RSE Cotransmission FCC Test Report

FOR:

Weathermatic

Model Name:

SLHUB-RF-5

Product Description:

Module receiving weather station data on a 15 or 60 minutes interval

FCC ID: OLPSLHUBRF900MZ

Applied Rules and Standards:
47 CFR Part 15.247 (DTS)

REPORT #: EMC_ASTRO-001-20001_15.247_DTS

DATE: 2020-04-08

A2LA Accredited

IC recognized #
3462B-1

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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.

No deviations were ascertained.

Company	Description	Model #
Weathermatic	Module receiving weather station data on a 15 or 60 minutes interval	SLHUB-RF-5

Responsible for Testing Laboratory	Cindy Li (EMC Lab Manager)	Cindy Li Digitally signed by cindy.li@cetecom.com DN: CN=cindy.li@cetecom.com Reason: I am approving this document Location: Date: 2020-05-05 14:19:30
Section EMC	**Name**	**Signature**

Responsible for the Report	Kris Lazarov (Senior EMC Engineer)	Kris Lazarov Digitally signed by Kris Lazarov Date: 2020.05.05 14:07:25 -07'00'
Section EMC	**Name**	**Signature**

The test results of this test report relate exclusively to the test item specified in Section3.
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
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EMC Lab Manager:	Cindy Li
Responsible Project Leader:	Kris Lazarov

2.2 Identification of the Client

Applicant Firm/Name:	Weathermatic
Street Address:	3301 W Kingsley Rd
City/Zip Code	Garland, TX 75041
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

Model No:	SLHUB-RF-5
HW Version :	FR
SW Version :	0.21
FCC-ID :	OLPSLHUBRF900MZ
Product Description:	Module receiving weather station data on a 15 or 60 minutes interval
FHSS Radio Module:	Weathermatic Model: SLHUBRF-5 FCC ID: OLPSLHUBRF900MZ
Wi-Fi & Bluetooth Module:	Espressif Systems Model: ESP32-WROOM-32D FCC ID: 2AC7Z-ESPWROOM32D
Modes of Operation:	WLAN and FHSS BTLE and FHSS
Power Supply/ Rated Operating Voltage Range:	Vmin: 20V dc/ Vnom: 24V dc / Vmax: 27.2V dc
Operating Temperature Range	-40 ºC to 85 ºC
Sample Revision	☐Prototype Unit; ■Production Unit; ☐Pre-Production

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	Engineering sample	FR	0.21	

3.3 Accessory Equipment details

AE #	Type	Model	Manufacturer	Serial Number
1	Irrigation C	SL1600	Weathermatic	0630160311

3.4 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#1 + AE#1	

3.5 Mode of Operation details

Mode of Operation	Description of Operating modes	Additional Information
1	WLAN and FHSS	The WiFi module was operated in 802.11b mode on Low, Mid, and High channel simultaneously with the FHSS radio on middle channel.
2	BTLE and FHSS	The BT LE module was operated on Low, Mid, and High channel simultaneously with the FHSS radio on middle channel.

3.6 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 highest power. 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.

This test report is to support a request for new equipment authorization under the FCC ID: OLPSLHUBRF900MZ

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	Modes	Result
§15.247(d); §15.209 RSS-Gen 6.13	TX Spurious emissions-Radiated	Nominal	WLAN and FHSS BTLE and FHSS	Complies
§15.207(a) RSS Gen 8.8	AC Conducted Emissions	Nominal	WLAN and FHSS	Complies

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:

04/02/2020 - 04/03/2020

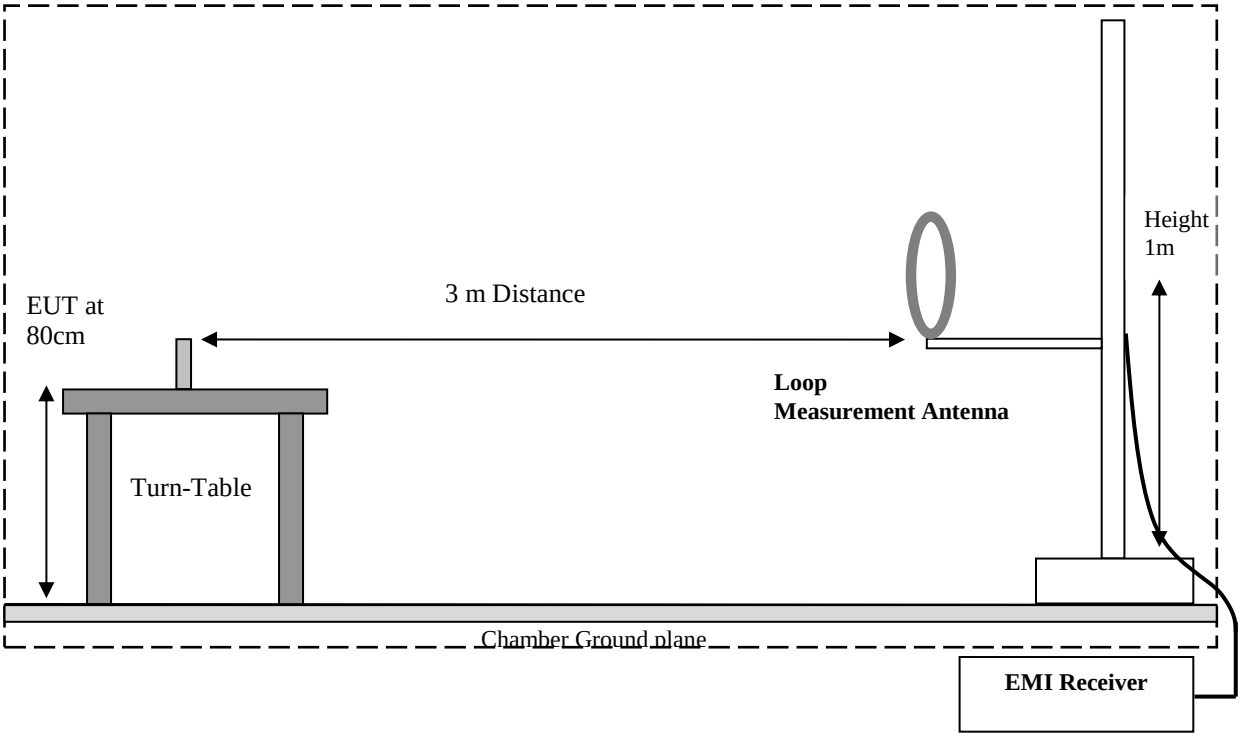
7 Measurement Procedures

7.1 Radiated Measurement

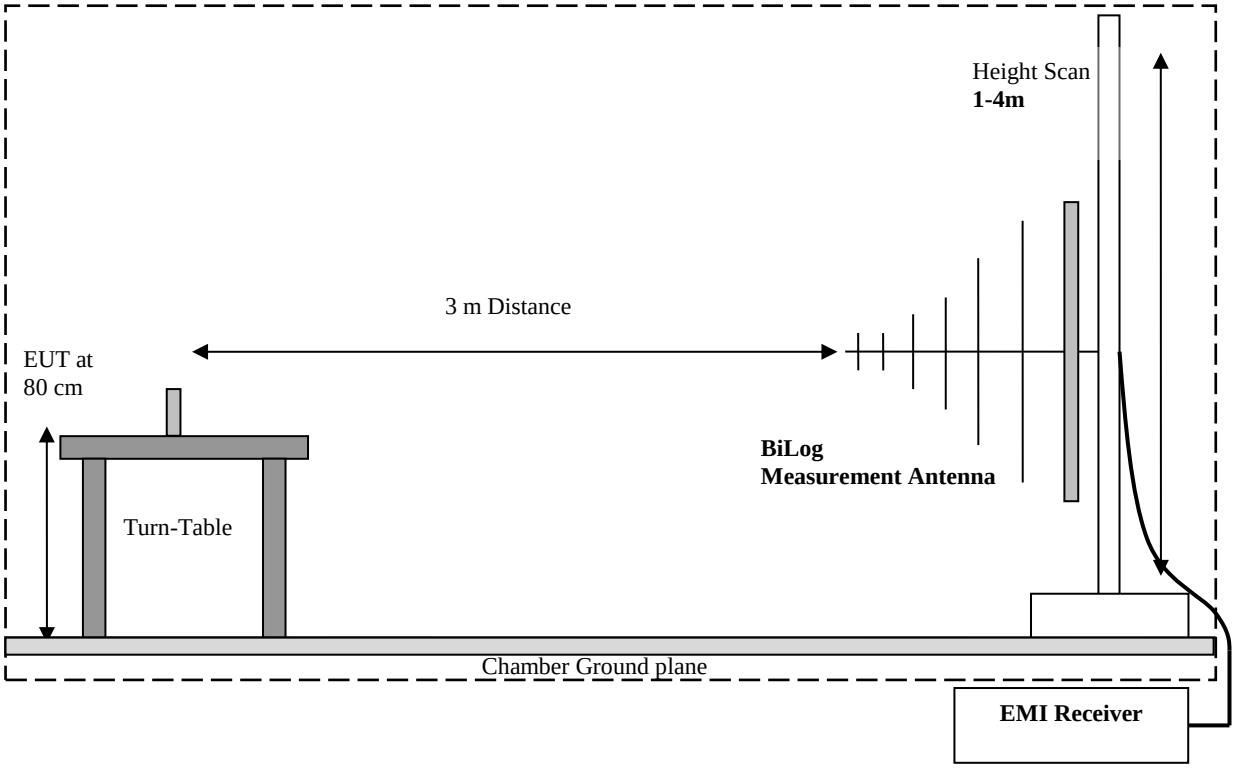
The radiated measurement is performed according to ANSI C63.10 (2013)

- 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.

