



FCC / ISED Test Report

For:
Telular Corporation

Model Name:
ST100

Product Description:
Telematic gateway for communicating measurement data

FCC ID: MTFST1001
ISED: 2175D-ST1001

Applied Rules and Standards:
47 CFR Part 15.247 (DTS)
RSS-247 Issue 3 (DTS) & RSS-Gen Issue 5

REPORT: EMC_TELUL_118_23001_FCC_15_247_Rev1

DATE: 2025-04-28



A2LA Accredited

IC recognized #
3462B

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 | 3 |
| 2 | ADMINISTRATIVE DATA..... | 4 |
| 2.1 | IDENTIFICATION OF THE TESTING LABORATORY ISSUING THE EMC TEST REPORT..... | 4 |
| 2.2 | IDENTIFICATION OF THE CLIENT | 4 |
| 2.3 | IDENTIFICATION OF THE MANUFACTURER..... | 4 |
| 3 | EQUIPMENT UNDER TEST (EUT) | 5 |
| 3.1 | EUT SPECIFICATIONS | 5 |
| 3.2 | EUT SAMPLE DETAILS | 6 |
| 3.3 | ACCESSORY EQUIPMENT (AE) DETAILS | 6 |
| 3.4 | TEST SAMPLE CONFIGURATION..... | 6 |
| 3.5 | MODE OF OPERATION DETAILS..... | 6 |
| 3.6 | JUSTIFICATION FOR MODE OF OPERATION | 6 |
| 4 | SUBJECT OF INVESTIGATION | 7 |
| 5 | MEASUREMENT RESULTS SUMMARY..... | 7 |
| 6 | MEASUREMENT UNCERTAINTY | 8 |
| 6.1 | ENVIRONMENTAL CONDITIONS DURING TESTING:..... | 8 |
| 6.2 | DATES OF TESTING: | 8 |
| 6.3 | DECISION RULE: | 8 |
| 7 | MEASUREMENT PROCEDURES..... | 9 |
| 7.1 | RADIATED MEASUREMENT | 9 |
| 7.2 | POWER LINE CONDUCTED MEASUREMENT PROCEDURE..... | 11 |
| 7.3 | RF CONDUCTED MEASUREMENT PROCEDURE | 11 |
| 8 | TEST RESULT DATA..... | 12 |
| 8.1 | MAXIMUM PEAK CONDUCTED OUTPUT POWER | 12 |
| 8.2 | POWER SPECTRAL DENSITY | 14 |
| 8.3 | BAND EDGE COMPLIANCE..... | 16 |
| 8.4 | EMISSION BANDWIDTH 6dB AND 99% OCCUPIED BANDWIDTH | 20 |
| 8.5 | RADIATED TRANSMITTER SPURIOUS EMISSIONS AND RESTRICTED BANDS..... | 24 |
| 9 | TEST SETUP PHOTOS..... | 40 |
| 10 | TEST EQUIPMENT AND ANCILLARIES USED FOR TESTING | 40 |
| 11 | HISTORY | 41 |

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 Name | Product Description | Model No. |
|---------------------|--|-----------|
| Telular Corporation | Telematic gateway for communicating measurement data | ST100 |

Responsible for Testing Laboratory:

| Alvin Ilarina (Senior Manager Regulatory Services) | | |
|---|------------|------|
| 2025-04-28 | Compliance | |
| Date | Section | Name |

Responsible for the Report:

| | | | |
|------------|------------|--|-----------|
| | | Art Thammanavarat (Senior EMC Engineer) | |
| 2025-04-28 | Compliance | | |
| Date | Section | Name | Signature |

The test results of this test report relate exclusively to the test item specified in Section 3.
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

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

2.2 Identification of the Client

| | |
|-------------------|----------------------------------|
| Applicant's Name: | Telular Corporation |
| Street Address: | 3225 Cumberland Blvd., Suite 300 |
| City/Zip Code | Atlanta, GA 30339 |
| 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

| | |
|---|--|
| Product Description: | Telematic gateway for communicating measurement data |
| Marketing Name: | SkyTank |
| Model No: | ST100 |
| HW Version: | X4 |
| SW Version: | v2.60 |
| FCC-ID: | MTFST1001 |
| ISED: | 2175D-ST1001 |
| Radio Information as declared: | <p><u>Cellular</u></p> <ul style="list-style-type: none"> • Module: Telit ME910G1-W1 • LTE Cat-M • Bands: 2, 4, 12, 13, 66 <p><u>Bluetooth 5.1 w/ BLE (1Mbps)</u></p> <p><u>ISM900</u></p> |
| Antenna Information as declared: | <p><u>LTE (KAVX P822601)</u>: 698-960MHz (2.6 dBi), 1710-2200MHz (4.4 dBi), 2500-2700MHz (3.4 dBi), 2300-2400MHz (1.8 dBi), 3300-3800MHz (2.8 dBi)</p> <p><u>BLE</u>: (integrated on module)</p> <p><u>ISM900 (WLAN) (KAVX 1001011)</u>: 868-928MHz (1.0 dBi)</p> |
| Power Supply/ Rated Operating Voltage Range | Four 1.5V Lithium Cells (Energizer L91) in Series -- 4V min, 6V nom, 7.2V max. |
| Operating Temperature Range | -30 to 60 deg C |
| Sample Revision | <input type="checkbox"/> Production <input checked="" type="checkbox"/> Pre-Production |
| EUT Diameter | <input checked="" type="checkbox"/> < 60 cm <input type="checkbox"/> Other _____ |
| Note 1: The EUT specifications listed in the table above were provided by the client. | |
| Note 2: The radios within the EUT do not operate simultaneously. | |

3.2 EUT Sample details

| EUT # | Serial Number | HW Version | SW Version | Notes/Comments |
|-------|---------------|------------|------------|--------------------|
| 1 | 0045 | X4 | v2.60 | Radiated Emissions |
| 2 | 0013 | X4 | v2.60 | Conducted RF |

3.3 Accessory Equipment (AE) details

| AE # | Type | Model | Manufacturer | Serial Number |
|------|----------------|-------|---------------------|---------------|
| 1 | Pre-Production | ST131 | Telular Corporation | 001 |

3.4 Test Sample Configuration

| EUT Set-up # | Combination of AE used for test set up | Comments |
|--------------|--|---|
| 1 | EUT#1 + AE #1 | The internal antenna of the EUT was connected. |
| 2 | EUT#2 | The measurement equipment was connected to the 50-ohm RF port of the EUT. |

3.5 Mode of Operation details

| Operating Mode | Description of Operating modes | Additional Information |
|----------------|--------------------------------|--|
| Op. 1 | ISM TX | The ISM radio in the EUT, operating in the 900 MHz band, was configured for fixed-channel transmission at the maximum achievable duty cycle using software inaccessible to the end user. |

Note: The radios within the EUT do not operate simultaneously.

3.6 Justification for Mode of Operation

During the testing process, the EUT was tested with transmitter sets on low, mid and high channels, 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.

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.

