



FCC RADIO TEST REPORT

FCC ID : S9GR770
Equipment : R770 Access Point
Brand Name : RUCKUS
Model Name : R770
Applicant : Ruckus Wireless, Inc.
350 W. Java Dr., Sunnyvale CA 94089 USA
Manufacturer : Ruckus Wireless, Inc.
350 W. Java Dr., Sunnyvale CA 94089 USA
Standard : FCC Part 15 Subpart C §15.247

The product was received on Sep. 15, 2023 and testing was performed from Sep. 21, 2023 to Oct. 12, 2023. We, Sporton International (USA) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval from Sporton International (USA) Inc., the test report shall not be reproduced except in full.

Approved by: Abi Lin

Sporton International (USA) Inc.
1175 Montague Expressway, Milpitas, CA 95035



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History of this test report

Report No.	Version	Description	Issue Date
FR230524001C	01	Initial issue of report	Nov. 08, 2023



Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.247(a)(2)	6dB Bandwidth	Pass	-
3.1	2.1049	99% Occupied Bandwidth	Reporting only	-
3.2	15.247(b)(3)	Output Power	Pass	-
3.3	15.247(e)	Power Spectral Density	Pass	-
3.4	15.247(d)	Conducted Band Edges and Spurious Emission	Pass	-
3.5	15.247(d)	Radiated Band Edges and Spurious Emission	Pass	0.14 dB under the limit at 2366.39 MHz
3.6	15.207	AC Conducted Emission	Pass	0.19 dB under the limit at 0.47 MHz
3.7	15.203 & 15.247(b)	Antenna Requirement	Pass	-

Conformity Assessment Condition:

1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. The measurement uncertainty please refer to each test result in the section "Measurement Uncertainty".

Disclaimer:

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.



1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
General Specs	Bluetooth-LE, Wi-Fi 2.4GHz 802.11b/g/n/ac/ax/be, Wi-Fi 5GHz 802.11a/n/ac/ax/be, Wi-Fi 6GHz 802.11a/n/ac/ax/be, GPS and ZigBee.
Antenna Type	WLAN: <Ant. A>: Omni-Directional Antenna <Ant. B>: Omni-Directional Antenna <Ant. C>: Omni-Directional Antenna <Ant. D>: Omni-Directional Antenna <Ant. E>: Omni-Directional Antenna <Ant. F>: Omni-Directional Antenna GPS: Omni-Directional Antenna Bluetooth / ZigBee: Omni-Directional Antenna

Antenna information		
2400 MHz ~ 2483.5 MHz	Peak Gain (dBi)	1.8

Remark: The above EUT's information is declared by manufacturer. Please refer to Disclaimer in report summary.

1.2 Modification of EUT

No modifications made to the EUT during the testing.

1.3 Testing Location

Test Site	Sporton International (USA) Inc.
Test Site Location	1175 Montague Expressway, Milpitas, CA 95035 TEL: 408 9043300
Test Site No.	Sporton Site No. CO01-CA, 03CH02-CA, TH01-CA

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC Designation No.: US1250

1.4 Applicable Standards

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

- ♦ FCC Part 15 Subpart C §15.247
- ♦ FCC KDB Publication No. 558074 D01 15.247 Meas. Guidance v05r02
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01
- ♦ ANSI C63.10-2013

Remark: All the test items were validated and recorded in accordance with the standards without any modification during the testing.



2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	11	2405	19	2445
	12	2410	20	2450
	13	2415	21	2455
	14	2420	22	2460
	15	2425	23	2465
	16	2430	24	2470
	17	2435	25	2475
	18	2440	26	2480



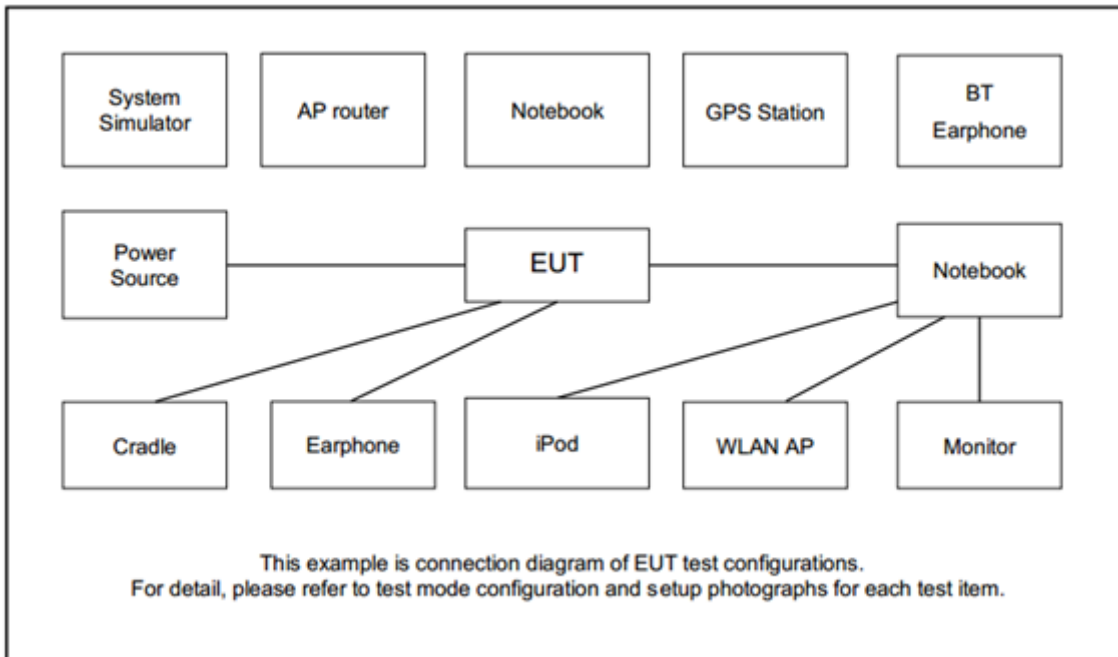
2.2 Test Mode

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, the measured emission level of the EUT was maximized by rotating the EUT on a turntable, adjusting the orientation of the EUT and EUT antenna in three orthogonal axis (X: flat, Y: portrait, Z: landscape), and adjusting the measurement antenna orientation, following C63.10 exploratory test procedures and only the worst case emissions were reported in this report..
- b. AC power line Conducted Emission was tested under maximum output power.

The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Test Cases	
Test Item	Data Rate / Modulation
Conducted Test Cases	250Kbps / GFSK
	Mode 1: ZigBee Tx CH11_2405 MHz
	Mode 2: ZigBee Tx CH17_2435 MHz
	Mode 3: ZigBee Tx CH25_2475 MHz
	Mode 4: ZigBee Tx CH26_2480 MHz
Radiated Test Cases	Mode 1: ZigBee Tx CH11_2405 MHz
	Mode 2: ZigBee Tx CH17_2435 MHz
	Mode 3: ZigBee Tx CH25_2475 MHz
	Mode 4: ZigBee Tx CH26_2480 MHz
	Mode 1: WLAN (2.4GHz) Link + WLAN (5GHz) Link + ZigBee Tx + Lan 1 + Lan 2 + PoE Adapter
AC Conducted Emission	Mode 2: WLAN (2.4GHz) Link + WLAN (5GHz) Link + ZigBee Tx + Lan 1 + Lan 2 + AC Adapter
	Mode 3: Bluetooth-LE TX + Lan 1 + Lan 2 + PoE Adapter
	Mode 4: WLAN (6GHz) TX + Lan 1 + Lan 2 + PoE Adapter
	Remark: The worst case of conducted emission is mode 4; only the test data of it was reported.

2.3 Connection Diagram of Test System



2.4 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model Name	FCC ID	Data Cable	Power Cord
1.	PoE Adapter	Ruckus	740-64214-001	NA	NA	Unshielded, 1.8m
2.	Laptop	MSI	MS-17F3	NA	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
3.	Laptop	Lenovo	TP00116F	NA	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
4.	Laptop	Dell	Latitude E7470	NA	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
5.	Adapter	Ruckus	740-64277-001	NA	NA	Unshielded, 1.0m



2.5 EUT Operation Test Setup

The RF test items, utility “PuTTY Version 0.62” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

2.6 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example :

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 4.2 dB and 10 dB attenuator.

$$\begin{aligned} \text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)}. \\ &= 4.2 + 10 = 14.2 \text{ (dB)} \end{aligned}$$

3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

3.1.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.1.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 6.9.3 (OBW) and 11.8.1 (6dB BW).
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1-5% of the emission bandwidth and set the Video bandwidth (VBW) $\geq 3 * RBW$.
6. Measure and record the results in the test report.

