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Amended

FCC/ISED Test Report

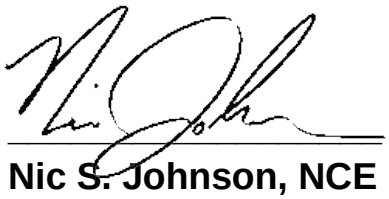
Prepared for: **Garmin International Inc.**

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

Product: **A03831**

Test Report No: **R20190913-21-01B**

Approved by:



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Technical Manager
iNARTE Certified EMC Engineer #EMC-003337-NE

DATE: **11 March 2020**

Total Pages: **43**

REVISION PAGE

Rev. No.	Date	Description
0	31 October 2019	Original – NJohnson Prepared by KVepuri/CFarrington
A	6 March 2020	Updated Section 3.3 and 4.4. Measured power measurements again with 8 MHz RBW average. Includes NCEE Labs report R20190913-21-01 and amendment in full. -NJ
B	11 March 2020	Updated table of power measurements in Section 4.2. Includes NCEE Labs report R20190913-21-01A and amendment in full. -NJ

CONTENTS

1.0 SUMMARY OF TEST RESULTS

The worst-case measurements were reported in this report. The EUT has been tested according to the following specifications:

APPLIED STANDARDS AND REGULATIONS		
Standard Section	**Test Type**	**Result**
FCC Part 15.35 RSS Gen, Issue 4, Section 6.10	Duty Cycle	Pass
FCC Part 15.247(a)(1) RSS-247 Issue 2 Section 5.2	Peak output power	Pass
FCC Part 15.247(a)(1) RSS-247 Issue 2 Section 5.2	Bandwidth	Pass
FCC Part 15.209 RSS-Gen Issue 4, Section 7.1	Receiver Radiated Emissions	Pass
FCC Part 15.209 (restricted bands), 15.247 (unrestricted) RSS-247 Issue 2 Section 5.5, RSS-Gen Issue 4, Section 8.9	Transmitter Radiated Emissions	Pass
FCC Part 15.247(a)(1) RSS-247 Issue 2 Section 5.2	Power Spectral Density	Pass
FCC Part 15.209, 15.247(d) RSS-247 Issue 2 Section 11.13	Band Edge Measurement	Pass
FCC Part 15.207 RSS-Gen Issue 4, Section 7.1	Conducted Emissions	Pass

See Section 4 for details on the test methods used for each test.

2.0 EUT DESCRIPTION

2.1 EQUIPMENT UNDER TEST

Summary

The Equipment Under Test (EUT) was a battery powered GMSK transceiver manufactured by GARMIN inc..

EUT	A03831
EUT Received	8 October 2019
EUT Tested	8 October 2019- 31 October 2019 6 March 2020 – fundamental emission power output only
Serial No.	3309354938 (conducted antenna port measurements); 3309354851 (radiated measurements)
Operating Band	2400 – 2483.5 MHz
Device Type	GMSK
Power Supply	Internal Battery/ Charger: Garmin (Phi Hong) MN: PSAI10R-050Q (Representative Power Supply)

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

2.2 DESCRIPTION OF TEST MODES

The EUT operates on, and was tested at the frequencies below:

Channel	Frequency
Low	2402 MHz
Mid	2440 MHz
High	2480 MHz

These are the only three 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.

This EUT was set to transmit in a worse-case scenario with modulation on. The manufacturer modified the unit to transmit continuously on the lowest, middle and highest frequency channels.

The EUT was tested for spurious emissions while running off of battery power.

2.3 DESCRIPTION OF SUPPORT UNITS

None

3.0 LABORATORY 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	Nic Johnson	Technical Manager	Review/editing
2	Karthik Vepuri	Test Engineer	Testing and report
3	Caleb Farrington	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.

3.3 TEST EQUIPMENT

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Rohde & Schwarz Test Receiver	ES126	100037	30 Jan 2018	30 Jan 2020
Keysight EXA Signal Analyzer	N9010A	MY56070862	14 Dec 2018	14 Dec 2020
Keysight MXE Signal Analyzer	N9038A	MY59050109	23 Apr 2019	23 Apr 2021
Keysight MXE Signal Analyzer	N9038A	MY59050111	26 Mar 2019	26 Mar 2020
SunAR RF Motion	JB1	A082918-1	15 Oct 2018	15 Oct 2020
EMCO Horn Antenna	3115	6416	26 Jan 2018	26 Jan 2020
EMCO Horn Antenna	3116	2576	31 Jan 2018	31 Jan 2020
Tektronix True Average Power Meter	PSM3110	118674	31 Jan 2018	31 Jan 2020
Rohde & Schwarz Preamplifier	TS-PR18	3545700803	09 Mar 2018*	09 Mar 2020*
Trilithic High Pass Filter	6HC330	23042	09 Mar 2018*	09 Mar 2020*
Rohde & Schwarz LISN	ESH3-Z5	836679/010	25 Jul 2019	25 Jul 2020
RF Cable (preamplifier to antenna)	MFR-57500	01-07-002	09 Mar 2018*	09 Mar 2020*
RF Cable (antenna to 10m chamber bulkhead)	FSCM 64639	01E3872	09 Mar 2018*	09 Mar 2020*
RF Cable (10m chamber bulkhead to control room bulkhead)	FSCM 64639	01E3874	09 Mar 2018*	09 Mar 2020*
RF Cable (Control room bulkhead to RF switch)	FSCM 64639	01E3871	09 Mar 2018*	09 Mar 2020*
RF Cable (RF switch to test receiver)	FSCM 64639	01F1206	09 Mar 2018*	09 Mar 2020*
RF switch – Rohde and Schwarz	TS-RSP	1113.5503.14	09 Mar 2018*	09 Mar 2020*
N connector bulkhead (10m chamber)	PE9128	NCEEBH1	09 Mar 2018*	09 Mar 2020*
N connector bulkhead (control room)	PE9128	NCEEBH2	09 Mar 2018*	09 Mar 2020*

*Internal Characterization

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

4.0 DETAILED RESULTS

4.1 DUTY CYCLE

Test Method: NA

The EUT was set to transmit continuously.

4.2 PEAK OUTPUT POWER

Test Method: ANSI C63.10:

1. Section(s) 11.9.1.1 “RBW >= DTS bandwidth”

Limits of power measurements:
The maximum allowed peak output power is 30 dBm.

Test procedures:
The EUT was connected to s spectrum analyzer directly with a low-loss shielded coaxial cable with 100 kHz RBW and 1 MHz VBW.

Deviations from test standard:
No deviation.

Test setup:

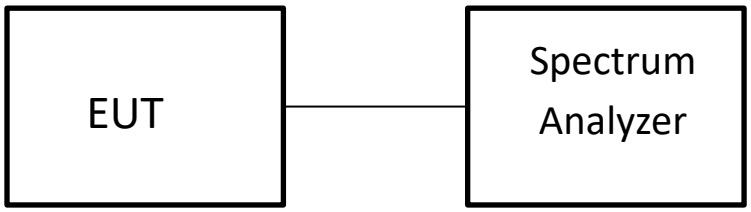


Figure 1 – Peak Output Power Measurements Test Setup

EUT operating conditions:
The EUT was powered by internal battery power unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range. EUT was set to transmit in indicated modulation.

Test results:

Output Power

CHANNEL	CHANNEL FREQUENCY (MHz)	AVG OUTPUT POWER (dBm)	AVG OUTPUT POWER (mW)	Method	RESULT	Transmitter
Low	2402	3.832	2.42	Conducted	PASS	GFSK
Mid	2440	3.737	2.36	Conducted	PASS	GFSK
High	2480	3.726	2.36	Conducted	PASS	GFSK

*Plots are located in Appendix C.

4.3 BANDWIDTH

Test Method: ANSI C63.10,
1. Section(s) 11.8.1 “DTS Bandwidth, Option 1”

Limits of bandwidth measurements:
The 99% occupied bandwidth is displayed.

The 6dB bandwidth of the signal must be greater than 500 kHz.

Test procedures:
The EUT was connected to the spectrum analyzer directly with a low-loss shielded coaxial cable. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100 kHz RBW and 1 MHz VBW.

The 99% occupied is defined as the bandwidth at which 99% of the signal power is found. This corresponds to 20dB down from the maximum power level. The maximum power was measured with the largest resolution bandwidth possible (10MHz) and this value was recorded. The signal was then captured with a 1 MHz resolution bandwidth and the frequencies where the measurements were 20dB below the maximum power were marked. The bandwidth between these frequencies was recorded as the 99% occupied bandwidth.

The 6 dB bandwidth is defined as the bandwidth of which is higher than peak power minus 6dB.

Deviations from test standard:
No deviation

Test setup:

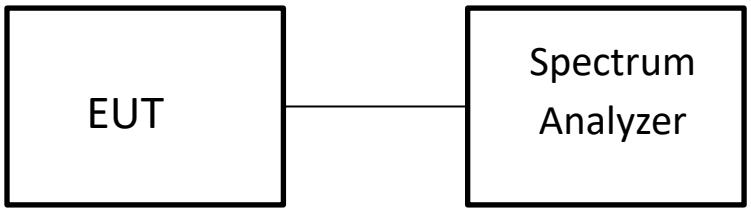


Figure 2 – Peak Output Power Measurements Test Setup

EUT operating conditions:
The EUT was powered by internal battery power unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range. EUT was set to transmit in indicated modulation.

Test results:

Occupied Bandwidth

CHANNEL	Mode	CHANNEL FREQUENCY (MHz)	OBW (KHz)	RESULT
Low	GFSK	2402	1094.4	PASS
Mid	GFSK	2440	1101.1	PASS
High	GFSK	2480	1095.2	PASS

6dB Bandwidth

CHANNEL	Mode	CHANNEL FREQUENCY (MHz)	6dB BW (KHz)	RESULT
Low	GFSK	2402	585.8	PASS
Mid	GFSK	2440	595.5	PASS
High	GFSK	2480	578.5	PASS

*Plots are located in Appendix C.

4.4 RADIATED EMISSIONS

Test Method: ANSI C63.10:2013:

1. Section 6.5, “Radiated emissions from unlicensed wireless devices in the frequency range of 30 MHz to 1000 MHz”
2. Section 6.6, “Radiated emissions from unlicensed wireless devices above 1 GHz”
3. Section 11.11, “Measurement in nonrestricted frequency bands”
4. Section 11.12, “Emissions in restricted bands”

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 about requirement from FCC Part 15.247(d) and RSS-247, Section 5.5:
In addition to the limits shown above, all emissions were also required to be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power using an average detector. All measurements were performed with a 1 MHz bandwidth, which would yield equal or higher results. Since all emissions were found to be compliant with the 15.209 limit using a 1MHz bandwidth, they will also be complaint with a 100 kHz bandwidth. In, addition Attenuation below the general limits specified in §15.209(a) is not required.

Since the fundamental emission was at least 30 dB over the spurious emissions limits from 15.209 and all spurious emissions were below the 15.209 limit, this requirement was met.

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.

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 form 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.

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.

Test setup:

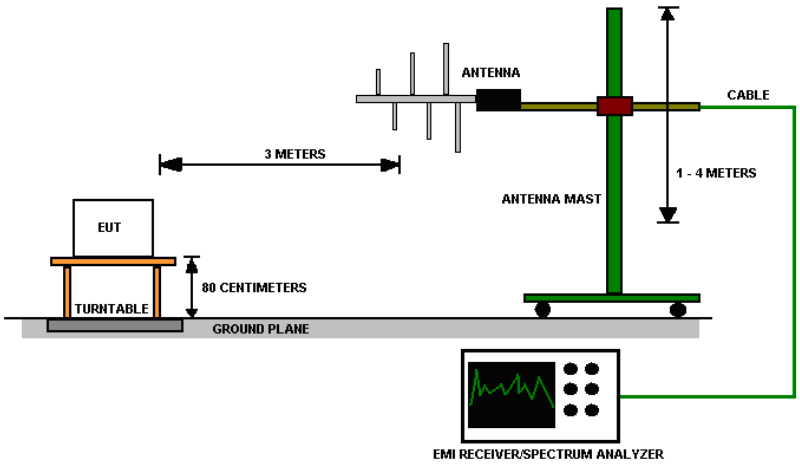


Figure 3 - Radiated Emissions Test Setup

EUT operating conditions
The EUT was powered by internal battery power unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range. EUT was set to transmit in indicated modulation.

