

Prüfbericht - Nr.: <i>Test Report No.:</i>	CN20UHV 001	Auftrags-Nr.: <i>Order No.:</i>	180195694	Seite 1 von 69 Page 1 of 69
Kunden-Referenz-Nr.: <i>Client Reference No.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	2020.12.03	
Auftraggeber: <i>Client:</i>	Ring LLC 1523 26th St, Santa Monica, CA 90404, USA			
Prüfgegenstand: <i>Test item:</i>	Outdoor Smart Plug			
Bezeichnung / Typ-Nr.: <i>Identification / Type No.:</i>	5E22E9			
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 RSS-247 Issue 2 February 2017 RSS-Gen Issue 5 March 2019 FCC Part15, Subpart B:2019 ICES-003:2017			
Wareneingangsdatum: <i>Date of receipt:</i>	2020.12.03	Refer to attachment 1		
Prüfmuster-Nr.: <i>Test sample No.:</i>	A002968971 001-002			
Prüfzeitraum: <i>Testing period:</i>	2020.12.02-2020.12.07			
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:		
2021.03.16 Caidong Xie/PE		2021.03.16 Feng Liang/TC		
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 page 5 to 6 for more information. FCC ID: 2AEUPRBWP001 IC: 20271-RBWP001				
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>				

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 PEAK 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 CHANNEL OCCUPANCY TIME

Result:

Pass

4.1.11 CONDUCTED EMISSION (AC POWER-LINE)

Result:

Pass

4.1.12 RADIATED EMISSION

Result:

Pass

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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	2020.11.25	2020.11.11
2.	Spectrum analyzer	FSV40	101412	2020.11.25	2020.11.11
3.	Pre-amplifier	SCU-18F	180051	2020.11.25	2020.11.11
4.	Horn antenna	HF907	102653	2020.08.03	2021.08.02
5.	Bilog Antenna	CBL6112D	49033	2018.04.13	2021.04.12
6.	EMI receiver	ESR3	102331	2020.11.25	2020.11.11
7.	LISN	ENV216	102250	2020.11.25	2020.11.11

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)	4.39dB
Radiated Emission (1-18GHz)	4.67dB

2 General Product Information

2.1 Product Function and Intended Use

The EUT(equipment under test) is an Outdoor Smart Plug 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
5E22E9	Block A: BLE operated at 2.4GHz Block B: LoRa DTS, LoRa FHSS and FSK FHSS operated at 902-928MHz

2.2 Ratings and System Details

Power input	: AC 120V, 60Hz
Protection Class	: Class I
FCC ID	: 2AEUPRBWP001
IC	: 20271-RBWP001
HVIN	: 5E22E9
FVIN	: 1.7.16-56
PMN	: Outdoor Smart Plug

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	PCB Layout antenna
Antenna Gain(dBi)	-2.5
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	PCB Layout antenna
Antenna Gain(dBi)	-3.8
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

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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	PCB Layout antenna
Antenna Gain(dBi)	-3.8
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	PCB Layout antenna		
Antenna Gain(dBi)	-3.8		
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:

Mode A: Transmitting continuously in a channel

Mode B: Hopping in a sequence of hopping channels and Transmitting

Mode C: Transmitting continuously or receiving continuously in a channel, the worst case recorded

Mode D: Switch working

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 Mode Cs 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)

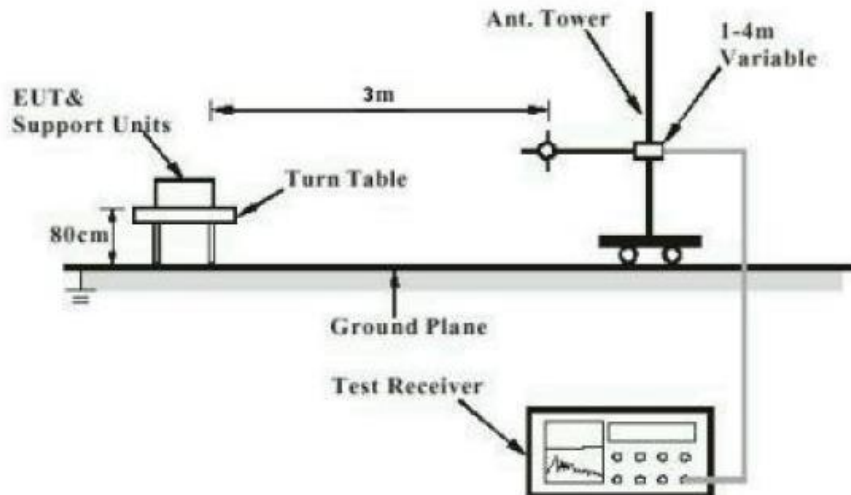


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

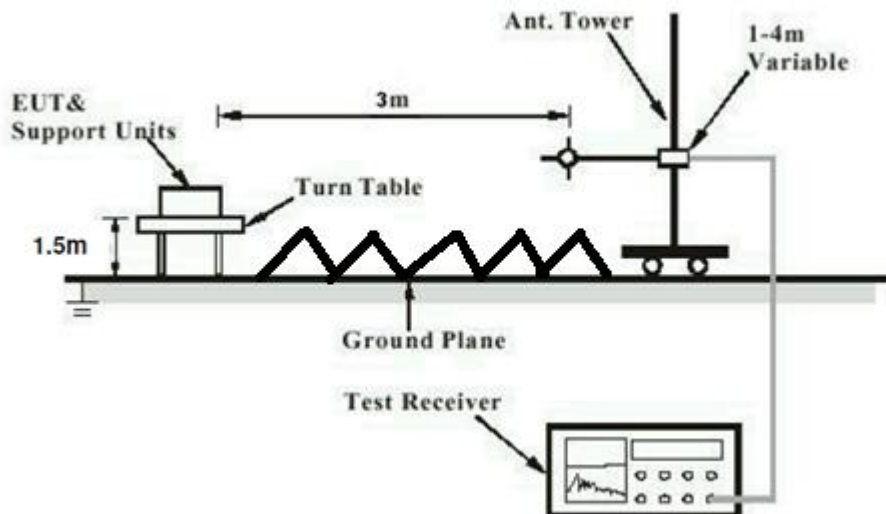
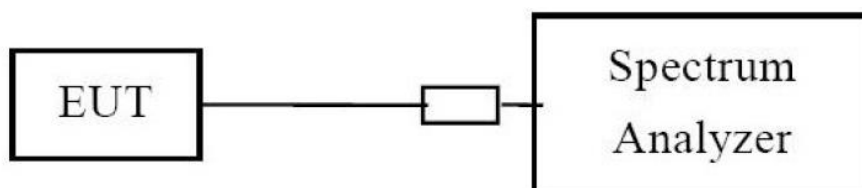


Diagram of Measurement Configuration for Conducted Transmitter Measurement



4 Test Results

4.1 Transmitter Requirement & Test Suites

4.1.1 Antenna Requirement

Result:

Pass

Test Specification
Test standard : FCC Part 15.203

The EUT has two internal antennas, which permanently attached and no consideration of replacement. Therefore, the EUT is considered sufficient to comply with the provision. Refer to EUT Photo for further details.

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4.1.2 6dB and 20dB Bandwidth Measurement

Result:

Pass

Test Specification

Test standard : FCC Part 15.247(a)(1)(i), (a)(2)
RSS-247 Issue 2 February 2017 Clause 5.1, Clause 5.2

Basic standard : ANSI C63.10: 2013, clause 6.9.2
KDB558074 D01v05r02, clause 8.3.1.1

Limits : At least 500kHz for 6dB bandwidth(DTS)
Not more than 500kHz for 20dB bandwidth(FHSS)

Kind of test site : Shielded Room

Test Setup

Date of testing : 2020.12.07
Input voltage : AC 120V, 60Hz
Operational mode : Mode A
Test channel : Lo, Mi, Hi
Temperature : 20°C
Relative humidity : 55%
Atmospheric pressure : 102.1 kPa

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

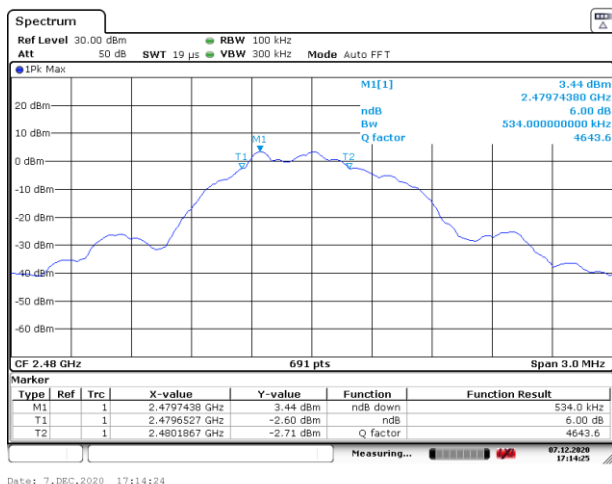
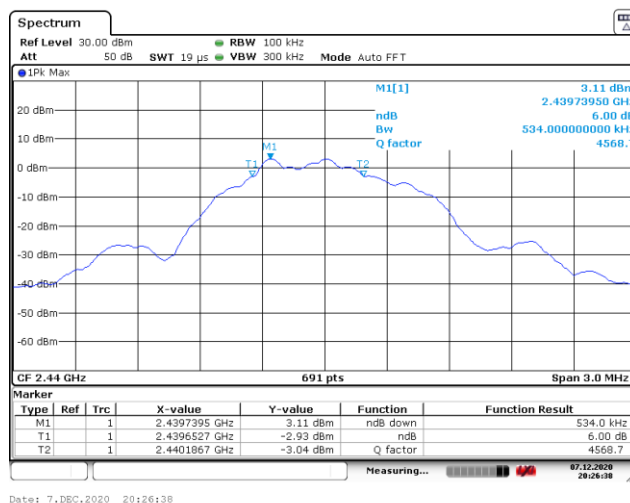
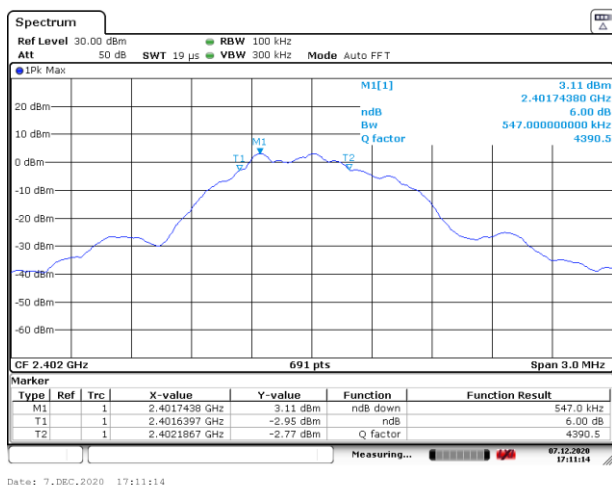
Modulation Type and Operation band	Channel	Channel Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)	Result
1. BLE 2402MHz~2480MHz 6dB Bandwidth	Low Channel	2402	547.00	500	Pass
	Mid Channel	2440	534.00	500	Pass
	High Channel	2480	534.00	500	Pass
2. LoRa 500kHz DTS 902.5MHz~926.5MHz 6dB Bandwidth	Low Channel	902.5	620.80	500	Pass
	Mid Channel	914.5	620.80	500	Pass
	High Channel	926.5	620.80	500	Pass
3. LoRa 125kHz FHSS 902.2MHz~927.8MHz 20dB Bandwidth	Low Channel	902.2	144.72	500	Pass
	Mid Channel	915	144.72	500	Pass
	High Channel	927.8	149.06	500	Pass
4. FSK 150Kbps FHSS 902.4MHz~927.6MHz 20dB Bandwidth	Low Channel	902.4	174.38	500	Pass
	Mid Channel	914.8	175.11	500	Pass
	High Channel	927.6	171.49	500	Pass
5. FSK 50Kbps FHSS 902.2MHz~927.8MHz 20dB Bandwidth	Low Channel	902.2	111.43	500	Pass
	Mid Channel	915	109.26	500	Pass
	High Channel	927.8	109.26	500	Pass
6. FSK 250Kbps FHSS 902.5MHz~927.5MHz 20dB Bandwidth	Low Channel	902.5	282.20	500	Pass
	Mid Channel	915	276.40	500	Pass
	High Channel	927.5	276.40	500	Pass

