

Prüfbericht-Nr.: <i>Test report no.:</i>	CN22LKDS 001	Auftrags-Nr.: <i>Order no.:</i>	168373838	Seite 1 von 30 <i>Page 1 of 30</i>
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	2022-05-24	
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>	WisDuo LPWAN SiP			
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	RAK3172-SiP, RAK3272-SiP (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>	2022-05-24	Please refer to photo documents		
Prüfmuster-Nr.: <i>Test sample no.:</i>	A003266647			
Prüfzeitraum: <i>Testing period:</i>	2022-05-25 - 2022-07-22			
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> 2022-08-03	X  Signed by: Alex Lan		X  Signed by: Winnie Hou	
Stellung / Position	Assistant Project Manager	Ausstellungsdatum: <i>Issue date:</i> 2022-08-04	Department Manager	
Sonstiges / Other:	FCC ID: 2AF6B-RAK3272 IC: 25908-RAK3272, HVIN: RAK3172-SiP, RAK3272-SiP			
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>			
* Legend: 1 = sehr gut P(ass) = entspricht o.g. Prüfgrundlage(n) 1 = very good P(ass) = passed a.m. test specifications(s)	2 = gut 2 = good	3 = befriedigend F(ail) = entspricht nicht o.g. Prüfgrundlage(n) 3 = satisfactory F(ail) = failed a.m. test specifications(s)	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

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1 General Remarks

1.1 Complementary Materials

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

Appendix A: Photographs of the Test Set-up

Appendix B: Test Results.

2 Test Sites

2.1 Test Facilities

TÜV Rheinland (Shenzhen) Co., Ltd.

362 Huanguan Road Middle Longhua District, Shenzhen 518110 People's Republic of China

FCC Registration No.: 694916

ISED wireless device testing laboratory: 25069, CAB identifier: CN0078

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

TÜV Rheinland (Shenzhen) Co., Ltd.

Radio Spectrum Testing				
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	MY61276100	2022-09-28
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	Y LX23JMF	N/A
Unwanted Emission Testing				
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	102680	2023-02-27
Artificial Mains Network	R&S	ENV216	101445	2023-02-27
EMC32 test software	R&S	EMC32(Ver.10.50.00)	N/A	N/A

2.3 Traceability

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

2.4 Calibration

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

2.5 Measurement Uncertainty

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

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

2.6 Location of Original Data

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

2.7 Status of Facility Used for Testing

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

3 General Product Information

3.1 Product Function and Intended Use

The EUTs are a WisDuo LoRa 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#	2701C02Q	0.8dBi	PCB Antenna	IPEX connector
2#	KRAKBJ2701C01A	2.3 dBi	Dipole Antenna	RPSMA connector
3#	KRAKBJ2701C01C	2.3 dBi	Dipole Antenna	RPSMA connector

Antennas 2# and 3# have the same type and similar in-band and out-of-band characteristics and only the color of enclosure different, they are considered as equivalent antennas. Thus, the antenna 3# 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

All models are identical except the construction, model RAK3272-SiP has an additional baseboard and other model model RAK3172-SiP doesn't have, the baseboard are the extension of I/O.

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

3.2 Ratings and System Details

Table 2: Technical Specification of EUT

General Information of EUT	Value
Kind of Equipment	WisDuo LPWAN SiP
Type Designation	RAK3172-SiP, RAK3272-SiP
Trademark	RAK
FCC ID	2AF6B-RAK3272
IC	25908-RAK3272
HVIN	RAK3172-SiP, RAK3272-SiP
Operating Voltage	DC 3.3V (Supplied by socket of PCB board)
Testing Voltage	DC 5V Via USB port
Technical Specification of Lora DTS	
Operating Frequency	903 – 914.2MHz
Type of Modulation	Lora
Data Rate	SF8 / DR4
Channel Number	8 channels (Upstream)
Channel Separation	1.6 MHz
Occupied Bandwidth	500 KHz
Technical Specification of Lora FHSS	
Frequency Range	902.3 – 914.9MHz
Type of Modulation	Lora
Data Rate	SF7 to SF10 / DR0 to DR3
Channel Number	64 channels (Upstream)
Channel Separation	200 KHz
Occupied Bandwidth	125 KHz

Table 3: RF Channel and Frequency of Lora FHSS

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

Table 4: RF Channel and Frequency of Lora DTS

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

3.3 Independent Operation Modes

The basic operation modes are:

- A. On, Lora transmitting mode (FHSS)
 - 1) Low Channel
 - 2) Middle Channel
 - 3) High Channel
- B. On, Lora transmitting mode (DTS)
 - 1) Low Channel
 - 2) Middle Channel
 - 3) High Channel
- C. On, Transmitting on Hopping channel
- D. 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 RAK3272-SiP with antenna #1, #3 in this report

4.3 Special Accessories and Auxiliary Equipment

Table 5: Auxiliary Equipment Used during Test

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

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)

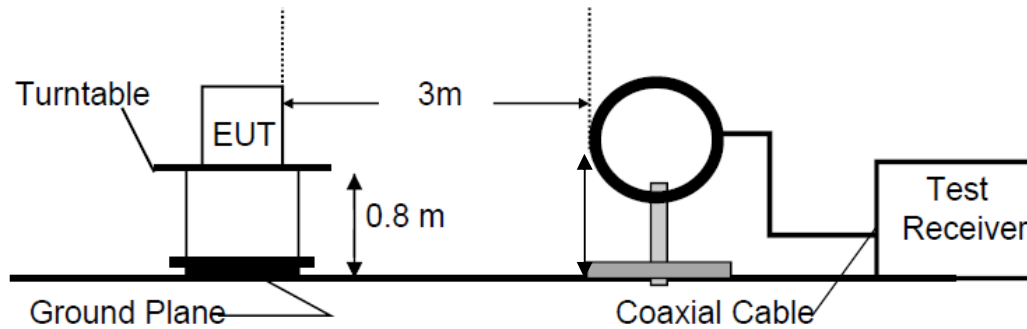


Diagram of Measurement Configuration for Radiation Test (Below 1GHz)

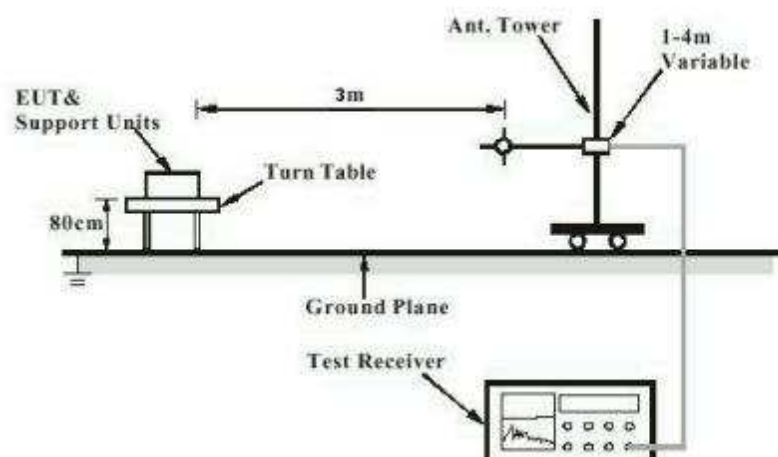


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

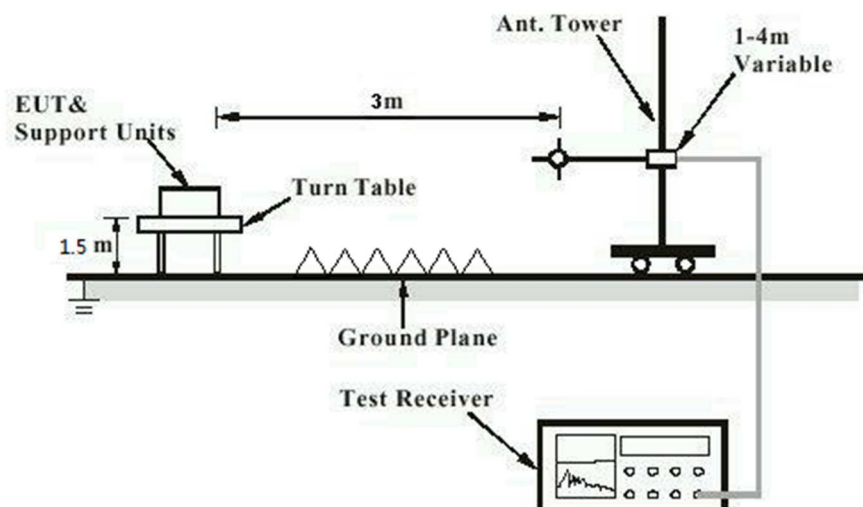


Diagram of Measurement Configuration for Mains Conduction Measurement

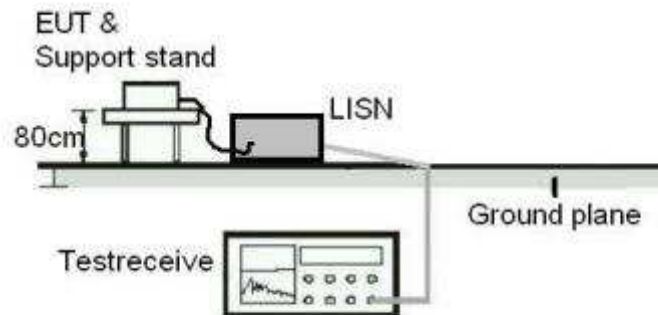
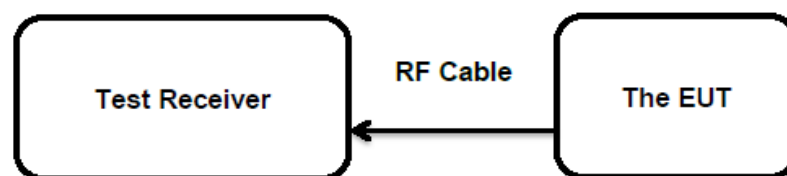


Diagram of Measurement Configuration for Conducted Transmitter Measurement



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 one IPEX Antenna, the directional gain of antenna are 2.3dBi & 0.8 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Therefore the EUT is considered sufficient to comply with the provision.

Refer to EUT Photo for further details.

5.1.2 Maximum Conducted Output Power

RESULT:
Pass
Test Specification

Test standard	: FCC Part 15.247(b)(2)&(3) RSS-247 Clause 5.4(a)&(d)
Basic standard	: ANSI C63.10: 2013 Not more than 1Watt(30dBm) for DTS in the band 902-928MHz
Limits	: Not more than 1Watt(30dBm) for FHSS with at least 50 hopping channels in the band 902-928MHz
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 2022-05-25 to 2022-07-22
Input voltage	: DC 5V Via USB port
Operation mode	: A, B
Test channel	: Low / Middle / High
Ambient temperature	: 25 °C
Relative humidity	: 56 %
Atmospheric pressure	: 101 kPa

Table 6: Test Result of Maximum Conducted Average Output Power

Test Mode	Test Channel (MHz)	Maximum Conducted Average Power		Limit (W)
		(dBm)	(W)	
Lora DTS	903.0	13.21	0.0209	< 1.0
	907.8	13.16	0.0207	
	914.2	12.89	0.0195	
Lora FHSS SF7	902.3	13.19	0.0208	< 0.125
	908.5	13.08	0.0203	
	914.9	12.92	0.0196	
Lora FHSS SF10	902.3	13.20	0.0209	< 0.125
	908.5	13.10	0.0204	
	914.9	12.96	0.0198	
Max. Measured Value		13.21	0.0209	

Note:

- 1) The cable loss is taken into account in results.
- 2) The maximum Antenna gain(G) : 2.3 dBi,
e.i.r.p.=15.51dBm = 35.56mW, which is far below the 4 W

5.1.3 Conducted Power Spectral Density

RESULT:**Pass****Test Specification**

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

Test Setup

Date of testing : 2022-05-25 to 2022-07-22
Input voltage : DC 5V Via USB port
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 7: Test Result of Maximum Peak Power Spectral Density, Lora DTS

Test Mode	Test Channel (MHz)	Measured Peak Power Spectral Density (dBm/3KHz)
Lora DTS	903.0	-7.55
	907.8	-8.02
	914.2	-8.86
Maximum Measured Value		-7.55

5.1.4 6dB Bandwidth

RESULT:

Pass

Test Specification

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

Test Setup

Date of testing : 2022-05-25 to 2022-07-22
 Input voltage : DC 5V Via USB port
 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 8: Test Result of 6dB Bandwidth

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

5.1.5 20dB Bandwidth

RESULT:
Pass
Test Specification

Test standard	: FCC Part 15.247(a)(1) (i) RSS-247 Clause 5.1(a)
Basic standard	: ANSI C63.10: 2013 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	: 2022-05-25 to 2022-07-22
Input voltage	: DC 5V Via USB port
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 9: Test Result of 20dB Bandwidth

Test Mode	Test Channel (MHz)	20dB Bandwidth (kHz)	Limit (KHz)
Lora FHSS	902.3	145.44	<500KHz
	908.5	145.44	
	914.9	144.72	
Maximum Measured Value		145.44	

5.1.6 99% Bandwidth**RESULT:****Pass****Test Specification**

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

Test Setup

Date of testing : 2022-05-25 to 2022-07-22
Input voltage : DC 5V Via USB port
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 10: Test Result of 99% Bandwidth

Test Mode	Test Channel (MHz)	99% Bandwidth (KHz)	Limit (KHz)
Lora DTS	903.0	500.72	/
	907.8	500.72	
	914.2	506.51	
Lora FHSS	902.3	126.63	
	908.5	126.63	
	914.9	126.63	
Minimum Measured Value		126.63	

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	: 30dB (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 5V Via USB port
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	: 2022-05-25 to 2022-07-22
Input voltage	: DC 5V Via USB port
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 vertical) orientations was recorded.

For the measurement records, refer to the appendix B.

5.1.9 Carrier Frequency Separation

RESULT:

Pass

Test Specification

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

Test Setup

Date of testing	:	2022-05-25 to 2022-07-22
Input voltage	:	DC 5V Via USB port
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 11: Test Result of Carrier Frequency Separation

Test Mode	Channel	Measured Channel Separation (KHz)	Limit (kHz)	Result
Lora FHSS	Low Channel	199.70	≥ 20dB bandwidth	Pass
	Adjacency Channel			
	Middle Channel	206.90		Pass
	Adjacency Channel			
	High Channel	206.95		Pass
	Adjacency Channel			

Note:

The limit is maximum 20 dB bandwidth: 145.44 KHz.

5.1.10 Number of Hopping Frequency**RESULT:****Pass****Test Specification**

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

Test Setup

Date of testing : 2022-05-25 to 2022-07-22
Input voltage : DC 5V Via USB port
Operation mode : C
Ambient temperature : 25 °C
Relative humidity : 56 %
Atmospheric pressure : 101 kPa

Table 12: Test result of hopping channel number

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

5.1.11 Time of Occupancy**RESULT:****Pass****Test Specification**

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

Test Setup

Date of testing : 2022-05-25 to 2022-07-22
Input voltage : DC 5V Via USB port
Operation mode : C
Test channel : Low / Middle / High
Ambient temperature : 25 °C
Relative humidity : 56 %
Atmospheric pressure : 101 kPa

Table 13: Test result of Channel Occupancy

Test Mode	20dB Bandwidth(kHz)	Period (s)	Channel Occupancy Time (ms)	Limit (ms)
Lora FHSS SF7	20dB Bandwidth < 250	20	107.248	400
Lora FHSS SF10	20dB Bandwidth < 250	20	116.000	400

5.1.12 Conducted Emission on AC Mains**RESULT:****Pass****Test Specification**

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

Test Setup

Date of testing	: 2022-05-25 to 2022-07-22
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 March 2019

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: 13.21 dBm with 2.3 dBi antenna gain

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

For Lora DTS: $S_{(mW/cm^2)} = PG/4\pi R^2 = 0.007 \text{ mW/cm}^2$

Limits for Maximum Permissible Exposure (MPE) according to FCC Part 1.1310: 1.0 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 FHSS & DTS: 1.37 W

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

Lora DTS: 13.21 dBm

Antenna Gain: 2.3 dBi

The Max. e.i.r.p. for Lora DTS: 15.51dBm = 0.036 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.

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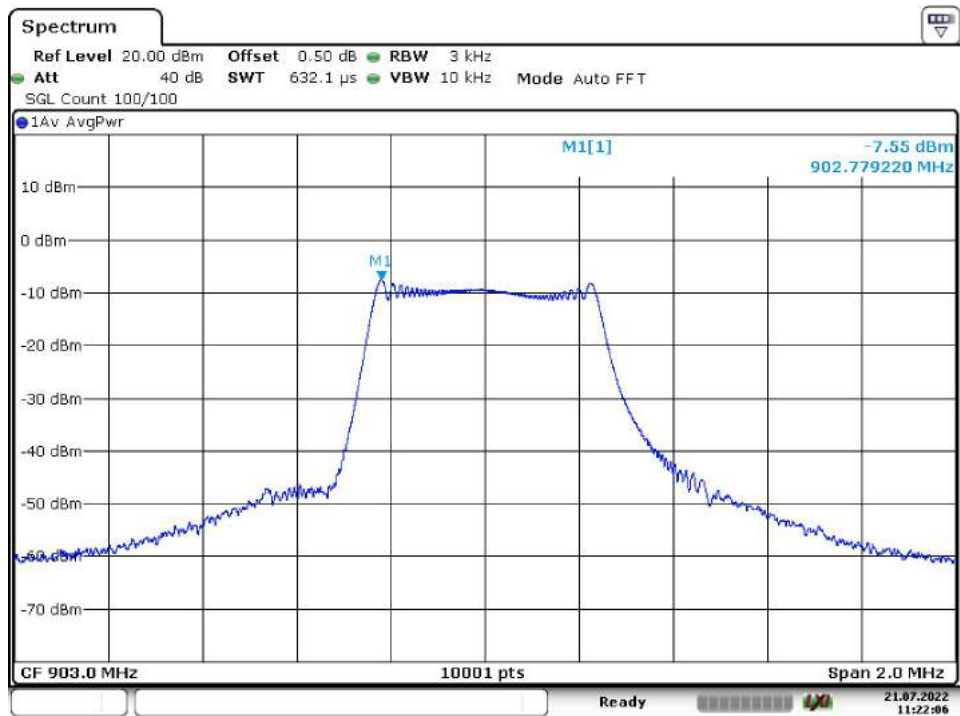
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Appendix B.1: Conducted Power Spectral Density