Test results:

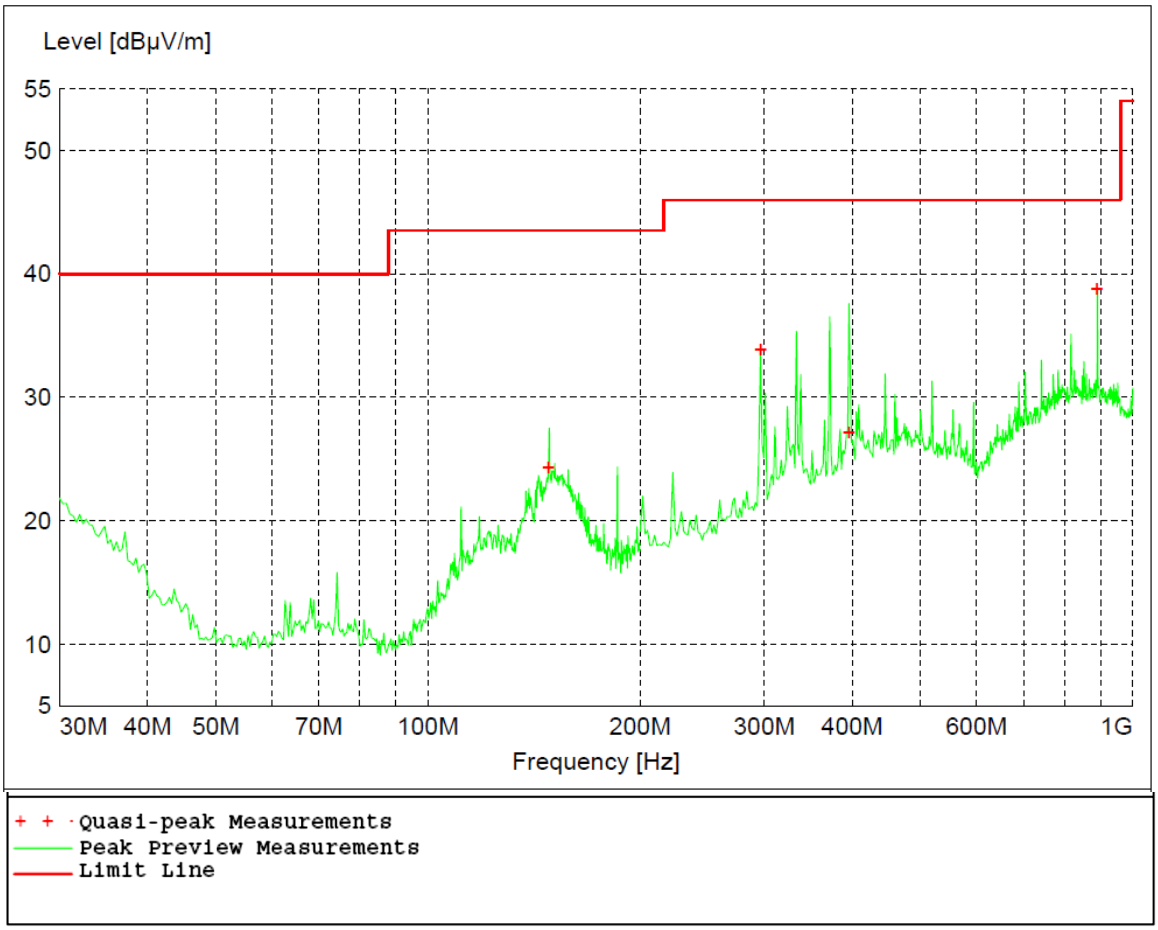


Figure 4 - Radiated Emissions Plot, Receive

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

Table 1 - Radiated Emissions Quasi-peak Measurements, Receive

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
148.320000	24.36	43.50	19.20	98	300	VERT
296.700000	33.88	46.00	12.10	101	85	HORI
396.000000	27.14	46.00	18.90	98	288	HORI
890.100000	38.86	46.00	7.10	99	169	HORI

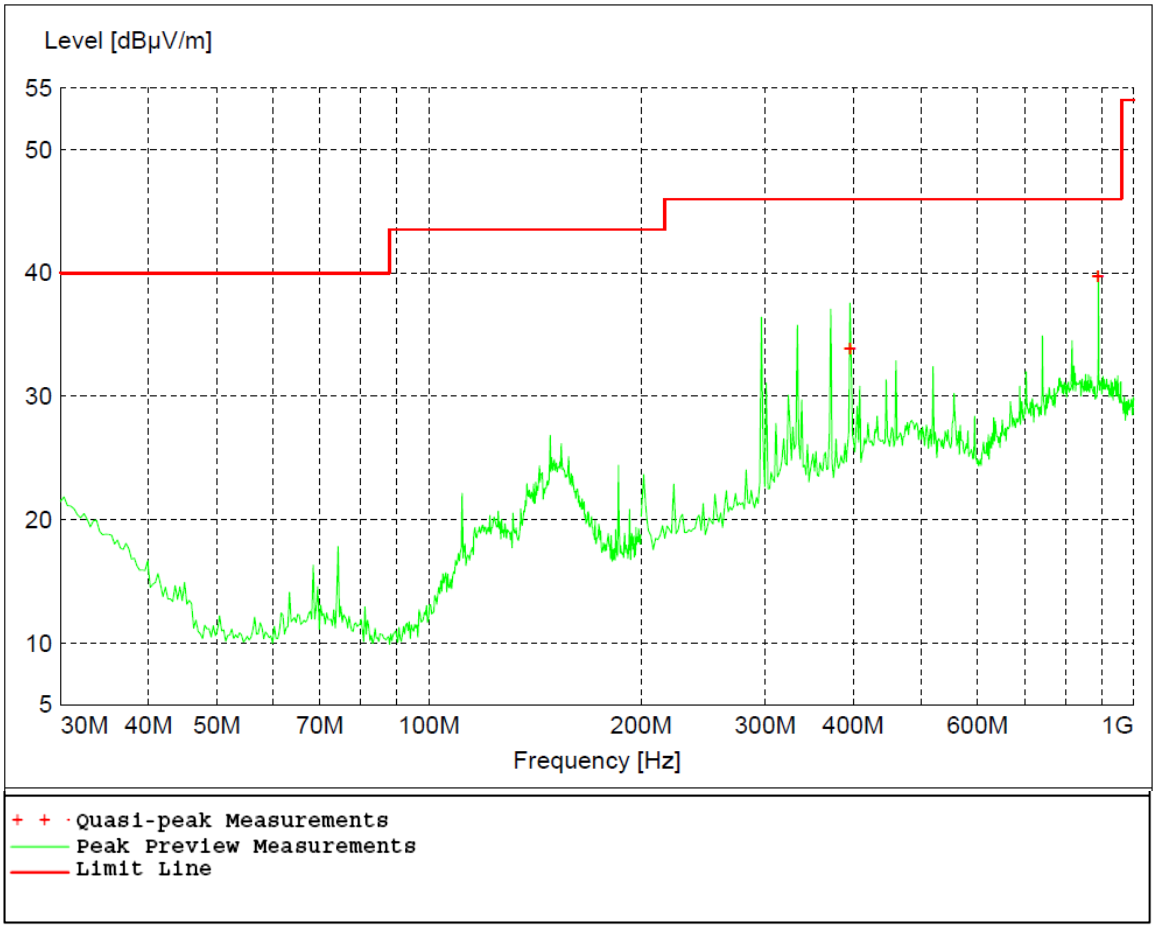


Figure 5 - Radiated Emissions Plot, Low Channel

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

Table 2 - Radiated Emissions Quasi-peak Measurements, Low Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
396.000000	33.90	46.00	12.10	101	58	HORI
890.100000	39.80	46.00	6.20	98	195	HORI

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

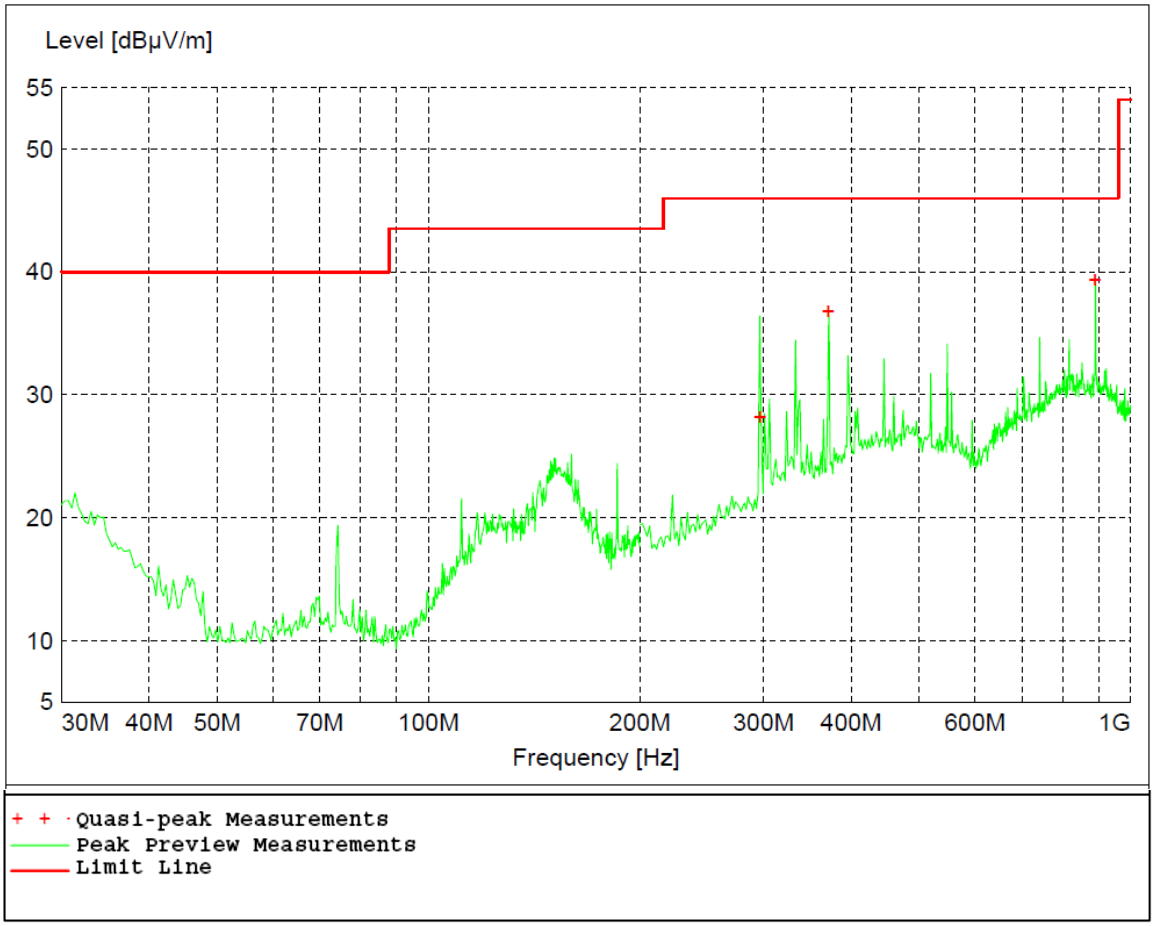


Figure 6 - Radiated Emissions Plot, Mid Channel

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

Table 3 - Radiated Emissions Quasi-peak Measurements, Mid Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
296.700000	28.24	46.00	17.80	98	69	HORI
370.860000	36.82	46.00	9.20	99	104	HORI
890.100000	39.39	46.00	6.60	101	205	HORI