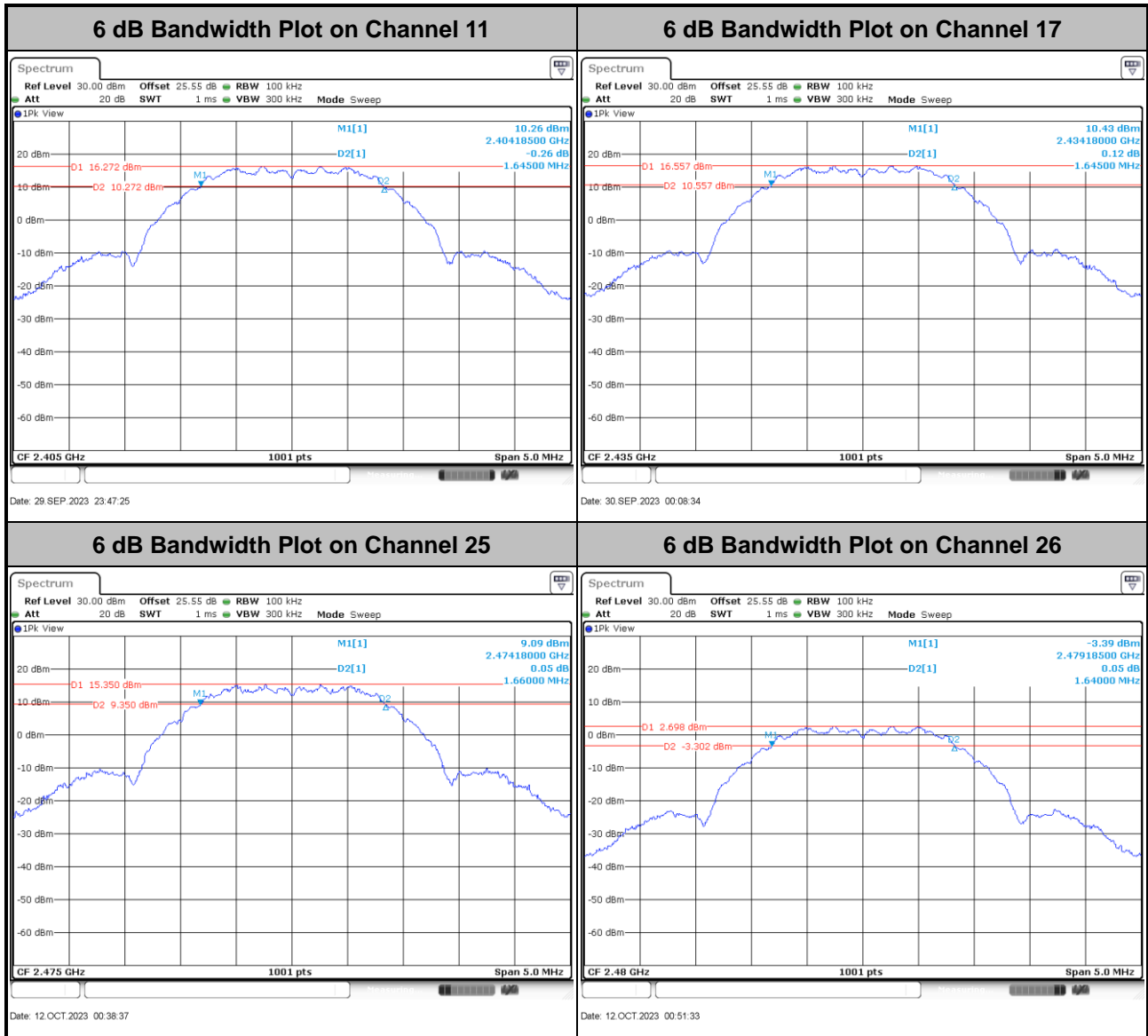
3.1.4 Test Setup





3.1.5 Test Result of 6dB Bandwidth

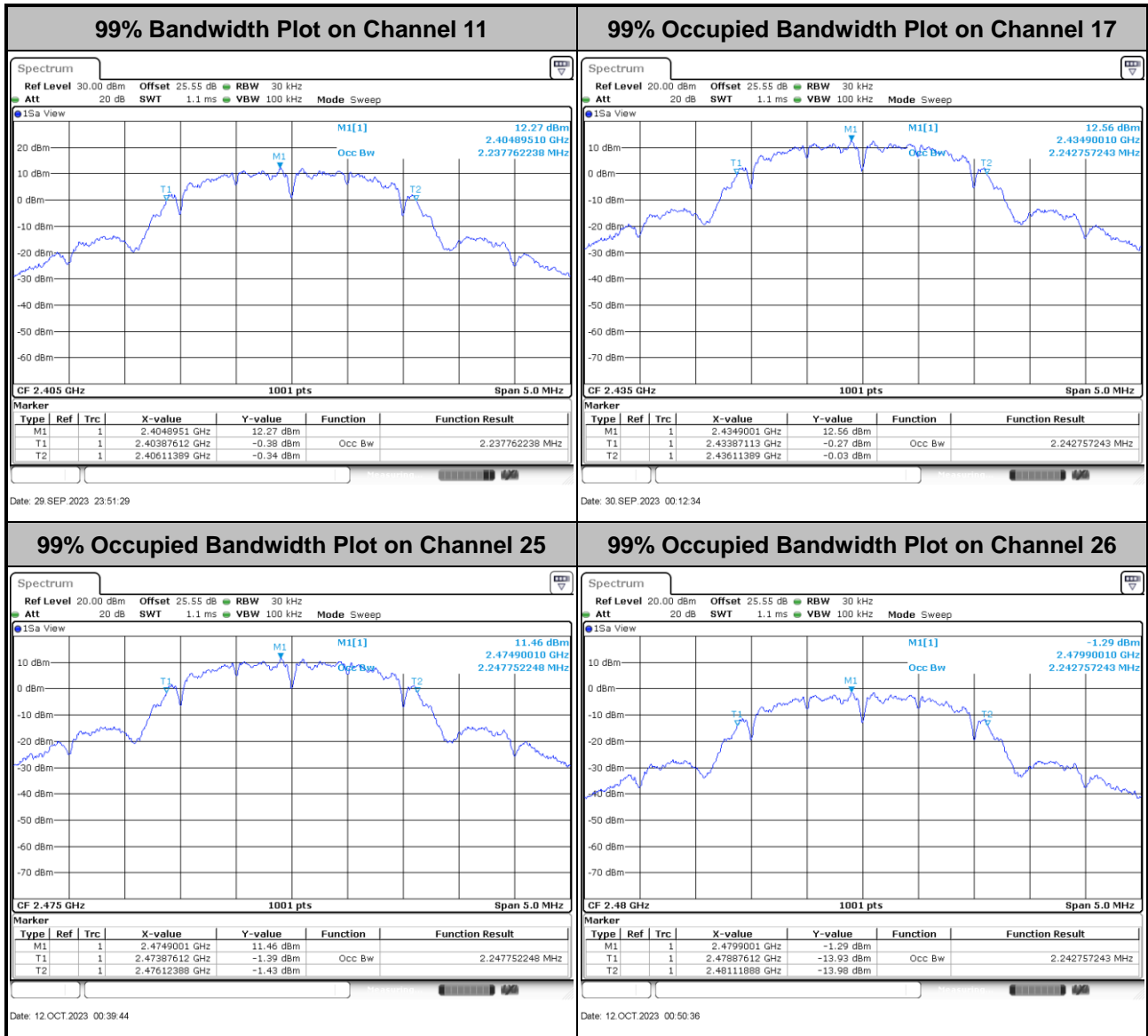
Please refer to Appendix A.





3.1.6 Test Result of 99% Occupied Bandwidth

Please refer to Appendix A.



Note: The occupied channel bandwidth is maintained within the band of operation.

3.2 Output Power Measurement

3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5 MHz, the limit for output power is 30 dBm. If transmitting antenna of directional gain greater than 6 dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

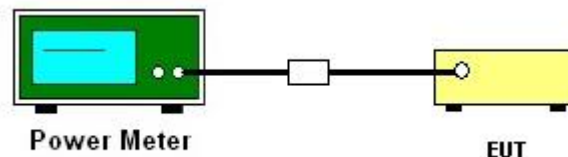
3.2.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.2.3 Test Procedures

1. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGP-M-G
2. The RF output of EUT is connected to the power meter by RF cable and attenuator.
3. The path loss is compensated to the results for each measurement.
4. Set the maximum power setting and enable the EUT to transmit continuously.
5. Measure the conducted output power and record the results in the test report.

3.2.4 Test Setup



3.2.5 Test Result of Average Output Power

Please refer to Appendix A.

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8 dBm in any 3 kHz band at any time interval of continuous transmission.

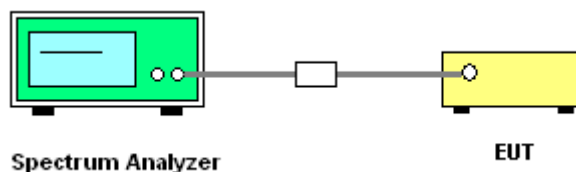
3.3.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.3.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.10.2 Method PKPSD.
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz. In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.
7. The Measured power density (dBm)/ 100 kHz is a reference level and is used as 20 dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

3.3.4 Test Setup

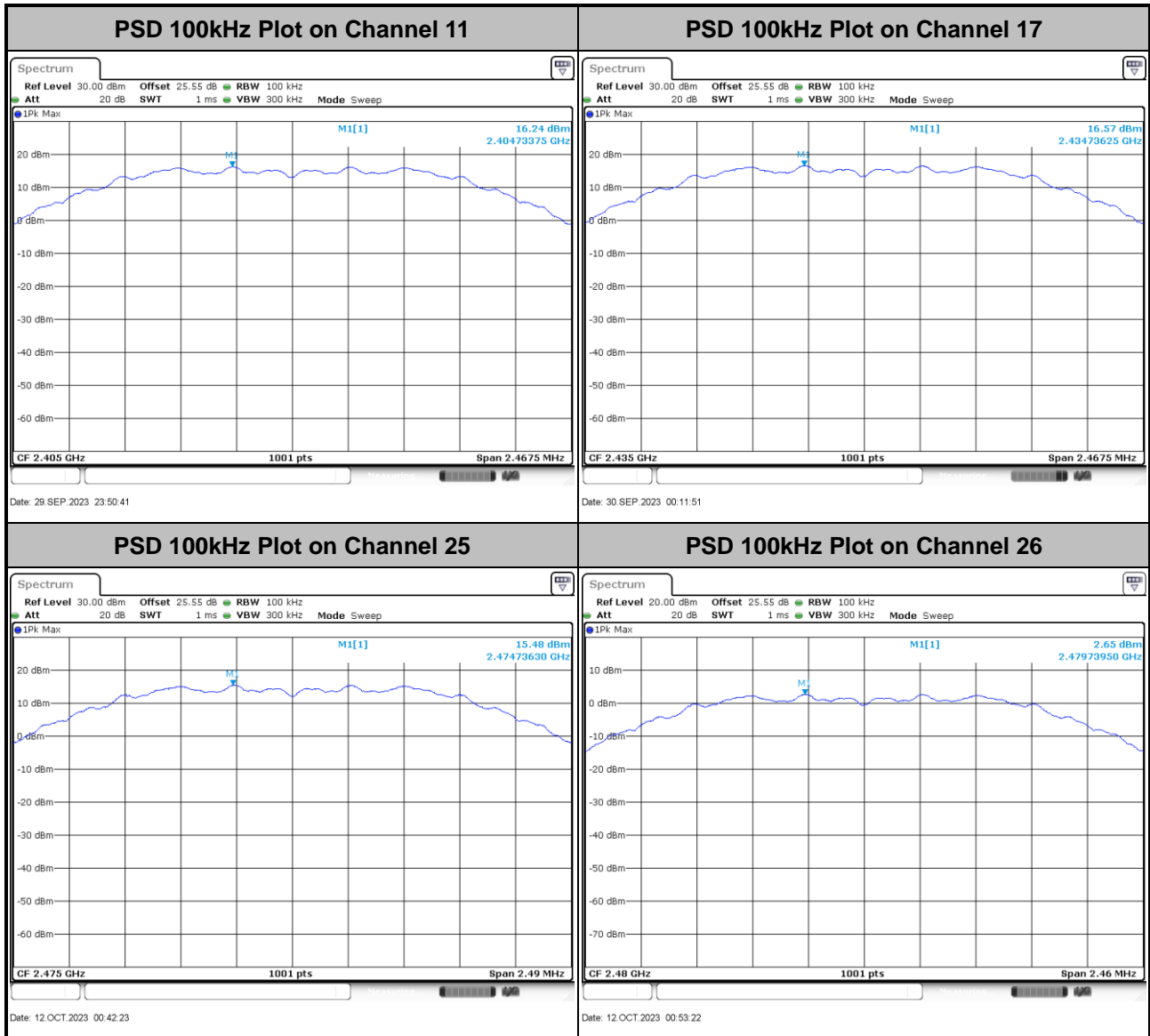


3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

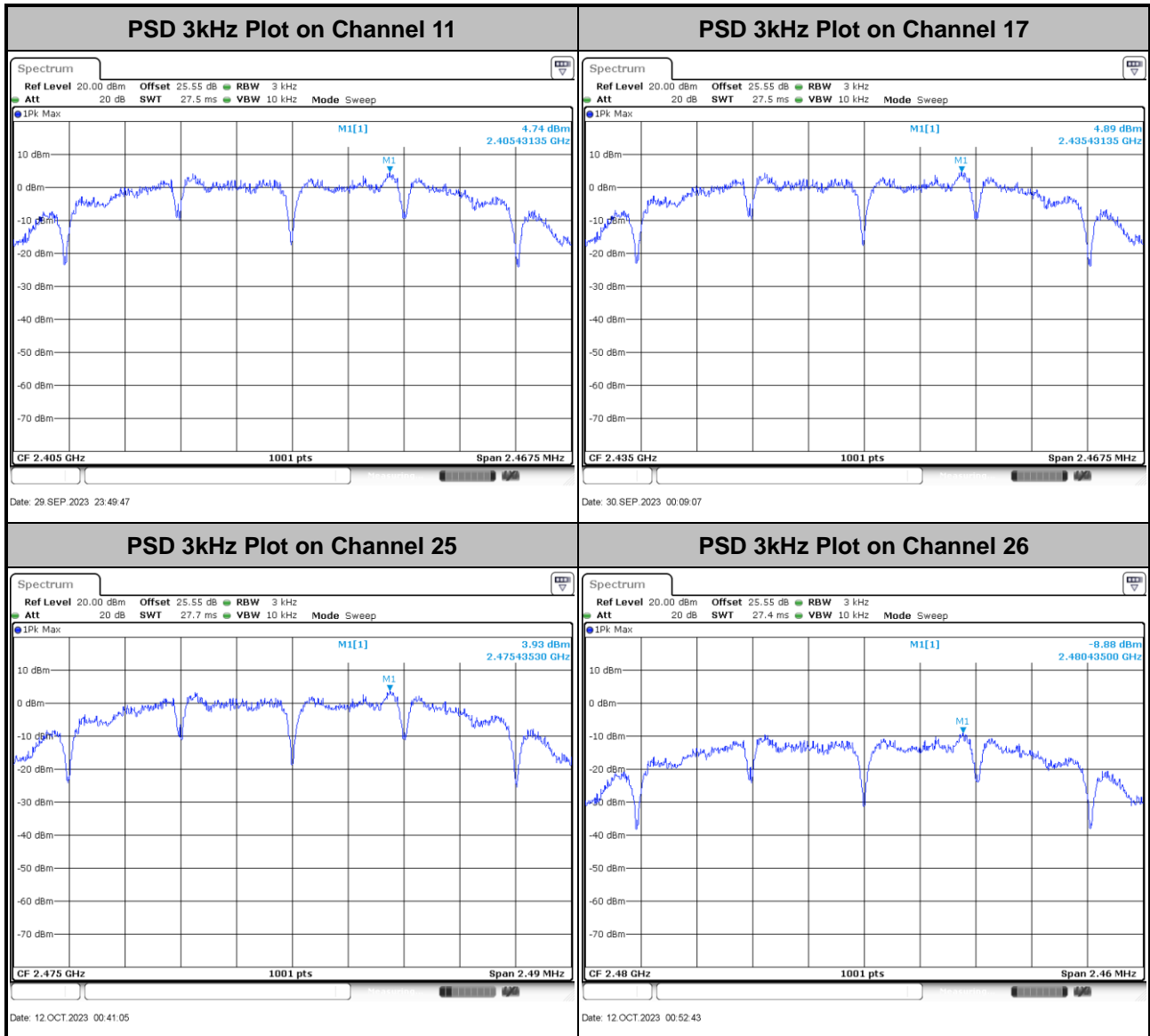


3.3.6 Test Result of Power Spectral Density Plots (100kHz)





3.3.7 Test Result of Power Spectral Density Plots (3kHz)



3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission

All harmonics/spurious must be at least 30 dB down from the highest emission level within the authorized band.

