

TNB Test Report

Class 2 Permissive Change

Prepared for: **Garmin International Inc.**

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

Product: **A03690 (host)**
A03302 (module)

Test Report No: **R20191028-24-E4D**

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Revision Page

Rev. No.	Date	Description
Original	28 February 2020	Original – Njohnson Prepared by CFarrington
A	3 June 2020	Updated discrete emissions.
B	11 June 2020	Added cables to calibration table
C	16 June 2020	Updated calibration Table
D	16 June 2020	Updated calibration Table

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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 and installation into host module A03690.

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	A03690
EUT Received	7 January 2020
EUT Tested	20 May 2020 - 3 June 2020
Serial No.	3319367796
Operating Band	1616 MHz – 1626 MHz
Device Type	Iridium
Power Supply	Internal Battery/ 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.

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 internal Battery for all the tests. EUT was tested with both the integral antenna and external passive antenna.

2.4 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
Rohde & Schwarz Preamplifier*	TS-PR18	3545700803	April 14, 2020	April 14, 2022
Trilithic High Pass Filter*	6HC330	23042	April 14, 2020	April 14, 2022
TDK Emissions Lab Software	V11.25	700307	NA	NA
RF Cable (preamplifier to antenna)	MFR-57500	01-07-002	09 Mar 2018*	09 Mar 2021*
RF Cable (antenna to 10m chamber bulkhead)	FSCM 64639	01E3872	09 Mar 2018*	09 Mar 2021*
RF Cable (10m chamber bulkhead to control room bulkhead)	FSCM 64639	01E3874	09 Mar 2018*	09 Mar 2021*
RF Cable (Control room bulkhead to RF switch)	FSCM 64639	01E3871	09 Mar 2018*	09 Mar 2021*
RF Cable (RF switch to test receiver)	FSCM 64639	01F1206	09 Mar 2018*	09 Mar 2021*
RF switch – Rohde and Schwarz	TS-RSP	1113.5503.14	09 Mar 2018*	09 Mar 2021*
N connector bulkhead (10m chamber)	PE9128	NCEEBH1	09 Mar 2018*	09 Mar 2021*
N connector bulkhead (control room)	PE9128	NCEEBH2	09 Mar 2018*	09 Mar 2021*

*Internal Characterization

Notes:

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

3 Test Results

3.1 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: 6 May 2019

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

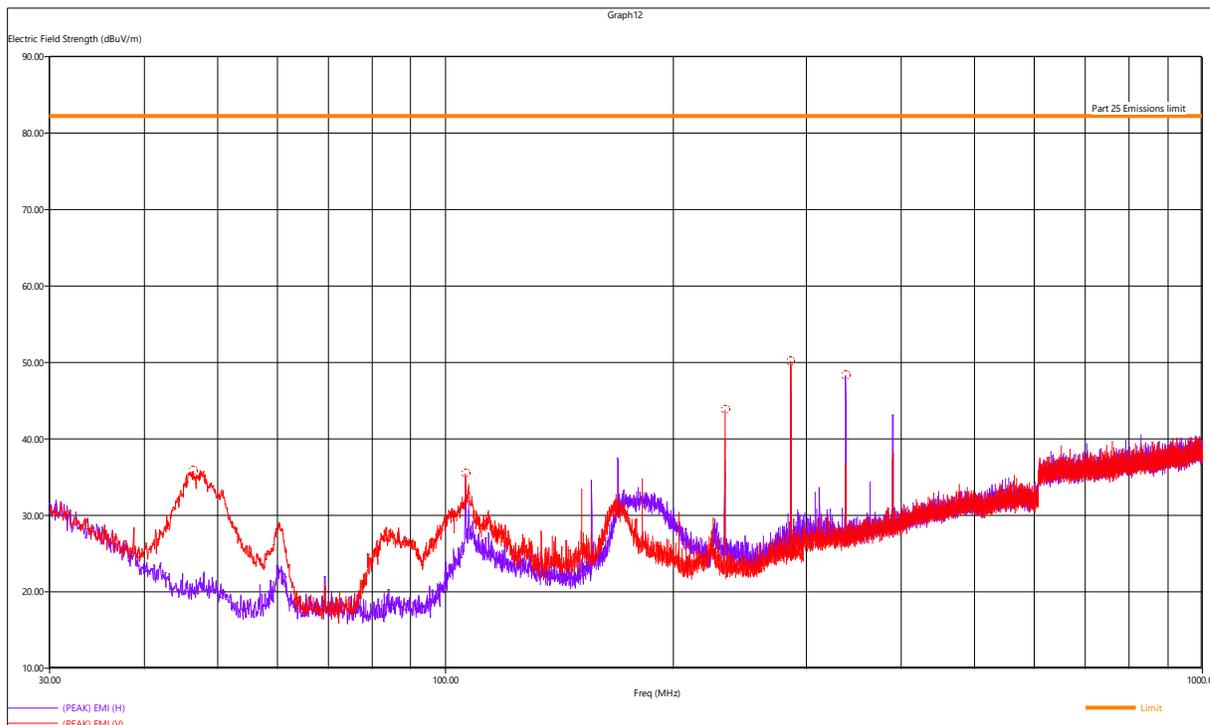


Figure 1 - Radiated Emissions Data Plot

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

Plot shows peak data.

