

Prüfbericht-Nr.: <i>Test report no.:</i>	CN24V7P1 001	Auftrags-Nr.: <i>Order no.:</i>	168478328	Seite 1 von 31 <i>Page 1 of 31</i>
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	2024-04-11	
Auftraggeber: <i>Client:</i>	Shenzhen RAKwireless Technology Co.,Ltd. Room 506, Building B, New Compark, Pingshan First Road, Taoyuan Street, Nanshan District, Shenzhen, Guangdong, P.R. China			
Prüfgegenstand: <i>Test item:</i>	WisDuo LPWAN+BLE Module			
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	RAK11720 (Trademark: RAK)			
Auftrags-Inhalt: <i>Order content:</i>	FCC CIIPC and IC CIIPC			
Prüfgrundlage: <i>Test specification:</i>	CFR47 FCC Part 15: Subpart C Section 15.247 RSS-247 Issue 3 August 2023 RSS-Gen Issue 5 February 2021			
Wareneingangsdatum: <i>Date of sample receipt:</i>	2024-04-11	Please refer to photo documents		
Prüfmuster-Nr.: <i>Test sample no.:</i>	A003697710-004~006			
Prüfzeitraum: <i>Testing period:</i>	2024-04-11 - 2024-05-17			
Ort der Prüfung: <i>Place of testing:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüfergebnis*: <i>Test result*:</i>	Pass			
geprüft von: <i>tested by:</i>	Hardy <i>X</i> <i>Hardy</i> <i>Suo</i>		genehmigt von: <i>authorized by:</i>	Lin <i>X</i> <i>Lin</i>
Datum: <i>Date:</i>	2024-05-27		Ausstellungsdatum: <i>Issue date:</i>	2024-05-27
Stellung / Position	Sachverständige(r)/Expert		Stellung / Position	Sachverständige(r)/Expert
Sonstiges / Other:	FCC ID: 2AF6B-RAK11720 IC: 25908-RAK11720, HVIN: RAK11720, FVIN: RUI_3.5.2+user_final.hex This report is a FCC CIIPC and IC CIIPC report for adding additional LoRa operating bands, refer to section 3.1 for details.			
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:	P(ass) = entspricht o.g. Prüfgrundlage(n)	F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
* Legend:	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 only 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 test mark.</i>				

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Anmerkungen
Remarks

1	<p>Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben. Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden.</p> <p><i>The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.</i></p>
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3	<p>Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben. Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt.</p> <p><i>Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report.</i> <i>Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.</i></p>
4	<p>Die Entscheidungsregel für Konformitätserklärungen basierend auf numerischen Messergebnissen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC G8:2019 und IEC Guide 115:2021, es sei denn, in der auf Seite 1 dieses Berichts genannten angewandten Norm ist etwas anderes festgelegt oder vom Kunden gewünscht. Dies bedeutet, dass die Messunsicherheit nicht berücksichtigt wird und daher auch nicht im Prüfbericht angegeben wird. Zu weiteren Informationen bezüglich des Risikos durch diese Entscheidungsregel siehe ILAC G8:2019.</p> <p><i>The decision rule for statements of conformity, based on numerical measurement results, in this test report is based on the "Zero Guard Band Rule" and "Simple Acceptance" in accordance with ILAC G8:2019 and IEC Guide 115:2021, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report. For additional information to the resulting risk based of this decision rule please refer to ILAC G8:2019.</i></p>

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*

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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

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 (TS8997-R&S)						
Equip. No.	Description	Manufacturer	Model	Serial No.	Calibrated Date (DD.MM.YYYY)	Calibrated until (DD.MM.YYYY)
G1825795	Signal Analyzer	R&S	FSV 40	101441	26.07.2023	25.07.2024
G1825798	OSP	R&S	OSP 150	101017	14.11.2023	13.11.2024
G1825799	Control PC	DELL	OptiPlex 7050	FTJZ9P2	N/A	N/A
G1825800	Test Software	R&S	WMS32 (V11.00.00)	N/A	N/A	N/A
G1825801	Power Meter	R&S	NRP2	107105	14.11.2023	13.11.2024
G1829620	Power Sensor	R&S	NRP-Z81	105677	26.07.2023	25.07.2024
G1826483	Humid & Temp Programmable Tester	BOST	NTH090-60	19040801	01.03.2024	28.02.2025
G1826431	Shielding Room 8#	Albatross	SR8	APC1715 1-SR8	22.06.2021	22.06.2024
Unwanted Emission Testing (TS9975)						
Equip. No.	Description	Manufacturer	Model	Serial No.	Calibrated Date (DD.MM.YYYY)	Calibrated until (DD.MM.YYYY)
G1826021	EMI Test Receiver	R&S	ESR 7	102021	26.07.2023	25.07.2024
G1826023	Signal Analyzer	R&S	FSV 40	101439	26.07.2023	25.07.2024
G1826024	System Controller Interface	R&S	SCI-100	S1001003 8	N/A	N/A
G1826025	Filterbank	R&S	Wlan	100759	26.07.2023	25.07.2024
G1826026	OSP	R&S	OSP 120	102040	N/A	N/A
G1826028	Pre-amplifier	R&S	SCU08F1	08320031	26.07.2023	25.07.2024
G1826029	Amplifier	R&S	SCU-18F	180070	26.07.2023	25.07.2024
G1826030	Amplifier	R&S	SCU40A	100475	26.07.2023	25.07.2024
G1826031	Trilog Broadband Antenna (30 MHz - 7 GHz)	Schwarzbeck	VULB 9162	193	07.08.2022	06.08.2024
G1826032	Double-Ridged Antenna (1 -18 GHz)	ETS-LINDGREN	3117	00218717	07.08.2022	06.08.2024
G1826033	Wideband Ridged Horn Antenna (18-40 GHz)	Steatite	QMS-00880	19067	28.08.2022	27.08.2024
G1826034	Active Loop Antenna	Schwarzbeck	FMZB 1513	302	07.08.2022	06.08.2024
G1826036	Test software	R&S	EMC32 (V10.60.10)	N/A	N/A	N/A
G1826037	Control PC	Dell	OptiPlex 7050	36NV9P2	N/A	N/A
G1826433	3m Semi-Anechoic Chamber	Albatross	SAC-3m	APC1715 1-SAC	22.06.2021	22.06.2024

Terminal Disturbance Voltage at Mains Terminals					
Equip. No.	Equipment	Manufacturer	M/N	S/N	Calibrated until
GC-SZ 001009	EMI Test Receiver	R&S	ESR3	102428	2024-09-13
GC-SZ 001010	Artificial Mains Network	R&S	ENV216	102333	2024-07-31
GC-SZ 001011	Artificial Mains Network	R&S	ENV432	101411	2024-07-31
G1825090	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 basis 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	$\pm 1 \times 10^{-7}$
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#	RAKARJ14	2.3 dBi	Dipole Antenna	RP-SMA connector
2#	RAKARJ16	2.3 dBi	Dipole Antenna	RP-SMA 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# 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

This report is a FCC CIIPC and IC CIIPC report for adding additional LoRa operating bands. New added LoRa has two different independent configurations and they cannot work simultaneously, details as below:

Configuration 1:

Data Rate	SF (Spreading factor)	Operating Frequency
0	LoRa Modulation: SF10 / Bandwidth 125 kHz	Original: 902.3 – 914.9 MHz New: 915.1 – 927.7 MHz
1	LoRa Modulation: SF9 / Bandwidth 125 kHz	
2	LoRa Modulation: SF8 / Bandwidth 125 kHz	
3	LoRa Modulation: SF7 / Bandwidth 125 kHz	
4	LoRa Modulation: SF8 / Bandwidth 500 kHz	Original: 903 – 914.2 MHz New: 915.8 – 927.0 MHz

Configuration 2:

Data Rate	SF (Spreading factor)	Operating Frequency
0	LoRa Modulation: SF12 / Bandwidth 500 kHz	Original: n/a New: 902.5 – 927.1 MHz
1	LoRa Modulation: SF11 / Bandwidth 500 kHz	
2	LoRa Modulation: SF10 / Bandwidth 500 kHz	
3	LoRa Modulation: SF9 / Bandwidth 500 kHz	
4	LoRa Modulation: SF8 / Bandwidth 500 kHz	
5	LoRa Modulation: SF7 / Bandwidth 500 kHz	

This report only includes test data for new operating frequency for both config1&2.

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+BLE 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 board)
Testing Voltage	DC 5V Via USB port
Technical Specification of Lora DTS	
Operating Frequency	903 – 914.2 MHz and 915.8 – 927.0 MHz 902.5 – 927.1 MHz
Type of Modulation	Lora
Data Rate	SF8 / DR4 for 903 – 914.2 MHz and 915.8 – 927.0 MHz SF7-SF12 / DR0 to DR5 for 902.5 – 927.1 MHz
Channel Number	16 channels (Upstream)
Channel Separation	1.6 MHz
Occupied Bandwidth	500 kHz
Technical Specification of Lora FHSS	
Frequency Range	902.3 – 914.9MHz and 915.1 – 927.7 MHz
Type of Modulation	Lora
Data Rate	SF7 to SF10 / DR0 to DR3
Channel Number	127 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 (902.3 – 914.9MHz and 915.1 – 927.7 MHz)

RF Channel	Center Frequency (MHz)	Occupied Bandwidth (kHz)	Channel Separation (kHz)	Modulation
0	902.30	125(SF7~SF10)	200	LoRa:CSS
1	902.50	125(SF7~SF10)	200	LoRa:CSS
2	902.70	125(SF7~SF10)	200	LoRa:CSS
3	902.90	125(SF7~SF10)	200	LoRa:CSS
4	903.10	125(SF7~SF10)	200	LoRa:CSS
5	903.30	125(SF7~SF10)	200	LoRa:CSS
6	903.50	125(SF7~SF10)	200	LoRa:CSS
7	903.70	125(SF7~SF10)	200	LoRa:CSS
8	903.90	125(SF7~SF10)	200	LoRa:CSS
9	904.10	125(SF7~SF10)	200	LoRa:CSS
10	904.30	125(SF7~SF10)	200	LoRa:CSS
11	904.50	125(SF7~SF10)	200	LoRa:CSS
12	904.70	125(SF7~SF10)	200	LoRa:CSS
13	904.90	125(SF7~SF10)	200	LoRa:CSS
14	905.10	125(SF7~SF10)	200	LoRa:CSS
15	905.30	125(SF7~SF10)	200	LoRa:CSS
16	905.50	125(SF7~SF10)	200	LoRa:CSS
17	905.70	125(SF7~SF10)	200	LoRa:CSS
18	905.90	125(SF7~SF10)	200	LoRa:CSS
19	906.10	125(SF7~SF10)	200	LoRa:CSS
20	906.30	125(SF7~SF10)	200	LoRa:CSS
21	906.50	125(SF7~SF10)	200	LoRa:CSS
22	906.70	125(SF7~SF10)	200	LoRa:CSS
23	906.90	125(SF7~SF10)	200	LoRa:CSS
24	907.10	125(SF7~SF10)	200	LoRa:CSS
25	907.30	125(SF7~SF10)	200	LoRa:CSS
26	907.50	125(SF7~SF10)	200	LoRa:CSS
27	907.70	125(SF7~SF10)	200	LoRa:CSS
28	907.90	125(SF7~SF10)	200	LoRa:CSS
29	908.10	125(SF7~SF10)	200	LoRa:CSS
30	908.30	125(SF7~SF10)	200	LoRa:CSS
31	908.50	125(SF7~SF10)	200	LoRa:CSS
32	908.70	125(SF7~SF10)	200	LoRa:CSS
33	908.90	125(SF7~SF10)	200	LoRa:CSS
34	909.10	125(SF7~SF10)	200	LoRa:CSS
35	909.30	125(SF7~SF10)	200	LoRa:CSS
36	909.50	125(SF7~SF10)	200	LoRa:CSS
37	909.70	125(SF7~SF10)	200	LoRa:CSS
38	909.90	125(SF7~SF10)	200	LoRa:CSS
39	910.10	125(SF7~SF10)	200	LoRa:CSS
40	910.30	125(SF7~SF10)	200	LoRa:CSS
41	910.50	125(SF7~SF10)	200	LoRa:CSS
42	910.70	125(SF7~SF10)	200	LoRa:CSS
43	910.90	125(SF7~SF10)	200	LoRa:CSS
44	911.10	125(SF7~SF10)	200	LoRa:CSS
45	911.30	125(SF7~SF10)	200	LoRa:CSS
46	911.50	125(SF7~SF10)	200	LoRa:CSS
47	911.70	125(SF7~SF10)	200	LoRa:CSS
48	911.90	125(SF7~SF10)	200	LoRa:CSS
49	912.10	125(SF7~SF10)	200	LoRa:CSS
50	912.30	125(SF7~SF10)	200	LoRa:CSS
51	912.50	125(SF7~SF10)	200	LoRa:CSS
52	912.70	125(SF7~SF10)	200	LoRa:CSS
53	912.90	125(SF7~SF10)	200	LoRa:CSS
54	913.10	125(SF7~SF10)	200	LoRa:CSS
55	913.30	125(SF7~SF10)	200	LoRa:CSS
56	913.50	125(SF7~SF10)	200	LoRa:CSS
57	913.70	125(SF7~SF10)	200	LoRa:CSS
58	913.90	125(SF7~SF10)	200	LoRa:CSS
59	914.10	125(SF7~SF10)	200	LoRa:CSS

60	914.30	125(SF7~SF10)	200	LoRa:CSS
61	914.50	125(SF7~SF10)	200	LoRa:CSS
62	914.70	125(SF7~SF10)	200	LoRa:CSS
63	914.90	125(SF7~SF10)	200	LoRa:CSS
64	915.10	125(SF7~SF10)	200	LoRa:CSS
65	915.30	125(SF7~SF10)	200	LoRa:CSS
66	915.50	125(SF7~SF10)	200	LoRa:CSS
67	915.70	125(SF7~SF10)	200	LoRa:CSS
68	915.90	125(SF7~SF10)	200	LoRa:CSS
69	916.10	125(SF7~SF10)	200	LoRa:CSS
70	916.30	125(SF7~SF10)	200	LoRa:CSS
71	916.50	125(SF7~SF10)	200	LoRa:CSS
72	916.70	125(SF7~SF10)	200	LoRa:CSS
73	916.90	125(SF7~SF10)	200	LoRa:CSS
74	917.10	125(SF7~SF10)	200	LoRa:CSS
75	917.30	125(SF7~SF10)	200	LoRa:CSS
76	917.50	125(SF7~SF10)	200	LoRa:CSS
77	917.70	125(SF7~SF10)	200	LoRa:CSS
78	917.90	125(SF7~SF10)	200	LoRa:CSS
79	918.10	125(SF7~SF10)	200	LoRa:CSS
80	918.30	125(SF7~SF10)	200	LoRa:CSS
81	918.50	125(SF7~SF10)	200	LoRa:CSS
82	918.70	125(SF7~SF10)	200	LoRa:CSS
83	918.90	125(SF7~SF10)	200	LoRa:CSS
84	919.10	125(SF7~SF10)	200	LoRa:CSS
85	919.30	125(SF7~SF10)	200	LoRa:CSS
86	919.50	125(SF7~SF10)	200	LoRa:CSS
87	919.70	125(SF7~SF10)	200	LoRa:CSS
88	919.90	125(SF7~SF10)	200	LoRa:CSS
89	920.10	125(SF7~SF10)	200	LoRa:CSS
90	920.30	125(SF7~SF10)	200	LoRa:CSS
91	920.50	125(SF7~SF10)	200	LoRa:CSS
92	920.70	125(SF7~SF10)	200	LoRa:CSS
93	920.90	125(SF7~SF10)	200	LoRa:CSS
94	921.10	125(SF7~SF10)	200	LoRa:CSS
95	921.30	125(SF7~SF10)	200	LoRa:CSS
96	921.50	125(SF7~SF10)	200	LoRa:CSS
97	921.70	125(SF7~SF10)	200	LoRa:CSS
98	921.90	125(SF7~SF10)	200	LoRa:CSS
99	922.10	125(SF7~SF10)	200	LoRa:CSS
100	922.30	125(SF7~SF10)	200	LoRa:CSS
101	922.50	125(SF7~SF10)	200	LoRa:CSS
102	922.70	125(SF7~SF10)	200	LoRa:CSS
103	922.90	125(SF7~SF10)	200	LoRa:CSS
104	923.10	125(SF7~SF10)	200	LoRa:CSS
105	923.30	125(SF7~SF10)	200	LoRa:CSS
106	923.50	125(SF7~SF10)	200	LoRa:CSS
107	923.70	125(SF7~SF10)	200	LoRa:CSS
108	923.90	125(SF7~SF10)	200	LoRa:CSS
109	924.10	125(SF7~SF10)	200	LoRa:CSS
110	924.30	125(SF7~SF10)	200	LoRa:CSS
111	924.50	125(SF7~SF10)	200	LoRa:CSS
112	924.70	125(SF7~SF10)	200	LoRa:CSS
113	924.90	125(SF7~SF10)	200	LoRa:CSS
114	925.10	125(SF7~SF10)	200	LoRa:CSS
115	925.30	125(SF7~SF10)	200	LoRa:CSS
116	925.50	125(SF7~SF10)	200	LoRa:CSS
117	925.70	125(SF7~SF10)	200	LoRa:CSS
118	925.90	125(SF7~SF10)	200	LoRa:CSS
119	926.10	125(SF7~SF10)	200	LoRa:CSS
120	926.30	125(SF7~SF10)	200	LoRa:CSS
121	926.50	125(SF7~SF10)	200	LoRa:CSS

122	926.70	125(SF7~SF10)	200	LoRa:CSS
123	926.90	125(SF7~SF10)	200	LoRa:CSS
124	927.10	125(SF7~SF10)	200	LoRa:CSS
125	927.30	125(SF7~SF10)	200	LoRa:CSS
126	927.50	125(SF7~SF10)	200	LoRa:CSS
127	927.70	125(SF7~SF10)	200	LoRa:CSS

Table 4: RF Channel and Frequency of Lora DTS (903 – 914.2 MHz and 915.8 – 927.0 MHz)

RF Channel	Center Frequency (MHz)	Occupied Bandwidth (kHz)	Channel Separation (kHz)	Modulation
1	903.00	500(SF8)	1600	LoRa:CSS
2	904.60	500(SF8)	1600	LoRa:CSS
3	906.20	500(SF8)	1600	LoRa:CSS
4	907.80	500(SF8)	1600	LoRa:CSS
5	909.40	500(SF8)	1600	LoRa:CSS
6	911.00	500(SF8)	1600	LoRa:CSS
7	912.60	500(SF8)	1600	LoRa:CSS
8	914.20	500(SF8)	1600	LoRa:CSS
9	915.80	500(SF8)	1600	LoRa:CSS
10	917.40	500(SF8)	1600	LoRa:CSS
11	919.00	500(SF8)	1600	LoRa:CSS
12	920.60	500(SF8)	1600	LoRa:CSS
13	922.20	500(SF8)	1600	LoRa:CSS
14	923.80	500(SF8)	1600	LoRa:CSS
15	925.40	500(SF8)	1600	LoRa:CSS
16	927.00	500(SF8)	1600	LoRa:CSS

Table 5: RF Channel and Frequency of Lora DTS (902.5 – 927.1 MHz)

RF Channel	Center Frequency (MHz)	Occupied Bandwidth (kHz)	Channel Separation (kHz)	Modulation
0	902.50	500	600	LoRa:CSS
1	903.10	500	600	LoRa:CSS
2	903.70	500	600	LoRa:CSS
3	904.30	500	600	LoRa:CSS
4	904.90	500	600	LoRa:CSS
5	905.50	500	600	LoRa:CSS
6	906.10	500	600	LoRa:CSS
7	906.70	500	600	LoRa:CSS
8	907.30	500	600	LoRa:CSS
9	907.90	500	600	LoRa:CSS
10	908.50	500	600	LoRa:CSS
11	909.10	500	600	LoRa:CSS
12	909.70	500	600	LoRa:CSS
13	910.30	500	600	LoRa:CSS
14	910.90	500	600	LoRa:CSS
15	911.50	500	600	LoRa:CSS
16	912.10	500	600	LoRa:CSS
17	912.70	500	600	LoRa:CSS
18	913.30	500	600	LoRa:CSS
19	913.90	500	600	LoRa:CSS
20	914.50	500	600	LoRa:CSS
21	915.10	500	600	LoRa:CSS
22	915.70	500	600	LoRa:CSS
23	916.30	500	600	LoRa:CSS
24	916.90	500	600	LoRa:CSS
25	917.50	500	600	LoRa:CSS
26	918.10	500	600	LoRa:CSS
27	918.70	500	600	LoRa:CSS
28	919.30	500	600	LoRa:CSS
29	919.90	500	600	LoRa:CSS
30	920.50	500	600	LoRa:CSS
31	921.10	500	600	LoRa:CSS

32	921.70	500	600	LoRa:CSS
33	922.30	500	600	LoRa:CSS
34	922.90	500	600	LoRa:CSS
35	923.50	500	600	LoRa:CSS
36	924.10	500	600	LoRa:CSS
37	924.70	500	600	LoRa:CSS
38	925.30	500	600	LoRa:CSS
39	925.90	500	600	LoRa:CSS
40	926.50	500	600	LoRa:CSS
41	927.10	500	600	LoRa:CSS

Table 6: 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 7: 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)

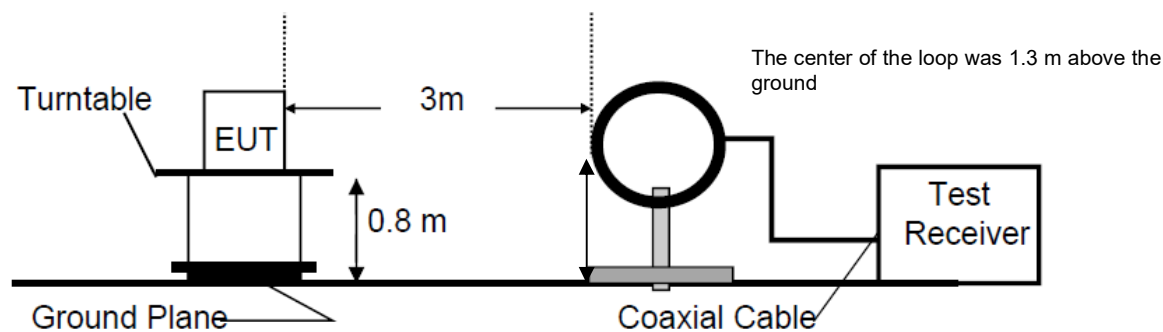


Diagram of Measurement Configuration for Radiation Test (Below 1GHz)

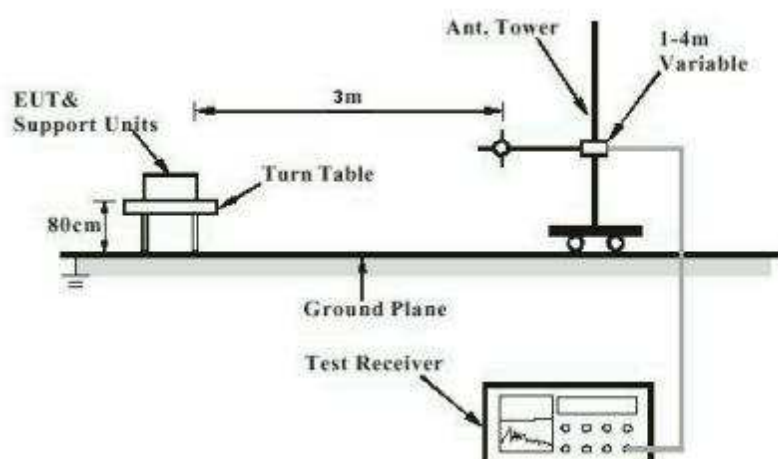


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

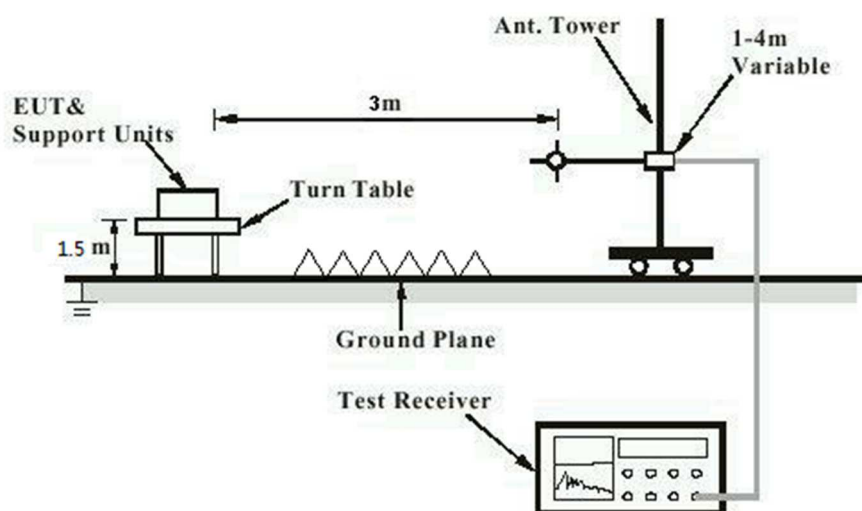


Diagram of Measurement Configuration for Mains Conduction Measurement

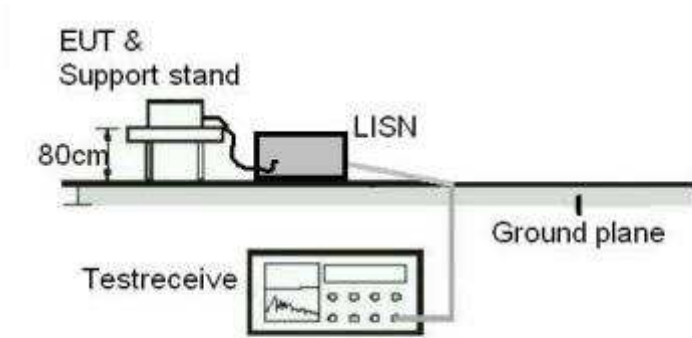
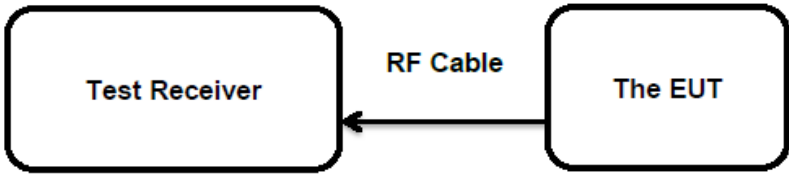


Diagram of Measurement Configuration for Conducted Transmitter Measurement



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 is 2.3dBi, 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 Not more than 1Watt(30dBm) for DTS in the band 902-928MHz
Limits	: 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	: 2024-04-11 - 2024-05-17
Input voltage	: DC 5V Via USB port
Operation mode	: A, B
Test channel	: Low / Middle / High
Ambient temperature	: 23 °C
Relative humidity	: 55 %
Atmospheric pressure	: 101 kPa

Antenna gain 2.3dBi

Table 8: Test Result of Maximum Conducted Output Power, Configuration 1:

Test Mode	Test Channel (MHz)	Maximum Conducted Power		Limit (W)
		(dBm)	(W)	
Lora DTS	915.8	21.31	0.1352	< 1.0
	920.6	21.26	0.1337	
	927.0	21.03	0.1268	
Lora FHSS SF7	915.1	20.56	0.1138	< 1.0
	921.5	20.38	0.1091	
	927.7	21.25	0.1334	
Lora FHSS SF10	915.1	20.83	0.1211	< 1.0
	921.5	20.43	0.1104	
	927.7	20.12	0.1028	
Max. Measured Value		21.31	0.1352	

Note:

- 1) The cable loss is taken into account in results.
- 2) The maximum Antenna gain(G) : 2.3 dBi
e.i.r.p.=21.31dBm + 2.3dBi = 23.61dBm = 229.61mW, which is far below the 4 W

Table 9: Test Result of Maximum Conducted Output Power, Configuration 2:

Test Mode	Test Channel (MHz)	Maximum Conducted Average Power		Limit (W)
		(dBm)	(W)	
Lora DTS/SF7	902.5	20.77	0.1194	< 1.0
	914.5	21.36	0.1368	
	927.1	21.21	0.1321	
Lora DTS/SF12	902.5	21.32	0.1355	
	914.5	21.35	0.1365	
	927.1	21.33	0.1358	
Max. Measured Value		21.36	0.1368	

Note:

- 3) The cable loss is taken into account in results.
- 4) The maximum Antenna gain(G) : 2.3 dBi
 e.i.r.p.=21.36dBm + 2.3dBi = 23.66dBm = 232.27mW, 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 : 2024-04-11 - 2024-05-17
 Input voltage : DC 5V Via USB port
 Operation mode : B
 Test channel : Low / Middle / High
 Ambient temperature : 23 °C
 Relative humidity : 55 %
 Atmospheric pressure : 101 kPa

For the measurement records, refer to the appendix B.

Table 10: Test Result of Maximum Peak Power Spectral Density, Lora DTS, Configuration 1

Antenna Gain	Test Mode	Test Channel (MHz)	Measured Peak Power Spectral Density (dBm/3kHz)
2.3 dBi	Lora DTS	915.8	0.96
		920.6	0.61
		927.0	1.02
Maximum Measured Value			1.02

Table 11: Test Result of Maximum Peak Power Spectral Density, Lora DTS, Configuration 2

Antenna Gain	Test Mode	Test Channel (MHz)	Measured Peak Power Spectral Density (dBm/3kHz)
2.3 dBi	Lora DTS/SF7	902.5	1.20
		914.5	1.23
		927.1	0.83
	Lora DTS/SF12	902.5	1.22
		914.5	1.46
		927.1	2.04
Maximum Measured Value			2.04

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 : 2024-04-11 - 2024-05-17
 Input voltage : DC 5V Via USB port
 Operation mode : B
 Test channel : Low / Middle / High
 Ambient temperature : 23 °C
 Relative humidity : 55 %
 Atmospheric pressure : 101 kPa

For the measurement records, refer to the appendix B.

