AS/NZS Test Report

Equipment	:	**Intelligent LoRa/BLE Module [915MHz LoRa) featuring smartBASIC**
Model No.	:	**RM191-SM**
Brand Name	:	**Laird Connectivity**
Applicant	:	**Laird Connectivity**
Address	:	**W66N220 Commerce Court, Cedarburg, Wisconsin 53012, USA**
Standard	:	**AS/NZS 4268:2017**
Received Date	:	**May 08, 2019**
Tested Date	:	**May 08 ~ Jul. 22, 2019**

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by: **Approved by:**

James Fan / Assistant Manager **Gary Chang / Manager**

Testing Laboratory 2732

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Release Record

Report No.	Version	Description	Issued Date
NR821301-03	Rev. 01	Initial issue	Jul. 30, 2019

Summary of Test Results

Ref. Std. Clause	Description	Measured	Result
6.3	Maximum EIRP	EIRP (dBm): 18.26	Pass
Row 58	Power Spectral Density	Meet the requirement of limit.	Pass
6.4	Transmitter Spurious Emissions	Meet the requirement of limit.	Pass
6.5	Emission Bandwidth	Meet the requirement of limit.	Pass
6.6	Operating Frequencies	Meet the requirement of limit.	Pass
7.2	Receiver Spurious Emissions	Meet the requirement of limit.	Pass

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information									
Country	Region	Frequency Range (MHz)	Modulation	Type	Test Channel Frequency (MHz)	Spreading Factor	UL / DL	Physical bit rate (bit/s)	Channel Bandwidth (kHz)
NEW ZEALAND	AS923	916.5 ~ 927.7	LoRa	DTS	916.5, 922, 927.7	12 ~ 7	UL/DL	250 ~ 5470	125
		916.5 ~ 927.6	LoRa	DTS	916.5, 922.2, 927.6	7	UL/DL	11000	250
		916 ~ 927.8	FSK	DTS	916, 922, 927.8	---	UL/DL	50000	125
Note: RF output power specifies that Maximum Peak Conducted Output Power.									

1.1.2 Antenna Details

Ant. No.	External Antenna Part Number	Laird Part Number	Mfg.	Type	Gain (dBi)	Connector Type
1	RFDPA131015IMB B301	0600-00060	Walsin	Dipole	0.9	U.FL
2	WPANTDP036-R5A	---	World Products	Dipole	2	U.FL
3	S152CL-L-PX-915S	---	Nearson	Dipole	2	U.FL
4	001-0002	---	Laird	Dipole	2	SMA
5	WPANT10009	---	World Products	PCB Dipole	2	MHF

1.1.3 EUT Operational Condition

Power Supply Type	3.5Vdc from host		
Operational Voltage	☒ Vnom (3.3 Vdc)	☒ Vmax (3.50 Vdc)	☒ Vmin (1.80 Vdc)
Operational Climatic	☒ Tnom (20°C)	☒ Tmax (85°C)	☒ Tmin (-40°C)

1.1.4 Accessories

N/A

1.1.5 Test Tool and Duty Cycle

Test Tool	test command		
Duty Cycle and Duty Factor	**LoRa 125kHz**	**LoRa 250kHz**	**FSK 50kbps**
Duty Cycle (%)	100	98.32	100
Duty Factor (dB)	0	0.07	0

1.1.6 Power Index of Test Tool

Channel Bandwidth 125 kHz			
Modulation Mode	**Test Frequency (MHz)**		
	916.5	**922**	**927.7**
LoRa 125kHz	15	15	15

Channel Bandwidth 250 kHz			
Modulation Mode	**Test Frequency (MHz)**		
	916.5	**922.2**	**927.6**
LoRa 250kHz	15	15	15

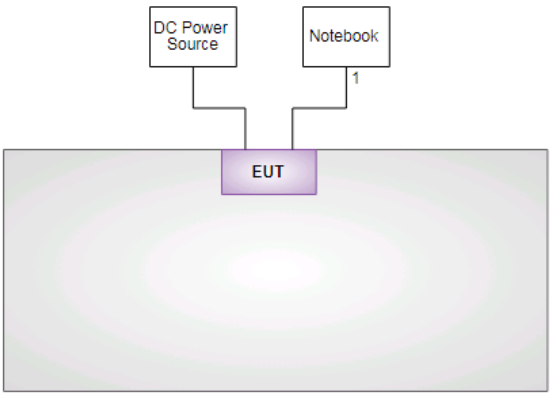
Channel Bandwidth 125 kHz			
Modulation Mode	**Test Frequency (MHz)**		
	916	**922**	**927.8**
FSK 50kbps	14	14	14

1.2 Local Support Equipment List

Support Equipment List					
No.	**Equipment**	**Brand**	**Model**	**FCC ID**	**Remarks**
1	Notebook	DELL	Latitude E6440	JPXMD12	---

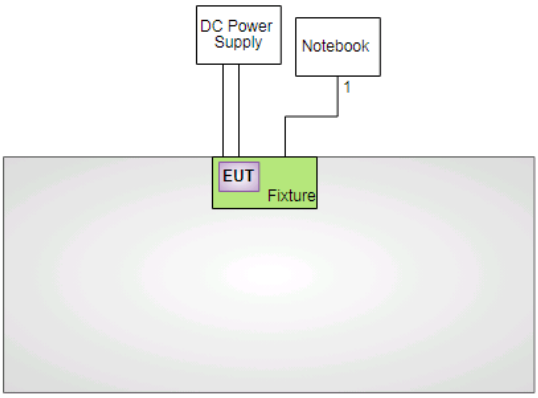
1.3 Test Setup Chart

Test Setup Diagram (below 30 MHz)



No.	Signal cable / Length (m)
1	USB, 0.5m non-shielded.

Test Setup Diagram above 30 MHz



No.	Signal cable / Length (m)
1	RJ45, 1.81m non-shielded.

1.4 Test Equipment and Calibration Data

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Tested Date	May 30 ~ Jul. 22, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101486	Jan. 08, 2019	Jan. 07, 2020
TEMP&HUMIDITY CHAMBER	GIANT FORCE	GCT-225-40-SP-SD	MAF1212-002	Dec. 05, 2018	Dec. 04, 2019
Power Sensor	Agilent	U2021XA	MY53480019	Jan. 30, 2019	Jan. 29, 2020
AC POWER SOURCE	APC	AFC-500W	F312060012	Nov. 29, 2018	Nov. 28, 2019
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA
Measurement Software	Agilent	EN RF test	1.1501125	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission				
Test Site	966 chamber1 / (03CH01-WS)				
Tested Date	May 11 ~ Jun. 13, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101498	Dec. 27, 2018	Dec. 26, 2019
Receiver	R&S	ESR3	101658	Dec. 11, 2018	Dec. 10, 2019
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Jul. 18, 2018	Jul. 17, 2019
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Dec. 18, 2018	Dec. 17, 2019
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 15, 2018	Nov. 14, 2019
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 09, 2018	Nov. 08, 2019
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 08, 2018	Oct. 07, 2019
Preamplifier	EMC	EMC02325	980225	Jul. 20, 2018	Jul. 19, 2019
Preamplifier	Agilent	83017A	MY39501308	Oct. 04, 2018	Oct. 03, 2019
Preamplifier	EMC	EMC184045B	980192	Aug. 09, 2018	Aug. 08, 2019
RF Cable	EMC	EMC104-SM-SM-8000	181106	Oct. 08, 2018	Oct. 07, 2019
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	Oct. 08, 2018	Oct. 07, 2019
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16014/4	Oct. 08, 2018	Oct. 07, 2019
LF cable 1M	EMC	EMCCFD400-NM-NM-1000	160502	Oct. 08, 2018	Oct. 07, 2019
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Oct. 08, 2018	Oct. 07, 2019
LF cable 10M	Woken	CFD400NL-LW	CFD400NL-002	Oct. 08, 2018	Oct. 07, 2019
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emissions				
Test Site	Fully-anechoic chamber 2 / (05CH02-WS)				
Tested Date	May 08 ~ Jun. 13, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	Agilent	N9010A	MY52221474	Oct. 10, 2018	Oct. 09, 2019
Bilog Antenna 30-1000MHz	SCHWARZBECK	VULB9168	9168-563	Jan. 04, 2019	Jan. 03, 2020
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	9120D-1205	Jan. 18, 2019	Jan. 17, 2020
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170508	Dec. 22, 2018	Dec. 21, 2019
Preamplifier	Agilent	83017A	MY53270013	Dec. 27, 2018	Dec. 26, 2019
Preamplifier	EMC	EMC02325	980188	Dec. 13, 2018	Dec. 12, 2019
Preamplifier	EMC	EMC184045B	980192	Aug. 09, 2018	Aug. 08, 2019
RF cable-1M	HUBER+SUHNER	SUCOFLEX104	MY22622/4	Oct. 16, 2018	Oct. 15, 2019
RF cable-1M	HUBER+SUHNER	SUCOFLEX104	MY22623/4	Oct. 16, 2018	Oct. 15, 2019
RF cable-3M	HUBER+SUHNER	SUCOFLEX104	MY22621/4	Oct. 16, 2018	Oct. 15, 2019
RF cable-4M	HUBER+SUHNER	SUCOFLEX104	MY22579/4	Oct. 16, 2018	Oct. 15, 2019
LF cable-0.8M	EMC	EMC8D-NM-NM-800	EMC8D-NM-NM-800-002	Oct. 16, 2018	Oct. 15, 2019
LF cable-3M	EMC	EMC8D-NM-NM-3000	131102	Oct. 16, 2018	Oct. 15, 2019
LF cable-10M	EMC	EMC8D-NM-NM-10000	131101	Oct. 16, 2018	Oct. 15, 2019
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emissions				
Test Site	(10CH01-HY)				
Tested Date	Jun. 13, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Receiver	Keysight	N9038A	MY54130031	Nov. 06, 2018	Nov. 05, 2019
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 09, 2018	Nov. 08, 2019
RF Cable-R10m	Suhner Switzerland + Rosenberger	RG223/U + UAA220A-0	CB022-DOOR	Nov. 11, 2018	Nov. 10, 2019
Turn Table	HD	DT 60 RPS	1513/004/00	NA	NA
Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

1.5 Testing Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

AS/NZS 4268:2017

1.6 Deviation from Test Standard and Measurement Procedure

None

1.7 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2).

Measurement Uncertainty	
Parameters	**Uncertainty**
Radio Frequency	$\pm 1.4 \times 10^{-9}$
RF Power Conducted	±0.808 dB
RF Power Radiated	±3.398 dB
Spurious Emission, Conducted	±2.470 dB
Spurious Emission, Radiated	±3.398 dB
Humidity	±0.8 ^{o}C
Temperature	±4.7%
Time	±0.1%

2 Test Configuration

2.1 Testing Condition

Testing Location			
☒	ICC Lab	ADD : No.3-1, Lane 6, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan (R.O.C.) TEL : 886-3-271-8666 FAX : 886-3-318-0155	
☒	Sporton Lab	ADD : No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL : 886-3-327-3456 FAX : 886-3-327-0973	

Test Item	Test Site	Ambient Condition	Tested By
Antenna port conducted measurement	TH01-WS	25°C / 62%	Birkin Cheng
Transmitter Radiated Emission > 30 MHz Receiver Radiated Emission > 30 MHz	03CH01-WS	22°C / 63%	Felix Sung
Transmitter Unwanted Emissions in the Spurious Domain** (Radiated measurement)	05CH01-WS	23°C / 55%	Ryan Lee
Transmitter Radiated Emission ≤ 30 MHz Receiver Radiated Emission ≤ 30 MHz	10CH01-HY*	25°C / 65%	Jack Li

Note: * ICC lab subcontracts this test item to Sporton Lab (TAF:1190).

Sporton Lab is a TAF accreditation test firm and also is an approved provider of ICC lab.

** This Test specification is from “NEW ZEALAND https://www.gazette.govt.nz/notice/id/2017-go4089 special condition23”..

2.2 The Worst Test Modes and Channel Details

Test item	Conducted / Radiated measurement	Configuration	SF	Voltage	Temperature	TX / RX test	Test Frequency (MHz)
EIRP	Conducted	LoRa 125 kHz LoRa 250 kHz FSK 50kbps	12 7 -	Vnom=3.3V, Vmin=1.8V Vmax=3.5V	Tnom=20°C Tmin=- 40°C Tmax=85°C	TX	916.5 / 922 / 927.7 916.5 / 922.2 / 927.6 916 / 922 / 927.8
Power Spectral Density	Conducted			Vnom=3.3V	Tnom=20°C		
Emission Bandwidth	Conducted			Vnom=3.3V	Tnom=20°C		
Operating Frequencies	Conducted			Vnom=3.3V, Vmin=1.8V, Vmax=3.5V	Tnom=20°C, Tmin=- 40°C, Tmax=85°C		
Transmitter Spurious Emissions	Radiated			Vnom=3.3V	Tnom=20°C		
Receiver Spurious Emissions ≤ 30 MHz	Radiated	LoRa 125 kHz LoRa 250 kHz FSK 50kbps	12 7 -	Vnom=3.3V	Tnom=20°C	RX	916.5 / 922 / 927.7 916.5 / 922.2 / 927.6 916 / 922 / 927.8
Transmitter Unwanted Emissions in the Spurious Domain[Note2]	Radiated	LoRa 125 kHz LoRa 250 kHz FSK 50kbps	12 7 -	Vnom=3.3V	Tnom=20°C	TX	916.5 / 927.7 916.5 / 927.6 916 / 927.8
Receiver Spurious Emissions > 30 MHz	Radiated	LoRa 125 kHz LoRa 250 kHz FSK 50kbps	12 7 -	Vnom=3.3V	Tnom=20°C	RX	922 922.2 922

NOTE:

1. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **Y-plane** result was found as the worst case and was shown in this report.
2. This Test specification is from "NEW ZEALAND https://www.gazette.govt.nz/notice/id/2017-go4089 special condition23"

3 Transmitter Test Results

3.1 Maximum EIRP & Power Spectral Density

3.1.1 Maximum EIRP & Power Spectral Density Limit

Permitted Operating Frequency Band (MHz)	Maximum EIRP	Other Requirements
915 to 928	1W (30dBm)	The radiated peak power spectral density in any 3 kHz is limited to 25 mW (14dBm) per 3 kHz.

Note: Limit is from AS/NZS 4268:2017

3.1.2 Test Procedures

Conducted Power

A broadband RF power meter is used for output power measurement. The video bandwidth of power meter is greater than DTS bandwidth of EUT. If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power.

ERIP

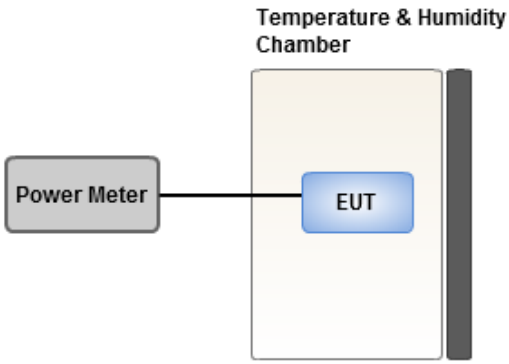
Antenna gain is added to measured conducted power

Power Density

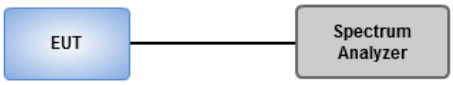
Set the RBW = 3 kHz, VBW = 10 kHz., Detector = RMS, Sweep time = auto couple,
Sweep time = auto couple.
Employ trace averaging (RMS) mode over a minimum of 100 traces.
Use the peak marker function to determine the maximum amplitude level.
Add antenna gain to measured Power density

3.1.3 Test Setup

Conducted Power



Power Density



3.1.4 Test Result of EIRP

LoRa 125 kHz / SF:12

Condition	Freqeuncy (MHz)	EIRP Power (dBm)	EIRP Limit (dBm)
$T_{nom}V_{nom}$	916.5	17.42	30
$T_{min}V_{max}$	916.5	18.26	30
$T_{min}V_{min}$	916.5	13.14	30
$T_{max}V_{max}$	916.5	17.05	30
$T_{max}V_{min}$	916.5	10.54	30
$T_{nom}V_{nom}$	922	17.29	30
$T_{min}V_{max}$	922	17.99	30
$T_{min}V_{min}$	922	12.92	30
$T_{max}V_{max}$	922	17.00	30
$T_{max}V_{min}$	922	10.61	30
$T_{nom}V_{nom}$	927.7	17.19	30
$T_{min}V_{max}$	927.7	17.84	30
$T_{min}V_{min}$	927.7	12.83	30
$T_{max}V_{max}$	927.7	16.83	30
$T_{max}V_{min}$	927.7	10.54	30

LoRa 250 kHz / SF:7

Condition	Freqeuncy (MHz)	EIRP Power (dBm)	EIRP Limit (dBm)
$T_{nom}V_{nom}$	916.5	17.34	30
$T_{min}V_{max}$	916.5	17.78	30
$T_{min}V_{min}$	916.5	12.66	30
$T_{max}V_{max}$	916.5	17.04	30
$T_{max}V_{min}$	916.5	10.53	30
$T_{nom}V_{nom}$	922	17.22	30
$T_{min}V_{max}$	922	17.68	30
$T_{min}V_{min}$	922	12.61	30
$T_{max}V_{max}$	922	16.89	30
$T_{max}V_{min}$	922	10.50	30
$T_{nom}V_{nom}$	927.6	17.20	30
$T_{min}V_{max}$	927.6	17.64	30
$T_{min}V_{min}$	927.6	12.63	30
$T_{max}V_{max}$	927.6	16.90	30
$T_{max}V_{min}$	927.6	10.61	30

FSK 50kbps

Condition	Freqeuncy (MHz)	EIRP Power (dBm)	EIRP Limit (dBm)
$T_{nom}V_{nom}$	916	15.69	30
$T_{min}V_{max}$	916	15.96	30
$T_{min}V_{min}$	916	10.84	30
$T_{max}V_{max}$	916	15.36	30
$T_{max}V_{min}$	916	8.85	30
$T_{nom}V_{nom}$	922	15.67	30
$T_{min}V_{max}$	922	15.92	30
$T_{min}V_{min}$	922	10.22	30
$T_{max}V_{max}$	922	15.34	30
$T_{max}V_{min}$	922	8.95	30
$T_{nom}V_{nom}$	927.8	15.65	30
$T_{min}V_{max}$	927.8	15.95	30
$T_{min}V_{min}$	927.8	10.94	30
$T_{max}V_{max}$	927.8	15.32	30
$T_{max}V_{min}$	927.8	9.03	30

3.1.5 Test Result of Power Density

LoRa 125 kHz / SF:12

Modulation Mode	Freqeuncy (MHz)	EIRP Power Density (dBm/3kHz)	EIRP Limit (dBm/3kHz)
LoRa	916.5	3.36	14
LoRa	922	3.82	14
LoRa	927.7	3.03	14

LoRa 250 kHz / SF:7

Modulation Mode	Freqeuncy (MHz)	EIRP Power Density (dBm/3kHz)	EIRP Limit (dBm/3kHz)
LoRa	916.5	0.14	14
LoRa	922	0.41	14
LoRa	927.6	-0.25	14

FSK 50kbps

Modulation Mode	Freqeuncy (MHz)	EIRP Power Density (dBm/3kHz)	EIRP Limit (dBm/3kHz)
FSK 50kbps	916	13.00	14
FSK 50kbps	922	12.97	14
FSK 50kbps	927.8	12.97	14

3.2 Transmitter Spurious Emissions

3.2.1 Transmitter Spurious Emissions Limit

Spurious Emissions Limit (Peak Power)	Frequency Range	Measurement Bandwidth
-56 dBW (2.5μW) e.i.r.p (59 dBμV/m at 10 metres)	< 150 kHz	1 kHz
	150 kHz – 30 MHz	10 kHz

Note: Limit is from "NEW ZEALAND https://gazette.govt.nz/notice/id/2015-go694 Table 2"

Restricted Band Emissions Limit			
Frequency Range (MHz)	**Field Strength (uV/m)**	**Field Strength (dBuV/m)**	**Measure Distance (m)**
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3
Note 1: Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit **Note 2:** Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.			

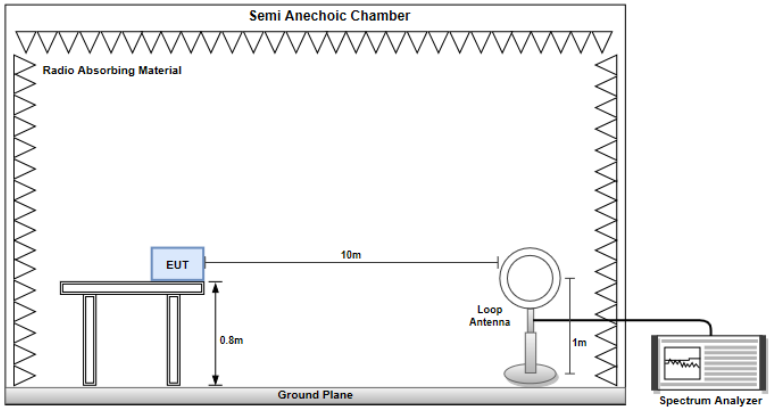
Note: Limit is from FCC Part 15.209

3.2.2 Test Procedures

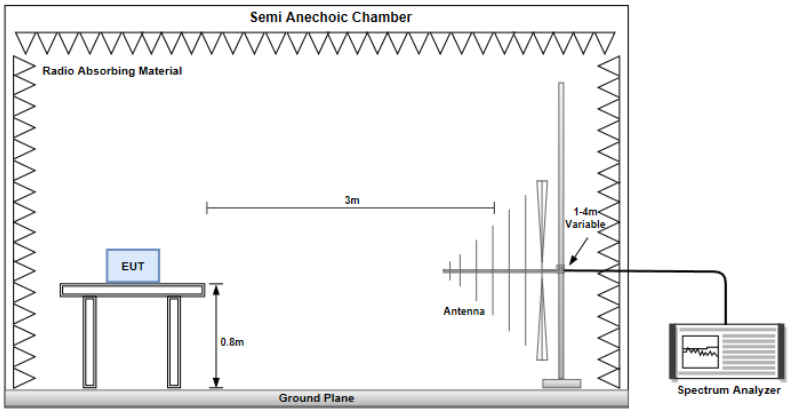
Reference to clause 6.2.1 of AS/NZS 4268:2017.

3.2.3 Test Setup

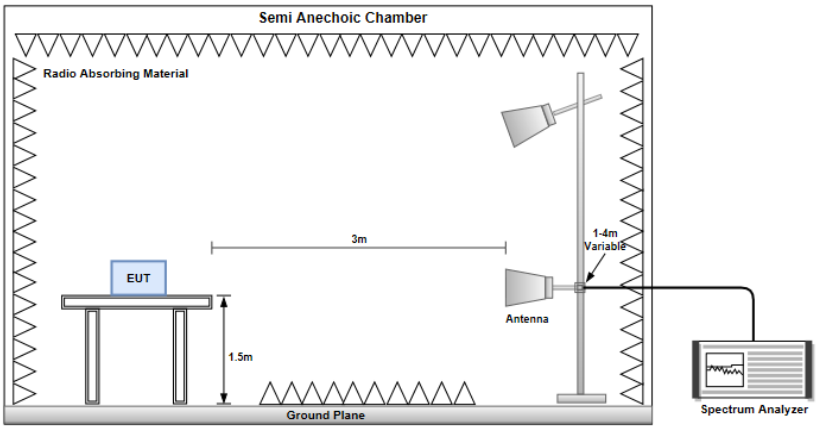
Below 30MHz



Below 1GHz



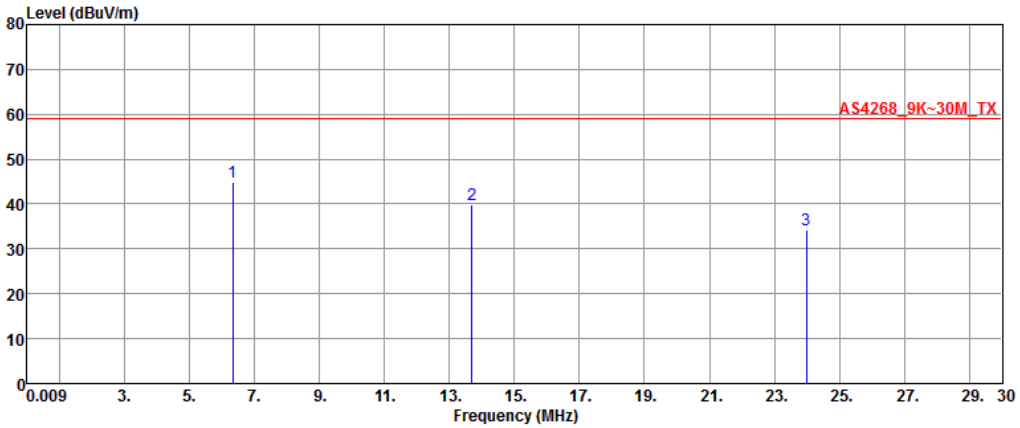
Above 1 GHz



3.2.4 Transmitter Spurious Emissions (≤ 30MHz)

LoRa 125 kHz

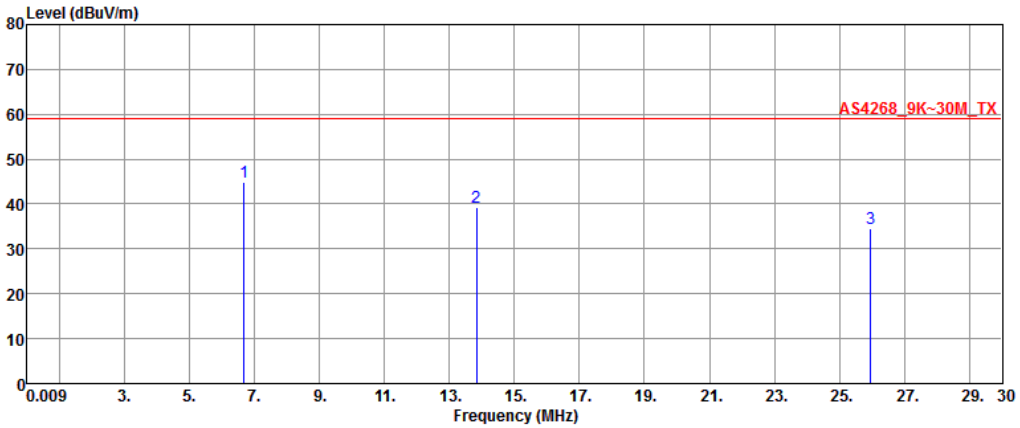
Modulation Mode	LoRa	**Test Freq. (MHz)**	916.5
Frequency	9kHz~30MHz	**Loop**	open



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBuV/m	dBuV/m	dB	dB	dBuV
1	6.32	44.87	59.00	-14.13	19.95	24.92
2	13.68	39.96	59.00	-19.04	20.99	18.97
3	23.98	34.13	59.00	-24.87	22.00	12.13

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

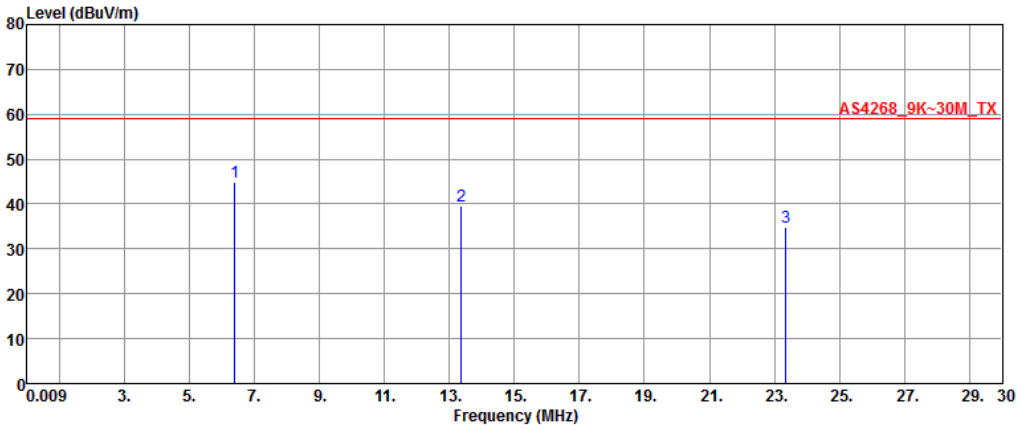
Modulation Mode	LoRa	Test Freq. (MHz)	922
Frequency	9kHz~30MHz	Loop	open



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBuV/m	dBuV/m	dB	dB	dBuV
1	6.68	44.95	59.00	-14.05	19.99	24.96
2	13.84	39.32	59.00	-19.68	21.02	18.30
3	25.97	34.54	59.00	-24.46	22.09	12.45

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

Modulation Mode	LoRa	Test Freq. (MHz)	927.7
Frequency	9kHz~30MHz	Loop	open

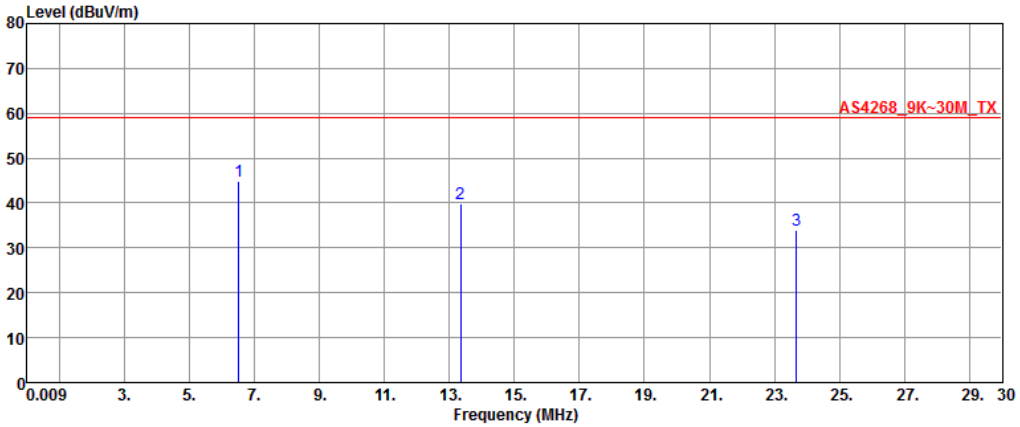


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBuV/m	dBuV/m	dB	dB	dBuV
1	6.39	44.96	59.00	-14.04	19.96	25.00
2	13.35	39.65	59.00	-19.35	20.94	18.71
3	23.35	34.85	59.00	-24.15	21.97	12.88

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

LoRa 250 kHz

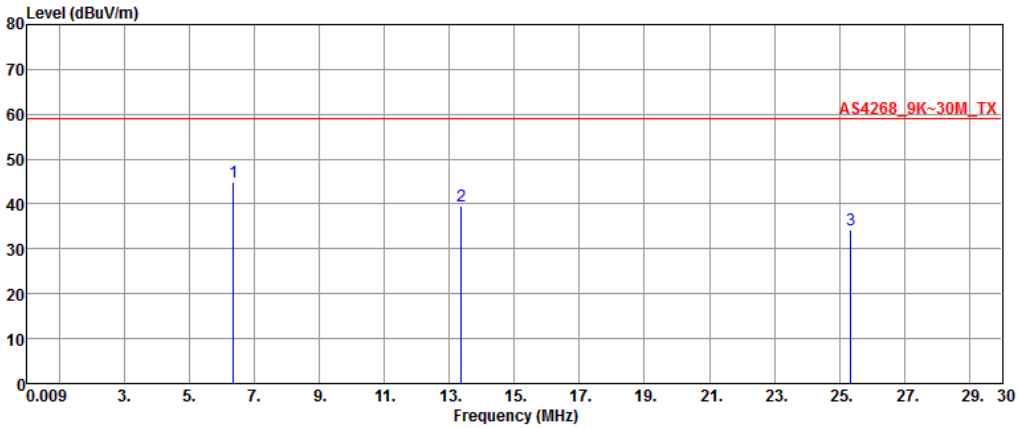
Modulation Mode	LoRa	**Test Freq. (MHz)**	916.5
Frequency	9kHz~30MHz	**Loop**	open



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBuV/m	dBuV/m	dB	dB	dBuV
1	6.51	44.84	59.00	-14.16	19.97	24.87
2	13.34	39.98	59.00	-19.02	20.94	19.04
3	23.69	34.00	59.00	-25.00	21.99	12.01

