

Amended
FCC/ISED Test Report

Prepared for: **Garmin International, Inc.**

Address: **1200 E. 151st Street**
Olathe, Kansas, 66062, USA

Product: **A03702**

FCC ID: **IPH-03702**

Test Report No: **R20200327-20-E1A**

Approved by:



Nic S. Johnson, NCE

Technical Manager

iNARTE Certified EMC Engineer #EMC-003337-NE

DATE: **2 July 2020**

Total Pages: **46**

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REVISION PAGE

Rev. No.	Date	Description
0	28 May 2020	Original – NJohnson Prepared by FLane/CFarngton/KVepuri
A	2 July 2020	Contains R20200327-20-E1 and its amendment in full - KV



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1.0 SUMMARY OF TEST RESULTS

The worst-case measurements were reported in this report. Summary of test results presented in this report correspond to the following section (Please see the checked box below for the rule part used):

The EUT has been tested according to the following specifications:

- (1) US Code of Federal Regulations, Title 47, Part 15.249
- (2) ISED RSS-Gen, Issue 5
- (3) ISED RSS-210, Issue 9

SUMMARY			
Requirement	Test Type and Limit	Result	Remark
FCC 15.203	Unique Antenna Requirement	Pass	PCB Antenna
FCC 15.35 RSS-Gen, 6.10	Duty cycle of pulsed emissions	Applied	Duty cycle was provided by the manufacturer
NA	Maximum Peak Output Power	N/A	Informational Purpose Only
NA	Minimum Bandwidth	N/A	Informational Purpose Only
FCC 15.209 RSS-Gen, 7.1	Receiver Radiated Emissions	Pass	Meets the requirement of the limit.
FCC 15.209 RSS-Gen, 8.9 RSS-210 A1.2 FCC 15.249(a)	Transmitter Radiated Emissions	Pass	Meets the requirement of the limit.
FCC 15.209, 15.205, 15.249(d) RSS-Gen, 8.9 RSS-210, 5.5	Band Edge Measurement	Pass	Meets the requirement of the limit.
FCC 15.207 RSS-Gen. 8.8	Conducted AC Emissions	Pass	Meets the requirement of the limit.



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2.0 EUT DESCRIPTION

2.1 EQUIPMENT UNDER TEST

Summary and Operating Condition:

EUT	A03702
EUT Received	17 April 2020
EUT Tested	17 April 2020- 27 May 2020
Serial No.	3312578651 (conducted antenna port measurements); 3323393990 (radiated measurements);
Operating Band	2400 – 2483.5 MHz
Device Type	Transceiver
Power Supply / Voltage	Internal Battery/ 5VDC Charger: Garmin (Phi Hong) MN: PSAF10R-050Q (Representative Power Supply)

NOTE: For more detailed features description, please refer to the manufacturer's specifications or user's manual. Please see the checked box in the above table for device/modulation type of the radio.

2.2 DESCRIPTION OF TEST MODES

For MODE 1/MODE 2 Transmissions:

Channel	Frequency
Low	2402.00 MHz
Mid	2440/2441 MHz
High	2480.00 MHz

Modulation modes in this report are referred to in this report as “Mode 1” and “Mode 2” See the operational description for details on these modes.

These are the only representative channels tested in the frequency range according to FCC Part 15.31 and RSS-Gen Table A1. See the operational description for a list of all channel frequency and designations. Please see the checked box on the above tables for transmission/ type of the radio.

2.3 DESCRIPTION OF SUPPORT UNITS

None

3.0 LABORATORY AND GENERAL TEST DESCRIPTION

3.1 LABORATORY DESCRIPTION

All testing was performed at the following Facility:

The Nebraska Center for Excellence in Electronics (NCEE Labs)
 4740 Discovery Drive
 Lincoln, NE 68521

A2LA Certificate Number:	1953.01
FCC Accredited Test Site Designation No:	US1060
Industry Canada Test Site Registration No:	4294A-1
NCC CAB Identification No:	US0177

Environmental conditions varied slightly throughout the tests:

Relative humidity of $35 \pm 4\%$
 Temperature of $22 \pm 3^\circ$ Celsius



3.2 TEST PERSONNEL

No.	PERSONNEL	TITLE	ROLE
1	Nic Johnson	Technical Manager	Review/editing
2	Karthik Vepuri	Test Engineer	Testing and report
3	Caleb Farrington	Test Engineer	Testing and report
4	Fox Lane	Test Technician	Testing and report

Notes:

All personnel are permanent staff members of NCEE Labs. No testing or review was sub-contracted or performed by sub-contracted personnel.



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3.3 TEST EQUIPMENT

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Keysight MXE Signal Analyzer	N9038A	MY59050109	April 23, 2019	April 23, 2021
Keysight EXA Signal Analyzer	N9010A	MY56070862	December 14, 2018	December 14, 2020
SunAR RF Motion	JB1	A091418	March 6, 2020	March 6, 2021
EMCO Horn Antenna	3115	6415	March 16, 2020	March 16, 2022
EMCO Horn Antenna	3116	2576	March 9, 2020	March 9, 2022
Rohde & Schwarz LISN	ESH3-Z5	836679/010	July 25, 2019	July 25, 2020
Rohde & Schwarz Preamplifier*	TS-PR18	3545700803	April 14, 2020	April 14, 2022
Trilithic High Pass Filter*	6HC330	23042	April 14, 2020	April 14, 2022
MiniCircuits High Pass Filter*	VHF-1320+	15542	April 14, 2020	April 14, 2022
RF Cable (preamplifier to antenna)*	MFR-57500	01-07-002	April 14, 2020	April 14, 2022
RF Cable (antenna to 10m chamber bulkhead)*	FSCM 64639	01E3872	April 14, 2020	April 14, 2022
RF Cable (10m chamber bulkhead to control room bulkhead)*	FSCM 64639	01E3874	April 14, 2020	April 14, 2022
RF Cable (control room bulkhead to test receiver)*	FSCM 64639	01F1206	April 14, 2020	April 14, 2022
N connector bulkhead (10m chamber)*	PE9128	NCEEBH1	April 14, 2020	April 14, 2022
N connector bulkhead (control room)*	PE9128	NCEEBH2	April 14, 2020	April 14, 2022
TDK Emissions Lab Software	V11.25	700307	NA	NA

*Internal Characterization

Notes:

All equipment is owned by NCEE Labs and stored permanently at NCEE Labs facilities.

3.4 GENERAL TEST PROCEDURE AND SETUP FOR RADIO MEASUREMENTS

Measurement type presented in this report (Please see the checked box below):

Conducted

The conducted measurements were performed by connecting the output of the transmitter directly into a spectrum analyzer using an impedance matched cable and connector soldered to the EUT in place of the antenna. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in the Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

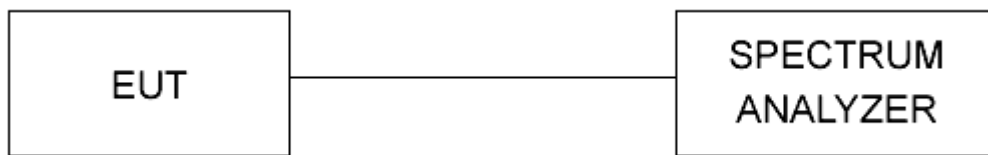


Figure 1 - Bandwidth Measurements Test Setup

Radiated

All the radiated measurements were taken at a distance of 3m from the EUT. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in the Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

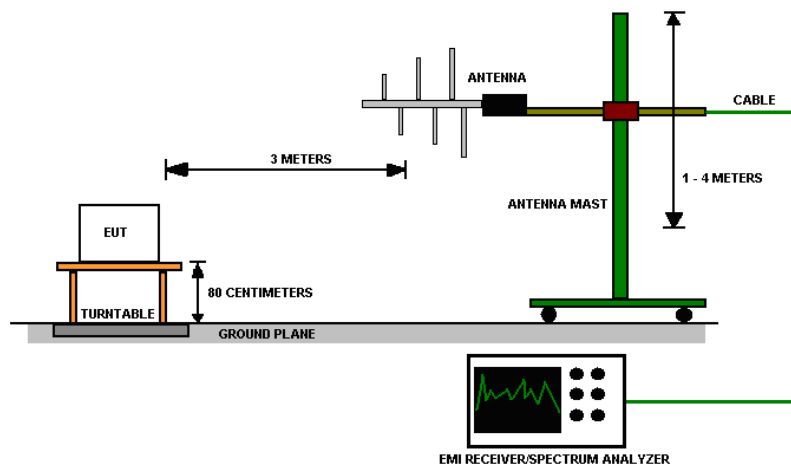


Figure 2 - Radiated Emissions Test Setup



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4.0 RESULTS

SUMMARY OF RADIO MEASUREMENTS

DTS Radio Measurements							
CHANNEL	Transmitter	Occupied Bandwidth (kHz)	6 dB Bandwidth (kHz)	PEAK OUTPUT POWER (dBm)	PEAK OUTPUT POWER (mW)	PSD (dBm)	RESULT
Low	MODE 2	1074.80	708.90	3.882	2.445	N/A	PASS
Mid	MODE 2	1077.90	722.00	3.796	2.397	N/A	PASS
High	MODE 2	1074.20	700.70	3.818	2.409	N/A	PASS
Low	MODE 1	994.18	466.90	3.923	2.468	N/A	PASS
Mid	MODE 1	1018.40	359.50	3.823	2.412	N/A	PASS
High	MODE 1	1015.20	357.50	3.839	2.420	N/A	PASS
Occupied Bandwidth = N/A; 6 dB Bandwidth Limit = N/A				Peak Output Power Limit = N/A; PSD Limit = N/A			
Unrestricted Band-Edge							
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level (dBm)	Relative Fundamental (dBm)	Delta (dB)	Min Delta (dB)	Result
Low	MODE 2	2400.00	-46.92	3.75	50.66	50.00	PASS
Low	MODE 1	2400.00	-47.73	3.83	51.57	50.00	PASS
High	MODE 2	2483.50	-49.14	3.70	52.84	50.00	PASS
High	MODE 1	2483.50	-57.38	3.75	61.13	50.00	PASS
FCC Part 15.249 requires the attenuation of all emissions outside of the specified band to be at least 50 dB below the fundamental or below the 15.209 limits.							
Restricted Band-Edge							
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Detector	Limit (dBuV/m @ 3m)	Margin	Result
Low	MODE 2	2388.50	49.04	Peak	53.98	4.94	PASS
Low	MODE 1	2389.00	49.75	Peak	53.98	4.23	PASS
High	MODE 2	2492.93	50.13	Peak	53.98	3.85	PASS
High	MODE 1	2484.17	50.63	Peak	53.98	3.35	PASS
*Limit shown is the average limit taken from FCC Part 15.209							



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4.1 OUTPUT POWER

Test Method: All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

Limits of power measurements:

For FCC Part 15.249 Device:

For Informational Purposes only

Test procedures:

Details can be found in section 3.4 of this report.

Deviations from test standard:

No deviation.

Test setup:

Details can be found in section 3.4 of this report.

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

1. All the output power plots can be found in the Appendix C.
2. Tabular data can be found in summary of radio measurements section 4.0.
3. All the measurements were found to be compliant.
4. The measurements are listed in the tables below.



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4.2 BANDWIDTH

Test Method: All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

Limits of bandwidth measurements:

For FCC Part 15.249 Device:

For Informational Purposes only

Test procedures:

Details can be found in section 3.4 of this report.

Deviations from test standard:

No deviation.

Test setup:

Test setup details can be found in section 3.4 of this report.

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

1. All the bandwidth plots can be found in the Appendix C.
2. Tabular data can be found in summary of radio measurements section 4.0.
3. All the measurements were found to be compliant.



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4.3 DUTY CYCLE

Test Method: NA

Duty cycle calculations as declared by manufacturer per the following provided table and paragraph.

MODE 2 Duty Cycle

State	Duty Cycle Theoretical Max	Duty Cycle Min Interval	Duty Cycle Typical	Duty Cycle, 0.1 second interval	Averaging correction factor
211ms Advertising			0.60%	1.43%	-56.9 dB
1022ms Advertising			0.10%	1.43%	-56.9 dB
Connected	4.60%		0.4% or less	4.6%	-36.3 dB
Download	49%	26.50%	4.40%	49%	-6.2 dB
Upload	17%	9.20%	1.50%	17%	-15.4 dB

The MODE 1 protocol allows for a 280us data packet every 3.1ms. If you include a 50-150us transmitter warm up period, the effective MODE 1 duty cycle at its maximum data rate of 60Kb/s is 13.8%, translating to an averaging correction factor of **-17.2 dB**.

The MODE 1 protocol allows for other modes of operation (beacon, upload, download), but all are limited to the max duty cycle defined above and limited to a max transmitter ON time of 13.8%.

4.4 RADIATED EMISSIONS

Test Method: ANSI C63.10-2013, Section 6.5, 6.6

Limits for radiated emissions measurements:

Emissions radiated outside of the specified bands shall be applied to the limits in 15.209 as followed:

FREQUENCIES (MHz)	FIELD STRENGTH ($\mu\text{V/m}$)	MEASUREMENT DISTANCE (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = $20 * \log * \text{Emission level } (\mu\text{V/m})$.
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.
4. The EUT was tested for spurious emissions while running off of battery power and external USB power. The worse-case emissions were produced while running off of USB power, so results from this mode are presented.



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Test procedures:

- a. The EUT was placed on the top of a rotating table above the ground plane in a 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. The table was 0.8m high for measurements from 30MHz-1Ghz and 1.5m for measurements from 1GHz and higher.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna was a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.
- d. For each suspected emission, the EUT was arranged to maximize its emissions and then the antenna height was varied from 1 meter to 4 meters and the rotating table was turned from 0 degrees to 360 degrees to find the maximum emission reading.
- e. The test-receiver system was set to use a peak detector with a specified resolution bandwidth. For spectrum analyzer measurements, the composite maximum of several analyzer sweeps was used for final measurements.
- f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- g. The EUT was maximized in all 3 orthogonal positions. The results are presented for the axis that had the highest emissions.

