



# **TEST REPORT**

**Report Number:** R15670843-E4

**Applicant :** Milwaukee Electric Tool Corporation  
13135 W. Lisbon Road  
Brookfield, WI 53005, USA

**Model :** 14209445

**FCC ID :** P36-CDCBB1

**IC :** 25187-CDCBB1

**EUT Description :** SiLab Module

**Test Standard(s) :** FCC 47 CFR PART 15 SUBPART C: 2025  
ISED RSS-247 ISSUE 3: 2023  
ISED RSS-GEN ISSUE 5 + A1 + A2: 2021

**Date Of Issue:**

2025-04-07

**Prepared by:**

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## REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	2025-04-07	Initial Issue	Charles Moody

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** Milwaukee Electric Tool Corporation  
13135 W. Lisbon Road  
Brookfield, WI 53005, USA

**EUT DESCRIPTION:** SiLab Module

**MODEL:** 14209445

**SERIAL NUMBER:** 02496-03458, 02496-92458, 92496-94600 H1, 92496-94600 H2, 92496-122939

**SAMPLE RECEIPT DATE:** 2024-06-06, 2024-06-25, 2024-06-26, 2025-03-24

**DATE TESTED:** 2024-06-06 TO 2024-06-26, 2025-03-27 TO 2025-03-31

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C: 2025	See Section 2
ISED RSS-247 Issue 3: 2023	See Section 2
ISED RSS-GEN Issue 5 + A1 + A2: 2021	See Section 2

UL LLC 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 taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document.

Approved & Released For  
UL LLC By:



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Project Engineer  
Consumer, Medical and IT Segment  
UL LLC

Prepared By:



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Senior Project Engineer  
Consumer, Medical and IT Segment  
UL LLC

## 2. TEST RESULTS SUMMARY

This report contains data provided by the customer which can impact the validity of results. UL LLC is only responsible for the validity of results after the integration of the data provided by the customer.

Below is a list of the data provided by the customer:

1. Antenna gain and type (see section 6.3)
2. Supported data rates (see section 6.5)

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		
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		
15.247 (d)	RSS-247 5.5	Conducted Spurious Emissions	Complies	None.
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions		
15.207	RSS-Gen 8.8		N/A	The EUT is a radio module, and it cannot connect directly to AC mains. It receives power through an intermediary device.
		AC Mains Conducted Emissions		

## 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 C63.10-2020 + Cor.1-2023 + C63.10a-2024, KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 414788 D01 Radiated Test Site v01r01, RSS-GEN Issue 5 + A1 + A2, and RSS-247 Issue 3.

## 4. FACILITIES AND ACCREDITATION

UL LLC is accredited by A2LA, certification # 0751.06, 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: 12 Laboratory Dr RTP, NC 27709, U.S.A	US0067	2180C	825374
<input checked="" type="checkbox"/>	Building: 2800 Perimeter Park Dr. Suite B Morrisville, NC 27560, U.S.A		27265	

## 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 <sub>Lab</sub>
Radio Frequency (Spectrum Analyzer)	141.2 Hz
Occupied Channel Bandwidth	1.22%
RF output power, conducted	1.3 dB (PK) 0.45 dB (AV)
Power Spectral Density, conducted	2.47 dB
Unwanted Emissions, conducted	1.94 dB
All emissions, radiated	6.01 dB
Conducted Emissions (0.150-30MHz) - LISN	3.40 dB
Temperature	0.57°C
Humidity	3.39%
DC Supply voltages	1.70%

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)

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

## 6. EQUIPMENT UNDER TEST

### 6.1. EUT DESCRIPTION

The Chip Down Carrier Board is a next-gen DTS solution to be used internally within Milwaukee Tool. It presents a fully certified and tuned off-the-shelf solution for future implementation within tools and contains a BLE radio. This report covers the full emissions testing of the BLE radio.

### 6.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	BLE - 125Kbps	10.49	11.19
2403 - 2480	BLE - 500Kbps	10.49	11.19
2404 - 2480	BLE - 1Mbps	10.48	11.17
2405 - 2480	BLE - 2Mbps	10.49	11.19

### 6.3. DESCRIPTION OF AVAILABLE ANTENNAS

The antenna(s) gain and type, as provided by the manufacturer' are as follows:

The radio utilizes a passive antenna, with a maximum gain of 1.5 dBi.

### 6.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was Gecko\_SDK v4.3.1.

### 6.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 1GHz, above 18GHz, and power line conducted emission were performed with the EUT set to transmit at the channel with highest power spectral density as worst-case scenario.

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to transmit at power setting 10 on low, and high channels, as well as middle channel for radiated spurious emissions. Radiated spurious emissions were performed on the worst-case power and PSD mode (125Kbps). Band edge testing was performed on the mode with the widest bandwidth (2Mbps) since average power for all modes was relatively the same.

The fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z, it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

## 6.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
DC Power Supply	Keysight	E3633A	MY58426145	NA
DC Power Supply	BK Precision	1687B	347K16126	NA
Support Laptop	Lenovo	T14 Gen3	PF4FKY5C	NA

### I/O CABLES

I/O Cable List						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	DC Power Leads	2	Banana	N/A	<3m	Connects the EUT to the DC Power Supply for Power

### TEST SETUP

The EUT is connected to a DC Power supply. Prior to testing, a support laptop is used to configure the EUT radio module. For final testing, the EUT was disconnected from the support laptop.

### SETUP DIAGRAMS

Please refer to R15670843-EP2 for setup diagrams

## 7. MEASUREMENT METHOD

On Time and Duty Cycle: ANSI C63.10, Section 11.6 : Zero-Span Spectrum Analyzer Method.

6 dB BW: ANSI C63.10 Subclause -11.8.1

Occupied BW (99%): ANSI C63.10-2020 Section 6.9.3

Output Power: ANSI C63.10 Subclause -11.9.1.2 Method PKPM1 Peak-reading power meter  
ANSI C63.10 Subclause -11.9.2.3.2 Method AVGPM-G (Measurement using a  
gated RF average-reading power meter)

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

Conducted emissions non-restricted frequency bands: ANSI C63.10 Subclause -11.11 and  
6.10.4

Radiated emissions restricted frequency bands: ANSI C63.10 Subclause -11.12.1 and 6.10.5

General radiated emissions: ANSI C63.10 Subclause – 6.3-6.6

## 8. TEST AND MEASUREMENT EQUIPMENT

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

### Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
<b>Common Equipment</b>					
<b>Conducted Room 1</b>					
90416	Spectrum Analyzer	Keysight Technologies	N9030A	2023-06-09	2024-06-30
211056	Real-Time Peak Power Sensor 50MHz to 8GHz	Boonton	RTP5000	2023-08-01	2024-08-01
86441	EMPower USB RF Power Sensor, 10MHz to 6GHz (USB ID: 1.47.238.189.27.0.0.80)	ETS Lindgren	7002-006	2023-11-13	2024-11-13
91219	True RMS Multimeter	Agilent	U1232A	2023-08-03	2024-08-03
-	DC Power Supply	Keysight Technologies	E3633A	-	-
207726	Temp/Humid Chamber	Thermotron	SM-32-8200	2024-01-12	2025-01-12
179892	Environmental Meter	Fisher Scientific	15-077-963	2023-07-26	2024-07-31
SOFTEMI	Antenna Port Software	UL	Version 2024.2.24	NA	NA
ETSI Power Software	EMPower ETSI Burst Measurement System	ETS-Lindgren	Version 1.0.3.18	NA	NA
Power Software	Boonton Power Analyzer	Boonton	Version 3.0.13.0	NA	NA
<b>Conducted Room 2</b>					
90410	Spectrum Analyzer	Keysight Technologies	N9030A	2024-06-14	2025-06-14
211057	Real-Time Peak Power Sensor 50MHz to 8GHz	Boonton	RTP5000	2023-08-01	2024-08-01
157590	EMPower USB RF Power Sensor, 10MHz to 6GHz (USB ID: 1.132.133.24.23.0.0.6)	ETS Lindgren	7002-006	2023-11-13	2024-11-13
91219	True RMS Multimeter	Agilent	U1232A	2023-08-03	2024-08-03
-	DC Power Supply	Keysight Technologies	E3633A	-	-
76023	Temp/Humid Chamber	Cincinnati Sub-Zero	ZPH-8-3.5-SCT/AC	2024-01-12	2025-01-12
248881	Environmental Meter	Control Company	06-662-4	2024-04-10	2026-04-10
SOFTEMI	Antenna Port Software	UL	Version 2024.2.24	NA	NA
ETSI Power Software	EMPower ETSI Burst Measurement System	ETS-Lindgren	Version 1.0.3.18	NA	NA
Power Software	Boonton Power Analyzer	Boonton	Version 3.0.13.0	NA	NA

Test Equipment Used - Wireless Conducted Attenuators, Cables, and Couplers

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
<b>Attenuators</b>					
226559	SMA Coaxial 10dB Attenuator 25MHz-18GHz	CentricRF	C18S2-10	2024-02-29	2025-02-28
226563	SMA Coaxial 10dB Attenuator 25MHz-18GHz	CentricRF	C18S2-10	2024-02-29	2025-02-28
<b>Cables</b>					
188125 (CBL098)	Micro-Coax UTiFLEX Cable Assembly, Low Loss, 40Ghz, 39.3", Connectors 2	Carlisle Interconnect Technologies	UFA147A-0-0180-200200	2024-06-26	2025-06-26
CBL105	Micro-Coax UTiFLEX Cable Assembly, Low Loss	Carlisle Interconnect Technologies	UFB-197C-0-0160-300300	2024-03-01	2025-03-01

\*\*NOTE: All conducted testing occurred in June 2024.

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville – Chamber 2)

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
<b>0.009-30MHz</b>					
135144	Active Loop Antenna	ETS-Lindgren	6502	2024-10-02	2025-10-02
	<b>30-1000 MHz</b>				
159203	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2024-03-05	2026-03-05
	<b>1-18 GHz</b>				
86408	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2023-06-19	2025-06-19
	<b>18-40 GHz</b>				
204704	Horn Antenna, 18-26.5GHz	Com-Power	AH-826	2023-07-20	2025-07-20
	<b>Gain-Loss Chains</b>				
91975	Gain-loss string: 0.009-30MHz	Various	Various	2024-05-10	2025-05-10
91978	Gain-loss string: 25-1000MHz	Various	Various	2024-05-10	2025-05-10
91977	Gain-loss string: 1-18GHz	Various	Various	2024-07-17	2025-07-17
136042	Gain-loss string: 18-40GHz	Various	Various	2024-05-10	2025-05-10
	<b>Receiver &amp; Software</b>				
197954	Spectrum Analyzer	Rohde & Schwarz	ESW44	2024-03-05	2025-03-31
81018	Spectrum Analyzer	Agilent	E4446A	2024-07-31	2025-07-31
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	<b>Additional Equipment used</b>				
200540	Environmental Meter	Fisher Scientific	15-077-963	2023-07-19	2025-07-19

\*\*NOTE: All radiated testing occurred in March 2025.

## 9. ANTENNA PORT TEST RESULTS

## 9.1. ON TIME AND DUTY CYCLE

## LIMITS

None; for reporting purposes only.

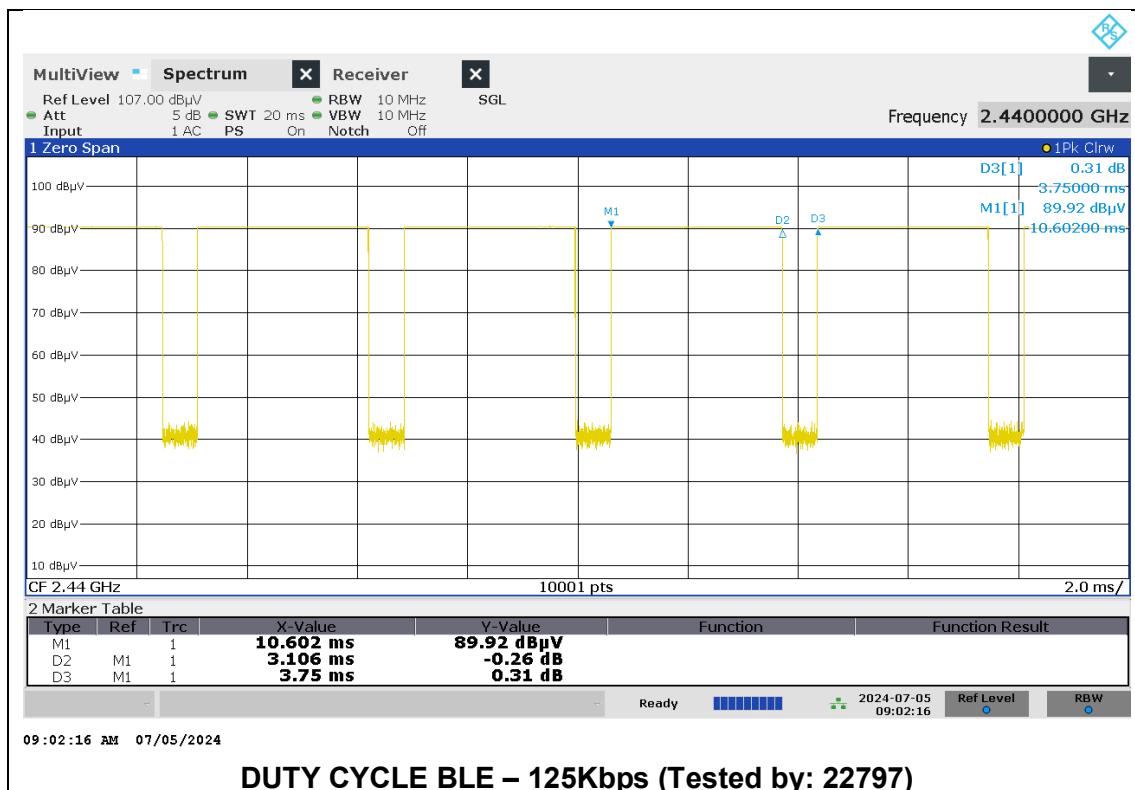
## **PROCEDURE**

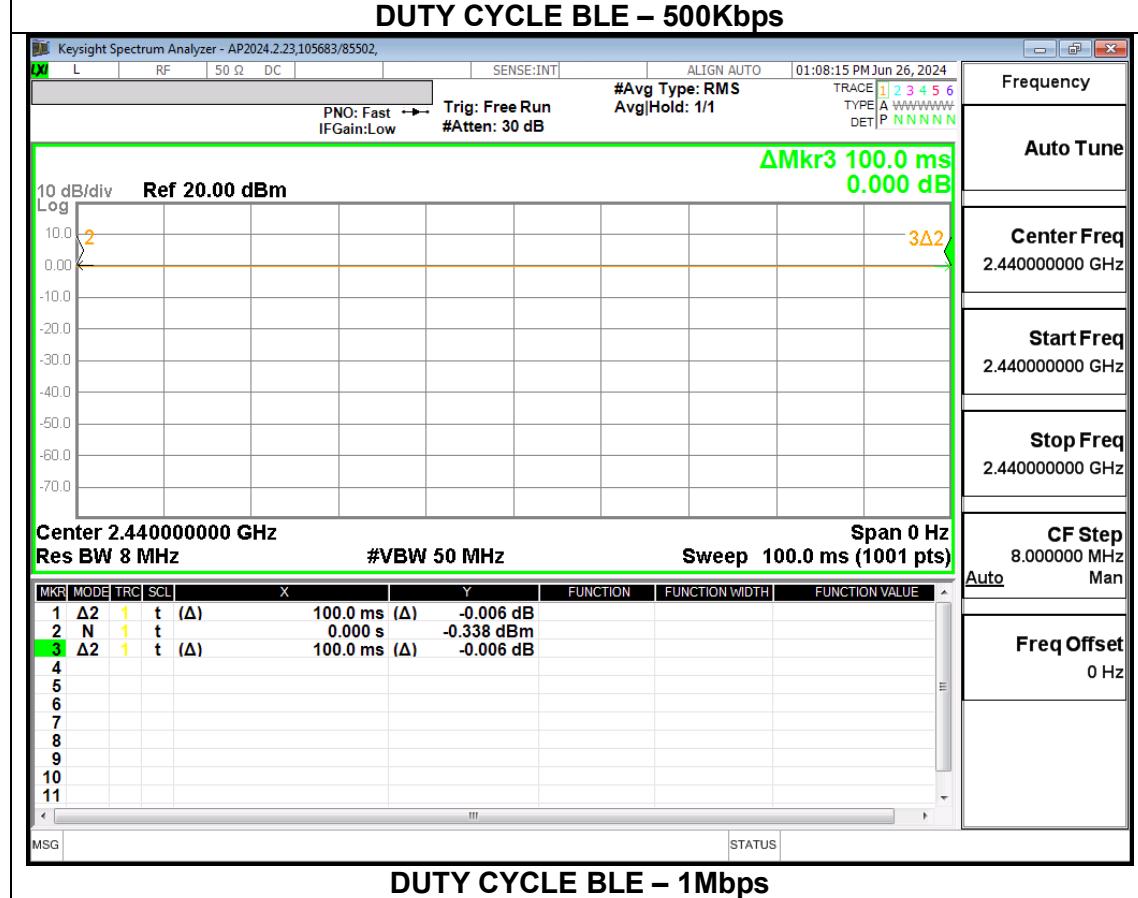
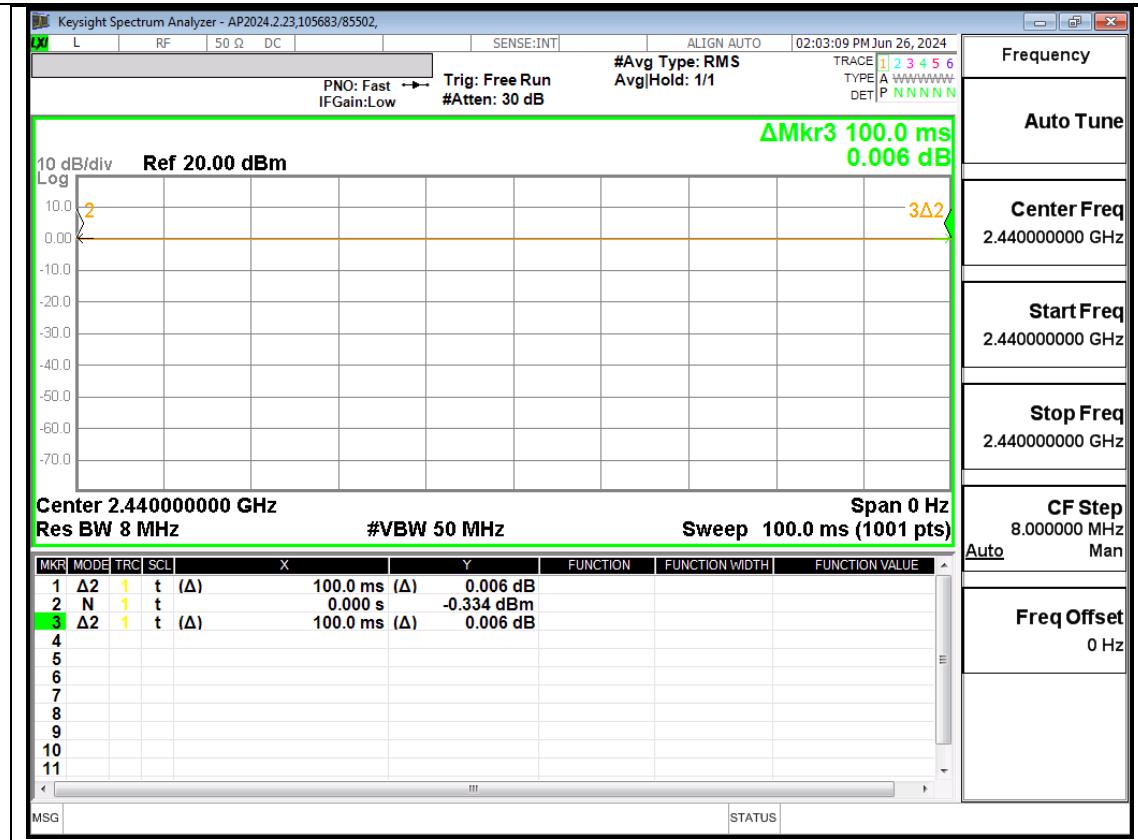
## KDB 558074 Zero-Span Spectrum Analyzer Method.

