



Testing Tomorrow's Technology

Permissive Change Application

For

**Certification for an Intentional Radiator per
Part 15, Subpart C, paragraphs 15.207, 15.209 and 15.247
and
Innovation Science and Economic Development Canada
Certification per
RSS-Gen General Requirements for Radio Apparatus
and
RSS-247 Digital Transmission Systems (DTS), Frequency Hopping Systems
(FHSS) and License-Exempt Local Area Network (LE-LAN) Devices**

For the

**Murata Electronics North America
Model: CCT24**

**FCC ID: HSW-CCT24
IC: 4492A-CCT24
UST Project: 17-0439
Issue Date: April 9, 2018**

Total Pages in This Report: 75

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Testing Tomorrow's Technology

I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: 

Title: Compliance Engineer – President

Date April 9, 2018



TESTING
NVLAP LAB CODE 200162-0

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17-0439
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MEASUREMENT TECHNICAL REPORT

COMPANYS NAME: Murata Electronics North America

MODEL: CCT24

FCC ID: HSW-CCT24

IC: 4492A-CCT24

DATE: April 5, 2018

This report concerns (check one): Original grant
Class II change

Equipment type: DTS Transmitter Module

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? Yes _____ No X

If Yes, defer until: N/A
date

agrees to notify the Commission by N/A
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

US Tech
3505 Francis Circle
Alpharetta, GA 30004

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- Application Forms
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- Block Diagram(s)
- Schematic(s)
- Test Configuration Photographs
- Internal Photographs
- External Photographs
- Antenna Photographs
- RF Exposure
- User's Manual

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1 General Information

1.1 Purpose of this Report

The purpose of this report is to file for a Class II permissive change. The reason for the Class II permissive change is due to the following:

- EUT PCB modifications (no circuits in the transmit path changed)
- EUT shielding improvements
- Transmitter Frequency shifted from originally approved frequencies (software level changes only)

The PCB changes consist of moving the up/down converter IC and associated passive components to the bottom of the board. Filtering was added to the receive path of this IC which is also placed on the back of the board. A 9 dB attenuator following the up/down converter was changed to a 0 dB attenuator and a 16 dB attenuator now precedes the up/down converter. No other circuit changes were made. There were no changes made to the circuit in the transmit path. The transmit path remains unchanged.

The shielding changes include installing a single piece shield on the back of the board in addition to the shielding that was originally in place.

The transmit channels were moved a block down in frequency, 2.95 MHz. Formerly, channel 0 (lowest channel) was at 2409.55 MHz and channel 25 (highest channel) was at 2479.85 MHz. Now, channel 0 is 2406.6 MHz and channel 25 is 2476.9 MHz. Spacing and channel bandwidth has not been altered. This is a software change only; no hardware changes and no changes to the basic frequency determining and stabilization circuits, frequency multiplication stages, basic modulator circuit or maximum output power levels.

Due to the changes, the following test were performed to show that the EUT continues to comply with the relevant subpart:

- Spurious conducted emissions
- Spurious radiated emissions
- Occupied Bandwidth
- Conducted output power
- Bandedge measurements
- Restricted band measurements

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1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on October 6, 2017 and March 14, 2018 in good operating condition.

1.3 Product Description

The Equipment Under Test (EUT) is the Murata Electronics North America, Model CCT24. The EUT is a 2.4 GHz transceiver designed for use in industrial and commercial monitoring and control markets.

Technical Information:

Detail	Description
Frequency Range	2406.60 – 2476.90 MHz
Number of Channels	38
Modulation Format	FSK
Data Rate(s)	362kbps
Operating Voltage	3.3VDC – 5.5VDC
Number of Inputs/Outputs	2(Tx/Rx Diversity)
Antenna Type / Gain	Corner Reflector / 14dBi PIFA / 4dBi CP Beam / 14dBi Patch / 12dBi Omni / 9dBi Yagi / 13.9dBi

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1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.10:2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices* for the intentional radiator aspect of the device and *ANSI C63.4:2014, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2014)* for the unintentional radiator aspect of the device as well as FCC subpart B and C of Part 15 and per FCC KDB Publication number 558074 v04 for Digital Transmission Systems Operating Under section 15.247.

A list of EUT and Peripherals is found in Table 1 below. A block diagram of the tested system is shown in Figure 1. Test configuration photographs are provided as separate exhibits.

1.5 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA 30004. This site has been fully described and registered with the FCC. Its designation number is 186022. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 9900A-1.

1.6 Related Submittals

The EUT is subject to the following FCC authorizations:

- a) Certification under section 15.247 as a transmitter.
- b) Verification under 15.101 as a digital device and receiver.

Table 1. EUT and Peripherals

EUT/ MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID/IC	CABLES P/D
Radio Module Murata	CCT24	000252	HSW-CCT24 4492A-CCT24	N/A
PERIPHERAL/ MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID/IC	CABLES P/D
Evaluation Board/ Murata	801039 REV A	E208126	None	1.5 m U P 1.5 m U D
Power Supply Adapter/ GlobTek Inc	GT-41052-1509	None	None	1.8 m U P
Antenna	Various	Various	None	N/A

U= Unshielded S= Shielded
 P= Power D= Data

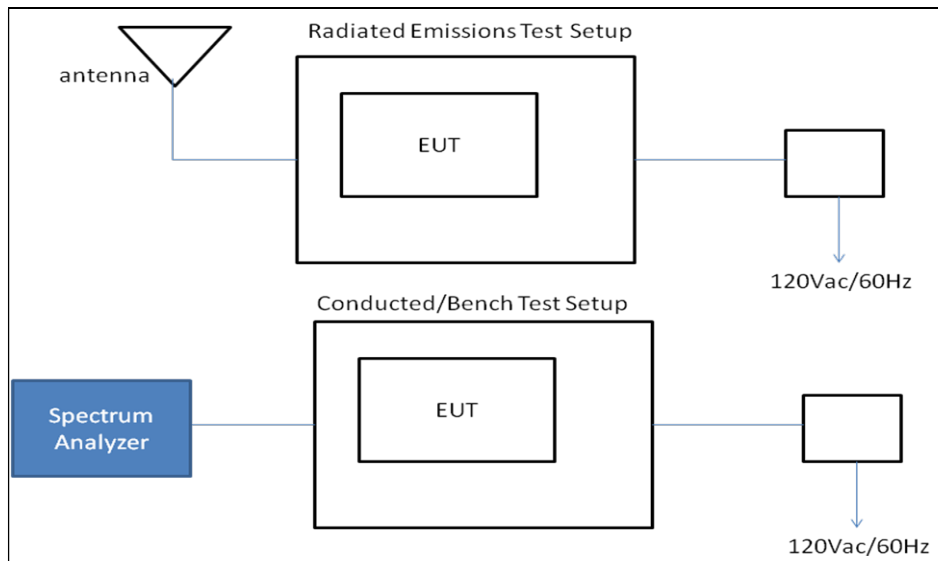


Figure 1. Block Diagram of Test Configuration

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2 Tests and Measurements

2.1 Test Equipment

The table below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are indicated.

Table 2. Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	CALIBRATION DUE DATE
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	10/25/2018
SPECTRUM ANALYZER	N9342CN	AGILENT	SG05310114	7/21/2018
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	6/22/2018
HORN ANTENNA	3115	EMCO	9107-3723	9/22/2018 2 yr.
PRE-AMPLIFIER	8449B	HEWLETT-PACKARD	3008A00480	12/01/2018

Note: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

2.2 Modifications to EUT Hardware

No physical modifications were made by US Tech in order to bring the EUT into compliance with FCC Part 15, Subpart C Intentional Radiator Limits for the transmitter portion of the EUT or the Subpart B Unintentional Radiator Limits (Receiver and Digital Device) Requirements.

2.3 Number of Measurements for Intentional Radiators (15.31(m))

Measurements of intentional radiators or receivers shall be performed and reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in Table 3 below.

Table 3. Number of Test Frequencies for Intentional Radiators

Frequency Range over which the device operates	Number of Frequencies	Location in the Range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near the Top 1 near the Bottom
Greater than 10 MHz	3	1 near Top 1 near Middle 1 near Bottom

Because the EUT operates at 2400 MHz to 2483.5 MHz, 3 test frequencies were used.

2.4 Frequency Range of Radiated Measurements (Part 15.33)

2.4.1 Intentional Radiator

The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 10th harmonic of the highest fundamental frequency generated or 40 GHz, whichever is the lowest.

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2.5 Measurement Detector Function and Bandwidth (CFR 15.35)

The radiated and conducted emissions limits shown herein are based on the following the following:

Detector Function and Associated Bandwidth

On frequencies below 1000 MHz, the limits herein are based upon measurement equipment employing a CISPR Quasi-peak detector function and related measurement bandwidths (i.e. 9 kHz from 150 kHz to 30 MHz and 120 kHz from 30 MHz to 1000 MHz). Alternatively, measurements may be made with equipment employing a peak detector function as long as the same bandwidths specified for the Quasi-peak device are used.

Corresponding Peak and Average Requirements

Above 1000 MHz, radiated limits are based on measuring instrumentation employing an average detector function. When average radiated emissions are specified there is also a corresponding Peak requirement, as measured using a peak detector, of 20 dB greater than the average limit. For all measurements above 1000 MHz the Resolution Bandwidth shall be at least 1 MHz.

Pulsed Transmitter Averaging (Duty Cycle)

When the radiated emissions limit is expressed as an average value, and the transmitter is pulsed, the measured field strength shall be determined by applying a Duty Cycle Correction Factor based upon dividing the total ON time during the first 100 ms period by 100 ms (or by the period if less than 100 ms). The duty cycle may be expressed logarithmically in dB.

For average radiated measurements, using a 5.083% duty cycle, the measured level was reduced by a factor -25.88dB. The duty cycle correction factor is determined using the formula $20\log(5.083/100) = -25.88\text{dB}$.

Detailed analysis of the duty cycle timing is provided in the Theory of Operation accompanying the original application for certification.

2.6 EUT Antenna Requirements (CFR 15.203)

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 shall be considered sufficient to comply with the provisions of this section. Only the antenna(s) listed in Table 4 will be used with this module.

Table 4. Allowed Antenna(s)

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB _i	TYPE OF CONNECTOR
Antenna 1	RF Venue	CP Beam	2.4 GHz CP Beam	14.0	RP-SMA to u.fl
Antenna 2	Murata	Patch	Patch P/N 800485	12.0	MMCX to u.fl
Antenna 3	World Products Inc	PIFA	WPANT100 80-S1A	4.0	u.fl
Antenna 4	Cushcraft	Yagi	PC2415	13.9	N type to u.fl
Antenna 5	Mobile Mark	Corner Reflector	SCR14- 2400CT	14.0	N type to u.fl
Antenna 6	Mobile Mark	Dipole	OD9-2400	9.0	N Type to u.fl

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2.7 Restricted Bands of Operation (Part 15.205)

Only spurious emissions can fall in the frequency bands of CFR 15.205. The field strength of these spurious cannot exceed the limits of 15.209. Radiated harmonics and other spurious emissions are examined for this requirement in the sections below.

2.8 Intentional Radiator, Emissions Measurements (CFR 15.209, 15.247(d))

2.8.1 Conducted Spurious emissions

The EUT was put into a continuous-transmit mode of operation and tested per ANSI C63.10:2013 and KDB 558074 v04, clause 11 for conducted out of band emissions in non restricted bands emanating from the antenna port over the frequency range of 30 MHz to 25 GHz. The measurements were performed on the EUT to identify and record the spurious signals that were related to the transmitter to show that all spurious emissions were at least 20 dB below the fundamental frequency.

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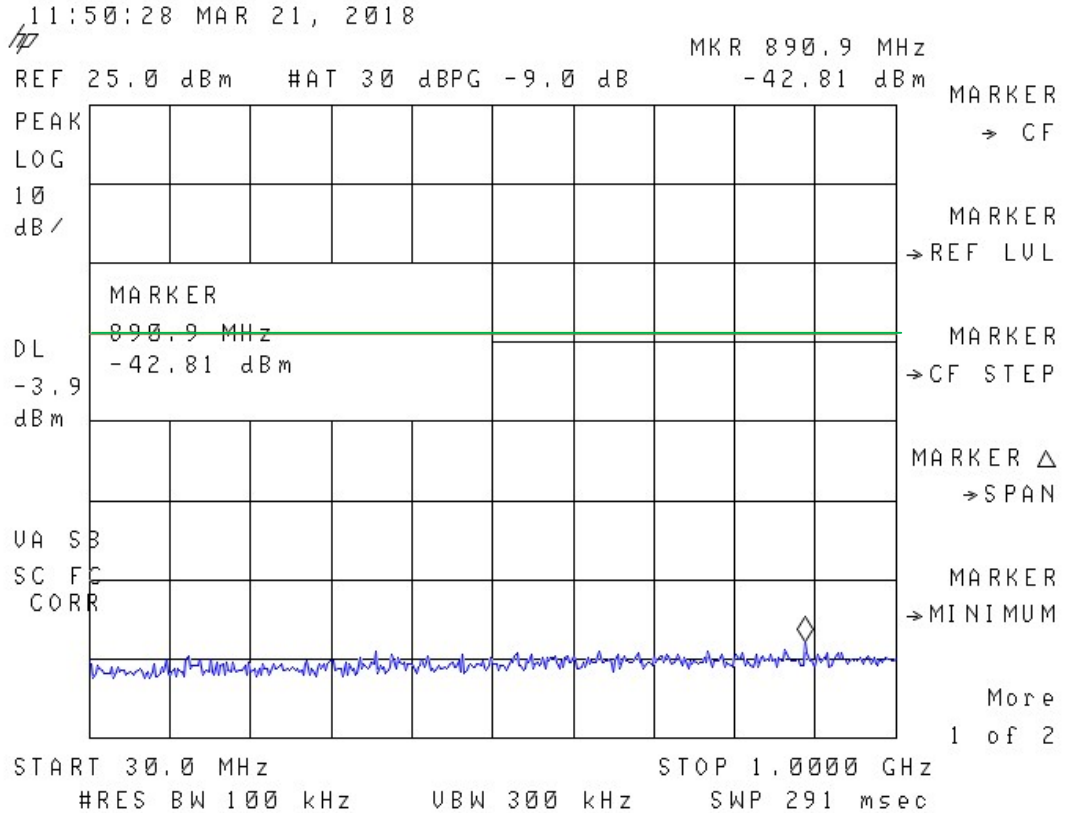


Figure 2. Antenna Conducted Emissions Low Channel, 30 MHz – 1 GHz
 Green Line= Limit line

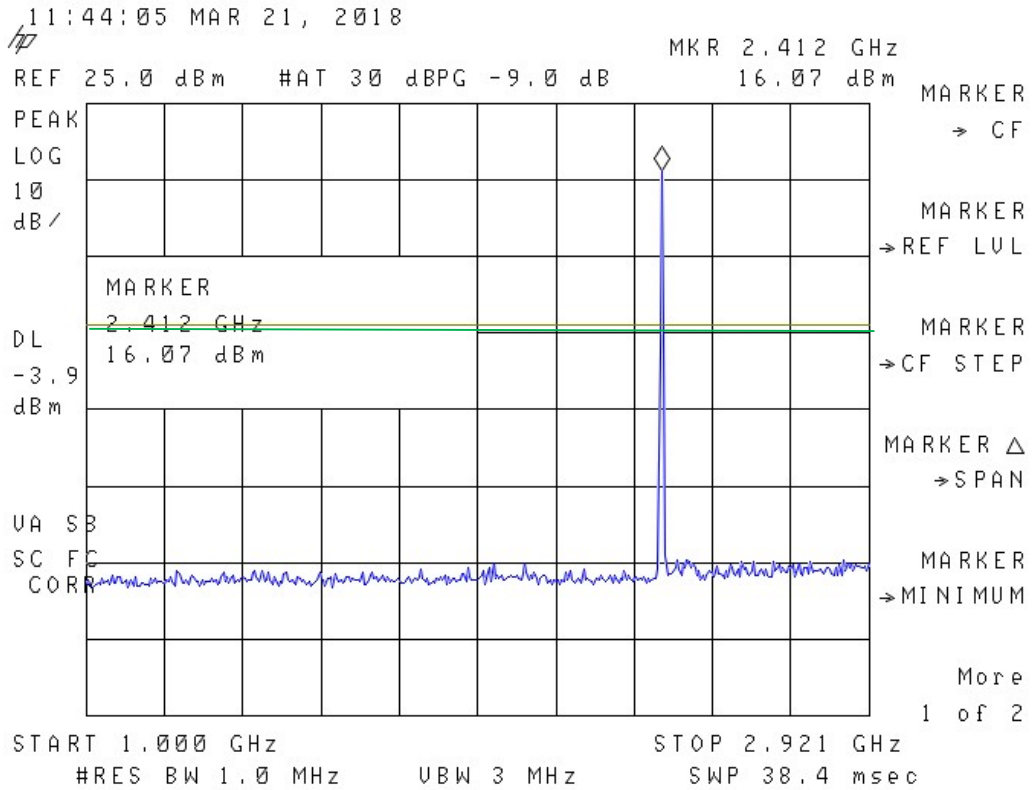


Figure 3. Antenna Conducted Emissions Low Channel, 1 GHz – 3 GHz
Green Line= Limit line

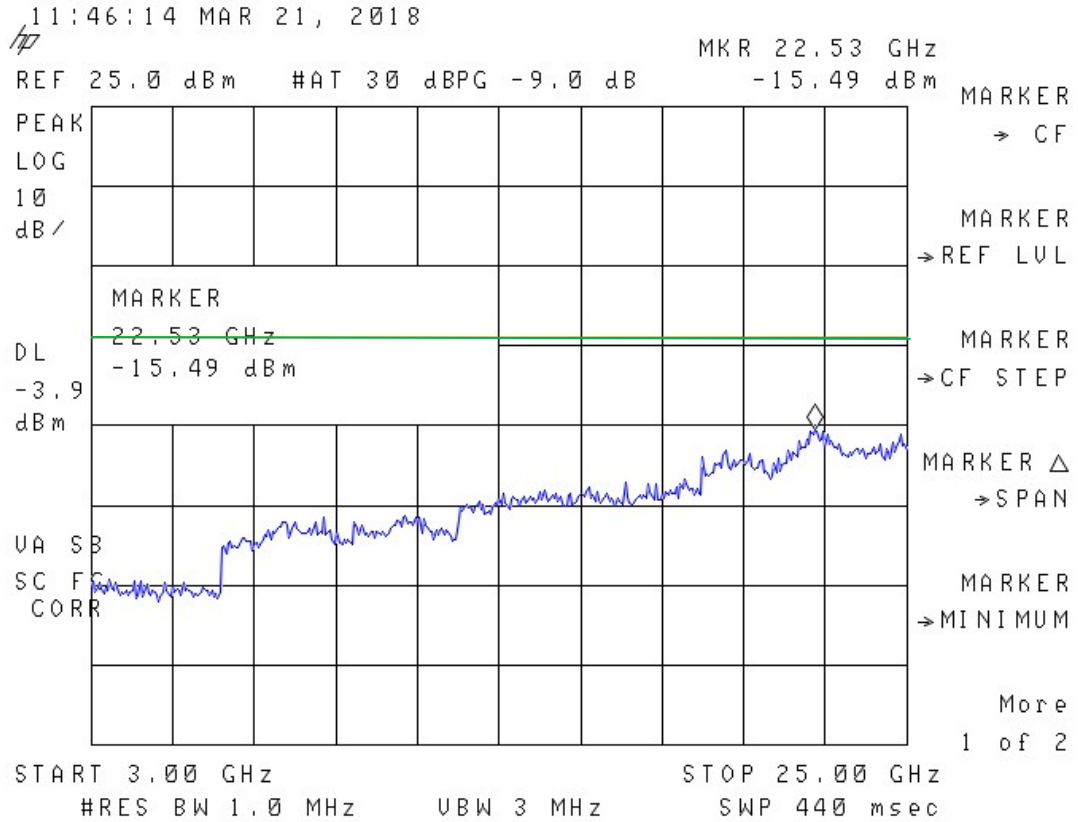


Figure 4. Antenna Conducted Emissions Low Channel, 3 GHz – 25 GHz
 Green Line= Limit line

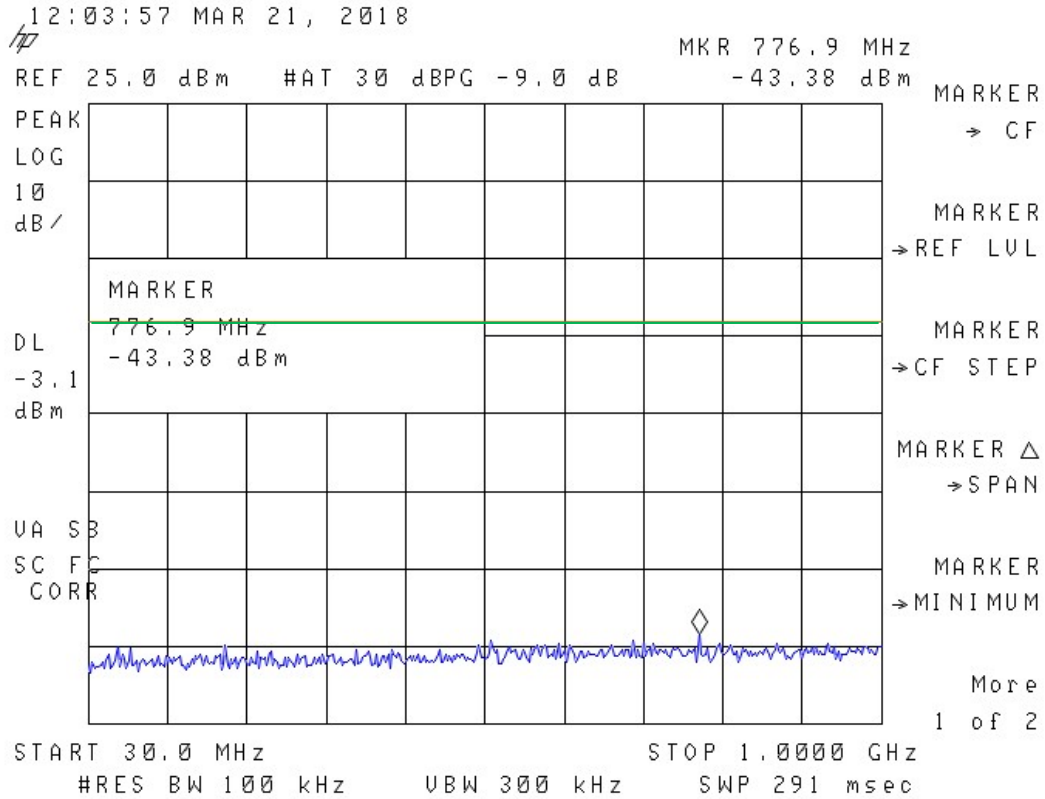


Figure 5. Antenna Conducted Emissions Mid Channel, 30 MHz – 1 GHz
 Green Line= Limit line