Test setup:

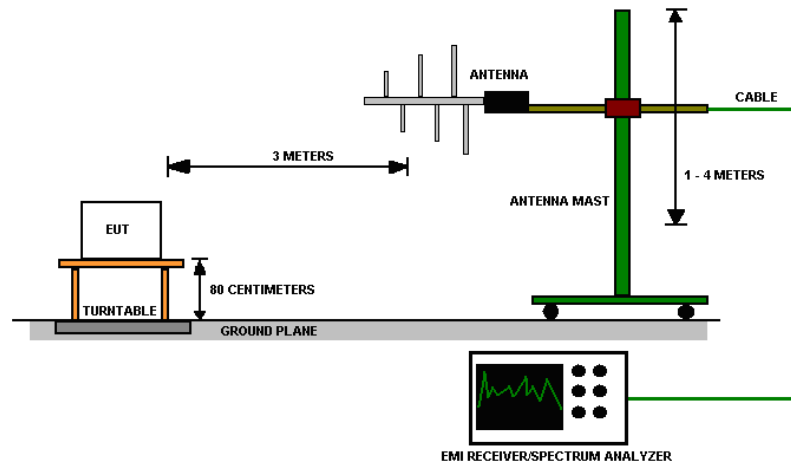


Figure 3 - Radiated Emissions Test Setup

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequencies below 1GHz.
2. The resolution bandwidth 1 MHz for all measurements and at frequencies above 1GHz, A peak detector was used for all measurements above 1GHz. Measurements were made with an EMI Receiver.

Deviations from test standard:

No deviation.

EUT operating conditions

Details can be found in section 2.1 of this report.

Test results:

