

TNB Test Report

Prepared for: Garmin International Inc.
Address: 1200 E. 151st Street
Olathe, Kansas, 66062, USA
Product: A03302
Test Report No: R20191022-26-04C

Approved By:



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Revision Page

Rev. No.	Date	Description
Original	27 March 2020	Original – Njohnson Prepared by CFarrington
A	20 May 2020	Includes NCEE Labs report R20191022-26-04 and its amendment in full
B	27 May 2020	Includes NCEE Labs report R20191022-26-04A and its amendment in full
C	27 May 2020	Includes NCEE Labs report R20191022-26-04B and its amendment in full

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1 Summary of Test Results

The following information is submitted for consideration in processing Class 2 Permissive Change (C2PC) to authorized equipment. The module model: A03302, was granted a module authorization operating under 47CFR part 25 and Industry Canada RSS-170 operations in the 1616.0-1626.5 MHz frequency band. This report presents documentation supporting a change in the PCB trace leading to the antenna. The new trace includes no active components.

The equipment under test (EUT) was tested for compliance to FCC Part 25 and Part 2 as well as RSS-170. Below is a summary of the test results. Complete results can be found in Section 3.

Report Section	47 CFR FCC Rule Part	Description	Result
3	§ 2.1046, §25.202	Spurious emissions	Compliant
3	RSS-170 Issue 3, Section 5.4	Power and emissions	Compliant

Test Methods:

- (1) ANSI C63.26-2015

2 EUT Description

2.1 Equipment under Test (EUT)

EUT	A03302
EUT Received	7 November 2019
EUT Tested	7 November 2019 - 20 May 2020
Serial No.	3314219992
Operating Band	1616 MHz – 1626 MHz
Device Type	Iridium
Power Supply	Internal Battery/ Charger: Garmin MN: LAC046

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

2.2 Testing Location

All testing was performed at the NCEE Lincoln facility, which is an A2LA accredited EMC test laboratory accredited per scope 1953.01.

2.3 EUT Setup

The EUT was powered by 3.7 VDC, internal Battery for all the tests. The EUT was a module tested inside of a representative host device.

2.4 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
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
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	26 Jul 2018	26 Jul 2019
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.

3 Test Results

Emissions Limitations Operation in the Band 1616.0-1626.5 MHz

Test: FCC Part 25.202, 2.1051, 2.1053
RSS-170, Clause 5.3
ANSI C63.26, Section 5.5, Annex B

Test Result: *Complies* Date: 20 May 2020

Test Description

25.202 Section 12(f) *Emission limitations*. Except for SDARS terrestrial repeaters and as provided for in paragraph (i), the mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the schedule set forth in paragraphs (f)(1) through (f)(4) of this section. The out-of-band emissions of SDARS terrestrial repeaters shall be attenuated in accordance with the schedule set forth in paragraph (h) of this section.

Test Environment

Testing was performed at the NCEE Labs Lincoln facility. Laboratory environmental conditions varied slightly throughout the test:

Relative humidity of $35 \pm 5\%$
Temperature of $22 \pm 2^{\circ} \text{C}$

Test Setup

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuators. The spectrum analyzer was used to make power measurements using the channel power function. The resolution bandwidth was set to 1 MHz and the channel bandwidth was set to match the occupied bandwidth as measured in Section 3.3.

Spurious emissions were measured using a pre-test site path loss according to Section 5.5.4 and Annex B of ANSI C63.26.

Radiated emissions measurements were made from 9 kHz to 12.5 GHz at a distance of 3m inside a semi-anechoic chamber. The EUT was rotated 360°, the antenna height varied from 1 – 4 meters and both the vertical and horizontal antenna polarizations examined. The results were compared against the limits. Measurements were made by first using a spectrum analyzer to acquire the signal spectrum; individual frequencies were then measured using a CISPR 16.1 compliant receiver with the following bandwidth setting:
30MHz – 1GHz:120kHz IF bandwidth, 60kHz steps.

Limits were converted from EIRP to 3m field strength. Measurements were performed with a quasi-peak detector. Path loss was measured during ANSI C63.4-2014 Normalized Site Attenuation measurements.