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

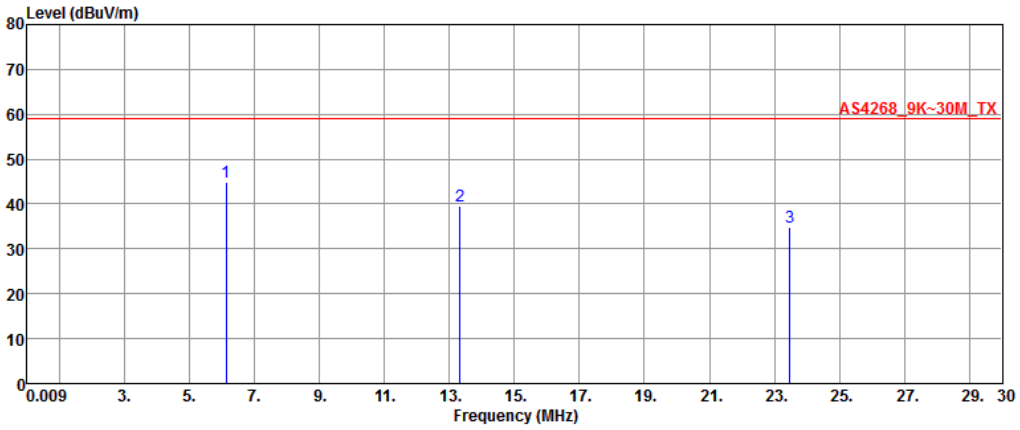
Modulation Mode	LoRa	Test Freq. (MHz)	922
Frequency	9kHz~30MHz	Loop	open



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBuV/m	dBuV/m	dB	dB	dBuV
1	6.36	44.85	59.00	-14.15	19.95	24.90
2	13.35	39.65	59.00	-19.35	20.94	18.71
3	25.36	34.29	59.00	-24.71	22.05	12.24

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

Modulation Mode	LoRa	Test Freq. (MHz)	927.6
Frequency	9kHz~30MHz	Loop	open

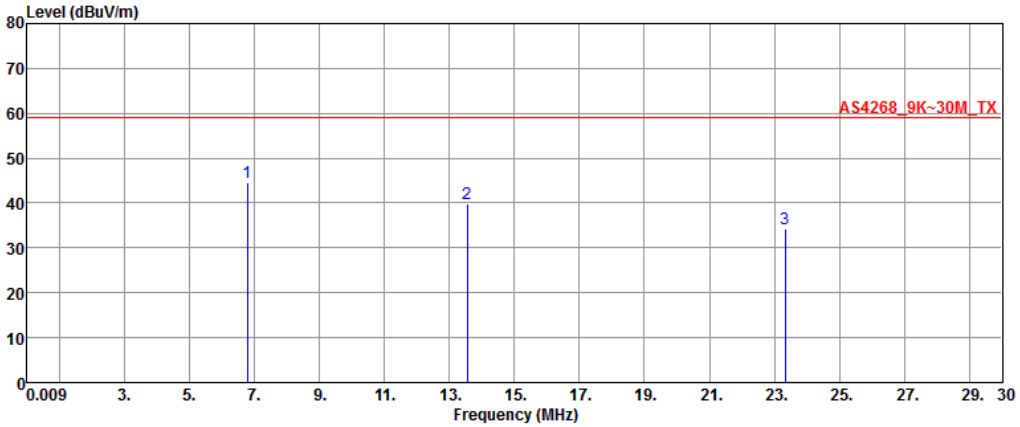


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBuV/m	dBuV/m	dB	dB	dBuV
1	6.13	44.90	59.00	-14.10	19.93	24.97
2	13.32	39.41	59.00	-19.59	20.94	18.47
3	23.47	34.69	59.00	-24.31	21.98	12.71

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

FSK 50kbps

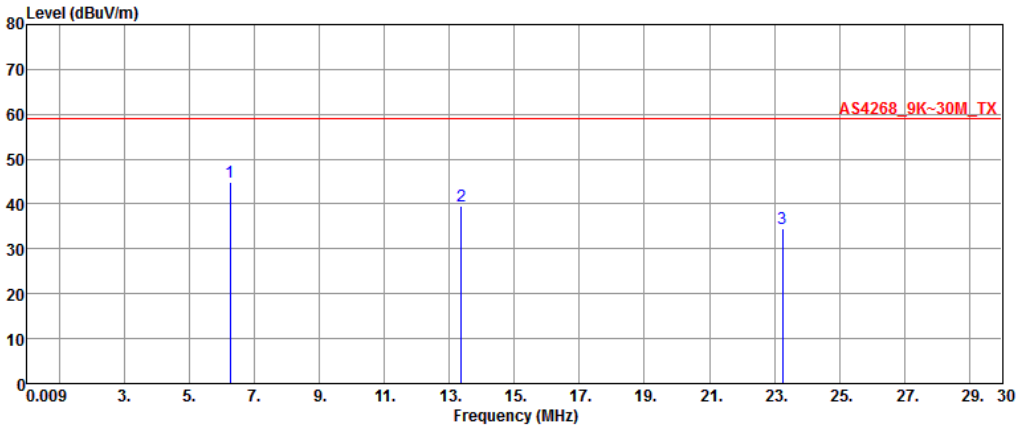
Modulation Mode	FSK	**Test Freq. (MHz)**	916
Frequency	9kHz~30MHz	**Loop**	open



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBuV/m	dBuV/m	dB	dB	dBuV
1	6.78	44.56	59.00	-14.44	20.01	24.55
2	13.54	39.99	59.00	-19.01	20.97	19.02
3	23.32	34.21	59.00	-24.79	21.97	12.24

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

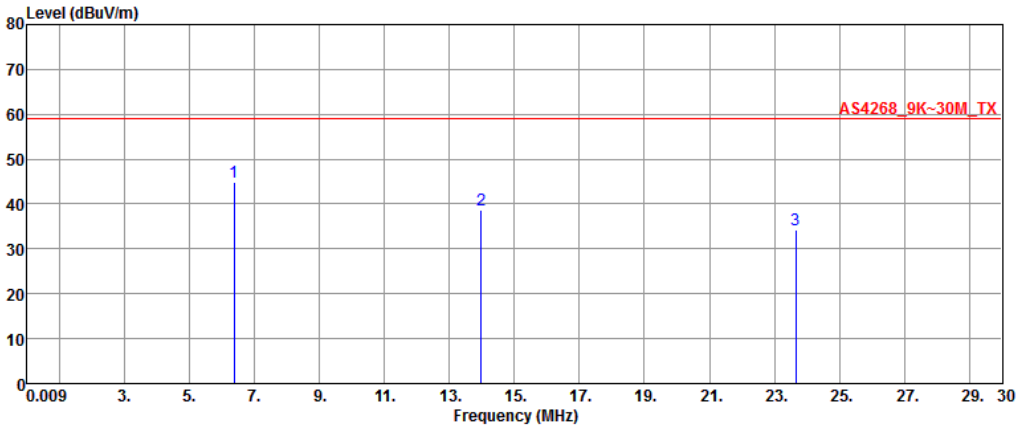
Modulation Mode	FSK	Test Freq. (MHz)	922
Frequency	9kHz~30MHz	Loop	open



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBuV/m	dBuV/m	dB	dB	dBuV
1	6.24	44.97	59.00	-14.03	19.94	25.03
2	13.36	39.65	59.00	-19.35	20.94	18.71
3	23.26	34.55	59.00	-24.45	21.97	12.58

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

Modulation Mode	FSK	Test Freq. (MHz)	927.8
Frequency	9kHz~30MHz	Loop	open



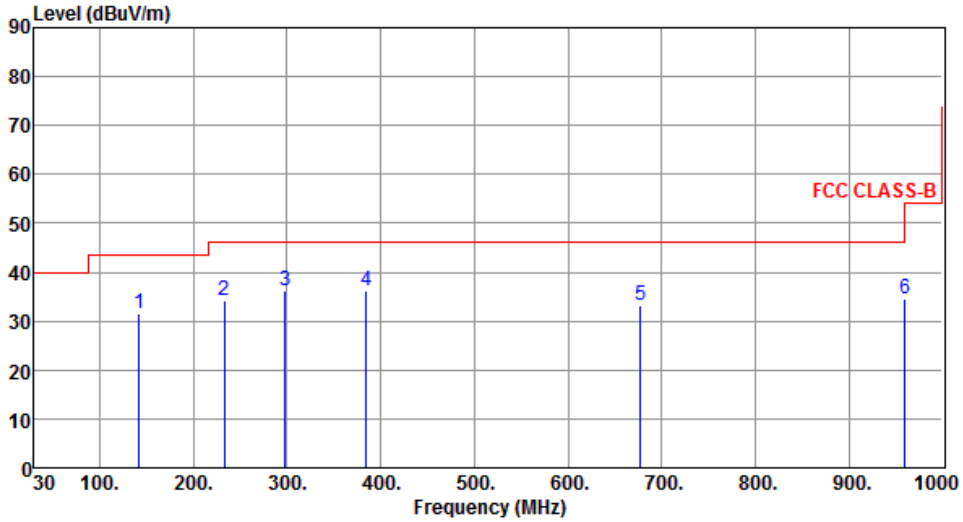
	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBuV/m	dBuV/m	dB	dB	dBuV
1	6.36	44.97	59.00	-14.03	19.95	25.02
2	13.98	38.65	59.00	-20.35	21.04	17.61
3	23.65	34.39	59.00	-24.61	21.99	12.40

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

3.2.5 Transmitter Spurious Emissions (Below 1GHz)

LoRa 125 kHz

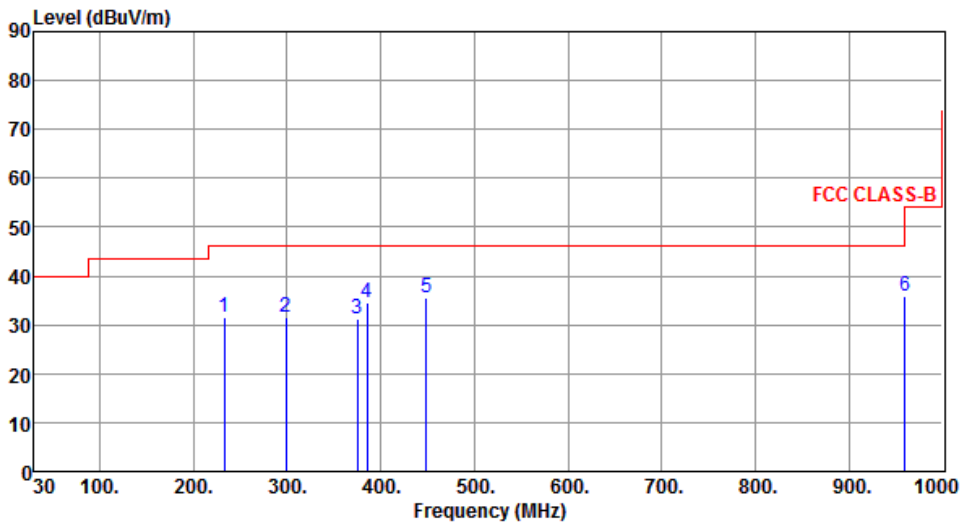
Modulation Mode	LoRa	**Test Freq. (MHz)**	916.5
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	141.85	31.52	43.50	-11.98	40.08	-8.56	Peak	---	---
2	232.96	34.25	46.00	-11.75	44.33	-10.08	Peak	---	---
3	297.85	36.24	46.00	-9.76	44.09	-7.85	Peak	---	---
4	384.85	36.24	46.00	-9.76	41.60	-5.36	Peak	---	---
5	677.52	33.24	46.00	-12.76	32.76	0.48	Peak	---	---
6	960.00	34.52	46.00	-11.48	29.93	4.59	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

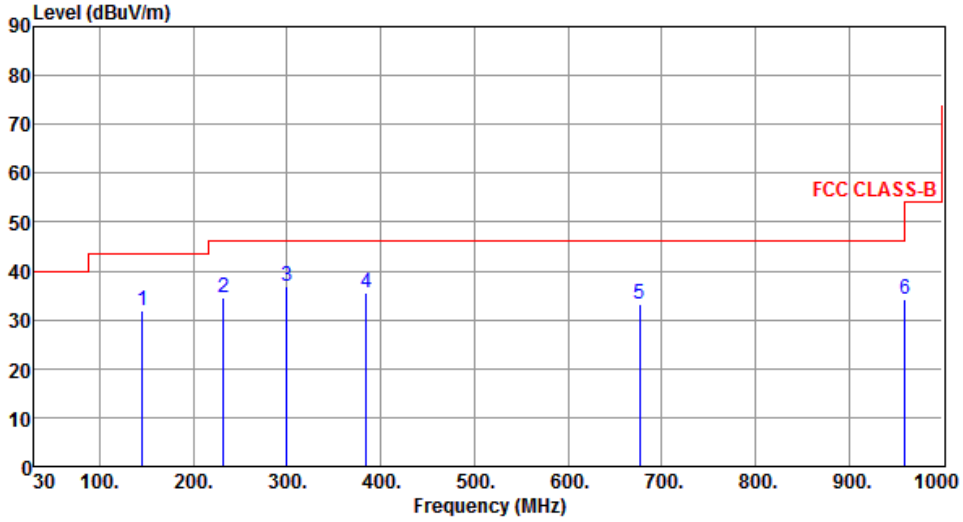
Modulation Mode	LoRa	Test Freq. (MHz)	916.5
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	232.78	31.52	46.00	-14.48	41.62	-10.10	Peak	---	---
2	298.74	31.59	46.00	-14.41	39.42	-7.83	Peak	---	---
3	375.52	31.28	46.00	-14.72	36.94	-5.66	Peak	---	---
4	385.54	34.52	46.00	-11.48	39.86	-5.34	Peak	---	---
5	449.14	35.41	46.00	-10.59	39.34	-3.93	Peak	---	---
6	960.00	35.85	46.00	-10.15	31.26	4.59	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

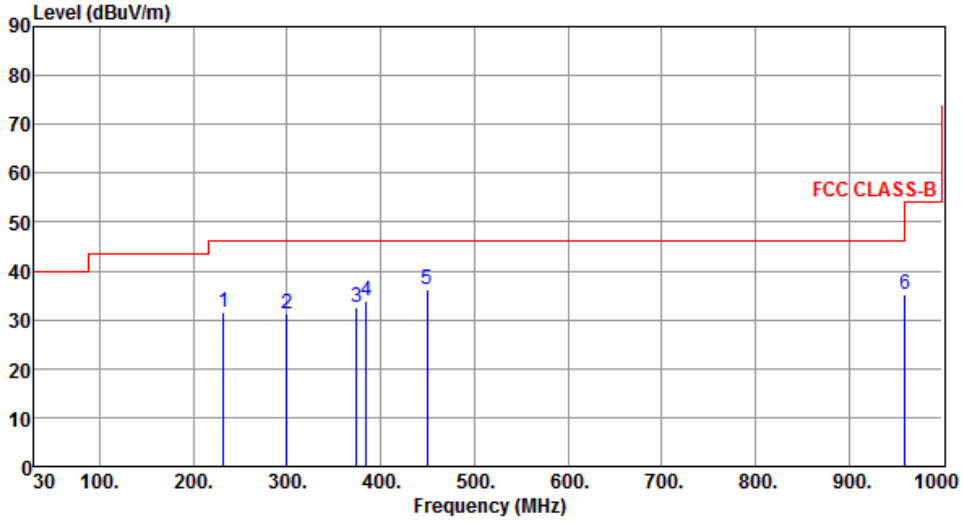
Modulation Mode	LoRa	Test Freq. (MHz)	922
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	145.32	31.85	43.50	-11.65	40.27	-8.42	Peak	---	---
2	232.47	34.58	46.00	-11.42	44.70	-10.12	Peak	---	---
3	299.58	36.75	46.00	-9.25	44.56	-7.81	Peak	---	---
4	384.21	35.45	46.00	-10.55	40.83	-5.38	Peak	---	---
5	676.24	33.24	46.00	-12.76	32.80	0.44	Peak	---	---
6	960.00	34.28	46.00	-11.72	29.69	4.59	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

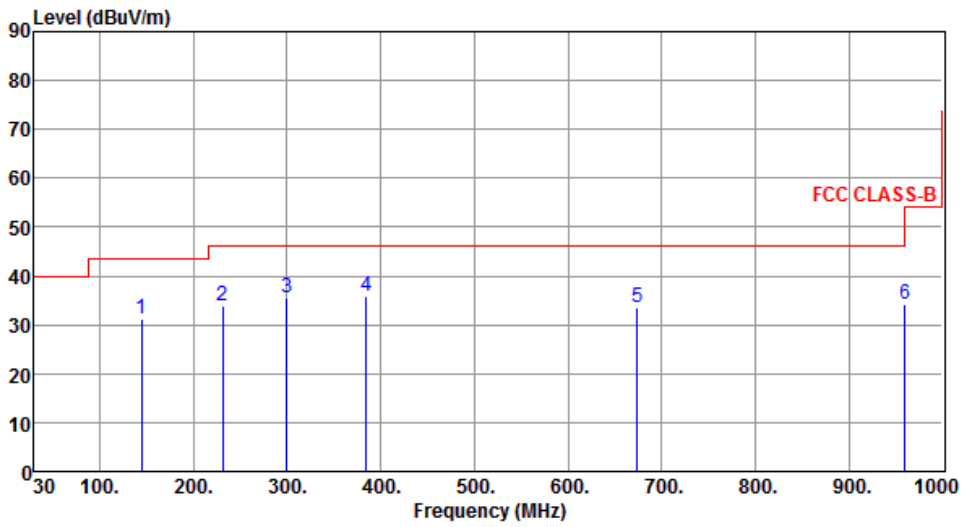
Modulation Mode	LoRa	Test Freq. (MHz)	922
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	232.47	31.52	46.00	-14.48	41.64	-10.12	Peak	---	---
2	299.41	31.21	46.00	-14.79	39.02	-7.81	Peak	---	---
3	374.59	32.52	46.00	-13.48	38.21	-5.69	Peak	---	---
4	384.69	33.99	46.00	-12.01	39.35	-5.36	Peak	---	---
5	449.52	36.21	46.00	-9.79	40.13	-3.92	Peak	---	---
6	960.00	35.14	46.00	-10.86	30.55	4.59	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

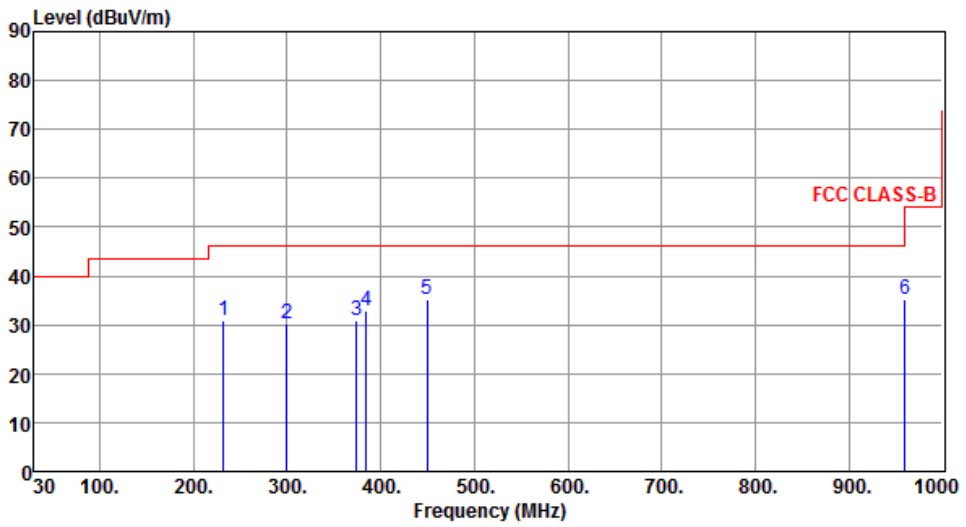
Modulation Mode	LoRa	Test Freq. (MHz)	927.7
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	144.35	31.08	43.50	-12.42	39.54	-8.46	Peak	---	---
2	231.68	33.99	46.00	-12.01	44.18	-10.19	Peak	---	---
3	300.06	35.55	46.00	-10.45	43.35	-7.80	Peak	---	---
4	384.35	35.74	46.00	-10.26	41.12	-5.38	Peak	---	---
5	674.29	33.47	46.00	-12.53	33.06	0.41	Peak	---	---
6	960.00	34.17	46.00	-11.83	29.58	4.59	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation Mode	LoRa	Test Freq. (MHz)	927.7
Polarization	Vertical		

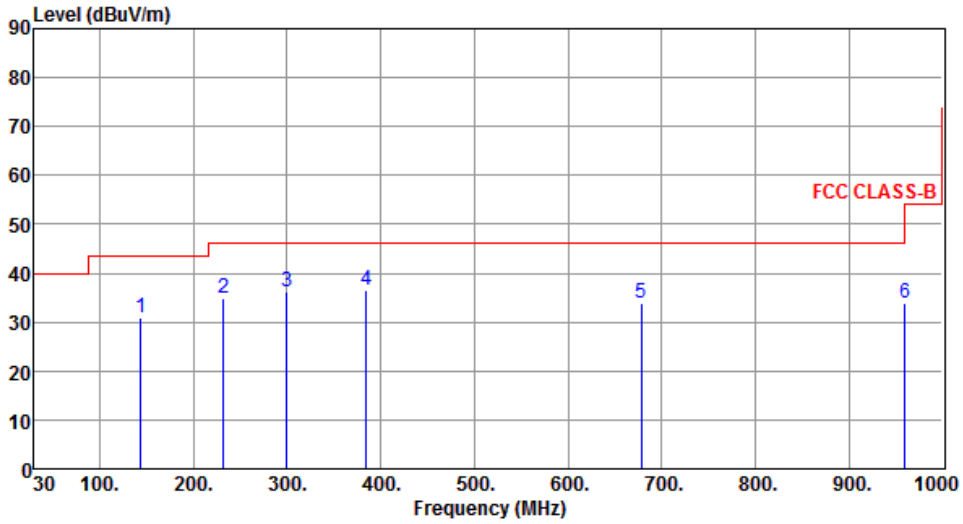


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	232.22	31.03	46.00	-14.97	41.17	-10.14	Peak	---	---
2	299.65	30.17	46.00	-15.83	37.98	-7.81	Peak	---	---
3	374.65	30.91	46.00	-15.09	36.60	-5.69	Peak	---	---
4	384.35	33.04	46.00	-12.96	38.42	-5.38	Peak	---	---
5	449.57	35.31	46.00	-10.69	39.23	-3.92	Peak	---	---
6	960.00	35.21	46.00	-10.79	30.62	4.59	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

LoRa 250 kHz

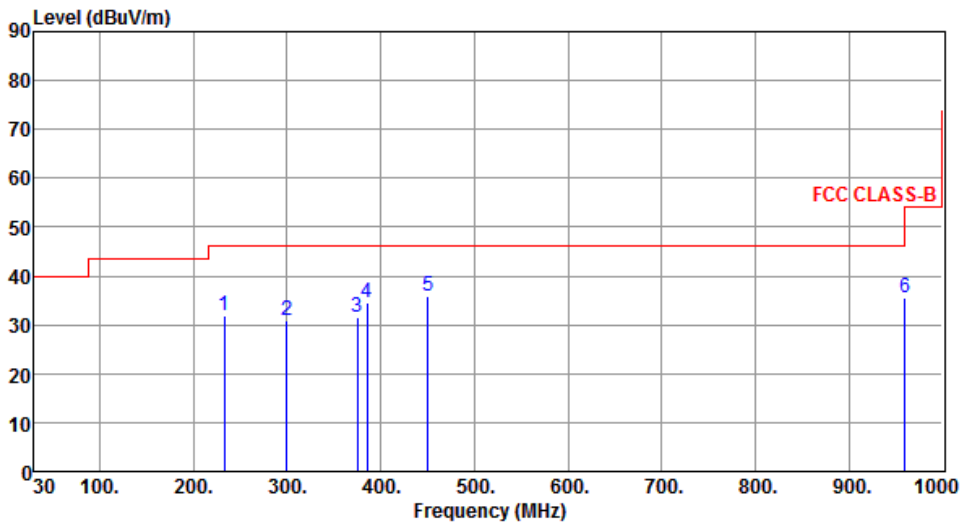
Modulation Mode	LoRa	**Test Freq. (MHz)**	916.5
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	144.24	30.75	43.50	-12.75	39.21	-8.46	Peak	---	---
2	231.98	34.85	46.00	-11.15	45.01	-10.16	Peak	---	---
3	299.41	36.28	46.00	-9.72	44.09	-7.81	Peak	---	---
4	384.67	36.41	46.00	-9.59	41.77	-5.36	Peak	---	---
5	678.54	33.78	46.00	-12.22	33.28	0.50	Peak	---	---
6	960.00	33.96	46.00	-12.04	29.37	4.59	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

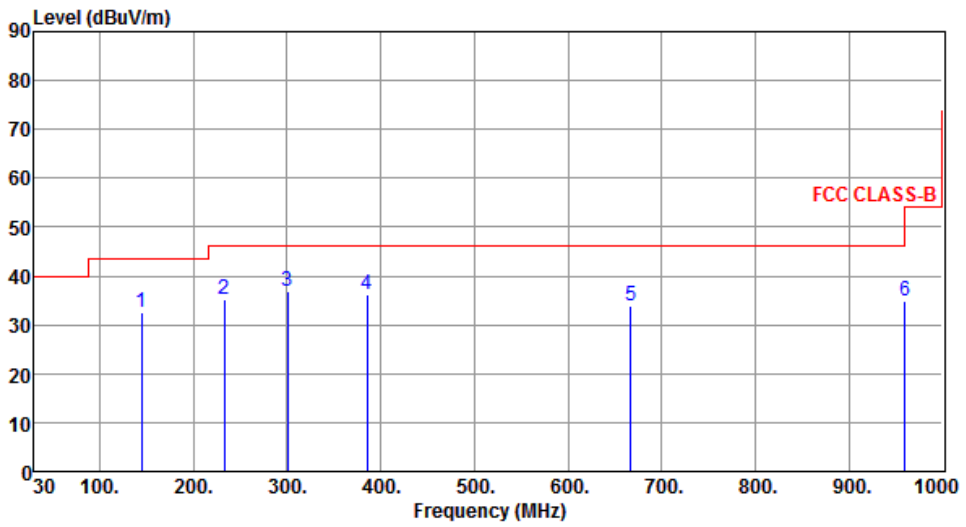
Modulation Mode	LoRa	Test Freq. (MHz)	916.5
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	232.74	31.85	46.00	-14.15	41.95	-10.10	Peak	---	---
2	299.89	30.85	46.00	-15.15	38.65	-7.80	Peak	---	---
3	375.14	31.58	46.00	-14.42	37.25	-5.67	Peak	---	---
4	385.24	34.51	46.00	-11.49	39.85	-5.34	Peak	---	---
5	450.58	35.85	46.00	-10.15	39.74	-3.89	Peak	---	---
6	960.00	35.58	46.00	-10.42	30.99	4.59	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

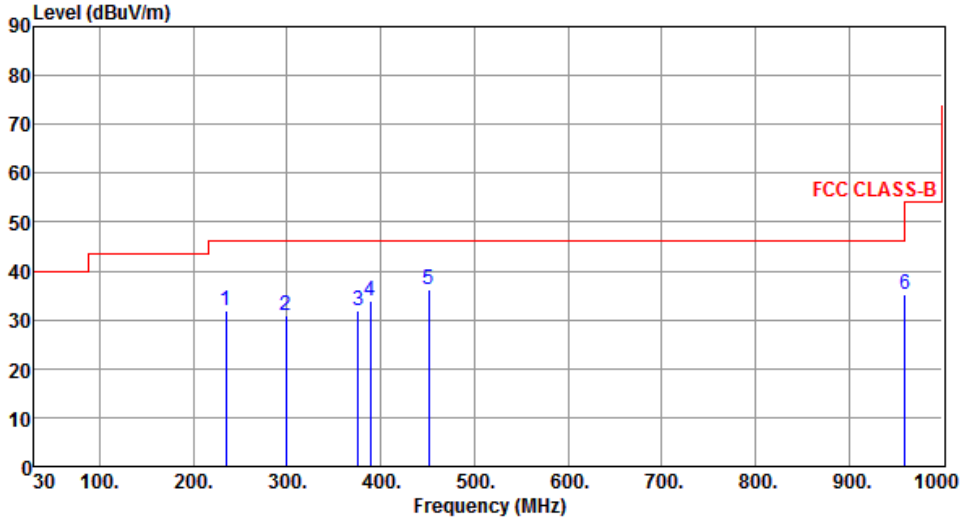
Modulation Mode	LoRa	Test Freq. (MHz)	922.2
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	144.85	32.55	43.50	-10.95	41.01	-8.46	Peak	---	---
2	232.74	35.21	46.00	-10.79	45.31	-10.10	Peak	---	---
3	300.25	36.88	46.00	-9.12	44.67	-7.79	Peak	---	---
4	385.44	36.21	46.00	-9.79	41.55	-5.34	Peak	---	---
5	666.88	33.96	46.00	-12.04	33.70	0.26	Peak	---	---
6	960.00	34.85	46.00	-11.15	30.26	4.59	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

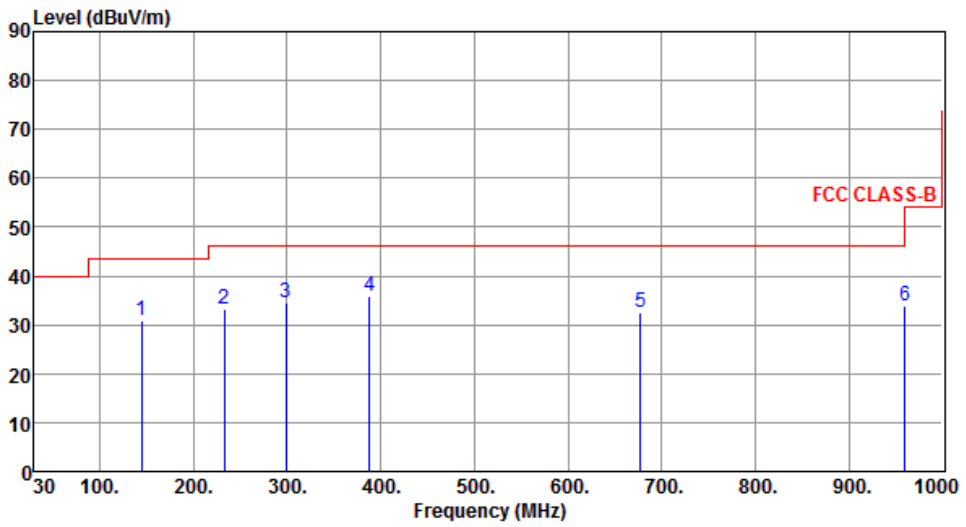
Modulation Mode	LoRa	Test Freq. (MHz)	922.2
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	234.52	31.85	46.00	-14.15	41.81	-9.96	Peak	---	---
2	298.52	30.77	46.00	-15.23	38.60	-7.83	Peak	---	---
3	375.85	31.85	46.00	-14.15	37.50	-5.65	Peak	---	---
4	389.21	33.96	46.00	-12.04	39.28	-5.32	Peak	---	---
5	451.21	36.22	46.00	-9.78	40.10	-3.88	Peak	---	---
6	960.00	35.21	46.00	-10.79	30.62	4.59	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

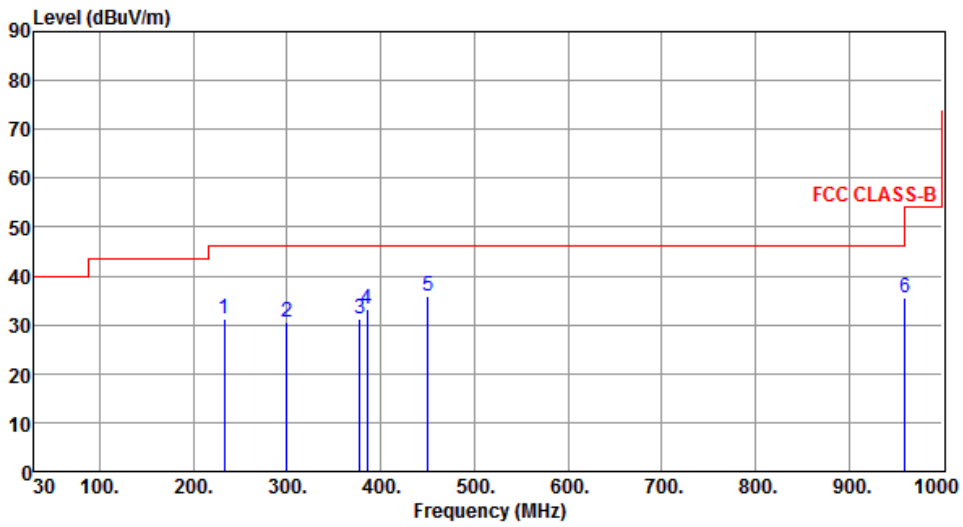
Modulation Mode	LoRa	Test Freq. (MHz)	927.6
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	144.43	30.81	43.50	-12.69	39.27	-8.46	Peak	---	---
2	232.87	33.30	46.00	-12.70	43.39	-10.09	Peak	---	---
3	299.26	34.59	46.00	-11.41	42.40	-7.81	Peak	---	---
4	388.29	35.83	46.00	-10.17	41.16	-5.33	Peak	---	---
5	677.25	32.69	46.00	-13.31	32.21	0.48	Peak	---	---
6	960.00	33.81	46.00	-12.19	29.22	4.59	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation Mode	LoRa	Test Freq. (MHz)	927.6
Polarization	Vertical		

