

MEASUREMENT REPORT

FCC PART 15.247 / ISED RSS-247 Bluetooth

Applicant Name: Stem Innovation, LLC dBa Iconoscope, LLC 21 G Street, Salt Lake City, UT 84102 USA	Date of Issue : 11/27/2017 Test Site/Location: EMCE ENGINEERING 1726 Ringwood Avenue, San Jose, CA 95131 USA Report No.: 4325-1 EMCE FRN: 0007198120
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FCC ID :	YM780-9500
IC :	9637A-809500
Application Type:	Certification
Model:	80-9500
Additional Model(s):	N/A
EUT Type:	IP Camera
Max. RF Output Power:	6.53dBm (4.49 mW) Peak Conducted
Frequency Range:	2402 MHz – 2480 MHz
Modulation type	GFSK(Normal), π/4DQPSK and 8DPSK(EDR)
FCC Classification	Spread Spectrum Transmitter (DSS)
FCC Rule Part(s): ISED Rule Part(s):	Part 15.247 RSS-247 Issue 2(Feb. 2017) / RSS-GEN Issue 4 (Nov. 2014)
Test Procedure(s):	ANSI C63.10-2013

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this Equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. **EMCE Engineering** Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998,21 U.S. C.853(a)

Amy Jones

Report prepared by
: Amy Jones
Administrative Assistant,
EMCE Engineering

R. Cole

Approved by
: Bob Cole
President
EMCE Engineering

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FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bleutooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

Version

TEST REPORT NO.	DATE	DESCRIPTION
4325-1	11/27/17	- First Approval Report

FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

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1. GENERAL INFORMATION

Applicant	Stem Innovation, LLC dBa Iconoscope, LLC
Applicant Address	21 G Street, Salt Lake City, UT 84102 USA
FCC ID	YM780-9500
IC	9637A-809500
EUT Type	IP Camera
Model name(s)	80-9500
Additional Model name(s):	N/A
Date(s) of Tests:	07/10/2017 – 10/20/2017
Place of Tests:	EMCE ENGINEERING 1726 Ringwood Avenue, San Jose, CA 95131 USA

2. EUT DESCRIPTION

EUT Type	IP Camera
Model Name	80-9500
Additional Model Name(s)	N/A
Power Supply	5 VDC
Battery type	Li-ion Battery(Standard)
Frequency Range	2402 MHz - 2480 MHz (Bluetooth)
Transmit Power	6.11 dBm (4.08 mW) Peak Conducted
BT Operating Mode	Normal, EDR
Modulation Type	GFSK(Normal), $\pi/4$ DQPSK and 8DPSK(EDR)
Modulation Technique	FHSS
Number of Channels	79 Channels
Antenna Specification	Manufacturer: MOLEX Antenna type: 2.4 / 5 GHz Balance Flex Antenna 1461530100 Peak Gain : 3.2 dBi

* 15.247 Requirements for Bluetooth transmitter

- This Bluetooth module has been tested by a Bluetooth Qualification Lab, and we confirm the following:
 - 1) This system is hopping pseudo-randomly.
 - 2) Each frequency is used equally on the average by each transmitter.
 - 3) The receiver input bandwidths that match the hopping channel bandwidths of their corresponding transmitters
 - 4) The receiver shifts frequencies in synchronization with the transmitted signals.
- 15.247(g): The system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this Section 15.247 should the transmitter be presented with a continuous data (or information) stream.

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- 15.247(h): The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

3. TEST METHODOLOGY

The measurement procedure described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices(ANSI C63.10-2013) is used in the measurement of the test device.

3.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

3.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

3.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable which is 0.8 m height from the ground floor. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2013) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on the turntable which is 0.8 m height from the ground floor for below 1GHz. And the EUT is placed on the turntable which is 1.5m height from the ground floor for above 1GHz with absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 8 of ANSI C63.10 (Version: 2013). To record the final measurements, the analyzer detector function was set to CISPR quasi-peak mode and the bandwidth of the spectrum analyzer was set to 120 kHz for frequencies below 1 GHz or 1 MHz for frequencies above 1 GHz. For average measurements above 1 GHz, the analyzer was set to peak detector with a reduced VBW setting(RBW = 1 MHz, VBW = 1/T Hz, where T = Pulse width).

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Conducted Antenna Terminal

See Section from 11.12.2 in ANSI C63.10 - 2013

3.4 DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel low, mid and high with highest data rate (worst case) is chosen for full testing.

4. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.

Especially, all antenna for measurements are calibrated in accordance with the requirements of ANSI C63.5 (Version : 2006).

5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at 1726 Ringwood Avenue, San Jose, CA 95131 USA. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22. Detailed description of test facility has been accredited by NVLAP, designated by NIST(US0125)

5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

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6. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203:

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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.”

* The Bluetooth antenna is a Flex Antenna attached to the PCB using a uFL connector and 4" cable.

* The E.U.T Complies with the requirement of §15.203

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7. SUMMARY OF TEST RESULTS

[FCC Part]

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
20 dB Bandwidth	§15.247(a)(1)(ii) or (iii)	NA	CONDUCTED	PASS
Occupied Bandwidth	NA	NA		NA
Conducted Maximum Peak Output Power	§15.247(b)(1)	< 1 Watts for 1Mbps < 125 Milliwatts for 2, 3Mbps		PASS
Carrier Frequency Separation	§15.247(a)(1)	>25 kHz or >2/3 of the 20dB BW		PASS
Number of Hopping Frequencies	§15.247(a)(1)(iii)	>15		PASS
Time of Occupancy	§15.247(a)(1)(iii)	<400 ms		PASS
Conducted Spurious Emissions	§15.247(d)	< 20 dB for all out-of band emissions		PASS
Band Edge(Out of Band Emissions)	§15.247(d)	< 20 dB for all out-of band emissions		PASS
AC Power line Conducted Emissions	§15.207(a)	cf. Section 8.7		PASS
Radiated Spurious Emissions	§15.247(d), 15.205, 15.209	cf. Section 8.6.2	RADIATED	PASS
Radiated Restricted Band Edge	§15.247(d), 15.205, 15.209	cf. Section 8.6.3		PASS

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[ISED Part]

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
20 dB Bandwidth	RSS-247, 5.1.a.	NA	CONDUCTED	PASS
99% Occupied Bandwidth	RSS-Gen, 6.6	NA		NA
Conducted Maximum Peak Output Power	RSS-247, 5.4.b.	< 1 Watts for 1Mbps < 125 Milliwatts for 2, 3Mbps		PASS
Carrier Frequency Separation	RSS-247, 5.1.b.	>25 kHz or >2/3 of the 20dB BW		PASS
Number of Hopping Frequencies	RSS-247, 5.1.d.	>15		PASS
Time of Occupancy	RSS-247, 5.1.d.	<400 ms		PASS
Conducted Spurious Emissions	RSS-247, 5.5	< 20 dB for all out-of band emissions		PASS
Band Edge(Out of Band Emissions)	RSS-247, 5.5	< 20 dB for all out-of band emissions		PASS
AC Power line Conducted Emissions	RSS-Gen, 8.8	RSS-Gen Section 8.8 table 3		PASS
Radiated Spurious Emissions	RSS-Gen, 8.9	RSS-Gen Section 8.9 table 4.5	RADIATED	PASS
Radiated Restricted Band Edge	RSS-Gen, 8.10	RSS-Gen Section 8.10 table 6		PASS

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8. FCC PART 15.247 REQUIREMENTS

8.1 PEAK POWER

LIMIT

The maximum peak output power of the intentional radiator shall not exceed the following:

1. For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 W for hopping mode, 125 mW for AFH mode
2. The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

Test Configuration



TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer. The Spectrum Analyzer is set to the peak detector mode. This test is performed with hopping off.

The Spectrum Analyzer is set to (7.8.5 in ANSI C63.10-2013)

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

VBW ≥ RBW

Sweep = Auto

Detector = Peak

Trace = Max hold

TEST RESULTS

No non-compliance noted

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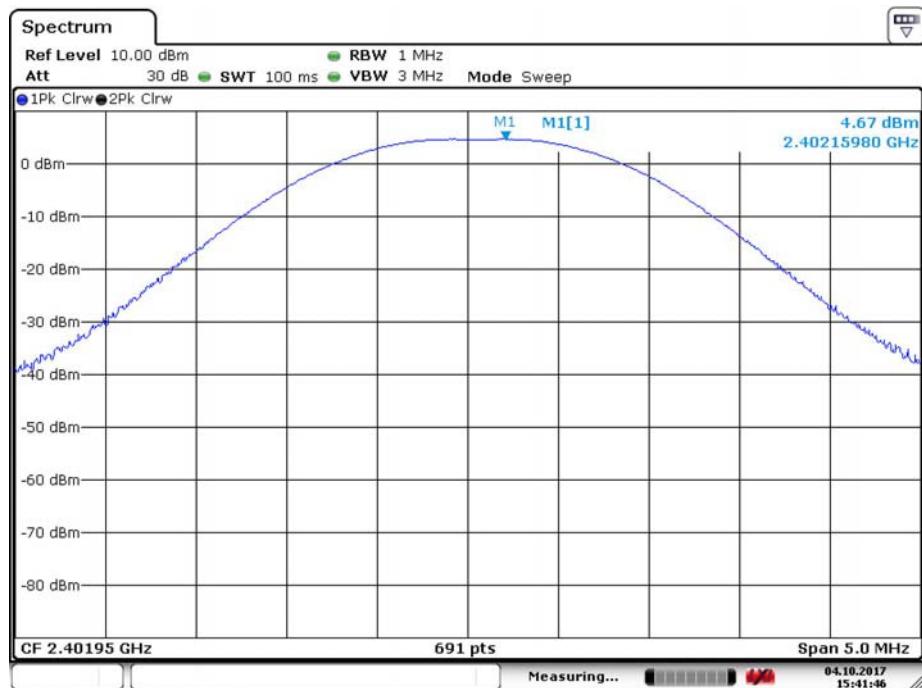
Test Data

Channel	Frequency (MHz)	Output Power (GFSK)		Limit (mW)	Result
		(dBm)	(mW)		
Low	2402	4.67	2.93	125	PASS
Mid	2441	4.77	2.99		PASS
High	2480	6.53	4.49		PASS

Channel	Frequency (MHz)	Output Power (8DPSK)		Output Power (π/4DQPSK)		Limit (mW)	Result
		(dBm)	(mW)	(dBm)	(mW)		
Low	2402	4.69	2.94	4.96	3.13	125	PASS
Mid	2441	5.36	3.43	5.44	3.49		PASS
High	2480	5.70	3.71	6.11	4.08		PASS

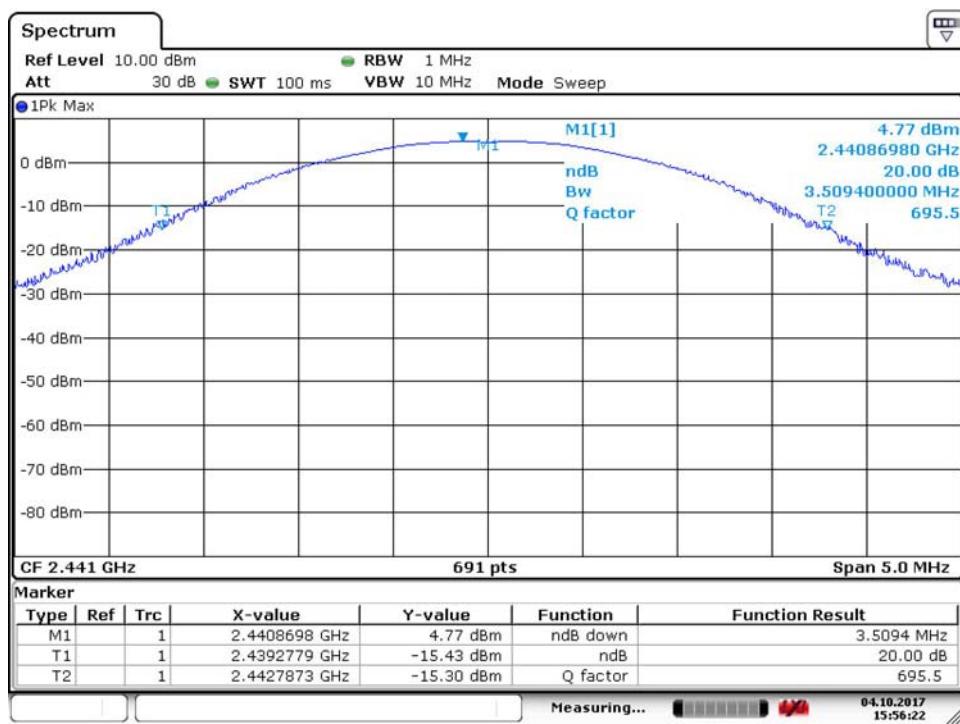
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Test Plots (GFSK)
Peak Power (Low-CH)



Date: 4.OCT.2017 15:41:47

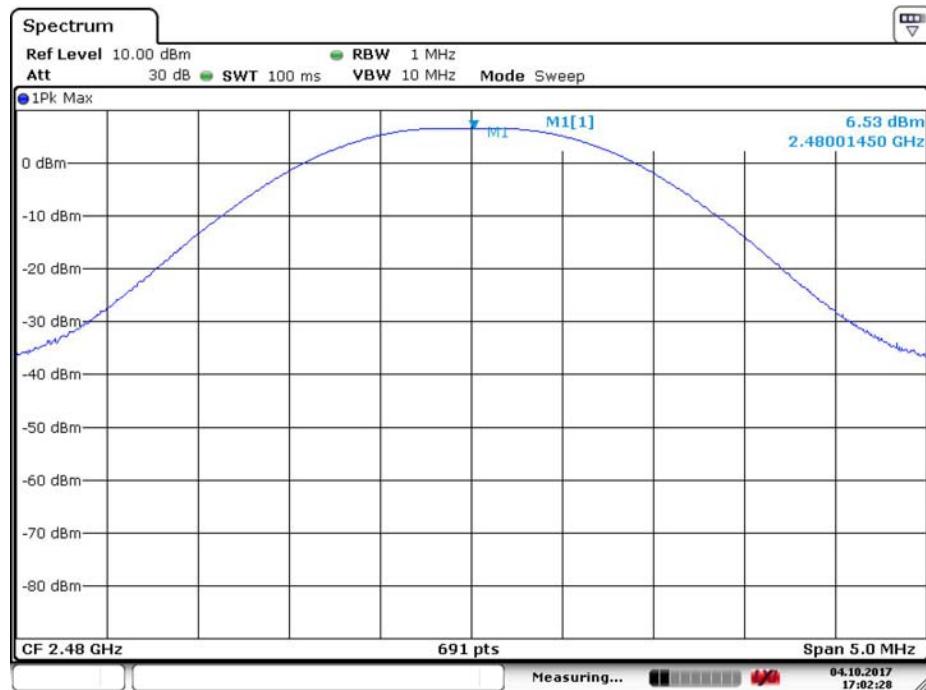
Test Plots (GFSK)
Peak Power (Mid-CH)



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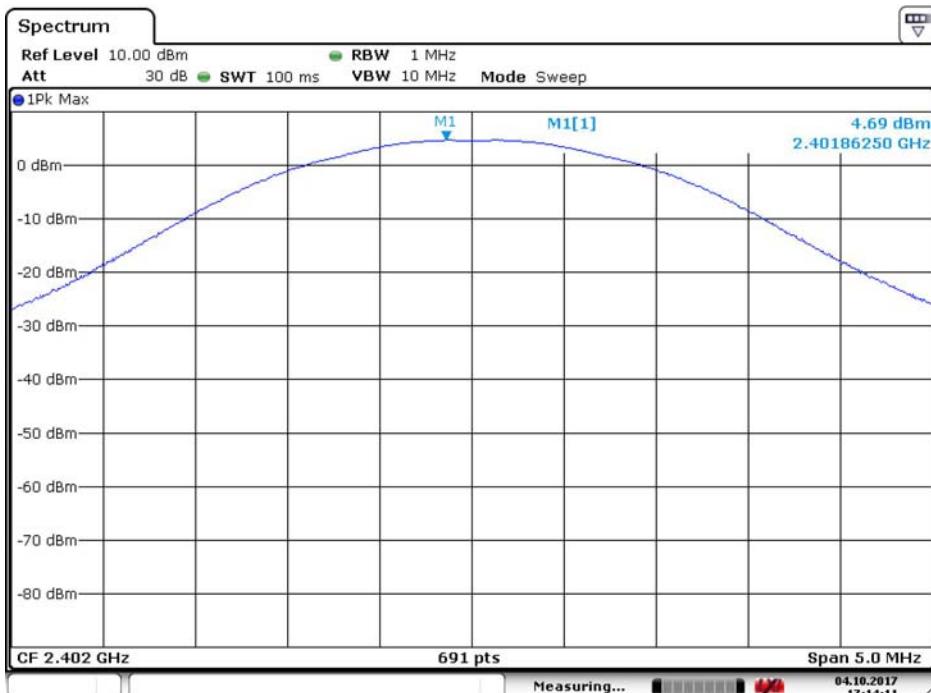
FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report			FCC ID : YM780-9500
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Test Plots (GFSK)
Peak Power (High-CH)