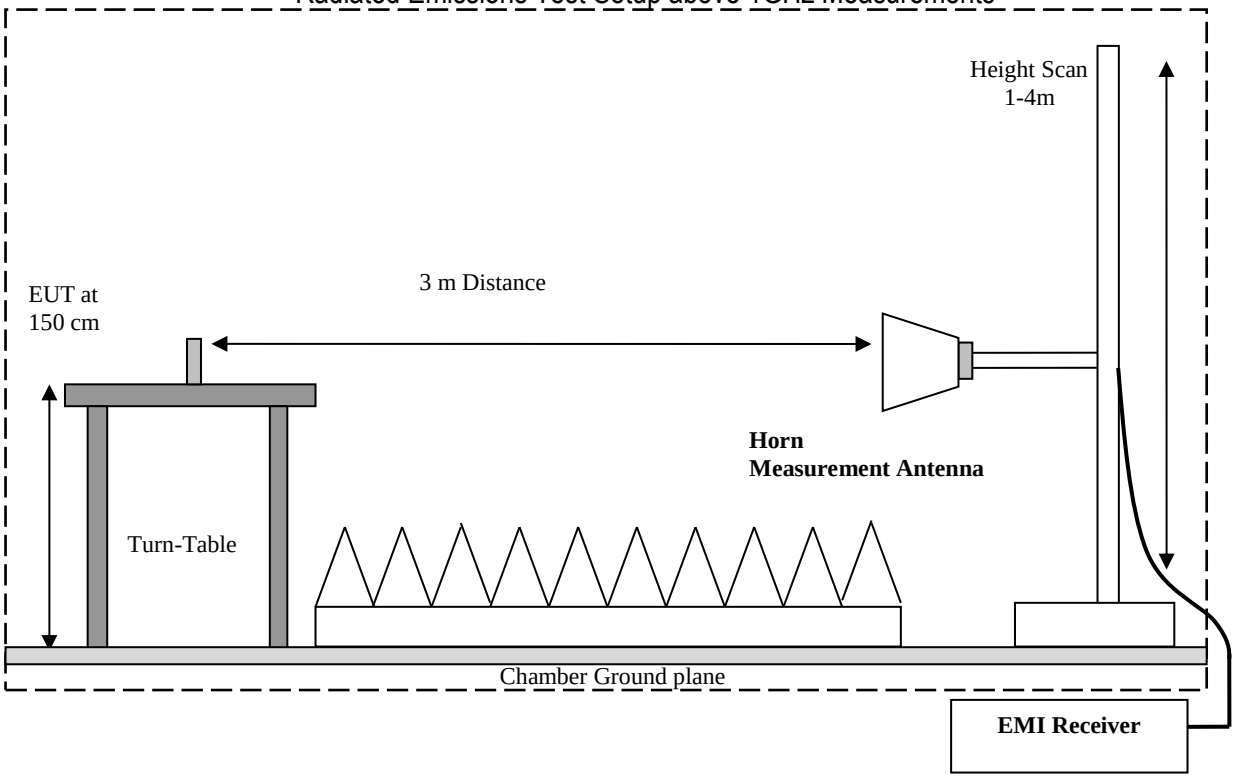
Radiated Emissions Test Setup below 30MHz Measurements



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

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

- 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

- 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
22° C	1	1 and 2	120V / 60Hz

DC correction was applied to the harmonics results for SLHUBRF-5 radio. The correction factor was derived from the Nemko test report # 10233152RUS2 published in FCC database.

Duty Cycle correction factor (dB) = 20 log (RFon ms / 100 ms) = 20 log (7.41 / 100) = -22.6 dB

8.1.4 Measurement result:

EUT operating mode 1 WLAN and FHSS				
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

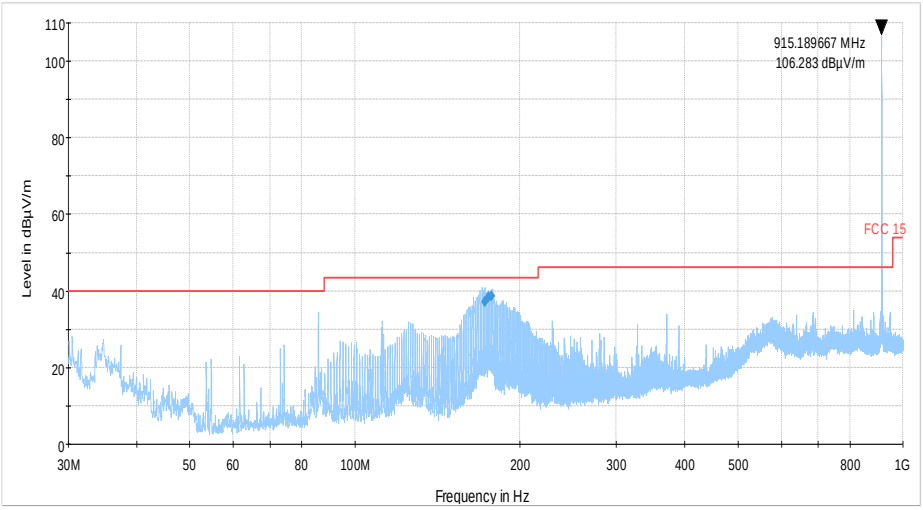
EUT operating mode 2 BTLE and FHSS				
Plot #	**Channel #**	**Scan Frequency**	**Limit**	**Result**
12-14	Low	30 MHz – 18 GHz	See section 8.1.2	Pass
15-19	Mid	9 kHz – 26 GHz	See section 8.1.2	Pass
20-22	High	30 MHz – 18 GHz	See section 8.1.2	Pass

8.1.5 Measurement Plots:

Plot #1 Radiated Emissions: 30 MHz – 1GHz

Mode: WLAN 802.11/b and FHSS | **Channel: WLAN Low / FHSS Mid**

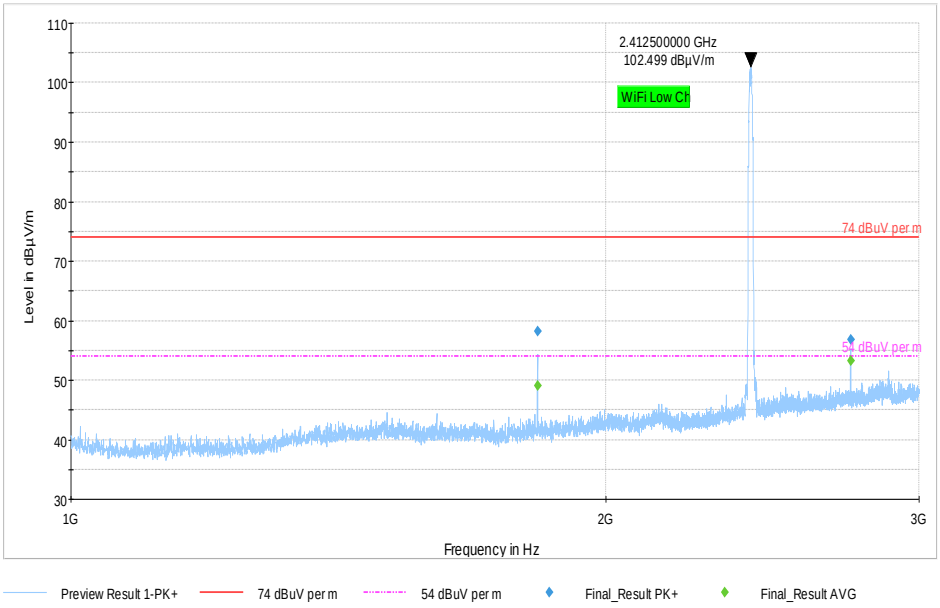
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
172.734	37.17	43.52	6.35	200.0	120.000	266.0	V	153.0
175.118	38.30	43.52	5.22	200.0	120.000	281.0	V	203.0
177.458	38.74	43.52	4.78	200.0	120.000	154.0	H	94.0