Figure 4 - Radiated Emissions Plot, Receive

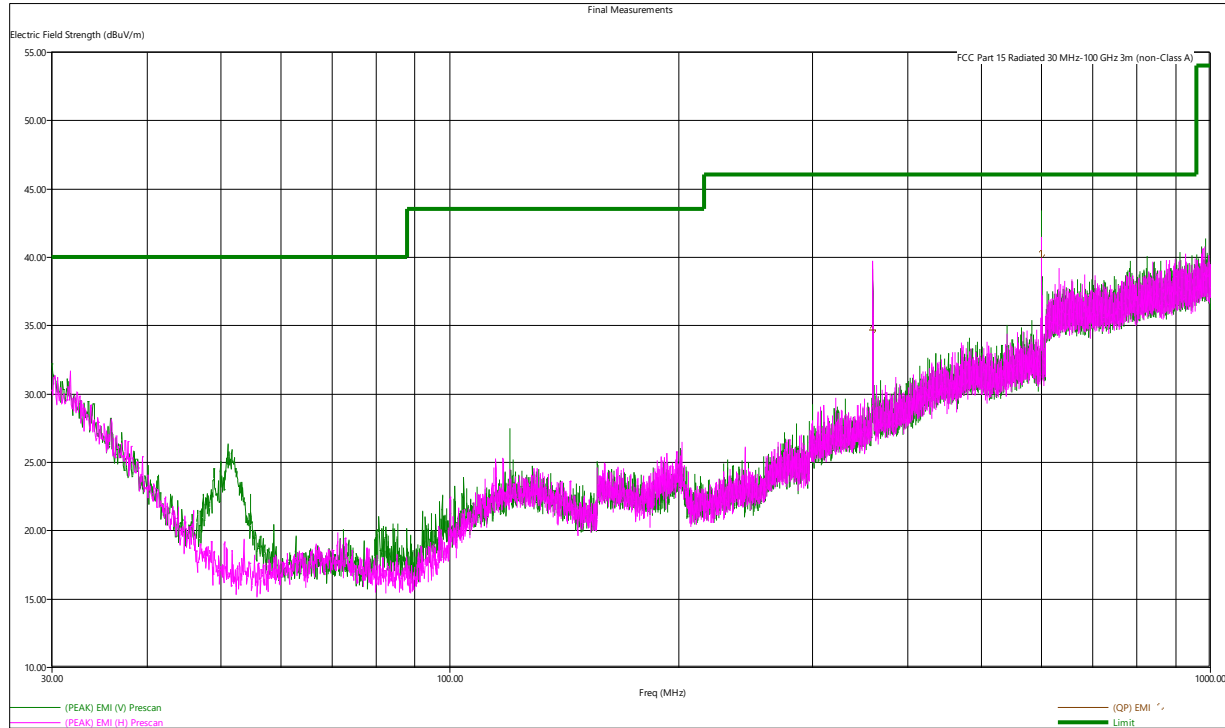


Figure 5 - Radiated Emissions Plot, Low Channel, MODE 1

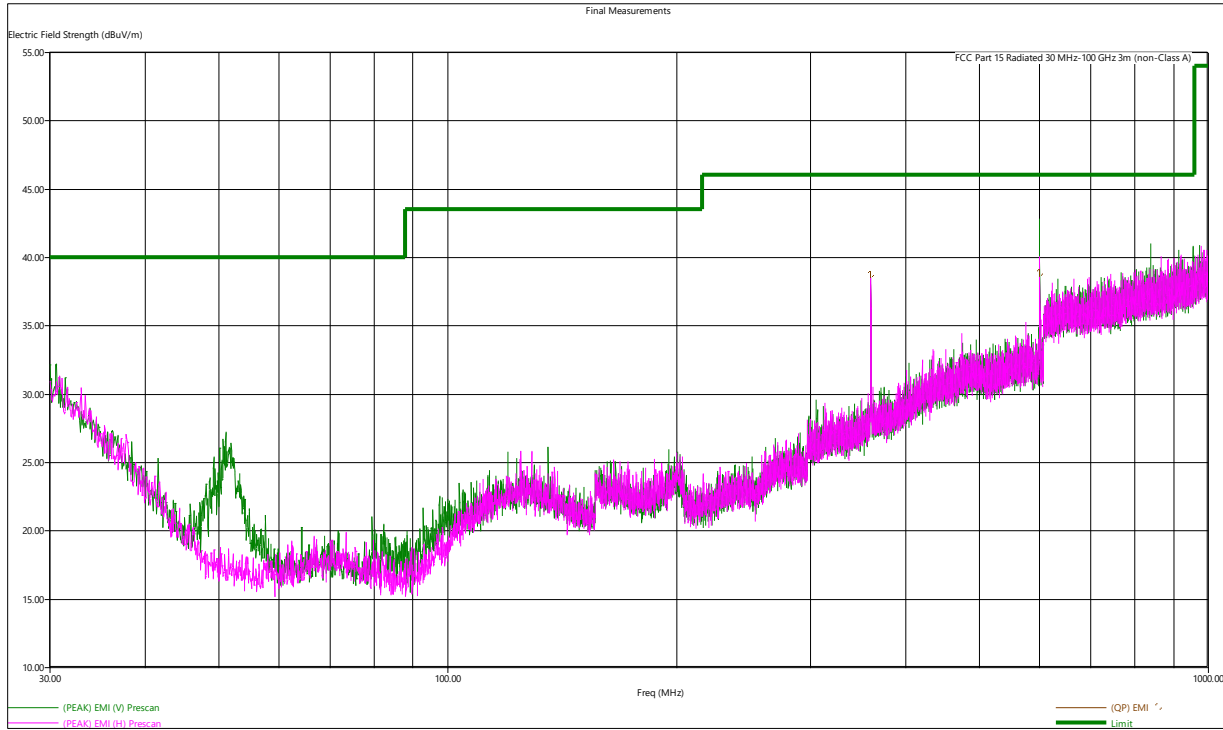


Figure 6 - Radiated Emissions Plot, Mid Channel, MODE 1

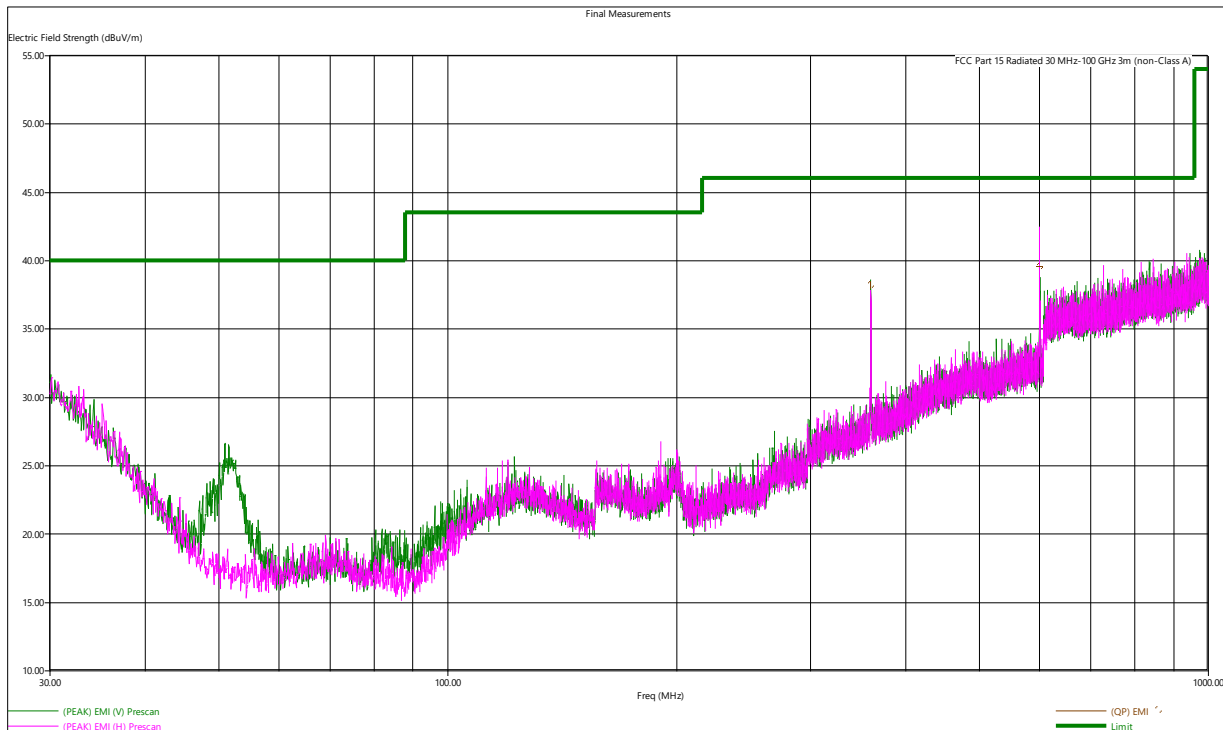


Figure 7 - Radiated Emissions Plot, High Channel, MODE 1

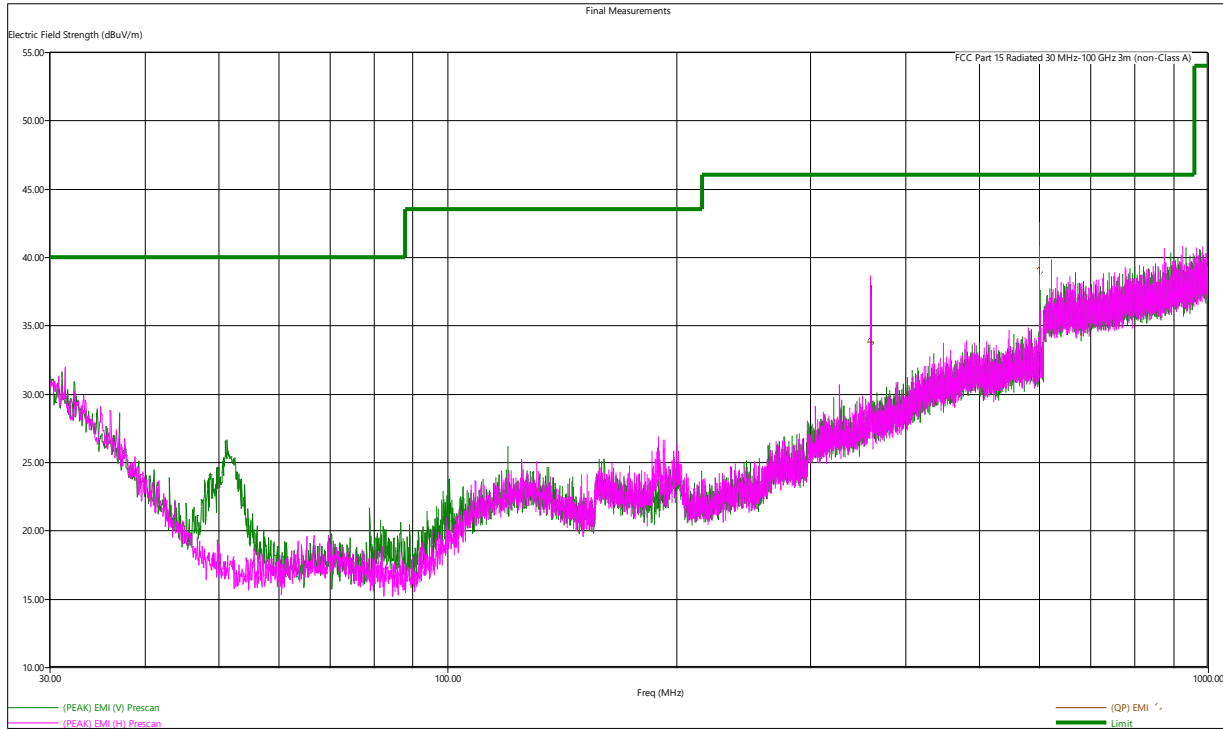


Figure 8 - Radiated Emissions Plot, Low Channel, MODE 2

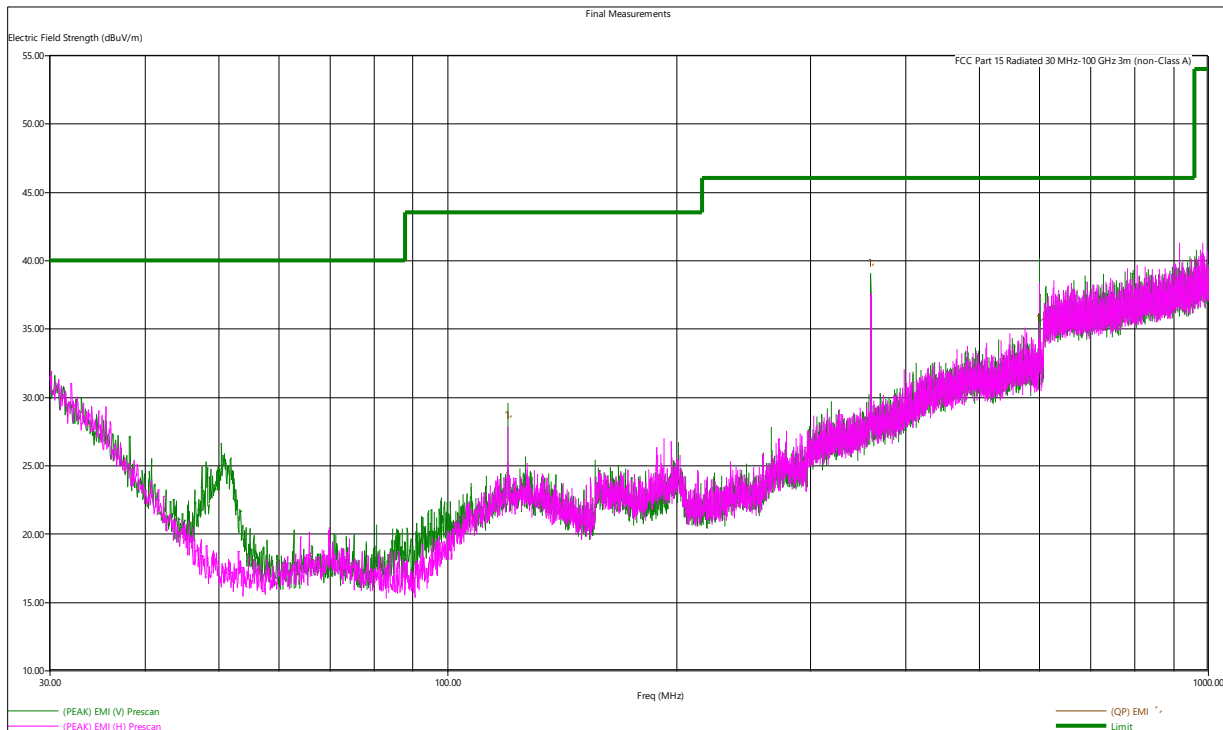


Figure 9 - Radiated Emissions Plot, Mid Channel, MODE 2

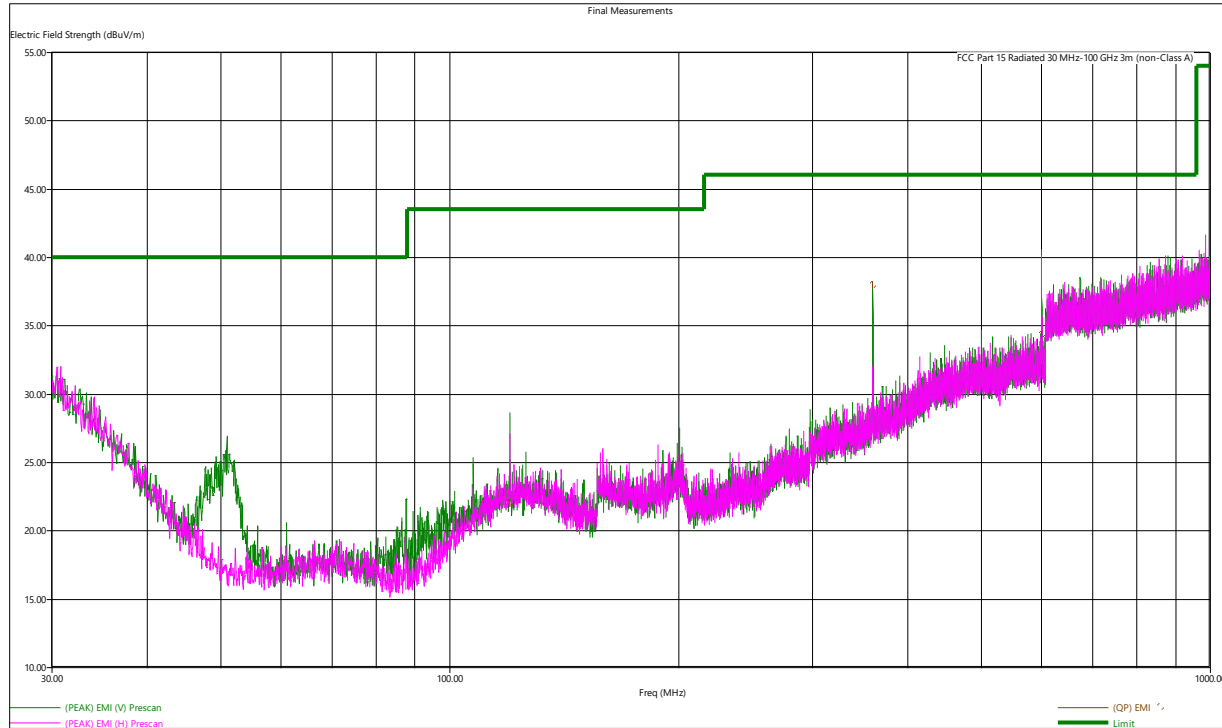


Figure 10 - Radiated Emissions Plot, High Channel, MODE 2

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value



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Quasi-Peak Measurements, MODE 2-MODE 1								
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.			
360.009840	33.77	46.02	12.25	270	66	H	Low	MODE 2
600.046560	38.96	46.02	7.06	108	223	V	Low	MODE 2
120.020640	28.64	43.52	14.88	107	271	V	Mid	MODE 2
359.997840	39.77	46.02	6.25	183	341	V	Mid	MODE 2
599.803440	35.81	46.02	10.21	127	80	V	Mid	MODE 2
120.091200	21.99	43.52	21.53	123	254	V	High	MODE 2
360.035040	37.97	46.02	8.05	166	298	V	High	MODE 2
599.916960	34.32	46.02	11.70	104	105	V	High	MODE 2
359.962320	34.62	46.02	11.4	104	58	H	Low	MODE 1
599.949600	40.15	46.02	5.87	110	226	V	Low	MODE 1
360.004800	38.7	46.02	7.32	165	287	V	Mid	MODE 1
600.106080	38.85	46.02	7.17	109	221	V	Mid	MODE 1
600.143040	39.51	46.02	6.51	151	287	H	High	MODE 1
360.002400	38.21	46.02	7.81	184	317	V	High	MODE 1
599.943120	39.53	46.02	6.49	170	312	H	Receive	
360.010080	39.54	46.02	6.48	166	4	V	Receive	

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the plot and table above.



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Peak Measurements, MODE 2-MODE 1								
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.			
2402.000000	87.78	114.00	26.22	126.00	148.00	H	Low	MODE 2
2440.232000	87.57	114.00	26.43	126.00	165.00	H	Mid	MODE 2
2480.000000	86.65	114.00	27.35	189.00	228.00	H	High	MODE 2
4803.284000	48.99	74.00	25.01	154.00	107.00	H	Low	MODE 2
7206.626000	59.13	74.00	14.87	194.00	29.00	H	Low	MODE 2
4880.212000	48.58	74.00	25.42	173.00	71.00	H	Mid	MODE 2
7320.940000	58.23	74.00	15.77	152.00	70.00	V	Mid	MODE 2
4960.348000	48.86	74.00	25.14	192.00	89.00	H	High	MODE 2
7441.508000	49.09	74.00	24.91	150.00	67.00	V	High	MODE 2
2402.022000	90.14	114.00	23.86	172.00	40.00	H	Low	MODE 1
2442.098000	86.98	114.00	27.02	213.00	314.00	H	Mid	MODE 1
2479.018000	87.42	114.00	26.58	210.00	138.00	H	High	MODE 1
4803.702000	46.68	74.00	27.32	203.00	188.00	H	Low	MODE 1
7206.036000	60.05	74.00	13.95	196.00	127.00	H	Low	MODE 1
4881.582000	46.55	74.00	27.45	156.00	192.00	H	Mid	MODE 1
7322.852000	58.66	74.00	15.34	133.00	167.00	V	Mid	MODE 1
4957.800000	48.10	74.00	25.90	156.00	172.00	H	High	MODE 1
7436.898000	55.94	74.00	18.06	201.00	135.00	H	High	MODE 1



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Average Measurements, MODE 2-MODE 1								
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.			
2402.000000	81.58	94.00	12.42	126.00	148.00	H	Low	MODE 2
2440.232000	81.37	94.00	12.63	126.00	165.00	H	Mid	MODE 2
2480.000000	80.45	94.00	13.55	189.00	228.00	H	High	MODE 2
4803.284000	42.79	54.00	11.21	154.00	107.00	H	Low	MODE 2
7206.626000	52.93	54.00	1.07	194.00	29.00	H	Low	MODE 2
4880.212000	42.38	54.00	11.62	173.00	71.00	H	Mid	MODE 2
7320.940000	52.03	54.00	1.97	152.00	70.00	V	Mid	MODE 2
4960.348000	42.66	54.00	11.34	192.00	89.00	H	High	MODE 2
7441.508000	42.89	54.00	11.11	150.00	67.00	V	High	MODE 2
2402.022000	72.94	94.00	21.06	172	40	H	Low	MODE 1
2442.098000	69.78	94.00	24.22	213	314	H	Mid	MODE 1
2479.018000	70.22	94.00	23.78	210	138	H	High	MODE 1
4803.702000	29.48	54.00	24.52	203	188	H	Low	MODE 1
7206.036000	42.85	54.00	11.15	196	127	H	Low	MODE 1
4881.582000	29.35	54.00	24.65	156	192	H	Mid	MODE 1
7322.852000	41.46	54.00	12.54	133	167	V	Mid	MODE 1
4957.800000	30.90	54.00	23.10	156	172	H	High	MODE 1
7436.898000	38.74	54.00	15.26	201	135	H	High	MODE 1

*Average level is based on duty cycle correction applied to the peak values.
 Duty cycle correction that was applied can be found in section 4.3.



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4.5 BAND EDGES

Test Method: All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

Limits of band-edge measurements:

For FCC Part 15.249 Device:

For emissions outside of the allowed band of operation, the emission level needs to be 50dB under the maximum fundamental field strength. However, if the emissions fall within one of the restricted bands from 15.205 the field strength levels need to be under that of the limits in 15.209.

Test procedures:

The highest emissions level beyond the band-edge was measured and recorded. All band edge measurements were evaluated to the general limits in Part 15.209. More details can be found in section 3.4 of this report.

Deviations from test standard:

No deviation.

Test setup:

Test setup details can be found in section 3.4 of this report.

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test results:

Pass

Comments:

1. All the band edge plots can be found in the Appendix C.
2. Tabular data can be found in summary of radio measurements section 4.0.
3. If the device falls under FCC Part 15.247 (Details can be found in summary of test results), compliance is shown in the unrestricted band edges by showing minimum delta of 20 dB between peak and the band edge.
4. If the device falls under FCC Part 15.249 (Details can be found in summary of test results), compliance is shown in the unrestricted band edges by showing minimum delta of 50 dB between peak and the band edge.
5. The restricted band edge compliance is shown by comparing to the general limit defined in Part 15.209. The limit shown in the graph accounts for the antenna gain of the device.

4.6 CONDUCTED AC MAINS EMISSIONS

Test Method: ANSI C63.10-2013, Section(s) 6.2

Limits for conducted emissions measurements:

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

Notes:

1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz
3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

Test Procedures:

- a. The EUT was placed 0.8m above a ground reference plane and 0.4 meters from the conducting wall of a shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). The LISN provides 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference as well as the ground.
- c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels over 10dB under the prescribed limits are not reported.
- d. Results were compared to the 15.207 limits.

Deviation from the test standard:

No deviation

EUT operating conditions:

Details can be found in section 2.1 of this report.

