

TEST REPORT

Report Number: 14982484-E5V3

Applicant : APPLE, INC.
1 APPLE PARK WAY
CUPERTINO, CA 95014, U.S. A

Model : A3081 (Parent Model)
A3286, A3287, A3288 (Variant Models)

Brand : APPLE

FCC ID : BCG-E8688A (Parent Model)
BCG-E8689A, BCG-E8690A, BCG-E8691A (Variant Models)

IC : 579C-E8688A (Parent Model)
579C-E8689A, 579C-E8690A, 579C-E8691A (Variant Models)

EUT Description : SMARTPHONE

Test Standard(s) : FCC 47 CFR PART 15 SUBPART C
ISED RSS-247 ISSUE 3
ISED RSS-GEN ISSUE 5 + A1 + A2

Date Of Issue:

2024/08/07

Prepared by:

UL Verification Services Inc.
47173 Benicia Street
Fremont, CA 94538 U.S.A.
TEL: (510) 319-4000
FAX: (510) 661-0888



REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	2024/07/15	Initial Issue	Chin Pang
V2	2024/07/16	Address TCB question section 9, 10	Chin Pang
V3	2024/08/07	Removed blank column	Chin Pang

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	5
2. TEST SUMMARY	7
3. TEST METHODOLOGY	7
4. FACILITIES AND ACCREDITATION	7
5. DECISION RULES AND MEASUREMENT UNCERTAINTY	8
5.1. METROLOGICAL TRACEABILITY	8
5.2. DECISION RULES.....	8
5.3. MEASUREMENT UNCERTAINTY.....	8
5.4. SAMPLE CALCULATION	9
6. EQUIPMENT UNDER TEST	10
6.1. EUT DESCRIPTION	10
6.2. MAXIMUM OUTPUT POWER.....	10
6.3. DESCRIPTION OF AVAILABLE ANTENNAS	10
6.4. SOFTWARE AND FIRMWARE.....	10
6.5. WORST-CASE CONFIGURATION AND MODE.....	11
6.6. DESCRIPTION OF TEST SETUP.....	12
7. MEASUREMENT METHOD.....	15
8. TEST AND MEASUREMENT EQUIPMENT	16
9. ANTENNA PORT TEST RESULTS	18
9.1. ON TIME AND DUTY CYCLE.....	18
9.2. 99% BANDWIDTH.....	19
9.2.1. HIGH POWER	20
9.3. 6 dB BANDWIDTH.....	21
9.3.1. HIGH POWER	22
9.4. OUTPUT POWER.....	23
9.4.1. HIGH POWER	24
9.4.2. LOW POWER	25
9.5. AVERAGE POWER.....	26
9.5.1. HIGH POWER	27
9.5.2. LOW POWER	28
9.6. POWER SPECTRAL DENSITY	29
9.6.1. HIGH POWER	30
9.7. CONDUCTED SPURIOUS EMISSIONS.....	31

9.7.1.	HIGH POWER	32
9.7.2.	LOW POWER	34
10.	RADIATED TEST RESULTS	36
10.1.	TRANSMITTER ABOVE 1 GHz.....	38
10.1.1.	ANT4, 802.15.4 HIGH POWER BANDEDGE	38
10.1.2.	ANT4, 802.15.4 LOW POWER BANDEDGE	42
10.1.3.	ANT4, 802.15.4 HIGH POWER, HARMONICS AND SPURIOUS EMISSIONS.....	46
10.1.4.	ANT4, 802.15.4 LOW POWER, HARMONICS AND SPURIOUS EMISSIONS.....	52
10.1.5.	ANT3, 802.15.4 HIGH POWER BANDEDGE	58
10.1.6.	ANT3, 802.15.4 LOW POWER BANDEDGE	62
10.1.7.	ANT3, 802.15.4 HIGH POWER, HARMONICS AND SPURIOUS EMISSIONS.....	66
10.1.8.	ANT3, 802.15.4 LOW POWER, HARMONICS AND SPURIOUS EMISSIONS.....	72
10.2.	WORST CASE BELOW 1 GHZ	78
10.3.	WORST CASE 18-26 GHZ.....	80
11.	AC POWER LINE CONDUCTED EMISSIONS	82
11.1.	AC Power Line With AC/DC Adapter	83
11.2.	AC Power Line with Laptop	85
12.	SETUP PHOTOS	87

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: APPLE INC.
1 APPLE PARK WAY
CUPERTINO, CA 95014, U.S.A

EUT DESCRIPTION: SMARTPHONE

MODEL: A3081 (Parent Model)
A3286, A3287, A3288

BRAND: APPLE

SERIAL NUMBER: L99GK666X1, LHXD9N2YTF

SAMPLE RECEIPT DATE: 2024/03/05.

DATE TESTED: 2024/03/06 – 2024/07/16.

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Complies
ISED RSS-247 Issue 3	Complies
ISED RSS-GEN Issue 5 + A1 + A2	Complies

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not considered unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, any agency of the Federal Government, or any agency of the U.S. government.

Approved & Released For
UL Verification Services Inc. By:



Frank Ibrahim
Staff Engineer
Consumer Technology Division
UL Verification Services Inc.

Prepared By:



Chris Xiong
Senior Test Engineer
Consumer Technology Division
UL Verification Services Inc.

2. TEST SUMMARY

FCC Clause	ISED Clause	Requirement	Result	Comment
See Comment		Duty Cycle	Reporting purposes only	ANSI C63.10 Section 11.6.
-	RSS-GEN 6.7	99% OBW	Reporting purposes only	ANSI C63.10 Section 6.9.3.
15.247 (a) (2)	RSS-247 5.2 (a)	6dB BW	Complies	None.
15.247 (b) (3)	RSS-247 5.4 (d)	Output Power	Complies	None.
See Comment		Average power	Reporting purposes only	Per ANSI C63.10, Section 11.9.2.3.2.
15.247 (e)	RSS-247 5.2 (b)	PSD	Complies	None.
15.247 (d)	RSS-247 5.5	Conducted Spurious Emissions	Complies	None.
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions	Complies	None.
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions	Complies	None.

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, KDB 558074 D01 DTS Meas Guidance v05r02, RSS-247 Issue 3, KDB 414788 D01 Radiated Test Site v01r01, RSS-GEN Issue 5 + A1 + A2.

4. FACILITIES AND ACCREDITATION

UL Verification Services Inc. is accredited by A2LA, certification #0751.05, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
<input type="checkbox"/>	Building 1: 47173 Benicia Street, Fremont, CA 94538, USA	US0104	2324A	550739
<input checked="" type="checkbox"/>	Building 2: 47266 Benicia Street, Fremont, CA 94538, USA			
<input type="checkbox"/>	Building 3: 843 Auburn Court, Fremont, CA 94538 USA			
<input checked="" type="checkbox"/>	Building 4: 47658 Kato Rd, Fremont, CA 94538 USA			
<input checked="" type="checkbox"/>	Building 5: 47670 Kato Rd, Fremont, CA 94538 USA			

5. DECISION RULES AND MEASUREMENT UNCERTAINTY

5.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

5.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

5.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	U _{LAB}
Conducted Antenna Port Emission Measurement	1.94
Power Spectral Density	2.466
Time Domain Measurements Using SA	3.39
RF Power Measurement Direct Method Using Power Meter	0.450 (Peak), 1.3 (Ave)
Radio Frequency (Spectrum Analyzer)	141.16 Hz
Occupied Bandwidth	1.2%
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.78 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.40 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.87 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	6.01 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.73 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.51 dB

Uncertainty figures are valid to a confidence level of 95%.

5.4. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable

Loss (dB) – Preamp Gain (dB)

$36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} = 28.9 \text{ dBuV/m}$

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) +

LISN Insertion Loss.

$36.5 \text{ dBuV} + 0 \text{ dB} + 10.1 \text{ dB} + 0 \text{ dB} = 46.6 \text{ dBuV}$

6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The Apple iPhone is a smartphone with cellular GSM, GPRS, EGPRS, WCDMA, LTE, 5G NR1, 5G NR2, IEEE 802.11a/b/g/n/ac/ax/be, Bluetooth (BT), Ultra-Wideband (UWB), Global Positioning System (GPS), Near-Field Communication (NFC), Narrow-Band (NB) UNII, 802.15.4, 802.15.4ab-Narrow Band (NB), WPT (wireless Power Transfer) and Mobile Satellite Service (MSS) technologies. The rechargeable battery is not user accessible. This device is not user-serviceable and requires special tools to disassemble.

6.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Antenna	Configuration	Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
ANT 4	High Power	2405 - 2475	802.15.4	21.28	134.28
	Low Power			10.74	11.86
ANT 3	High Power	2405 - 2475	802.15.4	21.26	133.66
	Low Power			10.73	11.83

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

The antenna(s) type is IFA type.

The antenna(s) gains, as provided by the manufacturer, are as follows:

Frequency Range (GHz)	ANT 4 (dBi)	ANT 3 (dBi)
2.4	0.5	-1.6

SMA Cable used for RF conducted testing has a loss as follows:

Loss used for Antenna 4 is 1.98 dB

Loss used for Antenna 3 is 2.18 dB

The cables were used for RF antenna port tests that had been offset to the test equipment during testing.

6.4. SOFTWARE AND FIRMWARE

The EUT firmware and software version installed during testing was 22.1.76.242

6.5. WORST-CASE CONFIGURATION AND MODE

The EUT was investigated in three orthogonal orientations X, Y and Z on ANT 4, and ANT 3. It was determined that X (Flatbed) was the worst-case orientation for ANT 4 and ANT 3.

Radiated band edge, harmonic, and spurious emissions from 1GHz to 18GHz were performed with the EUT was set to transmit at highest power on Low/Middle/High channels.

Radiated emissions below 1GHz, 18-26GHz and power line conducted emissions were performed with the EUT transmits at the channel with the highest output power as worst-case scenario. There were no emissions found below 30MHz within 20dB of the limit.

For below 1GHz tests were performed with EUT connected to AC power adapter as the worst case; and for above 1GHz, the worst-case configuration reported was tested with EUT only. For AC line conducted emission, test was investigated with AC power adapter and with laptop.

For simultaneous transmission of multiple channels in the 2.4GHz and 5GHz bands. No noticeable emission was found.

