Application

For

Certification for an Intentional Radiator per Title 47
Part 95, Subpart H, Wireless Medical Telemetry Service (WMTS) paragraphs 95.2365, 95.2369, 95.2379
and
Part 2, Subpart J, Equipment Authorization Procedures

For the

Murata Electronics North America

Model: WIT608B

FCC ID: HSW-608B

UST Project: 21-0024

Issue Date: March 15, 2021

Total Pages in This Report: 26

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I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: 

Title: Compliance Engineer – President

Date: March 15, 2021

TESTING
NVLAP LAB CODE 200162-0

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MEASUREMENT TECHNICAL REPORT

COMPANYS NAME: Murata Electronics North America

MODEL: WIT608B

FCC ID: HSW-608B

DATE: March 15, 2021

This report concerns (check one): Original grant [X] Class II change [ ]

Equipment type: WMTS Transceiver

Technical: WMTS radio module
Technology: FHSS
Frequency of Operation: 608.3925 – 613.5808 MHz
Output Power: +10 dBm
Power setting: 93
Type of Modulation: GFSK
Data/Bit Rate:230.4 kbps
Antenna Gain: 2.0 Dipole & 2.0 Patch
EUT test software: WIT608 firmware
EUT normal operating software: Murata proprietary firmware.

Report prepared by:

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1 General Information

1.1 Purpose of this Report

This is an original certification request for a Modular Approval of a WMTS radio module that operates in the band 608-614 MHz. Compliance results are presented herein.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on February15, 2021 in good operating condition.

1.3 Product Description

The WIT608B radio transceiver provides wireless connectivity for either point-to-point or multipoint applications. Frequency hopping spread spectrum technology ensures maximum resistance to noise and multipath fading and robustness in the presence of interfering signals, while operation in the 611 MHz WMTS band allows protected operation in the US. A simple serial interface supports asynchronous data up to 115200 bps. An on-board 3 KB buffer and an error-correcting over-the-air protocol provide smooth data flow and simplify the task of integration with existing applications.

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.26-2015, American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services* as well as *TIA 603-E (2016), Land Mobile FM or PM Communications Equipment Measurement and Performance Standards*

A list of EUT and Peripherals is found in Table 1 below. A block diagram of the tested system is shown in Figure 1. Test configuration photographs are provided in separate Appendices.

1.5 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA 30004. This site has been fully described and registered with the FCC under registration number US5301.

Table 1. EUT and Peripherals

EUT	MODEL NUMBER	SERIAL NUMBER	FCC ID	CABLES P/D
Murata (EUT)	WIT608B	N/A	HSW-608B	P/D
PERIPHERAL/ MANUFACTURER	**MODEL NUMBER**	**SERIAL NUMBER**	**FCC ID:**	**CABLES P/D**
AC Adaptor/ NETGEAR	2ABF060R	332-108 771-01	N/A	P
Ethernet Switch/ NETGEAR	GS308P	4F219B55A076D	N/A	D
Patch Antenna	See Table 3 below for details.			
Dipole Antenna				

U= Unshielded S= Shielded P= Power D= Data

2 Tests and Measurements

2.1 Test Equipment

The table below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are indicated.

Table 2. Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	CALIBRATION DUE
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	9/02/2022
SPECTRUM ANALYZER	8593E	HEWLETT PACKARD	3205A00124	1/29/2022
BICONICAL ANTENNA	3110B	EMCO	9306-1708	6/27/2021 2 yr.
LOG PERIDOC ANTENNA	3146	EMCO	9110-3236	8/22/2021 2 yr.
LOG PERIDOC ANTENNA	3146	EMCO	9305-3600	5/01/2021 Extended 2 yr.
HORN ANTENNA	3115	EMCO	9107-3723	3/02/2023 2 yr.
LOOP ANTENNA	6502	EMCO	9810-3246	6/04/2022 2 yr.
BAND PASS FILTER	NHP-800+	MINI CIRCUITS	15542	5/12/2021
PRE-AMPLIFIER	8449B	HEWLETT-PACKARD	3008A00480	5/13/2021
PRE-AMPLIFIER	8447D	HEWLETT-PACKARD	1937A02980	5/13/2021
TEMPERATURE CHAMBER	SM16	THERMOTRON	17095	3/27/2021

Note: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

2.2 Modifications to EUT Hardware

No physical modifications were made by US Tech in order to bring the EUT into compliance with FCC Part 95, Subpart H Intentional Radiator Limits for the transmitter portion of the EUT.

2.3 EUT Antenna Requirements

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. Only the antenna(s) listed in Table 4 will be used with this module.

