



Certificate #4312.01

TEST REPORT

Product Name: IP Phone
Trade Mark: GRANDSTREAM
Model No.: GRP2650
HVIN: GRP2650V2
Report Number: 24032510301RFC-1
Test Standards: FCC 47 CFR Part 15 Subpart C
RSS-247 Issue 3
RSS-Gen Issue 5
FCC ID: YZZGRP2650V2
IC: 11964A-GRP2650V2
Test Result: PASS
Date of Issue: July 25, 2024

Prepared for:

Grandstream Networks, Inc.
126 Brookline Ave., 3rd Floor Boston, MA 02215, USA

Prepared by:

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Version

Version No.	Date	Description
V1.0	July 25, 2024	Original



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CONTENTS

1. GENERAL INFORMATION	4
1.1. CLIENT INFORMATION	4
1.2. EUT INFORMATION	4
1.2.1 GENERAL DESCRIPTION OF EUT	4
1.2.2 DESCRIPTION OF ACCESSORIES	4
1.3. PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD	6
1.4. OTHER INFORMATION	6
1.5. DESCRIPTION OF SUPPORT UNITS	6
1.6. TEST LOCATION	6
1.7. TEST FACILITY	7
1.8. DEVIATION FROM STANDARDS	7
1.9. ABNORMALITIES FROM STANDARD CONDITIONS	7
1.10. OTHER INFORMATION REQUESTED BY THE CUSTOMER	7
1.11. MEASUREMENT UNCERTAINTY	7
2. TEST SUMMARY	9
3. EQUIPMENT LIST	10
4. TEST CONFIGURATION	11
4.1 ENVIRONMENTAL CONDITIONS FOR TESTING	11
4.1.1 NORMAL OR EXTREME TEST CONDITIONS	11
4.1.2 RECORD OF NORMAL ENVIRONMENT AND TEST SAMPLE	11
4.2 TEST CHANNELS	11
4.3 EUT TEST STATUS	11
4.4 TEST SETUP	12
4.4.1 FOR RADIATED EMISSIONS TEST SETUP	12
4.4.2 FOR CONDUCTED EMISSIONS TEST SETUP	13
4.4.3 FOR CONDUCTED RF TEST SETUP	14
4.5 SYSTEM TEST CONFIGURATION	14
4.6 DUTY CYCLE	15
5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION	18
5.1 REFERENCE DOCUMENTS FOR TESTING	18
5.2 ANTENNA REQUIREMENT	18
5.3 CONDUCTED PEAK OUTPUT POWER	19
5.4 6 DB BANDWIDTH & OCCUPIED BANDWIDTH	20
5.5 POWER SPECTRAL DENSITY	21
5.6 CONDUCTED OUT OF BAND EMISSION	22
5.7 RADIATED SPURIOUS EMISSIONS	23
5.8 BAND EDGE MEASUREMENTS (RADIATED)	25
5.9 CONDUCTED EMISSION	26
APPENDIX A RF TEST DATA	29
A.1 99% BANDWIDTH	29
A.2 6dB BANDWIDTH	32
A.3 CONDUCTED OUT OF BAND EMISSION	35
A.4 POWER SPECTRAL DENSITY	41
A.5 RADIATED SPURIOUS EMISSIONS	44
A.6 BAND EDGE MEASUREMENTS (RADIATED)	58
APPENDIX 1 PHOTOS OF TEST SETUP	67
APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS	67

1. GENERAL INFORMATION

1.1. CLIENT INFORMATION

Applicant:	Grandstream Networks, Inc.
Address of Applicant:	126 Brookline Ave., 3rd Floor Boston, MA 02215, USA
Manufacturer:	Grandstream Networks, Inc.
Address of Manufacturer:	126 Brookline Ave., 3rd Floor Boston, MA 02215, USA

1.2. EUT INFORMATION

1.2.1 General Description of EUT

Product Name:	IP Phone		
Model No.:	GRP2650		
HVIN:	GRP2650V2		
Trade Mark:	GRANDSTREAM		
DUT Stage:	Production Unit		
EUT Supports Function: (Provided by the customer)	2.4 GHz ISM Band:	IEEE 802.11b/g/n/ax	
		Bluetooth V5.0	
	5 GHz U-NII Bands:	5 150 MHz to 5 250 MHz	IEEE 802.11a/n/ac/ax
		5 250 MHz to 5 350 MHz	IEEE 802.11a/n/ac/ax
		5 470 MHz to 5 725 MHz	IEEE 802.11a/n/ac/ax
		5 725 MHz to 5 850 MHz	IEEE 802.11a/n/ac/ax
Sample Received Date:	March 23, 2024		
Sample Tested Date:	May 4, 2024 to May 30, 2024		

Remark: The above EUT's information was provided by customer. Please refer to the specifications or user's manual for more detailed description.

1.2.2 Description of Accessories

Adapter (1)	
Model No.:	GQ12-120100-AU
Manufacture:	Dong Guan City GangQi Electronic Co., Ltd.
Input:	100-240V~50/60Hz 0.4 A Max
Output:	12.0V==1.0 A
DC Cable	2.5 Meter, Unshielded without ferrite

Adapter (2)	
Model No.:	F12US1200100A
Manufacture:	SHENZHEN SUNLIGHT ELECTRONIC TECHNOLOGY CO LTD
Input:	100-240V~50/60Hz 0.5 A Max
Output:	12.0V==1.0 A
DC Cable	2.5 Meter, Unshielded without ferrite

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Adapter (3)	
Model No.:	DCT12W120100US-A2
Manufacture:	Zhuzhou Dachuan Electronic Technology Co., Ltd.
Input:	100-240V~50/60Hz 0.3 A Max
Output:	12.0V==1.0 A
DC Cable	2.5 Meter, Unshielded without ferrite

Cable(1)	
Description:	Ethernet Cable
Cable Type:	Unshielded without ferrite
Length:	1.5 Meter

Cable(2)	
Description:	Phone Cord
Cable Type:	Unshielded without ferrite
Length:	3.5 Meter

Others	
1x Handset, 1x Phone Stand	

1.3. PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

Frequency Band:	2400 MHz to 2483.5 MHz
Frequency Range:	2402 MHz to 2480 MHz
Bluetooth Version:	Bluetooth LE/2LE/LE Code
Type of Modulation:	GFSK
Number of Channels:	40
Channel Separation:	2 MHz
Antenna Type:	Dipole Antenna
Antenna Gain: (Provided by the customer)	4.5 dBi
Maximum Peak Power:	7.37 dBm
Normal Test Voltage:	12 Vdc

1.4. OTHER INFORMATION

Operation Frequency Each of Channel	
$f = 2402 + 2k \text{ MHz, } k = 0, \dots, 39$	
Note:	
f	is the operating frequency (MHz);
k	is the operating channel.

1.5. DESCRIPTION OF SUPPORT UNITS

The EUT has been tested with associated equipment below.

1) Support Equipment

Description	Manufacturer	Model No.	Serial Number	Supplied by
Notebook	DELL	Latitude 3400	16238087894	UnionTrust
Mouse	DELL	MS111	CN-011D3V-738	UnionTrust

2) Support Cable

Cable No.	Description	Connector	Length	Supplied by
1	Antenna Cable	SMA	0.1Meter	UnionTrust

1.6. TEST LOCATION**Shenzhen UnionTrust Quality and Technology Co., Ltd.**

Address: Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and technology park, Longhua district, Shenzhen, China

Telephone: +86 (0) 755 2823 0888

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Tests were sub-contracted. (Radiated Emissions and Band Edge Measurement)

Dongguan DN Testing Co., Ltd.

Address: No. 1, West 4th Street, Xingfa South Road, Wusha Community, Chang'an Town, Dongguan, People's Republic of China

Telephone: +86-769-88087383

Email: joise.yang@dn-testing.com

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1.7. TEST FACILITY

The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: L9069

The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

A2LA-Lab Certificate No.: 4312.01

Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

ISED Wireless Device Testing Laboratories

CAB identifier: CN0032

FCC Accredited Lab.

Designation Number: CN1194

Test Firm Registration Number: 259480

Dongguan DN Testing Co., Ltd.

A2LA-Lab Certificate No.: 7050.01

CAB identifier: CN0149

1.8. DEVIATION FROM STANDARDS

None.

1.9. ABNORMALITIES FROM STANDARD CONDITIONS

None.

1.10. OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

1.11. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

No.	Item	Measurement Uncertainty
1	Conducted emission 9kHz-150kHz	±3.2 dB
2	Conducted emission 150kHz-30MHz	±2.7 dB
3	Radiated emission 9kHz-30MHz	± 4.7 dB
4	Radiated emission 30MHz-1GHz	± 4.9 dB
5	Radiated emission 1GHz-18GHz	± 4.8 dB

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6	Radiated emission 18GHz-26GHz	± 5.1 dB
7	Radiated emission 26GHz-40GHz	± 5.1 dB
8	Conducted spurious emissions	± 2.7 dB
9	RF Power, Conducted	± 0.68 dB
10	Occupied Bandwidth	± 1.86 %
11	Radio Frequency	2.4 GHz: ± 6.5 x 10 ⁻⁸
12	Transmission Time	± 0.19 %



2. TEST SUMMARY

Test Cases			
Test Item	Test Requirement	Test Method	Result
Antenna Requirement	FCC 47 CFR Part 15 Subpart C Section 15.203/15.247 (b)(4) RSS-Gen Issue 5, Section 6.8	N/A	PASS
AC Power Line Conducted Emission	FCC 47 CFR Part 15 Subpart C Section 15.207 RSS-Gen Issue 5, Section 8.8	ANSI C63.10-2013 Clause 6.2	PASS
Conducted Peak Output Power	FCC 47 CFR Part 15 Subpart C Section 15.247 (b)(3) RSS-247 Issue 3, Section 5.4(d)	ANSI C63.10-2013 Clause 11.9.1.3	PASS
6dB Bandwidth	FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(2) RSS-247 Issue 3, Section 5.2(a)	ANSI C63.10-2013 Clause 11.8.1	PASS
Occupied Bandwidth	RSS-Gen Issue 5, Section 6.7	RSS-Gen Issue 5, Section 6.7	PASS
Power Spectral Density	FCC 47 CFR Part 15 Subpart C Section 15.247 (e) RSS-247 Issue 3, Section 5.2(b)	ANSI C63.10-2013 Clause 11.10.2	PASS
Conducted Out of Band Emission	FCC 47 CFR Part 15 Subpart C Section 15.247(d) RSS-247 Issue 3, Section 5.5	ANSI C63.10-2013 Clause 11.11	PASS
Radiated Spurious Emissions	FCC 47 CFR Part 15 Subpart C Section 15.205/15.209 RSS-Gen Issue 5, Section 6.13/8.9/8.10	ANSI C63.10-2013 Clause 11.11 & Clause 11.12	PASS
Band Edge Measurements (Radiated)	FCC 47 CFR Part 15 Subpart C Section 15.205/15.209 RSS-247 Issue 3, Section 5.5	ANSI C63.10-2013 Clause 11.13	PASS
Disclaimer and Explanations: The declared of product specification and data (e.g. antenna gain, RF specification, etc) for EUT presented in the report are provided by the customer, and the customer takes all the responsibilities for the accuracy of product specification.			

3. EQUIPMENT LIST

Dongguan DN Testing Co., Ltd.