Plot # 2 Radiated Emissions: 1-3 GHz

Mode: WLAN 802.11/b and FHSS | **Channel: WLAN Low / FHSS Mid**

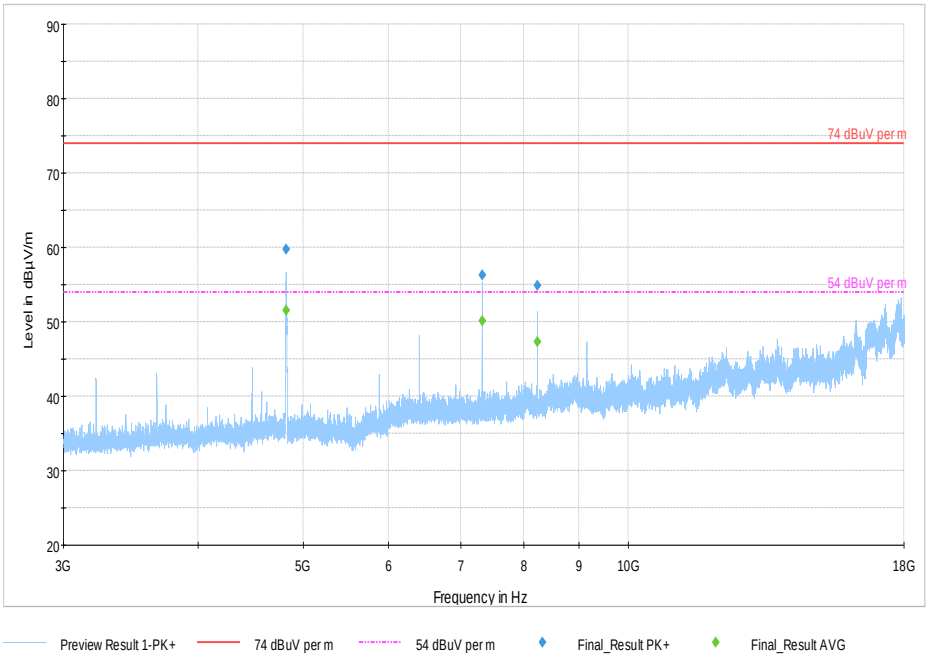
Frequency (MHz)	MaxPeak (dBµV/m)	Average* (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1830.579	58.20	---	74.00	15.80	200.0	1000.000	161.0	V	259.0
1830.579	---	35.6	54.00	18.4	200.0	1000.000	161.0	V	259.0
2745.466	56.78	---	74.00	17.22	200.0	1000.000	160.0	H	50.0
2745.466	---	34.18	54.00	19.82	200.0	1000.000	160.0	H	50.0



Plot # 3 Radiated Emissions: 3-18 GHz

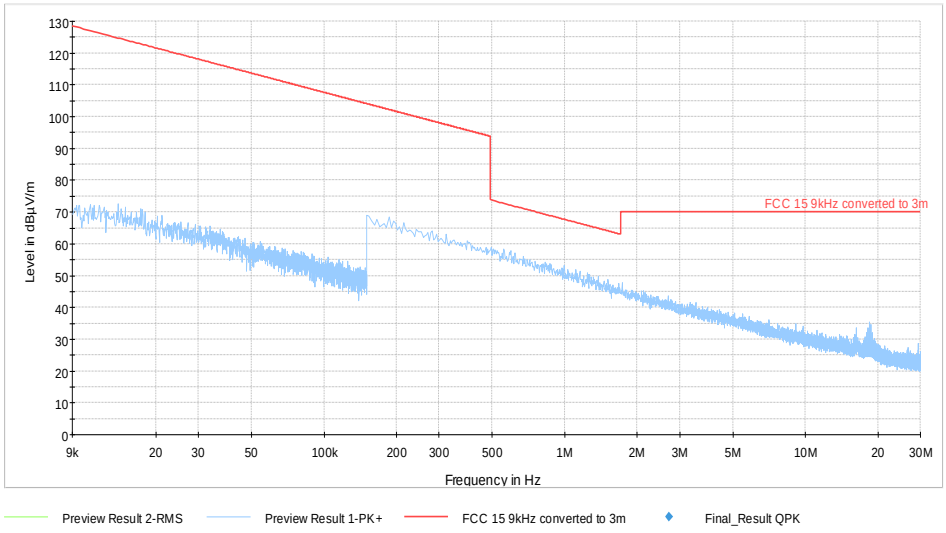
Mode: WLAN 802.11/b and FHSS | **Channel: WLAN Low / FHSS Mid**

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
4824.858	---	51.60	54.00	2.40	200.0	1000.000	181.0	V	148.0
4824.858	59.75	---	74.00	14.25	200.0	1000.000	181.0	V	148.0
7322.191	56.27	---	74.00	17.73	200.0	1000.000	230.0	H	23.0
7322.191	---	50.13	54.00	3.87	200.0	1000.000	230.0	H	23.0
8236.608	54.87	---	74.00	19.13	200.0	1000.000	219.0	H	27.0
8236.608	---	47.30	54.00	6.70	200.0	1000.000	219.0	H	27.0



Plot # 4 Radiated Emissions: 9 KHz – 30 MHz

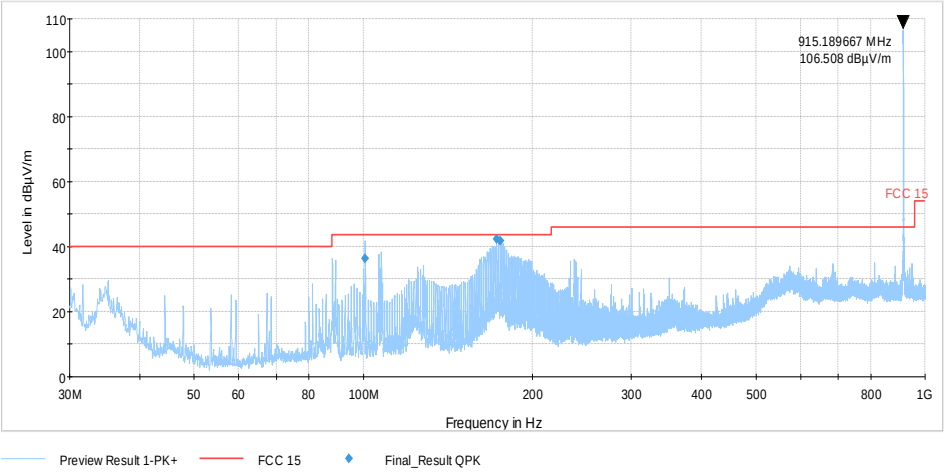
Mode: WLAN 802.11/b and FHSS | **Channel: WLAN Mid / FHSS Mid**



Plot #5 Radiated Emissions: 30 MHz – 1GHz

Mode: WLAN 802.11/b and FHSS | **Channel: WLAN Mid / FHSS Mid**

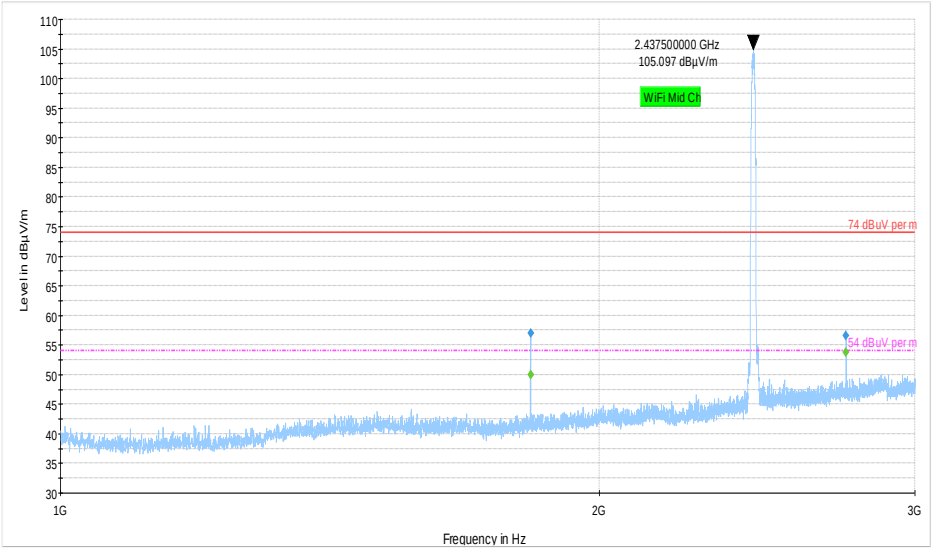
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
100.785	36.35	43.52	7.17	200.0	120.000	151.0	V	193.0
172.863	42.25	43.52	1.27	200.0	120.000	191.0	H	92.0
175.191	41.76	43.52	1.76	200.0	120.000	209.0	H	86.0