Table 3. Allowed Antenna(s)

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	PART NO.	GAIN dB_i	TYPE OF CONNECTOR
Antenna 1	Nearson	Dipole	OEM181AM-608S	+2	SMA
Antenna 2	Cushcraft	Patch	SL6081P	+2	SMA

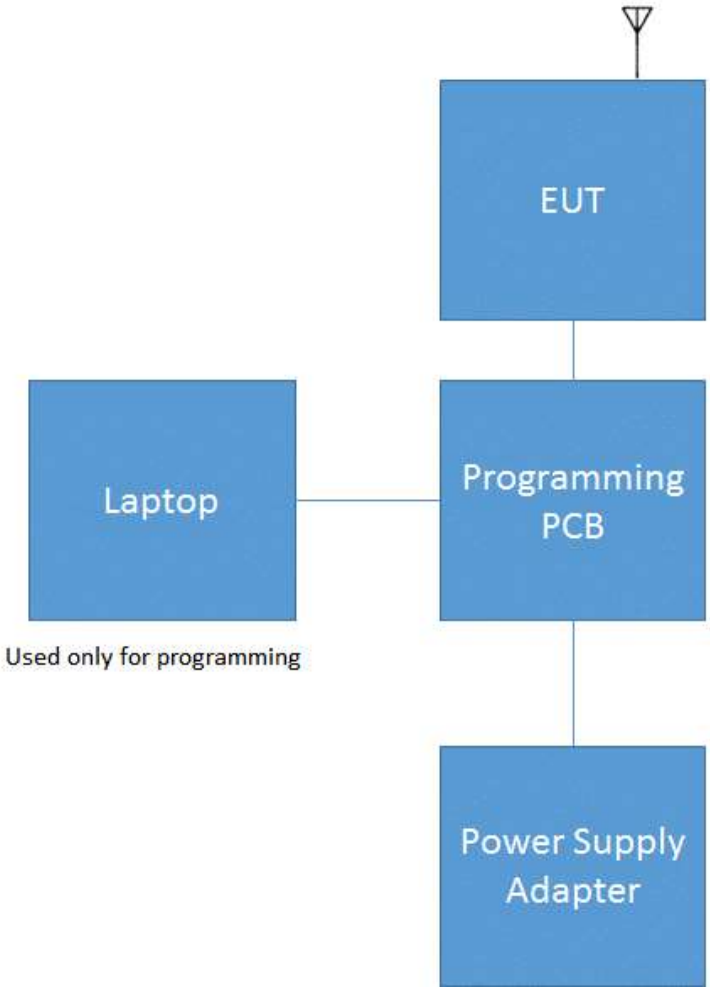

Figure 1. Test Configuration

2.4 WTMS Frequency Accuracy (CFR 95.2365)

Manufacturers of wireless medical telemetry devices are responsible for ensuring frequency accuracy such that all emissions are maintained within the designated bands of operation under all of the manufacturer's specified conditions.

According to the manufacturer the frequency drift of the transmitter is +/- 20 ppm. This value was determined by the crystal used to stabilize the frequency synthesizer. The +/- 20 ppm corresponds to an actual frequency drift of +4.3kHz/-5.5kHz.

Frequency stability measurements were performed. The test data is presented below:

Table 4. Frequency Stability vs. Temperature (at startup)

Temperature (degrees C)	Measured Frequency (MHz)	Deviation (ppm)
-30	608.3977	-2.1
-20	608.4015	4.1
-10	608.4041	8.4
0	608.4020	4.9
10	608.4015	4.1
20	608.3990	0.0
30	608.3990	0.0
40	608.3977	-2.1
50	608.3938	-8.5

Maximum Deviation = 0.0002% or 20ppm

Test Date: March 3, 2021

Tested By
Signature: S. Mafakher Name: Shahram Mafakher

2.5 WMTS Frequency Bands and Channels (CFR 95.2363)

The channel plan for this radio is presented below. The channels fall within the operating frequency band, 608-614 MHz for WMTS devices.

	ChHEX	Fout (MHz)
Lowest Ch.	FFFFFFFFFE	608.392533
	FFFFFFFFFF	608.529067
	0	608.665600
	1	608.802133
	2	608.938667
	3	609.075200
	4	609.211733
	5	609.348267
	6	609.484800
	7	609.621333
	8	609.757867
	9	609.894400
	A	610.030933
	B	610.167467
	C	610.304000
	D	610.440533
	E	610.577067
	F	610.713600
	10	610.850133
	11	610.986667
Mid Ch.	12	611.123200
	13	611.259733
	14	611.396267
	15	611.532800
	16	611.669333
	17	611.805867
	18	611.942400
	19	612.078933
	1A	612.215467
	1B	612.352000
	1C	612.488533
	1D	612.625067
	1E	612.761600
	1F	612.898133
	20	613.034667
	21	613.171200
	22	613.307733
	23	613.444267
Highest Ch.	24	613.580800

Figure 2. Expanded Frequency Channels

2.6 WMTS Field Strength Limits (CFR 95.2369(a))

For WMTS transmitter types operating in the 608-614 band, the field strength of the transmitted signal must not exceed 200 mV/m, measured at a distance of 3 meters (106 dBuV/m), using instrumentation with an CISPR quasi-peak detector.