Test Results

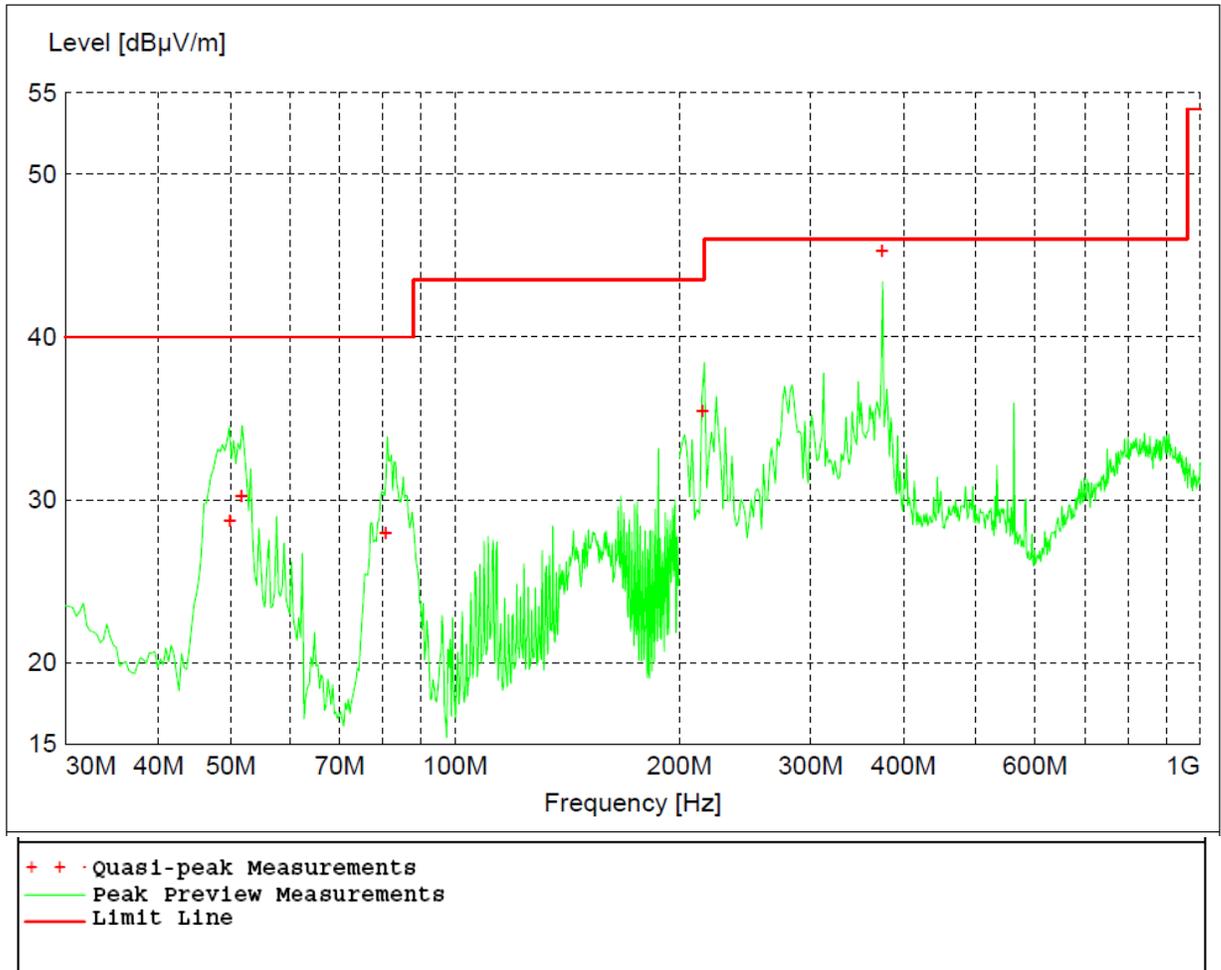


Figure 1 - Radiated Emissions Data Plot

All three channel were investigated and the channel with the highest emissions is shown for the 30 MHz – 1 GHz frequency range.

Table 1 - Radiated Emissions Measurements

Frequency	Pre-test Level	Emission Power Level	Limit	Margin	Height	Angle	Pol	Channel
MHz	dBμV/m	dBm	dBm	dB	cm.	deg.		
49.920000	28.74	-66.49	-13.00	53.49	101	41	VERT	Mid
51.720000	30.28	-64.95	-13.00	51.95	99	7	VERT	Mid
80.760000	27.96	-67.27	-13.00	54.27	100	0	VERT	Mid
214.980000	35.45	-59.78	-13.00	46.78	102	319	HORI	Mid
374.400000	45.28	-49.95	-13.00	36.95	100	100	HORI	Mid

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

Emission Power Level = Pre-test level – Path Loss (95.23 dB)

Table 2 - Radiated Emissions Peak Measurements

Frequency	Level	Emission Power Level	Limit	Margin	Height	Angle	Pol	Channel
MHz	dBμV/m	dBm	dBm	dB	cm.	deg.		
1616.028330	92.517	-2.713	N/A	N/A	225	200	H	Low
1620.979167	91.735	-3.495	N/A	N/A	225	200	H	Mid
1625.979167	90.872	-4.358	N/A	N/A	225	200	H	High
3232.050000	37.190	-58.04	-13.00	45.04	225	200	H	Low
3241.960000	36.092	-59.138	-13.00	46.138	225	200	H	Mid
3251.960000	40.787	-54.443	-13.00	41.443	225	200	H	High

No other signals were detected above system sensitivity

Requirement from FCC Part 25.202(f)

(f) *Emission limitations.* Except for SDARS terrestrial repeaters and as provided for in paragraph (i), the mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the schedule set forth in paragraphs (f)(1) through (f)(4) of this section. The out-of-band emissions of SDARS terrestrial repeaters shall be attenuated in accordance with the schedule set forth in paragraph (h) of this section.

(1) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: 25 dB;

(2) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: 35 dB;

(3) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts;

(4) In any event, when an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in paragraphs (f) (1), (2) and (3) of this section.

