



FCC / ISED Test Report

For:
Ezlo Innovation LLC

Model No:
ESWV1-US

Product Description:
Ezlo Smart Water Shut-Off Valve

FCC ID: 2AIYW-ESWV
IC: 26382-ESWV

Applied Rules and Standards:
47 CFR Part 15.249
RSS-210 Issue 10 & RSS-Gen Issue 5

REPORT #: EMC_EZLOI-007-21001_FCC_15.249_Rev3

DATE: 2023-05-31



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IC recognized #
3462B-1

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1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.249 of Title 47 of the Code of Federal Regulations and the relevant ISED Canada standard RSS-210.

No deviations were ascertained.

Company	Description	Model #
Ezlo Innovation LLC	Ezlo Smart Water Shut-Off Valve	ESWV1-US

Responsible for Testing Laboratory:

2023-05-31	Compliance	Arndt Stoecker (Director of Regulatory Services)	
Date	Section	Name	Signature

Responsible for the Report:

2023-05-31	Compliance	Cheng Song (EMC Engineer)	
Date	Section	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
Fax:	+1 (408) 586 6299
Director of Regulatory Services:	Arndt Stoecker
Responsible Project Leader:	Akanksha Baskaran

2.2 Identification of the Client

Client's Name:	Ezlo Innovation LLC
Street Address:	200 Broadacres Drive
City/Zip Code	Bloomfield, NJ / 07003
Country	USA

2.3 Identification of the Manufacturer

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

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Model No:	ESWV1-US
HW Version :	HW: 1.23
SW Version :	FW: 0.8.1503
FCC-ID :	2AIYW-ESWV
IC-ID:	26382-ESWV
PMN:	Smart Water Shut-Off Valve
Product Description:	Ezlo Smart Water Shut-Off Valve
Radio Information:	<u>Z-Wave:</u> <ul style="list-style-type: none"> • Module Name: SiLabs • Module Number: EFR32ZG14
Antenna Information:	<u>Z-Wave Antenna:</u> <ul style="list-style-type: none"> • Type: PCB Antenna • Location: Internal • Frequency Band: 902-928 MHz ISM
Power Supply/ Rated Operating Voltage Range:	External Power Adapter 100 - 240V , 50/60Hz. converter to 24Vdc for the Water Valve
Operating Temperature Range	0°C to 65 °C
Other Radios Included	<u>Wi-Fi:</u> <ul style="list-style-type: none"> • Module: ESP32-D0WDQ6 • 802.11 b/g/n 20MHz • 2.4GHz : Ch1-13
Sample Revision	<input type="checkbox"/> Prototype Unit; <input type="checkbox"/> Production Unit; <input checked="" type="checkbox"/> Pre-Production

3.2 EUT Sample details

EUT #	Model Number	HW Version	SW Version	Notes/Comments
1	ESWV1-US	HW: 1.23	FW: 0.8.1503	Conducted RF
2	ESWV1-US	HW: 1.23	FW: 0.8.1503	Radiated

3.3 Accessory Equipment (AE) details

AE #	Type	Model	Manufacturer	Notes/Comments
1	AC / DC power adapter	FX65C-240200Z	Level VI	

3.4 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#1 + AE#1	The radio of the EUT was configured to a fixed channel transmission with highest possible duty cycle using software that is not available to the end user. The measurement equipment was connected to the 50 ohm RF port of the EUT.
2	EUT#2 + AE#1	The radio of the EUT was configured to a fixed channel transmission with highest possible duty cycle using software that is not available to the end user. The external antenna was connected.

Note: In radiated testing, two snap ferrites # 74275812 were clamped on communication cables extended outside which will not appear in actual device.

3.5 Justification for Worst Case Mode of Operation

During the testing process, the EUT was tested with transmitter sets on 908.42MHz, and 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.

908.42MHz Z-wave signal transmitted simultaneously with 802.11b 20MHz 1Mbps channel 1 in radiated testing.

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 15.249 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-210 of ISED Canada.

5 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	NA	NP	Result
§15.215(c)	Emission Bandwidth 20 dB Bandwidth	Nominal	Zwave	■	□	□	Complies
§15.249(a)	General Field Strength Limit	Nominal	Zwave	■	□	□	Complies
§15.249; §15.209	TX Spurious emissions- Radiated	Nominal	Zwave	■	□	□	Complies
§15.207(a) RSS Gen 8.8	AC Conducted Emissions	Nominal	Zwave	■	□	□	Complies

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

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=2.

Measurement System	EMC 1	EMC 2
Conducted Emissions (mains port)	1.12 dB	0.46 dB
Radiated Emissions		
(<30 MHz)	3.66 dB	3.88 dB
(30 MHz – 1 GHz)	3.17 dB	3.34 dB
(1 GHz – 3 GHz)	5.01 dB	4.45 dB
(> 3 GHz)	4.0 dB	4.79 dB

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:

05/03/2022 – 05/12/2022

6.3 Decision Rule

Cetecom advanced follows [ILAC G8:2019 chapter 4.2.1 \(Simple Acceptance Rule\)](#).

