

Prüfbericht - Nr.: <i>Test Report No.:</i>	50321015 001	Auftrags-Nr.: <i>Order No.:</i>	180116641	Seite 1 von 118 <i>Page 1 of 118</i>
Kunden-Referenz-Nr.: <i>Client Reference No.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	18.11.2019	
Auftraggeber: <i>Client:</i>	Ring LLC 1523 26th St, Santa Monica, CA 90404, USA			
Prüfgegenstand: <i>Test item:</i>	Smart Lightbulb			
Bezeichnung / Typ-Nr.: <i>Identification / Type No.:</i>	5AT1S3, 5AT3S4			
Auftrags-Inhalt: <i>Order content:</i>	TÜV Rheinland – FCC/IC Service			
Prüfgrundlage: <i>Test specification:</i>	CFR47 FCC Part 15: Subpart C Section 15.207 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>	18.11.2019	N.A		
Prüfmuster-Nr.: <i>Test sample No.:</i>	A001035241 001-002			
Prüfzeitraum: <i>Testing period:</i>	27.11.2019-30.12.2019			
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:		
08.01.2020 Caidong Xie/PE <i>Caidong Xie</i>		08.01.2020 Feng Liang/TC <i>Feng Liang</i>		
Datum <i>Date</i>	Name/Stellung <i>Name/Position</i>	Unterschrift <i>Signature</i>	Datum <i>Date</i>	Name/Stellung <i>Name/Position</i>
Sonstiges/ Other: Refer to the test report 50325316 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 50323449 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 P(ass)=entspricht o.g. Prüfgrundlage(n) Legend: 1= very good P(ass)= passed a.m. test specification(s)	2= gut 2= good F(ail)= entspricht o.g. Prüfgrundlage(n) 3= satisfactory F(ail)= failed a.m. test specification(s)	3= befriedigend 4= ausreichend N/A = nicht anwendbar 4= sufficient N/A = not applicable	5= mangelhaft N/T =nicht getestet 5= poor 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>				

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.....	7
2.4	NOISE GENERATING AND NOISE SUPPRESSING PARTS.....	7
2.5	SUBMITTED DOCUMENTS	7
3	TEST SET-UP AND OPERATION MODES	8
3.1	PRINCIPLE OF CONFIGURATION SELECTION.....	8
3.2	TEST OPERATION AND TEST SOFTWARE.....	8
3.3	SPECIAL ACCESSORIES AND AUXILIARY EQUIPMENT	8
3.4	COUNTERMEASURES TO ACHIEVE EMC COMPLIANCE.....	8
3.5	TEST SET-UP	9
4	TEST RESULTS.....	10
4.1	TRANSMITTER REQUIREMENT & TEST SUITES.....	10
4.1.1	Antenna Requirement.....	10
4.1.2	6dB and 20dB Bandwidth Measurement.....	11
4.1.3	99% Emission Bandwidth Measurement.....	20
4.1.4	Maximum Peak Conducted Output Power.....	29
4.1.5	Equivalent Isotropically Radiated Power.....	38
4.1.6	Power Spectral Density	40
4.1.7	Conducted Spurious Emissions Measured in 100 kHz Bandwidth.....	44
4.1.8	Carrier Separation Measurement.....	59
4.1.9	The number of hopping channels.....	63
4.1.10	Dwell Time.....	68
4.1.11	Conducted Emission	76
4.1.12	Radiated Emission	79
5	PHOTOGRAPHS OF THE TEST SET-UP	112
6	LIST OF TABLES.....	117
7	LIST OF FIGURES.....	118
8	LIST OF PHOTOGRAPHS	118

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 Smart Lightbulb 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	Color Temperature	Function	FCC ID/IC
5AT1S3	3500K	Block A: BLE operated at 2.4GHz Block B: LoRa DTS, LoRa FHSS and FSK FHSS operated at 902-928MHz	FCC ID: 2AEUPRB19001 IC: 20271-RB19001
5AT3S4	2700K		

2.2 Ratings and System Details

Operating Voltage	: 120Vac, 60Hz	For all models
Rated current	: 75mA	For all models
Rated power	: 8.5W	For all models
Protection Class	: Class II	For all models

In electrical characteristics, all models are the same except color temperature aspects. Therefore the model 5AT3S4 was selected to be tested in this report. Refer to the user's manual for further information.

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 ~ 40°C
Modulation	GFSK
Antenna Type	Monopole Antenna
Antenna Gain(dBi)	2.44
Channel	0~39

Technical Specification of LoRa DTS

Technical Specification	LoRa DTS 500KHz 902.5-926.5MHz	LoRa DTS 500KHz 903-914.2MHz	LoRa DTS 500KHz 923.3-926.9MHz
Operating Frequency band	902 – 928 MHz		
Extreme Temperature Range	-20°C ~ 40°C		
Bandwidth(KHz)	500		
Modulation	LoRa DTS		
Antenna Type	Monopole Antenna		
Antenna Gain(dBi)	-1.69		
Channel Separation (KHz)	800	1600	600

Prüfbericht - Nr.: 50321015 001

Test Report No.:

Seite 6 von 118

Page 6 of 118

Channel Number	31	8	7
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	903, 904.6, 906.2, 907.8, 909.4, 911, 912.6, 914.2	923.3, 923.9, 924.5, 925.1, 925.7, 926.3, 926.9

Technical Specification of LoRa FHSS

Technical Specification	LoRa 250KHz FHSS 902.3-926.7MHz	LoRa 125KHz FHSS 902.3-914.9MHz	LoRa 125KHz FHSS 902.2-927.8MHz
Operating Frequency band	902 – 928 MHz		
Extreme Temperature Range	-20°C ~ 40°C		
Modulation	LoRa FHSS		
Antenna Type	Monopole Antenna		
Antenna Gain(dBi)	-1.69		
Channel Separation (KHz)	400	200	200
Channel Number	62	64	129
Bandwidth (KHz)	250	125	125
Hopping channel(MHz)	902.3~926.7	902.3~914.9	902.2-927.8

Technical Specification of FSK FHSS

Technical Specification	FSK150Kbps FHSS	FSK 50Kbps FHSS	FSK 5Kbps FHSS	FSK 250Kbps FHSS
Operating Frequency band	902 – 928 MHz			
Extreme Temperature Range	-20°C ~ 40°C			
Modulation	FSK FHSS			
Antenna Type	Monopole Antenna			
Antenna Gain(dBi)	-1.69			
Channel Separation (KHz)	400	200	200	500
Channel Number	64	129	129	51
Data Rate (Kbps)	150	50	5	250
Hopping Channel(MHz)	902.4~927.6	902.2~927.8	902.2~927.8	902.5~927.5

2.3 Independent Operation Modes

The basic operation modes are:
Light On, 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)

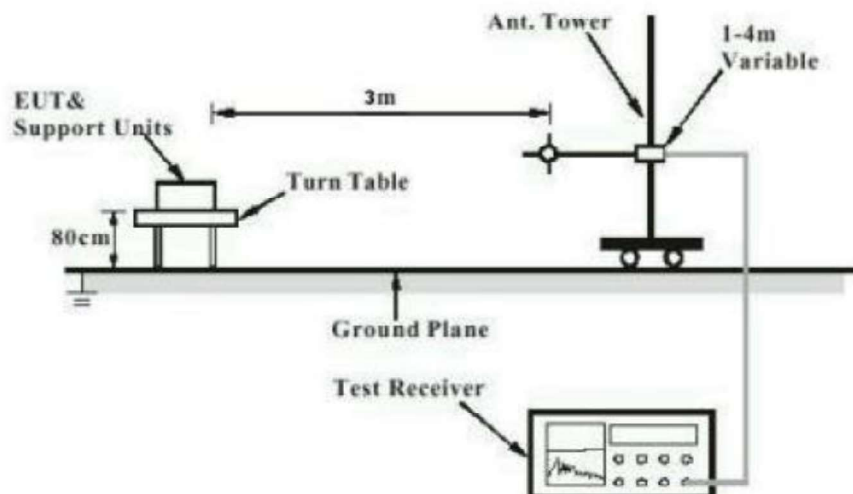


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

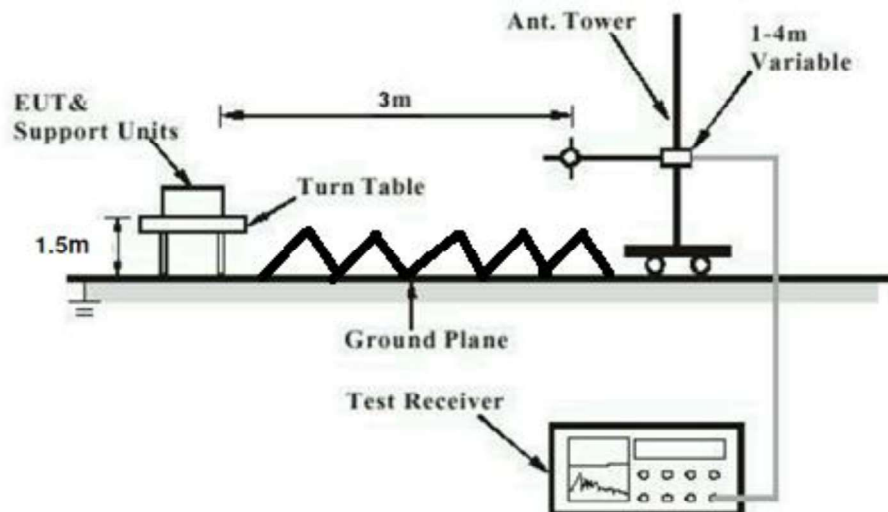
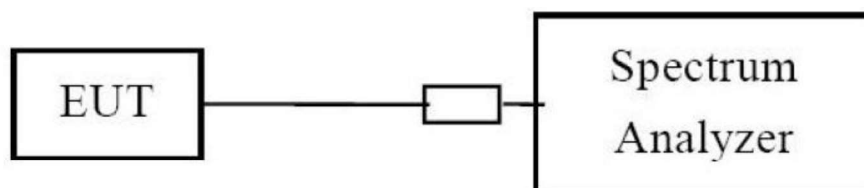


Diagram of Measurement Configuration for Conducted Transmitter Measurement



4 Test Results

4.1 Transmitter Requirement & Test Suites

4.1.1 Antenna Requirement

Result:

Pass

Test Specification

Test standard

Limits

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

: 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 2.44dBi, 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.: 50321015 001
Test Report No.:

Seite 11 von 118
Page 11 of 118

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, Clause 5.2
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 : 27.11.2019~25.12.2019
Input voltage : 120Vac, 60Hz
Operational mode : Test mode of BLE, LoRa DTS, LoRa FHSS, FSK FHSS
Test channel : Lo, Mi, Hi
Temperature : 21.1°C
Relative humidity : 57%
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	534.0	500	Pass
	Mid Channel	2440	516.6	500	Pass
	High Channel	2480	538.4	500	Pass
2. LoRa 500KHz DTS 902.5MHz~926.5 6dB Bandwidth	Low Channel	902.5	620.8	500	Pass
	Mid Channel	914.5	620.8	500	Pass
	High Channel	926.5	620.8	500	Pass
3. LoRa 500KHz DTS 903MHz~914.2MHz 6dB Bandwidth	Low Channel	903	620.8	500	Pass
	Mid Channel	907.8	620.8	500	Pass
	High Channel	914.2	620.8	500	Pass
4. LoRa 500KHz DTS 923.3MHz~926.9MHz 6dB Bandwidth	Low Channel	923.3	620.8	500	Pass
	Mid Channel	925.1	629.5	500	Pass
	High Channel	926.9	620.8	500	Pass
5. LoRa 250KHz FHSS 902.3MHz~926.7MHz 20dB Bandwidth	Low Channel	902.3	324.2	500	Pass
	Mid Channel	914.3	321.3	500	Pass
	High Channel	926.7	312.6	500	Pass
6. LoRa 125KHz FHSS 902.3MHz~914.9MHz	Low Channel	902.3	149.78	500	Pass
	Mid Channel	908.5	148.34	500	Pass

Prüfbericht - Nr.: 50321015 001

Test Report No.:

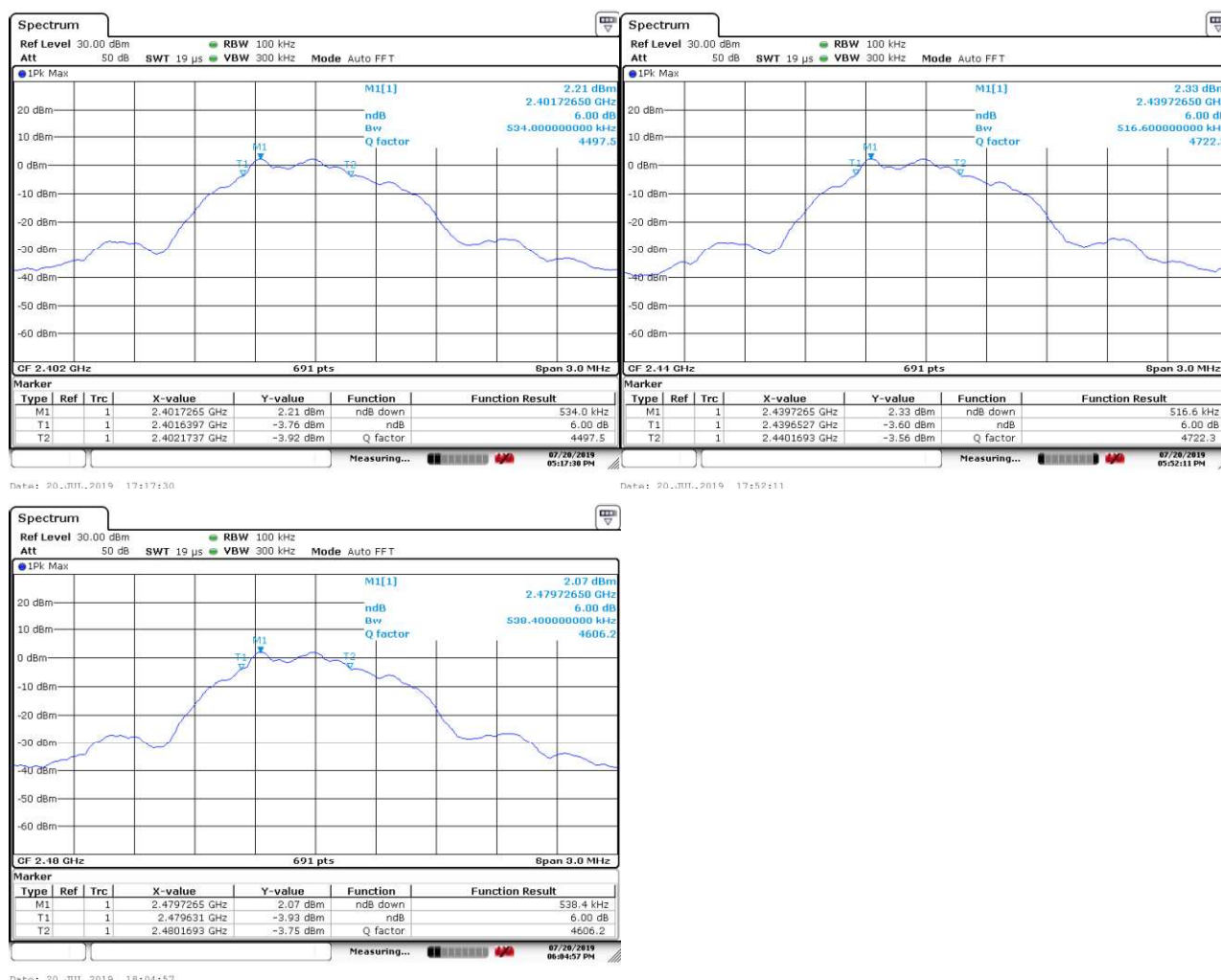
Seite 12 von 118

Page 12 of 118

20dB Bandwidth	High Channel	914.9	148.34	500	Pass
7. LoRa 125KHz FHSS 902.2-927.8MHz 20dB Bandwidth	Low Channel	902.2	147.61	500	Pass
	Mid Channel	915	147.61	500	Pass
	High Channel	927.8	145.44	500	Pass
8. FSK 150Kbps FHSS 902.4MHz~927.6MHz 20dB Bandwidth	Low Channel	902.4	176.56	500	Pass
	Mid Channel	914.8	176.56	500	Pass
	High Channel	927.6	175.83	500	Pass
9. FSK 50Kbps FHSS 902.2MHz~927.8MHz 20dB Bandwidth	Low Channel	902.2	107.81	500	Pass
	Mid Channel	915	109.99	500	Pass
	High Channel	927.8	110.71	500	Pass
10. FSK 5Kbps FHSS 902.2MHz~927.8MHz 20dB Bandwidth	Low Channel	902.2	10.539	500	Pass
	Mid Channel	915	10.463	500	Pass
	High Channel	927.8	10.507	500	Pass
11. FSK 250Kbps FHSS 902.5MHz~927.5MHz 20dB Bandwidth	Low Channel	902.5	273.50	500	Pass
	Mid Channel	915	273.50	500	Pass
	High Channel	927.5	277.90	500	Pass