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

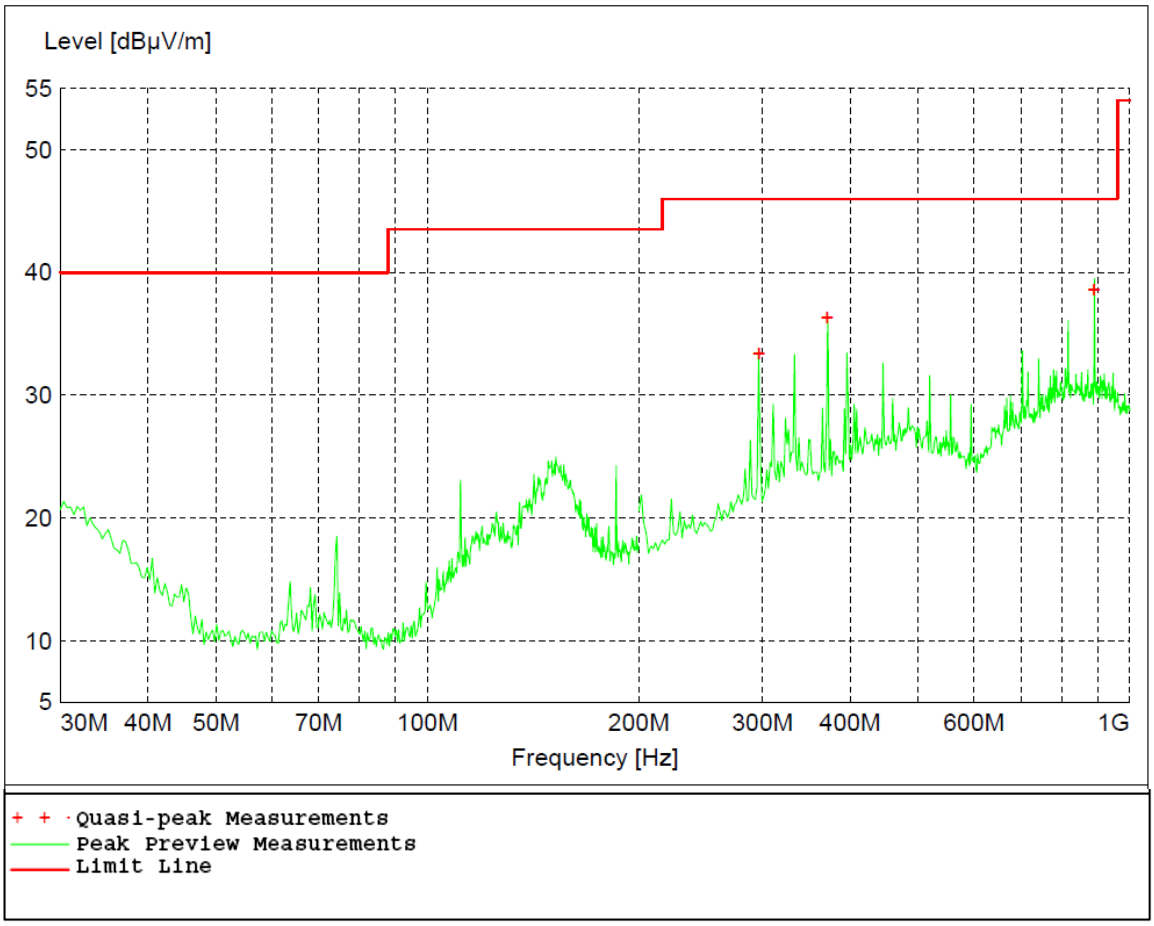


Figure 7 - Radiated Emissions Plot, High Channel

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

Table 4 - Radiated Emissions Quasi-peak Measurements, High Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBµV/m	dBµV/m	dB	cm.	deg.	
296.700000	33.44	46.00	12.60	101	85	HORI
370.860000	36.36	46.00	9.60	98	47	HORI
890.100000	38.62	46.00	7.40	98	170	HORI

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

Table 5 - Radiated Emissions Average Measurements, GFSK

Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel
MHz	dBµV/m	dBµV/m	dB	cm.	deg.		
1762.000000	34.96	54.00	19.04	234	151	HORI	Low
2402.000000	96.30	NA	NA	155	245	HORI	Low
7206.000000	44.20	54.00	9.80	98	85	VERT	Low
2440.000000	96.22	NA	NA	155	114	HORI	Mid
4883.800000	33.59	54.00	20.41	126	68	VERT	Mid
7326.000000	42.07	54.00	11.93	100	360	VERT	Mid
2480.000000	93.84	NA	NA	175	123	HORI	High
4960.000000	31.47	54.00	22.53	170	76	VERT	High
5993.000000	49.68	54.00	4.32	349	92	VERT	High
7440.000000	38.71	54.00	15.29	117	80	VERT	High
9925.800000	38.71	54.00	15.29	99	18	VERT	High

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

Table 6 - Radiated Emissions Peak Measurements, GFSK

Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel
MHz	dBµV/m	dBµV/m	dB	cm.	deg.		
1762.000000	49.10	74.00	24.90	234	151	HORI	Low
2402.000000	96.62	NA	NA	155	245	HORI	Low
7206.000000	61.25	74.00	12.75	98	85	VERT	Low
2440.000000	96.51	NA	NA	155	114	HORI	Mid
4883.800000	46.62	74.00	27.38	126	68	VERT	Mid
7326.000000	57.72	74.00	16.28	100	360	VERT	Mid
2480.000000	94.34	NA	NA	175	123	HORI	High
4960.000000	45.36	74.00	28.64	170	76	VERT	High
5993.000000	50.56	74.00	23.44	349	92	VERT	High
7440.000000	56.73	74.00	17.27	117	80	VERT	High
9925.800000	51.01	74.00	22.99	99	18	VERT	High

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

4.5 BAND EDGES

Test Method: ANSI C63.10:

1. Section 6.10.5 (used for restricted bands)
2. Section 11.13.2 “Marker-delta method” (for unrestricted bands)
3. Section 11.11, “Measurement in unrestricted frequency bands”

Limits of band-edge measurements:
For emissions outside of the allowed band of operation (2400.0MHz – 2480.0MHz), the emission level needs to be 20dB 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 EUT was tested in the same method as described in section *4.4 - Bandwidth*. The resolution bandwidth was set to 100kHz and video bandwidth to 1000 kHz the EMI receiver was used to scan from the band-edge to the fundamental frequency with a quasi-peak detector. 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.

Deviations from test standard:
No deviation.

Test setup:
See Section 4.3

EUT operating conditions:
The EUT was powered by internal battery power unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range. EUT was set to transmit in indicated modulation.

Test results:

CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level dBm	Relative Fundamental dBm	Delta (dB)	Min Delta (dB)	Result
Low, Continuous (restricted)	GFSK	2390	-62.584	3.931	66.515	42.62	PASS
High, Continuous (restricted)	GFSK	2483.5	-51.796	3.781	55.577	40.34	PASS
Low, Continuous (unrestricted)	GFSK	2400	-47.796	3.931	51.727	30.00	PASS
High, Continuous (unrestricted)	GFSK	2483.5	-51.333	3.781	55.114	30.00	PASS

*Minimum delta = [highest fundamental peak field strength from Section 4.2] – [Part 15.209 radiated emissions limit.]

From Section 4.2

Fundamental peak field strength at Low Channel = 96.62 dBµV/m
Fundamental peak field strength at High Channel = 94.34 dBµV/m

Low Channel minimum delta GFSK = 96.62 – 54.0 dBµV/m = 42.62 dBc
High Channel minimum delta GFSK = 94.34 – 54.0 dBµV/m = 40.34 dBc