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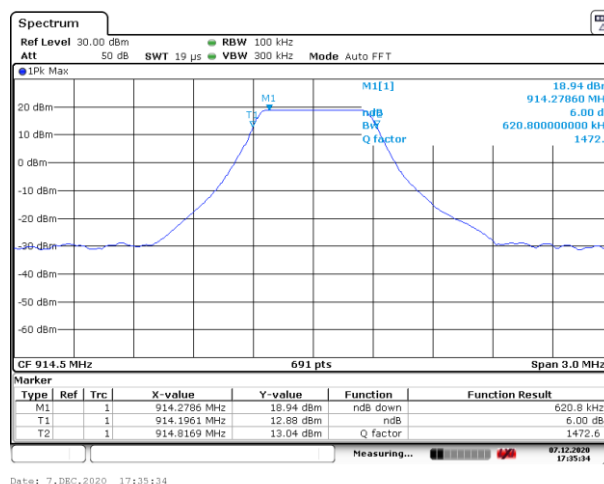
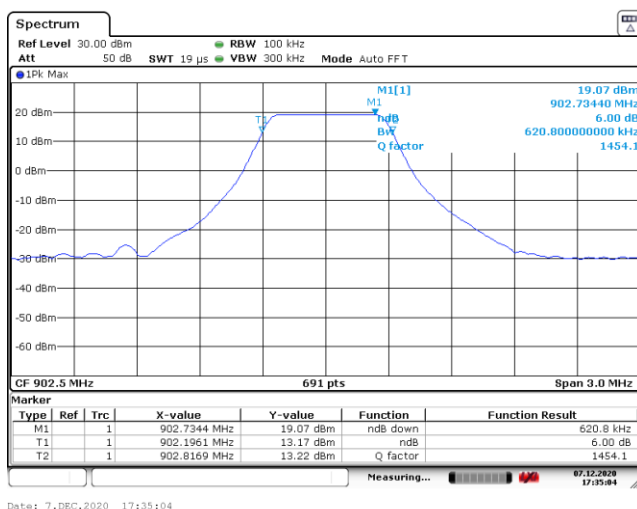
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Figure 1: 6dB&20dB Bandwidth Measurement

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



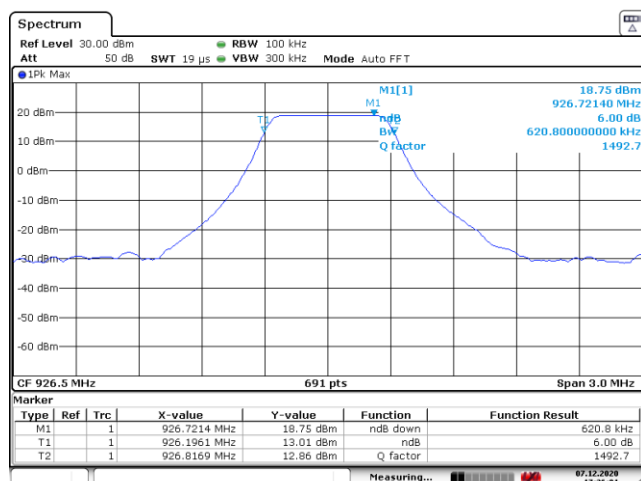
2. LoRa 500kHz DTS, 6dB Bandwidth, 902.5MHz~926.5MHz



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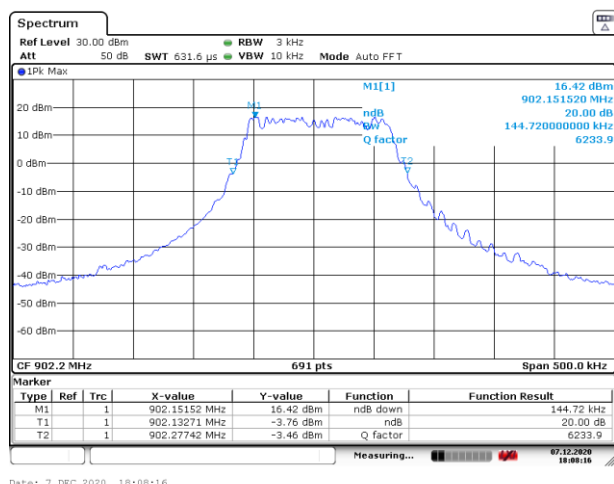
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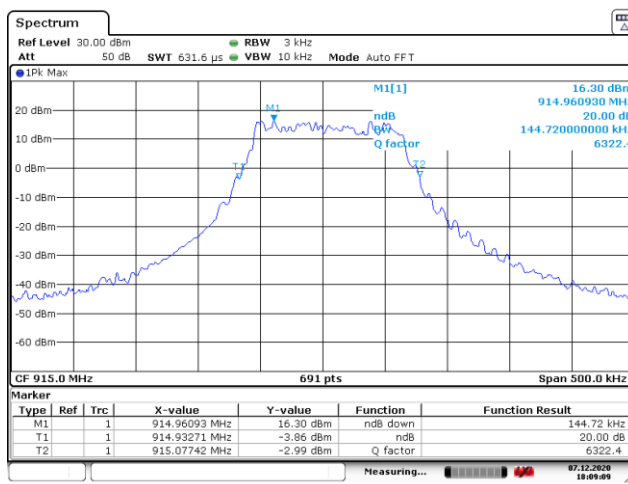


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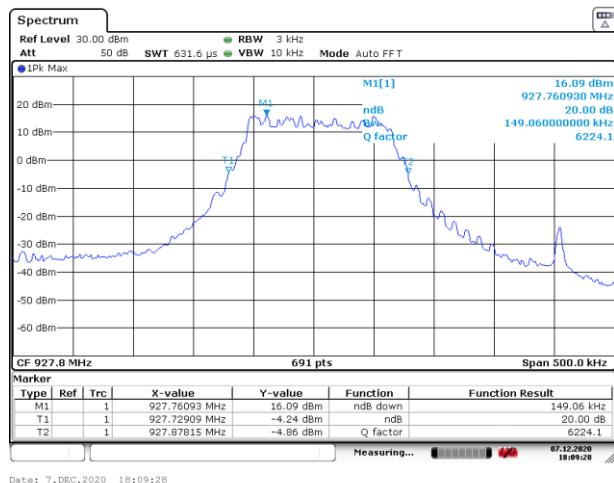
3. LoRa 125kHz FHSS, 20dB Bandwidth, 902.2MHz-927.8MHz



Date: 7.DEC.2020 18:08:16



Date: 7.DEC.2020 18:09:09

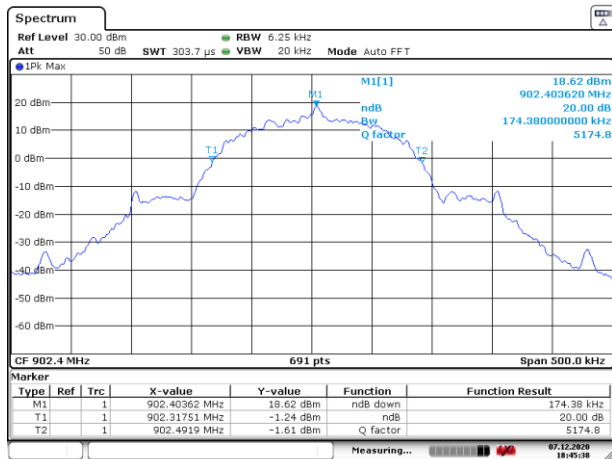


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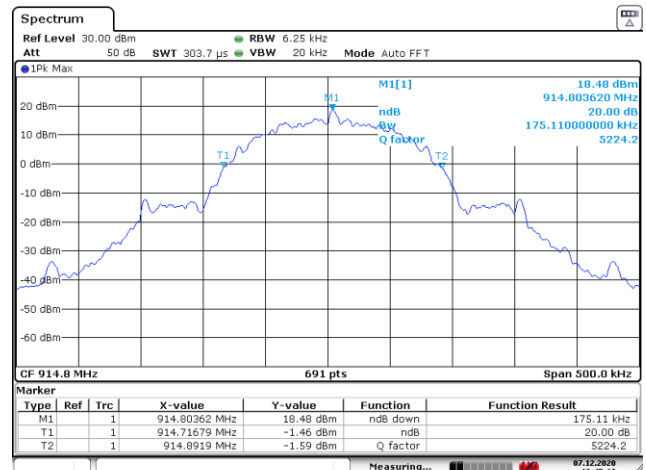
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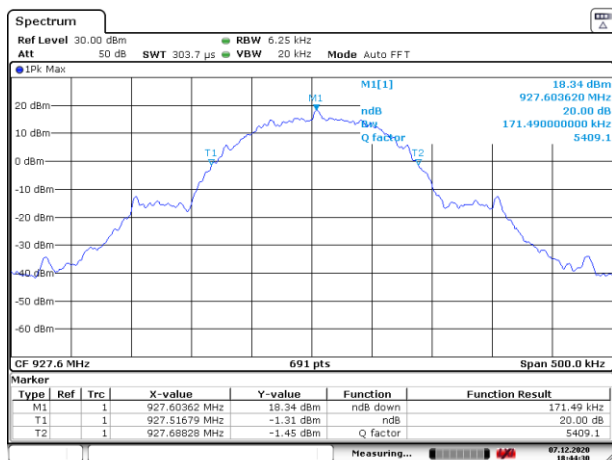
4. FSK 150Kbps FHSS, 20dB Bandwidth, 902.4MHz~927.6MHz



Date: 7.DEC.2020 18:45:38

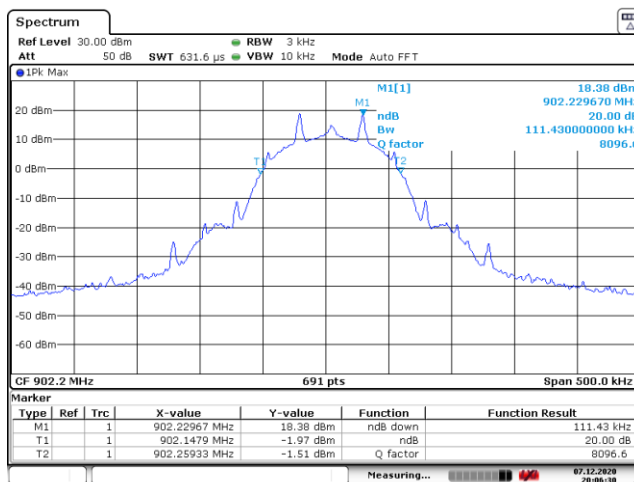


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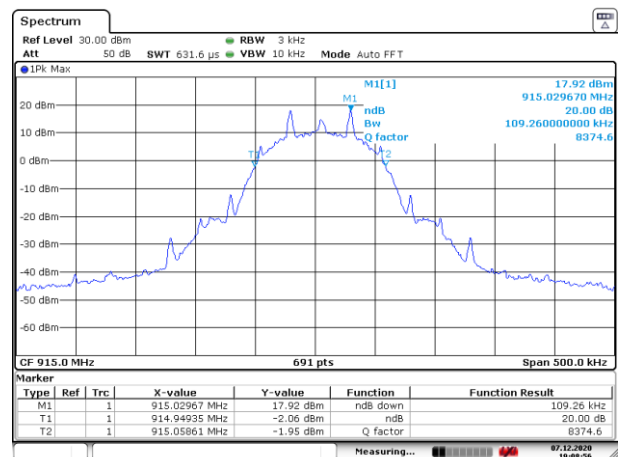


Date: 7.DEC.2020 18:44:30

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



Date: 7.DEC.2020 20:06:30



Date: 7.DEC.2020 19:08:56

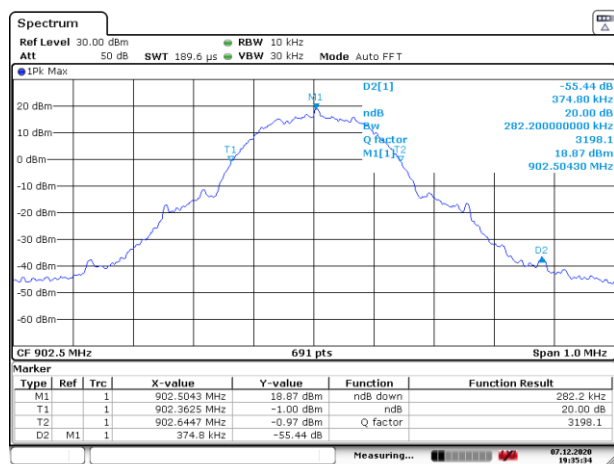
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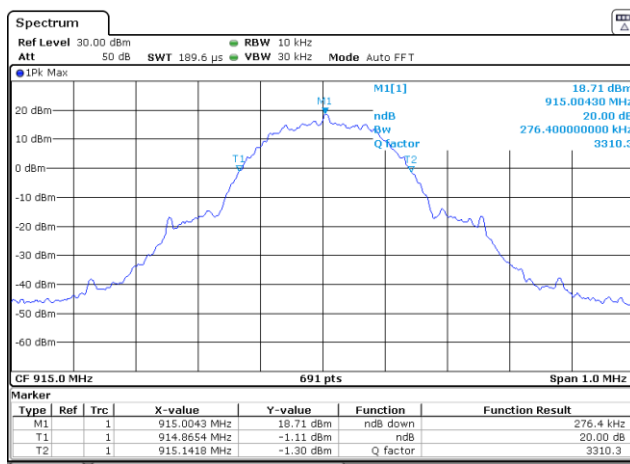


