



FCC / ISED DFS Client Test Report

FOR:

Axon Enterprise, Inc.

Model Name:

Axon Body 3

Product Description:

Body Worn Camera

FCC ID: X4GS01200

IC: 8803A-S01200

Applied Rules and Standards:

47 CFR Part 15.407 (UNII)

RSS-247 Issue 2 (DTSS)

REPORT #: EMC_AXONN-006-19001_15.407_DFS

DATE: 2020-02-27



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1 Assessment

The following device was evaluated against the applicable DFS criteria specified in FCC rules Parts 15.407 of Title 47 of the Code of Federal Regulations and the relevant ISED Canada standard RSS-247.

No deviations were ascertained.

Company	Description	Marketing Name	Model #
Axon Enterprise, Inc.	Body Worn Camera	Axon Body 3	AX1023

Responsible for Testing Laboratory:

2020-02-27	Compliance	Cindy Li (EMC Lab Manager)	
Date	Section	Name	Signature

Responsible for the Report:

2020-02-27	Compliance	Kevin Wang (Senior EMC Engineer)	
Date	Section	Name	Signature

The test results of this test report relate exclusively to the test item specified in Section 3.

CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Street Address:	411 Dixon Landing Road
City/Zip Code	Milpitas, CA 95035
Country	USA
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
EMC Lab Manager:	Cindy Li
Responsible Project Leader:	Sangeetha Sivaraman

2.2 Identification of the Client

Applicant's Name:	Axon Enterprise, Inc.
Street Address:	17800 N 85th St.
City/Zip Code	Scottsdale, AZ / 85255
Country	USA

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as Applicant
Manufacturers Address:	-----
City/Zip Code	-----
Country	-----

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Marketing Name:	Axon Body 3	
Model No:	AX1023	
HW Version :	Rev B	
SW Version :	1.2	
FCC-ID :	X4G01200	
IC-ID:	8803A-S01200	
FWIN:	N/A	
HVIN:	AX1023	
PMN:	Axon Body 3	
Product Description:	Body Worn Camera, with Wi-Fi 802.11a/b/g/n40/ac80, Bluetooth Classis + BLE, Passive NFC TAG, LTE, 3G Fallback support, GPS/GLONASS Receiver Model AX1023 has Sierra Wireless WP7610	
Frequency Range / number of channels:	Frequency Range (MHz)	Channel Number
	5150-5250	36-48 [4]
	5250-5350	52-64[4]
	5470-5725	100-144 [12]
	5725-5850	149-165 [5]
Modes of Operation / Channel Bandwidths:	IEEE Std. 802.11(xxxx)	Data Rate / MCS
	a	6-54 Mbps
	n: HT20 & HT40	MCS 0-7; MCS 8-15
	ac: VHT20; VHT40; VHT80	MCS 0-9
Transmit Chains(N_{TX})	1	
Type(s) of Modulation:	OFDM	
Antenna Information as declared:	Refer to section 3.6 for more information	
Max. Output Power:	Conducted Power 19.28dBm @CH144	
DFS Operation Mode:	Client without Radar Detection	
Power Supply/ Rated Operating Voltage Range:	Rechargeable Battery Vmin: 3.4 VDC/ Vnom: 3.8 VDC / Vmax: 4.3 VDC	
Operating Temperature Range	-20° to 50° C	

Other Radios included in the device:	Bluetooth Basic / EDR: GFSK, $\pi/4$ DQPSK, 8DPSK Bluetooth 4.0 Low Energy (BT LE) GPS, Qualcomm WGR7640 UMTS/LTE, Sierra Wireless WP7610
Sample Revision	<input type="checkbox"/> Prototype Unit; <input checked="" type="checkbox"/> Production Unit; <input type="checkbox"/> Pre-Production

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	X6039C80L	-----	-----	FCC#2

3.3 Accessory Equipment (AE) details

AE #	Type	Model	Manufacturer	Serial Number
1	-----	-----	-----	-----

3.4 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#1	An Access Point was used as the DFS host device. The EUT was declared as Client Without Radar Detection.

3.5 Justification for Worst Case Mode of Operation

Since the EUT was Client without Radar Detection, only one channel was used for the test.