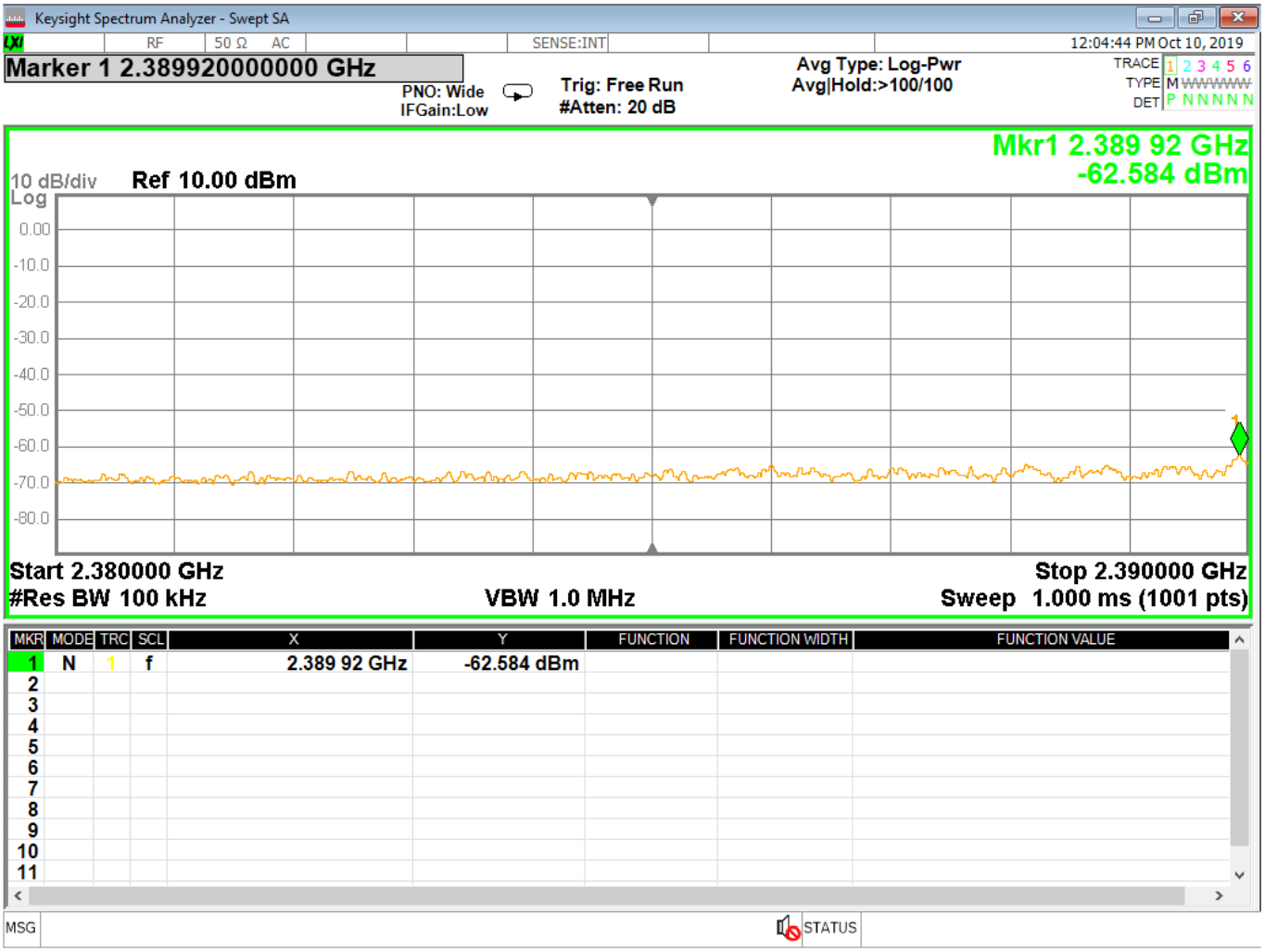


Figure 8 - Band-edge Measurement, Low Channel, Restricted Frequency, Peak

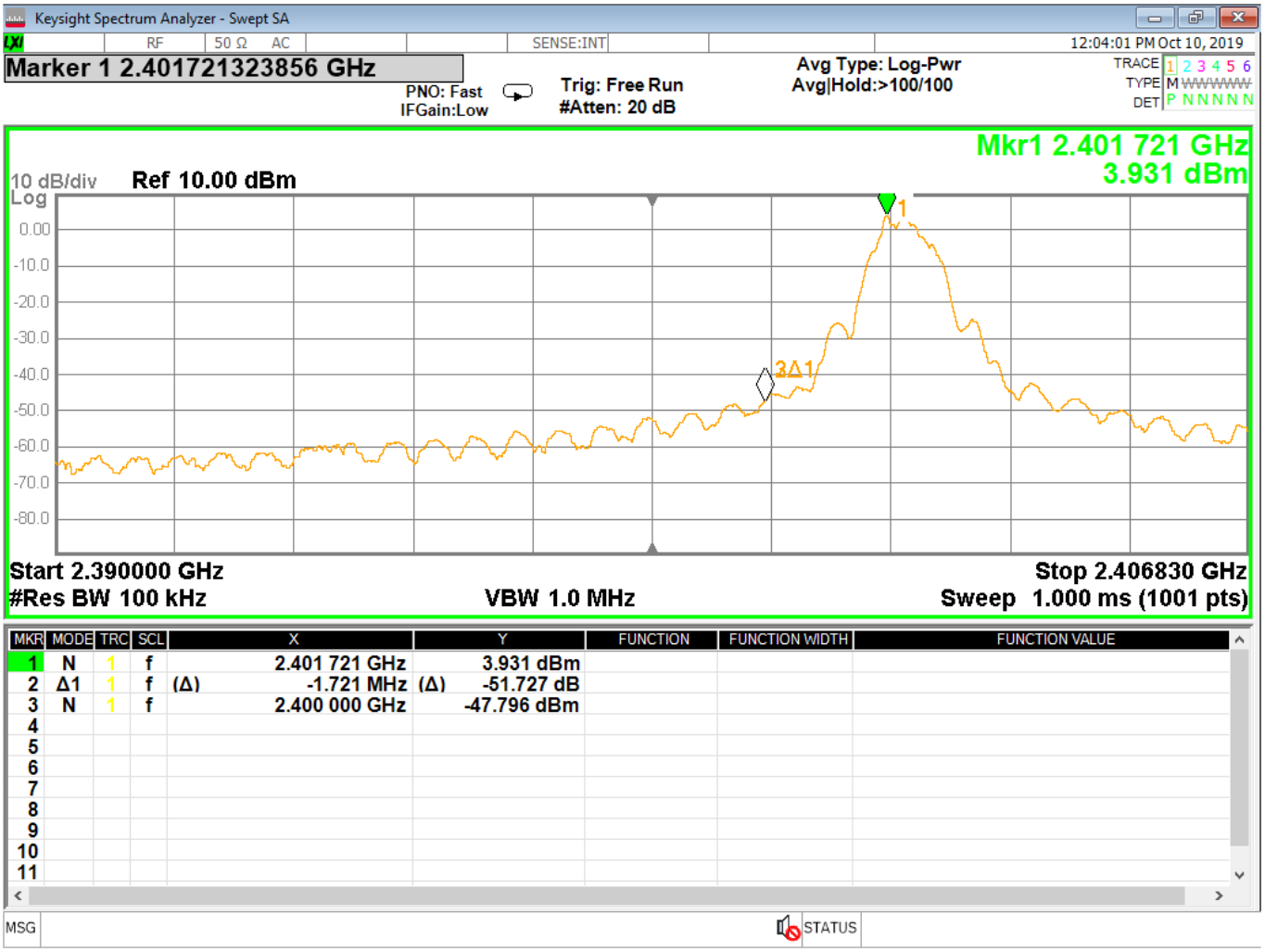


Figure 9 - Band-edge Measurement, Low Channel, Fundamental, Peak

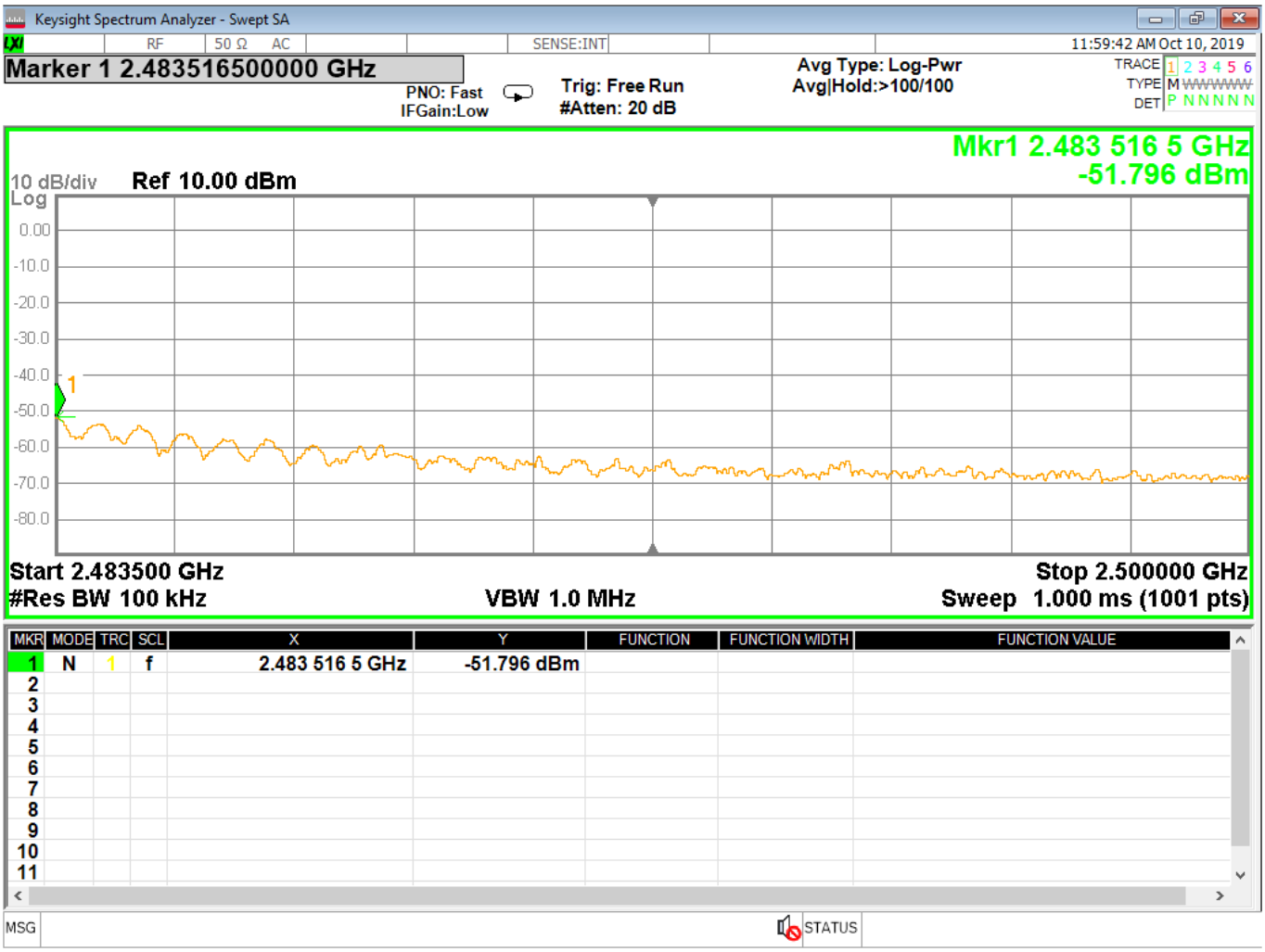


Figure 10 - Band-edge Measurement, High Channel, Restricted Frequency, Peak

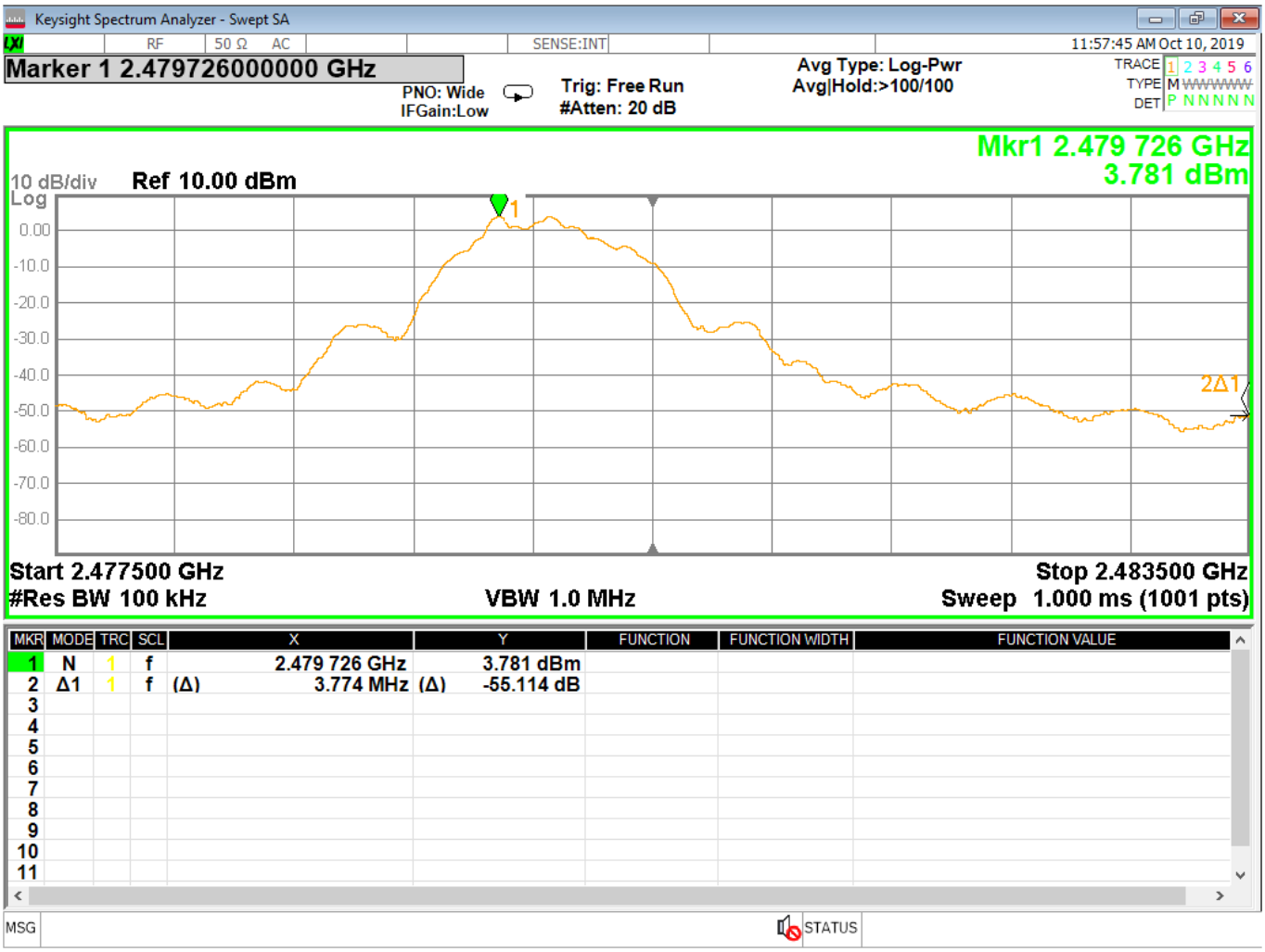


Figure 11 - Band-edge Measurement, High Channel, Fundamental, Peak

4.6 POWER SPECTRAL DENSITY

Test Method: ANSI C63.10,

1. Section 11.10.2 “Method PKPSD (peak PSD)”

Limits of power measurements:
The maximum PSD allowed is 8 dBm.