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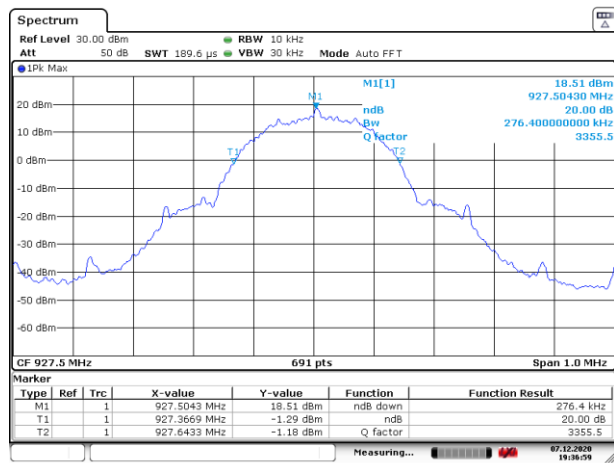
6. FSK 250Kbps FHSS, 20dB Bandwidth, 902.5MHz~927.5MHz



Date: 7.DEC.2020 19:05:34



Date: 7.DEC.2020 19:06:39



Date: 7.DEC.2020 19:06:59

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4.1.3 99% Emission Bandwidth Measurement

Result:

Pass

Test Specification

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

Basic standard : ANSI C63.10: 2013, clause 6.9.3

Kind of test site : Shielded Room

Test Setup

Date of testing : 2020.12.07

Input voltage : AC 120V, 60Hz

Operational mode : Mode A

Test channel : Lo, Mi, Hi

Temperature : 20°C

Relative humidity : 55%

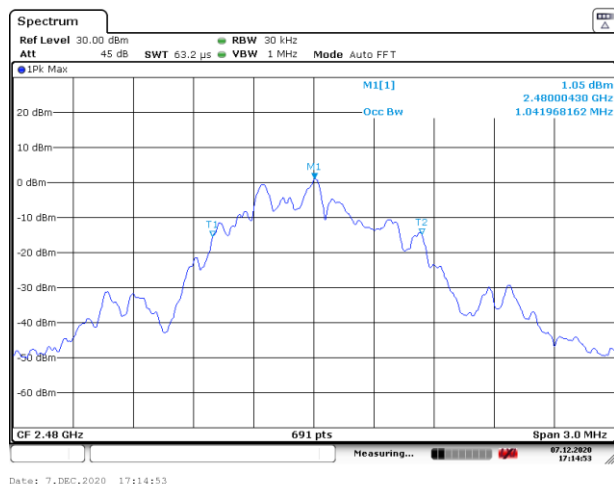
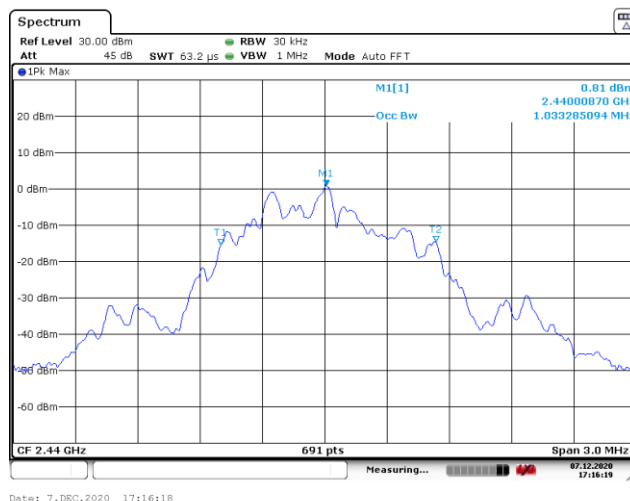
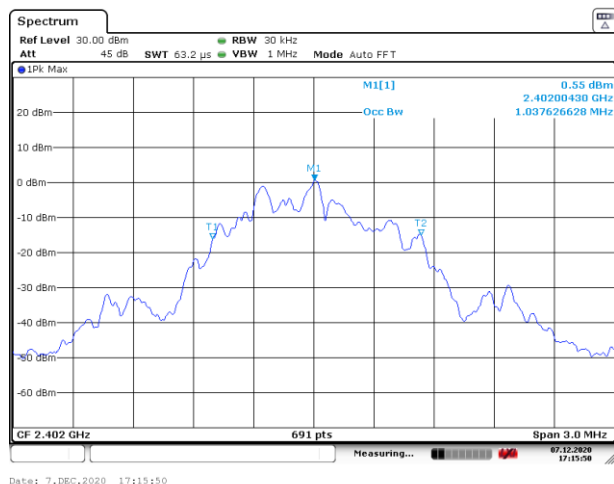
Atmospheric pressure : 102.1 kPa

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

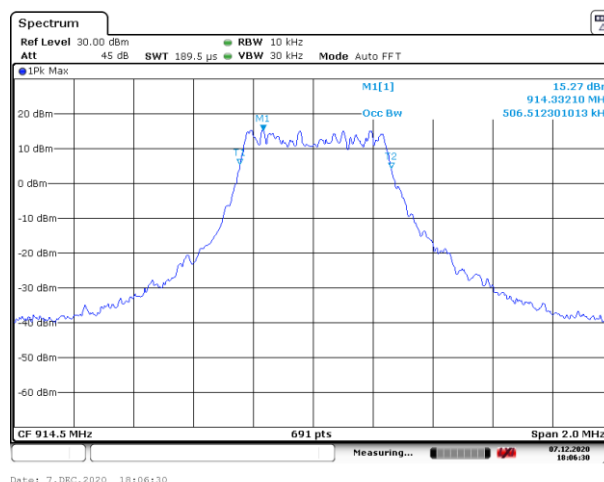
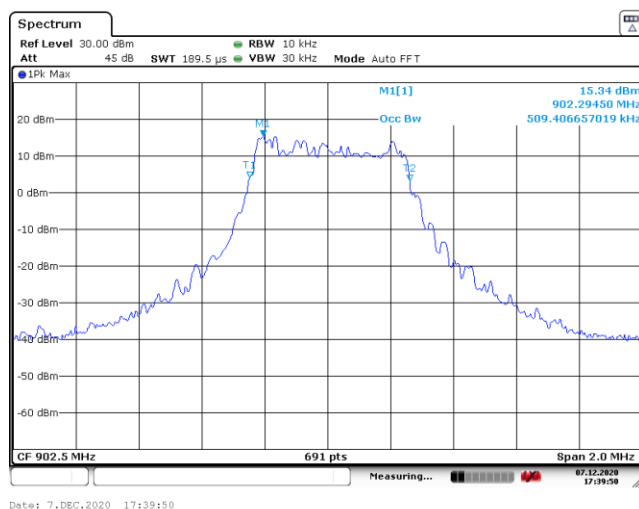
Modulation Type and Operation band	Channel	Channel Frequency (MHz)	Bandwidth (kHz)
1. BLE 2402MHz~2480MHz 99% Emission Bandwidth	Low Channel	2402	1037.63
	Mid Channel	2440	1033.29
	High Channel	2480	1041.97
2. LoRa 500kHz DTS 902.5MHz~926.5MHz 99% Emission Bandwidth	Low Channel	902.5	509.41
	Mid Channel	914.5	506.51
	High Channel	926.5	515.20
3. LoRa 125kHz FHSS 902.2MHz~927.8MHz 99% Emission Bandwidth	Low Channel	902.2	125.90
	Mid Channel	915	126.63
	High Channel	927.8	128.80
4. FSK 150Kbps FHSS 902.4MHz~927.6MHz 99% Emission Bandwidth	Low Channel	902.4	158.47
	Mid Channel	914.8	157.74
	High Channel	927.6	157.74
5. FSK 50Kbps FHSS 902.2MHz~927.8MHz 99% Emission Bandwidth	Low Channel	902.2	104.92
	Mid Channel	915	104.20
	High Channel	927.8	102.75
6. FSK 250Kbps FHSS 902.5MHz~927.5MHz 99% Emission Bandwidth	Low Channel	902.5	250.36
	Mid Channel	915	251.81
	High Channel	927.5	251.81

Figure 2: 99% Emission Bandwidth Measurement

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

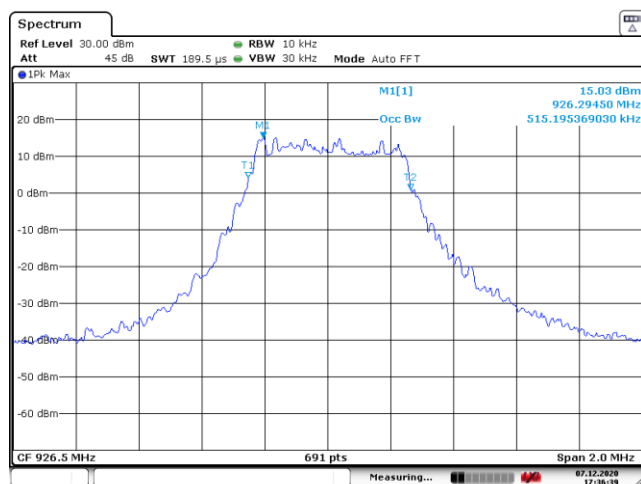


2. LoRa 500kHz DTS, 99% Emission Bandwidth, 902.5MHz~926.5MHz



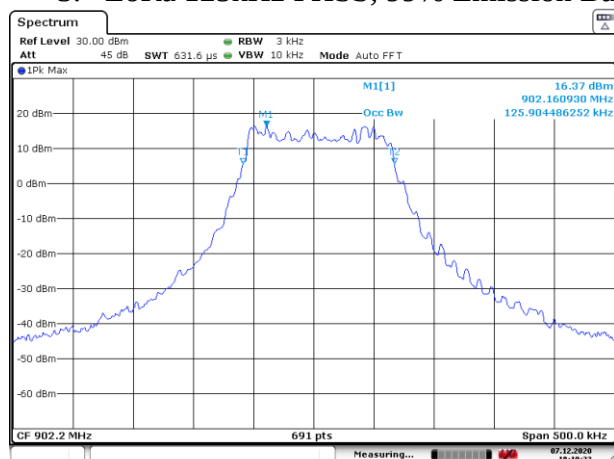
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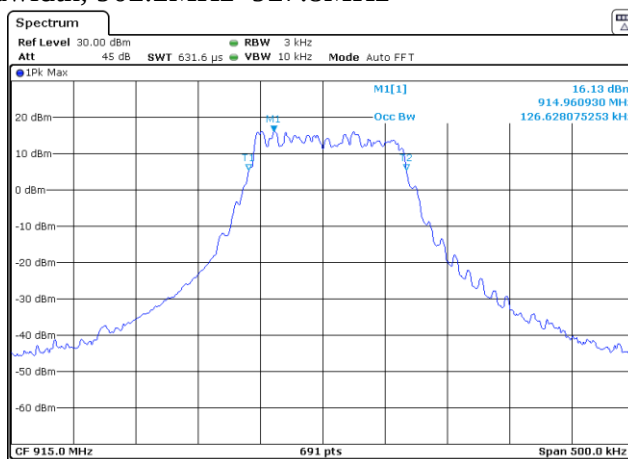


Date: 7.DEC.2020 17:36:39

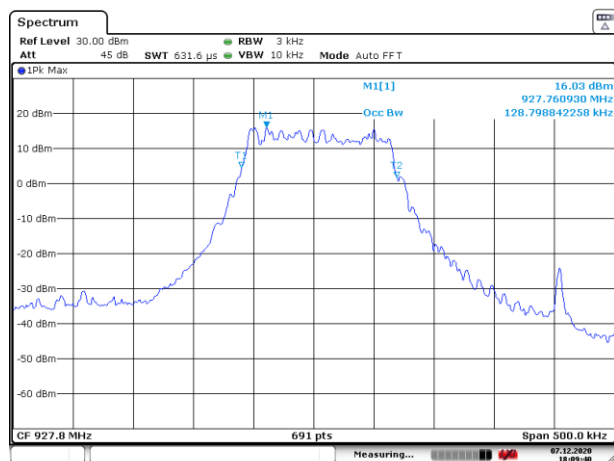
3. LoRa 125kHz FHSS, 99% Emission Bandwidth, 902.2MHz~927.8MHz