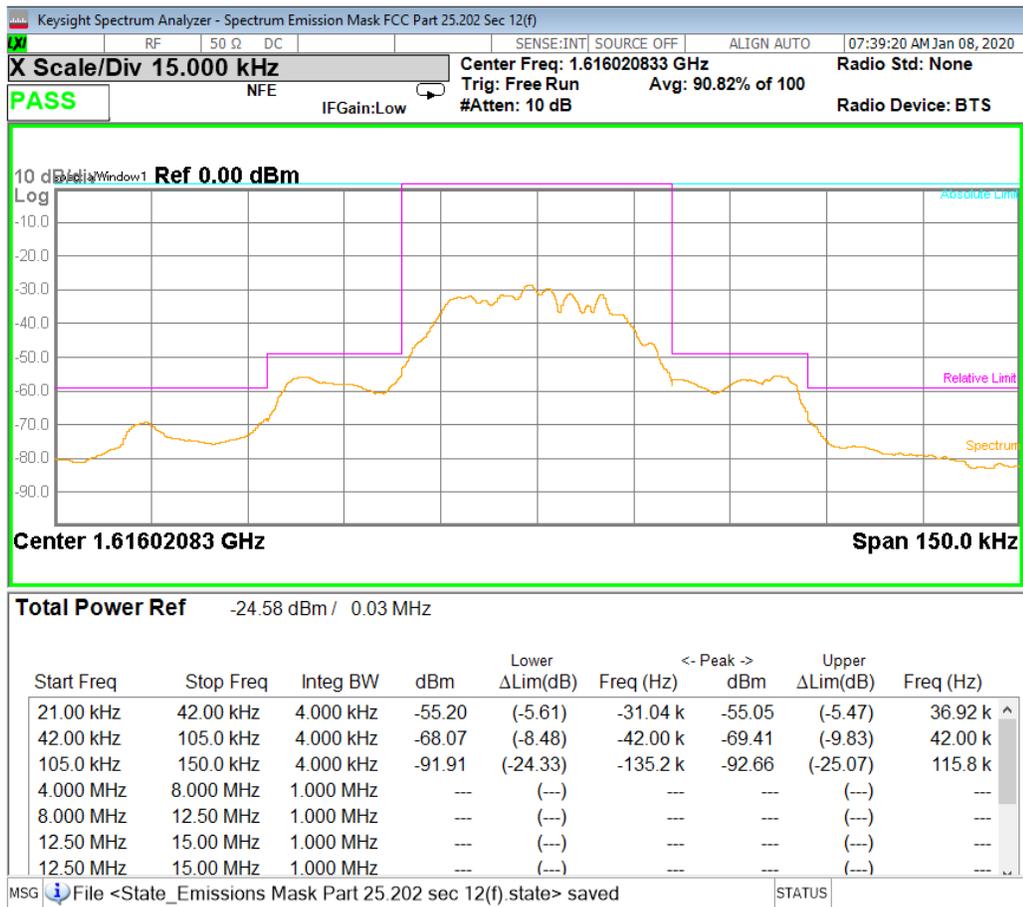


Figure 2 – Part 25.202(f) Mask, Transmitting at 1616.028330 MHz

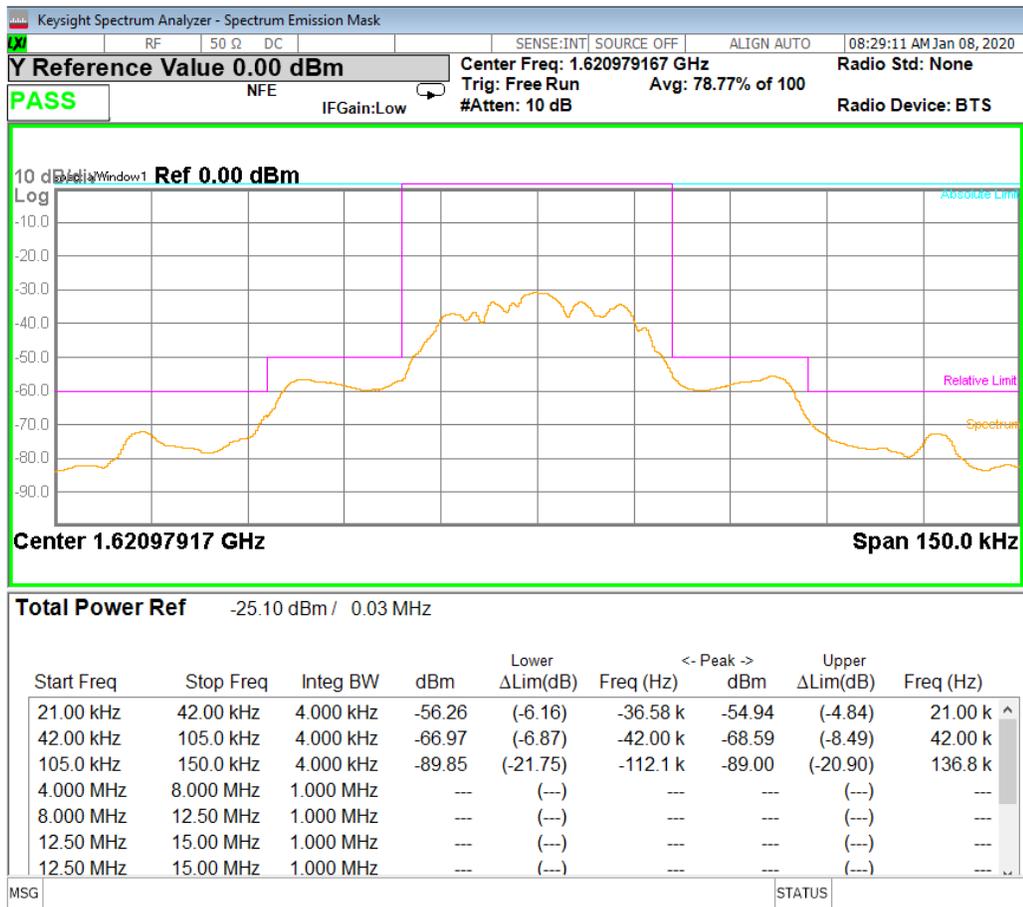


Figure 3 – Part 25.202(f) Mask, Transmitting at 1620.979167 MHz

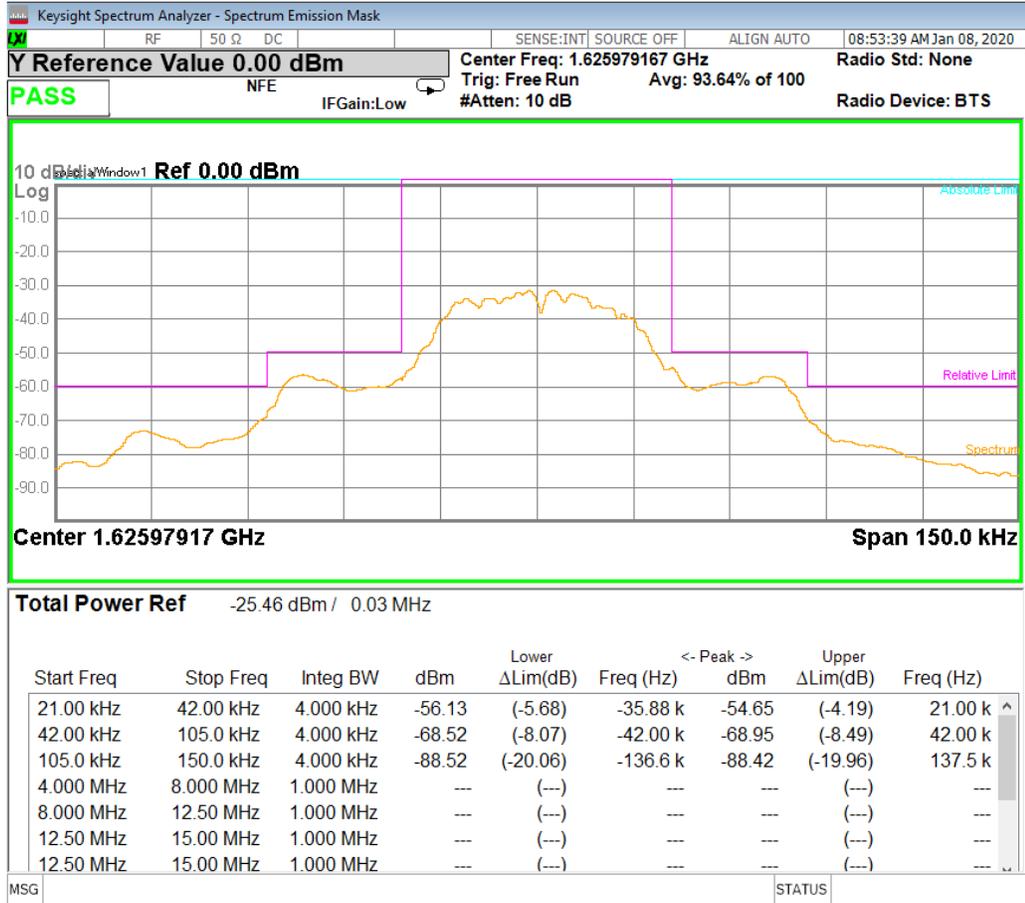


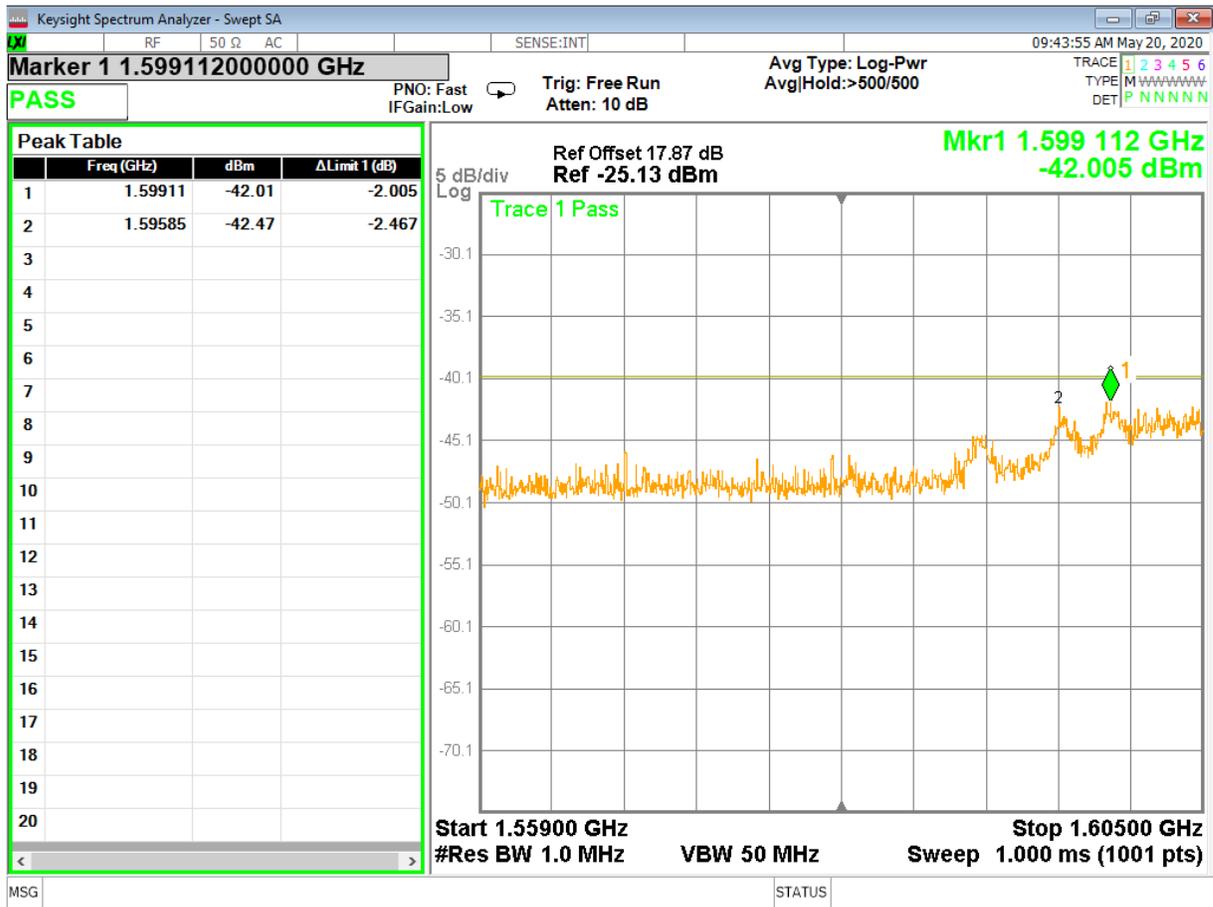
Figure 4 – Part 25.202(f) Mask, Transmitting at 1625.979167 MHz

The measurements shown for Part 25.202(f) in figures 2-4 use a spectral mask built from the description found in the requirements described above. Device is shown to be compliant.

Requirement from FCC Part 25.216

(c) The e.i.r.p. density of emissions from mobile earth stations placed in service after July 21, 2002 with assigned uplink frequencies between 1610 MHz and 1660.5 MHz shall not exceed -70 dBW/MHz, averaged over any 2 millisecond active transmission interval, in the band 1559-1605 MHz. The e.i.r.p. of discrete emissions of less than 700 Hz bandwidth from such stations shall not exceed -80 dBW, averaged over any 2-millisecond active transmission interval, in the 1559-1605 MHz band.