Plot #6 Radiated Emissions: 1-3 GHz

Mode: WLAN 802.11/b and FHSS | **Channel: WLAN Mid / FHSS Mid**

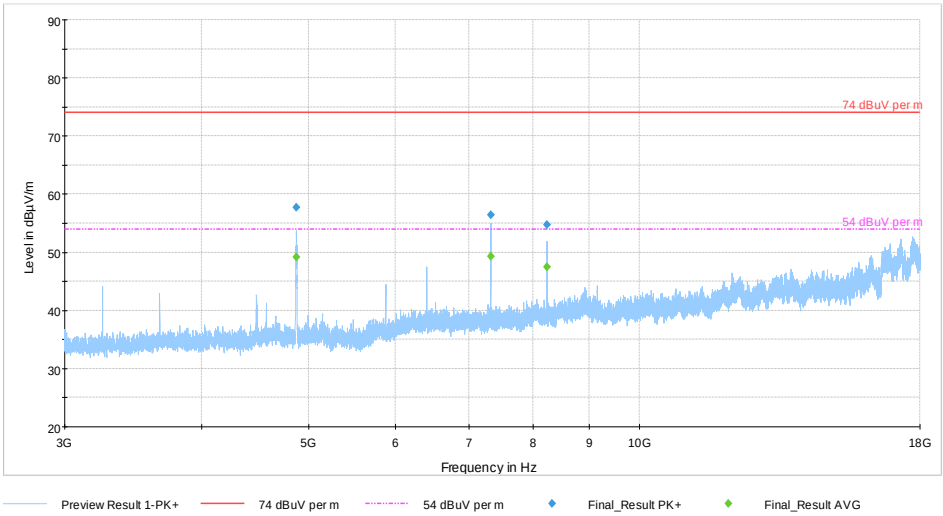
Frequency (MHz)	MaxPeak (dBµV/m)	Average* (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1830.561	---	34.38	54.00	19.62	200.0	1000.000	155.0	H	33.0
1830.561	56.98	---	74.00	17.02	200.0	1000.000	155.0	H	33.0
2745.826	---	33.91	54.00	20.09	200.0	1000.000	155.0	H	51.0
2745.826	56.51	---	74.00	17.49	200.0	1000.000	155.0	H	51.0



Plot #7 Radiated Emissions: 3-18 GHz

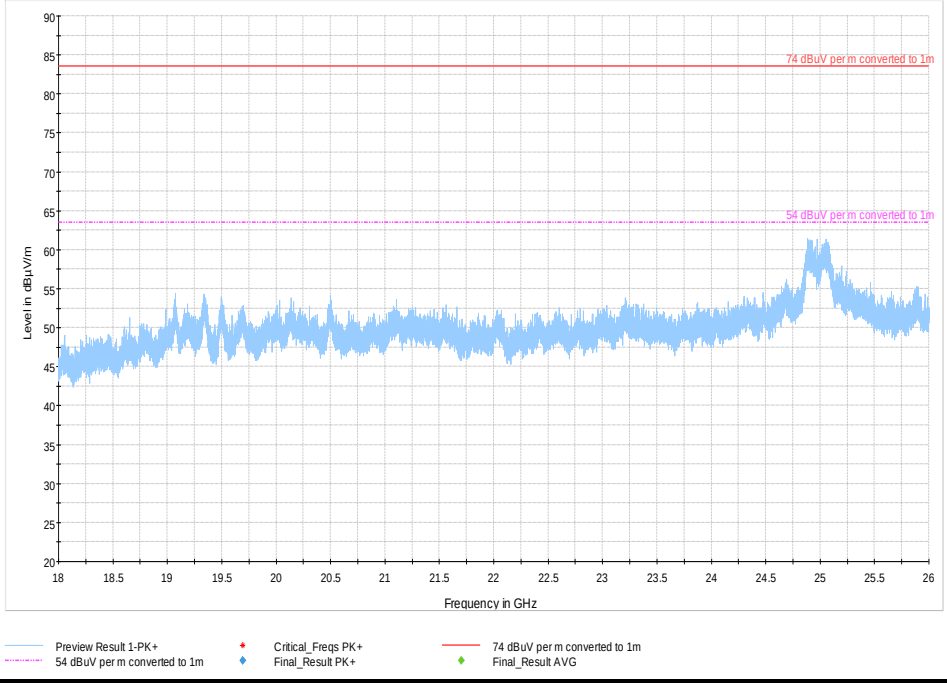
Mode: WLAN 802.11/b and FHSS | **Channel: WLAN Mid / FHSS Mid**

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
4874.992	57.76	---	74.00	16.24	200.0	1000.000	212.0	V	156.0
4874.992	---	49.16	54.00	4.84	200.0	1000.000	212.0	V	156.0
7321.440	56.42	---	74.00	17.58	200.0	1000.000	140.0	V	248.0
7321.440	---	49.35	54.00	4.65	200.0	1000.000	140.0	V	248.0
8237.584	---	47.49	54.00	6.51	200.0	1000.000	190.0	H	26.0
8237.584	54.79	---	74.00	19.21	200.0	1000.000	190.0	H	26.0



Plot #8 Radiated Emissions: 18-26 GHz

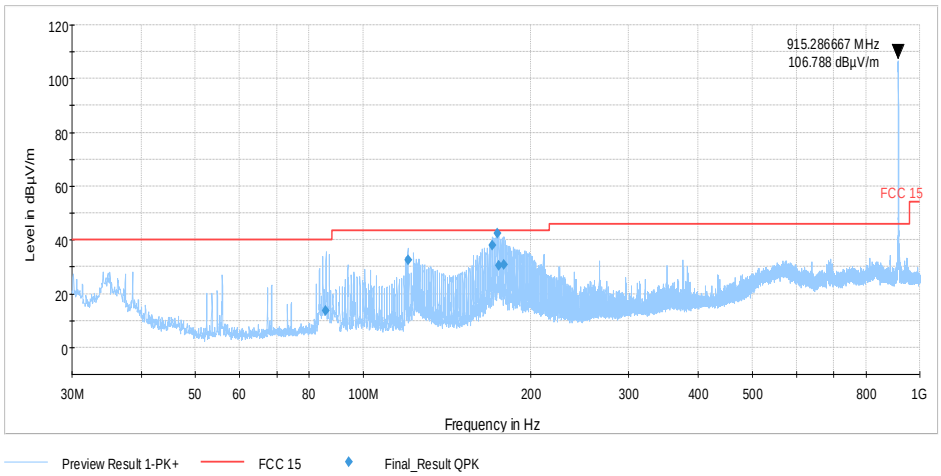
Mode: WLAN 802.11/b and FHSS | **Channel: WLAN Mid / FHSS Mid**



Plot # 9 Radiated Emissions: 30 MHz – 1GHz

Mode: WLAN 802.11/b and FHSS | **Channel: WLAN High / FHSS Mid**

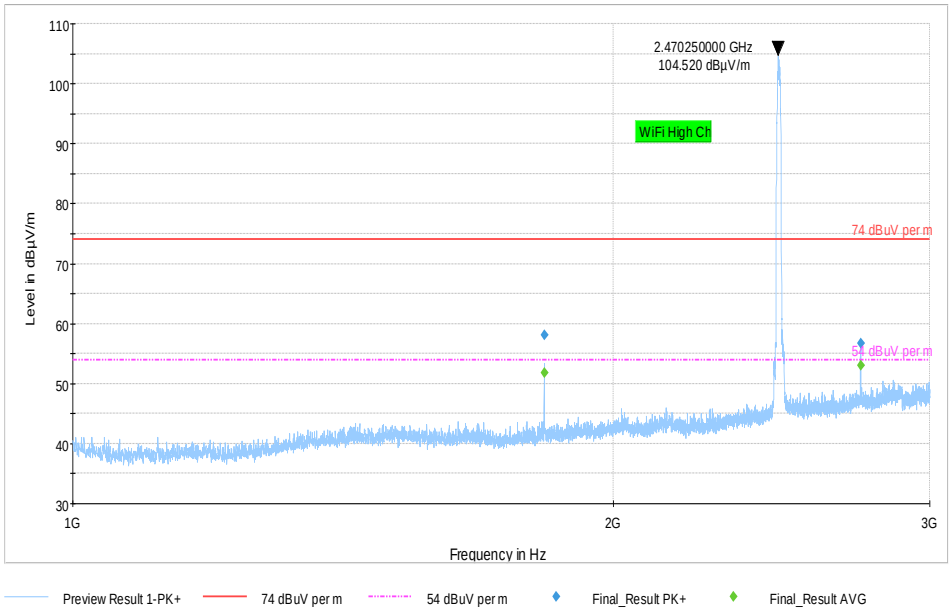
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
85.757	13.80	40.00	26.20	200.0	120.000	315.0	V	255.0
120.395	32.60	43.52	10.93	200.0	120.000	166.0	V	200.0
170.726	37.88	43.52	5.64	200.0	120.000	174.0	V	18.0
174.207	42.52	43.52	1.00	200.0	120.000	192.0	H	84.0
175.510	30.62	43.52	12.90	200.0	120.000	186.0	H	73.0
178.963	30.71	43.52	12.81	200.0	120.000	180.0	H	100.0



