



RADIO TEST REPORT

For

MODEL NO.: 1843

FCC ID: C3K1843

IC ID: 3048A-1843

Test Report No. R-TR525-FCCISED-BTLE-1

Issue Date: May 3, 2019

FCC CFR47 Part 15 Subpart C
Innovation, Science and Economic Development
Canada RSS-247 Issue 2

Prepared by
Microsoft EMC Laboratory
17760 NE 67th Ct,
Redmond WA, 98052, U.S.A.
425-421-9799



TESTING CERT #3472.01

[illegible]

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Test Report Attestation

Microsoft Corporation**Model:** 1843**FCC ID:** C3K1843**IC ID:** 3048A-1843**Applicable Standards**

Specification	Test Result
FCC 47CFR Rule Parts 15.207, 15.209, 15.247	Pass
Innovation, Science and Economic Development Canada RSS-247 Issue 2, RSS-GEN Issue 5	Pass

Microsoft EMC Laboratory attests that the product model identified in this report has been tested to and meets the requirements identified in the above standards. The test results in this report solely pertain to the specific sample tested, under the conditions and operating modes as provided by the customer.

This report shall not be used to claim product certification, approval, or endorsement by A2LA or any agency of any Government. Reproduction, duplication or publication of extracts from this test report is prohibited and requires prior written approval of Microsoft EMC Laboratory.

This report replaces report R-TR525-FCCISED-BTLE-1 issued April 23, 2019.



Written By: Vishwas

Radio Test Engineer



Reviewed/ Issued By: Daniel Salinas

RF Compliance Lab Technical
Manager

2 Deviations from Standards

None.

3 Facilities and Accreditations

3.1 Test Facility

All test facilities used to collect the test data are located at
Microsoft EMC Laboratory,
17760 NE 67th Ct,
Redmond WA, 98052, USA

3.2 Accreditations

The lab is established and follows procedures as outlined in IEC/ISO 17025 and A2LA accreditation requirements.

A2LA Accredited Testing Certificate Number: 3472.01

FCC Registration Number: US1141

IC Site Registration Numbers: 3048A-3, 3048A-4

3.3 Test Equipment

The site and related equipment are constructed in conformance with the requirements of ANSI C63.4:2014 and other equivalent applicable standards.

Test site requirements for measurements above 1 GHz are in accordance with ANSI C63.4:2014.

ANSI C63.10:2013 and the appropriate KDB test methods were followed.

4 Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the product, as specified in ETSI TR 100 028. This represents an expanded uncertainty expressed at 95% confidence level using a coverage factor $k=2$. These levels are for reference only and not included to determine product compliance.

Expanded uncertainty calculations are available upon request.

Test item	Uncertainty	Unit
Radiated disturbance (9 kHz to 30 MHz)	5.32	dB
Radiated disturbance (30 MHz to 1 GHz)	5.99	dB
Radiated disturbance (1 GHz to 18 GHz)	5.12	dB
Radiated disturbance (18 GHz to 26.5 GHz)	4.86	dB
Conducted Disturbance at Mains Port	3.31	dB
Uncertainty for Conducted Power test	1.277	dB
Uncertainty for Conducted Spurious emission test	2.742	dB
Uncertainty for Bandwidth test	4.98	kHz
Uncertainty for DC power test	0.05	%
Uncertainty for test site temperature	0.5	°C
Uncertainty for test site Humidity	3	%
Uncertainty for time	0.189	%

5 Product Description

Company Name:	Microsoft Corporation
Address:	One Microsoft Way
City, State, Zip:	Redmond, WA 98052-6399
Customer Contact:	Choon Sian Ooi
Functional Description of the EUT:	Smart Display with 802.11a/b/g/n/ac 20/40/80/160 MHz, Bluetooth 5.0, and 24.2 GHz SRD radios
Model:	1843
FCC ID:	C3K1843
IC ID:	3048A-1843
Radio under test:	BTLE (2402- 2480 MHz)
Modulation(s):	GFSK
Antenna Information:	Integral Antenna. Manufacturer declared max Antenna Gain in 2.4GHz band of operation: 3.6 dBi
EUT Classification:	DTS
Equipment Design State:	Prototype/Production Equivalent (EV4)
Equipment Condition:	Good
Test Sample Details:	RF Conducted Test Sample Asset no.: R-525-021419-01, S/N: 17566293000013M RF Radiated Test Sample Asset no.: R-525-021419-01, S/N: 000059790462 Asset no.: R-525-021419-02, S/N: 000052790462

5.1 Test Configurations

Test software “DRTU” (V11.1904.0-09154) provided by the customer was used to program the EUT to transmit continuously.

The device can operate in only GFSK modulation. Channel numbers 0, 19 and 38 were used as Low, Mid and High channels, respectively.

5.2 Environmental Conditions

Ambient air temperature of the test site was within the range of 10 °C to 40 °C (50 °F to 104 °F) unless the EUT specified testing over a different temperature range. Humidity levels were in the range of 10% to 90% relative humidity. Testing conditions were within tolerance, and any deviations required from the EUT are reported.

5.3 Antenna Requirements

The antennas are permanently attached and there are no provisions for connection to an external antenna.

5.4 Equipment Modifications

No modifications were made during testing.

5.5 Dates of Testing

Testing was performed from January 28th, 2019 to April 3rd, 2019.

6 Test Results Summary

Test Description	FCC CFR 47/ ISED Rule Part	Limit	Test Result
Duty Cycle	Reporting & Measurements	Reporting & Measurement Purposes only	N/A
6dB Bandwidth	15.247 (a)(2) RSS-247 [5.2]	$\geq 500\text{kHz}$	Pass
Occupied Bandwidth	Reporting & Measurements	Reporting & Measurement Purposes only	N/A
Output Power	15.247 (b)(3) RSS-247 [5.4]	$\leq 1 \text{ Watt}$	Pass
Equivalent Isotropic Radiated Power	RSS-247 [5.4]	$\leq 4 \text{ Watt}$	Pass
Power Spectral Density	15.247 (e) RSS-247 [5.2]	$\leq 8\text{dBm}/3\text{kHz}$	Pass
Conducted Band Edge/Unwanted Emissions	15.247 (d) RSS-247 [5.5]	At least 20dBc	Pass
Radiated Spurious Emissions/ Restricted Band Emissions	15.205, 15.209 RSS-247 [5.5] RSS-Gen [8.9]	FCC CFR 47 15.209 limits RSS-Gen [8.9]	Pass
AC Power Line Conducted Emissions	15.207 RSS-Gen [8.8]	FCC CFR 47 15.207 limits RSS-Gen [8.8]	Pass

7 Test Equipment List

Equipment used for Radiated and Conducted Measurements				
Manufacturer	Description	Model #	Asset #	Calibration Due
Agilent	Spectrum Analyzer	N9030A	EMC-370	10/19/2019
Rohde & Schwarz	EMI Test Receiver	ESU40	RF-192	4/8/2019
Rohde & Schwarz	EMI Test Receiver	ESR26	RF-568	4/11/2019
Rohde & Schwarz	Open Switch and Control Unit	OSP130	RF-018	N/A
Rohde & Schwarz	Open Switch and Control Unit	OSP130	RF-019	N/A
Rohde & Schwarz	Open Switch and Control Unit	OSP130	RF-569	N/A
Rohde & Schwarz	Custom Filter Bank	SFUNIT RX	RF-322	N/A
ETS-Lindgren	Antenna - Double-Ridged Guide	3117-PA	EMC-858	10/8/2019
ETS-Lindgren	Antenna - Standard Gain	3160-09	RF-179	7/30/2019
Sunol Sciences	Antenna - Broadband Hybrid	JB6	EMC-639	8/17/2019
Pasternack	6dB Attenuator	PE7004-6	EMC-950	8/17/2019
Pasternack	10dB Attenuator	PE7087-10	EMC-653	1/21/2020
Pasternack	10dB Attenuator	PE7087-10	RF-125	9/18/2019
Utiflex	RF Cable	OSP120/DUT3	RF-872	10/4/2019
Utiflex	RF Cable	OSP120/DUT8	RF-869	10/4/2019
Mouser	RF Cable	CabS02	RF-937	11/15/2019

Equipment used for Radiated and Conducted Measurements				
Manufacturer	Description	Model #	Asset #	Calibration Due
Huber and Suhner	RF Cable	Sucoflex 100	RF-452	N/A
Micro-Coax	RF Cable	UFA210A-Q-2755-3005GU	EMC-648	N/A
Micro-Coax	RF Cable	UFB311A-1-0787-50U50U	EMC-351	N/A
Micro-Coax	RF Cable	UTI Flex	RF-359	N/A
Micro-Coax	RF Cable	UTI Flex	RF-647	N/A
Micro-Coax	RF Cable	UTI Flex	RF-646	N/A
Huber & Suhner	RF Cable	Sucoflex 102A	RF-269	N/A
Rohde & Schwarz	Pre-Amplifier	TS-PR26	RF-199	11/29/2019
PCE	Climate Meter	PCE-THB 40	EMC-1206	9/28/2019
Madge Tech	THP Monitor	PRHTemp2000	EMC-838	3/5/2019*
Madge Tech	THP Monitor	PRHTemp2000	EMC-170	10/18/2019

Equipment used for AC Line Conducted Emissions Measurement				
Manufacturer	Description	Model #	Asset #	Calibration Due
Rohde & Schwarz	Analyzer/Receiver	ESR3	EMC-669	4/8/2019
Teseq	EUT LISN	NNB 051	EMC-056	6/7/2019
Teseq	EUT LISN	NNB 051	EMC-057	8/9/2019
Micro-Coax	Cable	UFA210A-1-1800-50U50U	EMC-367	N/A
ETS-Lindgren	TILE Profile	Version 7.3.1.27	EMC-985	N/A
Fluke	Multimeter	87V	EMC-192	10/18/2019
MadgeTech	Environmental Monitor	PRHTemp2000	EMC-680	11/16/2019
Chroma	AC Power Source	61602	EMC-055	N/A

Note: Items with Calibration Due date marked as N/A are characterized before use, where applicable.

Note*: Equipment was within calibration during test.

8 Test Site Description

8.1 Radiated Emissions Test Site

Radiated measurements are performed in a 3m semi-anechoic chamber, which meets NSA requirements for the frequency range of 30MHz to 1000MHz. For measurements above 1 GHz, absorbers are placed on the ground plane between the receiving antenna and the EUT to meet Site VSWR requirements in accordance with ANSI C63.4:2014. Measurements below 30 MHz were performed on a site demonstrating equivalence to an open field site per KDB 414788 D01.

8.1.1 Radiated Measurements in 9kHz- 30 MHz

The EUT is positioned as a floor standing device with center of the EUT aligned with the center of the turntable. A loop antenna is positioned at 3m from the EUT periphery at 1m height from the ground. The turntable is rotated 360 degrees to determine the highest emissions. This is repeated for two orientations of the measurement antenna- parallel and perpendicular. All possible orientations of the EUT were investigated for emissions and the landscape orientation was identified as the worst-case configuration.

8.1.2 Radiated Measurements in 30 MHz - 1000 MHz

The EUT is positioned as a floor standing device with center of the EUT aligned with the center of the turntable. A linearly polarized broadband antenna is positioned at 3m from the EUT periphery. The turntable is rotated 360 degrees, and the antenna height varied from 1m to 4m to determine the highest emissions. This is repeated for both horizontal and vertical polarizations of the measurement antenna. All possible orientations of the EUT were investigated for emissions and the landscape standing orientation was identified as the worst-case configuration.

8.1.3 Radiated Measurements above 1GHz

The EUT is positioned as a floor standing device with center of the EUT aligned with the center of the turntable. A linearly polarized antenna is positioned 3m from the EUT periphery. Guidelines in ANSI C63.10:2013 were followed with respect to maximizing the emissions. The turntable is rotated 360 degrees, and the antenna height varied from 1m to 4m to determine the highest emissions. This is repeated for both horizontal and vertical polarizations of the measurement antenna. Measurements above 18GHz were performed at a 3m distance. Near field scanning is performed to identify suspect frequencies above 1GHz.

8.2 Antenna port conducted measurements

All antenna port conducted measurements were performed on a bench-top setup consisting of a spectrum analyzer, power meter (as necessary), splitters/combiners (as necessary), attenuators, and pre-characterized RF cables.

The correction factors between the EUT and the spectrum analyzer were added internally in the analyzer settings, where applicable. The plots displayed take these correction factors into account.