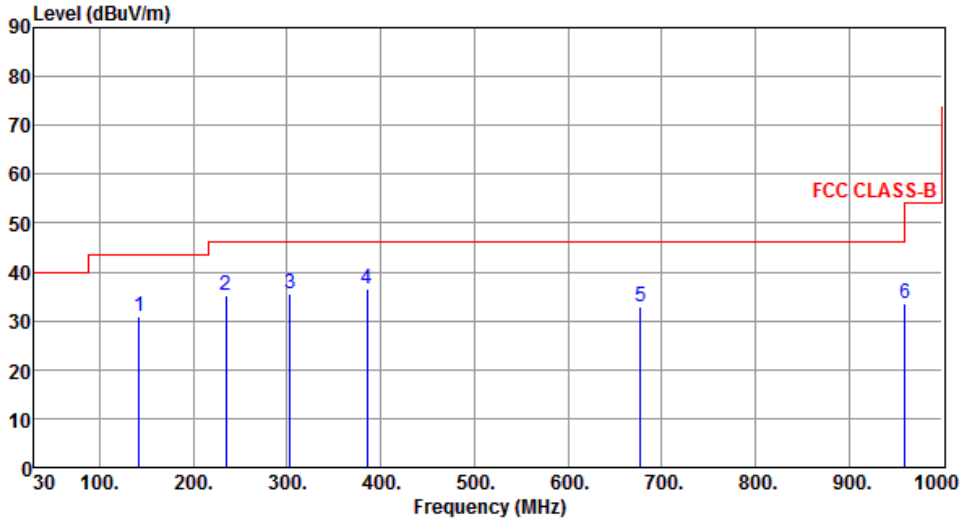


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	233.31	31.06	46.00	-14.94	41.12	-10.06	Peak	---	---
2	299.65	30.54	46.00	-15.46	38.35	-7.81	Peak	---	---
3	377.35	31.36	46.00	-14.64	36.98	-5.62	Peak	---	---
4	385.27	33.22	46.00	-12.78	38.56	-5.34	Peak	---	---
5	450.27	35.98	46.00	-10.02	39.87	-3.89	Peak	---	---
6	960.00	35.62	46.00	-10.38	31.03	4.59	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

FSK 50kbps

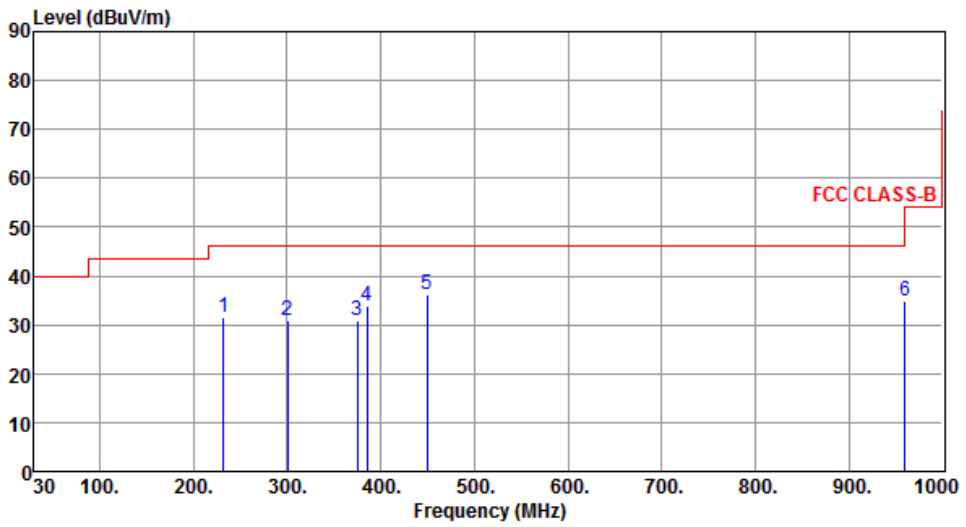
Modulation Mode	FSK	**Test Freq. (MHz)**	916
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	142.24	30.89	43.50	-12.61	39.45	-8.56	Peak	---	---
2	234.51	35.21	46.00	-10.79	45.17	-9.96	Peak	---	---
3	303.27	35.45	46.00	-10.55	43.17	-7.72	Peak	---	---
4	385.32	36.52	46.00	-9.48	41.86	-5.34	Peak	---	---
5	677.21	32.87	46.00	-13.13	32.40	0.47	Peak	---	---
6	960.20	33.44	54.00	-20.56	28.85	4.59	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

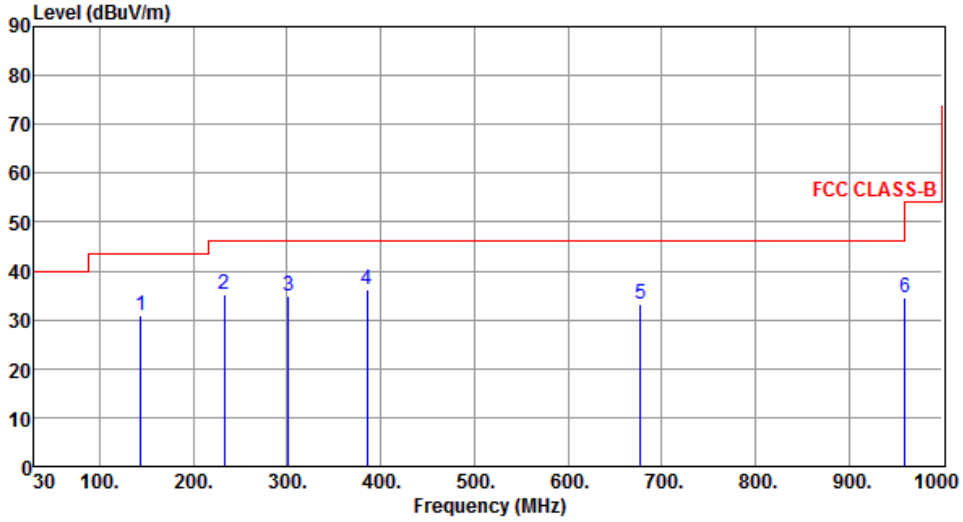
Modulation Mode	FSK	Test Freq. (MHz)	916
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	232.47	31.47	46.00	-14.53	41.59	-10.12	Peak	---	---
2	300.21	30.88	46.00	-15.12	38.68	-7.80	Peak	---	---
3	375.25	30.74	46.00	-15.26	36.41	-5.67	Peak	---	---
4	385.24	33.75	46.00	-12.25	39.09	-5.34	Peak	---	---
5	449.54	36.36	46.00	-9.64	40.28	-3.92	Peak	---	---
6	960.00	34.89	46.00	-11.11	30.30	4.59	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

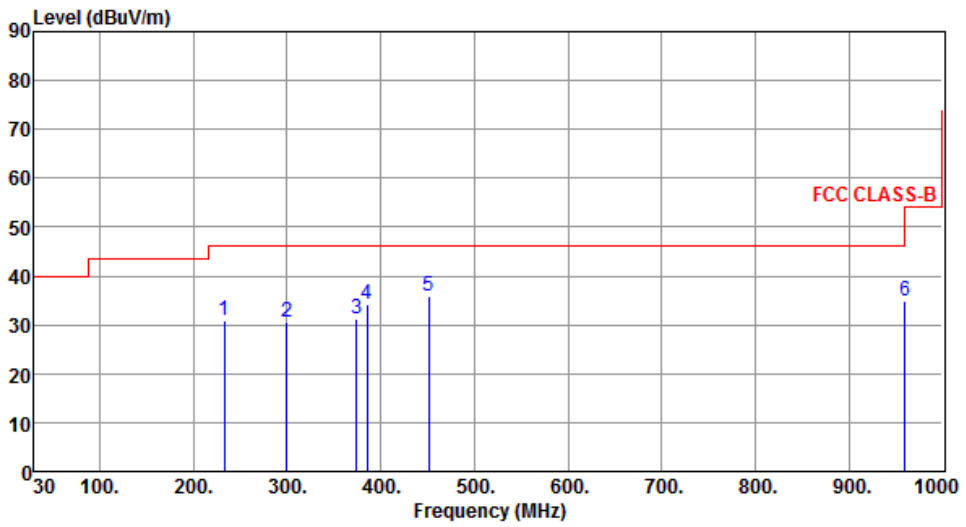
Modulation Mode	FSK	Test Freq. (MHz)	922
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	144.21	30.89	43.50	-12.61	39.35	-8.46	Peak	---	---
2	232.74	35.21	46.00	-10.79	45.31	-10.10	Peak	---	---
3	301.21	34.86	46.00	-11.14	42.64	-7.78	Peak	---	---
4	385.20	36.25	46.00	-9.75	41.59	-5.34	Peak	---	---
5	677.21	33.28	46.00	-12.72	32.81	0.47	Peak	---	---
6	960.00	34.52	46.00	-11.48	29.93	4.59	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

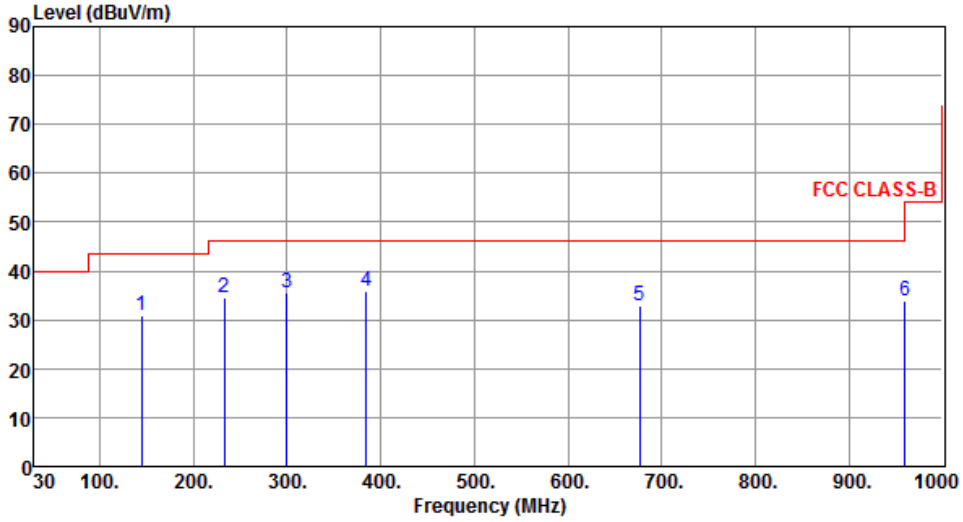
Modulation Mode	FSK	Test Freq. (MHz)	922
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	233.24	30.85	46.00	-15.15	40.91	-10.06	Peak	---	---
2	299.54	30.57	46.00	-15.43	38.38	-7.81	Peak	---	---
3	374.24	31.21	46.00	-14.79	36.91	-5.70	Peak	---	---
4	385.24	34.24	46.00	-11.76	39.58	-5.34	Peak	---	---
5	451.21	35.96	46.00	-10.04	39.84	-3.88	Peak	---	---
6	960.00	34.78	46.00	-11.22	30.19	4.59	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

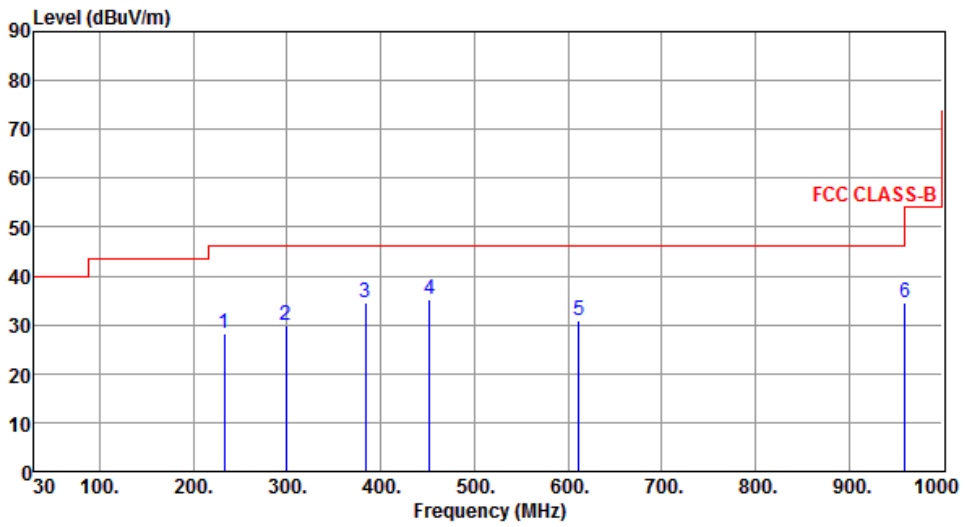
Modulation Mode	FSK	Test Freq. (MHz)	927.8
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	144.29	30.97	43.50	-12.53	39.43	-8.46	Peak	---	---
2	232.65	34.41	46.00	-11.59	44.52	-10.11	Peak	---	---
3	299.53	35.54	46.00	-10.46	43.35	-7.81	Peak	---	---
4	384.26	35.74	46.00	-10.26	41.12	-5.38	Peak	---	---
5	676.59	32.73	46.00	-13.27	32.27	0.46	Peak	---	---
6	960.00	33.77	46.00	-12.23	29.18	4.59	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation Mode	FSK	Test Freq. (MHz)	927.8
Polarization	Vertical		



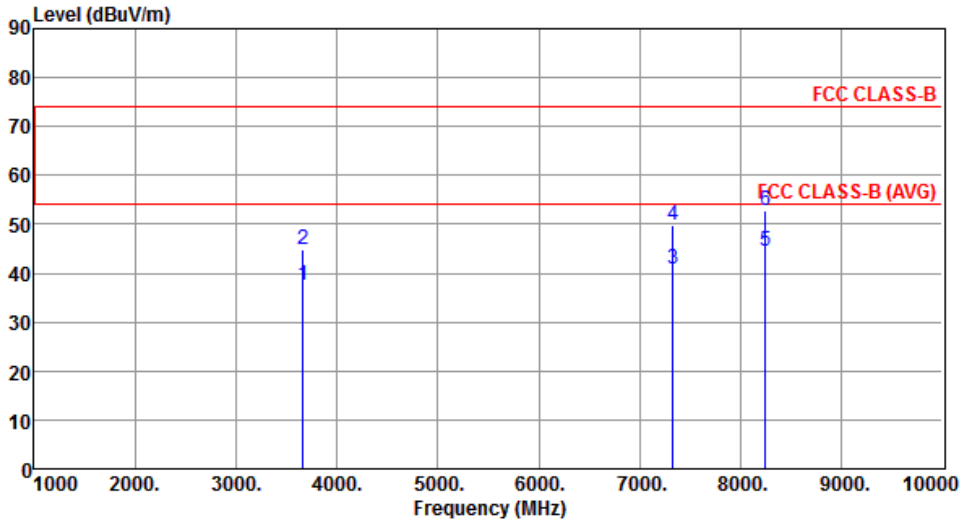
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	232.73	28.24	46.00	-17.76	38.34	-10.10	Peak	---	---
2	298.69	29.85	46.00	-16.15	37.68	-7.83	Peak	---	---
3	384.05	34.70	46.00	-11.30	40.09	-5.39	Peak	---	---
4	451.95	35.27	46.00	-10.73	39.13	-3.86	Peak	---	---
5	612.00	30.86	46.00	-15.14	31.30	-0.44	Peak	---	---
6	960.00	34.70	46.00	-11.30	30.11	4.59	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

3.2.6 Transmitter Spurious Emissions (Above 1GHz)

LoRa 125 kHz

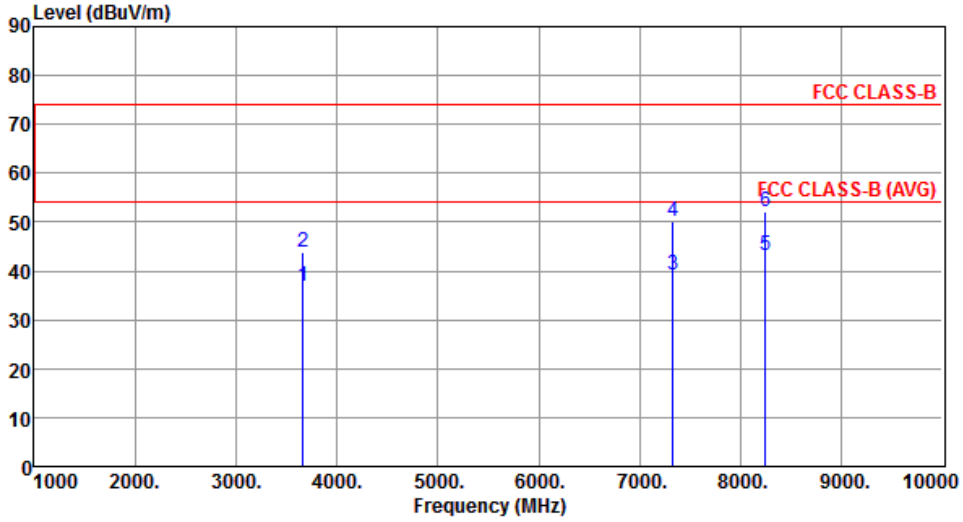
Modulation Mode	LoRa	**Test Freq. (MHz)**	916.5
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3666.00	37.44	54.00	-16.56	37.15	0.29	Average	287	16
2	3666.00	44.74	74.00	-29.26	44.45	0.29	Peak	287	16
3	7332.00	40.74	54.00	-13.26	31.98	8.76	Average	210	56
4	7332.00	49.74	74.00	-24.26	40.98	8.76	Peak	210	56
5	8248.50	44.65	54.00	-9.35	35.52	9.13	Average	199	31
6	8248.50	52.84	74.00	-21.16	43.71	9.13	Peak	199	31

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

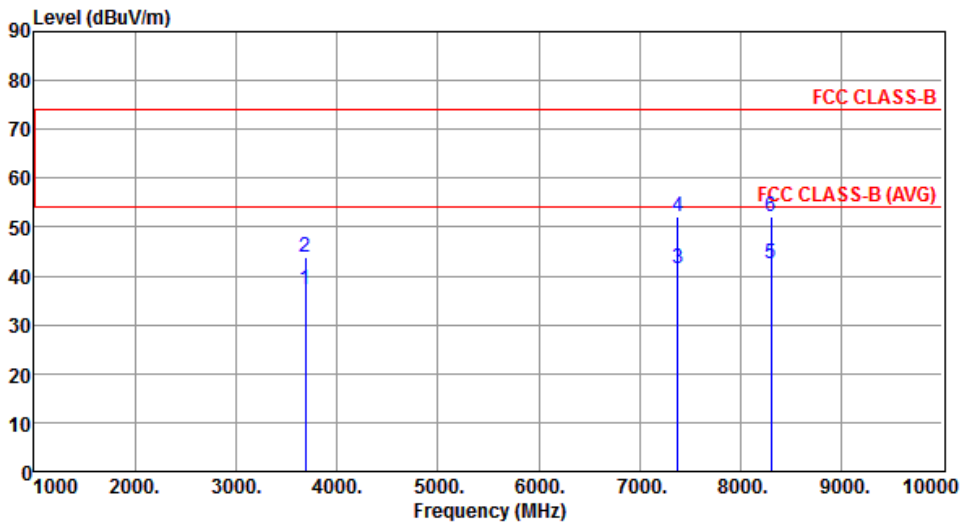
Modulation Mode	LoRa	Test Freq. (MHz)	916.5
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3666.00	36.78	54.00	-17.22	36.49	0.29	Average	301	351
2	3666.00	43.89	74.00	-30.11	43.60	0.29	Peak	301	351
3	7332.00	39.22	54.00	-14.78	30.46	8.76	Average	288	350
4	7332.00	50.10	74.00	-23.90	41.34	8.76	Peak	288	350
5	8248.50	43.21	54.00	-10.79	34.08	9.13	Average	284	14
6	8248.50	52.01	74.00	-21.99	42.88	9.13	Peak	284	14

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

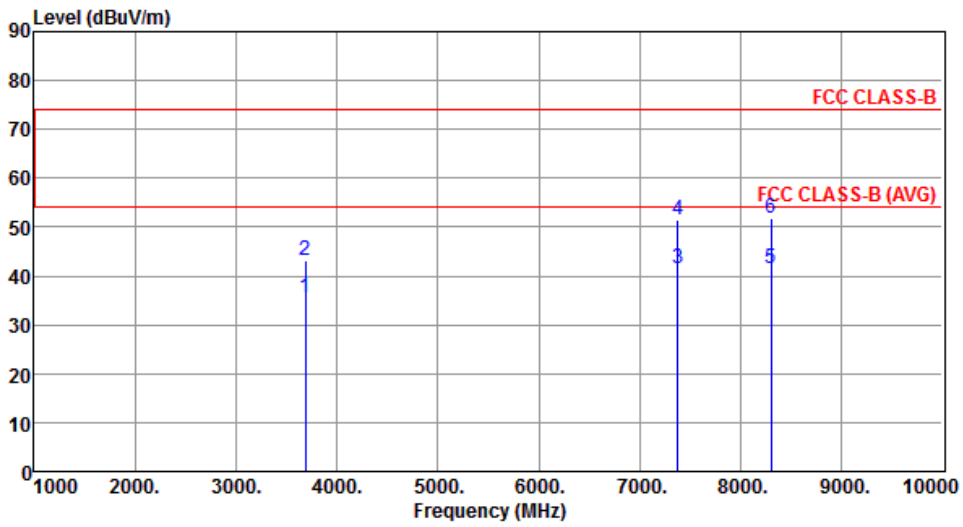
Modulation Mode	LoRa	Test Freq. (MHz)	922
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3688.00	37.18	54.00	-16.82	36.91	0.27	Average	284	16
2	3688.00	43.98	74.00	-30.02	43.71	0.27	Peak	284	16
3	7376.00	41.40	54.00	-12.60	32.80	8.60	Average	220	51
4	7376.00	52.00	74.00	-22.00	43.40	8.60	Peak	220	51
5	8298.00	42.57	54.00	-11.43	33.42	9.15	Average	215	42
6	8298.00	52.14	74.00	-21.86	42.99	9.15	Peak	215	42

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

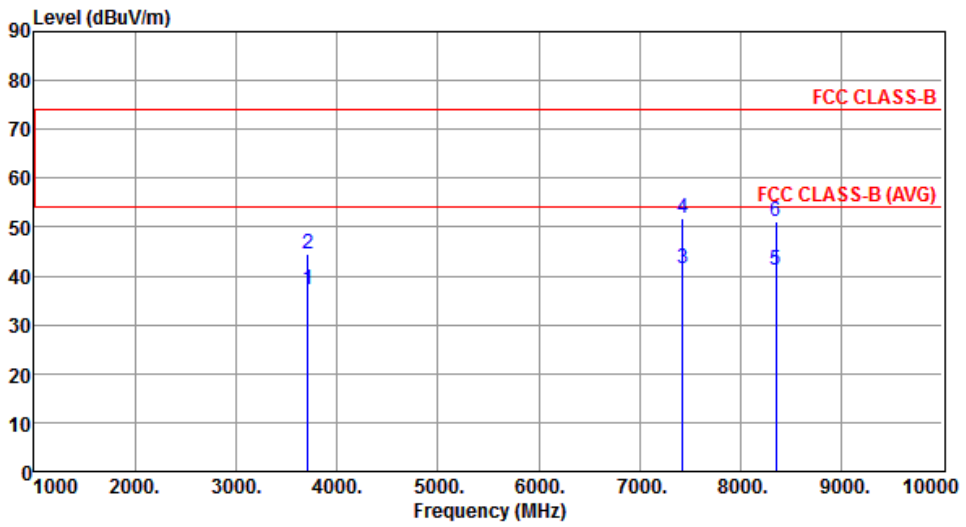
Modulation Mode	LoRa	Test Freq. (MHz)	922
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3688.00	35.40	54.00	-18.60	35.13	0.27	Average	284	310
2	3688.00	43.14	74.00	-30.86	42.87	0.27	Peak	284	310
3	7376.00	41.57	54.00	-12.43	32.97	8.60	Average	279	211
4	7376.00	51.58	74.00	-22.42	42.98	8.60	Peak	279	211
5	8298.00	41.54	54.00	-12.46	32.39	9.15	Average	286	13
6	8298.00	51.70	74.00	-22.30	42.55	9.15	Peak	286	13

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

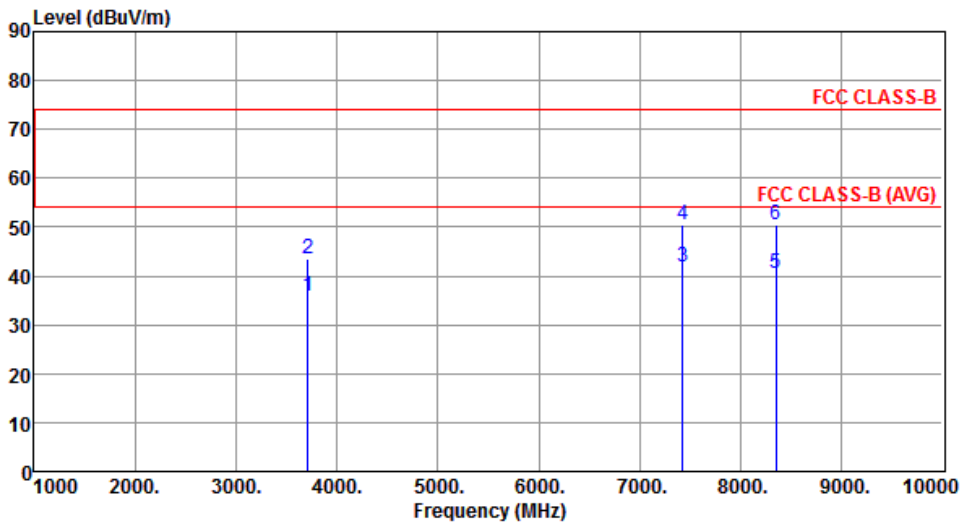
Modulation Mode	LoRa	Test Freq. (MHz)	927.7
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3710.80	37.19	54.00	-16.81	36.88	0.31	Average	263	13
2	3710.80	44.47	74.00	-29.53	44.16	0.31	Peak	263	13
3	7421.60	41.40	54.00	-12.60	32.89	8.51	Average	220	45
4	7421.60	51.73	74.00	-22.27	43.22	8.51	Peak	220	45
5	8349.30	41.33	54.00	-12.67	32.26	9.07	Average	208	42
6	8349.30	51.07	74.00	-22.93	42.00	9.07	Peak	208	42

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation Mode	LoRa	Test Freq. (MHz)	927.7
Polarization	Vertical		

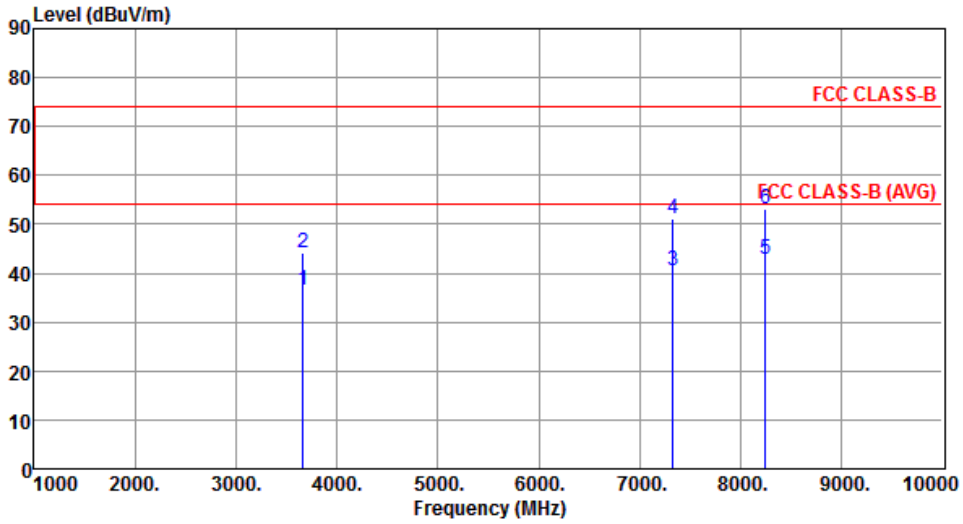


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3710.80	35.86	54.00	-18.14	35.55	0.31	Average	311	315
2	3710.80	43.47	74.00	-30.53	43.16	0.31	Peak	311	315
3	7421.60	41.76	54.00	-12.24	33.25	8.51	Average	265	256
4	7421.60	50.62	74.00	-23.38	42.11	8.51	Peak	265	256
5	8349.30	40.63	54.00	-13.37	31.56	9.07	Average	271	11
6	8349.30	50.52	74.00	-23.48	41.45	9.07	Peak	271	11

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

LoRa 250 kHz

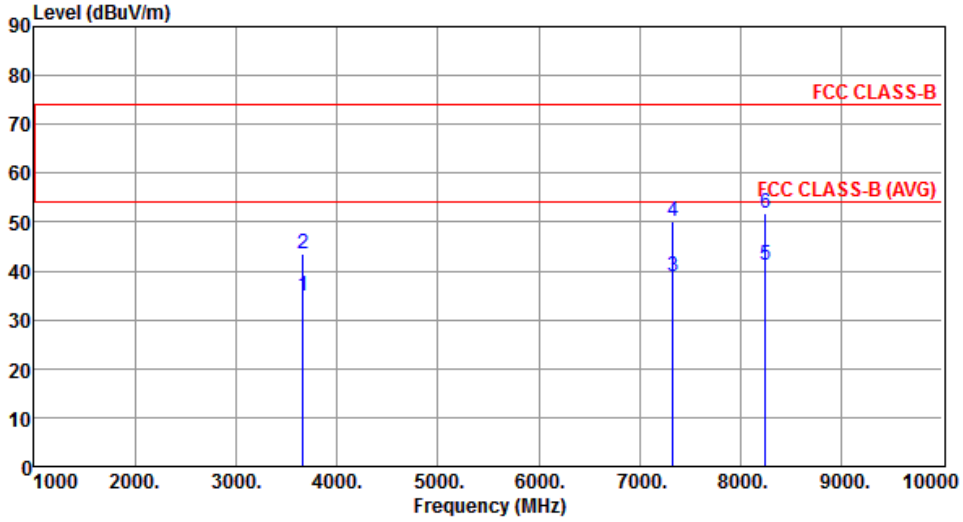
Modulation Mode	LoRa	**Test Freq. (MHz)**	916.5
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3666.00	36.41	54.00	-17.59	36.12	0.29	Average	282	23
2	3666.00	44.14	74.00	-29.86	43.85	0.29	Peak	282	23
3	7332.00	40.52	54.00	-13.48	31.76	8.76	Average	212	49
4	7332.00	51.15	74.00	-22.85	42.39	8.76	Peak	212	49
5	8248.50	42.86	54.00	-11.14	33.73	9.13	Average	209	32
6	8248.50	53.08	74.00	-20.92	43.95	9.13	Peak	209	32