Date: 7.DEC.2020 18:10:22



Date: 7.DEC.2020 18:10:01

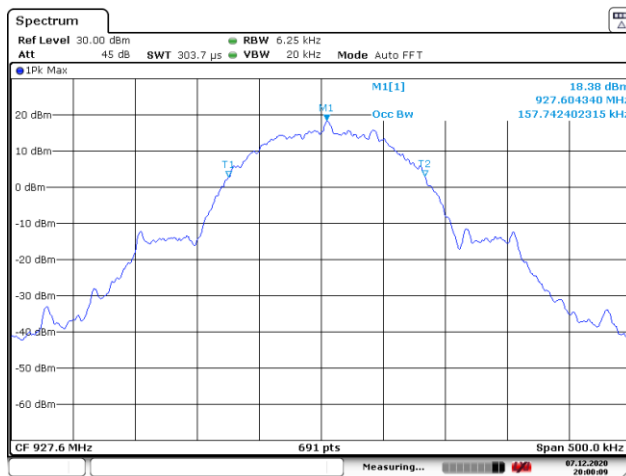
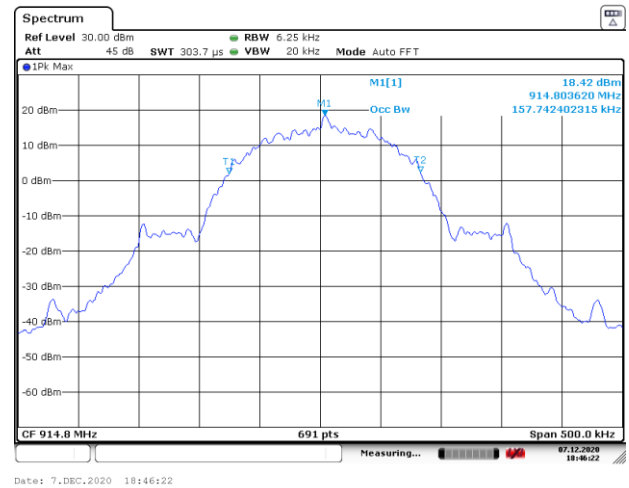
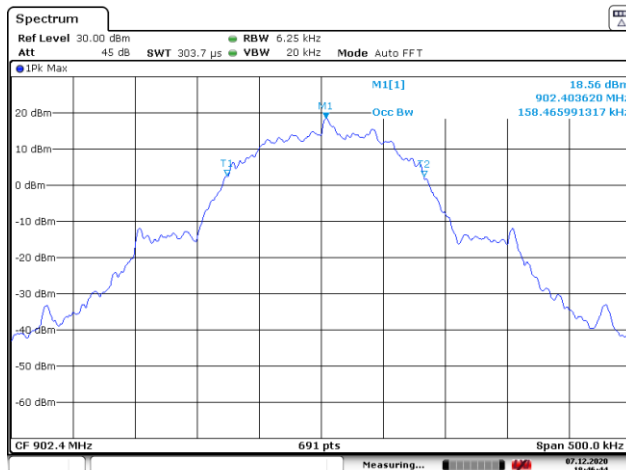


Date: 7.DEC.2020 18:09:40

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

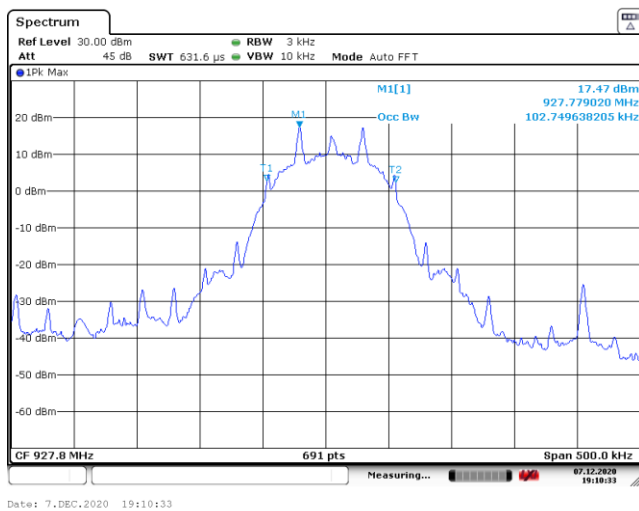


5. FSK 50Kbps FHSS, 99% Emission Bandwidth, 902.2MHz~927.8MHz

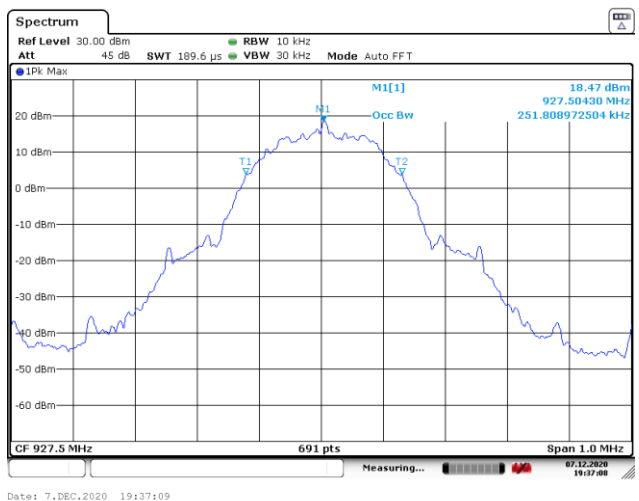
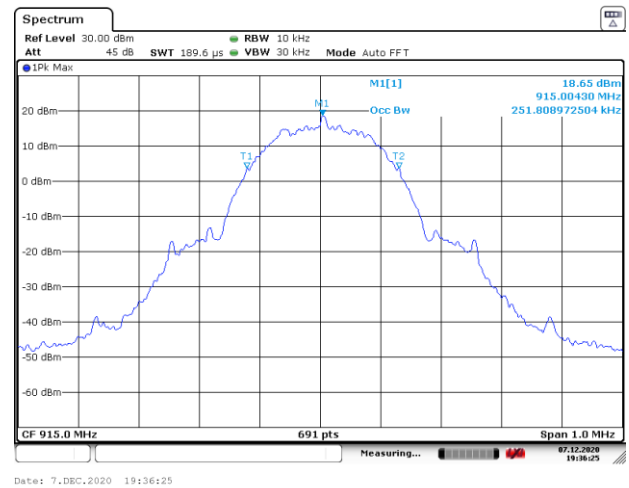
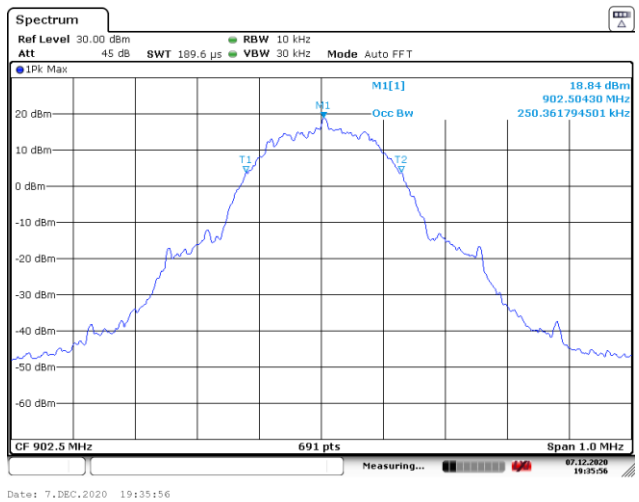


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6. FSK 250Kbps FHSS, 99% Emission Bandwidth, 902.5MHz~927.5MHz



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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, clause 11.9.1
KDB558074 D01v05r02, clause 8.3.1.3

Limits : Not more than 1Watt(30dBm) for DTS in the band
902-928MHz and 2400-2483.5MHz;
Not more than 1Watt(30dBm) for FHSS with at least
50 hopping channels in the band 902-928MHz

Kind of test site : Shielded Room

Test Setup

Date of testing : 2020.12.07

Input voltage : AC 120V, 60Hz

Operational mode : Mode A

Test channel : Lo, Mi, Hi

Temperature : 20°C

Relative humidity : 55%

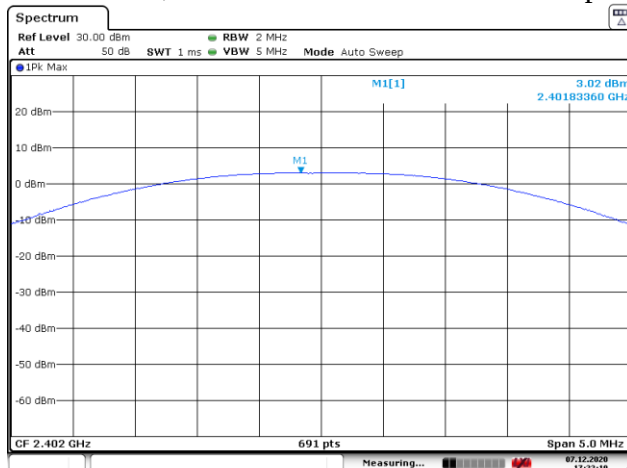
Atmospheric pressure : 102.1 kPa

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

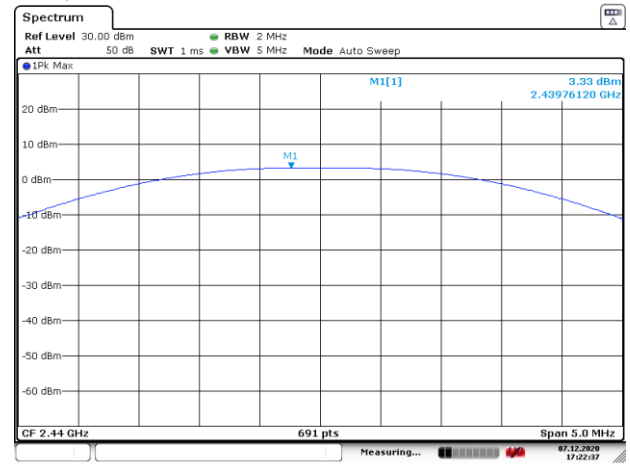
Modulation Type and Operation band	Channel	Channel Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)
1. BLE 2402MHz~2480MHz	Low Channel	2402	3.02	30
	Mid Channel	2440	3.33	30
	High Channel	2480	3.45	30
2. LoRa 500kHz DTS 902.5MHz~926.5MHz	Low Channel	902.5	19.09	30
	Mid Channel	914.5	18.96	30
	High Channel	926.5	18.77	30
3. LoRa 125kHz FHSS 902.2MHz~927.8MHz	Low Channel	902.2	19.02	30
	Mid Channel	915	18.89	30
	High Channel	927.8	18.69	30
4. FSK 150Kbps FHSS 902.4MHz~927.6MHz	Low Channel	902.4	19.06	30
	Mid Channel	914.8	18.92	30
	High Channel	927.6	18.72	30
5. FSK 50Kbps FHSS 902.2MHz~927.8MHz	Low Channel	902.2	19.08	30
	Mid Channel	915	18.95	30
	High Channel	927.8	18.74	30
6. FSK 250Kbps FHSS 902.5MHz~927.5MHz 20dB Bandwidth	Low Channel	902.5	19.10	30
	Mid Channel	915	18.97	30
	High Channel	927.5	18.74	30

Figure 3: Maximum peak Conducted Output Power

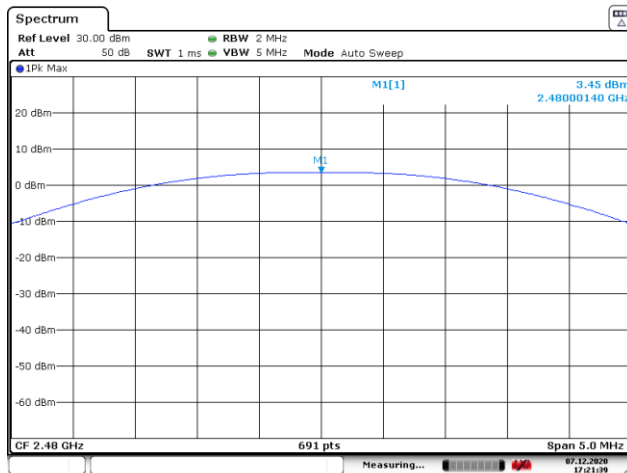
1. BLE, Maximum Peak Conducted Output Power, 2402MHz~2480MHz



