

Prüfbericht - Nr.: <i>Test Report No.:</i>	50332845 001	Auftrags-Nr.: <i>Order No.:</i>	180118337	Seite 1 von 81 Page 1 of 81	
Kunden-Referenz-Nr.: <i>Client Reference No.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	19.12.2019		
Auftraggeber: <i>Client:</i>	Ring LLC 1523 26th St, Santa Monica, CA 90404, USA				
Prüfgegenstand: <i>Test item:</i>	Solar Floodlight				
Bezeichnung / Typ-Nr. : <i>Identification / Type No. :</i>	5AT1S5				
Auftrags-Inhalt: <i>Order content:</i>	TÜV Rheinland – FCC/IC Service				
Prüfgrundlage: <i>Test specification:</i>	CFR47 FCC Part 15: Subpart C Section 15.209 CFR47 FCC Part 15: Subpart C Section 15.247 FCC Part15, Subpart B:2018 RSS-247 Issue 2 February 2017 RSS-Gen Issue 5 March 2019 ICES-003:2016				
Wareneingangsdatum: <i>Date of receipt:</i>	19.12.2019				
Prüfmuster-Nr.: <i>Test sample No.:</i>	A001058700 001-002				
Prüfzeitraum: <i>Testing period:</i>	27.12.2019-15.01.2020				
Ort der Prüfung: <i>Place of testing:</i>	Refer to section 1.1.				
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland / CCIC (Ningbo) Co., Ltd.				
Prüfergebnis*: <i>Test result*:</i>	Pass				
geprüft von / tested by:	kontrolliert von / reviewed by:				
19.01.2020 Caidong Xie/PE <i>Caidong Xie</i>	19.01.2020 Feng Liang/TC <i>Feng Liang</i>				
Datum Date	Name/Stellung Name/Position	Unterschrift Signature	Datum Date	Name/Stellung Name/Position	Unterschrift Signature
Sonstiges/ Other: Refer to the test report 50335822 001 for the conformance of the BLE radiated Emission above 1GHz requirement according to the standards FCC part 15.209 & RSS-Gen. Refer to the test report 50332849 001 for the conformance of Radio Frequency Exposure requirement. Refer to page 5 to 7 for more information.					
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery :</i>			Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>		
*Legende: 1= Sehr gut 2 = gut 3= befriedigend 4= ausreichend 5 = mangelhaft P(ass) =entspricht o.g. Prüfgrundlage(n) F(ail)= entspricht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T =nicht getestet Legend: 1= very good 2 = good 3= satisfactory 4= sufficient 5 = poor P(ass) = passed a.m. test specification(s) F(ail)= failed a.m. test specification(s) N/A = not applicable N/T = not tested					
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any safety mark on this or similar products.</i>					

Prüfbericht - Nr.: 50332845 001
Test Report No.:

Seite 2 von 81
Page 2 of 81

TEST SUMMARY

4.1.1 ANTENNA REQUIREMENT

Result:

Pass

4.1.2 6dB AND 20dB BANDWIDTH MEASUREMENT

Result:

Pass

4.1.3 99% EMISSION BANDWIDTH MEASUREMENT

Result:

Pass

4.1.4 MAXIMUM PEAK CONDUCTED OUTPUT POWER

Result:

Pass

4.1.5 EQUIVALENT ISOTROPICALLY RADIATED POWER

Result:

Pass

4.1.6 POWER SPECTRAL DENSITY

Result:

Pass

4.1.7 CONDUCTED SPURIOUS EMISSIONS MEASURED IN 100 kHz BANDWIDTH

Result:

Pass

4.1.8 CARRIER SEPARATION MEASUREMENT

Result:

Pass

4.1.9 THE NUMBER OF HOPPING CHANNELS

Result:

Pass

4.1.10 DWELL TIME

Result:

Pass

4.1.11 CONDUCTED EMISSION

Result:

Pass

4.1.12 RADIATED EMISSION

Result:

Pass

Contents

1 TEST SITES	4
1.1 TEST FACILITIES	4
1.2 LIST OF TEST AND MEASUREMENT INSTRUMENTS.....	4
1.3 MEASUREMENT UNCERTAINTY	4
2 GENERAL PRODUCT INFORMATION	5
2.1 PRODUCT FUNCTION AND INTENDED USE	5
2.2 RATINGS AND SYSTEM DETAILS.....	5
2.3 INDEPENDENT OPERATION MODES.....	6
2.4 NOISE GENERATING AND NOISE SUPPRESSING PARTS.....	6
2.5 SUBMITTED DOCUMENTS	6
3 TEST SET-UP AND OPERATION MODES	7
3.1 PRINCIPLE OF CONFIGURATION SELECTION.....	7
3.2 TEST OPERATION AND TEST SOFTWARE.....	7
3.3 SPECIAL ACCESSORIES AND AUXILIARY EQUIPMENT	7
3.4 COUNTERMEASURES TO ACHIEVE EMC COMPLIANCE.....	7
3.5 TEST SET-UP	8
4 TEST RESULTS.....	9
4.1 TRANSMITTER REQUIREMENT & TEST SUITES.....	9
4.1.1 Antenna Requirement.....	9
4.1.2 6dB and 20dB Bandwidth Measurement.....	10
4.1.3 99% Emission Bandwidth Measurement.....	15
4.1.4 Maximum Peak Conducted Output Power.....	20
4.1.5 Equivalent Isotropically Radiated Power.....	25
4.1.6 Power Spectral Density	26
4.1.7 Conducted Spurious Emissions Measured in 100 kHz Bandwidth.....	29
4.1.8 Carrier Separation Measurement	38
4.1.9 The number of hopping channels	41
4.1.10 Dwell Time.....	44
4.1.11 Conducted Emission	49
4.1.12 Radiated Emission	52
5 PHOTOGRAPHS OF THE TEST SET-UP	71
6 LIST OF TABLES.....	80
7 LIST OF FIGURES.....	80
8 LIST OF PHOTOGRAPHS	81

1 Test Sites

1.1 Test Facilities

Laboratory: TÜV Rheinland /CCIC(Ningbo) Co., Ltd.

**1st Floor, Building 11, Scholar Innovation Park, No.1188 Zhongguan Road,
Zhenhai District, Ningbo 315200 P.R. China.**

The used test equipment is in accordance with CISPR 16-1 series standards for measurement of radio interference.

1.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

No.	Equipment	Model	Inventory no.	Last cal. date	Cal. due date
1.	EMI test receiver	ESR7	101929	2019.11.26	2020.11.25
2.	Spectrum analyzer	FSV40	101412	2019.11.26	2020.11.25
3.	Pre-amplifier	SCU-18F	180051	2019.11.26	2020.11.25
4.	Horn antenna	HF907	102653	2017.08.03	2020.08.02
5.	Bilog Antenna	CBL6112D	49033	2018.04.13	2021.04.12
6.	EMI receiver	ESR3	102331	2019.11.26	2020.11.25
7.	LISN	ENV216	102250	2019.11.26	2020.11.25

1.3 Measurement Uncertainty

Test Item	Expanded Measurement Uncertainty (k=2)
Conducted Emission (9-150kHz)	3.70dB
Conducted Emission (150k-30MHz)	3.30dB
Radiated Emission (30-1000MHz)	4.52dB
Radiated Emission (1-18GHz)	4.37dB

2 General Product Information

2.1 Product Function and Intended Use

The EUT(equipment under test) is a Solar Floodlight which support Bluetooth, LoRa DTS, LoRa FHSS and FSK HFSS function operated at 2400-2483.5MHz and 902-928MHz respectively. For the further information, refer to the user's manual.

Model list:

Model name	Function	FCC ID/IC
5AT1S5	Block A: BLE operated at 2.4GHz Block B: LoRa DTS, LoRa FHSS and FSK FHSS operated at 902-928MHz	FCC ID: 2AEUPRBFS001 IC: 20271-RBFS001

2.2 Ratings and System Details

- Operating Voltage : DC 3.65V
 Charging Voltage : DC 5V
 Protection Class : Class III operate with battery
 Class II operate with adaptor

Technical Specification of BLE

Technical Specification	BLE
Operating Frequency band	2402 – 2480 MHz
Bluetooth Core Version	Bluetooth Low Energy 4.2
Channel separation	2MHz
Extreme Temperature Range	-20°C ~ 50°C
Modulation	GFSK
Antenna Type	PIFA Antenna
Antenna Gain(dBi)	4.0
Channel	0~39

Technical Specification of LoRa DTS

Technical Specification	LoRa DTS 500KHz 902.5-926.5MHz
Operating Frequency band	902 – 928 MHz
Extreme Temperature Range	-20°C ~ 50°C
Bandwidth(KHz)	500
Modulation	LoRa DTS
Antenna Type	PIFA Antenna
Antenna Gain(dBi)	1.0
Channel Separation (KHz)	800
Channel Number	31
Channel (MHz)	902.5, 903.3, 904.1, 904.9, 905.7, 906.5, 907.3, 908.1, 908.9, 909.7, 910.5, 911.3, 912.1, 912.9, 913.7, 914.5, 915.3, 916.1, 916.9, 917.7, 918.5, 919.3, 920.1, 920.9, 921.7, 922.5, 923.3, 924.1, 924.9, 925.7, 926.5

Prüfbericht - Nr.: 50332845 001
Test Report No.:
Seite 6 von 81
Page 6 of 81
Technical Specification of LoRa FHSS

Technical Specification	LoRa 125KHz FHSS 902.2-927.8MHz		
Operating Frequency band	902 – 928 MHz		
Extreme Temperature Range	-20°C ~ 50°C		
Modulation	LoRa FHSS		
Antenna Type	PIFA Antenna		
Antenna Gain(dBi)	1.0		
Channel Separation (KHz)	200		
Channel Number	129		
Bandwidth (KHz)	125		
Hopping channel(MHz)	902.2-927.8		

Technical Specification of FSK FHSS

Technical Specification	FSK150Kbps FHSS	FSK 50Kbps FHSS	FSK 250Kbps FHSS
Operating Frequency band	902 – 928 MHz		
Extreme Temperature Range	-20°C ~ 50°C		
Modulation	FSK FHSS		
Antenna Type	PIFA Antenna		
Antenna Gain(dBi)	1.0		
Channel Separation (KHz)	400	200	500
Channel Number	64	129	51
Data Rate (Kbps)	150	50	250
Hopping Channel(MHz)	902.4~927.6	902.2~927.8	902.5~927.5

2.3 Independent Operation Modes

The basic operation modes are:

Light On, Battery Charging, BLE, LoRa DTS, LoRa FHSS, and FSK FHSS.

2.4 Noise Generating and Noise Suppressing Parts

Refer to the Circuit diagram for further information.

2.5 Submitted Documents

Circuit diagram, PCB layout, Labels, user's manual, etc.

3 Test Set-up and Operation Modes

3.1 Principle of Configuration Selection

The equipment under test (EUT) was configured to measure its maximum power level. The test modes were adapted accordingly in reference to the instructions for use.

3.2 Test Operation and Test Software

During testing, Channel & Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power was selected according to the instruction given by the manufacturer. The setting of the RF output power expected by the customer shall be fixed on the firmware of the final end product.

All testing were performed according to the procedures in ANSI C63.10: 2013.

Test Software EMC32 V10.30 was used in the radiated emission test.

3.3 Special Accessories and Auxiliary Equipment

Description	Manufacturer	Model No.
notebook	Lenovo	T420

3.4 Countermeasures to achieve EMC Compliance

The tested sample contained noise suppression components as specified in the circuit diagram. No special measure is employed to achieve the requirement.

3.5 Test set-up

Diagram of Measurement Configuration for Radiation Test (Below 1GHz)

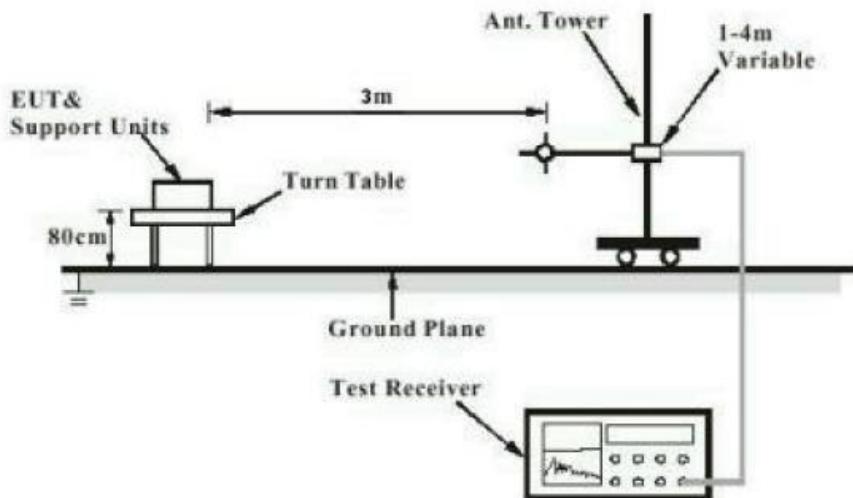


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

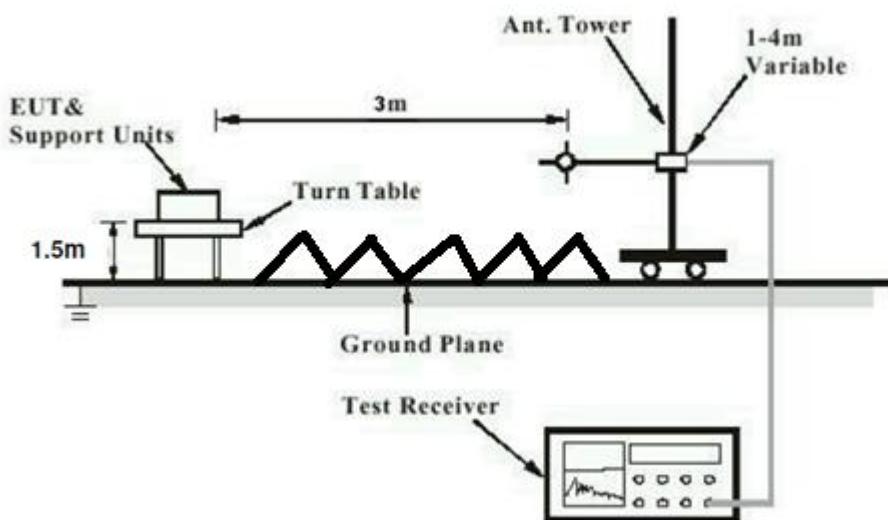
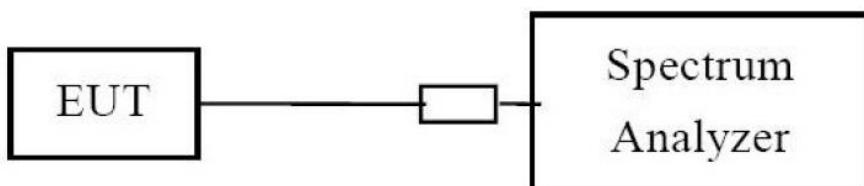


Diagram of Measurement Configuration for Conducted Transmitter Measurement



Prüfbericht - Nr.: 50332845 001
Test Report No.:

Seite 9 von 81
Page 9 of 81

4 Test Results

4.1 Transmitter Requirement & Test Suites

4.1.1 Antenna Requirement

Result:

Pass

Test Specification

Test standard

: FCC Part 15.247(b)(4) and Part 15.203

Limits

: the use of antennas with directional gains that do not exceed 6dBi

According to the manufacturer declared, the EUT has two internal antennas, the maximum directional gain of antennas is 4.0dBi, and the antennas connector are designed with permanent attachment and no consideration of replacement. Therefore the EUT is considered sufficient to comply with the provision. For more details, refer to EUT photo.

