

FCC 15.407 U-NII 5GHz Test Report

for

LG Electronics Inc.

**222, LG-ro, Jinwi-myeon Pyeongtaek-Si,
Gyeonggi-Do, 17709 Republic of Korea**

Product Name : Wireless Audio Module
Model Name : WL2SB23
Brand : LG
FCC ID : BEJ-WL2SB23

**Prepared by: : AUDIX Technology Corporation,
EMC Department**



The test report is based on a single evaluation of one sample of the above-mentioned products. It does not imply an assessment of the whole production and does not permit the use of the test lab logo.

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APPENDIX A TEST DATA AND PLOTS
APPENDIX B TEST PHOTOGRAPHS

TEST REPORT

Applicant : LG Electronics Inc.
Manufacturer : LG Electronics Inc.
Factory : HUIZHOU GAOSHENGDA TECHNOLOGY CO., LTD.
EUT Description
(1) Product : Wireless Audio Module
(2) Model : WL2SB23
(3) Brand : LG
(4) Power Supply : DC 3.3V

Applicable Standards:

Title 47 FCC CFR Part 15 Subpart E

Audix Technology Corp. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Audix Technology Corp. does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens and samples.

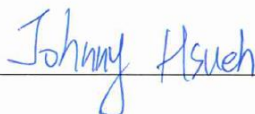
Date of Report: 2023. 08. 23

Reviewed by:



(Sunnie Huang/Administrator)

Approved by:



(Johnny Hsueh/Section Manager)

1. REVISION RECORD OF TEST REPORT

Edition No	Issued Date	Revision Summary	Report Number
0	2023. 08. 23	Original Report	EM-F230422

2. SUMMARY OF TEST RESULTS

Rule	Description	Results
15.207	Conducted Emission	PASS
15.205/15.209/15.407(b)	Undesirable Emissions Limits: Radiated Band Edge and Radiated Spurious Emission	PASS
15.407(a)(5)/15.407(e)	Emission/Occupied Bandwidth	PASS
15.407(a)	Maximum Output Power	PASS
15.407(a)	Power Spectral Density	PASS
15.407	Frequency Stability	PASS
Note: 1. Decision rule according to the limit of the test standard chapter, the test value is lower than the limit specified in the test chapter, and it is judged as Pass. 2. The uncertainties value is not used in determining the result. 3. N/A is an abbreviation for Not Applicable.		

3. GENERAL INFORMATION

3.1. Description of Application

Applicant	LG Electronics Inc. 222, LG-ro, Jinwi-myeon Pyeongtaek-Si, Gyeonggi-Do, 17709 Republic of Korea
Manufacturer	LG Electronics Inc. 222, LG-ro, Jinwi-myeon Pyeongtaek-Si, Gyeonggi-Do, 17709 Republic of Korea
Factory	HUIZHOU GAOSHENGDA TECHNOLOGY CO., LTD. NO.2, JIN-DA ROAD, HUINAN HIGH-TECH INDUSTRIAL PARK, HUI-AO AVENUE, HUIZHOU CITY, GUANGDONG, CHINA
Product	Wireless Audio Module
Model	WL2SB23
Brand	LG

3.2. Description of EUT

Test Model	WL2SB23											
Serial Number	N/A											
Power Rating	DC 3.3V											
Software Version	V1.0											
Hardware version	V1.0											
RF Features	GFSK											
Transmit Type	1T1R											
Device Category	☐ Outdoor Access Point ☐ Fixed point-to-point Access Point ☐ Indoor Access Point ☒ Mobile and Portable client device											
Test Sample	<table><tr><th>Sample No.</th><th>Test Item</th><th>Firmware</th></tr><tr><td>02</td><td>AC Conduction, Radiated</td><td>N/A</td></tr><tr><td>01</td><td>RF Conducted</td><td>N/A</td></tr></table>			Sample No.	Test Item	Firmware	02	AC Conduction, Radiated	N/A	01	RF Conducted	N/A
	Sample No.	Test Item	Firmware									
	02	AC Conduction, Radiated	N/A									
01	RF Conducted	N/A										
Sample Status	Trial sample											
Date of Receipt	2023. 07. 27											
Date of Test	2023. 07. 27 ~ 08. 22											
Interface Ports of EUT	None											
Accessories Supplied	None											

Note: Pursuant ISO 17025:2017 section 7.8.2, Audix Technology Corp. does not assume responsibility for all EUT's information including RF features, transmit type, antenna information etc are provided by customer.

3.3. Reference Test Guidance

KDB 789033 D02 General UNII Test Procedures New Rules v02r01
ANSI C63.10:2013

3.4. Antenna Information

No.	Antenna Part Number	Manufacturer	Antenna Type	Frequency (MHz)	Gain (dBi)
1.	WA0A-PCB (ANT 1)	Shenzhen ZTX Communication Technology Co., LTD.	PCB Printing Antenna	5150	2.64
				5200	2.55
				5250	2.66
				5700	3.49
				5750	3.30
				5800	3.07
				5850	3.21
2.	WA0A-PCB (ANT 2)	Shenzhen ZTX Communication Technology Co., LTD.	PCB Printing Antenna	5150	1.84
				5200	1.94
				5250	1.38
				5700	1.76
				5750	2.45
				5800	2.94
				5850	2.97

3.5. EUT Specifications Assessed in Current Report

Modulation	U-NII Band	Fundamental Range (MHz)	Channel Number	Data Rate
GFSK	1	5160-5245	18	2Mbps
	3	5730-5845	24	

Channel List			
U-NII Band 1			
Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
0	5160	9	5205
1	5165	10	5210
2	5170	11	5215
3	5175	12	5220
4	5180	13	5225
5	5185	14	5230
6	5190	15	5235
7	5195	16	5240
8	5200	17	5245
Channel List			
U-NII Band 3			
Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
0	5730	12	5790
1	5735	13	5795
2	5740	14	5800
3	5745	15	5805
4	5750	16	5810
5	5755	17	5815
6	5760	18	5820
7	5765	19	5825
8	5770	20	5830
9	5775	21	5835
10	5780	22	5840
11	5785	23	5845

Note: Test modes are presented at section 3.7.

3.6. Description of Key Components

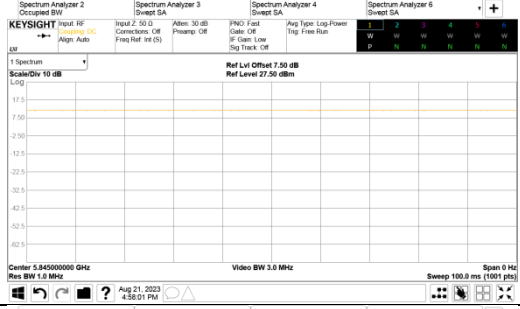
None

3.7. Test Configuration

GFSK Mode	TX _{on} (ms)	TX _{on+off} (ms)	Duty Cycle (x)	Duty Cycle Factor [10log(1/x)] (dB)
ANT 1	N/A ^{Note 2}	N/A ^{Note 2}	1	N/A
ANT 2	N/A ^{Note 2}	N/A ^{Note 2}	1	N/A

Note: 1. When duty cycle is less than 98% (0.98) that duty cycle factor 10log(1/x) is needed to add in conducted test items measured in average detector.

2. N/A represent the duty cycle is 100%, TX_{on} and TX_{on+off} cannot be measured.

GFSK Mode	TX _{on} (ms)	T _{on} +T _{off} (ms)
ANT 1		---
ANT 2		---

AC Conduction					
Normal Operation					

Item		Modulation	Data Rate	Antenna	Test Frequency (MHz)
Radiated Test Case	Radiated Spurious Emission (30MHz~1GHz) ^{Note1 & 2}	GFSK	2 Mbps	ANT 1	5205 / 5785
				ANT 2	5205 / 5785
	Radiated Band Edge	GFSK	2 Mbps	ANT 1	5160 / 5705 / 5845
				ANT 2	5160 / 5705 / 5845
	Radiated Spurious Emission (Above 1GHz)	GFSK	2 Mbps	ANT 1	5160 / 5205 / 5245 / 5730 / 5785 / 5845
				ANT 2	5160 / 5205 / 5245 / 5730 / 5785 / 5845

Item		Modulation	Data Rate	Antenna	Test Frequency (MHz)
Conducted Test Case	Emission/Occupied Bandwidth	GFSK	2 Mbps	ANT 1	5160 / 5205 / 5245 / 5730 / 5785 / 5845
				ANT 2	5160 / 5205 / 5245 / 5730 / 5785 / 5845
	Maximum output power	GFSK	2 Mbps	ANT 1	5160 / 5205 / 5245 / 5730 / 5785 / 5845
				ANT 2	5160 / 5205 / 5245 / 5730 / 5785 / 5845
	Power spectral density	GFSK	2 Mbps	ANT 1	5160 / 5205 / 5245 / 5730 / 5785 / 5845
				ANT 2	5160 / 5205 / 5245 / 5730 / 5785 / 5845

Note 1: ☐ Mobile Device ☒ Portable Device,

and 3 axis were assessed. The worst scenario for Radiated Spurious Emission as follow: ☒ Lie ☐ Side ☐ Stand

Note 2: Low, mid, and high channels were measured, only the worst channel was presented in this report.

3.8. Output Power Setting

Mode	U-NII Band	Antenna	Centre Frequency (MHz)	Power Setting
GFSK	1	ANT 1	5160	1
			5205	1
			5245	1
	3		5730	2
			5785	2
			5845	2
	1	ANT 2	5160	1
			5205	1
			5245	1
	3		5730	2
			5785	2
			5845	2

3.9. Tested Supporting System List

3.9.1. Support Peripheral Unit

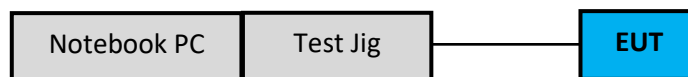
No.	Product	Brand	Model No.	Serial No.	Approval
1.	Test Jig	N/A	N/A	N/A	N/A
2.	Notebook PC	acer	N22Q3	N/A	N/A

3.9.2. Cable Lists

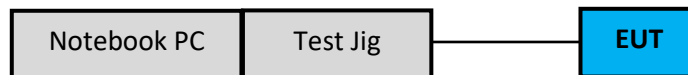
No.	Cable Description Of The Above Support Units
1.	Data Cable: Unshielded, Undetectable, 0.5m
2.	Adapter: LITEON, M/N PA-1900-32, DC Power Cord : Unshielded, Undetachable, 1.7m, Bonded a ferrite core AC Power Cord : Unshielded, Detachable, 0.9m

3.10. Setup Configuration

3.10.1. EUT Configuration for Power Line & Radiated Emission



3.10.2. EUT Configuration for RF Conducted Test Items



3.11. Operating Condition of EUT

Test program “EVB_Tool_230425.exe” is used for enabling EUT RF function under continues transmitting and choosing channel.

3.12. Description of Test Facility

Name of Test Firm	Audix Technology Corporation / EMC Department No. 491, Zhongfu Rd., Linkou Dist., New Taipei City 244, Taiwan Tel: +886-2-26092133 Fax: +886-2-26099303 Website : www.audixtech.com Contact e-mail: attemc_report@audixtech.com
Accreditations	The laboratory is accredited by following organizations under ISO/IEC 17025:2017 (1) NVLAP(USA) NVLAP Lab Code 200077-0 (2) TAF(Taiwan) No. 1724
Test Facilities	FCC OET Designation Number under APEC MRA by NCC is : TW1724 ISED CAB Identifier Number under APEC TEL MRA by NCC is TW1724 (1) No.8 Shielded Room (2) No.1 3m Semi Anechoic Chamber

3.13.Measurement Uncertainty

The measurement uncertainty levels have been estimated as specified in ETSI TR 100 028-2001

Test Items/Facilities			Frequency Range	Uncertainty
Conduction Test	☐	No. 7 Shielded Room	30MHz-200MHz, 3m, Horizontal	±3.6dB
			200MHz-1000MHz, 3m, Horizontal	±4.3dB
	☒	No. 8 Shielded Room	30MHz-200MHz, 3m, Vertical	±4.4dB
			200MHz-1000MHz, 3m, Vertical	±4.8dB
Radiation Test	☒	No.1 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±3.6dB
			200MHz-1000MHz, 3m, Horizontal	±4.3dB
			30MHz-200MHz, 3m, Vertical	±4.4dB
			200MHz-1000MHz, 3m, Vertical	±4.8dB
			1GHz-6GHz, 3m	±4.8dB
			6GHz-18GHz, 3m	±4.5dB
	☐	No.3 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±3.7dB
			200MHz-1000MHz, 3m, Horizontal	±4.1dB
			30MHz-200MHz, 3m, Vertical	±4.6dB
			200MHz-1000MHz, 3m, Vertical	±4.9dB
			1GHz-6GHz, 3m	±4.7dB
			6GHz-18GHz, 3m	±4.1dB
	☐	No.4 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±4.0dB
			200MHz-1000MHz, 3m, Horizontal	±4.4dB
			30MHz-200MHz, 3m, Vertical	±4.7dB
			200MHz-1000MHz, 3m, Vertical	±4.5dB
			1GHz-6GHz, 3m	±4.8dB
			6GHz-18GHz, 3m	±4.5dB
	☐	No.5 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±4.3dB
			200MHz-1000MHz, 3m, Horizontal	±4.2dB
			30MHz-200MHz, 3m, Vertical	±4.8dB
			200MHz-1000MHz, 3m, Vertical	±4.7dB
			1GHz-6GHz, 3m	±4.6dB
			6GHz-18GHz, 3m	±4.4dB
	Radiated emissions (18GHz-40GHz)		18GHz-40GHz, 3m	±3.4dB

Remark : Uncertainty = $kuc(y)$

Test Items	Uncertainty
Bandwidth	± 0.2kHz
Maximum output power	± 0.33dB
Power spectral density	± 0.13dB

4. MEASUREMENT EQUIPMENT LIST

4.1. Conducted Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Test Receiver	R&S	ESR3	101774	2023.01.11	1 Year
2.	A.M.N.	R&S	ENV432	101567	2023.06.02	1 Year
3.	L.I.S.N.	Kyoritsu	KNW-407	8-855-9	2022.12.19	1 Year
4.	Pulse Limiter	R&S	ESH3-Z2	100354	2022.12.14	1 Year
5.	Digital Thermo-Hygro Meter	iMax	HTC-1	No.8 S/R	2023.04.13	1 Year
6.	Coaxial Cable	Yeida	RG/58AU	CE-08	2022.09.07	1 Year
7.	Test Software	Audix	e3	V9 18621a	N.C.R.	N.C.R.