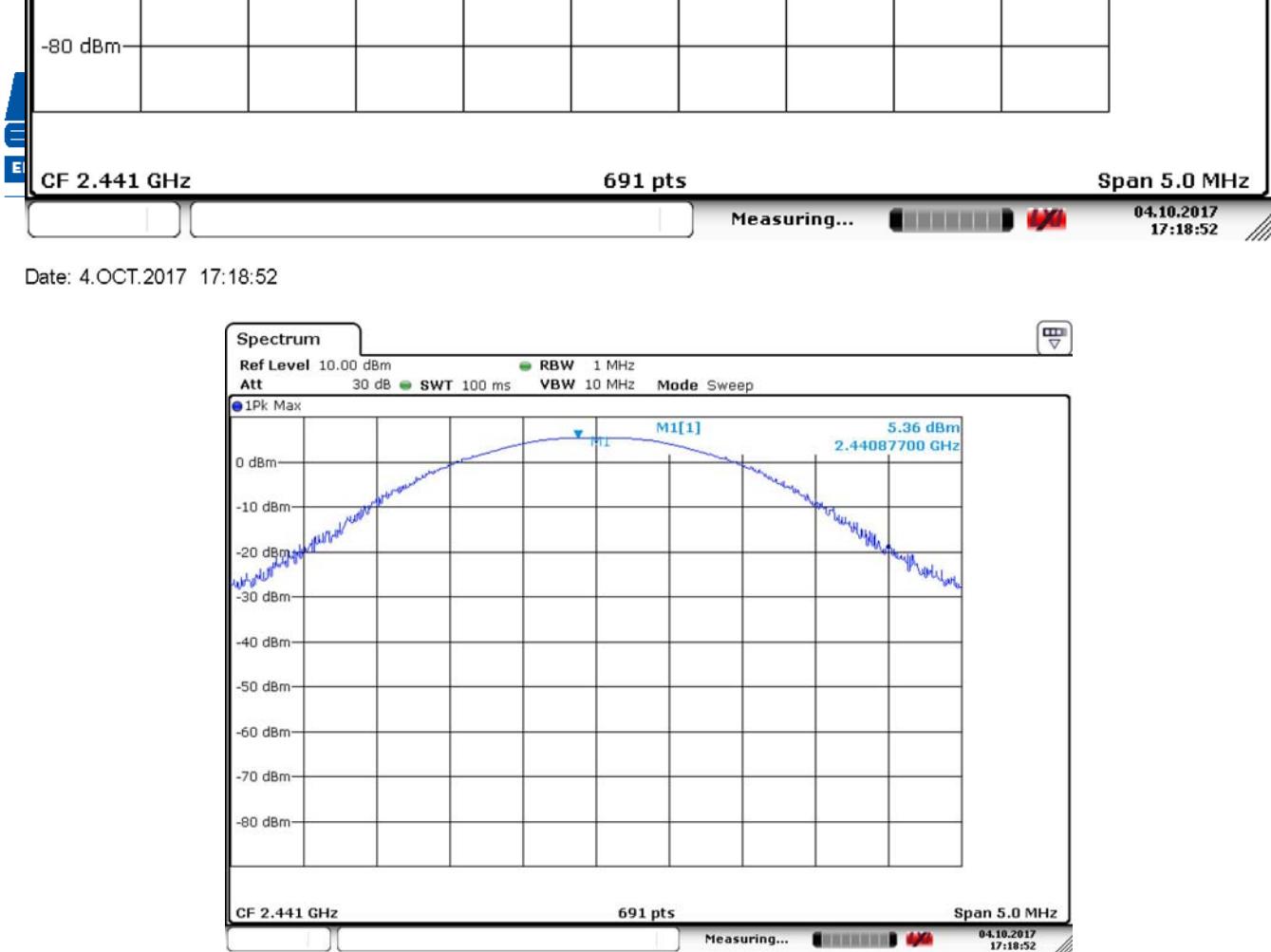
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Test Plots (8DPSK)
Peak Power (Low-CH)



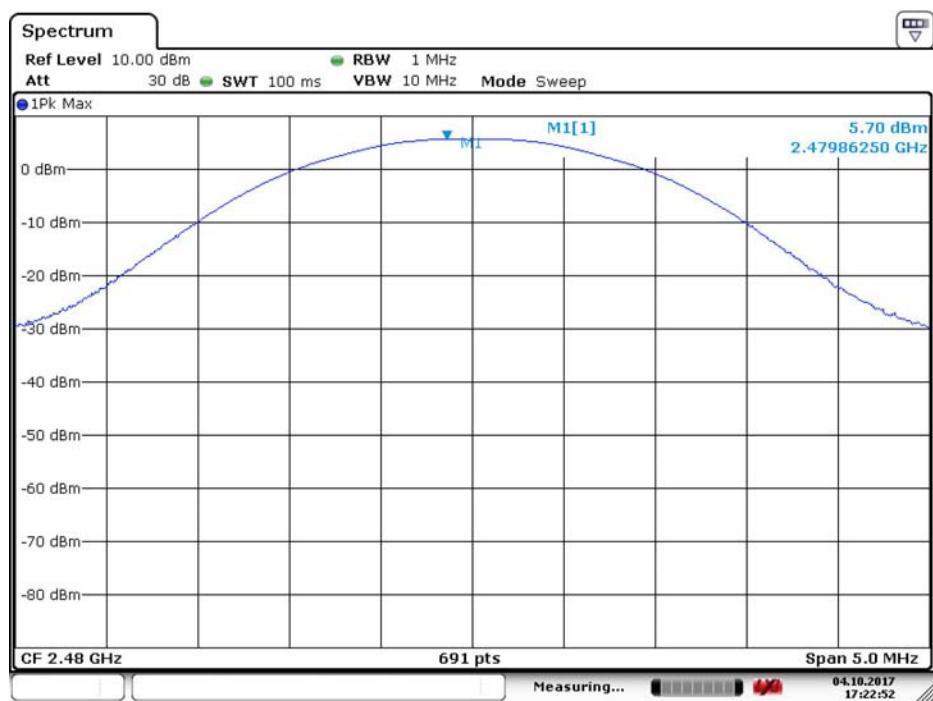
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FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
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Test Plots (8DPSK)

Peak Power (High-CH)



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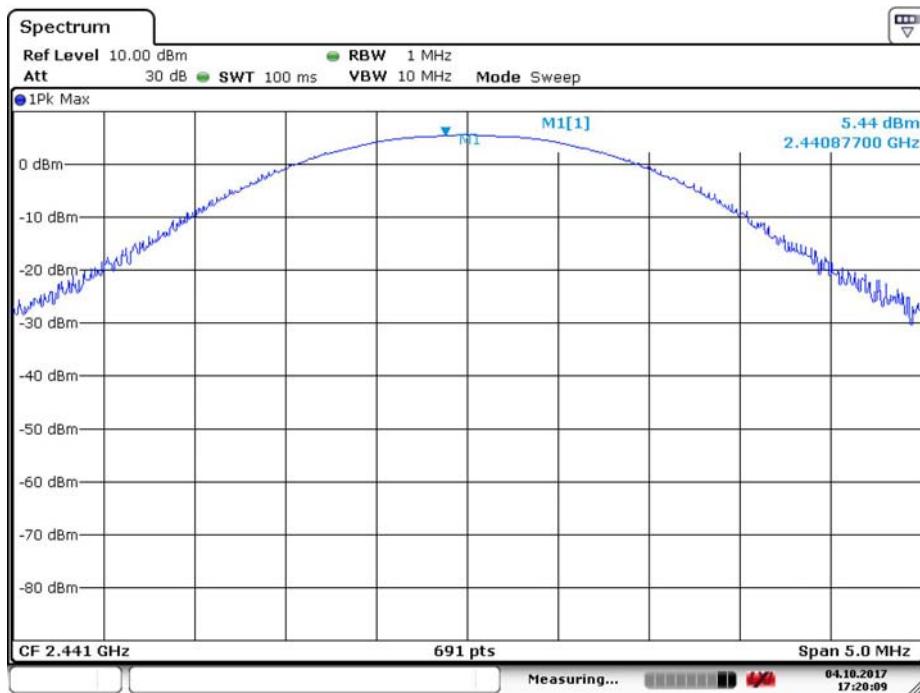
IC : 9637A-809500

Test Plots ($\pi/4$ DQPSK)
Peak Power (Low-CH)



Date: 4.OCT.2017 17:15:19

Test Plots ($\pi/4$ DQPSK)
Peak Power (Mid-CH)



Date: 4.OCT.2017 17:20:08

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Test Plots ($\pi/4$ DQPSK)

Peak Power (High-CH)



Date: 4.OCT.2017 17:26:45

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8.2 BAND EDGES

LIMIT

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

Test Configuration



TEST PROCEDURE

This test is performed with hopping off and hopping on.

The Spectrum Analyzer is set to (6.10.4 in ANSI C63.10-2013)

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation

RBW \geq 1% of the span

VBW \geq RBW

Sweep = Auto

Detector = Peak

Trace = Max hold

TEST RESULTS

See attached.

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Test Data

- Without hopping

Outside Frequency Band	GFSK	8DPSK	$\pi/4$ DQPSK	Limit (dBc)	Margin			Result
	(dB)	(dB)	(dB)		GFSK (dBc)	8DPSK (dBc)	$\pi/4$ DQPSK (dBc)	
Lower	54.03	45.14	44.10	20	34.03	25.14	24.10	PASS
Upper	62.83	56.74	55.42		42.83	36.74	35.42	PASS

Test Plots without hopping (GFSK)

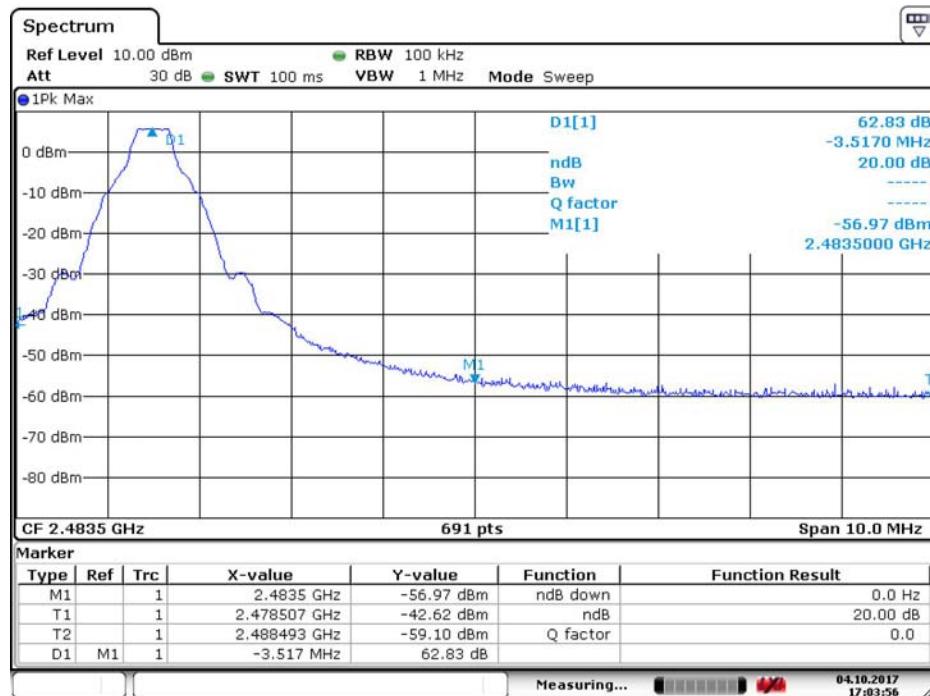
Band Edges (Low-CH)



Date: 4.OCT.2017 15:52:07

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Test Plots without hopping (GFSK)
Band Edges (High-CH)



Date: 4.OCT.2017 17:03:57

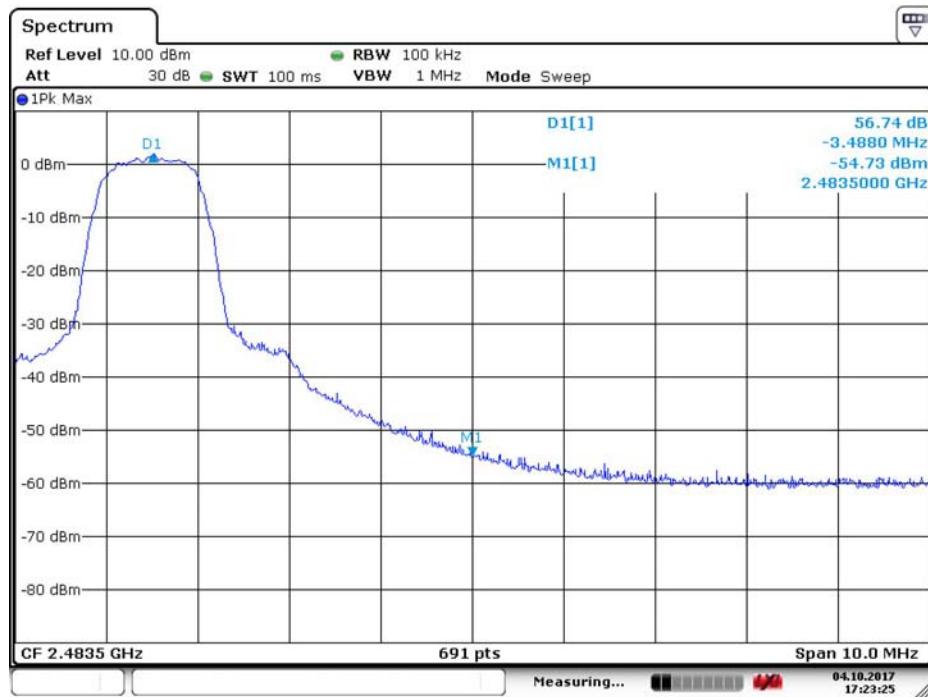
Test Plots without hopping (8DPSK)
Band Edges (Low-CH)



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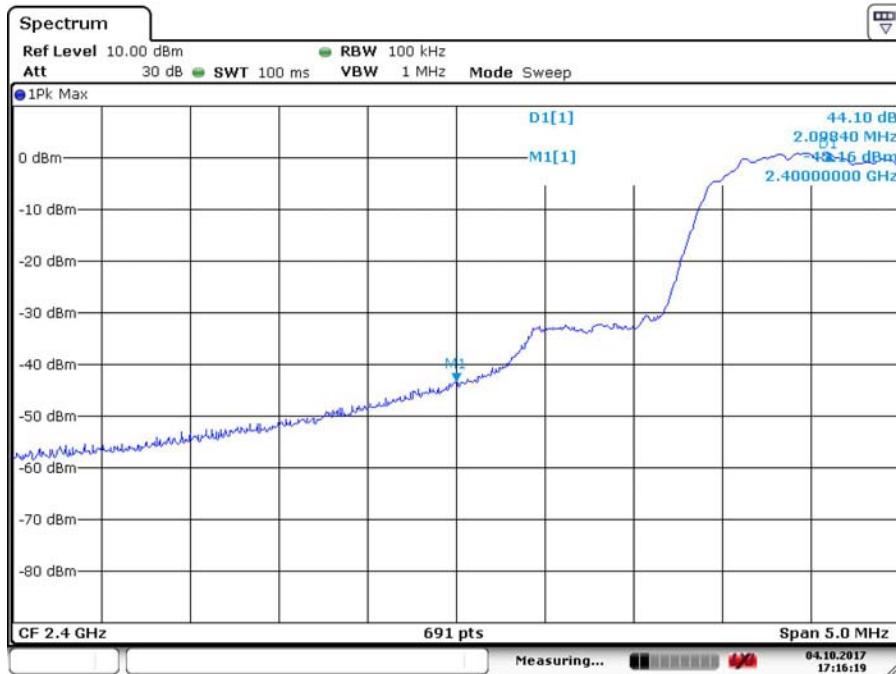
FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
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Test Plots without hopping (8DPSK)
Band Edges (High-CH)



Date: 4.OCT.2017 17:23:26

Test Plots without hopping ($\pi/4$ DQPSK)
Band Edges (Low-CH)

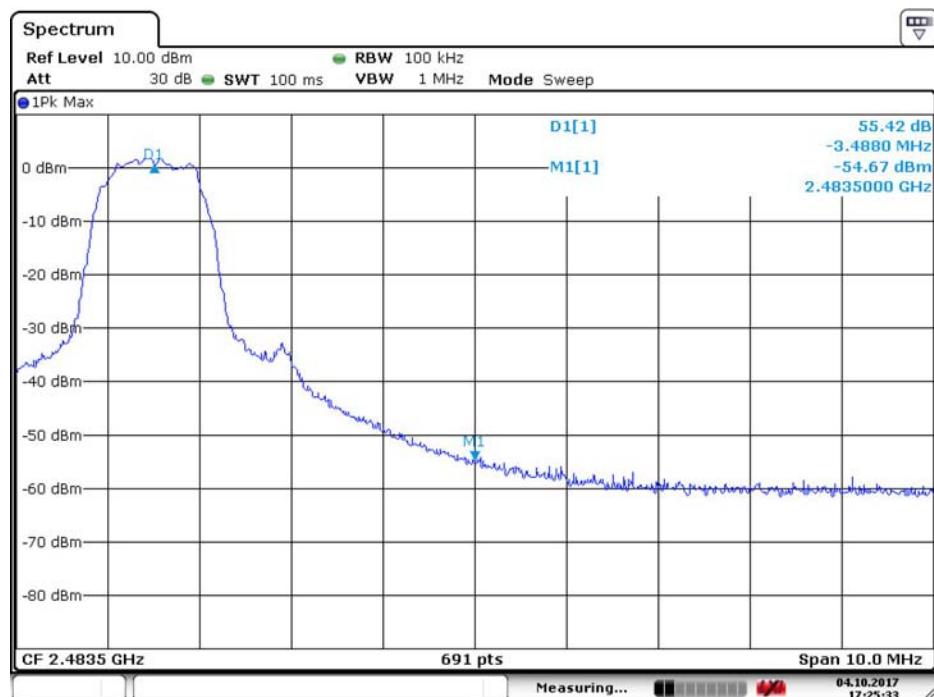


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FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
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Test Plots without hopping ($\pi/4$ DQPSK)

Band Edges (High-CH)



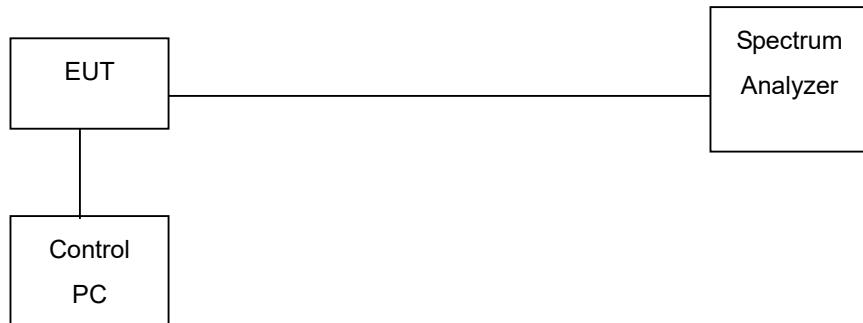
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8.3 FREQUENCY SEPARATION / 20 BANDWIDTH / OCCUPIED BANDWIDTH (99% BW) LIMIT

According to §15.247(a)(1), Frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

Test Configuration



TEST PROCEDURE

The Channel Separation test is performed with hopping on. And the 20 dB Bandwidth test is performed with hopping off.

