ncee labs
Product Compliance Solutions

4740 Discovery Drive | Lincoln, NE 68521
tel- 402.323.6233 | tel -888.657.6860 | fax - 402.323.6238
info@nceelabs.com | http://nceelabs.com

Amended

FCC/ISED Test Report

Prepared for:	**Garmin International, Inc.**
Address:	**1200 E. 151st Street** **Olathe, Kansas, 66062, USA**
Product:	**A04556**
Test Report No:	**R20210922-20-E2B**
Approved by:	**Nic S. Johnson, NCE** Techncial Manager iNARTE certified EMC Engineer EMC-003337-NE
DATE:	**14 January 2022**
Total Pages:	**36**

The Nebraska Center for Excellence in Electronics (NCEE) authorizes the above named company to reproduce this report provided it is reproduced in its entirety for use by the company's employees only. Any use that a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. NCEE accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This report applies only to the items tested.

ilac-MRA
ACCREDITED
TESTING LABORATORY
CERTIFICATE NO. 1953.01

REVISION PAGE

Rev. No.	Date	Description
0	8 December 2021	Original – KVepuri Prepared by KVepuri/FLane
A	9 December 2021	Updated the table in section 2.1 and the revision page. Contains R20210922-20-E2 in full and its changes - KV
B	13 January 2022	Added remarks about intermodulation Added remarks about frequency range tested - FL

CONTENTS

Revision Page 2

1.0 Summary of test results 4

2.0 EUT Description 5

2.1 Equipment under test 5

2.2 Description of test modes 5

2.3 Description of support units 5

3.0 Laboratory and General Test Description 6

3.1 Laboratory description 6

3.2 Test personnel 6

3.3 Test equipment 7

3.4 General Test Procedure and Setup for Radio Measuremnts 8

4.0 Results 9

4.1 Output Power 11

4.2 Bandwidth 12

4.3 Duty Cycle 13

4.4 Radiated emissions 14

4.5 Band edges 19

4.6 Conducted AC Mains Emissions 20

Appendix A: Sample Calculation 23

Appendix B – Measurement Uncertainty 25

Appendix C – Graphs and Tables 26

REPORT END 36

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:

FCC Part 15.249

The EUT has been tested according to the following specifications:

(1) US Code of Federal Regulations, Title 47, Part 15
(2) ISED RSS-Gen, Issue 5
(3) ISED RSS-210, Issue 10

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	N/A	Informational Purpose Only
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	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.

2.0 EUT DESCRIPTION

2.1 EQUIPMENT UNDER TEST

Summary and Operating Condition:

EUT	A04556
EUT Received	26 October 2021
EUT Tested	26 October 2021- 3 December 2021
Serial No.	3392525130 (conducted antenna port measurements); 3391975621 (radiated measurements);
Operating Band	2400 – 2483.5 MHz
Device Type	☐ GMSK ☒ GFSK ☐ BT BR ☐ BT EDR 2MB ☐ BT EDR 3MB ☐ 802.11x
Power Supply / Voltage	Internal Battery/ Charger: Garmin (Phi Hong) MN: LAC046 (worst case power supply, all the measurements presented in this report); Garmin MN: PSM10R-050; Garmin MN: PSAF10R-050Q; Garmin car charger MN:320-00239-56

NOTE: For more detailed features description, please refer to the manufacturer's specifications or user's manual.

2.2 DESCRIPTION OF TEST MODES

The operating range of the EUT is dependent on the device type found in section 2.1:

For Bluetooth Transmissions:

Channel	Frequency
Low	2402 MHz
Mid	2440/2441 MHz
High	2480 MHz

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.

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 ± 4%
Temperature of 22 ± 3° Celsius

3.2 TEST PERSONNEL

No.	PERSONNEL	TITLE	ROLE
1	Karthik Vepuri	Test Engineer	Review/editing, testing and report
2	Fox Lane	Test Engineer	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.

3.3 TEST EQUIPMENT

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Keysight MXE Signal Analyzer (44GHz)	N9038A	MY59050109	July 21, 2021	July 21, 2023
Keysight MXE Signal Analyzer (26.5GHz)	N9038A	MY56400083	May 5, 2020	May 5, 2022
Keysight EXA Signal Analyzer	N9010A	MY56070862	July 20, 2021	July 20, 2023
SunAR RF Motion	JB1	A091418	July 27, 2021	July 27, 2022
EMCO Horn Antenna	3115	6415	March 16, 2020	March 16, 2022
EMCO Horn Antenna	3116	2576	March 9, 2020	March 9, 2022
Com-Power LISN 50µH / 250µH - 50Ω	LI-220C	20070017	September 22, 2020	September 22, 2022
8447F POT H64 Preamplifier*	8447F POT H64	3113AD4667	February 1, 2021	February 1, 2022
Rohde & Schwarz Preamplifier*	TS-PR18	3545700803	April 14, 2020	April 14, 2022
Trilithic High Pass Filter*	6HC330	23042	April 14, 2020	April 14, 2022
ETS – Lindgren- VSWR on 10m Chamber	10m Semi-anechoic chamber-VSWR	4740 Discovery Drive	July 30, 2020	July 30, 2023
NCEE Labs-NSA on 10m Chamber	10m Semi-anechoic chamber-NSA	NCEE-001	October 25, 2019	October 25, 2022
TDK Emissions Lab Software	V11.25	700307	NA	NA
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	September 24, 2021	September 24, 2023
RF Cable (10m chamber bulkhead to control room bulkhead)*	FSCM 64639	01E3864	September 24, 2021	September 24, 2023
RF Cable (control room bulkhead to test receiver)*	FSCM 64639	01F1206	September 24, 2021	September 24, 2023
N connector bulkhead (10m chamber)**	PE9128	NCEEBH1	September 24, 2021	September 24, 2023
N connector bulkhead (control room)**	PE9128	NCEEBH2	September 24, 2021	September 24, 2023

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

3.4 GENERAL TEST PROCEDURE AND SETUP FOR RADIO MEASUREMNTS

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.

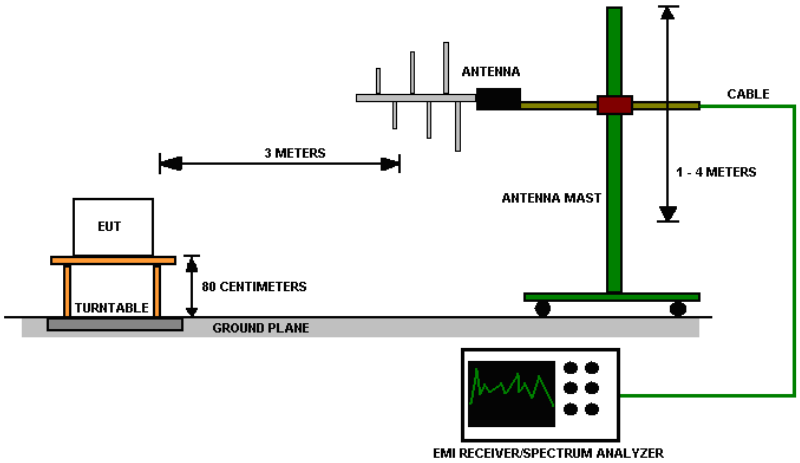


Figure 2 - Radiated Emissions Test Setup

4.0 RESULTS

DTS Radio Measurements						
CHANNEL	Transmitter	Occupied Bandwidth (kHz)	6 dB Bandwidth (kHz)	PEAK OUTPUT POWER (dBm)	PEAK OUTPUT POWER (mW)	RESULT
Low	GFSK	998.25	470.50	0.257	1.061	PASS
Mid	GFSK	1000.90	469.90	0.173	1.041	PASS
High	GFSK	987.84	461.70	0.150	1.035	PASS
Occupied Bandwidth = N/A; 6 dB Bandwidth Limit =NA				Peak Output Power Limit = NA;		

Radiated Unrestricted Band-Edge, Low Channel							
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m)	Measurement Type	Limit (dBuV/m @ 3m)	Margin	Result
Low	GFSK	2400.00	69.65	Peak	74.00	4.35	PASS
Low	GFSK	2400.00	52.45	Average	54.00	1.55	PASS
*Limit shown are the limits from FCC Part 15.209; Average measurements were obtained by applying duty cycle correction from section 4.3 to peak restricted band edge measurements. Average Highest out of band level (dBuV/m @ 3m) = Peak Highest out of band level (dBuV/m @ 3m) – Duty Cycle Correction Factor.							

Note that the lower unrestricted band edge compliance is proven by comparing the radiated emissions value at the band edge to FCC Part 15.209 limits.

