Prüfbericht - Produkte
Test Report - Products

TÜVRheinland®

Prüfbericht-Nr.: *Test report no.:*	**CN211F02 001**	**Auftrags-Nr.:** *Order no.:*	168337755	Seite 1 von 31 *Page 1 of 31*
Kunden-Referenz-Nr.: *Client reference no.:*	N/A	**Auftragsdatum:** *Order date:*	2021-09-26	
Auftraggeber: *Client:*	**Shenzhen RAKwireless Technology Co.,Ltd.** Room 506, Building B, New Compark, Pingshan First Road, Taoyuan Street, Nanshan District, Shenzhen, Guangdong, China			
Prüfgegenstand: *Test item:*	LoRa Concentrator Module			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	RAK2287X (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 CFR47 FCC Part 2: Section 2.1093		RSS-247 Issue 2 February 2017 RSS-Gen Issue 5 February 2021 RSS-102 Issue 5 February 2021	

Wareneingangsdatum: *Date of sample receipt:*	2021-09-27
Prüfmuster-Nr.: *Test sample no.:*	A003136820-001~010
Prüfzeitraum: *Testing period:*	2021-09-28 - 2021-10-18
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 Hardy Suo
Datum: *Date:* 2021-10-19	Signed by: Alex Lan	**Ausstellungsdatum:** *Issue date:* 2021-10-19	Signed by: Hardy Suo
Stellung / Position	Senior Project Engineer	**Stellung** / Position	Reviewer

Sonstiges / *Other:* FCC ID: 2AF6B-RAK2287X
IC: 25908-RAK2287X, HVIN: RAK2287X

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

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.
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.

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 5
1.1 COMPLEMENTARY MATERIALS 5
2 TEST SITES 5
2.1 TEST FACILITIES 5
2.2 LIST OF TEST AND MEASUREMENT INSTRUMENTS 6
2.3 TRACEABILITY 7
2.4 CALIBRATION 7
2.5 MEASUREMENT UNCERTAINTY 7
2.6 LOCATION OF ORIGINAL DATA 7
2.7 STATUS OF FACILITY USED FOR TESTING 7
3 GENERAL PRODUCT INFORMATION 8
3.1 PRODUCT FUNCTION AND INTENDED USE 8
3.2 RATINGS AND SYSTEM DETAILS 9
3.3 INDEPENDENT OPERATION MODES 10
3.4 NOISE GENERATING AND NOISE SUPPRESSING PARTS 10
3.5 SUBMITTED DOCUMENTS 10
4 TEST SET-UP AND OPERATION MODES 11
4.1 PRINCIPLE OF CONFIGURATION SELECTION 11
4.2 TEST OPERATION AND TEST SOFTWARE 11
4.3 SPECIAL ACCESSORIES AND AUXILIARY EQUIPMENT 11
4.4 COUNTERMEASURES TO ACHIEVE EMC COMPLIANCE 11
4.5 TEST SETUP DIAGRAM 12
5 TEST RESULTS 14
5.1 TRANSMITTER REQUIREMENT & TEST SUITES 14
5.1.1 Antenna Requirement 14
5.1.2 Maximum Conducted Output Power 15
5.1.3 Conducted Power Spectral Density 17
5.1.4 6dB Bandwidth 19
5.1.5 20dB Bandwidth 20
5.1.6 99% Bandwidth 21
5.1.7 Conducted Spurious Emissions Measured in 100 kHz Bandwidth 22
5.1.8 Radiated Spurious Emission 23
5.1.9 Carrier Frequency Separation 24
5.1.10 Number of Hopping Frequency 26
5.1.11 Time of Occupancy 27
5.1.12 Conducted Emission on AC Mains 28
6 SAFETY HUMAN EXPOSURE 29
6.1 RADIO FREQUENCY EXPOSURE COMPLIANCE 29
6.1.1 Electromagnetic Fields 29

7 **PHOTOGRAPHS OF THE TEST SET-UP** **31**

8 **LIST OF TABLES** **31**

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

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

TÜV Rheinland (Shenzhen) Co., Ltd.

Radio Spectrum Testing (SRD-Tonscend)				
Equipment	**Manufacturer**	**Model**	**Serial No.**	**Cal. until**
EXA Signal Analyzer, Multi-touch	Keysight	N9010B	MY60241175	2022-09-28
MXG X-Series RF Vector Signal Generator	Keysight	N5182B	MY61250137	2022-09-28
EXG X-Series Microwave Analog Signal Generator	Keysight	N5173B	MY61250141	2022-09-28
DC power supply	Keysight	E3642A	N/A	2022-09-28
Wireless Connectivity Tester	R&S	CMW270	101375	2022-08-09
Power Control Unit	Tonscend	JS0806-4ADC	N/A	2022-09-28
Automation Control Unit	Tonscend	JS0806-2	21C8060396	2022-09-28
Test Software	Tonscend	JS1120-3	N/A	N/A
Control PC	Lenovo	TianYi510S-071MB	YLX23JMF	N/A
Unwanted Emission Testing (TS9975)				
Equipment	**Manufacturer**	**Model**	**Serial No.**	**Cal. until**
EMI Test Receiver	R&S	ESR 7	102021	2022-08-10
Signal Analyzer	R&S	FSV 40	101439	2022-08-09
System Controller Interface	R&S	SCI-100	S10010038	N/A
Filterbank	R&S	Wlan	100759	2022-08-09
OSP	R&S	OSP 120	102040	N/A
Pre-amplifier	R&S	SCU08F1	08320031	2022-08-09
Amplifier	R&S	SCU-18F	180070	2022-08-09
Amplifier	R&S	SCU40A	100475	2022-08-09
Trilog Broadband Antenna (30 MHz - 7 GHz)	Schwarzbeck	VULB 9162	193	2022-08-08
Double-Ridged Antenna (1 -18 GHz)	ETS-LINDGREN	3117	00218717	2022-08-08
Wideband Ridged Horn Antenna (18-40 GHz)	Steatite	QMS-00880	19067	2022-08-08
Active Loop Antenna	Schwarzbeck	FMZB 1513	302	2022-09-13
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	102428	2022-08-10
Artificial Mains Network	R&S	ENV216	102333	2022-08-10
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

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 LoRa Concentrator Module which supports Lora technology.

This module has three different antennas, the details specifications for these antennas as below:

Antenna #	Model	Antenna Gain	Antenna Type	Connector Type
1#	RAKARG15	8dBi	Fiber Glass Antenna	N-type male connector
2#	RAKARG14	5.8dBi	Fiber Glass Antenna	N-type male connector
3#	RAKARJ14	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, they are considered as equivalent antennas. Thus, the antenna 1# with highest gain was selected to be tested.

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
8	LoRa Modulation: SF12 / Bandwidth 500 kHz	980
9	LoRa Modulation: SF11 / Bandwidth 500 kHz	1760
10	LoRa Modulation: SF10 / Bandwidth 500 kHz	3900
11	LoRa Modulation: SF9 / Bandwidth 500 kHz	7000
12	LoRa Modulation: SF8 / Bandwidth 500 kHz	12500
13	LoRa Modulation: SF7 / Bandwidth 500 kHz	21900

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	LoRa Concentrator Module
Type Designation	RAK2287X
Trademark	RAK
FCC ID	2AF6B-RAK2287X
IC	25908-RAK2287X
HVIN	RAK2287X
Operating Voltage	DC 3.3V (Supplied by socket of PCB board)

Technical Specification of Lora DTS	
Operating Frequency	904.6MHz, 923.3 - 927.5MHz
Type of Modulation	Lora
Data Rate	SF8 / DR4 for 904.6MHz SF7 – SF12 / DR8 – DR13 for 923.3 - 927.5MHz
Channel Number	8 channels for 923.3 - 927.5MHz
Occupied Bandwidth	500 KHz
Technical Specification of Lora Hybrid	
Frequency Range	903.9MHz - 905.3MHz
Type of Modulation	Lora
Data Rate	SF7 – SF10 / DR0 – DR3
Channel Number	8 channels
Channel Separation	200 KHz
Occupied Bandwidth	125 KHz

Table 3: RF Channel and Frequency of Lora DTS

RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)
0	**923.3**	2	924.5	4	925.7	6	926.9
1	923.9	**3**	**925.1**	5	926.3	**7**	**927.5**

Table 4: RF Channel and Frequency of Lora Hybrid

RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)
0	**903.9**	2	904.3	4	904.7	6	905.1
1	904.1	**3**	**904.5**	5	904.9	**7**	**905.3**

3.3 Independent Operation Modes

The basic operation modes are:

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

B. On, Transmitting on Hopping channel (Hybrid)

C. 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 RAK2287X with Ant#1 & Ant#3 in this report.

4.3 Special Accessories and Auxiliary Equipment

Table 5: Auxiliary Equipment Used during Test

Description	Manufacturer	Model	S/N	Rating
Laptop	Lenovo	T480	PF-16A6N8	N/A
Power adapter	RISUNIC	RA040-0503000US	N/A	Input: 100-240V, 50/60Hz Output: 5.0V, 3.0A

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)

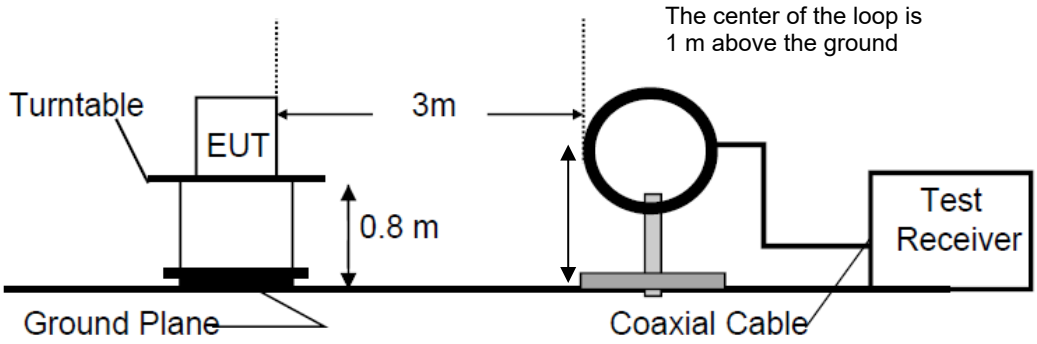


Diagram of Measurement Configuration for Radiation Test (Below 1GHz)

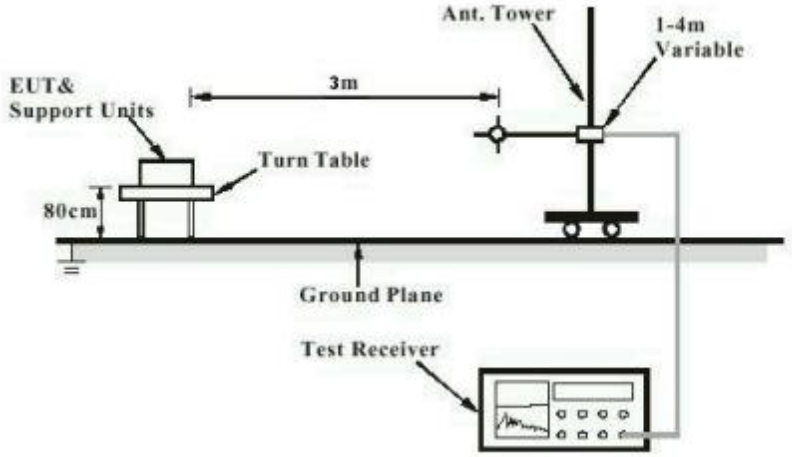


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

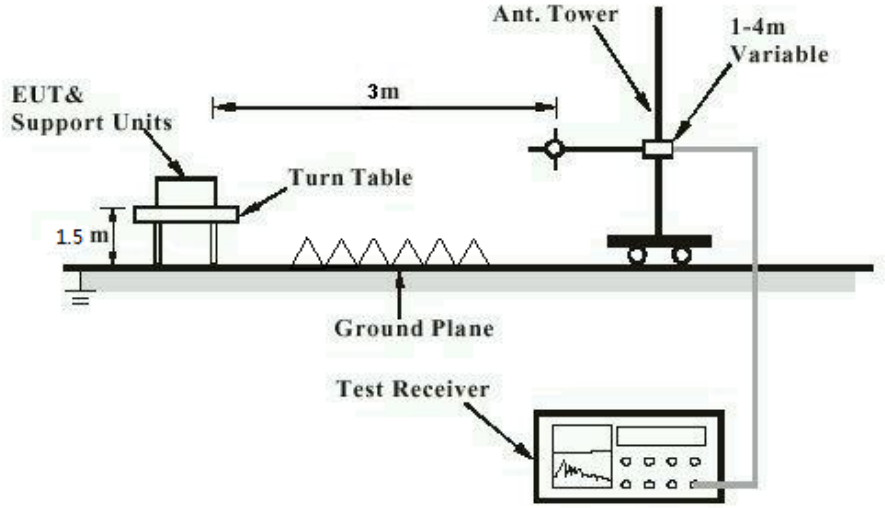


Diagram of Measurement Configuration for Mains Conduction Measurement

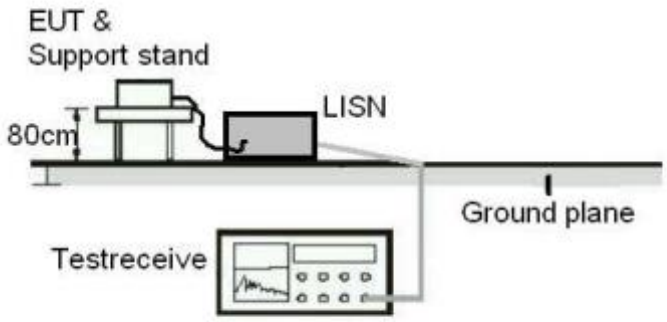
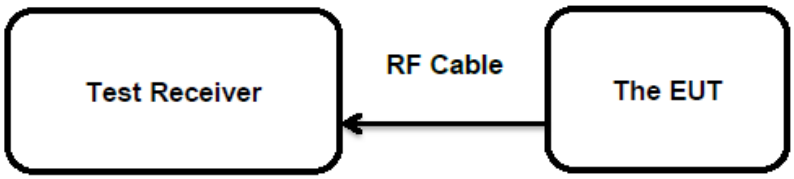


Diagram of Measurement Configuration for Conducted Transmitter Measurement



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 three external antennas, the maximum directional gain of antenna are 2.3dBi & 5.8dBi & 8dBi, 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	:	< 1.0 W (30 dBm) for antenna gain less than 6dBi < 0.631 W (28 dBm) for antenna gain more than 6dBi
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2021-09-29 - 2021-10-11
Input voltage	:	DC 3.3V
Operation mode	:	A, B
Test channel	:	Low / Middle / High
Ambient temperature	:	25 ℃
Relative humidity	:	56 %
Atmospheric pressure	:	101 kPa

For Antenna Gain less than 6dBi

Table 6: Test Result of Maximum Conducted Output Power, Lora DTS

Test Mode	Test Channel (MHz)	Measured Conducted Power		Limit
		(dBm)	(W)	
Lora DTS SF7	923.3	23.59	0.2286	< 1.0 W (30 dBm)
	925.1	23.94	0.2477	
	927.5	23.67	0.2328	
Lora DTS SF12	923.3	23.68	0.2333	
	925.1	23.89	0.2449	
	927.5	23.68	0.2333	
Lora DTS SF8	904.6	24.39	0.2748	
Max. Measured Value		24.39	0.2748	

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

Test Mode	Test Channel (MHz)	Measured Conducted Power		Limit (W)
		(dBm)	(W)	
Lora Hybrid SF7	903.9	19.87	0.0971	< 1.0 W (30 dBm)
	904.5	19.74	0.0942	
	905.3	19.72	0.0938	
Lora Hybrid SF9	903.9	20.58	0.1143	
	904.5	20.50	0.1122	
	905.3	20.79	0.1199	
Lora Hybrid SF10	903.9	19.89	0.0975	
	904.5	19.70	0.0933	
	905.3	19.66	0.0925	
Max. Measured Value		20.79	0.1199	

Note:
1) The cable loss is taken into account in results.
2) Maximum Antenna gain(G) : 5.8 dBi,
Maximum e.i.r.p.=30.19dBm = 1.045W, which is far below the 4 W

For Antenna Gain 8dBi

Table 8: Test Result of Maximum Conducted Output Power, Lora DTS

Test Mode	Test Channel (MHz)	Measured Conducted Power		Limit
		(dBm)	(W)	
Lora DTS SF7	923.3	22.00	0.1585	< 0.631 W (28 dBm)
	925.1	22.10	0.1622	
	927.5	22.00	0.1585	
Lora DTS SF12	923.3	21.96	0.1570	
	925.1	22.26	0.1683	
	927.5	21.97	0.1574	
Lora DTS SF8	904.6	22.06	0.1607	
Max. Measured Value		22.26	0.1683	

Table 9: Test Result of Maximum Conducted Output Power, Lora Hybrid

Test Mode	Test Channel (MHz)	Measured Conducted Power		Limit (W)
		(dBm)	(W)	
Lora Hybrid SF7	903.9	18.23	0.0665	< 0.631 W (28 dBm)
	904.5	18.10	0.0646	
	905.3	18.06	0.0640	
Lora Hybrid SF9	903.9	18.11	0.0647	
	904.5	17.94	0.0622	
	905.3	18.04	0.0637	
Lora Hybrid SF10	903.9	18.25	0.0668	
	904.5	18.06	0.0640	
	905.3	18.02	0.0634	
Max. Measured Value		18.25	0.0668	

Note:
3) The cable loss is taken into account in results.
4) Maximum Antenna gain(G) : 8 dBi,
Maximum e.i.r.p.=30.26dBm = 1.062W, 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), FCC Part 15.247(f) RSS-247 Clause 5.2(b), RSS-247 Clause 5.3
Basic standard	:	ANSI C63.10: 2013
Limits	:	< 8 dBm / 3kHz for antenna gain less than 6dBi < 6 dBm / 3kHz for antenna gain 8dBi
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2021-09-29 - 2021-10-11
Input voltage	:	DC 3.3V
Operation mode	:	B
Test channel	:	Low / Middle / High
Ambient temperature	:	25 ℃
Relative humidity	:	56 %
Atmospheric pressure	:	101 kPa

For Antenna Gain less than 6dBi

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

Test Mode	Test Channel (MHz)	Measured Power Spectral Density (dBm/3KHz)
Lora DTS SF7	923.3	4.763
	925.1	4.921
	927.5	4.876
Lora DTS SF12	923.3	5.297
	925.1	5.416
	927.5	5.100
Lora DTS SF8	904.6	4.213
Maximum Measured Value		5.416

Table 11: Test Result of Maximum Power Spectral Density, Lora Hybrid

Test Mode	Test Channel (MHz)	Measured Power Spectral Density (dBm/3KHz)
Lora Hybrid SF7	903.9	7.248
	904.5	7.073
	905.3	7.154
Lora Hybrid SF9	903.9	7.232
	904.5	7.289
	905.3	7.187
Lora Hybrid SF10	903.9	7.302
	904.5	7.374
	905.3	7.216
Maximum Measured Value		7.374

For Antenna Gain 8dBi

Table 12: Test Result of Maximum Power Spectral Density, Lora DTS

Test Mode	Test Channel (MHz)	Measured Power Spectral Density (dBm/3KHz)
Lora DTS SF7	923.3	2.248
	925.1	1.943
	927.5	1.988
Lora DTS SF12	923.3	3.796
	925.1	3.979
	927.5	3.95
Lora DTS SF8	904.6	1.897
Maximum Measured Value		3.979

Table 13: Test Result of Maximum Power Spectral Density, Lora Hybrid

Test Mode	Test Channel (MHz)	Measured Power Spectral Density (dBm/3KHz)
Lora Hybrid SF7	903.9	5.321
	904.5	5.174
	905.3	5.036
Lora Hybrid SF9	903.9	5.096
	904.5	5.030
	905.3	5.021
Lora Hybrid SF10	903.9	5.469
	904.5	5.292
	905.3	5.445
Maximum Measured Value		5.469

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	:	2021-10-11
Input voltage	:	DC 3.3V
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 14: Test Result of 6dB Bandwidth, Lora DTS

Test Mode	Test Channel (MHz)	6dB Bandwidth (KHz)	Limit (MHz)
Lora DTS SF7	923.3	623.0	>500KHz
	925.1	622.0	
	927.5	619.0	
Lora DTS SF12	923.3	641.0	
	925.1	641.0	
	927.5	641.0	
Lora DTS SF8	904.6	674.0	
Minimum Measured Value		674.0	

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	:	2021-10-11
Input voltage	:	DC 3.3V
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 15: Test Result of 20dB Bandwidth, Lora Hybrid

Test Mode	Channel Frequency (MHz)	20dB Bandwidth (kHz)	Limit (MHz)
Lora Hybrid SF7	903.9	120.40	<500KHz
	904.5	120.45	
	905.3	120.75	
Lora Hybrid SF9	903.9	123.33	
	904.5	123.47	
	905.3	123.49	
Lora Hybrid SF10	903.9	123.72	
	904.5	123.62	
	905.3	123.67	

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	:	2021-10-11
Input voltage	:	DC 3.3V
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 16: Test Result of 99% Bandwidth, Lora DTS

Test Mode	Test Channel (MHz)	99% Bandwidth (KHz)	Limit (MHz)
Lora DTS SF7	923.3	502.87	/
	925.1	501.34	
	927.5	500.41	
Lora DTS SF12	923.3	505.11	
	925.1	504.93	
	927.5	504.40	
Lora DTS SF8	904.6	529.50	
Minimum Measured Value		529.50	

Table 17: Test Result of 99% Bandwidth, Lora Hybrid

Test Mode	Test Channel (MHz)	99% Bandwidth (KHz)	Limit (MHz)
Lora Hybrid SF7	903.9	120.45	/
	904.5	120.49	
	905.3	120.68	
Lora Hybrid SF9	903.9	123.44	
	904.5	123.45	
	905.3	123.50	
Lora Hybrid SF10	903.9	123.72	
	904.5	123.69	
	905.3	123.68	
Minimum Measured Value		123.72	

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	:	Refer to test result
Input voltage	:	DC 3.3V
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	:	2021-10-08 to 2021-10-09
Input voltage	:	DC 3.3V
Operation mode	:	A, B
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 horizontal) 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
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2021-10-11
Input voltage	:	DC 3.3V
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 18: Test Result of Carrier Frequency Separation

Test Mode	Channel	Channel Frequency (MHz)	Measured Channel Separation (KHz)	Limit (kHz)	Result
Lora Hybrid (FHSS SF7)	Low Channel	903.900	200	≥ 20dB bandwidth	Pass
	Adjacency Channel	903.700			
	Middle Channel	904.500	200		Pass
	Adjacency Channel	904.300			
	High Channel	905.101	201		Pass
	Adjacency Channel	904.900			
Lora Hybrid (FHSS SF9)	Low Channel	903.901	200	≥ 20dB bandwidth	Pass
	Adjacency Channel	903.701			
	Middle Channel	904.500	200		Pass
	Adjacency Channel	904.300			
	High Channel	905.101	201		Pass
	Adjacency Channel	904.900			
Lora Hybrid (FHSS SF10)	Low Channel	903.901	200	≥ 20dB bandwidth	Pass
	Adjacency Channel	903.701			
	Middle Channel	904.501	200		Pass
	Adjacency Channel	904.301			
	High Channel	905.100	200		Pass
	Adjacency Channel	904.900			

Note:

The limit is maximum 20 dB bandwidth: 123.72KHz.

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	:	2021-10-11
Input voltage	:	DC 3.3V
Operation mode	:	C
Ambient temperature	:	25 ℃
Relative humidity	:	56 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix B.

Table 19: Test result of hopping channel number

Test Mode	Hopping frequencies	Limit
Lora Hybrid (FHSS SF7)	8	/
Lora Hybrid (FHSS SF9)	8	/
Lora Hybrid (FHSS SF10)	8	/

5.1.11 Time of Occupancy

RESULT: **Pass**

Test Specification

Test standard	:	FCC part 15.247(f) RSS-247 Clause 5.3
Basic standard	:	ANSI C63.10: 2013
Limits	:	< 0.4s
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2021-10-11
Input voltage	:	DC 3.3V
Operation mode	:	C
Test channel	:	Low / Middle / High
Ambient temperature	:	25 ℃
Relative humidity	:	56 %
Atmospheric pressure	:	101 kPa

Table 20: Test result of Channel Occupancy

Test Mode	Period (s)	Channel Occupancy Time (ms)	Limit (ms)
Lora Hybrid (FHSS SF7)	20	52.76	400
Lora Hybrid (FHSS SF9)	20	240.0	400
Lora Hybrid (FHSS SF10)	20	138.6	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	:	2021-10-18
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 Safety Human Exposure

6.1 Radio Frequency Exposure Compliance

6.1.1 Electromagnetic Fields

RESULT: **Pass**

Test Specification

Test standard	:	CFR47 FCC Part 2: Section 2.1091
		CFR47 FCC Part 1: Section 1.1310
		FCC KDB Publication 447498 v06
		FCC KDB Publication 865664 D02 v01r02
		OET Bulletin 65 (Edition 97-01)
		RSS-102 Issue 5 February 2021

This module has three different antennas, and the maximum e.r.i.p. configuration be evaluated as below:

FCC requirement: Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 20cm normally can be maintained between the user and the device.