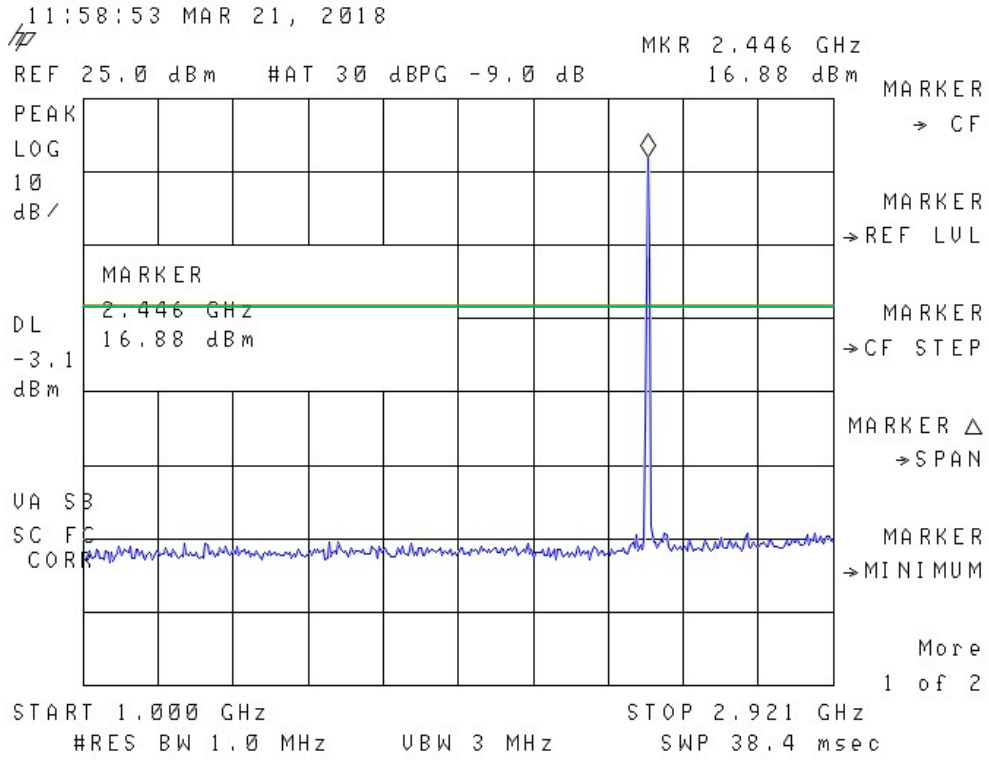


Figure 6. Antenna Conducted Emissions Mid Channel, 1 GHz – 3 GHz
 Green Line= Limit line

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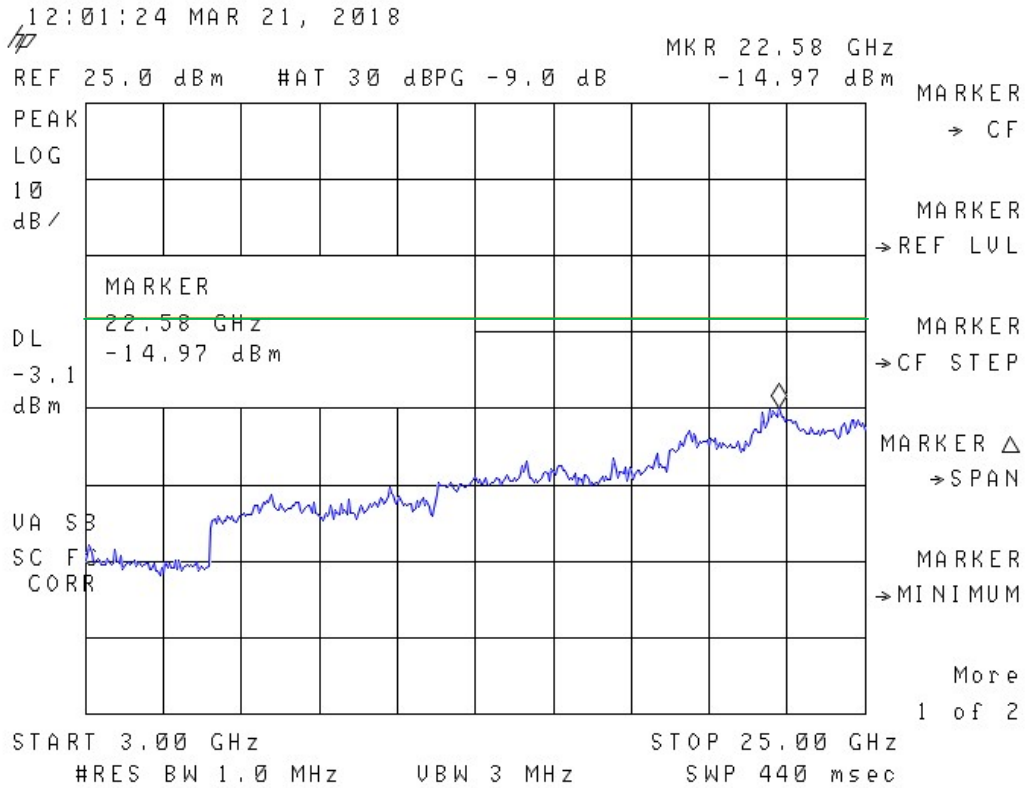


Figure 7. Antenna Conducted Emissions Mid Channel, 3 GHz – 25 GHz
Green Line= Limit line

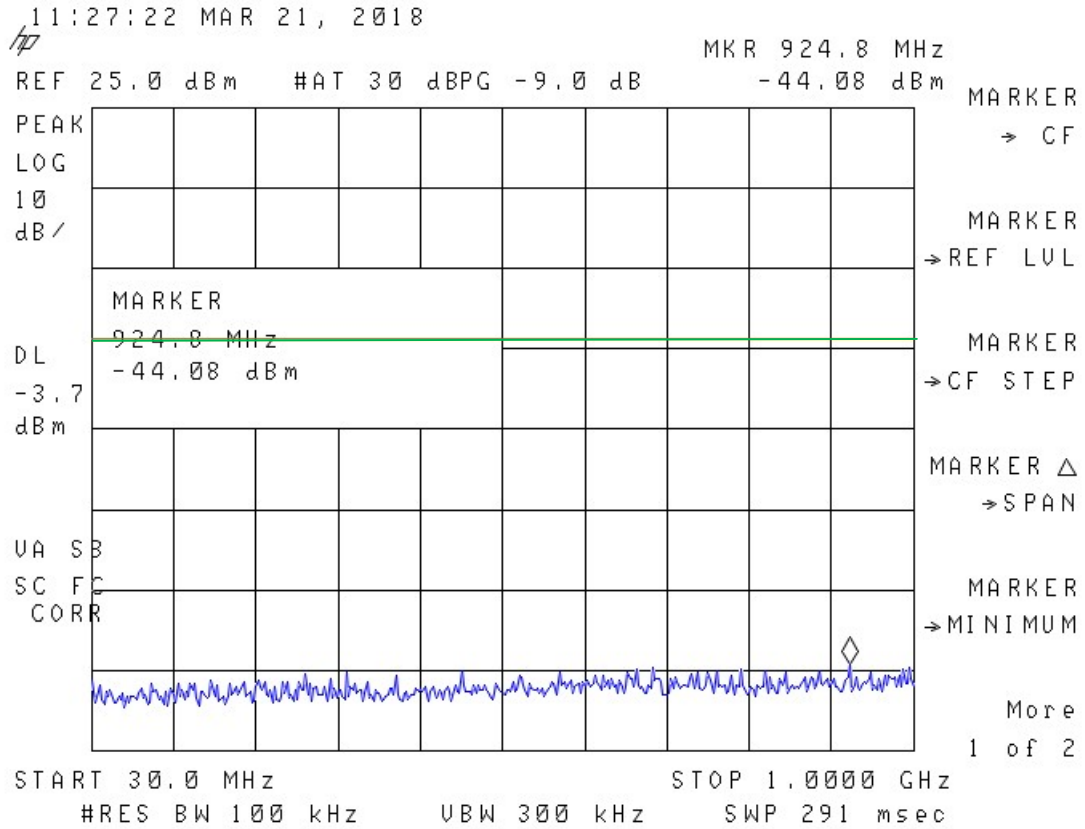


Figure 8. Antenna Conducted Emissions High Channel, 30 MHz – 1 GHz
 Green Line= Limit line

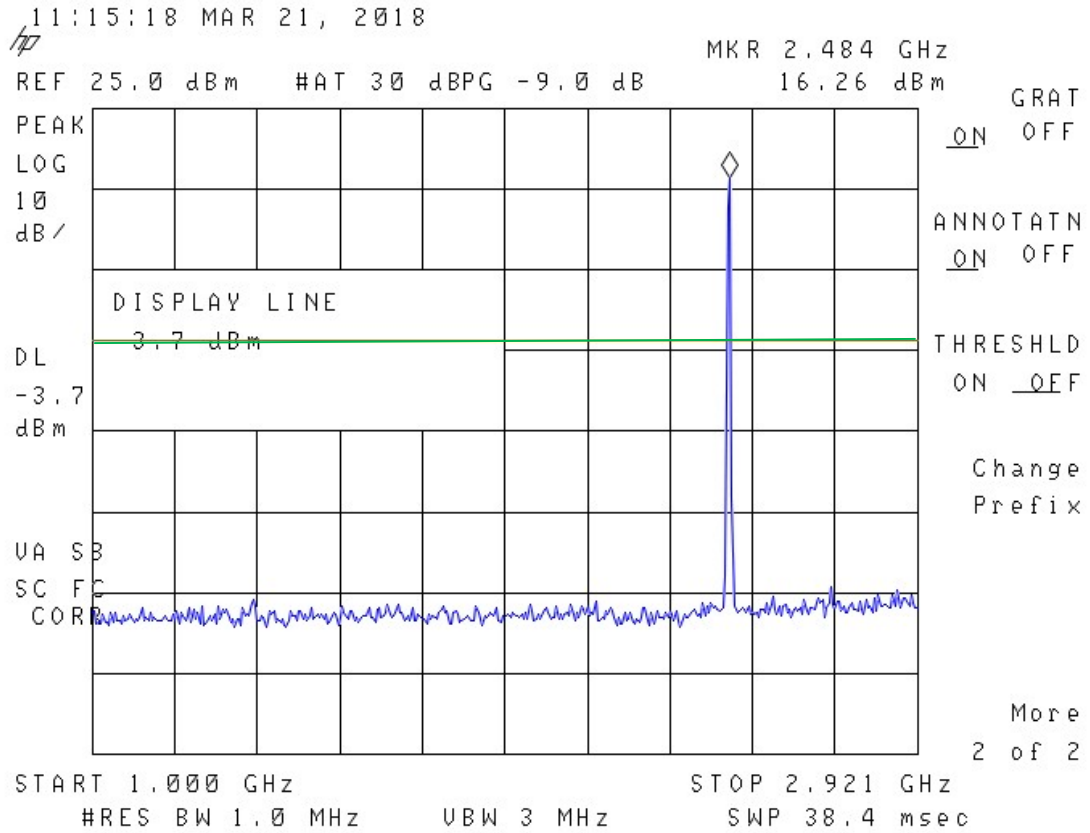


Figure 9. Antenna Conducted Emissions High Channel, 1 GHz – 3 GHz
 Green Line= Limit line

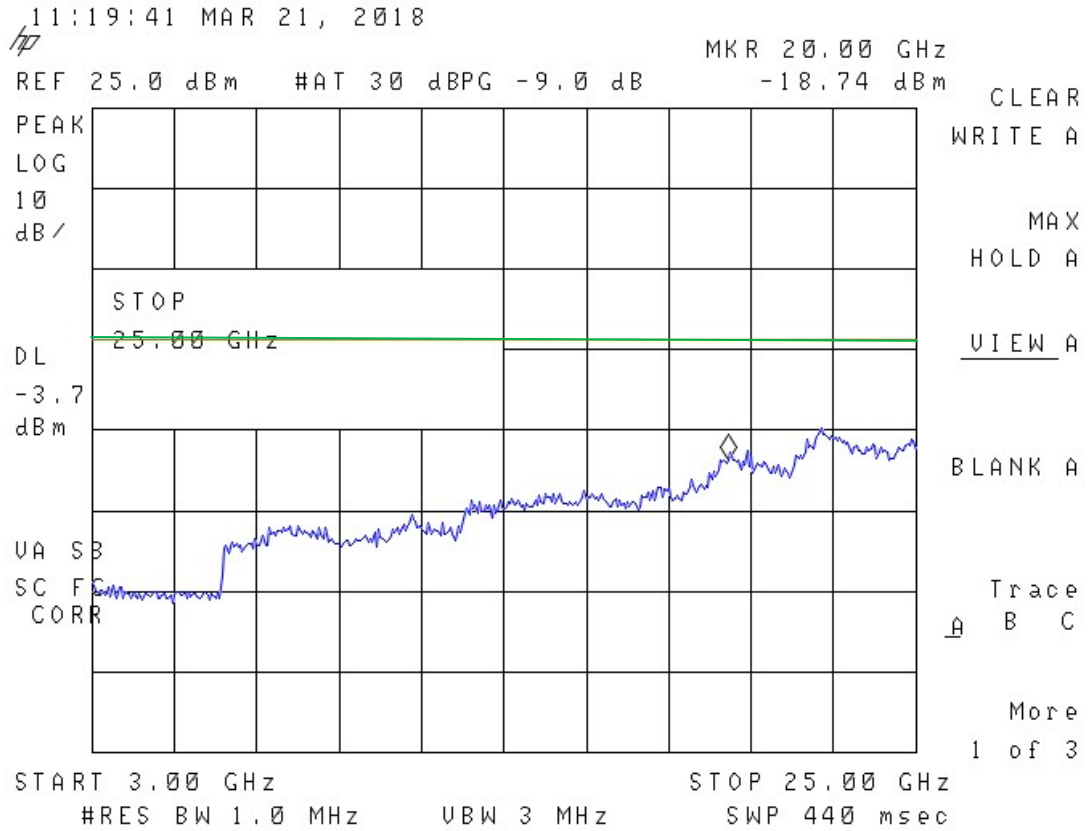


Figure 10. Antenna Conducted Emissions High Channel, 3 GHz – 25 GHz
 Green Line= Limit line

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2.8.2 Radiated Spurious Emissions

The EUT was placed into a continuous transmit mode of operation (>98% duty cycle) and tested per ANSI C63.10:2013. A preliminary scan was performed on the EUT to find signal frequencies that were caused by the transmitter part of the device. A preliminary scan was performed on the EUT to find the worse case results. The EUT was tested in X, Y, and Z axes or in the orientation of normal operation if the device is designed to operate in a fixed position. For spurious emissions other than fundamental and harmonic emissions, spurious emissions emanating from the EUT enclosure, the antenna port was terminated with a 50 ohm load during testing. For fundamental and harmonic emissions the EUT was tested with each of the antennas reference in Table 4 above.

Table 5. Spurious Radiated Emissions 150 kHz-30MHz (CFR 15.209)

Test By: JF	Test: FCC Part 15.209			Client: Murata			
	Project: 17-0439			Model: CCT24			
Frequency (MHz)	Test Data (dBuV)	AF+CL-PA (dB)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	DETECTOR PK / QP/AVG
This test was not re-evaluated.							

SAMPLE CALCULATION: N/A

Test Date: March 19, 2018

Tested By
 Signature: 

Name: John Freeman

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Table 6. Spurious Radiated Emissions (CFR 15.209), 30 MHz to 1000 MHz

30 MHz to 1000 MHz								
Test: Radiated Emissions				Client: Murata				
Project: 17-0439				Model: CCT24				
Frequency (MHz)	Test Data (dBuv)	Additional Factor (dB)	AF+CA-AMP (dB/m)	Results (dBuV/m)	QP Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector PK, or QP
39.14	31.92	--	-13.81	18.11	40.0	3m./HORZ	21.9	PK
133.08	43.16	--	-14.73	28.43	43.5	3m./HORZ	15.1	PK
51.03	39.71	--	-17.17	22.54	40.0	3m./VERT	17.5	PK
124.50	39.99	--	-14.82	25.17	43.5	3m./VERT	18.3	PK
201.00	33.88	--	-13.59	20.29	43.5	3m./HORZ	23.2	PK
264.36	34.98	--	-11.83	23.15	46.0	3m./HORZ	22.8	PK
965.40	29.95	--	-1.30	28.65	54.0	3m./HORZ	25.3	PK
201.00	32.98	--	-13.89	19.09	43.5	3m./VERT	24.4	PK
262.50	33.80	--	-12.32	21.48	46.0	3m./VERT	24.5	PK
981.60	29.80	--	-2.19	27.61	54.0	3m./VERT	26.4	PK

SAMPLE CALCULATION at: 39.14 MHz

Magnitude of Measured Frequency	31.92	dBuV
+Additional Factor (Distance Extrapolation)	0.0	dB
+Antenna Factor + Cable Loss+ Amplifier Gain – Duty Cycle	-13.81	dB/m
Corrected Result	18.11	dBuV/m

Test Date: March 19, 2018

Tested By
 Signature: 

Name: John Freeman

US Tech Test Report:
 FCC ID:
 IC:
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 Customer:
 Model:

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Table 7. Spurious Radiated Emissions (CFR 15.209) 1 GHz to 25 GHz

1 GHz to 25 GHz, Part 15.209 Limits							
Test: Radiated Emissions				Client: Murata			
Project: 17-0439				Model: CCT24			
Frequency (MHz)	Test Data (dBuv)	AF+CA-AMP (dB/m)	Results (dBuV/m)	AVG Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector PK, or AVG
Besides the emissions reported in the table below, all other emissions were at least 20 dB from the applicable limit.							

SAMPLE CALCULATION at: N/A

Test Date: March 19, 2018

Tested By
 Signature: 

Name: John Freeman

US Tech Test Report:
 FCC ID:
 IC:
 Test Report Number:
 Issue Date:
 Customer:
 Model:

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Table 8. Radiated Fundamental & Harmonic Emissions - ANTENNA 1

Test: FCC Part 15, Para 15.209, 15.247(d)					Client: Murata Electronics North America			
Project: 17-0439					Model: CCT24			
Frequency (MHz)	Test Data (dBuV)	Factor (dB)	AF+CA -AMP (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector Mode
2406.6	87.86		31.26	119.12		3.0m./HORZ		PK
2406.6	81.28		31.26	112.54		3.0m./HORZ		AVG
4813.2*	46.68		5.58	52.26	74.0	3.0m./HORZ	21.7	PK
4813.2*	38.36		5.58	43.94	54.0	3.0m./HORZ	10.1	AVG
2440.80	85.24		31.26	116.50		3.0m./HORZ		PK
2440.80	78.85		31.26	110.11		3.0m./HORZ		AVG
4881.60*	45.49		5.52	51.01	74.0	3.0m./HORZ	23.0	PK
4881.60*	38.45		5.52	43.97	54.0	3.0m./HORZ	10.0	AVG
2476.90	84.37		31.26	115.63		3.0m./HORZ		PK
2476.90	78.62		31.26	109.88		3.0m./HORZ		AVG
4953.80*	45.57		5.81	51.38	74.0	3.0m./HORZ	22.6	PK
4953.80*	38.48		5.81	44.29	54.0	3.0m./HORZ	9.7	AVG

- (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 15.247
- No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
- Measurements taken at 1 meter were extrapolated to 3 meter using a factor of (-9.5 dB).
- The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at 4813.20 MHz:

Magnitude of Measured Frequency	46.68	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	5.58	dB/m
1 meter to 3 meter extrapolation	0.0	dB
Corrected Result	52.26	dBuV/m

Test Date: November 6, 2017

Tested By
 Signature: 

Name: John Freeman

US Tech Test Report:
 FCC ID:
 IC:
 Test Report Number:
 Issue Date:
 Customer:
 Model:

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Table 9. Radiated Fundamental & Harmonic Emissions - ANTENNA 2

Test: FCC Part 15, Para 15.209, 15.247(d)					Client: Murata Electronics North America			
Project: 17-0439					Model: CCT24			
Frequency (MHz)	Test Data (dBuV)	Factor (dB)	AF+CA -AMP (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector Mode
2406.6	90.88		31.26	122.14		3.0m./HORZ		PK
2406.6	85.18		31.26	116.44		3.0m./HORZ		AVG
4813.2*	46.14		6.91	53.05	74.0	3.0m./HORZ	20.9	PK
4813.2*	37.76		6.91	44.67	54.0	3.0m./HORZ	9.3	AVG
2440.80	90.43		31.26	121.69		3.0m./HORZ		PK
2440.80	84.69		31.26	115.95		3.0m./HORZ		AVG
4881.60*	45.64		6.75	52.39	74.0	3.0m./HORZ	21.6	PK
4881.60*	38.47		6.75	45.22	54.0	3.0m./HORZ	8.8	AVG
2476.90	91.05		31.26	122.31		3.0m./HORZ		PK
2476.90	85.28		31.26	116.54		3.0m./HORZ		AVG
4953.80*	46.58		6.90	53.48	74.0	3.0m./HORZ	20.5	PK
4953.80*	38.70		6.90	45.60	54.0	3.0m./HORZ	8.4	AVG

- (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 15.247
- No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
- Measurements taken at 1 meter were extrapolated to 3 meter using a factor of (-9.5 dB).
- The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at 4813.20 MHz:

Magnitude of Measured Frequency	46.14	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	6.91	dB/m
1 meter to 3 meter extrapolation	0.0	dB
Corrected Result	53.05	dBuV/m

Test Date: November 6, 2017

Tested By 
 Signature: _____

Name: John Freeman

US Tech Test Report:
 FCC ID:
 IC:
 Test Report Number:
 Issue Date:
 Customer:
 Model:

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Table 10. Radiated Fundamental & Harmonic Emissions - ANTENNA 3

Test: FCC Part 15, Para 15.209, 15.247(d)					Client: Murata Electronics North America			
Project: 17-0439					Model: CCT24			
Frequency (MHz)	Test Data (dBuV)	Factor (dB)	AF+CA -AMP (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector Mode
2406.6	78.50		31.26	109.76		3.0m./HORZ		PK
2406.6	72.84		31.26	104.10		3.0m./HORZ		AVG
4813.2*	46.28		6.91	53.19	74.0	3.0m./HORZ	20.8	PK
4813.2*	37.74		6.91	44.65	54.0	3.0m./HORZ	9.3	AVG
2440.80	78.98		31.26	110.24		3.0m./HORZ		PK
2440.80*	73.49		31.26	104.75		3.0m./HORZ		AVG
4881.60*	45.51		6.75	52.26	74.0	3.0m./HORZ	21.7	PK
4881.60*	37.65		6.75	44.40	54.0	3.0m./HORZ	9.6	AVG
2476.90	80.87		31.26	112.13		3.0m./HORZ		PK
2476.90	73.18		31.26	104.44		3.0m./HORZ		AVG
4953.80*	45.93		6.90	52.83	74.0	3.0m./HORZ	21.2	PK
4953.80*	37.13		6.90	44.03	54.0	3.0m./HORZ	10.0	AVG

- (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 15.247
- No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
- Measurements taken at 1 meter were extrapolated to 3 meter using a factor of (-9.5 dB).
- The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at 4813.20 MHz:

Magnitude of Measured Frequency	46.28	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	6.91	dB/m
1 meter to 3 meter extrapolation	0.00	dB
Corrected Result	53.19	dBuV/m

Test Date: November 6, 2017

Tested By
 Signature: 

Name: John Freeman

US Tech Test Report:
 FCC ID:
 IC:
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 Customer:
 Model:

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Table 11. Radiated Fundamental & Harmonic Emissions- ANTENNA 4