Note: The worst-case spurious emissions from the original certification (Report number: 170927) were measured and found to be compliant.



Measurements according to FCC Part 25.212(c)

Figure 5 – Part 25.212(c), Transmitting at 1616.028330 MHz, Conducted Measurement

*Limits have been extrapolated from dBW to dBm. dBW = dBm + 30
 Limit = -40.00 dBm

Antenna Gain = -1.9 dB
 External Attenuation = 19.77 dB

Ref Offset = 19.77 – 1.9 = 17.87 dB



Figure 6 – Part 25.212(c), Transmitting at 1620.979167 MHz, Conducted Measurement
 *Limits have been extrapolated from dBW to dBm. dBW = dBm + 30
 Limit = -40.00 dBm

Antenna Gain = -1.9 dB
 External Attenuation = 19.77 dB

Ref Offset = 19.77 – 1.9 = 17.87 dB

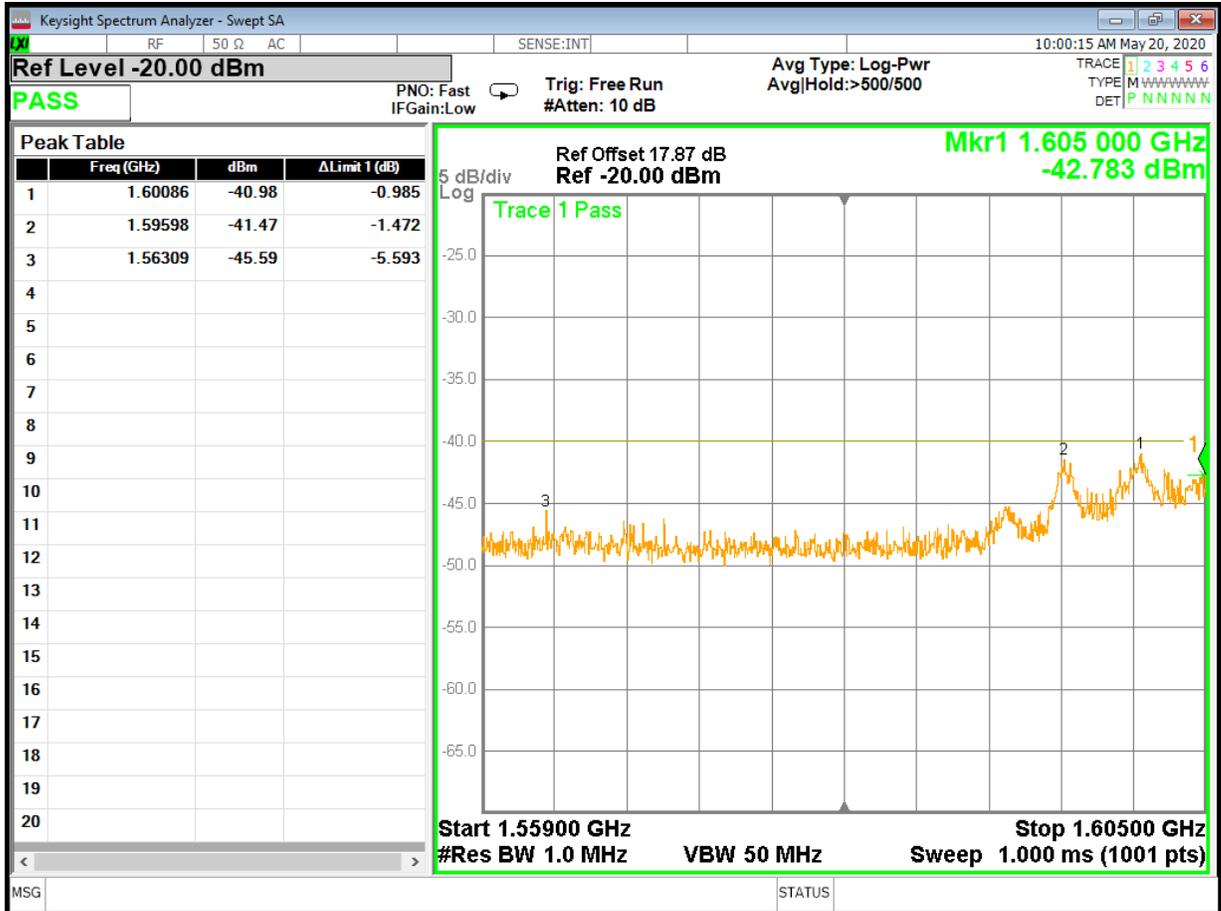


Figure 7 – Part 25.212(c), Transmitting at 1625.979167 MHz, Conducted Measurement
 *Limits have been extrapolated from dBW to dBm. dBW = dBm + 30
 Limit = -40.00 dBm

