FCC / ISED 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 15.247 (DSS)
RSS-247 Issue 2 (FHSs) & RSS-Gen Issue 5

REPORT #: EMC_AXONN-004-19001_15.247_DSS

DATE: 2019-07-17

A2LA Accredited

IC recognized #
3462B-2

***CETECOM* Inc.**
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CETECOM Inc. is a Delaware Corporation with Corporation number: 2905571

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1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.247 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:

Date	Section	Name	Signature
2019-07-17	Compliance	Cindy Li (EMC Lab Manager)	Cindy Li Digitally signed by Cindy Li DN: cn=Cindy Li, o=Cetecom Inc., ou=EMC, email=cindy.li@cetecom.com, c=US Date: 2019.07.17 14:39:00 -07'00'

Responsible for the Report:

Date	Section	Name	Signature
2019-07-17	Compliance	Kevin Wang (Senior EMC Engineer)	Kevin Wang Digitally signed by: Kevin Wang DN: CN = Kevin Wang email = kevin.wang@cetecom.com C = US O = Cetecom Inc. Date: 2019.07.17 13:30:15 -07'00'

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:	Kevin Wang

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 :	PVT
SW Version :	1.0.151
FCC-ID :	X4G01200
IC:	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:	Nominal band: 2400 MHz – 2483.5 MHz Center to center: 2402 MHz (ch 0) – 2480 MHz (ch 78), 79 Channels
Type(s) of Modulation:	Bluetooth Basic/EDR: GFSK, π /4 DQPSK, 8DPSK
Modes of Operation:	Hopping
Antenna Information as declared:	max gain 3.4 dBi for 2.4GHz, refer to section 3.6 for more information
Max. declared output Powers:	Conducted Power 12.01dBm
Power Supply/ Rated Operating Voltage Range:	Rechargeable Battery Vmin: 3.4 VDC/ Vnom: 3.8 VDC / Vmax: 4.3 VDC
Operating Temperature Range	-20º to 50º C
Other Radios included in the device:	Bluetooth 4.0 Low Energy (BT LE) Wi-Fi 802.11 a/b/g/n/ac, Qualcomm WCN3680B GPS, Qualcomm WGR7640 UMTS/LTE, Sierra Wireless WP7610
Sample Revision	☐Prototype Unit; ☐Production Unit; ■Pre-Production

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	X60000190	DVT3	1.0.48	Conducted Sample
2	X60495001	PVT1	1.0.68	Radiated Sample

3.3 Accessory Equipment (AE) details

AE #	Type	Model	Manufacturer	Serial Number
1	Laptop	HSTNN-I33C-4	HP	-
2	USB Cable	-	AXON	-
3	AC Adaptor	KSA01A5210100D5	Ktec	-

3.4 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#1 + AE#1 + AE#2	The radio of the EUT was configured to a fixed channel transmission with 30% duty cycle using Putty tool and Qualcomm software QRCT to configure the EUT. The measurement equipment was connected to the 50 ohm RF port of the EUT.
2	EUT#2 + AE#1 + AE#2	The radio of the EUT was configured to a fixed channel transmission with 30% duty cycle using Putty tool and Qualcomm software QRCT to configure the EUT. The internal antenna was connected.
3	EUT#2 + AE#2 + AE#3	The radio of the EUT was configured to a fixed channel transmission with 30% duty cycle using Putty tool and Qualcomm software QRCT to configure the EUT. The internal antenna was connected.

3.5 Justification for Worst Case Mode of Operation

During the testing process, the EUT was tested with transmitter sets on low, mid and high channels, and 30% duty cycle.
For radiated measurements, all data in this report shows the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

For conducted measurements, the highest power and the widest occupied bandwidth mode of operation (GFSK), was used to evaluate the worst case performance of the EUT, including the band edge compliance and TX radiated spurious emissions testing. Maximum peak conducted output power and spectrum bandwidth, were measured in all supported modulation modes for the EUT.

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

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to assess the performance of the EUT according to the relevant requirements specified in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-247 Issue 2 of ISED Canada.

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

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

Testing procedures are based on ANSI C63.10:2013 including section 7.8 for FHSS systems.

5 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	NA	NP	Result
§15.247(b)(1) RSS-247 5.4(b)	Maximum Peak Conducted Output Power	Nominal	GFSK DQPSK 8DPSK	■	☐	☐	Complies
§15.247(d) RSS-247 5.5 RSS-Gen 8.10	Band Edge Compliance	Nominal	GFSK	■	☐	☐	Complies
§15.247(a)(1) RSS-247 5.1(b)	Spectrum Bandwidth	Nominal	GFSK DQPSK 8DPSK	■	☐	☐	Complies
§15.247(a)(1) RSS-247 5.1(b)	Carrier Frequency Separation	Nominal	GFSK	■	☐	☐	Complies
§15.247(a)(1) RSS-247 5.1(d)	Number of Hopping Channels	Nominal	GFSK	■	☐	☐	Complies
§15.247(a)(1)(iii) RSS-247 5.1(d)	Time of occupancy	Nominal	GFSK	■	☐	☐	Complies
§15.247(d) §15.209 (a) RSS-Gen 6.13	TX Spurious emissions-Radiated	Nominal	GFSK	■	☐	☐	Complies
§15.207(a) RSS-Gen 8.8	AC Conducted Emissions	Nominal	GFSK	■	☐	☐	Complies

Note1: NA= Not Applicable; NP= Not Performed.

6 Measurements

6.1 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

9 kHz to 30MHz	±2.5 dB (Magnetic Loop Antenna)
30 MHz to 1000 MHz	±2.0 dB (Biconilog Antenna)
1 GHz to 40 GHz	±2.3 dB (Horn Antenna)

Conducted measurement

RF conducted measurement	±0.5 dB

6.2 Environmental Conditions During Testing:

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

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

6.3 Dates of Testing:

05/14/2019 – 06/04/2019

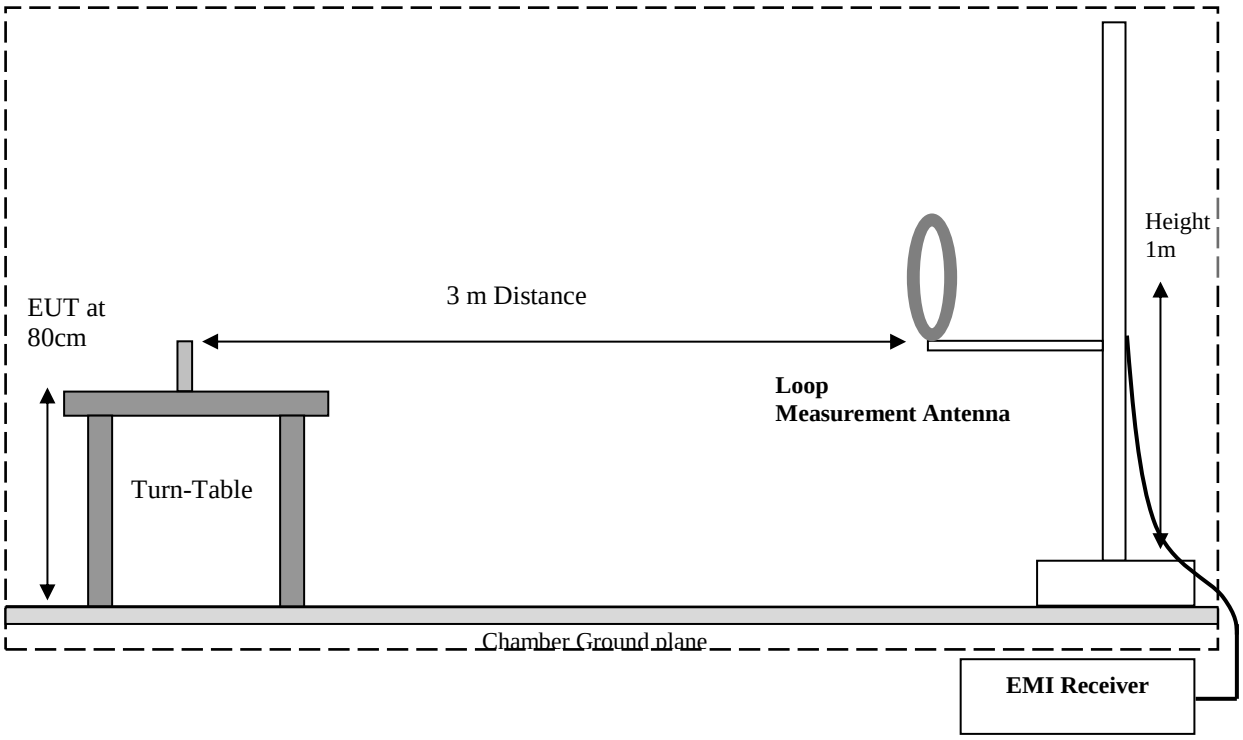
7 Measurement Procedures

7.1 Radiated Measurement

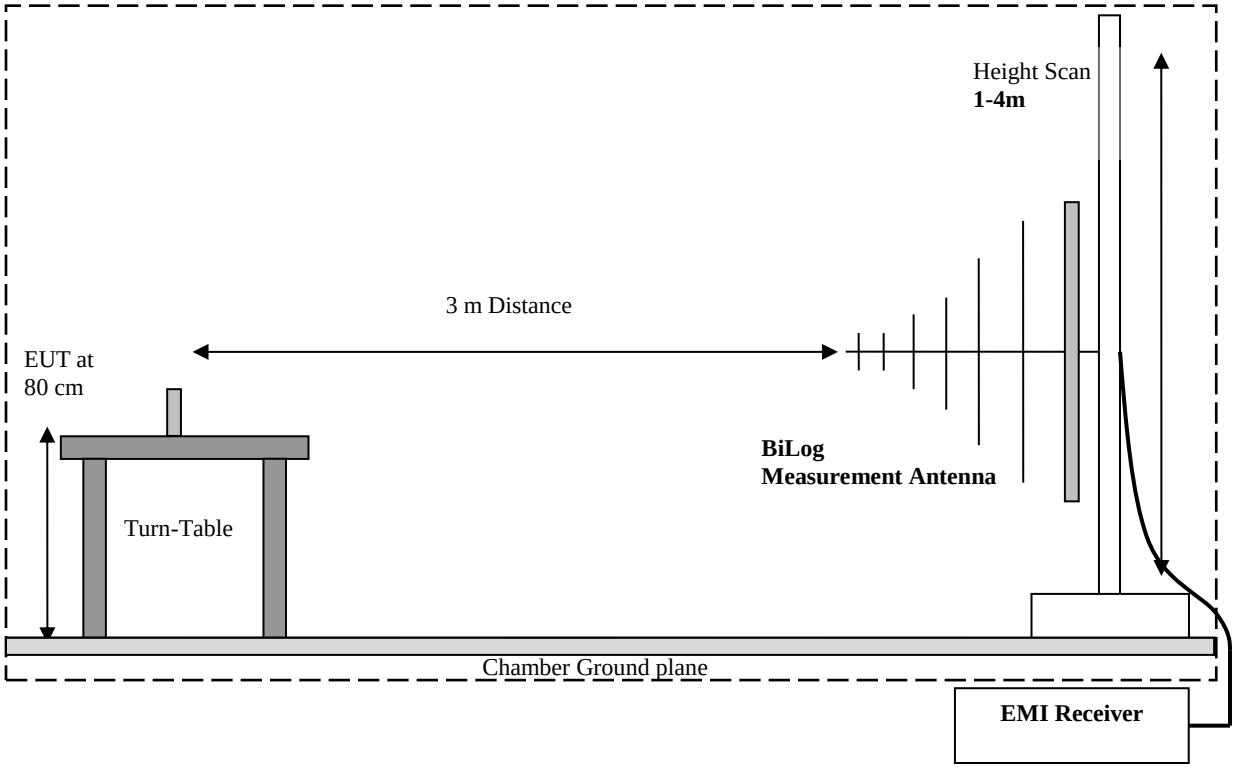
The radiated measurement is performed according to: ANSI C63.10 (2013)

- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.