Date: 7.DEC.2020 17:22:19

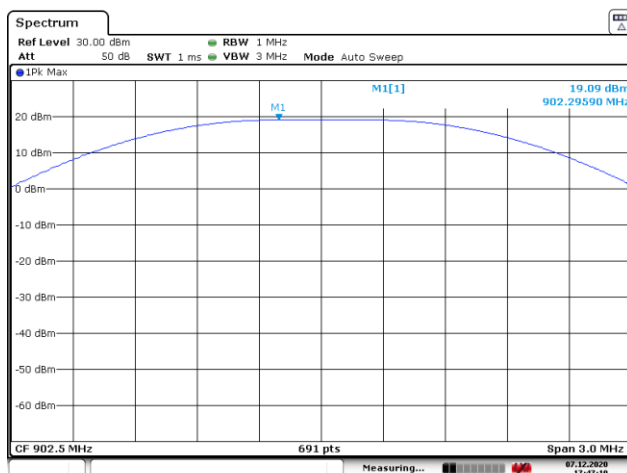


Date: 7.DEC.2020 17:22:37

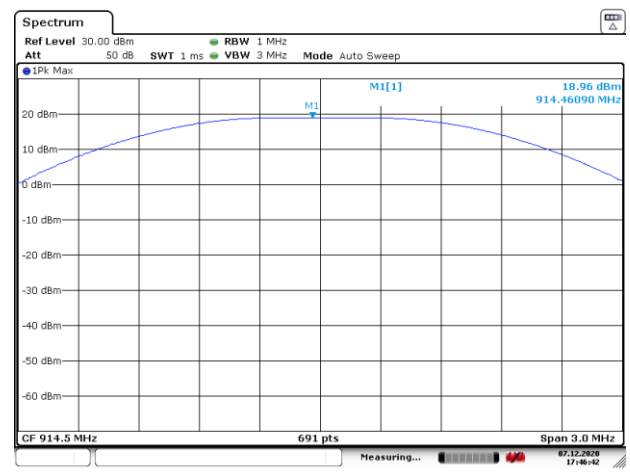


Date: 7.DEC.2020 17:21:38

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



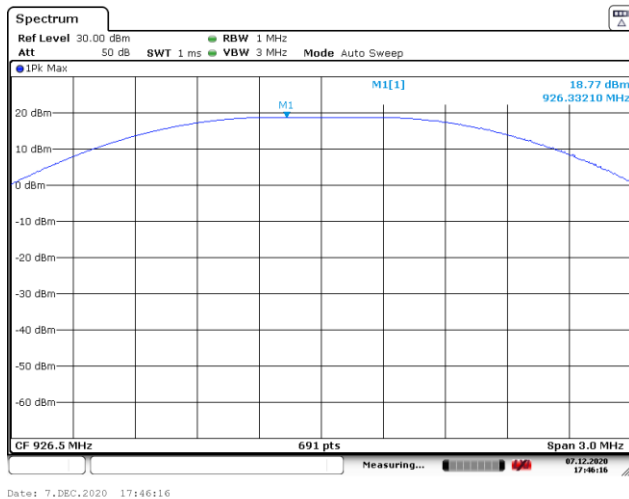
Date: 7.DEC.2020 17:47:10



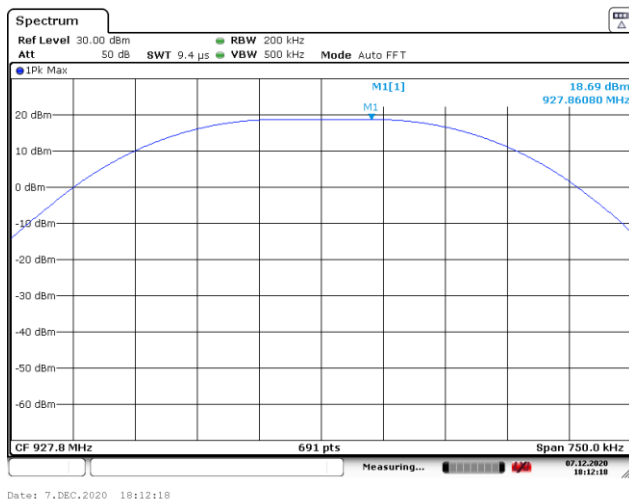
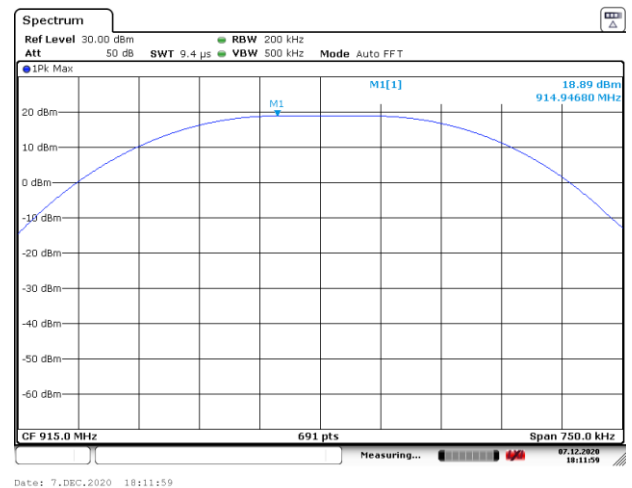
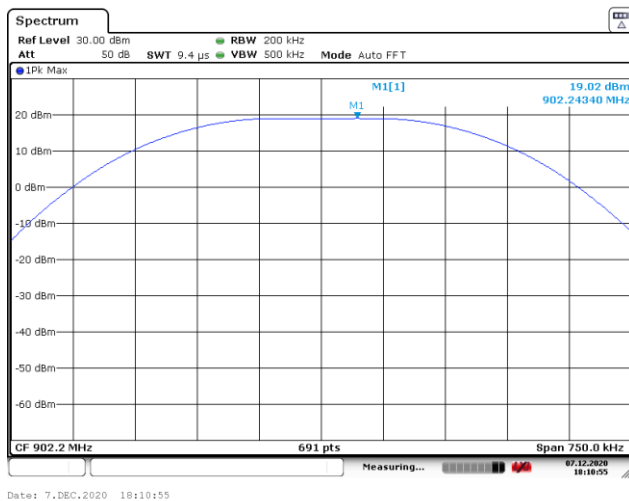
Date: 7.DEC.2020 17:46:42

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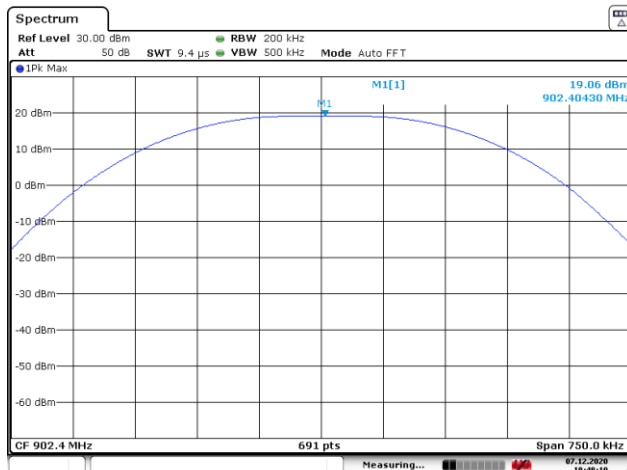
3. LoRa 125kHz FHSS, Maximum Peak Conducted Output Power, 902.2MHz~927.8MHz



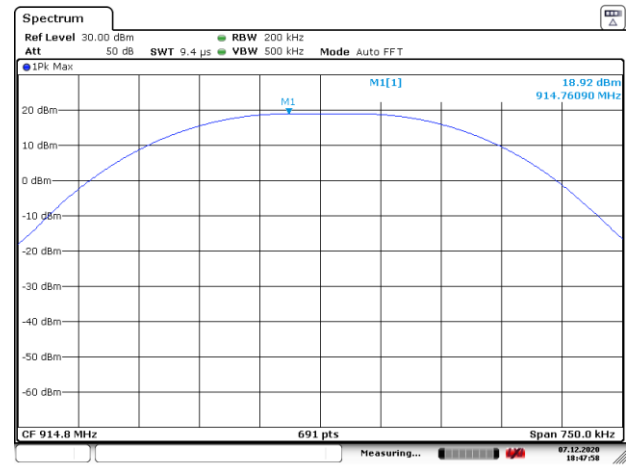
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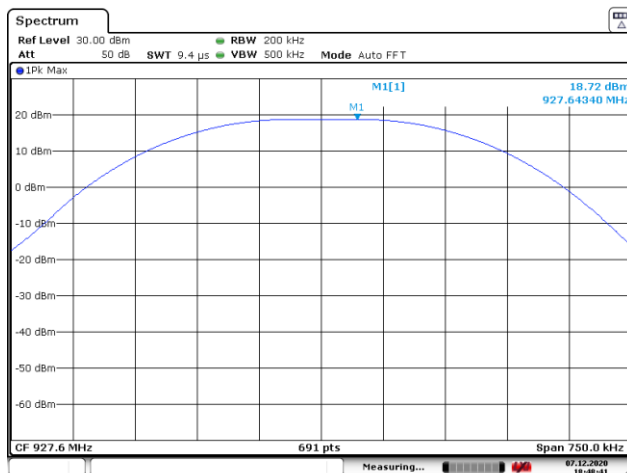
4. FSK 150Kbps FHSS, Maximum Peak Conducted Output Power, 902.4MHz~927.6MHz



Date: 7.DEC.2020 18:48:19

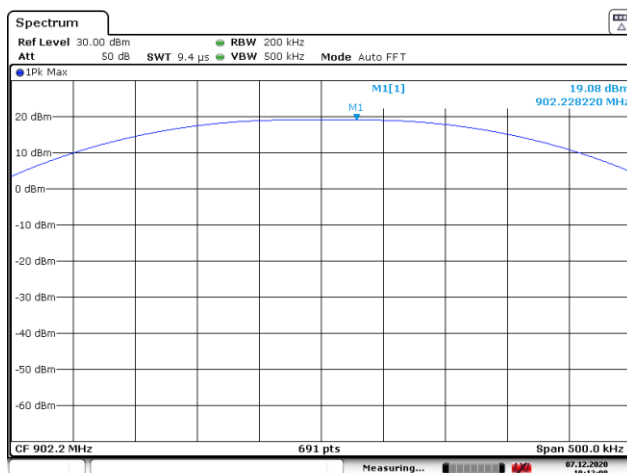


Date: 7.DEC.2020 18:47:58

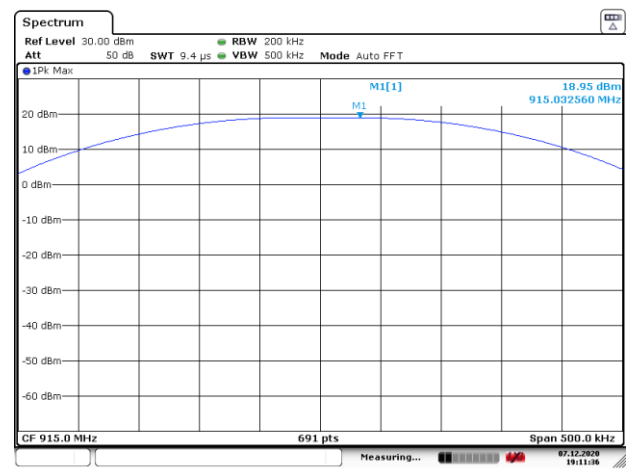


Date: 7.DEC.2020 18:48:41

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



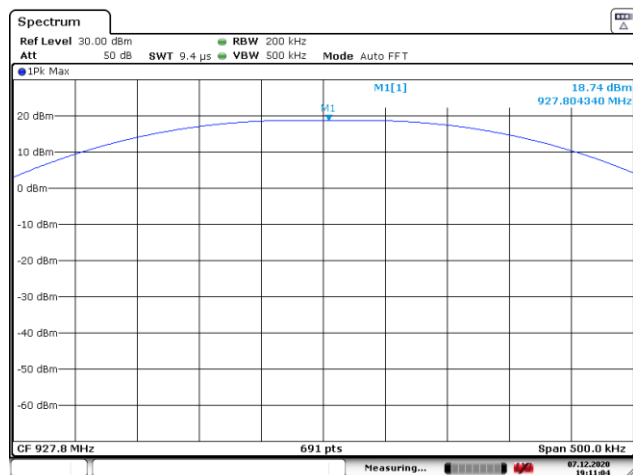
Date: 7.DEC.2020 19:12:08



Date: 7.DEC.2020 19:11:36

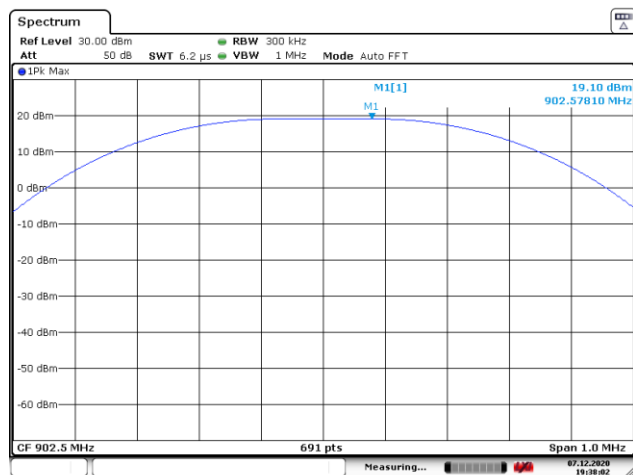
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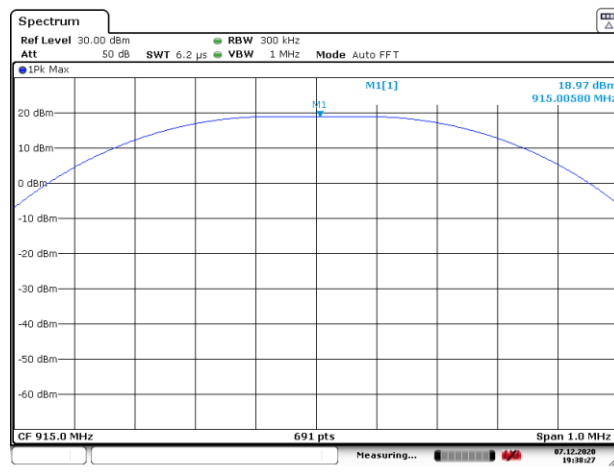