8.3 Test Setup Diagrams

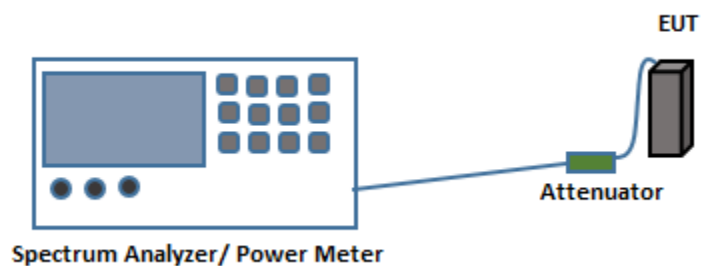


Fig.1. Test Setup for Antenna port conducted measurements

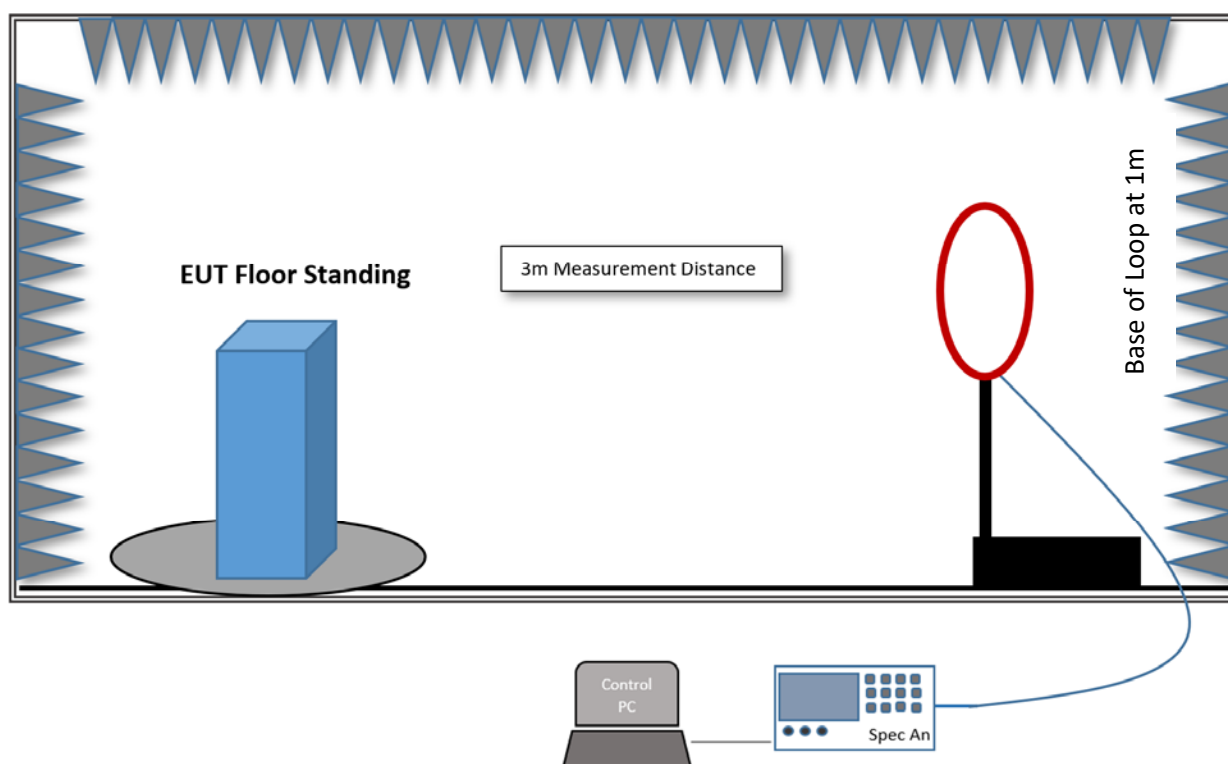


Fig.2. Test Setup for Radiated measurements in 9kHz - 30MHz Range

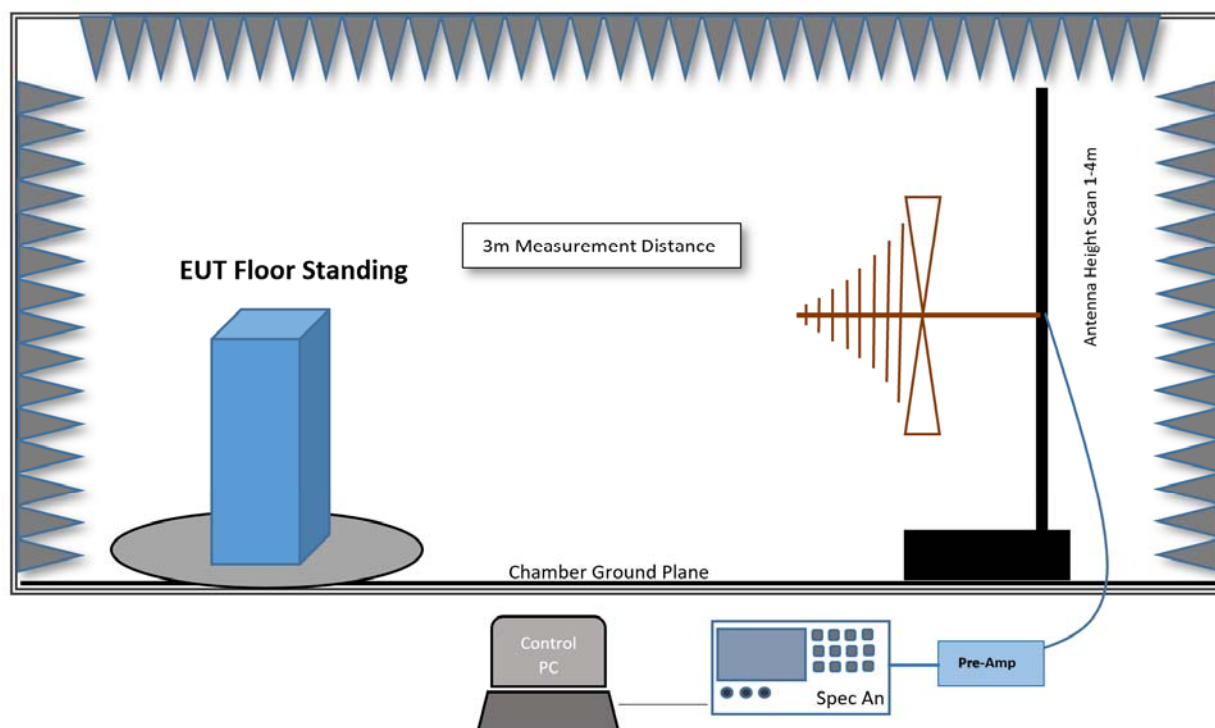


Fig.3. Test Setup for Radiated measurements in 30MHz- 1GHz Range

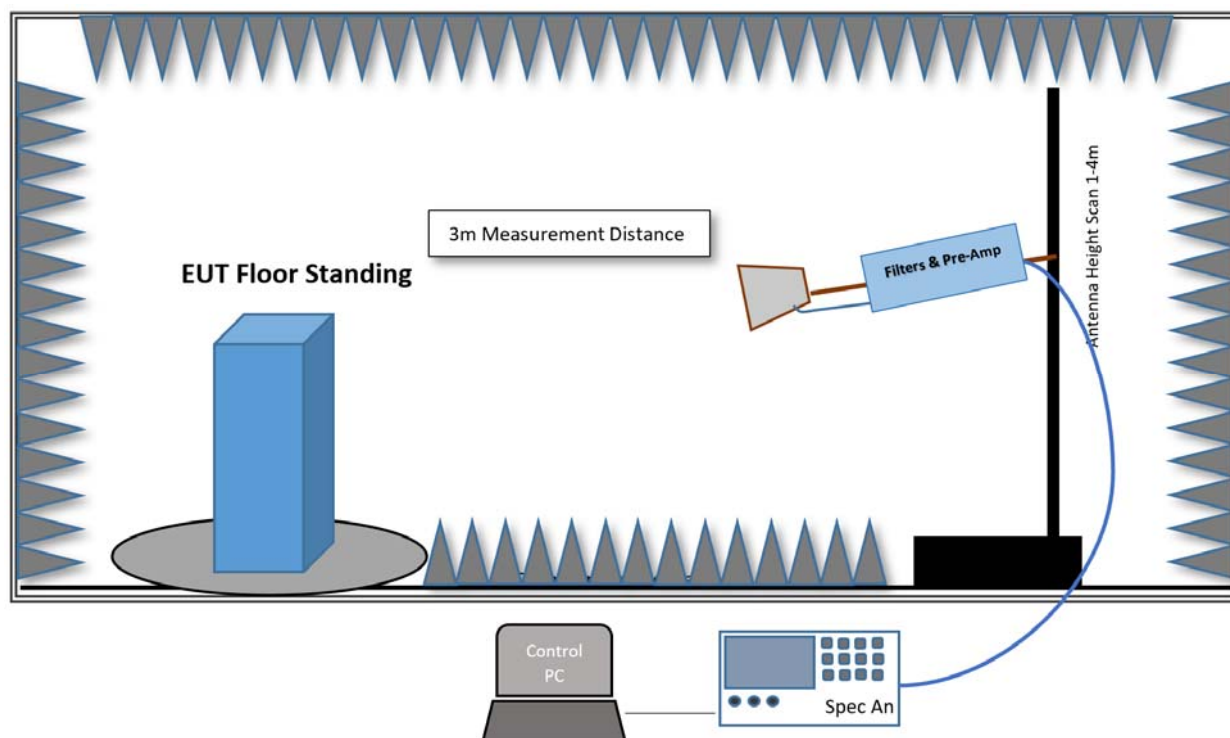


Fig.4. Test Setup for Radiated measurements in 1GHz- 18GHz Range

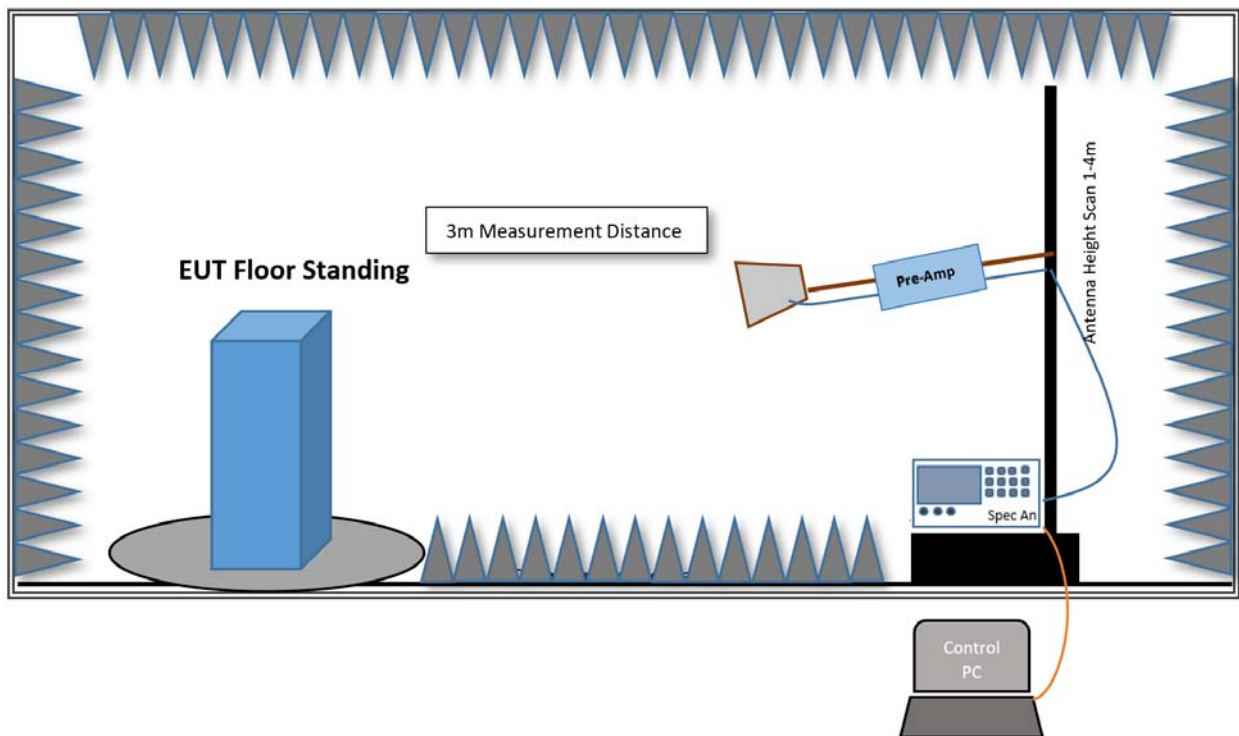


Fig.5. Test Setup for Radiated measurements >18GHz

9 Test Results- Conducted

9.1 Duty Cycle

9.1.1 Test Requirement:

Reporting and measurement purposes only.

9.1.2 Test Method:

Measurements were performed according to the procedure defined in ANSI C63.10: 2013.

Spectrum Analyzer Settings:

RBW \geq Occupied Bandwidth if possible; otherwise, set RBW to the largest available value

VBW \geq RBW \geq Signal Period

Detector = Peak

Span = 0 Hz

Sweep points > 100

9.1.3 Limits:

Reporting and measurement purposes only.

9.1.4 Test Results:

Frequency (MHz)	Band width (MHz)	On Time (ms)	Period (ms)	Duty Cycle (%)	Correction Factor (dB)
2440	2	0.209	0.747	27.979	5.532
2402	1	0.390	0.625	62.4	2.048

9.1.5 Test Data:

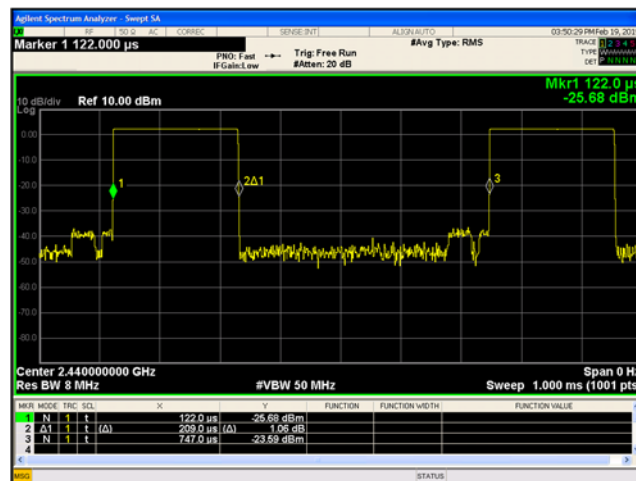


Figure 9-1 Duty Cycle 2440MHz (Ch.19) 2MHz BW

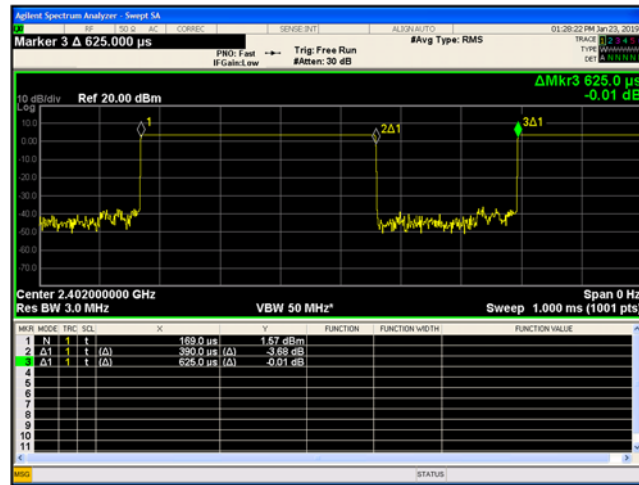


Figure 9-2 Duty Cycle 2402MHz (Ch.0) 1MHz BW

9.2 6-dB Bandwidth

9.2.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (a)(2)

ISED RSS-247 [5.2]

9.2.2 Test Method:

Measurements were performed according to the procedure defined in KDB 558074- Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 V05 and ANSI C63.10: 2013.

Spectrum Analyzer settings:

RBW= 100 kHz

VBW \geq 3 RBW= 300 kHz.

Trace Mode= Peak Detector (Max Hold)

Sweep time= Auto Couple

The in-built functionality of the Spectrum Analyzer is used to measure the 6-dB bandwidth.

