Prüfbericht - Produkte
Test Report - Products

TÜVRheinland®

Prüfbericht-Nr.: *Test report no.:*	**CN22DK0H 001**	**Auftrags-Nr.:** *Order no.:*	168399706	Seite 1 von 28 *Page 1 of 28*
Kunden-Referenz-Nr.: *Client reference no.:*	N/A	**Auftragsdatum:** *Order date:*	2022-11-09	
Auftraggeber: *Client:*	**Shenzhen RAKwireless Technology Co.,Ltd.** Room 506, Building B, New Compark, Pingshan First Road, Taoyuan Street, Nanshan District, Shenzhen, Guangdong, P.R. China			
Prüfgegenstand: *Test item:*	WisDuo LPWAN Module			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	RAK11720 (Trademark: RAK)			
Auftrags-Inhalt: *Order content:*	FCC and IC approval			
Prüfgrundlage: *Test specification:*	CFR47 FCC Part 15: Subpart C Section 15.247 CFR47 FCC Part 15: Subpart C Section 15.207 CFR47 FCC Part 15: Subpart C Section 15.209		RSS-247 Issue 2 February 2017 RSS-Gen Issue 5 February 2021	

Wareneingangsdatum: *Date of sample receipt:*	2022-12-09
Prüfmuster-Nr.: *Test sample no.:*	A003386865-001 to 005
Prüfzeitraum: *Testing period:*	2022-12-09 - 2023-01-04
Ort der Prüfung: *Place of testing:*	TÜV Rheinland (Shenzhen) Co., Ltd.
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland (Shenzhen) Co., Ltd.
Prüfergebnis*: *Test result*:*	Pass

Please refer to photo documents

geprüft von: *tested by:*	X Alex Lan	**genehmigt von:** *authorized by:*	X Winnie Hou
Datum: *Date:* 2023-01-13	Signed by: Alex Lan	**Ausstellungsdatum:** *Issue date:* 2023-01-16	Signed by: Winnie Hou
Stellung / Position	Assistant Project Manager	**Stellung** / Position	Department Manager

Sonstiges / *Other:* FCC ID: 2AF6B-RAK11720
IC: 25908-RAK11720, HVIN: RAK11720

Zustand des Prüfgegenstandes bei Anlieferung: Prüfmuster vollständig und unbeschädigt
Condition of the test item at delivery: *Test item complete and undamaged:*

*	1 = sehr gut	2 = gut	3 = befriedigend	4 = ausreichend	5 = mangelhalt
	P(ass) = entspricht o.g. Prüfgrundlage(n)		F(ail) = entspricht nicht 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 specifications(s)		F(ail) = failed a.m. test specifications(s)	N/A = not applicable	N/T = not tested

TUV Rheinland (Shenzhen) Co., Ltd. 1601 R&D Room, 1602-1604, 17-18F, Building 7 Site C, Vanke Cloud City Phase I, Xingke First Street, Xili Street, Xili Community, Nanshan District, Shenzhen 518052, P.R. China
Mail: service@de.tuv.com http://www.tuv.com

Test Summary

5.1.1 ANTENNA REQUIREMENT
RESULT: Pass

5.1.2 MAXIMUM CONDUCTED OUTPUT POWER
RESULT: Pass

5.1.3 CONDUCTED POWER SPECTRAL DENSITY
RESULT: Pass

5.1.4 6DB BANDWIDTH
RESULT: Pass

5.1.5 20DB BANDWIDTH
RESULT: Pass

5.1.6 99% BANDWIDTH
RESULT: Pass

5.1.7 CONDUCTED SPURIOUS EMISSIONS MEASURED IN 100 KHZ BANDWIDTH
RESULT: Pass

5.1.8 RADIATED SPURIOUS EMISSION
RESULT: Pass

5.1.9 CARRIER FREQUENCY SEPARATION
RESULT: Pass

5.1.10 NUMBER OF HOPPING FREQUENCY
RESULT: Pass

5.1.11 TIME OF OCCUPANCY
RESULT: Pass

5.1.12 CONDUCTED EMISSION ON AC MAINS
RESULT: Pass

6.1.1 ELECTROMAGNETIC FIELDS
RESULT: Pass

Contents

1 General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix A: Photographs of the Test Set-up

Appendix B: Test Results of Conducted & Radiated Testing

2 Test Sites

2.1 Test Facilities

TÜV Rheinland (Shenzhen) Co., Ltd.
362 Huanguan Road Middle Longhua District, Shenzhen 518110 People's Republic of China

FCC Registration No.: 694916
ISED wireless device testing laboratory: 25069, CAB identifier: CN0078

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

TÜV Rheinland (Shenzhen) Co., Ltd.

Radio Spectrum Testing				
Equipment	**Manufacturer**	**Model**	**Serial No.**	**Cal. until**
EXA Signal Analyzer, Multi-touch	Keysight	N9010B	MY60241175	2023-10-10
MXG X-Series RF Vector Signal Generator	Keysight	N5182B	MY61250137	2023-10-10
EXG X-Series Microwave Analog Signal Generator	Keysight	N5173B	MY61250141	2023-10-10
DC Power Supply	Keysight	E3642A	MY61276100	2023-10-10
Wireless Connectivity Tester	R&S	CMW270	102505	2023-10-10
Power Control Unit	Tonscend	JS0806-4ADC	N/A	2023-10-10
Automation Control Unit	Tonscend	JS0806-2	21C8060396	2023-10-10
Test Software	Tonscend	JS1120-3	N/A	N/A
Control PC	Lenovo	TianYi510S-071MB	YLX23JMF	N/A
Unwanted Emission Testing				
Equipment	**Manufacturer**	**Model**	**Serial No.**	**Cal. until**
EMI Test Receiver	R&S	ESR 7	102021	2024-08-02
Signal Analyzer	R&S	FSV 40	101439	2024-08-01
System Controller Interface	R&S	SCI-100	S10010038	N/A
Filterbank	R&S	Wlan	100759	2024-08-01
OSP	R&S	OSP 120	102040	N/A
Pre-amplifier	R&S	SCU08F1	08320031	2024-08-02
Amplifier	R&S	SCU-18F	180070	2024-08-02
Amplifier	R&S	SCU40A	100475	2024-08-02
Trilog Broadband Antenna (30 MHz - 7 GHz)	Schwarzbeck	VULB 9162	193	2024-08-06
Double-Ridged Antenna (1 -18 GHz)	ETS-LINDGREN	3117	00218717	2024-08-06
Wideband Ridged Horn Antenna (18-40 GHz)	Steatite	QMS-00880	19067	2024-08-07
Active Loop Antenna	Schwarzbeck	FMZB 1513	302	2024-08-06
Test software	R&S	EMC32 (V10.60.10)	N/A	N/A
Control PC	Dell	OptiPlex 7050	36NV9P2	N/A
3m Semi-Anechoic Chamber	Albatross	SAC-3m	APC17151-SAC	2024-06-22

Conducted Emission on AC Mains				
Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Cali. until**
EMI Test Receiver	R&S	ESR3	102680	2023-02-27
Artificial Mains Network	R&S	ENV216	101445	2023-02-27
EMC32 test software	R&S	EMC32(Ver.10.50.00)	N/A	N/A

2.3 Traceability

All measurement equipment calibrations are traceable to NIM (National Institute of Metrology) or where calibration is performed in other countries, to equivalent nationally recognized standards organizations.

2.4 Calibration

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer's specifications. Additionally all equipment is verified for proper performance on a regular basics using in house standards or comparisons.

2.5 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements as below table.

Parameter	Uncertainty
Radio Frequency	±1 x 10-7
RF Power (conducted)	±2.5 dB
Radiated Emission of Transmitter, valid up to 26.5 GHz	±6 dB
Radiated Emission of Receiver, valid up to 26.5 GHz	±6 dB
Conducted Emission, (9kHz to 150kHz)/(150kHz to 30MHz)	± 3.70 dB / ± 3.30 dB
Radiated Emission (3m SAC), 30MHz to 1000MHz	± 4.52 dB
Radiated Emission (3m SAC), above 1000MHz	± 4.37 dB

2.6 Location of Original Data

The original copies of all test data taken during actual testing were attached at Appendix A & B of this report and delivered to the applicant. A copy has been retained in the TÜV Rheinland (Shenzhen) Co., Ltd. file for certification follow-up purposes.

2.7 Status of Facility Used for Testing

The TÜV Rheinland (Shenzhen) Co., Ltd. Test facility located at 362 Huanguan Road Middle Longhua District, Shenzhen 518110 People's Republic of China is listed on the US Federal Communications Commission list of facilities approved to perform measurements.

3 General Product Information

3.1 Product Function and Intended Use

The EUT is a WisBlock LPWAN Module which supports Lora and Bluetooth Low Energy technologies.
This module has two different antennas for Lora and one antenna for BLE, the details specifications for these antennas as below:

For Lora:

Antenna #	Model	Antenna Gain	Antenna Type	Connector Type
1#	KRAKBJ2701C01A	2.3 dBi	Dipole Antenna	RPSMA connector
2#	KRAKBJ2701C01C	2.3 dBi	Dipole Antenna	RPSMA connector

Note:
1. When connecting to the module, all antennas listed above need to transfer to an **IPEX connector**.
2. Antennas 1# and 2# have the same type and similar in-band and out-of-band characteristics and only the color of enclosure differnet, they are considered as equivalent antennas. Thus, the antenna 1# with highest gain was selected to be tested.

For BLE:

Antenna #	Model	Antenna Gain	Antenna Type	Connector Type
1#	S2B1BH2A1B01000	3.12 dBi	PCB Layout Antenna	IPEX connector

Data Rate	Configuration	Indicative physical bit rate [bit/sec]
0	LoRa Modulation: SF10 / Bandwidth 125 kHz	980
1	LoRa Modulation: SF9 / Bandwidth 125 kHz	1760
2	LoRa Modulation: SF8 / Bandwidth 125 kHz	3125
3	LoRa Modulation: SF7 / Bandwidth 125 kHz	5470
4	LoRa Modulation: SF8 / Bandwidth 500 kHz	12500

For details refer to the User Manual, Technical Description and Circuit Diagram.

3.2 Ratings and System Details

Table 2: Technical Specification of EUT

General Information of EUT	Value
Kind of Equipment	WisDuo LPWAN Module
Type Designation	RAK11720
Trademark	RAK
FCC ID	2AF6B-RAK11720
IC	25908-RAK11720
HVIN	RAK11720
Operating Voltage	DC 3.6V Max. (Supplied by socket of PCB borad)
Testing Voltage	DC 5V Via USB port
Technical Specification of Lora DTS	
Operating Frequency	903 – 914.2MHz
Type of Modulation	Lora
Data Rate	SF8 / DR4
Channel Number	8 channels (Upstream)
Channel Separation	1.6 MHz
Occupied Bandwidth	500 KHz
Technical Specification of Lora FHSS	
Frequency Range	902.3 – 914.9MHz
Type of Modulation	Lora
Data Rate	SF7 to SF10 / DR0 to DR3
Channel Number	64 channels (Upstream)
Channel Separation	200 KHz
Occupied Bandwidth	125 KHz
Technical Specification of BLE	
Operating Frequency	2402 - 2480 MHz
Type of modulation	GFSK
Channel Number	40 channels
Channel Separation	2 MHz
Data Rate	1Mbps

Table 3: RF Channel and Frequency of Lora FHSS

RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)
0	**902.3**	16	905.5	**32**	**908.7**	48	911.9
1	902.5	17	905.7	33	908.9	49	912.1
2	902.7	18	905.9	34	909.1	50	912.3
3	902.9	19	906.1	35	909.3	51	912.5
4	903.1	20	906.3	36	909.5	52	912.7
5	903.3	21	906.5	37	909.7	53	912.9
6	903.5	22	906.7	38	909.9	54	913.1
7	903.7	23	906.9	39	910.1	55	913.3
8	903.9	24	907.1	40	910.3	56	913.5
9	904.1	25	907.3	41	910.5	57	913.7
10	904.3	26	907.5	42	910.7	58	913.9
11	904.5	27	907.7	43	910.9	59	914.1
12	904.7	28	907.9	44	911.1	60	914.3
13	904.9	29	908.1	45	911.3	61	914.5
14	905.1	30	908.3	46	911.5	62	914.7
15	905.3	31	908.5	47	911.7	**63**	**914.9**

Table 4: RF Channel and Frequency of Lora DTS

RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)
64	**903.0**	66	906.2	68	909.4	70	912.6
65	904.6	**67**	**907.8**	69	911.0	**71**	**914.2**

Table 5: RF Channel and Frequency of Bluetooth Low Energy

RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)
00	**2402.00**	10	2422.00	20	2442.00	30	2462.00
01	2404.00	11	2424.00	21	2444.00	31	2464.00
02	2406.00	12	2426.00	22	2446.00	32	2466.00
03	2408.00	13	2428.00	23	2448.00	33	2468.00
04	2410.00	14	2430.00	24	2450.00	34	2470.00
05	2412.00	15	2432.00	25	2452.00	35	2472.00
06	2414.00	16	2434.00	26	2454.00	36	2474.00
07	2416.00	17	2436.00	27	2456.00	37	2476.00
08	2418.00	18	2438.00	28	2458.00	38	2478.00
09	2420.00	**19**	**2440.00**	29	2460.00	**39**	**2480.00**

3.3 Independent Operation Modes

The basic operation modes are:

A. On, Lora transmitting mode (FHSS)
    1) Low Channel
    2) Middle Channel
    3) High Channel

B. On, Lora transmitting mode (DTS)
    1) Low Channel
    2) Middle Channel
    3) High Channel

C. On, Transmitting on Hopping channel (Lora FHSS)

D. On, Simultaneous Transmission operation mode (Lora +BLE)

E. Off

3.4 Noise Generating and Noise Suppressing Parts

Refer to Circuit Diagram for further details.

3.5 Submitted Documents

- ID Label and Location Info
- User Manual

4 Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

Radio Spectrum: The equipment under test (EUT) was configured at its highest power output in order to measure its highest possible radiation and conducted level. The test modes were adapted accordingly in reference to the instructions for use.

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Test operation refers to test setup in chapter 5. All tests were performed according to the procedures in ANSI C63.10: 2013 and ANSI C63.4: 2014.

According to clause 3.1, all tests were performed on model RAK11720

4.3 Special Accessories and Auxiliary Equipment

Table 6: Auxiliary Equipment Used during Test

Description	Manufacturer	Model	S/N
PC	Lenovo	ThinkPad T480	N/A
PC adapter	Lenovo	ADLX65YDC3A	01FR030

4.4 Countermeasures to Achieve EMC Compliance

The test sample which has been tested contained the noise suppression parts as described in the Technical Construction File (TCF).

No additional measures were employed to achieve compliance.

4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test (Below 30MHz)

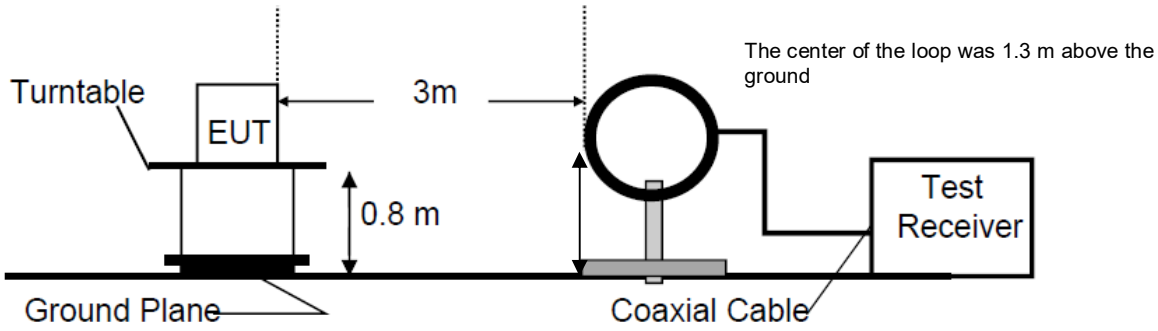


Diagram of Measurement Configuration for Radiation Test (Below 1GHz)

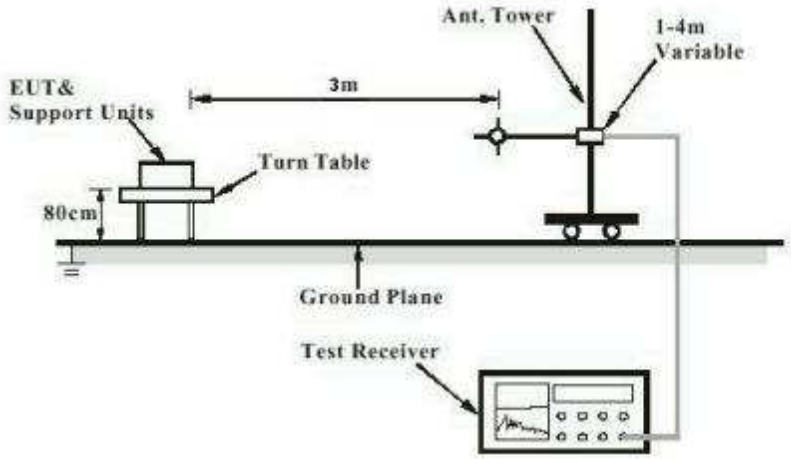


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

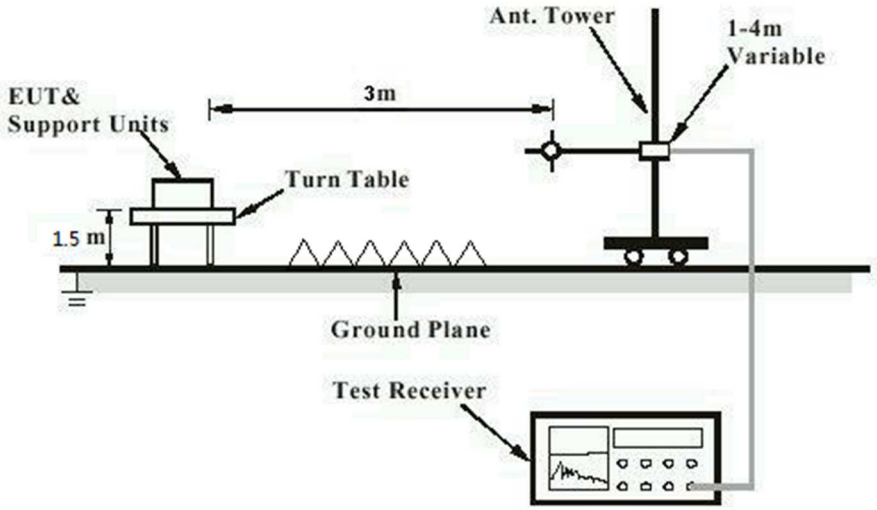


Diagram of Measurement Configuration for Mains Conduction Measurement

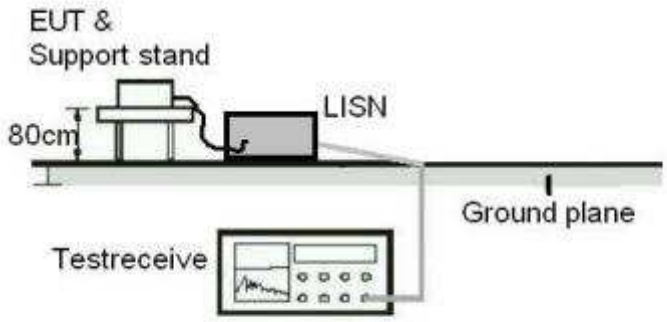
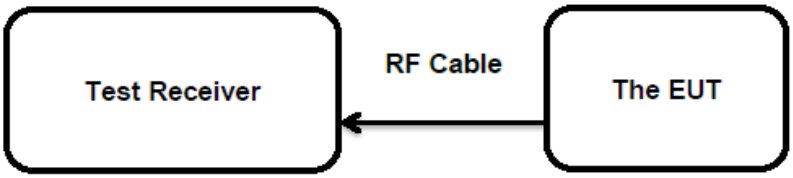


Diagram of Measurement Configuration for Conducted Transmitter Measurement



5 Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT: **Pass**

Test Specification

Test standard : FCC Part 15.247(b)(4) and Part 15.203
RSS-Gen Clause 6.8

According to the manufacturer declared, the EUT has two IPEX Antenna, the directional gain of antenna are 2.3dBi & 3.12 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Therefore the EUT is considered sufficient to comply with the provision.

Refer to EUT Photo for further details.

5.1.2 Maximum Conducted Output Power

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.247(b)(2)&(3) RSS-247 Clause 5.4(a)&(d)
Basic standard	:	ANSI C63.10: 2013
Limits	:	Not more than 1Watt(30dBm) for DTS in the band 902-928MHz 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	:	2022-12-09 to 2023-01-04
Input voltage	:	DC 5V Via USB port
Operation mode	:	A, B
Test channel	:	Low / Middle / High
Ambient temperature	:	25 ℃
Relative humidity	:	56 %
Atmospheric pressure	:	101 kPa

Antenna gain 2.3dBi

Table 7: Test Result of Maximum Conducted Output Power, Lora FHSS

Test Mode	Test Channel (MHz)	Maximum Conducted Average Power		Limit (W)
		(dBm)	(W)	
Lora DTS	903.0	21.49	0.1409	< 1.0
	907.8	21.40	0.1380	
	914.2	21.25	0.1334	
Lora FHSS SF7	902.3	21.60	0.1445	< 1.0
	908.5	21.51	0.1416	
	914.9	21.39	0.1377	
Lora FHSS SF10	902.3	21.58	0.1439	< 1.0
	908.5	21.49	0.1409	
	914.9	21.40	0.1380	
Max. Measured Value		21.60	0.1445	

Note:
1) The cable loss is taken into account in results.
2) The maximum Antenna gain(G) : 2.3 dBi,
e.i.r.p.=23.90dBm = 245.47mW, which is far below the 4 W

5.1.3 Conducted Power Spectral Density

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.247(e) RSS-247 Clause 5.2(b)
Basic standard	:	ANSI C63.10: 2013
Limits	:	< 8 dBm / 3kHz
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2022-12-09 to 2023-01-04
Input voltage	:	DC 5V Via USB port
Operation mode	:	B
Test channel	:	Low / Middle / High
Ambient temperature	:	25 ℃
Relative humidity	:	56 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix B.

Table 8: Test Result of Maximum Peak Power Spectral Density, Lora DTS

Antenna Gain	Test Mode	Test Channel (MHz)	Measured Peak Power Spectral Density (dBm/3KHz)
2.3 dBi	Lora DTS	903.0	1.21
		907.8	0.65
		914.2	0.72
Maximum Measured Value			1.21

5.1.4 6dB Bandwidth

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.247(a)(2) RSS-247 Clause 5.2(a)
Basic standard	:	ANSI C63.10: 2013
Limits	:	At least 500kHz for bandwidth(DTS)
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2022-12-09 to 2023-01-04
Input voltage	:	DC 5V Via USB port
Operation mode	:	B
Test channel	:	Low / Middle / High
Ambient temperature	:	25 ℃
Relative humidity	:	56 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix B.

Table 9: Test Result of 6dB Bandwidth

Test Mode	Test Channel (MHz)	6dB Bandwidth (KHz)	Limit (KHz)
Lora DTS	903.0	628.1	>500KHz
	907.8	628.1	
	914.2	639.7	
Minimum Measured Value		628.1	

5.1.5 20dB Bandwidth

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.247(a)(1) (i) RSS-247 Clause 5.1(a)
Basic standard	:	ANSI C63.10: 2013
Limits	:	Not more than 500kHz and < 250KHz for at least 50 hopping frequencies >=250KHz for at least 25 hooping frequencies
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2022-12-09 to 2023-01-04
Input voltage	:	DC 5V Via USB port
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	25 ℃
Relative humidity	:	56 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix B.

Table 10: Test Result of 20dB Bandwidth

Test Mode	Test Channel (MHz)	20dB Bandwidth (kHz)	Limit (KHz)
Lora FHSS SF7	902.3	146.16	<500KHz
	908.5	146.89	
	914.9	143.99	
Lora FHSS SF10	902.3	140.38	
	908.5	140.38	
	914.9	138.93	
Maximum Measured Value		146.89	

5.1.6 99% Bandwidth

RESULT: **Pass**

Test Specification

Test standard	:	RSS-Gen Clause 6.7
Basic standard	:	ANSI C63.10: 2013
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2022-12-09 to 2023-01-04
Input voltage	:	DC 5V Via USB port
Operation mode	:	A, B
Test channel	:	Low / Middle / High
Ambient temperature	:	25 ℃
Relative humidity	:	56 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix B.

Table 11: Test Result of 99% Bandwidth

Test Mode	Test Channel (MHz)	99% Bandwidth (KHz)	Limit (KHz)
Lora DTS	903.0	500.72	
	907.8	500.72	
	914.2	509.41	
Lora FHSS SF7	902.3	127.35	
	908.5	127.35	
	914.9	126.63	
Lora FHSS SF10	902.3	125.90	
	908.5	125.90	
	914.9	125.90	
Minimum Measured Value		125.90	

5.1.7 Conducted Spurious Emissions Measured in 100 kHz Bandwidth

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.247(d) RSS-247 Clause 5.5
Basic standard	:	ANSI C63.10: 2013
Limits	:	20dB (below that in the 100kHz bandwidth within the band that contains the highest level of the desired power); In addition, radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits specified in 15.209(a)
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2022-12-09 to 2023-01-04
Input voltage	:	DC 5V Via USB port
Operation mode	:	A, B
Test channel	:	Low / Middle / High
Ambient temperature	:	25 ℃
Relative humidity	:	56 %
Atmospheric pressure	:	101 kPa

Test results of 100kHz Bandwidth of Frequency Band Edge by Conducted method refer to test plots, and compliance is achieved as well.

For the measurement records, refer to the appendix B.

5.1.8 Radiated Spurious Emission

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.247(d) & FCC Part 15.205 RSS-247 Clause 3.3
Basic standard	:	ANSI C63.10: 2013
Limits	:	Refer to 15.209(a) of FCC part 15.247(d)
Kind of test site	:	3m Semi-anechoic Chamber

Test Setup

Date of testing	:	2022-12-09 to 2023-01-04
Input voltage	:	DC 5V Via USB port
Operation mode	:	A, B, D
Test channel	:	Low / Middle / High
Ambient temperature	:	Refer to test result
Relative humidity	:	Refer to test result
Atmospheric pressure	:	101 kPa

Remark:
Testing was carried out within frequency range 9kHz to the tenth harmonics with all data rate and three channels (Lowest, middle and highest). Only the worst case spurious emissions configuration of the each mode were reported.

Radiated spurious emissions were performed on the EUT with antenna in three orthogonal orientations and only the worst (antenna vertical) orientations was recorded.

For the measurement records, refer to the appendix B.

5.1.9 Carrier Frequency Separation

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.247(a)(1) RSS-247 Clause 5.1(b)
Basic standard	:	ANSI C63.10: 2013
Limits	:	≥ 20dB bandwidth, whichever is greater
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2022-12-09 to 2023-01-04
Input voltage	:	DC 5V Via USB port
Operation mode	:	C
Test channel	:	Low / Middle / High
Ambient temperature	:	25 ℃
Relative humidity	:	56 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix B.

Table 12: Test Result of Carrier Frequency Separation

Test Mode	Channel	Measured Channel Separation (KHz)	Limit (kHz)	Result
Lora FHSS SF7	Low Channel	200.72	≥ 20dB bandwidth	Pass
	Adjacency Channel			
	Middle Channel	200.87		Pass
	Adjacency Channel			
	High Channel	200.58		Pass
	Adjacency Channel			
Lora FHSS SF10	Low Channel	200.58	≥ 20dB bandwidth	Pass
	Adjacency Channel			
	Middle Channel	200.72		Pass
	Adjacency Channel			
	High Channel	200.58		Pass
	Adjacency Channel			

Note:
The limit is maximum 20 dB bandwidth: 146.89 kHz.

5.1.10 Number of Hopping Frequency

RESULT: **Pass**

Test Specification

Test standard	:	FCC part 15.247(a)(1)(iii) RSS-247 Clause 5.1(d)
Basic standard	:	ANSI C63.10: 2013
Limits	:	≥ 15 non-overlapping channels
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2022-12-09 to 2023-01-04
Input voltage	:	DC 5V Via USB port
Operation mode	:	C
Ambient temperature	:	25 ℃
Relative humidity	:	56 %
Atmospheric pressure	:	101 kPa

Table 13: Test result of hopping channel number

Test Mode	20dB Bandwidth(kHz)	Hopping frequencies	Limit
Lora FHSS SF7	20dB Bandwidth < 250	64	≥50
Lora FHSS SF10	20dB Bandwidth < 250	64	≥50

5.1.11 Time of Occupancy

RESULT: **Pass**

Test Specification

Test standard	:	FCC part 15.247(a)(1)(iii) RSS-247 Clause 5.1(d)
Basic standard	:	ANSI C63.10: 2013
Limits	:	< 0.4s
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2022-12-09 to 2023-01-04
Input voltage	:	DC 5V Via USB port
Operation mode	:	C
Test channel	:	Low / Middle / High
Ambient temperature	:	25 ℃
Relative humidity	:	56 %
Atmospheric pressure	:	101 kPa

Table 14: Test result of Channel Occupancy

Test Mode	20dB Bandwidth(kHz)	Period (s)	Channel Occupancy Time (ms)	Limit (ms)
Lora FHSS SF7	20dB Bandwidth < 250	20	50.724	400
Lora FHSS SF10	20dB Bandwidth < 250	20	205.80	400

5.1.12 Conducted Emission on AC Mains

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.207(a) RSS-Gen Clause 8.8
Basic standard	:	ANSI C63.10: 2013
Frequency range	:	0.15 – 30MHz
Limits	:	FCC Part 15.207(a) RSS-Gen Table 3
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2022-12-09 to 2023-01-04
Input voltage	:	Powered by PC Adapter
Operation mode	:	A, B
Earthing	:	Not connected
Ambient temperature	:	22 ℃
Relative humidity	:	64 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix B.

6 Photographs of the Test Set-Up

For photographs of the test set-up, refer to the appendix A.

