AS/NZS Test Report

Equipment	:	**LoRaWAN-enabled Gateway with Wi-Fi**
Model No.	:	**Sentrius RG191 Gateway**
Brand Name	:	**Laird Connectivity**
Applicant	:	**Laird Connectivity**
Address	:	**W66N220 Commerce Court, Cedarburg, Wisconsin 53012, USA**
Standard	:	**AS/NZS 4268:2017**
Received Date	:	**Feb. 25, 2019**
Tested Date	:	**May 08 ~ Jun. 19, 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
AR932202-01-1	Rev. 01	Initial issue	Jul. 25, 2019

Summary of Test Results

Ref. Std. Clause	Test Items	Measured	Result
6.3	Maximum EIRP	EIRP (dBm): 29.61	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
Row 54	Hopping Frequencies & Dwell time	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)	Type	Modulation	Test Channel Frequency (MHz)	Number of Channels	UL/DL	Spreading Factor	Physical bit rate (bits/s)	Channel Band width (kHz)
AUSTRALIA	AS923	915.2 ~ 927.8	FHSS	FSK	915.2, 921.6, 927.8	64	UL/DL	-	50000	125
Note1: RF output power specifies that Maximum Peak Conducted Output Power. Note2: This device is as FHSS operation with sliding 20 hop channels for FSK 50kbps modulation										

1.1.2 Antenna Details

Ant. No.	Brand / Model	Type	Connector	Gain (dBi)
1	LSR/001-0002	Dipole	RP-SMA	2

1.1.3 EUT Operational Condition

Power Supply Type	12Vdc from adapter		
Operational Voltage	☒ Vnom (12 Vdc)	☒ Vmax (12.19 Vdc)	☒ Vmin (11.81Vdc)
Operational Climatic	☒ Tnom (20°C)	☒ Tmax (70°C)	☒ Tmin (-30°C)

1.1.4 Accessories

Accessories		
No.	**Equipment**	**Description**
1	Adapter	Brand: MW Model: GST25U12 Power Rating: I/P: 100-240Vac, 50/60Hz, 0.6A O/P: 12Vdc, 2.08A, 25W MAX Power line: 1m non-shielded with two cores
2	RJ45 cable	Brand: BRIGHT PLUS CO., LTD Model: WAS-G0736-1 1.81m non-shielded without core

1.1.5 Test Tool and Duty Cycle

Test Tool	By command	
Duty Cycle and Duty Factor	Duty Cycle (%)	Duty Factor (dB)
	100	0

1.1.6 Power Index of Test Tool

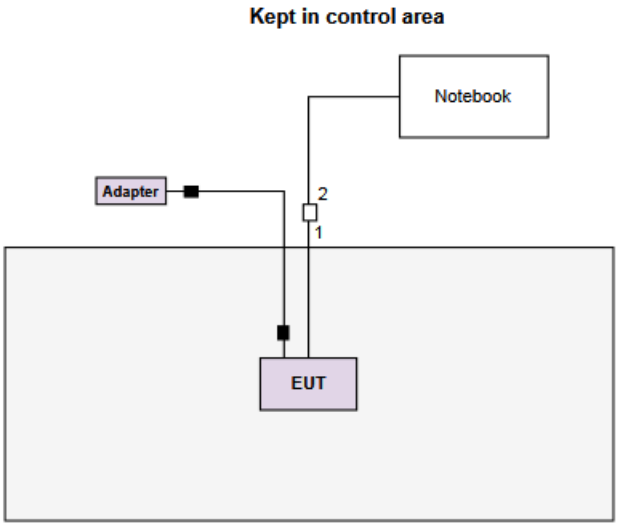
Channel Bandwidth 125 kHz			
Modulation Mode	Test Frequency (MHz)		
	915.2	921.6	927.8
FSK	dig 0--mix 9--Pa3	dig 0--mix 9--Pa3	dig 0--mix 9--Pa3

1.2 Local Support Equipment List

Support Equipment List					
No.	Equipment	Brand	Model	FCC ID	Remarks
1	Notebook	DELL	Latitude E5470	DoC	---
2	AP	Buffalo Inc.	WRM-D2133HP	---	Provided by applicant.

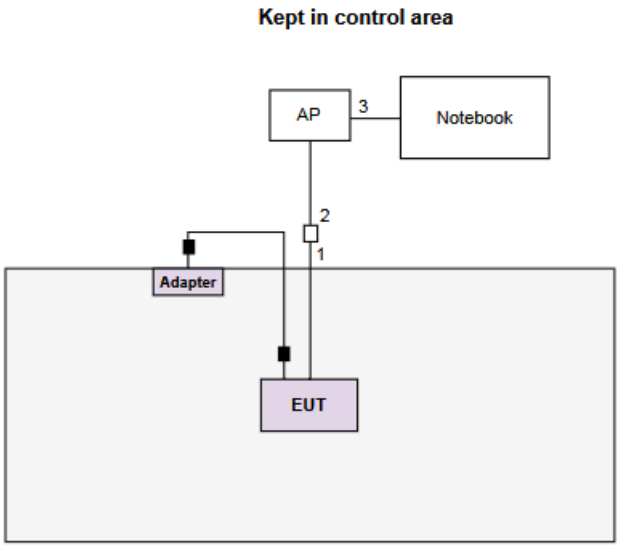
1.3 Test Setup Chart

Test Setup Diagram (below 30 MHz)



No.	Signal cable / Length (m)
1	RJ45, 1.81m non-shielded.
2	RJ45, 10m non-shielded.

Test Setup Diagram (above 30 MHz)



No.	Signal cable / Length (m)
1	RJ45, 1.81m non-shielded.
2	RJ45, 10m non-shielded.
3	RJ45, 1.5m non-shielded.

1.4 Test Equipment List and Calibration Data

Test Item	RF Conducted				
Test Site	(TH01-WS)				
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)				
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	(10CH01-HY)				
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	Conducted / Radiated measurement	TX/ RX test	Tested By
RF Conducted	TH01-WS	25.2°C / 62%	Conducted	TX	Ryan Lee
Radiated Emission > 30 MHz	03CH01-WS	22-24°C / 64-66%	Radiated	TX RX	Akun Chung Aska Huang
Radiated Emission ≤ 30 MHz	10CH01-HY*	25°C / 65%	Radiated	TX RX	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.

2.2 The Worst Test Modes and Channel Details

Test item	Modulation	Test mode	Conducted / Radiated measurement	TX/ RX test	Test Frequency (MHz)
EIRP	FSK	Non-hopping	Conducted	TX	915.2 / 921.6 / 927.8
Transmitter Spurious Emissions		Non-hopping	Radiated	TX	
Emission Bandwidth		Non-hopping	Conducted	TX	
Operating frequencies		Non-hopping	Conducted	TX	
Receiver Spurious Emissions ≤ 30 MHz		Non-hopping	Radiated	RX	
Hopping Frequencies	FSK	Hopping	Conducted	TX	915.2 ~ 927.8
Dwell Time	FSK	Hopping	Conducted	TX	915.2
Receiver Spurious Emissions >30 MHz	FSK	Non-hopping	Radiated	RX	915.2

NOTE:

1. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **Z-plane** results were found as the worst case and were shown in this report.

3 Transmitter Test Results

3.1 Maximum EIRP

3.1.1 Maximum EIRP Limit

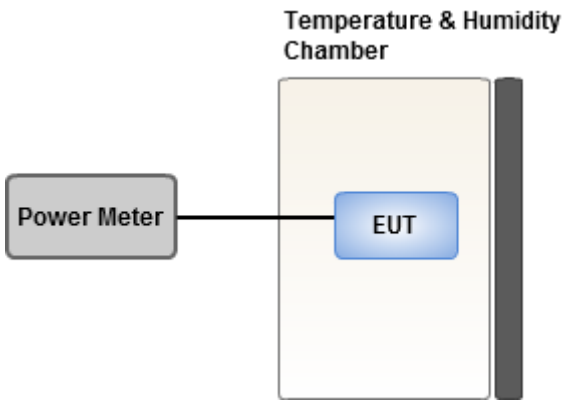
Permitted Operating Frequency Band (MHz)	Maximum EIRP	Other Requirements
915 to 928	1W (30dBm)	A minimum of 20 hopping frequencies shall be used.

Note: Limit is from AS/NZS 4268:2017

3.1.2 Test Procedures

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

3.1.3 Test Setup



3.1.4 Test Result of EIRP

Condition	Freqeuncy (MHz)	EIRP Power (dBm)	EIRP Limit (dBm)
$T_{nom}V_{nom}$	915.2	27.11	30
$T_{min}V_{max}$	915.2	29.59	30
$T_{min}V_{min}$	915.2	29.61	30
$T_{max}V_{max}$	915.2	25.04	30
$T_{max}V_{min}$	915.2	25.00	30
$T_{nom}V_{nom}$	921.6	26.98	30
$T_{min}V_{max}$	921.6	29.34	30
$T_{min}V_{min}$	921.6	29.38	30
$T_{max}V_{max}$	921.6	24.69	30
$T_{max}V_{min}$	921.6	24.66	30
$T_{nom}V_{nom}$	927.8	25.77	30
$T_{min}V_{max}$	927.8	28.47	30
$T_{min}V_{min}$	927.8	28.49	30
$T_{max}V_{max}$	927.8	23.42	30
$T_{max}V_{min}$	927.8	23.40	30

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.			

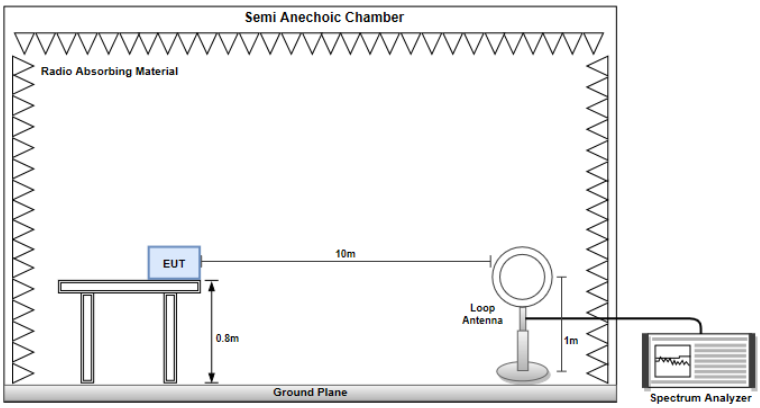
Note: Limit is from FCC Part 15.209

3.2.2 Test Procedures

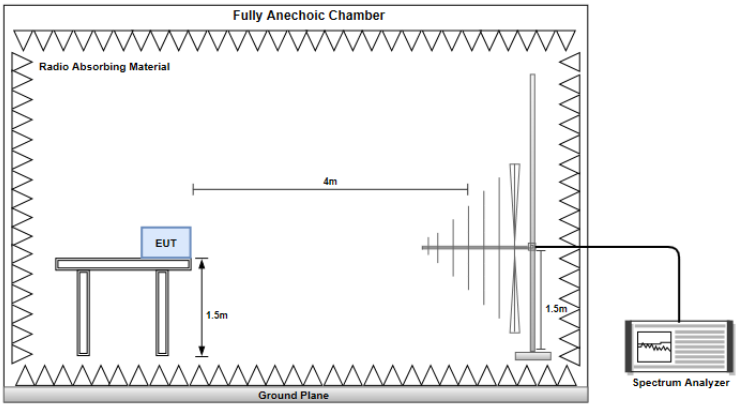
Reference to clause 6.2.1 of AS/NZS 4268:2017.

