FCC / IC Test Report

FOR:
MP CONSULTING LLC

Model Name:
84000100019_04

Product Description:
Daughterboard: A communications module capable of WIFI and Bluetooth communications

FCC ID: 2AQ89-APT0001
IC ID: 24336-AT0001

Applied Rules and Standards:
47 CFR Part 15.247 (DTS)
RSS-247 Issue 2 (DTS) & RSS-Gen Issue 5

REPORT #: EMC_ACTIV_001_18001_FCC_15.247_BT_DTS

DATE: 2019-08-07

A2LA Accredited

IC recognized # 3462B-1

***CETECOM* Inc.**
411 Dixon Landing Road ◆ Milpitas, CA 95035 ◆ U.S.A.
Phone: + 1 (408) 586 6200 ◆ Fax: + 1 (408) 586 6299 ◆ E-mail: info@cetecom.com ◆ http://www.cetecom.com
CETECOM Inc. is a Delaware Corporation with Corporation number: 2905571

TABLE OF CONTENTS

1 Assessment

The following device was evaluated against the radiated spurious emission 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	Model #
AVCTIVE PROTECTIVE TECHNOLOGIES, INC.	Daughterboard: A communications module capable of WIFI and Bluetooth communications	84000100019_04 (DB Module)

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2019-08-07	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: 2019.08.07 15:46:52 -07'00'

Responsible for the Report:

Date	Section	Name	Signature
2019-08-07	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: 2019.08.07 11:10:26 -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:	Rami Saman

2.2 Identification of the Client

Applicant's Name:	MP CONSULTING LLC
Street Address:	21805 W. FIELD PKWY, SUITE #160
City/Zip Code:	DEER PARK, IL 60010
Country:	USA

2.3 Identification of the Manufacturer

Manufacturer's Name:	ACTIVE PROTECTIVE TECHNOLOGIES, INC.
Manufacturers Address:	580 Virginia Dr., Suite 230
City/Zip Code	Fort Washington, PA 19034
Country	USA

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Model No:	84000100019_04
HW Version :	84000100019_A
SW Version :	Daughterboard REV.A
FCC-ID:	2AQ89-APT0001
IC-ID:	24336-APT0001
HVIN:	84000100019_04
PMN:	WIFI Daughterboard
Product Description:	Daughterboard (Module Integrated)
Frequency Range / number of channels:	Murata LBEE5KL1DX: Nominal band: 2400 MHz – 2483.5 MHz; Center to center: 2402 MHz (ch 0) – 2480 MHz (ch 39), 40 channels
Type(s) of Modulation:	Bluetooth version 4.2, Low Energy, using Dynamic Sequence Spread Spectrum with GFSK modulation.
Modes of Operation:	Bluetooth LE in both advertising and connected mode of operation
Antenna Information as declared:	PCB Chip Antenna (PULSE), Max Gain=2.2dBi
Max. Peak Output Power:	Conducted Power 7.379 dBm[1]
Power Supply/ Rated Operating Voltage Range:	In-Box charger or On-board Battery / Vmin: 3.3 VDC/ Vnom: 3.6 VDC / Vmax: 4.2 VDC
Operating Temperature Range:	-30-70°C
Other Radios included in the device:	Bluetooth BR / EDR WIFI 802.11a/b/g/n
Sample Revision:	☐Prototype Unit; ■Production Unit; ☐Pre-Production

Note1: Leverage form module report “RF151228C18B-2”

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	P18370015	84000100019_A	Daughterboard REV.A	Radiated Emissions

3.3 Test Support Equipment (TSE) details

AE #	Type	Model	Manufacturer	Serial Number
1	Laptop	Dell	Latitude E5540	NA

3.4 Test Sample Configuration

EUT Set-up #	Combination of TSE used for test set up	Comments
1	EUT#1 + TSE#1	The radio of the EUT was configured to a fixed channel with highest possible duty cycle using software provided by client that is not available to the end user.

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 with the highest possible 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.

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 of ISED Canada.

Testing procedures are based on 558074 D01 DTS Meas Guidance v04 – "GUIDANCE FOR PERFORMING COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEMS (DTS) OPERATING UNDER SECTION 15.247" - April 5, 2017, by the Federal Communications Commission, Office of Engineering and Technology, Laboratory Division.

5 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	NA	NP	Result
§15.247(a)(1) RSS-247 5.2(1)	Emission Bandwidth	Nominal	BTLE	☐	☐	■	N/A
§15.247(e) RSS-247 5.2(2)	Power Spectral Density	Nominal	BTLE	☐	☐	■	N/A
§15.247(b)(1) RSS-247 5.4(4)	Maximum Conducted Output Power and EIRP	Nominal	BTLE	☐	☐	■	N/A
§15.247(d) RSS-247 5.5	Band edge compliance Unrestricted Band Edges	Nominal	BTLE	☐	☐	■	N/A
§15.247; 15.209; 15.205 RSS-Gen 8.9; 8.10	Band edge compliance Restricted Band Edges	Nominal	BTLE	☐	☐	■	N/A
§15.247(d); §15.209 RSS-Gen 6.13	TX Spurious emissions-Radiated	Nominal	BTLE	■	☐	☐	Complies
§15.207(a) RSS Gen 8.8	AC Conducted Emissions	Nominal	BTLE	☐	☐	■	N/A[2]

Note1: NA= Not Applicable; NP= Not Performed.
Note2: EUT is not connected to AC mains

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

9 kHz to 30 MHz	±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

150 kHz to 30 MHz	±0.7 dB (LISN)

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:

