

Prüfbericht-Nr.: <i>Test report no.:</i>	CN211F02 001	Auftrags-Nr.: <i>Order no.:</i>	168337755	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>	2021-09-26	
Auftraggeber: <i>Client:</i>	Shenzhen RAKwireless Technology Co.,Ltd. Room 506, Building B, New Compark, Pingshan First Road, Taoyuan Street, Nanshan District, Shenzhen, Guangdong, China			
Prüfgegenstand: <i>Test item:</i>	LoRa Concentrator Module			
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	RAK2287X (Trademark: RAK)			
Auftrags-Inhalt: <i>Order content:</i>	FCC and IC approval			
Prüfgrundlage: <i>Test specification:</i>	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: <i>Date of sample receipt:</i>	2021-09-27	Please refer to photo documents		
Prüfmuster-Nr.: <i>Test sample no.:</i>	A003136820-001~010			
Prüfzeitraum: <i>Testing period:</i>	2021-09-28 - 2021-10-18			
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>	genehmigt von: <i>authorized by:</i>			
Datum: <i>Date:</i> 2021-10-19	 Signed by: Alex Lan		 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: <i>Condition of the test item at delivery:</i>	Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged:</i>			
* 1 = sehr gut P(ass) = entspricht o.g. Prüfgrundlage(n) Legend: 1 = very good P(ass) = passed a.m. test specifications(s)	2 = gut F(ail) = entspricht nicht o.g. Prüfgrundlage(n) 2 = good F(ail) = failed a.m. test specifications(s)	3 = befriedigend 3 = satisfactory	4 = ausreichend N/A = nicht anwendbar 4 = sufficient N/A = not applicable	5 = mangelhaft N/T = nicht getestet 5 = poor N/T = not tested
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report 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>				

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	<i>Antenna Requirement.....</i>	<i>14</i>
5.1.2	<i>Maximum Conducted Output Power.....</i>	<i>15</i>
5.1.3	<i>Conducted Power Spectral Density.....</i>	<i>17</i>
5.1.4	<i>6dB Bandwidth</i>	<i>19</i>
5.1.5	<i>20dB Bandwidth</i>	<i>20</i>
5.1.6	<i>99% Bandwidth.....</i>	<i>21</i>
5.1.7	<i>Conducted Spurious Emissions Measured in 100 kHz Bandwidth.....</i>	<i>22</i>
5.1.8	<i>Radiated Spurious Emission</i>	<i>23</i>
5.1.9	<i>Carrier Frequency Separation</i>	<i>24</i>
5.1.10	<i>Number of Hopping Frequency</i>	<i>26</i>
5.1.11	<i>Time of Occupancy</i>	<i>27</i>
5.1.12	<i>Conducted Emission on AC Mains.....</i>	<i>28</i>
6	SAFETY HUMAN EXPOSURE.....	29
6.1	RADIO FREQUENCY EXPOSURE COMPLIANCE	29
6.1.1	<i>Electromagnetic Fields</i>	<i>29</i>

Prüfbericht - Nr.: CN211F02 001
Test Report No.

Seite 4 von 31
Page 4 of 31

7	PHOTOGRAPHS OF THE TEST SET-UP	31
8	LIST OF TABLES	31

Prüfbericht - Nr.: CN211F02 001
Test Report No.

Seite 5 von 31
Page 5 of 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 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

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)

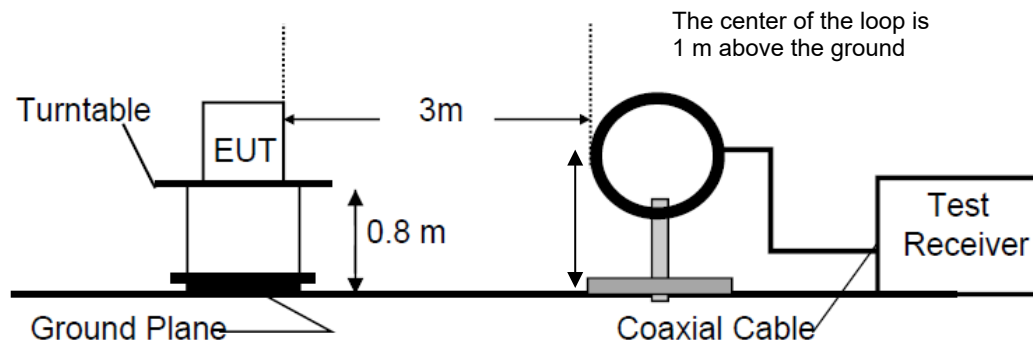


Diagram of Measurement Configuration for Radiation Test (Below 1GHz)

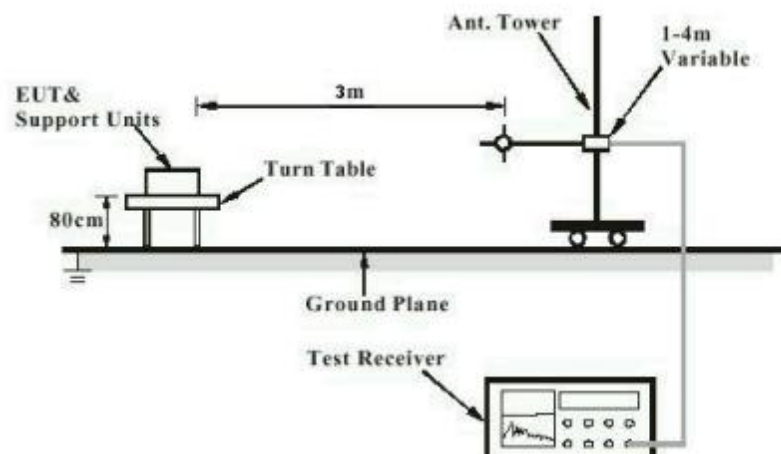


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

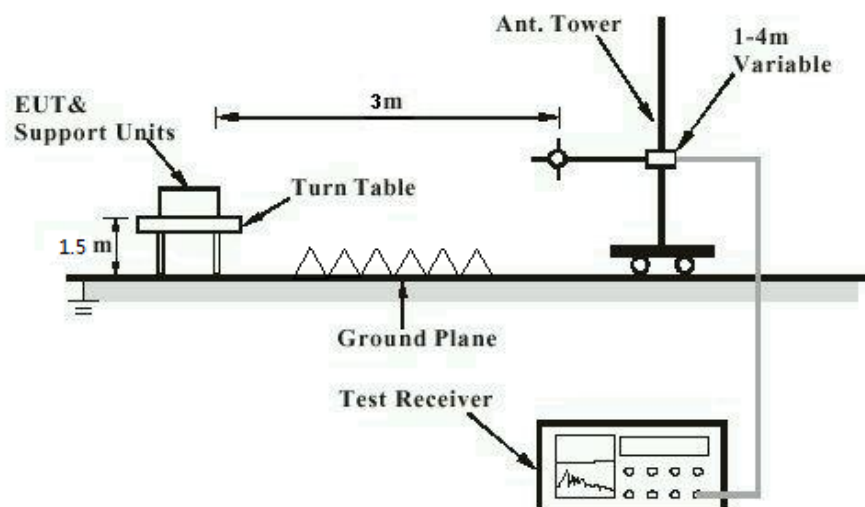


Diagram of Measurement Configuration for Mains Conduction Measurement

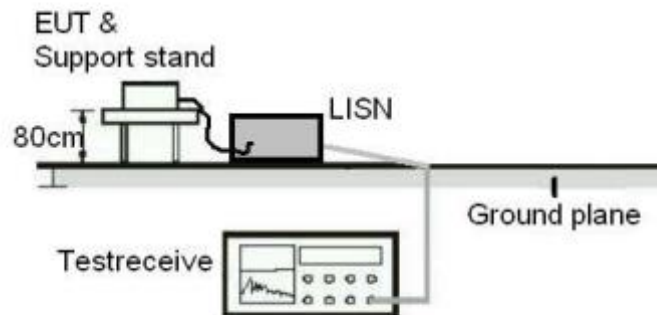
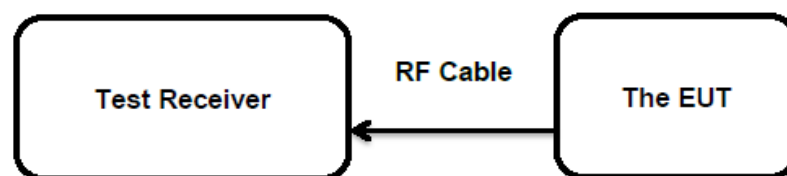


Diagram of Measurement Configuration for Conducted Transmitter Measurement



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 °C
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 °C
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 °C
 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 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	: 2021-10-11
Input voltage	: DC 3.3V
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: 25 °C
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 °C
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	

Prüfbericht - Nr.: **CN211F02 001**
Test Report No.Seite 22 von 31
Page 22 of 31**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 °C
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.

Prüfbericht - Nr.: CN211F02 001
Test Report No.

Seite 24 von 31
Page 24 of 31

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 : $\geq 20\text{dB}$ 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 °C
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 °C
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 °C
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

Prüfbericht - Nr.: CN211F02 001
Test Report No.

Seite 28 von 31
Page 28 of 31

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 °C
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: $S_{(mW/cm^2)} = PG/4\pi R^2$ or $EIRP/4\pi R^2$

Where:

S = power density (mW/cm²)

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: $S_{(mW/cm^2)} = PG/4\pi R^2 = 0.208 \text{ mW/cm}^2$

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
<i>Lora DTS 8</i>	2
<i>Lora DTS 7</i>	2
<i>Lora DTS 12</i>	3
APPENDIX B.2: 20dB BANDWIDTH	5
<i>Lora Hybrid SF7</i>	5
<i>Lora Hybrid SF9</i>	6
<i>Lora Hybrid SF10</i>	7
APPENDIX B.3: 99% BANDWIDTH	9
<i>Lora DTS 8</i>	9
<i>Lora DTS SF7</i>	9
<i>Lora DTS SF12</i>	10
<i>Lora Hybrid SF7</i>	11
<i>Lora Hybrid SF9</i>	12
<i>Lora Hybrid SF10</i>	13
APPENDIX B.4: CONDUCTED SPURIOUS EMISSIONS MEASURED IN 100 kHz BANDWIDTH	15
<i>Lora DTS 8</i>	15
<i>Lora DTS SF7</i>	16
<i>Lora DTS SF12</i>	19
APPENDIX B.5: CARRIER FREQUENCY SEPARATION	22
<i>Lora Hybrid SF7</i>	22
<i>Lora Hybrid SF9</i>	23
<i>Lora Hybrid SF10</i>	24
APPENDIX B.6: NUMBER OF HOPPING FREQUENCY	25
<i>Lora Hybrid SF7</i>	25
<i>Lora Hybrid SF9</i>	25
<i>Lora Hybrid SF10</i>	25
APPENDIX B.7: TEST RESULTS OF RADIATED SPURIOUS EMISSIONS	26
<i>Lora DTS SF7 with 2.3dBi antenna</i>	26
<i>Lora DTS SF12 with 2.3dBi antenna</i>	44
<i>Lora DTS SF8 with 2.3dBi antenna</i>	50
<i>Lora DTS SF7 with 8 dBi antenna</i>	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