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

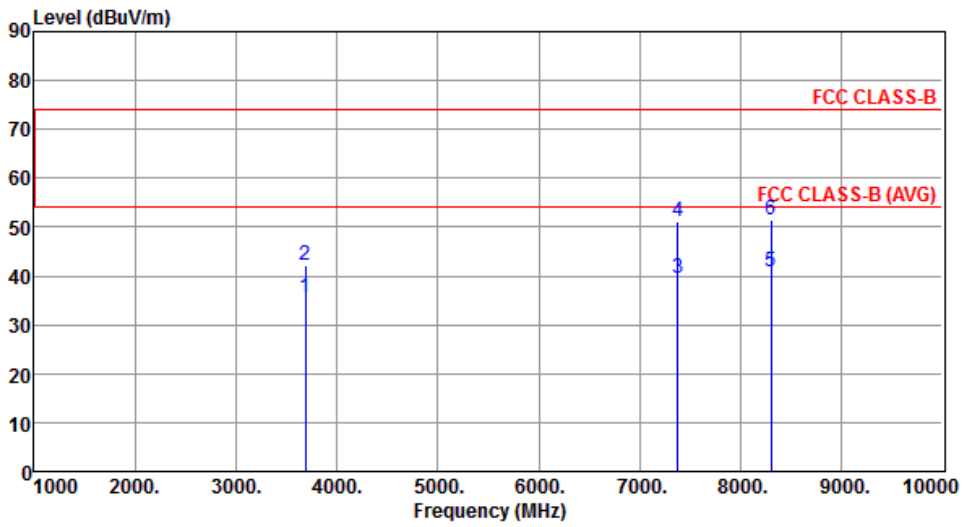
Modulation Mode	LoRa	Test Freq. (MHz)	916.5
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3666.00	34.85	54.00	-19.15	34.56	0.29	Average	315	342
2	3666.00	43.52	74.00	-30.48	43.23	0.29	Peak	315	342
3	7332.00	38.70	54.00	-15.30	29.94	8.76	Average	298	340
4	7332.00	50.24	74.00	-23.76	41.48	8.76	Peak	298	340
5	8248.50	41.17	54.00	-12.83	32.04	9.13	Average	281	14
6	8248.50	51.66	74.00	-22.34	42.53	9.13	Peak	281	14

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

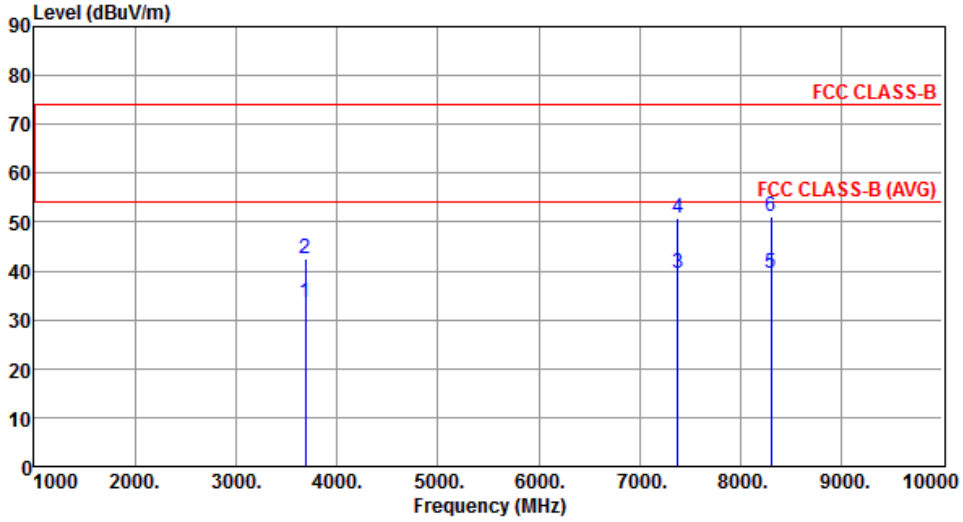
Modulation Mode	LoRa	Test Freq. (MHz)	922.2
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3688.00	35.44	54.00	-18.56	35.17	0.27	Average	283	17
2	3688.00	42.10	74.00	-31.90	41.83	0.27	Peak	283	17
3	7376.00	39.44	54.00	-14.56	30.84	8.60	Average	210	42
4	7376.00	51.04	74.00	-22.96	42.44	8.60	Peak	210	42
5	8298.00	40.75	54.00	-13.25	31.60	9.15	Average	211	45
6	8298.00	51.42	74.00	-22.58	42.27	9.15	Peak	211	45

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

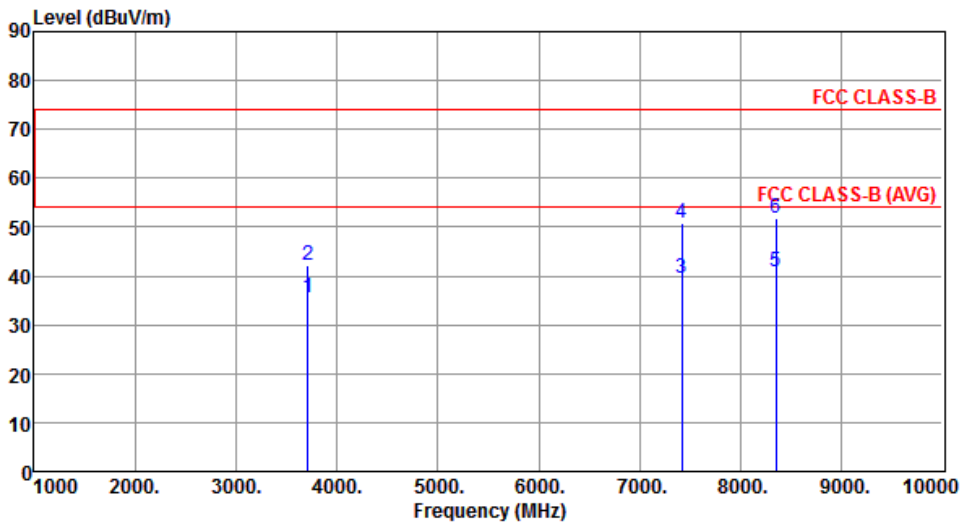
Modulation Mode	LoRa	Test Freq. (MHz)	922.2
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3688.00	33.48	54.00	-20.52	33.21	0.27	Average	281	310
2	3688.00	42.57	74.00	-31.43	42.30	0.27	Peak	281	310
3	7376.00	39.45	54.00	-14.55	30.85	8.60	Average	286	211
4	7376.00	50.84	74.00	-23.16	42.24	8.60	Peak	286	211
5	8298.00	39.51	54.00	-14.49	30.36	9.15	Average	284	12
6	8298.00	51.14	74.00	-22.86	41.99	9.15	Peak	284	12

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

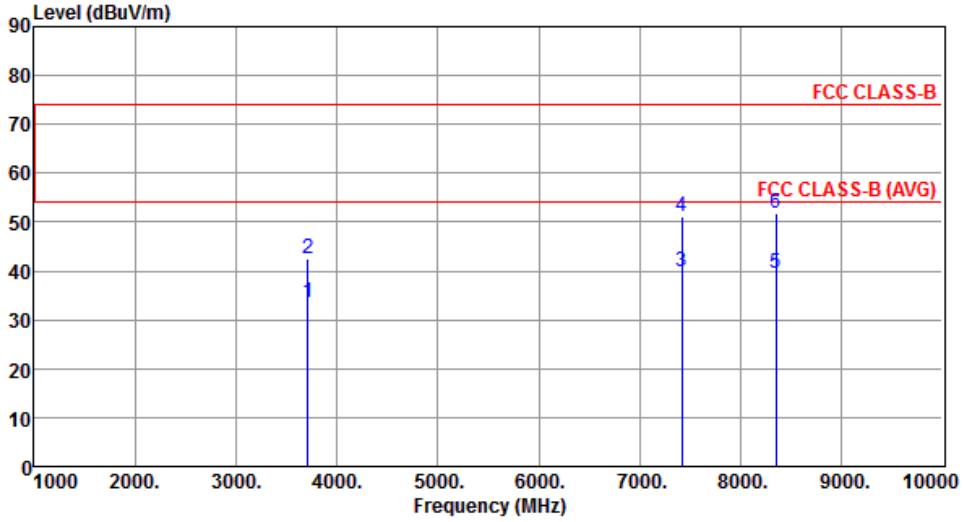
Modulation Mode	LoRa	Test Freq. (MHz)	927.6
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3710.40	35.41	54.00	-18.59	35.10	0.31	Average	287	17
2	3710.40	42.29	74.00	-31.71	41.98	0.31	Peak	287	17
3	7420.80	39.53	54.00	-14.47	31.02	8.51	Average	210	42
4	7420.80	50.79	74.00	-23.21	42.28	8.51	Peak	210	42
5	8348.40	40.70	54.00	-13.30	31.63	9.07	Average	213	48
6	8348.40	51.71	74.00	-22.29	42.64	9.07	Peak	213	48

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation Mode	LoRa	Test Freq. (MHz)	927.6
Polarization	Vertical		

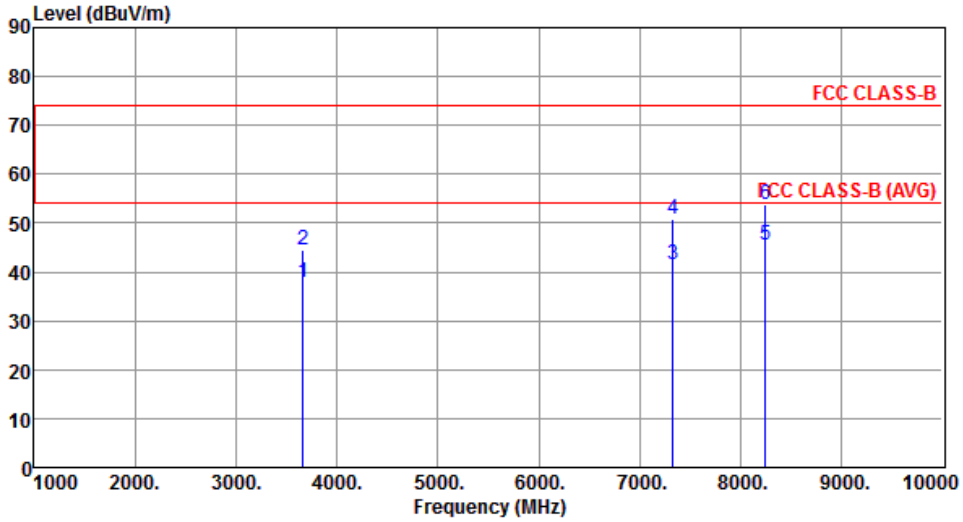


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3710.40	33.47	54.00	-20.53	33.16	0.31	Average	284	302
2	3710.40	42.64	74.00	-31.36	42.33	0.31	Peak	284	302
3	7420.80	39.79	54.00	-14.21	31.28	8.51	Average	286	208
4	7420.80	50.98	74.00	-23.02	42.47	8.51	Peak	286	208
5	8348.40	39.64	54.00	-14.36	30.57	9.07	Average	296	20
6	8348.40	51.82	74.00	-22.18	42.75	9.07	Peak	296	20

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

FSK 50kbps

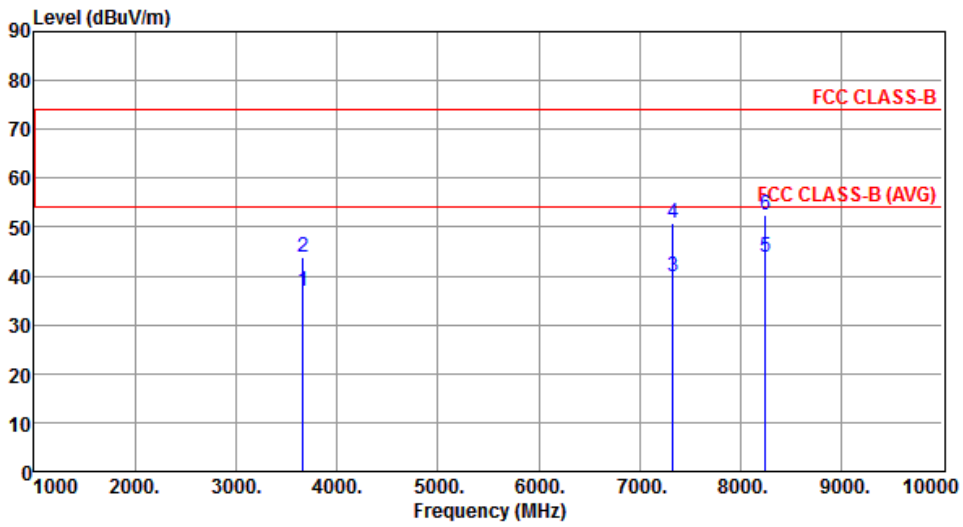
Modulation Mode	FSK	**Test Freq. (MHz)**	916
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3664.00	37.71	54.00	-16.29	37.42	0.29	Average	291	12
2	3664.00	44.47	74.00	-29.53	44.18	0.29	Peak	291	12
3	7328.00	41.42	54.00	-12.58	32.65	8.77	Average	223	50
4	7328.00	50.80	74.00	-23.20	42.03	8.77	Peak	223	50
5	8244.00	45.54	54.00	-8.46	36.38	9.16	Average	217	29
6	8244.00	53.84	74.00	-20.16	44.68	9.16	Peak	217	29

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

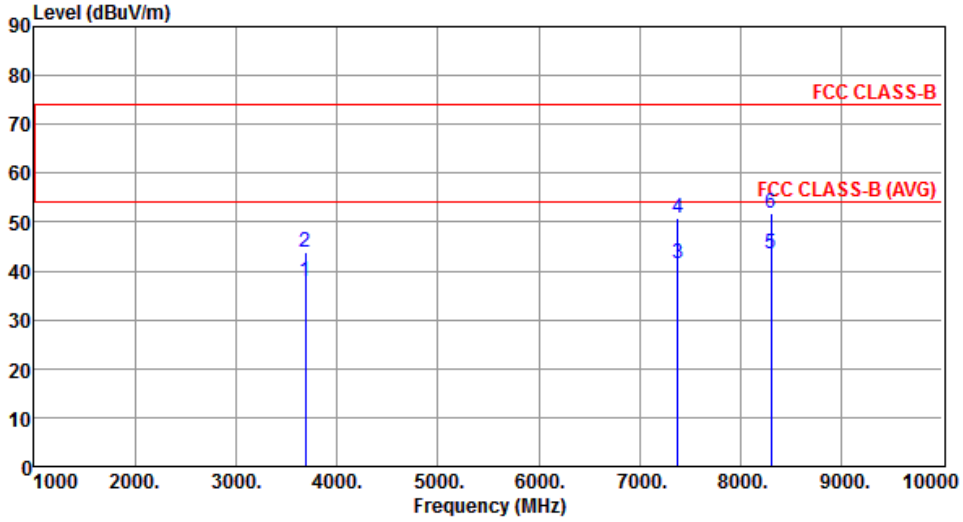
Modulation Mode	FSK	Test Freq. (MHz)	916
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3664.00	36.85	54.00	-17.15	36.56	0.29	Average	299	331
2	3664.00	43.95	74.00	-30.05	43.66	0.29	Peak	299	331
3	7328.00	39.75	54.00	-14.25	30.98	8.77	Average	301	340
4	7328.00	50.75	74.00	-23.25	41.98	8.77	Peak	301	340
5	8244.00	43.68	54.00	-10.32	34.52	9.16	Average	287	18
6	8244.00	52.47	74.00	-21.53	43.31	9.16	Peak	287	18

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

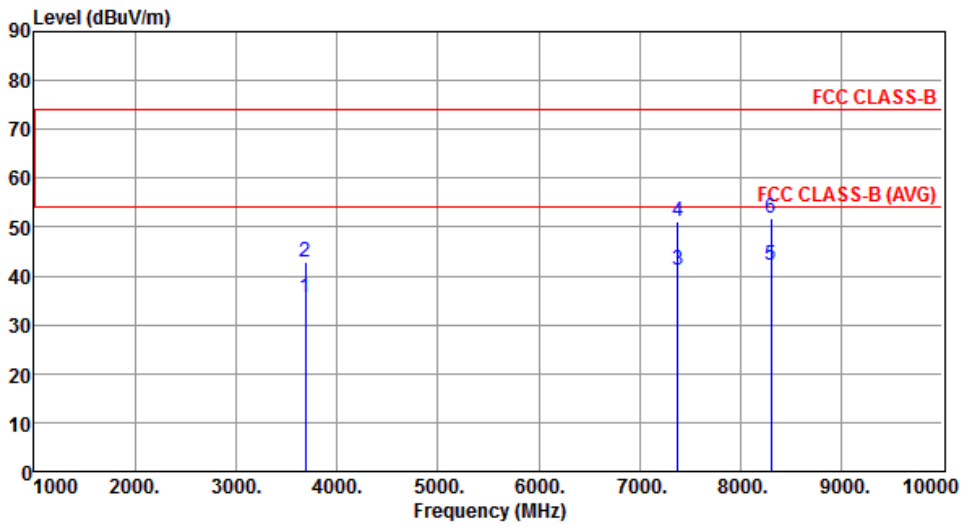
Modulation Mode	FSK	Test Freq. (MHz)	922
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3688.00	37.85	54.00	-16.15	37.58	0.27	Average	278	15
2	3688.00	43.80	74.00	-30.20	43.53	0.27	Peak	278	15
3	7376.00	41.44	54.00	-12.56	32.84	8.60	Average	211	50
4	7376.00	50.84	74.00	-23.16	42.24	8.60	Peak	211	50
5	8298.00	43.41	54.00	-10.59	34.26	9.15	Average	215	45
6	8298.00	51.87	74.00	-22.13	42.72	9.15	Peak	215	45

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

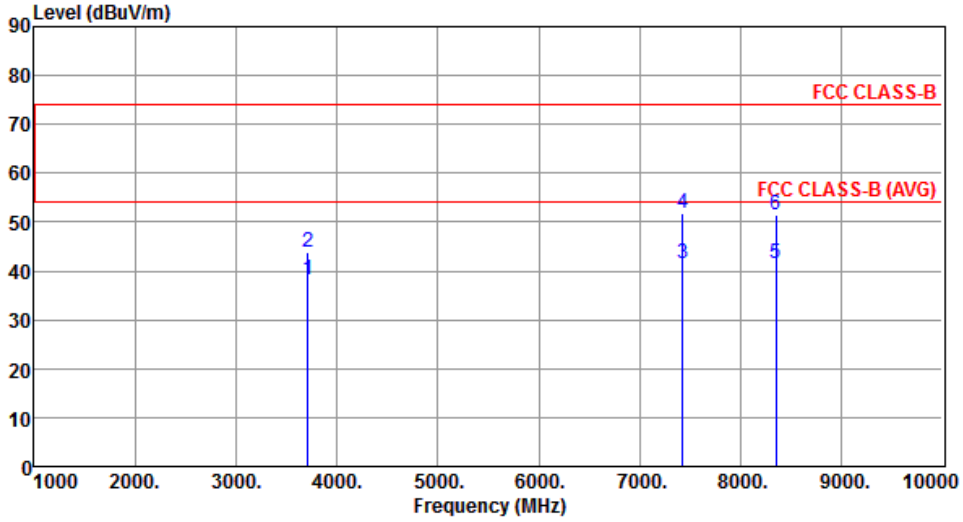
Modulation Mode	FSK	Test Freq. (MHz)	922
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3688.00	35.47	54.00	-18.53	35.20	0.27	Average	284	321
2	3688.00	42.89	74.00	-31.11	42.62	0.27	Peak	284	321
3	7376.00	41.24	54.00	-12.76	32.64	8.60	Average	285	210
4	7376.00	51.24	74.00	-22.76	42.64	8.60	Peak	285	210
5	8298.00	42.14	54.00	-11.86	32.99	9.15	Average	277	20
6	8298.00	51.74	74.00	-22.26	42.59	9.15	Peak	277	20

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

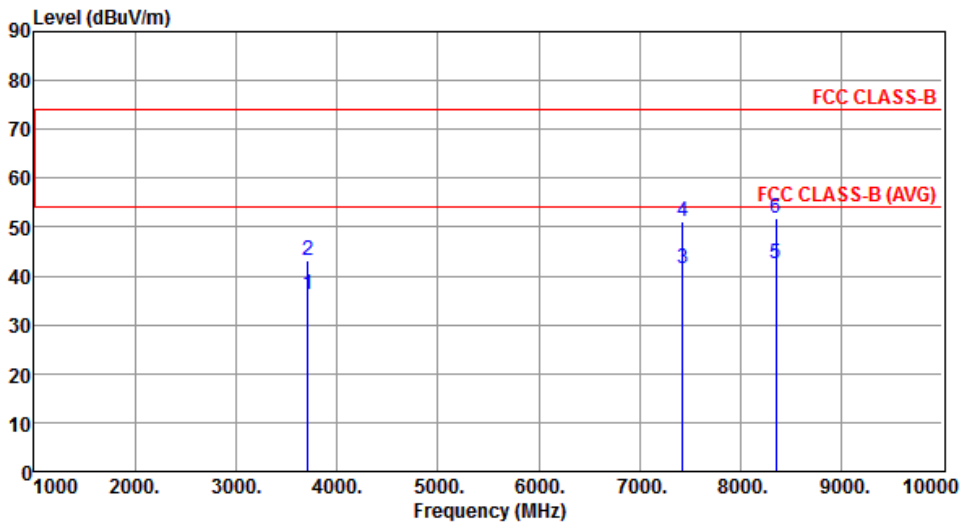
Modulation Mode	FSK	Test Freq. (MHz)	927.8
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3711.20	38.07	54.00	-15.93	37.76	0.31	Average	283	12
2	3711.20	43.86	74.00	-30.14	43.55	0.31	Peak	283	12
3	7422.40	41.39	54.00	-12.61	32.88	8.51	Average	212	44
4	7422.40	51.86	74.00	-22.14	43.35	8.51	Peak	212	44
5	8350.20	41.41	54.00	-12.59	32.33	9.08	Average	210	41
6	8350.20	51.36	74.00	-22.64	42.28	9.08	Peak	210	41

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation Mode	FSK	Test Freq. (MHz)	927.8
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	3711.20	36.33	54.00	-17.67	36.02	0.31	Average	281	306
2	3711.20	43.06	74.00	-30.94	42.75	0.31	Peak	281	306
3	7422.40	41.46	54.00	-12.54	32.95	8.51	Average	288	211
4	7422.40	51.24	74.00	-22.76	42.73	8.51	Peak	288	211
5	8350.20	42.37	54.00	-11.63	33.29	9.08	Average	288	25
6	8350.20	51.95	74.00	-22.05	42.87	9.08	Peak	288	25

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

3.3 Transmitter Unwanted Emissions in the Spurious Domain

3.3.1 Emissions Limit

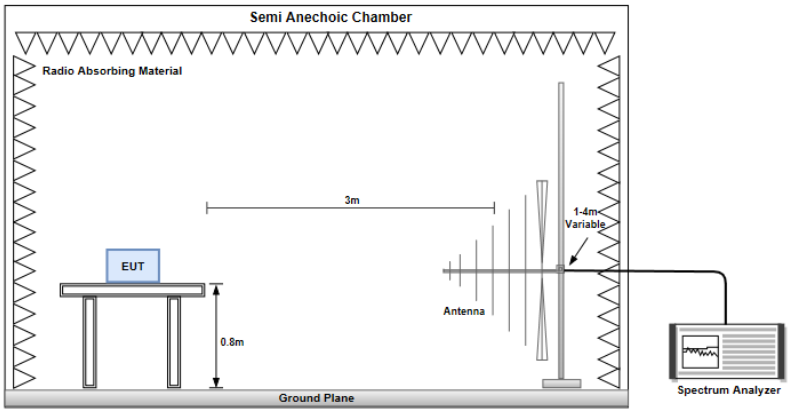
Transmissions must not exceed the following unwanted emission limits: –79 dBW (–49 dBm) e.i.r.p. within 800 – 915 MHz and –63 dBW (–33 dBm) e.i.r.p. within 928 MHz – 1 GHz. The reference bandwidth for emissions is 100 kHz.

Note: Limit is from "NEW ZEALAND https://www.gazette.govt.nz/notice/id/2017-go4089 special condition23"

3.3.2 Test Procedures

Set RBW= VBW= 10 kHz, Detector = Average, using band power measurement function to integrate output power over 100 kHz.

3.3.3 Test Setup



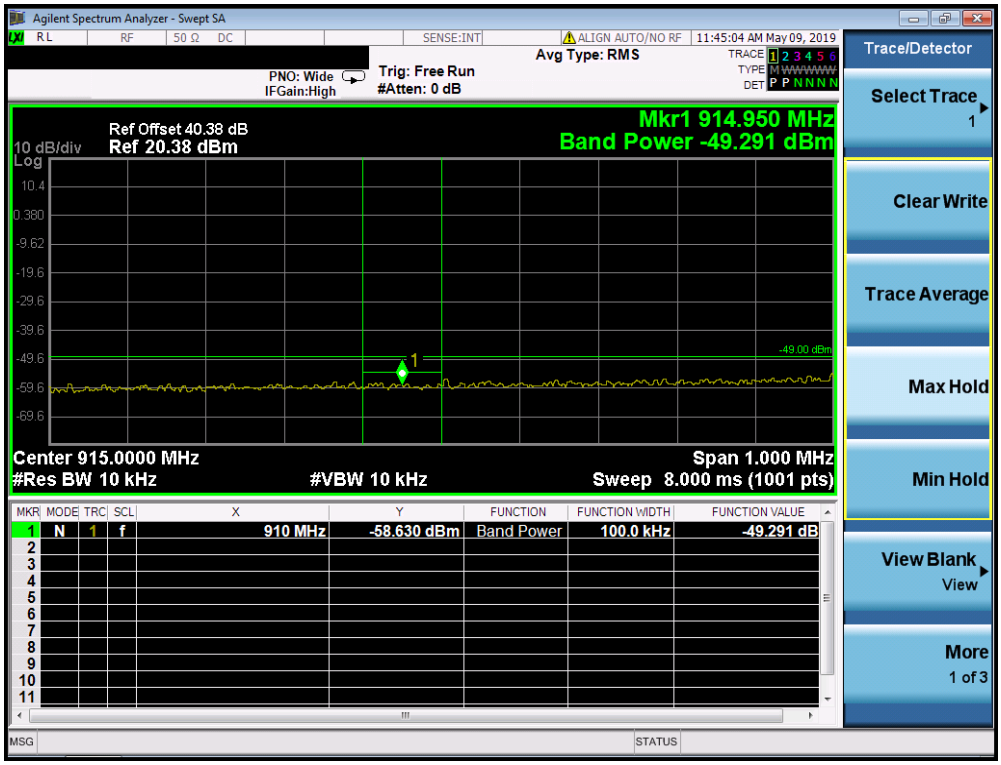
3.3.4 Test Results

Mode	Center Frequency (MHz)	Measured Frequency (MHz)	Measured Level (dBm)	Limit (dBm)
LoRa 125 kHz	916.5	914.95	-49.291	-49
		928.05	-54.264	-33
	927.7	914.95	-54.722	-49
		928.275	-33.821	-33
LoRa 250 kHz	916.5	914.95	-49.398	-49
		928.05	-54.937	-33
	927.6	914.95	-55.047	-49
		928.05	-33.760	-33
FSK 50kbps	916	914.95	-49.442	-49
		928.05	-55.171	-33
	927.8	914.95	-55.031	-49
		928.05	-33.420	-33