3.2.3 Test Setup

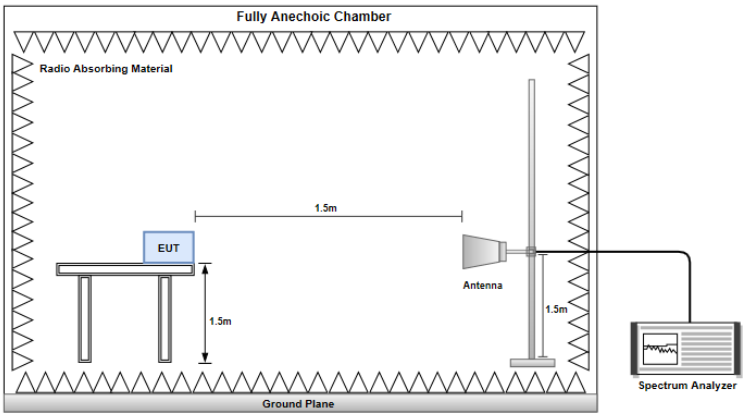
Below 30MHz



Below 1GHz

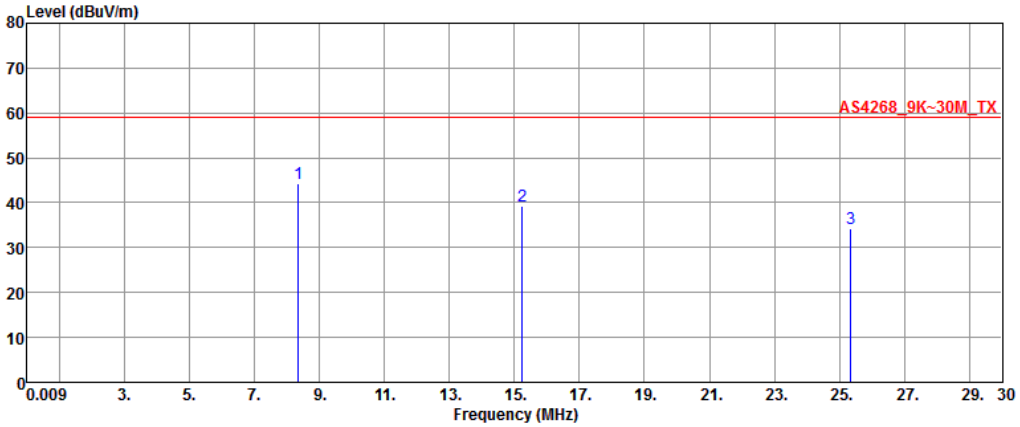


Above 1 GHz



3.2.4 Transmitter Spurious Emissions (≤ 30MHz)

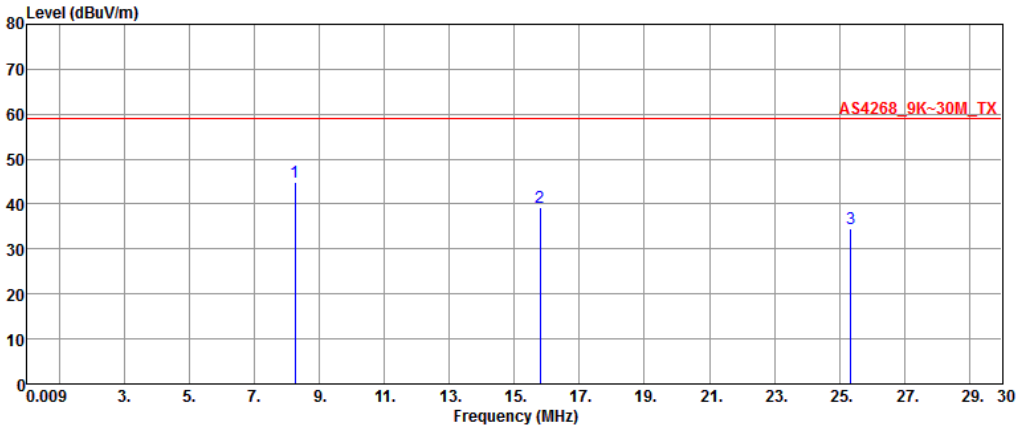
Modulation	FSK	**Test Freq. (MHz)**	915.2
Frequency	9kHz~30MHz	**Loop**	open



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBuV/m	dBuV/m	dB	dB	dBuV
1	8.36	44.26	59.00	-14.74	20.17	24.09
2	15.25	39.26	59.00	-19.74	21.22	18.04
3	25.35	34.22	59.00	-24.78	22.05	12.17

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

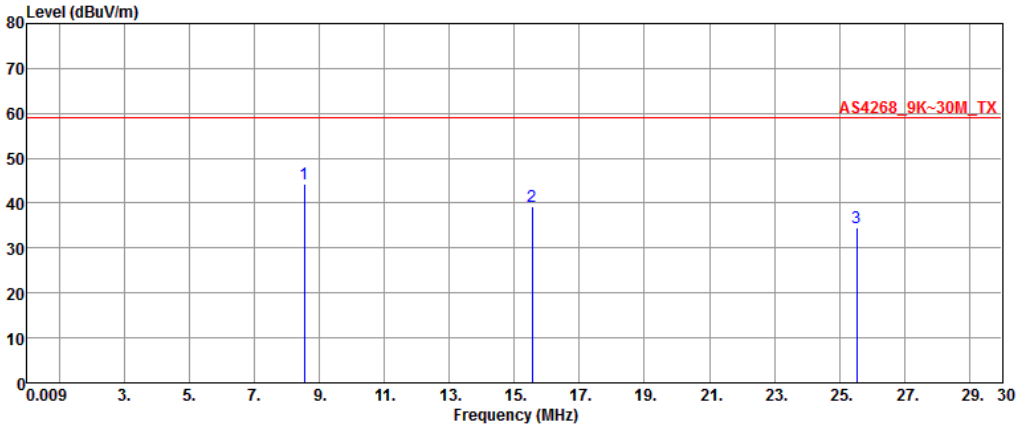
Modulation	FSK	Test Freq. (MHz)	921.6
Frequency	9kHz~30MHz	Loop	open



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBuV/m	dBuV/m	dB	dB	dBuV
1	8.26	44.76	59.00	-14.24	20.16	24.60
2	15.79	39.14	59.00	-19.86	21.30	17.84
3	25.35	34.56	59.00	-24.44	22.05	12.51

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

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

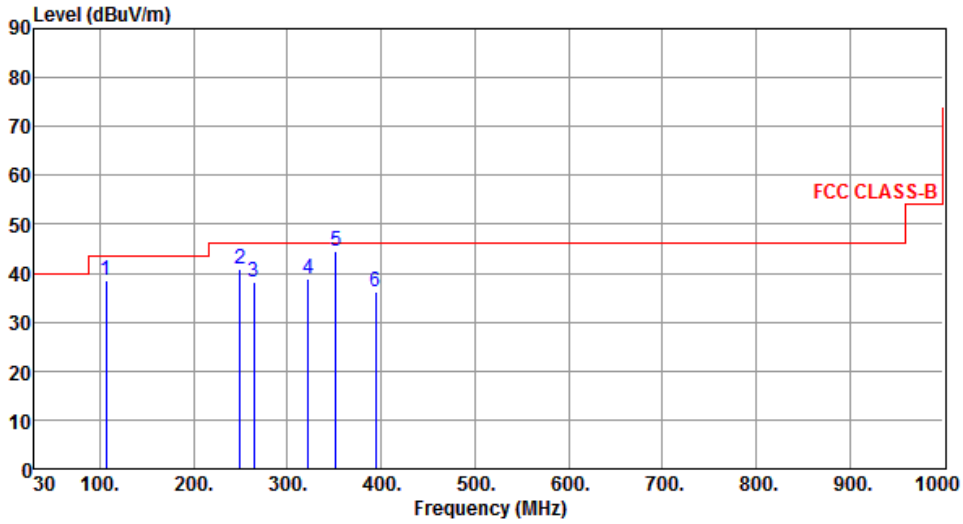


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBuV/m	dBuV/m	dB	dB	dBuV
1	8.52	44.39	59.00	-14.61	20.19	24.20
2	15.55	39.29	59.00	-19.71	21.26	18.03
3	25.53	34.47	59.00	-24.53	22.07	12.40

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)

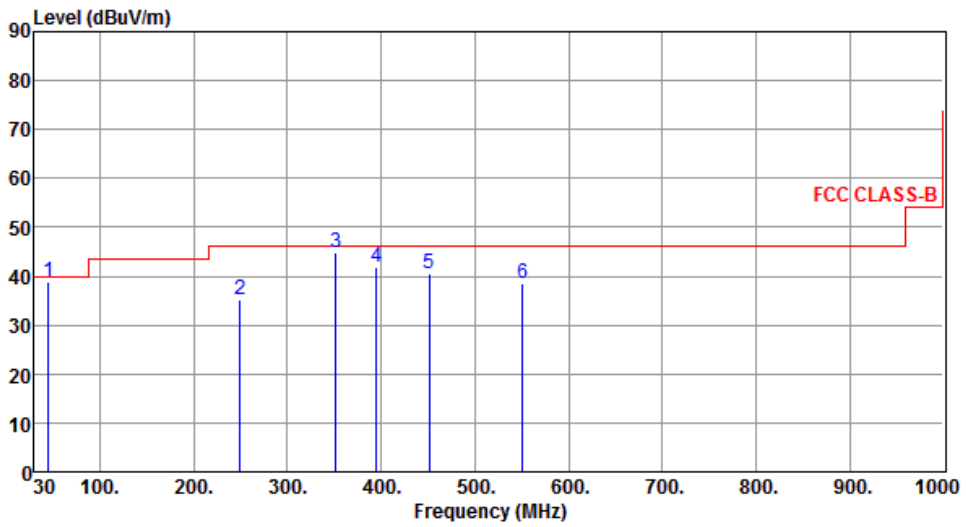
Modulation Mode	FSK	**Test Freq. (MHz)**	915.2
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	106.95	38.66	43.50	-4.84	50.53	-11.87	Peak	---	---
2	249.85	40.96	46.00	-5.04	50.33	-9.37	Peak	---	---
3	264.21	38.25	46.00	-7.75	47.09	-8.84	Peak	---	---
4	321.88	38.96	46.00	-7.04	46.16	-7.20	Peak	---	---
5	351.85	44.36	46.00	-1.64	50.77	-6.41	QP	100	171
6	394.58	36.22	46.00	-9.78	41.44	-5.22	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).

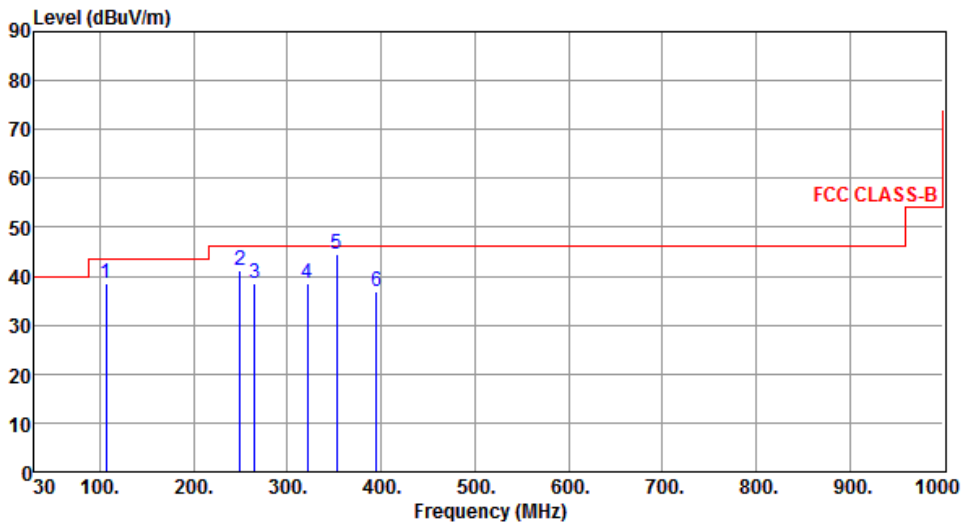
Modulation Mode	FSK	Test Freq. (MHz)	915.2
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	44.89	38.96	40.00	-1.04	46.81	-7.85	QP	104	348
2	249.66	35.36	46.00	-10.64	44.74	-9.38	Peak	---	---
3	351.89	44.85	46.00	-1.15	51.26	-6.41	QP	155	72
4	394.85	41.85	46.00	-4.15	47.06	-5.21	Peak	---	---
5	451.21	40.36	46.00	-5.64	44.24	-3.88	Peak	---	---
6	550.77	38.69	46.00	-7.31	40.39	-1.70	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).

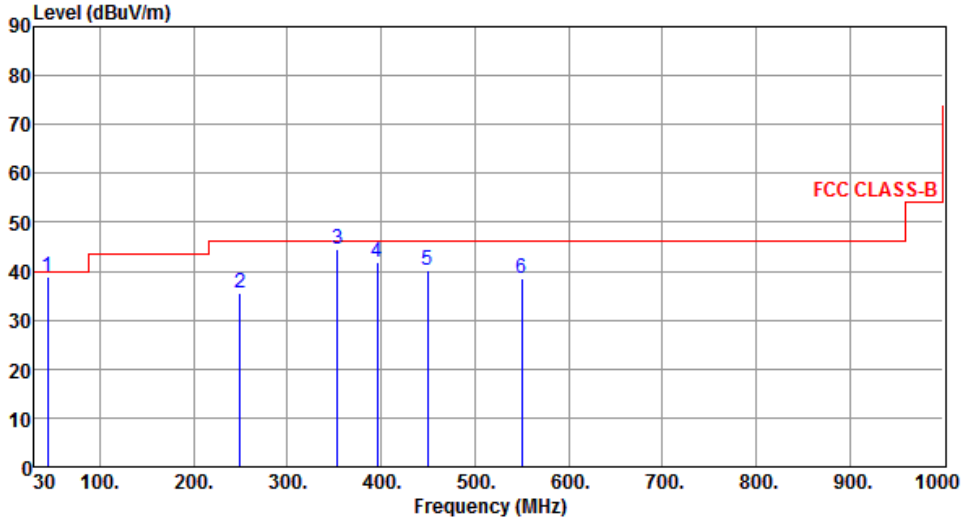
Modulation Mode	FSK	Test Freq. (MHz)	921.6
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	106.85	38.66	43.50	-4.84	50.54	-11.88	Peak	---	---
2	249.54	41.29	46.00	-4.71	50.67	-9.38	Peak	---	---
3	265.23	38.66	46.00	-7.34	47.46	-8.80	Peak	---	---
4	321.47	38.42	46.00	-7.58	45.63	-7.21	Peak	---	---
5	352.60	44.36	46.00	-1.64	50.76	-6.40	QP	100	168
6	395.21	36.85	46.00	-9.15	42.05	-5.20	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).