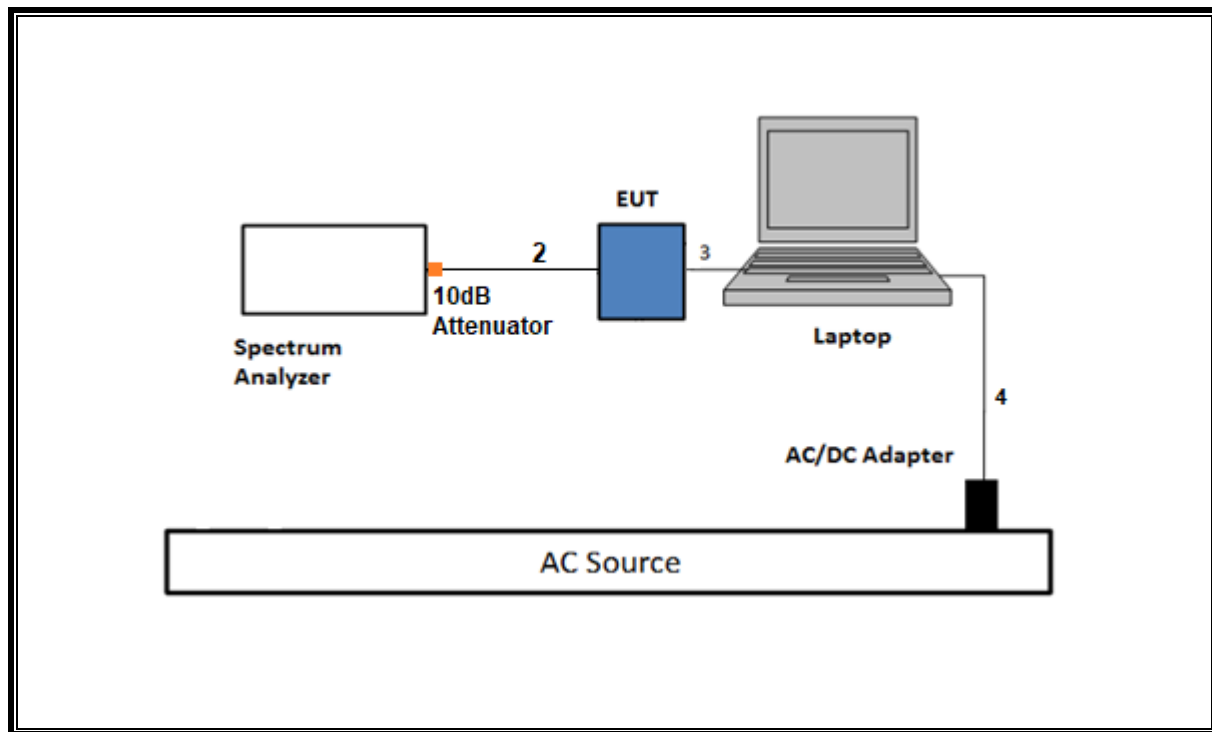
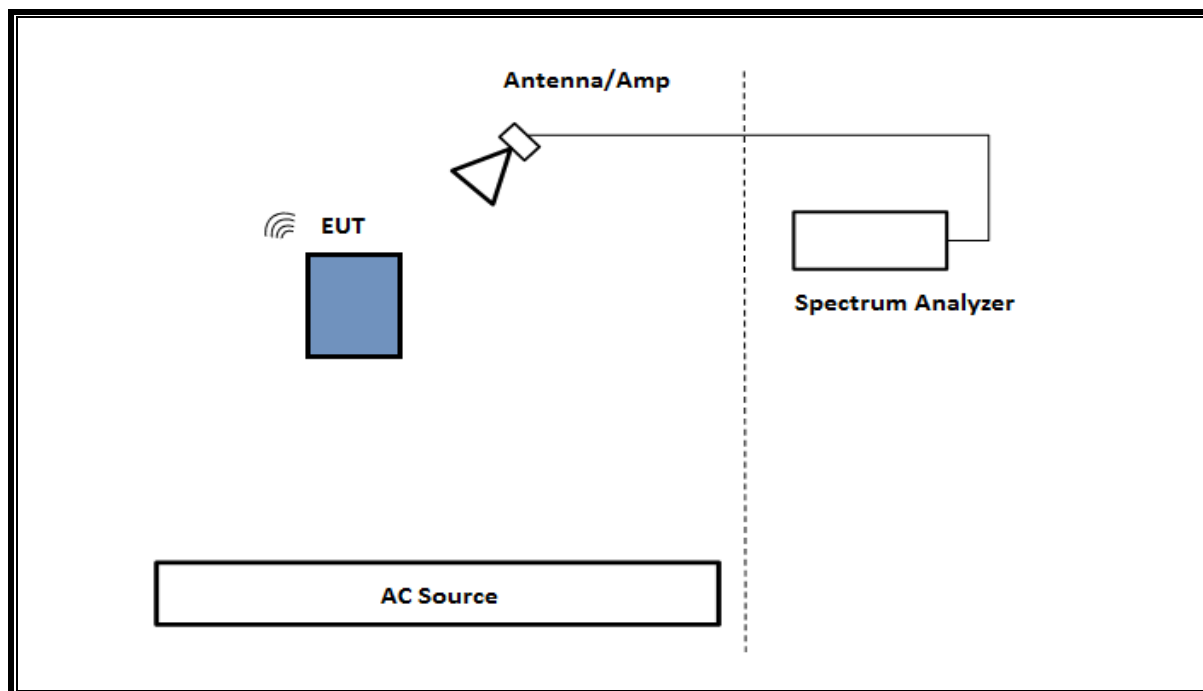
Note: In the Radiated Plots and emissions data, ANT0=ANT4 and ANT1=ANT 3.

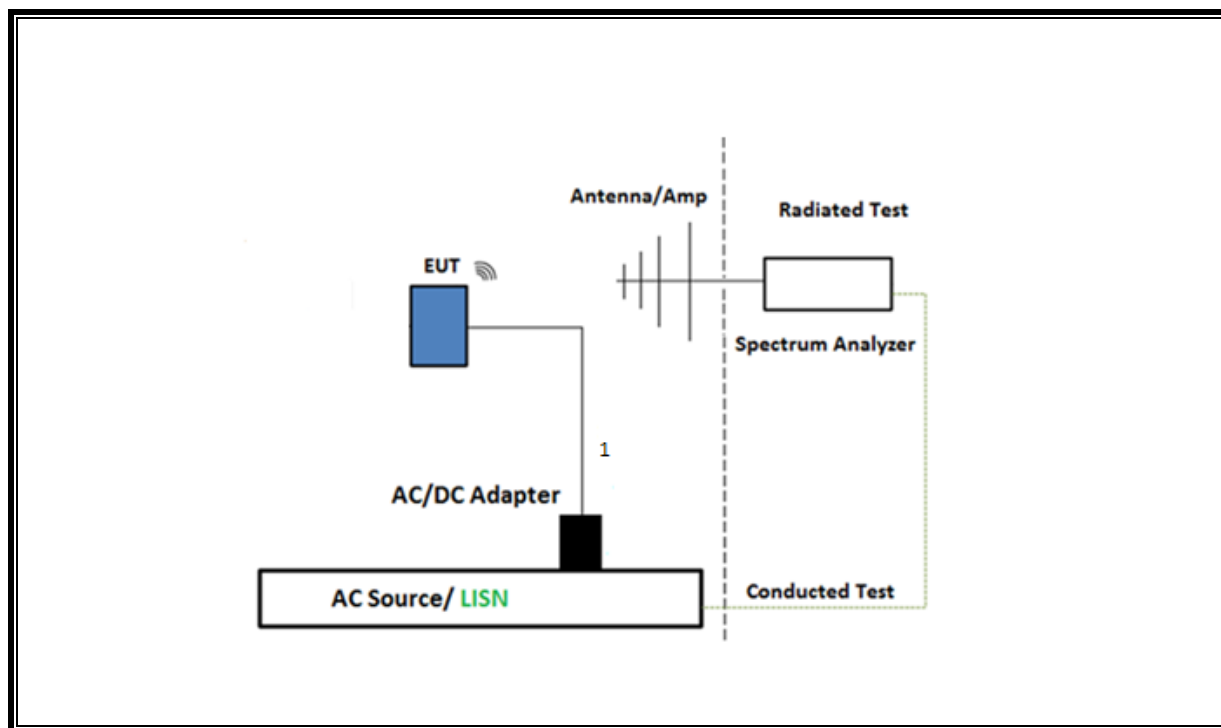
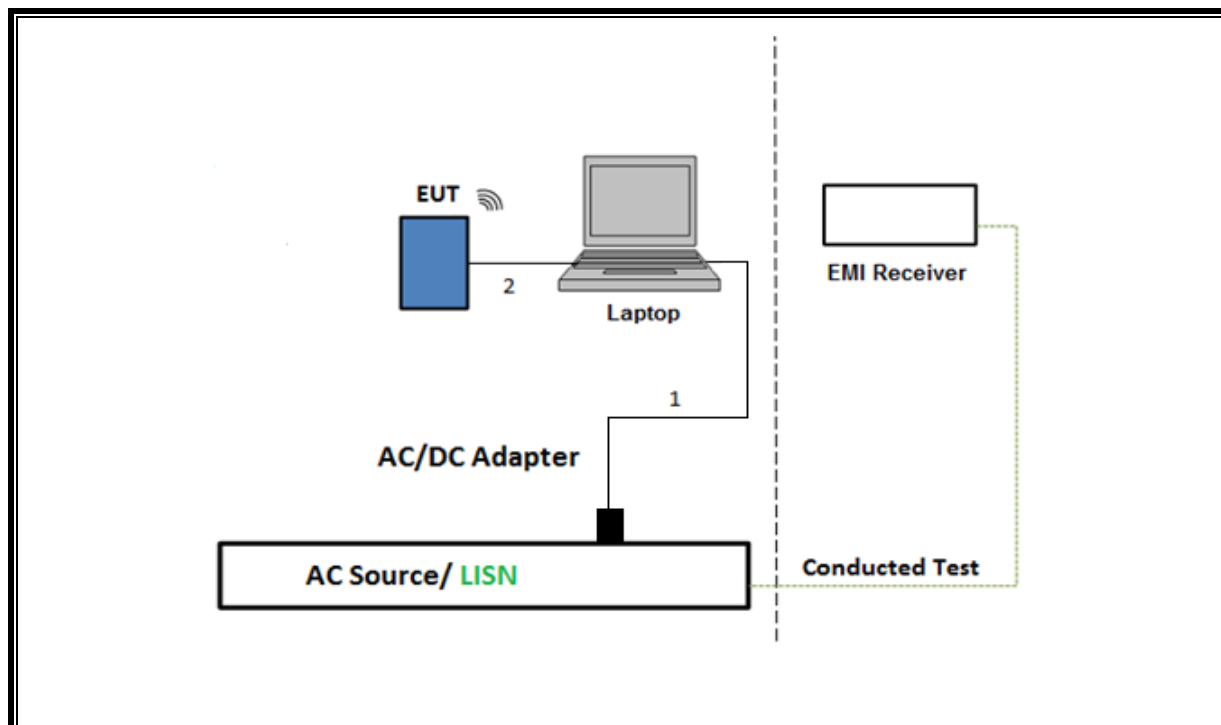
6.6. DESCRIPTION OF TEST SETUP

SUPPORT TEST EQUIPMENT						
Description		Manufacturer	Model	Serial Number		FCC ID/ DoC
Laptop		Apple	Macbook Pro	C02VD7SAHV22		BCGA1708
Laptop AC/DC adapter		Liteon Technology	A1424	NSW25679		DoC
EUT AC/DC adapter		Apple	A1720	C3D8417A7R93KVPA8		DoC
10dB Fixed Attenuator, 2 Watts Up to 26.5 GHz		Pasternack Enterprises	PE7024-10	236353		N/A
I/O CABLES (RF CONDUCTED TEST)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	SMA	1	SMA	Shielded	0.75	To spectrum Analyzer
2	Antenna	2	SMA	Un-shielded	0.2	To Conducted Switch Box
3	USB-C	1	USB-C	Shielded	1.0	N/A
4	AC	1	AC	Un-shielded	2	N/A
I/O CABLES (RF RADIATED AND AC LINE CONDUCTED TEST)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Un-shielded	2	N/A
2	USB	1	USB	Shielded	1	N/A

TEST SETUP

The EUT setup is shown as below. Test software exercised the radio card.