The Spectrum Analyzer is set to (7.8.2 in ANSI C63.10-2013)

Span = wide enough to capture the peaks of two adjacent channels

RBW \geq 1% of the span

VBW \geq RBW

Sweep = Auto

Detector = Peak

Trace = Max hold

The trace was allowed to stabilize. The marker-delta function was used to determine the separation between the peaks of the adjacent channels.

TEST RESULTS

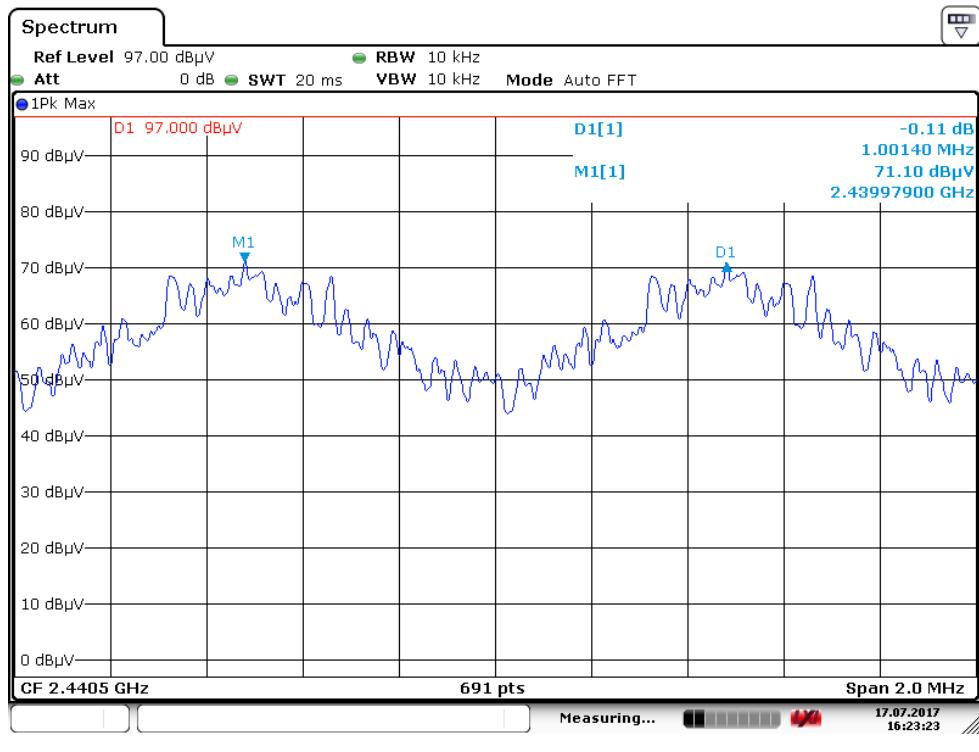
No non-compliance noted

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Test Data

Channel Separation (kHz)			20dB Bandwidth (kHz)				Limit (kHz)	Result
GFSK	8DPSK	$\pi/4$ DQPSK	Channel	GFSK	8DPSK	$\pi/4$ DQPSK		
1001	998	1000	Low CH	937.2	1308.0	1322.0	>25 or >2/3 of the 20dB BW	Pass
			Middle CH	937.3	1311.0	1342.0		
			High CH	938.3	1321.0	1339.0		

To simplify report, GFSK channel spacing is shown. All 3 modes exhibit the same channel spacing.



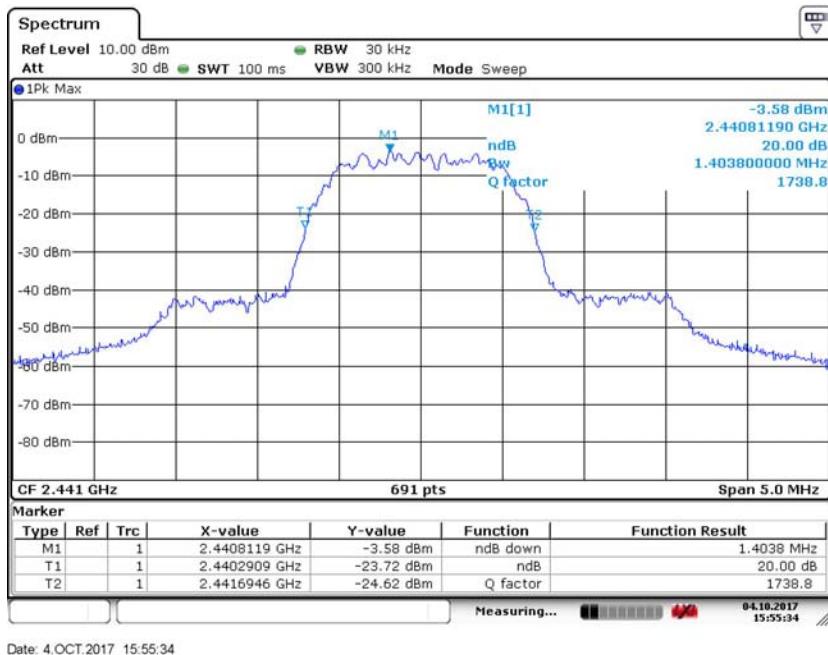
Date: 17 JUL 2017 16:23:23

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To simplify report, center channel bandwidth measurements are shown and are representative of Low and high channel data also.

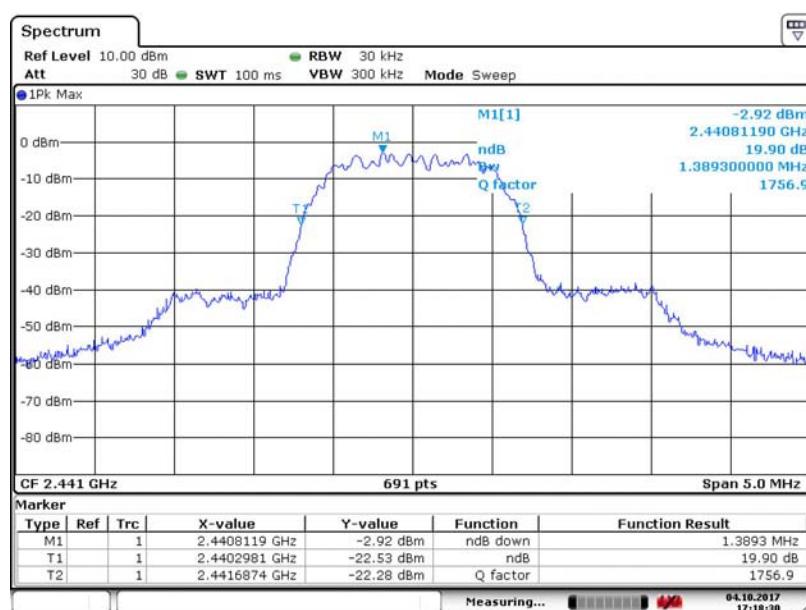
Test Plots (GFSK)

20 dB BW(Mid-CH)



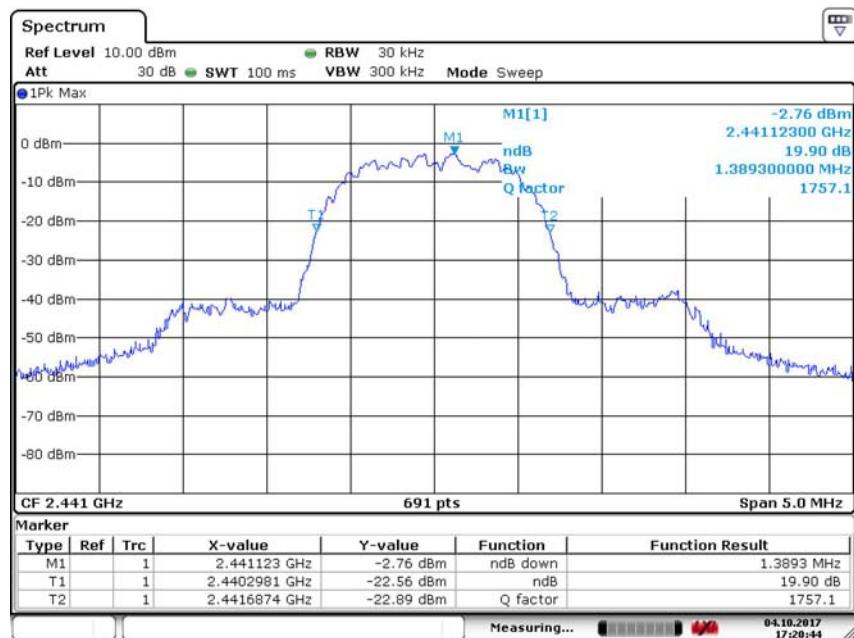
Test Plots (8DPSK)

20 dB BW(Mid-CH)



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Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

Test Plots (π /4DQPSK)
20 dB BW(Mid-CH)



Date: 4.OCT.2017 17:20:45

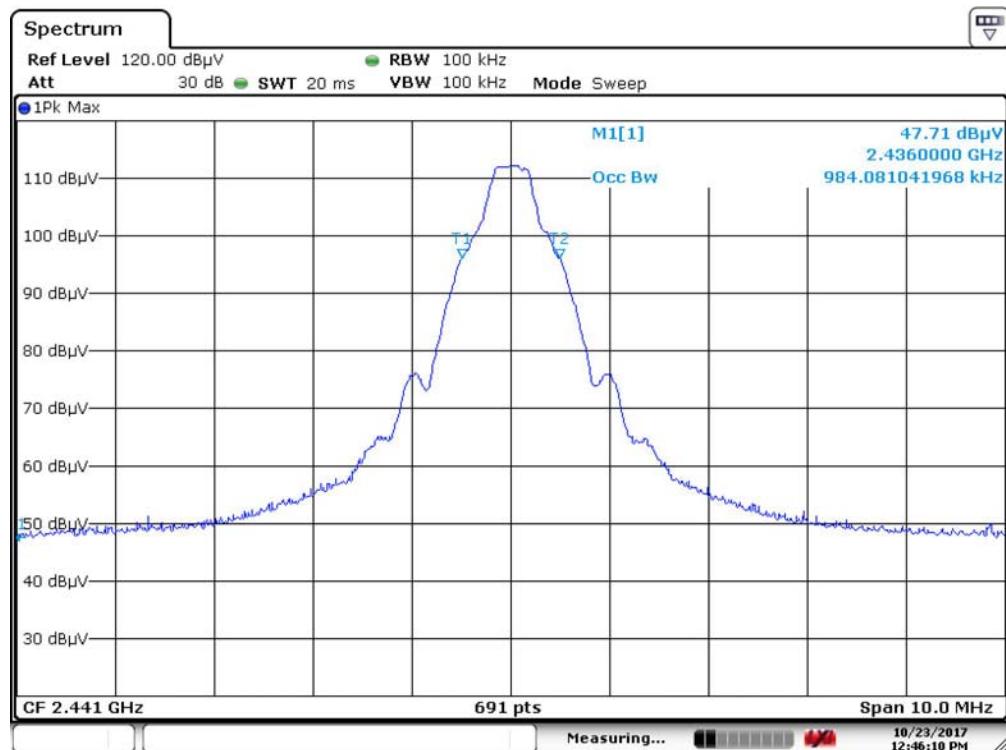
FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

Occupied Bandwidth (99% BW)

99% BW (kHz)			
Channel	GFSK	8DPSK	$\pi/4$ DQPSK
Middle CH	994.1	1259.0	1273.5

To simplify the report, mid-channel plots a presented here.

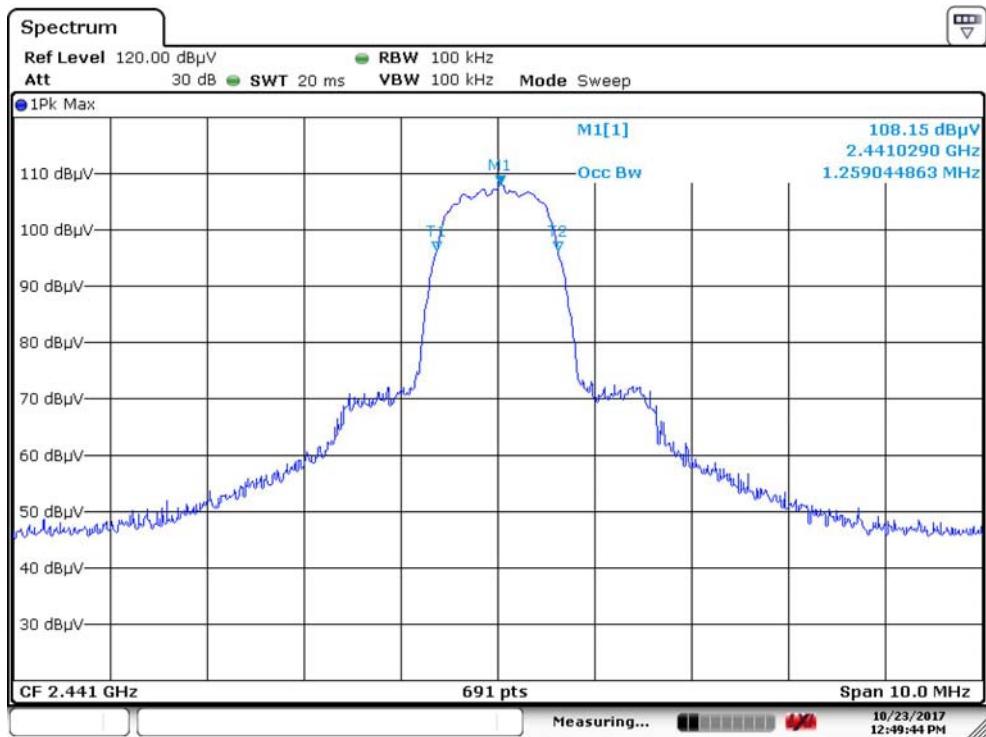
99% BW GFSK



Date: 23.OCT.2017 12:46:11

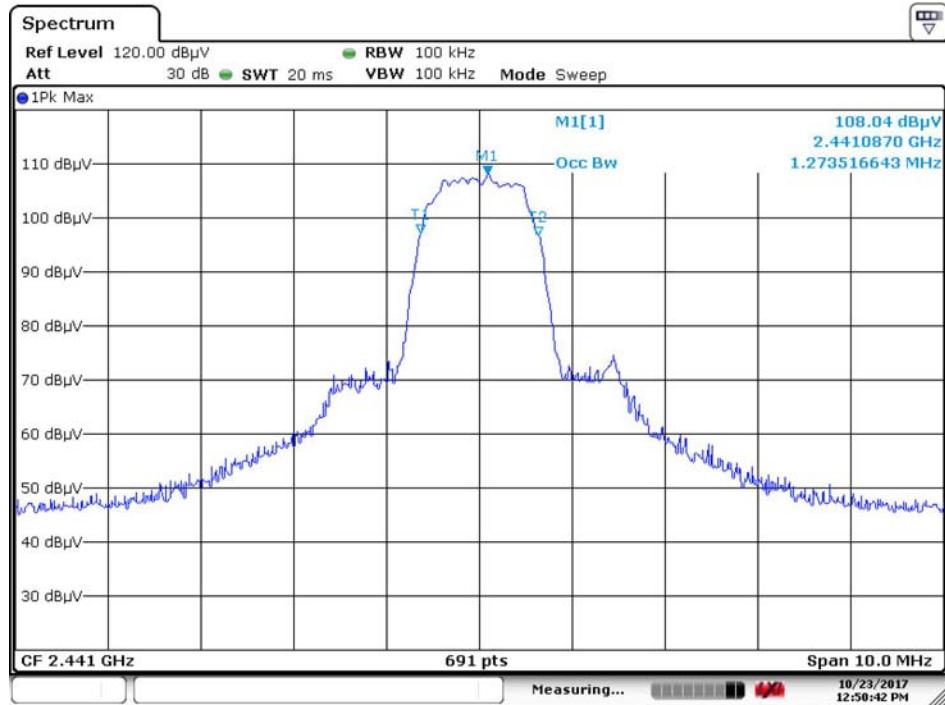
FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

99% BW 8DPSK



Date: 23.OCT.2017 12:49:44

99% BW _4DQPSK



Date: 23.OCT.2017 12:50:42

FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

8.4 NUMBER OF HOPPING FREQUENCY

LIMIT

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400 MHz ~ 2483.5 MHz bands shall use at least 15 hopping frequencies.