Table 5. Quasi-Peak Radiated Fundamental Emissions (Antenna 1)

Test: FCC Part 95, Para 95.2369					**Model:** WIT608B			
Project: 21-0024								
Frequency (MHz)	**Test Data (dBuV)**	**Factor (dB)**	**AF+CA -AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector Mode**
Low Channel - QP								
608.30	80.86	--	24.73	105.59	106.0	3m./VERT	0.4	**QP**
Mid Channel - QP								
610.71	80.61	--	24.75	105.36	106.0	3m./VERT	0.6	**QP**
High Channel - QP								
613.56	80.02	--	24.85	104.87	106.0	3m./VERT	1.1	**QP**

*Note: Decimal Value was set to 93 for adjusting output power

Table 6. Quasi-Peak Radiated Fundamental Emissions (Antenna 2)

Test: FCC Part 95, Para 95.2369					**Model:** WIT608B			
Project: 21-0024								
Frequency (MHz)	**Test Data (dBuV)**	**Factor (dB)**	**AF+CA -AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector Mode**
Low Channel - QP								
608.33	79.66	--	24.73	104.39	106.0	3m./VERT	1.6	**QP**
Mid Channel - QP								
610.79	79.51	--	24.85	104.36	106.0	3m./VERT	1.6	**QP**
High Channel - QP								
613.50	79.39	--	24.95	104.34	106.0	3m./VERT	1.7	**QP**

*Note: Decimal Value was set to 48 for adjusting output power

1. The EUT was placed in its normal operating position and the transmitter was in constant broadcast mode, with a duty cycle of less than 15%. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at 608.30 MHz:

Magnitude of Measured Frequency	80.86	dBuV
+Antenna Factor + Cable Loss - Amplifier Gain	24.73	dB/m
Corrected Result	105.59	dBuV/m

Test Date: March 24, 2018 and March 25, 2018
Tested By
Signature: _____ Name: Shahram Mafakher

2.7 WMTS unwanted emissions limits (CFRP95.2379)

Each WMTS transmitter must be designed to comply with the following requirements:

(a) Unwanted emissions on frequencies below 960 MHz must not exceed 200 μV/m (46 dBuV/m), measured at a distance of 3 meters using measuring instrumentation with a CISPR quasi-peak detector.

(b) Unwanted emissions on frequencies above 960 MHz must not exceed 500 μV/m (54 dBuV/m), measured at a distance of 3 meters using measuring equipment with an averaging detector and a 1 MHz measurement bandwidth.

Table 7. Radiated Emissions Test Data 9 kHz to 30 MHz (Part 95.2379)

Test: FCC Part 95, Para 95.2379				**Model:** WIT608B			
Project: 21-0024							
Frequency (MHz)	**Test Data (dBuV)**	**AF+CA -AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector Mode**
All emissions were more than 20 dB below the limit.							

1. No other signals detected within 20 dB of specification limit.
2. The EUT was placed in its normal operating position and the transmitter was in constant broadcast (test) mode, with a duty cycle of greater than its normal operating duty cycle. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Test Date: March 8, 2021

Tested By
Signature : S. Mafakher Name: Shahram Mafakher

Table 8. Radiated Emissions Test Data 30 MHz to 1000 MHz (Part 95.2379)

Test: FCC Part 95, Para 95.2379				**Model:** WIT608B			
Project: 21-0024							
Frequency (MHz)	**Test Data (dBuV)**	**AF+CA -AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector Mode**
46.2200	45.77	-15.61	30.16	46.0	3.0m./HORZ	15.8	**PK**
178.6800	45.17	-11.77	33.40	46.0	3.0m./HORZ	12.6	**PK**
833.3500	42357	0.02	42.59	46.0	3.0m./HORZ	3.4	**PK**
46.7800	58.45	-16.31	42.14	46.0	3.0m./VERT	3.9	**PK**
167.6800	44.48	-11.55	32.93	46.0	3.0m./VERT	13.1	**PK**
857.5800	41.45	-0.90	40.55	46.0	3.0m./VERT	5.4	**PK**

1. Worst case emissions presented above. All other emissions presented in the graphs that follow.
2. The EUT was placed in its normal operating position and the transmitter was in constant broadcast (test) mode, with a duty cycle of greater than its normal operating duty cycle. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at 46.2200 MHz:

Magnitude of Measured Frequency	45.77	dBuV
+Antenna Factor + Cable Loss - Amplifier Gain	-15.61	dB/m
Corrected Result	30.16	dBuV/m