MPE Calculation Method according to OET Bulletin 65

Power Density: $S_{(mW/cm^2)}$= PG/4πR^2 or EIRP/4πR^2

Where:

S = power density (mW/cm^2)

P = power input to the antenna (mW)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna (cm)

The worst-case mode (the configuration having highest EIRP) specified:

Lora DTS: 24.39 dBm with 5.8 dBi antenna gain

From the peak RF output power, the minimum mobile separation distance, d=20 cm, the RF power density can be calculated as below:

For Lora DTS: **$S_{(mW/cm^2)}$= PG/4πR^2 =** 0.208 mW/cm^2

Limits for Maximum Permissible Exposure (MPE) according to FCC Part 1.1310: 0.6026 mW/cm2

- **IC requirements:** The EUT shall comply with the requirement of RSS-102 section 2.5.2.

Exemption from Routine Evaluation Limits – RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;

- RF exposure evaluation exempted power for Lora Hybrid & DTS: 1.37 W

The worst-case mode (the configuration having highest EIRP) specified:

Lora DTS: 24.39 dBm

Antenna Gain: 5.8 dBi

The Max. e.i.r.p. for Lora DTS: 30.19dBm = 1.045 W

Both e.i.r.p. for the Lora FHSS and Lora DTS are less than the RF exposure evaluation exempted power. So RF exposure evaluation is not required.

"RF Radiation Exposure Statement Caution: This Transmitter must be installed to provide a separation distance of at least 20 cm from all persons."

7 Photographs of the Test Set-Up

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

8 List of Tables

Table 1: List of Test and Measurement Equipment 6
Table 2: Technical Specification of EUT 9
Table 3: RF Channel and Frequency of Lora DTS 9
Table 4: RF Channel and Frequency of Lora Hybrid 9
Table 5: Auxiliary Equipment Used during Test 11
Table 6: Test Result of Maximum Conducted Output Power, Lora DTS 15
Table 7: Test Result of Maximum Conducted Output Power, Lora Hybrid 15
Table 8: Test Result of Maximum Conducted Output Power, Lora DTS 16
Table 9: Test Result of Maximum Conducted Output Power, Lora Hybrid 16
Table 10: Test Result of Maximum Power Spectral Density, Lora DTS 17
Table 11: Test Result of Maximum Power Spectral Density, Lora Hybrid 18
Table 12: Test Result of Maximum Power Spectral Density, Lora DTS 18
Table 13: Test Result of Maximum Power Spectral Density, Lora Hybrid 18
Table 14: Test Result of 6dB Bandwidth, Lora DTS 19
Table 15: Test Result of 20dB Bandwidth, Lora Hybrid 20
Table 16: Test Result of 99% Bandwidth, Lora DTS 21
Table 17: Test Result of 99% Bandwidth, Lora Hybrid 21
Table 18: Test Result of Carrier Frequency Separation 25
Table 19: Test result of hopping channel number 26
Table 20: Test result of Channel Occupancy 27

Appendix B: Test Results

APPENDIX B: TEST RESULTS 1

APPENDIX B.1: 6DB BANDWIDTH 2
Lora DTS 8 2
Lora DTS 7 2
Lora DTS 12 3
APPENDIX B.2: 20DB BANDWIDTH 5
Lora Hybrid SF7 5
Lora Hybrid SF9 6
Lora Hybrid SF10 7
APPENDIX B.3: 99% BANDWIDTH 9
Lora DTS 8 9
Lora DTS SF7 9
Lora DTS SF12 10
Lora Hybrid SF7 11
Lora Hybrid SF9 12
Lora Hybrid SF10 13
APPENDIX B.4: CONDUCTED SPURIOUS EMISSIONS MEASURED IN 100 KHZ BANDWIDTH 15
Lora DTS 8 15
Lora DTS SF7 16
Lora DTS SF12 19
APPENDIX B.5: CARRIER FREQUENCY SEPARATION 22
Lora Hybrid SF7 22
Lora Hybrid SF9 23
Lora Hybrid SF10 24
APPENDIX B.6: NUMBER OF HOPPING FREQUENCY 25
Lora Hybrid SF7 25
Lora Hybrid SF9 25
Lora Hybrid SF10 25
APPENDIX B.7: TEST RESULTS OF RADIATED SPURIOUS EMISSIONS 26
Lora DTS SF7 with 2.3dBi antenna 26
Lora DTS SF12 with 2.3dBi antenna 44
Lora DTS SF8 with 2.3dBi antenna 50
Lora DTS SF7 with 8 dBi antenna 56
APPENDIX B.8: TEST RESULTS OF CONDUCTED EMISSION ON AC MAINS 62

Appendix B.1: 6dB Bandwidth

Lora DTS 8
904.6MHz



Lora DTS 7
Low Channel



Middle Channel



High Channel



Lora DTS 12

Low Channel



Middle Channel



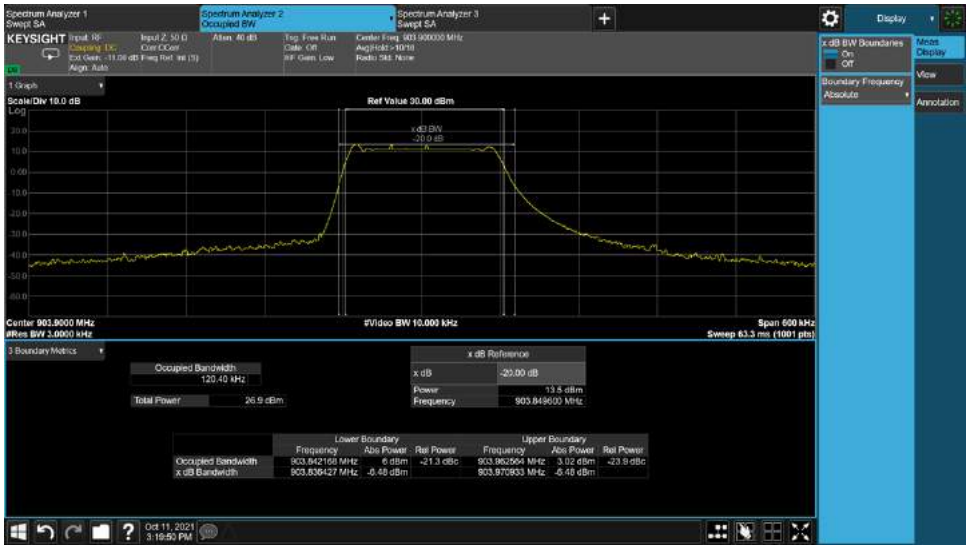
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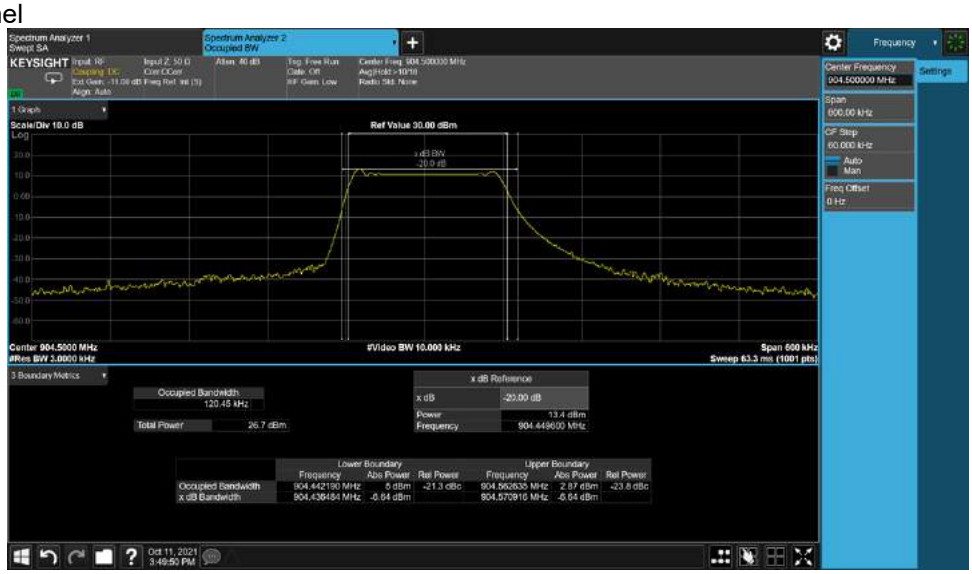
Appendix B.2: 20dB Bandwidth

Lora Hybrid SF7

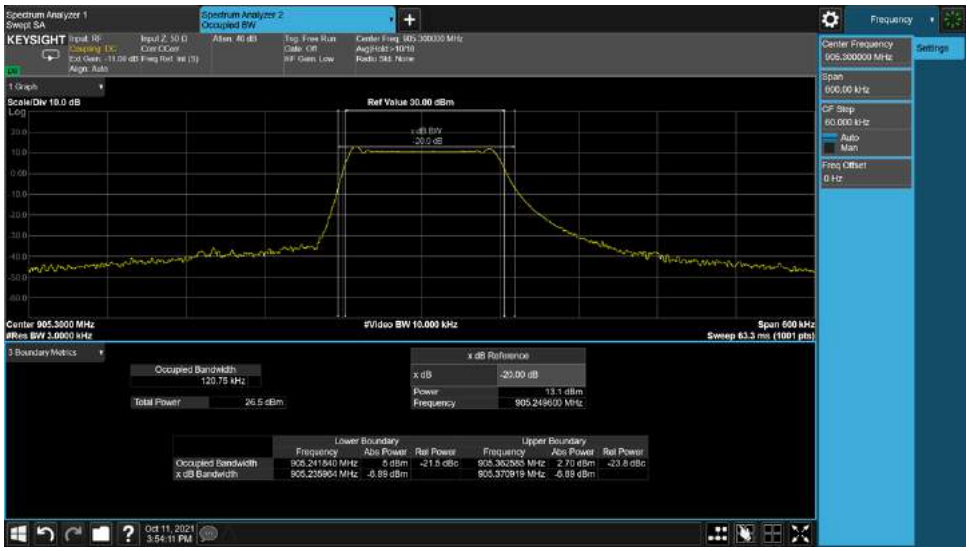
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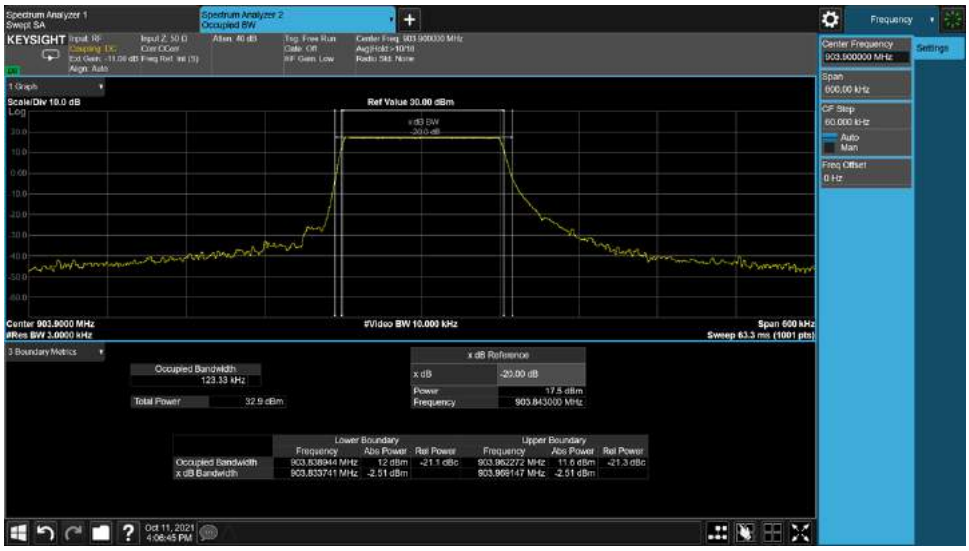
Middle Channel



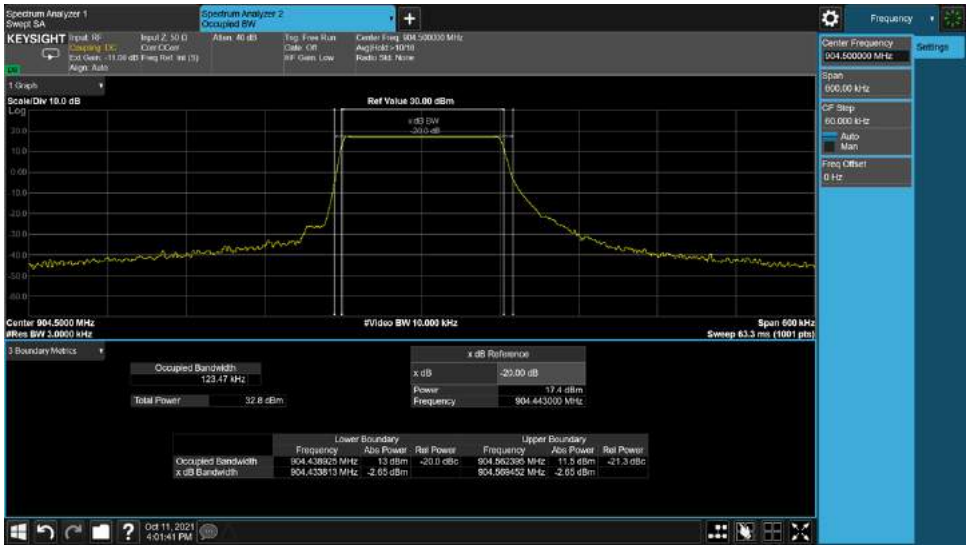
High Channel



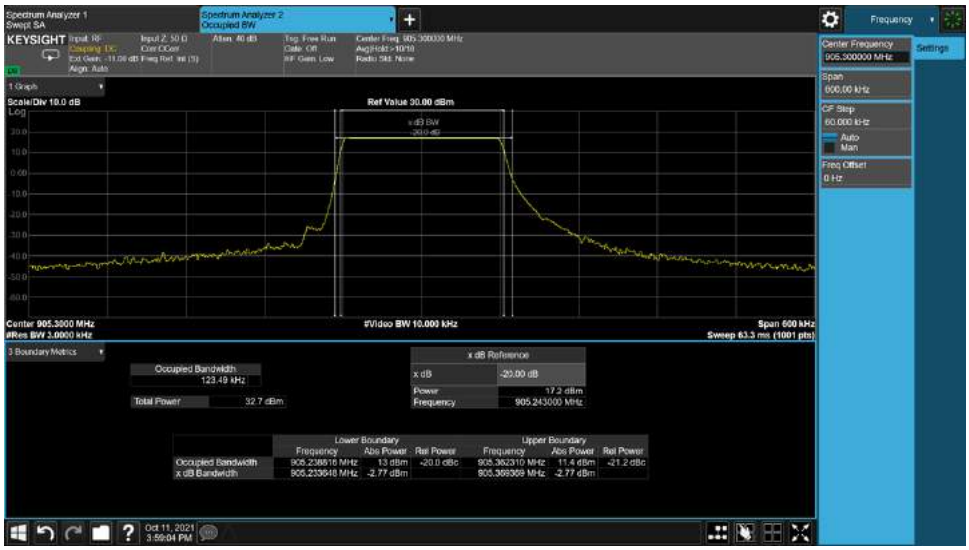
Lora Hybrid SF9
Low Channel



Middle Channel

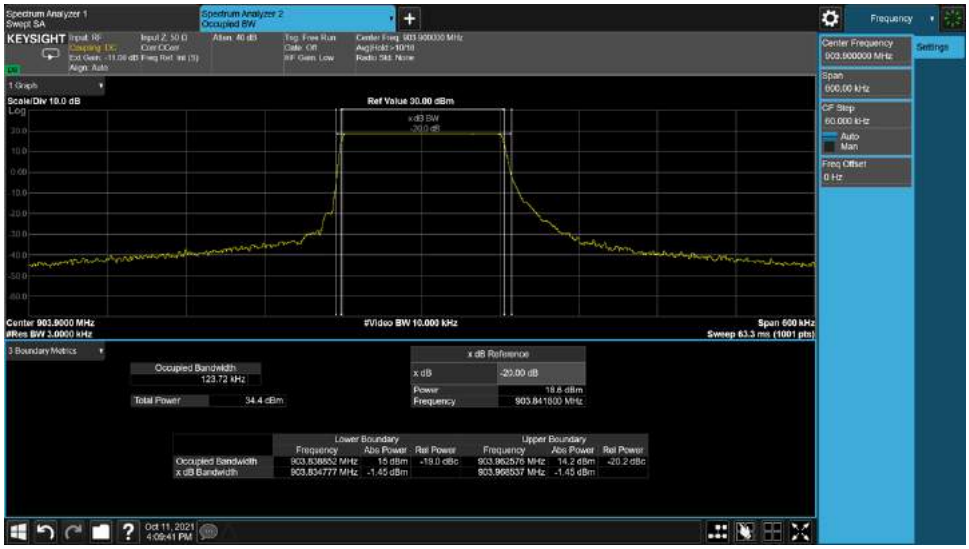


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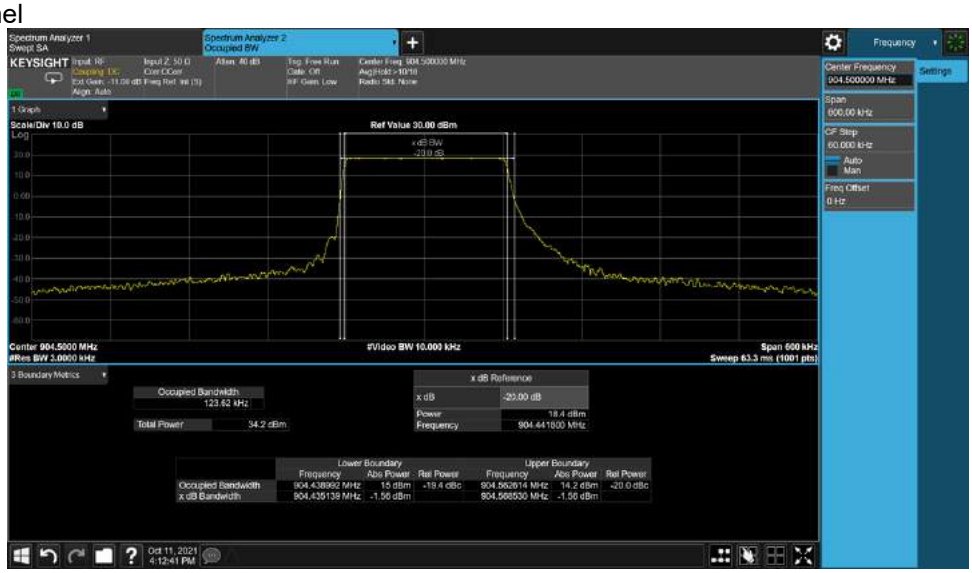


Lora Hybrid SF10

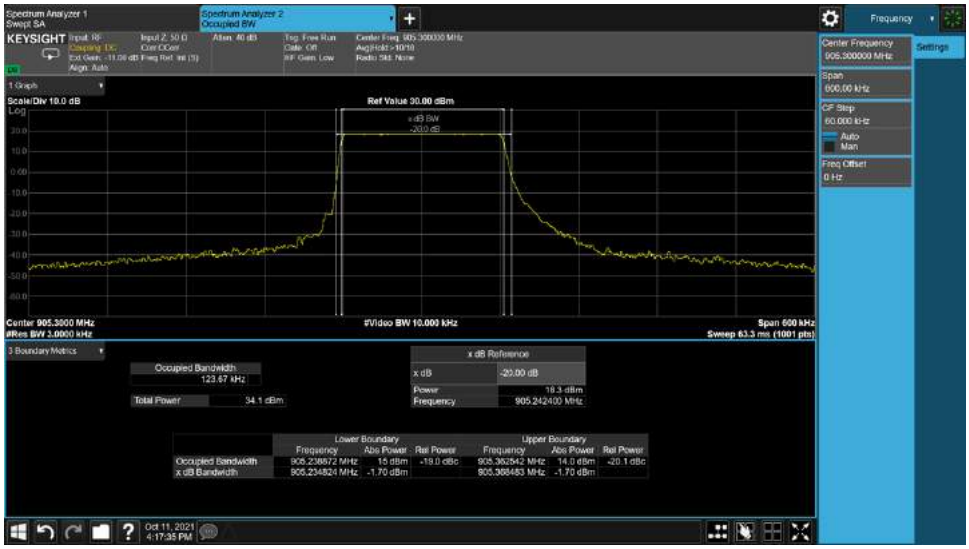
Low Channel



Middle Channel

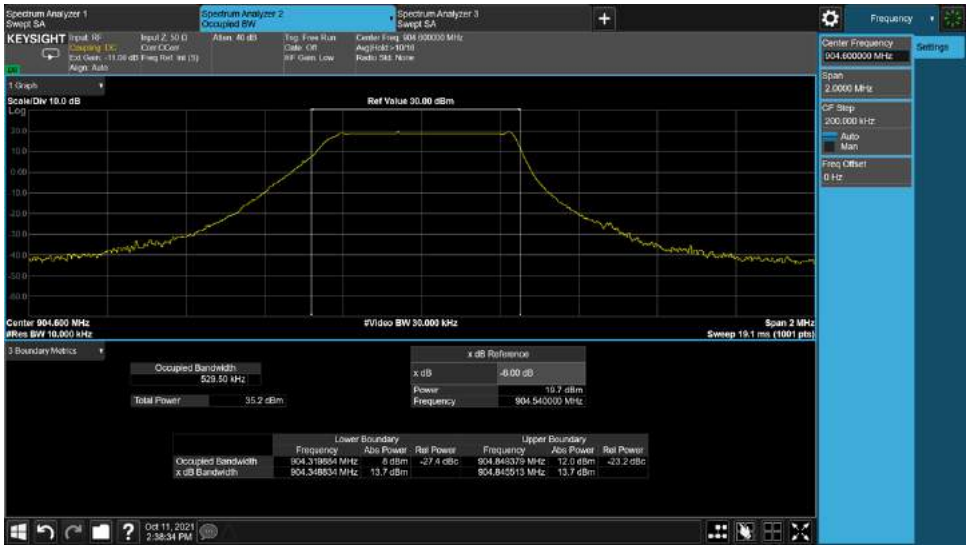


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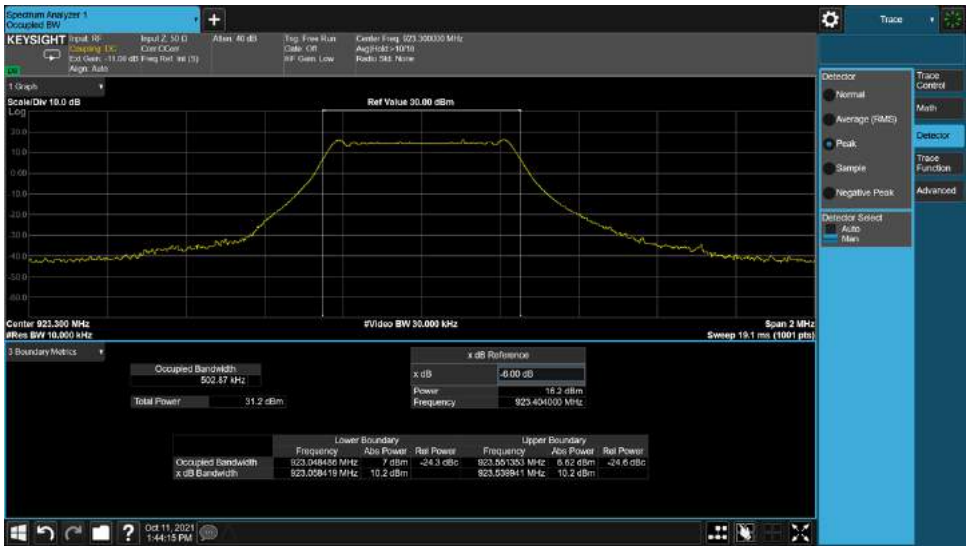