Antenna Gain = -1.9 dB
 External Attenuation = 19.77 dB

Ref Offset = 19.77 – 1.9 = 17.87 dB

Discrete emissions

Resolution Bandwidth = 120 kHz, except where indicate with *, RBW = 750 Hz

1616.028 MHz

Freq	Level	Limit	Margin
GHz	dBm	dBm	dB
1.5592	-51.5700*	-50.0000	1.5700
1.5908	-54.7600*	-50.0000	4.7600
1.5960	-55.8000	-50.0000	5.8000
1.5824	-63.0100	-50.0000	13.0100
1.5785	-64.7100	-50.0000	14.7100
1.5656	-65.7100	-50.0000	15.7100

1620.979 MHz

Freq	Level	Limit	Margin
GHz	dBm	dBm	dB
1.6042	-51.0840	-50.0000	1.0840
1.5958	-50.9480*	-50.0000	0.9480
1.5960	-54.9600	-50.0000	4.9600
1.5874	-59.1700	-50.0000	9.1700
1.5706	-64.6500	-50.0000	14.6500

1625.979 MHz

Freq	Level	Limit	Margin
GHz	dBm	dBm	dB
1.6008	-50.0760*	-50.0000	0.0760
1.5924	-53.2700	-50.0000	3.2700
1.5960	-54.7700	-50.0000	4.7700

Antenna Gain = -1.9 dB

External Attenuation = 19.77 dB

Ref Offset = 19.77 – 1.9 = 17.87 dB

Limit = -80 dBW = -50 dBm

All other emissions were at least 20 dB below the limit

Measurements according to FCC Part 25.212 (g)

(g) Mobile earth stations manufactured more than six months after FEDERAL REGISTER publication of the rule changes adopted in FCC 03-283 with assigned uplink frequencies in the 1610-1626.5 MHz band shall suppress the power density of emissions in the 1605-1610 MHz band-segment to an extent determined by linear interpolation from -70 dBW/MHz at 1605 MHz to -10 dBW/MHz at 1610 MHz averaged over any 2 millisecond active transmission interval. The e.i.r.p of discrete emissions of less than 700 Hz bandwidth from such stations shall not exceed a level determined by linear interpolation from -80 dBW at 1605 MHz to -20 dBW at 1610 MHz, averaged over any 2 milli-second active transmission interval.

Note: The worst-case spurious emissions from the original certification (Report number: 170927) were measured and found to be compliant.

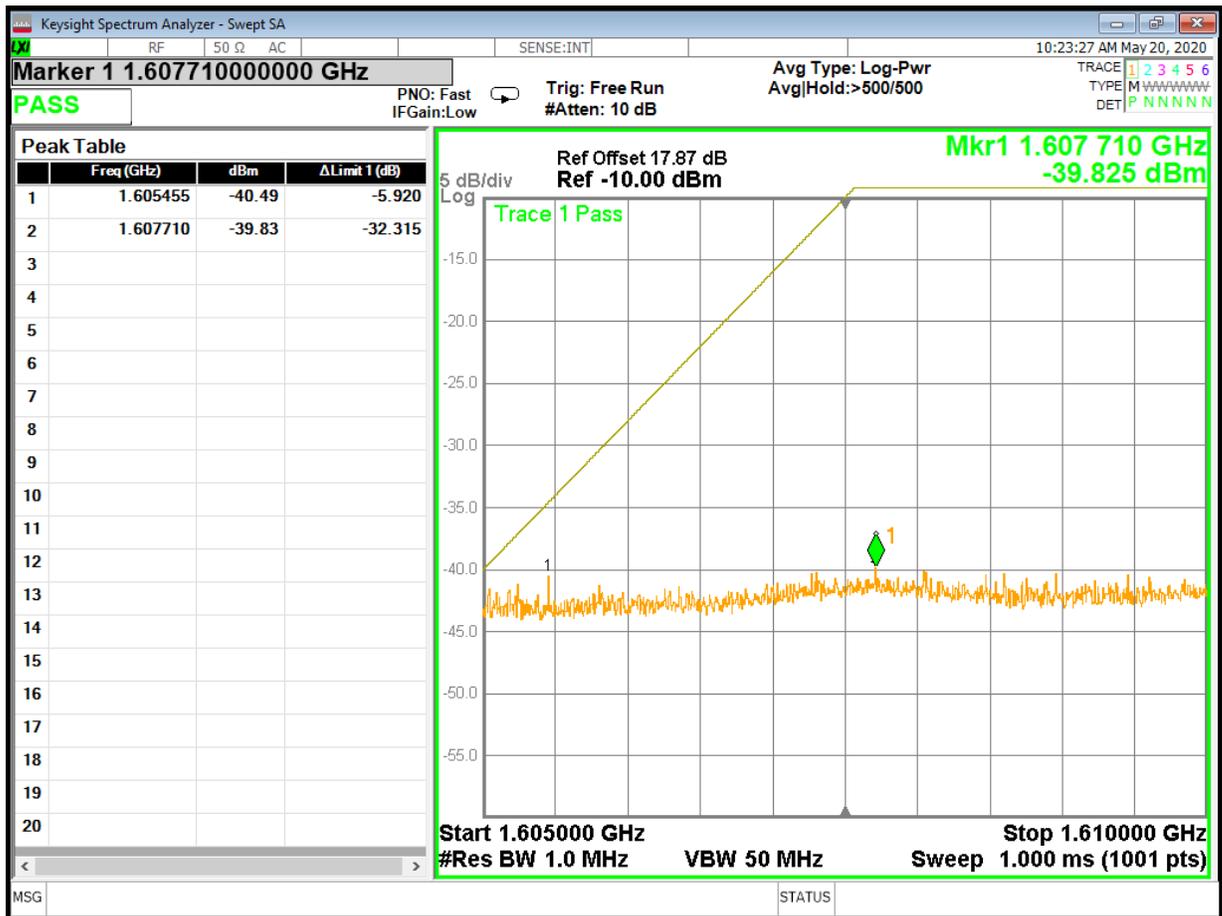


Figure 8 – Part 25.212(g), Transmitting at 1616.028330 MHz, Conducted Measurement
 *Limits have been extrapolated from dBW to dBm. dBW = dBm + 30