11/8/2018 - 11/14/2018

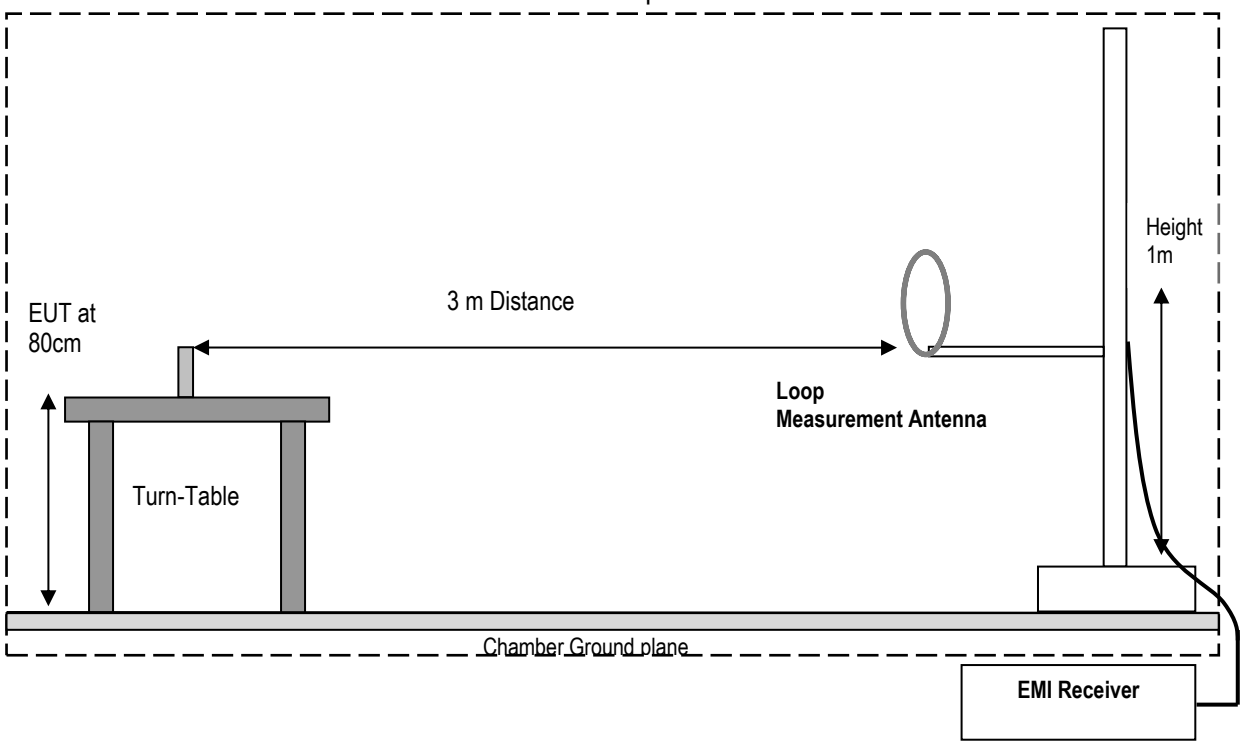
7 Measurement Procedures

7.1 Radiated Measurement

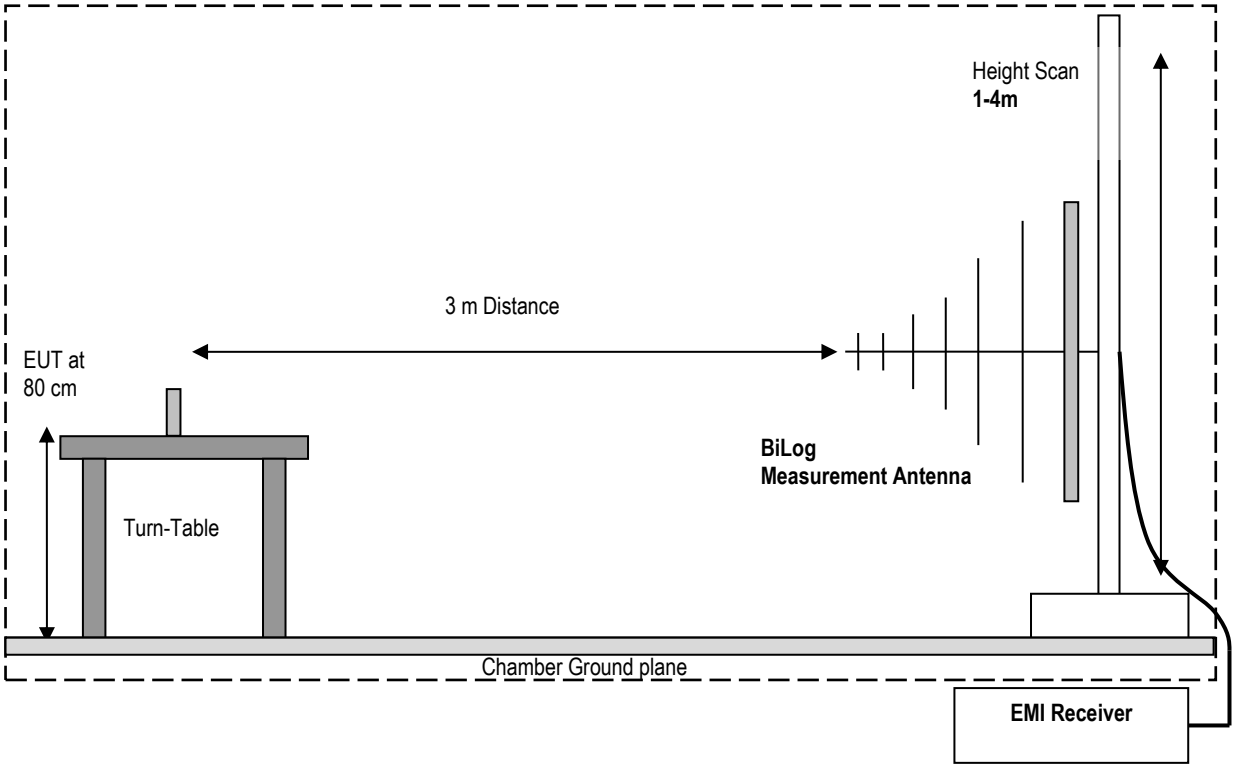
The radiated measurement is performed according to ANSI C63.10 (2013)

- 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.