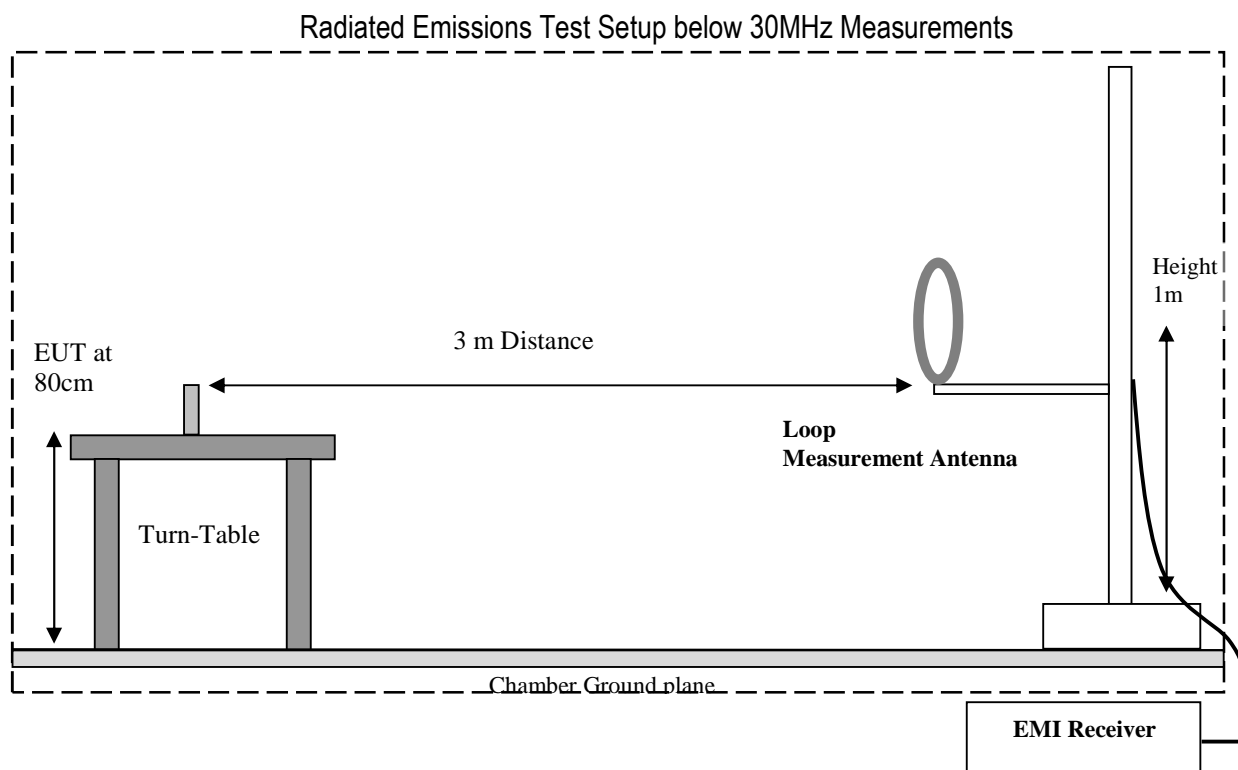
“Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3. The measurement uncertainty is mentioned in this test report, See chapter 9, but is not taken into account – neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong.”