4.2. Radiated Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A-526	MY53400071	2022.08.24	1 Year
2.	Spectrum Analyzer	Keysight	N9010B-544	MY55460198	2023.03.29	1 Year
3.	Test Receiver	R&S	ESCS30	100338	2023.06.20	1 Year
4.	Microwave Amplifier	Agilent	8449B	3008A02678	2023.02.17	1 Year
5.	Microwave Amplifier	Keysight	83051A	MY56480113	2022.09.07	1 Year
6.	Bilog Antenna	TESEQ	CBL6112D	33821	2023.06.30	1 Year
7.	Double-Ridged Waveguide Horn	EMCO	3115	9112-3775	2023.05.04	1 Year
8.	Horn Antenna	COM-POWER	AH-840	101092	2022.12.30	1 Year
9.	5G Notch Filter	Microwave Circuits	N0452502	459775	2023.05.03	1 Year
10.	5G Notch Filter	Microwave	N0257881	489480	2023.07.01	1 Year
11.	Coaxial Cable	MIYAZAKI	5D2W	RE-11	2023.01.07	1 Year
12.	Coaxial Cable	HUBER+SUHNER	SUCOFLEX 106	RE-14	2023.01.07	1 Year
13.	Coaxial Cable	HUBER+SUHNER	SUCOFLEX 102	RE-30	2023.08.21	1 Year
14.	Digital Thermo-Hygro Meter	iMax	HTC-1	No.1 3m A/C	2023.04.13	1 Year
15.	Test Software	Audix	e3	V9 18621a	N.C.R.	N.C.R.

4.3. RF Conducted Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Keysight	N9010B-544	MY55460198	2023.03.29	1 Year
2.	Power Meter	Anritsu	ML2495A	1145008	2023.06.13	1 Year
3.	Power Sensor	Anritsu	MA2411B	1126096	2023.06.13	1 Year
4.	Digital Thermo-Hygro Meter	iMax	HTC-1	RF-03	2023.04.13	1 Year

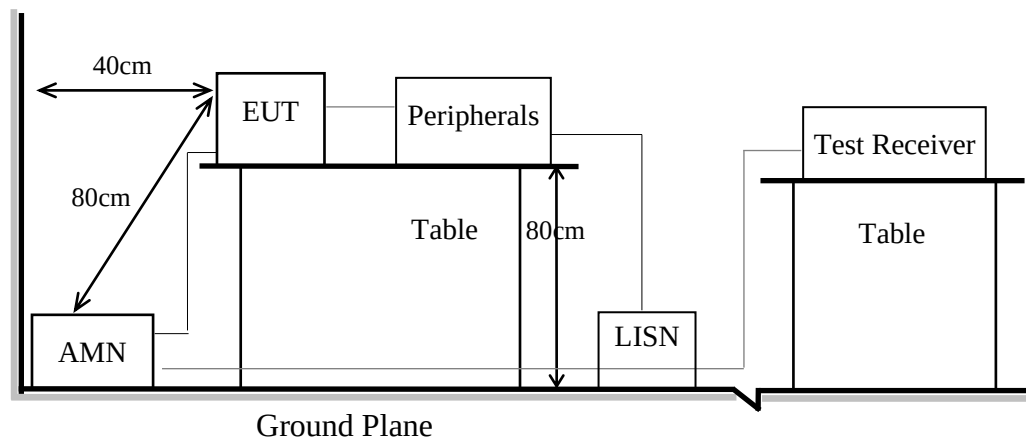
5. CONDUCTED EMISSION

5.1. Block Diagram of Test Setup

5.1.1. Block Diagram of EUT

Indicated as section 3.10

5.1.2. Shielded Room Setup Diagram



5.2. Conducted Emission Limit

Frequency	Conducted Limit	
	Quasi-Peak Level	Average Level
150kHz ~ 500kHz	66 ~ 56 dB μ V	56 ~ 46 dB μ V
500kHz ~ 5MHz	56 dB μ V	46 dB μ V
5MHz ~ 30MHz	60 dB μ V	50 dB μ V

Remark1.: If the average limit is met when using a Quasi-Peak detector, the measurement using the average detector is not required.

2.: The lower limit applies to the band edges.

5.3. Test Procedure

- 5.3.1. To set up the EUT as indicated in ANSI C63.10. The EUT was placed on the table which has 80 cm height to the ground and 40 cm distance to the conducting wall.
- 5.3.2. Power supplier of the EUT was connected to the AC mains through an Artificial Mains Network (A.M.N.).
- 5.3.3. The AC power supplies to all peripheral devices must be provided through line impedance stabilization network (L.I.S.N.)
- 5.3.4. Checking frequency range from 150kHz to 30 MHz and record the emission which does not have 20 dB below limit.

5.4. Test Results

Please refer to Appendix A.

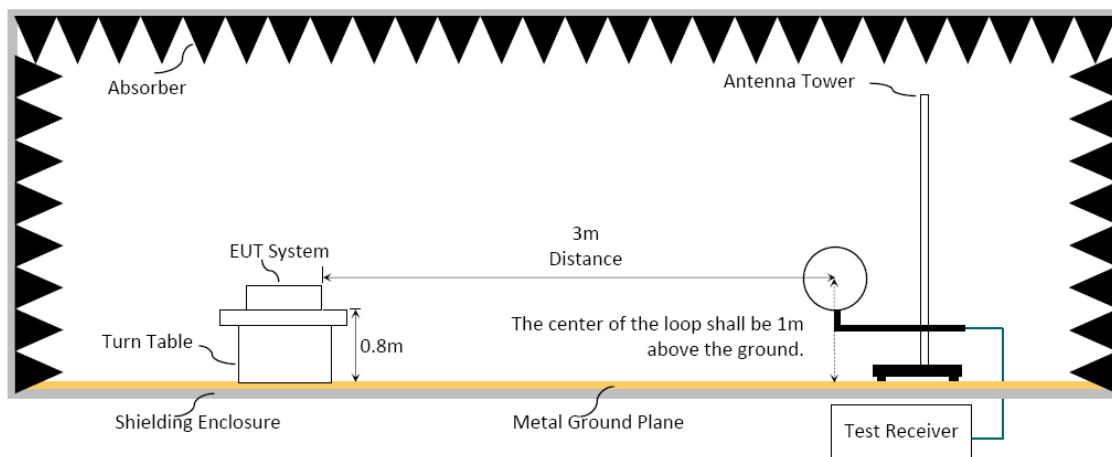
6. RADIATED EMISSION

6.1. Block Diagram of Test Setup

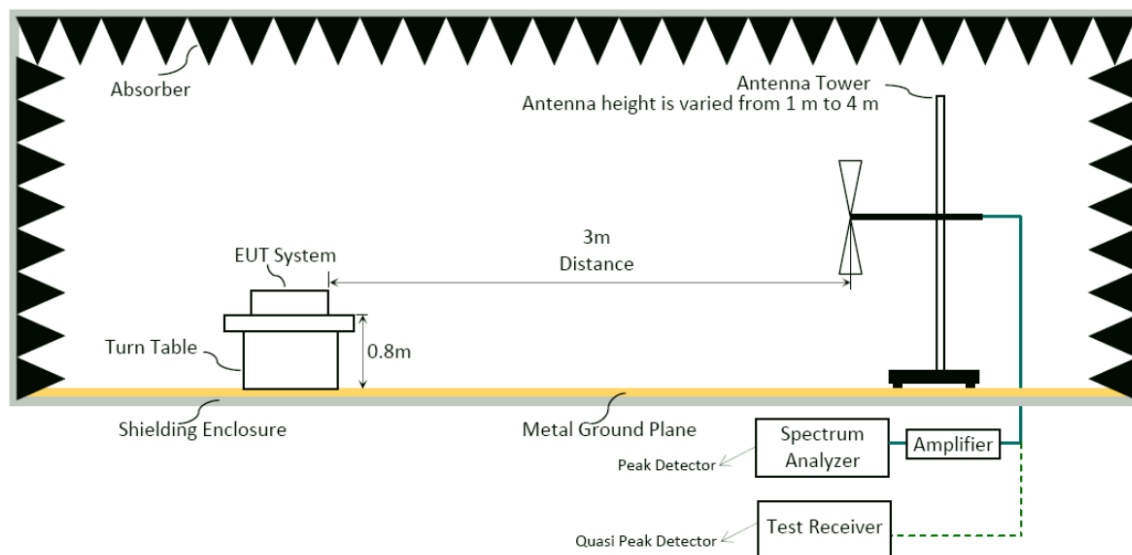
6.1.1. Block Diagram of EUT

Indicated as section 3.10

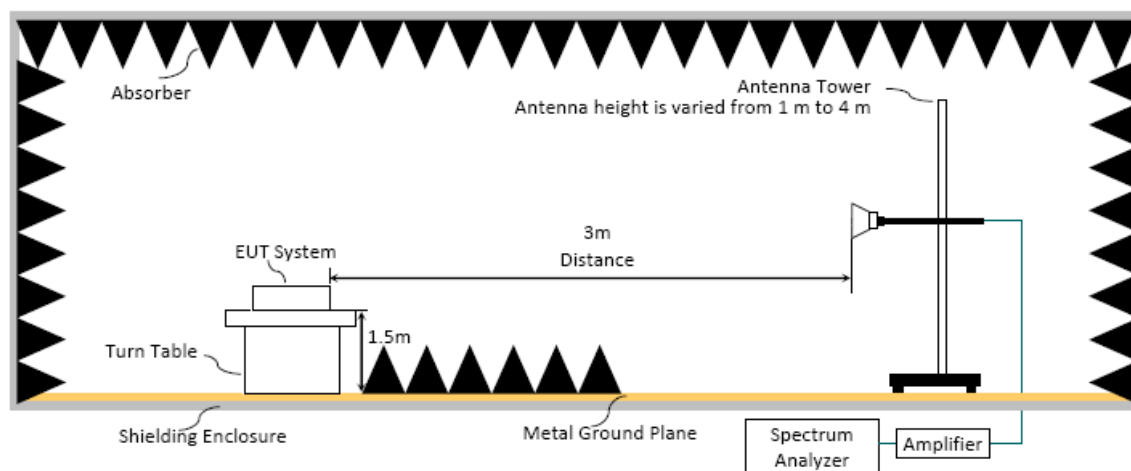
6.1.2. Setup Diagram for 9kHz-30MHz



6.1.3. Setup Diagram for 30-1000MHz



6.1.4. Setup Diagram for above 1GHz



6.2. Radiated Emission Limits

Radiated emissions fall in restricted bands, as defined in Section 15.205 must be in compliance with the radiated emission limits specified in 15.209 as below.

6.2.1. General Limit

Frequency (MHz)	Distance(m)	Limits	
		dBμV/m	μV/m
0.009 - 0.490	300	67.6-20 log f(kHz)	2400/f kHz
0.490 - 1.705	30	87.6-20 log f(kHz)	24000/f kHz
1.705 - 30	30	29.5	30
30 - 88	3	40.0	100
88- 216	3	43.5	150
216- 960	3	46.0	200
Above 960	3	54.0	500
Above 1000	3	74.0 dBμV/m (Peak) 54.0 dBμV/m (Average)	

Remark : (1) $\text{dB}\mu\text{V/m} = 20 \log (\mu\text{V/m})$

(2) The tighter limit applies to the edge between two frequency bands.

(3) Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

(4) Fundamental and emission fall within operation band are exempted from this section.

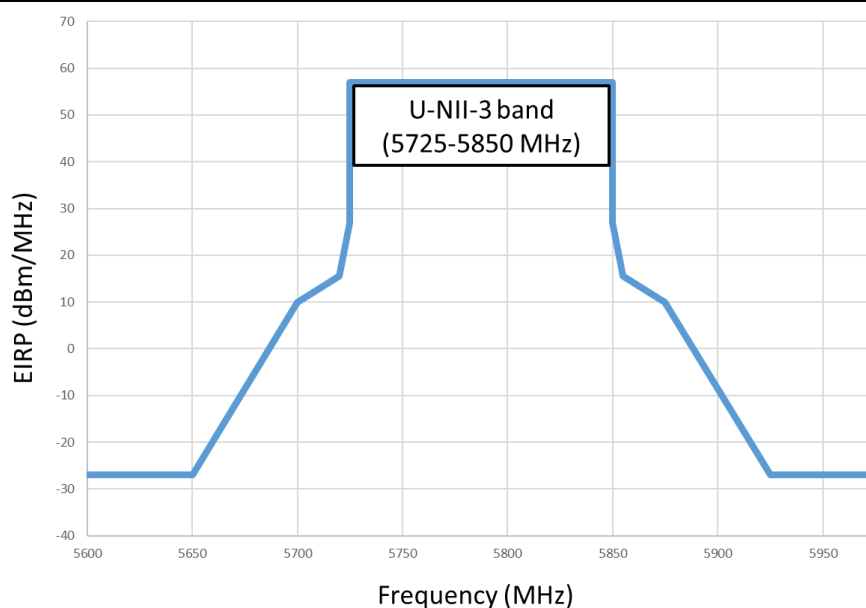
(5) Pursuant to ANSI C63.10: 6.6.4.3, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement.

6.2.2. Limit for non-restricted frequency above 1 GHz

Frequency Band (MHz)	E.I.R.P. Limit	Field Strength Limit at 3 m
5150 to 5250	-27 dBm	68.2 dB μ V/m
5250 to 5350		68.2 dB μ V/m
5470 to 5725		68.2 dB μ V/m

Note: Field Strength at 3 m= E.I.R.P. + 95.2 dB

Frequency Band (MHz)	Field Strength Limit at 3 m	
5725 to 5850	☒	15.407(b)(4)(i) All emissions shall be limited to a level of 68.2 dB μ V/m at 75 MHz or more above or below the band edge increasing linearly to 105.2 dB μ V/m at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 110.8 dB μ V/m at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 122.2 dB μ V/m at the band edge.