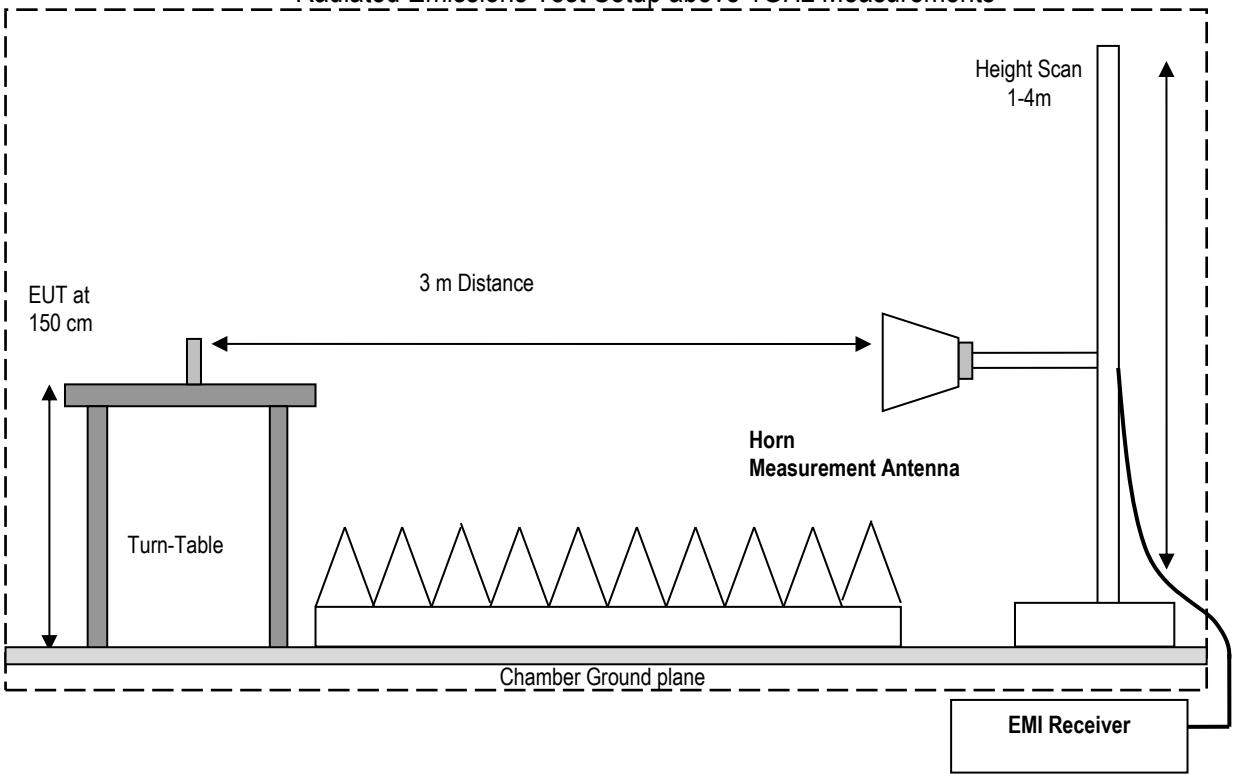
Radiated Emissions Test Setup below 30MHz Measurements



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 RF Conducted Measurement Procedure

Testing procedures are based on 558074 D01 DTS Meas Guidance v04 – "GUIDANCE FOR PERFORMING COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEMS (DTS) OPERATING UNDER SECTION 15.247" - April 5, 2017, by the Federal Communications Commission, Office of Engineering and Technology, Laboratory Division.

- 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.
- Calculate the conducted power by taking into account attenuation of the cable and the attenuator

8 Test Result Data

8.1 Radiated Transmitter Spurious Emissions and Restricted Bands

8.1.1 Measurement according to ANSI C63.10 (2013)

Spectrum Analyzer Settings:

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

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

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

- 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.
- 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 factor as follow: Conversion factor (CF) = 40 log (D/d) = 40 log (300m / 3m) = 80dB

8.1.2 Limits:

FCC §15.247

- 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)).

FCC §15.209 & RSS-Gen 8.9

- Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency of emission (MHz)	Field strength (µV/m)	Measurement Distance (m)	Field strength @ 3m (dBµV/m)
0.009–0.490	2400/F(kHz) / ---------	300	-
0.490–1.705	24000/F(kHz) / --------	30	-
1.705–30.0	30 / (29.5)	30	-
30–88	100	3	40 dBµV/m
88–216	150	3	43.5 dBµV/m
216–960	200	3	46 dBµV/m
Above 960	500	3	54 dBµV/m

FCC §15.205 & RSS-Gen 8.10

- Except as shown in paragraph (d) of this section, 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
[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= 74 dBµV/m
  *AVG. LIMIT= 54 dBµV/m

8.1.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
23° C	1	GFSK continuous fixed channel	3.6 VDC

8.1.4 Measurement result:

Plot #	Channel #	Scan Frequency	Limit	Result
1-3	Low	30 MHz – 18 GHz	See section 8.1.2	Pass
4-8	Mid	9 kHz – 26 GHz	See section 8.1.2	Pass
9-11	High	30 MHz – 18 GHz	See section 8.1.2	Pass

