RADIO TEST REPORT

For

MODEL NO.: 1962
FCC ID: C3K1962
IC ID: 3048A-1962

Test Report No. R-TR733-FCCISED-BTLE-3
Issue Date: August 18th, 2021

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

Prepared by
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A2LA ACCREDITED
TESTING CERT #3472.01

1 Record of Revisions

Revision	Date	Section	Page(s)	Summary of Changes	Author/Revised By:
1.0	07/20/2021	All	All	Version 1.0	Pooja Akhoury
2.0	08/11/2021	5	8	Test Name Updated	Daniel Salinas
3.0	08/18/2021	3	7	ISED CABID included	Daniel Salinas

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Test Report Attestation

Microsoft Corporation
Model: 1962
FCC ID: C3K1962
IC ID: 3048A-1962

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 pertains 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 previously issued report #R-TR733-FCCISED-BTLE-2 issued by Microsoft EMC Laboratory on 08/11/2021.

Written By: Pooja Akhoury
RF Test Engineer

Reviewed/ Issued By: Daniel Salinas
Radio Test Lead

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 Number: 26315
ISED CABID: US0212

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. The test site for measurements below 30 MHz has been demonstrated to correlate with an open field site per KDB 414788.
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 (30 MHz to 1 GHz)	5.99	dB
Radiated disturbance (1 GHz to 18 GHz)	5.12	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	ºC
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:	Wei Sun
Functional Description of the EUT:	Wireless Input Accessory Device
Model:	1962
FCC ID:	C3K1962
IC ID:	3048A-1962
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:** 0.9 dBi
EUT Classification:	DTS
Equipment Design State:	Prototype/Production Equivalent (EV2)
Equipment Condition:	Good
Test Sample Details:	**RF Conducted Test Sample** R-733-EV2-CERT-03 **RF Radiated Test Sample** R-733-EV2-CERT-01 R-733-EV2-CERT-02

5.1 Test Configurations

Test software Device Communicator 7.22.00 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 39 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 ºC to 40 ºC (50 ºF to 104 ºF) 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 April 29th 2021 to May 7th 2021.

5.6 TEST SAMPLE DETAILS

Internal Identifer	Serial Number	Test Cases
R-733-EV2-CERT-01	0F0025S210900D	Radiated
R-733-EV2-CERT-02	0F0025P210900D	Radiated
R-733-EV2-CERT-03	M1162049-002	Conducted
R-733-EV2-CERT-02	'0F0025P210900D	AC Power Line Conducted Emissions

5.7 Test Engineers

Test Cases	Test Engineers
Conducted	Akshay Landge
Radiated	Akshay Landge
AC Power Line Conducted Emissions	Benjamin Atsu

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]	≥ 500kHz	Pass
Occupied Bandwidth	Reporting & Measurements	Reporting & Measurement Purposes only	N/A
Output Power	15.247 (b)(3) RSS-247 [5.4]	≤ 1 Watt	Pass
Equivalent Isotropic Radiated Power	RSS-247 [5.4]	≤ 4 Watt	Pass
Power Spectral Density	15.247 (e) RSS-247 [5.2]	≤ 8dBm/3kHz	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**
Keysight	Spectrum Analyzer	N9020B	RF-997	10/01/2021
Rohde & Schwarz	EMI Test Receiver	ESU40	RF-192	03/31/2021*
Rohde & Schwarz	Open Switch and Control Unit	OSP130	RF-018	12/10/2021
Rohde & Schwarz	Open Switch and Control Unit	OSP150	RF-019	12/10/2021
Rohde & Schwarz	Custom Filter Bank	SFUNIT RX	RF-322	12/10/2021
ETS-Lindgren	Antenna - Horn	3117	EMC-1022	06/30/2021*
ETS-Lindgren	Antenna - Standard Gain Horn	3160-09	EMC-452	01/13/2022
ETS-Lindgren	Antenna – Passive Loop	6512	RF-202	02/26/2022
Sunol Sciences	Antenna - Broadband Hybrid	JB6	RF-039	01/13/2022
Rohde & Schwarz	Pre-Amp	TS-PR26	RF-042	12/10/2021
Pasternack	6dB Attenuator	PE7004-6	EMC-949	N/A
MCL	6dB Attenuator	BHBW-S6-2W263+	RF-710	N/A
Huber & Suhner	RF Cable	SucoFlex 100	RF-452	N/A
Teledyne	RF Cable	PR90-198-276	RF-1036	N/A
Maury Microwave	RF Cable	SP-292-MM-197	RF-1202	N/A
Micro-Coax	RF Cable	UFB311A-8-3150-50U50U	EMC-1187	N/A
Micro-Coax	RF Cable	UFB311A-1-0787-50U50U	EMC-351	N/A
Micro-Coax	RF Cable	UtiFlex	EMC-359	N/A
Madge Tech	Temp Meter	PRHTemp2000	EMC-678	01/29/2022

Note*: Equipment was within calibration dates at the time of test.

Equipment used for AC Line Conducted Emissions Measurement				
Manufacturer	**Description**	**Model #**	**Asset #**	**Calibration Due**
Rohde & Schwarz	Analyzer/ Receiver	ESR	EMC-911	4/4/2022
Teseq	EUT LISN	NNB 051	EMC-187	11/19/2021
Micro-Coax	Cable	UFB311A-0-0787-5005G0	EMC-872	12/10/2021
ETS-Lindgren	TILE Profile	Version 7.2.5.7	EMC-1386	N/A
Fluke	Multimeter	87V	EMC-650	9/1/2021
MadgeTech	Environmental Monitor	PRHTemp2000	EMC-170	11/16/2021
Cal Instruments	AC Power Source	1251P	EMC-269	N/A

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

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.

8.1.1 Radiated Measurements in 9kHz- 30 MHz

The EUT is positioned on a turntable at a height of 80cm using a non-conducting table. 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 three orientations of the measurement antenna- parallel, perpendicular and ground-parallel. All possible orientations of the EUT were investigated for emissions and the flat orientation was identified as the worst-case configuration.

8.1.2 Radiated Measurements in 30 MHz - 1000 MHz

The EUT is positioned on a turntable at a height of 80cm using a non-conducting table. 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 vertical standing orientation was identified as the worst-case configuration.