Prüfbericht - Nr.: 50332845 001
Test Report No.:
Seite 10 von 81
Page 10 of 81

4.1.2 6dB and 20dB Bandwidth Measurement

Result:
Pass
Test Specification

Test standard	:	FCC Part 15.247(a)(1), (a)(2) RSS-247 Issue 2 February 2017 Clause 5.1, Clause5.2
Basic standard	:	ANSI C63.10: 2013
Limits	:	At least 500kHz for BLE, LoRa 500DTS Not more than 500KHz for LoRa FHSS, FSK FHSS

Kind of test site

:

Shielded Room

Test Setup

Date of testing	:	27.12.2019~29.12.2019
Input voltage	:	DC 3.65V
Operational mode	:	Test mode of BLE, LoRa DTS, LoRa FHSS, FSK FHSS
Test channel	:	Lo, Mi, Hi
Temperature	:	20°C
Relative humidity	:	58%
Atmospheric pressure	:	101 kPa

Table 2: Test result of 6dB Bandwidth for BLE and LoRa DTS, 20dB Bandwidth for LoRa FHSS and FSK FHSS

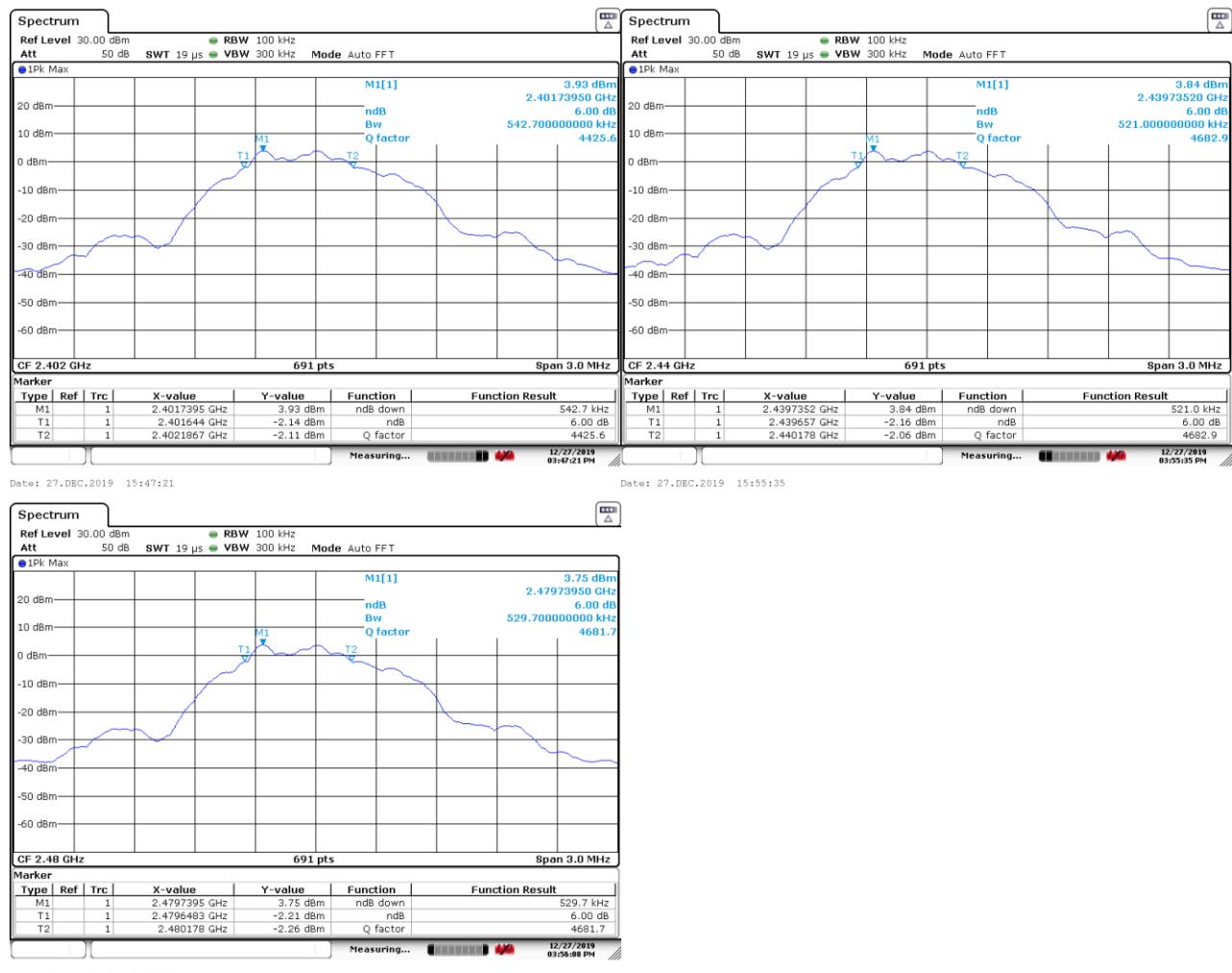
Modulation Type and Operation band	Channel	Channel Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)	Result
1. BLE 2402MHz~2480MHz 6dB Bandwidth	Low Channel	2402	542.7	500	Pass
	Mid Channel	2440	521.0	500	Pass
	High Channel	2480	529.7	500	Pass
2. LoRa 500KHz DTS 902.5MHz~926.5 6dB Bandwidth	Low Channel	902.5	625.2	500	Pass
	Mid Channel	914.5	620.8	500	Pass
	High Channel	926.5	625.2	500	Pass
3. LoRa 125KHz FHSS 902.2-927.8MHz 20dB Bandwidth	Low Channel	902.2	143.27	500	Pass
	Mid Channel	915	143.27	500	Pass
	High Channel	927.8	146.16	500	Pass
4. FSK 150Kbps FHSS 902.4MHz~927.6MHz 20dB Bandwidth	Low Channel	902.4	173.66	500	Pass
	Mid Channel	914.8	174.38	500	Pass
	High Channel	927.6	176.56	500	Pass
5. FSK 50Kbps FHSS 902.2MHz~927.8MHz 20dB Bandwidth	Low Channel	902.2	109.26	500	Pass
	Mid Channel	915	107.81	500	Pass
	High Channel	927.8	109.26	500	Pass
6. FSK 250Kbps FHSS 902.5MHz~927.5MHz 20dB Bandwidth	Low Channel	902.5	285.1	500	Pass
	Mid Channel	915	283.6	500	Pass
	High Channel	927.5	283.6	500	Pass

Prüfbericht - Nr.: 50332845 001

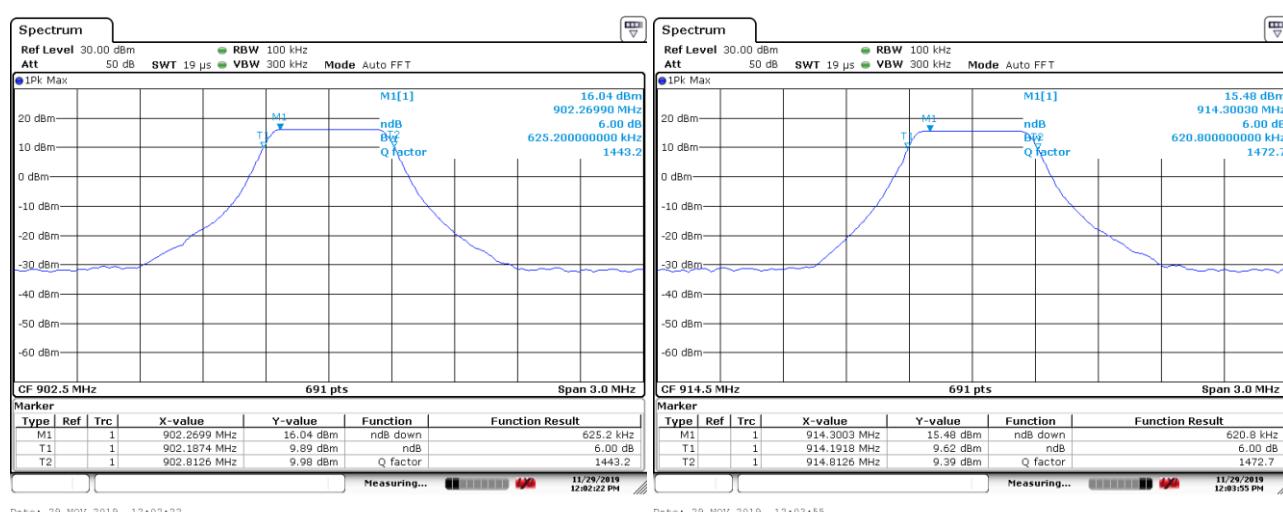
Test Report No.:
Seite 11 von 81
Page 11 of 81

Figure 1: 6dB&20dB Bandwidth Measurement

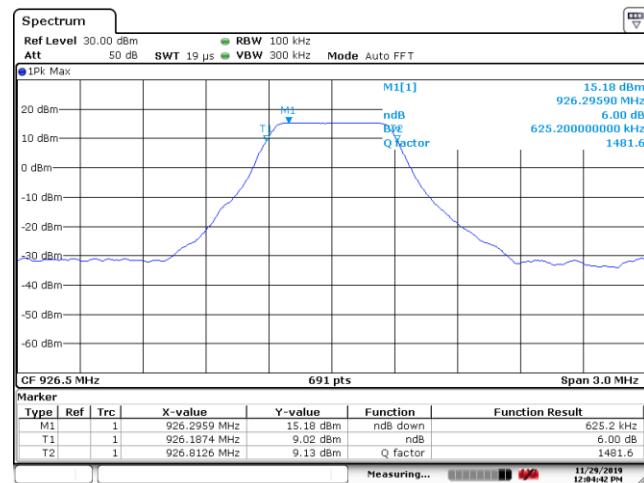
1. BLE, 6dB Bandwidth, 2402MHz~2480MHz



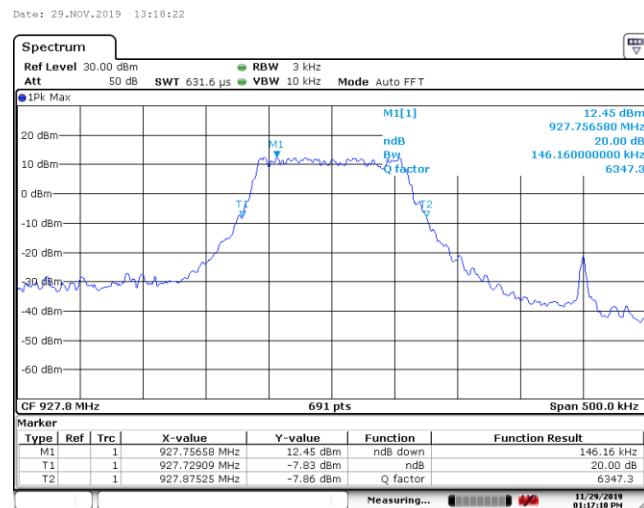
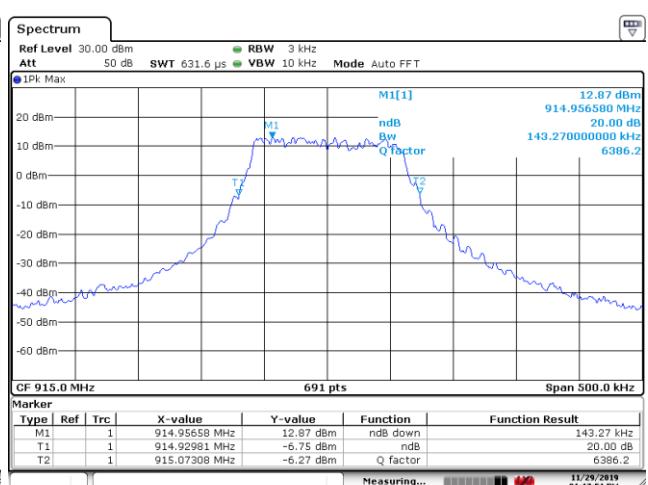
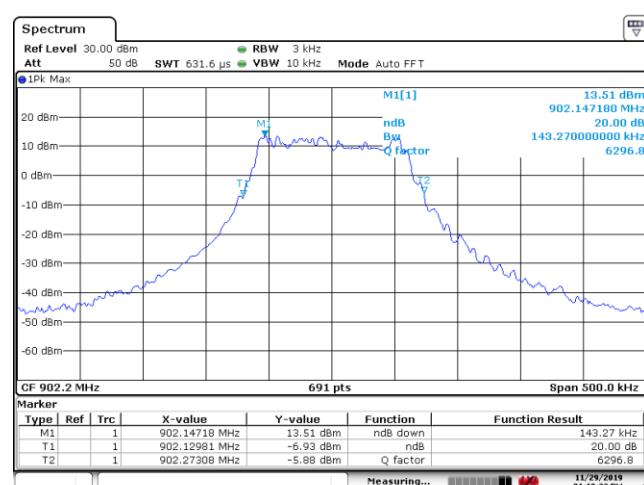
2. LoRa 500KHz DTS, 6dB Bandwidth, 902.5MHz~926.5



Prüfbericht - Nr.: 50332845 001

Test Report No.:
Seite 12 von 81
Page 12 of 81


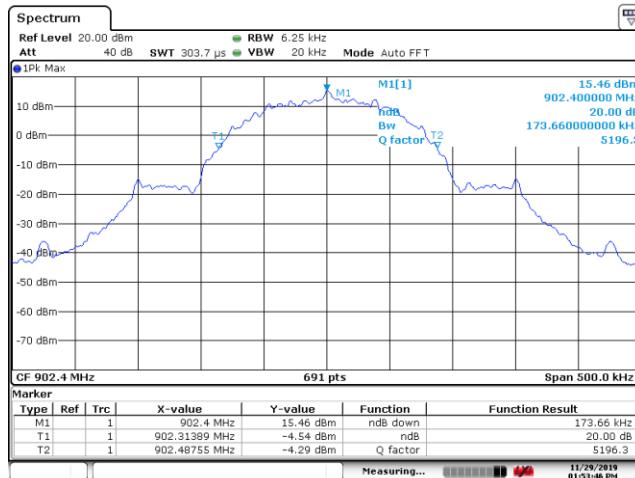
3. LoRa 125KHz FHSS, 20dB Bandwidth, 902.2-927.8MHz



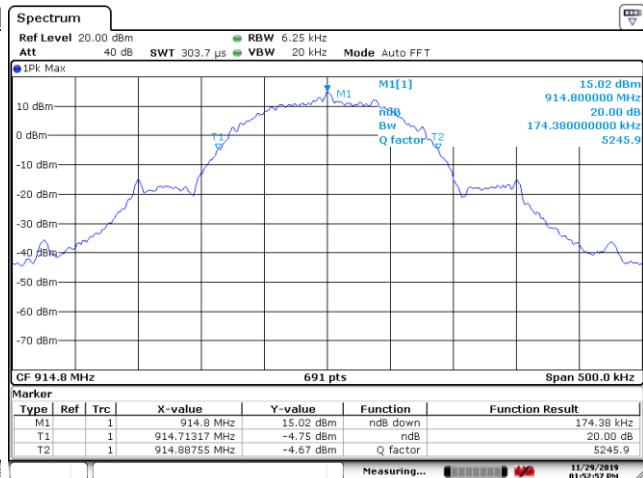
Prüfbericht - Nr.: 50332845 001

Test Report No.:
Seite 13 von 81
Page 13 of 81

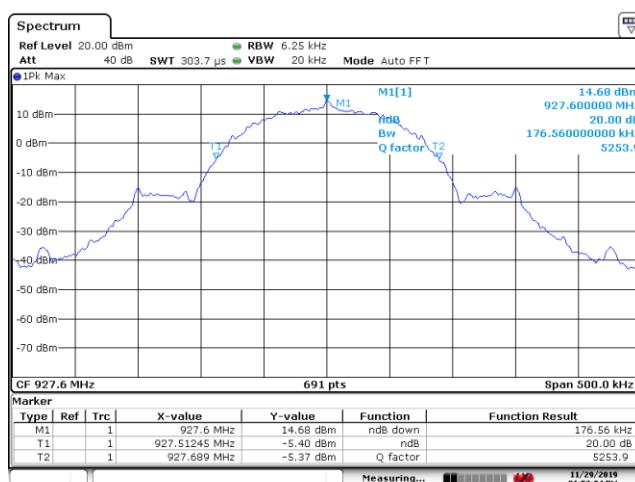
4. FSK 150Kbps FHSS, 20dB Bandwidth, 902.4MHz~927.6MHz