8.1.5 Measurement Plots:

Plot #1 Radiated Emissions: 30 MHz – 1GHz

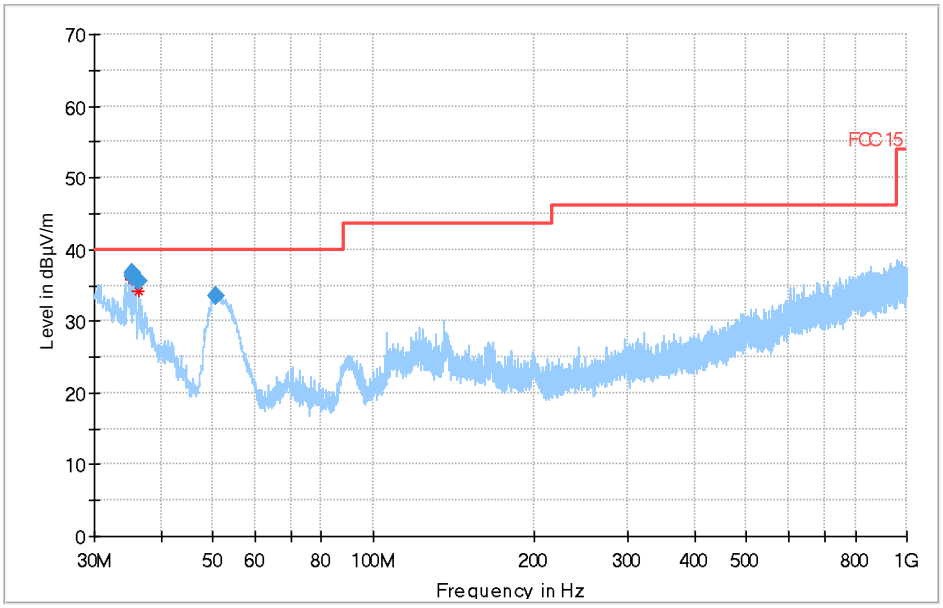
Modulation: BT LE | **Channel: Low**

Final_Result

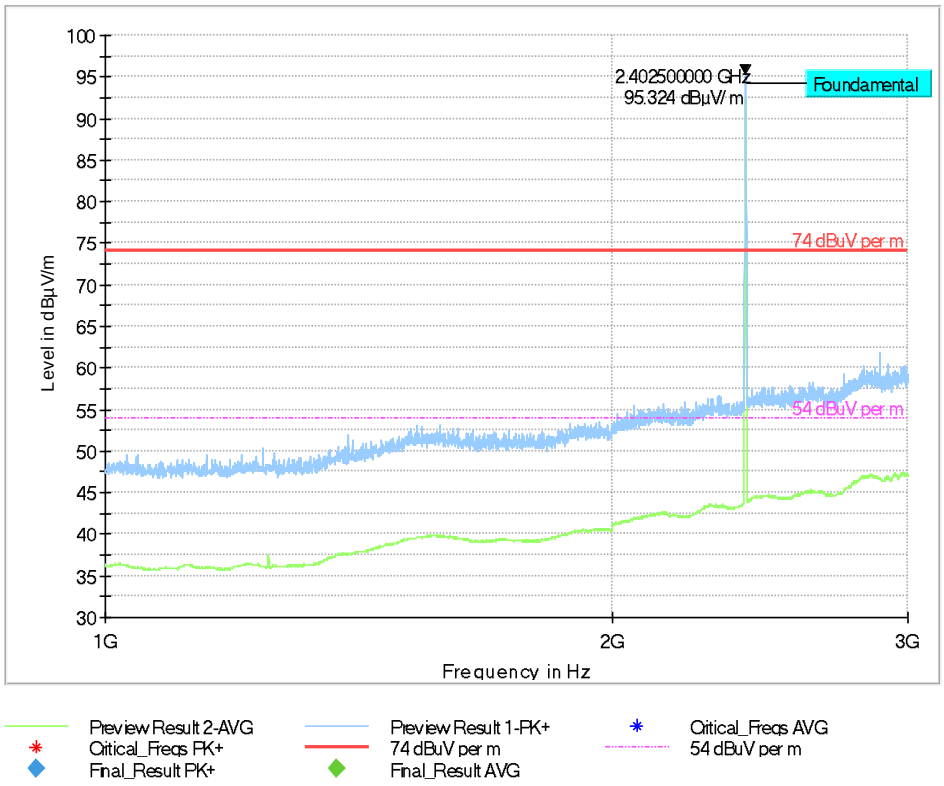
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
35.231945	36.23	40.00	3.77	200.0	120.000	235.0	H	30.0	26.8
35.344377	36.81	40.00	3.19	200.0	120.000	178.0	H	43.0	26.7
36.322833	35.49	40.00	4.51	200.0	120.000	242.0	H	139.0	25.8
50.792418	33.52	40.00	6.48	200.0	120.000	152.0	V	-66.0	2.6

(continuation of the "Final_Result" table from column 16 ...)