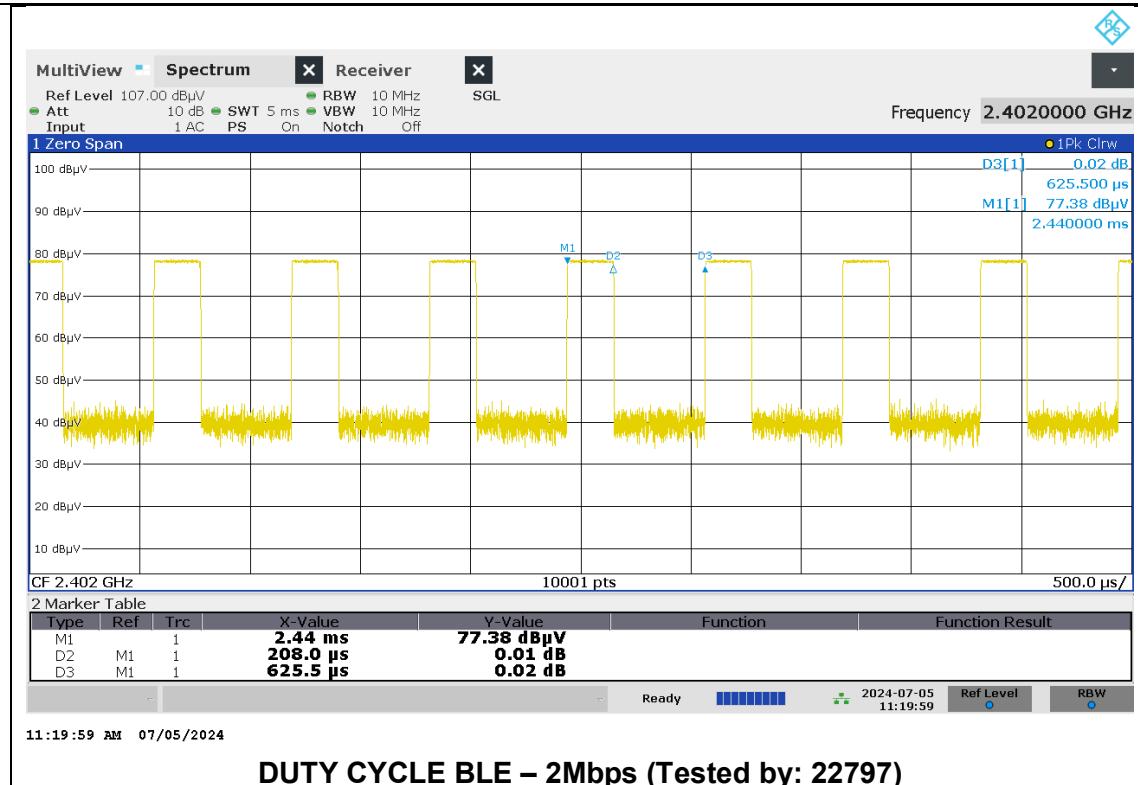
## ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
<b>2.4GHz Band</b>						
BLE - 125Kbps	3.106	3.750	0.828	82.83	1.64	0.322
BLE - 500Kbps	100.000	100.000	1.000	100.00	0.00	0.010
BLE - 1Mbps	100.000	100.000	1.000	100.00	0.00	0.010
BLE - 2 Mbps	0.208	0.626	0.333	33.25	9.56	4.808

## DUTY CYCLE PLOTS







## 9.2. 99% BANDWIDTH

### LIMITS

None; for reporting purposes only.

### RESULTS

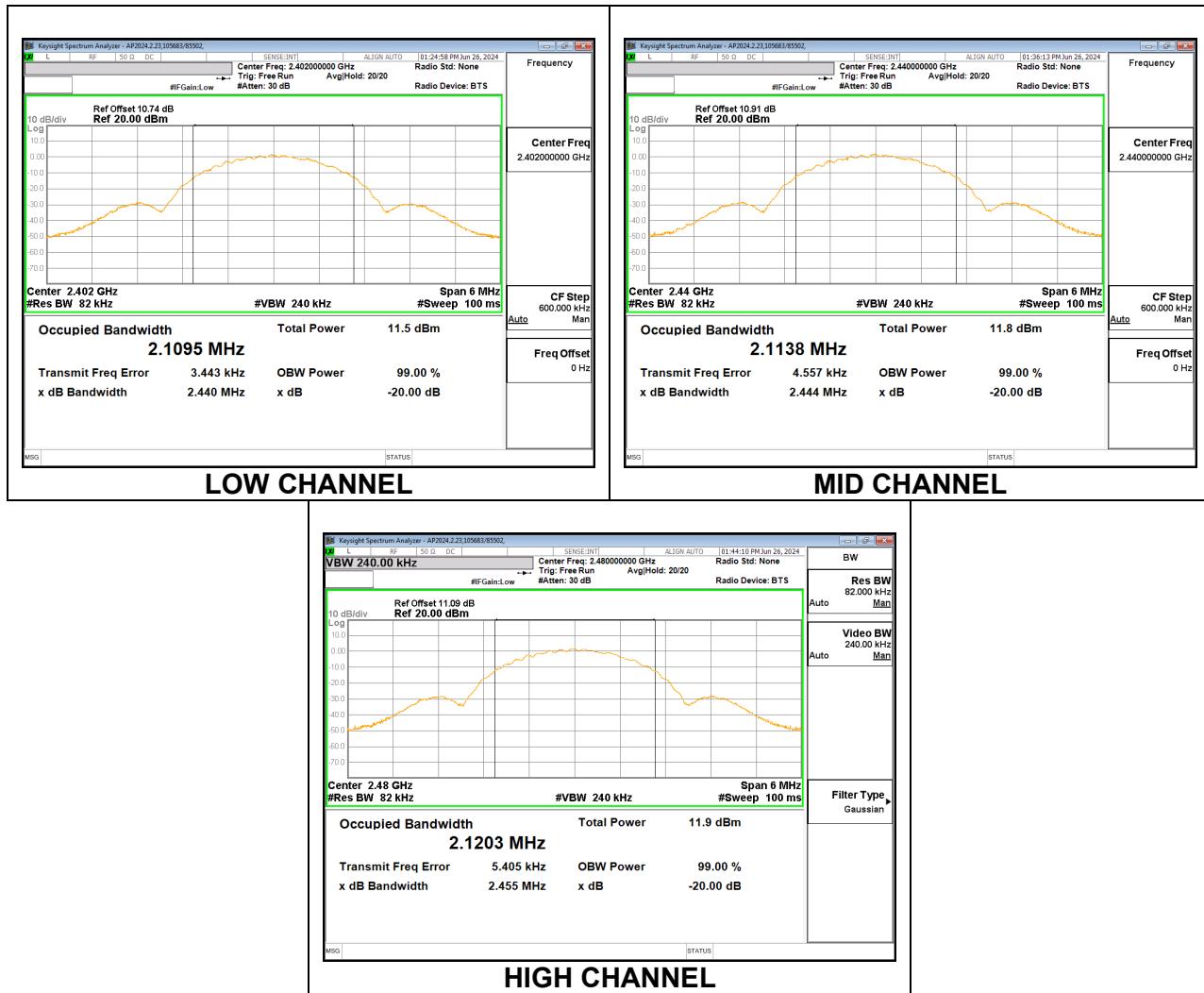
#### 9.2.1. BLE (1Mbps)

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0285
Middle	2440	1.0288
High	2480	1.0293



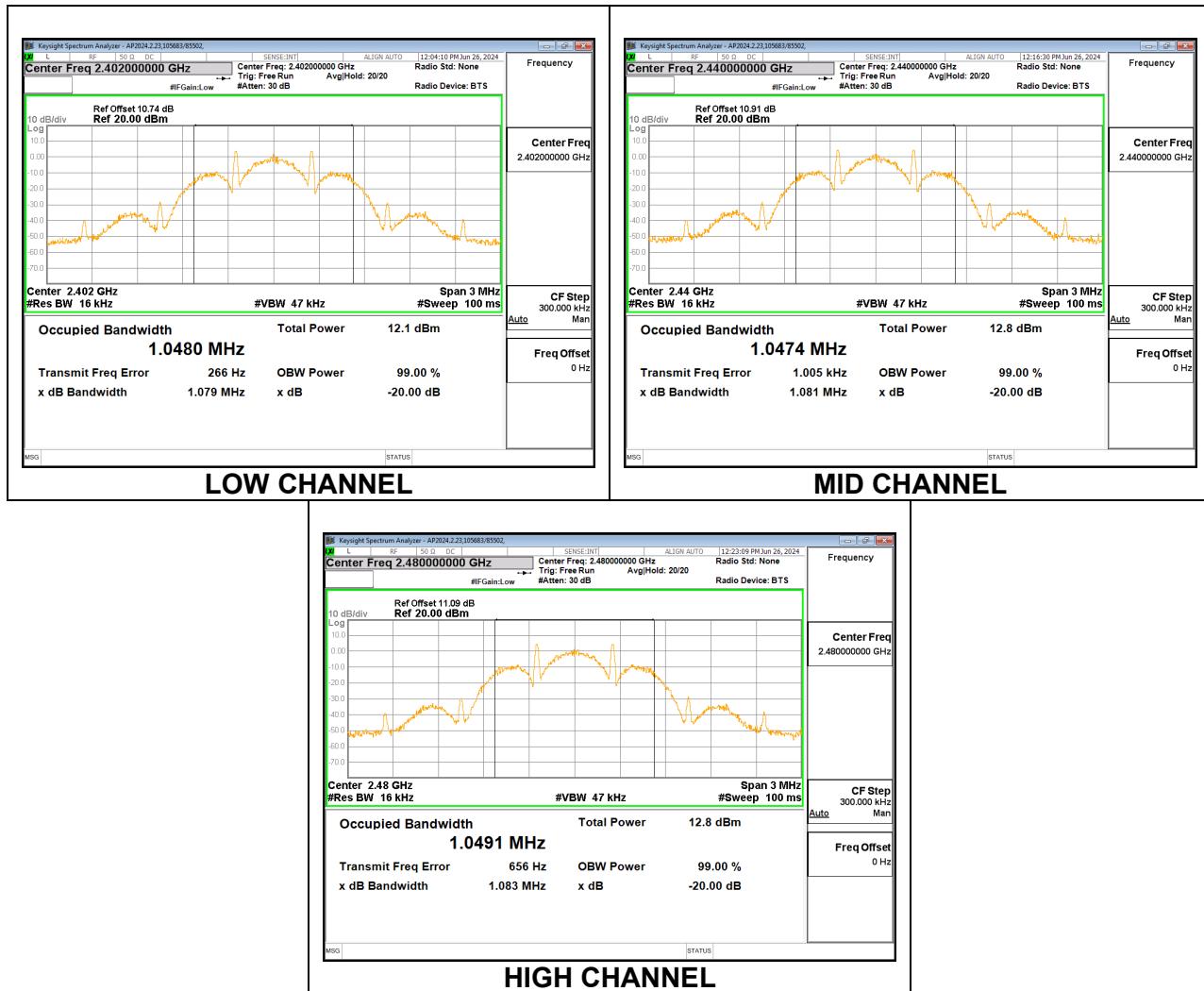
### 9.2.2. BLE (2Mbps)

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	2.1095
Middle	2440	2.1138
High	2480	2.1203



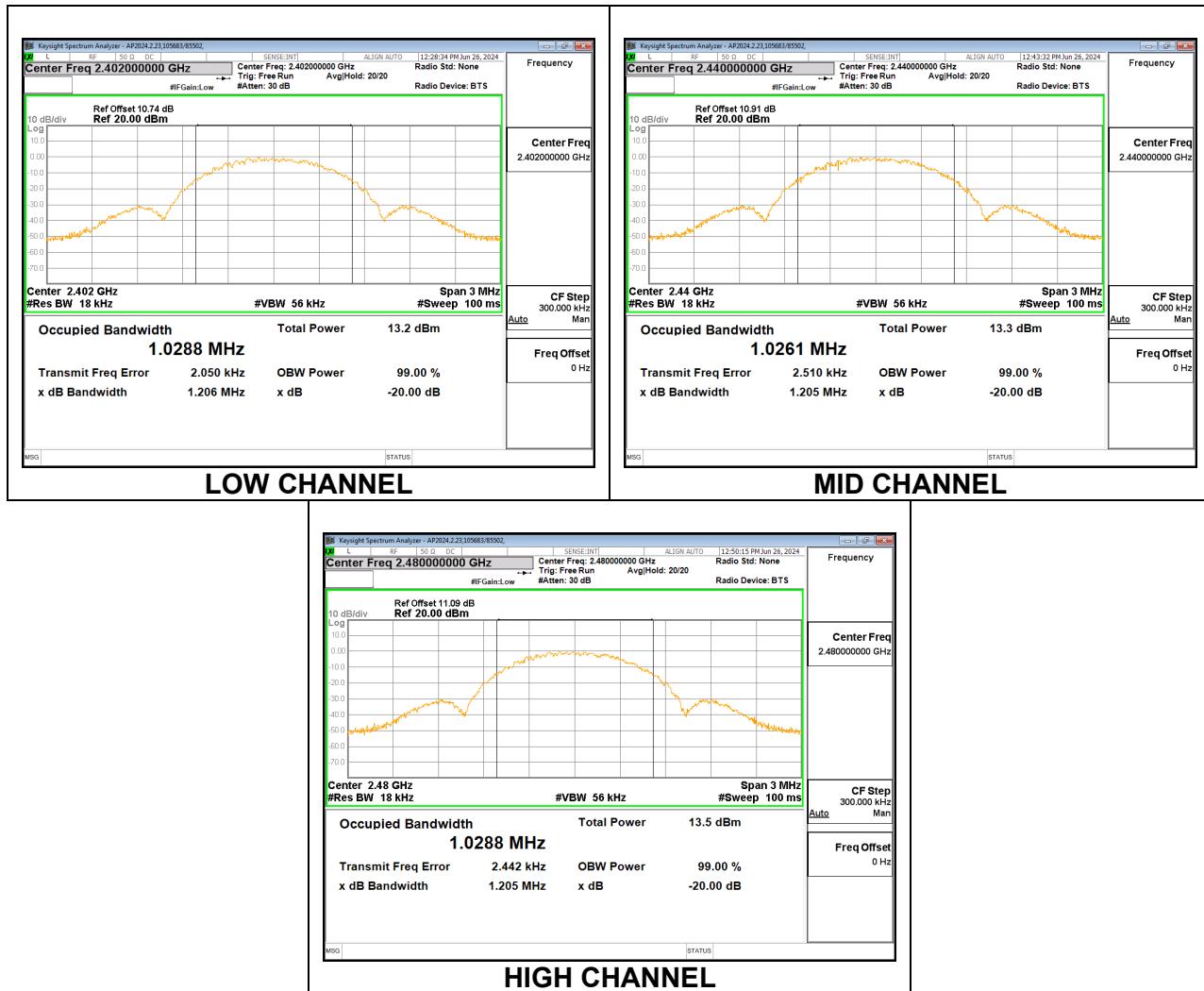
### 9.2.3. BLE (125Kbps)

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0480
Middle	2440	1.0474
High	2480	1.0491



### 9.2.4. BLE (500Kbps)

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0288
Middle	2440	1.0261
High	2480	1.0288