Test Results:

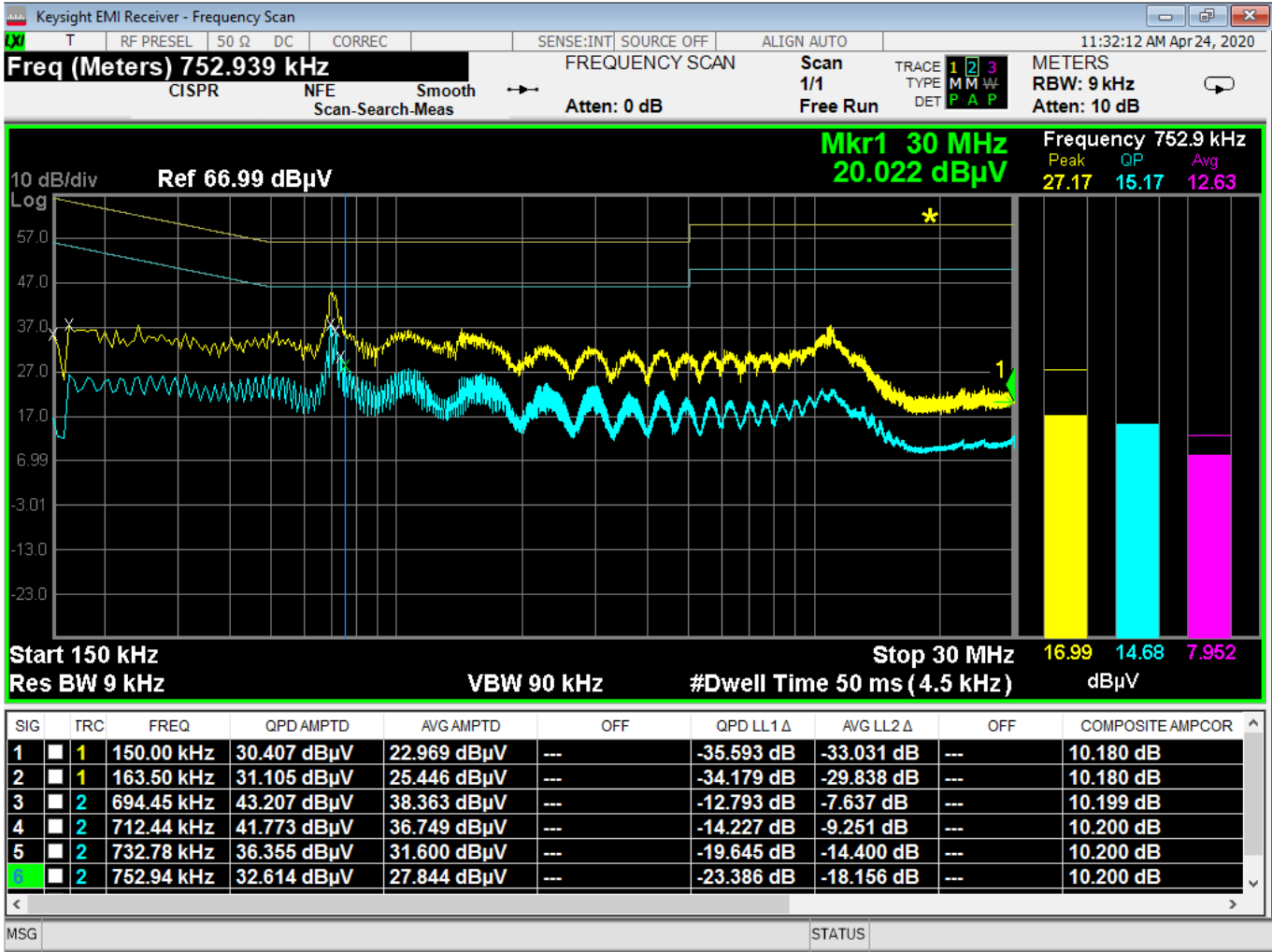


Figure 11 - Conducted Emissions Plot, Line

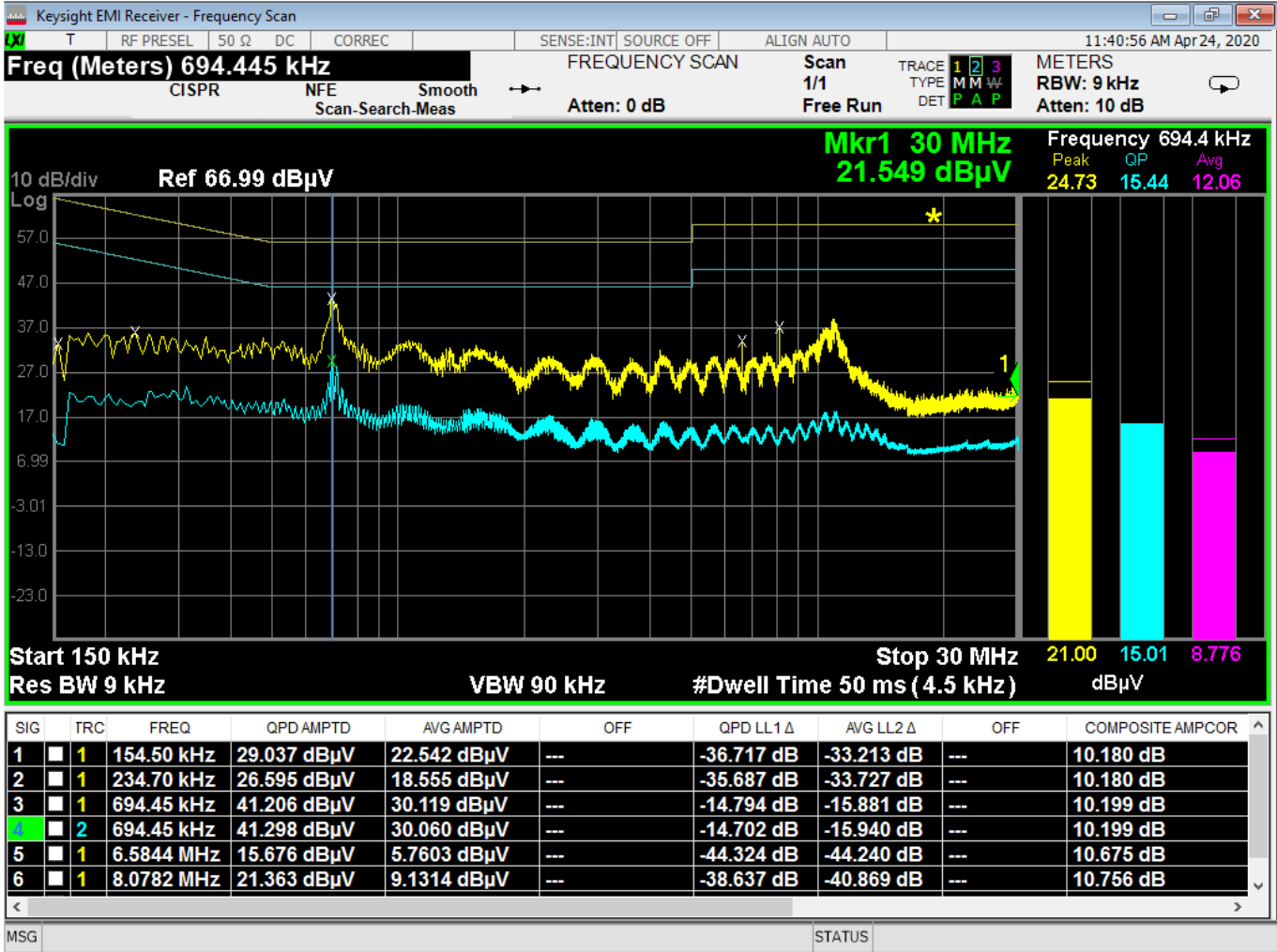


Figure 12 - Conducted Emissions Plot, Neutral



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APPENDIX A: SAMPLE CALCULATION

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF - (-CF + AG) + AV$$

where FS = Field Strength

- RA = Receiver Amplitude
- AF = Antenna Factor
- CF = Cable Attenuation Factor
- AG = Amplifier Gain
- AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dB μ V is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dB μ V/m.

$$FS = 55 + 12 - (-1.1 + 20) + 0 = 48.1 \text{ dB}\mu\text{V/m}$$

The 48.1 dB μ V/m value can be mathematically converted to its corresponding level in μ V/m.

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(48.1 \text{ dB}\mu\text{V/m})/20] = 254.1 \mu\text{V/m}$$

AV is calculated by the taking the $20 \cdot \log(T_{on}/100)$ where T_{on} is the maximum transmission time in any 100ms window.



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EIRP Calculations

In cases where direct antenna port measurement is not possible or would be inaccurate, output power is measured in EIRP. The maximum field strength is measured at a specified distance and the EIRP is calculated using the following equation;

$$EIRP \text{ (Watts)} = [\text{Field Strength (V/m)} \times \text{antenna distance (m)}]^2 / 30$$

$$\text{Power (watts)} = 10^{[\text{Power (dBm)}/10]} / 1000$$

$$\text{Voltage (dB}\mu\text{V)} = \text{Power (dBm)} + 107 \text{ (for } 50\Omega \text{ measurement systems)}$$

$$\text{Field Strength (V/m)} = 10^{[\text{Field Strength (dB}\mu\text{V/m)} / 20]} / 10^6$$

$$\text{Gain} = 1 \text{ (numeric gain for isotropic radiator)}$$

Conversion from 3m field strength to EIRP (d=3):

$$EIRP = [\text{FS(V/m)} \times d^2]/30 = \text{FS [0.3]} \quad \text{for } d = 3$$

$$EIRP(\text{dBm}) = \text{FS}(\text{dB}\mu\text{V/m}) - 10(\log 10^9) + 10\log[0.3] = \text{FS}(\text{dB}\mu\text{V/m}) - 95.23$$

10log(10^9) is the conversion from micro to milli



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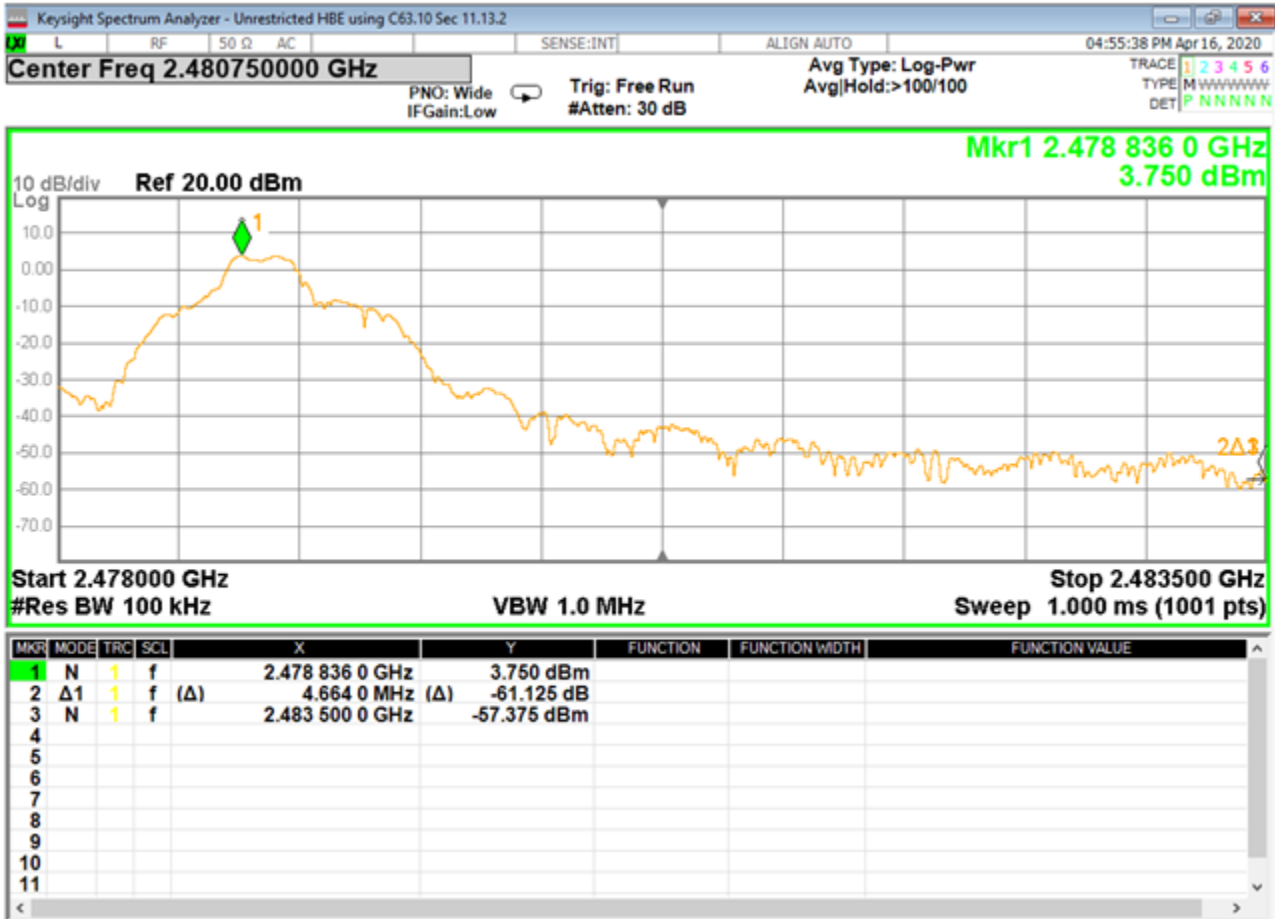
APPENDIX B – MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

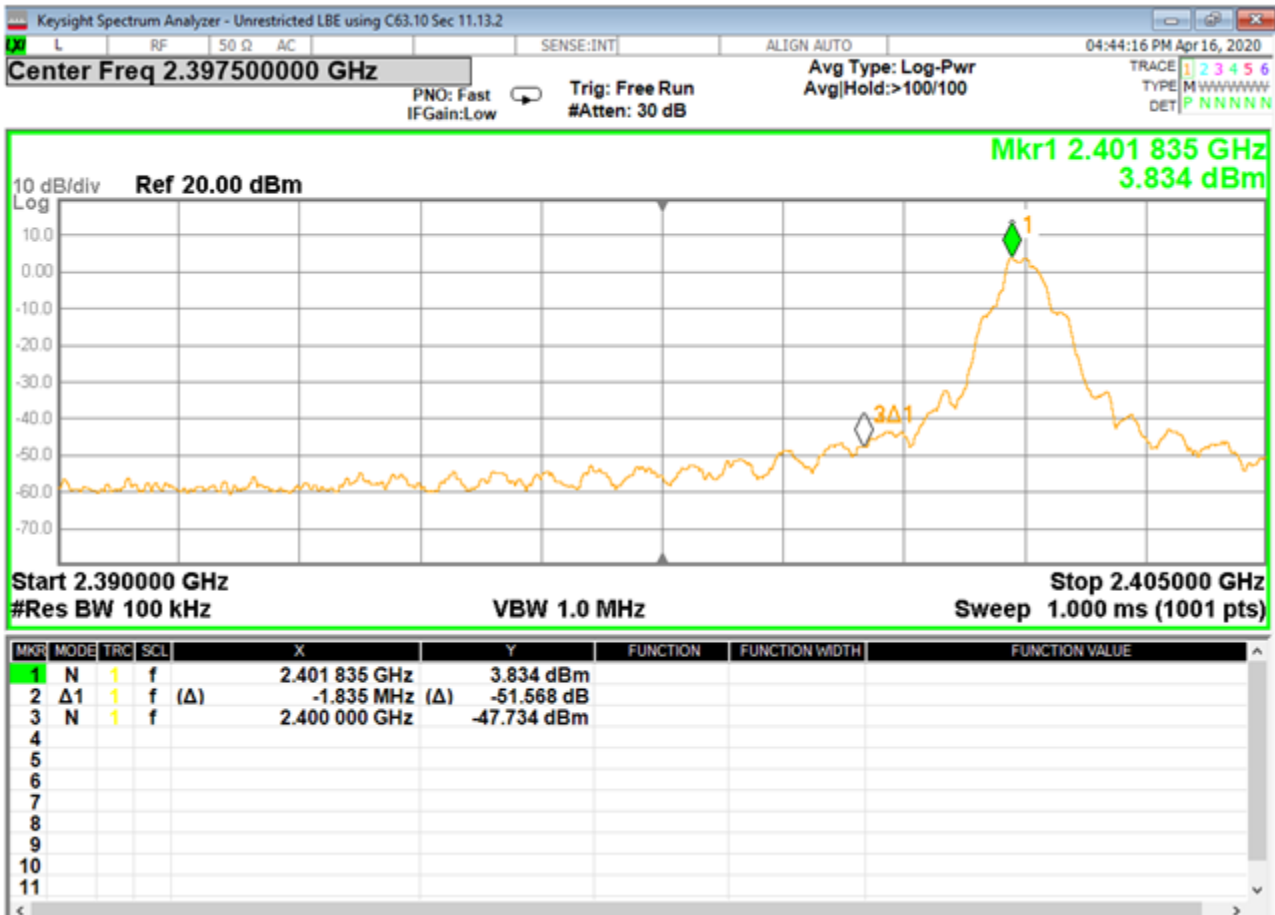
Test	Frequency Range	Uncertainty Value (dB)
Radiated Emissions, 3m	30MHz - 1GHz	3.82
Radiated Emissions, 3m	1GHz - 18GHz	4.44
Emissions limits, conducted	30MHz – 18GHz	±3.30 dB

Expanded uncertainty values are calculated to a confidence level of 95%.