Test Date: March 8, 2021

Tested By
Signature : S. Mafakher Name: Shahram Mafakher

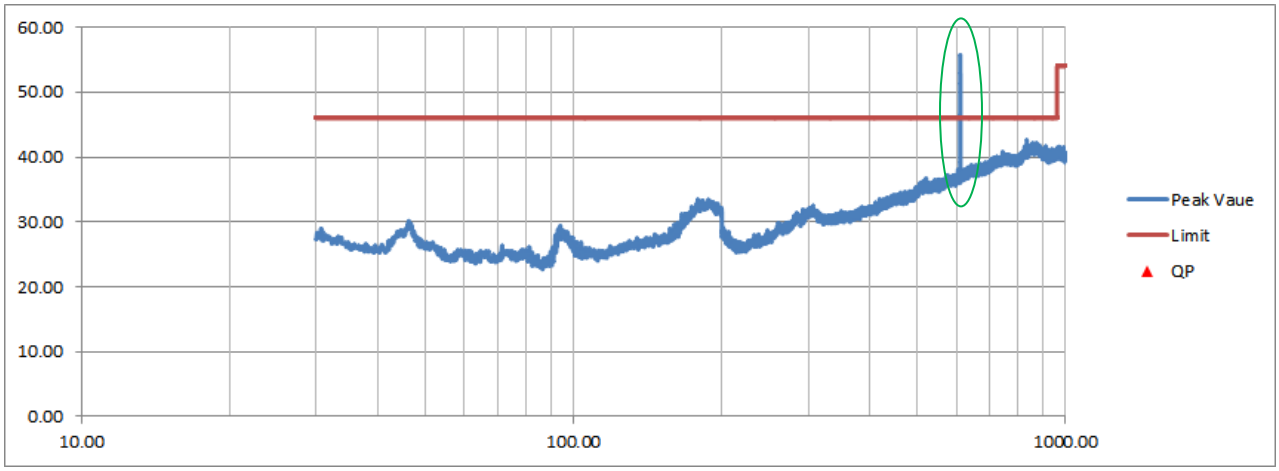

Figure 3. Radiated Emissions 30 MHz to 1000 MHz, Horizontal Polarity

Note: Large signal at 610 MHz is fundamental signal.

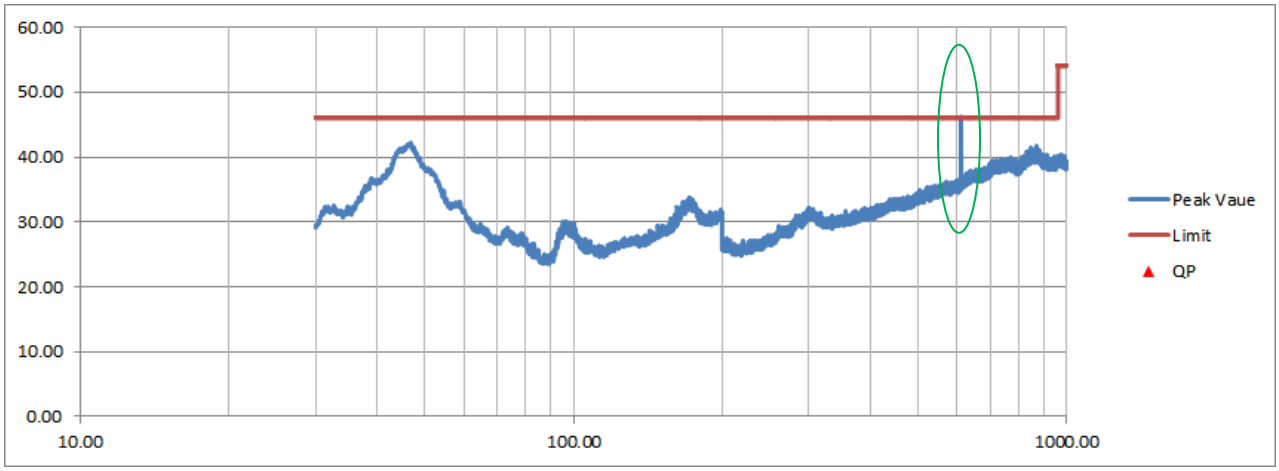

Figure 4. Radiated Emissions 30 MHz to 1000 MHz, Vertical Polarity

Note: Large signal at 610 MHz is fundamental signal.

Table 9. Radiated Emissions Test Data above 1000 MHz (Part 95.2379)

Test: FCC Part 95, Para 95.2379				**Model:** WIT608B			
Project: 21-0024							
Frequency (MHz)	**Test Data (dBuV)**	**AF+CA -AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector Mode**
2463.29	55.85	-8.68	47.18	54.0	3.0m./HORZ	6.8	**PK**
2979.40	55.27	-5.94	49.33	54.0	3.0m./HORZ	4.7	**PK**
6034.61	51.07	-0.86	50.21	54.0	3.0m./HORZ	3.8	**PK**
2463.29	57.78	-8.78	49.00	54.0	3.0m./VERT	5.0	**PK**
2976.40	54.71	-6.08	48.63	54.0	3.0m./VERT	5.4	**PK**
6807.16	50.19	0.49	50.68	54.0	3.0m./VERT	3.3	**PK**

1. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
2. The EUT was placed in its normal operating position and the transmitter was in constant broadcast (test) mode, with a duty cycle of greater than its normal operating duty cycle. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at 2463.29 MHz:

Magnitude of Measured Frequency	55.85	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	-8.68	dB/m
Corrected Result	47.18	dBuV/m

Test Date: March 8, 2021

Tested By
Signature : S. Mafakher Name: Shahram Mafakher

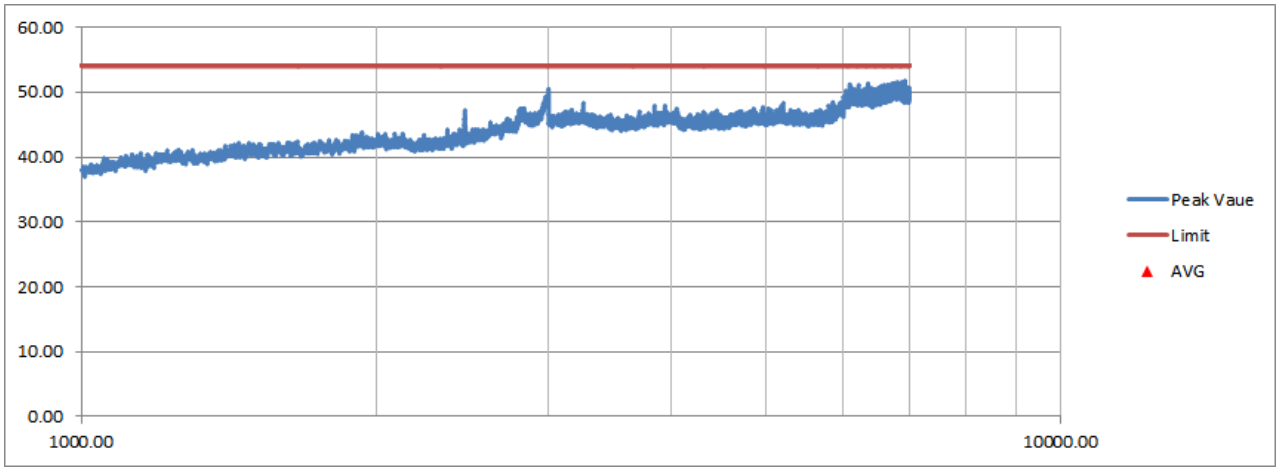

Figure 5. Radiated Emissions, above 1 GHz, Horizontal Polarity

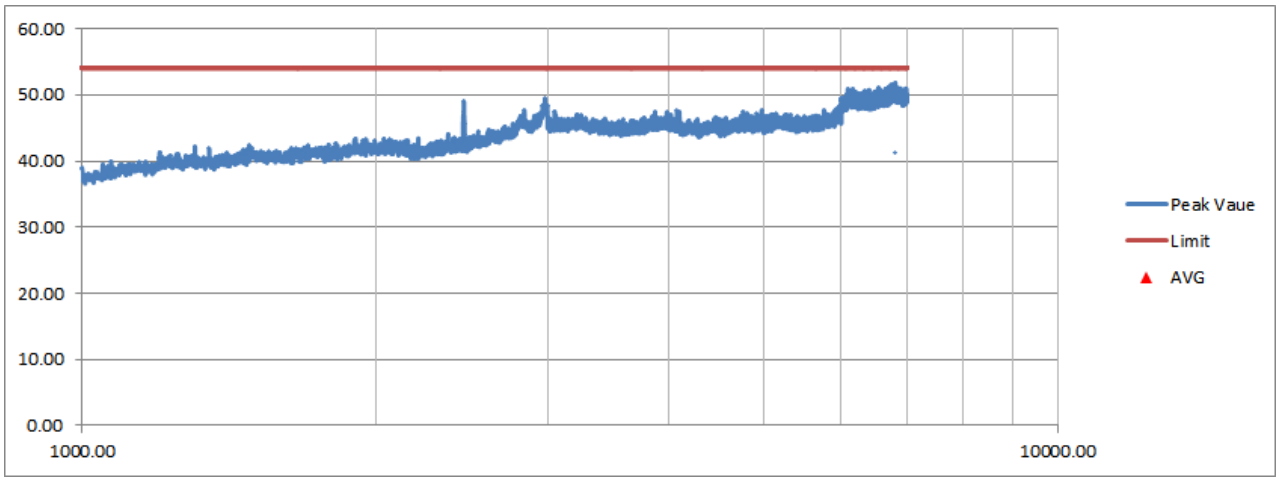

Figure 6. Radiated Emissions, above 1 GHz, Vertical Polarity

2.8 Occupied Bandwidth (CFR 2.1049)

These measurements were performed while the EUT was in a constant transmit mode. A method similar to the marker delta method was used to capture the points. The RBW was set to approximately 1/100 of the manufacturers claimed RBW and with the VBW ≥ RBW. The results of this test are given in Table 16 and Figures 29-31.