Test procedures:
1. The EUT was connected to the spectrum analyzer directly with a low-loss shielded coaxial cable.

2. The resolution bandwidth was set to 3 kHz and the video bandwidth was set to 10 kHz to capture the signal. The analyzer used a peak detector in max hold mode.

Test setup:
The EUT was connected to the spectrum analyzer directly with a low-loss shielded coaxial cable on a bench top.

EUT operating conditions:
The EUT was powered by internal battery power unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range. EUT was set to transmit in indicated modulation.

Test results:

Power Spectral Density

CHANNEL	MODE	CHANNEL FREQUENCY (MHz)	PEAK PSD(dBm)	Method	Limit (dBm)	RESULT
Low	GFSK	2402	-12.246	Conducted	8.00	PASS
Middle	GFSK	2440	-12.313	Conducted	8.00	PASS
High	GFSK	2480	-12.582	Conducted	8.00	PASS

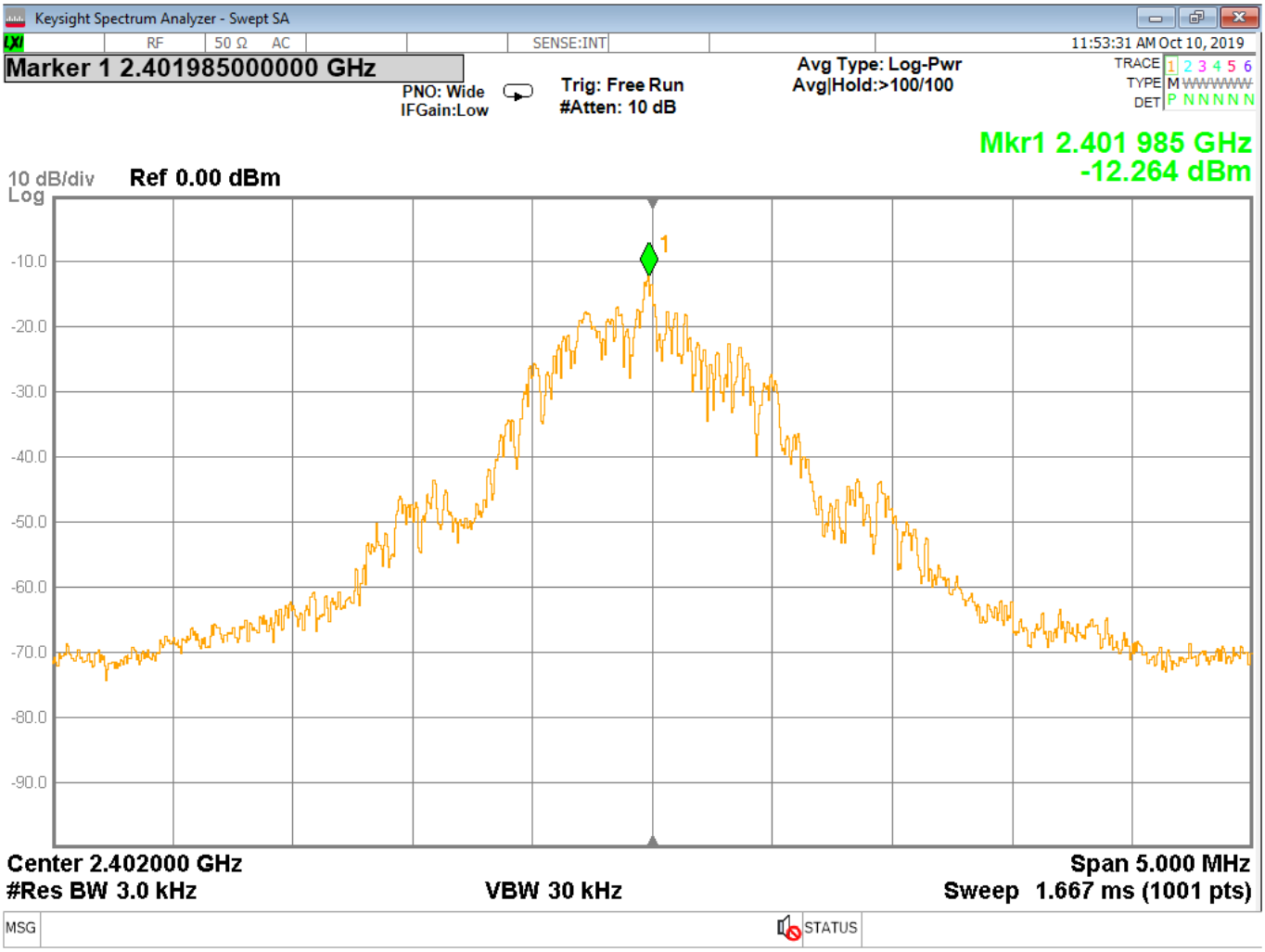


Figure 12 - Power Spectral Density, Low Channel, GFSK

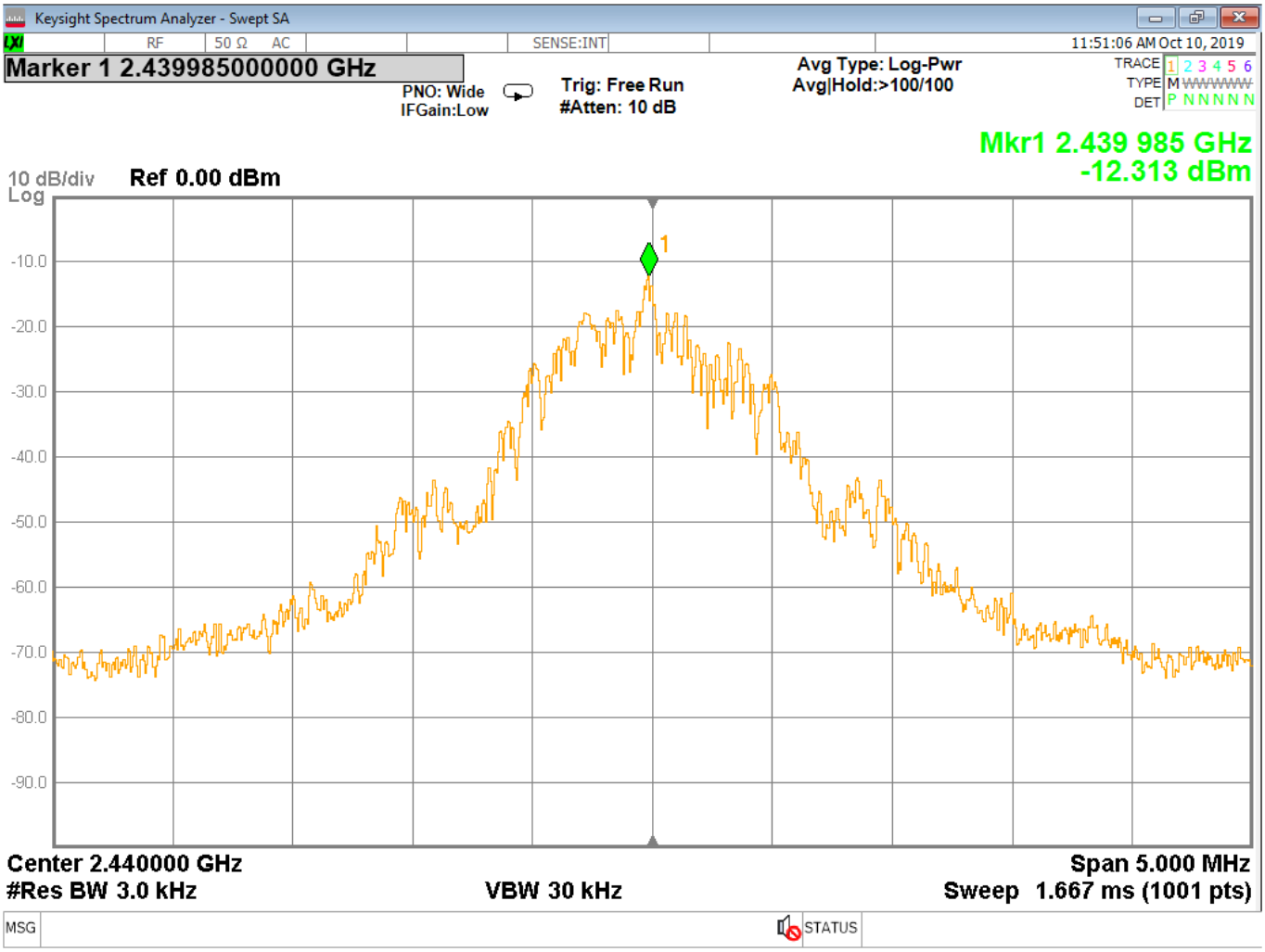


Figure 13 - Power Spectral Density, Mid Channel, GFSK

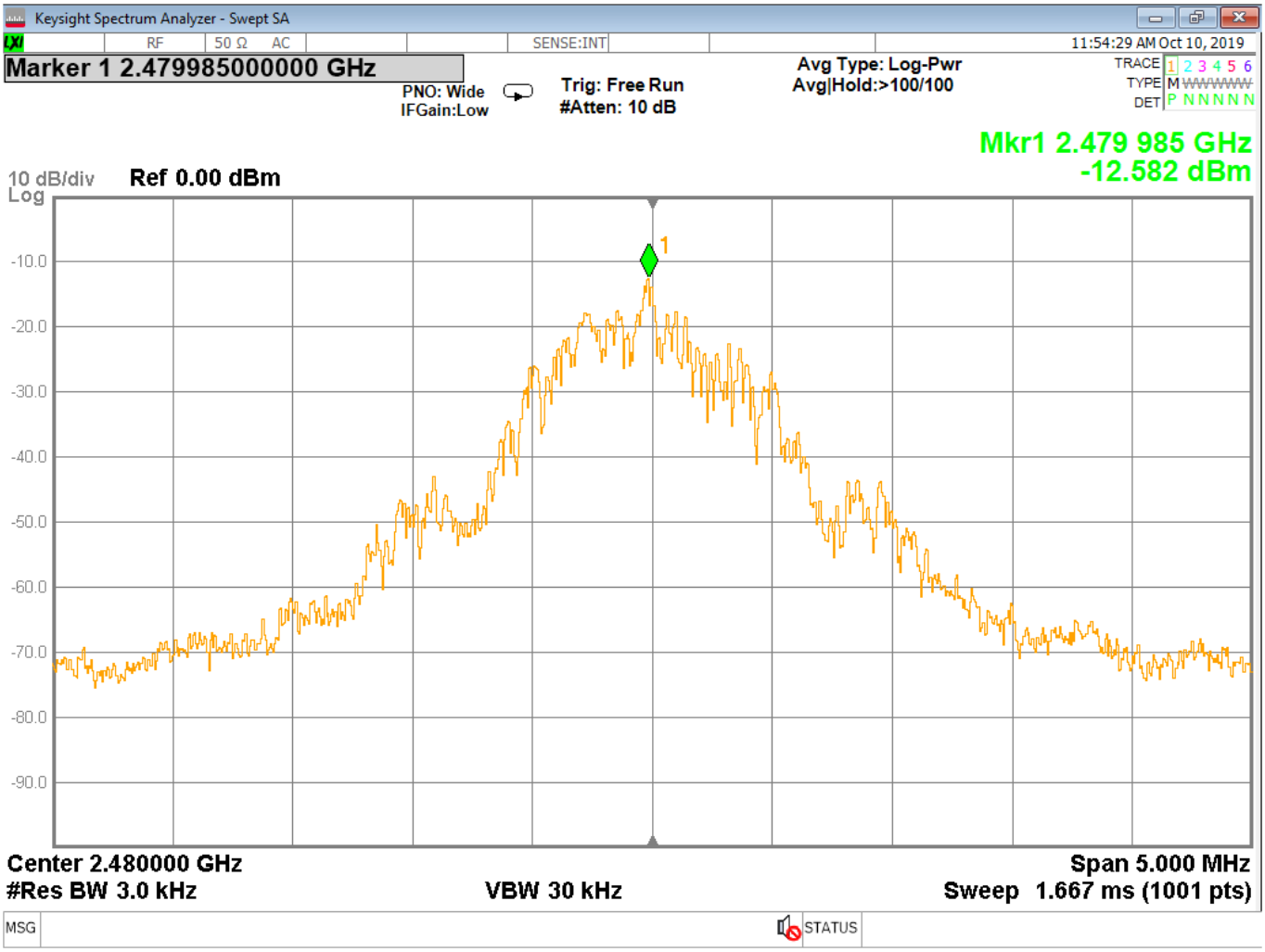


Figure 14 - Power Spectral Density, High Channel, GFSK

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.