3.6 Antenna Gain provided by the Customer

Frequency (MHz)	2400	2420	2440	2460	2480
Antenna Gain (dBi)	2.01	2.9	2.81	3.4	3.22

Frequency (MHz)	5150	5200	5250	5300	5350	5400	5450	5500	5550	5600	5650	5700	5750	5800	5850
Antenna Gain (dBi)	2.93	2.63	3.02	3.25	3.58	3.94	3.85	4.11	3.96	4.14	4.1	4.13	3.57	3.29	3.58

3.7 Power Setting Table

	CH36 - CH 64		CH100 - CH 144		CH149 - CH165
a	17		17		17
n20	17		17		17

	CH38	CH46	CH54	CH62		CH102	CH110	CH118	CH126	CH134	CH142		CH151	CH159
n40	14	17	17	12.5		12.5	17	17	17	17	17		17	17

	CH42	CH58		CH106	CH122	CH138		CH155
ac80	14.5	13		13	17	17		17

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to assess the DFS performance of the EUT according to the relevant requirements specified in FCC rules Part 15.407 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-247 of ISED Canada.

This test report is to support a request for new equipment authorization under the:

- FCC ID: X4GS01200
- IC: 8803A-S01200

5 Measurement Results Summary

The tests in this section are run sequentially and the EUT must pass all tests successfully. If the EUT fails any one of the tests it will count as a failure of compliance. To show compliance, all tests must be performed with waveforms randomly generated as specified with test results meeting the required percentage of successful detection criteria. All test results must be reported to the FCC. One frequency will be chosen from the operating Channels of the UUT within the 5250-5350 MHz or 5470-5725 MHz bands.

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	NA	NP	Result
§15.407(h) RSS-247 6.3	U-NII Detection Bandwidth	Nominal	-	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Note 2
§15.407(h) RSS-247 6.3	Performance Requirements Check	Nominal	-	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Note 2
§15.407(h) RSS-247 6.3	In Service Monitoring	Nominal	802.11n / HT20	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Complies
§15.407(h) RSS-247 6.3	Statistical Performance Check	Nominal	-	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Note 2

Note 1: NA= Not Applicable; NP= Not Performed.

Note 2: The EUT is a client device without radar detection.

6 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor k=1.

Radiated measurement

1 GHz to 40 GHz ± 2.3 dB (Horn Antenna)

Conducted measurement

RF conducted measurement ± 0.5 dB

According to TR 102 273 a multiplicative propagation of error is assumed for RF measurement systems. For this reason the RMS method is applied to dB values and not to linear values as appropriate for additive propagation of error. Also used: <http://physics.nist.gov/cuu/Uncertainty/typeb.html>. The above calculated uncertainties apply to direct application of the Substitution method. The Substitution method is always used when the EUT comes closer than 3 dB to the limit.

6.1 Environmental Conditions during Testing:

The following environmental conditions were maintained during the course of testing:

- Ambient Temperature: 20-25° C
- Relative humidity: 40-60%

6.2 Dates of Testing:

02/11/2020 - 02/12/2020

7 DFS Requirements in the 5250-5350 MHz and 5470-5725 MHz Bands

The test methods used for this DFS functionality evaluation are based on FCC 905462 D02 UNII DFS Compliance Procedures New Rules v02

A U-NII network will employ a DFS function to detect signals from radar systems and to avoid co-channel operation with these systems. This applies to the 5250-5350 MHz and/or 5470-5725 MHz bands

7.1 Applicability of DFS Requirements Prior to Use of a Channel

Requirement	Operational Mode		
	Master	Client Without Radar Detection	Client With Radar Detection
<i>Non-Occupancy Period</i>	Yes	Not required	Yes
<i>DFS Detection Threshold</i>	Yes	Not required	Yes
<i>Channel Availability Check Time</i>	Yes	Not required	Not required
<i>U-NII Detection Bandwidth</i>	Yes	Not required	Yes

7.2 Applicability of DFS requirements during normal operation

Requirement	Operational Mode	
	Master Device or Client With Radar Detection	Client Without Radar Detection
<i>DFS Detection Threshold</i>	Yes	Not required
<i>Channel Closing Transmission Time</i>	Yes	Yes
<i>Channel Move Time</i>	Yes	Yes
<i>U-NII Detection Bandwidth</i>	Yes	Not required

Additional requirements for devices with multiple bandwidth modes	Master Device or Client With Radar Detection	Client Without Radar Detection
<i>U-NII Detection Bandwidth and Statistical Performance Check</i>	All BW modes must be tested	Not required
<i>Channel Move Time and Channel Closing Transmission Time</i>	Test using widest BW mode available	Test using the widest BW mode available for the link
<i>All other tests</i>	Any single BW mode	Not required

Note: Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in each of the bonded 20 MHz channels and the channel center frequency.