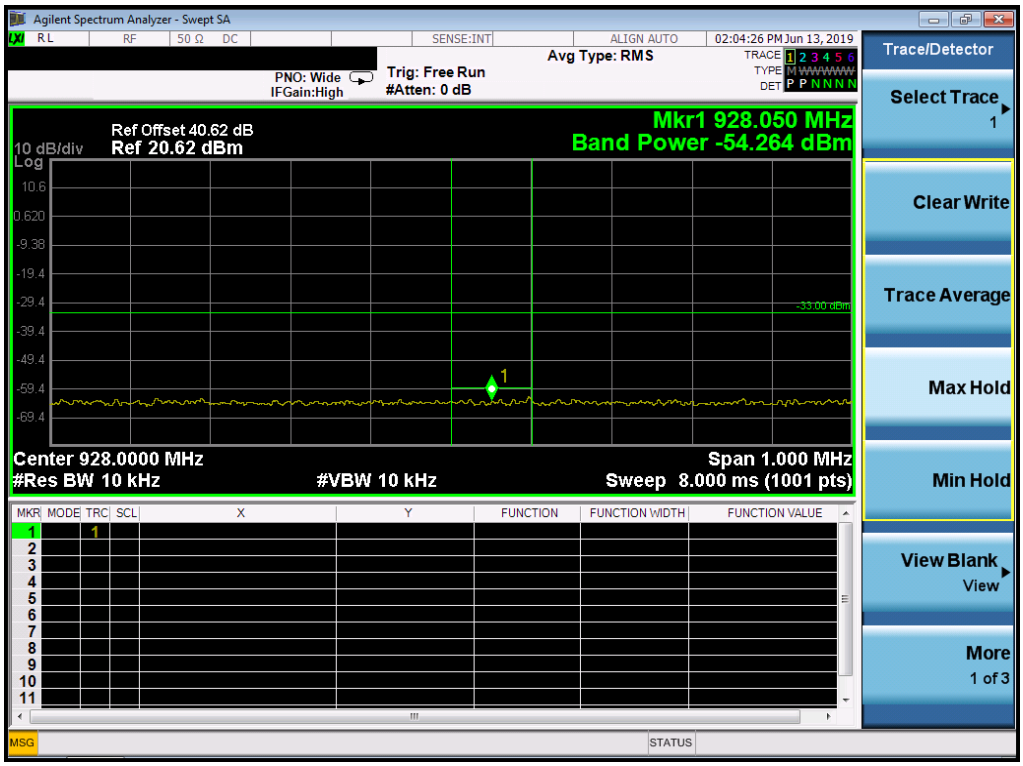
LoRa 125 kHz

Channel: 916.5 MHz

880~915 MHz

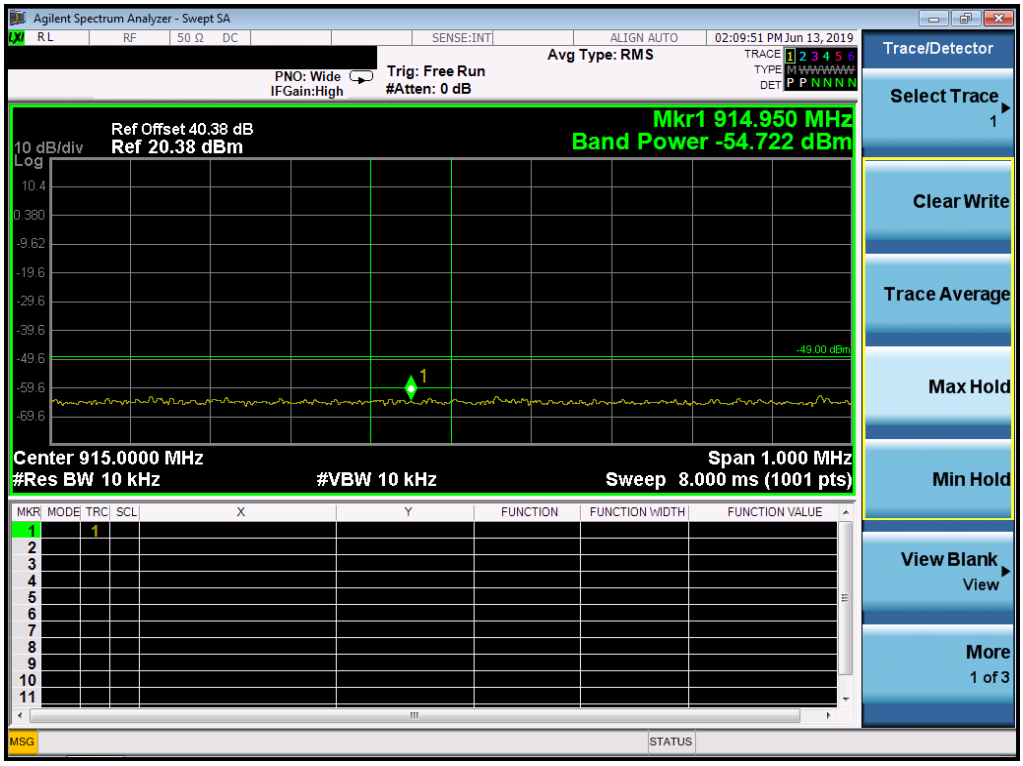


928~1000 MHz

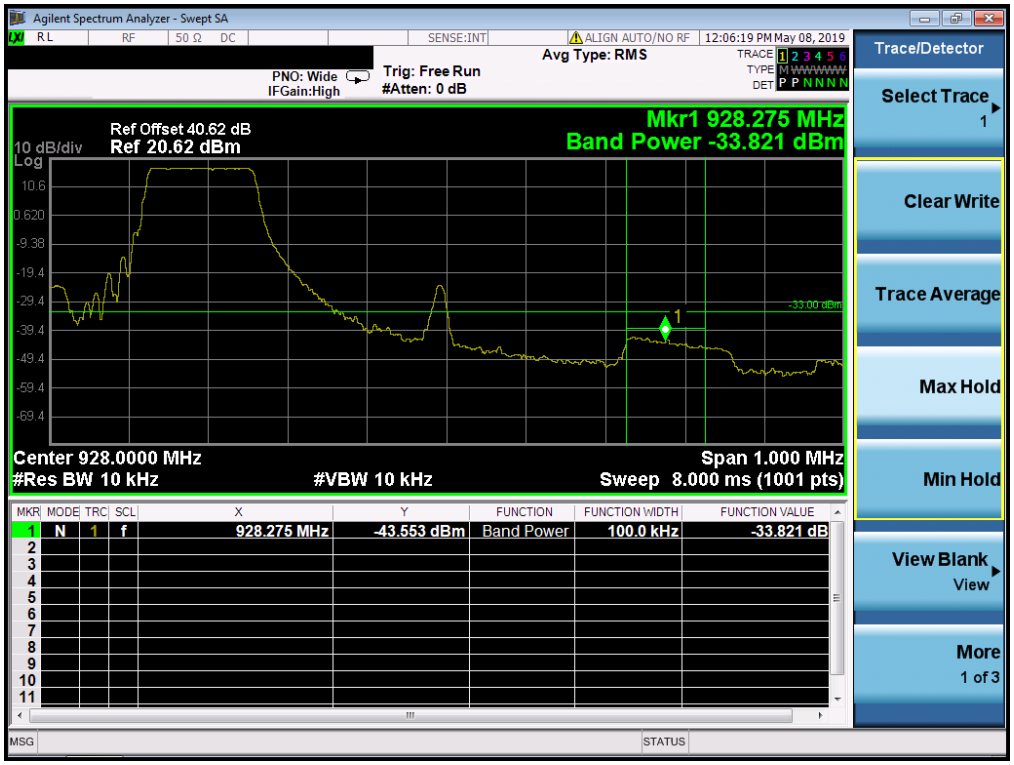


Channel: 927.7 MHz

880~915 MHz



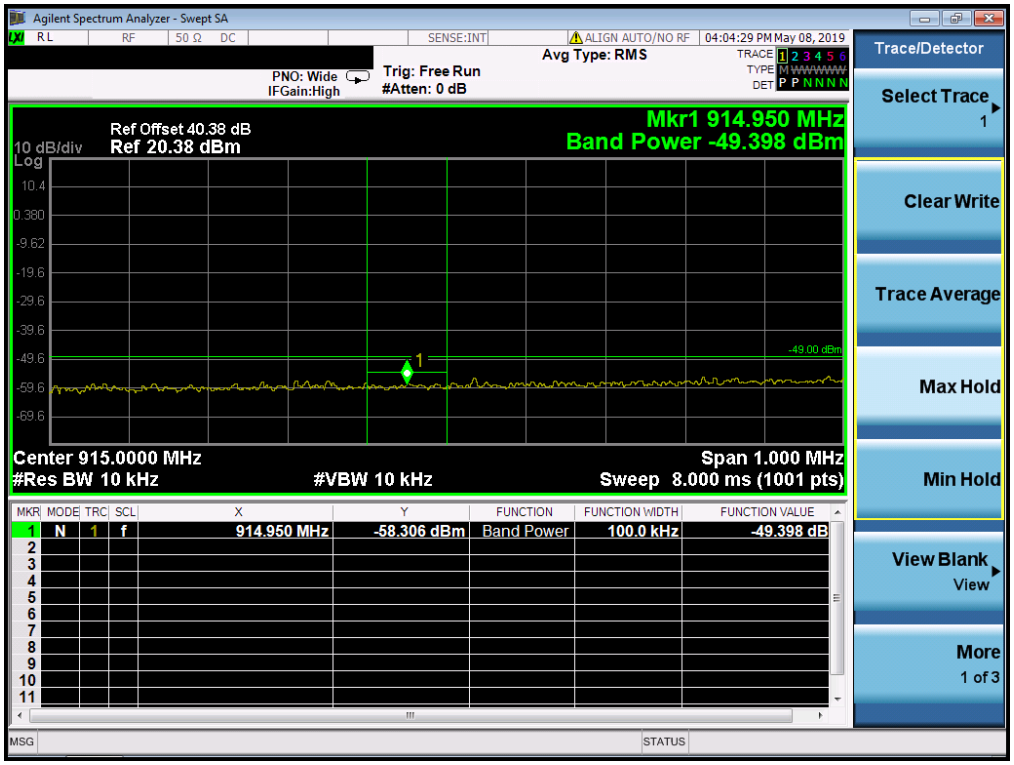
928~1000 MHz



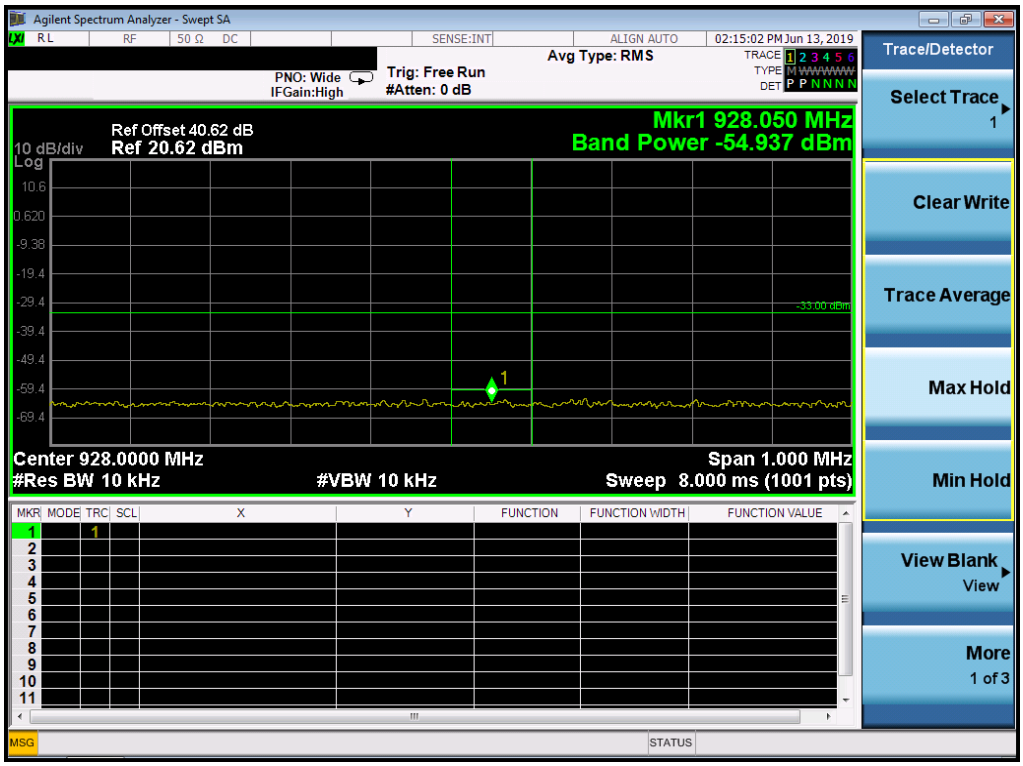
LoRa 250 kHz

Channel: 916.5 MHz

880~915 MHz

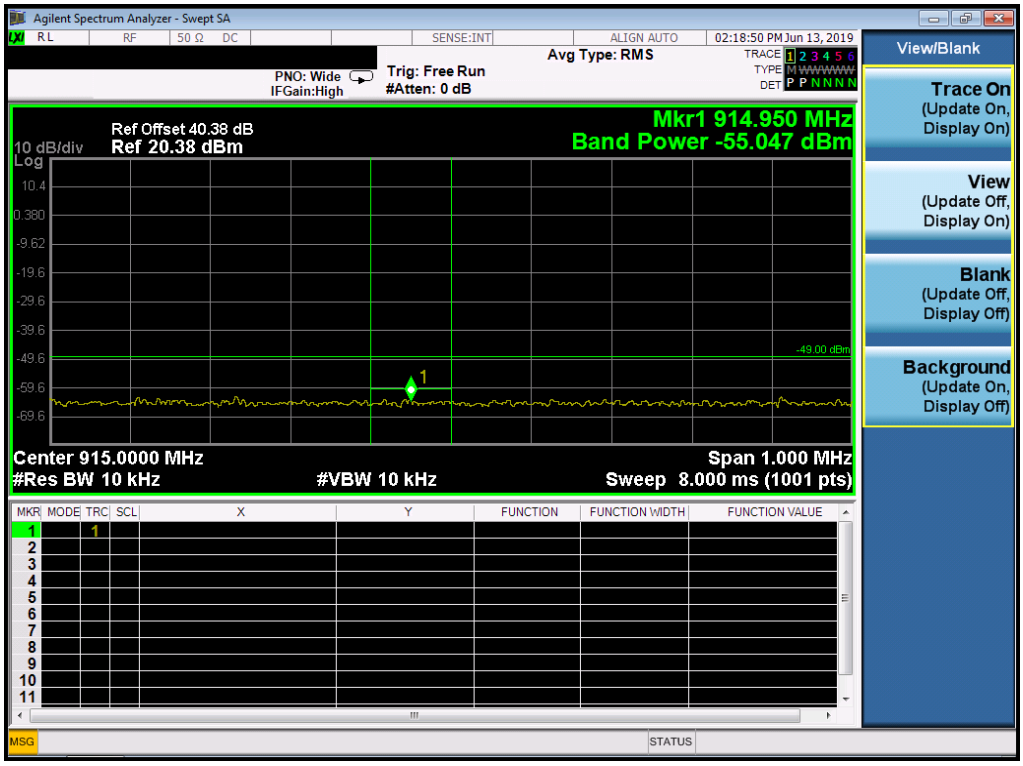


928~1000 MHz

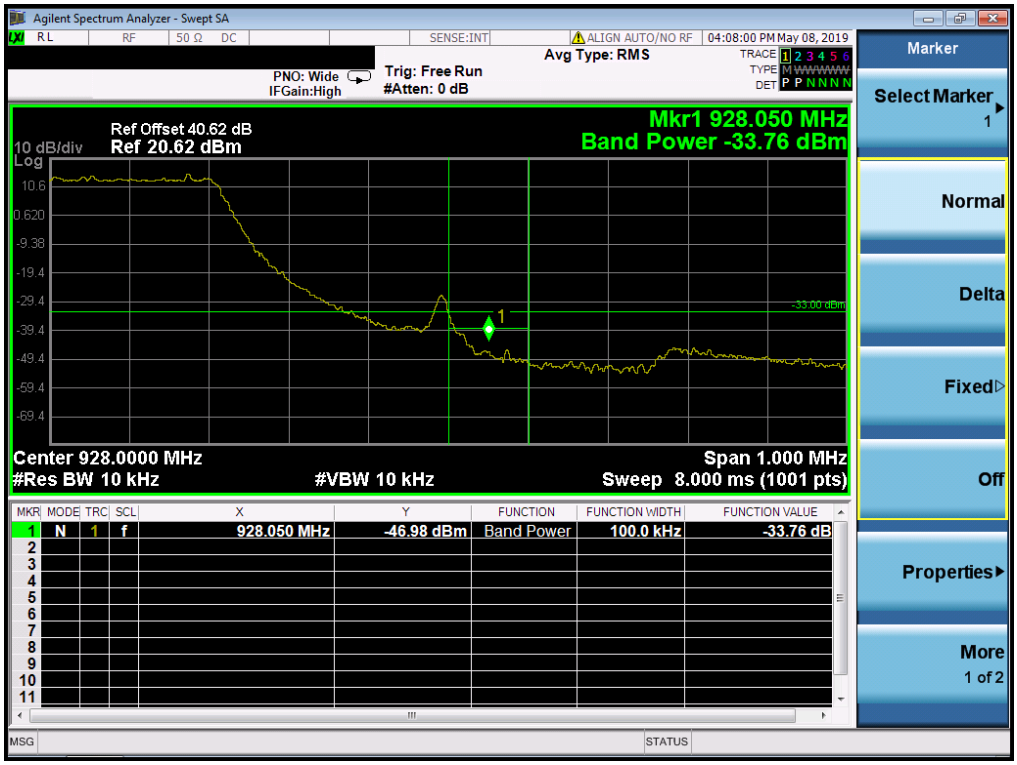


Channel: 927.6 MHz

880~915 MHz



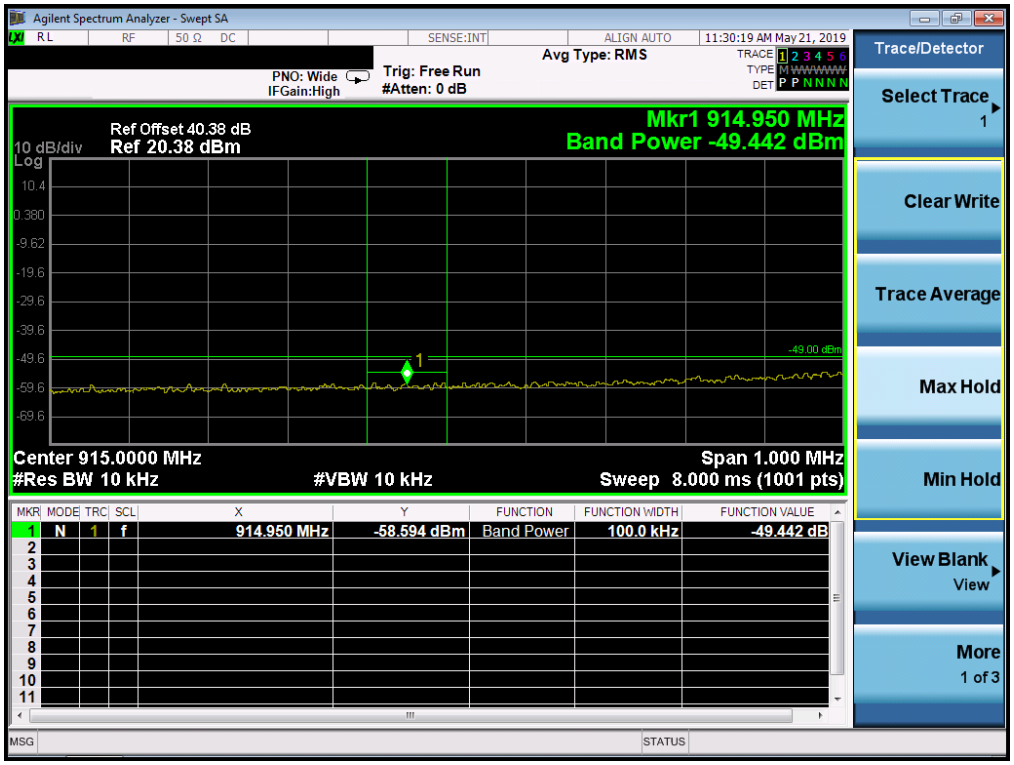
928~1000 MHz



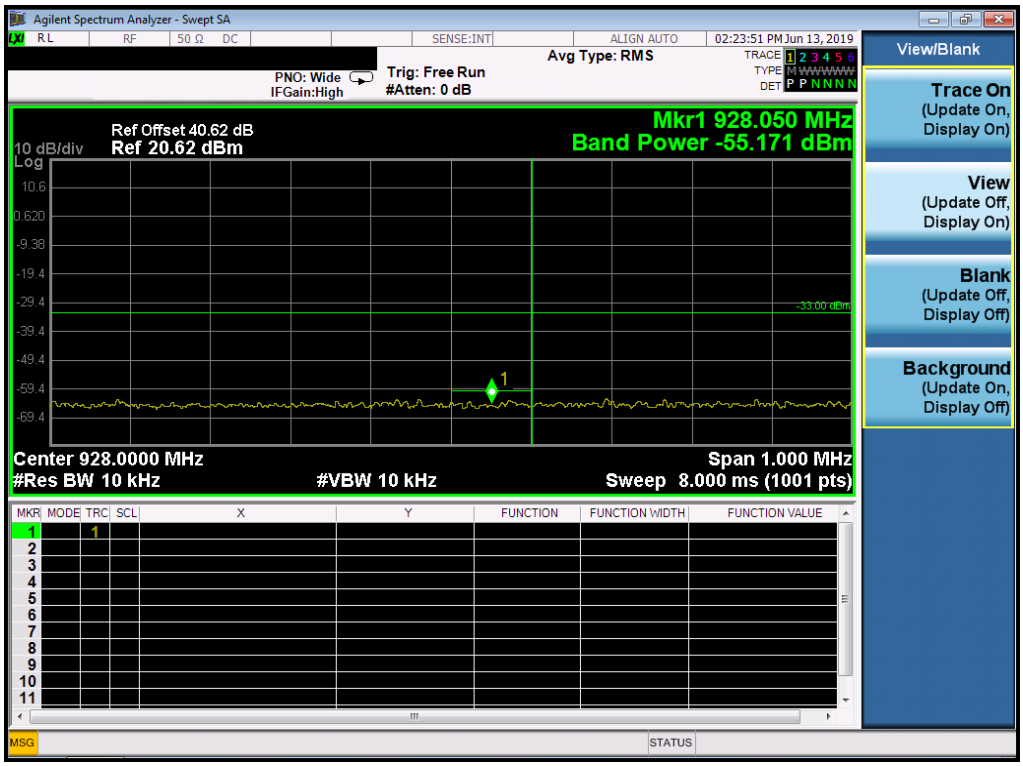
FSK 50kbps

Channel: 916 MHz

880~915 MHz

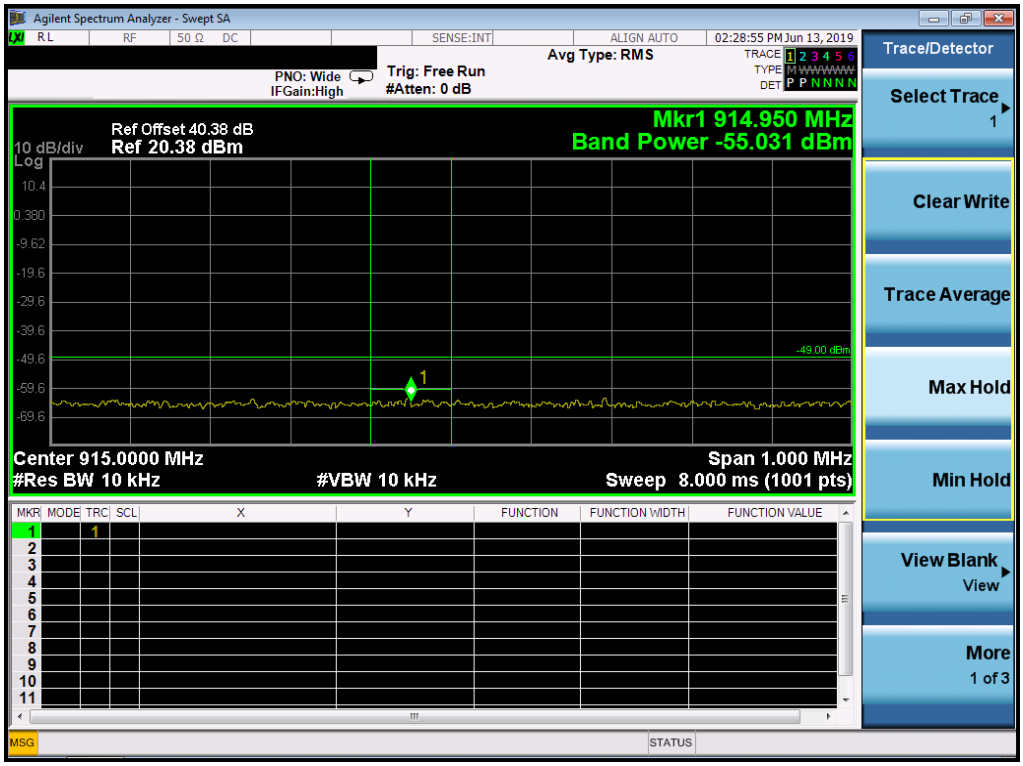


928~1000 MHz



Channel: 927.8 MHz

880~915 MHz



928~1000 MHz

3.4 Emissions in Non-Restricted Frequency Bands

3.4.1 Emissions in Non-Restricted Frequency Bands Limit

Peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz.

Note: Limit is from FCC 15.247

3.4.2 Test Procedures

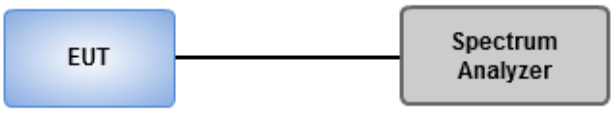
Reference level measurement

1. Set RBW=100kHz, VBW = 300kHz , Detector = Peak, Sweep time = Auto
2. Trace = max hold , Allow Trace to fully stabilize
3. Use the peak marker function to determine the maximum PSD level

Emission level measurement

1. Set RBW=100kHz, VBW = 300kHz , Detector = Peak, Sweep time = Auto
2. Trace = max hold , Allow Trace to fully stabilize
3. Scan Frequency range is up to 10GHz
4. Use the peak marker function to determine the maximum amplitude level

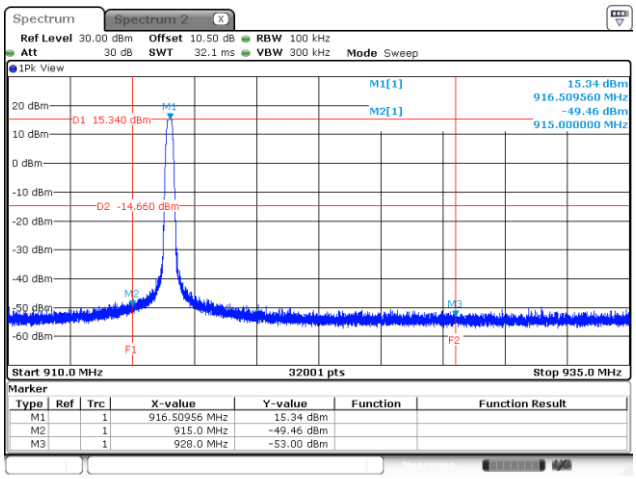
3.4.3 Test Setup



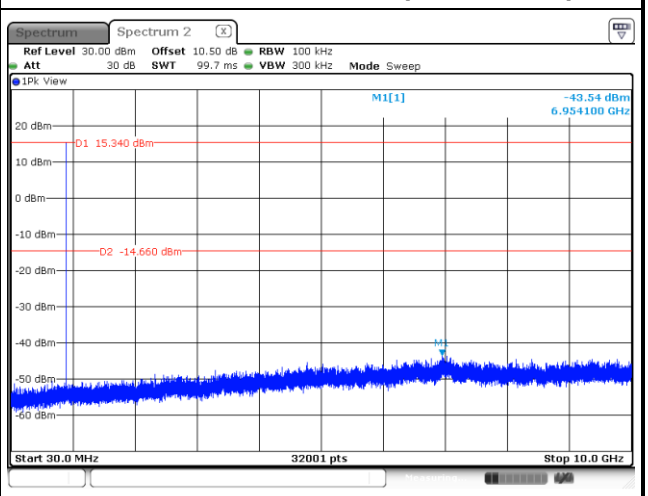
3.4.4 Test Result of Emissions in non-restricted Frequency Bands

LoRa 125 kHz

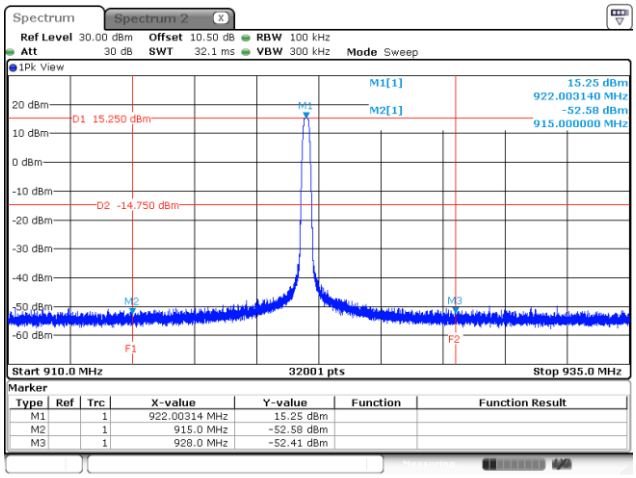
916.5MHz / 910MHz~935MHz (down 30dBc)



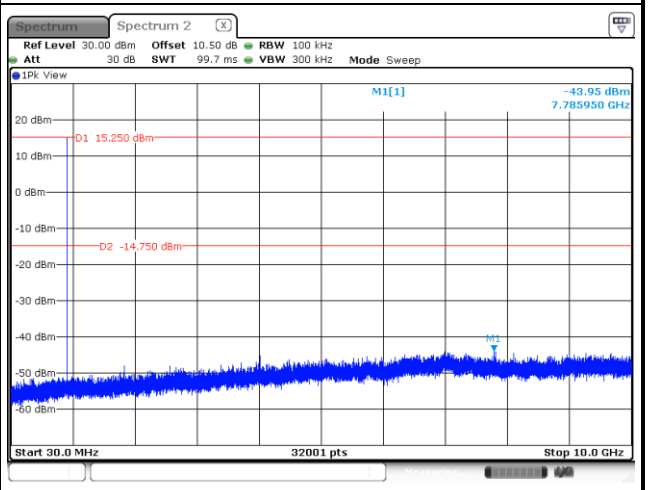
916.5MHz / 30MHz~10GHz (down 30dBc)



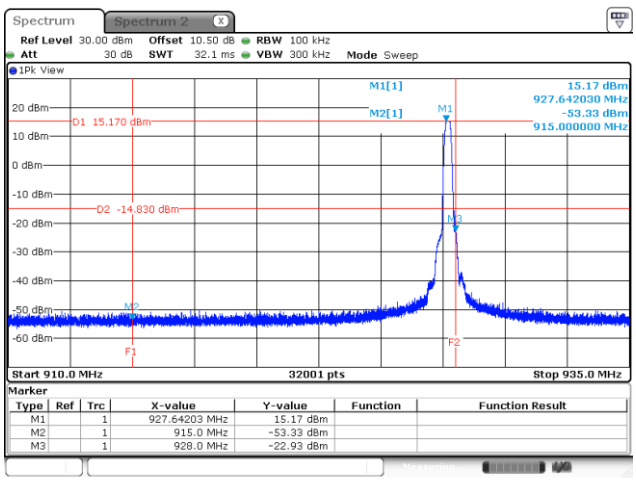
922MHz / 910MHz~935MHz (down 30dBc)



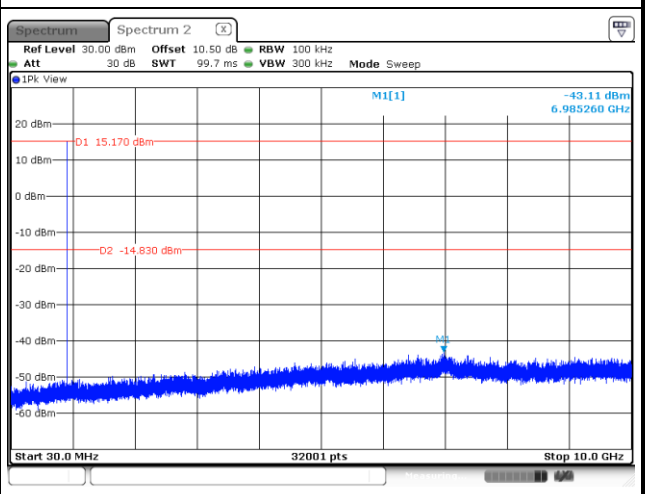
922MHz / 30MHz~10GHz (down 30dBc)



927.7MHz / 910MHz~935MHz (down 30dBc)

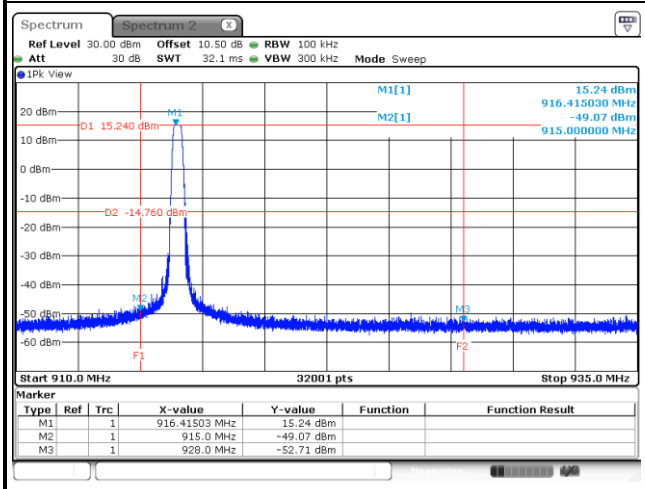


927.7MHz / 30MHz~10GHz (down 30dBc)

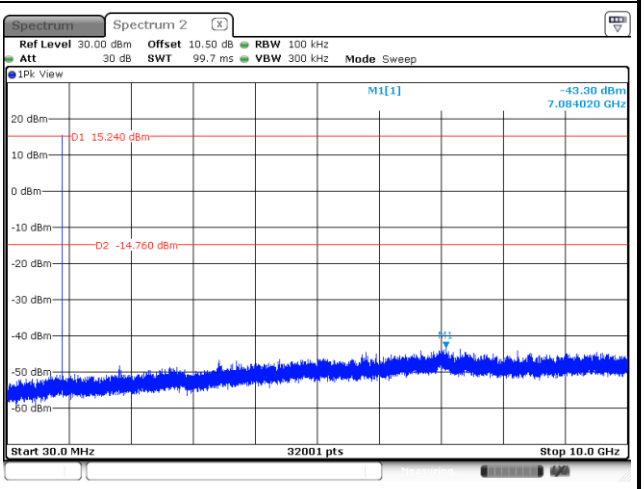


LoRa 250 kHz

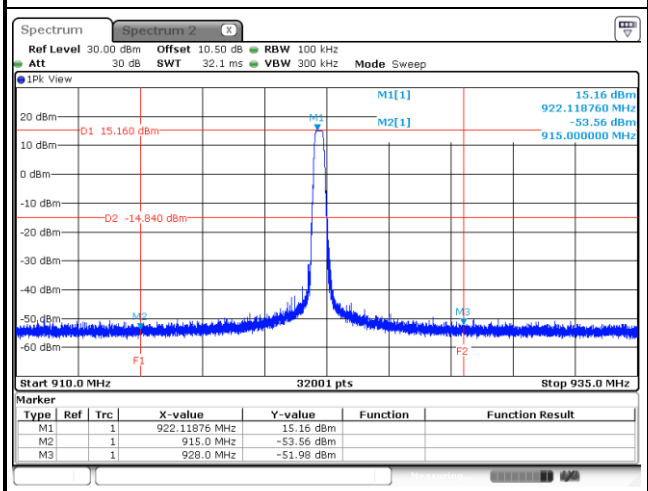
916.5MHz / 910MHz~935MHz (down 30dBc)



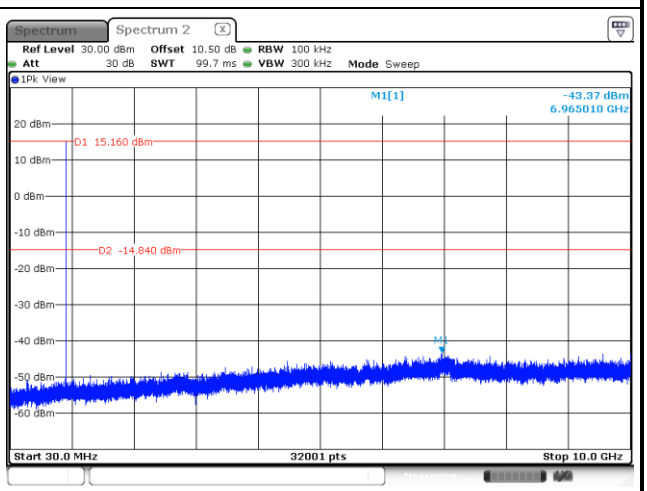
916.5MHz / 30MHz~10GHz (down 30dBc)