Radiated Unrestricted Band-Edge, High Channel							
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level (dBuV/m)	Relative Fundamental (dBuV/m)	Delta (dB)	Min Delta (dB)	Result
High	GFSK	2483.50	54.54	106.95	52.41	50.00	PASS
*See section 4.5 for higher band edge requirements and procedures							

Peak Restricted Band-Edge							
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)	Margin	Result
Low	GFSK	2390.00	52.13	Peak	73.98	21.85	PASS
High	GFSK	2483.50	65.28	Peak	73.98	8.70	PASS
*Limit shown is the peak limit taken from FCC Part 15.209							

Average Restricted Band-Edge							
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit* (dBuV/m @ 3m)	Margin	Result
Low	GFSK	2390.00	34.93	Average	53.98	19.05	PASS
High	GFSK	2483.50	48.08	Average	53.98	5.90	PASS
*Limit shown is the average limit from FCC Part 15.209; Average measurements were obtained by applying duty cycle correction from section 4.3 to peak restricted band edge measurements. The average measurements were obtained by applying duty cycle correction factor found in section 4.3 to peak measurements. Average Highest out of band level (dBuV/m @ 3m) = Peak Highest out of band level (dBuV/m @ 3m) – Duty Cycle Correction Factor.							

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. All data is in the table in results section 4.0.
3. All the measurements were found to be compliant.

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. All data is in the table in results section 4.0.
3. All the measurements were found to be compliant.

4.3 DUTY CYCLE

Test Method: Manufacturer declared that the maximum possible duty cycle is 13.8 % so duty cycle correction of 20 log (13.8%) = -17.2 dB was used as the correction to obtain average value, from peak value.

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 (µV/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 * Emission level (µV/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.

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:

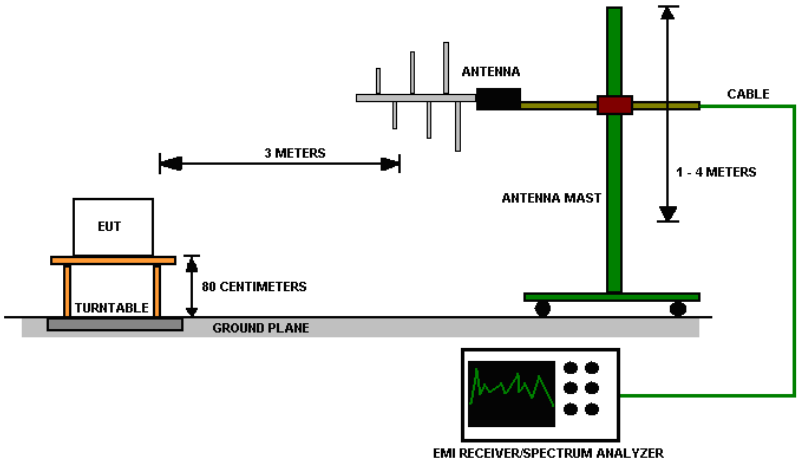


Figure 3 - Radiated Emissions Test Setup

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:

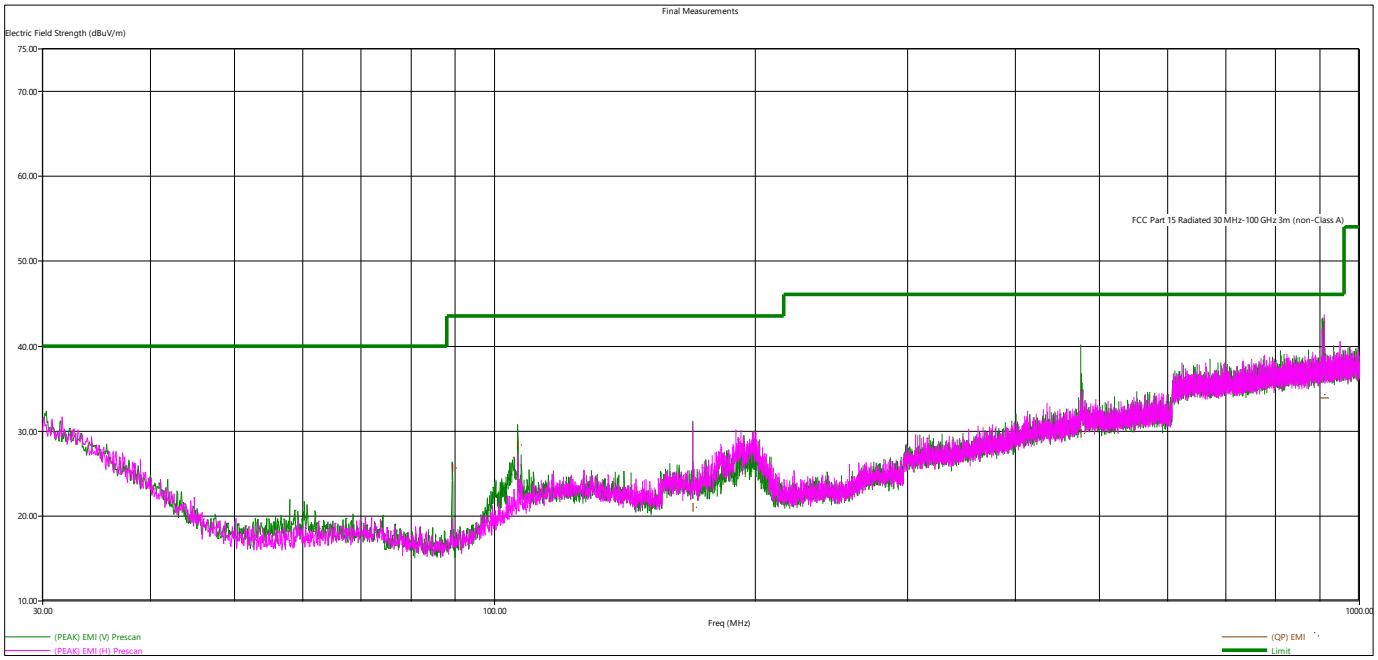


Figure 4 - Radiated Emissions Plot, Receive, GFSK

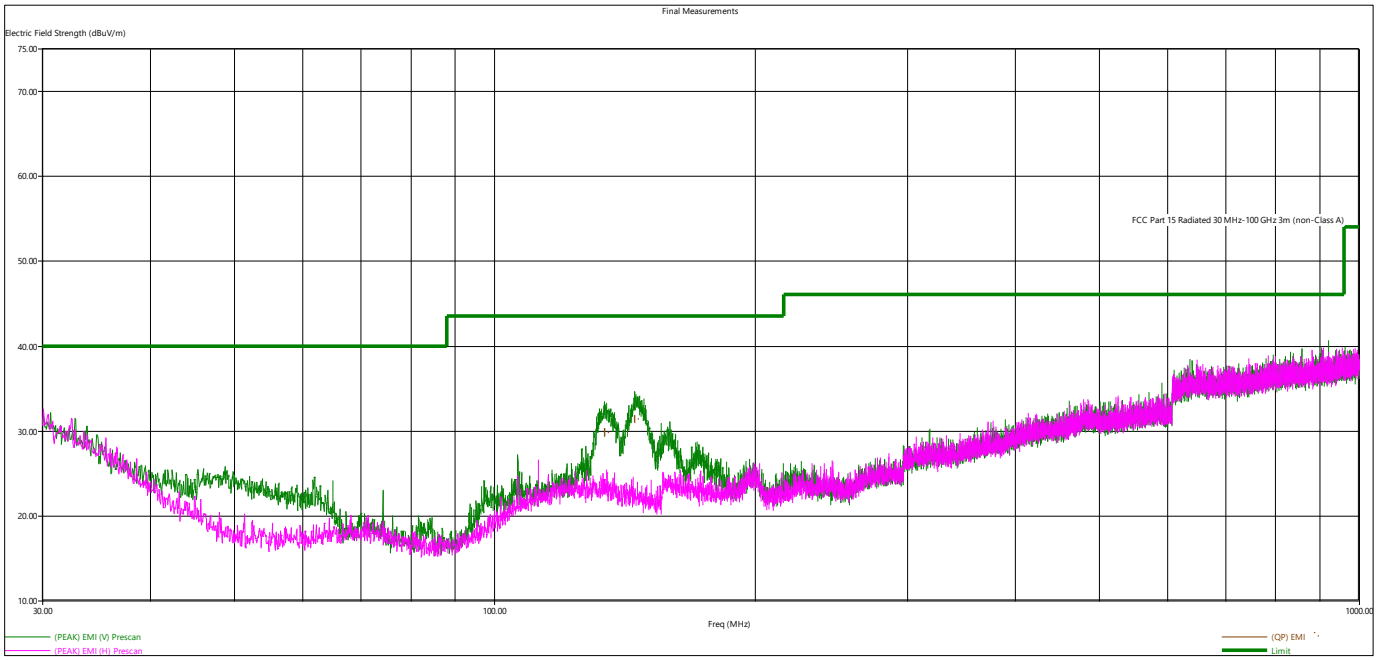


Figure 5 - Radiated Emissions Plot, Low Channel, GFSK

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 = Limit value – Emission Level
5. EUT was investigated for intermodulation. No intermodulation was found above system's noise floor