Frequency Band (MHz)	Field Strength Limit at 3 m	
5850 to 5895	☐	15.407(b)(5)(i) For an indoor access point or subordinate device, all emissions at or above 5.895 GHz shall not exceed an e.i.r.p. of 110.5 dBm/MHz and shall decrease linearly to an e.i.r.p. of 90.2 dBm/MHz at or above 5.925 GHz.
	☐	15.407(b)(5)(ii) , For a client device, all emissions at or above 5.895 GHz shall not exceed an e.i.r.p. of 90.2 dBm/MHz and shall decrease linearly to an e.i.r.p. of 68.2 dBm/MHz at or above 5.925 GHz.
	☐	15.407(b)(5)(iii) , For a client device or indoor access point or subordinate device, all emissions below 5.725 GHz shall not exceed an e.i.r.p. of 68.2 dBm/MHz at 5.65 GHz increasing linearly to 105.2 dBm/MHz at 5.7 GHz, and from 5.7 GHz increasing linearly to a level of 110.8 dBm/MHz at 5.72 GHz, and from 5.72 GHz increasing linearly to a level of 122.2 dBm/MHz at 5.725 GHz.

U-NII-4 Unwanted Emission Levels

PSD (dBm/MHz)

Frequency (GHz)

Legend:

- Client/Indoor AP/Sub
- Subordinate/Indoor AP
- Client
- U-NII-3 (Lower Edge)
- U-NII-3 (Upper Edge)
- U-NII-4 (Lower Edge)
- U-NII-4 (Upper Edge)

6.3. Test Procedure

Frequency Range 9kHz~30MHz:

The EUT setup on the turntable which has 0.8 m height to the ground. The turn table rotated 360 degrees and antenna fixed to 1 m to find the maximum emission level. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013 regulation.

- (1) RBW = 9kHz with peak and average detector.
- (2) Detector: average and peak (9kHz-490kHz)
Q.P. (490kHz-30MHz)

Frequency Range 30MHz ~ 40GHz:

The EUT setup on the turn table which has 80cm (for 30-1000MHz) and 1.5m (for above 1GHz) height to the ground. The turn table rotated 360 degrees and antenna varied from 1 m to 4 m to find the maximum emission level. Both horizontal and vertical polarization are required. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013 regulation.

Frequency below 1GHz:

Spectrum Analyzer is used for pre-testing with following setting:

- (1) RBW = 120kHz
- (2) VBW $\geq 3 \times$ RBW.
- (3) Detector = Peak.
- (4) Sweep time = auto.
- (5) Trace mode = max hold.
- (6) Allow sweeps to continue until the trace stabilizes.

Note 1: When peak-detected value is lower than limit that the measurement using the Q.P. detector is not required, otherwise using Q.P. for final measurement.

Note 2: When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.

Frequency above 1GHz to 10th harmonic(up to 40 GHz):

Peak Detector:

- (1) RBW = 1MHz
- (2) VBW $\geq 3 \times$ RBW.
- (3) Detector = Peak.
- (4) Sweep time = auto.
- (5) Trace mode = max hold.
- (6) Allow sweeps to continue until the trace stabilizes.

Note: When peak-detected value is lower than limit that the measurement using the average detector is not required, otherwise using average detector for final measurement.

Average Detector:**■ Option 1:**

(1) RBW = 1MHz

(2) VBW $\geq 1/T$. (Duty Cycle < 98%, when duty cycle presented in section 3.7)

(3) VBW = set VBW $\leq$ RBW / 100, but not less than 10Hz (Duty Cycle $\geq$ 98%, when duty cycle presented in section 3.7)

Mode	Antenna	VBW Setting
GFSK	ANT 1	10Hz
	ANT 2	10Hz

(4) Detector = Peak.

(5) Sweep time = auto.

(6) Trace mode = max hold.

(7) Allow sweeps to continue until the trace stabilizes.

□ Option 2:

Average Emission Level(dB μ V/m) = Peak Emission Level(dB μ V/m) + DCCF(dB).

6.4. Measurement Result Explanation

■ Peak Emission Level(dB μ V/m) = Antenna Factor(dB/m) + Cable Loss (dB) – Preamp Gain (dB) + Reading(dB μ V).

■ Average Emission Level(dB μ V/m) = Antenna Factor(dB/m) + Cable Loss (dB) – Preamp Gain (dB) + Reading(dB μ V).

□ Average Emission Level(dB μ V/m) = Peak Emission Level(dB μ V/m) + DCCF(dB)
Duty Cycle Correction Factor (DCCF)(dB) = $20\log(TX_{on}/TX_{on+off})$ presented in section 3.7.

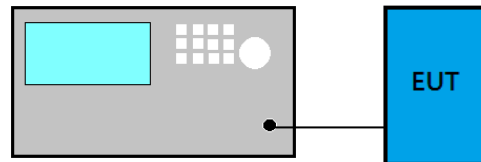
□ ERP(dBm) = Peak Emission Level(dB μ V/m) - 95.2dB - 2.14dB

6.5. Test Results

Please refer to Appendix A.

7. EMISSION/OCCUPIED BANDWIDTH

7.1. Block Diagram of Test Setup



7.2. Specification Limits

Frequency Band (MHz)	Limit
5150 to 5250	Reference only
5250 to 5350	
5470 to 5725	
5725 to 5895	$\geq 500\text{kHz}$

7.3. Test Procedure

Following measurement procedure is reference to KDB 789033 D02 General UNII Test Procedures New Rules v02r01 and KDB 291074 D02 EMC Measurement v01:

For Emission Bandwidth

■ Applicable to all bands except to 5725 MHz –5850 MHz.

- (1) Set RBW = 1% of the emission bandwidth
- (2) Set VBW > RBW
- (3) Detector = Peak
- (4) Trace mode = max hold
- (5) Setting channel bandwidth function x dB to -26 dB to record the final bandwidth.

■ Minimum Emission Bandwidth for the band 5725 MHz –5850 MHz.

- (1) Set RBW = 100 kHz.
- (2) Set the video bandwidth (VBW) $\geq 3 \times \text{RBW}$.
- (3) Detector = Peak.
- (4) Trace mode = max hold.
- (5) Sweep = auto couple.
- (6) Allow the trace to stabilize.
- (7) Setting channel bandwidth function x dB to -6 dB to record the final bandwidth.

For 99% Occupied Bandwidth

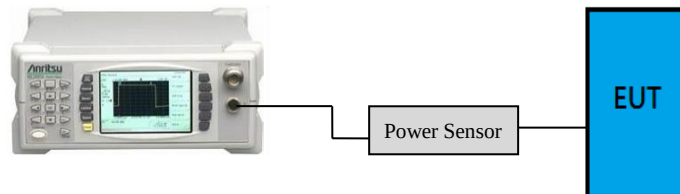
- (1) Set Span range 1.5~5 times the OBW
- (2) Set RBW close to 1% to 5% of OBW.
- (3) Set $VBW \geq 3 \times RBW$.
- (4) Detector = Peak.
- (5) Trace mode = Max hold
- (6) Sweep = Auto couple.
- (7) Allow the trace to stabilize.

7.4. Test Results

Please refer to Appendix A

8. MAXIMUM OUTPUT POWER

8.1. Block Diagram of Test Setup



8.2. Specification Limits

Frequency Band (MHz)	Category	Limit
5150 to 5250	Outdoor Access Point	1 W(30 dBm)/ Max e.i.r.p. ≤ 125 mW(21 dBm) at any elevation angle above 30 degrees as measured from the horizon
	Fixed point-to-point Access Point	1 W(30 dBm)
	Indoor Access Point	1 W(30 dBm)
	Mobile and Portable client device	250 mW(24 dBm)
5250 to 5350	N/A	250 mW or $11 \text{ dBm} + 10 \log B$ ^{Note1}
5470 to 5725		250 mW or $11 \text{ dBm} + 10 \log B$ ^{Note1}
5725 to 5850	N/A	1 W(30 dBm)
5850 to 5895	indoor access point	4 W (36 dBm) (e.i.r.p.)
	client devices	1 W (30 dBm) (e.i.r.p.)
	subordinate device	4 W (36 dBm) (e.i.r.p.)

Note 1: B is the 26 dB emission bandwidth, which presented in section 7 and appendix A.1.

8.3. Test Procedure

Following measurement procedure is reference to KDB 789033 D02 General UNII Test Procedures New Rules v02r01 and KDB 291074 D02 EMC Measurement v01:

■ Method AVGPM (Measurement using an RF average power meter):

EUT is connected to power sensor and record the maximum average output power and duty cycle factor is added when duty cycle presented in section 3.7 is < 98%.

□ Method AVGSA-2 (Spectrum channel power)

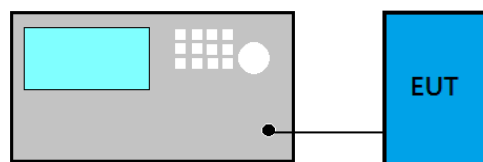
- (1) Set span to at least 1.5 times the OBW
- (2) Set RBW = 1 MHz
- (3) Set the video bandwidth (VBW) ≥ 3 MHz.
- (4) Detector = RMS.
- (5) Trace mode = trace average at least 100 traces
- (6) Sweep = auto couple.
- (7) Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges.
- (8) Duty cycle factor is added when duty cycle presented in section 3.7 is < 98%.

8.4. Test Results

Please refer to Appendix A

9. POWER SPECTRAL DENSITY

9.1. Block Diagram of Test Setup



9.2. Specification Limits

Frequency Band (MHz)	Category	Limit
5150 to 5250	Outdoor Access Point	17dBm/MHz
	Fixed point-to-point Access Point	
	Indoor Access Point	
	Mobile and Portable client device	11 dBm/MHz
5250 to 5350	N/A	11 dBm/MHz
5470 to 5725		11 dBm/MHz
5725 to 5850		30 dBm/500kHz
5850 to 5895	indoor access point	20dBm/MHz(e.i.r.p.)
	client devices	14dBm/MHz(e.i.r.p.)
	subordinate device	20dBm/MHz(e.i.r.p.)

9.3. Test Procedure

Following measurement procedure is reference to KDB 789033 D02 General UNII Test Procedures New Rules v02r01:

■ Method AVGSA-2

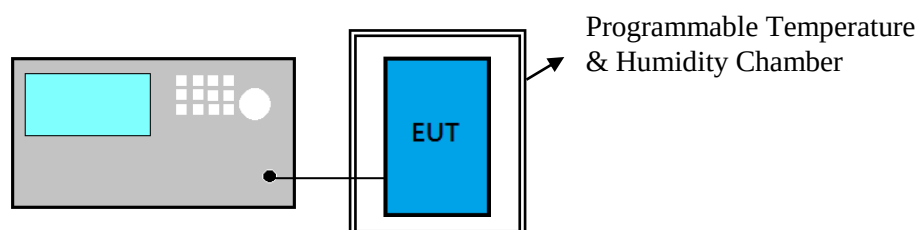
- (1) Set span to encompass the EBW (or 99% OBW) of the signal.
- (2) Set RBW = 1 MHz (Applicable to all bands except to 5725 MHz- 5850 MHz)/
Set RBW=100 KHz(when EUT operate at 5725 MHz- 5850 MHz)
- (3) Set the video bandwidth (VBW) ≥ 3 RBW.
- (4) Detector = RMS.
- (5) Trace mode = trace average at least 100 traces
- (6) Sweep = auto couple.
- (7) Use peak search function to find out the maximum power density.
- (8) Duty cycle factor is added when duty cycle presented in section 3.7 is $< 98\%$.
- (9) Offset BWCF (7dB) when EUT operate at 5725 MHz –5850 MHz.

9.4. Test Results

Please refer to Appendix A

10. FREQUENCY STABILITY

10.1. Block Diagram of Test Setup



10.2. Specification Limits

NONE

10.3. Test Procedure

- (1) Frequency: Test frequency.
- (2) Span: enough to cover the complete power envelope
- (3) RBW: 1MHz(modulation ON) ; 10KHz(CW)
- (4) VBW: 1MHz(modulation ON) ; 10KHz(CW)
- (5) Detector Mode: Positive Peak
- (6) Indication mode: Max hold
- (7) Find the peak frequency and take calculate by the formula:
(Measurement Value-declaration frequency)/ declaration frequency)

10.4. Test Results

Please refer to Appendix A

11.DEVIATION TO TEST SPECIFICATIONS

【NONE】



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APPENDIX A

TEST DATA AND PLOTS

(Model: WL2SB23)

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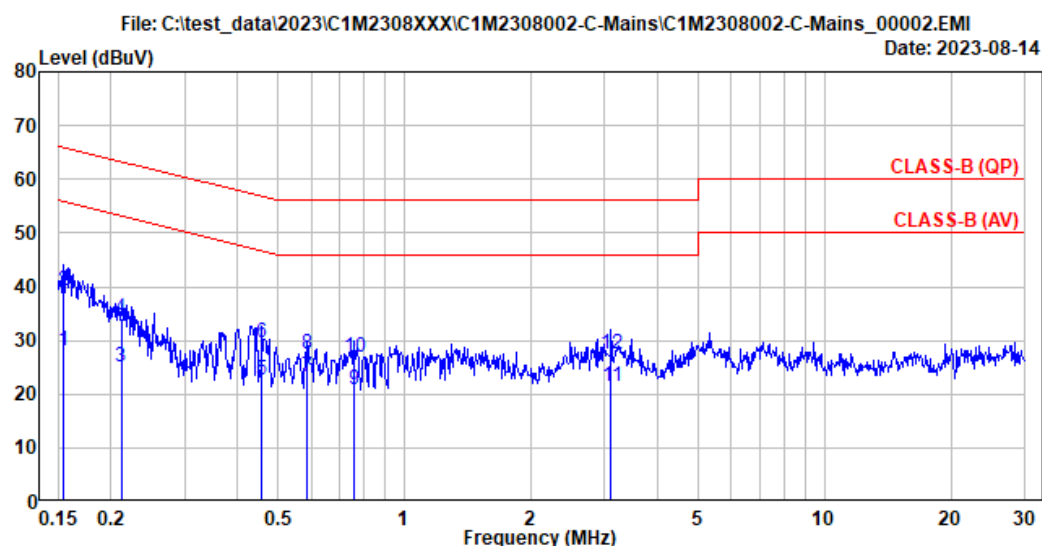
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A.1 CONDUCTED EMISSION

