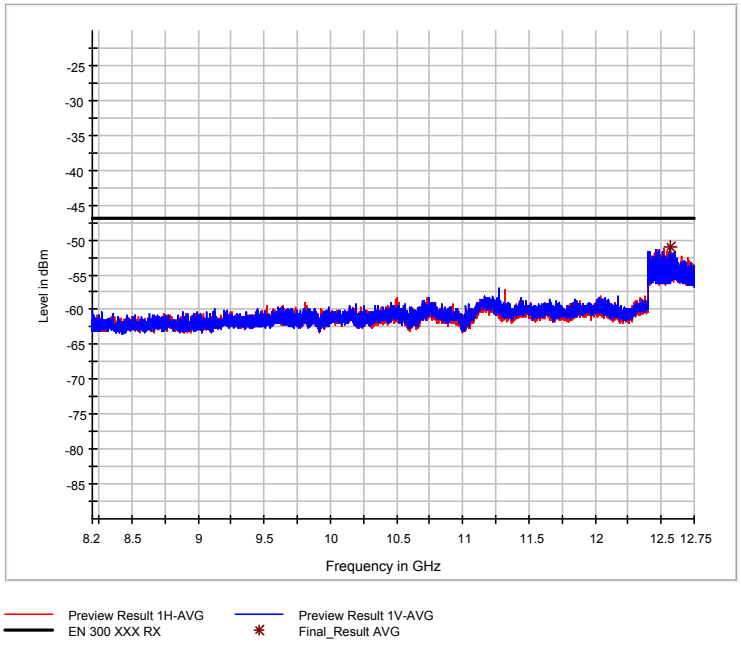
Grenzwert / *Limit*	
Frequencies ≤ 1000 MHz	*Frequencies > 1000 MHz*
2 nW (-57 dBm)	20 nW (-47 dBm)



Preview Result 1H-PK+
EN 300 XXX RX
Preview Result 1V-PK+
Final_Result PK+



Preview Result 1H-PK+
EN 300 XXX RX
Preview Result 1V-PK+
Final_Result PK+


-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
-75
-80
-85
Level in dBm
8.2
8.5
9
9.5
10
10.5
11
11.5
12
12.5
12.75
Frequency in GHz
Preview Result 1H-AVG
EN 300 XXX RX
Preview Result 1V-AVG
Final_Result AVG

8 Application form for testing

The application forms were declared as confidential by the applicant.

9 Additional informations

There are no additional information to this test report.

10 Revision History

Revision History			
Edition	*Date*	*Issued by*	*Modifications*
1	2016-05-20	M. Steindl(as)	First Edition