Quasi-Peak Measurements, GFSK								
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dBµV/m	dBµV/m	dB	cm.	deg.			
133.783200	29.69	43.52	13.83	106	291	V	Low	GFSK
145.368960	31.31	43.52	12.21	106	316	V	Low	GFSK

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

Peak Measurements, GFSK								
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dBµV/m	dBµV/m	dB	cm.	deg.			
2401.842000	95.44	114.00	18.56	153	217	H	Low	GFSK
2438.376000	92.36	114.00	21.64	117	214	H	Mid	GFSK
2478.842000	96.49	114.00	17.51	109	199	H	High	GFSK

*All other emissions up to 25GHz were found to be at least 6dB below the limit line

Average Measurements, GFSK								
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dBµV/m	dBµV/m	dB	cm.	deg.			
2401.842000	78.24	94.00	15.76	153	217	H	Low	GFSK
2438.376000	75.16	94.00	18.84	117	214	H	Mid	GFSK
2478.842000	79.29	94.00	14.71	109	199	H	High	GFSK

*Declared Duty Cycle by the manufacturer is 13.8 % so duty cycle correction is -17.2 dB. See section 4.3 for more details. Average level (dBuV/m @ 3m) = Peak level (dBuV/m @ 3m) – Duty Cycle Correction Factor.
**All other emissions up to 25GHz were found to be at least 6dB below the limit line

s

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. All data is in the table in results section 4.0.
3. 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 or band edge was compared to FCC Part 209 limit.
4. 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 (dBµV)	
	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.

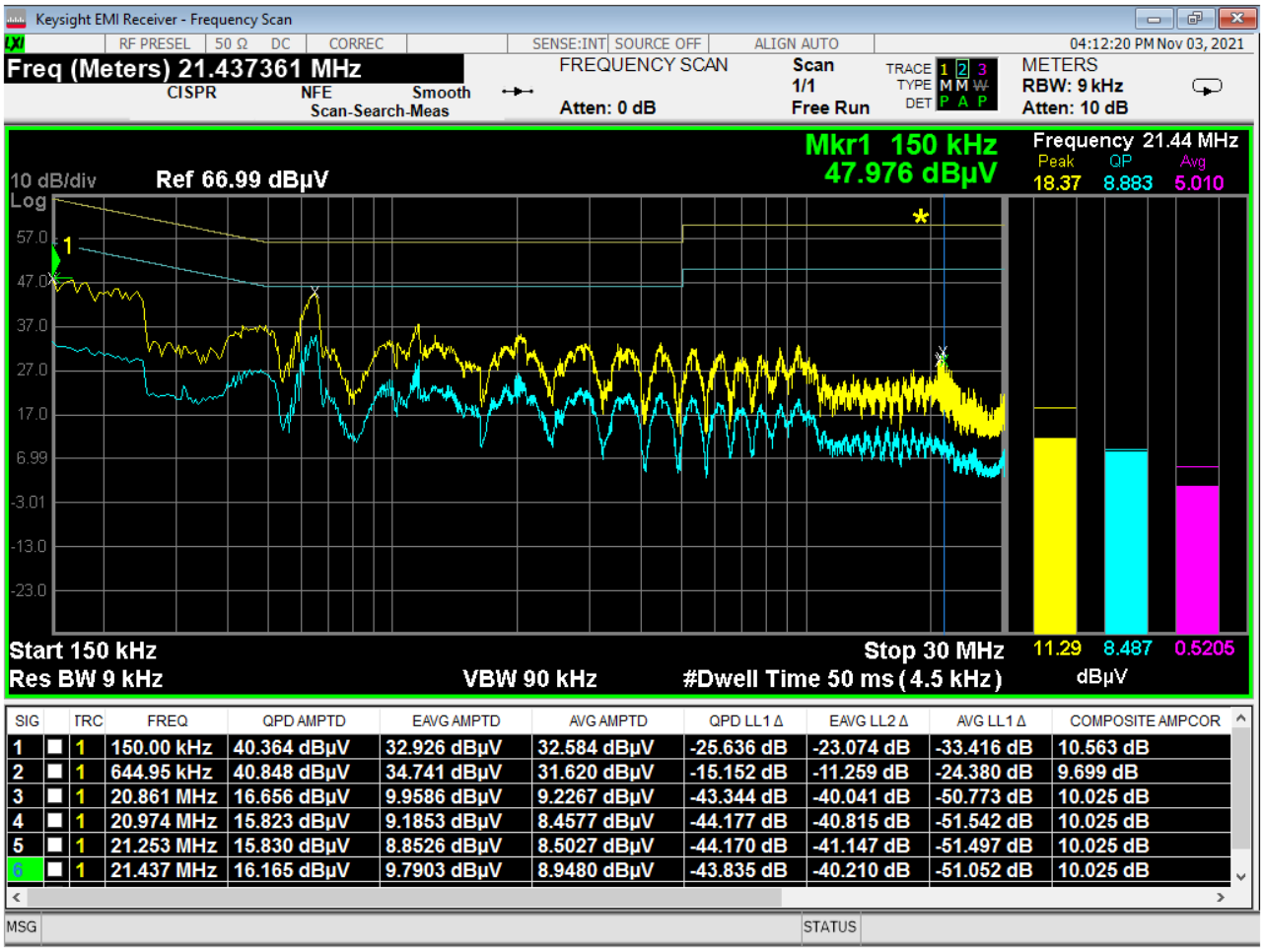
Test Procedures:

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

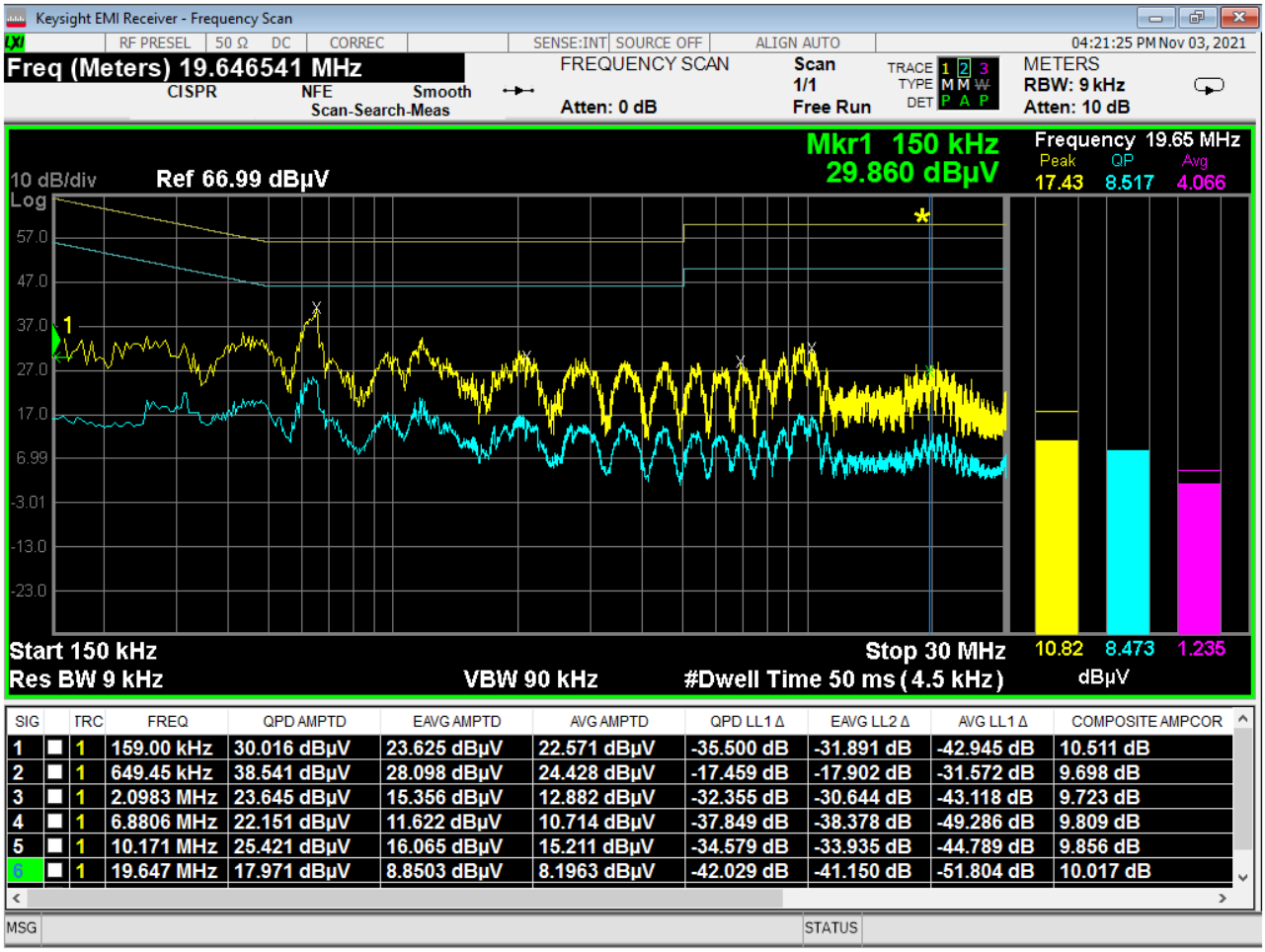
EUT operating conditions:
Details can be found in section 2.1 of this report.
.