Date: 7.DEC.2020 19:11:04

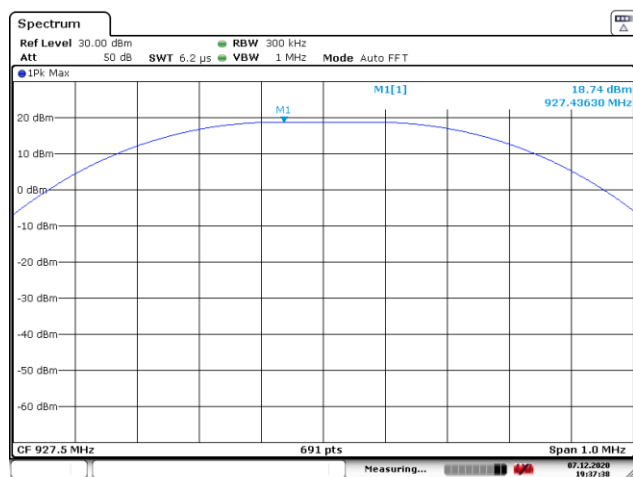
6. FSK 250Kbps FHSS, Maximum Peak Conducted Output Power, 902.5MHz~927.5MHz



Date: 7.DEC.2020 19:38:02



Date: 7.DEC.2020 19:38:27



Date: 7.DEC.2020 19:37:38

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4.1.5 Equivalent Isotropically Radiated Power

Result:

Pass

Test Specification

Test standard : RSS-247 Issue 2 February 2017 Clause 5.4(a), (d)
 Basic standard : ANSI C63.10: 2013, clause 9.5
 Limits : Not more than 4Watt(36dBm) for DTS in the band 902-928MHz and 2400-2483.5MHz;
 Not more than 4Watt(36dBm) for FHSS system with at least 50 hopping channels in the band 902-928MHz
 Kind of test site : Shielded Room

Test Setup

Date of testing : 2020.12.07
 Input voltage : AC120V, 60Hz
 Operational mode : Mode A
 Test channel : Lo, Mi, Hi
 Temperature : 20°C
 Relative humidity : 55%
 Atmospheric pressure : 102.1 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	3.02	-2.5	0.52	36
	Mid Channel	2440	3.33	-2.5	0.83	36
	High Channel	2480	3.45	-2.5	0.95	36
2. LoRa 500kHz DTS 902.5MHz~926.5MHz	Low Channel	902.5	19.09	-3.8	15.29	36
	Mid Channel	914.5	18.96	-3.8	15.16	36
	High Channel	926.5	18.77	-3.8	14.97	36
3. LoRa 125kHz FHSS 902.2MHz~927.8MHz	Low Channel	902.2	19.02	-3.8	15.22	36
	Mid Channel	915	18.89	-3.8	15.09	36
	High Channel	927.8	18.69	-3.8	14.89	36
4. FSK 150Kbps FHSS 902.4MHz~927.6MHz	Low Channel	902.4	19.06	-3.8	15.26	36
	Mid Channel	914.8	18.92	-3.8	15.12	36
	High Channel	927.6	18.72	-3.8	14.92	36
5. FSK 50Kbps FHSS 902.2MHz~927.8MHz	Low Channel	902.2	19.08	-3.8	15.28	36
	Mid Channel	915	18.95	-3.8	15.15	36
	High Channel	927.8	18.74	-3.8	14.94	36
6. FSK 250Kbps FHSS 902.5MHz~927.5MHz	Low Channel	902.5	19.10	-3.8	15.30	36
	Mid Channel	915	18.97	-3.8	15.17	36
	High Channel	927.5	18.74	-3.8	14.94	36

4.1.6 Peak 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, clause 11.10.2
KDB558074 D01v05r02, clause 8.4

Limits : Not more than 8 dBm in any 3 kHz band

Kind of test site : Shielded Room

Test Setup

Date of testing : 2020.12.07

Input voltage : AC120V, 60Hz

Operational mode : Mode A

Test channel : Lo, Mi, Hi

Temperature : 20°C

Relative humidity : 55%

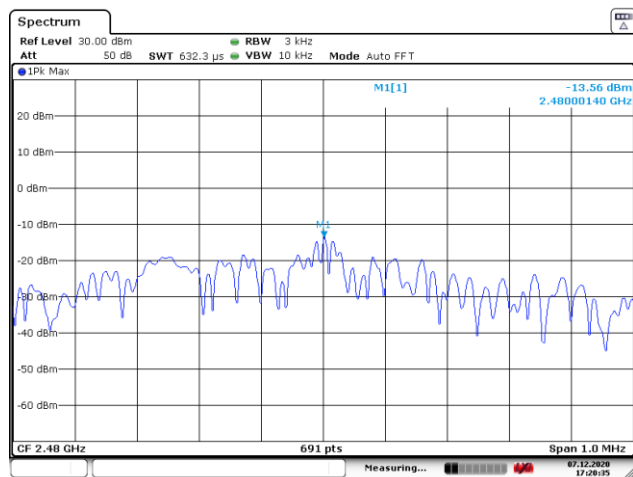
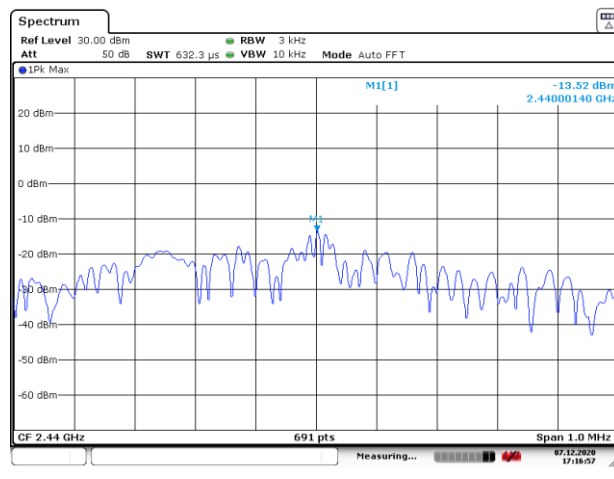
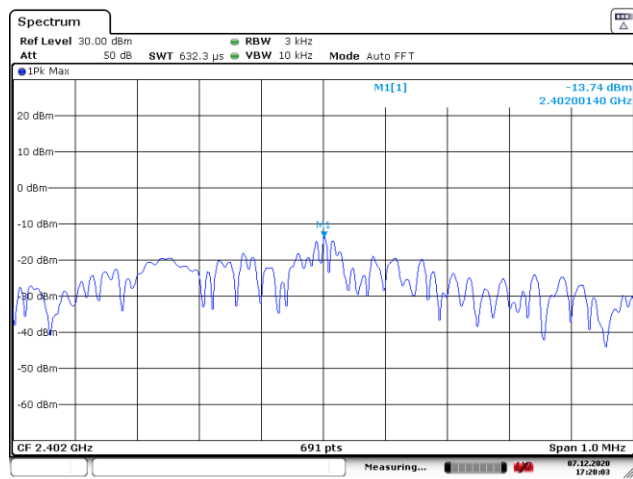
Atmospheric pressure : 102.1 kPa

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

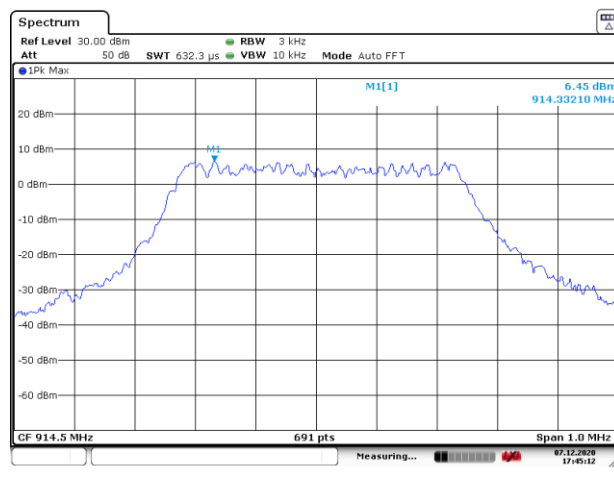
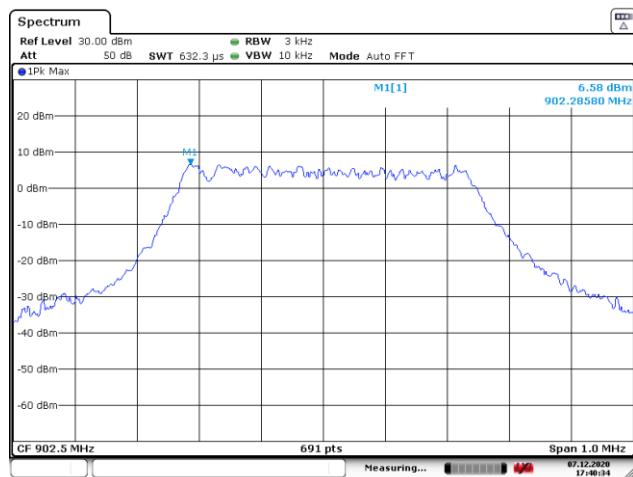
Modulation Type and Operation band	Channel	Channel Frequency (MHz)	Measured Power Density (dBm)	Limit (dBm)	Result
1. BLE 2402MHz~2480MHz	Low Channel	2402	-13.74	8.0	Pass
	Mid Channel	2440	-13.52	8.0	Pass
	High Channel	2480	-13.56	8.0	Pass
2. LoRa 500kHz DTS 902.5MHz~926.5MHz	Low Channel	902.5	6.58	8.0	Pass
	Mid Channel	914.5	6.45	8.0	Pass
	High Channel	926.5	6.26	8.0	Pass

Figure 4: Peak Power Spectral Density

1. BLE, PSD, 2402MHz~2480MHz

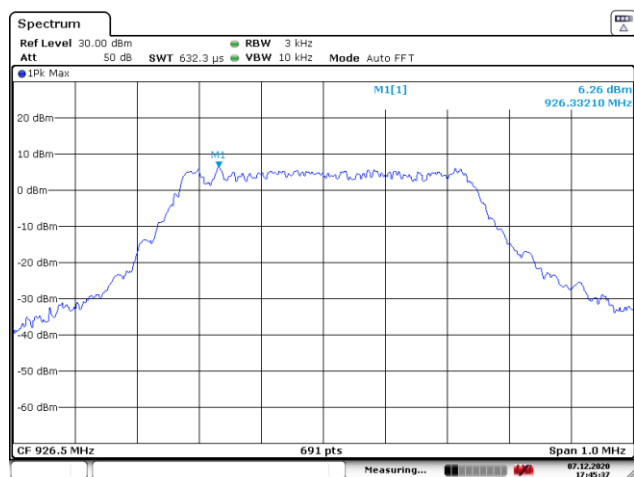


2. LoRa 500KHz DTS, PSD, 902.5MHz~926.5MHz



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4.1.7 Conducted Spurious Emissions Measured in 100 kHz Bandwidth

Result:

Pass

Test Specification

Test standard : FCC Part 15.247(d)
RSS-247 Issue 2 February 2017 Clause 5.5

Basic standard : ANSI C63.10: 2013, 14.3.3(Spurious)
ANSI C63.10: 2013, 6.10(Band edge)
KDB 558074 D01 v05r02, clause 8.5