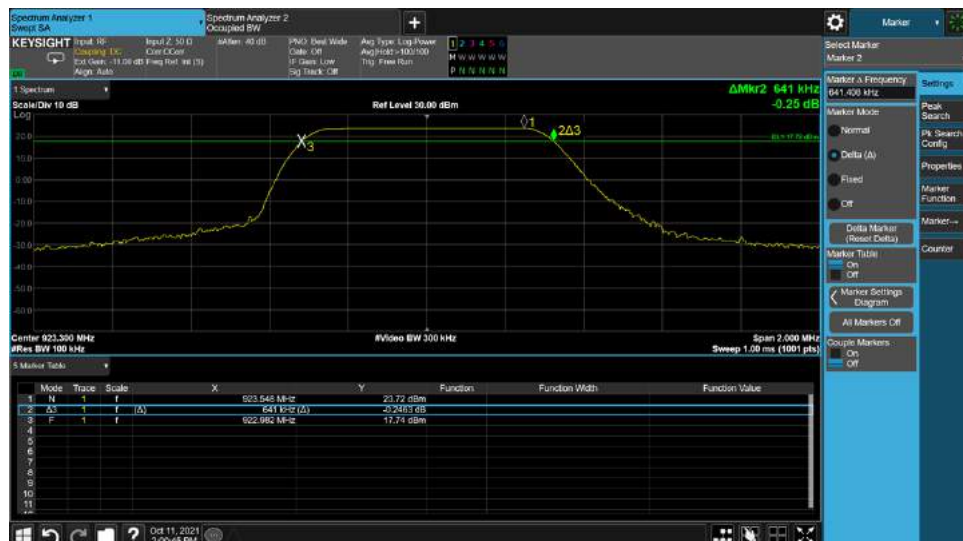


High Channel



Lora DTS 12

Low Channel



Prüfbericht - Produkte
Test Report - Products

Middle Channel



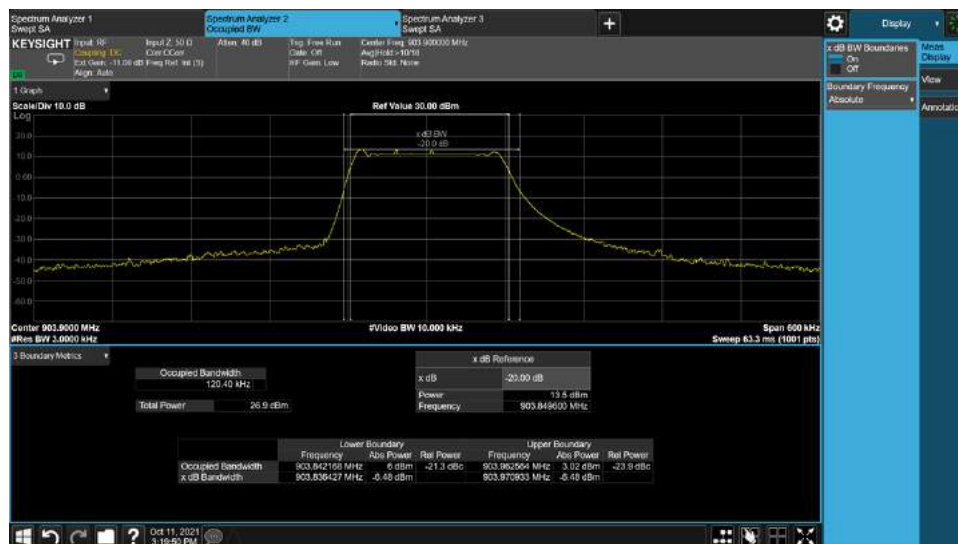
High Channel



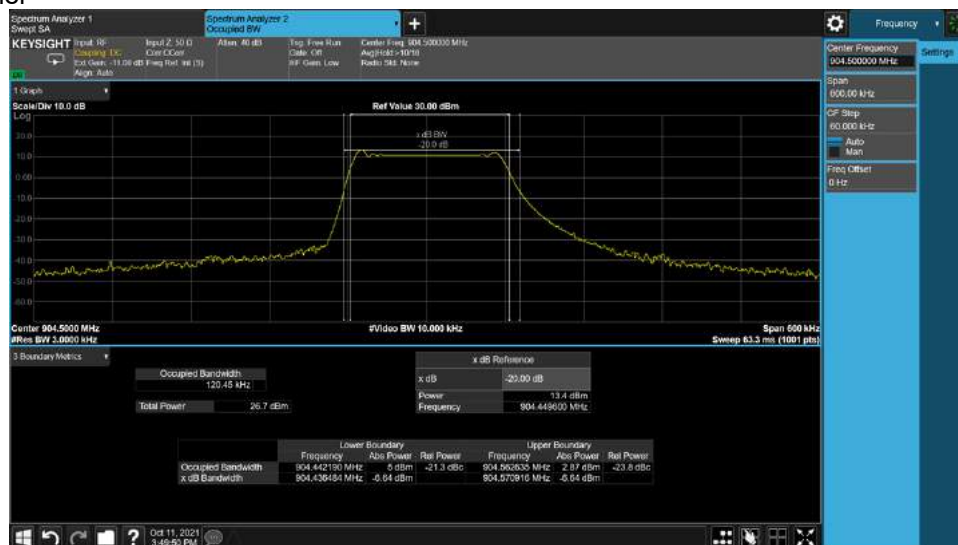
Appendix B.2: 20dB Bandwidth

Lora Hybrid SF7

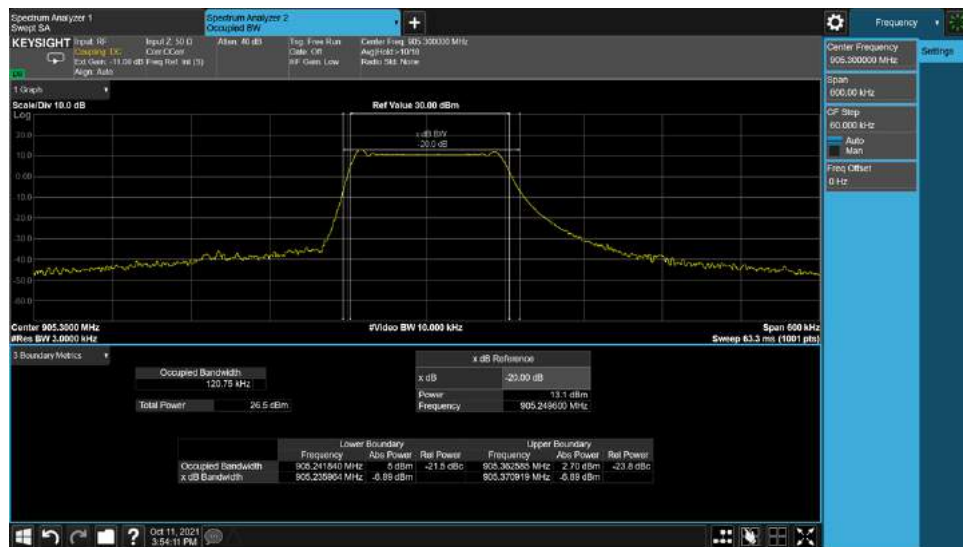
Low Channel



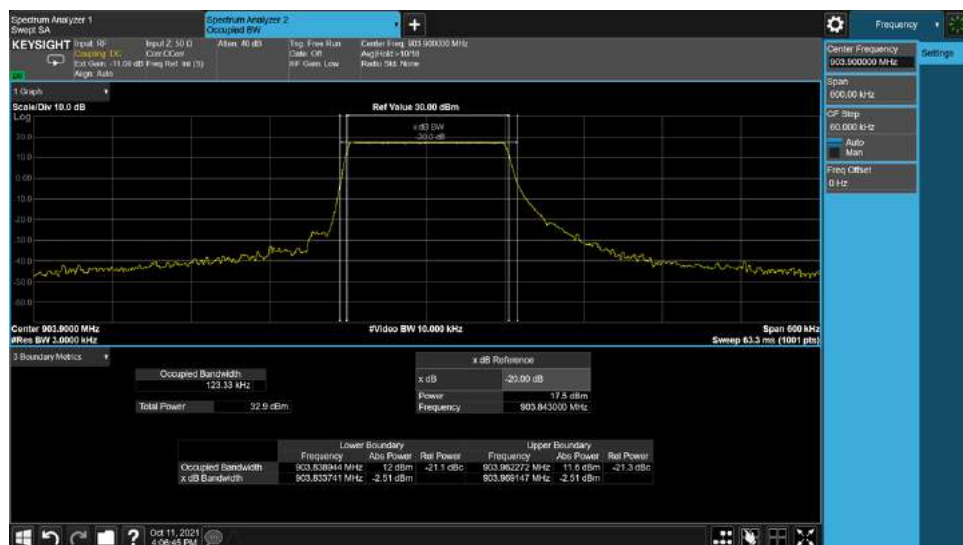
Middle Channel



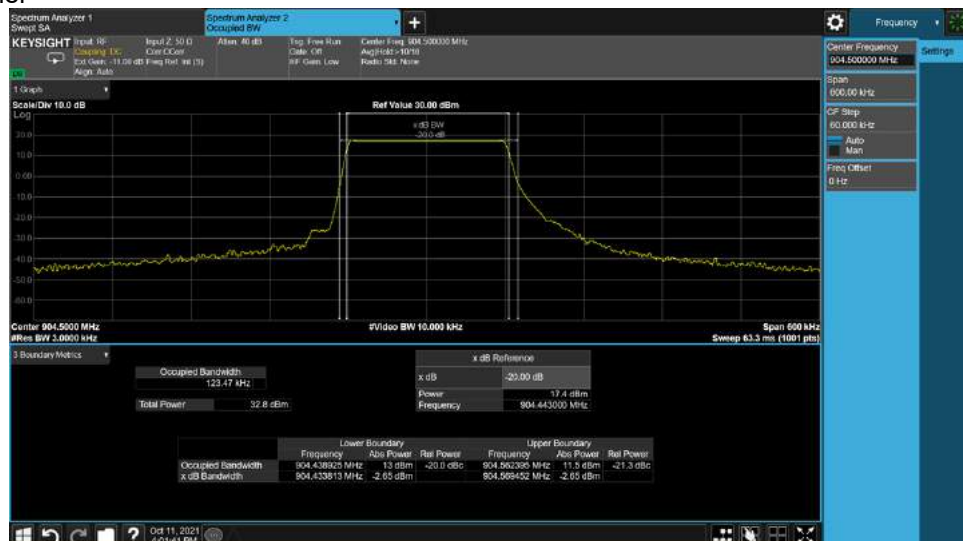
High Channel



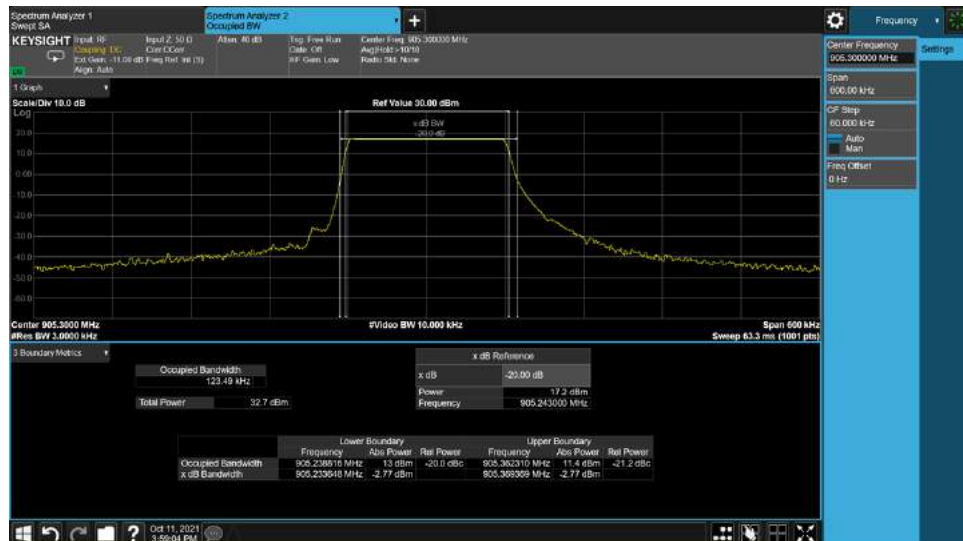
Lora Hybrid SF9 Low Channel



Middle Channel

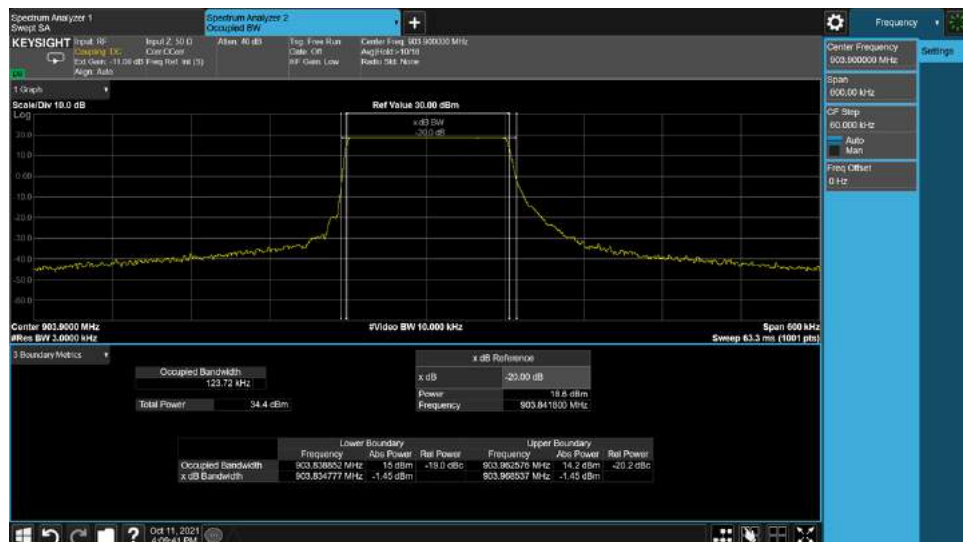


High Channel

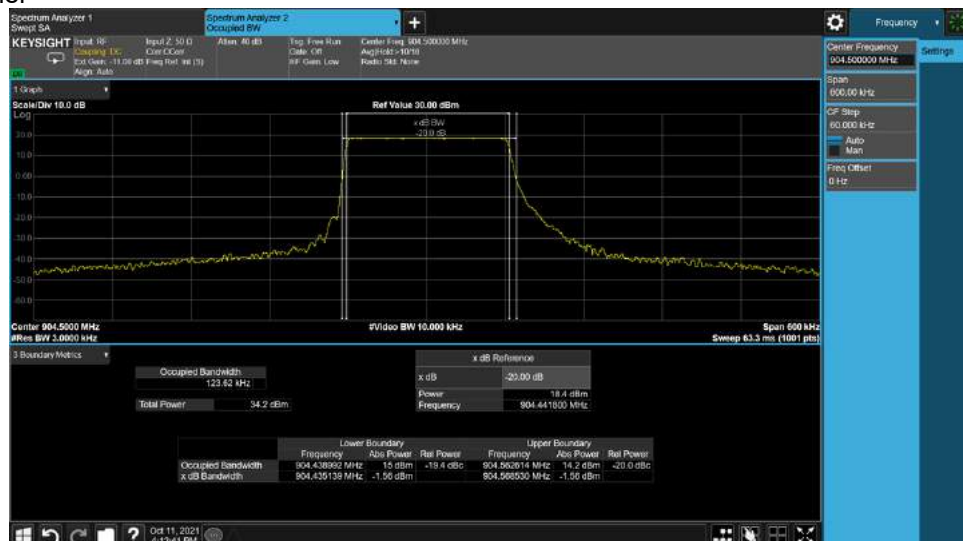


Lora Hybrid SF10

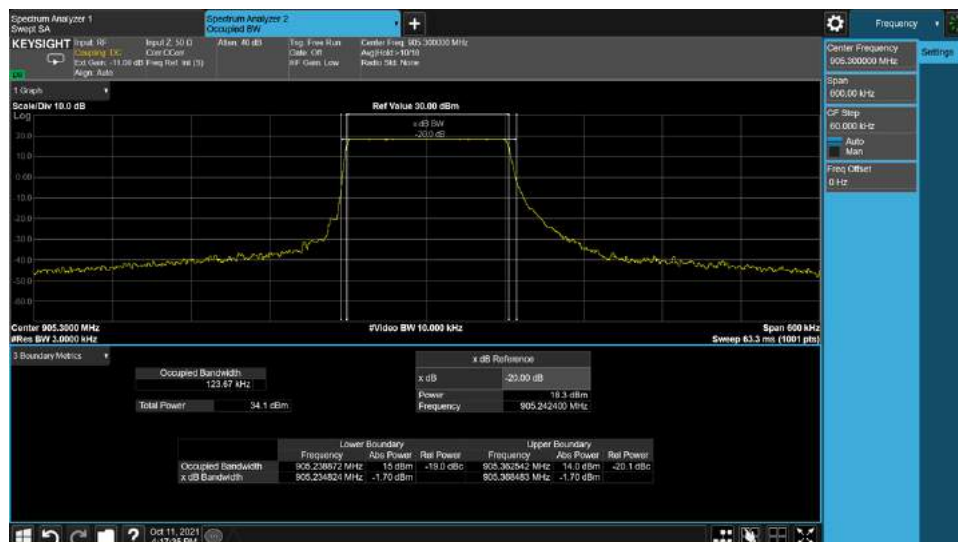
Low Channel



Middle Channel

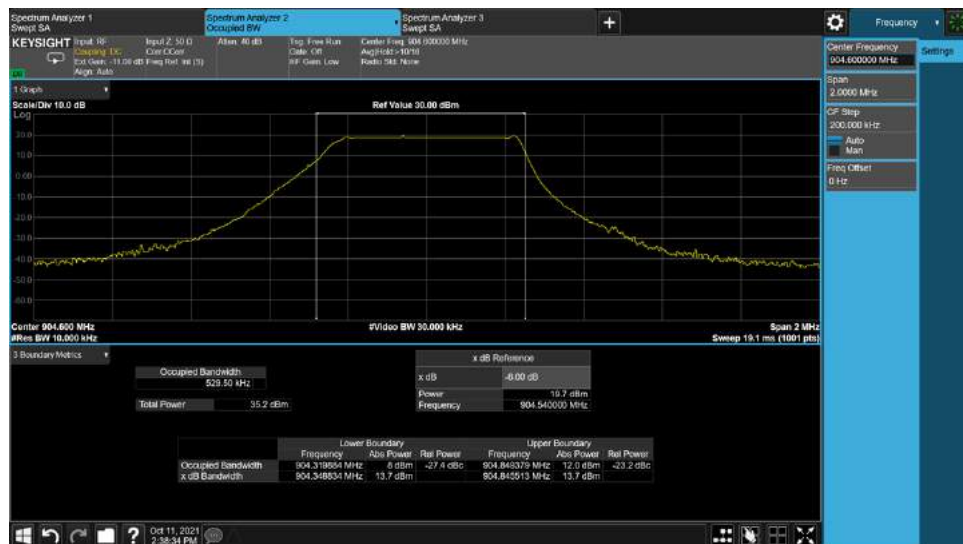


High Channel

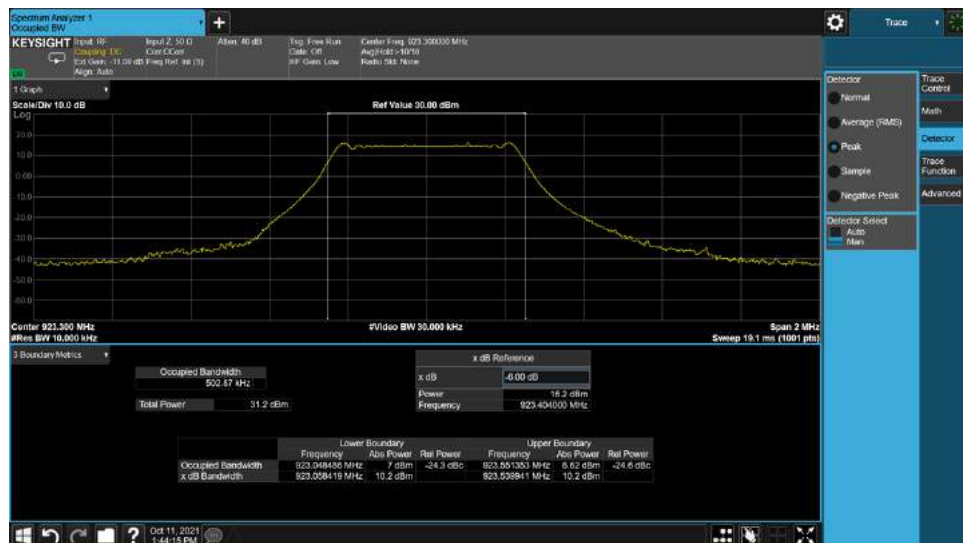


Appendix B.3: 99% Bandwidth

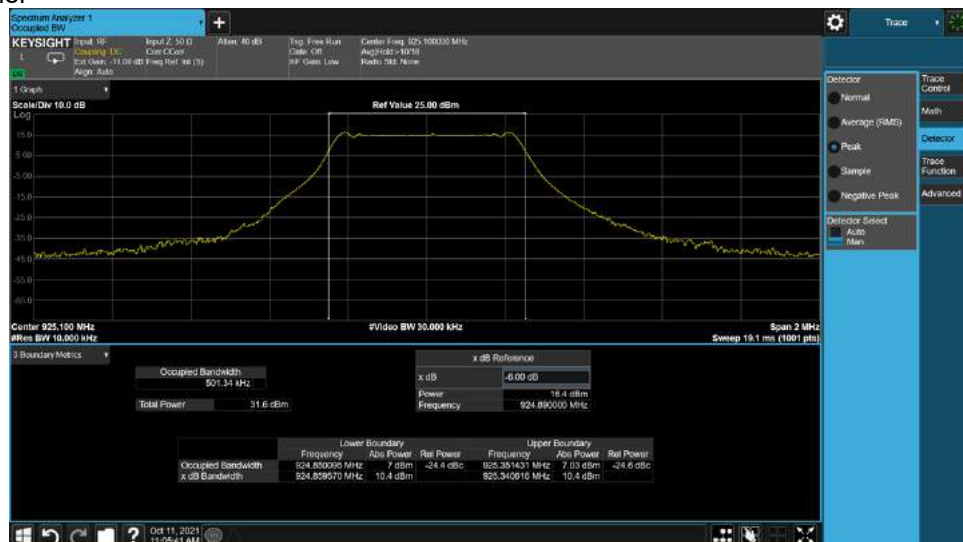
Lora DTS 8 904.6MHz



Lora DTS SF7 Low Channel



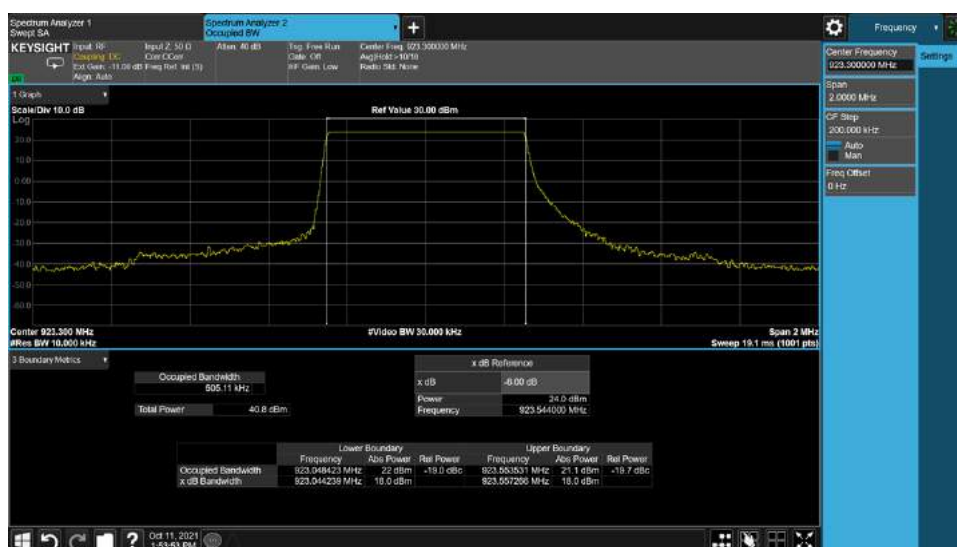
Middle Channel



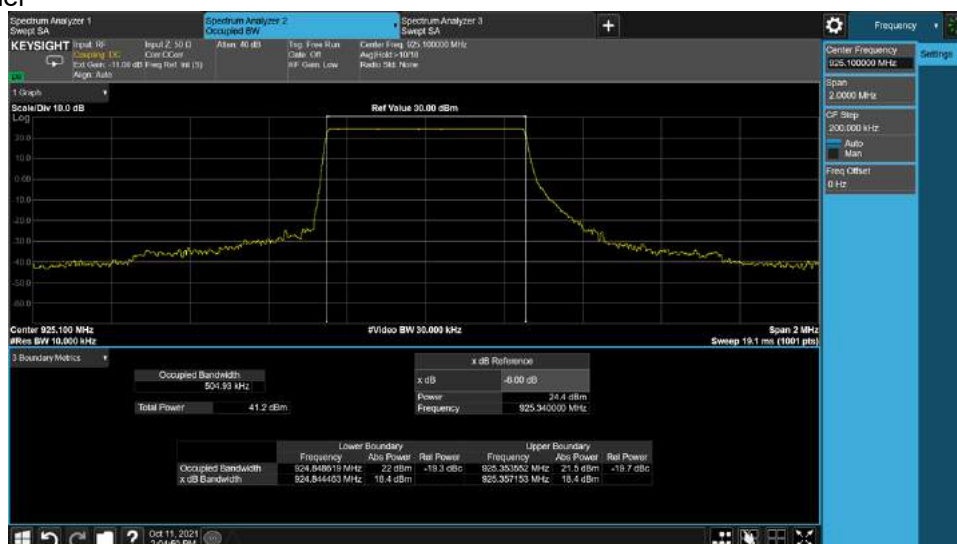
High Channel