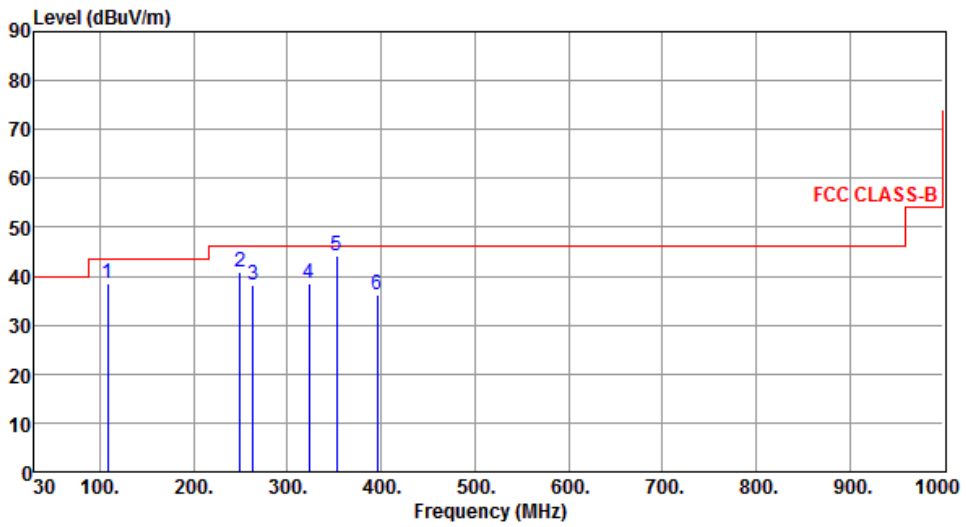
Modulation Mode	FSK	Test Freq. (MHz)	921.6
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	44.57	38.74	40.00	-1.26	46.62	-7.88	QP	102	348
2	249.85	35.63	46.00	-10.37	45.00	-9.37	Peak	---	---
3	353.21	44.45	46.00	-1.55	50.84	-6.39	QP	150	72
4	395.71	41.88	46.00	-4.12	47.07	-5.19	Peak	---	---
5	449.85	40.33	46.00	-5.67	44.24	-3.91	Peak	---	---
6	549.85	38.41	46.00	-7.59	40.14	-1.73	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).

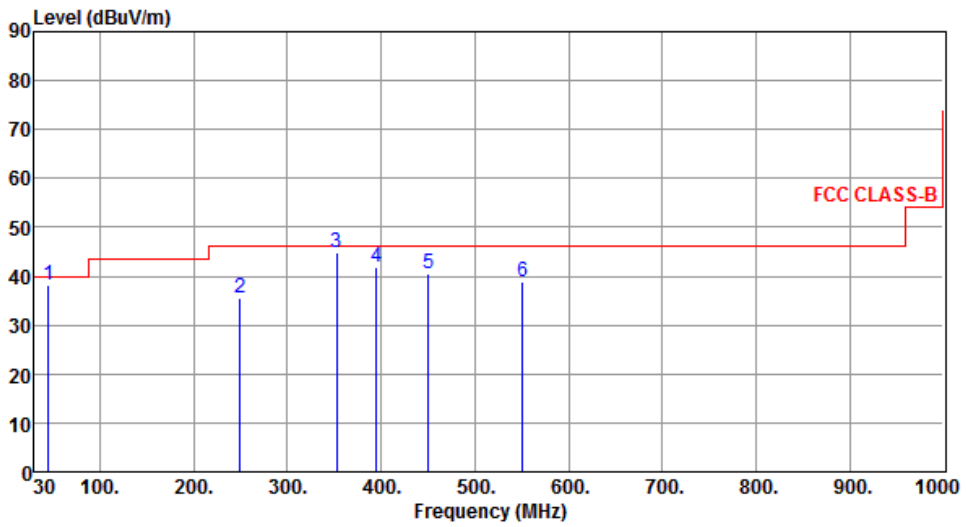
Modulation Mode	FSK	Test Freq. (MHz)	927.8
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	108.24	38.42	43.50	-5.08	50.12	-11.70	Peak	---	---
2	249.84	40.85	46.00	-5.15	50.22	-9.37	Peak	---	---
3	263.50	38.32	46.00	-7.68	47.20	-8.88	Peak	---	---
4	322.84	38.36	46.00	-7.64	45.54	-7.18	Peak	---	---
5	352.41	44.23	46.00	-1.77	50.63	-6.40	QP	100	168
6	395.74	36.29	46.00	-9.71	41.48	-5.19	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		

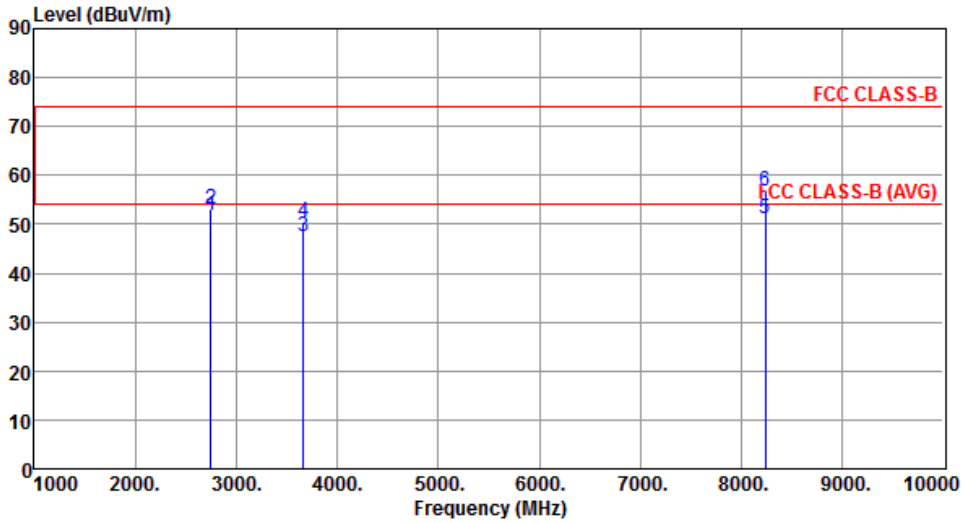


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	44.63	38.23	40.00	-1.77	46.11	-7.88	QP	105	338
2	249.52	35.38	46.00	-10.62	44.76	-9.38	Peak	---	---
3	352.25	44.89	46.00	-1.11	51.29	-6.40	QP	150	74
4	394.88	41.88	46.00	-4.12	47.09	-5.21	Peak	---	---
5	450.23	40.36	46.00	-5.64	44.26	-3.90	Peak	---	---
6	550.74	38.96	46.00	-7.04	40.66	-1.70	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)

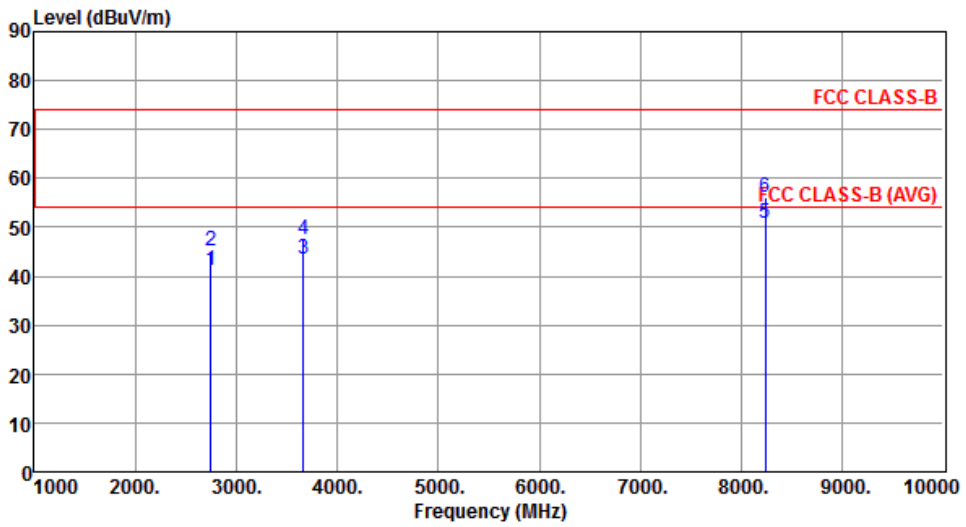
Modulation Mode	FSK	Test Freq. (MHz)	915.2
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2745.60	51.65	54.00	-2.35	54.01	-2.36	Average	233	1
2	2745.60	53.29	74.00	-20.71	55.65	-2.36	Peak	233	1
3	3660.80	47.49	54.00	-6.51	47.19	0.30	Average	106	302
4	3660.80	50.40	74.00	-23.60	50.10	0.30	Peak	106	302
5	8236.80	51.15	54.00	-2.85	41.95	9.20	Average	120	320
6	8236.80	56.74	74.00	-17.26	47.54	9.20	Peak	120	320

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).

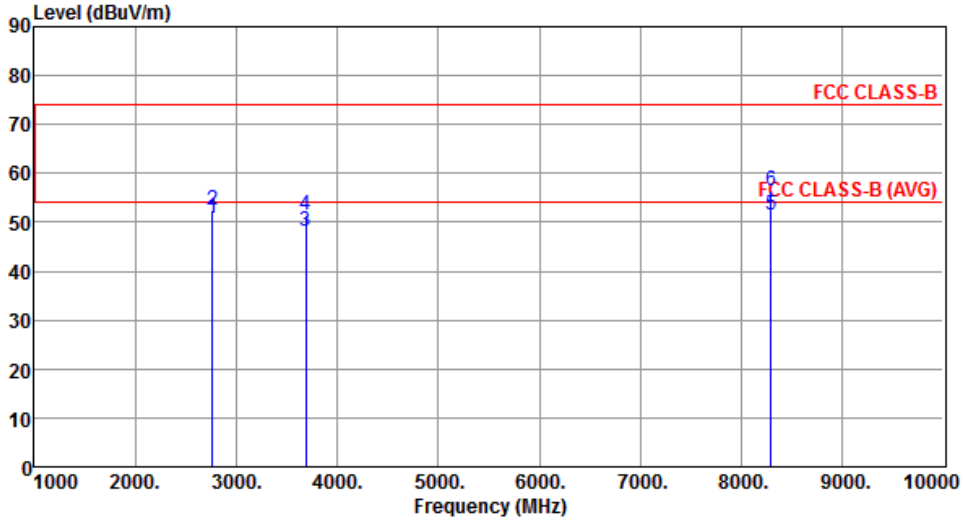
Modulation Mode	FSK	Test Freq. (MHz)	915.2
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2745.60	41.09	54.00	-12.91	43.45	-2.36	Average	115	246
2	2745.60	45.23	74.00	-28.77	47.59	-2.36	Peak	115	246
3	3660.80	43.63	54.00	-10.37	43.33	0.30	Average	129	336
4	3660.80	47.56	74.00	-26.44	47.26	0.30	Peak	129	336
5	8236.80	50.96	54.00	-3.04	41.76	9.20	Average	190	1
6	8236.80	56.27	74.00	-17.73	47.07	9.20	Peak	190	1

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).

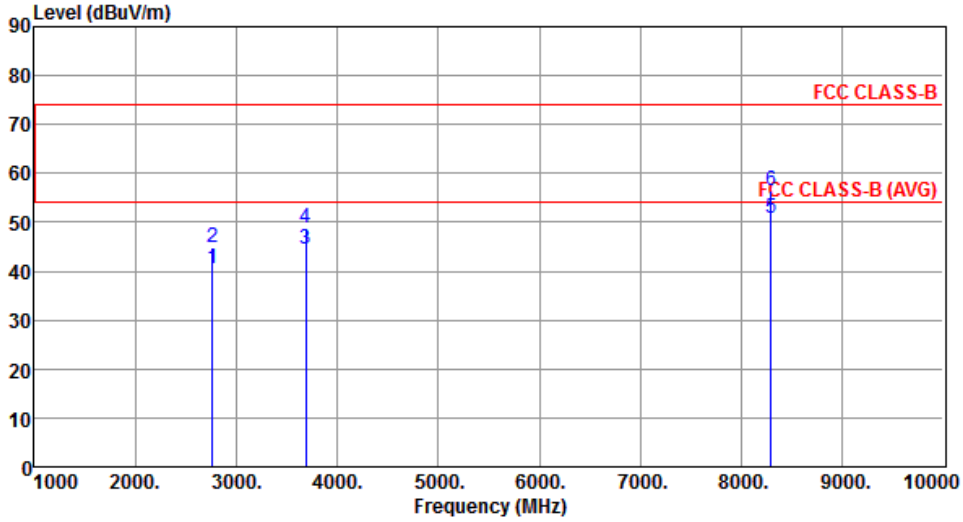
Modulation Mode	FSK	Test Freq. (MHz)	921.6
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2764.80	50.95	54.00	-3.05	53.18	-2.23	Average	211	353
2	2764.80	52.49	74.00	-21.51	54.72	-2.23	Peak	211	353
3	3686.40	48.11	54.00	-5.89	47.83	0.28	Average	100	302
4	3686.40	51.45	74.00	-22.55	51.17	0.28	Peak	100	302
5	8294.40	51.38	54.00	-2.62	42.23	9.15	Average	142	45
6	8294.40	56.43	74.00	-17.57	47.28	9.15	Peak	142	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).