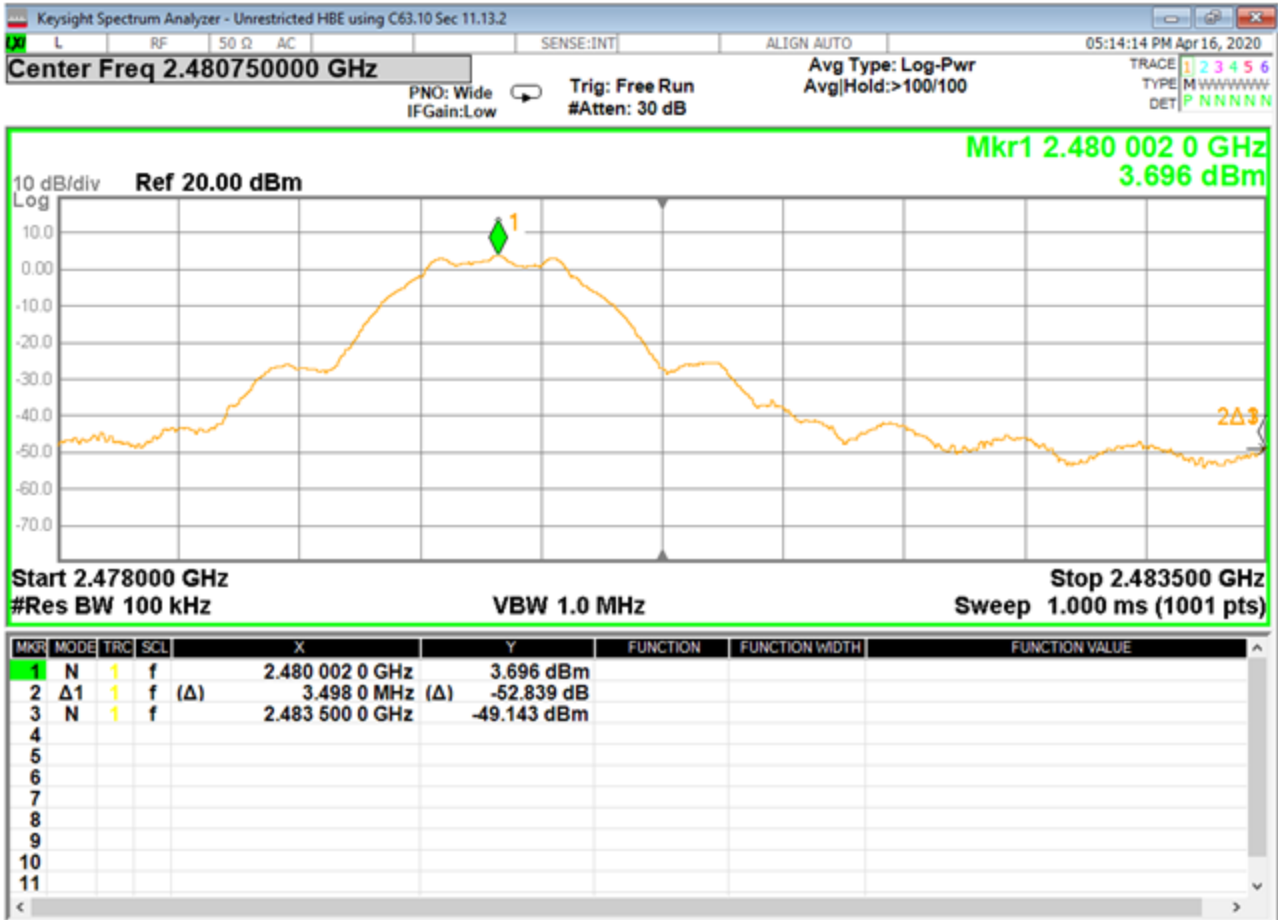
APPENDIX C – GRAPHS AND TABLES



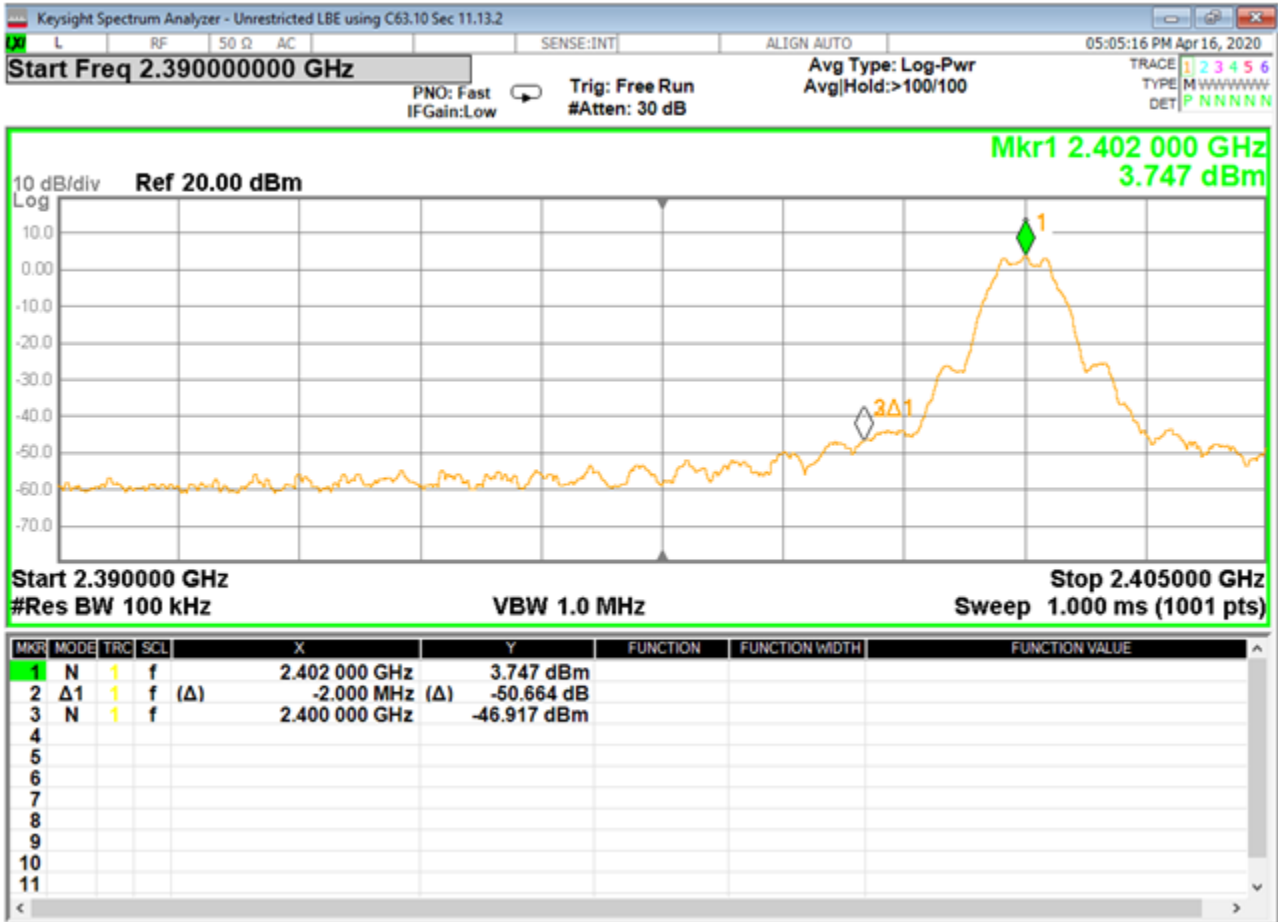
Bandedge_MODE 1_High Channel_Unrestricted



Bandedge_MODE 1_Low Channel_Unrestricted



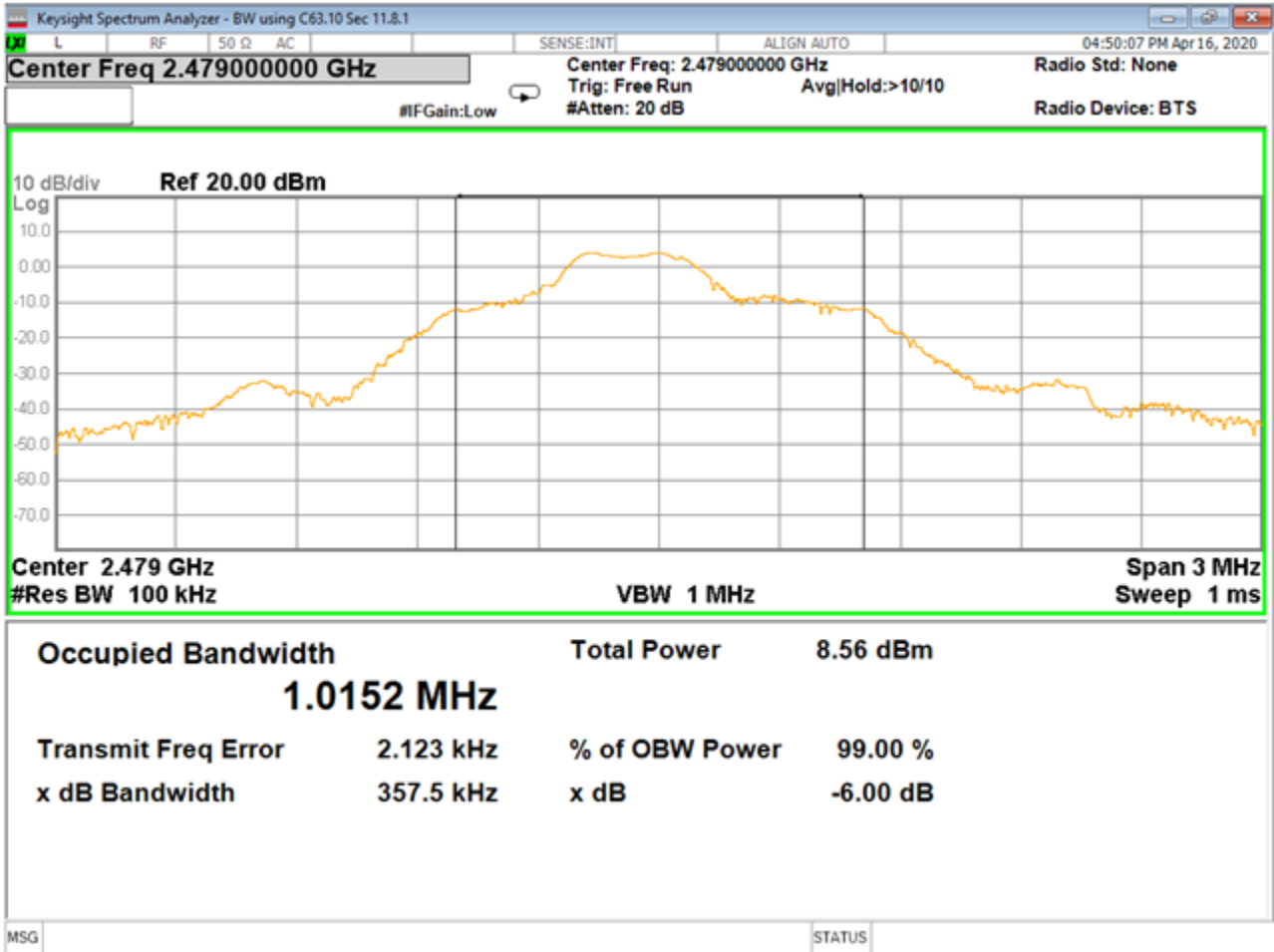
Bandedge_MODE 2_High Channel_Unrestricted