Test Results:



SIG	TRC	FREQ	QPD AMPTD	EAVG AMPTD	AVG AMPTD	QPD LL1 Δ	EAVG LL2 Δ	AVG LL1 Δ	COMPOSITE AMPCOR
1	1	150.00 kHz	40.364 dBµV	32.926 dBµV	32.584 dBµV	-25.636 dB	-23.074 dB	-33.416 dB	10.563 dB
2	1	644.95 kHz	40.848 dBµV	34.741 dBµV	31.620 dBµV	-15.152 dB	-11.259 dB	-24.380 dB	9.699 dB
3	1	20.861 MHz	16.656 dBµV	9.9586 dBµV	9.2267 dBµV	-43.344 dB	-40.041 dB	-50.773 dB	10.025 dB
4	1	20.974 MHz	15.823 dBµV	9.1853 dBµV	8.4577 dBµV	-44.177 dB	-40.815 dB	-51.542 dB	10.025 dB
5	1	21.253 MHz	15.830 dBµV	8.8526 dBµV	8.5027 dBµV	-44.170 dB	-41.147 dB	-51.497 dB	10.025 dB
6	1	21.437 MHz	16.165 dBµV	9.7903 dBµV	8.9480 dBµV	-43.835 dB	-40.210 dB	-51.052 dB	10.025 dB

Figure 6 - Conducted Emissions Plot, Line



SIG		TRC	FREQ	QPD AMPTD	EAVG AMPTD	AVG AMPTD	QPD LL1 Δ	EAVG LL2 Δ	AVG LL1 Δ	COMPOSITE AMPCOR
1	■	1	159.00 kHz	30.016 dBµV	23.625 dBµV	22.571 dBµV	-35.500 dB	-31.891 dB	-42.945 dB	10.511 dB
2	■	1	649.45 kHz	38.541 dBµV	28.098 dBµV	24.428 dBµV	-17.459 dB	-17.902 dB	-31.572 dB	9.698 dB
3	■	1	2.0983 MHz	23.645 dBµV	15.356 dBµV	12.882 dBµV	-32.355 dB	-30.644 dB	-43.118 dB	9.723 dB
4	■	1	6.8806 MHz	22.151 dBµV	11.622 dBµV	10.714 dBµV	-37.849 dB	-38.378 dB	-49.286 dB	9.809 dB
5	■	1	10.171 MHz	25.421 dBµV	16.065 dBµV	15.211 dBµV	-34.579 dB	-33.935 dB	-44.789 dB	9.856 dB
6	■	1	19.647 MHz	17.971 dBµV	8.8503 dBµV	8.1963 dBµV	-42.029 dB	-41.150 dB	-51.804 dB	10.017 dB

Figure 7 - Conducted Emissions Plot, Neutral

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 dBμV 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 dBμV/m.

FS = 55 + 12 – (-1.1 + 20) + 0 = 48.1 dBμV/m

The 48.1 dBμV/m value can be mathematically converted to its corresponding level in μV/m.

Level in μV/m = Common Antilogarithm [(48.1 dBμV/m)/20]= 254.1 μV/m

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

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 (Watts) = [Field Strength (V/m) x antenna distance (m)]^2 / 30
Power (watts) = 10^[Power (dBm)/10] / 1000
Voltage (dBµV) = Power (dBm) + 107 (for 50Ω measurement systems)
Field Strength (V/m) = 10^[Field Strength (dBµV/m) / 20] / 10^6
Gain = 1 (numeric gain for isotropic radiator)
Conversion from 3m field strength to EIRP (d=3):