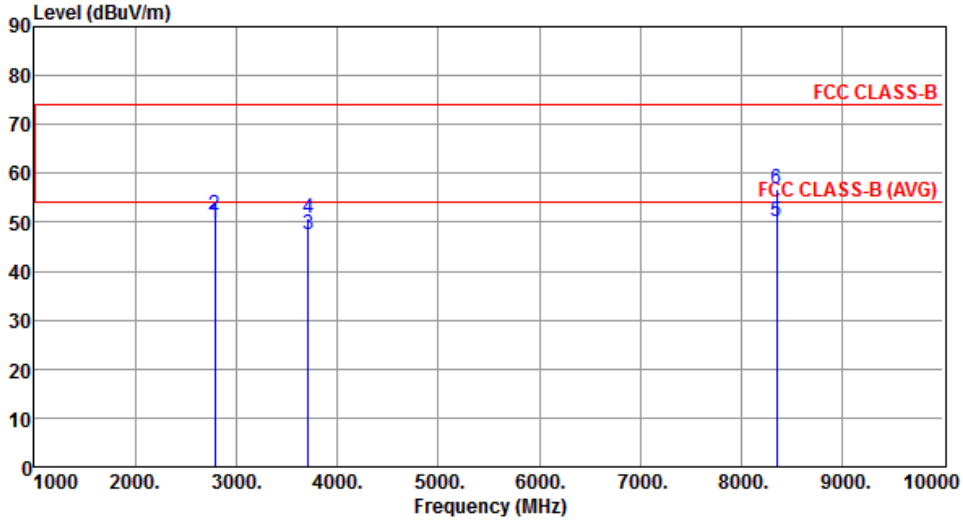
Modulation Mode	FSK	Test Freq. (MHz)	921.6
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2764.80	40.39	54.00	-13.61	42.62	-2.23	Average	165	222
2	2764.80	44.81	74.00	-29.19	47.04	-2.23	Peak	165	222
3	3686.40	44.56	54.00	-9.44	44.28	0.28	Average	129	345
4	3686.40	48.77	74.00	-25.23	48.49	0.28	Peak	129	345
5	8294.40	50.80	54.00	-3.20	41.65	9.15	Average	187	0
6	8294.40	56.45	74.00	-17.55	47.30	9.15	Peak	187	0

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).

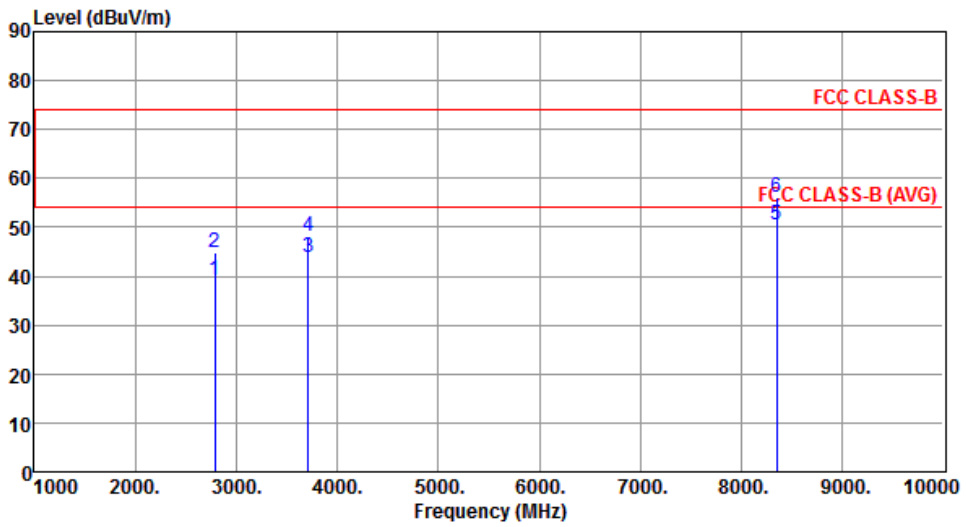
Modulation Mode	FSK	Test Freq. (MHz)	927.8
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2783.40	49.90	54.00	-4.10	51.99	-2.09	Average	231	347
2	2783.40	51.53	74.00	-22.47	53.62	-2.09	Peak	231	347
3	3711.20	47.48	54.00	-6.52	47.17	0.31	Average	109	301
4	3711.20	50.79	74.00	-23.21	50.48	0.31	Peak	109	301
5	8350.20	50.15	54.00	-3.85	41.07	9.08	Average	152	4
6	8350.20	56.82	74.00	-17.18	47.74	9.08	Peak	152	4

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	2783.40	39.19	54.00	-14.81	41.28	-2.09	Average	152	204
2	2783.40	44.83	74.00	-29.17	46.92	-2.09	Peak	152	204
3	3711.20	43.92	54.00	-10.08	43.61	0.31	Average	115	228
4	3711.20	48.17	74.00	-25.83	47.86	0.31	Peak	115	228
5	8350.20	50.40	54.00	-3.60	41.32	9.08	Average	191	1
6	8350.20	56.24	74.00	-17.76	47.16	9.08	Peak	191	1

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 Emissions in Non-Restricted Frequency Bands

3.3.1 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 20 dB relative to the maximum in-band peak PSD level in 100 kHz.

Note: Limit is from FCC Part 15.247

3.3.2 Test Procedures

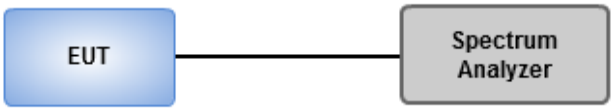
Reference level measurement

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

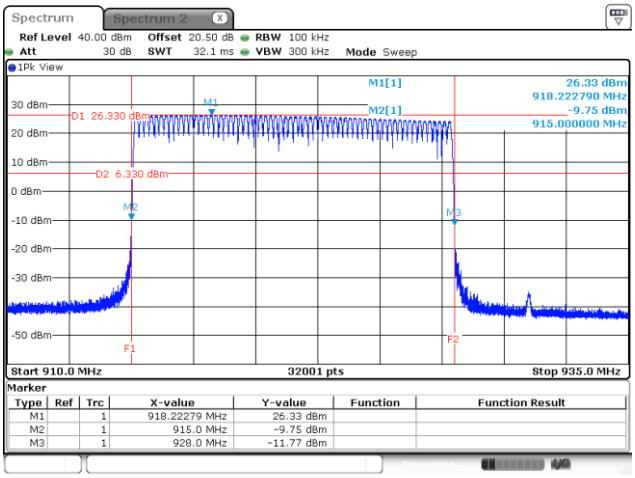
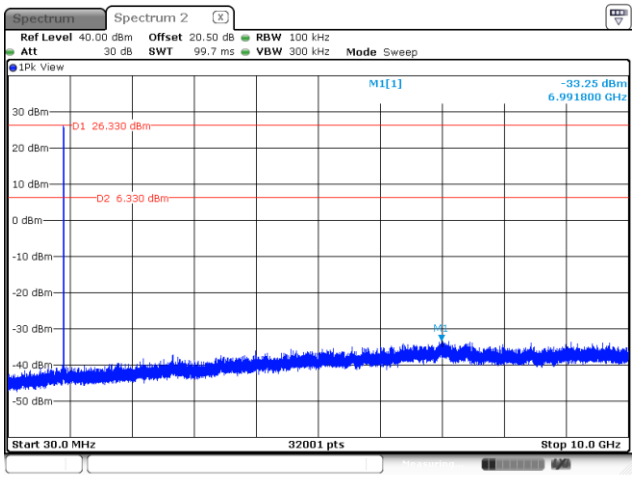
Emission level measurement

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

3.3.3 Test Setup

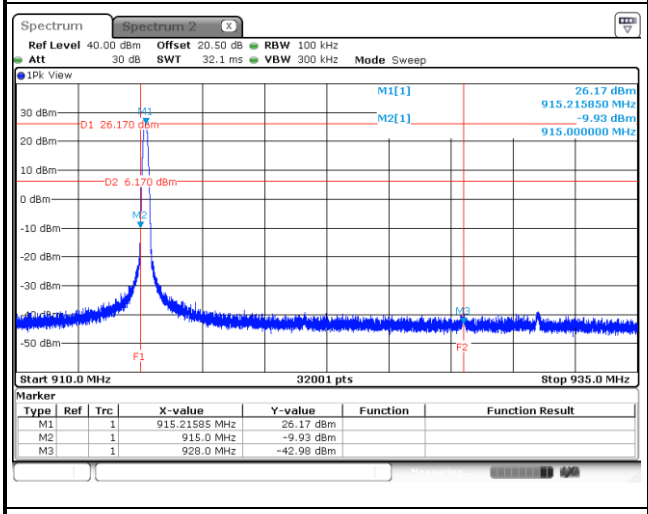


3.3.4 Test Result of Emissions in non-restricted Frequency Bands - Hopping

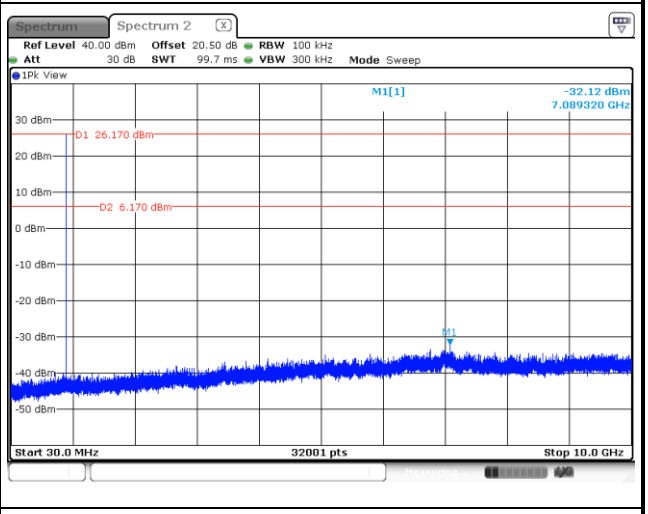
915.2MHz / 910MHz~935MHz (down 20dBc)	915.2MHz / 30MHz~10GHz (down 20dBc)
	

3.3.5 Test Result of Emissions in non-restricted Frequency Bands - No Hopping

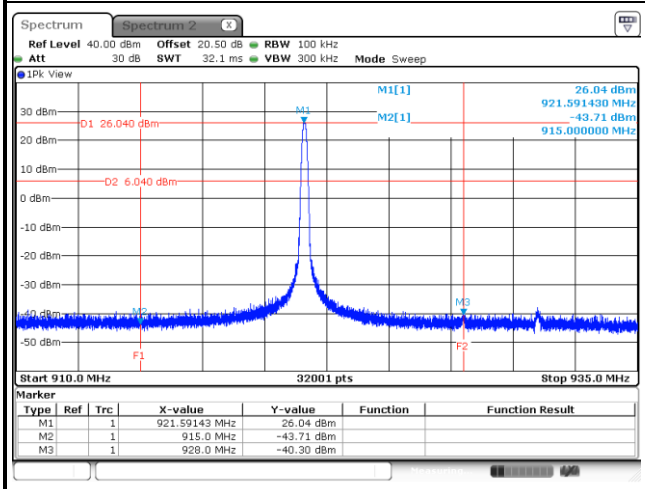
915.2MHz / 910MHz~935MHz (down 20dBc)



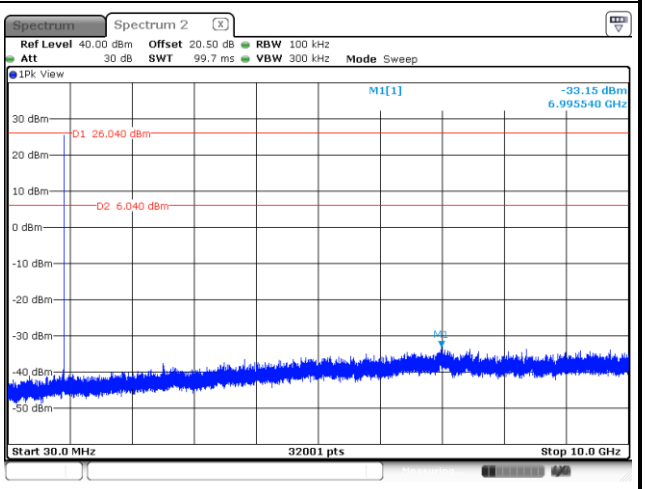
915.2MHz / 30MHz~10GHz (down 20dBc)



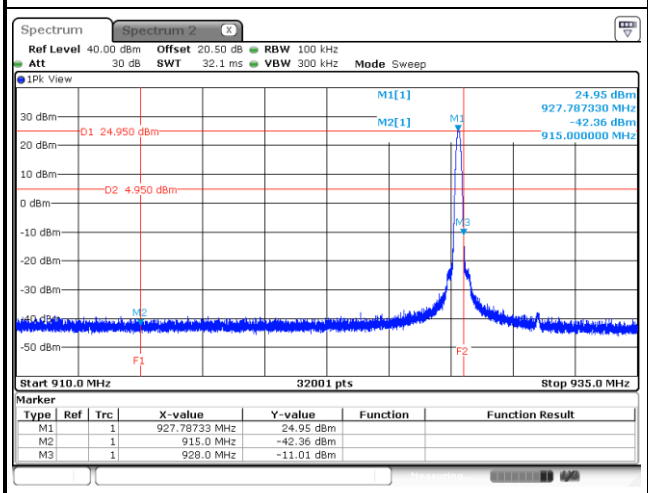
921.6MHz / 910MHz~935MHz (down 20dBc)



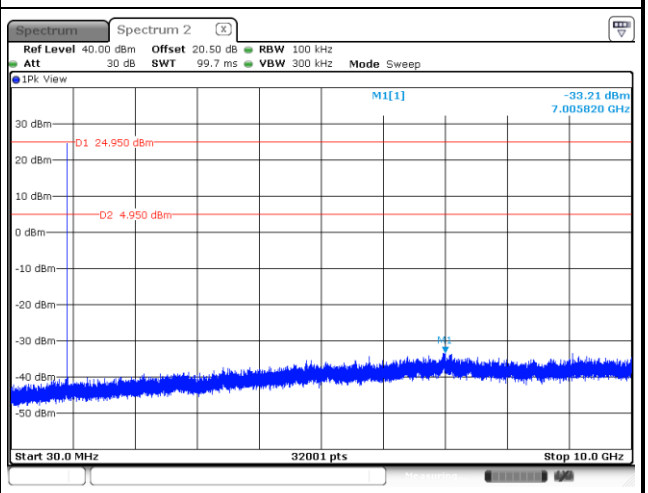
921.6MHz / 30MHz~10GHz (down 20dBc)