Table 12: Test Result of 6dB Bandwidth, Lora DTS, Configuration 1

Test Mode	Test Channel (MHz)	6dB Bandwidth (kHz)	Limit (kHz)
Lora DTS	915.8	628.1	>500kHz
	920.6	628.1	
	927.0	628.1	
Minimum Measured Value		628.1	

Table 13: Test Result of 6dB Bandwidth, Lora DTS, Configuration 2

Test Mode	Test Channel (MHz)	6dB Bandwidth (kHz)	Limit (kHz)
Lora DTS	902.5	642.5	>500kHz
	914.5	639.7	
	927.1	512.3	
Minimum Measured Value		642.5	

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 Not more than 500kHz and
Limits	: < 250kHz for at least 50 hopping frequencies >=250kHz for at least 25 hopping frequencies
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 2024-04-11 - 2024-05-17
Input voltage	: DC 5V Via USB port
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: 23 °C
Relative humidity	: 55 %
Atmospheric pressure	: 101 kPa

For the measurement records, refer to the appendix B.

Table 14: Test Result of 20dB Bandwidth, Lora FHSS, Configuration 1

Test Mode	Test Channel (MHz)	20dB Bandwidth (kHz)	Limit (kHz)
Lora FHSS SF7	915.1	144.70	n/a
	921.5	144.70	
	927.7	145.90	
Maximum Measured Value		145.90	

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 : 2024-04-11 - 2024-05-17
 Input voltage : DC 5V Via USB port
 Operation mode : A, B
 Test channel : Low / Middle / High
 Ambient temperature : 23 °C
 Relative humidity : 55 %
 Atmospheric pressure : 101 kPa

For the measurement records, refer to the appendix B.

Table 15: Test Result of 99% Bandwidth, Configuration 1:

Test Mode	Test Channel (MHz)	99% Bandwidth (kHz)	Limit
Lora DTS	915.8	500.62	Within assigned band
	920.6	503.62	
	927.0	500.72	
Lora FHSS SF7	915.1	127.35	
	921.5	127.35	
	927.7	127.35	
Maximum Measured Value		503.62	

Table 16: Test Result of 99% Bandwidth, Configuration 2:

Test Mode	Test Channel (MHz)	99% Bandwidth (kHz)	Limit
Lora DTS	902.5	506.51	Within assigned band
	914.5	503.62	
	927.1	506.51	
Maximum Measured Value		506.51	

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	: 2024-04-11 - 2024-05-17
Input voltage	: DC 5V Via USB port
Operation mode	: A, B
Test channel	: Low / Middle / High
Ambient temperature	: 23 °C
Relative humidity	: 55 %
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	:	2024-04-11 - 2024-05-17
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 : 2024-04-11 - 2024-05-17
- Input voltage : DC 5V Via USB port
- Operation mode : C
- Test channel : Low / Middle / High
- Ambient temperature : 23 °C
- Relative humidity : 55 %
- Atmospheric pressure : 101 kPa

For the measurement records, refer to the appendix B.

Table 17: Test Result of Carrier Frequency Separation, Lora FHSS, Configuration 1

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

Note:
 The limit is maximum 20 dB bandwidth: 144.90 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 : 2024-04-11 - 2024-05-17
 Input voltage : DC 5V Via USB port
 Operation mode : C
 Ambient temperature : 23 °C
 Relative humidity : 55 %
 Atmospheric pressure : 101 kPa

Table 18: Test result of hopping channel number, Lora FHSS, Configuration 1

Test Mode	20dB Bandwidth(kHz)	Hopping frequencies	Limit
Lora FHSS	20dB Bandwidth < 250	63	≥ 50

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	:	2024-04-25
Input voltage	:	Powered by PC Adapter
Operation mode	:	A, B
Earthing	:	Not connected
Ambient temperature	:	22 °C
Relative humidity	:	56 %
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.

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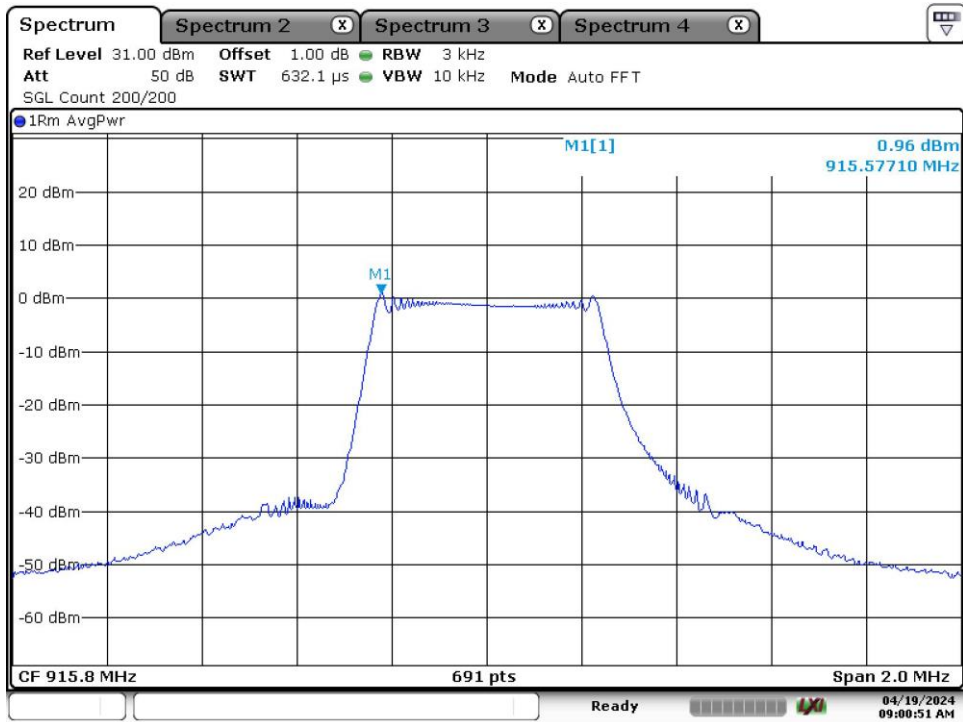
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Appendix B.1: Conducted Power Spectral Density