Lora DTS SF12 Low Channel



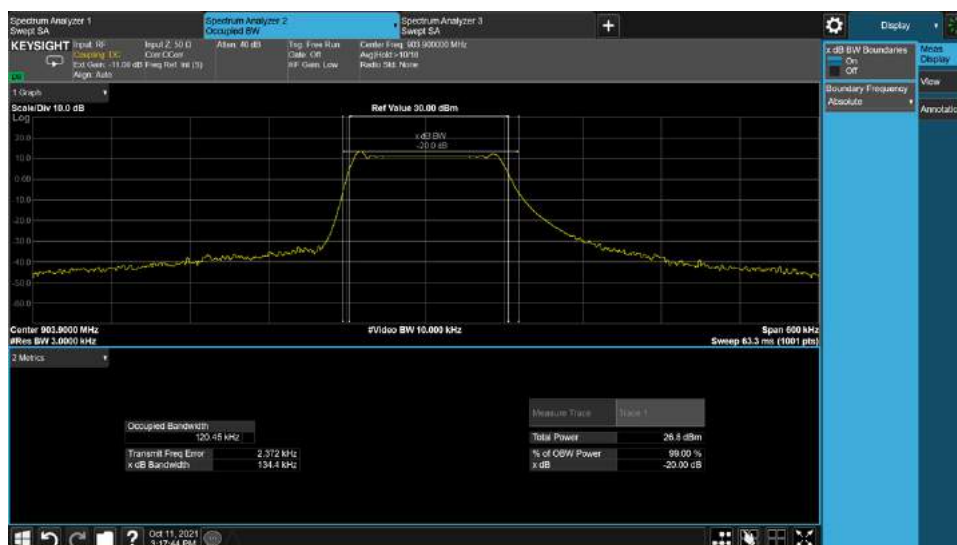
Middle Channel



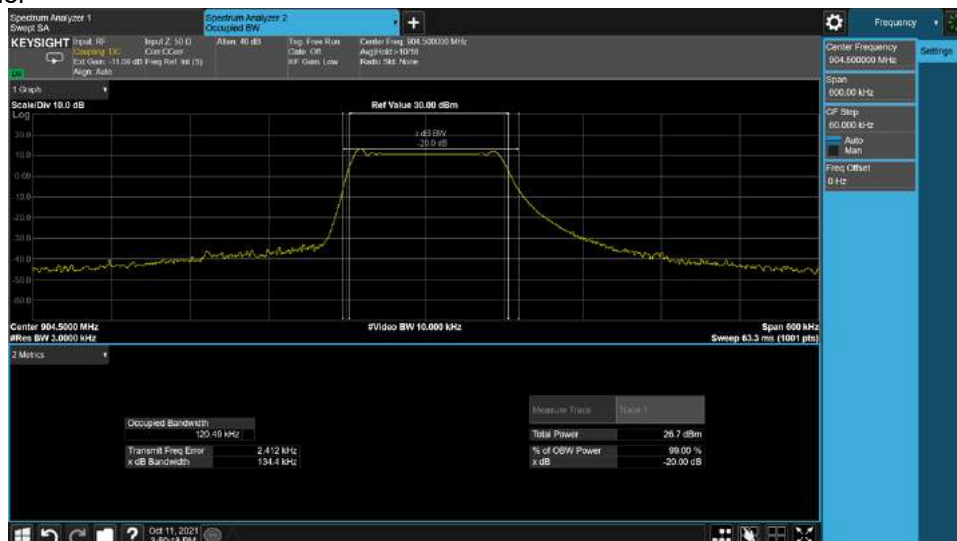
High Channel



Lora Hybrid SF7 Low Channel

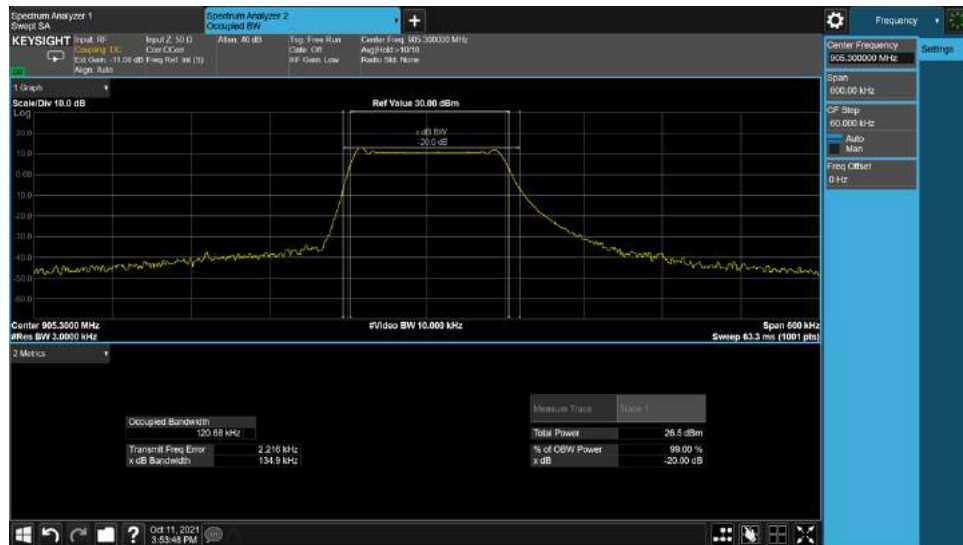


Middle Channel

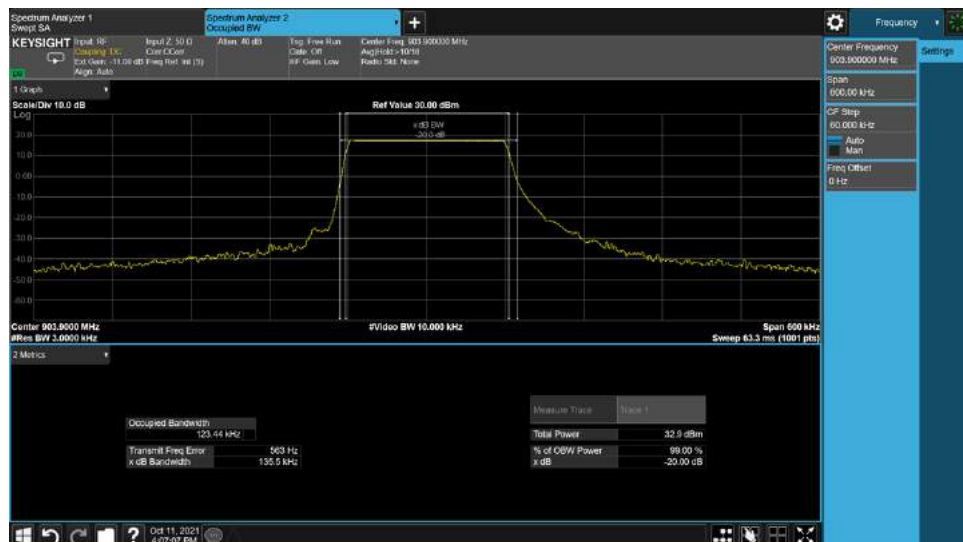


Prüfbericht - Produkte
Test Report - Products

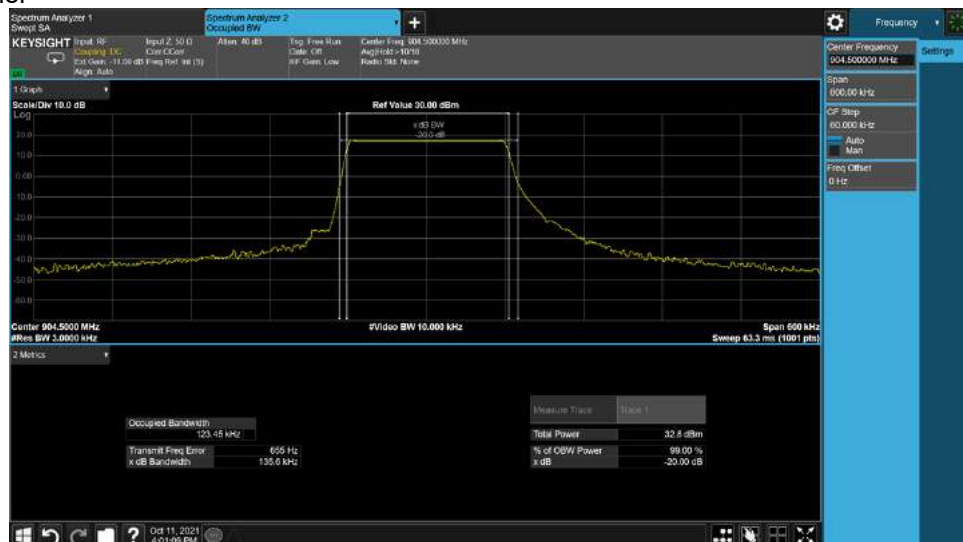
High Channel



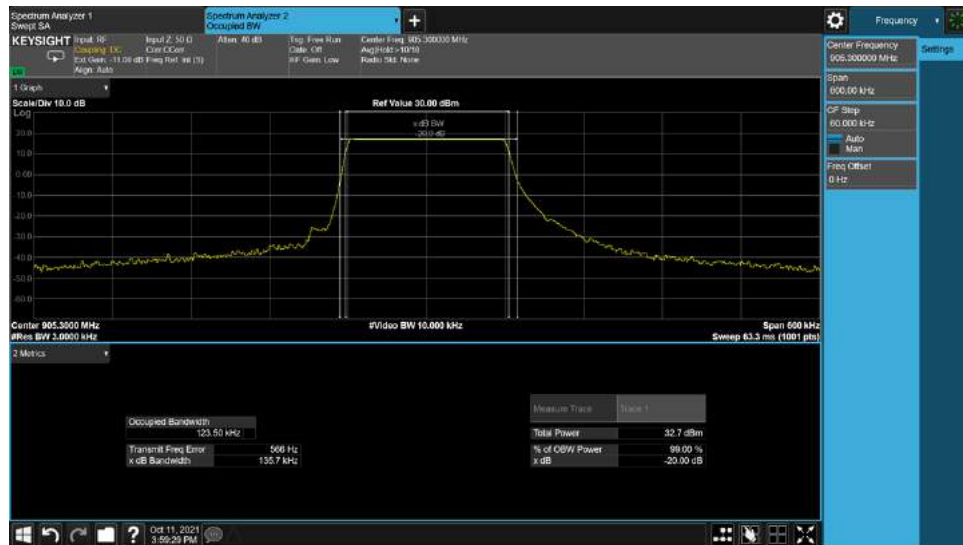
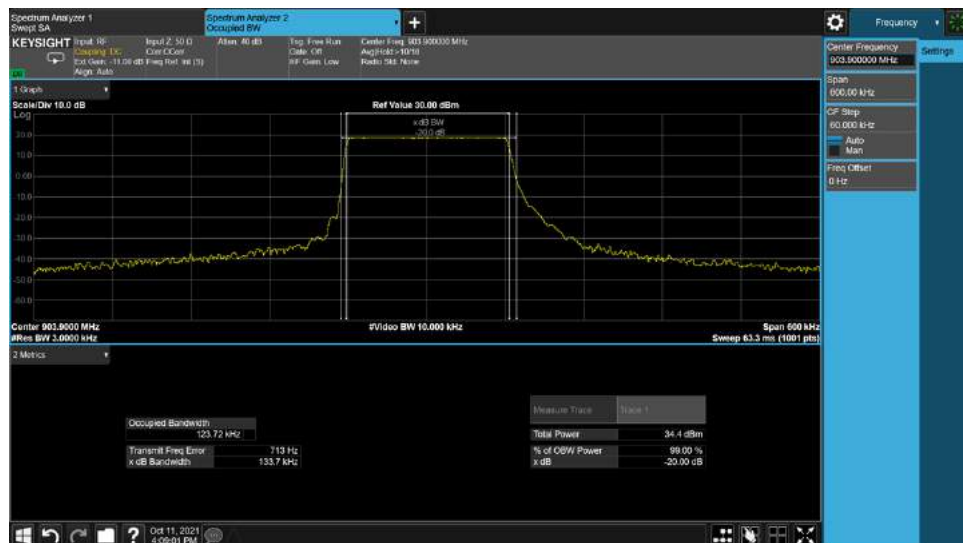
Lora Hybrid SF9
Low Channel



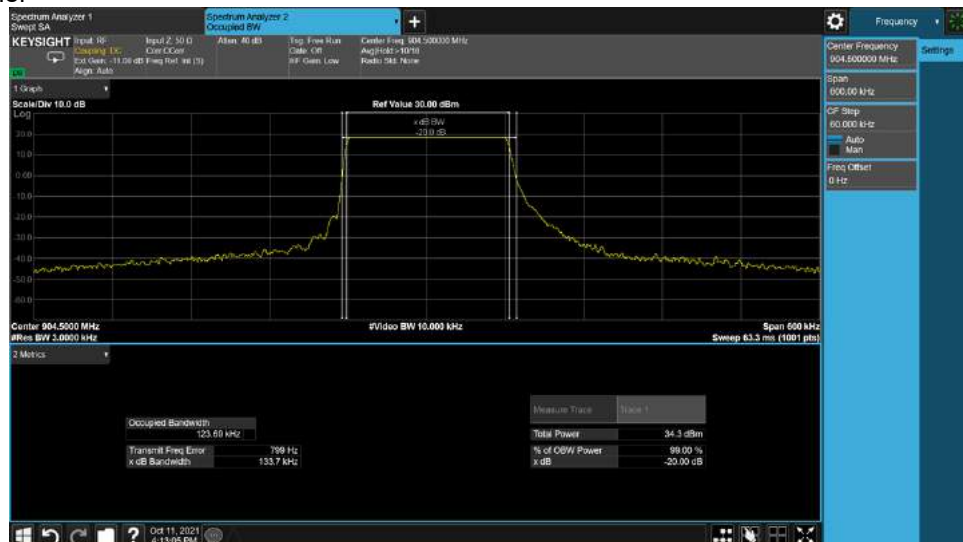
Middle Channel



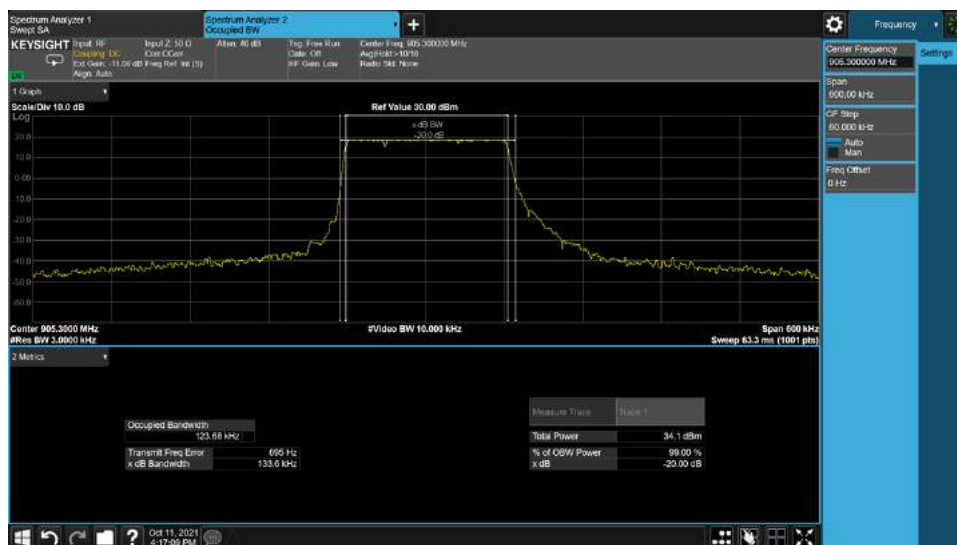
High Channel

Lora Hybrid SF10
Low Channel

Middle Channel

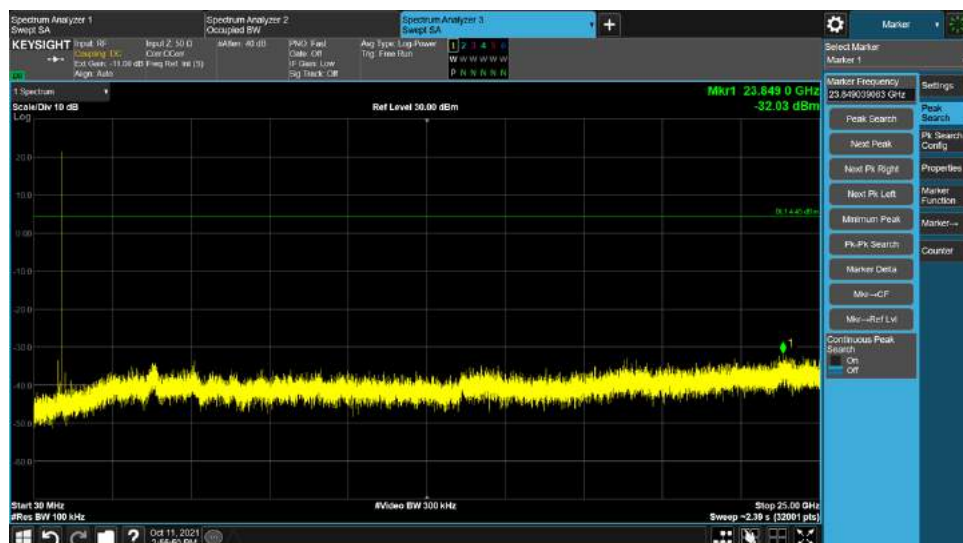
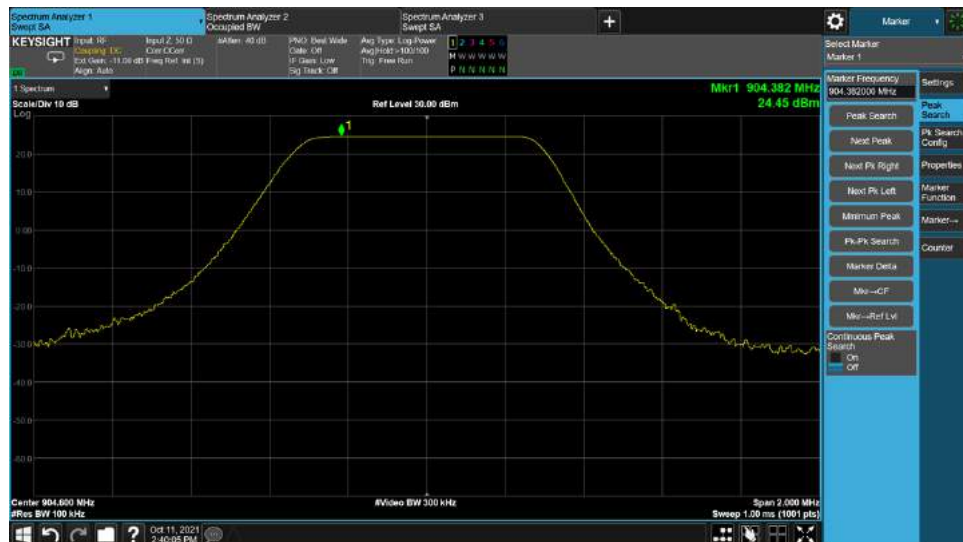


High Channel



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

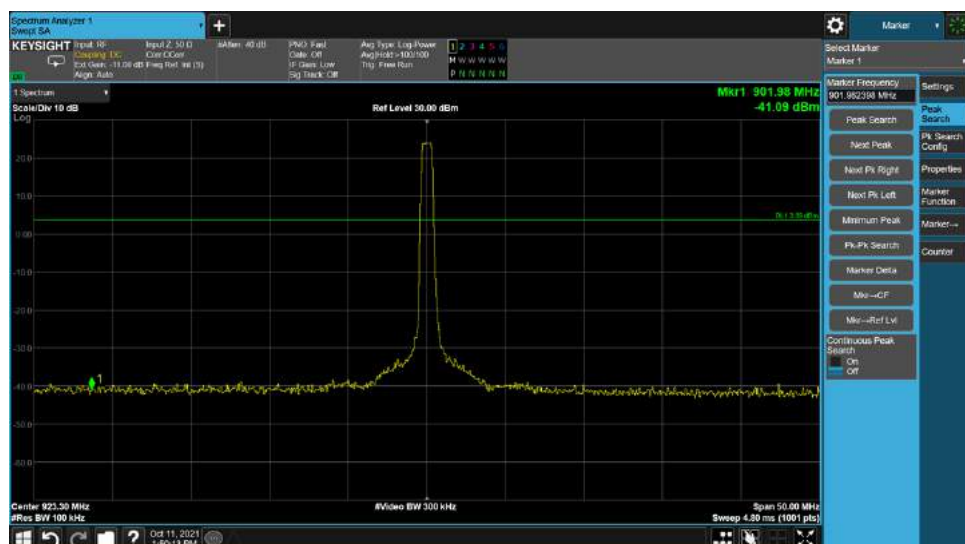
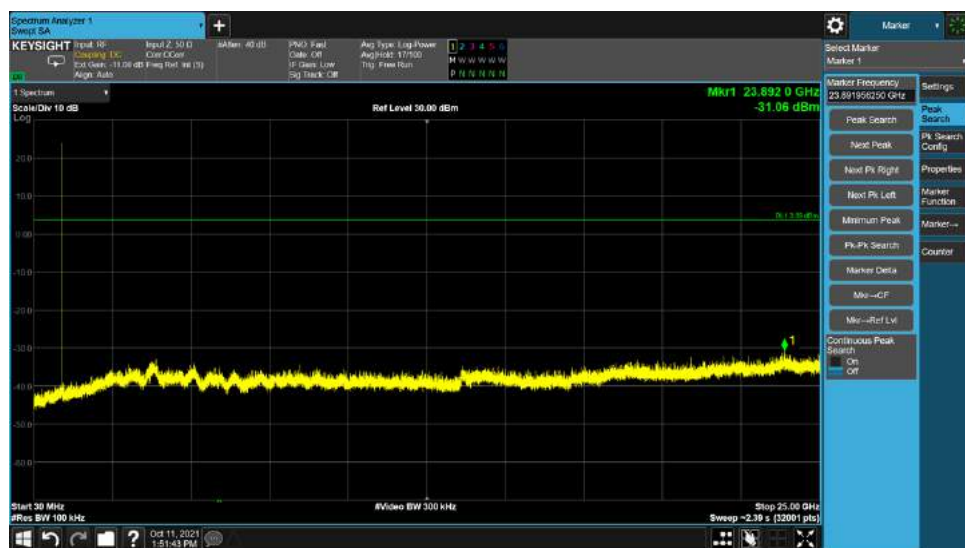
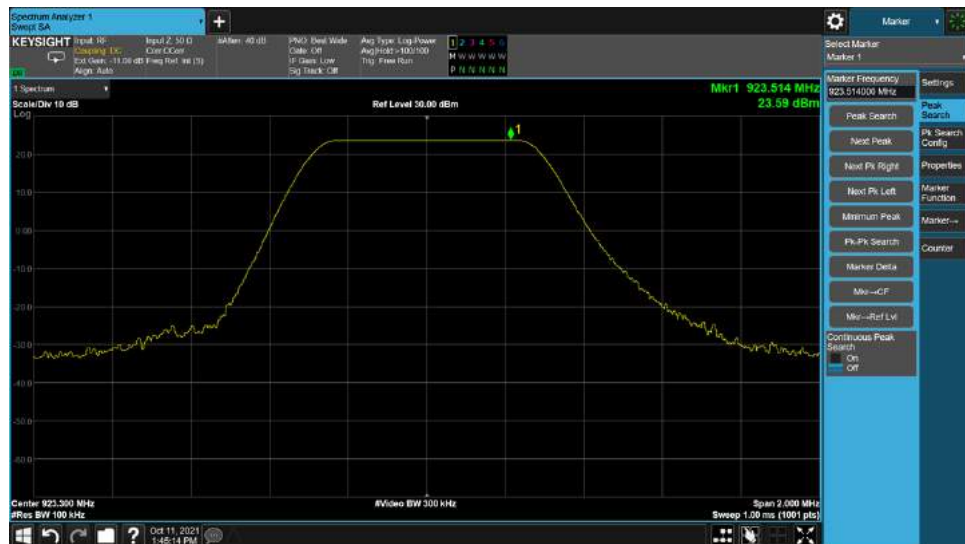
Lora DTS 8
904.6MHz



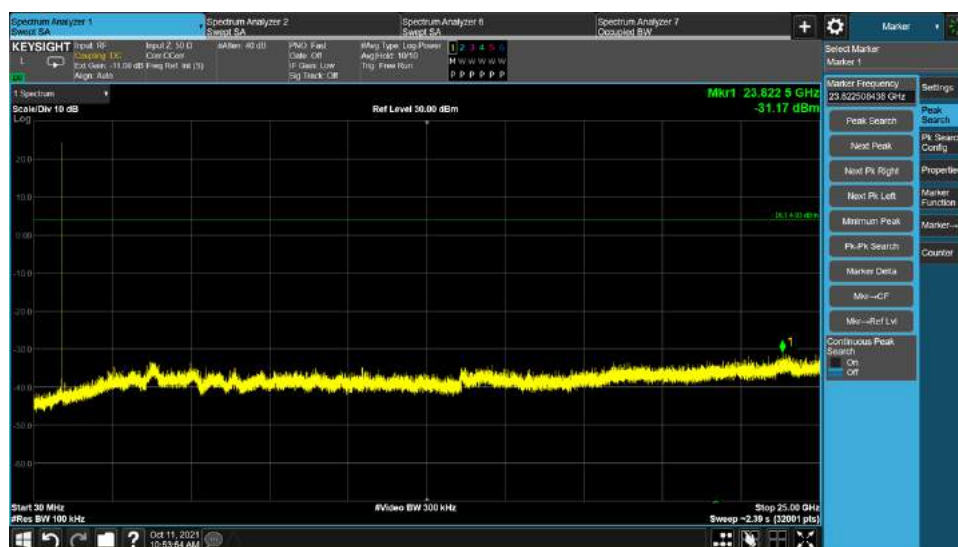
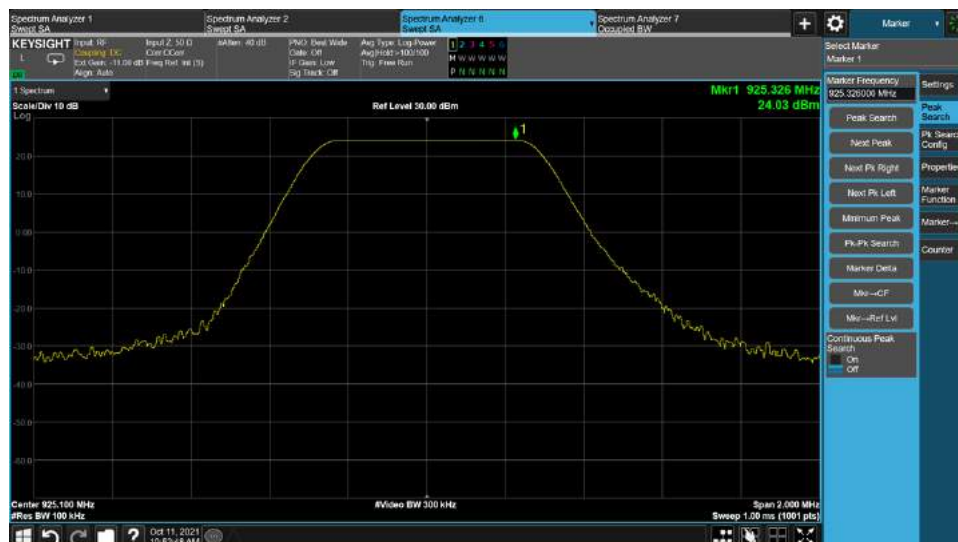
Prüfbericht - Produkte
Test Report - Products