Test: FCC Part 15, Para 15.209, 15.247(d)					Client: Murata Electronics North America			
Project: 17-0439					Model: CCT24			
Frequency (MHz)	Test Data (dBuV)	Factor (dB)	AF+CA -AMP (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector Mode
2406.6	84.55		31.26	115.81		3.0m./HORZ		PK
2406.6	78.96		31.26	110.22		3.0m./HORZ		AVG
4813.2*	46.94		5.58	52.52	74.0	3.0m./HORZ	21.5	PK
4813.2*	37.75		5.58	43.33	54.0	3.0m./HORZ	10.7	AVG
2440.80	87.41		31.26	118.67		3.0m./HORZ		PK
2440.80	81.74		31.26	113.00		3.0m./HORZ		AVG
4881.60*	45.29		5.52	50.81	74.0	3.0m./HORZ	23.2	PK
4881.60*	38.35		5.52	43.87	54.0	3.0m./HORZ	10.1	AVG
2476.90	88.04		31.26	119.30		3.0m./HORZ		PK
2476.90	81.79		31.26	113.05		3.0m./HORZ		AVG
4953.80*	46.03		5.81	51.84	74.0	3.0m./HORZ	22.2	PK
4953.80*	38.39		5.81	44.20	54.0	3.0m./HORZ	9.8	AVG

- (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 15.247
- No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
- Measurements taken at 1 meter were extrapolated to 3 meter using a factor of (-9.5 dB).
- The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at 4813.20 MHz:

Magnitude of Measured Frequency	46.94	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	5.58	dB/m
1 meter to 3 meter extrapolation	0.0	dB
Corrected Result	52.52	dBuV/m

Test Date: November 6, 2017

Tested By

Signature: 

Name: John Freeman

US Tech Test Report:
 FCC ID:
 IC:
 Test Report Number:
 Issue Date:
 Customer:
 Model:

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Table 12. Radiated Fundamental & Harmonic Emissions- ANTENNA 5

Test: FCC Part 15, Para 15.209, 15.247(d)					Client: Murata Electronics North America			
Project: 17-0439					Model: CCT24			
Frequency (MHz)	Test Data (dBuV)	Factor (dB)	AF+CA -AMP (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector Mode
2406.6	91.07		30.07	121.14		3.0m./HORZ		PK
2406.6	84.80		30.07	114.87		3.0m./HORZ		AVG
4813.2*	50.42		3.79	54.21	74.0	3.0m./HORZ	19.8	PK
4813.2*	41.42		3.79	45.21	54.0	3.0m./HORZ	8.8	AVG
2440.80	89.84		30.11	119.95		3.0m./HORZ		PK
2440.80	84.17		30.11	114.28		3.0m./HORZ		AVG
4881.60*	46.37		3.75	50.12	74.0	3.0m./HORZ	23.9	PK
4881.60*	37.24		3.75	40.99	54.0	3.0m./HORZ	13.0	AVG
2476.90	89.89		30.13	120.02		3.0m./HORZ		PK
2476.90	84.17		30.13	114.30		3.0m./HORZ		AVG
4953.80*	46.56		4.08	50.64	74.0	3.0m./HORZ	23.4	PK
4953.80*	38.32		4.08	42.40	54.0	3.0m./HORZ	11.6	AVG

- (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 15.247
- No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
- Measurements taken at 1 meter were extrapolated to 3 meter using a factor of (-9.5 dB).
- The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at 4813.20 MHz:

Magnitude of Measured Frequency	50.42	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	3.79	dB/m
1 meter to 3 meter extrapolation	0.00	dB
Corrected Result	54.21	dBuV/m

Test Date: November 6, 2017

Tested By
 Signature: 

Name: John Freeman

US Tech Test Report:
 FCC ID:
 IC:
 Test Report Number:
 Issue Date:
 Customer:
 Model:

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Table 13. Radiated Fundamental & Harmonic Emissions - ANTENNA 6

Test: FCC Part 15, Para 15.209, 15.247(d)					Client: Murata Electronics North America			
Project: 17-0439					Model: CCT24			
Frequency (MHz)	Test Data (dBuV)	Factor (dB)	AF+CA -AMP (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector Mode
2406.6	84.17		31.26	115.43		3.0m./HORZ		PK
2406.6	77.89		31.26	109.15		3.0m./HORZ		AVG
4813.2*	45.79		5.58	51.37	74.0	3.0m./HORZ	22.6	PK
4813.2*	38.05		5.58	43.63	54.0	3.0m./HORZ	10.4	AVG
2440.80	84.87		31.26	116.13		3.0m./HORZ		PK
2440.80	79.36		31.26	110.62		3.0m./HORZ		AVG
4881.60*	46.48		5.52	52.00	74.0	3.0m./HORZ	22.0	PK
4881.60*	38.17		5.52	43.69	54.0	3.0m./HORZ	10.3	AVG
2476.90	82.68		31.26	113.94		3.0m./HORZ		PK
2476.90	77.09		31.26	108.35		3.0m./HORZ		AVG
4953.80*	45.30		5.81	51.11	74.0	3.0m./HORZ	22.9	PK
4953.80*	38.33		5.81	44.14	54.0	3.0m./HORZ	9.9	AVG

- (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 15.247
- No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
- Measurements taken at 1 meter were extrapolated to 3 meter using a factor of (-9.5 dB).
- The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at 4813.20 MHz:

Magnitude of Measured Frequency	45.79	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	5.58	dB/m
1 meter to 3 meter extrapolation	0.0	dB
Corrected Result	51.37	dBuV/m

Test Date: November 6, 2017

Tested By
 Signature: 

Name: John Freeman

US Tech Test Report:
FCC ID:
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2.9 Six (6) dB Bandwidth per CFR 15.247(a)(2)

The EUT antenna port was connected to a spectrum analyzer having a 50Ω input impedance. Measurements were performed following the guidelines of ANSI C63.10:2013.

Table 14. 6 dB Bandwidth and 99% Occupied Bandwidth

Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum FCC Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2406.60	1.273	0.5	1.4032
2440.80	1.263	0.5	1.4178
2476.90	1.261	0.5	1.4299

Test Date: March 23, 2018

Tested By
Signature: 

Name: John Freeman

US Tech Test Report:
 FCC ID:
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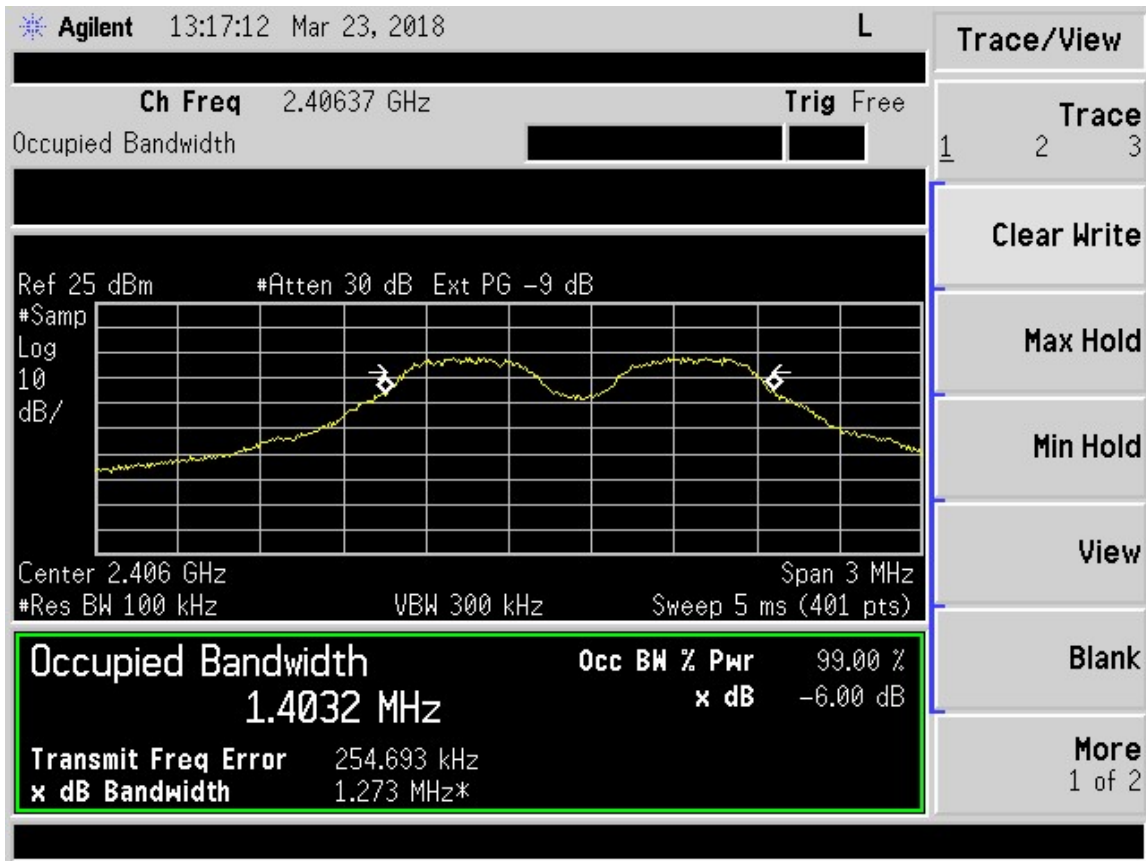


Figure 11. Six (6) dB Bandwidth– Low Channel

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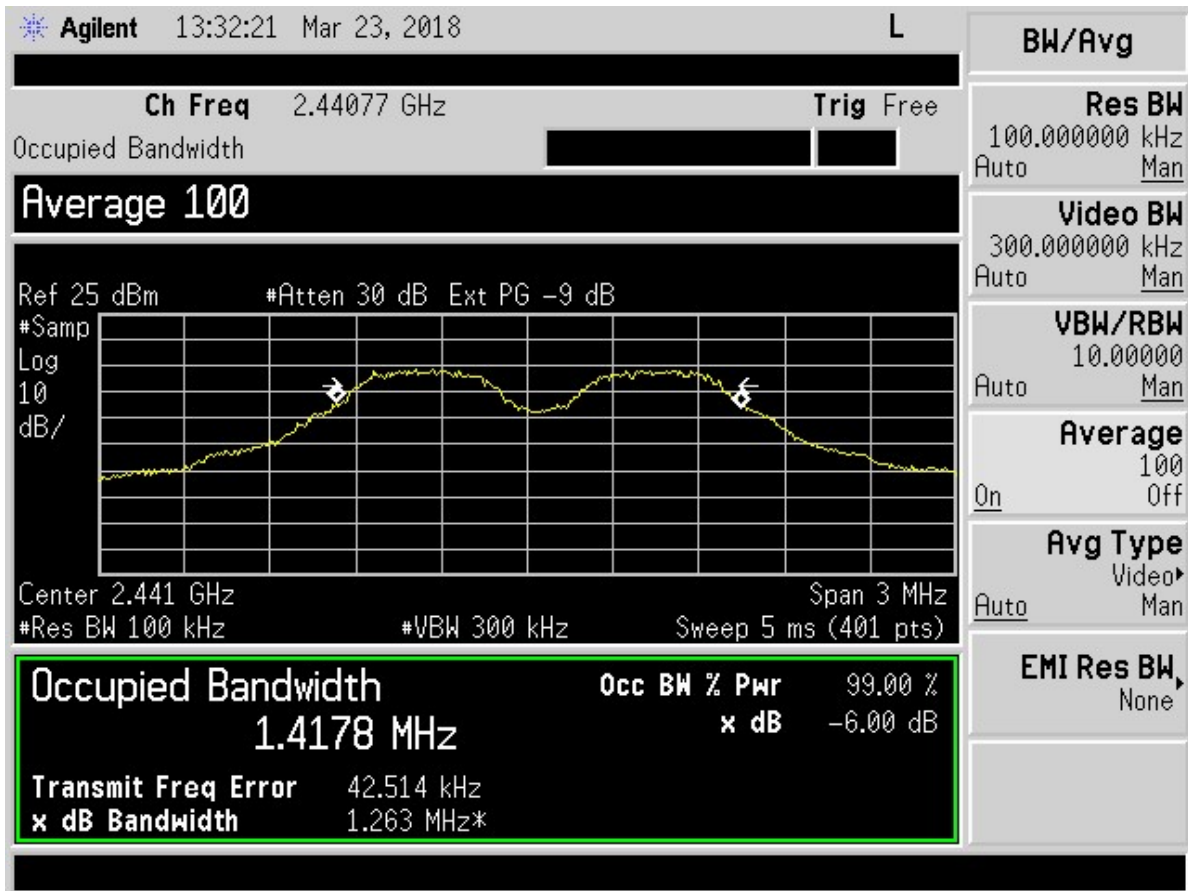


Figure 12. Six (6) dB Bandwidth – Mid Channel

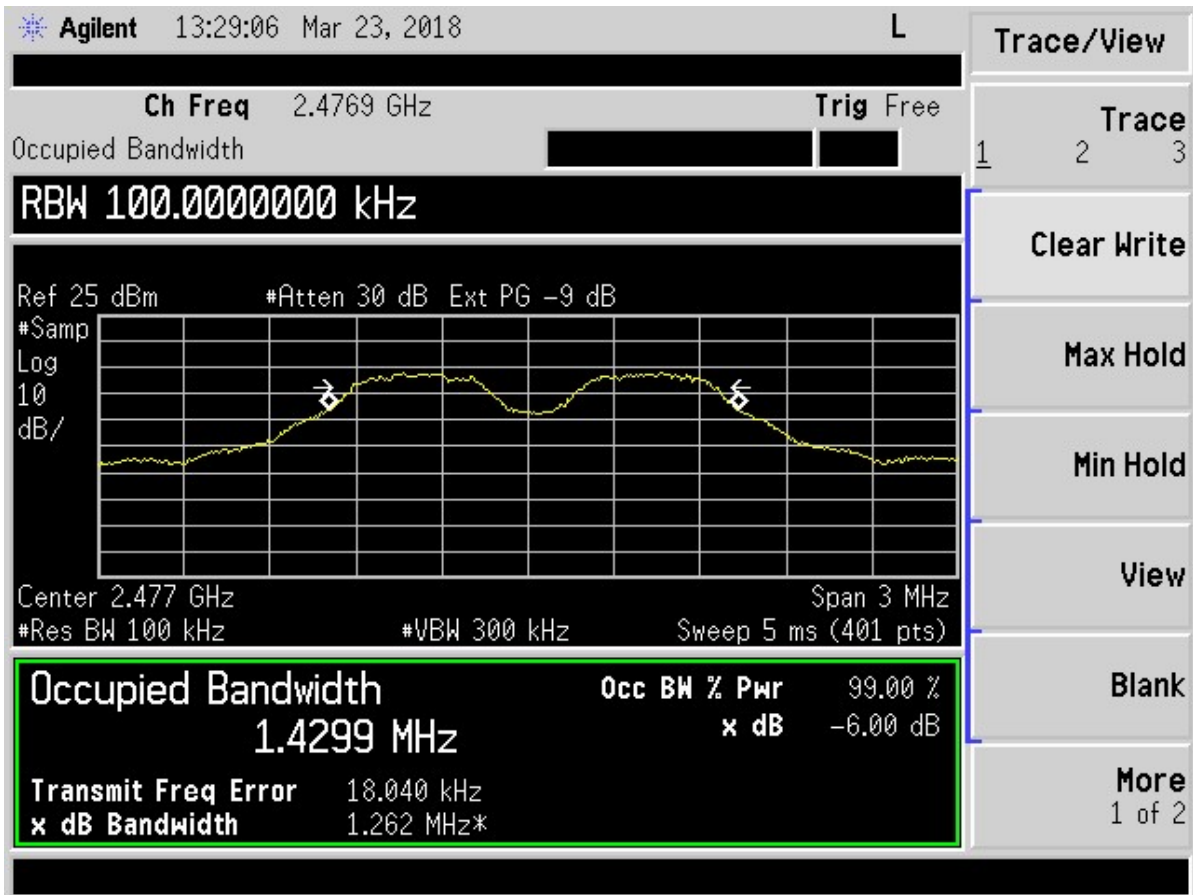


Figure 13. Six (6) dB Bandwidth – High Channel

2.10 Maximum Peak Conducted Output Power (CFR 15.247 (b) (3))

Peak power within the band 2400 MHz to 2483.5 MHz was measured per FCC KDB Publication 558074 v04 and ANSI C63.10:2013 as an Antenna Conducted test with a spectrum analyzer by connecting the spectrum analyzer directly, via a short RF cable, and attenuators to the antenna output terminals on the EUT. The spectrum analyzer was set for an impedance of 50 Ω with the RBW set greater than the 6 dB bandwidth of the EUT, and the VBW \geq RBW. Peak antenna conducted output power is tabulated in the table following.

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Table 15. Peak Antenna Conducted Output Power per Part 15.247 (b) (3)

Frequency of Fundamental (MHz)	Measured Data dBm	Converted Data (mW)	FCC Limit (mW Maximum)
2406.60	17.37	54.57	158.50 (22 dBm)
2440.80	17.68	58.61	158.50 (22 dBm)
2476.90	17.12	51.52	158.50 (22 dBm)

Note: Antenna gain exceeds 6.0 dBi by a maximum value of 8.0 dB, therefore the output power limit is reduced by 8.0 dB per Part 15.247(b)(4).

Test Date: March 21, 2018

Tested By

Signature: 

Name: John Freeman

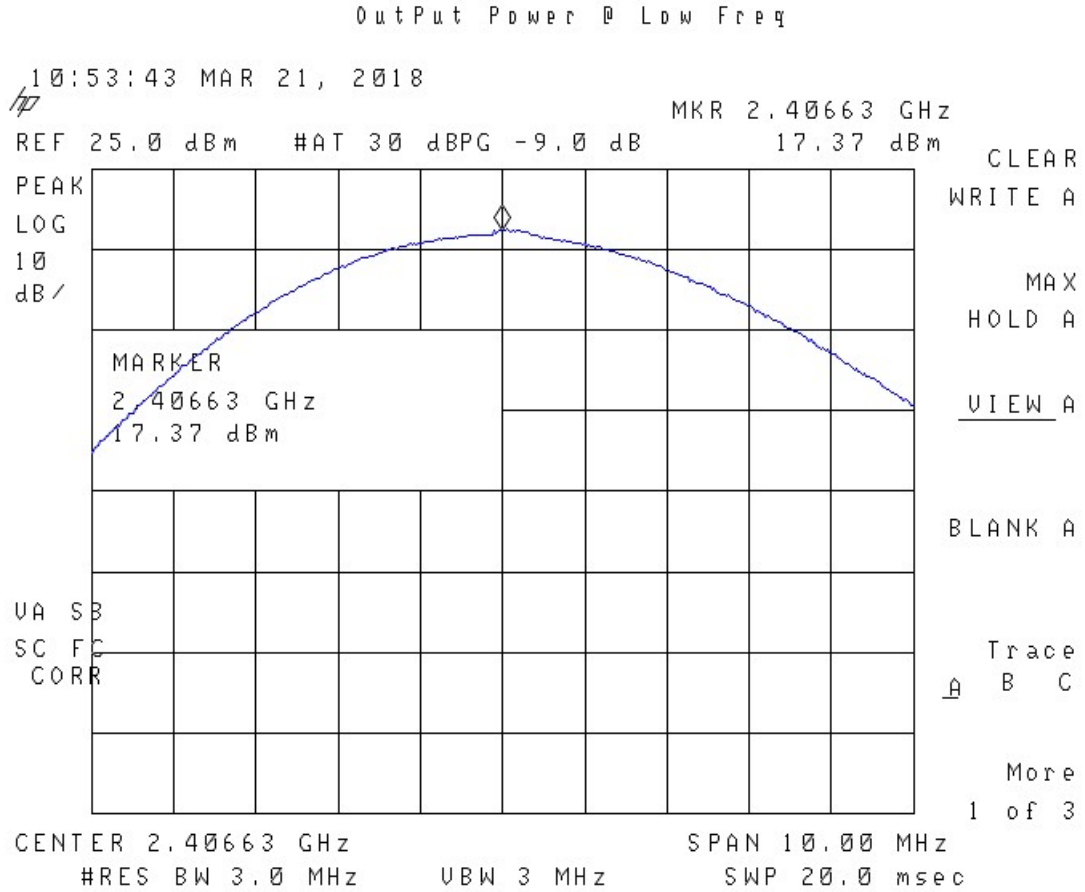


Figure 14. Peak Antenna Conducted Output Power, Low Channel

US Tech Test Report:
FCC ID:
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Model:

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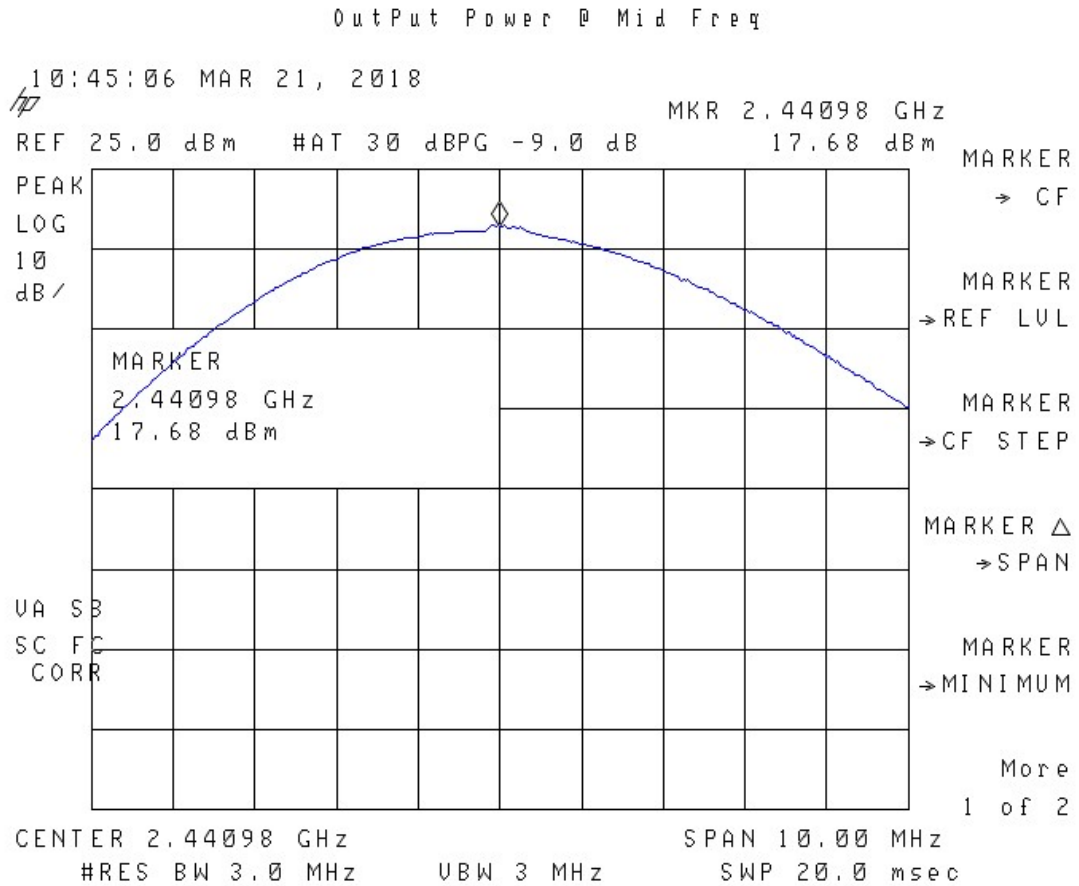