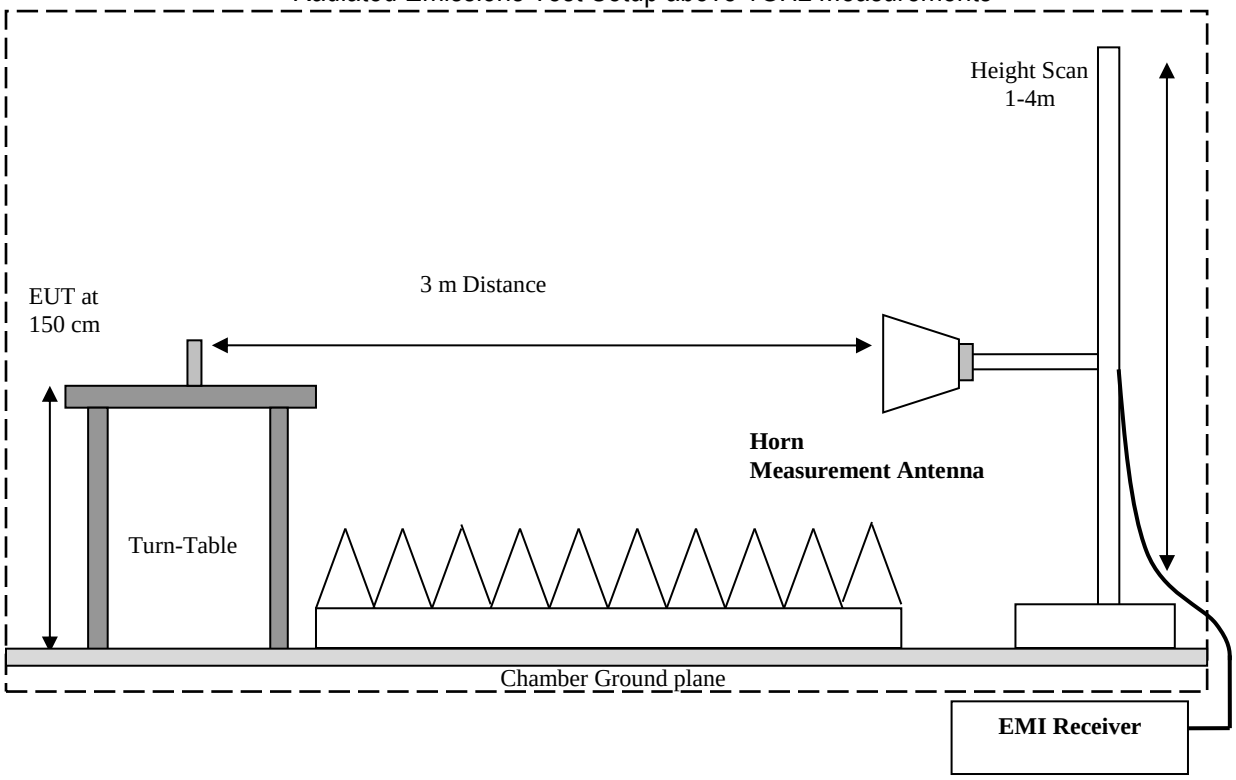
Radiated Emissions Test Setup below 30MHz Measurements



Radiated Emissions Test Setup 30MHz-1GHz Measurements



Radiated Emissions Test Setup above 1GHz Measurements



7.1.1 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, taking into account the following parameters:

1. Measured reading in dBµV
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the following equation:

FS (dBµV/m) = Measured Value on SA (dBµV)- Cable Loss (dB)+ Antenna Factor (dB/m)

Example:

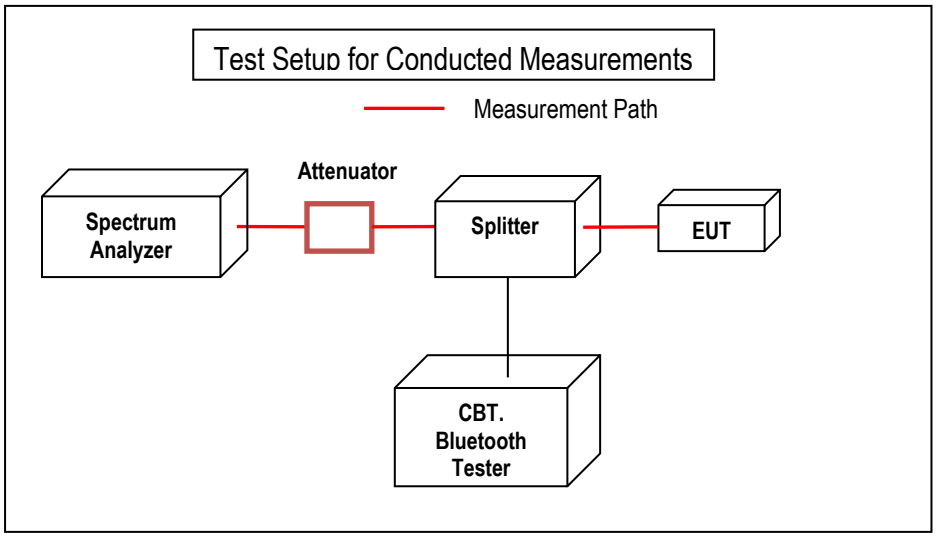
Frequency (MHz)	Measured SA (dBµV)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dBµV/m)
1000	80.5	3.5	14	98.0

7.2 Power Line Conducted Measurement Procedure

AC Power Line conducted emissions measurements performed according to: ANSI C63.4 (2014)

7.3 RF Conducted Measurement Procedure

Reference: ANSI C63.10 (2013) Section 6.9, 6.10, and 7.8



- Connect the equipment as shown in the above diagram.
- Adjust the settings of the SA (Rohde-Schwarz Spectrum Analyzer) to connect the EUT at the required mode of test.
- Measurements are to be performed with the EUT set to the low, middle and high channels and for worst case modulation schemes.

8 Test Result Data

8.1 Maximum Peak Conducted Output Power

8.1.1 Measurement according to ANSI C63.10 Section 7.8.5

Spectrum Analyzer settings:

- Span = approximately 5 times the 20 dB bandwidth
- RBW > the 20 dB bandwidth of the emission being measured
- VBW ≥ RBW
- Sweep = Auto Couple
- Detector function = Peak
- Trace = Max hold
- Use the marker-peak function to set the marker to the peak of the emission.

8.1.2 Limits:

Maximum Peak Output Power:

FCC 15.247: (b) The maximum peak conducted 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 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

IC RSS-247 5.4:

- (b) For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels.

8.1.3 Test conditions and setup:

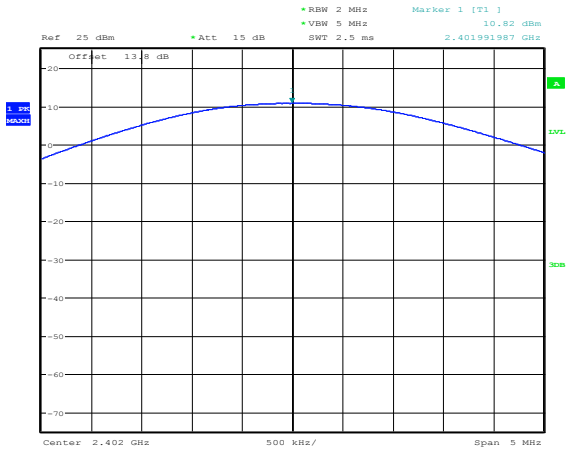
Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain
21° C	1	GFSK, DQPSK, 8DPSK – DH1	110 VAC	3.4 dBi

8.1.4 Measurement result:

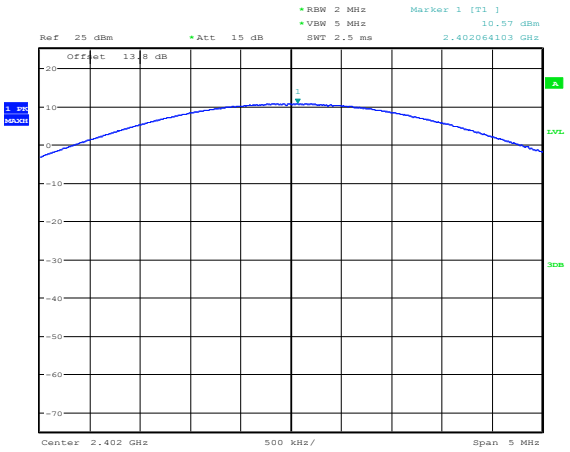
Plot #	Frequency (MHz)	EUT operating mode	Maximum Peak Conducted Output Power (dBm)	EIRP (dBm)	Limit (dBm)	Result
1	2402	GFSK DH1	10.82	14.22	30(Pk) / 36(EIRP)	Pass
2	2402	DQPSK DH1	10.57	13.97	30(Pk) / 36(EIRP)	Pass
3	2402	8DPSK DH1	10.82	14.22	30(Pk) / 36(EIRP)	Pass
4	2441	GFSK DH1	12.01	15.41	30(Pk) / 36(EIRP)	Pass
5	2441	DQPSK DH1	11.79	15.19	30(Pk) / 36(EIRP)	Pass
6	2441	8DPSK DH1	11.99	15.39	30(Pk) / 36(EIRP)	Pass
7	2480	GFSK DH1	10.4	13.8	30(Pk) / 36(EIRP)	Pass
8	2480	DQPSK DH1	10.24	13.64	30(Pk) / 36(EIRP)	Pass
9	2480	8DPSK DH1	10.41	13.81	30(Pk) / 36(EIRP)	Pass

8.1.5 Measurement Plots:

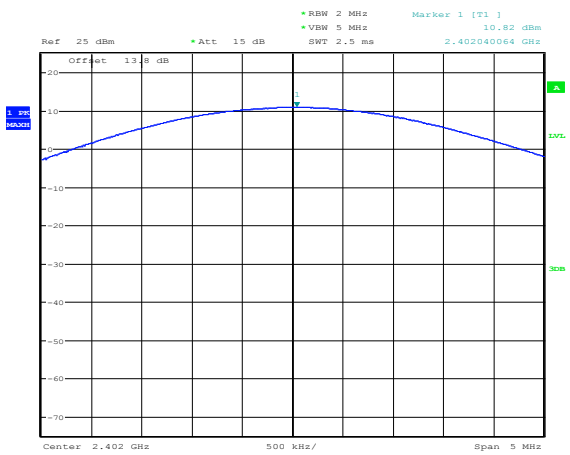
Plot # 1: Maximum Peak Conducted Output Power	
2402MHz	GFSK / DH1