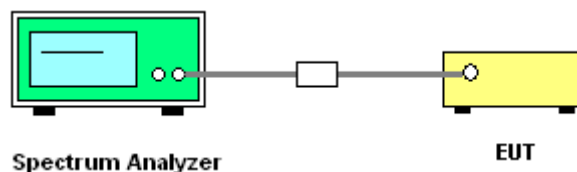
3.4.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.4.3 Test Procedure

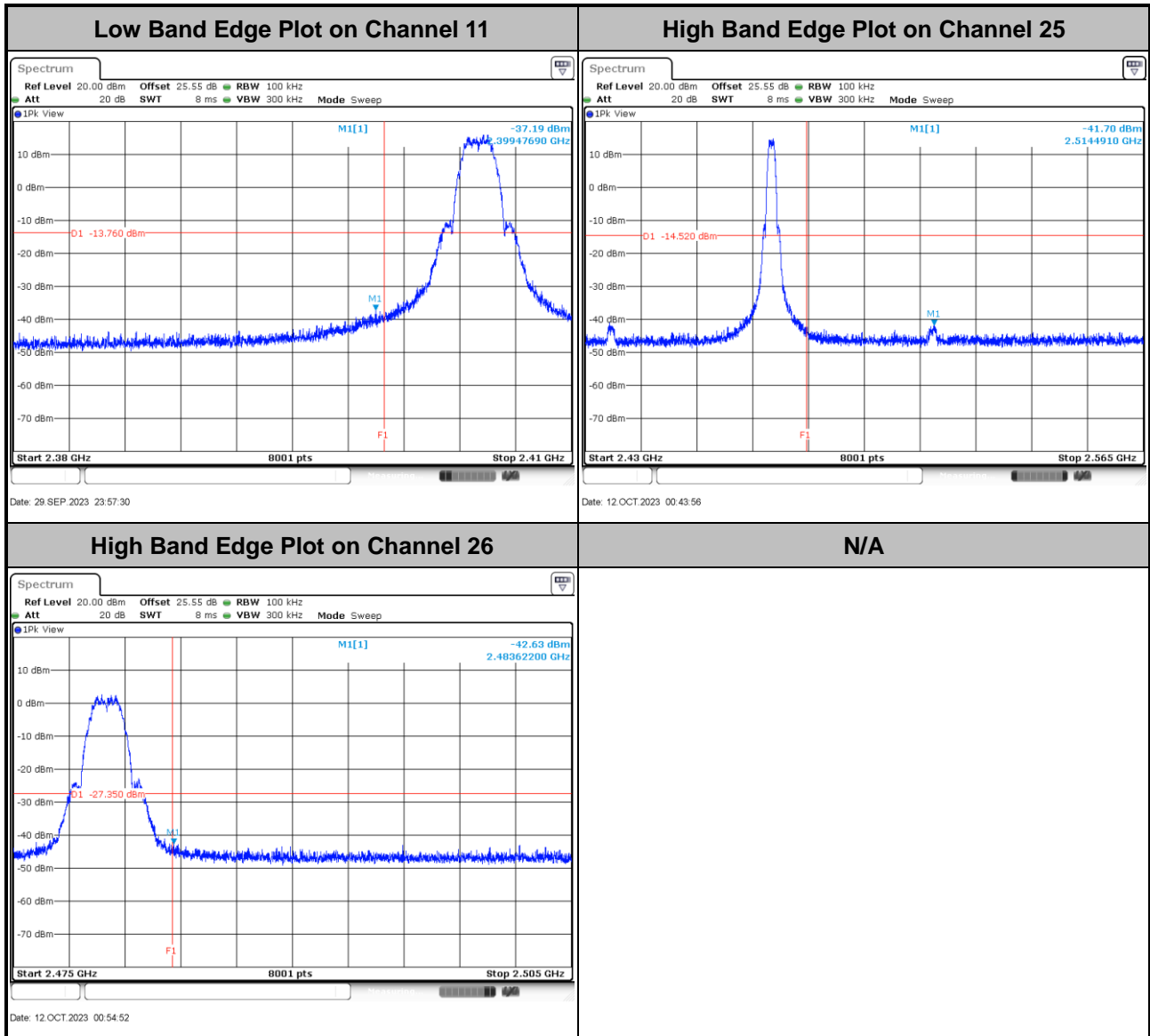
1. The testing follows the ANSI C63.10 Section 11.11.1 General and 11.11.3 Emission level measurement.
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Set RBW = 100 kHz, VBW = 300 kHz, Peak Detector. Unwanted Emissions measured 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 when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.4.4 Test Setup



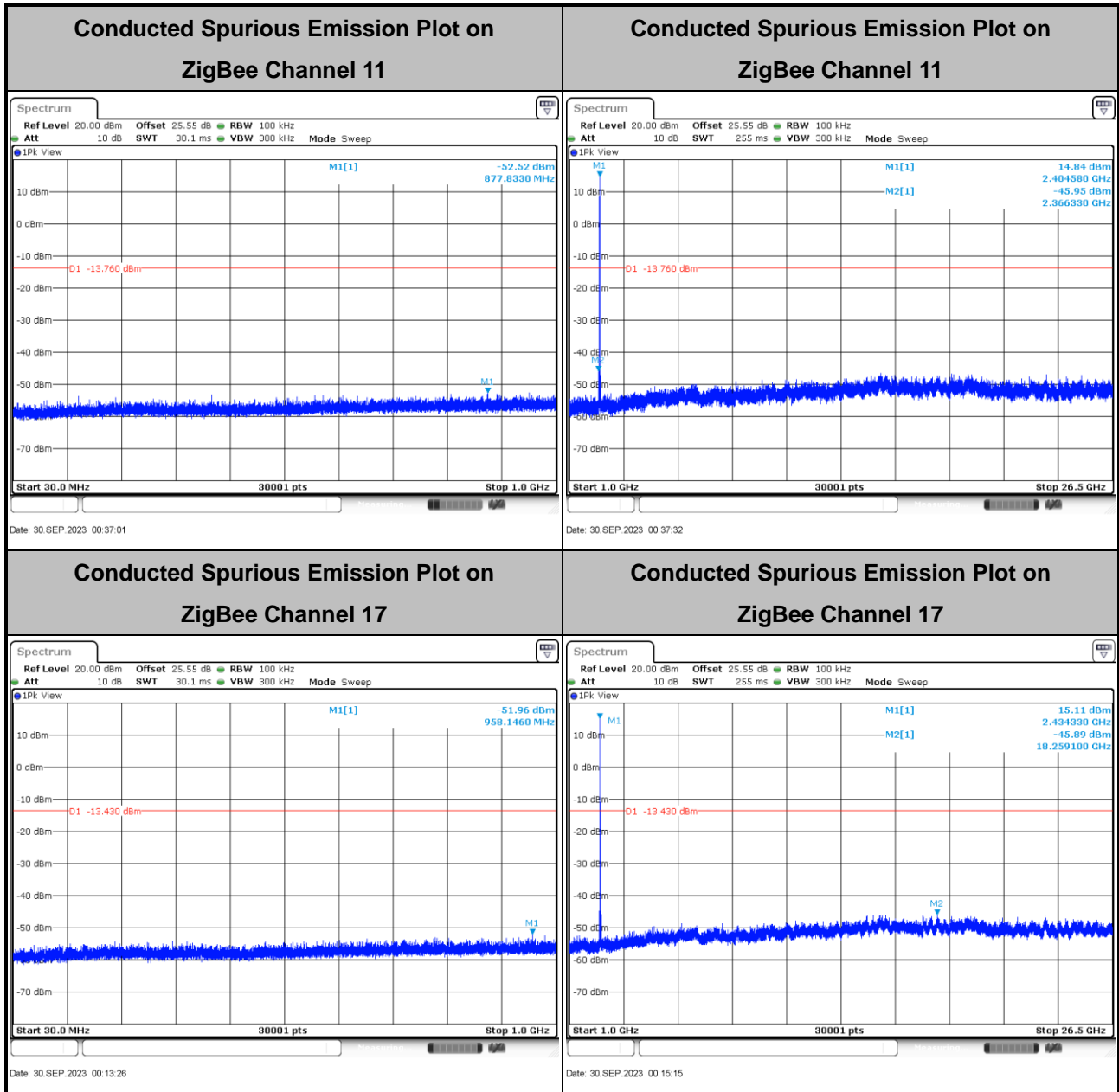


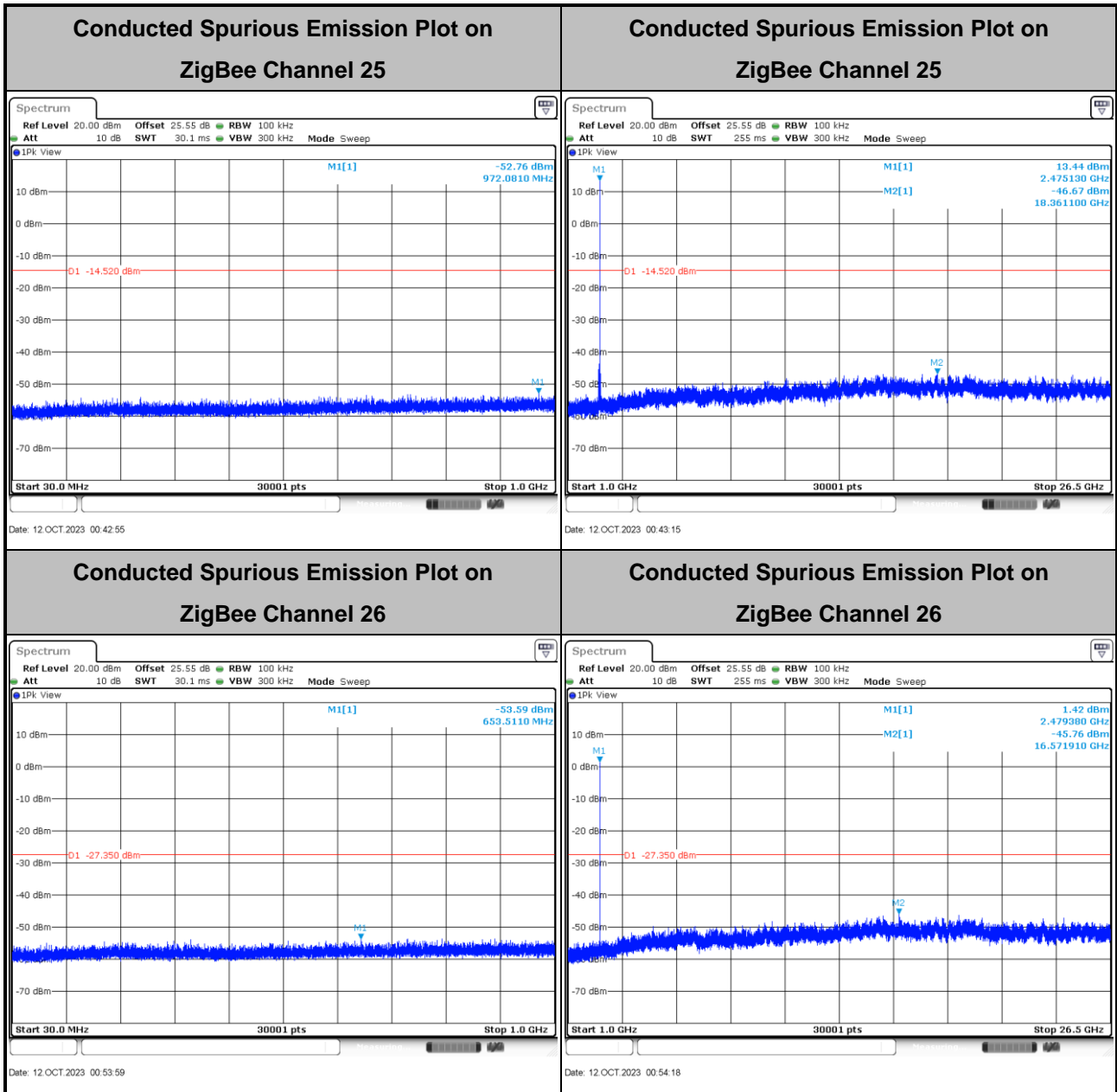
3.4.5 Test Result of Conducted Band Edges Plots





3.4.6 Test Result of Conducted Spurious Emission Plots







3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands shall comply with the general field strength limits as following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