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(a) | Emission Bandwidth | Nominal | Op. 1 | ■ | □ | □ | Complies |
| §15.247(e) RSS-247 5.2(b) | Power Spectral Density | Nominal | Op. 1 | ■ | □ | □ | Complies |
| §15.247(b)(1) RSS-247 5.4(d) | Maximum Conducted Output Power and EIRP | Nominal | Op. 1 | ■ | □ | □ | Complies |
| §15.247(d) RSS-247 5.5 | Band edge compliance Unrestricted Band Edges | Nominal | Op. 1 | ■ | □ | □ | Complies |
| §15.247; 15.209; 15.205 RSS-Gen 8.9; 8.10 | Band edge compliance Restricted Band Edges | Nominal | Op. 1 | ■ | □ | □ | Complies |
| §15.247(d); §15.209 RSS-Gen 6.13 | TX Radiated Spurious Emissions | Nominal | Op. 1 | ■ | □ | □ | Complies |
| §15.207(a) RSS Gen 8.8 | AC Conducted Emissions | Nominal | - | □ | ■ | □ | Note 1 Note 2 |

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

Note 2: The EUT does not draw power from AC public mains; therefore, this test case is not applicable.

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.

Radiated measurement

| Measurement System | | EMC Lab 1 | EMC Lab 2 |
|----------------------------------|------------------|-----------|-----------|
| Conducted emissions (mains port) | 150 kHz – 30 MHz | 2.47 dB | N/A |
| Radiated emissions | 9 kHz – 30 MHz | 2.68 dB | 2.53 dB |
| | 30 – 100 MHz | 4.39 dB | 3.85 dB |
| | 100 MHz – 1 GHz | 5.65 dB | 5.24 dB |
| | 1 – 6 GHz | 5.0 dB | 4.88 dB |
| | 6 – 18 GHz | 4.76 dB | 4.58 dB |
| | 18 – 40 GHz | 4.65 dB | 4.61 dB |

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 3dB 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:

12/10/2024 – 12/11/2024

6.3 Decision Rule:

Cetecom Inc follows ILAC G8:09/2019 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.

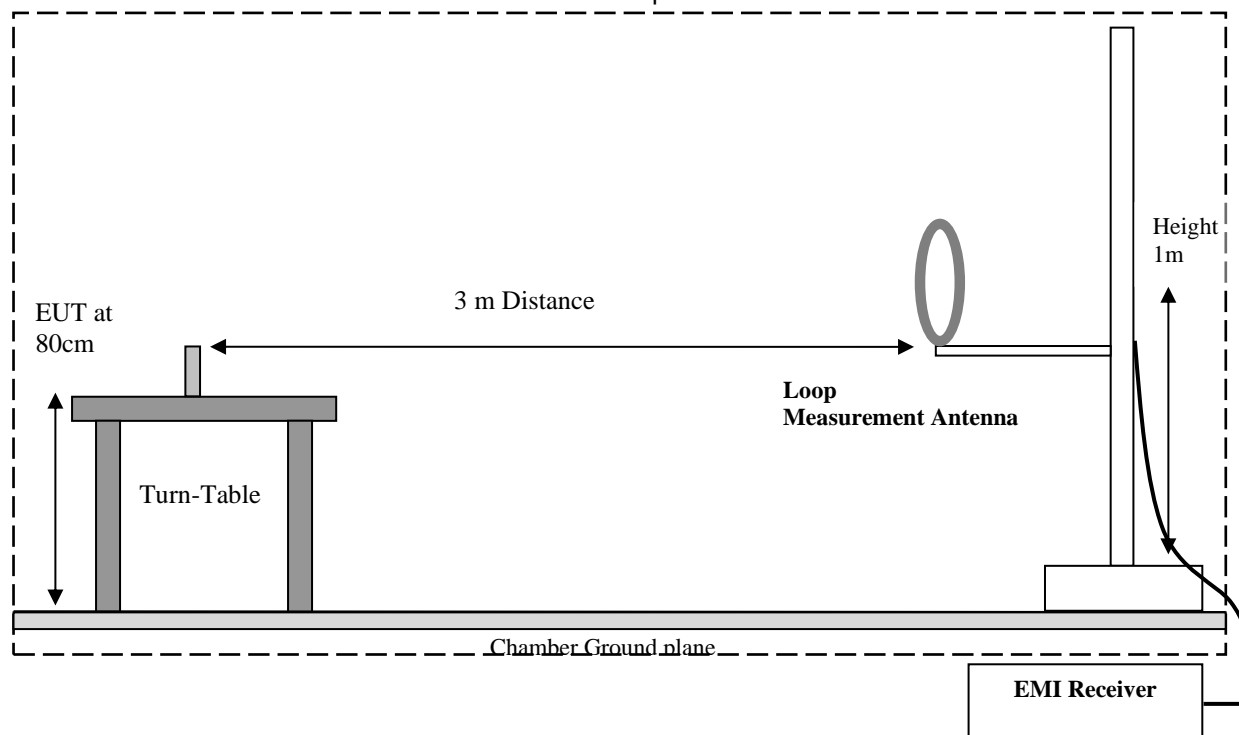
7 Measurement Procedures

7.1 Radiated Measurement

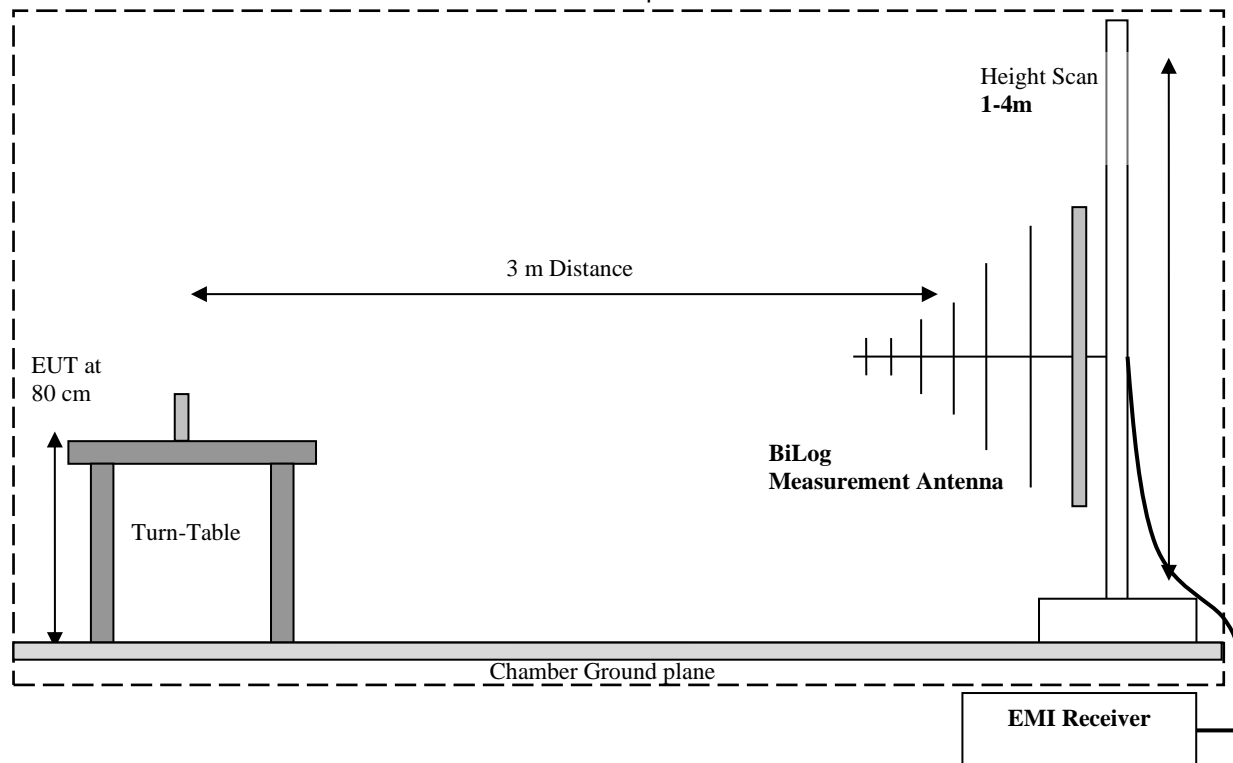
The radiated measurement is performed according to ANSI C63.10 (2013)

- 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.