Lora DTS SF7

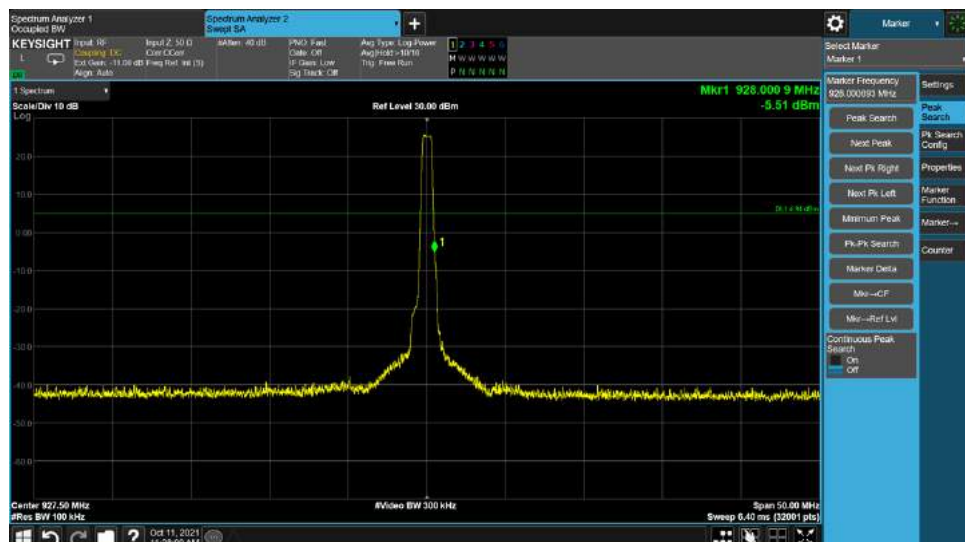
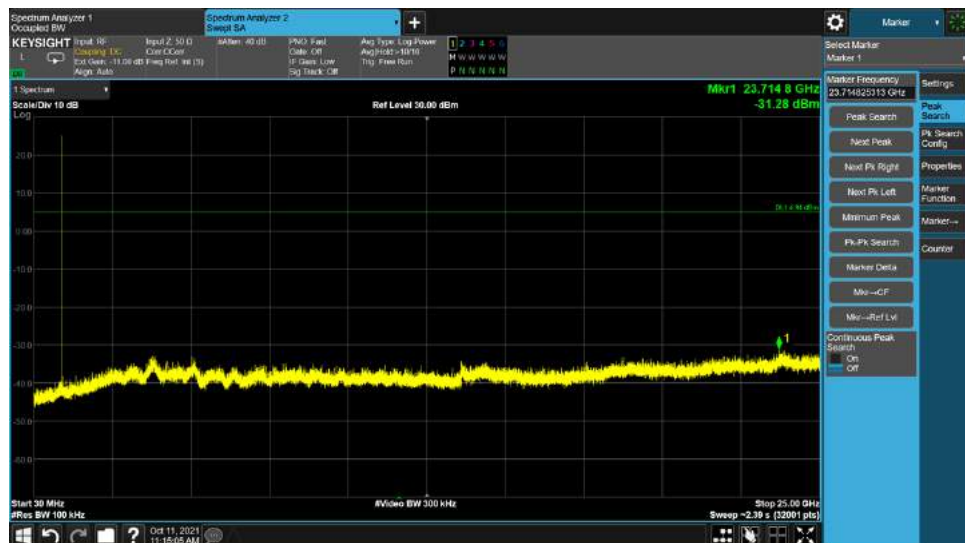
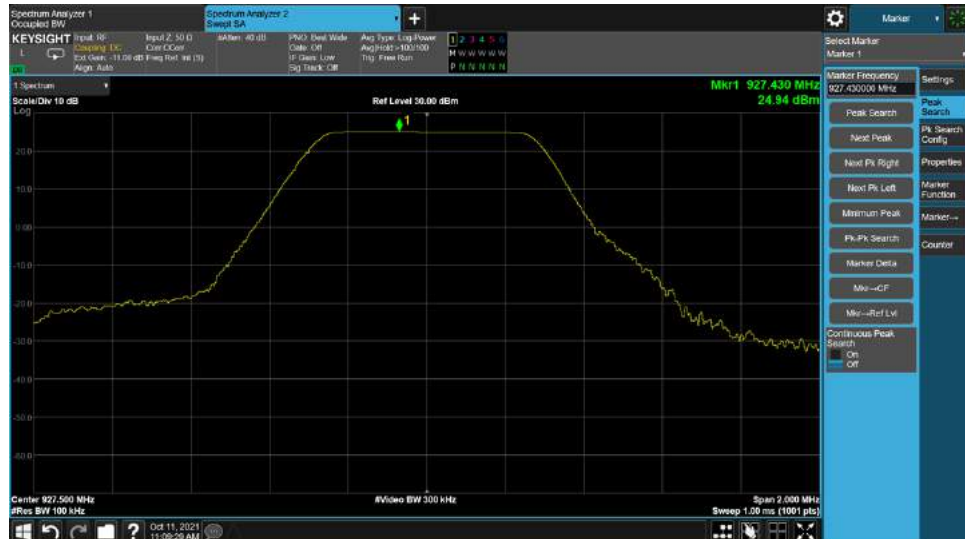
Low Channel



Middle Channel

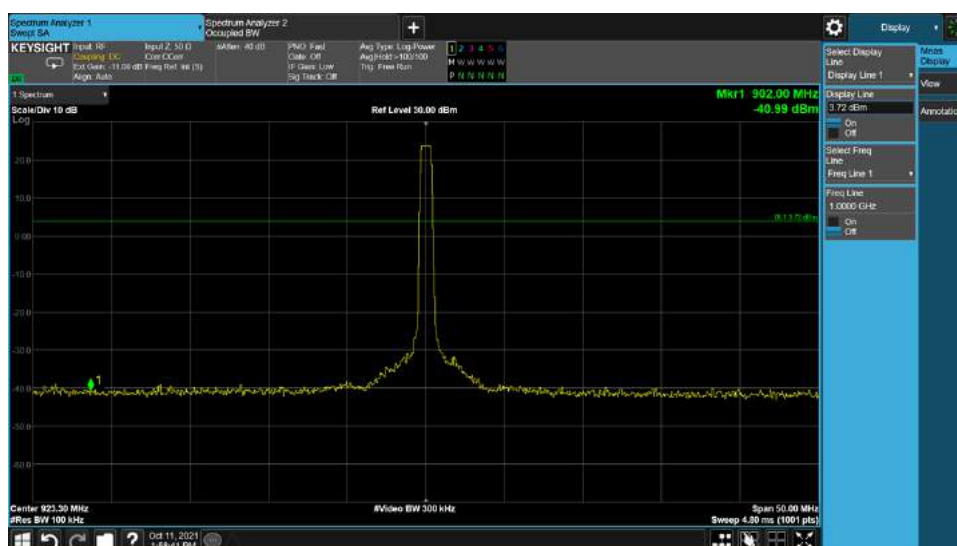
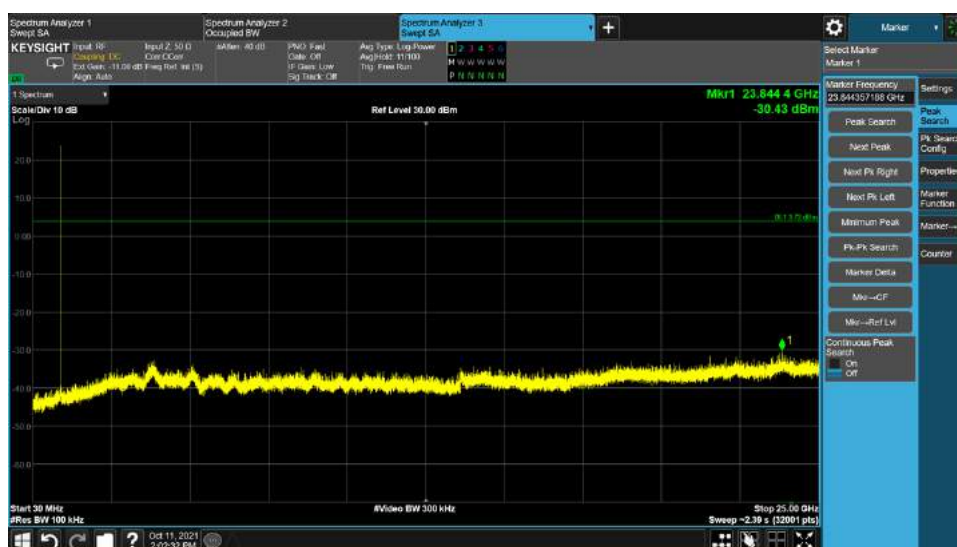
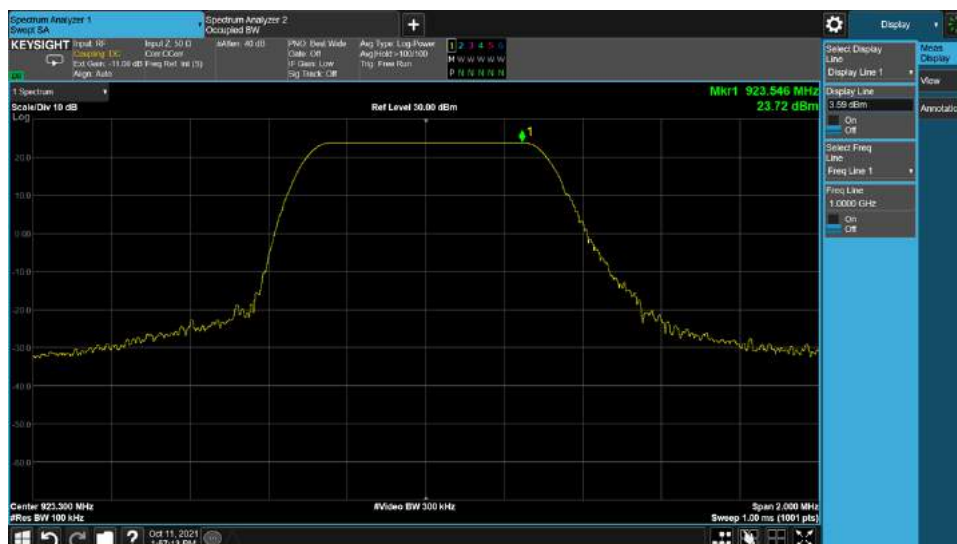


High Channel

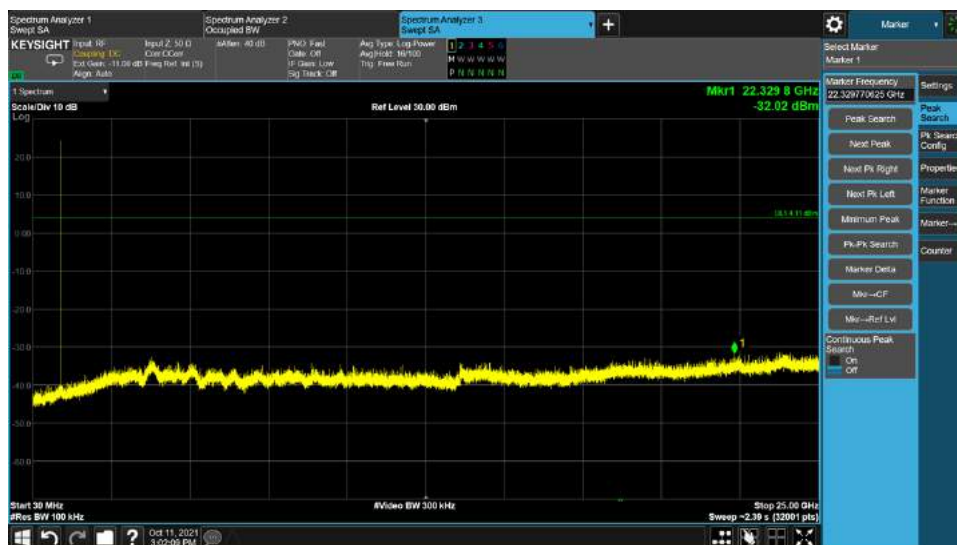
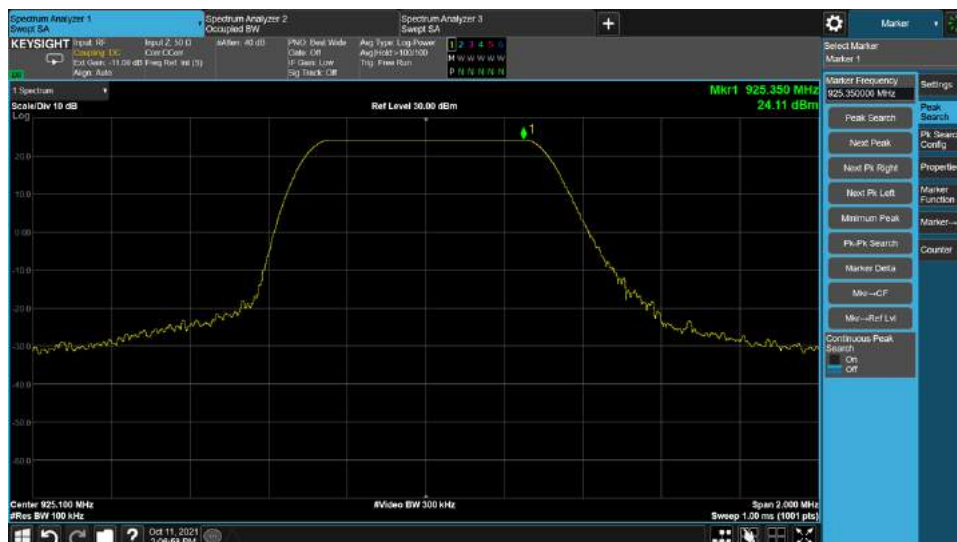


Lora DTS SF12

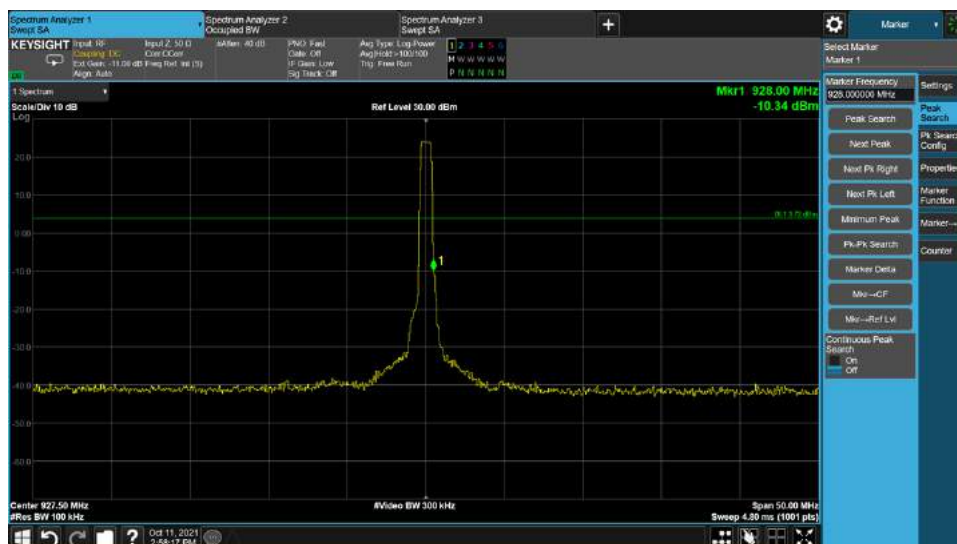
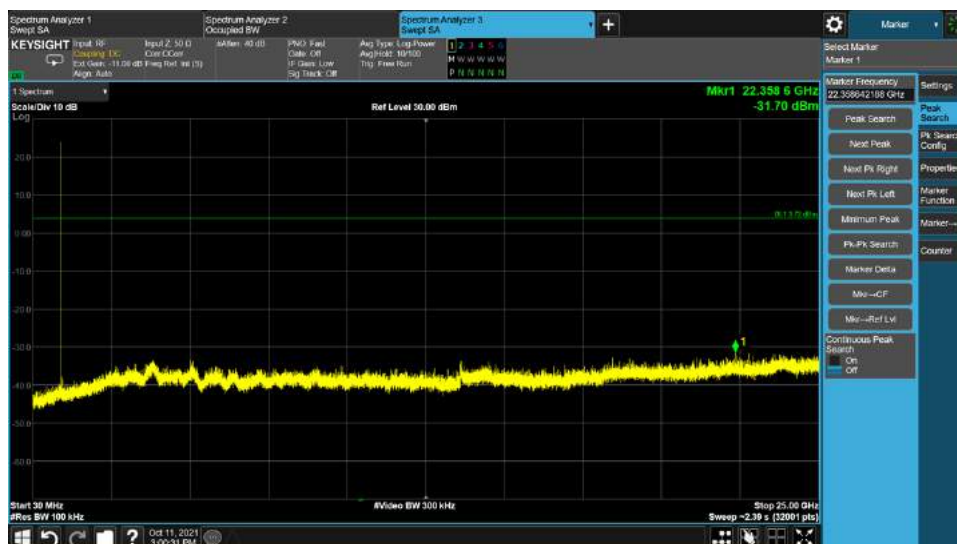
Low Channel