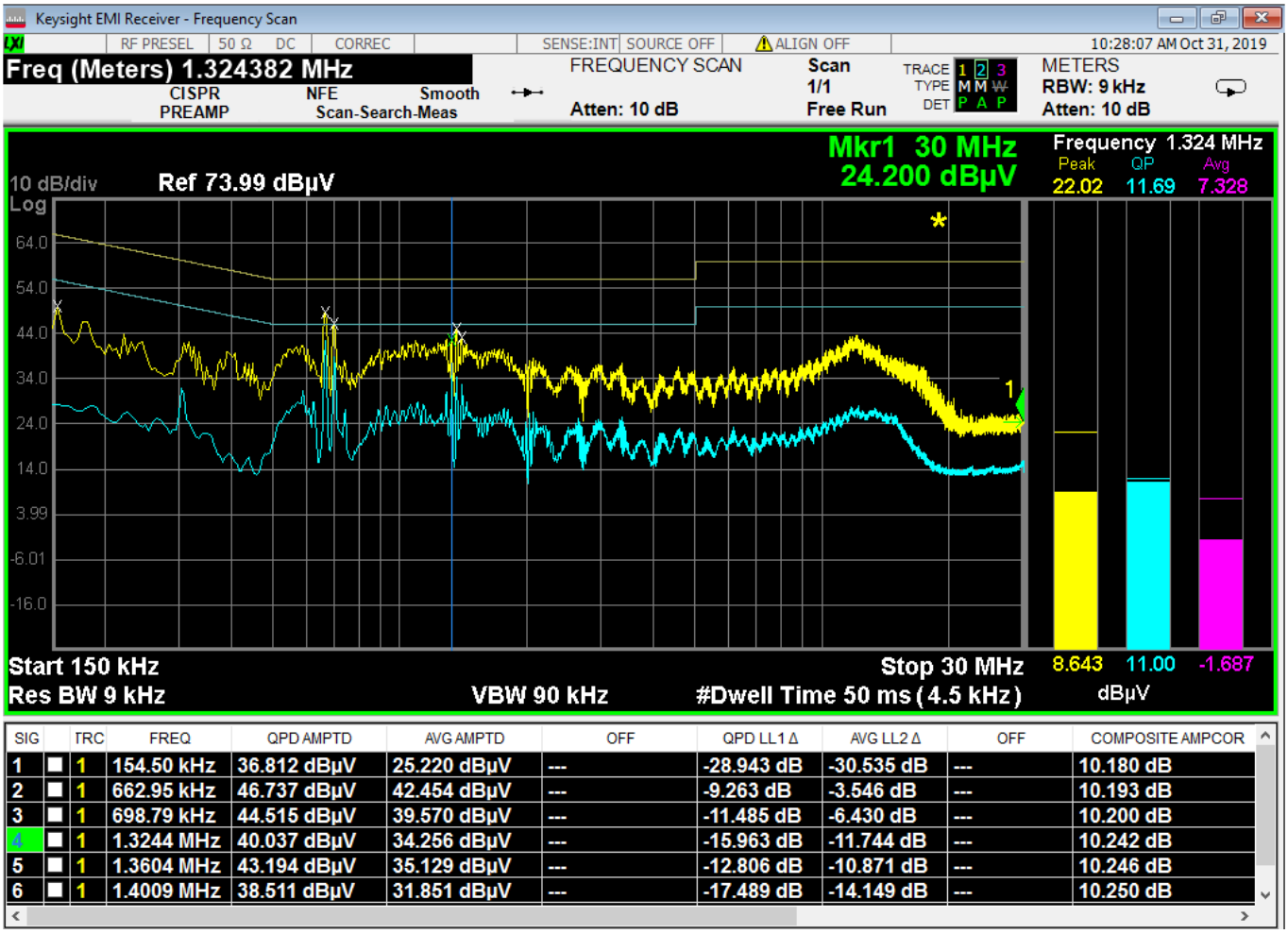
Test Procedures:

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:
The EUT was powered by 5 VDC unless specified and set to transmit continuously on the middle channel.

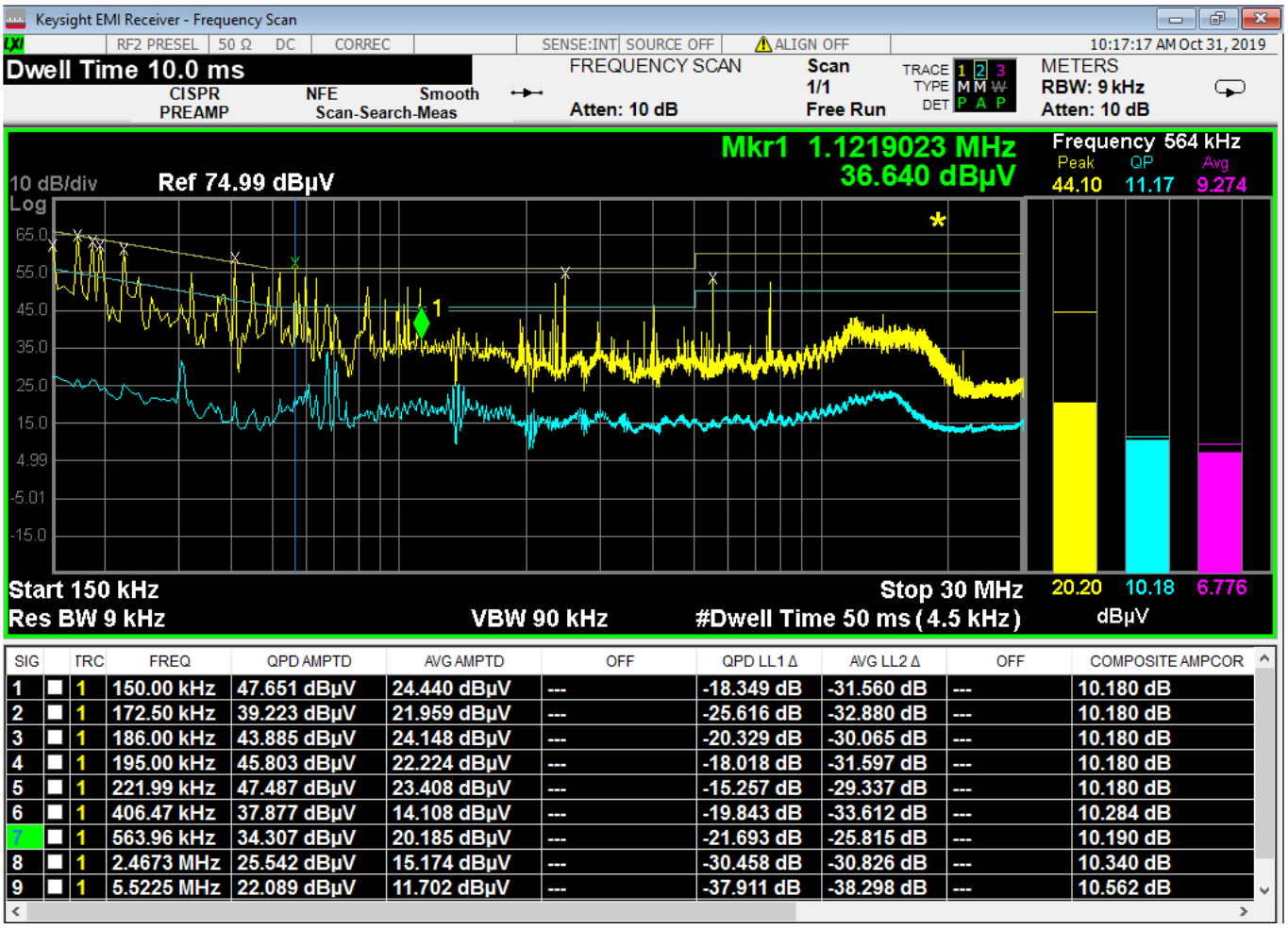
Test Results:



SIG		TRC	FREQ	QPD AMPTD	AVG AMPTD	OFF	QPD LL1 Δ	AVG LL2 Δ	OFF	COMPOSITE AMPCOR
1	■	1	154.50 kHz	36.812 dBµV	25.220 dBµV	---	-28.943 dB	-30.535 dB	---	10.180 dB
2	■	1	662.95 kHz	46.737 dBµV	42.454 dBµV	---	-9.263 dB	-3.546 dB	---	10.193 dB
3	■	1	698.79 kHz	44.515 dBµV	39.570 dBµV	---	-11.485 dB	-6.430 dB	---	10.200 dB
4	■	1	1.3244 MHz	40.037 dBµV	34.256 dBµV	---	-15.963 dB	-11.744 dB	---	10.242 dB
5	■	1	1.3604 MHz	43.194 dBµV	35.129 dBµV	---	-12.806 dB	-10.871 dB	---	10.246 dB
6	■	1	1.4009 MHz	38.511 dBµV	31.851 dBµV	---	-17.489 dB	-14.149 dB	---	10.250 dB

Figure 15 - Conducted Emissions, Line

All Measurements were found to be at least 10 dB below the limits.



SIG	TRC	FREQ	QPD AMPTD	AVG AMPTD	OFF	QPD LL1 Δ	AVG LL2 Δ	OFF	COMPOSITE AMPCOR
1	1	150.00 kHz	47.651 dBµV	24.440 dBµV	---	-18.349 dB	-31.560 dB	---	10.180 dB
2	1	172.50 kHz	39.223 dBµV	21.959 dBµV	---	-25.616 dB	-32.880 dB	---	10.180 dB
3	1	186.00 kHz	43.885 dBµV	24.148 dBµV	---	-20.329 dB	-30.065 dB	---	10.180 dB
4	1	195.00 kHz	45.803 dBµV	22.224 dBµV	---	-18.018 dB	-31.597 dB	---	10.180 dB
5	1	221.99 kHz	47.487 dBµV	23.408 dBµV	---	-15.257 dB	-29.337 dB	---	10.180 dB
6	1	406.47 kHz	37.877 dBµV	14.108 dBµV	---	-19.843 dB	-33.612 dB	---	10.284 dB
7	1	563.96 kHz	34.307 dBµV	20.185 dBµV	---	-21.693 dB	-25.815 dB	---	10.190 dB
8	1	2.4673 MHz	25.542 dBµV	15.174 dBµV	---	-30.458 dB	-30.826 dB	---	10.340 dB
9	1	5.5225 MHz	22.089 dBµV	11.702 dBµV	---	-37.911 dB	-38.298 dB	---	10.562 dB

Figure 16 - Conducted Emissions, Neutral

All Measurements were found to be at least 10 dB below the limits.

Note: the X's shown in the plot show the peak values where the quasi-peaks were measured.

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 – FIGURES

The following figures were used to obtain the data displayed in sections 4.1, 4.2, and 4.3.