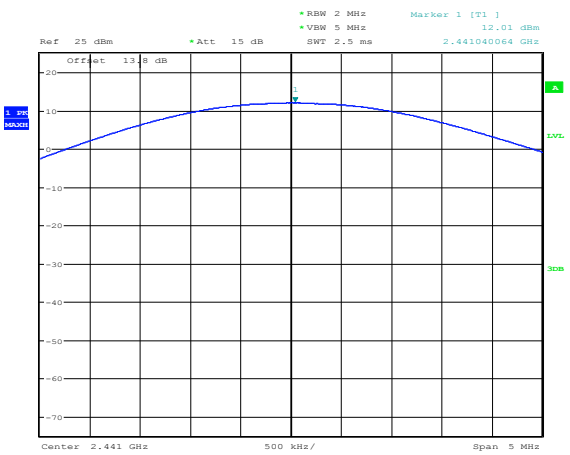
Plot # 2: Maximum Peak Conducted Output Power	
2402MHz	DQPSK / DH1



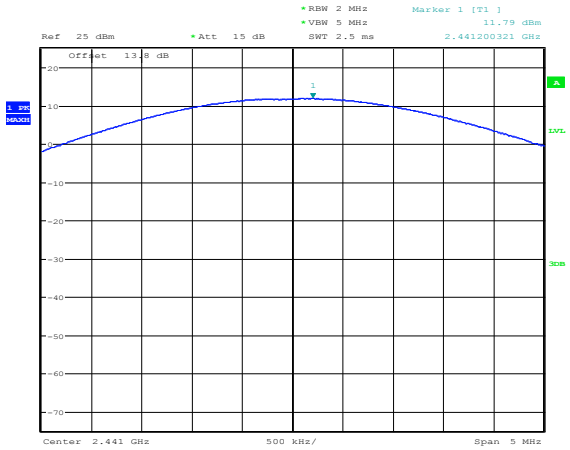
Plot # 3: Maximum Peak Conducted Output Power	
2402MHz	8DPSK / DH1



Plot # 4: Maximum Peak Conducted Output Power	
2441MHz	GFSK / DH1



Plot # 5: Maximum Peak Conducted Output Power	
2441MHz	DQPSK / DH1



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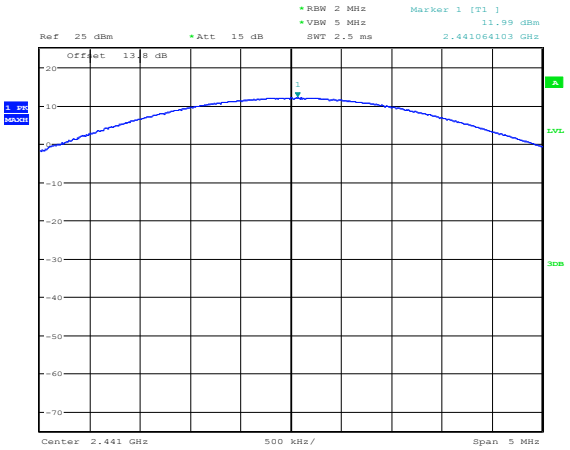
Plot # 6: Maximum Peak Conducted Output Power	
2441MHz	8DPSK / DH1



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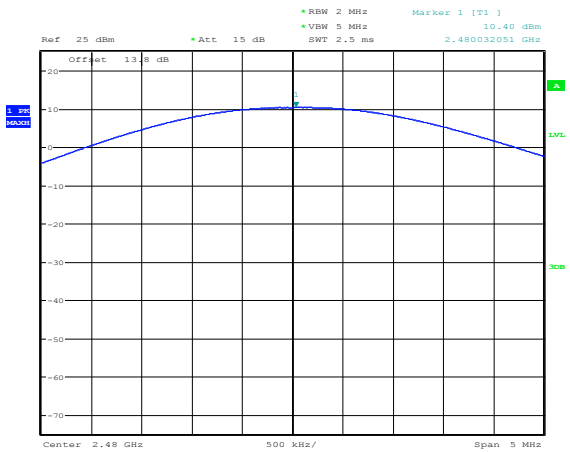
Plot # 7: Maximum Peak Conducted Output Power	
2480MHz	GFSK / DH1



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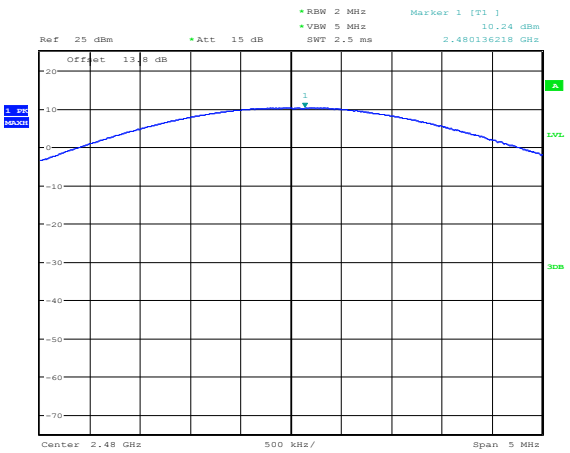
Plot # 8: Maximum Peak Conducted Output Power	
2480MHz	DQPSK / DH1



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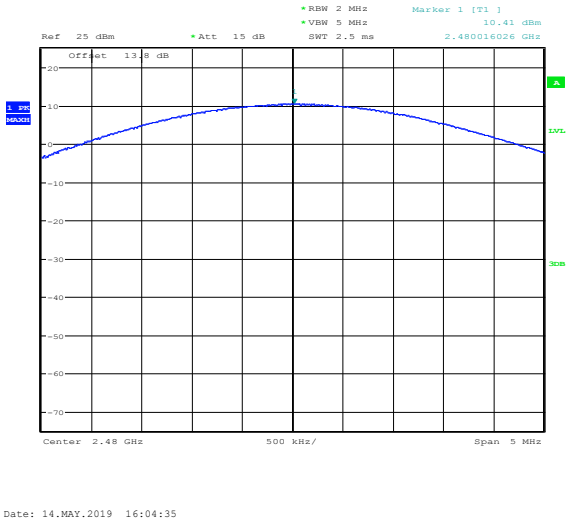
Plot # 9: Maximum Peak Conducted Output Power	
2480MHz	**8DPSK / DH1**



8.2 Band Edge Compliance

8.2.1 Measurement according to ANSI C63.10 Section 6.10

Non Restricted Band Edge and Restricted Band Edge Peak Measurement Spectrum Analyzer Settings:

- Set the center frequency and span to encompass frequency range to be measured
- RBW = 1 MHz
- VBW ≥ 3 x RBW
- Sweep Time: Auto couple
- Detector = Peak
- Trace = Max hold
- Allow trace to fully stabilize
- Use the peak marker function to determine the maximum amplitude level
- Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge

Restricted Band Edge Average Measurement Spectrum Analyzer Settings(Method VB):

- Set the center frequency and span to encompass frequency range to be measured
- RBW = 1 MHz
- VBW = 10 Hz
- Sweep Time: Auto couple
- Detector = Peak
- Trace = Max hold
- Perform a trace max hold of at least 50 traces if the transmission is continuous or has at least 98% duty cycle. For lower duty cycles, increase the minimum number of traces by a factor of 1/x, where x is the duty cycle.
- Use the peak marker function to determine the maximum amplitude level
- Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge

8.2.2 Limits: Restricted Band FCC 15.209 and RSS-Gen 8.10

- PEAK LIMIT= 74 dBµV/m @3 m =-21.23 dBm
- AVG. LIMIT= 54 dBµV/m @3 m =-41.23 dBm
- Start frequency & stop frequency according to frequency range specified in the restricted band table in FCC section 15.205

Restricted bands of operation:

- Except as shown in CFR 47 Part 15.205 paragraph (d), only spurious emissions are permitted in any of the frequency bands listed below

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[10].495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

8.2.3 Limits: Non-restricted Band §15.247 and RSS-247 5.5

FCC15.247 (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)).

RSS-247 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

8.2.4 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna gain
21° C	1	GFSK DH1 - fixed channel	120VAC	3.4 dBi

8.2.5 Measurement result:

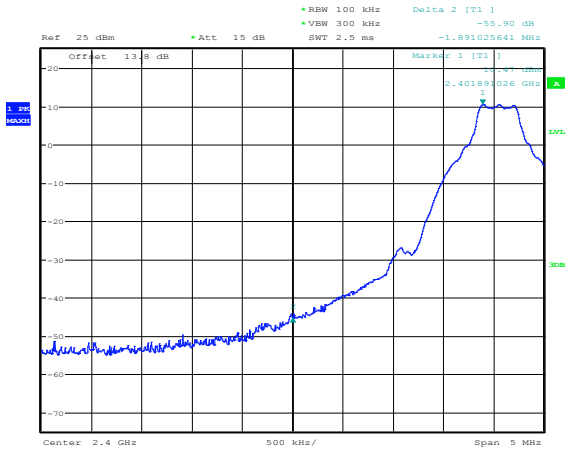
Plot #	EUT operating mode	Band Edge	Band Edge Delta (dBc)	Limit (dBc)	Result
1	GFSK DH1 fixed channel	Lower, non-restricted	55.9	> 20	Pass

Plot #	EUT operating mode	Band Edge	Measured value	Corrected by duty cycle	Corrected by Antenna gain	Limit (dBm)	Result
2	GFSK DH1 fixed channel	Upper restricted Peak	-31.83	NA due to peak detector	-28.43	-21.23 Peak	Pass
3, 4, 5	GFSK DH1 fixed channel	Upper restricted Average	-57.29	-52.09	-48.69	-41.23 AVG	Pass

Note: Duty Cycle: D = 0.376/1.25 = 30%
Then Correction factor = 10*log(1/D) = 5.2

8.2.6 Measurement Plots:

Plot # 1: Lower Band Edge	
2402MHz	GFSK / DH1



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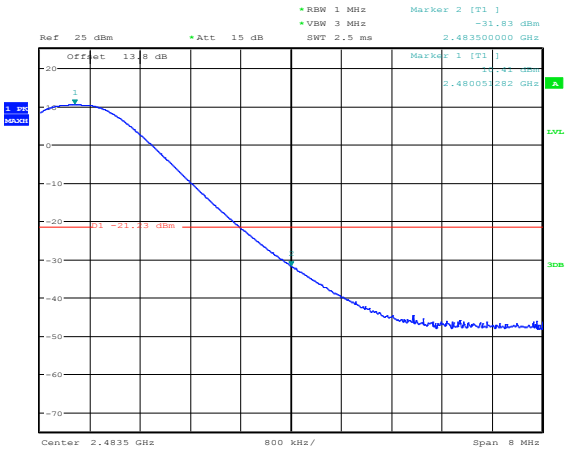
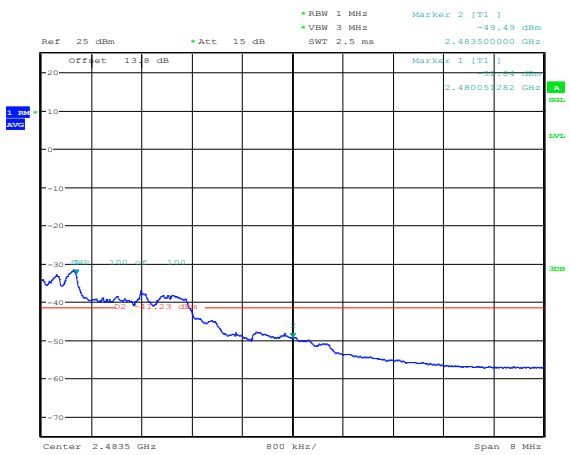
Plot # 2: Upper Band Edge – Peak	
2480MHz	GFSK / DH1