8.1.3 Radiated Measurements above 1GHz

The EUT is positioned on a turntable at a height of 1.5m. 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 measurement antenna is set at a fixed 1.5m height while the turntable is rotated 360 degrees and the EUT elevation angle is varied from 0 to 150 degrees 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

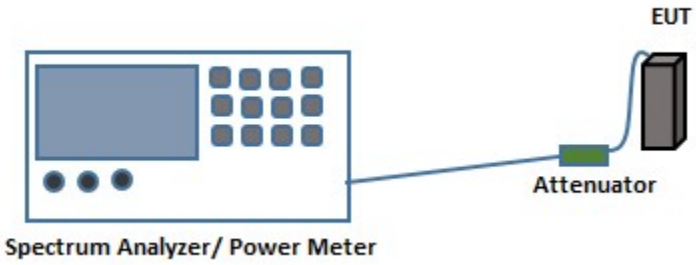

Fig.1. Test Setup for Antenna port conducted measurements

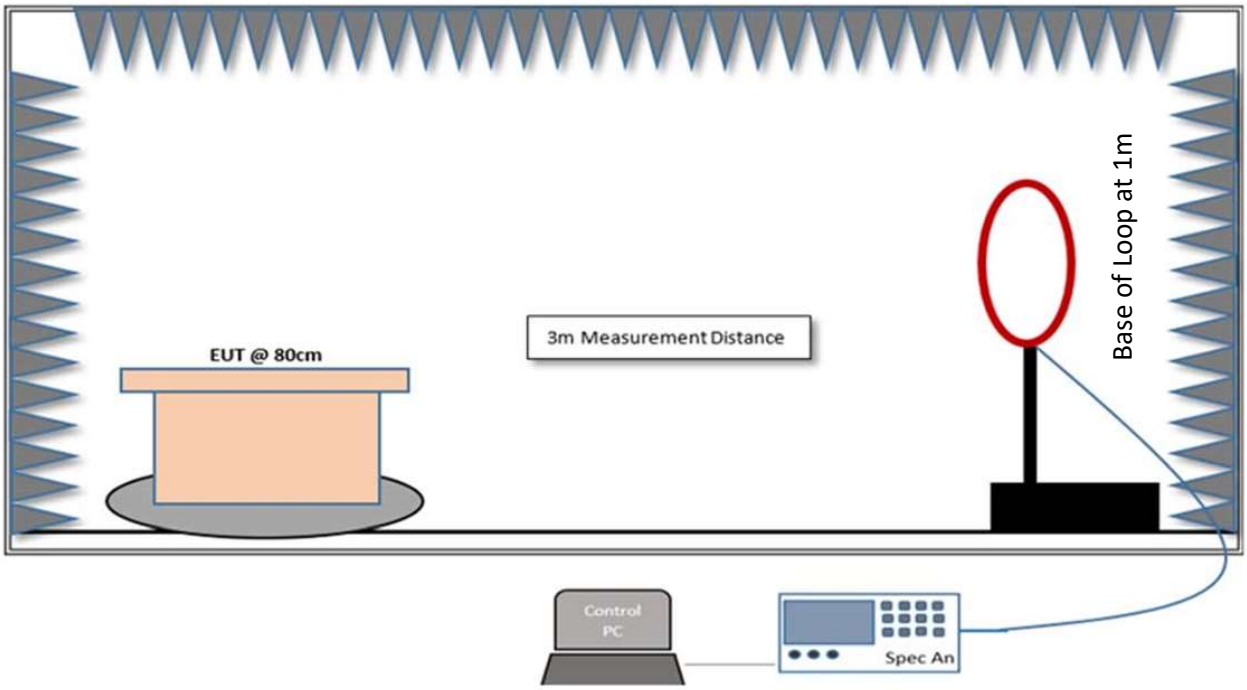

Fig.2. Test Setup for Radiated measurements in 9kHz - 30MHz Range