Bandedge_MODE 2_Low Channel_Unrestricted



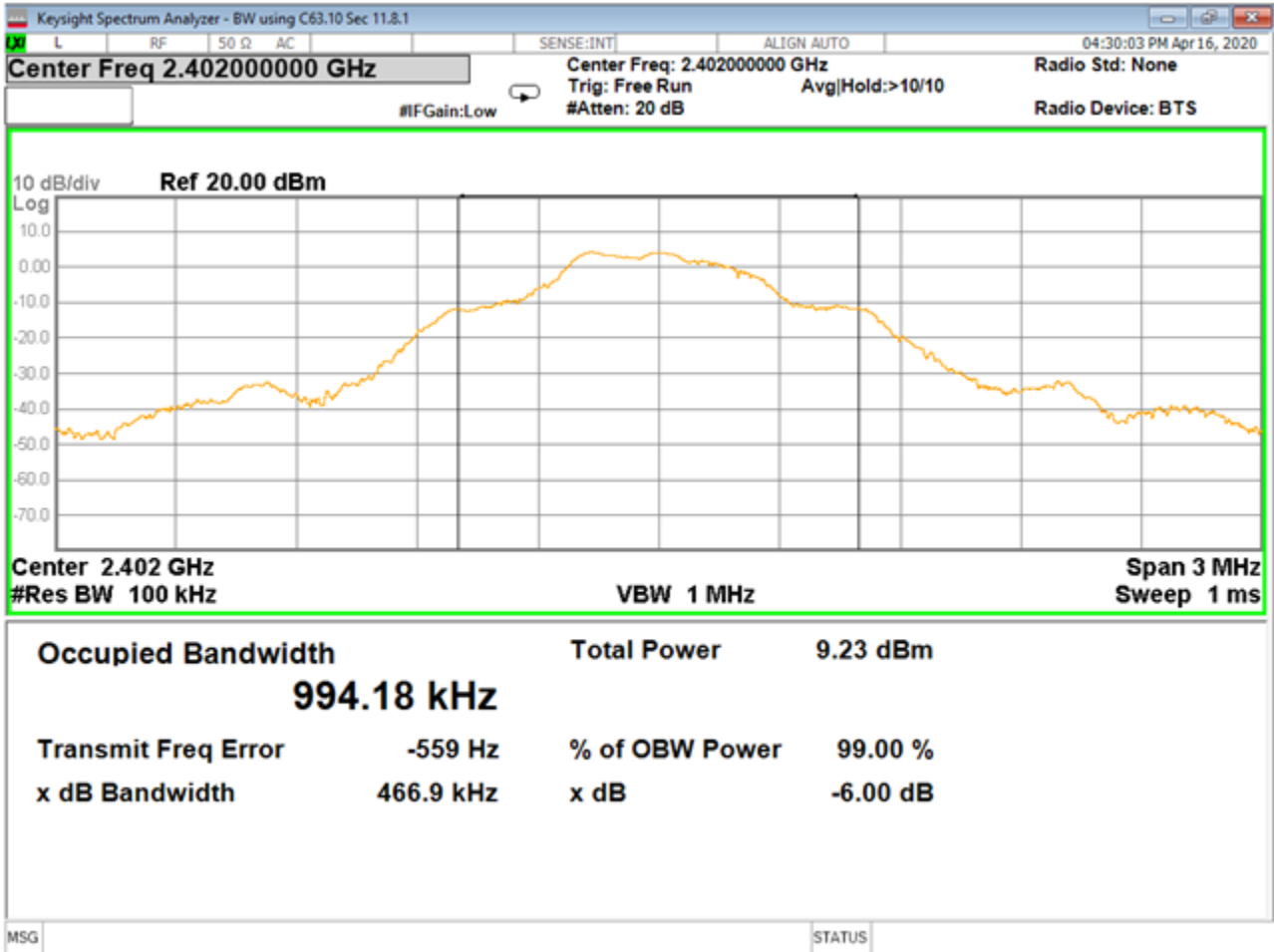
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Bandwidth_MODE 1_High Channel



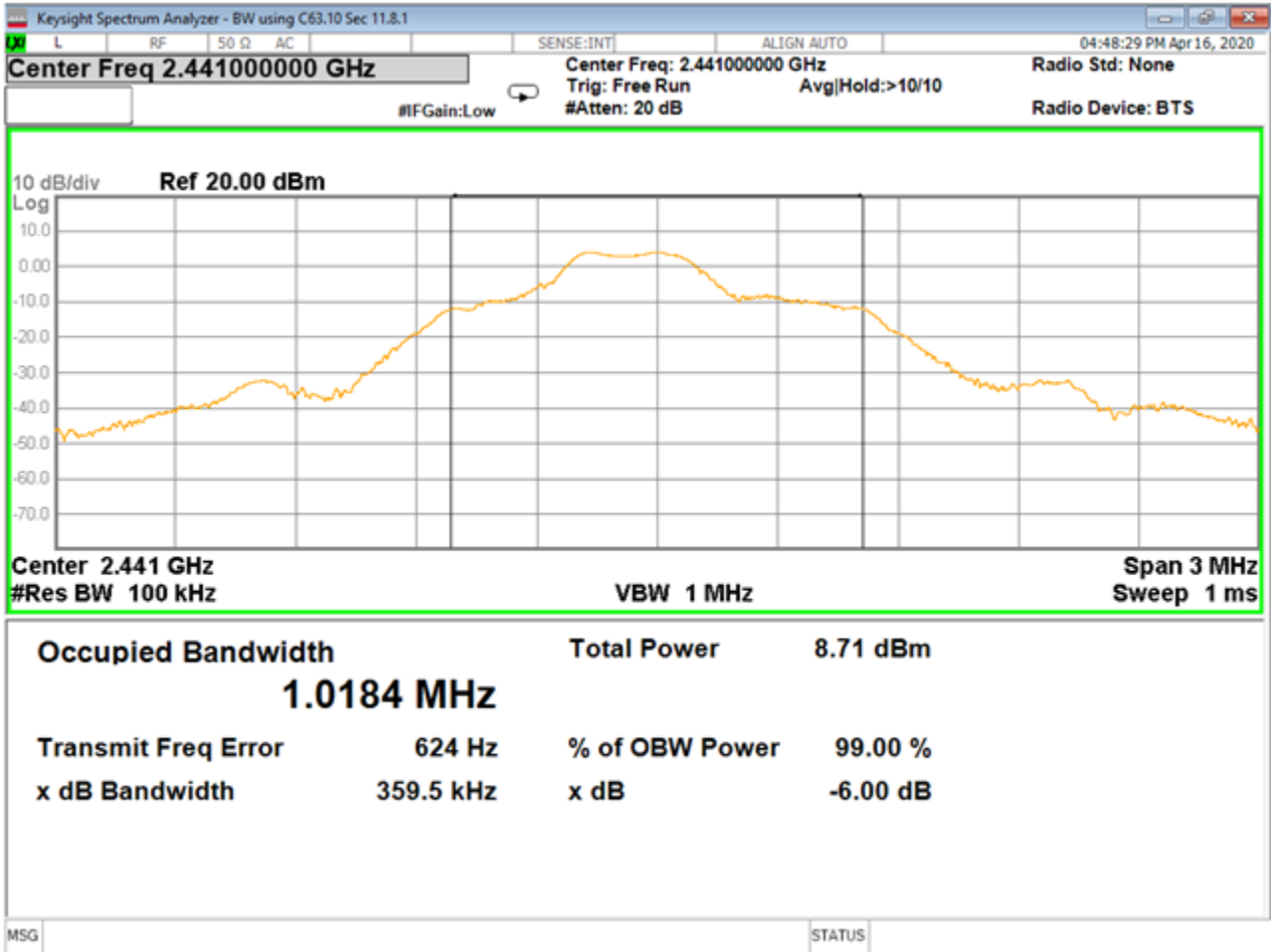
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Bandwidth_MODE 1_Low Channel



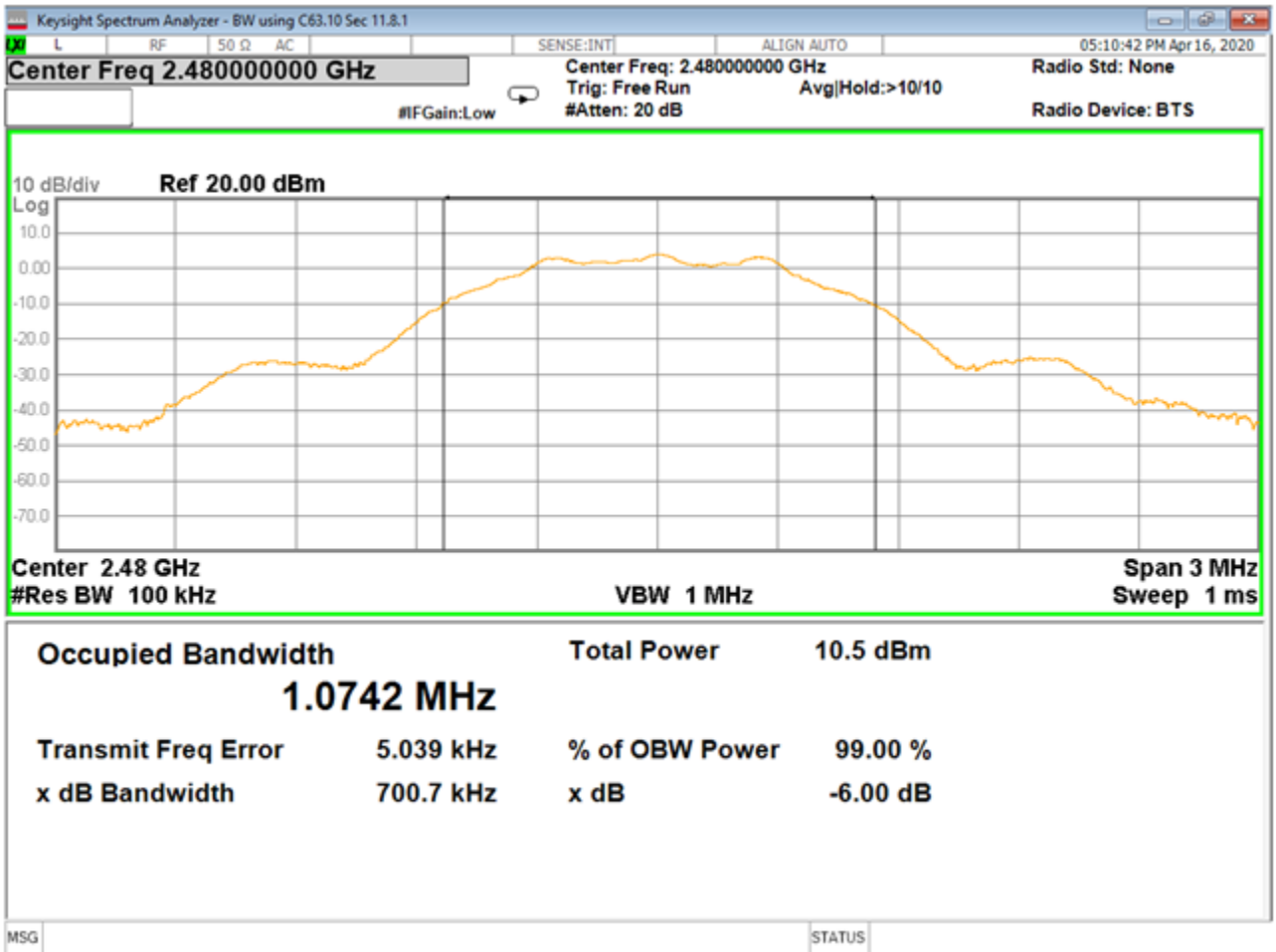
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Bandwidth_MODE 1_Mid Channel