Middle Channel

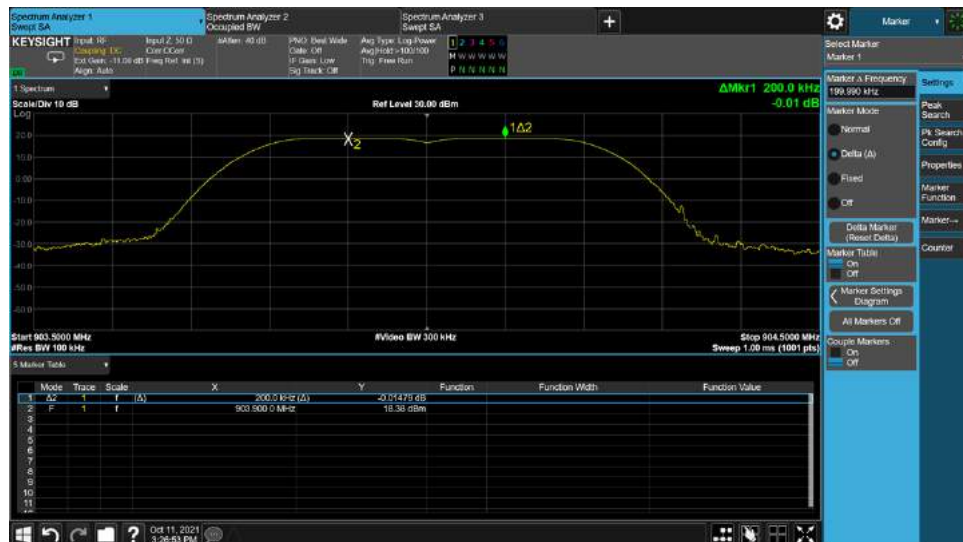


High Channel

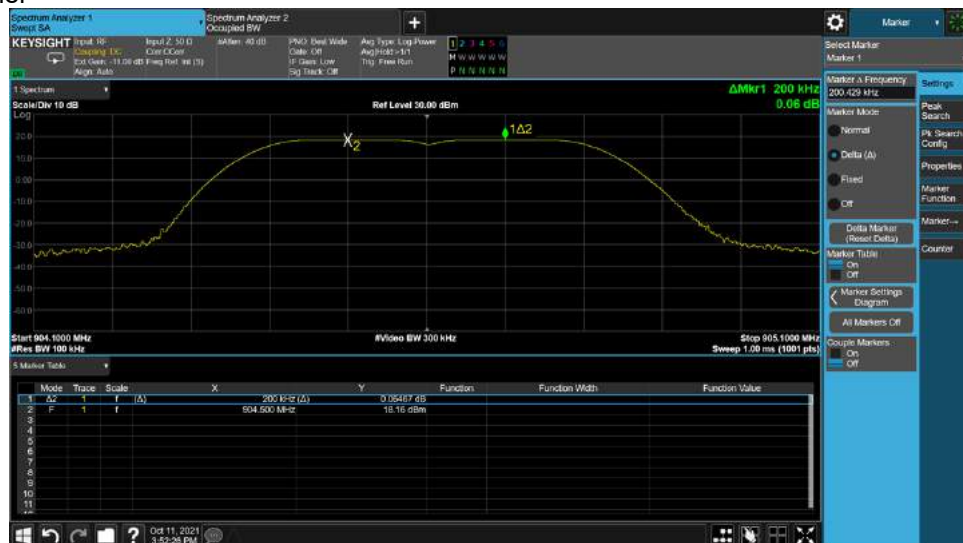


Appendix B.5: Carrier Frequency Separation

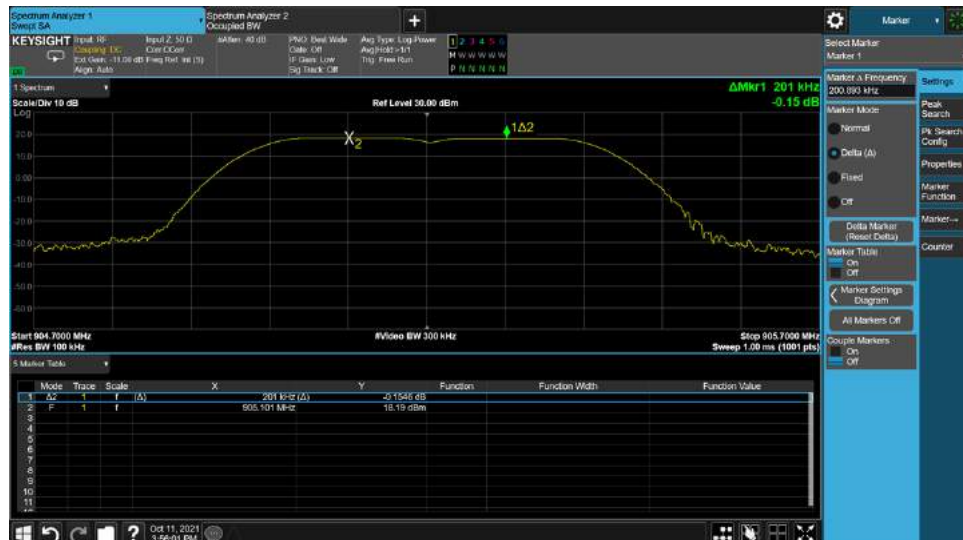
Lora Hybrid SF7 Low Channel



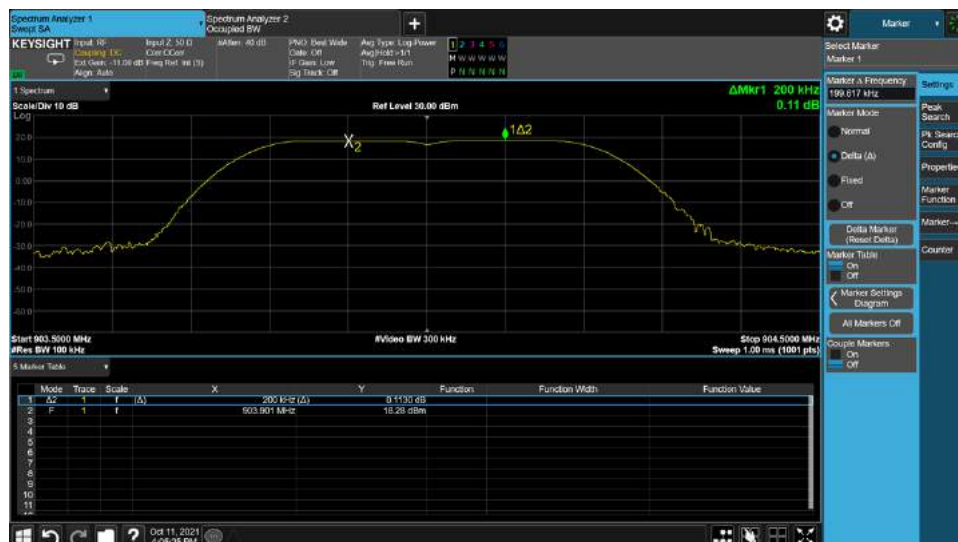
Middle Channel



High Channel



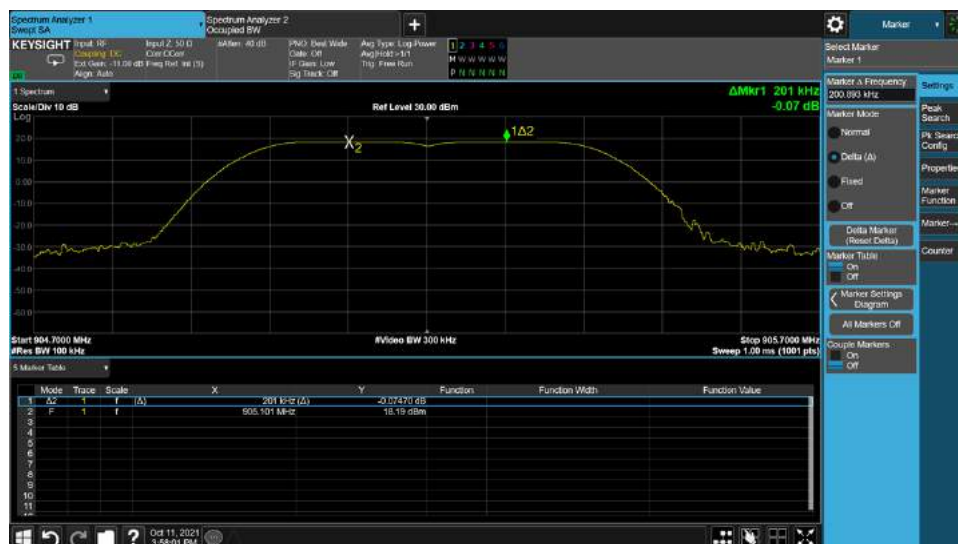
Lora Hybrid SF9 Low Channel



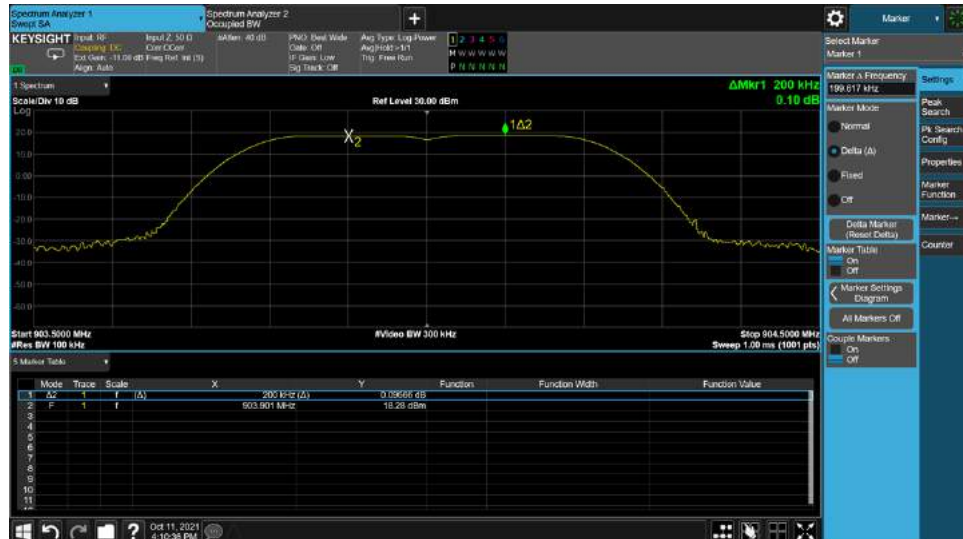
Middle Channel



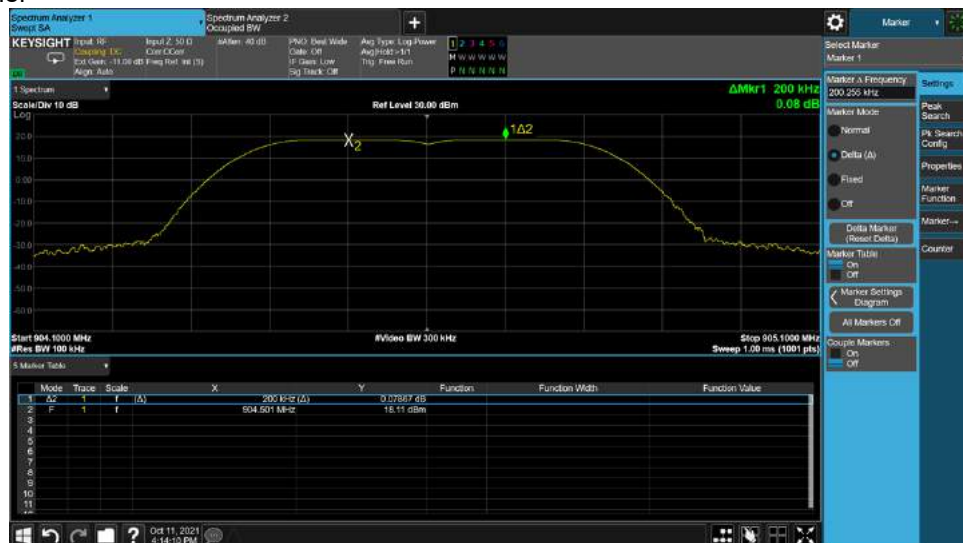
High Channel



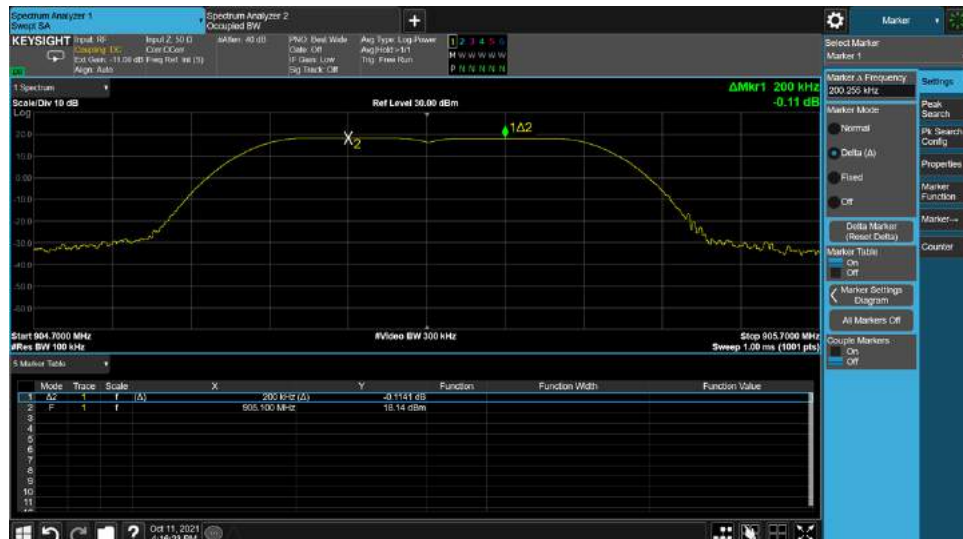
Lora Hybrid SF10 Low Channel



Middle Channel



High Channel

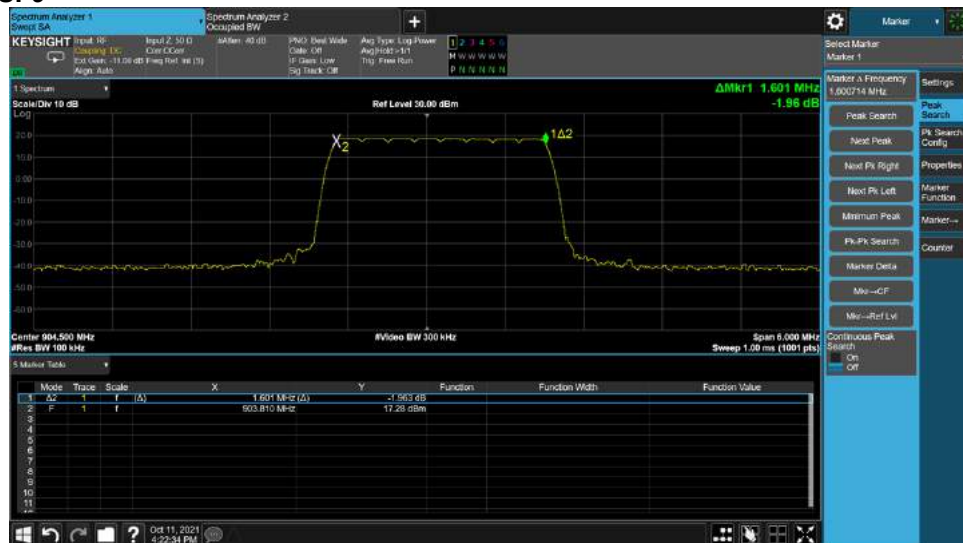


Appendix B.6: Number of Hopping Frequency

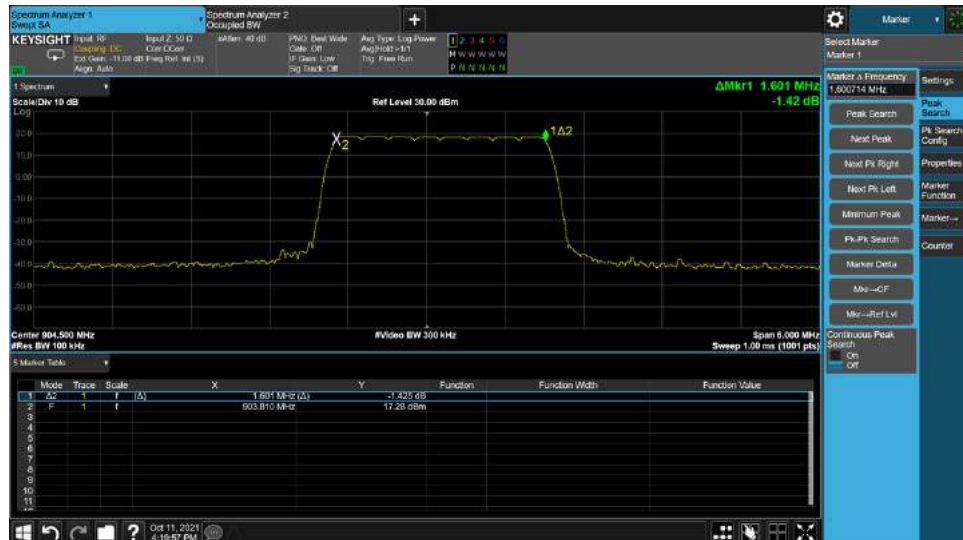
Lora Hybrid SF7



Lora Hybrid SF9



Lora Hybrid SF10

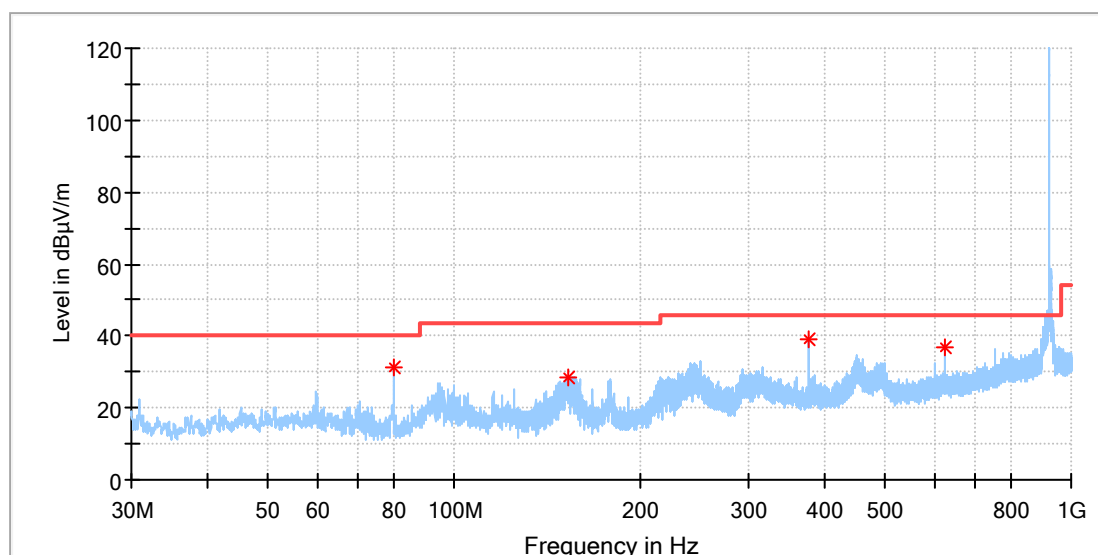


Appendix B.7: Test Results of Radiated Spurious Emissions

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

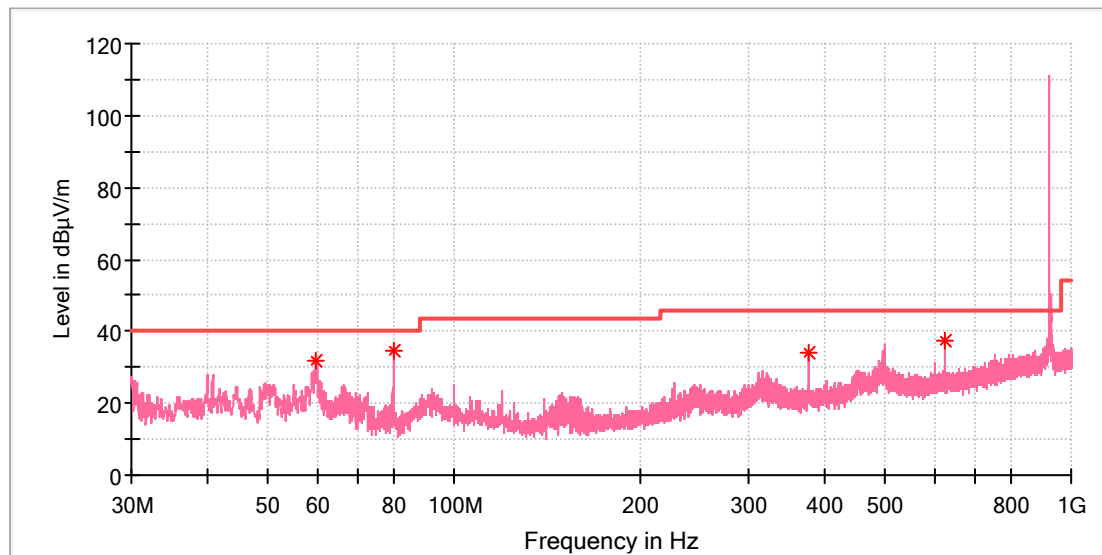


Critical_Freqs

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

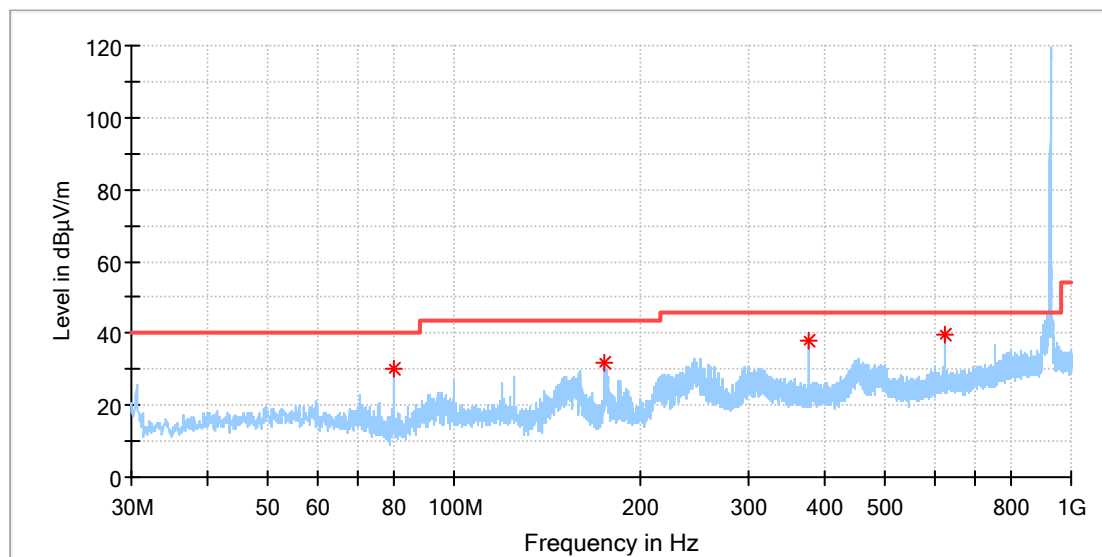


Critical_Freqs

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

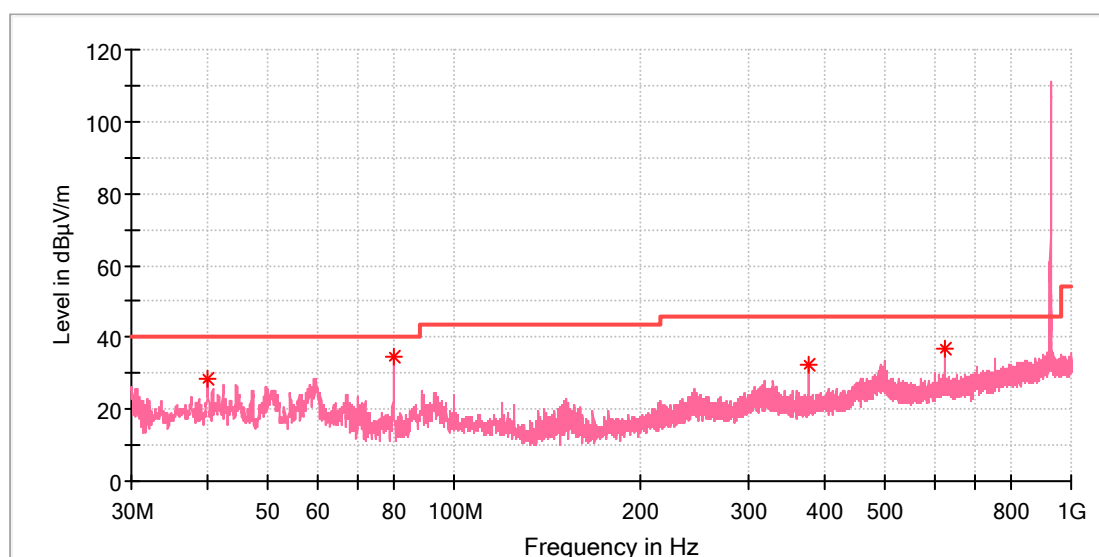


Critical_Freqs

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

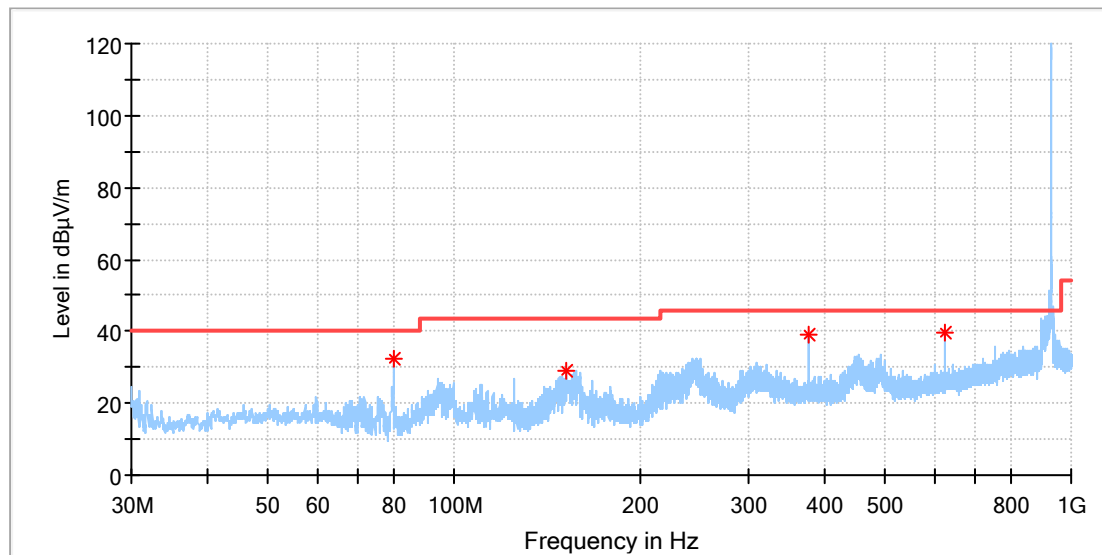


Critical_Freqs