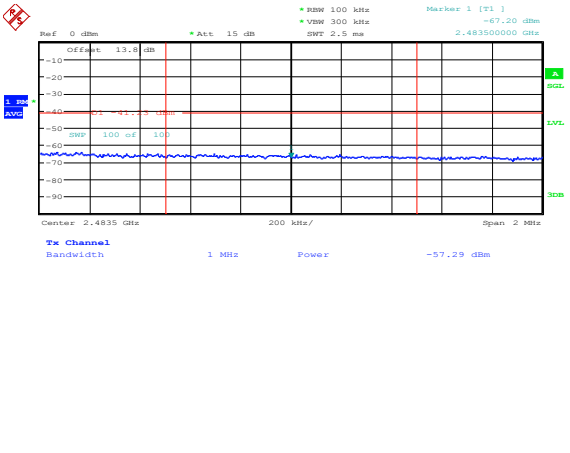
Date: 14.MAY.2019 16:11:56

Plot # 3: Upper Band Edge – Average	
2480MHz	GFSK / DH1



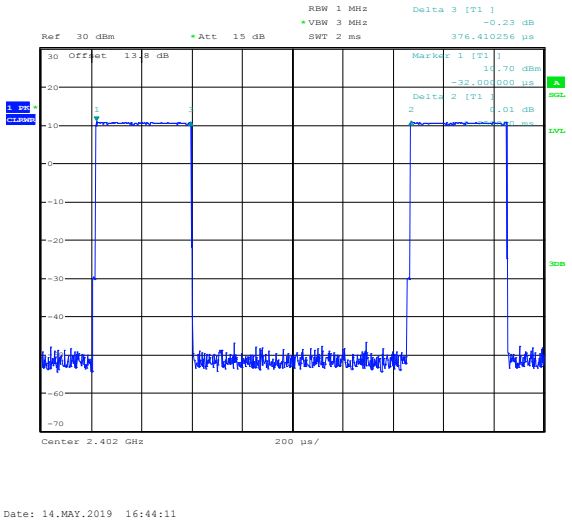
Date: 14.MAY.2019 16:15:06

Plot # 4: Upper Band Edge – Average – Integration Method	
2480MHz	GFSK / DH1



Date: 15.MAY.2019 12:18:34

Plot # 5: Duty Cycle	
2441MHz	GFSK / DH1



8.3 20dB Bandwidth

8.3.1 Measurement according to ANSI C63.10 Section 6.9.2

Spectrum Analyzer settings:

- Span: approximately 2 to 3 times the 20 dB bandwidth, centered on the hopping channel
- RBW ≥ 1% of the 20 dB bandwidth
- Sweep Time = Auto couple
- Detector = Peak
- Trace = Max hold

8.3.2 Limits: FCC 15.247 (a) (1), RSS-247 5.1(b)

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, provided the systems operate with an output power no greater than 125 mW.

8.3.3 Test conditions and setup:

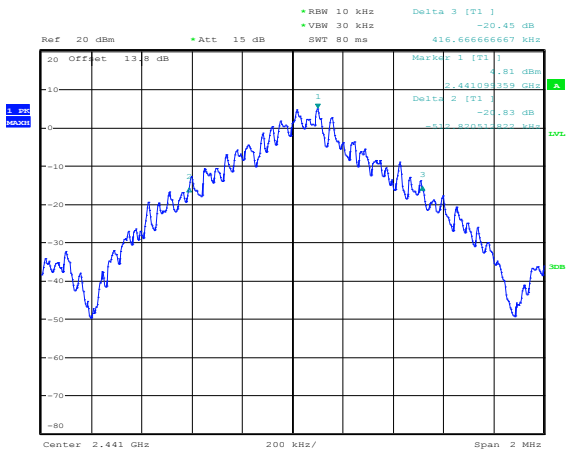
Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
21° C	1	GFSK, DQPSK, 8DPSK – DH1	120 VAC

8.3.4 Measurement result:

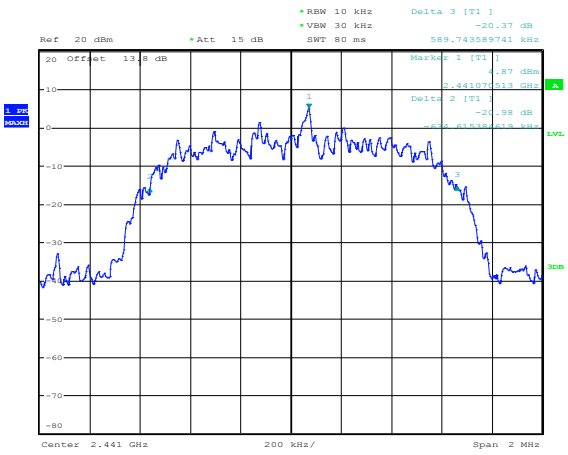
Plot #	EUT operating mode	20 dB Bandwidth (MHz)
1	GFSK DH1 fixed channel	0.929
2	DQPSK DH1 fixed channel	1.224
3	8DPSK DH1 fixed channel	1.253

8.3.5 Measurement Plots:

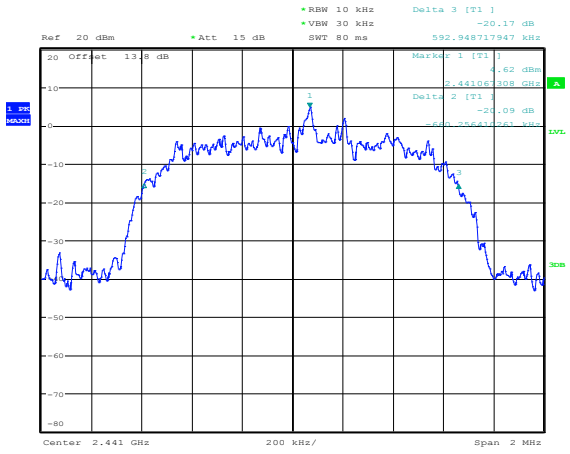
Plot # 1: 20dB Bandwidth	
2441MHz	GFSK / DH1



Plot # 2: 20dB Bandwidth	
2441MHz	DQPSK / DH1



Plot # 3: 20dB Bandwidth	
2441MHz	8DPSK / DH1



8.4 Carrier Frequency Separation

8.4.1 Measurement according to ANSI C63.10 Section 7.8.2

Spectrum Analyzer settings:

- Span = Wide enough to capture the peaks of the two adjacent channels
- RBW ≥ 1% of the span
- VBW ≥ RBW or 3 x
- Sweep = Auto couple
- Detector function = Peak
- Trace = Max hold
- Use marker-delta function to determine the separation between the peaks of the two adjacent channels.

8.4.2 Limits: FCC 15.247 (a) (1) & RSS-247 5.1 (b)

Frequency hopping systems shall have hoppin
g channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, 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, provided the systems operate with an output power no greater than 125 mW.

8.4.3 Test conditions and setup:

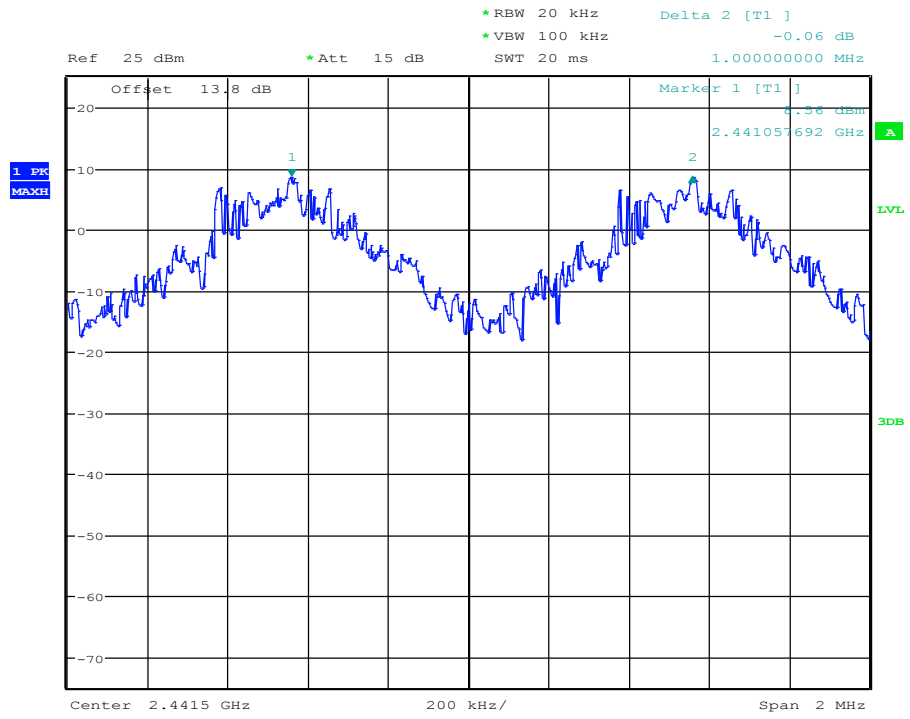
Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
21° C	1	GFSK DH1 Hopping	120 VAC

8.4.4 Measurement result:

Plot #	Carrier Frequency Separation (MHz)	Limit (MHz)	Result
1	1.00	> 2/3 * OBW = 0.835	Pass

8.4.5 Measurement Plots:

Plot # 1 Carrier Frequency Separation	
Packet Type: DH1	Modulation: GFSK
Hopping On	Channel 39 & Channel 40



8.5 Number of hopping channels

8.5.1 Measurement according to ANSI C63.10 Section 7.8.3

Spectrum Analyzer settings:

- Span = the entire frequency band of operation
- RBW ≥ 50 KHz
- VBW ≥ RBW or 3X
- Sweep = Auto couple
- Detector function = Peak
- Trace = Max hold