Test Date	2023/08/14	Temp./Hum.	24°C/53%
Test Voltage	DC 3.3V	Tested By	Xar Zhou



Site No.	: No.8 Shielded Room	Data No.	: 2
Instrument 1	: Receiver ESR(774)		
Instrument 2	: ENV432 (567)(A) CE-08 ESH3-Z2 (354)		
Limit	: CLASS-B (QP)	Phase	: Line
Environment	: 24°C/53%	Test Rating	: 110Vac/60Hz
EUT Model	: WL2SB23	Engineer	: Xar Zhuo
Test Mode	: Operating		

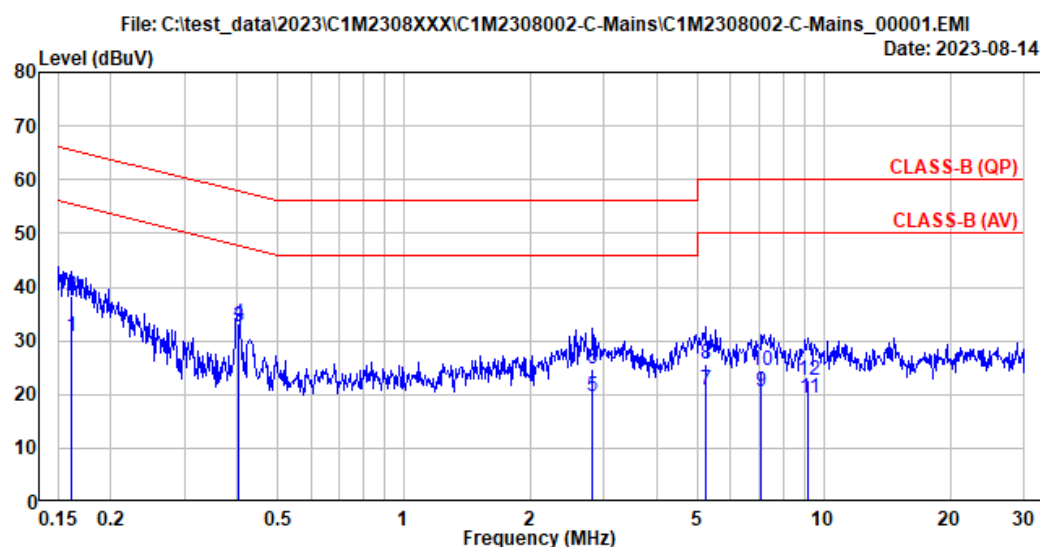
	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBμV)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Remark
1	0.155	10.30	0.03	9.85	7.85	28.03	55.75	27.72	Average
2	0.155	10.30	0.03	9.85	18.96	39.14	65.75	26.61	QP
3	0.212	10.28	0.03	9.85	4.80	24.96	53.14	28.18	Average
4	0.212	10.28	0.03	9.85	13.94	34.10	63.14	29.04	QP
5	0.458	10.27	0.03	9.85	2.52	22.67	46.73	24.06	Average
6	0.458	10.27	0.03	9.85	9.30	29.45	56.73	27.28	QP
7	0.588	10.27	0.03	9.85	2.96	23.11	46.00	22.89	Average
8	0.588	10.27	0.03	9.85	7.35	27.50	56.00	28.50	QP
9	0.762	10.28	0.04	9.85	0.68	20.85	46.00	25.15	Average
10	0.762	10.28	0.04	9.85	6.71	26.88	56.00	29.12	QP
11	3.106	10.32	0.07	9.86	1.19	21.44	46.00	24.56	Average
12	3.106	10.32	0.07	9.86	7.07	27.32	56.00	28.68	QP

Remarks: 1. Emission Level(dBμV)= AMN Factor(dB) + Cable Loss(dB) + Pulse Att.(dB) + Reading(dBμV).

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Test Date	2023/08/14	Temp./Hum.	24°C/53%
Test Voltage	DC 3.3V	Tested By	Xar Zhou



Site No.	: No.8 Shielded Room	Data No.	: 1
Instrument 1	: Receiver ESR(774)		
Instrument 2	: ENV432 (567)(A) CE-08 ESH3-Z2 (354)		
Limit	: CLASS-B (QP)	Phase	: Line
Environment	: 24°C/53%	Test Rating	: 110Vac/60Hz
EUT Model	: WL2SB23	Engineer	: Xar Zhuo
Test Mode	: Operating		

	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBμV)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Remark
1	0.162	10.29	0.03	9.85	10.73	30.90	55.38	24.48	Average
2	0.162	10.29	0.03	9.85	18.19	38.36	65.38	27.02	QP
3	0.402	10.27	0.03	9.85	12.49	32.64	47.80	15.16	Average
4	0.402	10.27	0.03	9.85	13.20	33.35	57.80	24.45	QP
5	2.811	10.31	0.07	9.86	-0.67	19.57	46.00	26.43	Average
6	2.811	10.31	0.07	9.86	4.63	24.87	56.00	31.13	QP
7	5.216	10.37	0.09	9.87	0.59	20.92	50.00	29.08	Average
8	5.216	10.37	0.09	9.87	5.23	25.56	60.00	34.44	QP
9	7.105	10.41	0.11	9.87	0.27	20.66	50.00	29.34	Average
10	7.105	10.41	0.11	9.87	4.06	24.45	60.00	35.55	QP
11	9.207	10.45	0.13	9.88	-1.07	19.39	50.00	30.61	Average
12	9.207	10.45	0.13	9.88	2.08	22.54	60.00	37.46	QP

Remarks: 1. Emission Level(dBμV)= AMN Factor(dB) + Cable Loss(dB) + Pulse Att.(dB) + Reading(dBμV).

A.2 RADIATED EMISSION

Test Date	2023/08/11 ~ 08/22	Temp./Hum.	25°C/48-58%
Test Voltage	DC 3.3V	Tested By	Kuper Hsu

A.2.1 Emissions within Restricted Frequency Bands

A.2.1.1 Frequency 9kHz~30MHz

The emissions (9kHz~30MHz) not reported for there is no emission be found.

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Mode	GFSK	U-NII Band	1
Antenna	ANT 1	Frequency	TX 5205MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
33.233	22.77	1.49	26.48	31.25	29.03	40.00	10.97	Peak
128.617	17.56	2.96	26.11	32.87	27.28	43.50	16.22	Peak
449.256	22.37	6.36	26.80	32.42	34.36	46.00	11.64	Peak
707.383	24.71	7.67	27.42	32.14	37.11	46.00	8.89	Peak
896.533	26.18	8.74	27.00	31.21	39.14	46.00	6.86	Peak
993.533	26.92	9.26	26.68	32.98	42.48	54.00	11.52	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
33.772	22.57	1.50	26.48	32.16	29.75	40.00	10.25	Peak
128.617	17.56	2.96	26.11	37.35	31.76	43.50	11.74	Peak
444.406	22.30	6.32	26.77	32.45	34.31	46.00	11.69	Peak
701.994	24.70	7.64	27.43	33.95	38.86	46.00	7.14	Peak
895.994	26.17	8.74	27.00	33.22	41.13	46.00	4.87	Peak
984.911	26.85	9.21	26.71	32.78	42.14	54.00	11.86	Peak

Mode	GFSK	U-NII Band	3
Antenna	ANT 1	Frequency	TX 5785MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
31.078	23.55	1.44	26.49	30.23	28.73	40.00	11.27	Peak
128.617	17.56	2.96	26.11	33.84	28.25	43.50	15.25	Peak
432.011	22.10	6.22	26.68	33.53	35.17	46.00	10.83	Peak
636.789	24.47	7.30	27.41	33.20	37.57	46.00	8.43	Peak
904.078	26.27	8.78	26.98	31.36	39.43	46.00	6.57	Peak
972.517	26.76	9.15	26.75	32.74	41.89	54.00	12.11	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
31.078	23.55	1.44	26.49	30.64	29.14	40.00	10.86	Peak
128.617	17.56	2.96	26.11	35.96	30.37	43.50	13.13	Peak
449.256	22.37	6.36	26.80	32.24	34.17	46.00	11.83	Peak
698.761	24.69	7.62	27.43	32.24	37.12	46.00	8.88	Peak
904.078	26.27	8.78	26.98	32.05	40.13	46.00	5.87	Peak
997.844	26.94	9.28	26.67	32.73	42.29	54.00	11.71	Peak

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Mode	GFSK	U-NII Band	1
Antenna	ANT 2	Frequency	TX 5205MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
31.078	23.55	1.44	26.49	30.76	29.27	40.00	10.73	Peak
128.617	17.56	2.96	26.11	33.18	27.59	43.50	15.91	Peak
432.011	22.10	6.22	26.68	32.81	34.44	46.00	11.56	Peak
707.383	24.71	7.67	27.42	32.34	37.31	46.00	8.69	Peak
904.078	26.27	8.78	26.98	31.23	39.31	46.00	6.69	Peak
974.672	26.78	9.16	26.74	32.80	42.00	54.00	12.00	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
31.078	23.55	1.44	26.49	30.45	28.95	40.00	11.05	Peak
128.617	17.56	2.96	26.11	35.91	30.32	43.50	13.18	Peak
432.011	22.10	6.22	26.68	33.09	34.73	46.00	11.27	Peak
690.678	24.66	7.58	27.43	32.31	37.12	46.00	8.88	Peak
895.456	26.17	8.74	27.00	32.97	40.87	46.00	5.13	Peak
996.767	26.94	9.27	26.67	32.25	41.79	54.00	12.21	Peak

Mode	GFSK	U-NII Band	3
Antenna	ANT 2	Frequency	TX 5785MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
31.078	23.55	1.44	26.49	30.95	29.45	40.00	10.55	Peak
128.617	17.56	2.96	26.11	32.55	26.96	43.50	16.54	Peak
456.261	22.48	6.42	26.85	32.82	34.88	46.00	11.12	Peak
654.033	24.53	7.40	27.42	32.52	37.03	46.00	8.97	Peak
895.456	26.17	8.74	27.00	32.10	40.00	46.00	6.00	Peak
974.672	26.78	9.16	26.74	32.75	41.95	54.00	12.05	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
34.311	22.39	1.51	26.48	31.61	29.03	40.00	10.97	Peak
128.617	17.56	2.96	26.11	36.24	30.65	43.50	12.85	Peak
432.011	22.10	6.22	26.68	32.80	34.44	46.00	11.56	Peak
707.383	24.71	7.67	27.42	31.97	36.94	46.00	9.06	Peak
901.922	26.25	8.77	26.98	34.87	42.91	46.00	3.09	Peak
994.611	26.93	9.26	26.68	32.01	41.53	54.00	12.47	Peak

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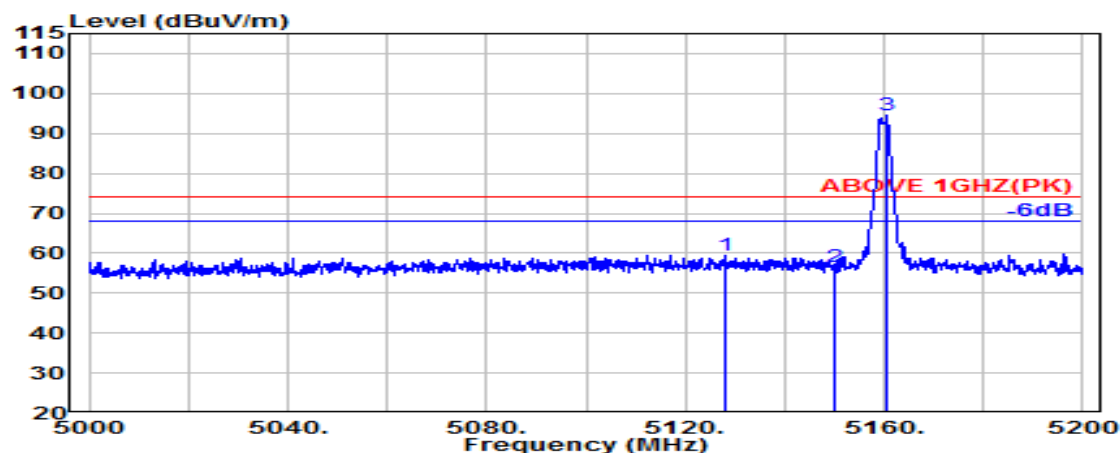
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A.2.1.3 Frequency Above 1 GHz to 10th harmonics

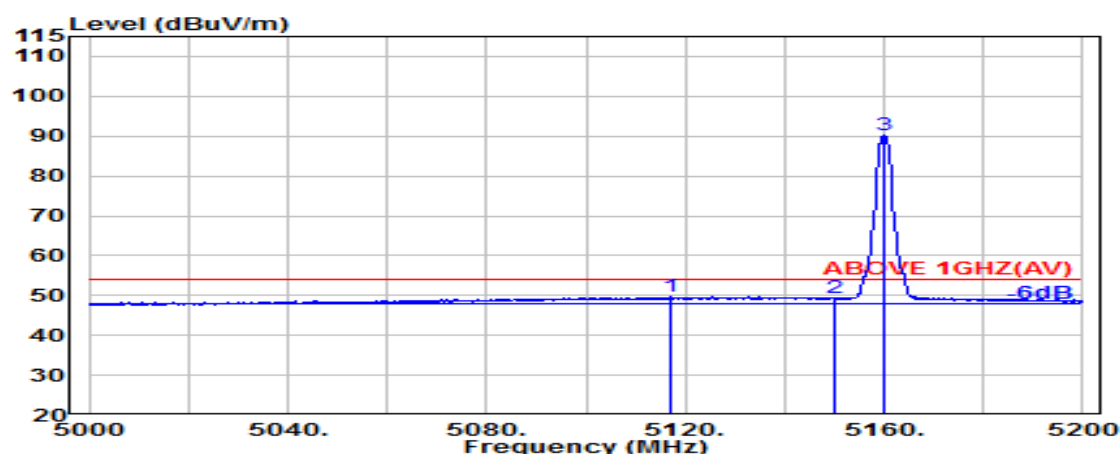
Band Edge:

Mode	GFSK	U-NII Band	1
Antenna	ANT 1	Frequency	TX 5160MHz



Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
5127.900	33.70	8.87	34.35	51.24	59.47	74.00	14.53	Peak
5150.000	33.70	8.89	34.34	48.31	56.56	74.00	17.44	Peak
@ 5160.500	33.70	8.89	34.33	86.47	94.72	---	---	Peak



Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
5117.200	33.70	8.87	34.35	41.48	49.69	54.00	4.31	Average
5150.000	33.70	8.89	34.34	41.10	49.35	54.00	4.65	Average
@ 5160.000	33.70	8.89	34.33	81.88	90.14	---	---	Average

Remark: The “@” means fundamental frequency, it is ignored in this section.