3.5.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

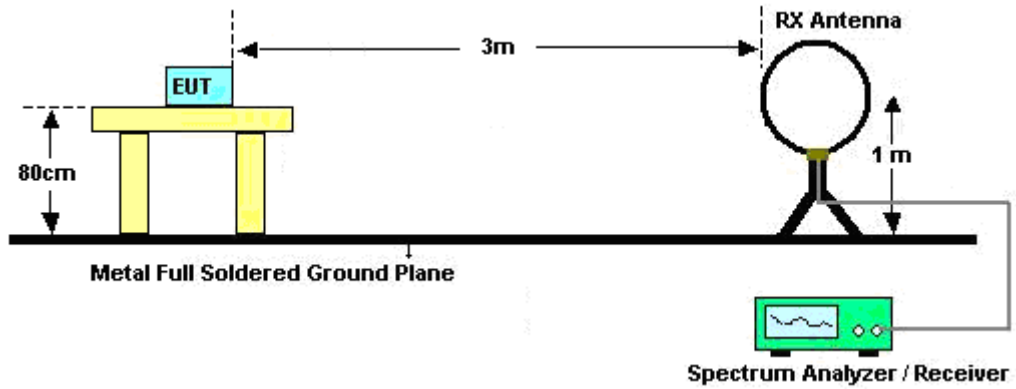


3.5.3 Test Procedures

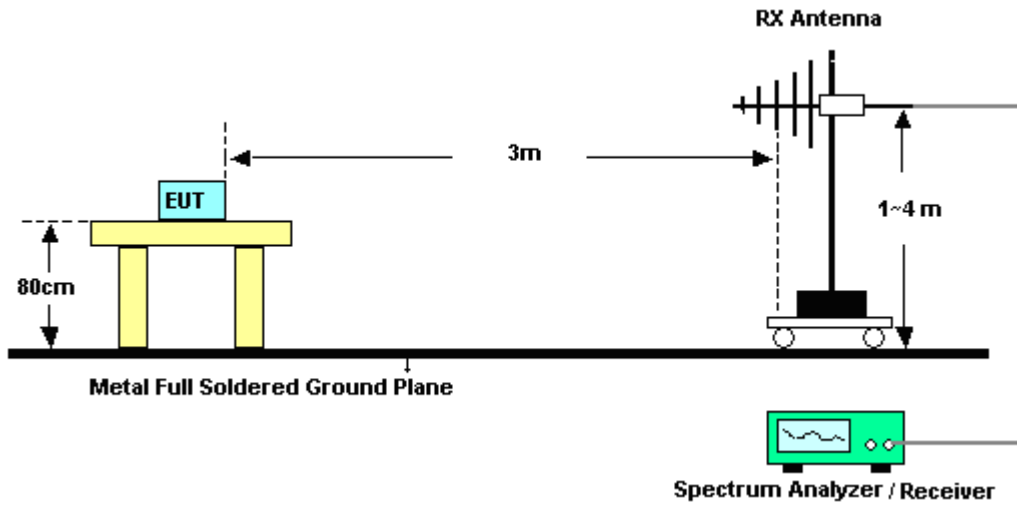
1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements.
2. The EUT is arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT is placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
4. The EUT is set 3 meters away from the receiving antenna, which is mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. Radiated testing below 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading. When there is no suspected emission found and the emission level is with at least 6 dB margin against QP limit line, the position is marked as “-“.
7. Radiated testing above 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading for scanning all frequencies. When there is no suspected emission found and the harmonic emission level is with at least 6 dB margin against average limit line, the position is marked as “-“.
8. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Set RBW = 100 kHz for $f < 1$ GHz; VBW \geq RBW; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, VBW = 3 MHz for $f \geq 1$ GHz for peak measurement.
For average measurement:
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW $\geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.5.4 Test Setup

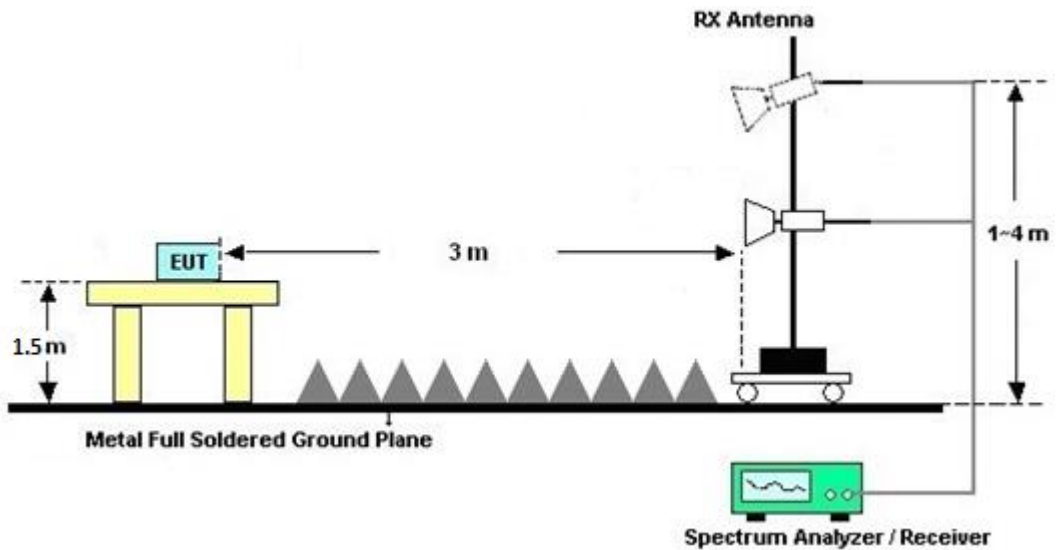
For radiated test below 30MHz



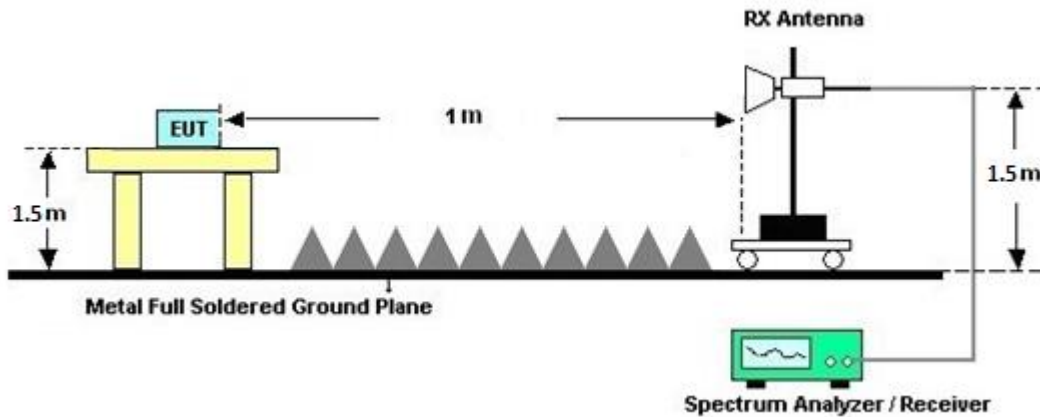
For radiated test from 30MHz to 1GHz



For radiated test from 1GHz to 18GHz



For radiated test above 18GHz



3.5.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which starts from 9 kHz to 30 MHz, is pre-scanned and the result which is 20 dB lower than the limit line is not reported.

There is adequate comparison measurement of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result comes out very similar.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C and D.

3.5.7 Duty Cycle

Please refer to Appendix E.

3.5.8 Test Result of Radiated Spurious Emission (30 MHz ~ 10th Harmonic)

Please refer to Appendix C and D.



3.6 AC Conducted Emission Measurement

3.6.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

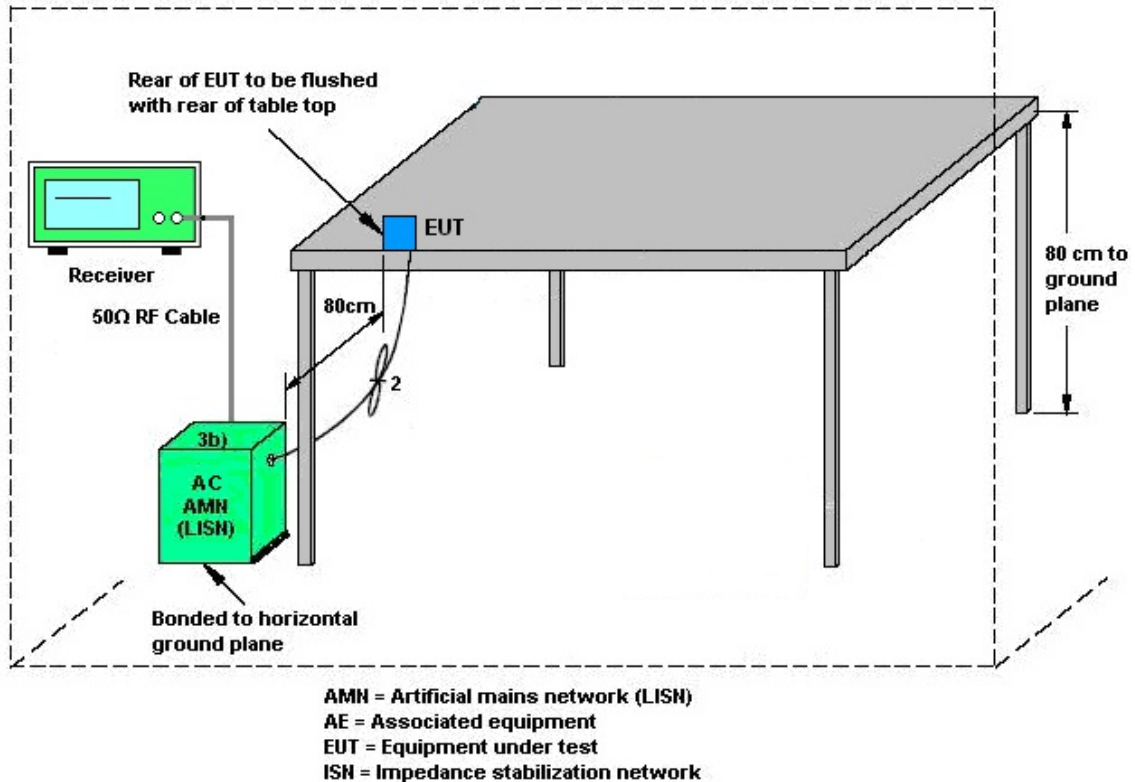
3.6.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.6.3 Test Procedures

1. The EUT is placed 0.4 meter away from the conducting wall of the shielding room, and is kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN shall be used.
6. Both Line and Neutral shall be tested in order to find out the maximum conducted emission.
7. The frequency range from 150 kHz to 30 MHz is scanned.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9 kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

3.6.4 Test Setup



3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix B.



3.7 Antenna Requirements

3.7.1 Standard Applicable

The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.