Date: 29.NOV.2019 13:53:46

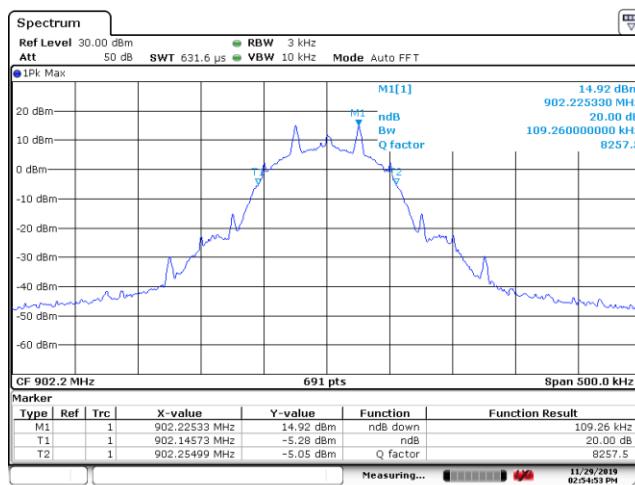


Date: 29.NOV.2019 13:52:57

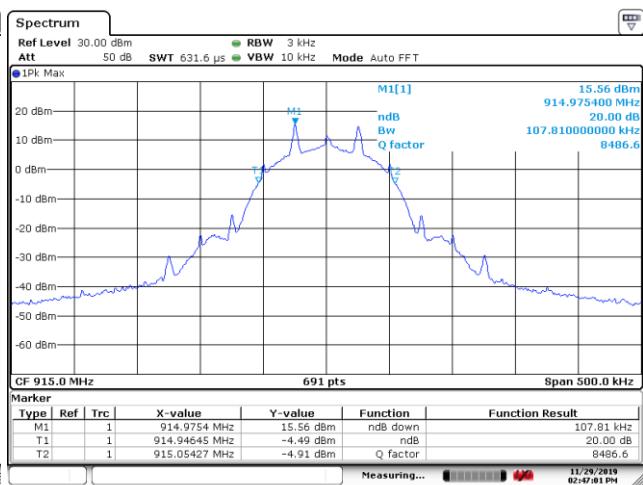


Date: 29.NOV.2019 13:52:04

5. FSK 50Kbps FHSS, 20dB Bandwidth, 902.2MHz~927.8MHz

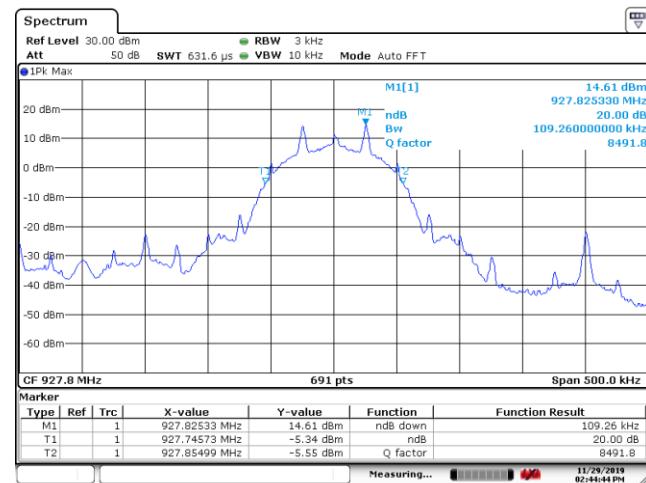


Date: 29.NOV.2019 14:54:53

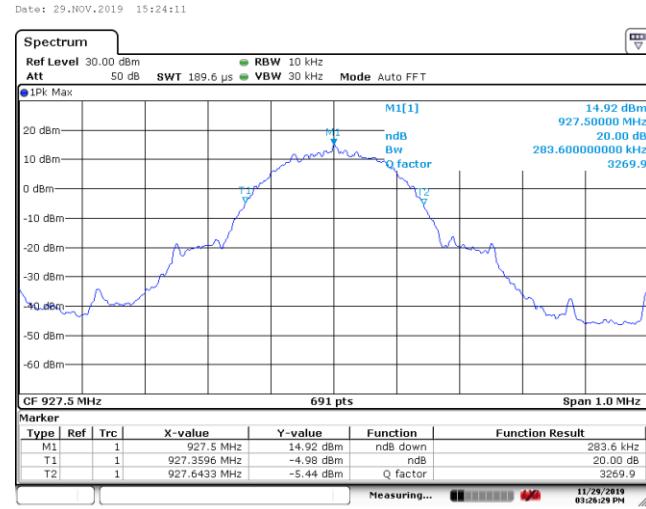
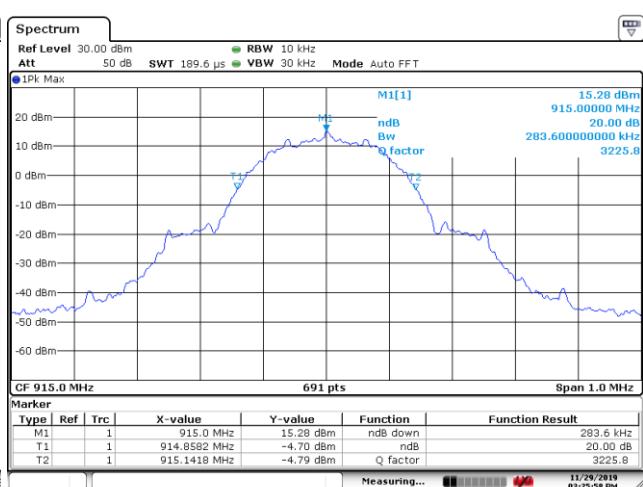
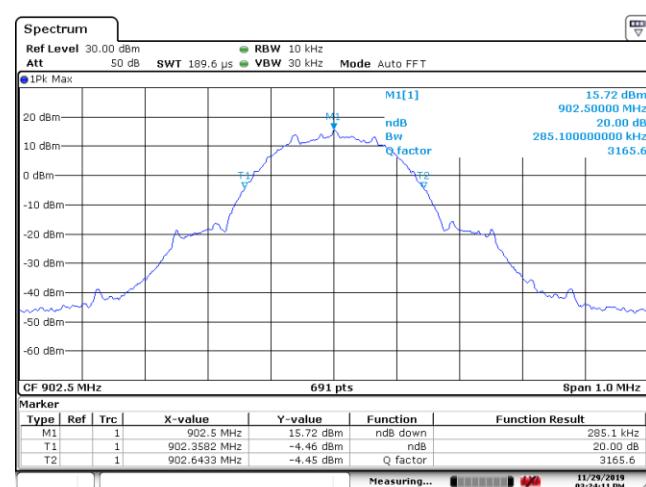


Date: 29.NOV.2019 14:47:01

Prüfbericht - Nr.: 50332845 001

Test Report No.:
Seite 14 von 81
Page 14 of 81


6. FSK 250Kbps FHSS, 20dB Bandwidth, 902.5MHz~927.5MHz



Prüfbericht - Nr.: 50332845 001
Test Report No.:
Seite 15 von 81
Page 15 of 81

4.1.3 99% Emission Bandwidth Measurement

Result:
Pass

Test Specification

Test standard : RSS Gen Issue 5 March 2019, clause 6.7

Kind of test site : Shielded Room

Test Setup

Date of testing : 27.12.2019-29.12.2019

Input voltage : DC 3.65V

Operational mode : Test mode of BLE, LoRa DTS, LoRa FHSS, FSK FHSS

Test channel : Lo, Mi, Hi

Temperature : 20°C

Relative humidity : 58%

Atmospheric pressure : 101 kPa

Table 3 Test result of 99% Emission Bandwidth for BLE, LoRa DTS, LoRa FHSS and FSK FHSS

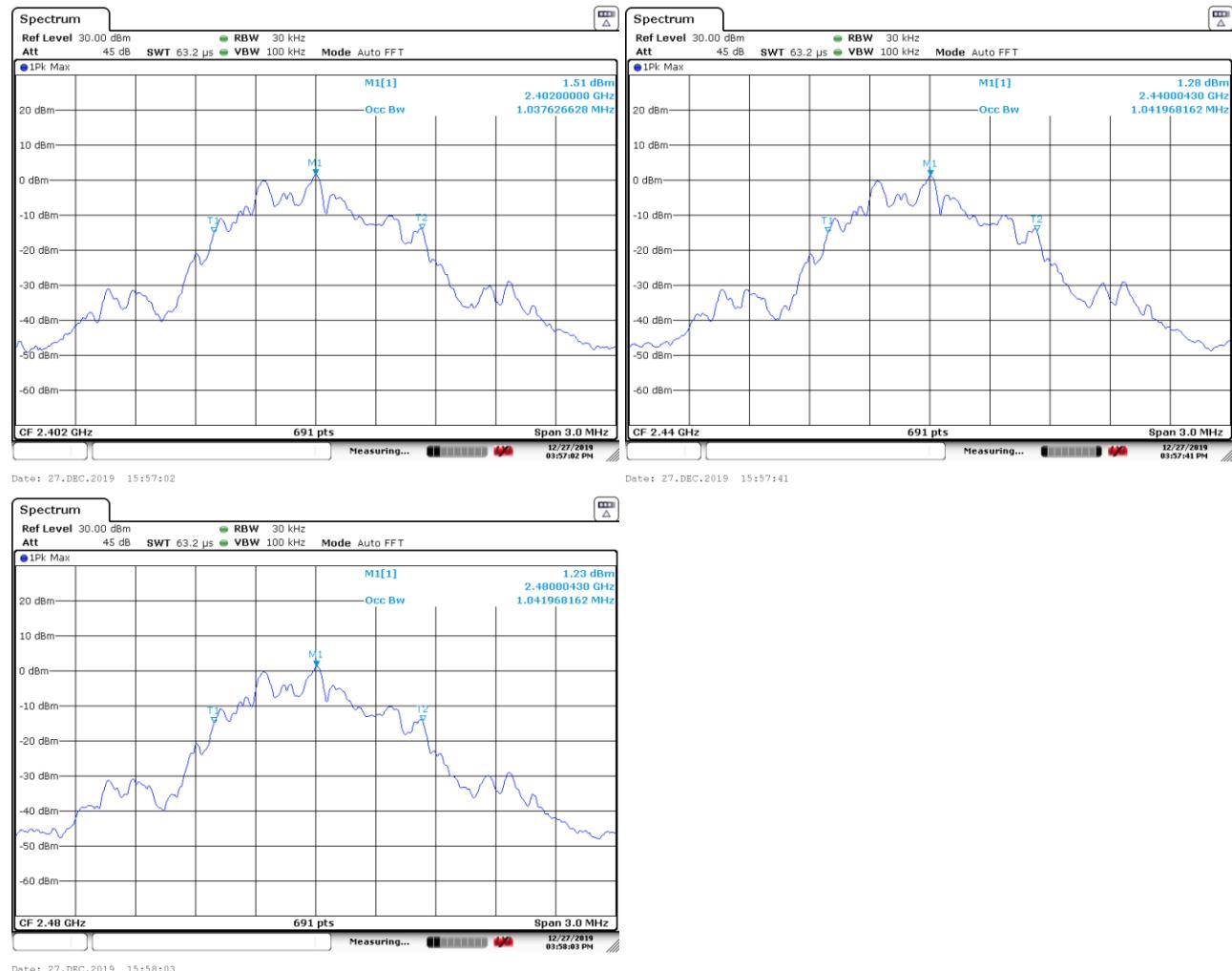
Modulation Type and Operation band	Channel	Channel Frequency (MHz)	Bandwidth (kHz)
1. BLE 2402MHz~2480MHz 99% Emissson Bandwidth	Low Channel	2402	1037.62
	Mid Channel	2440	1041.97
	High Channel	2480	1041.97
2. LoRa 500KHz DTS 902.5MHz~926.5 99% Emissson Bandwidth	Low Channel	902.5	497.83
	Mid Channel	914.5	506.51
	High Channel	926.5	518.09
3. LoRa 125KHz FHSS 902.2MHz~927.8MHz 99% Emissson Bandwidth	Low Channel	902.2	125.18
	Mid Channel	915	126.63
	High Channel	927.8	125.18
4. FSK 150Kbps FHSS 902.4MHz~927.6MHz 99% Emissson Bandwidth	Low Channel	902.4	157.74
	Mid Cha1nnel	914.8	157.74
	High Channel	927.6	156.30
5. FSK 50Kbps FHSS 902.2MHz~927.8MHz 99% Emissson Bandwidth	Low Channel	902.2	104.20
	Mid Channel	915	103.47
	High Channel	927.8	103.47
6. FSK 250Kbps FHSS 902.5MHz~927.5MHz 99% Emissson Bandwidth	Low Channel	902.5	253.26
	Mid Channel	915	253.26
	High Channel	927.5	253.26

Prüfbericht - Nr.: 50332845 001

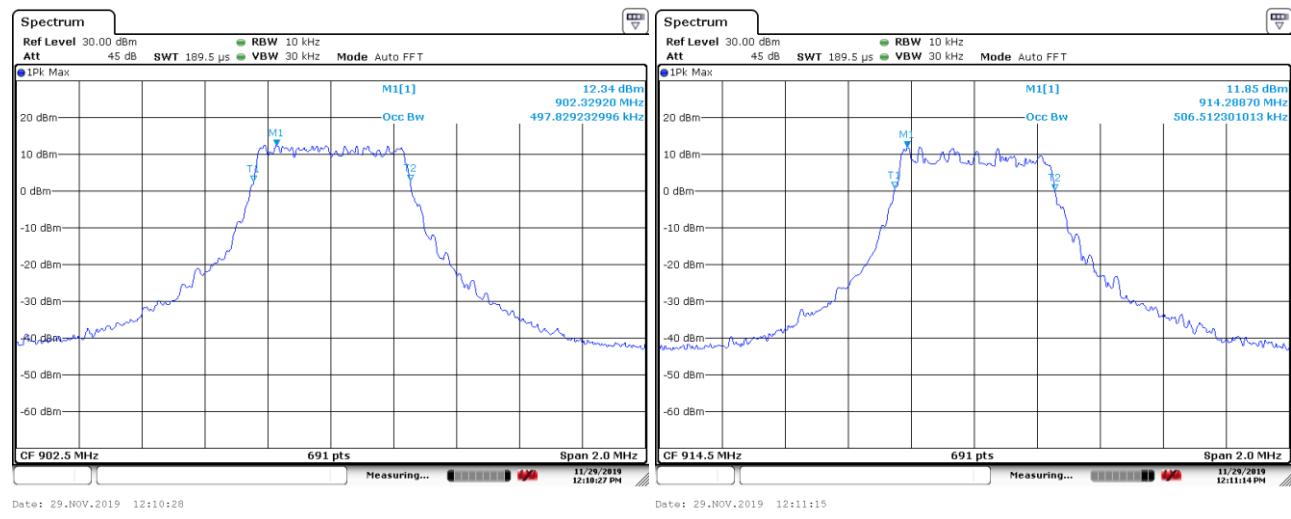
Test Report No.:
Seite 16 von 81
Page 16 of 81