Figure 1: 6dB&20dB Bandwidth Measurement

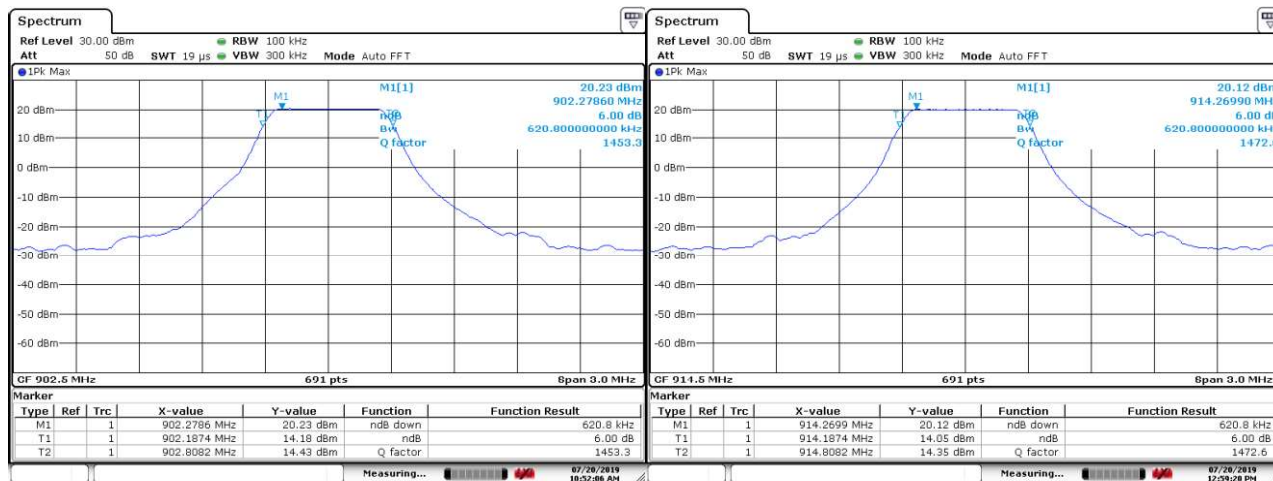
1. BLE, 6dB Bandwidth, 2402MHz~2480MHz



Prüfbericht - Nr.: 50321015 001
Test Report No.:

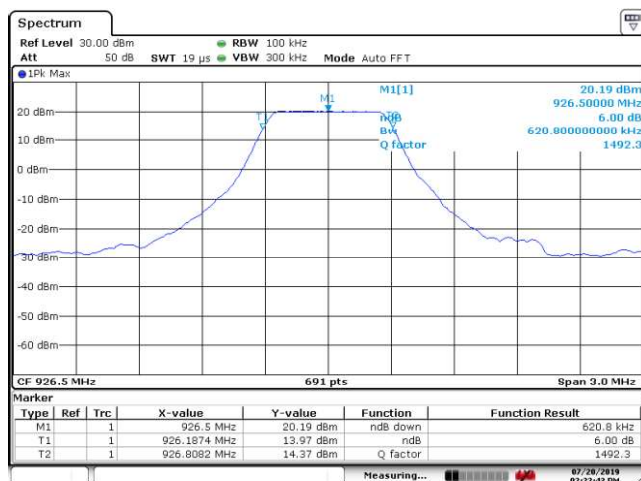
Seite 13 von 118
Page 13 of 118

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



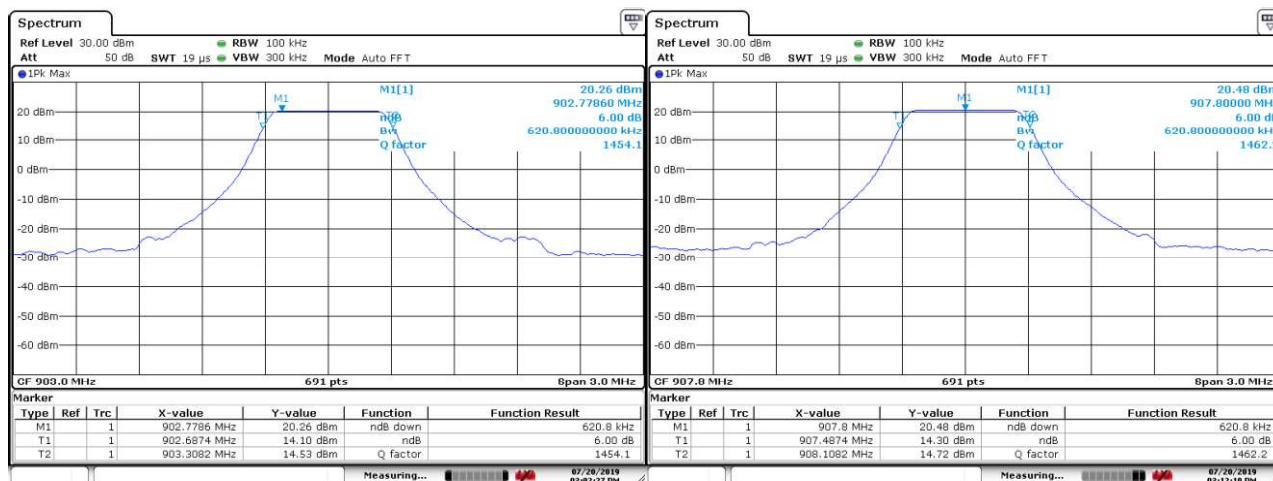
Date: 20..JUL..2019 10:52:06

Date: 20..JUL..2019 12:59:20



Date: 20..JUL..2019 14:22:43

3. LoRa 500KHz DTS, 6dB Bandwidth, 903MHz~914.2MHz

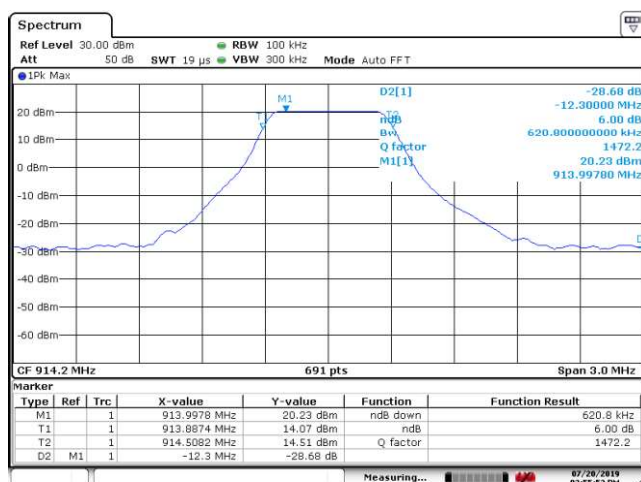


Date: 20..JUL..2019 15:02:27

Date: 20..JUL..2019 15:12:10

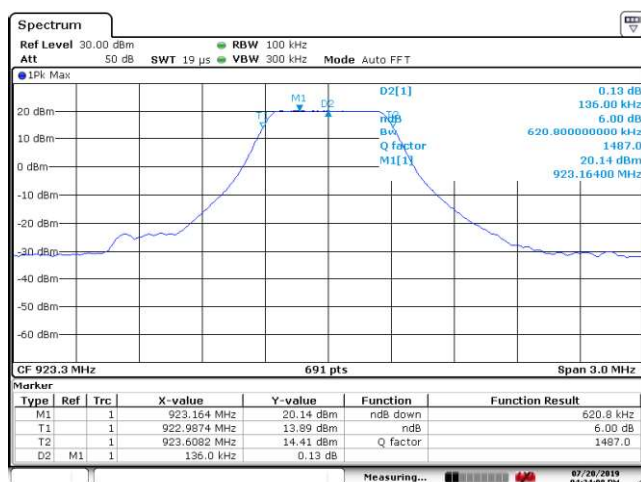
Prüfbericht - Nr.: 50321015 001
Test Report No.:

Seite 14 von 118
Page 14 of 118

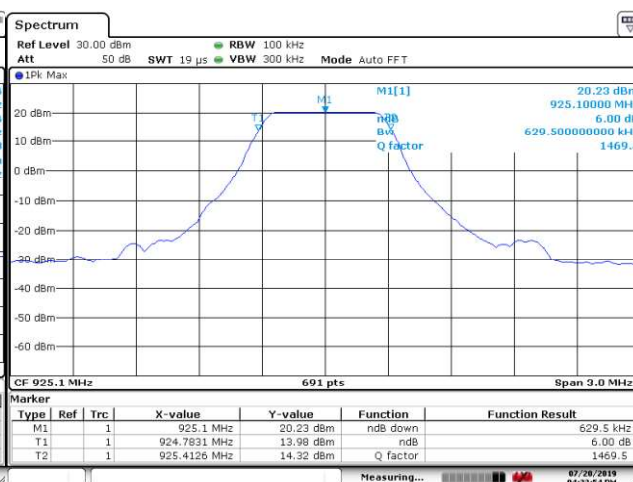


Date: 20.JUL.2019 15:55:53

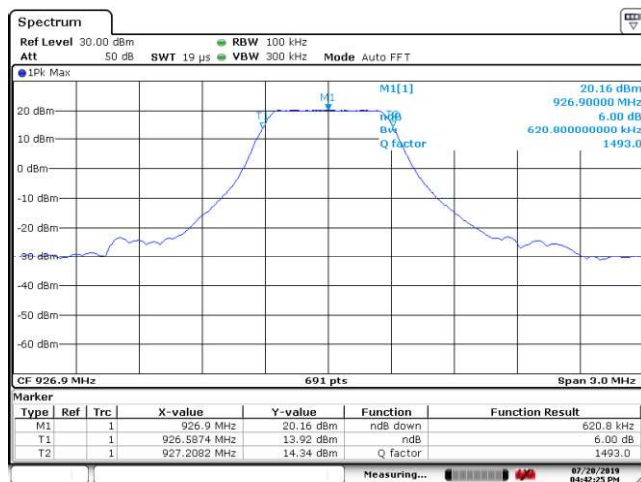
4. LoRa 500KHz DTS, 6dB Bandwidth, 923.3MHz~926.9MHz



Date: 20.JUL.2019 16:24:08



Date: 20.JUL.2019 16:33:53

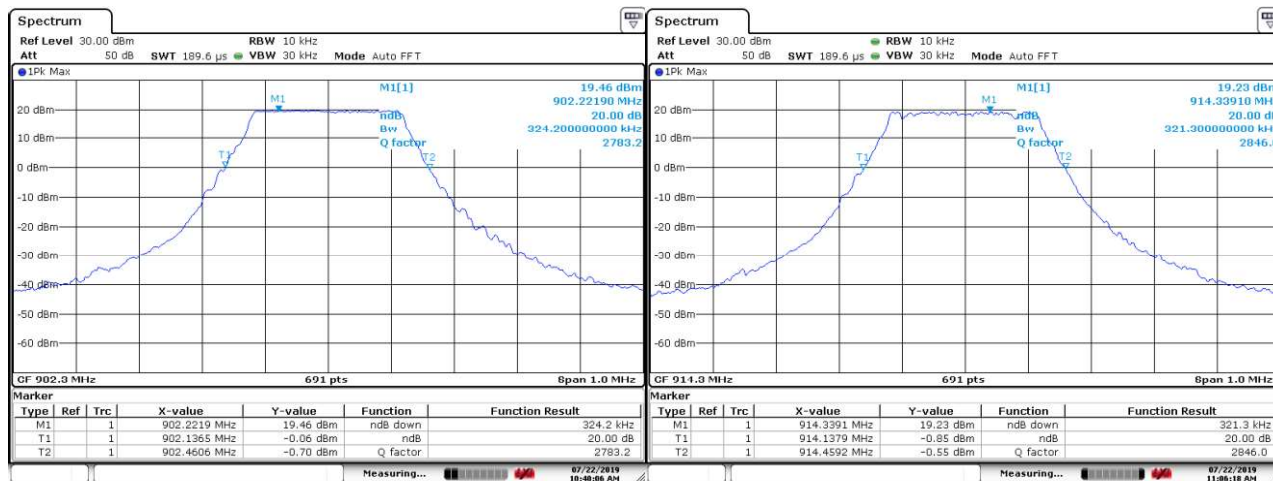


Date: 20.JUL.2019 16:42:25

Prüfbericht - Nr.: 50321015 001
Test Report No.:

Seite 15 von 118
Page 15 of 118

5. LoRa 250KHz FHSS, 20dB Bandwidth, 902.3MHz~926.7MHz



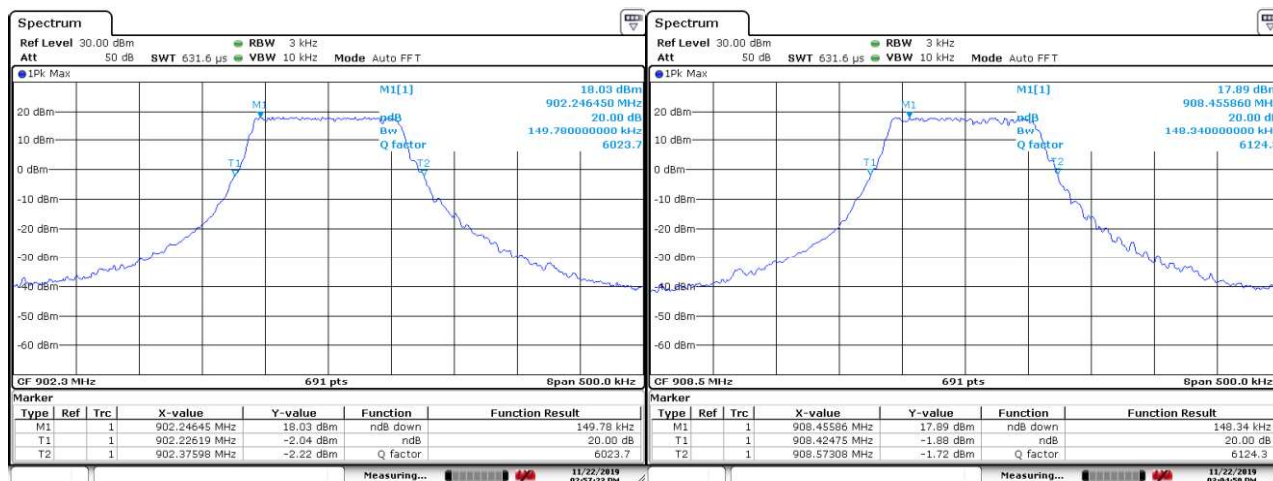
Date: 22.JUL.2019 10:40:06

Date: 22.JUL.2019 11:06:18



Date: 22.JUL.2019 11:21:34

6. LoRa 125KHz FHSS, 20dB Bandwidth, 902.3MHz~914.9MHz

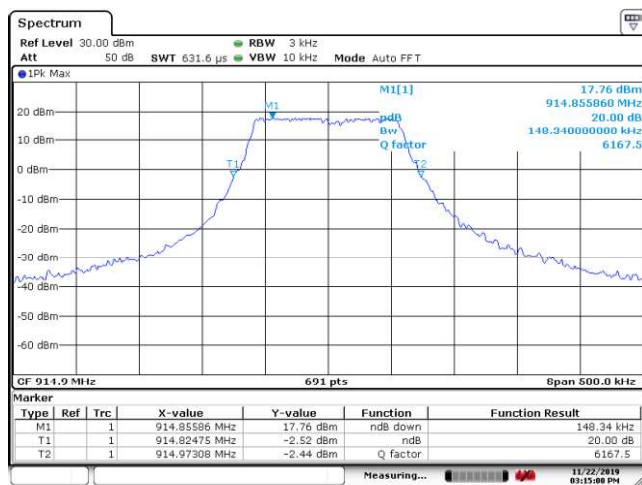


Date: 22.NOV.2019 14:57:23

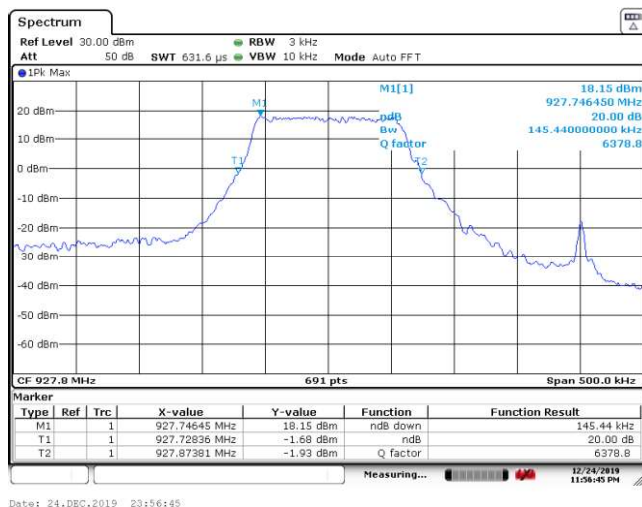
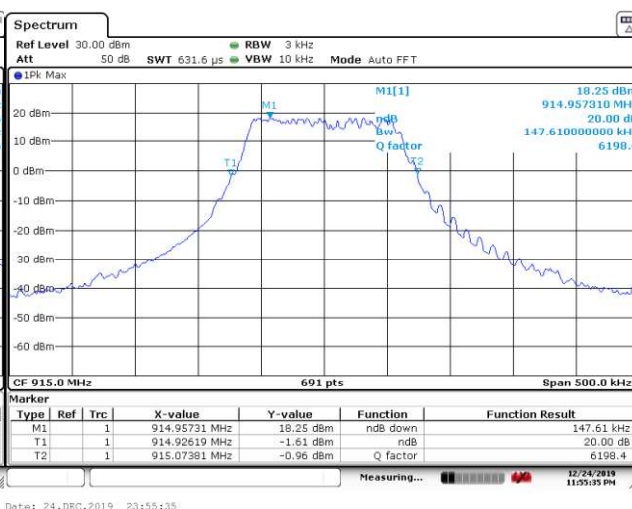
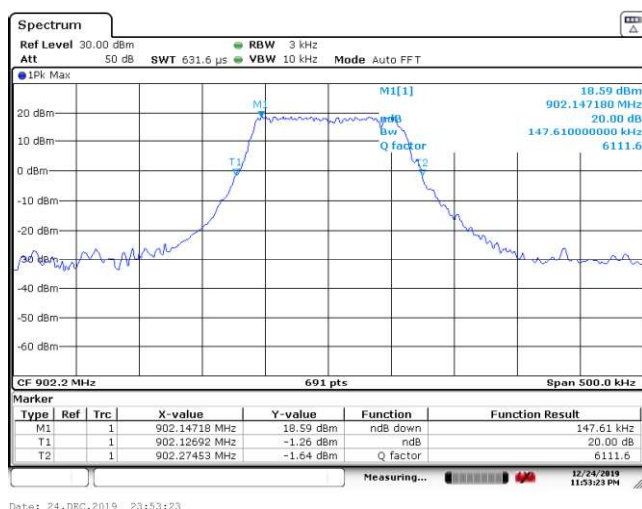
Date: 22.NOV.2019 15:04:59

Prüfbericht - Nr.: 50321015 001
Test Report No.:

Seite 16 von 118
Page 16 of 118



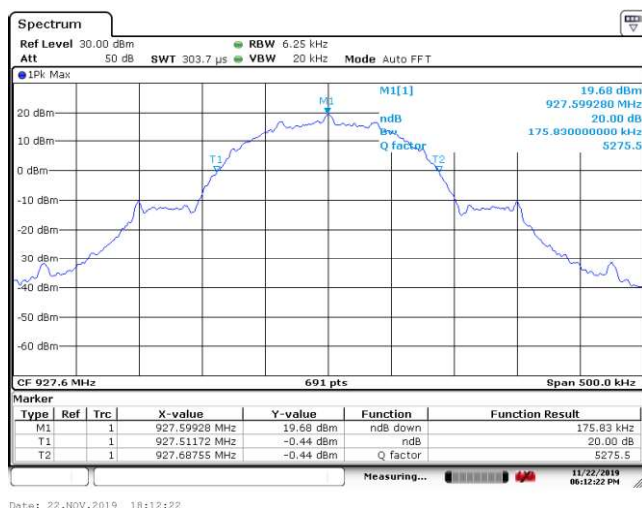
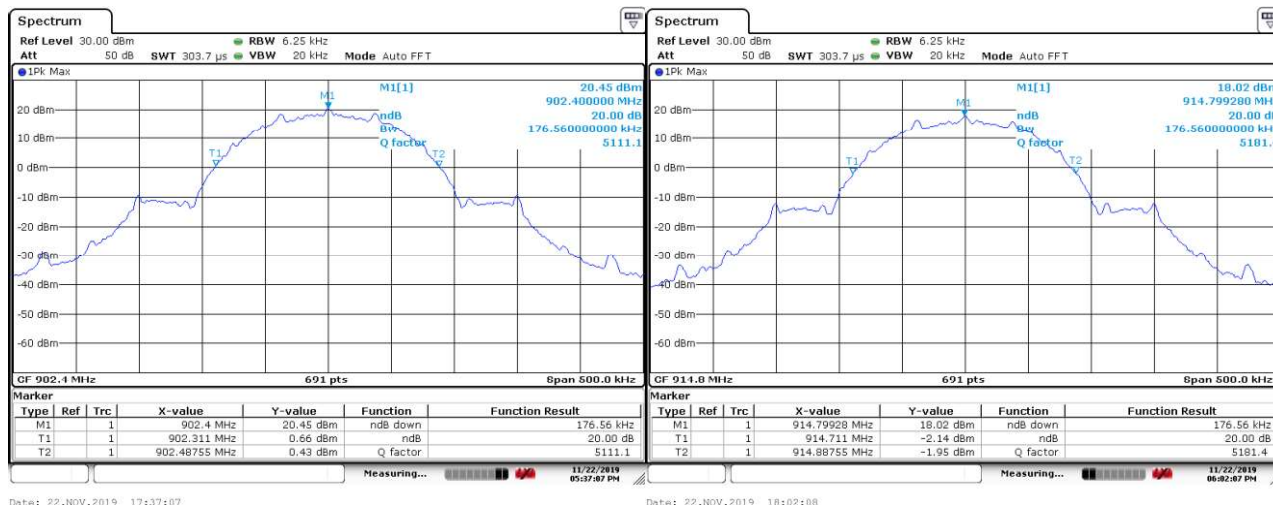
7. LoRa 125KHz FHSS, 20dB Bandwidth, 902.2-927.8MHz



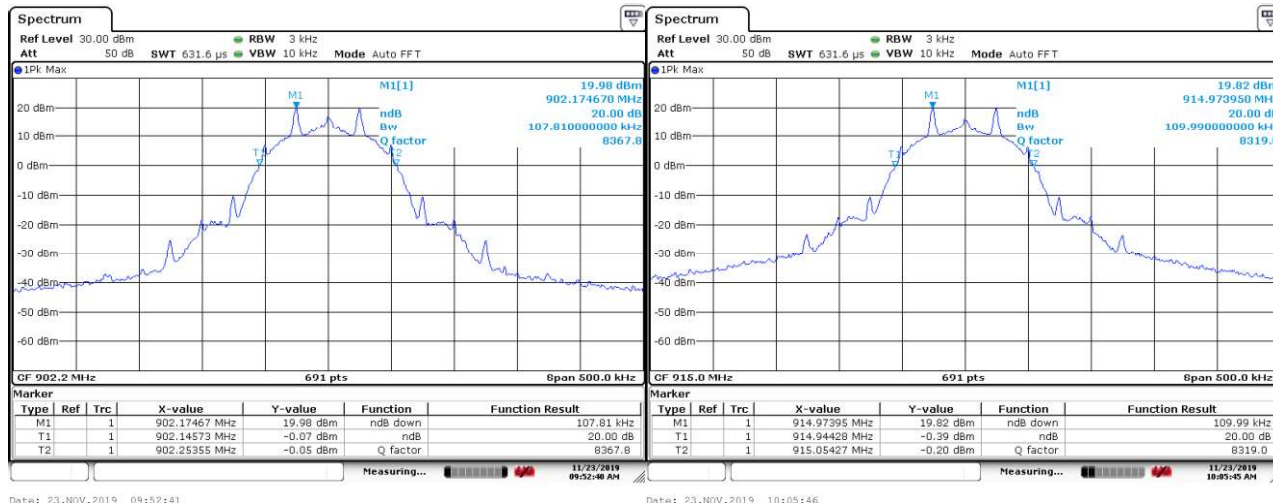
Prüfbericht - Nr.: 50321015 001
Test Report No.:

Seite 17 von 118
Page 17 of 118

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



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

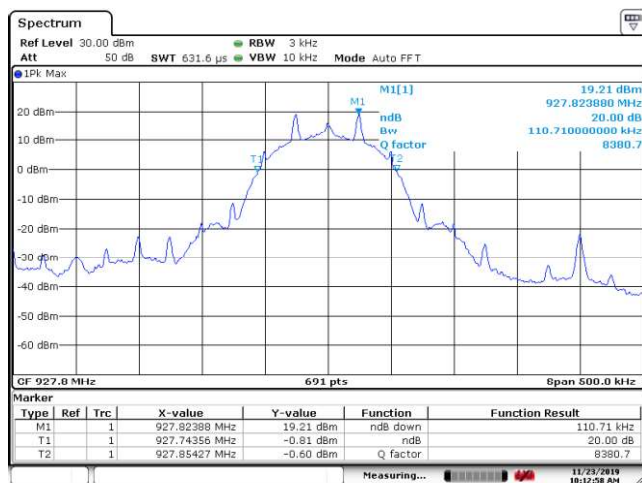


Prüfbericht - Nr.: 50321015 001

Test Report No.:

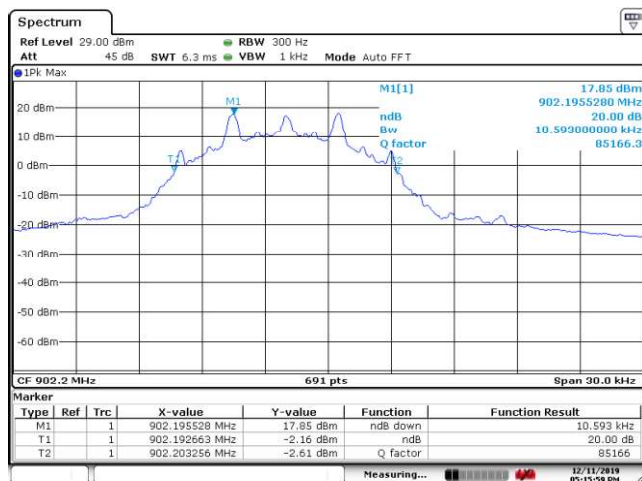
Seite 18 von 118

Page 18 of 118



Date: 23.NOV.2019 10:12:59

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



Date: 11.DEC.2019 17:16:00



Date: 23.NOV.2019 11:52:57



Date: 23.NOV.2019 12:08:43

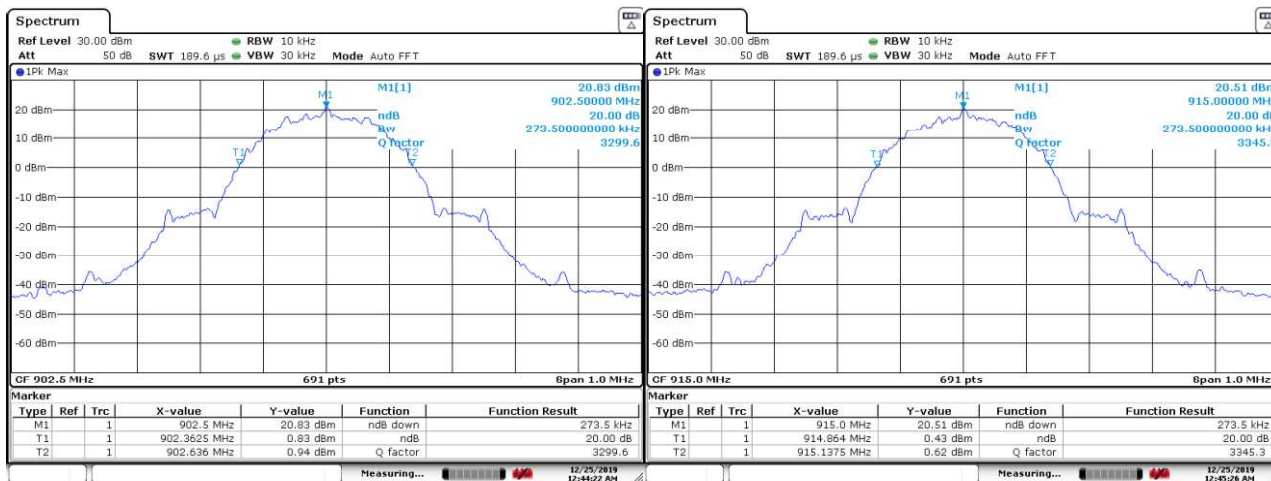
Prüfbericht - Nr.: 50321015 001

Test Report No.:

Seite 19 von 118

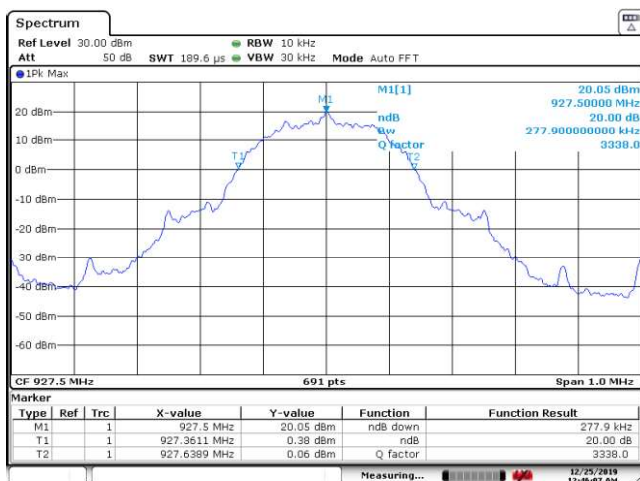
Page 19 of 118

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



Date: 25.DEC.2019 00:44:22

Date: 25.DEC.2019 00:45:26



Date: 25.DEC.2019 00:46:07

Prüfbericht - Nr.: 50321015 001
Test Report No.:

Seite 20 von 118
Page 20 of 118

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 : 27.11.2019-25.12.2019

Input voltage : AC 120V, 60Hz

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

Test channel : Lo, Mi, Hi

Temperature : 21.1°C

Relative humidity : 57%

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% Emission Bandwidth	Low Channel	2402	1041.968
	Mid Channel	2440	1037.626
	High Channel	2480	1041.968
2. LoRa 500KHz DTS 902.5MHz~926.5 99% Emission Bandwidth	Low Channel	902.5	506.512
	Mid Channel	914.5	512.300
	High Channel	926.5	506.512
3. LoRa 500KHz DTS 903MHz~914.2MHz 99% Emission Bandwidth	Low Channel	903	503.617
	Mid Channel	907.8	497.829
	High Channel	914.2	509.406
4. LoRa 500KHz DTS 923.3MHz~926.9MHz 99% Emission Bandwidth	Low Channel	923.3	506.512
	Mid Channel	925.1	515.195
	High Channel	926.9	512.301
5. LoRa 250KHz FHSS 902.3MHz~926.7MHz 99% Emission Bandwidth	Low Channel	902.3	274.963
	Mid Channel	914.3	270.622
	High Channel	926.7	267.727
6. LoRa 125KHz FHSS 902.3MHz~914.9MHz 99% Emission Bandwidth	Low Channel	902.3	125.904
	Mid Channel	908.5	126.628
	High Channel	914.9	125.180
7. LoRa 125KHz FHSS 902.2MHz~927.8MHz 99% Emission Bandwidth	Low Channel	902.2	125.904
	Mid Channel	915	126.628
	High Channel	927.8	125.180
8. FSK 150Kbps FHSS 902.4MHz~927.6MHz	Low Channel	902.4	157.019
	Mid Channel	914.8	156.295

Prüfbericht - Nr.: 50321015 001

Test Report No.:

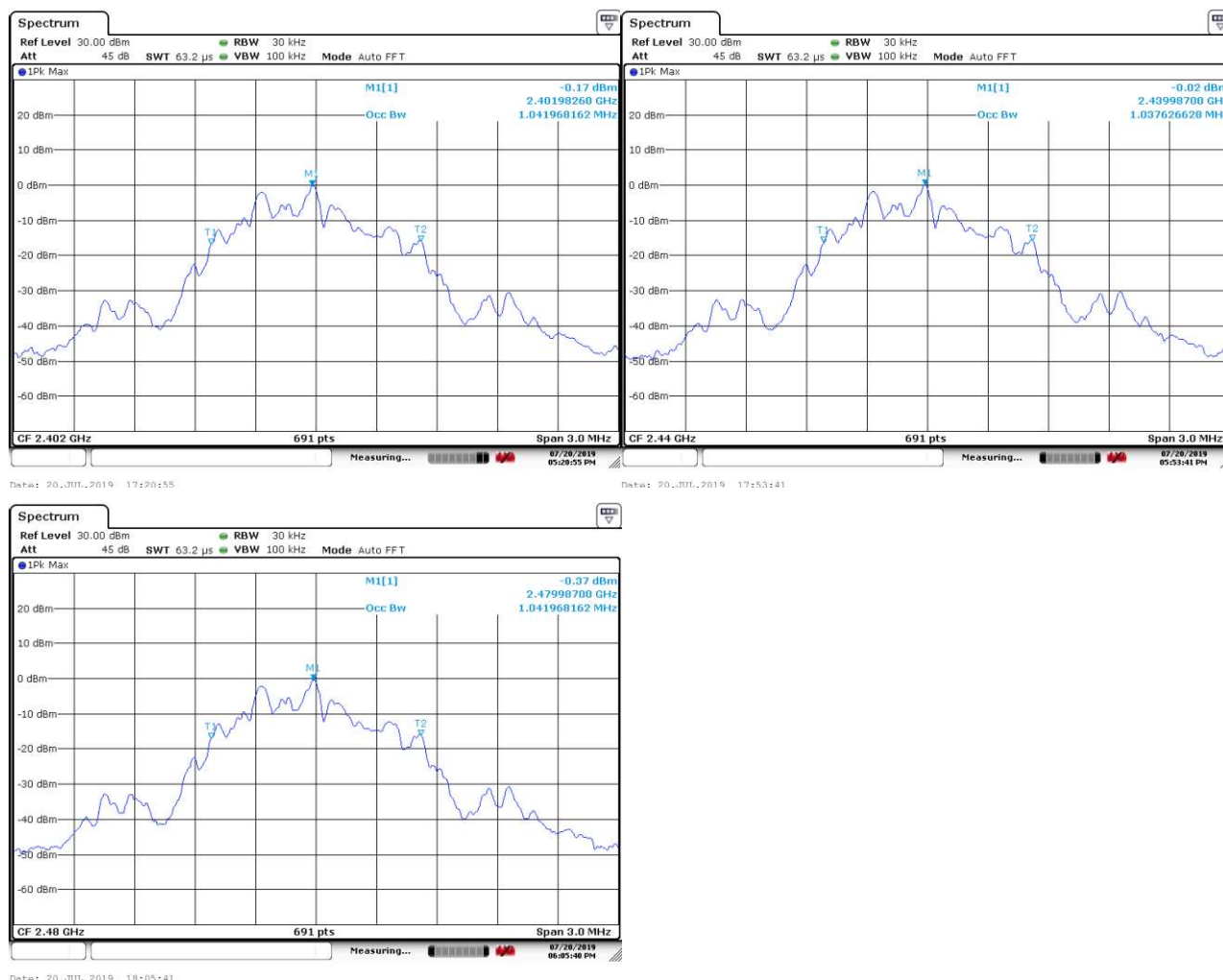
Seite 21 von 118

Page 21 of 118

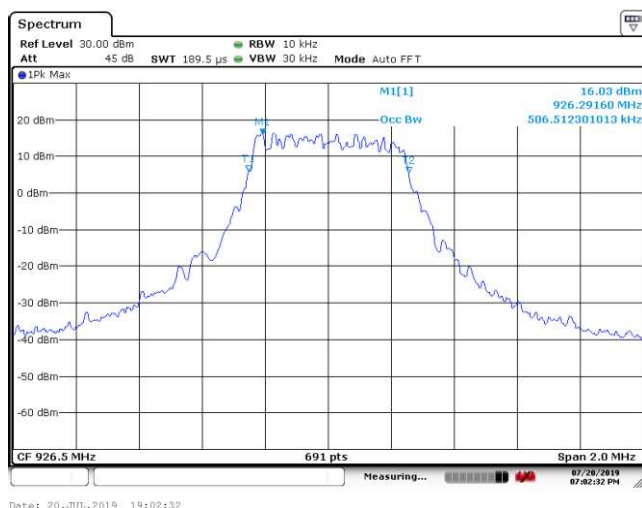
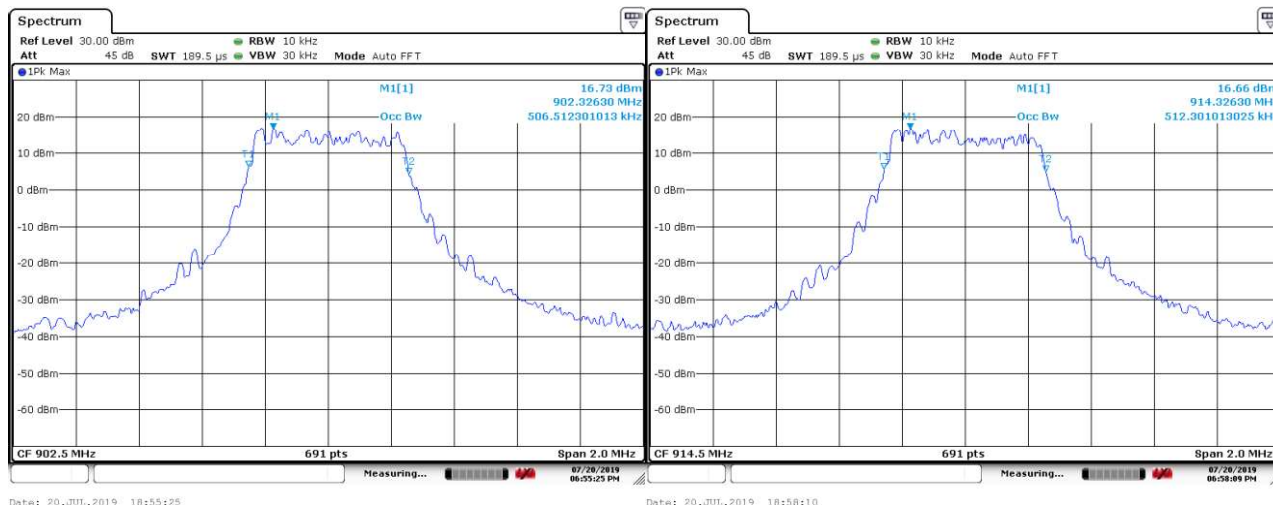
99% Emission Bandwidth	High Channel	927.6	158.465
9. FSK 50Kbps FHSS 902.2MHz~927.8MHz 99% Emission Bandwidth	Low Channel	902.2	102.749
	Mid Channel	915	104.196
	High Channel	927.8	104.196
10. FSK 5Kbps FHSS 902.2MHz~927.8MHz 99% Emission Bandwidth	Low Channel	902.2	10.116
	Mid Channel	915	10.116
	High Channel	927.8	10.116
11. FSK 250Kbps FHSS 902.5MHz~927.5MHz 99% Emission Bandwidth	Low Channel	902.5	250.361
	Mid Channel	915	248.914
	High Channel	927.5	256.150

Figure 2: 99% Emission Bandwidth Measurement

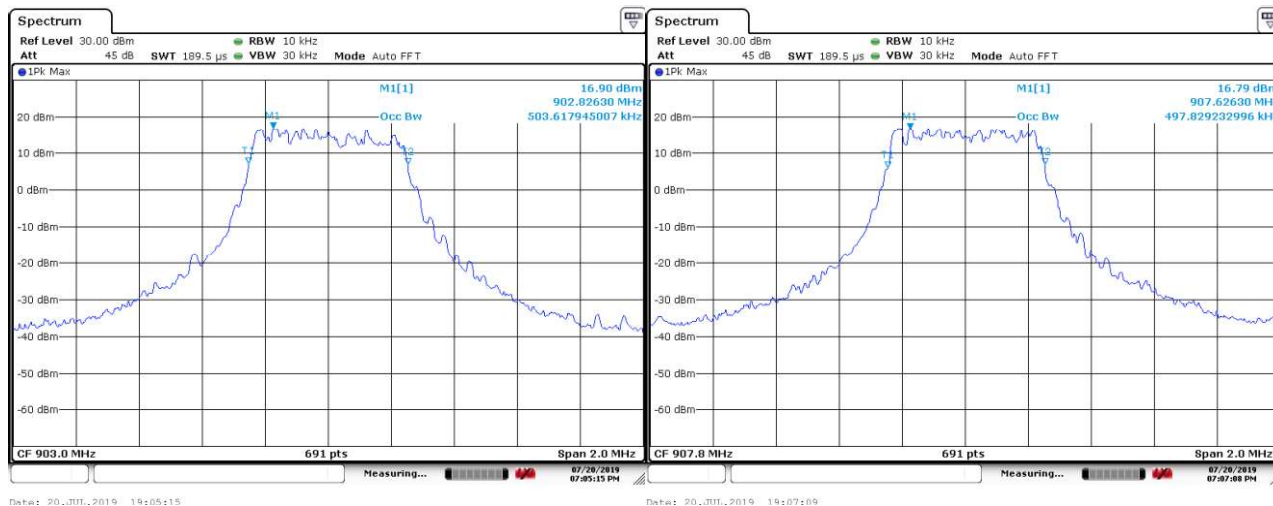
1. BLE, 99% Emission Bandwidth, 2402MHz~2480MHz