Appendix B.3: 99% Bandwidth

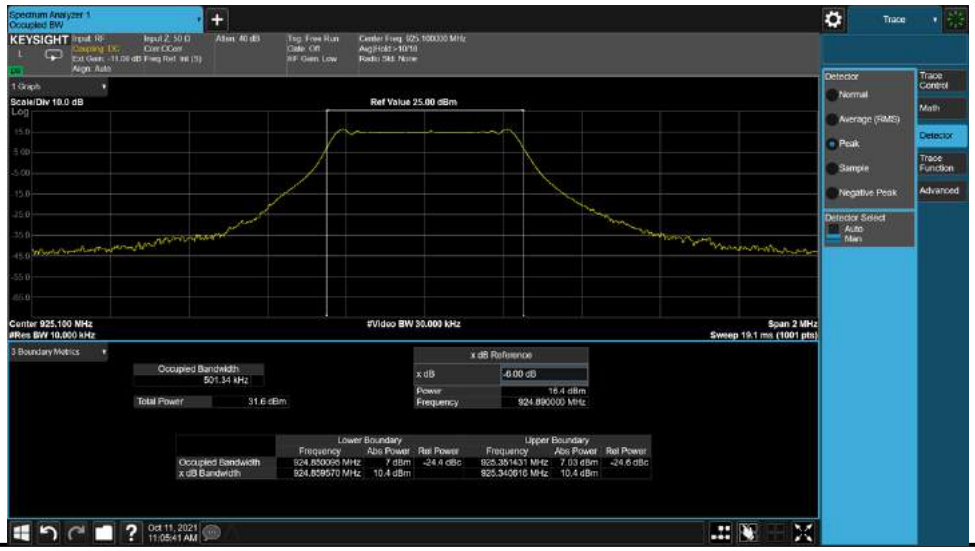
Lora DTS 8
904.6MHz



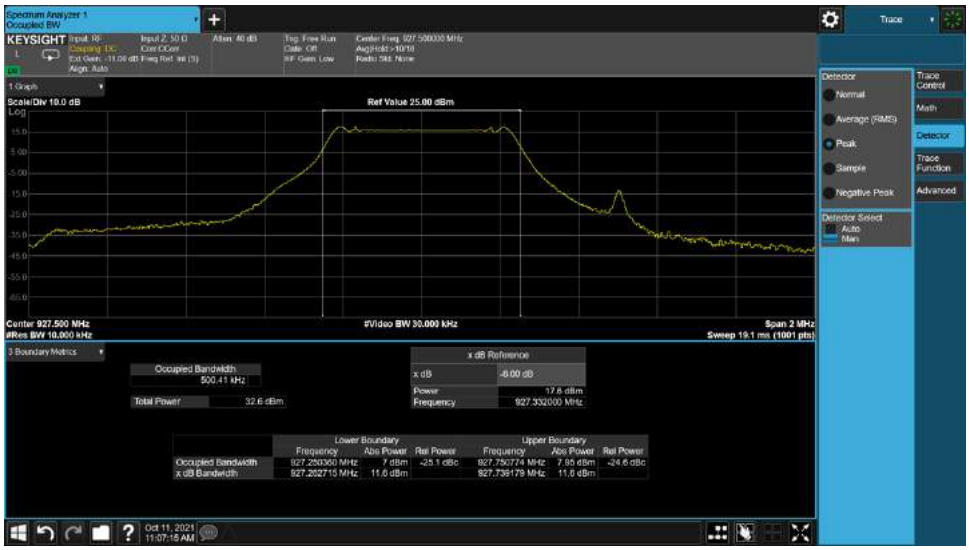
Lora DTS SF7
Low Channel



Middle Channel

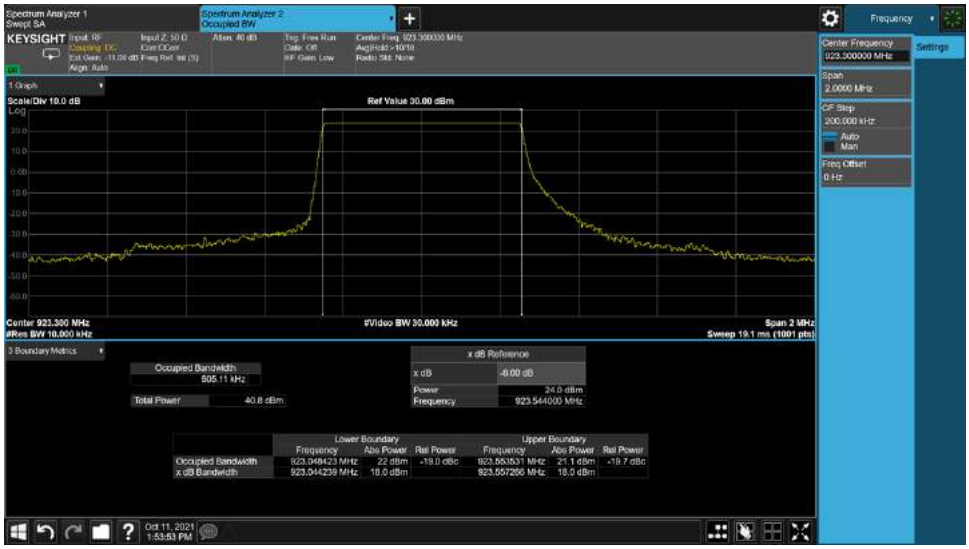


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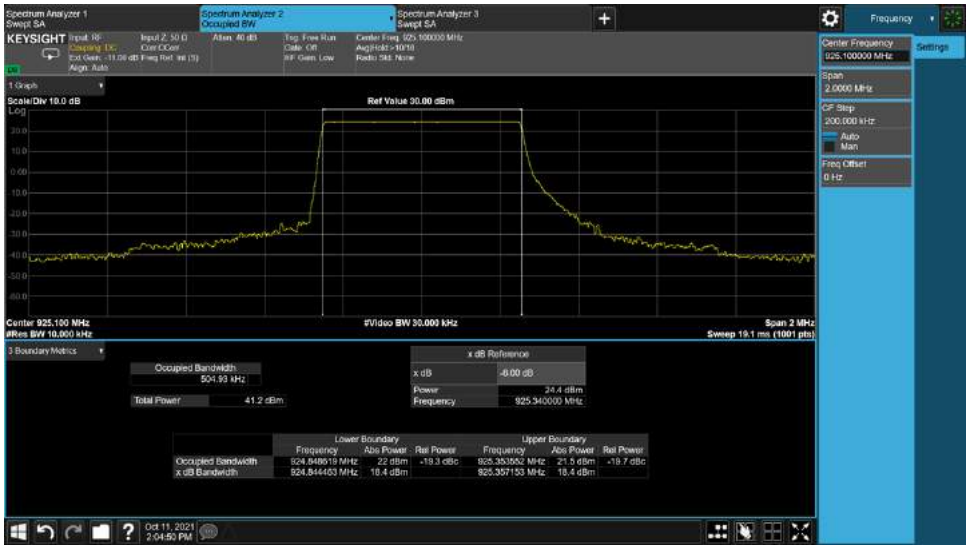