Limits : 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

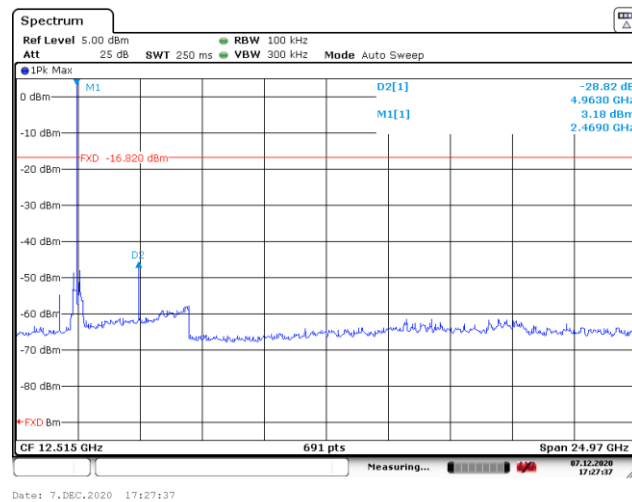
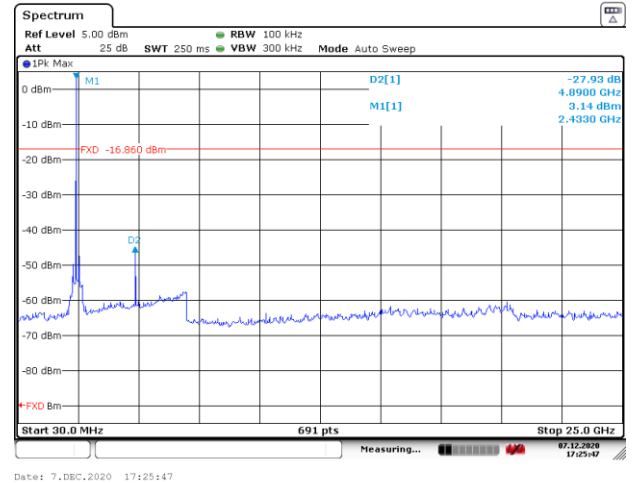
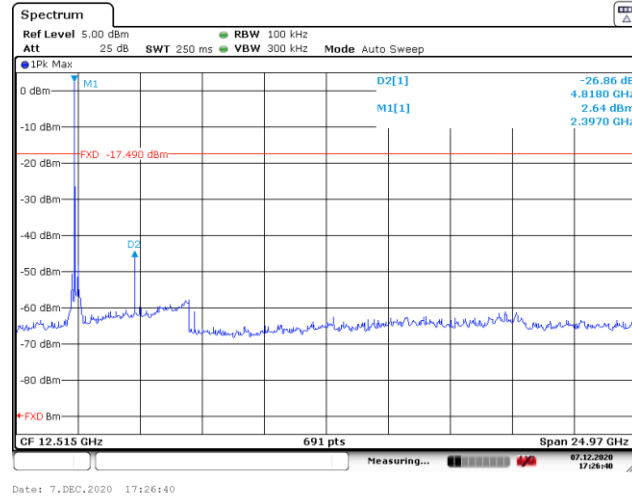
Date of testing : 2020.12.07
Input voltage : AC 120V, 60Hz
Operational mode : Mode A, Mode B
Test channel : Lo, Mi, Hi
Temperature : 20°C
Relative humidity : 55%
Atmospheric pressure : 102.1 kPa

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

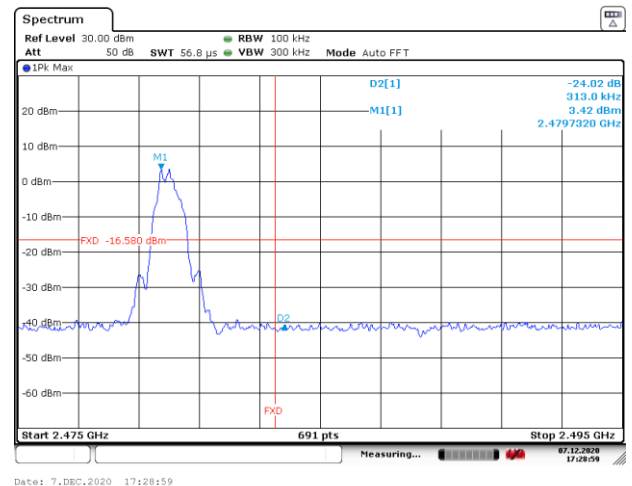
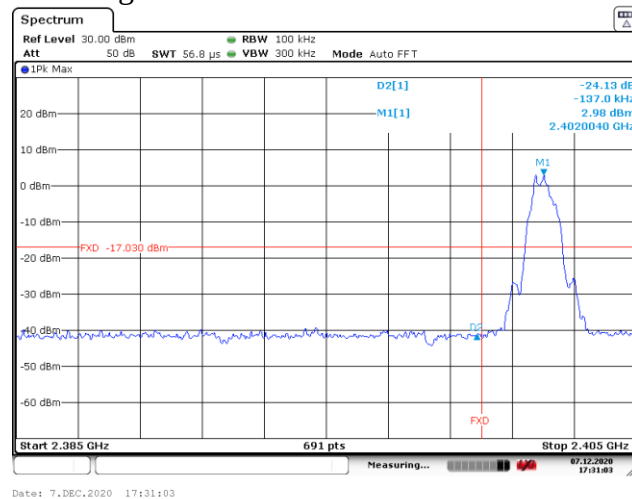
Figure 5: Conducted Spurious Emission

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

Conducted Spurious Emission

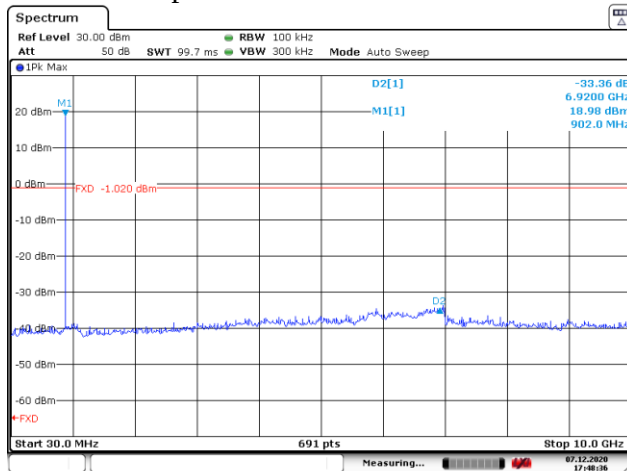


Band edge

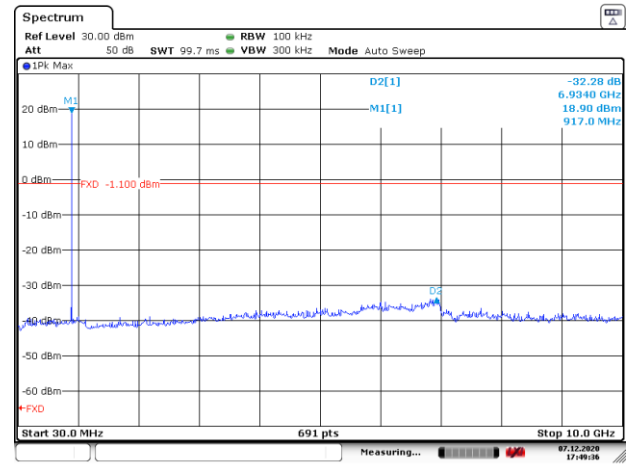


2. LoRa 500kHz DTS, Conducted Spurious Emission and Band edge, 902.5MHz~926.5MHz

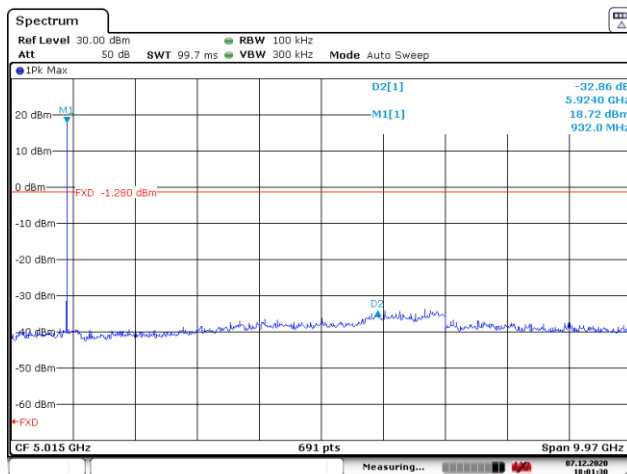
Conducted Spurious Emission



Date: 7.DEC.2020 17:48:36

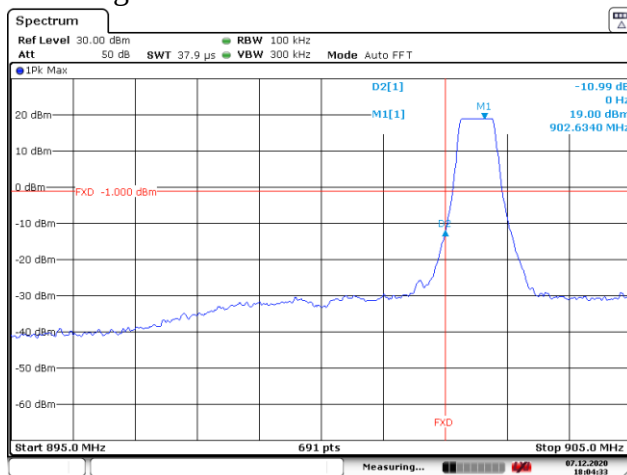


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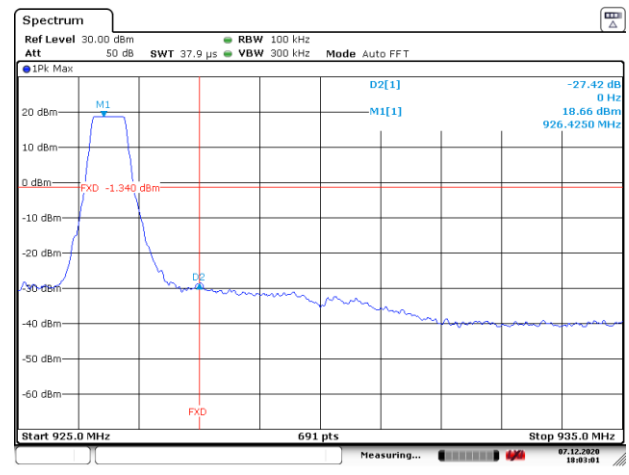


Date: 7.DEC.2020 18:01:30

Band edge



Date: 7.DEC.2020 18:04:33



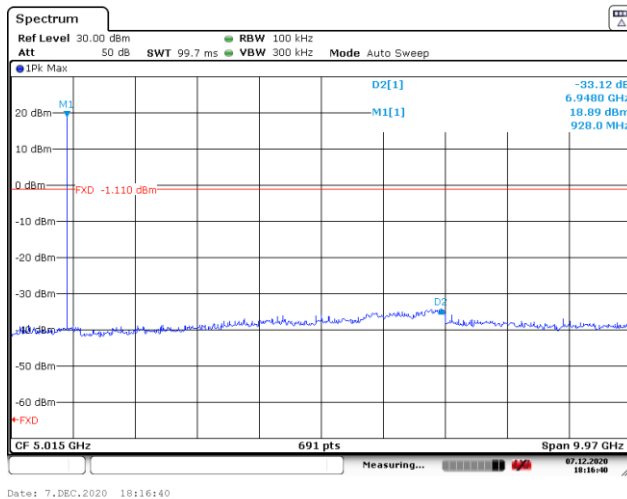
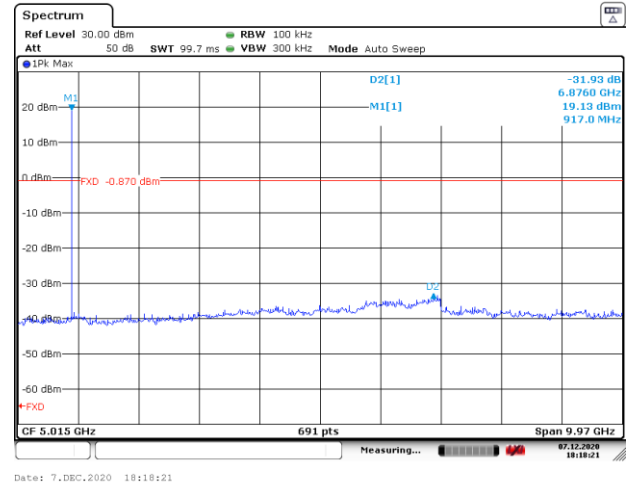
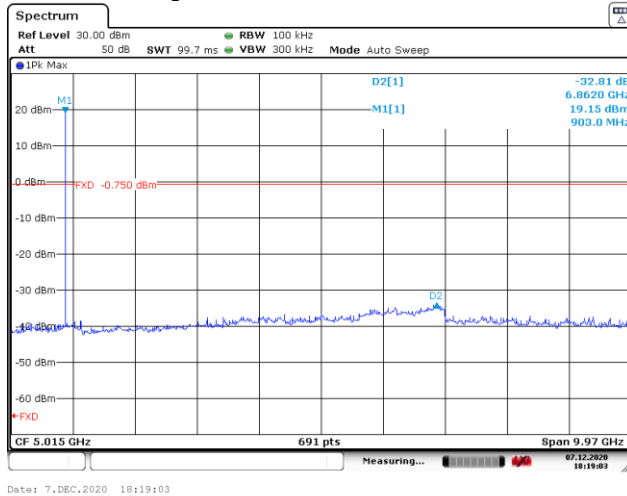
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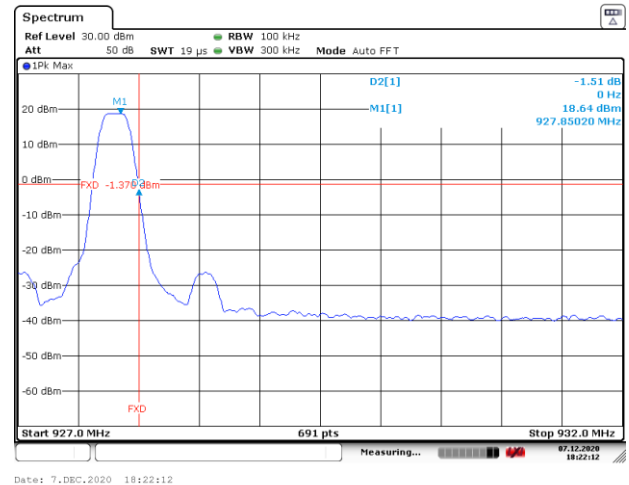
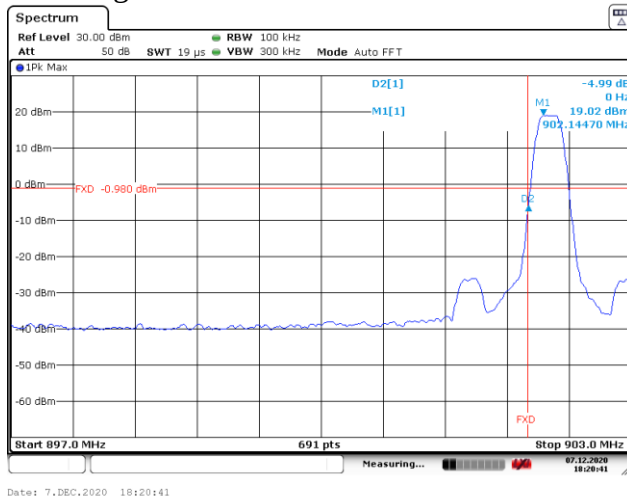
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3. LoRa 125kHz FHSS, Conducted Spurious Emission, 902.2MHz~927.8MHz