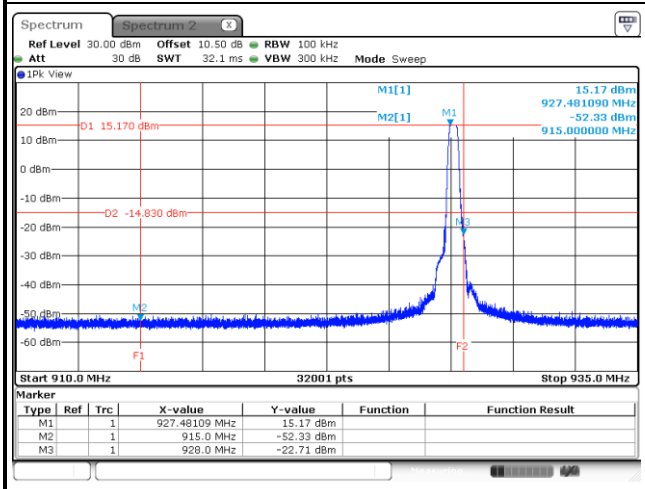
922MHz / 910MHz~935MHz (down 30dBc)



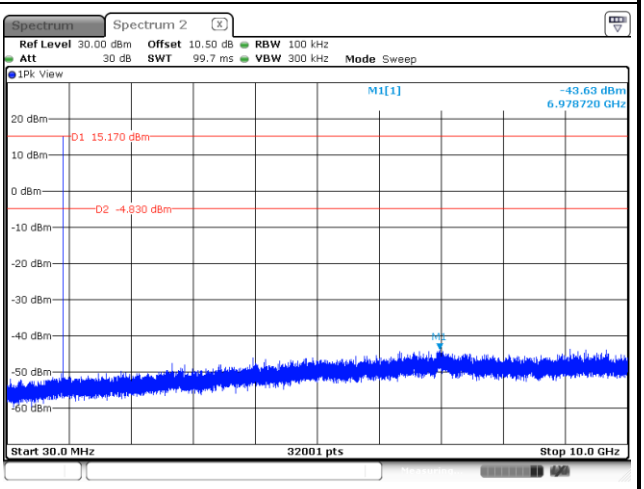
922MHz / 30MHz~10GHz (down 30dBc)



927.6MHz / 910MHz~935MHz (down 30dBc)

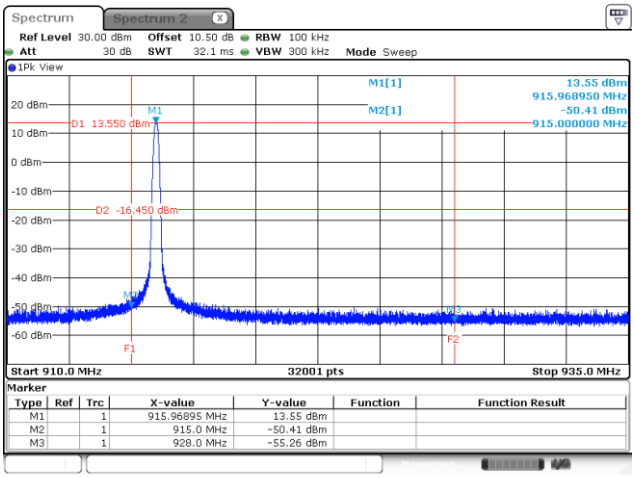


927.6MHz / 30MHz~10GHz (down 30dBc)

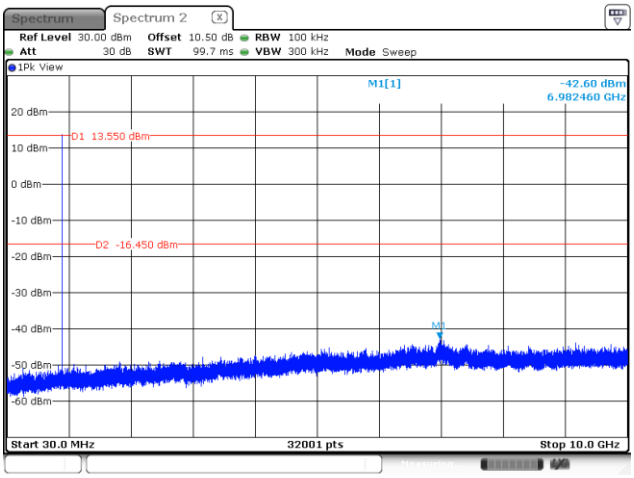


FSK 50kbps

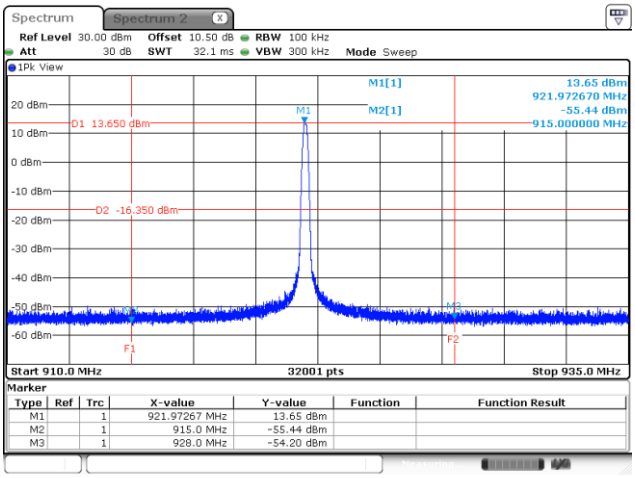
916MHz / 910MHz~935MHz (down 30dBc)



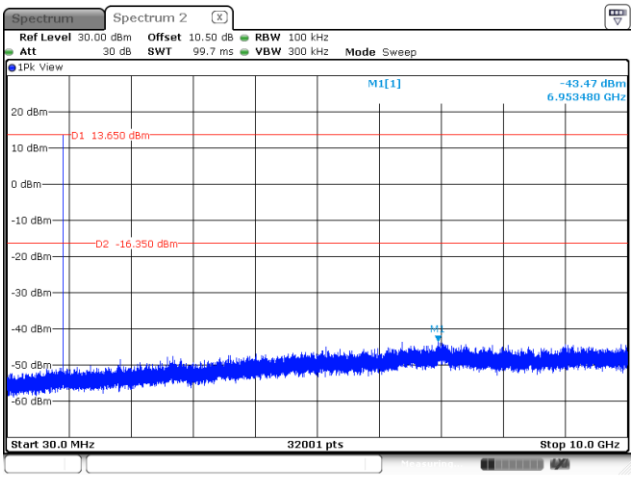
916MHz / 30MHz~10GHz (down 30dBc)



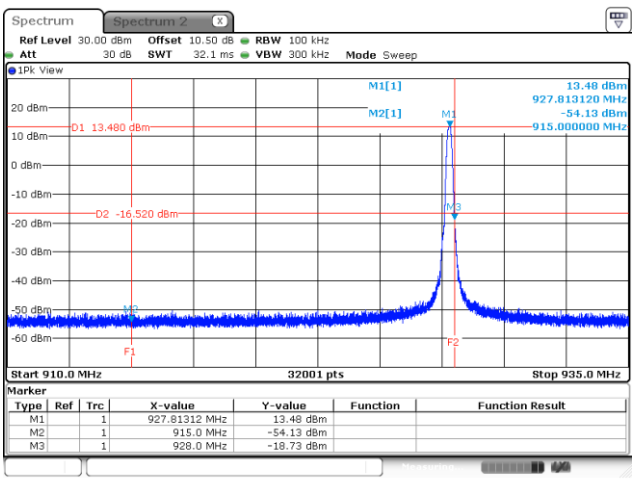
922MHz / 910MHz~935MHz (down 30dBc)



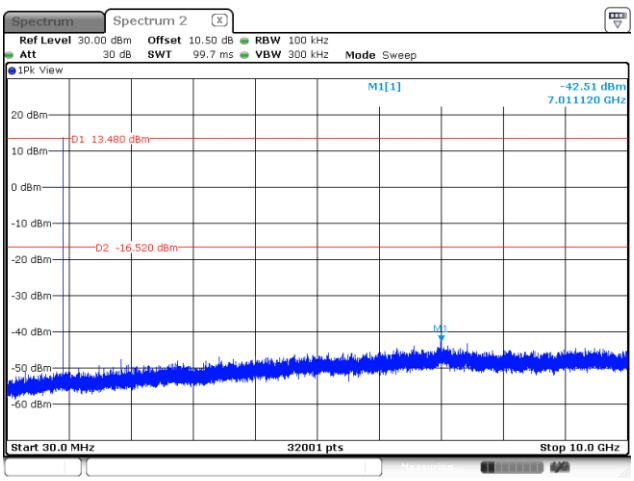
922MHz / 30MHz~10GHz (down 30dBc)



927.8MHz / 910MHz~935MHz (down 30dBc)



927.8MHz / 30MHz~10GHz (down 30dBc)



3.5 Emission Bandwidth

3.5.1 Limit of Emission Bandwidth

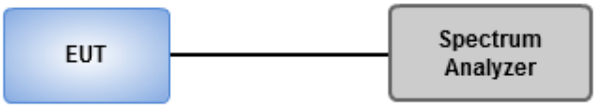
The upper and lower frequency limits of the transmitter 99% emission power bandwidth shall at all times remain within the operating frequency limits (915 ~ 928 MHz).

Note: Limit is from AS/NZS 4268:2017

3.5.2 Test Procedures

Reference to clause 6.2.1 of AS/NZS 4268:2017.

3.5.3 Test Setup



3.5.4 Test Result of Emission Bandwidth

Summary

Mode	OBW (Hz)	ITU-Code
915-928MHz	-	-
LoRa 125kHz	125.156k	125KF1D
915-928MHz	-	-
LoRa 250kHz	262.684k	262KF1D
915-928MHz	-	-
FSK 50kbps	100.912k	100KF1D

OBW = Minimum99% occupied bandwidth;

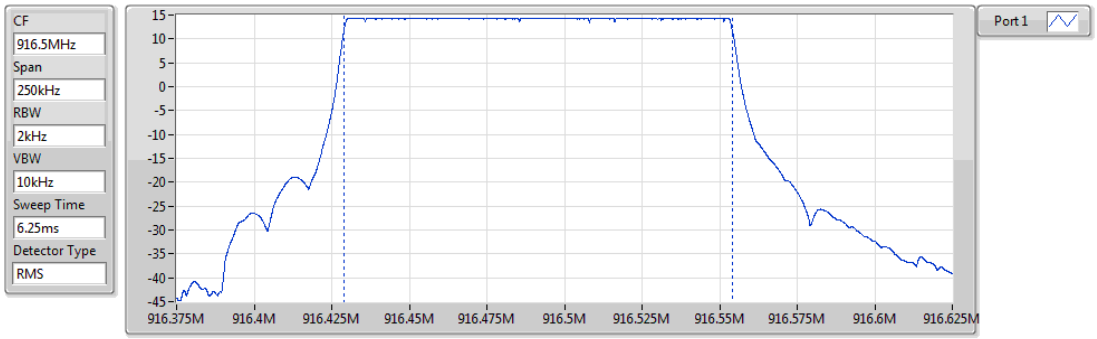
Result

Mode	Result	OBW (Hz)	Fl-OBW (Hz)	Fh-OBW (Hz)	Fl-Limit (Hz)	Fh-Limit (Hz)
LoRa 125kHz	-	-	-	-	-	-
916.5MHz_TnomVnom	Pass	125.031k	916.42908M	916.554111M	915M	928M
922MHz_TnomVnom	Pass	125.094k	921.929018M	922.054111M	915M	928M
927.7MHz_TnomVnom	Pass	125.156k	927.62883M	927.753987M	915M	928M
LoRa 250kHz	-	-	-	-	-	-
916.5MHz_TnomVnom	Pass	262.684k	916.35891M	916.621595M	915M	928M
922.2MHz_TnomVnom	Pass	261.935k	922.058785M	922.32072M	915M	928M
927.6MHz_TnomVnom	Pass	262.059k	927.45816M	927.72022M	915M	928M
FSK 50kbps	-	-	-	-	-	-
916MHz_TnomVnom	Pass	100.912k	915.941077M	916.04199M	915M	928M
922MHz_TnomVnom	Pass	100.85k	921.941077M	922.041927M	915M	928M
927.8MHz_TnomVnom	Pass	100.85k	927.741015M	927.841865M	915M	928M

fl-OBW = fl lower edge 99% occupied bandwidth; **fh-OBW** = fh higher edge 99% occupied bandwidth; **OBW** = 99% occupied bandwidth;

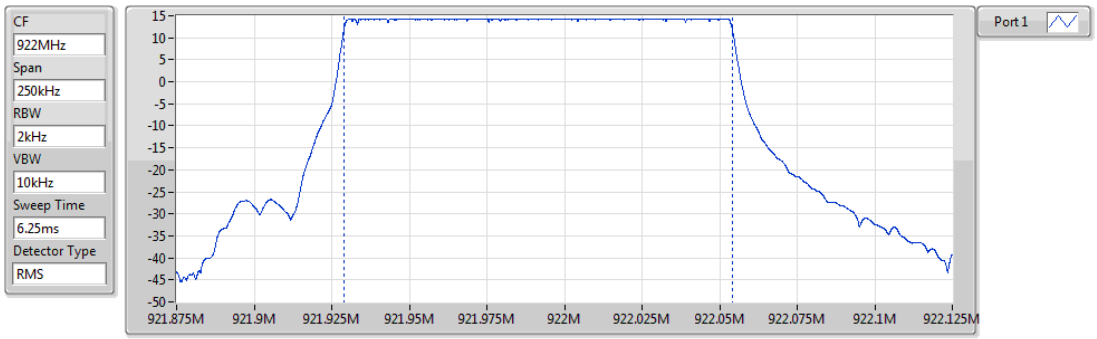
LoRa 125kHz

916.5MHz_TnomVnom



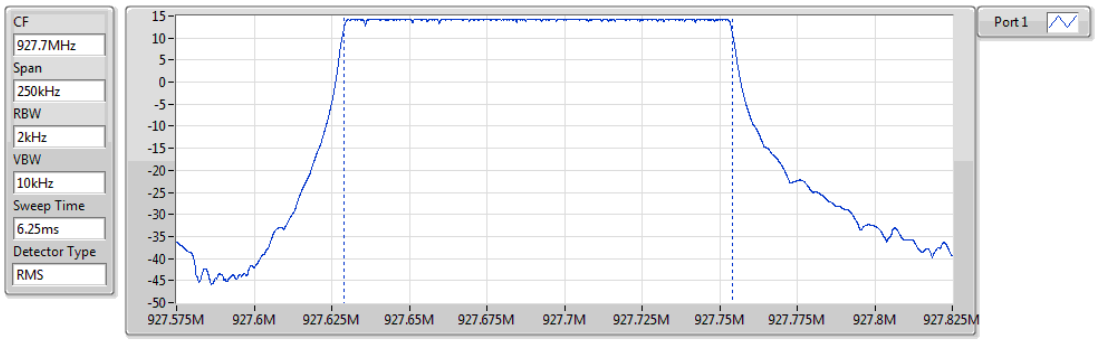
OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Fl-Limit(Hz)	Fh-Limit(Hz)
125.031k	916.42908M	916.554111M	13M	915M	928M

922MHz_TnomVnom



OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Fl-Limit(Hz)	Fh-Limit(Hz)
125.094k	921.929018M	922.054111M	13M	915M	928M

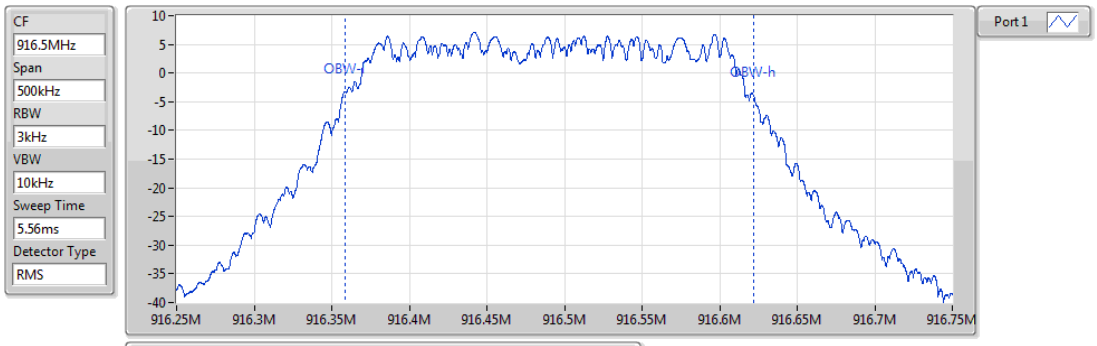
927.7MHz_TnomVnom



OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Fl-Limit(Hz)	Fh-Limit(Hz)
125.156k	927.62883M	927.753987M	13M	915M	928M

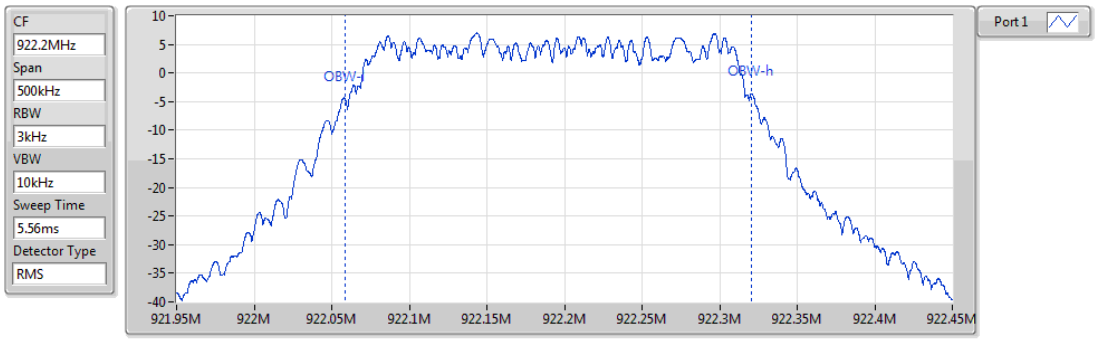
LoRa 250kHz

916.5MHz_TnomVnom



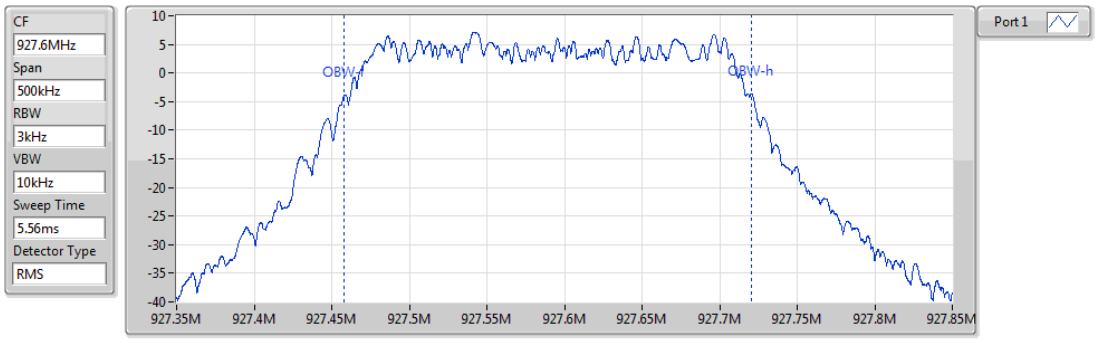
OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Fl-Limit(Hz)	Fh-Limit(Hz)
262.684k	916.35891M	916.621595M	13M	915M	928M

922.2MHz_TnomVnom



OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Fl-Limit(Hz)	Fh-Limit(Hz)
261.935k	922.058785M	922.32072M	13M	915M	928M

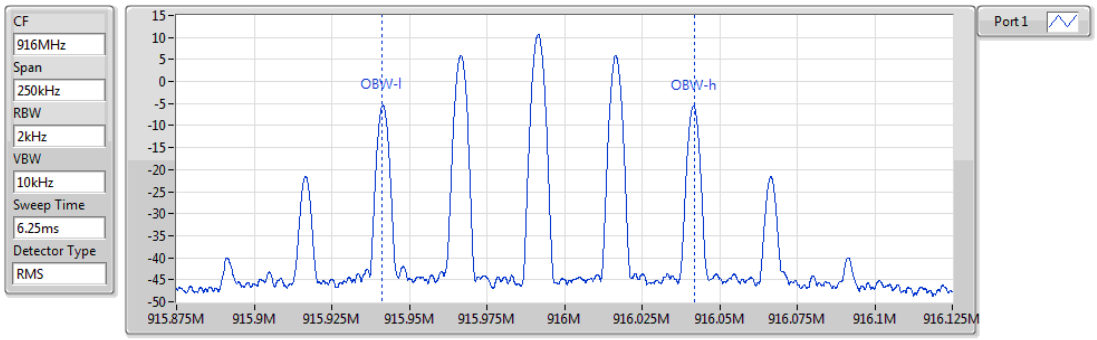
927.6MHz_TnomVnom



OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Fl-Limit(Hz)	Fh-Limit(Hz)
262.059k	927.45816M	927.72022M	13M	915M	928M

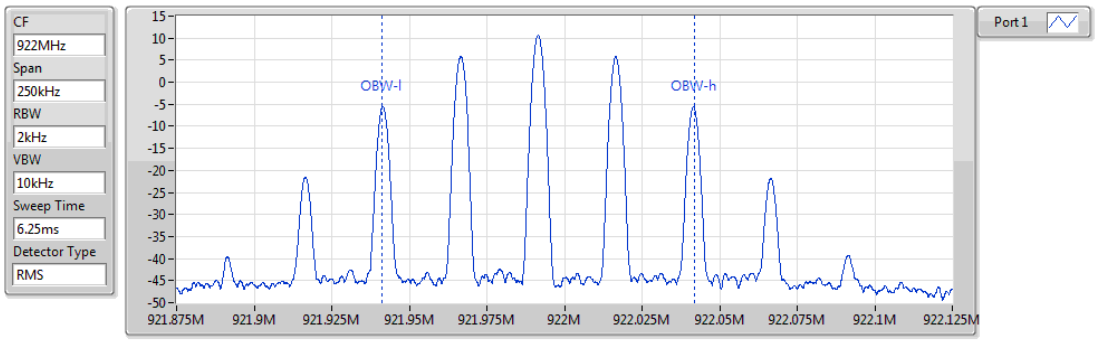
FSK 50kbps

916MHz_TnomVnom



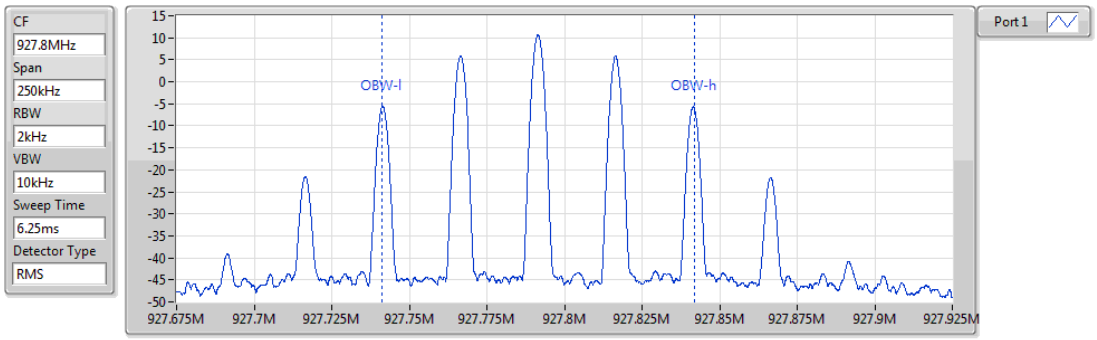
OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Fl-Limit(Hz)	Fh-Limit(Hz)
100.912k	915.941077M	916.04199M	13M	915M	928M

922MHz_TnomVnom



OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Fl-Limit(Hz)	Fh-Limit(Hz)
100.85k	921.941077M	922.041927M	13M	915M	928M

927.8MHz_TnomVnom



OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Fl-Limit(Hz)	Fh-Limit(Hz)
100.85k	927.741015M	927.841865M	13M	915M	928M

3.6 Operating Frequencies

3.6.1 Limit of Operating Frequencies

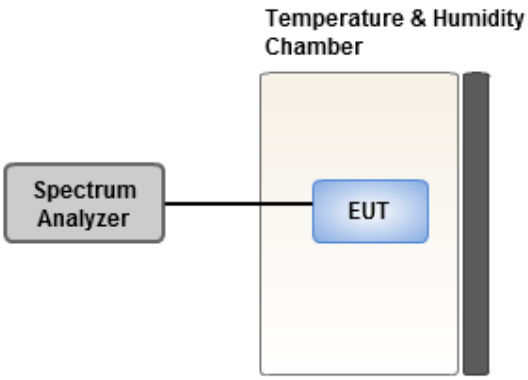
The upper and lower frequency limits of the transmitter 99% emission power bandwidth shall at all times remain within the operating frequency limits (915 ~ 928 MHz).

Note: Limit is from AS/NZS 4268:2017

3.6.2 Test Procedures

Reference to clause 6.2.1 of AS/NZS 4268:2017.

3.6.3 Test Setup



3.6.4 Test Result of Operating Frequencies

LoRa 125 kHz

Condition	Freqeuncy (MHz)	F_L (MHz)	F_H (MHz)	F_L Limit (MHz)	F_H Limit (MHz)
$T_{nom}V_{nom}$	916.5	916.429	-	915	928
$T_{min}V_{max}$	916.5	916.427	-	915	928
$T_{min}V_{min}$	916.5	916.428	-	915	928
$T_{max}V_{max}$	916.5	916.430	-	915	928
$T_{max}V_{min}$	916.5	916.429	-	915	928
$T_{nom}V_{nom}$	927.7	-	927.753	915	928
$T_{min}V_{max}$	927.7	-	927.754	915	928
$T_{min}V_{min}$	927.7	-	927.754	915	928
$T_{max}V_{max}$	927.7	-	927.751	915	928
$T_{max}V_{min}$	927.7	-	927.751	915	928

LoRa 250 kHz

Condition	Freqeuncy (MHz)	F_L (MHz)	F_H (MHz)	F_L Limit (MHz)	F_H Limit (MHz)
$T_{nom}V_{nom}$	916.5	916.358	-	915	928
$T_{min}V_{max}$	916.5	916.356	-	915	928
$T_{min}V_{min}$	916.5	916.358	-	915	928
$T_{max}V_{max}$	916.5	916.360	-	915	928
$T_{max}V_{min}$	916.5	916.359	-	915	928
$T_{nom}V_{nom}$	927.6	-	927.720	915	928
$T_{min}V_{max}$	927.6	-	927.721	915	928
$T_{min}V_{min}$	927.6	-	927.719	915	928
$T_{max}V_{max}$	927.6	-	927.718	915	928
$T_{max}V_{min}$	927.6	-	927.717	915	928

FSK 50kbps

Condition	Freqeuncy (MHz)	F_L (MHz)	F_H (MHz)	F_L Limit (MHz)	F_H Limit (MHz)
$T_{nom}V_{nom}$	916	915.941	-	915	928
$T_{min}V_{max}$	916	915.939	-	915	928
$T_{min}V_{min}$	916	915.940	-	915	928
$T_{max}V_{max}$	916	915.942	-	915	928
$T_{max}V_{min}$	916	915.941	-	915	928
$T_{nom}V_{nom}$	927.8	-	927..841	915	928
$T_{min}V_{max}$	927.8	-	927.843	915	928
$T_{min}V_{min}$	927.8	-	927.841	915	928
$T_{max}V_{max}$	927.8	-	927.840	915	928
$T_{max}V_{min}$	927.8	-	927.839	915	928

4 Receiver Test Results

4.1 Receiver Spurious Emissions

4.1.1 Receiver Spurious Emissions Limits

Spurious Emissions Limit (Peak Power)	Frequency Range	Measurement Bandwidth
-56 dBW (2.5μW) e.i.r.p (59 dBμV/m at 10 metres)	< 150 kHz	1 kHz
	150 kHz – 30 MHz	10 kHz

Note: Limit is from "NEW ZEALAND https://gazette.govt.nz/notice/id/2015-go694 Table 2"

Emissions Limit			
Frequency Range (MHz)	**Field Strength (uV/m)**	**Field Strength (dBuV/m)**	**Measure Distance (m)**
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:
Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit
Note 2:
Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

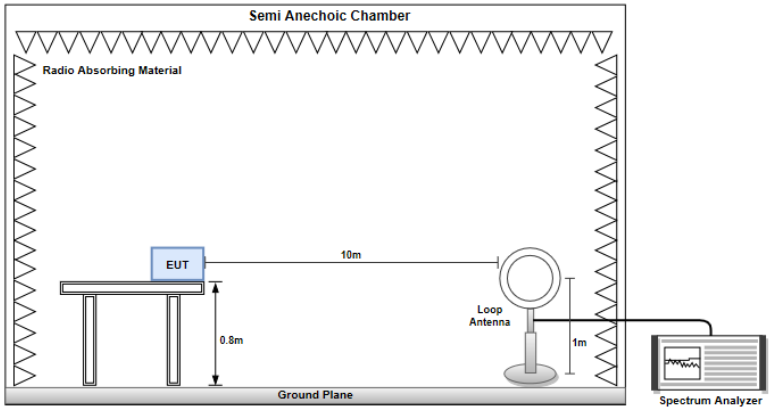
Note: Limit is from FCC Part 15.109

4.1.2 Test Procedures

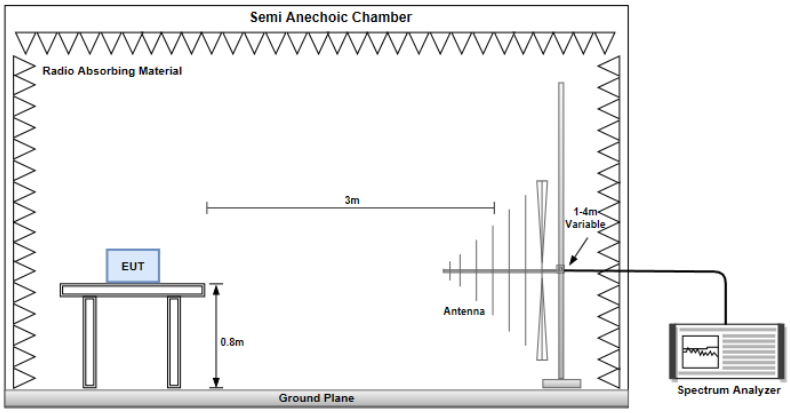
Reference to clause 7.2.1 of AS/NZS 4268:2017.