Lora DTS SF12

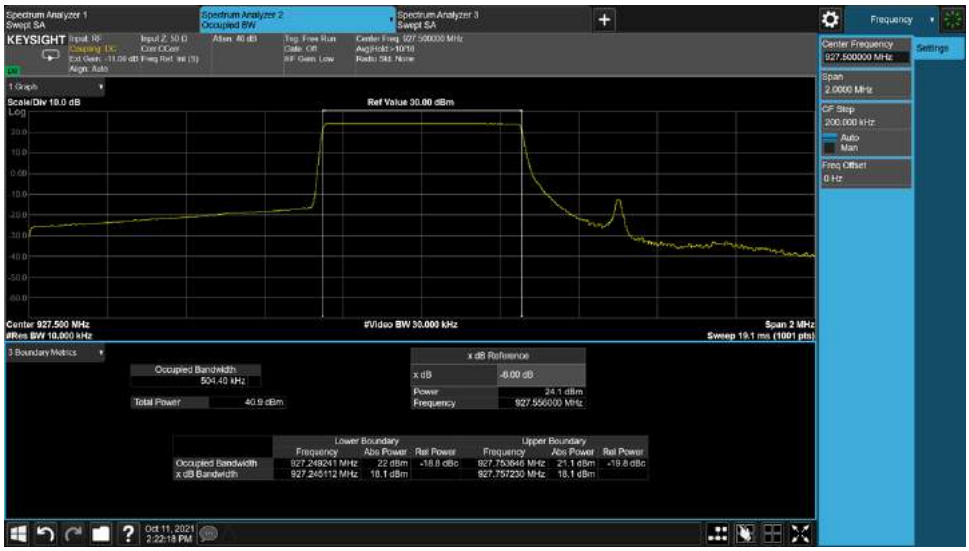
Low Channel



Middle Channel

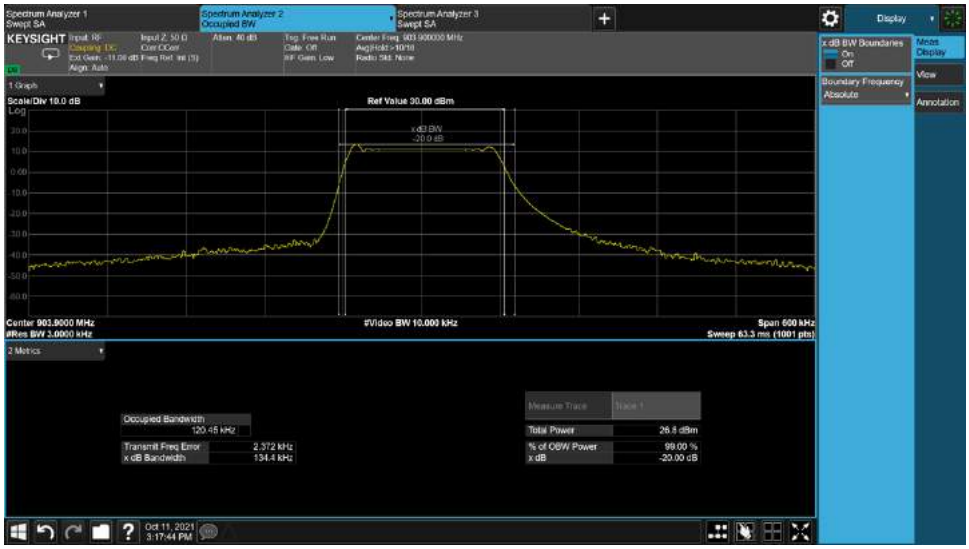


High Channel

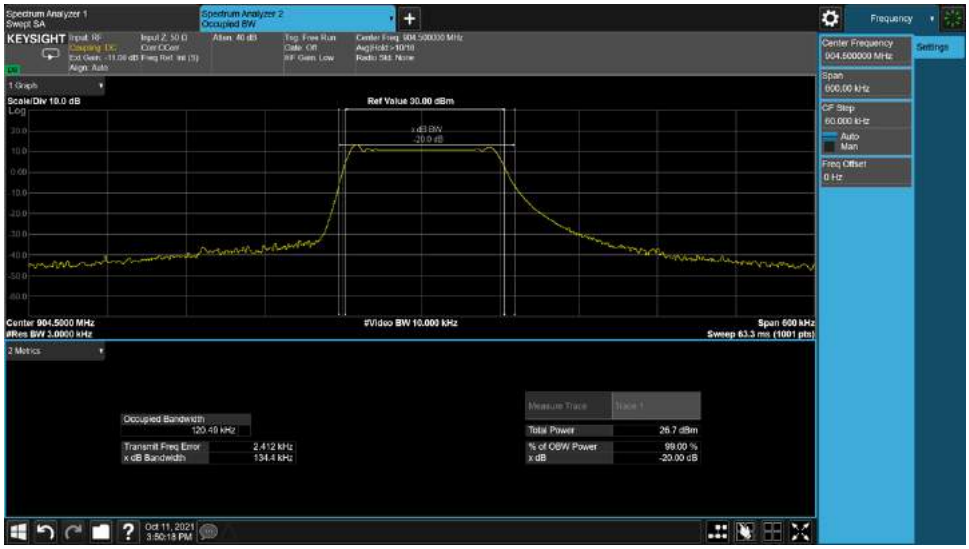


Lora Hybrid SF7

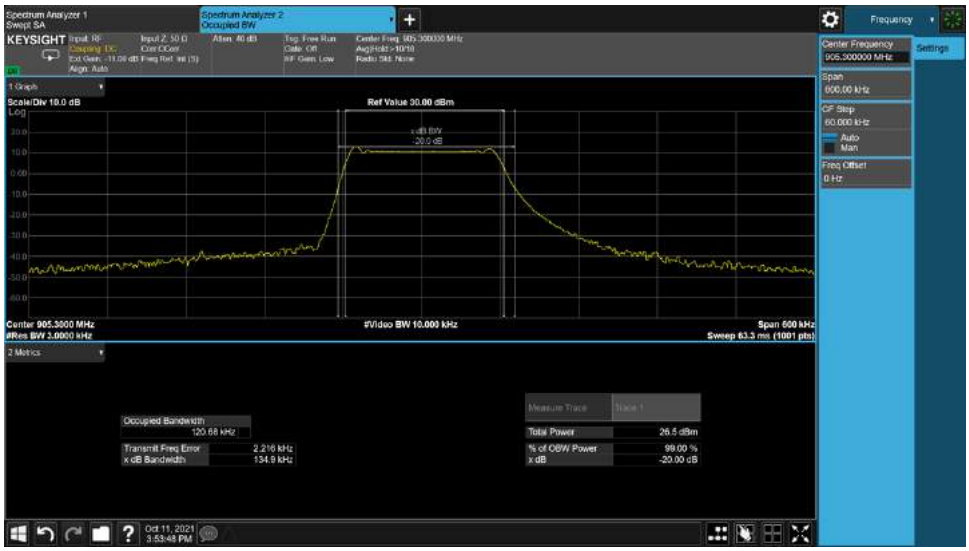
Low Channel



Middle Channel

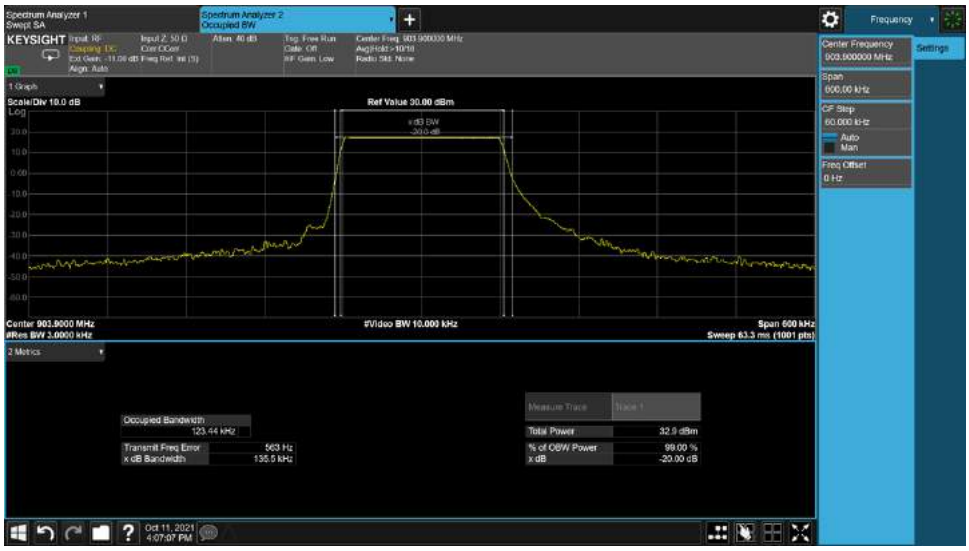


High Channel

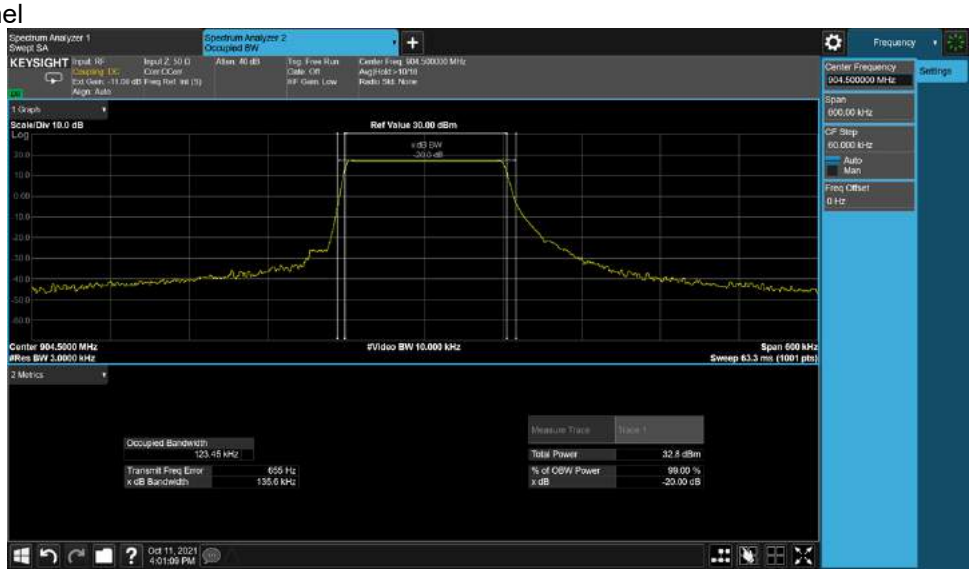


Lora Hybrid SF9

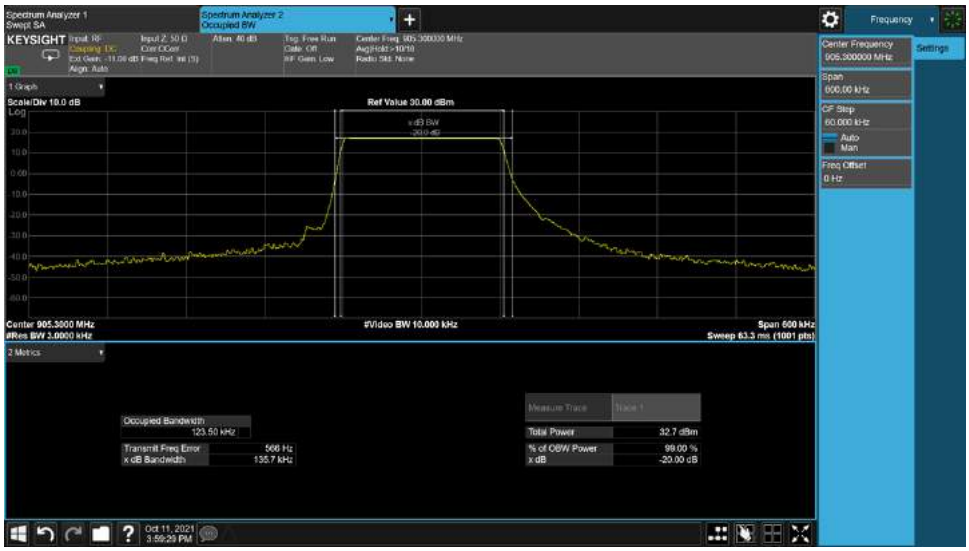
Low Channel



Middle Channel

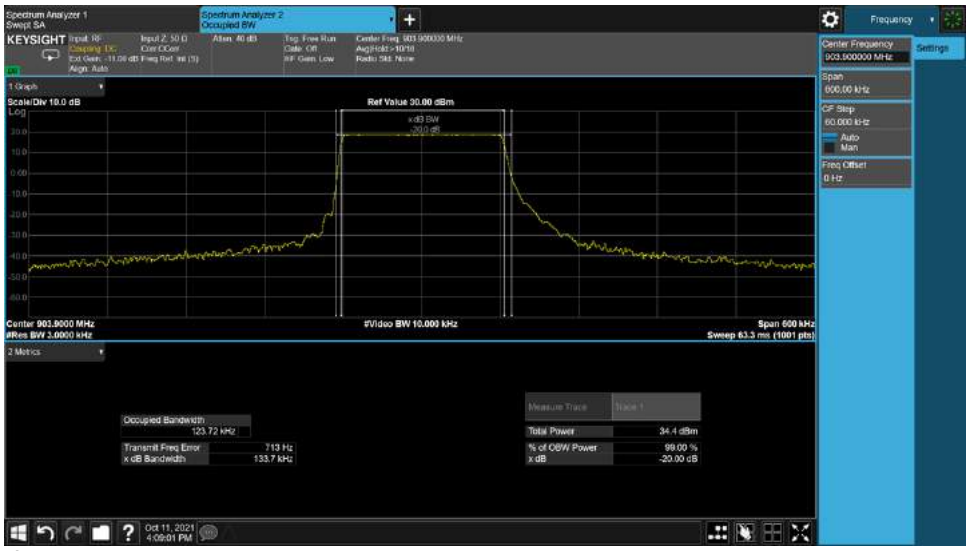


High Channel

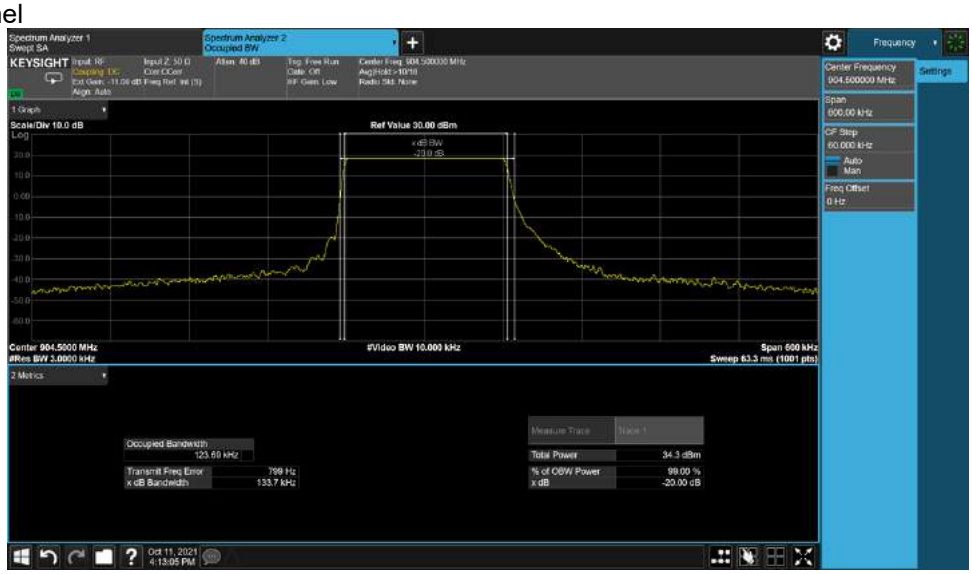


Lora Hybrid SF10

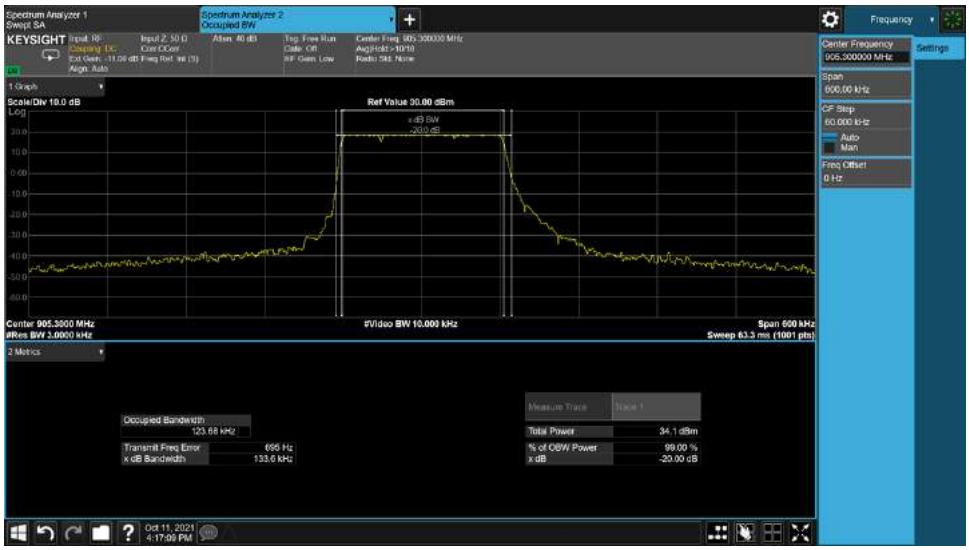
Low Channel



Middle Channel

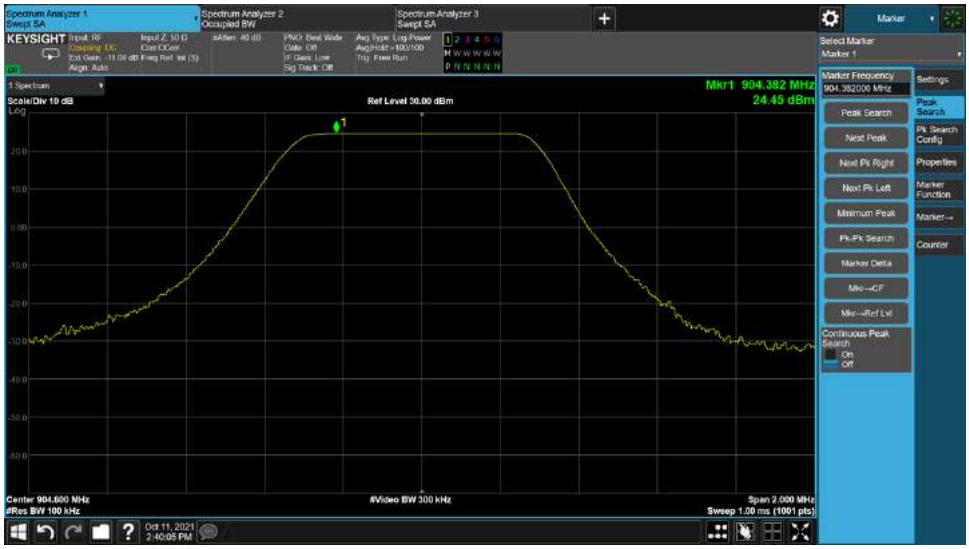


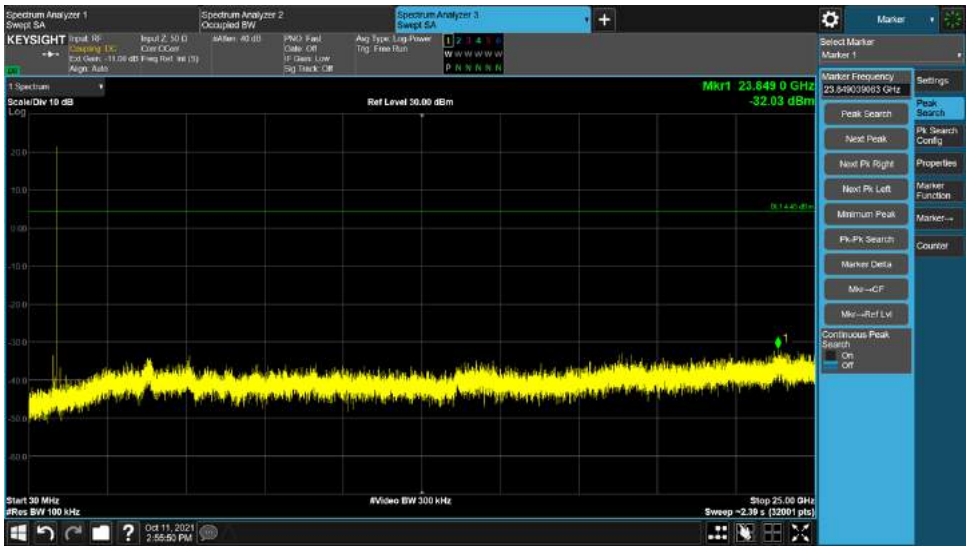
High Channel



Appendix B.4: Conducted Spurious Emissions Measured in 100 kHz Bandwidth

Lora DTS 8
904.6MHz

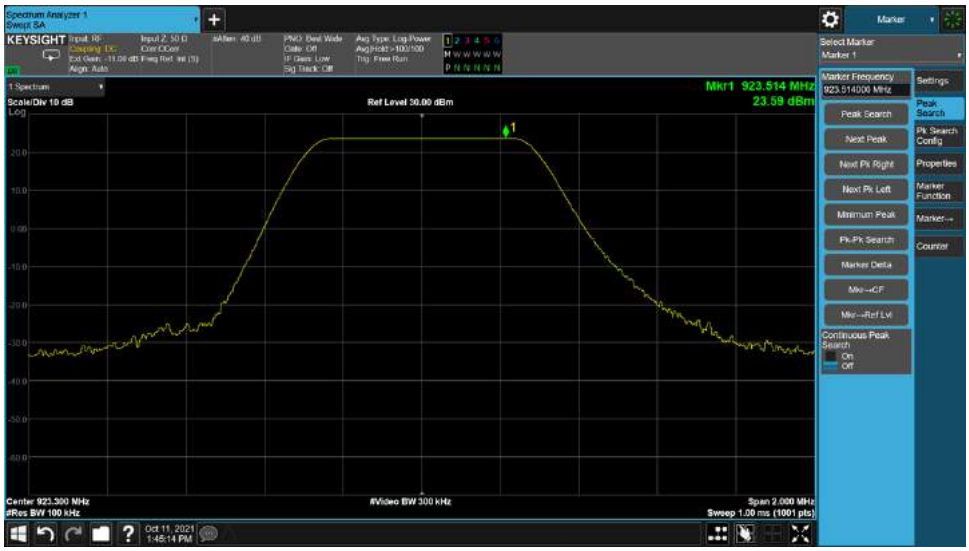


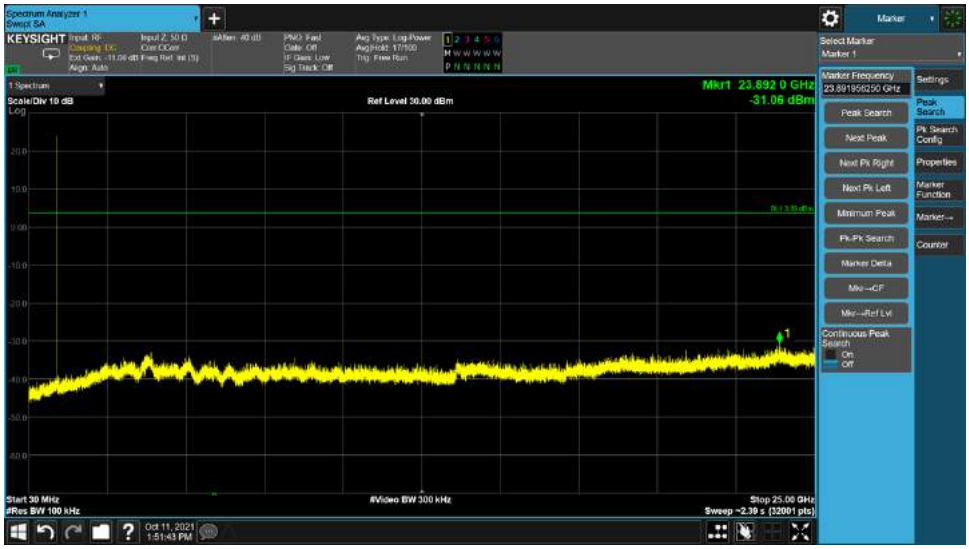


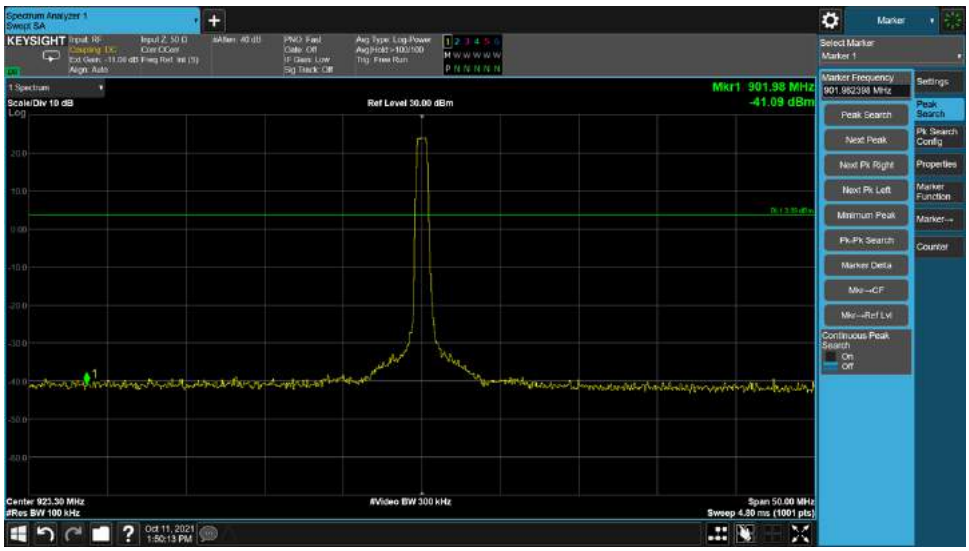


Lora DTS SF7

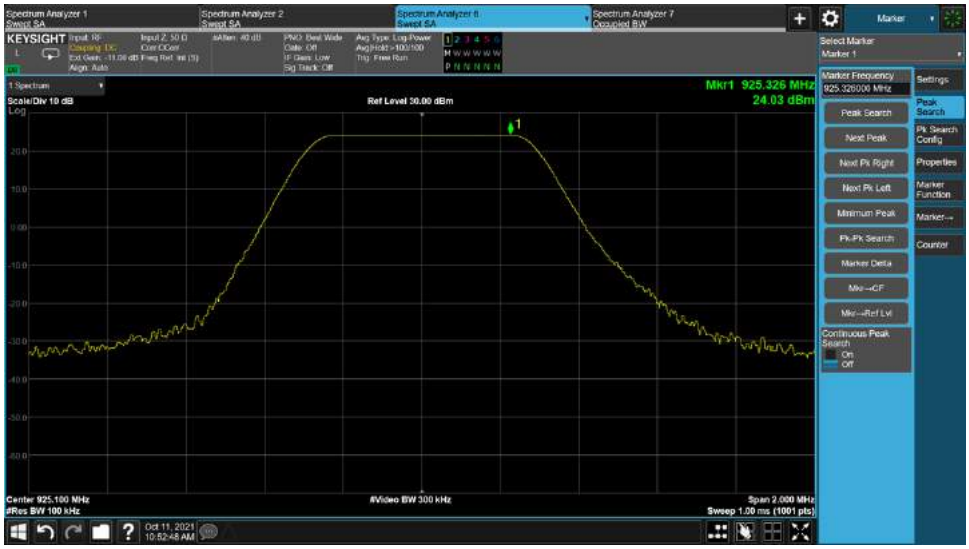
Low Channel

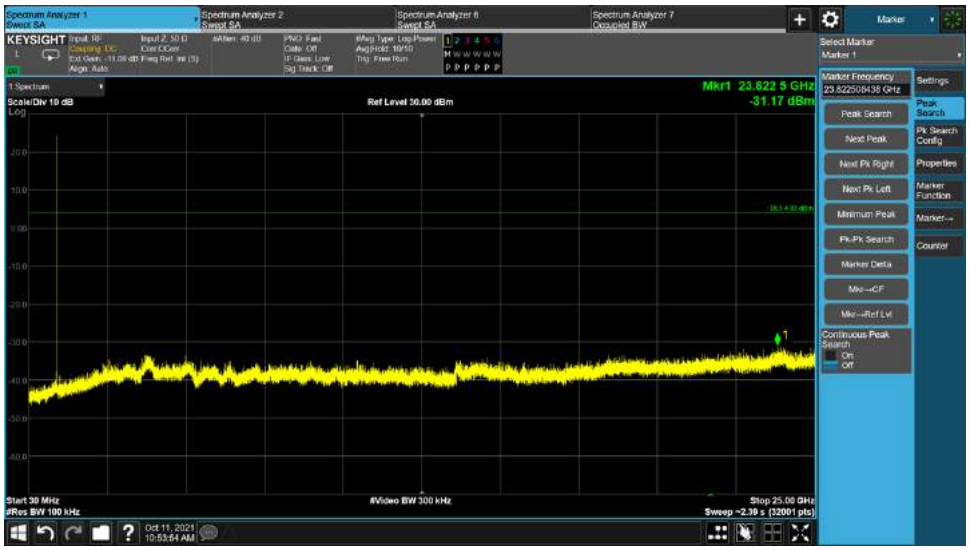




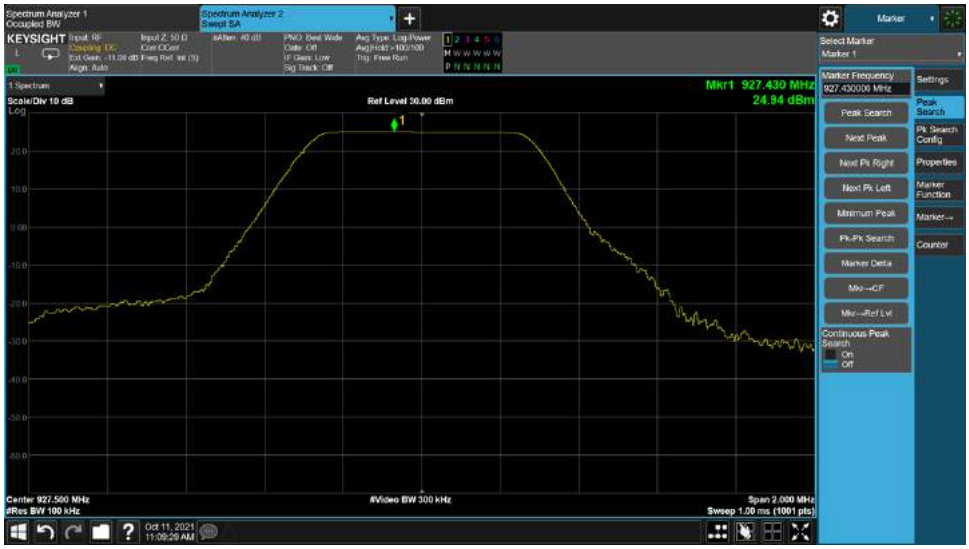


Middle Channel

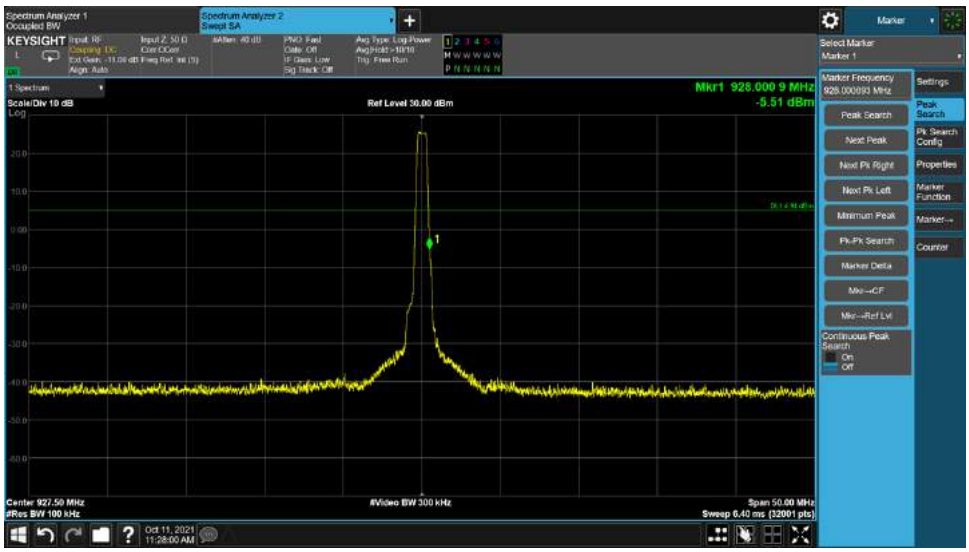




High Channel

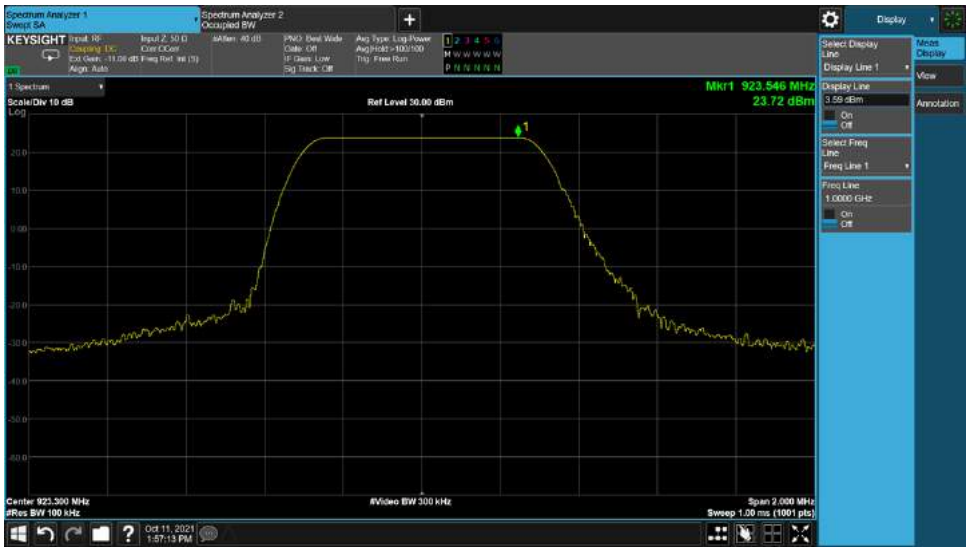


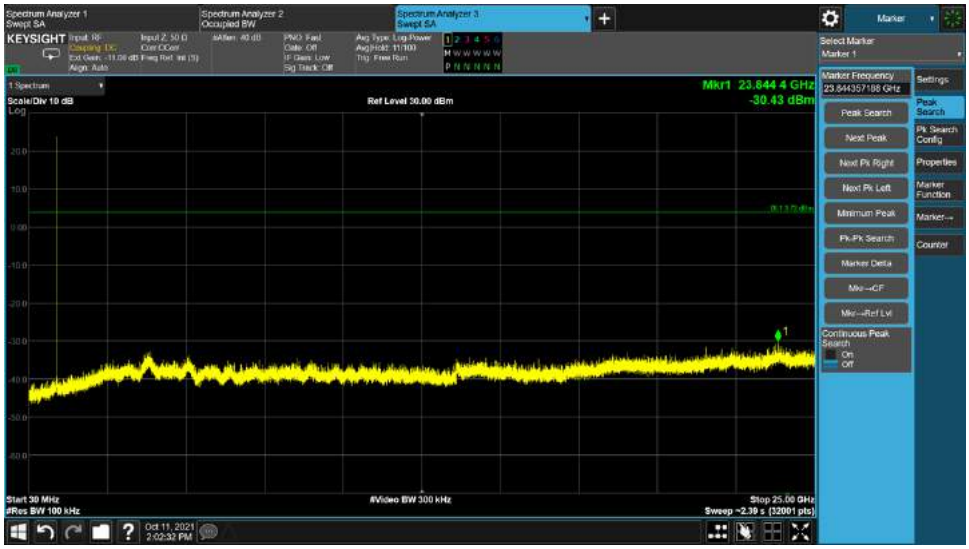


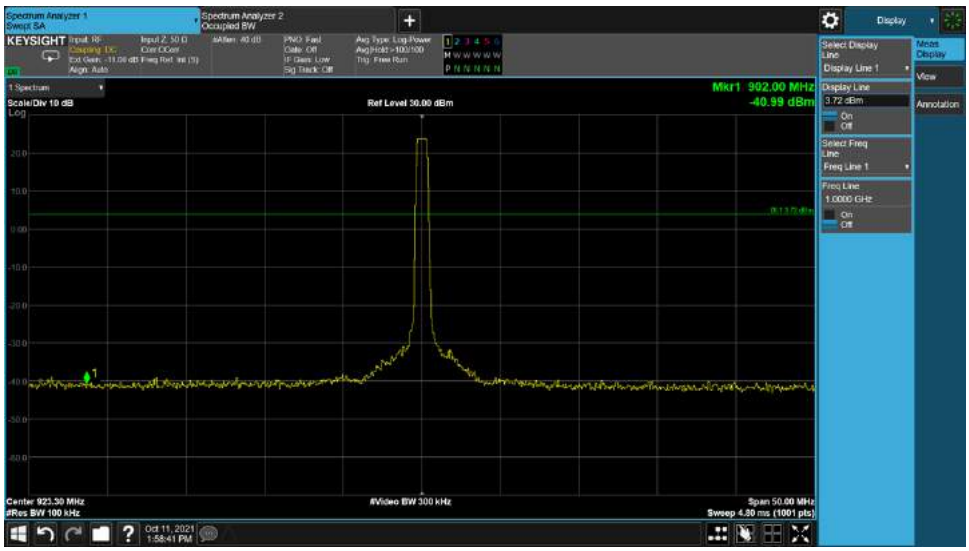


Lora DTS SF12

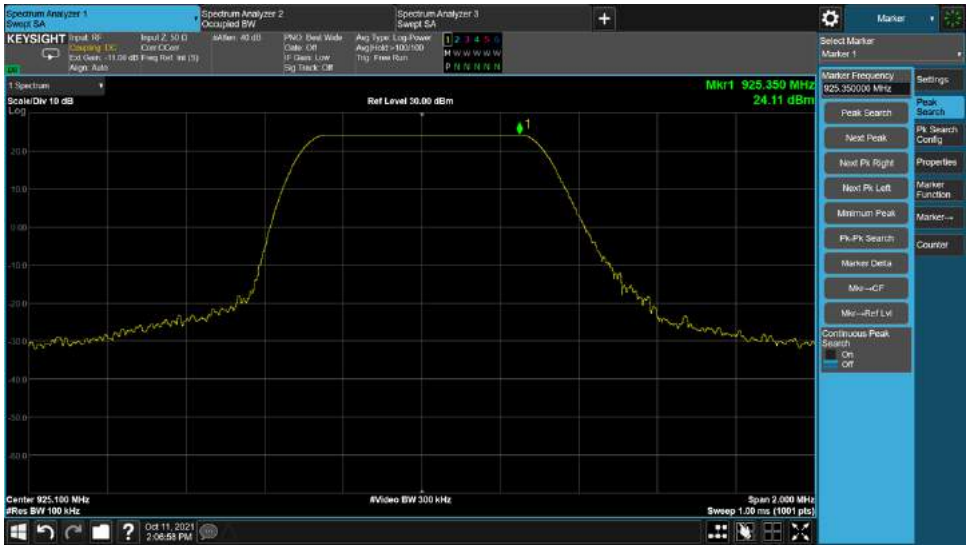
Low Channel

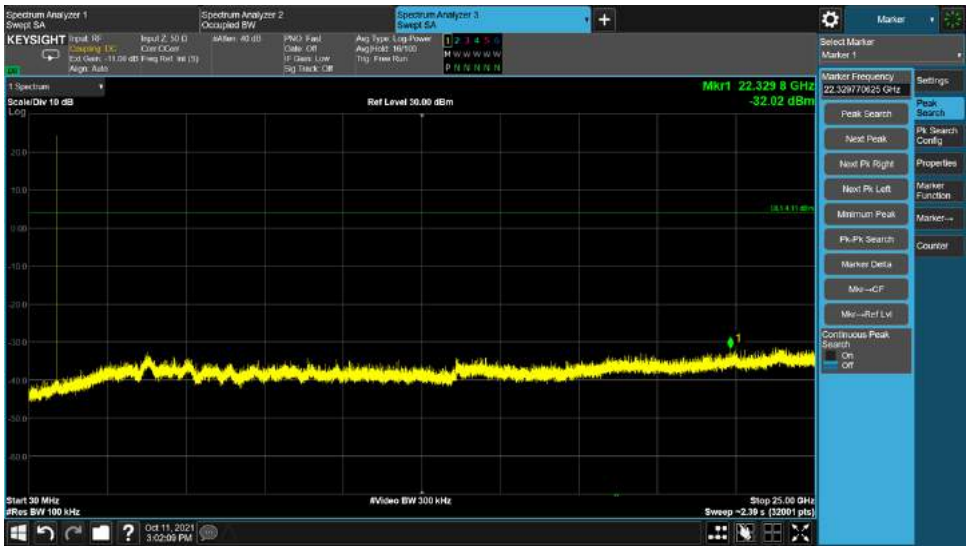






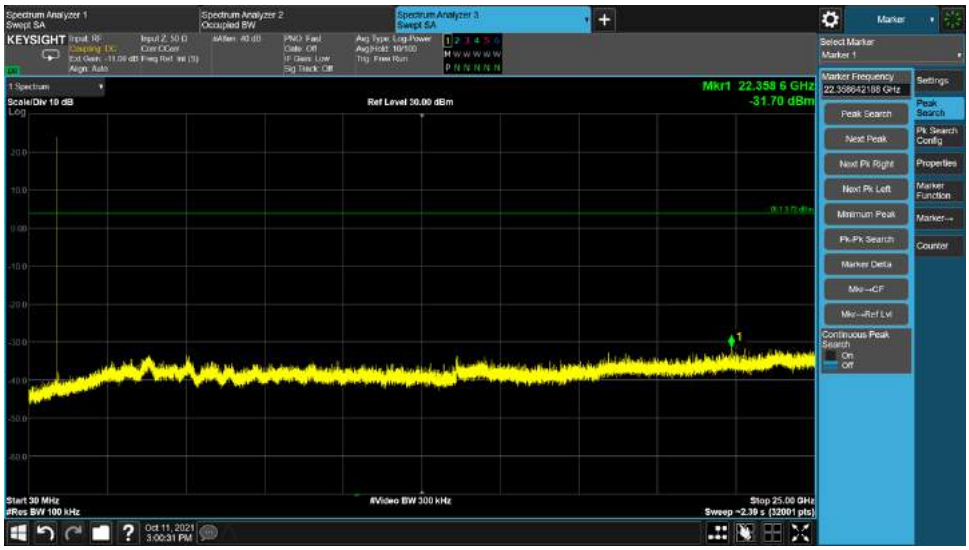
Middle Channel

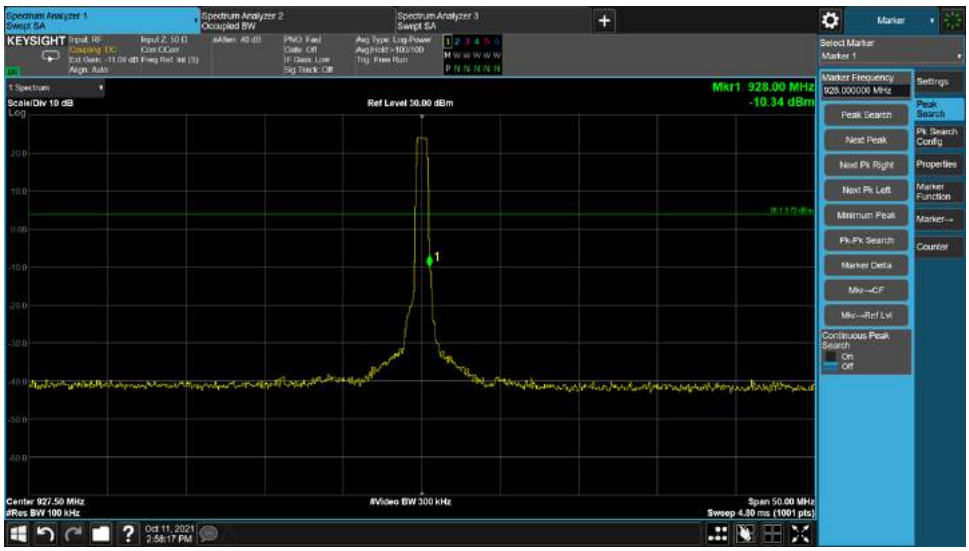




High Channel







Appendix B.5: Carrier Frequency Separation

Lora Hybrid SF7

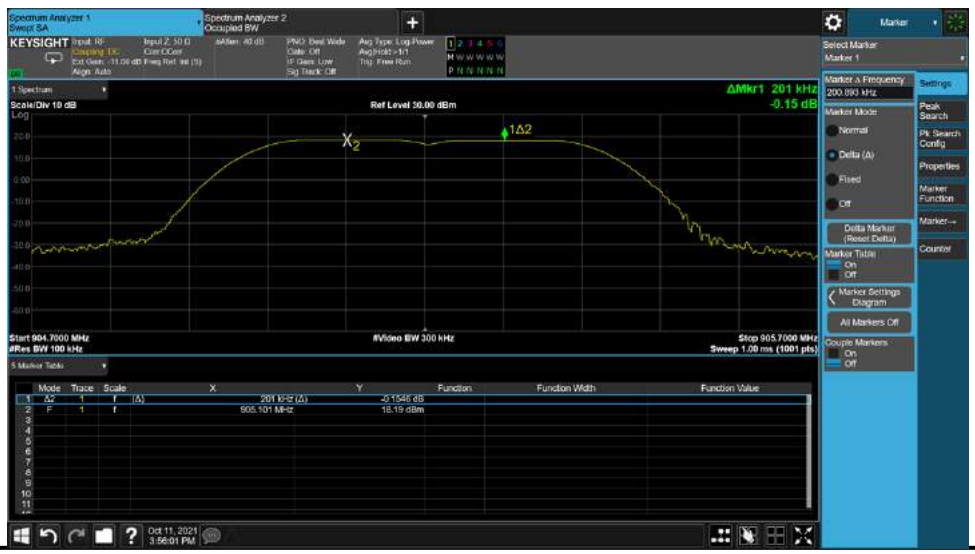
Low Channel



Middle Channel



High Channel

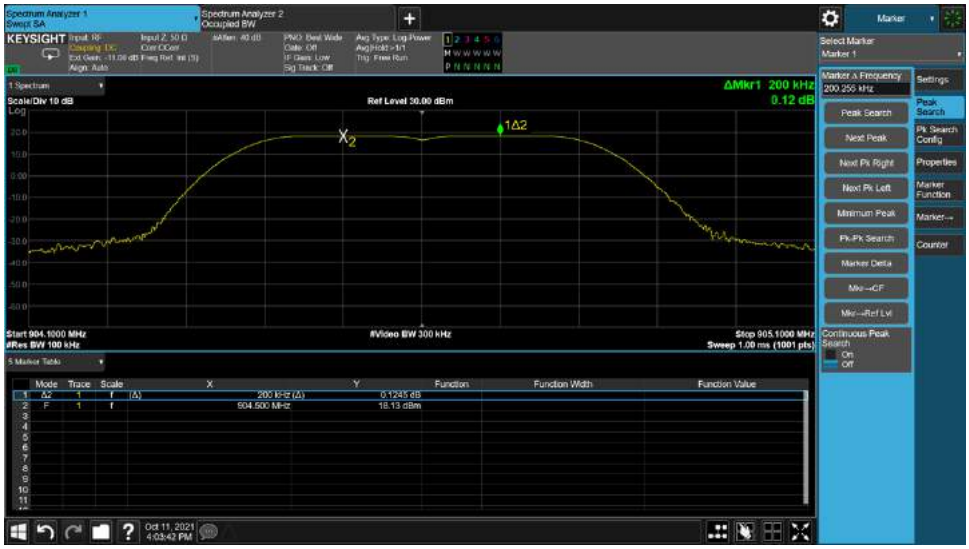


Lora Hybrid SF9

Low Channel



Middle Channel



High Channel



Lora Hybrid SF10

Low Channel



Middle Channel

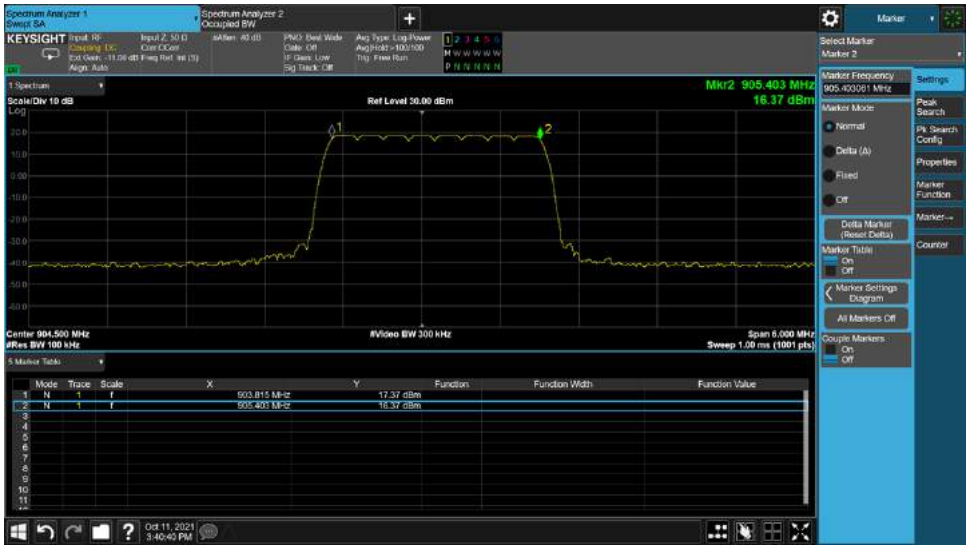


High Channel

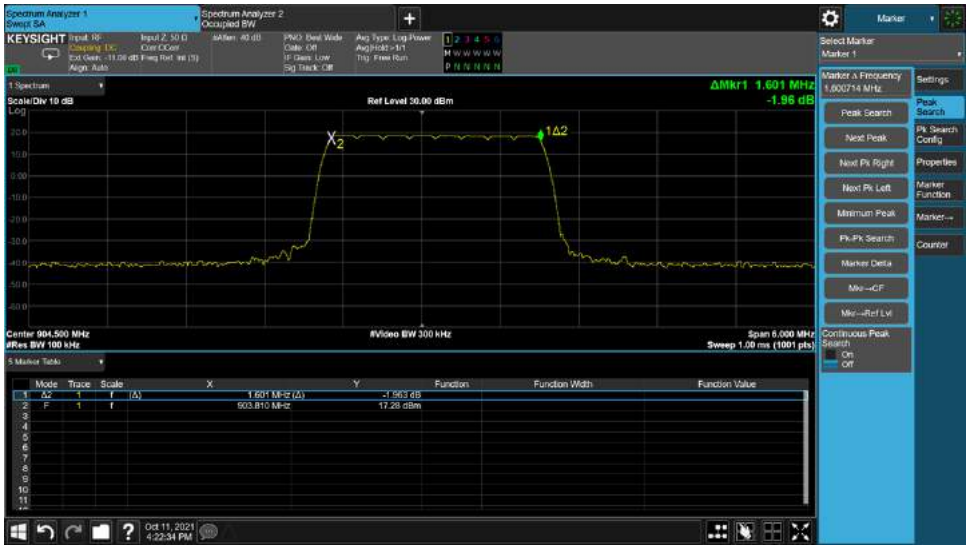


Appendix B.6: Number of Hopping Frequency

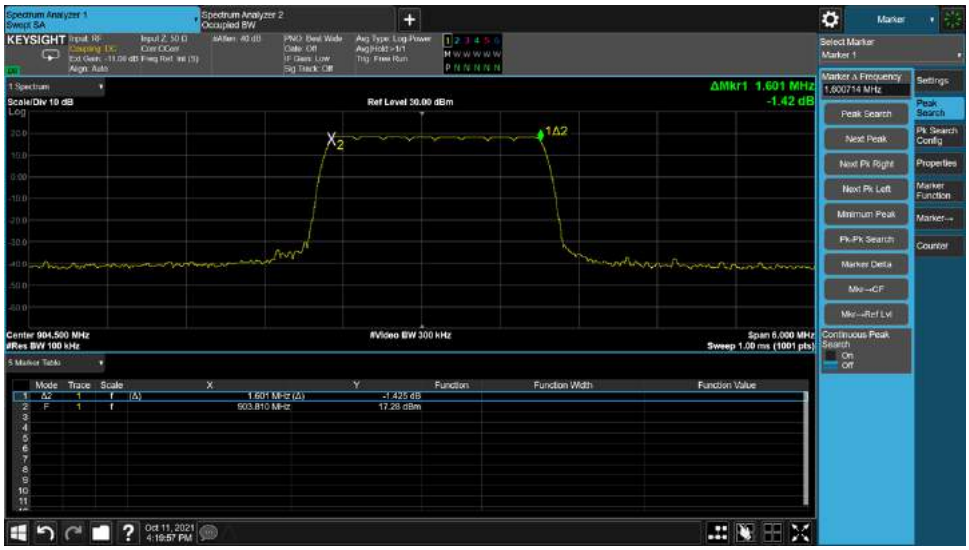
Lora Hybrid SF7



Lora Hybrid SF9



Lora Hybrid SF10

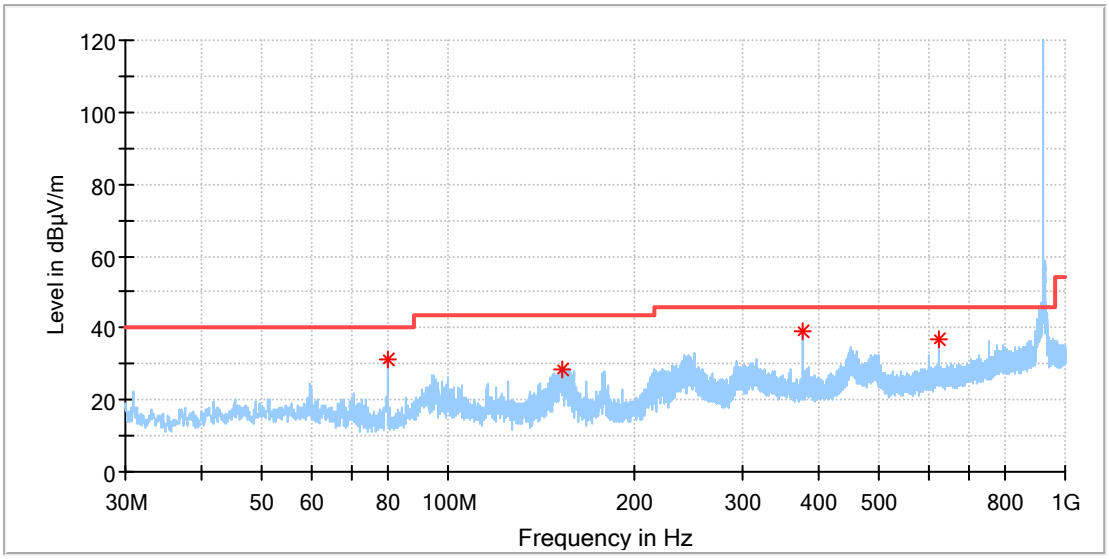


Appendix B.7: Test Results of Radiated Spurious Emissions

Lora DTS SF7 with 2.3dBi antenna
30MHz - 1GHz

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_923.3MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