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

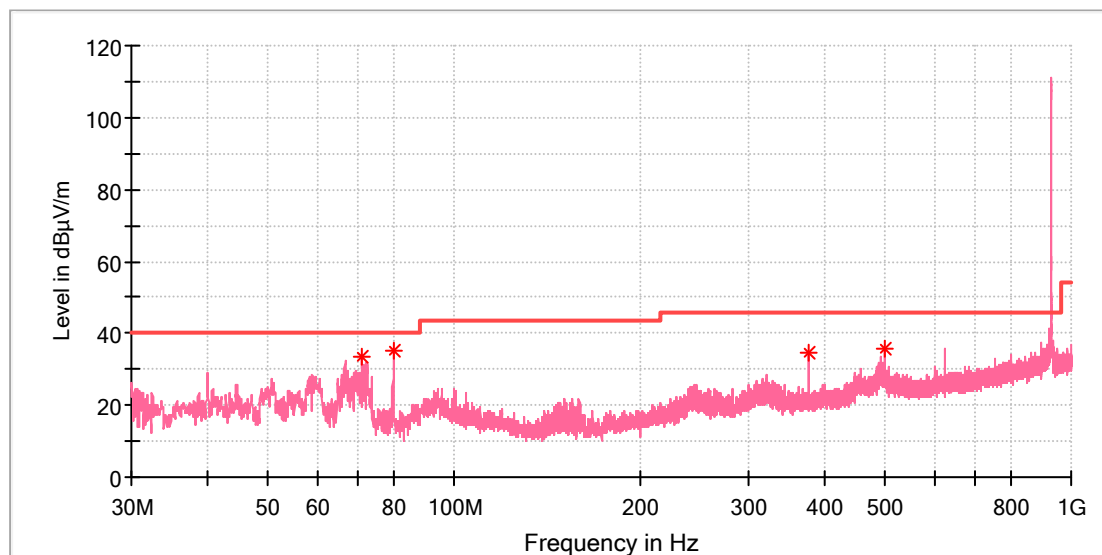


Critical_Freqs

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



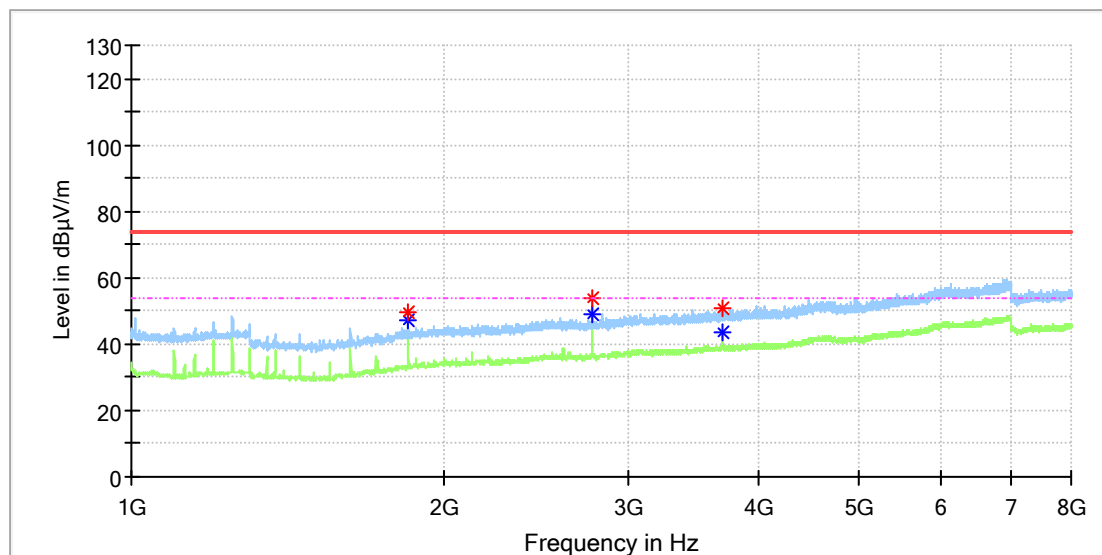
Critical_Freqs

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

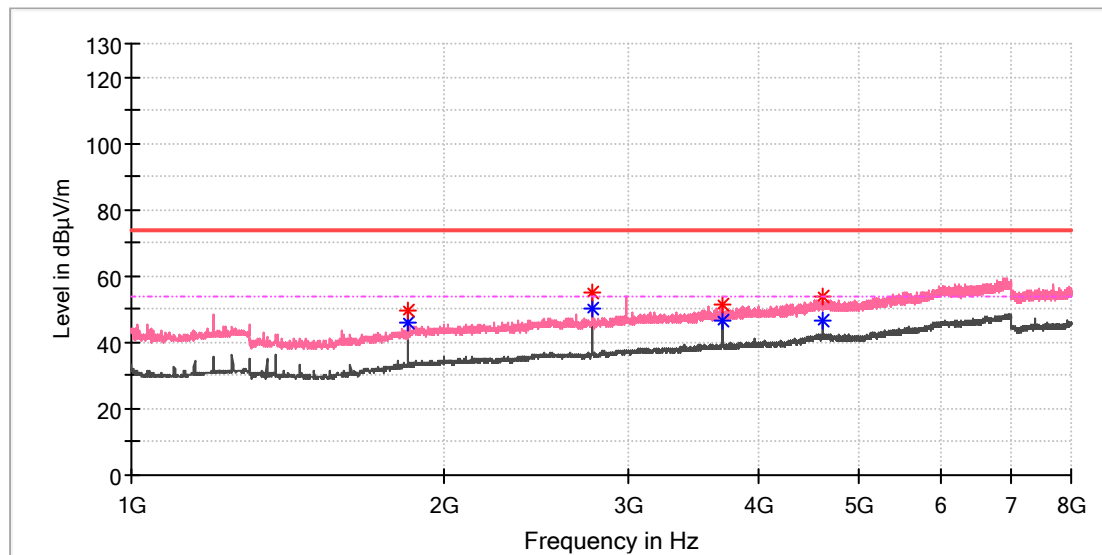


Critical_Freqs

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

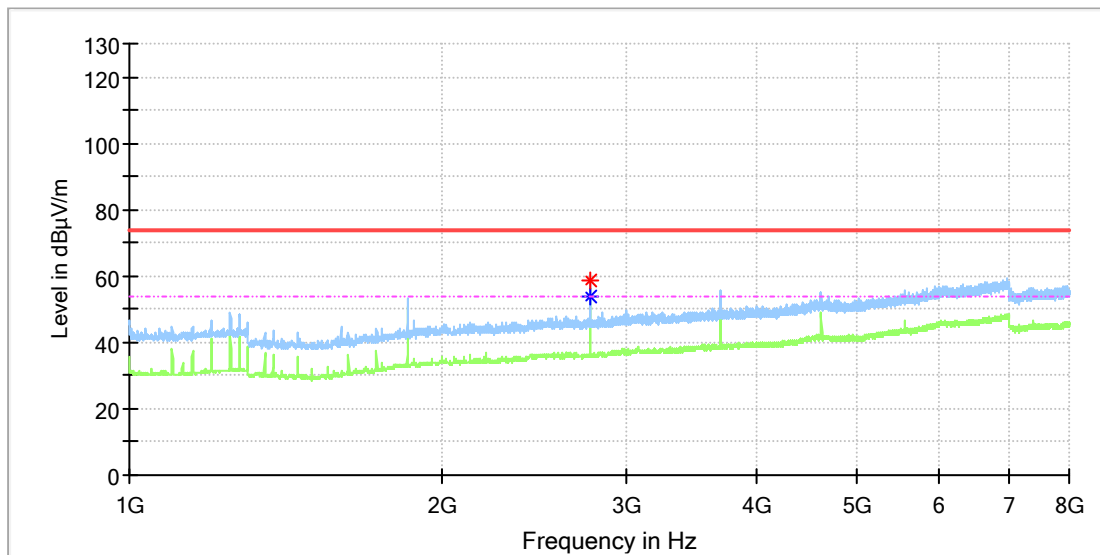


Critical Freqs

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

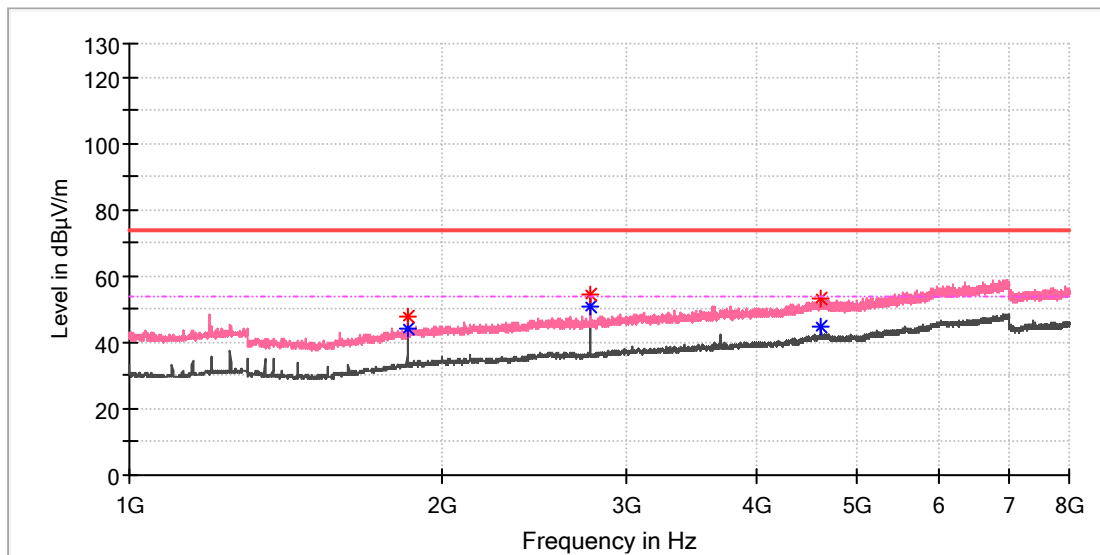


Critical Freqs

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

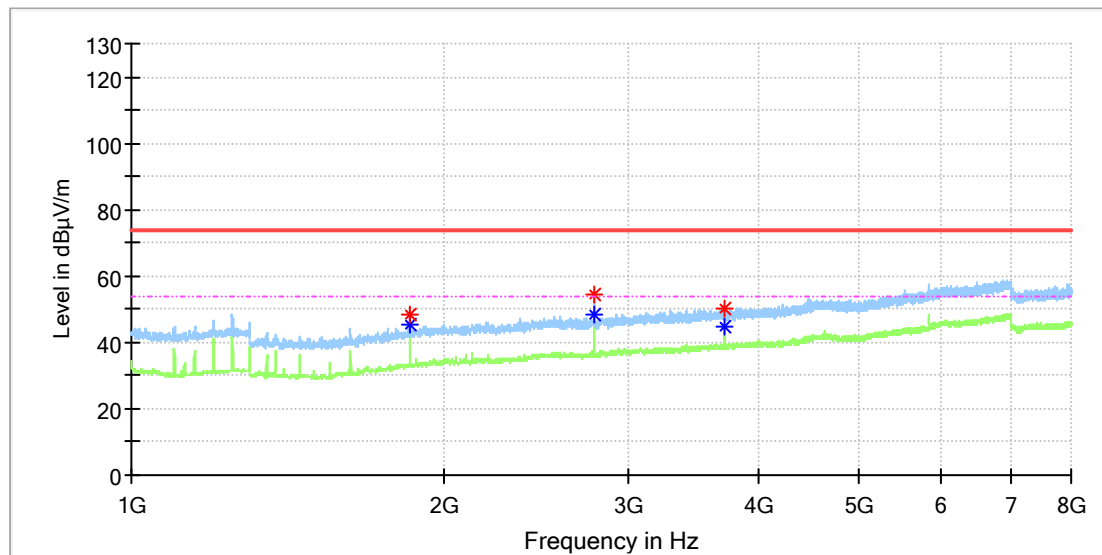


Critical_Freqs

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

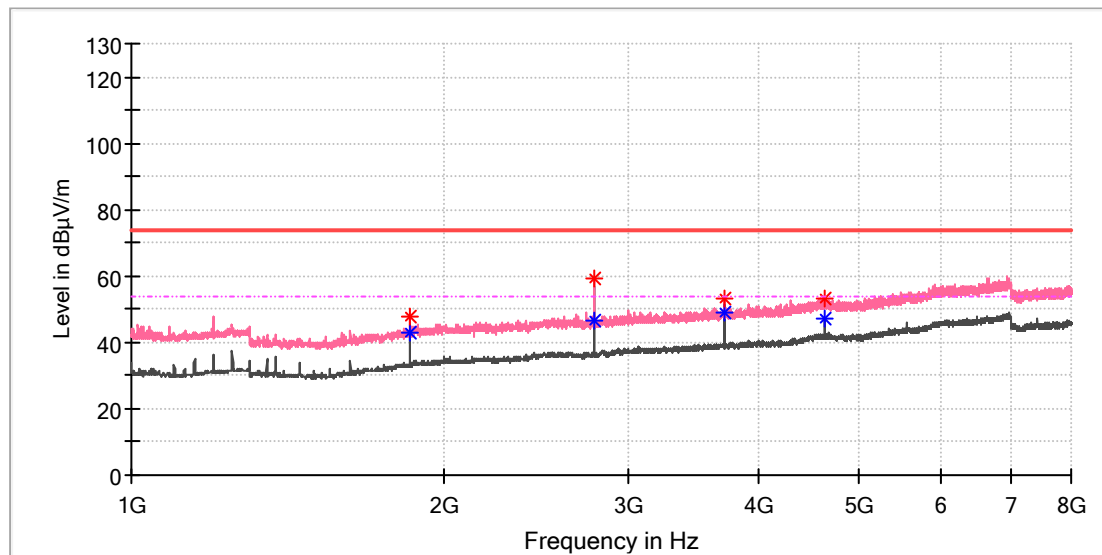


Critical Freqs

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



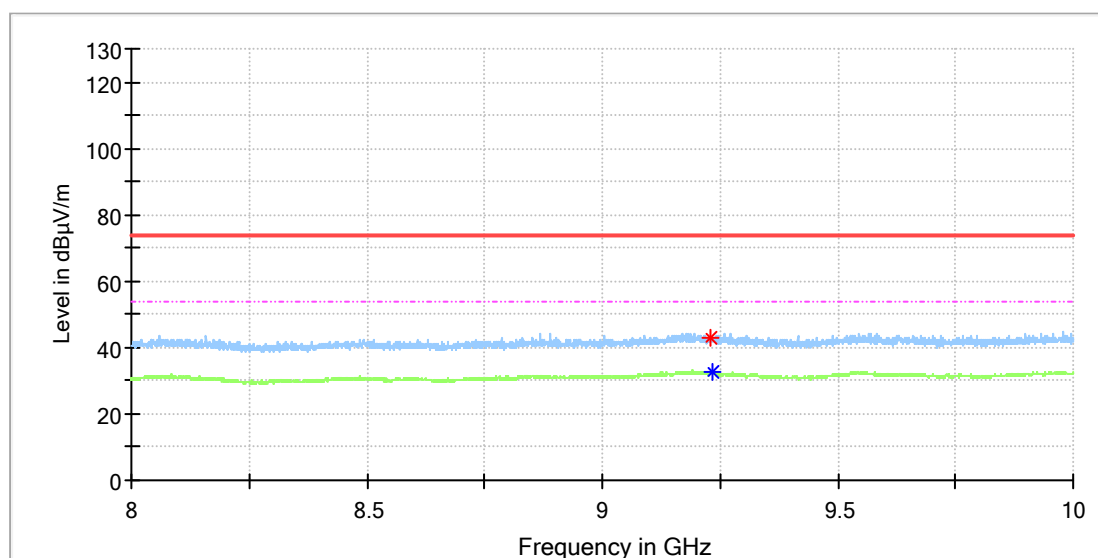
Critical Freqs

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

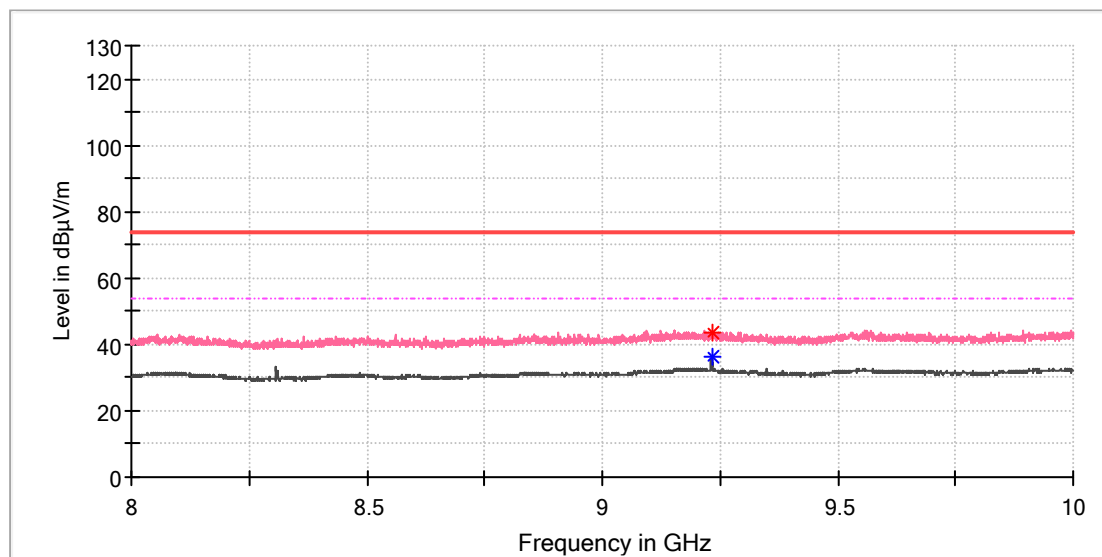


Critical_Freqs

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

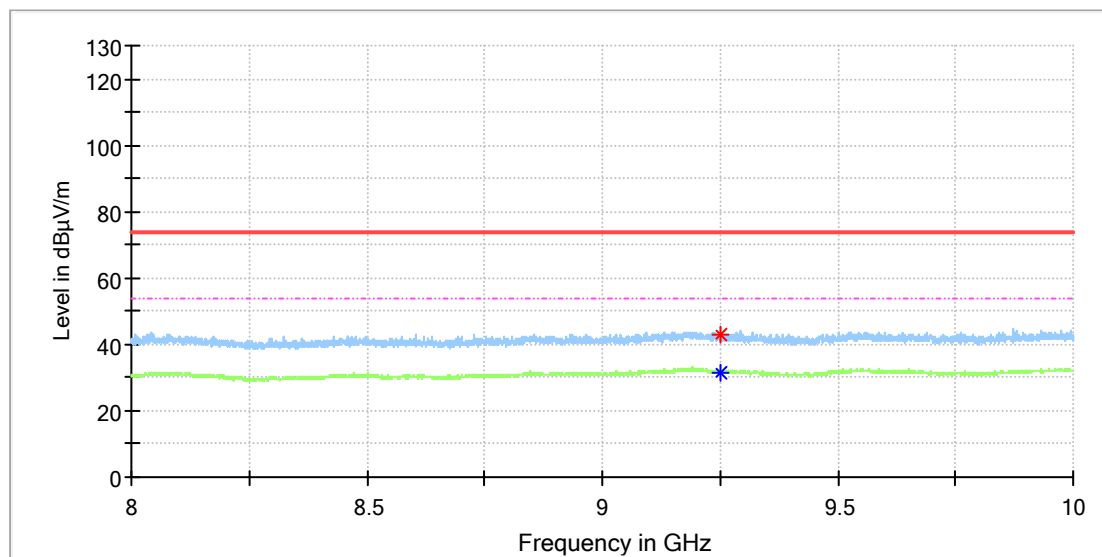


Critical_Freqs

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

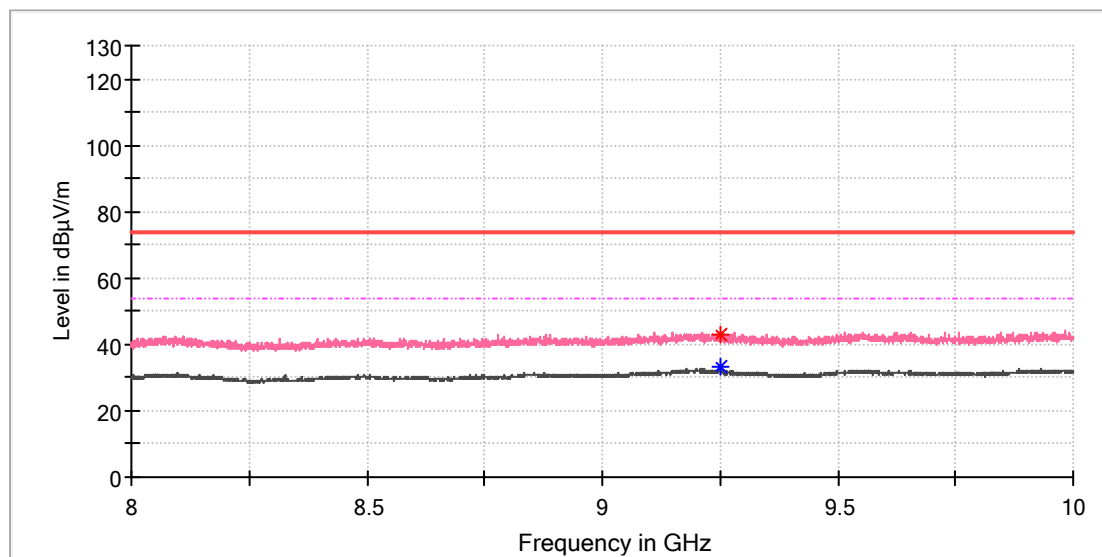


Critical_Freqs

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

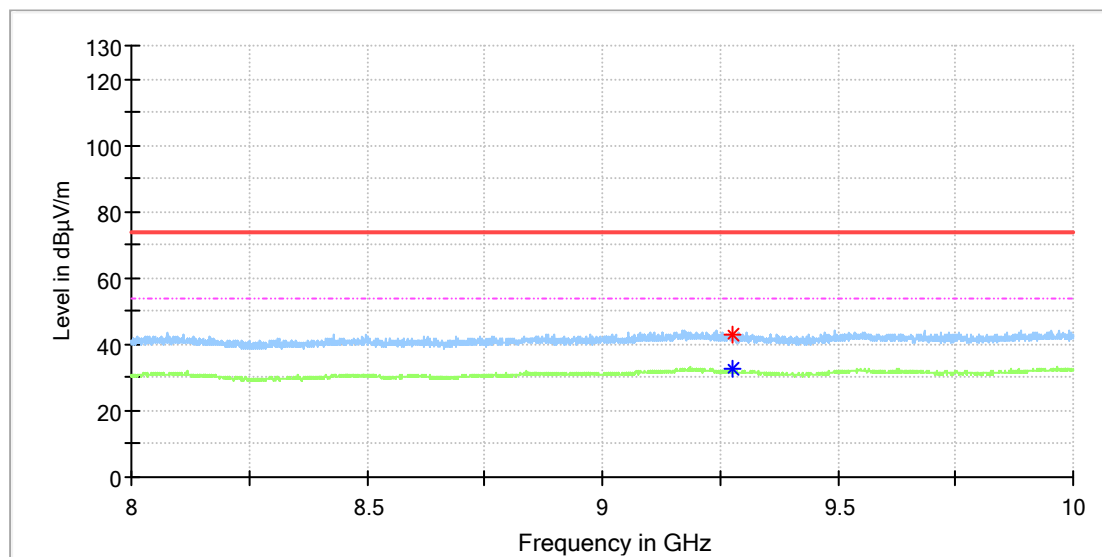


Critical Freqs