Table 1 - Radiated Emissions Measurements

Frequency	Pre-test Level PK	Emission Power Level PK	Limit	Margin	Height	Angle	Pol	Channel
MHz	dBµV/m	dBm	dBm	dB	cm.	deg.		
46.44	35.75	-59.48	-13	46.48	121	118	V	High
106.26	35.46	-59.77	-13	46.77	114	279	V	High
234.00	43.72	-51.51	-13	38.51	203	135	V	High
286.02	50.10	-45.13	-13	32.13	356	354	V	High
337.98	48.24	-46.99	-13	33.99	110	317	H	High

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.		
1616.03	131.58	36.35	N/A	N/A	150	0	V	Low
1620.98	131.33	36.10	N/A	N/A	150	0	V	Mid
1625.98	131.85	36.62	N/A	N/A	150	0	V	High
3232.06	73.63	-21.60	-13.00	8.60	150	0	V	Low
3241.96	73.46	-21.77	-13.00	8.77	150	0	V	Mid
3251.96	73.83	-21.40	-13.00	8.40	150	0	V	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.

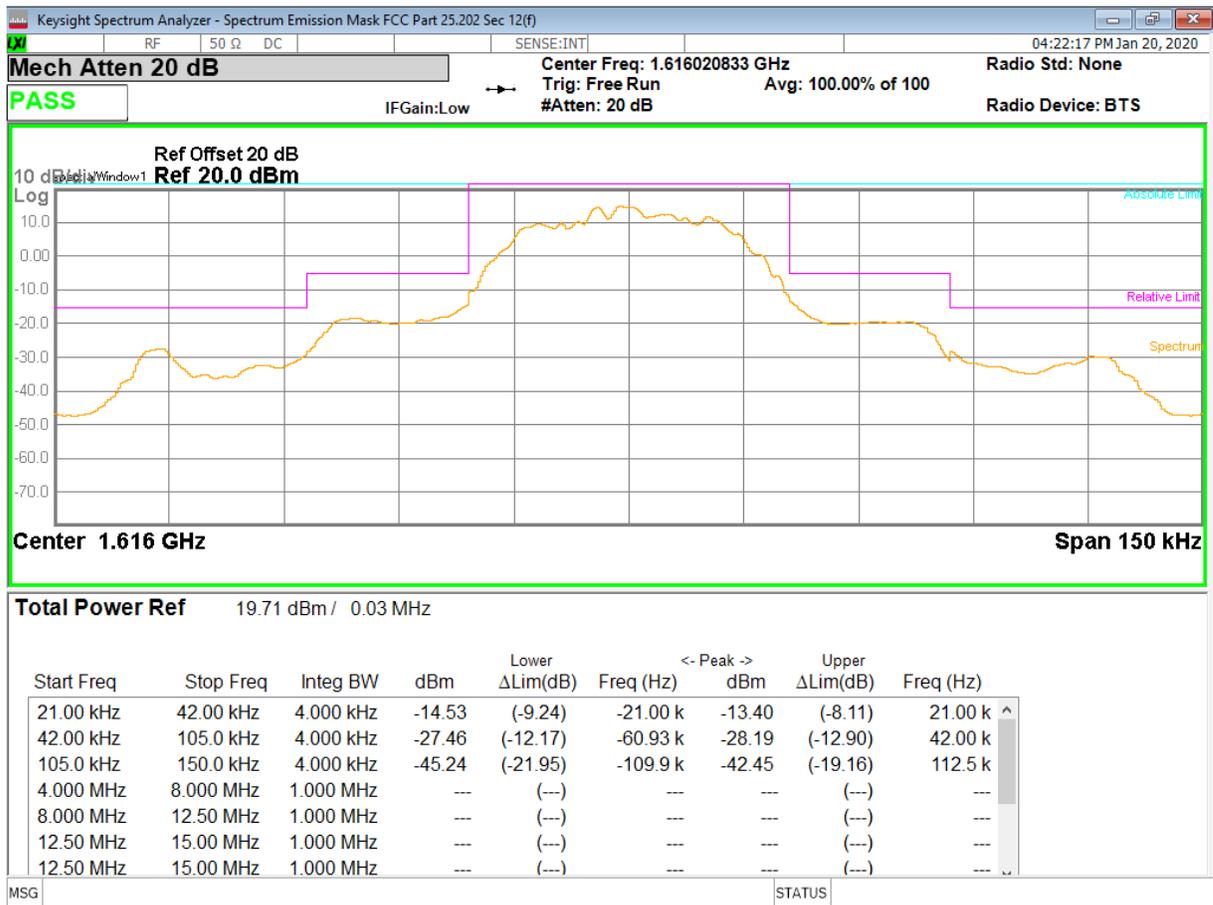


Figure 2 – Part 25.202(f) Mask, Transmitting at 1616.028330 MHz

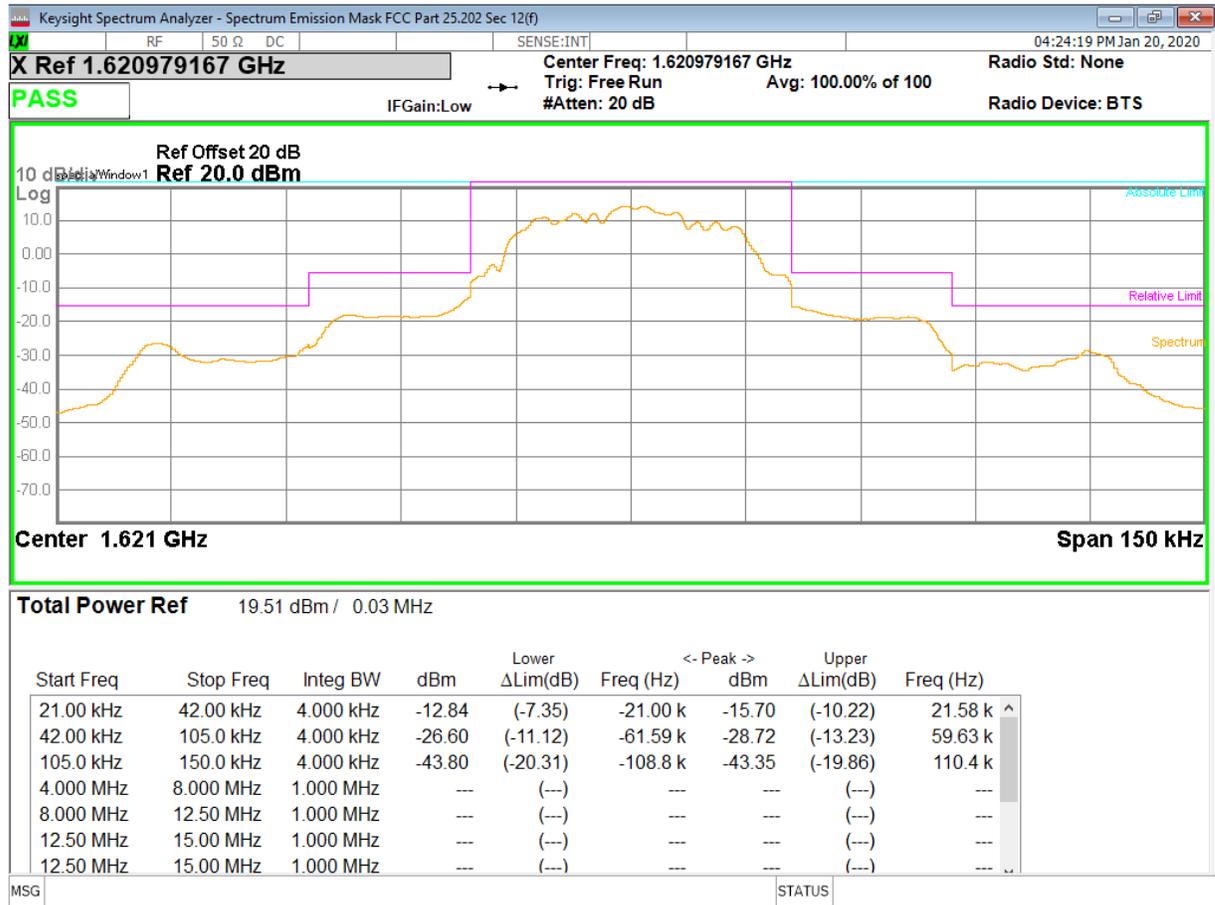


Figure 3 – Part 25.202(f) Mask, Transmitting at 1620.979167 MHz

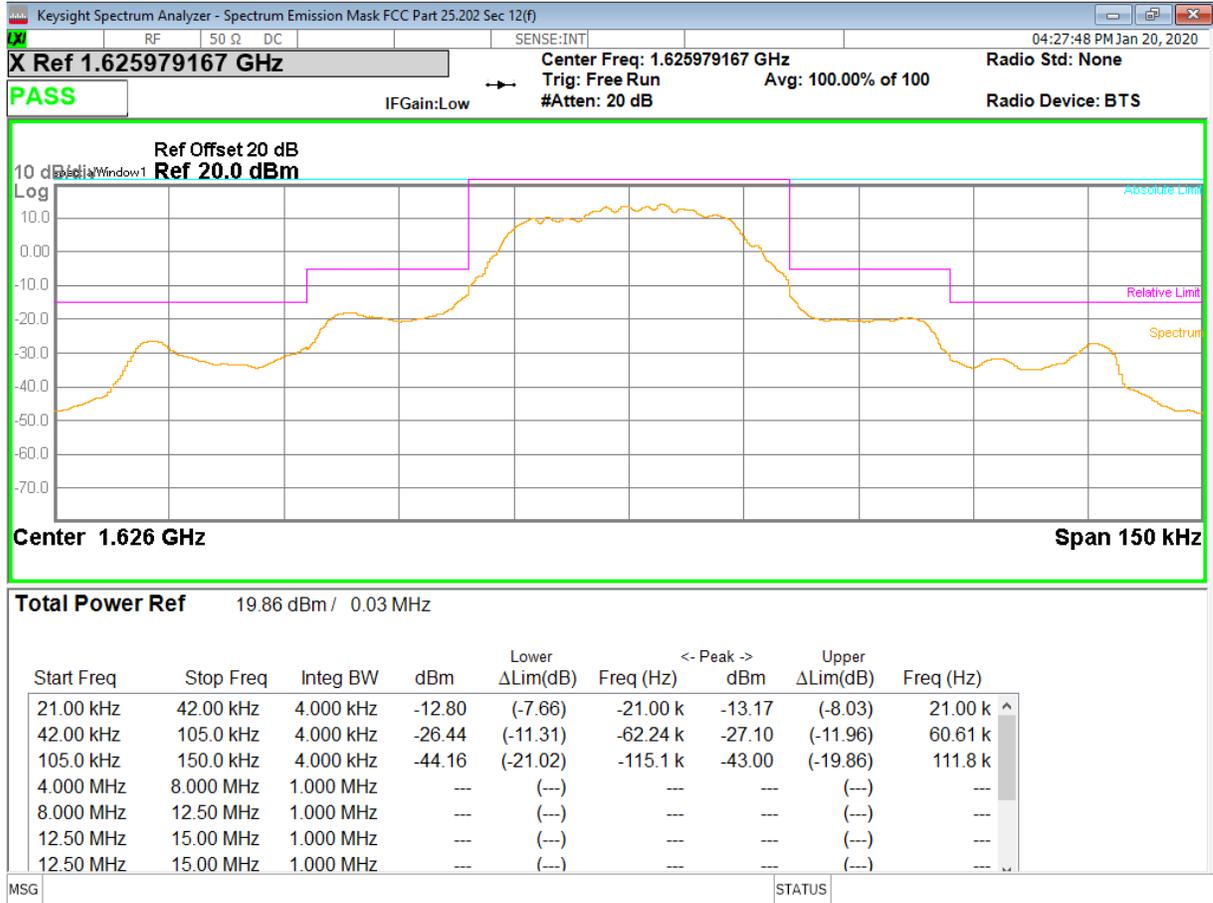


Figure 4 – Part 25.202(f) Mask, Transmitting at 1625.979167 MHz

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.

Measurements were taken in dBm. Limit value has been converted from dBW to dBm.

RBW is set to a value greater than 700 Hz and 1 kHz thus showing compliance for discrete emissions described in the referenced FCC rule part and RSS-170.

Antenna gain is -1.9 dBm as declared by the manufacturer and thus the provided plots which assume antenna gain of 0 dBm are considered valid proof of compliance.

Limit = -80 dBW/MHz + 30 dB = -50 dBm/MHz

Measurements according to FCC Part 25.216(c)