Figure 2: 99% Emission Bandwidth Measurement

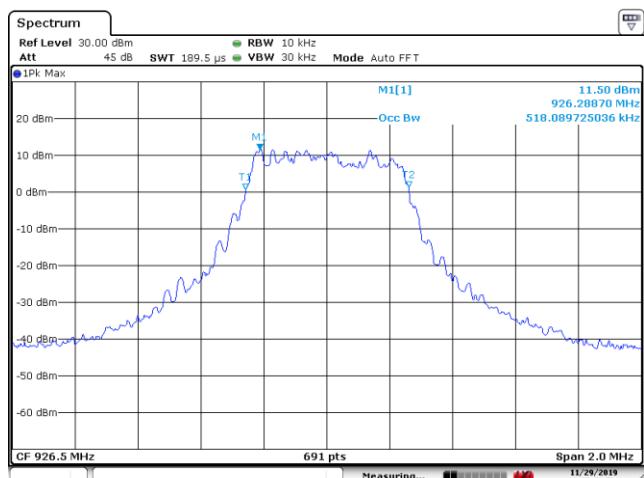
1. BLE, 99% Emission Bandwidth, 2402MHz~2480MHz



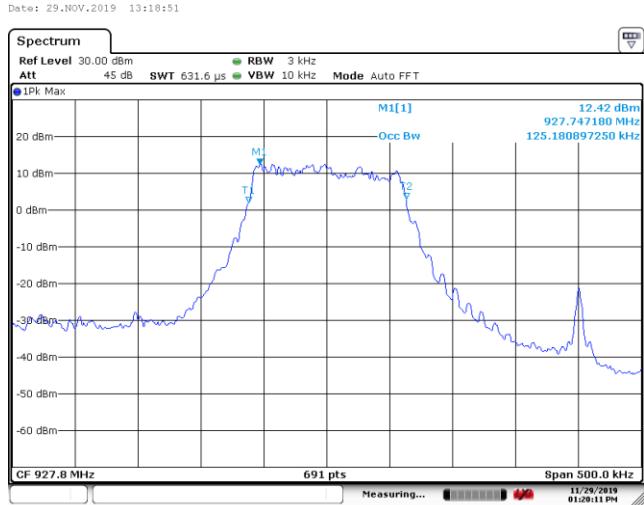
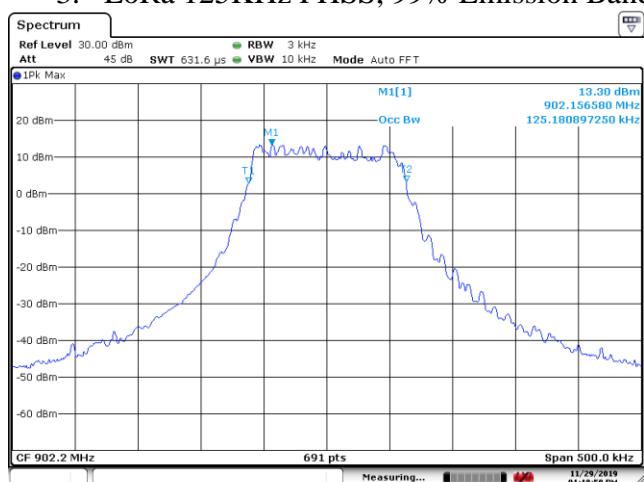
2. LoRa 500KHz DTS, 99% Emission Bandwidth, 902.5MHz~926.5MHz



Prüfbericht - Nr.: 50332845 001

Test Report No.:
Seite 17 von 81
Page 17 of 81


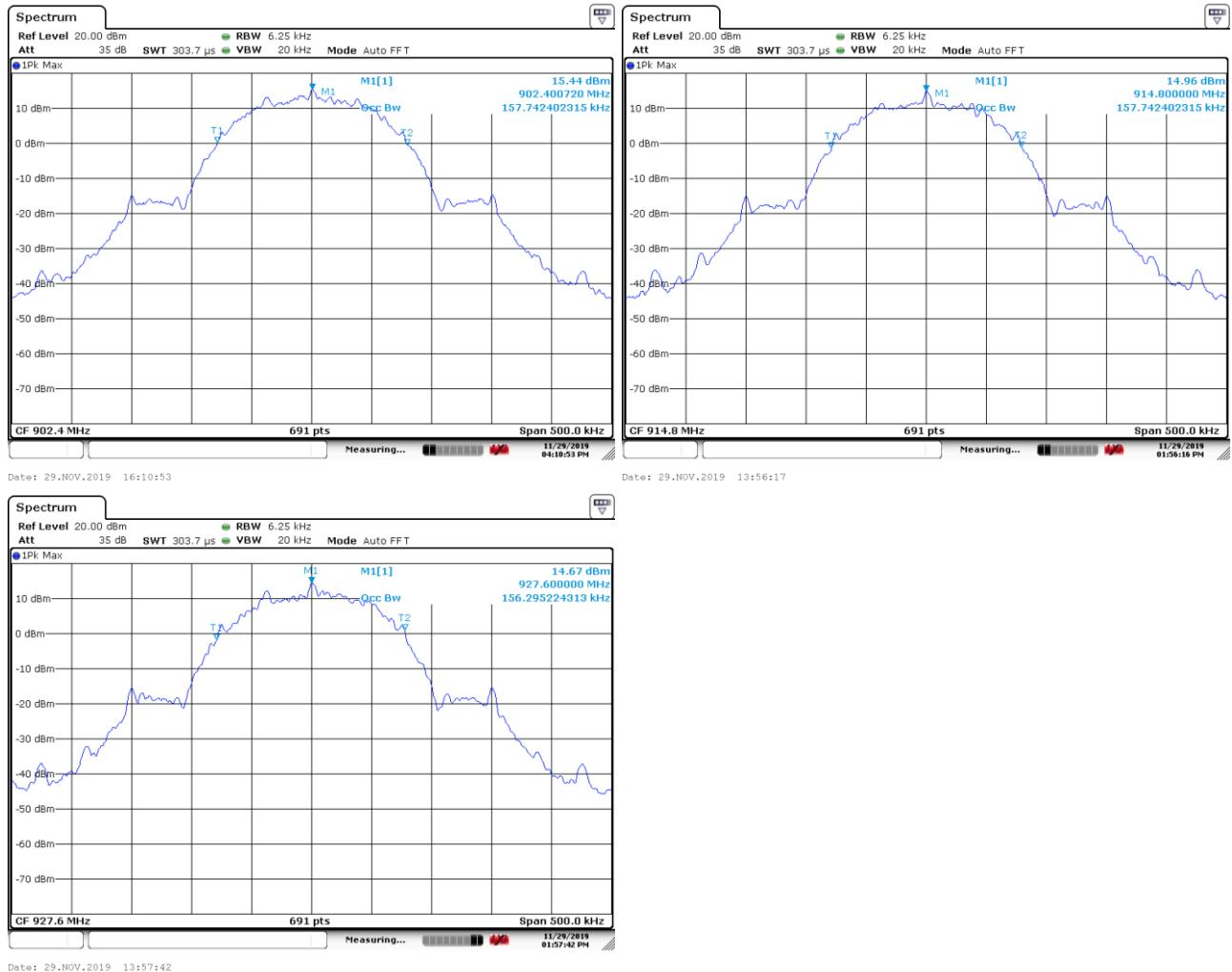
3. LoRa 125KHz FHSS, 99% Emission Bandwidth, 902.2MHz~927.8MHz



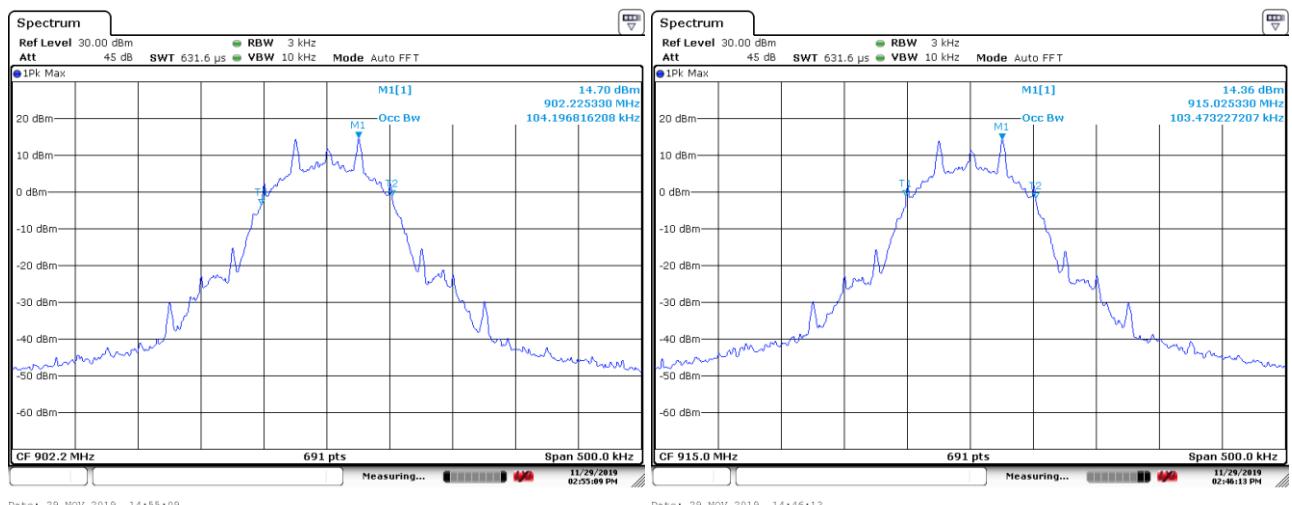
Prüfbericht - Nr.: 50332845 001

Test Report No.:
Seite 18 von 81
Page 18 of 81

4. FSK 150Kbps FHSS, 99% Emission Bandwidth, 902.4MHz~927.6MHz



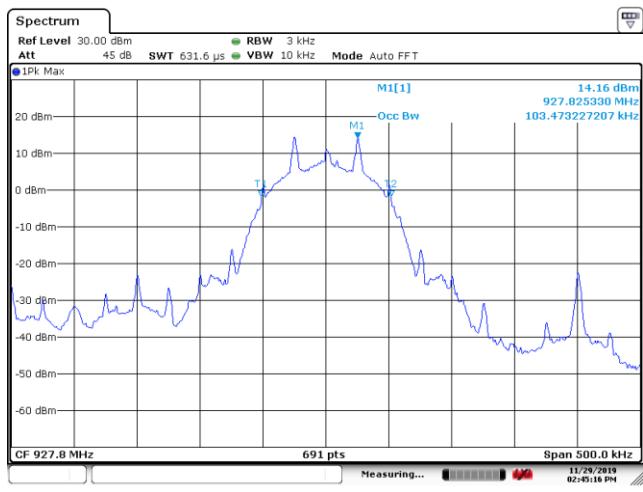
5. FSK 50Kbps FHSS, 99% Emission Bandwidth, 902.2MHz~927.8MHz



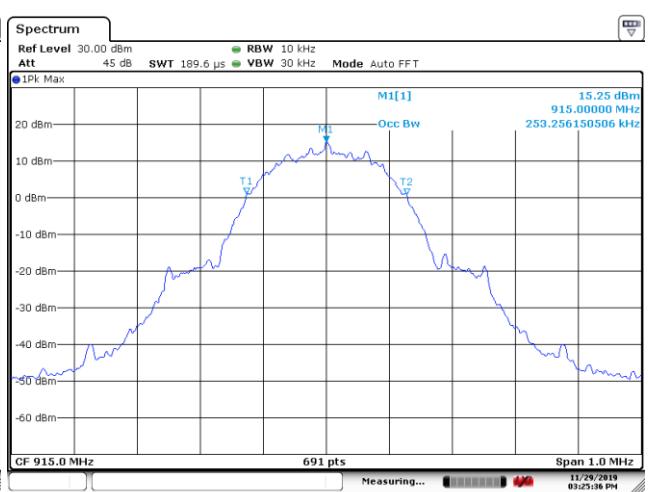
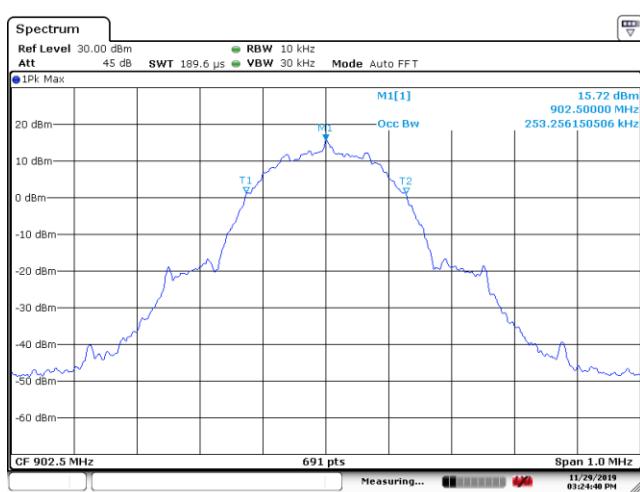
Prüfbericht - Nr.: 50332845 001

Test Report No.:

Seite 19 von 81
 Page 19 of 81



6. FSK 250Kbps FHSS, 99% Emission Bandwidth, 902.5MHz~927.5MHz



Prüfbericht - Nr.: 50332845 001
Test Report No.:
Seite 20 von 81
Page 20 of 81

4.1.4 Maximum Peak Conducted Output Power

Result:
Pass

Test Specification

 Test standard : FCC Part 15.247(b)(2)&(3)
 RSS-247 Issue 2 February 2017 Clause 5.4(a)&(d)

Basic standard :

ANSI C63.10: 2013

Limits :

 Not more than 1 Watt for DTS;
 Not more than 1Watt for 902~928 FHSS system with
 more than 50 hopping channels;

Kind of test site :