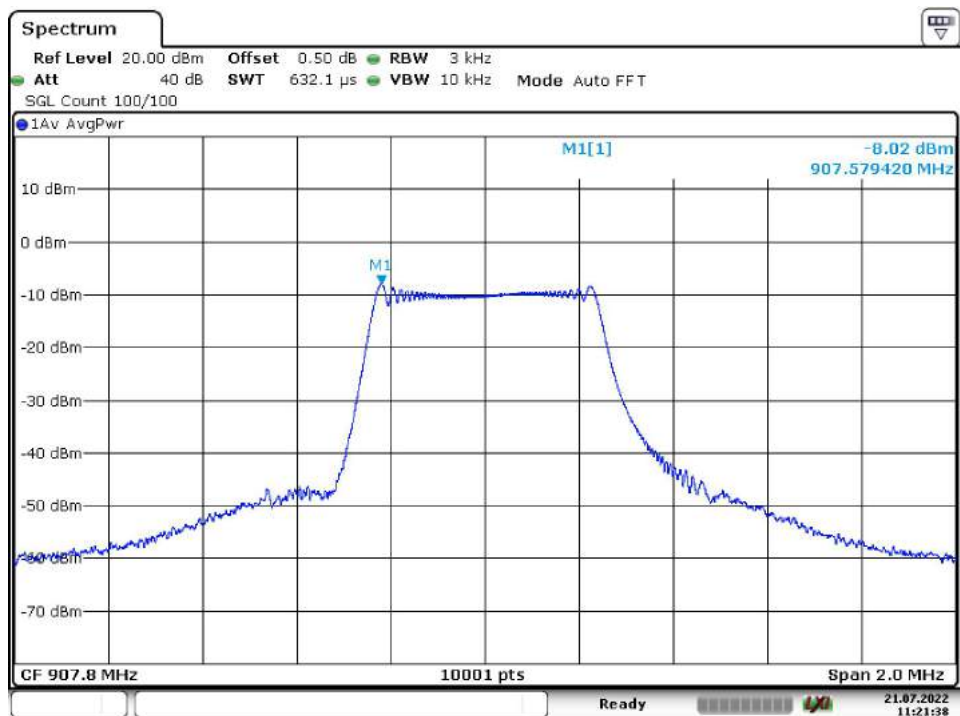
Lora DTS

Low Channel



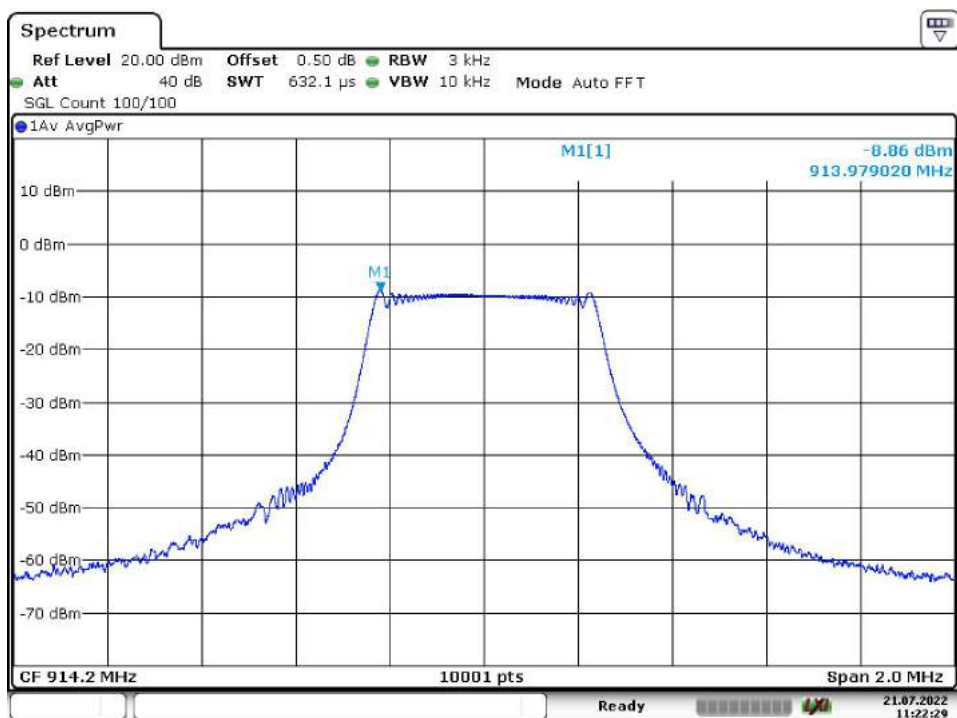
Date: 21.JUL.2022 11:22:06

Middle Channel



Date: 21.JUL.2022 11:21:38

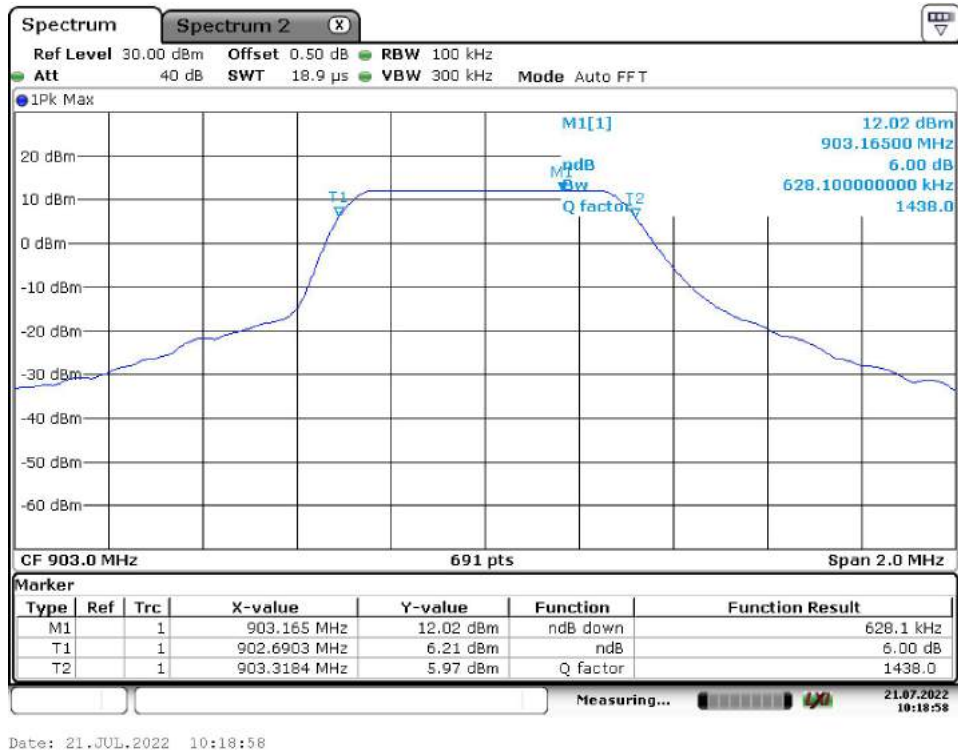
High Channel



Date: 21.JUL.2022 11:22:29

Appendix B.2: 6dB Bandwidth

Lora DTS Low Channel



Middle Channel



High Channel

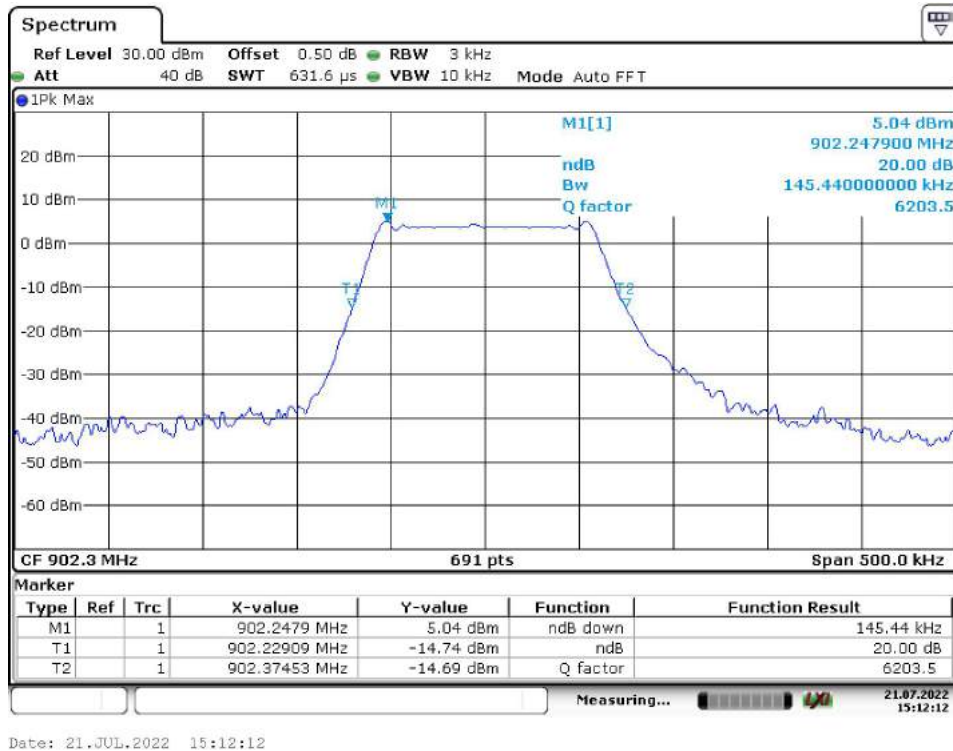


Date: 21.JUL.2022 10:24:30

Appendix B.3: 20dB Bandwidth

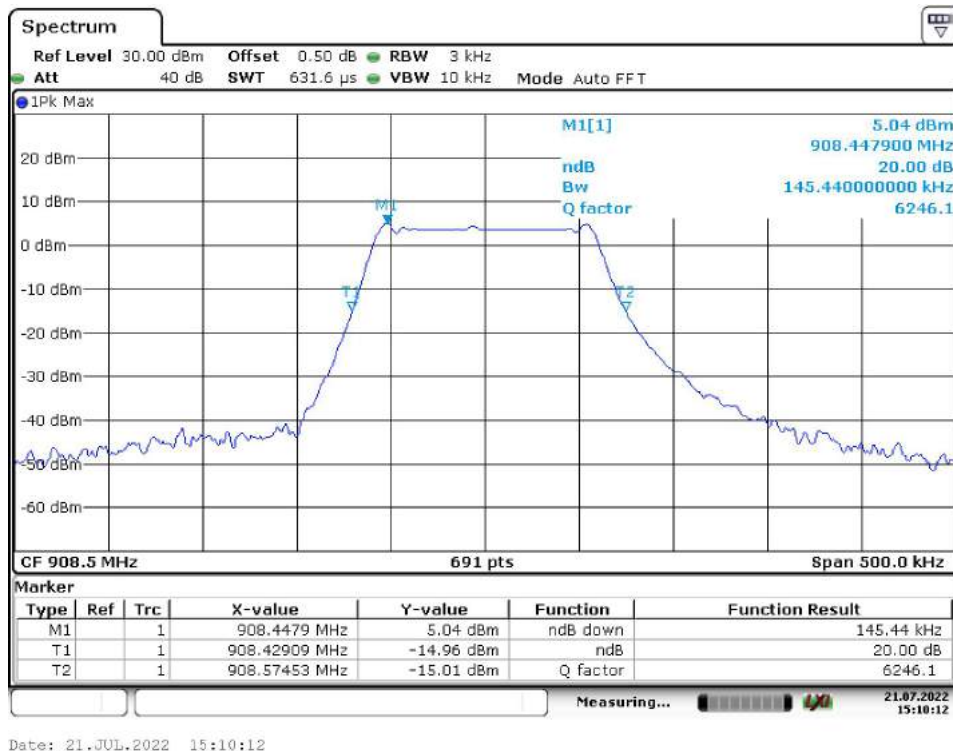
Lora FHSS

Low Channel



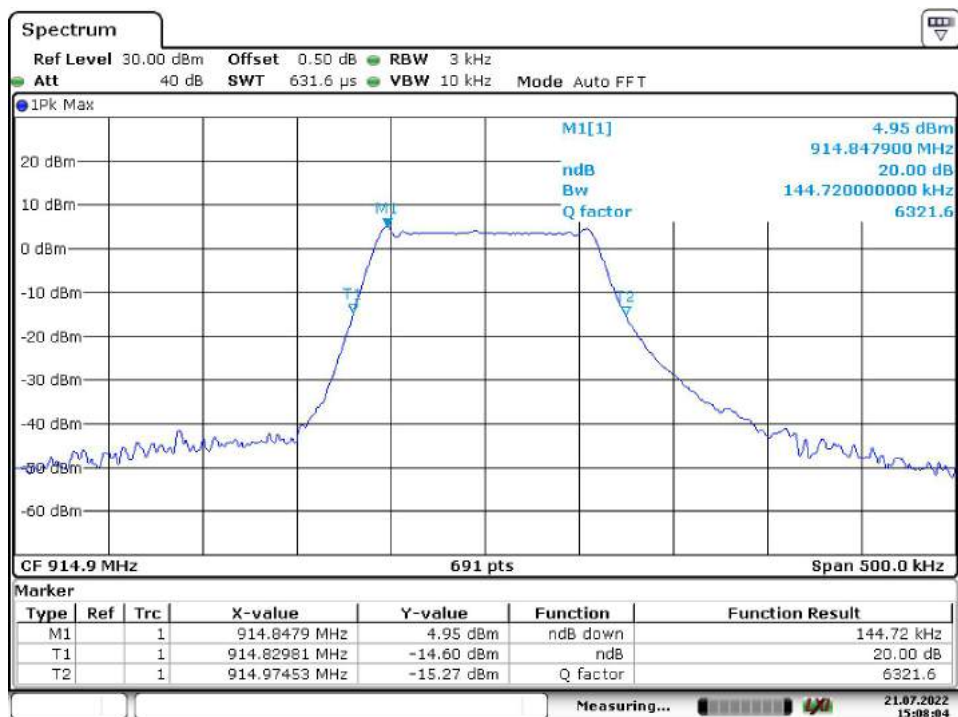
Date: 21.JUL.2022 15:12:12

Middle Channel



Date: 21.JUL.2022 15:10:12

High Channel

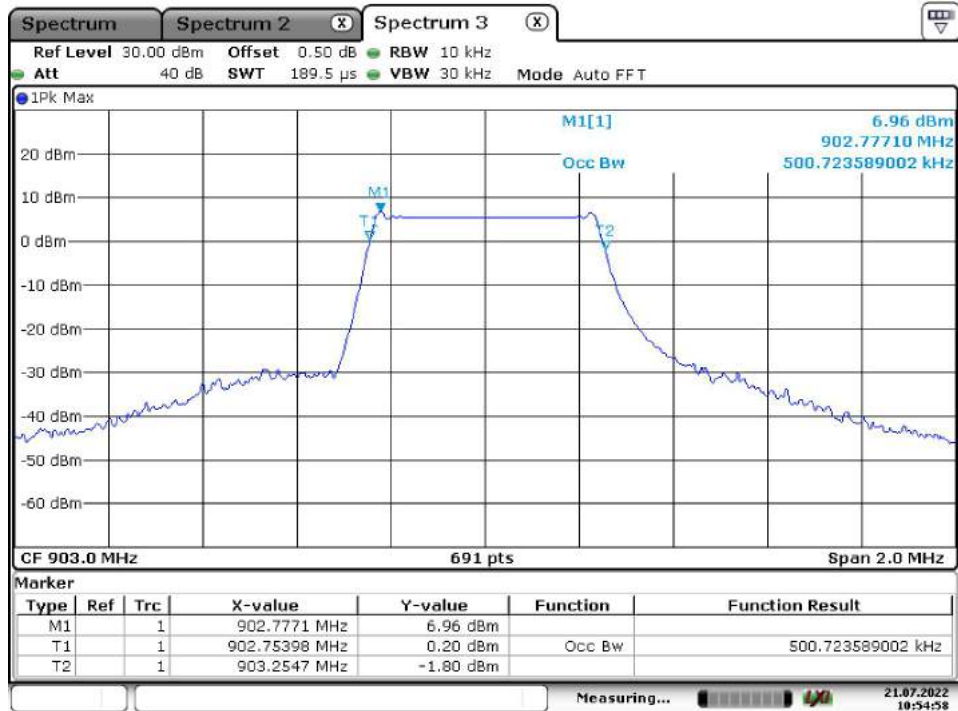


Date: 21.JUL.2022 15:08:04

Appendix B.4: 99% Bandwidth

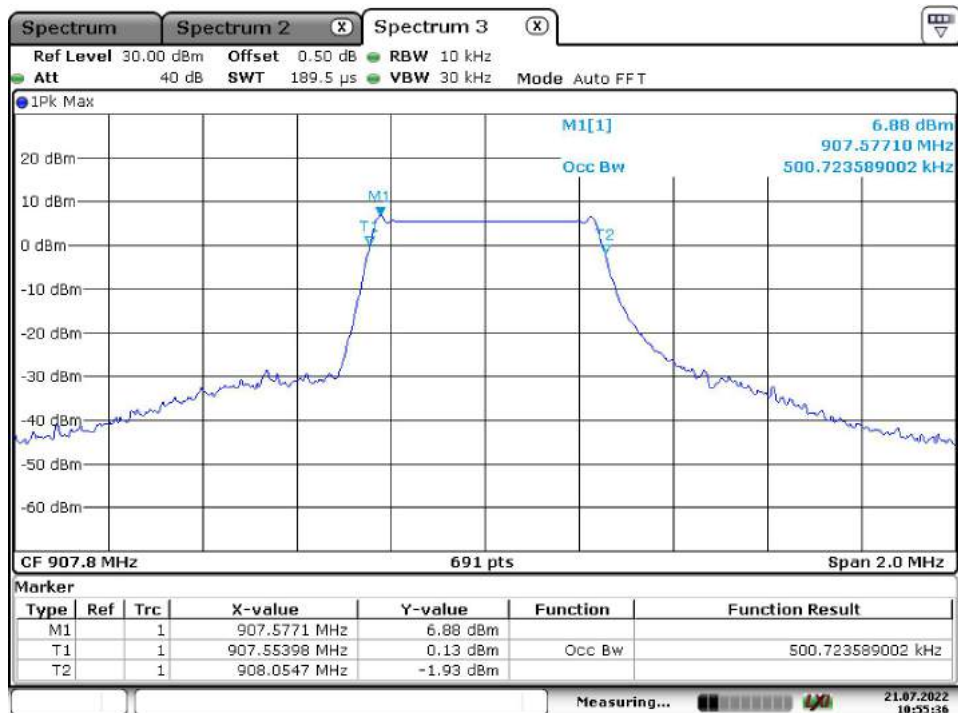
Lora DTS

Low Channel



Date: 21.JUL.2022 10:54:58

Middle Channel



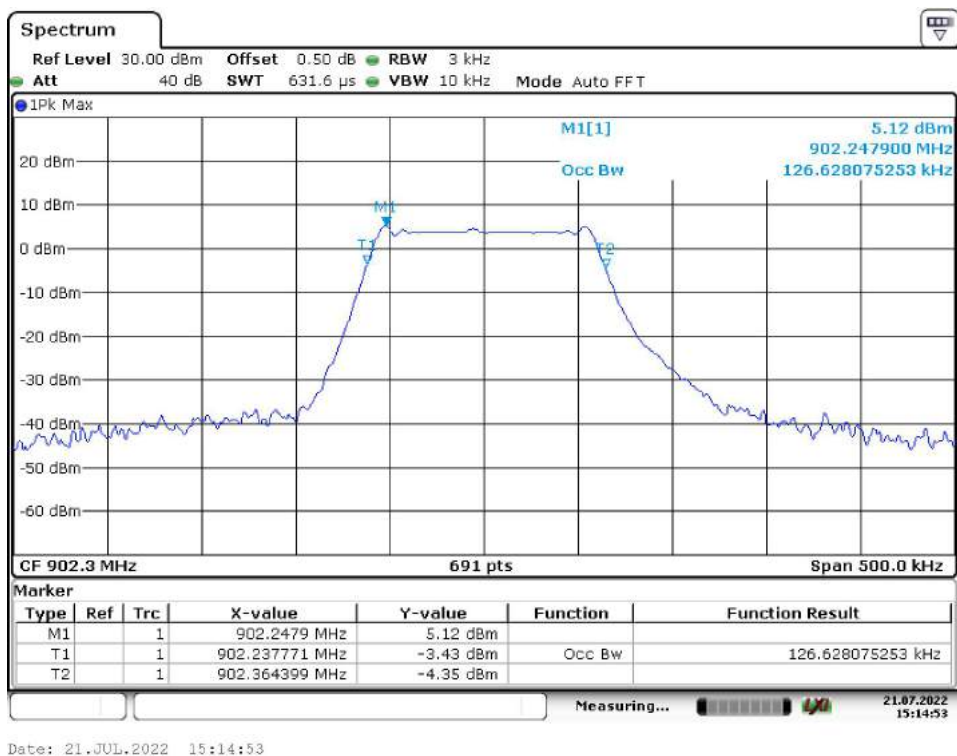
Date: 21.JUL.2022 10:55:36

High Channel

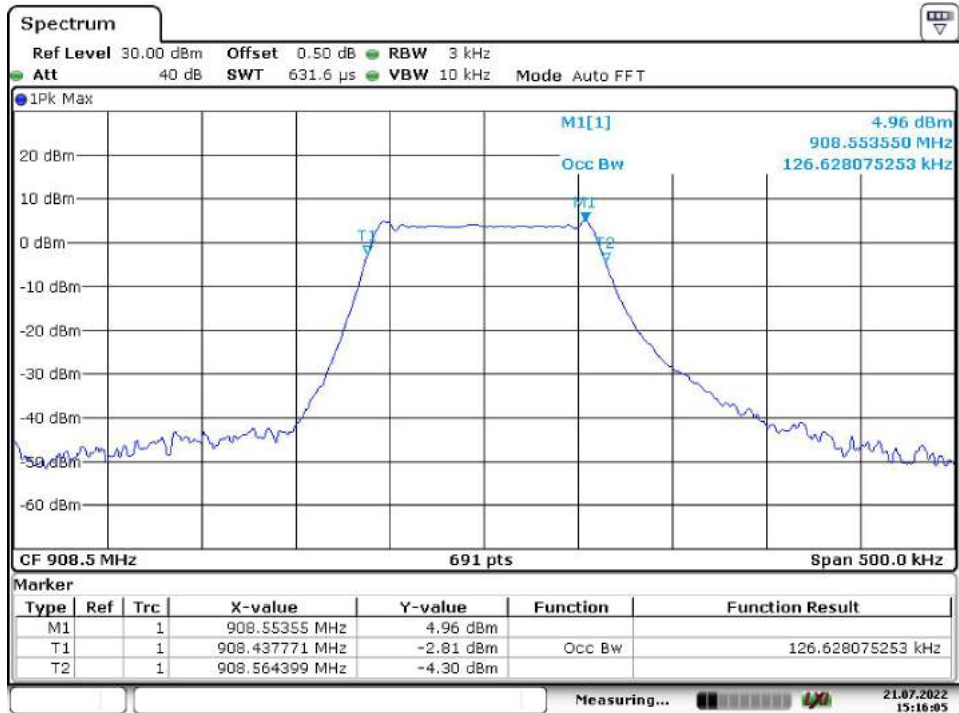


Lora FHSS

Low Channel

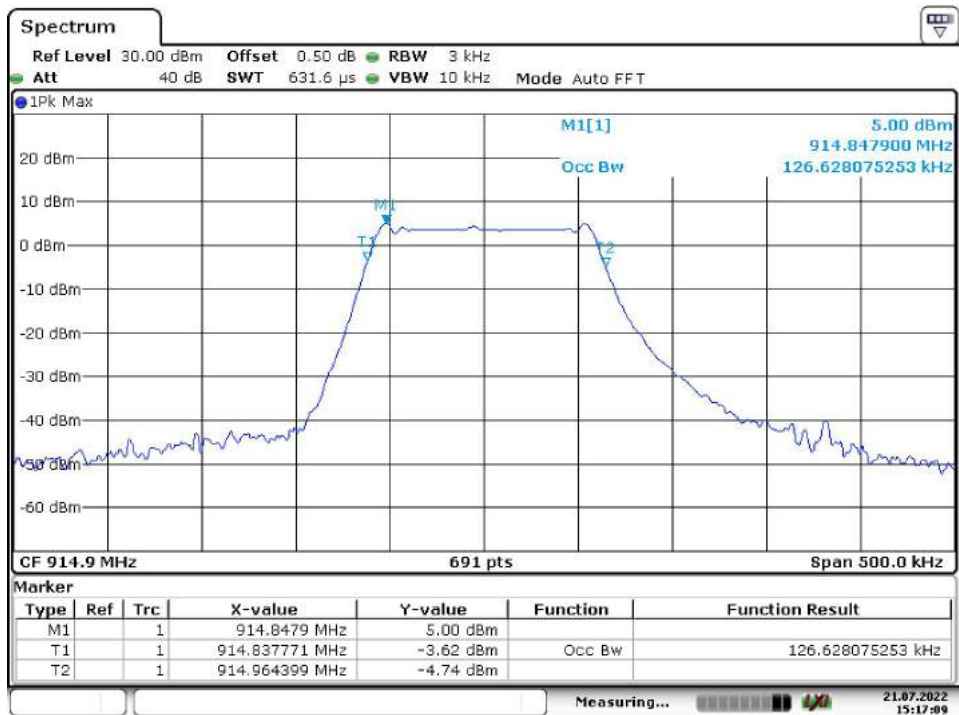


Middle Channel



Date: 21.JUL.2022 15:16:05

High Channel



Date: 21.JUL.2022 15:17:09

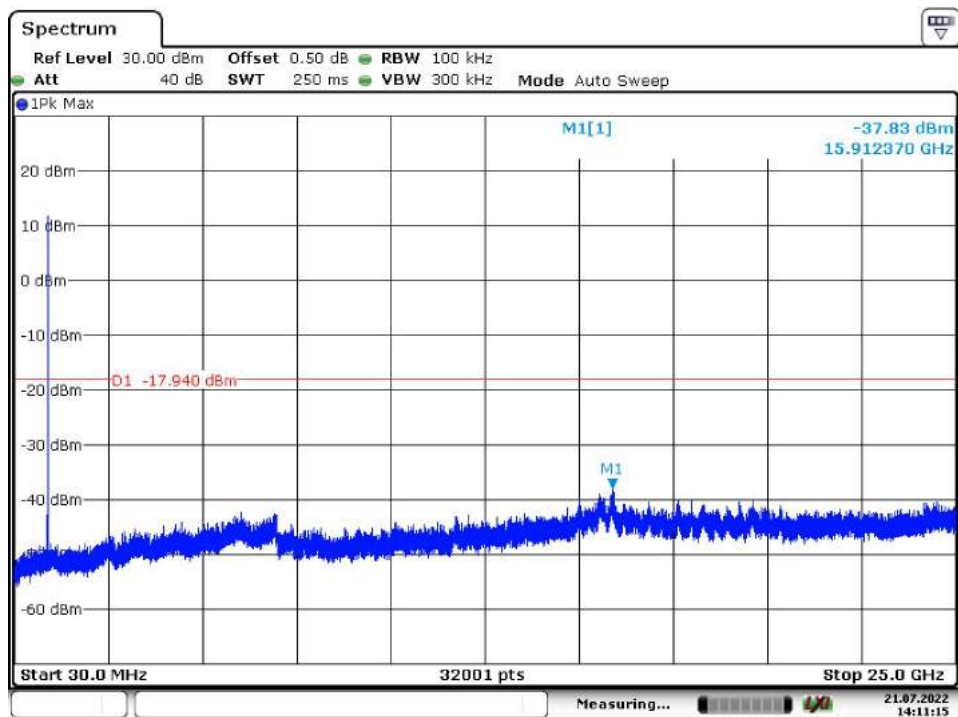
Appendix B.5: Conducted Spurious Emissions Measured in 100 kHz Bandwidth