8.5.2 Limits: FCC 15.247 (a) (1) (ii)(iii) & RSS-247 5.1 (d)

At least 15 non-overlapping channels

8.5.3 Test conditions and setup:

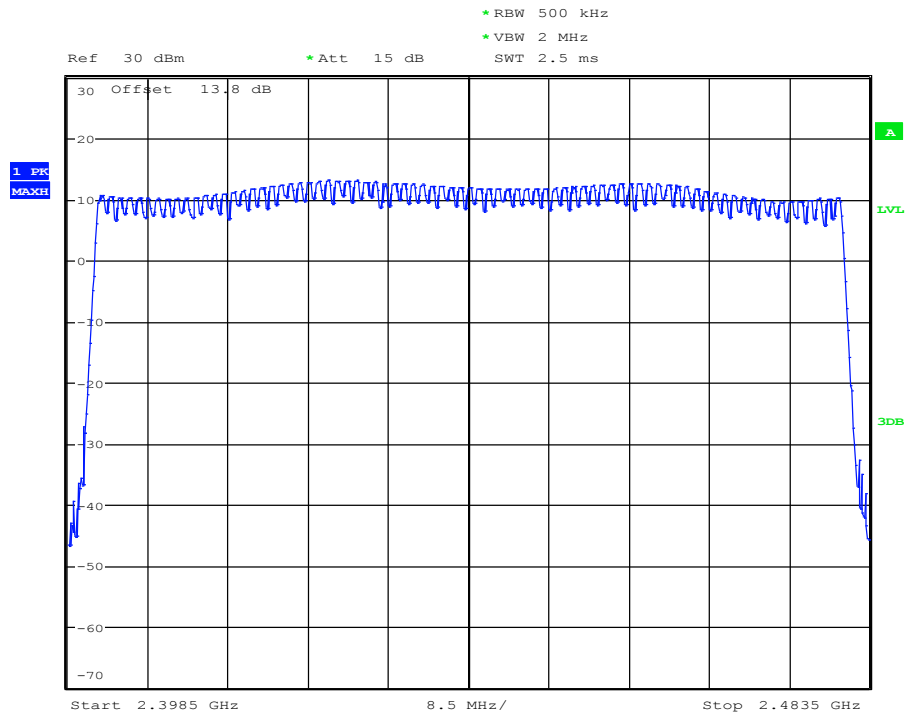
Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
21° C	1	GFSK DH1 hopping	120 VAC

8.5.4 Measurement result:

Plot #	Number of Hopping Frequencies	Limit	Result
1	79	15 non-overlapping channels	Pass

8.5.5 Measurement Plots:

Plot # 1 Number of Hopping Frequencies	
Packet Type: DH1	Modulation: GFSK
Hopping On	Total Hopping channels = 79



8.6 Time of Occupancy (Dwell Time)

8.6.1 Measurement according to ANSI C63.10 Section 7.8.4

Spectrum Analyzer settings:

Duration of Pulse Measurement

- RBW = 1 MHz
- VBW = 3 MHz
- Span = 0
- Sweep Time = 10 ms
- Sweep Mode = Single
- Detector =Peak
- Trigger = Video

Observation Period

- RBW = 1 MHz
- VBW = 3 MHz
- Span = 0
- Sweep Time = 31.6 s
- Sweep Mode = Single
- Detector = Peak
- Trigger = Free Run

Observation Period = 0.4s x No. of hopping channels = 0.4 x 79 = 31.6 s

8.6.2 Limits: FCC 15.247 (a) (1) (iii) & RSS-247 5.1 (d)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

8.6.3 Test conditions and setup:

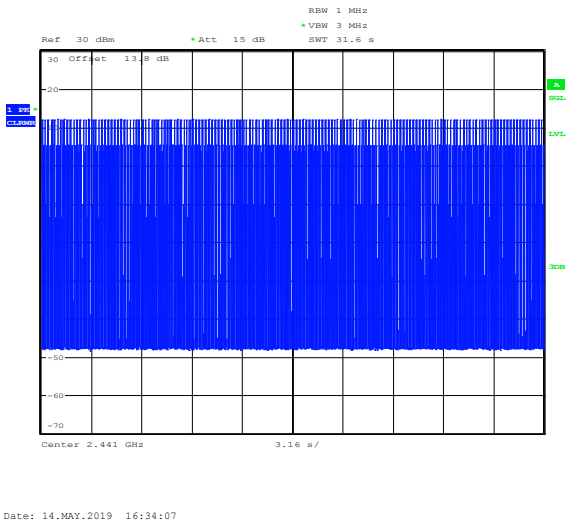
Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
21° C	1	GFSK DH1 hopping	120 VAC

8.6.4 Measurement result:

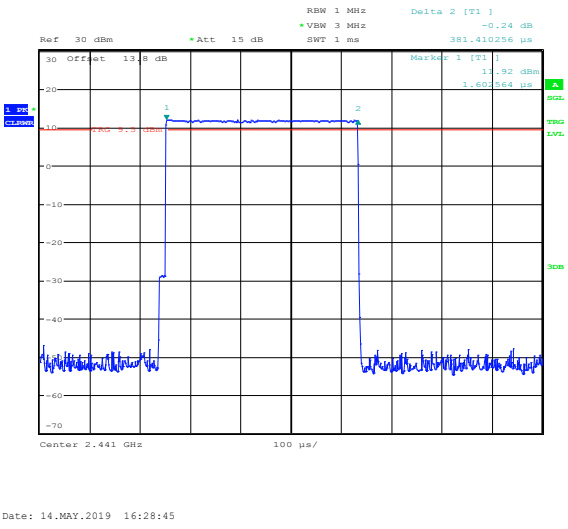
Plot #	Modulation	Timing	Number of hops 31.6s	Pulse Width (ms)	Total Dwell Time in 31.6s (ms)	Limit (ms)	Result
1	GFSK	DH1	320	0.381	121.92	< 400 in 31.6s	Pass

8.6.5 Measurement Plots:

Plot # 1: Transmission on Time in Observation Period > (31.6 s)	
GFSK	DH1



Plot # 2: Pulse Duration	
GFSK	DH1



8.7 Transmitter Spurious Emissions and Restricted Bands

8.7.1 Measurement according to ANSI C63.10

Analyzer Settings:

- Frequency = 9 KHz – 30 MHz
- RBW = 9 KHz
- Detector = Peak

- Frequency = 30 MHz – 1 GHz
- Detector = Peak / Quasi-Peak
- RBW = 120 KHz (<1 GHz)

- Frequency > 1 GHz
- Detector = Peak / Average
- RBW = 1MHz

Plots reported here represent the worst case emissions for horizontal and vertical antenna polarizations and for three orientations of the EUT. Unless mentioned otherwise, the emissions outside the limit lines in the plots are from the transmit signal.

8.7.2 Limits: FCC 15.247(d)/15.209(a) /RSS-Gen 6.13

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

- 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)).
- PEAK LIMIT= 74dB µV/m
- AVG. LIMIT= 54dB µV/m

- Except as shown in CFR 47 Part 15.205 paragraph (d), only spurious emissions are permitted in any of the frequency bands listed below

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements described in 5.4.
The highest (or worst-case) data rate shall be recorded for each measurement.

For testing at distance other than the specified in the standard, the limit conversion is calculated by using 40 dB/decade extrapolation as follow:

Conversion factor (CF) = 40 log (D/d) = 40 log (300 m / 3 m) = 80 dB

8.7.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
23° C	2	GFSK DH1 fixed channel	120 VAC

8.7.4 Measurement result:

Plot #	Channel #	Scan Frequency	Limit	Result
1-3	Low	30 MHz – 18 GHz	See section 8.7.2	Pass
4-8	Mid	9 kHz – 26 GHz	See section 8.7.2	Pass
9-11	High	30 MHz – 18 GHz	See section 8.7.2	Pass

8.7.5 Measurement Plots:

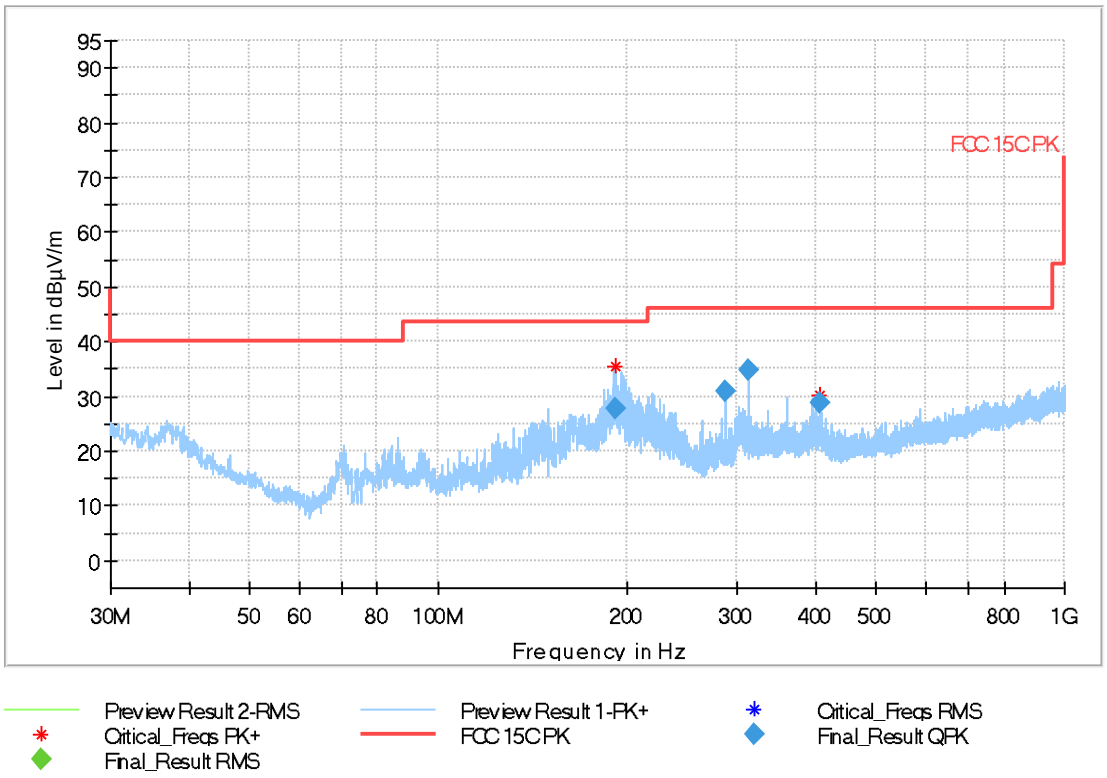
Plot #1 Radiated Emissions: 30 MHz – 1GHz