Test Equipment for Radiated Emission(30MHz-1000MHz)						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date	Cal. Due date
☒	Receiver	R&S	ESR7	102497	2023-10-24	2024-10-23
☒	Test Software	Tonscend	JS32-RE V5.0.0	NA	NA	NA
☒	RF Cable	ETS-LINDGREN	RFC-NMS-100-NMS-350-IN	DNT-001	2023-10-24	2024-10-23
☒	Log periodic antenna	ETS-LINDGREN	VULB 9168	01475	2023-10-24	2024-10-23
☒	Pre-amplifier	Schwarzbeck	BBV9743B	00423	2023-10-24	2024-10-23

Test Equipment for Radiated Emission(Above 1000MHz)						
☒	Frequency analyser	Keysight	N9010A	MY52221458	2023-10-24	2024-10-23
☒	RF Cable	ETS-LINDGREN	RFC-NMS-100-NMS-350-IN	DNT-002	2023-10-24	2024-10-23
☒	Horn Antenna	ETS-LINDGREN	3117	00252567	2023-10-24	2024-10-23
☒	Double ridged waveguide antenna	ETS-LINDGREN	3116C	00251780	2023-10-24	2024-10-23
☒	Test Software	Tonscend	JS32-RE V5.0.0	NA	NA	NA
☒	Pre-amplifier	ETS-LINDGREN	3117-PA	252567	2023-10-24	2024-10-23
☒	Pre-amplifier	ETS-LINDGREN	3116C-PA	251780	2023-10-24	2024-10-23

Shenzhen UnionTrust Quality and Technology Co., Ltd.

Conducted Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date	Cal. Due date
☒	Receiver	R&S	ESR7	1316.3003K07-101181-K3	27-Oct-2023	26-Oct-2024
☒	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	27-Oct-2023	26-Oct-2024
☒	LISN	R&S	ESH2-Z5	860014/024	27-Oct-2023	26-Oct-2024
☒	LISN	ETS-Lindgren	3816/2SH	00201088	27-Oct-2023	26-Oct-2024
☒	Test Software	EZ-EMC	EZ-CON	Software Version: EMC-CON 3A1.1		

Conducted RF test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date	Cal. Due date
☒	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	29-Mar-2024	28-Mar-2025
☒	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	27-Oct-2023	26-Oct-2024
☐	MXG X-Series RF Vector Signal Generator	KEYSIGHT	N5182B	MY51350267	27-Oct-2023	26-Oct-2024

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4. TEST CONFIGURATION

4.1 ENVIRONMENTAL CONDITIONS FOR TESTING

4.1.1 Normal or Extreme Test Conditions

Environment Parameter	Selected Values During Tests		
Test Condition	Ambient		
	Temperature (°C)	Voltage (V)	Relative Humidity (%)
NT/NV	+15 to +35	12	20 to 75
Remark: 1) NV: Normal Voltage; NT: Normal Temperature			

4.1.2 Record of Normal Environment and Test Sample

Test Item	Temperature (°C)	Relative Humidity (%)	Pressure (kPa)	Sample No.	Tested by
AC Power Line Conducted Emission	22.9	51.1	100.2	S202403232938-ZJA02/4	Linson Xie
Conducted Peak Output Power	25.3	59	100.2	S202403232938-ZJA03/4	Allen Zhou
6dB Bandwidth & Occupied Bandwidth					
Power Spectral Density					
Conducted Out of Band Emission	25	60	100.1	S202403232938-ZJA04/4	Wayne Lin
Radiated Spurious Emissions					
Band Edge Measurements (Radiated)					

4.2 TEST CHANNELS

Type of Modulation	Tx/Rx Frequency	Test RF Channel Lists		
GFSK	2402 MHz to 2480 MHz	Lowest(L)	Middle(M)	Highest(H)
		Channel 0	Channel 19	Channel 39
		2402 MHz	2440 MHz	2480 MHz

4.3 EUT TEST STATUS

Type of Modulation	Tx Function	Description
GFSK	1Tx	1. Keep the EUT in continuously transmitting with modulation test single.

Power Setting(Provided by the customer)

Power Setting: not applicable, test used software default power level.

Test Software(Provided by the customer)

Test software name: Putty

4.4 TEST SETUP

4.4.1 For Radiated Emissions test setup

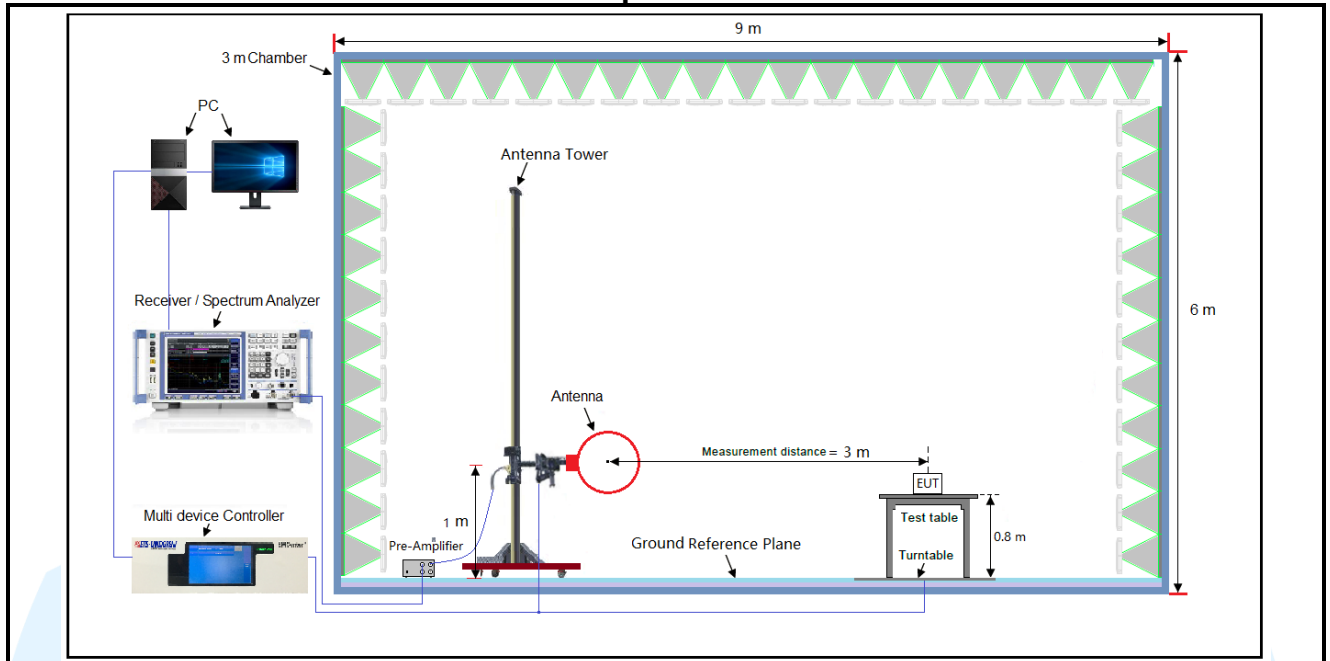


Figure 1. Below 30MHz

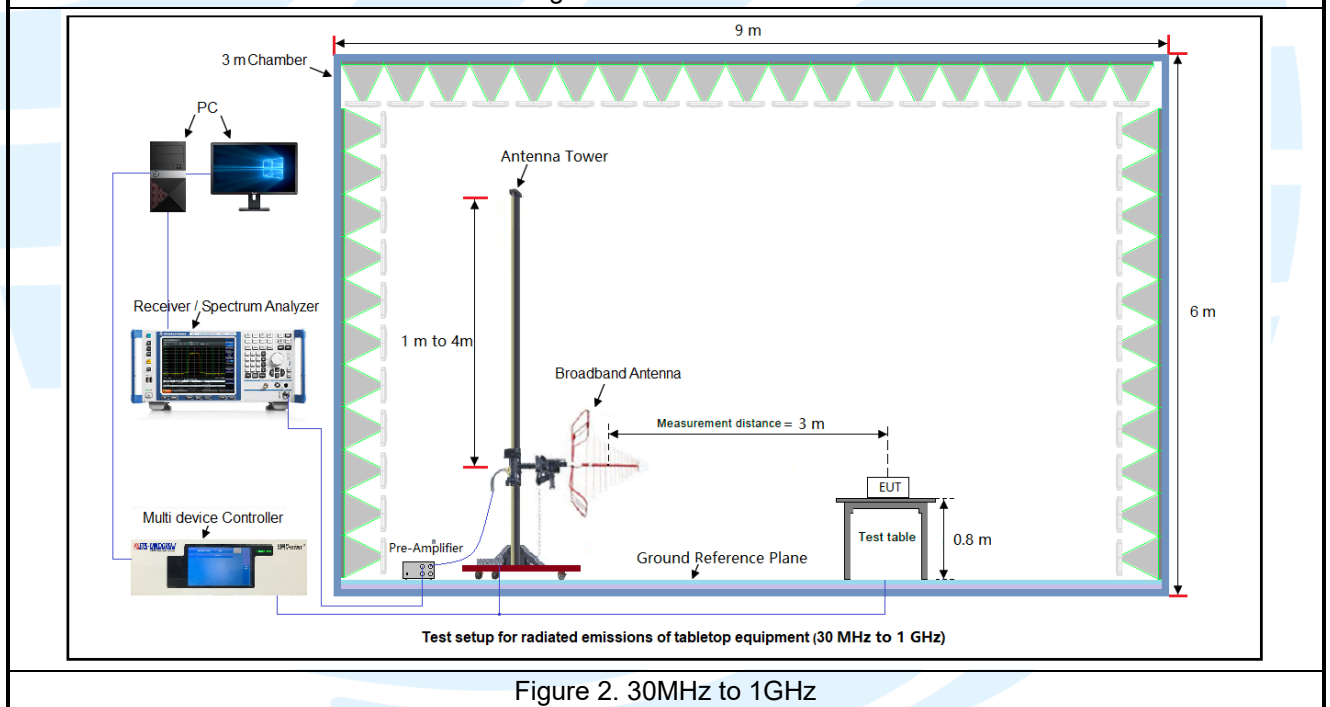
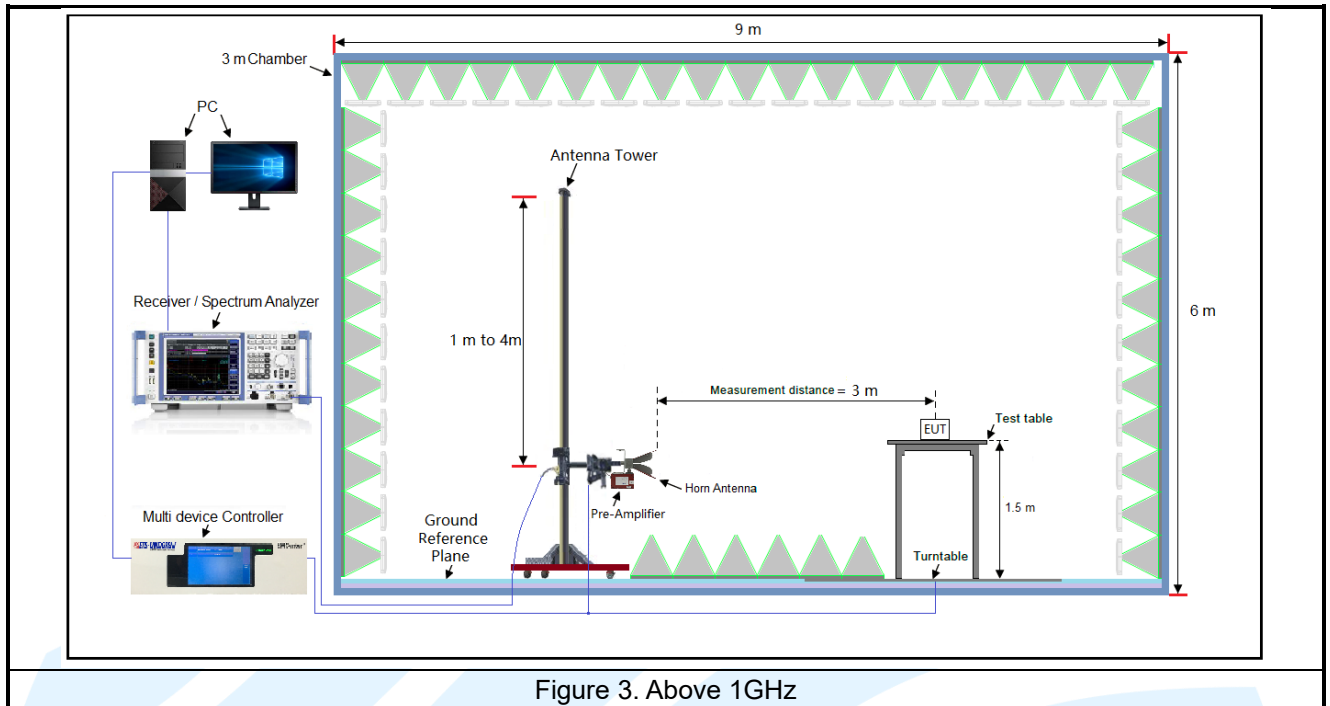
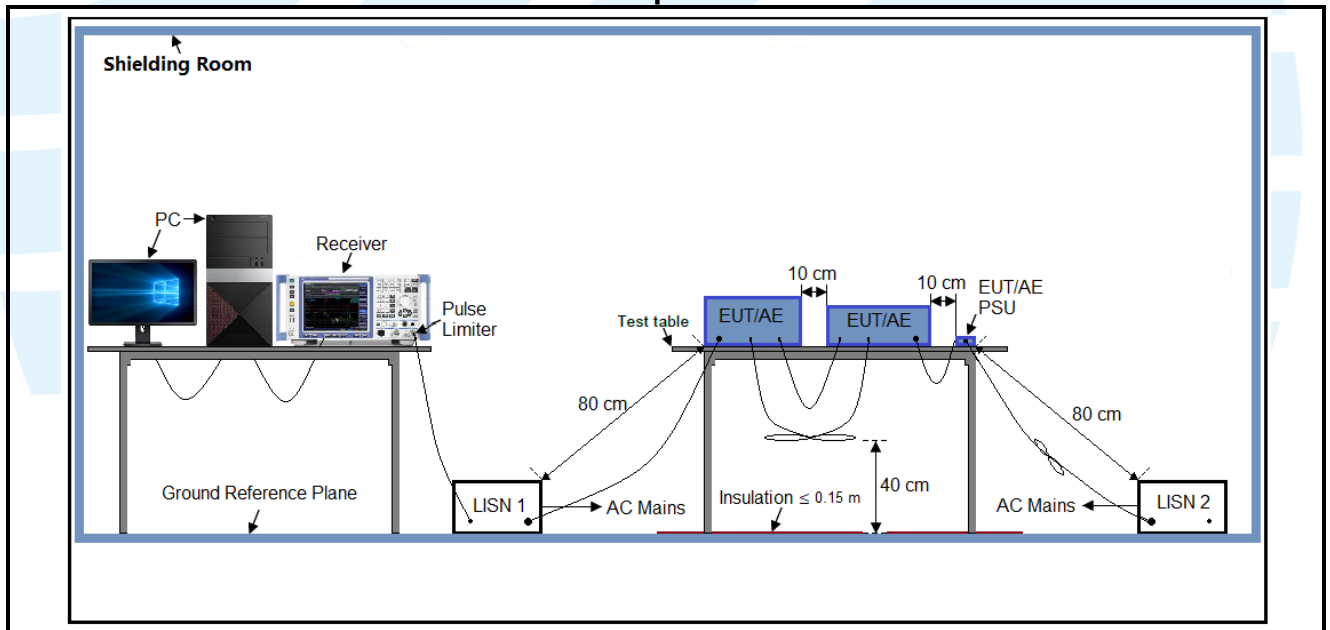