Lora DTS

Low Channel



Date: 21.JUL.2022 11:26:41

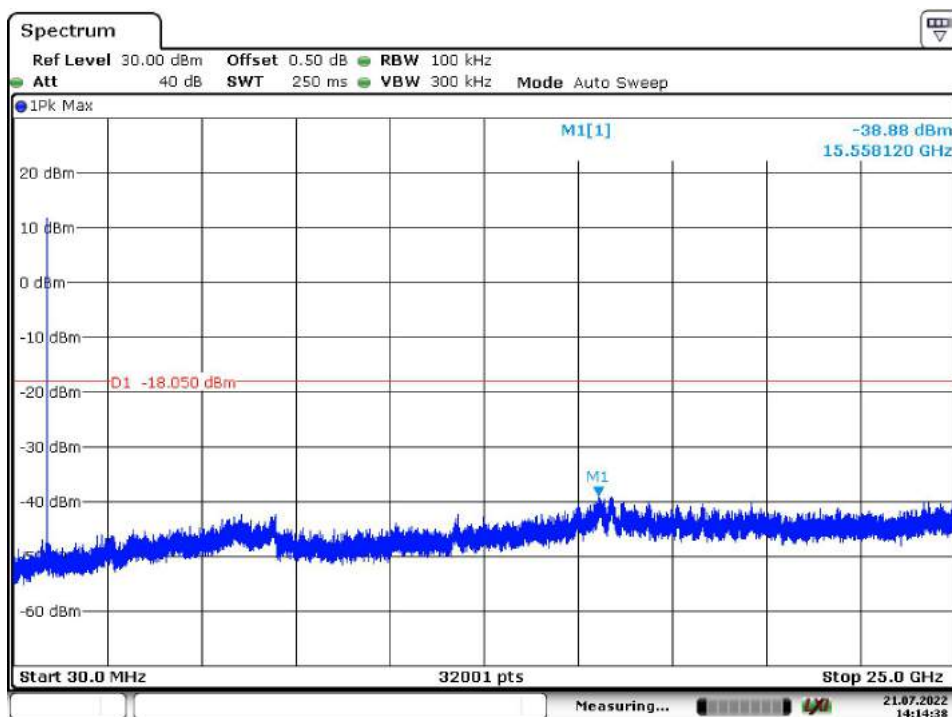


Date: 21.JUL.2022 14:11:16

Middle Channel



Date: 21.JUL.2022 11:27:29

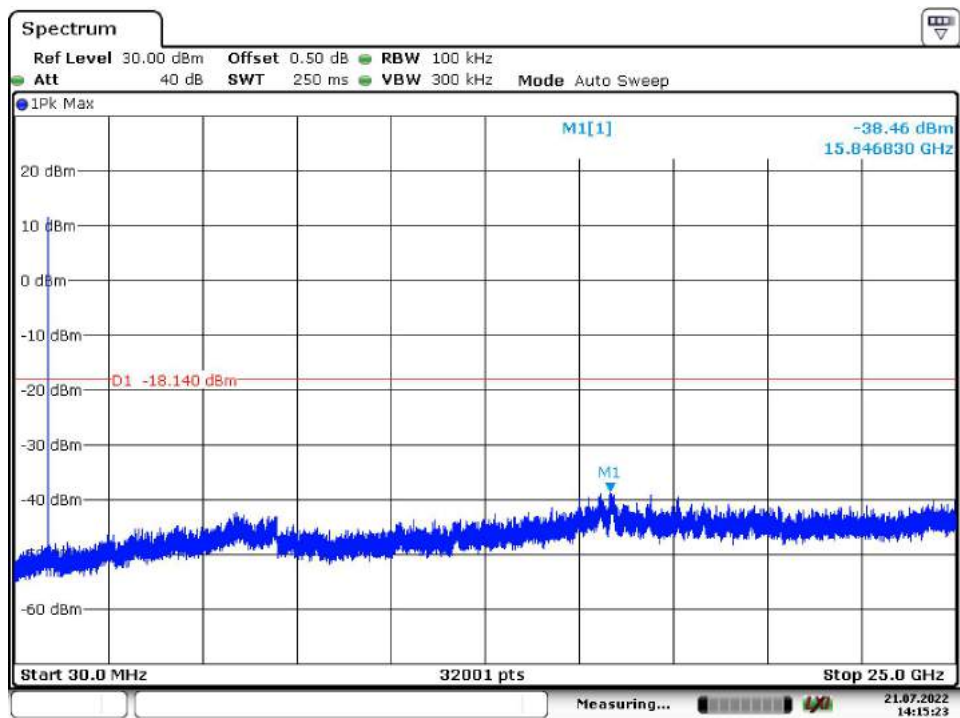


Date: 21.JUL.2022 14:14:38

High Channel



Date: 21.JUL.2022 11:28:36



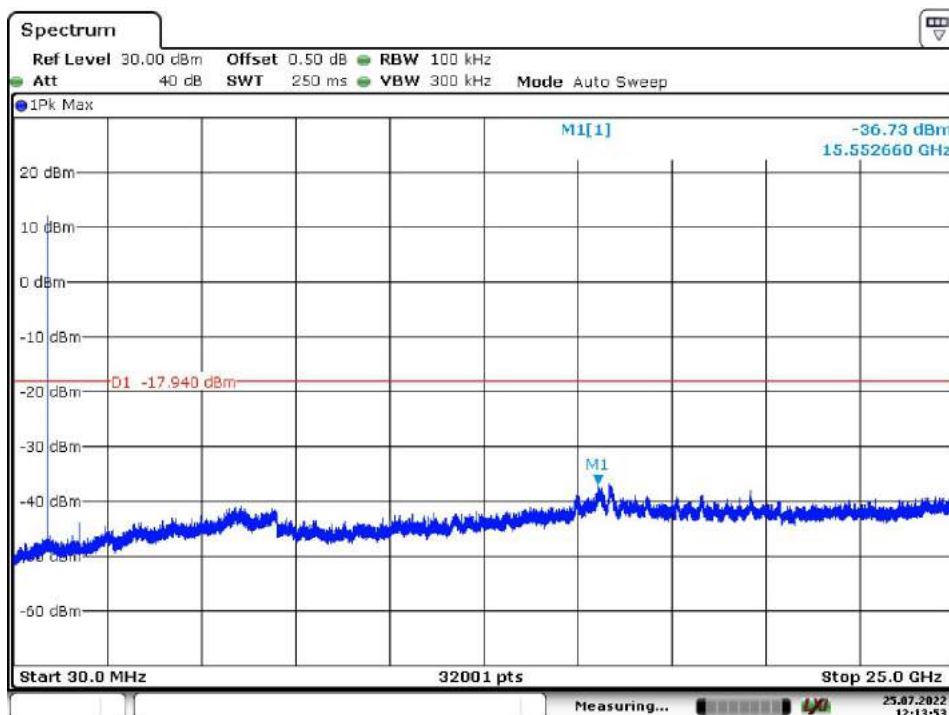
Date: 21.JUL.2022 14:15:23

Lora FHSS, No hopping

Low Channel



Date: 21.JUL.2022 14:56:08

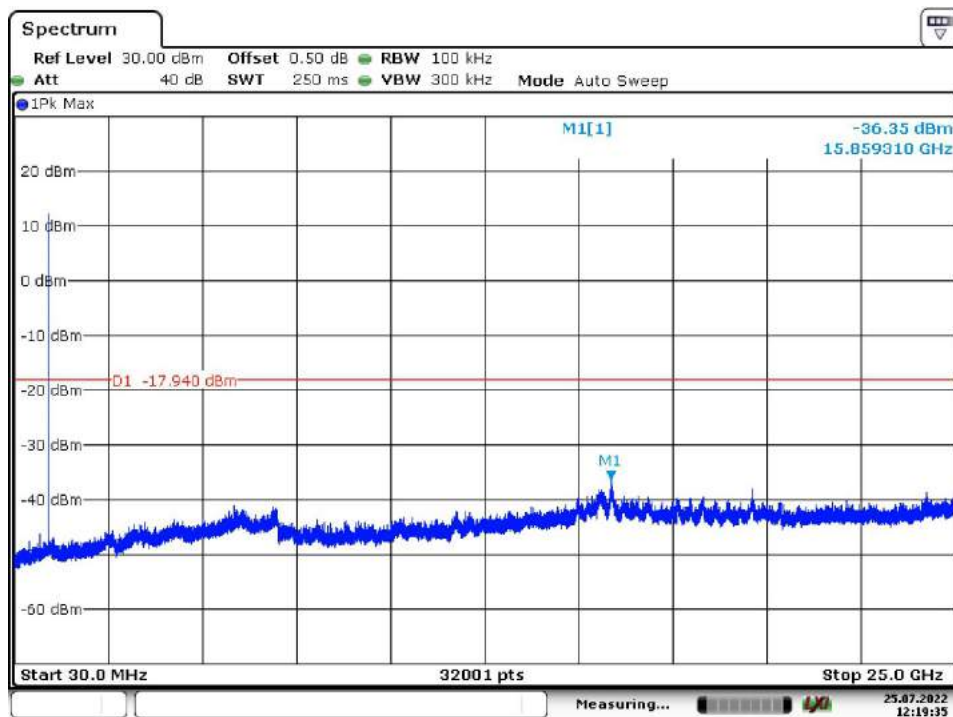


Date: 25.JUL.2022 12:13:54

Middle Channel



Date: 21.JUL.2022 14:54:52

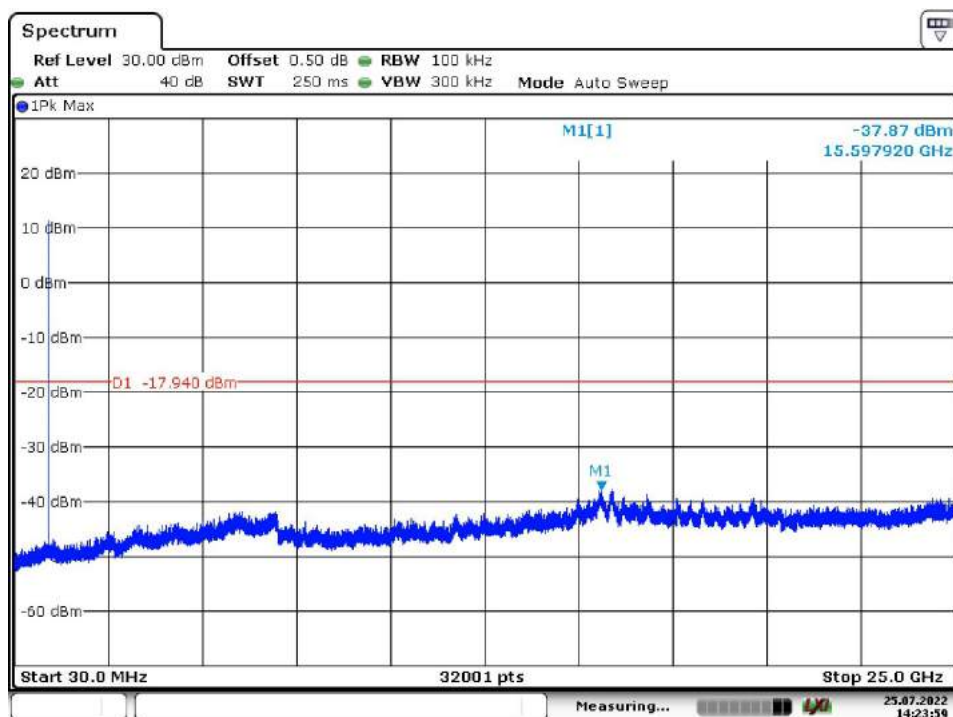


Date: 25.JUL.2022 12:19:34

High Channel

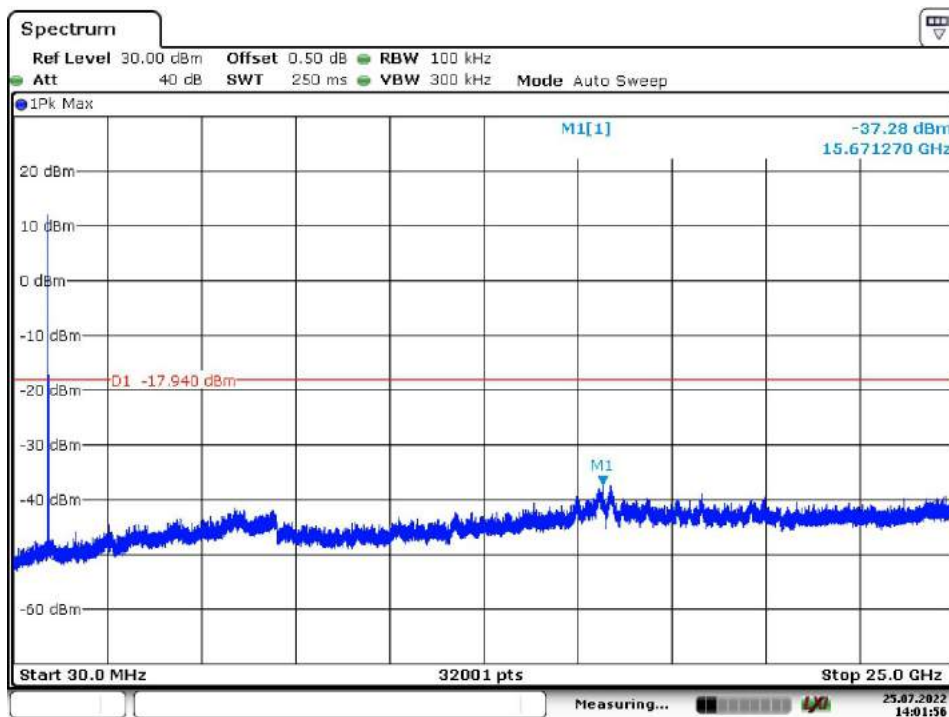
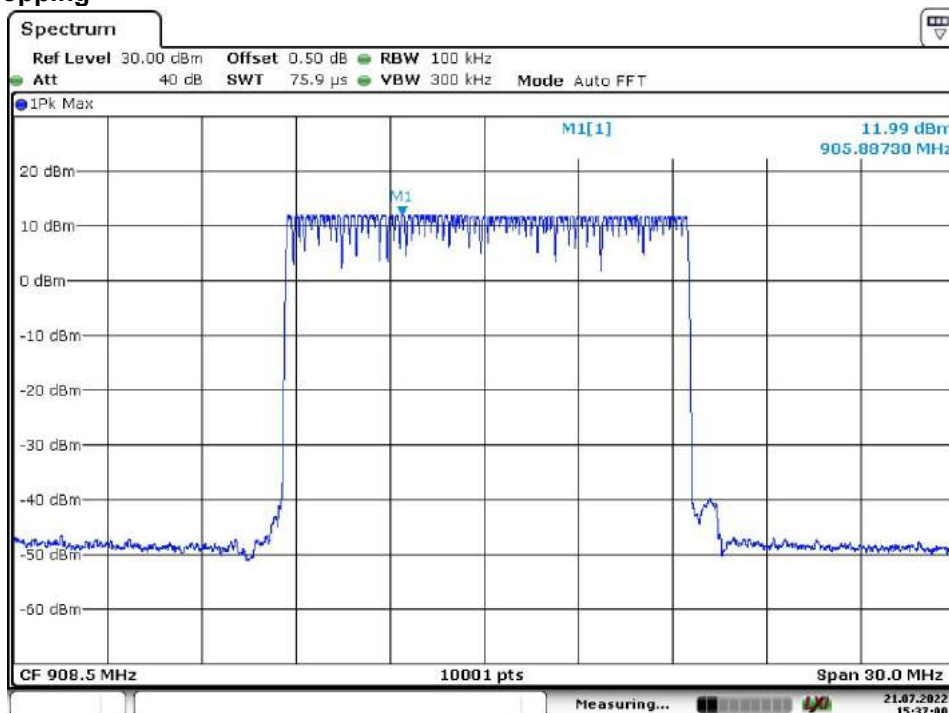


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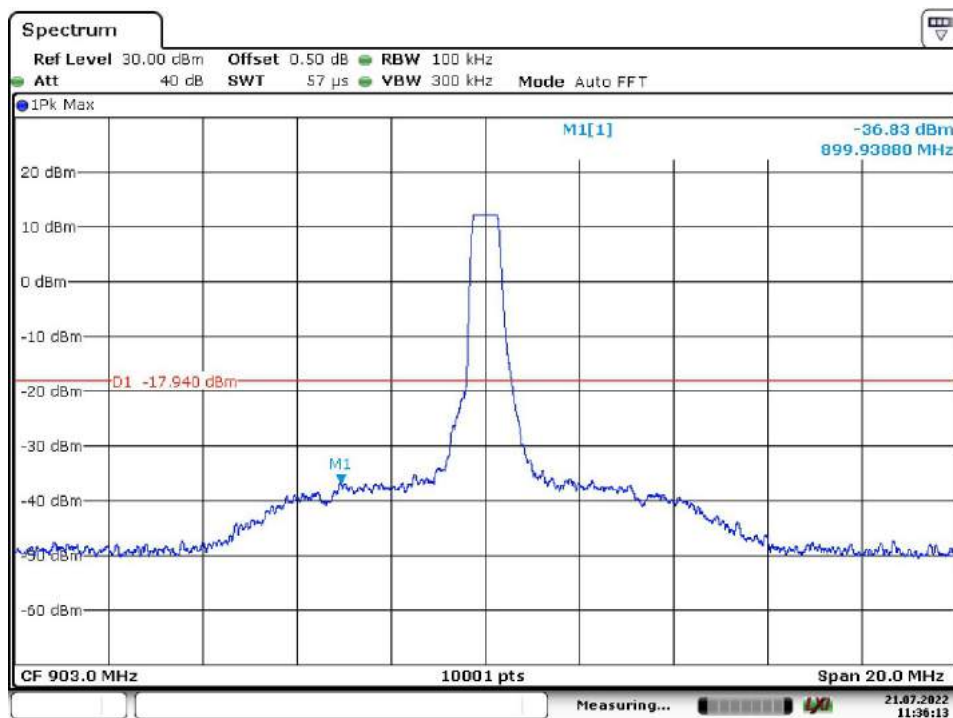
Date: 25.JUL.2022 14:23:59

Lora FHSS, hopping



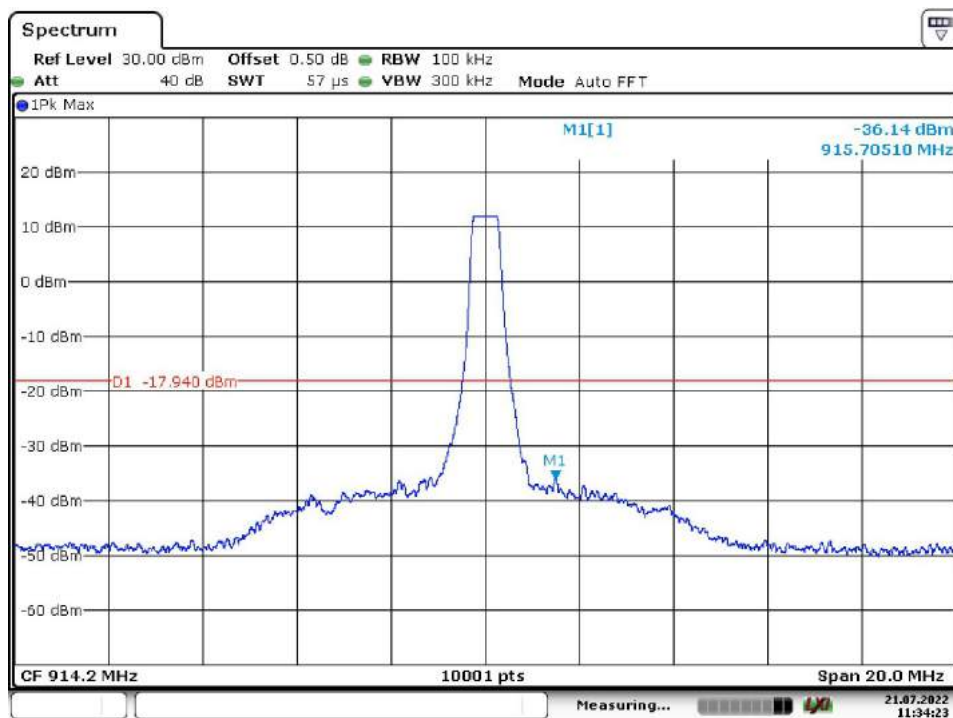
Lora DTS, Band Edge

Low Channel



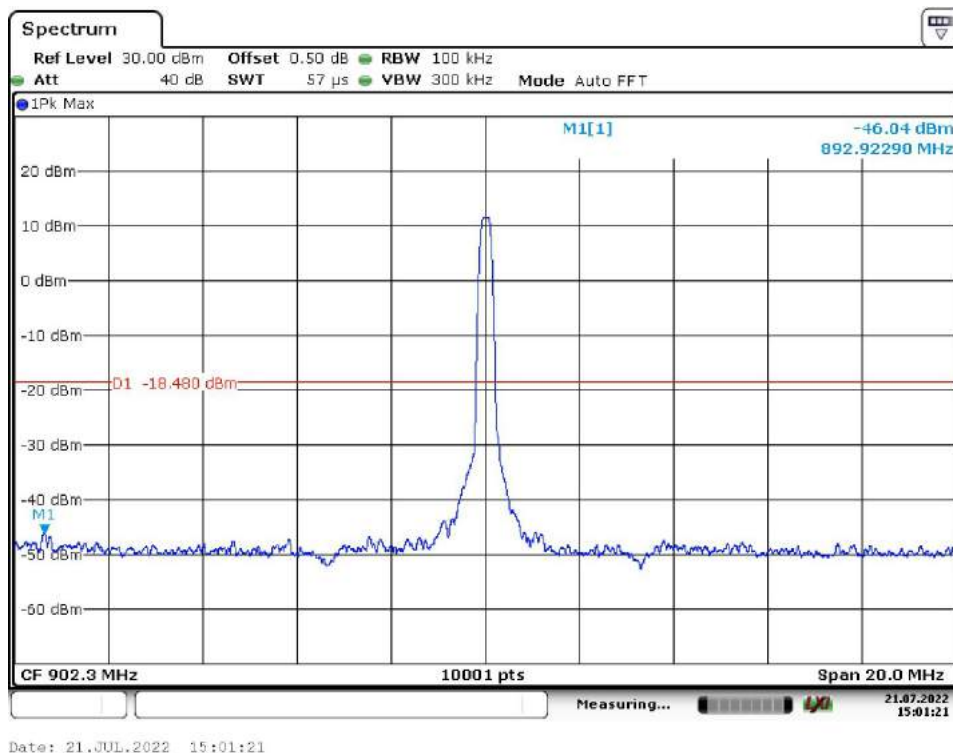
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High Channel

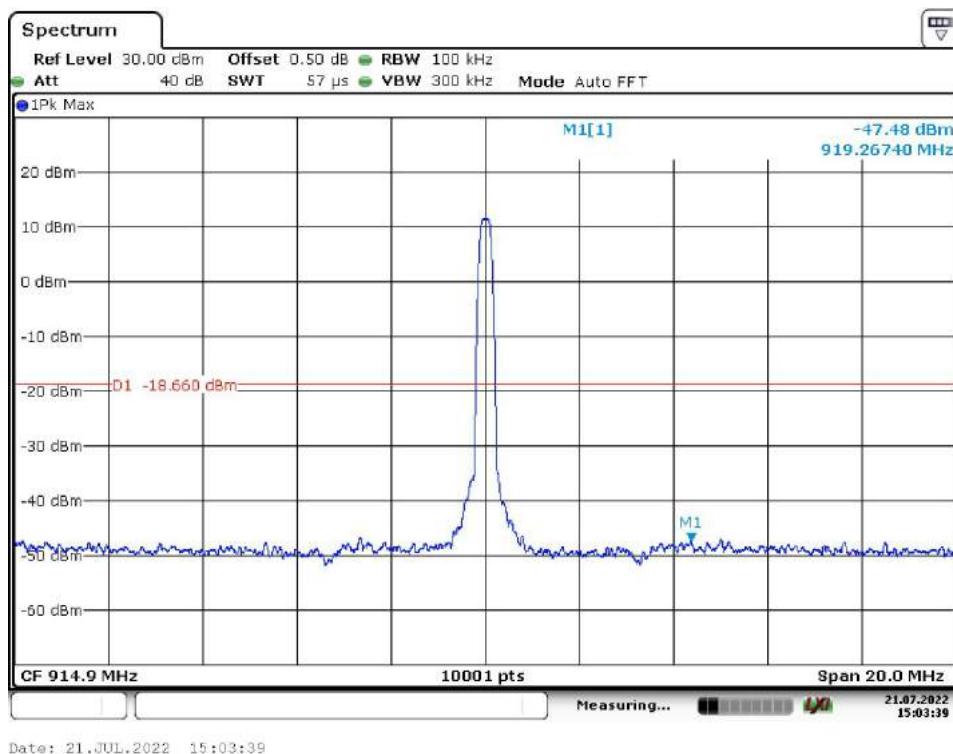


Date: 21.JUL.2022 11:34:23

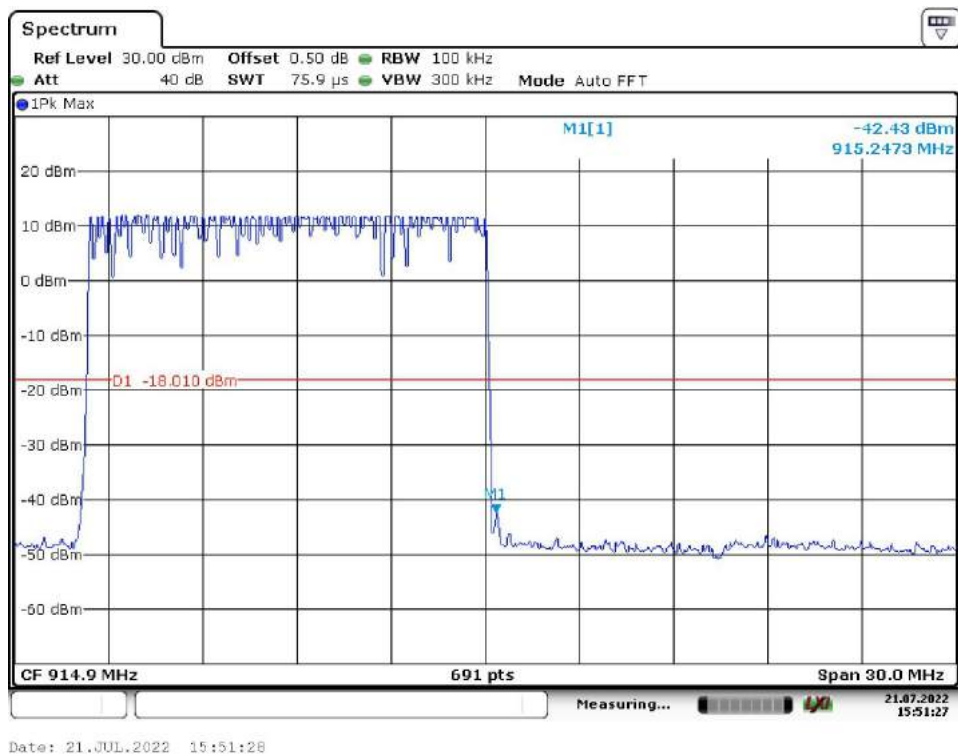
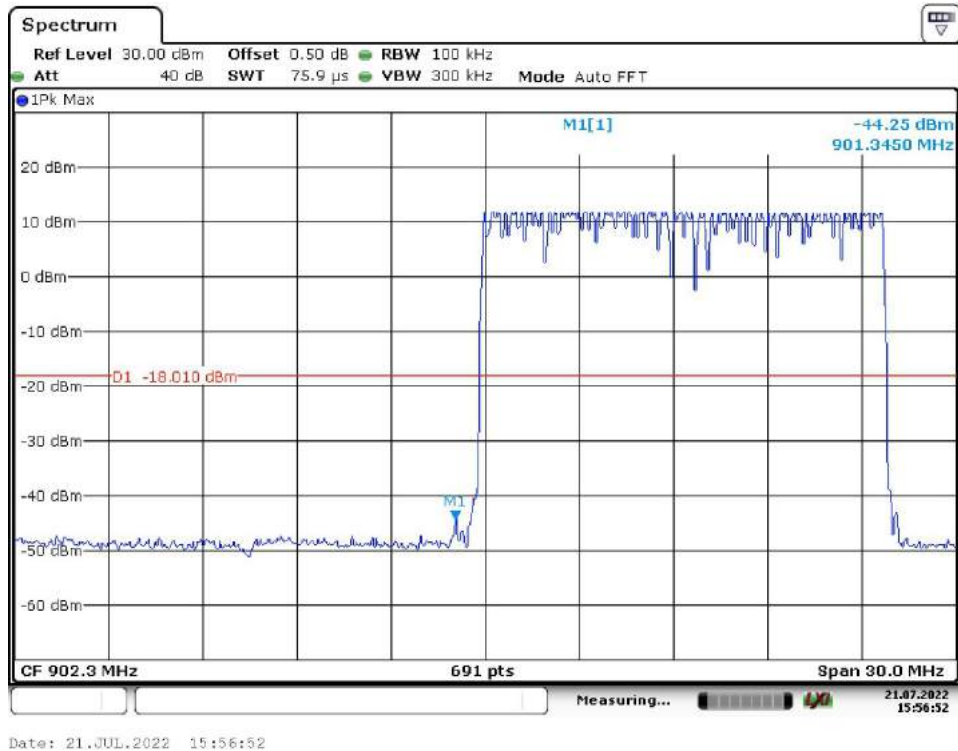
Lora FHSS, No hopping, Band Edge
Low Channel