SETUP DIAGRAM FOR CONDUCTED TESTS**SETUP DIAGRAM FOR RADIATED TESTS Above 1 GHz (1 to 26.5GHz)**

SETUP DIAGRAM FOR 30-1000MHz and AC LINE CONDUCTED TEST**TEST SETUP- AC LINE CONDUCTED: LAPTOP CONFIGURATION**

7. MEASUREMENT METHOD

On Time and Duty Cycle: KDB 558074 D01 v05r02, Section 6.

6 dB BW: ANSI C63.10 Subclause -11.8.1 RBW \geq DTS BW

Occupied BW (99%): ANSI C63.10 Section 6.9.3

Output Power: ANSI C63.10 Subclause -11.9.1.3 Method PKPM1 Peak-reading power meter

Output Power: ANSI C63.10 Subclause -11.9.2.3.2 Measurement using gated average power meter.

PSD: ANSI C63.10 Subclause -11.10.2 Method PKPSD (peak PSD)

Radiated emissions restricted frequency bands: ANSI C63.10 Subclause -11.12.1 & Clause 13

Conducted emissions in restricted frequency bands: ANSI C63.10 Subclause -11.12.2

Band-edge: ANSI C63.10 Subclause -11.13.3.2 & Clause 13: Integration method -Peak detection

Band-edge: ANSI C63.10 Subclause -11.13.3.3 & Clause 13: Integration method -Trace averaging with continuous transmission at full power

AC Power Line Conducted Emissions: ANSI C63.10, Section 6.2.

Radiated emissions non-restricted frequency bands ANSI C63.10 Subclause -11.11 & Clause 13

Radiated Spurious Emissions Below 30MHz: ANSI C63.10 Section 6.4 & 13

8. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Description	Manufacturer	Model	ID Num	Cal Due
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	84797	2024/09/30
RF Filter Box, 1-18GHz	Miteq	UL-FR1	216812	2025/01/30
EMI Test Receiver	Rohde & Schwarz	ESW44	223461	2025/02/28
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	206806	2025/02/28
RF Filter Box, 1-18GHz, 17 Ports	UL-FR1	RATS 2	224478	2025/01/31
EMI Test Receiver	Rohde & Schwarz	ESW44	201500	2025/02/28
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	41112	2024/10/31
RF Filter Box, 1-18GHz, 12 Ports	UL-FR1	Frankenstein	217255	2024/10/31
EMI Test Receiver	Rohde & Schwarz	ESW44	225683	2025/02/28
*Antenna, Horn 1-18GHz	ETS-Lindgren	3117	206808	2024/03/31
RF Filter Box, 1-18GHz, 12 Port.	UL-FR1	Frankenstein	231874	2024/08/30
*EMI TEST RECEIVER	Rohde & Schwarz	ESW44	226079	2024/05/01
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	80404	2024/08/31
RF Filter Box, 1-18GHz, 17 Ports	UL-FR1	RATS 2	225474	2025/04/30
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	230548	2025/02/28
Antenna, Broadband Hybrid, 30MHz to 3GHz	Sunol Sciences Corp.	JB3	203090	2025/02/29
Link File, @3m, 9kHz-1000MHz Hybrid Path Loss	UL-FR1	Port 0 Factors	226862	2025/01/31
10dB Fixed Attenuator	Pasternack Enterprises	PE7087-10	178557	Verified Before Use
Antenna, Horn 18 to 26.5GHz	A.R.A	MWH-1826/B	81139	2024/08/31
Link File, RF Amplifier Assembly, 18-26.5GHz, 60dB Gain	AMPLICAL	AMP18G26.5-60	220194	2024/08/31
Antenna, Passive Loop 30Hz - 1MHz	ELECTRO-METRICS	EM-6871	170014	2024/08/31
Antenna, Passive Loop 100kHz to 30MHz	ELECTRO-METRICS	EM-6872	170016	2024/08/31
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight Technologies Inc	N9030A	80397	2025/01/31
Spectrum Analyzer, PXA, 3Hz to 50GHz w/Ext. Mixer	Keysight Technologies Inc	N9030A	80400	2025/02/02
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Keysight Technologies Inc	N1921A	80120	2025/01/31
Power Meter, P-series single channel	Keysight Technologies Inc	N1911A	90731	2025/01/31

AC Line Conducted				
Description	Manufacturer	Model	ID Num	Cal Due
EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESR	93091	2025/02/28
LISN for Conducted Emissions CISPR-16	FISCHER CUSTOM COMMUNICATIONS	FCC-LISN- 50/250-25-2-01- 480V	175765	2025/01/31
Transient Limiter	TE	TBFL1	207996	2024/08/31
UL AUTOMATION SOFTWARE				
Radiated Software	UL	UL EMC	Ver 9.5, 2023, May 1	
Conducted Software	UL	UL EMC	2020.8.16	
AC Line Conducted Software	UL	UL EMC	Ver 9.5, 2023, Mar 3	

*Testing was completed before equipment calibration date

9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

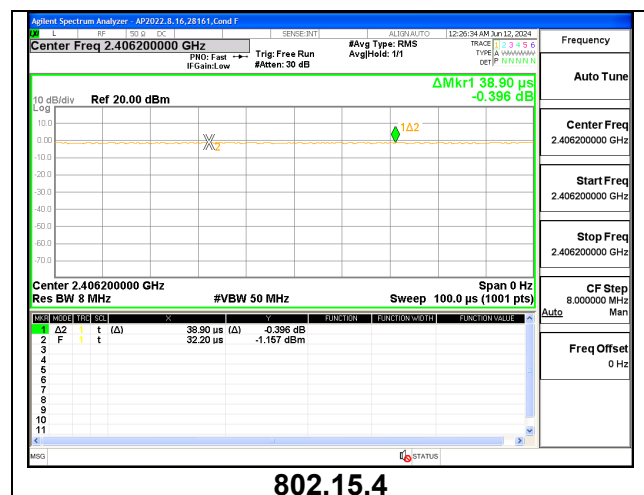
PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
2.4GHz Band						
802.15.4, 2405MHz	0.39	0.39	1.000	100.00%	0.00	0.010

DUTY CYCLE PLOTS



9.2. 99% BANDWIDTH**LIMITS**

None; for reporting purposes only.

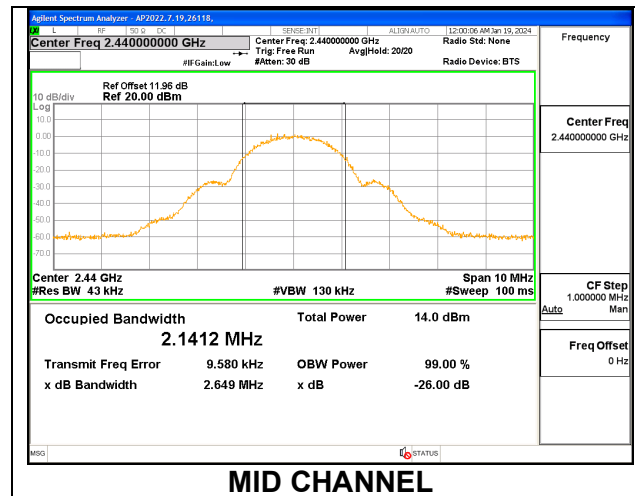
RESULTS

Only High-Power modes result is reported, it covers all Low Power modes. Only Mid channel plot is reported to show setting parameter complies with testing method/procedure.

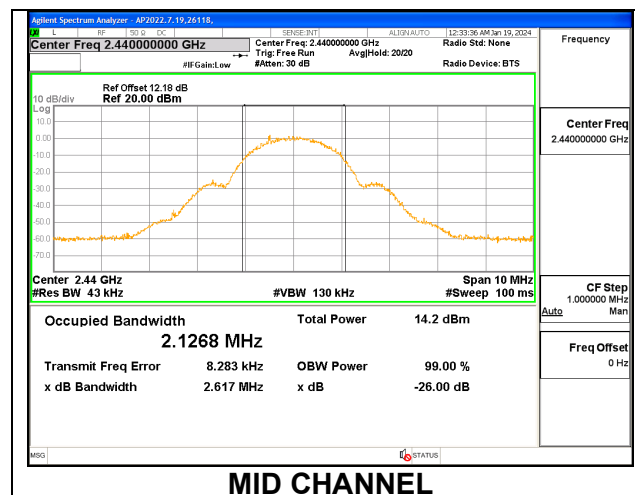
9.2.1. HIGH POWER

ANT 4

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2405	2.1227
Middle	2440	2.1412
High	2475	2.1336

ANT 3

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2405	2.1353
Middle	2440	2.1268
High	2475	2.1393



9.3. 6 dB BANDWIDTH

LIMITS

FCC §15.407 (e)

RSS-247 5.2 (a)

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

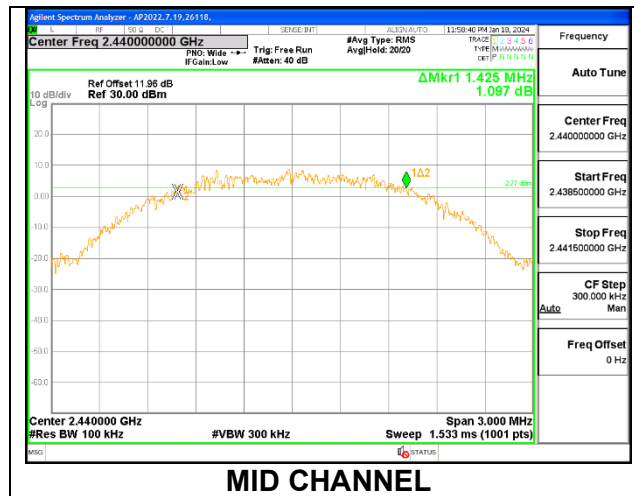
RESULTS

Only High-Power modes result is reported, it covers all Low Power modes. Only Mid channel plot is reported to show setting parameter complies with testing method/procedure.

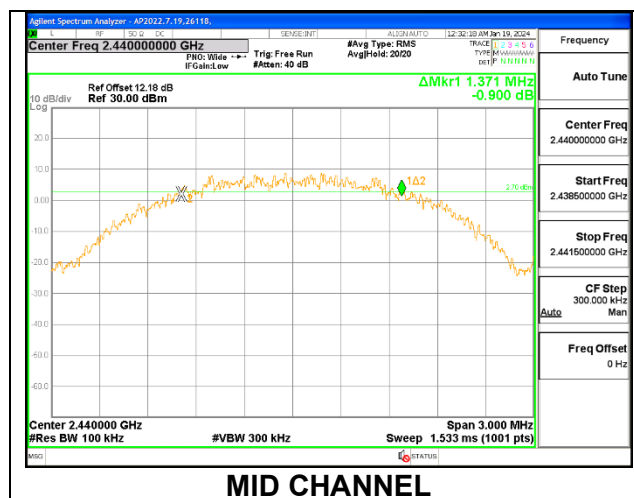
9.3.1. HIGH POWER

ANT 4

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2405	1.458	0.5
Middle	2440	1.425	0.5
High	2475	1.425	0.5

ANT 3

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2405	1.446	0.5
Middle	2440	1.371	0.5
High	2475	1.407	0.5



9.4. OUTPUT POWER

LIMITS

FCC §15.247 (b) (3)

RSS-247 5.4 (d)

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

Measurements perform using a wideband RF power meter.

The power output was measured on the EUT antenna port using SMA cable with 10dB attenuator connected to a power meter via wideband peak power sensor. Peak output power was read directly from the power meter.