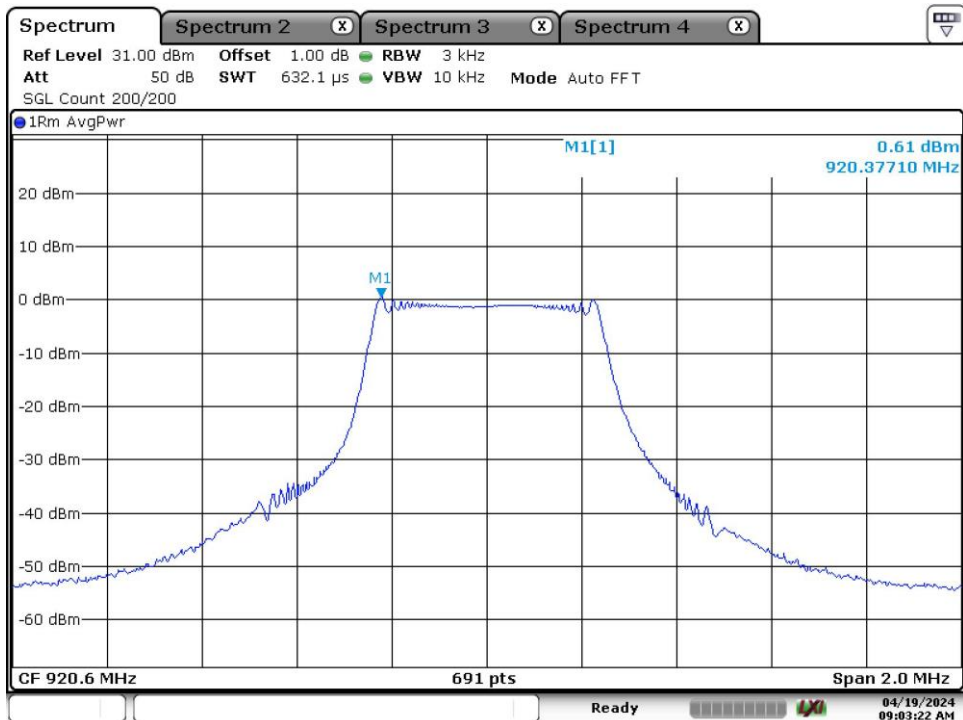
Lora DTS, Lora DTS, Configuration 1

Low Channel



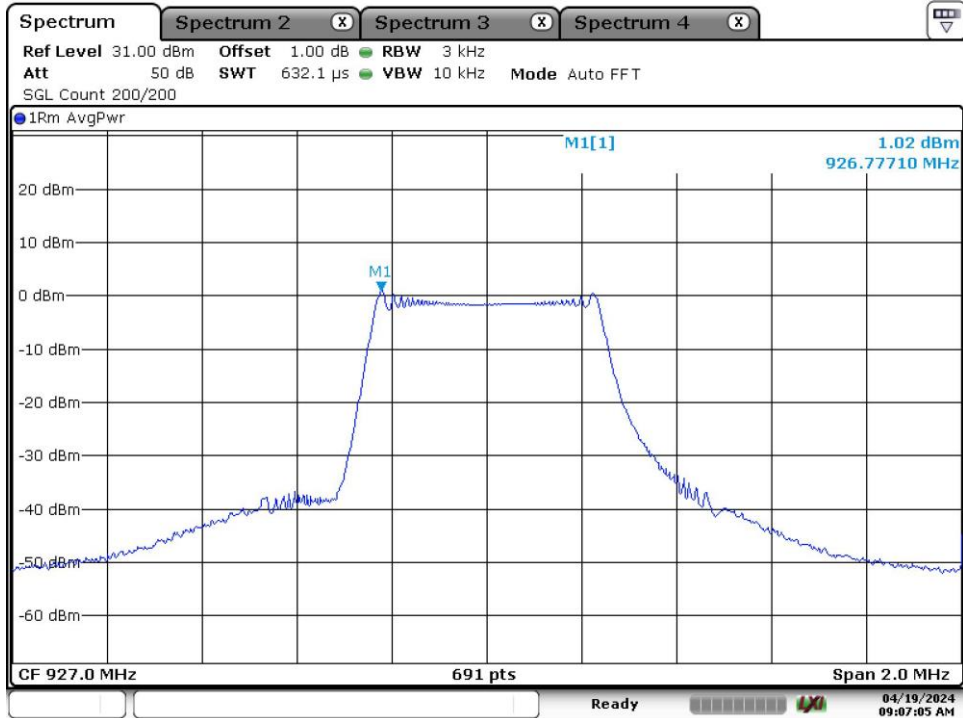
Date: 19.APR.2024 09:00:51

Middle Channel



Date: 19.APR.2024 09:03:22

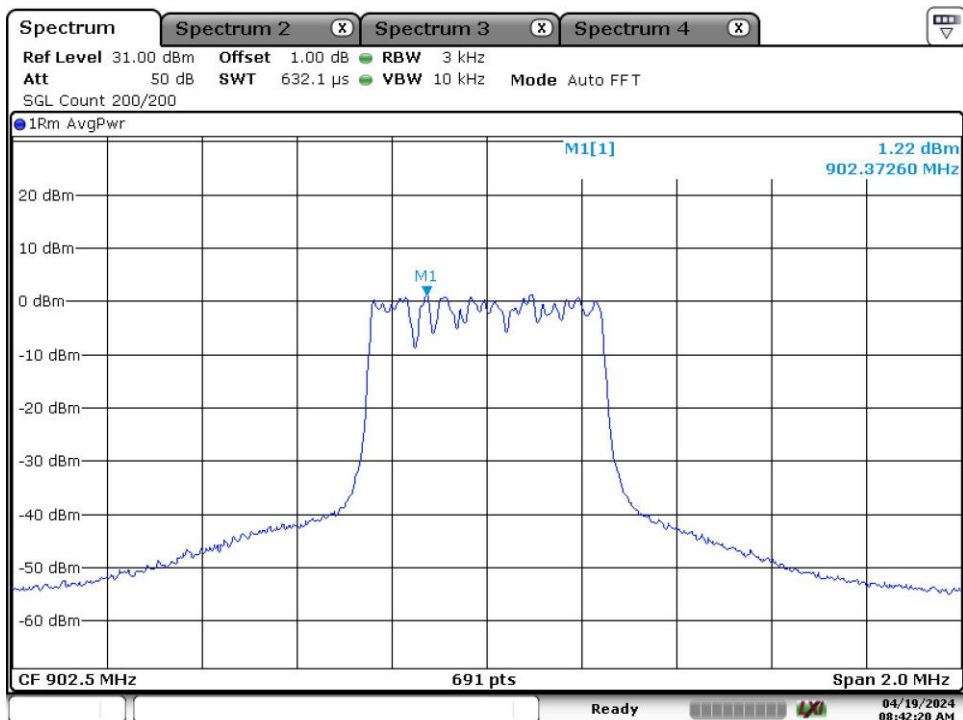
High Channel



Date: 19.APR.2024 09:07:05

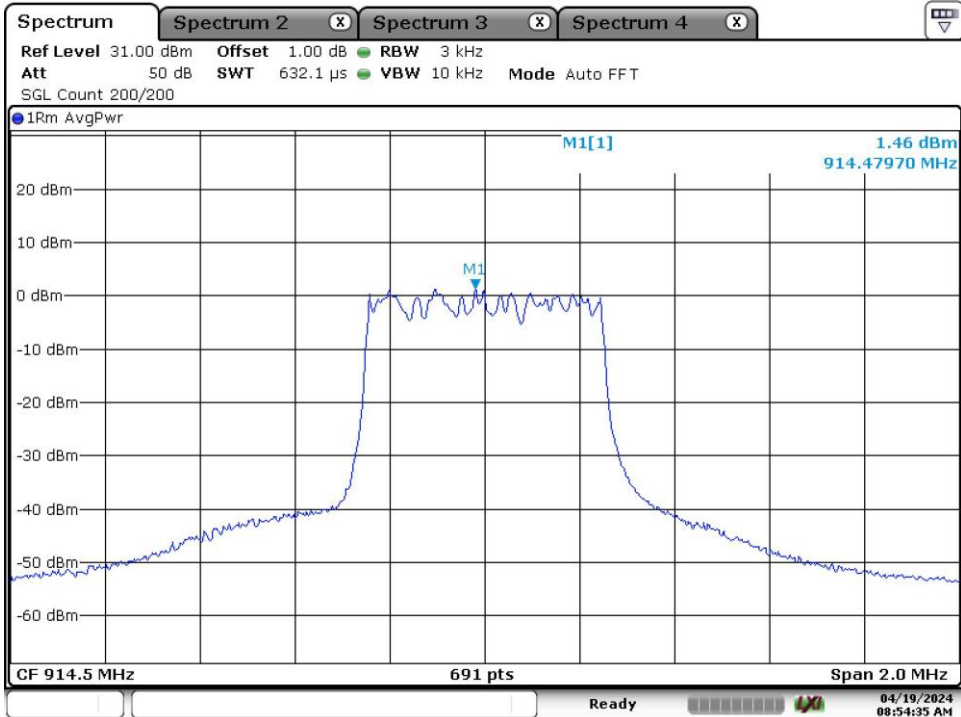
Lora DTS, Lora DTS, Configuration 2

Low Channel



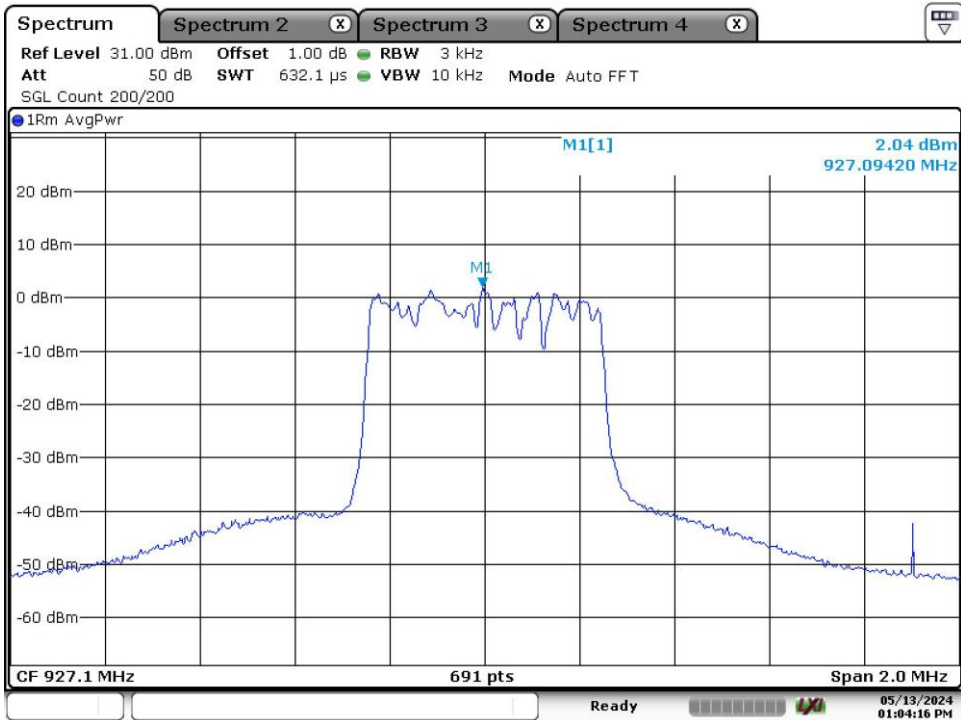
Date: 19.APR.2024 08:42:20

Middle Channel



Date: 19.APR.2024 08:54:35

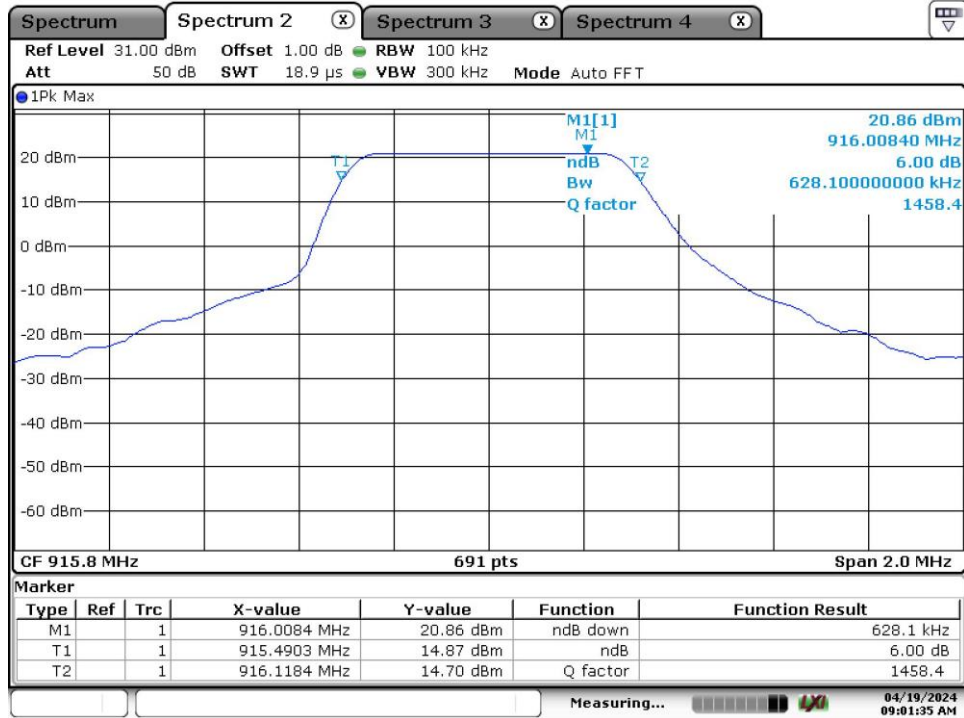
High Channel



Date: 13.MAY.2024 13:04:17

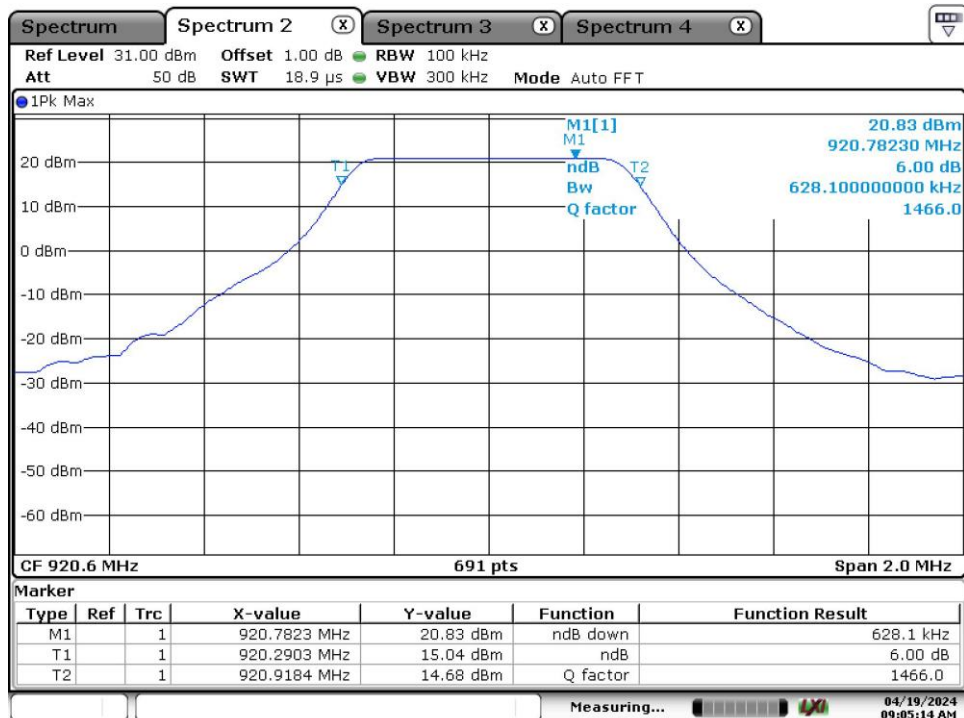
Appendix B.2: 6dB Bandwidth

Lora DTS, Configuration 1 Low Channel



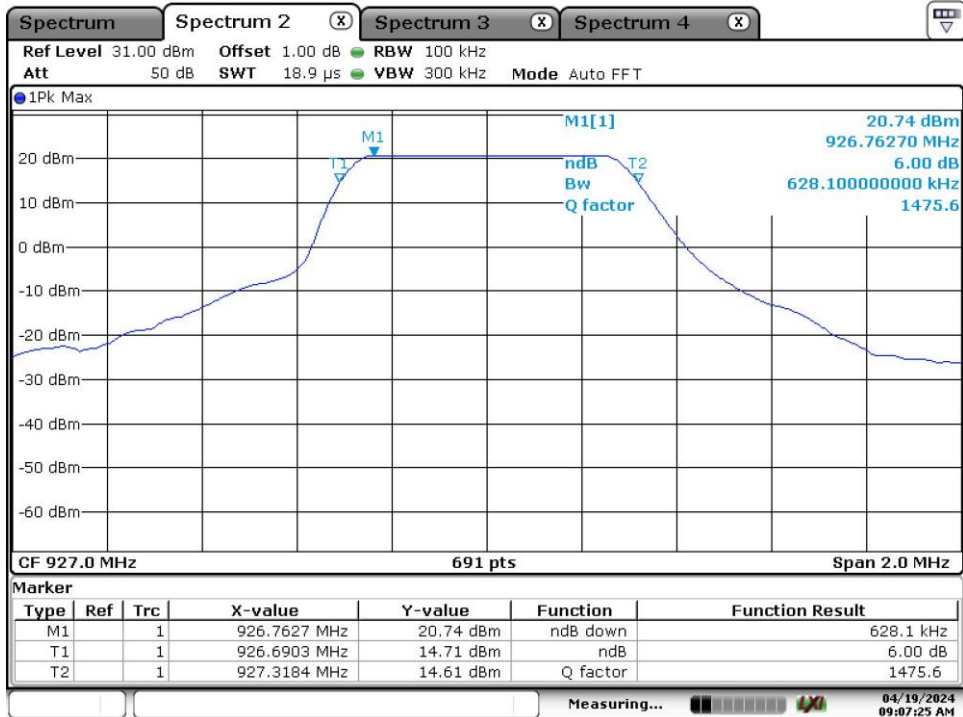
Date: 19.APR.2024 09:01:35

Middle Channel



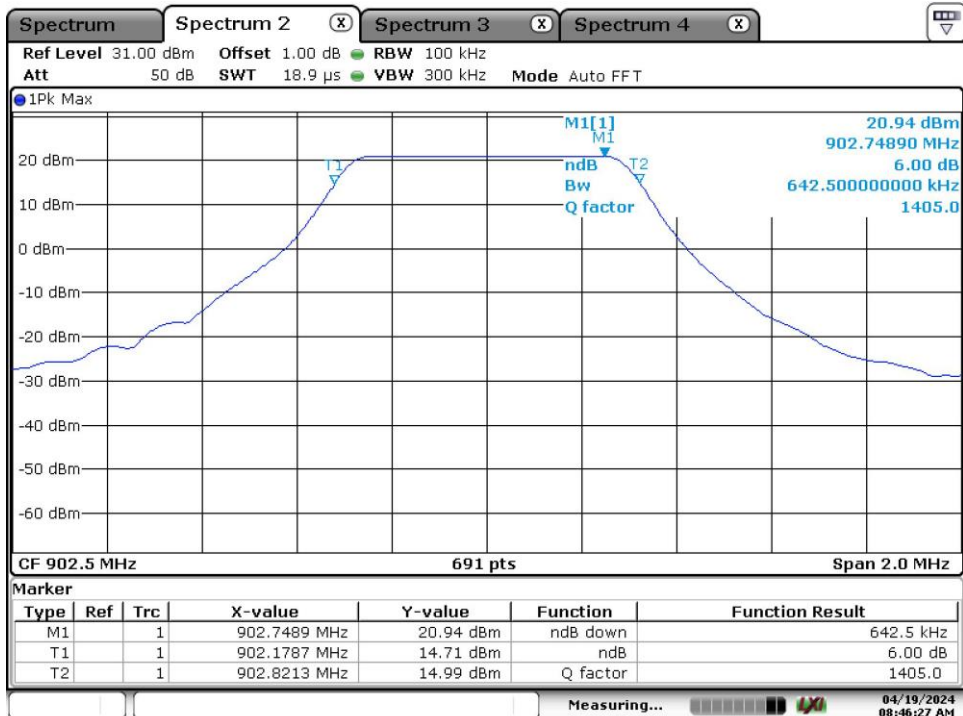
Date: 19.APR.2024 09:05:14

High Channel



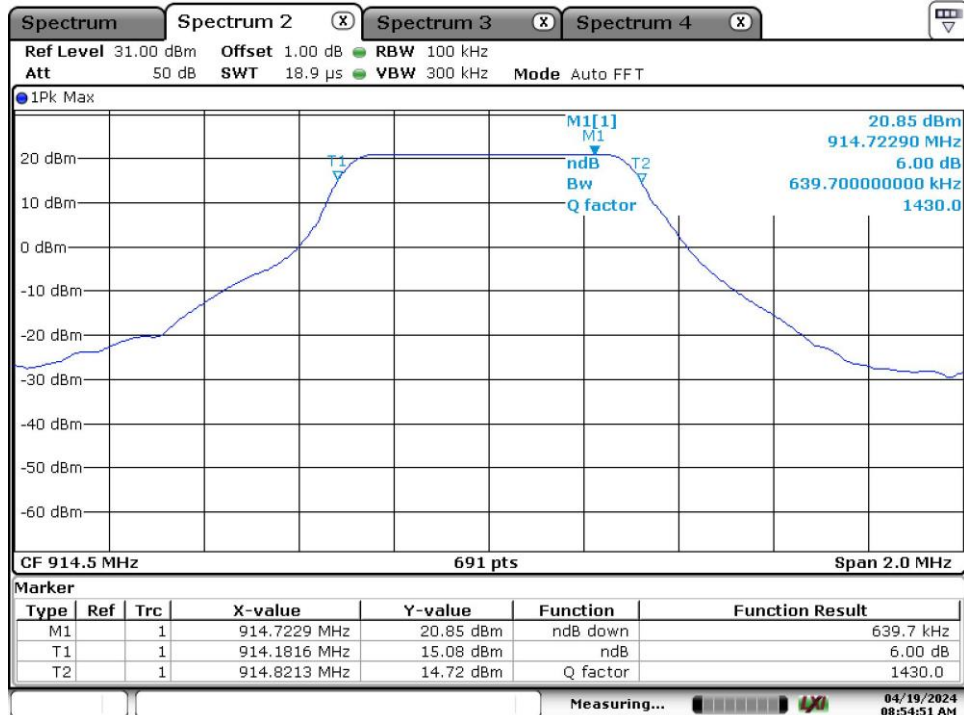
Date: 19.APR.2024 09:07:25

Lora DTS, Configuration 2
 Low Channel



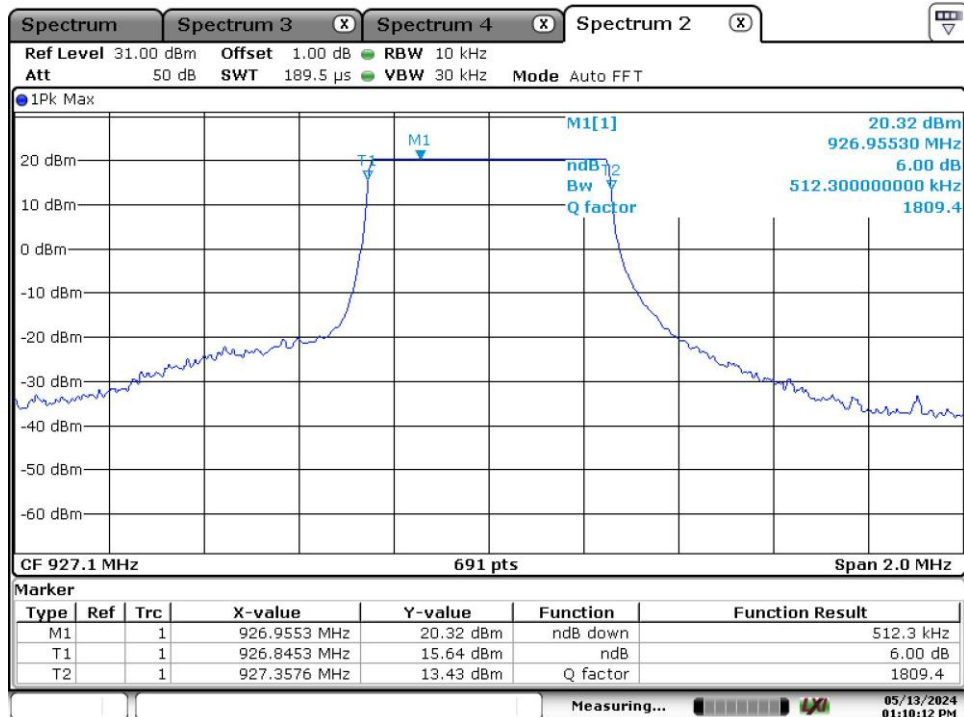
Date: 19.APR.2024 08:46:27

Middle Channel



Date: 19.APR.2024 08:54:51

High Channel

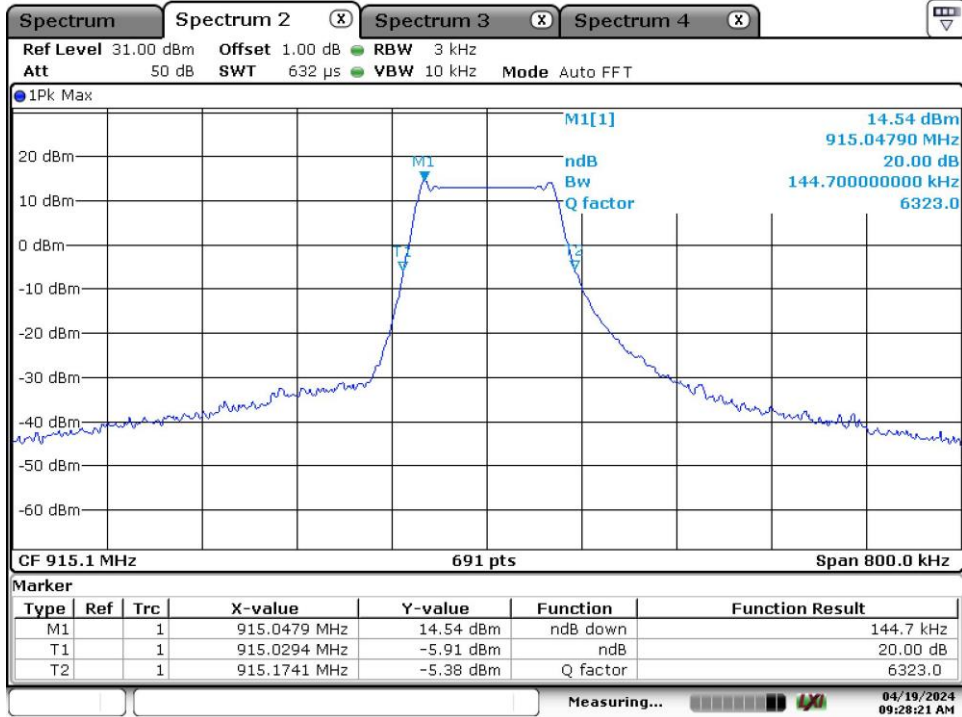


Date: 13.MAY.2024 13:10:12

Appendix B.3: 20dB Bandwidth

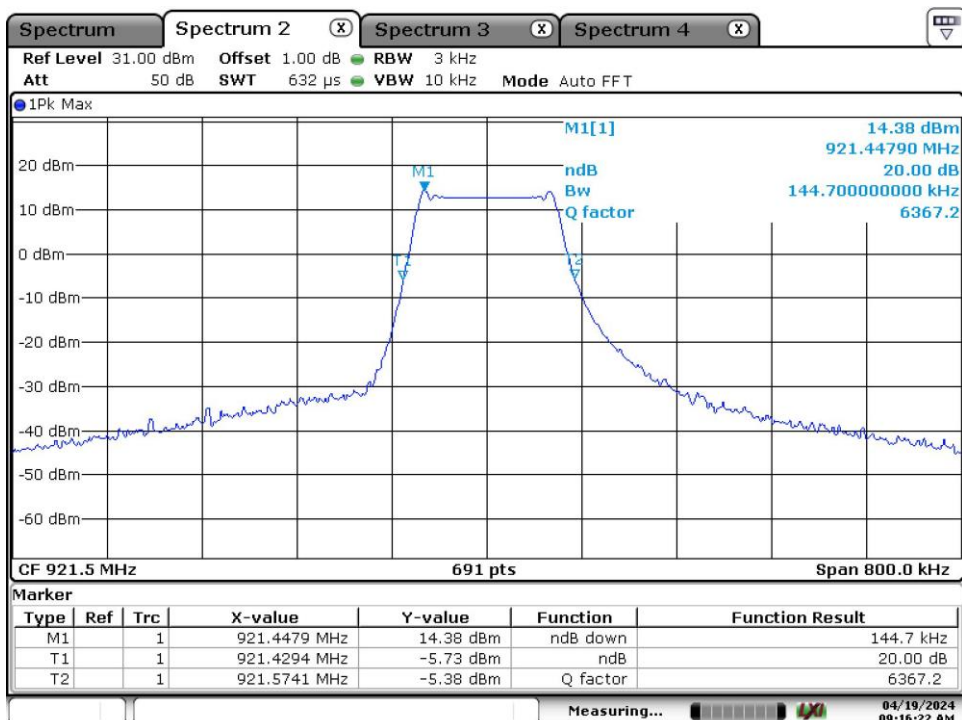
Lora FHSS, Configuration 1

Low Channel



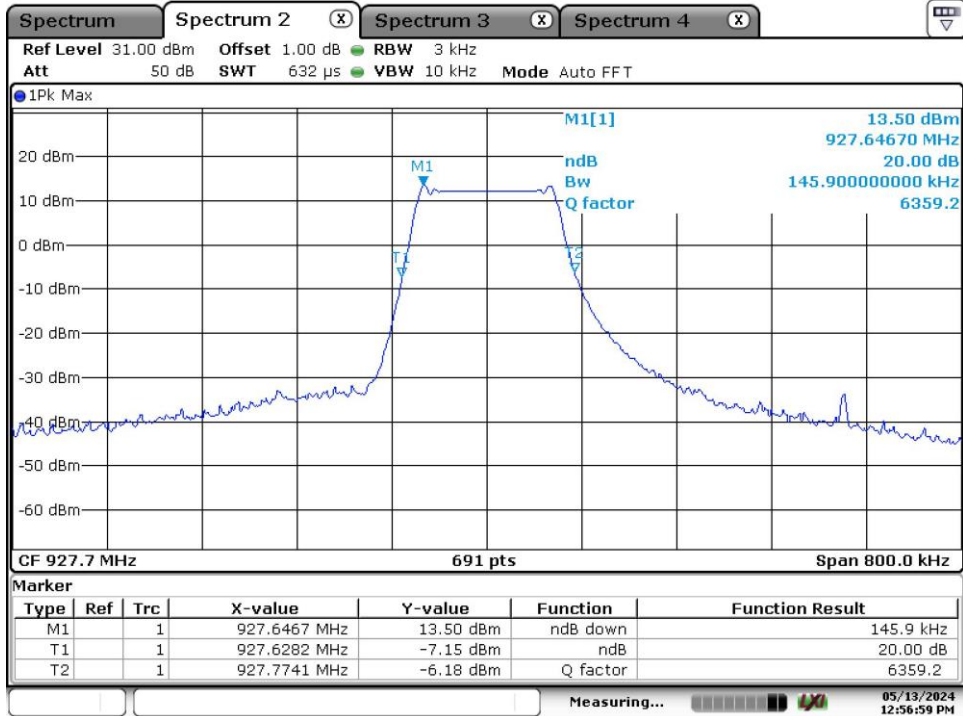
Date: 19.APR.2024 09:28:21

Middle Channel



Date: 19.APR.2024 09:16:22

High Channel

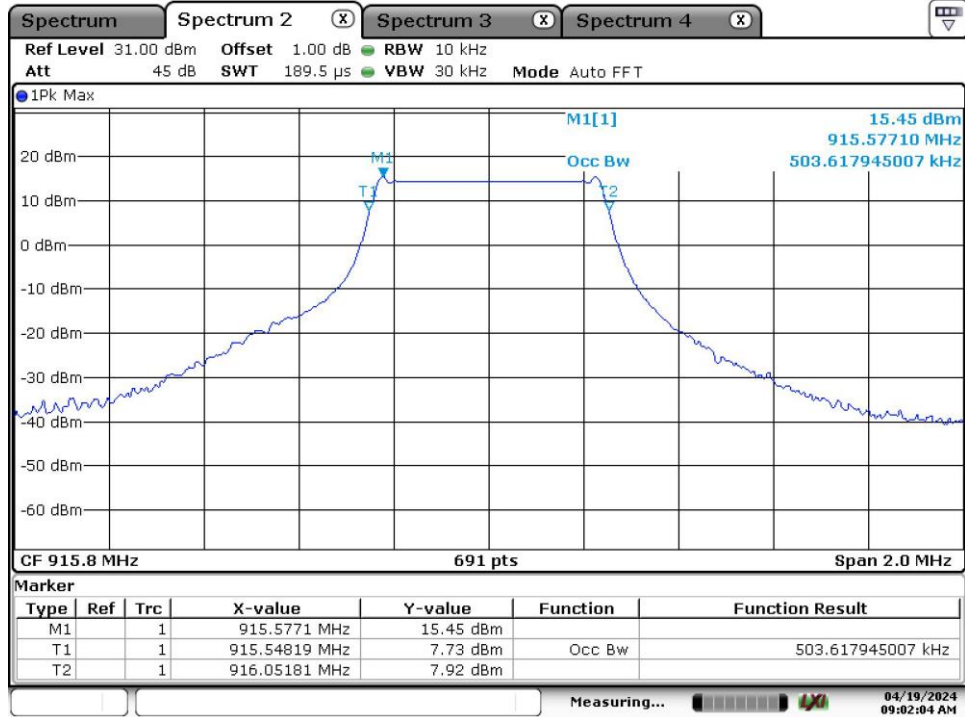


Date: 13.MAY.2024 12:57:00

Appendix B.4: 99% Bandwidth

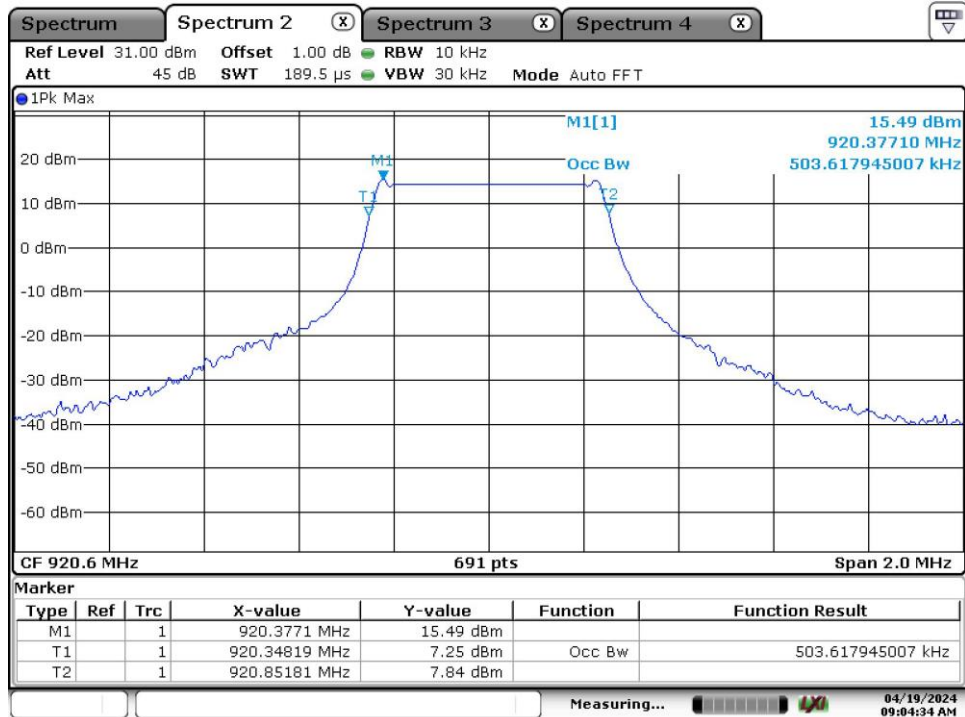
Lora DTS, Configuration 1:

Low Channel



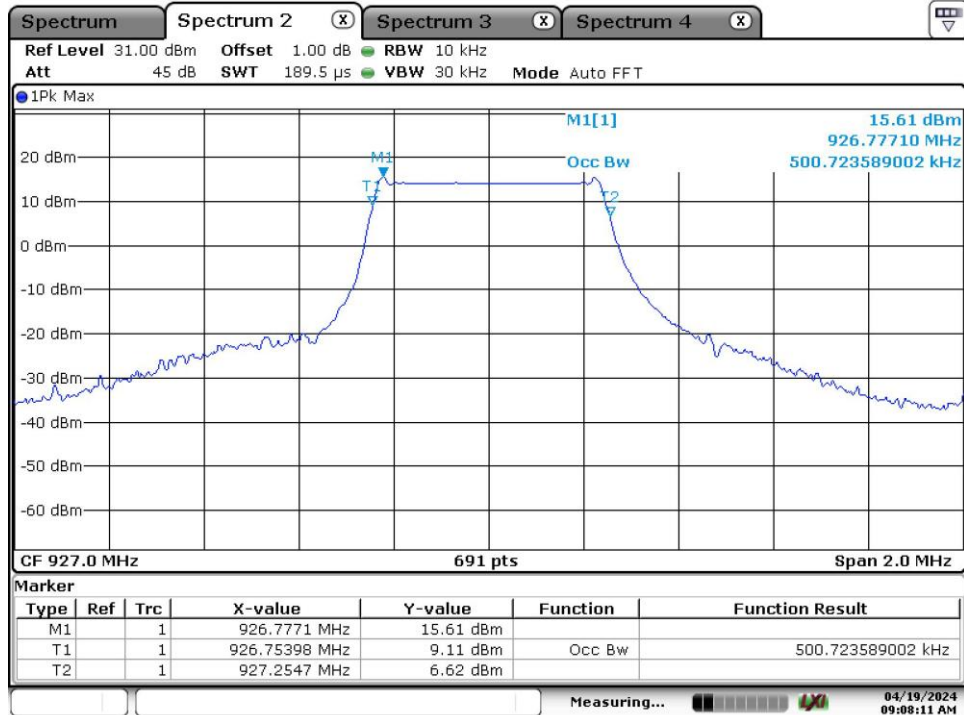
Date: 19.APR.2024 09:02:04

Middle Channel



Date: 19.APR.2024 09:04:34

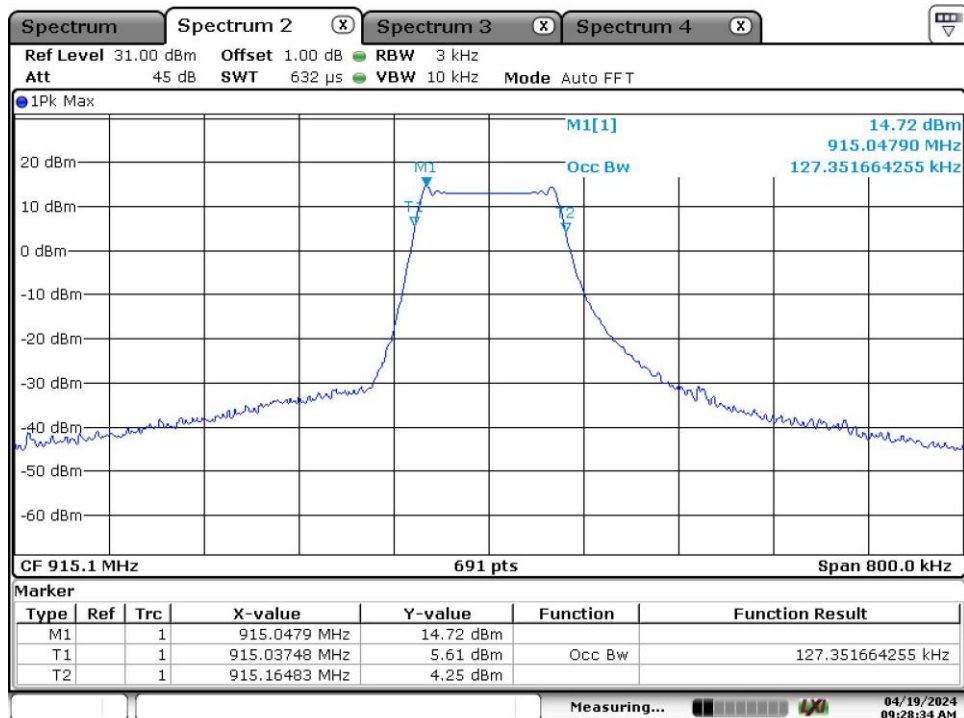
High Channel



Date: 19.APR.2024 09:08:11

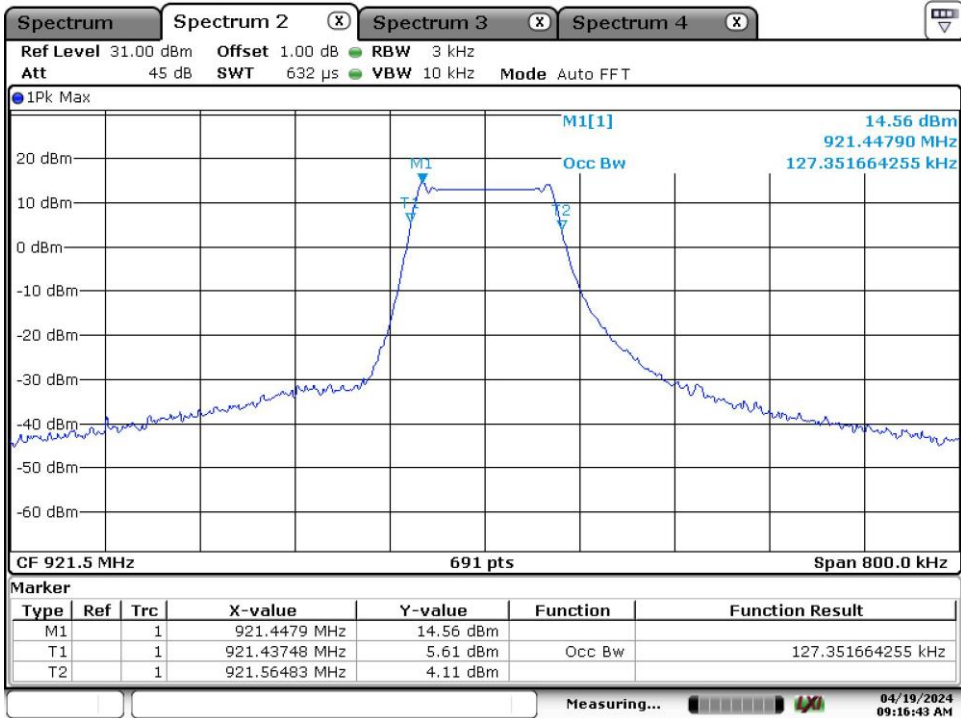
Lora FHSS, Configuration 1:

Low Channel



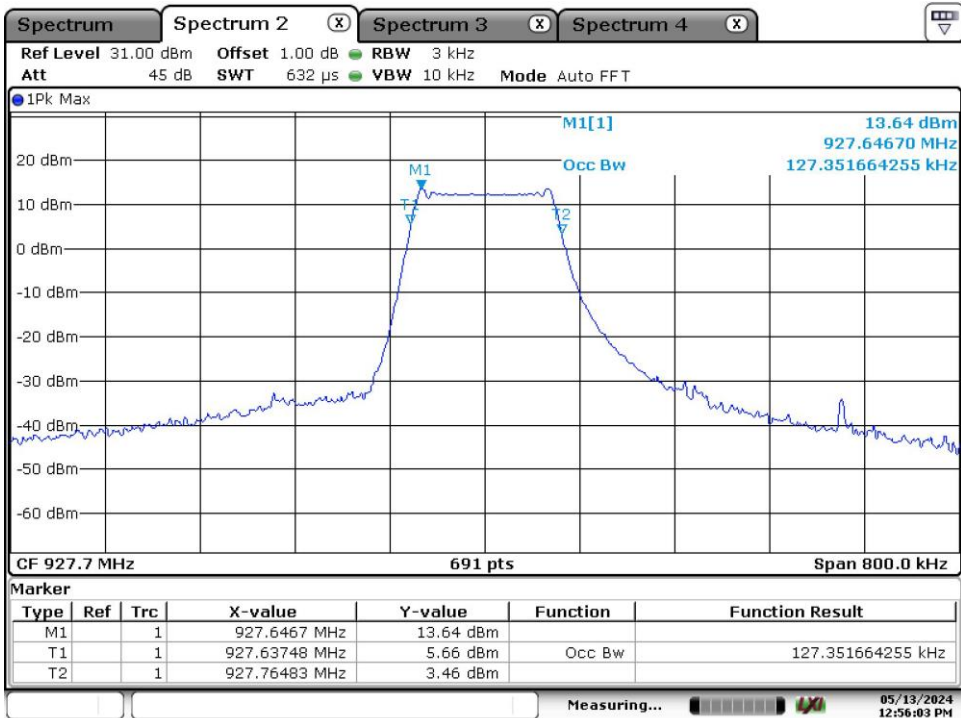
Date: 19.APR.2024 09:28:34

Middle Channel



Date: 19.APR.2024 09:16:43

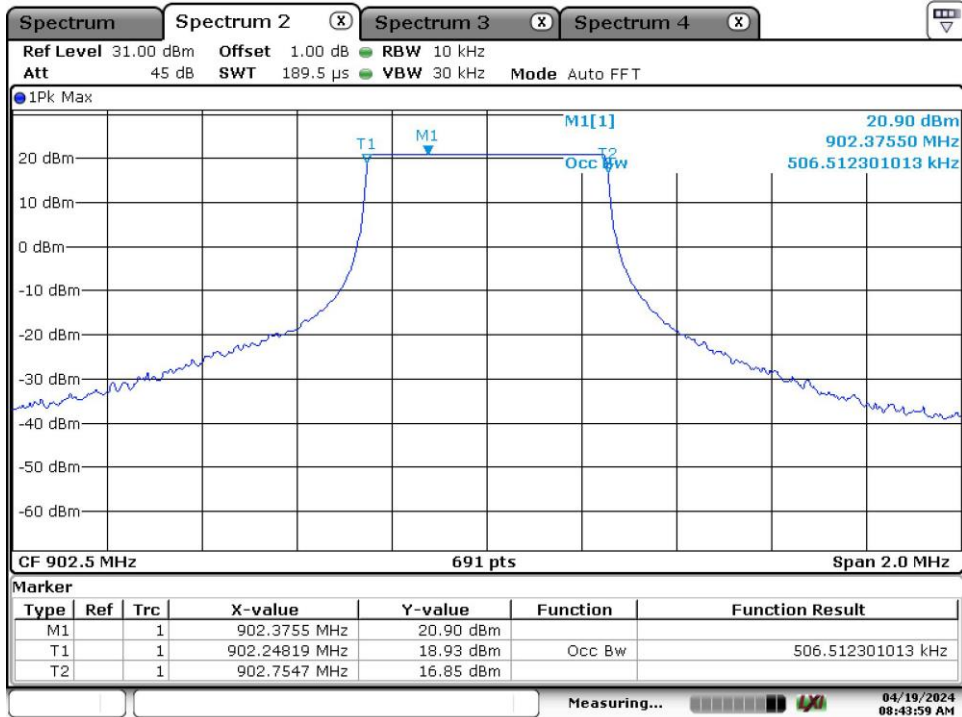
High Channel



Date: 13.MAY.2024 12:56:04

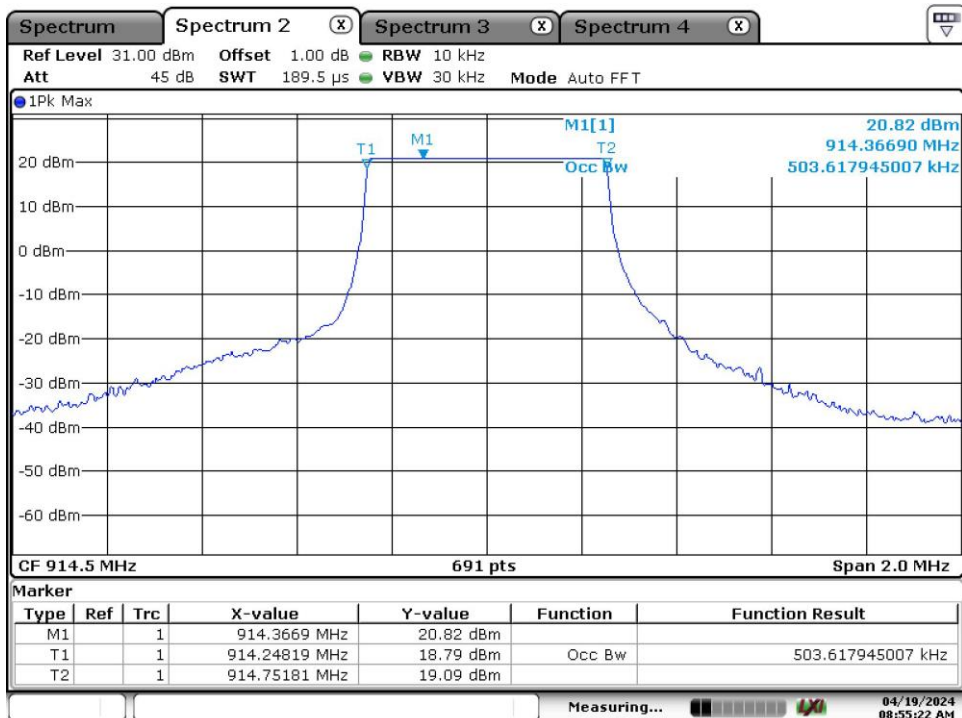
Lora DTS, Configuration 2:

Low Channel



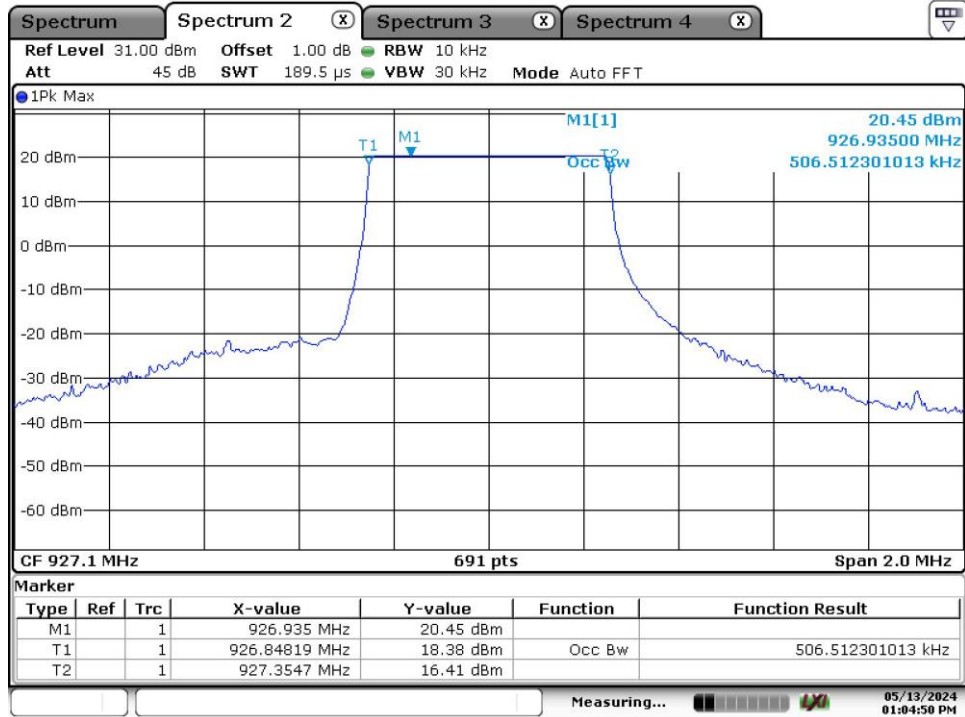
Date: 19.APR.2024 08:43:59

Middle Channel



Date: 19.APR.2024 08:55:21

High Channel



Date: 13.MAY.2024 13:04:50

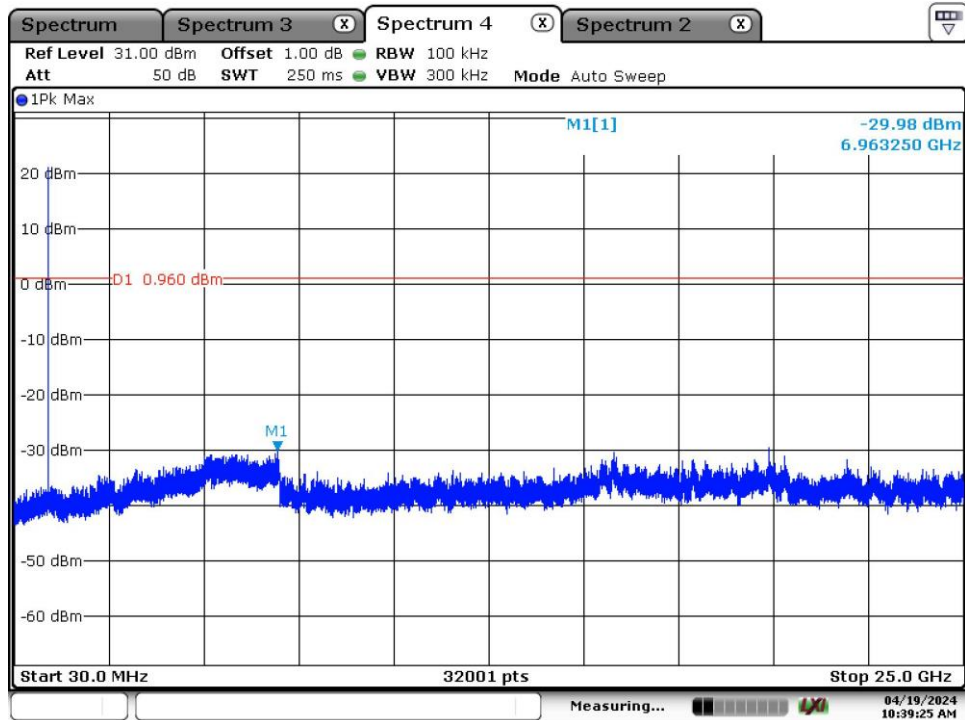
Appendix B.5: Conducted Spurious Emissions Measured in 100 kHz Bandwidth