4.1.3 Test Setup

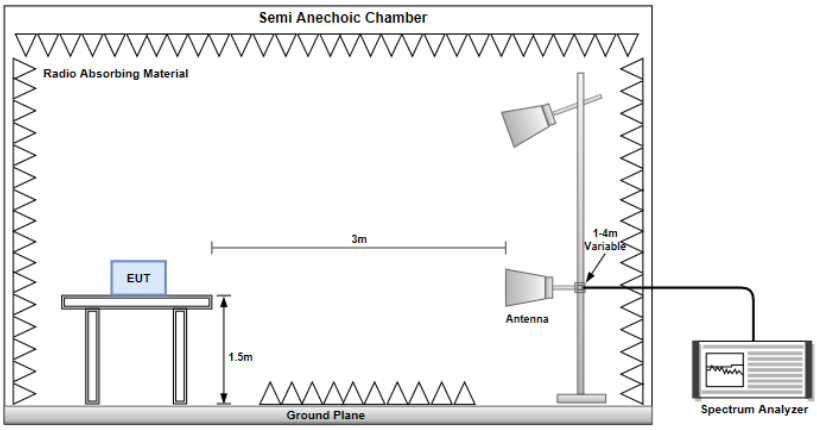
Below 30MHz



Below 1GHz



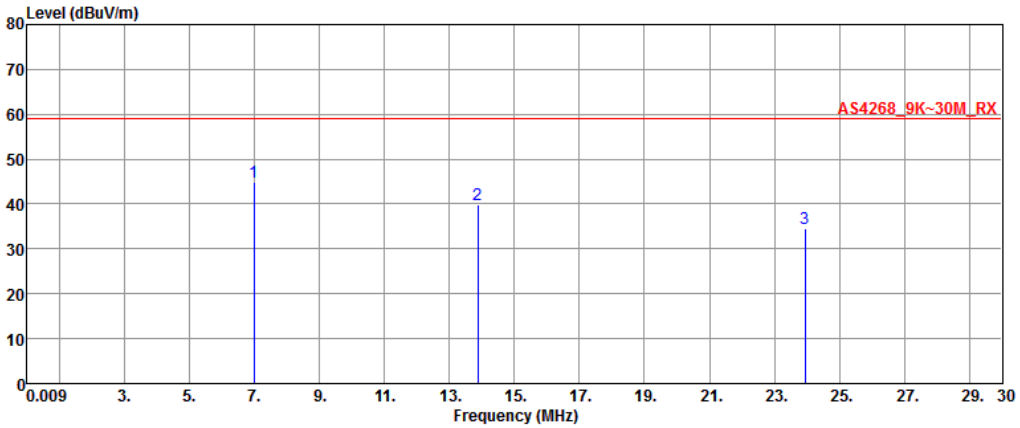
Above 1 GHz



4.1.4 Receiver Spurious Emissions (≤ 30MHz)

LoRa 125 kHz

Modulation	LoRa	**Test Freq. (MHz)**	922
Frequency	9kHz~30MHz	**Loop**	open

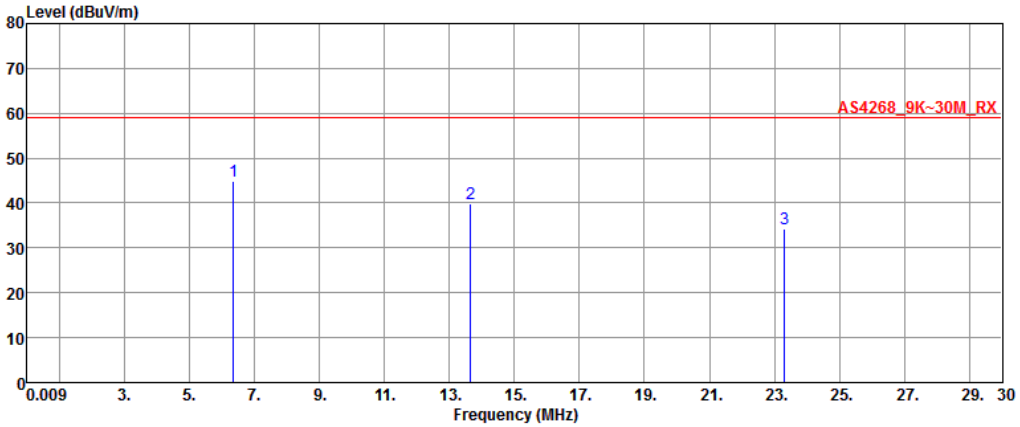


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBuV/m	dBuV/m	dB	dB	dBuV
1	6.98	44.90	59.00	-14.10	20.03	24.87
2	13.87	39.87	59.00	-19.13	21.02	18.85
3	23.94	34.65	59.00	-24.35	22.00	12.65

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

LoRa 250 kHz

Modulation	LoRa	**Test Freq. (MHz)**	922.2
Frequency	9kHz~30MHz	**Loop**	open

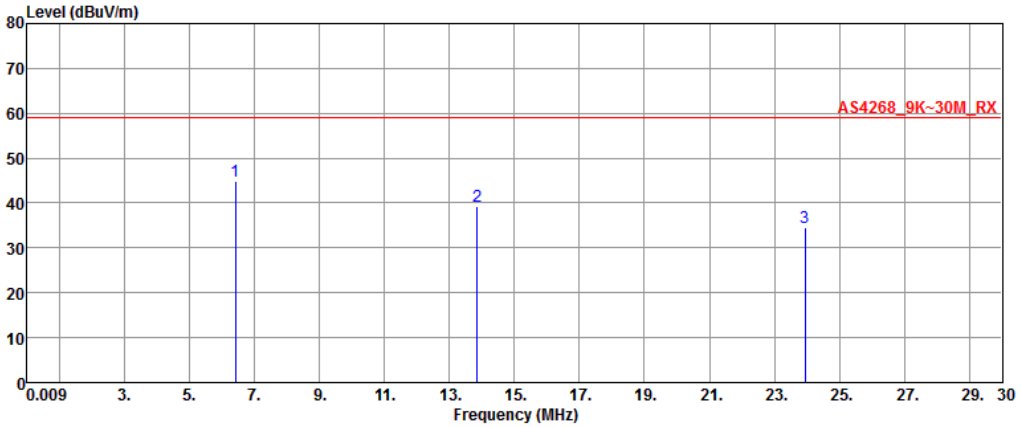


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBuV/m	dBuV/m	dB	dB	dBuV
1	6.35	44.95	59.00	-14.05	19.95	25.00
2	13.65	39.98	59.00	-19.02	20.99	18.99
3	23.32	34.35	59.00	-24.65	21.97	12.38

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

FSK 50kbps

Modulation	FSK	**Test Freq. (MHz)**	922
Frequency	9kHz~30MHz	**Loop**	open



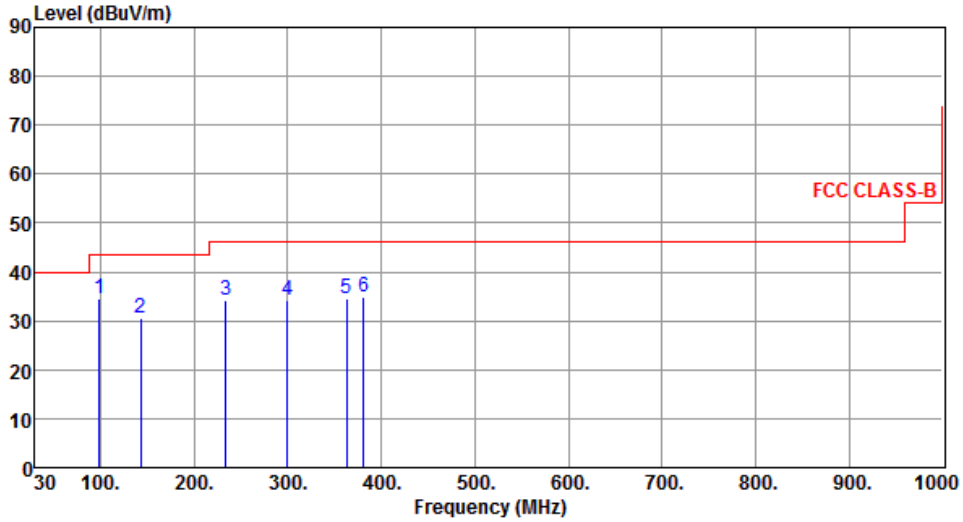
	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBuV/m	dBuV/m	dB	dB	dBuV
1	6.42	44.94	59.00	-14.06	19.96	24.98
2	13.85	39.39	59.00	-19.61	21.02	18.37
3	23.95	34.54	59.00	-24.46	22.00	12.54

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

4.1.5 Receiver Spurious Emissions (Below 1GHz)

LoRa 125 kHz

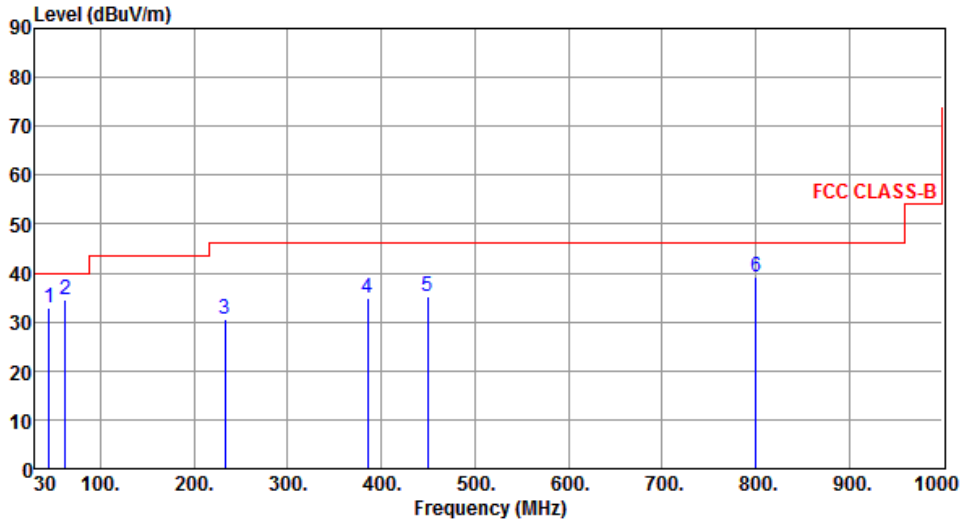
Modulation Mode	LoRa	**Test Freq. (MHz)**	922
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	98.54	34.51	43.50	-8.99	47.77	-13.26	Peak	---	---
2	143.24	30.44	43.50	-13.06	38.98	-8.54	Peak	---	---
3	233.84	34.24	46.00	-11.76	44.25	-10.01	Peak	---	---
4	299.85	34.24	46.00	-11.76	42.04	-7.80	Peak	---	---
5	362.81	34.52	46.00	-11.48	40.52	-6.00	Peak	---	---
6	381.59	34.85	46.00	-11.15	40.35	-5.50	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation Mode	LoRa	Test Freq. (MHz)	922
Polarization	Vertical		

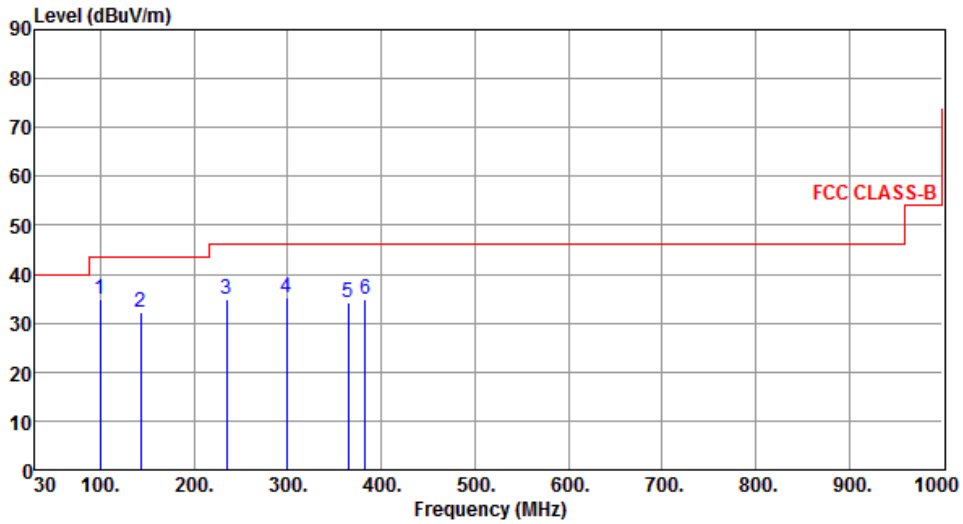


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	44.86	32.82	40.00	-7.18	40.67	-7.85	Peak	---	---
2	62.21	34.54	40.00	-5.46	43.66	-9.12	Peak	---	---
3	232.85	30.54	46.00	-15.46	40.63	-10.09	Peak	---	---
4	385.48	34.84	46.00	-11.16	40.18	-5.34	Peak	---	---
5	449.35	35.24	46.00	-10.76	39.16	-3.92	Peak	---	---
6	800.25	39.14	46.00	-6.86	36.87	2.27	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

LoRa 250 kHz

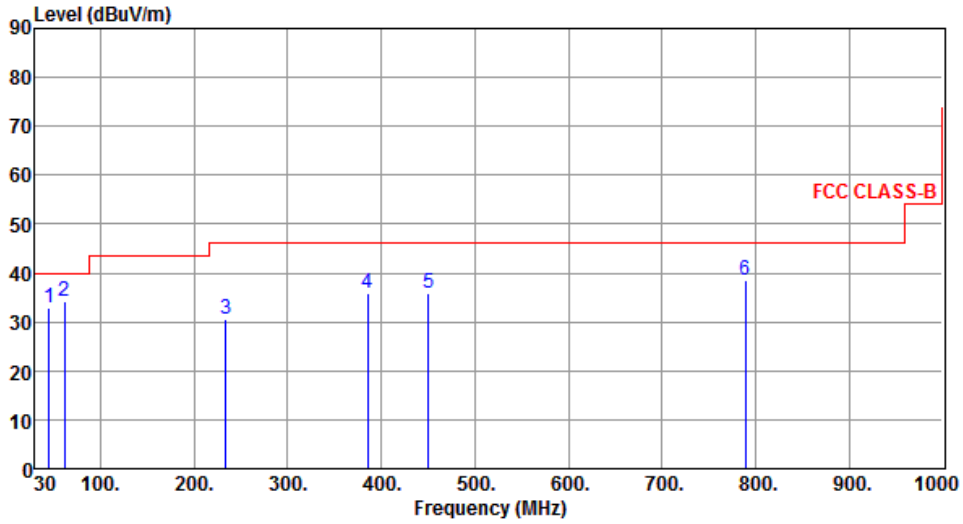
Modulation Mode	FSK	**Test Freq. (MHz)**	922.2
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	99.54	34.82	43.50	-8.68	47.88	-13.06	Peak	---	---
2	143.25	32.21	43.50	-11.29	40.75	-8.54	Peak	---	---
3	234.81	34.81	46.00	-11.19	44.75	-9.94	Peak	---	---
4	298.84	35.24	46.00	-10.76	43.06	-7.82	Peak	---	---
5	364.28	34.11	46.00	-11.89	40.05	-5.94	Peak	---	---
6	383.24	34.87	46.00	-11.13	40.29	-5.42	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation Mode	FSK	Test Freq. (MHz)	922.2
Polarization	Vertical		

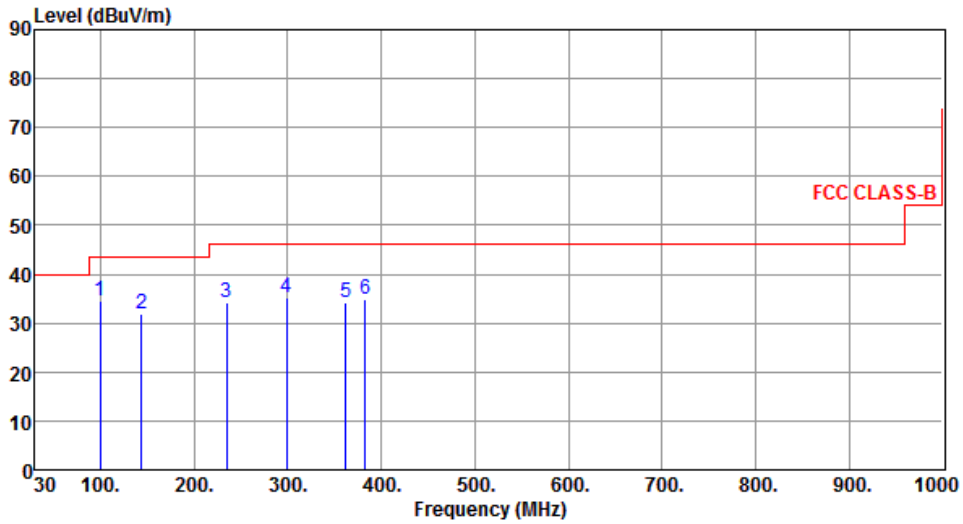


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	44.78	32.74	40.00	-7.26	40.60	-7.86	Peak	---	---
2	61.52	34.28	40.00	-5.72	43.24	-8.96	Peak	---	---
3	234.28	30.58	46.00	-15.42	40.56	-9.98	Peak	---	---
4	385.44	35.93	46.00	-10.07	41.27	-5.34	Peak	---	---
5	450.47	35.72	46.00	-10.28	39.61	-3.89	Peak	---	---
6	788.89	38.45	46.00	-7.55	36.28	2.17	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

FSK 50kbps

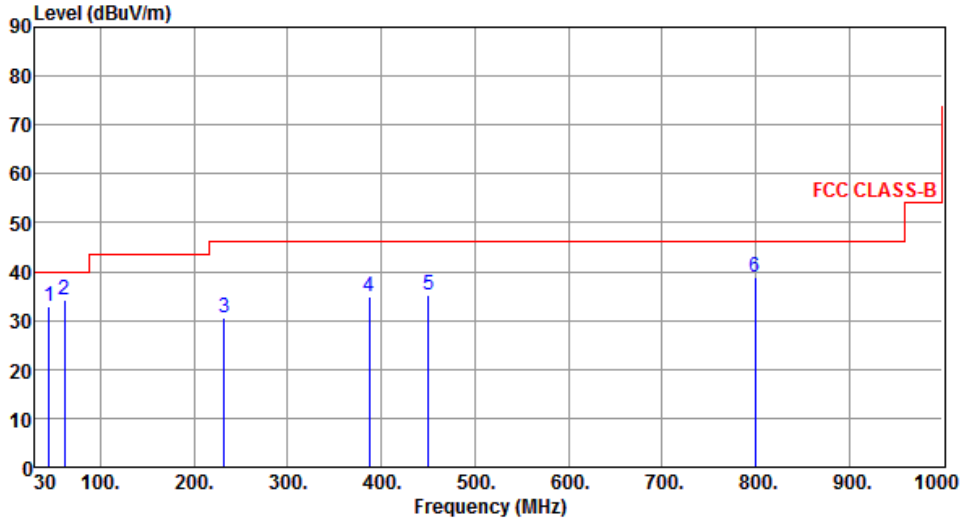
Modulation Mode	FSK	**Test Freq. (MHz)**	922
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	99.52	34.52	43.50	-8.98	47.59	-13.07	Peak	---	---
2	144.24	31.85	43.50	-11.65	40.31	-8.46	Peak	---	---
3	234.41	34.25	46.00	-11.75	44.22	-9.97	Peak	---	---
4	298.85	35.24	46.00	-10.76	43.06	-7.82	Peak	---	---
5	361.85	34.11	46.00	-11.89	40.16	-6.05	Peak	---	---
6	382.55	34.85	46.00	-11.15	40.30	-5.45	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation Mode	FSK	Test Freq. (MHz)	922
Polarization	Vertical		



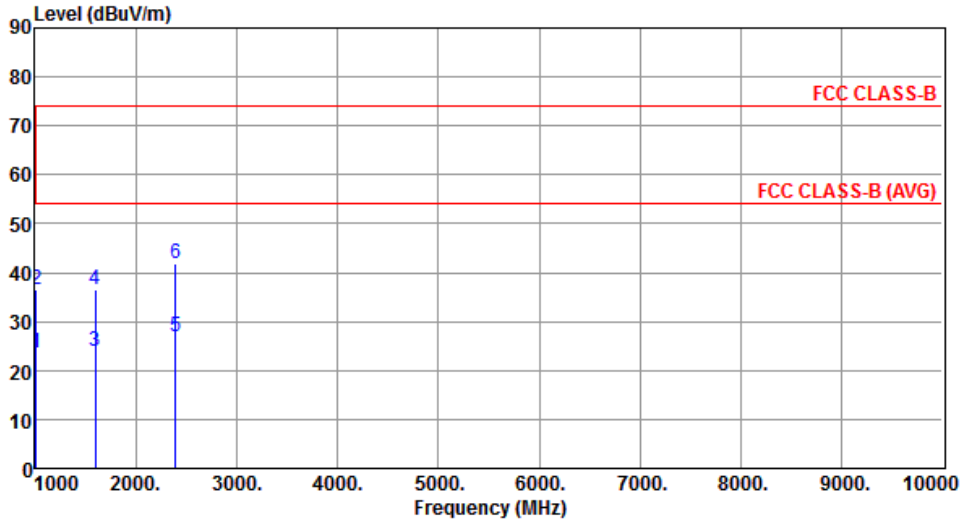
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	45.41	32.85	40.00	-7.15	40.65	-7.80	Peak	---	---
2	61.25	34.25	40.00	-5.75	43.13	-8.88	Peak	---	---
3	231.89	30.59	46.00	-15.41	40.76	-10.17	Peak	---	---
4	387.21	34.85	46.00	-11.15	40.19	-5.34	Peak	---	---
5	450.28	35.20	46.00	-10.80	39.09	-3.89	Peak	---	---
6	799.69	38.96	46.00	-7.04	36.71	2.25	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

4.1.6 Receiver Spurious Emissions (Above 1GHz)

LoRa 125 kHz

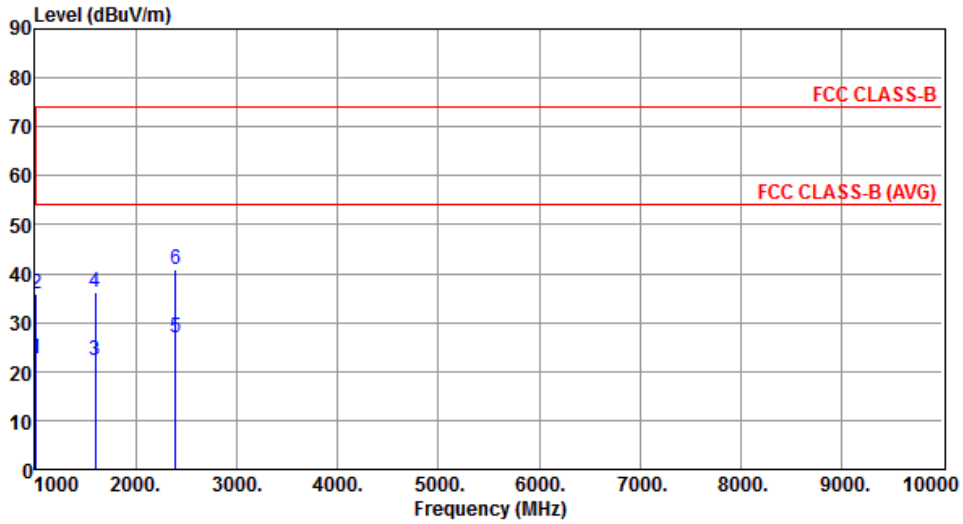
Modulation Mode	LoRa	**Test Freq. (MHz)**	922
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1010.00	23.52	54.00	-30.48	33.75	-10.23	Average	100	56
2	1010.00	36.66	74.00	-37.34	46.89	-10.23	Peak	100	56
3	1600.00	23.85	54.00	-30.15	30.85	-7.00	Average	100	271
4	1600.00	36.51	74.00	-37.49	43.51	-7.00	Peak	100	281
5	2395.00	26.76	54.00	-27.24	29.84	-3.08	Average	100	255
6	2395.00	41.88	74.00	-32.12	44.96	-3.08	Peak	100	255

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation Mode	LoRa	Test Freq. (MHz)	922
Polarization	Vertical		

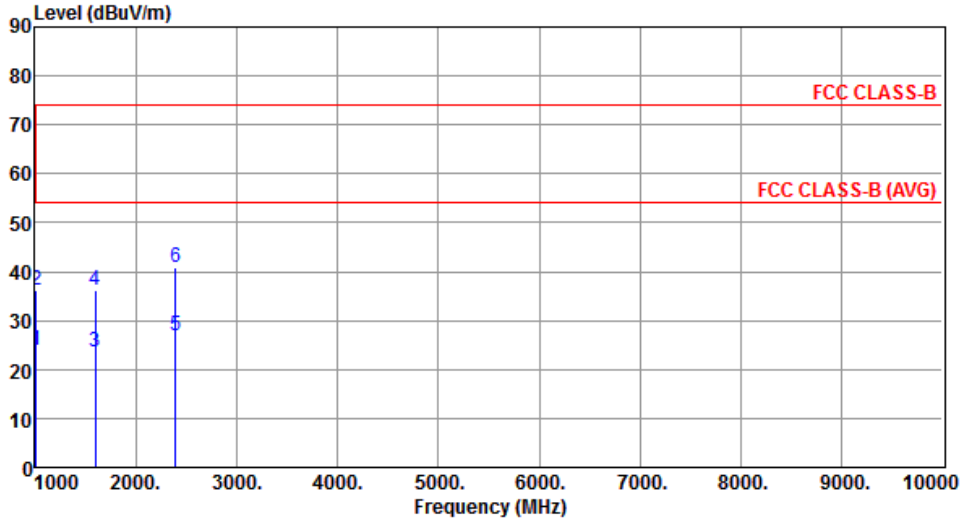


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1010.00	22.63	54.00	-31.37	32.86	-10.23	Average	100	220
2	1010.00	35.73	74.00	-38.27	45.96	-10.23	Peak	100	220
3	1600.00	22.24	54.00	-31.76	29.24	-7.00	Average	100	177
4	1600.00	36.22	74.00	-37.78	43.22	-7.00	Peak	100	177
5	2395.00	26.77	54.00	-27.23	29.85	-3.08	Average	100	72
6	2395.00	40.81	74.00	-33.19	43.89	-3.08	Peak	100	72

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

LoRa 250 kHz

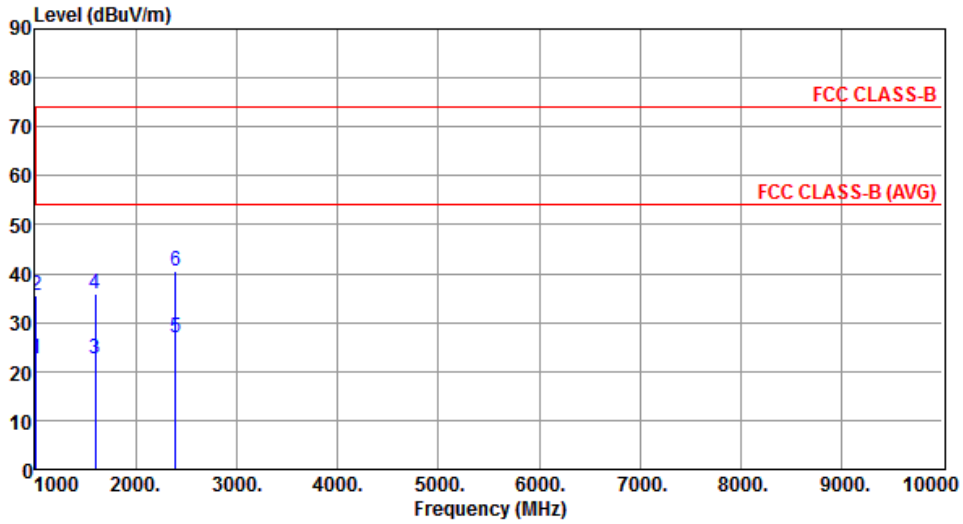
Modulation Mode	LoRa	**Test Freq. (MHz)**	922.2
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1010.00	23.98	54.00	-30.02	34.21	-10.23	Average	100	51
2	1010.00	36.30	74.00	-37.70	46.53	-10.23	Peak	100	51
3	1600.00	23.54	54.00	-30.46	30.54	-7.00	Average	100	272
4	1600.00	36.20	74.00	-37.80	43.20	-7.00	Peak	100	272
5	2395.00	26.77	54.00	-27.23	29.85	-3.08	Average	100	251
6	2395.00	40.81	74.00	-33.19	43.89	-3.08	Peak	100	251

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation Mode	LoRa	Test Freq. (MHz)	922.2
Polarization	Vertical		

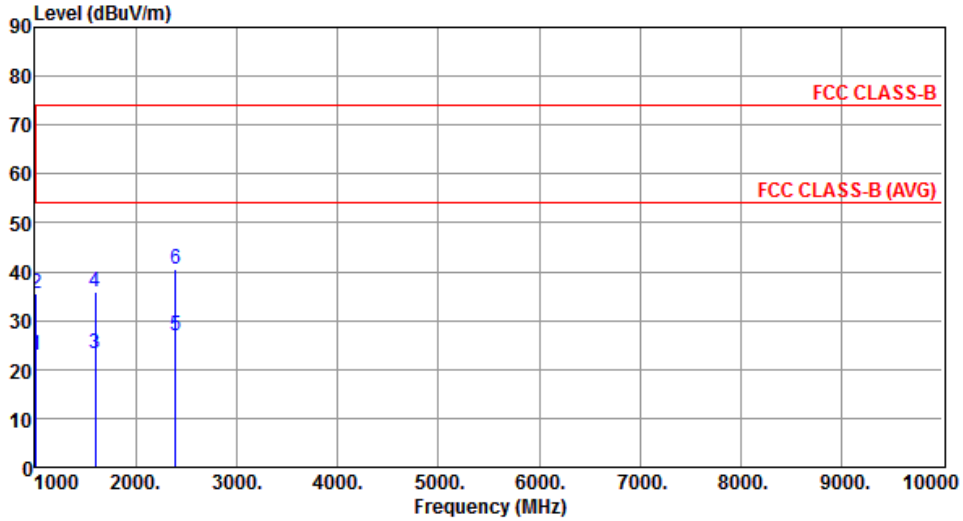


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1010.00	22.64	54.00	-31.36	32.87	-10.23	Average	100	230
2	1010.00	35.66	74.00	-38.34	45.89	-10.23	Peak	100	230
3	1600.00	22.42	54.00	-31.58	29.42	-7.00	Average	100	185
4	1600.00	35.84	74.00	-38.16	42.84	-7.00	Peak	100	185
5	2395.00	26.77	54.00	-27.23	29.85	-3.08	Average	100	75
6	2395.00	40.49	74.00	-33.51	43.57	-3.08	Peak	100	75

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

FSK 50kbps

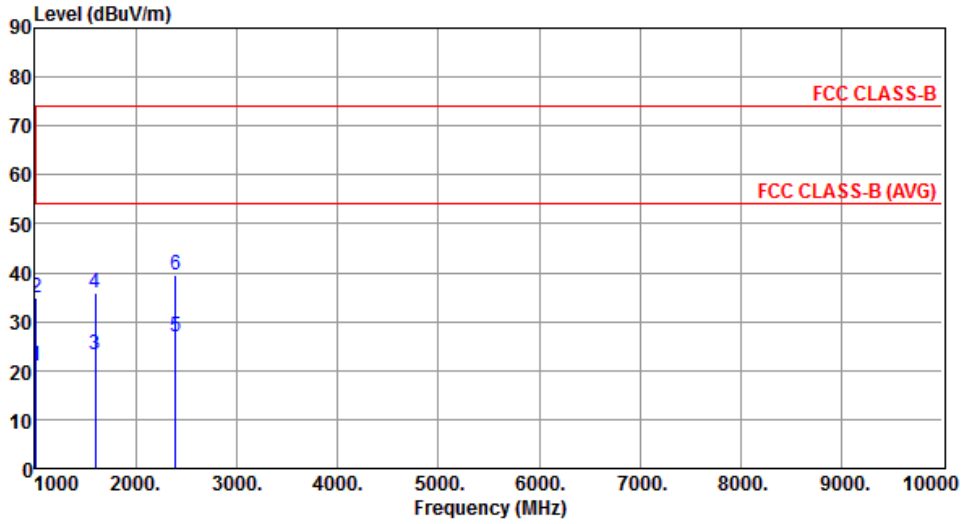
Modulation Mode	FSK	**Test Freq. (MHz)**	922
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1010.00	23.04	54.00	-30.96	33.27	-10.23	Average	100	75
2	1010.00	35.48	74.00	-38.52	45.71	-10.23	Peak	100	75
3	1600.00	23.21	54.00	-30.79	30.21	-7.00	Average	100	272
4	1600.00	35.96	74.00	-38.04	42.96	-7.00	Peak	100	272
5	2395.00	26.88	54.00	-27.12	29.96	-3.08	Average	100	251
6	2395.00	40.46	74.00	-33.54	43.54	-3.08	Peak	100	251

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation Mode	FSK	Test Freq. (MHz)	922
Polarization	Vertical		