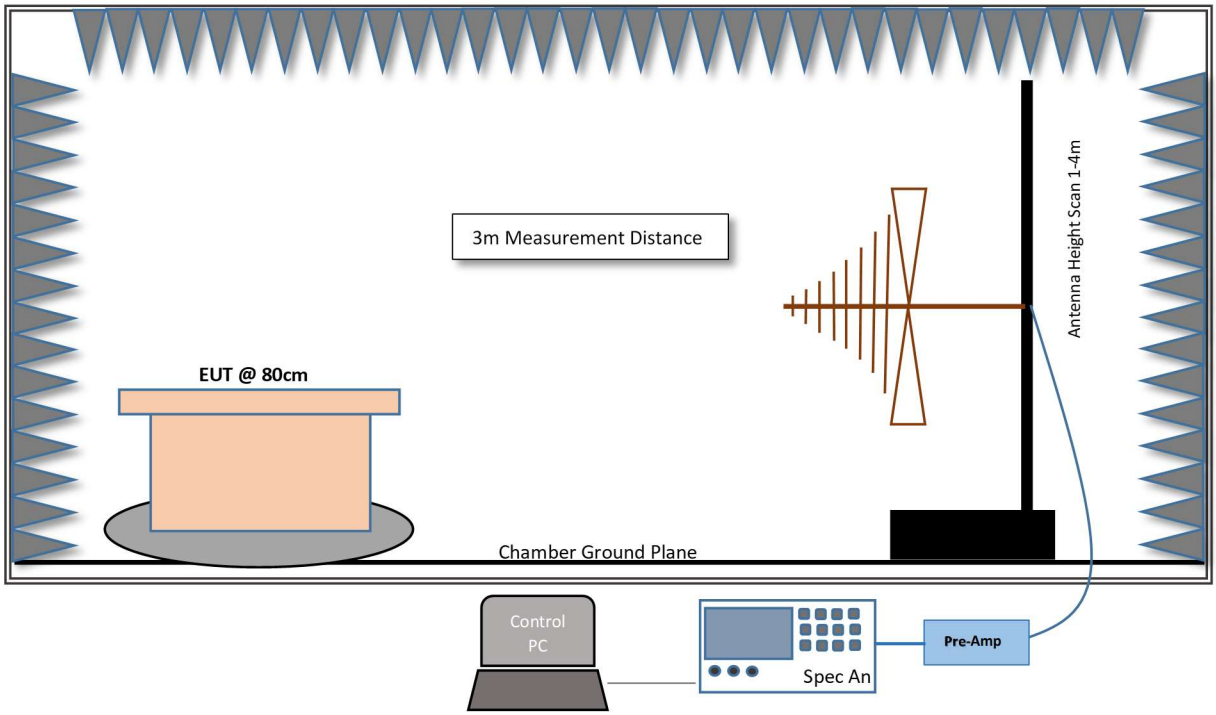

Fig.3. Test Setup for Radiated measurements in 30MHz- 1GHz Range

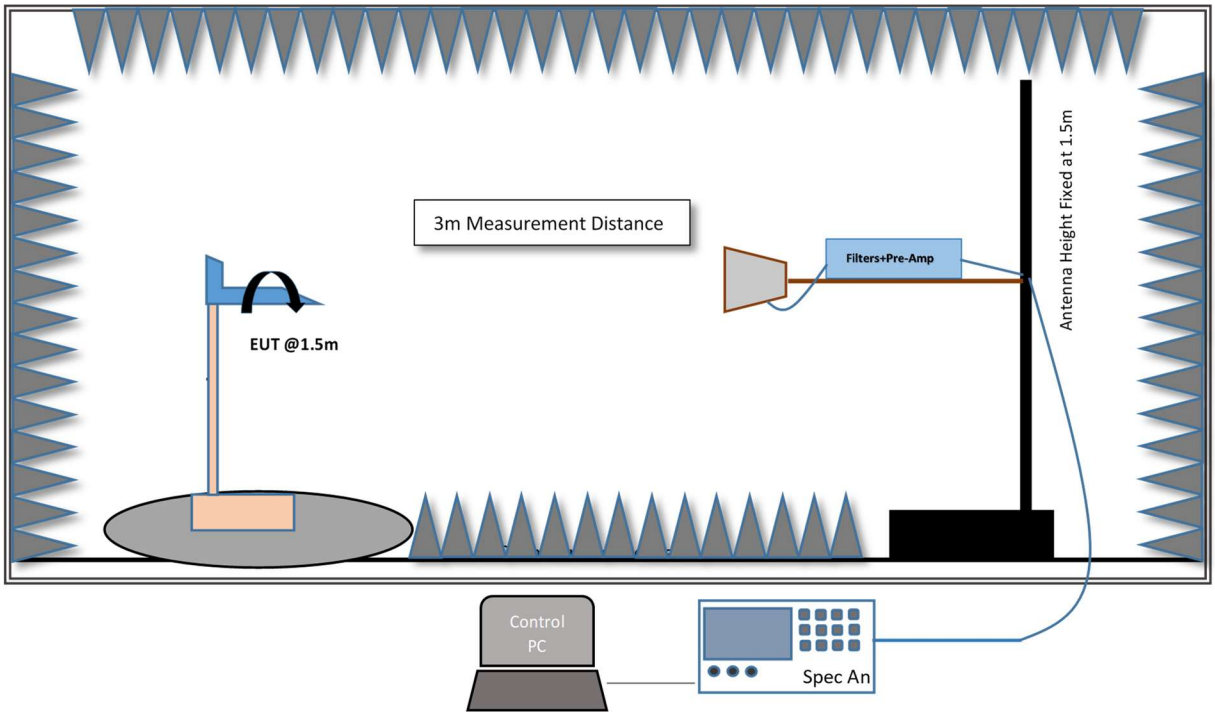

Fig.4. Test Setup for Radiated measurements in 1GHz- 18GHz Range

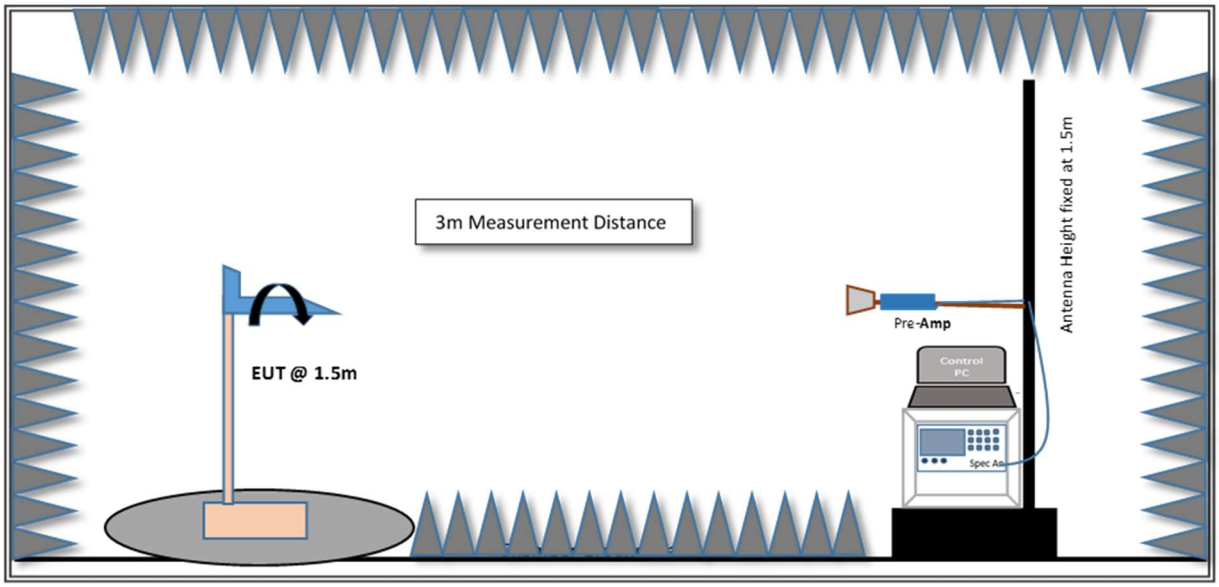

Fig.5. Test Setup for Radiated measurements >18GHz

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 ≥ Occupied Bandwidth if possible; otherwise, set RBW to the largest available value
VBW ≥ RBW ≥ 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)	On Time (ms)	Period (ms)	Duty Cycle (%)	Correction Factor (dB)
2402	--	--	100	0