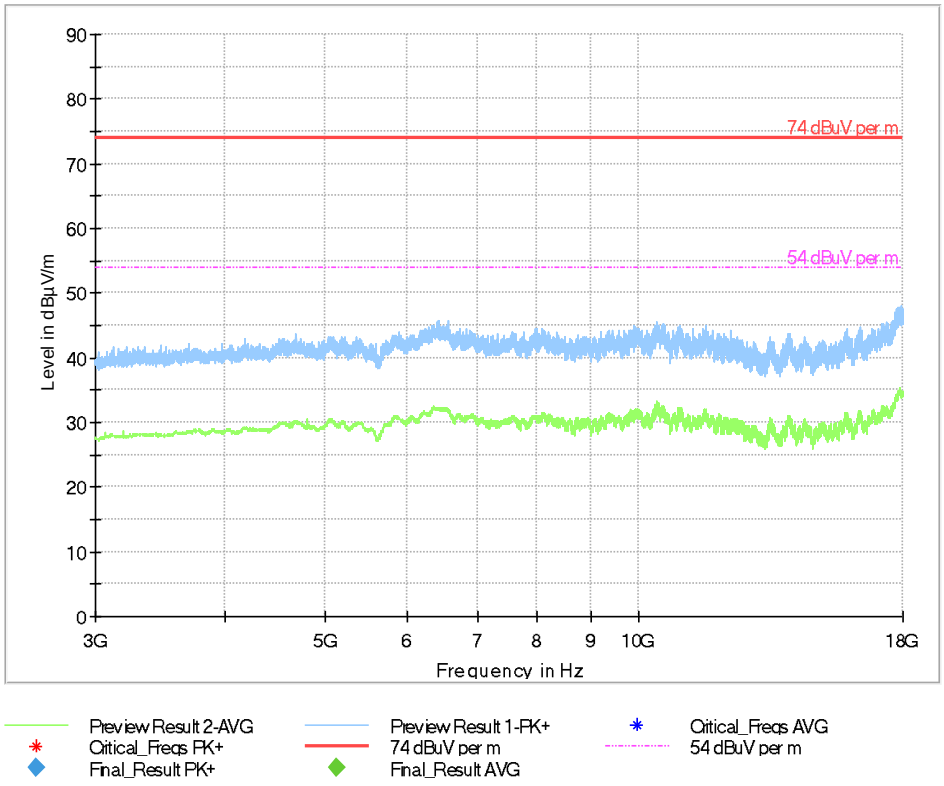
Frequency (MHz)	Comment
35.231945	6:35:17 PM - 11/9/2018
35.344377	6:37:13 PM - 11/9/2018
36.322833	6:39:11 PM - 11/9/2018
50.792418	6:33:16 PM - 11/9/2018



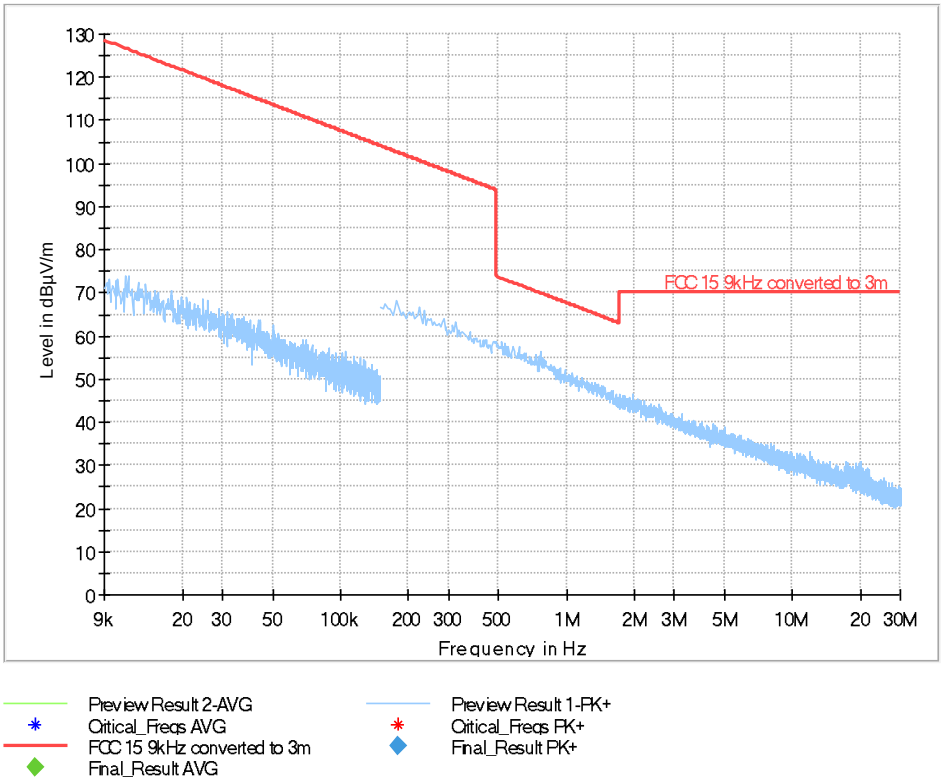
Plot #2 Radiated Emissions: 1-3 GHz		
Modulation: BT LE	**Channel: Low**	



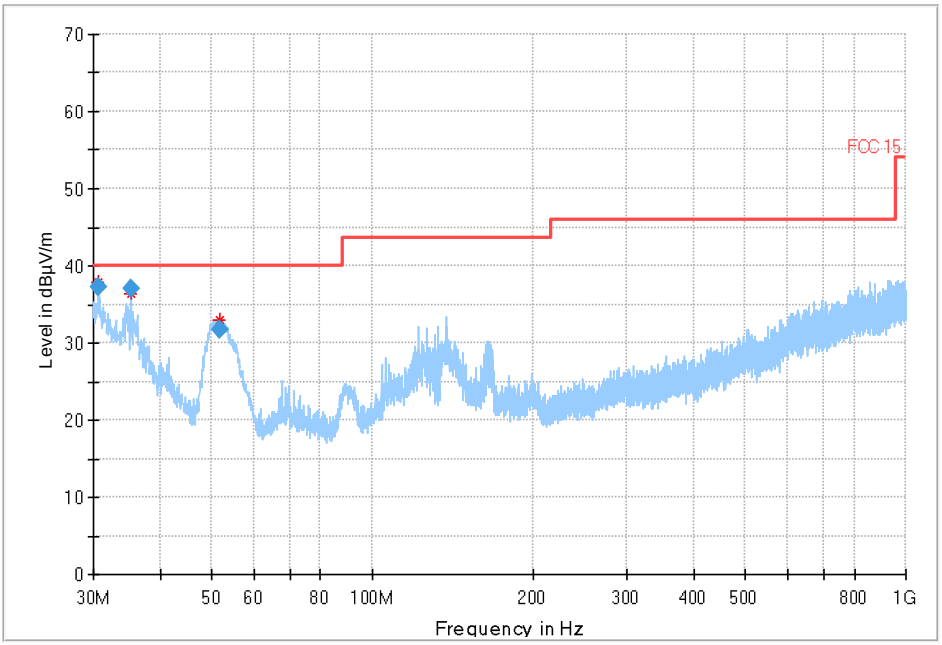
Plot #3 Radiated Emissions: 3-18 GHz		
Modulation: BT LE	**Channel: Low**	