Plot #10 Radiated Emissions: 1-3 GHz

Mode: WLAN 802.11/b and FHSS | **Channel: WLAN High / FHSS Mid**

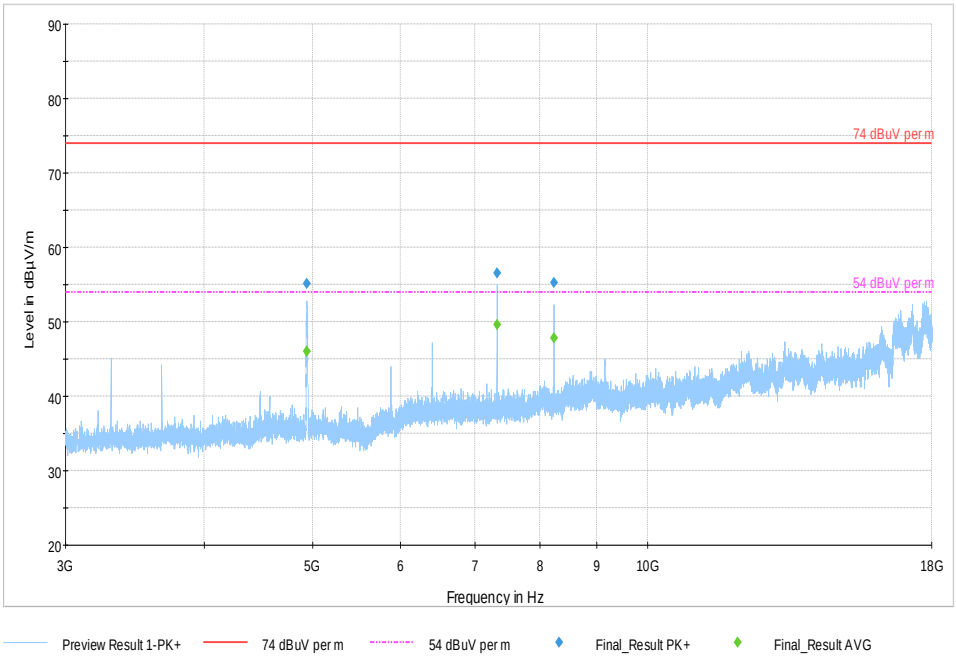
Frequency (MHz)	MaxPeak (dBµV/m)	Average* (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1830.526	---	35.55	54.00	18.45	200.0	1000.000	140.0	H	41.0
1830.526	58.15	---	74.00	15.85	200.0	1000.000	140.0	H	41.0
2745.449	---	34.17	54.00	19.83	200.0	1000.000	151.0	V	110.0
2745.449	56.77	---	74.00	17.23	200.0	1000.000	151.0	V	110.0



Plot #11 Radiated Emissions: 3-18 GHz

Mode: WLAN 802.11/b and FHSS | **Channel: WLAN High / FHSS Mid**

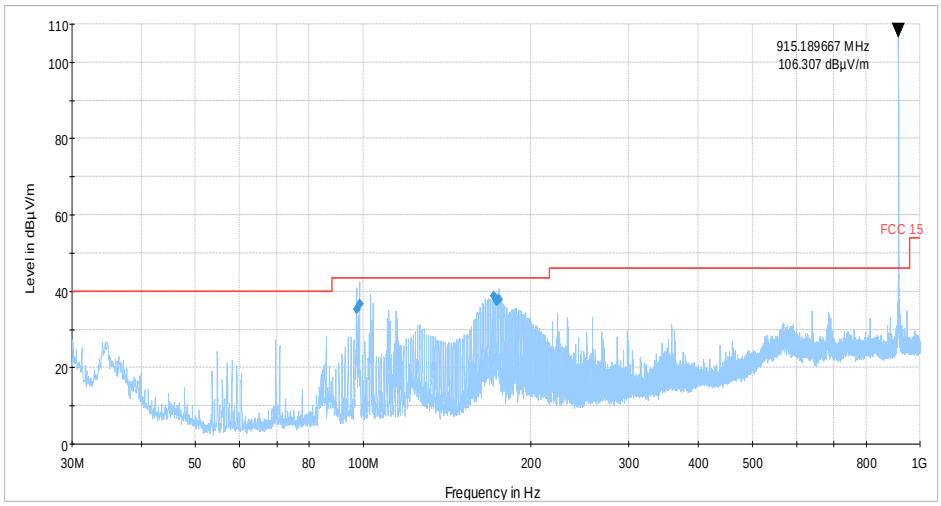
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
4944.927	55.08	---	74.00	18.92	200.0	1000.000	172.0	H	138.0
4944.927	---	46.05	54.00	7.95	200.0	1000.000	172.0	H	138.0
7321.426	56.55	---	74.00	17.45	200.0	1000.000	154.0	V	247.0
7321.426	---	49.66	54.00	4.34	200.0	1000.000	154.0	V	247.0
8237.535	---	47.88	54.00	6.12	200.0	1000.000	207.0	H	27.0
8237.535	55.22	---	74.00	18.78	200.0	1000.000	207.0	H	27.0



Plot #12 Radiated Emissions: 30 MHz – 1GHz

Mode: BTLE and FHSS | **Channel: BTLE Low / FHSS Mid**

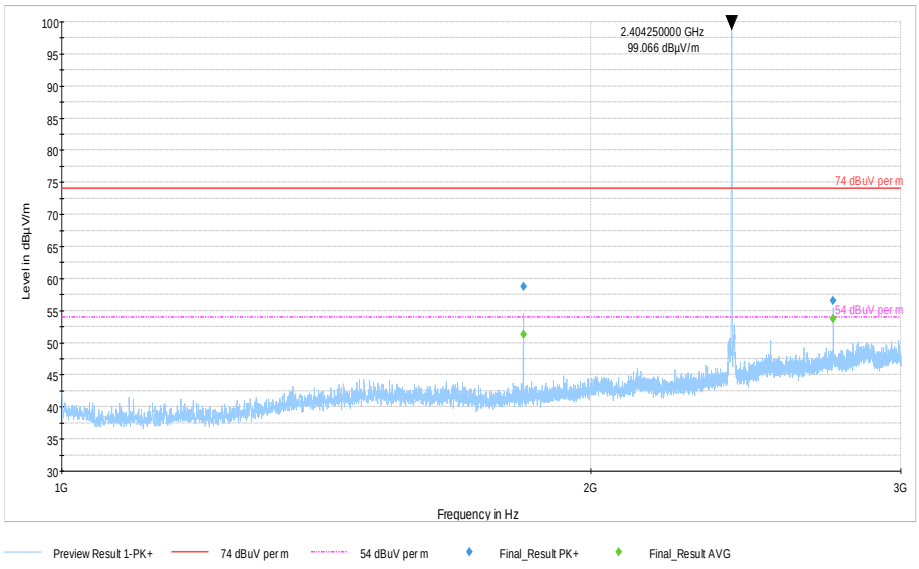
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
97.295	35.30	43.52	8.22	200.0	120.000	140.0	V	258.0
98.532	36.68	43.52	6.84	200.0	120.000	153.0	V	50.0
171.646	38.84	43.52	4.68	200.0	120.000	198.0	H	57.0
173.977	37.27	43.52	6.25	200.0	120.000	236.0	V	192.0
175.102	37.93	43.52	5.60	200.0	120.000	214.0	H	108.0