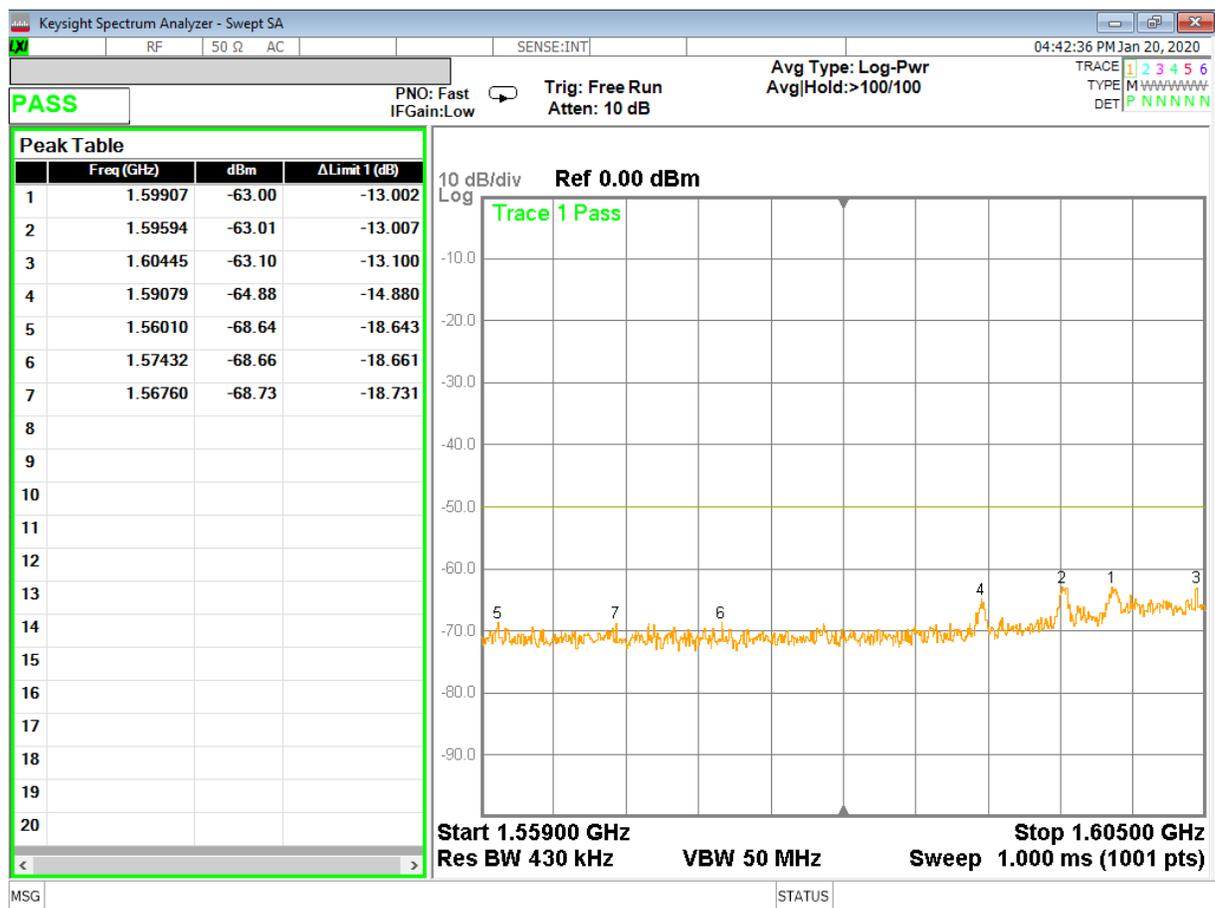


Figure 5 – Part 25.216(c), Transmitting at 1616.028330 MHz, Conducted Measurement