Test Configuration



TEST PROCEDURE

The Bluetooth frequency hopping function of the EUT was enabled.

The Spectrum Analyzer is set to (7.8.3 in ANSI C63.10-2013)

Span = the frequency band of operation

RBW \geq 1% of the span

VBW \geq RBW

Sweep = Auto

Detector = Peak

Trace = Max hold

The trace was allowed to stabilize.

TEST RESULTS

No non-compliance noted

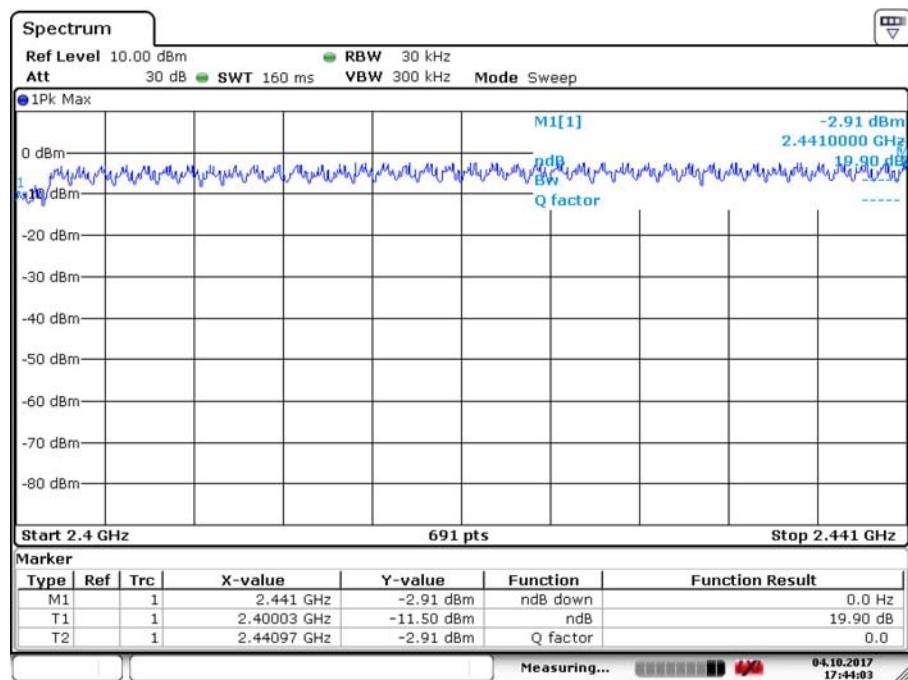
Test Data

Result (No. of CH)			Limit	Result
GFSK	8DPSK	$\pi/4$ DQPSK		
79	79	79	>15	Pass

FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

Test Plots (GFSK)

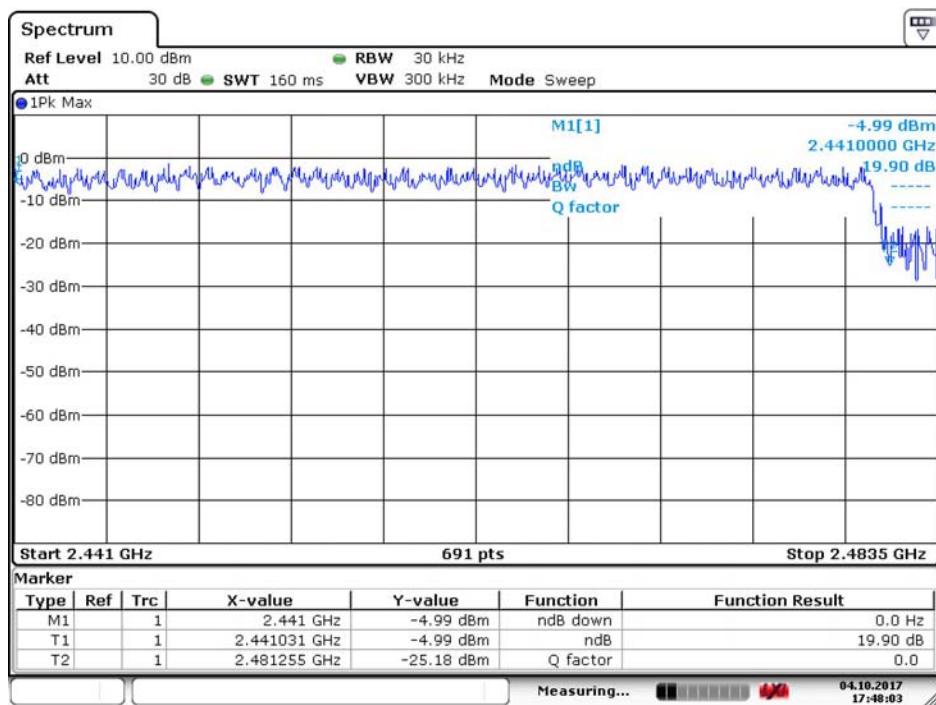
Number of Channels (2.4 GHz - 2.441 GHz)



Date: 4.OCT.2017 17:44:04

Test Plots (GFSK)

Number of Channels (2.441 GHz - 2.4835 GHz)



Date: 4.OCT.2017 17:48:03

FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report			FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera		IC : 9637A-809500

TIME OF OCCUPANCY (DWELL TIME)

LIMIT

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400 MHz ~ 2483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4 s within a period 0.4 s multiplied by the number of hopping channels employed.

Test Configuration



TEST PROCEDURE

This test is performed with hopping off.

EUT was set to transmit the longest packet type (DH5)

The Spectrum Analyzer is set to (7.8.4 in ANSI C63.10-2013)

Span = Zero span, Centered on a hopping channel

RBW = 1 MHz

VBW \geq RBW

Sweep = as necessary to capture the entire dwell time per hopping channel

Detector = Peak

Trace = Max hold

The marker-delta function was used to determine the dwell time.

Normal Mode / EDR Mode

DH 5(The longest packet type for GFSK)

CH Mid : $2.80 * (1600/6)/79 * 31.6 = 308.26$ (ms)

2-DH 5(The longest packet type for $\pi/4$ DQPSK)

CH Mid : $2.80 * (1600/6)/79 * 31.6 = 308.26$ (ms)

3-DH 5(The longest packet type for 8DPSK)

CH Mid : $2.90 * (1600/6)/79 * 31.6 = 309.33$ (ms)

FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
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Note :

A DH5 Packet need 5 time slot for transmitting and 1 time slot for receiving. Then the system makes worst case 1600/6 hops per second with 79 channels. So the system have each channel 3.3755 times per second and so for 31.6 seconds the system have 106.7 times of appearance.

Each tx-time per appearance of DH5 is 2.883 ms.

Dwell time = Tx-time * 106.7

TEST RESULTS

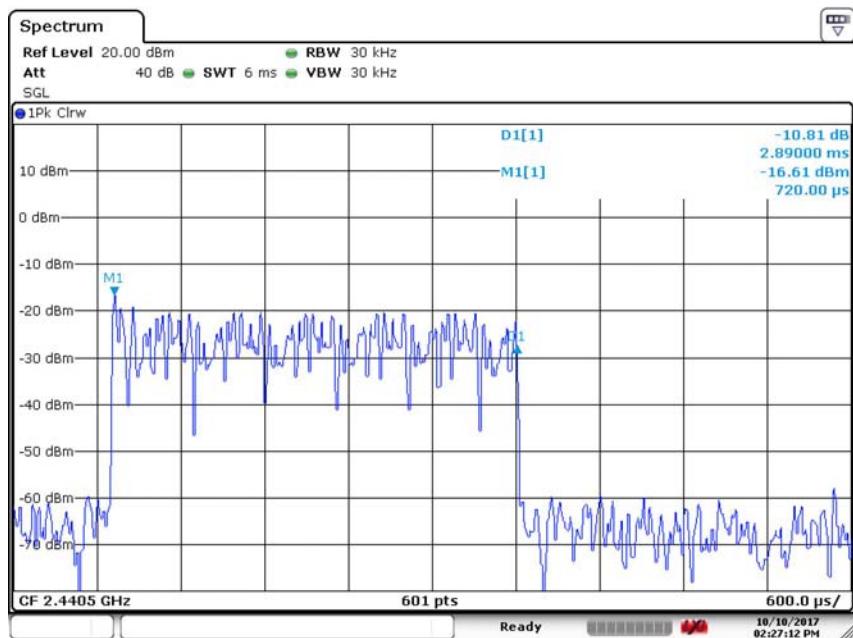
See the table.

	Channel	GFSK	8DPSK	$\pi/4$ DQPSK
Pulse Time (ms)	Mid	2.89	2.89	2.90

	Channel	GFSK	8DPSK	$\pi/4$ DQPSK	Period Time (s)	Limit (ms)	Result
Total of Dwell (ms)	Mid	308.26	308.26	309.33	31.6	400	PASS

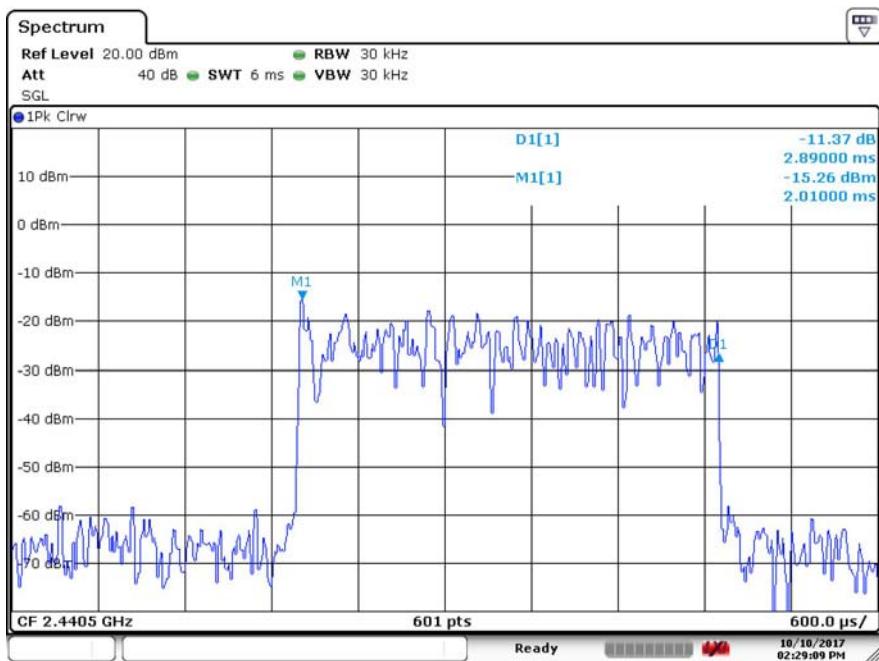
FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

Test Plots (GFSK)
Dwell Time (Mid-CH)



Date: 10.OCT.2017 14:27:12

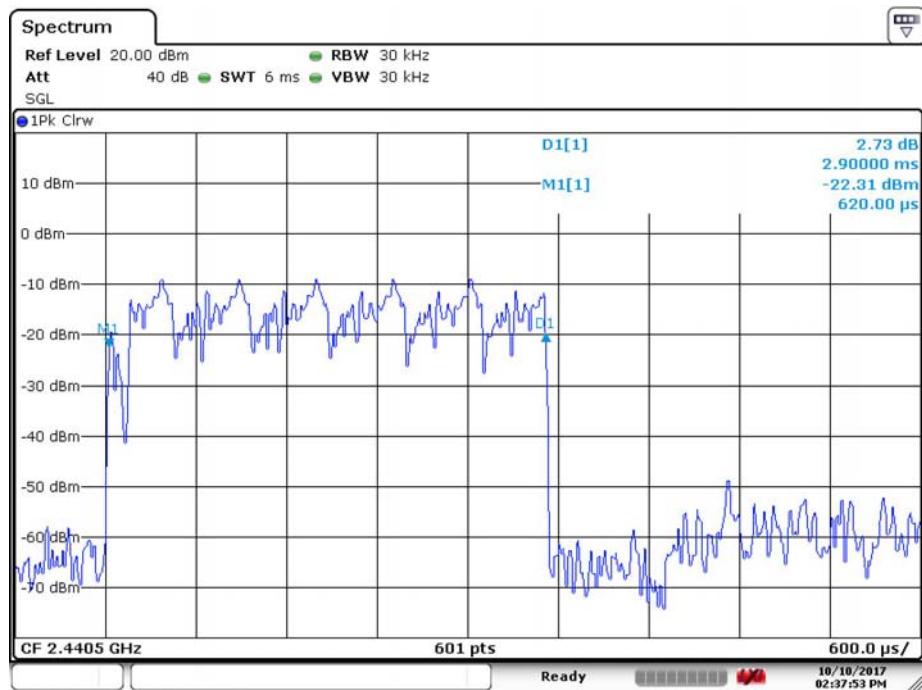
Test Plots (8DPSK)
Dwell Time (Mid-CH)



Date: 10.OCT.2017 14:29:09

FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

Test Plots (π /4DQPSK)
Dwell Time (Mid-CH)



Date: 10.OCT.2017 14:37:53

FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

SPURIOUS EMISSIONS

8.3.1 CONDUCTED SPURIOUS EMISSIONS

Test Requirements and limit, §15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

Limit : 20 dBc

Test Configuration



TEST PROCEDURE

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer.

The Spectrum Analyzer is set to (7.8.8 in ANSI C63.10-2013)

1. Span = wide enough to capture the peak level of the in-band emission and all spurious emissions(e.g.,harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.
2. RBW = 100 kHz
3. VBW ≥ 300 kHz

FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

4. Sweep = auto
5. Sweep point $\geq 2 \times \text{span}/\text{RBW}$
5. Detector function = peak
6. Trace = max hold

Measurements are made over the 30 MHz to 25 GHz range with the transmitter set to the lowest, middle, and highest channels.

This test is performed with hopping off.

TEST RESULTS

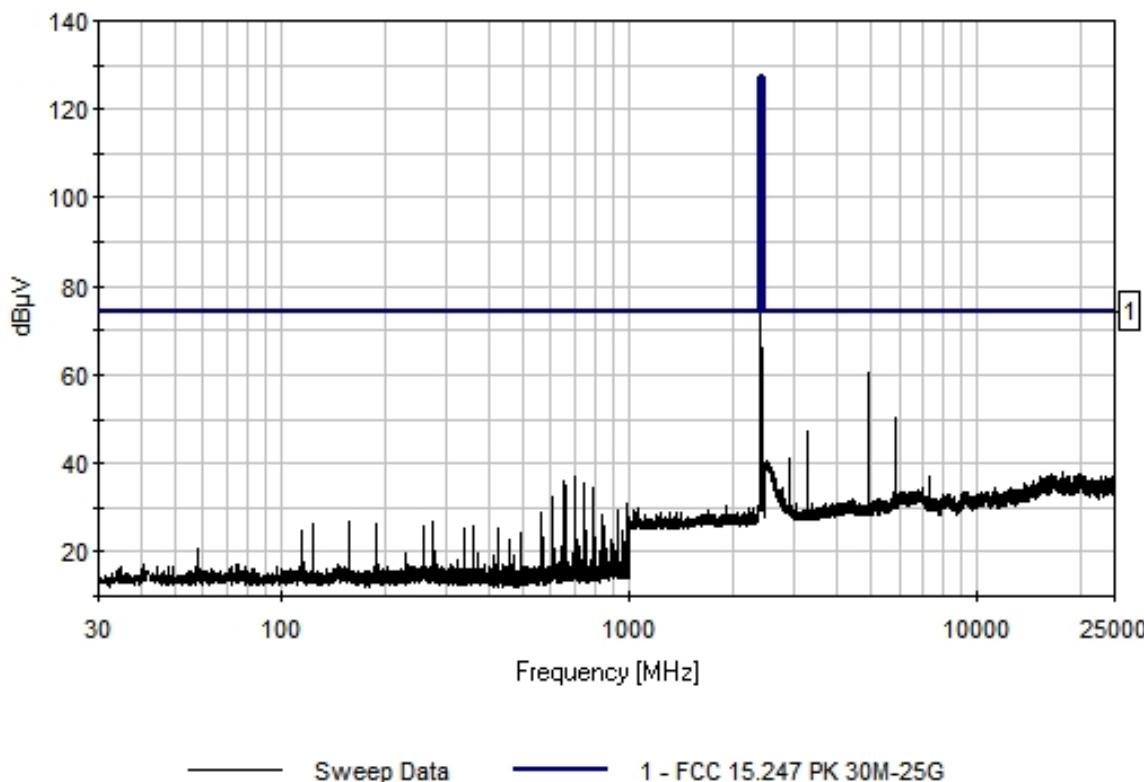
No non-compliance noted.

Note : In order to simplify the report, attached plots show only the worst case channel and data rate.