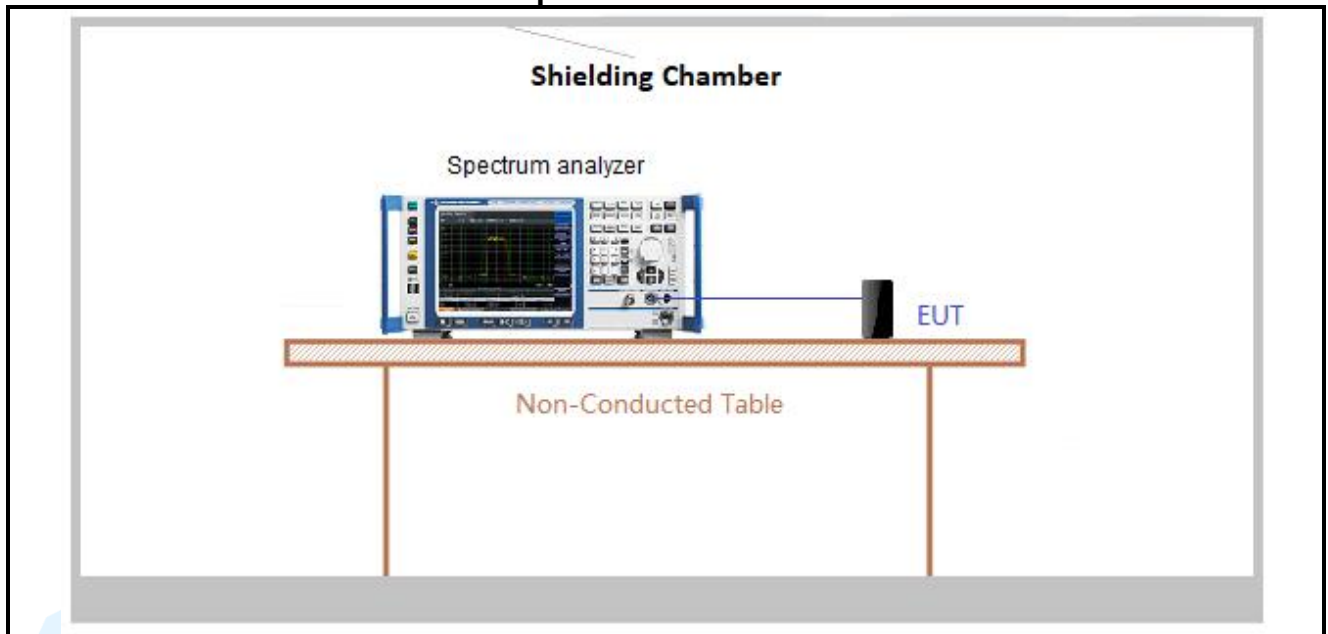
Figure 2. 30MHz to 1GHz



4.4.2 For Conducted Emissions test setup



4.4.3 For Conducted RF test setup



4.5 SYSTEM TEST CONFIGURATION

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, radiated emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario. Only the worst case data were recorded in this test report.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Therefore, all final radiated testing was performed with the EUT in (see table below) orientation.

Frequency	Mode	Antenna Port	Worst-case axis positioning
Above 1GHz	1TX	Chain 0	Y axis

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000 MHz. The resolution is 1 MHz or greater for frequencies above 1000 MHz. The spurious emissions more than 20 dB below the permissible value are not reported.

Radiated emission measurement were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

4.6 DUTY CYCLE

Test Procedure: ANSI C63.10-2013 Clause 11.6.