Modulation: GFSK | **Channel: Low**

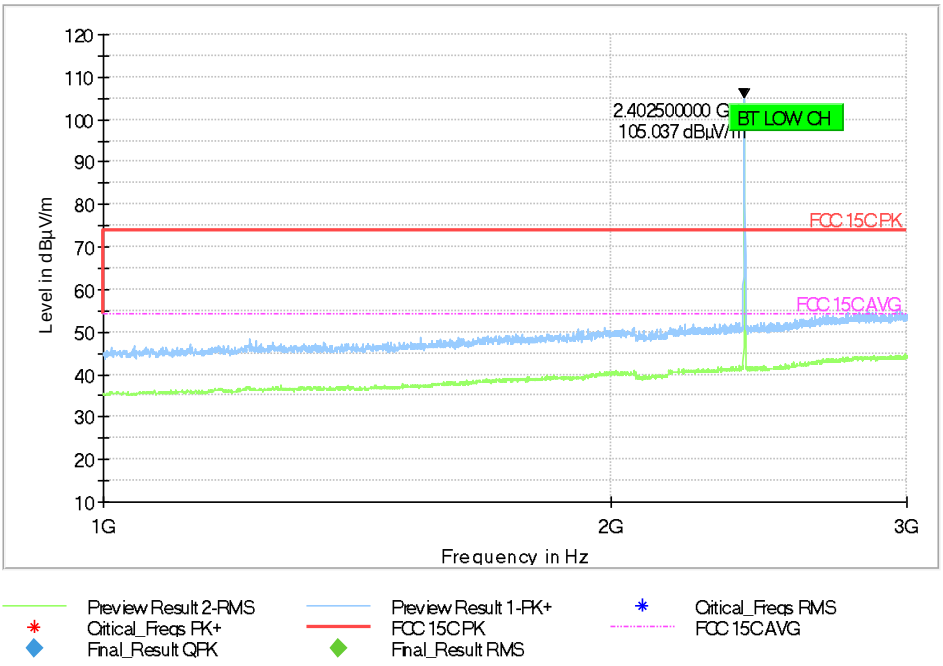
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
191.422	27.83	---	43.50	15.67	100.0	100.0	100.0	V
288.007	30.95	---	46.00	15.05	100.0	100.0	138.0	H
312.013	34.85	---	46.00	11.15	100.0	100.0	145.0	H
408.017	28.81	---	46.00	17.19	100.0	100.0	108.0	H

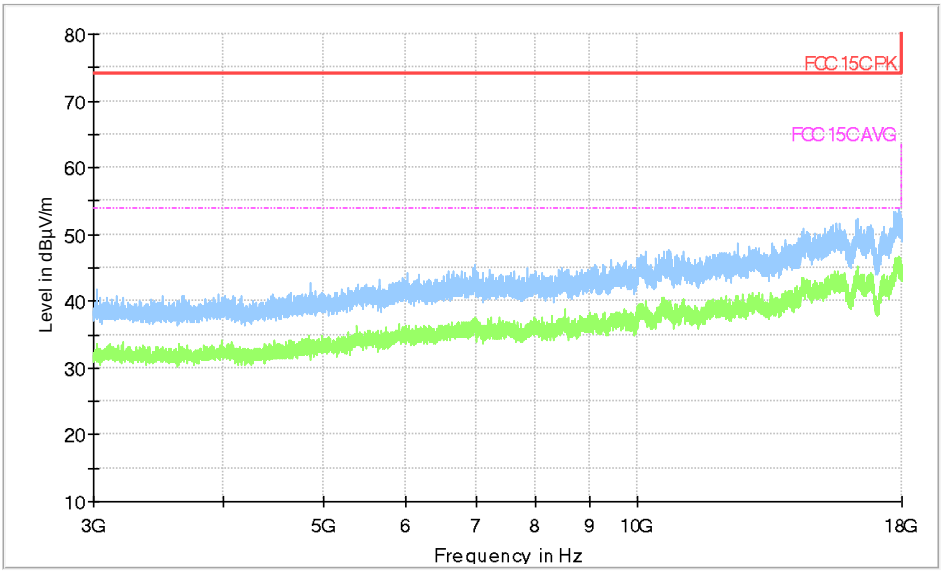
Disclaimer: Any measurement data within 2dB from the limit line is conditional PASS/FAIL due to measurement uncertainty considerations.



Plot # 2 Radiated Emissions: 1-3 GHz		
Modulation: GFSK	**Channel: Low**	

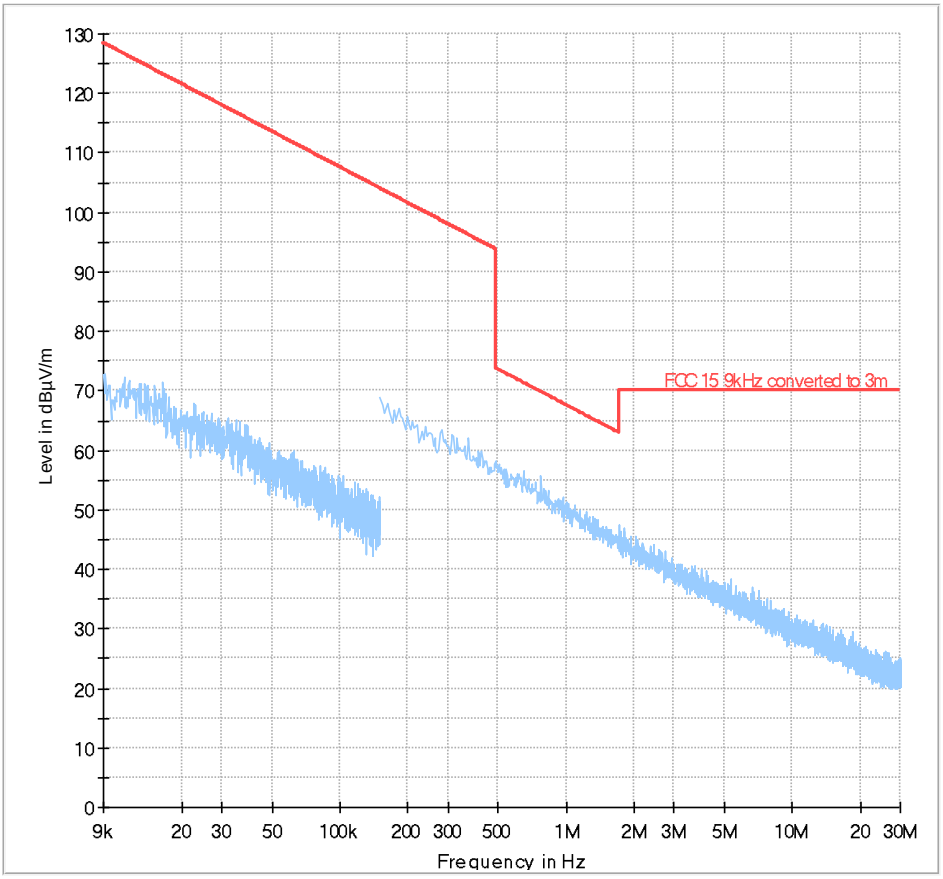


Plot # 3 Radiated Emissions: 3-18 GHz		
Modulation: GFSK	**Channel: Low**	



Plot # 4 Radiated Emissions: 9 KHz - 30 MHz		
Modulation: GFSK	**Channel: Mid**	

Disclaimer: Any measurement data within 2dB from the limit line is conditional PASS/FAIL due to measurement uncertainty considerations.



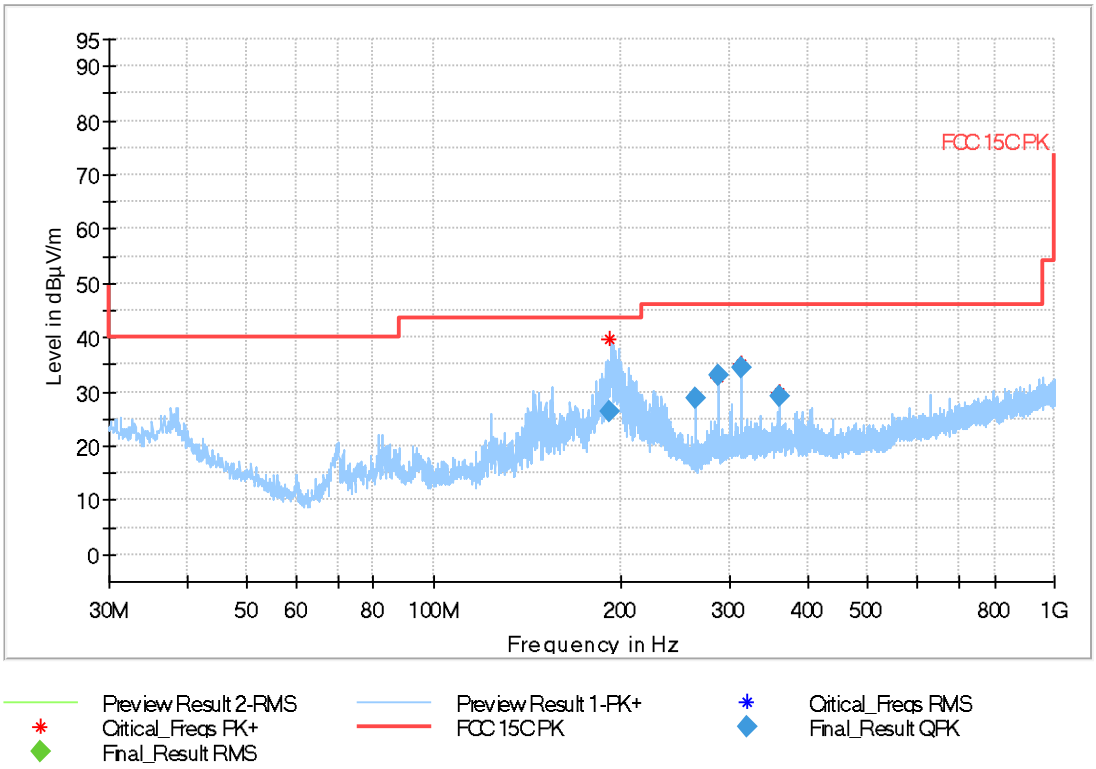
Plot #5 Radiated Emissions: 30 MHz – 1GHz

Modulation: GFSK | **Channel: Mid**

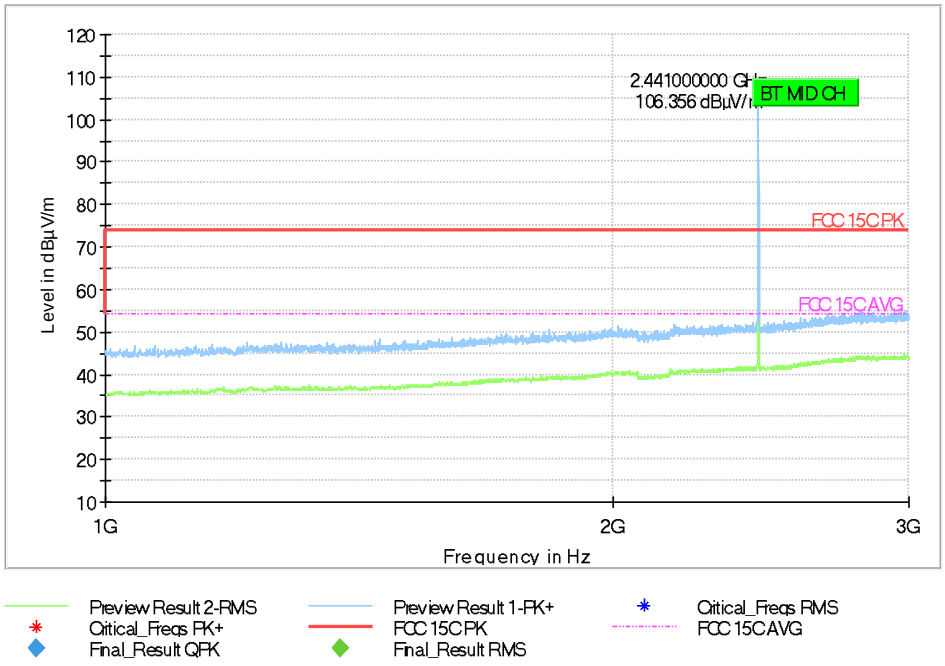
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
192.489	26.47	---	43.50	17.03	100.0	100.0	143.0	V
264.006	28.75	---	46.00	17.25	100.0	100.0	100.0	V
287.991	32.94	---	46.00	13.06	100.0	100.0	145.0	H
312.001	34.53	---	46.00	11.47	100.0	100.0	138.0	H
359.965	29.09	---	46.00	16.91	100.0	100.0	100.0	H

Disclaimer: Any measurement data within 2dB from the limit line is conditional PASS/FAIL due to measurement uncertainty considerations.



