Testing Tomorrow's Technology

Application for Certification

Per
Title 47 USC Part 2, Subpart J, Equipment Authorization Procedures, Paragraph 2.907, Certification and Part 15, Subpart C, Intentional Radiators, Paragraph 15.231, Periodic Operation in the band 40.66 MHz to 40.70 MHz and above 70 MHz
And
Innovation, Science, and Economic Development Canada Certification Per
ICRSS-Gen General Requirements for Radio Apparatus
And
RSS-210 License-Exempt Radio Apparatus: Category I Equipment

For the

The Watt Stopper, Inc.
d/b/a Qmotion

Model: QMO-MC433FM2

UST Project: 17-0465
Issue Date: November 3, 2017

Number of Pages in this report: 22

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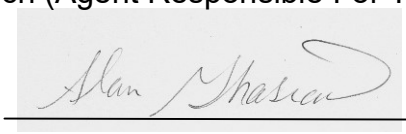
I certify that I am authorized to sign for the test facility and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US Tech (Agent Responsible For Test):

By: 

Name: Alan Ghasiani

Title: President – Consulting Engineer

Date: November 3, 2017

TESTING
NVLAP LAB CODE 200162-0

3505 Francis Circle Alpharetta, GA 30004
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MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: The Watt Stopper, Inc. d/b/a Qmotion
MODEL: QMO-MC433FM2
FCC ID: 2AHG4-MC433FM2
IC: 21161-MC433FM2
DATE: December 12, 2017

This report concerns (check one): Original grant X
Class II change_____

Equipment type: 433 MHz Remote Transmitter

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No X

If yes, defer until:_____
date

N.A. agrees to notify the Commission by N.A.
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

US Tech
3505 Francis Circle
Alpharetta, GA 30004

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1. General Information

This report is prepared as a means of presenting test data to be used by a Telecom Certification Body in determination of whether this product is permitted for unlicensed dissemination to the general public according to the Innovation, Science, and Economic Development Canada and FCC Rules and Regulations for RF Devices Intentional Radiators.

1.1 Product Description

The Equipment under Test (EUT) is the QMotion model QMO-MC433FM2. The EUT is a handheld, remote control designed to operate an electronic, wireless window shade or group of shades. By pressing one of the many buttons a compatible window shade can be made to go completely up or down, or to other user defined positions in between. Although a single frequency is used, different channels or “groups” can be assigned to shades in a particular location. Operation is from a single 3V coin cell and is user replaceable.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on October 31, 2017 in good operating condition.

1.3 Related Submittal(s)/Grant(s)

The EUT is subject to the following FCC Equipment Authorizations:

a) Certification of the transmitter.

b) Verification as a Class B digital device.

2. Tests and Measurements

2.1 Configuration of Tested System

The Test sample was tested per *ANSI C63.10, Methods of Measurement from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2014).* Radiated emissions data were taken according to paragraph 8.0 with the test receiver or spectrum analyzer's resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. There were no interconnecting cables to manipulate in an attempt to maximize emissions; however, the physical position of the EUT was varied through the three mutually exclusive orthogonal planes in an attempt to maximize the emissions. The worse case position is the position used for final measurements and is gathered in this test report. A block diagram of the tested system is shown in Figure 1.

2.2 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. This site has been fully described and registered with the FCC, under site designation number US5301. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 9900A-1 and is also a NVLAP accredited test lab; lab code 200162-0.