Plot # 13 Radiated Emissions: 1-3 GHz

Mode: BTLE and FHSS | **Channel: BTLE Low / FHSS Mid**

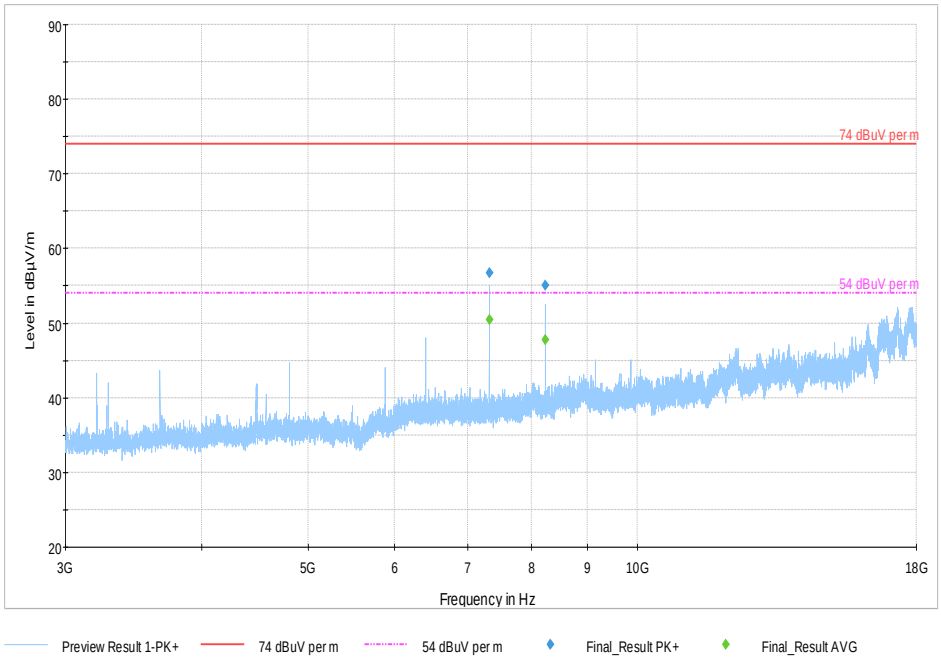
Frequency (MHz)	MaxPeak (dBµV/m)	Average* (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1830.627	---	36.1	54.00	17.9	200.0	1000.000	140.0	H	46.0
1830.627	58.70	---	74.00	15.30	200.0	1000.000	140.0	H	46.0
2745.575	---	33.96	54.00	20.04	200.0	1000.000	181.0	H	71.0
2745.575	56.56	---	74.00	17.44	200.0	1000.000	181.0	H	71.0



Plot # 14 Radiated Emissions: 3-18 GHz

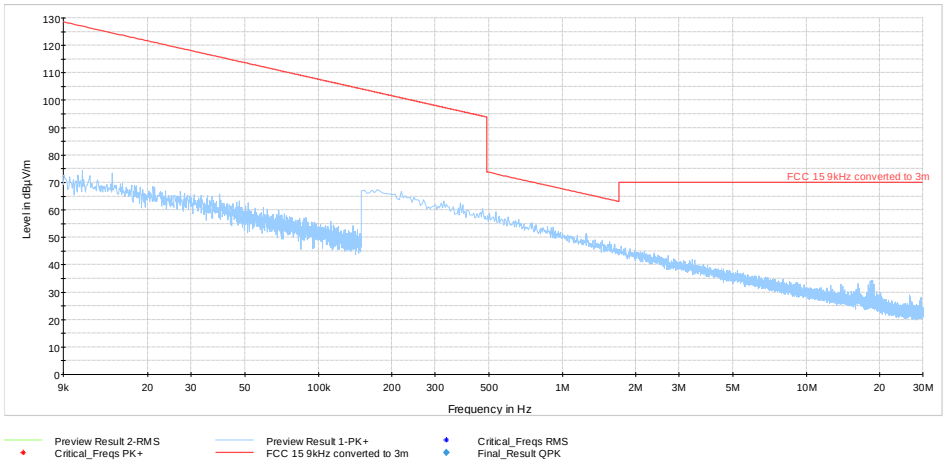
Mode: BTLE and FHSS | **Channel: BTLE Low / FHSS Mid**

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
7321.508	---	50.45	54.00	3.55	200.0	1000.000	207.0	H	22.0
7321.508	56.74	---	74.00	17.26	200.0	1000.000	207.0	H	22.0
8237.553	---	47.71	54.00	6.29	200.0	1000.000	218.0	H	27.0
8237.553	55.06	---	74.00	18.94	200.0	1000.000	218.0	H	27.0



Plot # 15 Radiated Emissions: 9 KHz – 30 MHz

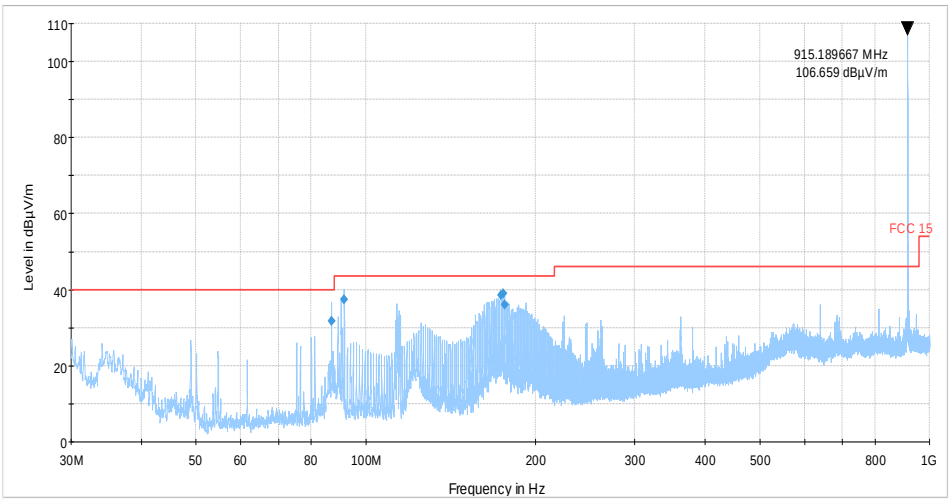
Mode: BTLE and FHSS | **Channel: BTLE Mid / FHSS Mid**



Plot #16 Radiated Emissions: 30 MHz – 1GHz

Mode: BTLE and FHSS | **Channel: BTLE Mid / FHSS Mid**

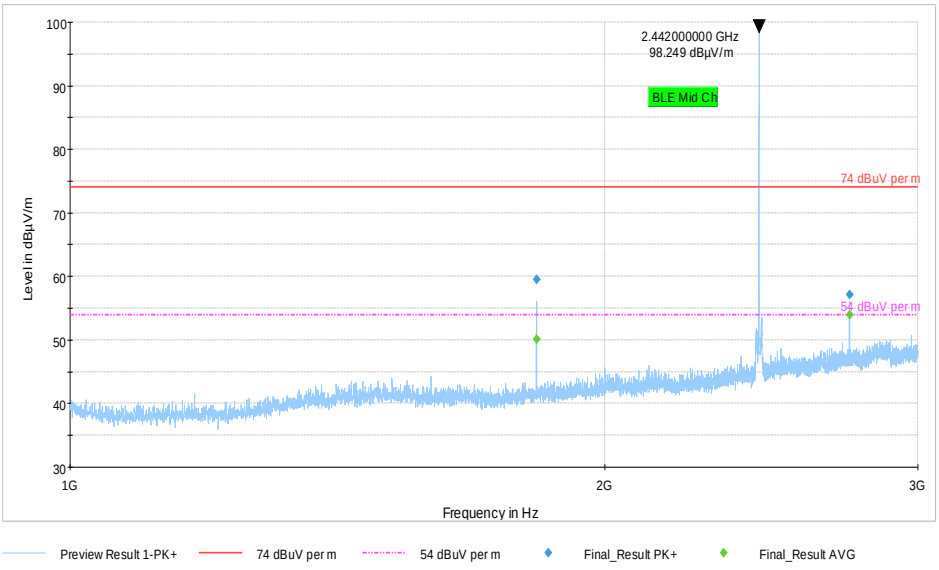
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
86.963	31.70	40.00	8.30	200.0	120.000	154.0	V	44.0
91.598	37.48	43.52	6.05	200.0	120.000	154.0	V	306.0
173.902	38.62	43.52	4.90	200.0	120.000	191.0	H	71.0
175.066	39.10	43.52	4.42	200.0	120.000	193.0	H	104.0
176.232	36.14	43.52	7.38	200.0	120.000	231.0	H	72.0