Figure 15. Peak Antenna Conducted Output Power, Mid Channel

US Tech Test Report:
FCC ID:
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Customer:
Model:

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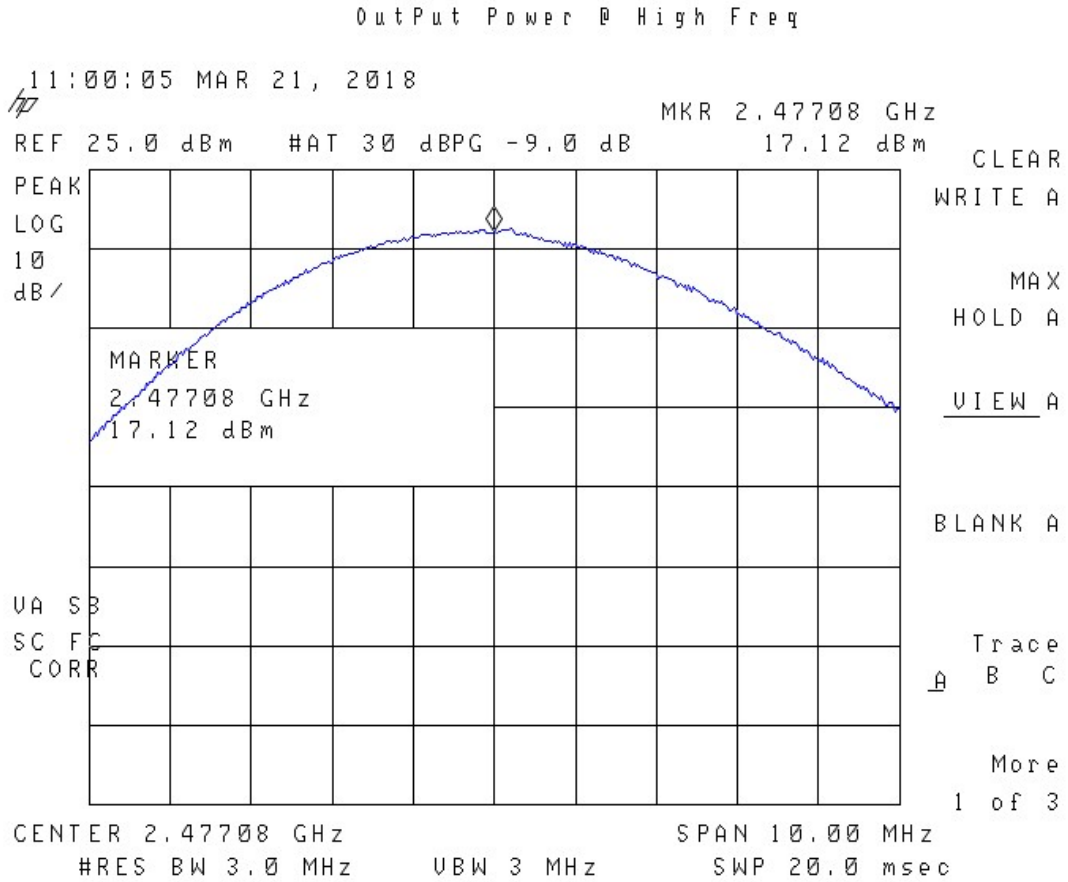


Figure 16. Peak Antenna Conducted Output Power, High Channel

US Tech Test Report:
FCC ID:
IC:
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Issue Date:
Customer:
Model:

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2.11 Band Edge Measurements – (CFR 15.247 (d))

Band Edge measurements are made following the guidelines in ANSI C63.10:2013 with the EUT initially operating on the Lowest Channel and then operating on the Highest Channel within its band of operation. Antenna port conducted measurements are performed to demonstrate compliance with the requirement of 15.247(d) that all emissions outside of the band edges be attenuated by at least 20 dB when compared to its highest in-band value (contained in a 100 kHz band).

To capture the band edge set the Spectrum Analyzer frequency span large enough (usually around 3 MHz) to capture the peak level of the emission operating on the channel closest to the band edge as well as any modulation products falling outside of the authorized band of operation. Conducted measurements are performed with RBW $\geq 1\%$ of the frequency span. In all cases, the VBW is set \geq RBW. See figure and calculations below for more detail. This measurement was performed with the EUT continuously transmitting on the low and high channels as well as in normal use mode.

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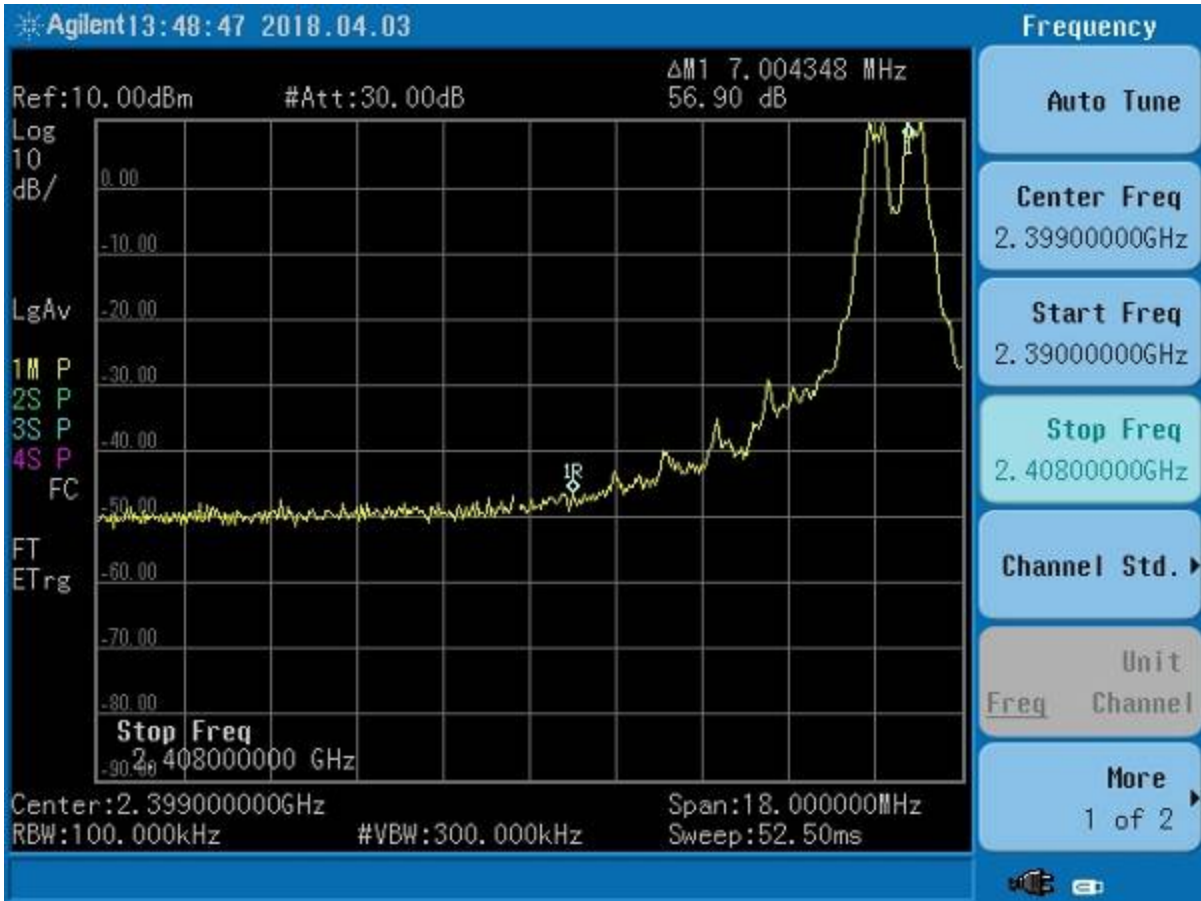


Figure 17. Band Edge Compliance, Low Channel Delta – Peak

Band edge must be 20 dB below the fundamental

Measured Result	56.90	dB
Band Edge Limit	20.00	dB
Band Edge Margin	36.90	dB

US Tech Test Report:
 FCC ID:
 IC:
 Test Report Number:
 Issue Date:
 Customer:
 Model:

FCC Part 15/ RSS 247 Class II Permissive Change
 HSW-CCT24
 4492A-CCT24
 17-0439
 April 9, 2018
 Murata Electronics North America
 CCT24

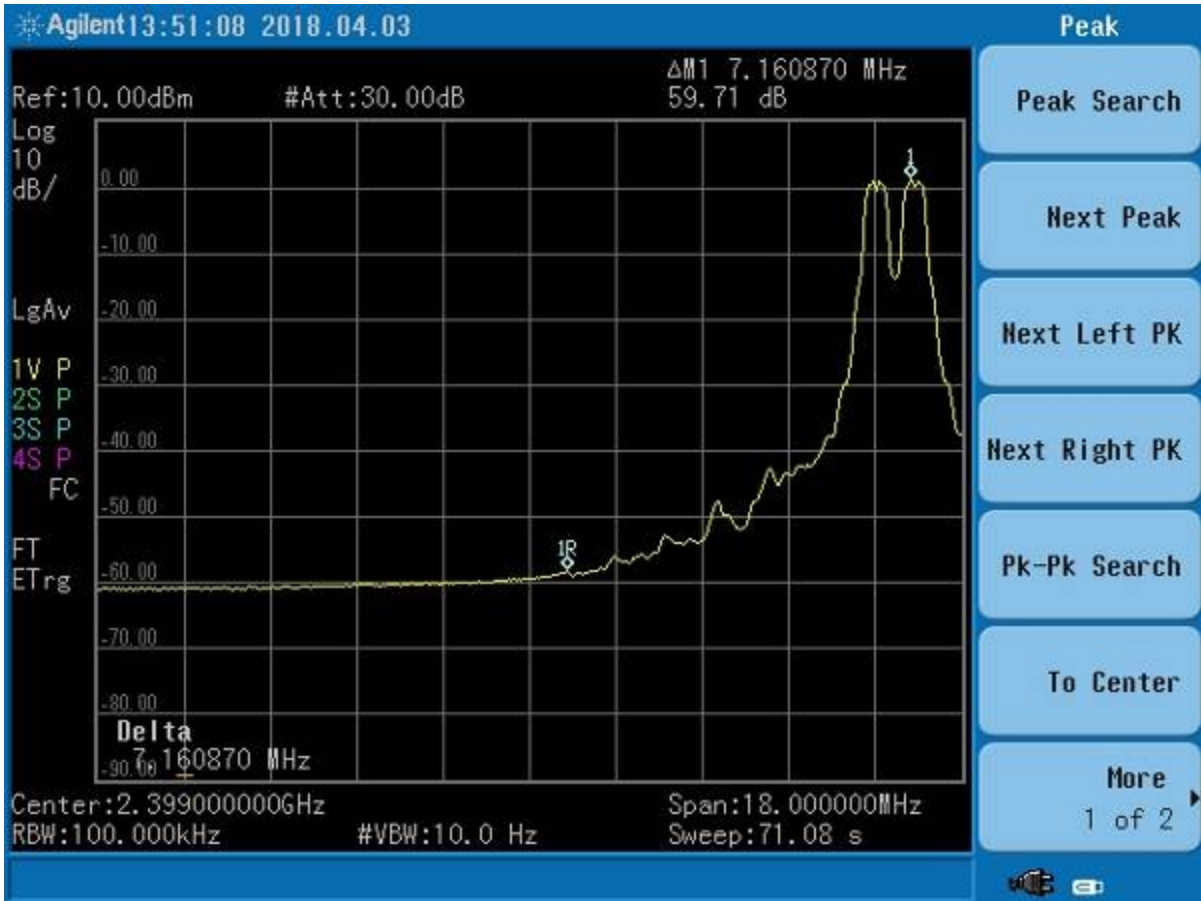


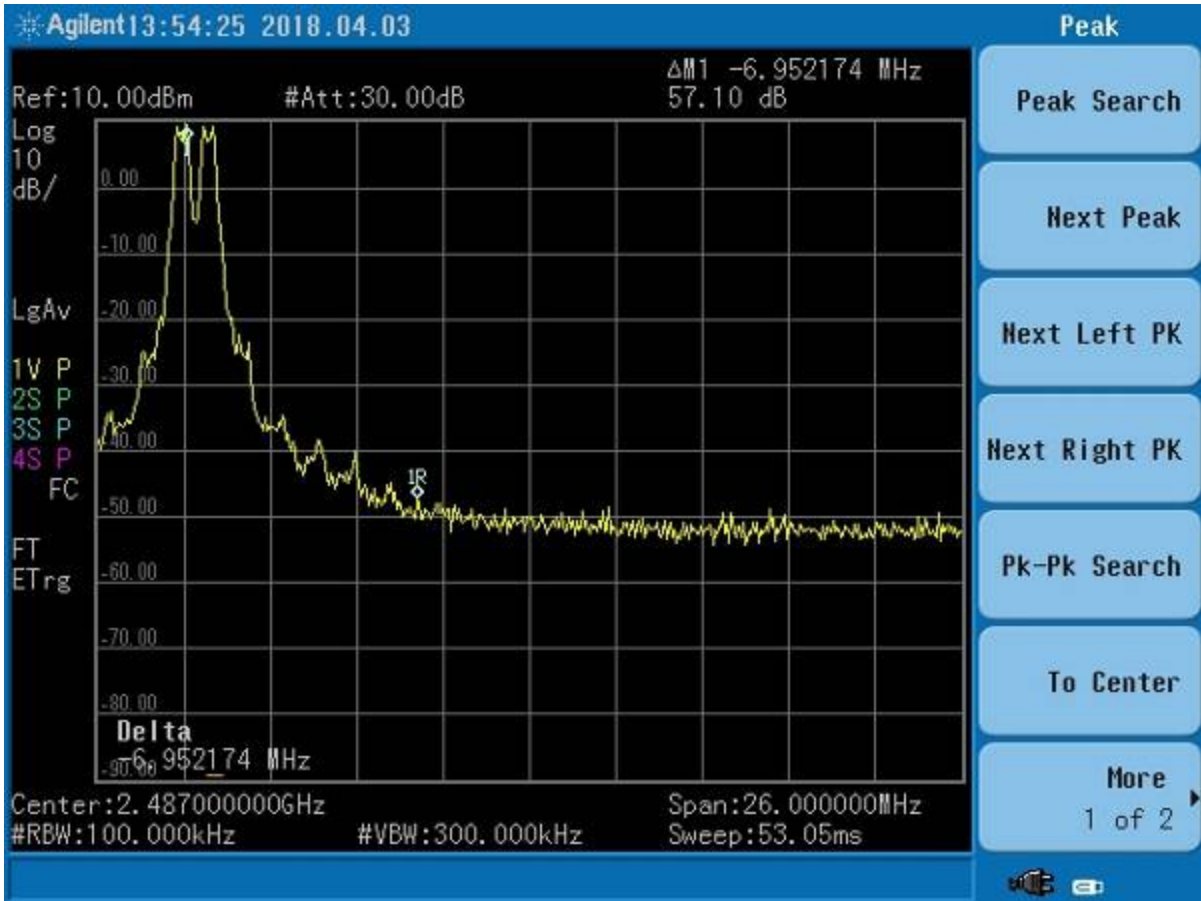
Figure 18. Band Edge Compliance, Low Channel Delta – Average

Band edge must be 20 dB below the fundamental

Measured Result	59.17	dB
Band Edge Limit	20.00	dB
Band Edge Margin	39.17	dB

US Tech Test Report:
 FCC ID:
 IC:
 Test Report Number:
 Issue Date:
 Customer:
 Model:

FCC Part 15/ RSS 247 Class II Permissive Change
 HSW-CCT24
 4492A-CCT24
 17-0439
 April 9, 2018
 Murata Electronics North America
 CCT24

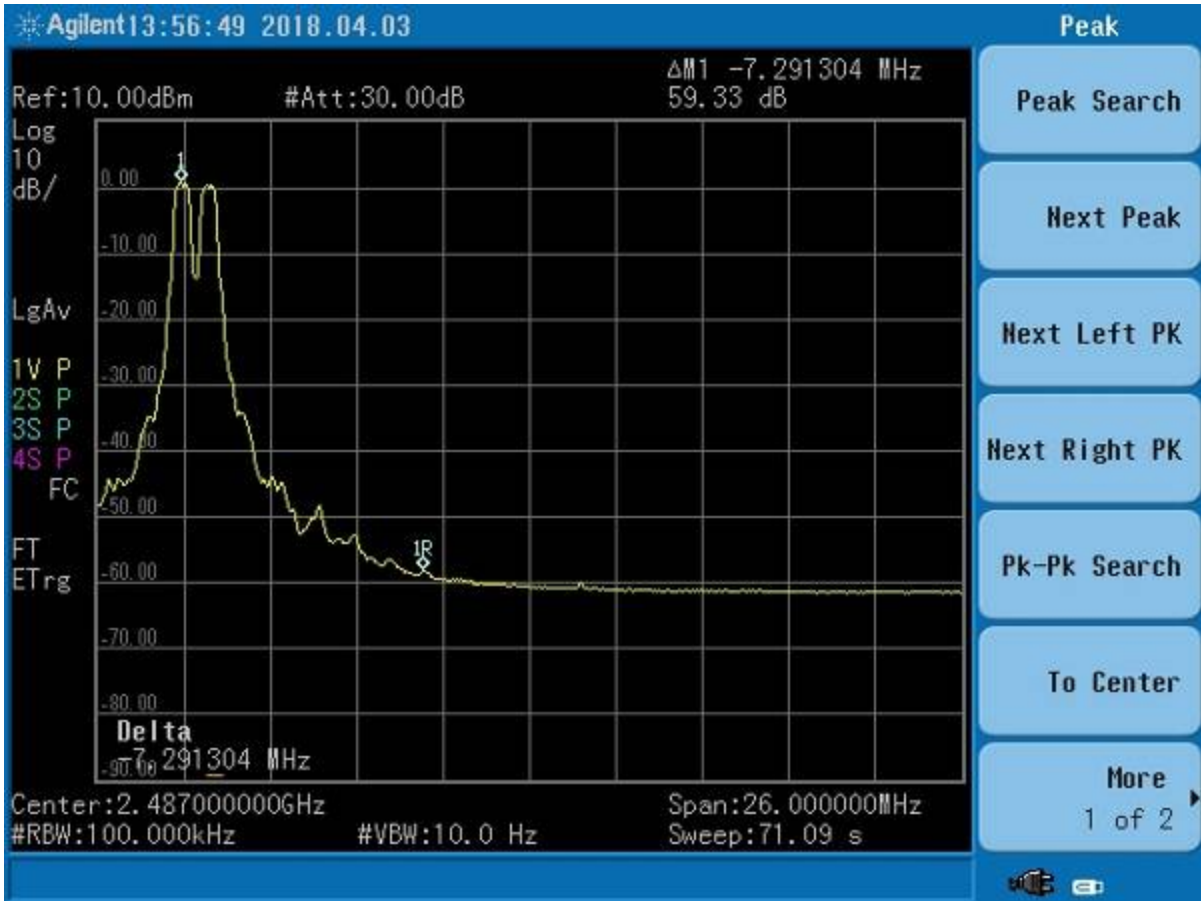


Band edge must be 20 dB below the fundamental

Measured Result	57.10	dB
Band Edge Limit	20.00	dB
Band Edge Margin	37.10	dB

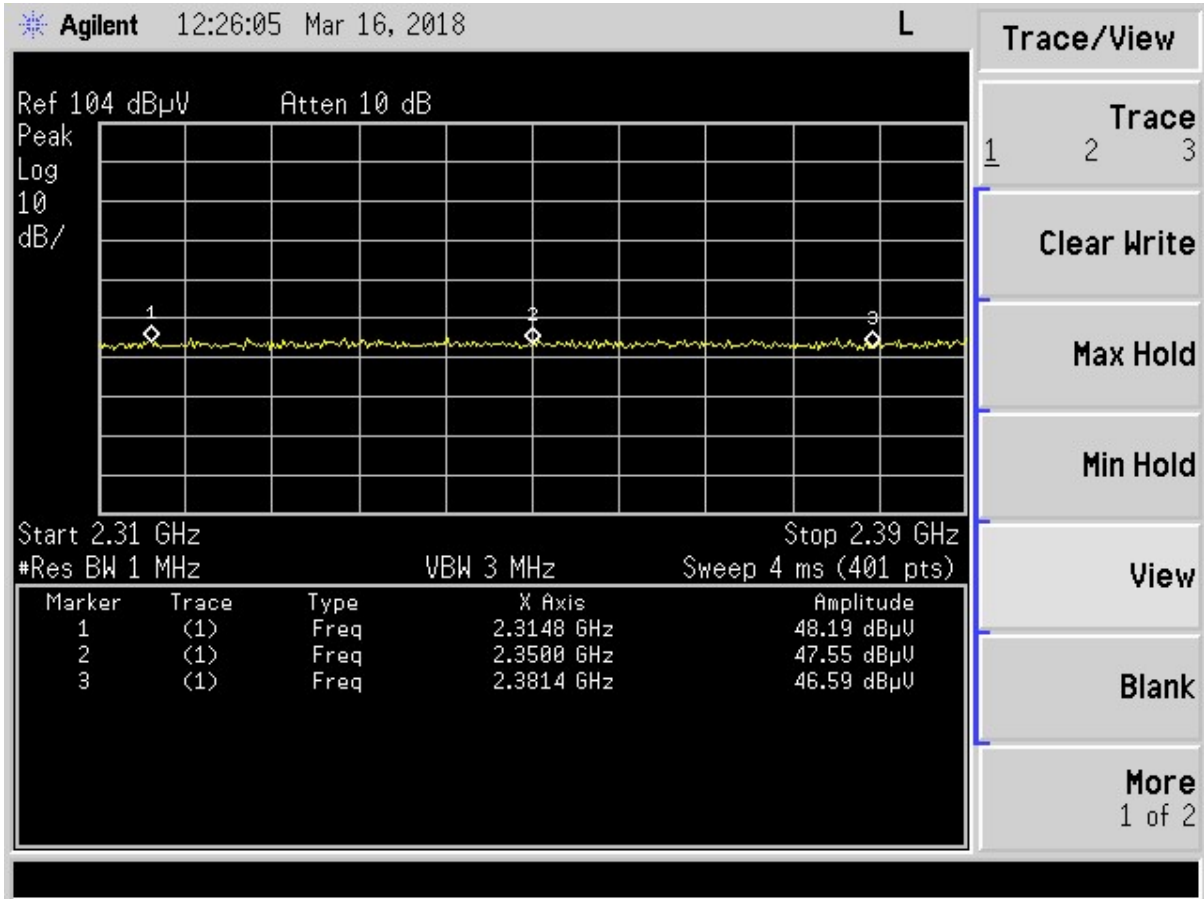
US Tech Test Report:
 FCC ID:
 IC:
 Test Report Number:
 Issue Date:
 Customer:
 Model:

FCC Part 15/ RSS 247 Class II Permissive Change
 HSW-CCT24
 4492A-CCT24
 17-0439
 April 9, 2018
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 CCT24