Plot #4 Radiated Emissions: 9 KHz – 30 MHz		
Modulation: BT LE	**Channel: Mid**	



Plot #5 Radiated Emissions: 30 MHz – 1GHz		
Modulation: BT LE	**Channel: Mid**	



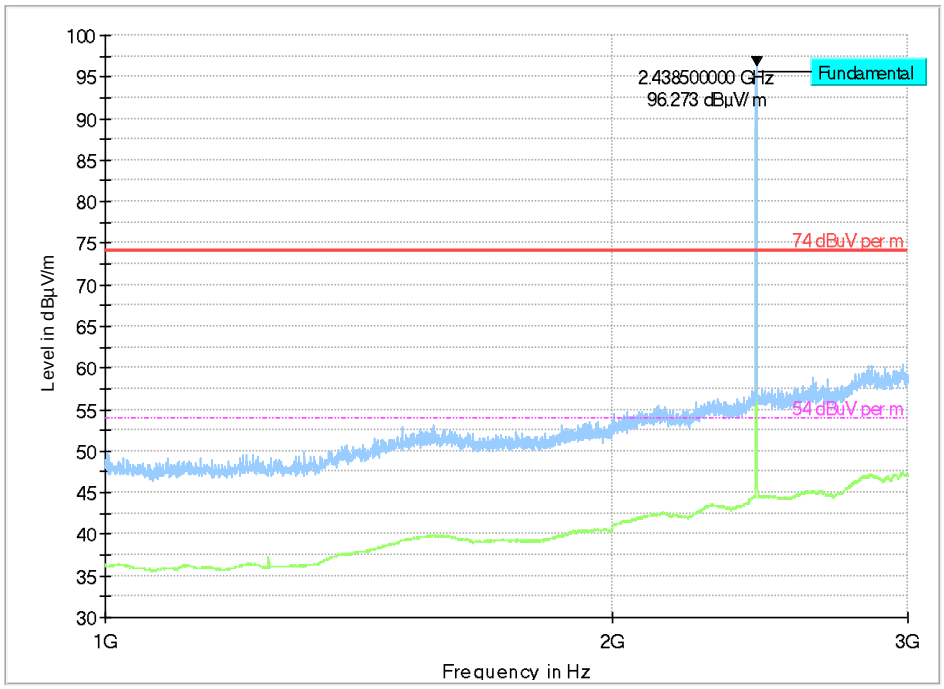
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.718469	37.14	40.00	2.86	200.0	120.000	156.0	H	-50.0	31.0
35.321501	37.07	40.00	2.93	200.0	120.000	303.0	H	12.0	26.8
51.835316	31.80	40.00	8.20	200.0	120.000	140.0	V	74.0	2.7

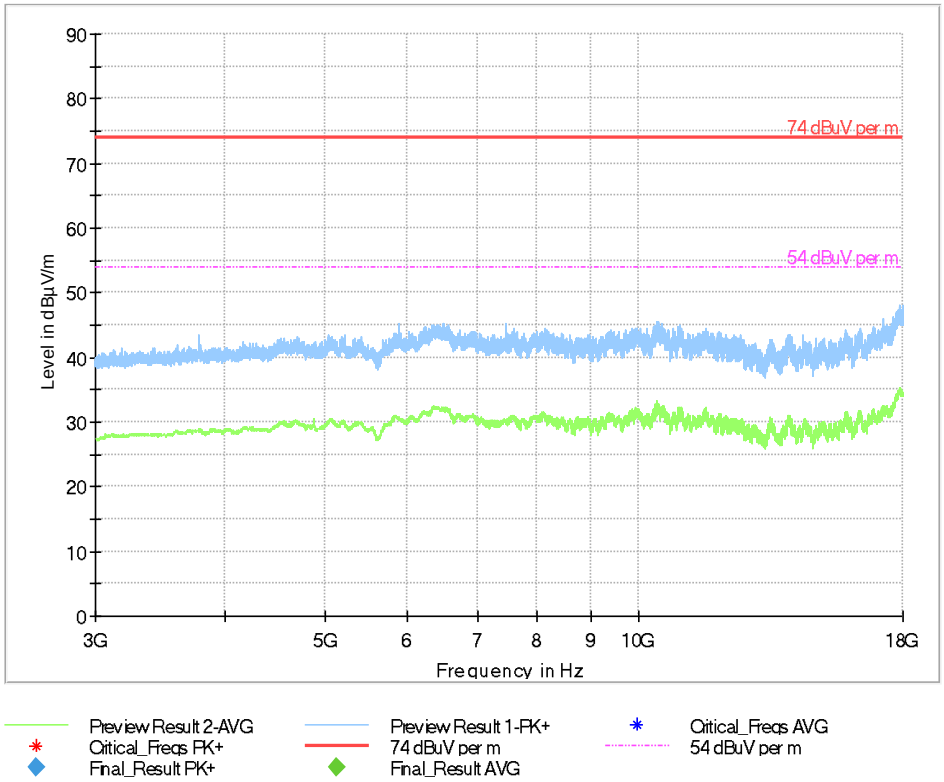
(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment
30.718469	6:18:02 PM - 11/9/2018
35.321501	6:19:55 PM - 11/9/2018
51.835316	6:22:10 PM - 11/9/2018