Plot #17 Radiated Emissions: 1-3 GHz

Mode: BTLE and FHSS | **Channel: BTLE Mid / FHSS Mid**

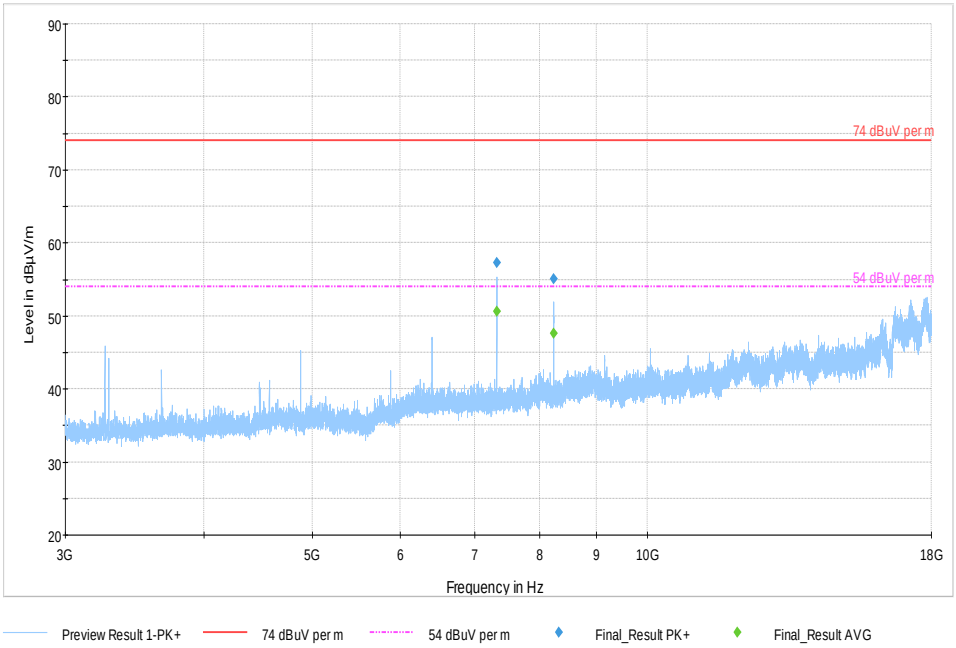
Frequency (MHz)	MaxPeak (dBµV/m)	Average* (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1830.679	59.45	---	74.00	14.55	200.0	1000.000	164.0	V	250.0
1830.679	---	36.85	54.00	17.15	200.0	1000.000	164.0	V	250.0
2745.852	57.08	---	74.00	16.92	200.0	1000.000	283.0	V	111.0
2745.852	---	34.48	54.00	19.52	200.0	1000.000	283.0	V	111.0



Plot #18 Radiated Emissions: 3-18 GHz

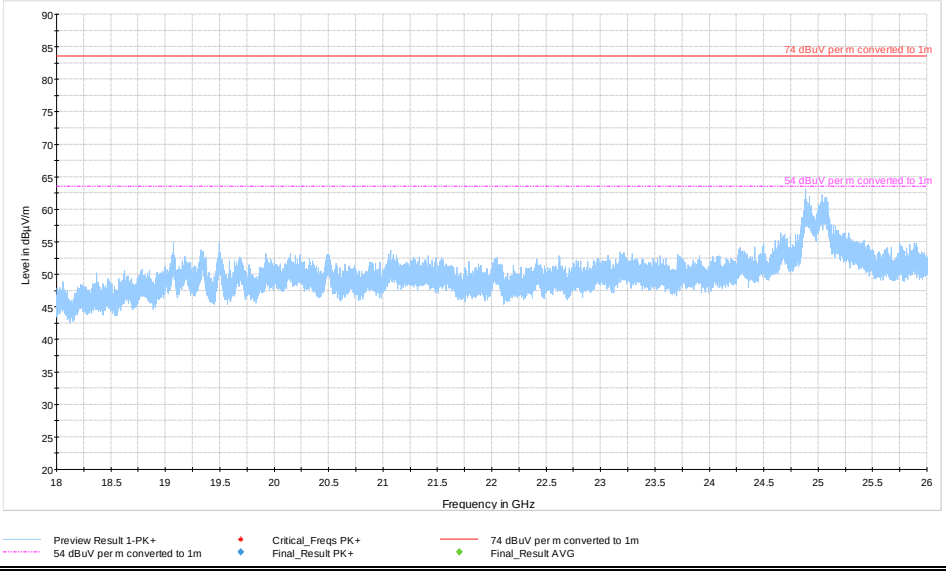
Mode: BTLE and FHSS | **Channel: BTLE Mid / FHSS Mid**

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
7321.412	---	50.61	54.00	3.39	200.0	1000.000	190.0	H	20.0
7321.412	57.30	---	74.00	16.70	200.0	1000.000	190.0	H	20.0
8236.618	---	47.62	54.00	6.38	200.0	1000.000	218.0	H	29.0
8236.618	55.08	---	74.00	18.92	200.0	1000.000	218.0	H	29.0



Plot #19 Radiated Emissions: 18-26 GHz

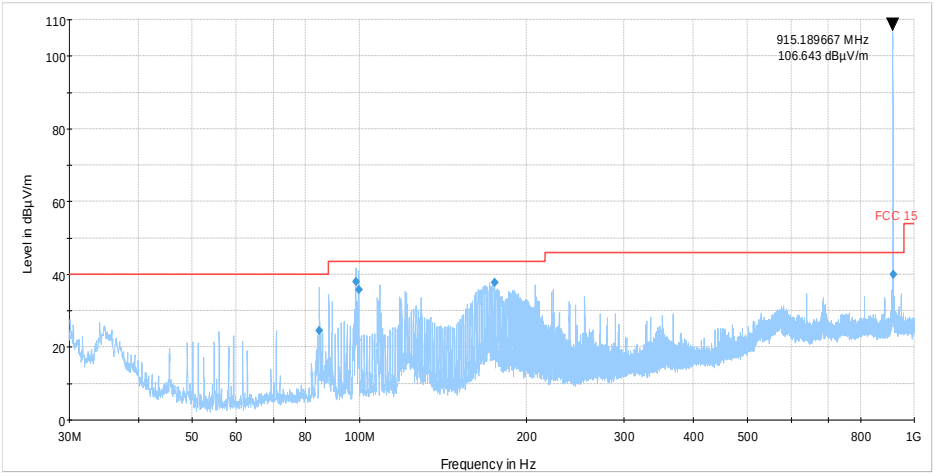
Mode: BTLE and FHSS | **Channel: BTLE Mid / FHSS Mid**



Plot # 20 Radiated Emissions: 30 MHz – 1GHz

Mode: BTLE and FHSS | **Channel: BTLE High / FHSS Mid**

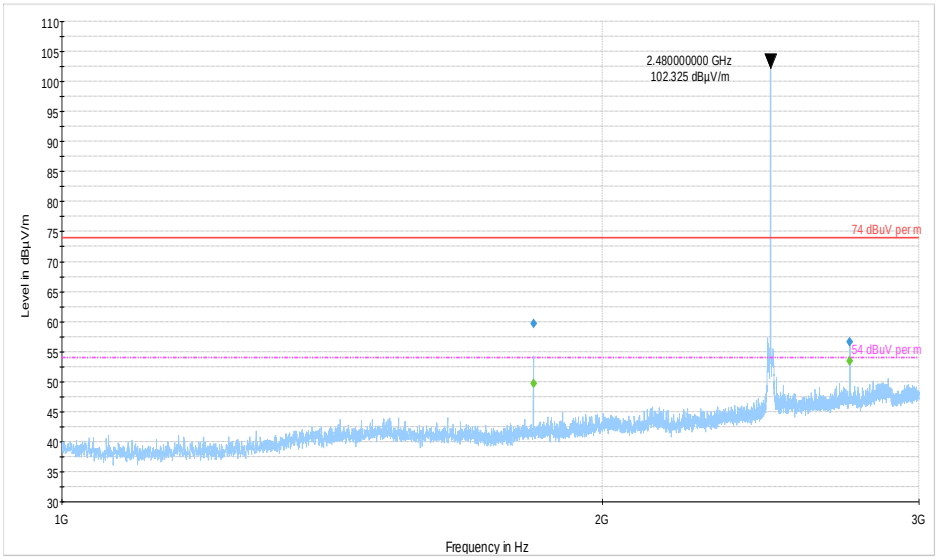
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
84.614	24.57	40.00	15.43	200.0	120.000	260.0	V	168.0
98.521	38.03	43.52	5.49	200.0	120.000	152.0	V	42.0
99.664	35.84	43.52	7.69	200.0	120.000	163.0	V	281.0
175.073	37.70	43.52	5.82	200.0	120.000	153.0	H	82.0
916.566	40.03	46.02	5.99	200.0	120.000	157.0	H	157.0