7.3 DFS Detection Thresholds for Master Devices and Client Devices with Radar Detection

Maximum Transmit Power	Value (See Notes 1, 2, and 3)
EIRP \geq 200 milliwatt	-64 dBm
EIRP < 200 milliwatt and power spectral density < 10 dBm/MHz	-62 dBm
EIRP < 200 milliwatt that do not meet the power spectral density requirement	-64 dBm
<p>Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna.</p> <p>Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.</p> <p>Note 3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.</p>	

7.4 DFS Response Requirement Values

Parameter	Value
<i>Non-occupancy period</i>	Minimum 30 minutes
<i>Channel Availability Check Time</i>	60 seconds
<i>Channel Move Time</i>	10 seconds - See Note 1.
<i>Channel Closing Transmission Time</i>	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. - See Notes 1 and 2.
<i>U-NII Detection Bandwidth</i>	Minimum 100% of the U-NII 99% transmission power bandwidth. See Note 3.
<p>Note 1: <i>Channel Move Time</i> and the <i>Channel Closing Transmission Time</i> should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst.</p> <p>Note 2: The <i>Channel Closing Transmission Time</i> is comprised of 200 milliseconds starting at the beginning of the <i>Channel Move Time</i> plus any additional intermittent control signals required to facilitate a <i>Channel</i> move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.</p> <p>Note 3: During the <i>U-NII Detection Bandwidth</i> detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.</p>	

7.5 Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a	Roundup $\left\{ \left(\frac{1}{360} \right) \cdot \left(\frac{19 \cdot 10^6}{\text{PRI}_{\mu\text{sec}}} \right) \right\}$	60%	30
		Test B: 15 unique PRI values randomly selected within the range of 518-3066 μsec, with a minimum increment of 1 μsec, excluding PRI values selected in Test A			
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120
Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.					

7.6 Long Pulse Radar Test Waveform

Radar Type	Pulse Width (μsec)	Chirp Width (MHz)	PRI (μsec)	Number of Pulses per Burst	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Number of Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

7.7 Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (μsec)	PRI (μsec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Number of Trials
6	1	333	9	0.333	300	70%	30