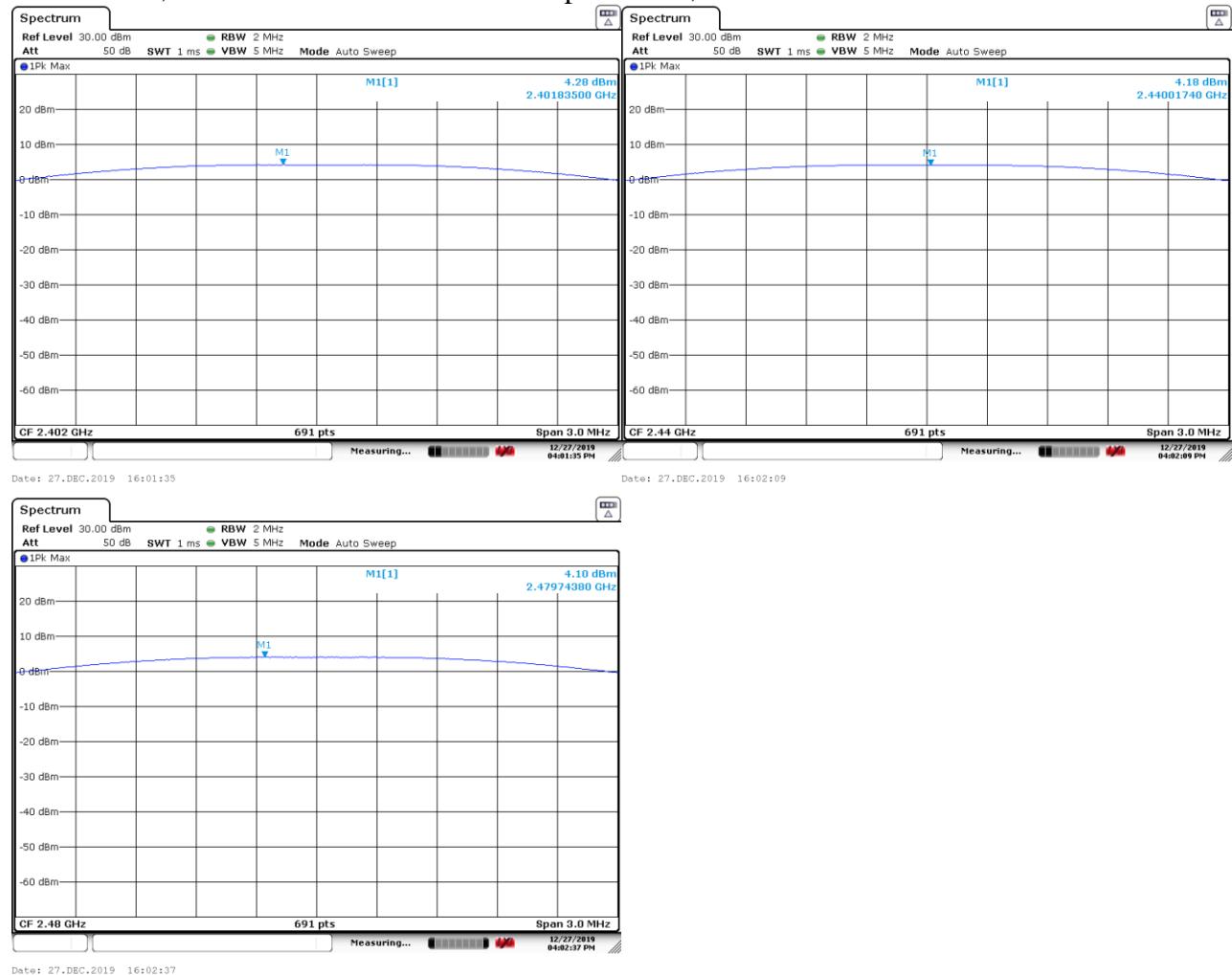
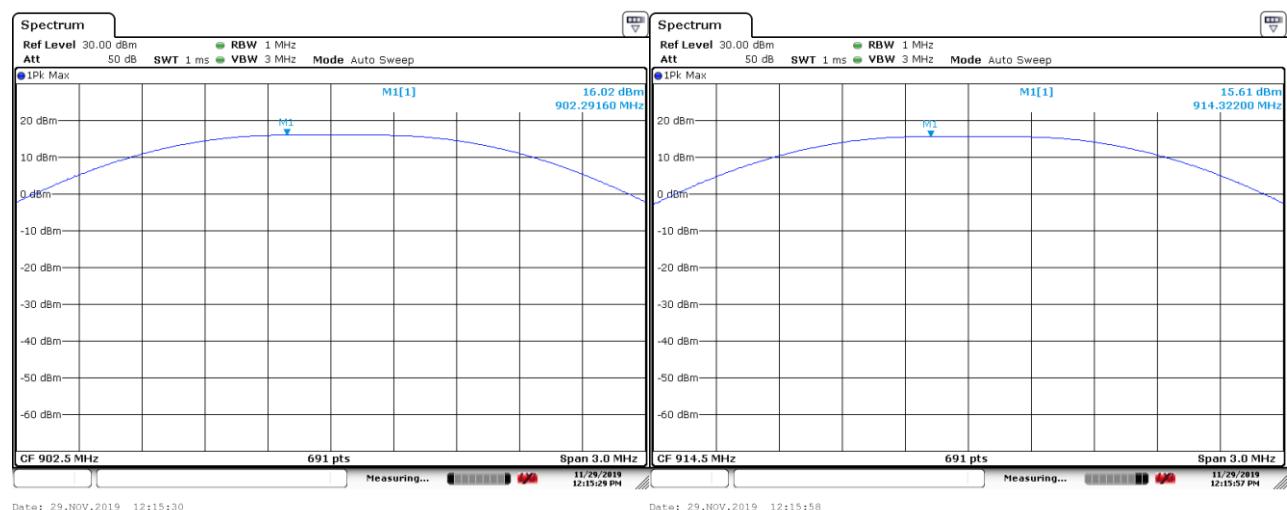
Shielded Room

Test Setup

 Date of testing : 27.12.2019~29.12.2019
 Input voltage : DC 3.65V
 Operational mode : Test mode of BLE, LoRa DTS, LoRa FHSS, FSK
 FHSS
 Test channel : Lo, Mi, Hi
 Temperature : 20 °C
 Relative humidity : 58%
 Atmospheric pressure : 101 kPa

Table 4: Test result of Maximum Peak Output Power for BLE, LoRa DTS, LoRa FHSS and FSK FHSS

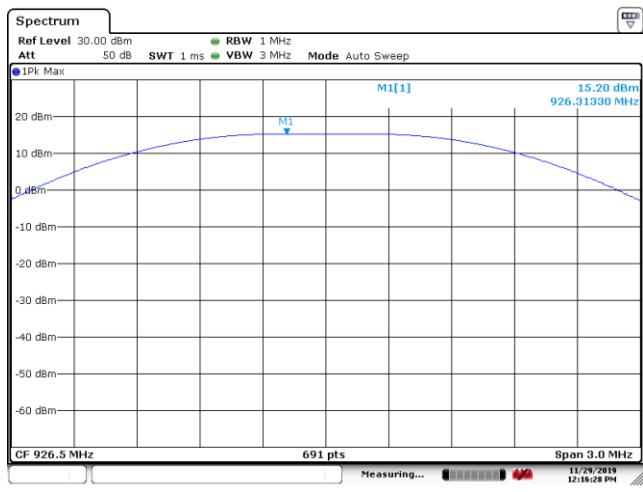
Modulation Type and Operation band	Channel	Channel Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)
1. BLE 2402MHz~2480MHz	Low Channel	2402	4.28	30
	Mid Channel	2440	4.18	30
	High Channel	2480	4.10	30
2. LoRa 500KHz DTS 902.5MHz~926.5	Low Channel	902.5	16.02	30
	Mid Channel	914.5	15.61	30
	High Channel	926.5	15.20	30
3. LoRa 125KHz FHSS 902.2MHz~927.8MHz	Low Channel	902.2	15.98	30
	Mid Channel	915	15.55	30
	High Channel	927.8	15.13	30
4. FSK 150Kbps FHSS 902.4MHz~927.6MHz	Low Channel	902.4	16.01	30
	Mid Channel	914.8	15.60	30
	High Channel	927.6	15.19	30
5. FSK 50Kbps FHSS 902.2MHz~927.8MHz	Low Channel	902.2	16.07	30
	Mid Channel	915	15.64	30
	High Channel	927.8	15.24	30
6. FSK 250Kbps FHSS 902.5MHz~927.5MHz 20dB Bandwidth	Low Channel	902.5	16.02	30
	Mid Channel	915	15.48	30
	High Channel	927.5	15.17	30

Prüfbericht - Nr.: 50332845 001
Test Report No.:
Seite 21 von 81
Page 21 of 81
Figure 3: Maximum peak Conducted Output Power
1. BLE, Maximum Peak Conducted Output Power, 2402MHz~2480MHz

2. LoRa 500KHz DTS, Maximum Peak Conducted Output Power, 902.5MHz~926.5


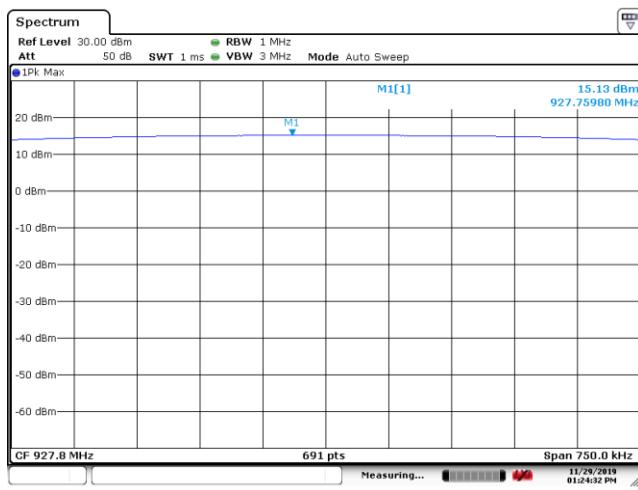
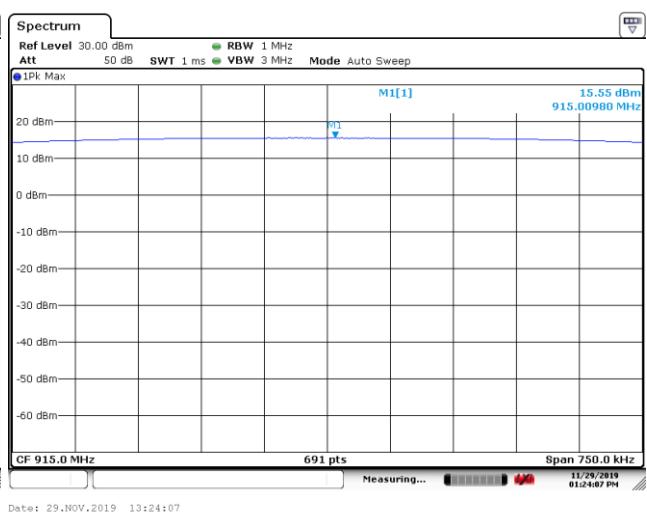
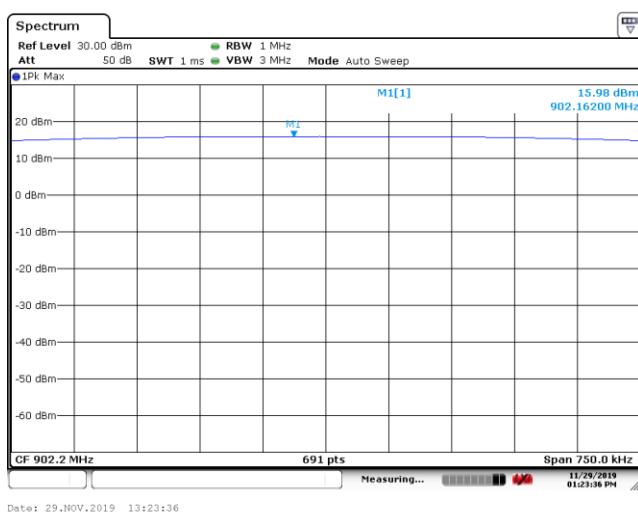
Prüfbericht - Nr.: 50332845 001

Test Report No.:

Seite 22 von 81
 Page 22 of 81



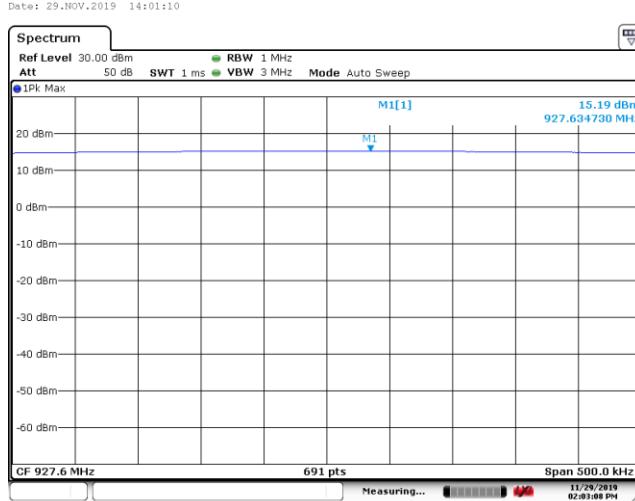
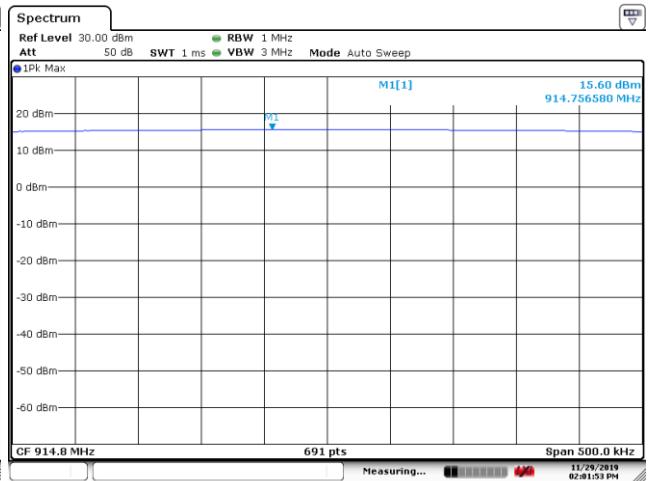
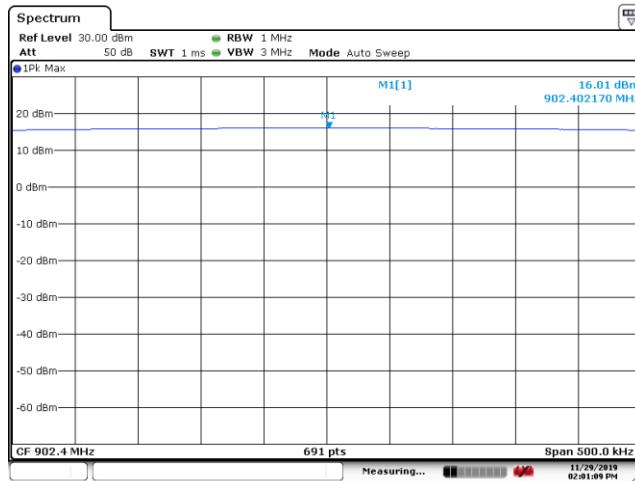
3. LoRa 125KHz FHSS, Maximum Peak Conducted Output Power, 902.2MHz~927.8MHz



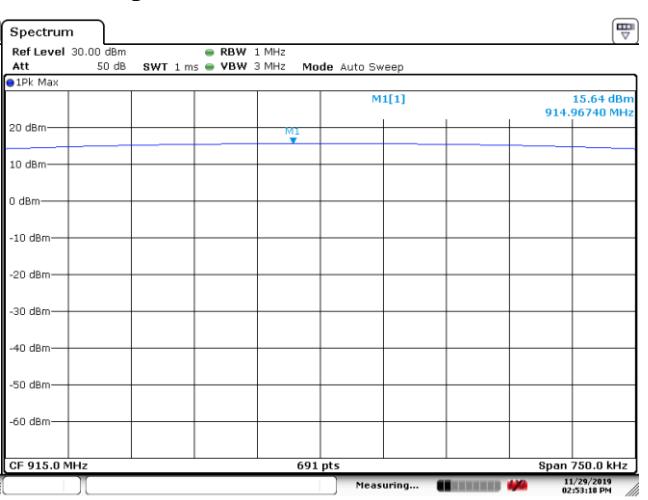
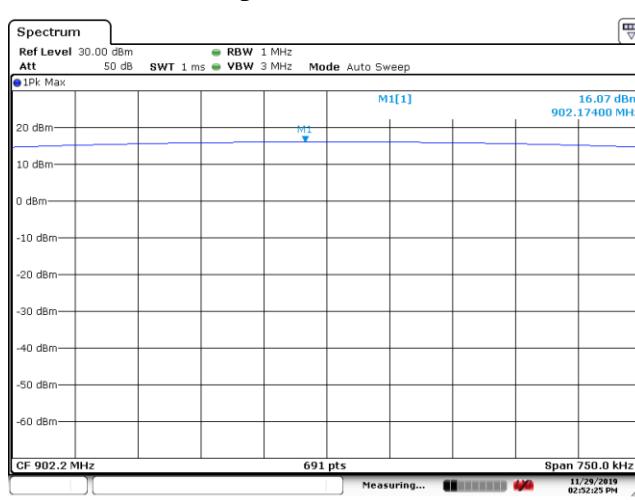
Prüfbericht - Nr.: 50332845 001