927.8MHz / 910MHz~935MHz (down 20dBc)



927.8MHz / 30MHz~10GHz (down 20dBc)



3.4 Hopping Frequencies

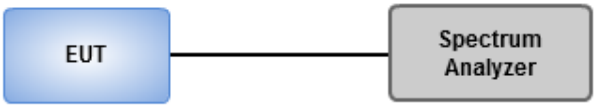
3.4.1 Limit of Hopping Frequencies

A minimum of 20 hopping frequencies shall be used.
Note: Limit is from AS/NZS 4268:2017

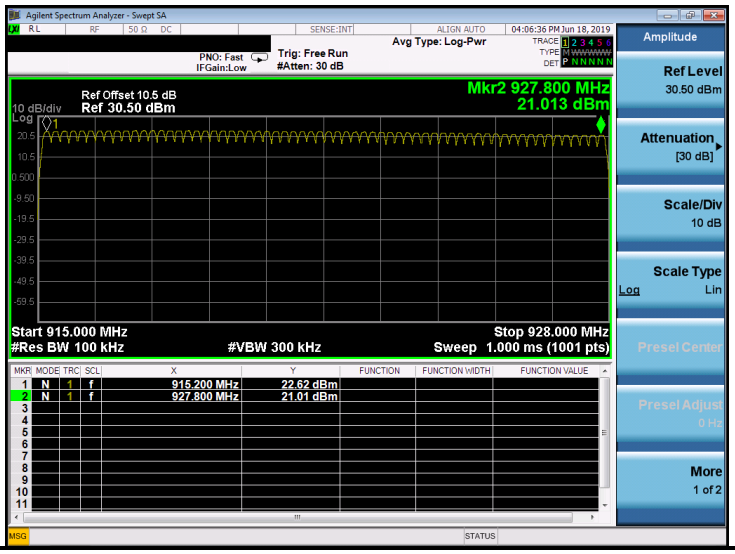
3.4.2 Test Procedures

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

3.4.3 Test Setup



3.4.4 Test Result of Hopping Frequencies



3.5 Dwell Time

3.5.1 Limit of Dwell time

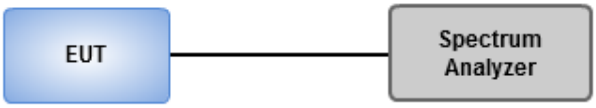
The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Note: Limit is from FCC Part 15.247

3.5.2 Test Procedures

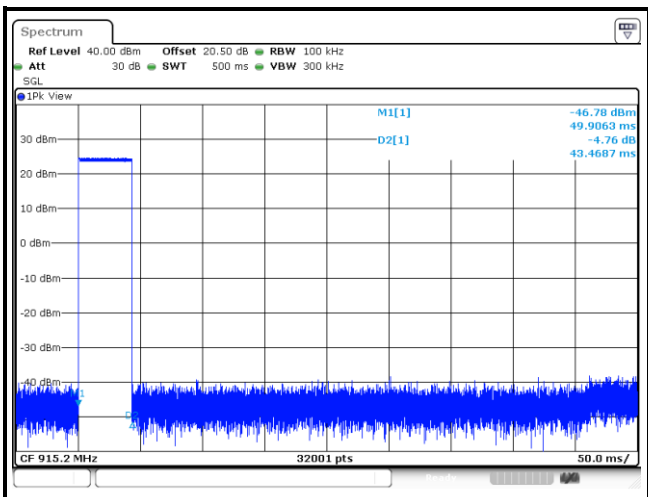
Reference to clause 6.2.1 of AS/NZS 4268:2017.

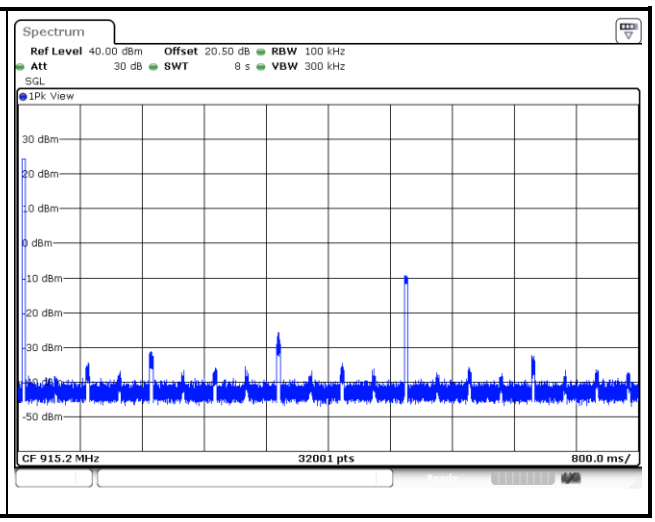
3.5.3 Test Setup



3.5.4 Test Result of Dwell time

Modulation Mode	Freq. (MHz)	Length of Transmission Time (sec.)	Number of Transmission in 8s (20 hopping channels *0.4s)	Result (s)	Limit (s)
FSK	915.2	0.0434687	1	0.0434687	0.4





3.6 Emission Bandwidth

3.6.1 Limit of Emission Bandwidth

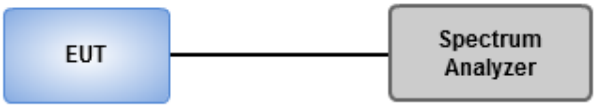
The upper and lower frequency limits of the transmitter 99% emission power bandwidth shall at all times remain within the operating frequency limits(915-928MHz).

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 Emission Bandwidth

Summary

Mode	OBW (Hz)	ITU-Code
915-928MHz	-	-
FSK	99.538k	99K5F1D

OBW = Minimum 99% occupied bandwidth;

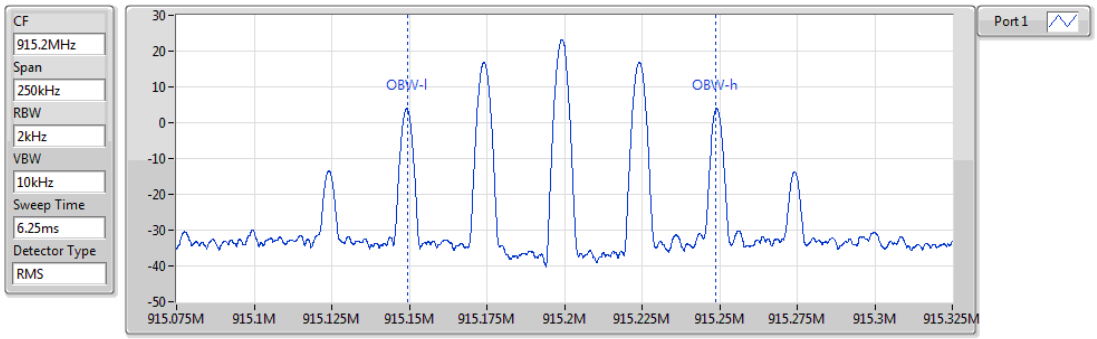
Result

Mode	Result	OBW (Hz)	Fl-OBW (Hz)	Fh-OBW (Hz)	Fl Limit (Hz)	Fh Limit (Hz)
FSK	-	-	-	-	-	
915.2MHz_TnomVnom	Pass	99.538k	915.149325M	915.248863M	915M	928M
921.6MHz_TnomVnom	Pass	99.538k	921.549388M	921.648925M	915M	928M
927.8MHz_TnomVnom	Pass	99.538k	927.749388M	927.848925M	915M	928M

fl-OBW = fl lower edge 99% occupied bandwidth; **fh-OBW** = fh higher edge 99% occupied bandwidth; **OBW** = 99% occupied bandwidth; **N dB** = 6dB down bandwidth;

FSK **EBW**

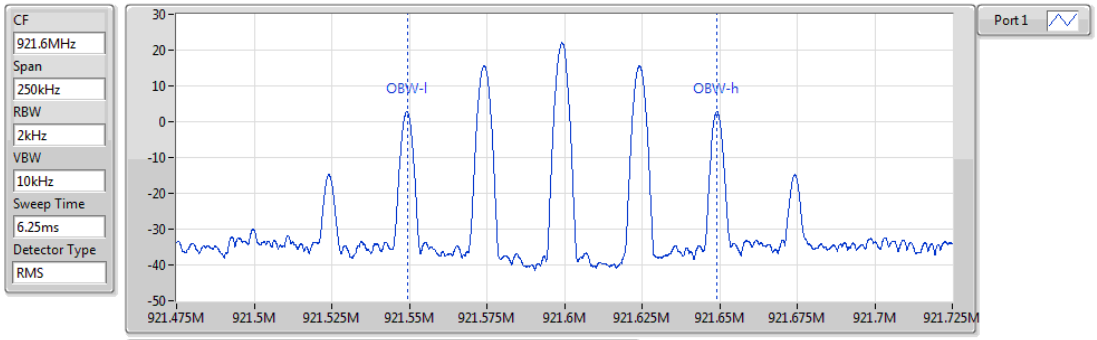
915.2MHz_TnomVnom



OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Fl-Limit(Hz)	Fh-Limit(Hz)
99.538k	915.149325M	915.248863M	13M	915M	928M

FSK **EBW**

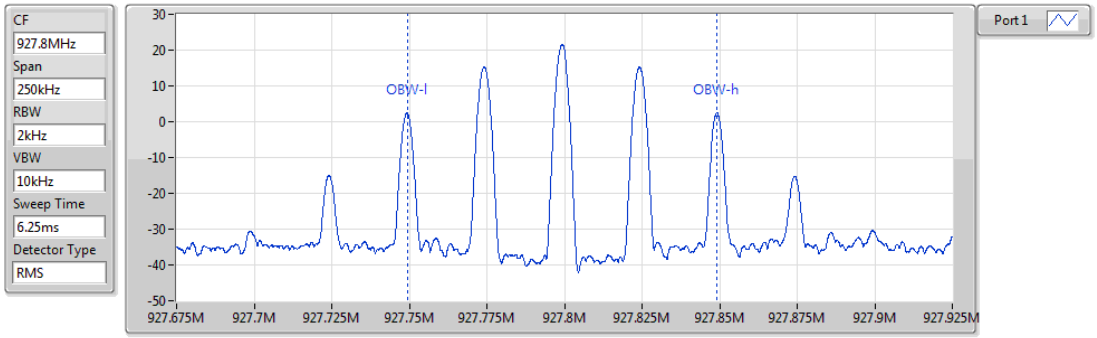
921.6MHz_TnomVnom



OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Fl-Limit(Hz)	Fh-Limit(Hz)
99.538k	921.549388M	921.648925M	13M	915M	928M

FSK **EBW**

927.8MHz_TnomVnom



OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Fl-Limit(Hz)	Fh-Limit(Hz)
99.538k	927.749388M	927.848925M	13M	915M	928M

3.7 Operating Frequencies

3.7.1 Limit of Operating Frequencies

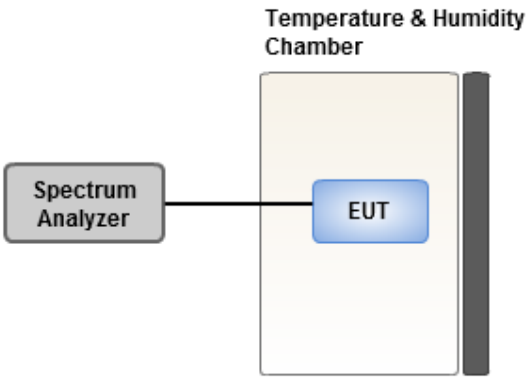
The upper and lower frequency limits of the transmitter 99% emission power bandwidth shall at all times remain within the operating frequency limits(915-928MHz).

Note: Limit is from AS/NZS 4268:2017

3.7.2 Test Procedures

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

3.7.3 Test Setup



3.7.4 Test Result of Operating Frequencies

Condition	Freqeuncy (MHz)	F_L (MHz)	F_H (MHz)	F_L Limit (MHz)	F_H Limit (MHz)
$T_{nom}V_{nom}$	915.2	915.149	-	915	928
$T_{min}V_{max}$	915.2	915.147	-	915	928
$T_{min}V_{min}$	915.2	915.147	-	915	928
$T_{max}V_{max}$	915.2	915.150	-	915	928
$T_{max}V_{min}$	915.2	915.150	-	915	928
$T_{nom}V_{nom}$	927.8	-	927.849	915	928
$T_{min}V_{max}$	927.8	-	927.850	915	928
$T_{min}V_{min}$	927.8	-	927.850	915	928
$T_{max}V_{max}$	927.8	-	927.848	915	928
$T_{max}V_{min}$	927.8	-	927.848	915	928

4 Receiver Test Results

4.1 Receiver Spurious Emissions

4.1.1 Limit of Receiver Spurious Emissions

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.