9.2.3 Limits:

The 6-dB bandwidth shall be at least 500 kHz

9.2.4 Test Results:

Frequency (MHz)	Bandwidth (MHz)	Channel No.	6dB Bandwidth (kHz)	Limit (kHz)	Result
2402	2	0	1139	>500	Pass
2440	2	19	1133	>500	Pass
2480	2	39	1141	>500	Pass
2402	1	0	643.9	>500	Pass
2440	1	19	641.9	>500	Pass
2480	1	39	649	>500	Pass

9.2.5 Test Data:

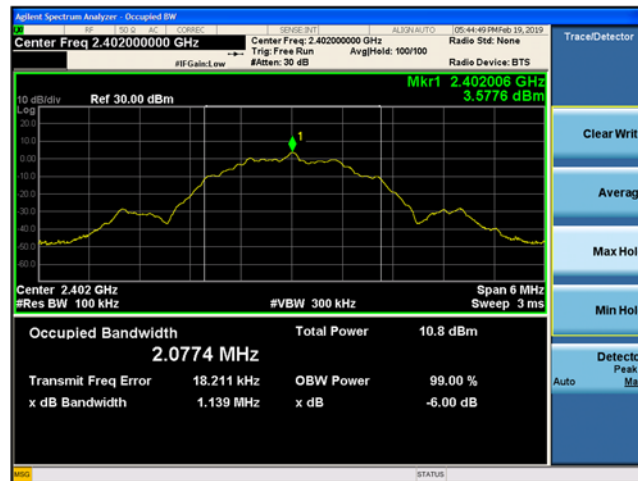


Figure 9-3 6dB Bandwidth (Ch. 0) 2MHz BW



Figure 9-4 6dB Bandwidth (Ch. 19) 2MHz BW



Figure 9-5 6dB Bandwidth (Ch. 39) 2MHz BW

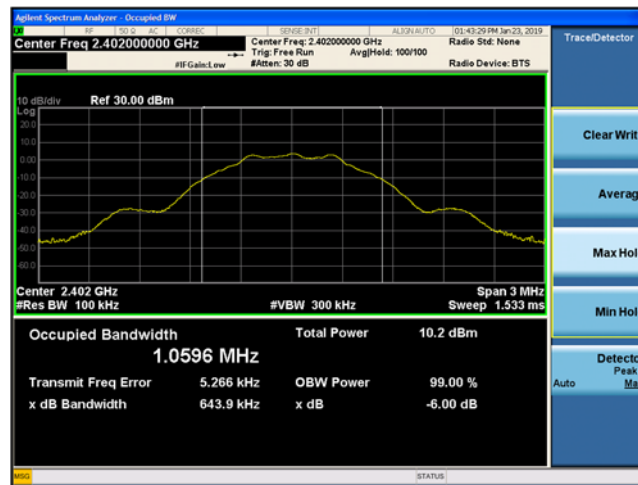


Figure 9-6 6dB Bandwidth (Ch.0) 1MHz BW

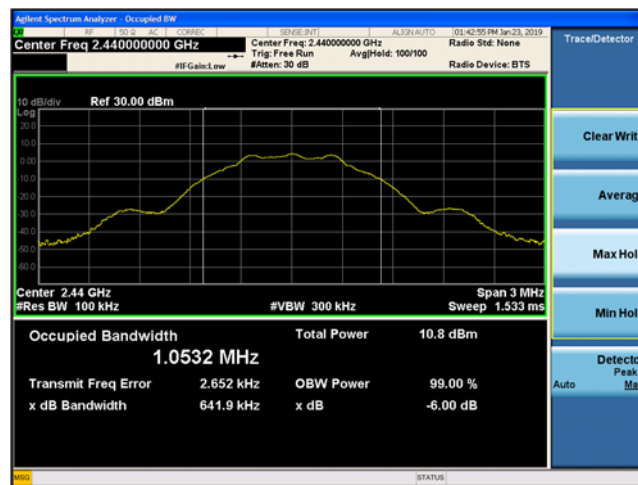


Figure 9-7 6dB Bandwidth (Ch. 19) 1MHz BW



Figure 9-8 6dB Bandwidth (Ch. 39) 1MHz BW

9.3 99% Occupied Bandwidth

9.3.1 Test Requirement:

The 99% Occupied Channel Bandwidth is the bandwidth that contains 99 % of the power of the signal. This test is performed for reporting and measurement purposes only.

9.3.2 Test Method:

Measurements are performed according to ANSI C63.10: 2013.

Spectrum Analyzer settings:

Set analyzer center frequency to the nominal EUT channel frequency

Span is set to between 1.5 and 5.0 times the DTS bandwidth

RBW: 1% to 5% of the OBW= 30 kHz

VBW: ≥ 3 RBW= 100 kHz

Detector = Peak

Sweep time = Auto Couple

Trace mode = max hold

Use the 99% power bandwidth function of the instrument.

9.3.3 Limits:

For reporting purpose only.

9.3.4 Test Results:

Frequency (MHz)	Bandwidth (MHz)	Channel No.	99% Bandwidth (MHz)
2402	2	0	2.08
2440	2	19	2.07
2480	2	39	2.07
2402	1	0	1.04
2440	1	19	1.04
2480	1	39	1.04

9.3.5 Test Data:

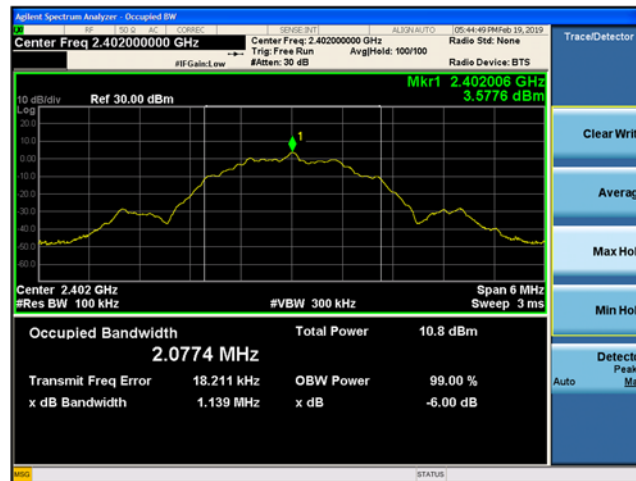


Figure 9-9 99% Bandwidth (Ch. 0) 2MHz BW



Figure 9-10 99% Bandwidth (Ch. 19) 2MHz BW

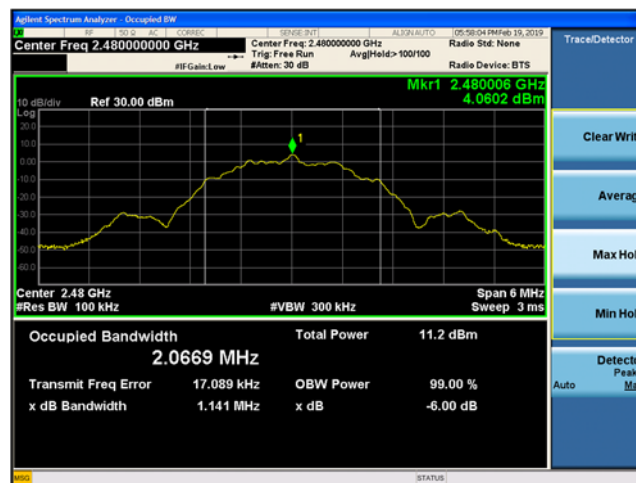


Figure 9-11 99% Bandwidth (Ch. 39) 2MHz BW



Figure 9-12 99% Bandwidth (Ch. 0) 1MHz BW

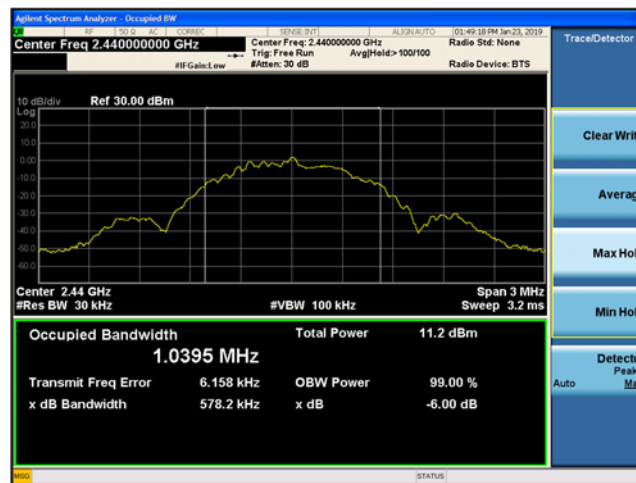


Figure 9-13 99% Bandwidth (Ch. 19) 1MHz BW



Figure 9-14 99% Bandwidth (Ch. 39) 1MHz BW

9.4 Output Power

9.4.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (b)(3)

ISED RSS-247 [5.4]

9.4.2 Test Method:

Measurements were performed according to the procedure defined in KDB 558074 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 V05 and ANSI C63.10: 2013.

Spectrum Analyzer settings:

Peak Power:

RBW= 1 MHz

VBW= 3 MHz

Trace Mode= Peak Detector (Max Hold)

Sweep time= Auto Couple

Span= 3 MHz

9.4.3 Limits:

15.247: The maximum permissible peak output power is 30dBm (1 W)

RSS-247: The maximum peak conducted output power shall not exceed 30dBm (1 W) and the maximum radiated output power shall not exceed 36dBm (4 W) EIRP.

9.4.4 Test Results:

Frequency (MHz)	Bandwidth (MHz)	Channel No.	Cond. Peak Power (dBm)	Cond. Peak Power (W)	Cond. Peak Limit (dBm)	Margin (dB)	Result
2402	2	0	3.709	2.349	30	-26.291	Pass
2440	2	19	4.308	2.696	30	-25.692	Pass
2480	2	39	4.196	2.628	30	-25.804	Pass
2402	1	0	3.814	2.407	30	-26.186	Pass
2440	1	19	4.373	2.737	30	-25.627	Pass
2480	1	39	4.187	2.622	30	-25.813	Pass

Frequency (MHz)	Bandwidth (MHz)	Channel No.	Cond. Peak Power (dBm)	Max Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
2402	2	0	3.709	3.6	7.309	36	-28.691	Pass
2440	2	19	4.308	3.6	7.098	36	-28.092	Pass
2480	2	39	4.196	3.6	7.796	36	-28.204	Pass
2402	1	0	3.814	3.6	7.414	36	-28.586	Pass
2440	1	19	4.373	3.6	7.973	36	-28.027	Pass
2480	1	39	4.187	3.6	7.787	36	-28.213	Pass

9.4.5 Test Data:

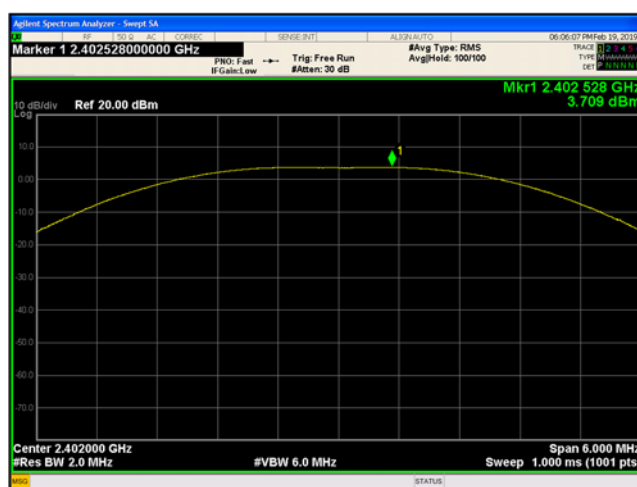


Figure 9-15 Peak Power (Ch. 0) 2MHz BW

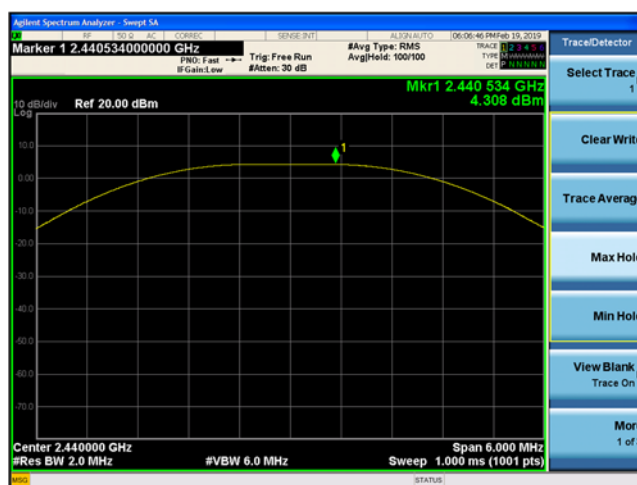


Figure 9-16 Peak Power (Ch. 19) 2MHz BW

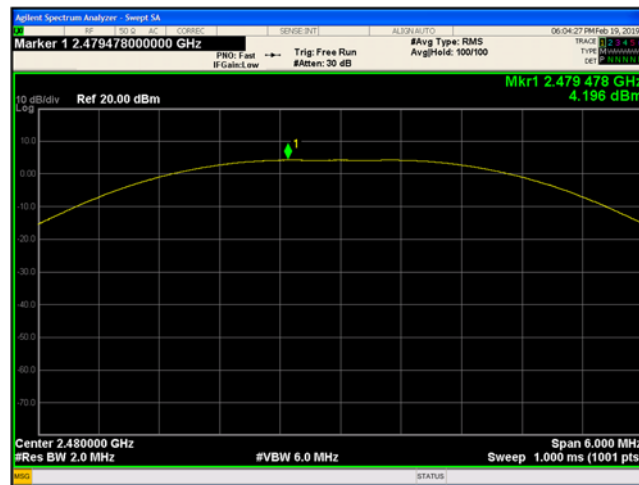


Figure 9-2 Peak Power (Ch. 39) 2MHz BW

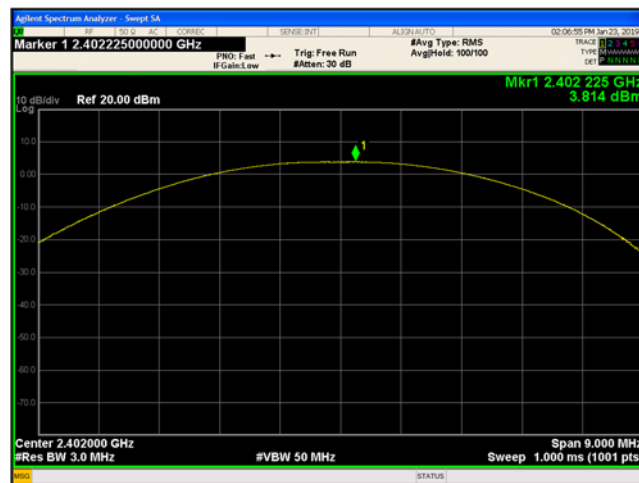


Figure 9-3 Peak Power (Ch. 0) 1MHz BW

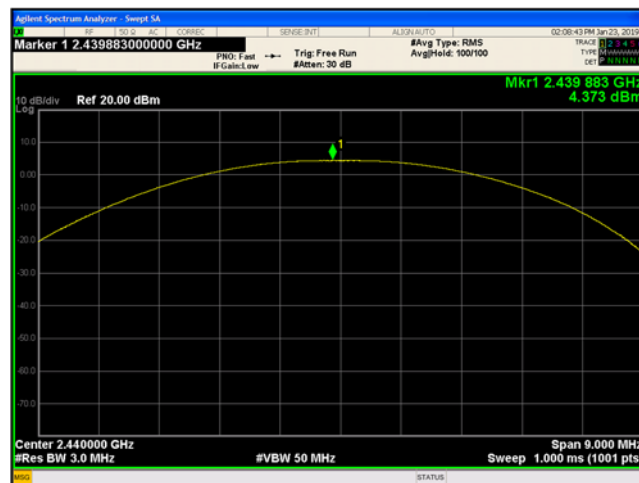


Figure 9-4 Peak Power (Ch. 19) 1MHz BW

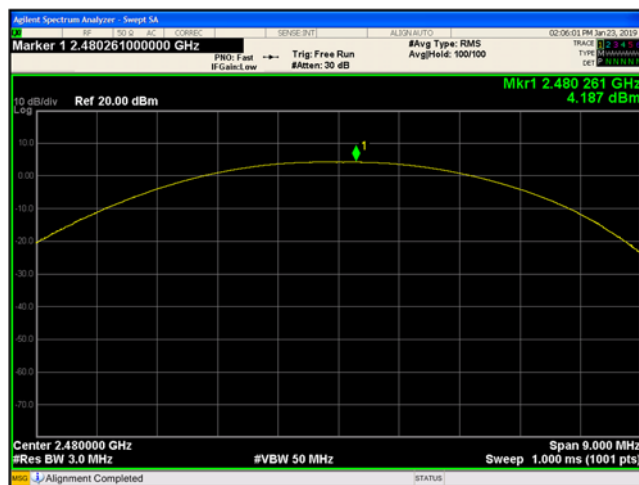


Figure 9-5 Peak Power (Ch. 39) 1MHz BW

9.5 Peak Power Density

9.5.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (e)

ISED RSS-247 [5.2]

9.5.2 Test Method:

Measurements were performed according to the procedure defined in KDB 558074 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 V05 and ANSI C63.10: 2013.