4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Loop Antenna	R&S	HFH2-Z2E	100840	9kHz~30MHz	Jun. 29, 2023	Oct. 06, 2023~ Oct. 11, 2023	Jun. 28, 2024	Radiation (03CH02-CA)
Bilog Antenna	TESEQ	6111D	50391	30MHz~1GHz	Aug. 16, 2023	Oct. 06, 2023~ Oct. 11, 2023	Aug. 15, 2024	Radiation (03CH02-CA)
Horn Antenna	SCHWARZBE CK	BBHA 9120D	02140	1GHz~18GHz	Jan. 09, 2023	Oct. 06, 2023~ Oct. 11, 2023	Jan. 08, 2024	Radiation (03CH02-CA)
Horn Antenna	SCHWARZBE CK	BBHA9170	00841	18GHz~40GHz	Aug. 22, 2023	Oct. 06, 2023~ Oct. 11, 2023	Aug. 21, 2024	Radiation (03CH02-CA)
Amplifier	SONOMA	310N	372240	N/A	May 03, 2023	Oct. 06, 2023~ Oct. 11, 2023	May 02, 2024	Radiation (03CH02-CA)
Preamplifier	Keysight	83017A	MY53270323	1GHz~26.5GHz	May 04, 2023	Oct. 06, 2023~ Oct. 11, 2023	May 03, 2024	Radiation (03CH02-CA)
Preamplifier	E-instrument	ERA-100M-18G- 56-01-A70	EC1900252	1GHz~18GHz	May 23, 2023	Oct. 06, 2023~ Oct. 11, 2023	May 22, 2024	Radiation (03CH02-CA)
Preamplifier	EMEC	EMC18G40G	060725	18GHz~40GHz	May 04, 2023	Oct. 06, 2023~ Oct. 11, 2023	May 03, 2024	Radiation (03CH02-CA)
RF Cable	HUBER+SUH NER	SUCOFLEX 102	804209/2, 802406/2, 802875/2, 802952/2	N/A	Nov. 14, 2022	Oct. 06, 2023~ Oct. 11, 2023	Nov. 13, 2023	Radiation (03CH02-CA)
Filter	Wainwright	WHKX12-2700-3 000-18000-60ST	SN10	3GHz High Pass Filter	Jun. 05, 2023	Oct. 06, 2023~ Oct. 11, 2023	Jun. 04, 2024	Radiation (03CH02-CA)
Filter	Wainwright	WLK12-1200-12 72-11000-40SS	SN2	1.2GHz Low Pass Filter	Jun. 05, 2023	Oct. 06, 2023~ Oct. 11, 2023	Jun. 04, 2024	Radiation (03CH02-CA)
Hygrometer	TESEO	608-H1	45142602	N/A	Aug. 30, 2023	Oct. 06, 2023~ Oct. 11, 2023	Aug. 29, 2024	Radiation (03CH02-CA)
Controller	ChainTek	EM-1000	060876	NA	N/A	Oct. 06, 2023~ Oct. 11, 2023	N/A	Radiation (03CH02-CA)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Oct. 06, 2023~ Oct. 11, 2023	N/A	Radiation (03CH02-CA)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Oct. 06, 2023~ Oct. 11, 2023	N/A	Radiation (03CH02-CA)
Software	Audix	E3	N/A	N/A	N/A	Oct. 06, 2023~ Oct. 11, 2023	N/A	Radiation (03CH02-CA)
LISN	TESEQ	NNB51	47415	N/A	Aug. 04, 2023	Sep. 21, 2023	Aug. 03, 2024	Conduction (CO01-CA)
EMI Test Receiver	R&S	ESR7	102177	9kHz~7GHz	May 23, 2023	Sep. 21, 2023	May 22, 2024	Conduction (CO01-CA)
Pulse limiter with 10dB attenuation	R&S	VTSD 9561-F N	9561-F- N00412	N/A	Jun. 05, 2023	Sep. 21, 2023	Jun. 04, 2024	Conduction (CO01-CA)
Test Software	R&S	EMC32 V10.30.0	N/A	N/A	N/A	Sep. 21, 2023	N/A	Conduction (CO01-CA)
Hygrometer	Testo	608-H1	45141354	N/A	Jul. 26, 2023	Sep. 29, 2023~ Oct. 12, 2023	Jul. 25, 2024	Conducted (TH01-CA)
Power Sensor	EM Electronics Corporation	RPR3006W	RPR6W-190 1027	10MHz-6GHz	May 01, 2023	Sep. 29, 2023~ Oct. 12, 2023	Apr. 30, 2024	Conducted (TH01-CA)
Spectrum Analyzer	Rohde & Schwarz	FSV40	101089	10Hz-40GHz	May 22, 2023	Sep. 29, 2023~ Oct. 12, 2023	May 21, 2024	Conducted (TH01-CA)
Switch Box & RF Cable	EM Electronics	EMSW18	1070902	N/A	Aug. 25, 2023	Sep. 29, 2023~ Oct. 12, 2023	Aug. 24, 2024	Conducted (TH01-CA)



5 Measurement Uncertainty

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.7 dB
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Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	4.5 dB
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Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	4.9 dB
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Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.2 dB
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Appendix A. Test Result of Conducted Test Items

Test Engineer:	Venkata Kondepudi	Temperature:	21.2~24.1	°C
Test Date:	2023/09/29~2023/10/12	Relative Humidity:	50.00~59.1	%

TEST RESULTS DATA **6dB and 99% Occupied Bandwidth**

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
Zigbee	250K	1	11	2405	2.238	1.645	0.50	Pass
Zigbee	250K	1	17	2435	2.243	1.645	0.50	Pass
Zigbee	250K	1	25	2475	2.248	1.660	0.50	Pass
Zigbee	250K	1	26	2480	2.243	1.640	0.50	Pass

TEST RESULTS DATA **Average Power Table**

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
Zigbee	250K	1	11	2405	19.90	30.00	1.80	21.70	36.00	Pass
Zigbee	250K	1	17	2435	20.03	30.00	1.80	21.83	36.00	Pass
Zigbee	250K	1	25	2475	19.01	30.00	1.80	20.81	36.00	Pass
Zigbee	250K	1	26	2480	6.17	30.00	1.80	7.97	36.00	Pass

TEST RESULTS DATA **Peak Power Density**

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
Zigbee	250K	1	11	2405	16.24	4.74	1.80	8.00	Pass
Zigbee	250K	1	17	2435	16.57	4.89	1.80	8.00	Pass
Zigbee	250K	1	25	2475	15.48	3.93	1.80	8.00	Pass
Zigbee	250K	1	26	2480	2.65	-8.88	1.80	8.00	Pass

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 30dBc limit.



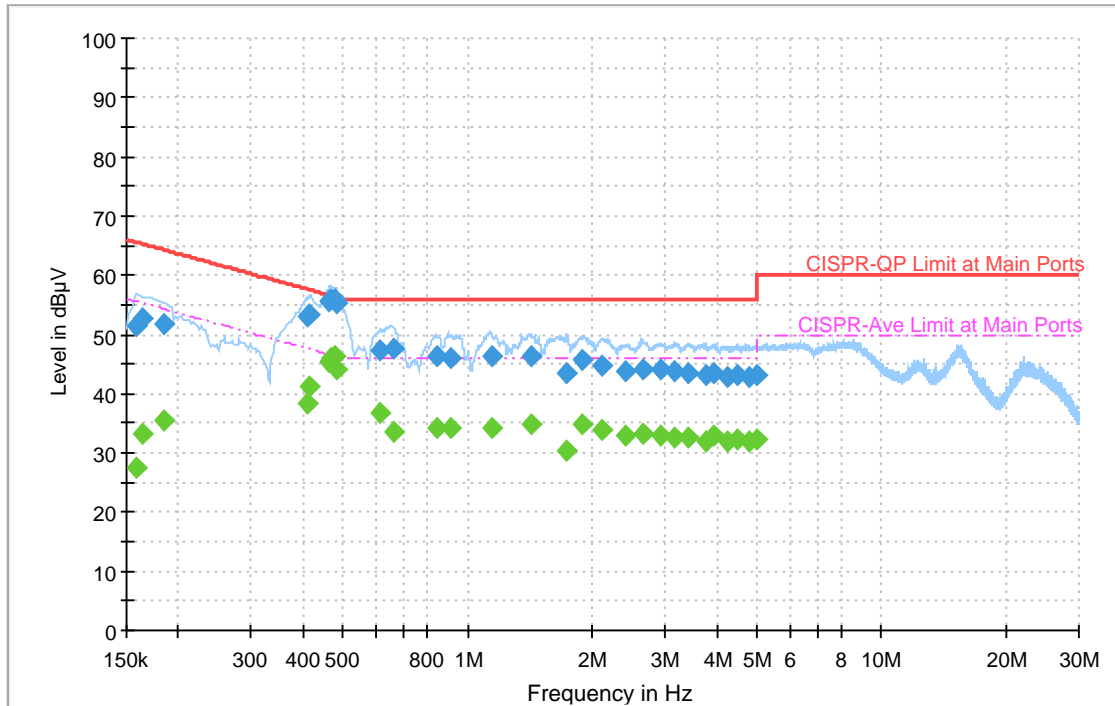
Appendix B. AC Conducted Emission Test Results

Test Engineer :	Fu Chen	Temperature :	20.1~24.2°C
		Relative Humidity :	41.2~48.5%

EUT Information

Site: CO01-CA
 Power: 120Vac/60Hz
 Project: 230524001
 Line

Full Spectrum



Final Result

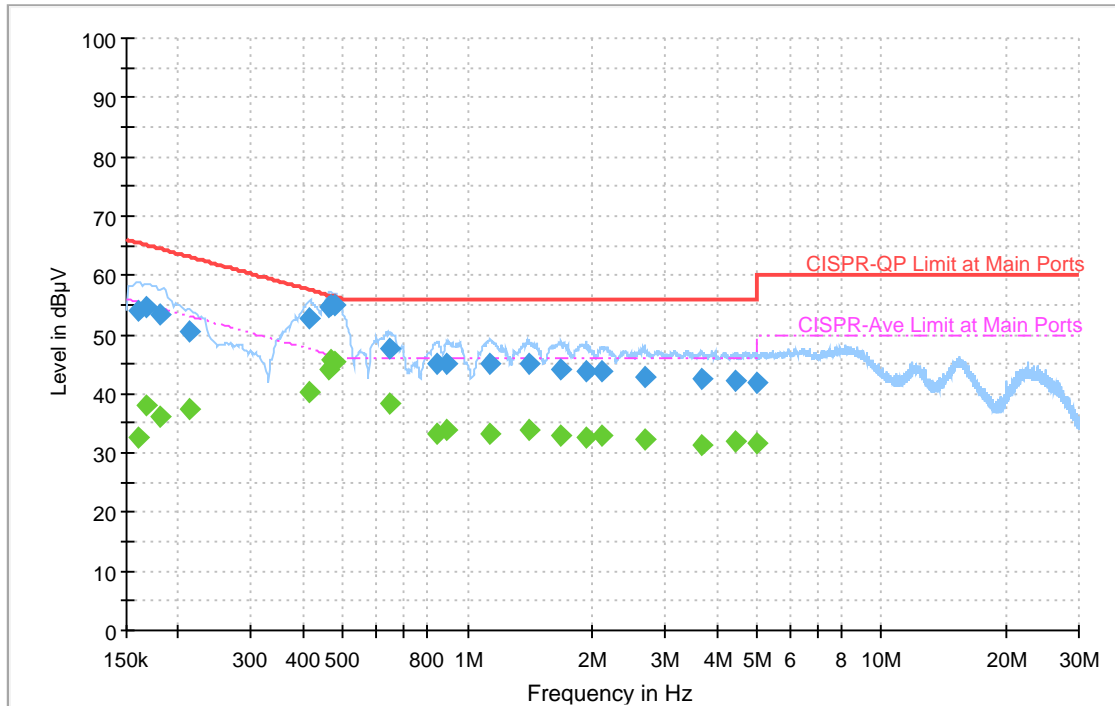
Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.158748	---	27.35	55.53	28.18	L1	OFF	20.2
0.158748	51.48	---	65.53	14.05	L1	OFF	20.2
0.163293	---	33.31	55.30	21.98	L1	OFF	20.2
0.163293	52.70	---	65.30	12.59	L1	OFF	20.2
0.183759	---	35.61	54.31	18.70	L1	OFF	20.3
0.183759	51.73	---	64.31	12.58	L1	OFF	20.3
0.407994	---	38.24	47.69	9.45	L1	OFF	20.3
0.407994	52.89	---	57.69	4.80	L1	OFF	20.3
0.414303	53.41	---	57.56	4.15	L1	OFF	20.3
0.414303	---	41.14	47.56	6.42	L1	OFF	20.3
0.463839	---	45.35	46.62	1.27	L1	OFF	20.3
0.463839	55.63	---	56.62	0.99	L1	OFF	20.3
0.466485	---	46.14	46.58	0.44	L1	OFF	20.3
0.466485	55.86	---	56.58	0.72	L1	OFF	20.3
0.474963	55.85	---	56.43	0.58	L1	OFF	20.3
0.474963	---	46.24	46.43	0.19	L1	OFF	20.3
0.480291	55.32	---	56.33	1.01	L1	OFF	20.3
0.480291	---	44.10	46.33	2.23	L1	OFF	20.3
0.611034	---	36.85	46.00	9.15	L1	OFF	20.3
0.611034	47.36	---	56.00	8.64	L1	OFF	20.3
0.664071	---	33.61	46.00	12.39	L1	OFF	20.3

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.664071	47.57	---	56.00	8.43	L1	OFF	20.3
0.845565	---	34.03	46.00	11.97	L1	OFF	20.3
0.845565	46.35	---	56.00	9.65	L1	OFF	20.3
0.914496	---	34.33	46.00	11.67	L1	OFF	20.3
0.914496	46.01	---	56.00	9.99	L1	OFF	20.3
1.141431	---	34.31	46.00	11.69	L1	OFF	20.3
1.141431	46.27	---	56.00	9.73	L1	OFF	20.3
1.416948	---	34.98	46.00	11.02	L1	OFF	20.3
1.416948	46.23	---	56.00	9.77	L1	OFF	20.3
1.738113	---	30.24	46.00	15.76	L1	OFF	20.3
1.738113	43.45	---	56.00	12.55	L1	OFF	20.3
1.895289	---	34.76	46.00	11.24	L1	OFF	20.3
1.895289	45.64	---	56.00	10.36	L1	OFF	20.3
2.116176	---	33.89	46.00	12.11	L1	OFF	20.3
2.116176	44.85	---	56.00	11.15	L1	OFF	20.3
2.398695	---	33.00	46.00	13.00	L1	OFF	20.3
2.398695	43.85	---	56.00	12.15	L1	OFF	20.3
2.642910	---	33.25	46.00	12.75	L1	OFF	20.4
2.642910	44.04	---	56.00	11.96	L1	OFF	20.4
2.935662	---	32.91	46.00	13.09	L1	OFF	20.4
2.935662	43.99	---	56.00	12.01	L1	OFF	20.4
3.174036	---	32.65	46.00	13.35	L1	OFF	20.4
3.174036	43.66	---	56.00	12.34	L1	OFF	20.4
3.423723	---	32.60	46.00	13.40	L1	OFF	20.4
3.423723	43.60	---	56.00	12.40	L1	OFF	20.4
3.749307	---	31.83	46.00	14.17	L1	OFF	20.4
3.749307	43.24	---	56.00	12.76	L1	OFF	20.4
3.922881	---	32.86	46.00	13.14	L1	OFF	20.4
3.922881	43.36	---	56.00	12.64	L1	OFF	20.4
4.256898	---	31.93	46.00	14.07	L1	OFF	20.4
4.256898	42.90	---	56.00	13.10	L1	OFF	20.4
4.460559	---	32.28	46.00	13.72	L1	OFF	20.4
4.460559	43.13	---	56.00	12.87	L1	OFF	20.4
4.762149	---	32.02	46.00	13.98	L1	OFF	20.4
4.762149	42.77	---	56.00	13.23	L1	OFF	20.4
4.977060	---	32.27	46.00	13.73	L1	OFF	20.4
4.977060	43.05	---	56.00	12.95	L1	OFF	20.4