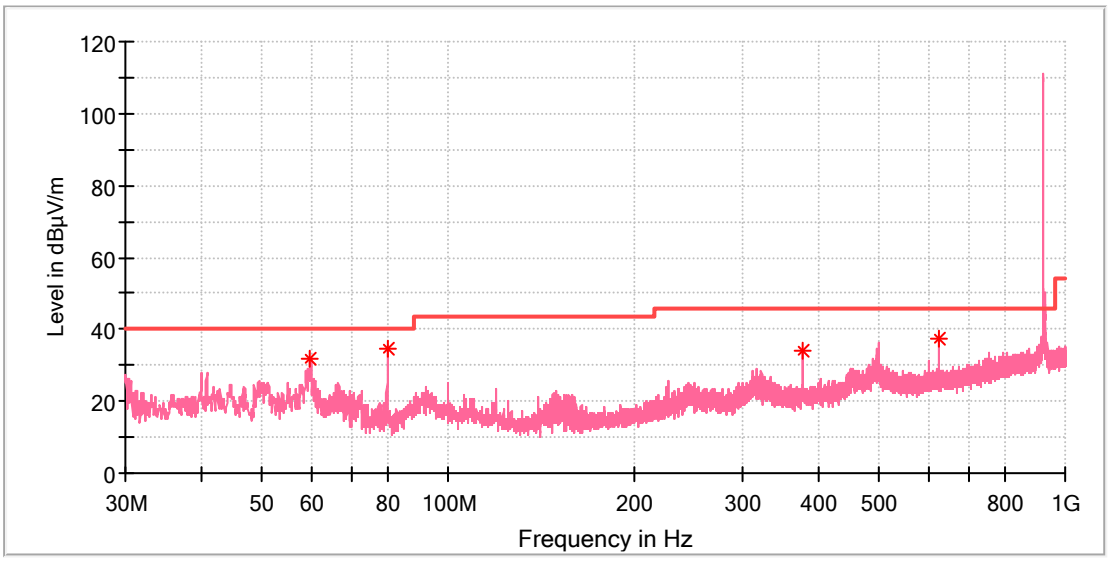


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
79.761000	31.27	40.00	8.73	100.0	H	174.0	-23.5
152.753500	28.33	43.50	15.17	100.0	H	81.0	-22.1
374.980500	39.12	46.00	6.88	100.0	H	127.0	-14.3
625.046500	36.75	46.00	9.25	100.0	H	148.0	-9.5

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_923.3MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

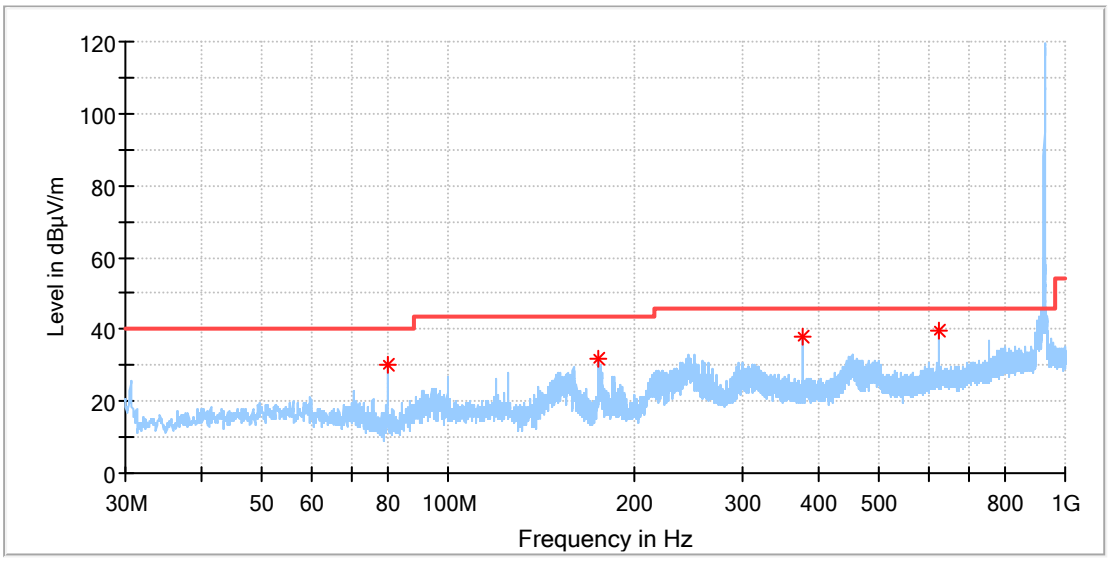


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
59.876000	31.85	40.00	8.15	100.0	V	119.0	-19.0
79.809500	34.47	40.00	5.53	100.0	V	252.0	-23.5
375.029000	34.01	46.00	11.99	100.0	V	143.0	-14.3
625.046500	37.66	46.00	8.34	100.0	V	111.0	-9.5

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_925.1MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

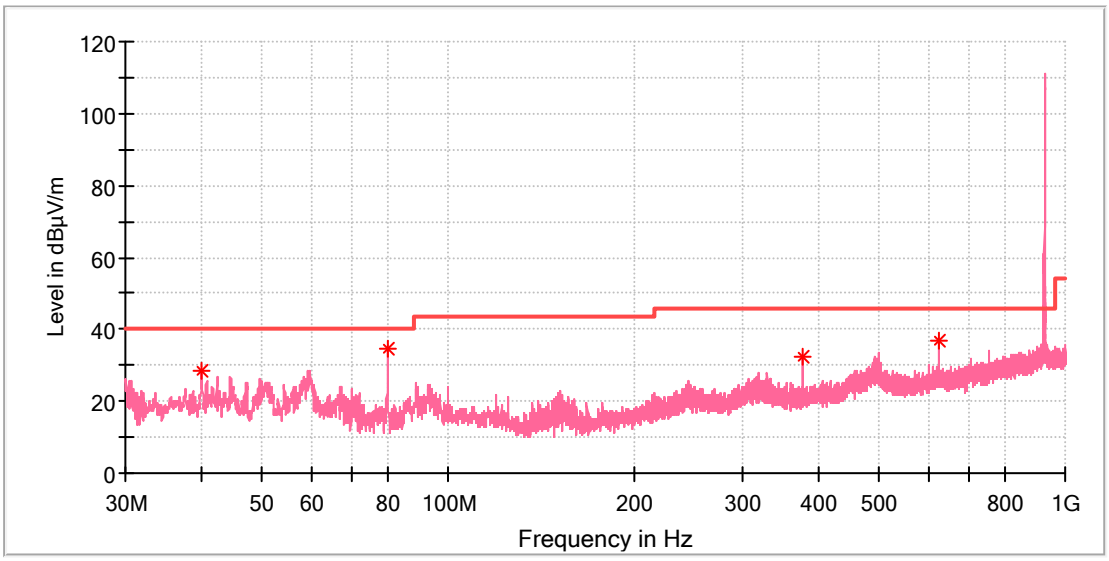


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
79.761000	30.07	40.00	9.93	100.0	H	237.0	-23.5
175.597000	31.75	43.50	11.75	100.0	H	71.0	-20.8
375.029000	37.75	46.00	8.25	100.0	H	140.0	-14.3
625.046500	39.67	46.00	6.33	100.0	H	151.0	-9.5

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_925.1MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

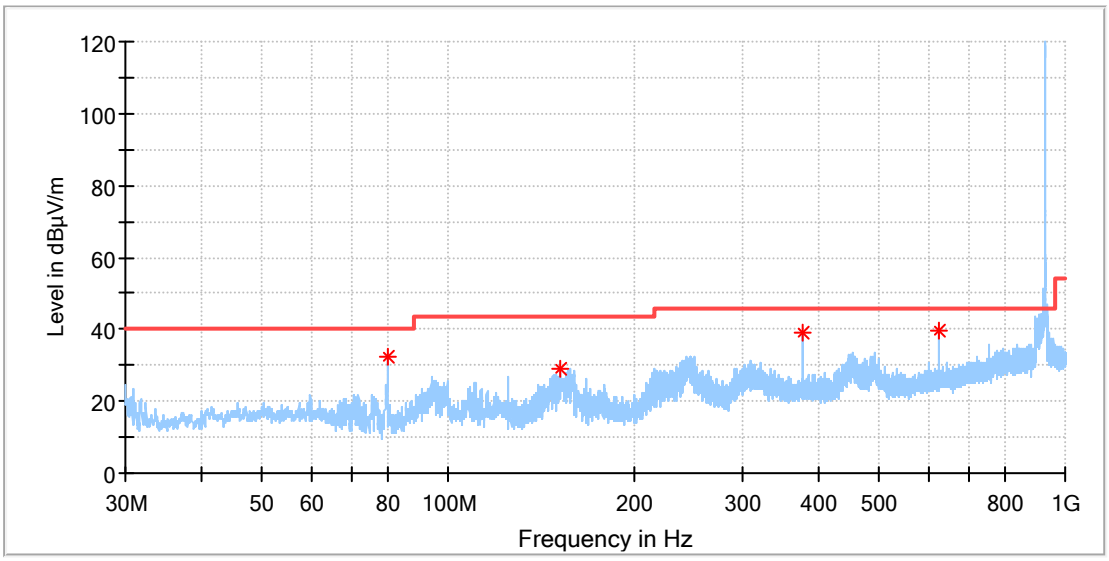


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
39.894000	28.61	40.00	11.39	100.0	V	113.0	-20.2
79.809500	34.56	40.00	5.44	100.0	V	295.0	-23.5
374.980500	32.21	46.00	13.79	100.0	V	211.0	-14.3
625.046500	37.11	46.00	8.89	100.0	V	195.0	-9.5

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_927.5MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

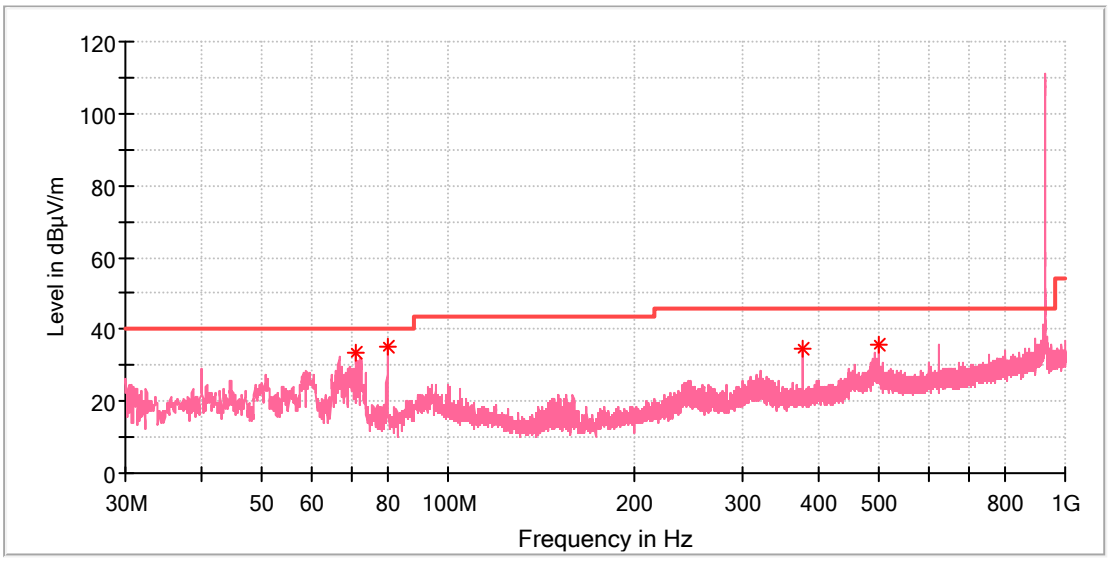


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
79.809500	32.27	40.00	7.73	100.0	H	218.0	-23.5
151.589500	28.96	43.50	14.54	100.0	H	152.0	-22.1
375.029000	39.17	46.00	6.83	100.0	H	135.0	-14.3
625.046500	39.86	46.00	6.14	100.0	H	338.0	-9.5

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_927.5MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



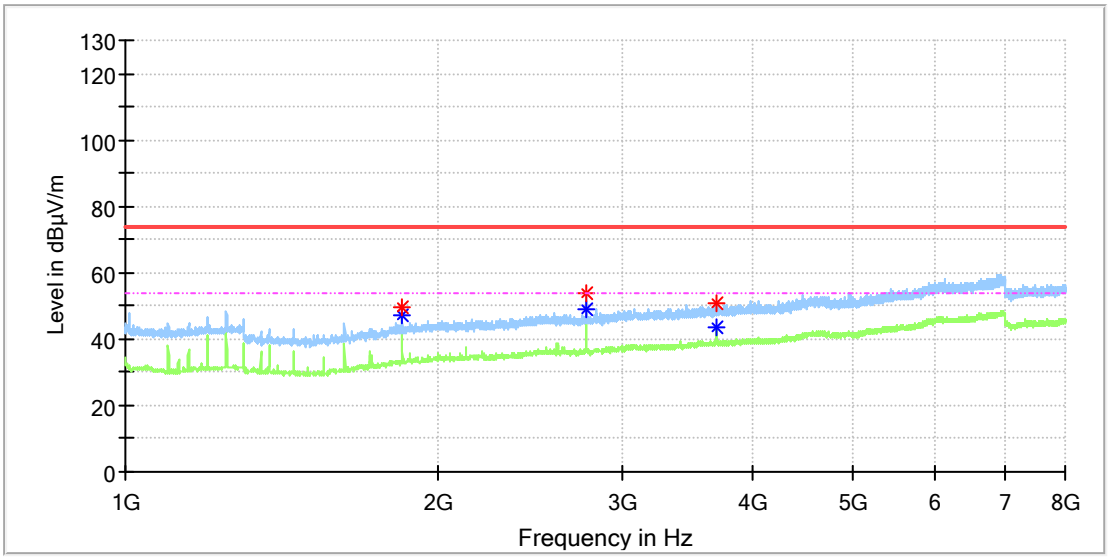
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
70.934000	33.75	40.00	6.25	100.0	V	0.0	-22.1
79.761000	34.98	40.00	5.02	100.0	V	267.0	-23.5
375.029000	34.64	46.00	11.36	100.0	V	210.0	-14.3
500.013500	35.79	46.00	10.21	100.0	V	83.0	-11.8