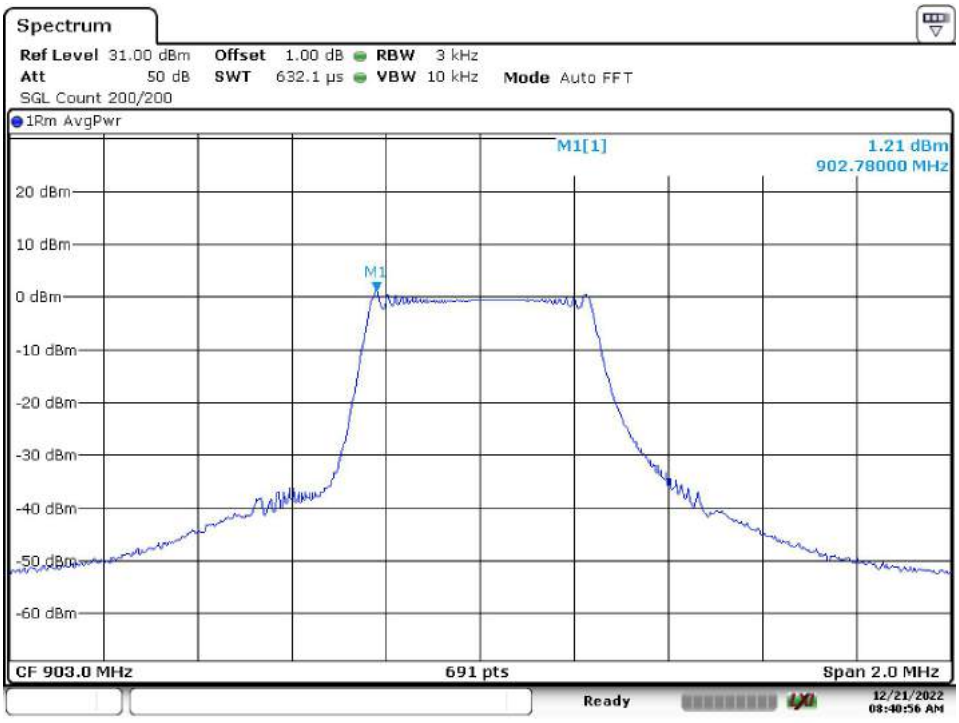
7 List of Tables

Appendix B: Test Results

Appendix B.1: Conducted Power Spectral Density

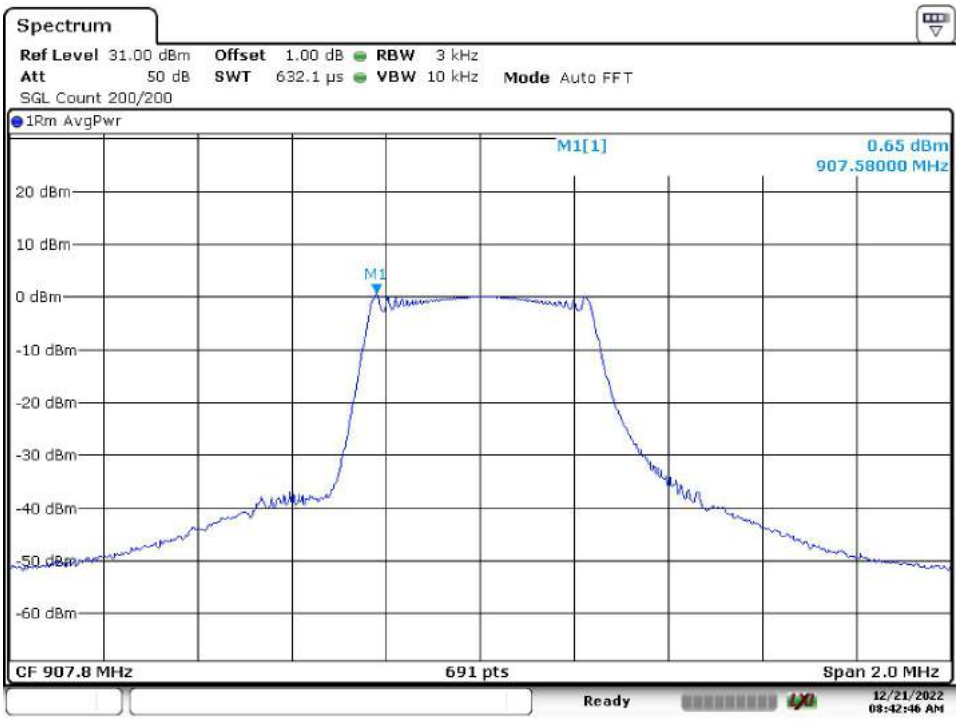
Lora DTS, Antenna Gain 2.3dBi

Low Channel



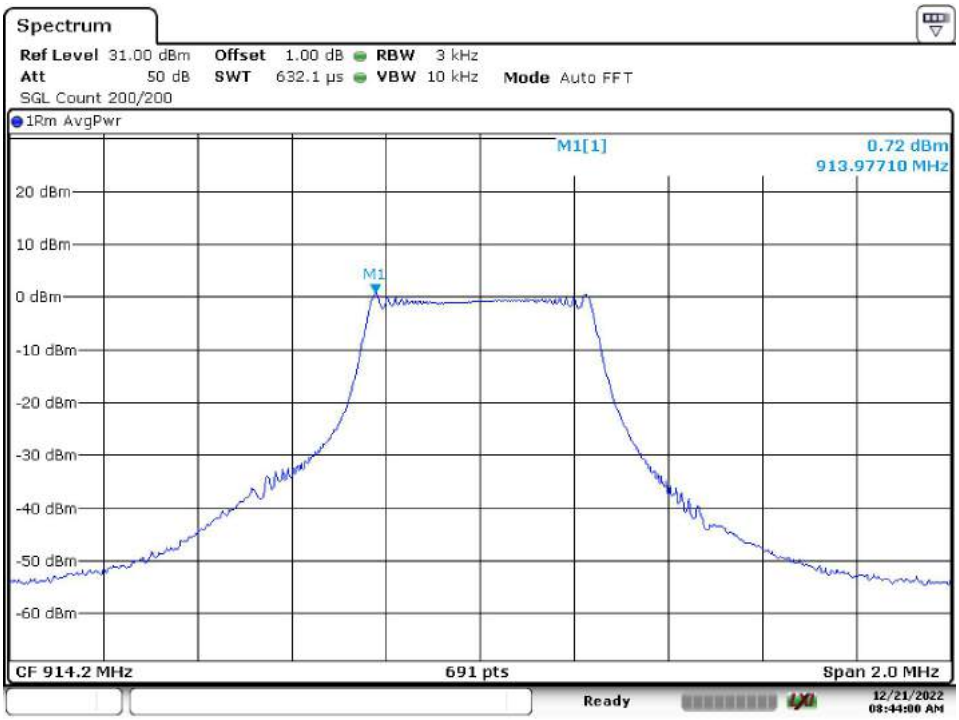
Date: 21.DEC.2022 08:40:56

Middle Channel



Date: 21.DEC.2022 08:42:46

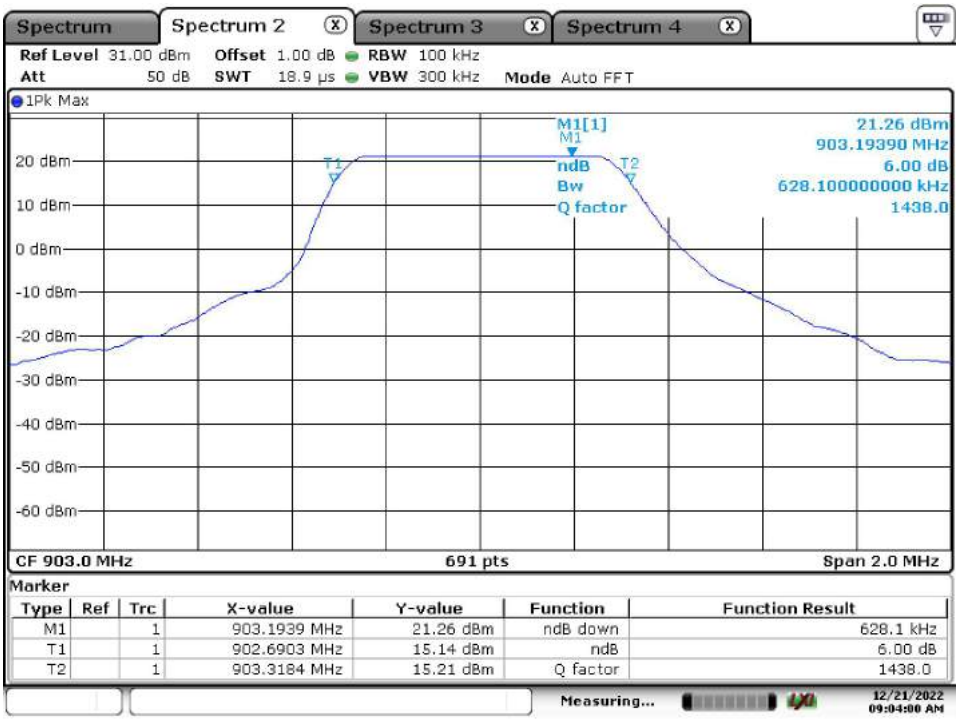
High Channel



Date: 21.DEC.2022 08:44:00

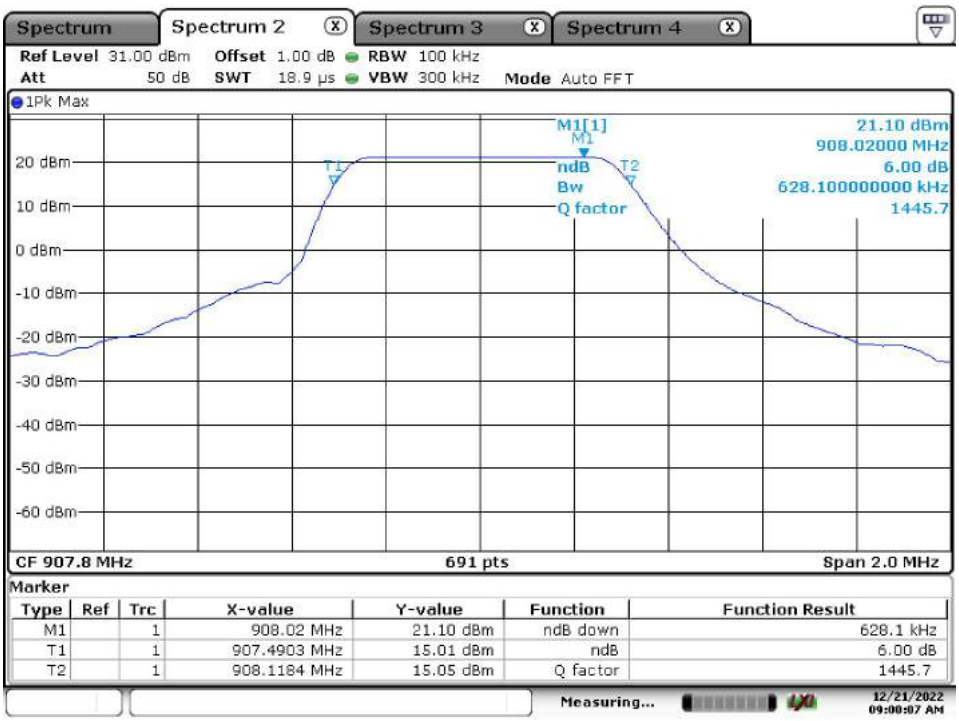
Appendix B.2: 6dB Bandwidth

Lora DTS
Low Channel



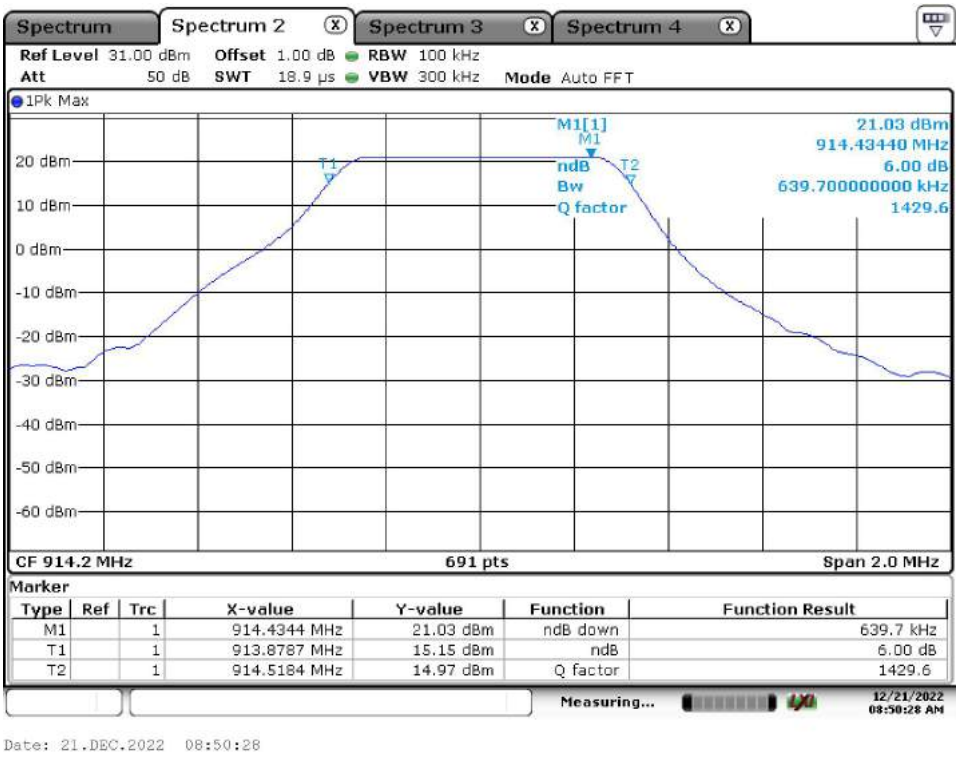
Date: 21.DEC.2022 09:04:00

Middle Channel



Date: 21.DEC.2022 09:00:07

High Channel

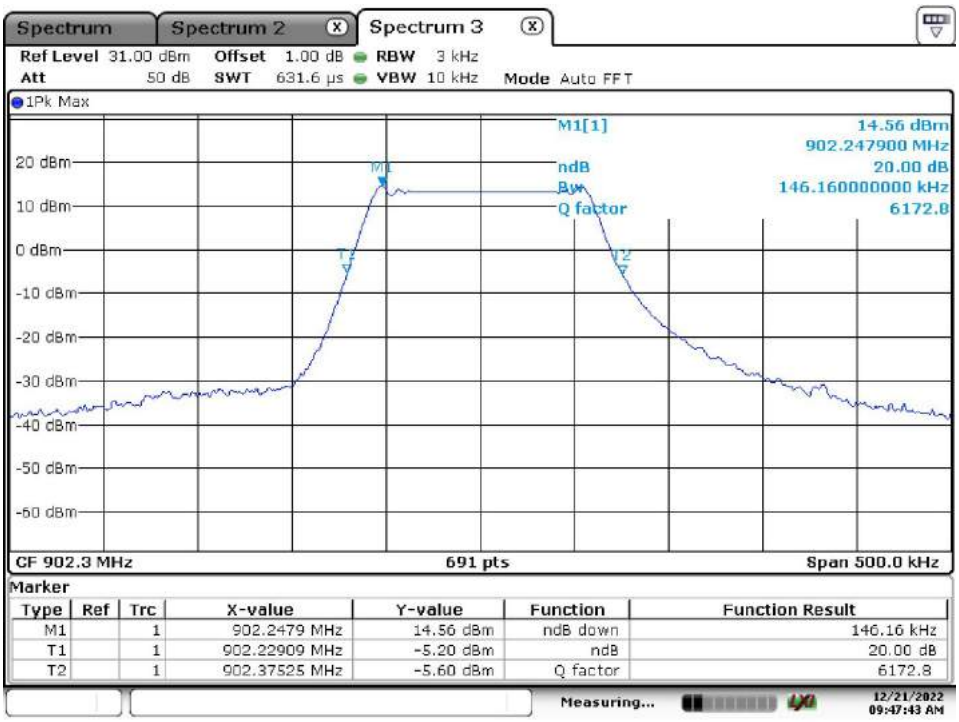


Date: 21.DEC.2022 08:50:28

Appendix B.3: 20dB Bandwidth

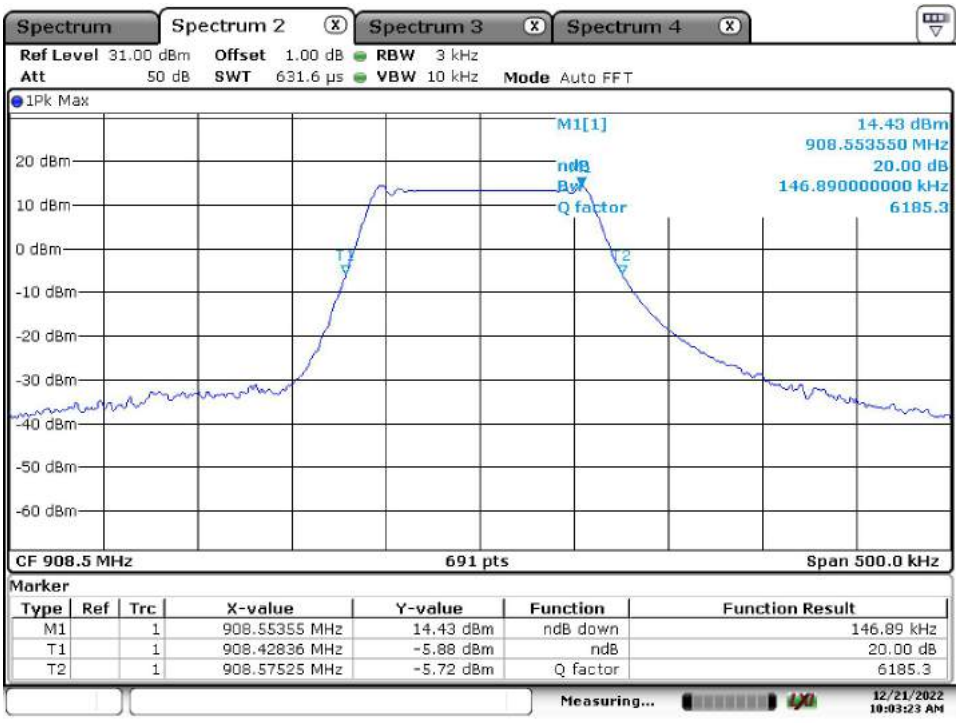
Lora FHSS, Data rate SF7

Low Channel



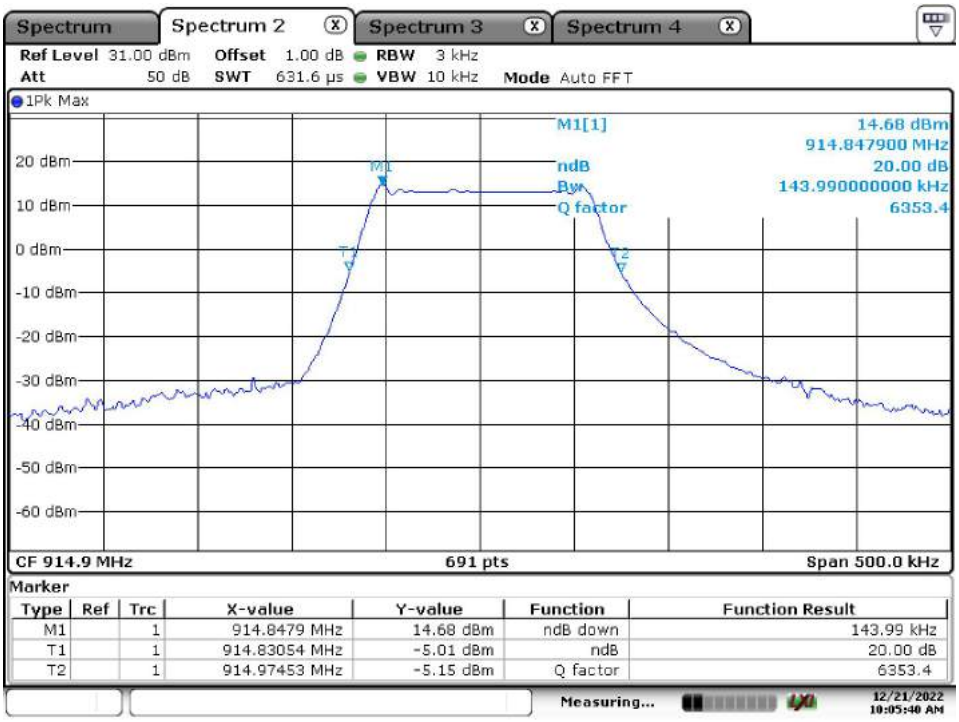
Date: 21.DEC.2022 09:47:43

Middle Channel



Date: 21.DEC.2022 10:03:23

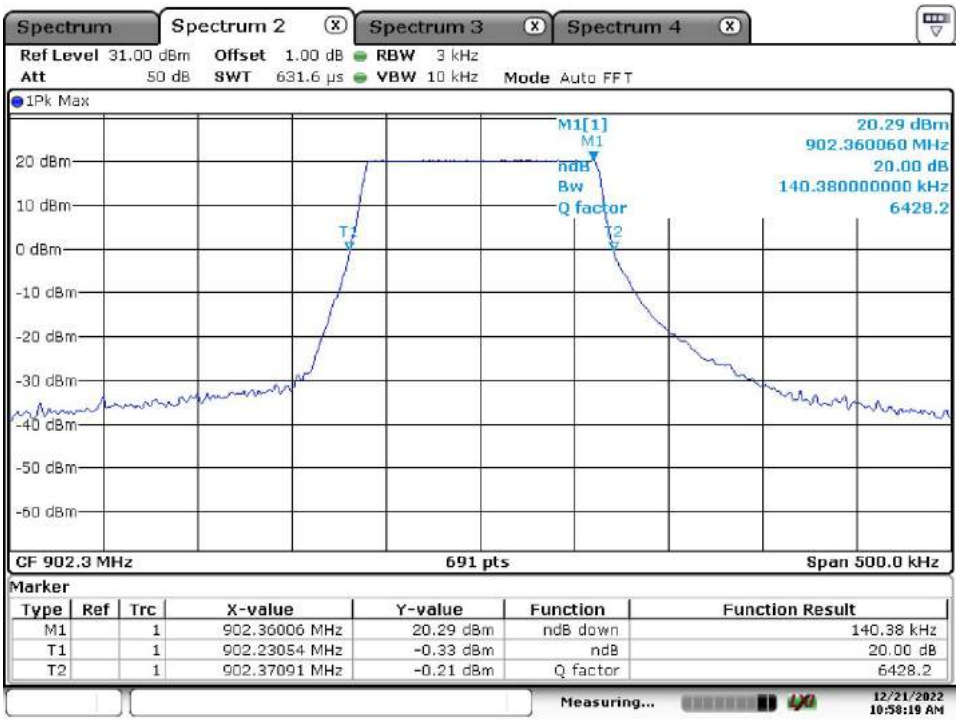
High Channel



Date: 21.DEC.2022 10:05:41

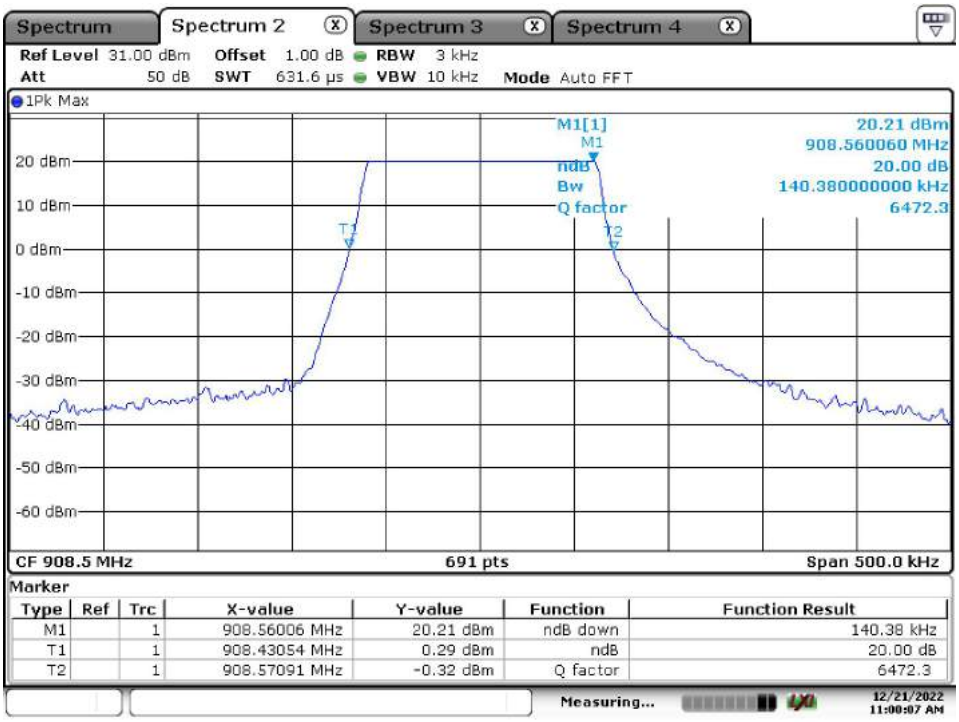
Lora FHSS, Data rate SF10

Low Channel



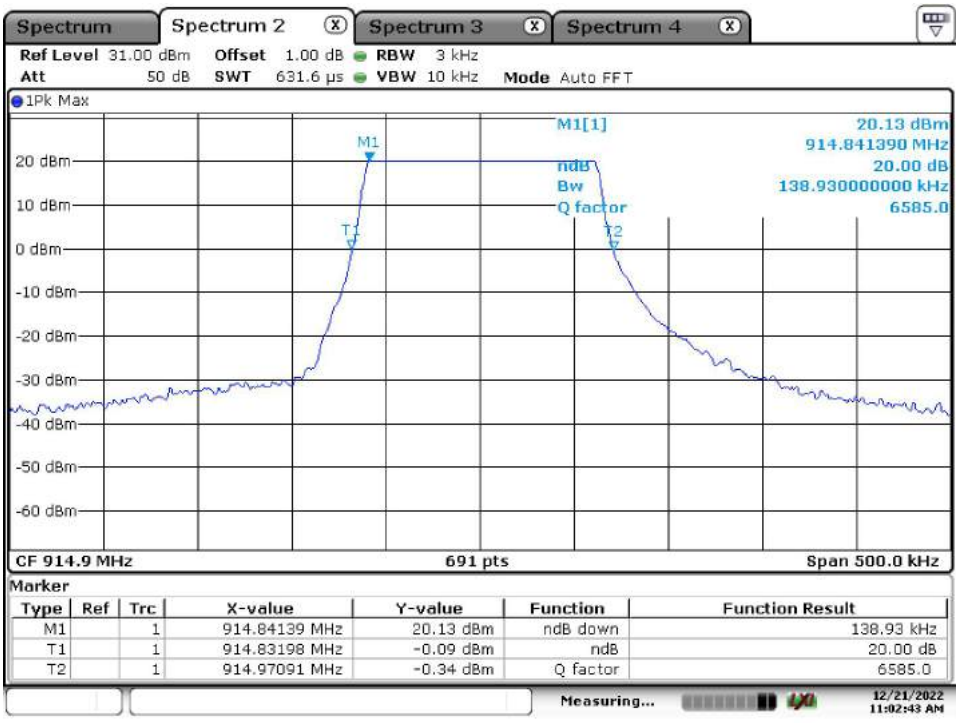
Date: 21.DEC.2022 10:58:20

Middle Channel



Date: 21.DEC.2022 11:00:07

High Channel

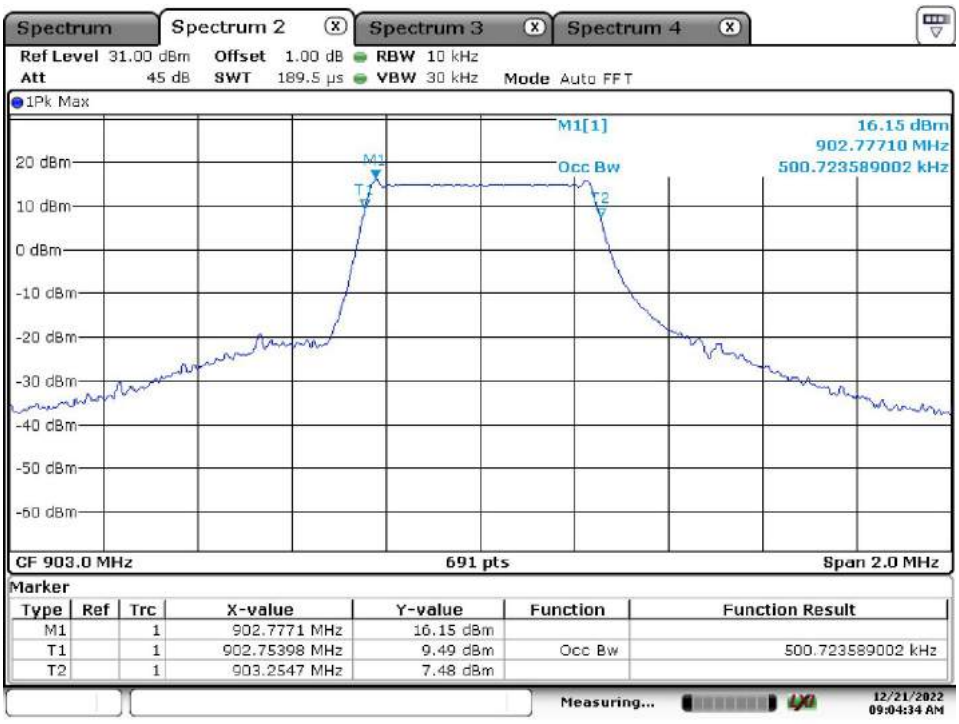


Date: 21.DEC.2022 11:02:44

Appendix B.4: 99% Bandwidth

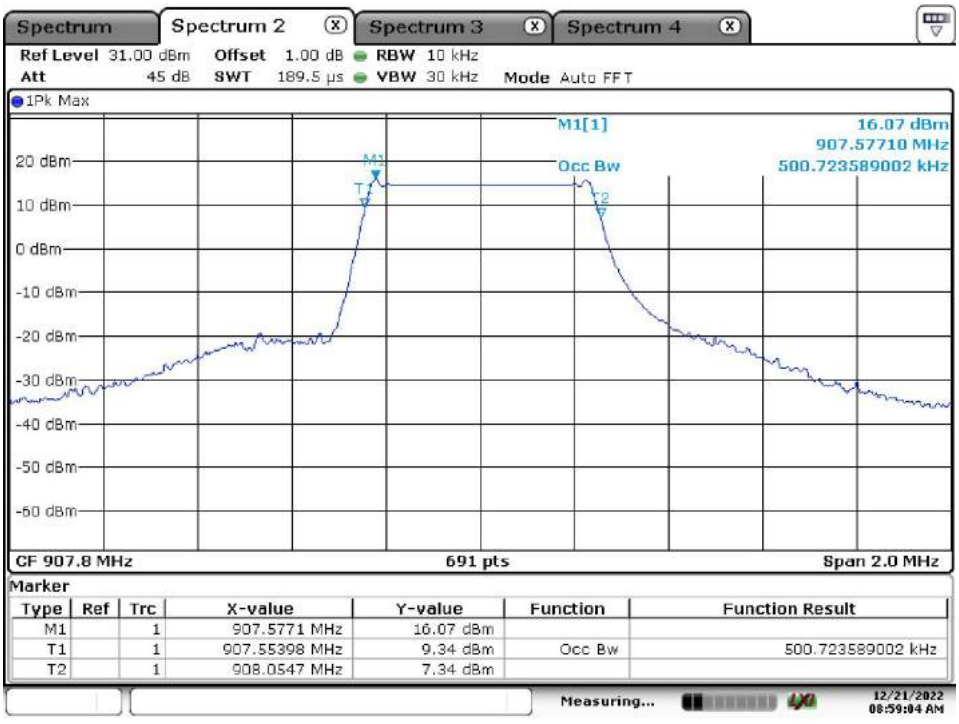