DIRECTIONAL ANTENNA GAIN

For 1 TX:

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

RESULTS

9.4.1. **HIGH POWER****ANT 4**

Tested By:	28502
Date:	7/16/2024

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2405	21.25	30	-8.75
Middle	2440	21.28	30	-8.72
High	2475	21.22	30	-8.78

ANT 3

Tested By:	28502
Date:	7/16/2024

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2405	21.24	30	-8.76
Middle	2440	21.22	30	-8.78
High	2475	21.26	30	-8.74

9.4.2. **LOW POWER****ANT 4**

Tested By:	28502
Date:	7/16/2024

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2405	10.65	30	-19.35
Middle	2440	10.74	30	-19.26
High	2475	10.62	30	-19.38

ANT 3

Tested By:	28502
Date:	7/16/2024

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2405	10.57	30	-19.43
Middle	2440	10.65	30	-19.35
High	2475	10.73	30	-19.27

9.5. AVERAGE POWER

TEST PROCEDURE

Measurements perform using a wideband RF power meter.

The power output was measured on the EUT antenna port using SMA cable with 10dB attenuator connected to a power meter via wideband average power sensor. Gated average output power was read directly from power meter.

RESULTS

9.5.1. **HIGH POWER****ANT 4**

Tested By:	28502
Date:	7/16/2024

Channel	Frequency (MHz)	AV power (dBm)
Low	2405	20.45
Middle	2440	20.47
High	2475	20.40

ANT 3

Tested By:	28502
Date:	7/16/2024

Channel	Frequency (MHz)	AV power (dBm)
Low	2405	20.43
Middle	2440	20.41
High	2475	20.45

9.5.2. LOW POWER**ANT 4**

Tested By:	28502
Date:	7/16/202

Channel	Frequency	AV power
	(MHz)	(dBm)
Low	2405	9.85
Middle	2440	9.92
High	2475	9.80

ANT 3

Tested By:	28502
Date:	7/16/2024

Channel	Frequency	AV power
	(MHz)	(dBm)
Low	2405	9.75
Middle	2440	9.82
High	2475	9.90

9.6. POWER SPECTRAL DENSITY

LIMITS

None; for reporting purposes only.

LIMITS

FCC §15.247 (e)

RSS-247 (5.2) (b)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

RESULTS

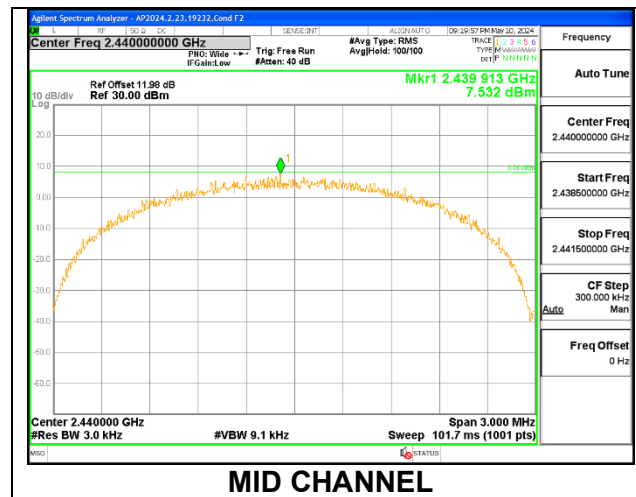
Only Mid channel plot is reported to show setting parameter complies with testing method/procedure.

Only High-Power modes result is reported, it covers all Low Power modes.

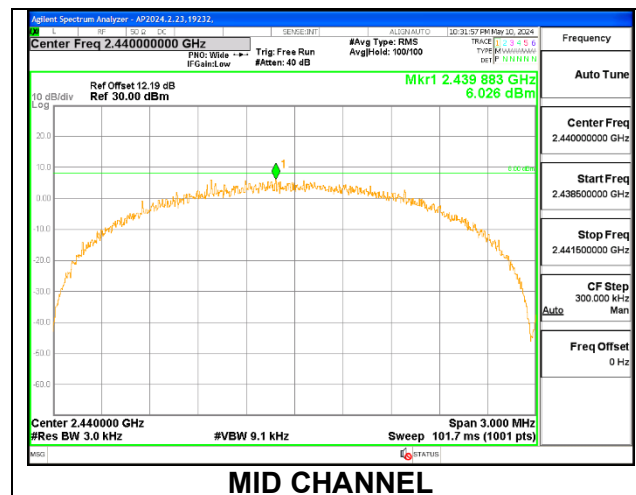
9.6.1. HIGH POWER

ANT 4

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2405	7.120	8	-0.88
Middle	2440	7.532	8	-0.47
High	2475	6.056	8	-1.94

ANT 3

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2405	7.238	8	-0.76
Middle	2440	6.026	8	-1.97
High	2475	6.331	8	-1.67



9.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

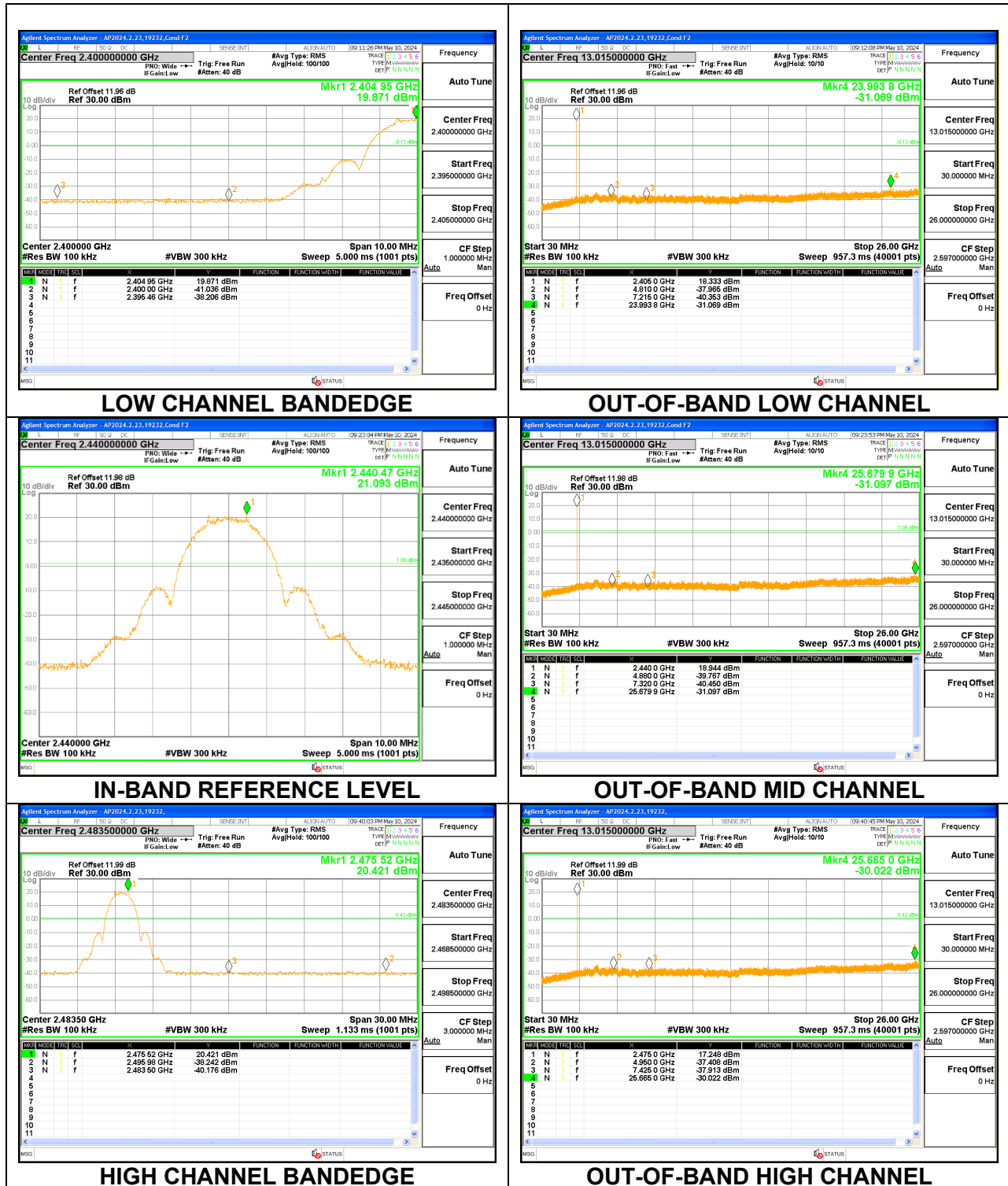
RSS-247 5.5

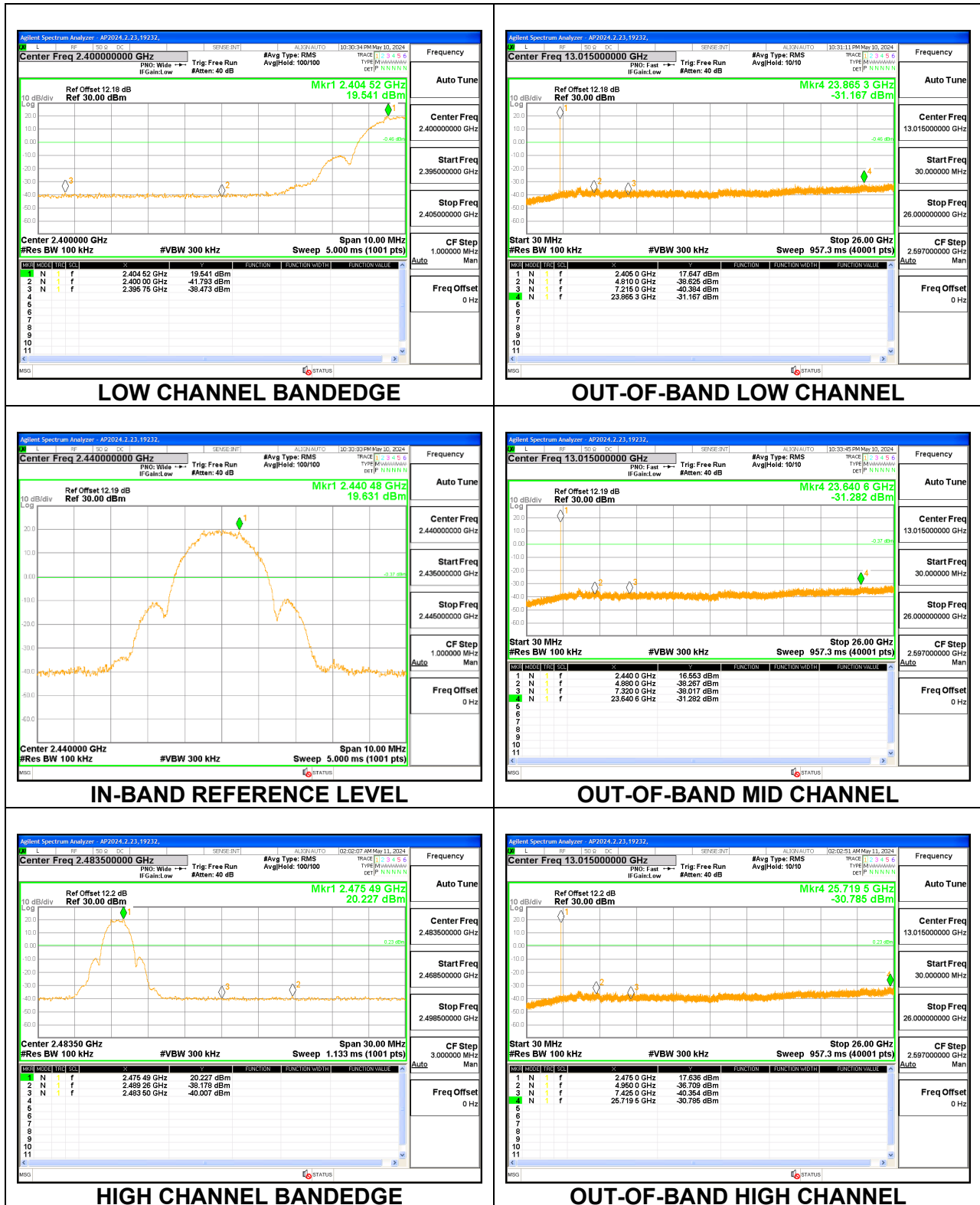
Output power was measured based on the use of a peak measurement; therefore the required attenuation is 20 dBc.