Test Plots (8DQPSK) - 30 MHz - 25 GHz

Spurious Emission (Mid-CH)

EMCE Engineering Date: 7/12/2017 Time: 3:45:54 PM Customer WO#:
FCC 15.247 PK 30M-25G Test Distance: N/A Sequence#: 14 Ext ATTN: 0 dB



FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No.	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500
4325-1			

8.3.2 RADIATED SPURIOUS EMISSIONS

LIMIT : §15.247(d), §15.205, §15.209

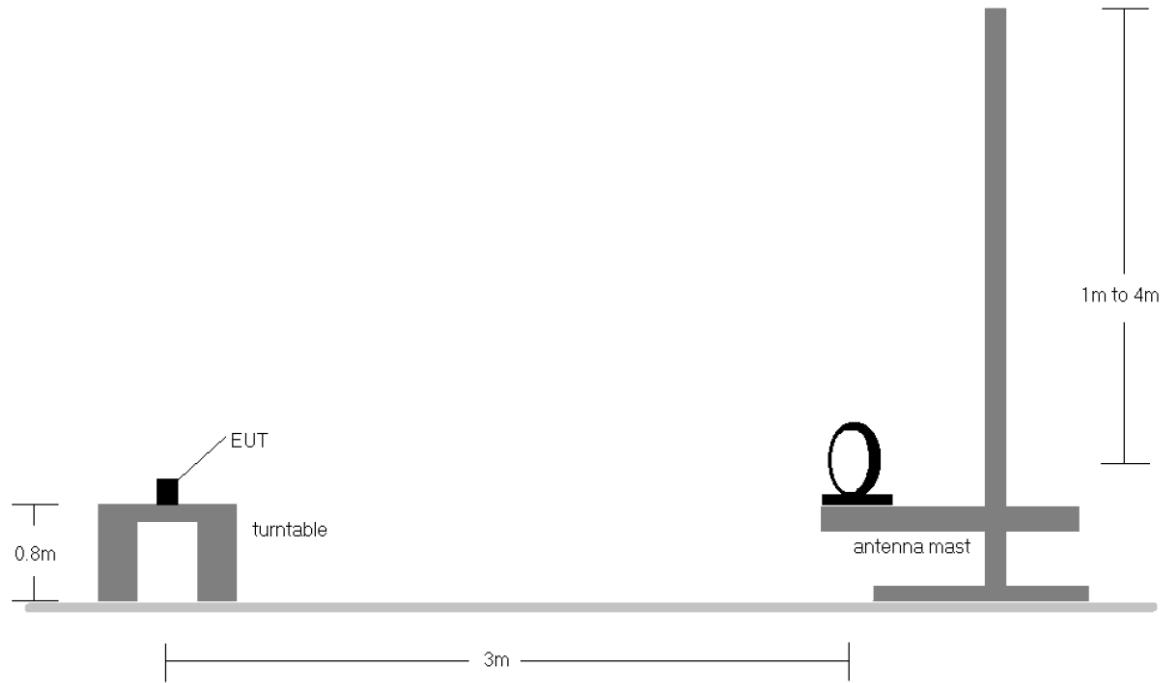
1. 20dBc in any 100kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

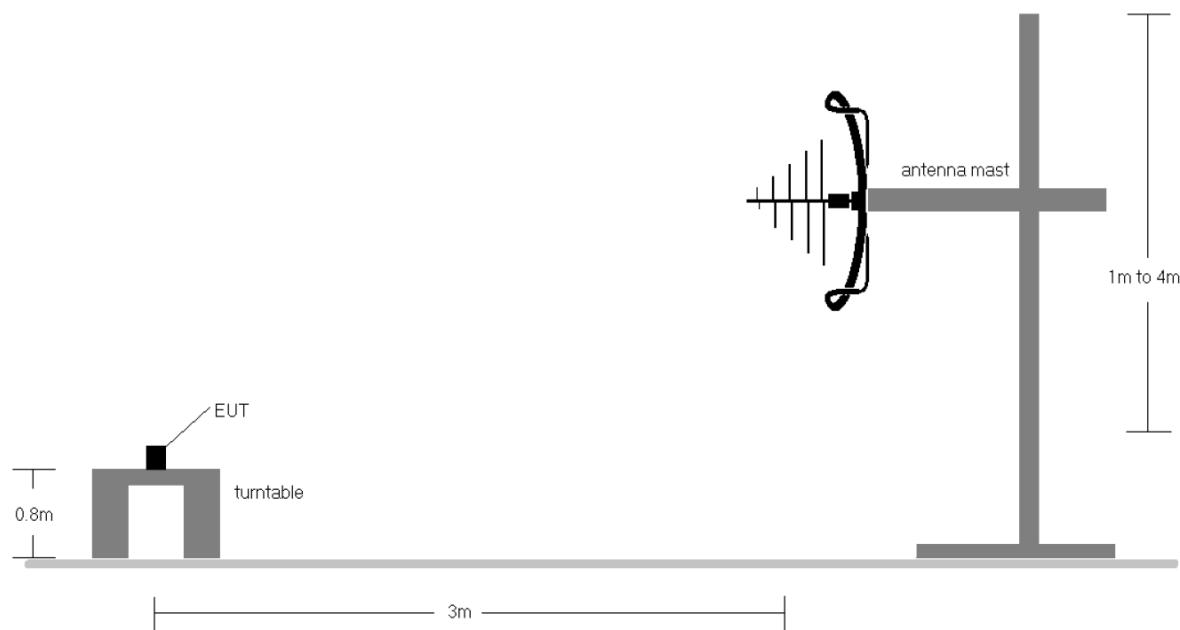
FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

Test Configuration

Below 30 MHz

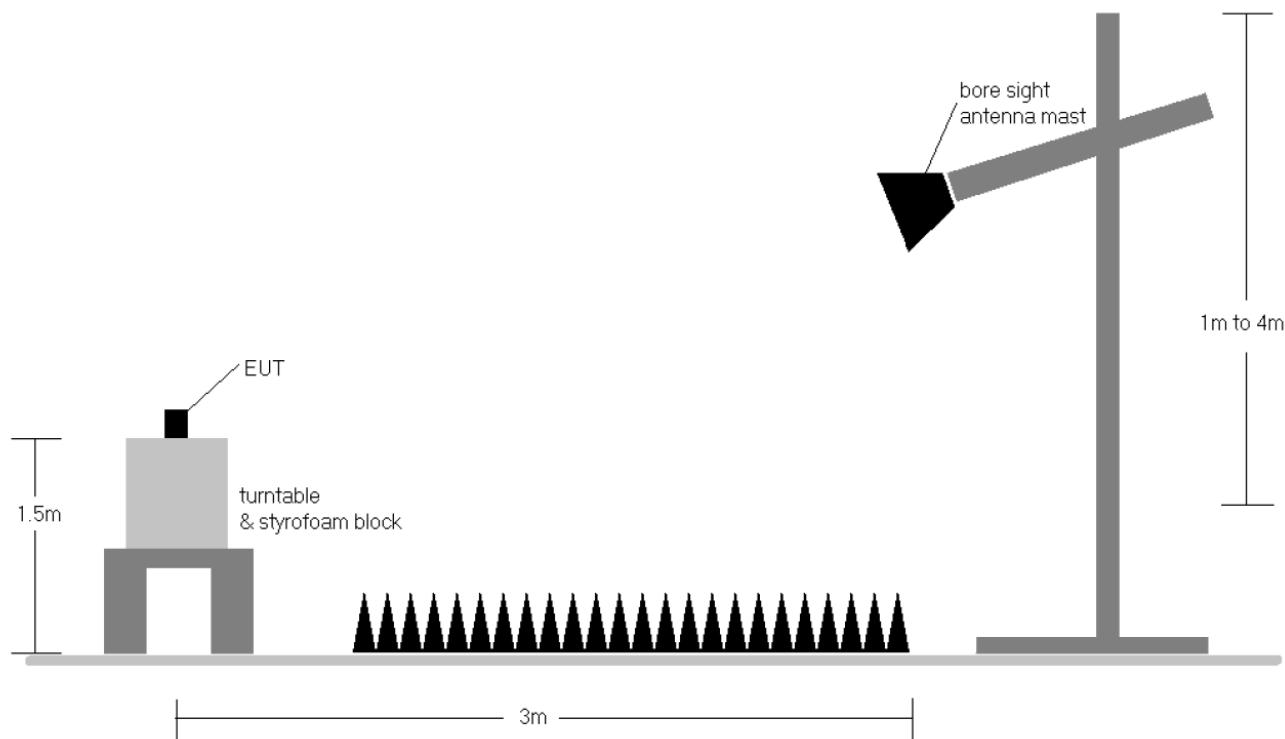


30 MHz - 1 GHz



FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

Above 1 GHz



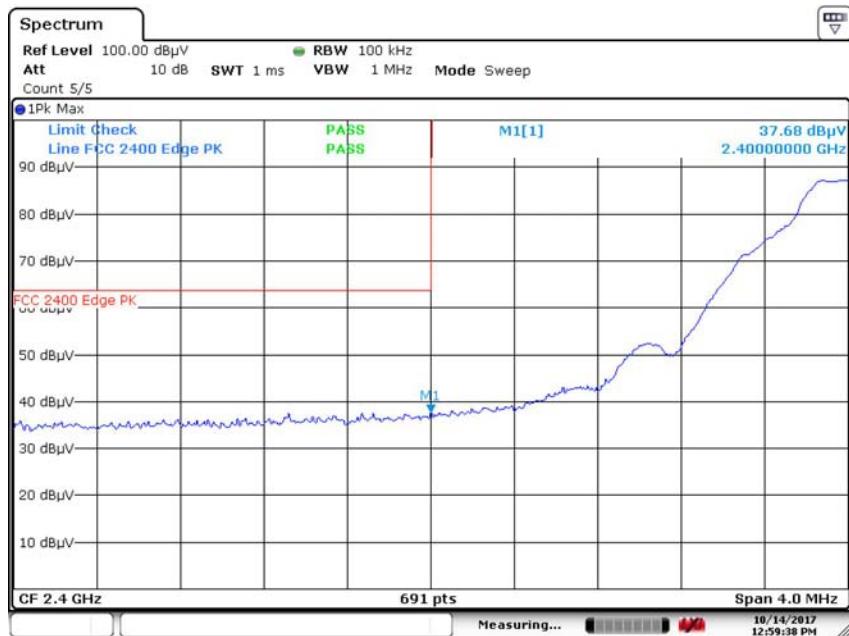
TEST PROCEDURE

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. Spectrum Setting
 - a. Peak Setting 1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 MHz.
 - b. AV Setting 1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 kHz $\geq 1/\tau$ Hz, where τ = pulse width in seconds.

FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

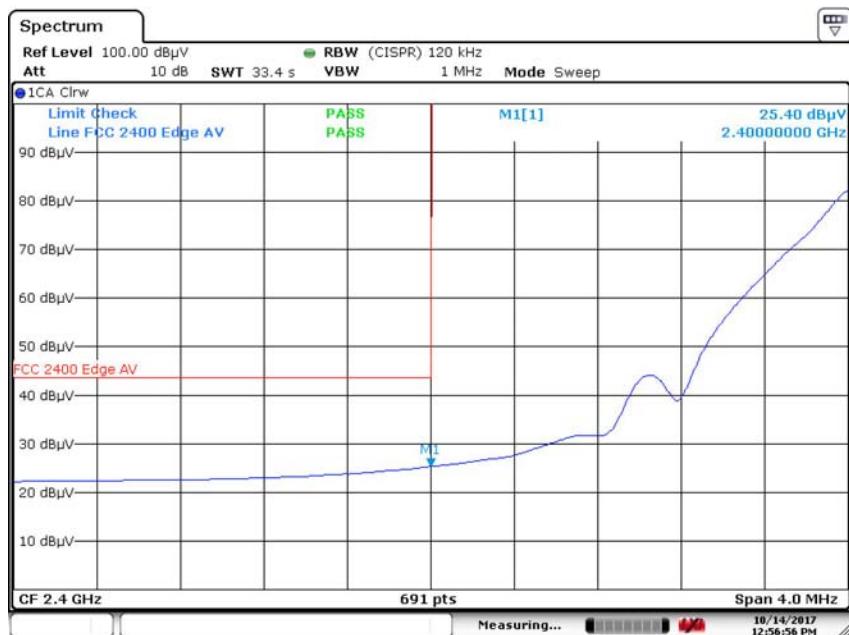
8.3.3 Radiated Band Edge

2402MHz GSFK PK Non-Hopping



Date: 14.OCT.2017 12:59:38

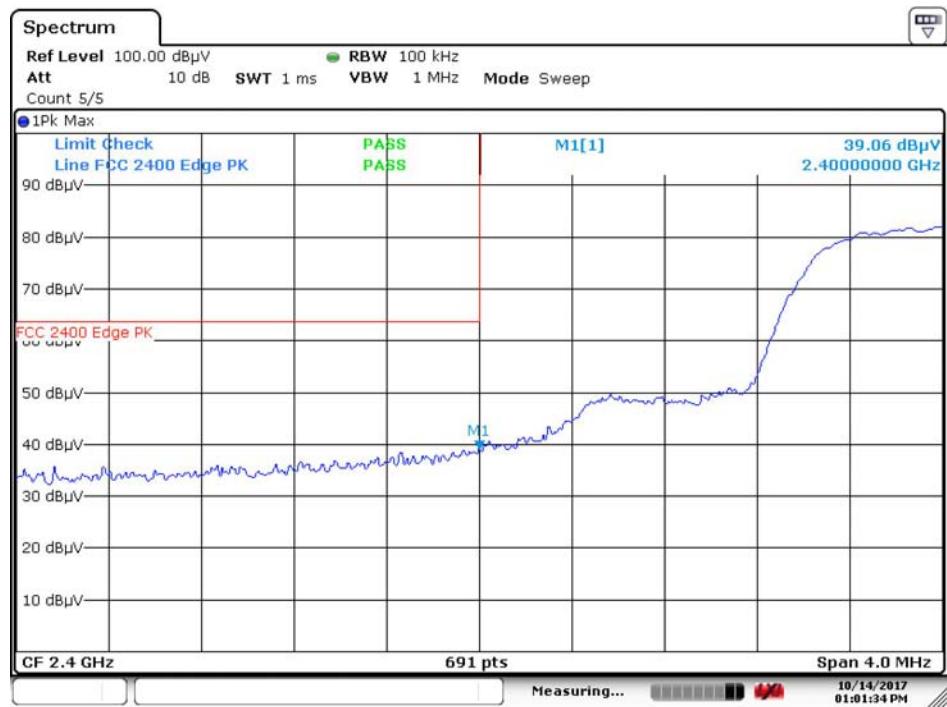
2402 MHz GSFK AVE Non-Hopping



Date: 14.OCT.2017 12:56:56

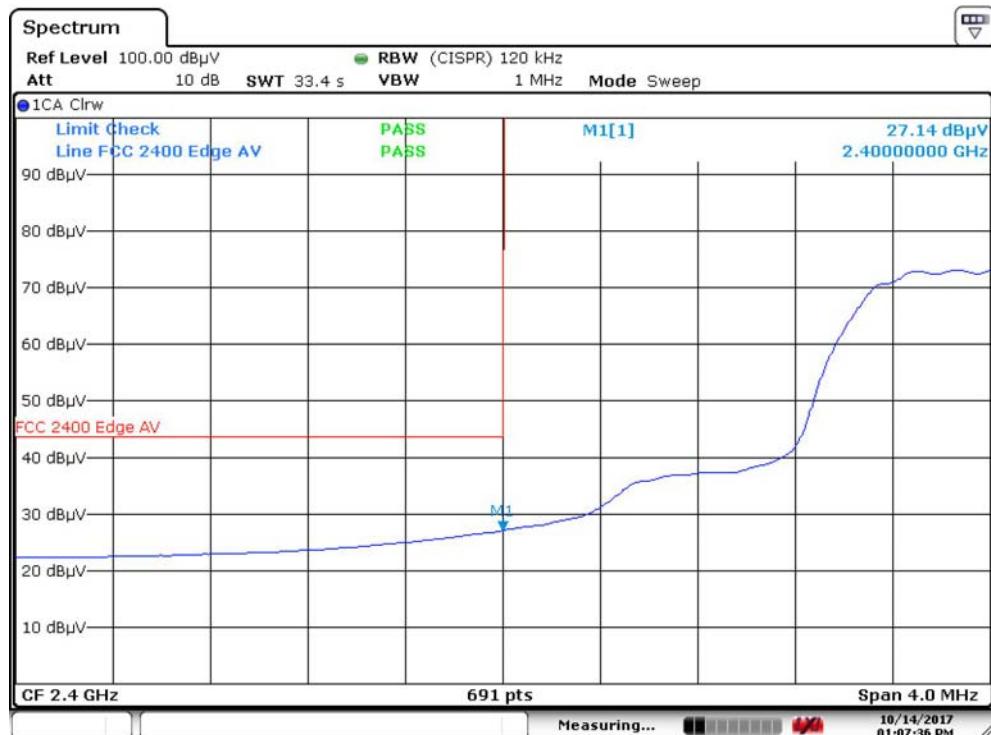
FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