### 9.3. 6 dB BANDWIDTH

#### LIMITS

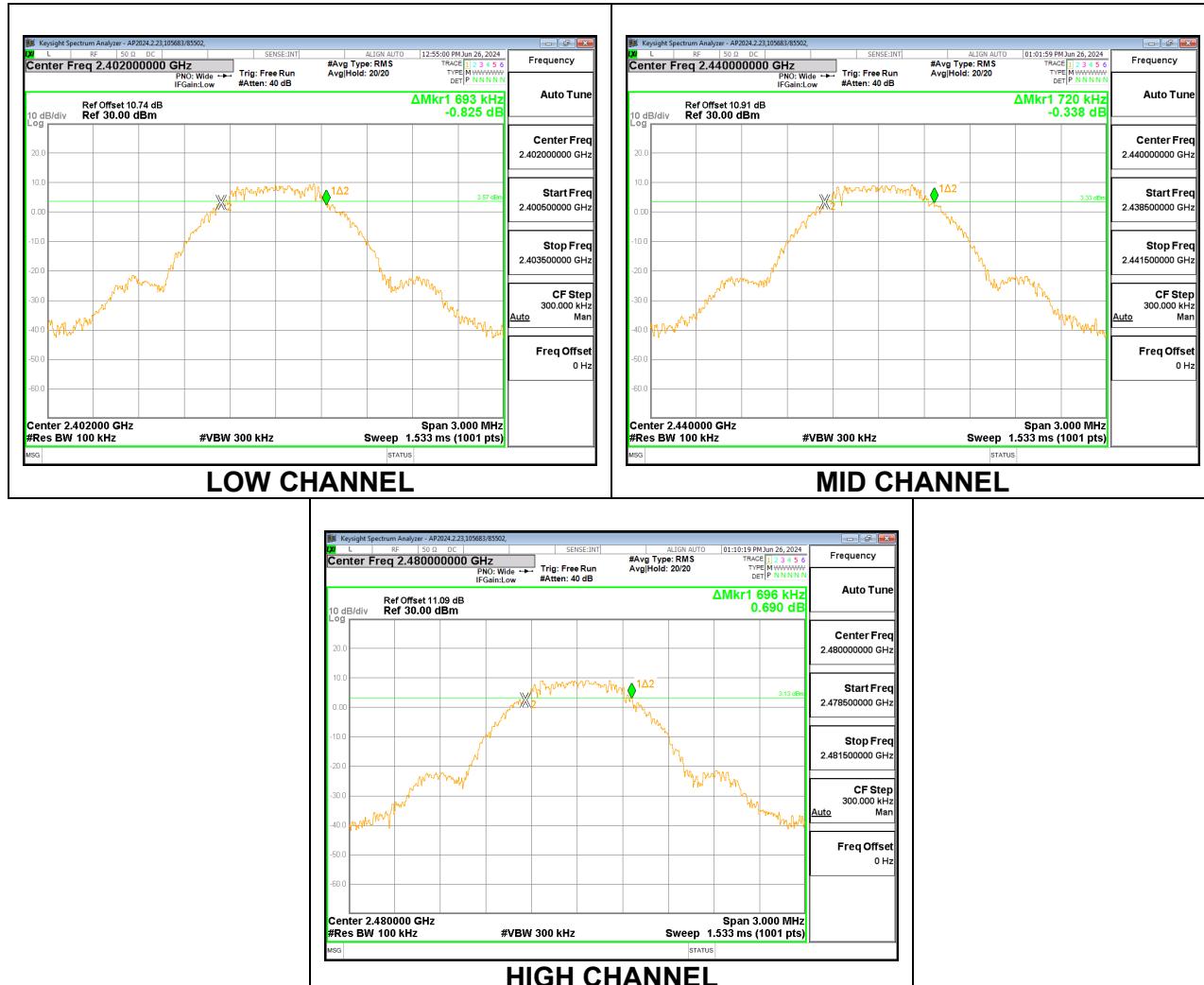
FCC §15.247 (a) (2)  
RSS-247 5.2 (a)

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

#### RESULTS

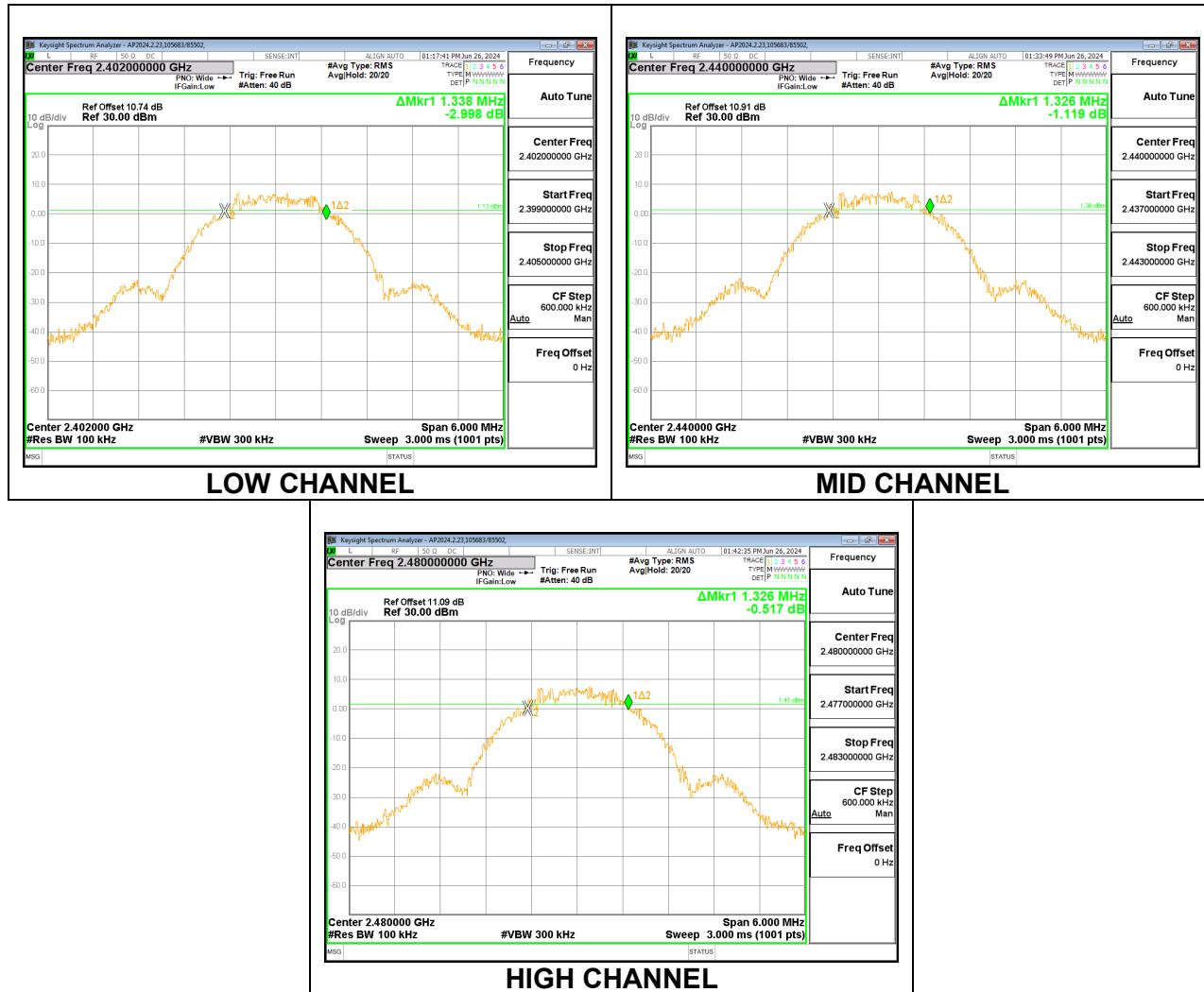
##### 9.3.1. BLE (1Mbps)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.6930	0.5
Middle	2440	0.7200	0.5
High	2480	0.6960	0.5



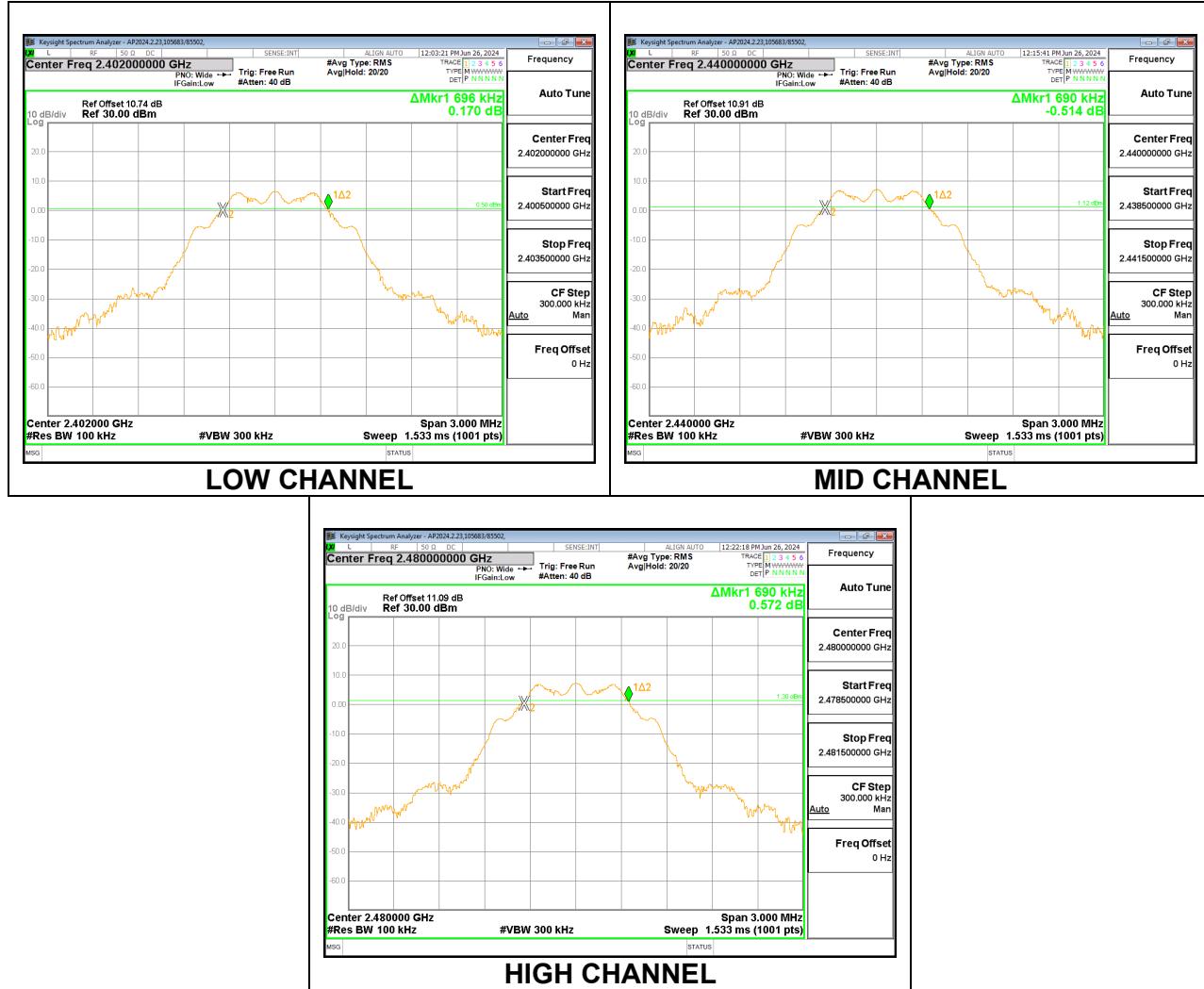
### 9.3.2. BLE (2Mbps)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	1.3380	0.5
Middle	2440	1.3260	0.5
High	2480	1.3260	0.5



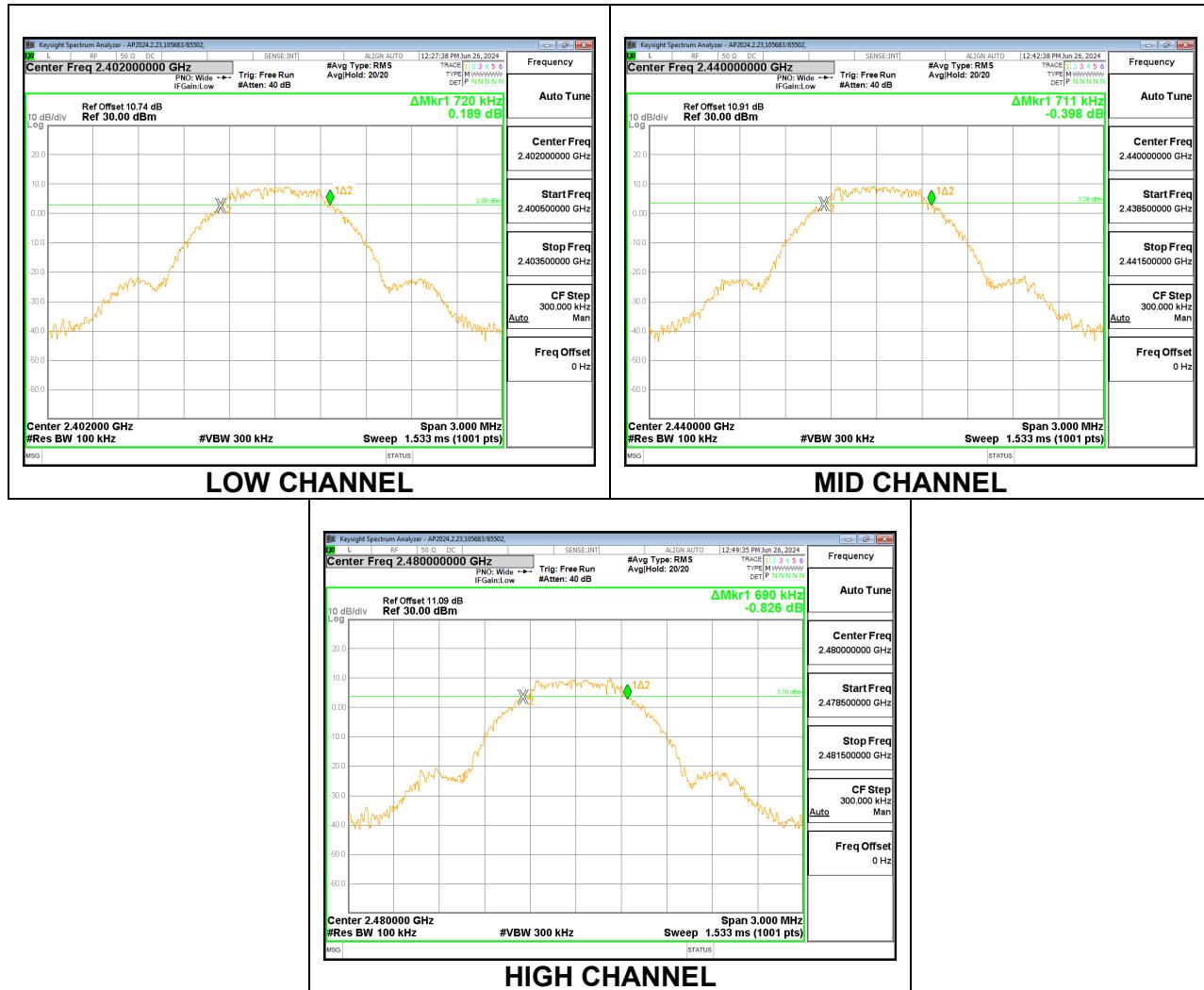
### 9.3.3. BLE (125Kbps)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.6960	0.5
Middle	2440	0.6900	0.5
High	2480	0.6900	0.5



### 9.3.4. BLE (500Kbps)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.7200	0.5
Middle	2440	0.7110	0.5
High	2480	0.6900	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

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.73 dB (including 10.17 dB pad and 0.56 dB cable) was entered as an offset in the 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 power sensor. Peak output power was read directly from power meter.

### RESULTS

#### 9.4.1. BLE (1Mbps)

Tested By:	104412/21193
Date:	2024-06-06

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	10.470	30	-19.530
Middle	2440	10.480	30	-19.520
High	2480	10.480	30	-19.520

#### 9.4.2. BLE (2Mbps)

Tested By:	104412/21193
Date:	2024-06-06

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	10.490	30	-19.510
Middle	2440	10.460	30	-19.540
High	2480	10.470	30	-19.530

#### 9.4.3. BLE (125Kbps)

Tested By:	104412/21193
Date:	2024-06-06

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	10.490	30	-19.510
Middle	2440	10.450	30	-19.550
High	2480	10.470	30	-19.530

#### 9.4.4. BLE (500Kbps)

Tested By:	104412/21193
Date:	2024-06-06

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	10.490	30	-19.510
Middle	2440	10.470	30	-19.530
High	2480	10.470	30	-19.530

## 9.5. AVERAGE POWER

### LIMITS

None; for reporting purposes only.

### TEST PROCEDURE

The transmitter output is connected to an average gated power meter.