RESULTS

9.7.1. HIGH POWER

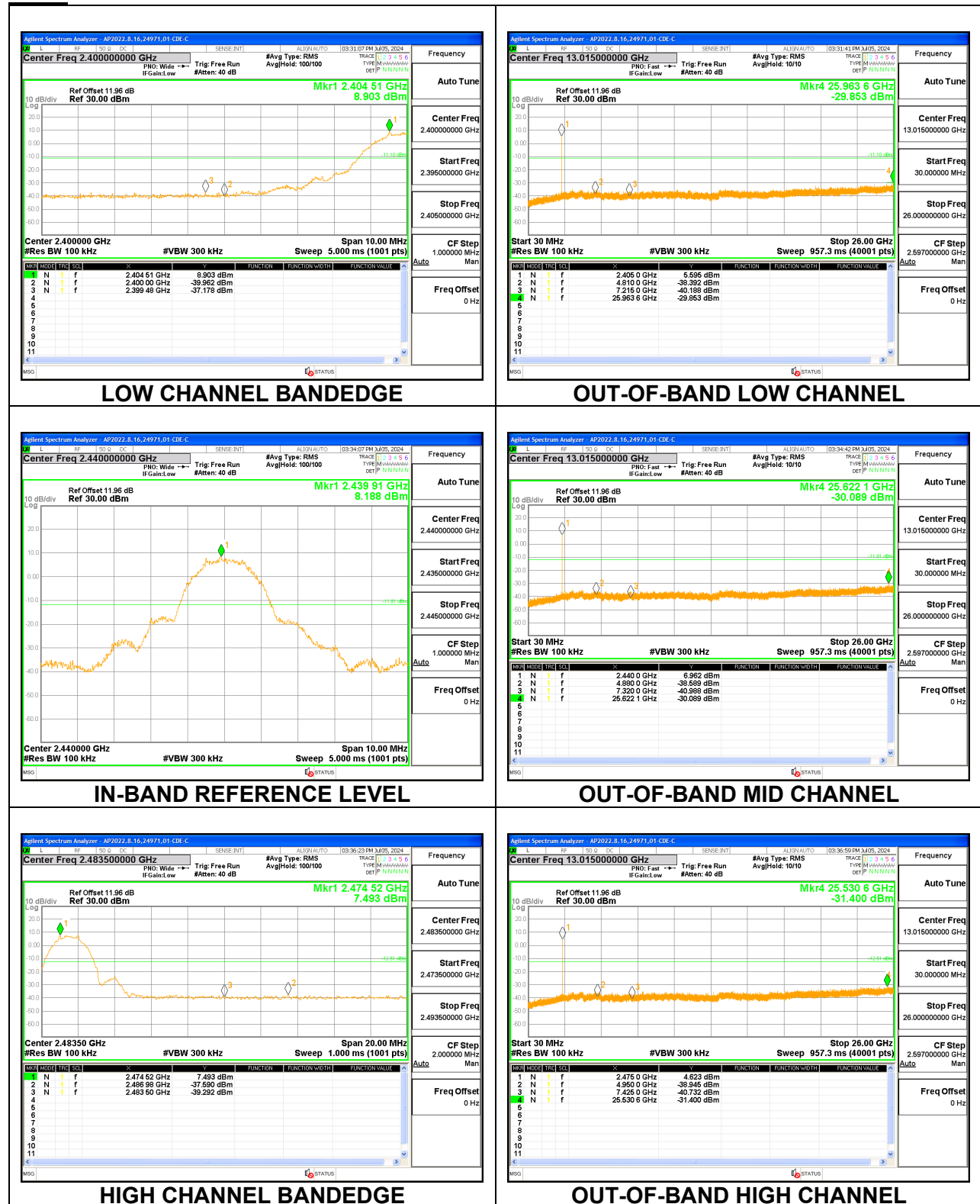
ANT 4



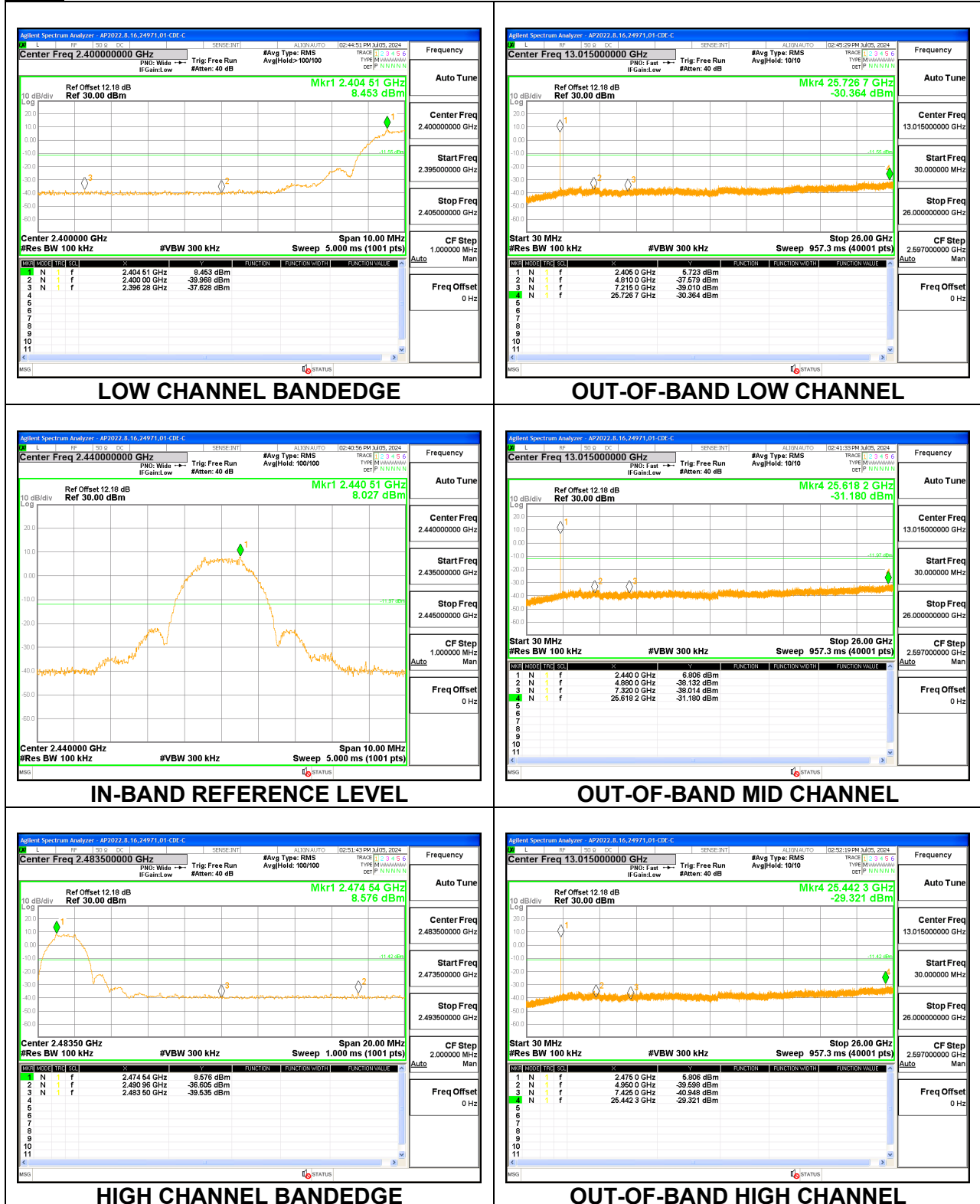
ANT 3

9.7.2. LOW POWER

ANT 4



ANT 3



10. RADIATED TEST RESULTS

LIMITS

FCC §15.205 and §15.209

RSS-GEN, Section 8.9 and 8.10.

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	2400/F(kHz) @ 300 m	-
0.490-1.705	24000/F(kHz) @ 30 m	-
1.705 - 30	30 @ 30m	-
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz: 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

Note: The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as report in the table) using free space impedance of 377 Ohms. For example, the measurement at frequency X kHz resulted in a level of Y dBuV/m, which is equivalent to $Y - 51.5 = Z$ dBuA/m, which has the same margin, W dB to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

KDB 414788 Open Field Site(OFS) and Chamber Correlation Justification

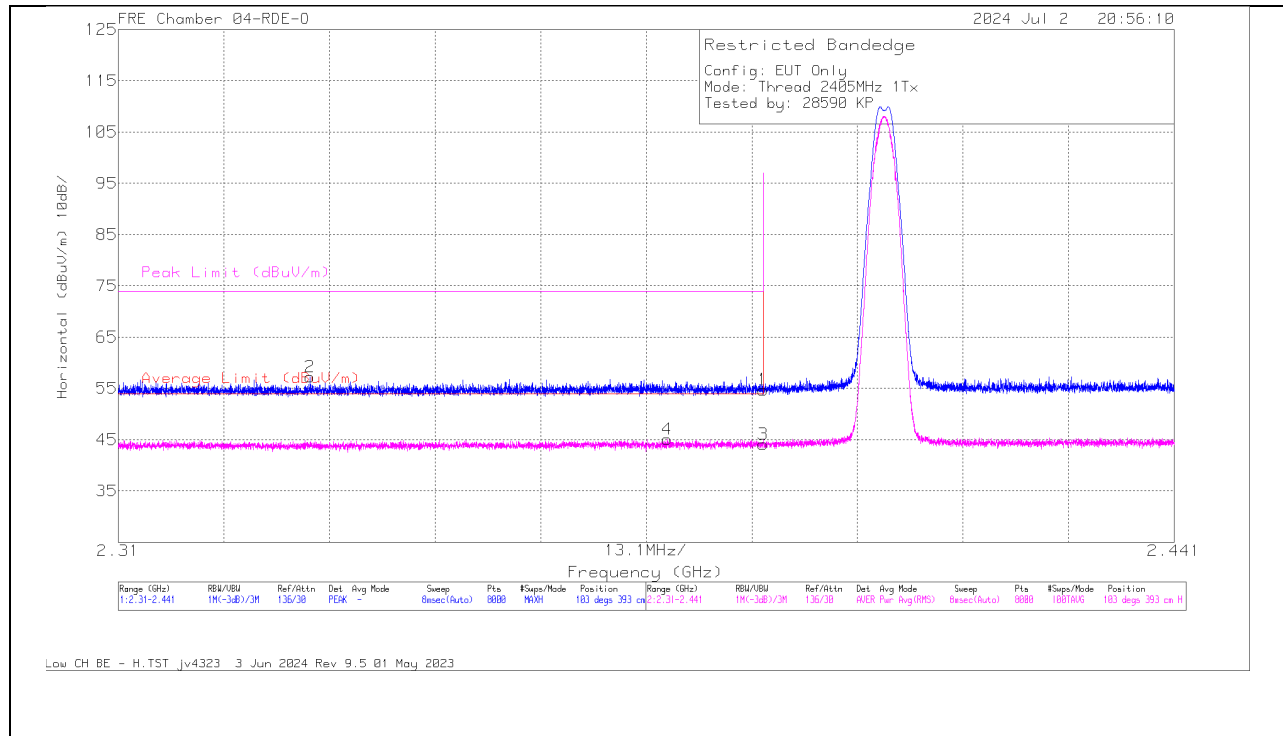
OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