Table 10. 20 dB Bandwidth and 99% Occupied Bandwidth

Frequency (MHz)	20 dB Bandwidth (kHz)	99% Occupied Bandwidth (kHz)
608.3900	265	265
610.8300	275	275
613.5800	270	270

Test Date: March 17, 2021

Tested By
Signature : S. Mafakher Name: Shahram Mafakher

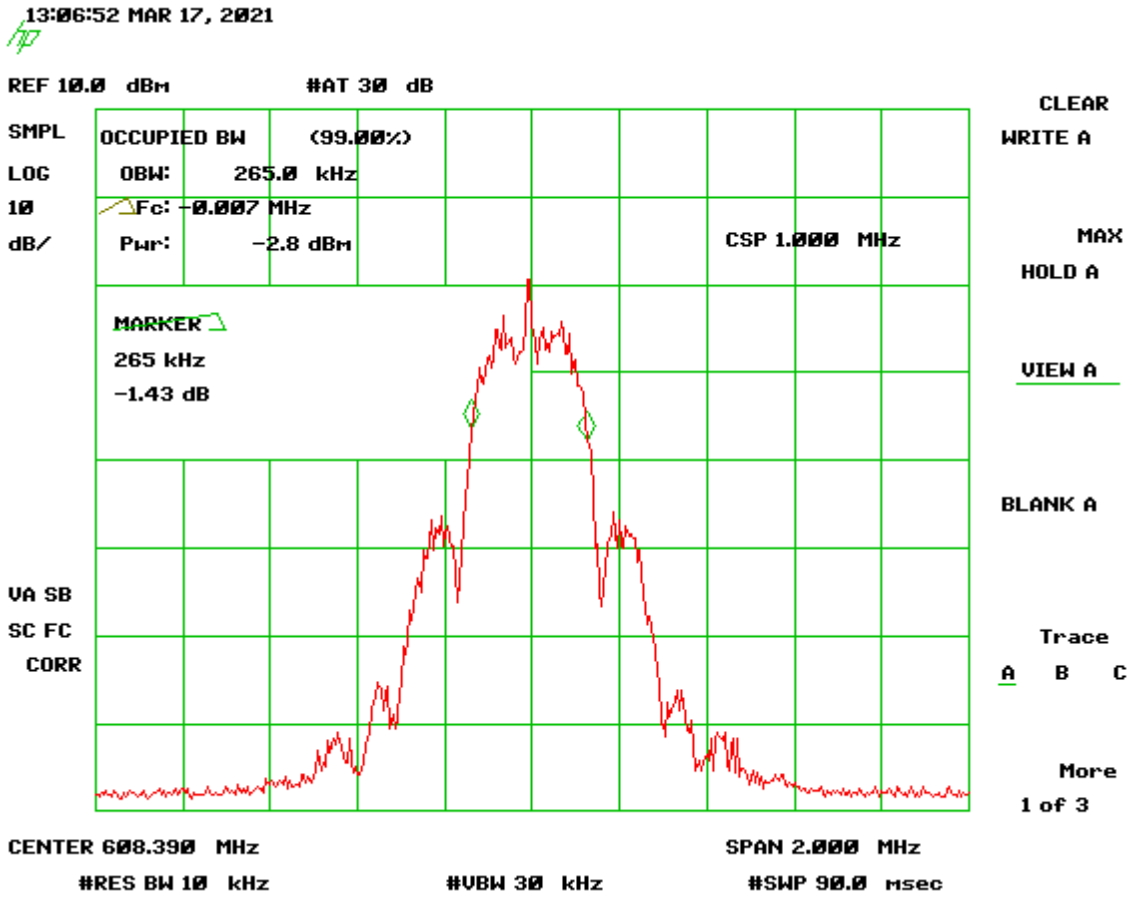

Figure 7. 20dB / 99% Bandwidth, Low

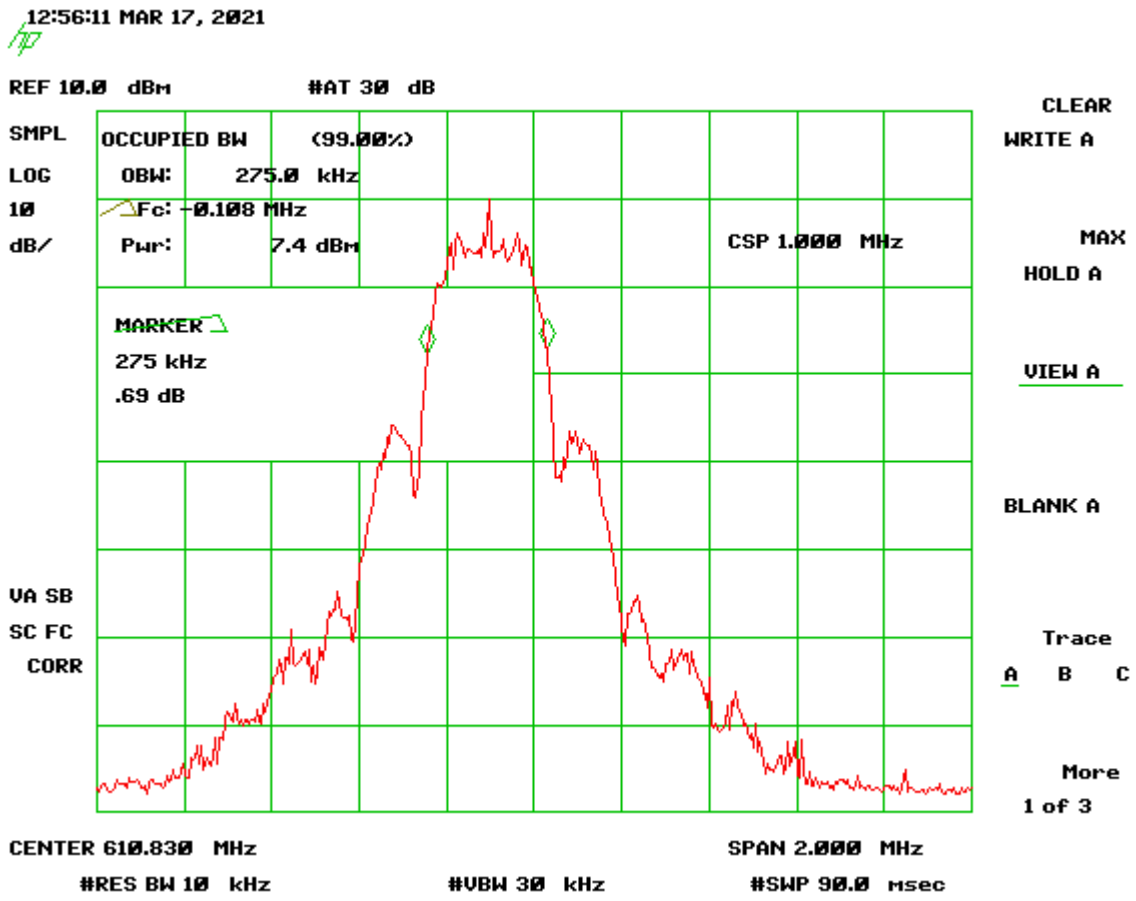

Figure 8. 20dB / 99% Bandwidth, Mid

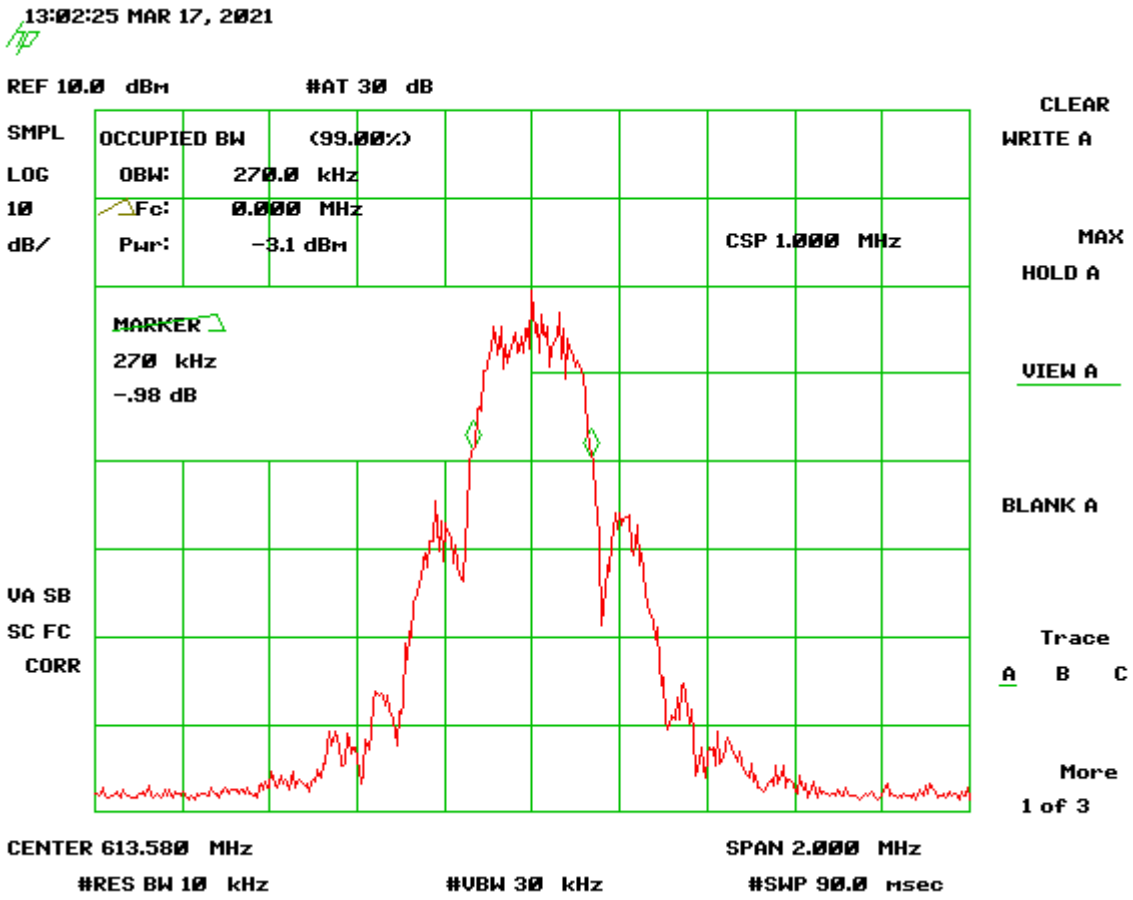

Figure 9. 20dB / 99% Bandwidth, High

2.9 WMTS RF Exposure Evaluation (CFR 95.2385)

The EUT does not meet the definition of a portable device per Part 2.1093(b) because the EUT is a transmitting device designed to be used so that the radiating structure