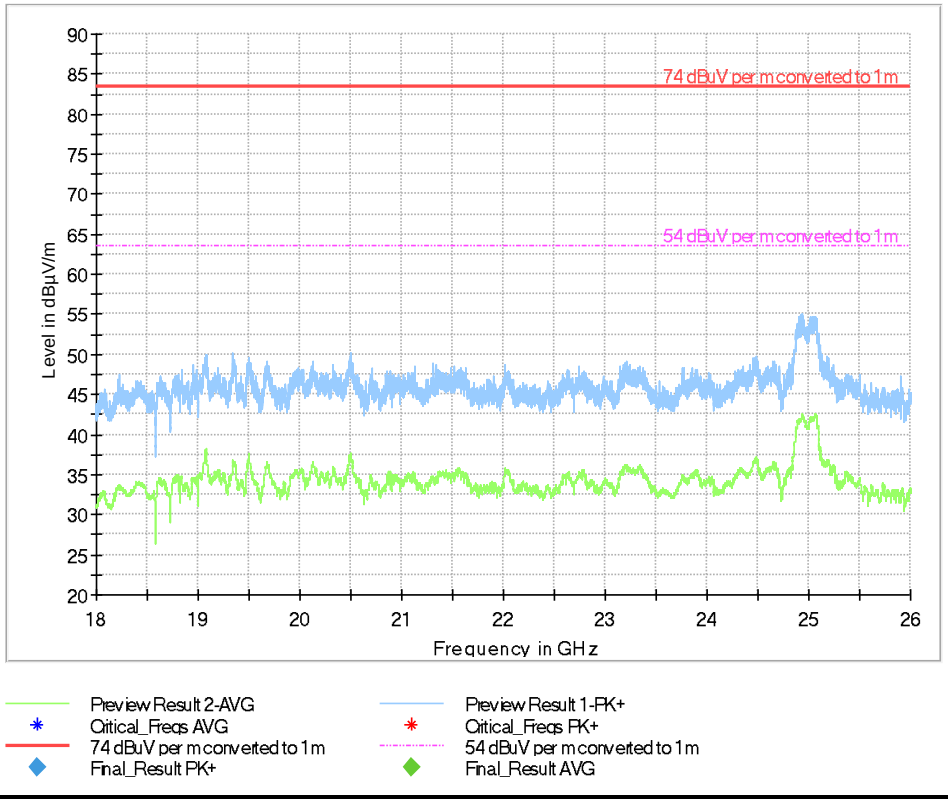
Plot #6 Radiated Emissions: 1-3 GHz		
Modulation: BT LE	**Channel: Mid**	



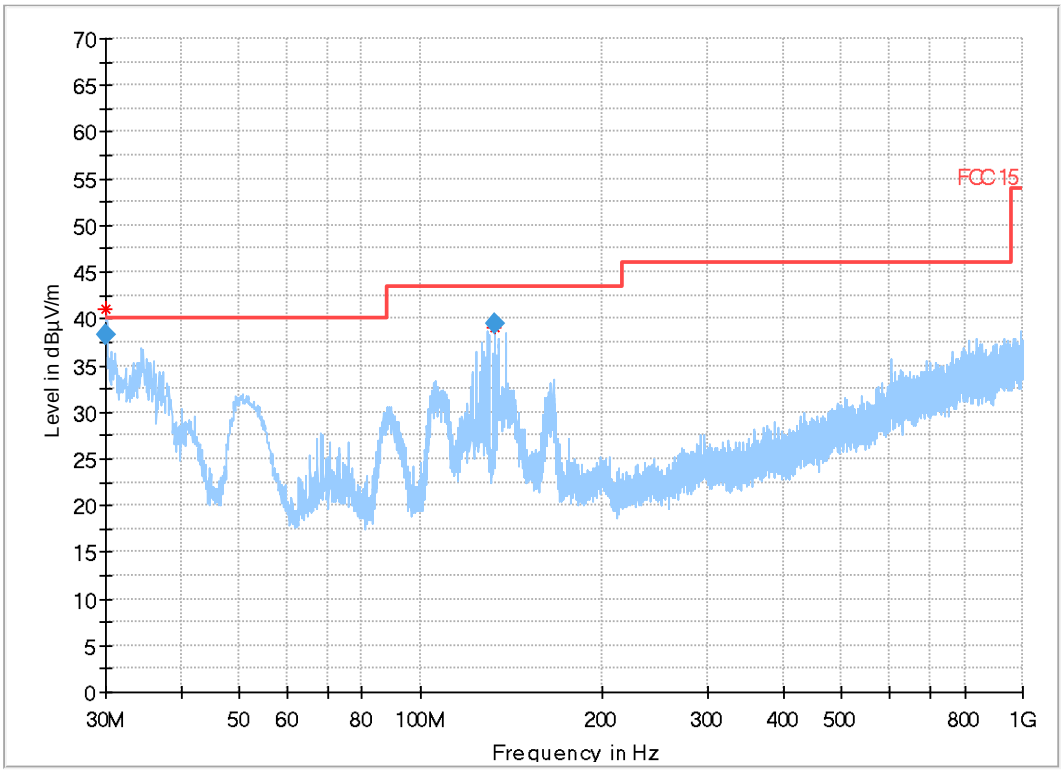
Plot #7 Radiated Emissions: 3-18 GHz		
Modulation: BT LE	**Channel: Mid**	