High Channel



Lora FHSS, hopping, Band Edge



Appendix B.6: Carrier Frequency Separation

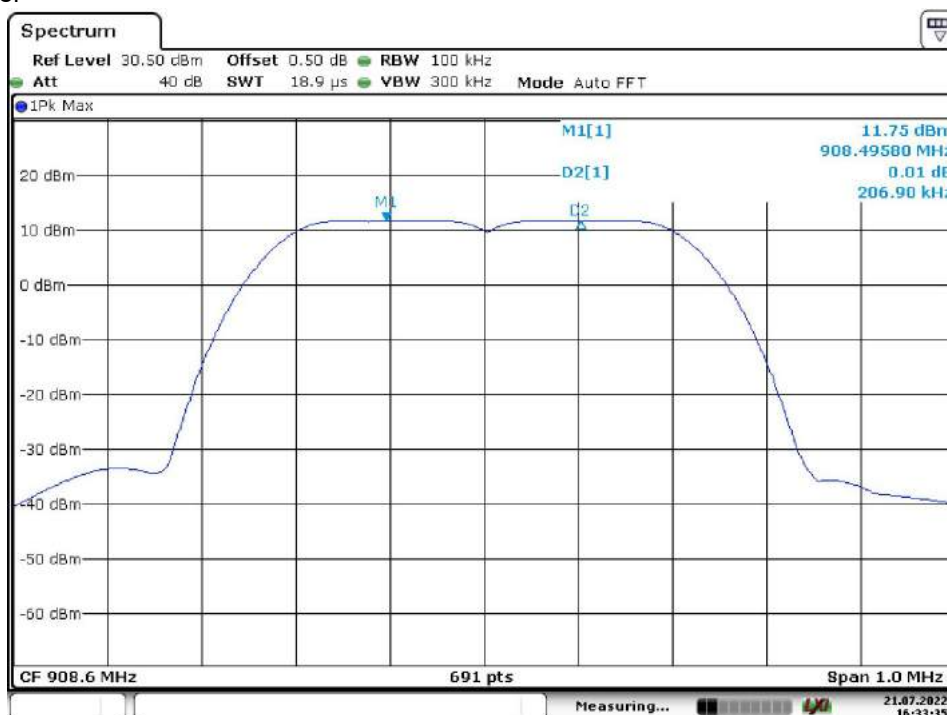
Lora FHSS

Low Channel



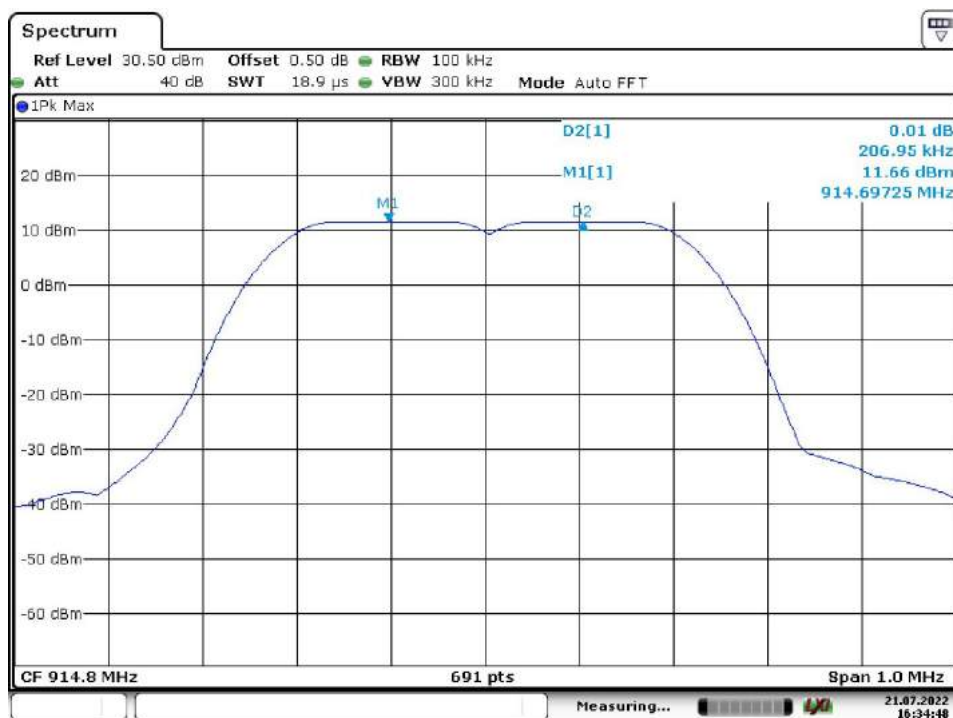
Date: 21.JUL.2022 16:30:44

Middle Channel



Date: 21.JUL.2022 16:33:36

High Channel



Date: 21.JUL.2022 16:34:49

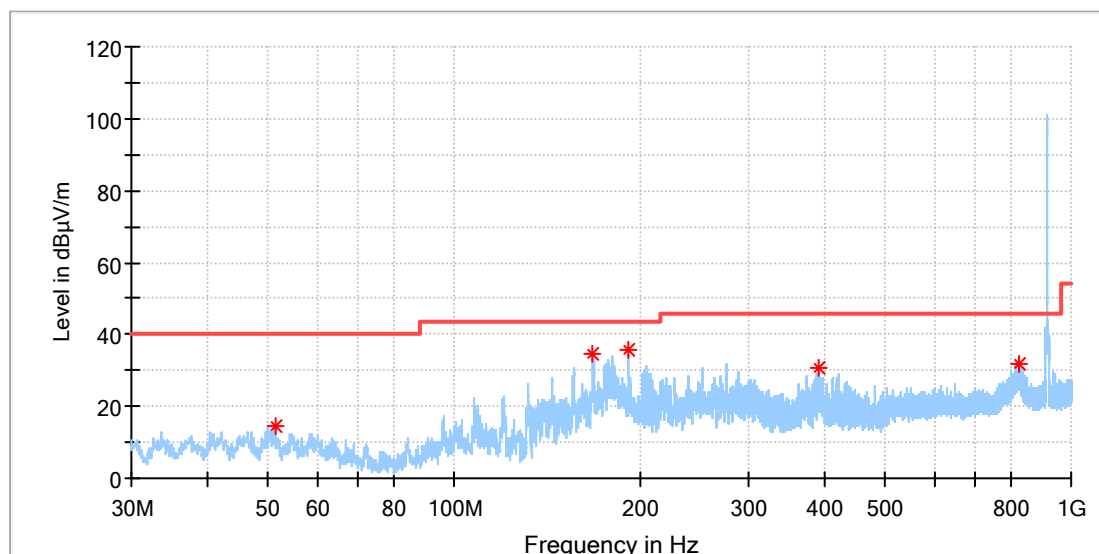
Note 1: Testing was carried out within frequency range 9 kHz to the tenth harmonics. The measurement results below 30MHz and above 18GHz were greater than 20dB below the limit, so only the radiated spurious emissions from 30MHz to 18GHz were reported.

Appendix B.7: Test Results of Radiated Spurious Emissions

Lora DTS, Antenna Gain: 0.8dBi

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_914.2MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

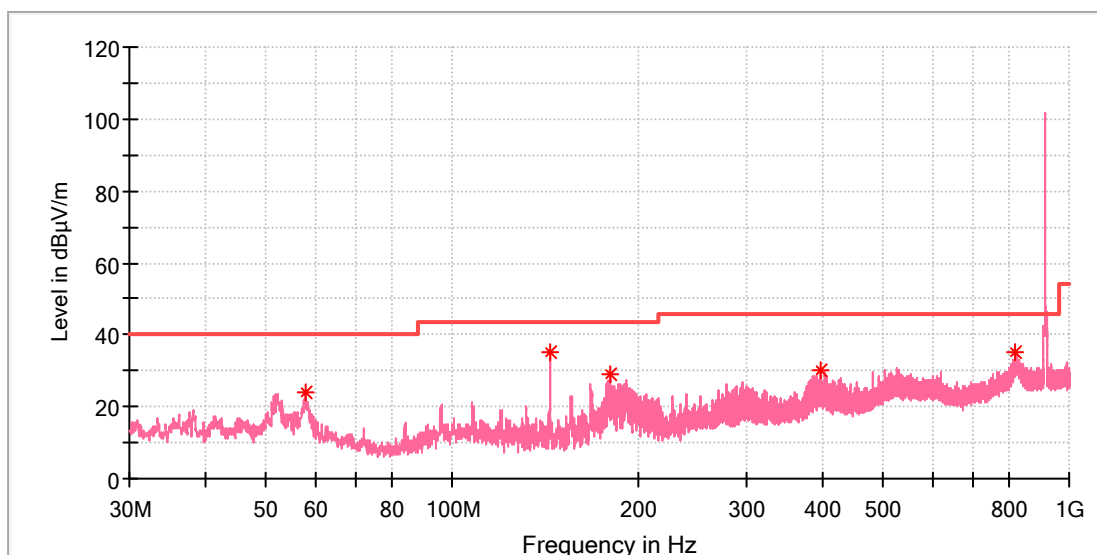


Critical Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
51.228077	14.67	40.00	25.33	100.0	H	29.0	-18.6
168.001154	34.80	43.50	8.70	100.0	H	21.0	-21.7
192.027308	35.58	43.50	7.92	100.0	H	38.0	-19.7
389.981923	30.97	46.00	15.03	100.0	H	247.0	-14.3
822.005000	31.80	46.00	14.20	100.0	H	353.0	-6.3

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_914.2MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

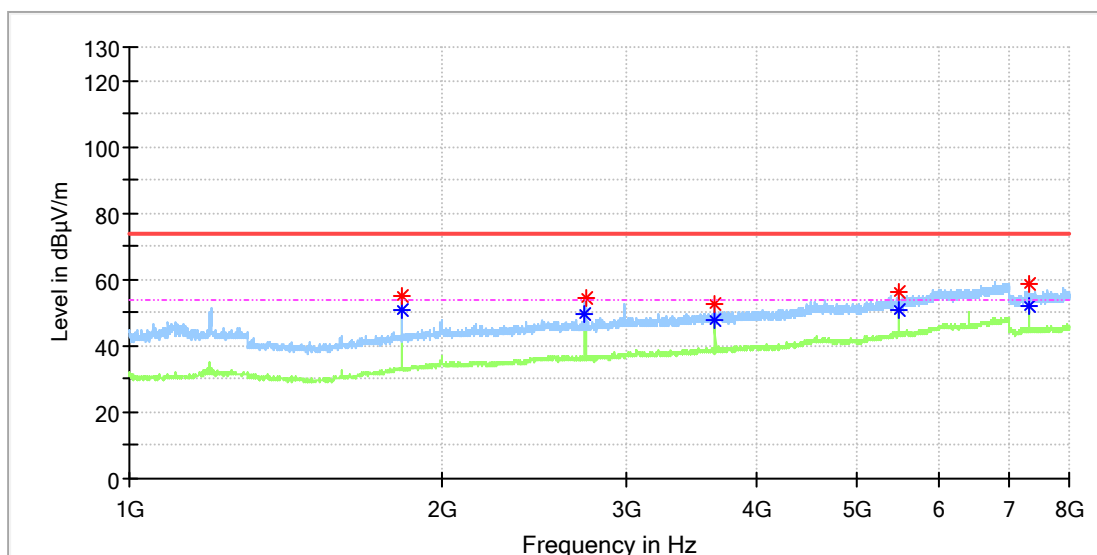


Critical Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
57.742000	23.91	40.00	16.09	100.0	V	207.0	-18.7
144.023500	35.01	43.50	8.49	100.0	V	146.0	-22.2
180.010500	29.03	43.50	14.47	100.0	V	80.0	-20.5
395.302000	30.42	46.00	15.58	100.0	V	47.0	-13.7
817.155000	35.21	46.00	10.79	100.0	V	264.0	-6.0

EUT Information

EUT Name: WisDuo LPWAN SiP
Model: RAK3272-SiP
Test Mode: Lora DTS 500K_SF8_914.2MHz
Order No/Sample No: 168373838/A003298487-001
Test Voltage:: DC 5V From USB
Remark: Temp 23 Humi:58%
Test Standard: FCC 15.247
Tested By: Kei Zhang
Reviewed By: Terry Yin

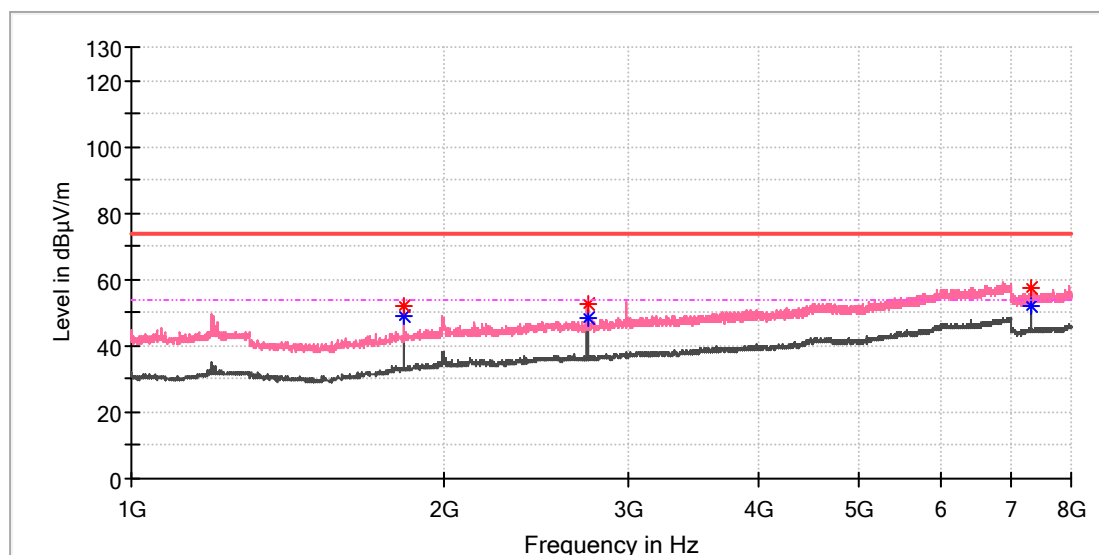


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1827.625000	54.73	---	74.00	19.27	100.0	H	159.0	4.9
1828.462500	---	50.55	54.00	3.45	100.0	H	151.0	4.9
2741.337500	---	49.35	54.00	4.65	100.0	H	54.0	7.8
2742.175000	54.57	---	74.00	19.43	100.0	H	54.0	7.8
3655.887500	---	47.86	54.00	6.14	100.0	H	326.0	9.4
3656.725000	52.43	---	74.00	21.57	100.0	H	318.0	9.4
5485.825000	56.53	---	74.00	17.47	100.0	H	12.0	13.7
5486.662500	---	51.04	54.00	2.96	100.0	H	29.0	13.7
7314.087500	58.60	---	74.00	15.40	100.0	H	1.0	17.9
7314.087500	---	52.24	54.00	1.76	100.0	H	1.0	17.9

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_914.2MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

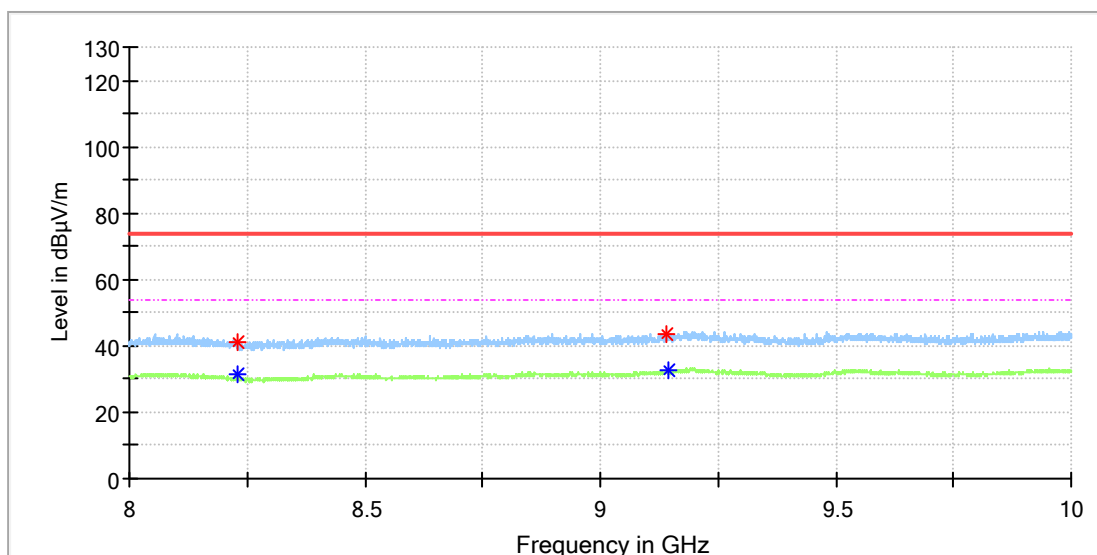


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1828.462500	52.18	---	74.00	21.82	100.0	V	302.0	4.9
1828.462500	---	48.68	54.00	5.32	100.0	V	302.0	4.9
2742.175000	---	48.21	54.00	5.79	100.0	V	249.0	7.8
2743.012500	52.47	---	74.00	21.53	100.0	V	249.0	7.8
7314.925000	57.53	---	74.00	16.47	100.0	V	319.0	17.9
7314.925000	---	51.81	54.00	2.19	100.0	V	319.0	17.9

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_914.2MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

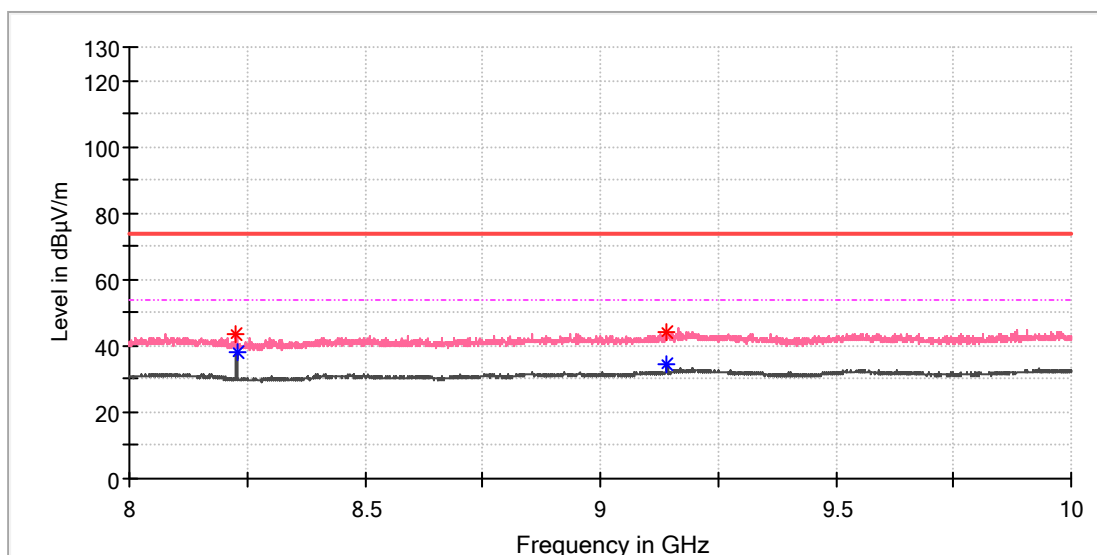


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8228.500000	41.27	---	74.00	32.73	100.0	H	325.0	8.4
8229.500000	---	31.36	54.00	22.64	100.0	H	133.0	8.4
9141.500000	43.70	---	74.00	30.30	100.0	H	181.0	10.0
9143.000000	---	32.50	54.00	21.50	100.0	H	0.0	10.1

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_914.2MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



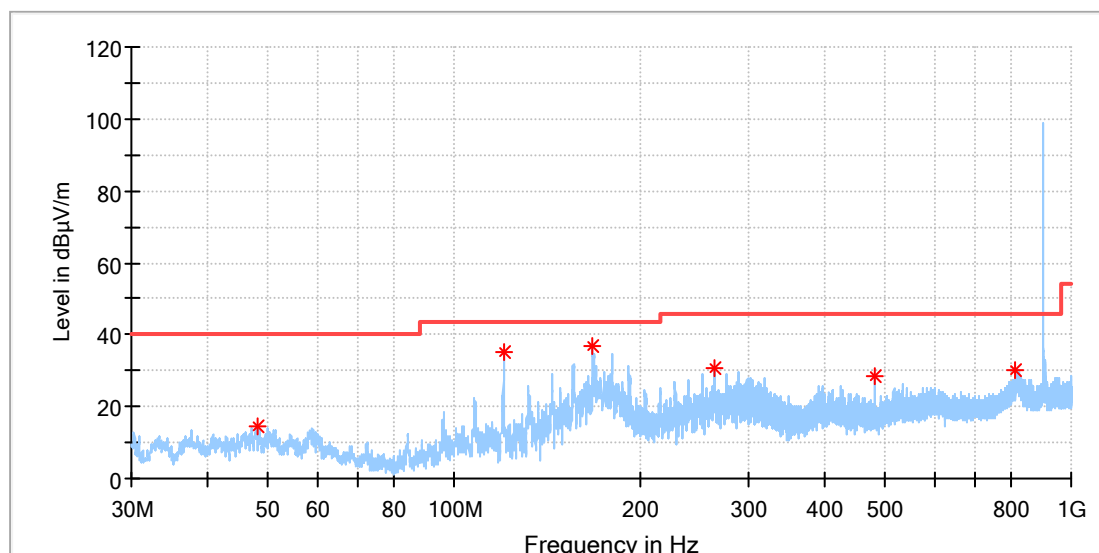
Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8226.500000	43.83	---	74.00	30.17	100.0	V	212.0	8.4
8229.500000	---	38.18	54.00	15.82	100.0	V	285.0	8.4
9141.000000	---	34.49	54.00	19.51	100.0	V	167.0	10.0
9142.000000	43.92	---	74.00	30.08	100.0	V	167.0	10.0

Lora FHSS SF7, Antenna Gain: 0.8dBi

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	FHSS 125k SF7_902.3MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

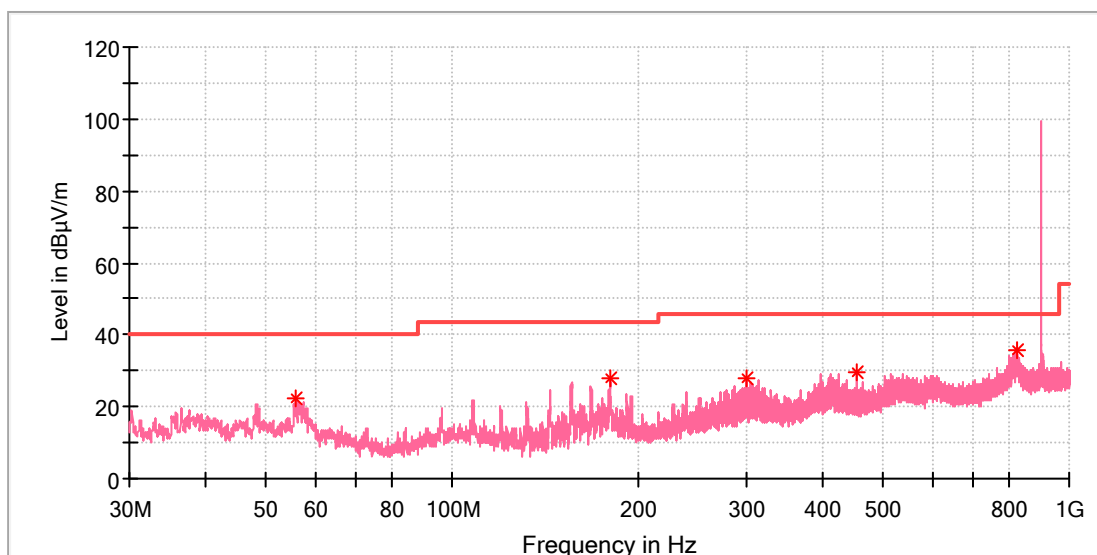


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
48.131539	14.67	40.00	25.33	100.0	H	29.0	-18.7
120.210000	35.09	43.50	8.41	100.0	H	85.0	-21.1
168.001154	37.07	43.50	6.43	100.0	H	312.0	-21.7
264.068462	30.58	46.00	15.42	100.0	H	143.0	-17.4
480.005385	28.61	46.00	17.39	100.0	H	215.0	-12.6
810.850000	30.36	46.00	15.64	100.0	H	346.0	-6.6

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	FHSS 125k SF7_902.3MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

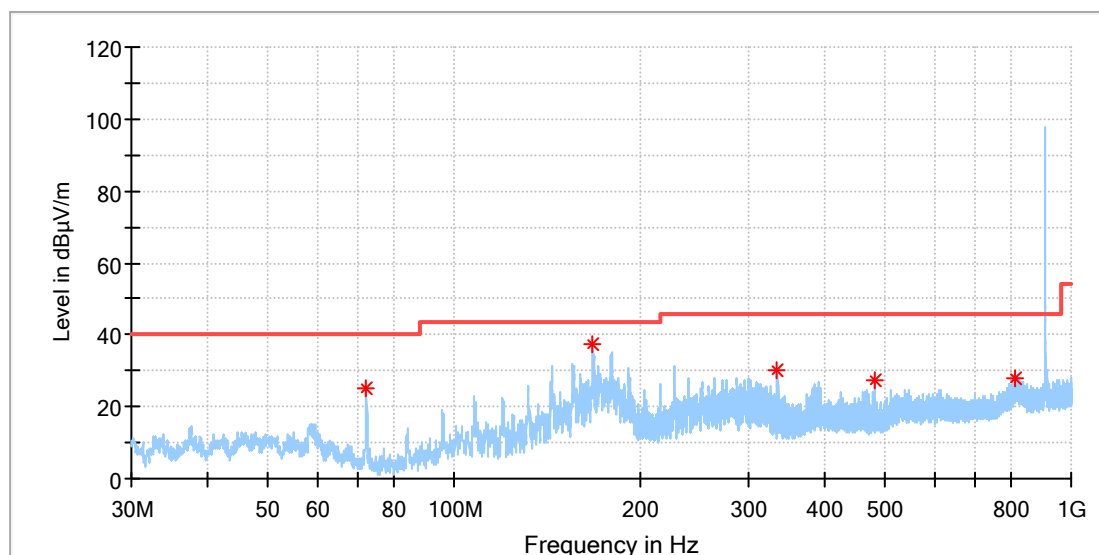


Critical Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
55.850500	22.50	40.00	17.50	100.0	V	230.0	-18.5
179.962000	28.14	43.50	15.36	100.0	V	224.0	-20.5
300.145000	28.02	46.00	17.98	100.0	V	250.0	-16.3
451.659000	29.57	46.00	16.43	100.0	V	117.0	-12.9
822.829500	35.57	46.00	10.43	100.0	V	109.0	-5.9

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	FHSS 125k SF7_908.5MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