7 Measurement Procedures

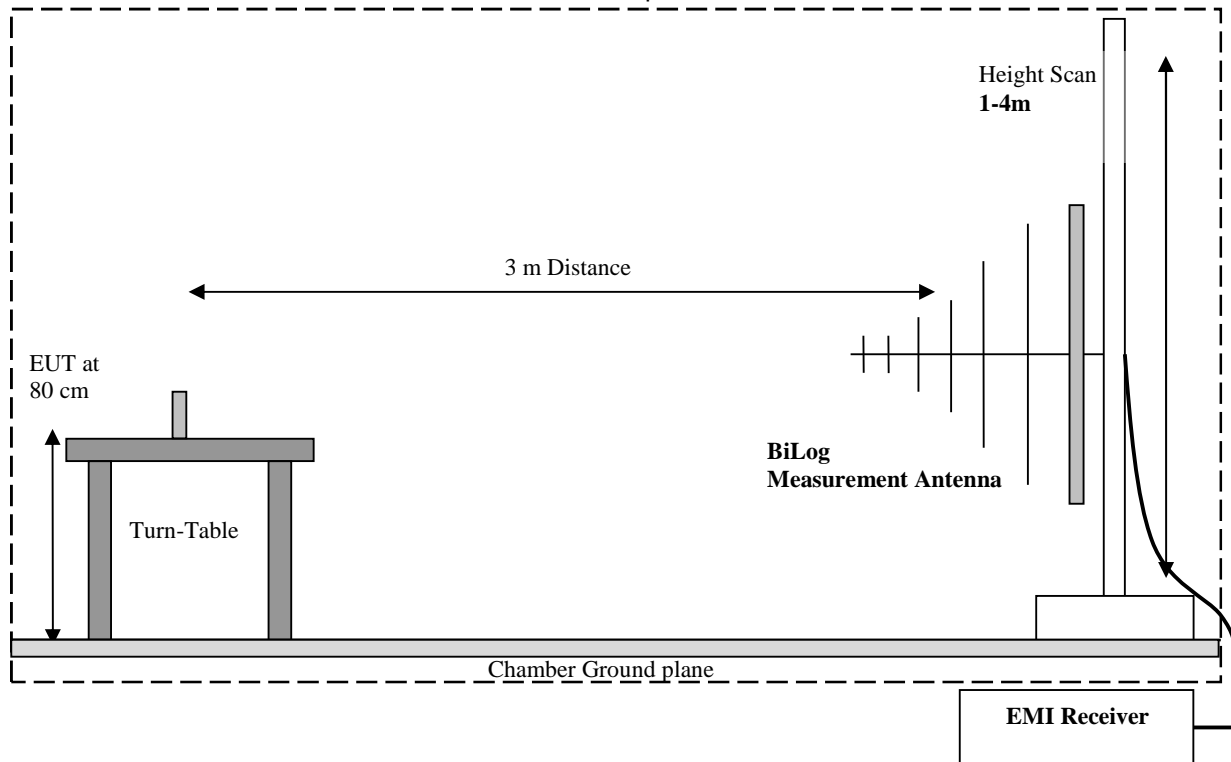
7.1 Radiated Measurement

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

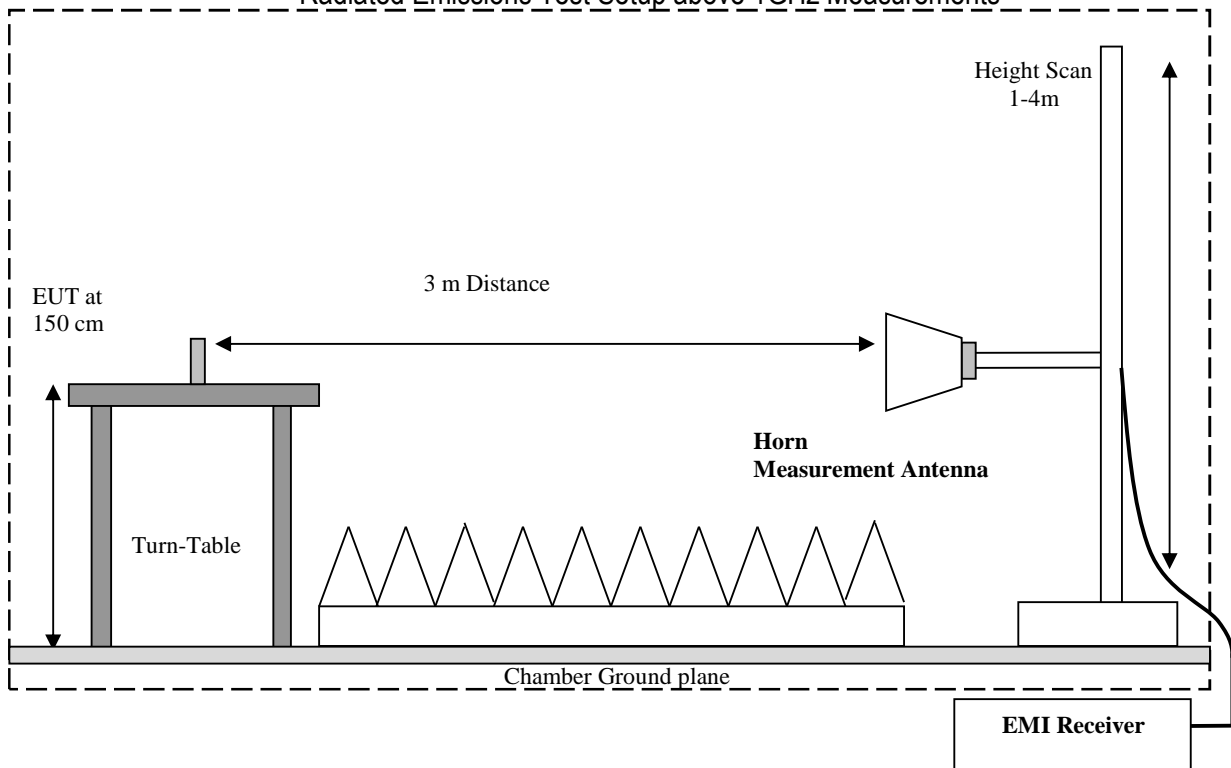
- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to 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 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 dB μ V
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:

$$FS \text{ (dB}\mu\text{V/m)} = \text{Measured Value on SA (dB}\mu\text{V)} + \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$$

Example:

Frequency (MHz)	Measured SA (dB μ V)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dB μ V/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)

8 Test Result Data

8.1 General Field Strength Limit

8.1.1 Measurement according to FCC 15.249(a)

Spectrum Analyzer settings:

- RBW = 100kHz
- VBW = 300kHz
- Span ≥ 3 x RBW
- Sweep = Auto couple
- Detector function = Peak
- Trace = Max hold
- Use peak marker function to determine the peak amplitude level

8.1.2 Limits:

General Filed Strength Limit:

- FCC §15.249 (a)