2.3 Test Equipment

Table 1. EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC/IC ID (PENDING)	CABLES P/D
Transmitter QMotion (EUT)	QMO-MC433FM2	Engineering Sample	2AHG4-MC433FM2 21161-MC433FM2	N/A
Antenna See antenna details	--	--	--	--

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

Table 2. Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	CALIBRATION DUE DATE
SPECTRUM ANALYZER	8593E	AGILENT	US41442935	10/25/2018
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	1937A02980	03/07/2018
PREAMP 1.0 GHz to 26.0 GHz	8449B	HEWLETT-PACKARD	3008A00480	01/26/2018 extended
LOOP ANTENNA	SAS-200/562	A. H. Systems	142	12/28/2017 2 yr extended
BICONICAL ANTENNA	3110B	EMCO	9307-1431	5/2/2019 2 yr
LOG PERIODIC ANTENNA	3146	EMCO	9110-3236	5/1/2019 2 yr
HORN ANTENNA	SAS-571	A.H SYSTEMS	605	10/18/2019 2 yr
HIGH PASS FILTER	NHP-800t	MINI CIRCUITS	N/A	3/7/2018
DC POWER SUPPLY	HY1803D	TEKPOWER	1072531	Not Required
CALCULATION PROGRAM	N/A	N/A	Ver. 6.0	N/A

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

2.4 EUT Antenna Description (FCC Sec. 15.203)

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.

Table 3. Antenna Description

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB_i	TYPE OF CONNECTOR
Antenna	Qmotion	Etched antenna	MCR etched antenna	0	Etched PCB trace

2.5 Modifications to Equipment

No modifications were needed to bring the EUT into compliance with the FCC Part or IC RSS requirements.

2.6 Test Procedure

The EUT was configured as shown in the following block diagram(s) and photograph(s). The sample was tested per ANSI C63.10, Methods of Measurement for Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2014) following US Tech's procedures paragraph 7 for conducted and paragraph 8 for radiated. Conducted and radiated emissions data were taken with the test receiver or spectrum analyzer's resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements are peak unless stated otherwise. The video filter on the spectrum analyzer was OFF throughout the evaluation process. Interconnecting cables were manipulated as necessary to maximize emissions. The EUT was rotated 360 degrees with the turntable to maximize emissions. The physical position of the EUT was varied through the three mutually exclusive orthogonal planes in an attempt to maximize the emissions. The final setup description is found in the test section of this report.

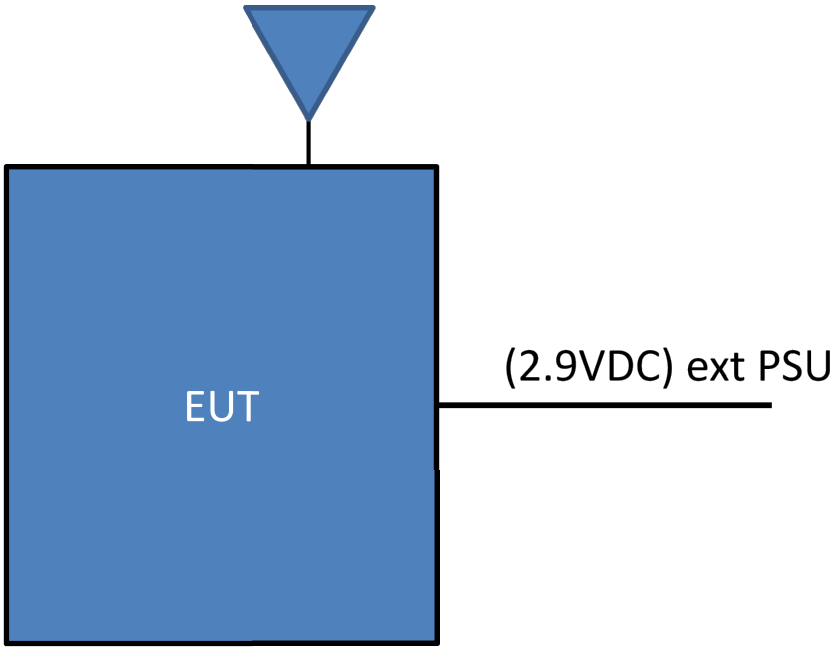

Figure 1. Block Diagram of Test Configuration

2.7 Compliance to CFR 15.231(a) Transmitter Activation/Deactivation

According to CFR 15.231(a) The provisions of this section are restricted to periodic operation within the band 40.66-40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation:

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

The transmitter is not a manually operated transmitter.