The cable assembly insertion loss of 10.73 dB (including 10.17 dB pad and 0.56 dB cable) was entered as an offset in the average gated 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. BLE (1Mbps)

Tested By:	104412/21193
Date:	2024-06-06

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	10.26
Middle	2440	10.25
High	2480	10.24

#### 9.5.2. BLE (2Mbps)

Tested By:	104412/21193
Date:	2024-06-06

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	10.26
Middle	2440	10.25
High	2480	10.25

### 9.5.3. BLE (125Kbps)

Tested By:	104412/21193
Date:	2024-06-06

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	10.26
Middle	2440	10.25
High	2480	10.25

### 9.5.4. BLE (500Kbps)

Tested By:	104412/21193
Date:	2024-06-06

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	10.26
Middle	2440	10.25
High	2480	10.25

## 9.6. POWER SPECTRAL DENSITY

### LIMITS

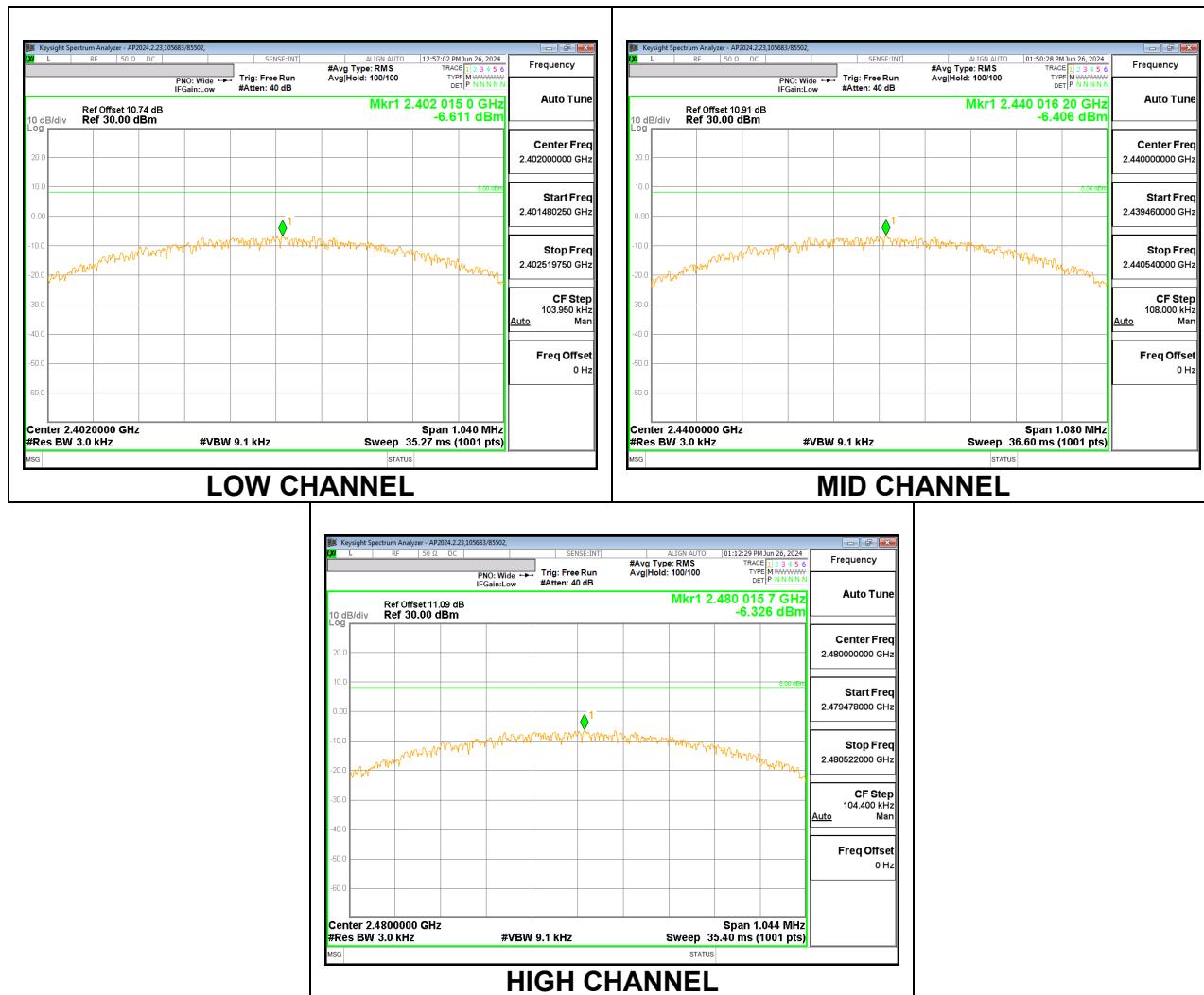
FCC §15.247 (e)  
RSS-247 (5.2) (b)

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

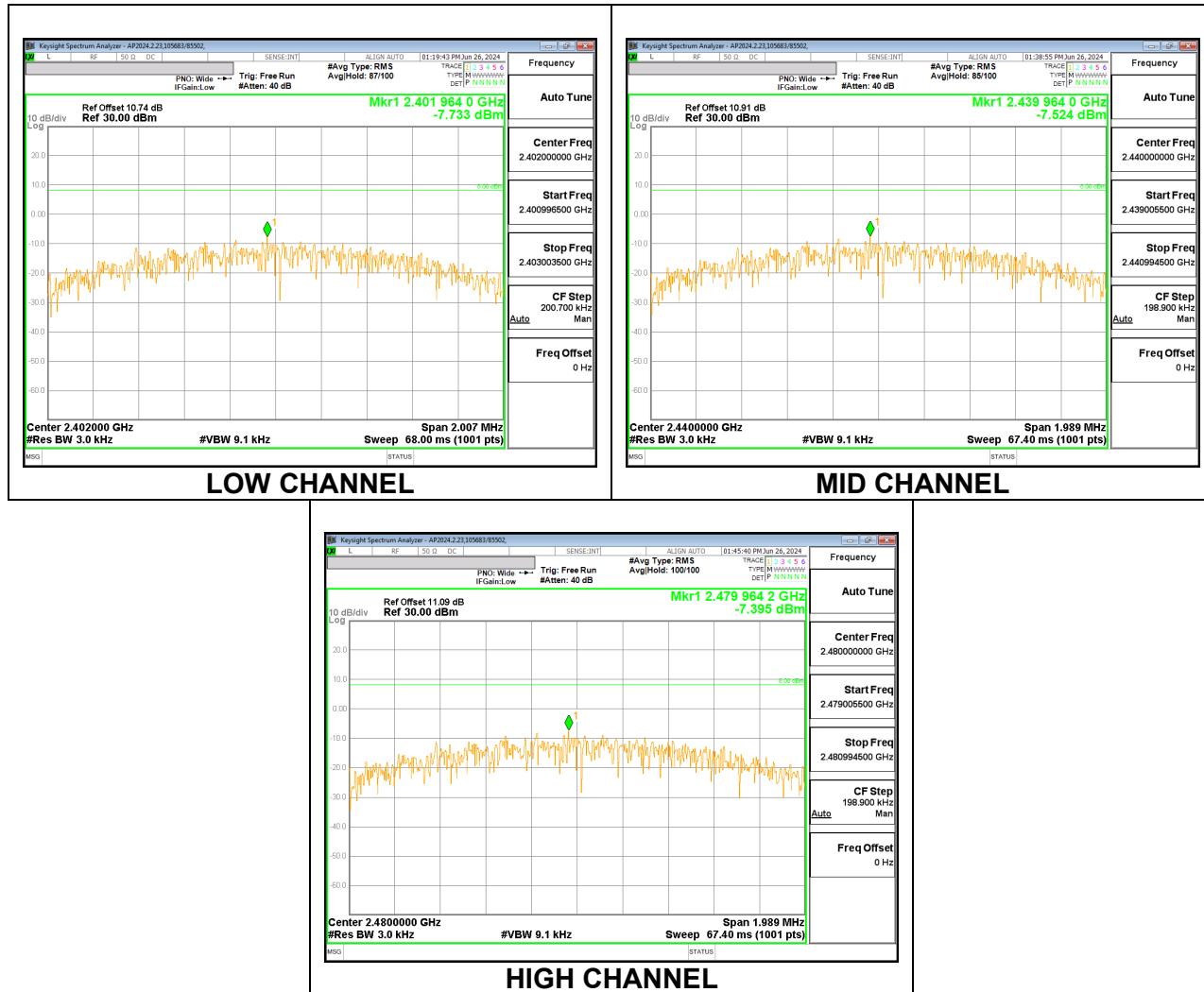
#### 9.6.1. BLE (1Mbps)

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-6.61	8	-14.61
Middle	2440	-6.41	8	-14.41
High	2480	-6.33	8	-14.33



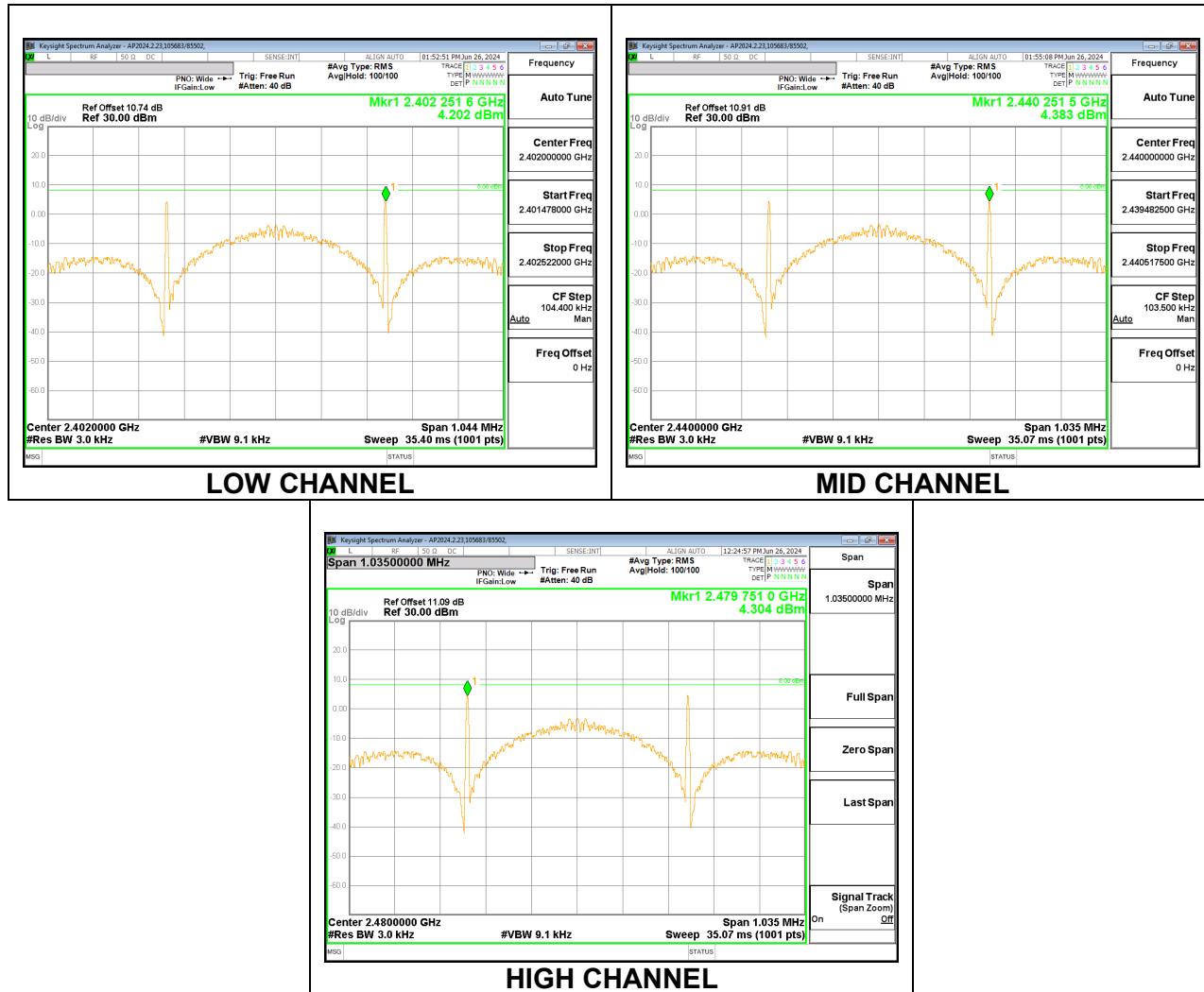
### 9.6.2. BLE (2Mbps)

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-7.73	8	-15.73
Middle	2440	-7.52	8	-15.52
High	2480	-7.40	8	-15.40



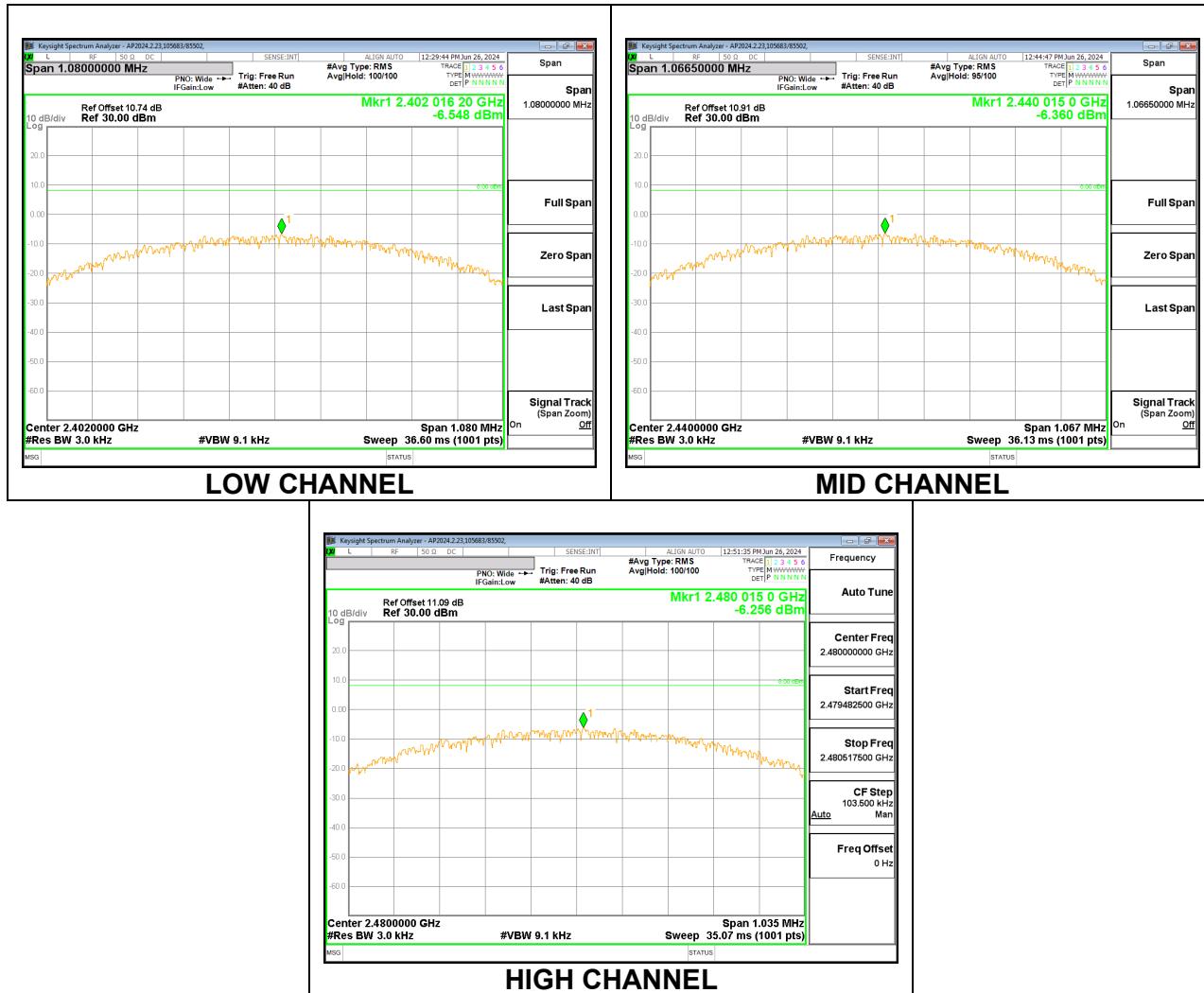
### 9.6.3. BLE (125Kbps)

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	4.20	8	-3.80
Middle	2440	4.38	8	-3.62
High	2480	4.30	8	-3.70



### 9.6.4. BLE (500Kbps)

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-6.55	8	-14.55
Middle	2440	-6.36	8	-14.36
High	2480	-6.26	8	-14.26



## 9.7. CONDUCTED SPURIOUS EMISSIONS

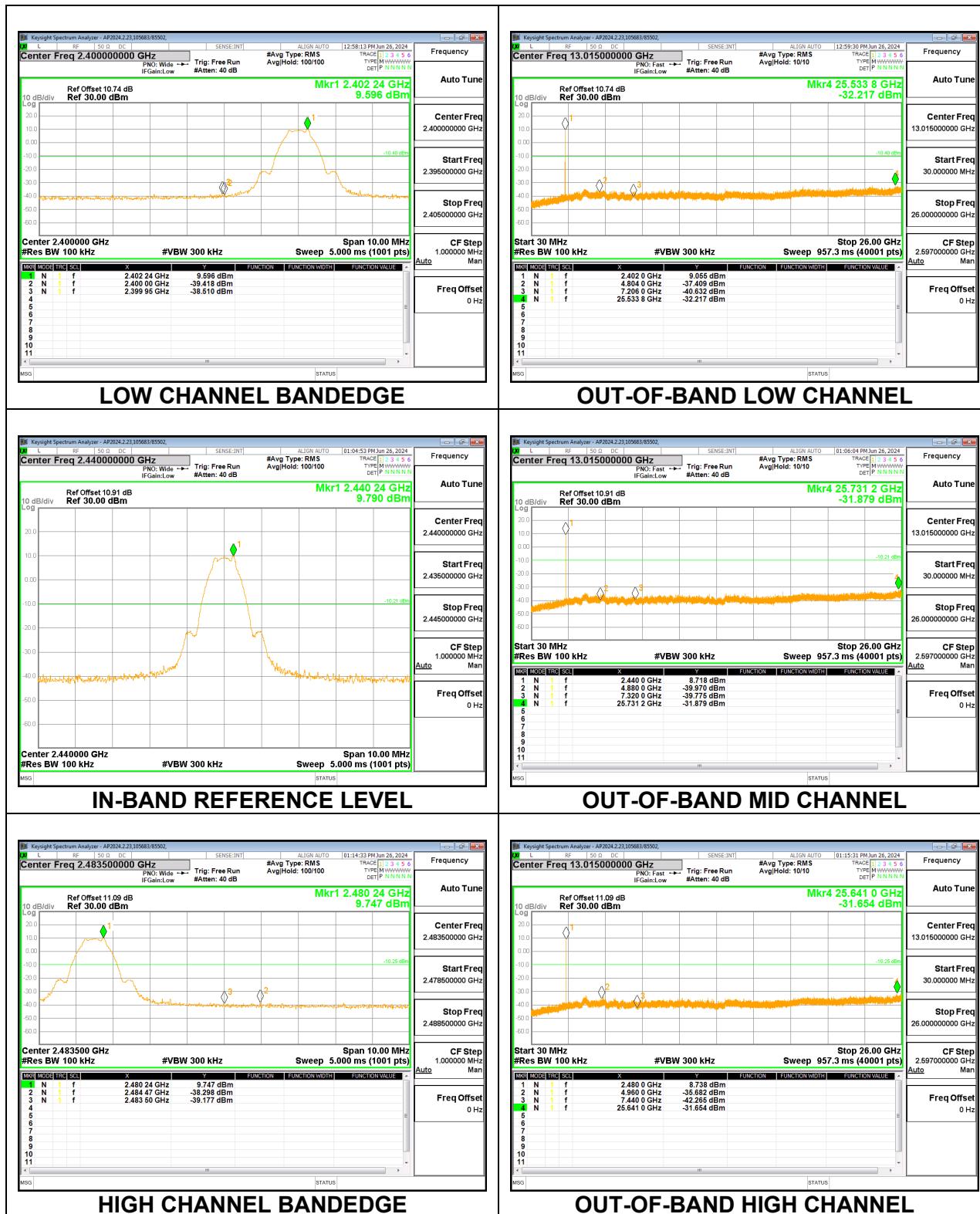
### LIMITS

FCC §15.247 (d)  
RSS-247 5.5

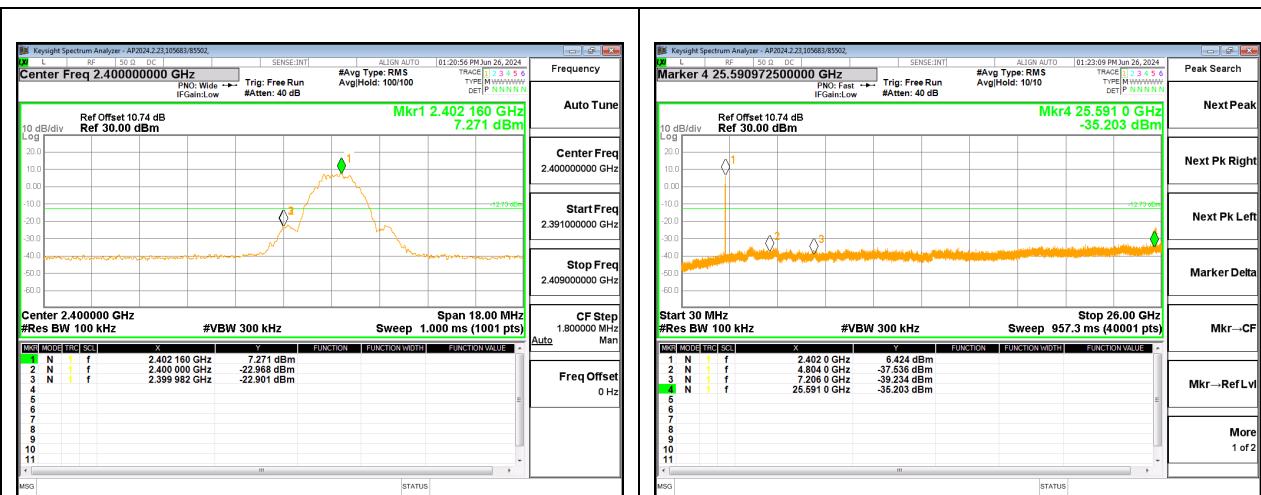
Output power was measured based on the use of a peak measurement, therefore the required attenuation is -20 dBc.