Lora DTS, Configuration 1:

Low Channel

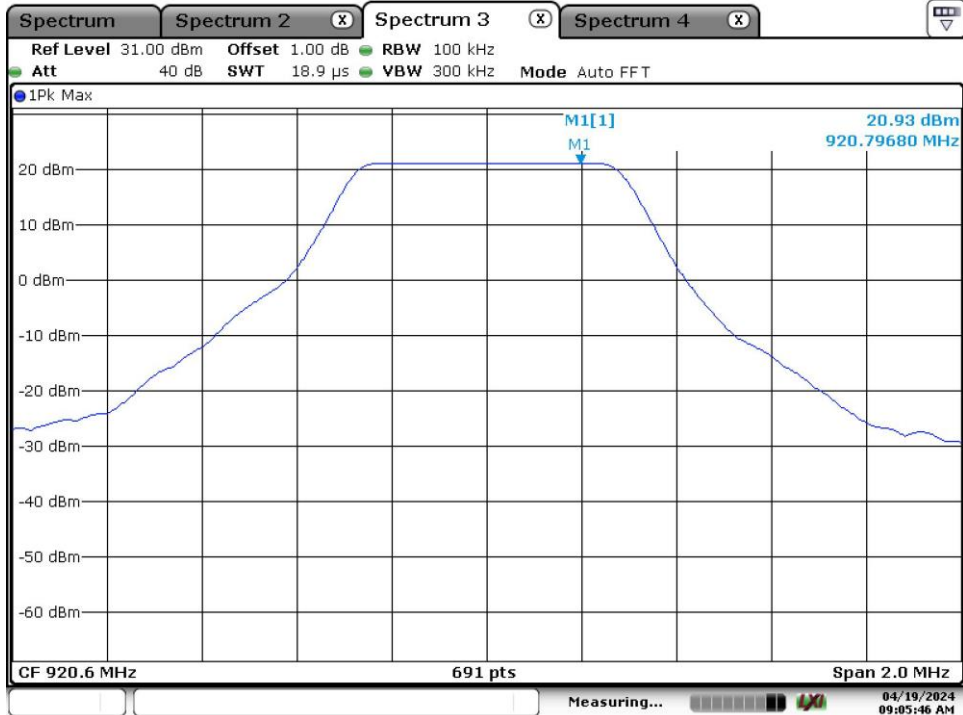


Date: 19.APR.2024 09:02:26

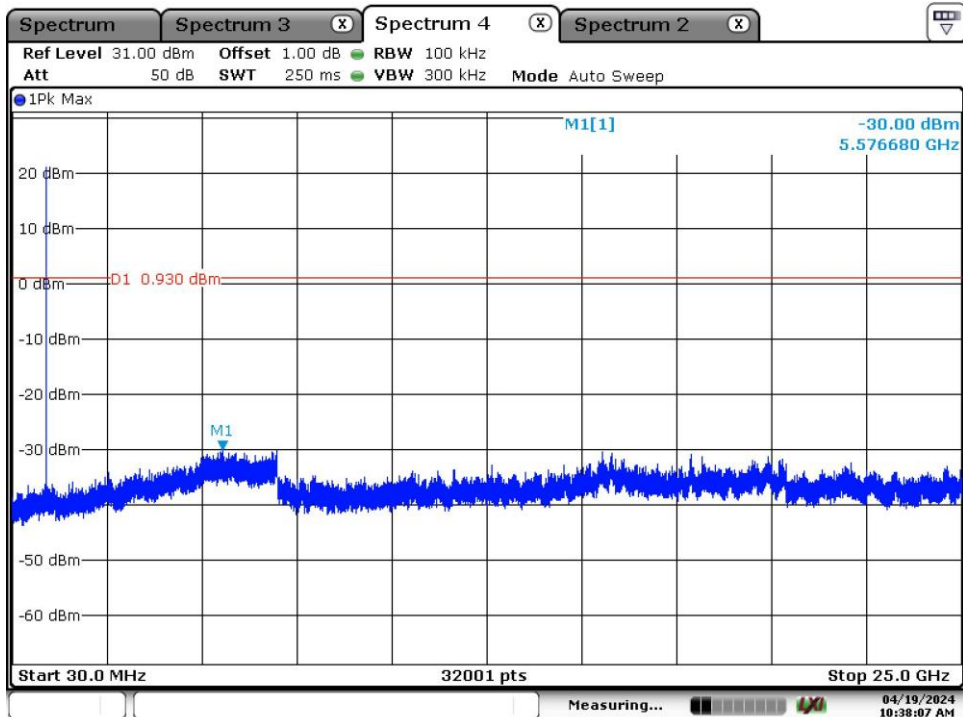


Date: 19.APR.2024 10:39:25

Middle Channel

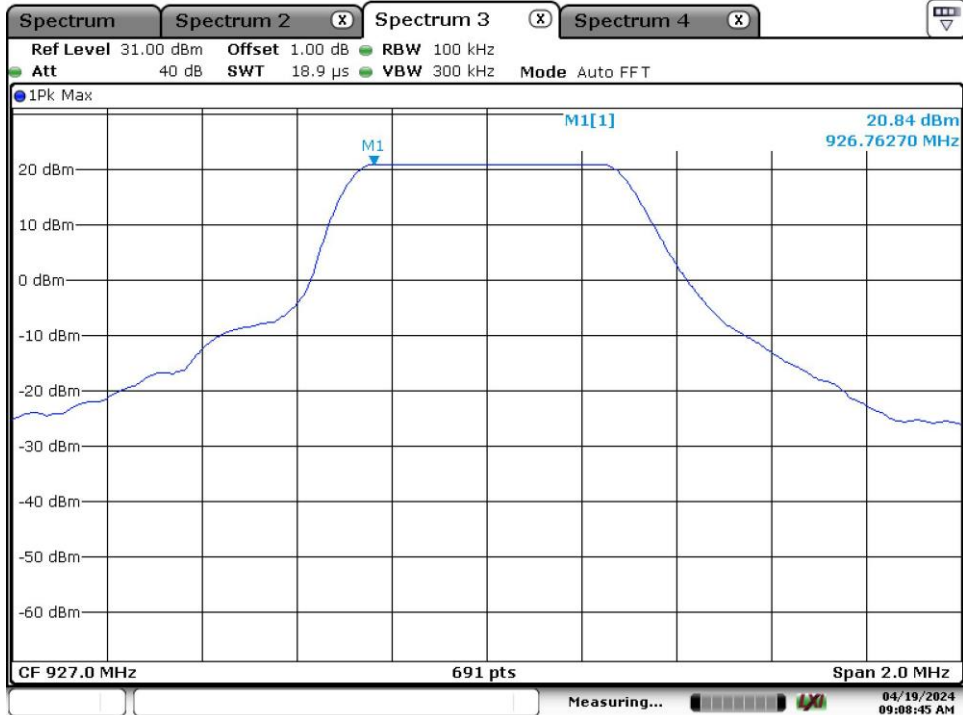


Date: 19.APR.2024 09:05:46

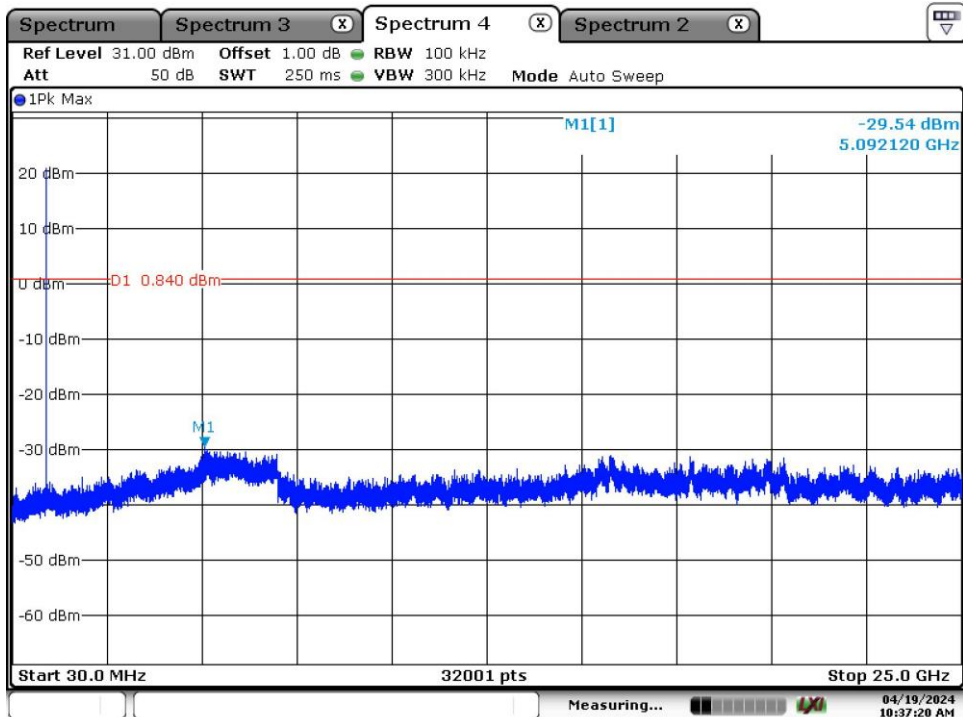


Date: 19.APR.2024 10:38:07

High Channel

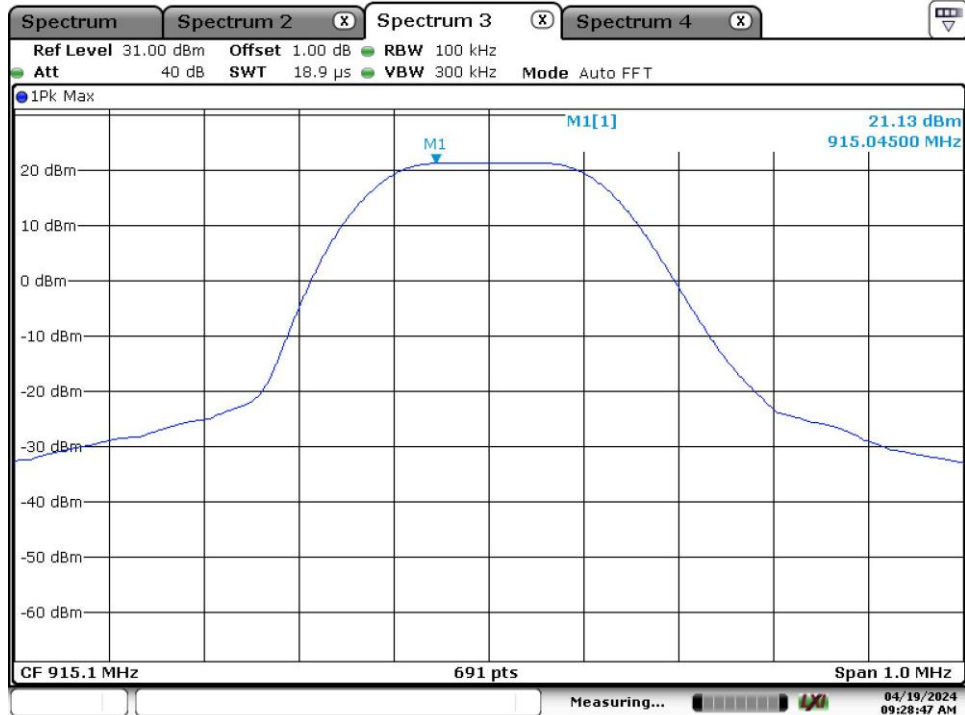


Date: 19.APR.2024 09:08:45

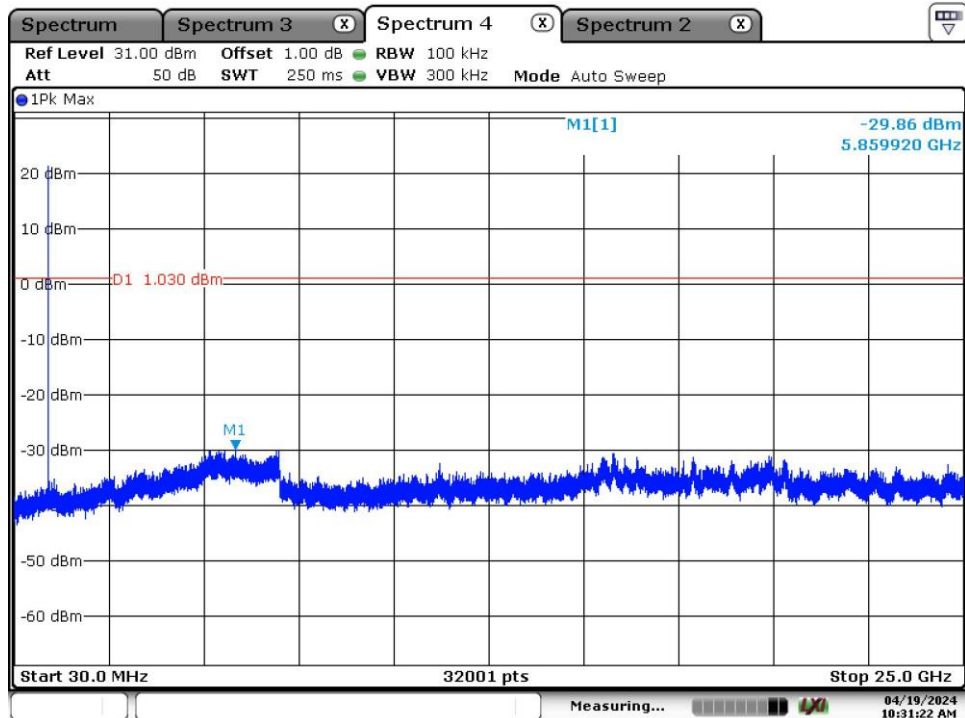


Date: 19.APR.2024 10:37:20

Lora FHSS, Configuration 1:
Low Channel



Date: 19.APR.2024 09:28:47

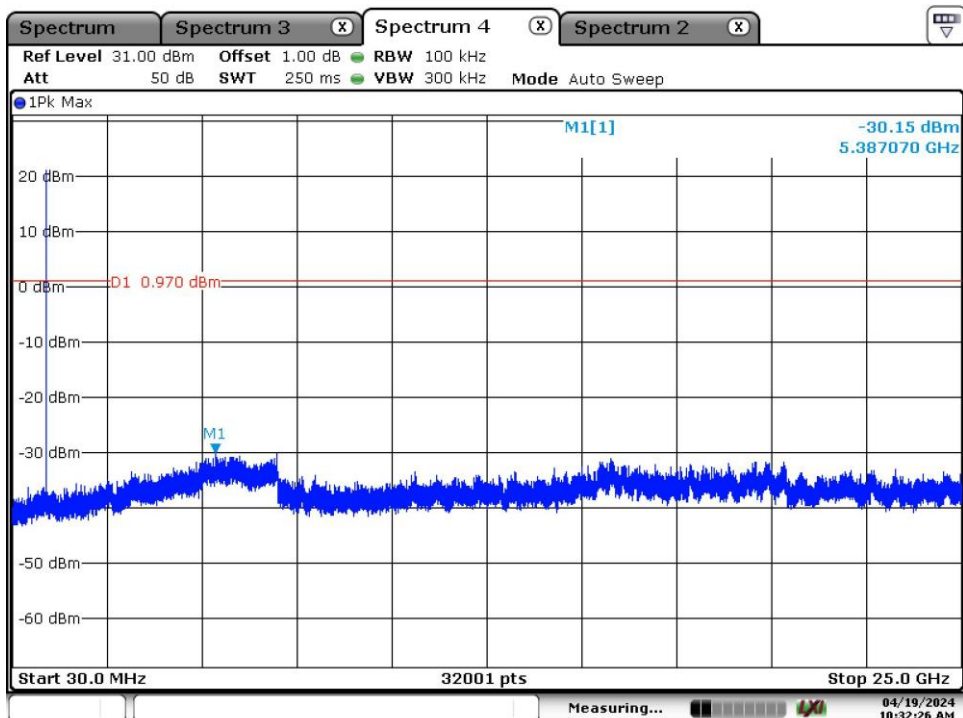


Date: 19.APR.2024 10:31:22

Middle Channel

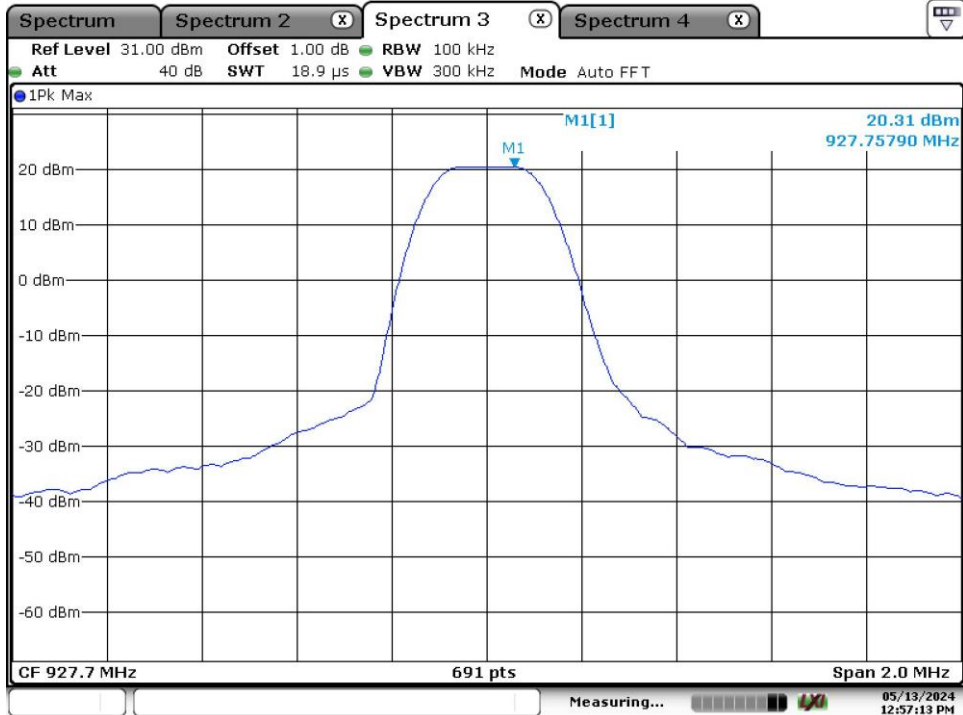


Date: 19.APR.2024 09:17:00

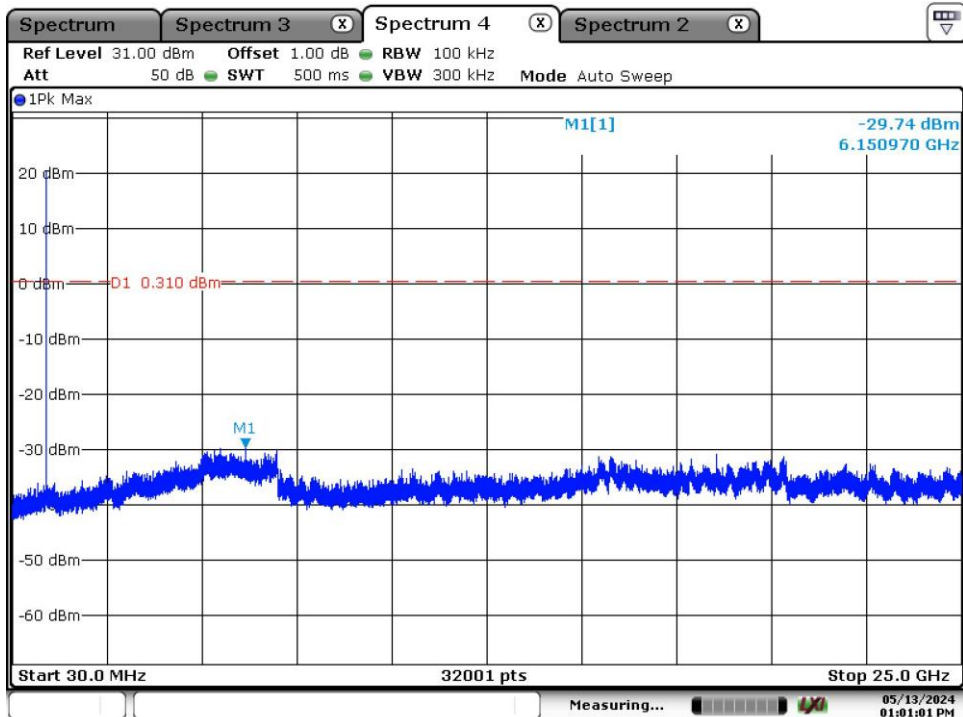


Date: 19.APR.2024 10:32:26

High Channel

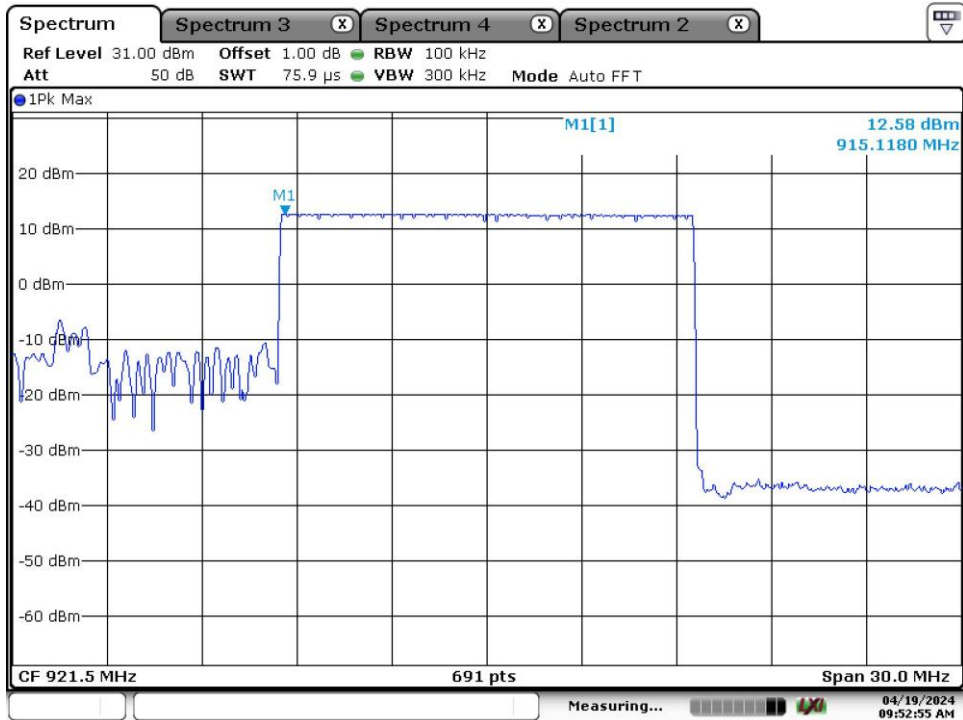


Date: 13.MAY.2024 12:57:14

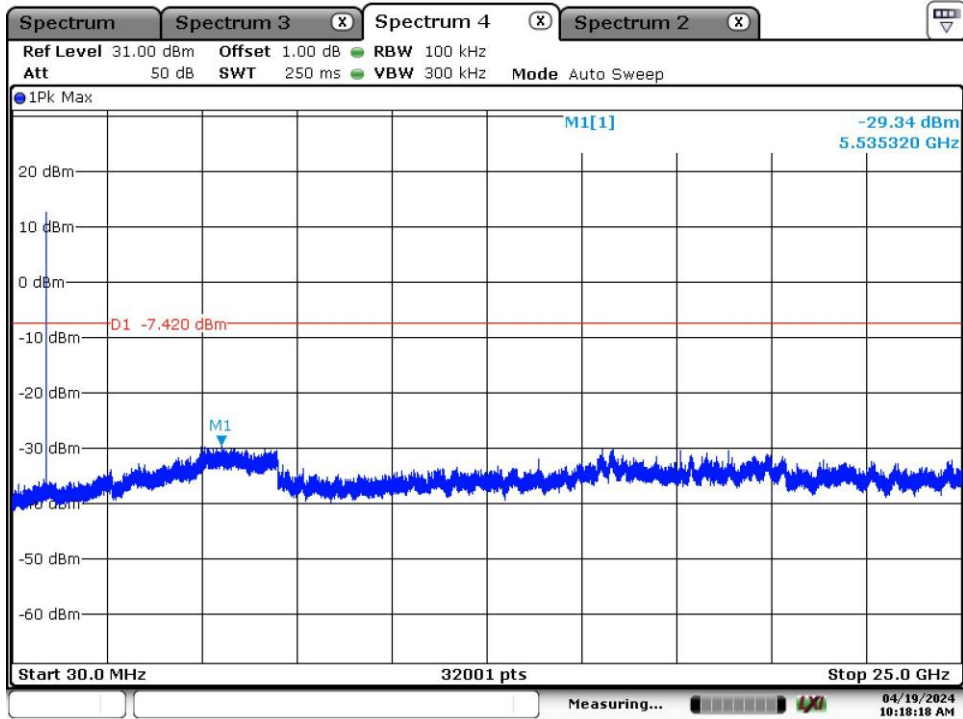


Date: 13.MAY.2024 13:01:02

Lora FHSS, no-hopping, Configuration 1:



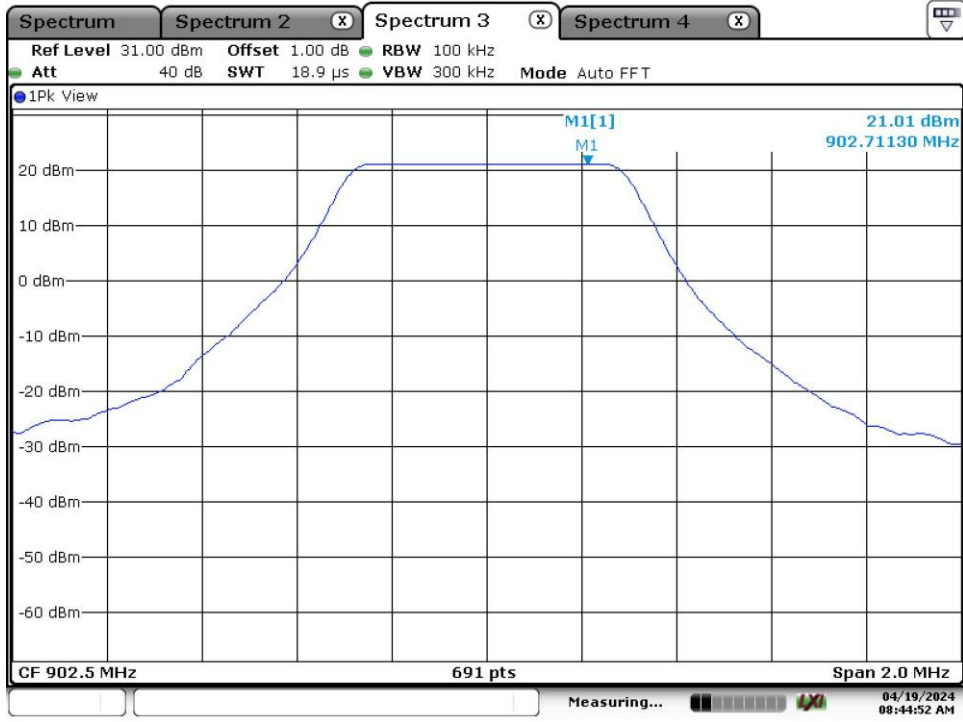
Date: 19.APR.2024 09:52:55



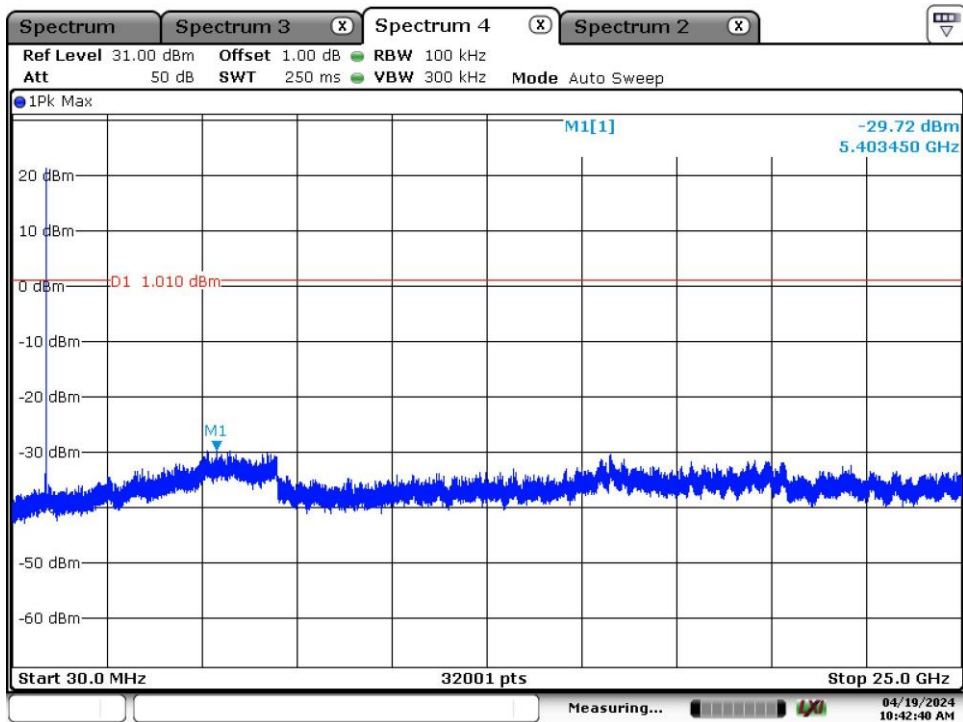
Date: 19.APR.2024 10:18:18

Lora DTS, Configuration 2:

Low Channel



Date: 19.APR.2024 08:44:52

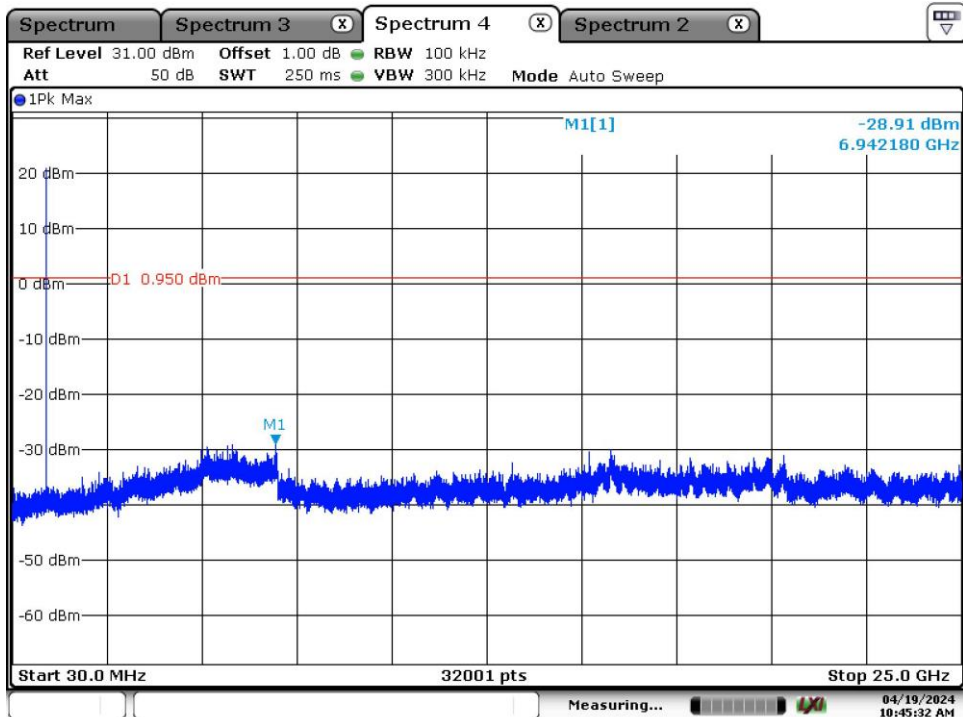


Date: 19.APR.2024 10:42:40

Middle Channel



Date: 19.APR.2024 08:56:03

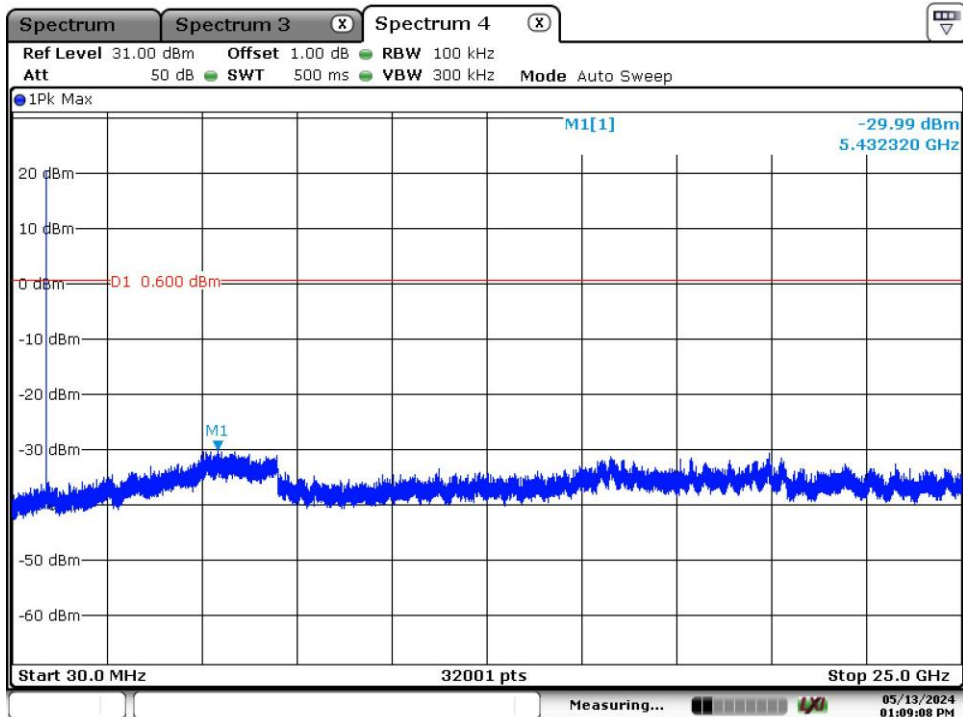


Date: 19.APR.2024 10:45:32

High Channel



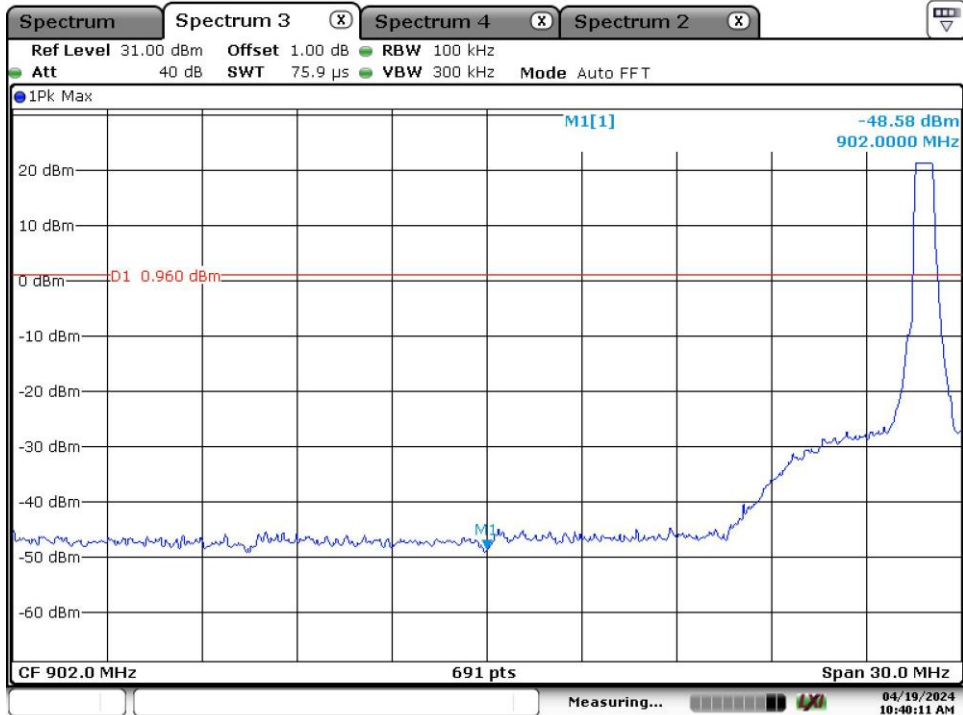
Date: 13.MAY.2024 13:05:39



Date: 13.MAY.2024 13:09:08

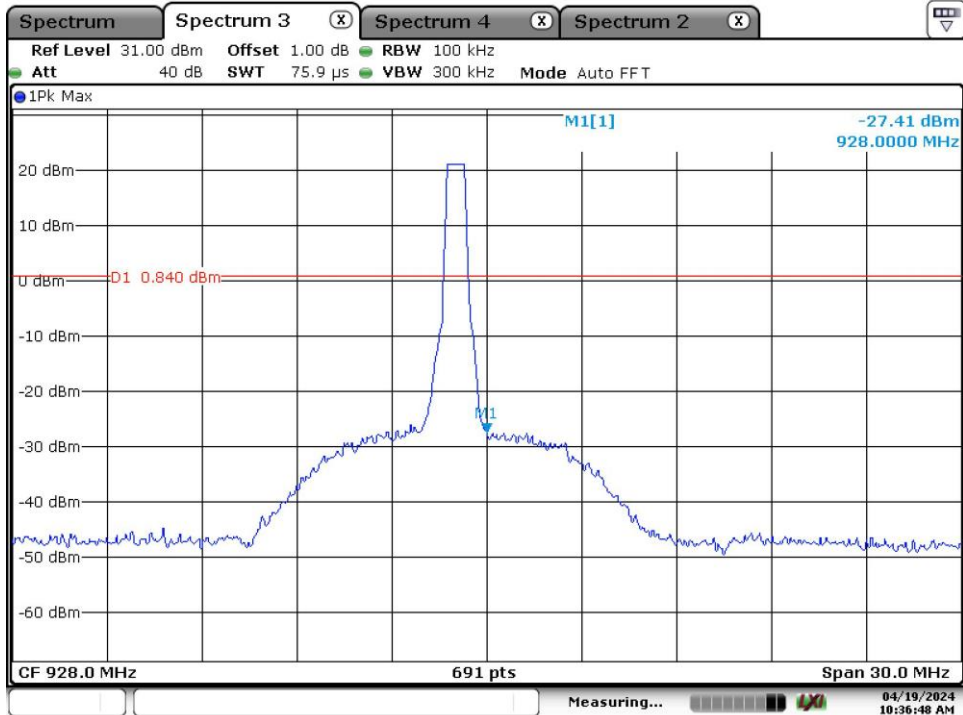
Lora DTS, Band Edge, Configuration 1:

Low Channel



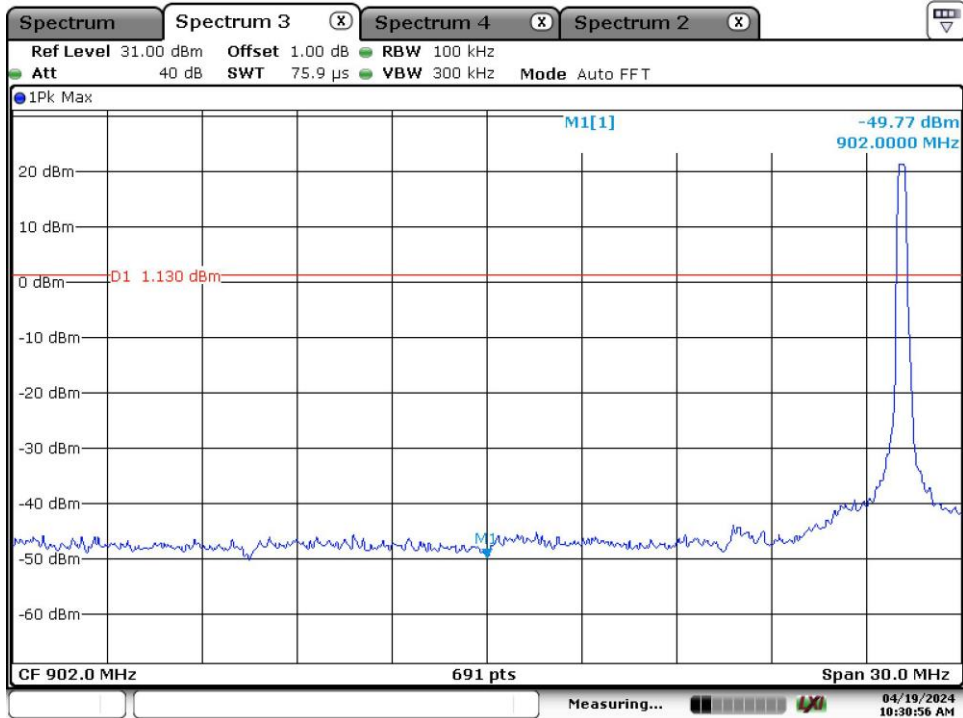
Date: 19.APR.2024 10:40:11

High Channel



Date: 19.APR.2024 10:36:48

Lora FHSS, Band Edge, Configuration 1:
Low Channel



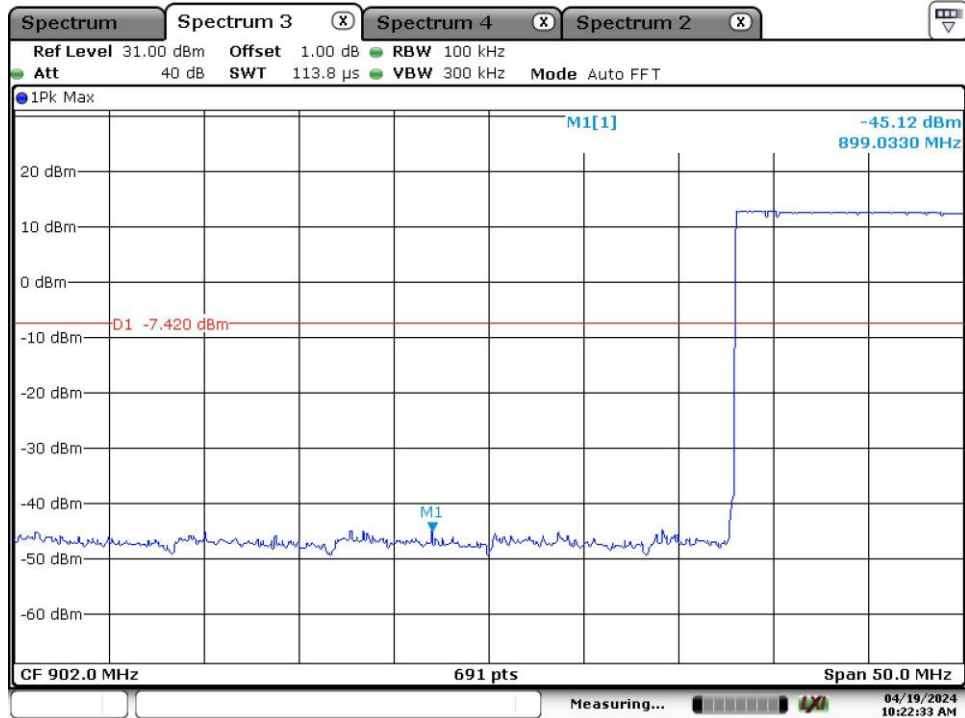
Date: 19.APR.2024 10:30:56

High Channel



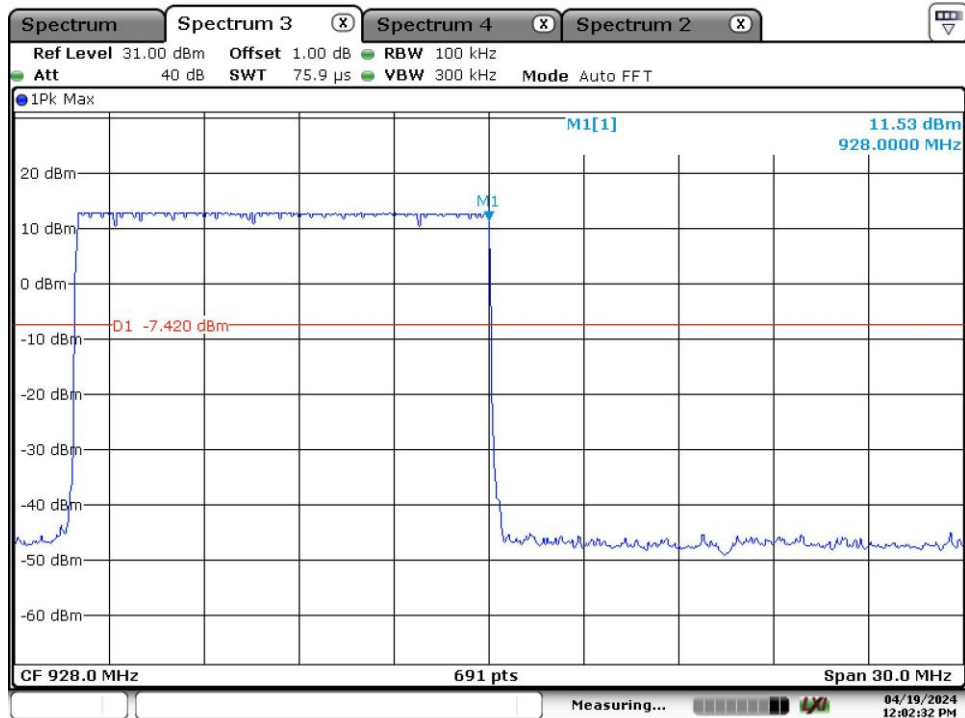
Date: 13.MAY.2024 13:00:22

Lora FHSS, no-hopping, Band Edge, Configuration 1:
Below 920MHz



Date: 19.APR.2024 10:22:33

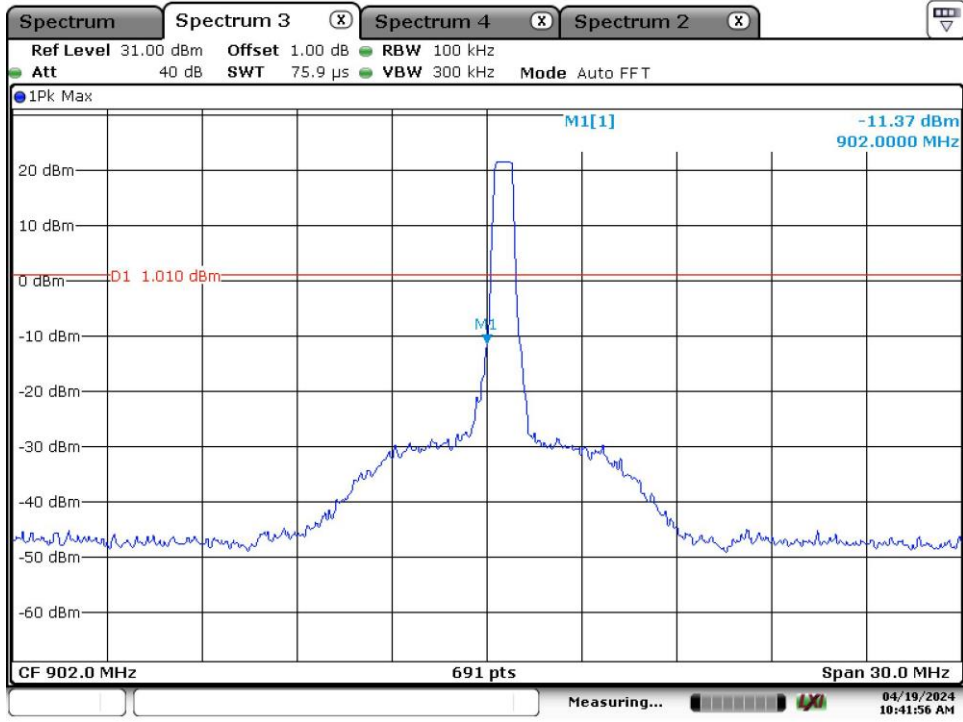
Above 928MHz



Date: 19.APR.2024 12:02:32

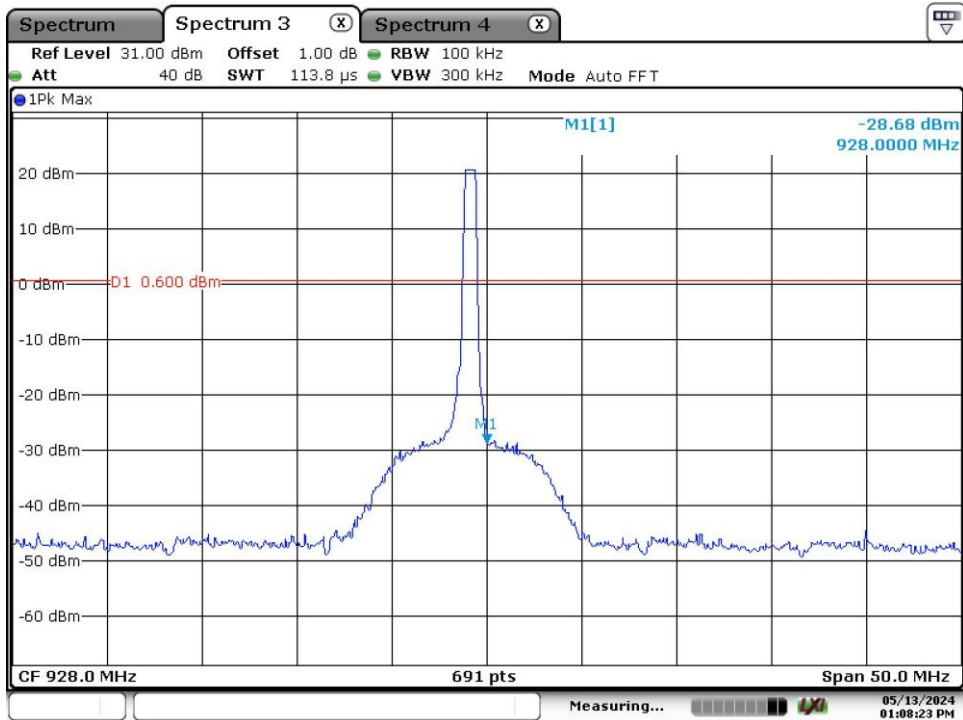
Lora DTS, Band Edge, Configuration 2:

Low Channel



Date: 19.APR.2024 10:41:55

High Channel

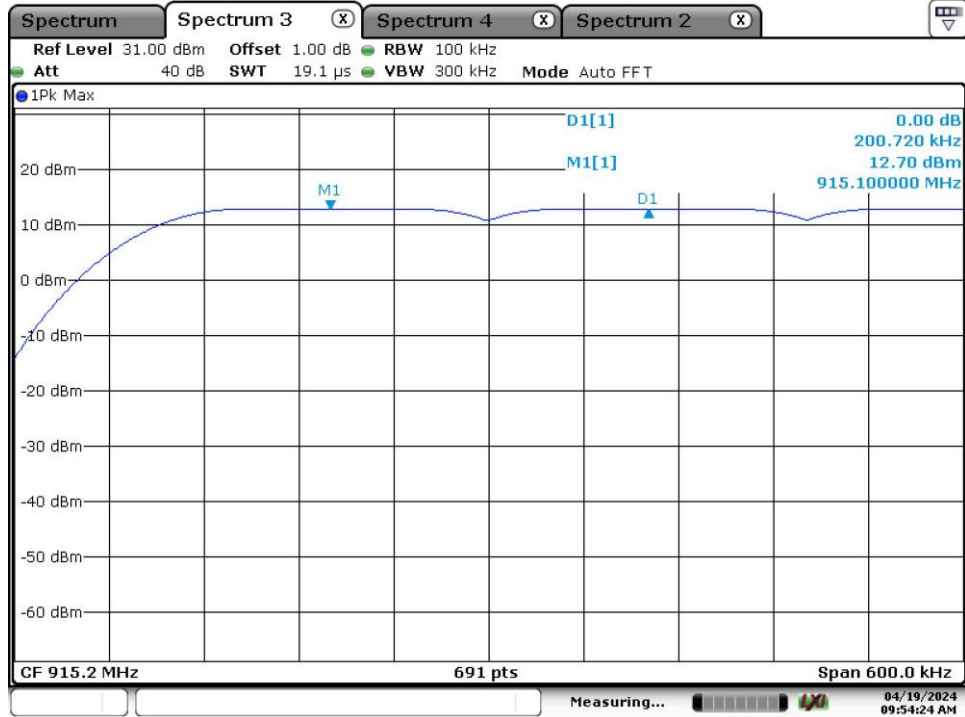


Date: 13.MAY.2024 13:08:23

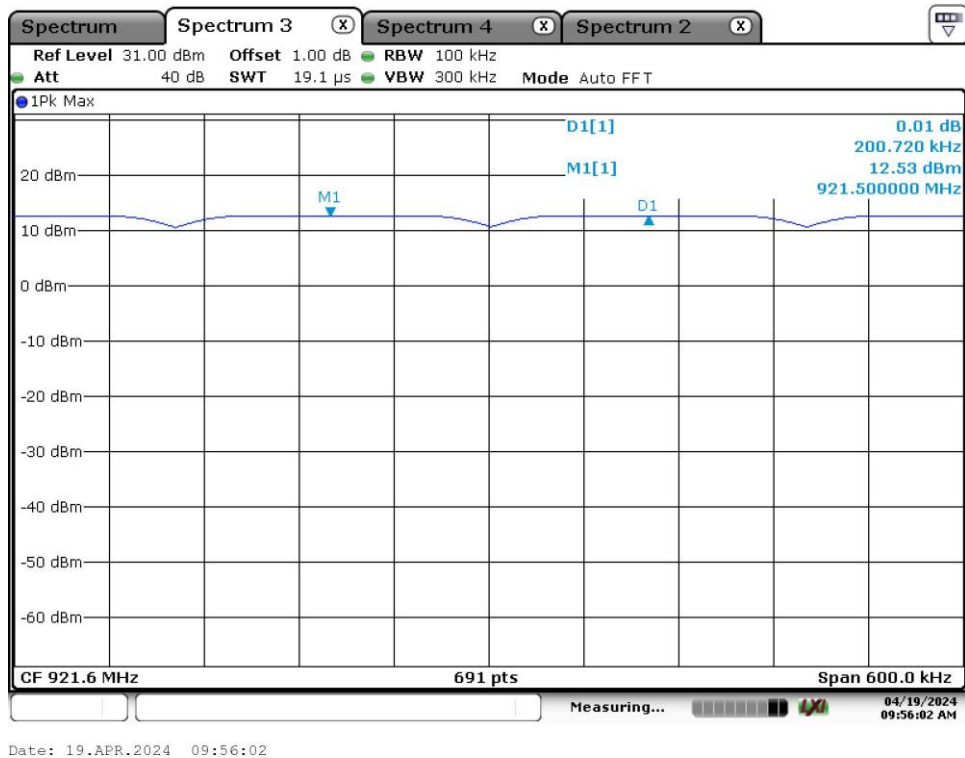
Appendix B.6: Carrier Frequency Separation

Lora FHSS, Configuration 1:

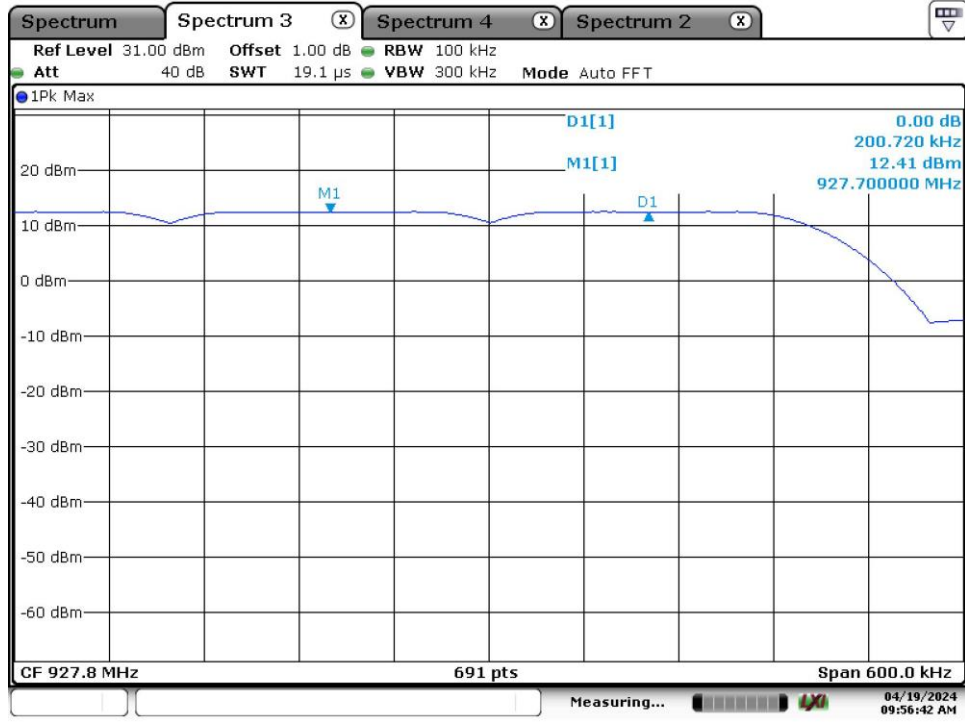
Low Channel



Middle Channel



High Channel



Date: 19.APR.2024 09:56:41

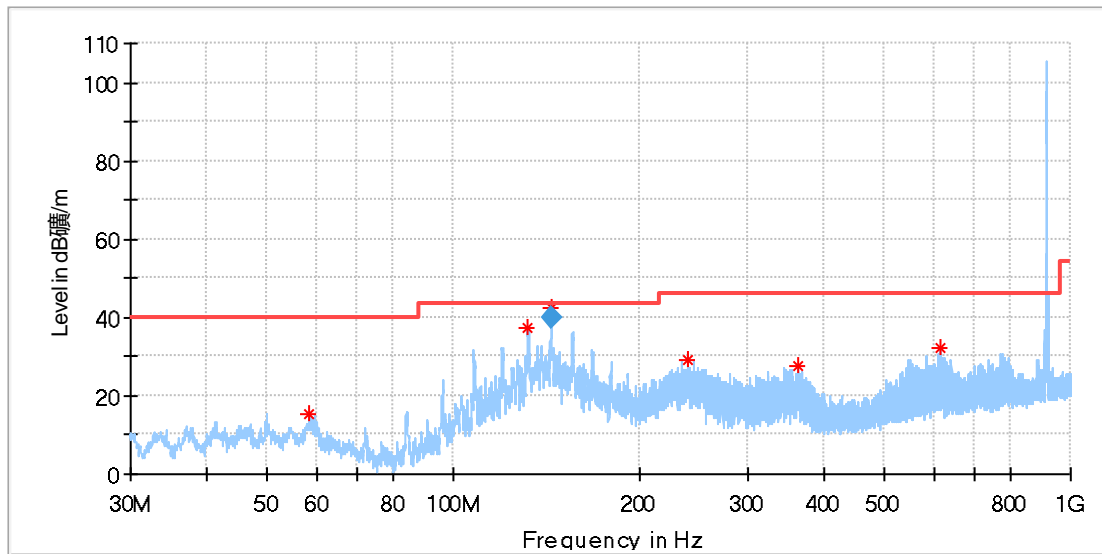
Note 1: Testing was carried out within frequency range 9 kHz to the tenth harmonics. The measurement results below 30MHz and above 18GHz were greater than 20dB below the limit, so only the radiated spurious emissions from 30MHz to 18GHz were reported.