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

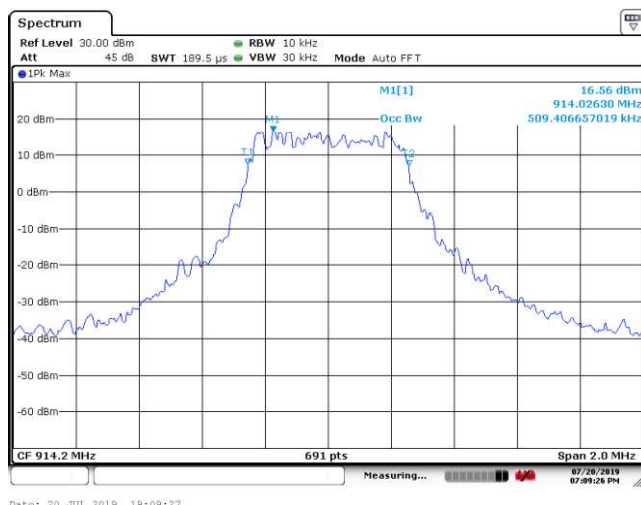


3. LoRa 500KHz DTS, 99% Emission Bandwidth, 903MHz~914.2MHz

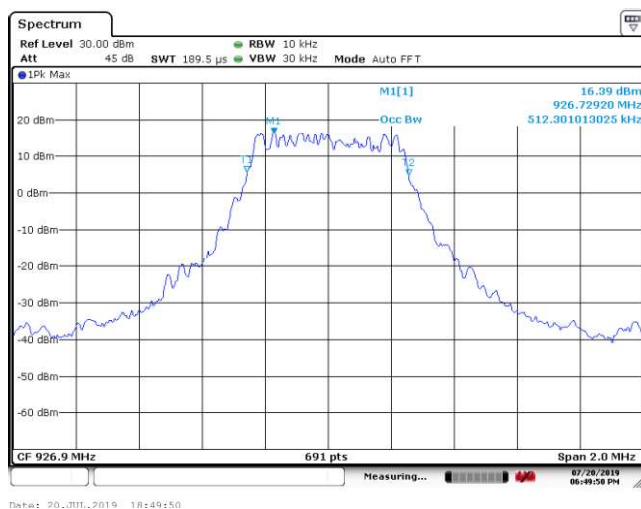
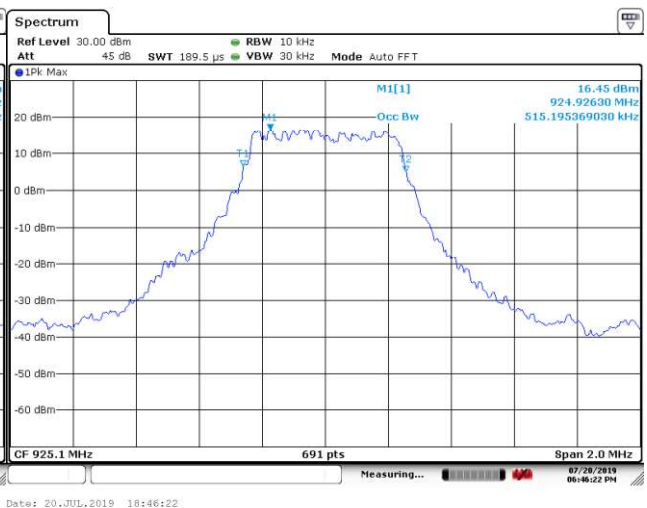
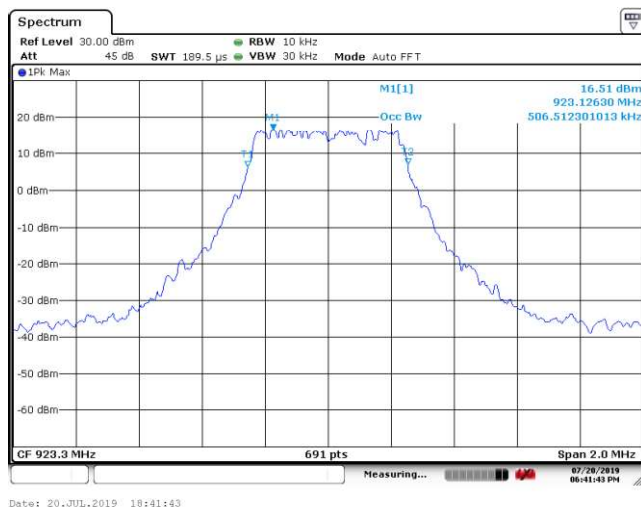


Prüfbericht - Nr.: 50321015 001
Test Report No.:

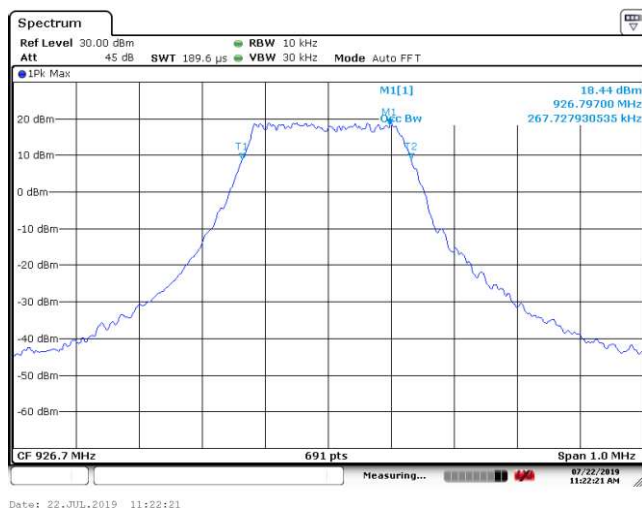
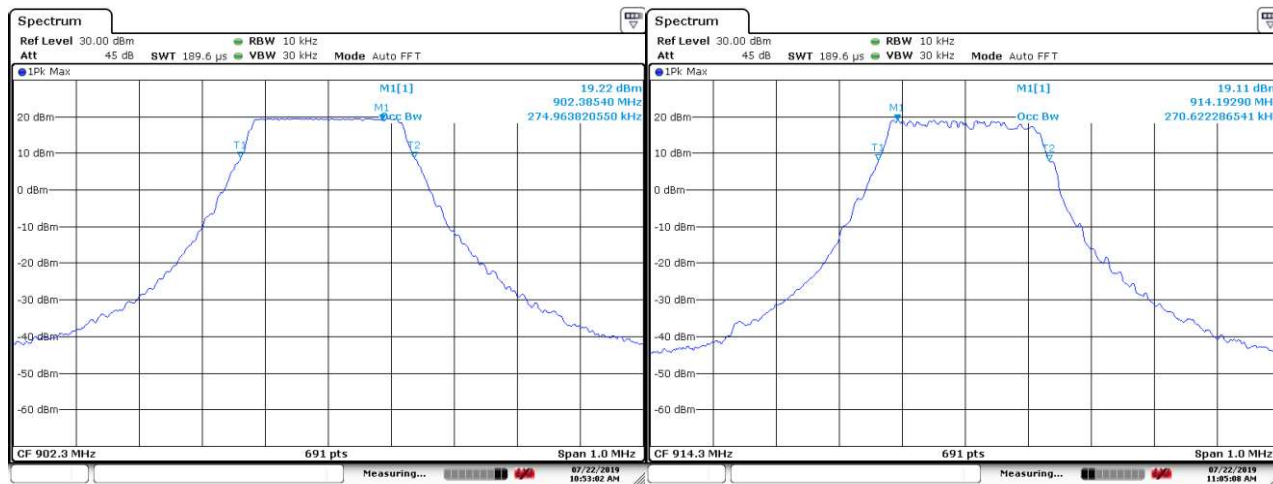
Seite 23 von 118
Page 23 of 118



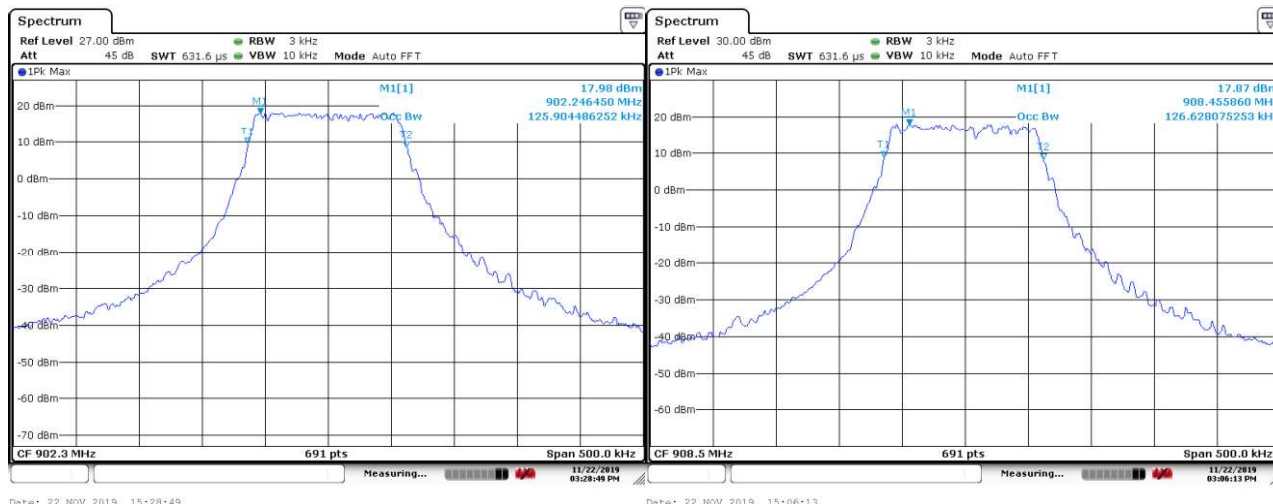
4. LoRa 500KHz DTS, 99% Emission Bandwidth, 923.3MHz~926.9MHz



5. LoRa 250KHz FHSS, 99% Emission Bandwidth, 902.3MHz~926.7MHz



6. LoRa 125KHz FHSS, 99% Emission Bandwidth, 902.3MHz~914.9MHz

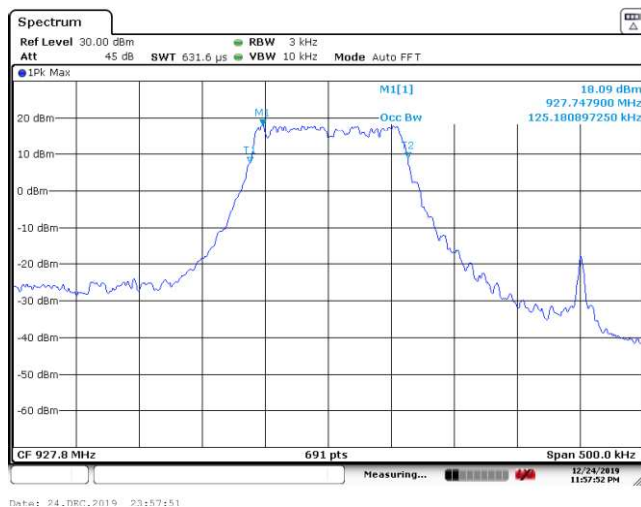


Prüfbericht - Nr.: 50321015 001
Test Report No.:

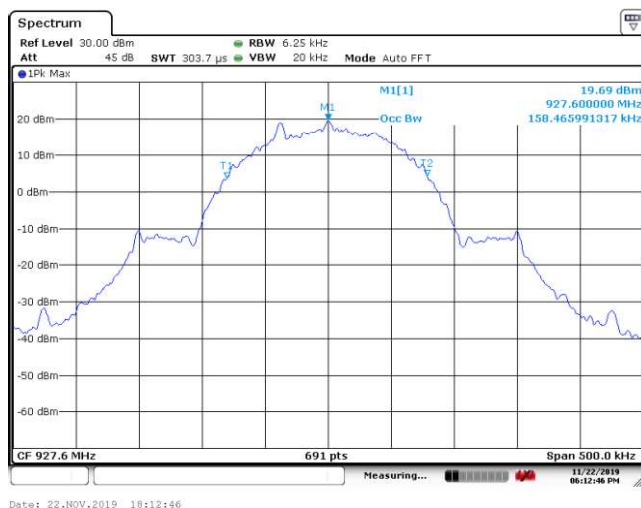
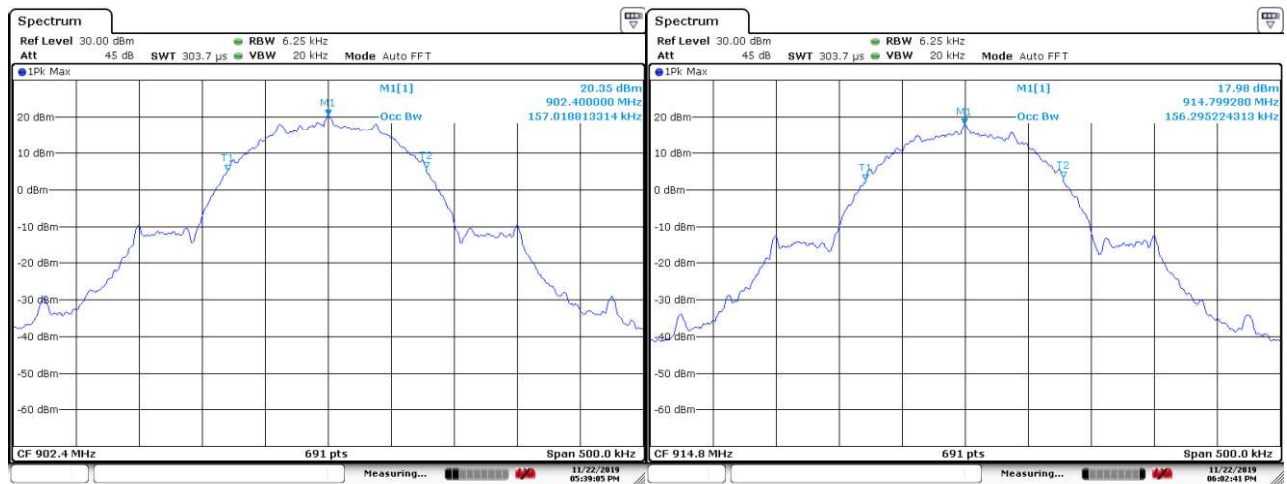
Seite 25 von 118
Page 25 of 118



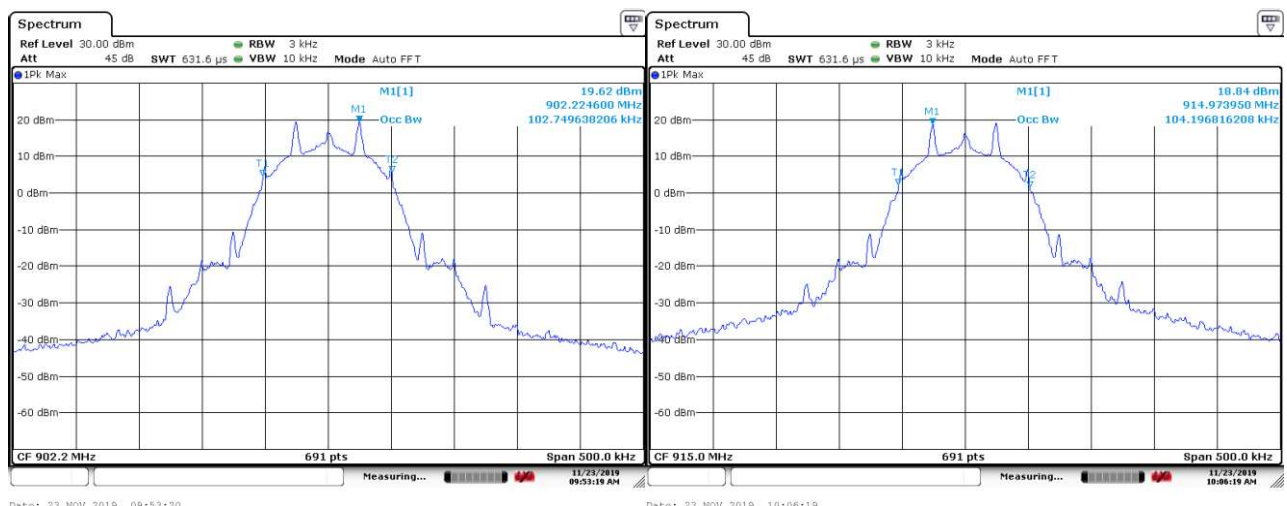
7. LoRa 125KHz FHSS, 99% Emission Bandwidth, 902.2MHz~927.8MHz