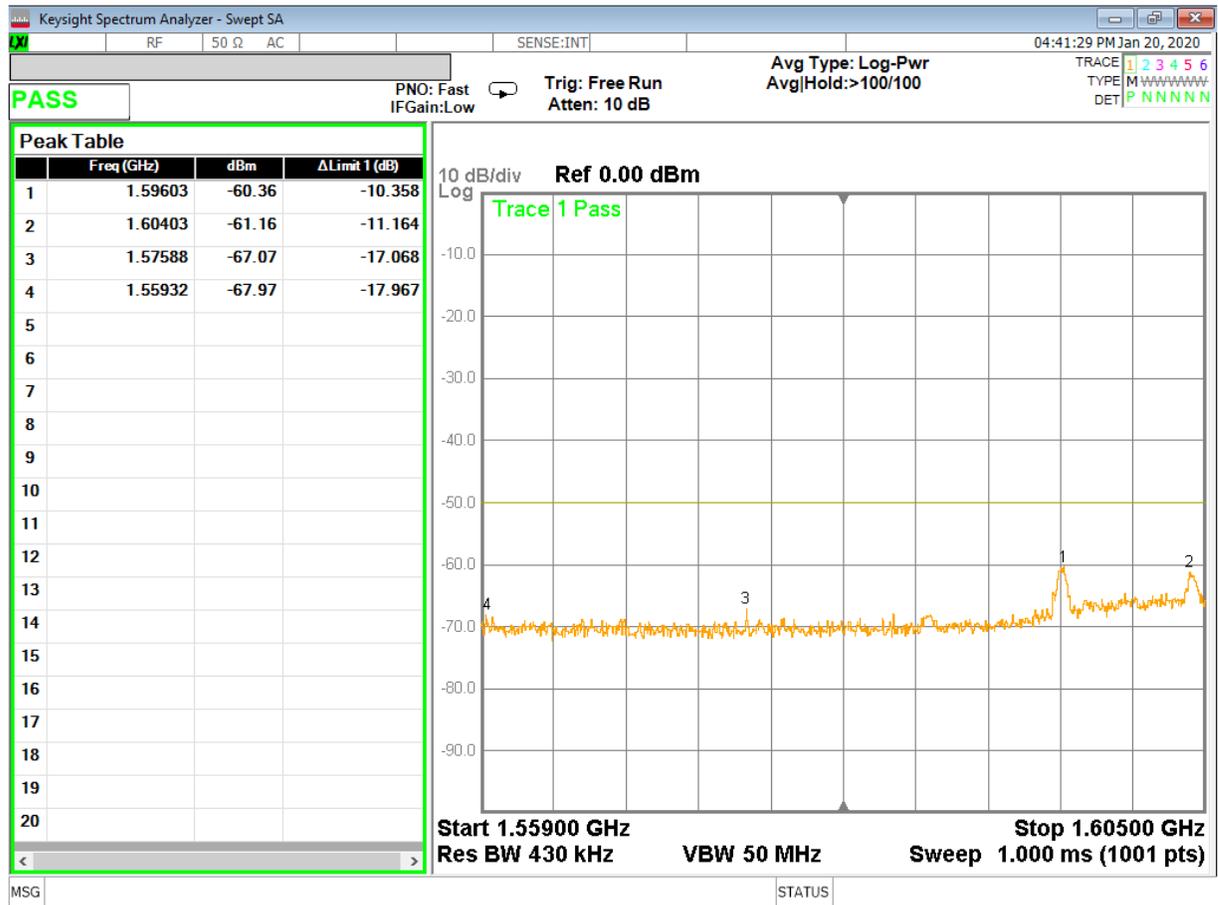


Figure 6 – Part 25.216(c), Transmitting at 1620.979167 MHz, Conducted Measurement



Figure 7 – Part 25.216(c), Transmitting at 1625.979167 MHz, Conducted Measurement

(g) <first section of paragraph removed because power density measurements are not applicable to permissive change validation>

...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-millisecond active transmission interval.

Measurements were taken in dBm. Limit value has been converted from dBW to dBm.

RBW is set to a value greater than 700 Hz and 1 kHz thus showing compliance for discrete emissions described in the referenced FCC rule part and RSS-170.

Antenna gain is -1.9 dBm as declared by the manufacturer and thus the provided plots which assume antenna gain of 0 dBm are considered valid proof of compliance.