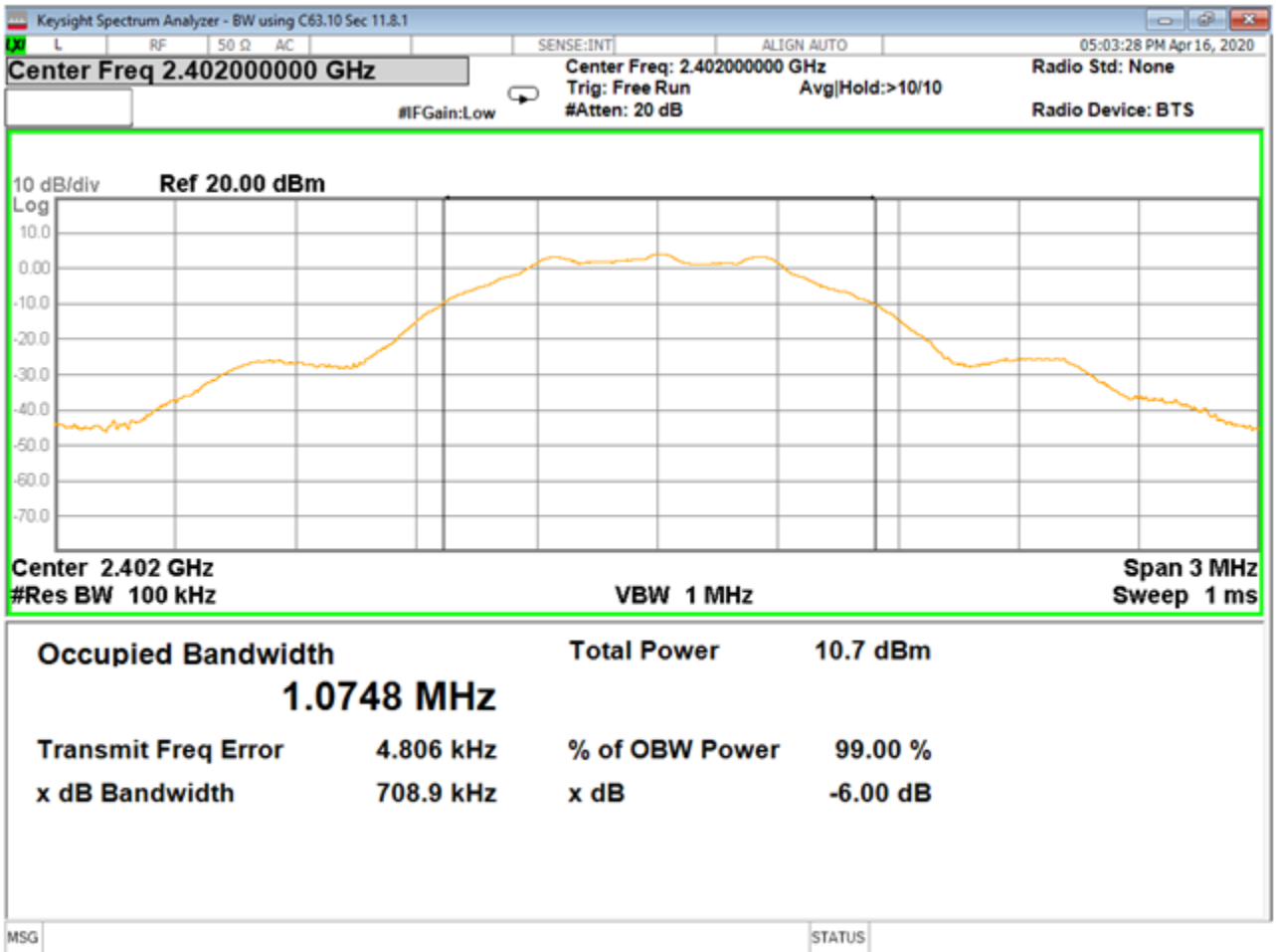
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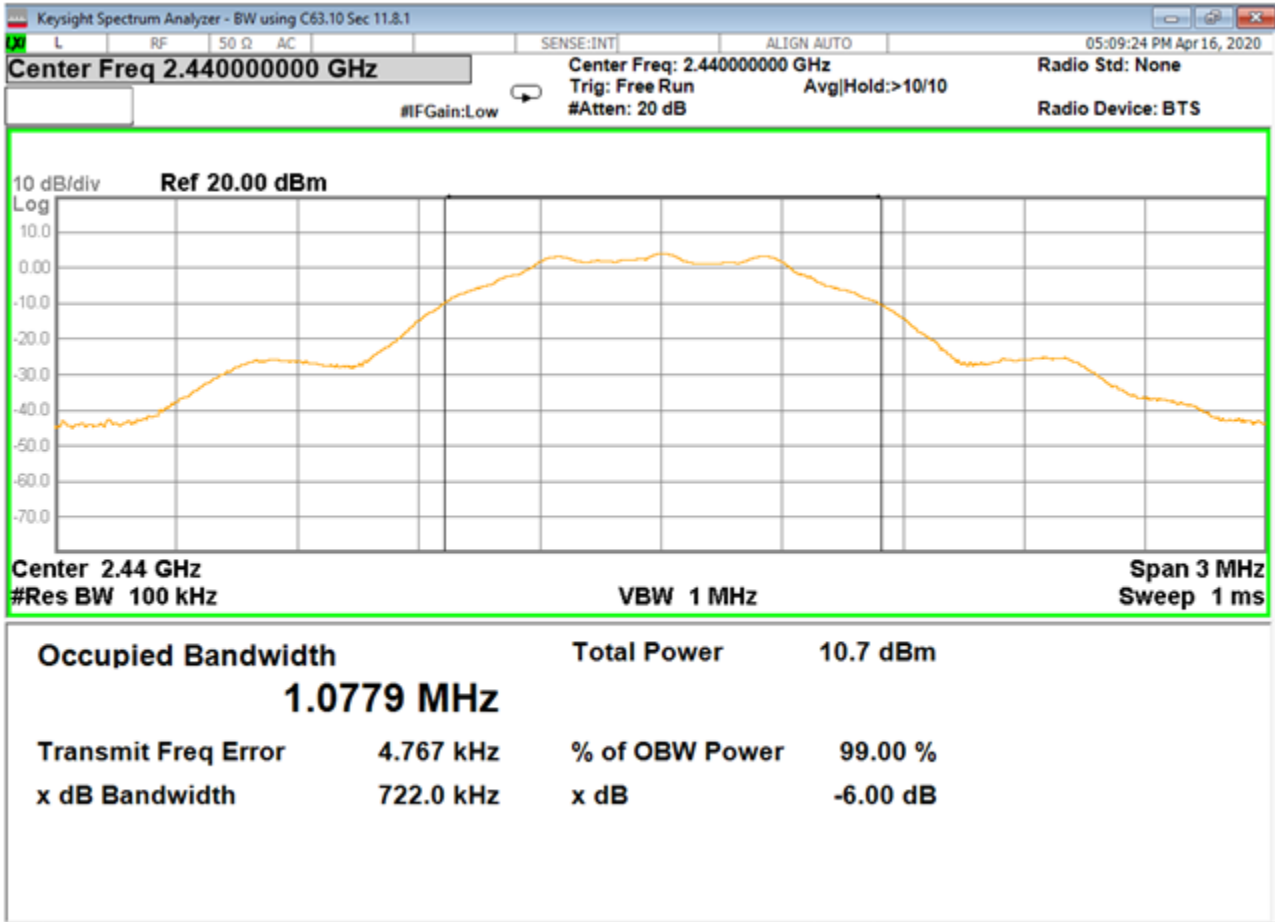
Bandwidth_MODE 2_High Channel



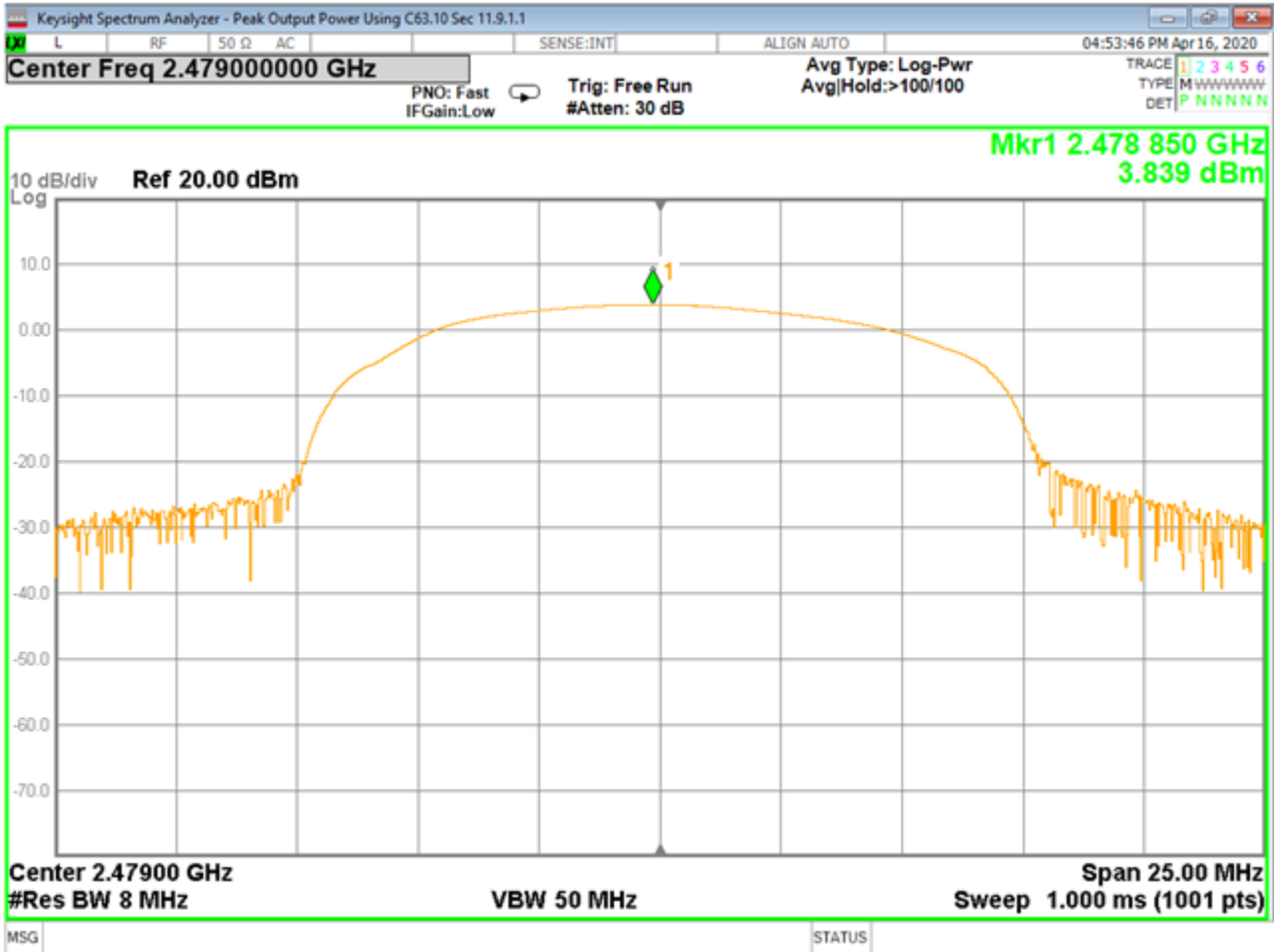
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Bandwidth_MODE 2_Low Channel