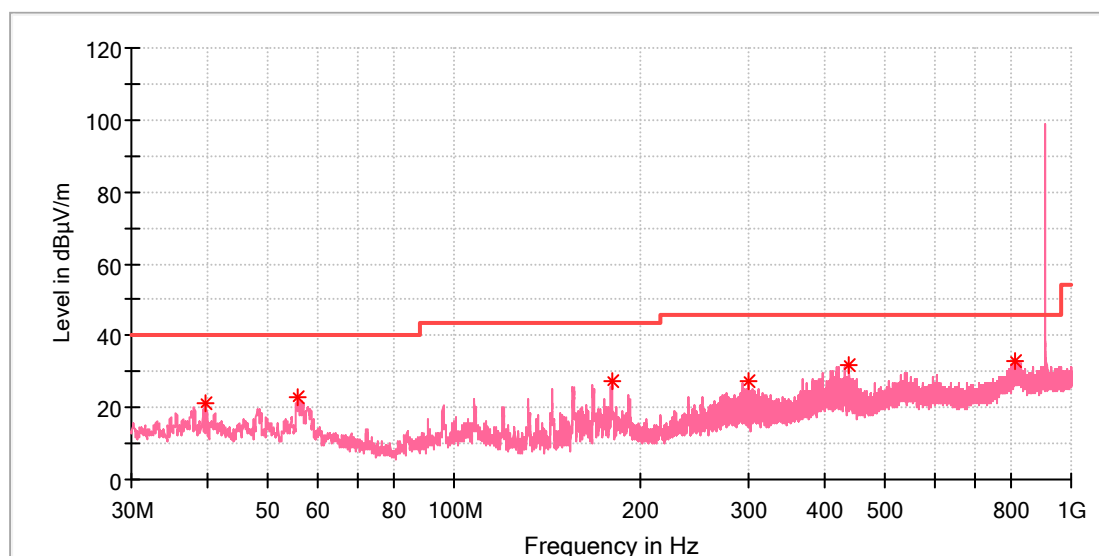


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
72.120385	25.36	40.00	14.64	100.0	H	345.0	-22.8
168.001154	37.56	43.50	5.94	100.0	H	160.0	-21.7
334.356154	30.25	46.00	15.75	100.0	H	160.0	-15.6
480.005385	27.16	46.00	18.84	100.0	H	217.0	-12.6
813.200385	28.16	46.00	17.84	100.0	H	336.0	-6.5

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	FHSS 125k SF7_908.5MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

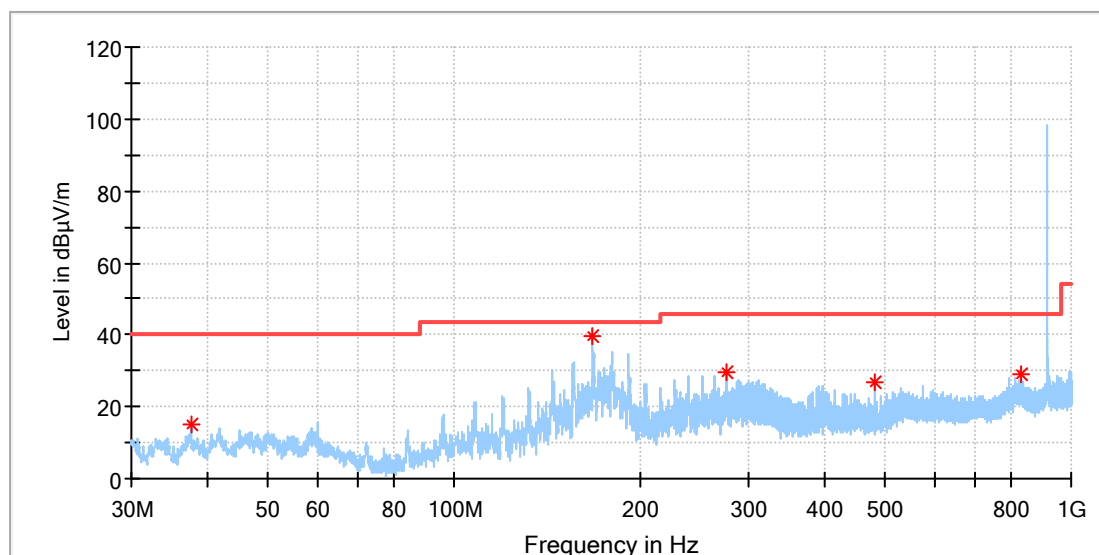


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
39.603000	21.31	40.00	18.69	100.0	V	147.0	-20.2
55.850500	22.73	40.00	17.27	100.0	V	0.0	-18.5
180.156000	27.33	43.50	16.17	100.0	V	212.0	-20.5
300.290500	27.56	46.00	18.44	100.0	V	173.0	-16.3
437.594000	31.76	46.00	14.24	100.0	V	44.0	-13.2
808.134000	32.89	46.00	13.11	100.0	V	100.0	-6.2

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	FHSS 125k SF7_914.9MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

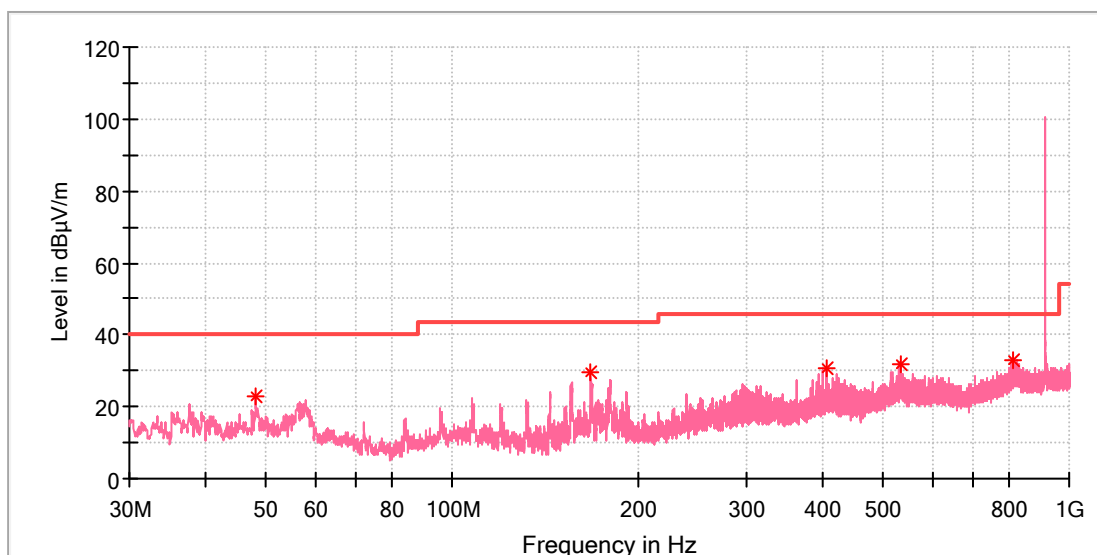


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.498846	15.01	40.00	24.99	100.0	H	177.0	-21.2
168.001154	39.51	43.50	3.99	100.0	H	289.0	-21.7
276.118846	29.73	46.00	16.27	100.0	H	139.0	-17.1
480.005385	26.61	46.00	19.39	100.0	H	259.0	-12.6
829.876923	28.94	46.00	17.06	100.0	H	250.0	-6.2

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	FHSS 125k SF7_914.9MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

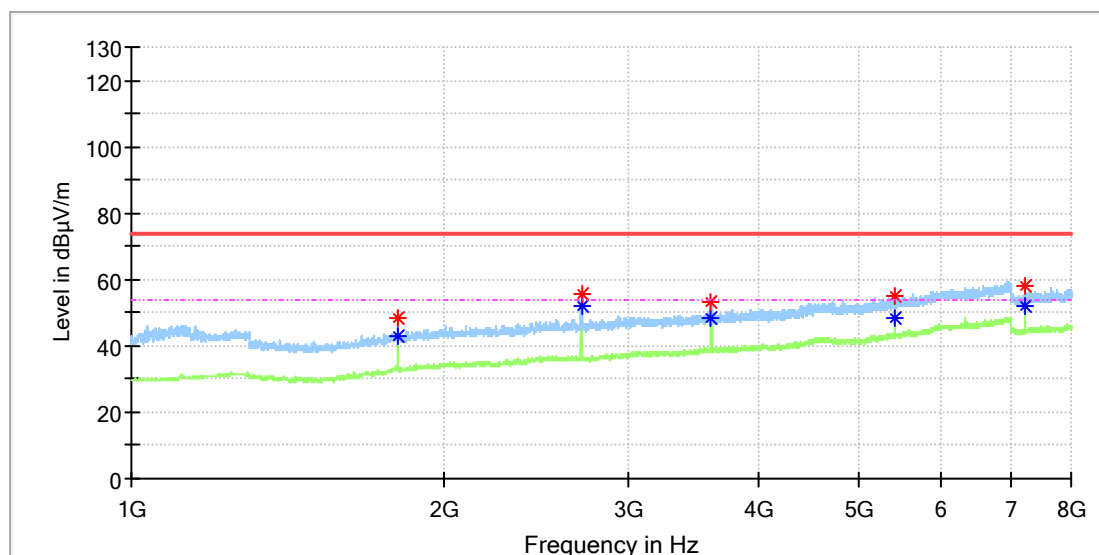


Critical Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
47.993500	22.85	40.00	17.15	100.0	V	166.0	-18.4
168.031000	29.71	43.50	13.79	100.0	V	207.0	-21.3
404.662500	30.95	46.00	15.05	100.0	V	286.0	-13.6
532.169000	31.69	46.00	14.31	100.0	V	100.0	-11.3
809.201000	33.03	46.00	12.97	100.0	V	106.0	-6.2

EUT Information

EUT Name: WisDuo LPWAN SiP
Model: RAK3272-SiP
Test Mode: FHSS 125k SF7_902.3MHz
Order No/Sample No: 168373838/A003298487-001
Test Voltage:: DC 5V From USB
Remark: Temp 23 Humi:58%
Test Standard: FCC 15.247
Tested By: Kei Zhang
Reviewed By: Terry Yin

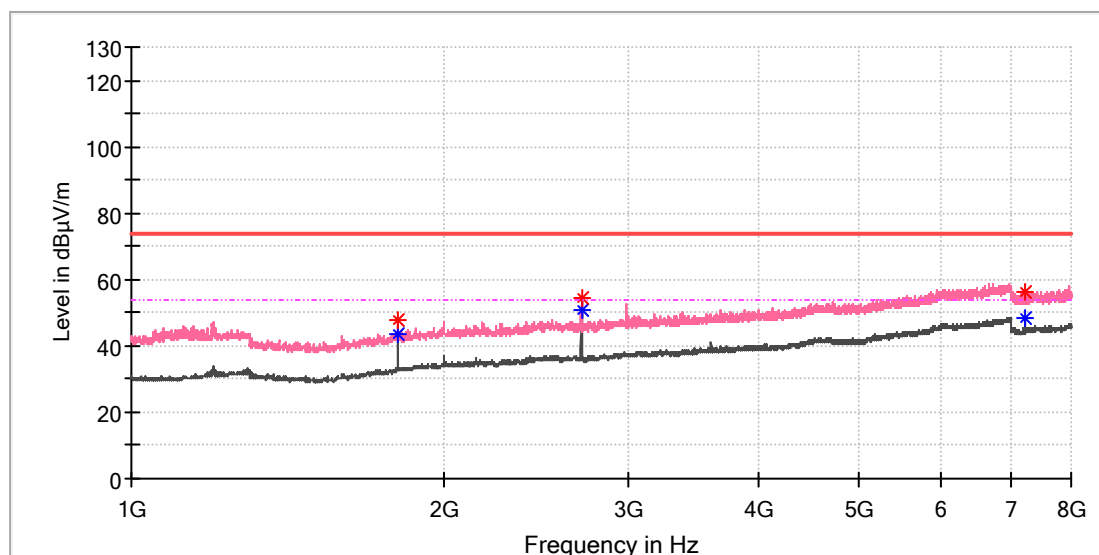


Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1804.175000	48.27	---	74.00	25.73	100.0	H	231.0	4.7
1804.175000	---	43.10	54.00	10.90	100.0	H	231.0	4.7
2707.000000	55.91	---	74.00	18.09	100.0	H	131.0	7.6
2707.000000	---	52.05	54.00	1.95	100.0	H	131.0	7.6
3608.987500	53.19	---	74.00	20.81	100.0	H	52.0	9.4
3608.987500	---	48.36	54.00	5.64	100.0	H	52.0	9.4
5413.800000	---	48.58	54.00	5.42	100.0	H	123.0	13.5
5414.637500	54.74	---	74.00	19.26	100.0	H	93.0	13.5
7219.450000	57.79	---	74.00	16.21	100.0	H	112.0	17.9
7219.450000	---	51.88	54.00	2.12	100.0	H	112.0	17.9

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	FHSS 125k SF7_902.3MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

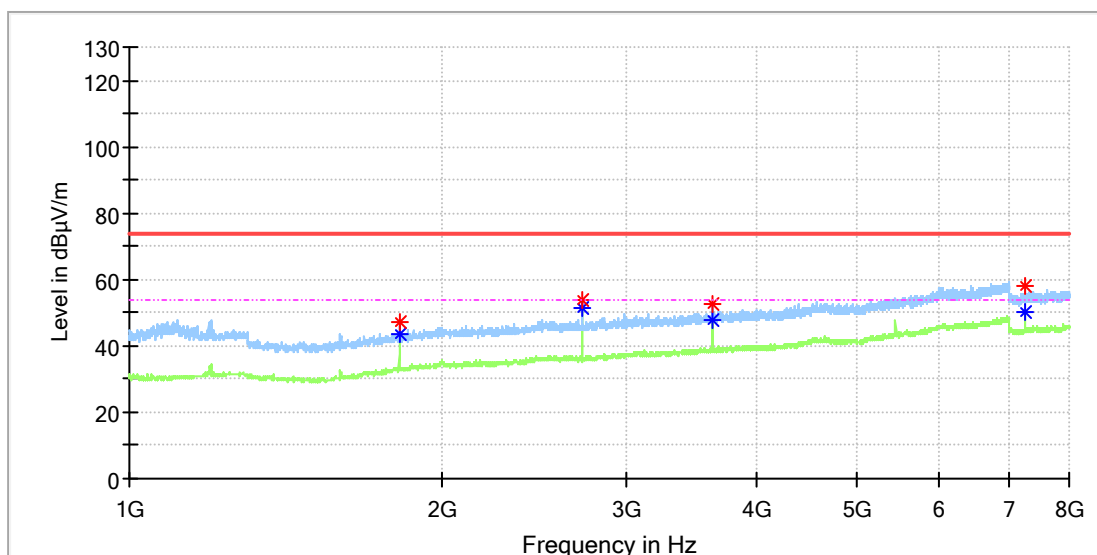


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1804.175000	---	43.83	54.00	10.17	100.0	V	215.0	4.7
1804.175000	48.00	---	74.00	26.00	100.0	V	215.0	4.7
2707.000000	54.30	---	74.00	19.70	100.0	V	153.0	7.6
2707.000000	---	50.57	54.00	3.43	100.0	V	153.0	7.6
7218.612500	56.09	---	74.00	17.91	100.0	V	55.0	17.9
7218.612500	---	48.08	54.00	5.92	100.0	V	55.0	17.9

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	FHSS 125k SF7_908.5MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

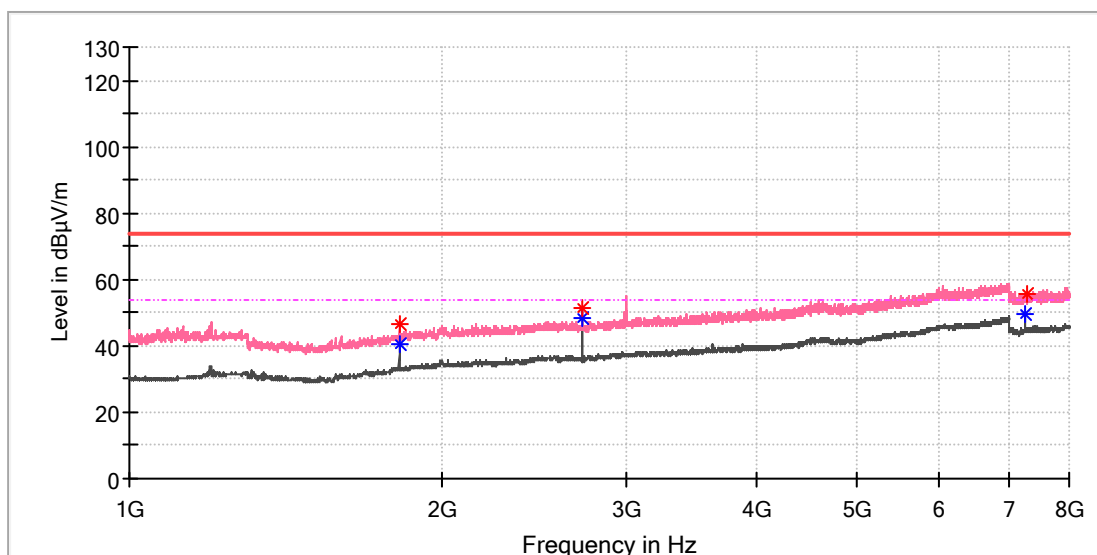


Critical Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1816.737500	46.87	---	74.00	27.13	100.0	H	236.0	4.8
1816.737500	---	43.35	54.00	10.65	100.0	H	236.0	4.8
2725.425000	---	51.39	54.00	2.61	100.0	H	130.0	7.7
2725.425000	53.86	---	74.00	20.14	100.0	H	130.0	7.7
3634.112500	---	47.85	54.00	6.15	100.0	H	54.0	9.4
3634.112500	52.82	---	74.00	21.18	100.0	H	54.0	9.4
7268.025000	58.08	---	74.00	15.92	100.0	H	111.0	17.9
7268.025000	---	50.47	54.00	3.53	100.0	H	111.0	17.9

EUT Information

EUT Name: WisDuo LPWAN SiP
Model: RAK3272-SiP
Test Mode: FHSS 125k SF7_908.5MHz
Order No/Sample No: 168373838/A003298487-001
Test Voltage:: DC 5V From USB
Remark: Temp 23 Humi:58%
Test Standard: FCC 15.247
Tested By: Kei Zhang
Reviewed By: Terry Yin

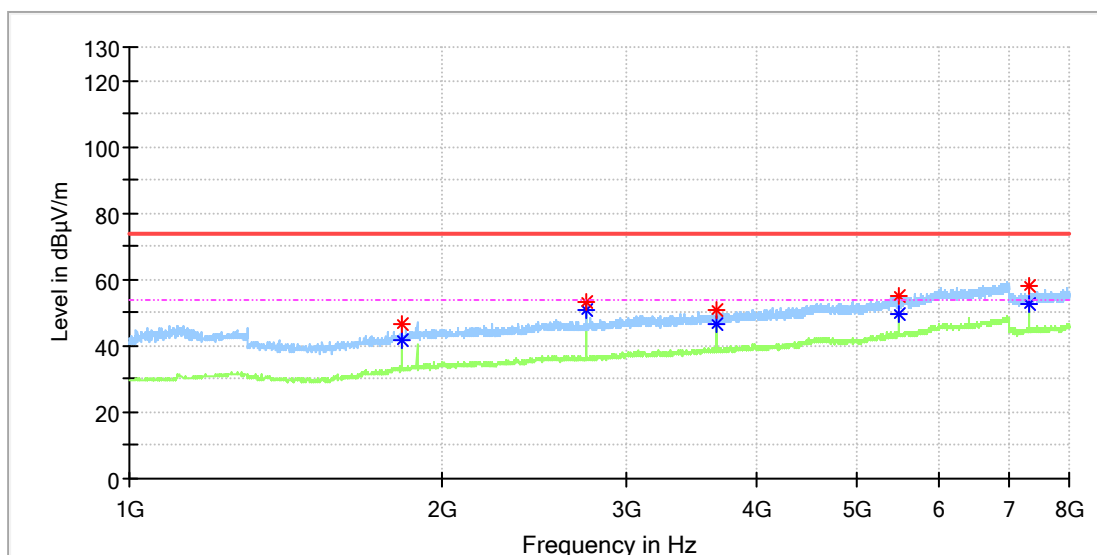


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1816.737500	46.34	---	74.00	27.66	100.0	V	100.0	4.8
1816.737500	---	40.73	54.00	13.27	100.0	V	100.0	4.8
2725.425000	51.56	---	74.00	22.44	100.0	V	126.0	7.7
2725.425000	---	48.65	54.00	5.35	100.0	V	126.0	7.7
7268.862500	---	49.32	54.00	4.68	100.0	V	36.0	17.9
7288.125000	55.91	---	74.00	18.09	100.0	V	207.0	17.9

EUT Information

EUT Name: WisDuo LPWAN SiP
Model: RAK3272-SiP
Test Mode: FHSS 125k SF7_914.9MHz
Order No/Sample No: 168373838/A003298487-001
Test Voltage:: DC 5V From USB
Remark: Temp 23 Humi:58%
Test Standard: FCC 15.247
Tested By: Kei Zhang
Reviewed By: Terry Yin

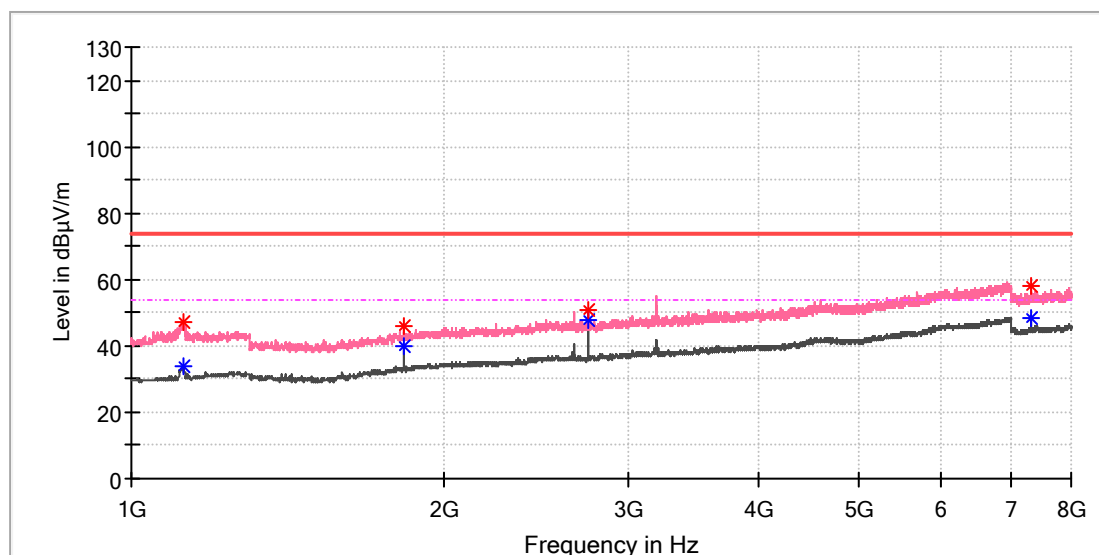


Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1829.300000	46.69	---	74.00	27.31	100.0	H	220.0	4.9
1829.300000	---	41.89	54.00	12.11	100.0	H	220.0	4.9
2744.687500	52.95	---	74.00	21.05	100.0	H	29.0	7.8
2744.687500	---	50.78	54.00	3.22	100.0	H	29.0	7.8
3659.237500	51.05	---	74.00	22.95	100.0	H	64.0	9.4
3659.237500	---	46.69	54.00	7.31	100.0	H	64.0	9.4
5480.800000	55.31	---	74.00	18.69	100.0	H	189.0	13.6
5489.175000	---	49.34	54.00	4.66	100.0	H	126.0	13.7
7319.112500	57.89	---	74.00	16.11	100.0	H	117.0	17.9
7319.950000	---	52.46	54.00	1.54	100.0	H	126.0	17.9

EUT Information

EUT Name: WisDuo LPWAN SiP
Model: RAK3272-SiP
Test Mode: FHSS 125k SF7_914.9MHz
Order No/Sample No: 168373838/A003298487-001
Test Voltage:: DC 5V From USB
Remark: Temp 23 Humi:58%
Test Standard: FCC 15.247
Tested By: Kei Zhang
Reviewed By: Terry Yin

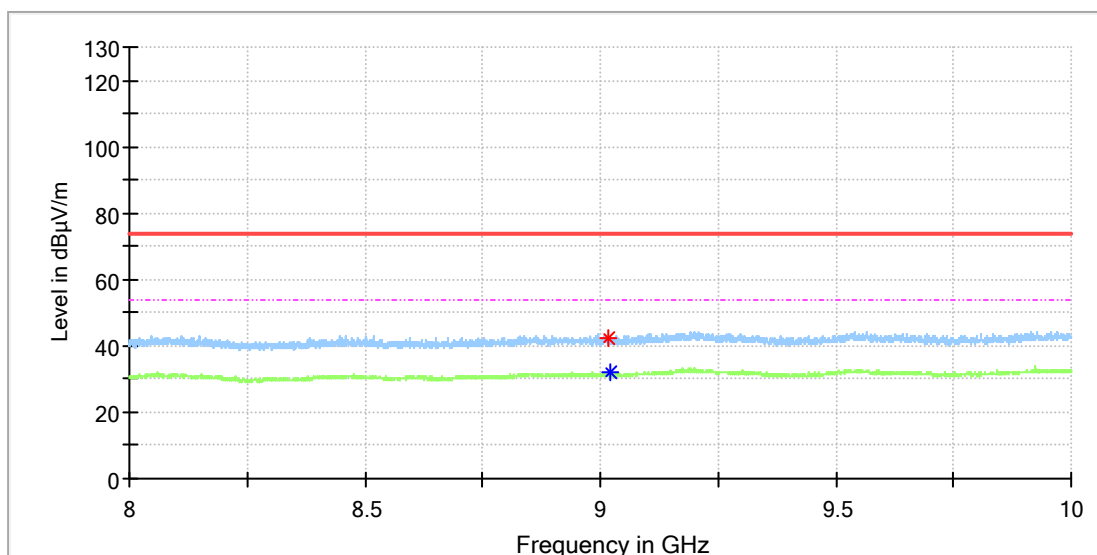


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1122.500000	47.43	---	74.00	26.57	100.0	V	281.0	0.2
1122.500000	---	33.79	54.00	20.21	100.0	V	281.0	0.2
1829.300000	45.85	---	74.00	28.15	100.0	V	1.0	4.9
1829.300000	---	40.00	54.00	14.00	100.0	V	1.0	4.9
2744.687500	51.06	---	74.00	22.94	100.0	V	160.0	7.8
2744.687500	---	48.05	54.00	5.95	100.0	V	160.0	7.8
7319.112500	57.80	---	74.00	16.20	100.0	V	47.0	17.9
7319.112500	---	48.56	54.00	5.44	100.0	V	47.0	17.9