$$\text{Limit} = -80 \text{ dBW/MHz} + 30 \text{ dB} = -50 \text{ dBm/MHz}$$

$$\text{to } -20 \text{ dBW/MHz} + 30 \text{ dB} = 10 \text{ dBm/MHz}$$

Measurements according to FCC Part 25.216 (g)
 Peak measurements

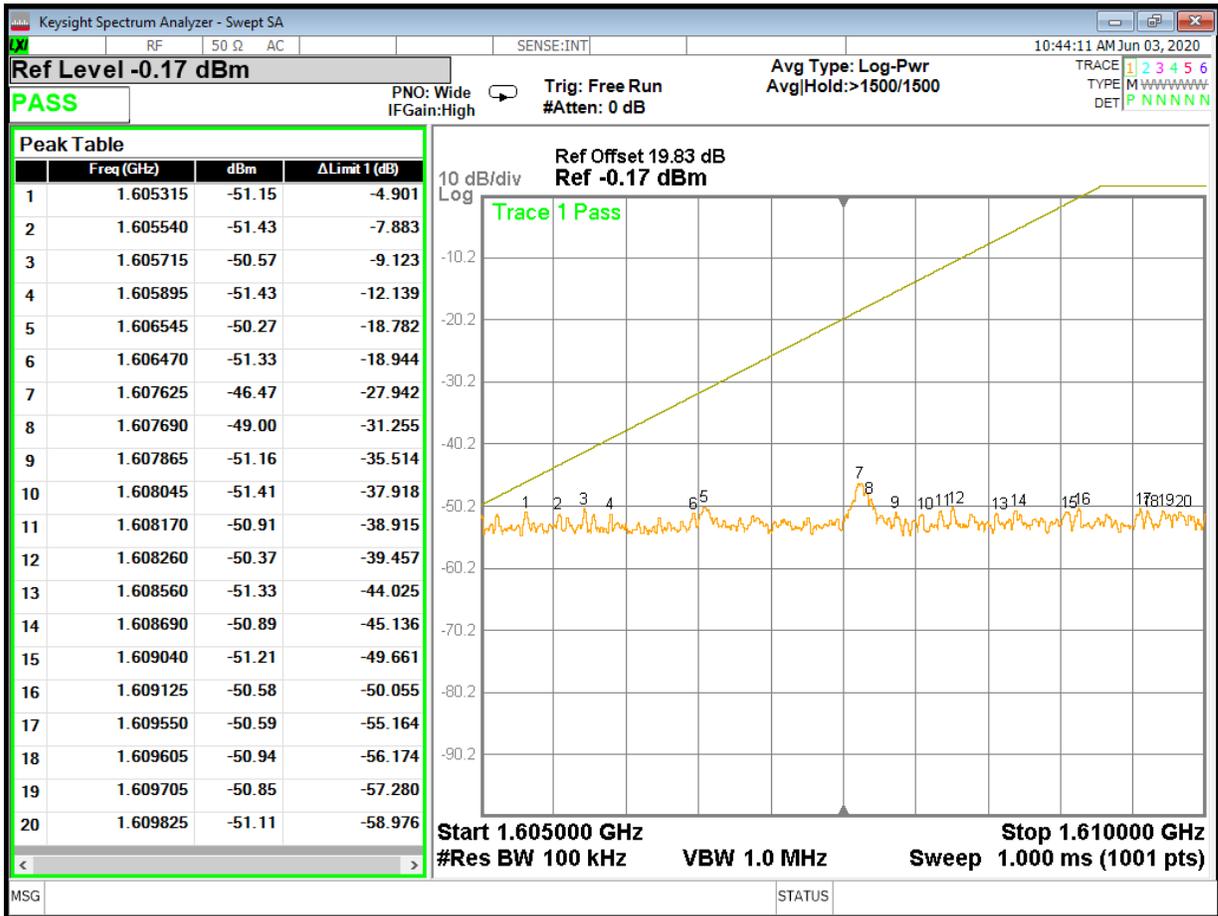


Figure 8 – Part 25.216(g), Transmitting at 1616.028330 MHz, Conducted Measurement