Appendix B.7: Test Results of Radiated Spurious Emissions

Lora DTS, Configuration 1:

EUT Information

EUT Name:	WisDuo LPWAN+BLE Module
Model:	RAK11720
Test Mode:	DTS 500K_SF7_915.8MHz
Order No/Sample No:	168478328A003697710-003
Test Voltage::	DC 5V From USB
Remark:	Temp 24 Humi:50%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical Freqs

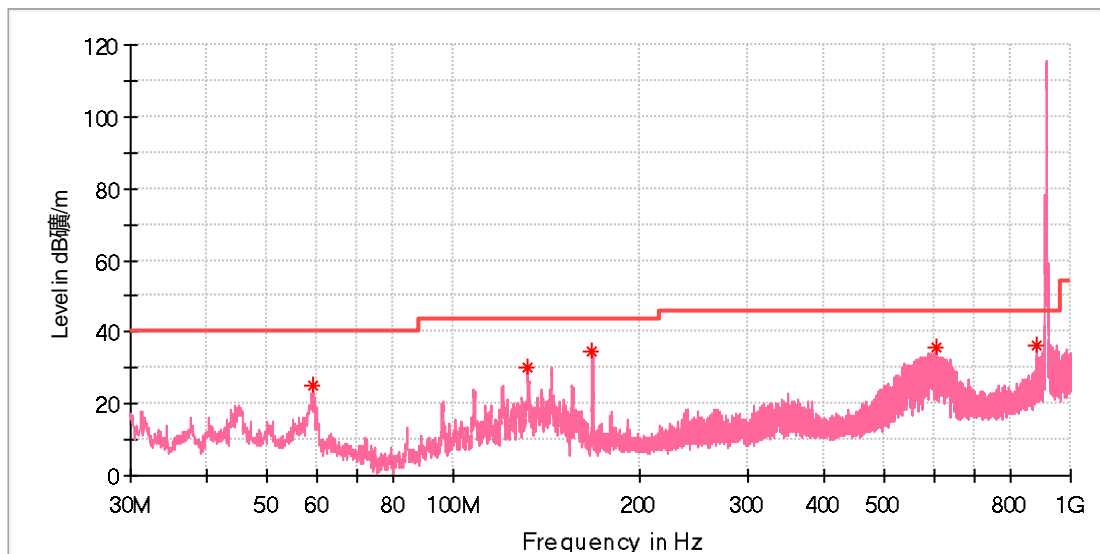
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
58.391154	15.36	40.00	24.64	100.0	H	36.0	-19.1
132.073846	37.24	43.50	6.26	100.0	H	116.0	-22.3
143.975000	42.23	43.50	1.27	100.0	H	150.0	-22.6
239.967692	29.16	46.00	16.84	100.0	H	309.0	-18.0
361.404231	27.40	46.00	18.60	100.0	H	251.0	-14.9
613.343077	32.44	46.00	13.56	100.0	H	251.0	-10.0

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
143.857500	40.12	43.50	3.38	105.0	H	155.0	-22.6

EUT Information

EUT Name:	WisDuo LPWAN+BLE Module
Model:	RAK11720
Test Mode:	DTS 500K_SF7_915.8MHz
Order No/Sample No:	168478328A003697710-003
Test Voltage::	DC 5V From USB
Remark:	Temp 24 Humi:50%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical_Freqs

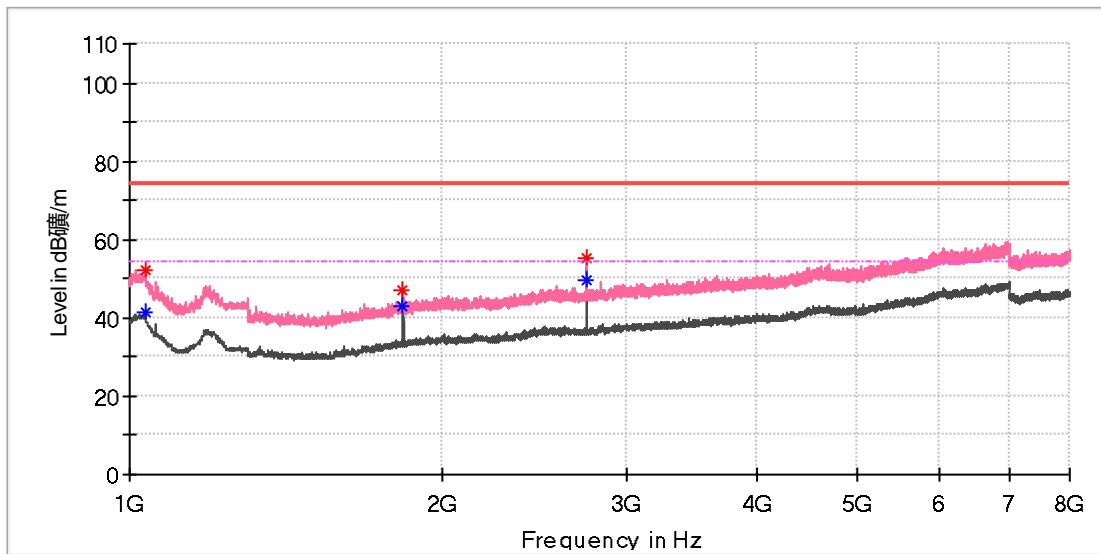
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
59.323846	25.13	40.00	14.87	100.0	V	345.0	-19.2
132.073846	30.35	43.50	13.15	100.0	V	214.0	-22.3
168.038462	34.68	43.50	8.82	100.0	V	75.0	-21.7
604.389231	35.75	46.00	10.25	100.0	V	308.0	-10.1
883.711923	36.30	46.00	9.70	100.0	V	345.0	-5.5

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
---	---	---	---	---		---	---

EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: DTS 500K_SF7_915.8MHz
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical_Freqs

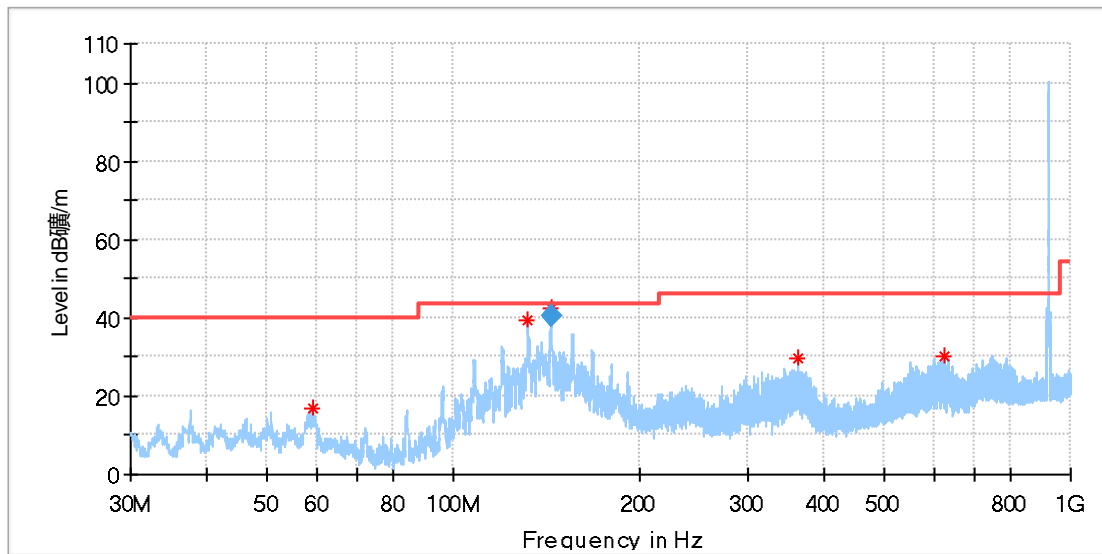
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1035.500000	52.17	---	74.00	21.83	150.0	V	317.0	-0.2
1035.500000	---	41.54	54.00	12.46	150.0	V	317.0	-0.2
1830.975000	46.95	---	74.00	27.05	150.0	V	289.0	4.9
1831.533333	---	43.15	54.00	10.85	150.0	V	289.0	4.9
2747.758333	55.36	---	74.00	18.64	150.0	V	139.0	7.8
2748.316667	---	49.38	54.00	4.62	150.0	V	139.0	7.8

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
---	---	---	---	---		---	---

EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: DTS 500K_SF7_920.6MHz
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical_Freqs

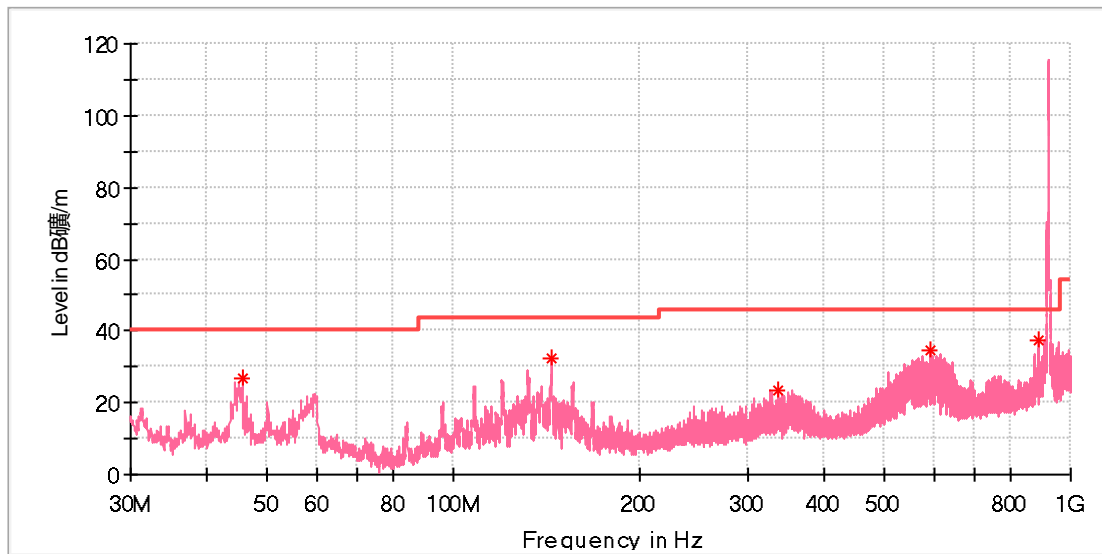
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
59.361154	17.09	40.00	22.91	100.0	H	354.0	-19.2
131.999231	39.28	43.50	4.22	100.0	H	311.0	-22.3
144.012308	42.39	43.50	1.11	100.0	H	138.0	-22.6
360.620769	29.76	46.00	16.24	100.0	H	254.0	-14.9
625.766539	30.00	46.00	16.00	100.0	H	254.0	-9.8

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
143.939731	40.25	43.50	3.25	105.0	H	133.0	-22.6

EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: DTS 500K_SF7_920.6MHz
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical_Freqs

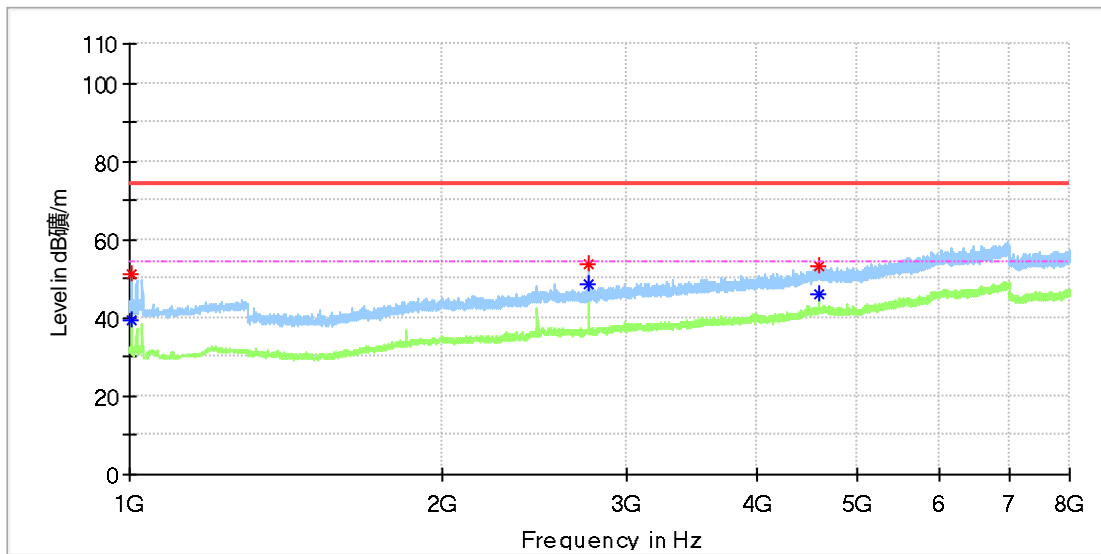
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
45.520000	26.66	40.00	13.34	100.0	V	187.0	-19.1
144.049615	32.43	43.50	11.07	100.0	V	219.0	-22.6
336.631923	23.39	46.00	22.61	100.0	V	155.0	-15.5
592.973077	34.49	46.00	11.51	100.0	V	0.0	-10.3
888.785769	37.30	46.00	8.70	100.0	V	0.0	-5.5

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: DTS 500K_SF7_920.6MHz
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical_Freqs

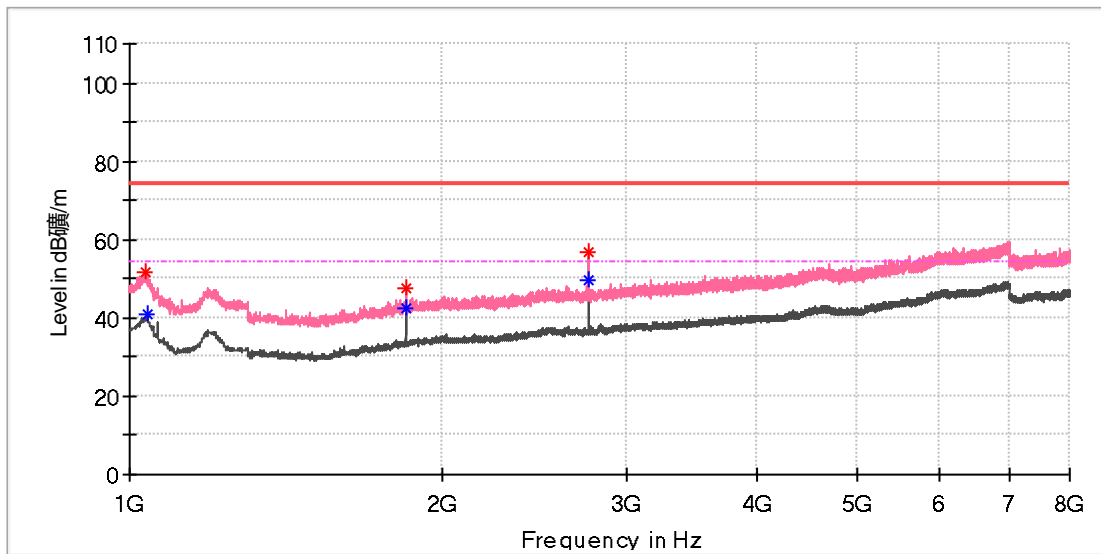
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1004.500000	51.09	---	74.00	22.91	150.0	H	358.0	-0.1
1004.500000	---	39.19	54.00	14.81	150.0	H	358.0	-0.1
2761.716667	---	48.35	54.00	5.65	150.0	H	0.0	7.9
2762.275000	53.48	---	74.00	20.52	150.0	H	0.0	7.9
4597.516667	53.04	---	74.00	20.96	150.0	H	146.0	12.0
4602.541667	---	46.28	54.00	7.72	150.0	H	213.0	12.0

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
---	---	---	---	---		---	---

EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: DTS 500K_SF7_920.6MHz
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 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)
1034.500000	51.50	---	74.00	22.50	150.0	V	284.0	-0.2
1040.000000	---	40.72	54.00	13.28	150.0	V	284.0	-0.2
1841.025000	47.77	---	74.00	26.23	150.0	V	71.0	4.9
1841.025000	---	42.66	54.00	11.34	150.0	V	71.0	4.9
2761.158333	56.61	---	74.00	17.39	150.0	V	280.0	7.9
2762.275000	---	49.84	54.00	4.16	150.0	V	280.0	7.9

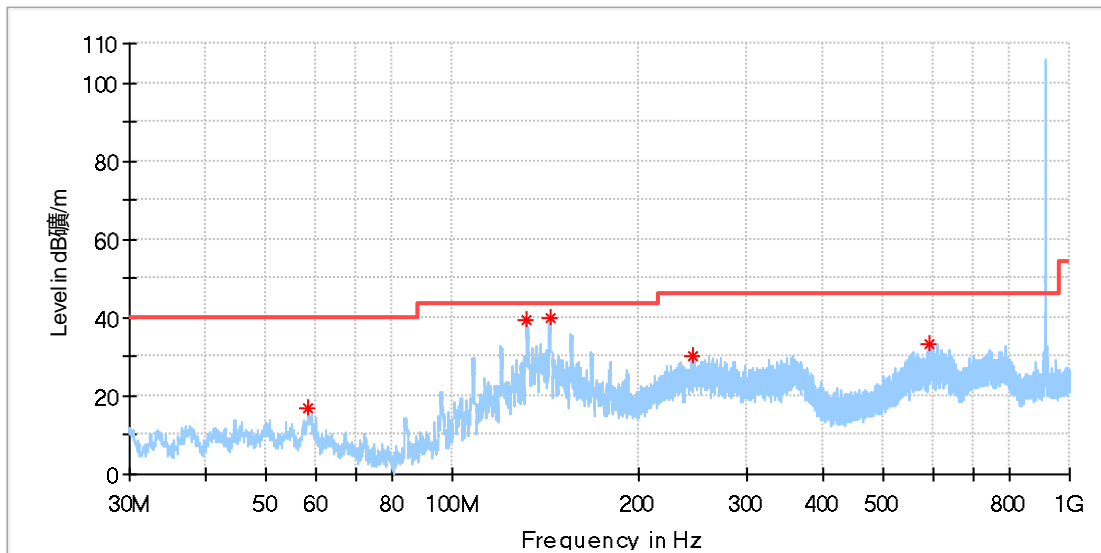
Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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Lora FHSS, Configuration 1:

EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: FHSS 125K_SF7_915.1MHz
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical_Freqs

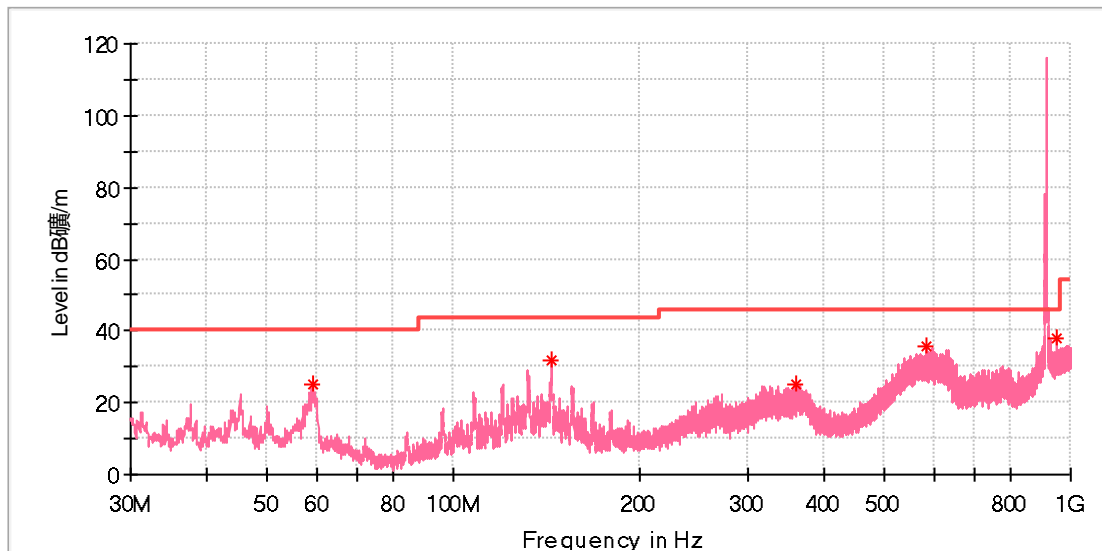
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
58.391154	16.76	40.00	23.24	100.0	H	216.0	-19.1
131.887308	39.63	43.50	3.87	100.0	H	270.0	-22.3
143.863077	39.90	43.50	3.60	100.0	H	270.0	-22.6
245.974231	30.34	46.00	15.66	100.0	H	160.0	-17.8
594.129615	33.12	46.00	12.88	100.0	H	295.0	-10.3

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: FHSS 125K_SF7_915.1MHz
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical_Freqs

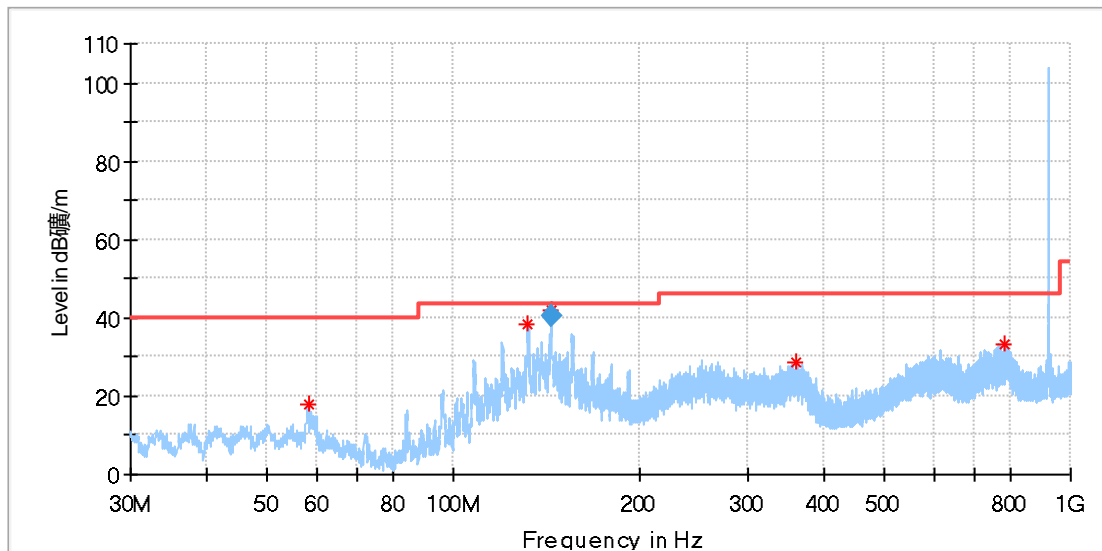
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
59.361154	24.97	40.00	15.03	100.0	V	223.0	-19.2
143.975000	31.64	43.50	11.86	100.0	V	206.0	-22.6
359.315000	25.34	46.00	20.66	100.0	V	181.0	-15.0
584.840000	35.75	46.00	10.25	100.0	V	67.0	-10.5
947.097692	38.02	46.00	7.98	100.0	V	271.0	-4.9

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: FHSS 125K_SF7_921.5MHz
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical_Freqs

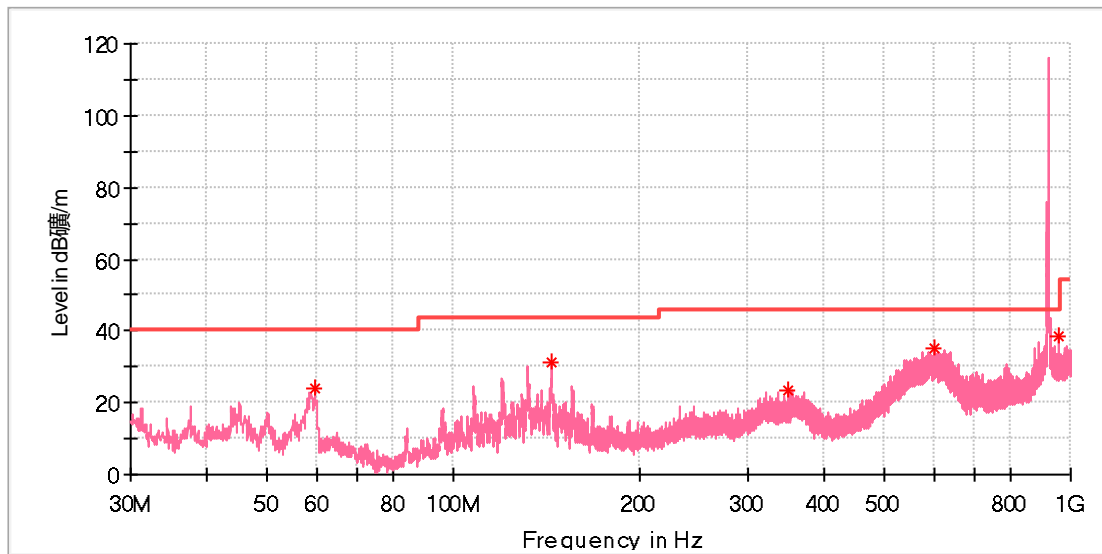
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
58.241923	17.86	40.00	22.14	100.0	H	133.0	-19.1
132.223077	38.49	43.50	5.01	100.0	H	315.0	-22.3
144.049615	42.06	43.50	1.44	100.0	H	149.0	-22.6
358.680769	28.51	46.00	17.49	100.0	H	133.0	-15.0
782.757308	33.37	46.00	12.63	100.0	H	92.0	-7.1

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
144.061077	40.17	43.50	3.33	105.0	H	144.0	-22.6

EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: FHSS 125K_SF7_921.5MHz
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical_Freqs

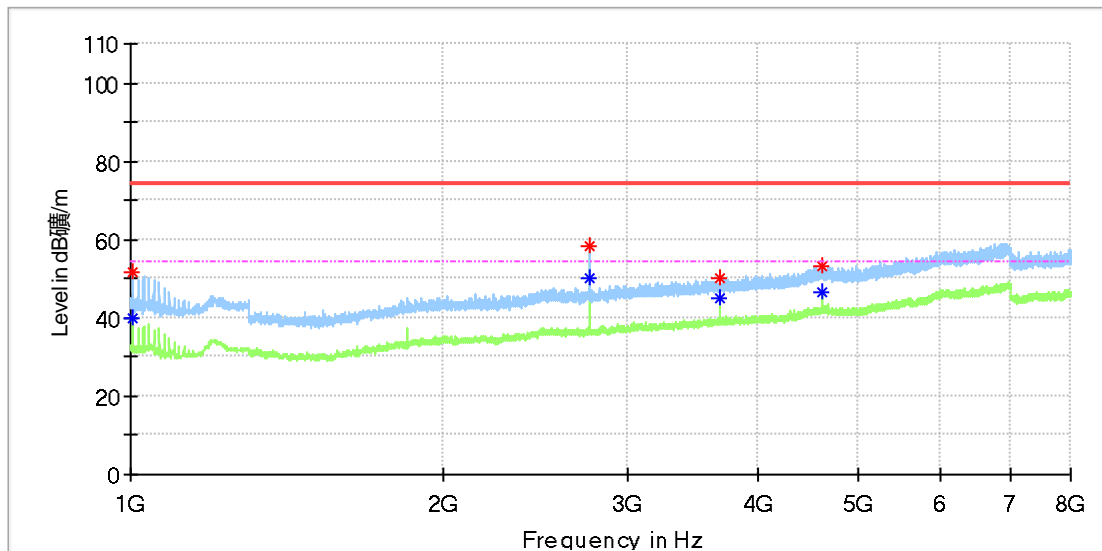
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
59.734231	23.79	40.00	16.21	100.0	V	136.0	-19.3
143.937692	31.41	43.50	12.09	100.0	V	231.0	-22.6
349.764231	23.41	46.00	22.59	100.0	V	207.0	-15.2
601.889615	35.06	46.00	10.94	100.0	V	95.0	-10.2
953.514615	38.26	46.00	7.74	100.0	V	301.0	-4.8

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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EUT Information

EUT Name:	WisDuo LPWAN+BLE Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_921.5MHz
Order No/Sample No:	168478328A003697710-003
Test Voltage::	DC 5V From USB
Remark:	Temp 24 Humi:50%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical_Freqs