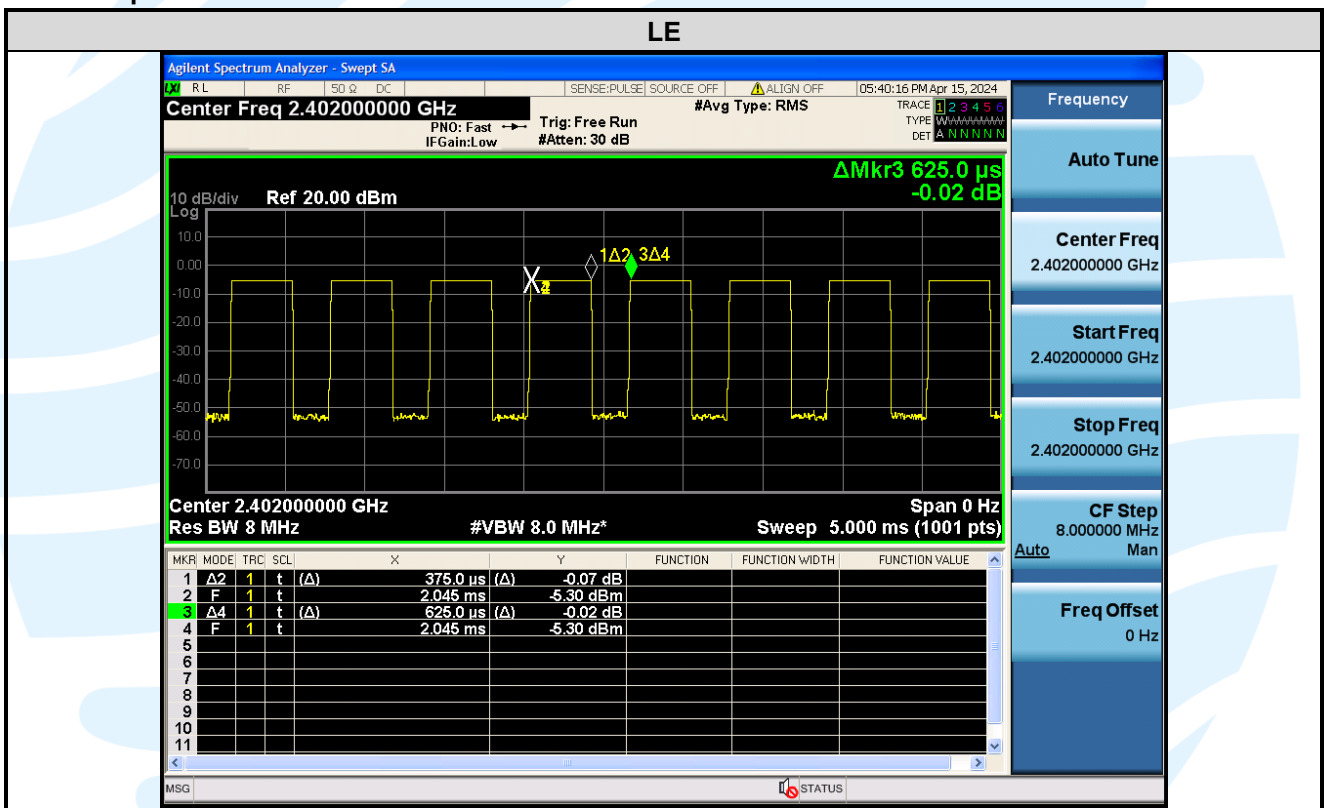
Test Results

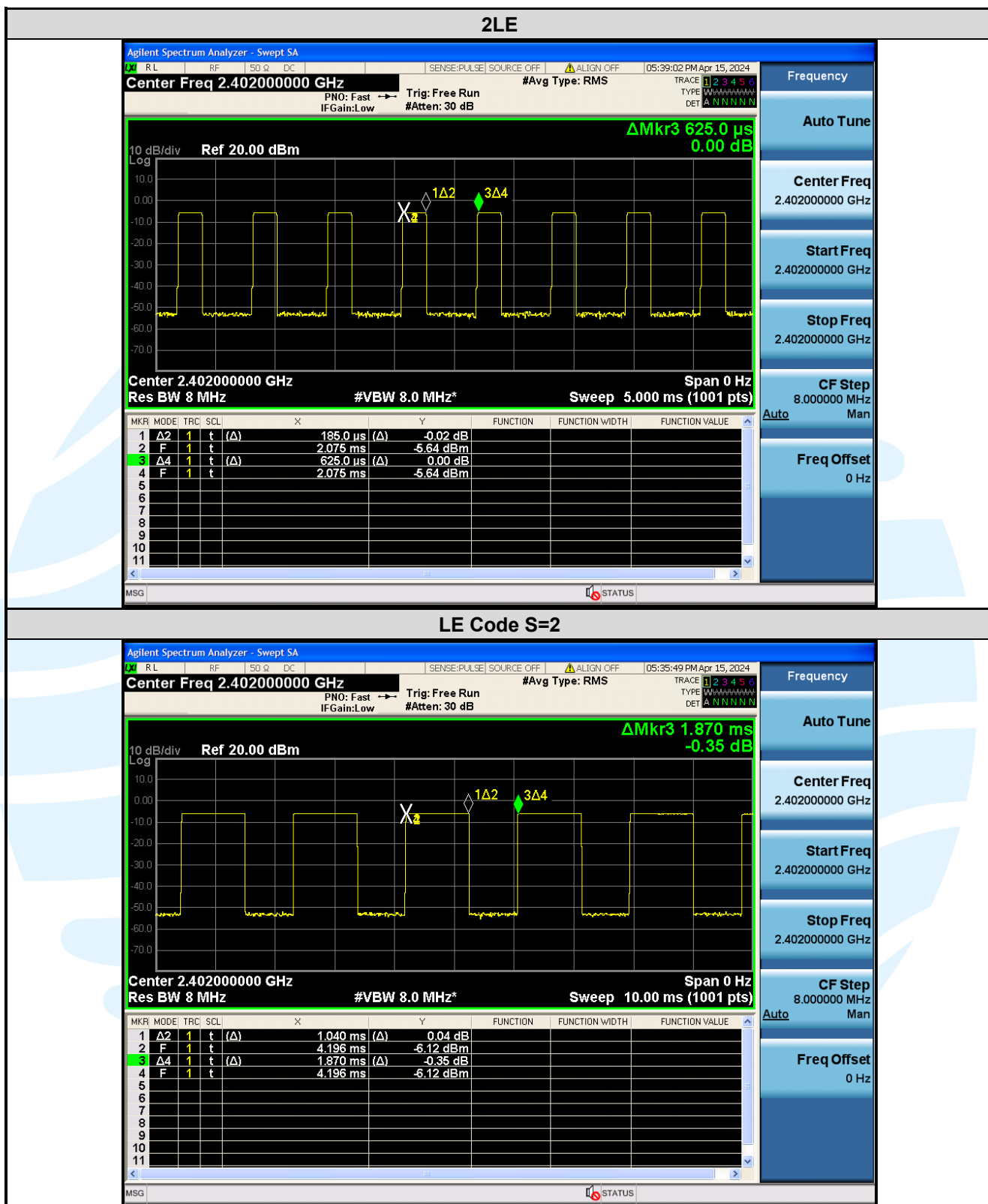
Mode	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/T Minimum VBW (kHz)
LE	0.375	0.625	0.60	60.00	2.22	2.67
2LE	0.185	0.625	0.30	29.60	5.29	5.41
LE Code (S=2)	1.040	1.870	0.56	55.61	2.55	0.96
LE Code (S=8)	3.060	3.750	0.82	81.60	0.88	0.33

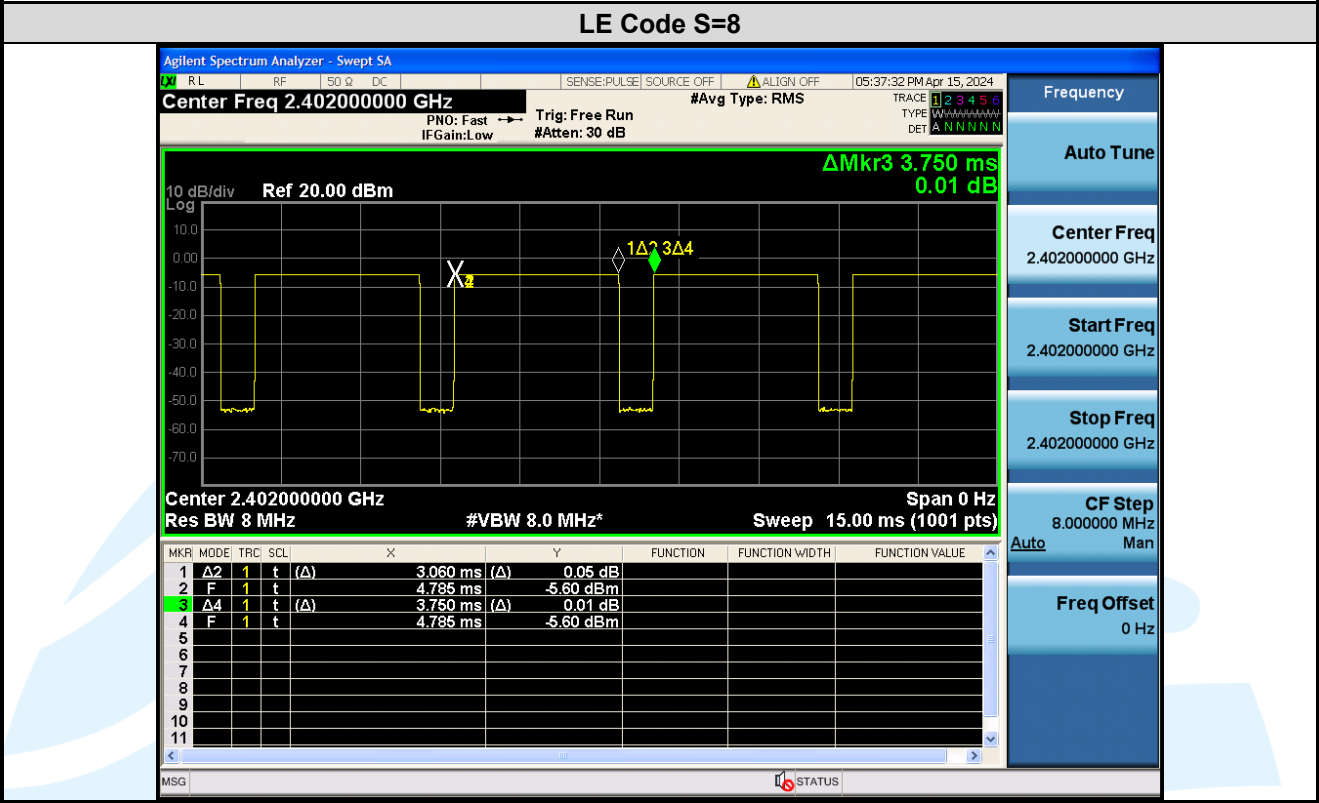
Remark:

- 1) Duty cycle= On Time/ Period;
- 2) Duty Cycle factor = $10 * \log(1/ \text{Duty cycle})$;
- 3) Average factor = $20 \log_{10} \text{Duty Cycle}$.

The test plot as follows







5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION

5.1 REFERENCE DOCUMENTS FOR TESTING

No.	Identity	Document Title
1	FCC 47 CFR Part 2	Frequency allocations and radio treaty matters; general rules and regulations
2	FCC 47 CFR Part 15	Radio Frequency Devices
3	RSS-247 Issue 3	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
4	RSS-Gen Issue 5	General Requirements for Compliance of Radio Apparatus
5	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
6	KDB 558074 D01 15.247 Meas Guidance v05r02	Guidance for compliance measurements on Digital Transmission Systems, Frequency Hopping Spread Spectrum system, and Hybrid system devices operating under Section 15.247 of the FCC rules

5.2 ANTENNA REQUIREMENT

Standard Requirement
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. 15.247(b) (4) requirement: The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi. RSS-Gen Issue 5, Section 6.8 requirement: According to RSS-Gen Issue 5, Section 6.8, a transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. EUT Antenna: Antenna in the interior of the equipment and no consideration of replacement. The gain of the antenna is 4.5dBi.

5.3 CONDUCTED PEAK OUTPUT POWER

- Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.247 (b)(3)
RSS-247 Issue 3, Section 5.4(d)
- Test Method:** ANSI C63.10-2013 Clause 11.9.1.3
- Limit:** For DTSs employing digital modulation techniques operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W.
- Test Procedure:**
1. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.
 2. Measure out each test modes' peak or average output power, record the power level.
- Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.
- Test Setup:** Refer to section 4.4.3 for details.
- Instruments Used:** Refer to section 3 for details
- Test Results:** Pass

Mode	Frequency	Max. Peak Power		Maximum e.i.r.p	Peak Power Limit	Maximum e.i.r.p Limit	Result
	(MHz)	(dBm)	(W)	(dBm)	(dBm)	(dBm)	
LE	2402	6.91	0.00491	11.41	30	36.02	Pass
	2440	7.11	0.00514	11.61	30	36.02	Pass
	2480	7.35	0.00543	11.85	30	36.02	Pass
2LE	2402	6.89	0.00489	11.39	30	36.02	Pass
	2440	7.09	0.00512	11.59	30	36.02	Pass
	2480	7.31	0.00538	11.81	30	36.02	Pass
LE Code (S=2)	2402	6.94	0.00494	11.44	30	36.02	Pass
	2440	7.13	0.00516	11.63	30	36.02	Pass
	2480	7.34	0.00542	11.84	30	36.02	Pass
LE Code (S=8)	2402	6.95	0.00495	11.45	30	36.02	Pass
	2440	7.14	0.00518	11.64	30	36.02	Pass
	2480	7.37	0.00546	11.87	30	36.02	Pass

Note:

1. The antenna gain of 4.5 dBi less than 6dBi maximum permission antenna gain value based on 1 watt peak output power limit.
2. The maximum EIRP is calculated from max output power and antenna gain, the antenna gain provided by the customer, and the customer takes all the responsibilities for the accuracy of antenna gain.

5.46 DB BANDWIDTH & OCCUPIED BANDWIDTH

Test Requirement:	FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(2) RSS-247 Issue 3, Section 5.2(a) RSS-Gen Issue 5, Section 6.7
Test Method:	ANSI C63.10-2013 Clause 11.8.1 RSS-Gen Issue 5, Section 6.7
Limit:	For digital transmission systems, the minimum 6 dB bandwidth shall be 500 kHz.
Test Procedure:	Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer. Use the following spectrum analyzer settings:

6dB Bandwidth

- Set RBW = 100 kHz.
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Occupied Bandwidth

- Set RBW = 1% to 5% of the occupied bandwidth
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup:	Refer to section 4.4.3 for details.
Instruments Used:	Refer to section 3 for details
Test Mode:	Link mode
Test Results:	Please refer to Appendix A

5.5 POWER SPECTRAL DENSITY

Test Requirement:	FCC 47 CFR Part 15 Subpart C Section 15.247 (e) RSS-247 Issue 3, Section 5.2(b)
Test Method:	ANSI C63.10-2013 Clause 11.10.2
Limit:	For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.
Test Procedure:	Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer. Use the following spectrum analyzer settings: a) Set analyzer center frequency to DTS channel center frequency. b) Set the span to 1.5 times the DTS bandwidth. c) Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$. d) Set the VBW $\geq 3 \times \text{RBW}$. e) Detector = peak. f) Sweep time = auto couple. g) Trace mode = max hold. h) Allow trace to fully stabilize. i) Use the peak marker function to determine the maximum amplitude level within the RBW. j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat. Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.
Test Setup:	Refer to section 4.4.3 for details.
Instruments Used:	Refer to section 3 for details
Test Mode:	Link mode
Test Results:	Please refer to Appendix A

5.6 CONDUCTED OUT OF BAND EMISSION

Test Requirement:	FCC 47 CFR Part 15 Subpart C Section 15.247(d) RSS-247 Issue 2, Section 5.5
Test Method:	ANSI C63.10-2013 Clause 11.11
Limit:	In any 100kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.
Test Procedure:	Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer. Use the following spectrum analyzer settings: Step 1: Reference level measurement a) Set instrument center frequency to DTS channel center frequency. b) Set the span to ≥ 1.5 times the DTS bandwidth. c) Set the RBW = 100 kHz. d) Set the VBW $\geq 3 \times$ RBW. e) Detector = peak. f) Sweep time = auto couple. g) Trace mode = max hold. h) Allow trace to fully stabilize. i) Use the peak marker function to determine the maximum PSD level. Note that the channel found to contain the maximum PSD level can be used to establish the reference level. Step 2: Emission level measurement a) Set RBW = 100 kHz. b) Set VBW ≥ 300 kHz. c) Detector = peak. d) Sweep = auto couple. e) Trace Mode = max hold. f) Allow trace to fully stabilize. g) Use the peak marker function to determine the maximum amplitude level. Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.
Test Setup:	Refer to section 4.4.3 for details.
Instruments Used:	Refer to section 3 for details
Test Mode:	Link mode
Test Results:	Please refer to Appendix A

5.7 RADIATED SPURIOUS EMISSIONS

Test Requirement: FCC 47 CFR Part 15 Subpart C Section 15.205/15.209
RSS-Gen Issue 5, Section 6.13/8.9/8.10

Test Method: ANSI C63.10-2013 Clause 11.11 & Clause 11.12

Receiver Setup:

Frequency	RBW
0.009 MHz-0.150 MHz	200/300 kHz
0.150 MHz -30 MHz	9/10 kHz
30 MHz-1 GHz	100/120 kHz
Above 1 GHz	1 MHz

Limits:

Spurious Emissions

Frequency	Field strength (microvolt/meter)	Limit (dB μ V/m)	Remark	Measurement distance (m)
0.009 MHz-0.490 MHz	2400/F(kHz)	--	--	300
0.490 MHz-1.705 MHz	24000/F(kHz)	--	--	30
1.705 MHz-30 MHz	30	--	--	30
30 MHz-88 MHz	100	40.0	Quasi-peak	3
88 MHz-216 MHz	150	43.5	Quasi-peak	3
216 MHz-960 MHz	200	46.0	Quasi-peak	3
960MHz-1GHz	500	54.0	Quasi-peak	3
Above 1 GHz	500	54.0	Average	3

Remark:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dB μ V/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

Test Setup: Refer to section 4.4.1 for details.