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

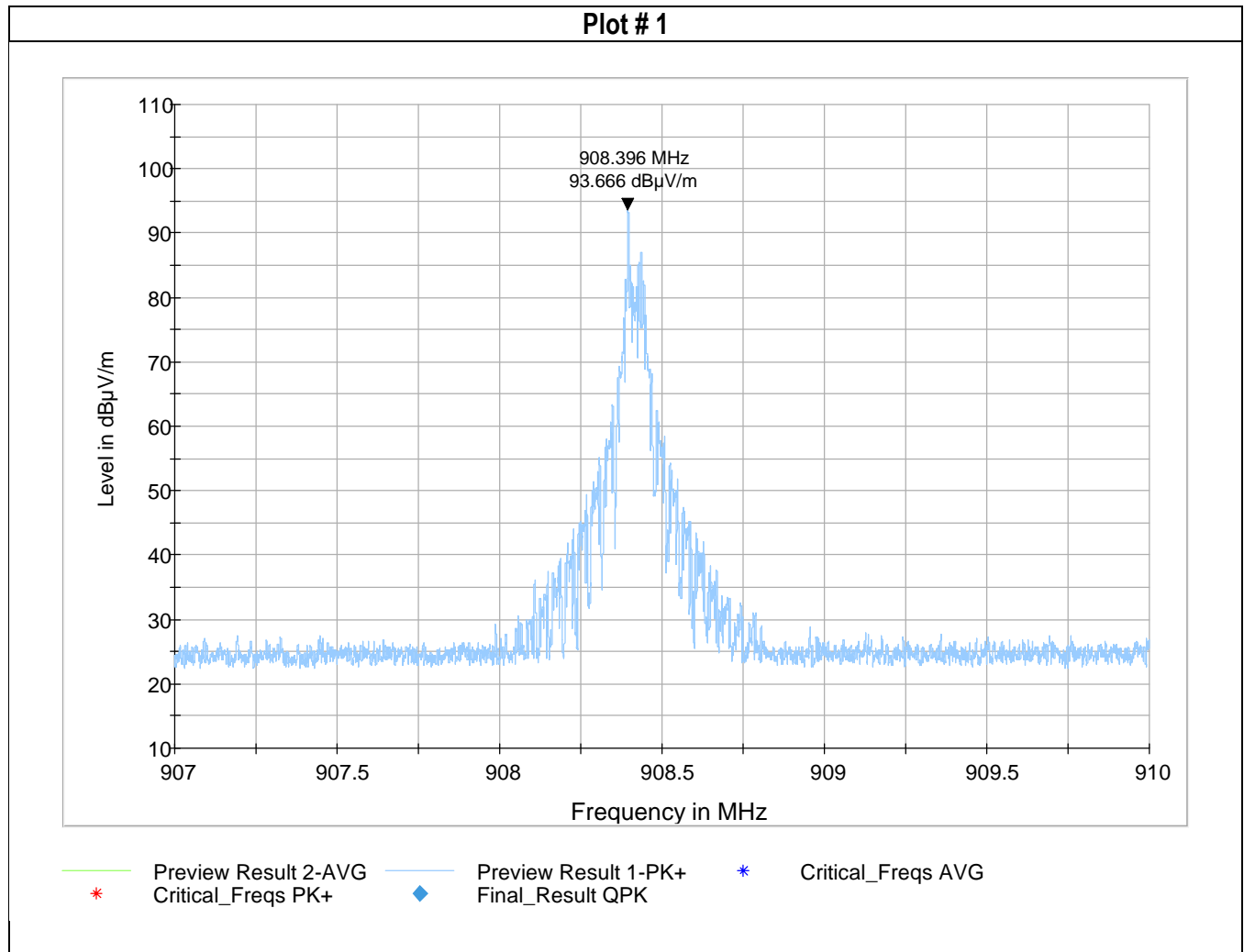
8.1.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22° C	2	continuous fixed channel	120 VAC

8.1.4 Measurement result:

Plot #	Frequency (MHz)	Field Strength (dBµV/m)	Limit (dBµV/m)	Result
1	908.40	93.67	93.98	Pass

8.1.5 Measurement Plots:



8.2 Emission Bandwidth 20dB and 99% Occupied Bandwidth

8.2.1 Measurement according to FCC 15.249

Spectrum Analyzer settings:

20dB (DTS) Bandwidth:

- Set RBW = 3 kHz
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW
- Detector = Peak
- Trace mode = Max hold
- Sweep = Auto couple
- Allow the trace to stabilize
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

99% Occupied Bandwidth:

- Set frequency = nominal EUT channel center frequency
- Set Span = 1.5 x to 5.0 x OBW
- Set RBW = 1% to 5% of OBW
- Set the video bandwidth (VBW) $\approx 3 \times$ RBW
- Detector = Peak
- Trace mode = Max hold
- Sweep = Auto couple
- Allow the trace to stabilize
- Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth
- If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.

8.2.2 Limits:

FCC §15.215 (c)

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

8.2.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22° C	1	continuous fixed channel	120 VAC

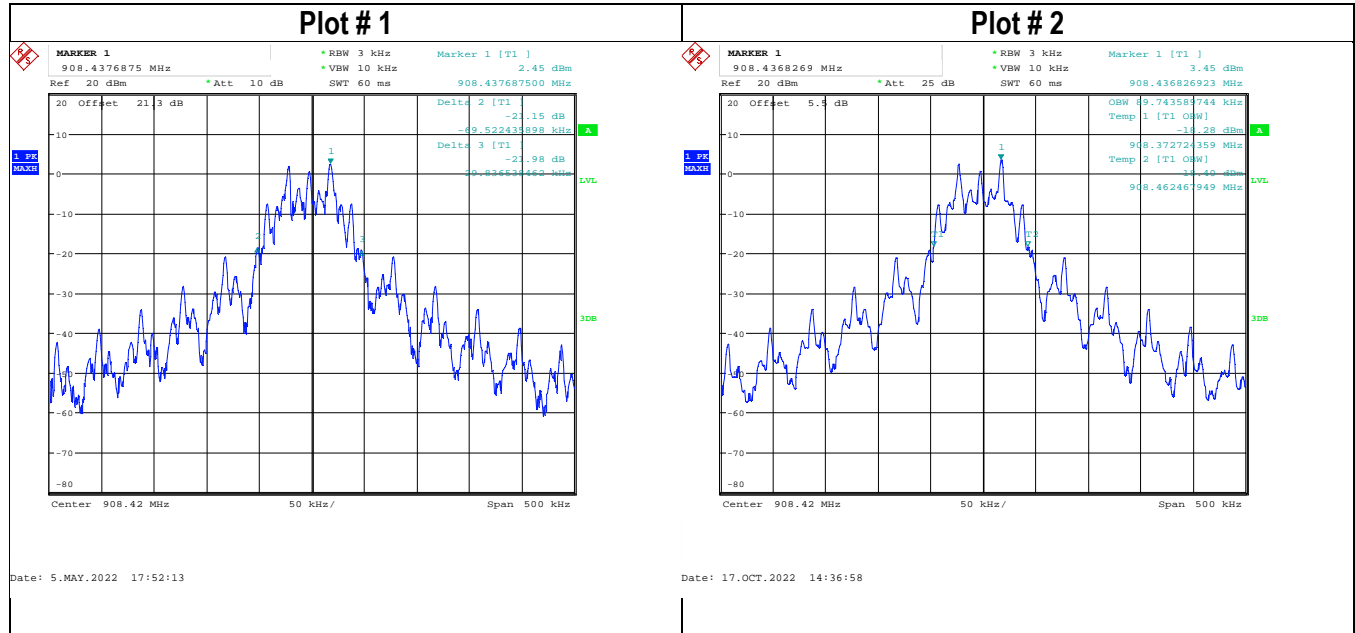
8.2.4 Measurement result:

Plot #	Frequency (MHz)	20dB Bandwidth (kHz)	Result
1	908.40	99.359	Pass

Plot #	Frequency (MHz)	99% Occupied Bandwidth (kHz)	Result
2	908.40	89.744	Pass



8.2.5 Measurement Plots:



8.3 Radiated Transmitter Spurious Emissions and Restricted Bands

8.3.1 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 frequencies below 30 MHz at distance other than the specified in the standard, the limit conversion is calculated by using the FCC materials for the ANSI 63 committee issued on January, 27 1991.