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

The transmitter is classified as an automatically activated transmitter and the transmitter does comply with transmissions ceasing after 5 seconds. See Figure 2 below.

(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

This does not apply; the transmitter does not have periodic transmissions at pre-determined intervals, and does not have polling or supervision transmissions to determine system integrity. Transmissions from the Clear Connect transmitter in this product are always initiated by a user initiated event, such as a button press on a product in the system or a user interaction in a smart-phone app to adjust the position of the light dimmer or window shade.

(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

This does not apply; the transmitter is not employed for radio control purposes during emergencies.

(5) Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.

This does not apply; the transmitter is not used for security systems.

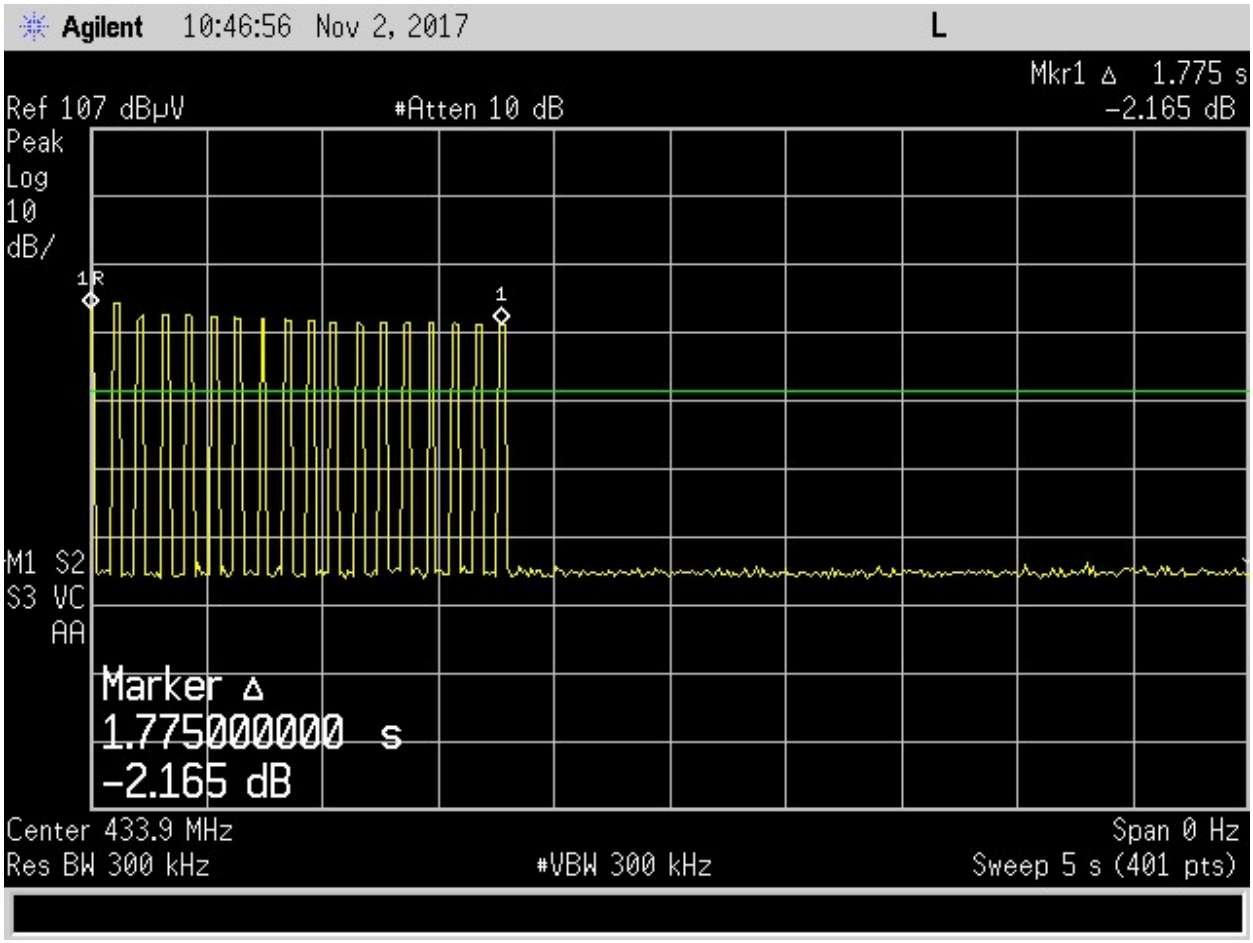

Figure 2. Deactivation per 15.231(a)(1)

Note 1: The EUT deactivates within 5 seconds.

2.8 Field Strength of Fundamental (47 CFR 15.231(b))

The results of the measurements for peak fundamental emissions are given in Table 4. The EUT emissions measurement was started by setting up the Antenna in the vertical orientation at a distance of 3 meters from the EUT and at a height of 1.0 meters above the ground. The EUT's major axis was set normal to the direction of the measuring antenna.

The Spectrum Analyzer (SA) displays were set to: Channel A free-running, Channel B to Max-Hold. Choose a frequency or frequency range and scan it at a coupled rate. When a signal is detected, raise and lower the antenna to maximize the signal.

When the signal has been maximized, the antenna height is fixed the turn-table is rotated through 360 degrees to further maximize the signal.