1GHz - 8GHz

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_923.3MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

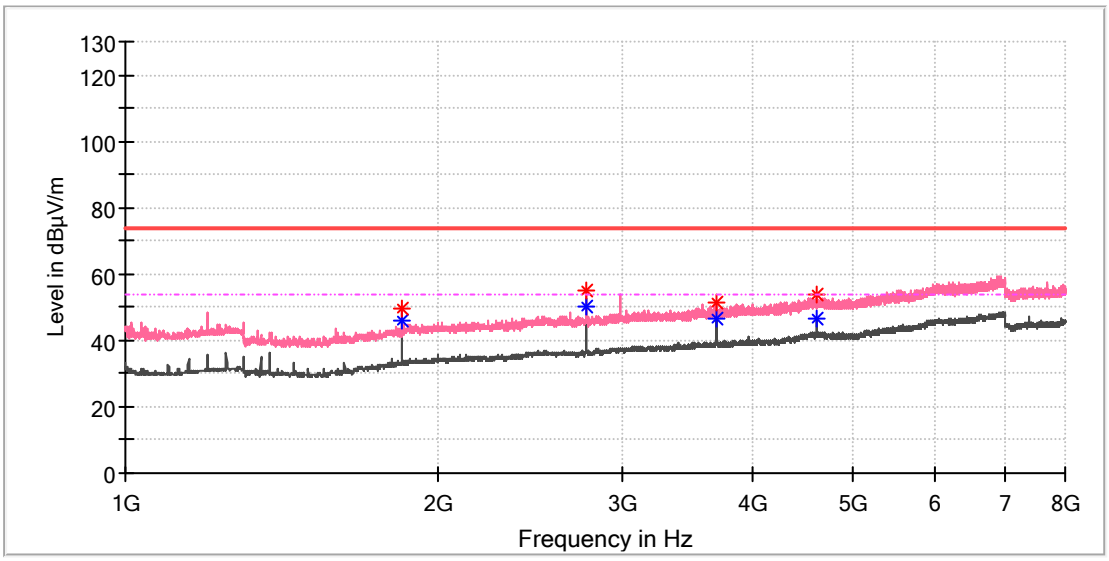


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1846.050000	49.62	---	74.00	24.38	100.0	H	168.0	5.0
1846.050000	---	47.06	54.00	6.94	100.0	H	168.0	5.0
2769.812500	---	48.69	54.00	5.31	100.0	H	168.0	7.9
2770.650000	53.86	---	74.00	20.14	100.0	H	1.0	7.9
3692.737500	50.64	---	74.00	23.36	100.0	H	200.0	9.6
3693.575000	---	43.75	54.00	10.25	100.0	H	91.0	9.6

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_923.3MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

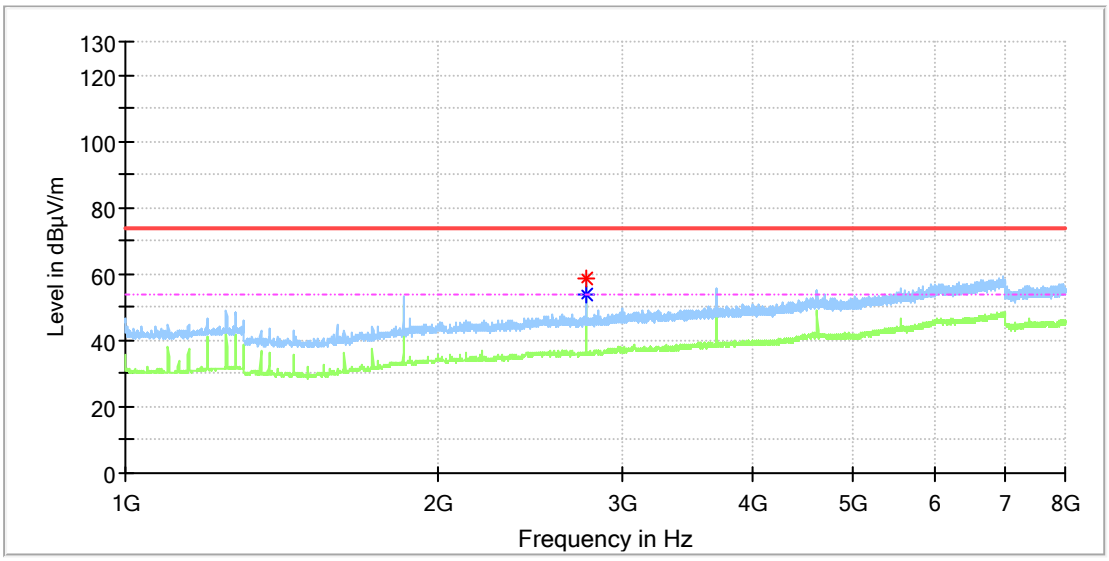


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1846.050000	49.40	---	74.00	24.60	100.0	V	81.0	5.0
1846.050000	---	45.94	54.00	8.06	100.0	V	81.0	5.0
2768.975000	---	50.28	54.00	3.72	100.0	V	165.0	7.9
2770.650000	55.10	---	74.00	18.90	100.0	V	175.0	7.9
3693.575000	---	46.37	54.00	7.63	100.0	V	61.0	9.6
3694.412500	51.47	---	74.00	22.53	100.0	V	61.0	9.6
4617.337500	53.53	---	74.00	20.47	100.0	V	124.0	12.0
4617.337500	---	46.35	54.00	7.65	100.0	V	124.0	12.0

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_925.1MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

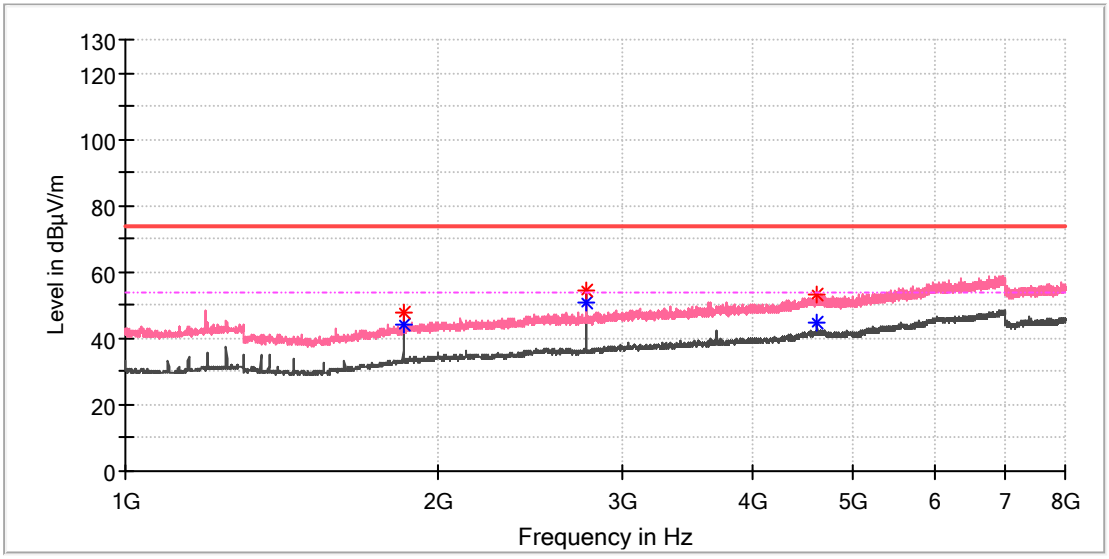


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2774.837500	58.83	---	74.00	15.17	100.0	H	358.0	7.9
2775.675000	---	53.60	54.00	0.40	100.0	H	358.0	7.9

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_925.1MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

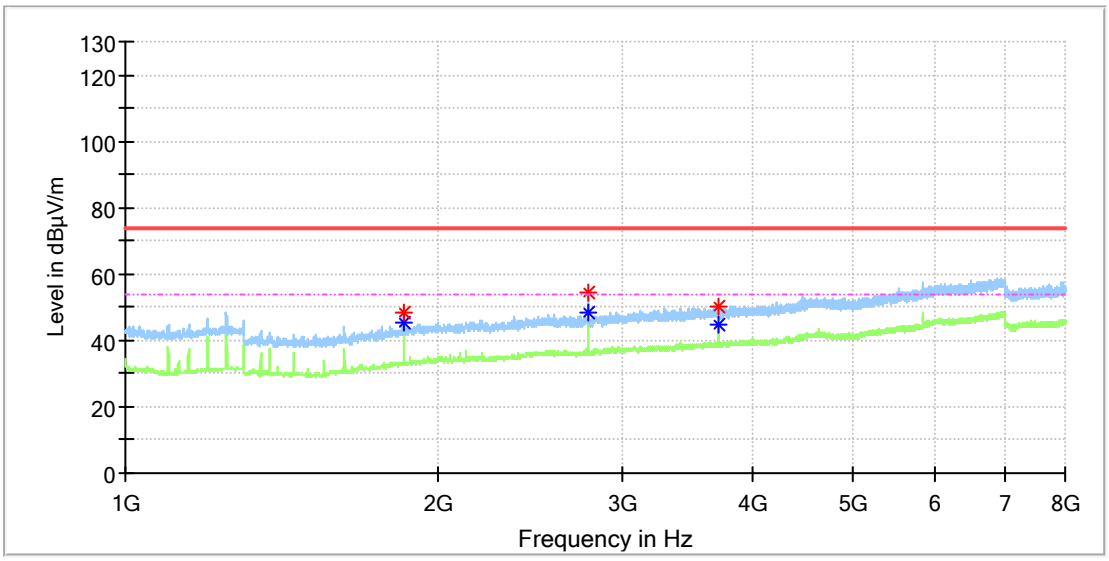


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1849.400000	47.99	---	74.00	26.02	100.0	V	77.0	5.0
1849.400000	---	44.37	54.00	9.63	100.0	V	77.0	5.0
2774.837500	---	50.73	54.00	3.27	100.0	V	289.0	7.9
2775.675000	54.66	---	74.00	19.34	100.0	V	323.0	7.9
4617.337500	53.12	---	74.00	20.88	100.0	V	8.0	12.0
4624.875000	---	44.47	54.00	9.53	100.0	V	27.0	12.0

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_927.5MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

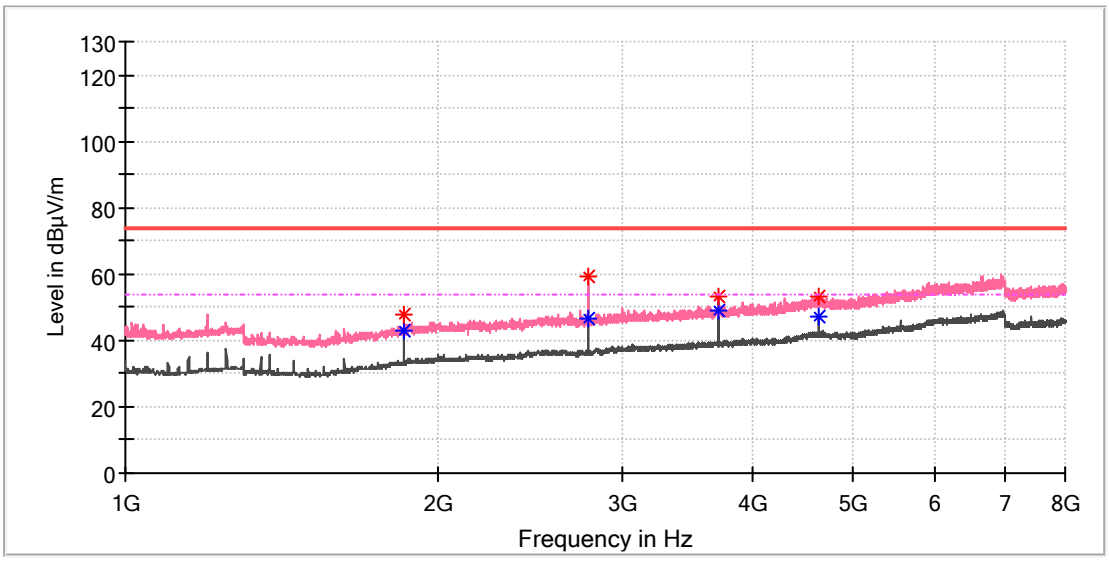


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1854.425000	48.59	---	74.00	25.41	100.0	H	168.0	5.0
1854.425000	---	45.20	54.00	8.80	100.0	H	168.0	5.0
2781.537500	---	48.25	54.00	5.75	100.0	H	0.0	7.9
2782.375000	54.24	---	74.00	19.76	100.0	H	0.0	7.9
3709.487500	---	44.59	54.00	9.41	100.0	H	202.0	9.6
3710.325000	50.30	---	74.00	23.70	100.0	H	190.0	9.6

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_927.5MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



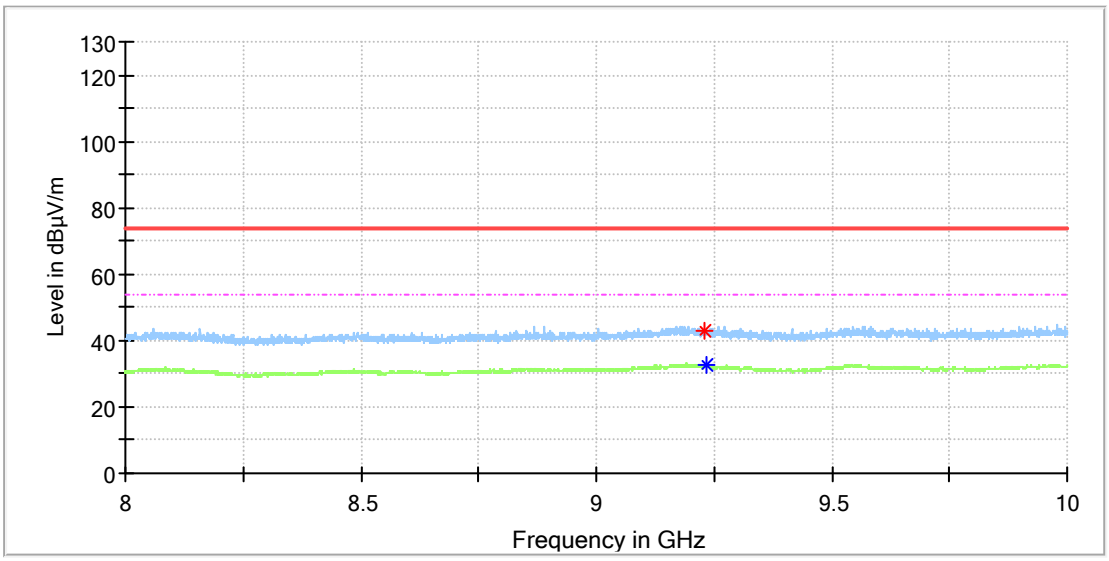
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1854.425000	47.48	---	74.00	26.52	100.0	V	70.0	5.0
1854.425000	---	42.96	54.00	11.04	100.0	V	70.0	5.0
2780.700000	---	46.59	54.00	7.41	100.0	V	324.0	7.9
2781.537500	59.26	---	74.00	14.74	100.0	V	312.0	7.9
3709.487500	52.91	---	74.00	21.09	100.0	V	59.0	9.6
3709.487500	---	49.21	54.00	4.79	100.0	V	59.0	9.6
4638.275000	---	46.89	54.00	7.11	100.0	V	126.0	12.0
4638.275000	53.44	---	74.00	20.56	100.0	V	126.0	12.0

8GHz - 10GHz

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_923.3MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

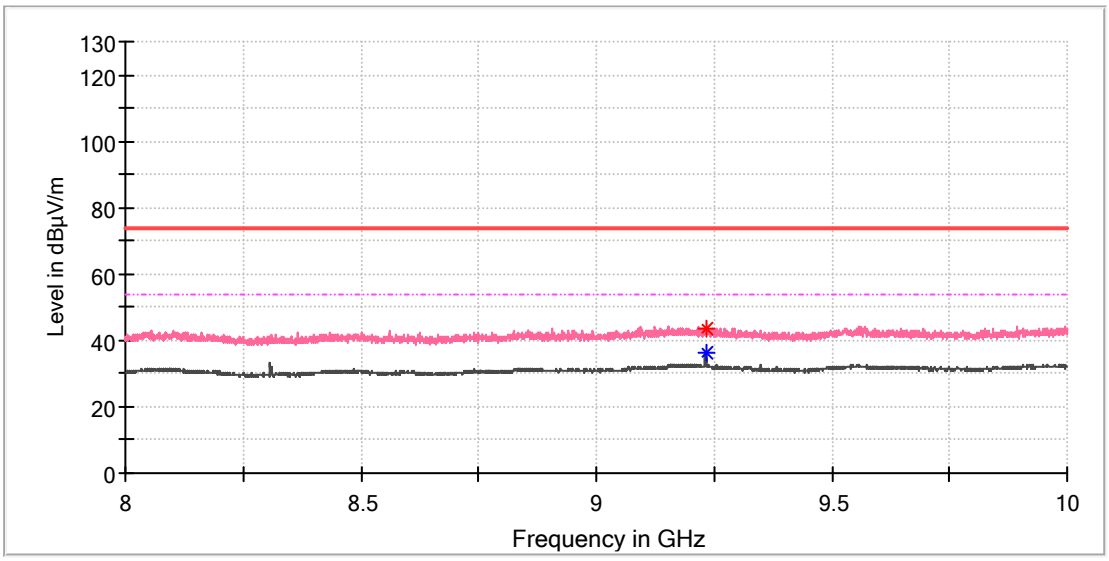


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9231.000000	43.23	---	74.00	30.77	100.0	H	79.0	10.4
9232.500000	---	32.52	54.00	21.48	100.0	H	71.0	10.4

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_923.3MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

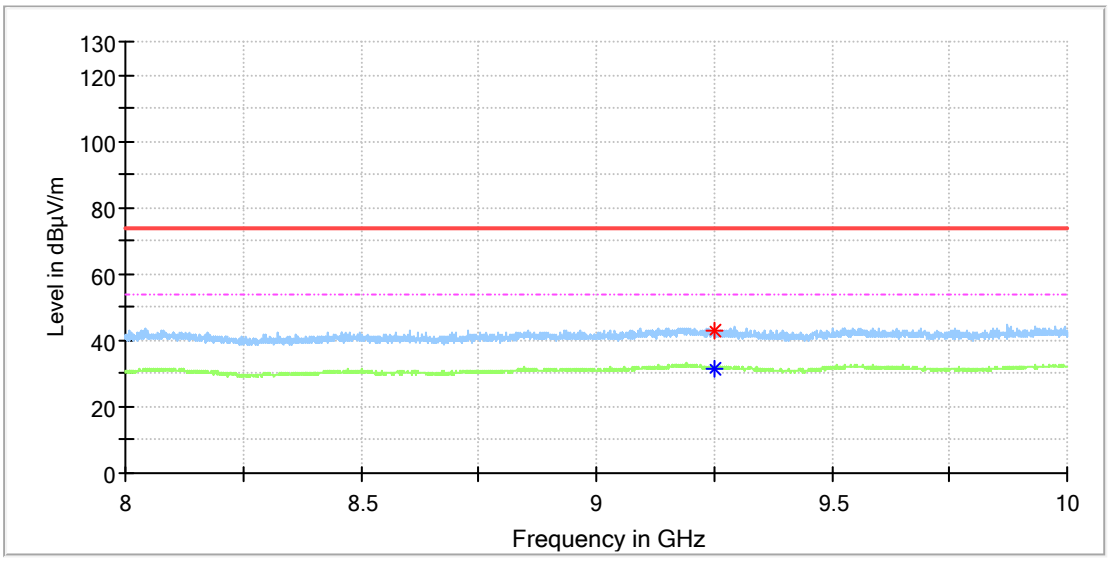


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9232.000000	---	36.20	54.00	17.80	100.0	V	281.0	10.4
9235.000000	43.55	---	74.00	30.45	100.0	V	291.0	10.4

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_925.1MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

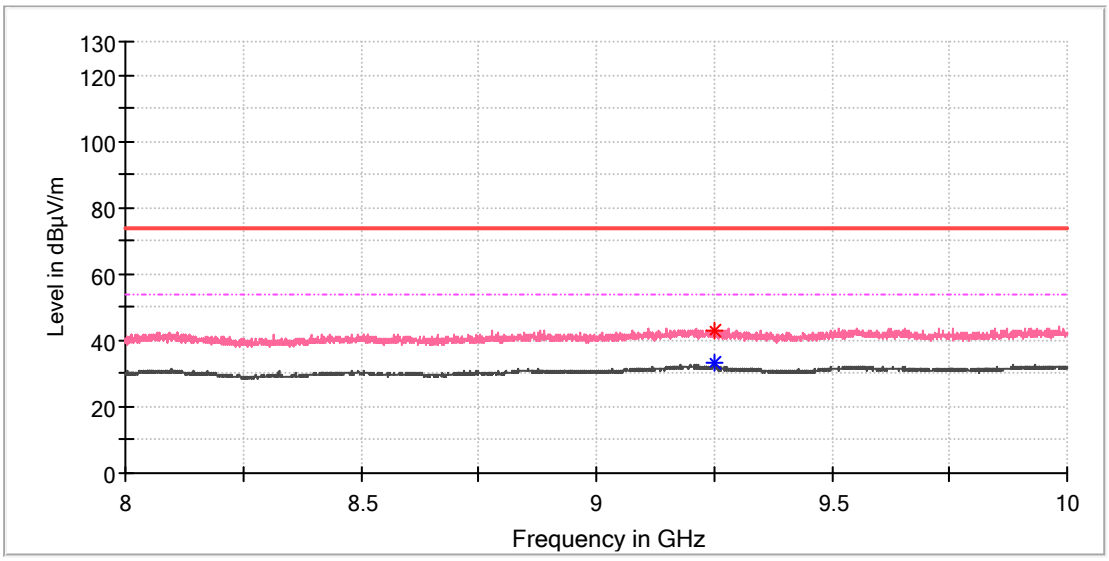


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9250.000000	---	31.66	54.00	22.34	100.0	H	342.0	10.5
9250.500000	42.78	---	74.00	31.22	100.0	H	268.0	10.4

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_925.1MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

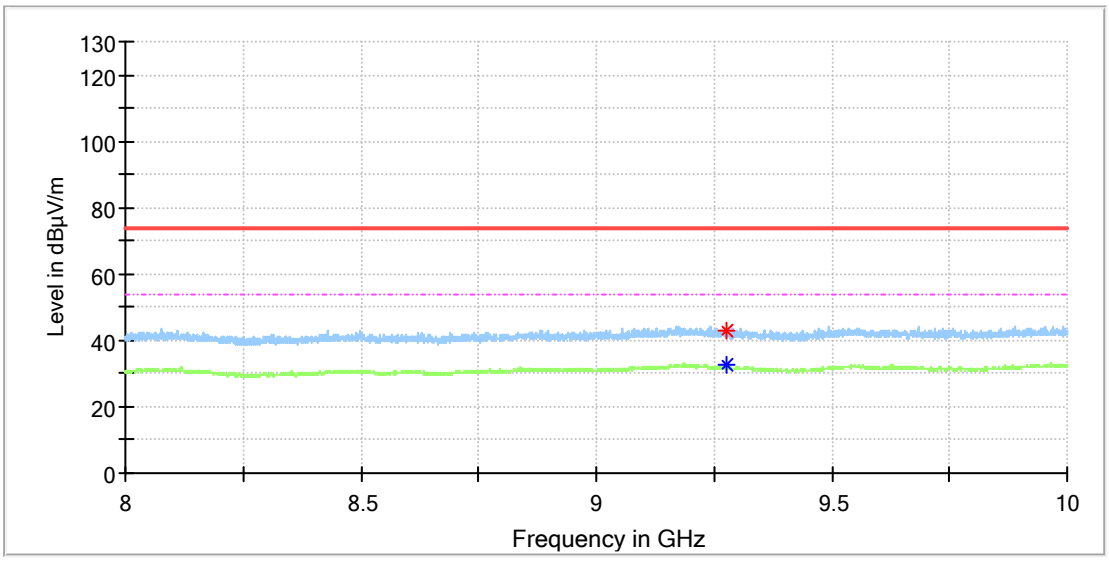


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9251.500000	---	33.33	54.00	20.67	100.0	V	296.0	10.4
9252.000000	42.78	---	74.00	31.22	100.0	V	7.0	10.4

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_927.5MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