Antenna Gain = -1.9 dB
 External Attenuation = 19.77 dB

Ref Offset = 19.77 – 1.9 = 17.87 dB

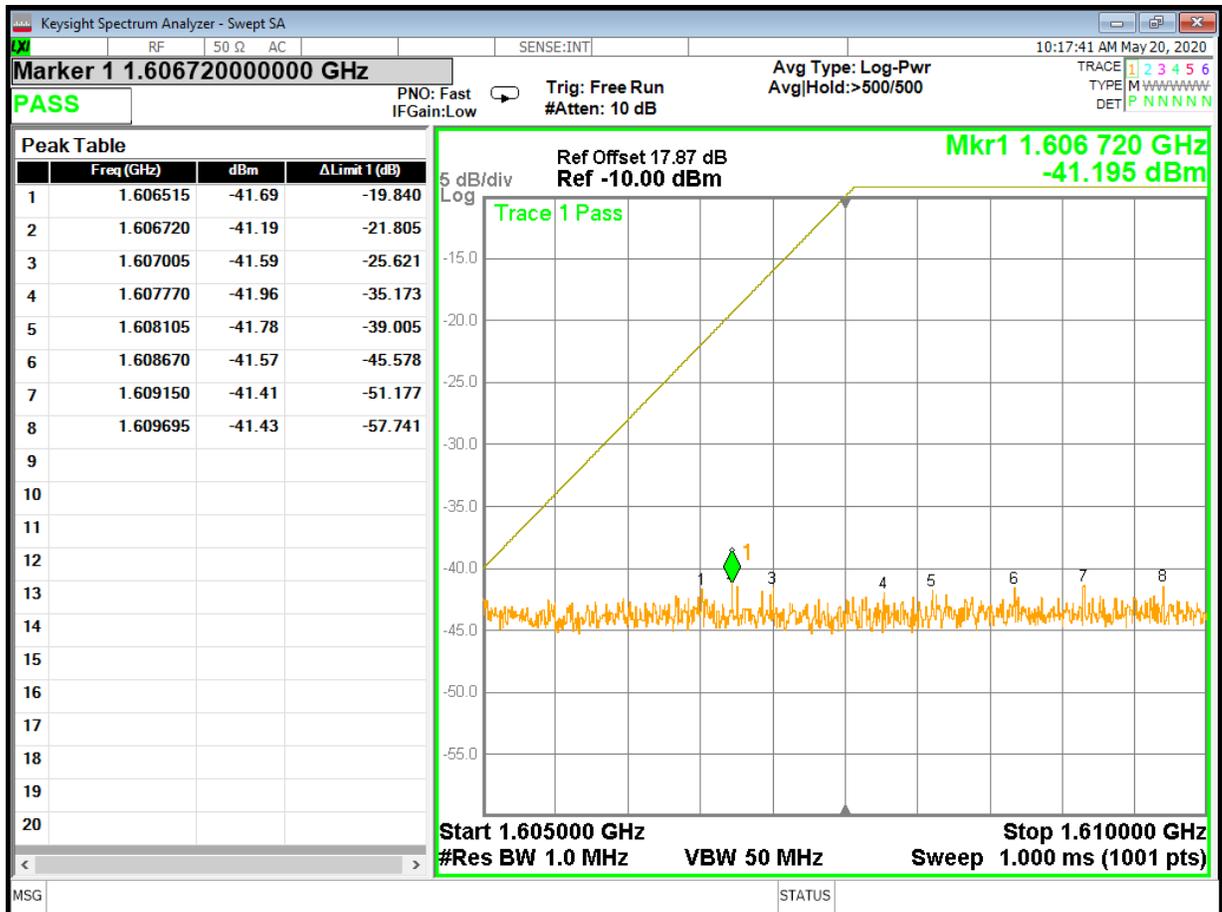


Figure 9 – Part 25.212(g), Transmitting at 1620.979167 MHz, Conducted Measurement
 *Limits have been extrapolated from dBW to dBm. dBW = dBm + 30