8.3.2 Limits:

FCC §15.249(a)

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

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
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			

- 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

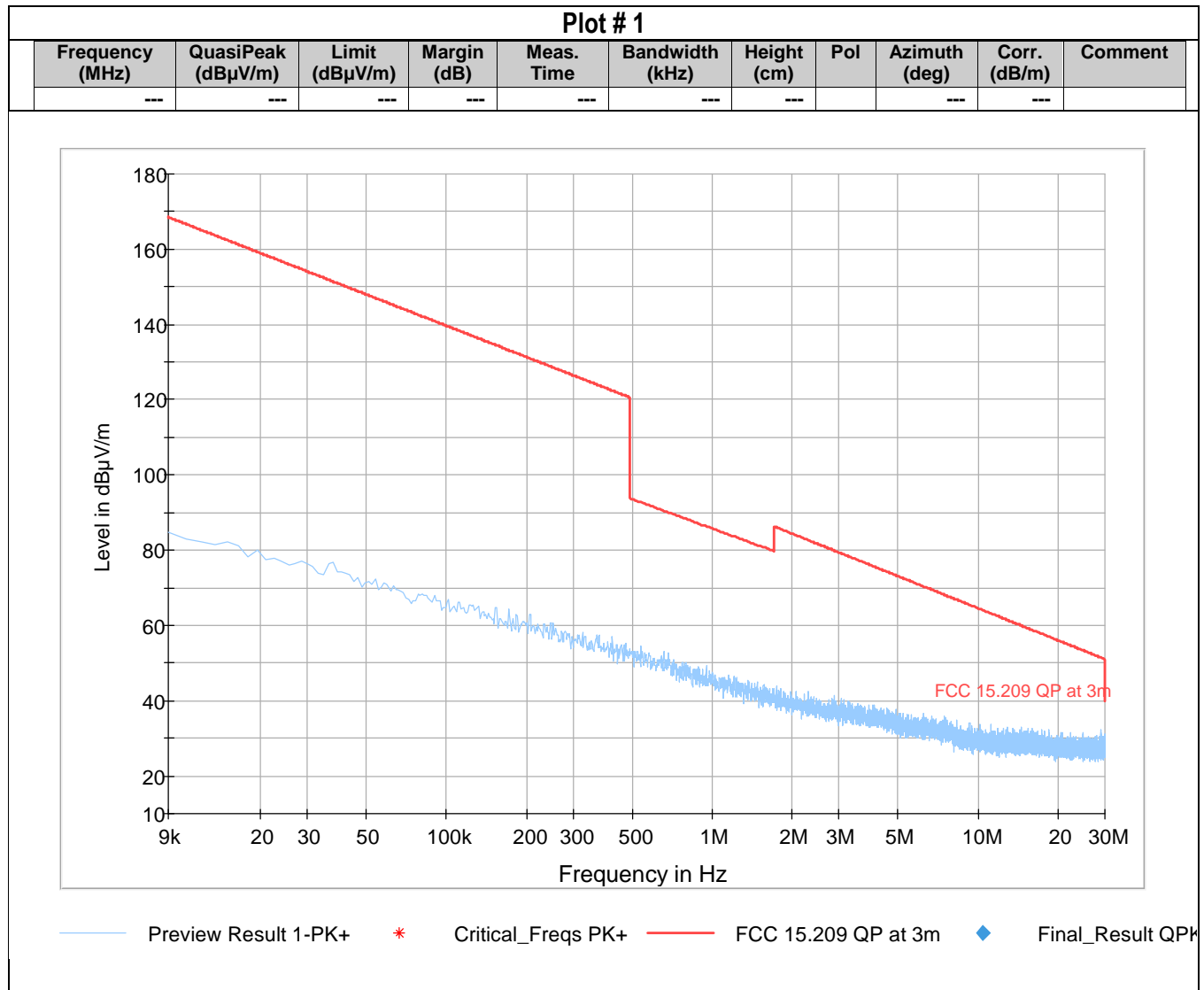
8.3.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22° C	2	continuous fixed channel	120 VAC

8.3.4 Measurement result:

Plot #	Channel #	Scan Frequency	Limit	Result
1-4	Mid	9 kHz – 10 GHz	See section 8.3.2	Pass