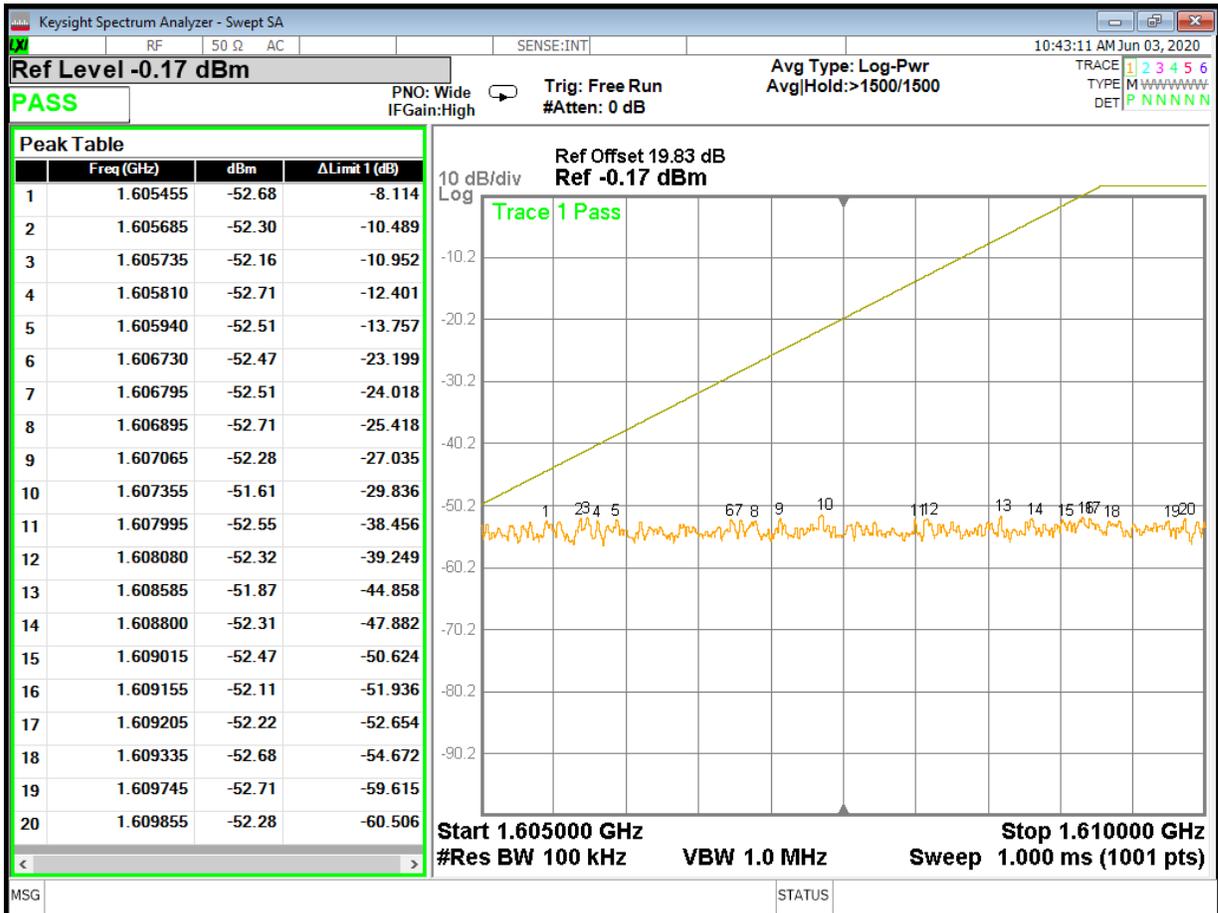


Figure 9 – Part 25.216(g), Transmitting at 1620.979167 MHz, Conducted Measurement

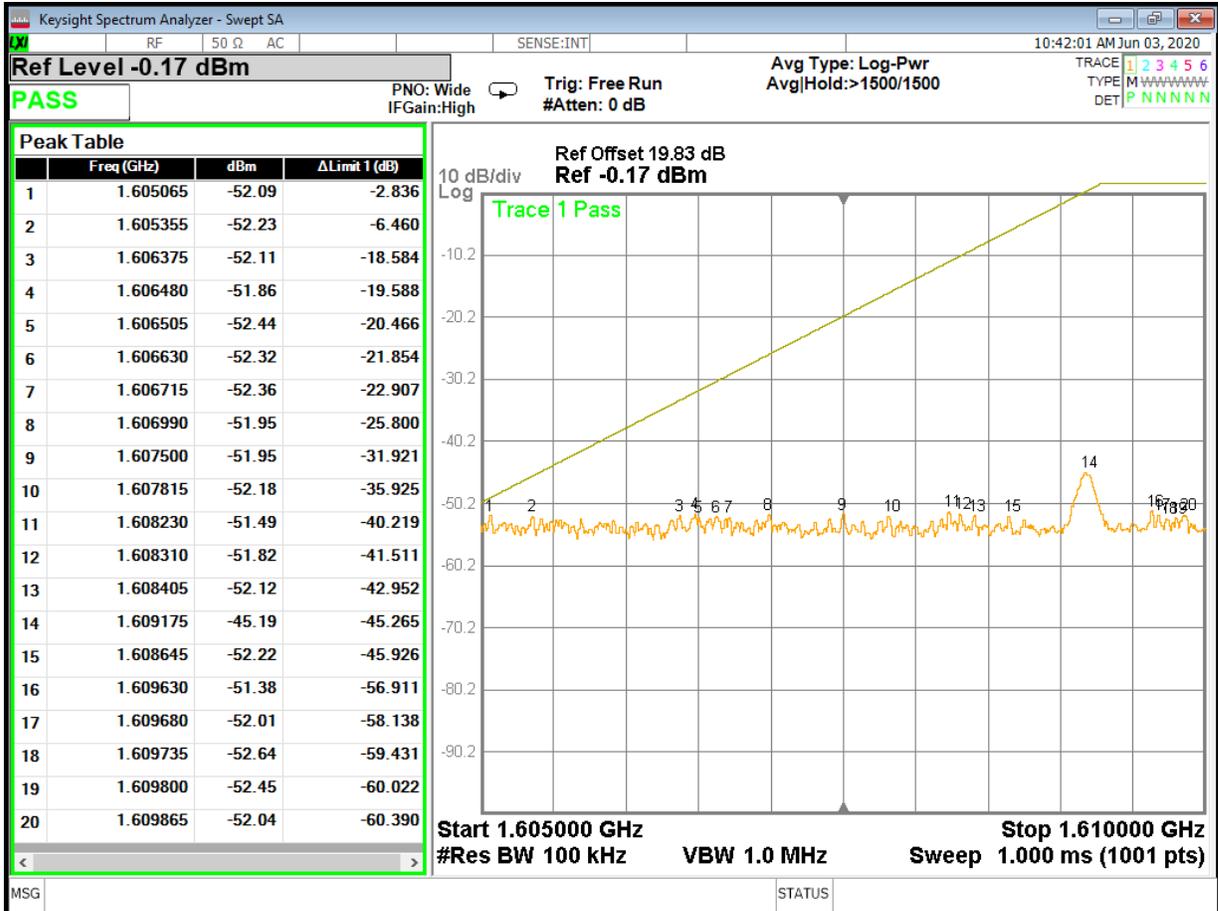


Figure 10 – Part 25.216(g), Transmitting at 1625.979167 MHz, Conducted Measurement

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