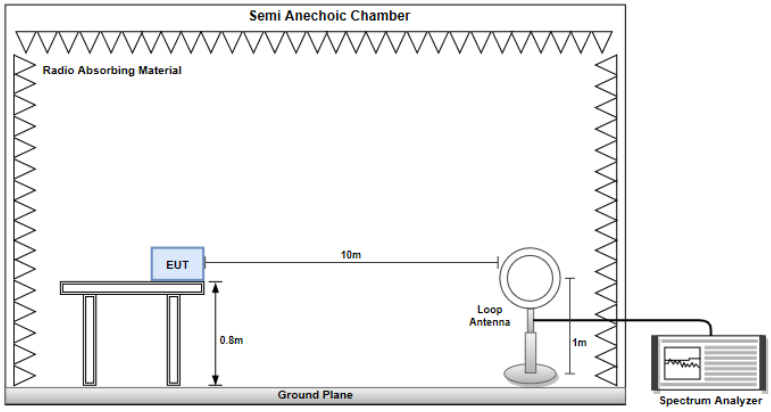
Note: Limit is from FCC Part 15.109

4.1.2 Test Procedures

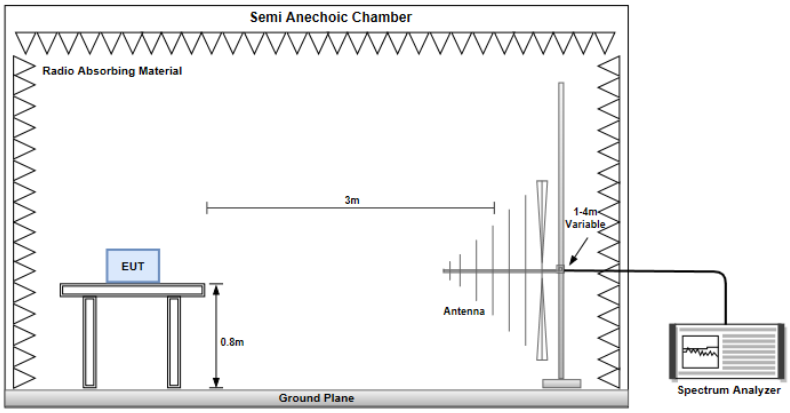
Reference to clause 7.2.1 of AS/NZS 4268:2017.

4.1.3 Test Setup

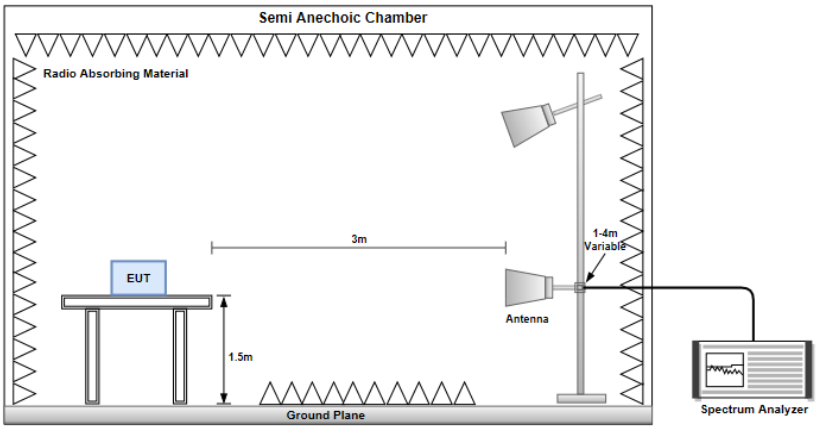
Below 30MHz



Below 1GHz

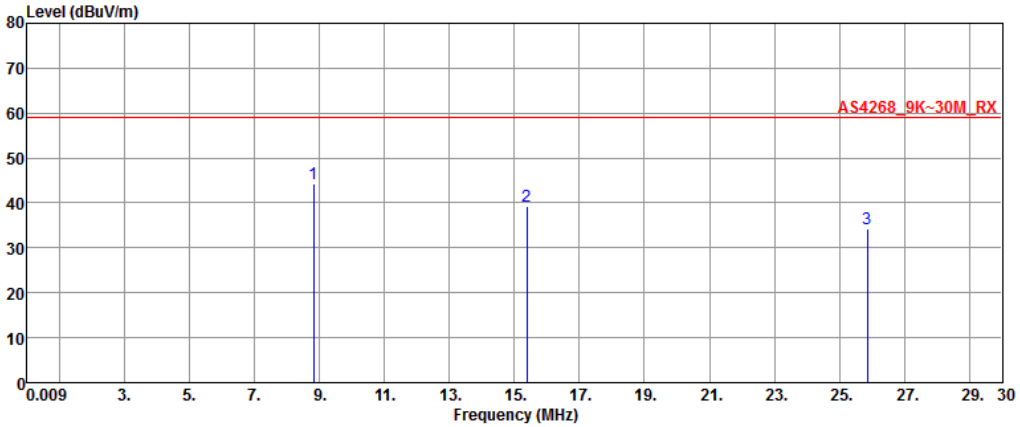


Above 1 GHz



4.1.4 Receiver Spurious Emissions (≤ 30MHz)

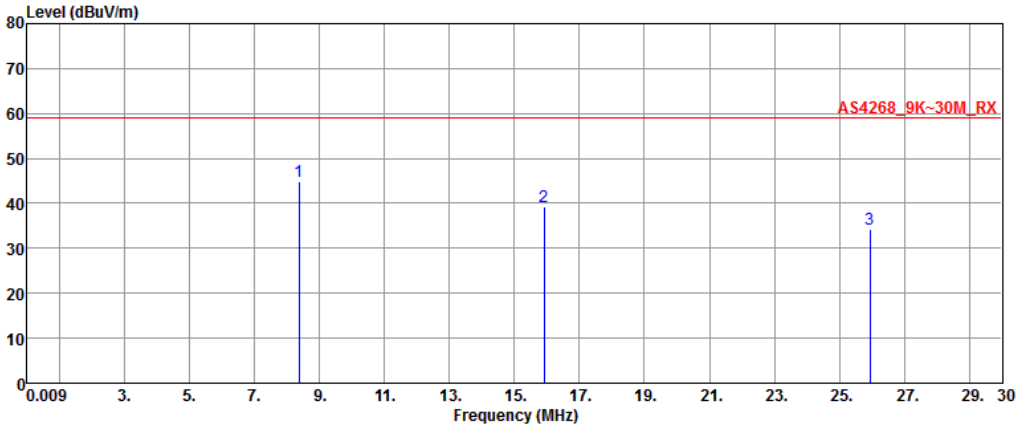
Modulation	FSK	**Test Freq. (MHz)**	915.2
Frequency	9kHz~30MHz	**Loop**	open



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBuV/m	dBuV/m	dB	dB	dBuV
1	8.82	44.26	59.00	-14.74	20.22	24.04
2	15.38	39.30	59.00	-19.70	21.24	18.06
3	25.85	34.12	59.00	-24.88	22.08	12.04

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

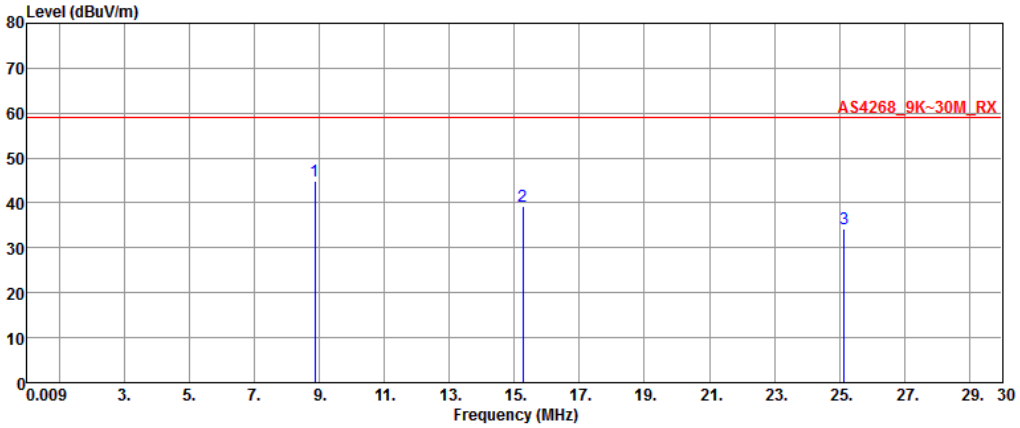
Modulation	FSK	Test Freq. (MHz)	921.6
Frequency	9kHz~30MHz	Loop	open



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBuV/m	dBuV/m	dB	dB	dBuV
1	8.37	44.81	59.00	-14.19	20.17	24.64
2	15.92	39.25	59.00	-19.75	21.32	17.93
3	25.95	34.29	59.00	-24.71	22.09	12.20

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

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

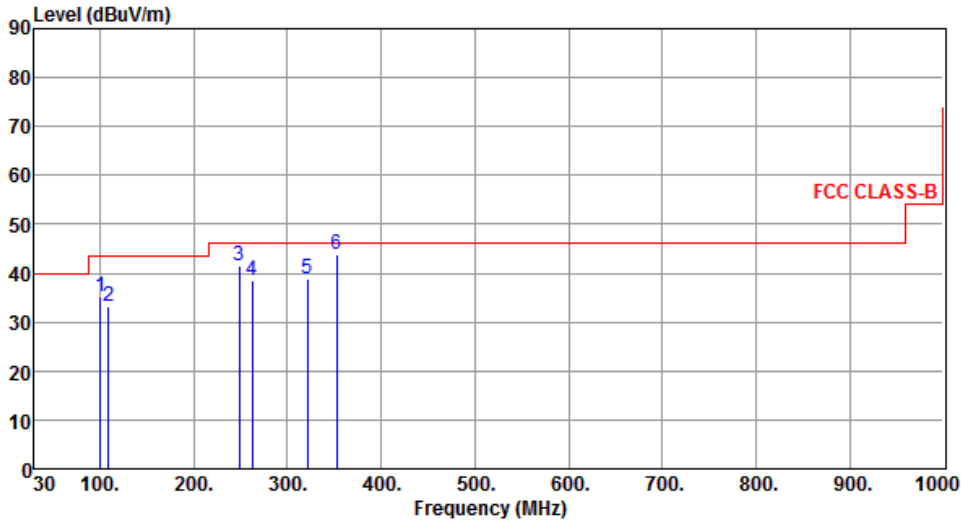


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBuV/m	dBuV/m	dB	dB	dBuV
1	8.85	44.87	59.00	-14.13	20.22	24.65
2	15.26	39.39	59.00	-19.61	21.22	18.17
3	25.15	34.24	59.00	-24.76	22.05	12.19

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)

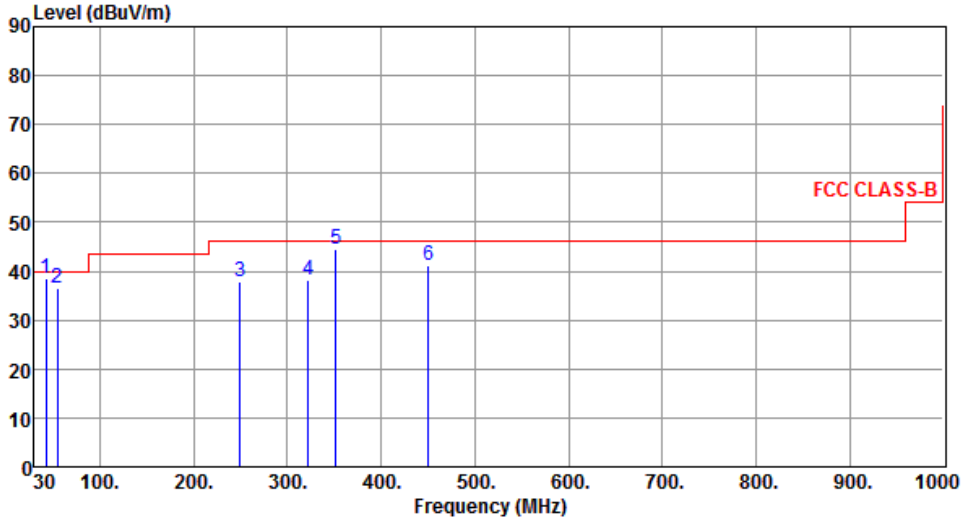
Modulation Mode	FSK	**Test Freq. (MHz)**	915.2
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	100.73	35.11	43.50	-8.39	47.93	-12.82	Peak	---	---
2	109.56	33.08	43.50	-10.42	44.57	-11.49	Peak	---	---
3	248.64	41.57	46.00	-4.43	50.97	-9.40	Peak	---	---
4	262.73	38.68	46.00	-7.32	47.59	-8.91	Peak	---	---
5	321.76	38.77	46.00	-7.23	45.97	-7.20	Peak	---	---
6	352.16	43.75	46.00	-2.25	50.16	-6.41	QP	100	172

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).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation Mode	FSK	Test Freq. (MHz)	915.2
Polarization	Vertical		

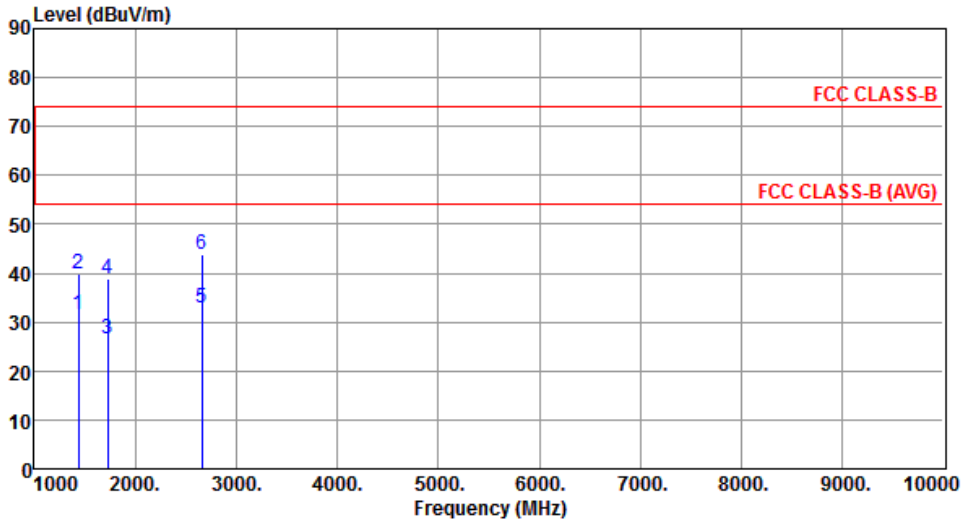


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	42.58	38.68	40.00	-1.32	46.60	-7.92	QP	100	341
2	54.53	36.48	40.00	-3.52	44.52	-8.04	Peak	---	---
3	249.53	37.92	46.00	-8.08	47.30	-9.38	Peak	---	---
4	321.85	38.11	46.00	-7.89	45.31	-7.20	Peak	---	---
5	352.04	44.48	46.00	-1.52	50.89	-6.41	QP	151	58
6	450.11	41.34	46.00	-4.66	45.24	-3.90	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).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