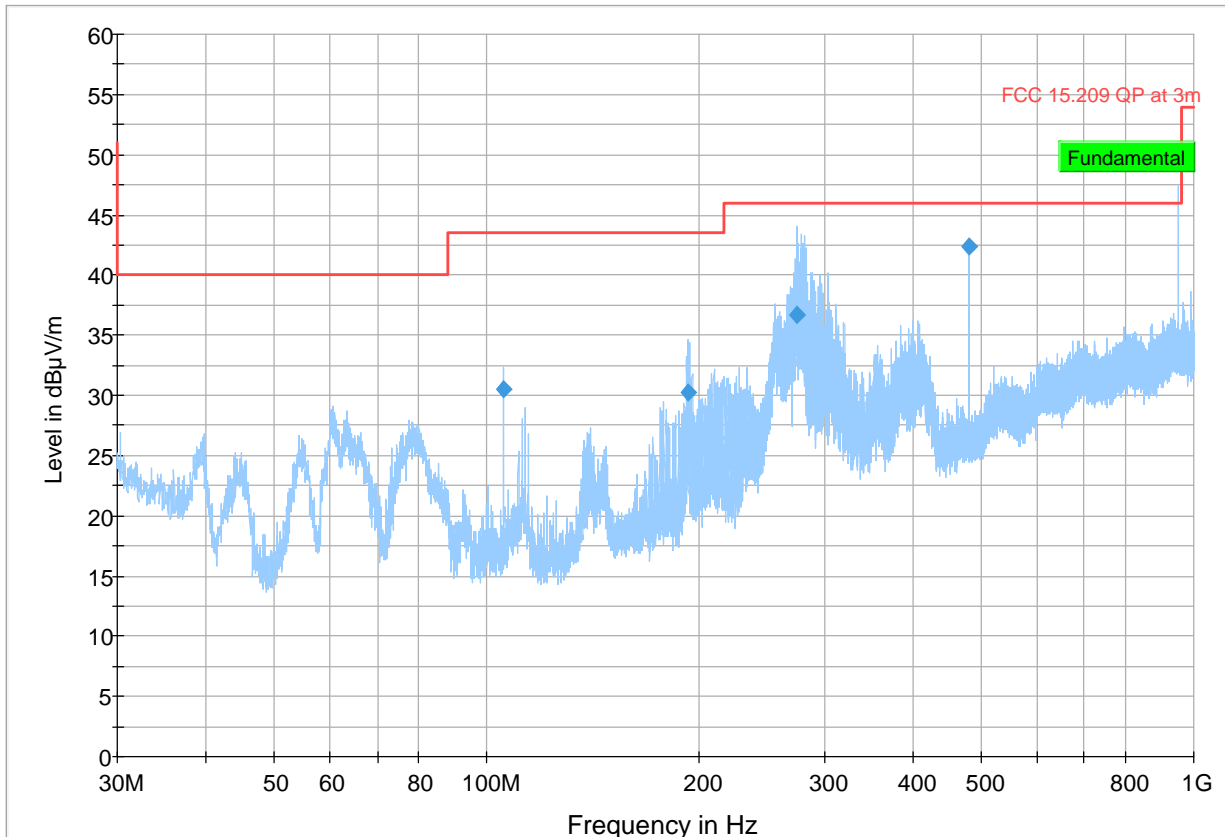
8.3.5 Measurement Plots:





Plot # 2

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
105.692	30.45	43.50	13.05	500.0	120.000	196.0	V	192.0	12.8	
192.572	30.31	43.50	13.19	500.0	120.000	150.0	V	112.0	14.6	
274.214	36.73	46.02	9.29	500.0	120.000	149.0	H	223.0	18.5	
480.015	42.31	46.02	3.71	500.0	120.000	149.0	V	304.0	22.7	

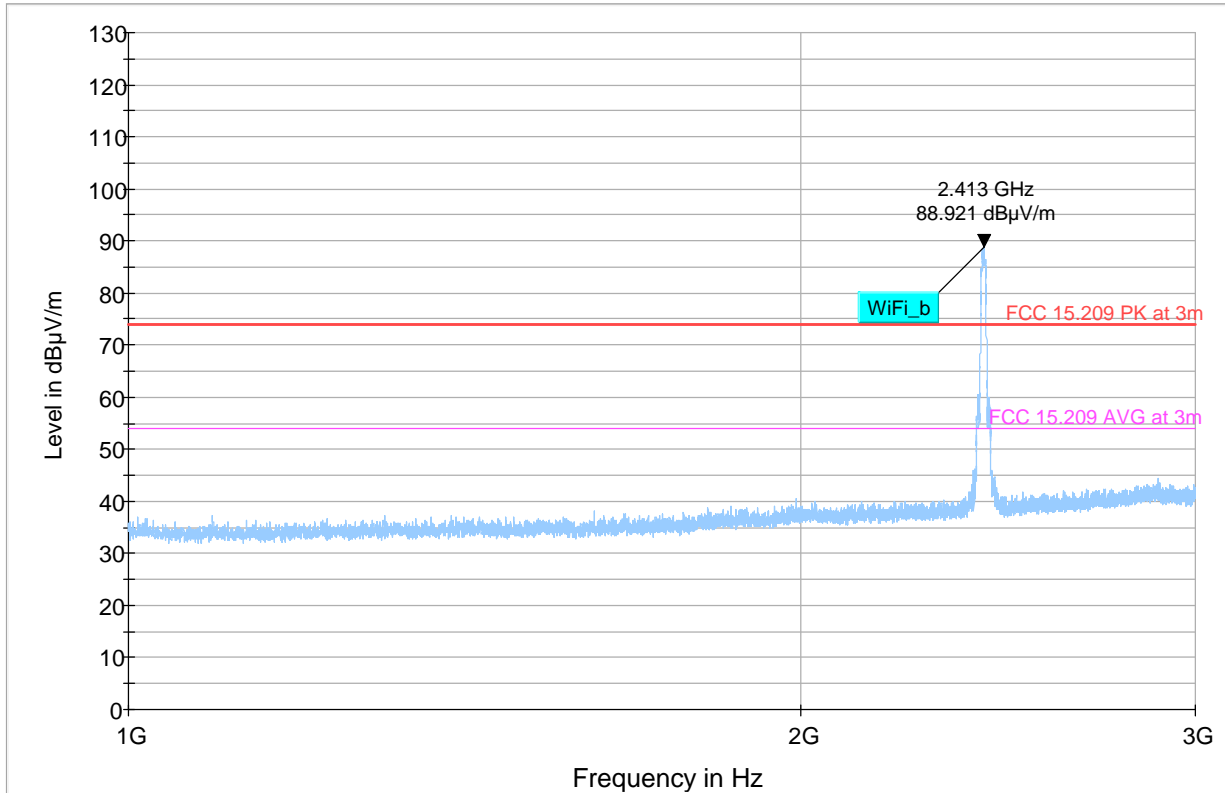


— Preview Result 1-PK+
 — FCC 15.209 QP at 3m
 ◆ Final_Result QPK



Plot # 3

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
---	---	---	---	---	---	---	---	---	---	---