EIRP = [FS(V/m) x d^2]/30 = FS [0.3] for d = 3

EIRP(dBm) = FS(dBµV/m) – 10(log 10^9)+ 10log[0.3] = FS(dBµV/m) - 95.23

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

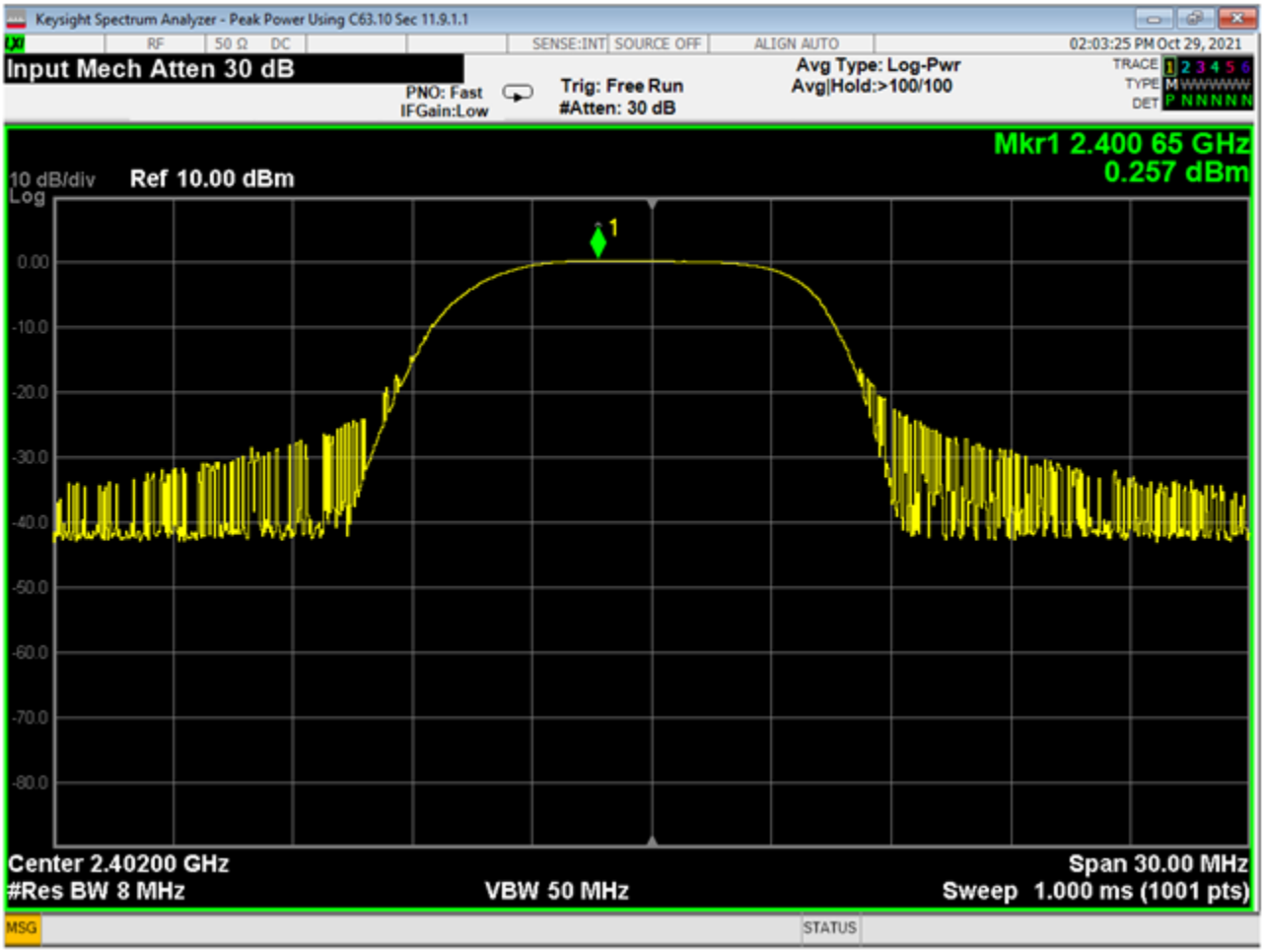
APPENDIX B – MEASUREMENT UNCERTAINTY

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

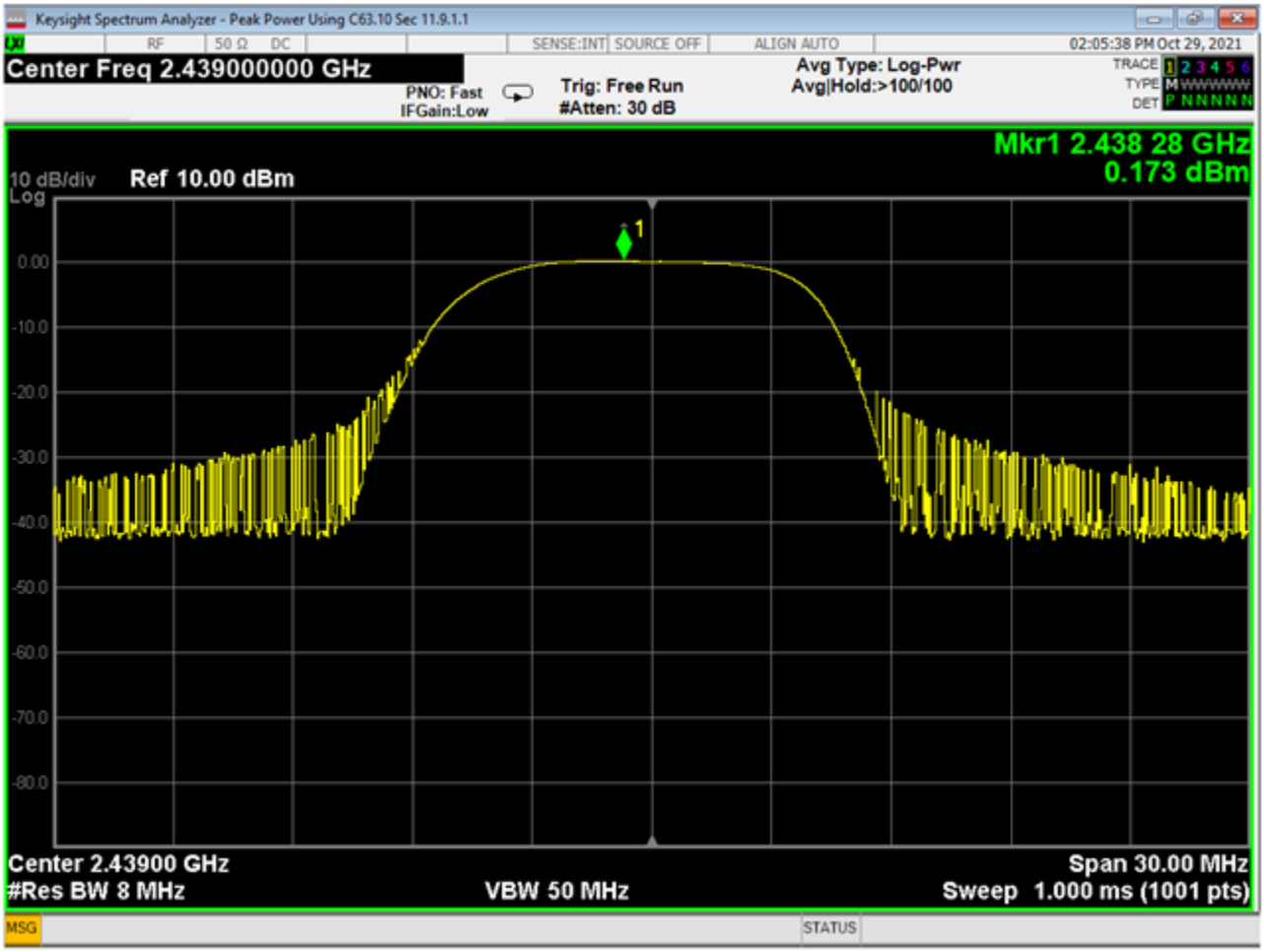
Test	Frequency Range	Uncertainty Value (dB)
Radiated Emissions, 3m	30MHz - 1GHz	3.82
Radiated Emissions, 3m	1GHz - 18GHz	4.44
Emissions limits, conducted	30MHz – 18GHz	±3.30 dB