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



Plot #9 Radiated Emissions: 30 MHz – 1GHz		
Modulation: BT LE	**Channel: High**	



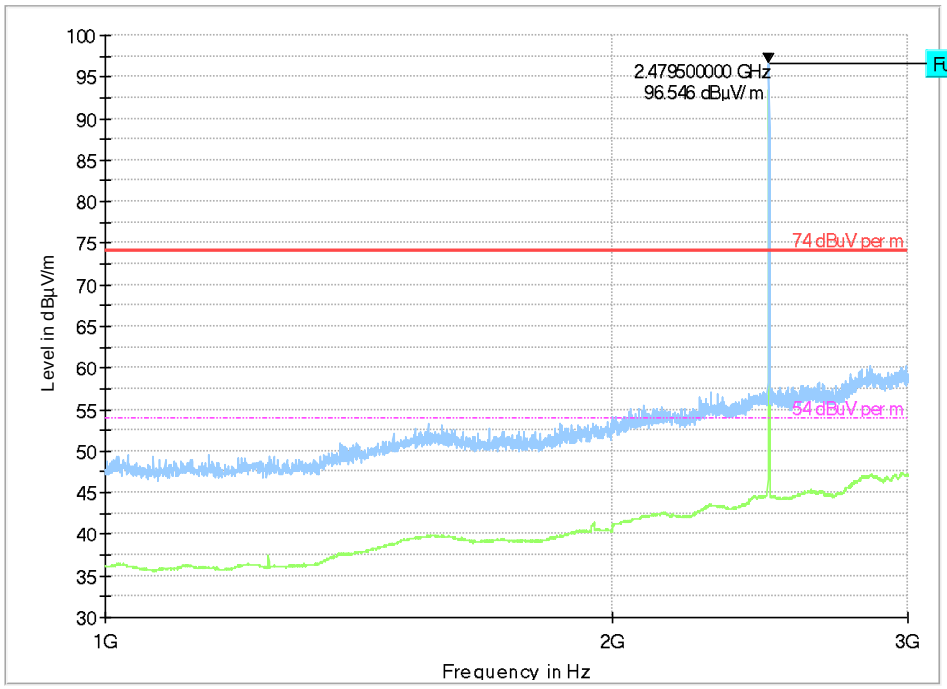
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.074592	38.35	40.00	1.65	200.0	120.000	157.0	H	154.0	31.7
132.705405	39.51	43.52	4.01	200.0	120.000	275.0	H	116.0	22.4

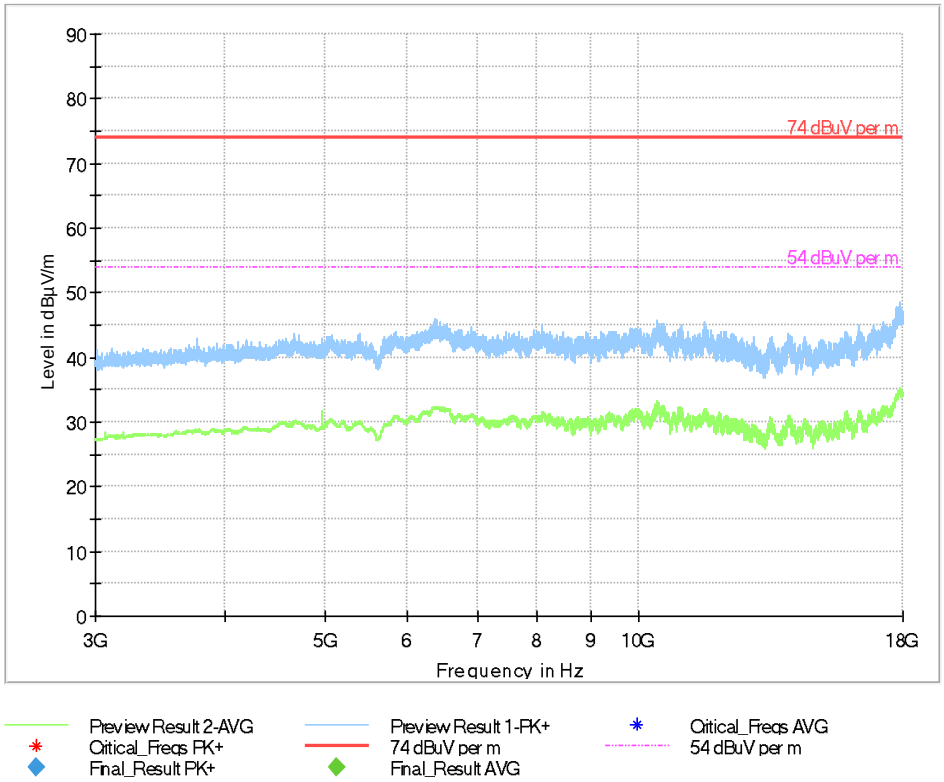
(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment
30.074592	6:07:16 PM - 11/9/2018
132.705405	6:09:00 PM - 11/9/2018

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



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



9 Test setup photos

Setup photos are included in supporting file name: "EMC__ACTIV_001_18001_FCC_15.247_Setup_Photos.pdf"

10 Test Equipment and Ancillaries Used For Testing

Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
Biconlog Antenna	EMCO	3142E	166067	3 years	6/28/2017
Loop Antenna	ETS Lindgren	6507	161344	3 years	10/26/2017
Horn Antenna	EMCO	3115	35114	3 years	7/31/2017
Horn Antenna	ETS Lindgren	3117 PA	169547	3 years	10/31/2017
Compact Digital Barometer	Control Company	35519-055	91119547	2 Years	6/20/2017
Spectrum Analyzer	R&S	FSU26	200065	3 years	7/3/2017
Spectrum Analyzer	R&S	FSV40	101022	3 years	7/5/2017
Thermometer Humidity	Dickson	TM320	5280063	2 Year	11/2/2017

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
2019-08-07	EMC_ACTIV_001_18001_FCC_15.247_BT_DTS	Initial version	Kevin Wang