Test Procedures:

1. From 30 MHz to 1GHz test procedure as below:

- 1) The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- 3) The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- 4) For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rota table table was turned from 0 degrees to 360 degrees to find the maximum reading.
- 5) The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 6) If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

2. Above 1GHz test procedure as below:

- 1) Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 meter to 1.5 meter(Above 18GHz the distance is 1 meter and table is 1.5 meter).

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- 2) Test the EUT in the lowest channel ,middle channel, the Highest channel
- 3) The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the Y axis positioning which it is worse case.
- 4) Repeat above procedures until all frequencies measured was complete.

Equipment Used: Refer to section 3 for details.

Test Result: Pass

The measurement data as follows:

Radiated Emission Test Data (9 KHz ~ 30 MHz):
--

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value need not be reported.
--

Radiated Emission Test Data (30 MHz ~ 1 GHz):
--

Please refer to Appendix A

Radiated Emission Test Data (Above 1GHz):
--

Please refer to Appendix A

5.8 BAND EDGE MEASUREMENTS (RADIATED)

Test Requirement: FCC 47 CFR Part 15 Subpart C Section 15.205/15.209
RSS-247 Issue 3, Section 5.5

Test Method: ANSI C63.10-2013 Clause 11.13

Limits:

Radiated emissions which fall in the restricted bands, as defined in section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a).

Frequency	Limit (dB μ V/m @3m)	Remark
30 MHz-88 MHz	40.0	Quasi-peak Value
88 MHz-216 MHz	43.5	Quasi-peak Value
216 MHz-960 MHz	46.0	Quasi-peak Value
960 MHz-1 GHz	54.0	Quasi-peak Value
Above 1 GHz	54.0	Average Value
	74.0	Peak Value

Test Setup: Refer to section 4.4.1 for details.

Test Procedures:

Radiated band edge measurements at 2390 MHz and 2483.5 MHz were made with the unit transmitting in the low end of the channel range and the high end closest to the restricted bands respectively. The emissions were made on the 966 Semi-Chamber. Use (resolution bandwidth (RBW) = 1 MHz, video bandwidth (VBW) = 3 MHz for peak levels and RBW = 1 MHz and VBW = 10 Hz or 1/T for average levels).

1. Use radiated spurious emission test procedure described in clause 5.10. The transmitter output (antenna port) was connected to the test receiver.
2. Set the PK and AV limit line.
3. Record the fundamental emission and emissions out of the band-edge.
4. Determine band-edge compliance as required.

Equipment Used: Refer to section 3 for details.

Test Result: Please refer to Appendix A

5.9 CONDUCTED EMISSION

Test Requirement: 47 CFR Part 15C Section 15.207
RSS-Gen Issue 5, Section 8.8

Test Method: ANSI C63.10-2013 Section 6.2

Limits:

Frequency range (MHz)	Limits (dB(μV))	
	Quasi-peak	Average
0,15 to 0,50	66 to 56	56 to 46
0,50 to 5	56	46
5 to 30	60	50

Remark:

1. The lower limit shall apply at the transition frequencies.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 to 0.50 MHz.

Test Setup: Refer to section 4.4.2 for details.

Test Procedures:

Test frequency range :150KHz-30MHz

- 1) The mains terminal disturbance voltage test was conducted in a shielded room.
- 2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
- 3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
- 4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
- 5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

Equipment Used: Refer to section 3 for details.

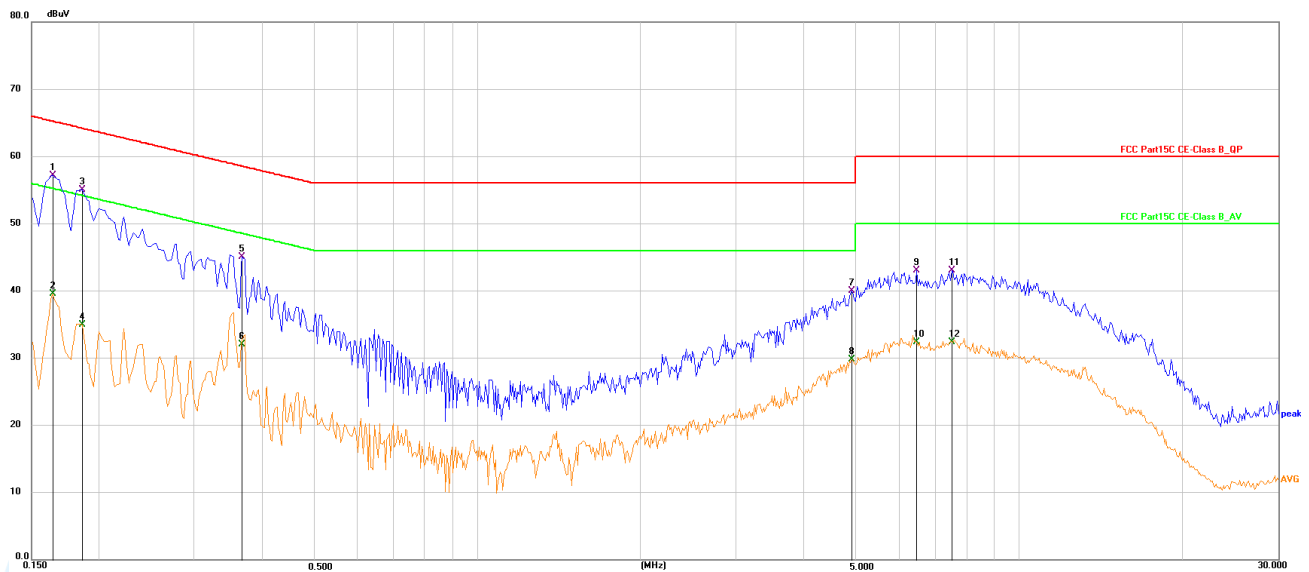
Test Result: Pass

The worst measurement data as follows:

Quasi Peak and Average:

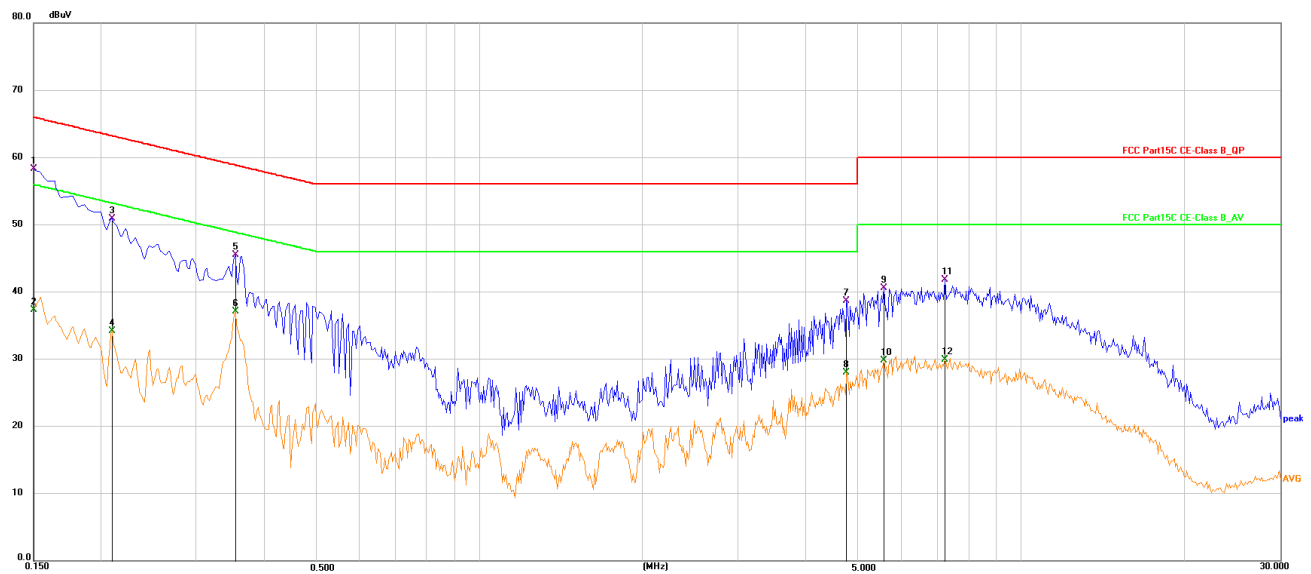
Mode: BT Link

Live Line



No.	Frequency (MHz)	Reading (dBμV)	Correction factor (dB)	Result (dBμV)	Limit (dBμV)	Margin (dB)	Detector
1	0.1635	47.02	10.19	57.21	65.28	-8.07	QP
2	0.1635	29.39	10.19	39.58	55.28	-15.70	AVG
3	0.1860	44.90	10.17	55.07	64.21	-9.14	QP
4	0.1860	24.83	10.17	35.00	54.21	-19.21	AVG
5	0.3660	34.88	10.15	45.03	58.59	-13.56	QP
6	0.3660	21.93	10.15	32.08	48.59	-16.51	AVG
7	4.9245	29.75	10.23	39.98	56.00	-16.02	QP
8	4.9245	19.57	10.23	29.80	46.00	-16.20	AVG
9	6.4813	32.54	10.44	42.98	60.00	-17.02	QP
10	6.4813	21.93	10.44	32.37	50.00	-17.63	AVG
11	7.5030	32.52	10.50	43.02	60.00	-16.98	QP
12	7.5030	21.83	10.50	32.33	50.00	-17.67	AVG

Neutral Line



No.	Frequency (MHz)	Reading (dBμV)	Correction factor (dB)	Result (dBμV)	Limit (dBμV)	Margin (dB)	Detector
1	0.1500	48.14	10.19	58.33	66.00	-7.67	QP
2	0.1500	27.08	10.19	37.27	56.00	-18.73	AVG
3	0.2094	40.85	10.05	50.90	63.23	-12.33	QP
4	0.2094	24.13	10.05	34.18	53.23	-19.05	AVG
5	0.3539	35.34	10.15	45.49	58.87	-13.38	QP
6	0.3539	26.89	10.15	37.04	48.87	-11.83	AVG
7	4.7464	28.41	10.28	38.69	56.00	-17.31	QP
8	4.7464	17.75	10.28	28.03	46.00	-17.97	AVG
9	5.5641	30.25	10.27	40.52	60.00	-19.48	QP
10	5.5641	19.55	10.27	29.82	50.00	-20.18	AVG
11	7.2135	31.54	10.30	41.84	60.00	-18.16	QP
12	7.2135	19.64	10.30	29.94	50.00	-20.06	AVG

Remark:

1. Correct Factor = LISN Factor + Cable Loss + Pulse Limiter Factor, the value was added to Original Receiver Reading by the software automatically.
2. Result = Reading + Correct Factor.
3. Margin = Result - Limit
4. An initial pre-scan was performed on the Phase and neutral lines with peak detector. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