### RESULTS

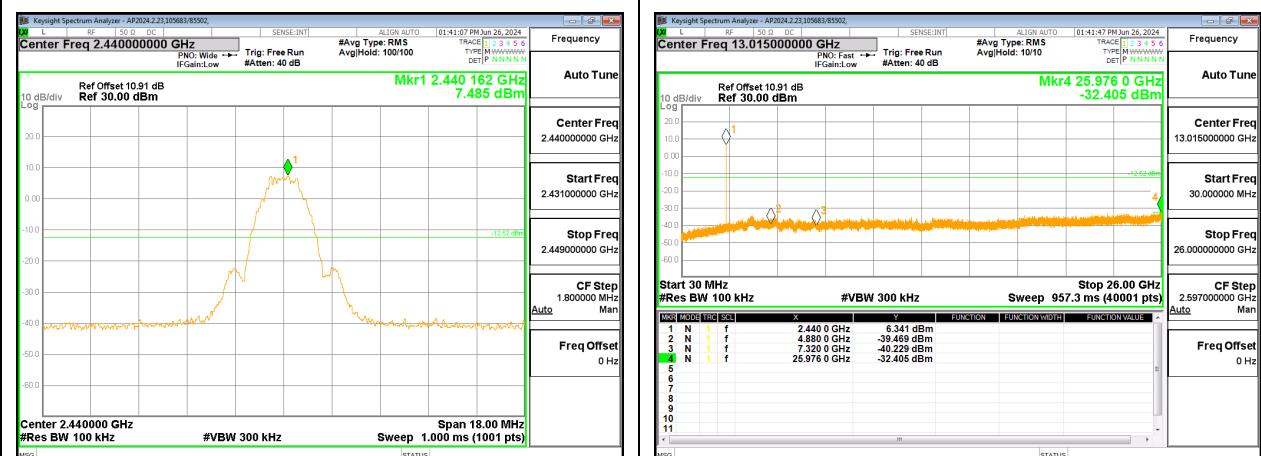
### 9.7.1. BLE (1Mbps)



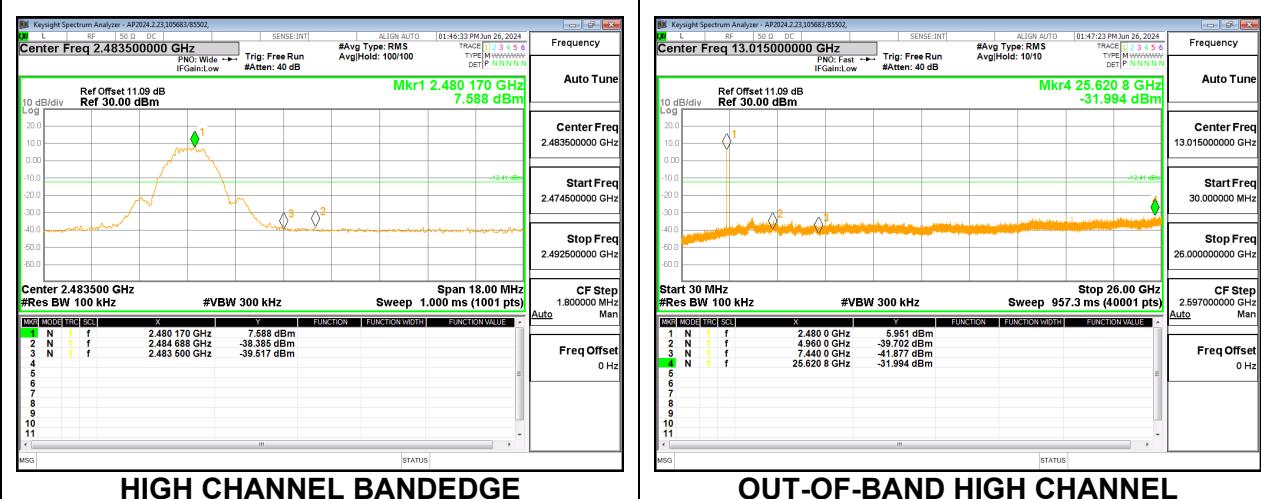
### 9.7.2. BLE (2Mbps)



## LOW CHANNEL BANDEDGE

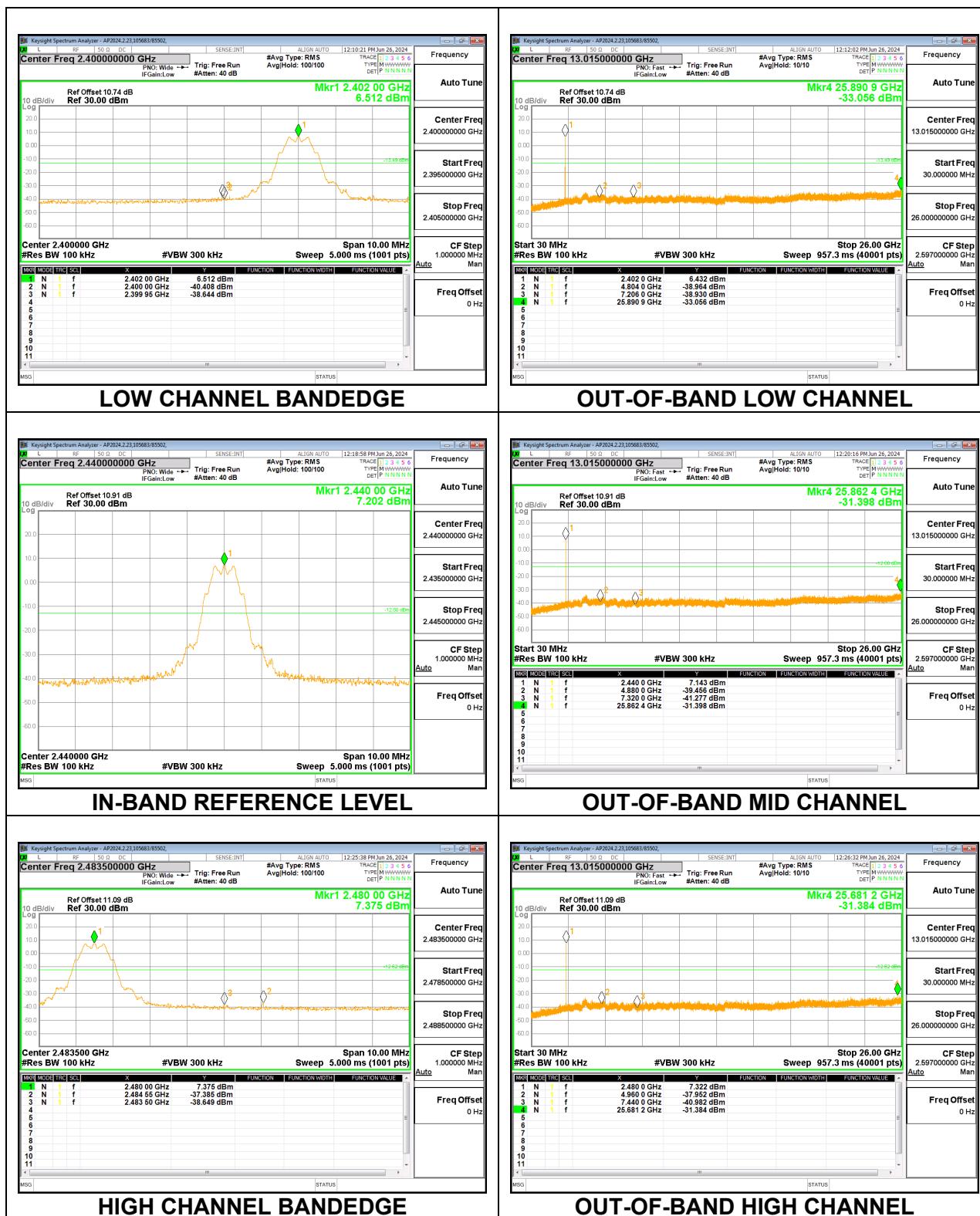


## IN-BAND REFERENCE LEVEL

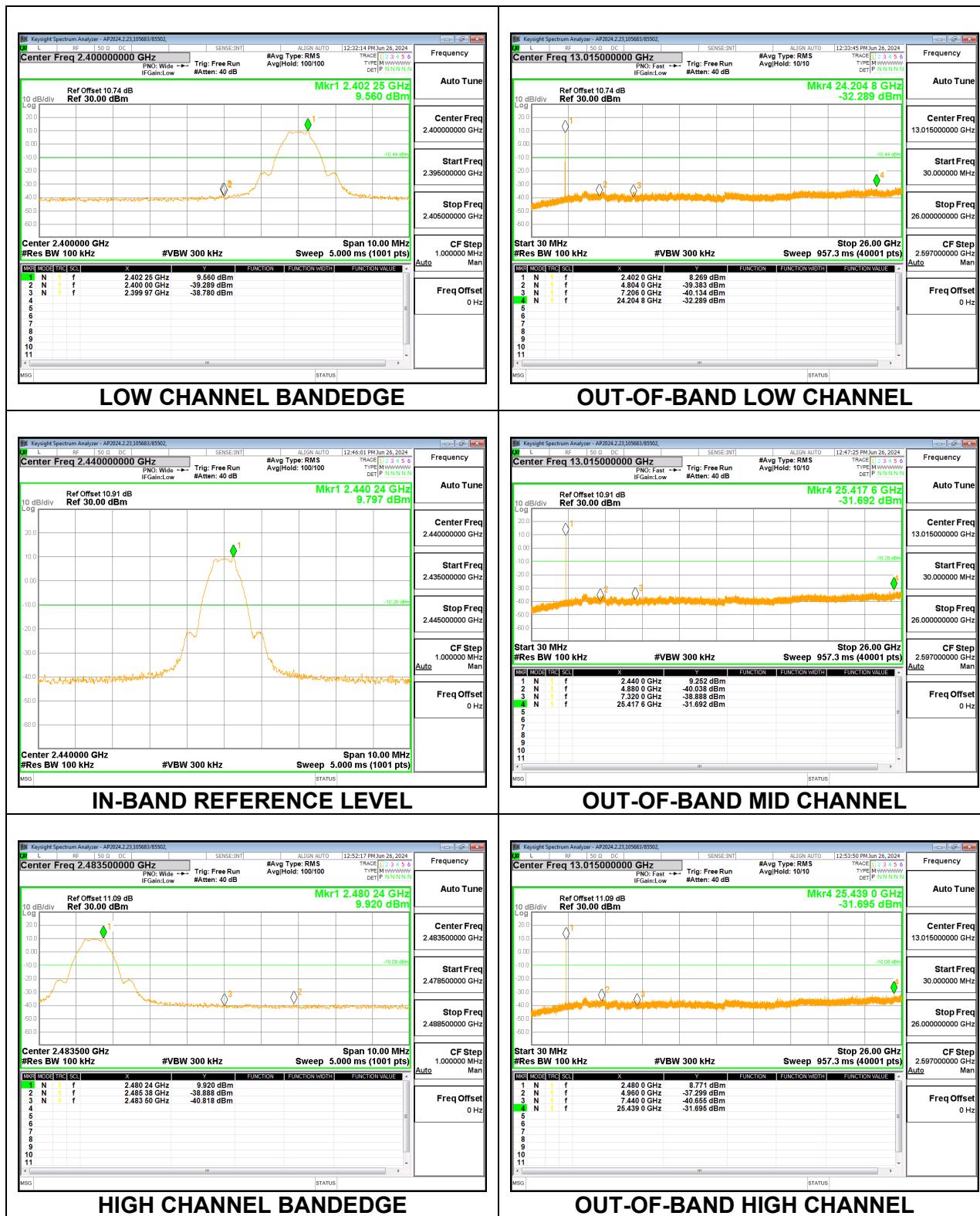


## HIGH CHANNEL BANDEDGE

### 9.7.3. BLE (125Kbps)



### 9.7.4. BLE (500Kbps)



## 10. RADIATED TEST RESULTS

### 10.1. LIMITS AND PROCEDURE

#### 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

RSS-GEN, Section 8.9 and 8.10.

Frequency Range (MHz)	Field Strength Limit (uA/m) at 3 m	Field Strength Limit (dBuA/m) at 3 m
0.009-0.490	6.37/F(kHz) @ 300 m	-
0.490-1.705	63.7/F(kHz) @ 30 m	-
1.705 - 30	0.08 @ 30m	-
Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
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 in the 30-1000MHz range, 9kHz for peak and/or quasi-peak detection measurements in the 0.15-30MHz range and 200Hz for peak and/or quasi-peak detection measurements in the 9 to 150kHz range. Peak detection is used unless otherwise noted as quasi-peak or average (9-90kHz and 110-490kHz).

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz 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. Voltage Averaging was used.

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 power spectral density 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.

3D antenna use - For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel).

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**

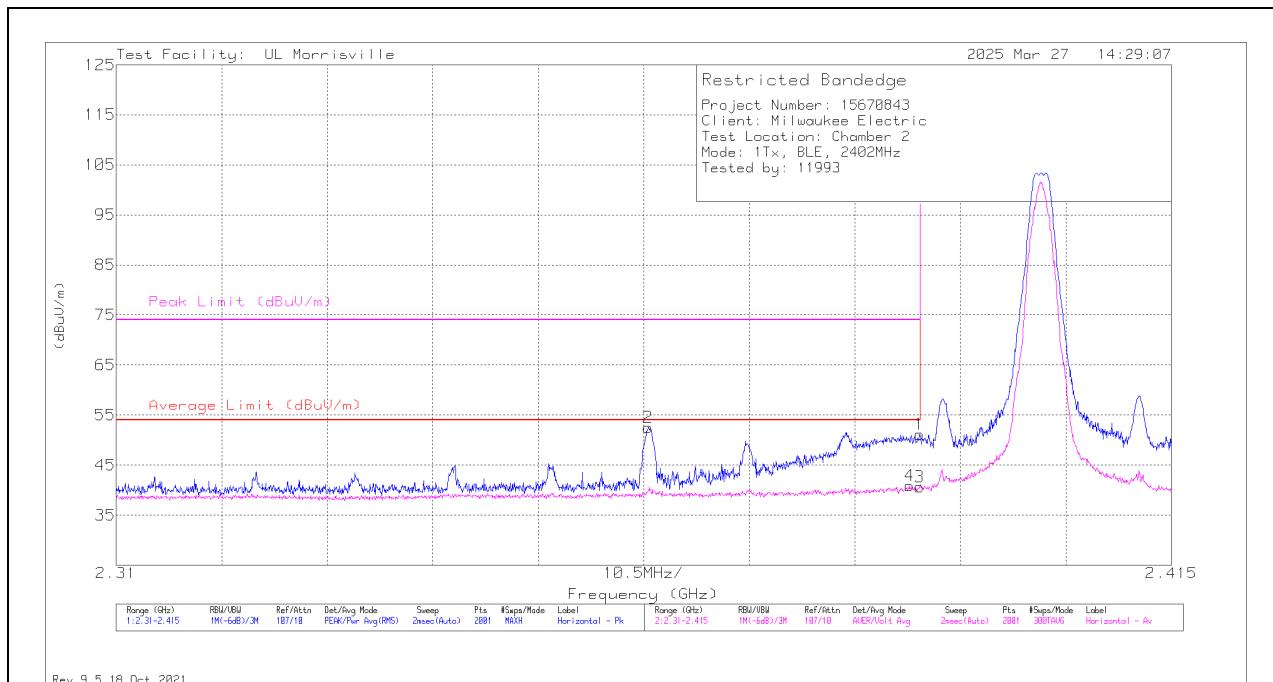
OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

## 10.2. TRANSMITTER ABOVE 1 GHz

### 10.2.1. BLE (2Mbps)

#### BANDEDGE (LOW CHANNEL)

#### HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	86408 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* *** 2.38996	42.5	Pk	32.3	-23.6	0	51.2	-	-	74	-22.8	68	147	H
2	* *** 2.36292	43.89	Pk	32.2	-23.6	0	52.49	-	-	74	-21.51	68	147	H
3	* *** 2.38996	22.33	ADV	32.3	-23.6	9.56	40.59	54	-13.41	-	-	68	147	H
4	* *** 2.38896	22.5	ADV	32.3	-23.5	9.56	40.86	54	-13.14	-	-	68	147	H