2402 MHz 8DPSK PK Non-Hopping



Date: 14.OCT.2017 13:01:35

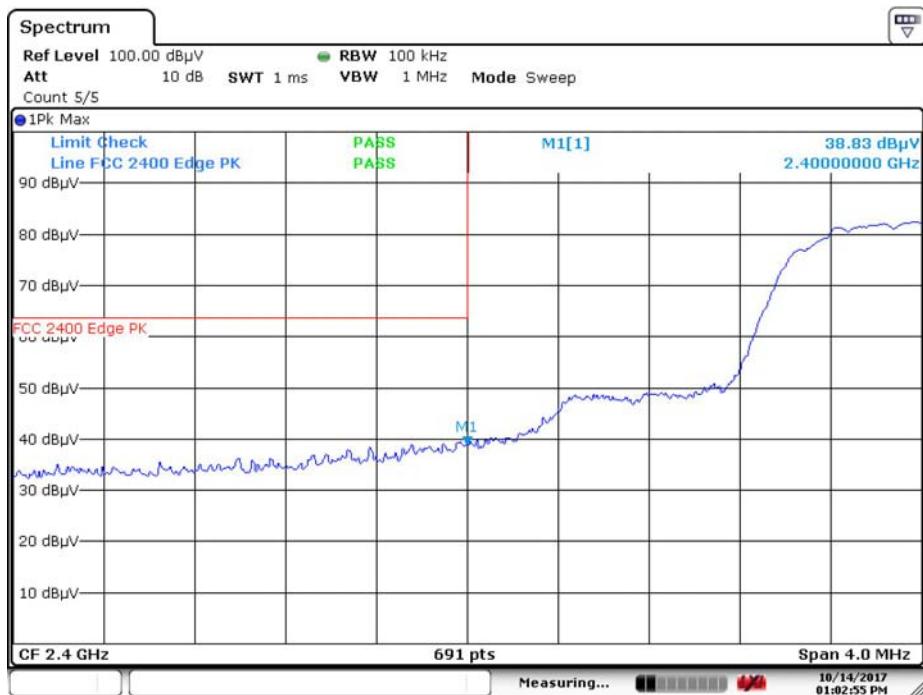
2402 MHz 8DPSK AVE Non-Hopping



Date: 14.OCT.2017 13:07:36

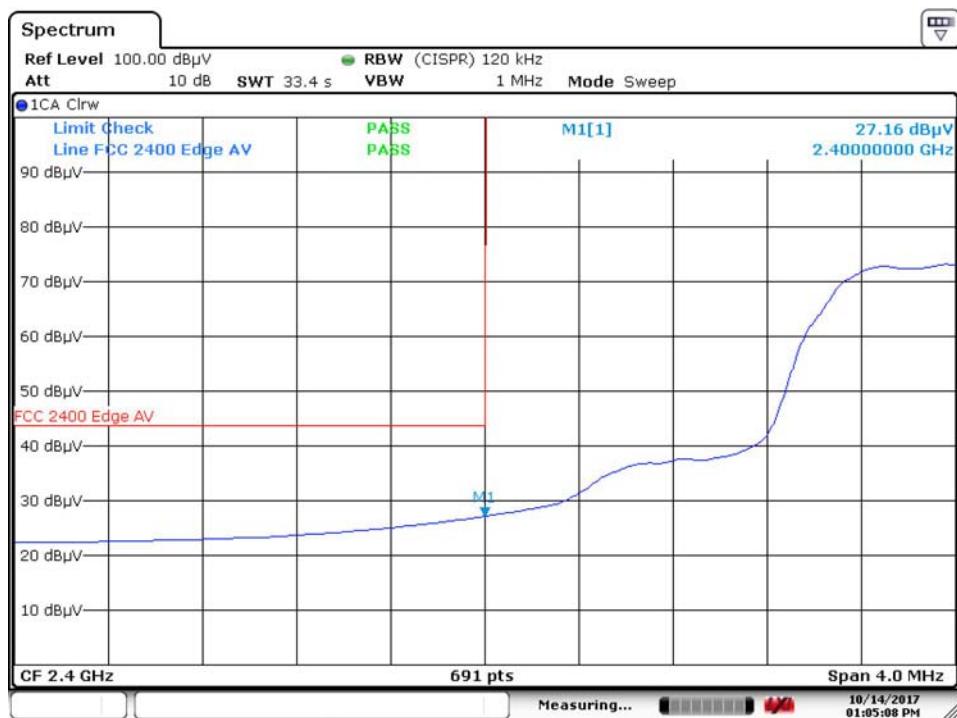
FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

2402 _4DQPSK PK Non-Hopping



Date: 14.OCT.2017 13:02:55

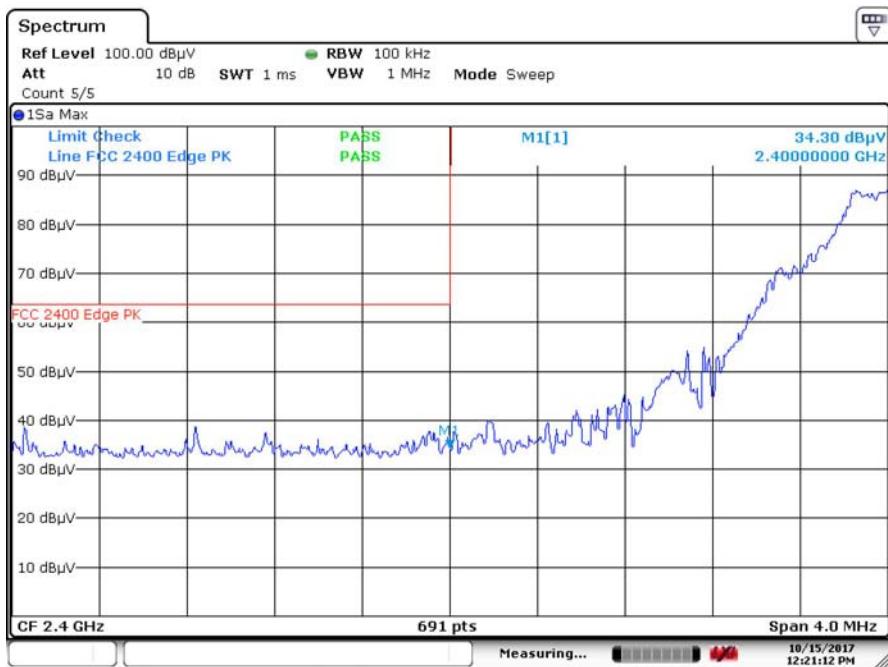
2402 _4DQPSK AVE Non-Hopping



Date: 14.OCT.2017 13:05:08

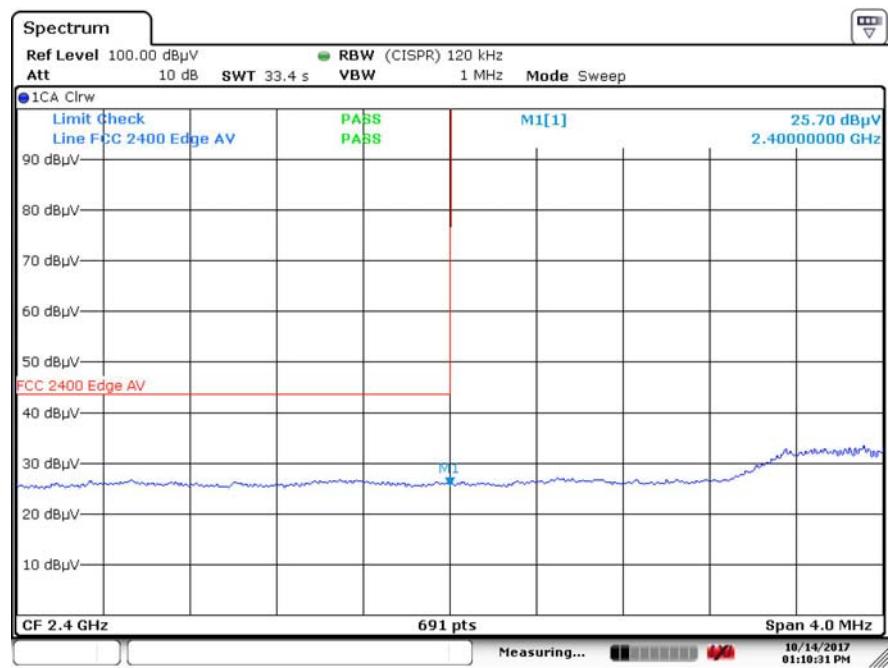
FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

2402 GSFK PK Hopping



Date: 15.OCT.2017 12:21:12

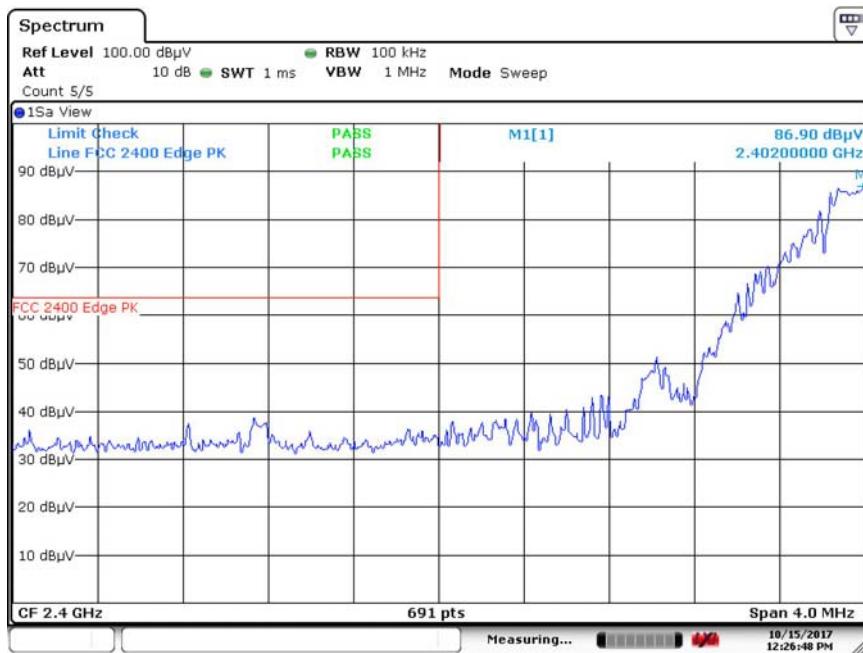
2402 GSFK AVE Hopping



Date: 14.OCT.2017 13:10:31

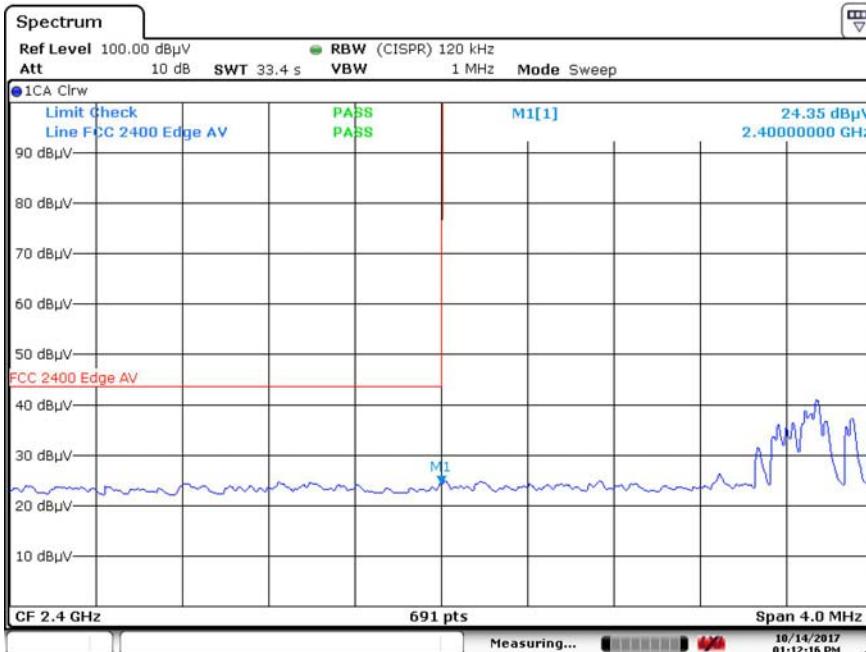
FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

2402 8DPSK PK Hopping



Date: 15.OCT.2017 12:26:48

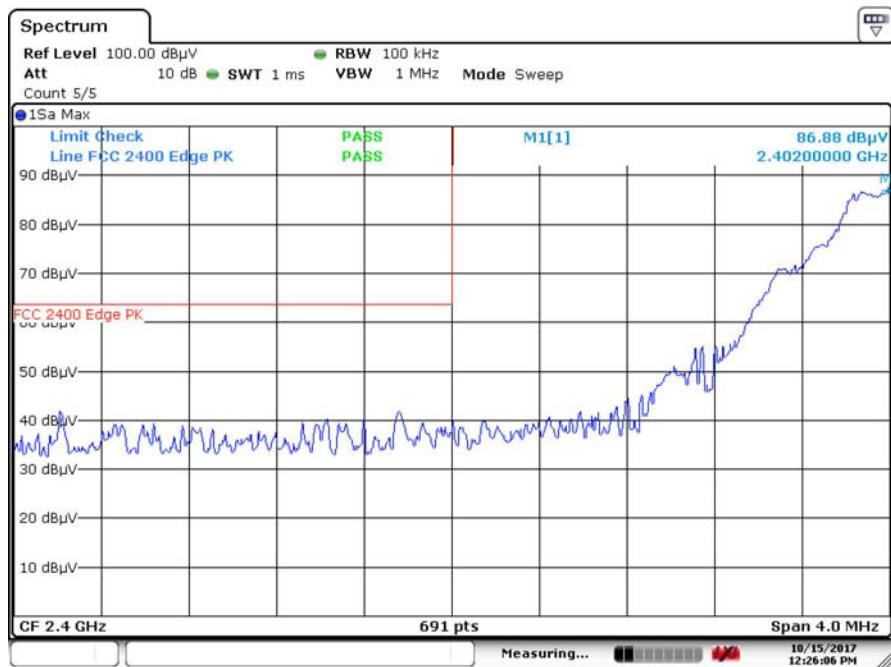
2402 8DPSK AVE Hopping



Date: 14.OCT.2017 13:12:16

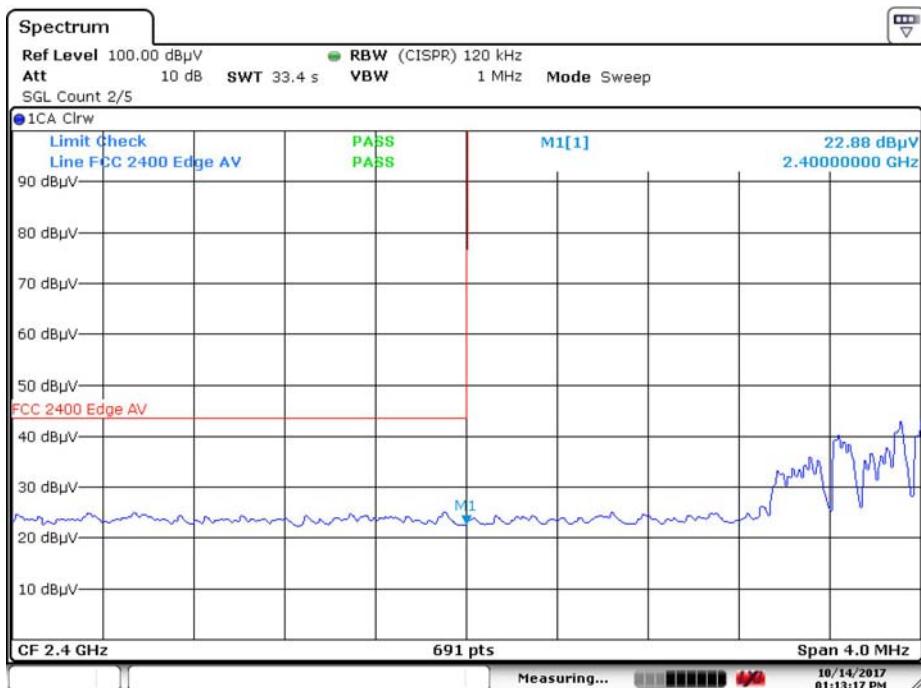
FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