9.1.5 Test Data:

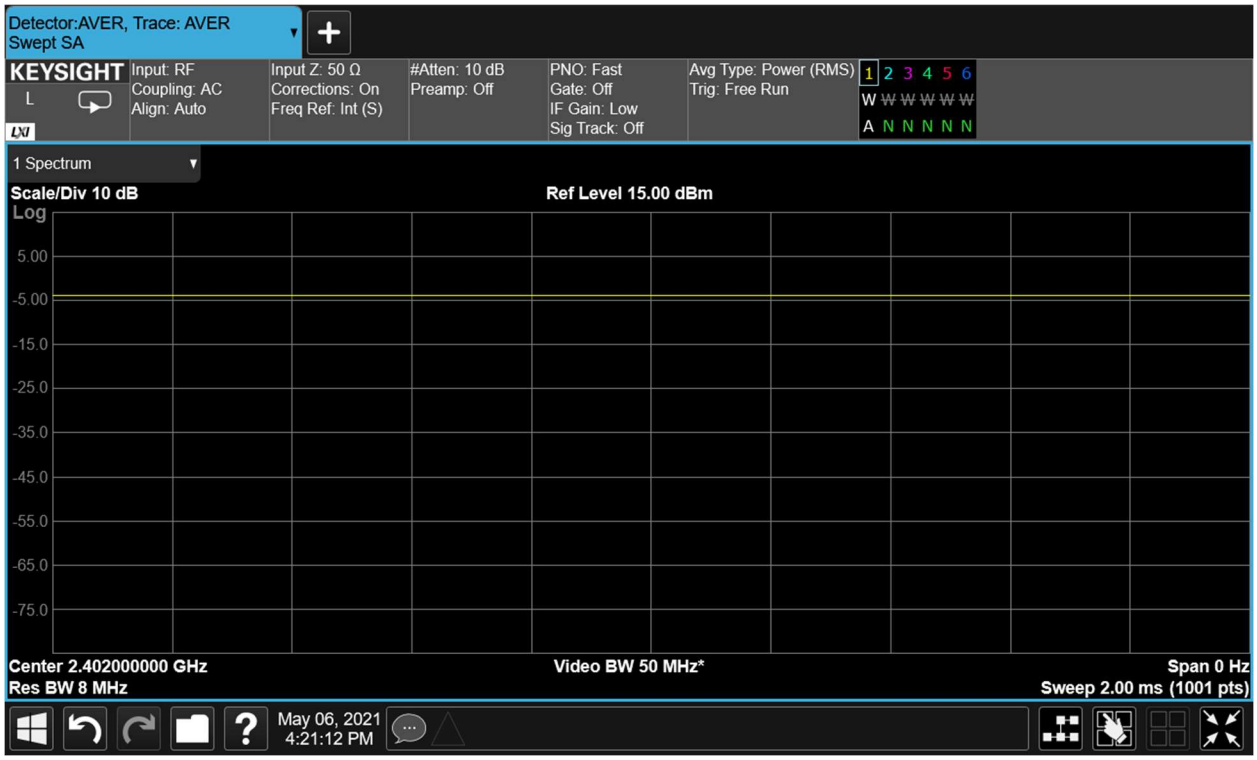

Figure 9-1 Duty Cycle 2402MHz (Ch.0)

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 ≥ 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)	Test Mode	Channel No.	6dB Bandwidth (kHz)	Limit (kHz)	Result
2402	BT LE	0	755.4	>500	Pass
2440	BT LE	19	726.1	>500	Pass
2480	BT LE	39	755.0	>500	Pass

9.2.5 Test Data:

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

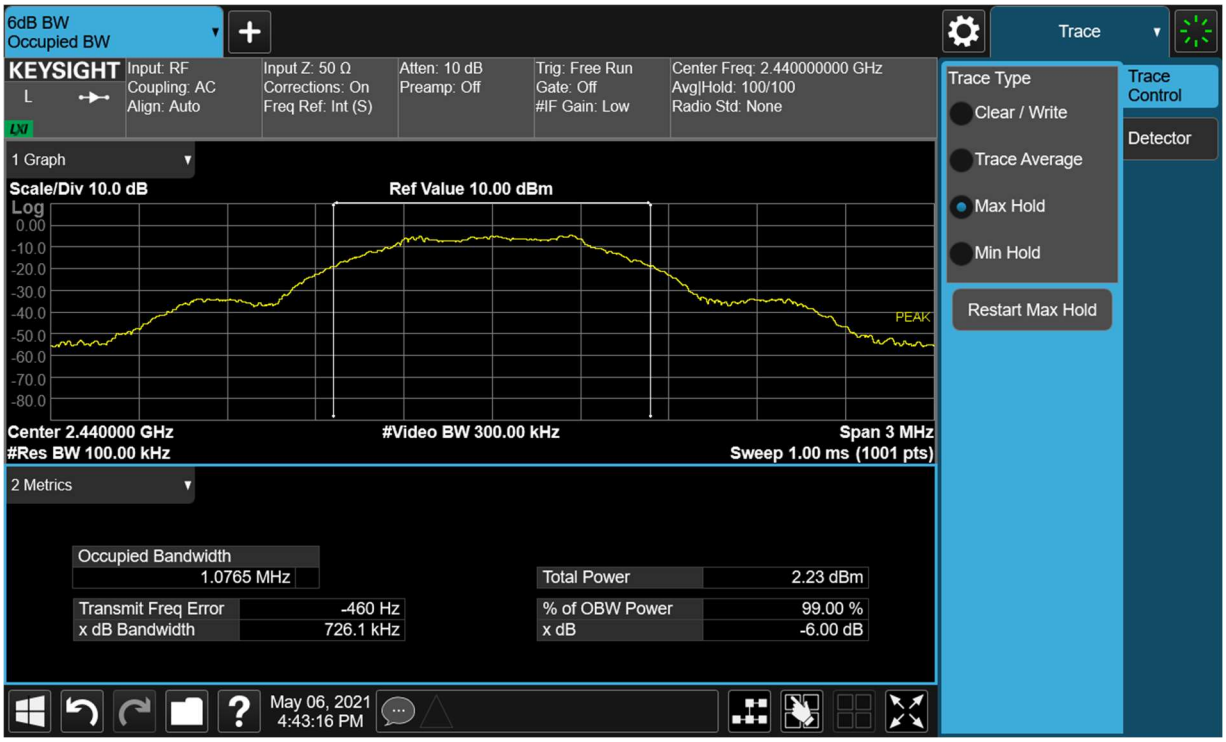

Figure 9-3 6dB Bandwidth (Ch. 19)