Lora DTS

Low Channel



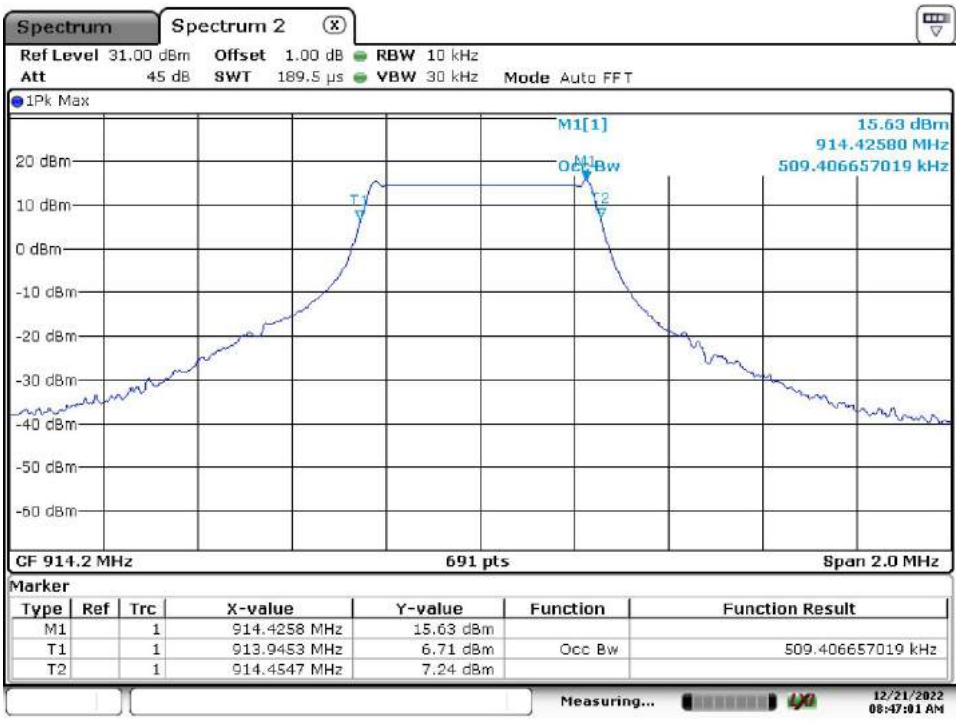
Date: 21.DEC.2022 09:04:34

Middle Channel



Date: 21.DEC.2022 08:59:04

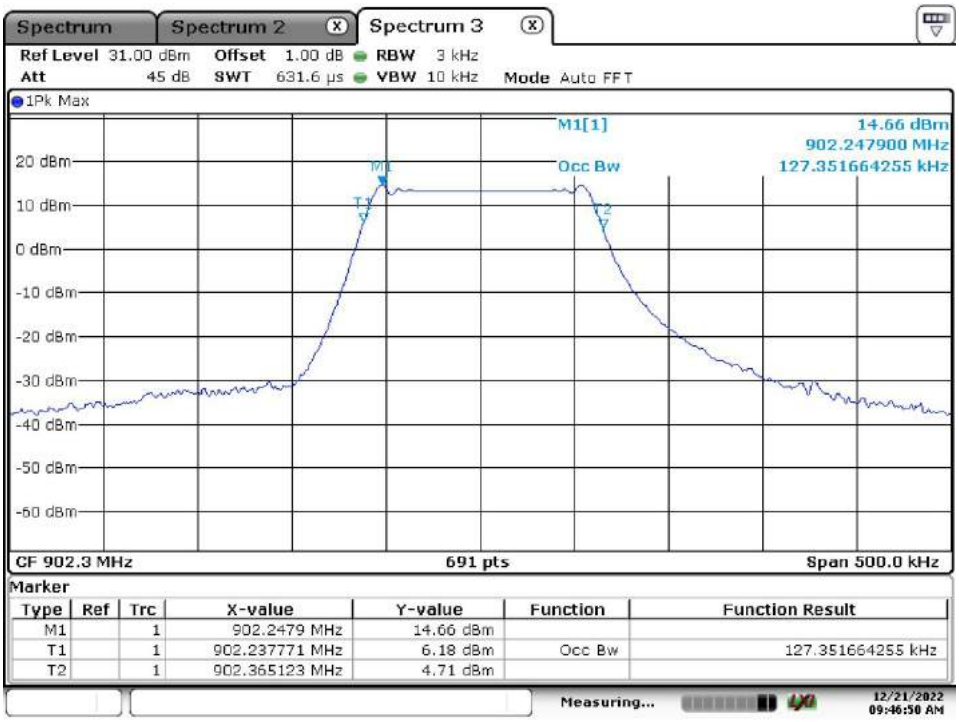
High Channel



Date: 21.DEC.2022 08:47:01

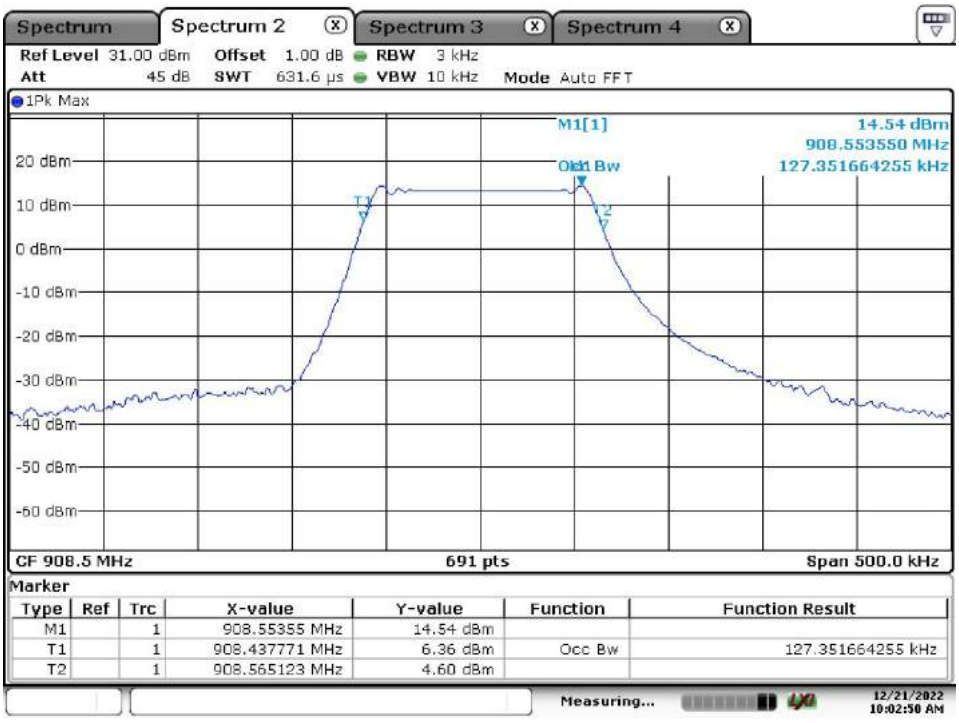
Lora FHSS, Data rate SF7

Low Channel



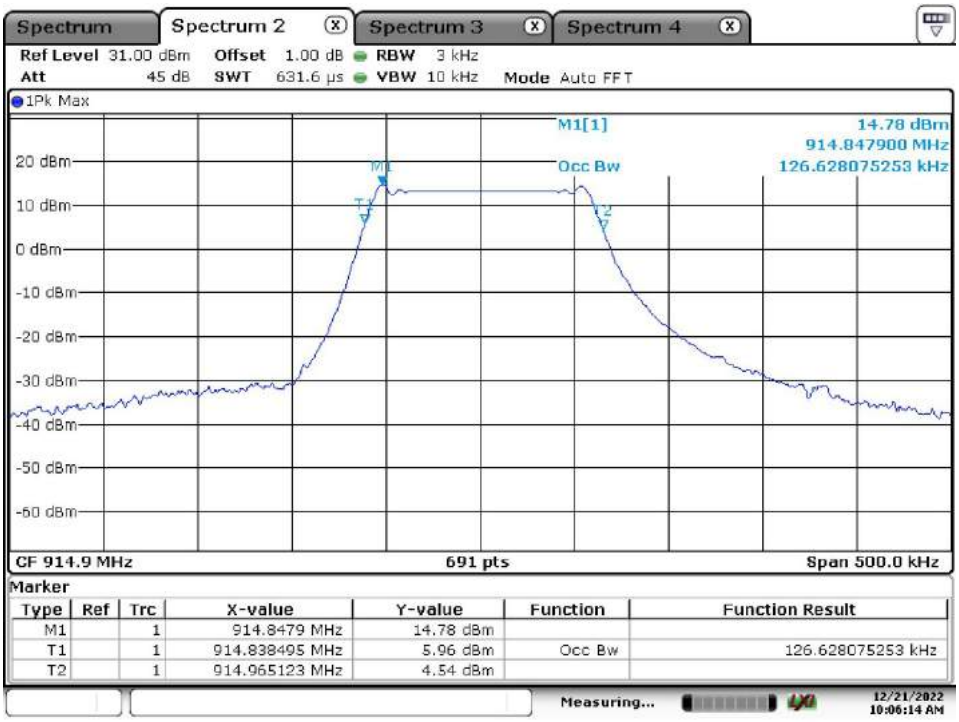
Date: 21.DEC.2022 09:46:50

Middle Channel



Date: 21.DEC.2022 10:02:50

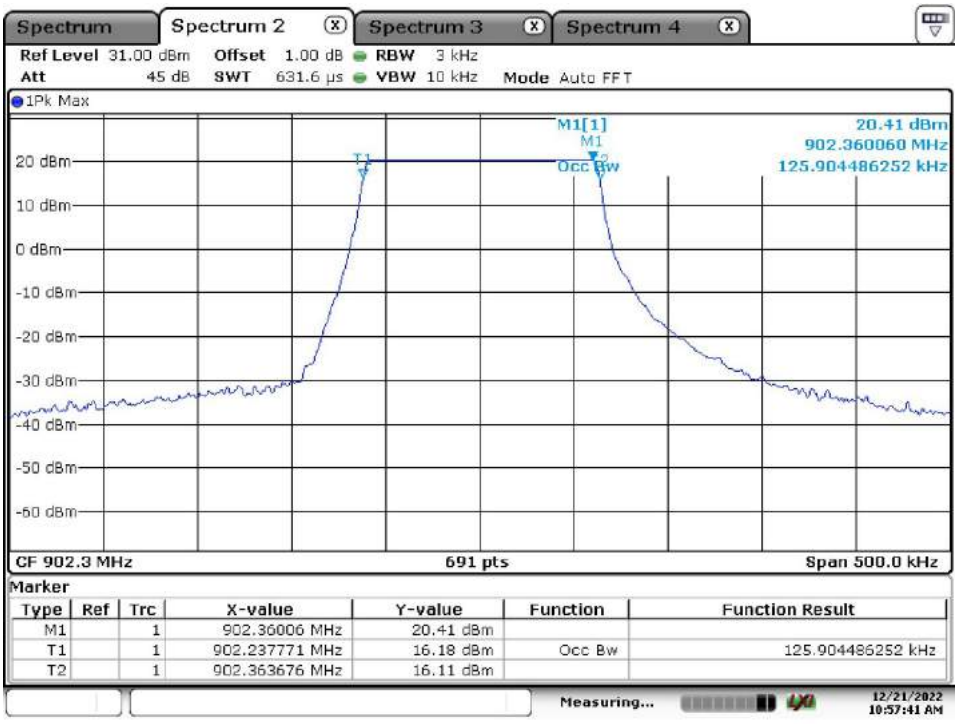
High Channel



Date: 21.DEC.2022 10:06:14

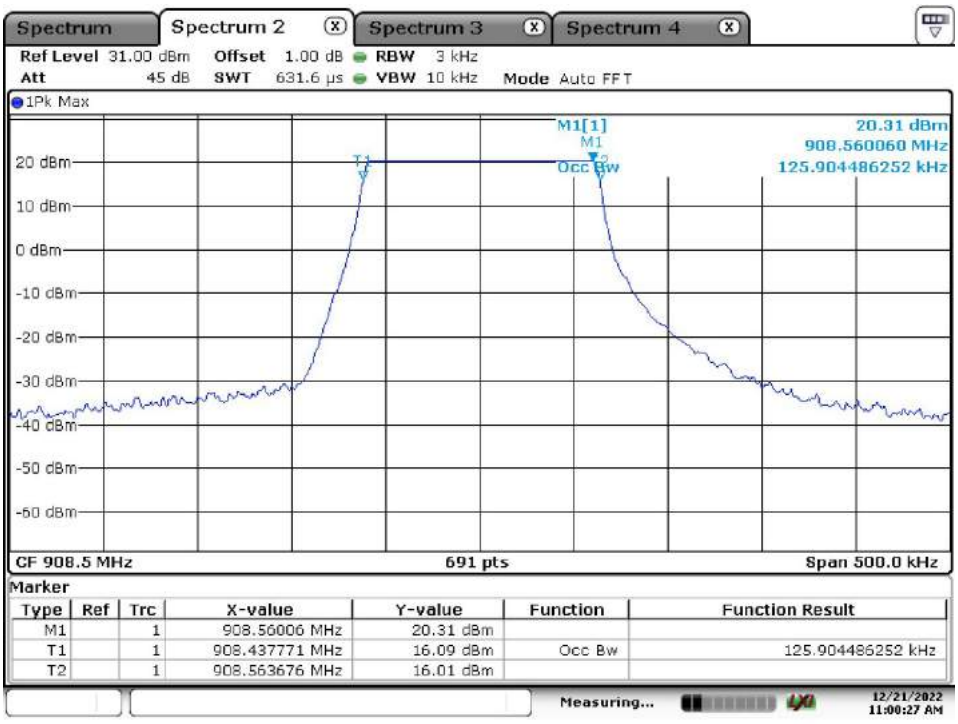
Lora FHSS, Data rate SF10

Low Channel



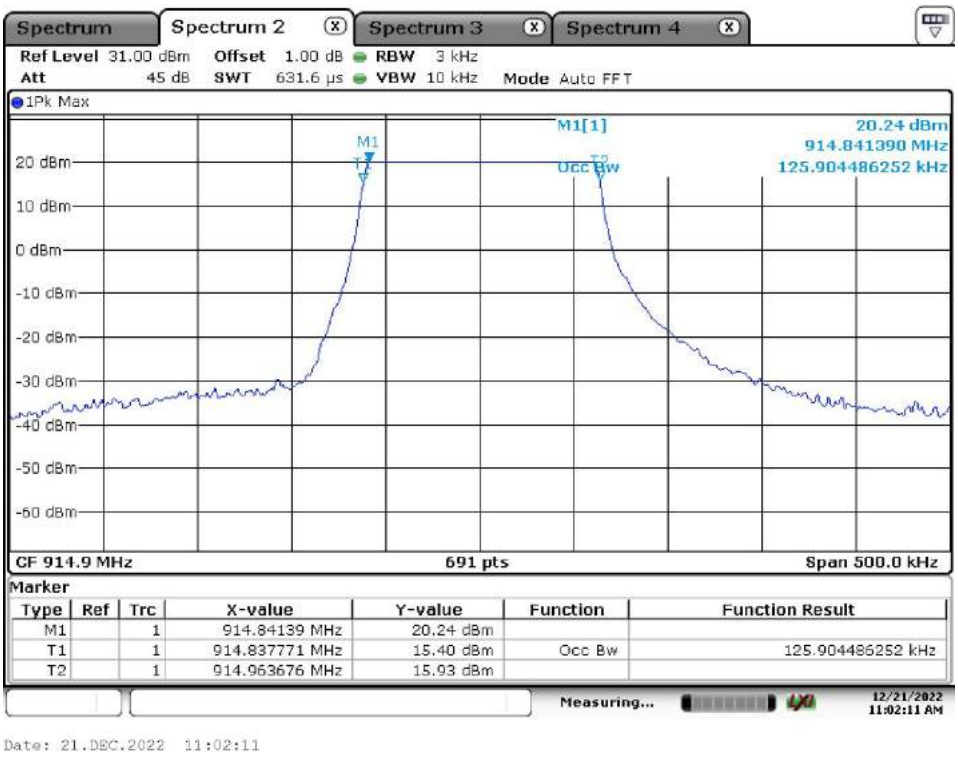
Date: 21.DEC.2022 10:57:41

Middle Channel



Date: 21.DEC.2022 11:00:27

High Channel



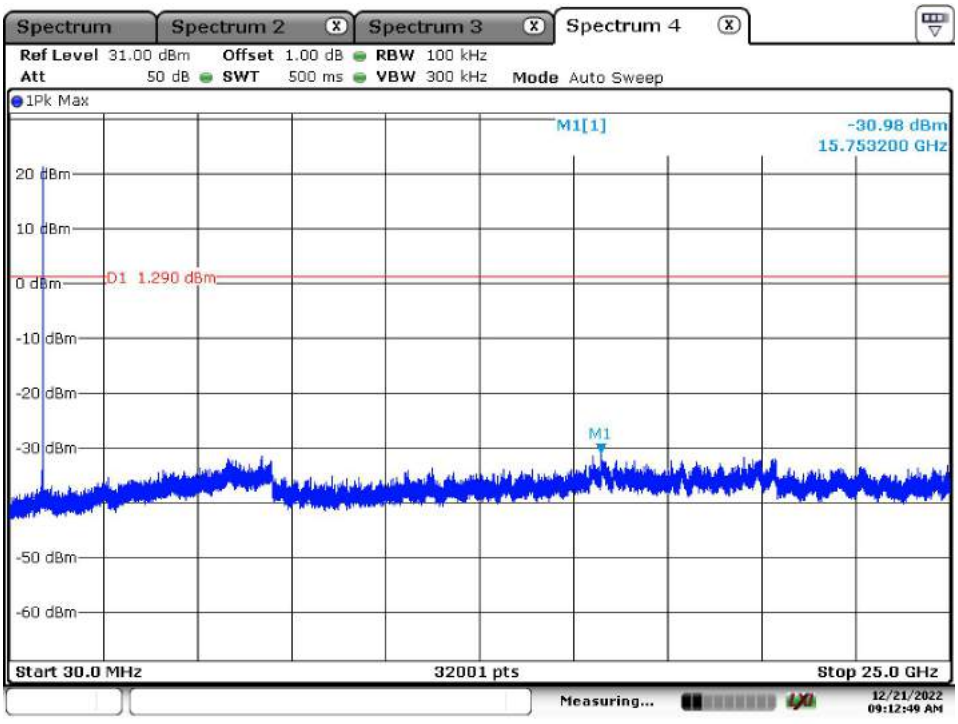
Date: 21.DEC.2022 11:02:11

Appendix B.5: Conducted Spurious Emissions Measured in 100 kHz Bandwidth

Lora DTS

Low Channel

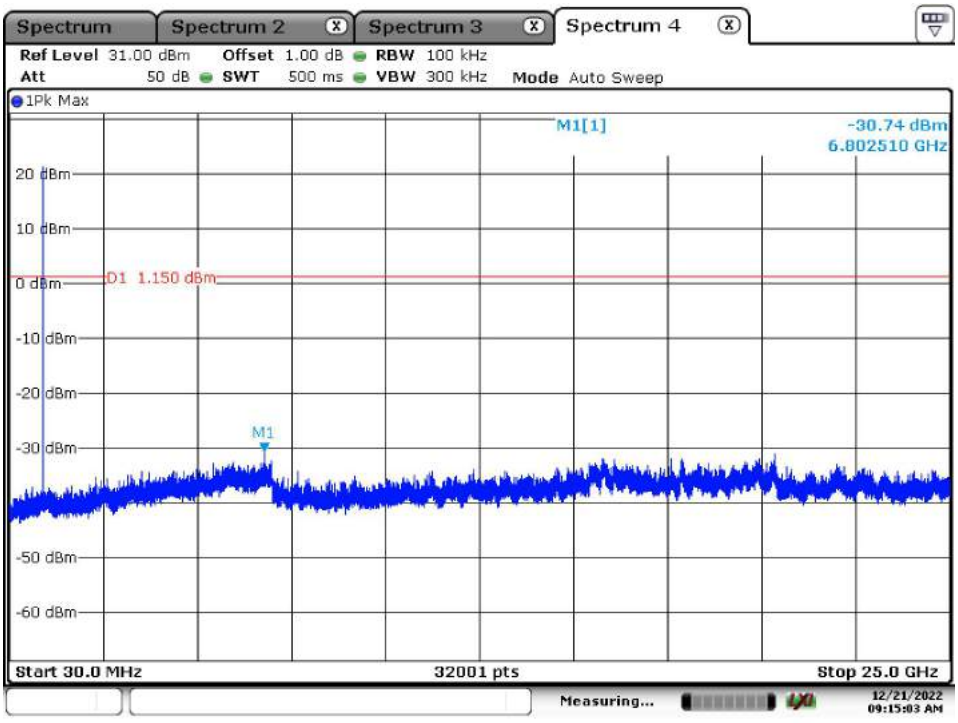
Date: 21.DEC.2022 09:05:03



Date: 21.DEC.2022 09:12:49

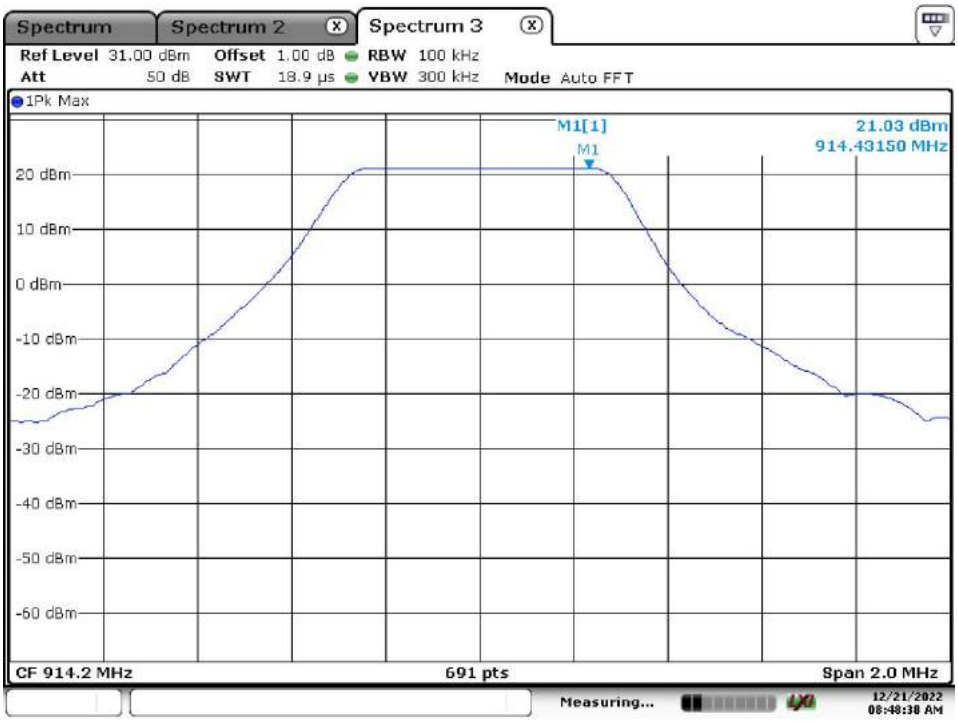
Middle Channel

Date: 21.DEC.2022 09:01:54

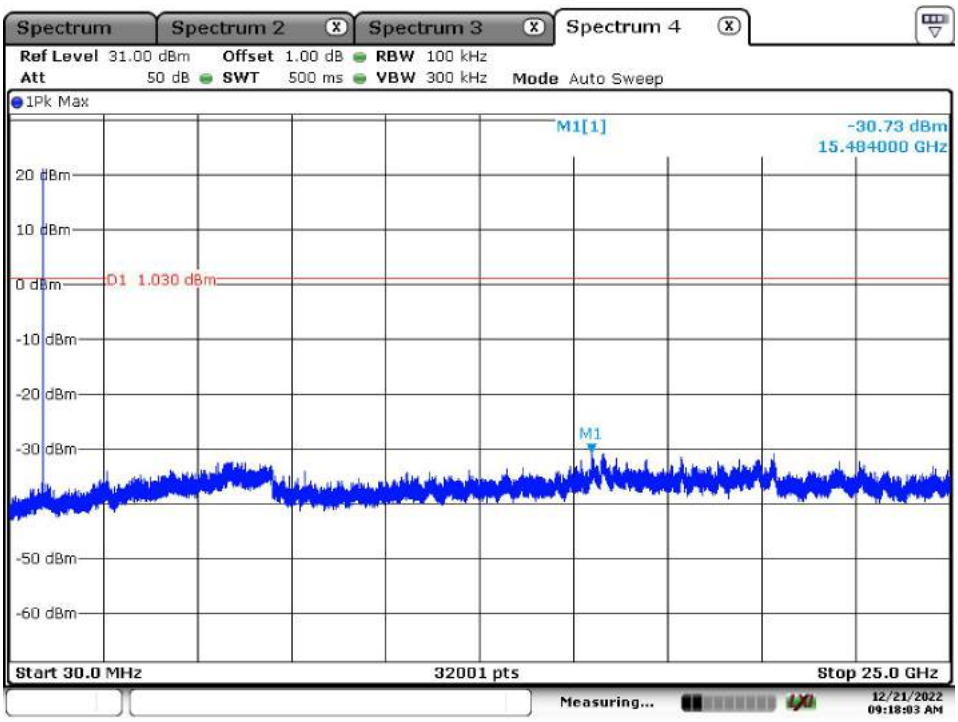


Date: 21.DEC.2022 09:15:03

High Channel



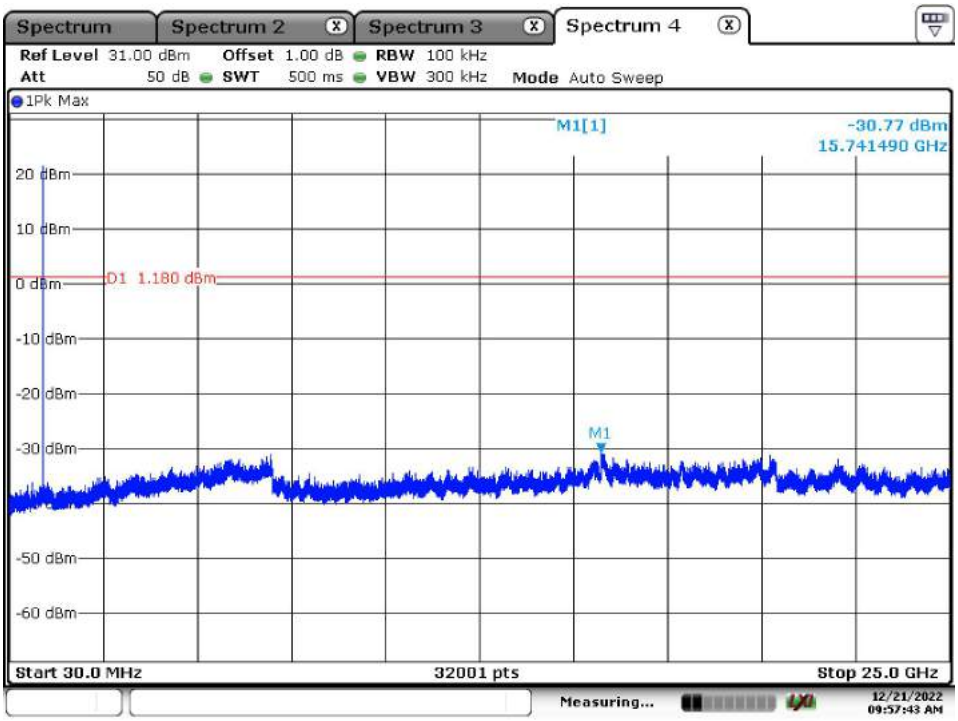
Date: 21.DEC.2022 08:48:38



Date: 21.DEC.2022 09:18:04

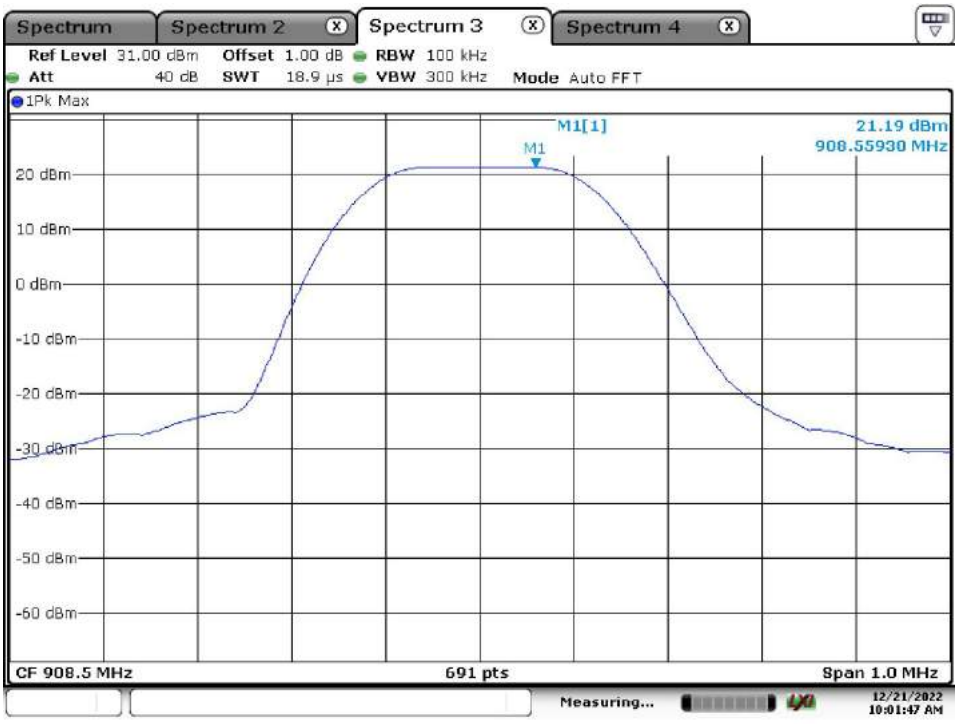
Lora FHSS, Data rate SF7, No hopping
Low Channel