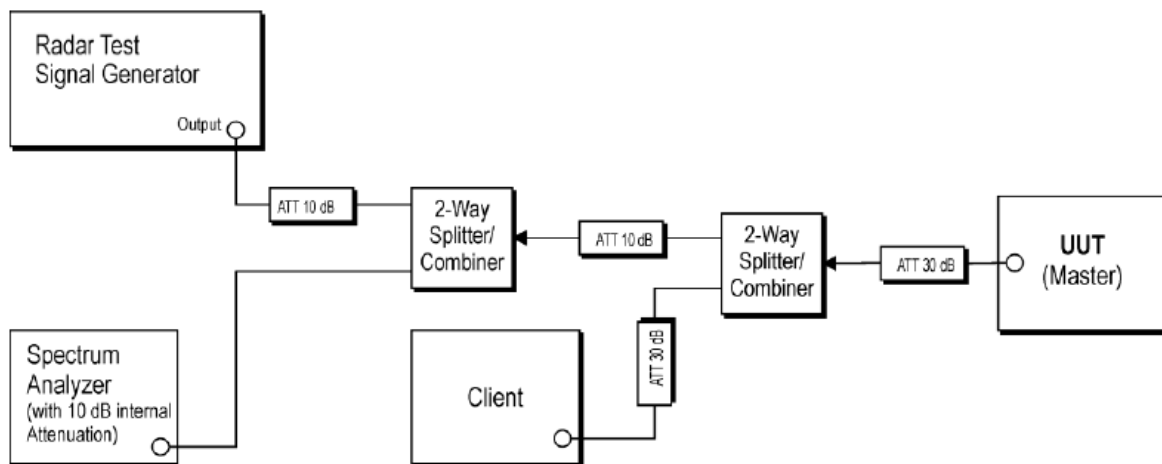
8 Measurement Procedures

8.1 Radar Waveform Generation

DFS waveform generator system NI PXI-1042 is used for all testing. The PXI system is a standard RF test system from National Instruments, Inc. It includes an embedded controller (with Windows XP), an RF signal generator comprised of an arbitrary waveform generator and two up / down-conversion modules. The parameters of the generated by the system waveforms are set and controlled through the integrated testing application iDFS by Redwolf Technology, LLC. The application is modeled around the FCC (06-96) guidelines for performing repetitive testing of different pre-defined radar signals along with scoring each trial in a test. The results of a test composed of a series of trials, typically 30 or more, can be save to a text file. That file is compatible with other applications, such as Microsoft's Word or Excel. The chirp has been verified by detuning the center frequency of the spectrum analyzer from the center frequency of the radar pulse and observing the slope on the burst.

8.2 DFS Test Setup Block Diagram

The section below contains block diagram example of conducted setup, where the EUT is master and the radar test waveforms are injected into the master.



For other test configurations for client testing and radiated measurements please refer to FCC 905462 D02 UNII DFS Compliance Procedures New Rules v02.

8.3 Setting the Test Signal Level

The test setup was calibrated at the EUT antenna port to the appropriate DFS threshold level are specified in Table 3 of the FCC 905462, with a spectrum analyzer according to Section 7.5 of the same KDB publication. The spectrum analyzer was centered on the channel under test and configured to zero span mode with a peak detector at a resolution and video bandwidth of at least 3MHz.

Signal level verification plots are included in section 9.1 of this report.

8.4 Channel Loading / Data Streaming

System testing will be performed with channel-loading using means appropriate to the data types that are used by the unlicensed device. The following requirements apply:

- The data file must be of a type that is typical for the device (i.e., MPEG-2, MPEG-4, WAV, MP3, MP4, AVI, etc.) and must generally be transmitting in a streaming mode.
- Software to ping the client is permitted to simulate data transfer but must have random ping intervals.
- Timing plots are required with calculations demonstrating a minimum channel loading of approximately 17% or greater. For example, channel loading can be estimated by setting the spectrum analyzer for zero span and approximate the Time On/ (Time On + Off Time). This can be done with any appropriate channel BW and modulation type.
- Unicast or Multicast protocols are preferable but other protocols may be used. The appropriate protocol used must be described in the test procedures.

Signal level verification plots are included in section 9.2 of this report.