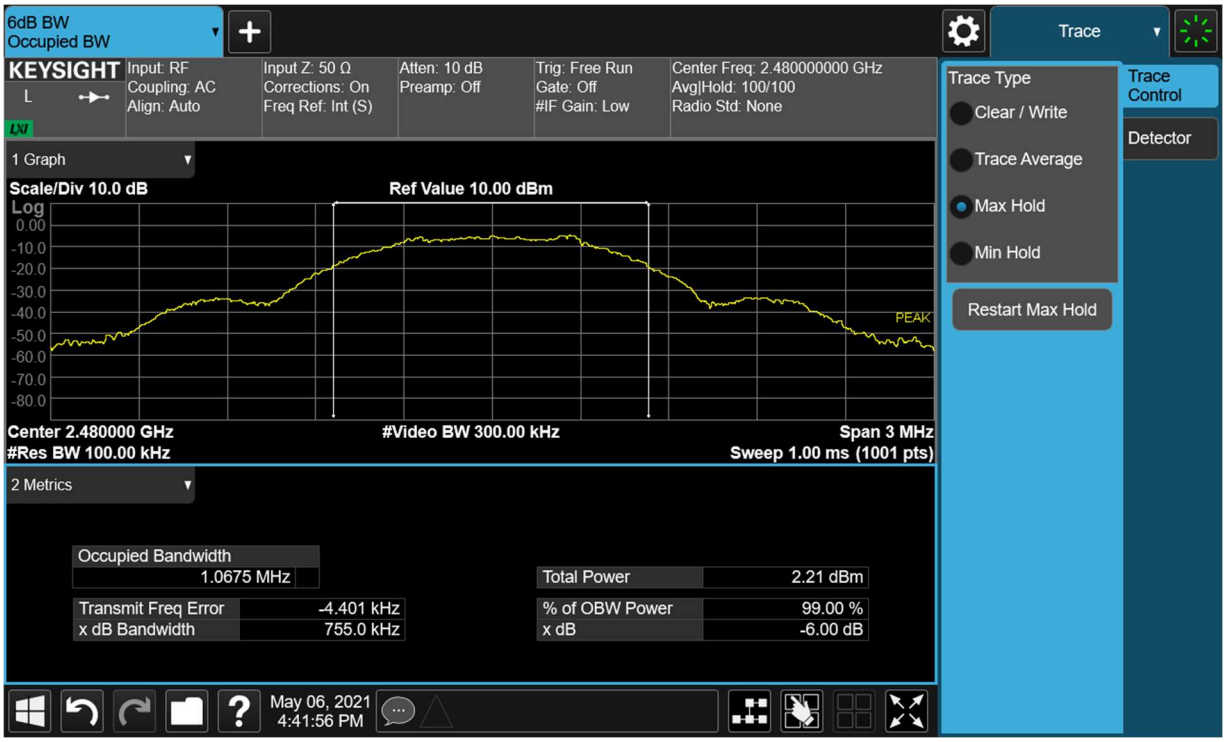

Figure 9-4 6dB Bandwidth (Ch. 39)

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 to: 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)	Test Mode	Channel No.	99% Bandwidth (MHz)
2402	BT LE	0	1.065
2440	BT LE	19	1.072
2480	BT LE	39	1.072

9.3.5 Test Data:

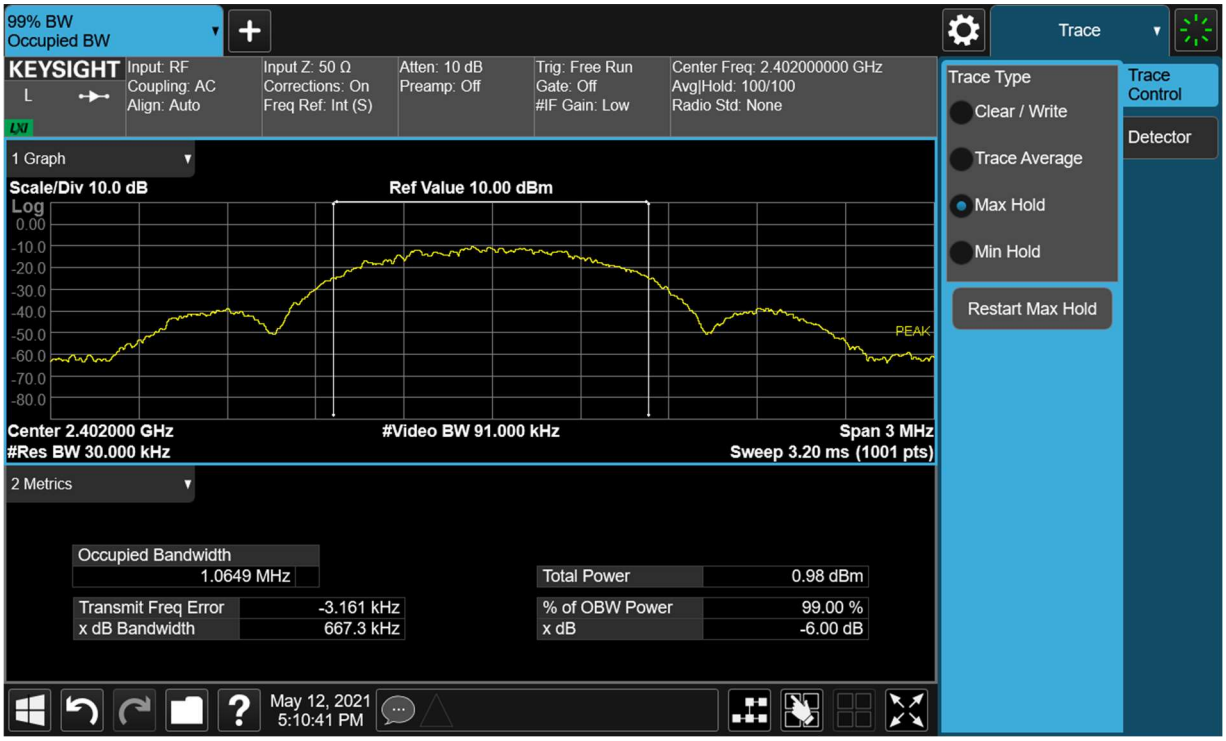

Figure 9-5 99% Bandwidth (Ch. 0)

Figure 9-6 99% Bandwidth (Ch. 19)

Figure 9-7 99% Bandwidth (Ch. 39)

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 Sample Calculations:

Peak Power: Amplitude (Analyzer level) + Correction Factor (Cable loss) = -11.88dBm+8dB=-3.88dBm.