Band edge must be 20 dB below the fundamental

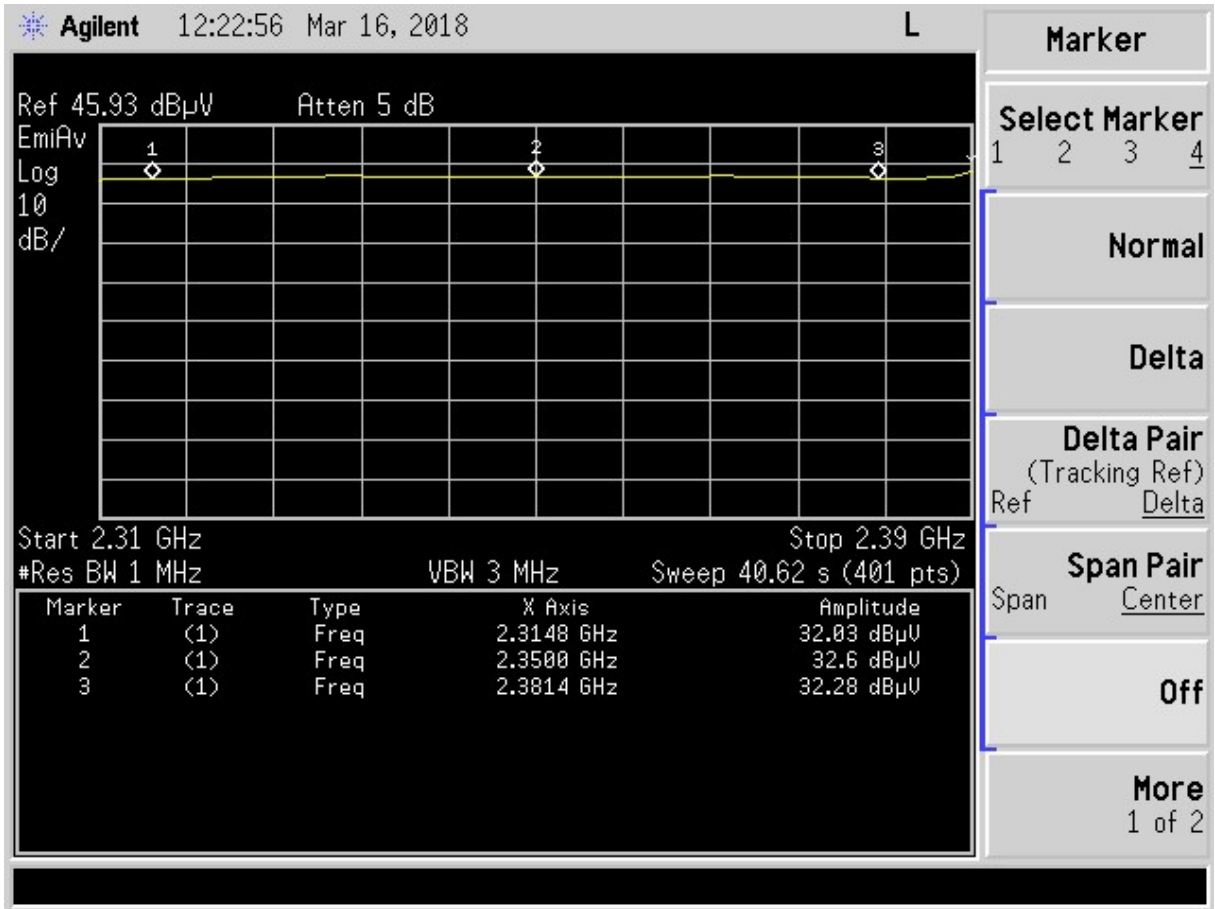
Measured Result	59.33	dB
Band Edge Limit	20.00	dB
Band Edge Margin	39.33	dB



**Figure 19. Antenna 1 Restricted Band Measurements
 2.31 GHz to 2.39 GHz –Peak**

Table 16. Antenna 1 Restricted Band Data (Peak)- Low Channel

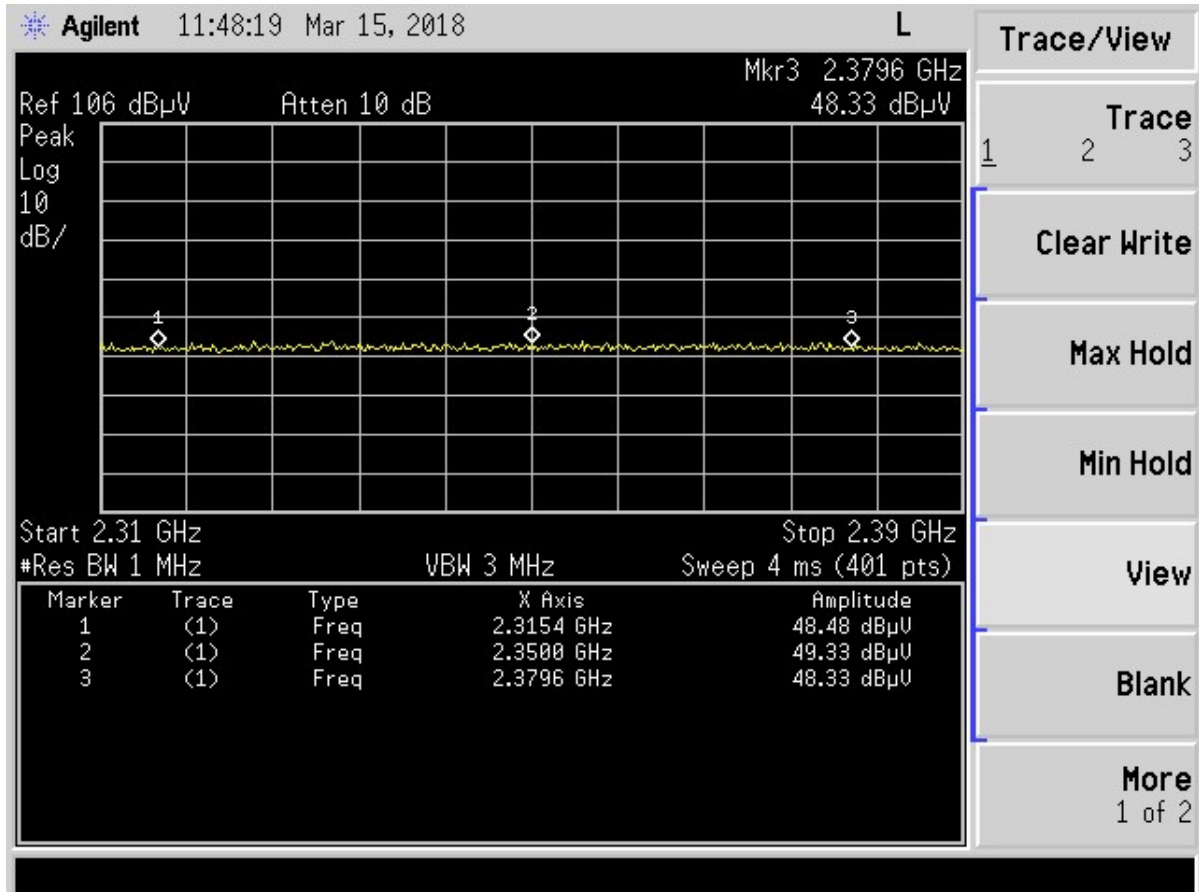
Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2314.80	48.19	-0.27	47.92	74.0	3.0m./HORZ	26.1	PK
2350.00	47.55	-0.25	47.30	74.0	3.0m./HORZ	26.7	PK
2381.40	46.59	-1.15	45.44	74.0	3.0m./HORZ	28.6	PK



**Figure 20. Antenna 1 Restricted Band Measurements
 2.31 GHz to 2.39 GHz – Average**

Table 17. Antenna 1 Restricted Band Data (AVG)- Low Channel

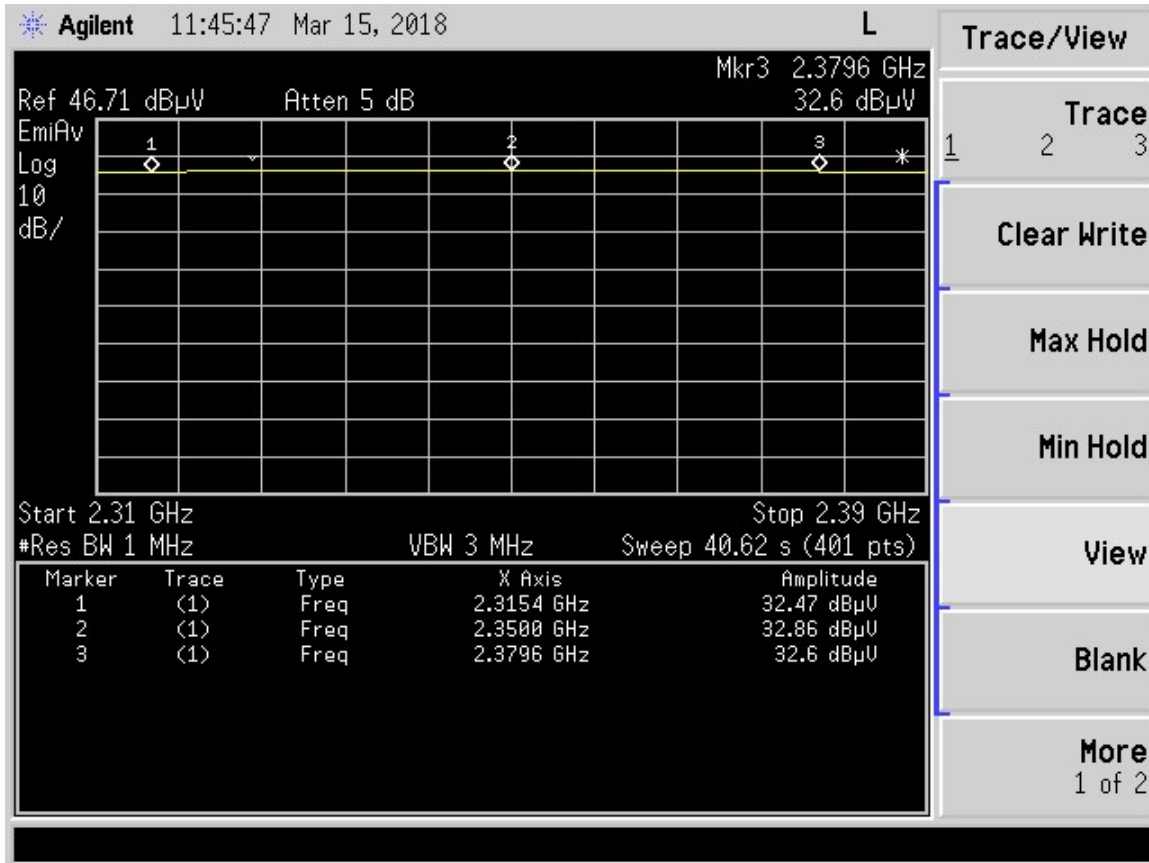
Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2314.80	32.03	-0.27	31.76	54.0	3.0m./HORZ	22.2	AVG
2350.00	32.60	-0.25	32.35	54.0	3.0m./HORZ	21.7	AVG
2381.40	32.28	-1.15	31.13	54.0	3.0m./HORZ	22.9	AVG



**Figure 21. Antenna 2 Restricted Band Measurements
 2.31 GHz to 2.39 GHz – Peak**

Table 18. Antenna 2 Restricted Band Data (Peak)- Low Channel

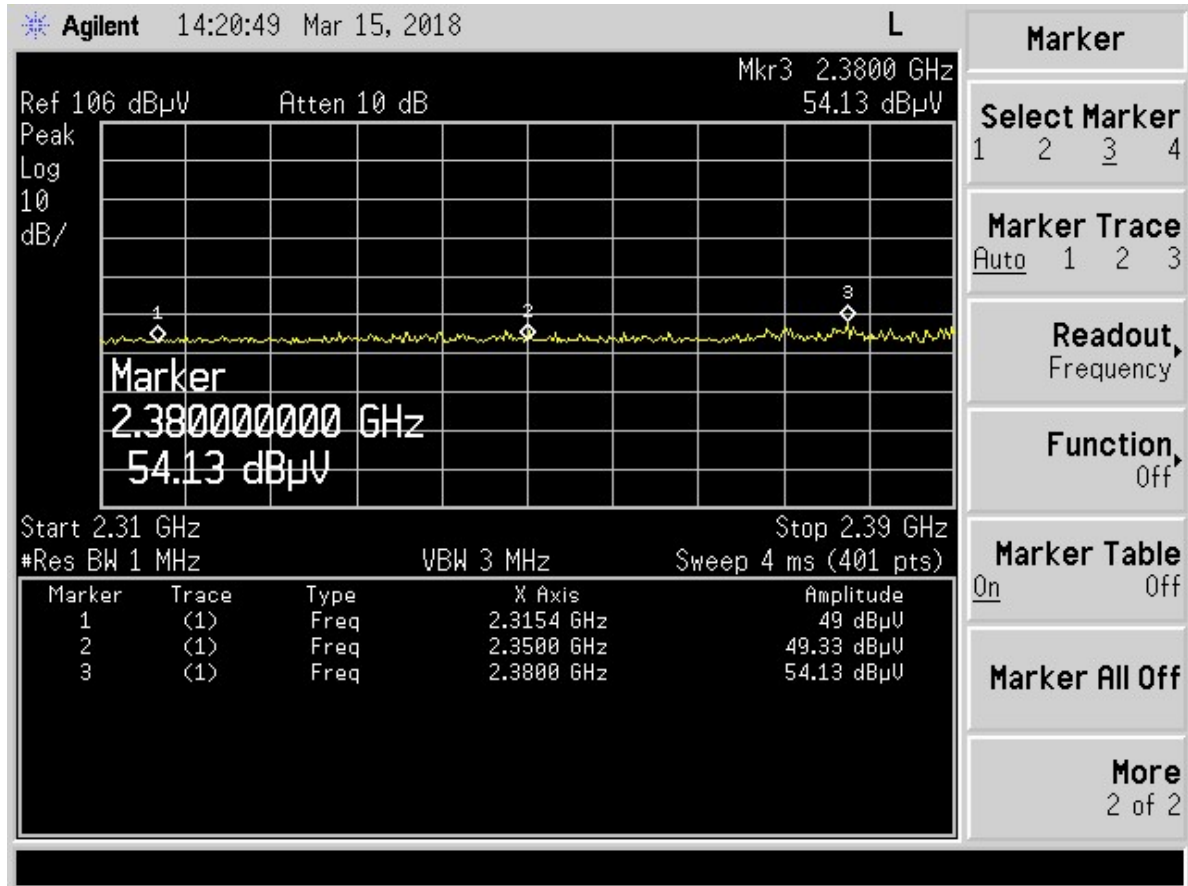
Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2315.40	48.43	-0.27	48.16	74.0	3.0m./HORZ	25.8	PK
2350.00	49.33	-0.25	49.08	74.0	3.0m./HORZ	24.9	PK
2379.60	48.33	-1.15	47.18	74.0	3.0m./HORZ	26.8	PK



**Figure 22. Antenna 2 Restricted Band Measurements
 2.31 GHz to 2.39 GHz – Average**

Table 19. Antenna 2 Restricted Band Data (AVG)- Low Channel

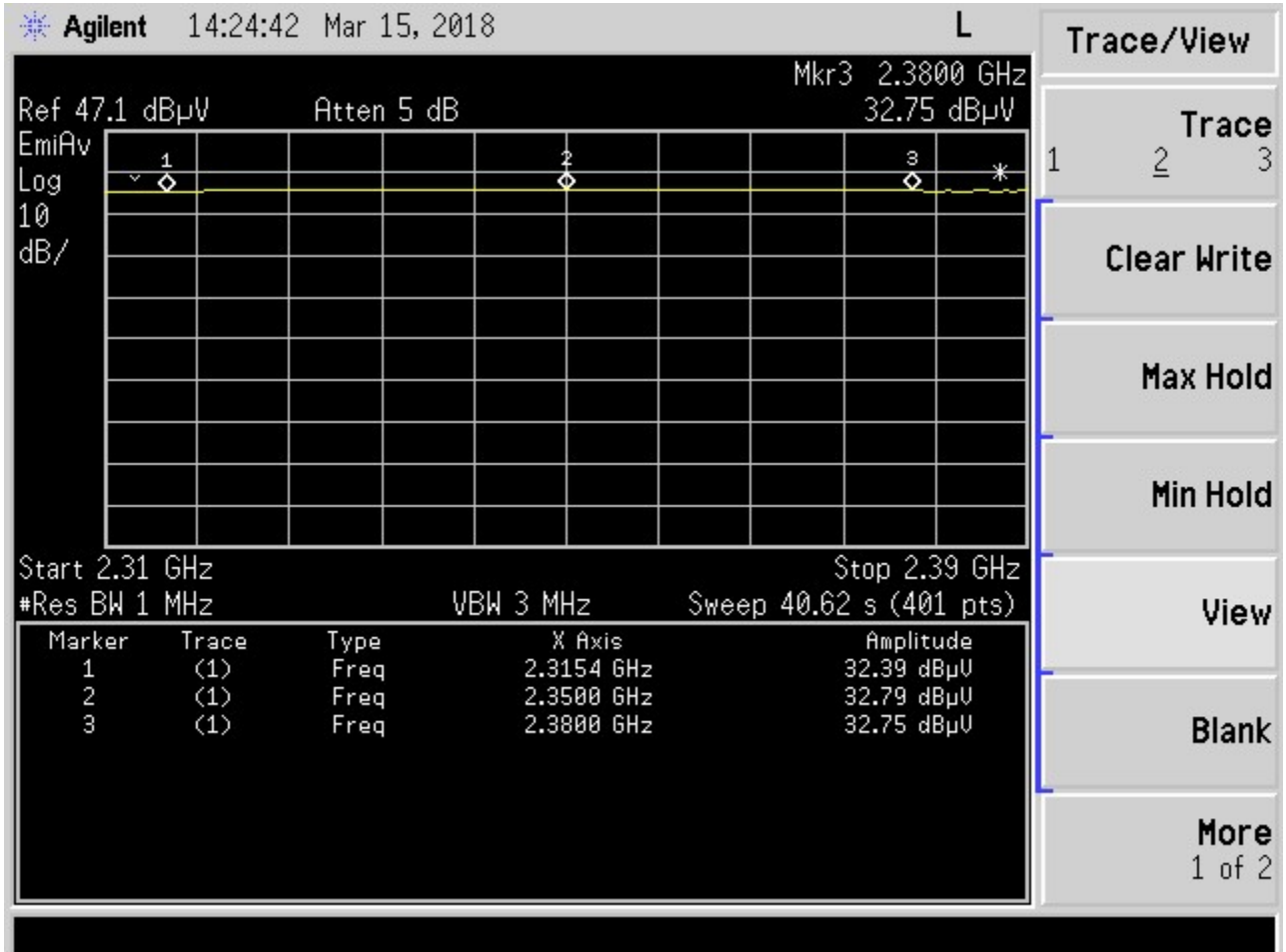
Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2315.40	32.47	-0.27	32.20	54.0	3.0m./HORZ	21.8	AVG
2350.00	32.86	-0.25	32.61	54.0	3.0m./HORZ	21.4	AVG
2379.60	32.60	-1.15	31.45	54.0	3.0m./HORZ	22.6	AVG



**Figure 23. Antenna 3 Restricted Band Measurements
 2.31 GHz to 2.39 GHz – Peak**

Table 20. Antenna 3 Restricted Band Data (Peak)- Low Channel

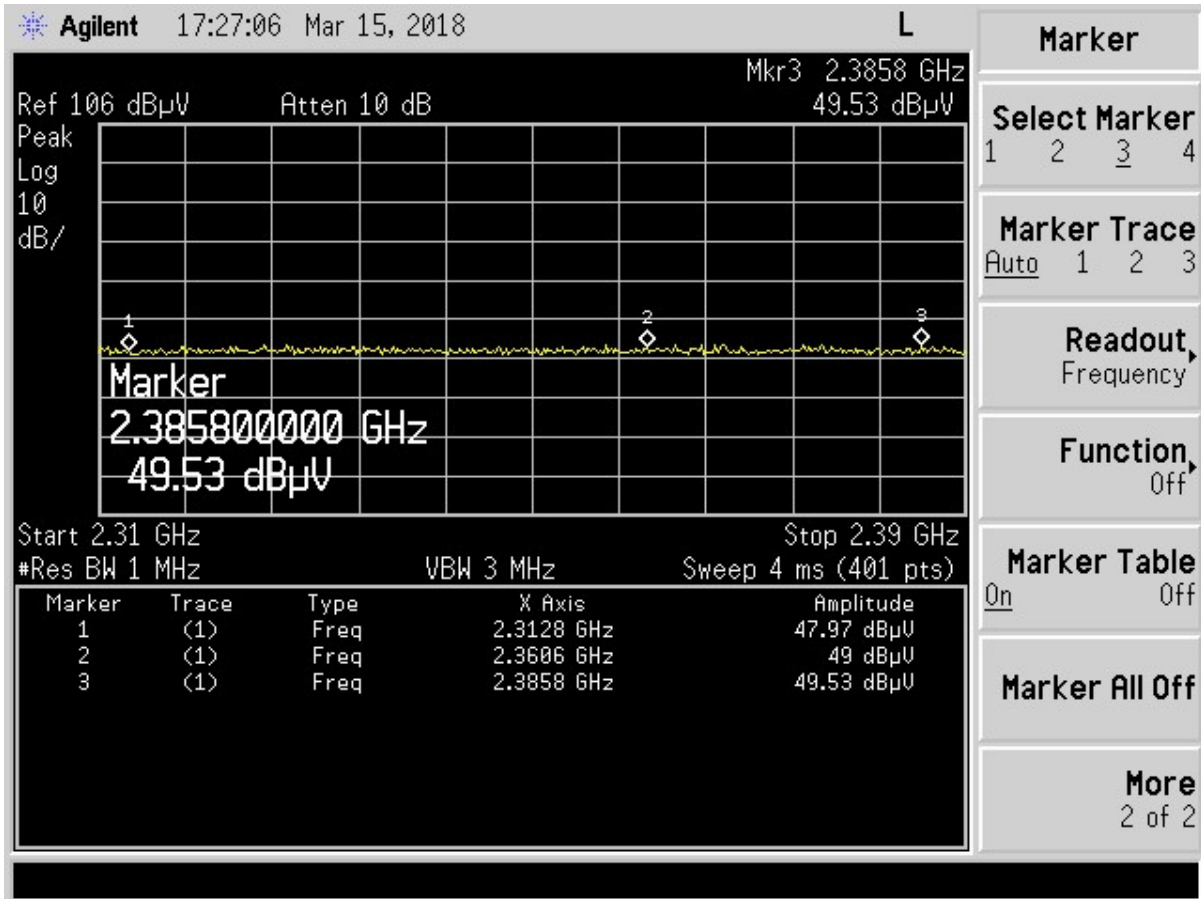
Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2315.40	49.00	-0.39	48.61	74.0	3.0m./VERT	25.4	PK
2350.00	49.33	-0.38	48.95	74.0	3.0m./VERT	25.0	PK
2380.00	54.13	-1.28	52.85	74.0	3.0m./VERT	21.1	PK



**Figure 24. Antenna 3 Restricted Band Measurements
 2.31 GHz to 2.39 GHz – Average**

Table 21. Antenna 3 Restricted Band Data (AVG)- Low Channel

Frequency (MHz)	Test Data (dB μ V)	AF+CA-AMP+DC (dB/m)	Results (dB μ V/m)	Limits (dB μ V/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2315.40	32.39	-0.27	32.12	54.0	3.0m./HORZ	21.9	AVG
2350.00	32.79	-0.25	32.54	54.0	3.0m./HORZ	21.5	AVG
2380.00	32.75	-1.15	31.60	54.0	3.0m./HORZ	22.4	AVG