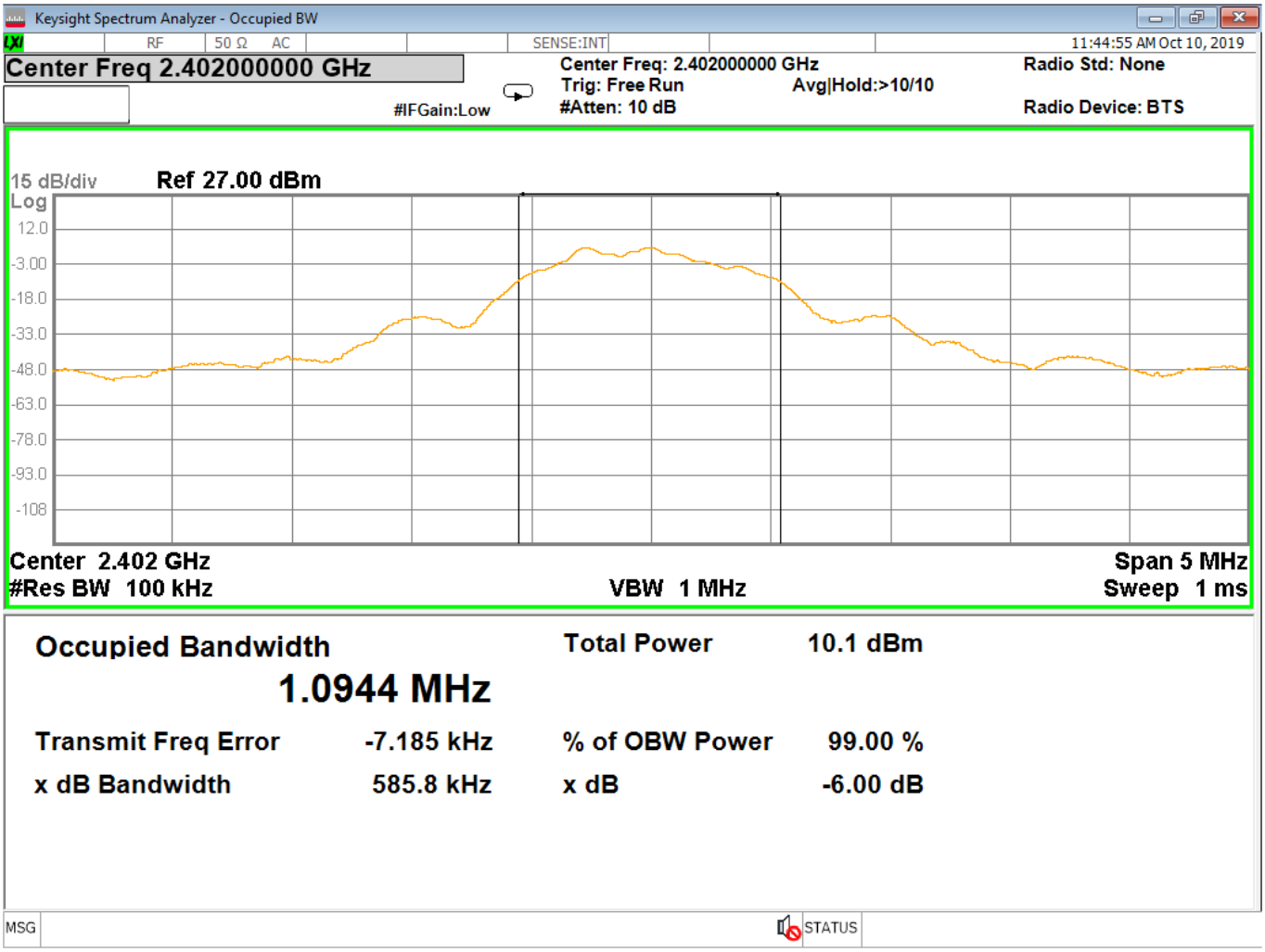


Figure 17 – Low Channel, GFSK

Occupied Bandwidth = 1094.4 kHz

6dB Bandwidth = 585.8 kHz

Cable loss was less than 0.1 dB and not included

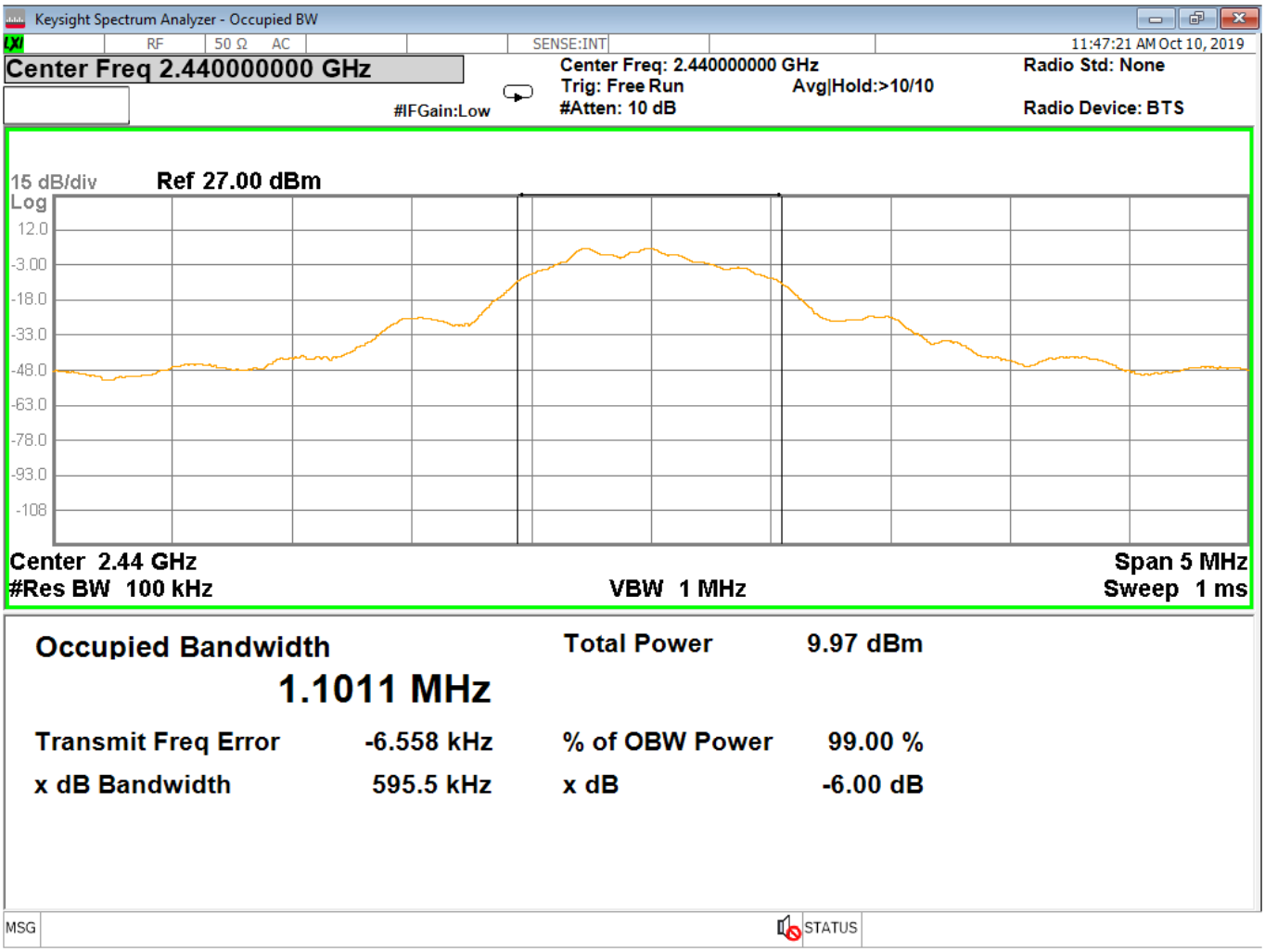


Figure 18 – Mid Channel, GFSK

Occupied Bandwidth = 1101.1 kHz

6dB Bandwidth = 595.5 kHz

Cable loss was less than 0.1 dB and not included

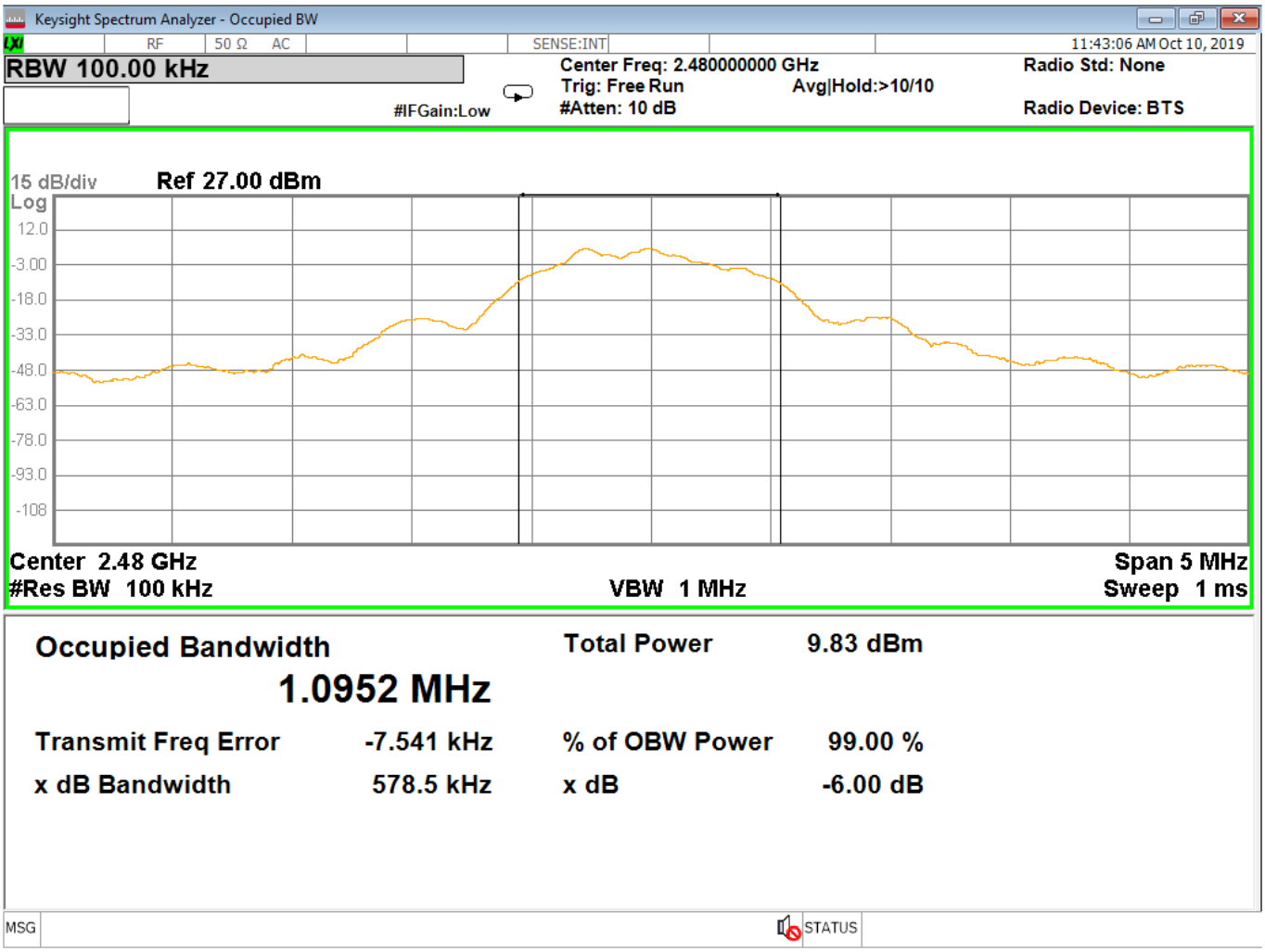
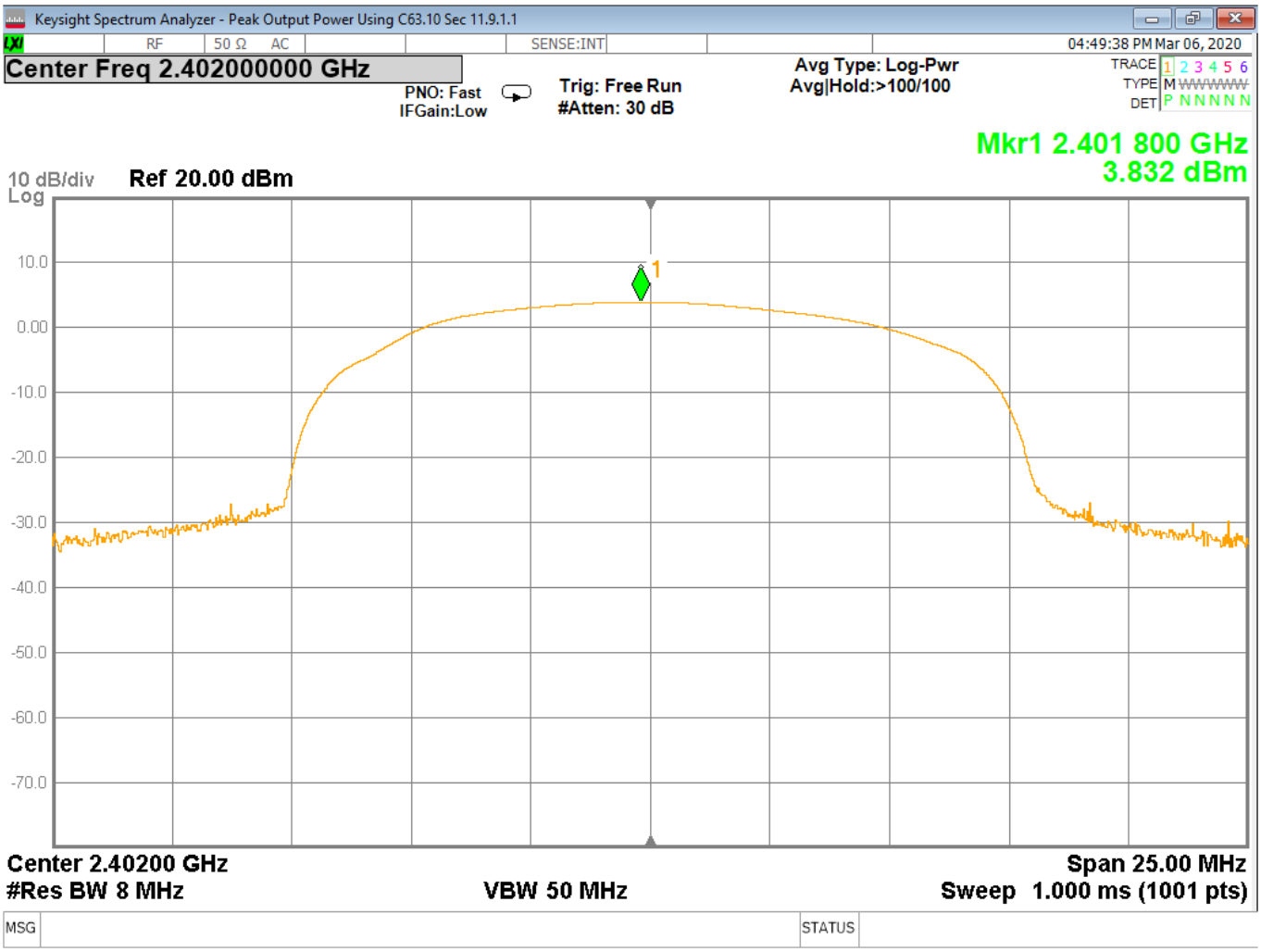