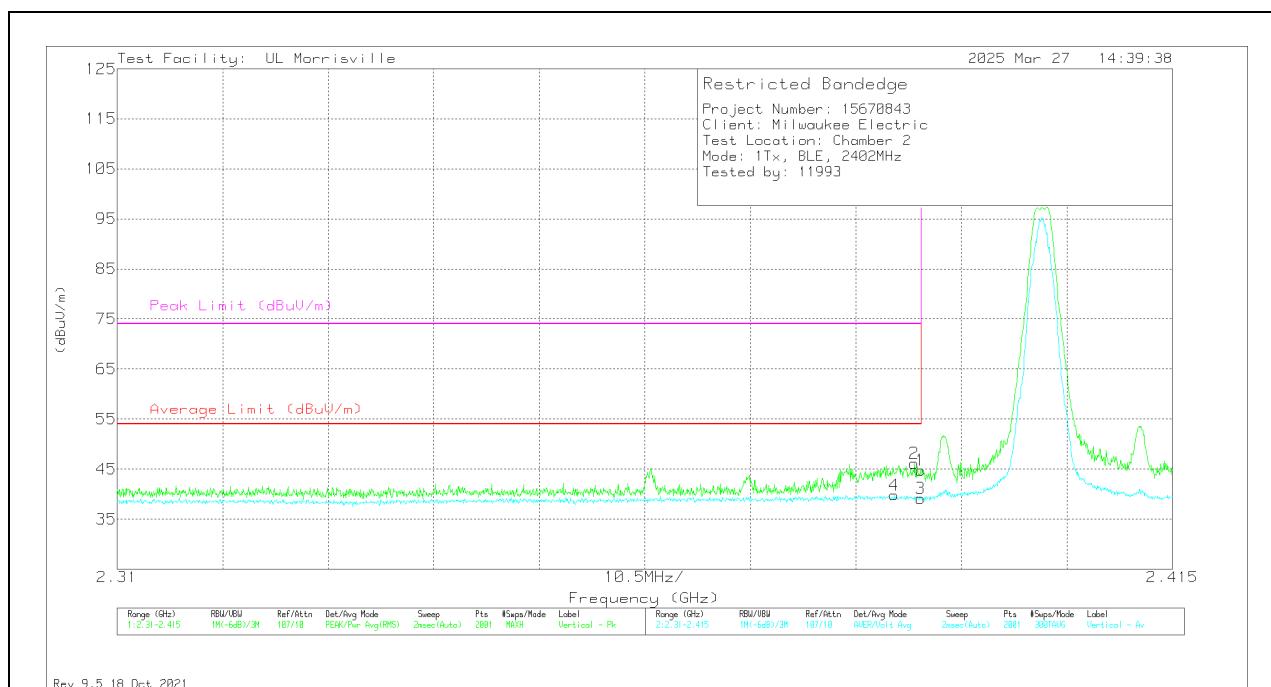
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

\*\* - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

## VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	86408 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* *** 2.38996	36.09	Pk	32.3	-23.6	0	44.79	-	-	74	-29.21	351	156	V
2	* *** 2.38933	37.38	Pk	32.3	-23.5	0	46.18	-	-	74	-27.82	351	156	V
3	* *** 2.38996	20.9	ADV	32.3	-23.6	9.56	39.16	54	-14.84	-	-	351	156	V
4	* *** 2.38733	21.45	ADV	32.2	-23.4	9.56	39.81	54	-14.19	-	-	351	156	V

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

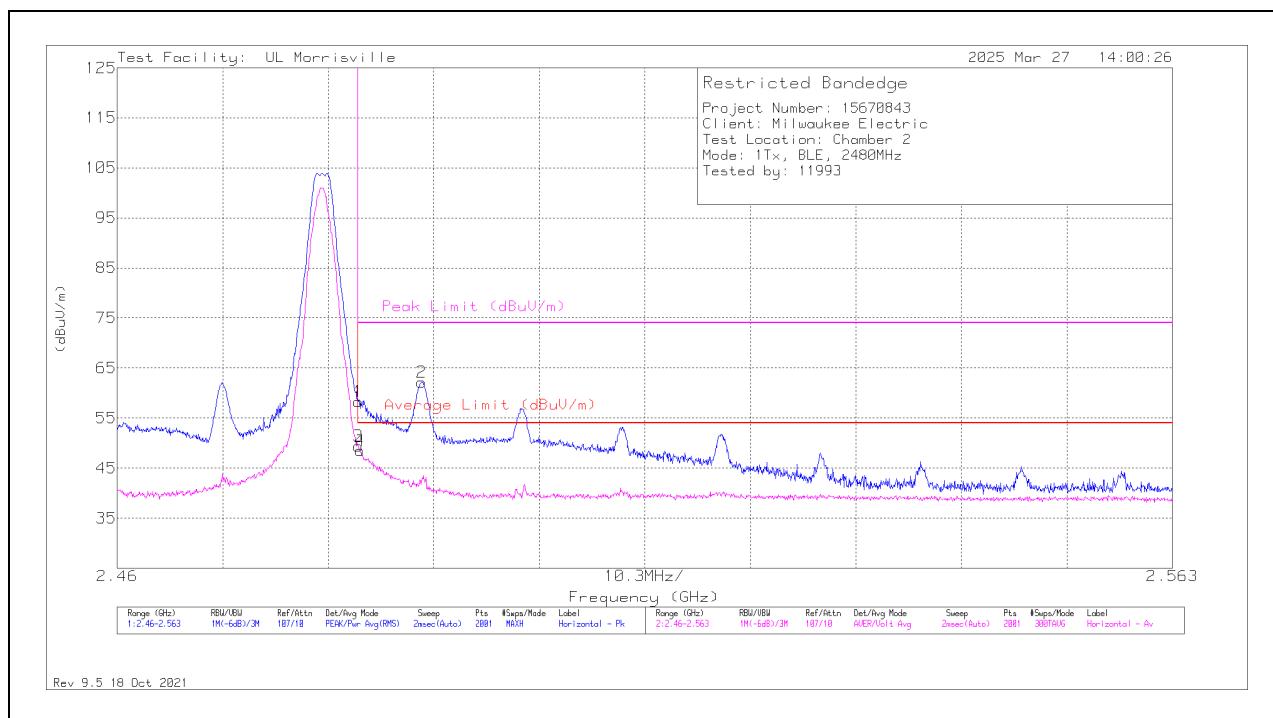
\*\* - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

## BANDEDGE (HIGH CHANNEL)

### HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	86408 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* *** 2.48354	49.91	Pk	32.5	-24.1	0	58.31	-	-	74	-15.69	341	179	H
2	* *** 2.48972	53.97	Pk	32.5	-24.3	0	62.17	-	-	74	-11.83	341	179	H
3	* *** 2.48354	31.47	ADV	32.5	-24.1	9.56	49.43	54	-4.57	-	-	341	179	H
4	* *** 2.48369	30.6	ADV	32.5	-24.1	9.56	48.56	54	-5.44	-	-	341	179	H

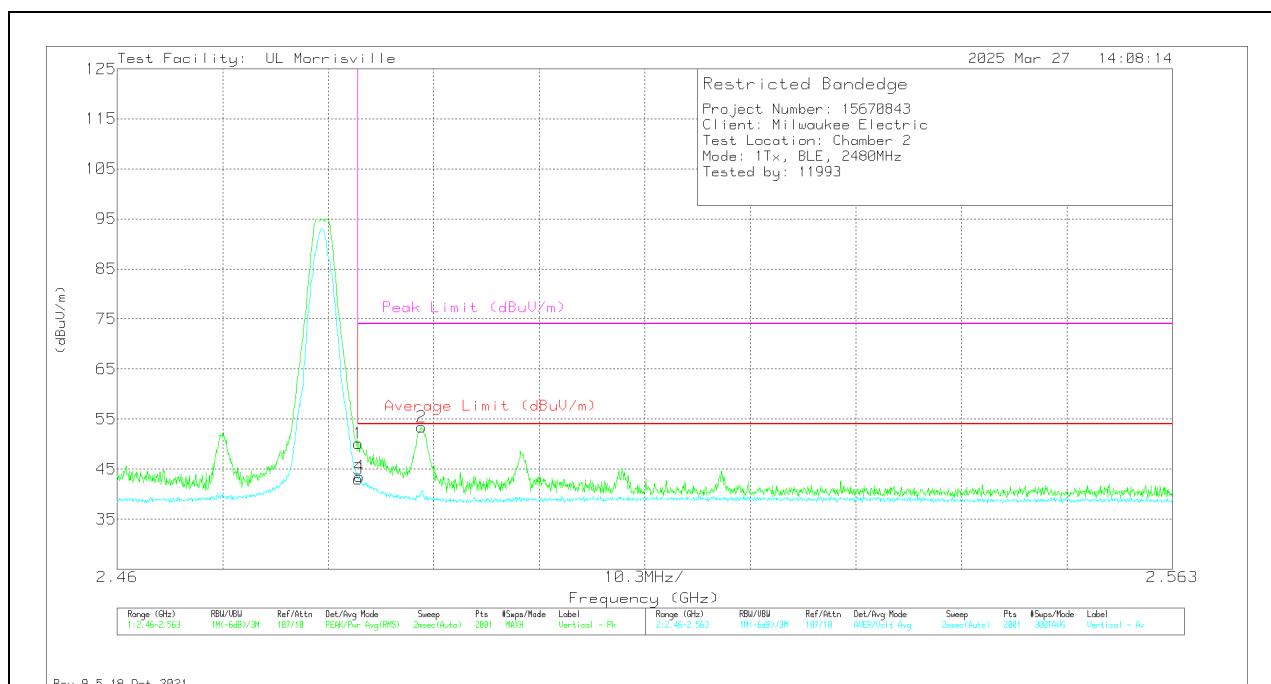
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

\*\* - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

## VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	86408 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* *** 2.48354	41.78	Pk	32.5	-24.1	0	50.18	-	-	74	-23.82	39	144	V
2	* *** 2.48972	45.25	Pk	32.5	-24.3	0	53.45	-	-	74	-20.55	39	144	V
3	* *** 2.48354	25.01	ADV	32.5	-24.1	9.56	42.97	54	-11.03	-	-	39	144	V
4	* *** 2.48364	25.5	ADV	32.5	-24.1	9.56	43.46	54	-10.54	-	-	39	144	V

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

\*\* - indicates frequency in Taiwan NCC LP0002 Restricted Band

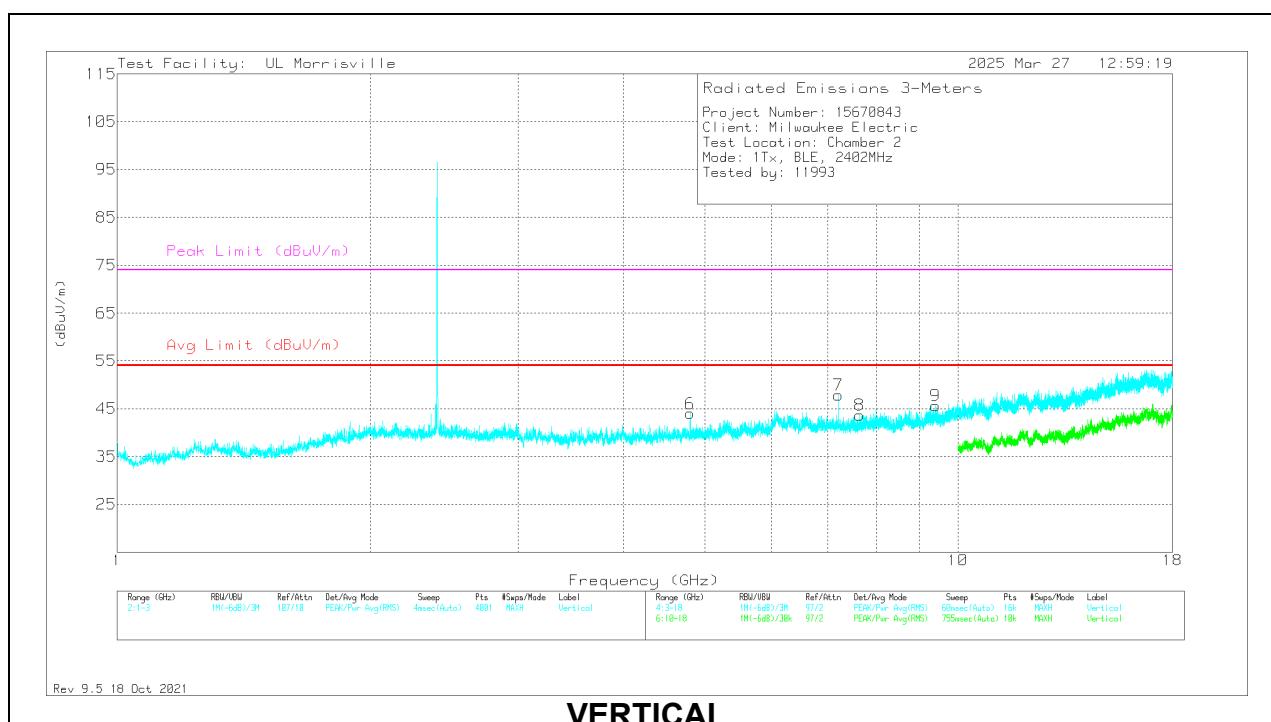
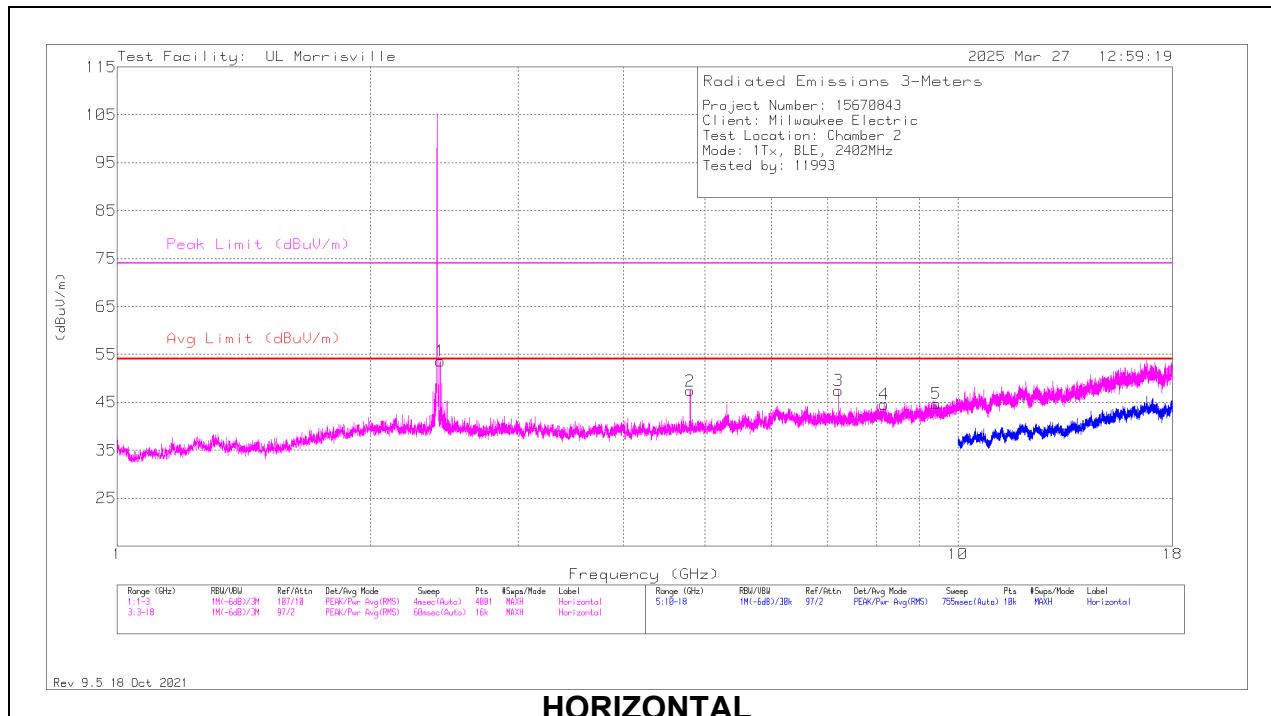
Pk - Peak detector

ADV - Linear Voltage Average

## 10.2.2. BLE (125Kbps)

### HARMONICS AND SPURIOUS EMISSIONS

#### LOW CHANNEL RESULTS



## RADIATED EMISSIONS

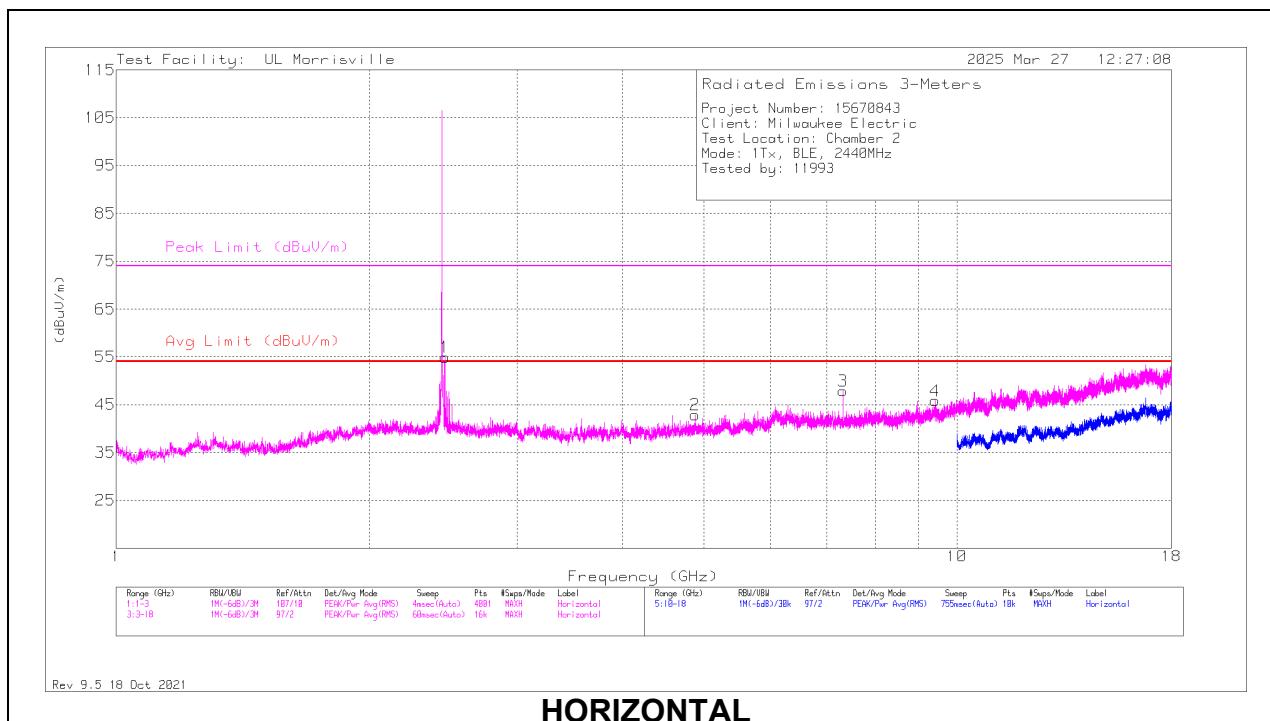
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	86408 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* *** 4.80375	57.09	Pk	34.2	-43.9	47.39	54	-6.61	74	-26.61	0-360	101	H
4	* *** 8.17219	49.06	Pk	35.8	-40.3	44.56	54	-9.44	74	-29.44	0-360	101	H
5	* *** 9.43031	48.53	Pk	36.3	-40.1	44.73	54	-9.27	74	-29.27	0-360	101	H
6	* *** 4.80375	53.69	Pk	34.2	-43.9	43.99	54	-10.01	74	-30.01	0-360	101	V
8	* *** 7.64625	49.1	Pk	35.7	-41.1	43.7	54	-10.3	74	-30.3	0-360	199	V
9	* *** 9.39938	49.1	Pk	36.2	-39.7	45.6	54	-8.4	74	-28.4	0-360	199	V
1	2.422	45.11	Pk	32.3	-23.8	53.61	-	-	-	-	0-360	100	H
7	7.20563	53.9	Pk	35.6	-41.7	47.8	-	-	-	-	0-360	101	V
3	7.20656	53.59	Pk	35.6	-41.7	47.49	-	-	-	-	0-360	101	H