Date: 21.DEC.2022 09:44:58

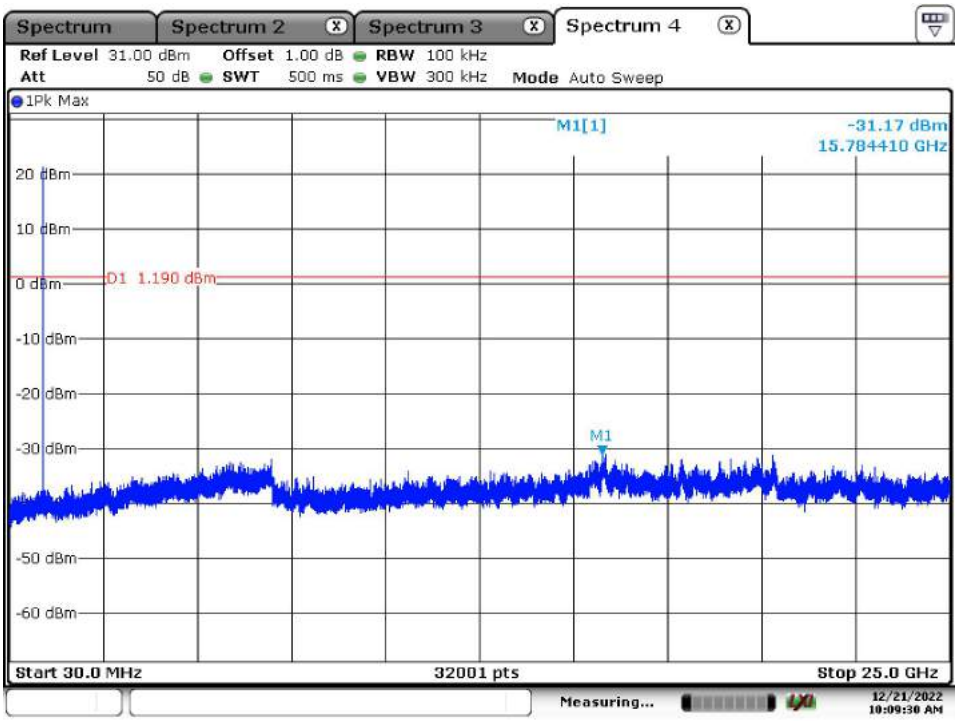


Date: 21.DEC.2022 09:57:44

Middle Channel



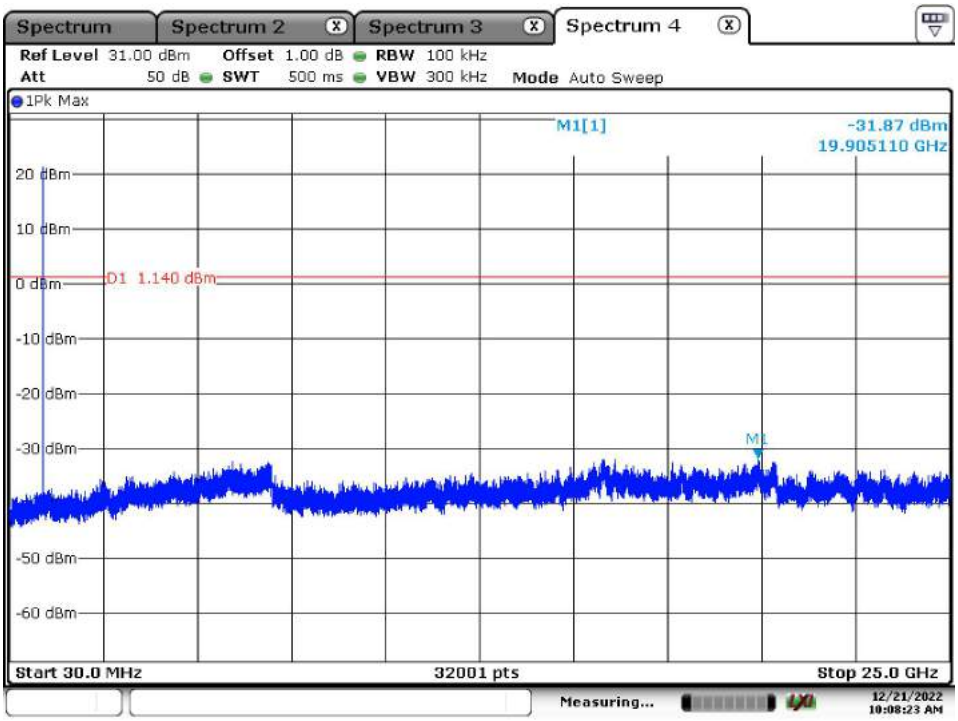
Date: 21.DEC.2022 10:01:48



Date: 21.DEC.2022 10:09:30

High Channel

Date: 21.DEC.2022 10:05:17

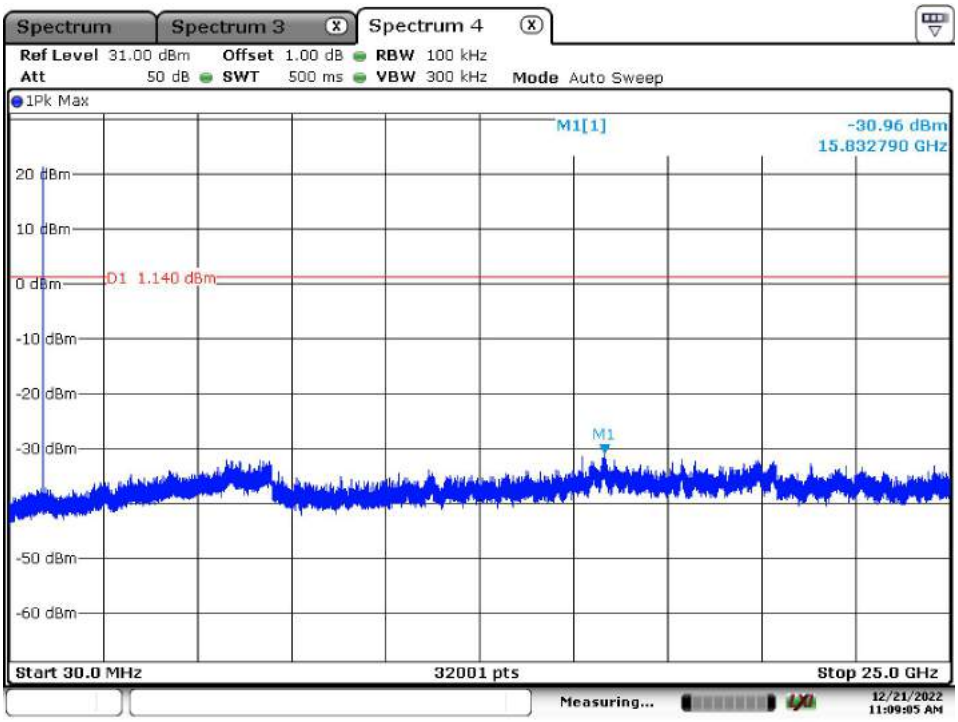


Date: 21.DEC.2022 10:08:24

Lora FHSS, Data rate SF10, No hopping

Low Channel

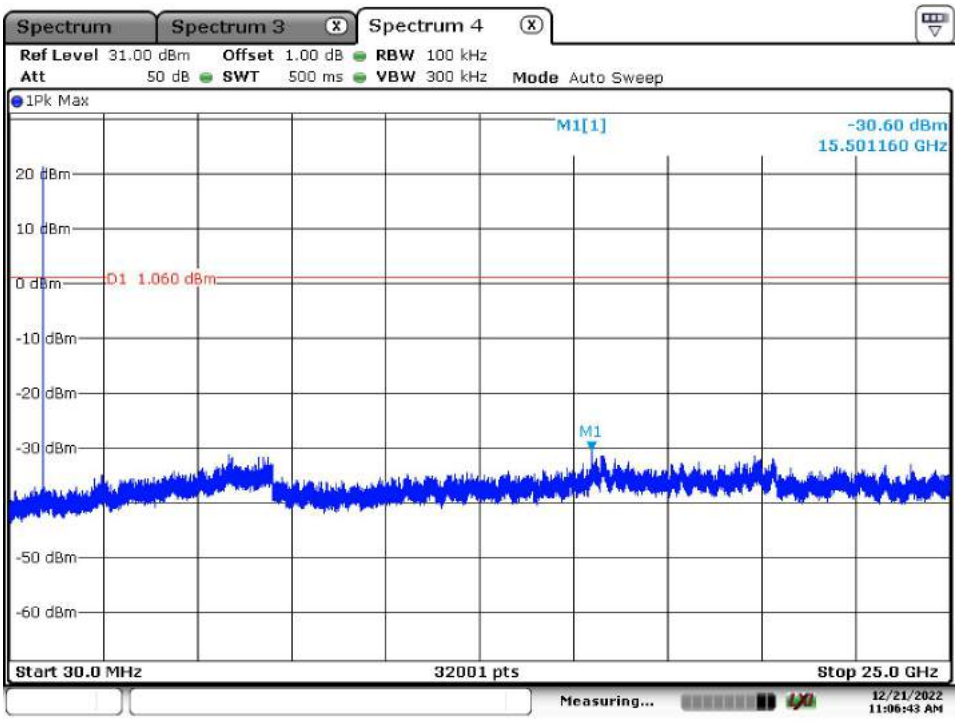
Date: 21.DEC.2022 10:56:26



Date: 21.DEC.2022 11:09:05

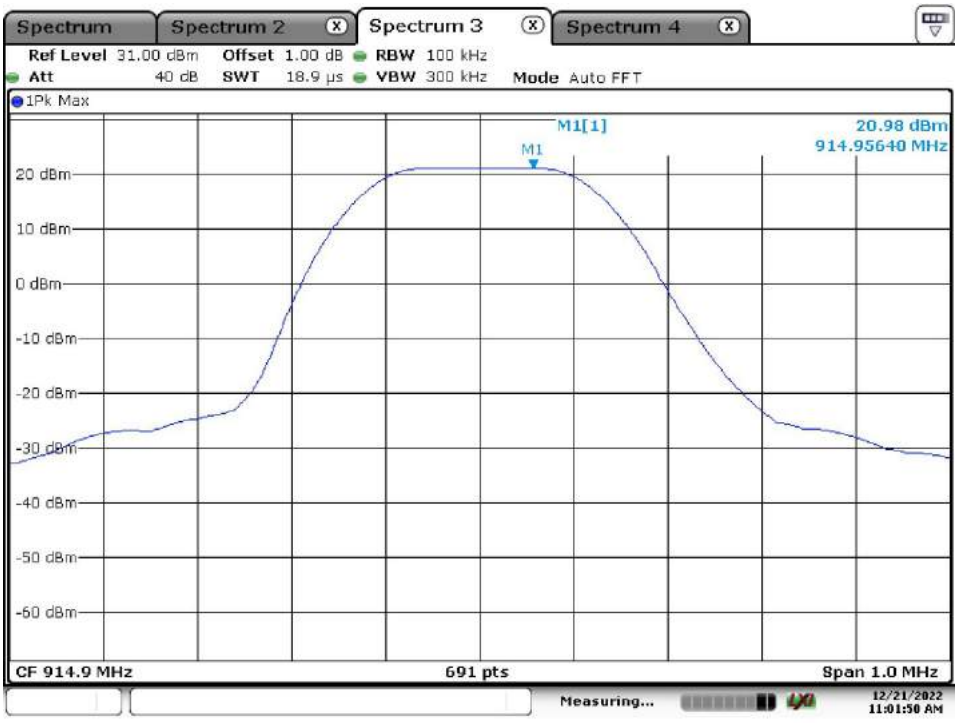
Middle Channel

Date: 21.DEC.2022 10:59:48

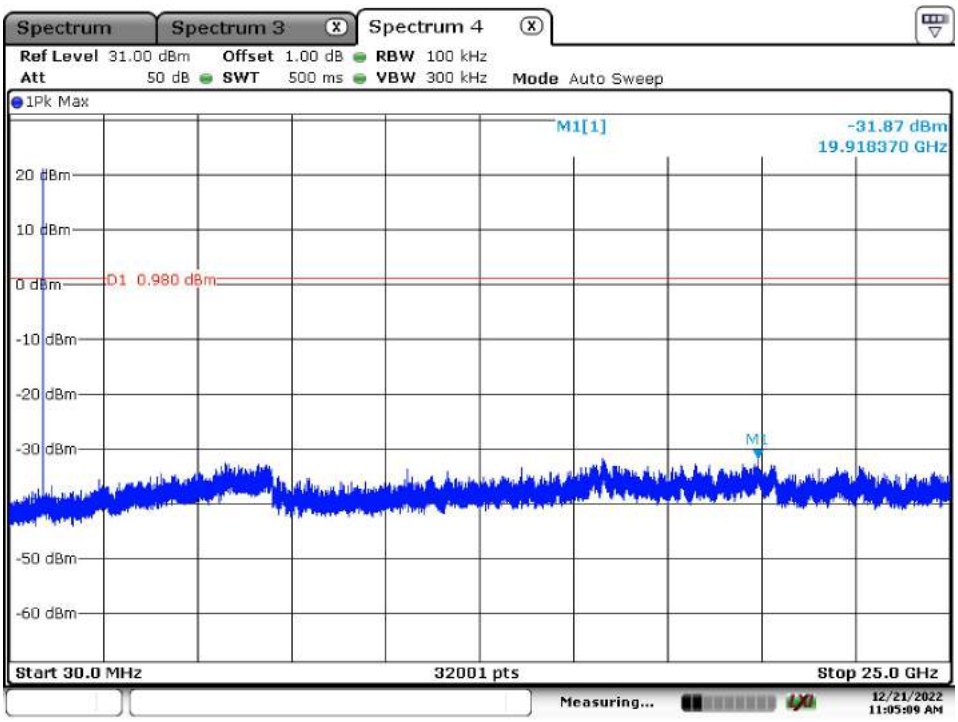


Date: 21.DEC.2022 11:06:43

High Channel

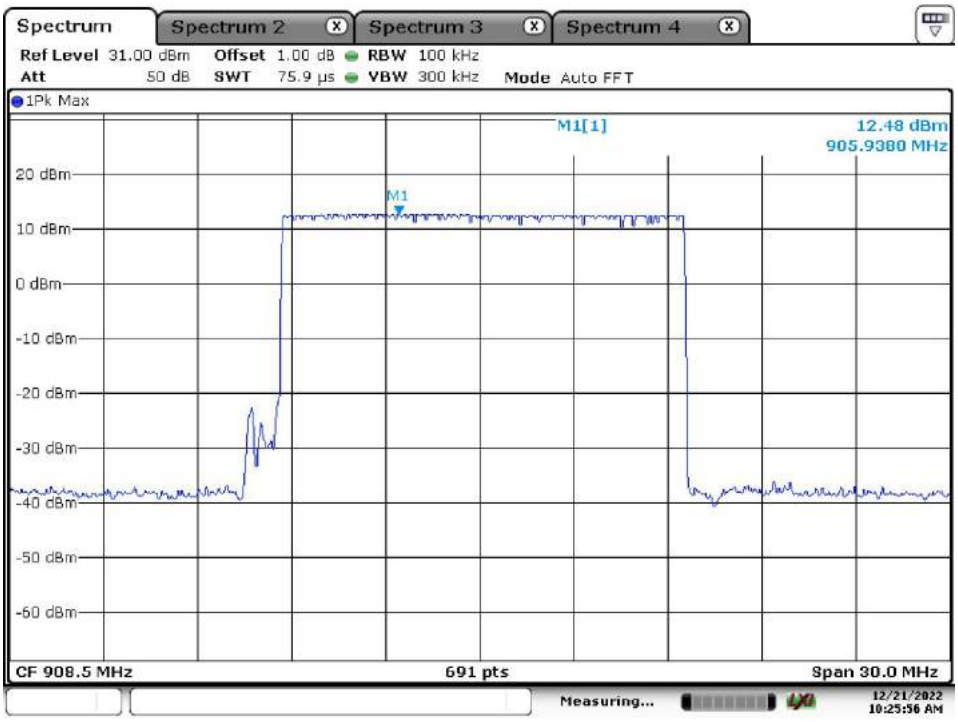


Date: 21.DEC.2022 11:01:50

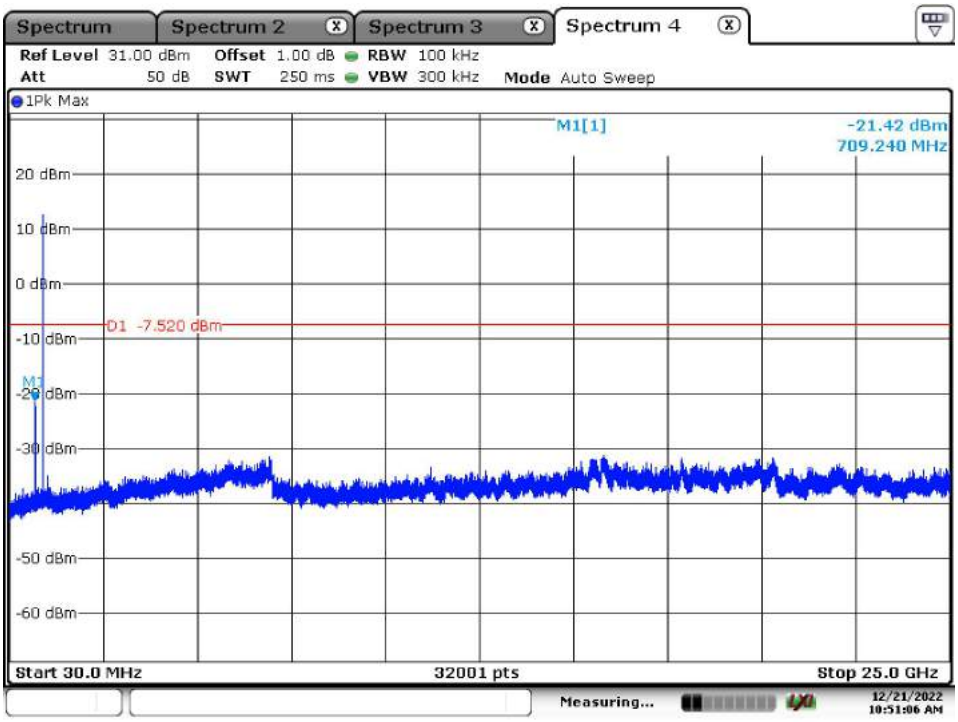


Date: 21.DEC.2022 11:05:10

Lora FHSS, Data rate SF7, hopping

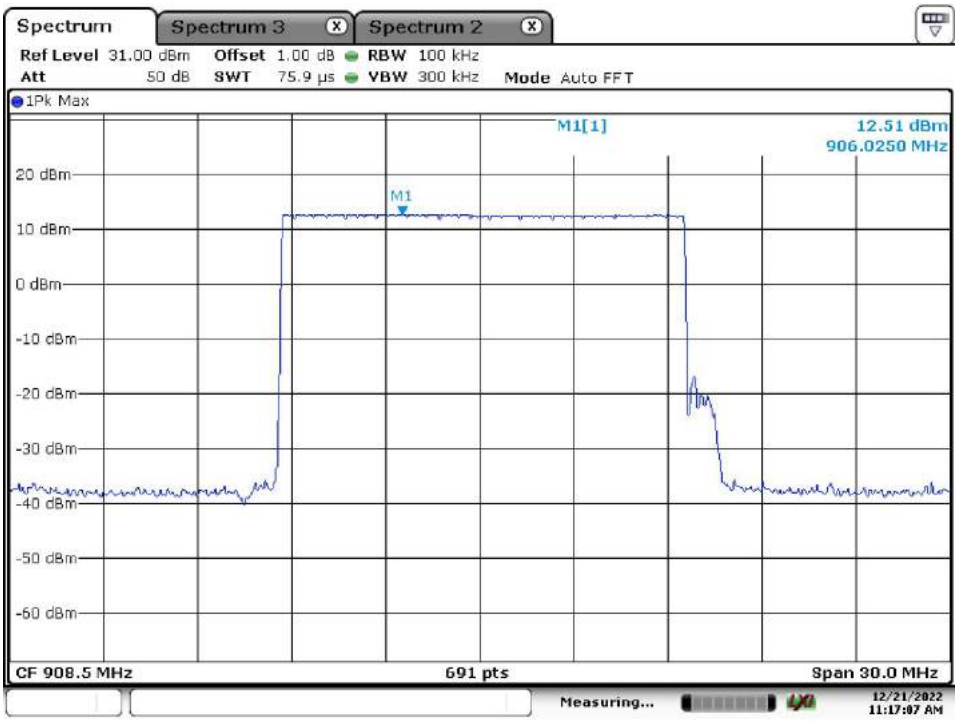


Date: 21.DEC.2022 10:25:56

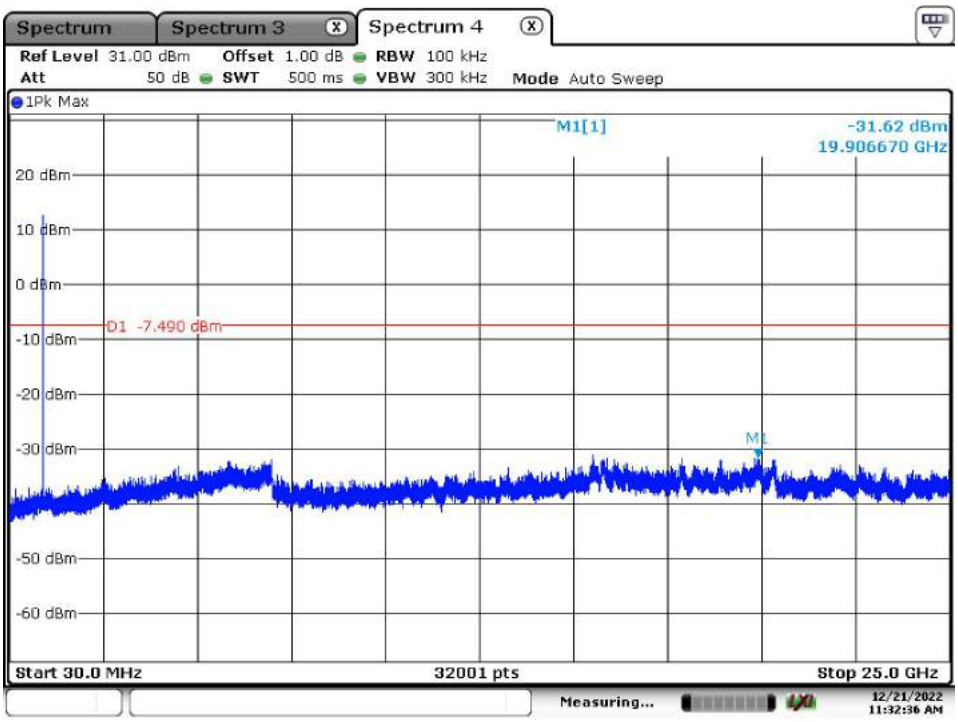


Date: 21.DEC.2022 10:51:07

Lora FHSS, Data rate SF10, hopping



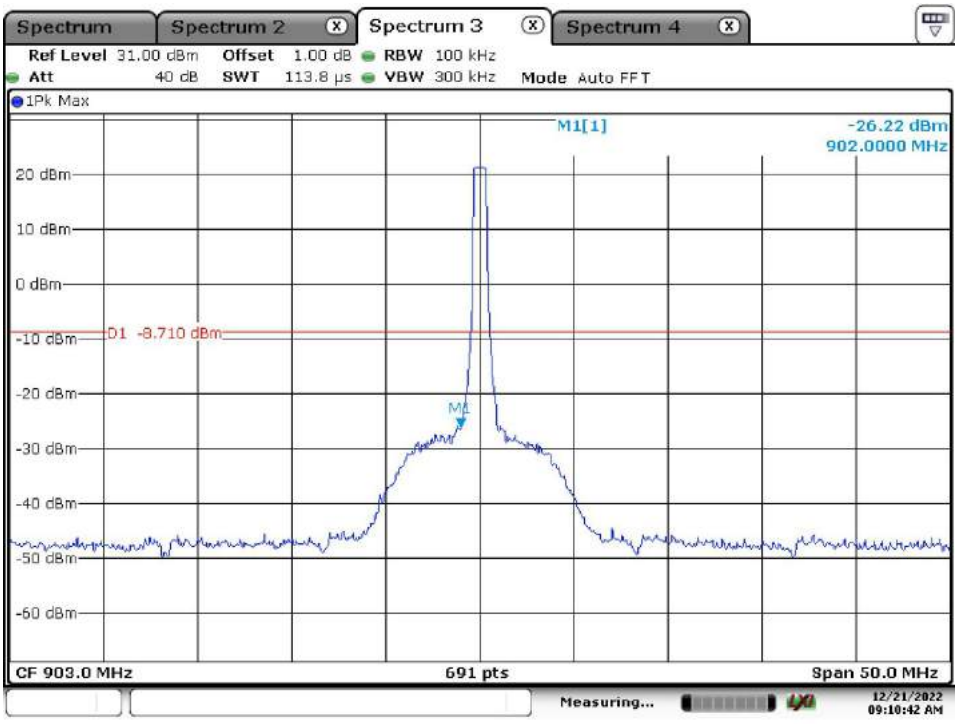
Date: 21.DEC.2022 11:17:07



Date: 21.DEC.2022 11:32:37

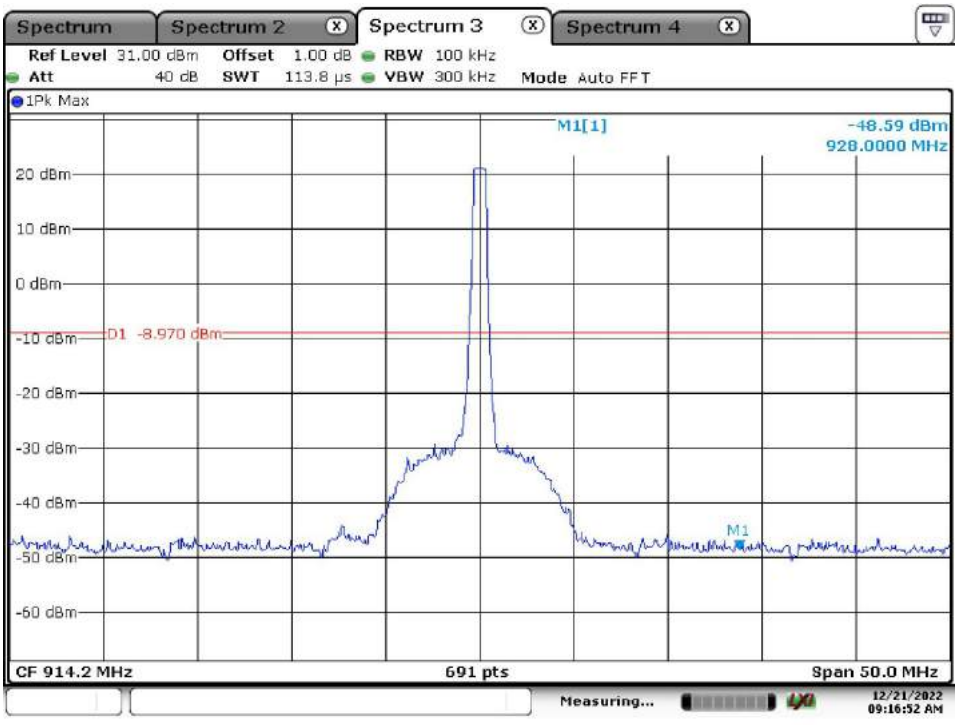
Lora DTS, Band Edge

Low Channel



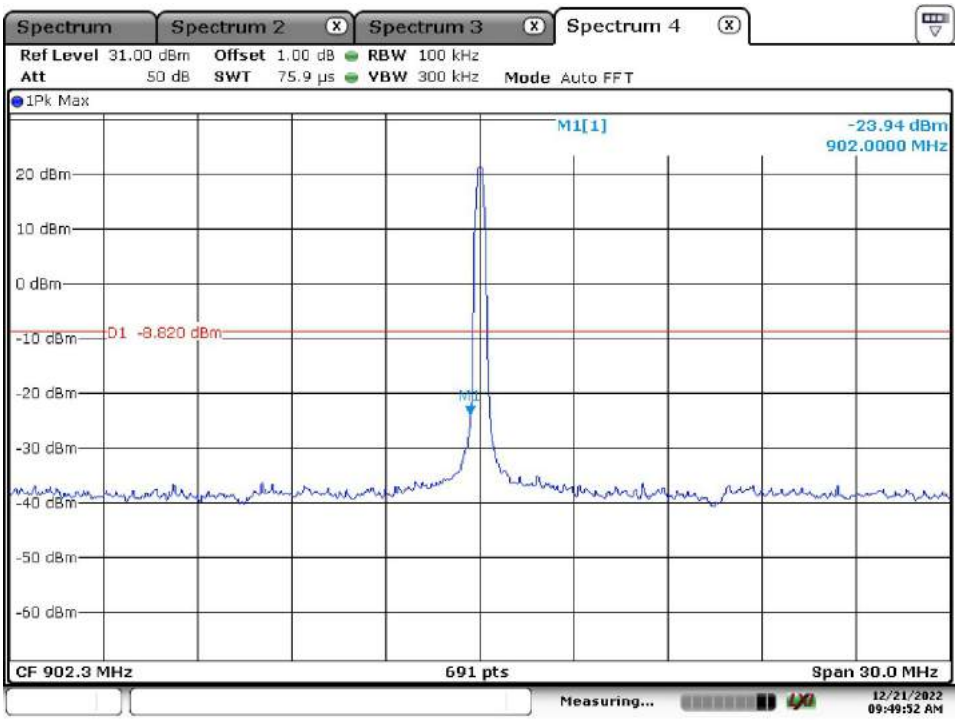
Date: 21.DEC.2022 09:10:42

High Channel



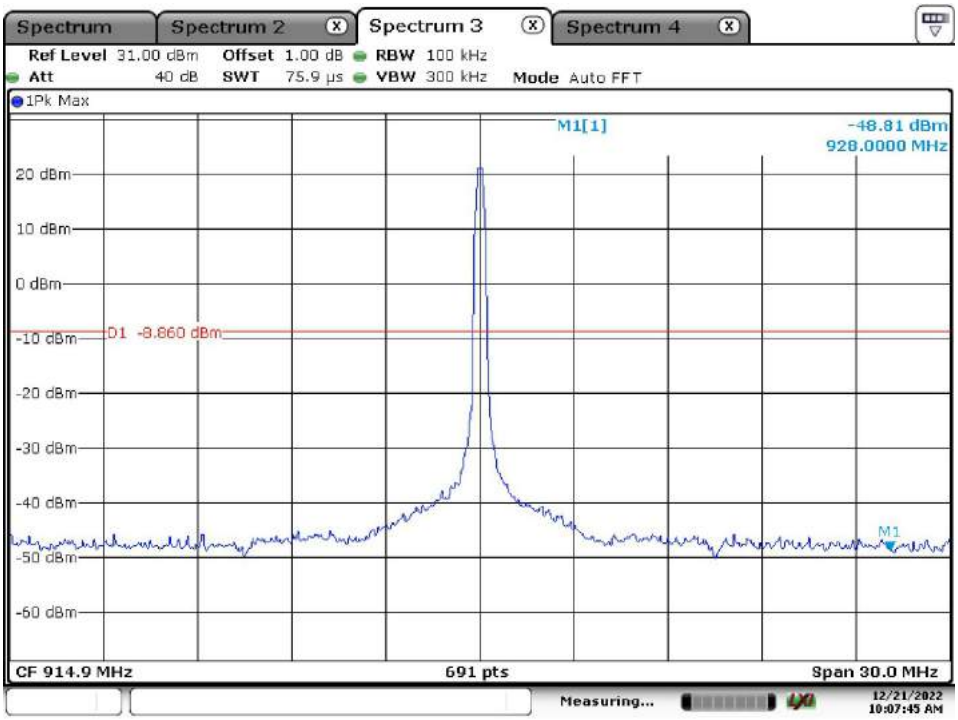
Date: 21.DEC.2022 09:16:53

Lora FHSS, Data rate SF7, No hopping, Band Edge
Low Channel



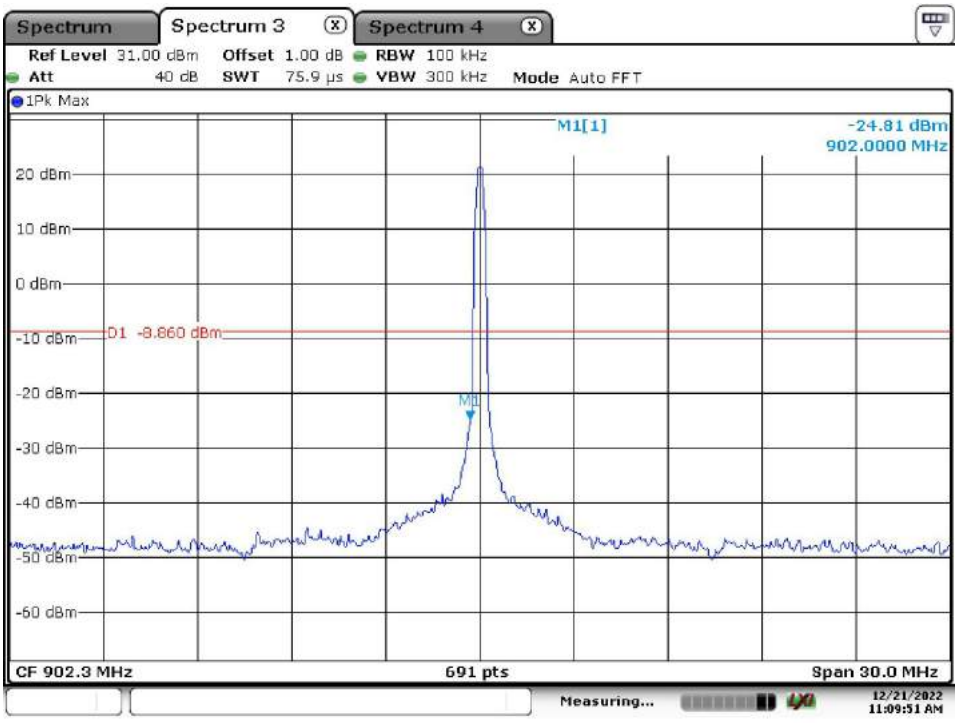
Date: 21.DEC.2022 09:49:52

High Channel



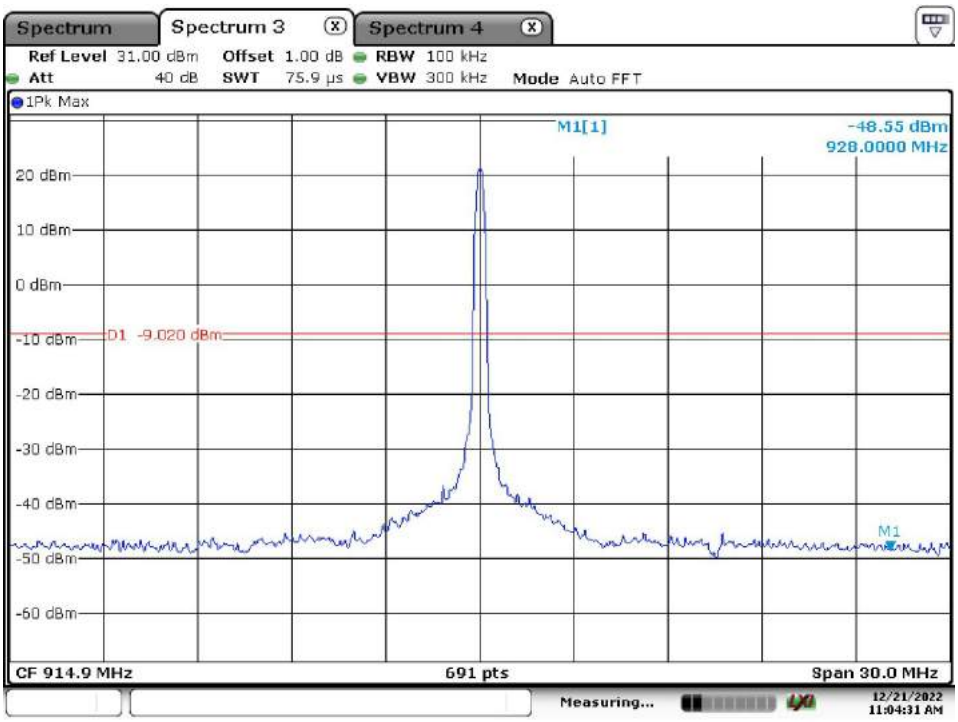
Date: 21.DEC.2022 10:07:46

Lora FHSS, Data rate SF10, No hopping, Band Edge
Low Channel



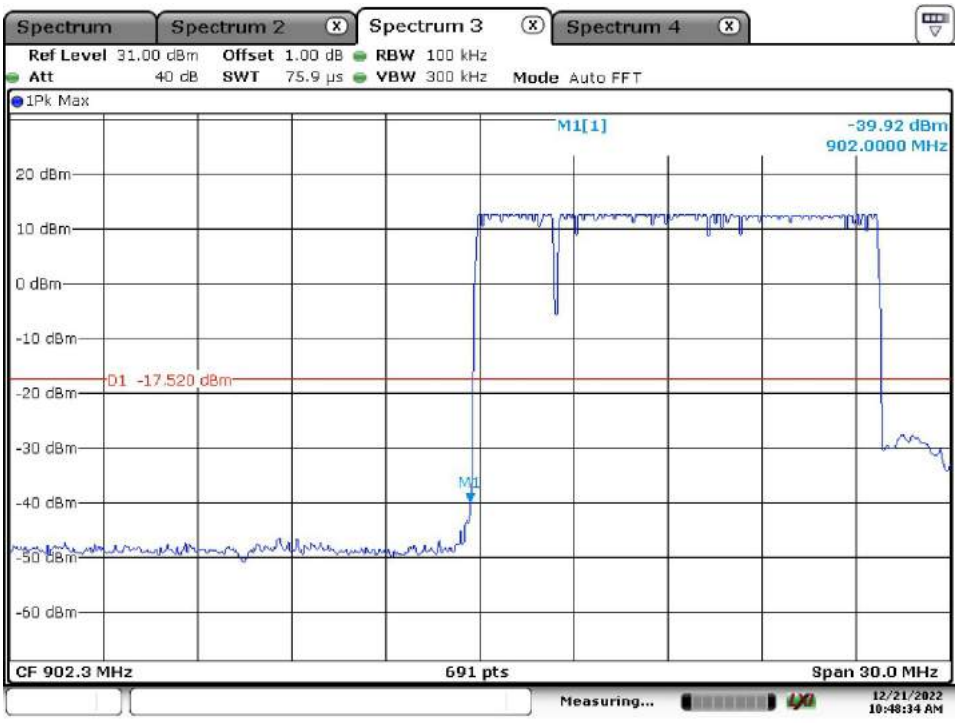
Date: 21.DEC.2022 11:09:51

High Channel

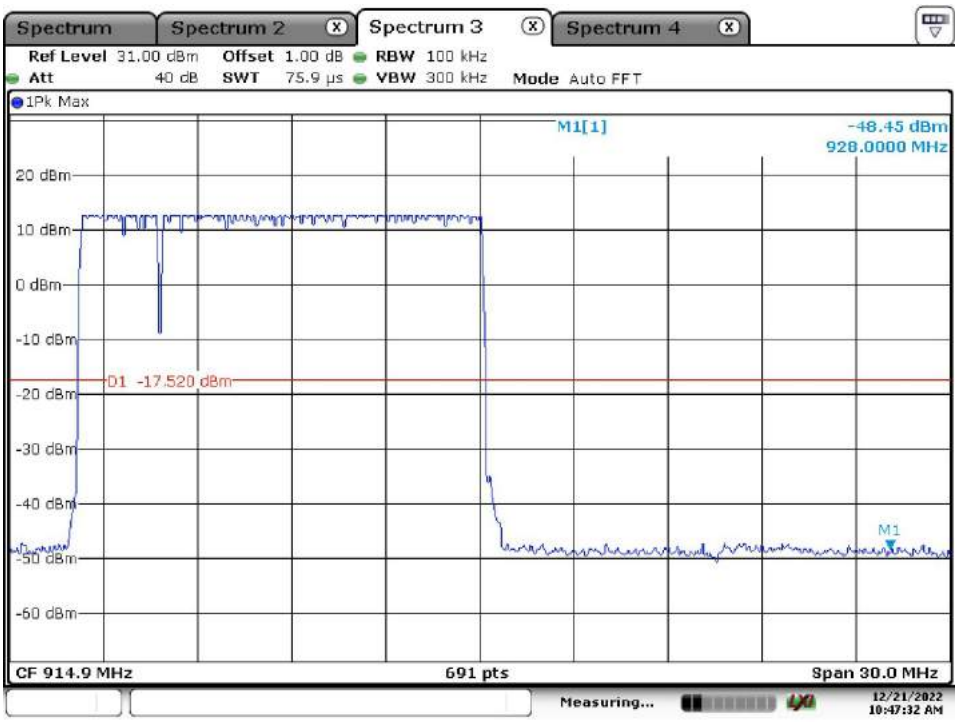


Date: 21.DEC.2022 11:04:32

Lora FHSS, Data rate SF7, hopping, Band Edge

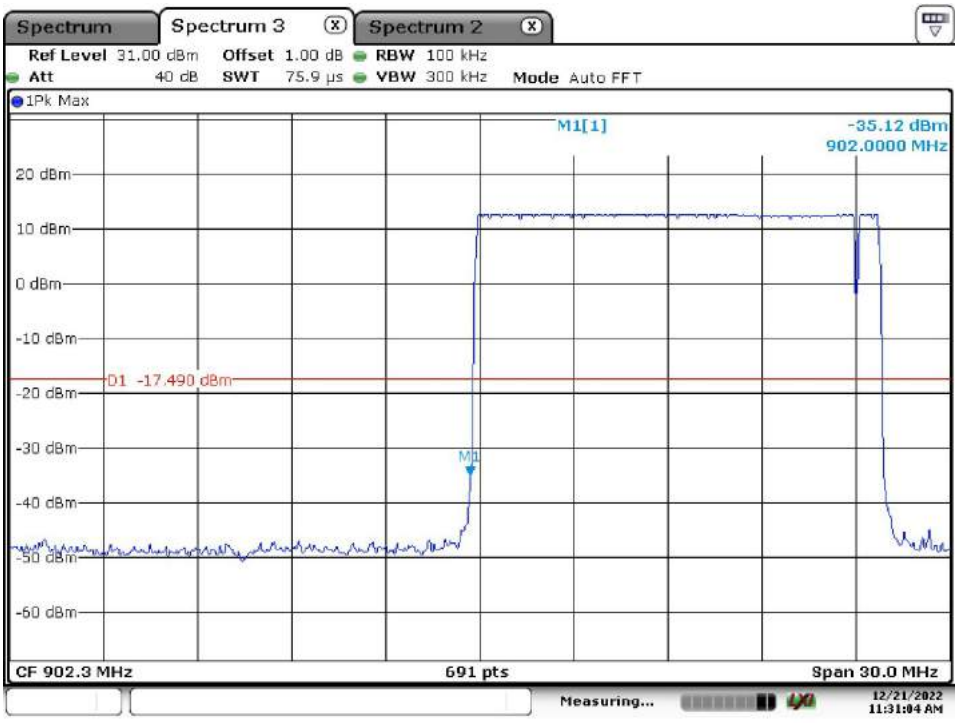


Date: 21.DEC.2022 10:48:35

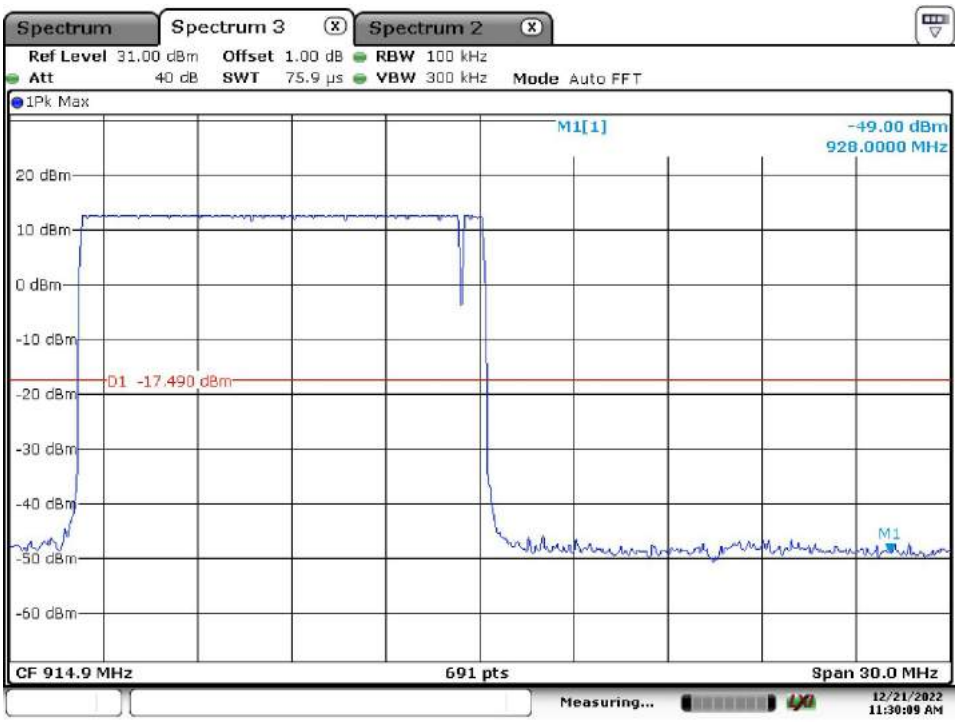


Date: 21.DEC.2022 10:47:33

Lora FHSS, Data rate SF10, hopping, Band Edge



Date: 21.DEC.2022 11:31:05

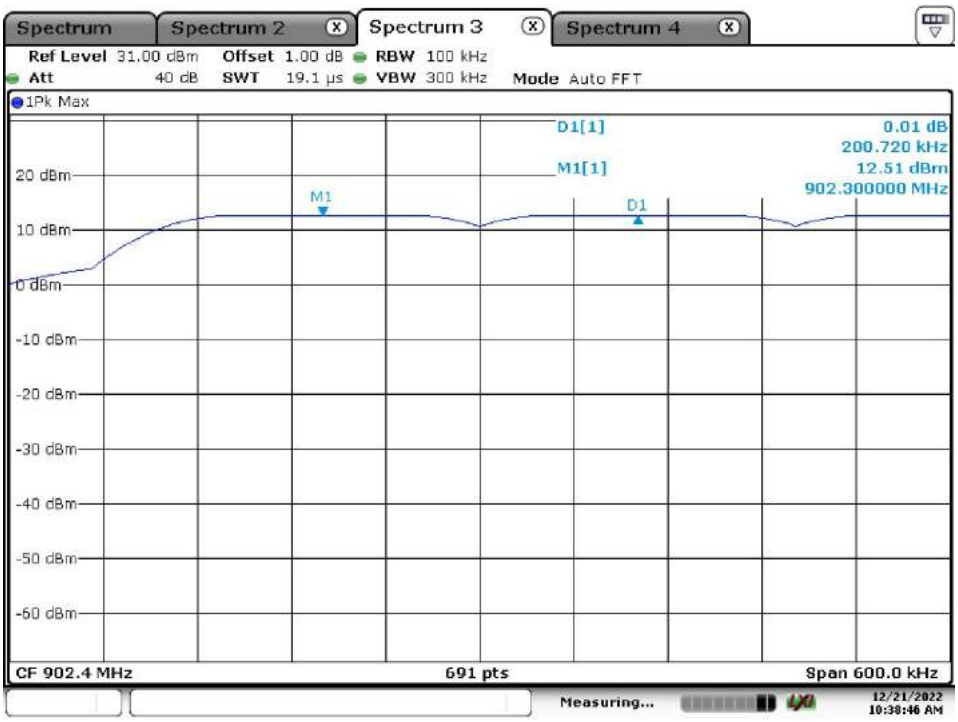


Date: 21.DEC.2022 11:30:09

Appendix B.6: Carrier Frequency Separation

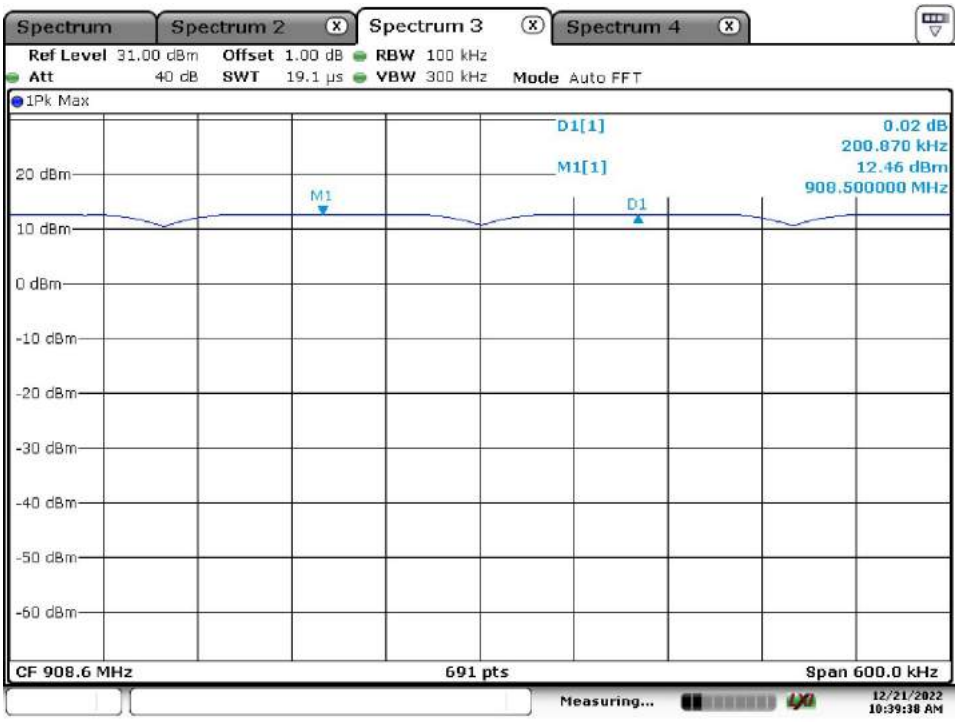
Lora FHSS, Data rate SF7

Low Channel



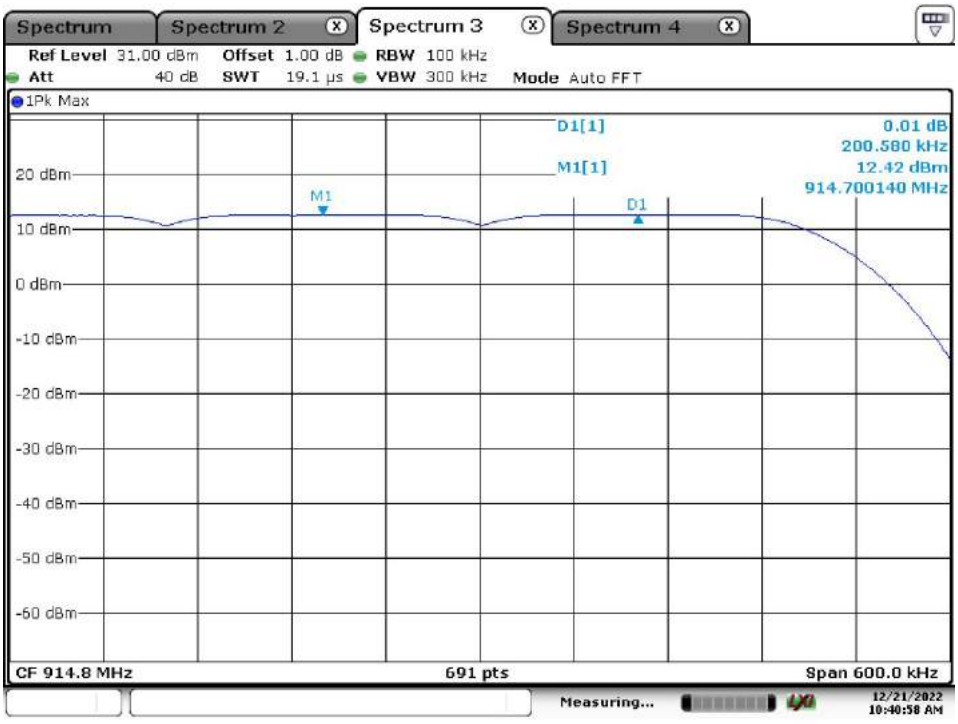
Date: 21.DEC.2022 10:38:46

Middle Channel



Date: 21.DEC.2022 10:39:38

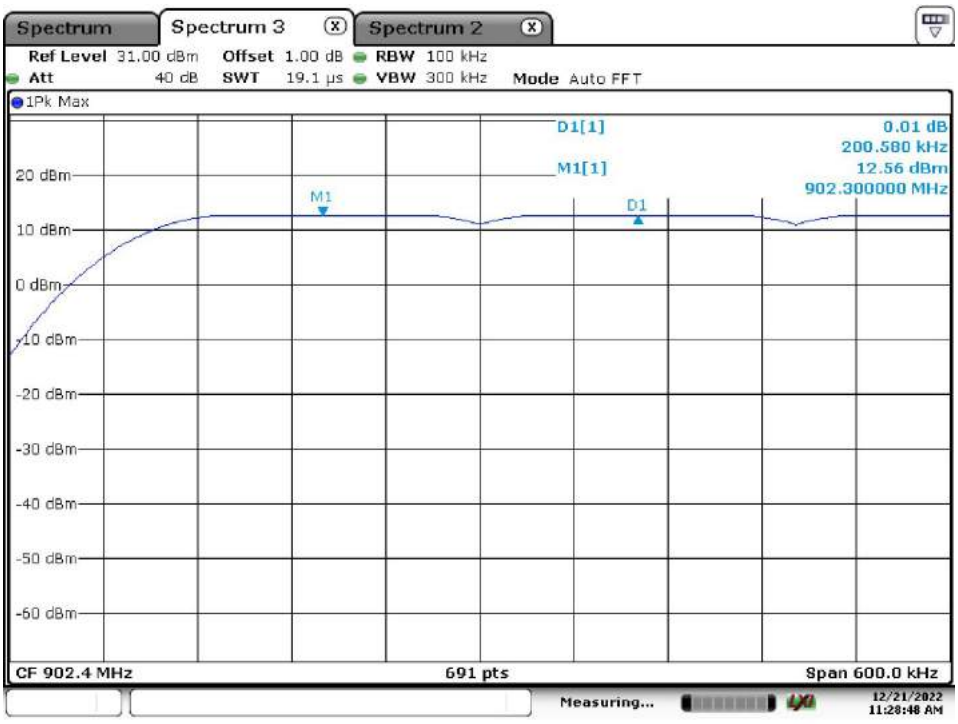
High Channel



Date: 21.DEC.2022 10:40:58

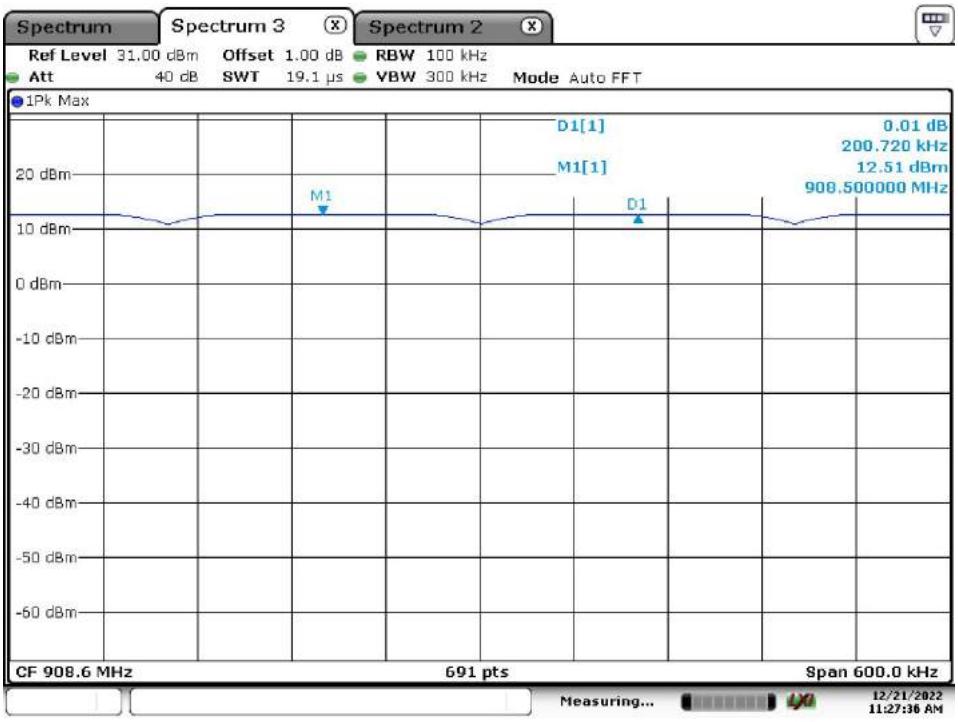
Lora FHSS, Data rate SF10

Low Channel



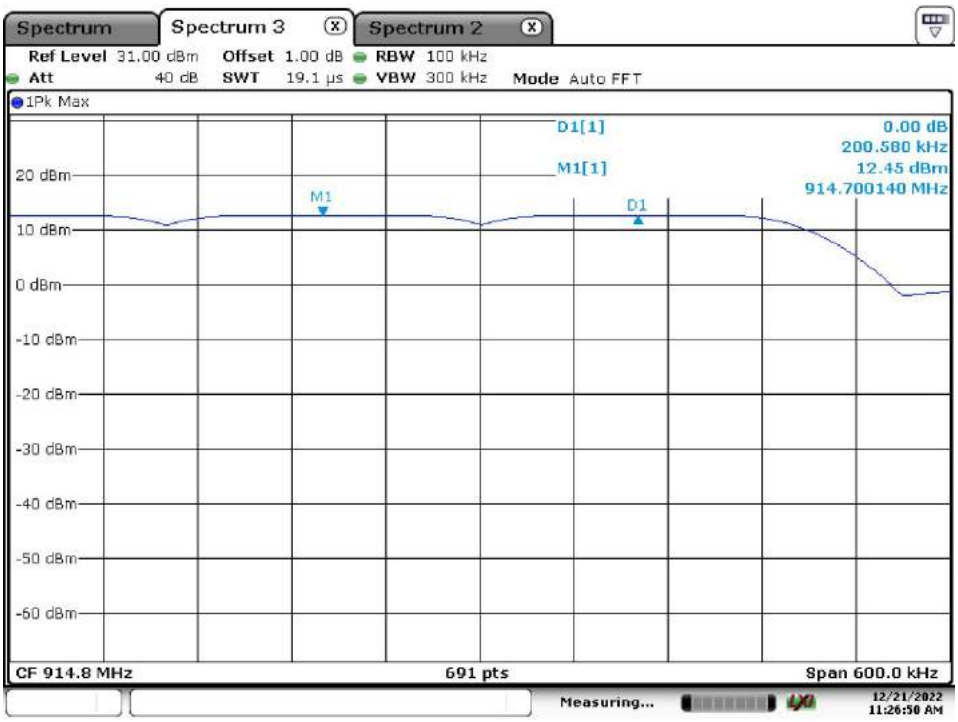
Date: 21.DEC.2022 11:28:49

Middle Channel



Date: 21.DEC.2022 11:27:36

High Channel



Date: 21.DEC.2022 11:26:50

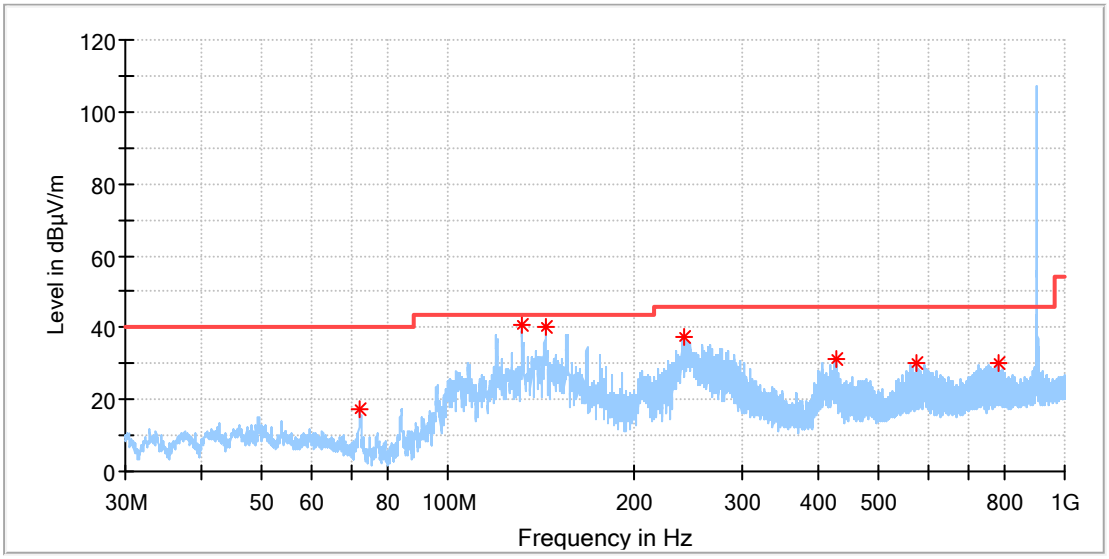
Note 1: Testing was carried out within frequency range 9 kHz to the tenth harmonics. The measurement results below 30MHz and above 18GHz were greater than 20dB below the limit, so only the radiated spurious emissions from 30MHz to 18GHz were reported.

Appendix B.7: Test Results of Radiated Spurious Emissions

Lora FHSS SF7, Antenna Gain: 2.3dBi

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_902.3MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

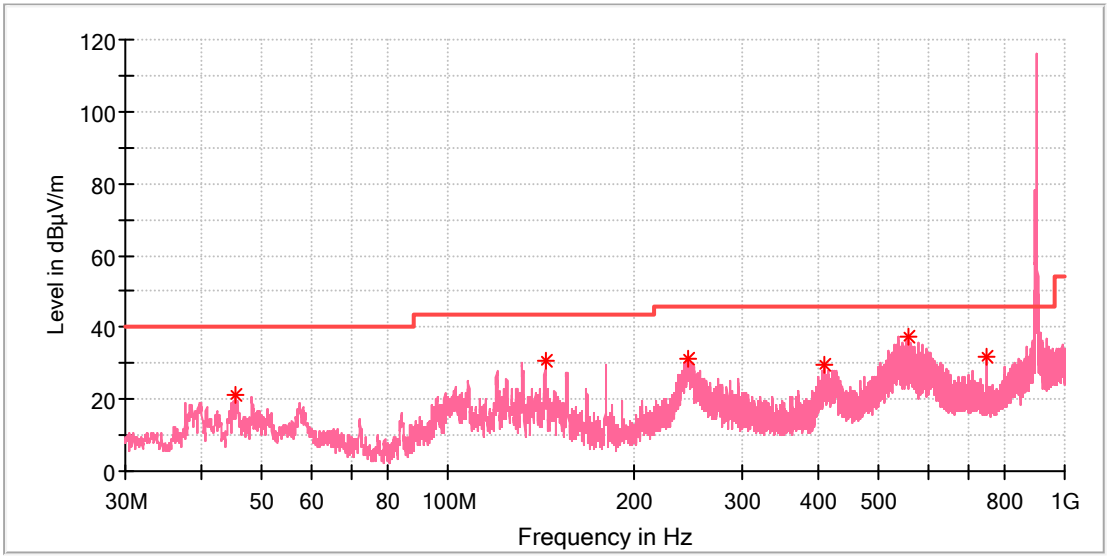


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
72.008462	17.04	40.00	22.96	100.0	H	356.0	-22.8
132.036539	40.49	43.50	3.01	100.0	H	212.0	-22.3
144.049615	40.26	43.50	3.24	100.0	H	186.0	-22.6
242.131539	37.66	46.00	8.34	100.0	H	153.0	-17.9
425.983846	31.38	46.00	14.62	100.0	H	311.0	-13.6
574.393846	29.89	46.00	16.11	100.0	H	113.0	-10.7
782.011154	30.08	46.00	15.92	100.0	H	331.0	-7.1