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

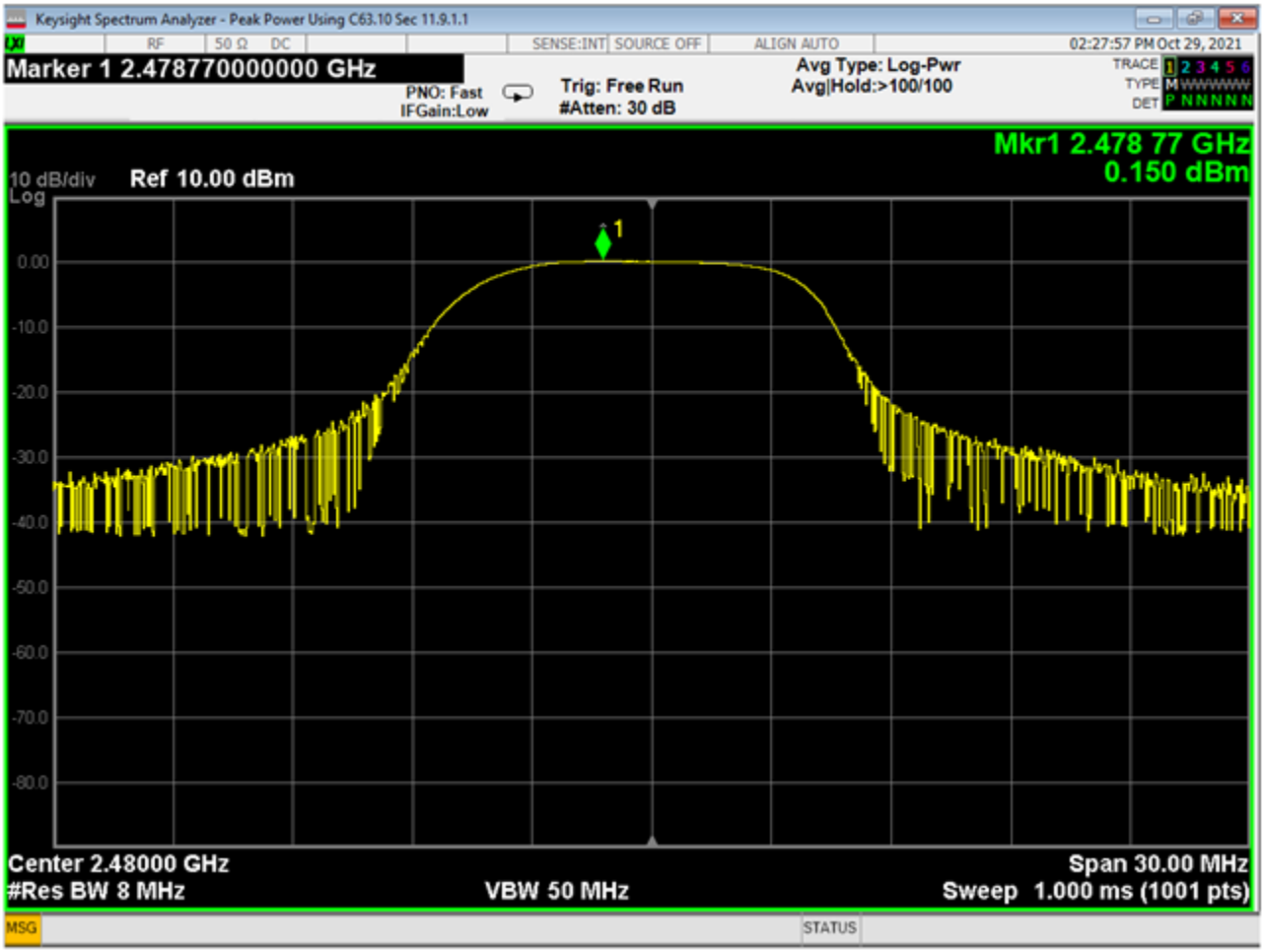
APPENDIX C – GRAPHS AND TABLES



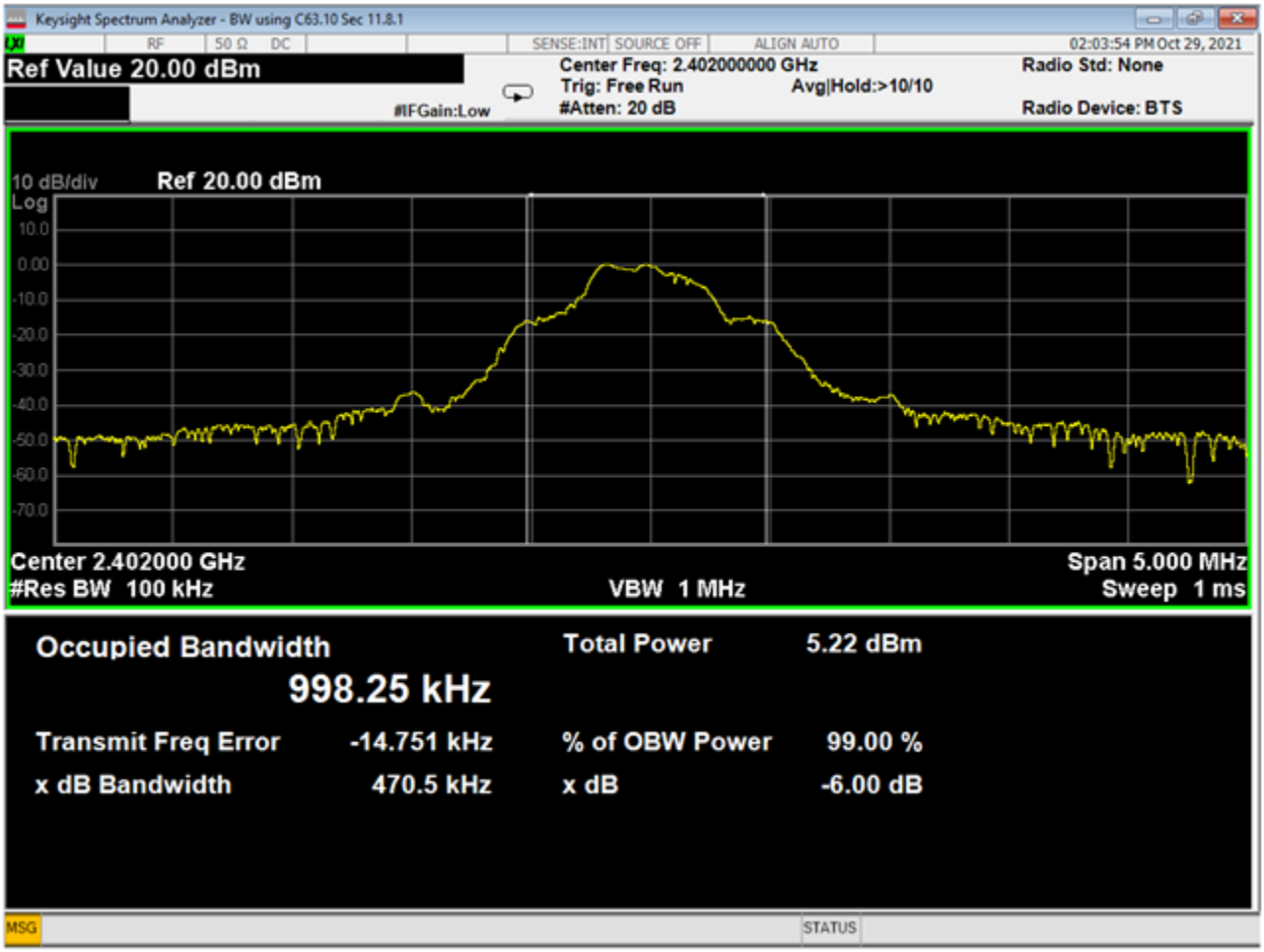
01 Power, Low Channel



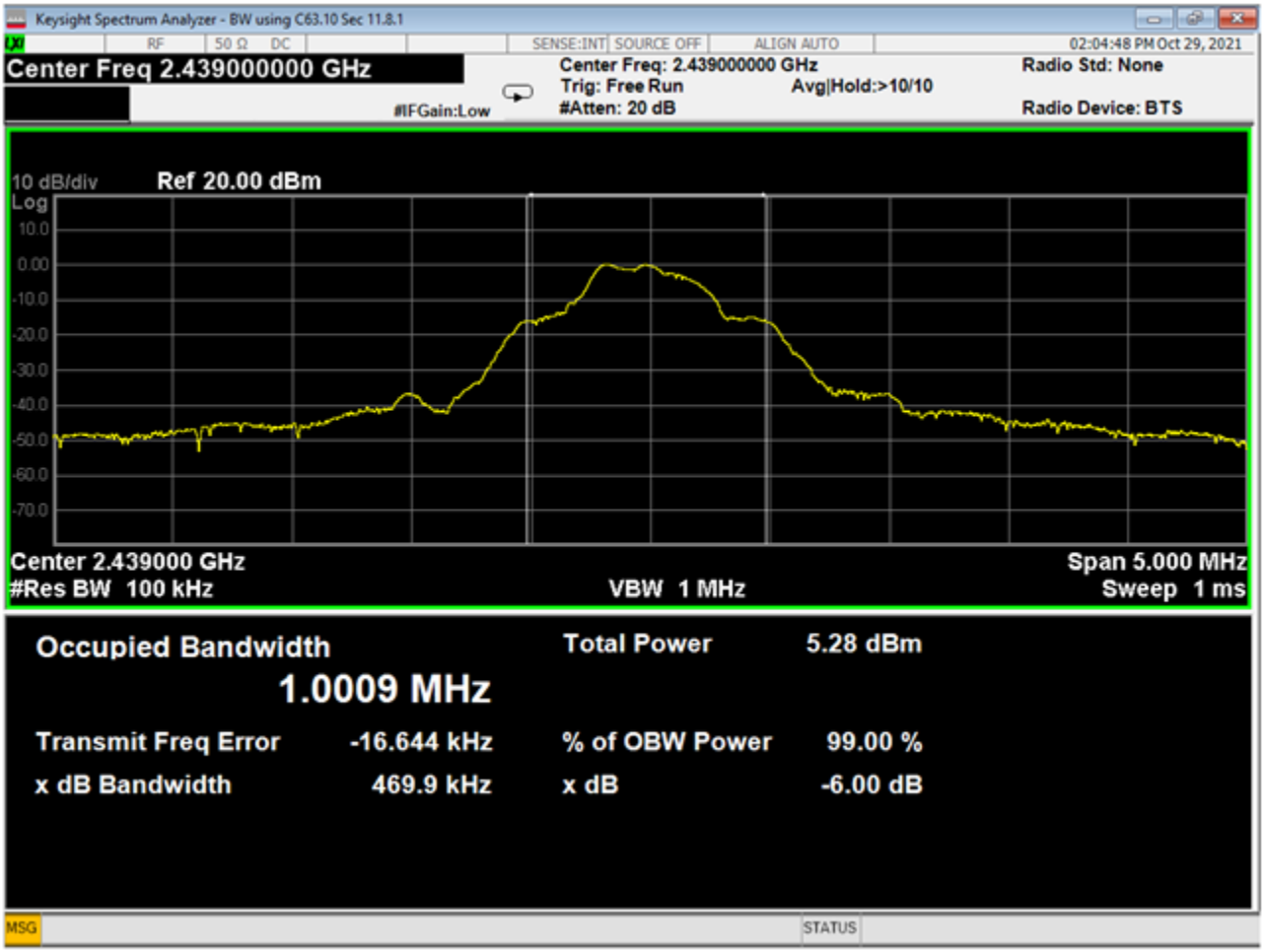
02 Power, Mid Channel



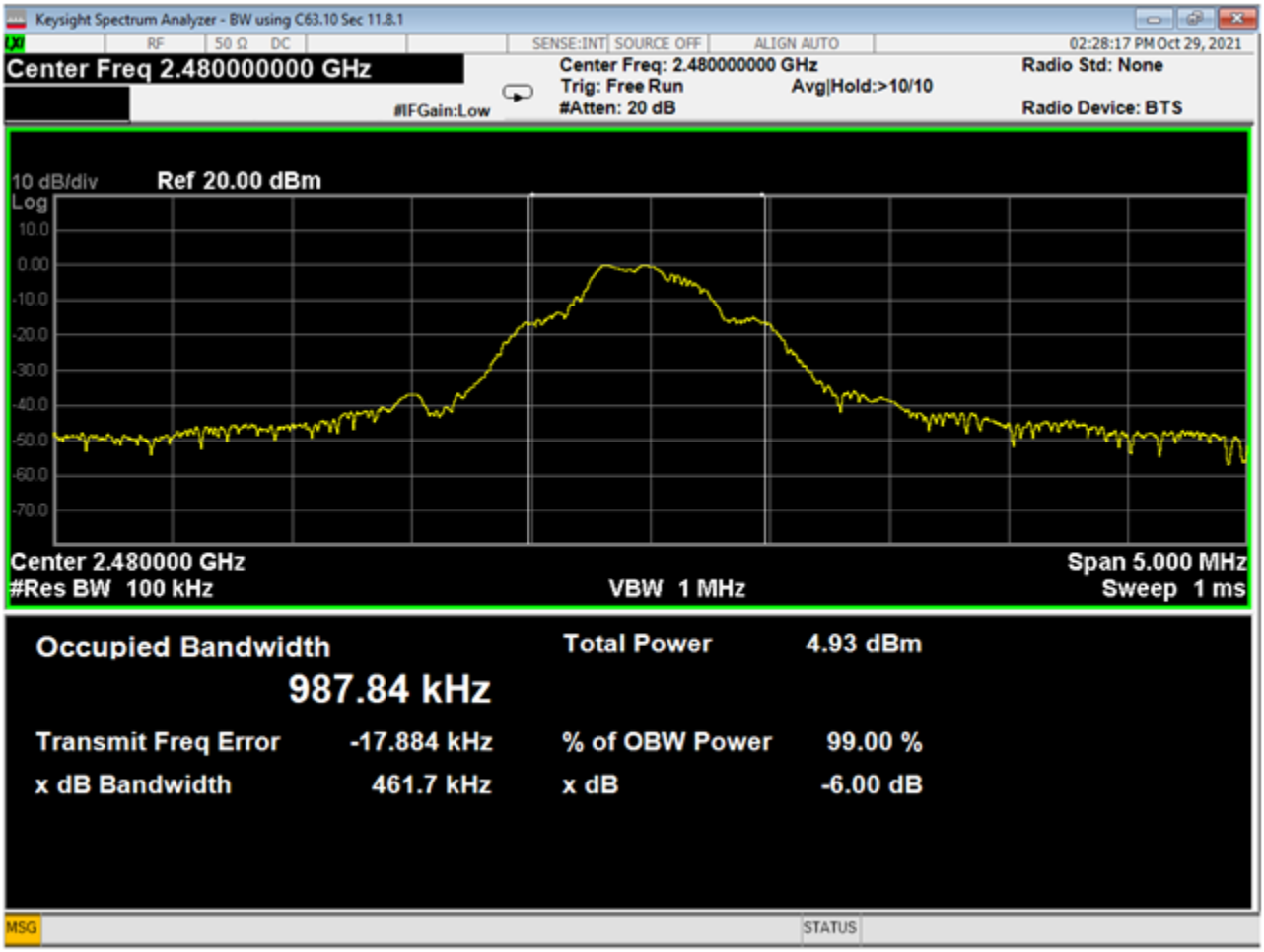
03 Power, High Channel



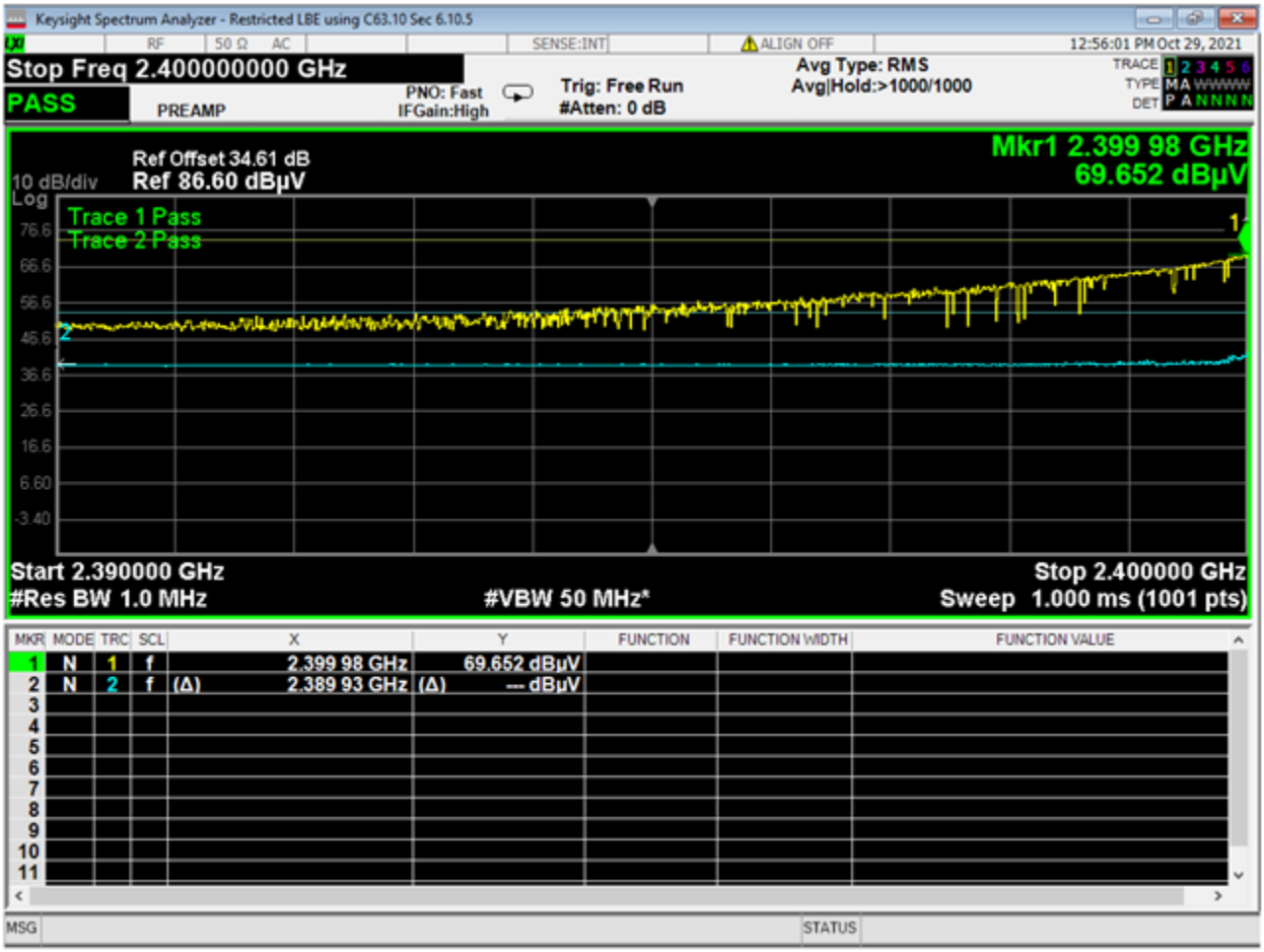
04 Bandwidth, Low Channel



05 Bandwidth, Mid Channel

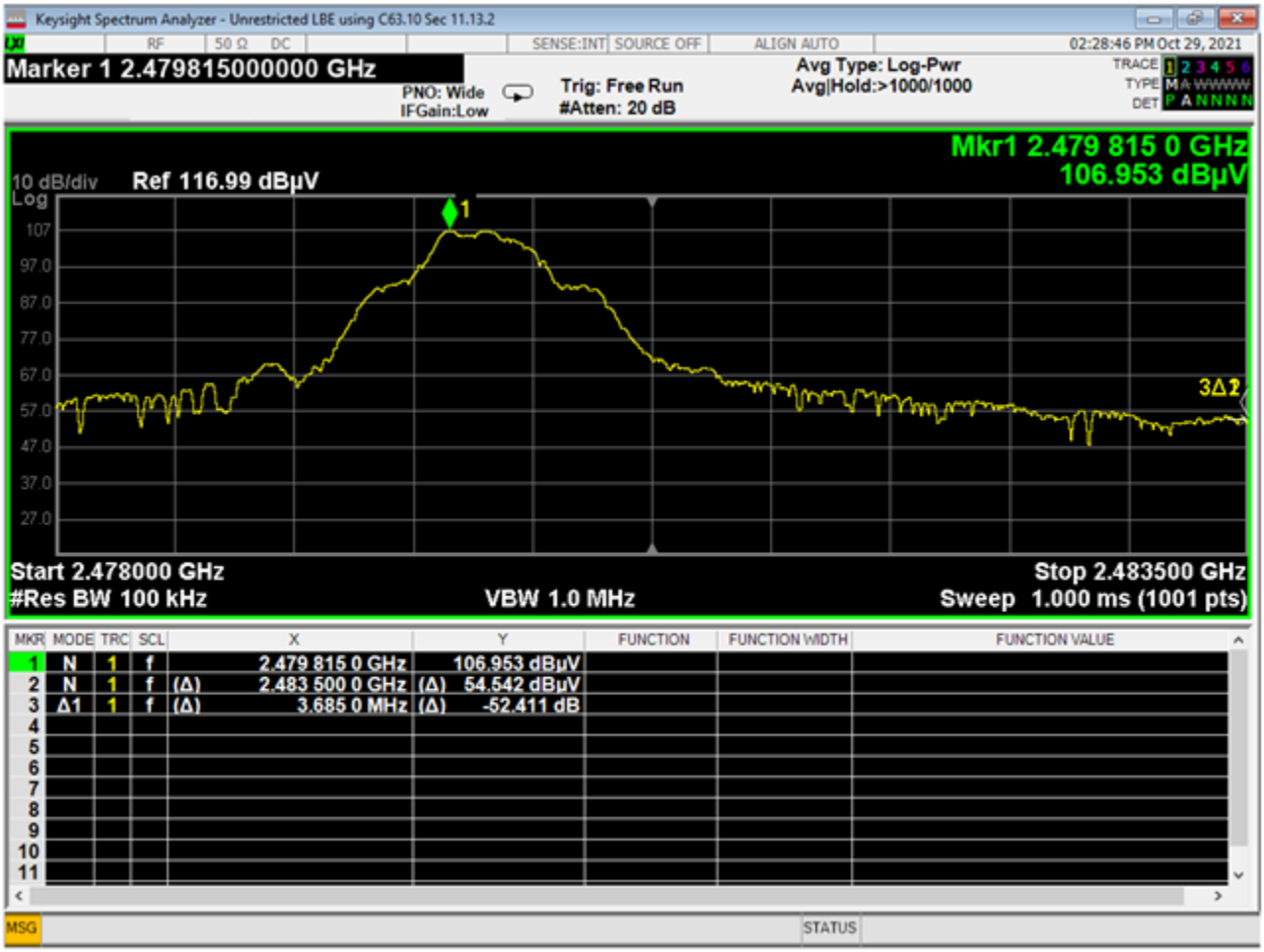


06 Bandwidth, High Channel



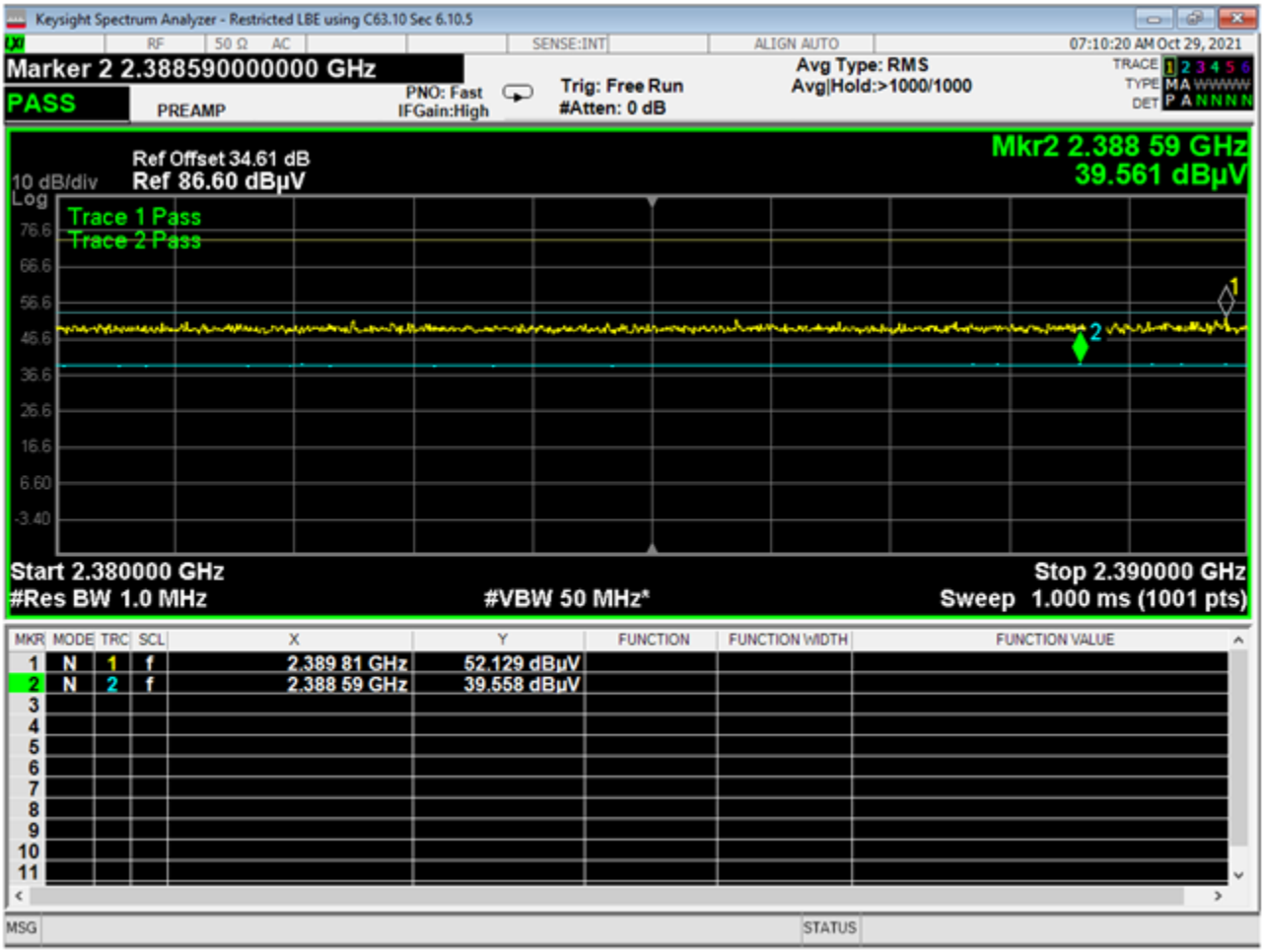
07 Lower Bandedge, Unrestricted, 2390-2400 compared to 15.209

*The corrections were included in the measurement.