Conducted Spurious Emission

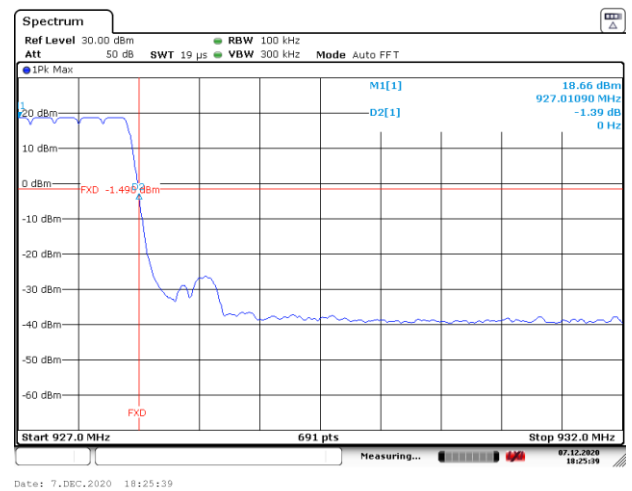
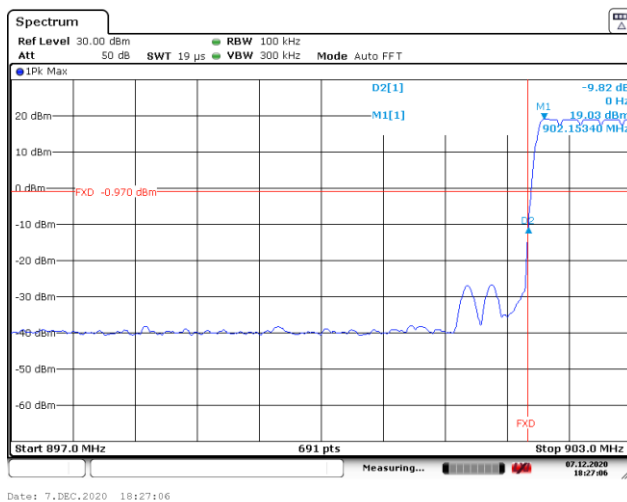


Band edge



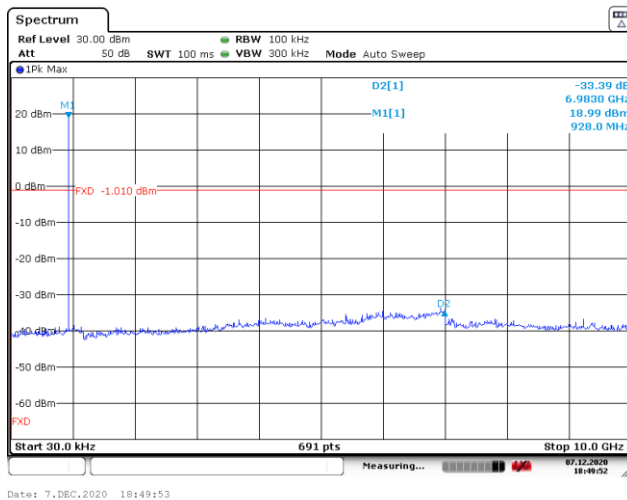
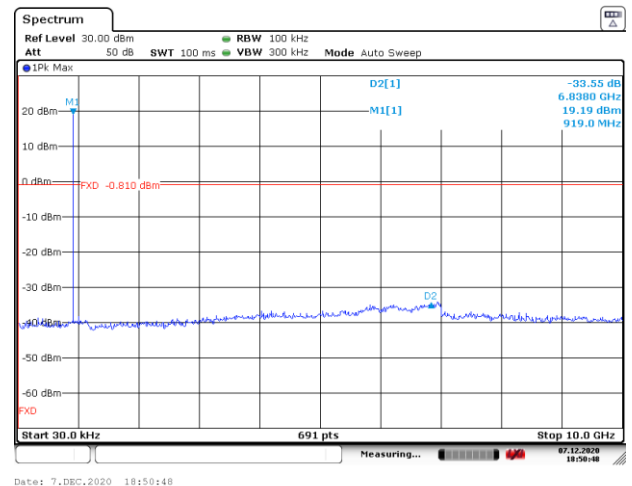
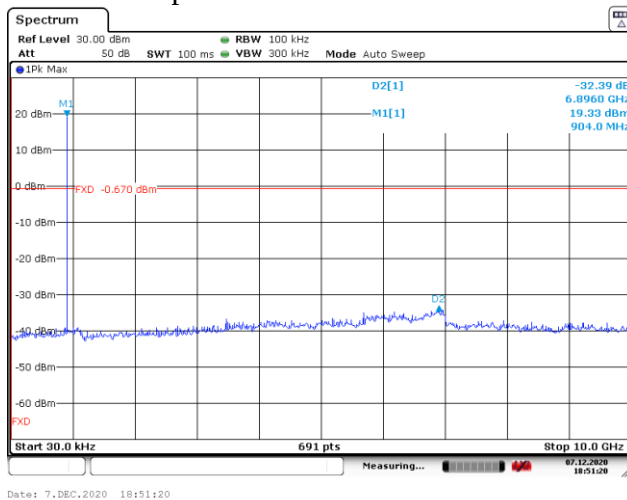
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4. FSK 150Kbps FHSS, Conducted Spurious Emission and Band edge, 902.4MHz~927.6MHz

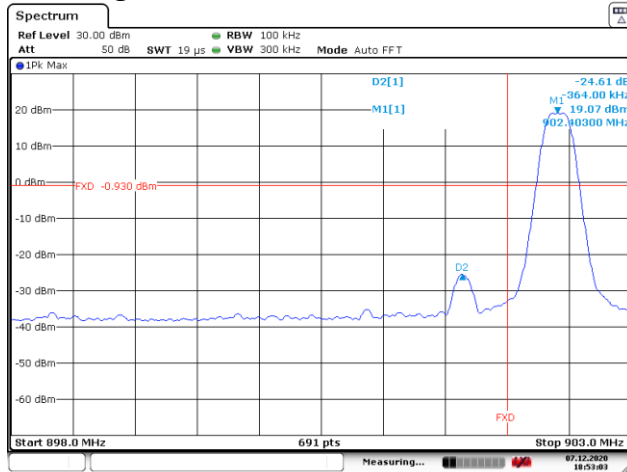
Conducted Spurious Emission



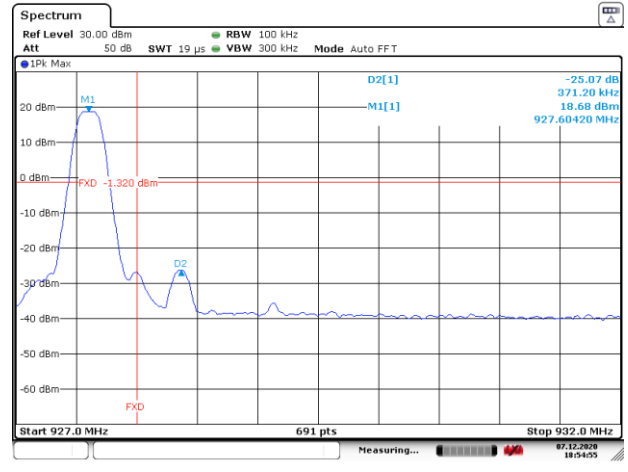
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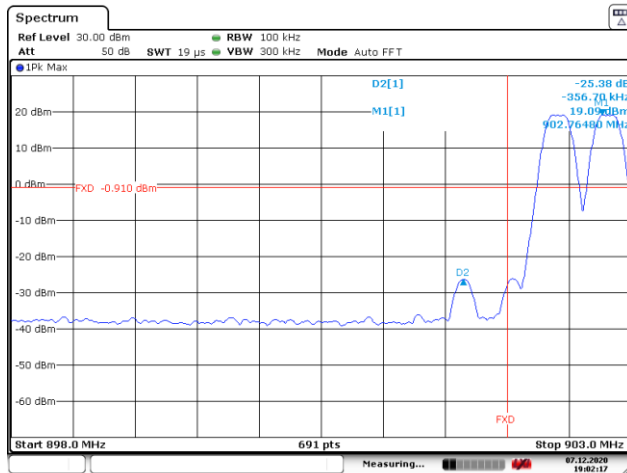
Band edge



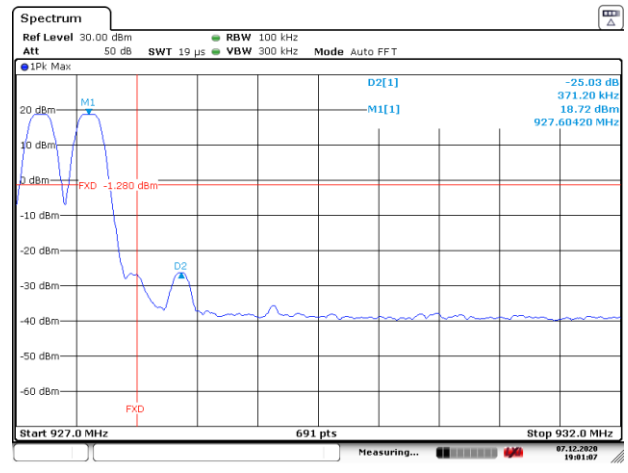
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Date: 7.DEC.2020 18:54:55



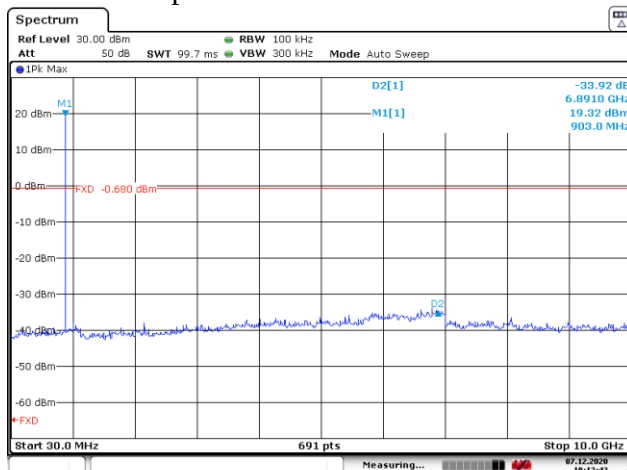
Date: 7.DEC.2020 19:02:17



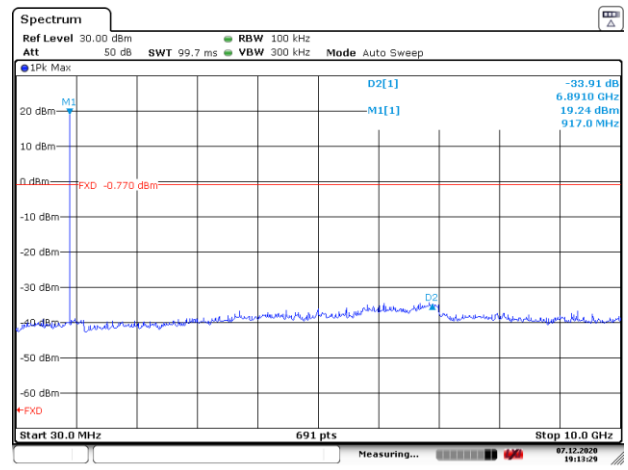
Date: 7.DEC.2020 19:01:07

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

Conducted Spurious Emission



Date: 7.DEC.2020 19:12:42



Date: 7.DEC.2020 19:13:29