9 Test Result Data

9.1 Test Signal Level Calibration

9.1.1 Measurement according to FCC 905462 D02 UNII DFS Compliance Procedures New Rules v02.

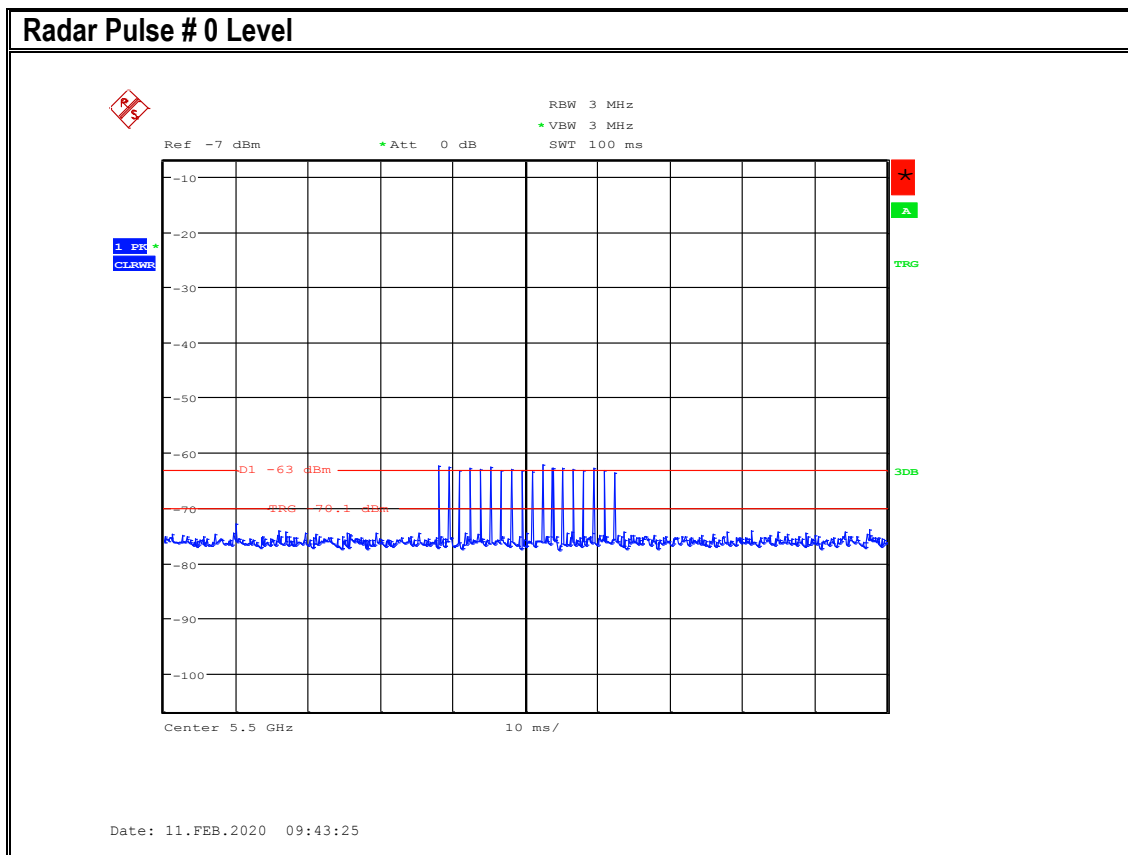
Spectrum Analyzer Settings

- Center Frequency = Channel Frequency
- Span = Zero Span
- RBW \geq 3 MHz
- VBW \geq 3 MHz
- Detector = Peak

9.1.2 Target Signal Level:

- For all DFS test pulses the target level is -63 dBm.