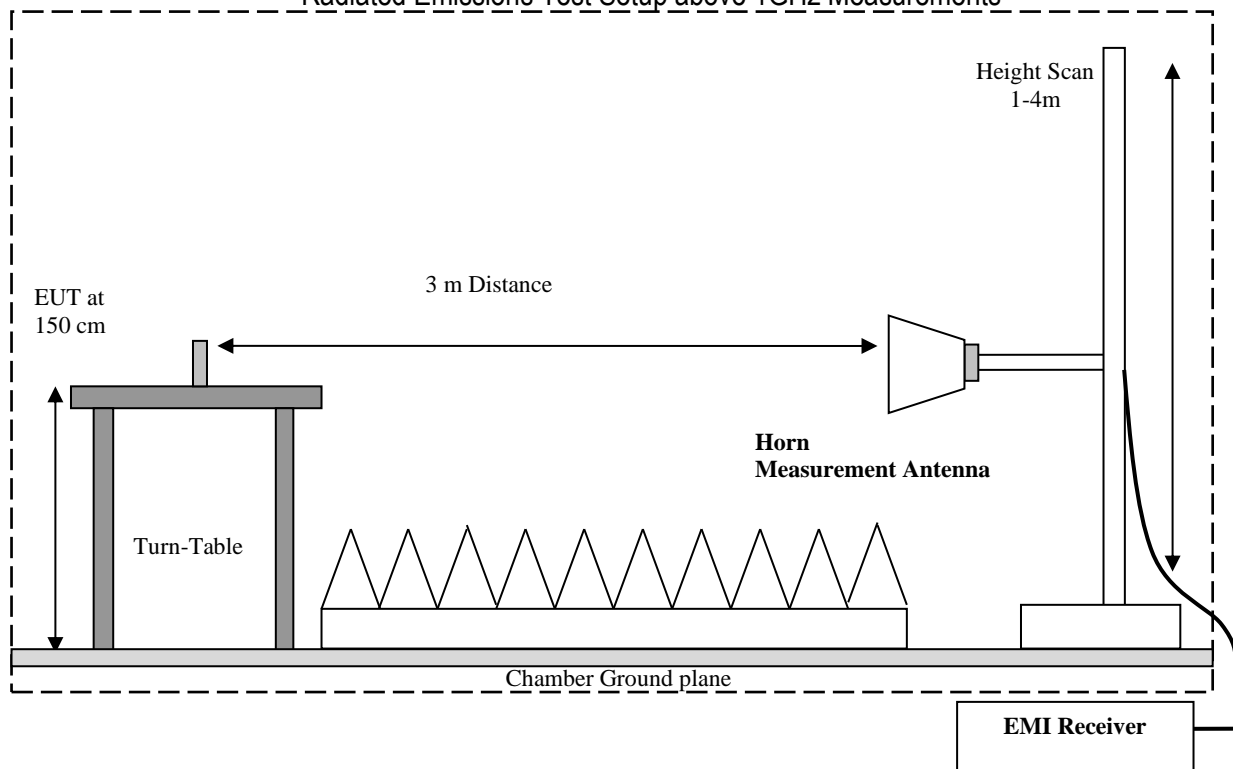
Radiated Emissions Test Setup below 30MHz Measurements



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 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:

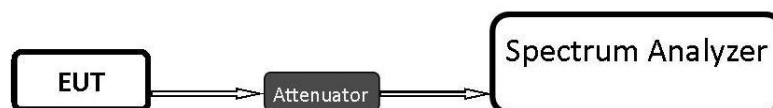
| Frequency (MHz) | Measured SA (dB μ V) | Cable Loss (dB) | Antenna Factor Correction (dB) | Field Strength Result (dB μ V/m) |
|-----------------|--------------------------|-----------------|--------------------------------|--------------------------------------|
| 1000 | 80.5 | 3.5 | 14 | 98.0 |

7.2 Power Line Conducted Measurement Procedure

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

7.3 RF Conducted Measurement Procedure

Testing procedures are based on 558074 D01 15.247 Meas Guidance v05r02 – “GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES” - April 2, 2019, 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.

8 Test Result Data

8.1 Maximum Peak Conducted Output Power

8.1.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r02 and ANSI C63.11.9

Spectrum Analyzer settings:

- $RBW \geq DTS$ bandwidth
- $VBW \geq 3 \times RBW$
- $Span \geq 3 \times RBW$
- Sweep = Auto couple
- Detector function = Peak
- Trace = Max hold
- Use peak marker function to determine the peak amplitude level

8.1.2 Limits:

Maximum Peak Output Power:

- FCC §15.247 (b)(1): 1 W
- IC RSS-247: 1 W

8.1.3 Test conditions and setup:

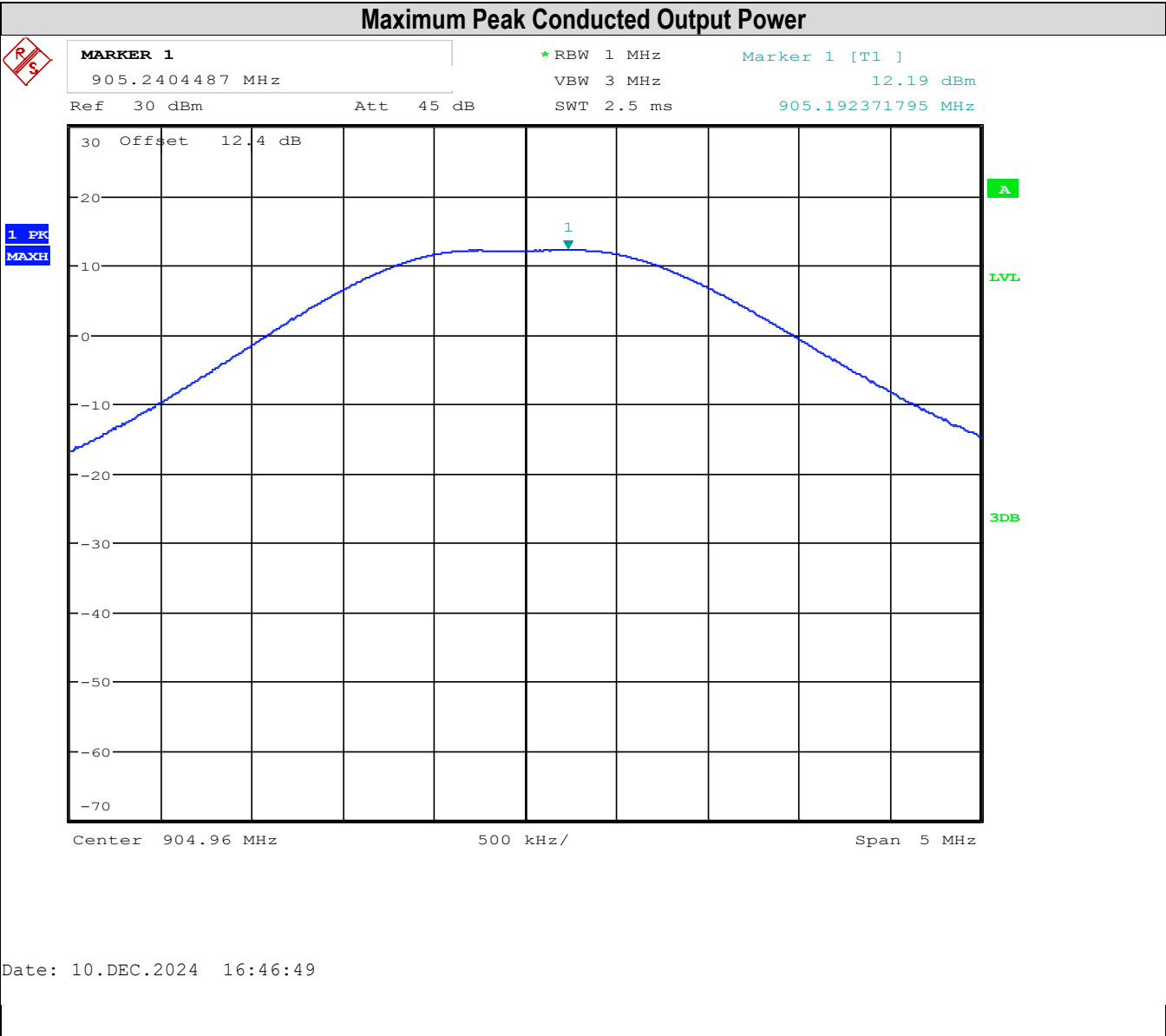
| Ambient Temperature | EUT Set-Up # | EUT operating mode | Power Input | Antenna Gain |
|---------------------|--------------|--------------------|-------------|--------------|
| 22° C | 2 | Op. 1 | Battery | 1 dBi |

8.1.4 Measurement result:

| Plot # | Channel | Maximum Peak Conducted Output Power (dBm) | EIRP (dBm) | Limit (dBm) | Result |
|--------|---------|---|------------|---------------------|--------|
| 1 | Low | 12.19 | 13.19 | 30 (Pk) / 36 (EIRP) | Pass |
| 2 | Mid | 12.10 | 13.10 | 30 (Pk) / 36 (EIRP) | Pass |
| 3 | High | 11.62 | 12.62 | 30 (Pk) / 36 (EIRP) | Pass |

Note: The plots presented in the section below represent the worst-case results from the measurements.

8.1.5 Measurement Plots:



8.2 Power Spectral Density

8.2.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r02

Spectrum Analyzer settings for Peak PSD method:

- Set analyzer center frequency to DTS channel center frequency
- Set the span to 1.5 x DTS bandwidth
- Set RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
- Set the VBW $\geq 3 \times \text{RBW}$
- Detector = Peak
- Sweep time = Auto couple
- Trace mode = Max hold
- Allow trace to fully stabilize
- Use the peak marker function to determine the maximum amplitude level within the RBW
- If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat

8.2.2 Limits:

FCC§15.247(e) & RSS-247 5.2(b)

- For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.2.3 Test conditions and setup:

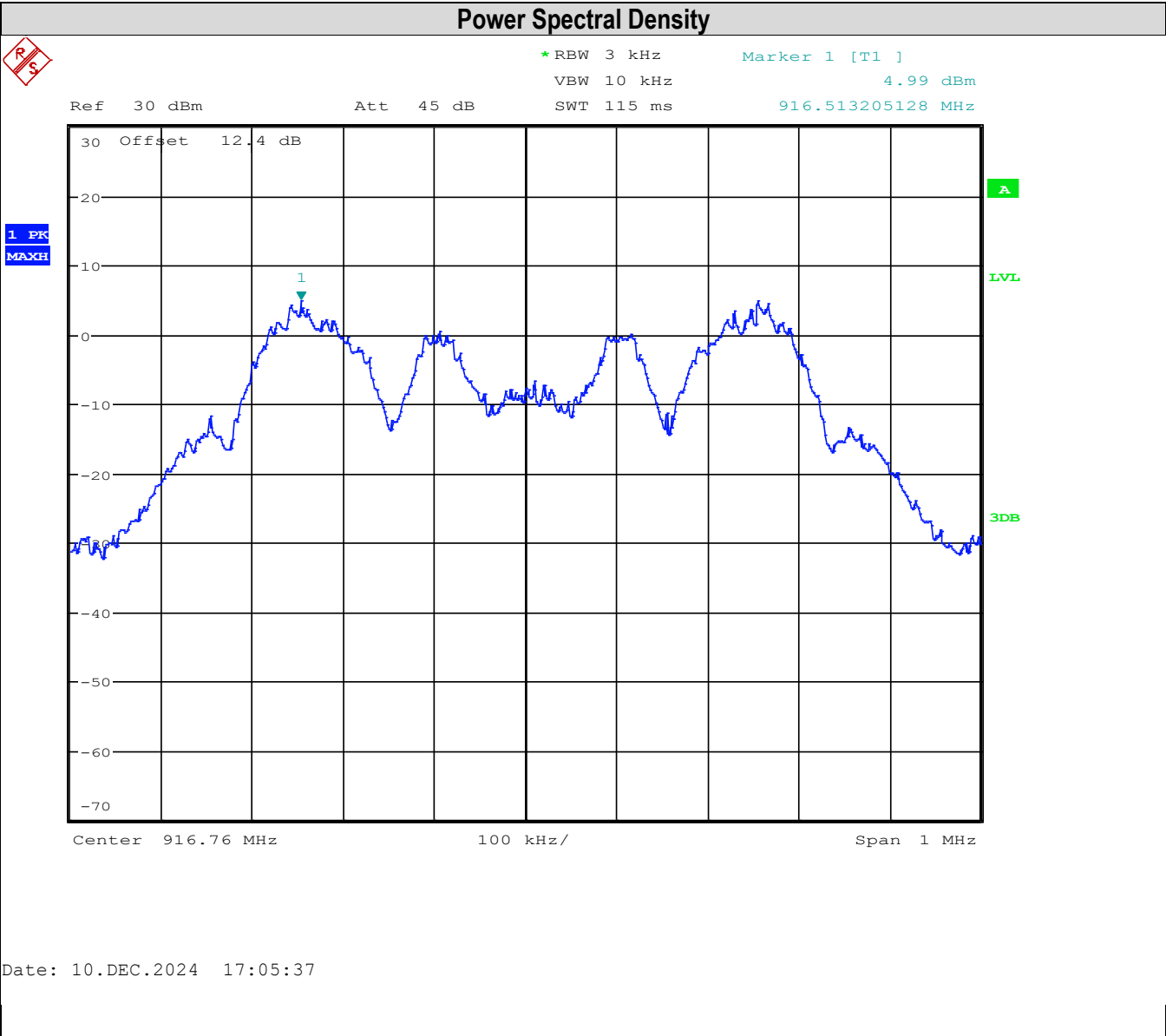
| Ambient Temperature | EUT Set-Up # | EUT operating mode | Power Input | Antenna Gain |
|---------------------|--------------|--------------------|-------------|--------------|
| 22° C | 2 | Op. 1 | Battery | 1 dBi |