APPENDIX A RF TEST DATA

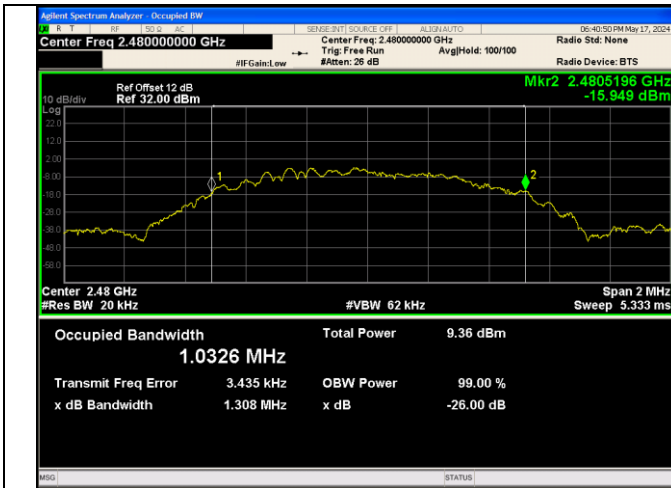
A.1 99% BANDWIDTH

Test Result

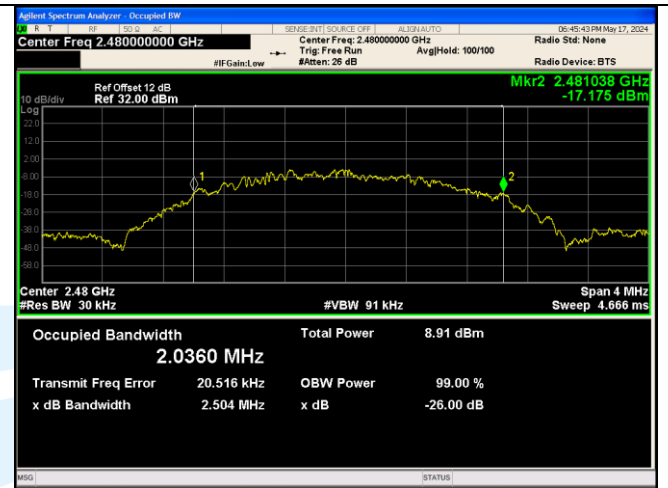
Mode	Channel	99% BW (MHz)
LE	0	1.0316
LE	19	1.0345
LE	39	1.0326
2LE	0	2.0349
2LE	19	2.0372
2LE	39	2.0360
LE Coded (S=2)	0	1.0190
LE Coded (S=2)	19	1.0197
LE Coded (S=2)	39	1.0196
LE Coded (S=8)	0	1.0462
LE Coded (S=8)	19	1.0530
LE Coded (S=8)	39	1.0598