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

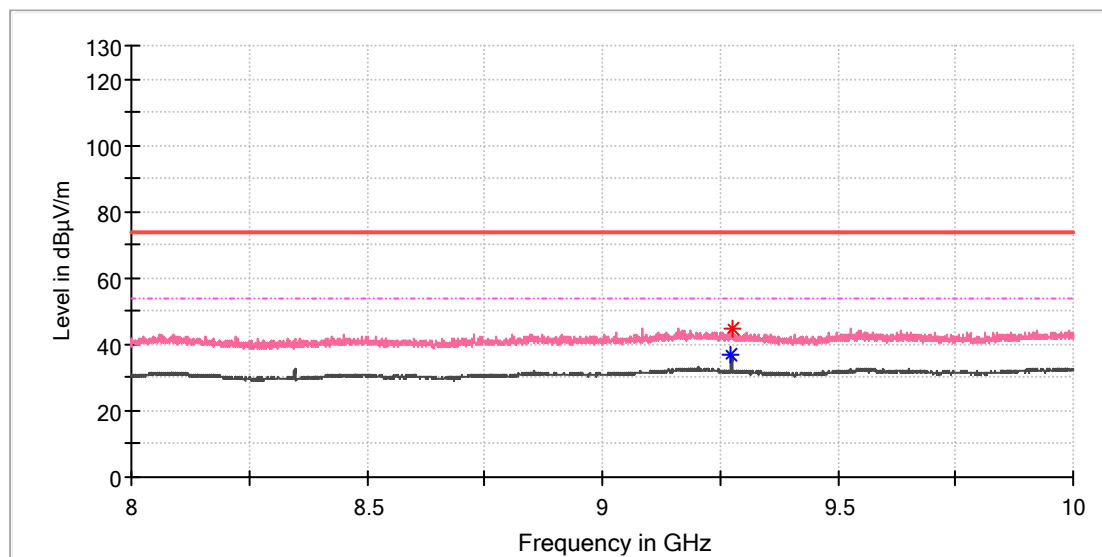


Critical_Freqs

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



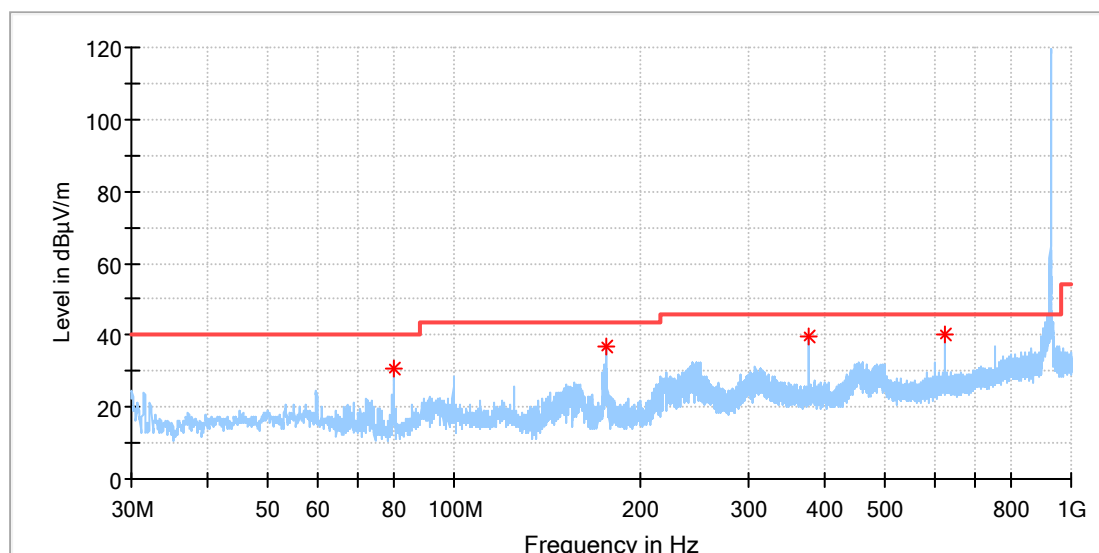
Critical Freqs

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

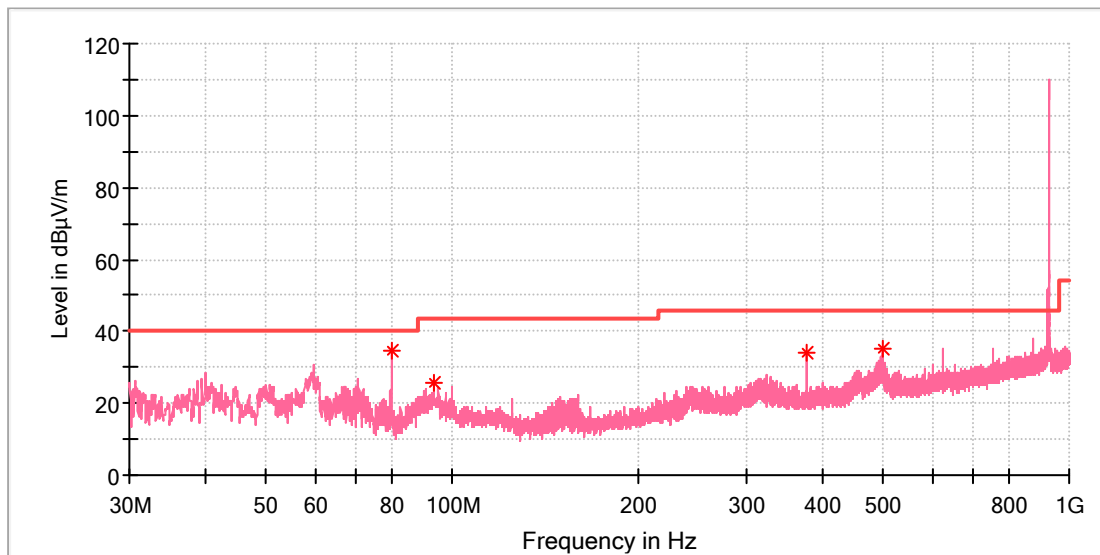


Critical_Freqs

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



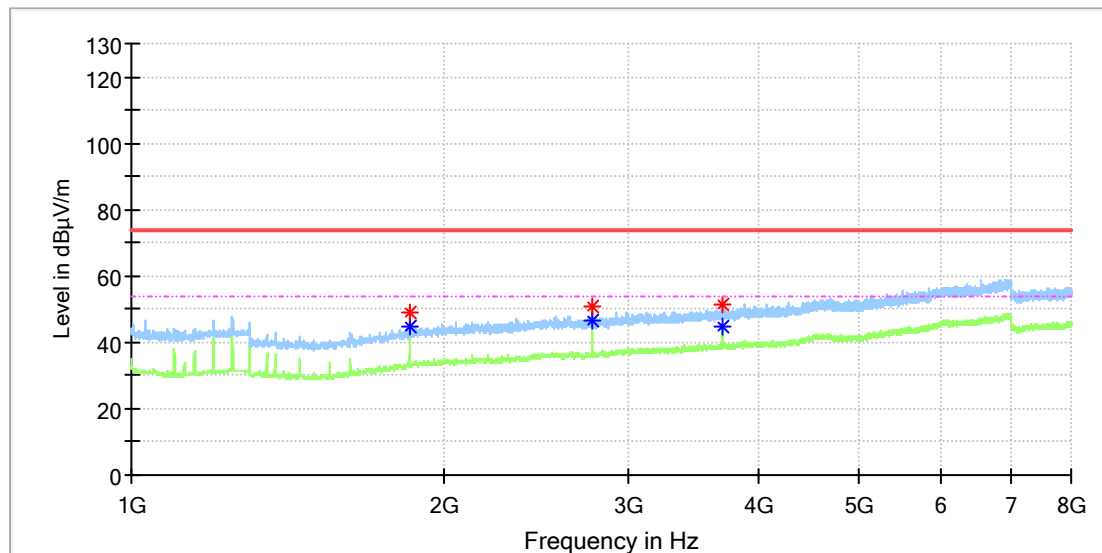
Critical_Freqs

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

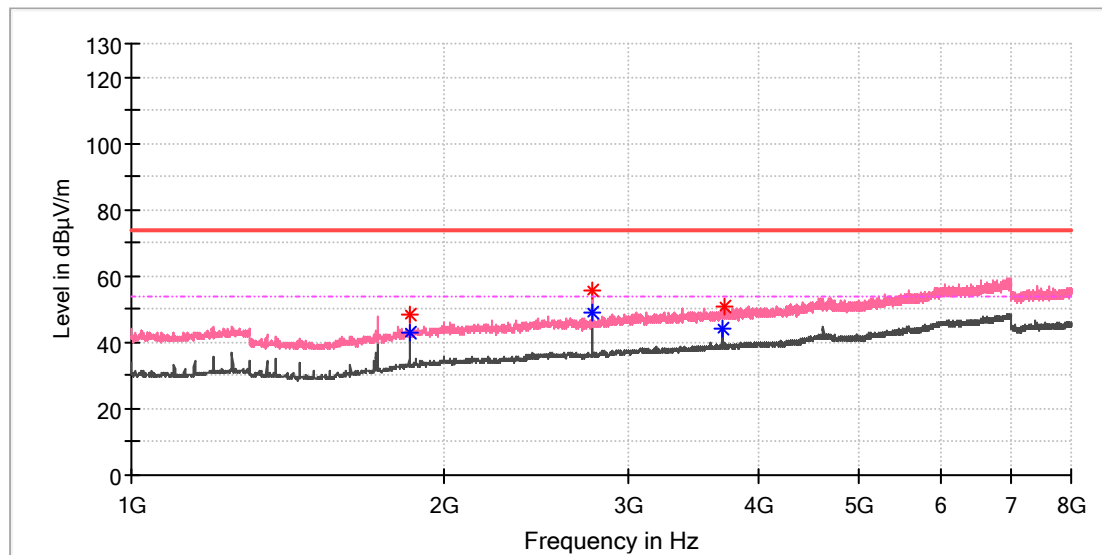


Critical_Freqs

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



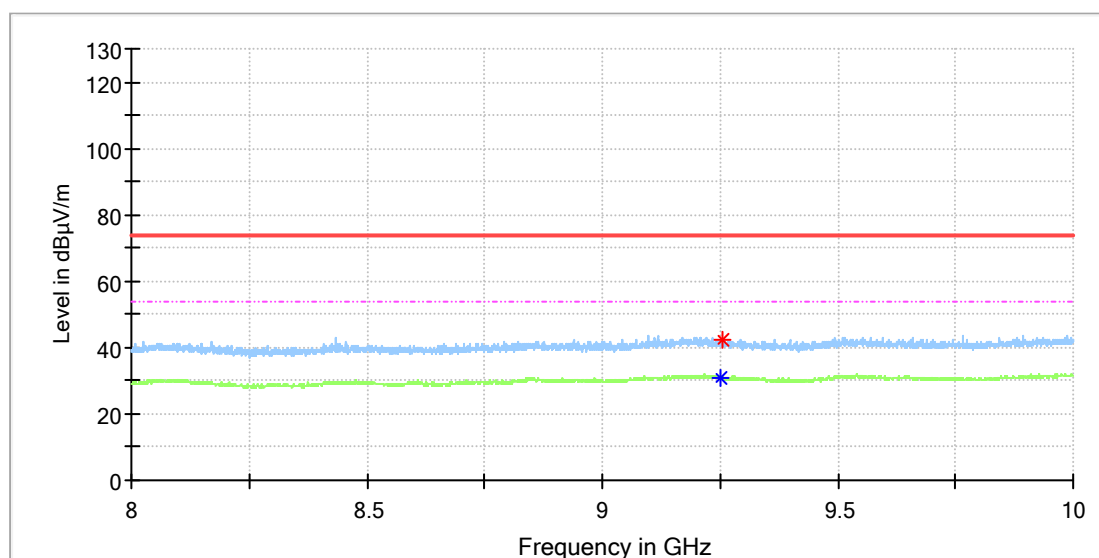
Critical_Freqs

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

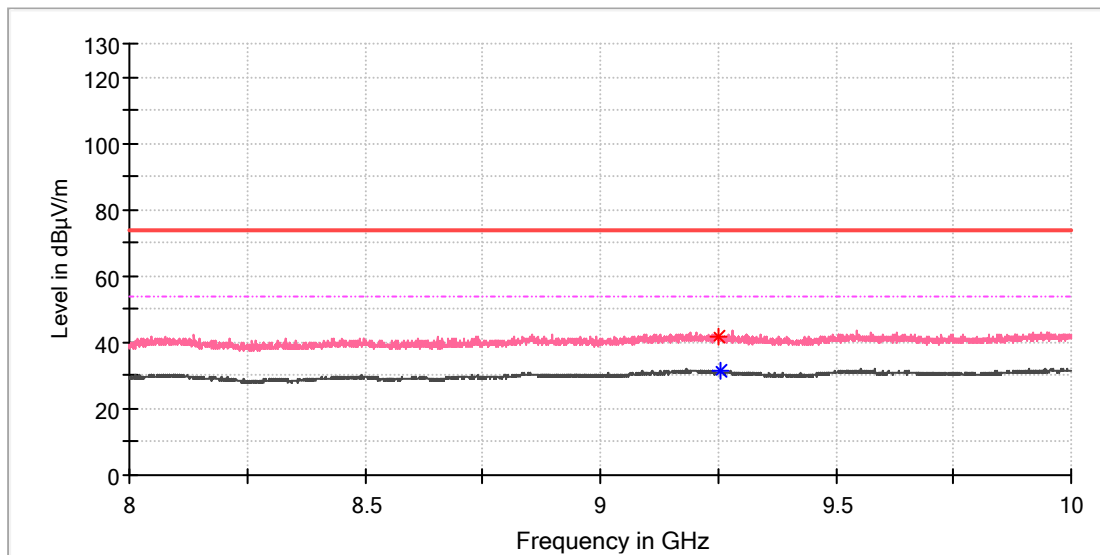


Critical_Freqs

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



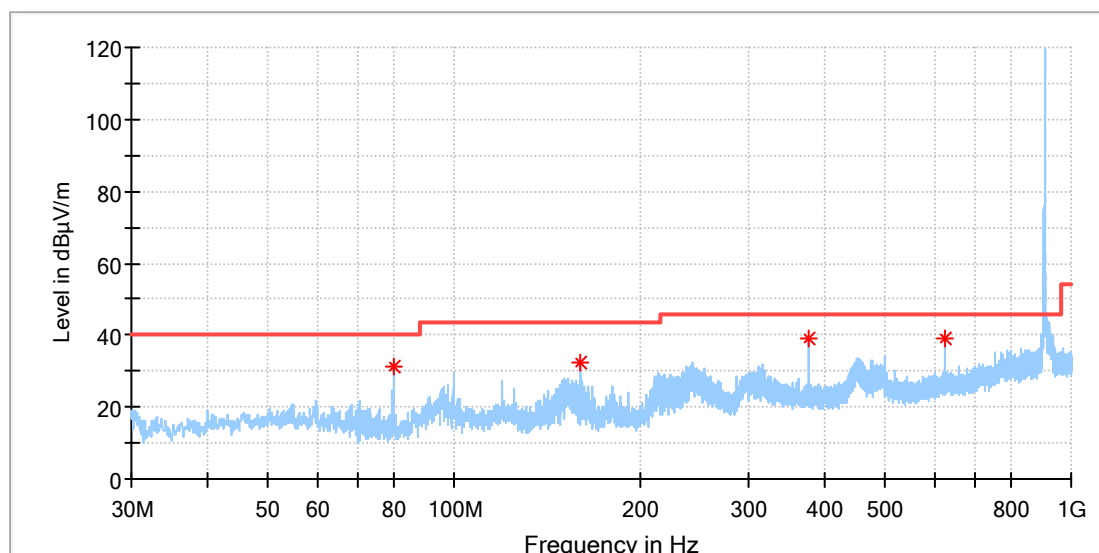
Critical Freqs

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

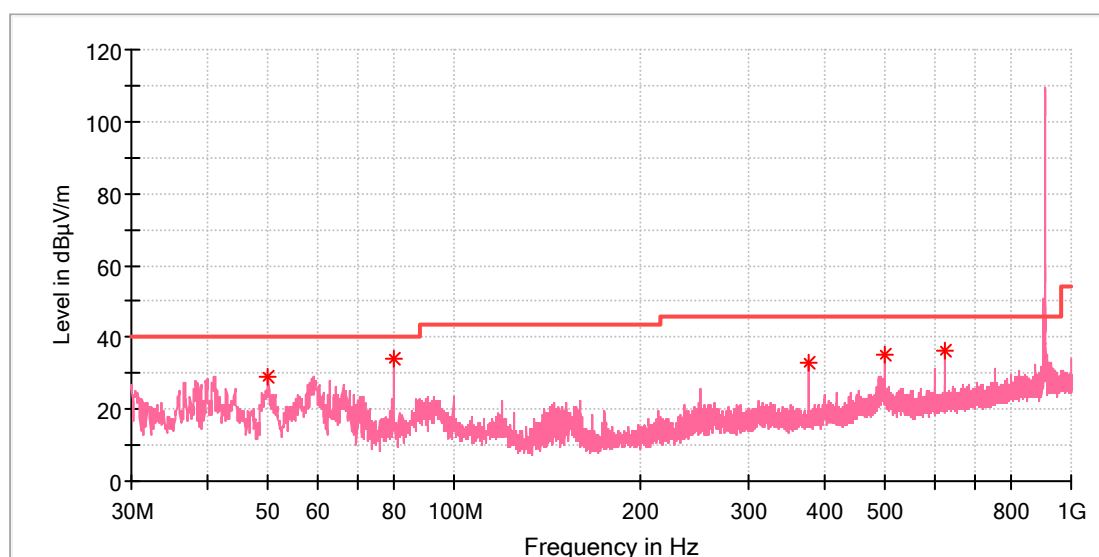


Critical_Freqs

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



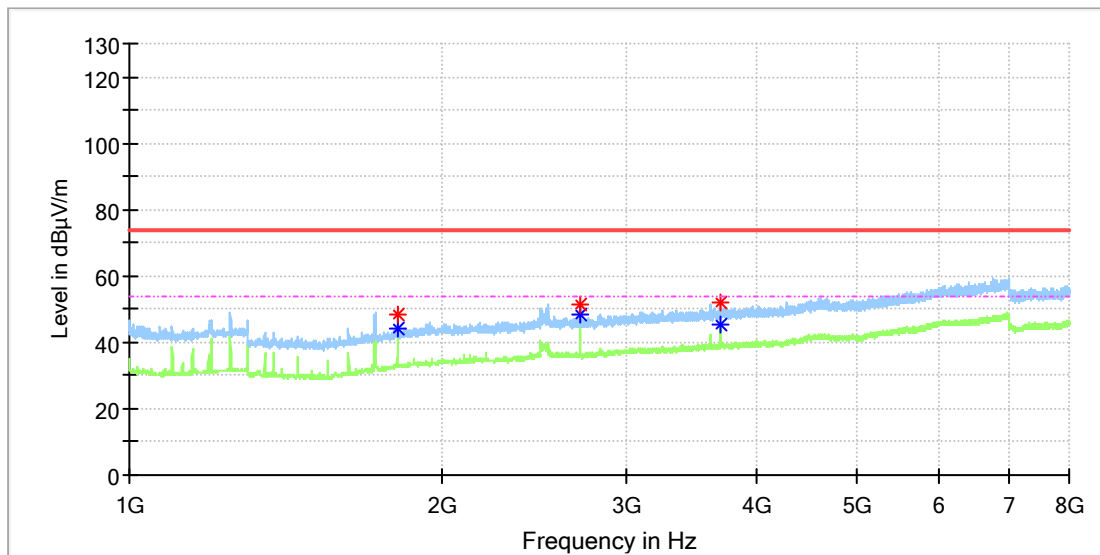
Critical_Freqs

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

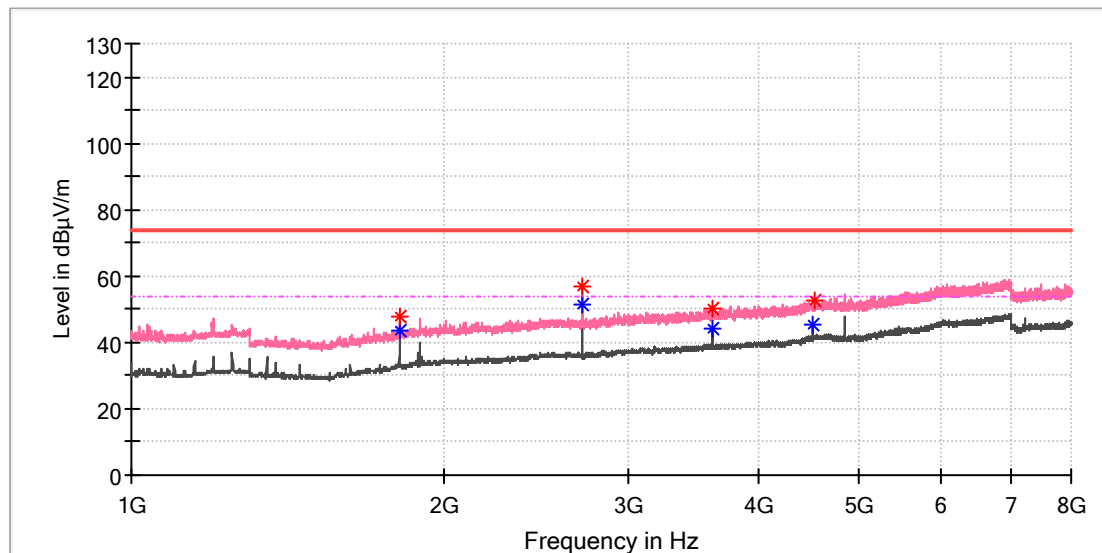


Critical_Freqs

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



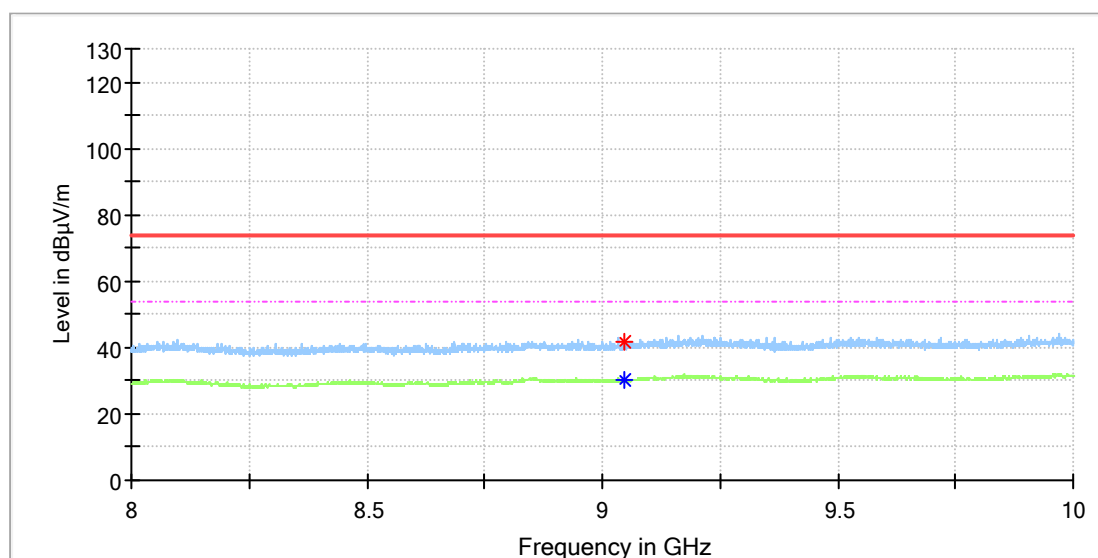
Critical Freqs