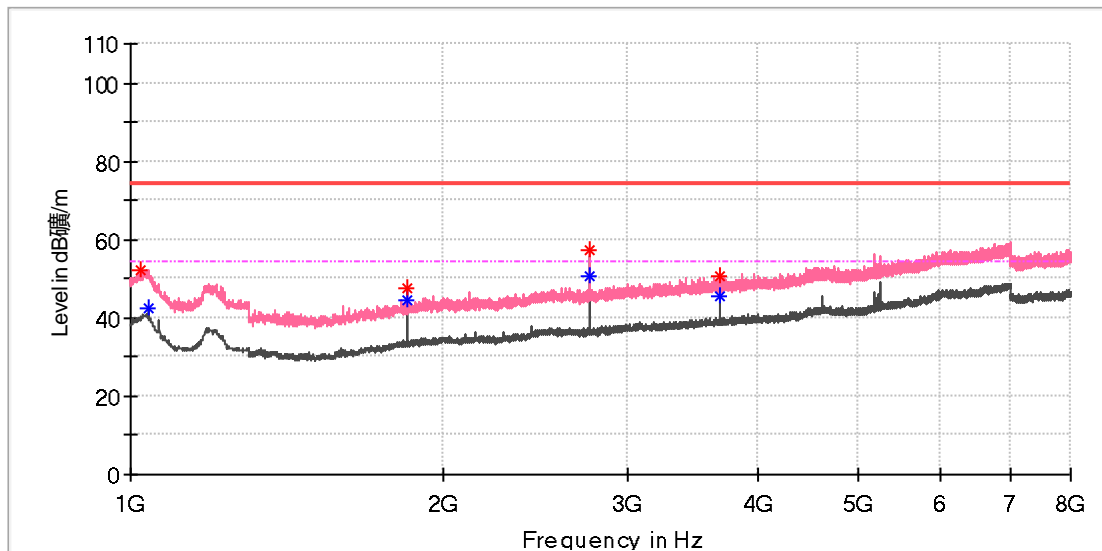
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1005.500000	51.50	---	74.00	22.50	150.0	H	329.0	-0.1
1005.500000	---	39.82	54.00	14.18	150.0	H	329.0	-0.1
2764.508333	58.15	---	74.00	15.85	150.0	H	67.0	7.9
2765.066667	---	50.07	54.00	3.93	150.0	H	67.0	7.9
3685.758333	50.13	---	74.00	23.87	150.0	H	67.0	9.5
3685.758333	---	44.96	54.00	9.04	150.0	H	67.0	9.5
4607.566667	---	46.35	54.00	7.65	150.0	H	203.0	12.0
4611.475000	53.02	---	74.00	20.98	150.0	H	2.0	12.0

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: FHSS 125K_SF7_921.5MHz
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical_Freqs

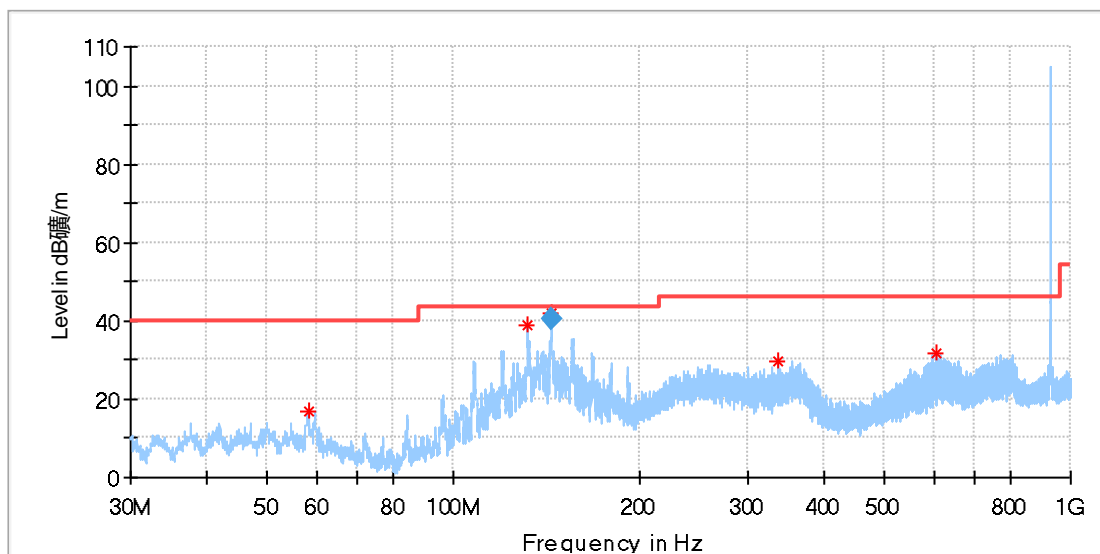
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1024.500000	52.09	---	74.00	21.91	150.0	V	348.0	-0.2
1041.500000	---	42.43	54.00	11.57	150.0	V	0.0	-0.2
1842.700000	47.59	---	74.00	26.41	150.0	V	185.0	4.9
1842.700000	---	44.62	54.00	9.38	150.0	V	185.0	4.9
2763.950000	57.54	---	74.00	16.46	150.0	V	275.0	7.9
2765.066667	---	50.52	54.00	3.48	150.0	V	335.0	7.9
3685.758333	50.82	---	74.00	23.18	150.0	V	126.0	9.5
3685.758333	---	45.71	54.00	8.29	150.0	V	126.0	9.5

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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EUT Information

EUT Name:	WisDuo LPWAN+BLE Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_927.7MHz
Order No/Sample No:	168478328A003697710-003
Test Voltage::	DC 5V From USB
Remark:	Temp 24 Humi:50%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical_Freqs

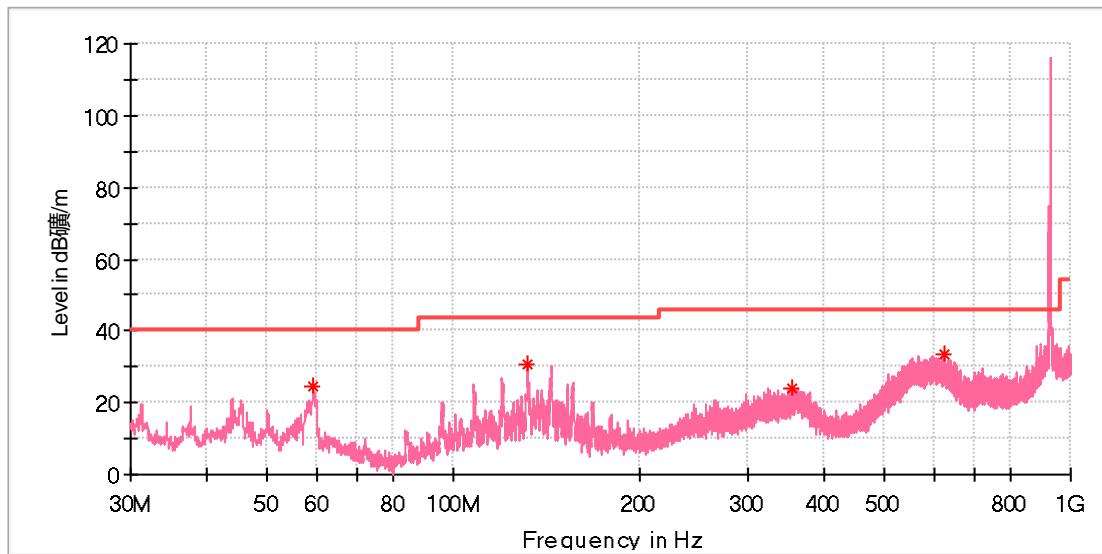
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
58.167308	16.76	40.00	23.24	100.0	H	326.0	-19.1
131.961923	39.00	43.50	4.50	100.0	H	319.0	-22.3
144.049615	42.11	43.50	1.39	100.0	H	319.0	-22.6
336.035000	29.93	46.00	16.07	100.0	H	155.0	-15.5
606.627692	31.61	46.00	14.39	100.0	H	295.0	-10.1

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
144.011577	40.38	43.50	3.12	100.0	H	324.0	-22.6

EUT Information

EUT Name:	WisDuo LPWAN+BLE Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_927.7MHz
Order No/Sample No:	168478328A003697710-003
Test Voltage::	DC 5V From USB
Remark:	Temp 24 Humi:50%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical_Freqs

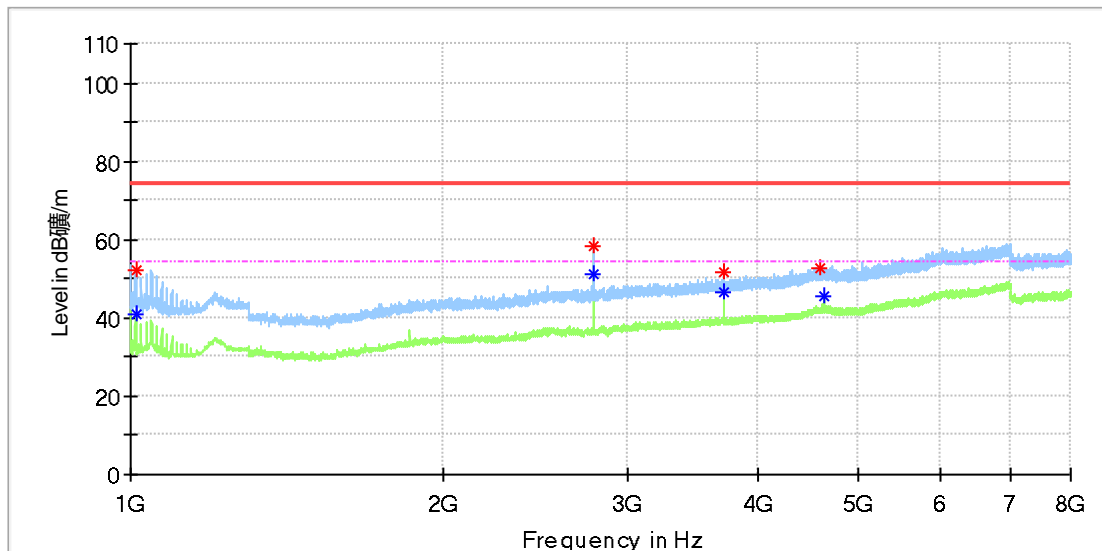
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
59.398462	24.44	40.00	15.56	100.0	V	354.0	-19.2
131.999231	30.65	43.50	12.85	100.0	V	232.0	-22.3
354.017308	23.95	46.00	22.05	100.0	V	177.0	-15.1
623.565385	33.56	46.00	12.44	100.0	V	354.0	-9.8

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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EUT Information

EUT Name:	WisDuo LPWAN+BLE Module
Model:	RAK11720
Test Mode:	FHSS 125K_SF7_927.7MHz
Order No/Sample No:	168478328A003697710-003
Test Voltage::	DC 5V From USB
Remark:	Temp 24 Humi:50%
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)
1011.500000	---	40.85	54.00	13.15	150.0	H	334.0	-0.2
1012.000000	52.14	---	74.00	21.86	150.0	H	334.0	-0.2
2783.491667	58.26	---	74.00	15.74	150.0	H	76.0	7.9
2784.050000	---	51.29	54.00	2.71	150.0	H	76.0	7.9
3711.441667	51.47	---	74.00	22.53	150.0	H	4.0	9.6
3711.441667	---	46.61	54.00	7.39	150.0	H	4.0	9.6
4591.375000	52.90	---	74.00	21.10	150.0	H	113.0	12.0
4639.950000	---	45.44	54.00	8.56	150.0	H	87.0	12.0

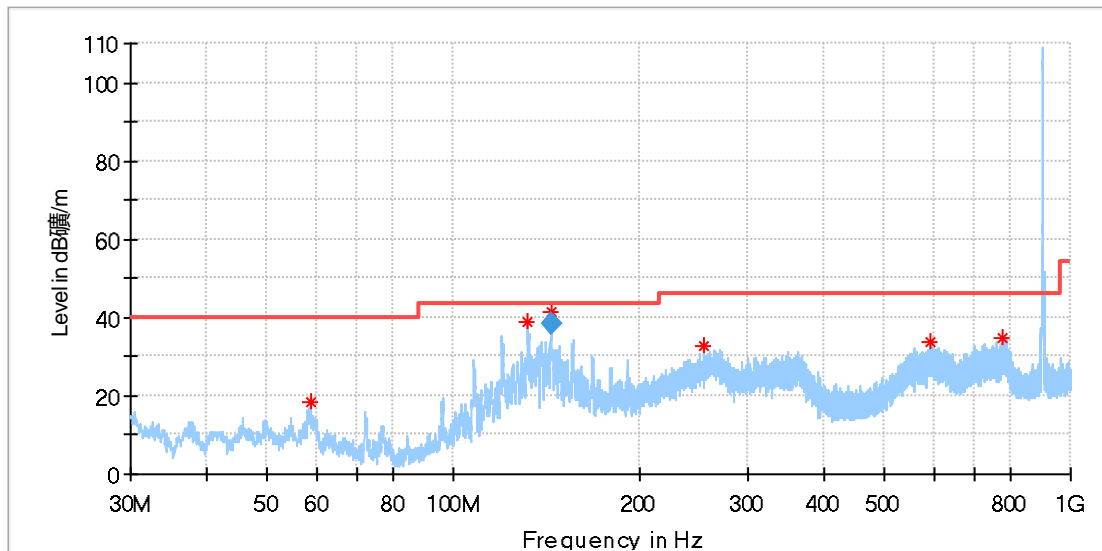
Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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Lora DTS, Configuration 2:

EUT Information

EUT Name:	WisDuo LPWAN+BLE Module
Model:	RAK11720
Test Mode:	DTS 500K_SF10_902.5MHz
Order No/Sample No:	168478328A003697710-003
Test Voltage::	DC 5V From USB
Remark:	Temp 24 Humi:50%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical_Freqs

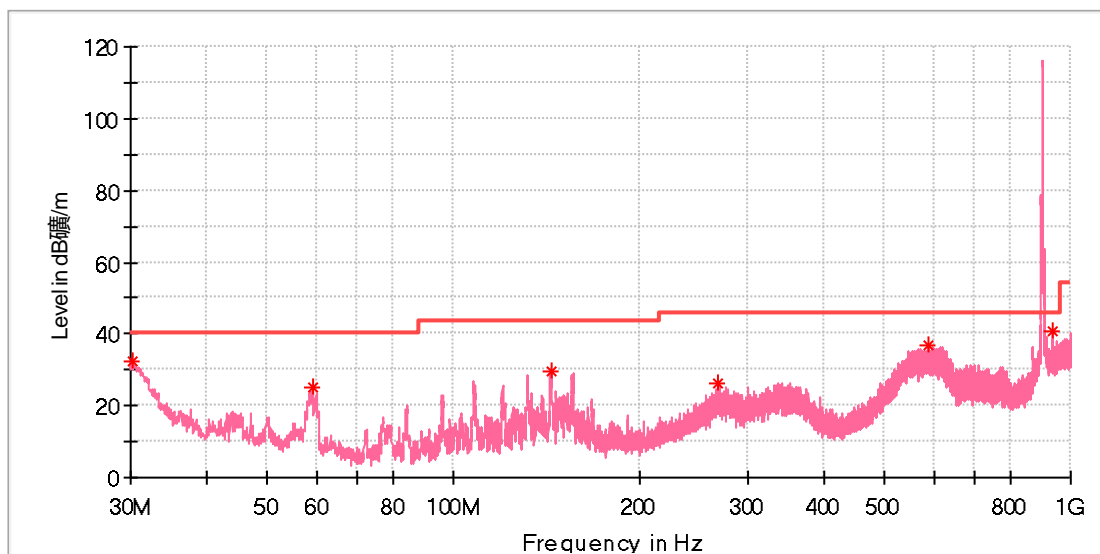
Frequency (MHz)	MaxiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
58.726923	18.65	40.00	21.35	100.0	H	151.0	-19.2
131.999231	38.99	43.50	4.51	100.0	H	276.0	-22.3
143.975000	41.69	43.50	1.81	100.0	H	276.0	-22.6
254.070000	32.65	46.00	13.35	100.0	H	151.0	-17.6
594.204231	33.52	46.00	12.48	100.0	H	291.0	-10.3
777.571539	34.63	46.00	11.37	100.0	H	284.0	-7.1

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
144.244923	38.24	43.50	5.26	105.0	H	274.0	-22.6

EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: DTS 500K_SF10_902.5MHz
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical_Freqs

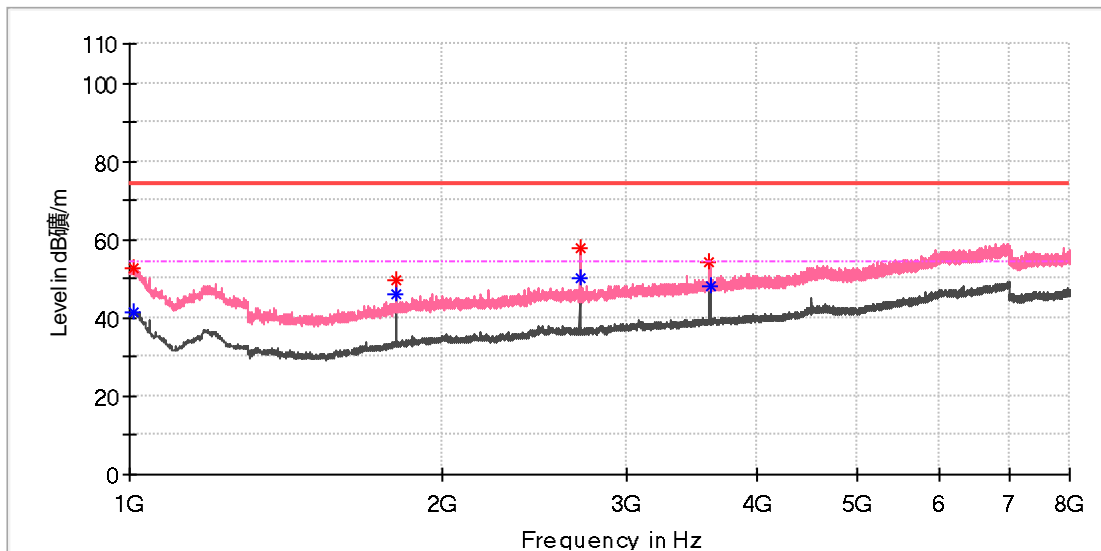
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.149231	32.57	40.00	7.43	100.0	V	256.0	-23.3
59.100000	24.99	40.00	15.01	100.0	V	233.0	-19.2
144.273462	29.56	43.50	13.94	100.0	V	218.0	-22.6
268.657308	26.23	46.00	19.77	100.0	V	163.0	-17.3
588.682692	36.64	46.00	9.36	100.0	V	62.0	-10.4
934.636923	40.70	46.00	5.30	100.0	V	272.0	-5.1

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: DTS 500K_SF10_902.5MHz
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical_Freqs

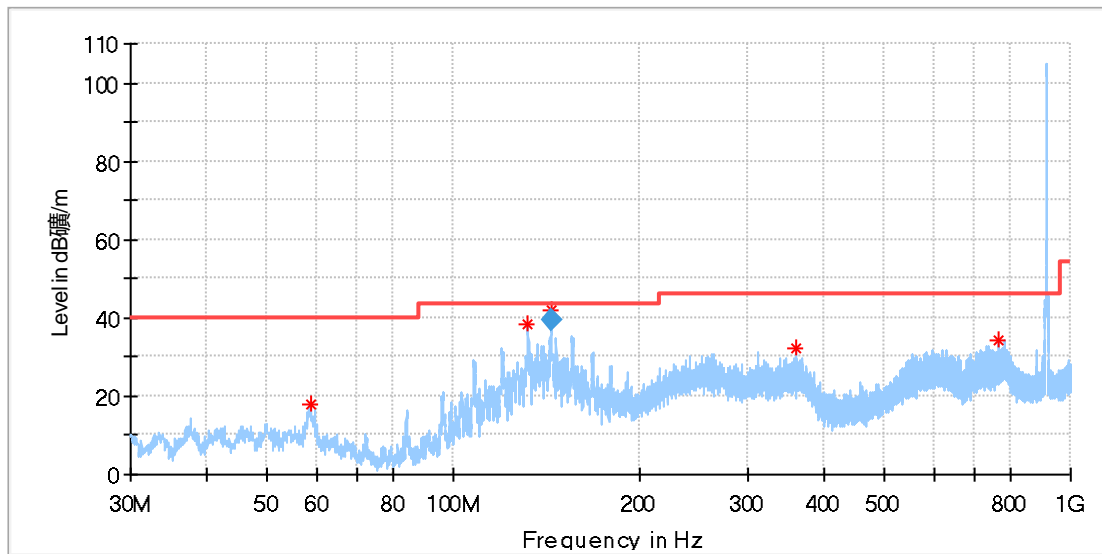
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1007.000000	---	41.51	54.00	12.49	150.0	V	2.0	-0.1
1008.000000	52.86	---	74.00	21.14	150.0	V	2.0	-0.1
1804.733333	49.85	---	74.00	24.15	150.0	V	220.0	4.8
1805.291667	---	45.97	54.00	8.03	150.0	V	200.0	4.8
2706.441667	---	50.09	54.00	3.91	150.0	V	190.0	7.5
2707.000000	58.04	---	74.00	15.96	150.0	V	190.0	7.6
3609.266667	54.03	---	74.00	19.97	150.0	V	117.0	9.4
3609.825000	---	48.17	54.00	5.83	150.0	V	117.0	9.4

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
---	---	---	---	---		---	---

EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: DTS 500K_SF10_914.5MHz
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical_Freqs

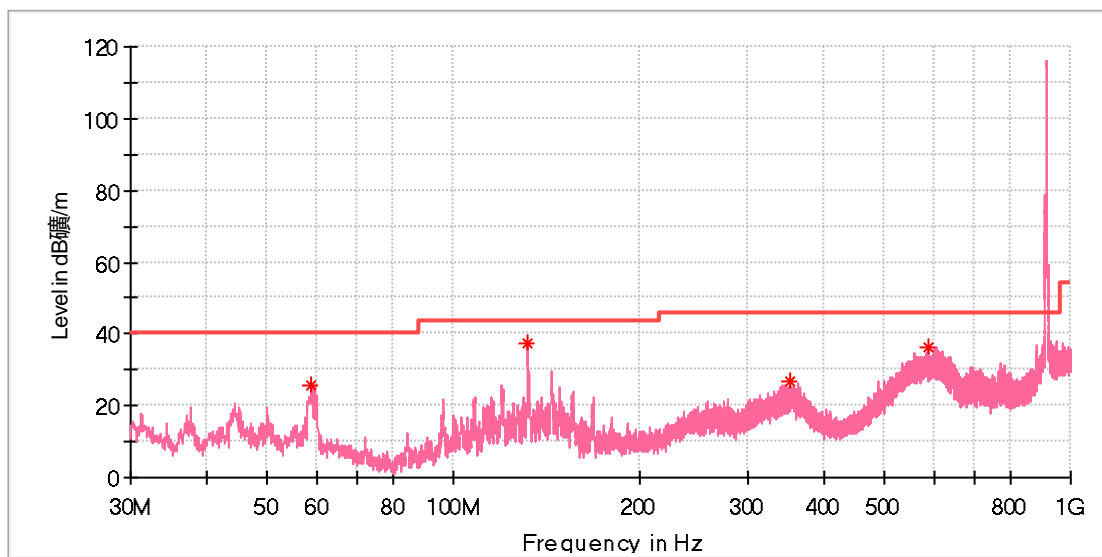
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
58.838846	18.09	40.00	21.91	100.0	H	343.0	-19.2
131.961923	38.52	43.50	4.98	100.0	H	156.0	-22.3
143.937692	41.72	43.50	1.78	100.0	H	141.0	-22.6
358.568846	32.15	46.00	13.85	100.0	H	148.0	-15.0
762.835000	34.52	46.00	11.48	100.0	H	274.0	-7.4

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
144.357423	39.52	43.50	3.98	100.0	H	139.0	-22.6

EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: DTS 500K_SF10_914.5MHz
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical_Freqs

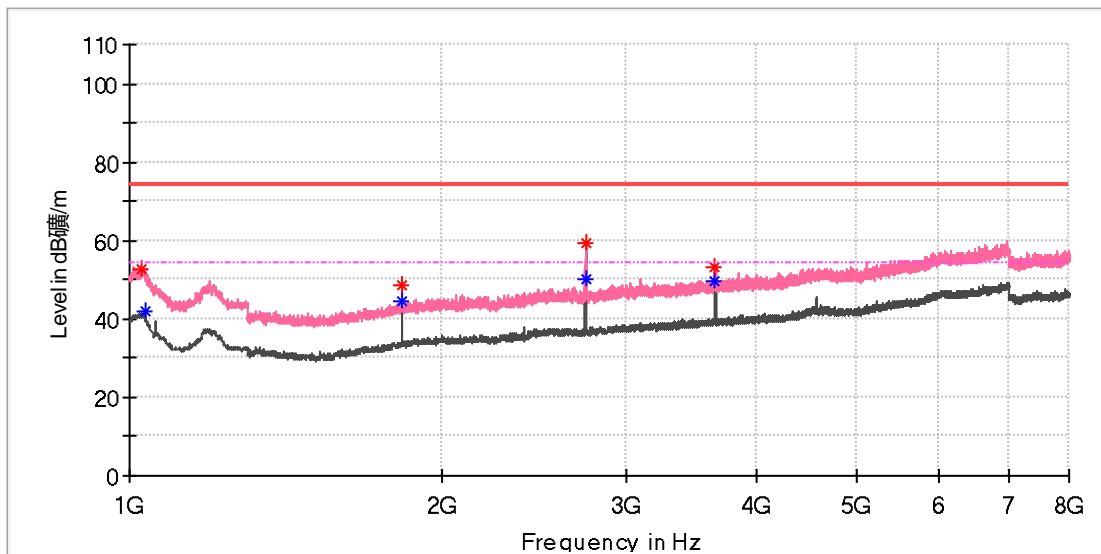
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
58.988077	25.44	40.00	14.56	100.0	V	0.0	-19.2
132.185769	37.28	43.50	6.22	100.0	V	322.0	-22.3
350.696923	26.84	46.00	19.16	100.0	V	167.0	-15.2
588.608077	36.53	46.00	9.47	100.0	V	77.0	-10.4

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
---	---	---	---	---		---	---

EUT Information

EUT Name:	WisDuo LPWAN+BLE Module
Model:	RAK11720
Test Mode:	DTS 500K_SF10_914.5MHz
Order No/Sample No:	168478328A003697710-003
Test Voltage::	DC 5V From USB
Remark:	Temp 24 Humi:50%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical_Freqs

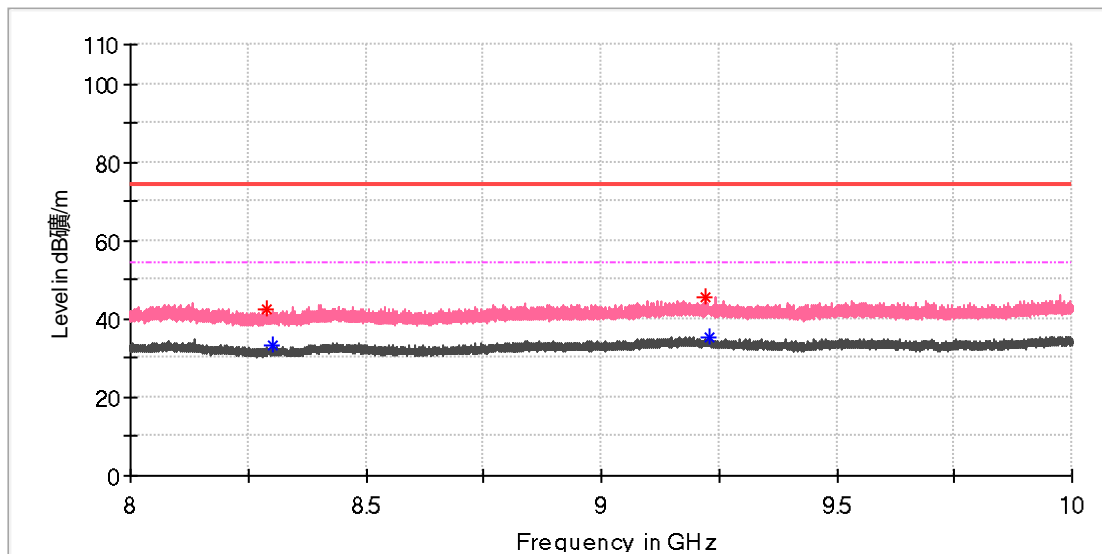
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1027.500000	52.91	---	74.00	21.09	150.0	V	0.0	-0.2
1034.000000	---	41.98	54.00	12.02	150.0	V	356.0	-0.2
1828.741667	48.36	---	74.00	25.64	150.0	V	305.0	4.9
1828.741667	---	44.75	54.00	9.25	150.0	V	305.0	4.9
2743.291667	59.21	---	74.00	14.79	150.0	V	254.0	7.8
2744.408333	---	50.05	54.00	3.95	150.0	V	92.0	7.8
3657.841667	53.43	---	74.00	20.57	150.0	V	121.0	9.4
3657.841667	---	49.77	54.00	4.23	150.0	V	121.0	9.4

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
---	---	---	---	---		---	---

EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: DTS 500K_SF10_914.5MHz
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical_Freqs