10.1. TRANSMITTER ABOVE 1 GHz

10.1.1. ANT4, 802.15.4 HIGH POWER BANDEDGE

Low Channel

HORIZONTAL RESULT



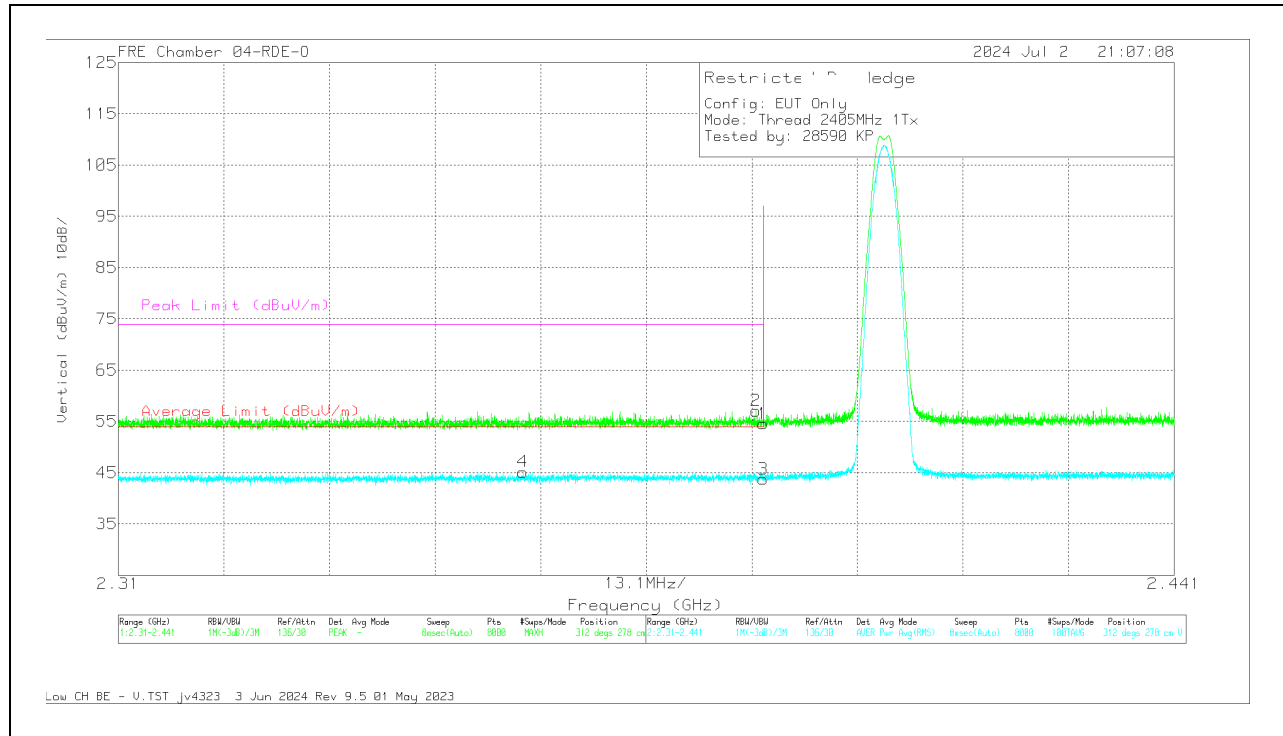
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	80402 1m ACF (dB/m)	DCCF (dB)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	(dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	*2.33812	62.24	Pk	32.4	0	-37.4	57.24	-	-	74	-16.76	103	393	H
4	*2.378112	50.07	RMS	32.5	0	-37.5	45.07	54	-8.93	-	-	103	393	H
1	*2.39	59.8	Pk	32.5	0	-37.6	54.7	-	-	74	-19.3	103	393	H
3	*2.39	49.2	RMS	32.5	0	-37.6	44.1	54	-9.9	-	-	103	393	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	80402 1m ACF (dB/m)	DCCF (dB)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	*2.360196	50.23	RMS	32.4	0	-37.48	45.15	54	-8.85	-	-	312	278	V
2	*2.389117	62.09	Pk	32.5	0	-37.51	57.08	-	-	74	-16.92	312	278	V
1	*2.39	59.62	Pk	32.5	0	-37.6	54.52	-	-	74	-19.48	312	278	V
3	*2.39	48.81	RMS	32.5	0	-37.6	43.71	54	-10.29	-	-	312	278	V

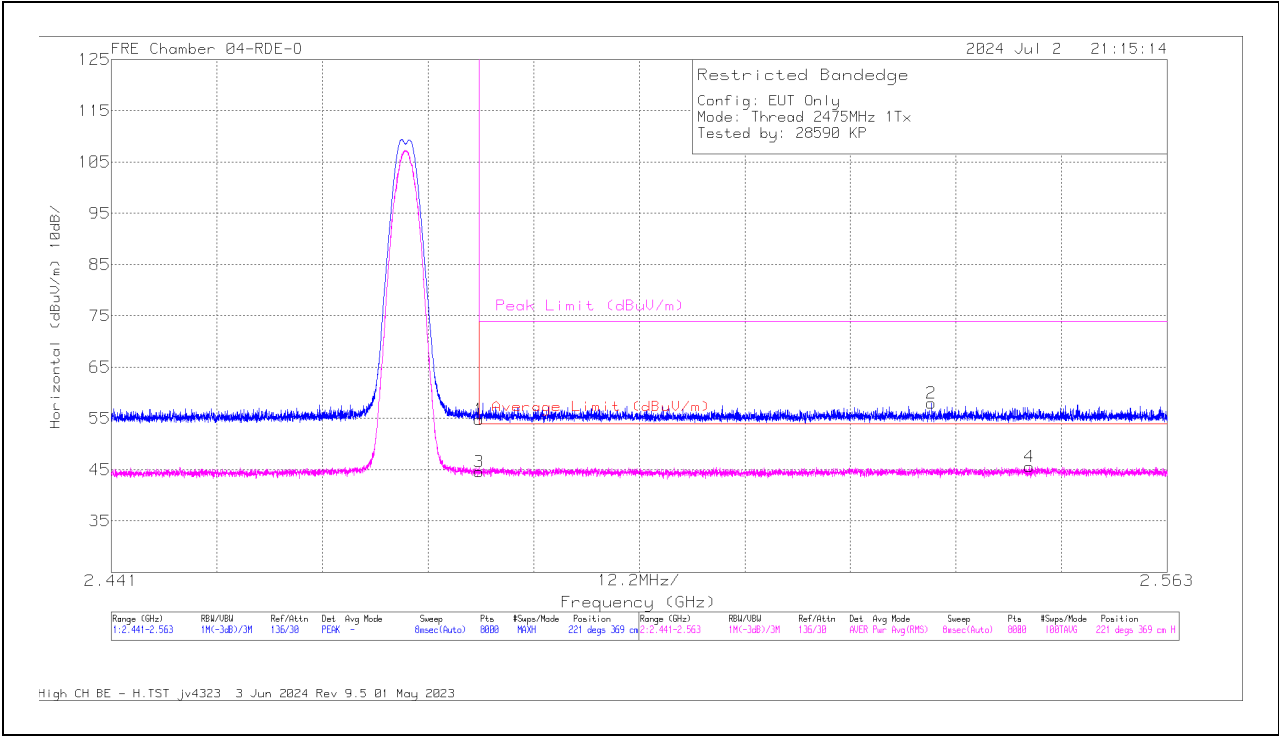
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK - Peak detector

RMS - RMS detection

High CHANNEL

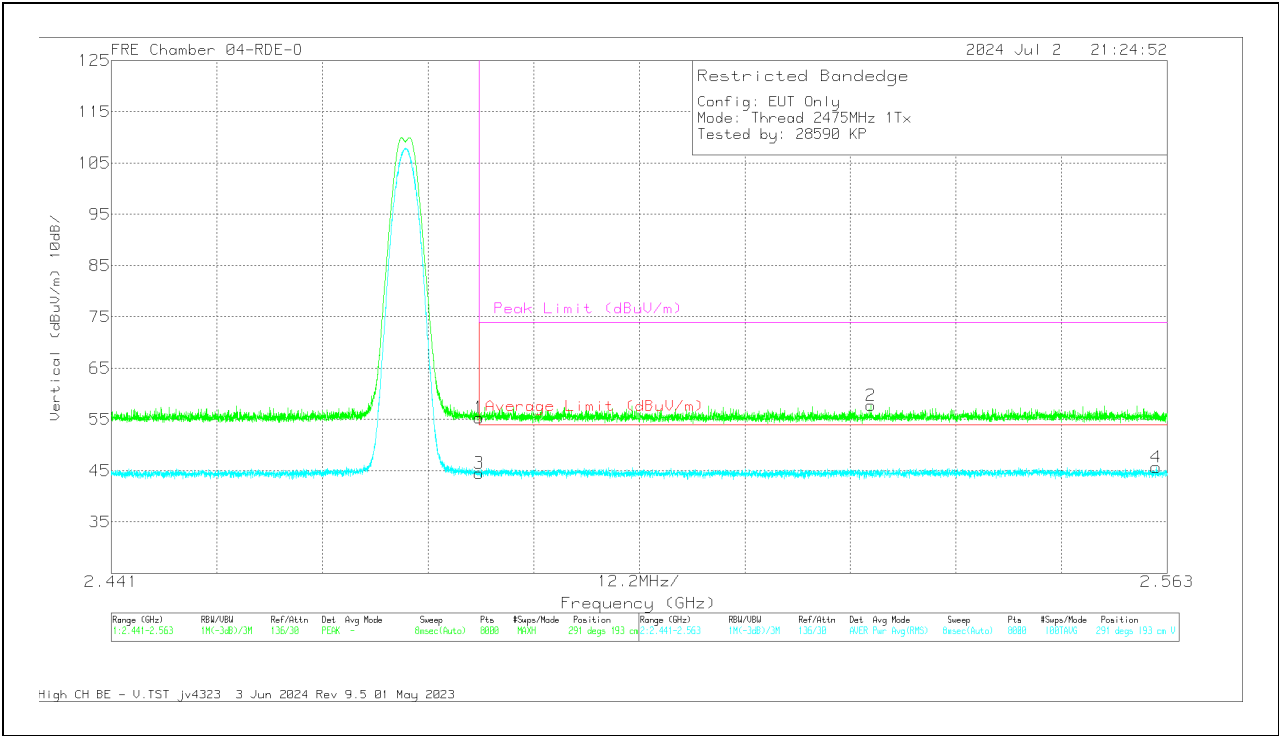
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	80402 1m ACF (dB/m)	DCCF (dB)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*2.4835	59.28	Pk	32.8	0	-37.3	54.78	-	-	74	-19.22	221	369	H
3	*2.4835	49.1	RMS	32.8	0	-37.3	44.6	54	-9.4	-	-	221	369	H
2	*2.535745	62.37	Pk	32.8	0	-37.2	57.97	-	-	74	-16.03	221	369	H
4	*2.547062	49.85	RMS	32.8	0	-37.09	45.56	54	-8.44	-	-	221	369	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
RMS - RMS detection