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	FHSS 125k SF7_902.3MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

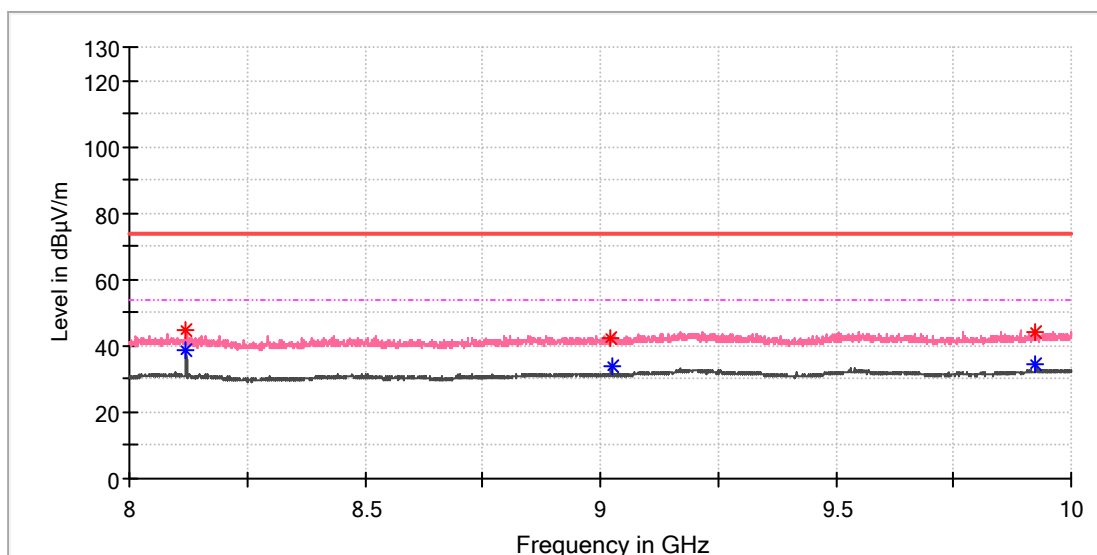


Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9019.000000	42.55	---	74.00	31.45	100.0	H	188.0	8.8
9022.500000	---	31.84	54.00	22.16	100.0	H	161.0	8.9

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	FHSS 125k SF7_902.3MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

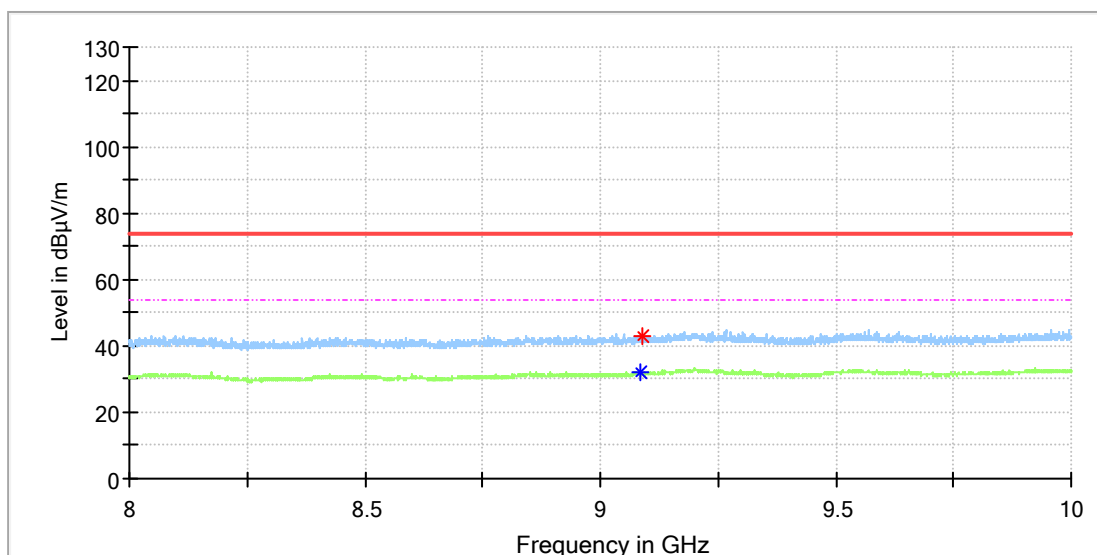


Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8120.500000	45.03	---	74.00	28.97	100.0	V	289.0	8.6
8121.000000	---	38.88	54.00	15.12	100.0	V	289.0	8.6
9022.000000	42.12	---	74.00	31.88	100.0	V	300.0	8.9
9023.500000	---	33.60	54.00	20.40	100.0	V	339.0	8.9
9925.000000	44.37	---	74.00	29.63	100.0	V	152.0	10.4
9925.000000	---	34.38	54.00	19.62	100.0	V	152.0	10.4

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	FHSS 125k SF7_908.5MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

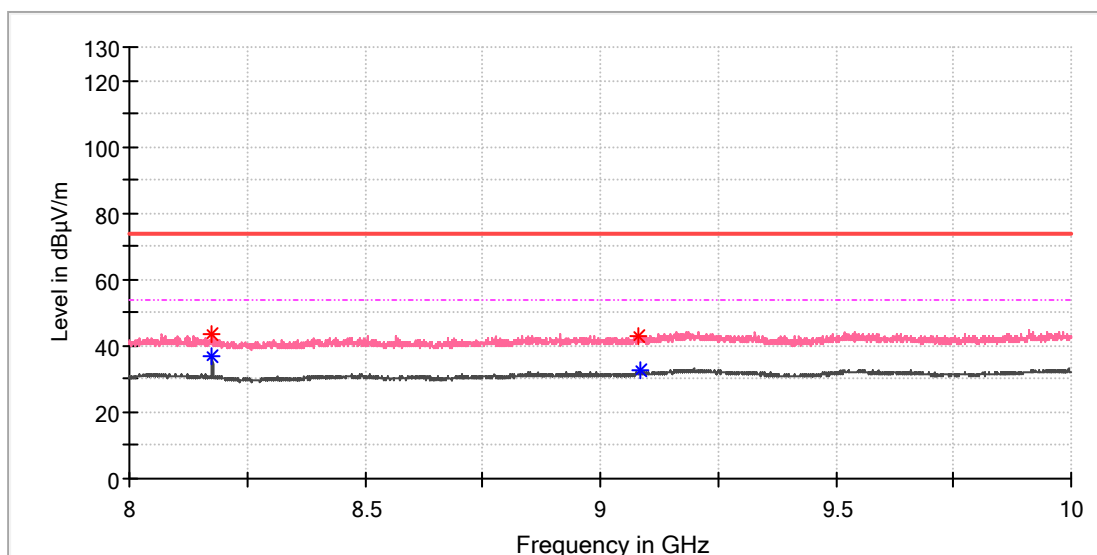


Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9086.000000	---	31.95	54.00	22.05	100.0	H	8.0	9.5
9089.500000	43.16	---	74.00	30.84	100.0	H	316.0	9.6

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	FHSS 125k SF7_908.5MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

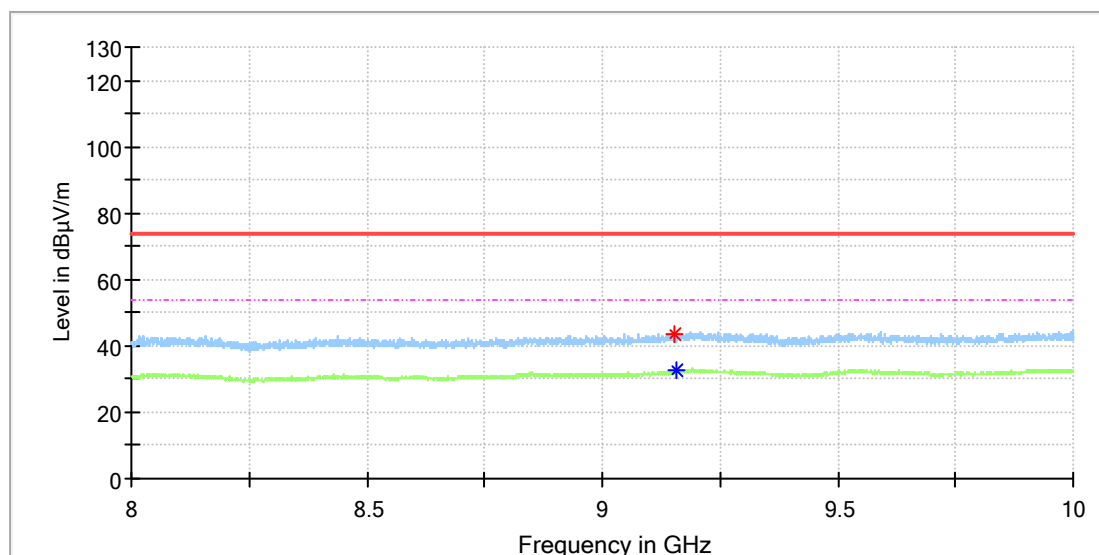


Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8175.500000	43.42	---	74.00	30.58	100.0	V	30.0	8.5
8176.000000	---	36.85	54.00	17.15	100.0	V	30.0	8.5
9079.000000	42.96	---	74.00	31.04	100.0	V	62.0	9.4
9085.500000	---	32.64	54.00	21.36	100.0	V	3.0	9.5

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	FHSS 125k SF7_914.9MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

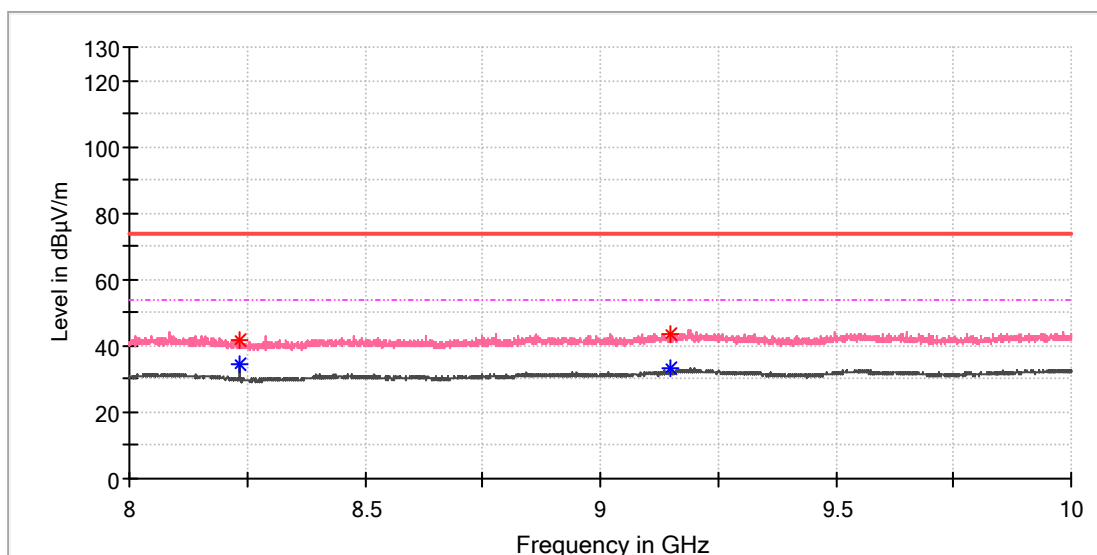


Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9153.500000	43.66	---	74.00	30.34	100.0	H	356.0	10.1
9159.500000	---	32.70	54.00	21.30	100.0	H	222.0	10.1

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	FHSS 125k SF7_914.9MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



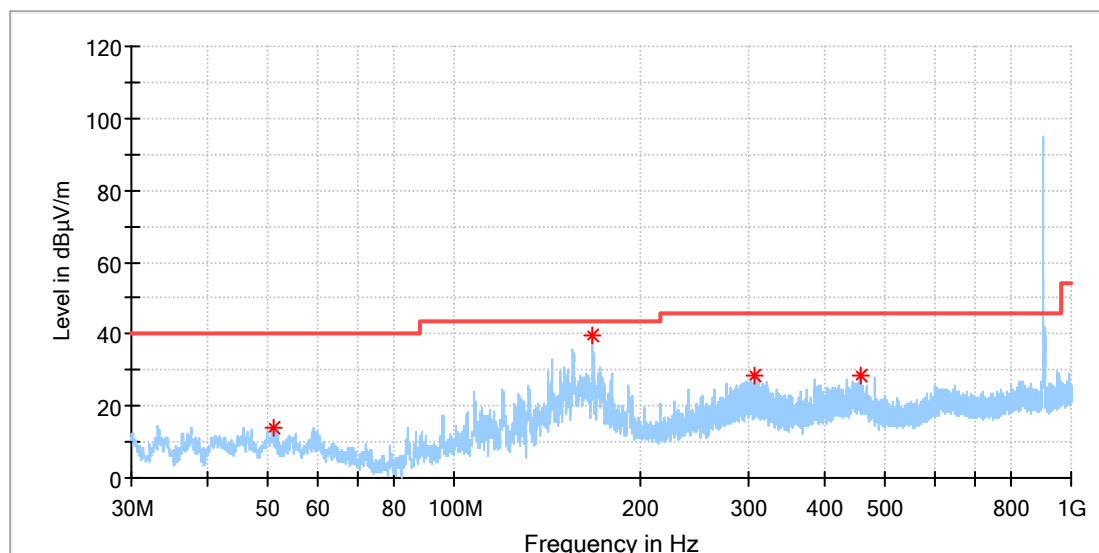
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8234.000000	41.61	---	74.00	32.39	100.0	V	32.0	8.4
8234.000000	---	34.64	54.00	19.36	100.0	V	32.0	8.4
9148.500000	43.61	---	74.00	30.39	100.0	V	0.0	10.1
9148.500000	---	33.09	54.00	20.91	100.0	V	0.0	10.1

Lora DTS, Antenna Gain: 2.3dBi

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_903MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

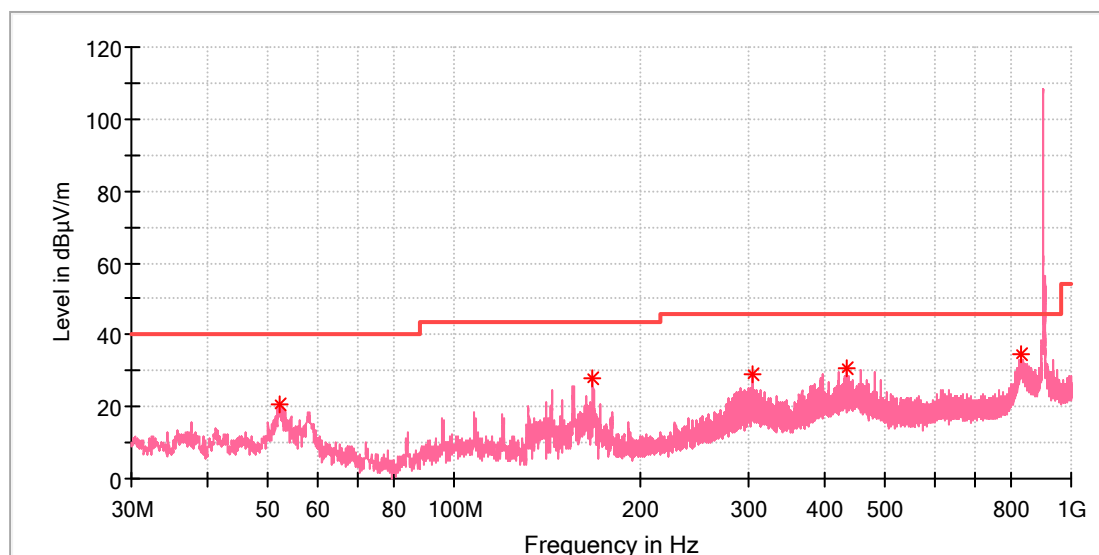


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
51.116154	13.89	40.00	26.11	100.0	H	285.0	-18.6
168.001154	39.37	43.50	4.13	100.0	H	122.0	-21.7
307.457308	28.19	46.00	17.81	100.0	H	189.0	-16.4
455.941923	28.21	46.00	17.79	100.0	H	130.0	-13.2

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_903MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

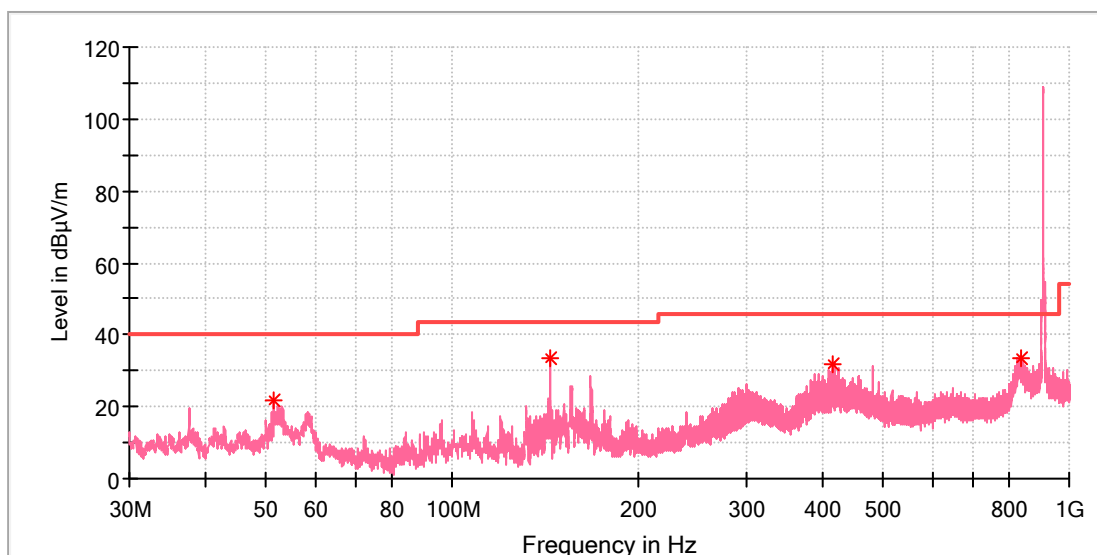


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
52.086154	20.83	40.00	19.17	100.0	V	268.0	-18.6
168.001154	27.94	43.50	15.56	100.0	V	17.0	-21.7
305.032308	29.04	46.00	16.96	100.0	V	114.0	-16.5
431.990385	30.64	46.00	15.36	100.0	V	24.0	-13.6
829.205385	34.44	46.00	11.56	100.0	V	2.0	-6.2

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_907.8MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

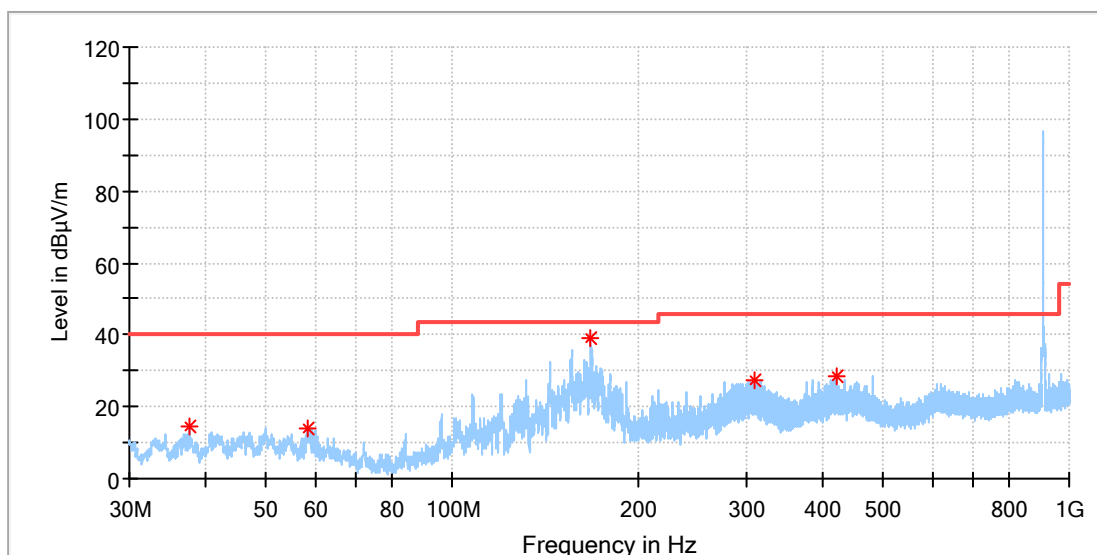


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
51.377308	21.94	40.00	18.06	100.0	V	229.0	-18.6
143.975000	33.62	43.50	9.88	100.0	V	38.0	-22.6
414.978077	31.79	46.00	14.21	100.0	V	0.0	-13.8
838.308462	33.62	46.00	12.38	100.0	V	0.0	-6.1

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_907.8MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

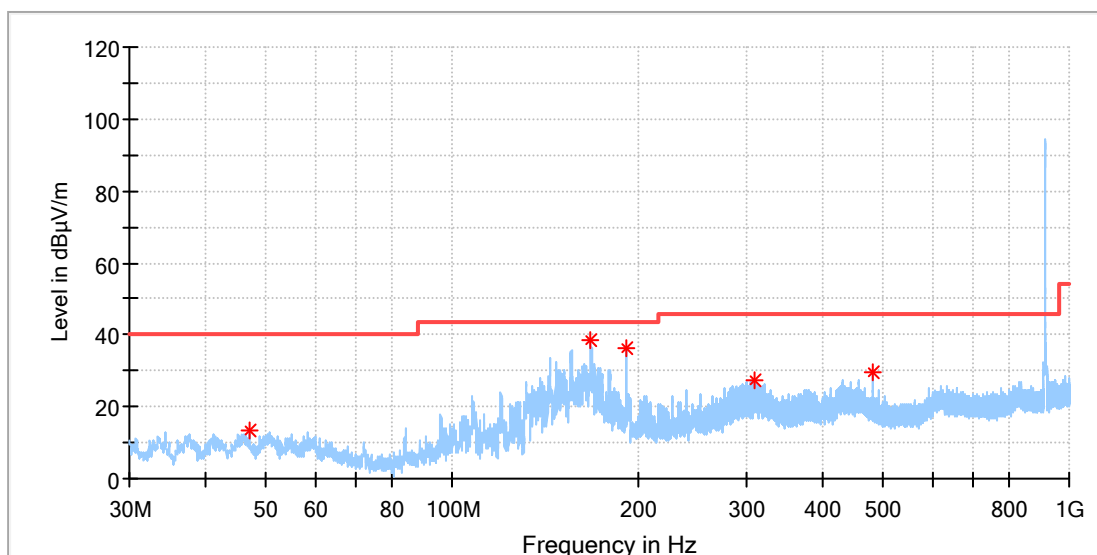


Critical Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.498846	14.48	40.00	25.52	100.0	H	72.0	-21.2
58.241923	14.11	40.00	25.89	100.0	H	231.0	-19.1
167.963846	39.01	43.50	4.49	100.0	H	119.0	-21.7
309.845000	27.51	46.00	18.49	100.0	H	167.0	-16.4
419.977308	28.24	46.00	17.76	100.0	H	111.0	-13.7

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_914.2MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

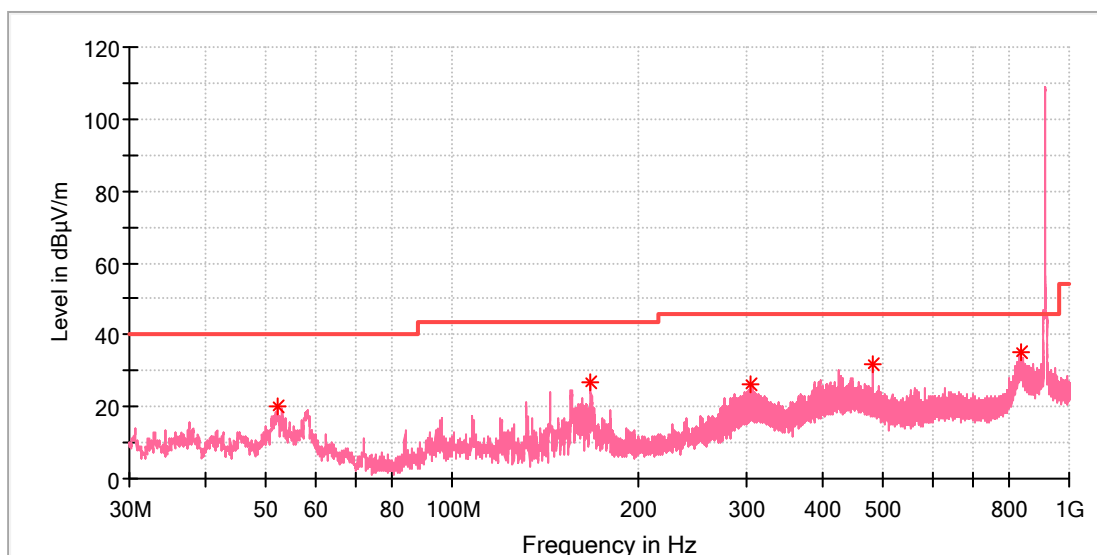


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
46.863077	13.53	40.00	26.47	100.0	H	252.0	-18.9
168.001154	38.58	43.50	4.92	100.0	H	291.0	-21.7
191.990000	36.16	43.50	7.34	100.0	H	245.0	-19.7
309.919615	27.57	46.00	18.43	100.0	H	156.0	-16.4
480.005385	29.70	46.00	16.30	100.0	H	260.0	-12.6