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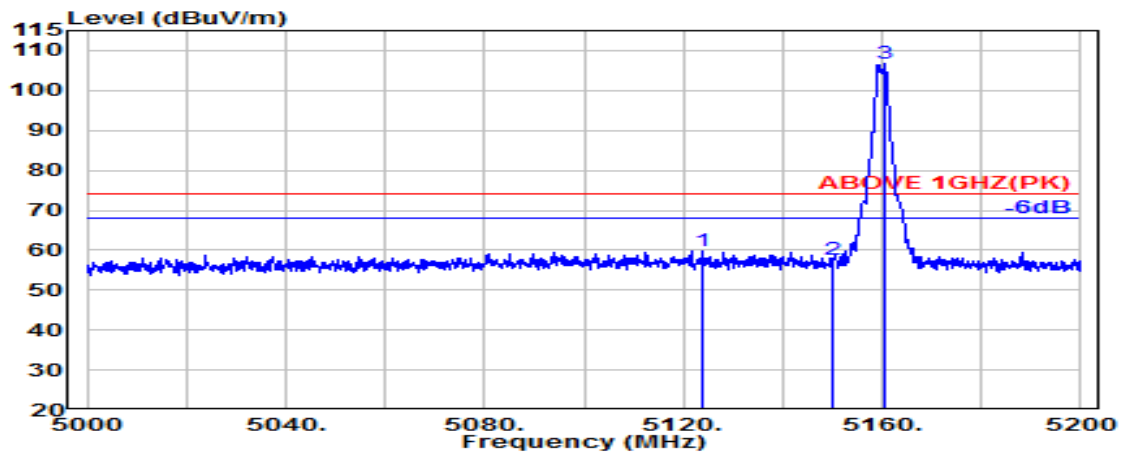
No. 491, Zhongfu Rd., Linkou Dist.,

New Taipei City244, Taiwan

Tel: +886 2 26099301

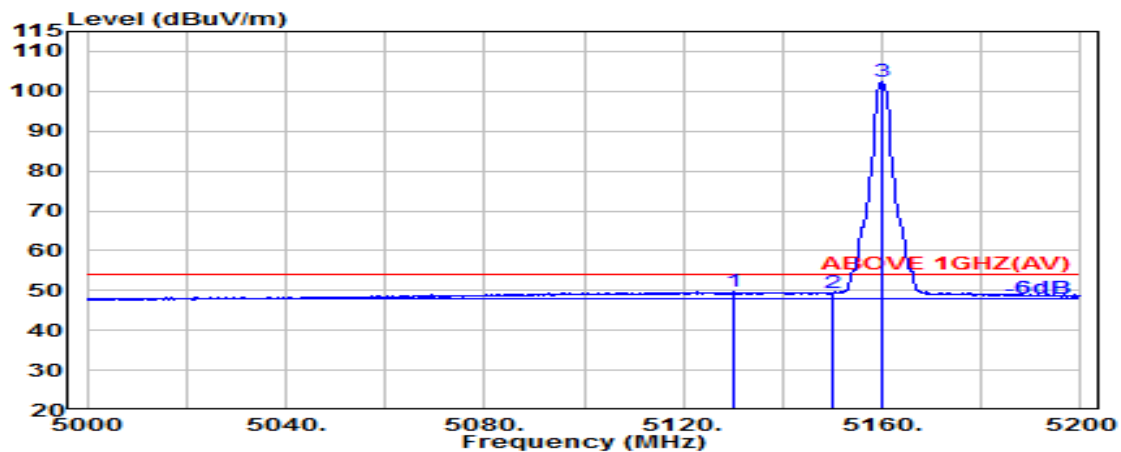
Fax: +886 2 26099303

Mode	GFSK	U-NII Band	1
Antenna	ANT 1	Frequency	TX 5160MHz



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
5123.800	33.70	8.87	34.35	51.52	59.74	74.00	14.26	Peak
5150.000	33.70	8.89	34.34	49.23	57.48	74.00	16.52	Peak
@ 5160.500	33.70	8.89	34.33	98.34	106.60	---	---	Peak



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
5130.000	33.70	8.87	34.35	41.47	49.70	54.00	4.30	Average
5150.000	33.70	8.89	34.34	41.08	49.33	54.00	4.67	Average
@ 5160.000	33.70	8.89	34.33	94.07	102.33	---	---	Average

Remark: The “@” means fundamental frequency, it is ignored in this section.

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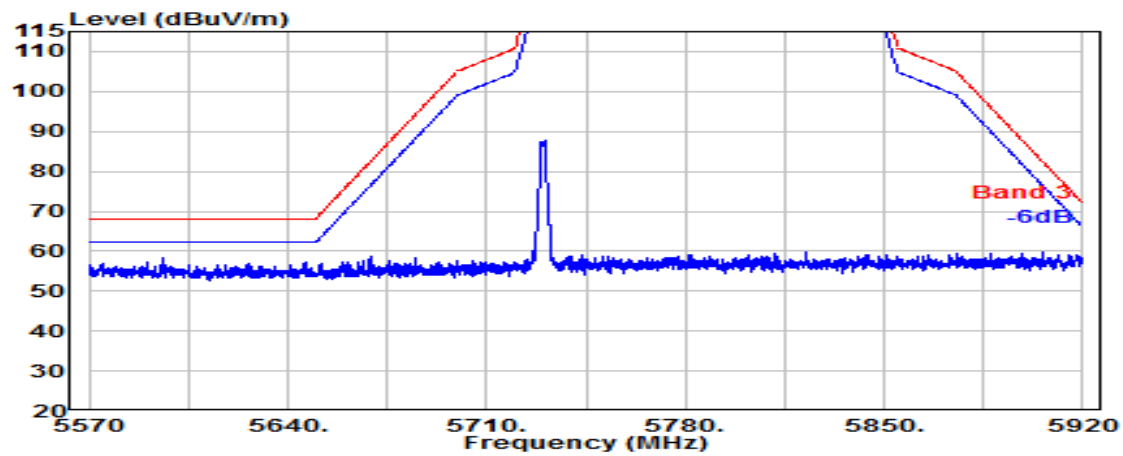
New Taipei City244, Taiwan

Tel: +886 2 26099301

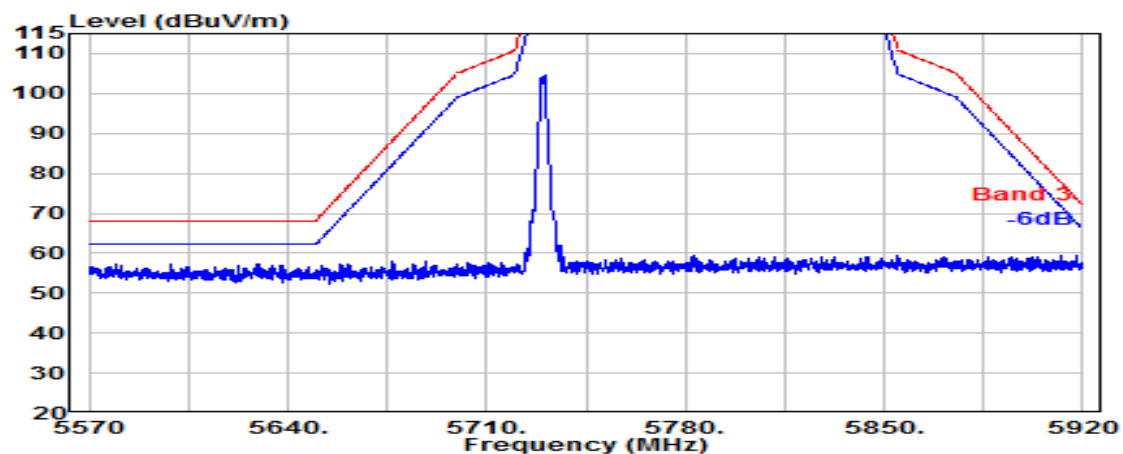
Fax: +886 2 26099303

Mode	GFSK	U-NII Band	3
Antenna	ANT 1	Frequency	TX 5730MHz

Antenna at Horizontal Polarization



Antenna at Vertical Polarization

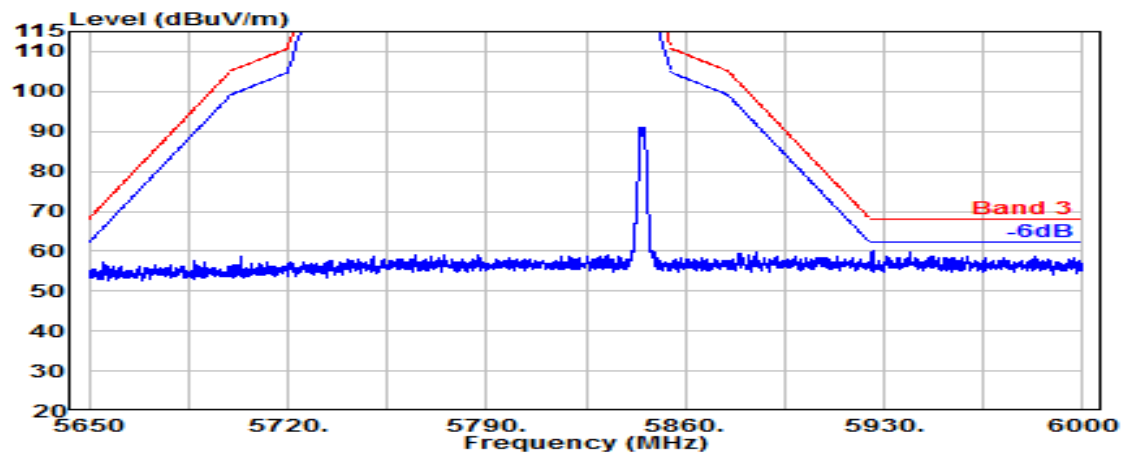


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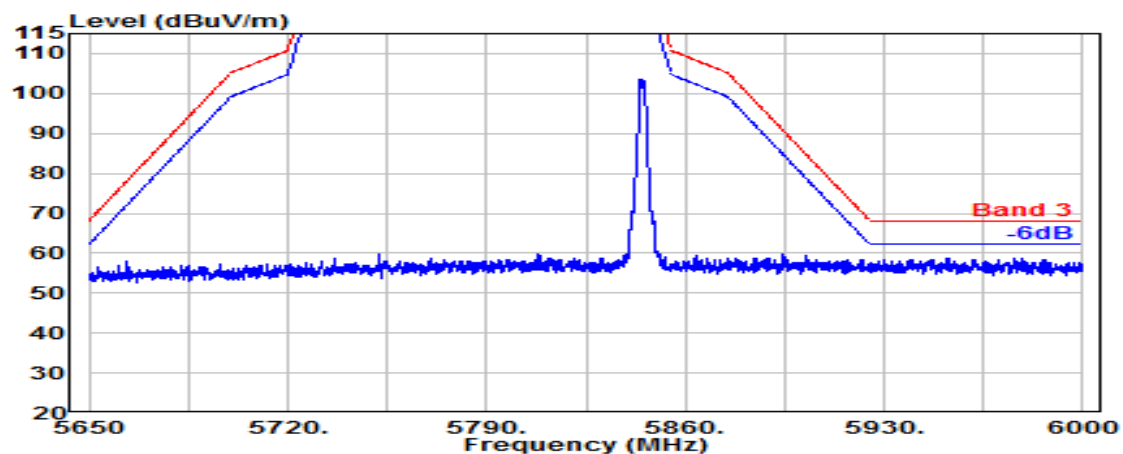
Tel: +886 2 26099301
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Mode	GFSK	U-NII Band	3
Antenna	ANT 1	Frequency	TX 5845MHz

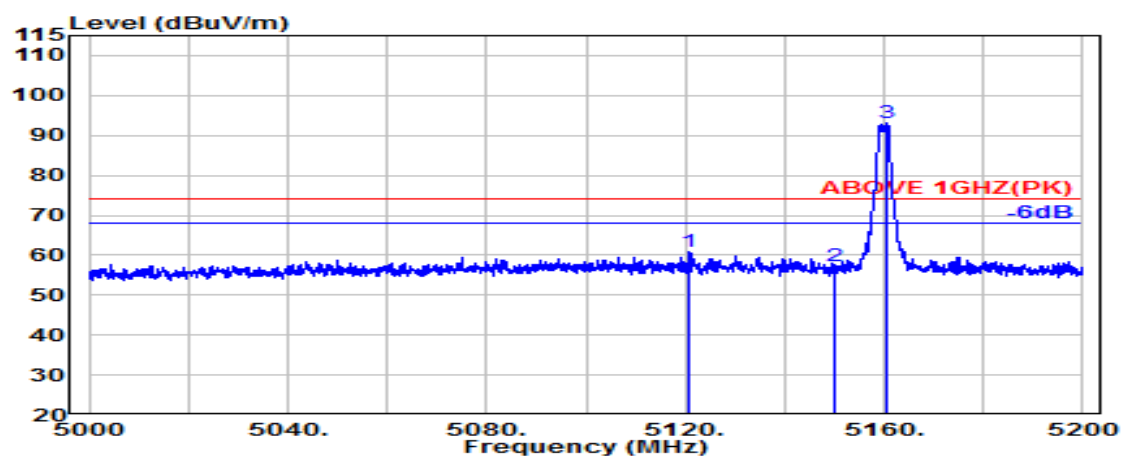
Antenna at Horizontal Polarization



Antenna at Vertical Polarization

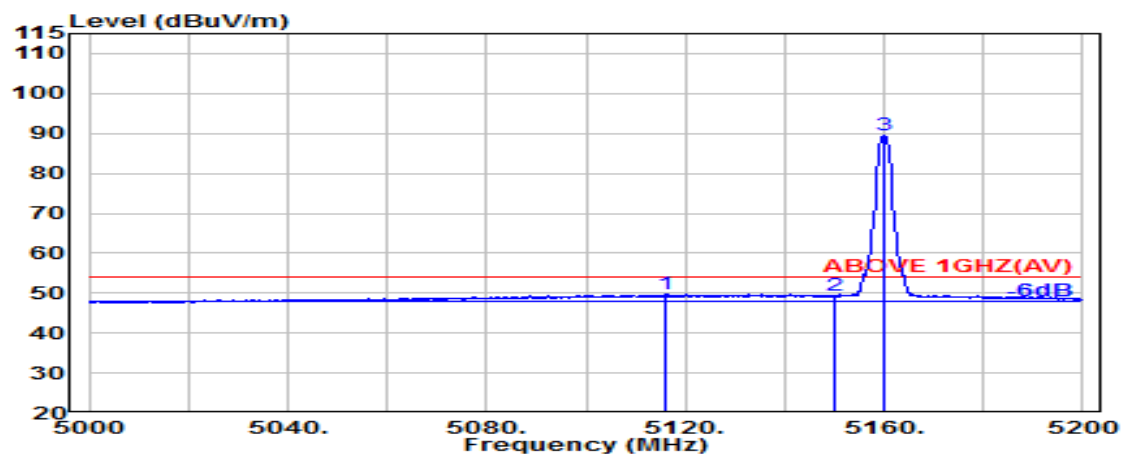


Mode	GFSK	U-NII Band	1
Antenna	ANT 2	Frequency	TX 5160MHz



Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
5120.900	33.70	8.87	34.35	52.73	60.94	74.00	13.06	Peak
5150.000	33.70	8.89	34.34	48.95	57.20	74.00	16.80	Peak
@ 5160.500	33.70	8.89	34.33	85.01	93.26	---	---	Peak