EUT Information

Site: CO01-CA
 Power: 120Vac/60Hz
 Project: 230524001
 Neutral

Full Spectrum



Final Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.160170	---	32.74	55.46	22.72	N	OFF	20.2
0.160170	54.01	---	65.46	11.45	N	OFF	20.2
0.166578	---	38.04	55.13	17.09	N	OFF	20.2
0.166578	54.70	---	65.13	10.43	N	OFF	20.2
0.180267	---	36.00	54.47	18.47	N	OFF	20.2
0.180267	53.29	---	64.47	11.18	N	OFF	20.2
0.212055	---	37.30	53.12	15.82	N	OFF	20.2
0.212055	50.49	---	63.12	12.63	N	OFF	20.2
0.414708	---	40.13	47.55	7.42	N	OFF	20.2
0.414708	52.80	---	57.55	4.75	N	OFF	20.2
0.462093	---	44.06	46.66	2.59	N	OFF	20.2
0.462093	54.66	---	56.66	1.99	N	OFF	20.2
0.465405	---	45.58	46.60	1.02	N	OFF	20.2
0.465405	54.87	---	56.60	1.73	N	OFF	20.2
0.474981	---	45.41	46.43	1.02	N	OFF	20.2
0.474981	54.83	---	56.43	1.60	N	OFF	20.2
0.647412	---	38.35	46.00	7.65	N	OFF	20.2
0.647412	47.71	---	56.00	8.29	N	OFF	20.2
0.845673	---	33.19	46.00	12.81	N	OFF	20.3
0.845673	45.12	---	56.00	10.88	N	OFF	20.3
0.892680	---	33.81	46.00	12.19	N	OFF	20.3

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.892680	45.05	---	56.00	10.95	N	OFF	20.3
1.136499	---	33.31	46.00	12.69	N	OFF	20.3
1.136499	45.15	---	56.00	10.85	N	OFF	20.3
1.409514	---	33.88	46.00	12.12	N	OFF	20.3
1.409514	44.95	---	56.00	11.05	N	OFF	20.3
1.682691	---	33.06	46.00	12.94	N	OFF	20.3
1.682691	44.17	---	56.00	11.83	N	OFF	20.3
1.939407	---	32.52	46.00	13.48	N	OFF	20.3
1.939407	43.64	---	56.00	12.36	N	OFF	20.3
2.110866	---	32.87	46.00	13.13	N	OFF	20.3
2.110866	43.86	---	56.00	12.14	N	OFF	20.3
2.684769	---	32.18	46.00	13.82	N	OFF	20.3
2.684769	42.97	---	56.00	13.03	N	OFF	20.3
3.689403	---	31.42	46.00	14.58	N	OFF	20.4
3.689403	42.40	---	56.00	13.60	N	OFF	20.4
4.428294	---	31.86	46.00	14.14	N	OFF	20.4
4.428294	42.08	---	56.00	13.92	N	OFF	20.4
4.973892	---	31.50	46.00	14.50	N	OFF	20.4
4.973892	41.76	---	56.00	14.24	N	OFF	20.4



Appendix C. Radiated Spurious Emission

Test Engineer :	Fu Chen, Yuan Lee and Think Hoang	Temperature :	20.1~24.2°C
		Relative Humidity :	42.1~52.1%

2.4GHz 2400~2483.5MHz

ZigBee (Band Edge @ 3m)

ZigBee	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
ZigBee CH 11 2405MHz		2366.595	61.2	-12.8	74	47.5	27.22	17.92	31.44	100	233	P	H
		2366.385	53.86	-0.14	54	40.16	27.22	17.92	31.44	100	233	A	H
	*	2405	118.27	-	-	104.36	27.31	17.99	31.39	100	233	P	H
		2444	60.75	-	-	46.45	27.58	18.05	31.33	100	233	P	H
	*	2405	115.21	-	-	101.3	27.31	17.99	31.39	100	233	A	H
		2444	52.97	-	-	38.67	27.58	18.05	31.33	100	233	A	H
		2366.175	57.52	-16.48	74	43.82	27.22	17.92	31.44	246	0	P	V
		2366.385	48.74	-5.26	54	35.04	27.22	17.92	31.44	246	0	A	V
	*	2405	111.33	-	-	97.42	27.31	17.99	31.39	246	0	P	V
		2444	57.25	-	-	42.95	27.58	18.05	31.33	246	0	P	V
	*	2405	108.19	-	-	94.28	27.31	17.99	31.39	246	0	A	V
		2444	47.54	-	-	33.24	27.58	18.05	31.33	246	0	A	V



ZigBee	Note	Frequency (MHz)	Level (dBµV/m)	Margin (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
ZigBee CH 17 2435MHz		2378.32	55.55	-18.45	74	41.75	27.28	17.94	31.42	200	233	P	H
		2357.36	44.82	-9.18	54	31.21	27.17	17.91	31.47	200	233	A	H
		2396	62.75	-26.41	89.16	48.89	27.29	17.97	31.4	200	233	P	H
	*	2435	119.16	-	-	104.95	27.52	18.04	31.35	200	233	P	H
		2474	62.24	-	-	47.59	27.83	18.12	31.3	200	233	P	H
		2396	56.17	-	-	42.31	27.29	17.97	31.4	200	233	A	H
	*	2435	117.37	-	-	103.16	27.52	18.04	31.35	200	233	A	H
		2474	55.04	-	-	40.39	27.83	18.12	31.3	200	233	A	H
		2484.64	56.8	-17.2	74	42.09	27.88	18.13	31.3	200	233	P	H
		2499.84	45.41	-8.59	54	30.49	28.02	18.16	31.26	200	233	A	H
		2357.04	55.95	-18.05	74	42.36	27.17	17.89	31.47	300	236	P	V
		2389.36	44.1	-9.9	54	30.26	27.29	17.96	31.41	300	236	A	V
		2396	58.23	-30.93	89.16	44.37	27.29	17.97	31.4	300	236	P	V
	*	2435	112.66	-	-	98.45	27.52	18.04	31.35	300	236	P	V
		2474	58.48	-	-	43.83	27.83	18.12	31.3	300	236	P	V
		2396	50.87	-	-	37.01	27.29	17.97	31.4	300	236	A	V
	*	2435	110.89	-	-	96.68	27.52	18.04	31.35	300	236	A	V
		2474	50.91	-	-	36.26	27.83	18.12	31.3	300	236	A	V
		2493.2	55.49	-18.51	74	40.67	27.95	18.15	31.28	300	236	P	V
		2499.76	45.13	-8.87	54	30.21	28.02	18.16	31.26	300	236	A	V



ZigBee	Note	Frequency (MHz)	Level (dBµV/m)	Margin (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
ZigBee CH 25 2475MHz		2436	62.31	-	-	48.09	27.52	18.04	31.34	250	231	P	H
	*	2475	118.3	-	-	103.65	27.83	18.12	31.3	250	231	P	H
		2514	61.2	-27.1	88.3	46.16	28.1	18.18	31.24	250	231	P	H
		2436	56.98	-	-	42.76	27.52	18.04	31.34	250	231	A	H
	*	2475	116.54	-	-	101.89	27.83	18.12	31.3	250	231	A	H
		2514	55	-	-	39.96	28.1	18.18	31.24	250	231	A	H
		2483.56	63.93	-10.07	74	49.23	27.87	18.13	31.3	250	231	P	H
		2483.52	53.48	-0.52	54	38.78	27.87	18.13	31.3	250	231	A	H
		2436	58.44	-	-	44.22	27.52	18.04	31.34	300	247	P	V
	*	2475	111.14	-	-	96.49	27.83	18.12	31.3	300	247	P	V
		2514	58.45	-29.85	88.3	43.41	28.1	18.18	31.24	300	247	P	V
		2436	51.54	-	-	37.32	27.52	18.04	31.34	300	247	A	V
	*	2475	109.28	-	-	94.63	27.83	18.12	31.3	300	247	A	V
		2514	51.21	-	-	36.17	28.1	18.18	31.24	300	247	A	V
		2483.68	58.14	-15.86	74	43.44	27.87	18.13	31.3	300	247	P	V
	2483.52	48.39	-5.61	54	33.69	27.87	18.13	31.3	300	247	A	V	
ZigBee CH 26 2480MHz	*	2480	106.03	-	-	91.35	27.85	18.13	31.3	246	235	P	H
	*	2480	104.2	-	-	89.52	27.85	18.13	31.3	246	235	A	H
		2483.68	62.6	-11.4	74	47.9	27.87	18.13	31.3	246	235	P	H
		2483.52	53.75	-0.25	54	39.05	27.87	18.13	31.3	246	235	A	H
	*	2480	98.88	-	-	84.2	27.85	18.13	31.3	300	247	P	V
	*	2480	96.99	-	-	82.31	27.85	18.13	31.3	300	247	A	V
		2483.52	57.96	-16.04	74	43.26	27.87	18.13	31.3	300	247	P	V
		2483.52	48.44	-5.56	54	33.74	27.87	18.13	31.3	300	247	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



2.4GHz 2400~2483.5MHz

ZigBee (Harmonic @ 3m)

ZigBee	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)	
ZigBee CH 11 2405MHz		4810	44.62	-29.38	74	67.2	32.36	11.84	66.78	100	160	P	H	
		4810	36.49	-17.51	54	59.07	32.36	11.84	66.78	100	160	A	H	
		7215	45.72	-52.55	98.27	58.63	36.94	14.74	64.59	-	-	P	H	
													H	
													H	
													H	
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													H	
													H	
			4810	46.07	-27.93	74	68.65	32.36	11.84	66.78	100	178	P	V
			4810	37.21	-16.79	54	59.79	32.36	11.84	66.78	100	178	A	V
			7215	45.44	-45.89	91.33	58.35	36.94	14.74	64.59	-	-	P	V
														V
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														V
														V
														V
													V	
													V	



ZigBee	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)	
ZigBee CH 17 2435MHz		4870	44.86	-29.14	74	66.92	32.62	12.1	66.78	300	182	P	H	
		4870	36.19	-17.81	54	58.25	32.62	12.1	66.78	300	182	A	H	
		7305	45.48	-28.52	74	59.47	36.98	14.81	65.78	-	-	P	H	
													H	
													H	
													H	
													H	
													H	
													H	
													H	
													H	
			4870	44.76	-29.24	74	66.82	32.62	12.1	66.78	100	180	P	V
			4870	36.1	-17.9	54	58.16	32.62	12.1	66.78	100	180	A	V
			7305	45.71	-28.29	74	59.7	36.98	14.81	65.78	-	-	P	V
														V
														V
													V	
													V	
													V	
													V	
													V	



ZigBee	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)	
ZigBee CH 26 2480MHz		4960	45.76	-28.24	74	67.26	33.01	12.48	66.99	200	107	P	H	
		4960	37.56	-16.44	54	59.06	33.01	12.48	66.99	200	107	A	H	
		7440	45.07	-28.93	74	60.16	36.42	14.9	66.41	-	-	P	H	
													H	
													H	
													H	
													H	
													H	
													H	
													H	
													H	
			4960	46.57	-27.43	74	68.07	33.01	12.48	66.99	400	199	P	V
			4960	39.61	-14.39	54	61.11	33.01	12.48	66.99	400	199	A	V
			7440	44.72	-29.28	74	59.81	36.42	14.9	66.41	-	-	P	V
														V
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													V	
Remark	<ol style="list-style-type: none"> No other spurious found. All results are PASS against Peak and Average limit line. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only. 													