9.4.5 Test Results:

Frequency (MHz)	Mode	Channel No.	Cond. Peak Power (dBm)	Cond. Peak Power (W)	Cond. Peak Limit (dBm)	Margin (dB)	Result
2402	BT LE	0	-3.88	0.00041	30	-33.88	Pass
2440	BT LE	19	-3.97	0.00040	30	-33.97	Pass
2480	BT LE	39	-3.86	0.00041	30	-33.86	Pass

Frequency (MHz)	Mode	Channel No.	Cond. Peak Power (dBm)	Max Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
2402	BT LE	0	-3.88	0.9	-2.98	36	-38.98	Pass
2440	BT LE	19	-3.97	0.9	-3.07	36	-39.70	Pass
2480	BT LE	39	-3.86	0.9	-2.96	36	-38.96	Pass

9.4.6 Test Data:

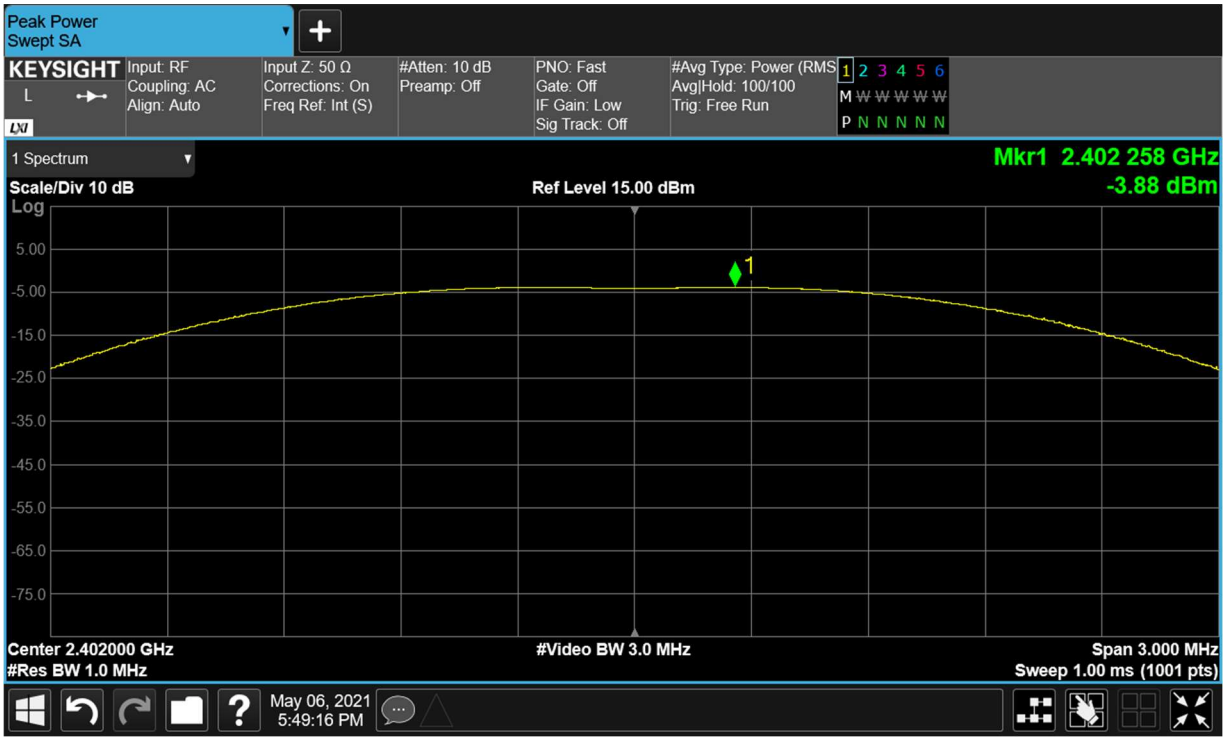

Figure 9-8 Peak Power (Ch. 0)

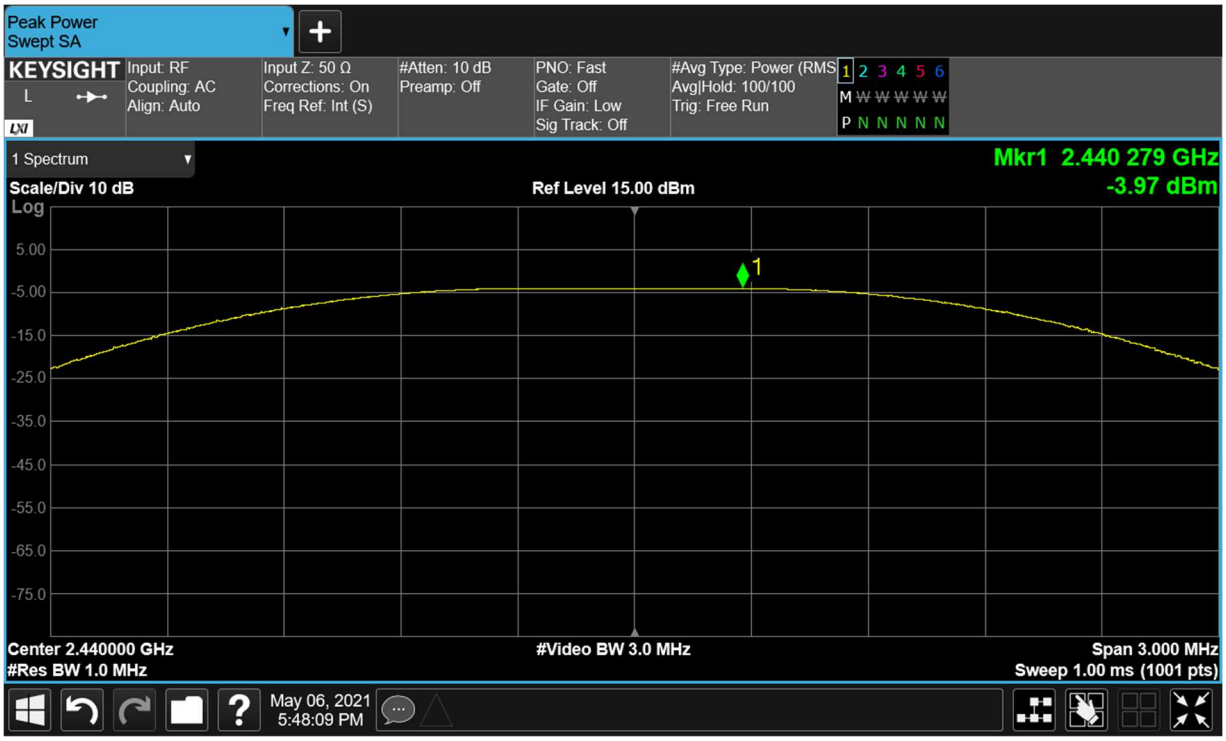

Figure 9-9 Peak Power (Ch. 19)