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

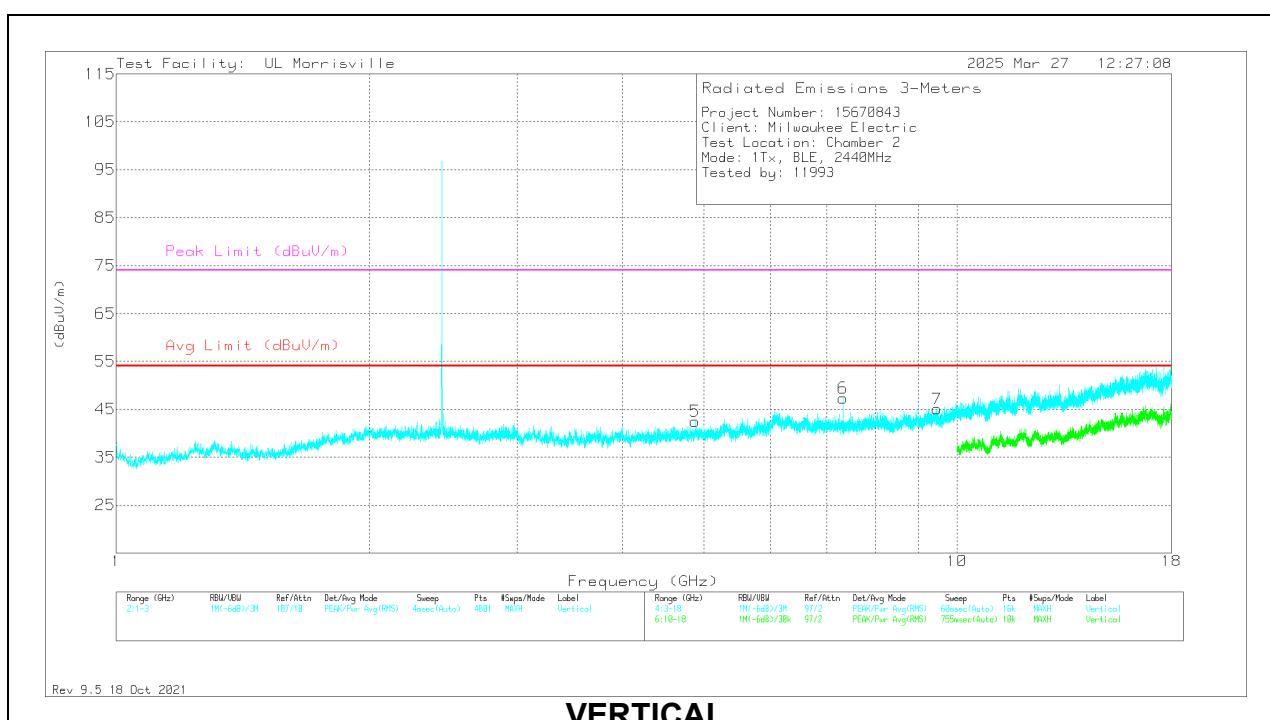
\*\* - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

## MID CHANNEL RESULTS



## HORIZONTAL



## VERTICAL

## RADIATED EMISSIONS

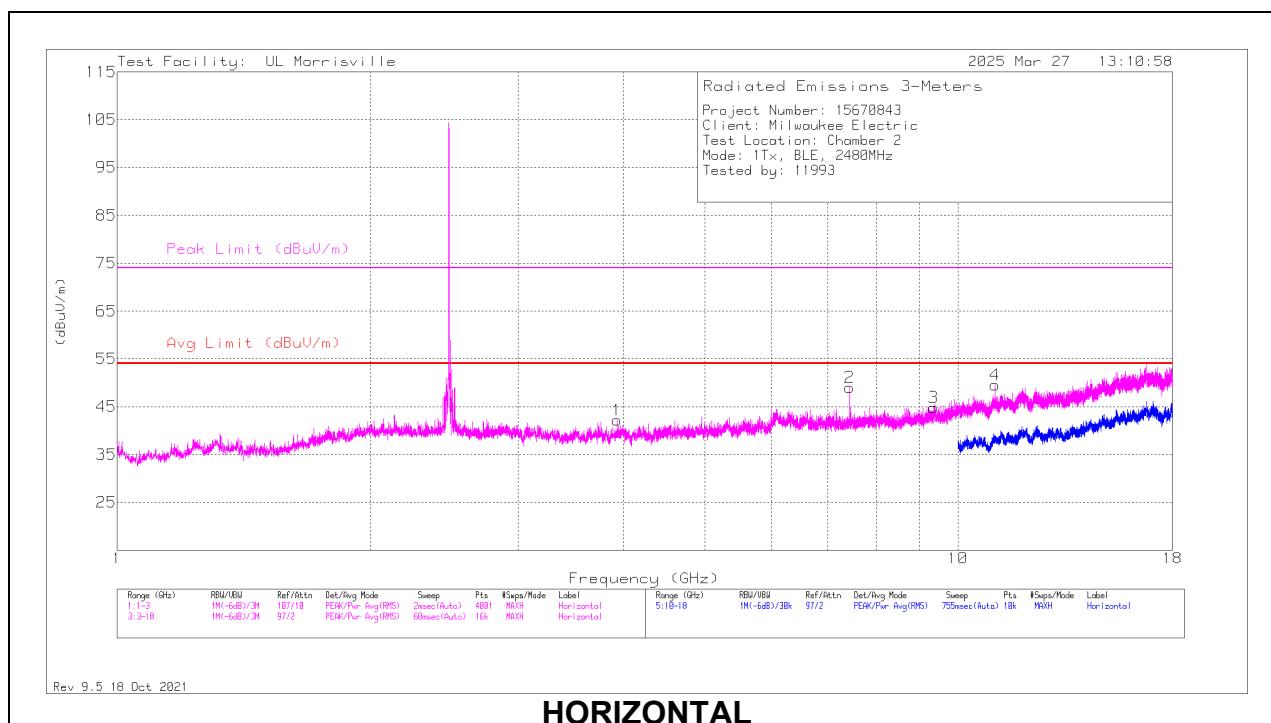
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	86408 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* *** 4.87969	52.53	Pk	34.1	-43.7	42.93	54	-11.07	74	-31.07	0-360	101	H
3	* *** 7.32	54.11	Pk	35.6	-41.8	47.91	54	-6.09	74	-26.09	0-360	200	H
4	* *** 9.42188	49.72	Pk	36.2	-40.1	45.82	54	-8.18	74	-28.18	0-360	200	H
5	* *** 4.88063	52.09	Pk	34.1	-43.7	42.49	54	-11.51	74	-31.51	0-360	101	V
6	* *** 7.32	53.52	Pk	35.6	-41.8	47.32	54	-6.68	74	-26.68	0-360	101	V
7	* *** 9.46594	48.85	Pk	36.3	-40.1	45.05	54	-8.95	74	-28.95	0-360	200	V
1	2.4595	46.77	Pk	32.4	-24.2	54.97	-	-	-	-	0-360	101	H

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

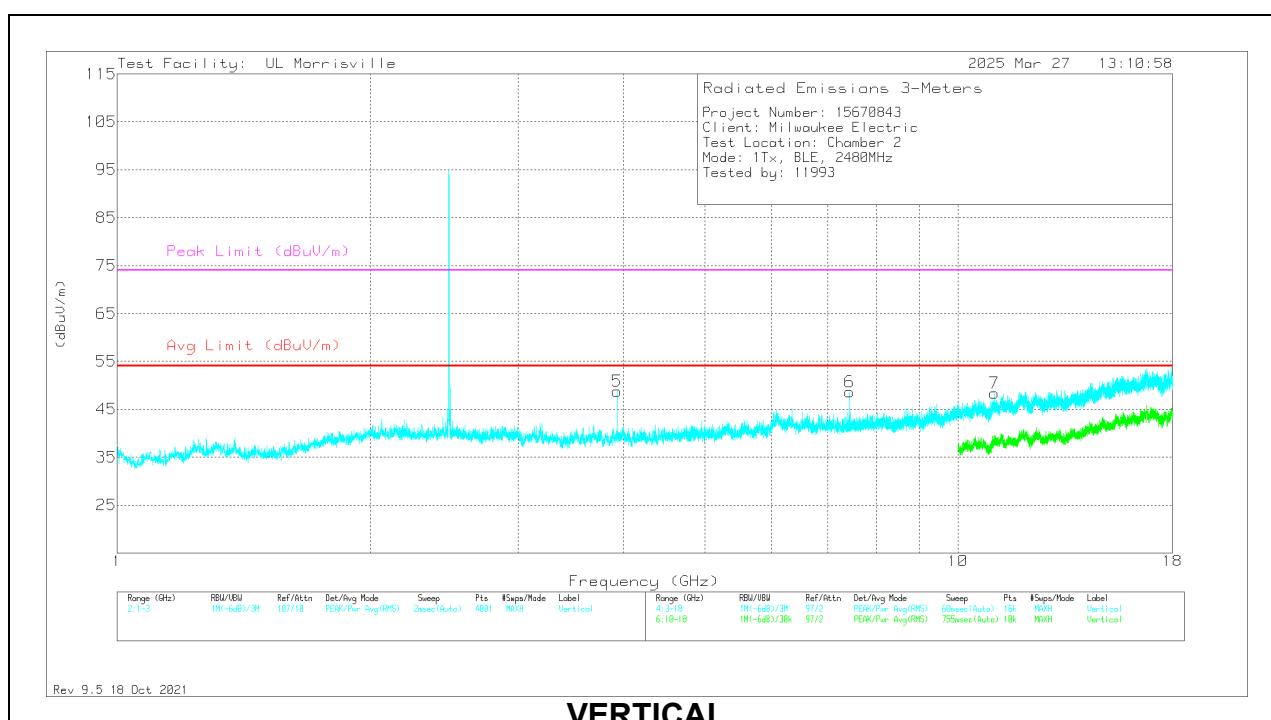
\*\* - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

## HIGH CHANNEL RESULTS



## HORIZONTAL



## VERTICAL

## RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	86408 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* *** 3.93281	53.67	Pk	33.4	-44.9	0	42.17	54	-11.83	74	-31.83	0-360	199	H
2	* *** 7.43932	60.15	PK2	35.6	-41.1	0	54.65	-	-	74	-19.35	357	131	H
	* *** 7.43939	52	ADV	35.6	-41.1	1.64	48.14	54	-5.86	-	-	357	131	H
3	* *** 9.35719	48.46	Pk	36.1	-39.7	0	44.86	54	-9.14	74	-29.14	0-360	199	H
4	* *** 11.0758	49.62	PK2	37.7	-38.8	0	48.52	-	-	74	-25.48	30	337	H
	* *** 11.0761	37.14	ADV	37.7	-38.8	1.64	37.68	54	-16.32	-	-	30	337	H
5	* *** 3.93633	62.39	PK2	33.4	-44.9	0	50.89	-	-	74	-23.11	177	195	V
	* *** 3.93462	41.49	ADV	33.4	-44.9	1.64	31.63	54	-22.37	-	-	177	195	V
6	* *** 7.43922	57.06	PK2	35.6	-41.1	0	51.56	-	-	74	-22.44	34	112	V
	* *** 7.43933	48.24	ADV	35.6	-41.1	1.64	44.38	54	-9.62	-	-	34	112	V
7	* *** 11.05738	49.27	PK2	37.7	-38.9	0	48.07	-	-	74	-25.93	219	211	V
	* *** 11.05403	37.13	ADV	37.7	-39	1.64	37.47	54	-16.53	-	-	219	211	V

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

\*\* - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

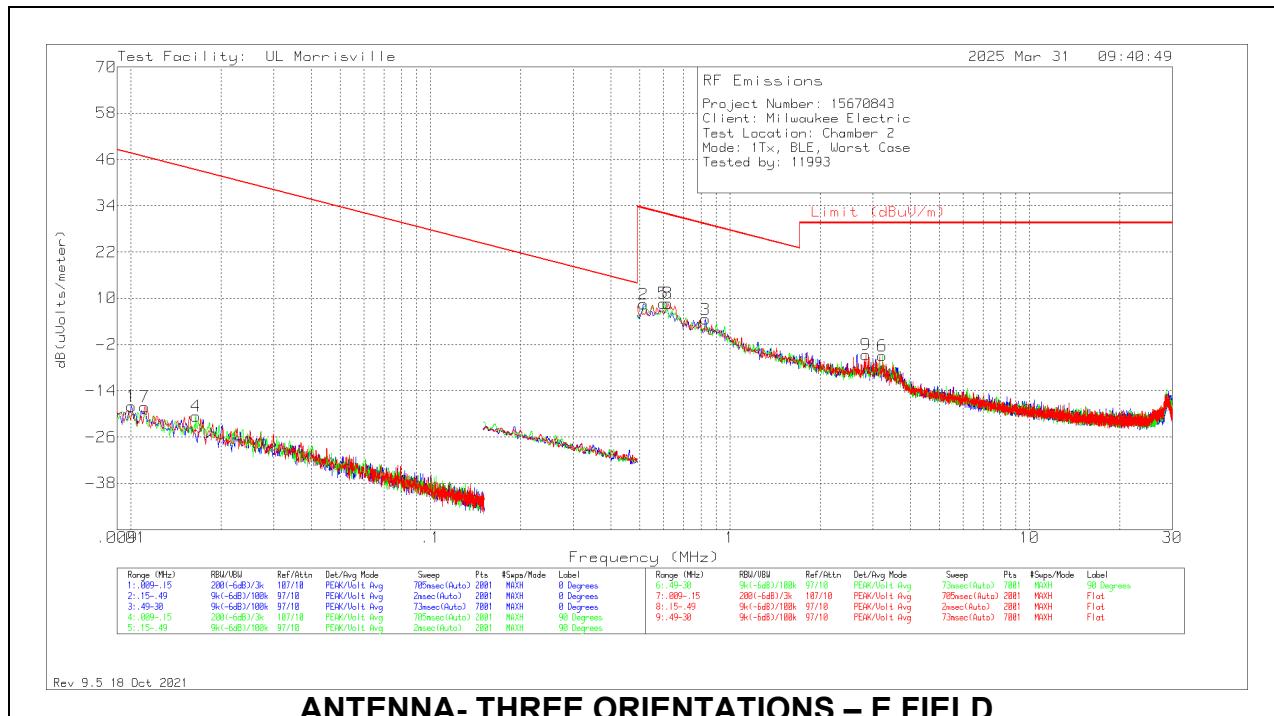
PK2 - Maximum Peak

ADV - Linear Voltage Average

## 10.3. WORST CASE BELOW 30MHZ

### SPURIOUS EMISSIONS BELOW 30 MHZ (WORST-CASE CONFIGURATION)

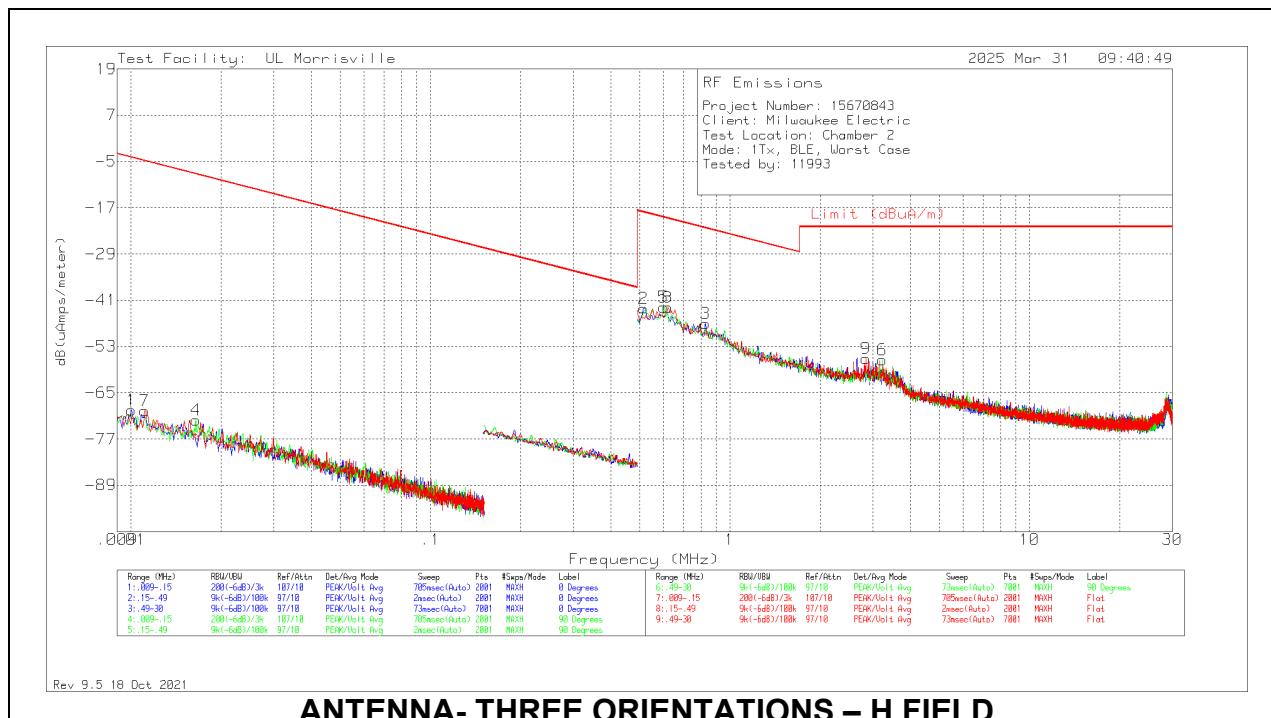
Note: All measurements were made at a test distance of 3 m. The measured data was extrapolated from the test distance (3m) to the specification distance (300 m from 9-490 kHz and 30 m from 490 kHz – 30 MHz) to clearly show the relative levels of fundamental and spurious emissions and demonstrate compliance with the requirement that the level of any spurious emissions be below the level of the intentionally transmitted signal. The extrapolation factor for the limits were 40\*Log (test distance / specification distance).