When all signals have been maximized for antenna height and direction, the EUT case is carefully maneuvered in each of the three mutually exclusive orthogonal planes while observing the same Max-hold/free-running SA display indication. When the EUT position is found that further maximizes the signal, record the antenna height, rotation orientation, EUT orthogonal position and signal strength on the data sheet for that particular frequency.

Next, the measurement antenna is re-oriented to a Horizontal polarization at 1 meter height and the process described above is repeated. All signals within 6 dB of the limit are recorded.

Finally, the collected data is input into the calculation spread sheet. The spread sheet is designed to calculate for the true value that is collected. The spread sheet takes into account the SA reading, the antenna correction factor, cable losses and duty cycle factors. See the data tables herein.

2.9 Limits for Operation in the Band above 70 MHz (CFR15.231 (b))

This limit versus frequency table is as follows (test distance = 3.0 meters):

Fundamental Frequency (MHz)	Limit Fundamental (Average) duV/m	Limit Harmonics and other spurious (Average) duV/m
260 to 470	3750 to 12500*, 1	375 to 1250*,2
* Linear Interpolation		

Note: formula 1: $limit_1 = E = 41.667F - 7083.5$
2: $limit_2 = E = 4.1667F - 708.35$
E= Electric field strength
F= fundamental frequency in MHz

The frequency spectrum above the fundamental to its 10th harmonic was examined and measured for signals falling into the restricted bands of 15.205. If average emissions measurements are employed, the provisions in 15.35 for averaging pulsed emissions and for limiting peak emissions were applied. Spurious and harmonics signals meet the requirements of the above table or the requirements of 15.209, whichever requirement permits higher field strength.

2.10 Radiated Spurious Emissions

The radiated spurious emissions were measured over the frequency range of 30 MHz to the 10th harmonic of the fundamental frequency of the intentional transmitter. The test results are shown below.