4.1.6 Receiver Spurious Emissions (Above 1GHz)

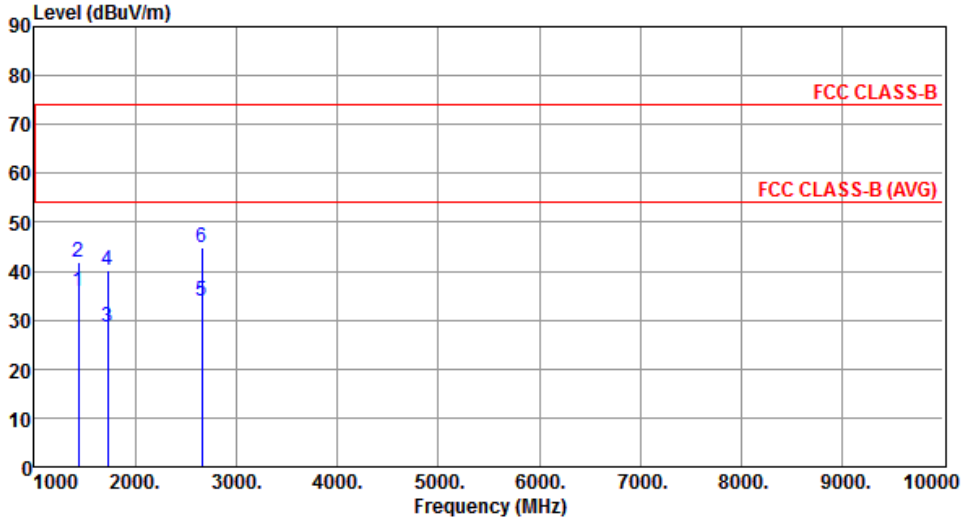
Modulation Mode	FSK	Test Freq. (MHz)	915.2
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1440.00	31.64	54.00	-22.36	38.52	-6.88	Average	100	6
2	1440.00	39.95	74.00	-34.05	46.83	-6.88	Peak	100	6
3	1728.00	26.58	54.00	-27.42	33.42	-6.84	Average	100	61
4	1728.00	38.83	74.00	-35.17	45.67	-6.84	Peak	100	61
5	2660.00	32.88	54.00	-21.12	35.63	-2.75	Average	100	251
6	2660.00	43.97	74.00	-30.03	46.72	-2.75	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)	915.2
Polarization	Vertical		

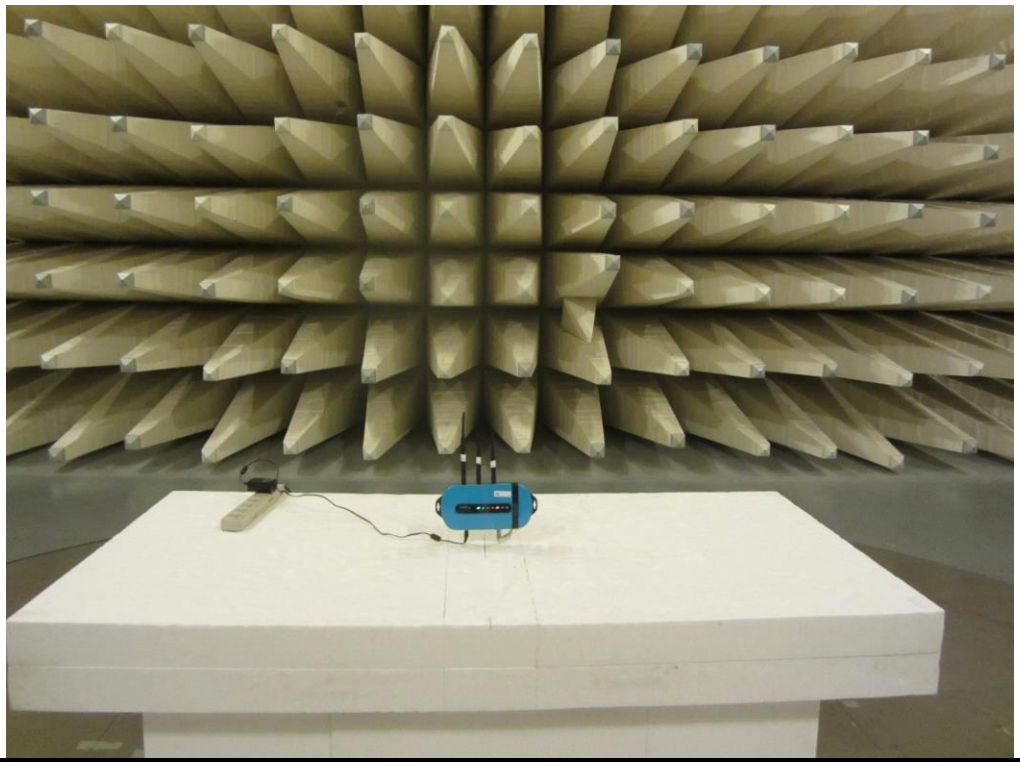


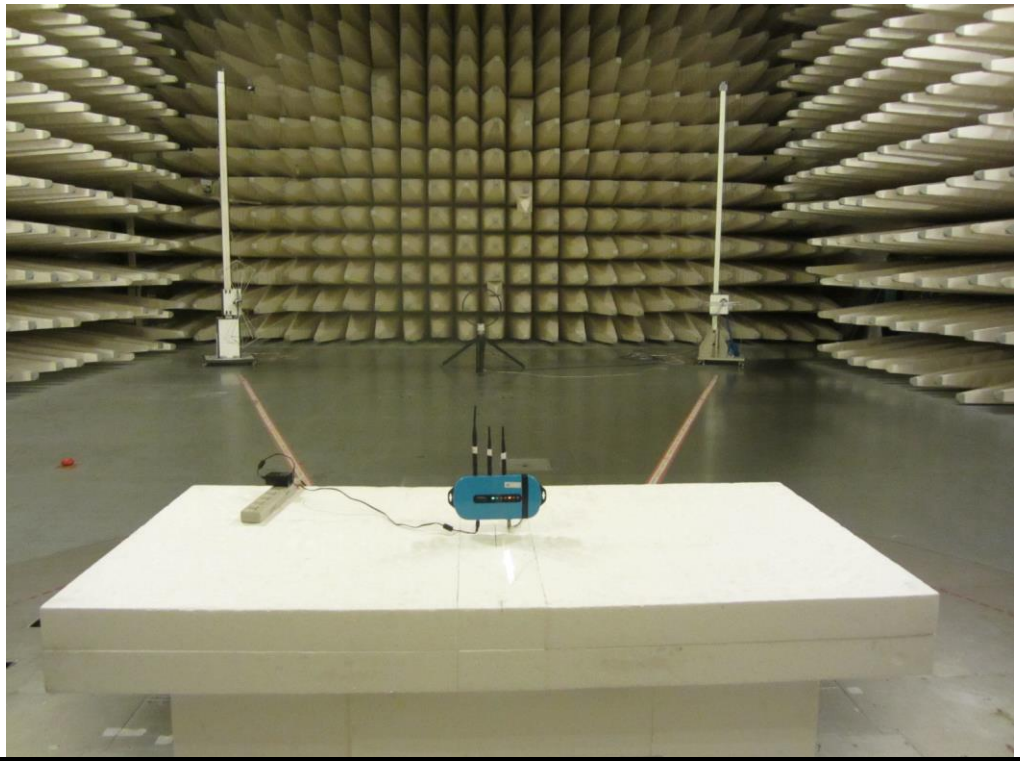
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1440.00	35.87	54.00	-18.13	42.75	-6.88	Average	100	26
2	1440.00	41.85	74.00	-32.15	48.73	-6.88	Peak	100	26
3	1728.00	28.62	54.00	-25.38	35.46	-6.84	Average	100	215
4	1728.00	40.28	74.00	-33.72	47.12	-6.84	Peak	100	215
5	2660.00	34.00	54.00	-20.00	36.75	-2.75	Average	100	65
6	2660.00	44.98	74.00	-29.02	47.73	-2.75	Peak	100	65

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).