9.1.3 Measurement result:



9.2 Channel Loading

9.2.1 Measurement according to FCC 905462 D02 UNII DFS Compliance Procedures New Rules v02

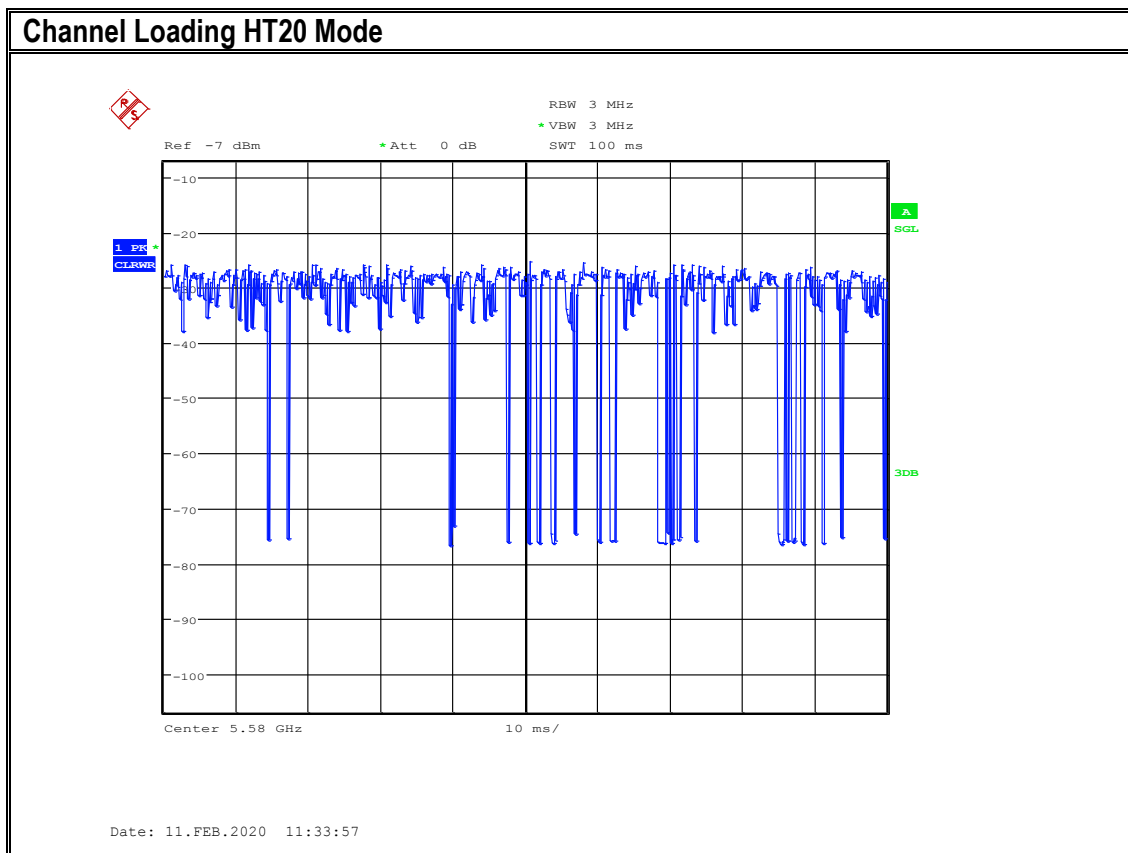
Spectrum Analyzer Settings

- Center Frequency = Channel Frequency
- Span = Zero Span
- RBW ≥ 1 MHz
- VBW ≥ 3 MHz
- Detector = Peak

9.2.2 Target Channel Loading Level:

- The channel loading shall be 17% or greater for each mode of operation

9.2.3 Measurement result:



9.3 In Service Monitoring

9.3.1 Measurement according to FCC 905462 D02 UNII DFS Compliance Procedures New Rules v02

Waveform Generator Settings

- Radar pulse used = Type 0
- Center frequency of the radar pulse = EUT operating channel
- Radar Pulse amplitude = DFS detection threshold level

Spectrum Analyzer Settings

- Center Frequency = Channel Frequency
- Span = Zero Span
- Sweep Time ≥ 11 s
- RBW ≥ 1 MHz
- VBW ≥ 3 MHz
- Detector = Peak

EUT Settings

- The EUT was streaming the channel loading test file to the Client Device
- The EUT was set to HT20 mode
- The EUT was set to a channel where control signals are detected