Antenna Gain = -1.9 dB
 External Attenuation = 19.77 dB

Ref Offset = 19.77 – 1.9 = 17.87 dB

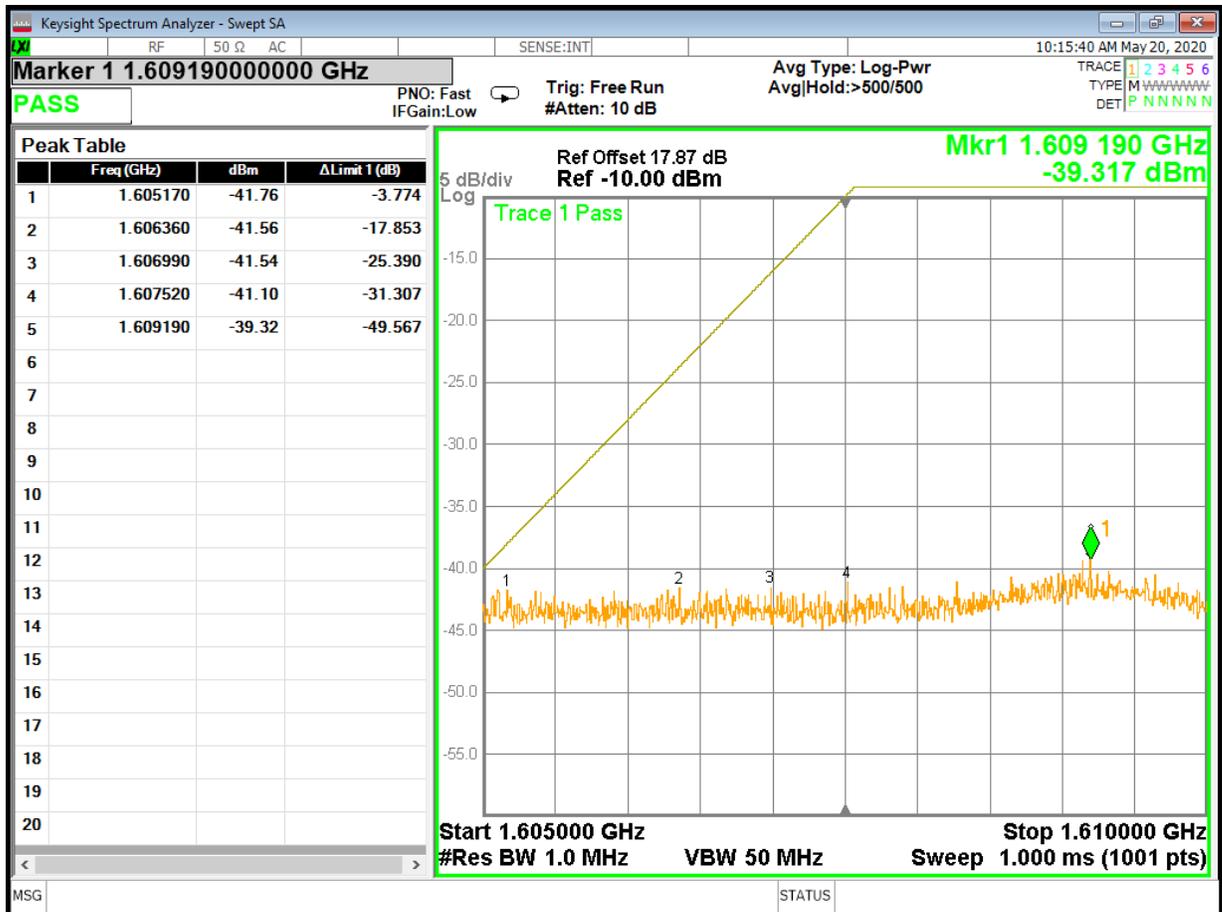


Figure 10 – Part 25.212(g), Transmitting at 1625.979167 MHz, Conducted Measurement
 *Limits have been extrapolated from dBW to dBm. dBW = dBm + 30

Antenna Gain = -1.9 dB
 External Attenuation = 19.77 dB

Ref Offset = 19.77 – 1.9 = 17.87 dB

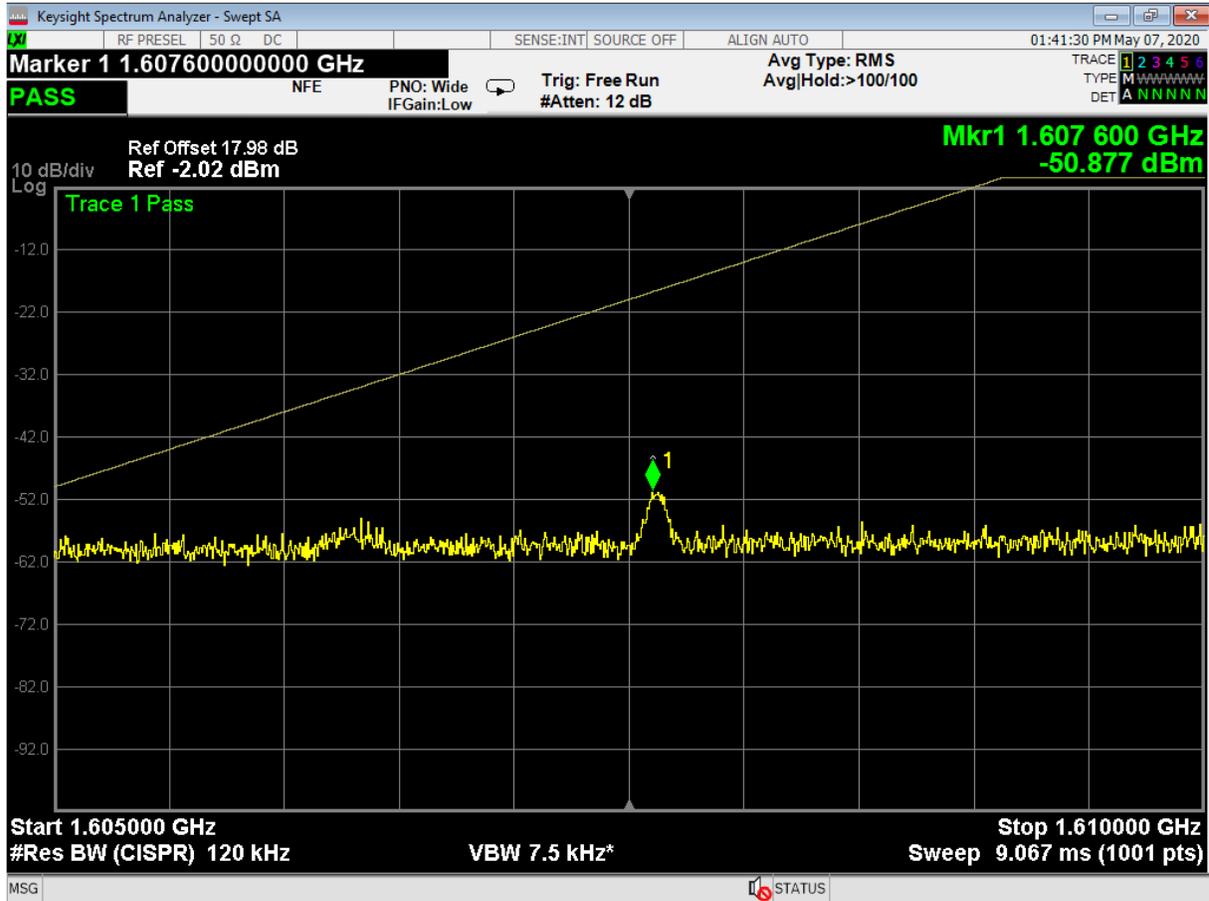


Figure 11 - Part 25.212(g), Transmitting at 1616.028330 MHz, Conducted Measurement