Test Graphs

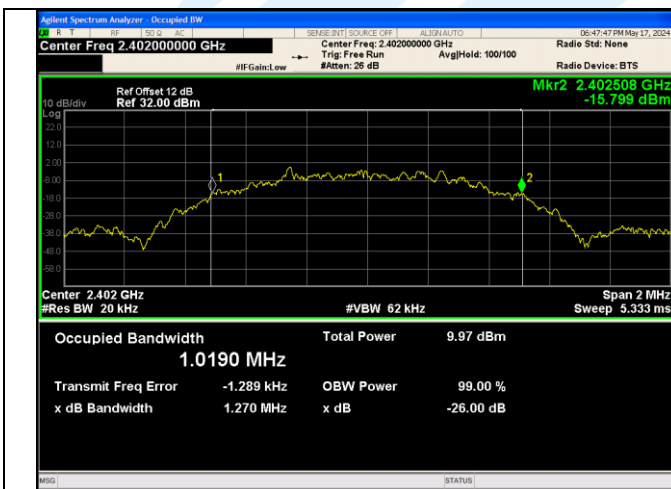




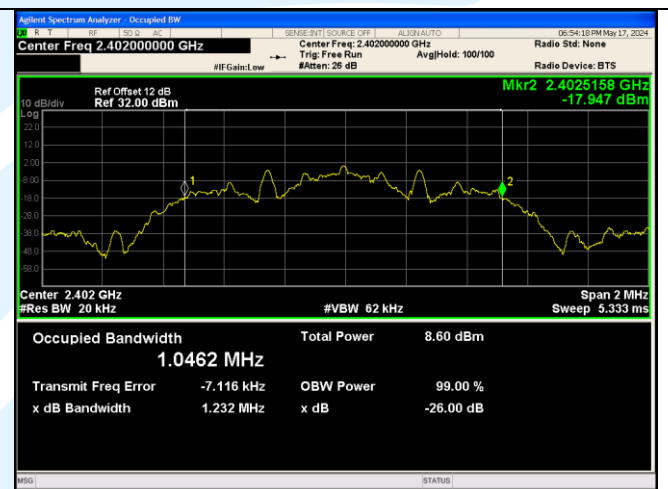
LE_Channel 39



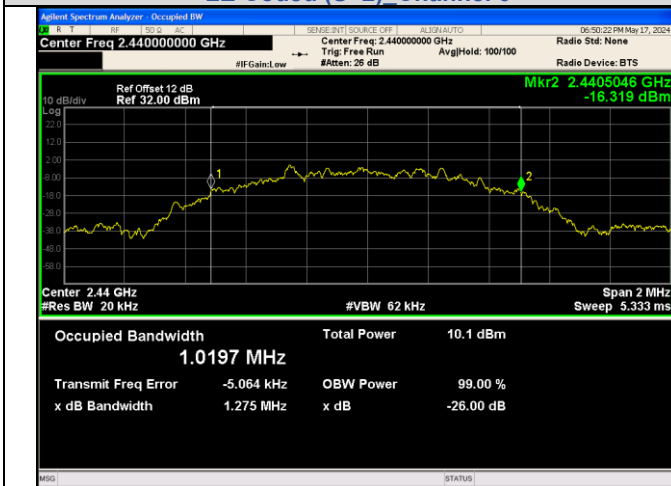
2LE_Channel 39



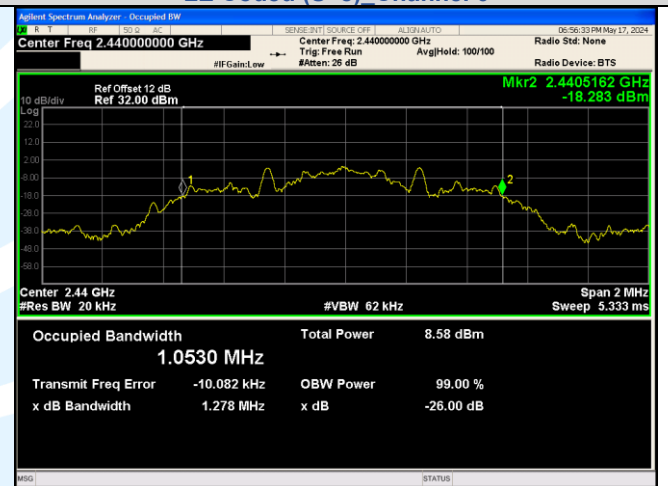
LE Coded (S=2)_Channel 0



LE Coded (S=8)_Channel 0



LE Coded (S=2)_Channel 19



LE Coded (S=8)_Channel 19



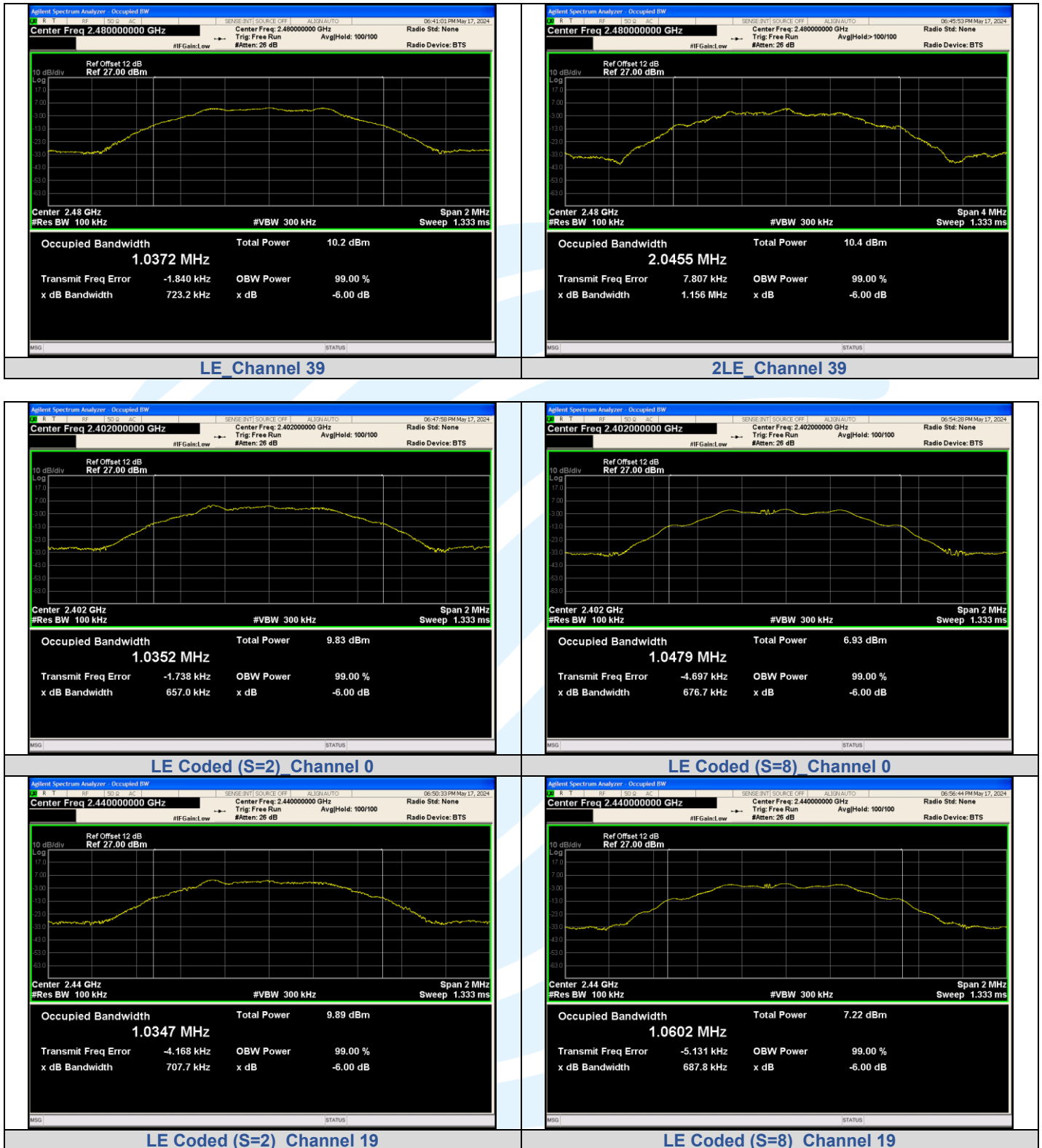
A.2 6DB BANDWIDTH

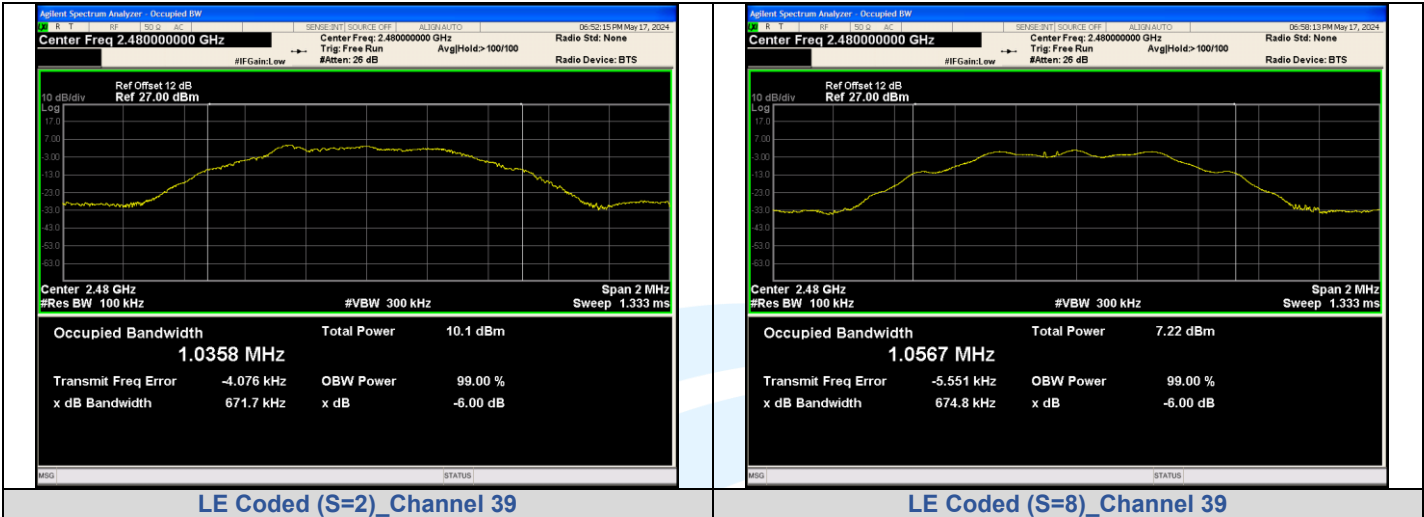
Test Result

Mode	Channel	Center Frequency (MHz)	6 dB Bandwidth (MHz)	Limit (MHz)	Result
LE	0	2402	0.7018	0.5	PASS
	19	2440	0.7437		PASS
	39	2480	0.7232		PASS
2LE	0	2402	1.149		PASS
	19	2440	1.228		PASS
	39	2480	1.156		PASS
LE Coded (S=2)	0	2402	0.6570		PASS
	19	2440	0.7077		PASS
	39	2480	0.6717		PASS
LE Coded (S=8)	0	2402	0.6767		PASS
	19	2440	0.6878		PASS
	39	2480	0.6748		PASS

Test Graphs







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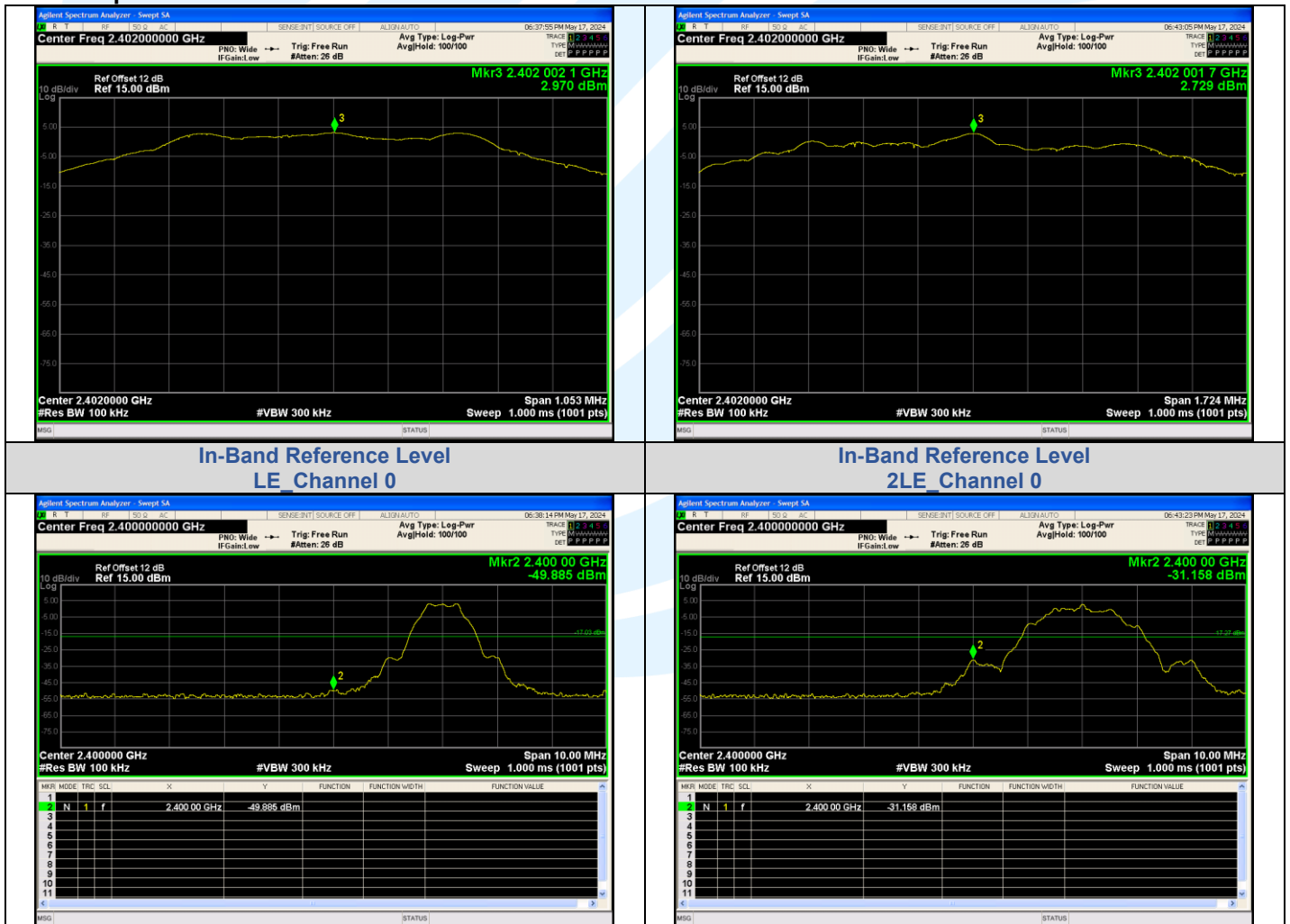
Address: Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and technology park, Longhua district, Shenzhen, China
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A.3 CONDUCTED OUT OF BAND EMISSION

Test Result

Mode	Channel	OOB Emission Frequency (MHz)	OOB Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result
LE	0	2400.00	-49.885	-17.03	-32.855	PASS
		9608.11	-49.554	-17.03	-32.524	PASS
	19	9759.80	-52.068	-17.12	-34.948	PASS
		2483.50	-53.057	-16.88	-36.177	PASS
		24711.6	-53.301	-16.88	-36.421	PASS
2LE	0	2400.00	-31.158	-17.27	-13.888	PASS
		9608.11	-49.528	-17.27	-32.258	PASS
	19	9759.80	-52.667	-17.29	-35.377	PASS
		2483.50	-53.542	-17.12	-36.422	PASS
		24310.8	-54.026	-17.12	-36.906	PASS
LE Coded (S=2)	0	2400.00	-49.836	-16.37	-33.466	PASS
		9608.11	-49.477	-16.37	-33.107	PASS
	19	9759.80	-52.984	-16.48	-36.504	PASS
		2483.50	-52.325	-16.2	-36.125	PASS
		24995.6	-53.436	-16.2	-37.236	PASS
LE Coded (S=8)	0	2400.00	-49.944	-19.46	-30.484	PASS
		9608.11	-49.508	-19.46	-30.048	PASS
	19	9759.80	-51.733	-19.19	-32.543	PASS
		2483.50	-53.158	-19.15	-34.008	PASS
		24953.8	-52.449	-19.15	-33.299	PASS

Test Graphs



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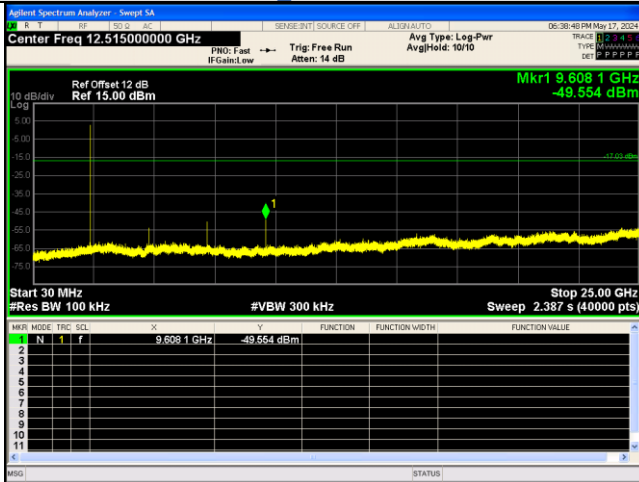
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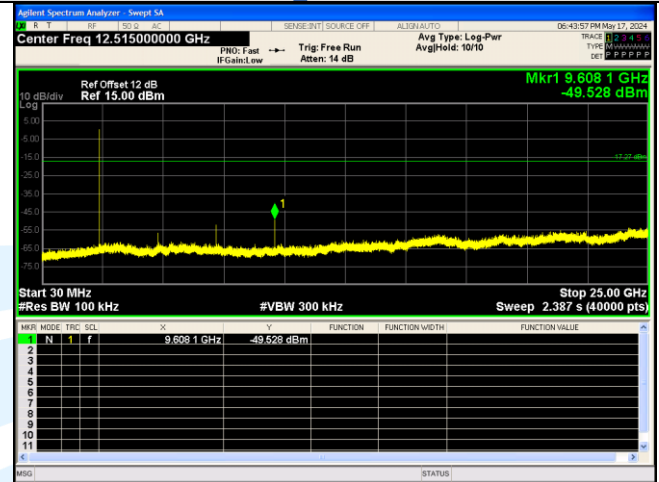
<http://www.uttlab.com>

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Out Of Band Emission LE_Channel 0