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

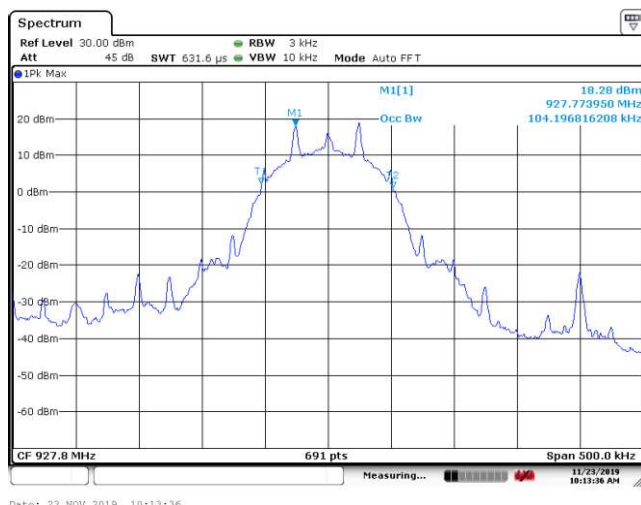


9. FSK 50Kbps FHSS, 99% Emission Bandwidth, 902.2MHz~927.8MHz

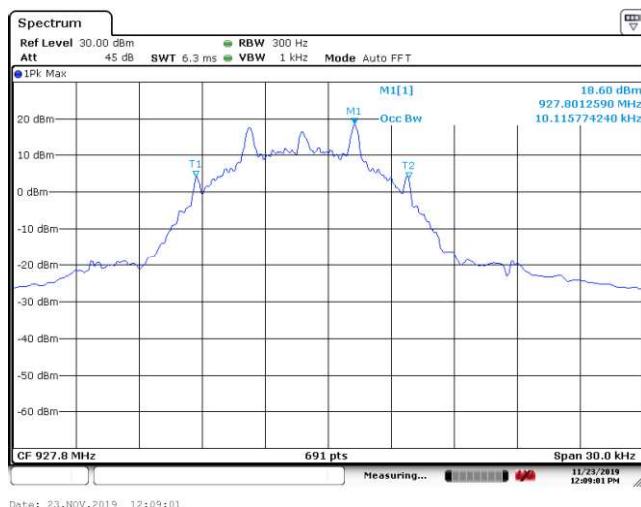
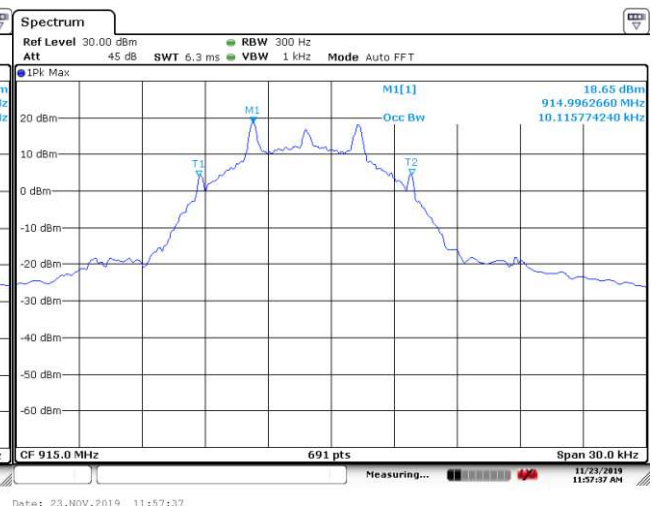
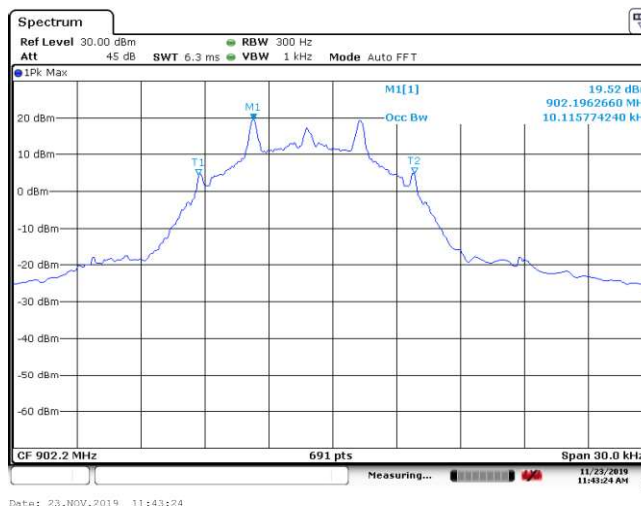


Prüfbericht - Nr.: 50321015 001
Test Report No.:

Seite 27 von 118
Page 27 of 118



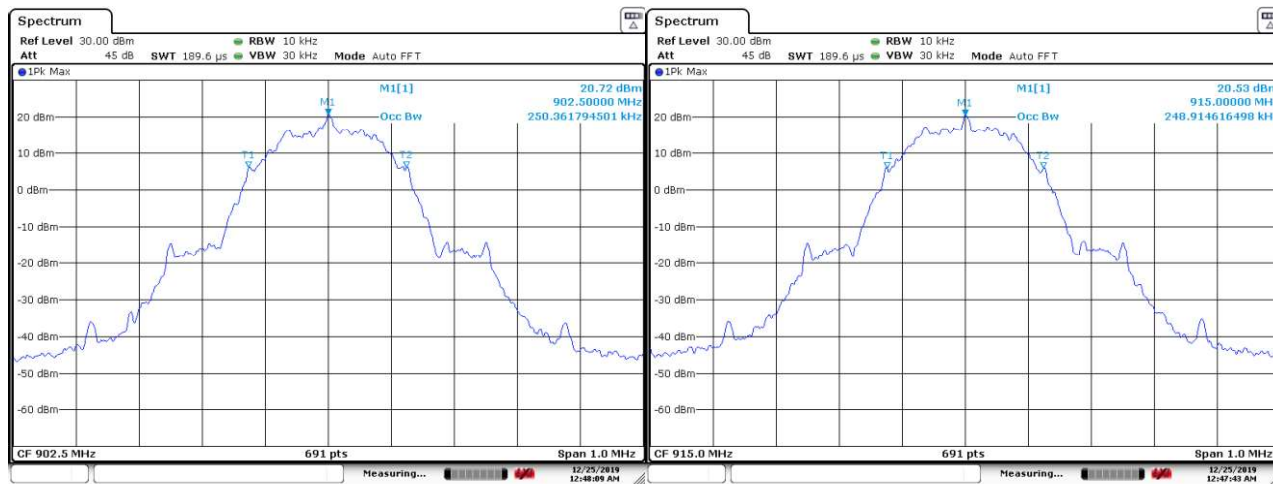
10. FSK 5Kbps FHSS, 99% Emission Bandwidth, 902.2MHz~927.8MHz



Prüfbericht - Nr.: 50321015 001
Test Report No.:

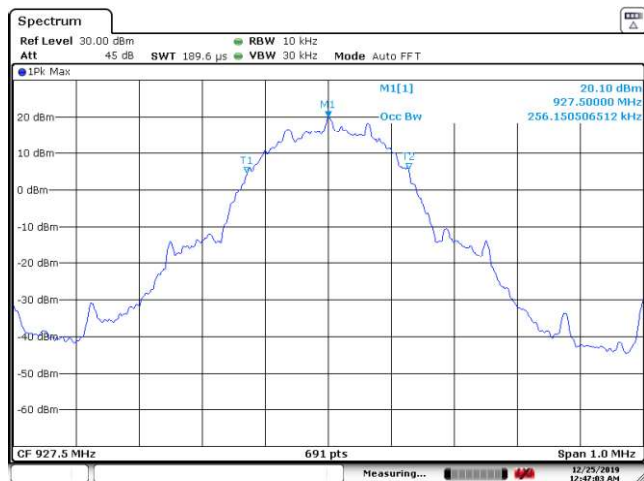
Seite 28 von 118
Page 28 of 118

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



Date: 25.DEC.2019 00:48:09

Date: 25.DEC.2019 00:47:43



Date: 25.DEC.2019 00:47:03

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 1 Watt for 902~928 FHSS system with more than 50 hopping channels;

Kind of test site : Shielded Room

Test Setup

Date of testing : 27.11.2019~25.12.2019

Input voltage : AC 120V, 60Hz

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

Test channel : Lo, Mi, Hi

Temperature : 20.1°C

Relative humidity : 57%

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	2.56	30
	Mid Channel	2440	2.43	30
	High Channel	2480	1.30	30
2. LoRa 500KHz DTS 902.5MHz~926.5	Low Channel	902.5	19.99	30
	Mid Channel	914.5	20.30	30
	High Channel	926.5	20.02	30
3. LoRa 500KHz DTS 903MHz~914.2MHz	Low Channel	903	20.28	30
	Mid Channel	907.8	20.64	30
	High Channel	914.2	20.35	30
4. LoRa 500KHz DTS 923.3MHz~926.9MHz	Low Channel	923.3	20.25	30
	Mid Channel	925.1	20.27	30
	High Channel	926.9	20.22	30
5. LoRa 250KHz FHSS 902.3MHz~926.7MHz	Low Channel	902.3	20.60	30
	Mid Channel	914.3	20.27	30
	High Channel	926.7	20.33	30
6. LoRa 125KHz FHSS	Low Channel	902.3	20.90	30

Prüfbericht - Nr.: 50321015 001

Test Report No.:

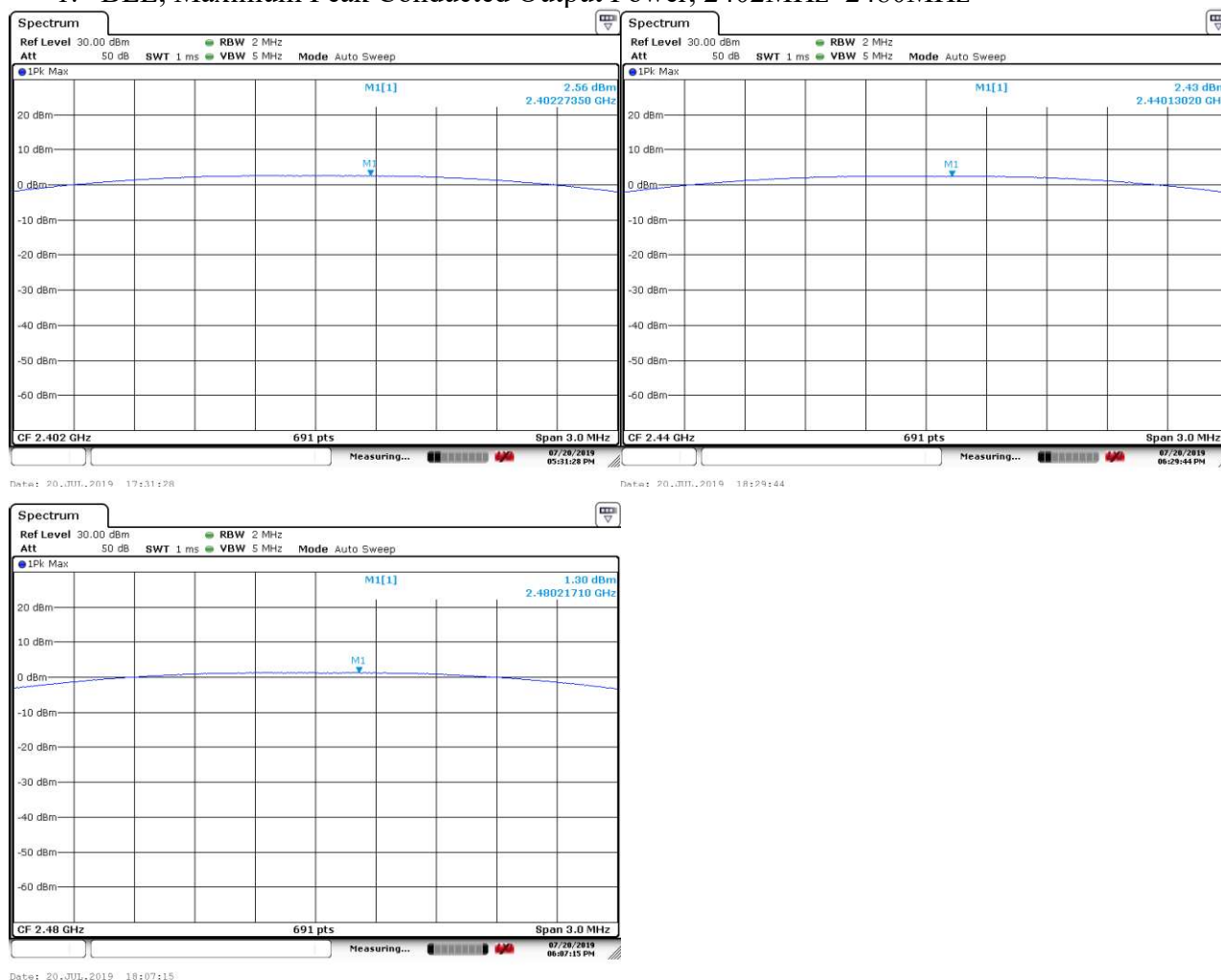
Seite 30 von 118

Page 30 of 118

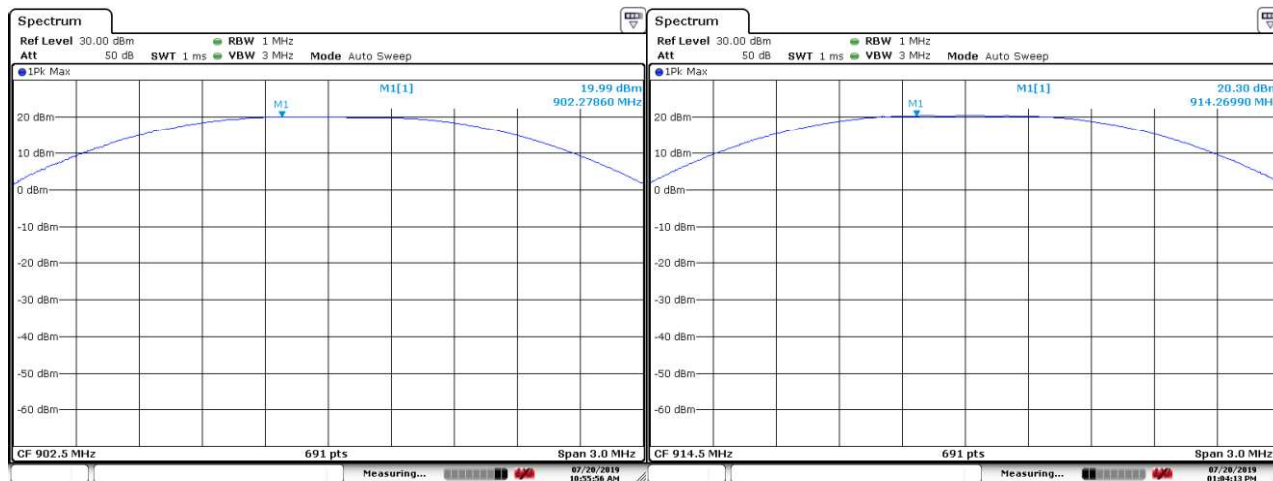
902.3MHz~914.9MHz	Mid Channel	908.5	20.82	30
	High Channel	914.9	20.64	30
7. LoRa 125KHz FHSS 902.2MHz~927.8MHz	Low Channel	902.2	21.23	30
	Mid Channel	915	20.91	30
	High Channel	927.8	20.49	30
8. FSK 150Kbps FHSS 902.4MHz~927.6MHz	Low Channel	902.4	20.08	30
	Mid Channel	914.8	20.32	30
	High Channel	927.6	19.07	30
9. FSK 50Kbps FHSS 902.2MHz~927.8MHz	Low Channel	902.2	20.86	30
	Mid Channel	915	20.39	30
	High Channel	927.8	20.06	30
10. FSK 5Kbps FHSS 902.2MHz~927.8MHz	Low Channel	902.2	20.53	30
	Mid Channel	915	20.39	30
	High Channel	927.8	20.23	30
11. FSK 250Kbps FHSS 902.5MHz~927.5MHz	Low Channel	902.5	21.01	30
	Mid Channel	915	20.63	30
	High Channel	927.5	20.31	30