*Limits have been extrapolated from dBW to dBm. $\text{dBW} = \text{dBm} + 30$

Antenna Gain = -1.9 dB
 External Attenuation = 19.77 dB

Ref Offset = $19.77 - 1.9 = 17.87$ dB

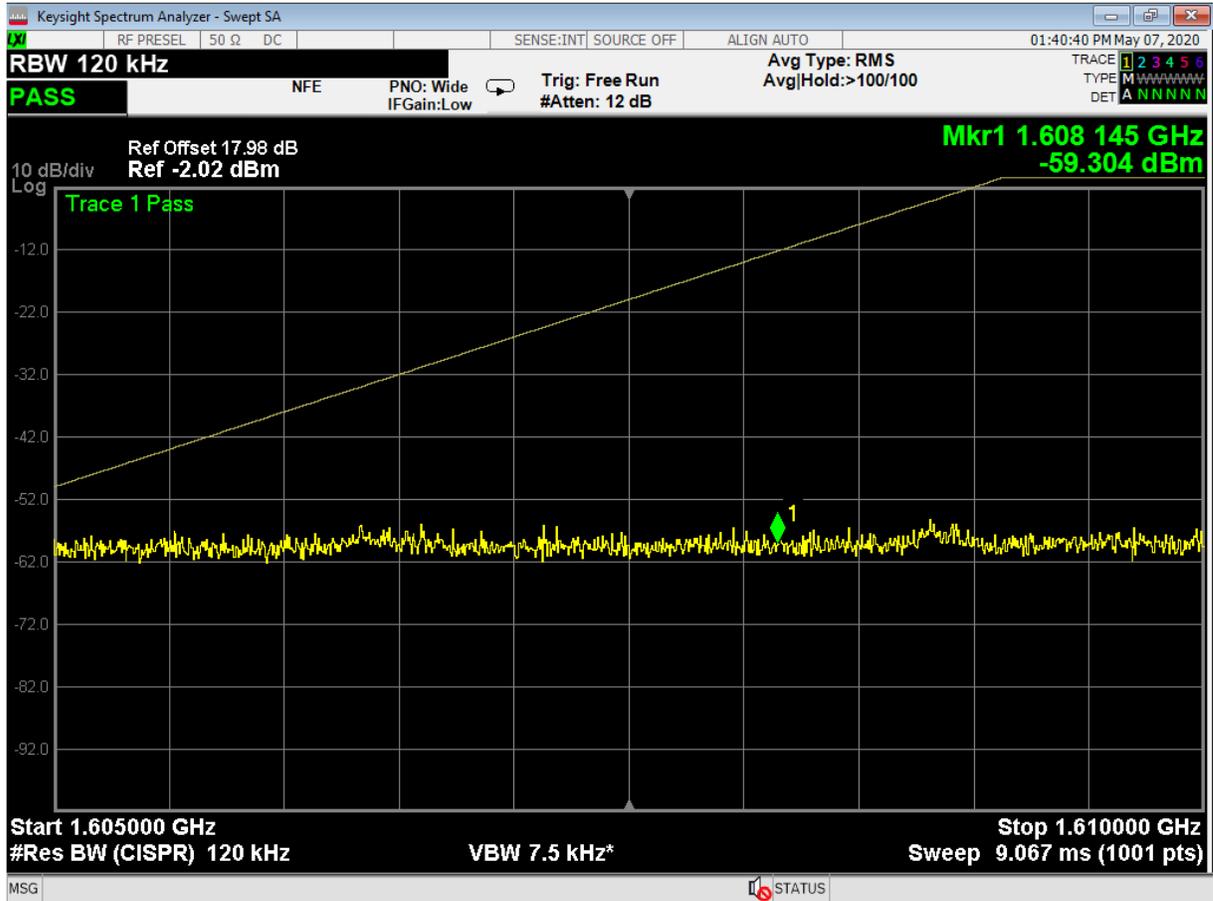


Figure 12 - Part 25.212(g), Transmitting at 1620.979167 MHz, Conducted Measurement

*Limits have been extrapolated from dBW to dBm. $\text{dBW} = \text{dBm} + 30$

Antenna Gain = -1.9 dB
 External Attenuation = 19.77 dB

Ref Offset = $19.77 - 1.9 = 17.87$ dB

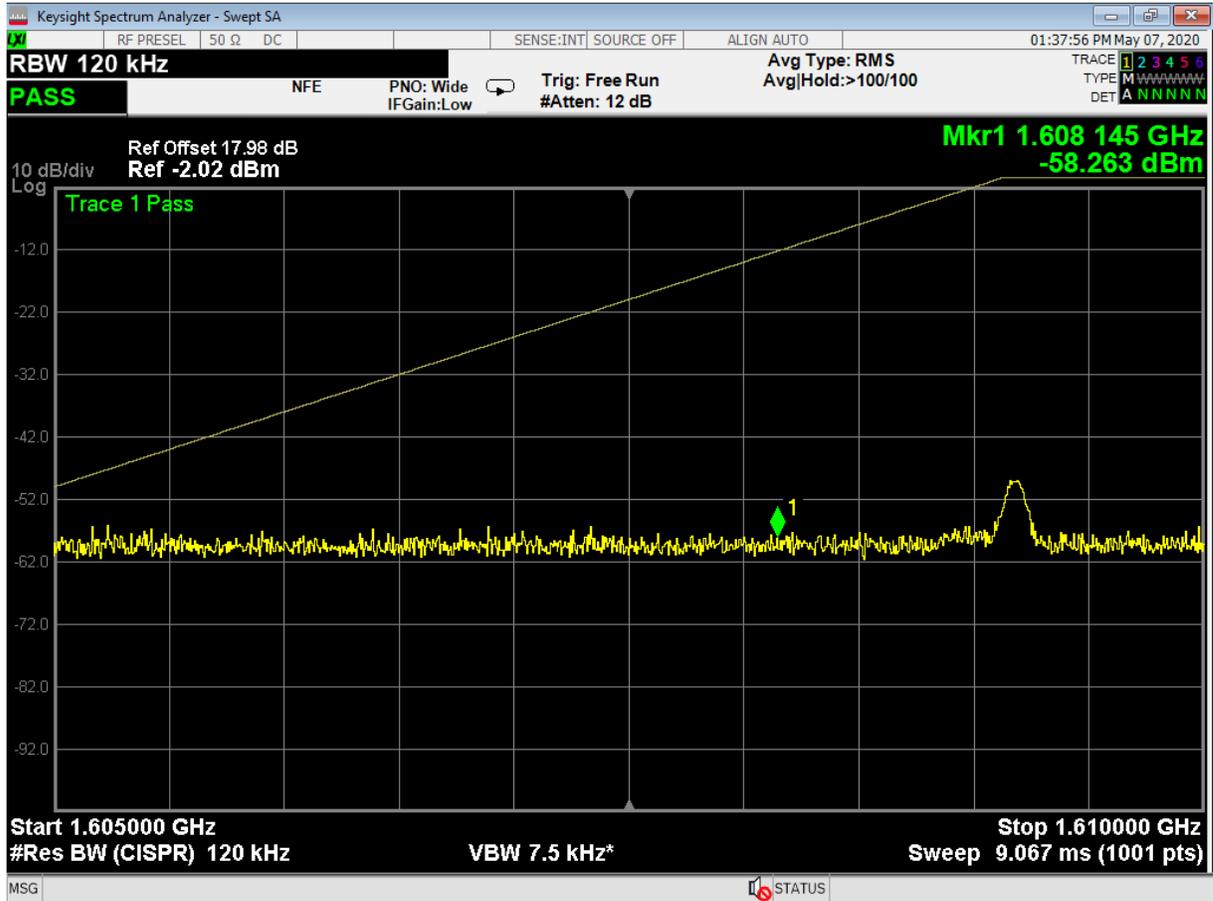


Figure 13 - Part 25.212(g), Transmitting at 1625.979167 MHz, Conducted Measurement

*Limits have been extrapolated from dBW to dBm. $\text{dBW} = \text{dBm} + 30$

Antenna Gain = -1.9 dB
 External Attenuation = 19.77 dB

Ref Offset = $19.77 - 1.9 = 17.87$ dB

Annex A – Sample Field Strength Calculation

Radiated Emissions

The field strength is calculated in decibels (dB) 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:

$$FS = R + AF - (-CF + AG)$$

where FS = Field Strength

R = Receiver Amplitude Receiver reading in dB μ V

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Preamplifier Amplifier Gain

Assume a receiver reading of 55.00 dB μ V is obtained. The Antenna Factor of 12.00 and a Cable Factor of 1.10 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.10 dB μ V/m.

$$FS = 55.00 + 12.00 - (-1.10 + 20.00) = 48.1 \text{ dB}\mu\text{V/m}$$

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

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

Annex 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

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

REPORT END