Plot #21 Radiated Emissions: 1-3 GHz

Mode: BTLE and FHSS | **Channel: BTLE High / FHSS Mid**

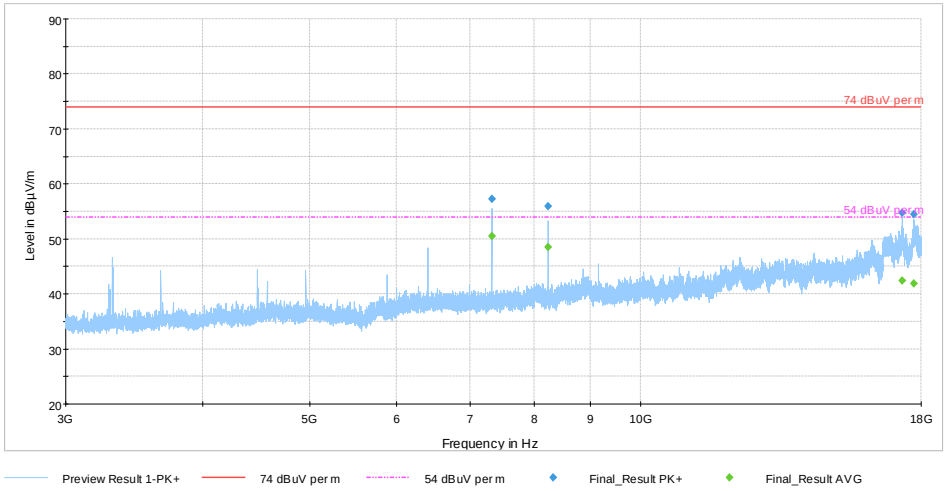
Frequency (MHz)	MaxPeak (dBµV/m)	Average* (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1830.533	59.74	---	74.00	14.26	200.0	1000.000	140.0	V	240.0
1830.533	---	37.14	54.00	16.86	200.0	1000.000	140.0	V	240.0
2745.546	56.58	---	74.00	17.42	200.0	1000.000	186.0	H	73.0
2745.546	---	33.98	54.00	20.02	200.0	1000.000	186.0	H	73.0



Plot #22 Radiated Emissions: 3-18 GHz

Mode: BTLE and FHSS | **Channel: BTLE High / FHSS Mid**

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
7322.287	---	50.47	54.00	3.53	200.0	1000.000	219.0	V	229.0
7322.287	57.24	---	74.00	16.76	200.0	1000.000	219.0	V	229.0
8237.543	---	48.50	54.00	5.50	200.0	1000.000	207.0	H	27.0
8237.543	55.98	---	74.00	18.02	200.0	1000.000	207.0	H	27.0
17295.175	---	42.47	54.00	11.53	200.0	1000.000	186.0	H	211.0
17295.175	54.77	---	74.00	19.23	200.0	1000.000	186.0	H	211.0
17726.379	---	41.92	54.00	12.08	200.0	1000.000	285.0	H	209.0
17726.379	54.48	---	74.00	19.52	200.0	1000.000	285.0	H	209.0



* The Average result was calculated from the peak measurement and -22.6 dB DC correction factor

8.2 AC Power Line Conducted Emissions

8.2.1 Measurement according to ANSI C63.4

Analyzer Settings:

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

8.2.2 Limits: §15.207

FCC §15.207(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.

8.2.3 Test conditions and setup:

Ambient Temperature ©	EUT Set-Up #	EUT operating mode	Power line (L1, L2, L3, N)	Power Input
22° C	1	1	Line & Neutral	120V / 60Hz

8.2.4 Measurement Result:

Plot #	Port	EUT Set-Up #:	EUT operating mode	Scan Frequency	Limit	Result
1	AC Mains	1	1	150 kHz – 30 MHz	See section 8.2.2	Pass

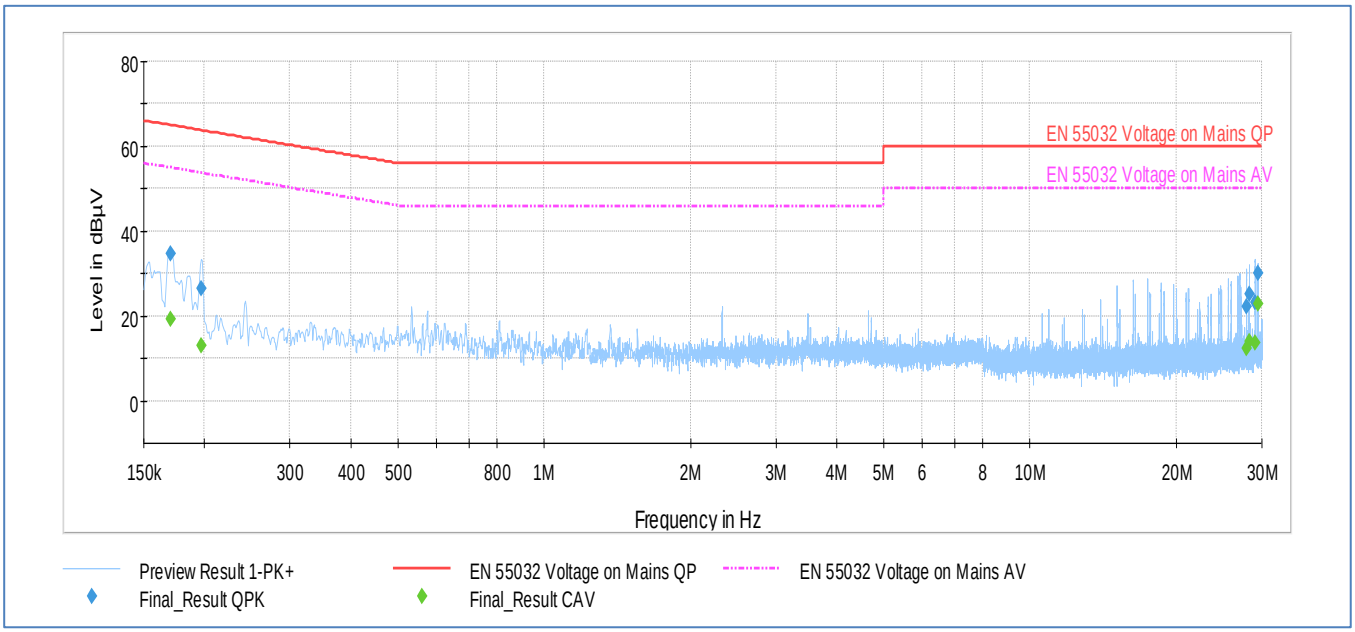
8.2.5 Measurement Plots:

Plot # 1

Final Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.170	34.77	---	64.95	30.17	500.0	9.000	N	GND	10.6
0.170	---	19.08	54.95	35.87	500.0	9.000	N	GND	10.6
0.197	26.52	---	63.74	37.23	500.0	9.000	N	GND	10.5
0.197	---	13.04	53.74	40.70	500.0	9.000	N	GND	10.5
27.922	22.29	---	60.00	37.71	500.0	9.000	N	GND	11.1
27.922	---	12.30	50.00	37.70	500.0	9.000	N	GND	11.1
28.255	25.03	---	60.00	34.97	500.0	9.000	N	GND	11.1
28.255	---	14.00	50.00	36.00	500.0	9.000	N	GND	11.1
29.089	---	13.56	50.00	36.44	500.0	9.000	L1	GND	11.2
29.089	23.23	---	60.00	36.77	500.0	9.000	L1	GND	11.2
29.425	---	22.81	50.00	27.19	500.0	9.000	L1	GND	11.2
29.425	30.06	---	60.00	29.94	500.0	9.000	L1	GND	11.2

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_WEATH_022_20501_15.247_DTS_Setup_Photos.pdf”

10 Test Equipment And Ancillaries Used For Testing

Equipment Name/Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
EMI Receiver/Analyzer	Rohde&Schwarz	ESU 40	100251	3 Years	07/16/2019
Loop antenna	ETS Lindgren	6507	161344	3 Years	10/26/2017
Biconlog Antenna	EMCO	3142E	166067	3 years	06/27/2017
Horn Antenna	EMCO	3115	35114	3 years	04/17/2019
Horn Antenna	ETS Lindgren	Horn 3117-PA	159547	3 years	8/8/2017
Horn Antenna	ETS Lindgren	Horn 3116	70497	3 years	10/31/2017
Compact Digital Barometer	Control Company	35519-055	91119547	3 Years	6/08/2017

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 History

Date	Report Name	Changes to report	Report prepared by
2020-04-08	EMC_WEATH_022_20501_15.247_DTS	Initial Version	Kris Lazarov

<<< The End >>>