Figure 19 – High Channel, GFSK

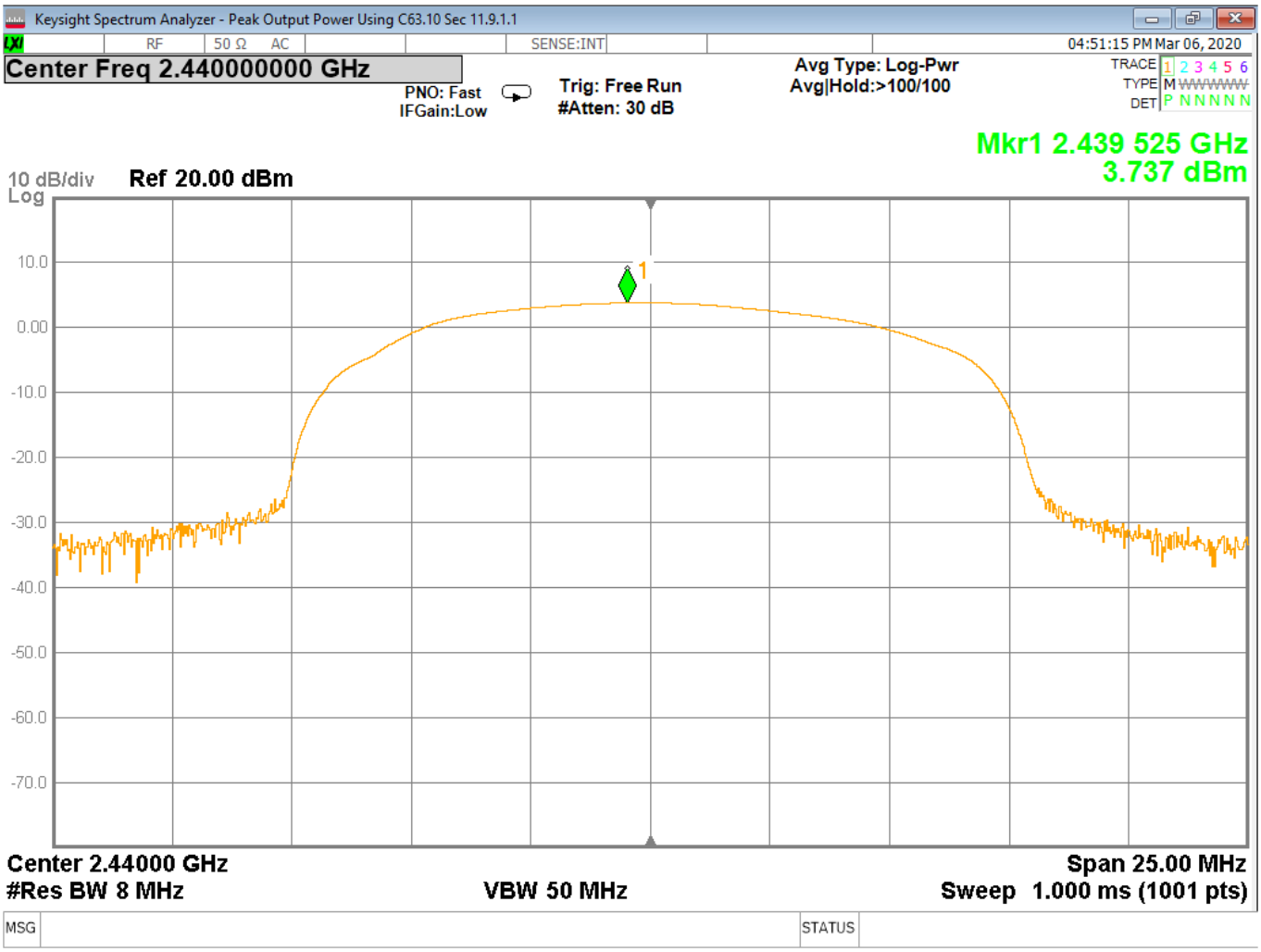
Occupied Bandwidth = 1095.2 kHz

6dB Bandwidth = 578.5 kHz

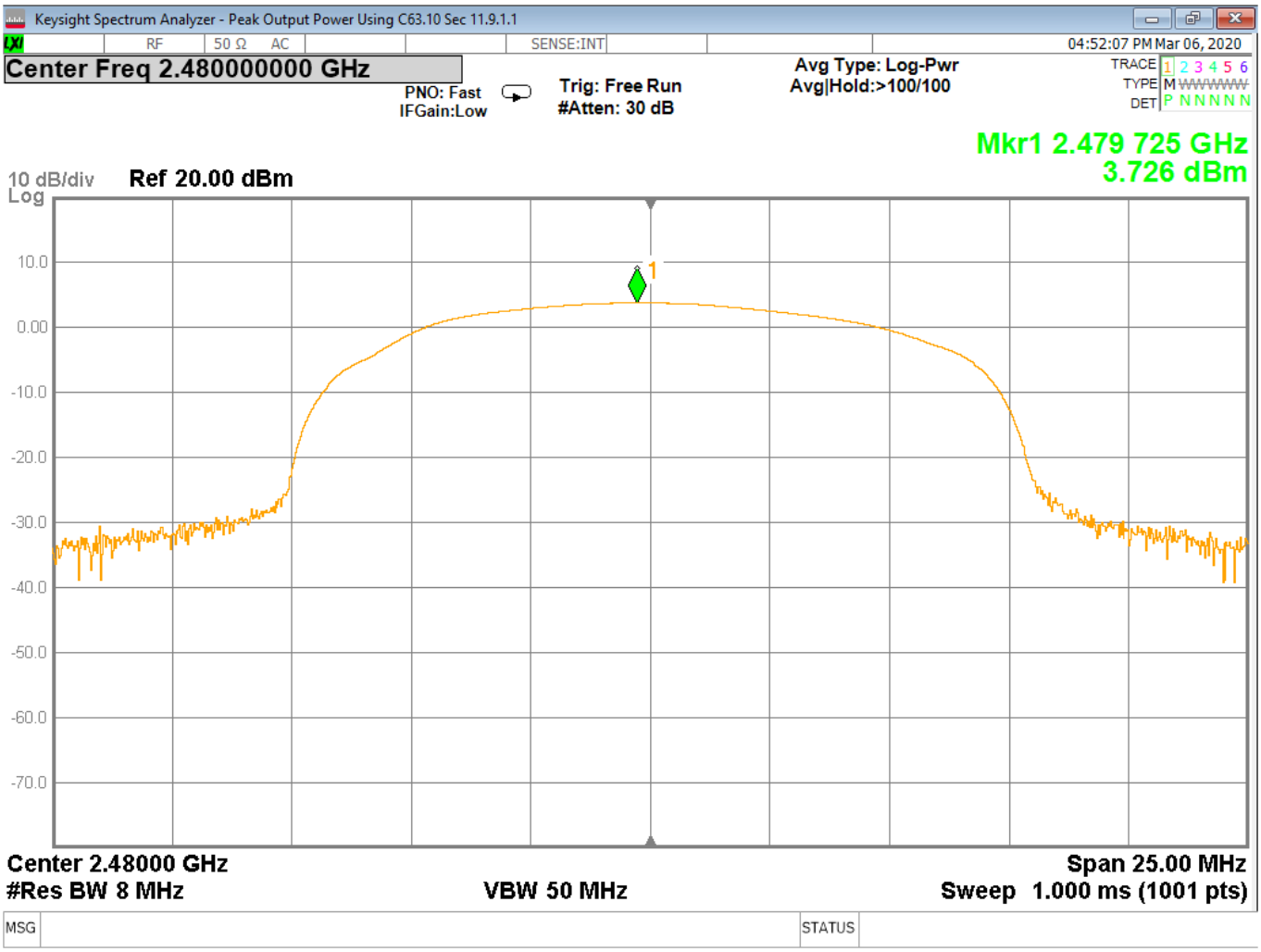
Cable loss was less than 0.1 dB and not included



Output power = 3.832 dBm



Output power = 3.737 dBm



Output power = 3.726 dBm

REPORT END