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_902.3MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

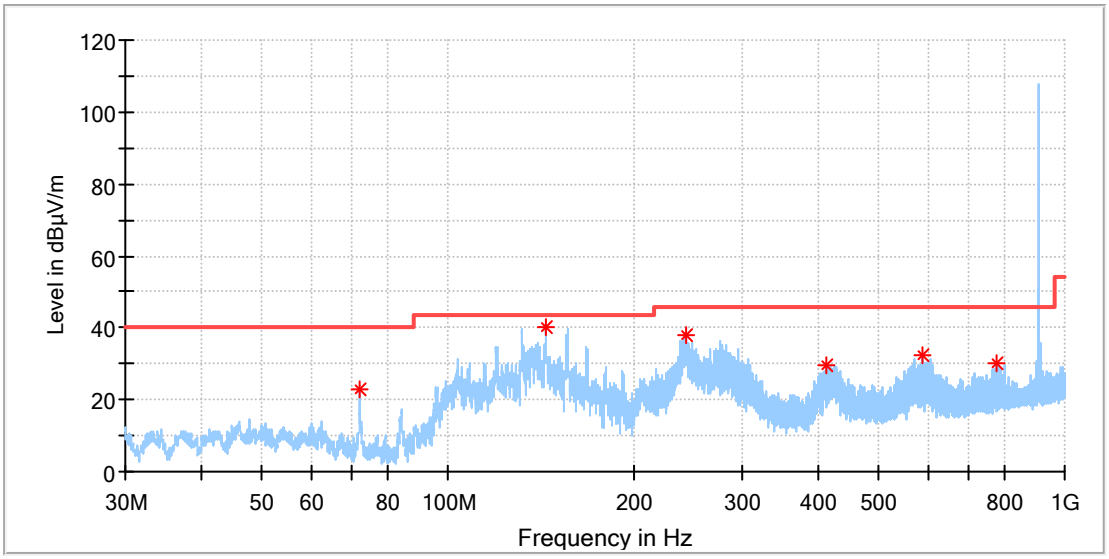


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
45.221539	21.14	40.00	18.86	100.0	V	128.0	-19.1
144.049615	30.93	43.50	12.57	100.0	V	138.0	-22.6
245.862308	31.31	46.00	14.69	100.0	V	32.0	-17.8
408.822308	29.74	46.00	16.26	100.0	V	48.0	-13.9
556.635385	37.45	46.00	8.55	100.0	V	128.0	-11.0
746.419615	32.00	46.00	14.00	100.0	V	294.0	-7.6

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_908.5MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

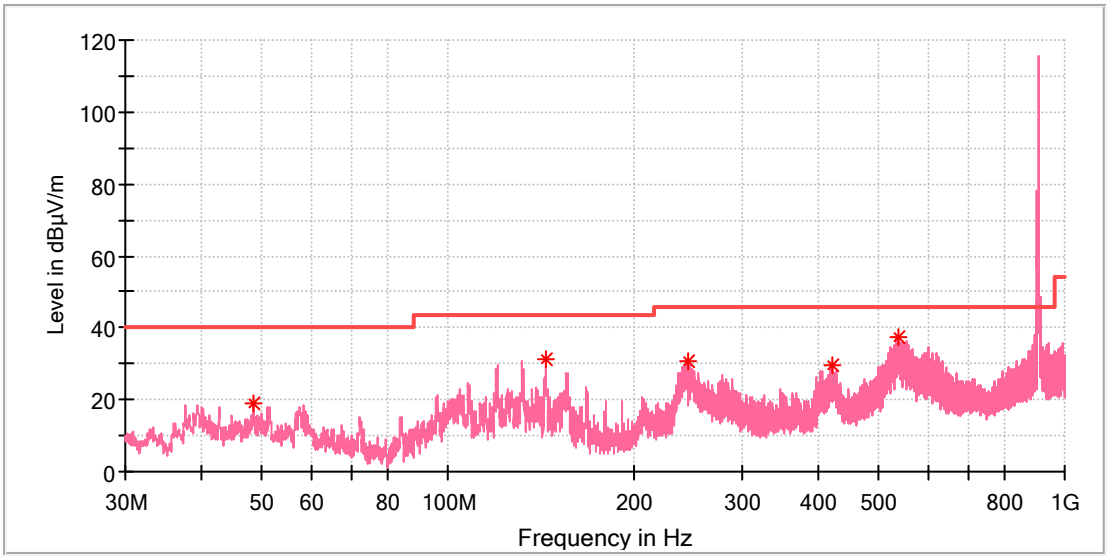


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
72.083077	23.05	40.00	16.95	100.0	H	33.0	-22.8
144.049615	40.27	43.50	3.23	100.0	H	187.0	-22.6
242.728462	37.72	46.00	8.28	100.0	H	162.0	-17.9
409.866923	29.60	46.00	16.40	100.0	H	345.0	-13.9
586.369615	32.15	46.00	13.85	100.0	H	82.0	-10.5
774.437692	30.06	46.00	15.94	100.0	H	337.0	-7.2

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_908.5MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

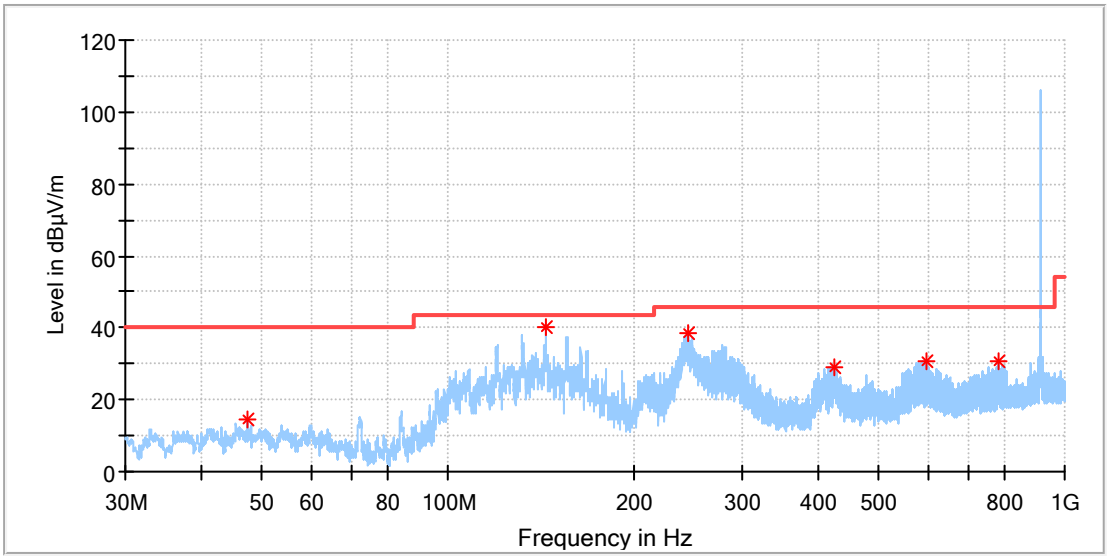


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
48.318077	18.92	40.00	21.08	100.0	V	287.0	-18.7
143.975000	31.04	43.50	12.46	100.0	V	129.0	-22.6
244.966923	30.65	46.00	15.35	100.0	V	263.0	-17.9
418.634231	29.39	46.00	16.61	100.0	V	4.0	-13.8
535.743077	37.40	46.00	8.60	100.0	V	247.0	-11.5

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_914.9MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

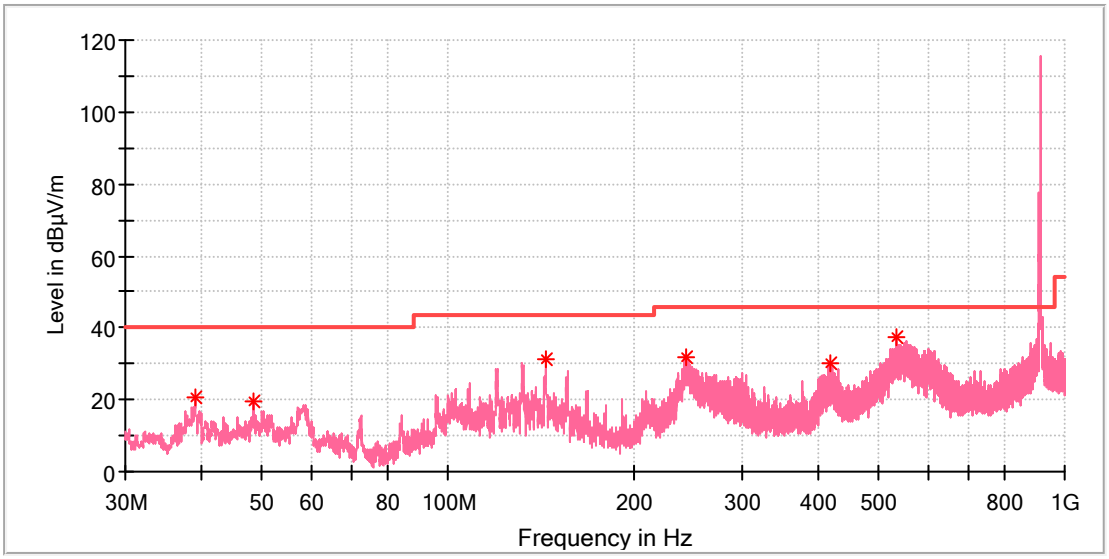


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
47.348077	14.55	40.00	25.45	100.0	H	116.0	-18.8
144.049615	40.36	43.50	3.14	100.0	H	52.0	-22.6
244.481923	38.65	46.00	7.35	100.0	H	320.0	-17.9
421.880000	29.14	46.00	16.86	100.0	H	0.0	-13.7
596.405385	30.68	46.00	15.32	100.0	H	93.0	-10.3
782.011154	30.71	46.00	15.29	100.0	H	243.0	-7.1

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_914.9MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

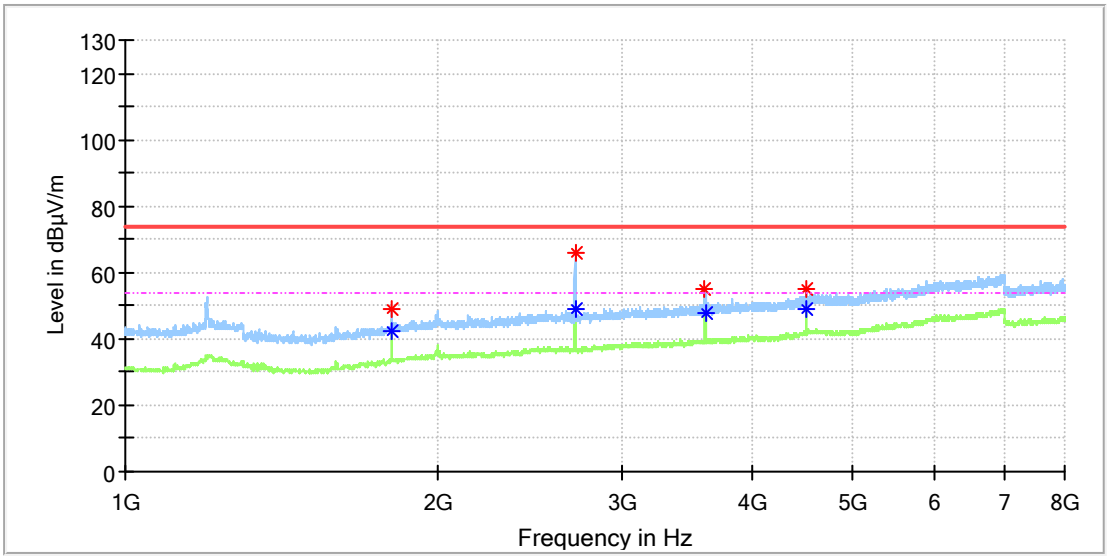


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
38.916539	20.58	40.00	19.42	100.0	V	0.0	-20.8
48.318077	19.29	40.00	20.71	100.0	V	0.0	-18.7
144.198846	31.30	43.50	12.20	100.0	V	142.0	-22.6
242.504615	31.72	46.00	14.28	100.0	V	74.0	-17.9
416.619615	30.41	46.00	15.59	100.0	V	12.0	-13.8
534.437308	37.63	46.00	8.37	100.0	V	3.0	-11.5

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_902.3MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

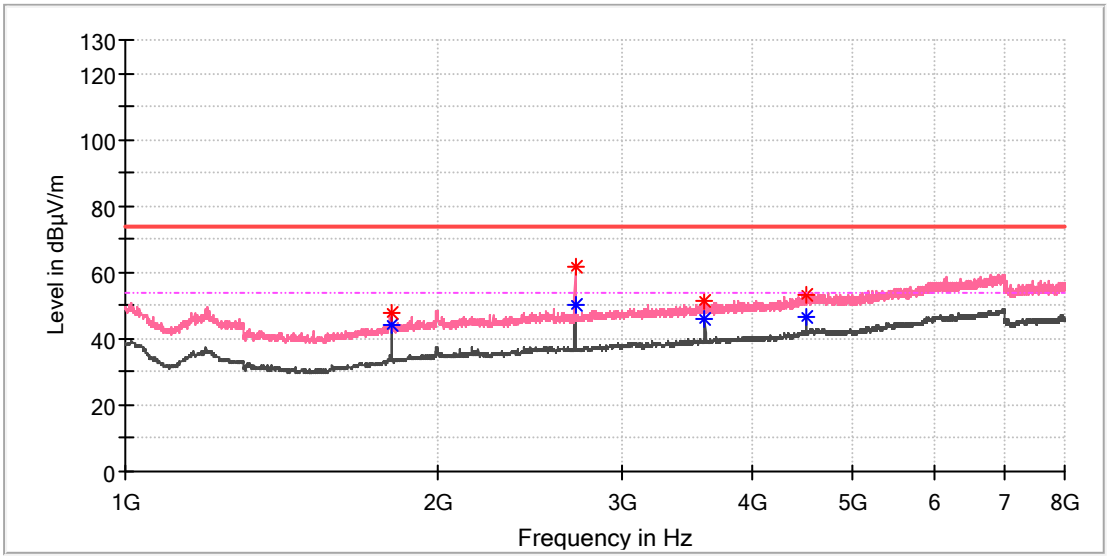


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1804.175000	49.17	---	74.00	24.83	100.0	H	6.0	4.7
1805.012500	---	42.04	54.00	11.96	100.0	H	6.0	4.8
2707.000000	65.67	---	74.00	8.33	100.0	H	170.0	7.6
2707.837500	---	49.01	54.00	4.99	100.0	H	170.0	7.6
3608.987500	54.94	---	74.00	19.06	100.0	H	254.0	9.4
3609.825000	---	47.68	54.00	6.32	100.0	H	254.0	9.4
4510.975000	---	48.92	54.00	5.08	100.0	H	254.0	11.6
4511.812500	55.24	---	74.00	18.76	100.0	H	254.0	11.6

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_902.3MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

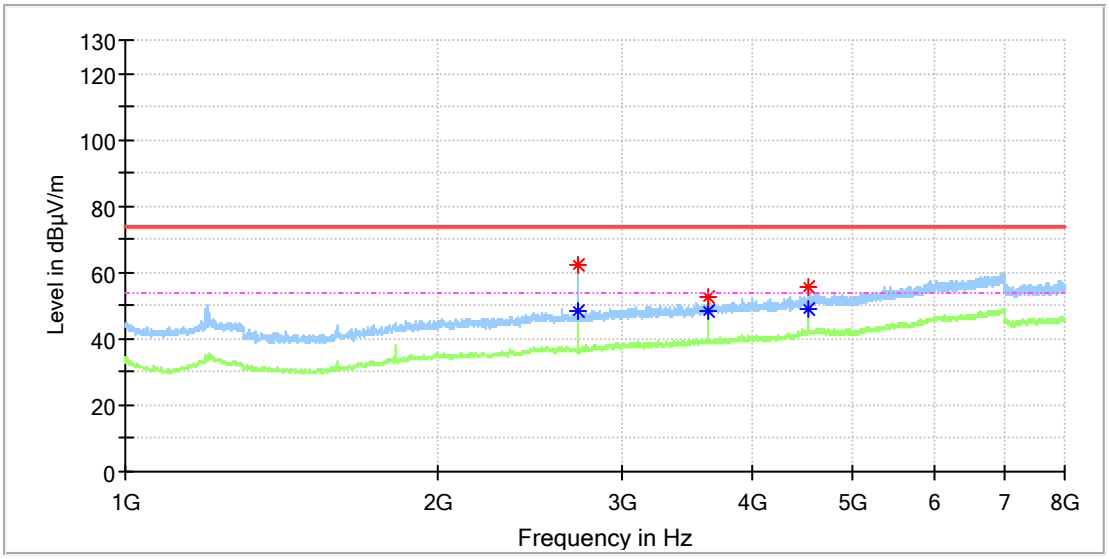


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1804.175000	---	44.15	54.00	9.85	100.0	V	315.0	4.7
1805.012500	47.55	---	74.00	26.45	100.0	V	0.0	4.8
2707.000000	61.66	---	74.00	12.34	100.0	V	219.0	7.6
2707.837500	---	50.04	54.00	3.96	100.0	V	219.0	7.6
3608.987500	51.33	---	74.00	22.67	100.0	V	121.0	9.4
3608.987500	---	46.26	54.00	7.74	100.0	V	121.0	9.4
4511.812500	53.15	---	74.00	20.85	100.0	V	166.0	11.6
4511.812500	---	46.54	54.00	7.46	100.0	V	166.0	11.6