### Below 30MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	135144 (dB/m)	Gain/Loss (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uVolts/meter)	QP/AV Limit (dBuV/m)	PK Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Loop Angle
1	.01007	43.68	Pk	18.2	.1	-80	-18.02	47.55	67.55	-65.57	0-360	0 degs
7	.01113	44	Pk	17.7	.1	-80	-18.2	46.67	66.67	-64.87	0-360	Flat
4	.01653	43.89	Pk	15.4	.1	-80	-20.61	43.24	63.24	-63.85	0-360	90 degs
2	.5153	37.34	Pk	11	.1	-40	8.44	33.36	-	-24.92	0-360	0 degs
5	.59962	37.57	Pk	11	.1	-40	8.67	32.05	-	-23.38	0-360	90 degs
8	.6207	37.52	Pk	11	.1	-40	8.62	31.75	-	-23.13	0-360	Flat
3	.82728	33.43	Pk	11	.1	-40	4.53	29.25	-	-24.72	0-360	0 degs
9	2.84253	24.06	Pk	11.1	.2	-40	-4.64	29.54	-	-34.18	0-360	Flat
6	3.22618	23.69	Pk	11.1	.3	-40	-4.91	29.54	-	-34.45	0-360	90 degs

Pk - Peak detector



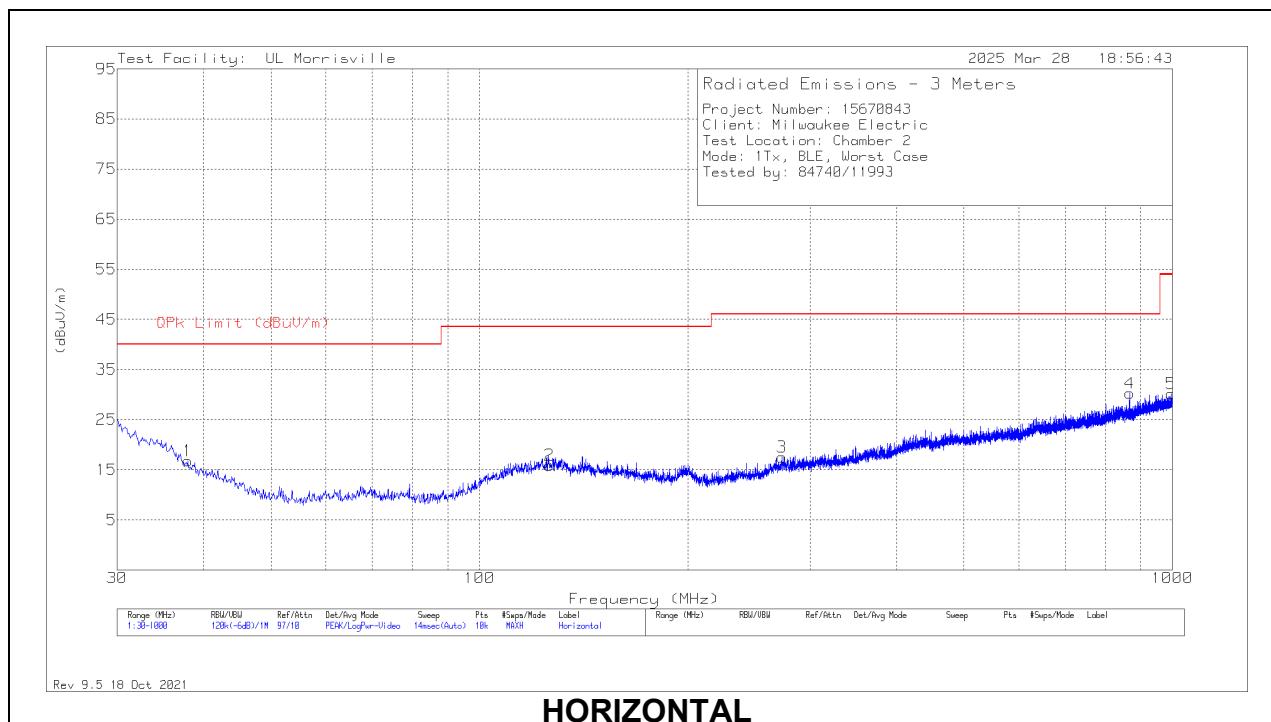
## ANTENNA- THREE ORIENTATIONS – H FIELD

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	135144 (dB/m)	Gain/Loss (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uAmps/meter)	QP/AV Limit (dBuA/m)	PK Limit (dBuA/m)	Margin (dB)	Azimuth (Degs)	Loop Angle
1	.01007	43.68	Pk	-33.3	.1	-80	-69.52	-3.95	16.05	-65.57	0-360	0 degs
7	.01113	44	Pk	-33.8	.1	-80	-69.7	-4.83	15.17	-64.87	0-360	Flat
4	.01653	43.89	Pk	-36.1	.1	-80	-72.11	-8.26	11.74	-63.85	0-360	90 degs
2	.5153	37.34	Pk	-40.5	.1	-40	-43.06	-18.14	-	-24.92	0-360	0 degs
5	.59962	37.57	Pk	-40.5	.1	-40	-42.83	-19.45	-	-23.38	0-360	90 degs
8	.6207	37.52	Pk	-40.5	.1	-40	-42.88	-19.75	-	-23.13	0-360	Flat
3	.82728	33.43	Pk	-40.5	.1	-40	-46.97	-22.25	-	-24.72	0-360	0 degs
9	2.84253	24.06	Pk	-40.4	.2	-40	-56.14	-21.96	-	-34.18	0-360	Flat
6	3.22618	23.69	Pk	-40.4	.3	-40	-56.41	-21.96	-	-34.45	0-360	90 degs

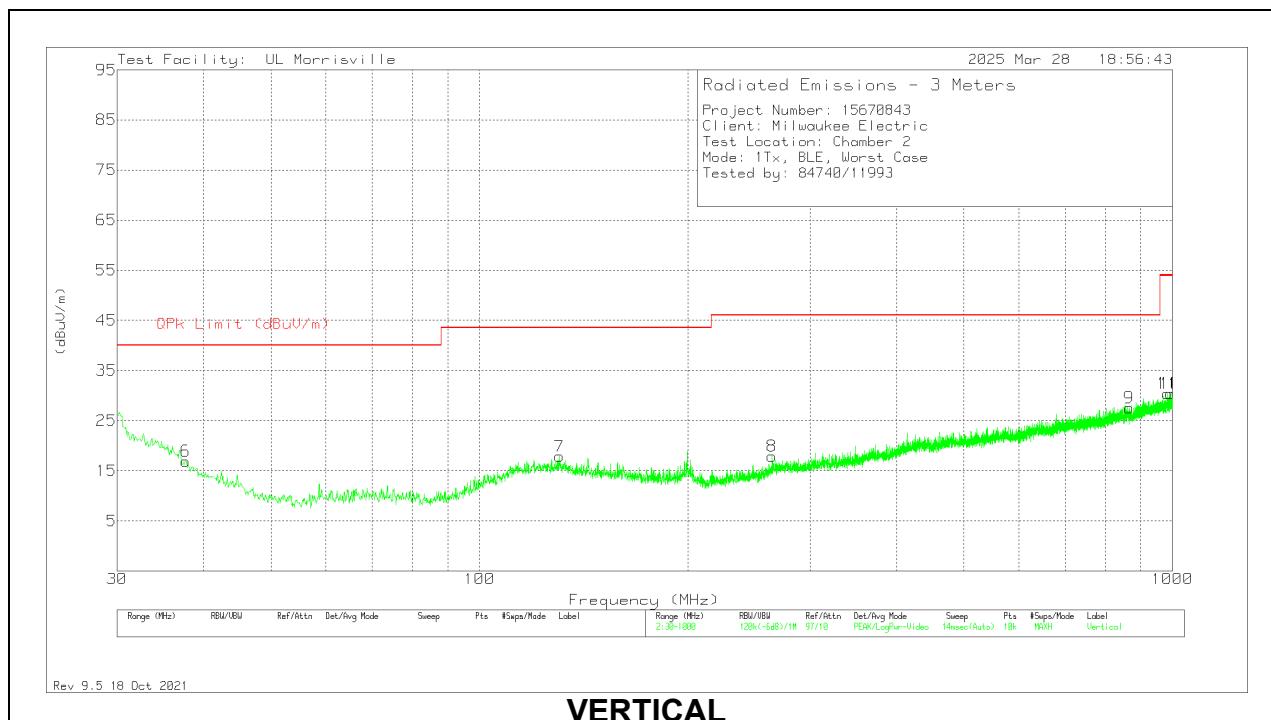
Pk - Peak detector

## 10.4. WORST CASE BELOW 1 GHZ

### **SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)**



**HORIZONTAL**



**VERTICAL**

## Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	159203 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* *** 37.954	26.54	Pk	21.8	-31.6	16.74	40	-23.26	0-360	399	H
2	* *** 126.127	26.02	Pk	20.4	-30.5	15.92	43.52	-27.6	0-360	399	H
3	* *** 273.373	27.24	Pk	19.8	-29.5	17.54	46.02	-28.48	0-360	399	H
4	** 867.789	28.24	Pk	28.5	-26.5	30.24	46.02	-15.78	0-360	101	H
5	** 995.635	25.14	Pk	30	-25	30.14	53.97	-23.83	0-360	101	H
6	* *** 37.663	26.5	Pk	22	-31.6	16.9	40	-23.1	0-360	299	V
7	* *** 130.492	28.24	Pk	20.2	-30.6	17.84	43.52	-25.68	0-360	299	V
8	* *** 264.449	28.23	Pk	19.3	-29.6	17.93	46.02	-28.09	0-360	101	V
9	** 865.655	25.68	Pk	28.5	-26.6	27.58	46.02	-18.44	0-360	299	V
10	* *** 993.307	25.48	Pk	29.9	-25	30.38	53.97	-23.59	0-360	199	V
11	* *** 982.831	25.67	Pk	29.8	-25.1	30.37	53.97	-23.6	0-360	299	V

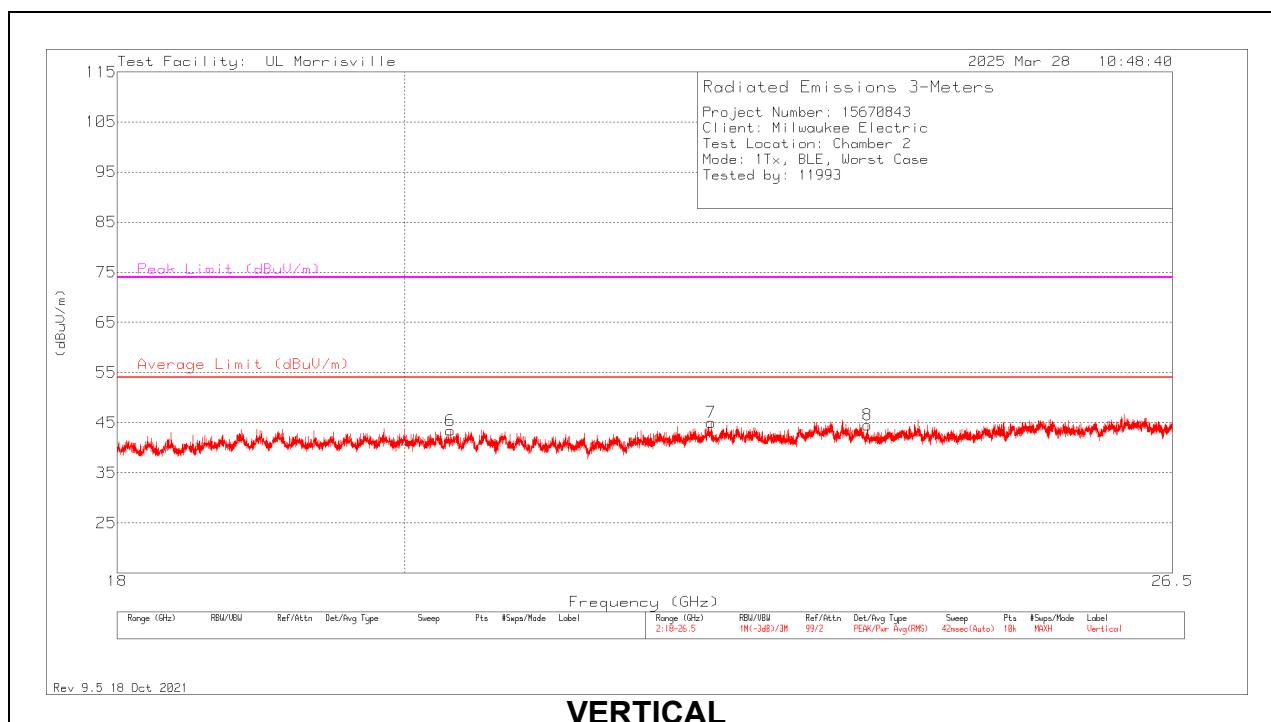
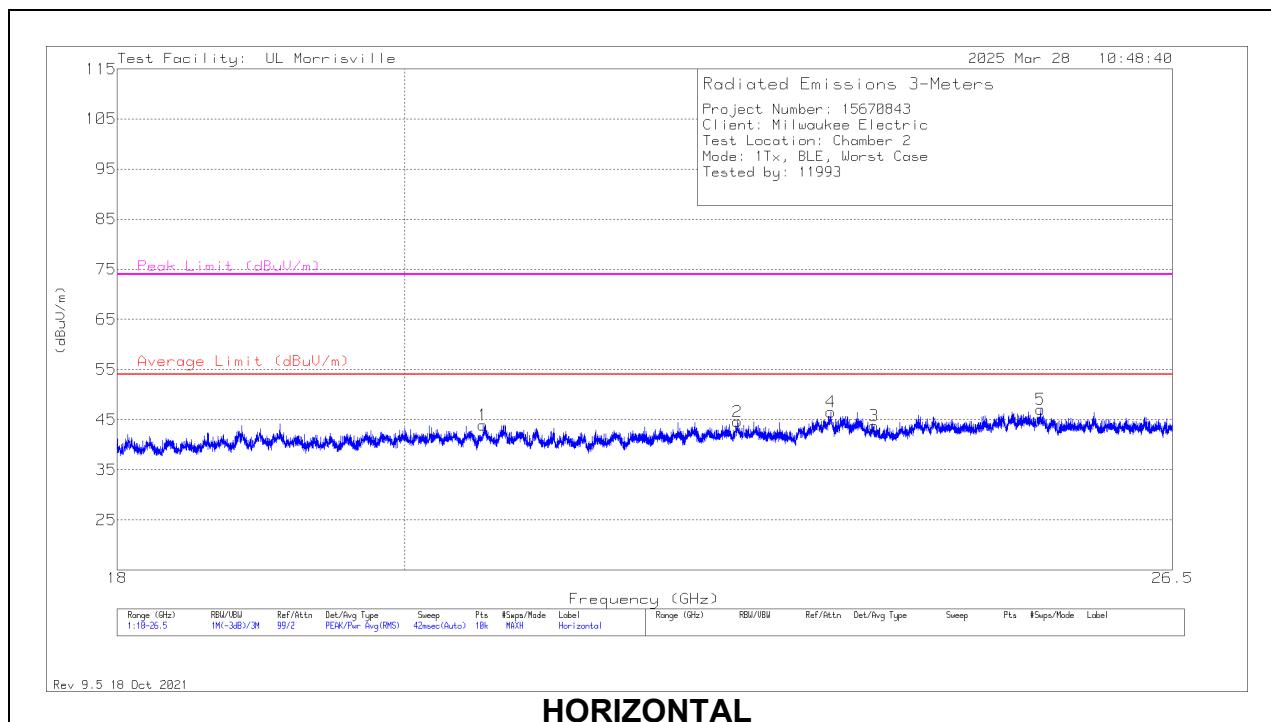
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

\*\* - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

## 10.5. WORST CASE 18-26 GHZ

### SPURIOUS EMISSIONS 18-26 GHz (WORST-CASE CONFIGURATION)



## 18 – 26GHz Data

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	204704 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* *** 20.58459	48.19	Pk	33.7	-38	43.89	54	-10.11	74	-30.11	0-360	150	H
2	* *** 22.59719	47.3	Pk	34.3	-37	44.6	54	-9.4	74	-29.4	0-360	101	H
3	* *** 23.75647	46.86	Pk	34.4	-37.5	43.76	54	-10.24	74	-30.24	0-360	300	H
6	* *** 20.34067	47.86	Pk	33.6	-38	43.46	54	-10.54	74	-30.54	0-360	300	V
7	* *** 22.37621	49.16	Pk	34.1	-38.2	45.06	54	-8.94	74	-28.94	0-360	101	V
8	* *** 23.69783	46.99	Pk	34.5	-37	44.49	54	-9.51	74	-29.51	0-360	300	V
4	23.37911	49.11	Pk	34.6	-37.2	46.51	-	-	-	-	0-360	249	H
5	25.24893	47.67	Pk	35.6	-36.2	47.07	-	-	-	-	0-360	101	H

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

\*\* - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

## 11. SETUP PHOTOS

Please refer to R15670843-EP2 for setup photos

**END OF TEST REPORT**