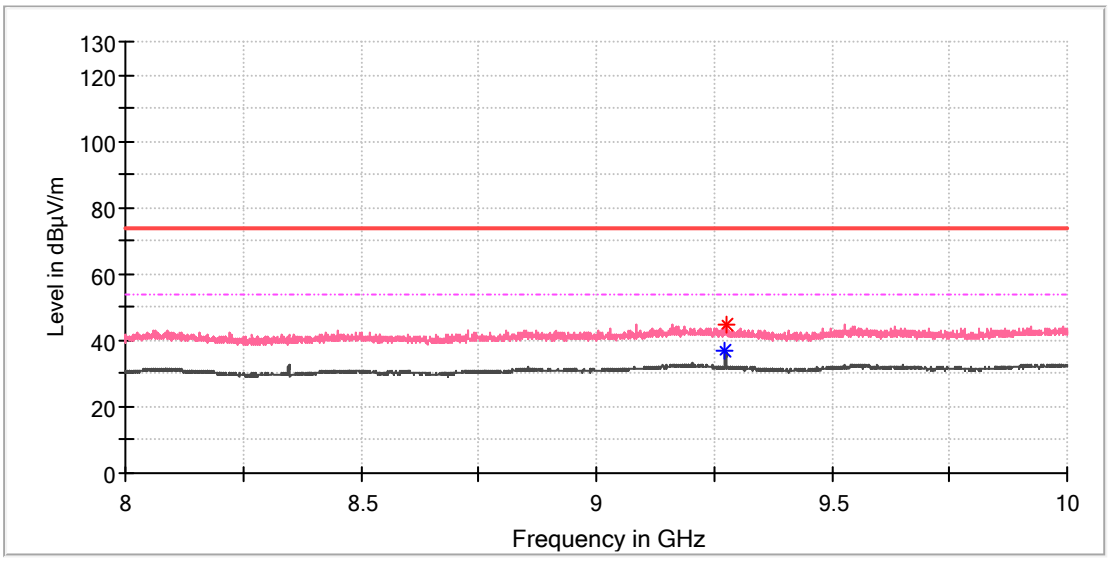


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9275.000000	---	32.90	54.00	21.10	100.0	H	309.0	10.2
9276.000000	42.75	---	74.00	31.25	100.0	H	263.0	10.2

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_927.5MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



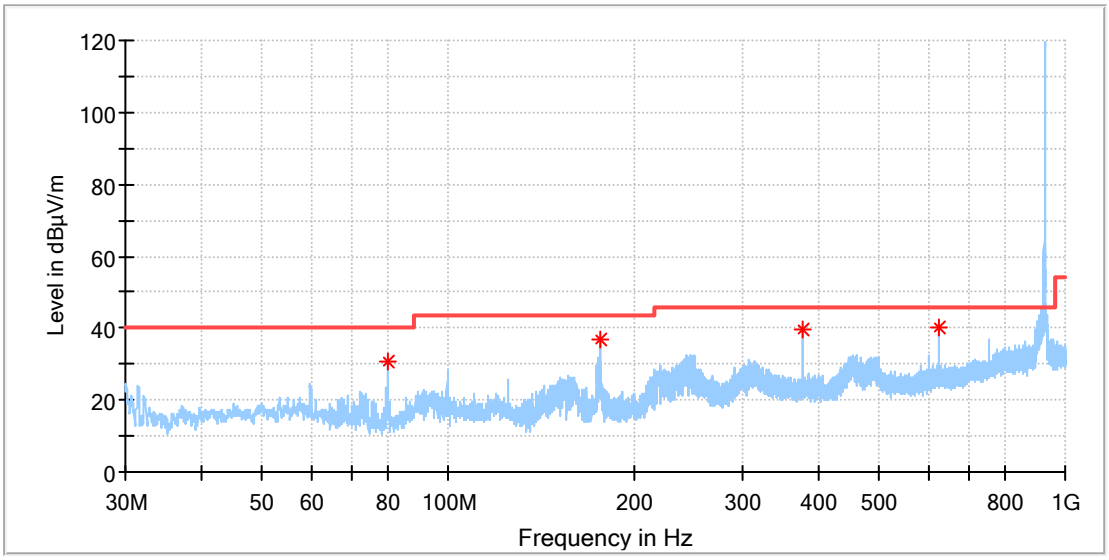
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9274.000000	---	37.07	54.00	16.93	100.0	V	297.0	10.2
9275.000000	44.47	---	74.00	29.53	100.0	V	353.0	10.2

Lora DTS SF12 with 2.3dBi antenna
30MHz - 1GHz

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF12_925.1MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

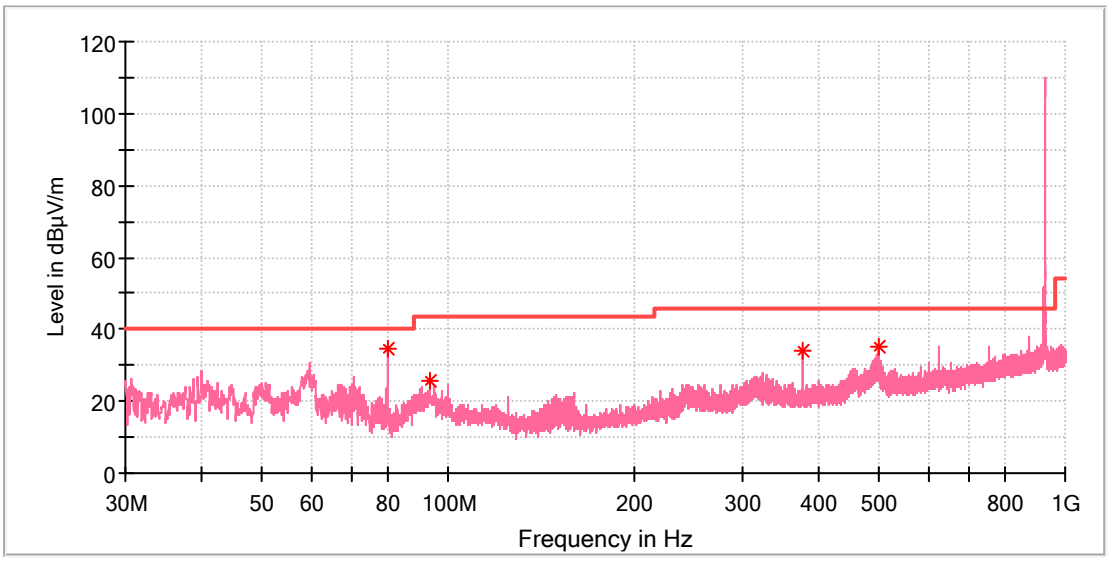


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
79.809500	30.49	40.00	9.51	100.0	H	153.0	-23.5
176.373000	36.63	43.50	6.87	100.0	H	120.0	-20.8
375.029000	39.90	46.00	6.10	100.0	H	128.0	-14.3
625.046500	40.12	46.00	5.89	100.0	H	264.0	-9.5

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF12_925.1MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



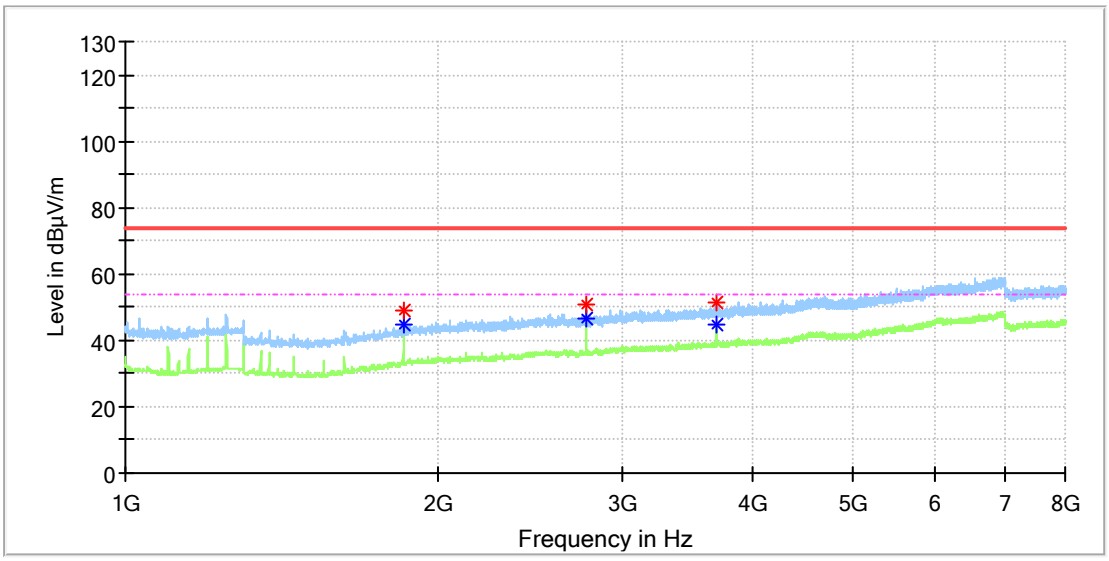
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
79.858000	34.79	40.00	5.21	100.0	V	262.0	-23.5
93.632000	25.68	43.50	17.82	100.0	V	159.0	-20.1
375.029000	33.91	46.00	12.09	100.0	V	106.0	-14.3
500.013500	34.93	46.00	11.07	100.0	V	247.0	-11.8

1GHz - 8GHz

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF12_925.1MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

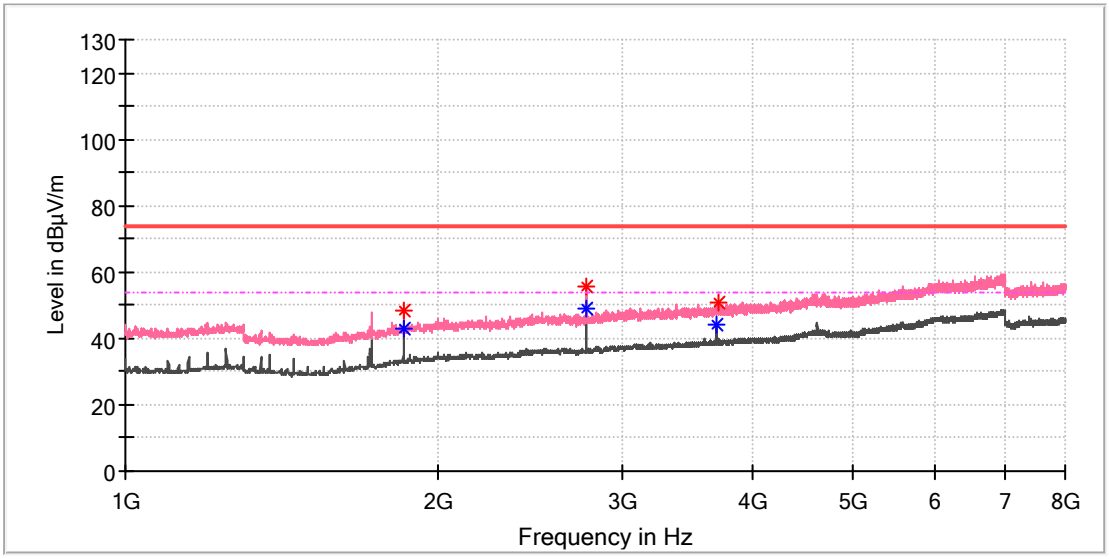


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1850.237500	49.17	---	74.00	24.83	100.0	H	160.0	5.0
1850.237500	---	44.81	54.00	9.19	100.0	H	160.0	5.0
2775.675000	50.94	---	74.00	23.06	100.0	H	235.0	7.9
2775.675000	---	46.84	54.00	7.16	100.0	H	235.0	7.9
3700.275000	51.10	---	74.00	22.90	100.0	H	204.0	9.6
3700.275000	---	44.45	54.00	9.55	100.0	H	204.0	9.6

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF12_925.1MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



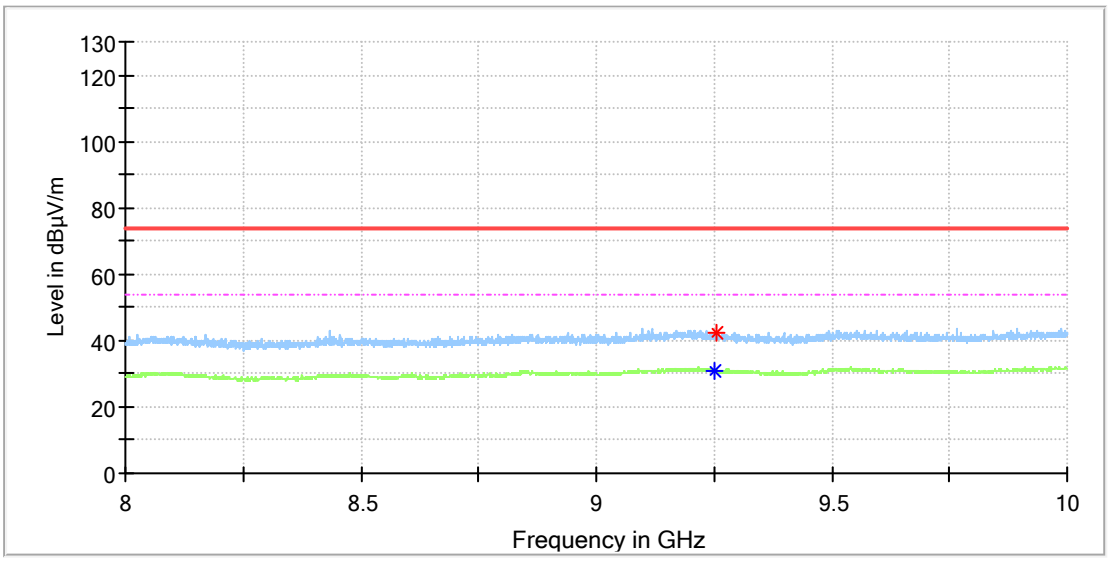
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1849.400000	48.11	---	74.00	25.89	100.0	V	83.0	5.0
1849.400000	---	42.84	54.00	11.16	100.0	V	83.0	5.0
2774.000000	---	49.00	54.00	5.00	100.0	V	342.0	7.9
2776.512500	55.52	---	74.00	18.48	100.0	V	354.0	7.9
3700.275000	---	44.10	54.00	9.90	100.0	V	234.0	9.6
3706.975000	50.62	---	74.00	23.38	100.0	V	175.0	9.6

8GHz - 10GHz

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF12_925.1MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

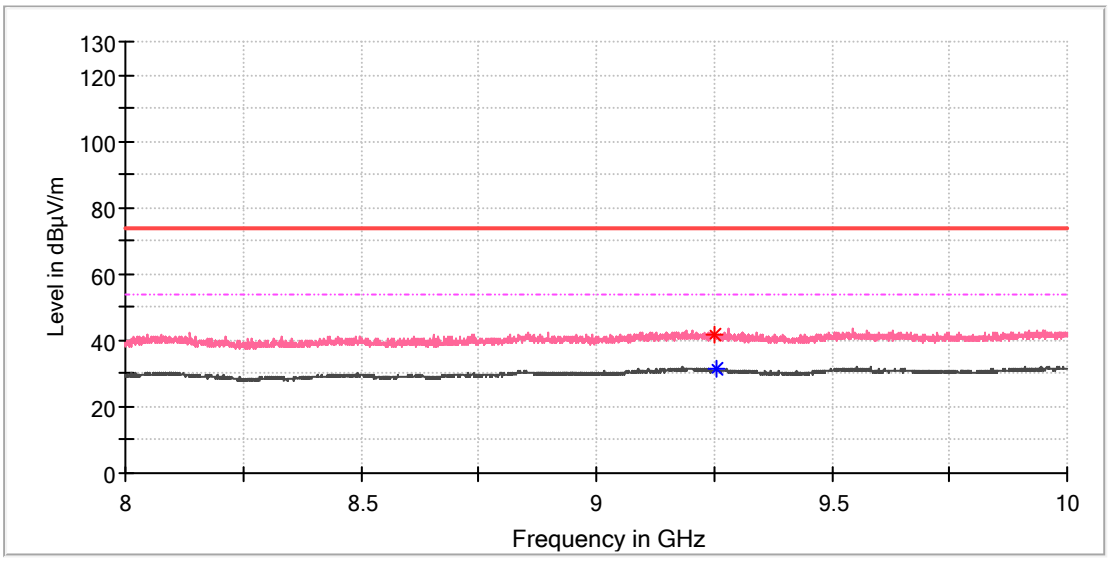


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9249.500000	---	31.13	54.00	22.87	100.0	H	281.0	10.5
9254.000000	42.14	---	74.00	31.86	100.0	H	145.0	10.4

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF12_925.1MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



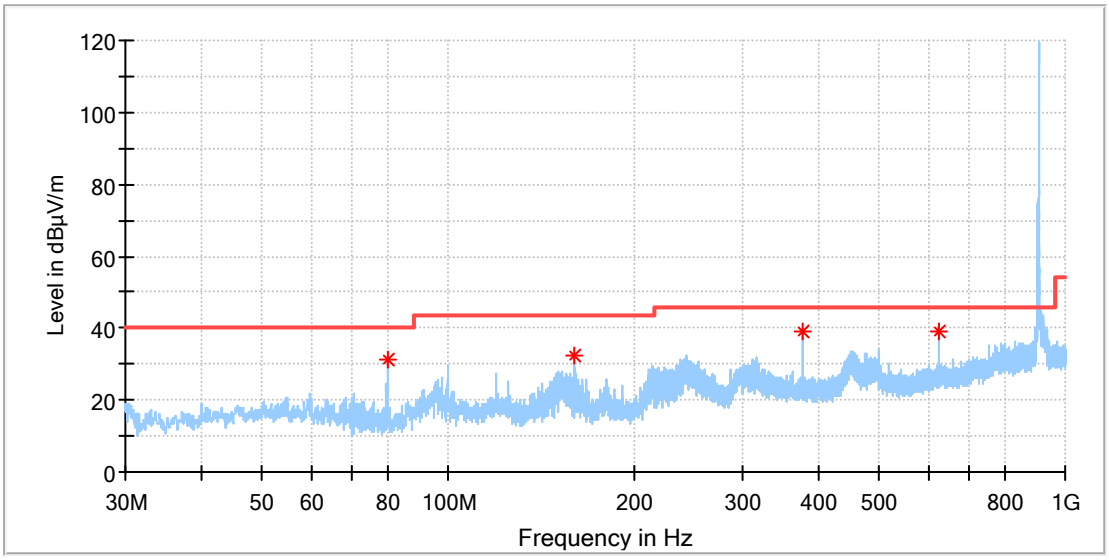
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9249.000000	41.95	---	74.00	32.05	100.0	V	14.0	10.4
9253.500000	---	31.27	54.00	22.73	100.0	V	30.0	10.4

Lora DTS SF8 with 2.3dBi antenna
30MHz - 1GHz

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF8_904.6MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

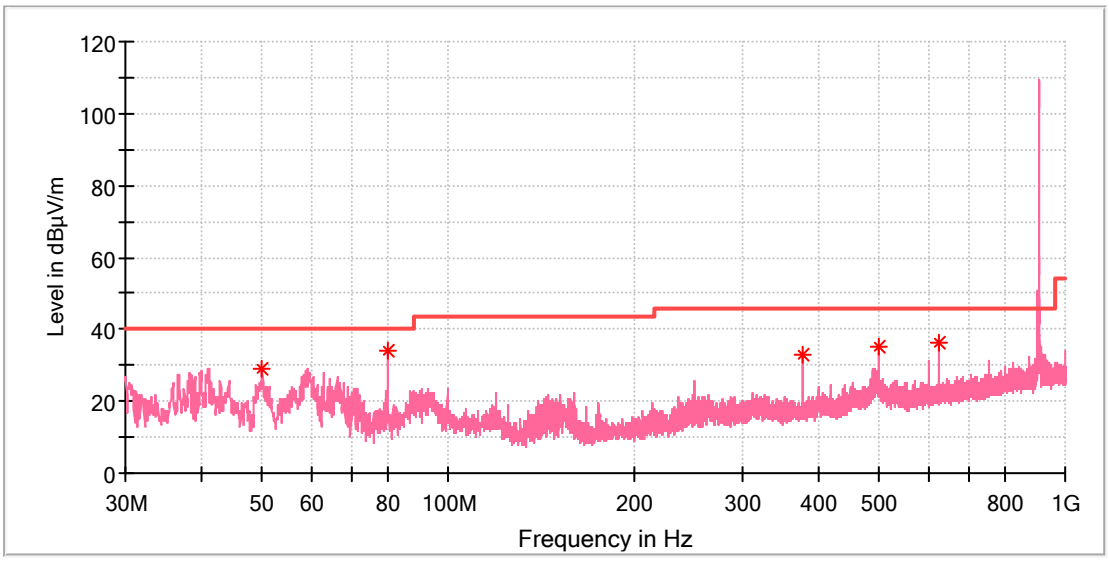


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
79.809500	31.19	40.00	8.81	100.0	H	160.0	-23.5
160.368000	32.17	43.50	11.33	100.0	H	59.0	-21.7
375.029000	38.98	46.00	7.02	100.0	H	140.0	-14.3
625.046500	39.07	46.00	6.93	100.0	H	259.0	-9.5

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF8_904.6MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



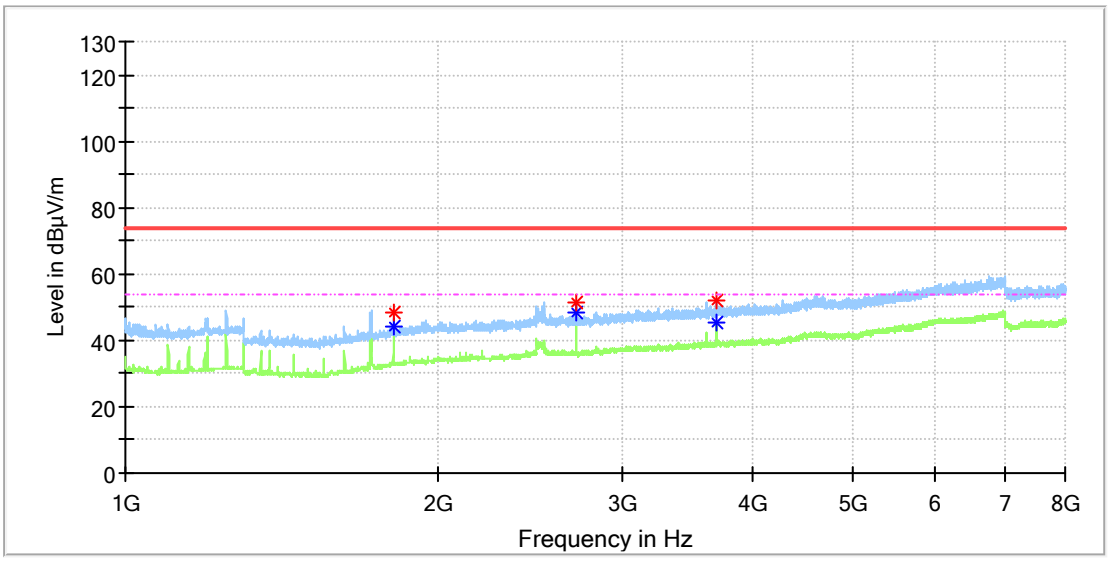
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
50.030500	28.93	40.00	11.07	100.0	V	237.0	-18.3
79.809500	34.03	40.00	5.97	100.0	V	304.0	-23.5
374.980500	33.09	46.00	12.91	100.0	V	237.0	-14.3
500.062000	35.06	46.00	10.94	100.0	V	279.0	-11.8
625.046500	36.11	46.00	9.89	100.0	V	88.0	-9.5

1GHz - 8GHz

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF8_904.6MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

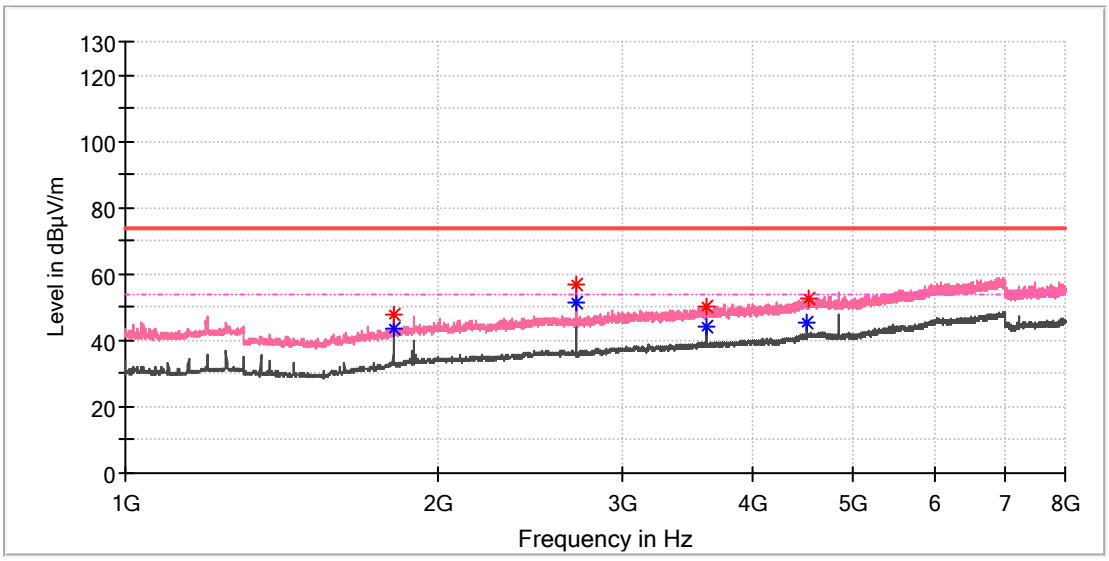


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1809.200000	48.49	---	74.00	25.51	100.0	H	308.0	4.8
1809.200000	---	44.28	54.00	9.72	100.0	H	308.0	4.8
2712.862500	---	48.38	54.00	5.62	100.0	H	0.0	7.6
2713.700000	51.52	---	74.00	22.48	100.0	H	241.0	7.6
3699.437500	---	45.42	54.00	8.58	100.0	H	140.0	9.6
3701.950000	51.80	---	74.00	22.20	100.0	H	140.0	9.6