8.2.4 Measurement result:

| Plot # | Channel | Maximum Power Spectral Density (dBm/3 kHz) | Limit (dBm / 3 kHz) | Result |
|--------|---------|--|--------------------------|--------|
| 1 | Low | 4.74 | 8 | Pass |
| 2 | Mid | 4.99 | 8 | Pass |
| 3 | High | 4.47 | 8 | Pass |

Note: The plots presented in the section below represent the worst-case results from the measurements.

8.2.5 Measurement Plots:



8.3 Band Edge Compliance

8.3.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r02

Spectrum Analyzer settings for band edge:

- Set the center frequency and span to encompass frequency range to be measured
- RBW = 100 kHz
- VBW $\geq 3 \times$ 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

8.3.2 Limits non restricted band:

FCC§15.247 (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 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 30dB instead of 20dB.

Spectrum Analyzer settings for restricted band:

- Peak measurements are made using a peak detector and RBW=1 MHz

8.3.3 Limits restricted band §15.247/15.209/15.205 and RSS-Gen 8.9/8.10

- *PEAK LIMIT= 74 dB μ V/m @3m =-21.23 dBm
- *AVG. LIMIT= 54 dB μ V/m @3m =-41.23 dBm
- Start frequency & stop frequency according to frequency range specified in the restricted band table in FCC section 15.205 & RSS-Gen 8.10
- Measurements with a peak detector were used to show compliance to average limits, thus showing compliance to both peak and average limits.

(a) 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 | | | |

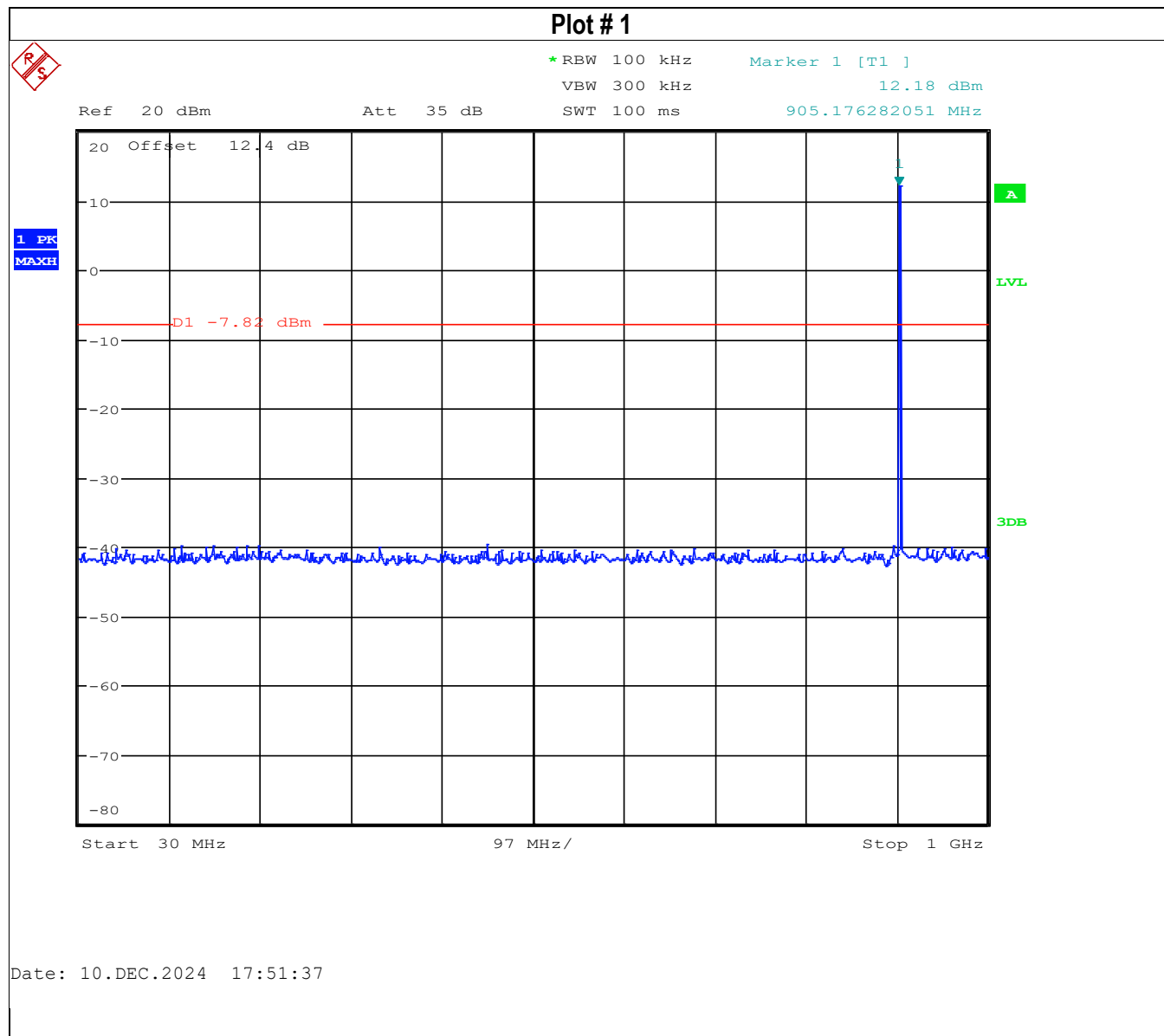
8.3.4 Test conditions and setup:

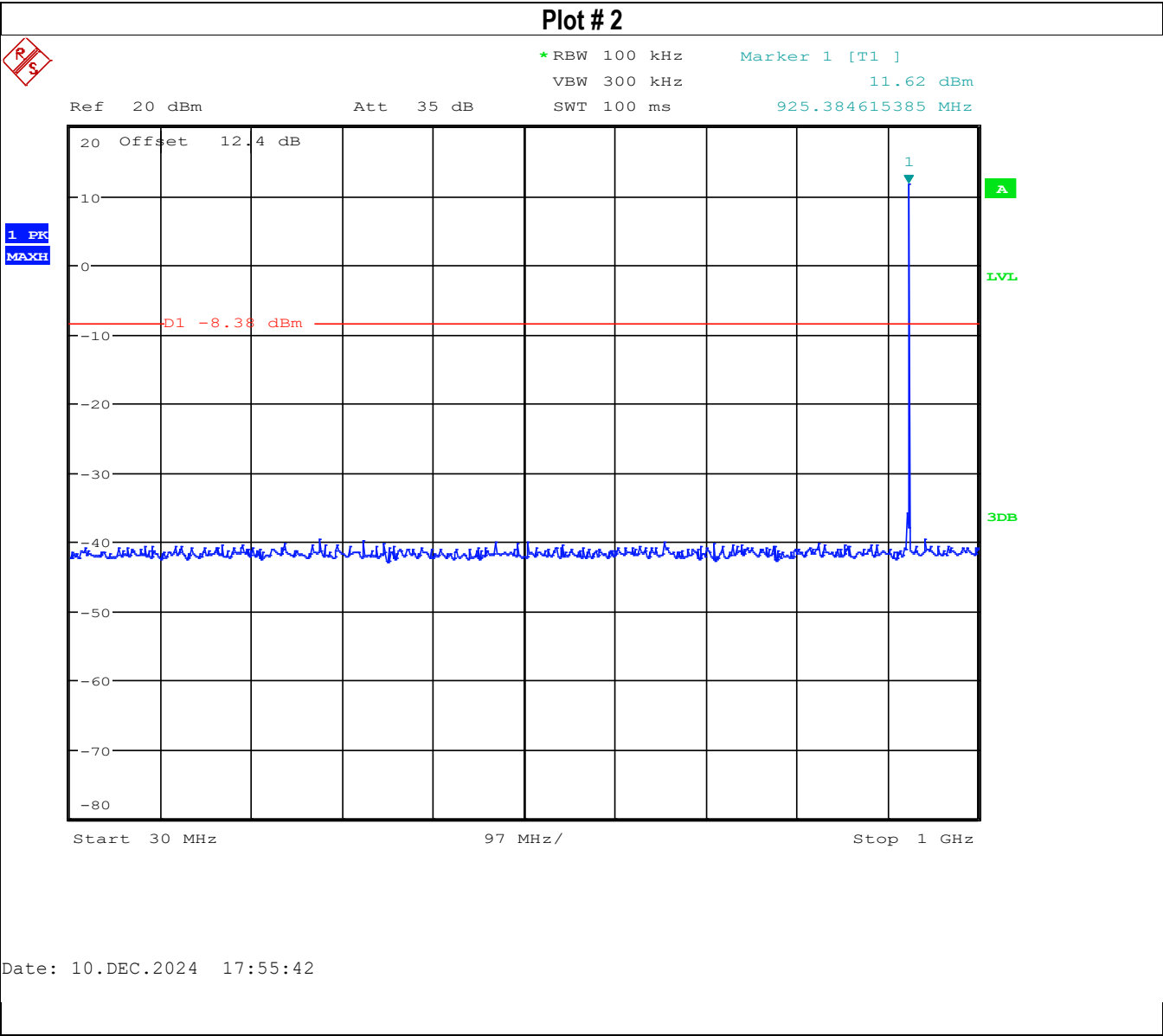
| Ambient Temperature | EUT Set-Up # | EUT operating mode | Power Input | Antenna Gain |
|---------------------|--------------|--------------------|-------------|--------------|
| 22° C | 2 | Op. 1 | Battery | 1 dBi |

8.3.5 Measurement result:

| Plot # | EUT Set-Up # | Band Edge | Limit (dBc) | Result |
|--------|--------------|-----------------------|-------------|--------|
| 1 | 2 | Lower, non-restricted | > 20 | Pass |
| 2 | 2 | Upper, non-restricted | > 20 | Pass |

8.3.6 Measurement Plots:





8.4 Emission Bandwidth 6dB and 99% Occupied Bandwidth

8.4.1 Measurement according to FCC 558074 D01 15.247 Meas Guidance v05r02

Spectrum Analyzer settings:

6dB (DTS) Bandwidth:

- Set RBW = 100 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 6 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.

8.4.2 Limits:

FCC §15.247(a)(2) and RSS-247 5.2(a)

- Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

8.4.3 Test conditions and setup:

| Ambient Temperature | EUT Set-Up # | EUT operating mode | Power Input |
|---------------------|--------------|--------------------|-------------|
| 22° C | 2 | Op. 1 | Battery |

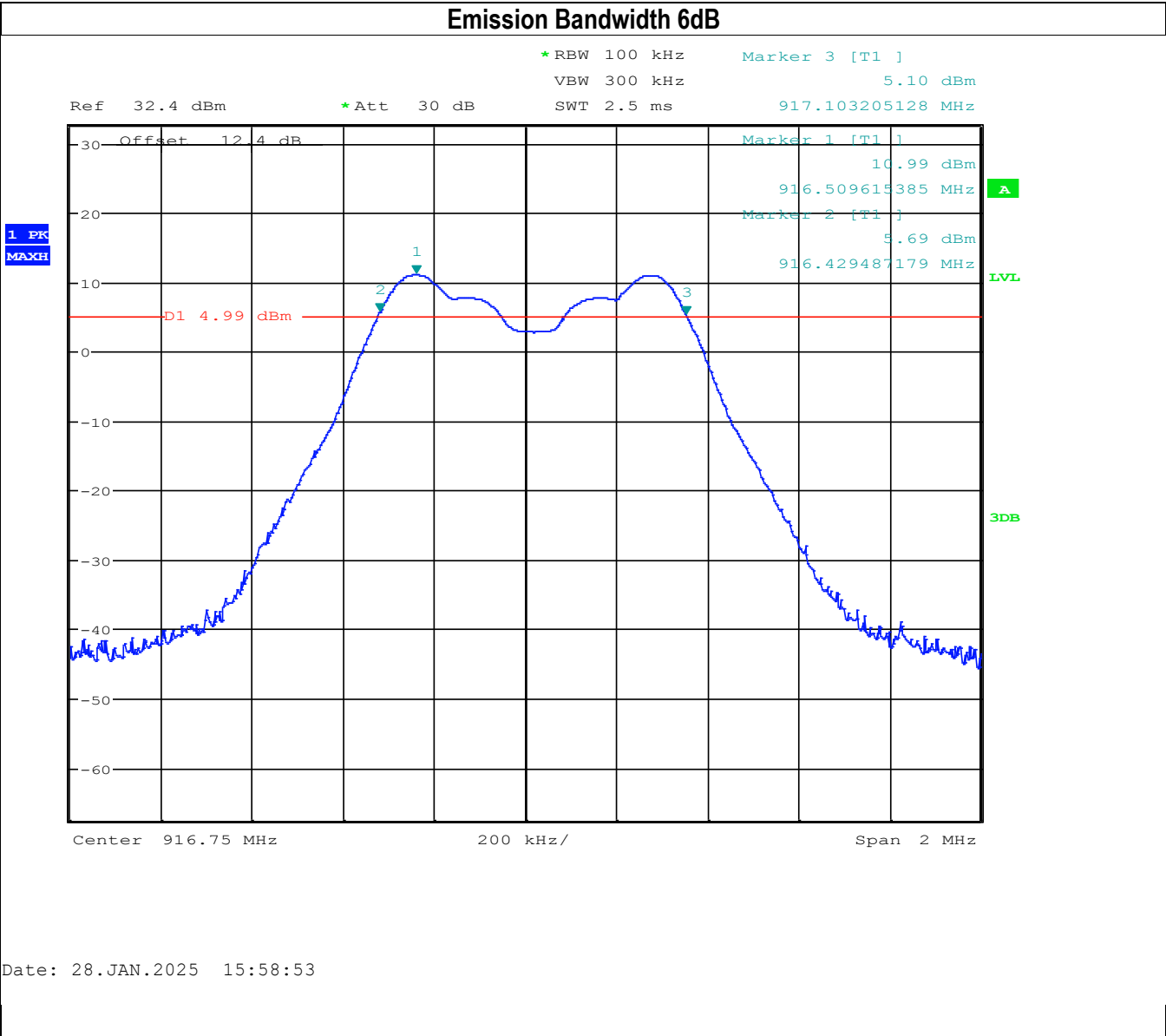
8.4.4 Measurement result:

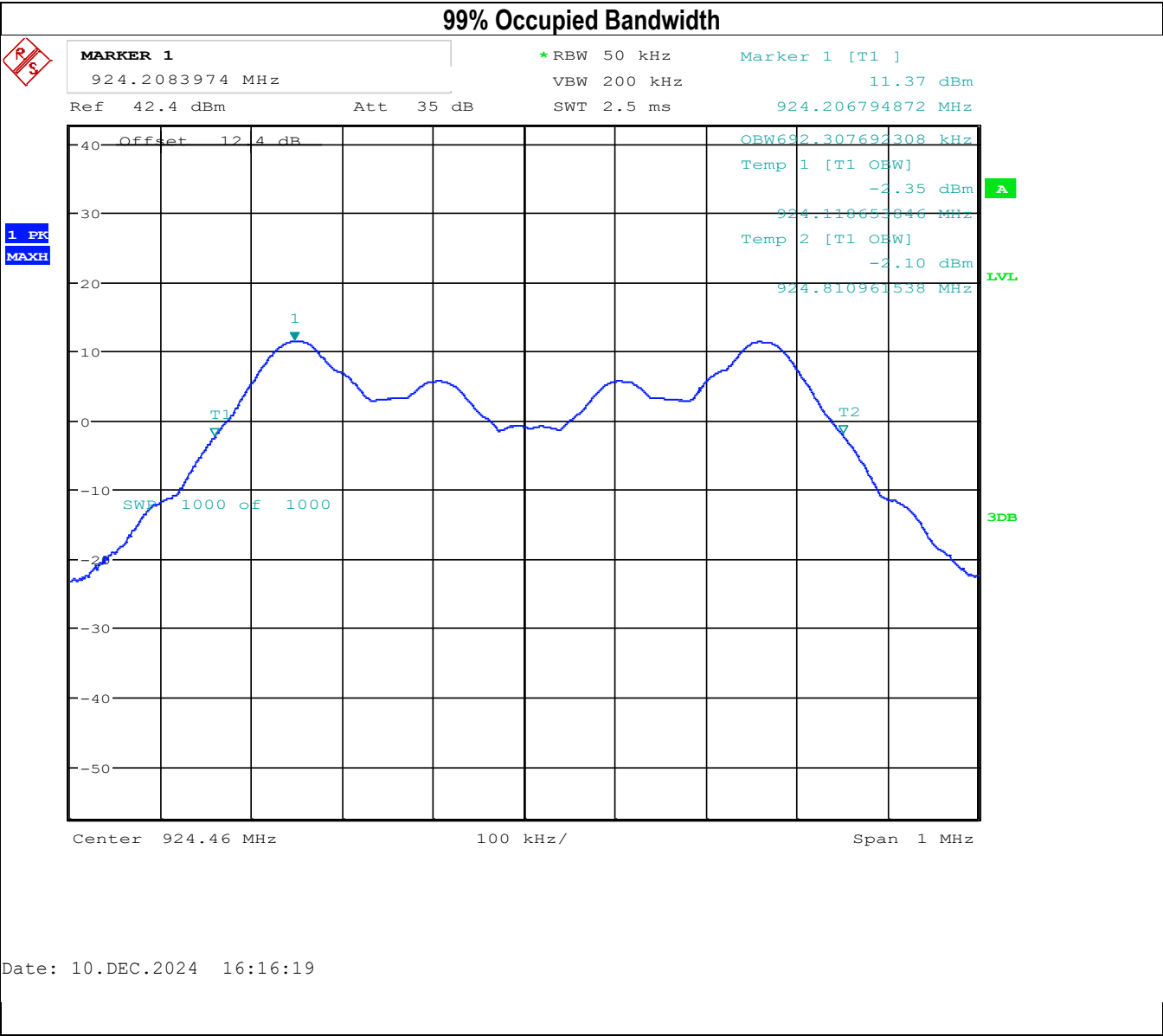
| Plot # | Channel | 6dB Emissions Bandwidth (MHz) | Limit (MHz) | Result |
|--------|---------|-------------------------------|-------------|--------|
| 1 | Low | 0.689 | > 0.5 | Pass |
| 2 | Mid | 0.674 | > 0.5 | Pass |
| 3 | High | 0.684 | > 0.5 | Pass |

| Plot # | Channel | 99% Occupied Bandwidth (MHz) | Limit (MHz) | Result |
|--------|---------|------------------------------|-------------|--------|
| 4 | Low | 0.691 | NA | Pass |
| 5 | Mid | 0.691 | NA | Pass |
| 6 | High | 0.692 | NA | Pass |

Note: The plots presented in the section below represent the worst-case results from the measurements.

8.4.5 Measurement Plots:





8.5 Radiated Transmitter Spurious Emissions and Restricted Bands

8.5.1 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.

8.5.2 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 |
| 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