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

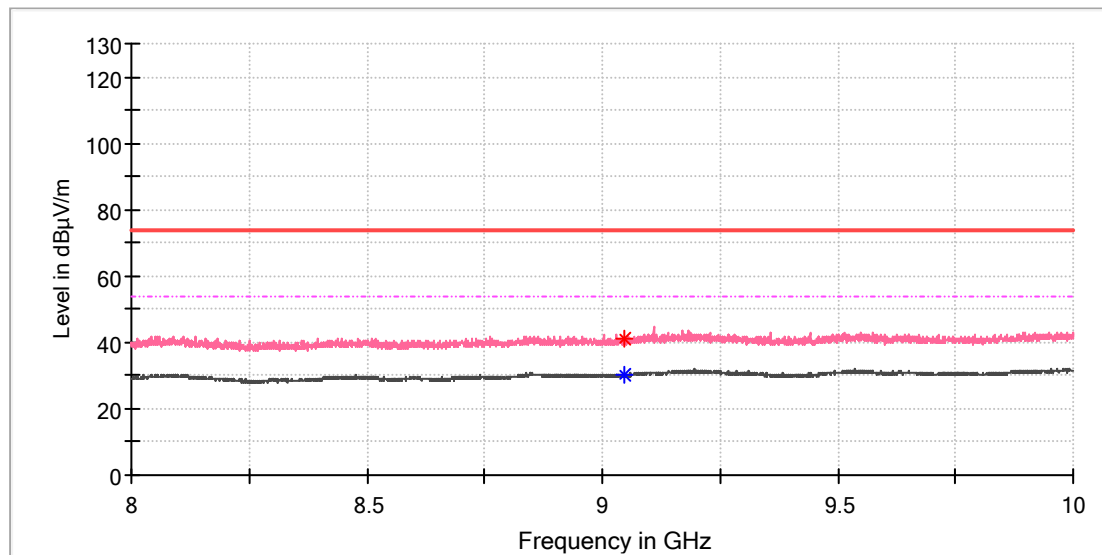


Critical_Freqs

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

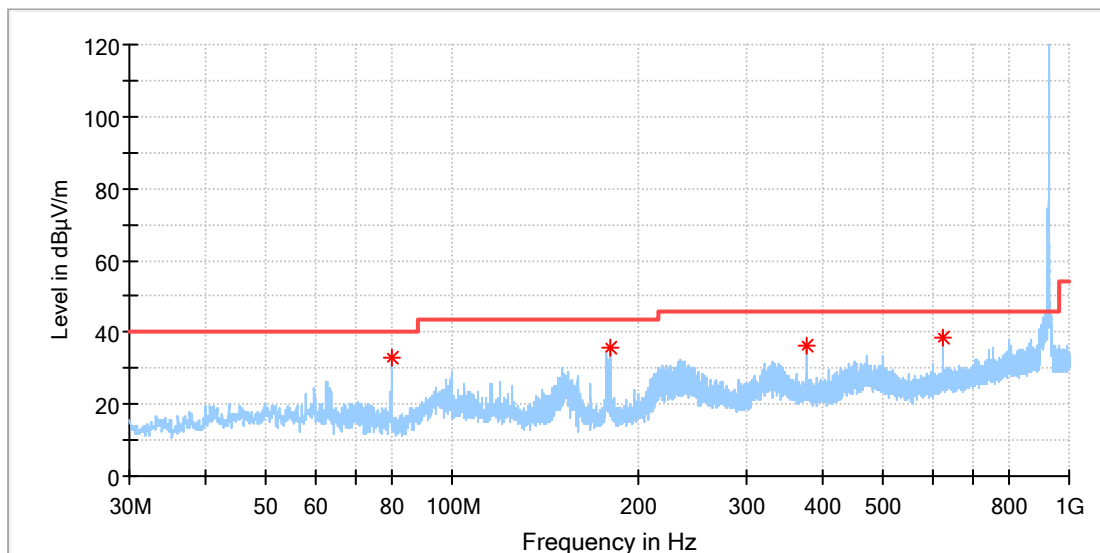
Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9048.000000	41.36	---	74.00	32.64	100.0	V	0.0	9.0
9048.500000	---	30.49	54.00	23.51	100.0	V	309.0	9.0

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

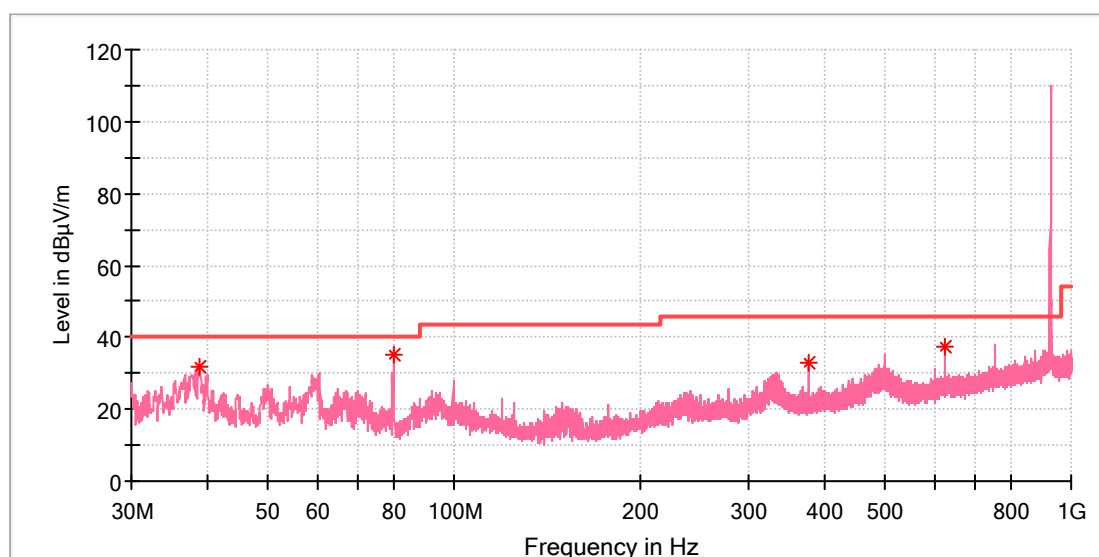


Critical_Freqs

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



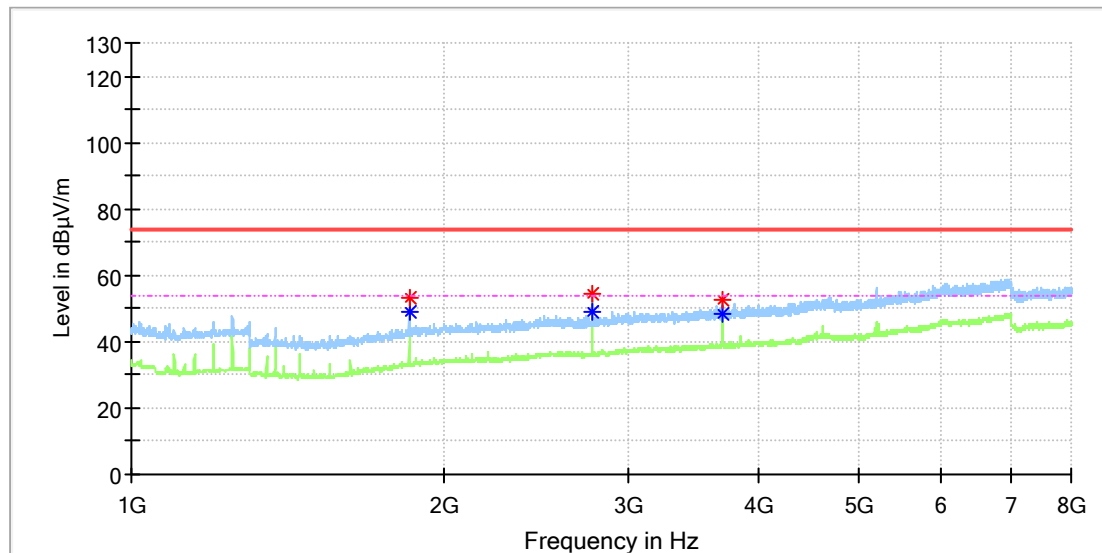
Critical_Freqs

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

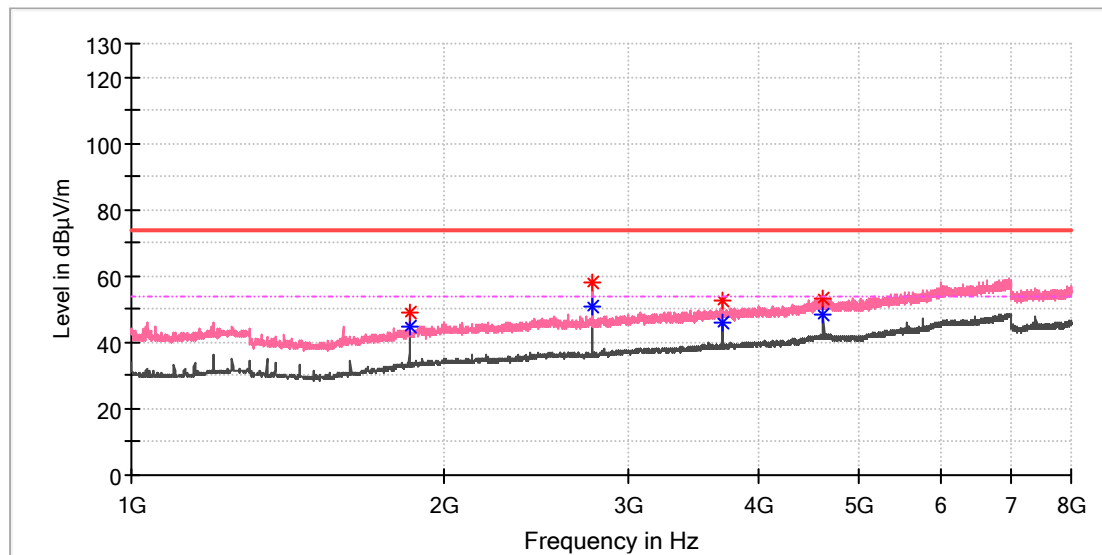


Critical_Freqs

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



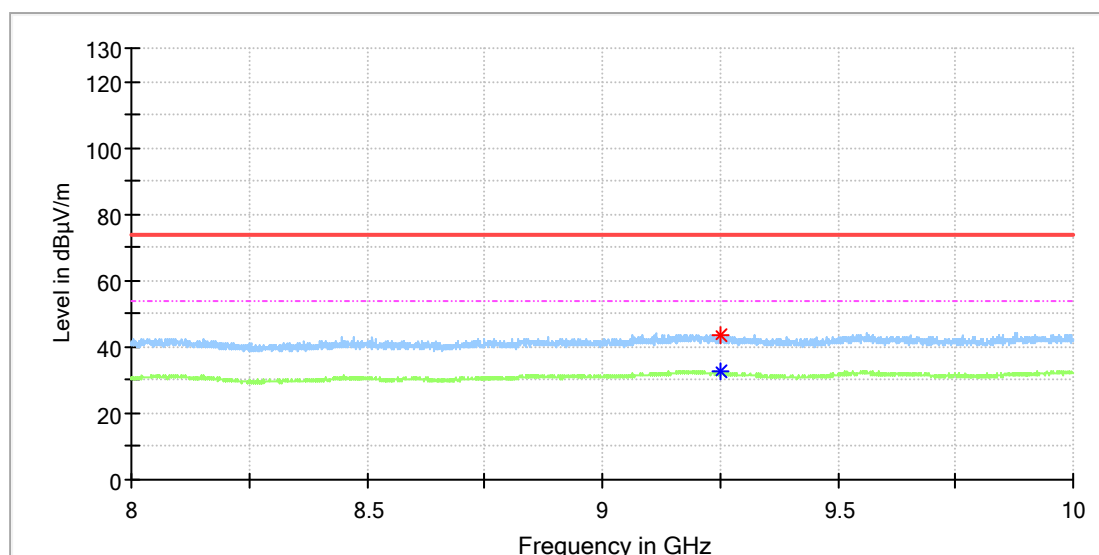
Critical_Freqs

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

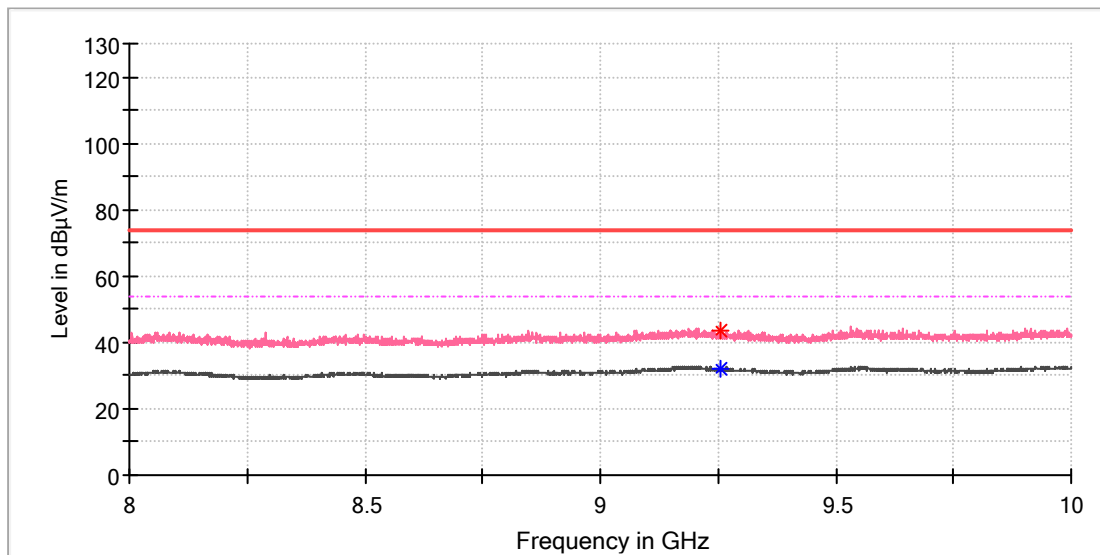


Critical_Freqs

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



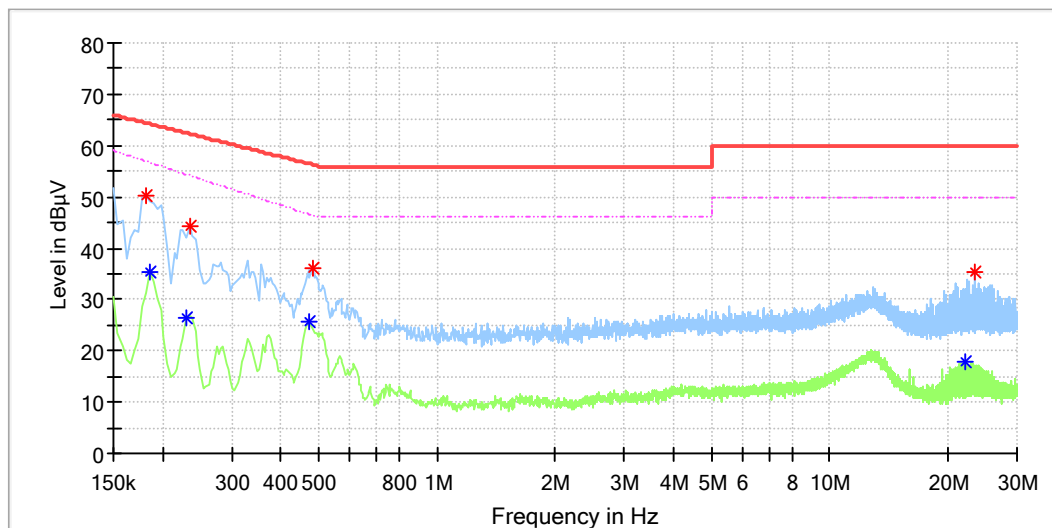
Critical Freqs

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

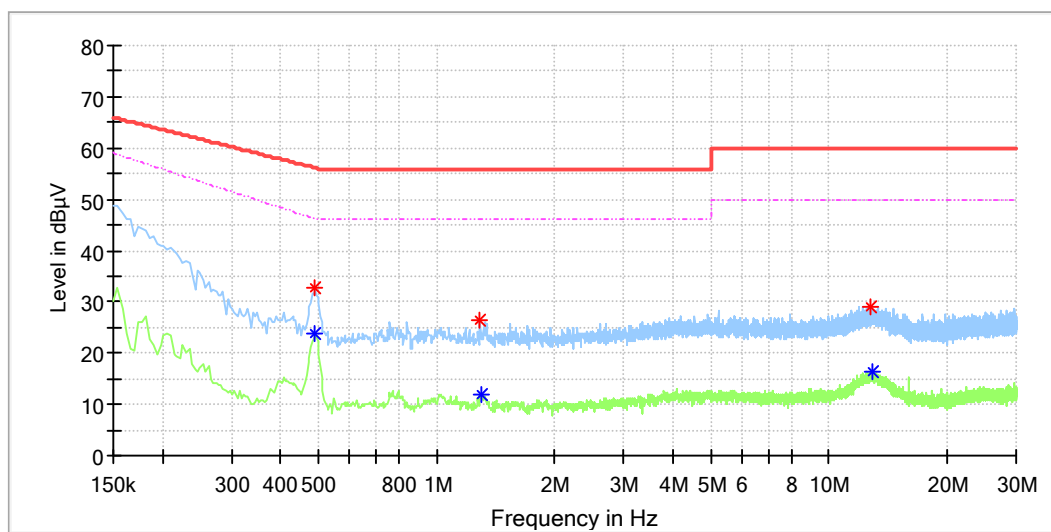


Critical Freqs

Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	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 (dBµV)	Average (dBµV)	Limit (dBµV)	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