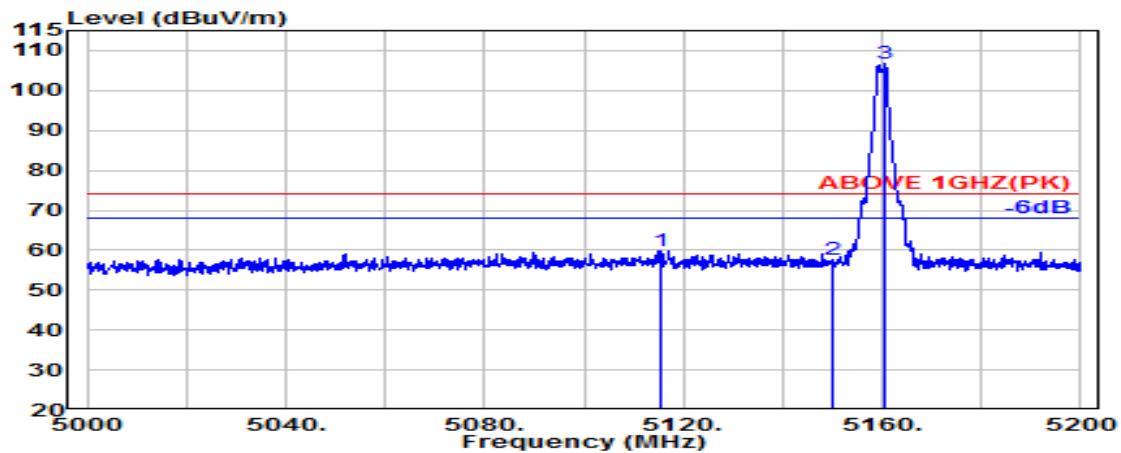


Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
5116.200	33.70	8.87	34.35	41.56	49.77	54.00	4.23	Average
5150.000	33.70	8.89	34.34	41.03	49.28	54.00	4.72	Average
@ 5160.000	33.70	8.89	34.33	81.30	89.56	---	---	Average

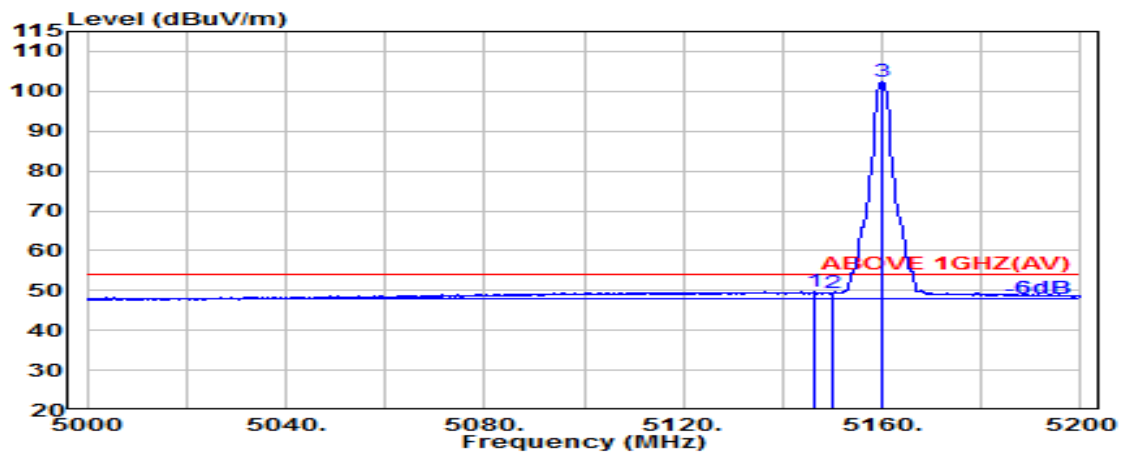
Remark: The “@” means fundamental frequency, it is ignored in this section.

Mode	GFSK	U-NII Band	1
Antenna	ANT 2	Frequency	TX 5160MHz



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
5115.700	33.70	8.87	34.35	51.65	59.86	74.00	14.14	Peak
5150.000	33.70	8.89	34.34	49.48	57.73	74.00	16.27	Peak
@ 5160.500	33.70	8.89	34.33	98.42	106.68	---	---	Peak



Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Gain (dB)	Reading (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
5146.400	33.70	8.88	34.34	41.39	49.64	54.00	4.36	Average
5150.000	33.70	8.89	34.34	41.11	49.36	54.00	4.64	Average
@ 5160.000	33.70	8.89	34.33	94.20	102.46	---	---	Average

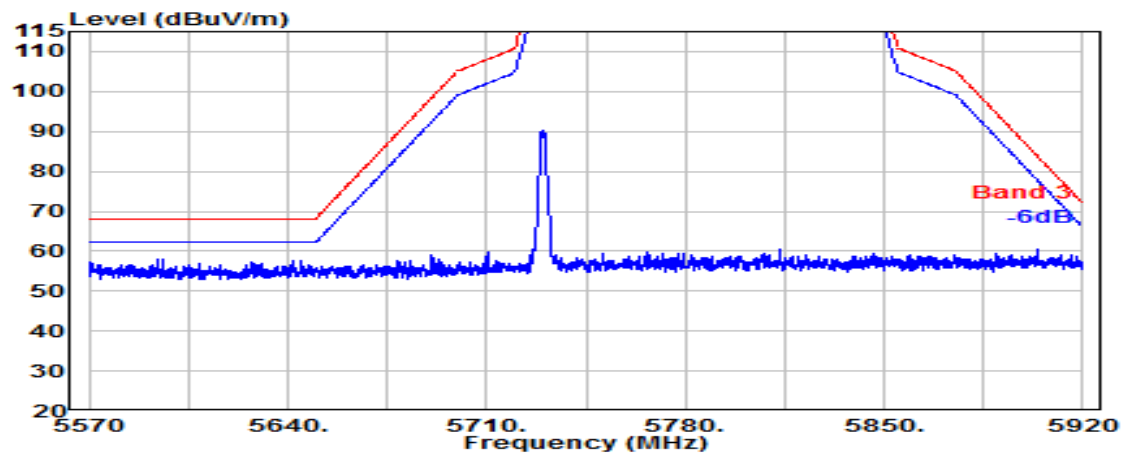
Remark: The “@” means fundamental frequency, it is ignored in this section.

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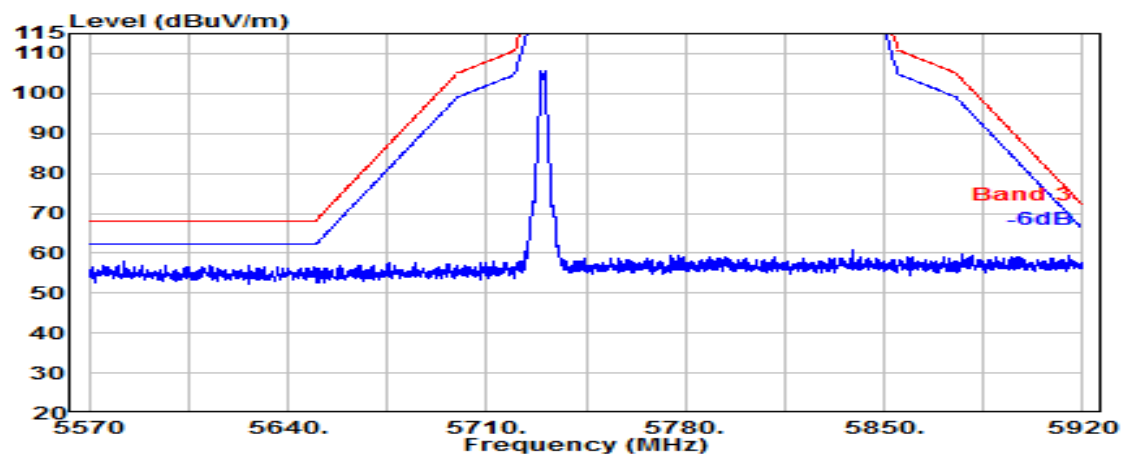
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Mode	GFSK	U-NII Band	3
Antenna	ANT 2	Frequency	TX 5730MHz

Antenna at Horizontal Polarization



Antenna at Vertical Polarization

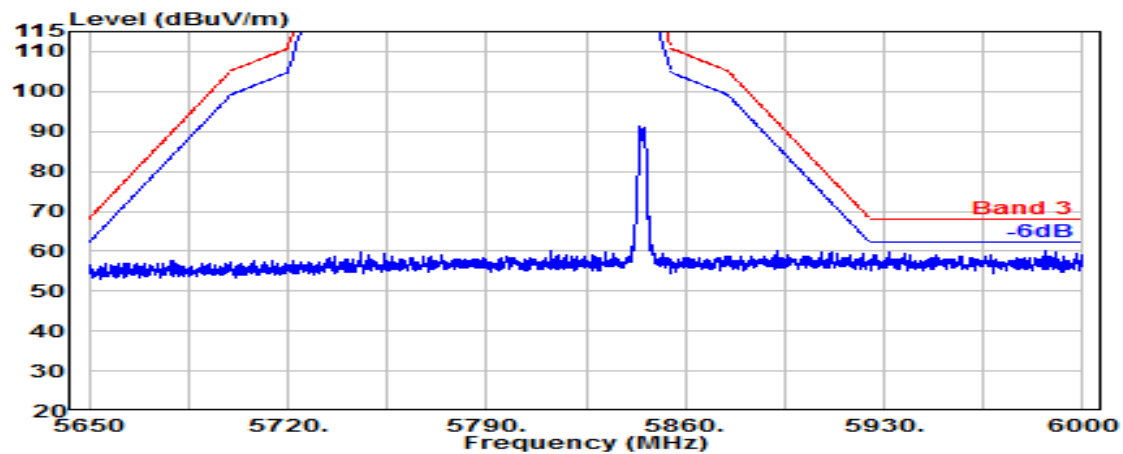


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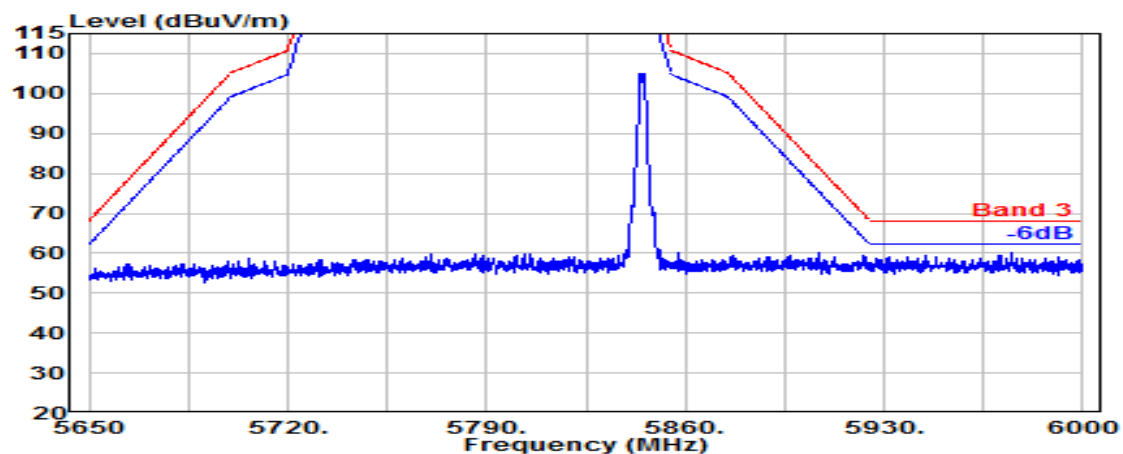
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Mode	GFSK	U-NII Band	3
Antenna	ANT 2	Frequency	TX 5845MHz

Antenna at Horizontal Polarization



Antenna at Vertical Polarization



A.2.2 Emissions outside the frequency band

The emissions (up to 40GHz) not reported for there is no emission be found.