**Figure 25. Antenna 4 Restricted Band Measurements
 2.31 GHz to 2.39 GHz – Peak**

Table 22. Antenna 4 Restricted Band Data (Peak)- Low Channel

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2312.80	47.97	-0.19	47.78	74.0	3.0m./HORZ	26.2	PK
2360.60	49.00	-1.15	47.85	74.0	3.0m./HORZ	26.2	PK
2385.80	49.53	-1.15	48.38	74.0	3.0m./HORZ	25.6	PK

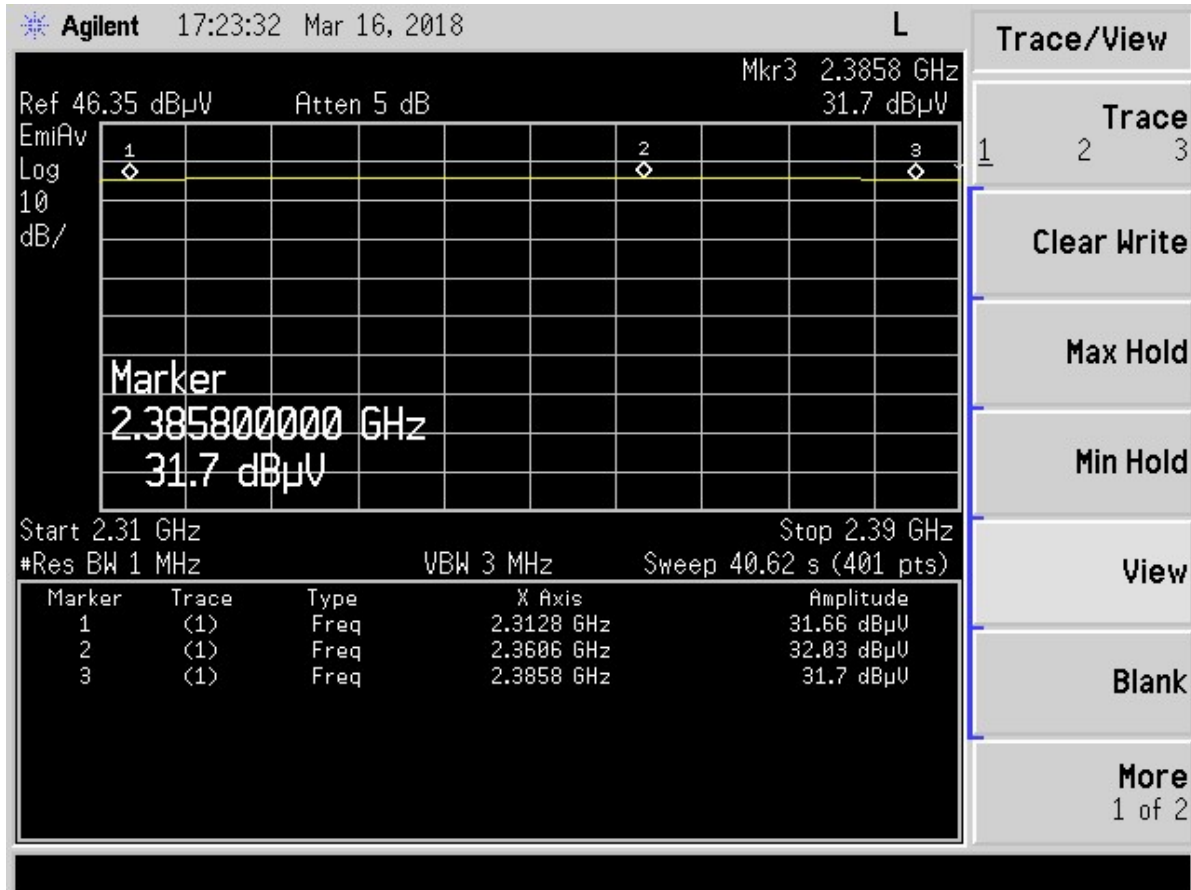
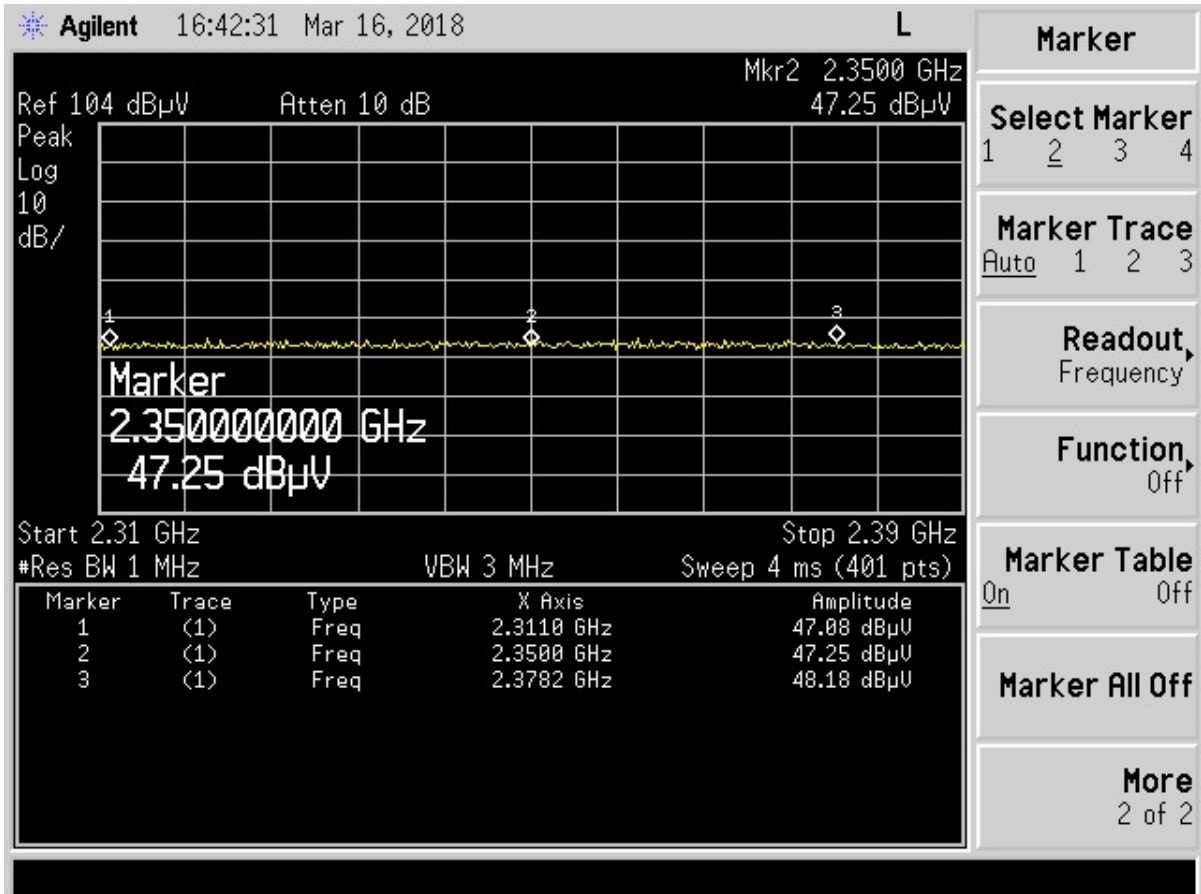


Figure 26. Antenna 4 Restricted Band Measurements
 2.31 GHz to 2.39 GHz – Average

Table 23. Antenna 4 Restricted Band Data (AVG)- Low Channel

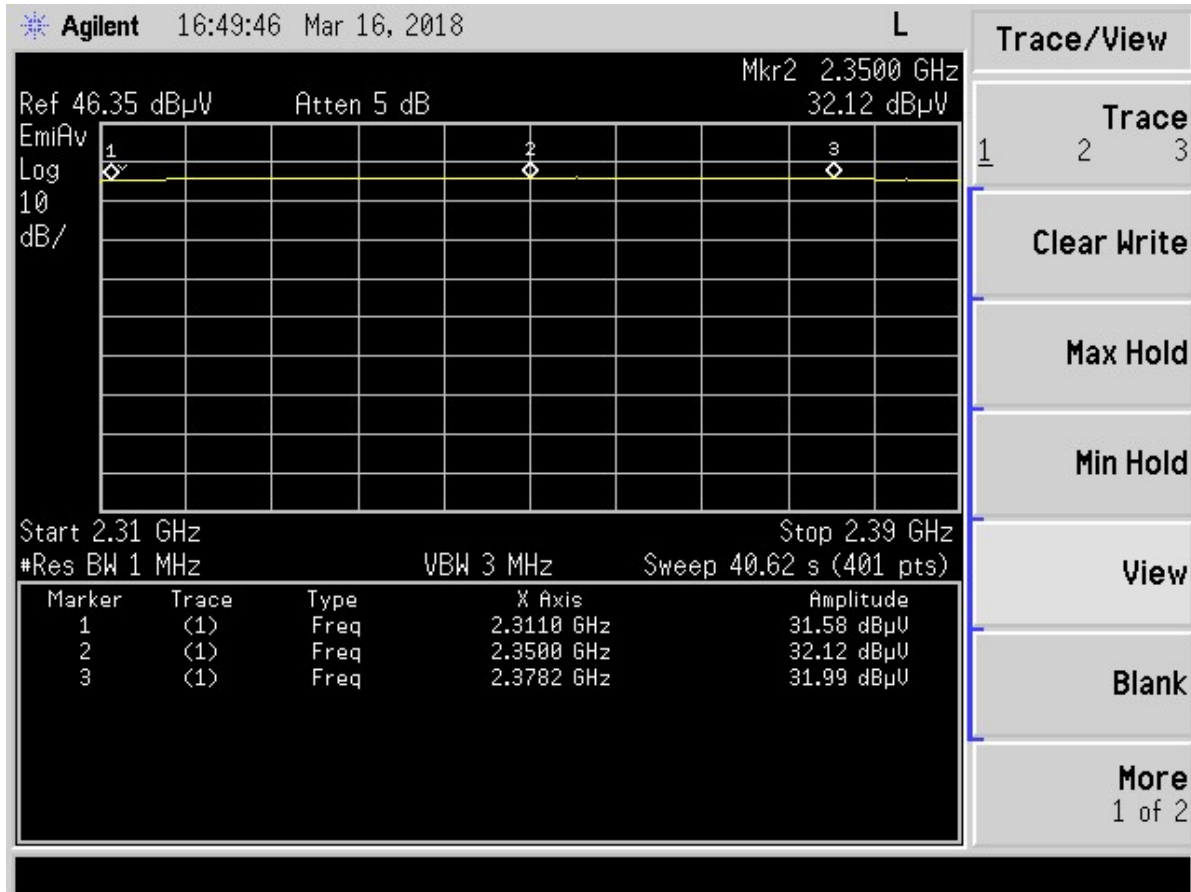
Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2312.80	31.66	-0.19	31.47	54.0	3.0m./HORZ	22.5	AVG
2360.60	32.03	-1.15	30.88	54.0	3.0m./HORZ	23.1	AVG
2385.80	31.70	-1.28	30.42	54.0	3.0m./VERT	23.6	AVG



**Figure 27. Antenna 5 Restricted Band Measurements
 2.31 GHz to 2.39 GHz – Peak**

Table 24. Antenna 5 Restricted Band Data (Peak)- Low Channel

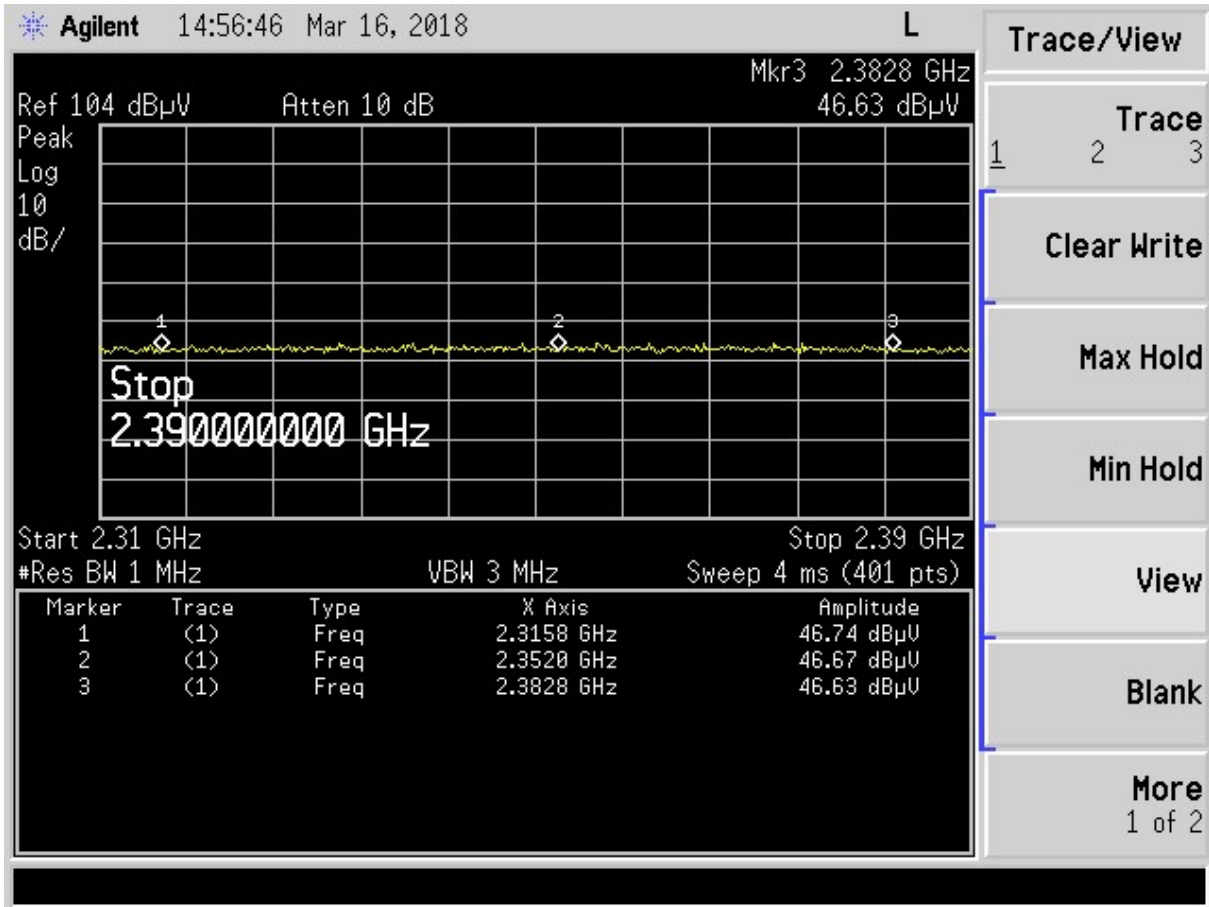
Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2311.00	47.08	-0.19	46.89	74.0	3.0m./HORZ	27.1	PK
2350.00	47.25	-0.25	47.00	74.0	3.0m./HORZ	27.0	PK
2378.20	48.18	-1.15	47.03	74.0	3.0m./HORZ	27.0	PK



**Figure 28. Antenna 5 Restricted Band Measurements
 2.31 GHz to 2.39 GHz – Average**

Table 25. Antenna 5 Restricted Band Data (AVG)- Low Channel

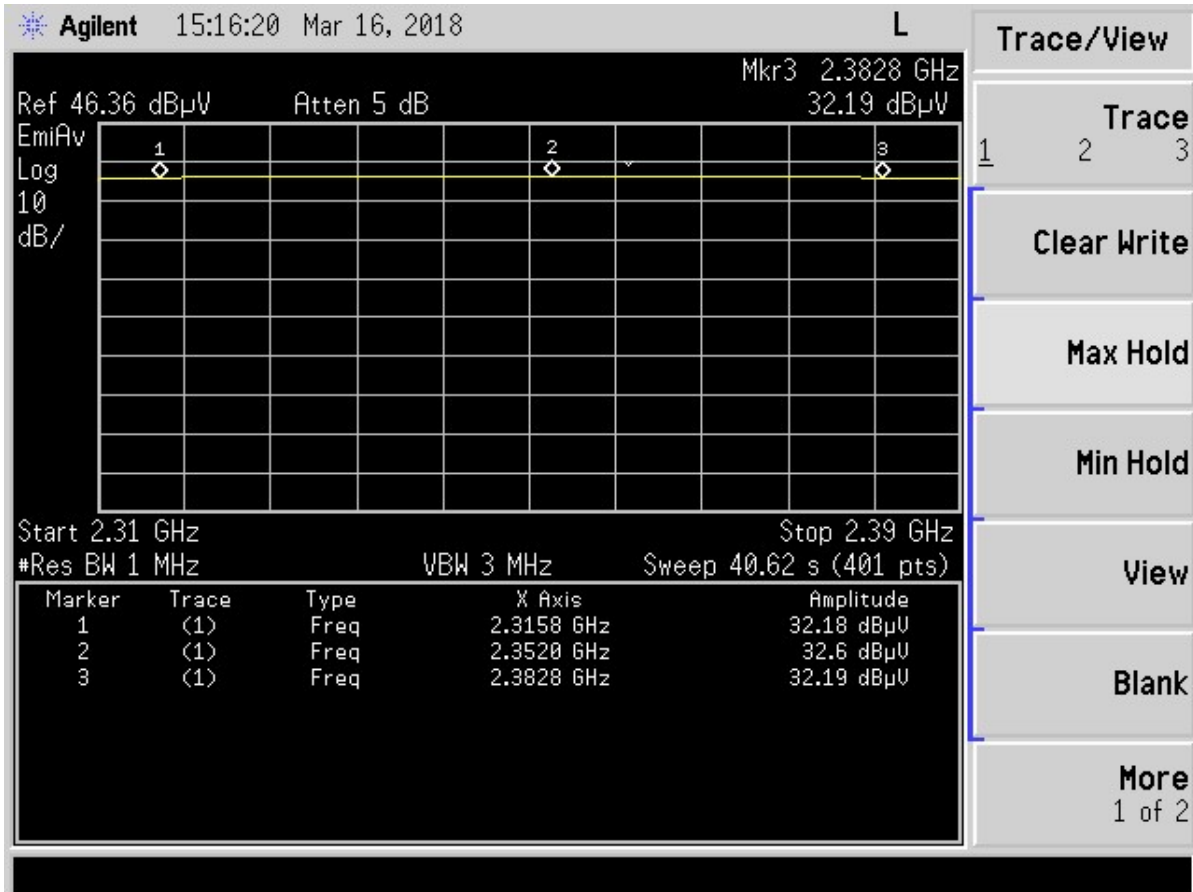
Frequency (MHz)	Test Data (dB μ V)	AF+CA-AMP+DC (dB/m)	Results (dB μ V/m)	Limits (dB μ V/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2311.00	31.58	-0.19	31.39	54.0	3.0m./HORZ	22.6	AVG
2350.00	32.12	-0.25	31.87	54.0	3.0m./HORZ	22.1	AVG
2378.20	31.99	-1.15	30.84	54.0	3.0m./HORZ	23.2	AVG



**Figure 29. Antenna 6 Restricted Band Measurements
 2.31 GHz to 2.39 GHz –Peak**

Table 26. Antenna 6 Restricted Band Data (Peak)- Low Channel

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2315.80	46.74	-0.27	46.47	74.0	3.0m./HORZ	27.5	PK
2352.00	46.67	-0.25	46.42	74.0	3.0m./HORZ	27.6	PK
2382.80	46.63	-1.15	45.48	74.0	3.0m./HORZ	28.5	PK



**Figure 30. Antenna 6 Restricted Band Measurements
 2.31 GHz to 2.39 GHz – Average**

Table 27. Antenna 6 Restricted Band Data (AVG)- Low Channel

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2315.80	32.18	-0.27	31.91	54.0	3.0m./HORZ	22.1	AVG
2352.00	32.60	-0.25	32.35	54.0	3.0m./HORZ	21.7	AVG
2382.80	32.19	-1.15	31.04	54.0	3.0m./HORZ	23.0	AVG

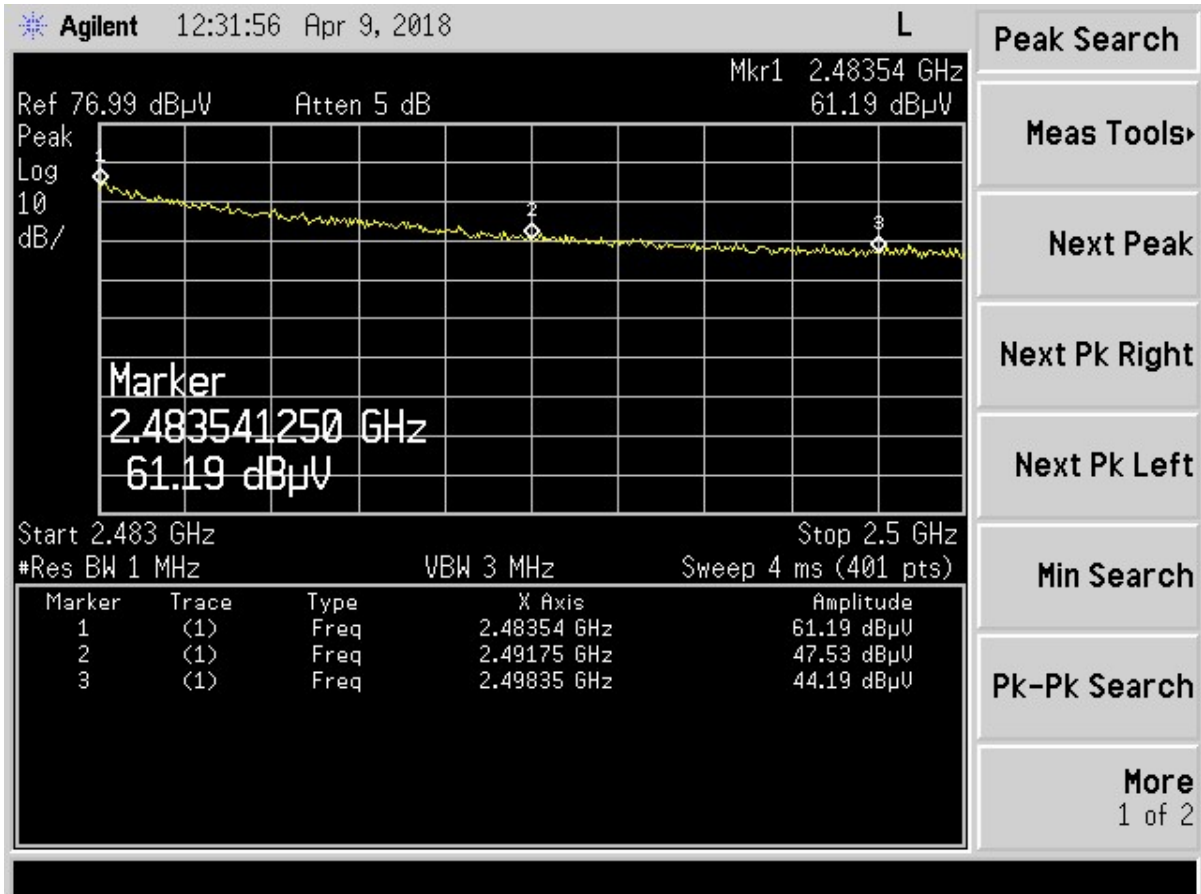
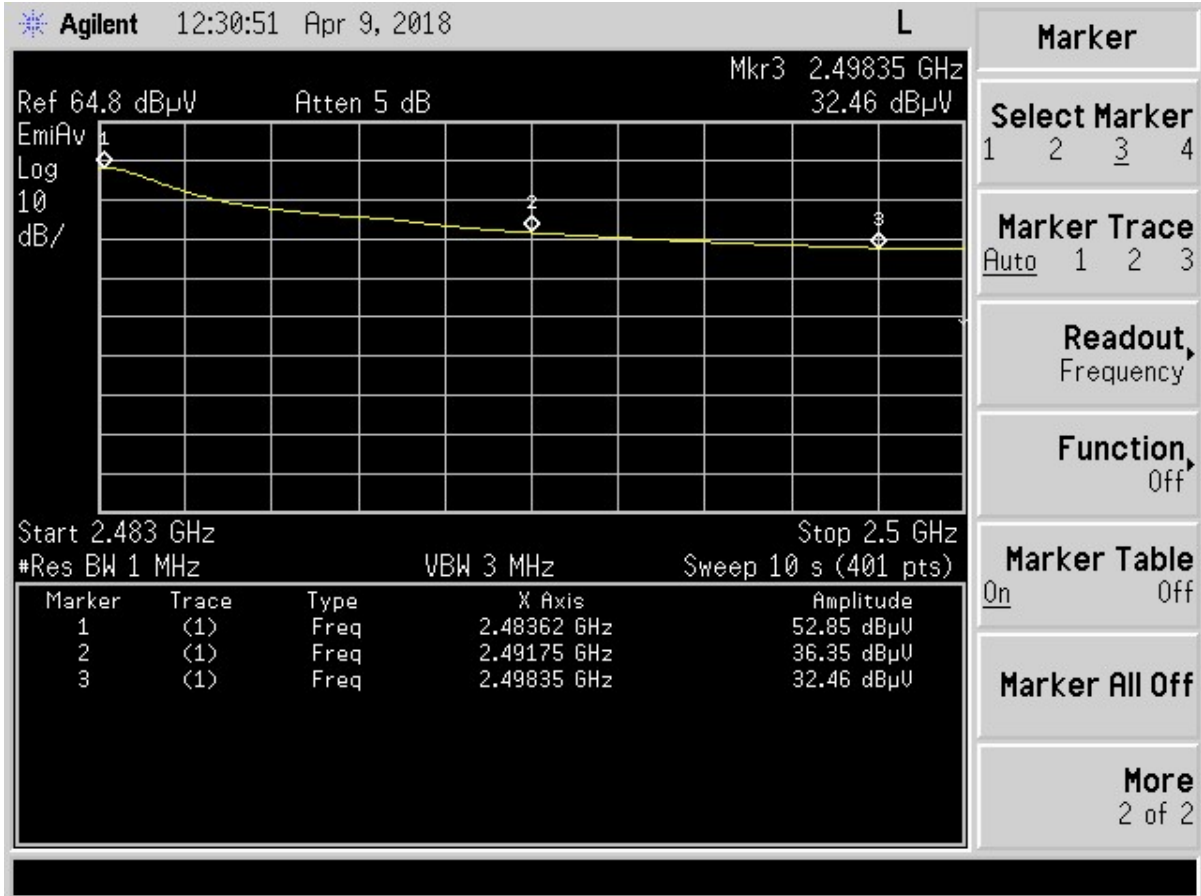