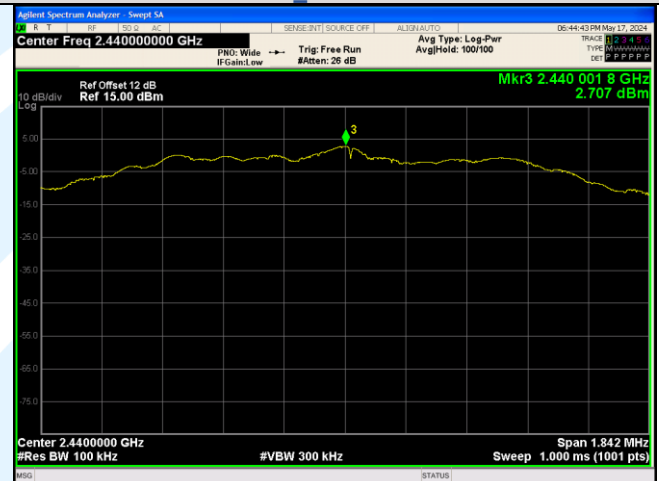
Out Of Band Emission 2LE_Channel 0



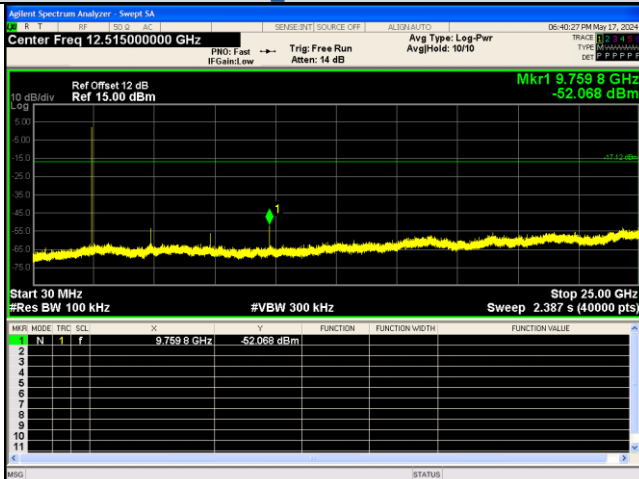
30.0 MHz - 25000.0 MHz LE_Channel 0



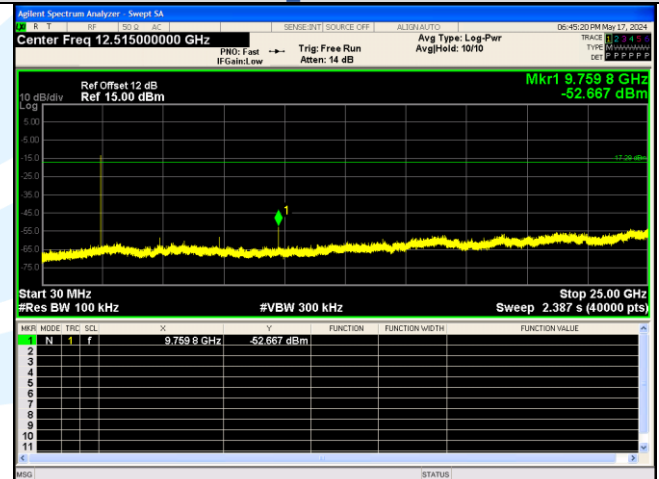
30.0 MHz - 25000.0 MHz 2LE_Channel 0



In-Band Reference Level LE_Channel 19

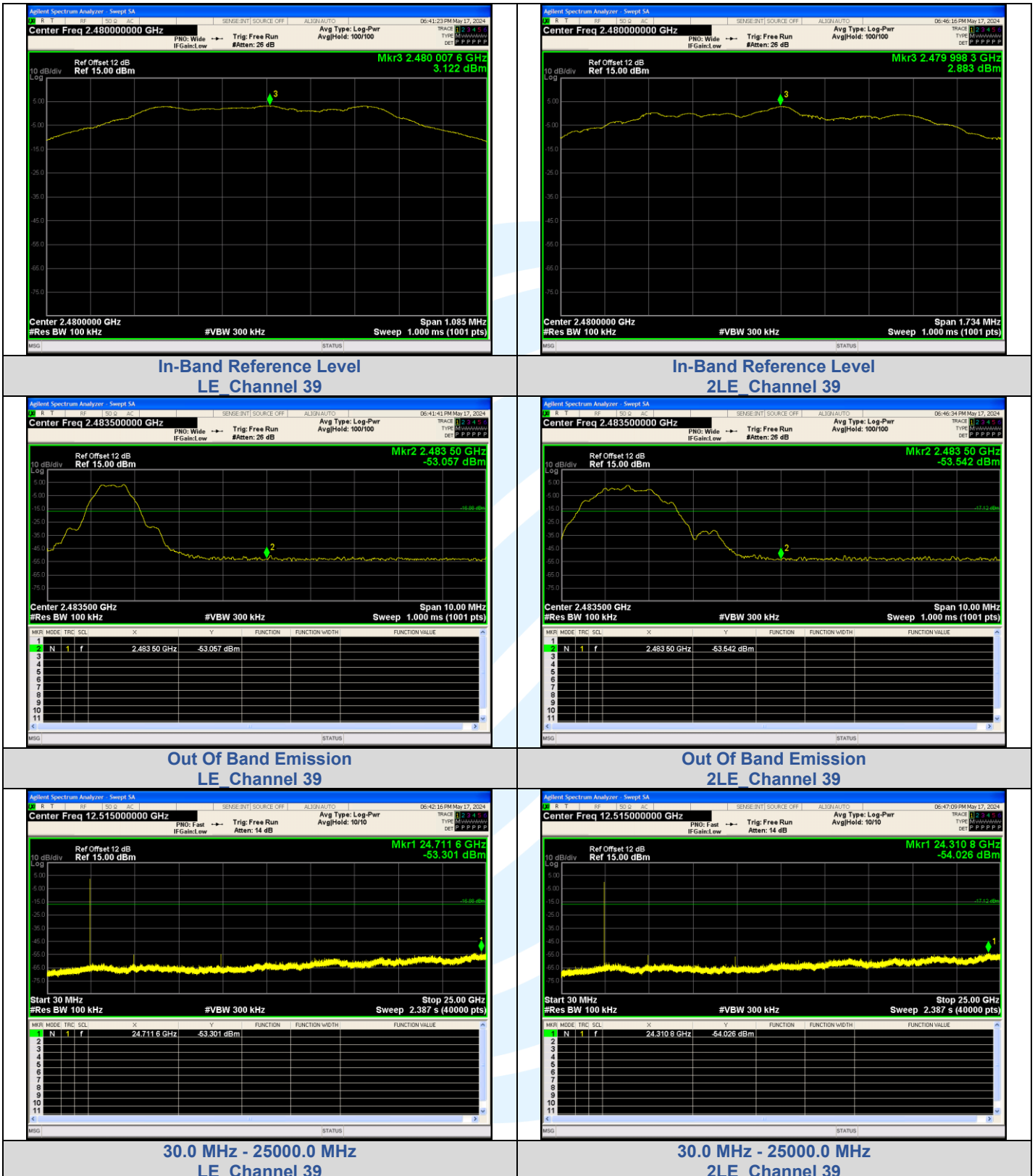


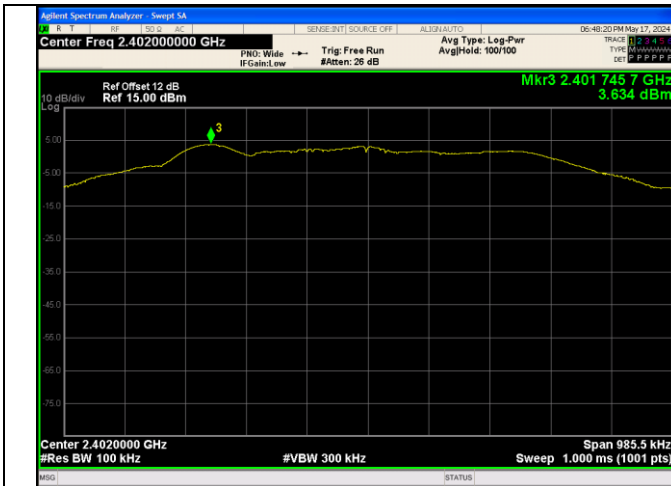
In-Band Reference Level 2LE_Channel 19



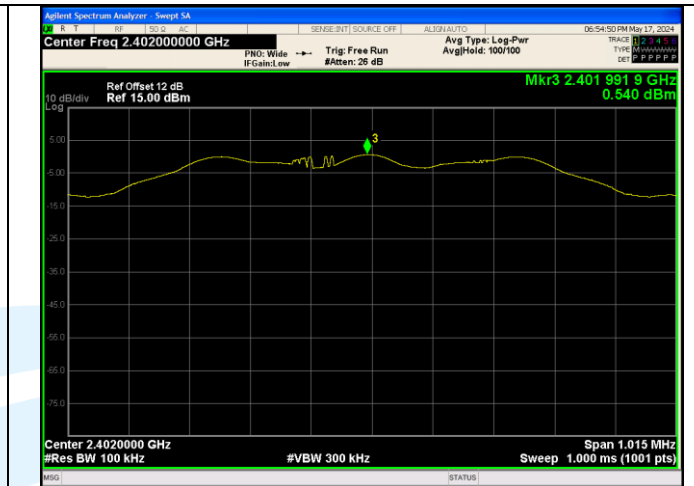
30.0 MHz - 25000.0 MHz LE_Channel 19

30.0 MHz - 25000.0 MHz 2LE_Channel 19

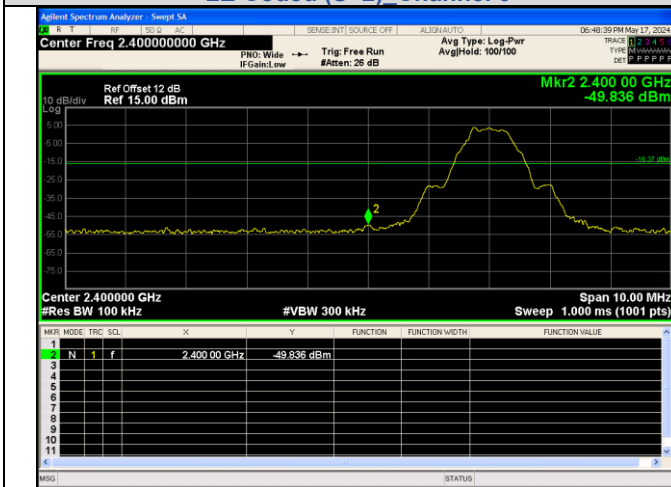




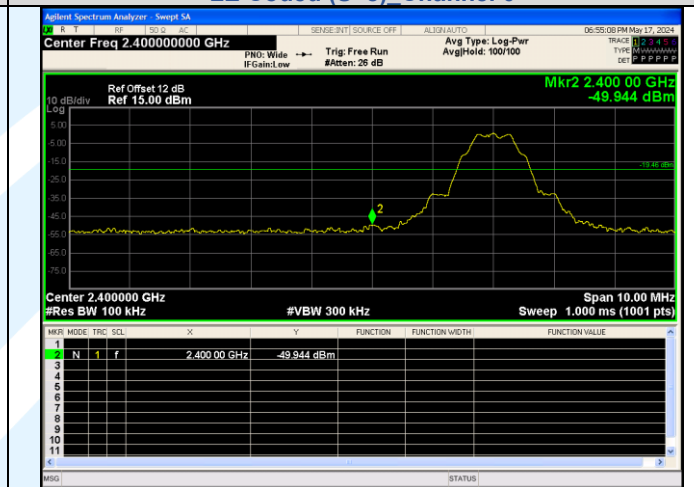
In-Band Reference Level
LE Coded (S=2) Channel 0



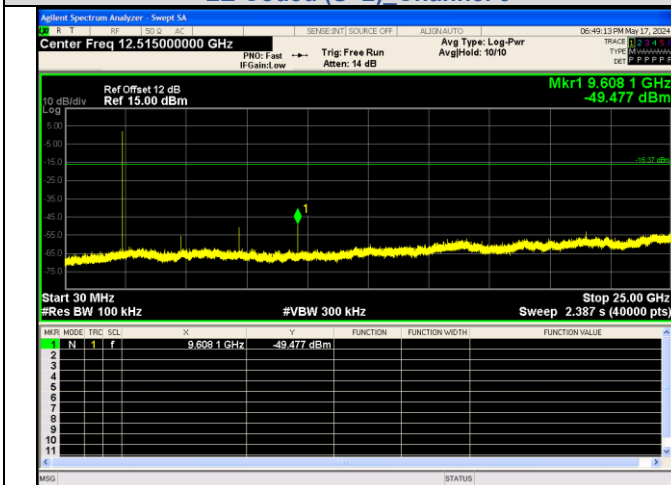
In-Band Reference Level
LE Coded (S=8) Channel 0



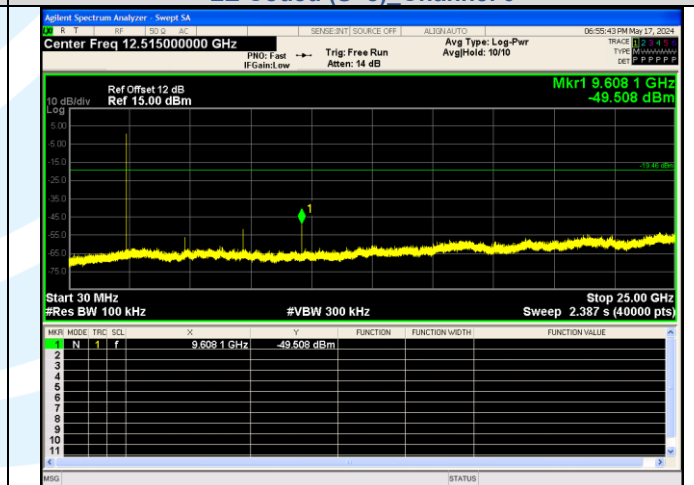
Out Of Band Emission
LE Coded (S=2) Channel 0



Out Of Band Emission
LE Coded (S=8) Channel 0



30.0 MHz - 25000.0 MHz
LE Coded (S=2) Channel 0



30.0 MHz - 25000.0 MHz
LE Coded (S=8) Channel 0