Note that the lower unrestricted band edge compliance is proven by comparing the radiated emissions value at the band edge to FCC Part 15.209 limits. Average measurements in the plot needs to be ignored, as the average values are determined by applying duty cycle correction to the peak value. The values can be found in section 4.0 of this report.
Average Highest out of band level (dBuV/m @ 3m) = Peak Highest out of band level (dBuV/m @ 3m) – Duty Cycle Correction Factor



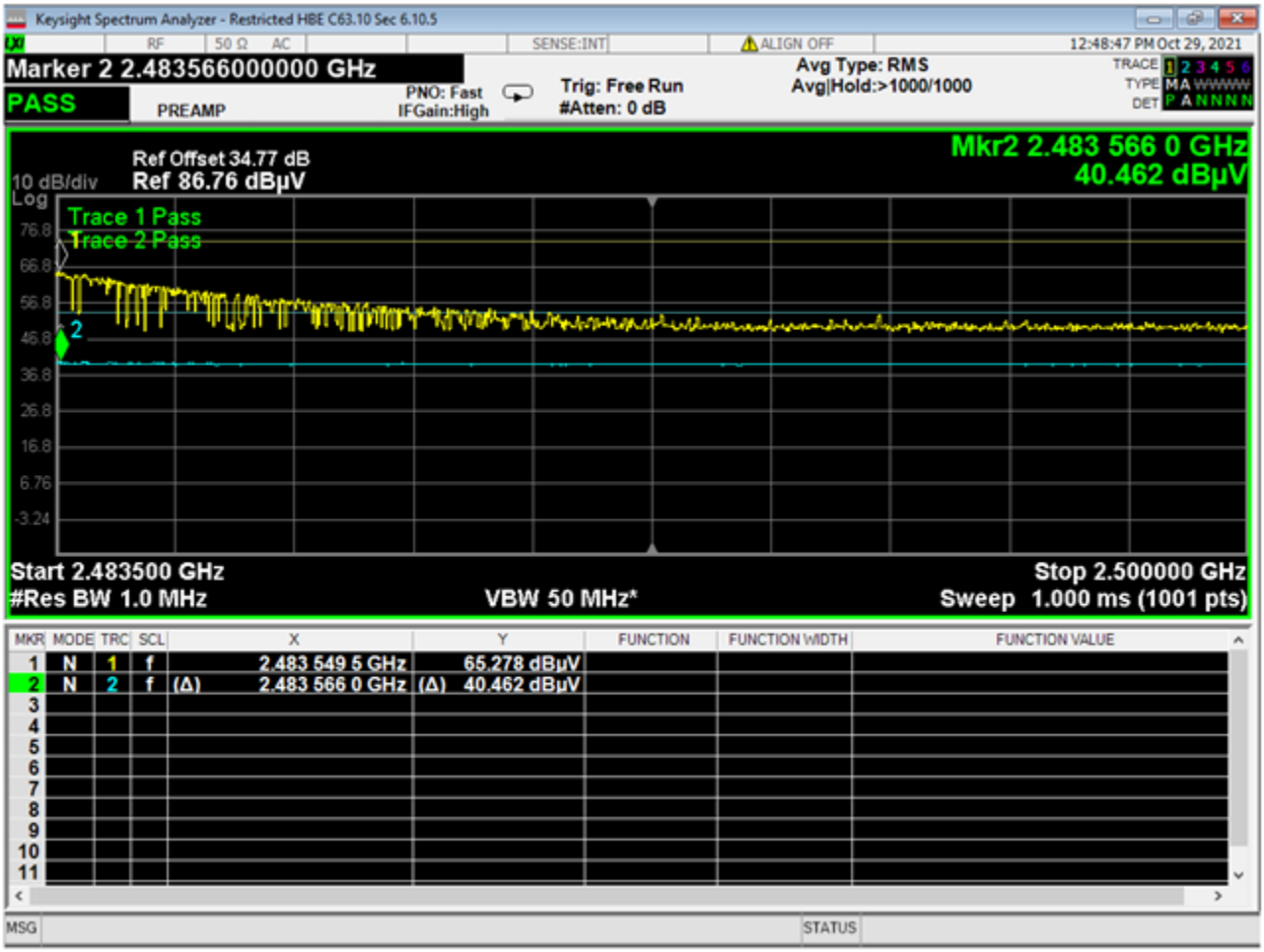
08 Higher Bandedge, Unrestricted

*The corrections were included in the measurement.



09 Lower Band edge, Restricted

*The corrections were included in the measurement.
Average measurements in the plot needs to be ignored, as the average values are determined by applying duty cycle correction to the peak value. The values can be found in section 4.0 of this report.
Average Highest out of band level (dBuV/m @ 3m) = Peak Highest out of band level (dBuV/m @ 3m) – Duty Cycle Correction Factor.



10 Higher Bandedge, Restricted, 2480

*The corrections were included in the measurement.
Average measurements in the plot needs to be ignored, as the average values are determined by applying duty cycle correction to the peak value. The values can be found in section 4.0 of this report.
Average Highest out of band level (dBuV/m @ 3m) = Peak Highest out of band level (dBuV/m @ 3m) – Duty Cycle Correction Factor.

REPORT END