9.3.2 Requirements FCC§15.407; RSS-247:

Channel Closing Transmission Time

- 10 seconds

Channel Move Time

- 200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period

Non-occupancy period

- Minimum 30 minutes

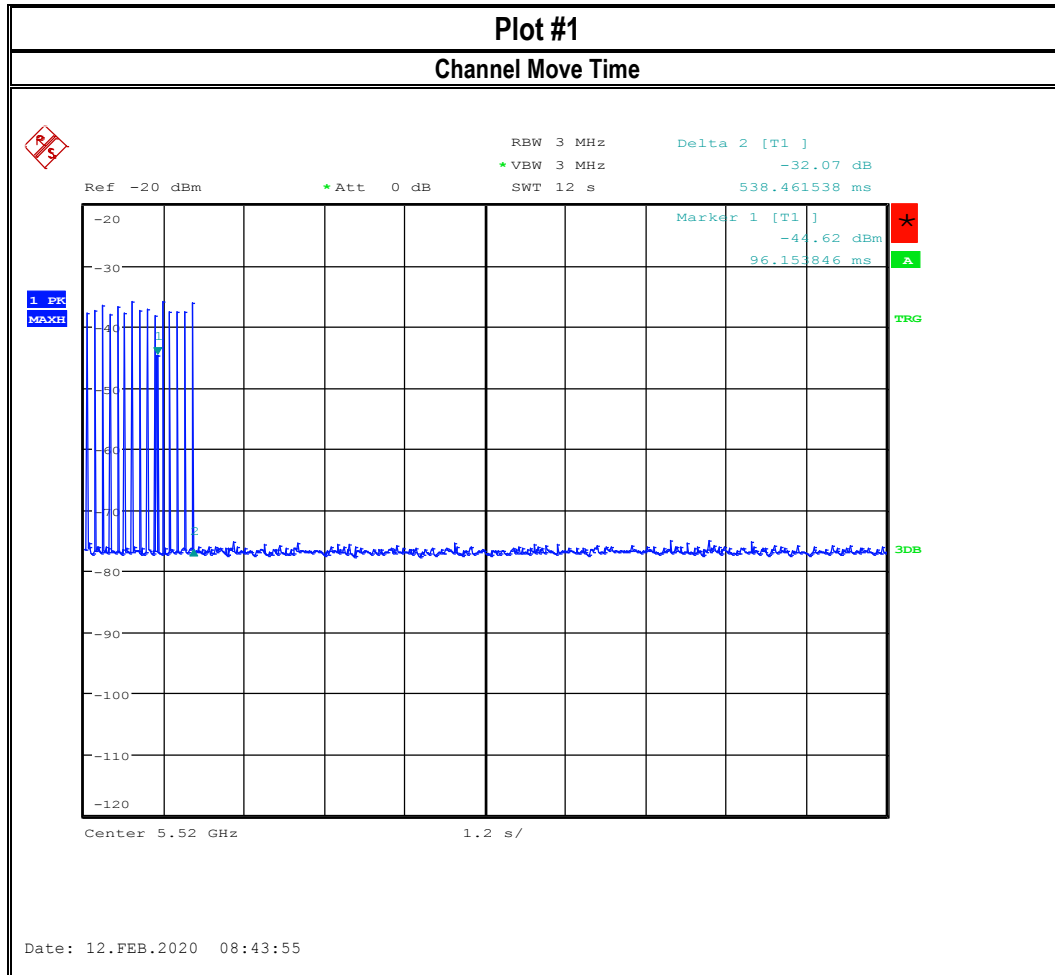
9.3.3 Test conditions and setup:

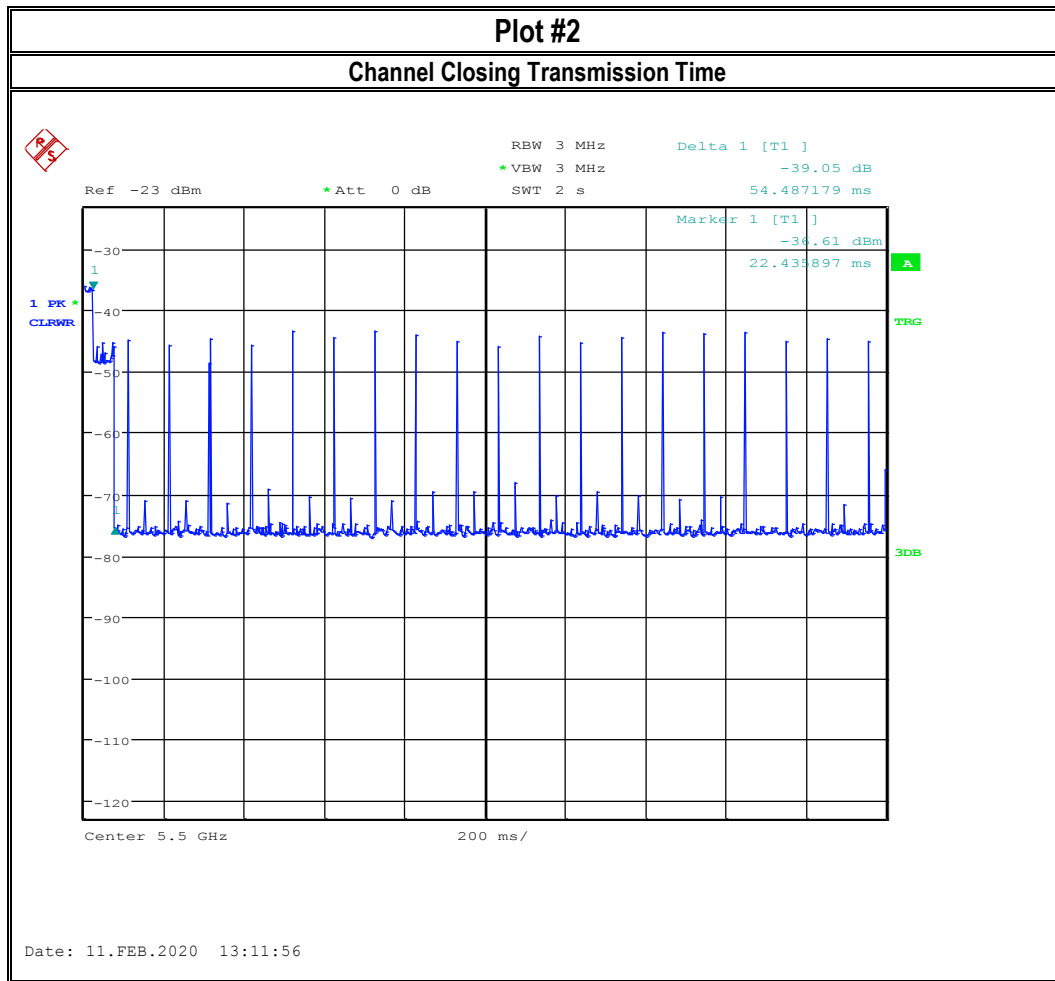
Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22° C	1	GFSK continuous fixed channel	Battery