Table 4. Radiated Intentional Emissions, Peak Measurements

Tested By: RKM	Test: Part 15B, Para 15.231				Client: QMotion			
	Project: 17-0465				Model: QMO-MC433FM2			
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor (dB)**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detection Method**
433.98	73.30	-	18.25	91.55	100.5	3m./VERT	9.0	**PK**
867.51	26.90	-	0.19	27.09	81.9	3m./VERT	54.8	**PK**
1301.43*	48.99	-	-9.58	39.41	74.0	3.0m./VERT	34.6	**PK**
1735.51	40.97	-	-7.53	33.44	81.9	3.0m./VERT	48.5	**PK**
2169.44	45.05	-	-3.71	41.34	81.9	3.0m./VERT	40.6	**PK**
2603.13	40.42	-	-1.60	38.82	81.9	3.0m./VERT	43.1	**PK**
3037.77	43.32	-	-0.07	43.25	81.9	3.0m./VERT	38.7	**PK**
3471.10	41.36	-	0.58	41.94	81.9	3.0m./VERT	40.0	**PK**
3904.44*	43.41	-	1.51	44.92	74.0	3.0m./VERT	29.1	**PK**
4339.94*	44.49	-	2.58	47.07	74.0	3.0m./VERT	26.9	**PK**
No other emissions found less than 20 dB below the applicable limit.								

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation for peak measurements of CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. (~) Measurements taken at 1 meter were extrapolated to 3 meter using a factor of (-9.5 dB).

Sample Calculation at: 433.98 MHz

Magnitude of Measured Frequency	73.30	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	18.25	dB/m
+Additional Factor	0	dB
Corrected Result	91.55	dBuV/m

Test Date: October 31, 2017
Tested By
Signature:  Name: Robert K. Mills

Table 5. Radiated Intentional Emissions, AVG Measurements

Tested By: RKM	Test: Part 15B, Para 15.231				Client: QMotion			
	Project: 17-0465				Model: QMO-MC433FM2			
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor (dB)**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detection Method**
433.98	56.05	-	18.25	74.30	80.5	3m./VERT	6.2	**AVG**
867.51	14.64	-	0.19	14.83	61.9	3m./VERT	47.1	**AVG**
1301.43*	40.35	-	-9.58	30.77	54.0	3.0m./VERT	23.2	**AVG**
1735.51	30.59	-	-7.53	23.06	61.9	3.0m./VERT	38.8	**AVG**
2169.44	34.24	-	-3.71	30.53	61.9	3.0m./VERT	31.4	**AVG**
2603.13	30.25	-	-1.60	28.65	61.9	3.0m./VERT	33.2	**AVG**
3037.77	32.59	-	-0.07	32.52	61.9	3.0m./VERT	29.4	**AVG**
3471.10	29.66	-	0.58	30.24	61.9	3.0m./VERT	31.7	**AVG**
3904.44*	32.04	-	1.51	33.55	54.0	3.0m./VERT	20.5	**AVG**
4339.94*	30.83	-	2.58	33.41	54.0	3.0m./VERT	20.6	**AVG**
No other emissions found less than 20 dB from the applicable limit.								

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation for peak measurements of CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. All measurements are corrected with a -19.17 dB duty cycle. See section 2.8

Sample Calculation at: 433.98 MHz

Magnitude of Measured Frequency	56.05	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	18.25	dB/m
+Duty Cycle	N/A	dB
Corrected Result	74.30	dBuV/m

Test Date: October 31, 2017
Tested By
Signature: _____ Name: Robert K. Mills

2.11 Radiated Spurious Emissions and Power Line Conducted Emissions (CFR 15.209, 15.207)

The EUT was placed in a state representative of how the device will function under normal operation. The radiated spurious emissions were measured over the frequency range of 150 kHz to 30 MHz and 30 MHz to the 10th Harmonic of the Fundamental frequency of the Intentional transmitter. The test results are shown below.

The EUT is battery operated and does not connect to the AC mains; therefore testing for compliance with 15.207 is not applicable.

Table 6. Radiated Spurious Emissions, 150 kHz – 30 MHz

Tested By: RKM	Test: Part 15B, Para 15.209				Client: QMotion			
	Project: 17-0465				Model: QMO-MC433FM2			
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor (dB)**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detection Method**
No other emissions found less than 20 dB below the applicable limit.								

1. No additional factor applied.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 5th harmonic of highest clock frequency.