Emission above 18GHz

2.4GHz ZigBee (SHF)

ZigBee	Note	Frequency (MHz)	Level (dBµV/m)	Margin (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
2.4GHz ZigBee SHF		24846	43.29	-30.71	74	35.4	39.12	17.82	49.05	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
			22662	44.21	-29.79	74	37.68	38.84	16.44	48.75	-	-	P
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
Remark	<ol style="list-style-type: none"> No other spurious found. All results are PASS against Peak and Average limit line. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only. 												



Emission below 1GHz

2.4GHz ZigBee (LF)

ZigBee	Note	Frequency (MHz)	Level (dBµV/m)	Margin (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/Q)	Pol. (H/V)	
2.4GHz ZigBee LF		90.14	36.36	-7.14	43.5	52.31	14.81	1.56	32.46	-	-	P	H	
		139.61	33.33	-10.17	43.5	46.31	17.41	1.95	32.44	-	-	P	H	
		242.43	33.36	-12.64	46	45.47	17.69	2.57	32.47	-	-	P	H	
		297.72	33.12	-12.88	46	43.38	19.15	2.85	32.41	-	-	P	H	
		672.14	33	-13	46	34.59	26.32	4.25	32.41	-	-	P	H	
		964.11	35.25	-18.75	54	29.61	31.12	5.06	30.93	-	-	P	H	
														H
														H
														H
														H
														H
														H
														H
			35.82	35.86	-4.14	40	45.35	21.91	0.98	32.45	-	-	P	V
			92.08	42.09	-1.41	43.5	57.7	15.11	1.58	32.46	127	303	Q	V
			232.73	36.39	-9.61	46	49.72	16.53	2.51	32.46	-	-	P	V
			304.51	33.8	-12.2	46	43.98	19.25	2.88	32.46	-	-	P	V
			755.56	30.97	-15.03	46	30	28.31	4.5	32.26	-	-	P	V
			960.23	34.82	-19.18	54	29.16	31.2	5.05	30.97	-	-	P	V
														V
													V	
													V	
													V	
													V	
													V	
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line. 3. The emission position marked as "-" means no suspected emission found and/or emission level has at least 6dB margin against limit or noise floor only.													



Note symbol

*	Fundamental Frequency which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is Margin line.
P/A	Peak or Average
H/V	Horizontal or Vertical



A calculation example for radiated spurious emission is shown as below:

ZigBee	Note	Frequency (MHz)	Level (dBμV/m)	Margin (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
ZigBee		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
CH 11		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H
2405MHz													

1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) =
Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)
3. Margin (dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2405MHz:

1. Level(dBμV/m)
= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)
= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)
= 55.45 (dBμV/m)
2. Margin (dB)
= Level(dBμV/m) – Limit Line(dBμV/m)
= 55.45(dBμV/m) – 74(dBμV/m)
= -18.55(dB)

For Average Limit @ 2405MHz:

1. Level(dBμV/m)
= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)
= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)
= 43.54 (dBμV/m)
2. Margin (dB)
= Level(dBμV/m) – Limit Line(dBμV/m)
= 43.54(dBμV/m) – 54(dBμV/m)
= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is “PASS”.



Appendix D. Radiated Spurious Emission Plots

Test Engineer :	Fu Chen, Yuan Lee and Thinh Hoang	Temperature :	20.1~24.2°C
		Relative Humidity :	42.1~52.1%

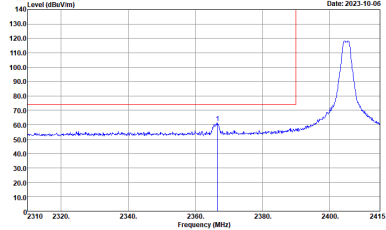
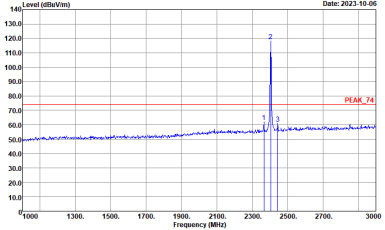
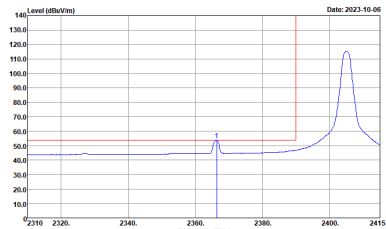
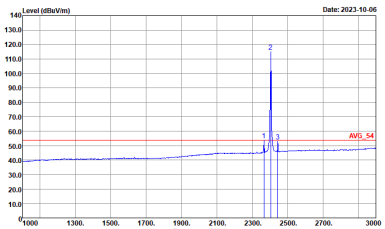
Note symbol

-L	Low channel location
-R	High channel location



2.4GHz 2400~2483.5MHz

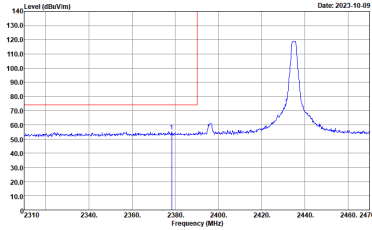
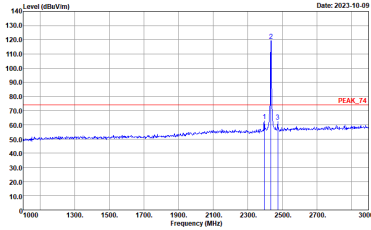
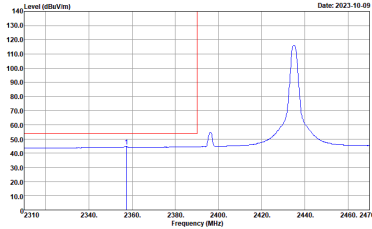
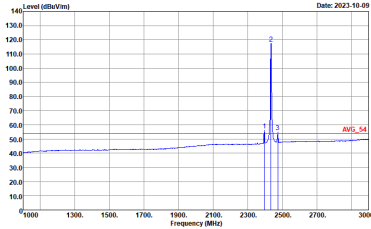
ZigBee (Band Edge @ 3m)

ZigBee	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	ZigBee CH11 2405MHz	
	Horizontal	Fundamental
Peak	 <p>Level (dBuV/m) vs Frequency (MHz) plot showing a peak at approximately 2405 MHz. The y-axis ranges from 10.0 to 140.0 dBuV/m, and the x-axis ranges from 2310 to 2415 MHz. A red vertical line marks the peak at 2405 MHz.</p> <p>Site : 03CH02-CA Condition : PEAK_BE_74 3m HORN_02140_230109 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>	 <p>Level (dBuV/m) vs Frequency (MHz) plot showing a peak at approximately 2405 MHz. The y-axis ranges from 10.0 to 140.0 dBuV/m, and the x-axis ranges from 1000 to 3000 MHz. A red horizontal line is labeled 'PEAK_74' at approximately 75 dBuV/m.</p> <p>Site : 03CH02-CA Condition : PEAK_74 3m HORN_02140_230109 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>
Avg.	 <p>Level (dBuV/m) vs Frequency (MHz) plot showing an average spectrum with a peak at approximately 2405 MHz. The y-axis ranges from 10.0 to 140.0 dBuV/m, and the x-axis ranges from 2310 to 2415 MHz. A red vertical line marks the peak at 2405 MHz.</p> <p>Site : 03CH02-CA Condition : AVG_BE_54 3m HORN_02140_230109 HORIZONTAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto</p>	 <p>Level (dBuV/m) vs Frequency (MHz) plot showing an average spectrum with a peak at approximately 2405 MHz. The y-axis ranges from 10.0 to 140.0 dBuV/m, and the x-axis ranges from 1000 to 3000 MHz. A red horizontal line is labeled 'AVG_54' at approximately 55 dBuV/m.</p> <p>Site : 03CH02-CA Condition : AVG_54 3m HORN_02140_230109 HORIZONTAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto</p>



ZigBee	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	ZigBee CH11 2405MHz	
	Vertical	Fundamental
Peak	<p>Date: 2023-10-06</p> <p>Site : 03CH02-CA Condition : PEAK_BE_74 3m HORN_02140_230109 VERTICAL : RBW:1000.000kHz VBW:3000.000kHz SWT:Auto</p>	<p>Date: 2023-10-06</p> <p>Site : 03CH02-CA Condition : PEAK_74 3m HORN_02140_230109 VERTICAL : RBW:1000.000kHz VBW:3000.000kHz SWT:Auto</p>
Avg.	<p>Date: 2023-10-06</p> <p>Site : 03CH02-CA Condition : AV6_BE_54 3m HORN_02140_230109 VERTICAL : RBW:1000.000kHz VBW:0.010kHz SWT:Auto</p>	<p>Date: 2023-10-06</p> <p>Site : 03CH02-CA Condition : AV6_54 3m HORN_02140_230109 VERTICAL : RBW:1000.000kHz VBW:0.010kHz SWT:Auto</p>

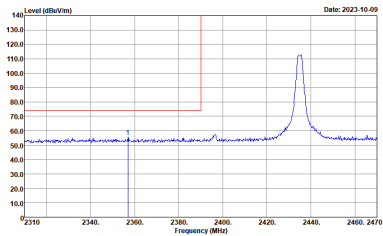
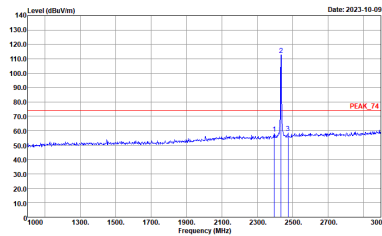
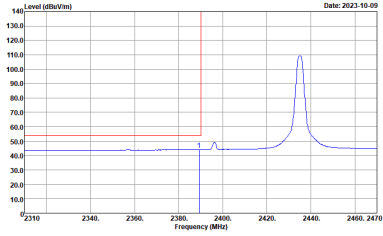
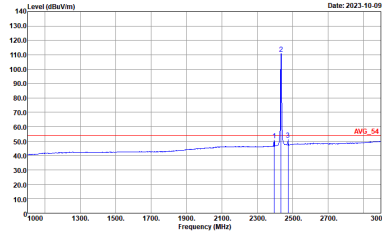


ZigBee	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ZigBee CH17 2435MHz - L		
Horizontal		Fundamental
Peak	 <p>Date: 2023-10-09</p> <p>Site : 03CH02-CA Condition : PEAK_BE_74 3m HORN_02140_230109 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>	 <p>Date: 2023-10-09</p> <p>Site : 03CH02-CA Condition : PEAK_74 3m HORN_02140_230109 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>
Avg.	 <p>Date: 2023-10-09</p> <p>Site : 03CH02-CA Condition : AVG_BE_54 3m HORN_02140_230109 HORIZONTAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto</p>	 <p>Date: 2023-10-09</p> <p>Site : 03CH02-CA Condition : AVG_54 3m HORN_02140_230109 HORIZONTAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto</p>



ZigBee	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	ZigBee CH17 2435MHz - R	
	Horizontal	Fundamental
Peak	<p>Site : 03CH02-CA Condition : PEAK_BE_74 3m HORN_02140_230109 HORIZONTAL RBW:1000.000kHz VBW:3000.000kHz SWT:Auto</p>	Left blank
Avg.	<p>Site : 03CH02-CA Condition : AVG_BE_54 3m HORN_02140_230109 HORIZONTAL RBW:1000.000kHz VBW:0.010kHz SWT:Auto</p>	Left blank

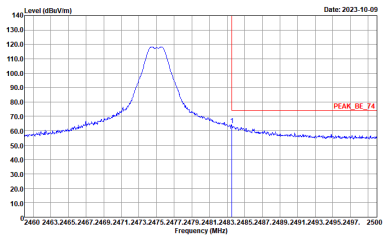
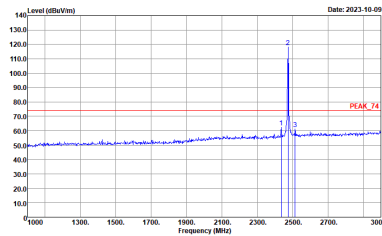
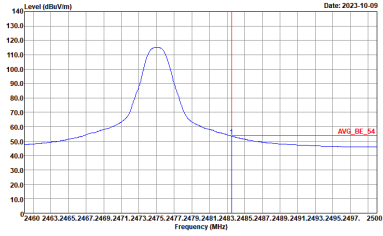
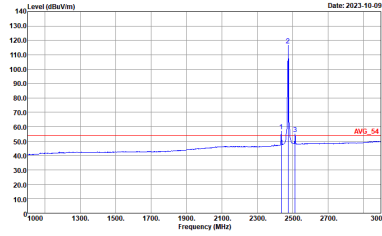