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_908.5MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

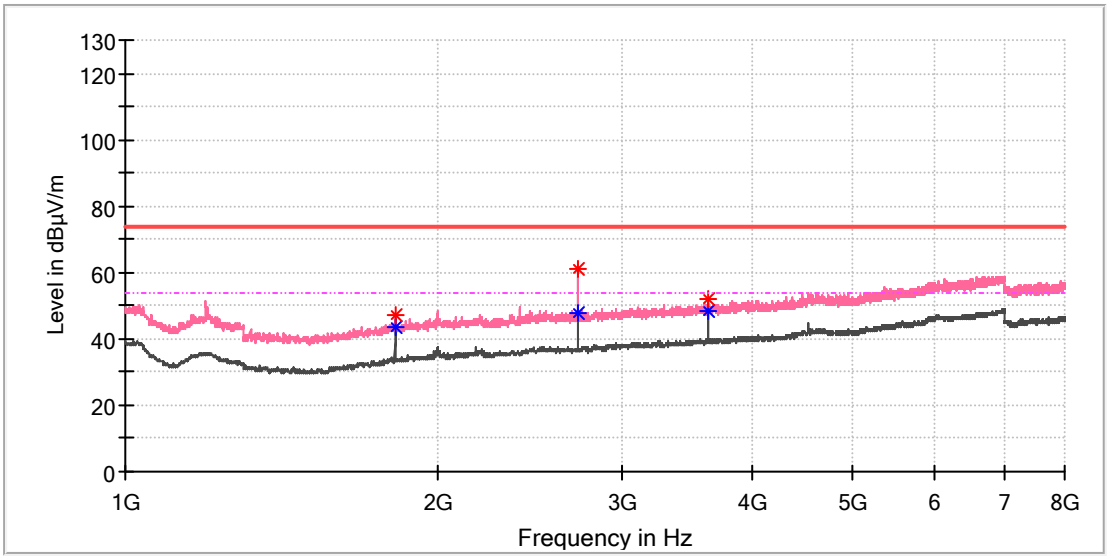


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2725.425000	61.99	---	74.00	12.01	100.0	H	236.0	7.7
2726.262500	---	48.11	54.00	5.89	100.0	H	236.0	7.7
3634.112500	---	48.09	54.00	5.91	100.0	H	288.0	9.4
3634.112500	52.34	---	74.00	21.66	100.0	H	288.0	9.4
4542.800000	---	49.24	54.00	4.76	100.0	H	12.0	11.9
4542.800000	55.45	---	74.00	18.55	100.0	H	12.0	11.9

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_908.5MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

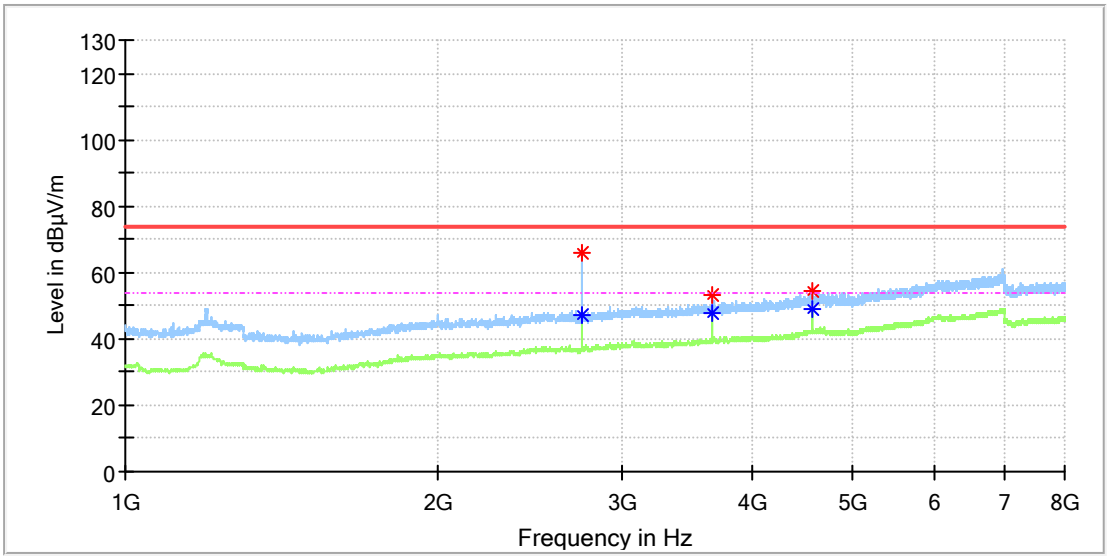


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1816.737500	---	43.48	54.00	10.52	100.0	V	150.0	4.8
1816.737500	47.12	---	74.00	26.88	100.0	V	150.0	4.8
2725.425000	60.98	---	74.00	13.02	100.0	V	150.0	7.7
2726.262500	---	47.53	54.00	6.47	100.0	V	150.0	7.7
3634.112500	51.83	---	74.00	22.17	100.0	V	69.0	9.4
3634.112500	---	48.49	54.00	5.51	100.0	V	69.0	9.4

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_914.9MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

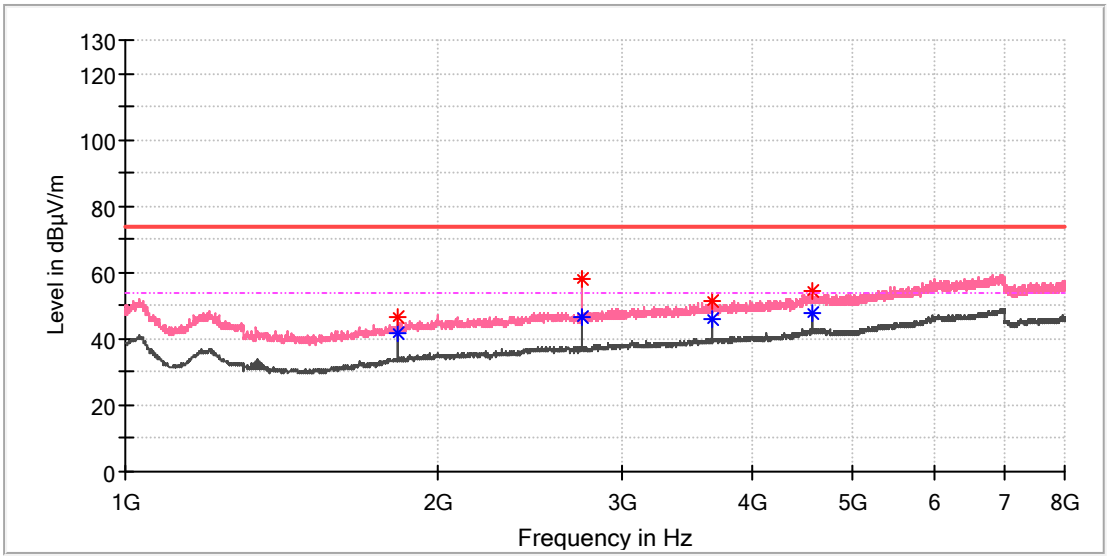


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2743.012500	---	47.25	54.00	6.75	100.0	H	278.0	7.8
2744.687500	65.65	---	74.00	8.35	100.0	H	278.0	7.8
3659.237500	---	47.80	54.00	6.20	100.0	H	8.0	9.4
3660.075000	53.30	---	74.00	20.70	100.0	H	8.0	9.4
4574.625000	54.20	---	74.00	19.80	100.0	H	98.0	12.0
4574.625000	---	49.18	54.00	4.82	100.0	H	98.0	12.0

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_914.9MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

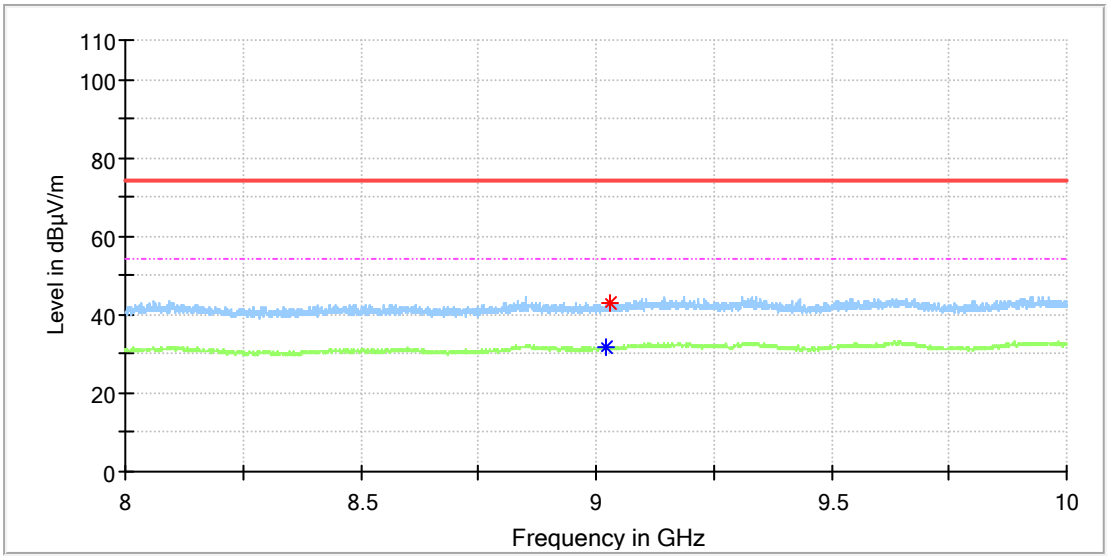


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1829.300000	---	41.45	54.00	12.55	100.0	V	224.0	4.9
1830.137500	46.80	---	74.00	27.20	100.0	V	224.0	4.9
2744.687500	58.07	---	74.00	15.93	100.0	V	83.0	7.8
2745.525000	---	46.58	54.00	7.42	100.0	V	83.0	7.8
3659.237500	---	45.73	54.00	8.27	100.0	V	30.0	9.4
3660.075000	51.42	---	74.00	22.58	100.0	V	173.0	9.4
4574.625000	54.22	---	74.00	19.78	100.0	V	337.0	12.0
4574.625000	---	47.51	54.00	6.49	100.0	V	337.0	12.0

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_902.3MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

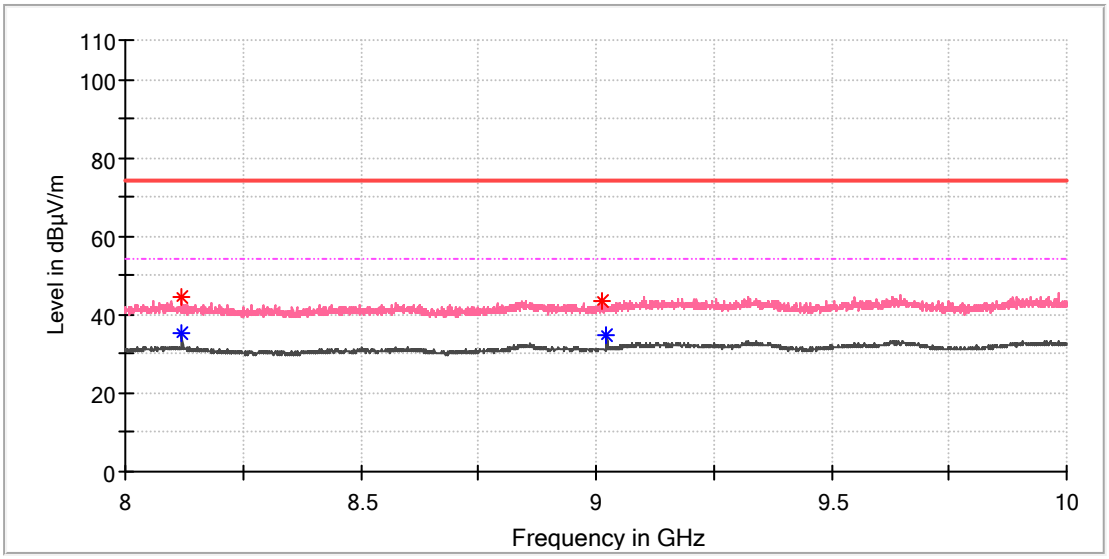


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9021.500000	---	31.75	54.00	22.25	100.0	H	119.0	8.9
9028.000000	42.99	---	74.00	31.01	100.0	H	0.0	8.9

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_902.3MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

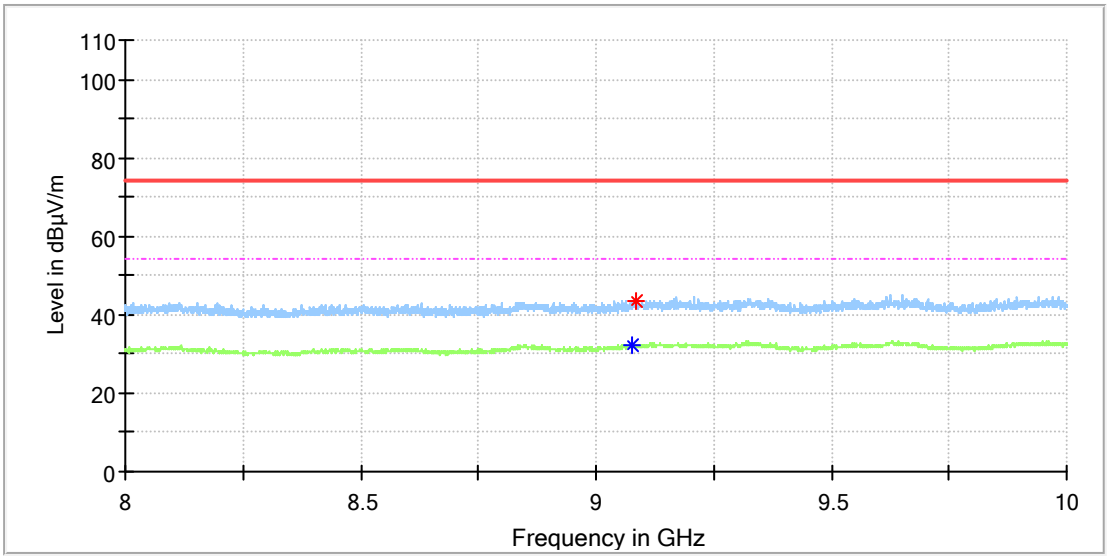


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8120.000000	44.26	---	74.00	29.74	100.0	V	72.0	8.6
8120.500000	---	35.50	54.00	18.50	100.0	V	0.0	8.6
9013.000000	43.25	---	74.00	30.75	100.0	V	321.0	8.8
9023.000000	---	35.03	54.00	18.97	100.0	V	90.0	8.9

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_908.5MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

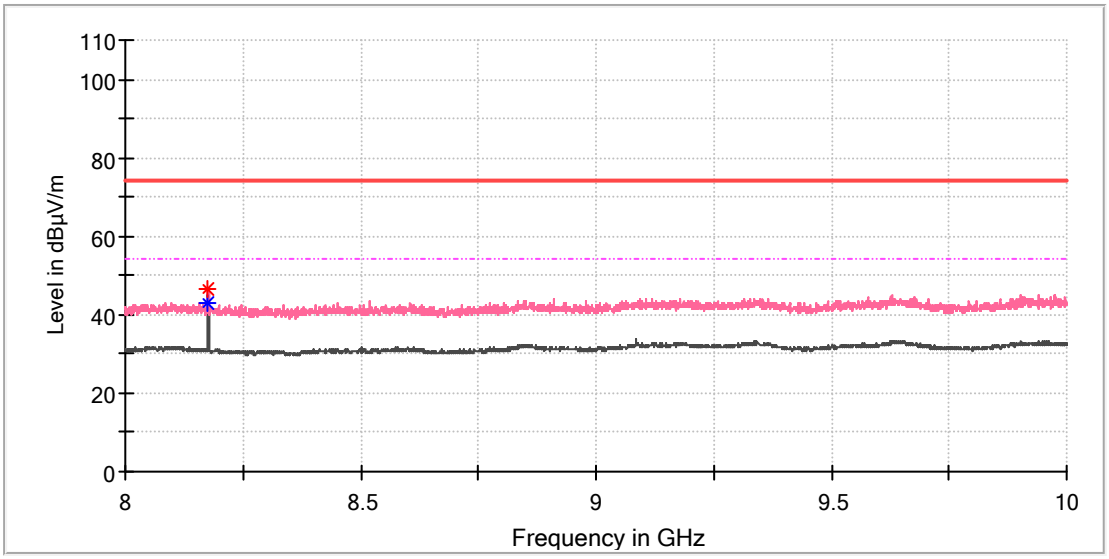


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9078.500000	---	32.30	54.00	21.70	100.0	H	0.0	9.4
9085.000000	43.52	---	74.00	30.48	100.0	H	29.0	9.5

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_908.5MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

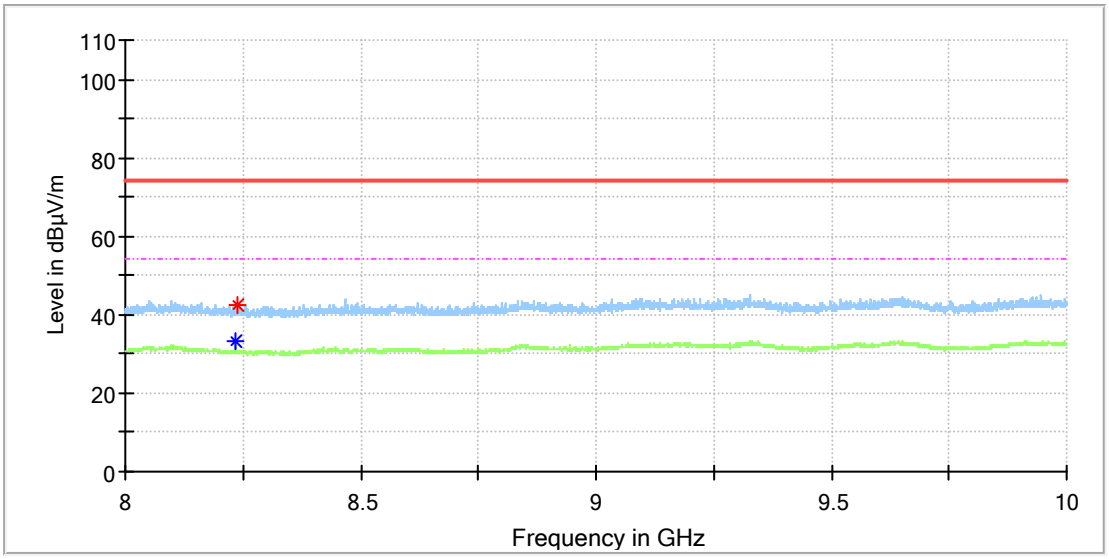


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8176.500000	46.43	---	74.00	27.57	100.0	V	161.0	8.5
8176.500000	---	42.85	54.00	11.15	100.0	V	161.0	8.5

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_914.9MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

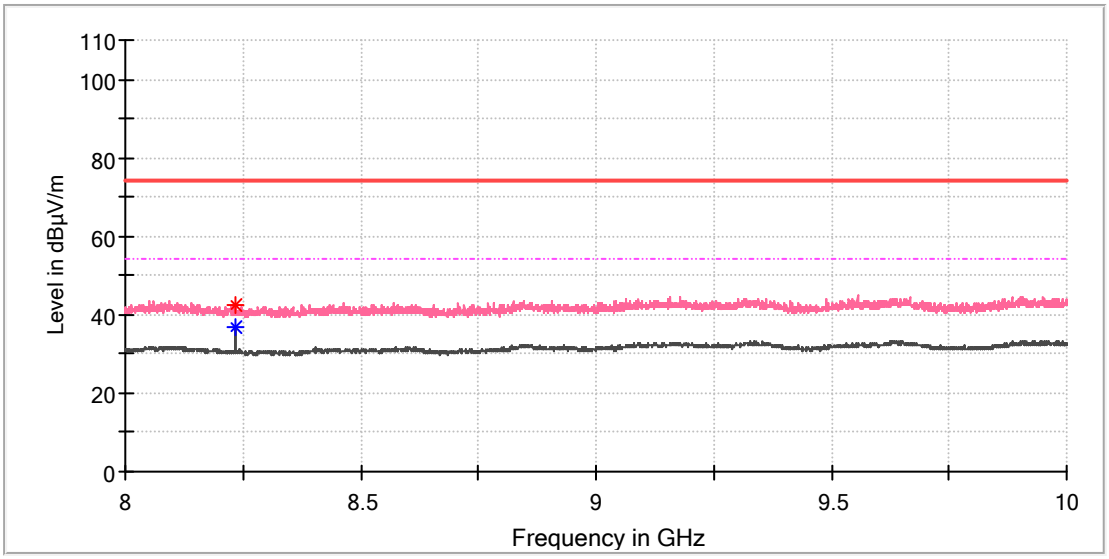


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8234.000000	---	33.32	54.00	20.68	100.0	H	229.0	8.4
8238.500000	42.30	---	74.00	31.70	100.0	H	190.0	8.4

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_914.9MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



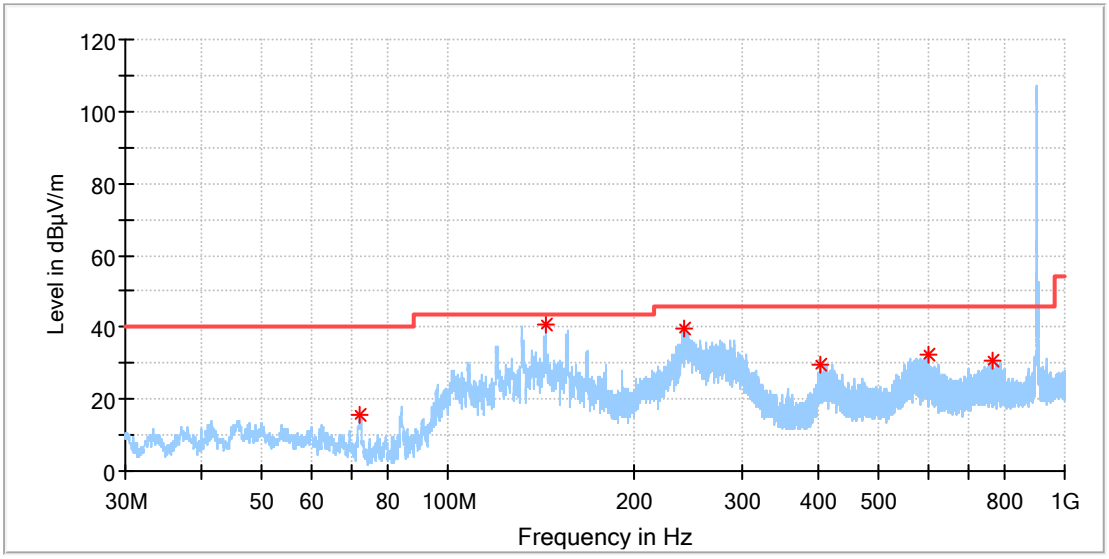
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8233.500000	42.44	---	74.00	31.56	100.0	V	184.0	8.4
8233.500000	---	36.61	54.00	17.39	100.0	V	184.0	8.4

Lora DTS, Antenna Gain: 2.3dBi

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	DTS 500K_SF8_903MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

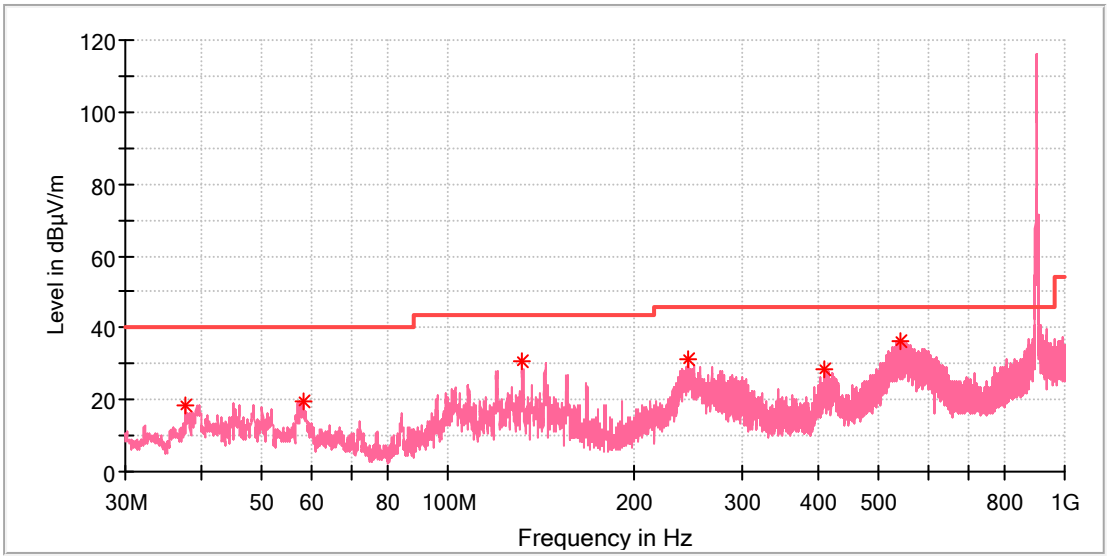


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
71.896539	15.75	40.00	24.25	100.0	H	0.0	-22.7
144.198846	40.50	43.50	3.00	100.0	H	170.0	-22.6
242.467308	39.91	46.00	6.09	100.0	H	154.0	-17.9
402.591923	29.81	46.00	16.19	100.0	H	304.0	-14.1
602.300000	32.34	46.00	13.66	100.0	H	91.0	-10.2
762.573846	30.74	46.00	15.26	100.0	H	0.0	-7.4

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	DTS 500K_SF8_903MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

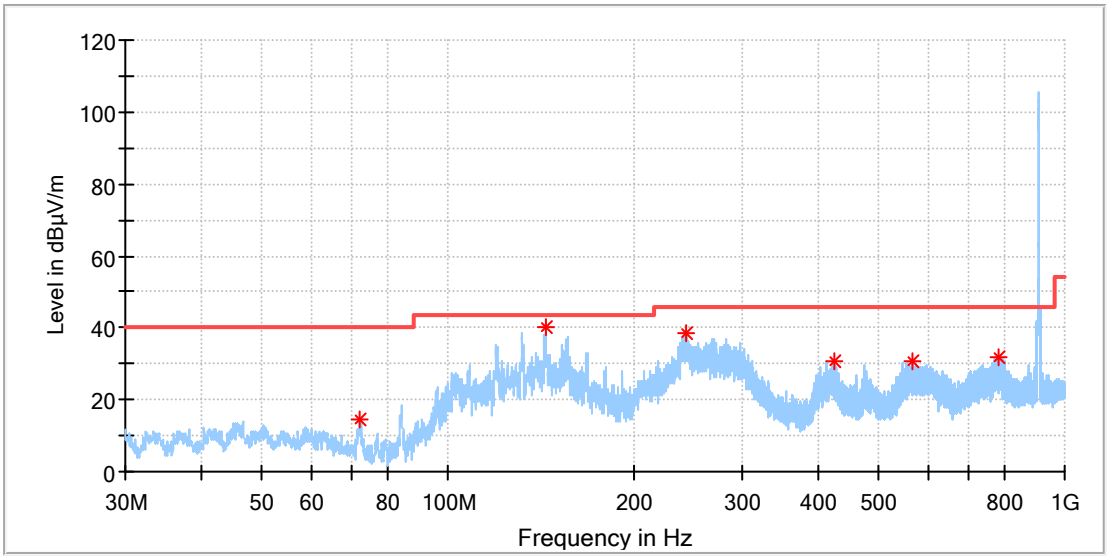


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.498846	18.67	40.00	21.33	100.0	V	187.0	-21.2
58.316539	19.68	40.00	20.32	100.0	V	283.0	-19.1
132.073846	30.86	43.50	12.64	100.0	V	120.0	-22.3
244.855000	31.04	46.00	14.96	100.0	V	21.0	-17.9
407.628462	28.31	46.00	17.69	100.0	V	5.0	-14.0
539.846923	36.34	46.00	9.66	100.0	V	101.0	-11.4

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	DTS 500K_SF8_907.8MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

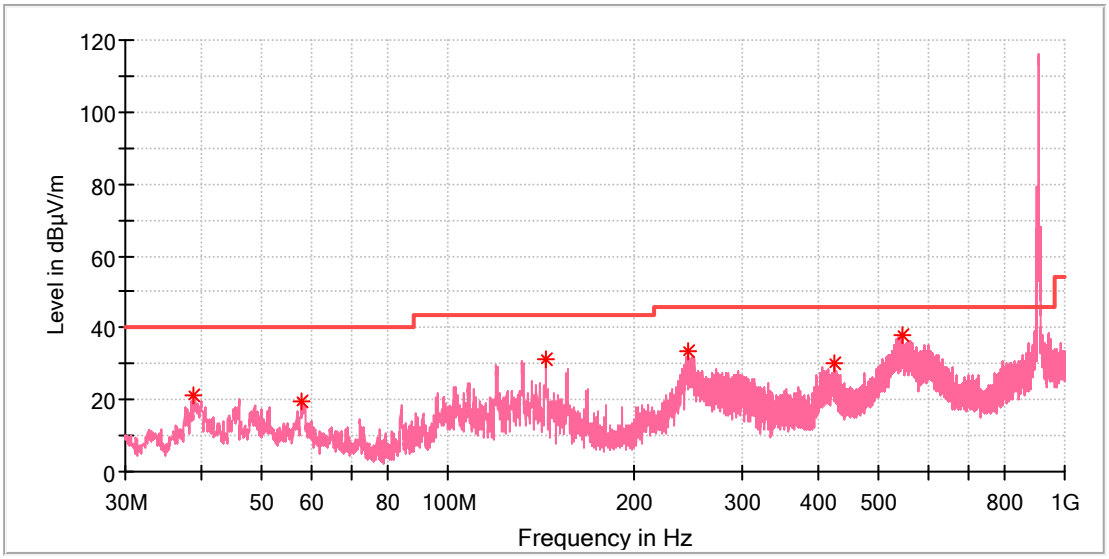


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
72.045769	14.75	40.00	25.25	100.0	H	3.0	-22.8
144.124231	40.45	43.50	3.05	100.0	H	196.0	-22.6
244.258077	38.73	46.00	7.27	100.0	H	316.0	-17.9
423.446923	30.60	46.00	15.40	100.0	H	331.0	-13.7
566.671154	30.67	46.00	15.33	100.0	H	163.0	-10.8
779.698077	31.76	46.00	14.24	100.0	H	147.0	-7.1

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	DTS 500K_SF8_907.8MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

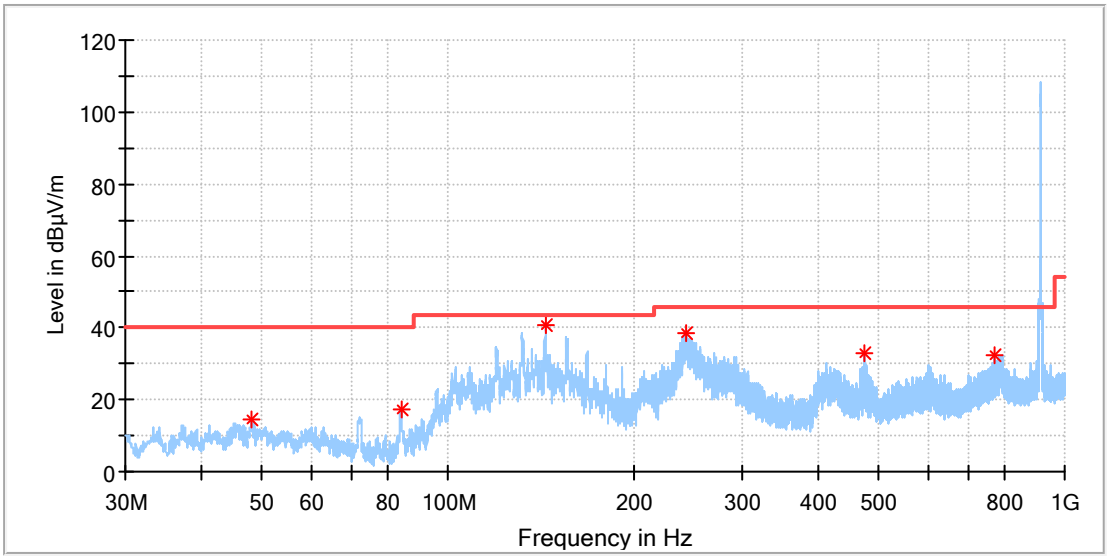


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
38.767308	21.03	40.00	18.97	100.0	V	106.0	-20.8
57.868846	19.78	40.00	20.22	100.0	V	40.0	-19.1
144.161539	31.46	43.50	12.04	100.0	V	106.0	-22.6
246.048846	33.41	46.00	12.59	100.0	V	49.0	-17.8
421.768077	30.14	46.00	15.86	100.0	V	33.0	-13.7
545.032692	37.68	46.00	8.32	100.0	V	336.0	-11.3

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	DTS 500K_SF8_914.2MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