Test Report No.:
Seite 23 von 81
Page 23 of 81

4. FSK 150Kbps FHSS, Maximum Peak Conducted Output Power, 902.4MHz~927.6MHz



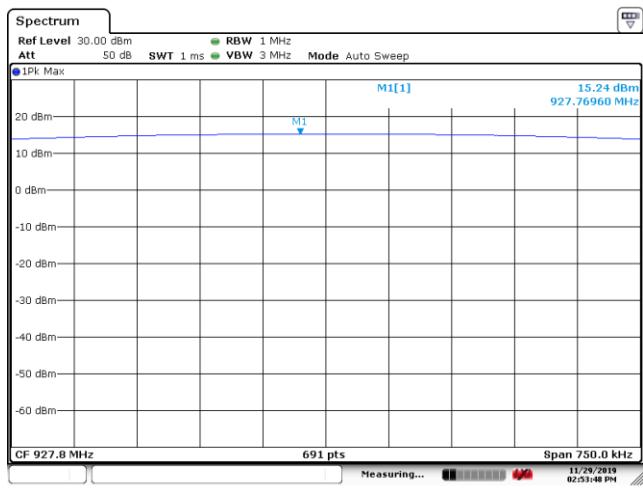
5. FSK 50Kbps FHSS, Maximum Peak Conducted Output Power, 902.2MHz~927.8MHz



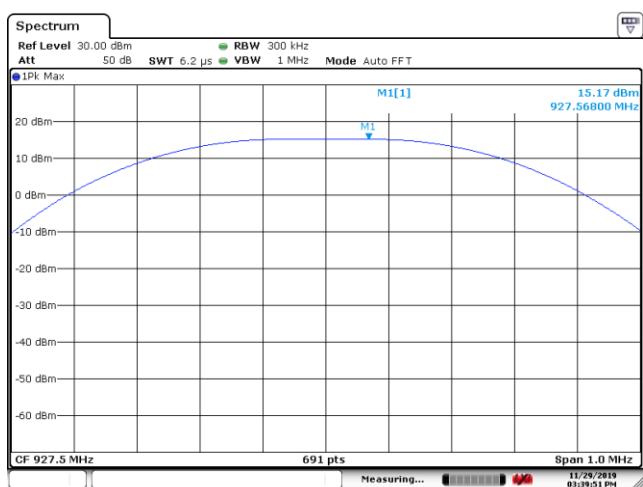
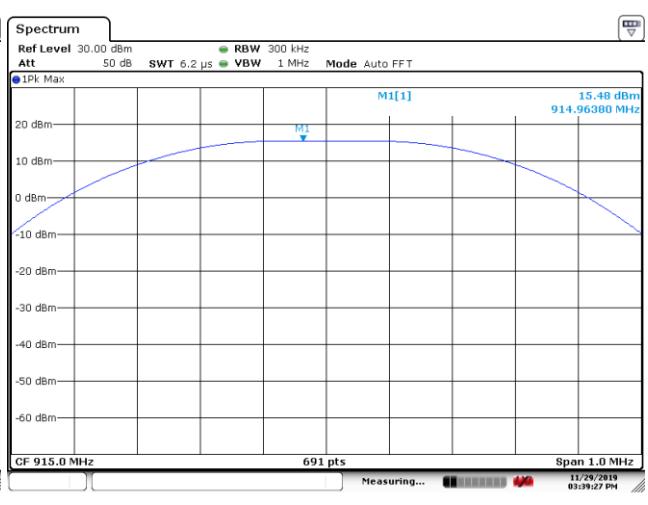
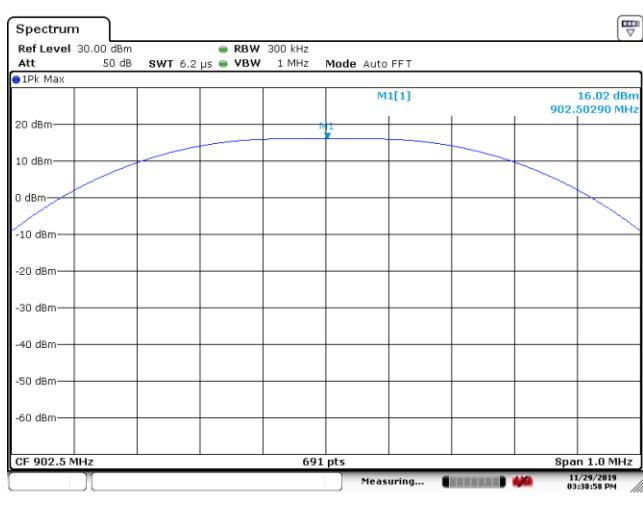
Prüfbericht - Nr.: 50332845 001

Test Report No.:

Seite 24 von 81
 Page 24 of 81



6. FSK 250Kbps FHSS, Maximum Peak Conducted Output Power, 902.5MHz~927.5MHz



Prüfbericht - Nr.: 50332845 001
Test Report No.:

Seite 25 von 81
Page 25 of 81

4.1.5 Equivalent Isotropically Radiated Power

Result:

Pass

Test Specification

Test standard : RSS-247 Issue 2 February 2017 Clause 5.4(a)&(d)
 Limits : For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz: 4 Watt (36dBm)
 Kind of test site : Shielded Room

Test Setup

Date of testing : 27.12.2019~29.12.2019
 Input voltage : DC 3.65V
 Operational mode : Test mode of BLE, LoRa DTS, LoRa FHSS, FSK FHSS
 Test channel : Lo, Mi, Hi
 Temperature : 20 °C
 Relative humidity : 58%
 Atmospheric pressure : 101 kPa

Table 5: Test result of E.I.R.P. for BLE, LoRa DTS, LoRa FHSS and FSK FHSS

Modulation Type and Operation band	Channel	Channel Frequency (MHz)	Peak Output Power (dBm)	Antenna Gain (dBi)	E.I.R.P. (dBm)	Limit (dBm)
1. BLE 2402MHz~2480MHz	Low Channel	2402	4.28	4	8.28	36
	Mid Channel	2440	4.18	4	8.18	36
	High Channel	2480	4.10	4	8.10	36
2. LoRa 500KHz DTS 902.5MHz~926.5	Low Channel	902.5	16.02	1	17.02	36
	Mid Channel	914.5	15.61	1	16.61	36
	High Channel	926.5	15.20	1	16.20	36
3. LoRa 125KHz FHSS 902.2MHz~927.8MHz	Low Channel	902.2	15.98	1	16.98	36
	Mid Channel	915	15.55	1	16.55	36
	High Channel	927.8	15.13	1	16.13	36
4. FSK 150Kbps FHSS 902.4MHz~927.6MHz	Low Channel	902.4	16.01	1	17.01	36
	Mid Channel	914.8	15.60	1	16.60	36
	High Channel	927.6	15.19	1	16.19	36
5. FSK 50Kbps FHSS 902.2MHz~927.8MHz	Low Channel	902.2	16.07	1	17.07	36
	Mid Channel	915	15.64	1	16.64	36
	High Channel	927.8	15.24	1	16.24	36
6. FSK 250Kbps FHSS 902.5MHz~927.5MHz	Low Channel	902.5	16.02	1	17.02	36
	Mid Channel	915	15.48	1	16.48	36
	High Channel	927.5	15.17	1	16.17	36

Prüfbericht - Nr.: 50332845 001
Test Report No.:
Seite 26 von 81
Page 26 of 81

4.1.6 Power Spectral Density

Result:
Pass
Test Specification

Test standard	:	FCC Part 15.247(e) RSS-247 Issue 2 February 2017 Clause 5.2(b)
Basic standard	:	ANSI C63.10: 2013
Limits	:	Not more than 8 dBm in any 3 kHz band
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	27.12.2019~29.12.2019
Input voltage	:	DC 3.65V
Operational mode	:	On, BLE, LoRa DTS
Test channel	:	Lo, Mi, Hi
Temperature	:	20°C
Relative humidity	:	58%
Atmospheric pressure	:	101 kPa

Table 6: Test result of Power Spectral Density for BLE, LoRa DTS

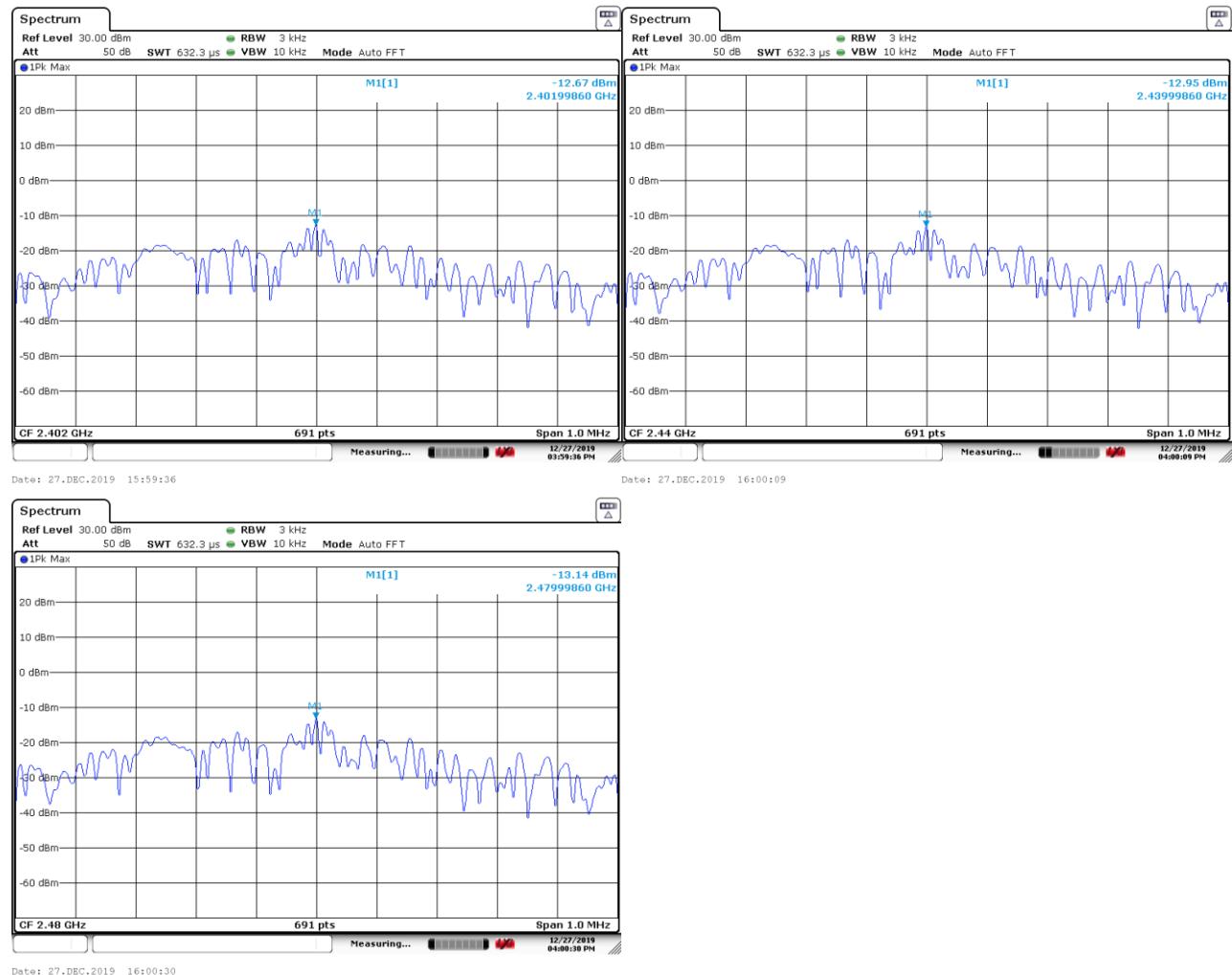
Modulation Type and Operation band	Channel	Channel Frequency (MHz)	Measured Power Density (dBm)	Limit (dBm)	Result
1. BLE 2402MHz~2480MHz	Low Channel	2402	-12.67	8.0	Pass
	Mid Channel	2440	-12.95	8.0	Pass
	High Channel	2480	-13.14	8.0	Pass
2. LoRa 500KHz DTS 902.5MHz~926.5	Low Channel	902.5	3.72	8.0	Pass
	Mid Channel	914.5	3.66	8.0	Pass
	High Channel	926.5	2.73	8.0	Pass

Prüfbericht - Nr.: 50332845 001

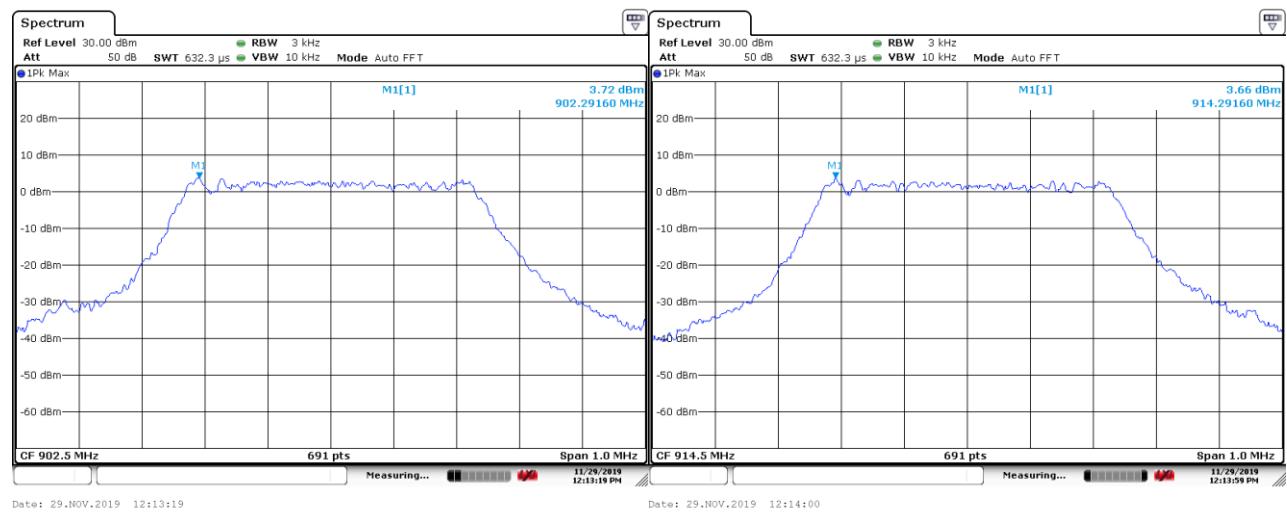
Test Report No.:
Seite 27 von 81
Page 27 of 81

Figure 4: Power Spectral Density

1. BLE, Maximum Conducted Output Power, 2402MHz~2480MHz



2. LoRa 500KHz DTS, Maximum Conducted Output Power, 902.5MHz~926.5

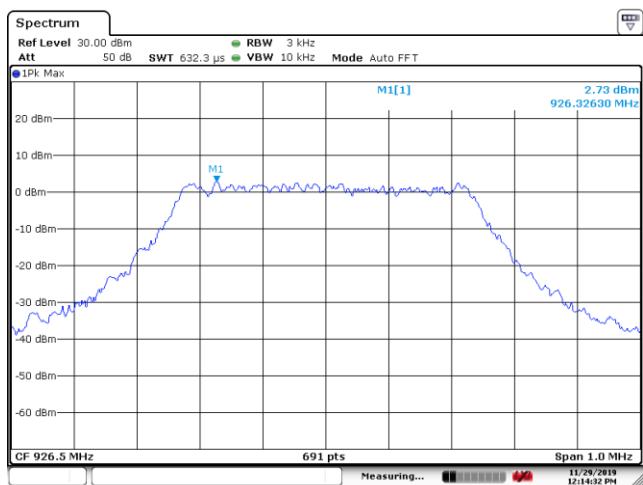


Prüfbericht - Nr.: 50332845 001

Test Report No.:

Seite 28 von 81

Page 28 of 81



Prüfbericht - Nr.: 50332845 001
Test Report No.:

Seite 29 von 81
Page 29 of 81

4.1.7 Conducted Spurious Emissions Measured in 100 kHz Bandwidth

Result:

Pass

Test Specification

Test standard : FCC Part 15.247(d)
Basic standard : RSS-247 Issue 2 February 2017 Clause 5.5
Limits : ANSI C63.10: 2013
Kind of test site : 20dB (below that in the 100kHz bandwidth within the band that contains the highest level of the desired power);
Kind of test site : Shielded Room

Test Setup

Date of testing : 27.12.2019~29.12.2019
Input voltage : DC 3.65V
Operational mode : Test mode of BLE, LoRa DTS, LoRa FHSS, FSK FHSS
Test channel : Lo, Mi, Hi
Temperature : 20°C
Relative humidity : 58%
Atmospheric pressure : 101 kPa

All emissions are more than 20dB below fundamental, compliance is achieved as well.