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF8_904.6MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



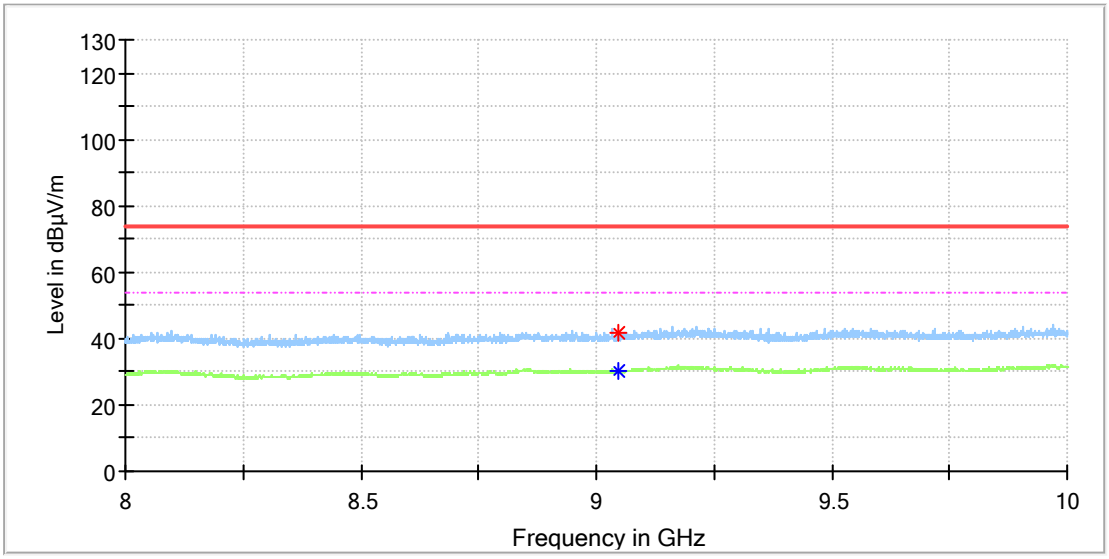
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1808.362500	47.97	---	74.00	26.03	100.0	V	95.0	4.8
1808.362500	---	43.56	54.00	10.44	100.0	V	95.0	4.8
2713.700000	56.57	---	74.00	17.43	100.0	V	327.0	7.6
2714.537500	---	50.92	54.00	3.08	100.0	V	339.0	7.6
3617.362500	---	44.30	54.00	9.70	100.0	V	307.0	9.4
3618.200000	49.93	---	74.00	24.07	100.0	V	288.0	9.4
4522.700000	---	45.54	54.00	8.46	100.0	V	317.0	11.7
4529.400000	52.67	---	74.00	21.33	100.0	V	355.0	11.7

8GHz - 10GHz

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF8_904.6MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

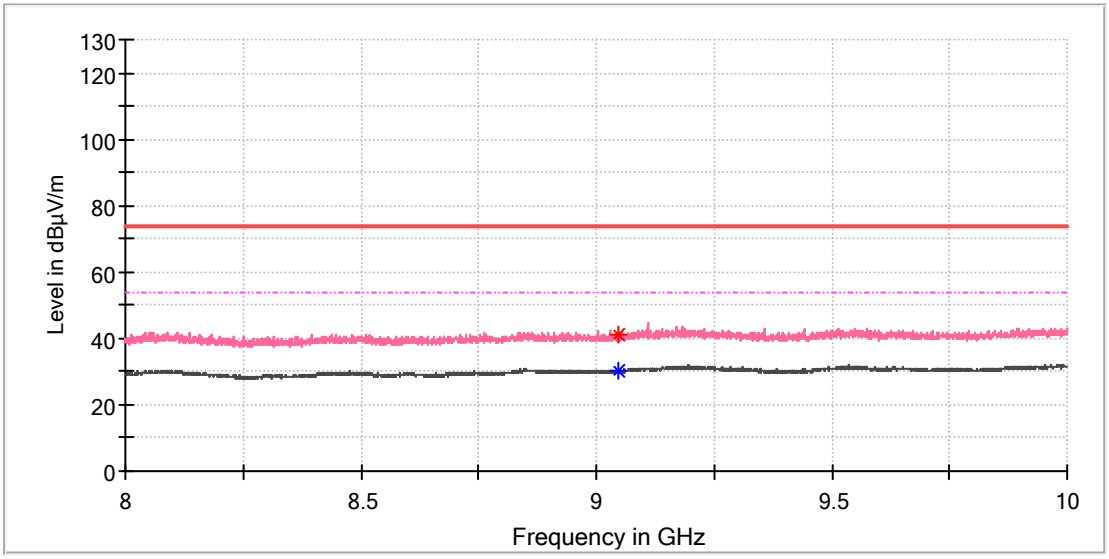


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9046.500000	---	30.28	54.00	23.72	100.0	H	160.0	9.0
9048.000000	41.51	---	74.00	32.49	100.0	H	41.0	9.0

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF8_904.6MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



Critical_Freqs

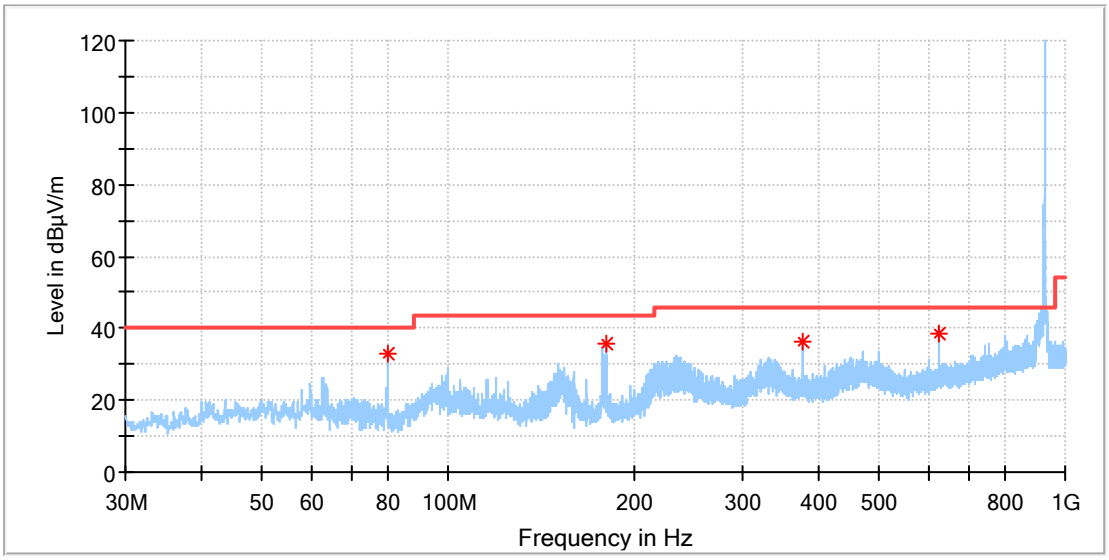
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9048.000000	41.36	---	74.00	32.64	100.0	V	0.0	9.0
9048.500000	---	30.49	54.00	23.51	100.0	V	309.0	9.0

Lora DTS SF7 with 8 dBi antenna

30MHz - 1GHz

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_925.1MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

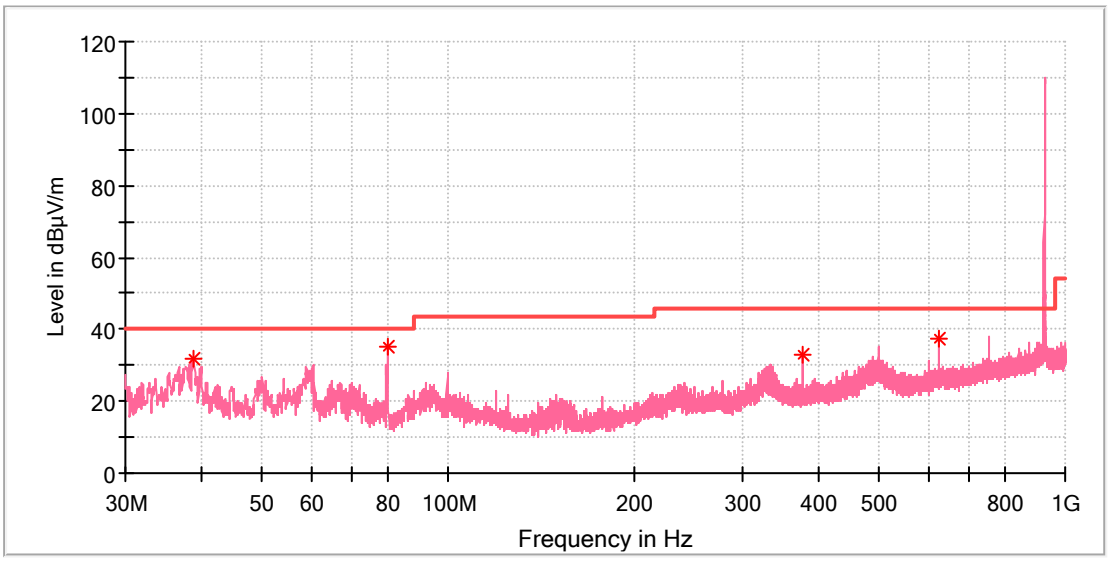


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
79.809500	32.68	40.00	7.32	100.0	H	240.0	-23.5
180.398500	35.91	43.50	7.59	100.0	H	109.0	-20.5
374.980500	36.24	46.00	9.76	100.0	H	69.0	-14.3
624.998000	38.51	46.00	7.49	100.0	H	265.0	-9.5

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_925.1MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



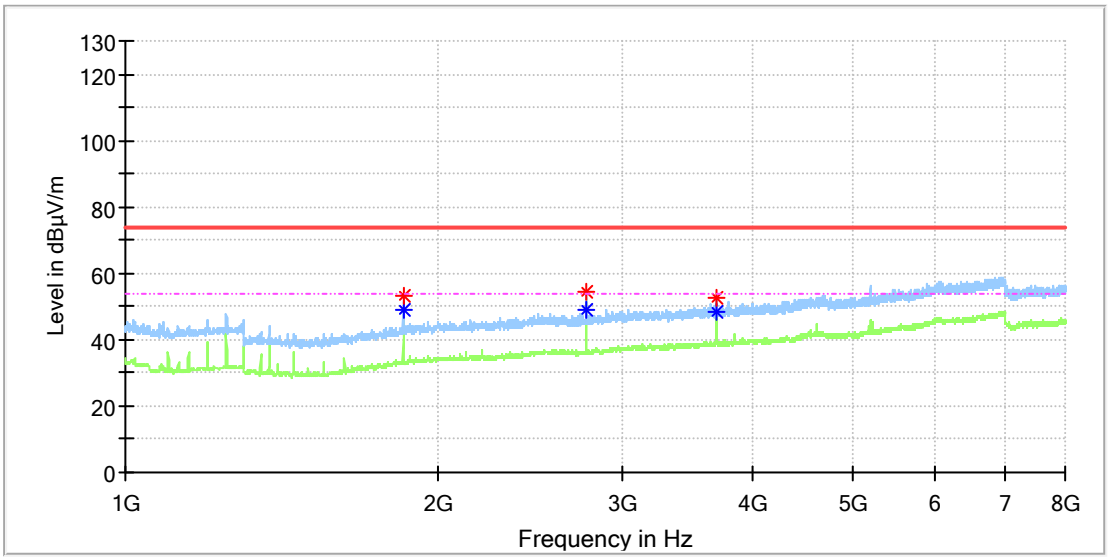
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
38.730000	31.75	40.00	8.25	100.0	V	20.0	-20.5
79.809500	35.28	40.00	4.72	100.0	V	294.0	-23.5
375.029000	32.75	46.00	13.25	100.0	V	228.0	-14.3
625.046500	37.55	46.00	8.45	100.0	V	99.0	-9.5

1GHz - 8GHz

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_925.1MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

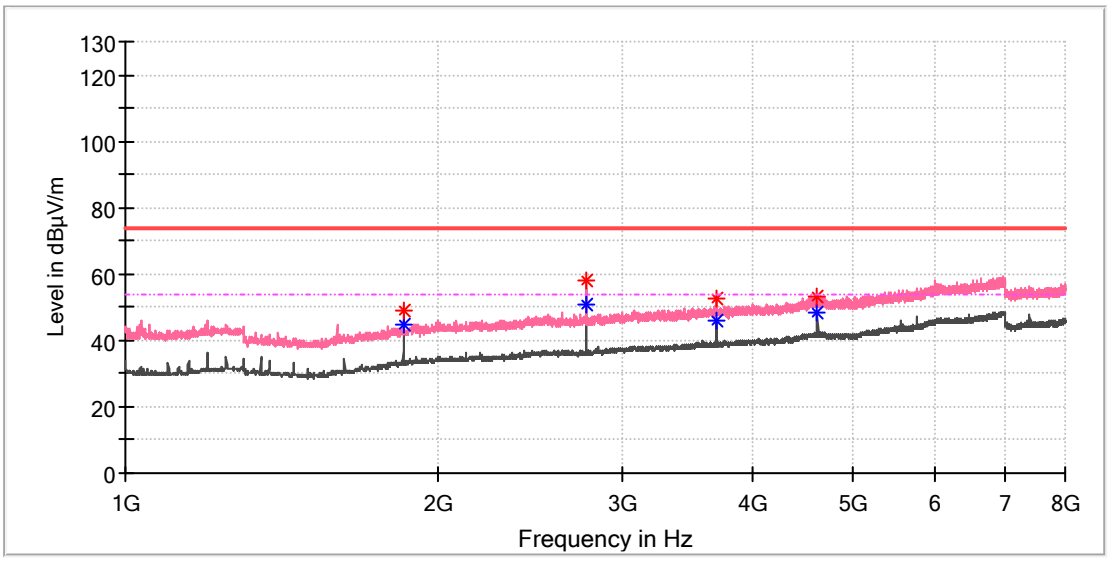


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1850.237500	53.21	---	74.00	20.79	100.0	H	220.0	5.0
1850.237500	---	49.02	54.00	4.98	100.0	H	220.0	5.0
2774.837500	---	48.84	54.00	5.16	100.0	H	359.0	7.9
2775.675000	54.16	---	74.00	19.84	100.0	H	163.0	7.9
3700.275000	---	48.18	54.00	5.82	100.0	H	185.0	9.6
3701.112500	52.62	---	74.00	21.38	100.0	H	173.0	9.6

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_925.1MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



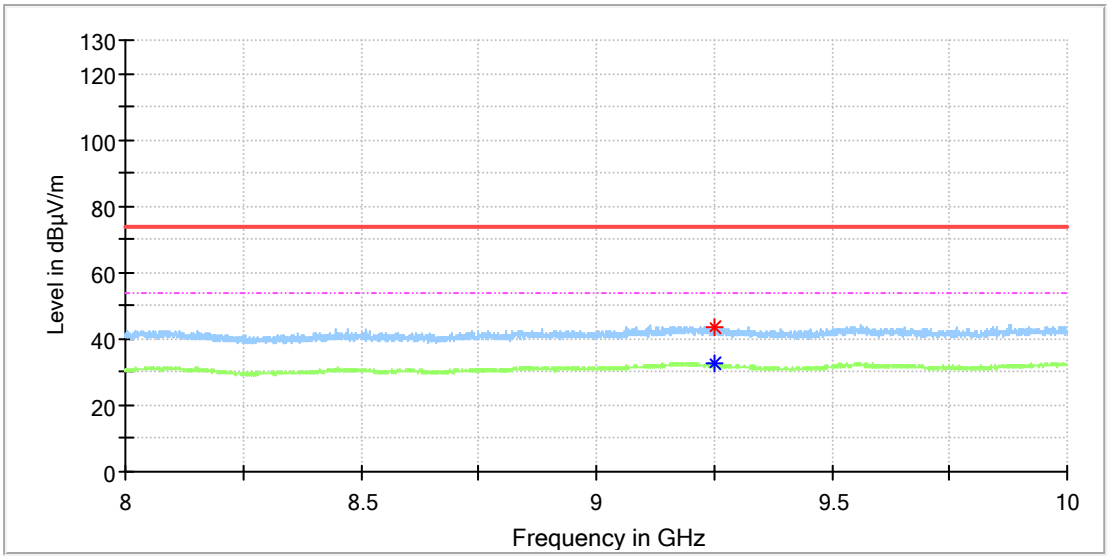
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1850.237500	49.17	---	74.00	24.83	100.0	V	313.0	5.0
1850.237500	---	44.80	54.00	9.20	100.0	V	313.0	5.0
2774.000000	---	50.81	54.00	3.19	100.0	V	178.0	7.9
2774.837500	58.29	---	74.00	15.71	100.0	V	323.0	7.9
3699.437500	---	46.00	54.00	8.00	100.0	V	323.0	9.6
3701.112500	52.63	---	74.00	21.37	100.0	V	28.0	9.6
4625.712500	---	48.12	54.00	5.88	100.0	V	313.0	12.0
4626.550000	53.51	---	74.00	20.49	100.0	V	323.0	12.0

8GHz - 10GHz

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_925.1MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

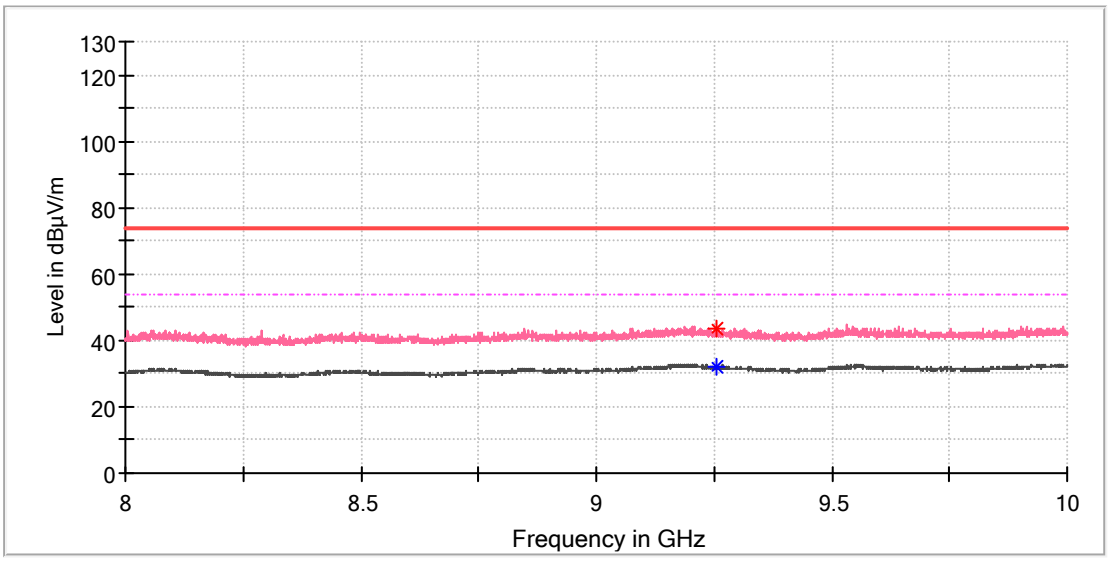


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9250.000000	43.48	---	74.00	30.52	100.0	H	218.0	10.5
9250.500000	---	32.87	54.00	21.13	100.0	H	148.0	10.4

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test Mode:	Lora_DTS 500K_SF7_925.1MHz
Test Voltage::	120V/60Hz
Remark:	Temp 23 Humi:45%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



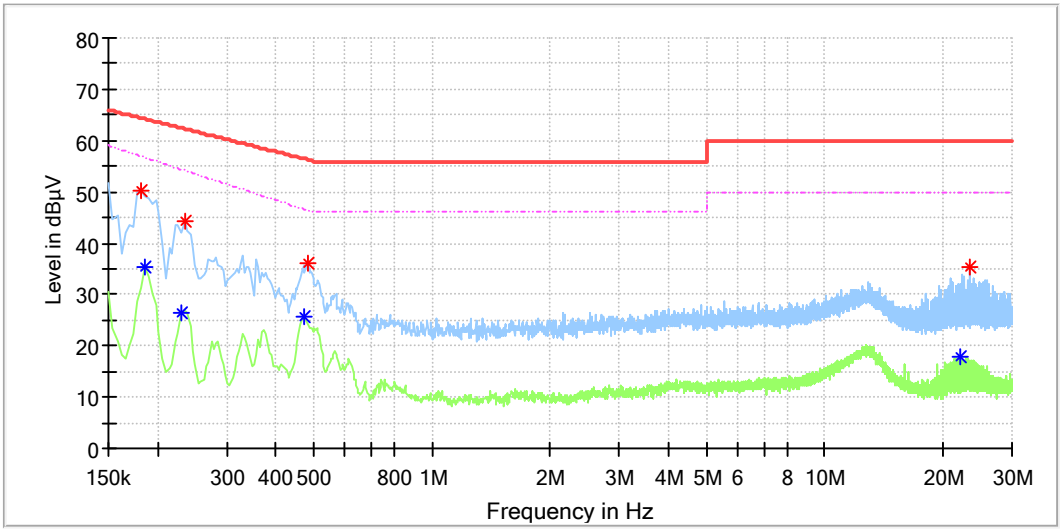
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9255.000000	43.26	---	74.00	30.74	100.0	V	353.0	10.4
9255.500000	---	32.19	54.00	21.81	100.0	V	0.0	10.4

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

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test mode:	Lora TX
Test Voltage:	AC 120V/60Hz
Test By:	Kei Zhang
Review By:	Terry Yin
Remark:	SR2

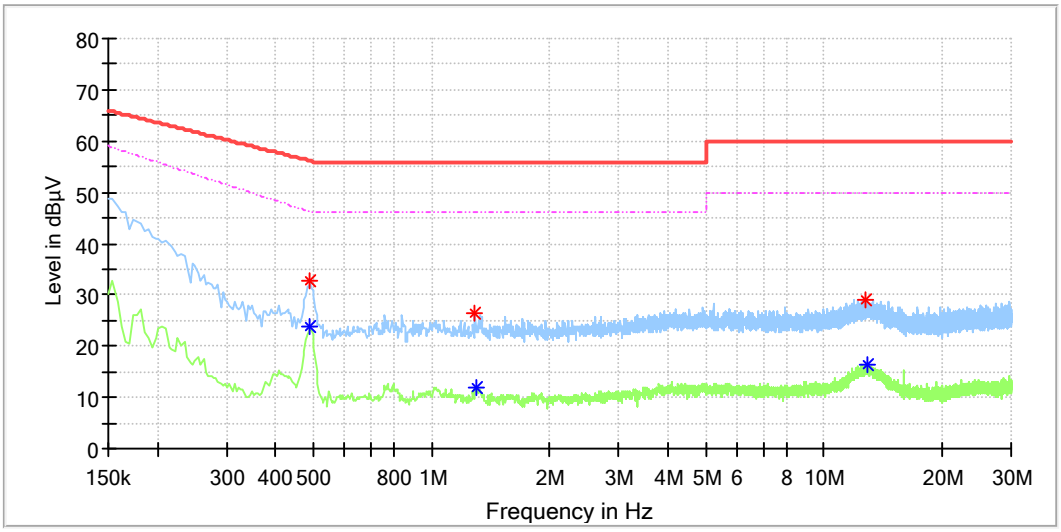


Critical_Freqs

Frequency (MHz)	MaxPeak (dB磺)	Average (dB磺)	Limit (dB磺)	Margin (dB)	Line	Corr. (dB)
0.182000	50.20	---	64.39	14.19	L1	9.9
0.186000	---	35.37	56.68	21.31	L1	9.9
0.230000	---	26.52	54.39	27.86	L1	9.9
0.234000	44.13	---	62.31	18.18	L1	9.9
0.474000	---	25.63	46.58	20.95	L1	10.0
0.482000	36.01	---	56.31	20.29	L1	10.0
22.194000	---	17.97	50.00	32.03	L1	10.4
23.370000	35.41	---	60.00	24.59	L1	10.4

EUT Information

EUT Name:	LoRa Concentrator Module
Model:	RAK2287X
Test mode:	Lora TX
Test Voltage:	AC 120V/60Hz
Test By:	Kei Zhang
Review By:	Terry Yin
Remark:	SR2



Critical_Freqs

Frequency (MHz)	MaxPeak (dB礦)	Average (dB礦)	Limit (dB礦)	Margin (dB)	Line	Corr. (dB)
0.490000	---	23.84	46.22	22.37	N	9.8
0.490000	32.91	---	56.17	23.26	N	9.8
1.290000	26.43	---	56.00	29.57	N	9.8
1.302000	---	11.81	46.00	34.19	N	9.8
12.798000	29.17	---	60.00	30.83	N	10.1
12.874000	---	16.55	50.00	33.45	N	10.1