Spectrum Analyzer settings:

RBW= 100 kHz

VBW= 300 kHz

Trace Mode= Peak Detector (Max Hold)

Sweep time= Auto Couple

Use the peak marker function to determine the maximum amplitude level within the RBW

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

9.5.3 Limits:

The maximum permissible power density is 8dBm/3kHz.

9.5.4 Test Results:

Frequency (MHz)	Bandwidth (MHz)	Channel No.	Power Spectral Density (dBm/100kHz)	Limit (dBm/3kHz)	Result
2402	2	0	3.554	8	Pass
2440	2	19	4.172	8	Pass
2480	2	39	4.020	8	Pass
2402	1	0	3.615	8	Pass
2440	1	19	4.191	8	Pass
2480	1	39	4.019	8	Pass

The test data shows that the EUT passes the requirement using 100kHz RBW setting and hence will meet the requirement for 3kHz BW.

9.5.5 Test Data:

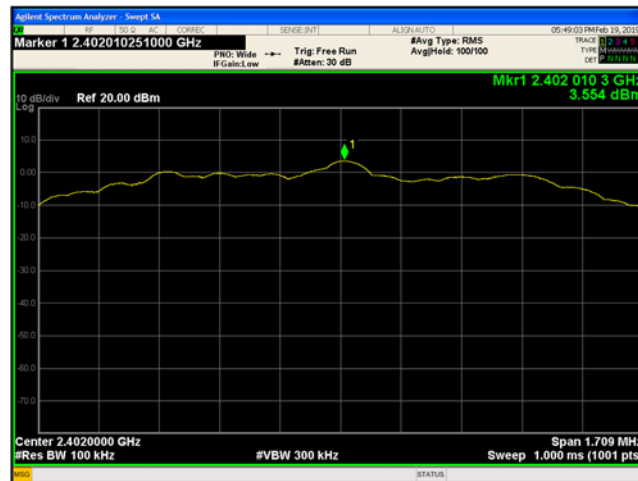


Figure 9-6 Power Spectral Density (Ch. 0) 2MHz BW

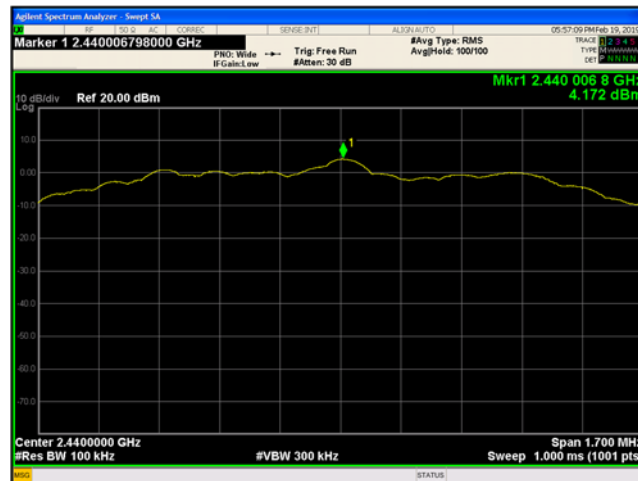


Figure 9-7 Power Spectral Density (Ch. 19) 2MHz BW

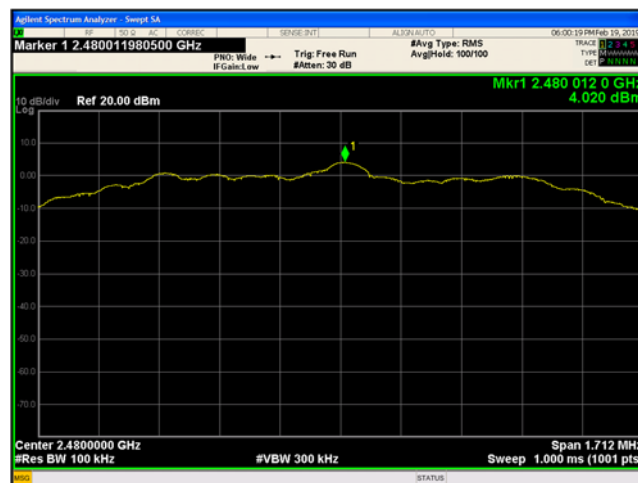


Figure 9-8 Power Spectral Density (Ch. 39) 2MHz BW



Figure 9-24 Power Spectral Density (Ch. 0) 1MHz BW

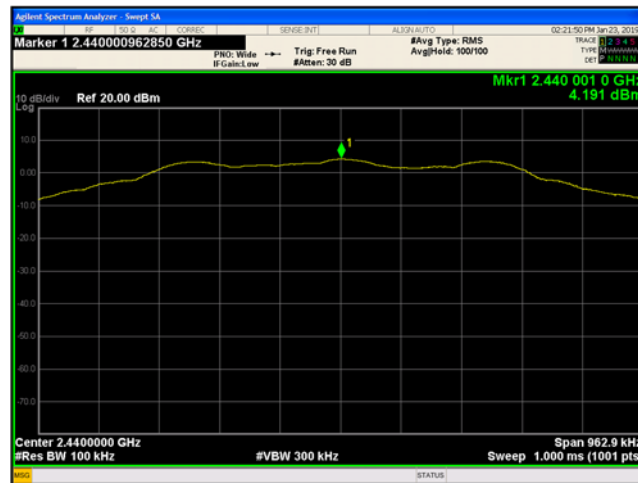


Figure 9-25 Power Spectral Density (Ch. 19) 1MHz BW

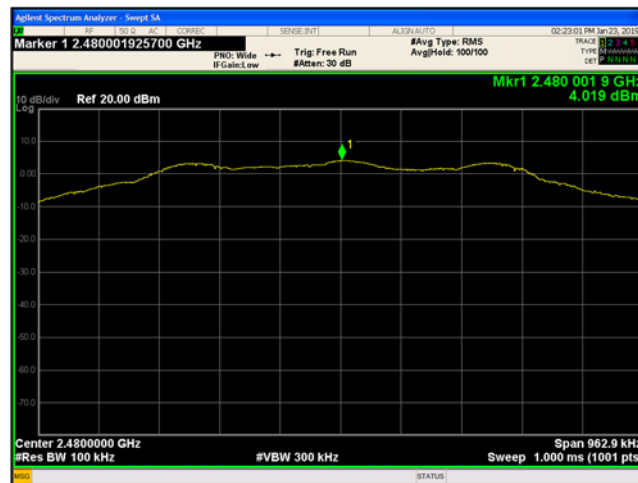


Figure 9-26 Power Spectral Density (Ch. 39) 1MHz BW

9.6 Conducted Spurious Emissions

9.6.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (d)

ISED RSS-247 [5.5]

9.6.2 Test Method:

Measurements were performed according to the procedure defined in KDB 558074 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 V05 and ANSI C63.10: 2013.

Spectrum Analyzer settings:

Identification of Reference Level:

RBW= 100 kHz

VBW $\geq 3 \times$ RBW

Trace Mode= Peak Detector (Max Hold)

Sweep time= Auto Couple

Span >1.5 times DTS Bandwidth

Peak Marker function to determine the max PSD level.

Conducted Spurious Emissions:

RBW= 1 MHz

VBW $\geq 3 \times$ RBW = 3 MHz

Trace Mode = Peak Detector (Max Hold)

Sweep time = Auto Couple

Span= 30 MHz- 12 GHz; 12 GHz – 25 GHz

Sweep Points = 30000

9.6.3 Limits:

All spurious emissions at least 20 dBc.

9.6.4 Test Result:

Channel	Bandwidth (MHz)	Carrier Frequency (MHz)	Emission Frequency (MHz)	Emissions Amplitude (dBm/MHz)	Limit (dBm)	Margin (dB)	Result
0	2	2402	11930.20	-39.90	-16.45	-23.45	Pass
0	2	2402	24932.00	-24.15	-16.45	-7.70	Pass
19	2	2440	11883.10	-39.86	-15.83	-24.03	Pass
19	2	2440	24965.30	-23.65	15.83	-7.82	Pass
39	2	2480	11150.10	-30.78	-15.98	-14.80	Pass
39	2	2480	24977.50	-23.68	-15.98	-7.70	Pass
0	1	2402	2411.30	-39.27	-16.39	-22.88	Pass
0	1	2402	24265.00	-23.81	-16.39	-7.42	Pass
19	1	2440	2449.60	-39.27	-15.81	-23.46	Pass
19	1	2440	24853.10	-24.30	-15.81	-8.49	Pass
39	1	2480	2489.50	-38.15	-15.98	-22.17	Pass
39	1	2480	24800.70	-24.59	-15.98	-8.61	Pass