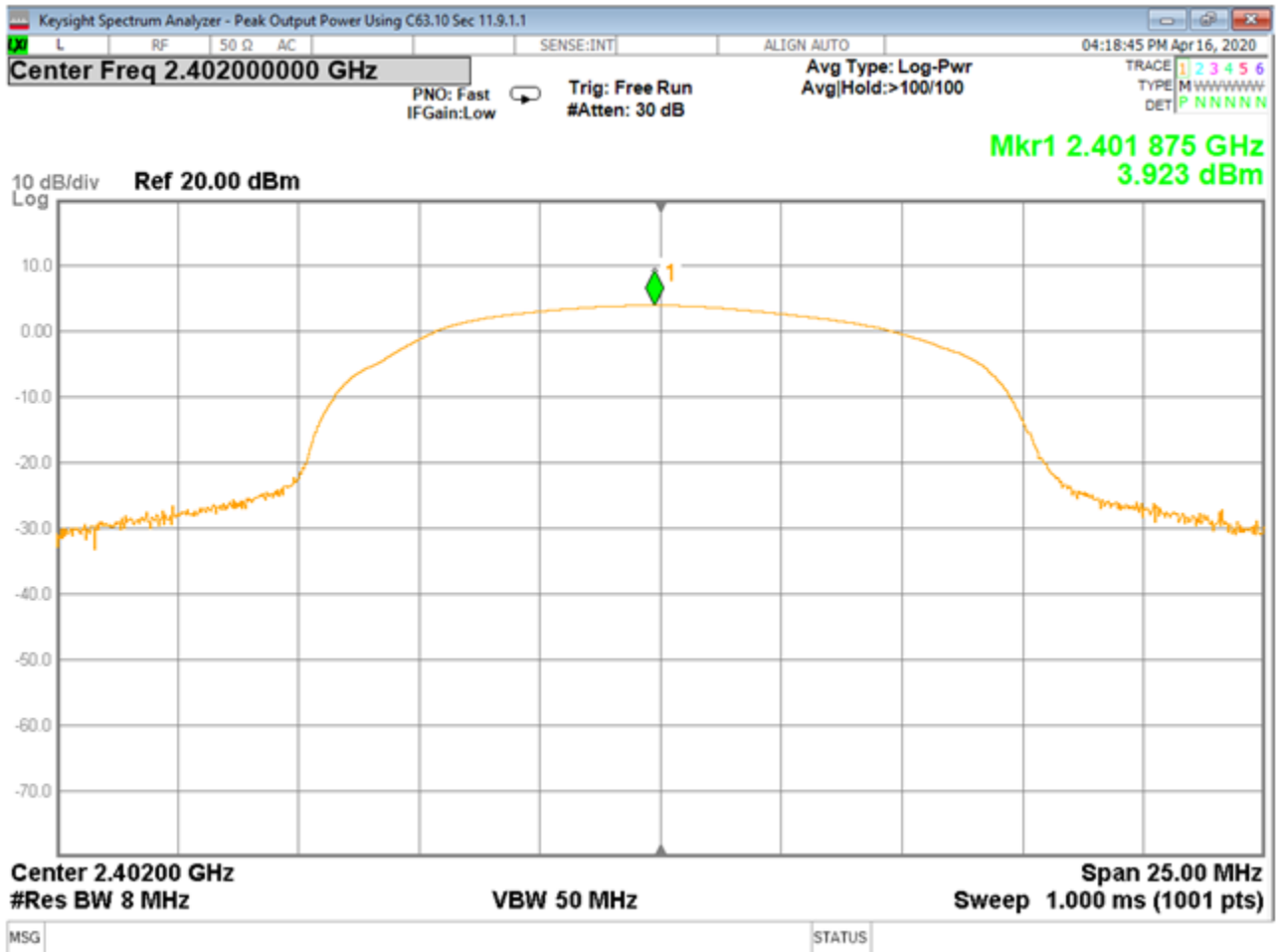
Bandwidth_MODE 2_Mid Channel



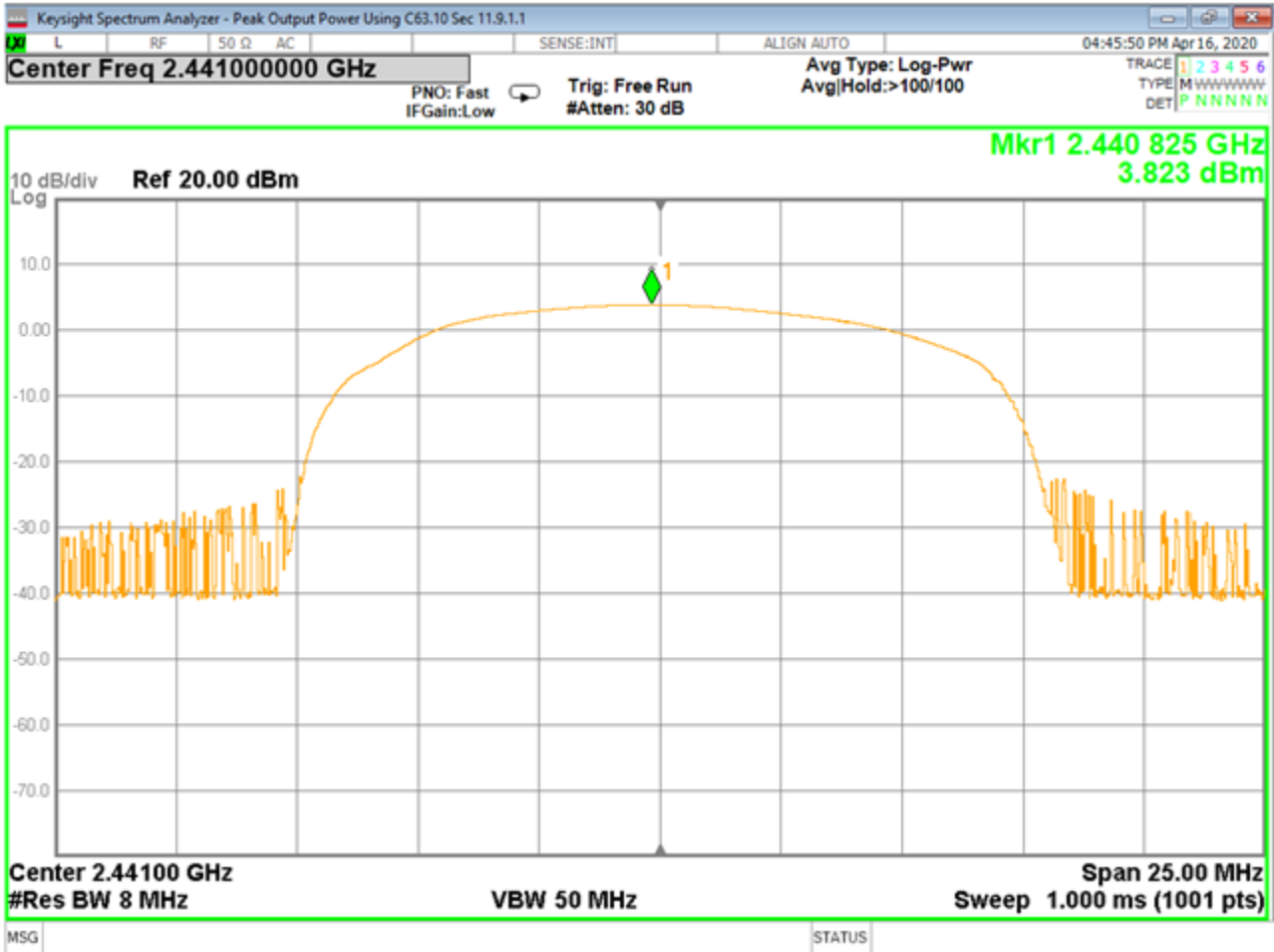
Peak Output Power_MODE 1_High Channel



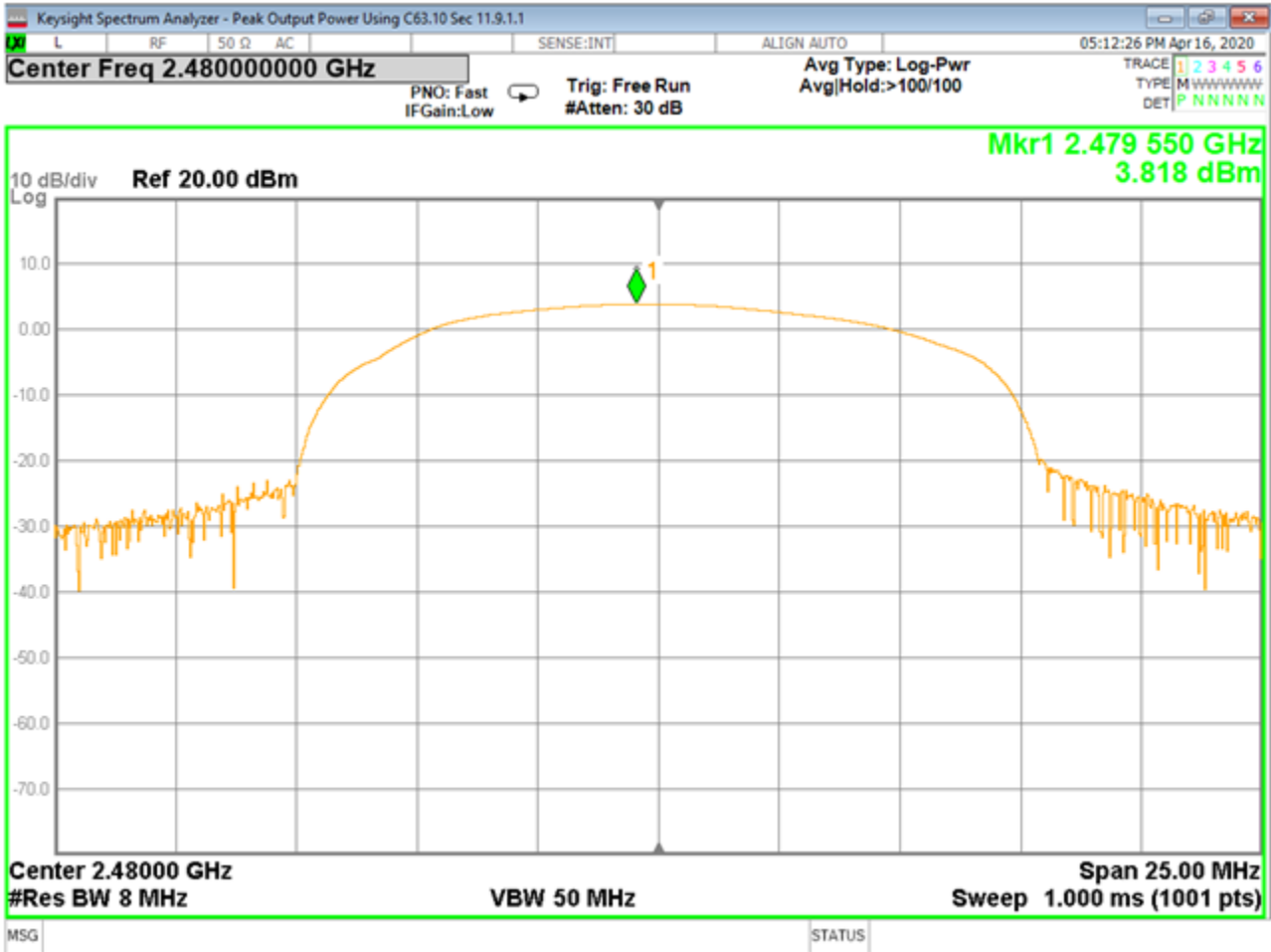
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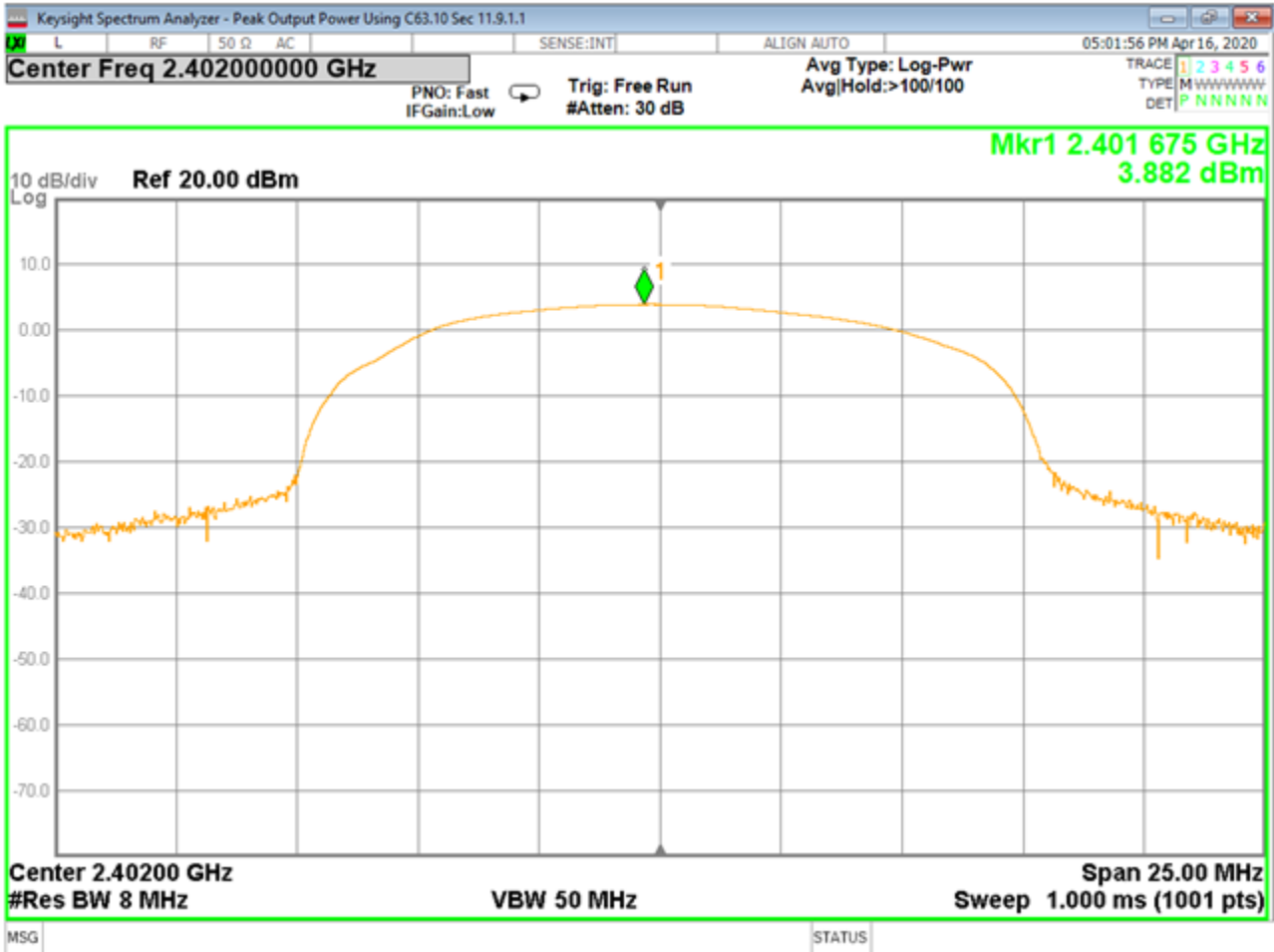
Peak Output Power_MODE 1_Low Channel



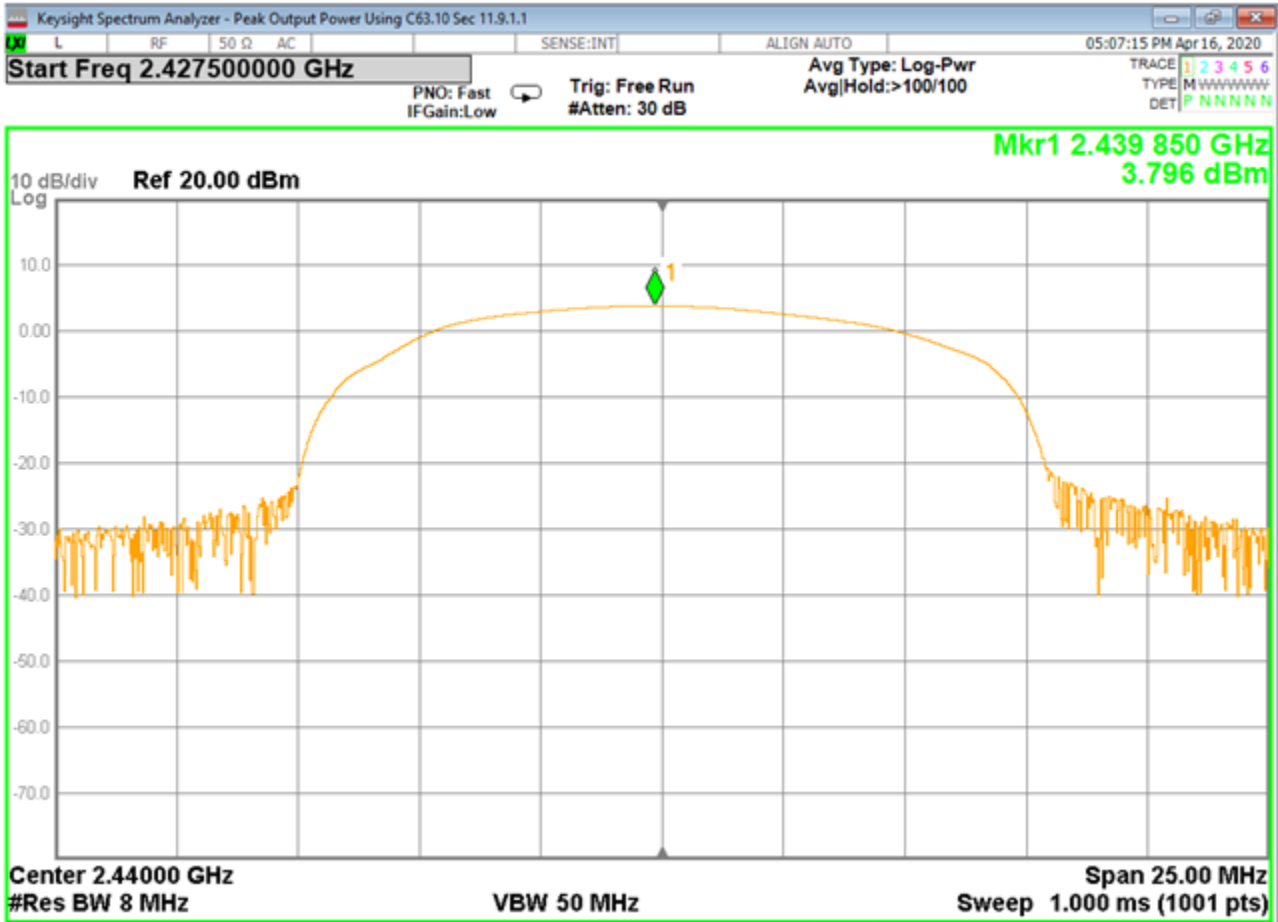
Peak Output Power_MODE 1_Mid Channel



Peak Output Power_MODE 2_High Channel



Peak Output Power_MODE 2_Low Channel



Peak Output Power_MODE 2_Mid Channel



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