Mode	GFSK	U-NII Band	1
Antenna	ANT 1	Frequency	TX 5160MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
10320.000	37.32	15.57	34.80	28.08	46.17	54.00	7.83	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
10320.000	37.32	15.57	34.80	27.70	45.79	54.00	8.21	Peak

Mode	GFSK	U-NII Band	1
Antenna	ANT 1	Frequency	TX 5205MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
10410.000	37.44	15.59	34.72	27.93	46.25	54.00	7.75	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
10410.000	37.44	15.59	34.72	26.95	45.26	54.00	8.74	Peak

Mode	GFSK	U-NII Band	1
Antenna	ANT 1	Frequency	TX 5245MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
10490.000	37.76	15.62	34.65	26.08	44.81	54.00	9.19	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
10490.000	37.76	15.62	34.65	27.14	45.88	54.00	8.12	Peak

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Mode	GFSK	U-NII Band	3
Antenna	ANT 1	Frequency	TX 5730MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
11460.000	38.22	16.12	34.52	27.86	47.69	54.00	6.31	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
11460.000	38.22	16.12	34.52	27.39	47.22	54.00	6.78	Peak

Mode	GFSK	U-NII Band	3
Antenna	ANT 1	Frequency	TX 5785MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
11570.000	38.30	16.20	34.54	26.32	46.28	54.00	7.72	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
11570.000	38.30	16.20	34.54	26.60	46.57	54.00	7.43	Peak

Mode	GFSK	U-NII Band	3
Antenna	ANT 1	Frequency	TX 5845MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
11690.000	38.30	16.29	34.57	27.00	47.02	54.00	6.98	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
11690.000	38.30	16.29	34.57	28.06	48.08	54.00	5.92	Peak

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Mode	GFSK	U-NII Band	1
Antenna	ANT 2	Frequency	TX 5160MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
10320.000	37.32	15.57	34.80	27.55	45.63	54.00	8.37	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
10320.000	37.32	15.57	34.80	26.99	45.07	54.00	8.93	Peak

Mode	GFSK	U-NII Band	1
Antenna	ANT 2	Frequency	TX 5205MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
10410.000	37.44	15.59	34.72	27.92	46.24	54.00	7.76	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
10410.000	37.44	15.59	34.72	25.52	43.83	54.00	10.17	Peak

Mode	GFSK	U-NII Band	1
Antenna	ANT 2	Frequency	TX 5245MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
10490.000	37.76	15.62	34.65	27.65	46.38	54.00	7.62	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
10490.000	37.76	15.62	34.65	27.47	46.20	54.00	7.80	Peak

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Mode	GFSK	U-NII Band	3
Antenna	ANT 2	Frequency	TX 5730MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
11460.000	38.22	16.12	34.52	28.74	48.56	54.00	5.44	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
11460.000	38.22	16.12	34.52	27.77	47.60	54.00	6.40	Peak

Mode	GFSK	U-NII Band	3
Antenna	ANT 2	Frequency	TX 5785MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
11570.000	38.30	16.20	34.54	26.40	46.36	54.00	7.64	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
11570.000	38.30	16.20	34.54	27.04	47.00	54.00	7.00	Peak

Mode	GFSK	U-NII Band	3
Antenna	ANT 2	Frequency	TX 5845MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
11690.000	38.30	16.29	34.57	26.44	46.46	54.00	7.54	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Gain (dB)	Read Level (dBμV)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector
11690.000	38.30	16.29	34.57	25.90	45.92	54.00	8.08	Peak

A.2.3 Emissions in Non-restricted Frequency Bands

Pursuant to KDB 789033 D02 General UNII Test Procedures New Rules v02r01 that emission levels below the 15.209 Section 8.9 table 4 general radiated emissions limits is not required.

A.3 MAXIMUM OUTPUT POWER AND EMISSION/OCCUPIED BANDWIDTH

Test Date	2023/07/27 ~ 08/22	Temp./Hum.	24-25°C/53-55%
Cable Loss	0.50dB	Tested By	Kuper Hsu
Test Voltage	DC 3.3V		

A.3.1 Average Output Power and Emission/Occupied Bandwidth

Mode GFSK	Centre Frequency (MHz)	Bandwidth(MHz)				Average Output Power (dBm)		Duty Cycle Factor (dB) 10log(1/X)	Max Average Output Power (dBm) Note 2	Limit (dBm)	Limit(11dBm +10 log B) ^{Note 4}
		Emission (26dB) Bandwidth		Occupied (99%) Bandwidth							
		ANT 1	ANT 2	ANT 1	ANT 2	ANT 1	ANT 2				
U-NII Band 1	5160	4.516	4.516	2.6641	2.6255	8.41	8.36	N/A	8.41	24	N/A
	5205	4.516	4.516	2.5442	2.5442	8.64	8.62		8.64		
	5245	4.523	4.523	2.7100	2.7100	8.57	8.57		8.57		
Mode GFSK	Centre Frequency (MHz)	Bandwidth(MHz)				Average Output Power (dBm)		Duty Cycle Factor (dB) 10log(1/X)	Max Average Output Power (dBm) Note 2	Limit (dBm)	Limit(11dBm +10 log B) ^{Note 4}
		Emission (6dB) Bandwidth		Occupied (99%) Bandwidth							
		ANT 1	ANT 2	ANT 1	ANT 2	ANT 1	ANT 2				
U-NII Band 3	5730	1.878	1.874	2.4690	2.4644	7.19	7.19	N/A	7.19	30	N/A
	5785	1.918	1.918	2.5657	2.5657	7.62	7.67		7.67		
	5845	1.987	1.980	3.0718	3.0752	6.95	6.93		6.95		

Note: 1. The results have been included cable loss.

2. Max Average Output Power (dBm) = Max of each average output power (dBm)+ Duty Cycle Factor (dB) when duty cycle is less than 98%.

3. N/A represent the duty cycle is 100%, TX_{on} and TX_{on+off} cannot be measured.

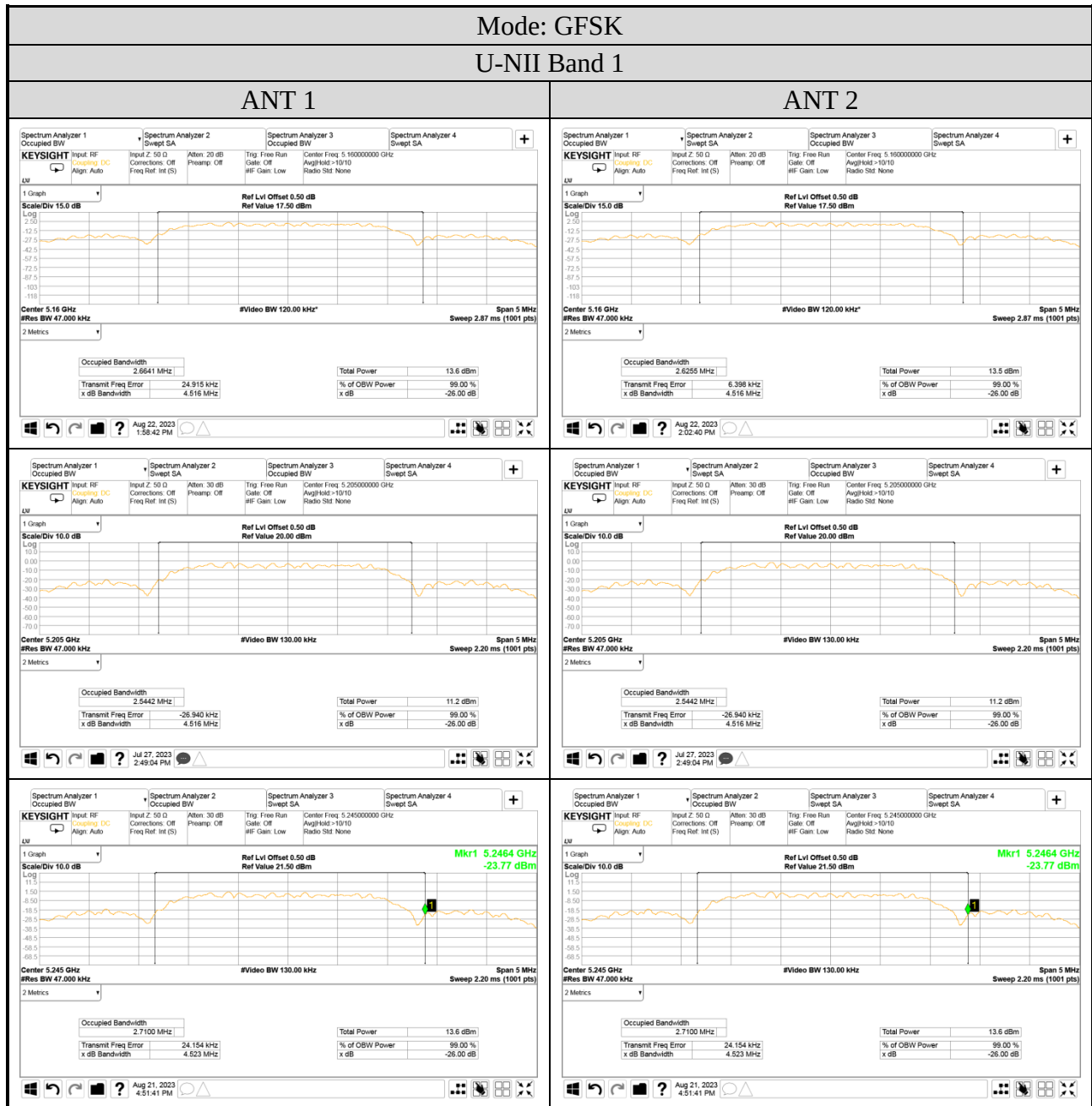
4. B is the 26 dB emission bandwidth.