9.6.5

9.6.6 Test Data:

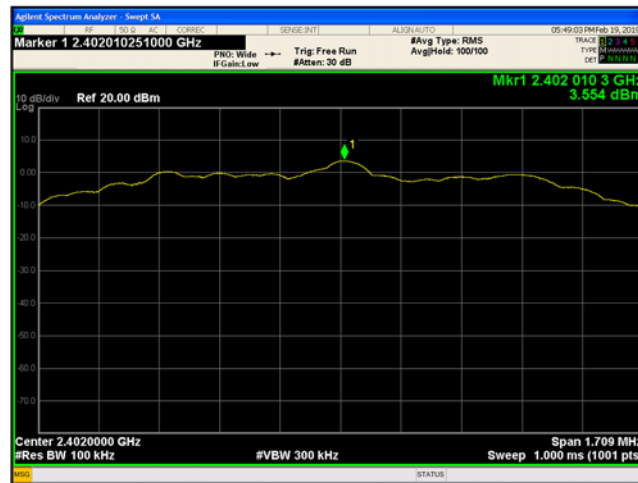


Figure 9-27 Reference Level Measurement (Ch.0) 2MHz BW

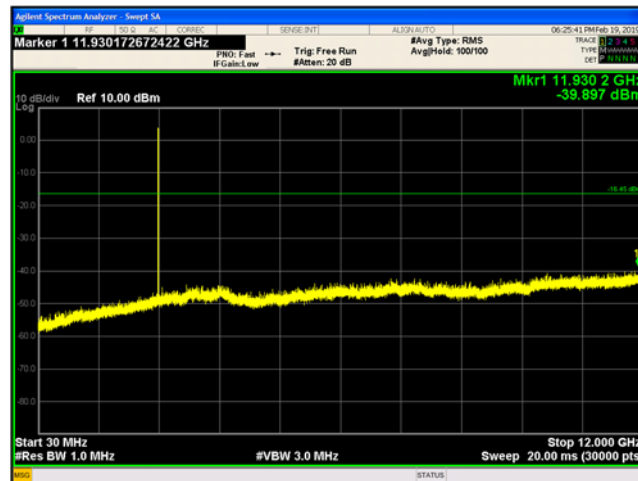


Figure 9-28 Conducted Spurious Emissions 30-12000 MHz (Ch. 0) 2MHz BW

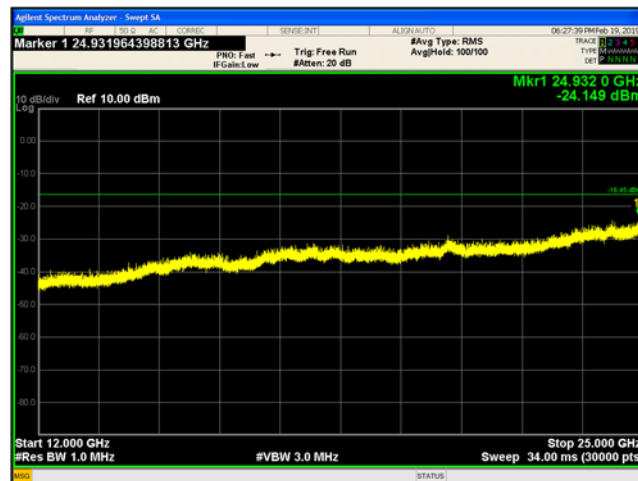


Figure 9-29 Conducted Spurious Emissions 12-25 GHz (Ch.0) 2MHz BW

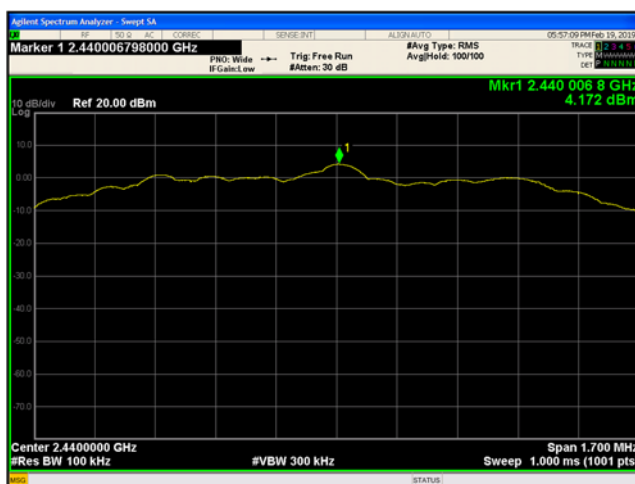


Figure 9-30 Reference Level Measurement (Ch.19) 2MHz BW

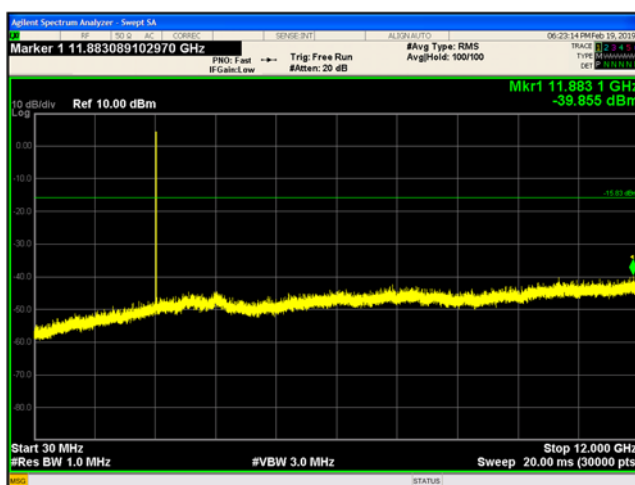


Figure 9-31 Conducted Spurious Emissions 30-12000 MHz (Ch. 19) 2MHz BW

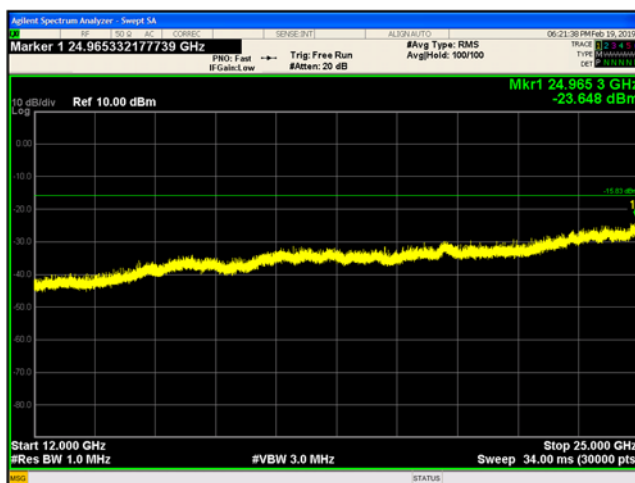


Figure 9-32 Conducted Spurious Emissions 12-25 GHz (Ch. 19) 2MHz BW

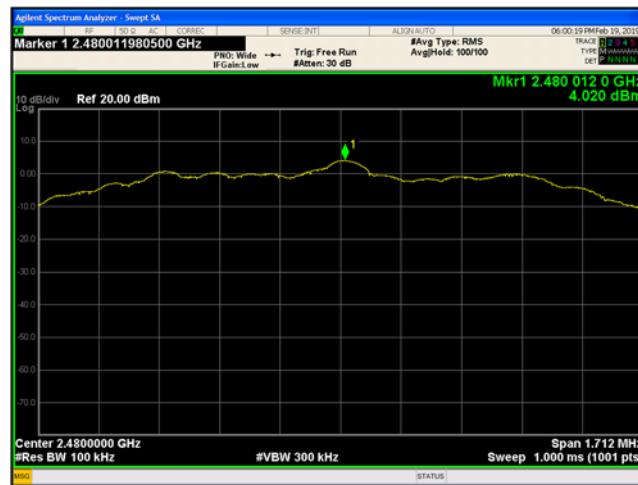


Figure 9-33 Reference Level Measurement (Ch.39) 2MHz BW

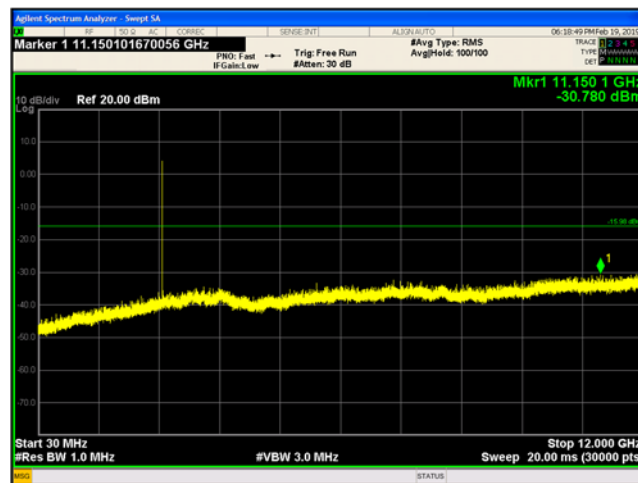


Figure 9-34 Conducted Spurious Emissions 30-12000 MHz (Ch.39) 2MHz BW

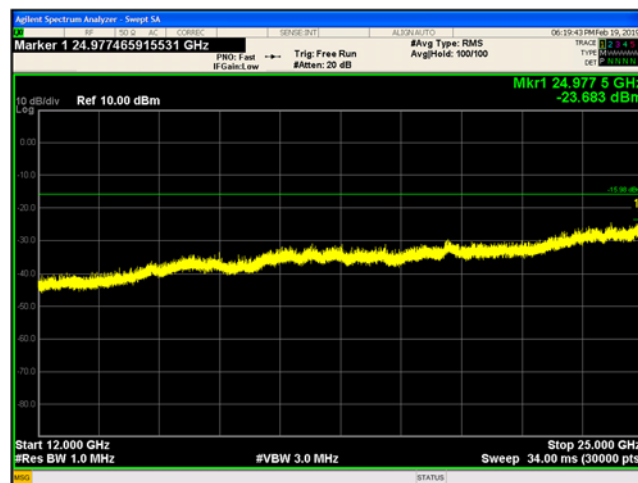


Figure 9-35 Conducted Spurious Emissions 12-25GHz (Ch.39) 2MHz BW

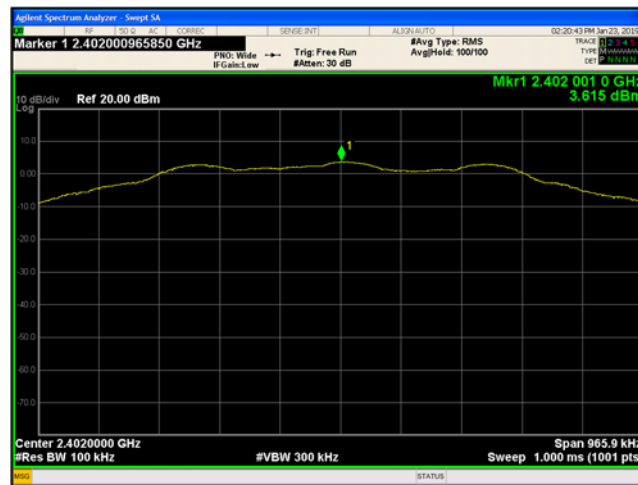


Figure 9-36 Reference Level Measurement (Ch.0) 1MHz BW

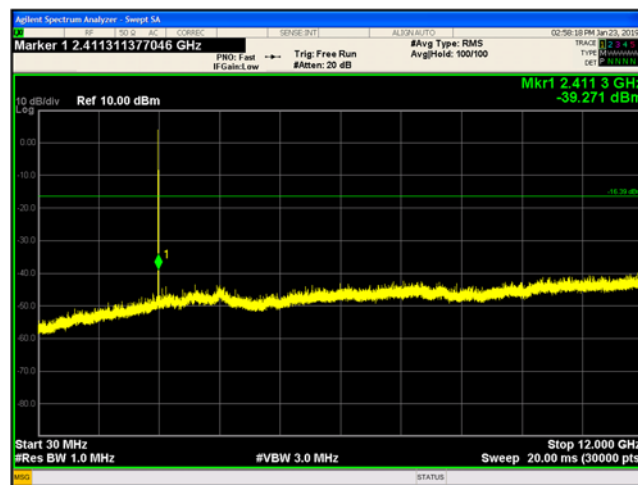


Figure 9-37 Conducted Spurious Emissions 30-12000 MHz (Ch. 0) 1MHz BW

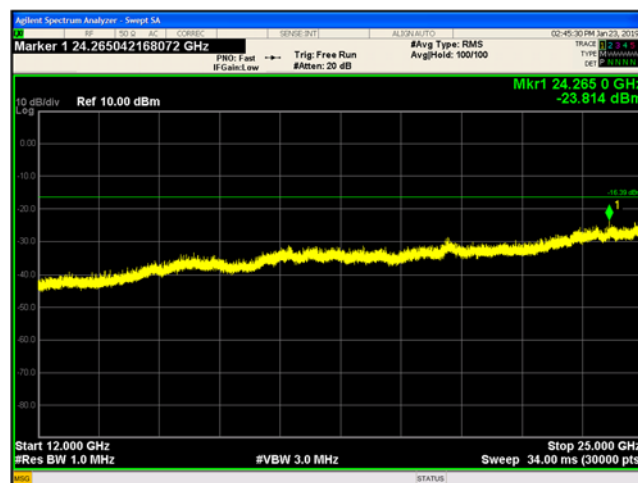


Figure 9-38 Conducted Spurious Emissions 12-25 GHz (Ch.0) 1MHz BW

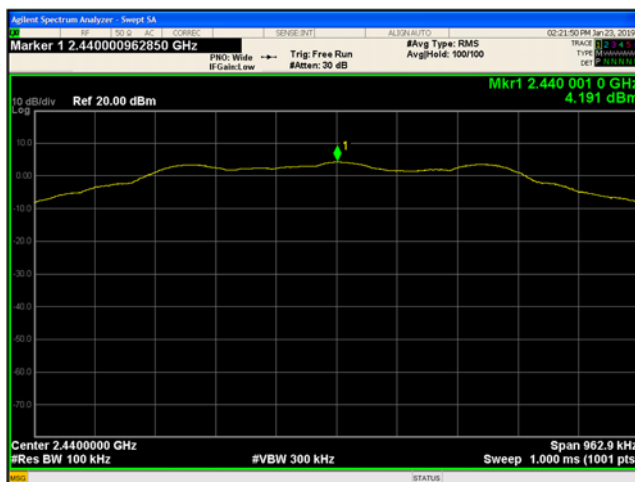


Figure 9-39 Reference Level Measurement (Ch.19) 1MHz BW

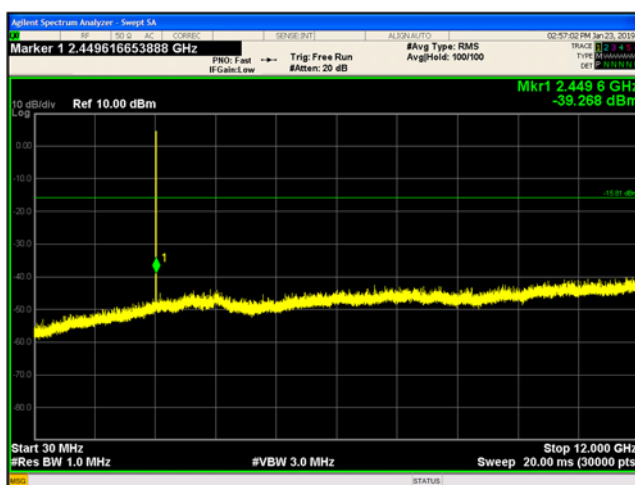


Figure 9-40 Conducted Spurious Emissions 30-12000 MHz (Ch. 19) 1MHz BW

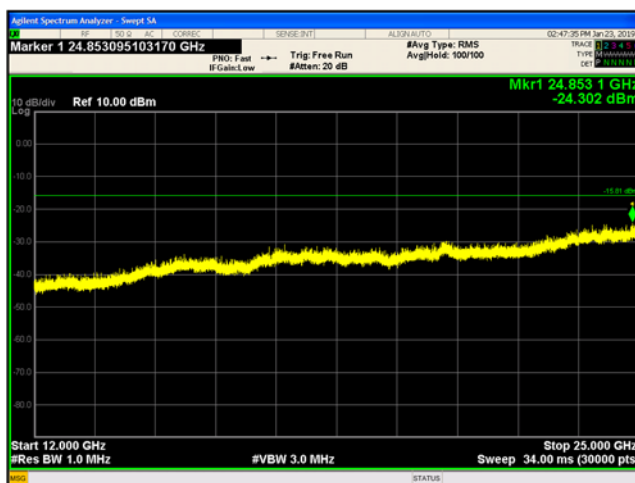


Figure 9-41 Conducted Spurious Emissions 12-25 GHz (Ch. 19) 1MHz BW

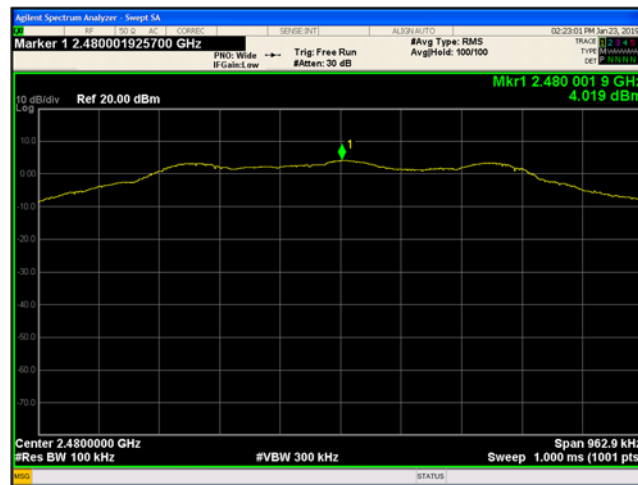


Figure 9-42 Reference Level Measurement (Ch.39) 1MHz BW

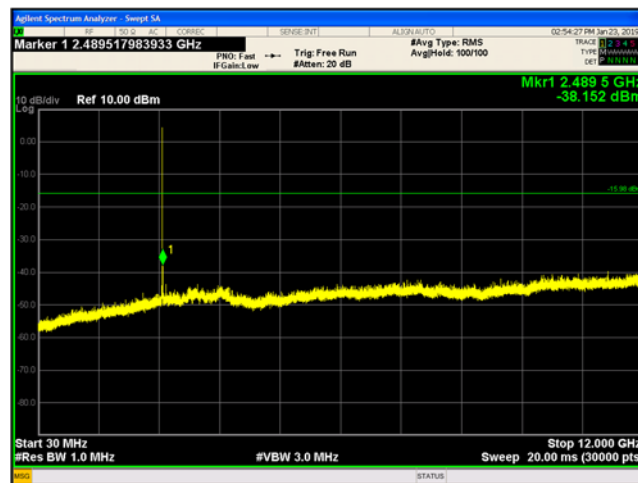


Figure 9-43 Conducted Spurious Emissions 30-12000 MHz (Ch.39) 1MHz BW

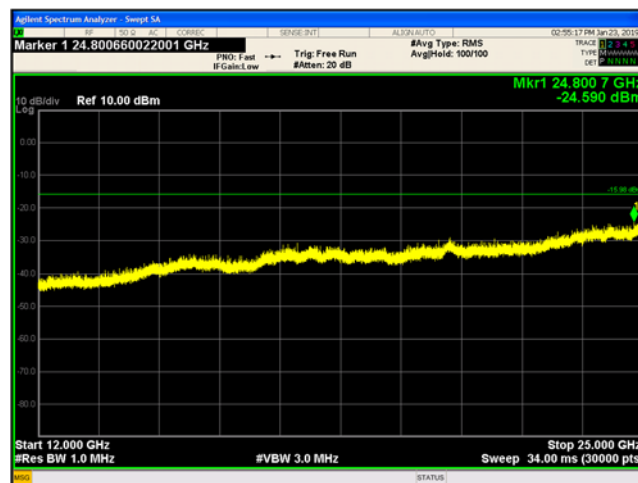


Figure 9-44 Conducted Spurious Emissions 30-12000 MHz (Ch.39) 1MHz BW

9.7 Conducted Band Edge Emissions

9.7.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (d)

ISED RSS-247 [5.5]

9.7.2 Test Method:

Measurements were performed according to the procedure defined in KDB 558074 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 V05 and ANSI C63.10: 2013.