of the device is greater than 20 cm of the body of the user. The user's manual includes instructions to the installer to ensure this separation distance is meet. An evaluation of the Spectrum Density (S) at 20 cm is provide here for reference.

Table 11. RF Exposure Evaluation

Frequency of Fundamental Signal (MHz)	Max Conducted Output Power reading (dBm)	Antenna Gain (dBi)	Power (eirp)
608.39-613.58	9.565	2.0 (both dipole & patch have same max gain value)	11.565 dBm (14.34 mW)

MPE calculation:

The limit for this unit (uncontrolled exposure) is 0.4 mW/cm^2
RF Density Field Equation: S= (EIRP in mW)/(4πR^2) and solving at 20cm for R.
S= (14. 34)/(4*π*20^2) = 9.046/5026.55 = 0.0028mW/cm^2

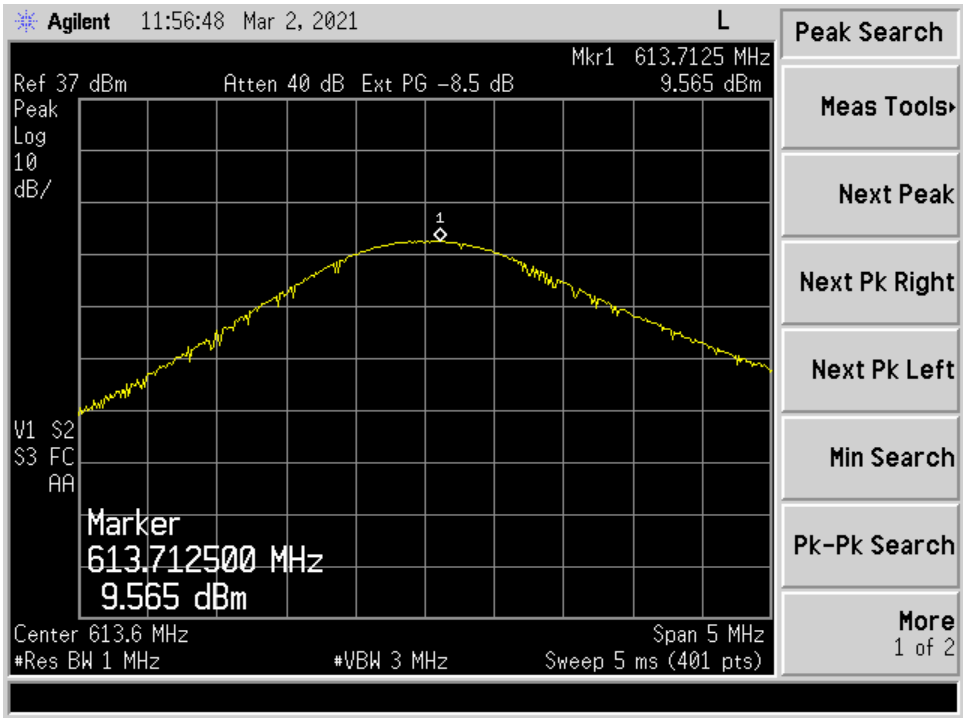

Figure 10. Maximum Conducted Output Power (613.7125 MHz)

2.10 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4. A coverage factor of k=2 was used to give a level of confidence of approximately 95%.

2.10.1 Conducted Emissions Measurement Uncertainty

Measurement uncertainty (within a 95% confidence level) for this test is ± 2.78dB.

2.10.2 Radiated Emissions Measurement Uncertainty

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ± 5.39dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ± 5.18 dB

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ±5.21dB.

3 Conclusions

The EUT meets the requirements when tested in the configurations tested herein.