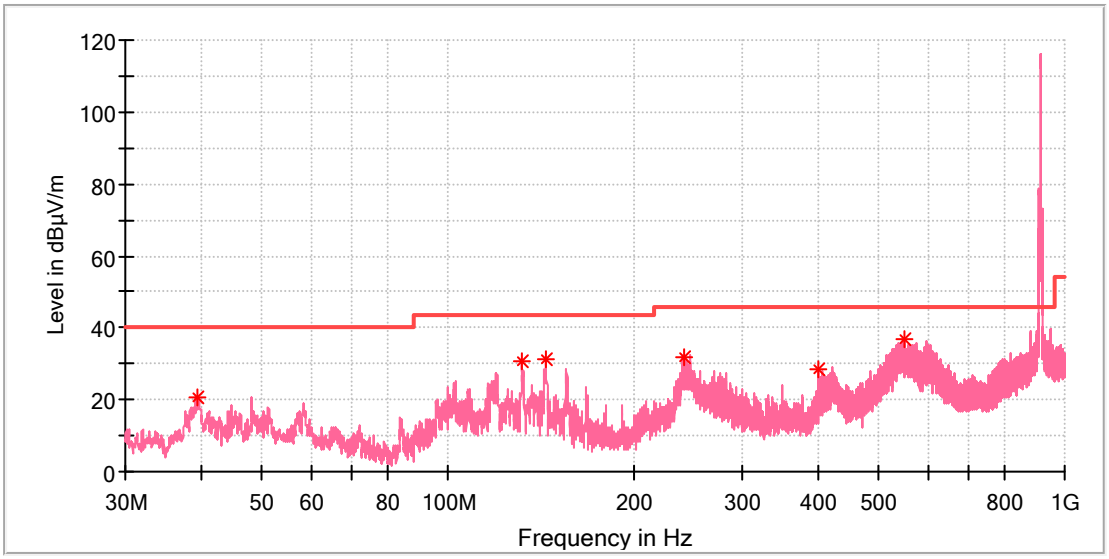


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
47.982308	14.38	40.00	25.62	100.0	H	2.0	-18.7
83.872308	17.32	40.00	22.68	100.0	H	24.0	-22.9
143.975000	40.48	43.50	3.02	100.0	H	39.0	-22.6
243.959615	38.52	46.00	7.48	100.0	H	111.0	-17.9
473.103462	32.88	46.00	13.12	100.0	H	46.0	-12.7
771.565000	32.42	46.00	13.58	100.0	H	0.0	-7.2

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	DTS 500K_SF8_914.2MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

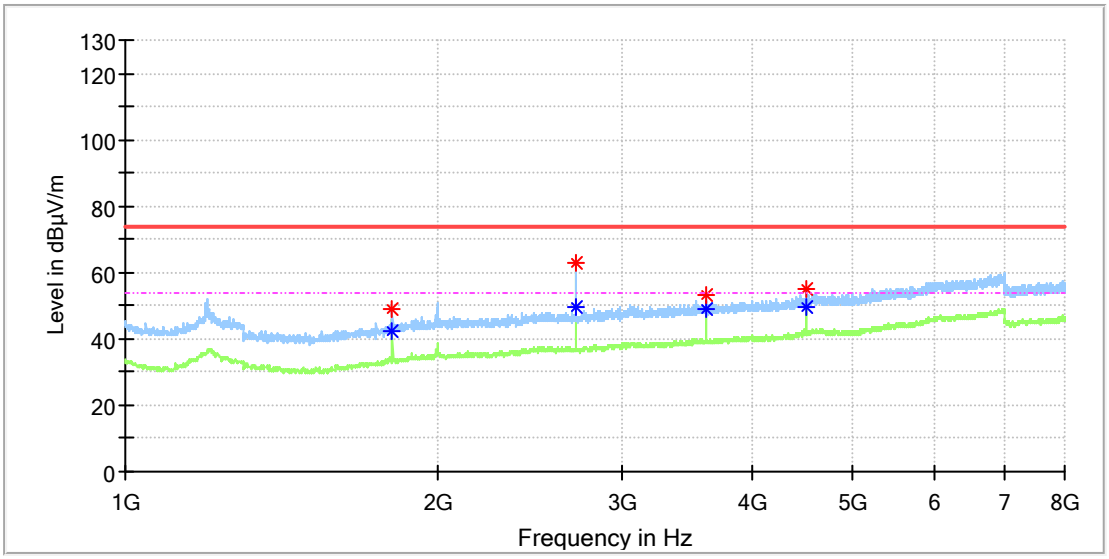


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
39.326923	20.58	40.00	19.42	100.0	V	347.0	-20.6
131.999231	30.75	43.50	12.75	100.0	V	92.0	-22.3
143.975000	31.06	43.50	12.44	100.0	V	101.0	-22.6
240.863077	31.75	46.00	14.25	100.0	V	53.0	-18.0
398.823846	28.52	46.00	17.48	100.0	V	53.0	-14.1
550.628846	36.90	46.00	9.10	100.0	V	313.0	-11.2

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	DTS 500K_SF8_903MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

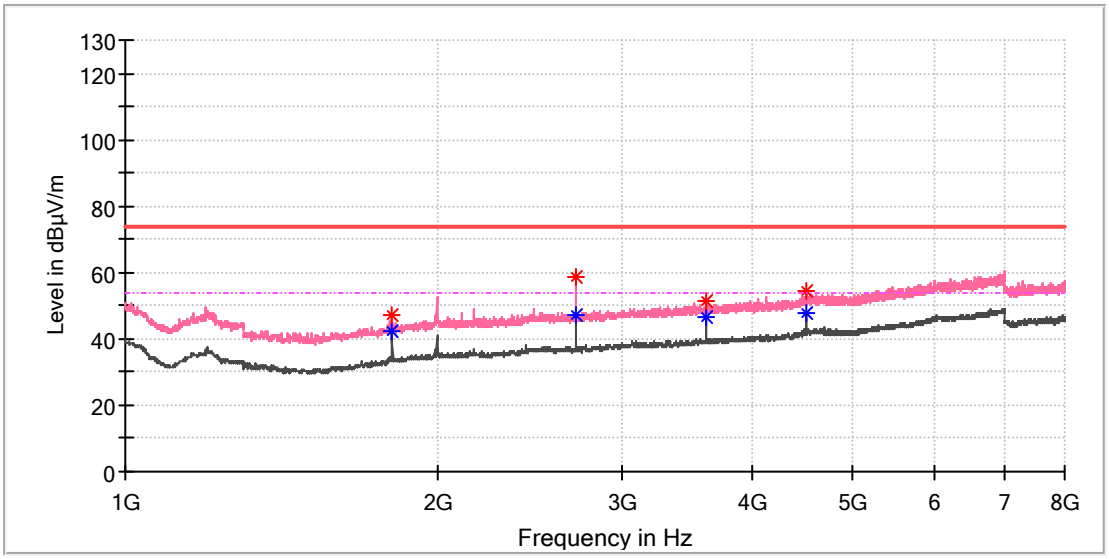


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1805.850000	48.91	---	74.00	25.09	100.0	H	2.0	4.8
1806.687500	---	42.09	54.00	11.91	100.0	H	2.0	4.8
2707.000000	---	49.31	54.00	4.69	100.0	H	2.0	7.6
2708.675000	62.96	---	74.00	11.04	100.0	H	2.0	7.6
3612.337500	53.06	---	74.00	20.94	100.0	H	239.0	9.4
3612.337500	---	48.88	54.00	5.12	100.0	H	239.0	9.4
4514.325000	54.91	---	74.00	19.09	100.0	H	97.0	11.6
4514.325000	---	49.82	54.00	4.18	100.0	H	97.0	11.6

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	DTS 500K_SF8_903MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

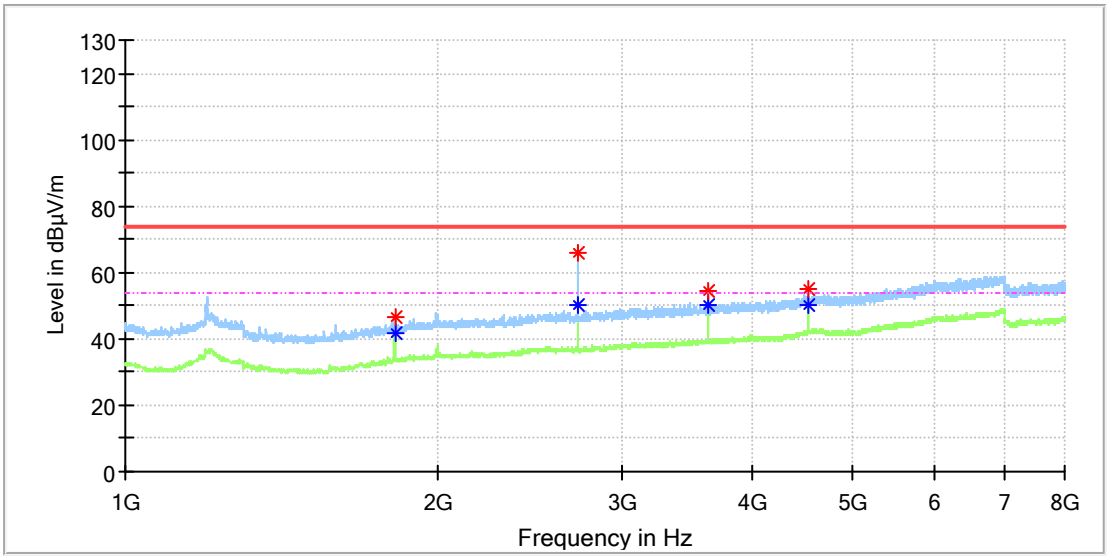


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1805.850000	47.45	---	74.00	26.55	100.0	V	1.0	4.8
1805.850000	---	42.33	54.00	11.67	100.0	V	1.0	4.8
2709.512500	58.80	---	74.00	15.20	100.0	V	191.0	7.6
2710.350000	---	46.93	54.00	7.07	100.0	V	191.0	7.6
3611.500000	51.61	---	74.00	22.39	100.0	V	49.0	9.4
3611.500000	---	46.58	54.00	7.42	100.0	V	49.0	9.4
4516.000000	54.44	---	74.00	19.56	100.0	V	138.0	11.6
4516.000000	---	47.62	54.00	6.38	100.0	V	138.0	11.6

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	DTS 500K_SF8_907.8MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

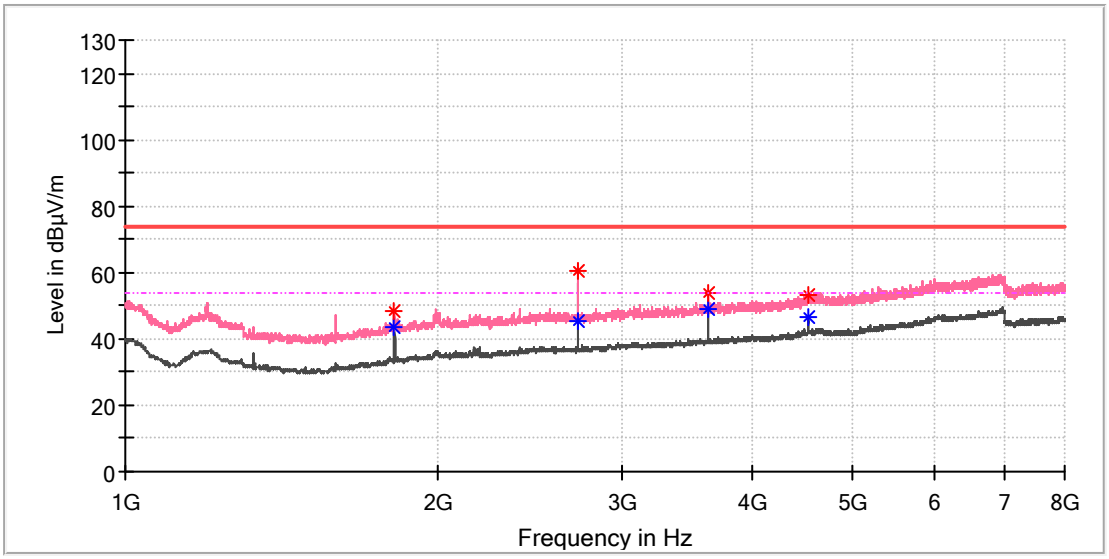


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1815.900000	46.49	---	74.00	27.51	100.0	H	26.0	4.8
1815.900000	---	41.89	54.00	12.11	100.0	H	26.0	4.8
2722.912500	65.89	---	74.00	8.12	100.0	H	109.0	7.7
2724.587500	---	50.03	54.00	3.97	100.0	H	189.0	7.7
3631.600000	---	49.98	54.00	4.02	100.0	H	251.0	9.4
3632.437500	54.47	---	74.00	19.53	100.0	H	251.0	9.4
4538.612500	---	50.34	54.00	3.66	100.0	H	298.0	11.8
4539.450000	55.07	---	74.00	18.93	100.0	H	72.0	11.8

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	DTS 500K_SF8_907.8MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

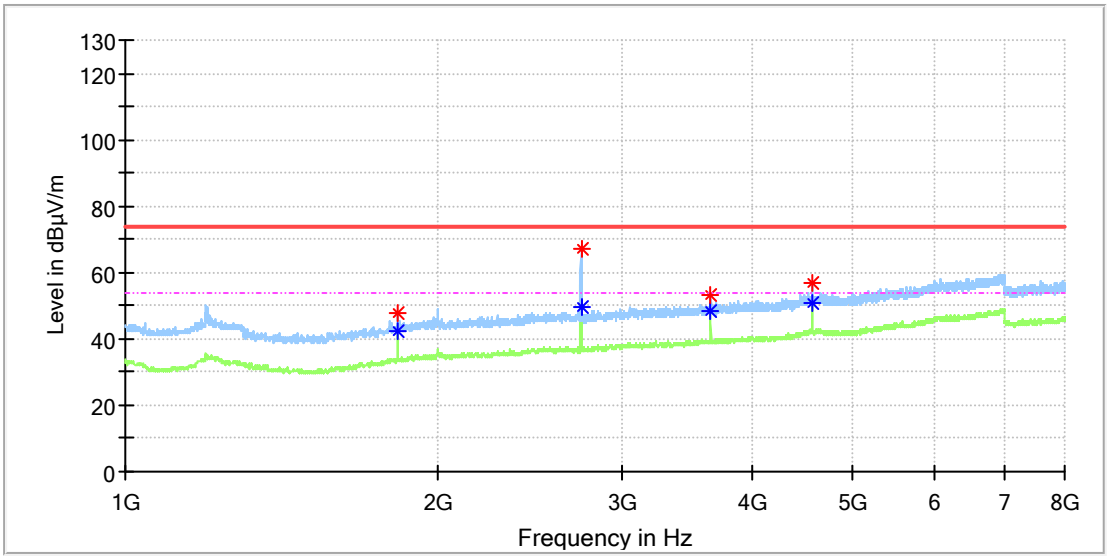


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1814.225000	48.25	---	74.00	25.75	100.0	V	121.0	4.8
1815.062500	---	43.59	54.00	10.41	100.0	V	121.0	4.8
2722.075000	---	45.50	54.00	8.50	100.0	V	3.0	7.7
2723.750000	60.21	---	74.00	13.79	100.0	V	0.0	7.7
3631.600000	53.63	---	74.00	20.37	100.0	V	85.0	9.4
3631.600000	---	49.08	54.00	4.92	100.0	V	85.0	9.4
4539.450000	53.01	---	74.00	20.99	100.0	V	165.0	11.8
4540.287500	---	46.67	54.00	7.33	100.0	V	165.0	11.8

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	DTS 500K_SF8_914.2MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

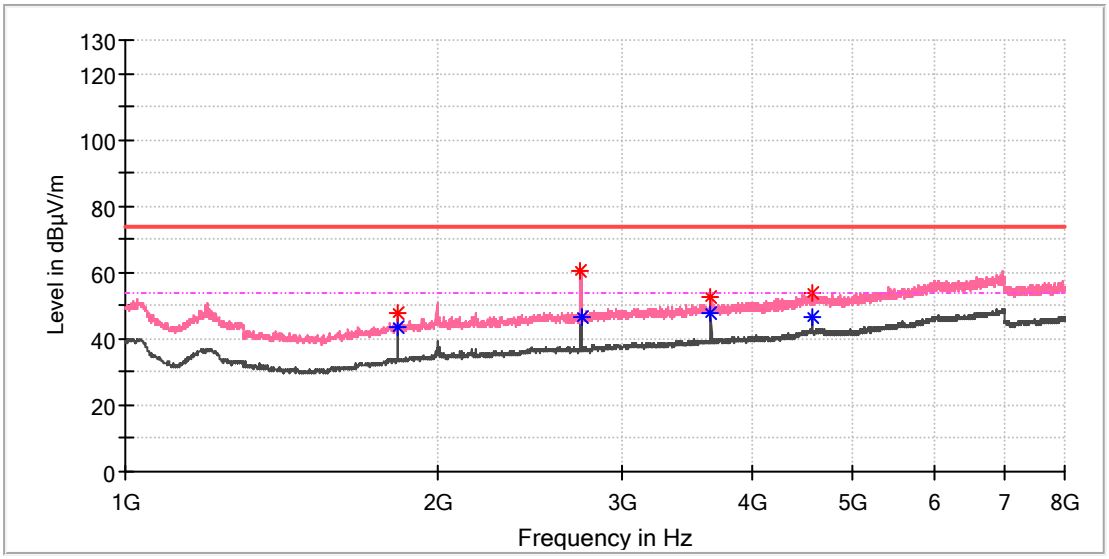


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1828.462500	47.52	---	74.00	26.48	100.0	H	249.0	4.9
1828.462500	---	42.55	54.00	11.45	100.0	H	249.0	4.9
2742.175000	66.90	---	74.00	7.10	100.0	H	75.0	7.8
2743.850000	---	49.55	54.00	4.45	100.0	H	323.0	7.8
3655.887500	---	48.15	54.00	5.85	100.0	H	279.0	9.4
3656.725000	53.16	---	74.00	20.84	100.0	H	128.0	9.4
4572.112500	56.84	---	74.00	17.16	100.0	H	323.0	12.0
4572.112500	---	50.89	54.00	3.11	100.0	H	323.0	12.0

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	DTS 500K_SF8_914.2MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

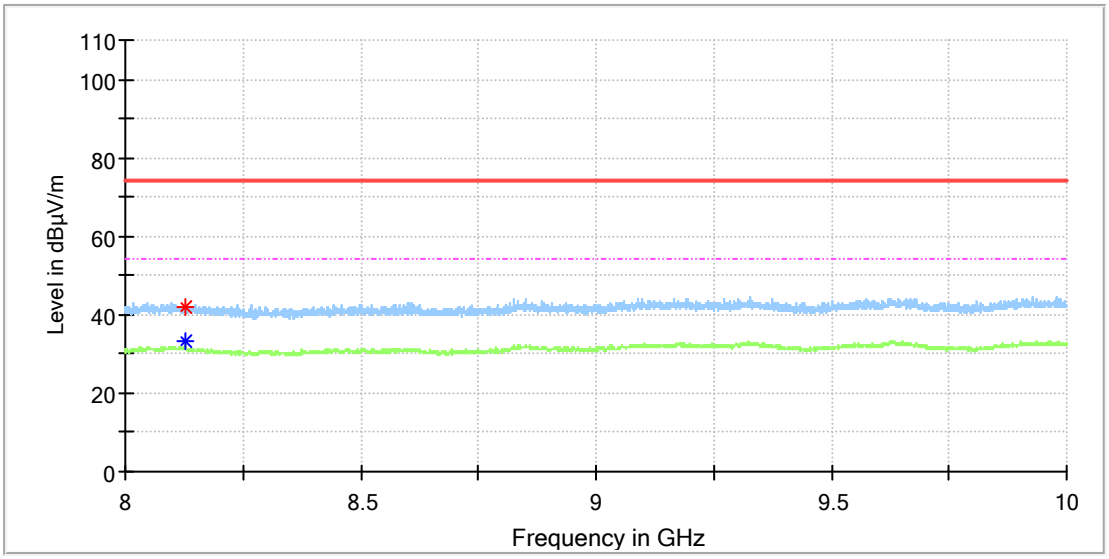


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1827.625000	---	43.43	54.00	10.57	100.0	V	132.0	4.9
1828.462500	47.86	---	74.00	26.14	100.0	V	140.0	4.9
2741.337500	60.49	---	74.00	13.51	100.0	V	6.0	7.8
2743.850000	---	46.64	54.00	7.36	100.0	V	337.0	7.8
3655.887500	52.79	---	74.00	21.21	100.0	V	51.0	9.4
3657.562500	---	47.52	54.00	6.48	100.0	V	60.0	9.4
4569.600000	53.66	---	74.00	20.34	100.0	V	203.0	12.0
4570.437500	---	46.26	54.00	7.74	100.0	V	140.0	12.0

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	DTS 500K_SF8_903MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

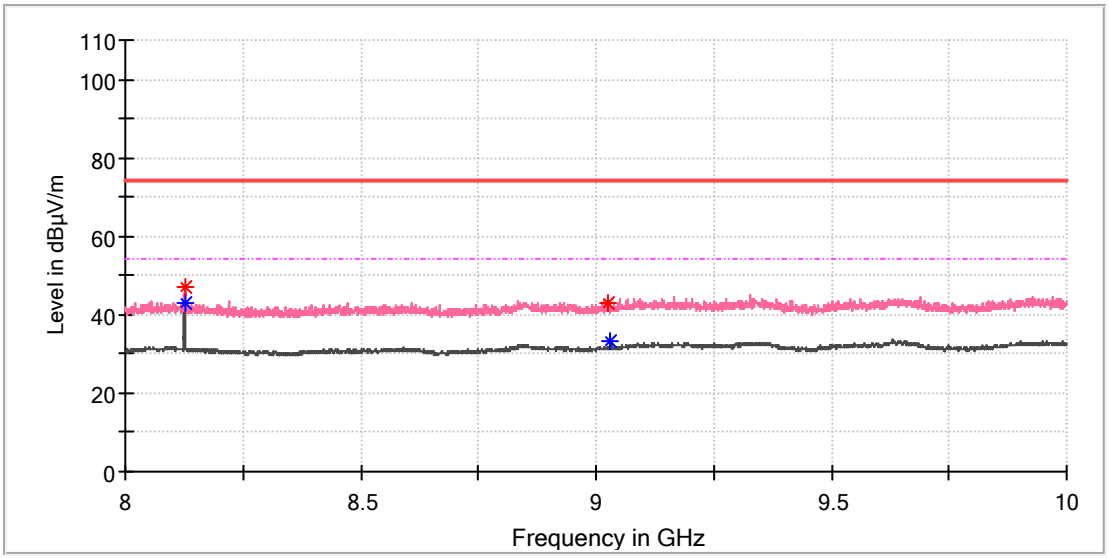


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8128.000000	---	33.18	54.00	20.82	100.0	H	64.0	8.6
8129.500000	42.08	---	74.00	31.92	100.0	H	253.0	8.6

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	DTS 500K_SF8_903MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

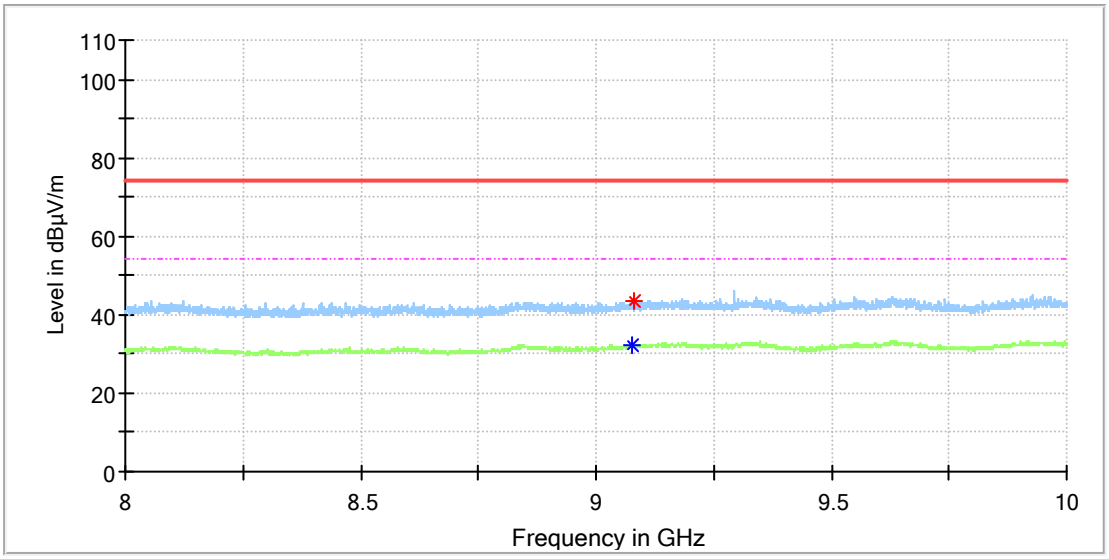


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8126.500000	---	43.11	54.00	10.89	100.0	V	159.0	8.6
8127.000000	46.84	---	74.00	27.16	100.0	V	159.0	8.6
9025.000000	43.21	---	74.00	30.79	100.0	V	59.0	8.9
9031.500000	---	33.30	54.00	20.70	100.0	V	271.0	8.9

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	DTS 500K_SF8_907.8MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

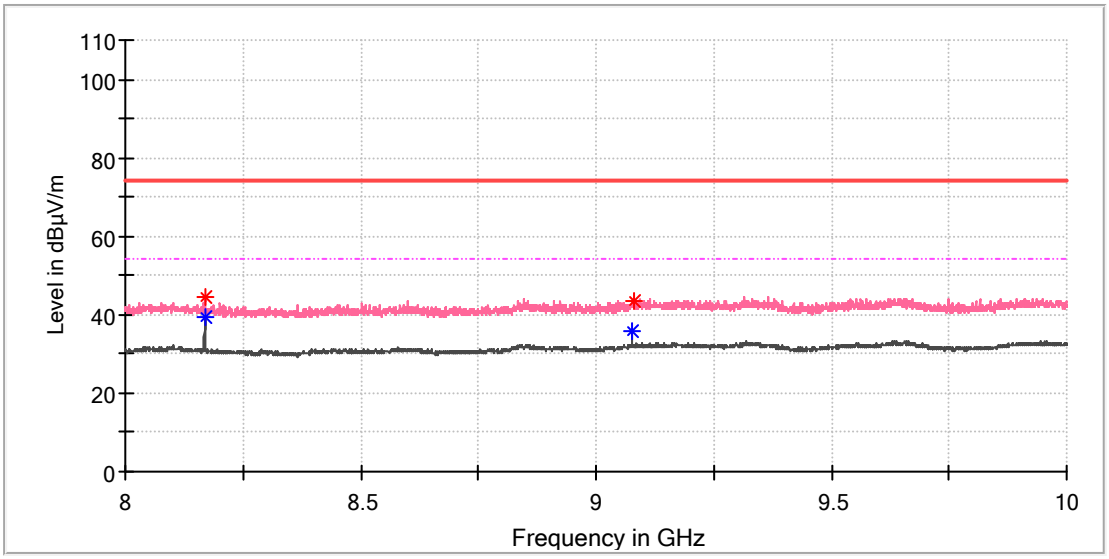


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9077.000000	---	32.41	54.00	21.59	100.0	H	272.0	9.4
9079.500000	43.63	---	74.00	30.37	100.0	H	252.0	9.4

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	DTS 500K_SF8_907.8MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

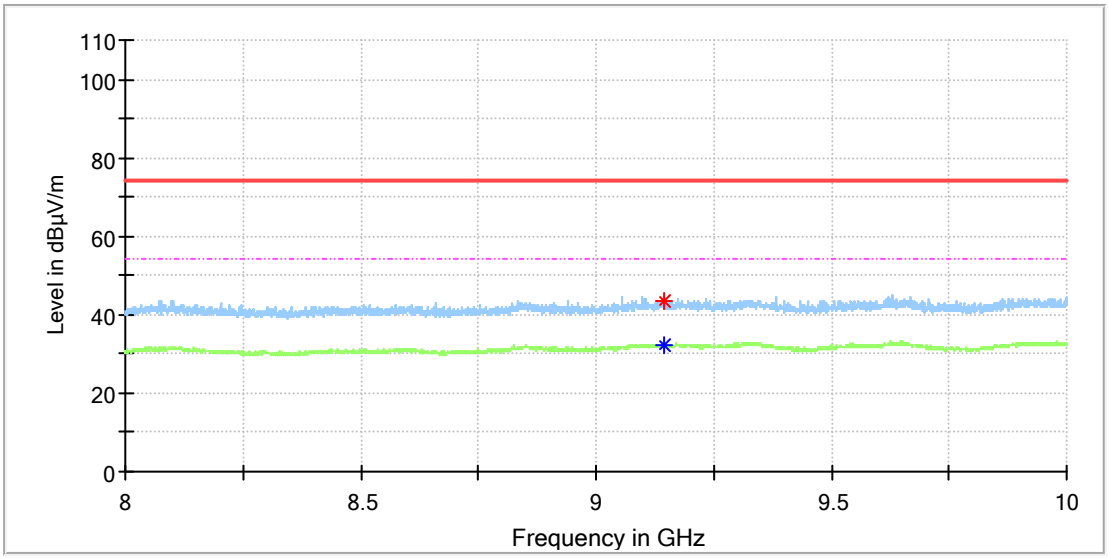


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8170.000000	---	39.32	54.00	14.68	100.0	V	106.0	8.5
8171.500000	44.66	---	74.00	29.34	100.0	V	106.0	8.5
9076.500000	---	35.78	54.00	18.22	100.0	V	106.0	9.4
9080.500000	43.61	---	74.00	30.39	100.0	V	117.0	9.4

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	DTS 500K_SF8_914.2MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

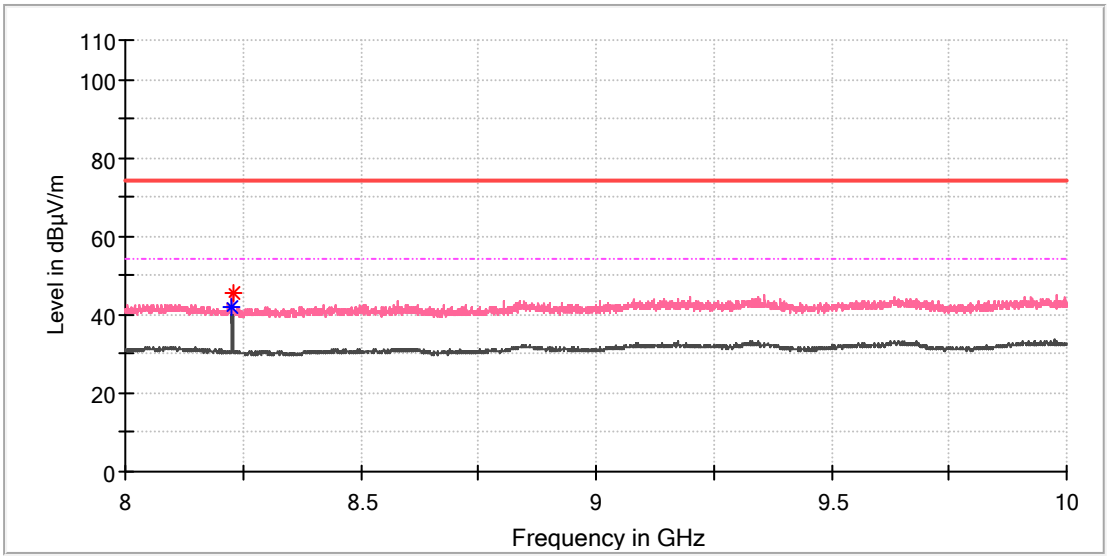


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9143.000000	43.35	---	74.00	30.65	100.0	H	249.0	10.1
9143.500000	---	32.23	54.00	21.77	100.0	H	103.0	10.1

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	DTS 500K_SF8_914.2MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



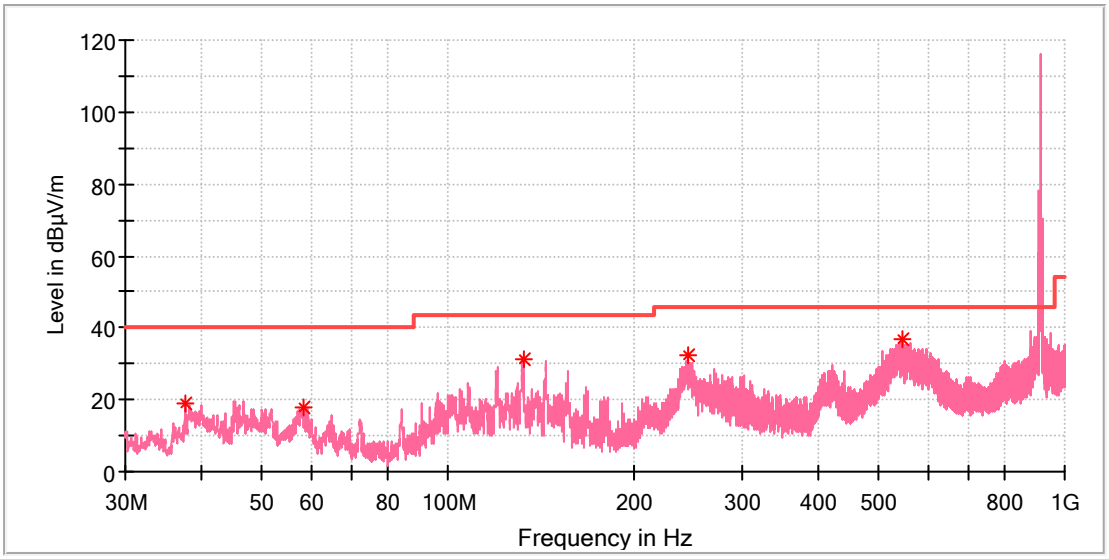
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8226.000000	---	42.11	54.00	11.89	100.0	V	159.0	8.4
8229.000000	45.63	---	74.00	28.37	100.0	V	150.0	8.4

Co-located mode (Lora FHSS+BLE)

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	BLE 1M_High channel+FHSS 125K_SF7_914.9MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