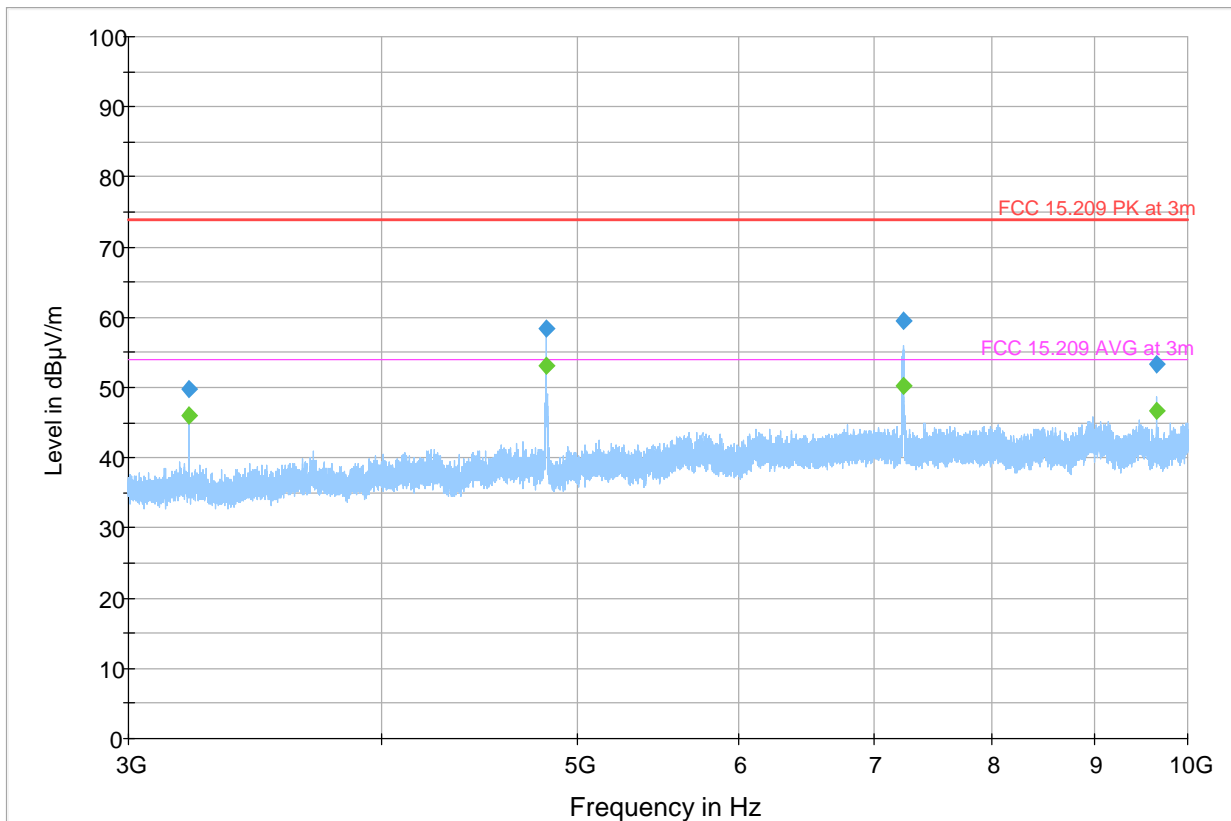


- Preview Result 2-AVG
- Preview Result 1-PK+
- FCC 15.209 PK at 3m
- FCC 15.209 AVG at 3m
- * Critical_Freqs AVG
- * Critical_Freqs PK+
- ♦ Final_Result PK+
- ♦ Final_Result CAV



Plot # 4

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3215.95	---	46.01	53.98	7.97	500.0	1000.0	100.0	H	117.0	-7.0
3215.95	49.69	---	73.98	24.29	500.0	1000.0	100.0	H	117.0	-7.0
4823.85	58.42	---	73.98	15.56	500.0	1000.0	117.0	H	139.0	-3.4
4823.85	---	53.16	53.98	0.82	500.0	1000.0	117.0	H	139.0	-3.4
7235.70	---	50.29	53.98	3.69	500.0	1000.0	100.0	V	29.0	-0.5
7235.70	59.52	---	73.98	14.46	500.0	1000.0	100.0	V	29.0	-0.5
9647.90	---	46.77	53.98	7.21	500.0	1000.0	144.0	V	58.0	1.6
9647.90	53.37	---	73.98	20.61	500.0	1000.0	144.0	V	58.0	1.6



— Preview Result 2-AVG — Preview Result 1-PK+ — FCC 15.209 PK at 3m
— FCC 15.209 AVG at 3m ◆ Final_Result PK+ ◆ Final_Result CAV

8.4 AC Power Line Conducted Emissions

8.4.1 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

8.4.2 Limits: §15.207 & RSS-Gen 8.8

FCC §15.207(a) & RSS-Gen 8.8

- 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.