Figure 3: Maximum peak Conducted Output Power

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

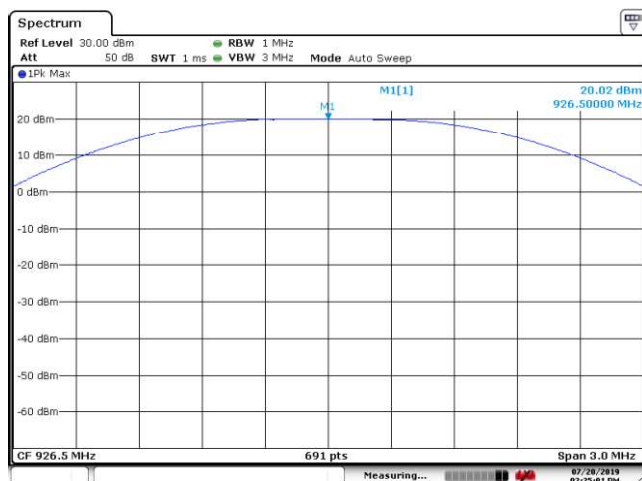


2. LoRa 500KHz DTS, Maximum Peak Conducted Output Power, 902.5MHz~926.5



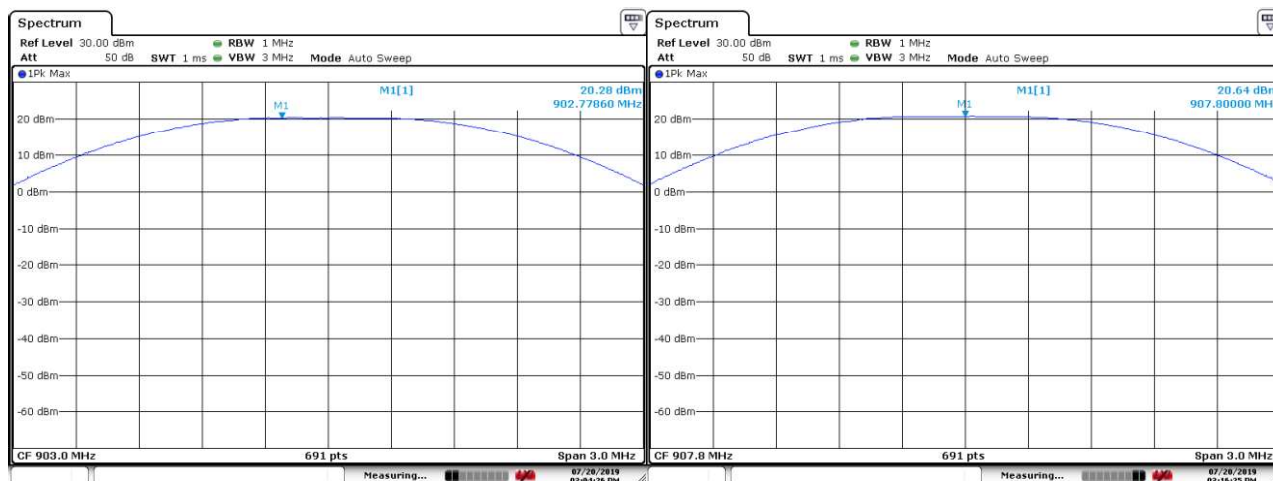
Date: 20.JUL.2019 10:55:55

Date: 20.JUL.2019 13:04:13



Date: 20.JUL.2019 14:25:01

3. LoRa 500KHz DTS, Maximum Peak Conducted Output Power, 903MHz~914.2MHz

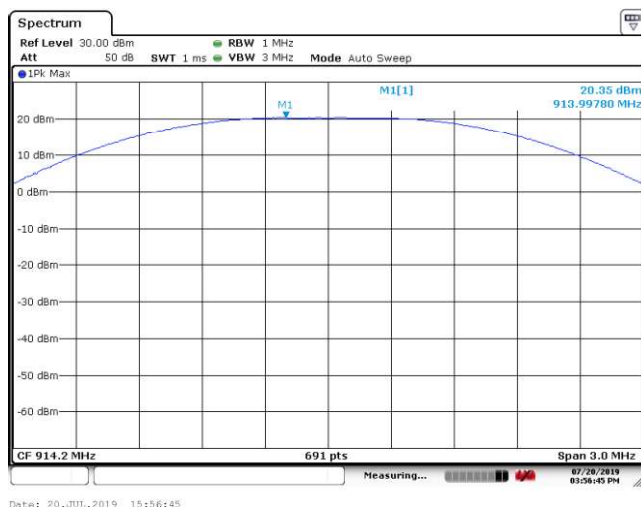


Date: 20.JUL.2019 15:04:26

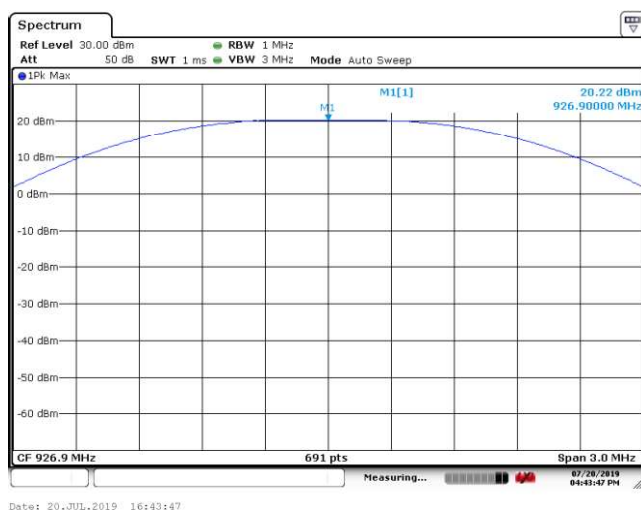
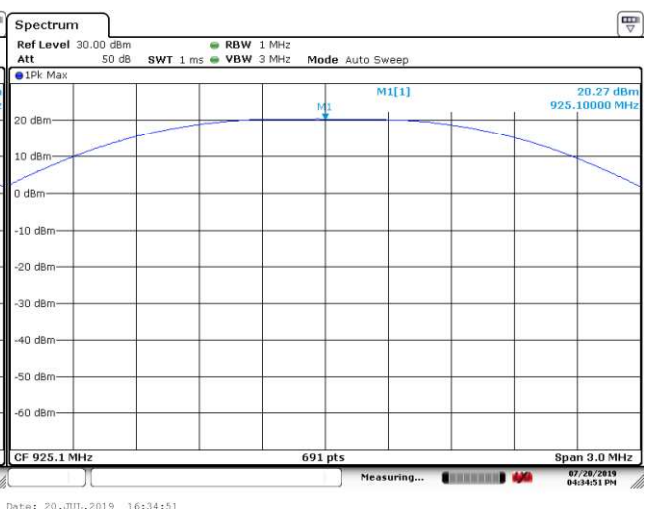
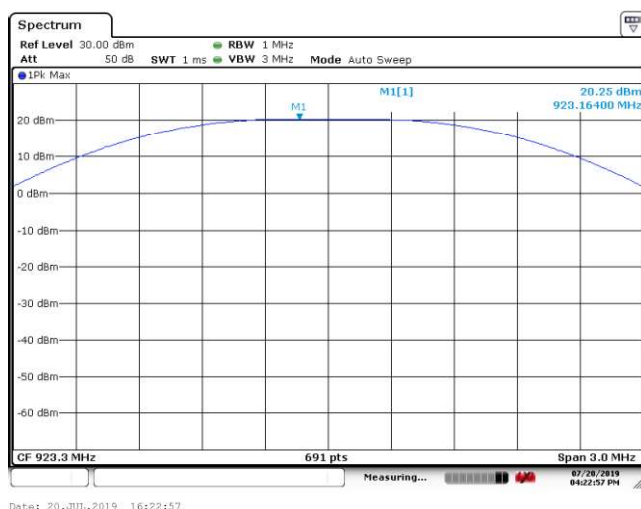
Date: 20.JUL.2019 15:16:24

Prüfbericht - Nr.: 50321015 001
Test Report No.:

Seite 32 von 118
Page 32 of 118



4. LoRa 500KHz DTS, Maximum Peak Conducted Output Power, 923.3MHz~926.9MHz



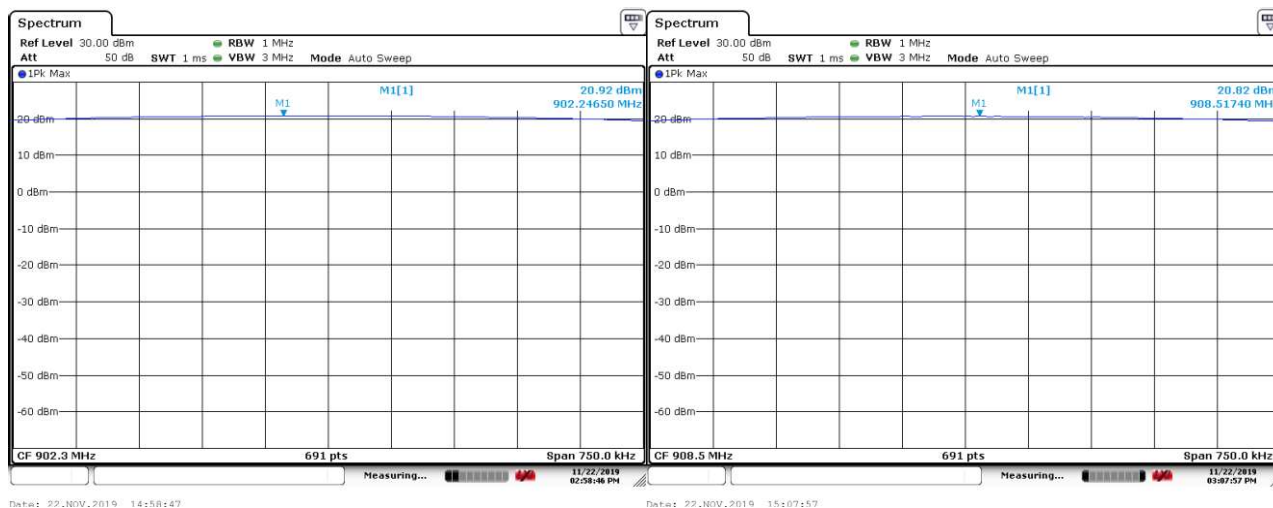
Prüfbericht - Nr.: 50321015 001
Test Report No.:

Seite 33 von 118
Page 33 of 118

5. LoRa 250KHz FHSS, Maximum Peak Conducted Output Power, 902.3MHz~926.7MHz

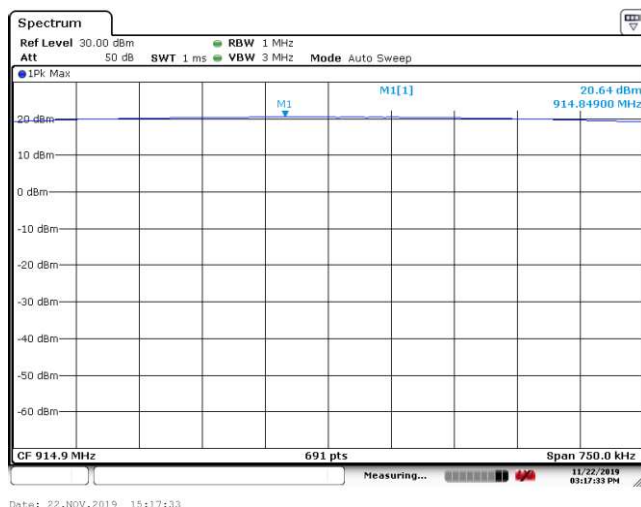


6. LoRa 125KHz FHSS, Maximum Peak Conducted Output Power, 902.3MHz~914.9MHz

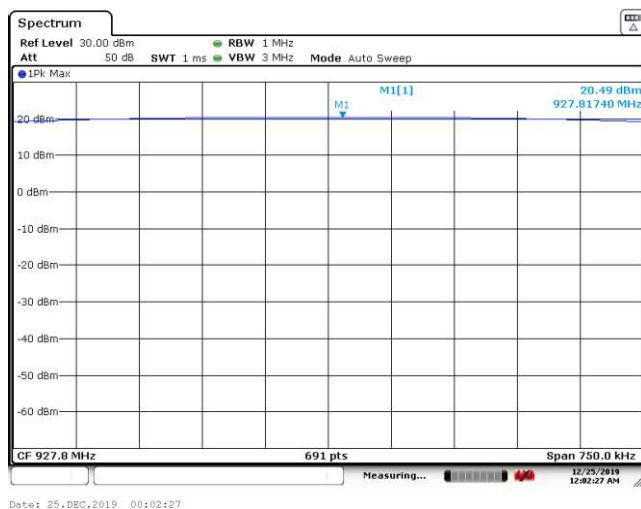
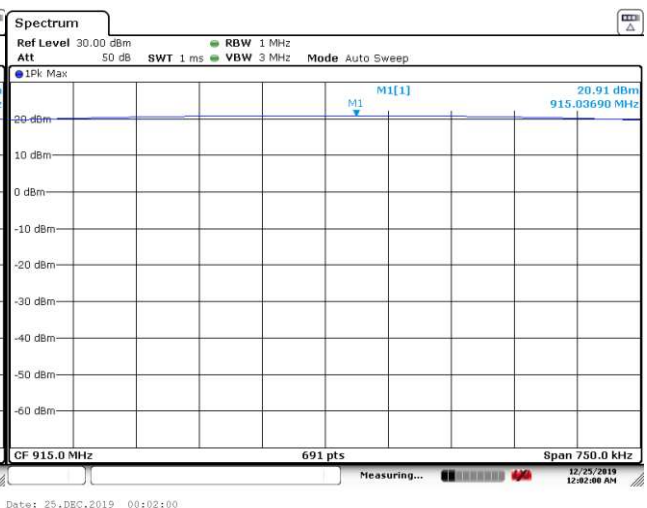
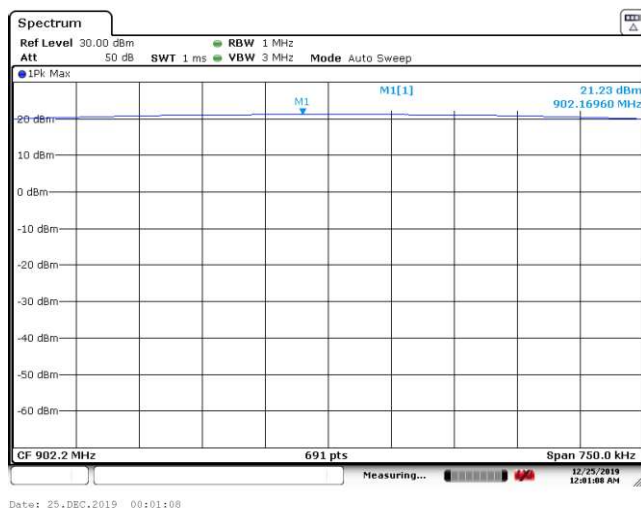