9.3.4 Measurement result:

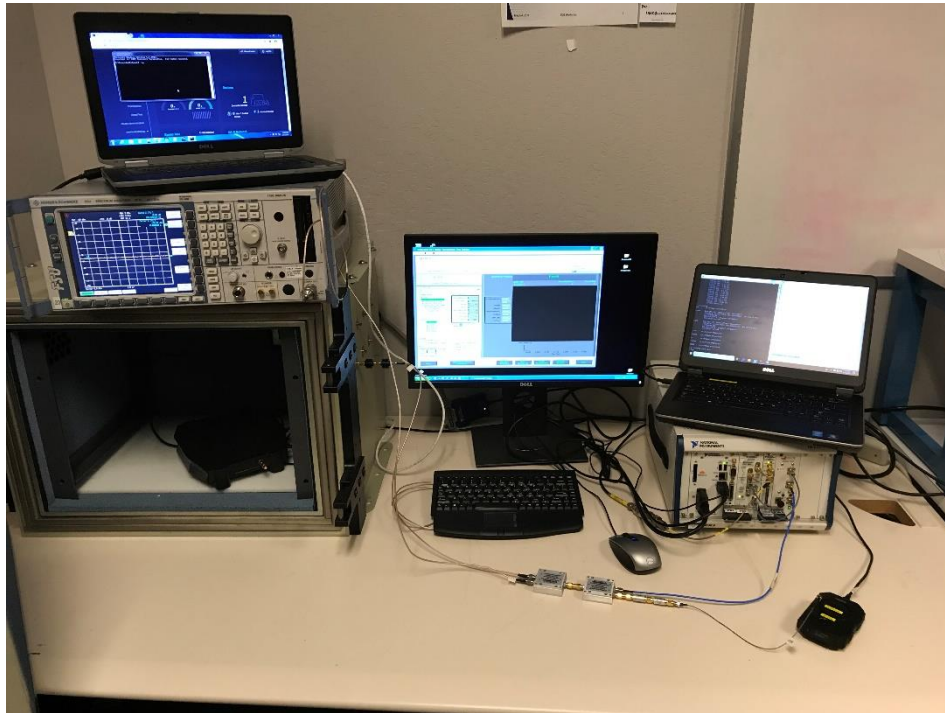
Plot #	Frequency (MHz)	Channel Closing Transmission Time (s)	Channel Move Time (s)	Non-occupancy period (s)	Limit (s)	Result
1	5520	N/A	0.538	N/A	<10	Pass
1	5500	0.054	N/A	N/A	See 9.3.2	Pass

9.3.5 Measurement Plots:





10 Test setup photos



11 Test Equipment And Ancillaries Used For Testing

Item Name	Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
FSU26	Spectrum Analyzer	R&S	FSU26	200302	3 years	7/16/2019
PXI-5421	Arbitrary waveform Generator	National Instrument	PXI-5421	E965F1	3 years	4/4/2019

Note:

1. Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels.

Calibration due dates, unless defined specifically, falls on the last day of the month. Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

12 History

Date	Report Name	Changes to report	Report prepared by
2020-02-27	EMC_AXONN-006-19001_15.407_DFS	Initial Version	Kevin Wang

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