Sample Calculation: N/A

Test Date: November 1, 2017
Tested By
Signature:  Name: Robert K. Mills

Table 7. Radiated Spurious Emissions, 30 – 1000 MHz

Tested By: RKM	Test: Part 15B, Para 15.209				Client: QMotion			
	Project: 17-0465				Model: QMO-MC433FM2			
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor (dB)**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detection Method**
94.60	32.54	-	-15.96	16.58	43.5	3m./VERT	26.9	**PK**
101.80	31.83	-	-16.49	15.34	43.5	3m./HORZ	28.2	**PK**
734.00	31.64	-	-1.91	29.73	46.0	3m./HORZ	16.3	**PK**
962.00	33.46	-	-1.89	31.57	46.0	3m./VERT	14.4	**PK**
No other emissions found less than 20 dB below the applicable limit.								

1. No additional factor applied.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 5th harmonic of highest clock frequency.

Sample Calculation at: 94.60 MHz

Magnitude of Measured Frequency	32.54	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	-15.96	dB/m
+Duty Cycle	N/A	dB
Corrected Result	16.58	dBuV/m

Test Date: November 1, 2017
Tested By
Signature: _____ Name: Robert K. Mills

Table 8. Radiated Spurious Emissions, Above 1 GHz

Tested By:	Test: Part 15B, Para 15.209				Client: QMotion			
RM	Project: 17-0465				Model: QMO-MC433FM2			
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor (dB)**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detection Method**
1269.00	47.26	-	-11.29	35.97	54.0	3.0m./VERT	18.0	**PK**
2465.00	48.66	-	-4.25	44.41	54.0	3.0m./HORZ	9.6	**PK**
3300.00	46.11	-	-0.46	45.65	54.0	3.0m./VERT	8.4	**PK**
3381.00	45.55	-	-0.46	45.09	54.0	3.0m./HORZ	8.9	**PK**
No other emissions found less than 20 dB below the applicable limit.								

1. No additional factor applied.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 5th harmonic of highest clock frequency.
3.

Sample Calculation at: 1269.00 MHz

Magnitude of Measured Frequency	47.26	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	-11.29	dB/m
+Duty Cycle	N/A	dB
Corrected Result	35.97	dBuV/m

Test Date: November 1, 2017
Tested By
Signature: _____ Name: Robert K. Mills

2.12 Transmitter Duty Cycle (47 CFR 15.35 (c))

The duty cycle de-rating factor used in the calculation of average radiated limits (per CFR 15.209 and 15.35(c)) is described below. This factor was calculated by first determining the worst case scenario for system operation. With the worst case operating scenario the transmission duty cycle is calculated as:

Total Time On from Figure 3. = 21.0mS

(21.0mS Total Time On)/(100mS FCC Standard) = 0.21 Numeric Duty Cycle
Duty Cycle = 20 Log (.21) = -13.6 dB