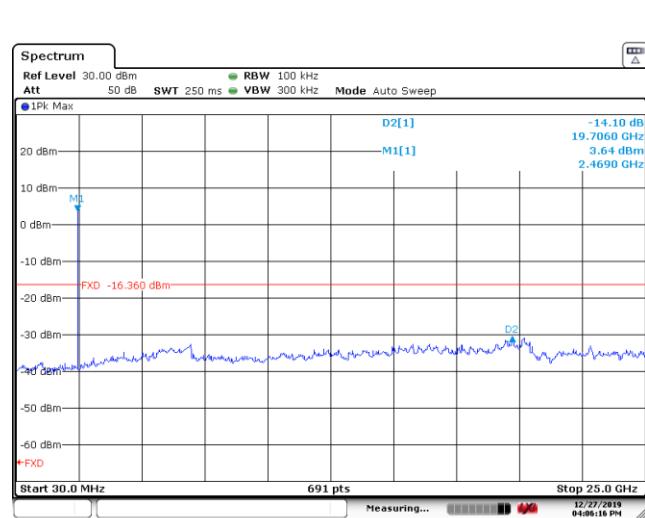
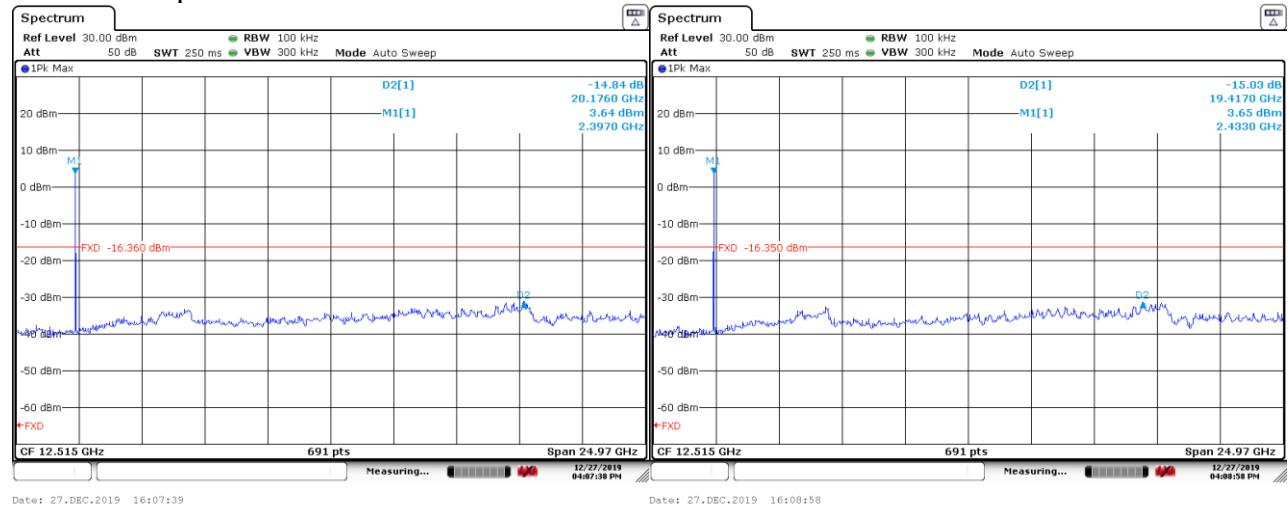
Prüfbericht - Nr.: 50332845 001

Test Report No.:
Seite 30 von 81
Page 30 of 81

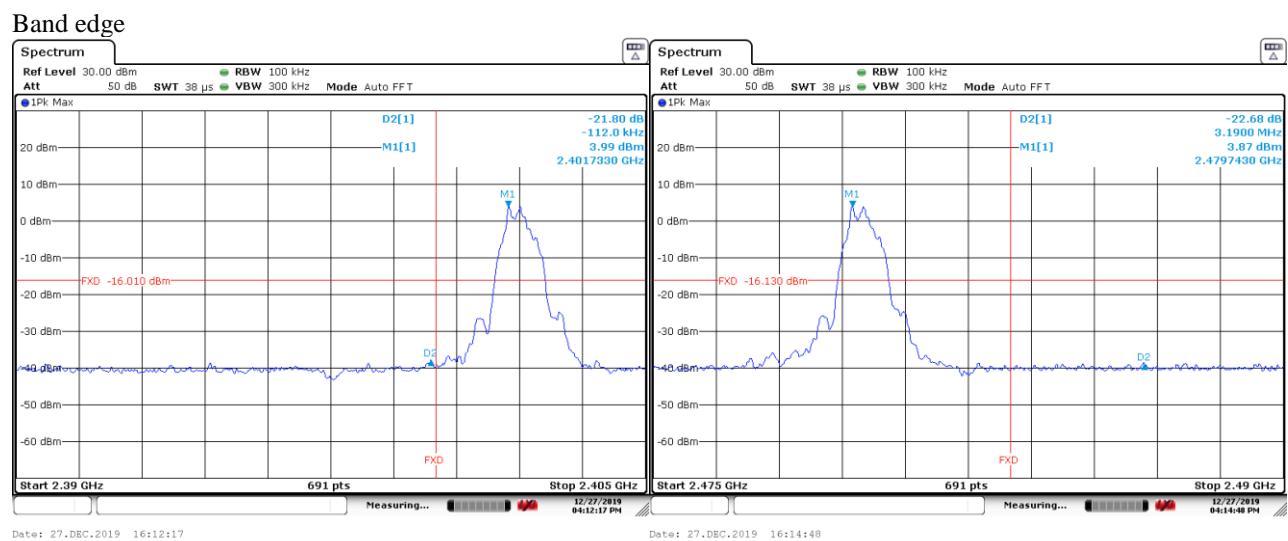
Figure 5: Conducted Spurious Emission

1. BLE, Conducted Spurious Emission and Band edge, 2402MHz~2480MHz

Conducted Spurious Emission



Band edge

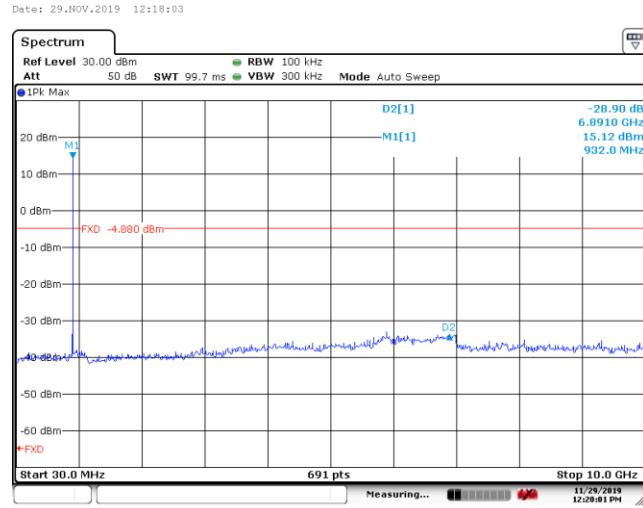
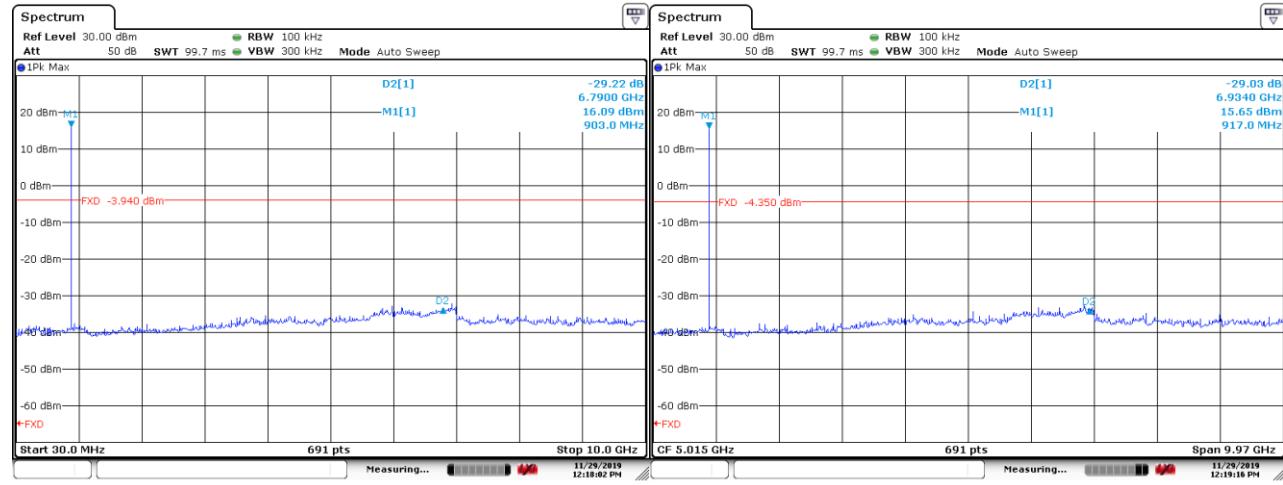


Prüfbericht - Nr.: 50332845 001

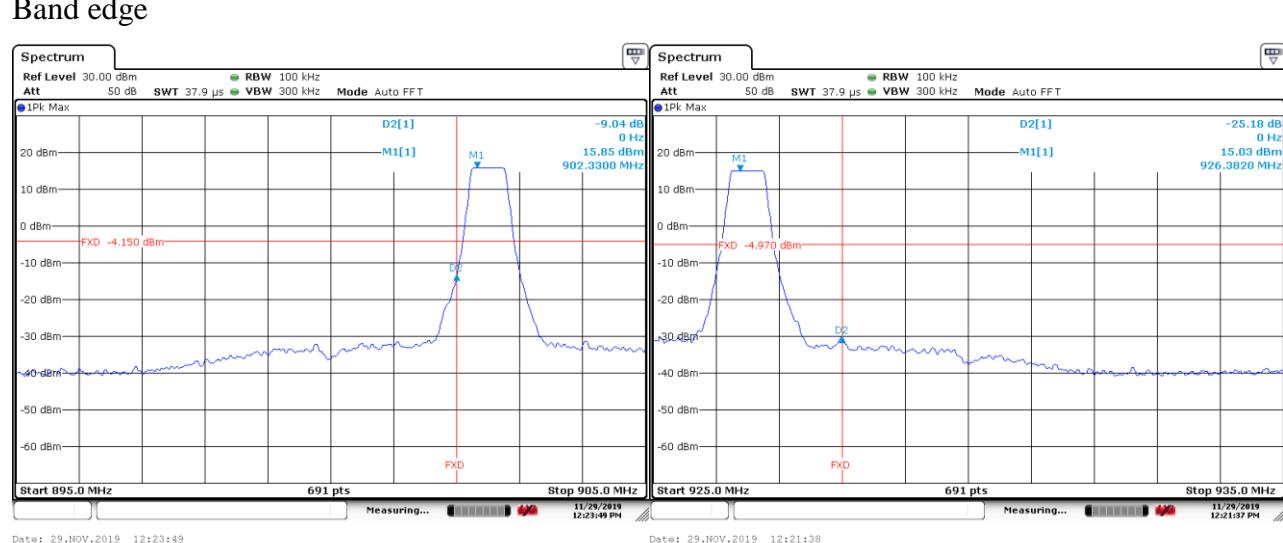
Test Report No.:
Seite 31 von 81
Page 31 of 81

2. LoRa 500KHz DTS, Conducted Spurious Emission and Band edge, 902.5MHz~926.5

Conducted Spurious Emission



Band edge

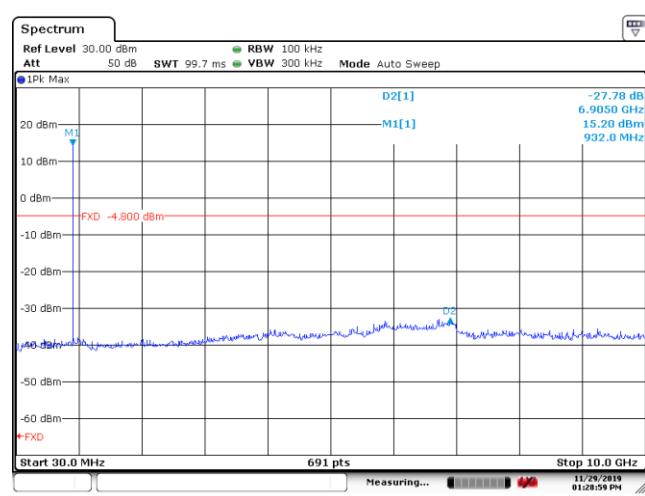
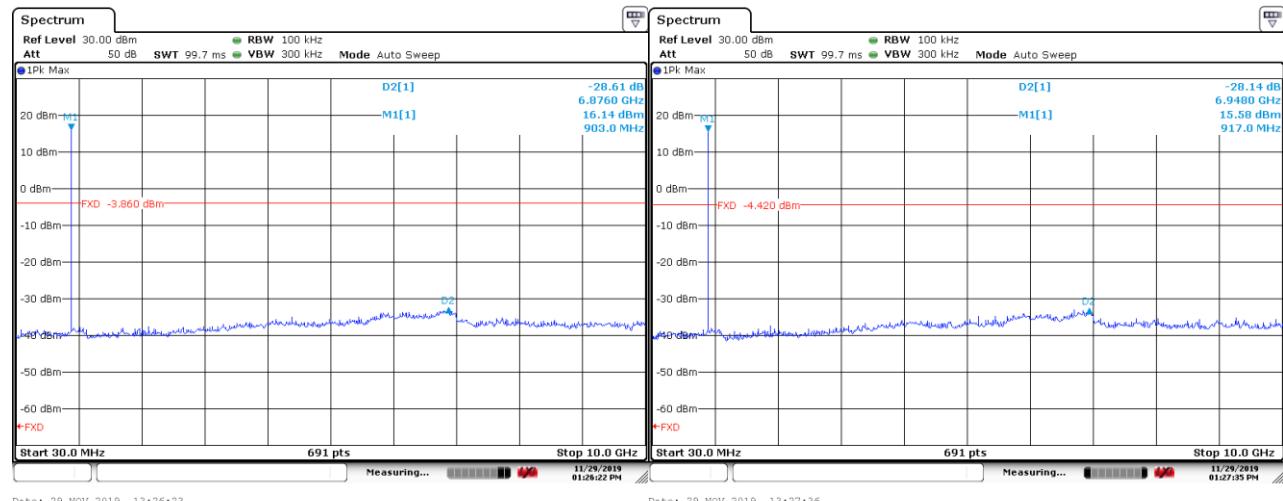