ZigBee	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	ZigBee CH17 2435MHz - L	
	Vertical	Fundamental
Peak	 <p>Date: 2023-10-09</p> <p>Site : 03CH02-CA Condition : PEAK_BE_74 3m HORN_02140_230109 VERTICAL : RBW:1000.000kHz VBW:3000.000kHz SWT:Auto</p>	 <p>Date: 2023-10-09</p> <p>Site : 03CH02-CA Condition : PEAK_74 3m HORN_02140_230109 VERTICAL : RBW:1000.000kHz VBW:3000.000kHz SWT:Auto</p>
Avg.	 <p>Date: 2023-10-09</p> <p>Site : 03CH02-CA Condition : AV6_BE_54 3m HORN_02140_230109 VERTICAL : RBW:1000.000kHz VBW:0.010kHz SWT:Auto</p>	 <p>Date: 2023-10-09</p> <p>Site : 03CH02-CA Condition : AV6_54 3m HORN_02140_230109 VERTICAL : RBW:1000.000kHz VBW:0.010kHz SWT:Auto</p>

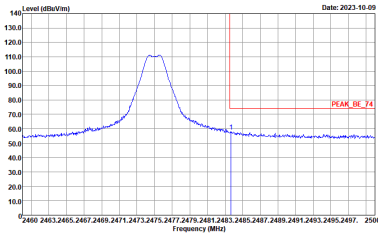
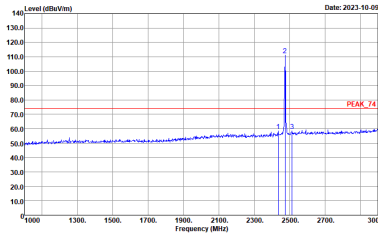
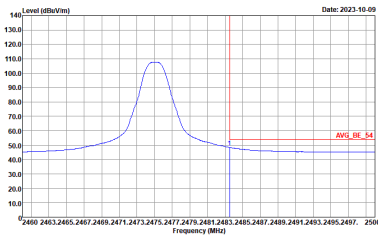
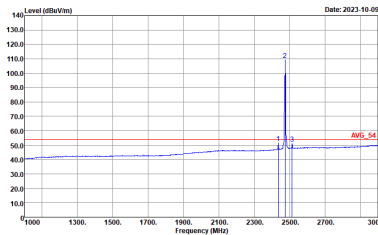


ZigBee	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	ZigBee CH17 2435MHz - R	
	Vertical	Fundamental
Peak	<p>Site : 03CH02-CA Condition : PEAK_BE_74 3m HORN_02140_230109 VERTICAL : RBW:1000.000kHz VBW:3000.000kHz SWT:Auto</p>	Left blank
Avg.	<p>Site : 03CH02-CA Condition : AVG_BE_54 3m HORN_02140_230109 VERTICAL : RBW:1000.000kHz VBW:0.010kHz SWT:Auto</p>	Left blank

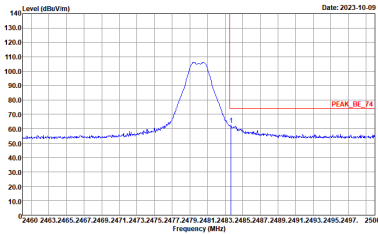
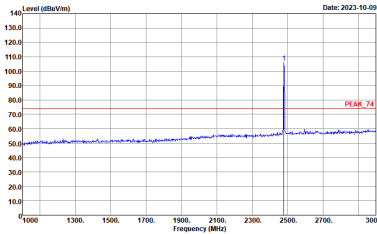
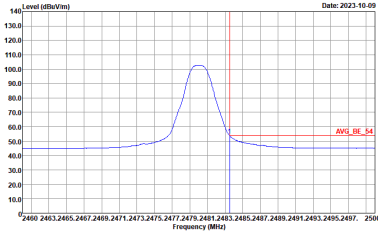
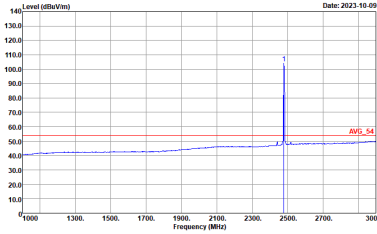


ZigBee	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	ZigBee CH25 2475MHz	
	Horizontal	Fundamental
Peak	 <p>Site : 03CH02-CA Condition : PEAK_BE_74 3m HORN_02140_230109 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>	 <p>Site : 03CH02-CA Condition : PEAK_74 3m HORN_02140_230109 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>
Avg.	 <p>Site : 03CH02-CA Condition : AVG_BE_54 3m HORN_02140_230109 HORIZONTAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto</p>	 <p>Site : 03CH02-CA Condition : AVG_54 3m HORN_02140_230109 HORIZONTAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto</p>

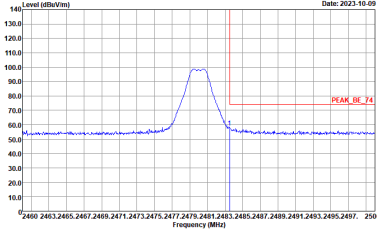
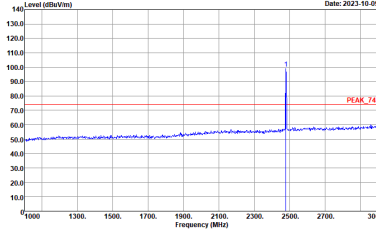
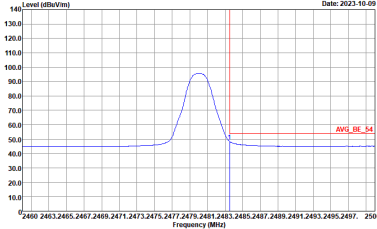
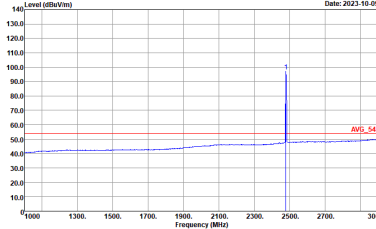


ZigBee	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	ZigBee CH25 2475MHz	
	Vertical	Fundamental
Peak	 <p>Site : 03CH02-CA Condition : PEAK_BE_74 3m HORN_02140_230109 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>	 <p>Site : 03CH02-CA Condition : PEAK_74 3m HORN_02140_230109 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>
Avg.	 <p>Site : 03CH02-CA Condition : AV6_BE_54 3m HORN_02140_230109 VERTICAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto</p>	 <p>Site : 03CH02-CA Condition : AV6_54 3m HORN_02140_230109 VERTICAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto</p>



ZigBee	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	ZigBee CH26 2480MHz	
	Horizontal	Fundamental
Peak	 <p>Site : 03CH02-CA Condition : PEAK_BE_74 3m HORN_02140_230109 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>	 <p>Site : 03CH02-CA Condition : PEAK_74 3m HORN_02140_230109 HORIZONTAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>
Avg.	 <p>Site : 03CH02-CA Condition : AV6_BE_54 3m HORN_02140_230109 HORIZONTAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto</p>	 <p>Site : 03CH02-CA Condition : AV6_54 3m HORN_02140_230109 HORIZONTAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto</p>



ZigBee	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
	ZigBee CH26 2480MHz	
	Vertical	Fundamental
Peak	 <p>Site : 03CH02-CA Condition : PEAK_BE_74 3m HORN_02140_230109 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>	 <p>Site : 03CH02-CA Condition : PEAK_74 3m HORN_02140_230109 VERTICAL : RBW:1000.000KHz VBW:3000.000KHz SWT:Auto</p>
Avg.	 <p>Site : 03CH02-CA Condition : AV6_BE_54 3m HORN_02140_230109 VERTICAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto</p>	 <p>Site : 03CH02-CA Condition : AV6_54 3m HORN_02140_230109 VERTICAL : RBW:1000.000KHz VBW:0.010KHz SWT:Auto</p>

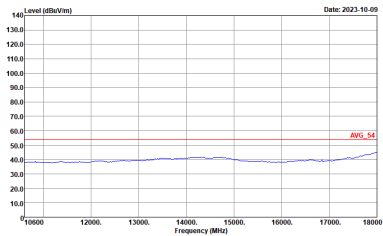
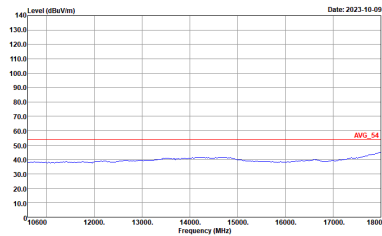


2.4GHz 2400~2483.5MHz

ZigBee (Harmonic @ 3m)

ZigBee	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	ZigBee CH11 2405MHz	
	Horizontal	Vertical
Peak Avg.	<p>Site : 03CH02-CA Condition : PEAK_74 3m HORN_02140_230109 HORIZONTAL</p>	<p>Site : 03CH02-CA Condition : PEAK_74 3m HORN_02140_230109 VERTICAL</p>

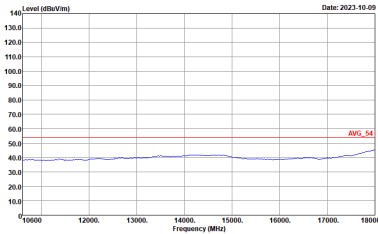
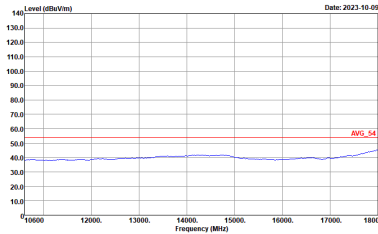


ZigBee	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	ZigBee CH11 2405MHz	
	Horizontal	Vertical
<p>10.6G ~18G Avg.</p>	 <p>Site : 03CH02-CA Condition : AVG_54 3m HORN_02140_230109 HORIZONTAL</p>	 <p>Site : 03CH02-CA Condition : AVG_54 3m HORN_02140_230109 VERTICAL</p>



ZigBee	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	ZigBee CH17 2435MHz	
	Horizontal	Vertical
Peak Avg.	<p>Site : 03CH02-CA Condition : PEAK_74 3m HORN_02140_230109 HORIZONTAL</p>	<p>Site : 03CH02-CA Condition : PEAK_74 3m HORN_02140_230109 VERTICAL</p>



ZigBee	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	ZigBee CH17 2435MHz	
	Horizontal	Vertical
<p>10.6G ~18G Avg.</p>	<p data-bbox="432 450 810 470">Date: 2023-10-09</p>  <p data-bbox="432 685 689 712">Site : 03CH02-CA Condition : AVG_54 3m HORN_02140_230109 HORIZONTAL</p>	<p data-bbox="904 450 1283 470">Date: 2023-10-09</p>  <p data-bbox="904 685 1161 712">Site : 03CH02-CA Condition : AVG_54 3m HORN_02140_230109 VERTICAL</p>



ZigBee	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	ZigBee CH25 2475MHz	
	Horizontal	Vertical
Peak	<p>Site : 03CH02-CA Condition : PEAK_74 3m HORN_02140_230109 HORIZONTAL</p>	<p>Site : 03CH02-CA Condition : PEAK_74 3m HORN_02140_230109 VERTICAL</p>



ZigBee	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	ZigBee CH25 2475MHz	
	Horizontal	Vertical
10.6G ~18G Avg.	<p>Site : 03CH02-CA Condition : AVG_54 3m HORN_02140_230109 HORIZONTAL</p>	<p>Site : 03CH02-CA Condition : AVG_54 3m HORN_02140_230109 VERTICAL</p>



ZigBee	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	ZigBee CH26 2480MHz	
	Horizontal	Vertical
Peak	<p>Site : 03CH02-CA Condition : PEAK_74 3m HORN_02140_230109 HORIZONTAL</p>	<p>Site : 03CH02-CA Condition : PEAK_74 3m HORN_02140_230109 VERTICAL</p>



ZigBee	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
	ZigBee CH26 2480MHz	
	Horizontal	Vertical
10.6G ~18G Avg.	<p>Site : 03CH02-CA Condition : AVG_54 3m HORN_02140_230109 HORIZONTAL</p>	<p>Site : 03CH02-CA Condition : AVG_54 3m HORN_02140_230109 VERTICAL</p>



Emission above 18GHz
2.4GHz ZigBee (SHF @ 1m)

ZigBee	2.4GHz 2400~2483.5MHz	
	ZigBee SHF	
	Horizontal	Vertical
Peak Avg.	<p>Site : 03CH02-CA Condition : PEAK_74 1m SHF_HORN_841_230822 HORIZONTAL</p>	<p>Site : 03CH02-CA Condition : PEAK_74 1m SHF_HORN_841_230822 VERTICAL</p>



Emission below 1GHz

2.4GHz ZigBee (LF)

ZigBee	2.4GHz 2400~2483.5MHz	
	ZigBee LF	
	Horizontal	Vertical
QP / Peak	<p>Site : 03CH02-CA Condition : QP 3m BIL06_5039L_230816 HORIZONTAL</p>	<p>Site : 03CH02-CA Condition : QP 3m BIL06_5039L_230816 VERTICAL</p>



Appendix E. Duty Cycle Plots

Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
ZigBee	100	-	-	10Hz