2402 _4DQPSK PK Hopping



Date: 15.OCT.2017 12:26:06

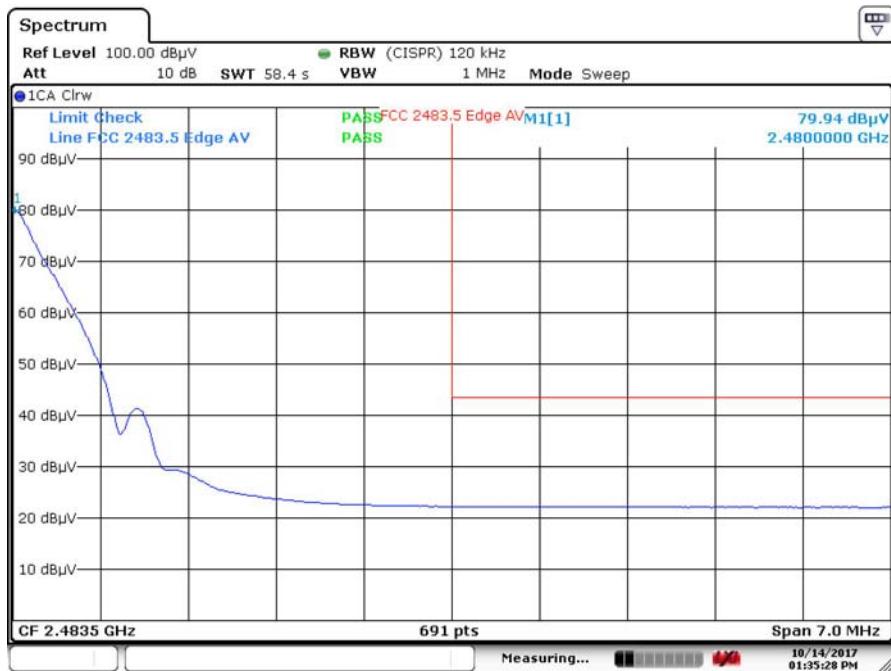
2402 _4DQPSK AVE Hopping



Date: 14.OCT.2017 13:13:17

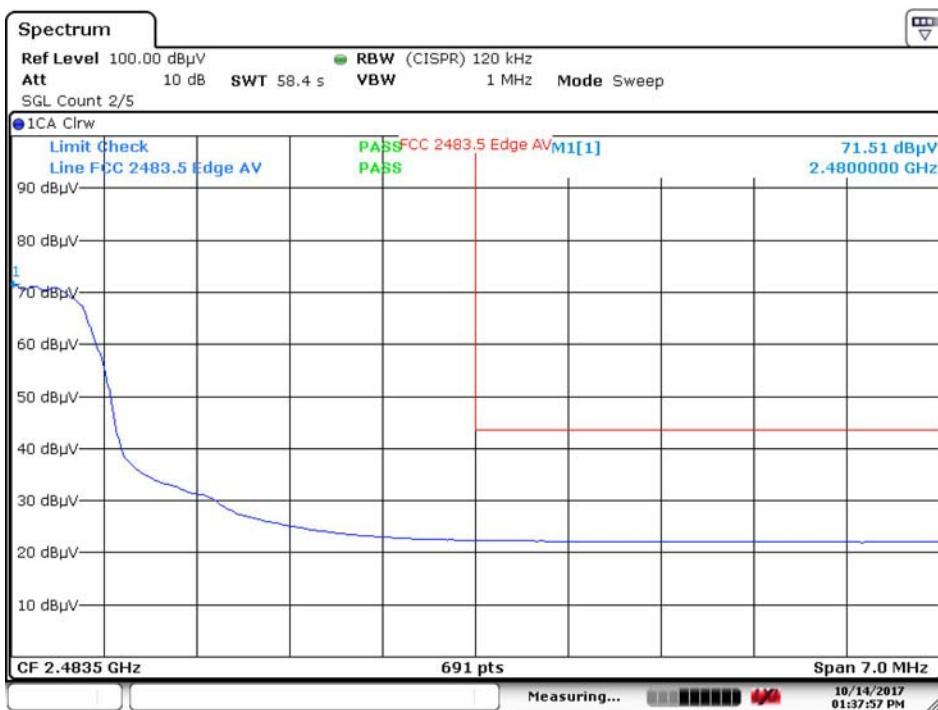
FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

2483.5 GSFK PK Non-Hopping



Date: 14.OCT.2017 13:35:29

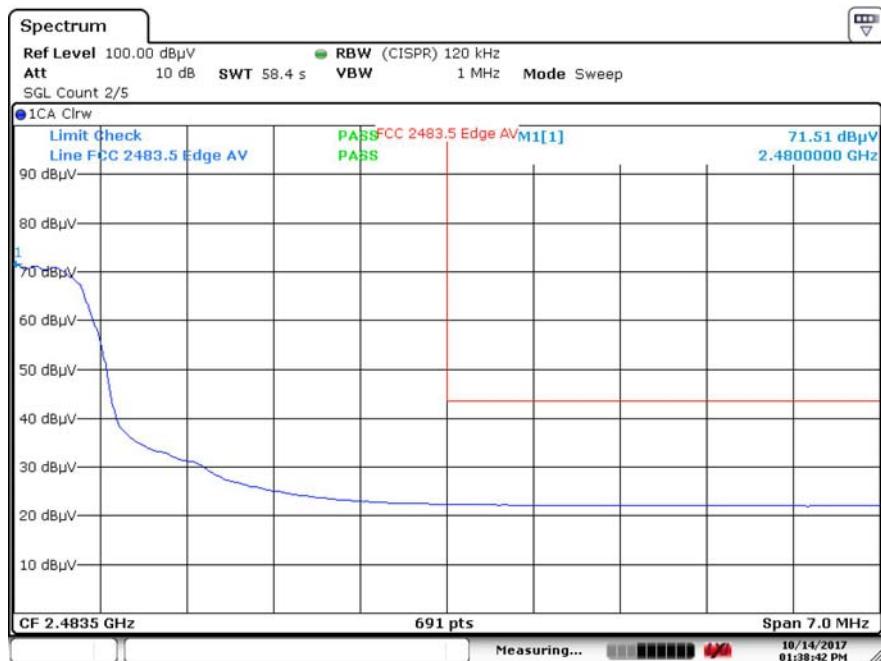
2483.5 GSFK AVE Non-Hopping



Date: 14.OCT.2017 13:37:57

FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

2483.5 8DPSK PK Non-Hopping



Date: 14.OCT.2017 13:38:42

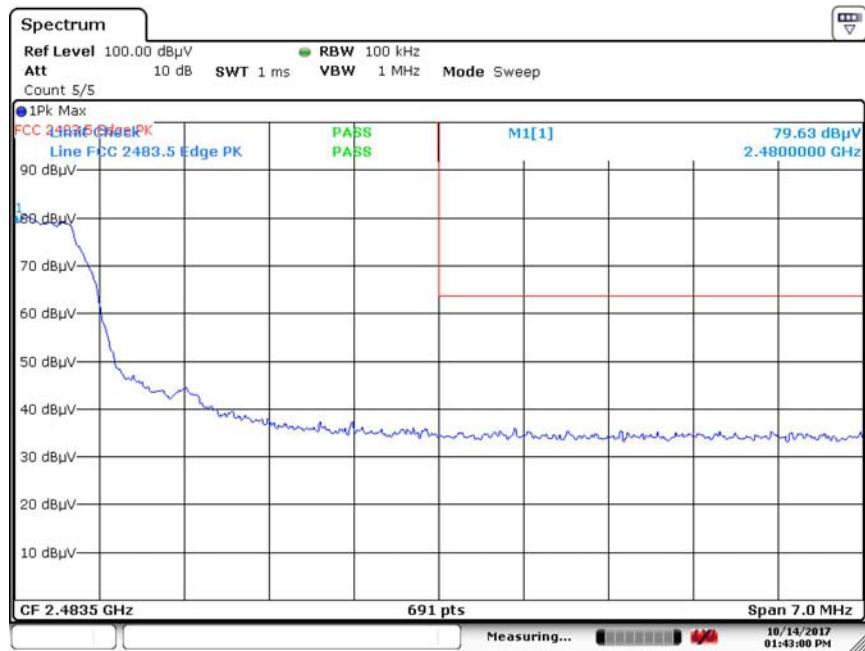
2483.5 8DPSK AVE Non-Hopping



Date: 14.OCT.2017 13:38:42

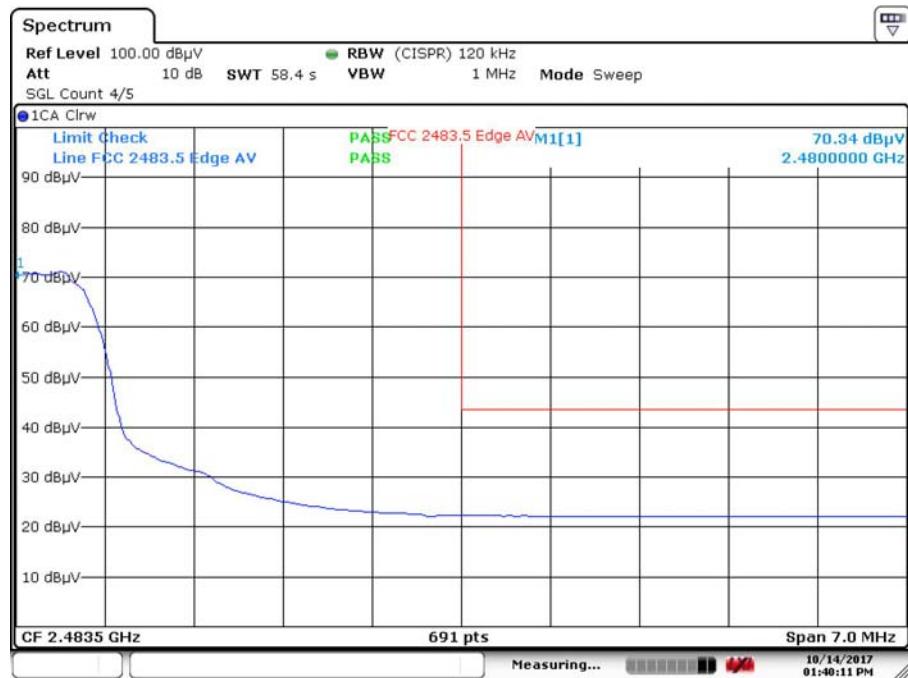
FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

2483.5 _4DQPSK PK Non-Hopping



Date: 14.OCT.2017 13:43:01

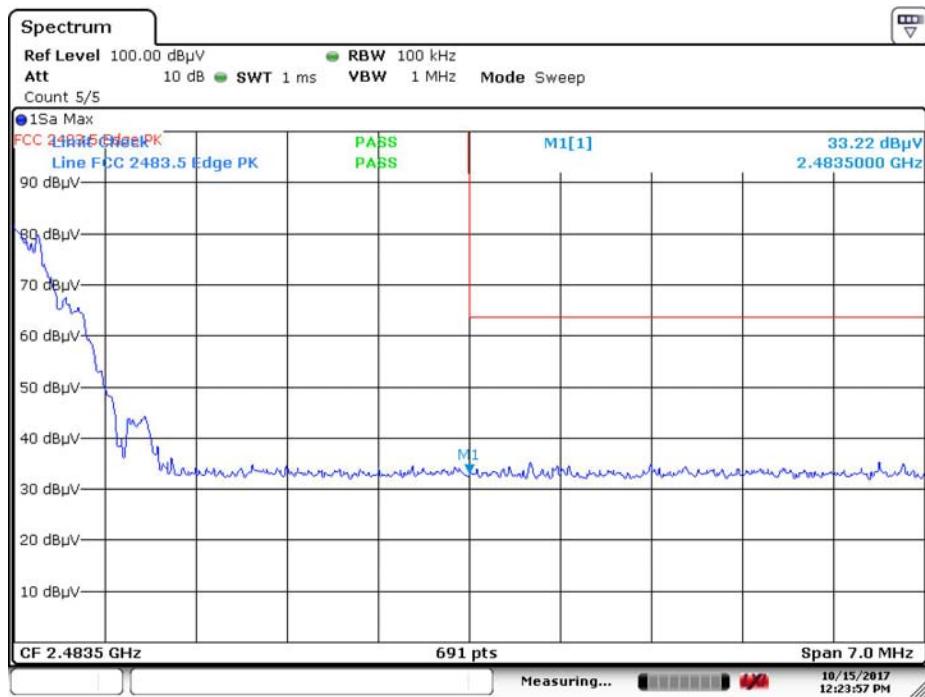
2483.5 _4DQPSK AVE Non-Hopping



Date: 14.OCT.2017 13:40:11

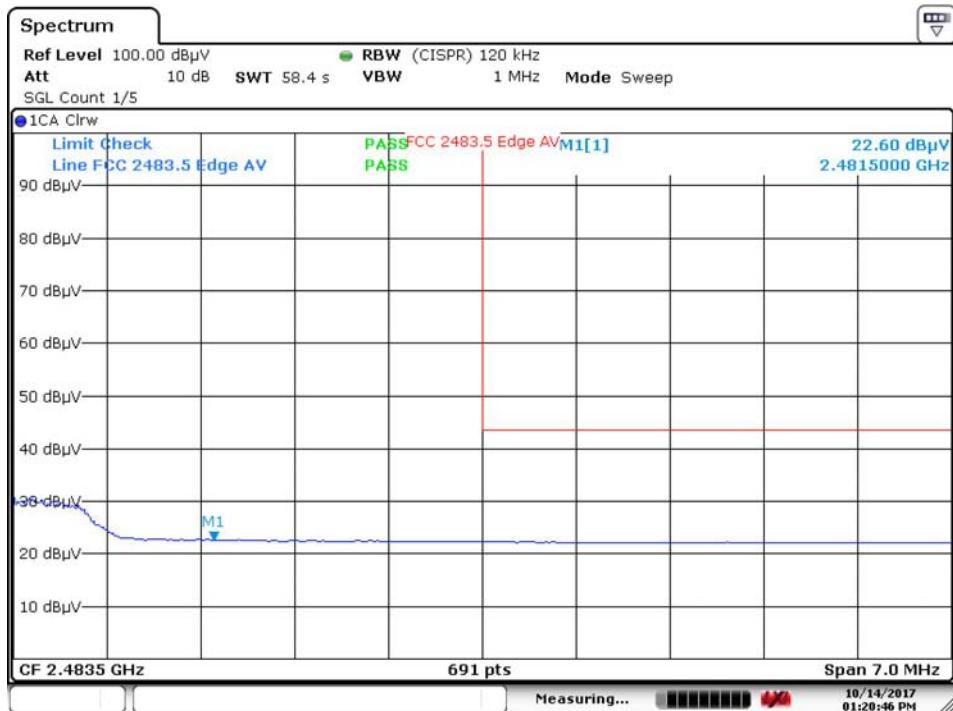
FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

2483.5 GSFK PK Hopping



Date: 15.OCT.2017 12:23:57

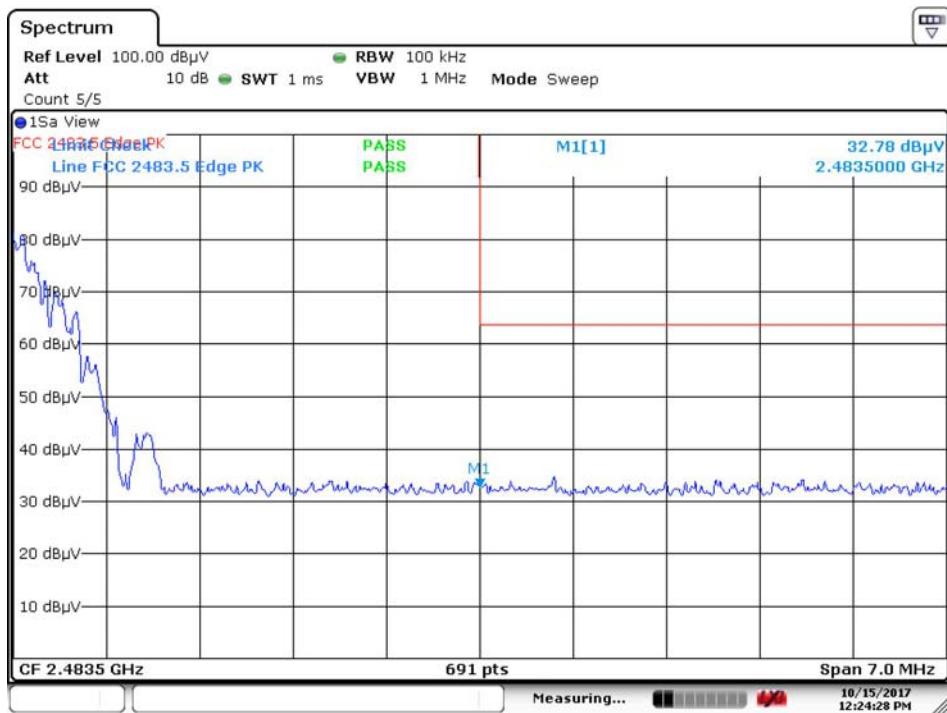
2483.5 GSFK AVE Hopping



Date: 14.OCT.2017 13:20:47

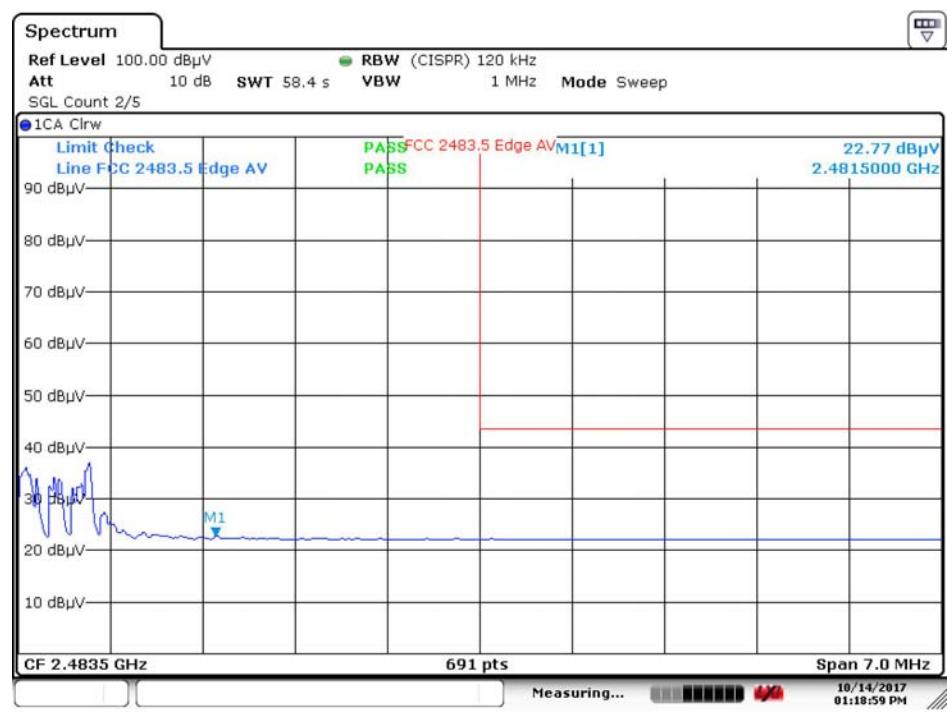
FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