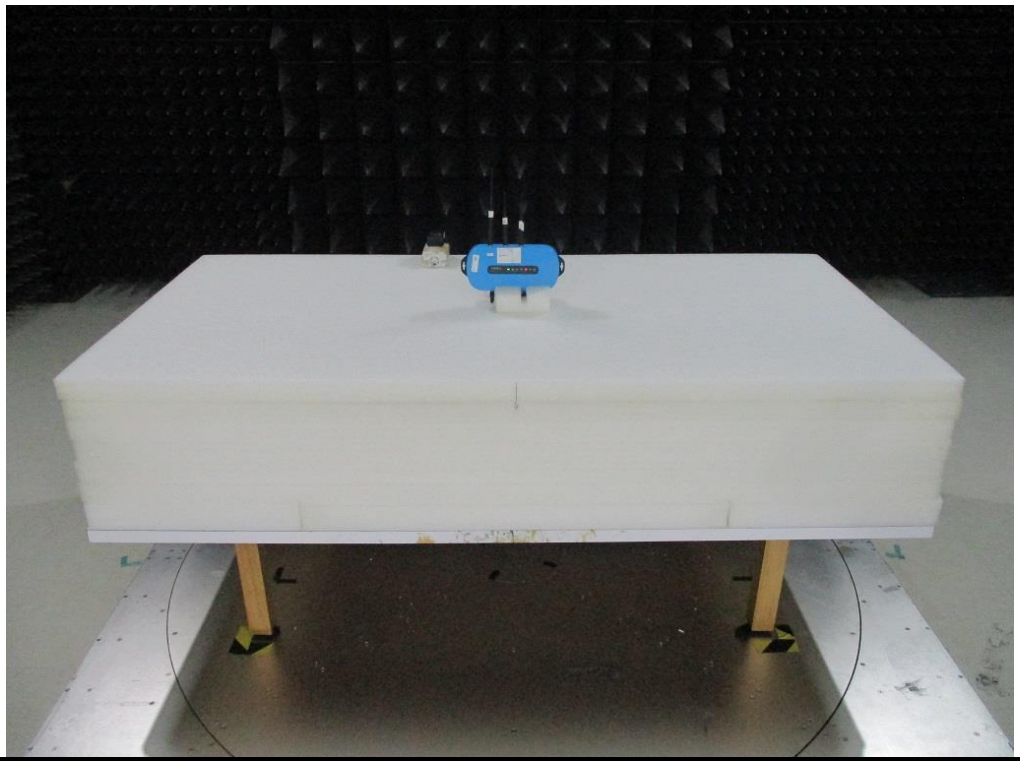
5 Photographs of the Test Configuration

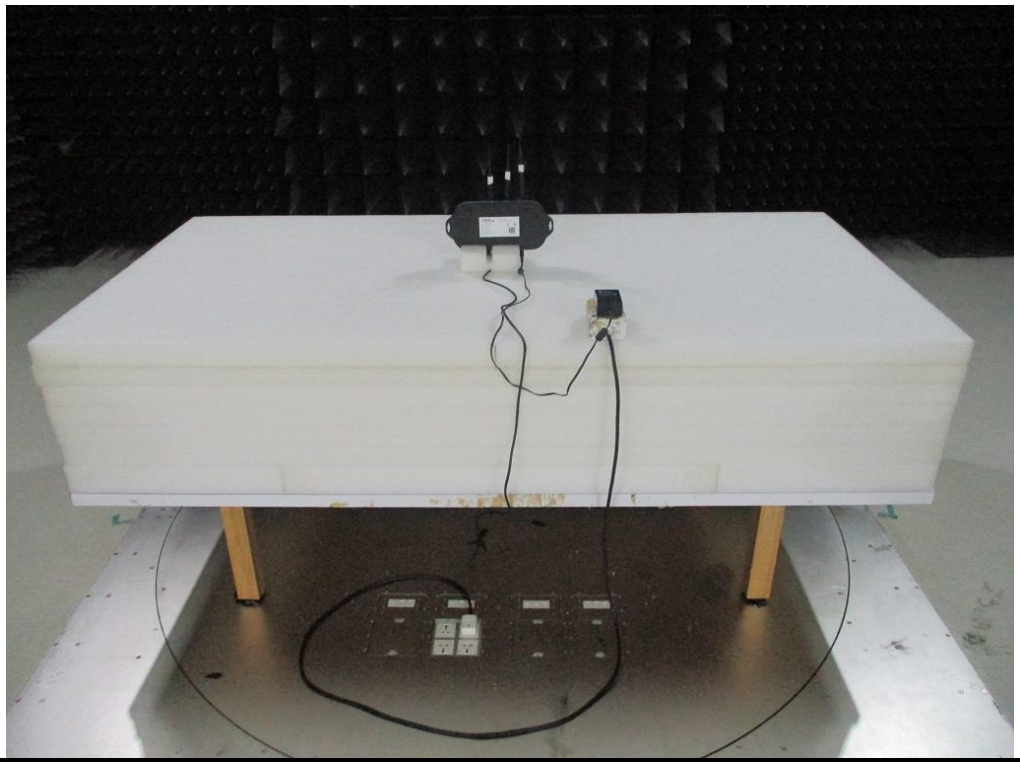
Spurious Emission below 30MHz Test



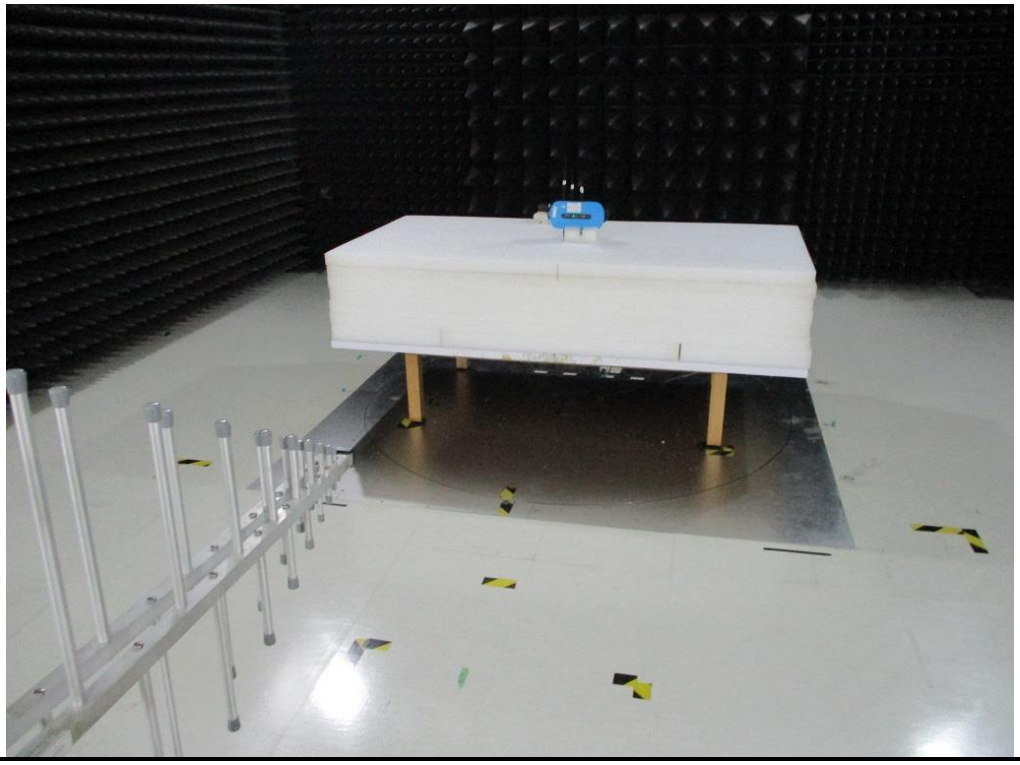


Spurious Emission Below 1GHz Test

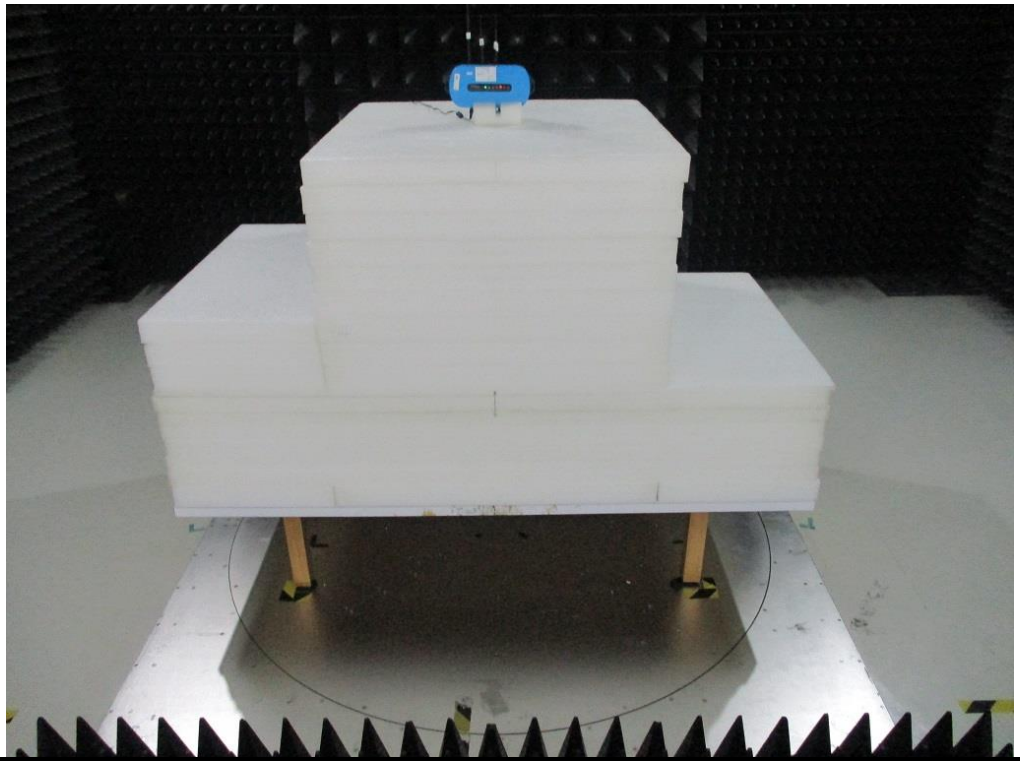


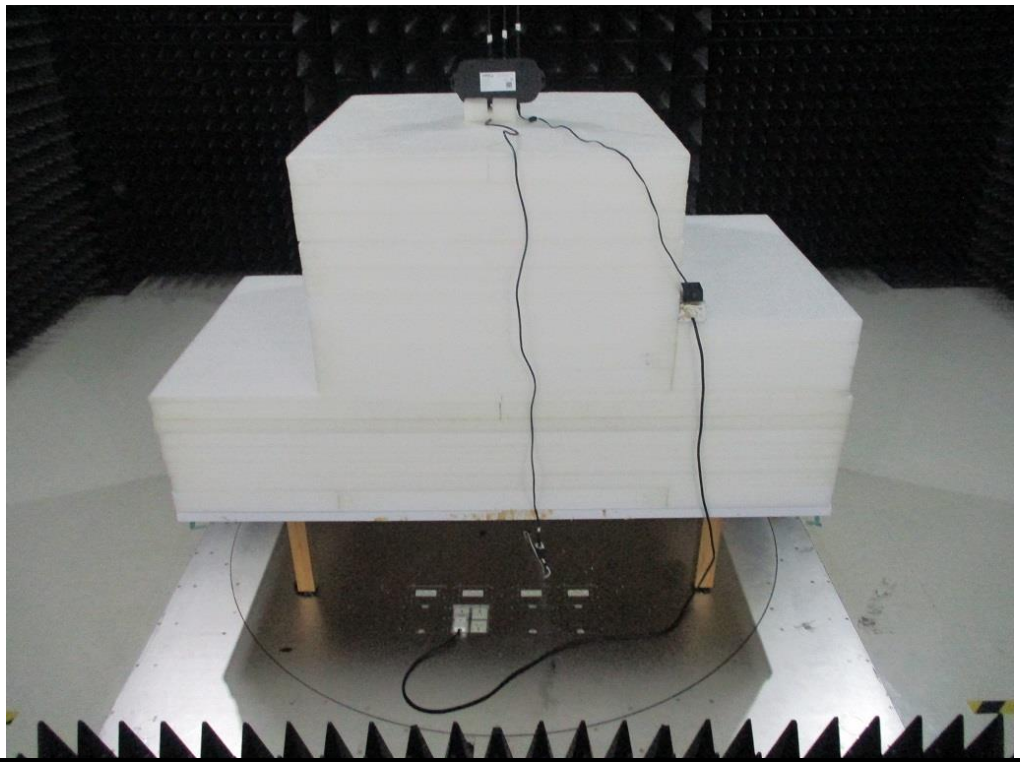


Spurious Emission Below 1GHz Test

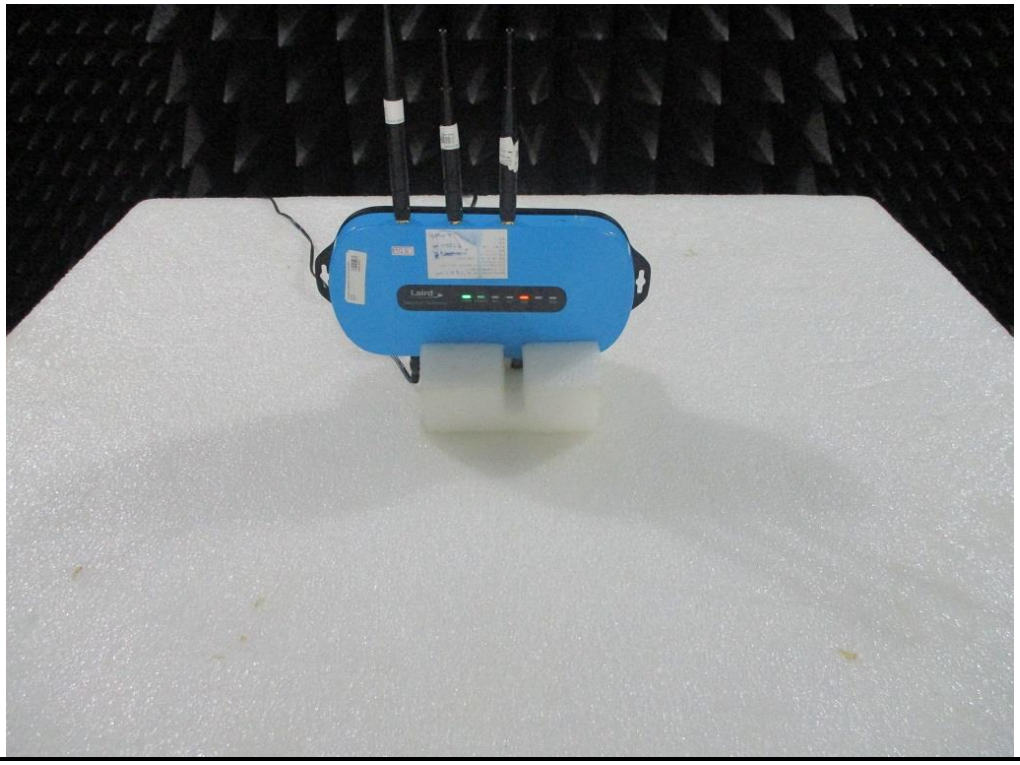


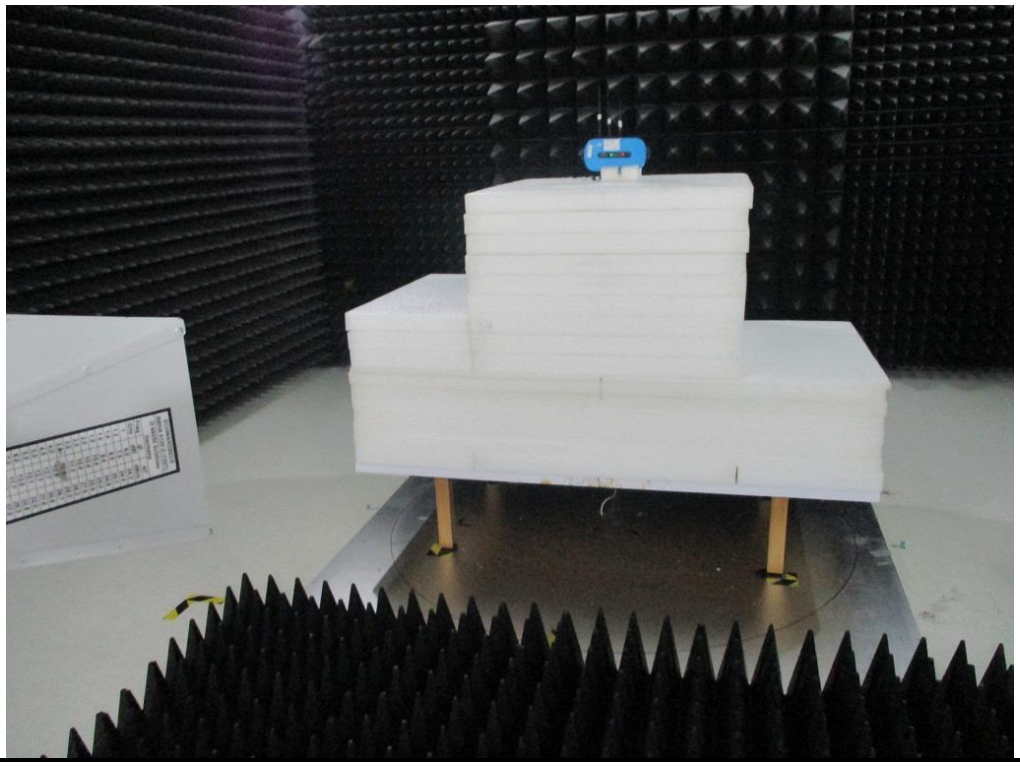
Spurious Emission Above 1GHz Test





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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