Plot #6 Radiated Emissions: 1-3 GHz		
Modulation: GFSK	**Channel: Mid**	

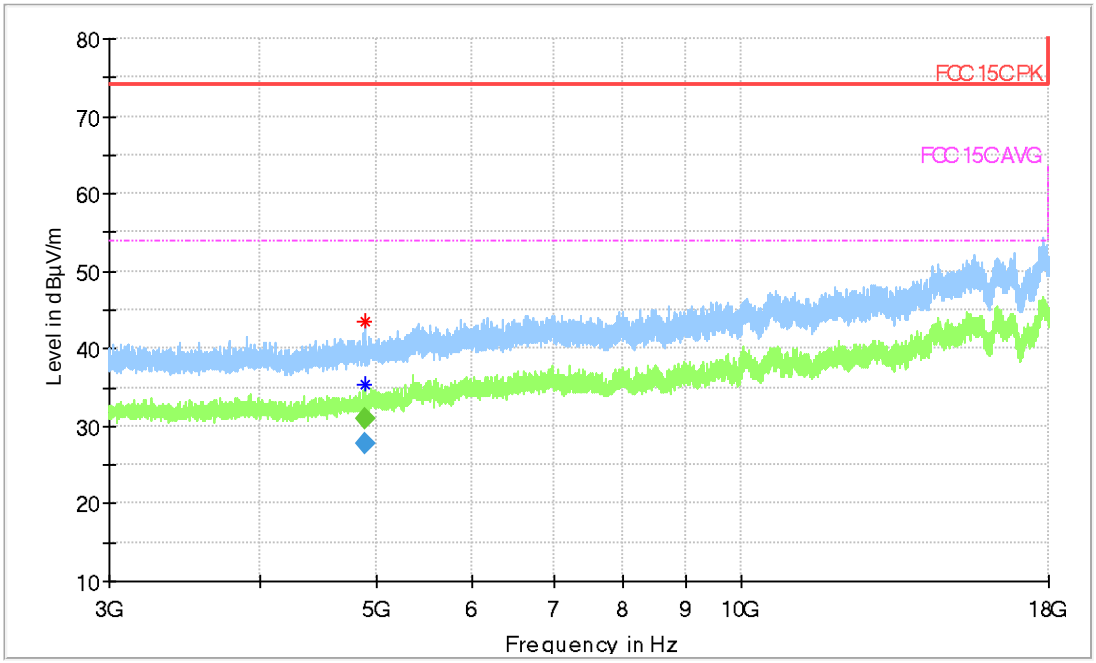


Plot #7 Radiated Emissions: 3-18 GHz

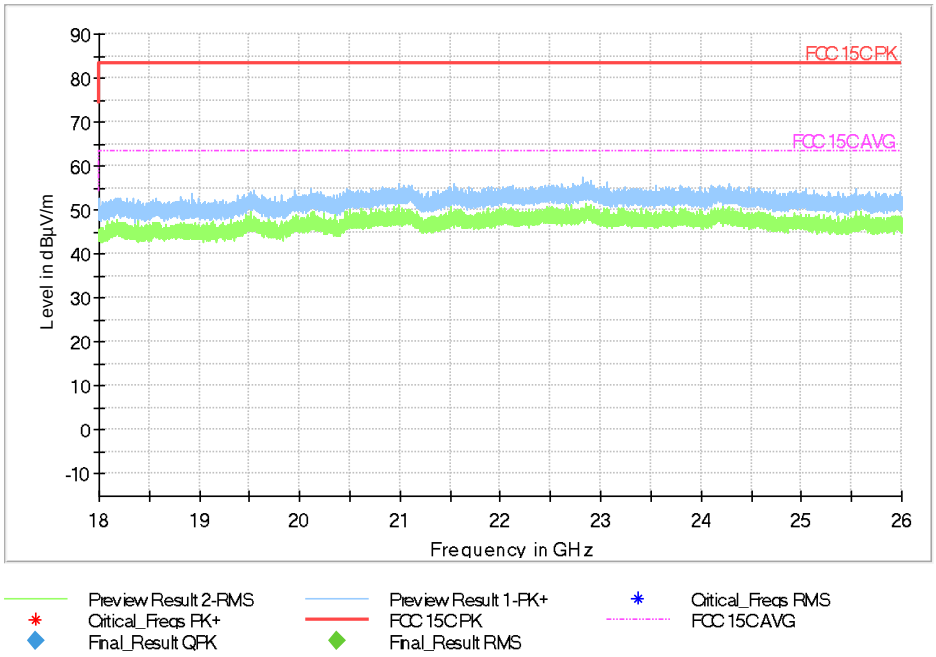
Modulation: GFSK | **Channel: Mid**

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
4881.746	---	30.98	53.98	23.00	200.0	1000.0	131.0	V
4881.877	27.74	---	73.99	46.25	200.0	1000.0	204.0	V



Plot #8 Radiated Emissions: 18-26 GHz		
Modulation: GFSK	**Channel: Mid**	

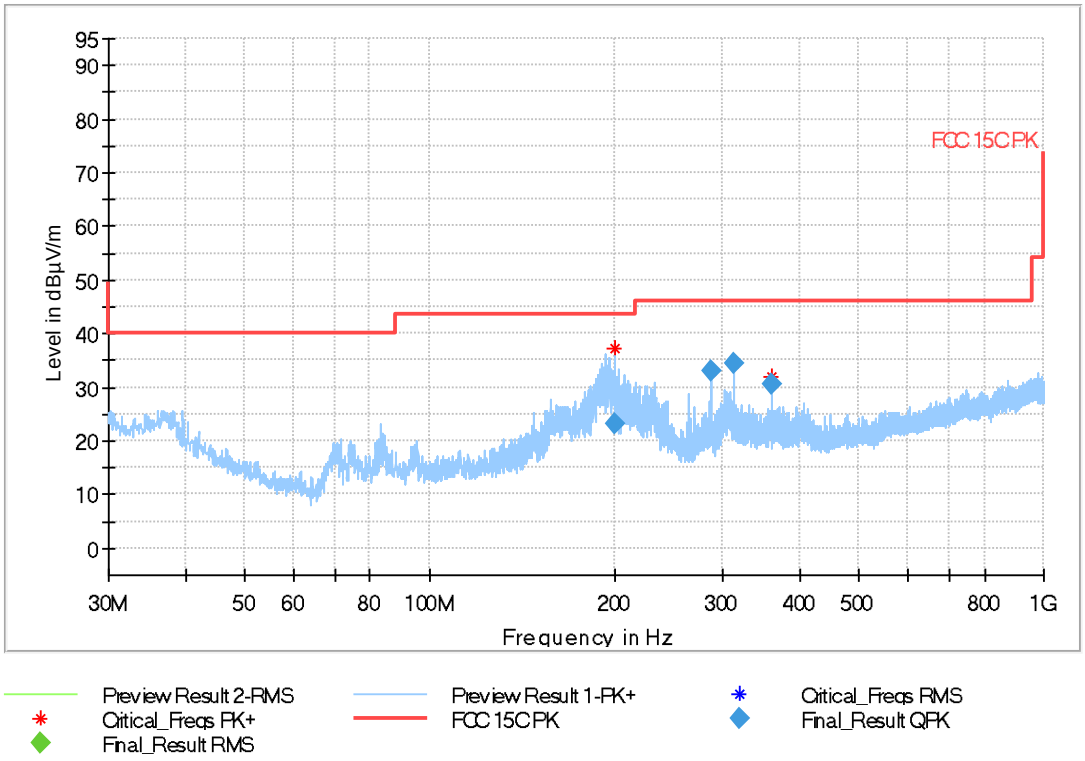


Plot #9 Radiated Emissions: 30 MHz – 1GHz

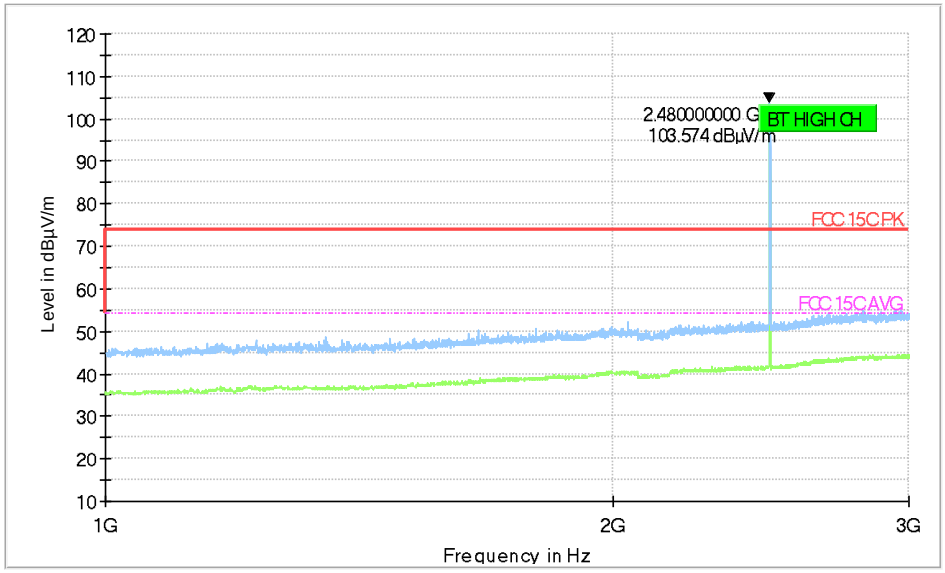
Modulation: GFSK | **Channel: High**

Final_Result

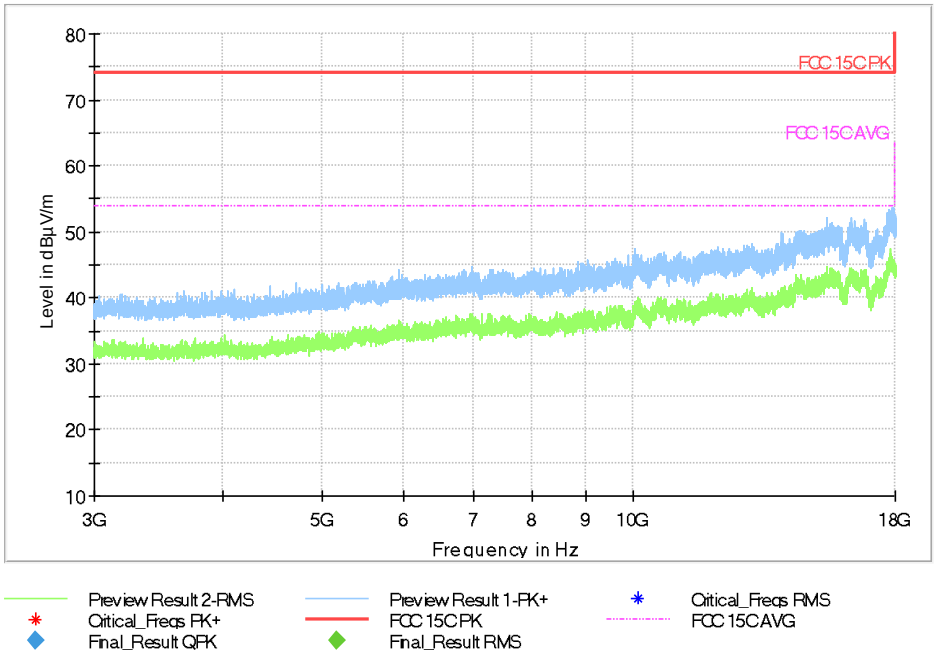
Frequency (MHz)	QuasiPeak (dBµV/m)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
200.545	23.12	---	43.50	20.38	100.0	100.0	100.0	V
288.005	32.97	---	46.00	13.03	100.0	100.0	117.0	H
312.009	34.26	---	46.00	11.74	100.0	100.0	145.0	H
359.990	30.52	---	46.00	15.48	100.0	100.0	100.0	H