VERTICAL RESULT



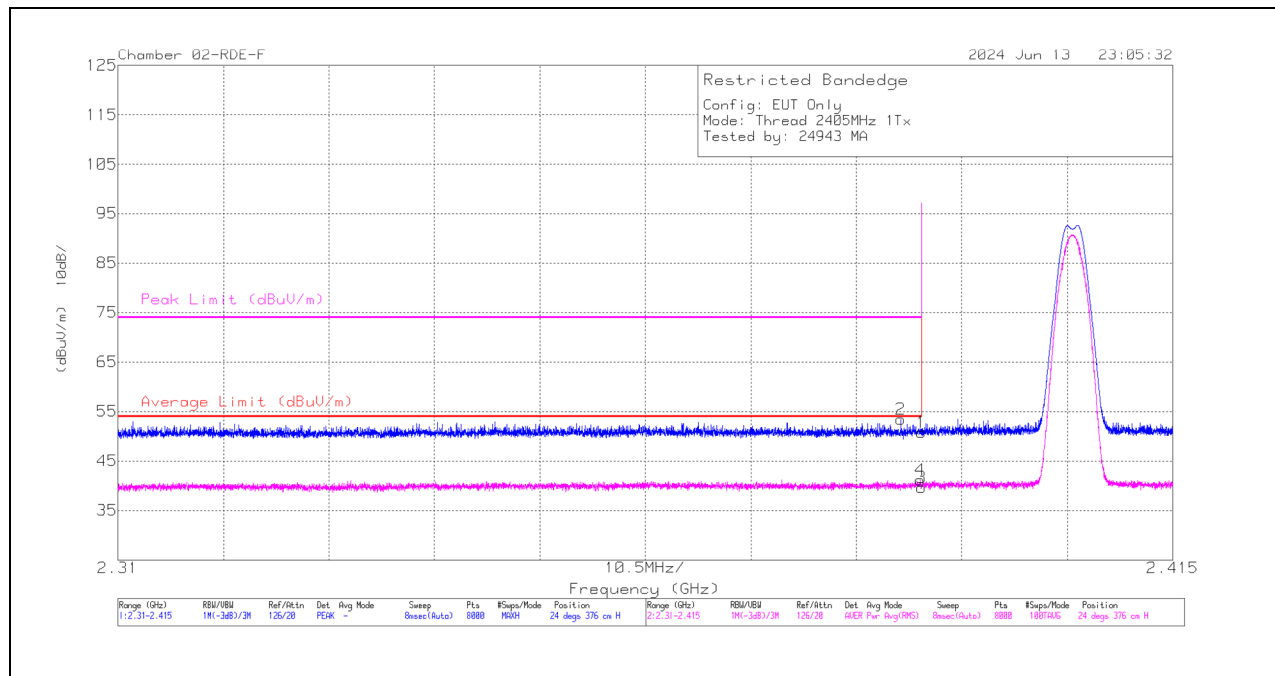
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	80402 1m ACF (dB/m)	DCCF (dB)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*2.4835	59.82	Pk	32.8	0	-37.3	55.32	-	-	74	-18.68	291	193	V
3	*2.4835	49.02	RMS	32.8	0	-37.3	44.52	54	-9.48	-	-	291	193	V
2	*2.528791	62.11	Pk	32.8	0	-37.2	57.71	-	-	74	-16.29	291	193	V
4	*2.56172	50.06	RMS	32.8	0	-37.2	45.66	54	-8.34	-	-	291	193	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
RMS - RMS detection

10.1.2. ANT4, 802.15.4 LOW POWER BANDEDGE

LOW CHANNEL

HORIZONTAL RESULT



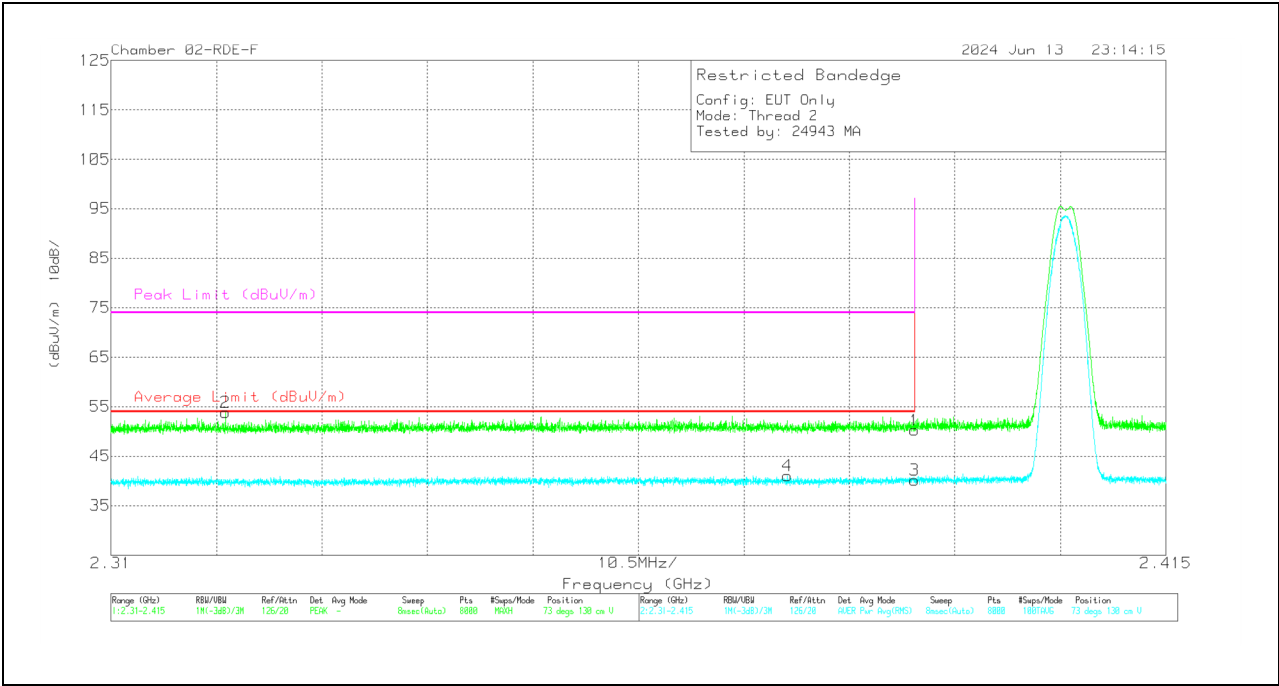
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	206806 ACF (dB/m)	DCCF (dB)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	57.49	Pk	32.2	0	-38.9	50.79	-	-	74	-23.21	24	376	H
2	* 2.387922	60.39	Pk	32.1	0	-39	53.49	-	-	74	-20.51	24	376	H
3	* 2.39	46.32	RMS	32.2	0	-38.9	39.62	54	-14.38	-	-	24	376	H
4	* 2.389891	47.88	RMS	32.2	0	-38.9	41.18	54	-12.82	-	-	24	376	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

VERTICAL RESULT



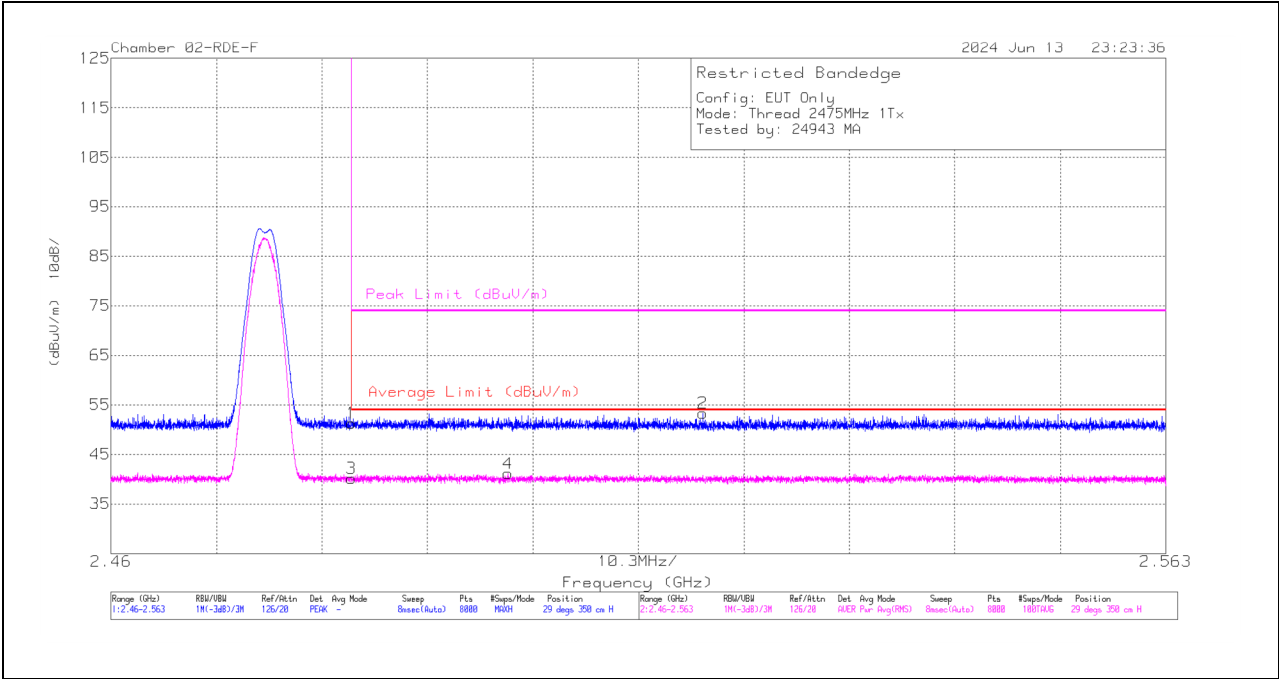
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	206806 ACF (dB/m)	DCCF (dB)	Amp/C bl (dB)	Correct ed Reading (dBuV/ m)	Average Limit (dBuV/ m)	Margin (dB)	Peak Limit (dBuV/ m)	PK Margin (dB)	Azimet h (Degs)	Height (cm)	Polarity
1	* 2.39	56.94	Pk	32.2	0	-38.9	50.24	-	-	74	-23.76	73	130	V
2	* 2.321368	60.98	Pk	32	0	-39.1	53.88	-	-	74	-20.12	73	130	V
3	* 2.39	46.82	RMS	32.2	0	-38.9	40.12	54	-13.88	-	-	73	130	V
4	* 2.377315	47.91	RMS	32.1	0	-39	41.01	54	-12.99	-	-	73	130	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK - Peak detector
RMS - RMS detection