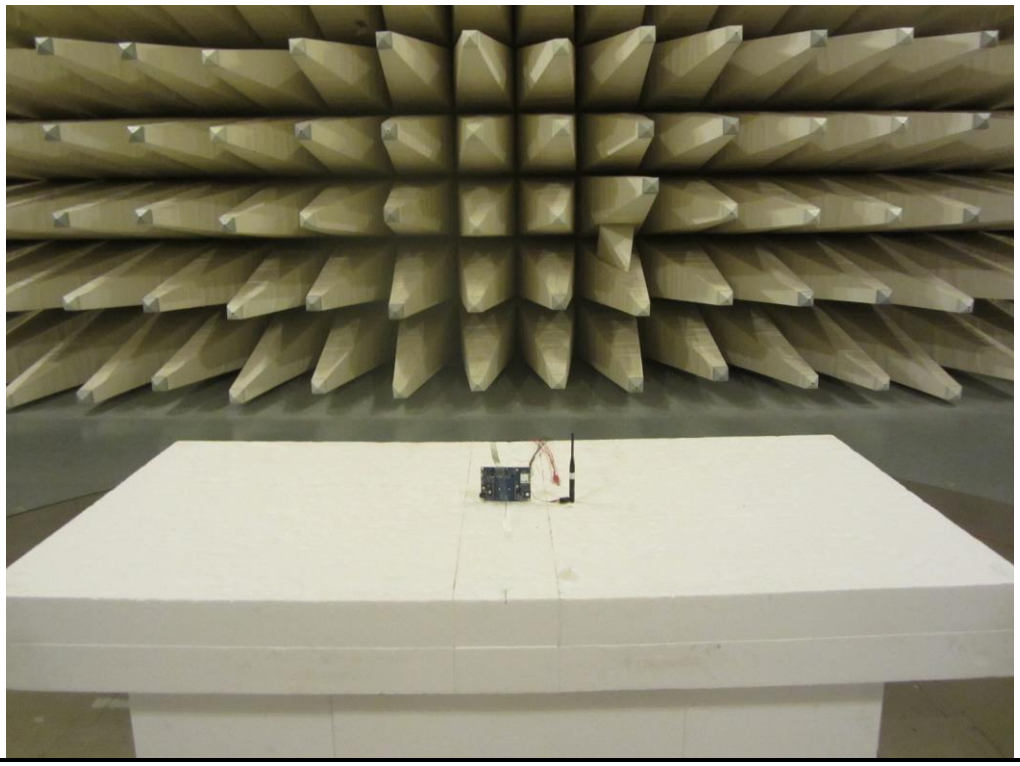


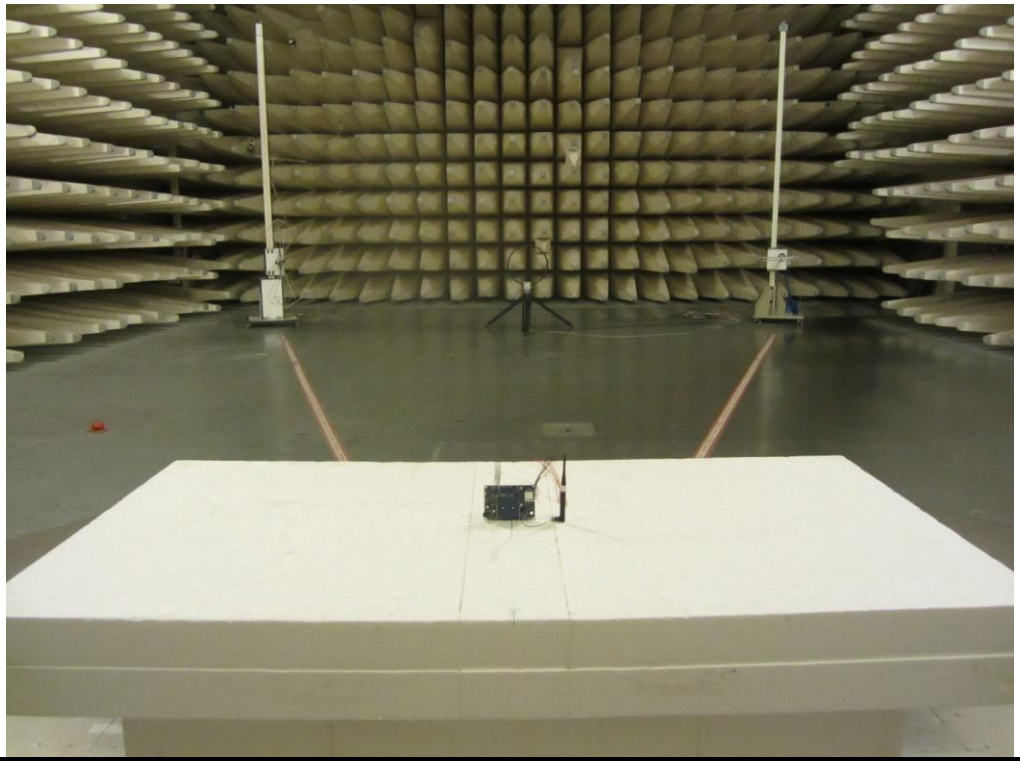
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1010.00	20.81	54.00	-33.19	31.04	-10.23	Average	100	239
2	1010.00	34.95	74.00	-39.05	45.18	-10.23	Peak	100	239
3	1600.00	23.26	54.00	-30.74	30.26	-7.00	Average	100	195
4	1600.00	35.96	74.00	-38.04	42.96	-7.00	Peak	100	195
5	2395.00	27.06	54.00	-26.94	30.14	-3.08	Average	100	84
6	2395.00	39.41	74.00	-34.59	42.49	-3.08	Peak	100	84

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

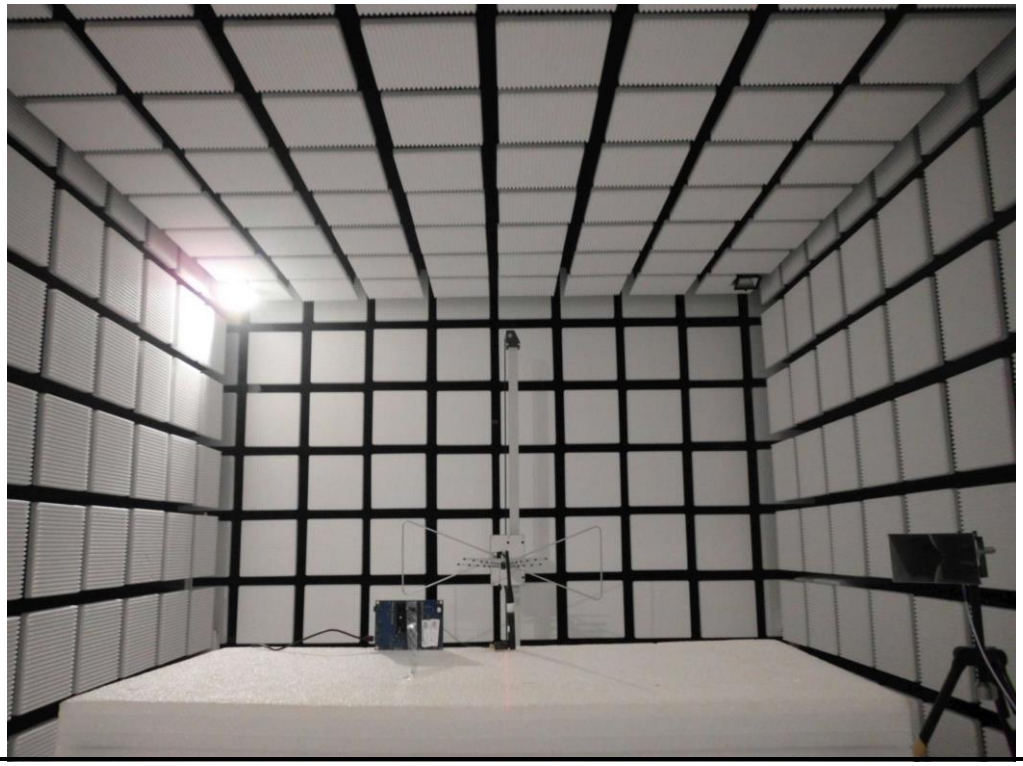
5 Photographs of the Test Configuration

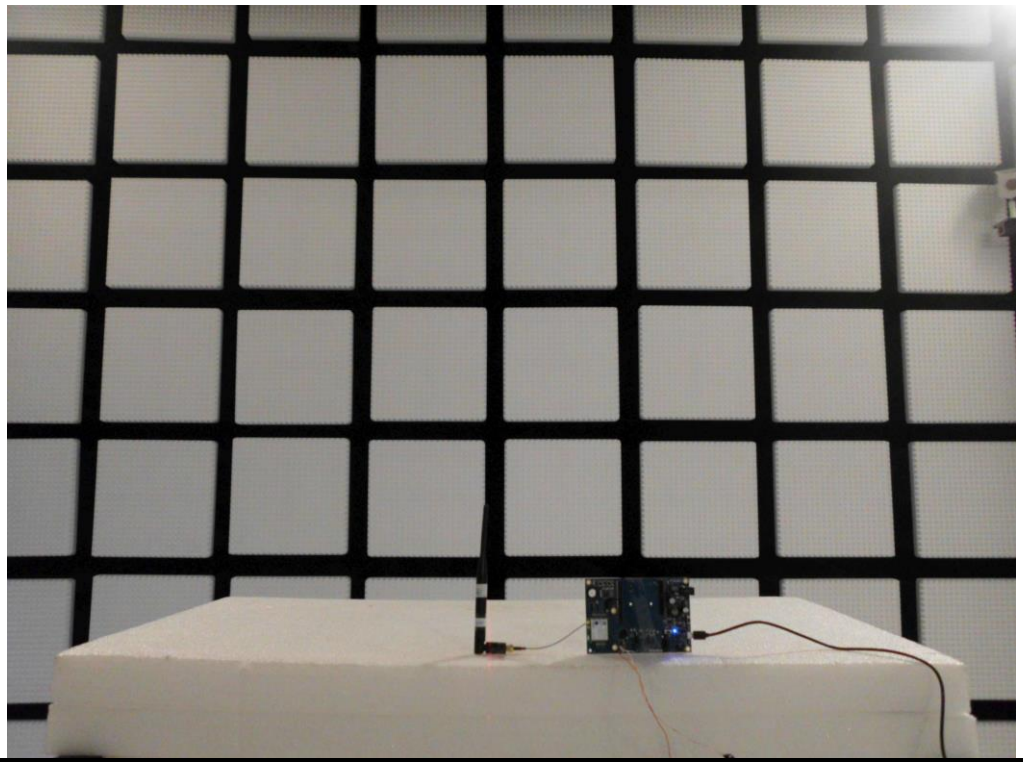
Spurious Emission below 30MHz Test



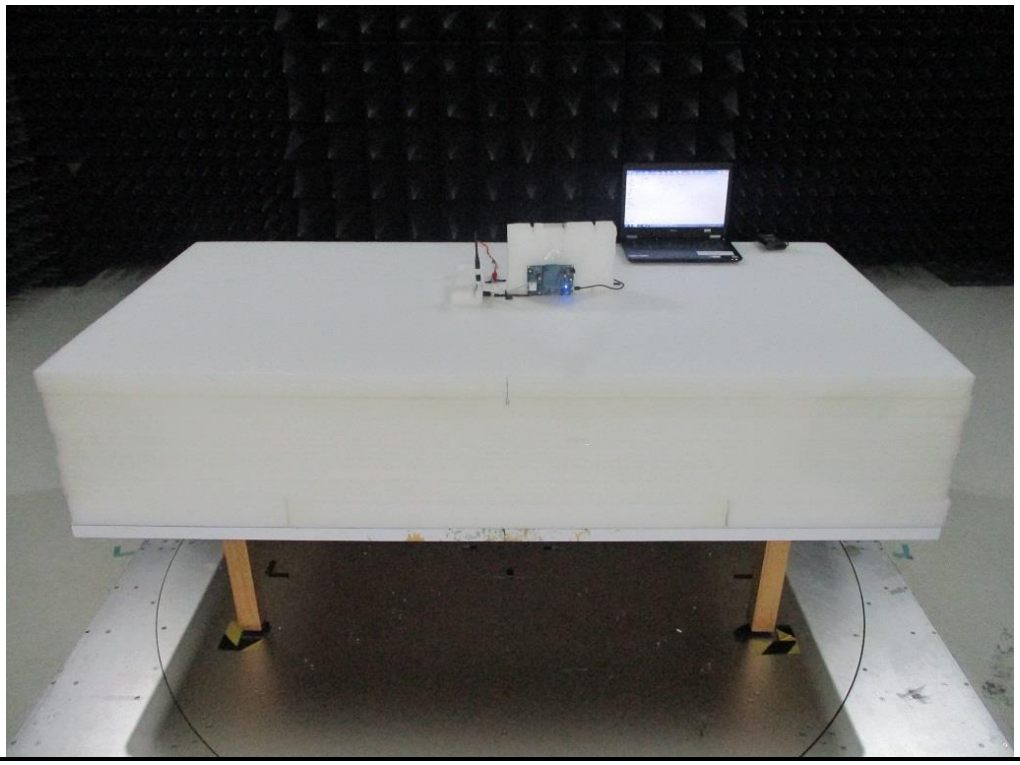


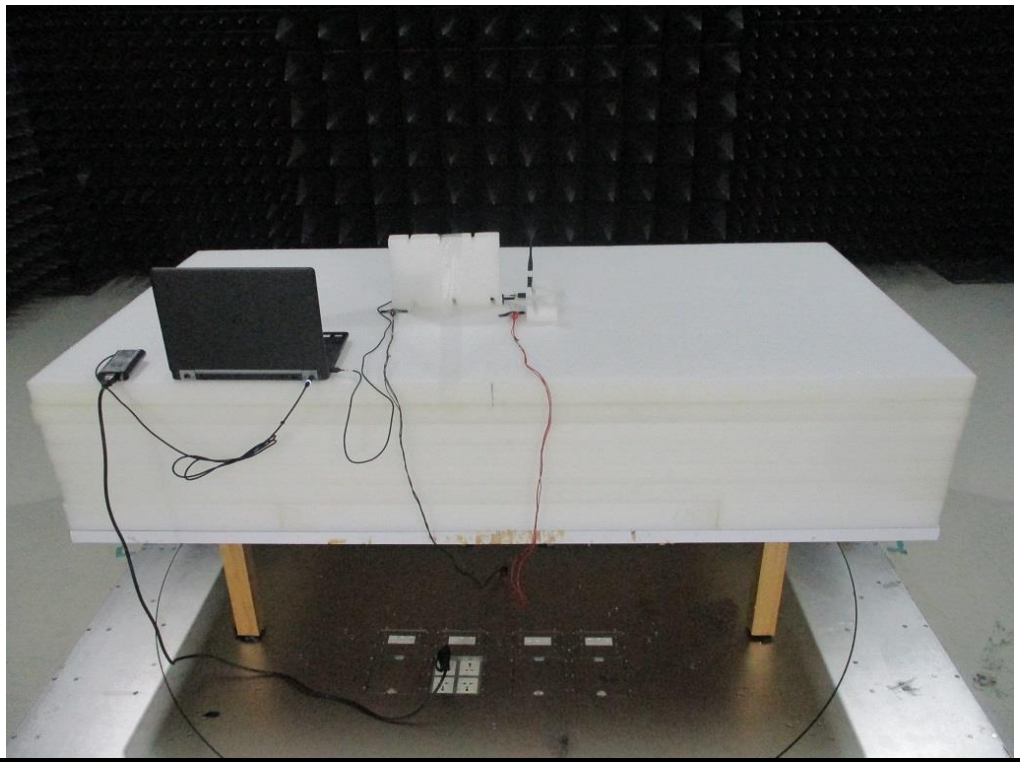
Spurious Emission Test



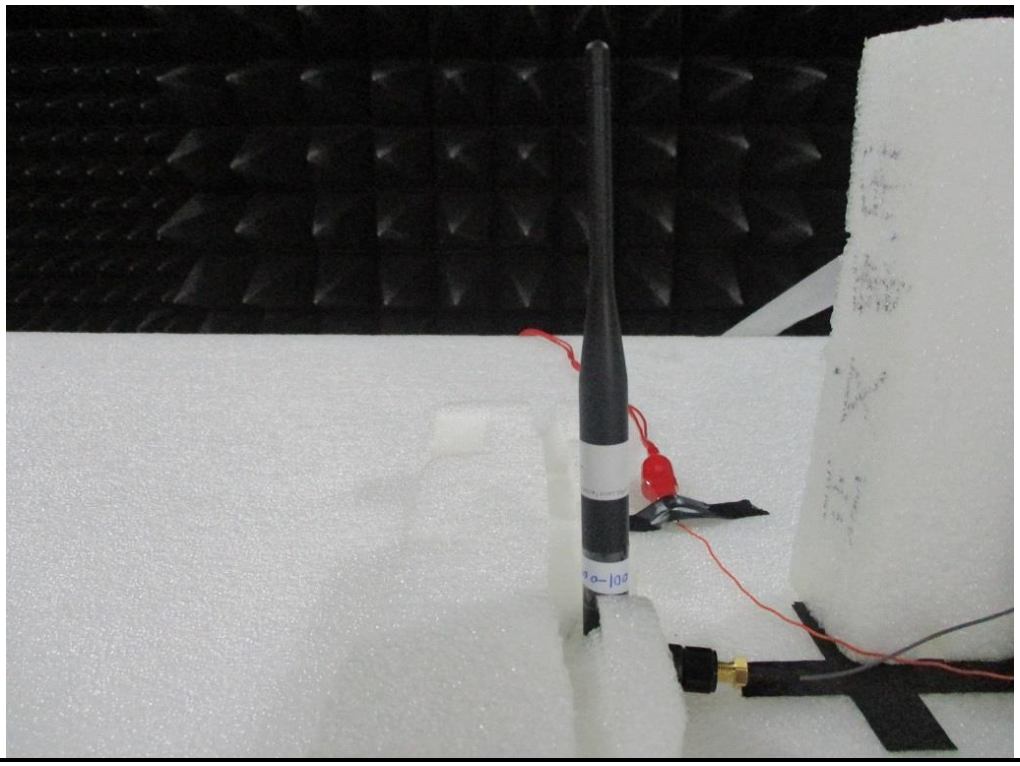


Spurious Emission Below 1GHz Test

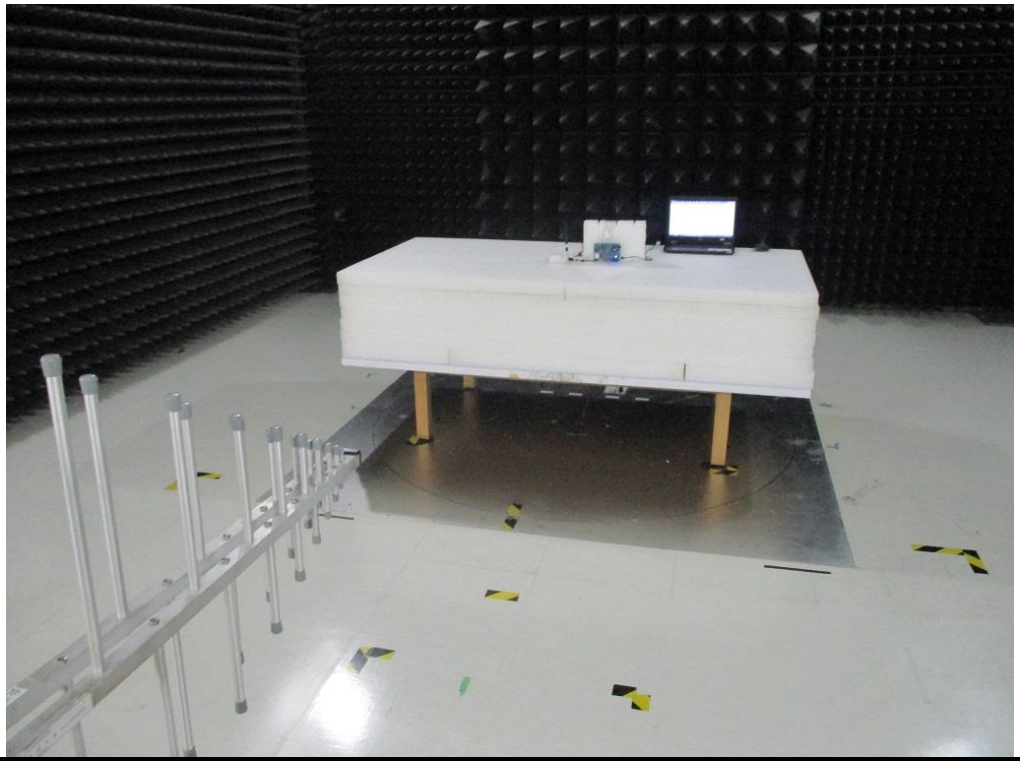




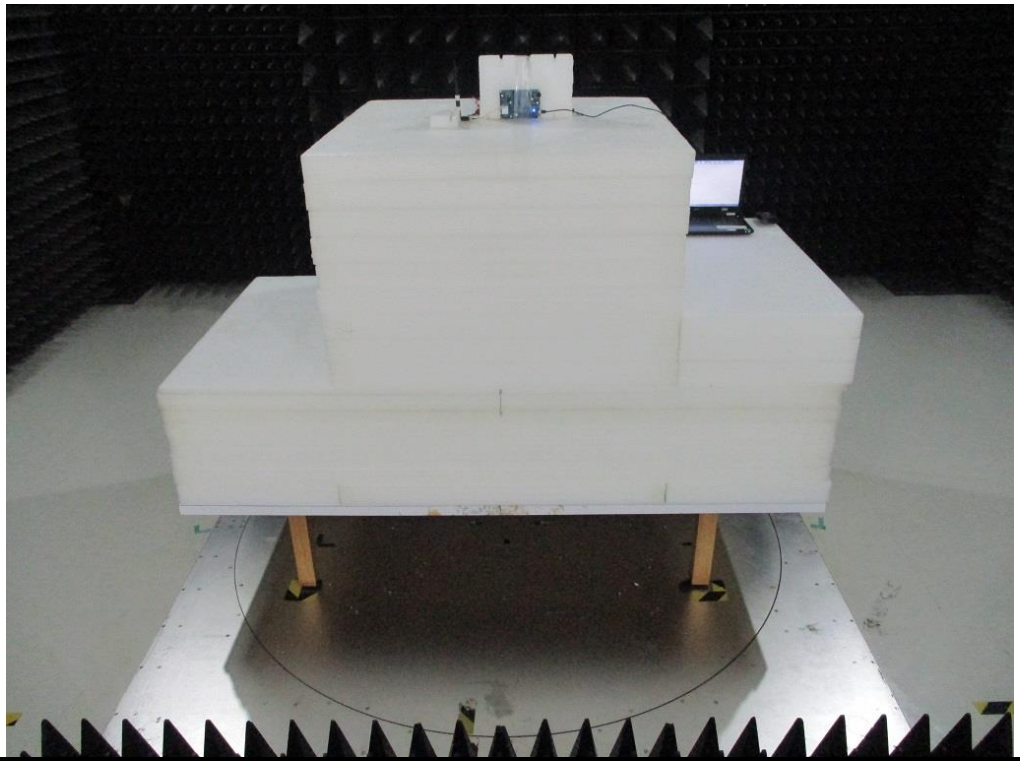
Spurious Emission Below 1GHz Test

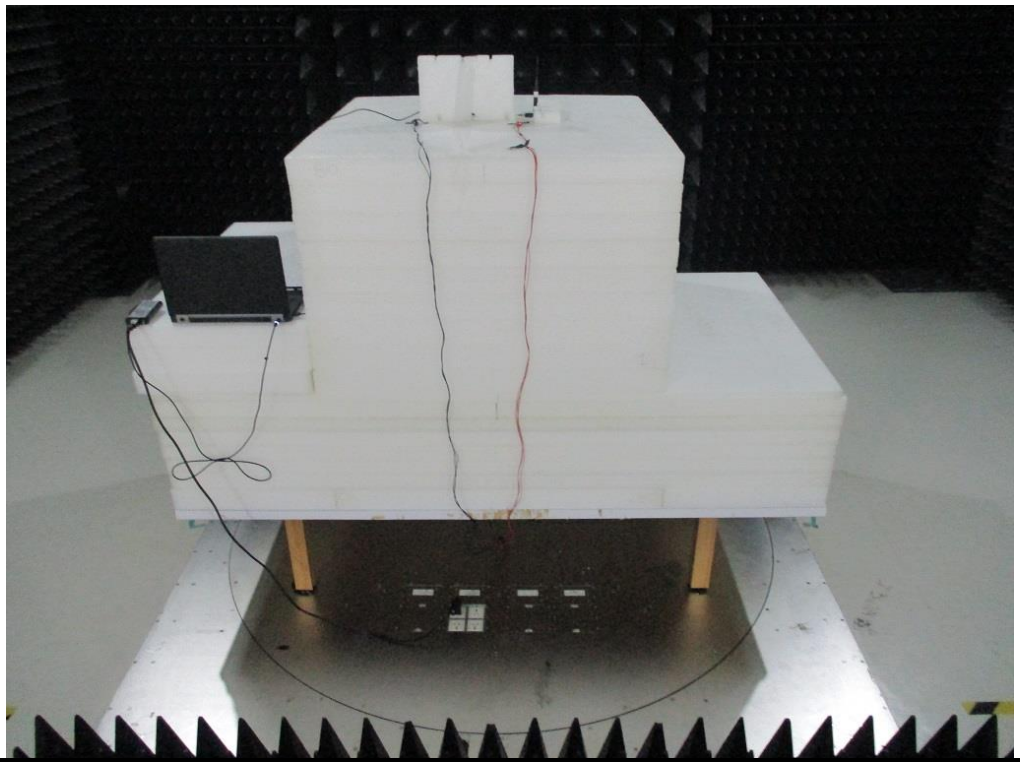


Spurious Emission Below 1GHz Test

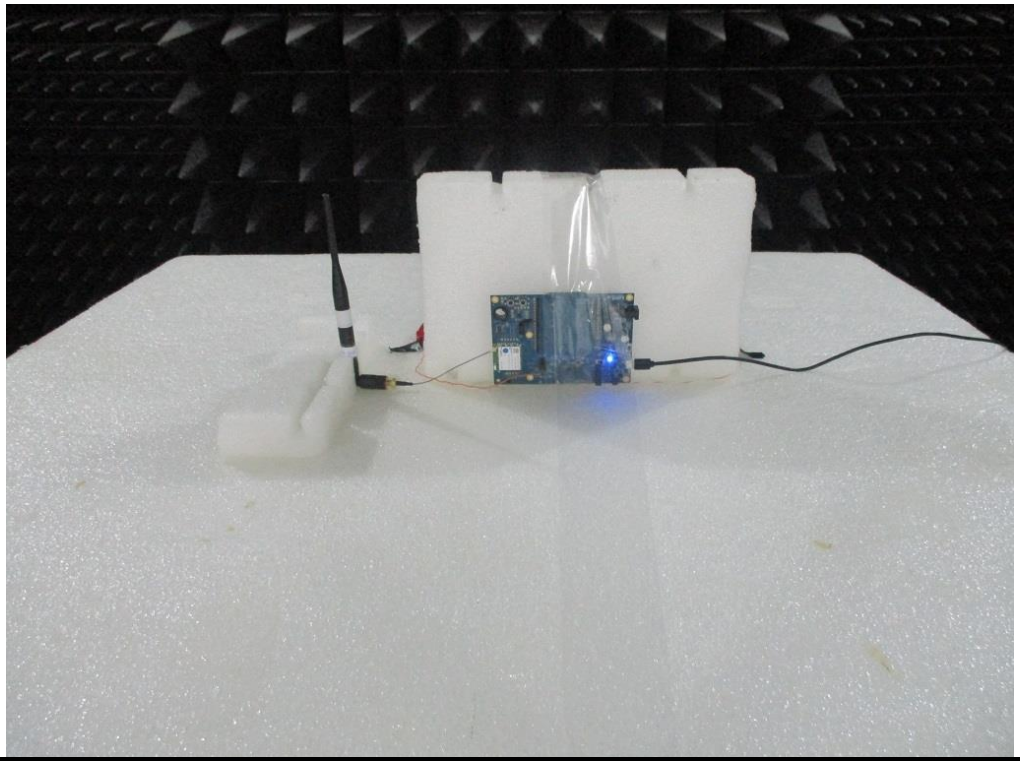


Spurious Emission Above 1GHz Test

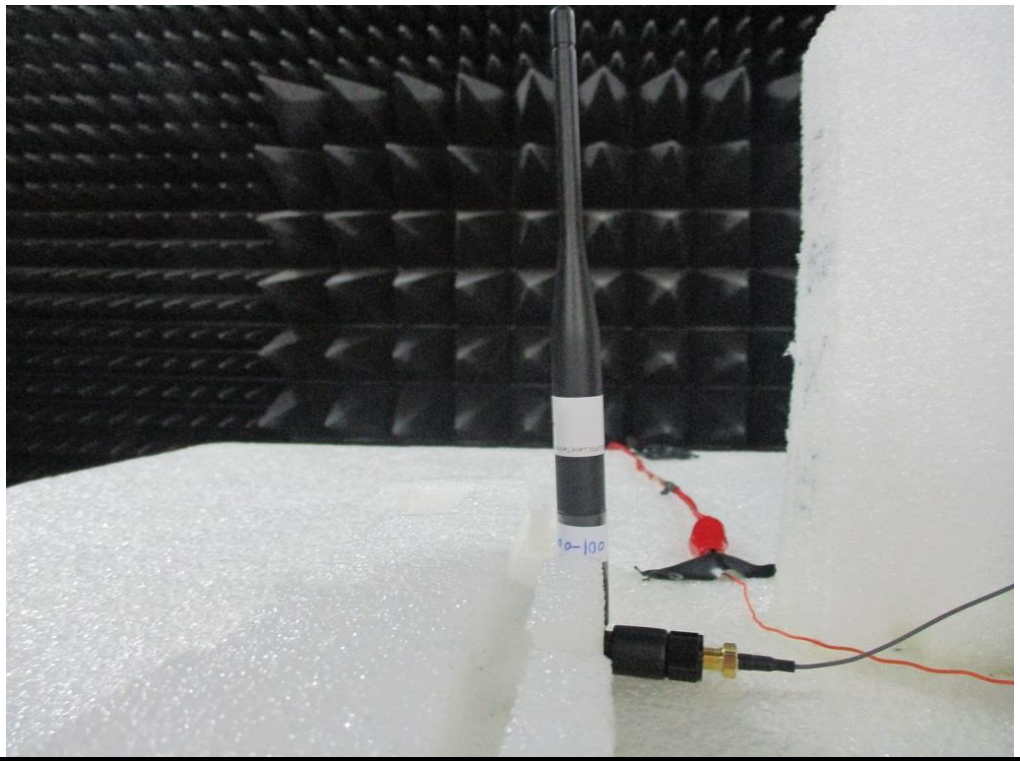


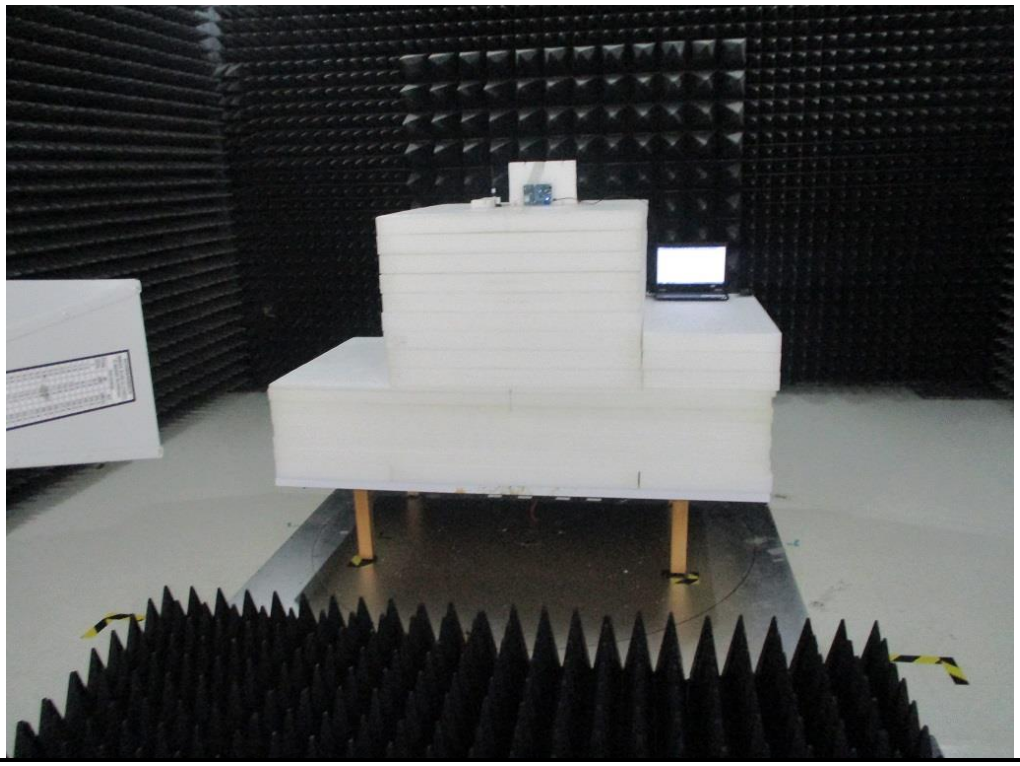


Spurious Emission Above 1GHz Test



Spurious Emission Above 1GHz Test





6 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website http://www.icertifi.com.tw.

Linkou	**Kwei Shan**	**Kwei Shan Site II**
Tel: 886-2-2601-1640	Tel: 886-3-271-8666	Tel: 886-3-271-8640
No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan, R.O.C.	No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.	No. 14-1, Lane 19, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C..

If you have any suggestion, please feel free to contact us as below information

Tel: 886-3-271-8666
Fax: 886-3-318-0155
Email: ICC_Service@icertifi.com.tw

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