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_914.2MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

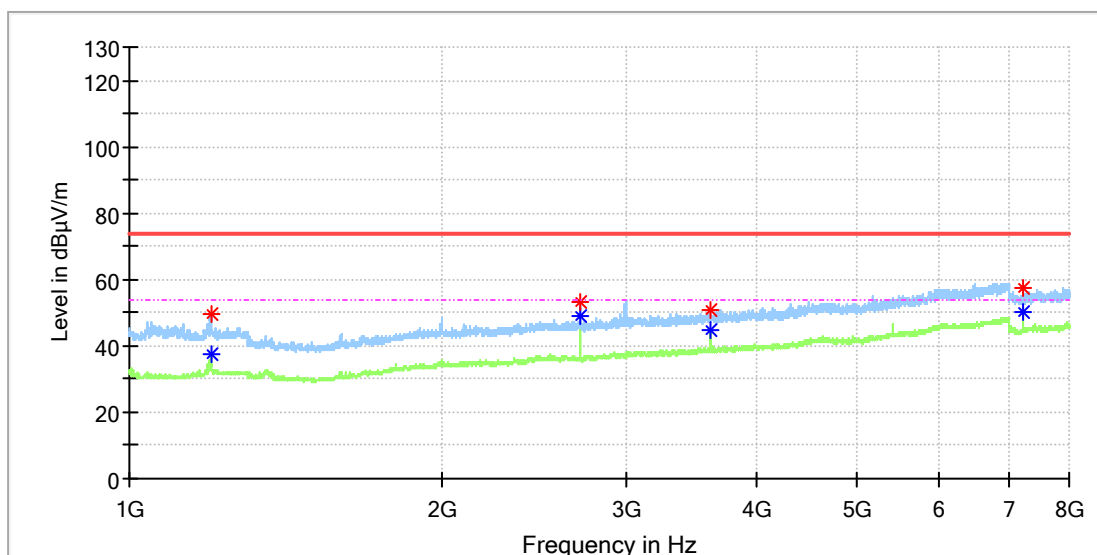


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
52.123462	20.08	40.00	19.92	100.0	V	0.0	-18.6
167.963846	26.72	43.50	16.78	100.0	V	21.0	-21.7
303.875769	26.14	46.00	19.86	100.0	V	209.0	-16.5
480.005385	31.65	46.00	14.35	100.0	V	209.0	-12.6
834.391154	35.09	46.00	10.91	100.0	V	6.0	-6.1

EUT Information

EUT Name: WisDuo LPWAN SiP
Model: RAK3272-SiP
Test Mode: Lora DTS 500K_SF8_903MHz
Order No/Sample No: 168373838/A003298487-001
Test Voltage:: DC 5V From USB
Remark: Temp 23 Humi:58%
Test Standard: FCC 15.247
Tested By: Kei Zhang
Reviewed By: Terry Yin

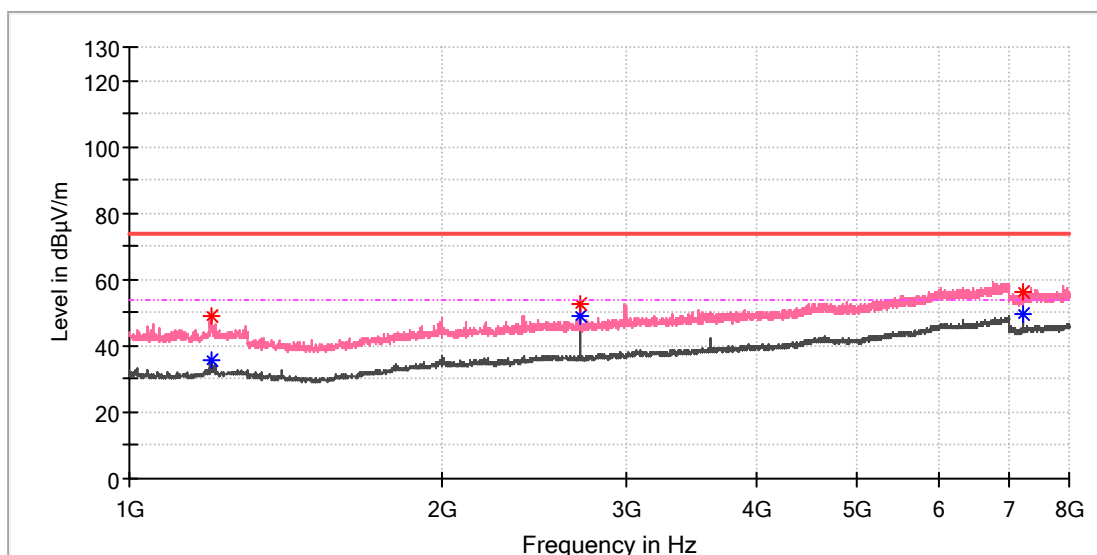


Critical Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1197.500000	---	37.72	54.00	16.28	100.0	H	298.0	1.1
1200.000000	49.57	---	74.00	24.43	100.0	H	336.0	1.1
2708.675000	53.06	---	74.00	20.94	100.0	H	20.0	7.6
2708.675000	---	48.73	54.00	5.27	100.0	H	20.0	7.6
3612.337500	50.68	---	74.00	23.32	100.0	H	64.0	9.4
3612.337500	---	44.60	54.00	9.40	100.0	H	64.0	9.4
7224.475000	---	50.13	54.00	3.87	100.0	H	73.0	17.9
7226.150000	57.47	---	74.00	16.53	100.0	H	91.0	17.9

EUT Information

EUT Name: WisDuo LPWAN SiP
Model: RAK3272-SiP
Test Mode: Lora DTS 500K_SF8_903MHz
Order No/Sample No: 168373838/A003298487-001
Test Voltage:: DC 5V From USB
Remark: Temp 23 Humi:58%
Test Standard: FCC 15.247
Tested By: Kei Zhang
Reviewed By: Terry Yin

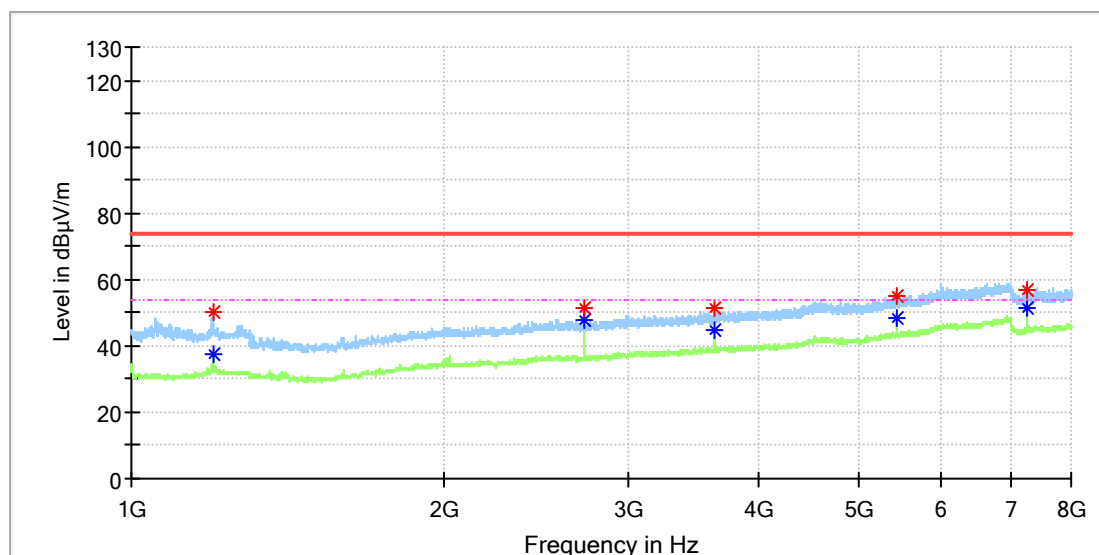


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1197.000000	---	35.67	54.00	18.33	100.0	V	72.0	1.1
1199.500000	48.73	---	74.00	25.27	100.0	V	275.0	1.1
2709.512500	52.90	---	74.00	21.10	100.0	V	344.0	7.6
2709.512500	---	49.01	54.00	4.99	100.0	V	344.0	7.6
7224.475000	---	49.64	54.00	4.36	100.0	V	165.0	17.9
7226.987500	56.39	---	74.00	17.61	100.0	V	66.0	17.9

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_907.8MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

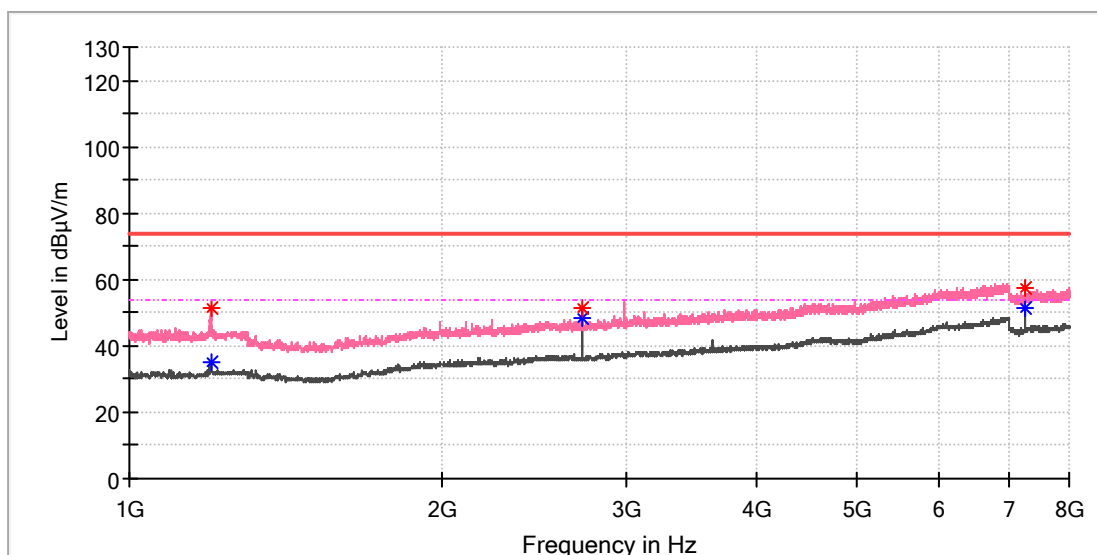


Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1197.500000	50.23	---	74.00	23.77	100.0	H	301.0	1.1
1198.000000	---	37.42	54.00	16.58	100.0	H	338.0	1.1
2722.912500	51.47	---	74.00	22.53	100.0	H	30.0	7.7
2722.912500	---	47.91	54.00	6.09	100.0	H	30.0	7.7
3630.762500	---	44.46	54.00	9.54	100.0	H	54.0	9.4
3632.437500	51.11	---	74.00	22.89	100.0	H	73.0	9.4
5447.300000	54.98	---	74.00	19.02	100.0	H	101.0	13.5
5448.137500	---	48.21	54.00	5.79	100.0	H	101.0	13.5
7264.675000	57.08	---	74.00	16.92	100.0	H	92.0	17.9
7264.675000	---	51.58	54.00	2.42	100.0	H	92.0	17.9

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_907.8MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

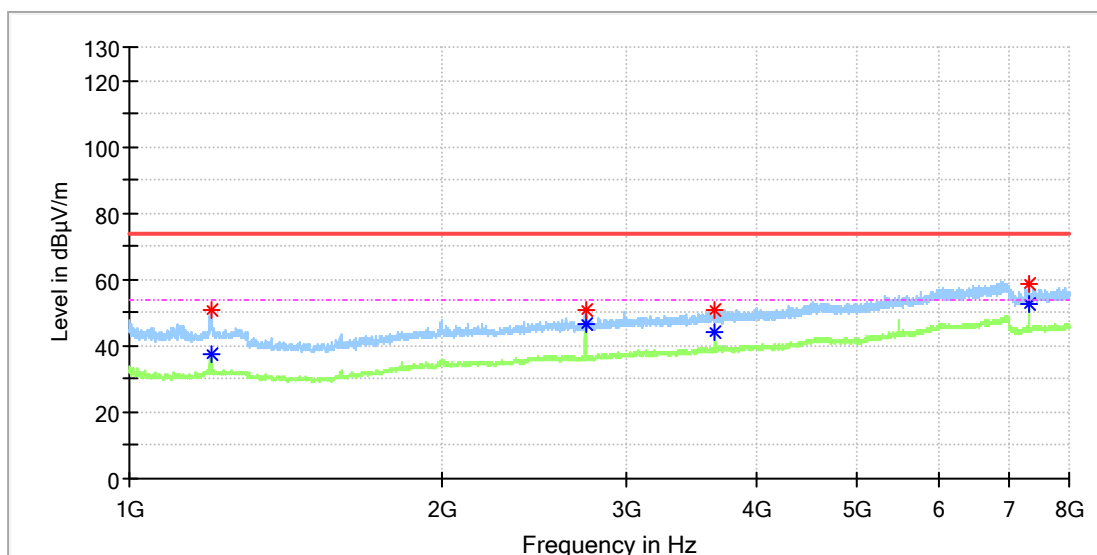


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1197.000000	51.26	---	74.00	22.74	100.0	V	277.0	1.1
1198.500000	---	35.00	54.00	19.00	100.0	V	258.0	1.1
2722.912500	51.41	---	74.00	22.59	100.0	V	343.0	7.7
2722.912500	---	48.12	54.00	5.88	100.0	V	343.0	7.7
7261.325000	57.32	---	74.00	16.68	100.0	V	231.0	17.9
7262.162500	---	51.24	54.00	2.76	100.0	V	241.0	17.9

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_914.2MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

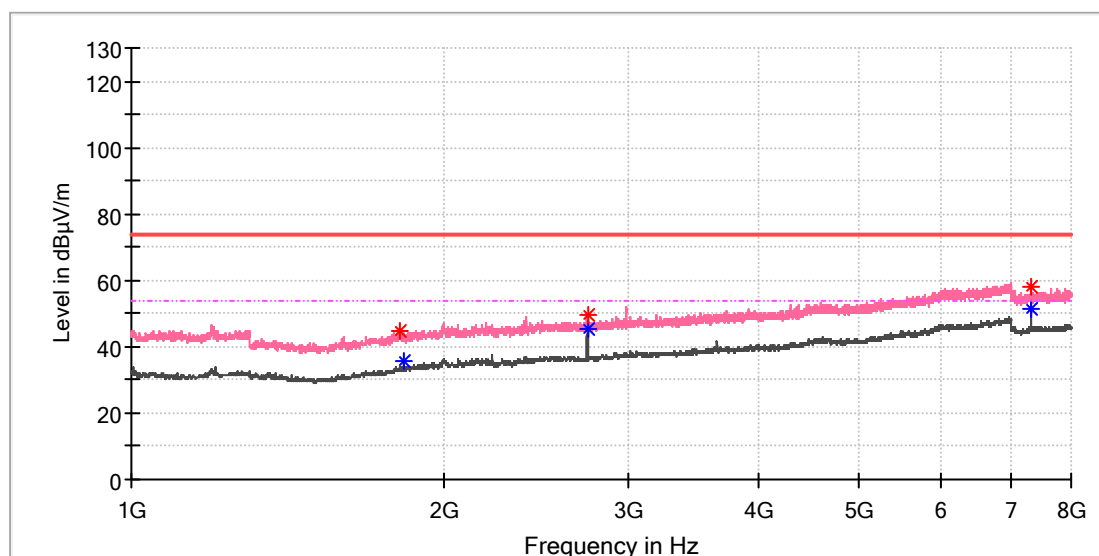


Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1197.000000	---	37.34	54.00	16.66	100.0	H	75.0	1.1
1198.500000	50.76	---	74.00	23.24	100.0	H	344.0	1.1
2742.175000	50.52	---	74.00	23.48	100.0	H	15.0	7.8
2742.175000	---	46.26	54.00	7.74	100.0	H	15.0	7.8
3655.887500	50.89	---	74.00	23.11	100.0	H	64.0	9.4
3657.562500	---	44.06	54.00	9.94	100.0	H	49.0	9.4
7312.412500	58.36	---	74.00	15.64	100.0	H	92.0	17.9
7312.412500	---	52.42	54.00	1.58	100.0	H	92.0	17.9

EUT Information

EUT Name: WisDuo LPWAN SiP
Model: RAK3272-SiP
Test Mode: Lora DTS 500K_SF8_914.2MHz
Order No/Sample No: 168373838/A003298487-001
Test Voltage:: DC 5V From USB
Remark: Temp 23 Humi:58%
Test Standard: FCC 15.247
Tested By: Kei Zhang
Reviewed By: Terry Yin

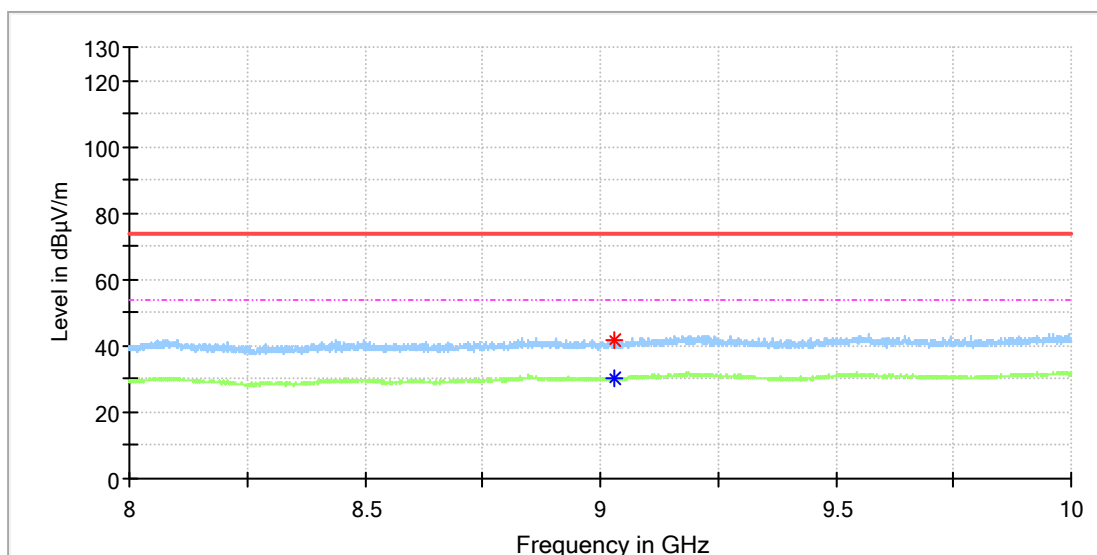


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1812.550000	44.85	---	74.00	29.15	100.0	V	37.0	4.8
1828.462500	---	35.78	54.00	18.22	100.0	V	5.0	4.9
2742.175000	49.86	---	74.00	24.14	100.0	V	1.0	7.8
2743.012500	---	45.21	54.00	8.79	100.0	V	282.0	7.8
7312.412500	57.84	---	74.00	16.16	100.0	V	244.0	17.9
7314.925000	---	51.68	54.00	2.32	100.0	V	235.0	17.9

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_903MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

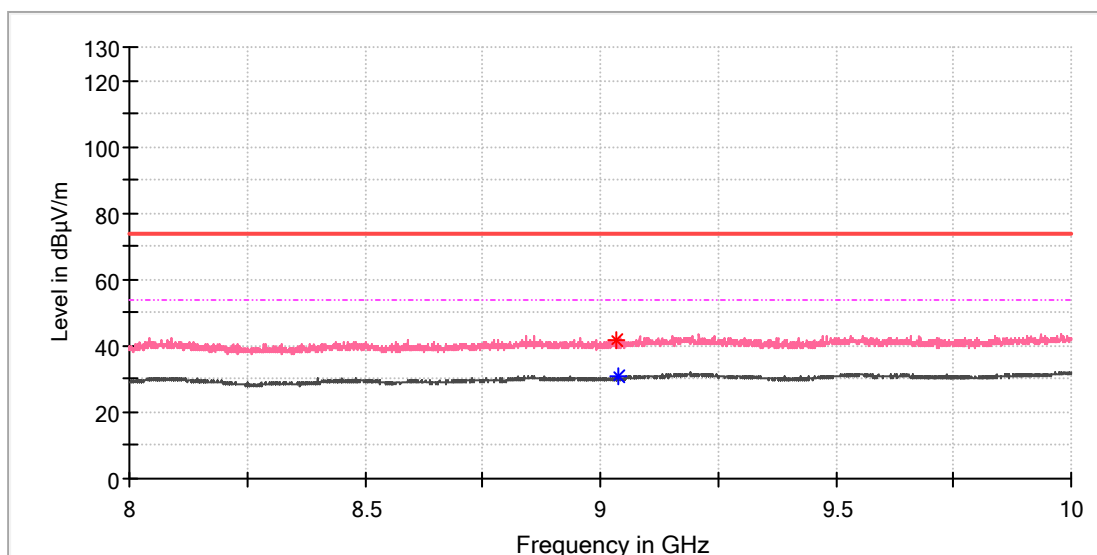


Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9028.000000	---	30.40	54.00	23.60	100.0	H	256.0	8.9
9030.500000	41.66	---	74.00	32.34	100.0	H	93.0	8.9

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_903MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

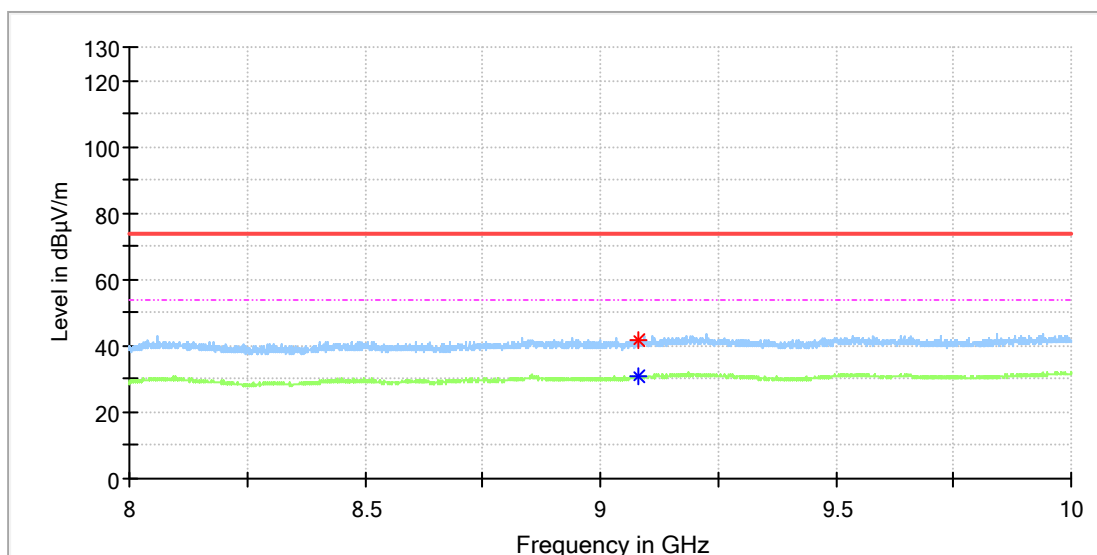


Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9035.500000	41.56	---	74.00	32.44	100.0	V	65.0	8.9
9040.000000	---	30.72	54.00	23.28	100.0	V	3.0	8.9

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_907.8MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

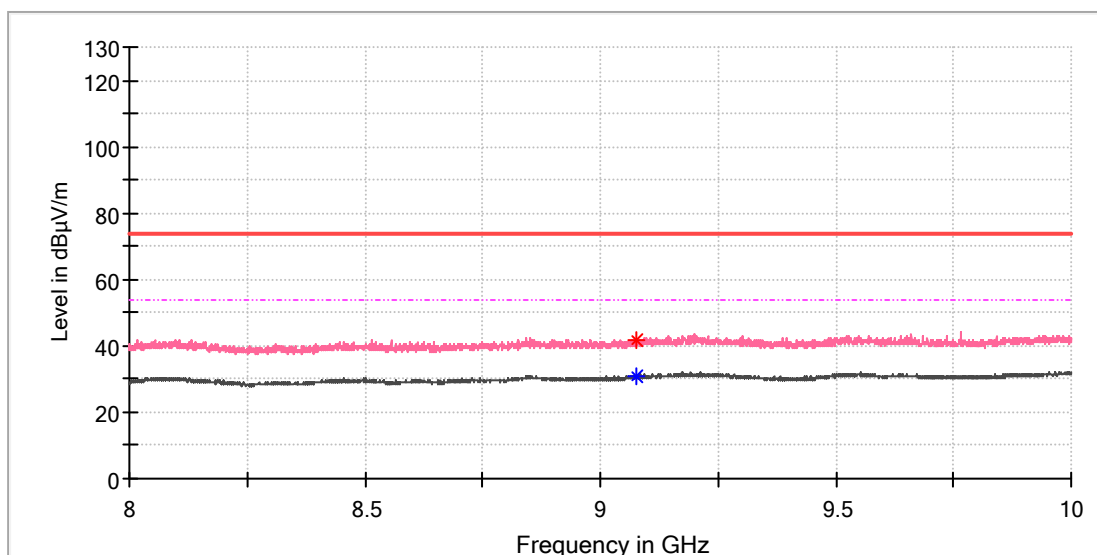


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9079.000000	---	30.84	54.00	23.16	100.0	H	0.0	9.4
9081.000000	41.91	---	74.00	32.09	100.0	H	2.0	9.5

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_907.8MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