Spectrum analyzer settings:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation

RBW = 100 kHz

VBW = 300 kHz

Sweep = Auto Couple

Detector function = Peak

Trace = Max Hold

The trace was allowed to stabilize. The marker was set on the emission at the band edge, or on the highest modulation product outside of the band if this level is greater than that at the band edge. The delta marker function was set, and the marker-to-peak function moved to the peak of the in-band emission.

9.7.3 Limits:

All spurious emissions at least 20dBc.

9.7.4 Test Result:

Pass.

9.7.5 Test Data:

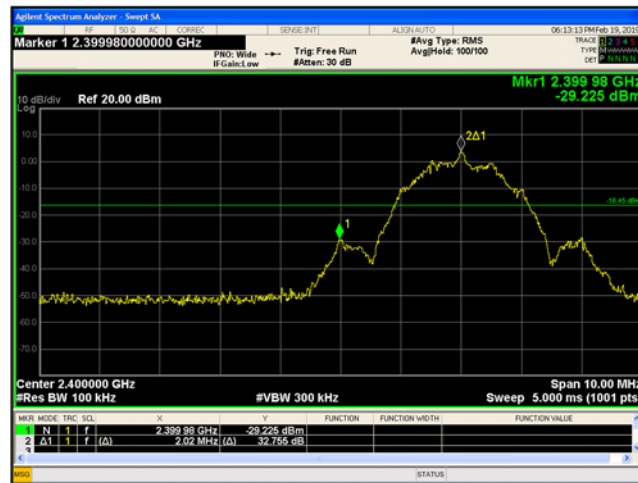


Figure 9-45 Conducted-Low Band Edge (Ch. 0) 2MHz BW

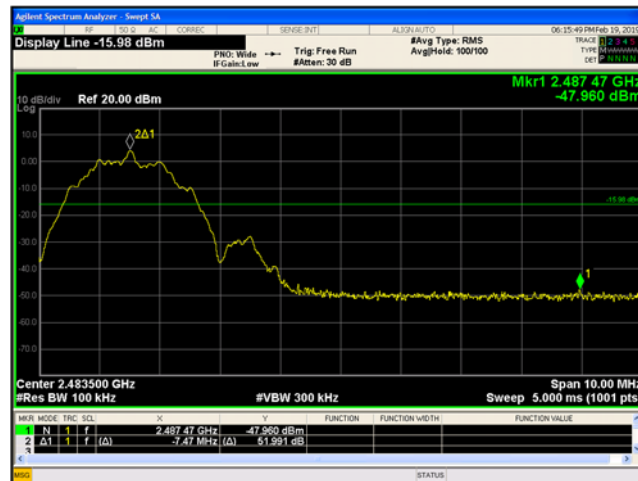


Figure 9-46 Conducted- High Band Edge (Ch. 39) 2MHz BW

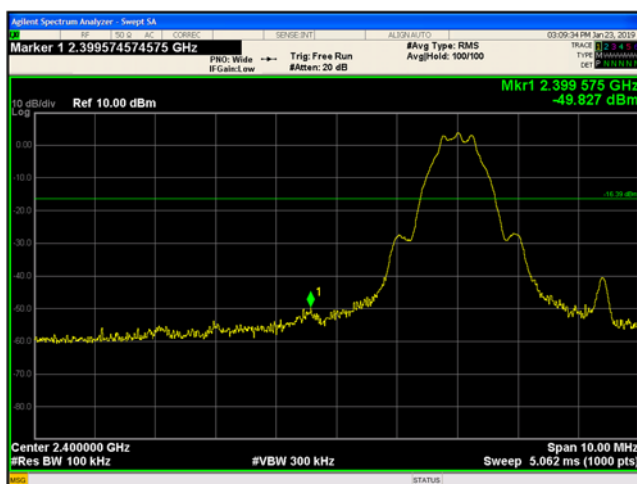


Figure 9-47 Conducted-Low Band Edge (Ch. 0) 1MHz BW

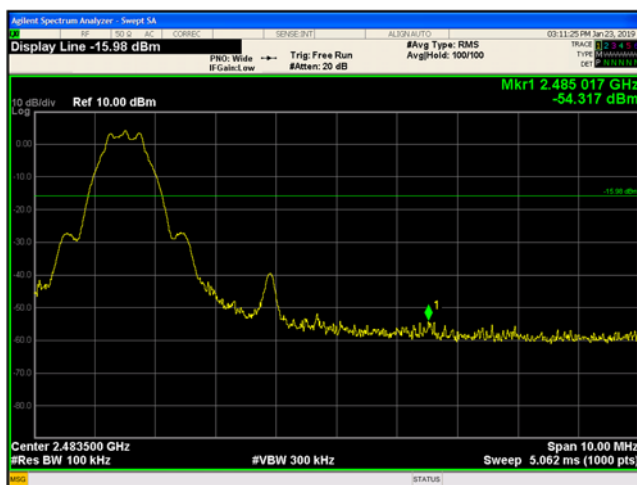


Figure 9-48 Conducted-Low Band Edge (Ch. 39) 1MHz BW

9.8 Radiated Spurious and Band Edge Emissions

9.8.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (d)

ISED RSS-247 [5.5] and RSS GEN [8.9]

9.8.2 Test Method:

Measurements were performed according to the procedure defined in KDB 558074 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 V05 and ANSI C63.10: 2013.

Radiated spurious measurements are made from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter. The limit for radiated spurious emissions is per 15.209 and RSS-247 [5.5]. Additionally, emissions found in the restricted bands listed in 15.205 and RSS-Gen were tested for compliance per limits in 15.209 and RSS-Gen.

The EUT was tested near the low, middle and high channels of operation. Guidelines in ANSI C63.10:2013 were followed with respect to maximizing the emissions.

A pre-amp and a high pass filter were required for this test, to provide the measuring system with sufficient sensitivity. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength.

Both horizontal and vertical antenna polarizations were investigated. Worst-case maximized data for both polarizations is shown in this test report.

Radiated Spurious Emissions

Spectrum Analyzer Settings:

30 MHz- 1 GHz:

RBW = 120 kHz

VBW $\geq 3 \times$ RBW

Trace Mode: Peak Detector (Max Hold). Final measurements performed using QP Detector.

Span= 30 MHz - 1 GHz

Sweep time= Auto

Sweep points $\geq 2 \times$ Span/RBW

Above 1 GHz:

RBW= 1 MHz

VBW= 3 MHz

Trace Mode: Peak Detector (Max Hold) and RMS Average Detector (Max Hold)

Span= 1 - 18 GHz and 18 - 26.5 GHz.

Sweep time= Auto

Sweep points $\geq 2 \times$ Span/RBW

Final Measurements above 1 GHz**Peak Measurements****Spectrum Analyzer Settings:**

RBW= 1 MHz

VBW= 3 MHz

Trace Mode: Peak Detector (Max Hold)

Span= wide enough to encompass the emission

Sweep Points $\geq 2 \times \text{Span}/\text{RBW}$

Sweep Time = Auto

RMS Average Measurements**Spectrum Analyzer Settings:**

RBW = 1 MHz

VBW $\geq 3 \times \text{RBW}$

Detector = RMS

Span = wide enough to encompass the emission

Sweep points $\geq 2 \times \text{Span}/\text{RBW}$

Sweep time = auto

Trace = Average at least 100 traces

Trace Averaging Type= power (RMS)

The duty cycle correction factor is added to the emission level.

Restricted Band-Edge Emissions**Peak Measurements****Spectrum Analyzer Settings:**

RBW = 1 MHz

VBW = 3 MHz

Trace Mode: Peak Detector (Max Hold)

Span = 2310 – 2500 MHz

Sweep Points = 401

Sweep Time = Auto

Average Measurements**Spectrum Analyzer Settings:**

RBW= 1 MHz

VBW= 3 kHz

VBW Mode = Linear

Trace Mode: RMS (Average)

Span= 2310 – 2500 MHz

Sweep Points = 401

Sweep Time = Auto

Sweep Count = 150

Sample Calculation:

Field Strength Level: Amplitude (Analyzer level) + AFCL (Antenna Factor and Cable losses) –
Amplifier Gain = 50dBuV + 33 dB – 25 dB = 58dBuV/m

9.8.3 Limits:

Frequency (MHz)	Field Strength ($\mu\text{V/m}$)	Measurement Distance (meters)	Corrected Field Strength for 3m measurement distance (dB $\mu\text{V/m}$)
0.009-0.490	2400/F (kHz)	300	48.5 - 13.8
0.490-1.705	24000/F (kHz)	30	33.8- 23.0
1.705-30	30	30	29.5
30-88	100	3	40
88-216	150	3	43.5
216-960	200	3	46
960-1000	500	3	54
Above 1000 (Restricted Frequency Bands)	500	3	54 (Average) 74 (Peak)

9.8.4 Test Result:

Pass.

9.8.5 Test Data:

9.8.5.1 Radiated Restricted Band-edge emissions

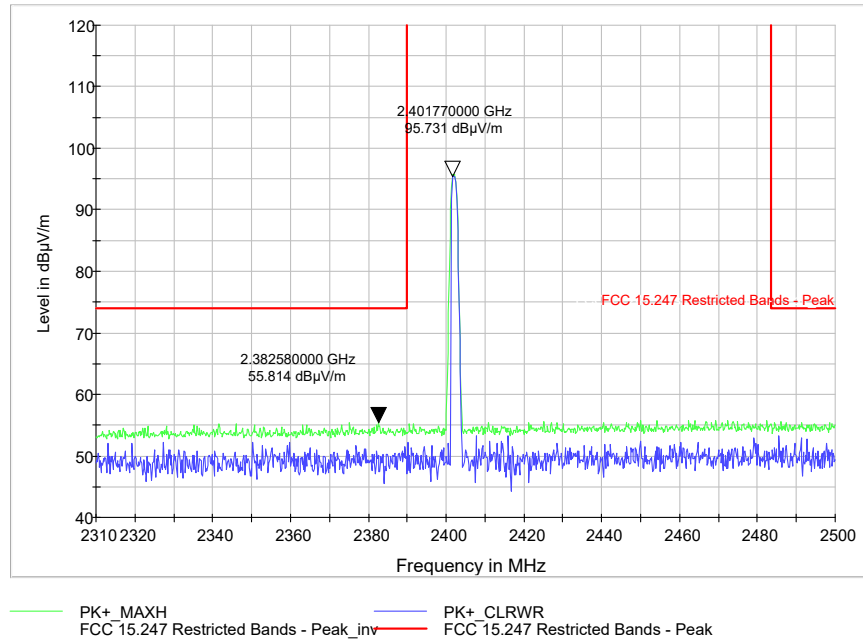
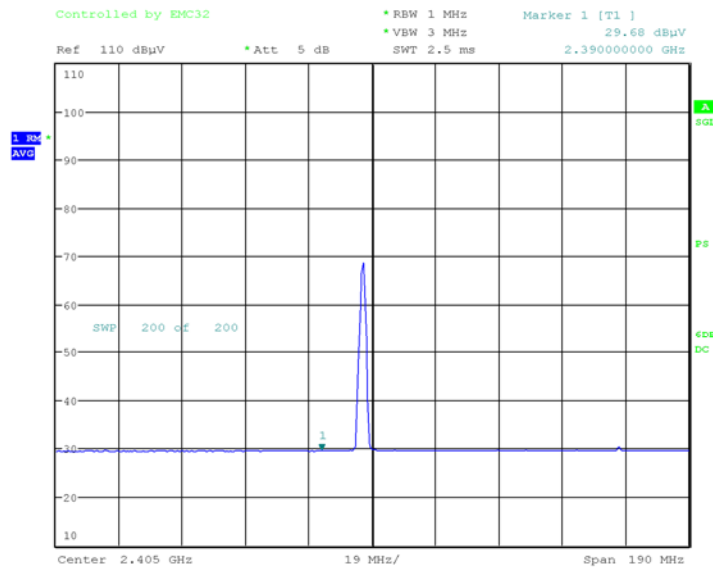


Figure 9-49 Radiated Restricted Band Edge (Ch. 0) Peak



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Figure 9-50 Radiated Restricted Band Edge (Ch. 0) Average

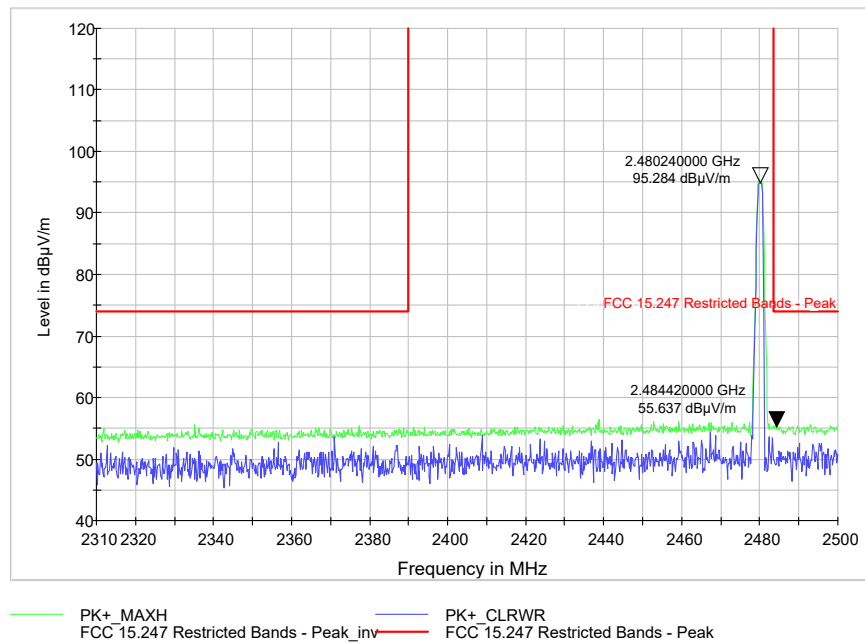
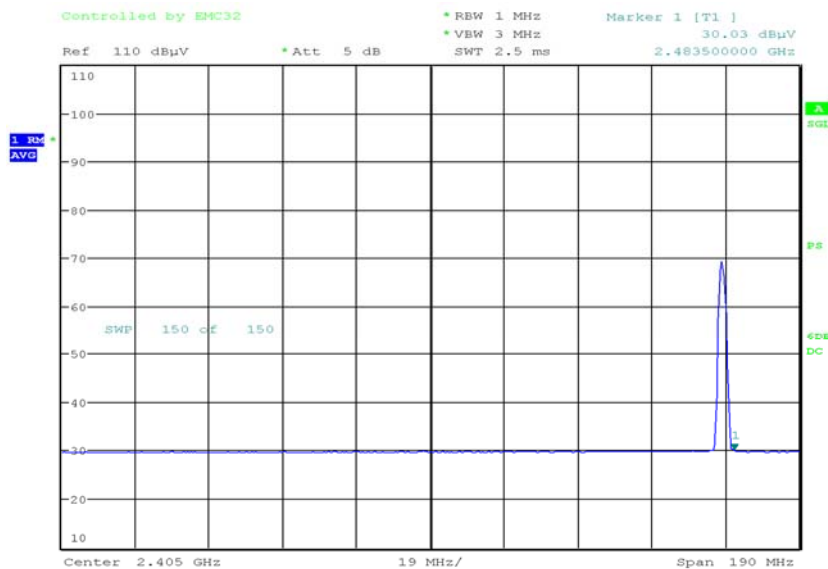


Figure 9-51 Radiated Restricted Band Edge (Ch. 39) Peak



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Figure 9-52 Radiated Restricted Band Edge (Ch. 39) Average

Band edge Average Data							
Carrier Frequency (MHz)	Spurious Frequency (MHz)	Raw Avg. Amplitude (dBμV)	System Correction Factor (dB)	Duty cycle correction factor(dB)	Corrected Avg. Field Strength (dBμV/m)	Average Limit (dBμV/m)	Margin (dB)
2402	2390.0	29.68	12.8	2.11	44.59	54	-9.41
2480	2483.5	30.03	13.2	2.113	45.34	54	-8.66

9.8.5.2 Emissions in 9KHz – 30MHz range

All channels were tested and worst-case results from channel 19 are shown here.