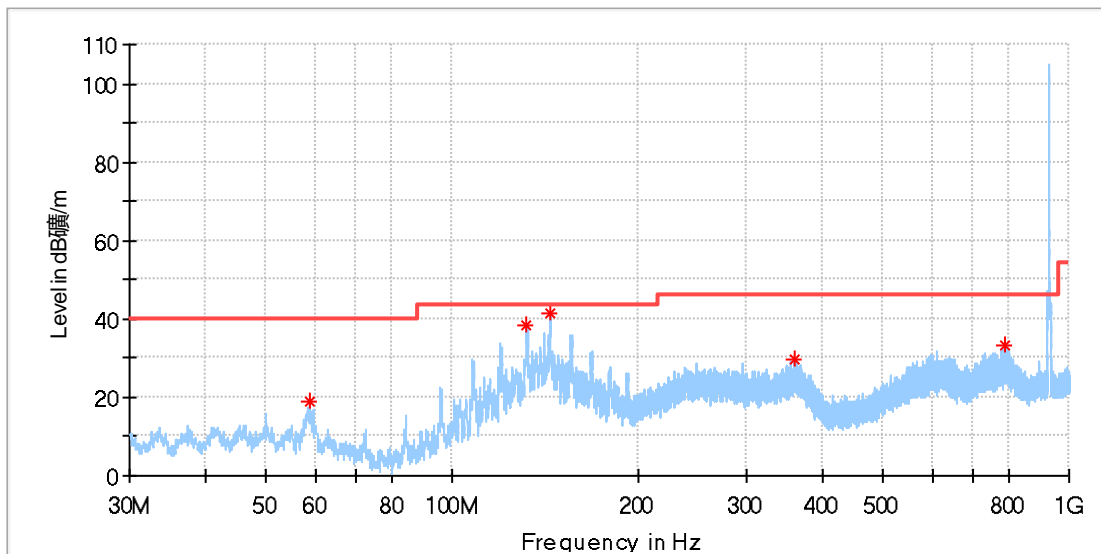
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8289.700000	42.71	---	74.00	31.29	150.0	V	52.0	8.7
8303.700000	---	33.26	54.00	20.74	150.0	V	86.0	8.7
9219.400000	45.50	---	74.00	28.50	150.0	V	104.0	10.7
9230.700000	---	35.25	54.00	18.75	150.0	V	150.0	10.7

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: DTS 500K_SF10_927.1MHz
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical_Freqs

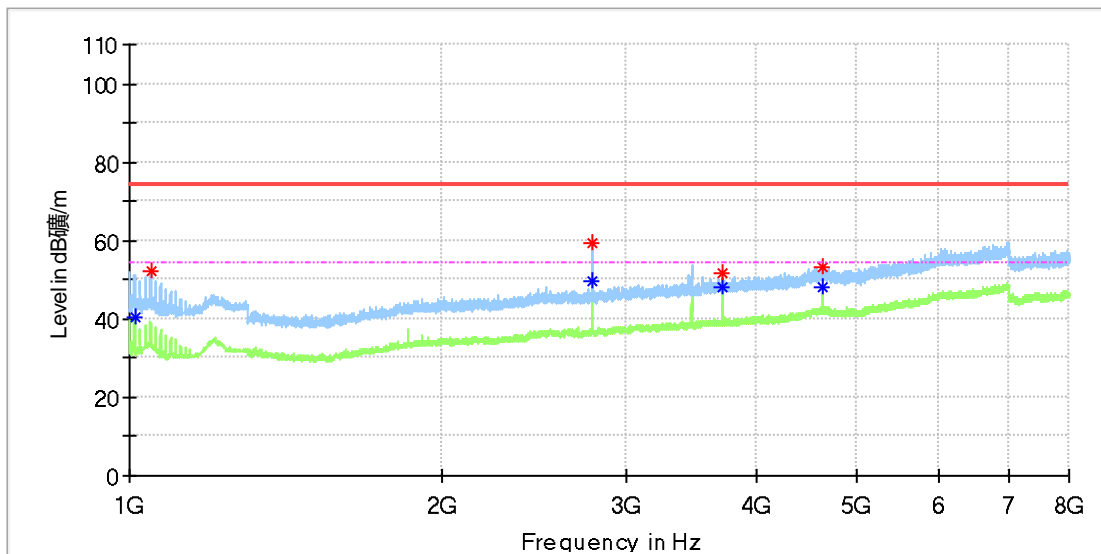
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
58.689615	18.90	40.00	21.10	100.0	H	42.0	-19.1
131.999231	38.25	43.50	5.25	100.0	H	154.0	-22.3
144.049615	41.29	43.50	2.21	100.0	H	112.0	-22.6
359.091154	29.54	46.00	16.46	100.0	H	175.0	-15.0
786.600000	33.07	46.00	12.93	100.0	H	283.0	-7.0

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
---	---	---	---	---		---	---

EUT Information

EUT Name:	WisDuo LPWAN+BLE Module
Model:	RAK11720
Test Mode:	DTS 500K_SF10_927.1MHz
Order No/Sample No:	168478328A003697710-003
Test Voltage::	DC 5V From USB
Remark:	Temp 24 Humi:50%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical_Freqs

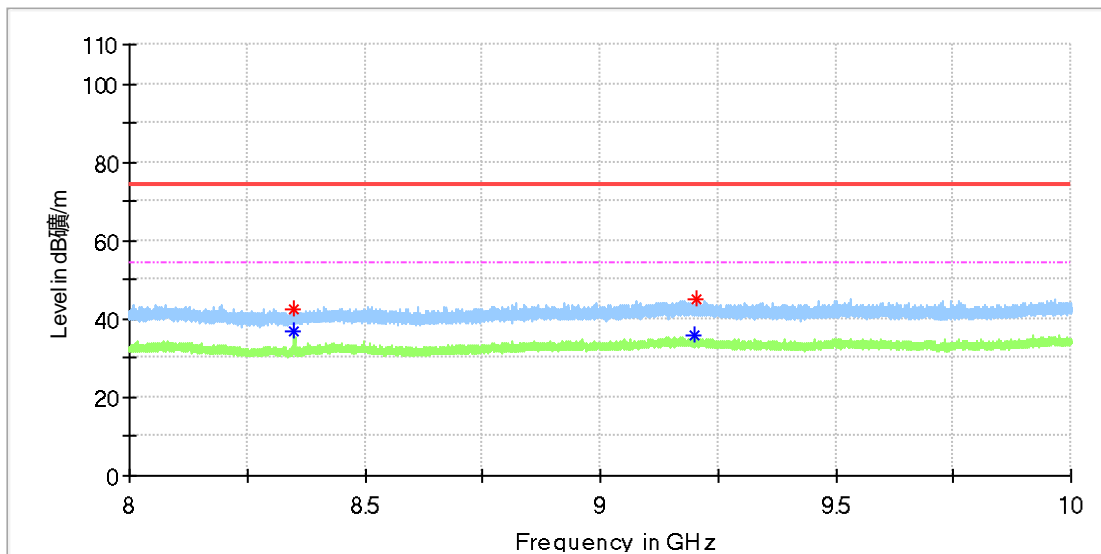
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1011.500000	---	40.24	54.00	13.76	150.0	H	227.0	-0.2
1048.000000	51.98	---	74.00	22.02	150.0	H	347.0	-0.2
2781.816667	---	49.39	54.00	4.61	150.0	H	355.0	7.9
2782.933333	59.19	---	74.00	14.81	150.0	H	71.0	7.9
3711.441667	51.65	---	74.00	22.35	150.0	H	231.0	9.6
3711.441667	---	48.07	54.00	5.93	150.0	H	231.0	9.6
4639.391667	53.21	---	74.00	20.79	150.0	H	82.0	12.0
4639.391667	---	47.95	54.00	6.05	150.0	H	82.0	12.0

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
---	---	---	---	---		---	---

EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: DTS 500K_SF10_927.1MHz
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical_Freqs

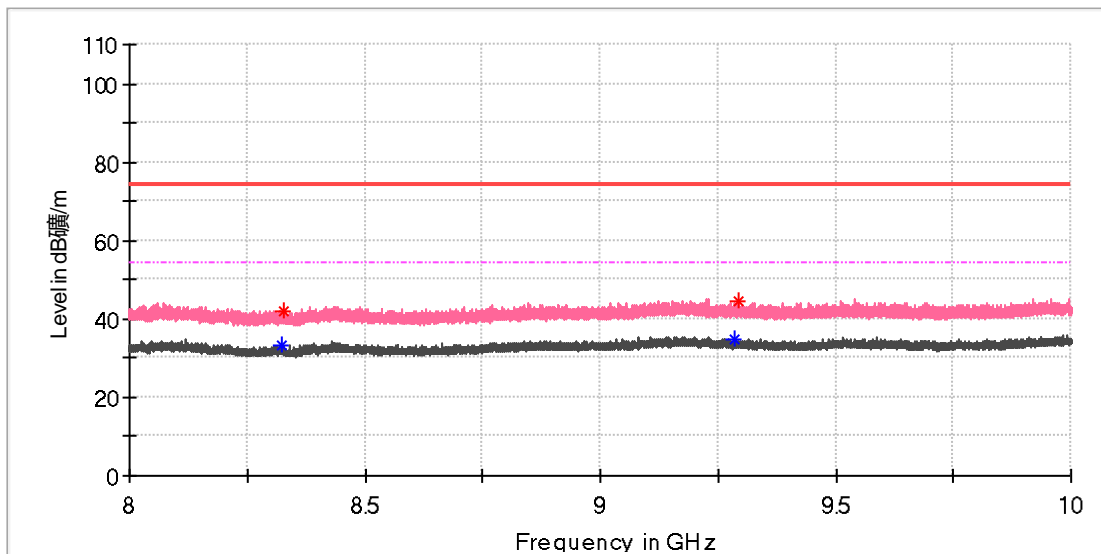
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8347.600000	42.44	---	74.00	31.56	150.0	H	325.0	8.9
8348.700000	---	36.89	54.00	17.11	150.0	H	221.0	8.9
9201.700000	---	35.69	54.00	18.31	150.0	H	1.0	10.6
9204.700000	44.78	---	74.00	29.22	150.0	H	335.0	10.6

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
---	---	---	---	---		---	---

EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: DTS 500K_SF10_927.1MHz
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 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)
8325.100000	---	33.31	54.00	20.69	150.0	V	225.0	8.8
8329.000000	41.94	---	74.00	32.06	150.0	V	356.0	8.8
9283.200000	---	34.64	54.00	19.36	150.0	V	54.0	10.3
9292.400000	44.46	---	74.00	29.54	150.0	V	180.0	10.2

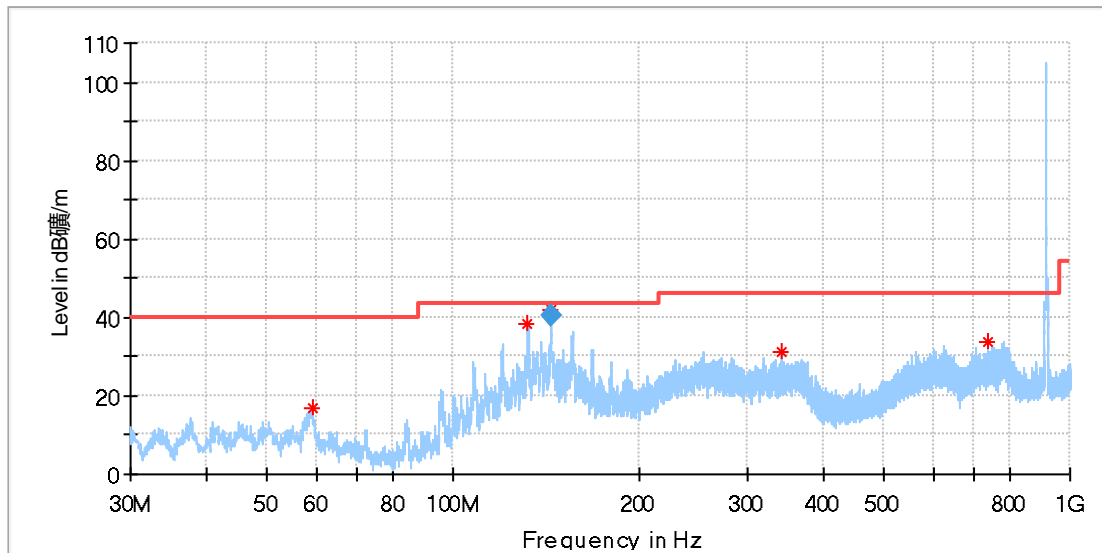
Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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Co-located mode (Lora FHSS+BLE)

EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: BLE+Lora
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical Freqs

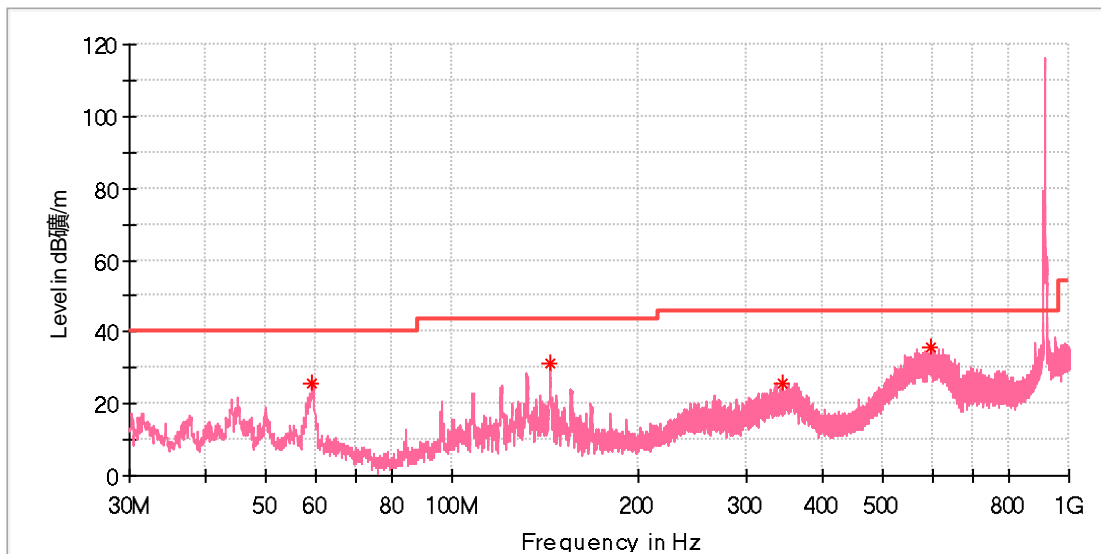
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
59.323846	16.80	40.00	23.20	100.0	H	8.0	-19.2
131.924615	38.44	43.50	5.06	100.0	H	328.0	-22.3
144.049615	41.78	43.50	1.72	100.0	H	133.0	-22.6
340.437308	31.03	46.00	14.97	100.0	H	155.0	-15.4
737.764231	33.81	46.00	12.19	100.0	H	276.0	-7.8

Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
144.111731	40.24	43.50	3.26	100.0	H	138.0	-22.6

EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: BLE+Lora
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 Test Standard: FCC 15.247
 Tested By: Kei Zhang
 Reviewed By: Terry Yin



Critical_Freqs

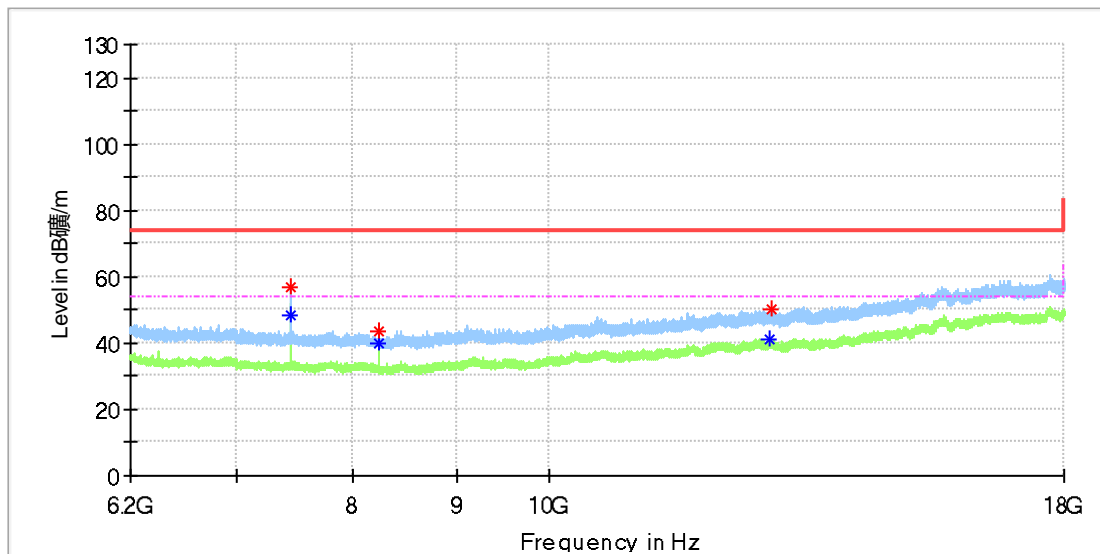
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
59.211923	25.62	40.00	14.38	100.0	V	236.0	-19.2
144.049615	31.00	43.50	12.50	100.0	V	217.0	-22.6
342.340000	25.88	46.00	20.12	100.0	V	185.0	-15.4
595.621923	35.62	46.00	10.38	100.0	V	90.0	-10.3

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
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EUT Information

EUT Name: WisDuo LPWAN+BLE Module
 Model: RAK11720
 Test Mode: BLE+Lora
 Order No/Sample No: 168478328A003697710-003
 Test Voltage:: DC 5V From USB
 Remark: Temp 24 Humi:50%
 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)
7438.508333	---	48.60	54.00	5.40	150.0	H	52.0	8.4
7439.983333	56.71	---	74.00	17.29	150.0	H	52.0	8.4
8229.108333	43.46	---	74.00	30.54	150.0	H	63.0	8.8
8229.108333	---	40.13	54.00	13.87	150.0	H	63.0	8.8
12864.541667	---	40.98	54.00	13.02	150.0	H	97.0	15.4
12893.058333	50.18	---	74.00	23.82	150.0	H	354.0	15.5

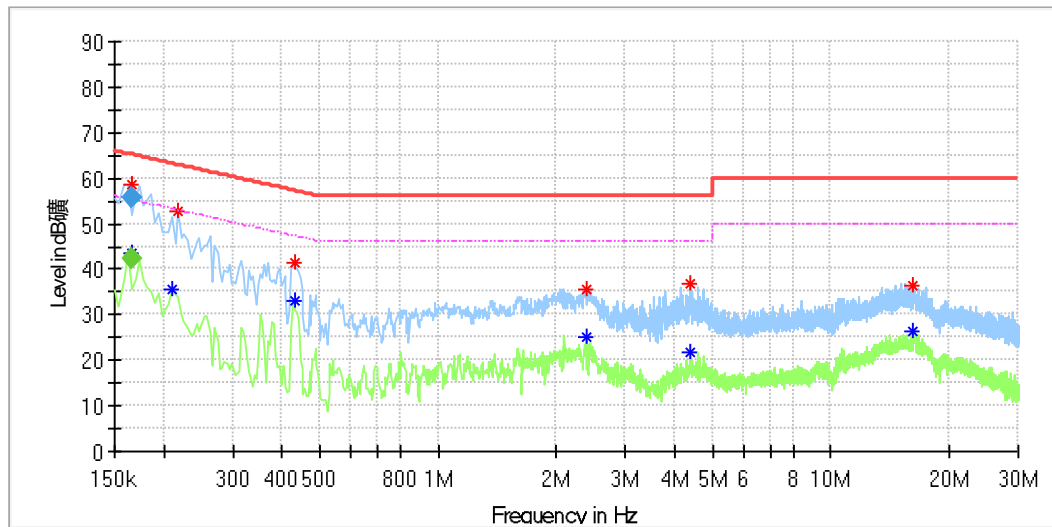
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
---	---	---	---	---		---	---

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

EUT Information

EUT Name:	WisDuo LPWAN+BLE Module
Order Number:	168478328 50(P01450873)
Model:	RAK11720
Test Mode:	On, Normal Operating (FCC-LoRa1+BLE)
Test Voltage:	DC 5V Via USB port
Test Standard:	EN 301489-1
Test By:/Review By:	Junhua/ Shower Dai
Tem./Hum./Pressure:	24.3°C/52.2%/101kPa
Remark:	SR2



Critical Freqs

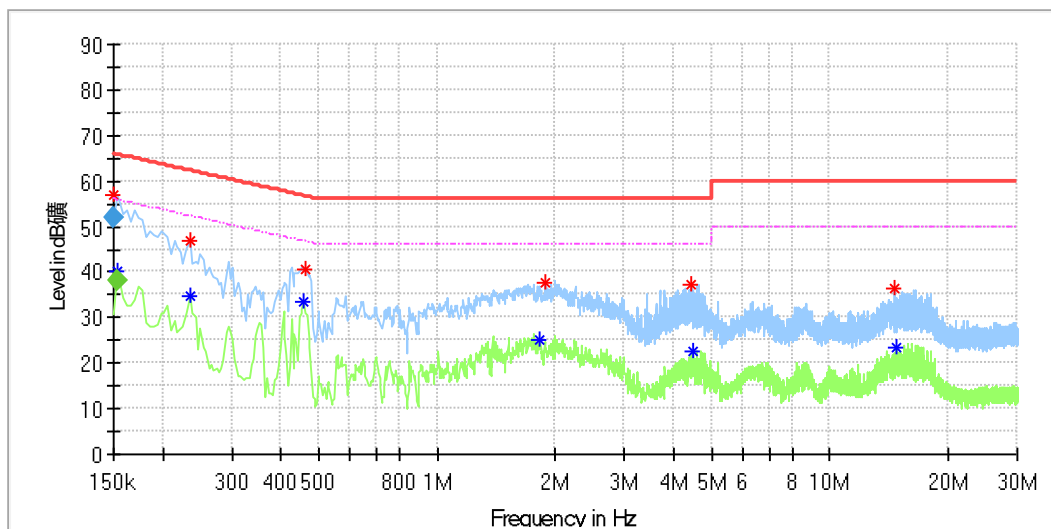
Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.165500	58.77	---	65.36	6.59	L1	9.9
0.166500	---	43.71	55.36	11.66	L1	9.9
0.210000	---	35.70	53.21	17.50	L1	9.9
0.218000	52.85	---	62.90	10.04	L1	9.9
0.430000	---	33.15	47.25	14.10	L1	9.9
0.430000	41.52	---	57.25	15.73	L1	9.9
2.374000	---	25.11	46.00	20.89	L1	10.2
2.382000	35.44	---	56.00	20.56	L1	10.2
4.366000	---	21.67	46.00	24.33	L1	10.2
4.366000	36.64	---	56.00	19.36	L1	10.2
16.186000	---	26.51	50.00	23.49	L1	10.4
16.206000	36.43	---	60.00	23.57	L1	10.4

Final Result

Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.165500	55.79	---	65.18	9.39	1000.0	9.000	L1	9.9
0.166500	---	42.25	55.13	12.89	1000.0	9.000	L1	9.9

EUT Information

EUT Name:	WisDuo LPWAN+BLE Module
Order Number:	168478328 50(P01450873)
Model:	RAK11720
Test Mode:	On, Normal Operating (FCC-LoRa1+BLE)
Test Voltage:	DC 5V Via USB port
Test Standard:	EN 301489-1
Test By./Review By:	Junhua/ Shower Dai
Tem./Hum./Pressure:	24.3°C/52.2%/101kPa
Remark:	SR2



Critical Freqs

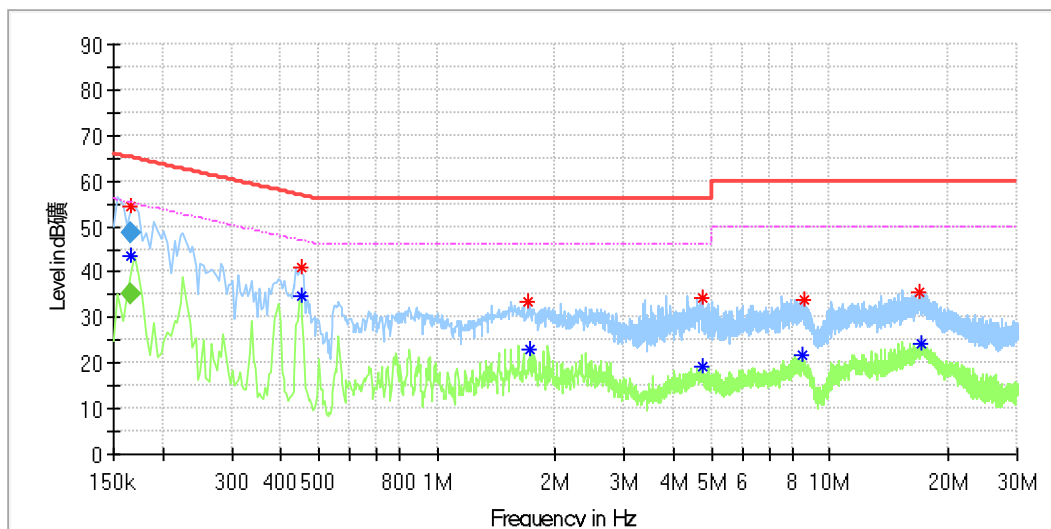
Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.150000	56.86	---	65.78	8.92	N	9.8
0.154000	---	40.22	55.78	15.56	N	9.8
0.234000	---	34.65	52.31	17.65	N	9.8
0.234000	47.03	---	62.31	15.27	N	9.8
0.458000	---	33.31	46.73	13.42	N	9.8
0.462000	40.46	---	56.66	16.19	N	9.8
1.830000	---	25.24	46.00	20.76	N	9.8
1.882000	37.64	---	56.00	18.36	N	9.8
4.446000	37.34	---	56.00	18.66	N	9.9
4.474000	---	22.80	46.00	23.20	N	9.9
14.542000	36.62	---	60.00	23.38	N	10.1
14.734000	---	23.41	50.00	26.59	N	10.1

Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.150000	52.09	---	66.00	13.91	1000.0	9.000	N	9.8
0.154000	---	38.24	55.78	17.54	1000.0	9.000	N	9.8

EUT Information

EUT Name:	WisDuo LPWAN+BLE Module
Order Number:	168478328 50(P01450873)
Model:	RAK11720
Test Mode:	On, Normal Operating (FCC-LoRa2+BLE)
Test Voltage:	DC 5V Via USB port
Test Standard:	EN 301489-1
Test By./Review By:	Junhua/ Shower Dai
Tem./Hum./Pressure:	24.3°C/52.2%/101kPa
Remark:	SR2



Critical Freqs

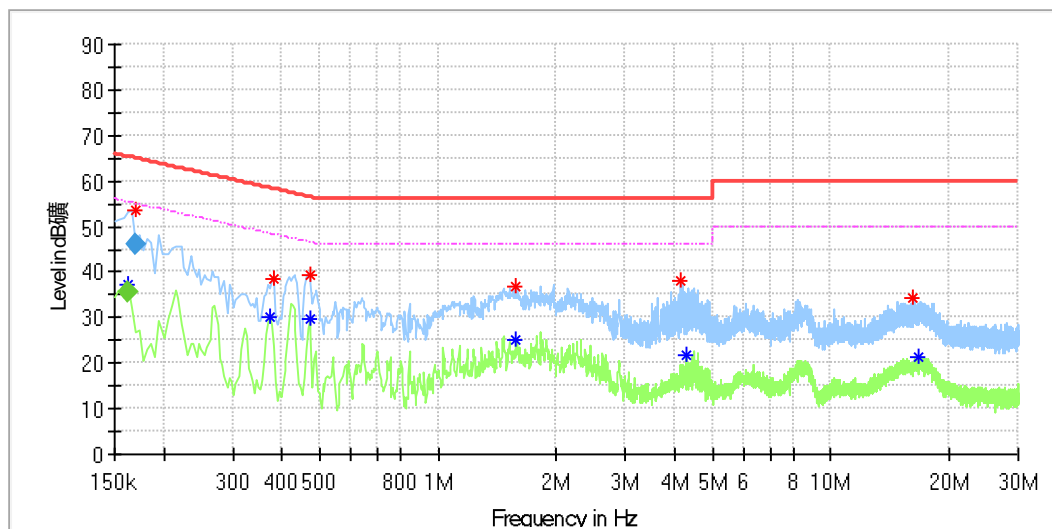
Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.165500	54.32	---	64.96	10.64	L1	9.9
0.165500	---	43.71	54.96	11.25	L1	9.9
0.450000	---	34.76	46.88	12.11	L1	9.9
0.450000	40.86	---	56.88	16.02	L1	9.9
1.710000	33.40	---	56.00	22.60	L1	10.1
1.718000	---	23.12	46.00	22.88	L1	10.1
4.722000	---	19.15	46.00	26.85	L1	10.2
4.730000	34.12	---	56.00	21.88	L1	10.2
8.506000	---	21.65	50.00	28.35	L1	10.3
8.618000	33.97	---	60.00	26.03	L1	10.3
16.814000	35.47	---	60.00	24.53	L1	10.4
17.038000	---	24.16	50.00	25.84	L1	10.4

Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.165500	---	35.08	55.18	20.10	1000.0	9.000	L1	9.9
0.165500	48.40	---	65.18	16.78	1000.0	9.000	L1	9.9

EUT Information

EUT Name:	WisDuo LPWAN+BLE Module
Order Number:	168478328 50(P01450873)
Model:	RAK11720
Test Mode:	On, Normal Operating (FCC-LoRa2+BLE)
Test Voltage:	DC 5V Via USB port
Test Standard:	EN 301489-1
Test By./Review By:	Junhua/ Shower Dai
Tem./Hum./Pressure:	24.3°C/52.2%/101kPa
Remark:	SR2



Critical Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.161500	---	37.27	55.36	18.09	N	9.8
0.169500	53.44	---	65.16	11.72	N	9.8
0.374000	---	30.19	48.41	18.23	N	9.8
0.382000	38.56	---	58.24	19.68	N	9.8
0.470000	---	29.90	46.51	16.62	N	9.8
0.470000	39.31	---	56.51	17.20	N	9.8
1.578000	36.77	---	56.00	19.23	N	9.8
1.582000	---	25.12	46.00	20.88	N	9.8
4.126000	38.28	---	56.00	17.72	N	9.9
4.278000	---	21.58	46.00	24.42	N	9.9
16.150000	34.50	---	60.00	25.50	N	10.2
16.710000	---	21.34	50.00	28.66	N	10.2

Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.161500	---	35.68	55.39	19.71	1000.0	9.000	N	9.8
0.169500	46.24	---	64.99	18.74	1000.0	9.000	N	9.8