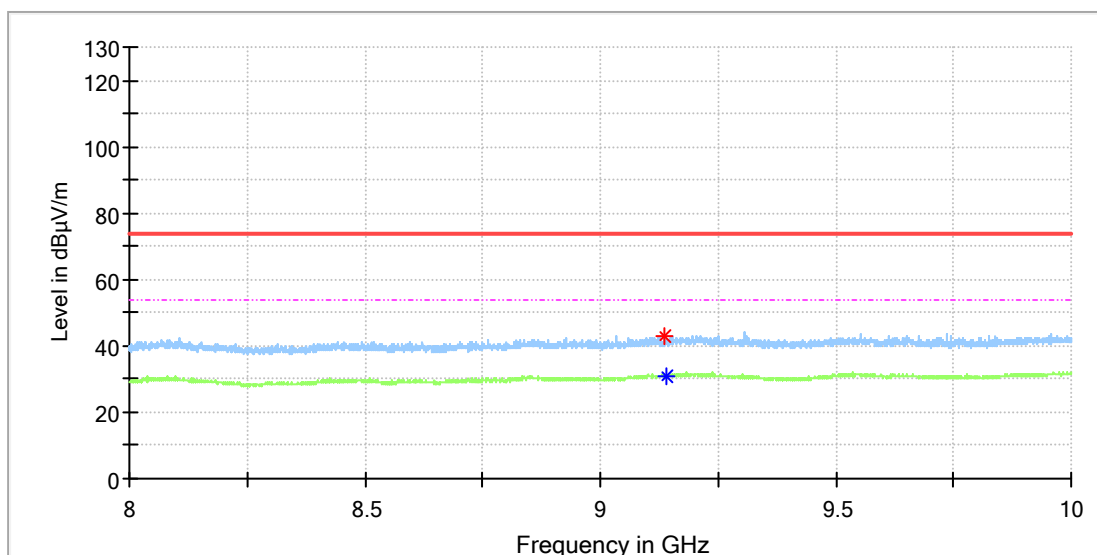


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9075.000000	41.45	---	74.00	32.55	100.0	V	73.0	9.4
9077.000000	---	30.82	54.00	23.18	100.0	V	251.0	9.4

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_914.2MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

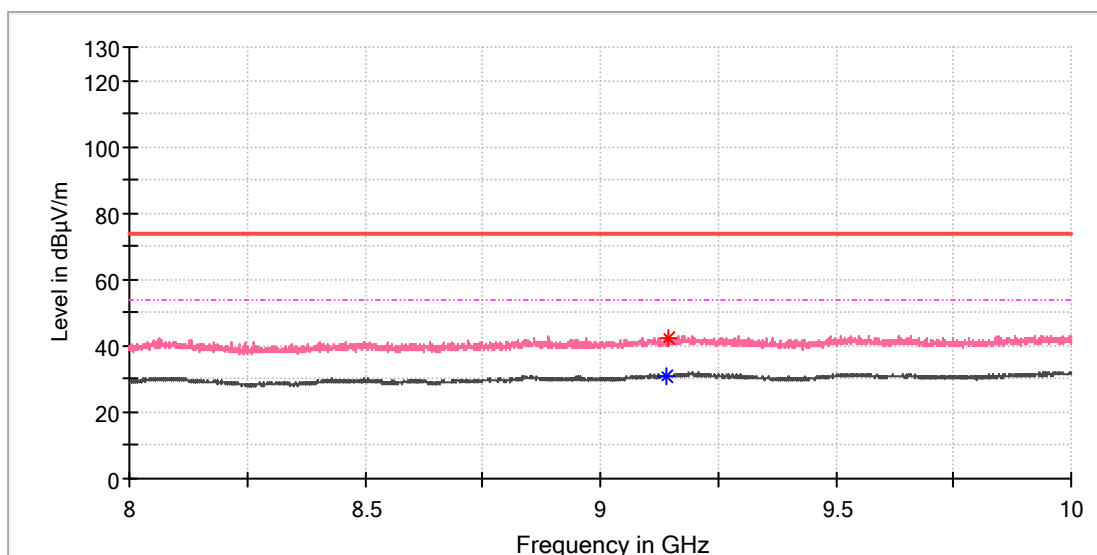


Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9135.500000	42.68	---	74.00	31.32	100.0	H	334.0	10.0
9138.500000	---	31.08	54.00	22.92	100.0	H	79.0	10.0

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	Lora DTS 500K_SF8_914.2MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



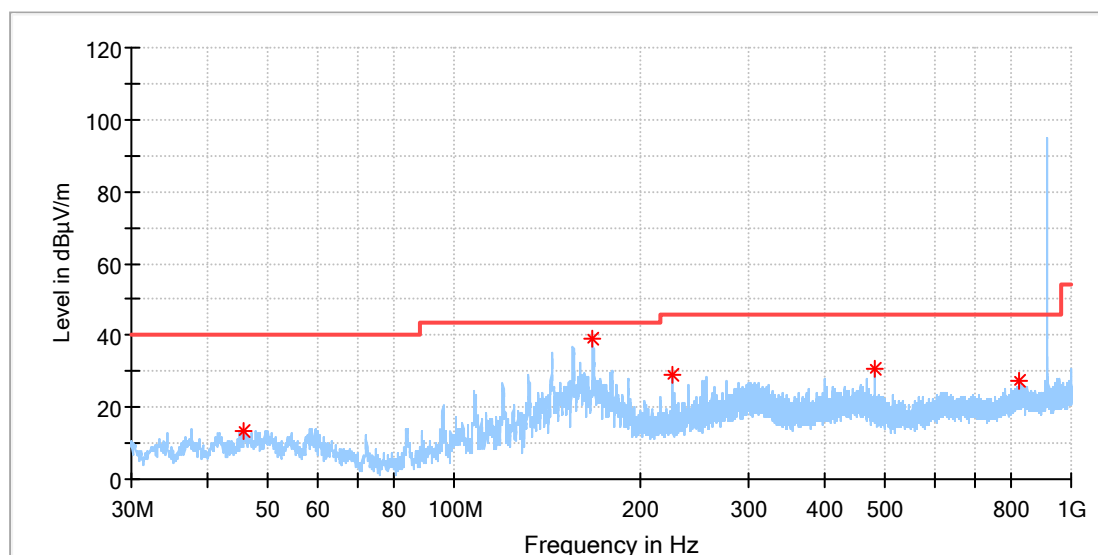
Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9140.500000	---	30.83	54.00	23.17	100.0	V	252.0	10.0
9144.500000	42.32	---	74.00	31.68	100.0	V	335.0	10.1

Lora FHSS SF7, Antenna Gain: 2.3dBi

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	FHSS 125k SF7_914.9MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

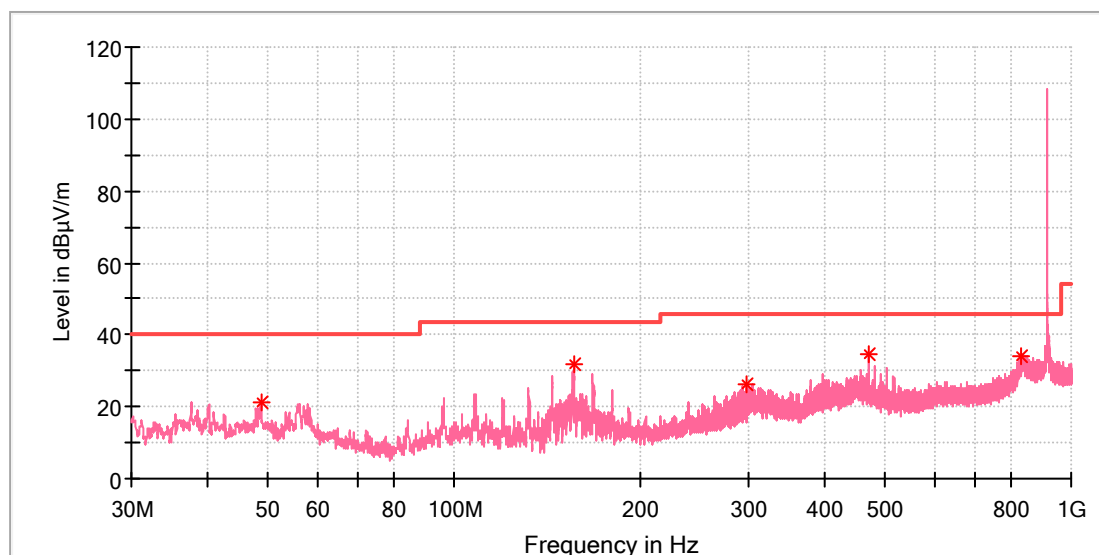


Critical Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
45.557308	13.40	40.00	26.60	100.0	H	180.0	-19.1
168.001154	38.88	43.50	4.62	100.0	H	318.0	-21.7
226.499615	28.86	46.00	17.14	100.0	H	300.0	-18.6
480.005385	30.73	46.00	15.27	100.0	H	300.0	-12.6
823.833077	27.28	46.00	18.72	100.0	H	244.0	-6.3

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	FHSS 125k SF7_914.9MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

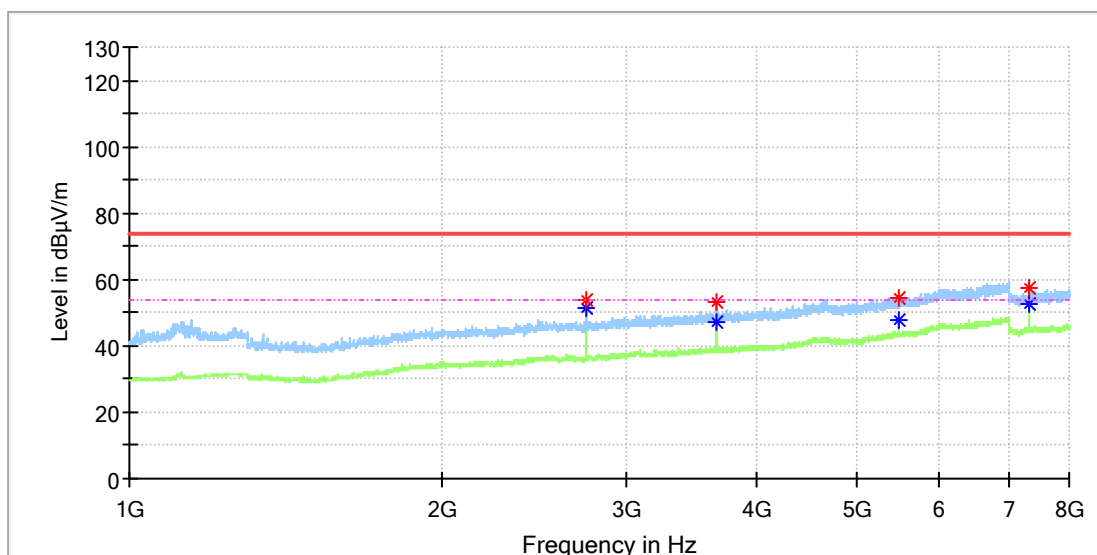


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
48.672500	21.47	40.00	18.53	100.0	V	71.0	-18.4
156.100000	31.94	43.50	11.56	100.0	V	214.0	-22.0
297.817000	26.19	46.00	19.81	100.0	V	159.0	-16.4
468.488500	34.34	46.00	11.66	100.0	V	193.0	-12.5
830.201500	34.16	46.00	11.84	100.0	V	123.0	-5.8

EUT Information

EUT Name: WisDuo LPWAN SiP
Model: RAK3272-SiP
Test Mode: FHSS 125k SF7_914.9MHz
Order No/Sample No: 168373838/A003298487-001
Test Voltage:: DC 5V From USB
Remark: Temp 23 Humi:58%
Test Standard: FCC 15.247
Tested By: Kei Zhang
Reviewed By: Terry Yin

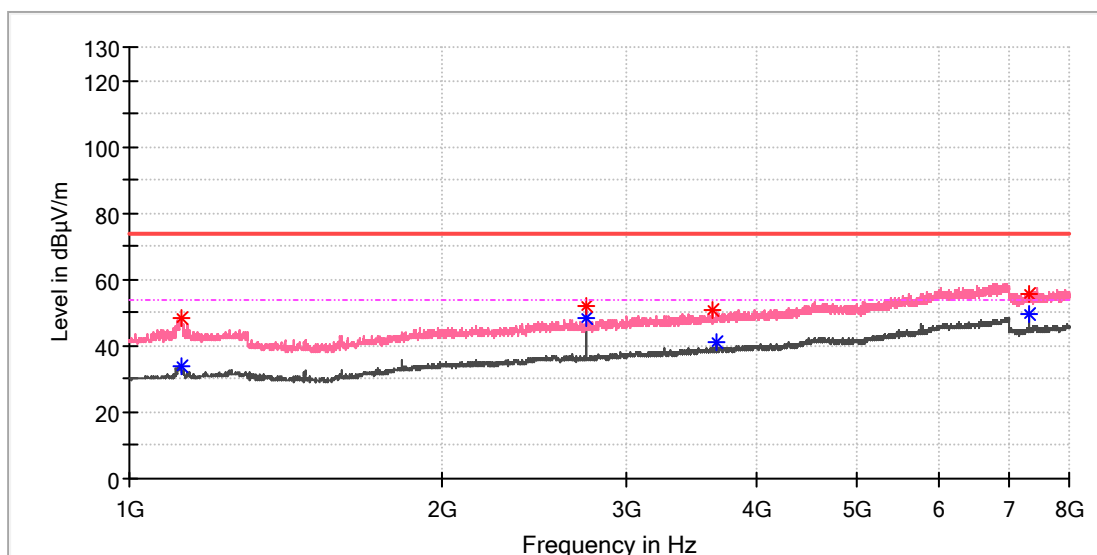


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2744.687500	---	51.55	54.00	2.45	100.0	H	141.0	7.8
2744.687500	54.11	---	74.00	19.89	100.0	H	141.0	7.8
3659.237500	---	47.09	54.00	6.91	100.0	H	56.0	9.4
3659.237500	53.47	---	74.00	20.53	100.0	H	56.0	9.4
5489.175000	54.67	---	74.00	19.33	100.0	H	103.0	13.7
5489.175000	---	47.70	54.00	6.30	100.0	H	103.0	13.7
7319.112500	---	52.38	54.00	1.62	100.0	H	94.0	17.9
7319.950000	57.53	---	74.00	16.47	100.0	H	103.0	17.9

EUT Information

EUT Name: WisDuo LPWAN SiP
Model: RAK3272-SiP
Test Mode: FHSS 125k SF7_914.9MHz
Order No/Sample No: 168373838/A003298487-001
Test Voltage:: DC 5V From USB
Remark: Temp 23 Humi:58%
Test Standard: FCC 15.247
Tested By: Kei Zhang
Reviewed By: Terry Yin

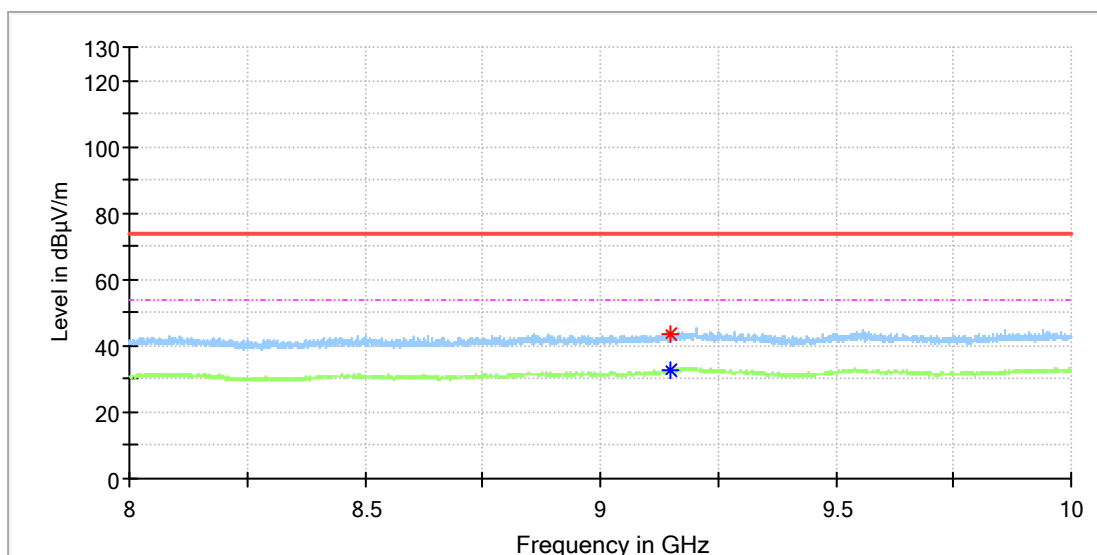


Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1120.000000	---	34.05	54.00	19.95	100.0	V	273.0	0.2
1124.000000	48.08	---	74.00	25.92	100.0	V	273.0	0.3
2744.687500	---	48.37	54.00	5.63	100.0	V	134.0	7.8
2744.687500	52.18	---	74.00	21.82	100.0	V	134.0	7.8
3636.625000	50.65	---	74.00	23.35	100.0	V	65.0	9.4
3660.075000	---	41.40	54.00	12.60	100.0	V	55.0	9.4
7319.112500	55.77	---	74.00	18.23	100.0	V	10.0	17.9
7319.950000	---	49.43	54.00	4.58	100.0	V	188.0	17.9

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	FHSS 125k SF7_914.9MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin

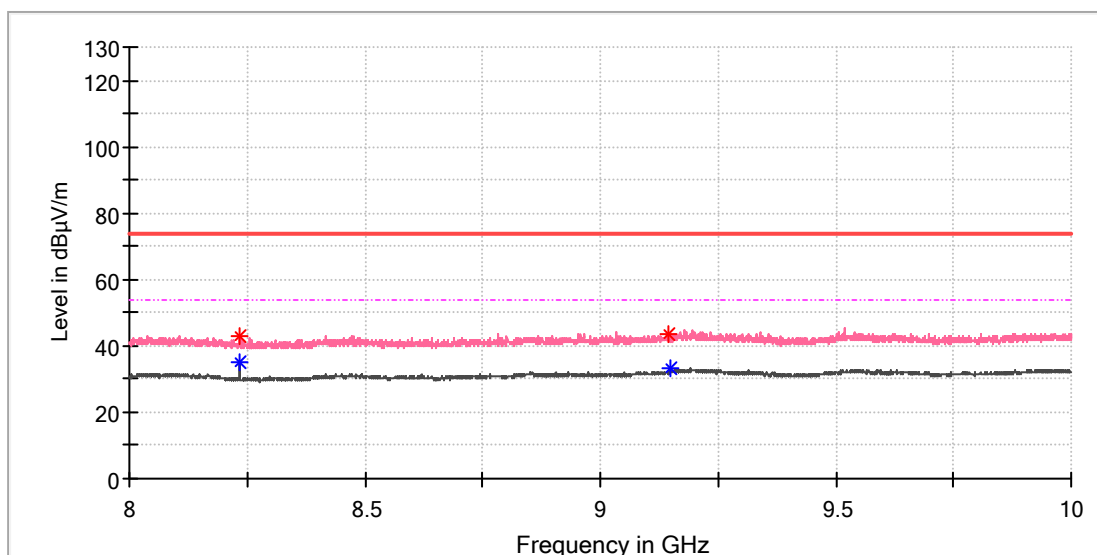


Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9148.500000	---	32.54	54.00	21.46	100.0	H	259.0	10.1
9149.000000	43.48	---	74.00	30.52	100.0	H	342.0	10.1

EUT Information

EUT Name:	WisDuo LPWAN SiP
Model:	RAK3272-SiP
Test Mode:	FHSS 125k SF7_914.9MHz
Order No/Sample No:	168373838/A003298487-001
Test Voltage::	DC 5V From USB
Remark:	Temp 23 Humi:58%
Test Standard:	FCC 15.247
Tested By:	Kei Zhang
Reviewed By:	Terry Yin



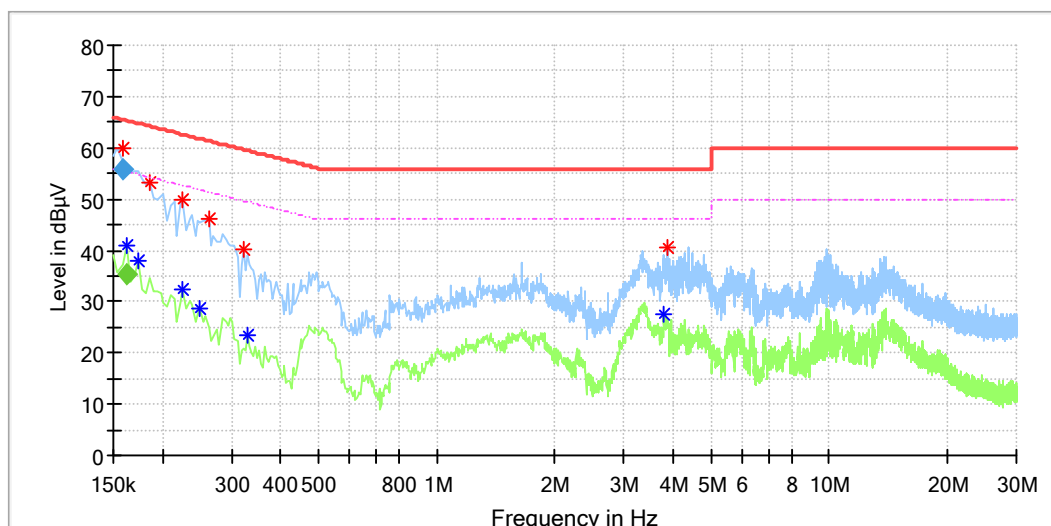
Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8233.000000	42.65	---	74.00	31.35	100.0	V	260.0	8.4
8233.500000	---	35.29	54.00	18.71	100.0	V	260.0	8.4
9144.000000	43.59	---	74.00	30.41	100.0	V	34.0	10.1
9149.000000	---	32.97	54.00	21.03	100.0	V	175.0	10.1

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

EUT Information

EUT Name: WisDuo LPWAN SiP
Order No: 168373838_P00701924
Model: RAK3172-SiP
Test mode: Lora connect
Test Voltage: AC 120V/60Hz
Test Standard: FCC Part 15
Test By:/Review By: Steve Lan/Gary Chen
Tem./Hum./Pressure: 24.2°C/51%/101kPa
Remark: SR2



Critical_Freqs

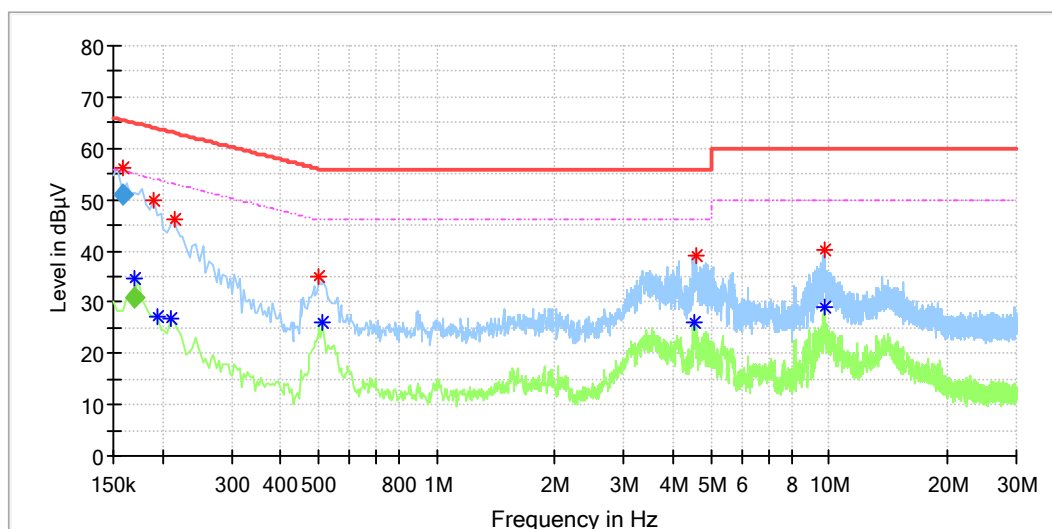
Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.158000	59.73	---	65.78	6.05	L1	9.9
0.161500	---	41.02	55.36	14.34	L1	9.9
0.174000	---	37.97	54.77	16.80	L1	9.9
0.186000	53.34	---	64.21	10.88	L1	9.9
0.226000	---	32.36	52.60	20.24	L1	9.9
0.226000	49.69	---	62.60	12.91	L1	9.9
0.250000	---	28.65	51.76	23.11	L1	9.9
0.262000	46.09	---	61.37	15.28	L1	9.9
0.322000	40.29	---	59.66	19.36	L1	9.9
0.330000	---	23.52	49.45	25.93	L1	9.9
3.790000	---	27.65	46.00	18.35	L1	10.2
3.862000	40.70	---	56.00	15.30	L1	10.2

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.158000	55.64	---	65.57	9.93	3000.0	9.000	L1	9.9
0.161500	---	35.31	55.39	20.08	3000.0	9.000	L1	9.9

EUT Information

EUT Name: WisDuo LPWAN SiP
Order No: 168373838_P00701924
Model: RAK3172-SiP
Test mode: Lora connect
Test Voltage: AC 120V/60Hz
Test Standard: FCC Part 15
Test By:/Review By: Steve Lan/Gary Chen
Tem./Hum./Pressure: 24.2°C/51%//101kPa
Remark: SR2



Critical Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.158000	56.10	---	65.78	9.68	N	9.8
0.169500	---	34.69	54.77	20.08	N	9.8
0.190000	49.88	---	64.04	14.16	N	9.8
0.194000	---	27.16	53.86	26.71	N	9.8
0.210000	---	26.67	53.21	26.53	N	9.8
0.214000	46.02	---	63.05	17.03	N	9.8
0.502000	34.92	---	56.00	21.08	N	9.8
0.514000	---	26.04	46.00	19.96	N	9.8
4.522000	---	26.16	46.00	19.84	N	9.9
4.594000	38.99	---	56.00	17.01	N	9.9
9.714000	40.30	---	60.00	19.70	N	10.0
9.742000	---	29.04	50.00	20.96	N	10.0

Final Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.158000	51.00	---	65.57	14.57	3000.0	9.000	N	9.8
0.169500	---	30.76	54.99	24.23	3000.0	9.000	N	9.8