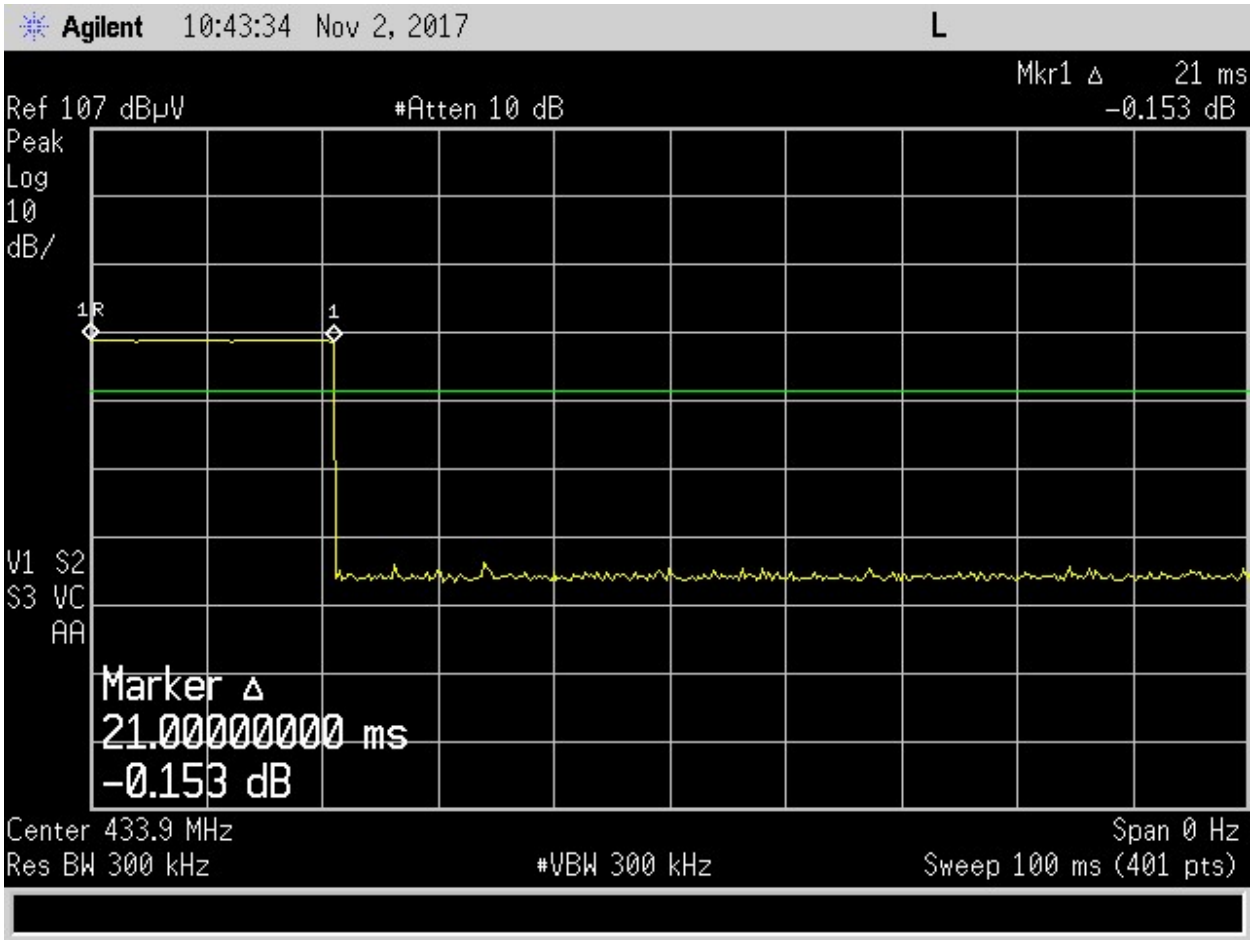

Figure 3. Duty Cycle

2.13 Bandwidth of Fundamental (CFR15.231 (c), RSS-210 (A.1.3))

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined by those frequencies that are at least 20 dB down on either side of the center frequency of the pulse.

0.0025 x 433,000,000.00 = 1.0825 MHz

The measured 20 dB bandwidth is 567.77 kHz, well within the limit.
The measured 99% bandwidth is 480.43 kHz and will be reported in RSP-100, Annex B (Appendix II).

See the figure below.