Plot # 10 Radiated Emissions: 1-3 GHz and Restricted Bands		
Modulation: GFSK	**Channel: High**	



Plot #11 Radiated Emissions: 3-18 GHz		
Modulation: GFSK	**Channel: High**	



8.8 AC Power Line Conducted Emissions

8.8.1 Measurement according to ANSI C63.4

Analyzer Settings:

- RBW = 9 KHz (CISPR Bandwidth)
- Pre-scan Detector = Peak / Average for
- Final Measurements Detector = Quasi-Peak / Average

8.8.2 Limits: FCC 15.207 & RSS-Gen 8.8

(a) Except as shown in paragraphs (b) and (c) of this section of the CFR, for an intentional radiator that 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 the limits in the following table (1), as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

8.8.3 Test conditions and setup:

Ambient Temperature (C)	EUT Set-Up #	EUT operating mode	Power line (L1, L2, L3, N)	Power Input
22	3	GFSK continuous fixed channel	Line & Neutral	110 V / 60 Hz

8.8.4 Measurement Result:

Plot #	Port	EUT Set-Up #	EUT operating mode	Scan Frequency	Limit	Result
1	AC Mains - L	3	GFSK continuous fixed channel	150 kHz – 30 MHz	See section 8.8.2	Pass
2	AC Mains - N	3	GFSK continuous fixed channel	150 kHz – 30 MHz	See section 8.8.2	Pass

8.8.5 Measurement Plots:

Plot # 1

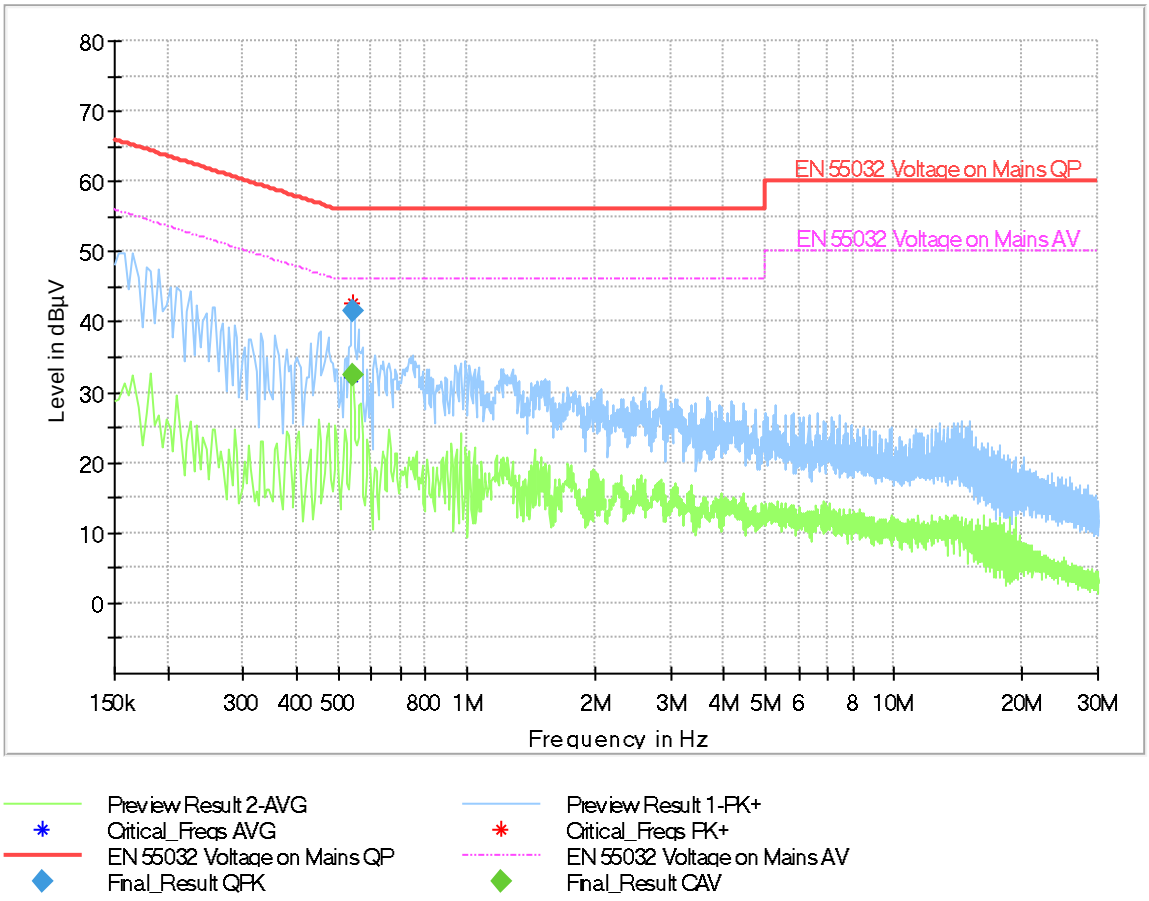
EUT Information

EUT Serial Number: X60495001
Manufacturer: AXON
Comment: L

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.542000	---	32.43	46.00	13.57	500.0	9.000	L1	GND	10.2
0.542000	41.57	---	56.00	14.43	500.0	9.000	L1	GND	10.2

Disclaimer: Any measurement data within 2dB from the limit line is conditional PASS/FAIL due to measurement uncertainty considerations.



Plot # 2

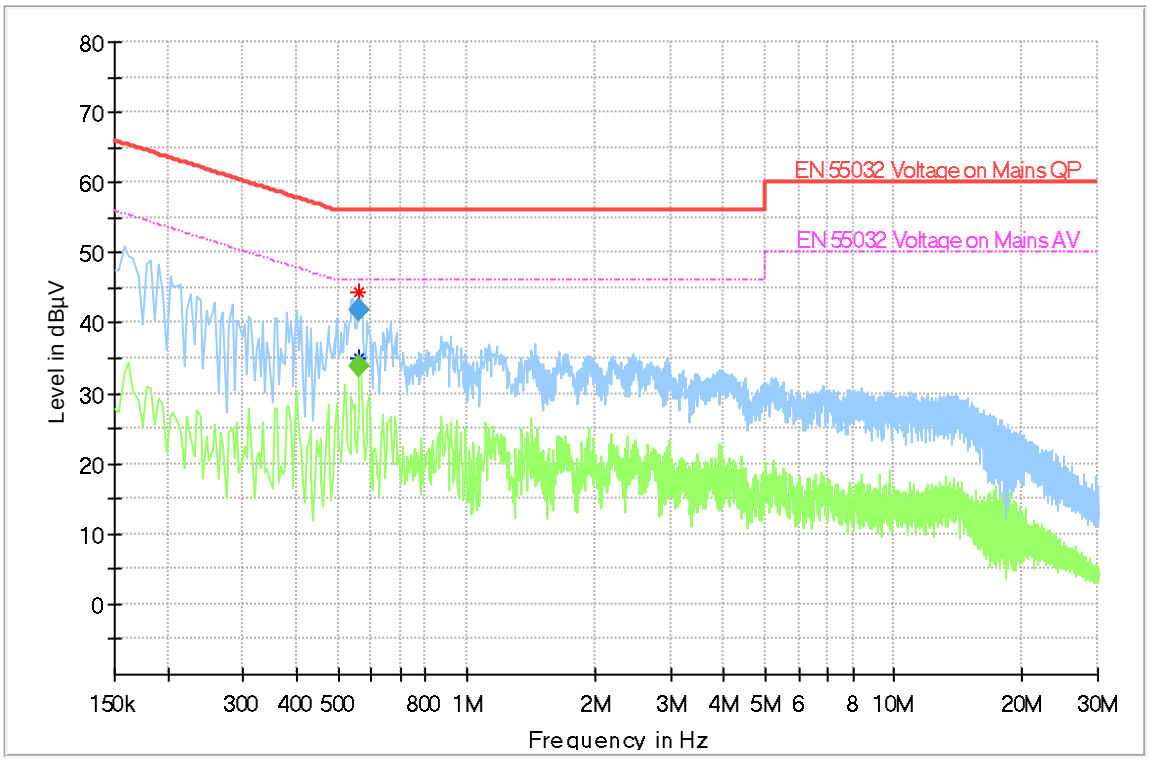
EUT Information

EUT Serial Number: X60495001
Manufacturer: AXON
Comment: N

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.558000	41.81	---	56.00	14.19	500.0	9.000	N	GND	10.3
0.562000	---	33.99	46.00	12.01	500.0	9.000	N	GND	10.3

Disclaimer: Any measurement data within 2dB from the limit line is conditional PASS/FAIL due to measurement uncertainty considerations.



9 Test setup photos

Setup photos are included in supporting file name: "EMC_AXONN-004-19001_FCC_Setup_Photos.pdf"

10 Test Equipment And Ancillaries Used For Testing

Item Name	Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
Antenna Biconilog 3142E	Biconlog Antenna	EMCO	3142E	166067	3 years	6/28/2017
Antenna Horn 3115 SN 35114	Horn Antenna	EMCO	3115	35114	3 years	7/31/2017
Antenna Horn 3117	Horn Antenna	ETS Lindgren	3117PA	169547	3 years	8/8/2017
Antenna Horn 3116	Horn Antenna	ETS Lindgren	3116C-PA	169535	3 years	9/24/2017
Active Loop Antenna	Active Loop Antenna	ETS Lindgren	6507	161344	3 years	10/26/2017
FSV40	Spectrum Analyzer	R&S	FSV40	101022	3 years	7/5/2017
Thermometer Humidity	Thermometer Humidity	Dickson	TM320	5280063	3 years	11/02/2017
FSU	Spectrum Analyzer	R&S	FSU26	200302	2 Years	7/5/2017
LISN	LISN	FCC	FCC-LISN-50-25-2-08	8014	3 years	11/10/2016

Note: 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.

11 Revision History

Date	Report Name	Changes to report	Report prepared by
2019-07-11	EMC_AXONN-004-19001_15.247_DSS	Initial Version	Kevin Wang