HIGH CHANNEL

HORIZONTAL RESULT

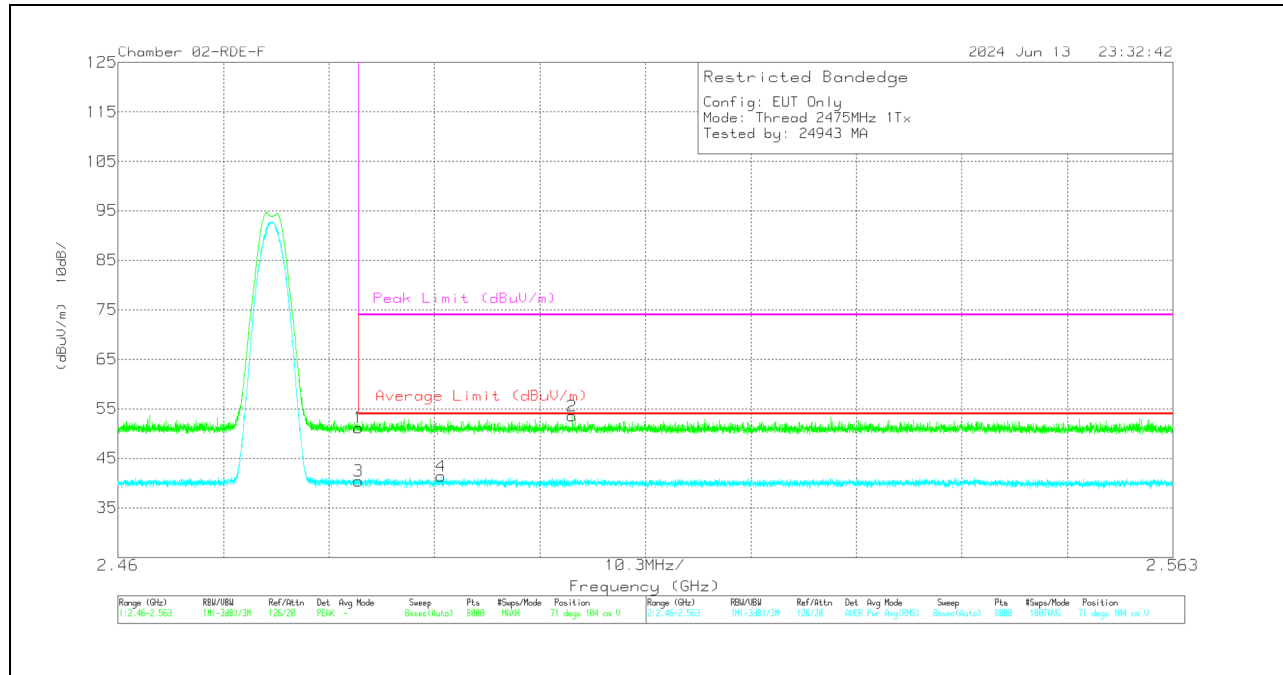


Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	206806 ACF (dB/m)	DCCF (dB)	Amp/C bi (dB)	Correct ed Reading (dBuV/ m)	Average Limit (dBuV/ m)	Margin (dB)	Peak Limit (dBuV/ m)	PK Margin (dB)	Azimet h (Degs)	Height (cm)	Polarity
1	* 2.4835	57.84	Pk	32.2	0	-38.7	51.34	-	-	74	-22.66	29	350	H
3	* 2.4835	46.67	RMS	32.2	0	-38.7	40.17	54	-13.83	-	-	29	350	H
4	* 2.49876	47.62	RMS	32.2	0	-38.7	41.12	54	-12.88	-	-	29	350	H
2	2.517792	59.69	Pk	32.2	0	-38.6	53.29	-	-	74	-20.71	29	350	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
RMS - RMS detection

VERTICAL RESULT



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	206806 ACF (dB/m)	DCCF (dB)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	57.71	Pk	32.2	0	-38.7	51.21	-	-	74	-22.79	71	104	V
3	* 2.4835	46.93	RMS	32.2	0	-38.7	40.43	54	-13.57	-	-	71	104	V
4	* 2.491574	47.88	RMS	32.2	0	-38.7	41.38	54	-12.62	-	-	71	104	V
2	2.504348	60.03	Pk	32.2	0	-38.7	53.53	-	-	74	-20.47	71	104	V

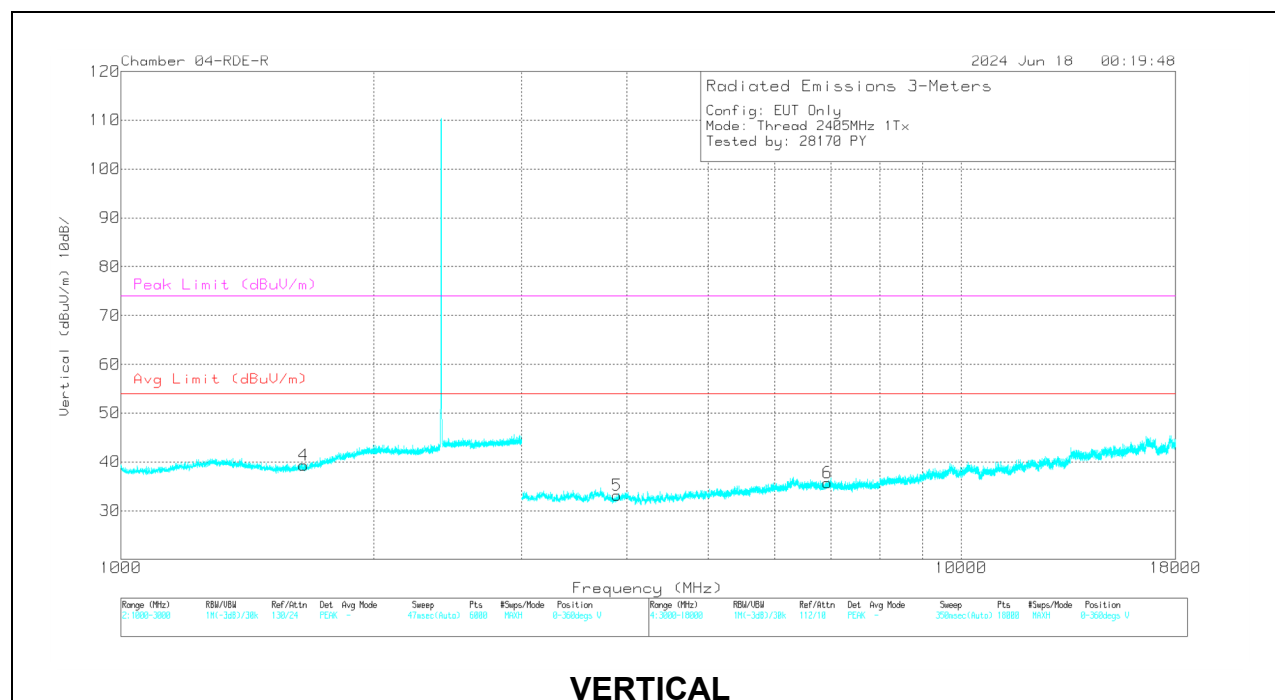
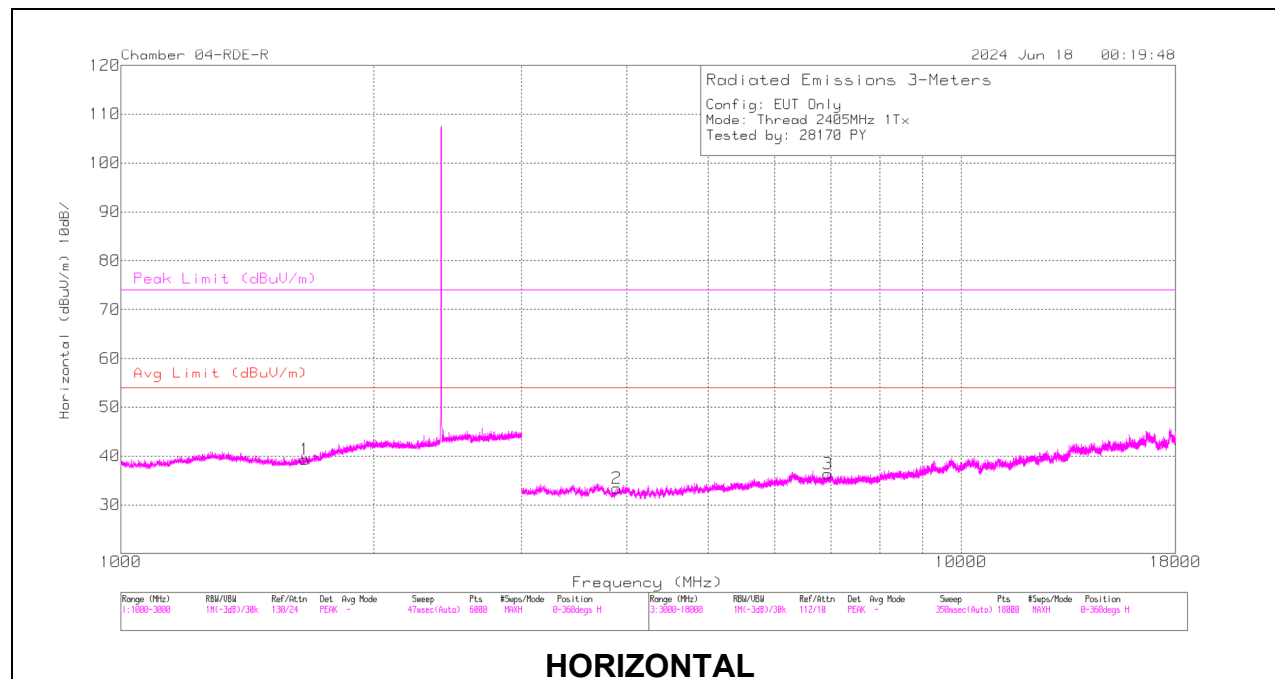
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK - Peak detector

RMS - RMS detection

10.1.3. ANT4, 802.15.4 HIGH POWER, HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	41112 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 3895.285	57.08	PK2	33.3	-47.4	42.98	-	-	74	-31.02	29	377	H
	* 3895.167	45.57	MAV1	33.3	-47.4	31.47	54	-22.53	-	-	29	377	H
5	* 3896.882	57.51	PK2	33.3	-47.44	43.37	-	-	74	-30.63	356	185	V
	* 3896.035	45.65	MAV1	33.3	-47.43	31.52	54	-22.48	-	-	356	185	V
4	1651.339	49.62	MAV1	28.3	-40.45	37.47	-	-	-	-	358	318	V
	1653.337	61.16	PK2	28.3	-40.45	49.01	-	-	74	-24.99	358	318	V
1	1654.844	61.4	PK2	28.3	-40.43	49.27	-	-	74	-24.73	351	202	H
	1655.663	49.74	MAV1	28.3	-40.42	37.62	-	-	-	-	351	202	H
6	6934.578	55.35	PK2	35.7	-45.16	45.89	-	-	74	-28.11	116	332	V
	6935.236	43.95	MAV1	35.7	-45.16	34.49	-	-	-	-	116	332	V
3	6938.287	55.46	PK2	35.7	-45.12	46.04	-	-	74	-27.96	3	128	H
	6939.626	43.74	MAV1	35.7	-45.12	34.32	-	-	-	-	3	128	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK2 - KDB558074 Method: Maximum Peak

MAV1 - KDB558074 Option 1 Maximum RMS Average