Prüfbericht - Nr.: 50321015 001
Test Report No.:

Seite 34 von 118
Page 34 of 118



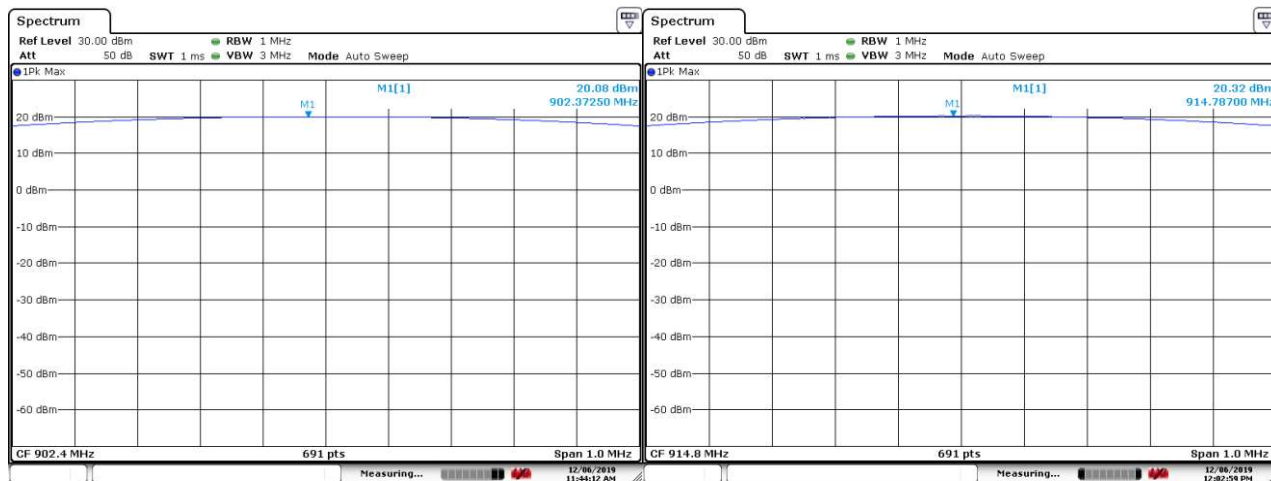
7. LoRa 125KHz FHSS, Maximum Peak Conducted Output Power, 902.2MHz~927.8MHz



Prüfbericht - Nr.: 50321015 001
Test Report No.:

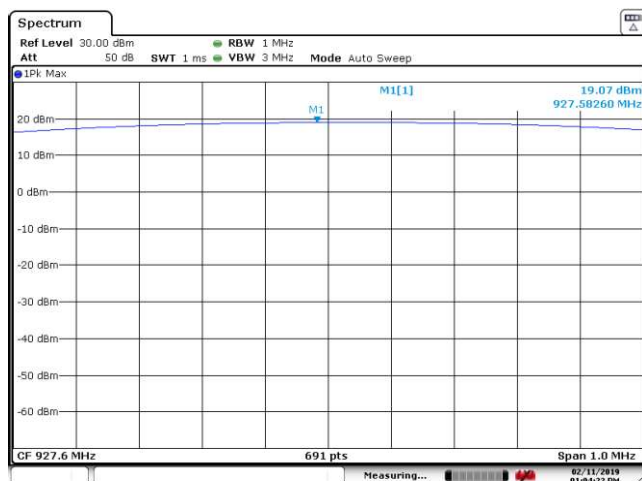
Seite 35 von 118
Page 35 of 118

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



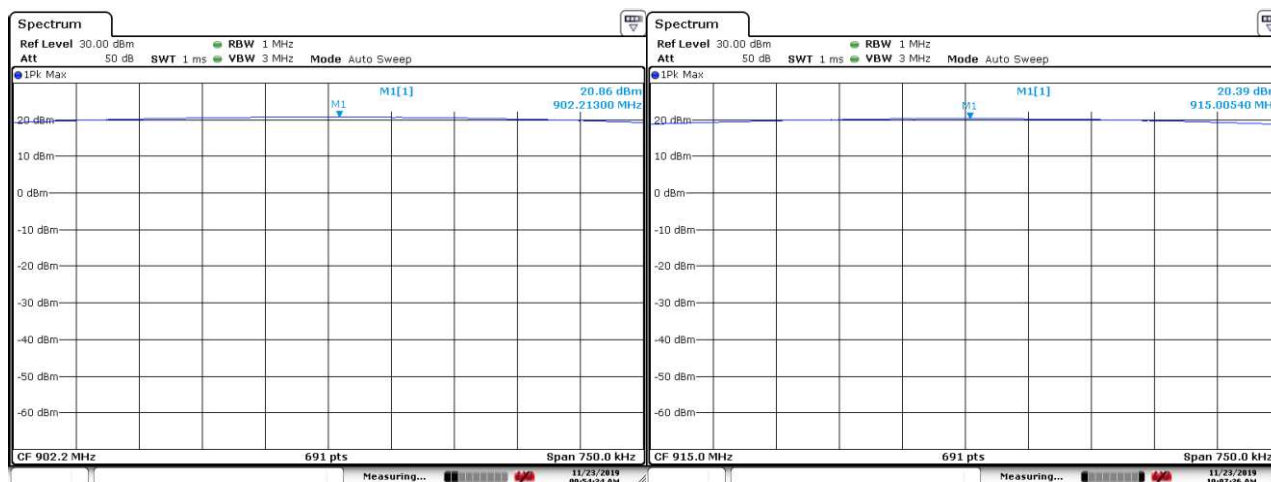
Date: 6.DEC.2019 11:44:12

Date: 6.DEC.2019 12:02:59



Date: 11.FEB.2019 13:04:22

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

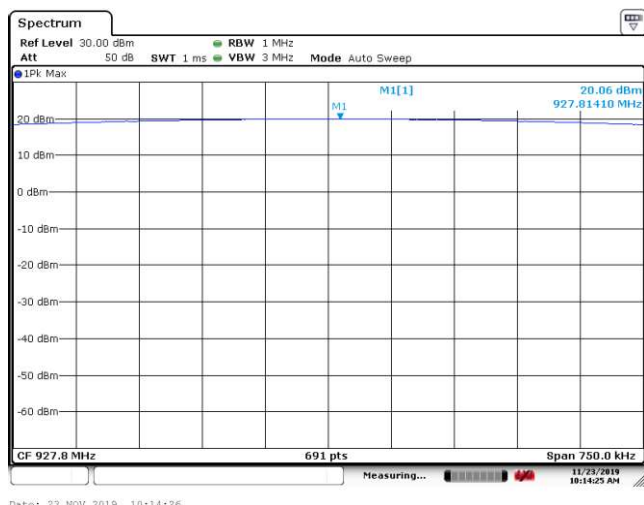


Date: 23.NOV.2019 09:54:35

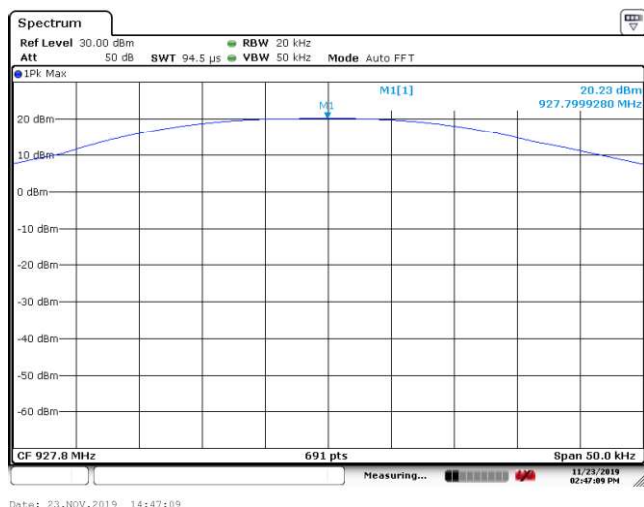
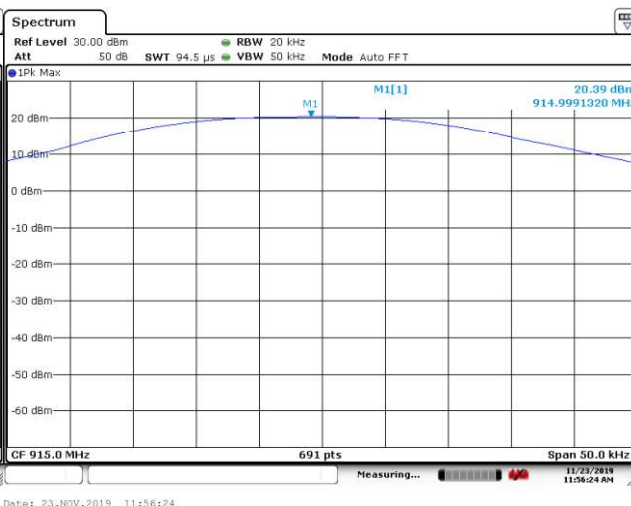
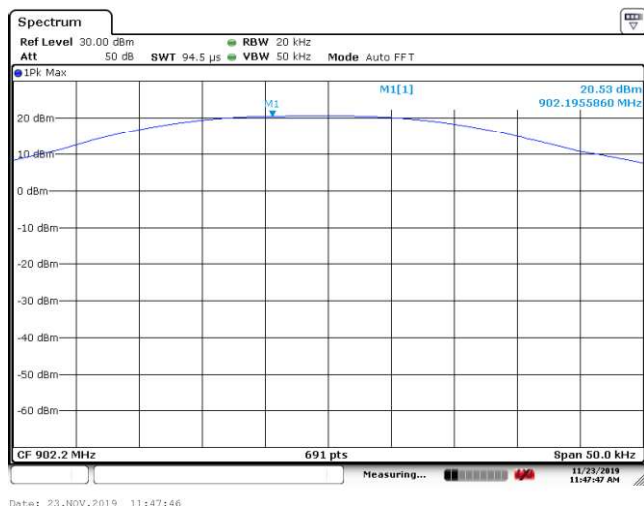
Date: 23.NOV.2019 10:07:36

Prüfbericht - Nr.: 50321015 001
Test Report No.:

Seite 36 von 118
Page 36 of 118



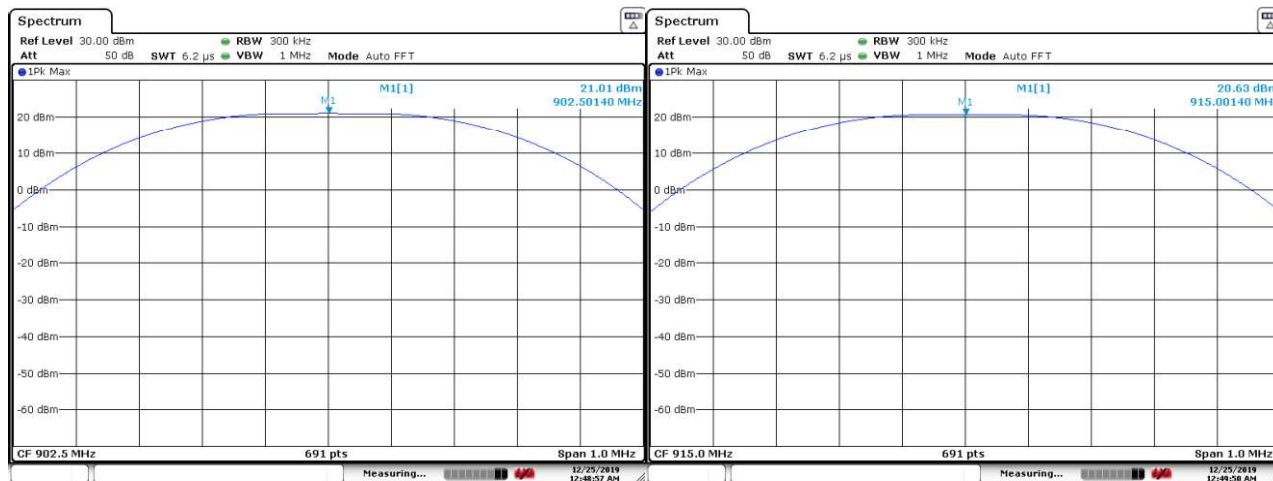
10. FSK 5Kbps FHSS, Maximum Peak Conducted Output Power, 902.2MHz~927.8MHz



Prüfbericht - Nr.: 50321015 001
Test Report No.:

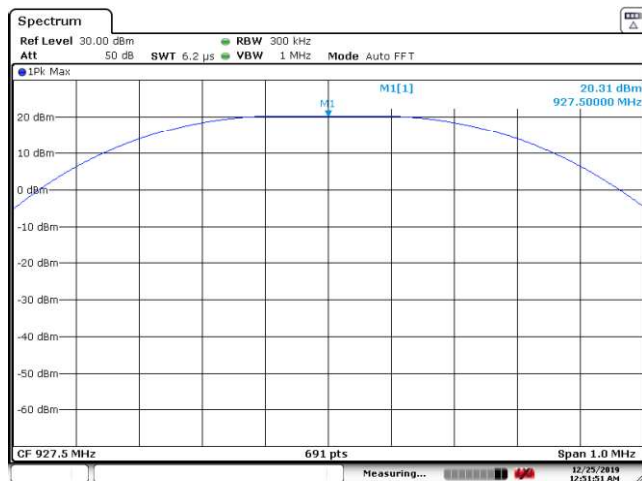
Seite 37 von 118
Page 37 of 118

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



Date: 25.DEC.2019 00:48:57

Date: 25.DEC.2019 00:49:50



Date: 25.DEC.2019 00:51:51