Figure 31. Antenna 1 Restricted Band Measurements
 2.4835 GHz to 2.5 GHz – Peak

Table 28. Antenna 1 Restricted Band Data (Peak)- High Channel

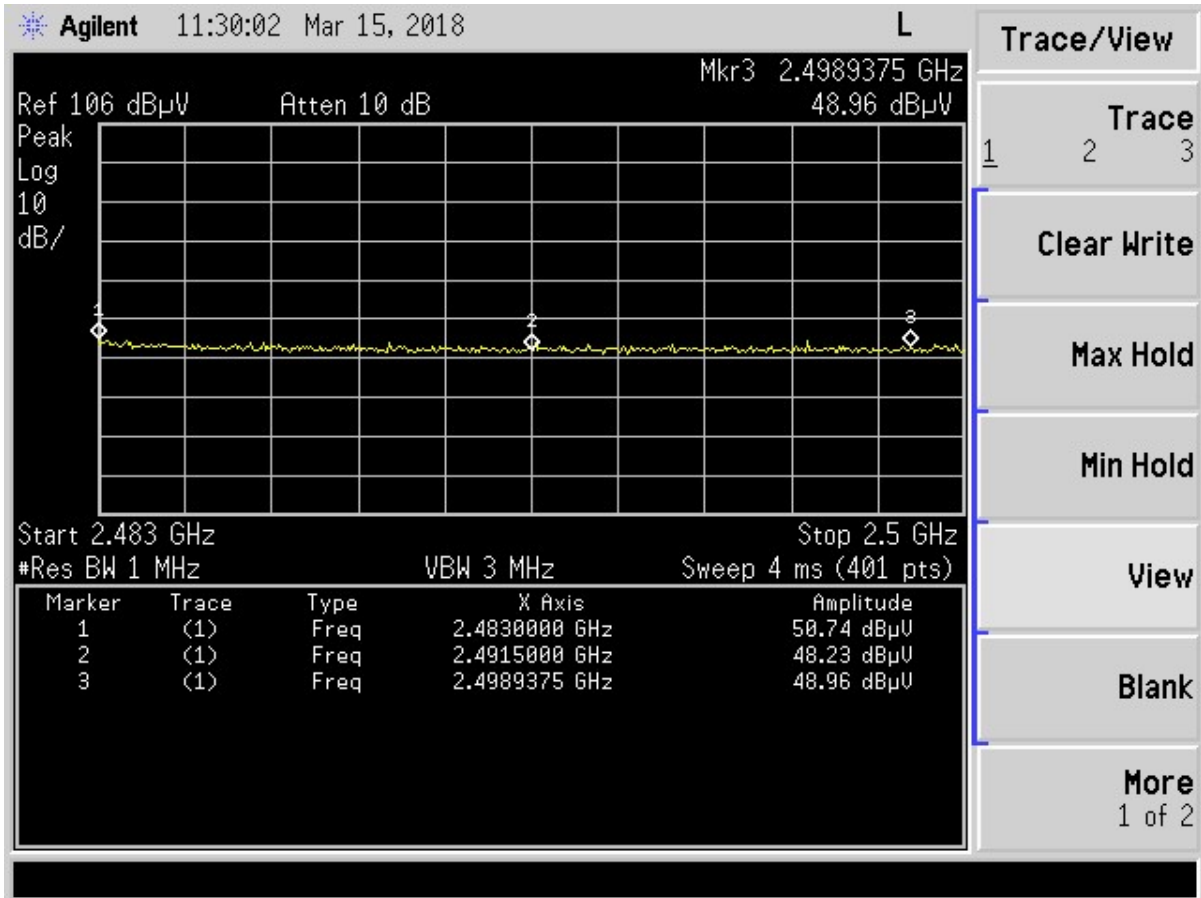
Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2483.54	65.63	0.29	61.48	74.0	3.0m./HORZ	12.5	PK
2491.75	51.14	0.29	47.82	74.0	3.0m./HORZ	26.2	PK
2498.35	47.56	0.29	44.48	74.0	3.0m./HORZ	29.5	PK



**Figure 32. Antenna 1 Restricted Band Measurements
 2.4835 GHz to 2.5 GHz – Average**

Table 29. Antenna 1 Restricted Band Data (AVG)- High Channel

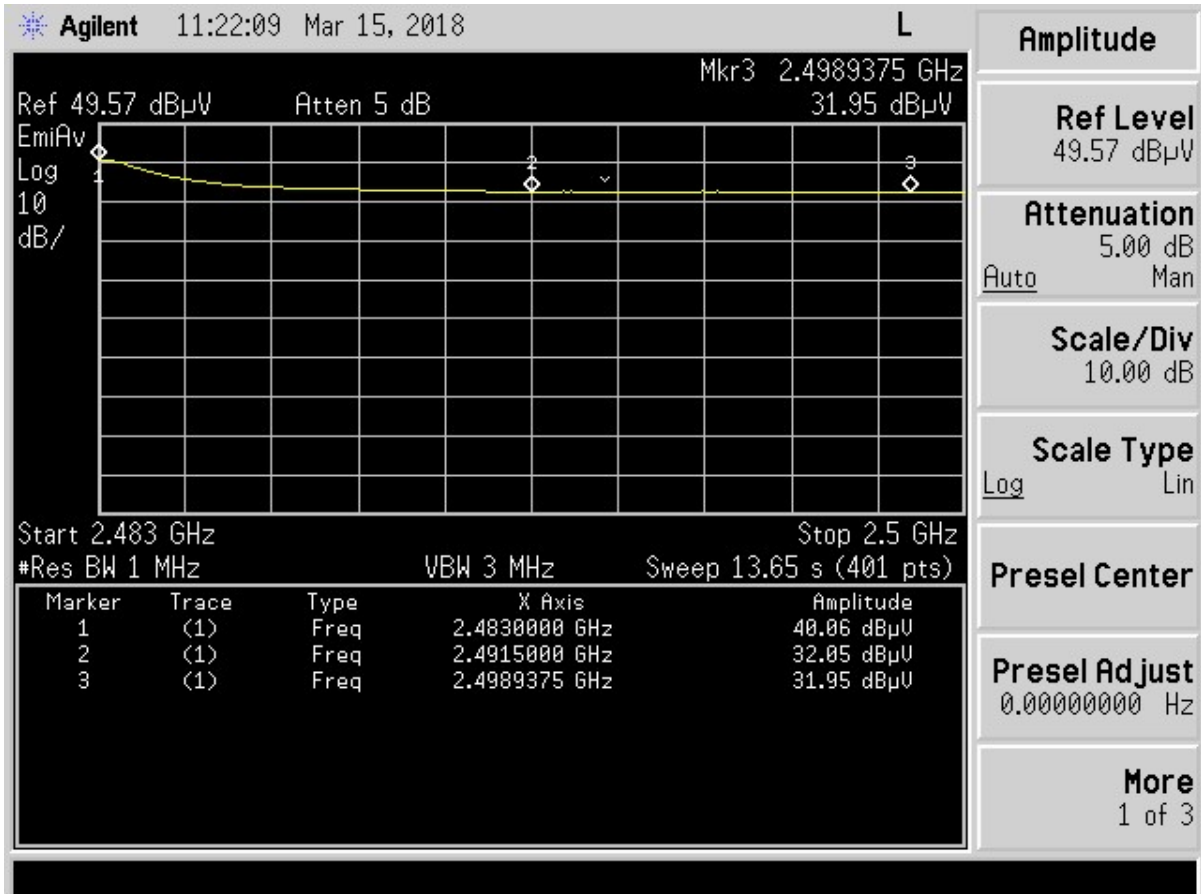
Frequency (MHz)	Test Data (dB μ V)	AF+CA-AMP+DC (dB/m)	Results (dB μ V/m)	Limits (dB μ V/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2483.54	52.85	0.29	53.14	54.0	3.0m./HORZ	.9	AVG
2491.75	36.35	0.29	36.64	54.0	3.0m./HORZ	17.4	AVG
2498.35	32.46	0.29	32.75	54.0	3.0m./HORZ	21.2	AVG



**Figure 33. Antenna 2 Restricted Band Measurements
 2.4835 GHz to 2.5 GHz – Peak**

Table 30. Antenna 2 Restricted Band Data (Peak)- High Channel

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2483.00	50.74	0.29	51.03	74.0	3.0m./HORZ	23.0	PK
2491.50	48.23	0.29	48.52	74.0	3.0m./HORZ	25.5	PK
2498.93	48.96	0.29	49.25	74.0	3.0m./HORZ	24.7	PK



**Figure 34. Antenna 2 Restricted Band Measurements
 2.4835 GHz to 2.5 GHz – Average**

Table 31. Antenna 2 Restricted Band Data (AVG)- High Channel

Frequency (MHz)	Test Data (dBµV)	AF+CA-AMP+DC (dB/m)	Results (dBµV/m)	Limits (dBµV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2483.00	40.06	0.29	40.35	54.0	3.0m./HORZ	13.6	AVG
2491.50	32.05	0.29	32.34	54.0	3.0m./HORZ	21.7	AVG
2498.93	31.95	0.48	32.43	54.0	3.0m./VERT	21.6	AVG

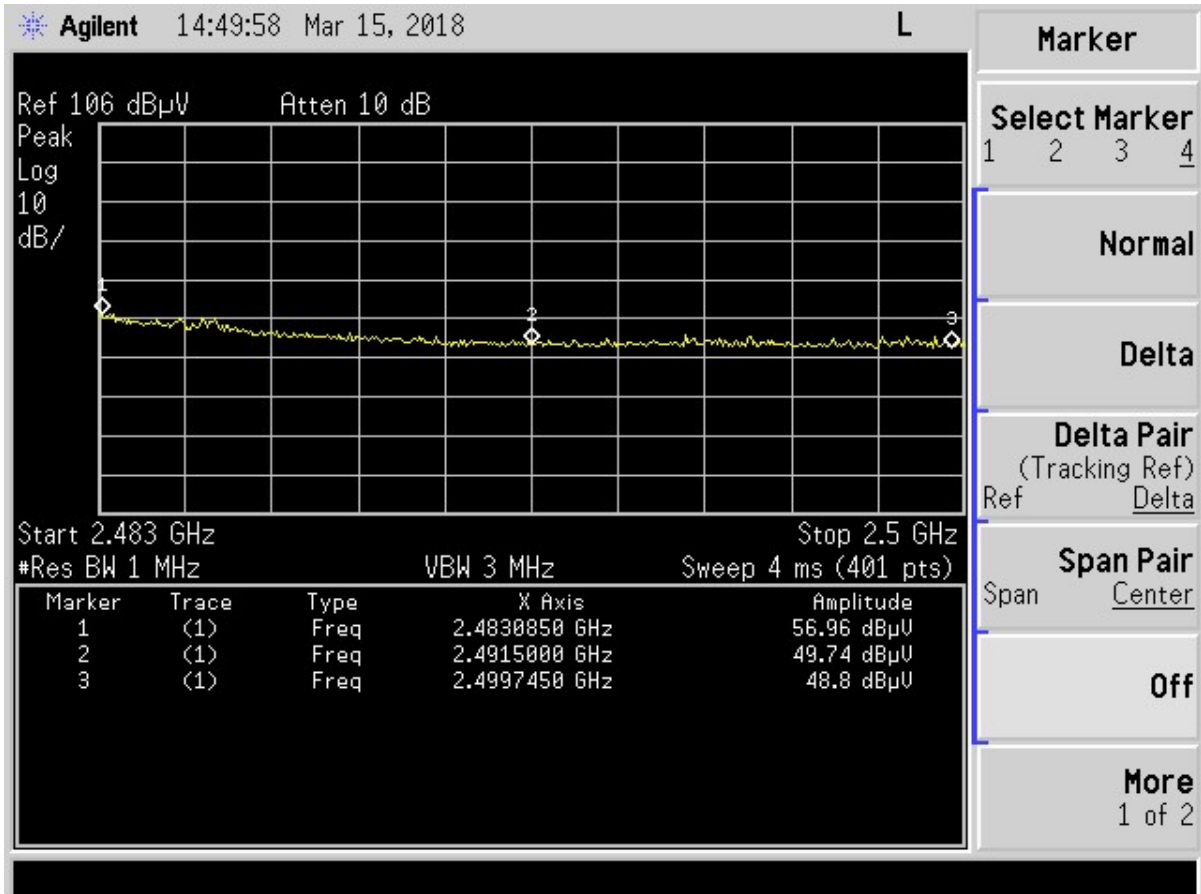


Figure 35. Antenna 3 Restricted Band Measurements
 2.4835 GHz to 2.5 GHz – Peak

Table 32. Antenna 3 Restricted Band Data (Peak)- High Channel

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector
2483.09	56.96	0.29	57.25	74.0	3.0m./HORZ	16.7	PK
2491.50	49.74	0.29	50.03	74.0	3.0m./HORZ	24.0	PK
2499.74	48.80	0.29	49.09	74.0	3.0m./HORZ	24.9	PK

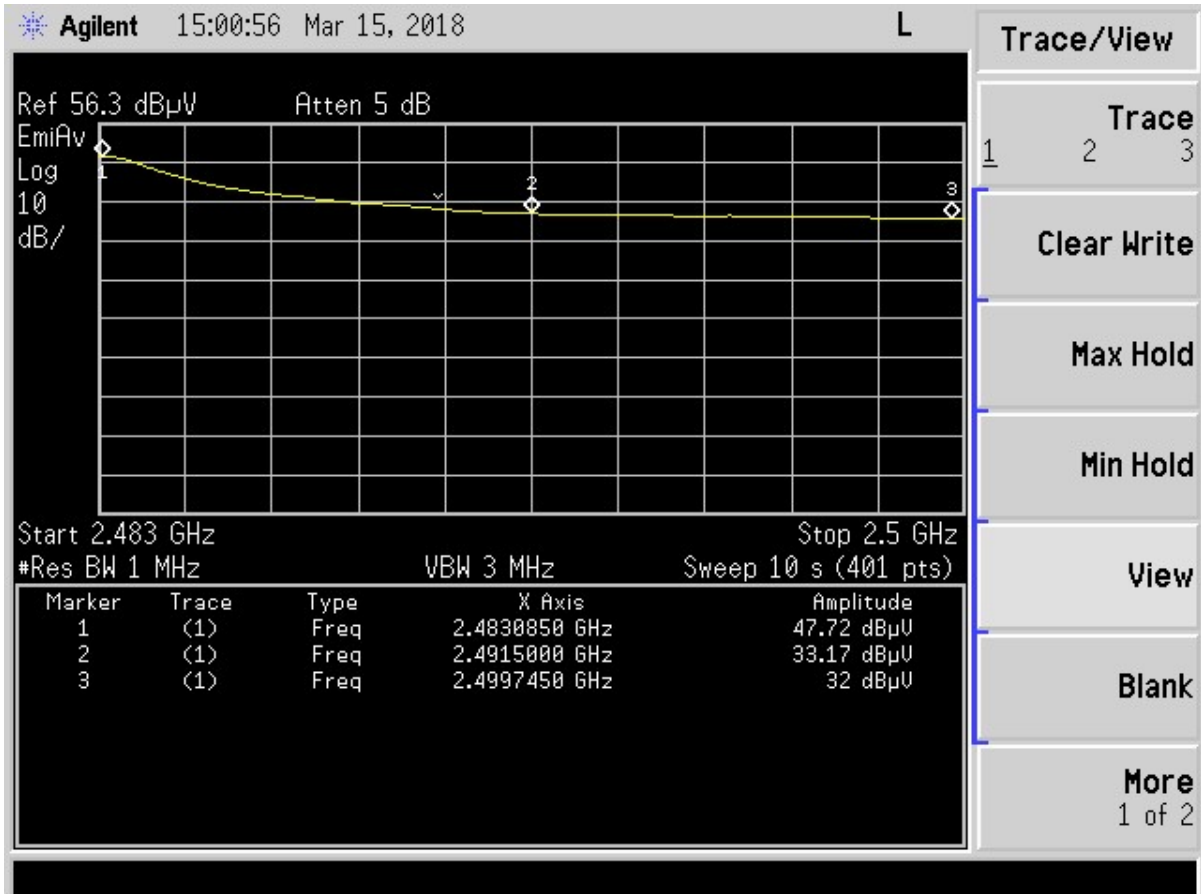
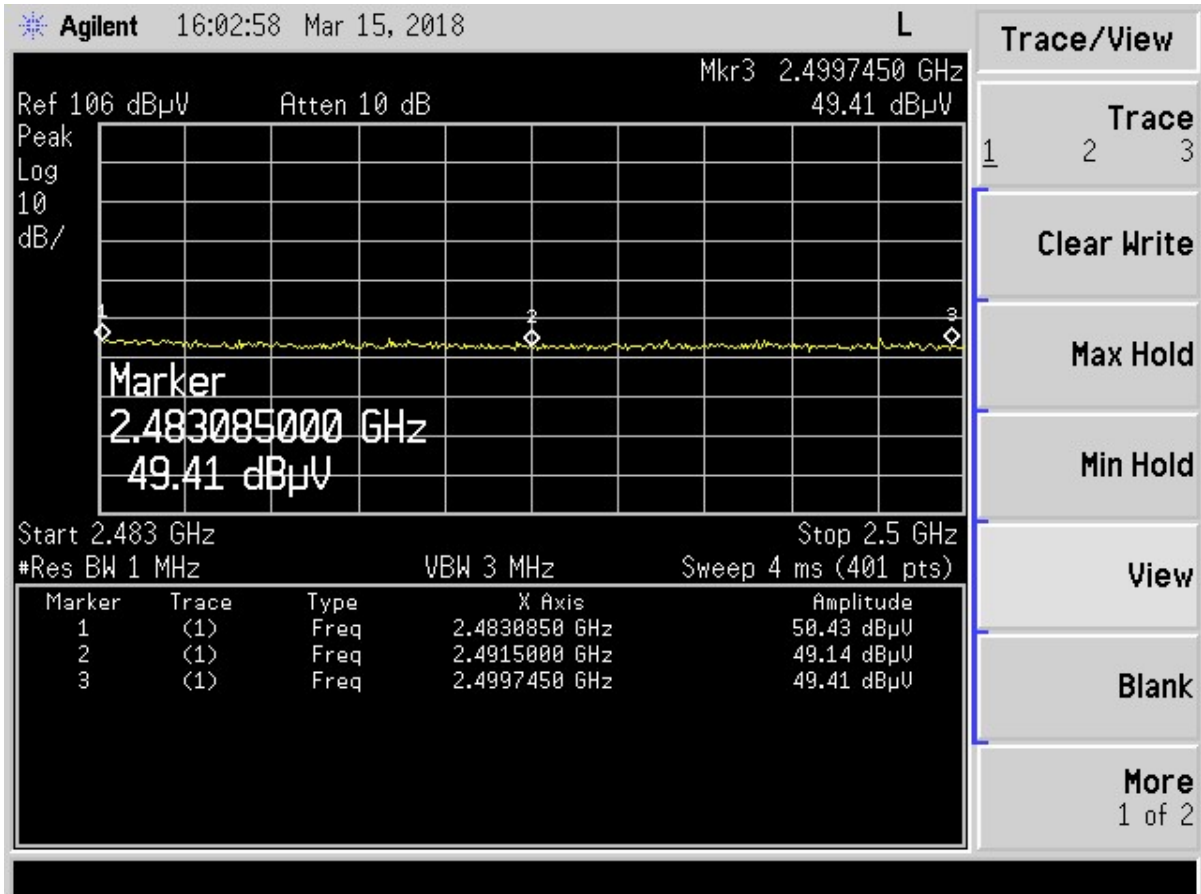


Figure 36. Antenna 3 Restricted Band Measurements
 2.4835 GHz to 2.5 GHz – Average