RSE 9KHz – 30MHz							
Carrier Frequency (MHz)	Loop orientation	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dBμV/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dBμV/m)	Quasi-Peak Limit (dBμV/m)	Quasi-Peak Margin (dB)
2440	Perpendicular	0.518	-4.30	12.00	7.70	33.32	-25.62
2440	Perpendicular	11.953	-15.13	-5.00	-20.13	29.54	-49.67
2440	Perpendicular	20.878	-8.58	-5.50	-14.08	29.54	-43.62
2440	Parallel	0.514	19.70	-12.00	7.70	33.39	-25.69
2440	Parallel	11.892	-12.61	-5.00	-17.61	29.54	-47.15

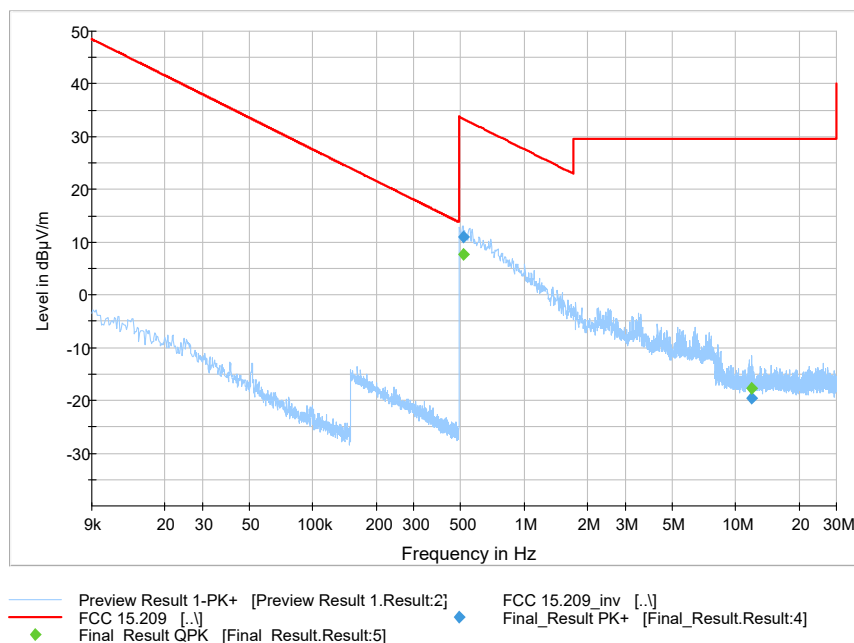


Figure 9-53 Radiated Spurious Emissions (Ch. 19) 2440 (9KHz – 30MHz) – Parallel orientation

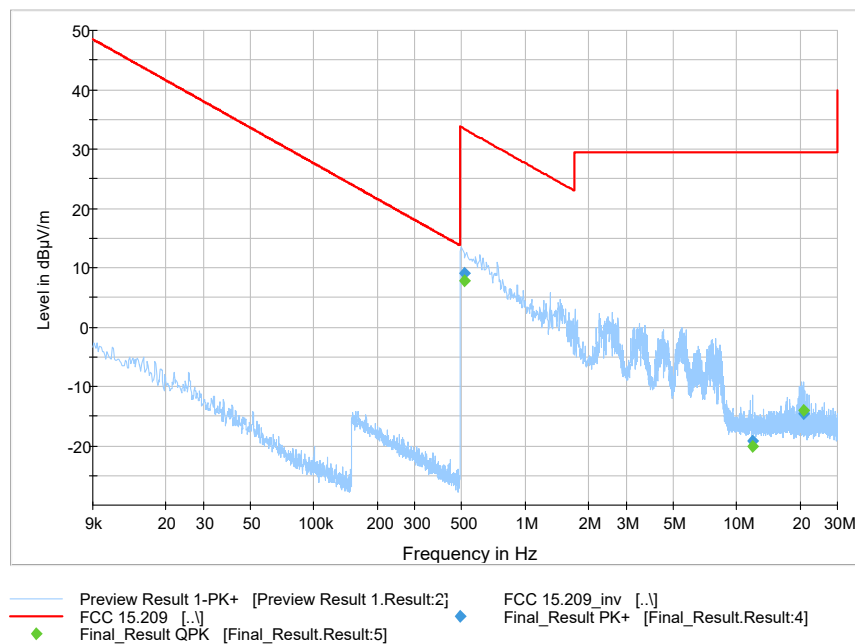


Figure 9-54 Radiated Spurious Emissions (Ch. 19) 2440 (9KHz – 30MHz) – Perpendicular orientation

9.8.5.3 Emissions in 30 MHz- 1 GHz range

All channels were tested and worst-case results from channel 0 and 19 are shown here.

RSE 30-1000 MHz						
Carrier Frequency (MHz)	Emission Frequency (MHz)	Raw Quasi-Peak Amplitude (dBμV/m)	Correction Factor (dB)	Corrected Quasi-Peak Field Strength (dBμV/m)	Quasi-Peak Limit (dBμV/m)	Quasi-Peak Margin (dB)
2402	936.54	-7.25	33.2	25.95	46.02	-20.07
2440	945.50	-7.18	33.2	26.02	46.02	-20.00

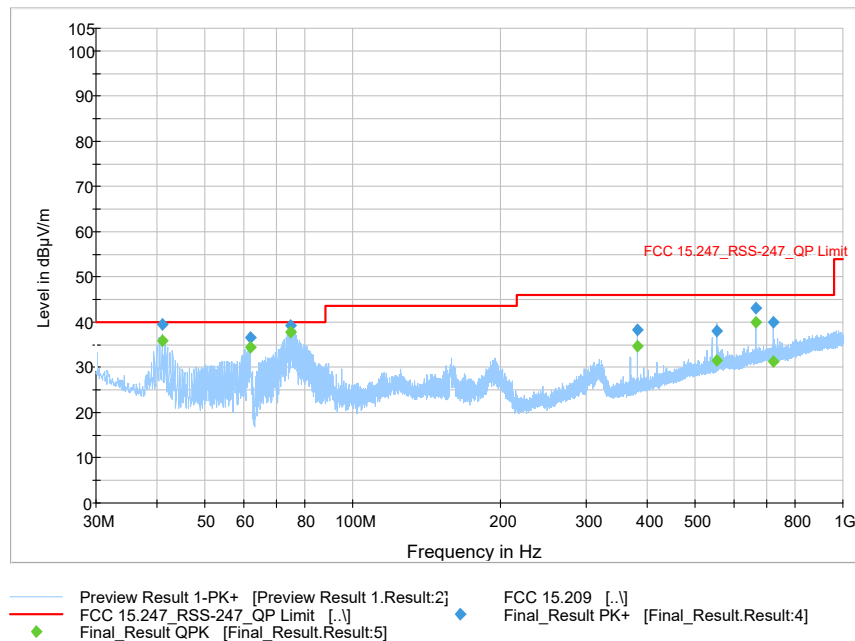


Figure 9-55 Radiated Spurious Emissions (30MHz - 1GHz) – Ambient – Radio OFF – Digital Transmissions

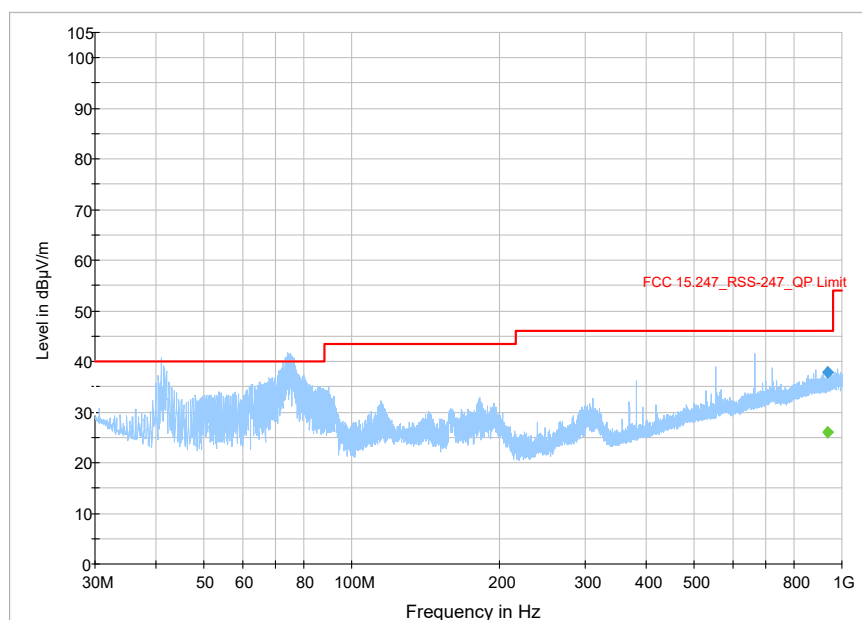


Figure 9-56 Radiated Spurious Emissions (Ch. 0) 2402 (30MHz - 1GHz)

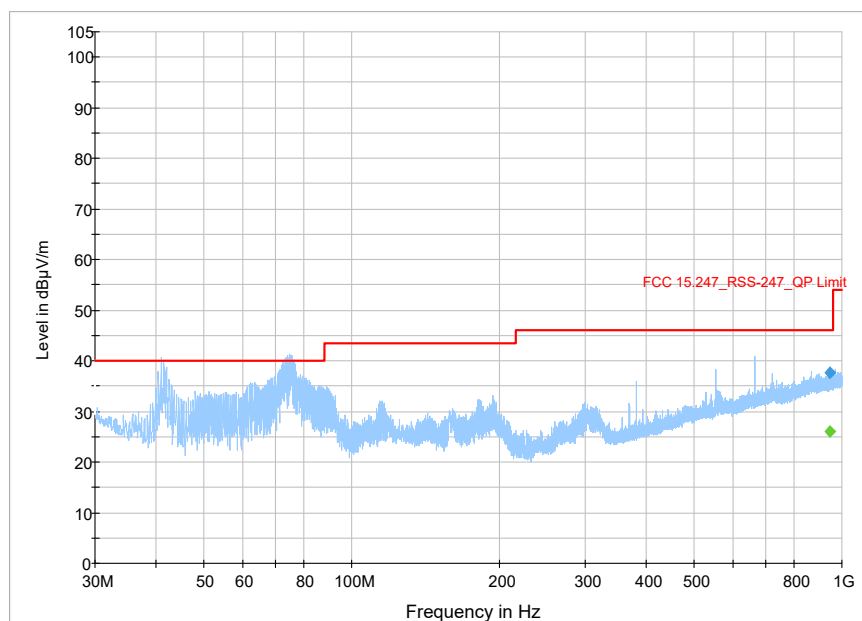


Figure 9-57 Radiated Spurious Emissions (Ch. 19) 2440 (30MHz - 1GHz)

9.8.5.4 Emissions in 1-18 GHz range

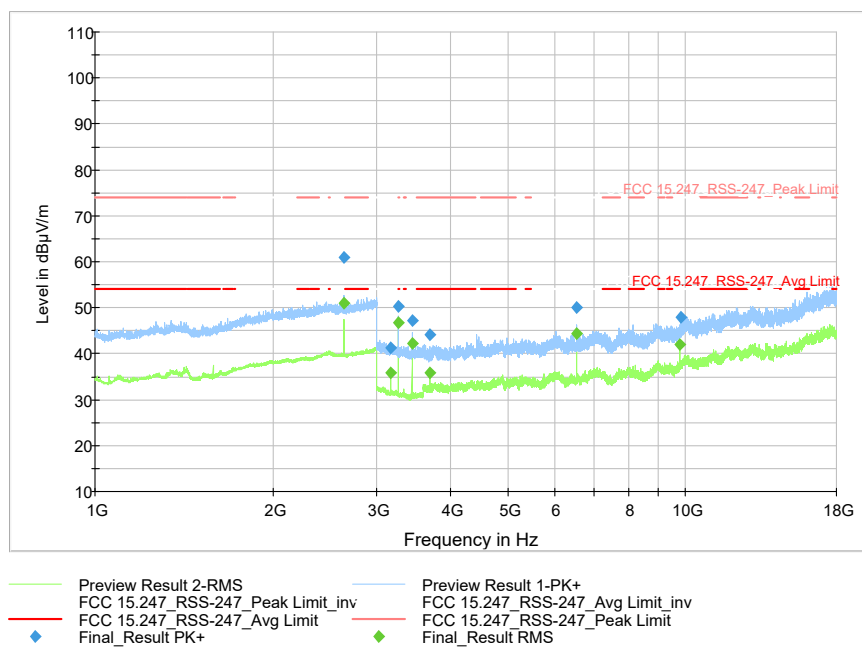


Figure 9-58 Radiated Spurious Emissions 1-18 GHz – Ambient – Radio OFF – Digital Transmissions

RSE 1 - 18GHz Average Data							
Carrier Frequency (MHz)	Frequency (MHz)	Raw Avg. Amplitude (dBμV)	Correction Factor (dB)	DC Correction Factor (dB)	Corrected Avg. Field Strength (dBμV/m)	Average Limit (dBμV/m)	Margin (dB)
2402	17795.5	20.11	23.5	0	43.61	54	-10.39
2440	17781.4	19.97	23.5	0	43.47	54	-10.53
2480	17840.6	19.76	23.9	0	43.66	54	-10.34