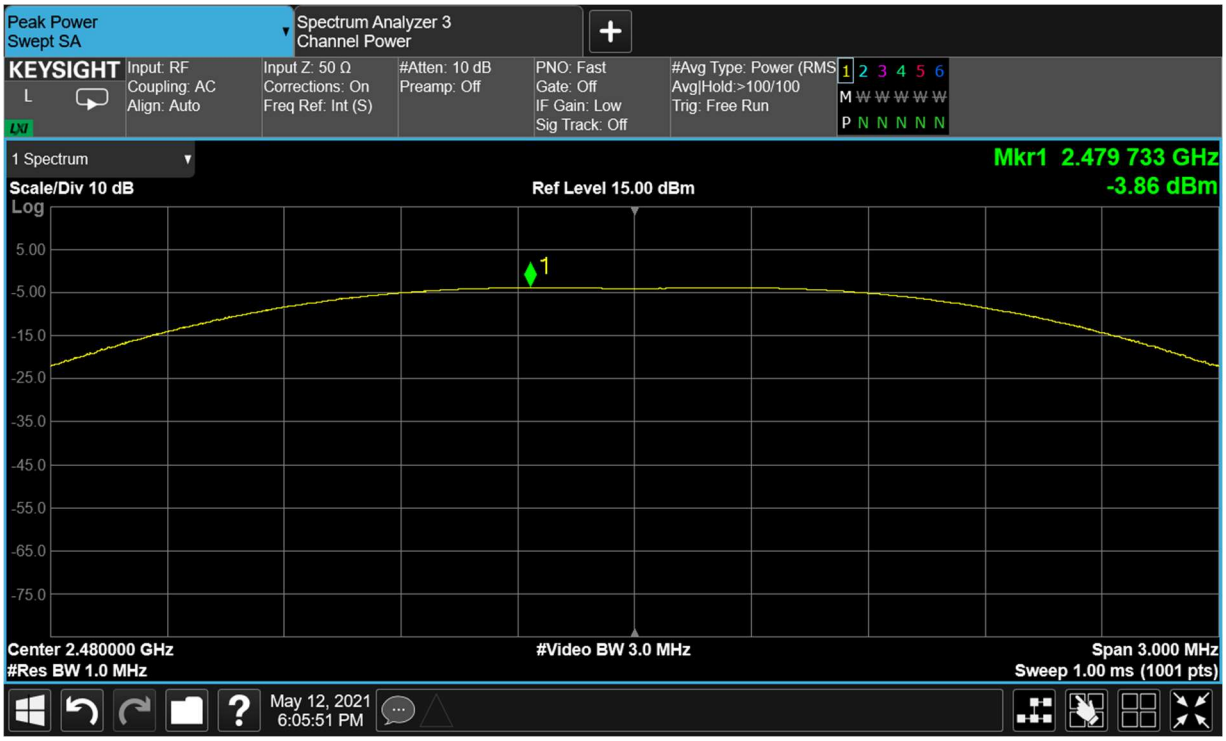

Figure 9-10 Peak Power (Ch. 39)

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 Sample Calculations:

Power Spectral Density(dBm/100kHz): Amplitude (Analyzer level) + Correction Factor (Cable loss) = -12.26dBm + 8dB = -4.26dBm/100kHz.

9.5.5 Test Results:

Frequency (MHz)	Test Mode	Channel No.	Power Spectral Density (dBm/100kHz)	Limit (dBm/3kHz)	Result
2402	BT LE	0	-4.26	8	Pass
2440	BT LE	19	-4.16	8	Pass
2480	BT LE	39	-4.37	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.

9.5.6 Test Data:

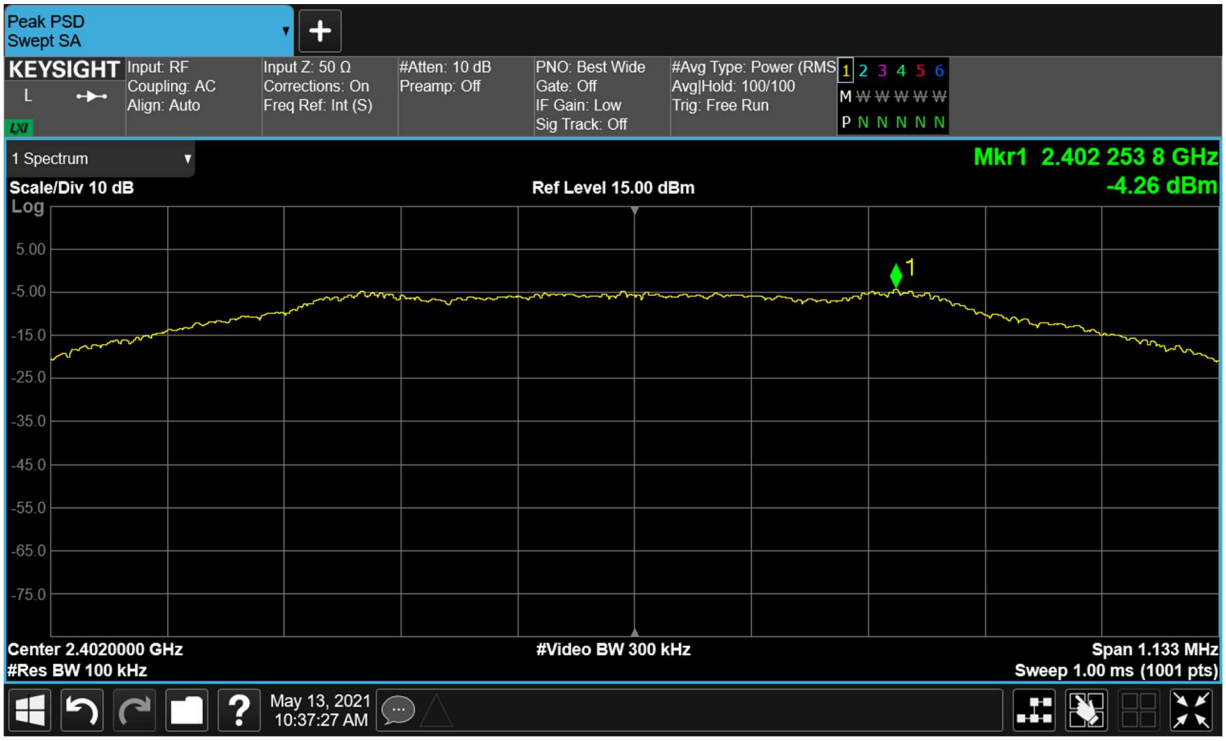

Figure 9-11 Power Spectral Density (Ch. 0)