Prüfbericht - Nr.: 50332845 001

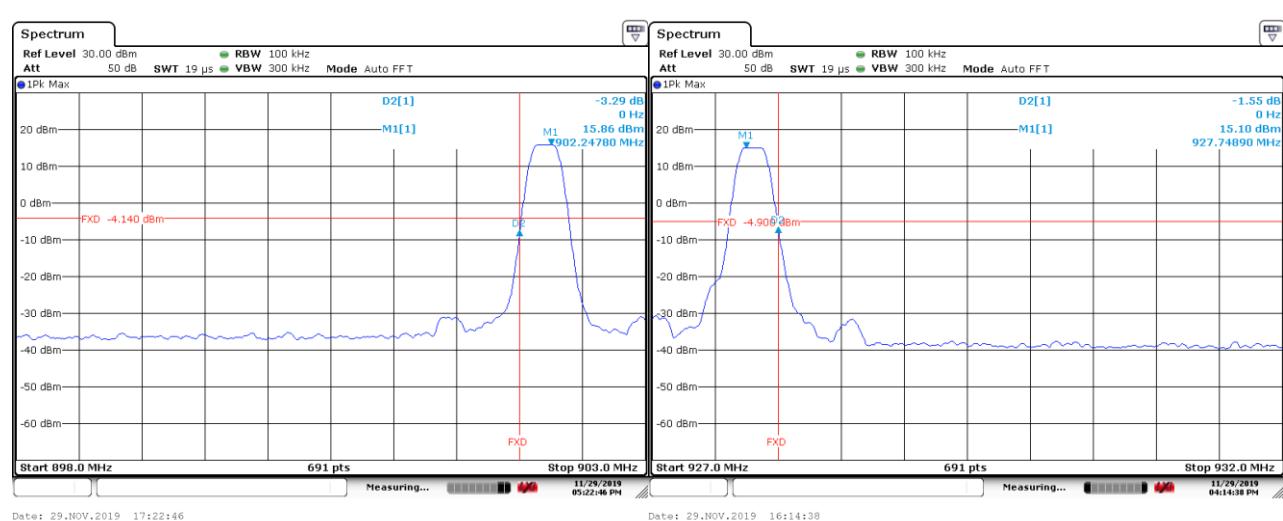
Test Report No.:
Seite 32 von 81
Page 32 of 81

3. LoRa 125KHz FHSS, Conducted Spurious Emission, 902.2MHz~927.8MHz

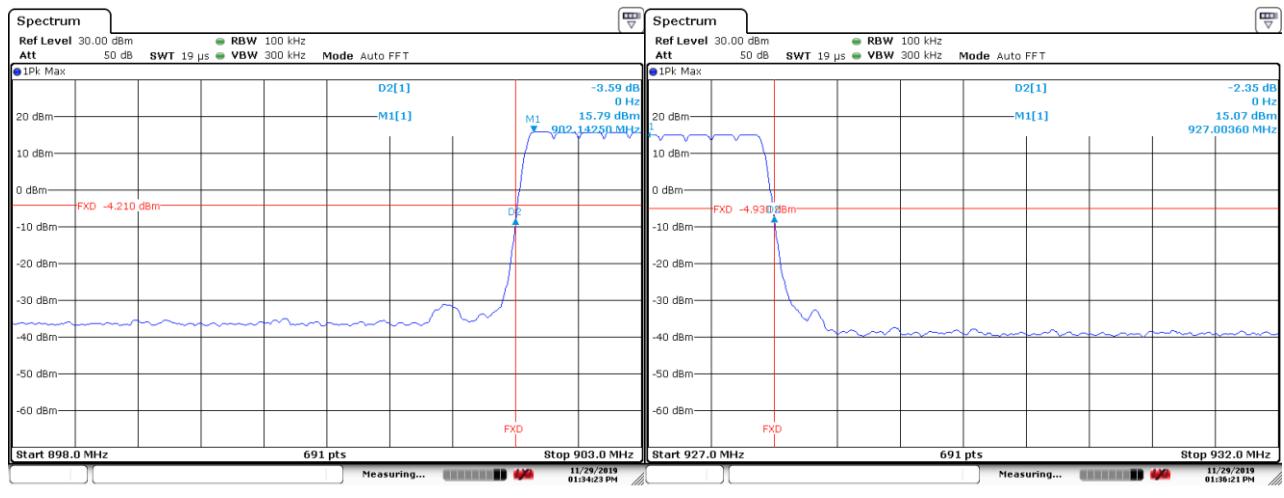
Conducted Spurious Emission



Band edge

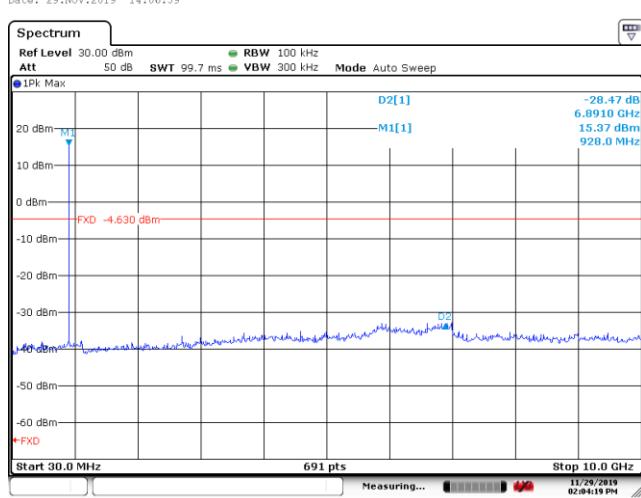
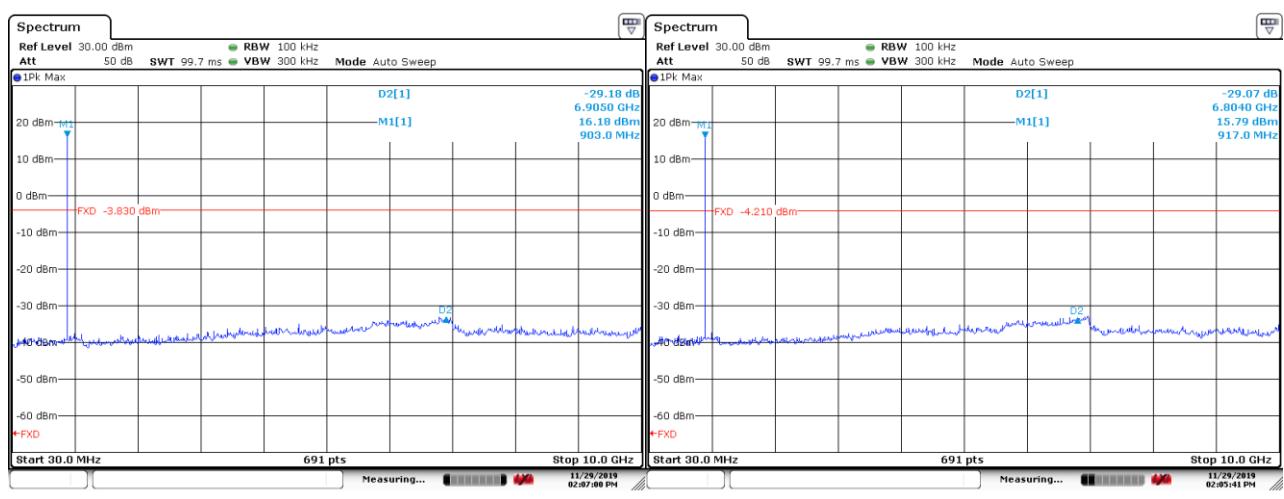


Prüfbericht - Nr.: 50332845 001

Test Report No.:
Seite 33 von 81
Page 33 of 81


4. FSK 150Kbps FHSS, Conducted Spurious Emission and Band edge, 902.4MHz~927.6MHz

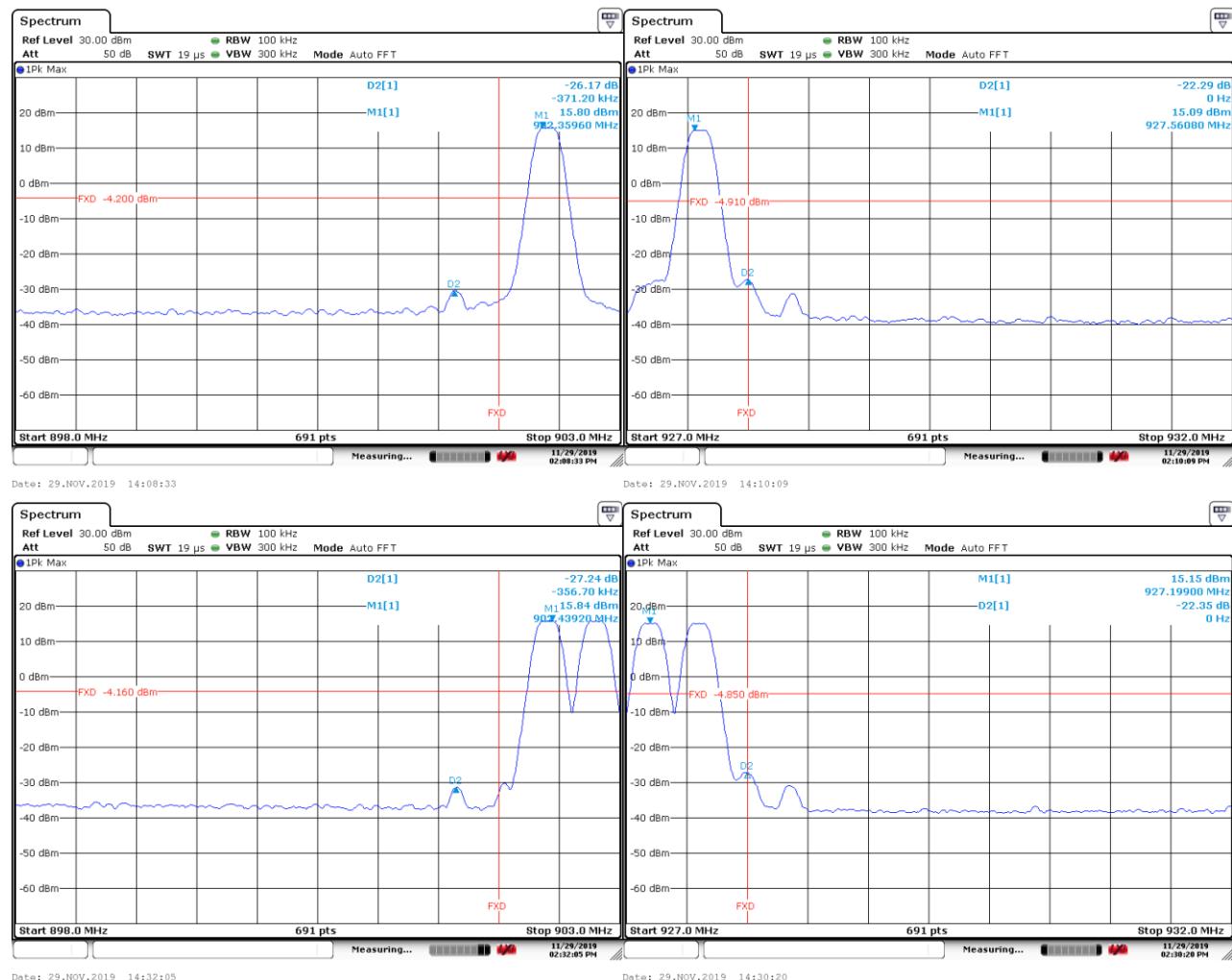
Conducted Spurious Emission



Prüfbericht - Nr.: 50332845 001
Test Report No.:

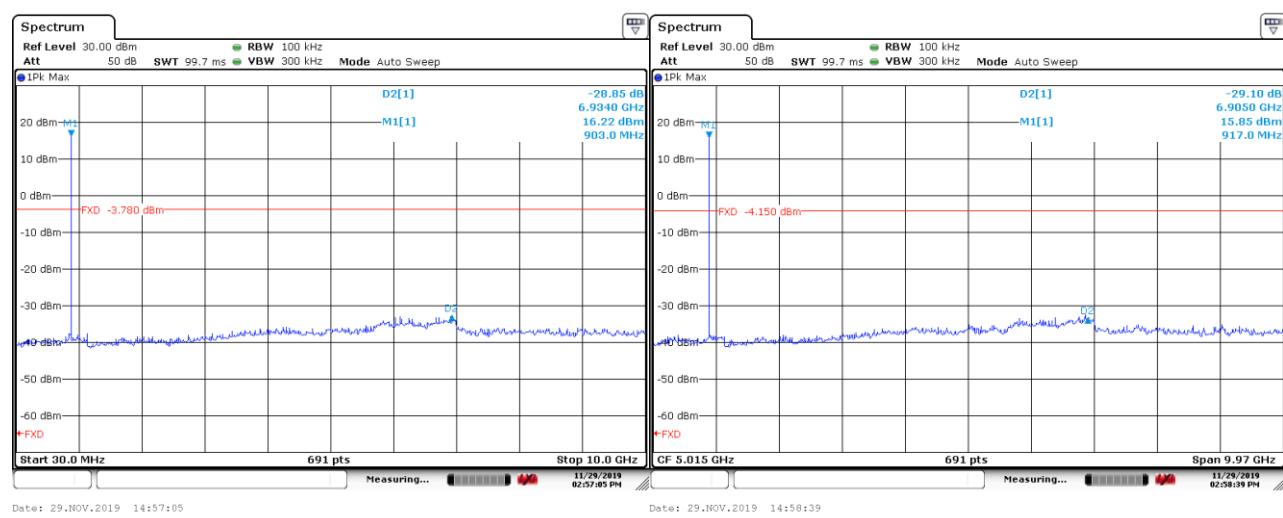
Seite 34 von 81
Page 34 of 81

Band edge



5. FSK 50Kbps FHSS, Conducted Spurious Emission and Band edge, 902.2MHz~927.8MHz

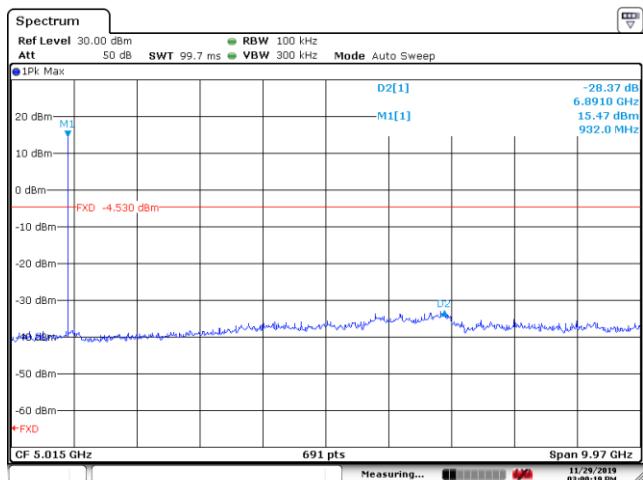
Conducted Spurious Emission



Prüfbericht - Nr.: 50332845 001

Test Report No.:

Seite 35 von 81
 Page 35 of 81



Band edge