RSE 1 - 18GHz Peak Data						
Carrier Frequency (MHz)	Frequency (MHz)	Raw Peak Amplitude (dBμV)	Correction Factor (dB)	Corrected Peak Field Strength (dBμV/m)	Peak Limit (dBμV/m)	Margin (dB)
2402	17996.6	31.76	23.5	55.26	74	-18.74
2440	17776.3	31.37	23.5	54.87	74	-19.13
2480	17760.4	32.09	23.4	55.49	74	-18.51

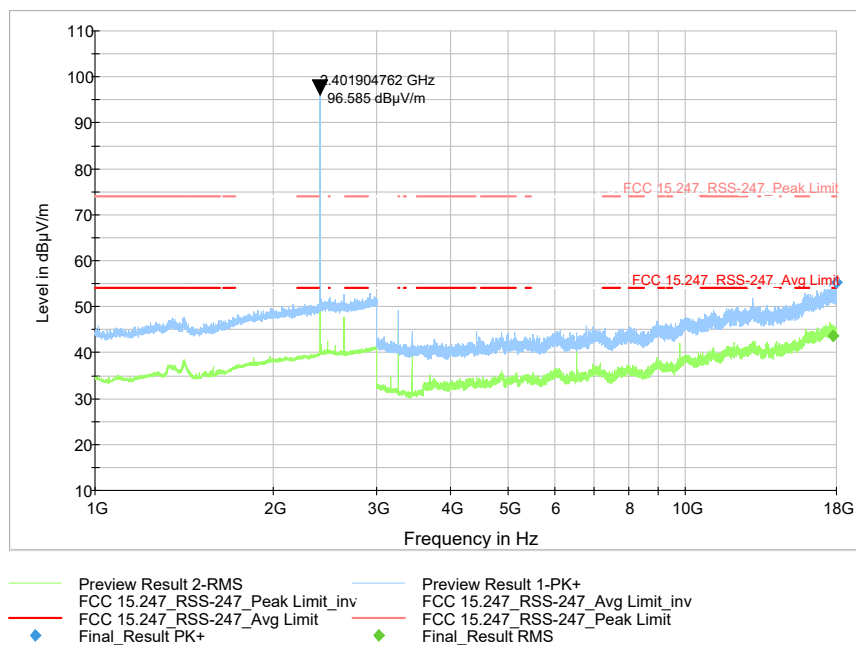


Figure 9-59 Radiated Spurious Emissions 1-18 GHz (Ch. 0)

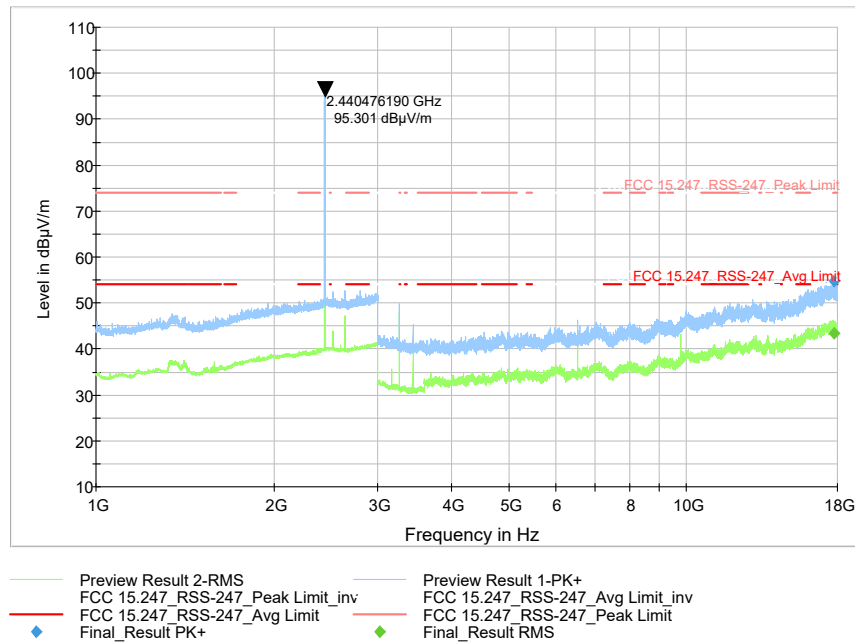


Figure 9-60 Radiated Spurious Emissions 1-18 GHz (Ch. 19)

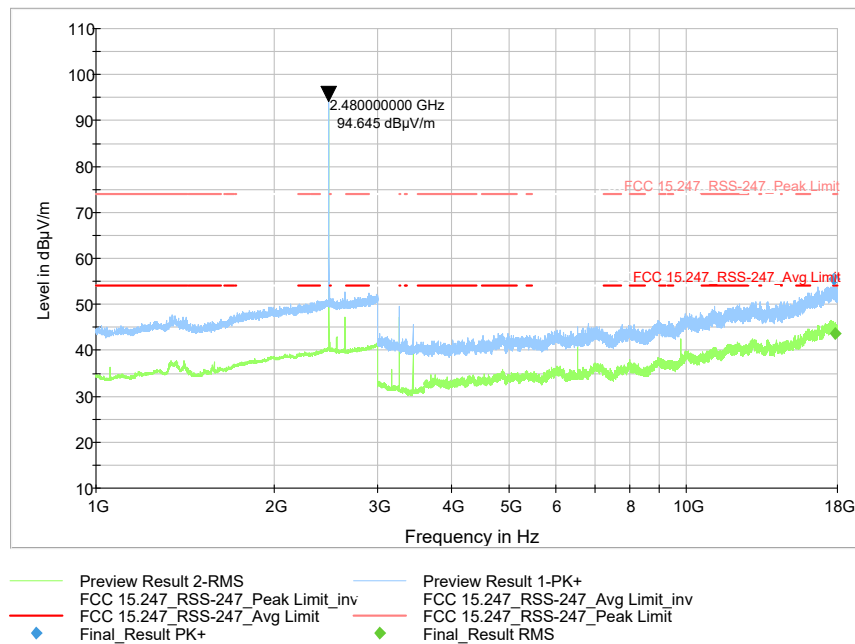


Figure 9-61 Radiated Spurious Emissions 1-18 GHz (Ch. 39)

9.8.5.5 Emissions in 18-26.5 GHz range

All channels were tested and worst-case results from channel 39 (2480 MHz) shown here.
No significant emissions to report above noise floor.

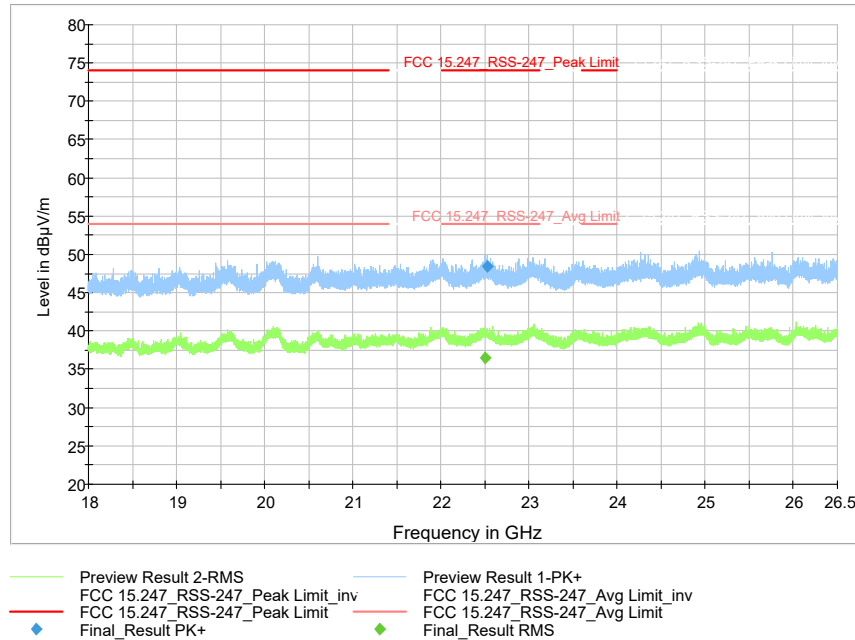


Figure 9-62 Radiated Spurious Emissions (Ch. 39) (18 – 26.5 GHz)

9.9 AC Line Conducted Emissions

9.9.1 Test Requirements

FCC CFR 47 Rule Part 15.207 (a)

ISED RSS Gen [8.8]

9.9.2 Test Method

Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the Unsymmetric radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Equipment is tested with the power cords that are used under normal operating conditions. These measurements are made using a LISN (Line Impedance Stabilization Network). AC powered peripherals are attached to a second LISN with the 50-ohm measuring port terminated by a 50-ohm resistive load.

The EUT is set to continuously transmit on Ch.39 at 4dBm power setting.

EMI Receiver Settings:

150 kHz – 30 MHz:

RBW= 9 kHz

VBW $\geq 3 \times$ RBW

Trace Mode: Peak Detector (Max Hold).

Final measurements were performed using Quasi-Peak and Average Detectors.

Span= 150 kHz – 30 MHz

Sweep time= Auto

9.9.3 Limit

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

9.9.4 Test Result:

Pass

9.9.5 Test Data:

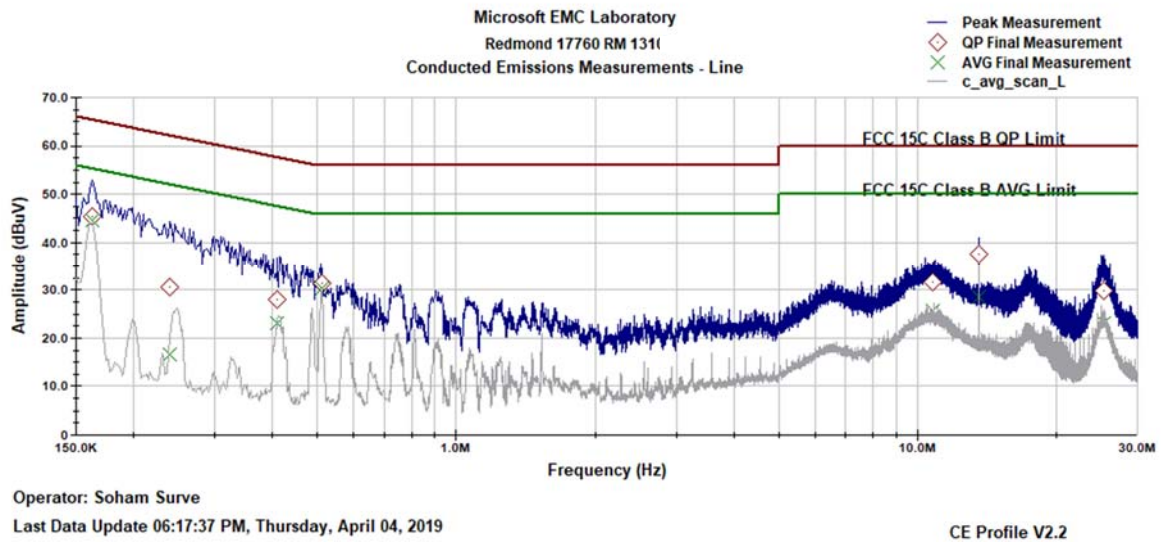


Figure 9-63 AC Line Conducted Emissions- Neutral (150 kHz- 30 MHz)

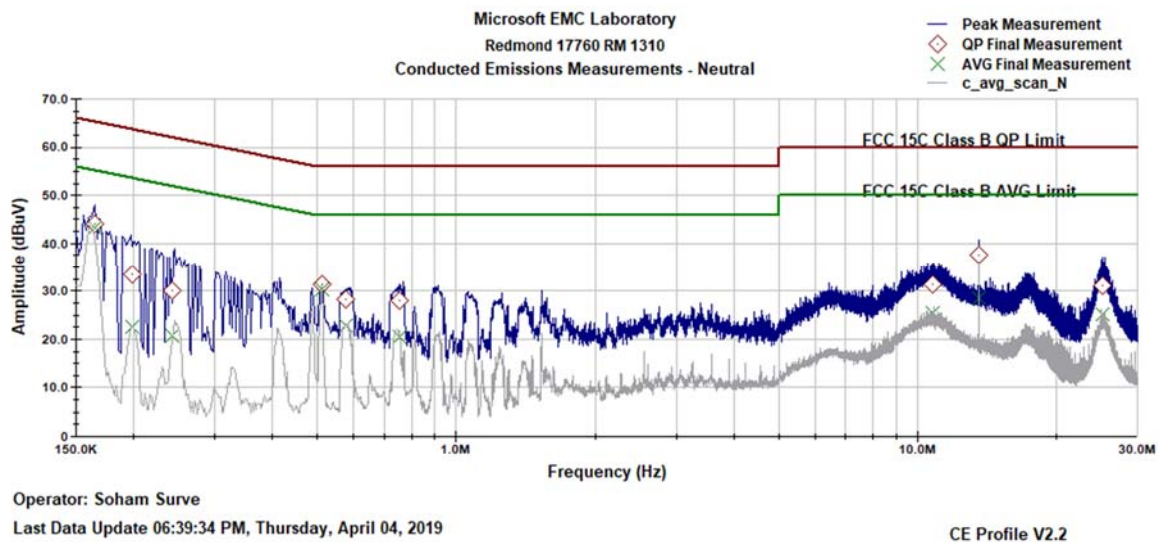


Figure 9-64 AC Line Conducted Emissions- Line (150 kHz- 30 MHz)

Frequency (MHz)	QP Net Reading (dBμV)	AVG Net Reading (dBμV)	Quasi-Peak Limit (dBμV)	Average Limit (dBμV)	Line Tested (L or N)	Quasi-Peak Margin (dB)	Average Margin (dB)
0.163	44.94	44.35	65.30	55.30	L	-20.37	-10.95
0.513	31.21	30.00	56.00	46.00	L	-24.79	-16.00
13.562	39.25	29.39	60.00	50.00	L	-20.75	-20.61
0.584	27.53	21.28	56.00	46.00	L	-28.47	-24.72
24.565	30.46	25.10	60.00	50.00	L	-29.54	-24.90
10.778	29.43	23.32	60.00	50.00	L	-30.57	-26.68
0.251	28.31	24.81	61.73	51.73	L	-33.43	-26.92
0.163	44.93	44.28	65.29	55.29	N	-20.37	-11.01
0.511	31.66	30.50	56.00	46.00	N	-24.34	-15.50
13.562	37.45	27.79	60.00	50.00	N	-22.55	-22.21
0.581	28.10	22.19	56.00	46.00	N	-27.90	-23.81
11.199	28.36	22.55	60.00	50.00	N	-31.64	-27.45
25.03	29.27	22.55	60.00	50.00	N	-30.74	-27.45
0.244	25.50	22.05	61.95	51.95	N	-36.45	-29.90

End of Report