Table 33. Antenna 3 Restricted Band Data (AVG)- High Channel

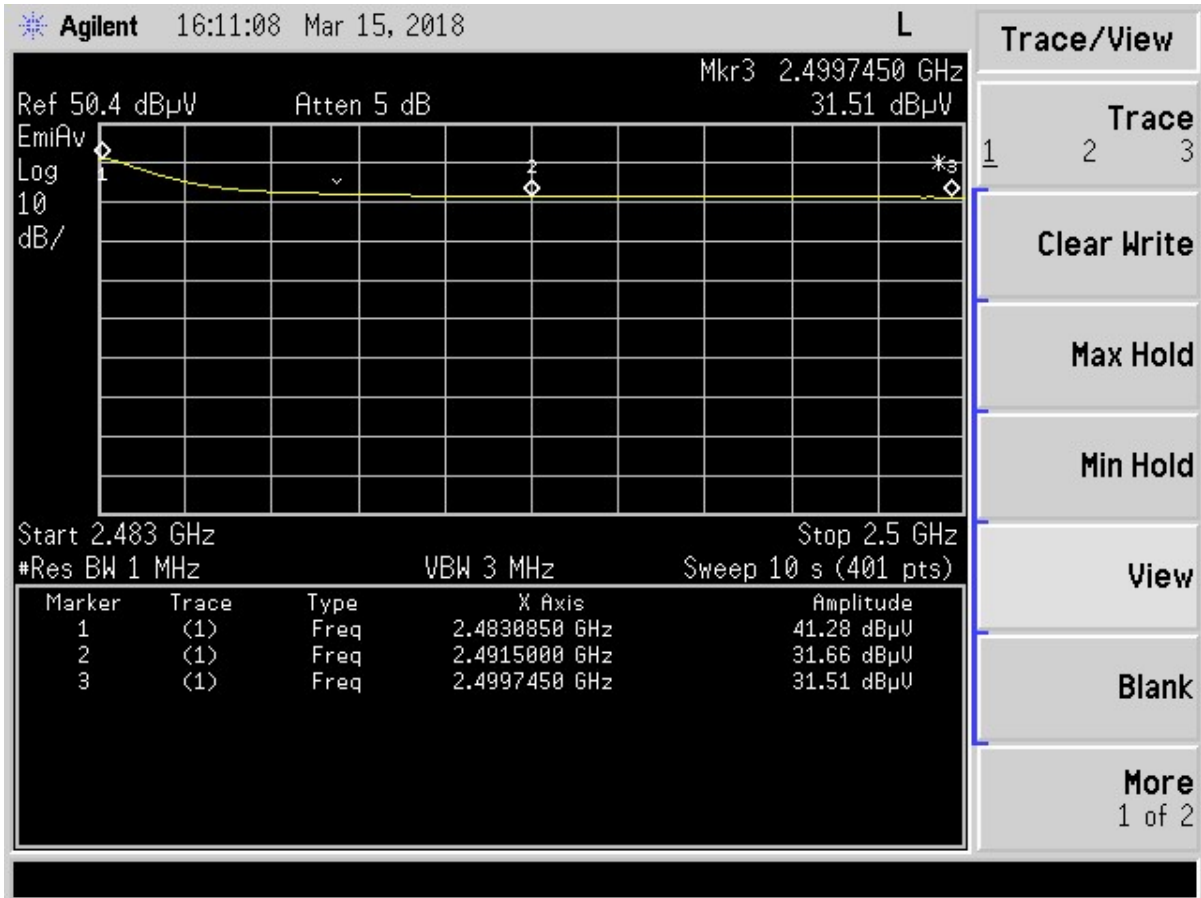
Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2483.09	47.72	0.29	48.01	54.0	3.0m./HORZ	6.0	AVG
2491.50	33.17	0.29	33.46	54.0	3.0m./HORZ	20.5	AVG
2499.75	32.00	0.48	32.48	54.0	3.0m./VERT	21.5	AVG



**Figure 37. Antenna 4 Restricted Band Measurements
 2.4835 GHz to 2.5 GHz –Peak**

Table 34. Antenna 4 Restricted Band Data (Peak)- High Channel

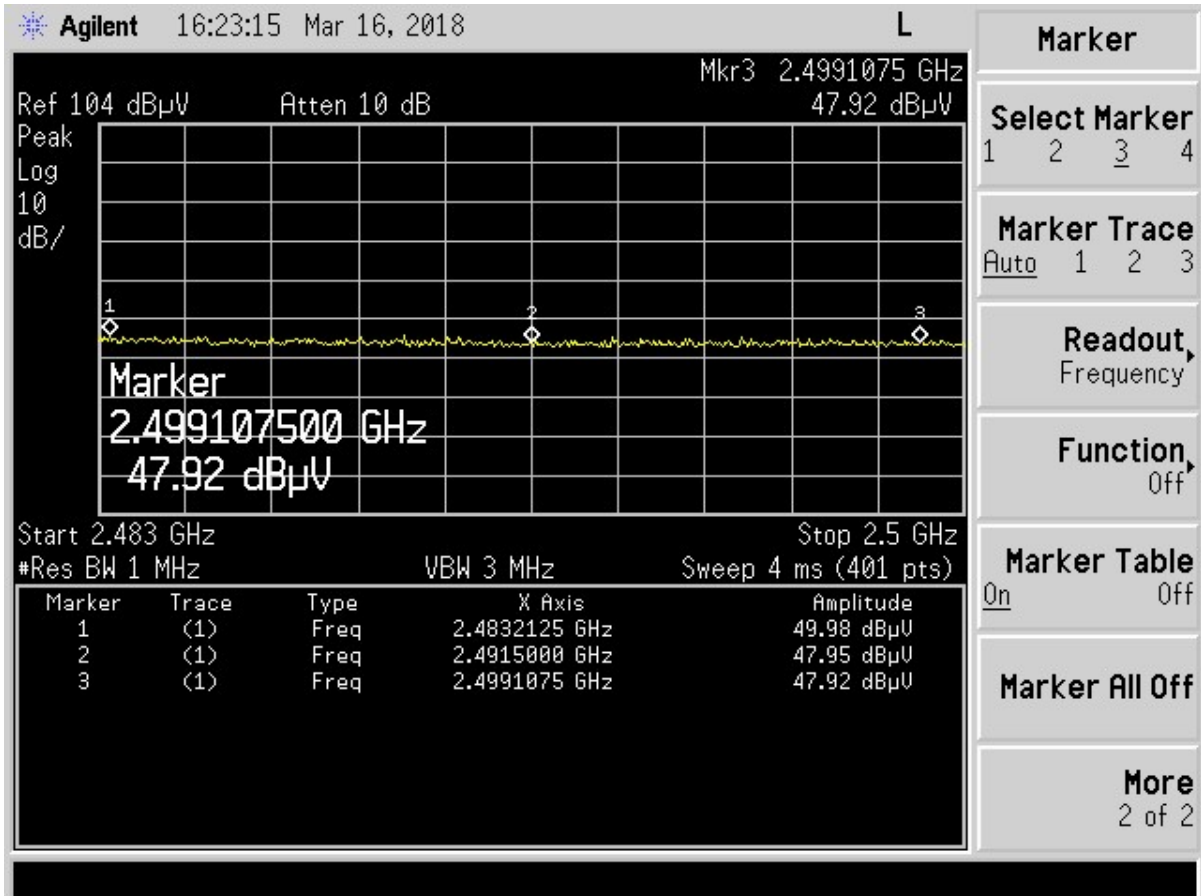
Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2483.09	50.43	0.29	50.72	74.0	3.0m./HORZ	23.3	PK
2491.50	49.14	0.29	49.43	74.0	3.0m./HORZ	24.6	PK
2499.75	49.41	0.29	49.70	74.0	3.0m./HORZ	24.3	PK



**Figure 38. Antenna 4 Restricted Band Measurements
 2.4835 GHz to 2.5 GHz – Average**

Table 35. Antenna 4 Restricted Band Data (AVG)- High Channel

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2483.09	41.28	0.29	41.57	54.0	3.0m./HORZ	12.4	AVG
2491.50	31.66	0.29	31.95	54.0	3.0m./HORZ	22.0	AVG
2499.75	31.51	0.29	31.80	54.0	3.0m./HORZ	22.2	AVG



**Figure 39. Antenna 5 Restricted Band Measurements
 2.4835 GHz to 2.5 GHz –Peak**

Table 36. Antenna 5 Restricted Band Data (Peak)- High Channel

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2483.21	49.98	0.29	50.27	74.0	3.0m./HORZ	23.7	PK
2491.50	47.95	0.29	48.24	74.0	3.0m./HORZ	25.8	PK
2499.11	47.92	0.29	48.21	74.0	3.0m./HORZ	25.8	PK

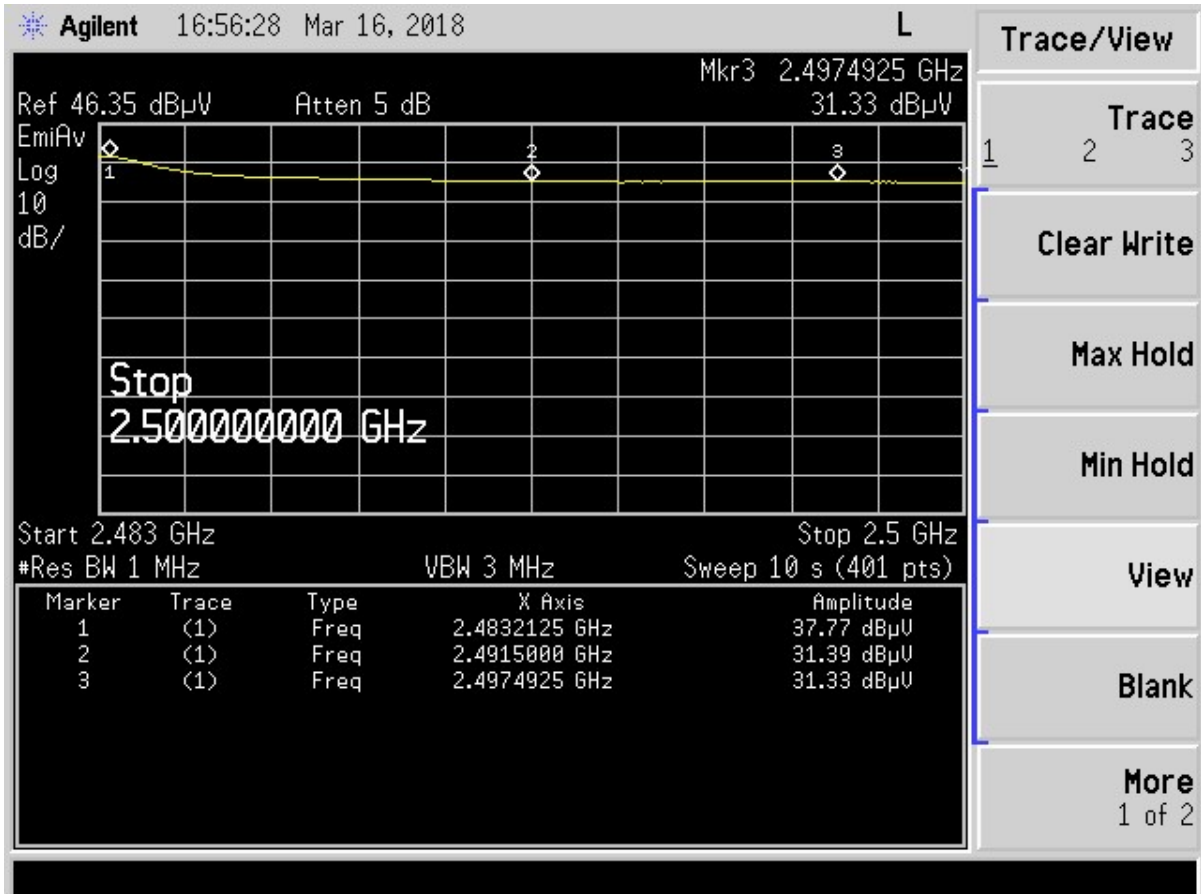


Figure 40. Antenna 5 Restricted Band Measurements
 2.4835 GHz to 2.5 GHz – Average

Table 37. Antenna 5 Restricted Band Data (AVG)- High Channel

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2483.21	37.77	0.29	38.06	54.0	3.0m./HORZ	15.9	AVG
2491.50	31.39	0.29	31.68	54.0	3.0m./HORZ	22.3	AVG
2499.11	31.33	0.29	31.62	54.0	3.0m./HORZ	22.4	AVG

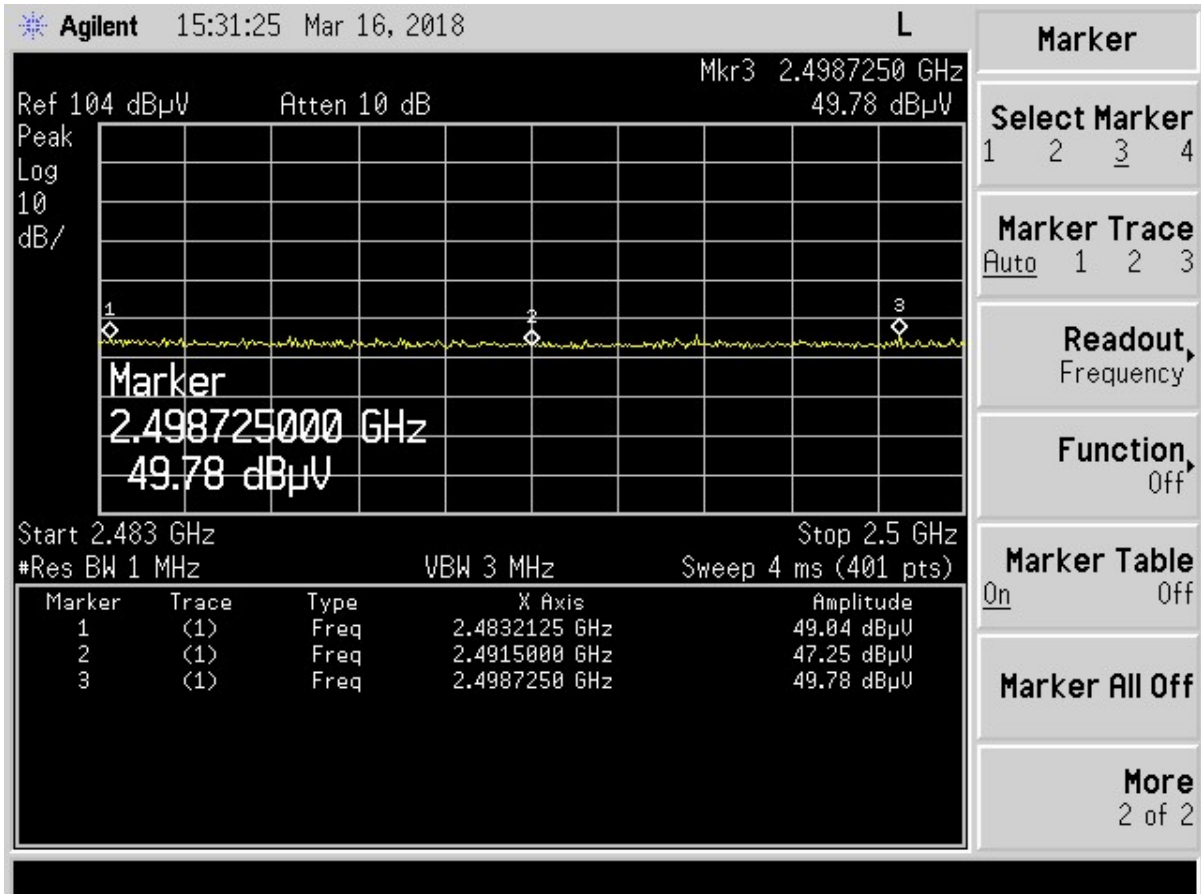
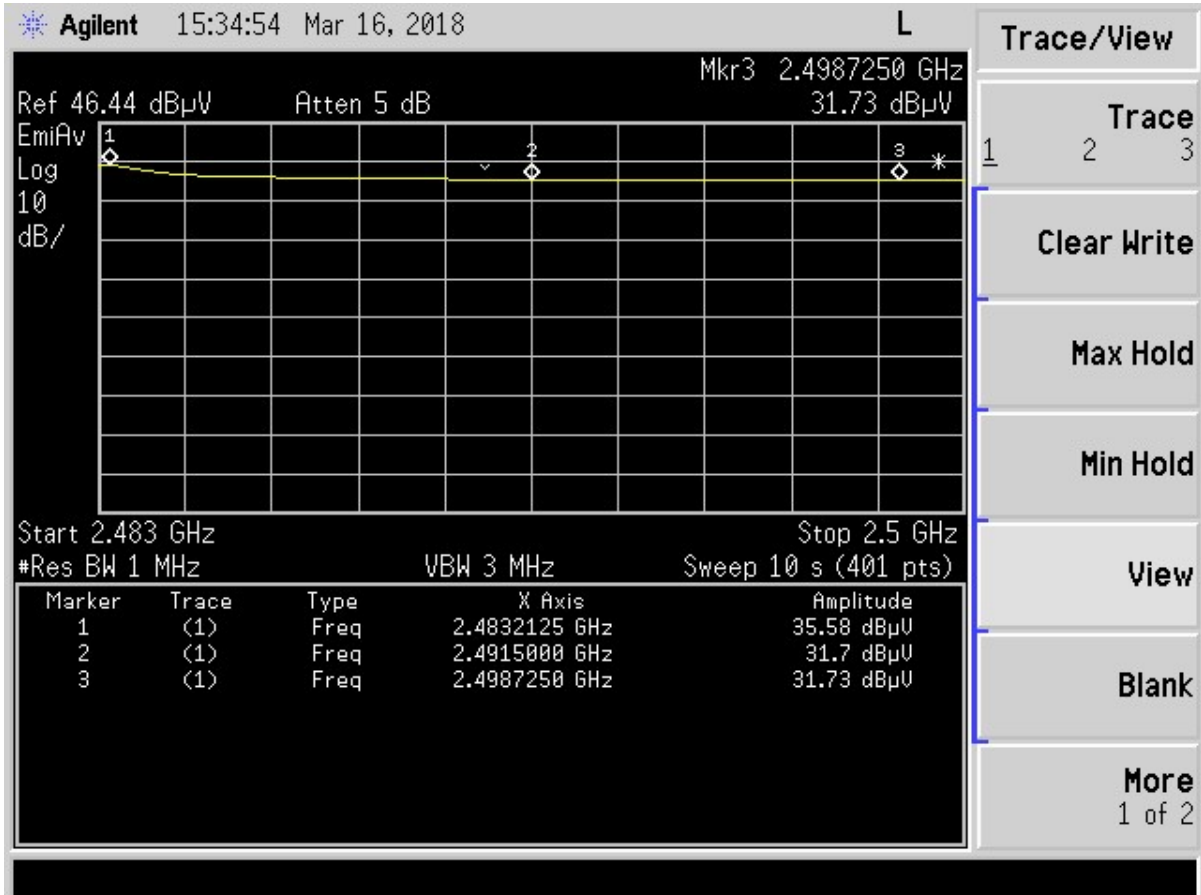


Figure 41. Antenna 6 Restricted Band Measurements
 2.4835 GHz to 2.5 GHz – Peak

Table 38. Antenna 6 Restricted Band Data (Peak)- High Channel

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2483.21	49.04	0.29	49.33	74.0	3.0m./HORZ	24.7	PK
2491.50	47.25	0.29	47.54	74.0	3.0m./HORZ	26.5	PK
2498.73	49.78	0.29	50.07	74.0	3.0m./HORZ	23.9	PK



**Figure 42. Antenna 6 Restricted Band Measurements
 2.4835 GHz to 2.5 GHz – Average**

Table 39. Antenna 6 Restrict Band Data (AVG)- High Channel

Frequency (MHz)	Test Data (dBuV)	AF+CA-AMP+DC (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector PK/QP/AVG
2483.21	35.58	0.29	35.87	54.0	3.0m./HORZ	18.1	AVG
2491.50	31.70	0.29	31.99	54.0	3.0m./HORZ	22.0	AVG
2498.73	31.73	0.29	32.02	54.0	3.0m./HORZ	22.0	AVG

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2.12 Unintentional Radiator and Intentional Radiator, Radiated Emissions (CFR 15.109)

The test data provided herein is to support the verification requirement for digital devices due to the changes made to the EUT. The EUT in the continuously transmitting state is considered the worst case condition and the data collected while the EUT was in this condition was compared to the Part 15.109 limits.

The EUT was evaluated from 30 MHz to 12.5 GHz the data is presented in the table below. The data presented is with the EUT and its transmitter ON and transmitting.

Measurements were made with the analyzer's resolution bandwidth set to 120 kHz for measurements made below 1 GHz and 1 MHz for measurements made above 1 GHz. The video bandwidth was set to three times the resolution bandwidth; 1 MHz RBW and 3 MHz VBW. The test data were maximized for magnitude by rotating the turn-table through 360 degrees and raising and lowering the receiving antenna between 1 to 4 meters in height as a part of the measurement procedure.

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Table 40. Spurious Radiated Emissions (CFR 15.109), 30 MHz to 1000 MHz

30 MHz to 1000 MHz								
Test: Radiated Emissions				Client: Murata				
Project: 17-0439				Model: CCT24				
Frequency (MHz)	Test Data (dBuv)	Additional Factor (dB)	AF+CA-AMP (dB/m)	Results (dBuV/m)	QP Limits (dBuV/m)	Antenna Distance/Polarization	Margin (dB)	Detector PK, or QP
39.14	31.92	--	-13.81	18.11	40.0	3m./HORZ	21.9	PK
133.08	43.16	--	-14.73	28.43	43.5	3m./HORZ	15.1	PK
51.03	39.71	--	-17.17	22.54	40.0	3m./VERT	17.5	PK
124.50	39.99	--	-14.82	25.17	43.5	3m./VERT	18.3	PK
201.00	33.88	--	-13.59	20.29	43.5	3m./HORZ	23.2	PK
264.36	34.98	--	-11.83	23.15	46.0	3m./HORZ	22.8	PK
965.40	29.95	--	-1.30	28.65	54.0	3m./HORZ	25.3	PK
201.00	32.98	--	-13.89	19.09	43.5	3m./VERT	24.4	PK
262.50	33.80	--	-12.32	21.48	46.0	3m./VERT	24.5	PK
981.60	29.80	--	-2.19	27.61	54.0	3m./VERT	26.4	PK

SAMPLE CALCULATION at: 39.14 MHz

Magnitude of Measured Frequency	31.92	dBuV
+Additional Factor (Distance Extrapolation)	0.0	dB
+Antenna Factor + Cable Loss+ Amplifier Gain – Duty Cycle	-13.81	dB/m
Corrected Result	18.11	dBuV/m

Test Date: March 19, 2018

Tested By
 Signature: 

Name: John Freeman

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Table 41. Spurious Radiated Emissions (CFR 15.109) 1 GHz to 12.5 GHz

1 GHz to 25 GHz, Part 15.209 Limits							
Test: Radiated Emissions				Client: Murata			
Project: 17-0439				Model: CCT24			
Frequency (MHz)	Test Data (dBuv)	AF+CA-AMP (dB/m)	Results (dBuV/m)	AVG Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector PK, or AVG
Besides the emissions reported in the table below, all other emissions were at least 20 dB from the applicable limit.							

SAMPLE CALCULATION at: N/A

Test Date: March 19, 2018

Tested By
 Signature: 

Name: John Freeman

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

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2.13 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4-2:2011. A coverage factor of $k=2$ was used to give a level of confidence of approximately 95%.

2.12.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is ± 2.78 dB.

2.12.2 Radiated Emissions Measurement Uncertainty

Measurement Uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ± 5.40 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ± 5.19 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ± 5.08 dB.

3 Conclusions

The EUT meets the requirements of the applicable standard when tested as presented in this test report.