2483.5 8DPSK PK Hopping



Date: 15.OCT.2017 12:24:28

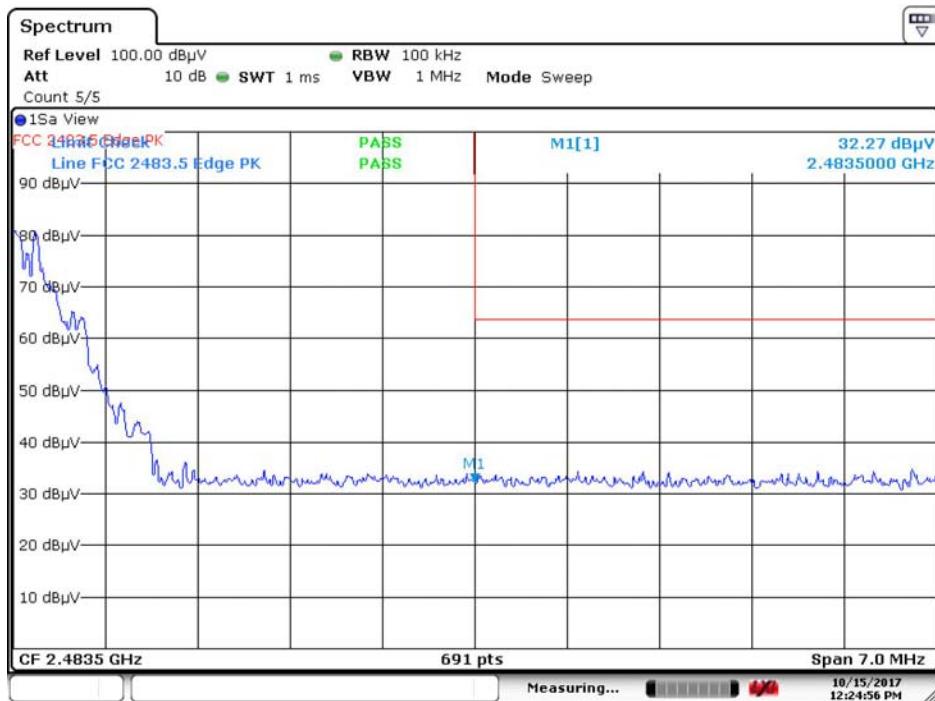
2483.5 8DPSK AVE Hopping



Date: 14.OCT.2017 13:18:59

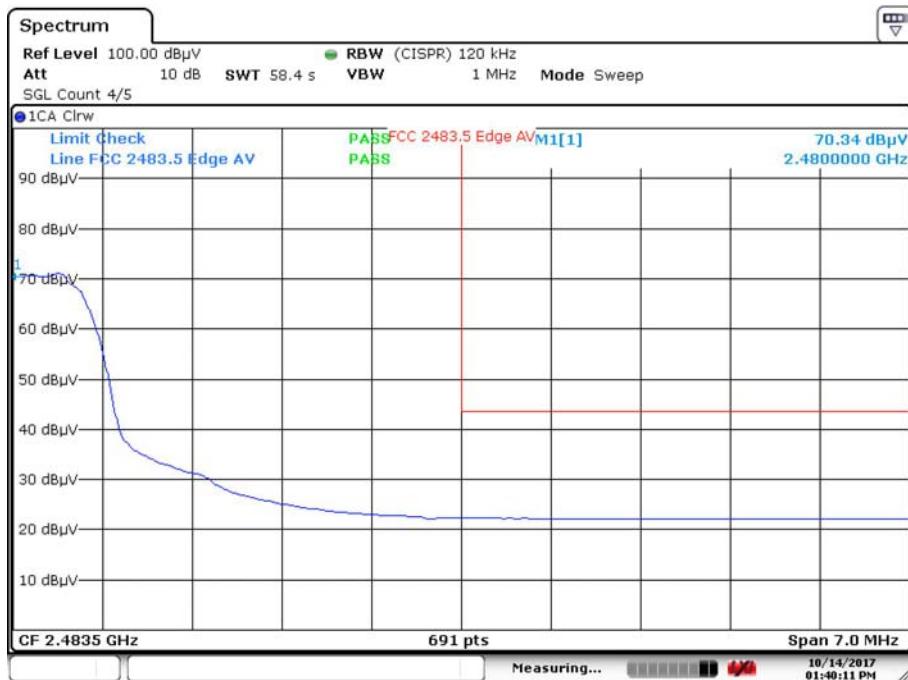
FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

2483.5 _4DQPSK PK Hopping



Date: 15.OCT.2017 12:24:56

2483.5 _4DQPSK AVE Hopping



Date: 14.OCT.2017 13:40:11

FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
Test Report No. 4325-1	Date of Issue: 11/27/2017	EUT : IP Camera	IC : 9637A-809500

RADIATED SPURIOUS EMISSIONS

TEST RESULTS

9 kHz – 30MHz

Operation Mode: Normal Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dB μ V	dB /m	dB	(H/V)	dB μ V/m	dB μ V/m	dB
No Critical peaks found							

Notes:

1. Measuring frequencies from 9 kHz to the 30MHz.
2. The reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
3. Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB)
4. Limit line = specific Limits (dB μ V) + Distance extrapolation factor
5. This test is performed with hopping off.
6. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

TEST RESULTS

Below 1 GHz

Operation Mode: Normal Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dB μ V	dB /m	dB	(H/V)	dB μ V/m	dB μ V/m	dB
No Critical peaks found							

Notes:

1. Measuring frequencies from 30 MHz to the 1 GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.
3. This test is performed with hopping off.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

FCC PT.15.247 TEST REPORT	FCC Part 15.247 Bluetooth Test Report		FCC ID : YM780-9500
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TEST RESULTS

Below 1 GHz

Operation Mode: CH Mid(GFSK)

Frequency (MHz)	Meter dB μ V/m	Corr. Factor	Corr. Reading	Spec	Margin	Detector Type	Polarity	Test Distance
4282	37.45	15.97	53.42	74	-20.58	PK	V	3 Meters
4282	28.59	15.97	44.56	54	-9.44	AVE	V	3 Meters
7323	38.12	20.24	58.36	74	-15.64	PK	H	3 Meters
7323	27.14	20.24	47.38	54	-6.62	AVE	H	3 Meters
4282	36.88	15.97	52.85	74	-21.15	PK	V	3 Meters
4282	30.29	15.97	46.26	54	-7.74	AVE	V	3 Meters
7323	34.50	20.24	54.74	74	-19.26	PK	H	3 Meters
7323	28.11	20.24	48.35	54	-5.65	AVE	H	3 Meters

Operation Mode: CH Mid(8DPSK)

Frequency (MHz)	Meter dB μ V/m	Corr. Factor	Corr. Reading	Spec	Margin	Detector Type	Polarity	Test Distance
4282	38.24	15.97	54.21	74	-19.79	PK	V	3 Meters
4282	30.16	15.97	46.13	54	-7.87	AVE	V	3 Meters
7323	36.82	20.24	57.06	74	-16.94	PK	H	3 Meters
7323	29.30	20.24	49.54	54	-4.46	AVE	H	3 Meters
4282	36.88	15.97	52.85	74	-21.15	PK	V	3 Meters
4282	30.29	15.97	46.26	54	-7.74	AVE	V	3 Meters
7323	34.50	20.24	54.74	74	-19.26	PK	H	3 Meters
7323	28.11	20.24	48.35	54	-5.65	AVE	H	3 Meters

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Operation Mode: CH Mid(π /4DQPSK)

Frequency (MHz)	Meter dB μ V/m	Corr. Factor	Corr. Reading	Spec	Margin	Detector Type	Polarity	Test Distance
4282	39.33	15.97	55.30	74	-18.70	PK	V	3 Meters
4282	27.81	15.97	43.78	54	-10.22	AVE	V	3 Meters
7323	36.94	20.24	57.18	74	-16.82	PK	H	3 Meters
7323	28.01	20.24	48.25	54	-5.75	AVE	H	3 Meters
4282	34.62	15.97	50.59	74	-23.41	PK	V	3 Meters
4282	31.38	15.97	47.35	54	-6.65	AVE	V	3 Meters
7323	36.95	20.24	57.19	74	-16.81	PK	H	3 Meters
7323	27.99	20.24	48.23	54	-5.77	AVE	H	3 Meters

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000 MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain
5. Spectrum setting:
 - a. Peak Setting 1 GHz – 26 GHz, RBW = 1 MHz, VBW = 3 MHz.
 - b. AV Setting 1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 kHz $\geq 1/\tau$ Hz, where τ = pulse width in seconds.
We performed using a reduced video BW method was done with the analyzer in linear mode.
6. We have done Normal Mode and EDR Mode test.
7. This test is performed with hopping off.
8. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

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8.3.4 RADIATED RESTRICTED BAND EDGES

Test Requirements and limit, §15.247(d), §15.205, §15.209

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a) (See section 15.205(c)).

Operation Mode	Normal(GFSK)
Operating Frequency	2402 MHz
Channel No	CH 0

Frequency (MHz)	Meter dB μ V/m	Corr. Factor	Corr. Reading	Spec	Margin	Detector Type	Polarity	Test Distance
2390.0	34.54	10.37	44.91	74	-29.09	PK	V	3 Meters
2390.0	27.34	10.37	37.71	54	-16.29	AVE	V	3 Meters
2390.0	33.98	10.37	44.35	74	-29.65	PK	H	3 Meters
2390.0	27.12	10.37	37.49	54	-16.51	AVE	H	3 Meters
2483.5	33.46	10.50	43.96	74	-30.04	PK	V	3 Meters
2483.5	29.05	10.50	39.55	54	-14.45	AVE	V	3 Meters
2483.5	34.09	10.50	44.59	74	-29.41	PK	H	3 Meters
2483.5	27.15	10.50	37.65	54	-16.35	AVE	H	3 Meters

Operation Mode	EDR(8DPSK)
Operating Frequency	2402 MHz
Channel No	CH 0

Frequency (MHz)	Meter dB μ V/m	Corr. Factor	Corr. Reading	Spec	Margin	Detector Type	Polarity	Test Distance
2390.0	35.19	10.37	45.56	74	-28.44	PK	V	3 Meters
2390.0	28.01	10.37	38.38	54	-15.62	AVE	V	3 Meters
2390.0	34.77	10.37	45.14	74	-28.86	PK	H	3 Meters
2390.0	27.59	10.37	37.96	54	-16.04	AVE	H	3 Meters
2483.5	33.62	10.50	44.12	74	-29.88	PK	V	3 Meters
2483.5	28.98	10.50	39.48	54	-14.52	AVE	V	3 Meters
2483.5	33.76	10.50	44.26	74	-29.74	PK	H	3 Meters
2483.5	27.75	10.50	38.25	54	-15.75	AVE	H	3 Meters

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Operation Mode	EDR($\pi/4$ DQPSK)
Operating Frequency	2402 MHz
Channel No	CH 0

Frequency (MHz)	Meter dB μ V/m	Corr. Factor	Corr. Reading	Spec	Margin	Detector Type	Polarity	Test Distance
2390.0	36.74	10.37	47.11	74	-26.89	PK	V	3 Meters
2390.0	27.35	10.37	37.72	54	-16.28	AVE	V	3 Meters
2390.0	35.09	10.37	45.46	74	-28.54	PK	H	3 Meters
2390.0	28.12	10.37	38.49	54	-15.51	AVE	H	3 Meters
2483.5	35.33	10.50	45.83	74	-28.17	PK	V	3 Meters
2483.5	28.25	10.50	38.75	54	-15.25	AVE	V	3 Meters
2483.5	34.02	10.50	44.52	74	-29.48	PK	H	3 Meters
2483.5	28.03	10.50	38.53	54	-15.47	AVE	H	3 Meters

Notes:

- 1.. Frequency range of measurement = 2310 MHz ~ 2390 MHz
2. Total = Fundamental Reading Value + Antenna Factor + Cable Loss
3. Spectrum setting:
 - a. Peak Setting 1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 MHz.
 - b. AV Setting 1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 kHz $\geq 1/\tau$ Hz, where τ = pulse width in seconds.

We performed using a reduced video BW method was done with the analyzer in linear mode.
4. We have done Normal Mode and EDR Mode.
5. This test is performed with hopping off.
6. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna

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8.4 POWERLINE CONDUCTED EMISSIONS

LIMIT

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolt (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dB μ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

Test Configuration

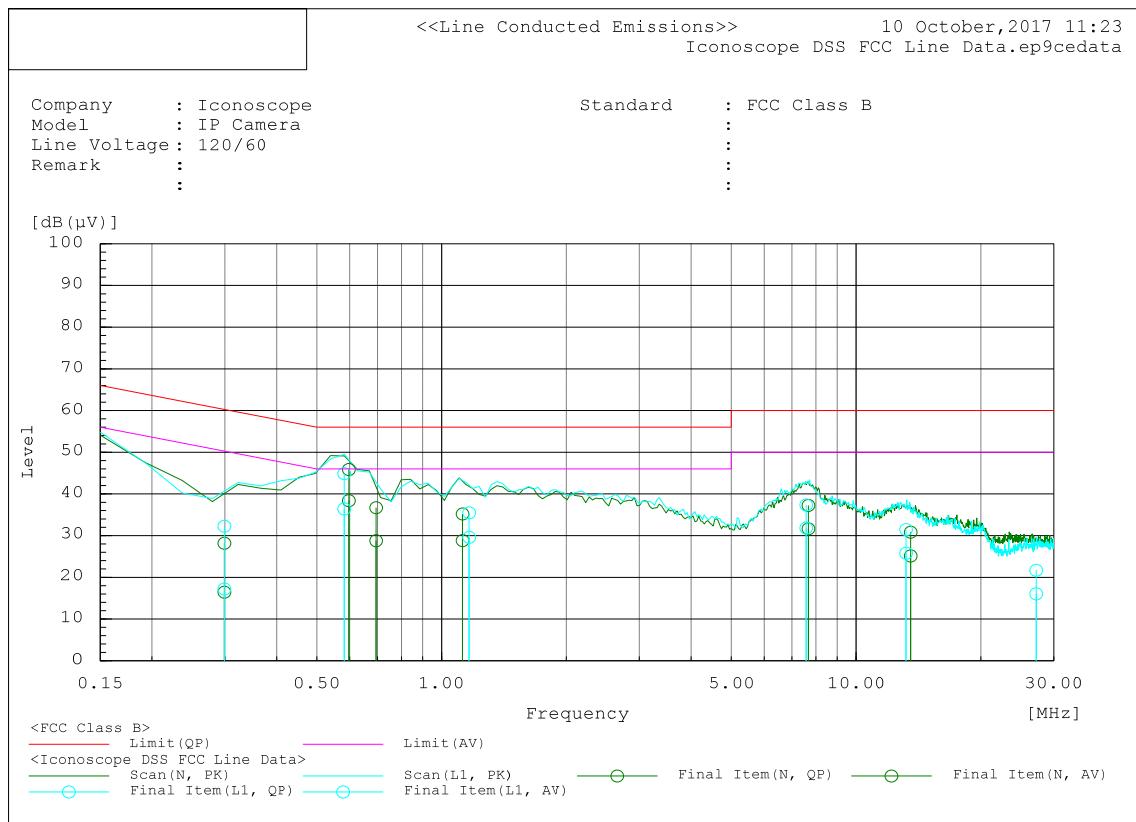
See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

TEST PROCEDURE

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors – Quasi Peak and Average Detector.
5. This test is performed with hopping on and EUT in 8DPSK modulation (worst case).

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Frequency MHz	Line	Reading dB(µV)		Factor dB	Level dB(µV)		Limit dB(µV)		Margin dB		Pass/Fail
		QP	AV		QP	AV	QP	AV	QP	AV	
		22.2	7.2	10	32.2	17.2	60.3	50.3	28.1	33.1	Pass
0.299	L1	22.2	7.2	10	32.2	17.2	60.3	50.3	28.1	33.1	Pass
0.582	L1	34.9	26	10	44.9	36.4	56	46	11.1	9.6	Pass
1.165	L1	25.4	20	10.1	35.5	29.6	56	46	20.5	16.4	Pass
7.576	L1	27	21	10.4	37.4	31.8	60	50	22.6	18.2	Pass
13.197	L1	20.9	15	10.6	31.5	25.8	60	50	28.5	24.2	Pass
27.192	L1	10.9	5.2	10.8	21.7	16	60	50	38.3	34	Pass
0.299	N	18.2	6.5	10	28.2	16.5	60.3	50.3	32.1	33.8	Pass
0.597	N	35.8	28	10	45.8	38.4	56	46	10.2	7.6	Pass
0.695	N	26.6	19	10.1	36.7	28.8	56	46	19.3	17.2	Pass
1.123	N	25.1	19	10.1	35.2	28.8	56	46	20.8	17.2	Pass
7.675	N	26.9	21	10.4	37.3	31.6	60	50	22.7	18.4	Pass
13.538	N	20.2	15	10.6	30.8	25.1	60	50	29.2	24.9	Pass



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9. LIST OF TEST EQUIPMENT

Manufacturer	Model / Equipment	Calibration Interval	Calibration Due	Serial No.
Omega	IBTHXBP / Temp & Humidity Meter	Annual	07/08/2018	14490199
Fluke	87 / DMM	Annual	07/28/2018	64920001
ETS	EmPower / Power Sensor	Annual	08/09/2018	141000-48SNO051
EMCO	3816-2 / LISN	Annual	08/12/2018	9809-1089
Rohde & Schwarz	FSV40 / Spectrum Analyzer	Annual	07/20/2018	101424
Sunol Sciences	JB6 / Bi-Conilog Antenna	Annual	07/08/2018	A042610
A.H. Systems	SAS- 571 / Horn Antenna	Annual	07/13/2018	236

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