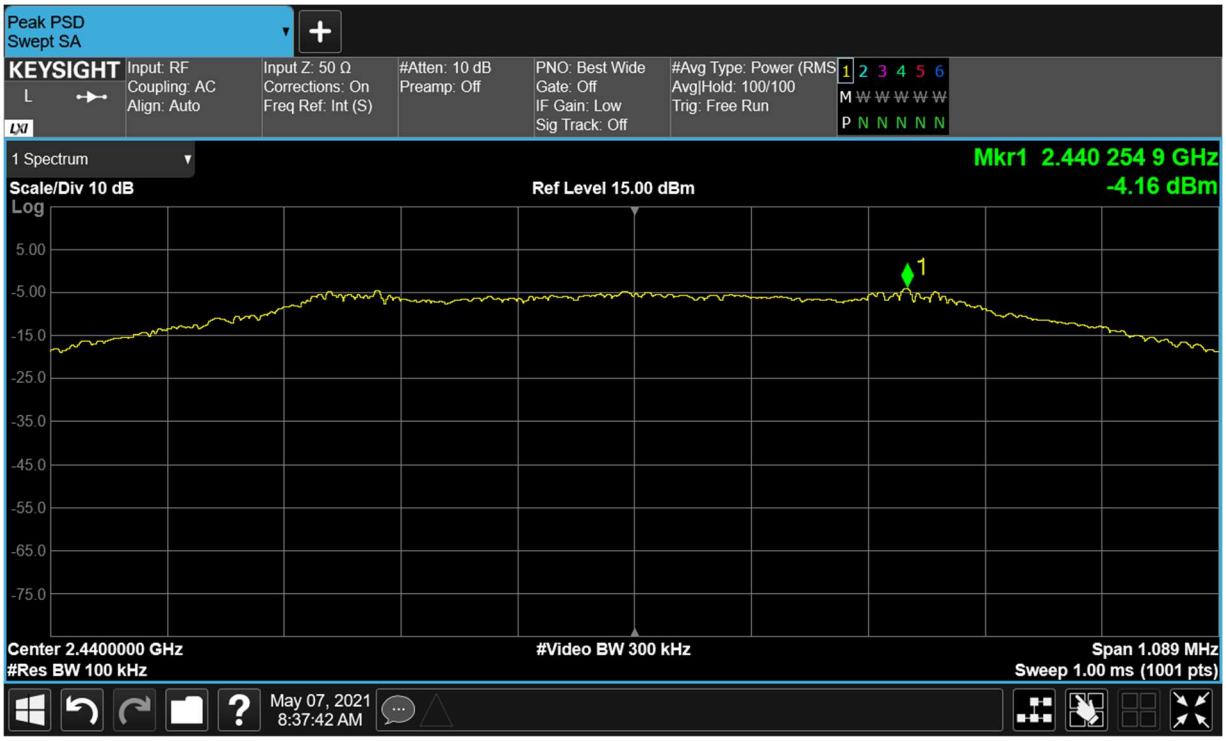

Figure 9-12 Power Spectral Density (Ch. 19)

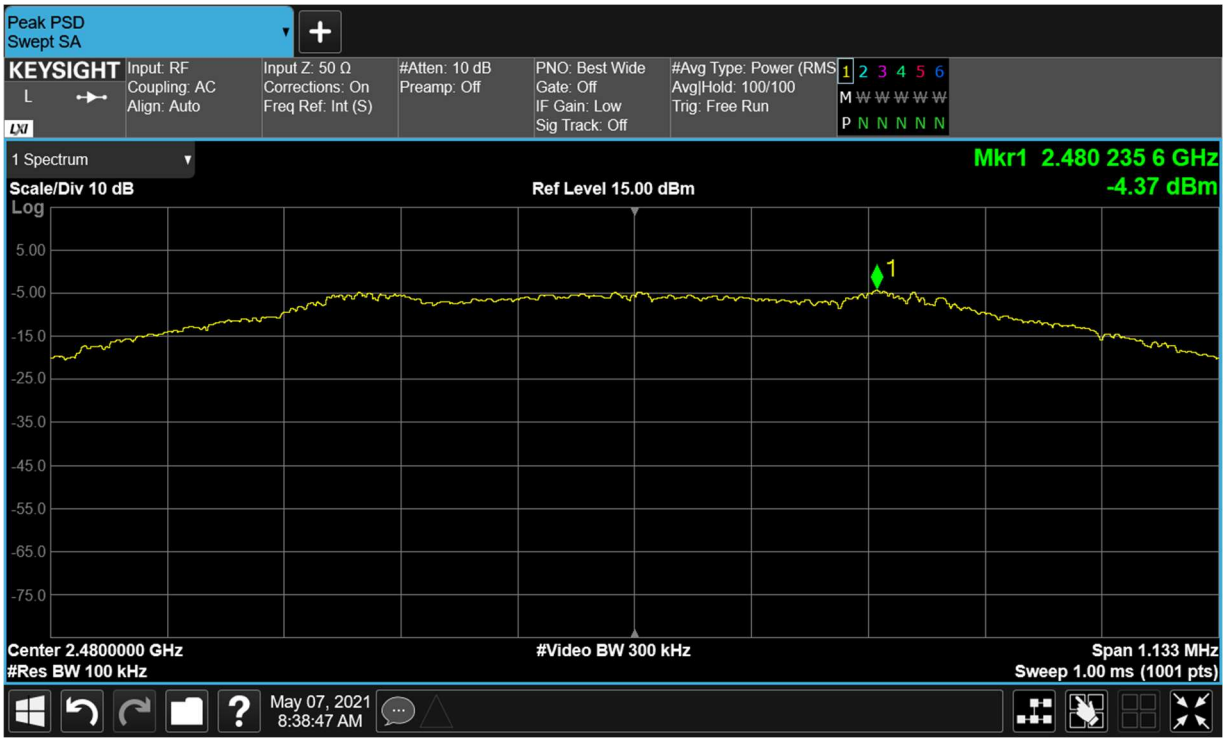

Figure 9-13 Power Spectral Density (Ch. 39)