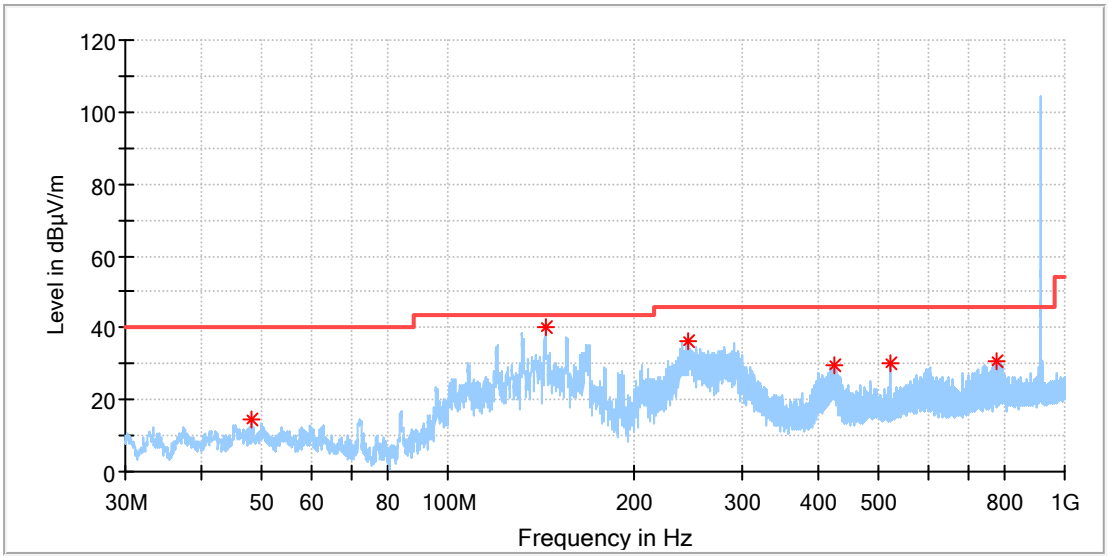


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.461539	19.25	40.00	20.75	100.0	V	172.0	-21.3
58.167308	17.93	40.00	22.07	100.0	V	68.0	-19.1
132.335000	31.03	43.50	12.47	100.0	V	112.0	-22.3
244.370000	32.34	46.00	13.66	100.0	V	229.0	-17.9
545.704231	36.63	46.00	9.37	100.0	V	254.0	-11.3

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	BLE 1M_High channel+FHSS 125K_SF7_914.9MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

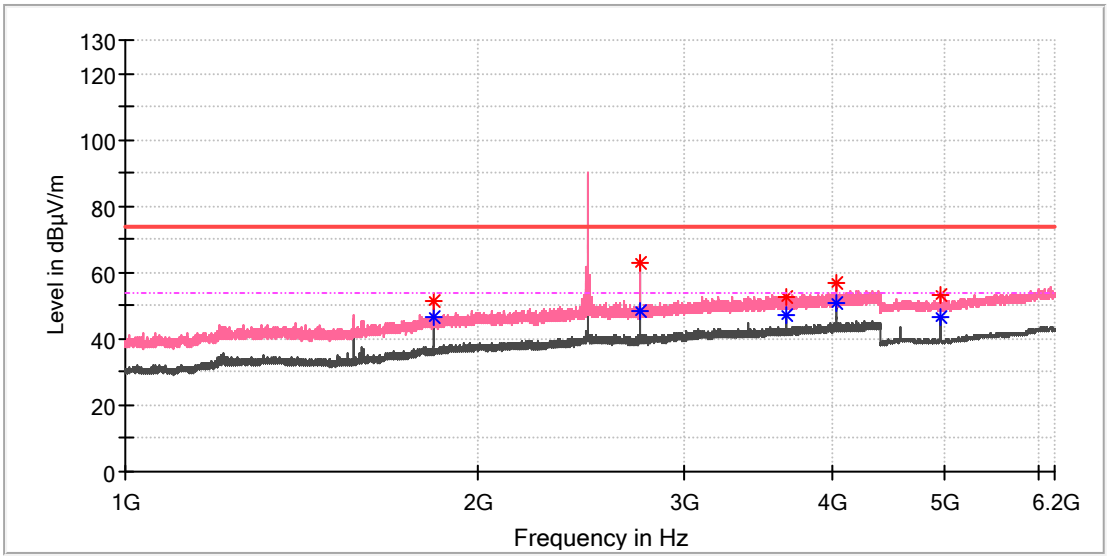


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
47.982308	14.77	40.00	25.23	100.0	H	103.0	-18.7
143.900385	40.09	43.50	3.41	100.0	H	185.0	-22.6
245.601154	36.41	46.00	9.59	100.0	H	168.0	-17.8
422.066539	29.62	46.00	16.38	100.0	H	322.0	-13.7
522.871923	30.06	46.00	15.94	100.0	H	228.0	-11.8
774.251154	30.61	46.00	15.39	100.0	H	0.0	-7.2

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	BLE 1M_High channel+FHSS 125K_SF7_914.9MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

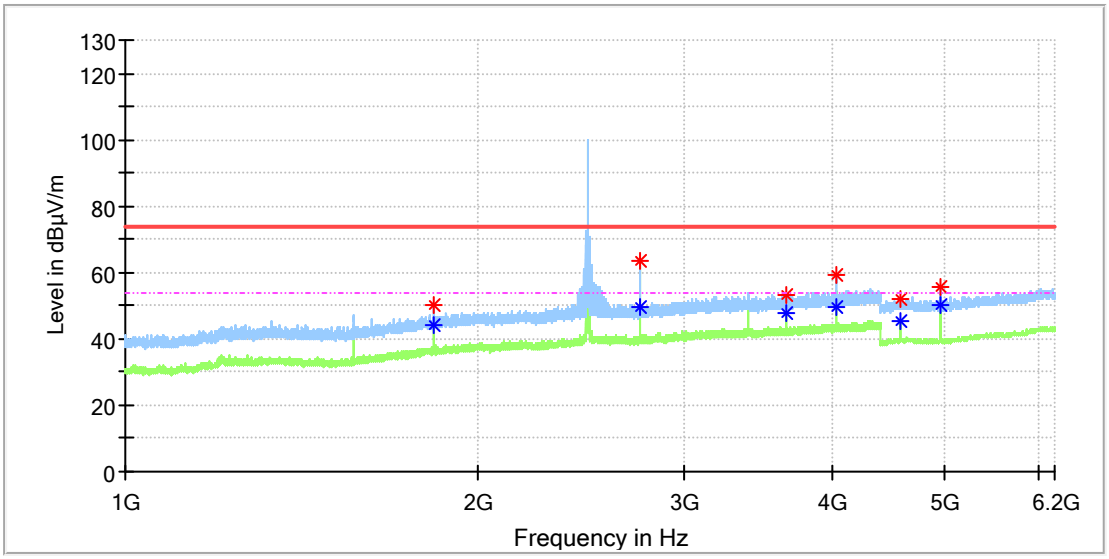


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1830.110000	---	46.83	54.00	7.17	100.0	V	101.0	4.9
1830.110000	51.70	---	74.00	22.30	100.0	V	101.0	4.9
2744.710000	63.00	---	74.00	11.00	100.0	V	167.0	7.8
2745.730000	---	48.56	54.00	5.44	100.0	V	167.0	7.8
3659.650000	---	47.11	54.00	6.89	100.0	V	167.0	9.4
3664.410000	52.89	---	74.00	21.11	100.0	V	67.0	9.5
4045.210000	56.92	---	74.00	17.08	100.0	V	41.0	10.1
4045.380000	---	50.84	54.00	3.16	100.0	V	4.0	10.1
4959.500000	53.45	---	74.00	20.55	100.0	V	91.0	11.8
4960.000000	---	46.34	54.00	7.66	100.0	V	91.0	11.8

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	BLE 1M_High channel+FHSS 125K_SF7_914.9MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

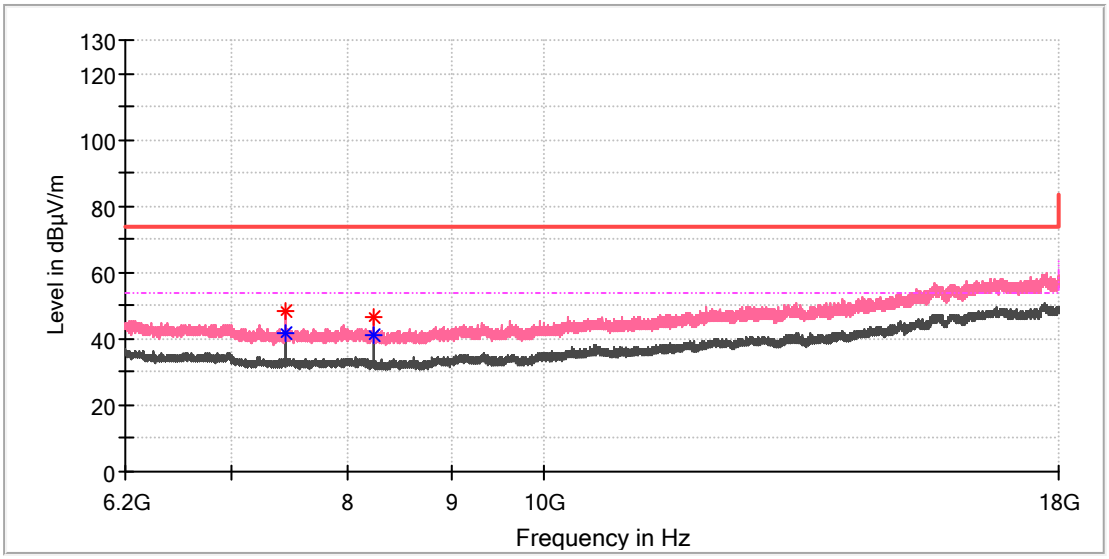


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1829.600000	---	43.92	54.00	10.08	100.0	H	345.0	4.9
1829.940000	50.42	---	74.00	23.58	100.0	H	345.0	4.9
2743.520000	---	49.66	54.00	4.34	100.0	H	292.0	7.8
2744.710000	63.43	---	74.00	10.57	100.0	H	292.0	7.8
3658.120000	53.46	---	74.00	20.54	100.0	H	271.0	9.4
3659.310000	---	48.02	54.00	5.98	100.0	H	150.0	9.4
4044.020000	---	49.39	54.00	4.61	100.0	H	0.0	10.1
4045.380000	59.09	---	74.00	14.91	100.0	H	0.0	10.1
4574.500000	51.83	---	74.00	22.17	100.0	H	8.0	12.0
4574.500000	---	45.38	54.00	8.62	100.0	H	8.0	12.0
4959.500000	---	50.05	54.00	3.95	100.0	H	202.0	11.8
4960.000000	55.36	---	74.00	18.64	100.0	H	30.0	11.8

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	BLE 1M_High channel+FHSS 125K_SF7_914.9MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

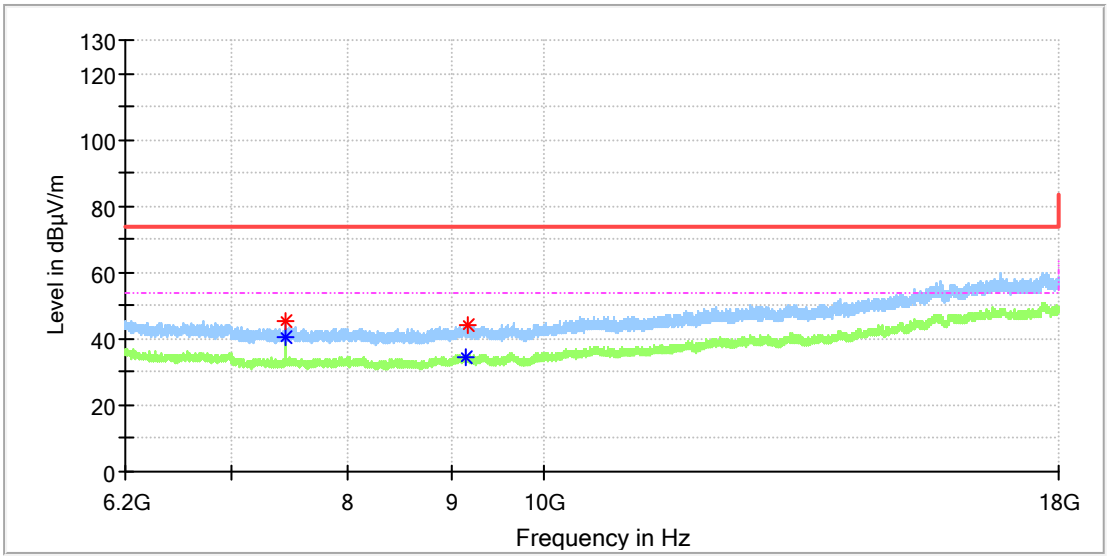


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7439.000000	---	41.97	54.00	12.03	100.0	V	168.0	8.4
7440.475000	48.38	---	74.00	25.62	100.0	V	17.0	8.4
8234.025000	---	40.90	54.00	13.10	100.0	V	180.0	8.8
8234.516667	46.47	---	74.00	27.53	100.0	V	180.0	8.8

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	BLE 1M_High channel+FHSS 125K_SF7_914.9MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



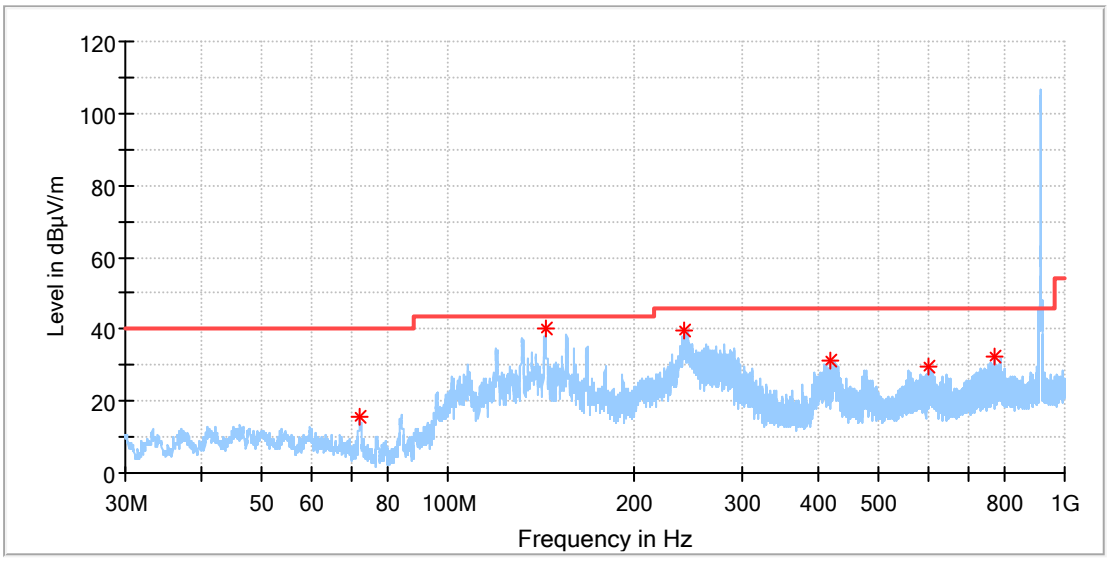
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7439.983333	45.24	---	74.00	28.76	100.0	H	48.0	8.4
7439.983333	---	40.30	54.00	13.70	100.0	H	48.0	8.4
9150.000000	---	34.48	54.00	19.52	100.0	H	0.0	10.4
9173.108333	44.20	---	74.00	29.80	100.0	H	347.0	10.5

Co-located mode (Lora DTS+BLE)

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	BLE 1M_High channel+Lora DTS 500K_SF8_914.2MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

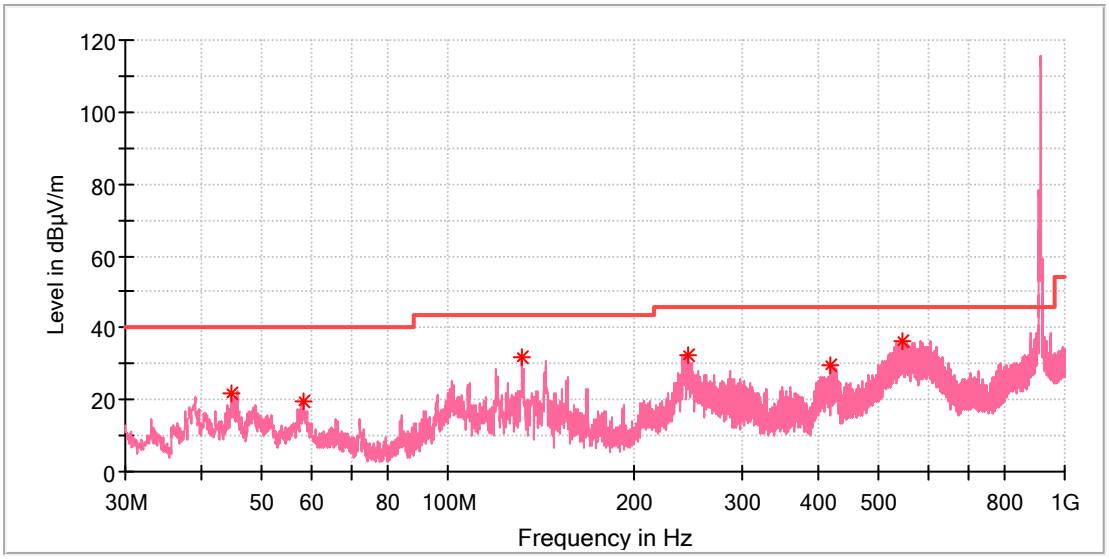


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
72.008462	15.65	40.00	24.35	100.0	H	203.0	-22.8
143.751154	40.03	43.50	3.47	100.0	H	47.0	-22.6
242.168846	39.69	46.00	6.31	100.0	H	325.0	-17.9
418.037308	31.07	46.00	14.93	100.0	H	317.0	-13.8
601.479231	29.64	46.00	16.36	100.0	H	354.0	-10.2
768.244615	32.34	46.00	13.66	100.0	H	8.0	-7.3

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	BLE 1M_High channel+Lora DTS 500K_SF8_914.2MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

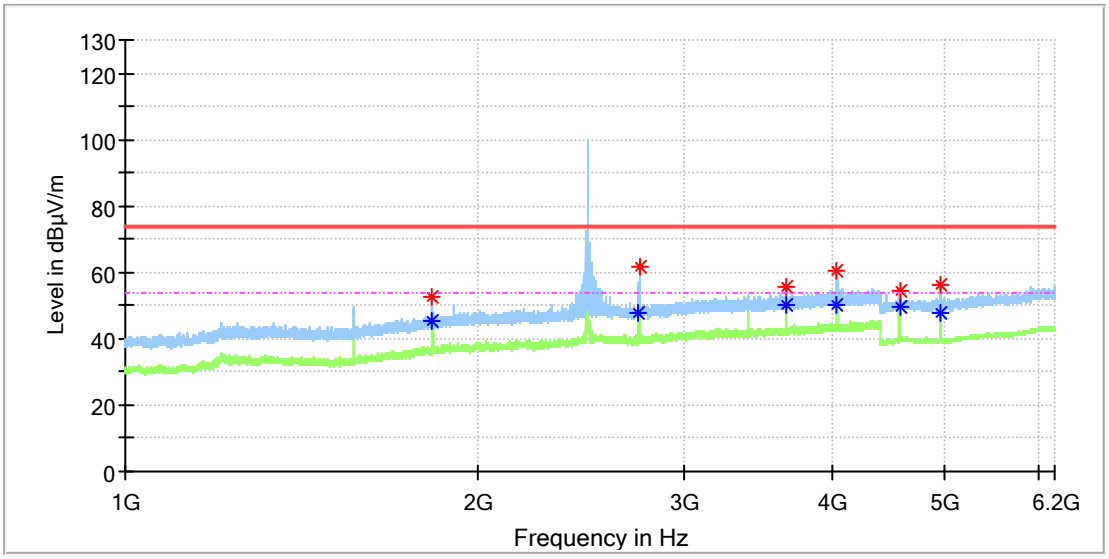


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
44.512692	21.85	40.00	18.15	100.0	V	115.0	-19.2
58.279231	19.26	40.00	20.74	100.0	V	69.0	-19.1
131.924615	31.92	43.50	11.58	100.0	V	289.0	-22.3
244.444615	32.39	46.00	13.61	100.0	V	34.0	-17.9
417.440385	29.70	46.00	16.30	100.0	V	11.0	-13.8
546.226539	36.54	46.00	9.46	100.0	V	353.0	-11.3

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	BLE 1M_High channel+Lora DTS 500K_SF8_914.2MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

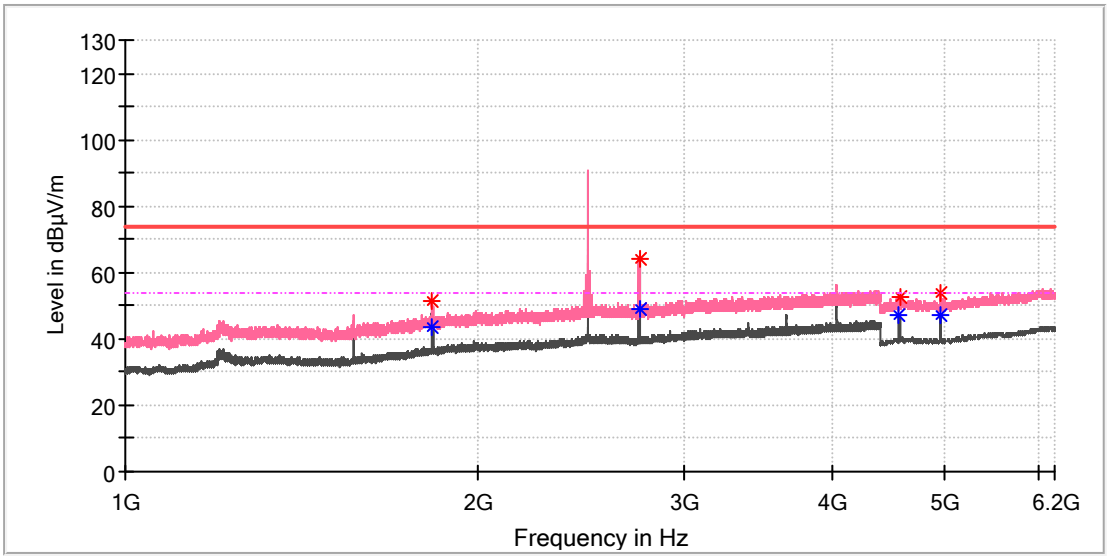


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1827.900000	---	45.08	54.00	8.92	100.0	H	5.0	4.9
1828.240000	52.46	---	74.00	21.54	100.0	H	64.0	4.9
2741.140000	---	47.82	54.00	6.18	100.0	H	41.0	7.8
2742.840000	61.88	---	74.00	12.12	100.0	H	242.0	7.8
3656.760000	55.72	---	74.00	18.28	100.0	H	242.0	9.4
3657.610000	---	50.11	54.00	3.89	100.0	H	242.0	9.4
4044.530000	---	50.18	54.00	3.82	100.0	H	17.0	10.1
4045.040000	60.30	---	74.00	13.70	100.0	H	107.0	10.1
4571.500000	---	49.31	54.00	4.69	100.0	H	325.0	12.0
4571.500000	54.21	---	74.00	19.79	100.0	H	325.0	12.0
4959.000000	56.50	---	74.00	17.50	100.0	H	204.0	11.8
4960.000000	---	47.95	54.00	6.05	100.0	H	30.0	11.8

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	BLE 1M_High channel+Lora DTS 500K_SF8_914.2MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

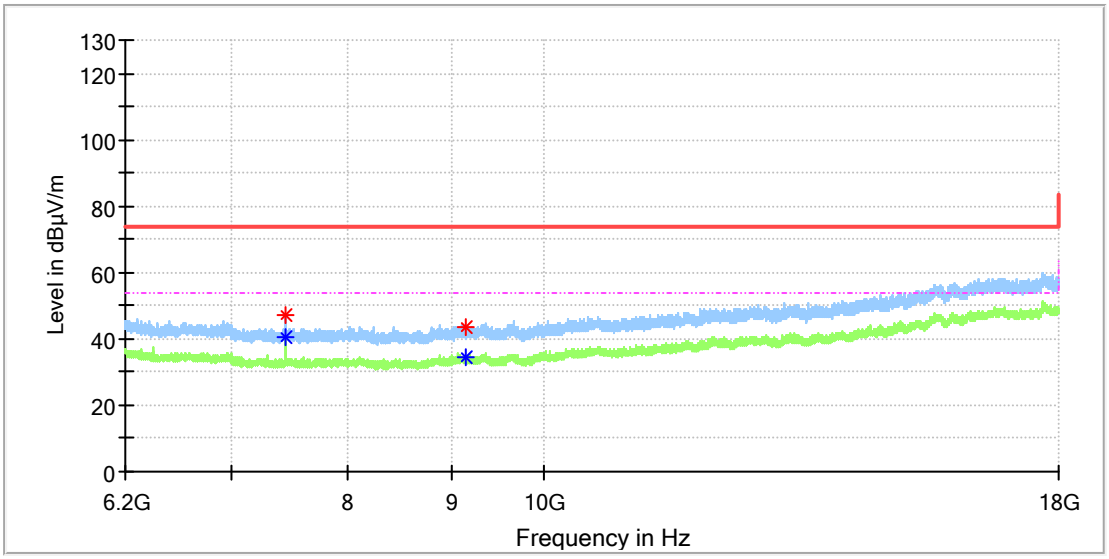


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1827.560000	---	43.79	54.00	10.21	100.0	V	29.0	4.9
1828.410000	51.28	---	74.00	22.72	100.0	V	29.0	4.9
2741.820000	63.91	---	74.00	10.09	100.0	V	132.0	7.8
2744.200000	---	48.81	54.00	5.19	100.0	V	245.0	7.8
4570.000000	---	47.07	54.00	6.93	100.0	V	197.0	12.0
4571.500000	52.86	---	74.00	21.14	100.0	V	190.0	12.0
4959.500000	54.03	---	74.00	19.97	100.0	V	94.0	11.8
4960.000000	---	46.97	54.00	7.03	100.0	V	94.0	11.8

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	BLE 1M_High channel+Lora DTS 500K_SF8_914.2MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

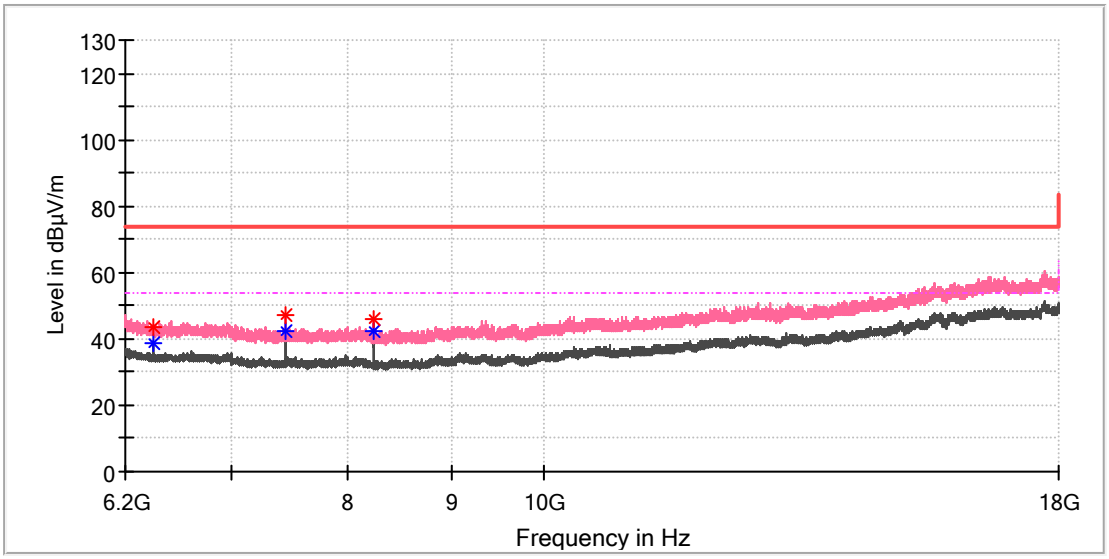


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7439.000000	46.92	---	74.00	27.08	100.0	H	46.0	8.4
7439.491667	---	40.58	54.00	13.42	100.0	H	137.0	8.4
9146.066667	43.54	---	74.00	30.46	100.0	H	46.0	10.4
9149.508333	---	34.76	54.00	19.24	100.0	H	285.0	10.4

EUT Information

EUT Name:	WisDuo LPWAN Module
Model:	RAK11720
Test Mode:	BLE 1M_High channel+Lora DTS 500K_SF8_914.2MHz
Order No/Sample No:	168399706/A003386865-004
Test Voltage::	DC 5V From USB
Remark:	Temp 22 Humi:52%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



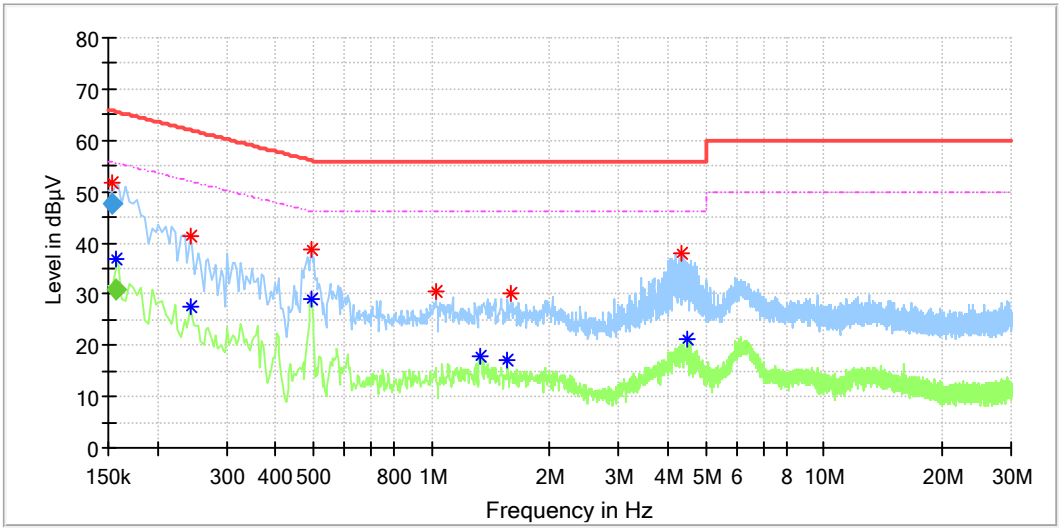
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
6400.600000	---	38.66	54.00	15.34	100.0	V	62.0	8.9
6405.025000	43.83	---	74.00	30.17	100.0	V	246.0	8.9
7439.983333	---	42.12	54.00	11.88	100.0	V	174.0	8.4
7440.475000	47.26	---	74.00	26.74	100.0	V	26.0	8.4
8227.633333	46.14	---	74.00	27.86	100.0	V	123.0	8.9
8227.633333	---	42.33	54.00	11.67	100.0	V	123.0	8.9

Appendix B.8: Test Results of Conducted Emission on AC Mains

EUT Information

EUT Name:	WisDuo LPWAN Module
Order Number:	168399706
Model:	RAK11720
Test Mode:	Lora & BLE connect
Test Voltage:	AC 120V 60Hz
Test By:/Review By:	Kevin Zhou/Gary Chen
Standard:	FCC Part 15
Tem./Hum./Pressure:	25.0°C/50.2%/101kPa
Remark:	SR2



Critical_Freqs

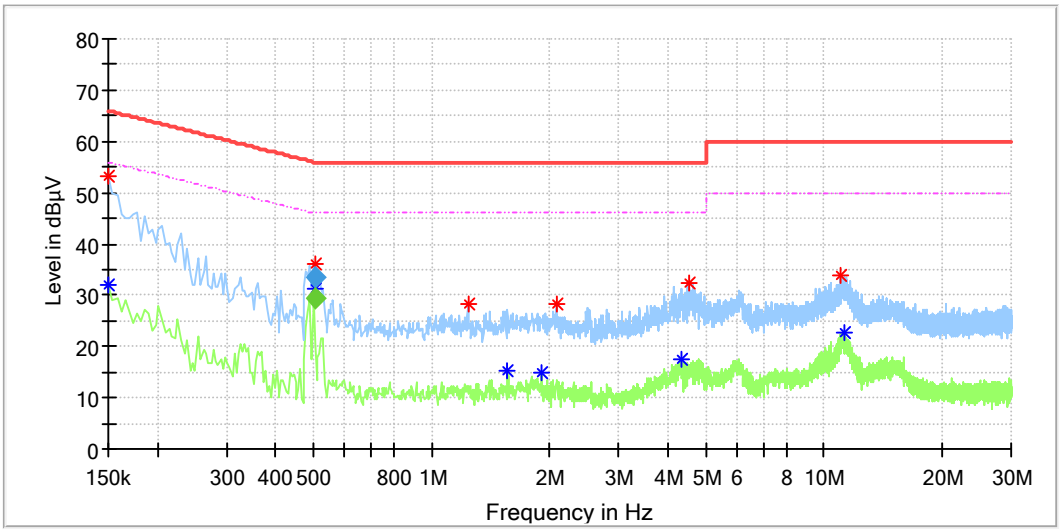
Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.153500	51.71	---	65.57	13.85	L1	9.9
0.157500	---	36.67	55.57	18.90	L1	9.9
0.242000	---	27.46	52.03	24.56	L1	9.9
0.242000	41.46	---	62.03	20.56	L1	9.9
0.494000	---	29.03	46.10	17.07	L1	10.0
0.494000	38.62	---	56.10	17.48	L1	10.0
1.026000	30.36	---	56.00	25.64	L1	10.0
1.326000	---	17.87	46.00	28.13	L1	10.1
1.562000	---	17.16	46.00	28.84	L1	10.1
1.590000	30.25	---	56.00	25.75	L1	10.1
4.326000	37.77	---	56.00	18.23	L1	10.2
4.502000	---	21.17	46.00	24.83	L1	10.2

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.153500	47.63	---	65.81	18.18	1000.0	9.000	L1	9.9
0.157500	---	30.84	55.60	24.76	1000.0	9.000	L1	9.9

EUT Information

EUT Name:	WisDuo LPWAN Module
Order Number:	168399706
Model:	RAK11720
Test Mode:	Lora & BLE connect
Test Voltage:	AC 120V 60Hz
Test By:/Review By:	Kevin Zhou/Gary Chen
Standard:	FCC Part 15
Tem./Hum./Pressure:	25.0°C/50.2%/101kPa
Remark:	SR2



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.150000	53.25	---	66.00	12.75	N	9.8
0.150000	---	32.16	56.00	23.84	N	9.8
0.505500	---	31.07	46.00	14.93	N	9.8
0.506500	36.04	---	56.00	19.96	N	9.8
1.238000	28.14	---	56.00	27.86	N	9.8
1.562000	---	15.41	46.00	30.59	N	9.8
1.906000	---	14.84	46.00	31.16	N	9.8
2.078000	28.34	---	56.00	27.66	N	9.9
4.326000	---	17.59	46.00	28.41	N	9.9
4.546000	32.27	---	56.00	23.73	N	9.9
11.078000	34.03	---	60.00	25.97	N	10.0
11.234000	---	22.79	50.00	27.21	N	10.0

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.505500	---	29.50	46.00	16.50	1000.0	9.000	N	9.8
0.506500	33.65	---	56.00	22.35	1000.0	9.000	N	9.8