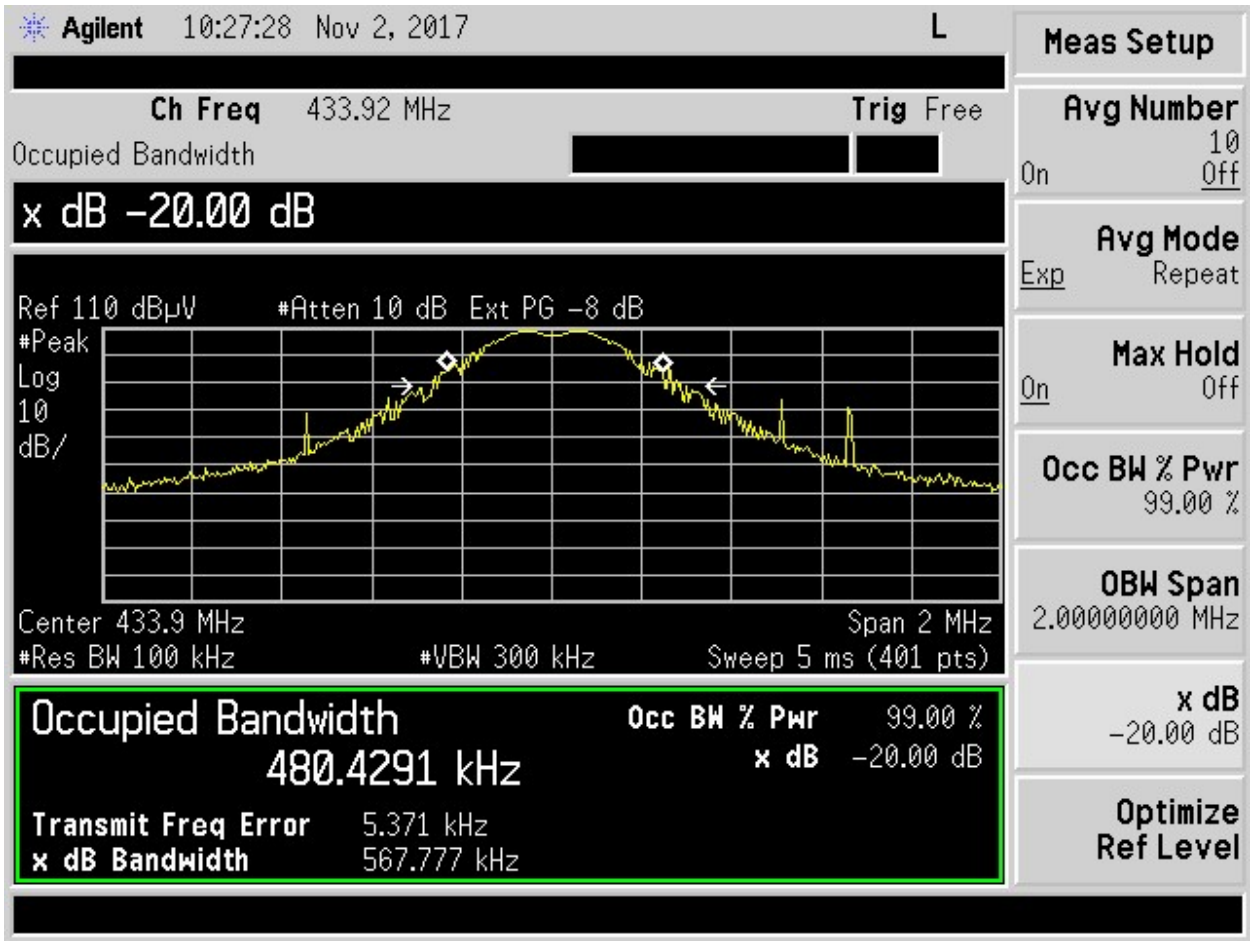

Figure 4. Fundamental Bandwidth Measurement

2.14 Measurement Uncertainty

2.14.1 Conducted Emissions Measurement Uncertainty

Measurement uncertainty (within a 95% confidence level) for this test is ± 2.85 dB.

Not applicable; The EUT is battery powered.

2.14.2 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 ± 5.40 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ± 5.19 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ± 5.08 dB (3 m distance).

The data listed in this test report does have sufficient margin to negate the effects of uncertainty. The EUT unconditionally passes this requirement.

2.15 Test Results

The EUT is deemed to have met all the requirements of this subpart.