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A.3.2 Measurement Plots

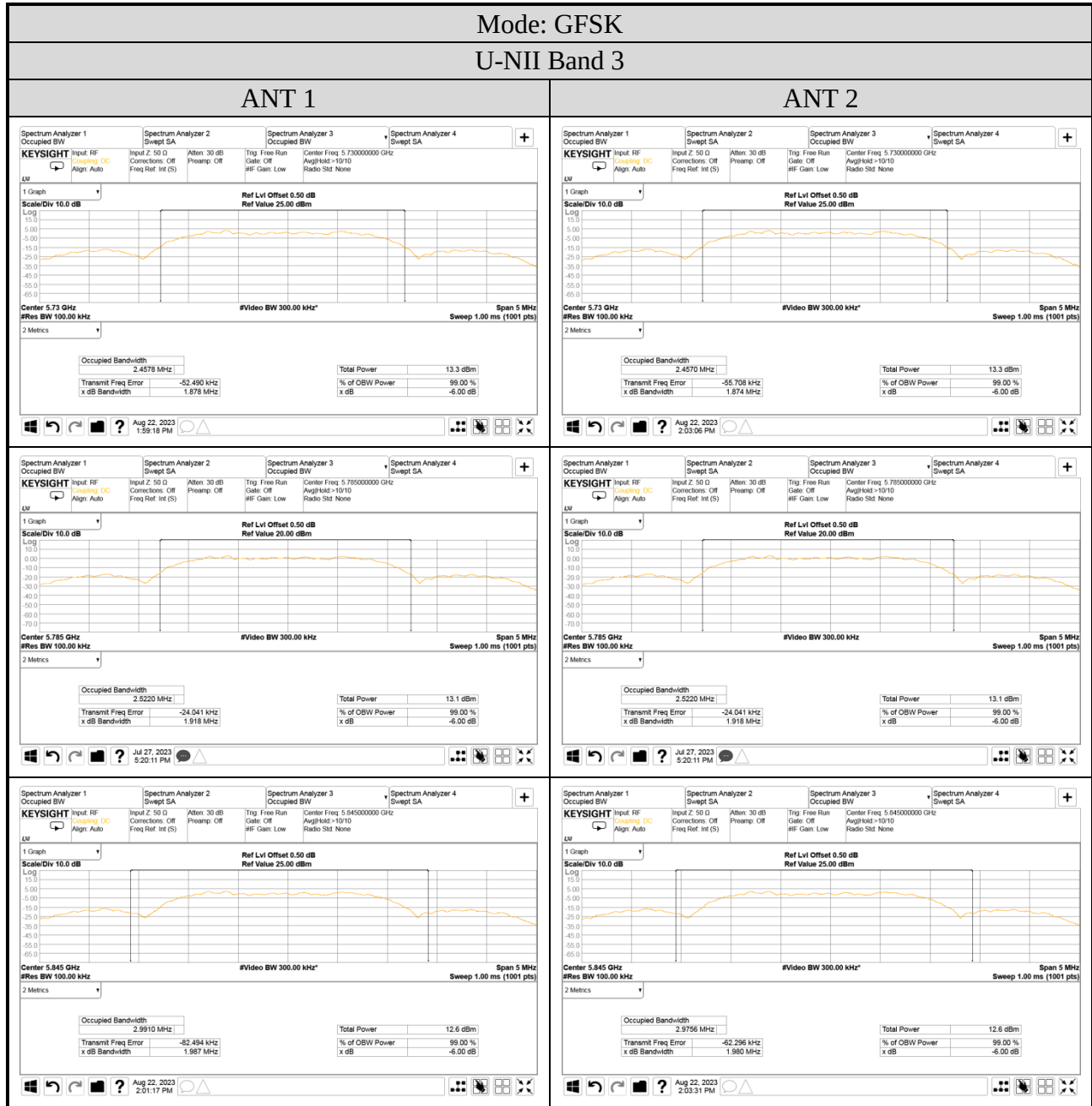
● Emission (26dB) Bandwidth



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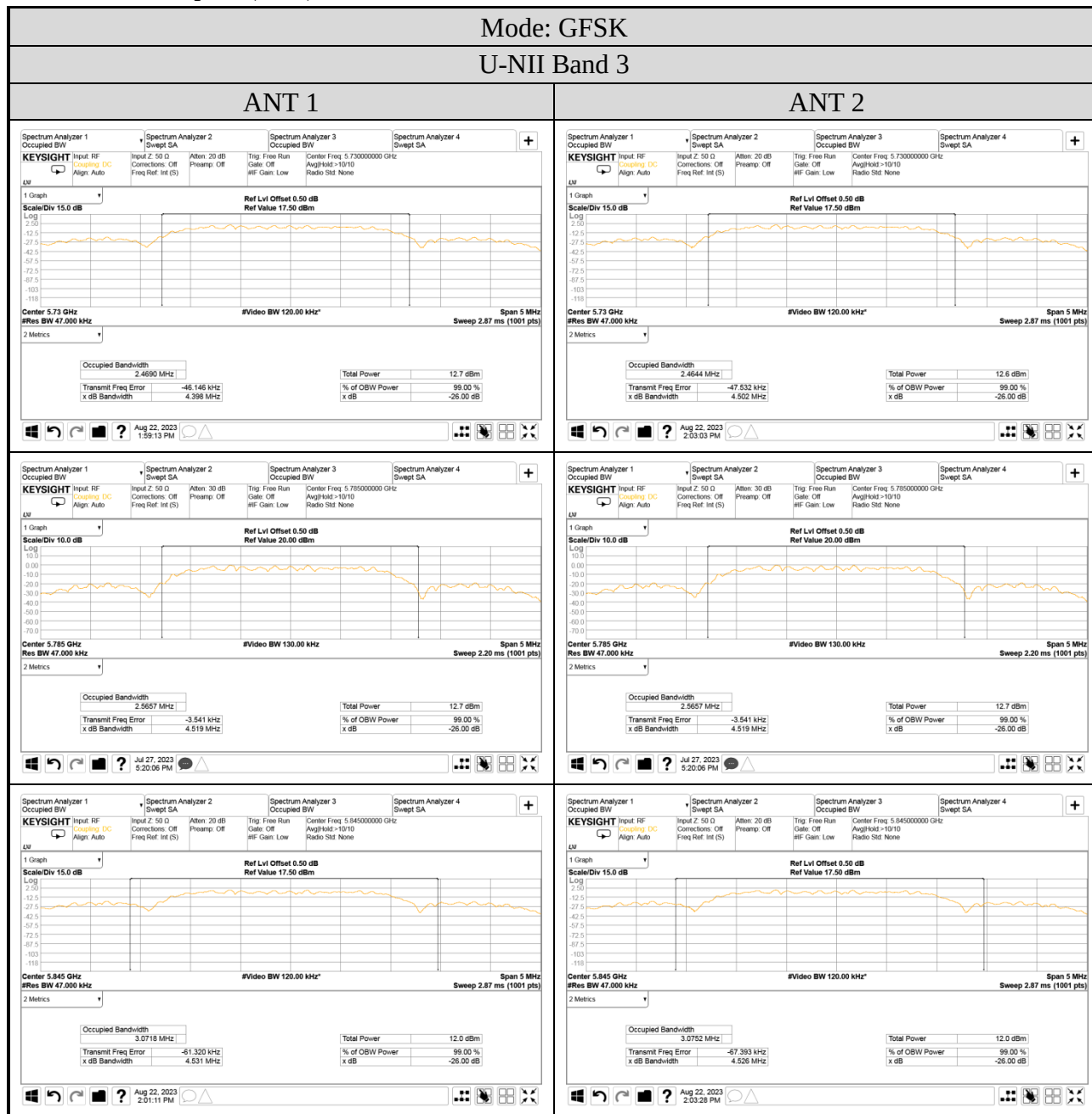
● Emission (6dB) Bandwidth



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● Occupied (99%) Bandwidth



A.4 POWER SPECTRAL DENSITY

Test Date	2023/07/27 ~ 08/22	Temp./Hum.	24-25°C/53-55%
Cable Loss	0.50dB	Tested By	Kuper Hsu
Test Voltage	DC 3.3V		

A.4.1 Power Spectral Density Result

Mode (GFSK)	Centre Frequency (MHz)	Power Spectral Density (dBm/1MHz)		Duty Cycle Factor (dB) 10log(1/X)	Max. Power Spectral Density (dBm/1MHz) Note 3	Limit
		ANT1	ANT2			
U-NII Band 1	5160	4.947	4.934	N/A	4.947	11dBm/1MHz
	5205	2.266	2.266	N/A	2.266	
	5245	2.116	4.749	N/A	4.749	
Mode (GFSK)	Centre Frequency (MHz)	Power Spectral Density (dBm/500kHz)		Duty Cycle Factor (dB) 10log(1/X)	Max. Power Spectral Density (dBm/500kHz) Note 4	Limit
		ANT1	ANT2			
U-NII Band 3	5730	2.260	2.408	N/A	2.408	30dBm/500 kHz
	5785	2.074	2.074	N/A	2.074	
	5845	1.570	1.259	N/A	1.570	

Note :1. All results have been included cable loss.

2. BWCF 7dB (100kHz converted to 500kHz) has been included in the test result.

For UNII Band 3, Ref Offset of measured plot: Cable Loss (dB) + BWCF (dB)= 0.5dB+7.5dB=8dB

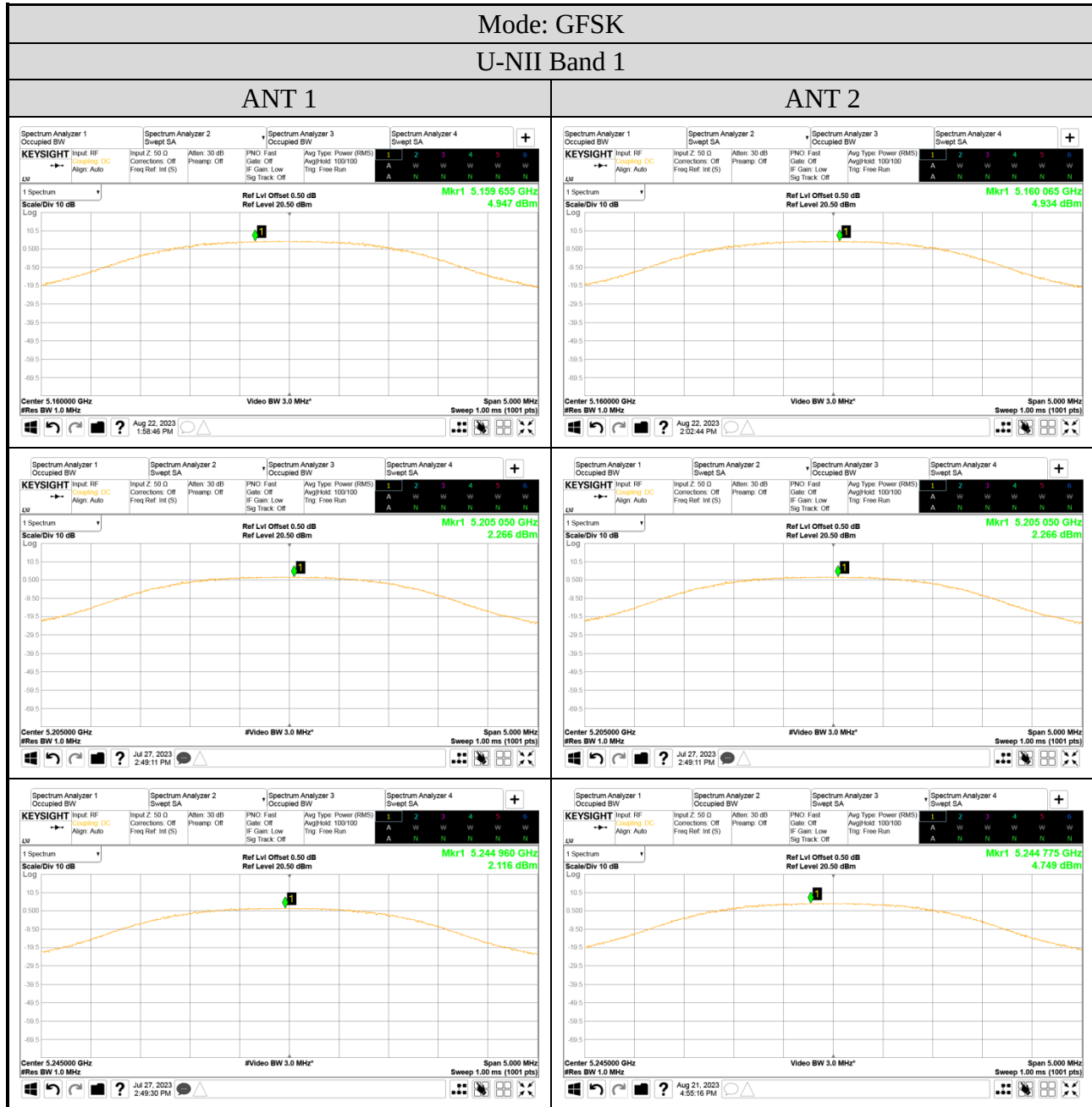
3. Max. Power Spectral Density (dBm/1MHz) = Max of each PSD (dBm1MHz) + Duty Cycle Factor(dB) when duty cycle is less than 98%.

4. Max. Power Spectral Density (dBm/500kHz) = Max of each PSD (dBm/500kHz) + Duty Cycle Factor(dB) when duty cycle is less than 98%.

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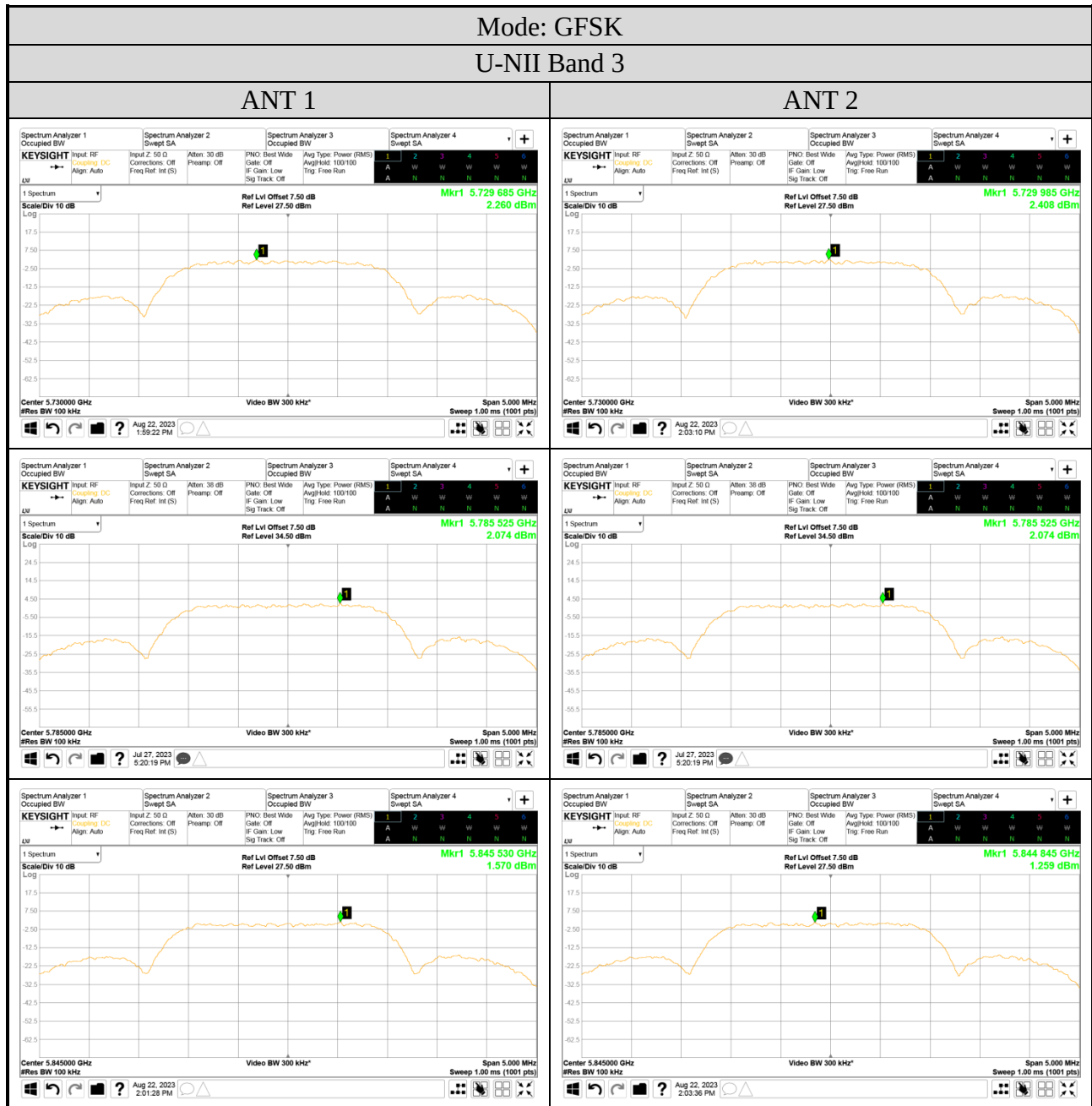
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A.4.2 Measurement Plots



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A.5 FREQUENCY STABILITY

Test Date	2023/08/21	Temp./Hum.	25°C/51%
Test Voltage	DC 3.3V	Tested By	Kuper Hsu

A.5.1 Frequency stability Result

ANT 1

Temperature (°C)	Voltage (Vdc)	Centre Frequency (MHz)	Measurement Value (MHz)	Frequency Stability (ppm)
25	3.30	5160	5159.974	-5.097
-30	3.15		5159.989	-2.190
	3.45		5160.022	4.205
-20	3.15		5160.016	3.140
	3.45		5159.987	-2.539
-10	3.15		5160.014	2.674
	3.45		5160.003	0.543
0	3.15		5159.989	-2.209
	3.45		5159.999	-0.116
10	3.15		5159.974	-5.078
	3.45		5159.981	-3.624
20	3.15		5160.001	0.116
	3.45		5159.985	-2.829
30	3.15		5160.005	1.047
	3.45		5160.029	5.659
40	3.15		5160.018	3.566
	3.45		5159.979	-4.109
50	3.15		5159.974	-5.039
	3.45		5159.983	-3.256

ANT 2

Temperature (°C)	Voltage (Vdc)	Centre Frequency (MHz)	Measurement Value (MHz)	Frequency Stability (ppm)
25	3.30	5160	5159.980	-3.876
-30	3.15		5159.9961	-0.756
	3.45		5159.9912	-1.705
-20	3.15		5160.0071	1.376
	3.45		5160.0031	0.601
-10	3.15		5160.012	2.326
	3.45		5160.0265	5.136
0	3.15		5160.0045	0.872
	3.45		5159.9947	-1.027
10	3.15		5160.0245	4.748
	3.45		5159.9922	-1.512
20	3.15		5160.0044	0.853
	3.45		5160.0083	1.609
30	3.15		5159.9886	-2.209
	3.45		5160.0165	3.198
40	3.15		5159.977	-4.535
	3.45		5160.0052	1.008
50	3.15		5160.0018	0.349
	3.45		5160.0189	3.663

Note: The extreme Voltage is declared by manufacturer.



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APPENDIX B

TEST PHOTOGRAPHS

(Model: WL2SB23)