8.4.3 Test conditions and setup:

Ambient Temperature ©	EUT Set-Up #	EUT operating mode	Power line (L1, L2, L3, N)	Power Input
22° C	2	continuous fixed channel	Line & Neutral	120 VAC

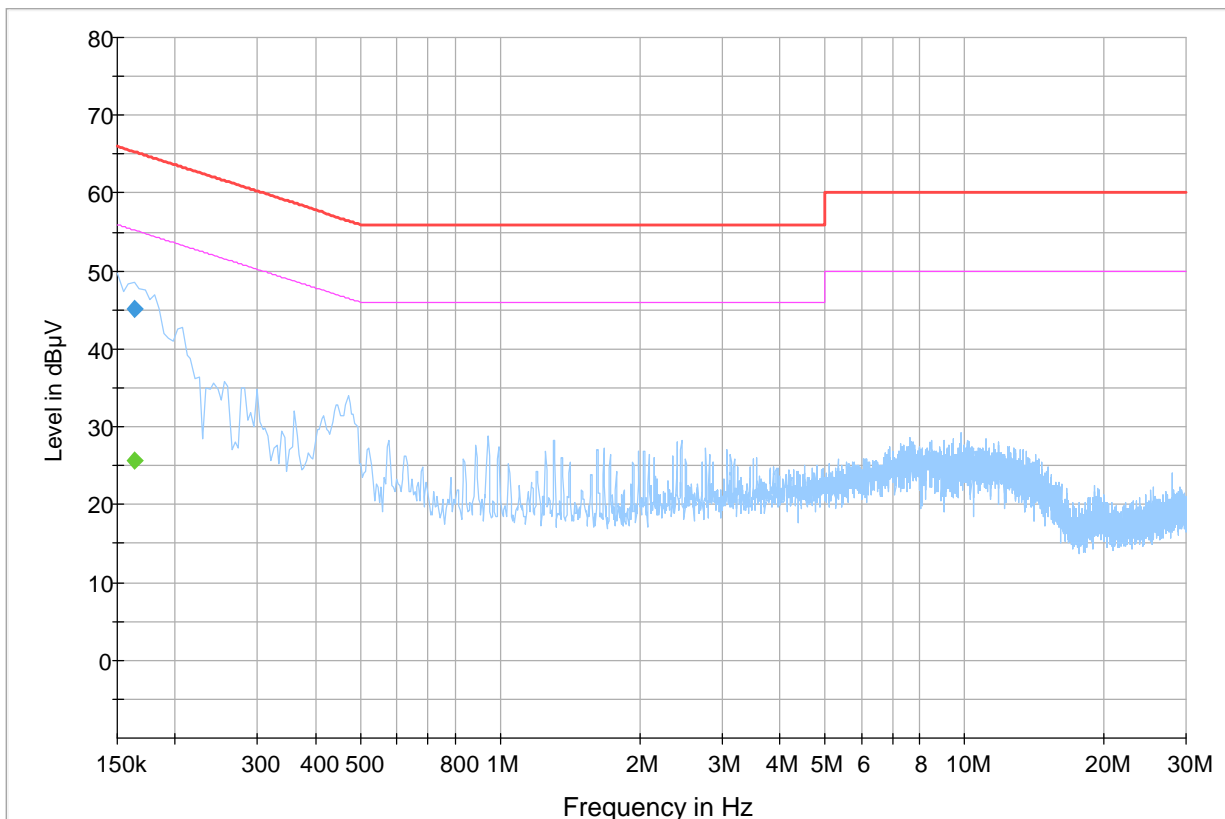
8.4.4 Measurement Result:

Plot #	Port	EUT Set-Up #:	EUT operating mode	Scan Frequency	Limit	Result
1	AC Mains	2	continuous fixed channel	150 kHz – 30 MHz	See section 8.4.2	Pass

8.4.5 Measurement Plots:

Plot # 1

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Line	PE	Corr. (dB)	Comment
0.163	---	25.65	55.30	29.65	500.0	9.000	N	GND	10.3	
0.163	45.10	---	65.30	20.20	500.0	9.000	N	GND	10.3	



◆ Preview Result 1-PK+ Final_Result QPK
 ◆ EN 55032 Voltage on Mains QP Final_Result CAV
 ◆ EN 55032 Voltage on Mains A

9 Test setup photos

Setup photos are included in supporting file name: "EMC_EZLOI-007-21001_FCC_Setup_Photos.pdf"

10 Test Equipment And Ancillaries Used For Testing

Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
ACTIVE LOOP ANTENNA	ETS LINDGREN	6507	00161344	2 YEARS	10/30/2020
BILOG ANTENNA	ETS.LINDGREN	3142E	00166067	2 YEARS	10/21/2021
HORN ANTENNA	EMCO	3115	00035114	2 YEARS	08/10/2020
HORN ANTENNA	ETS.LINDGREN	3117	00215984	2 YEARS	01/31/2021
TEST RECEIVER	R&S	ESU40	100251	2 YEARS	09/13/2021
LISN	FCC	FCC-LISN-50-25-2-08	8014	2 YEARS	08/31/2021
DIGITAL THRMOMETER	CONTROL COMPANY	36934-164	181230565	3 YEARS	10/20/2021

Note:

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

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



11 History

Date	Report Name	Changes to report	Report prepared by
2022-05-25	EMC_EZLOI-007-21001_FCC_15.249	Initial Version	Cheng Song
2022-10-17	EMC_EZLOI-007-21001_FCC_15.249_Rev1	Updated section 3.3 Accessory Equipment (AE) details Added 99% Occupied Bandwidth measurement in section 8.2	Cheng Song
2023-04-18	EMC_EZLOI-007-21001_FCC_15.249_Rev2	Updated section 3.1	Cheng Song
2023-05-31	EMC_EZLOI-007-21001_FCC_15.249_Rev3	Updated section 3.1	Cheng Song

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