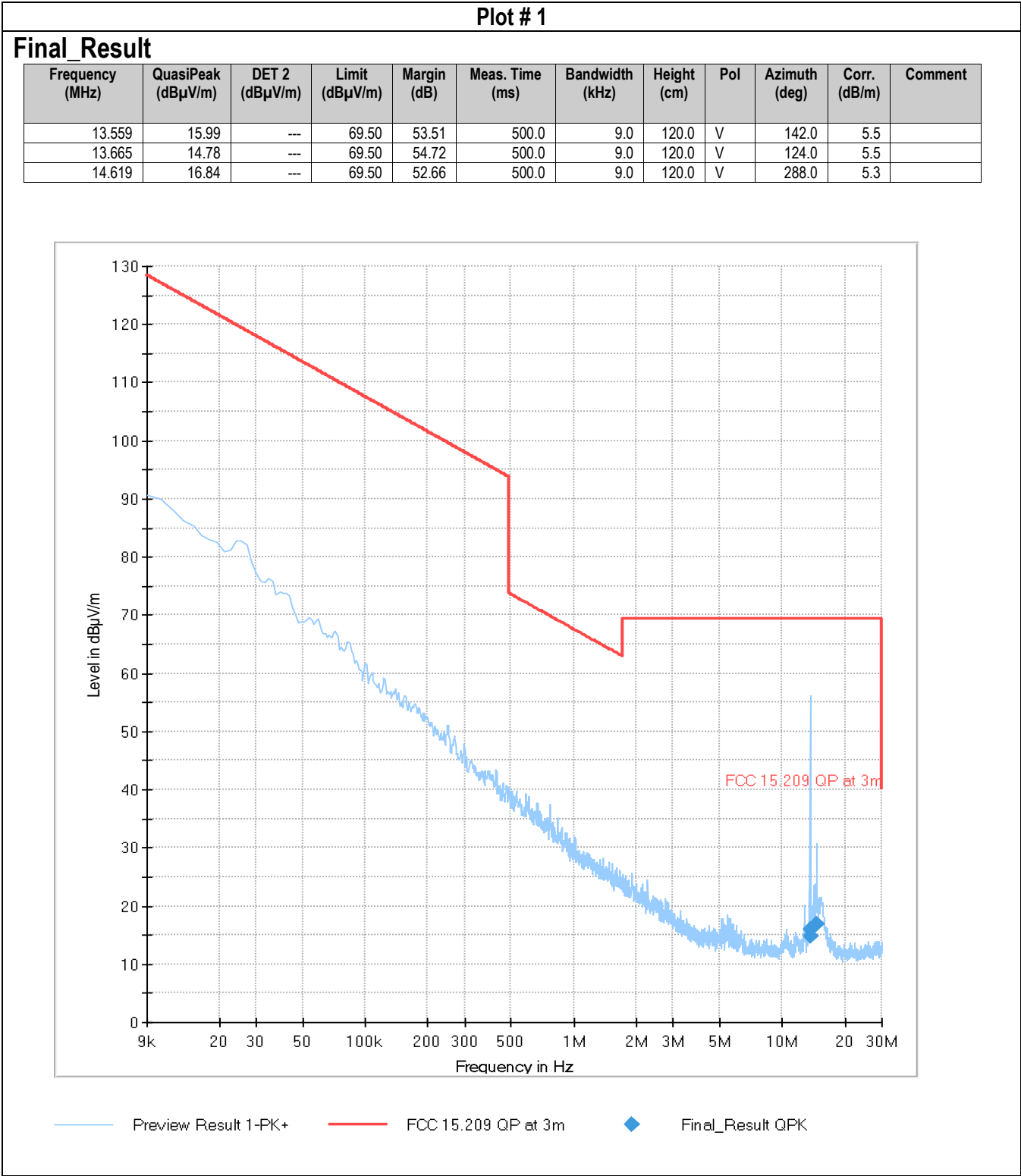
8.5.3 Test conditions and setup:

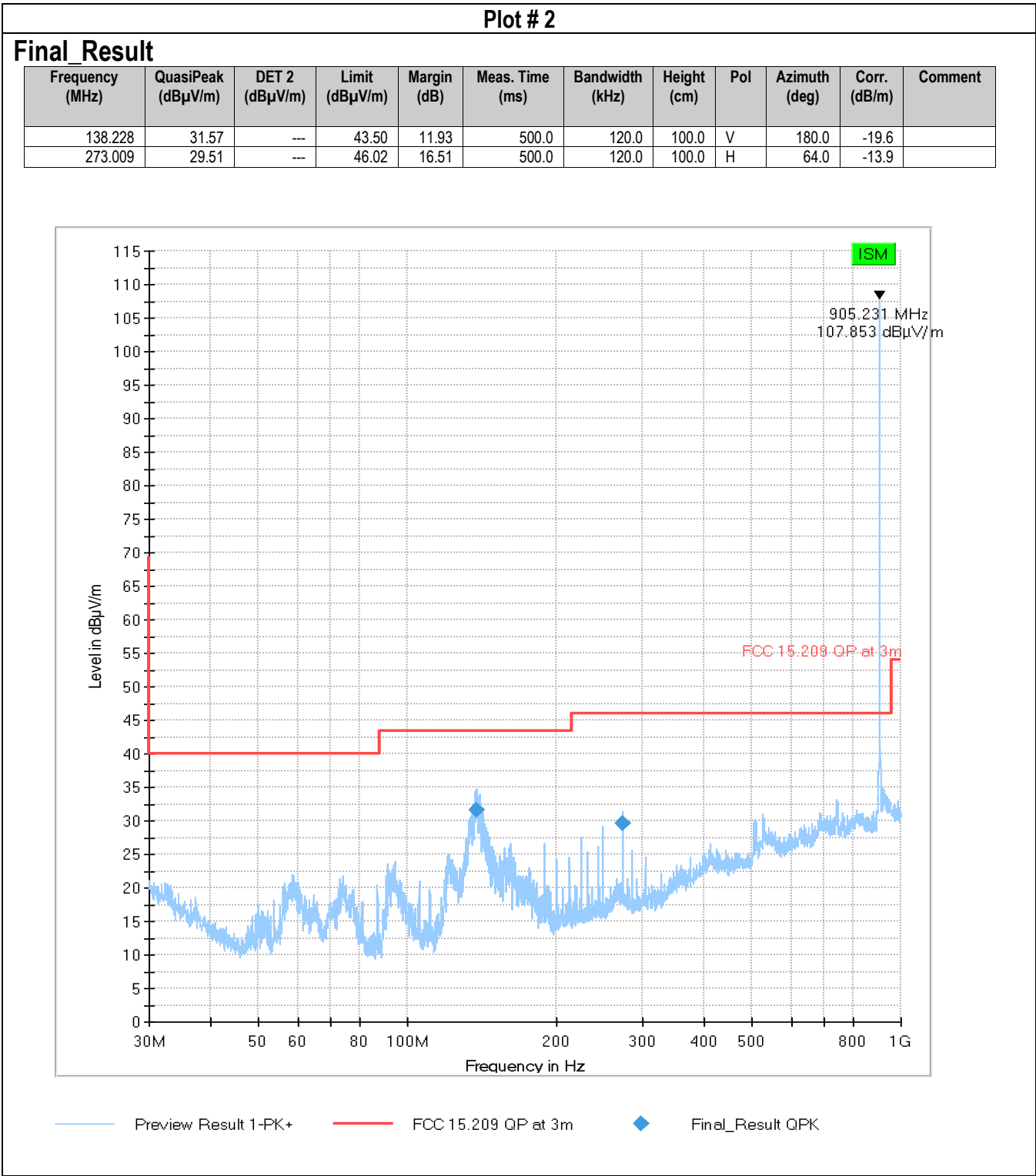
| Ambient Temperature | EUT Set-Up # | EUT operating mode | Power Input |
|---------------------|--------------|--------------------|-------------|
| 22° C | 1 | Op. 1 | Battery |

8.5.4 Measurement result:

| Plot # | Channel # | Scan Frequency | Limit | Result |
|--------|-----------|----------------------------|-------------------|--------|
| 1-4 | Low | 9 kHz – 18 GHz | See section 8.5.2 | Pass |
| 5-8 | Mid | 9 kHz – 18 GHz | See section 8.5.2 | Pass |
| 9-12 | High | 9 kHz – 18 GHz | See section 8.5.2 | Pass |
| 13 | High | Upper Restricted Band Edge | See section 8.5.2 | Pass |

8.5.5 Measurement Plots:

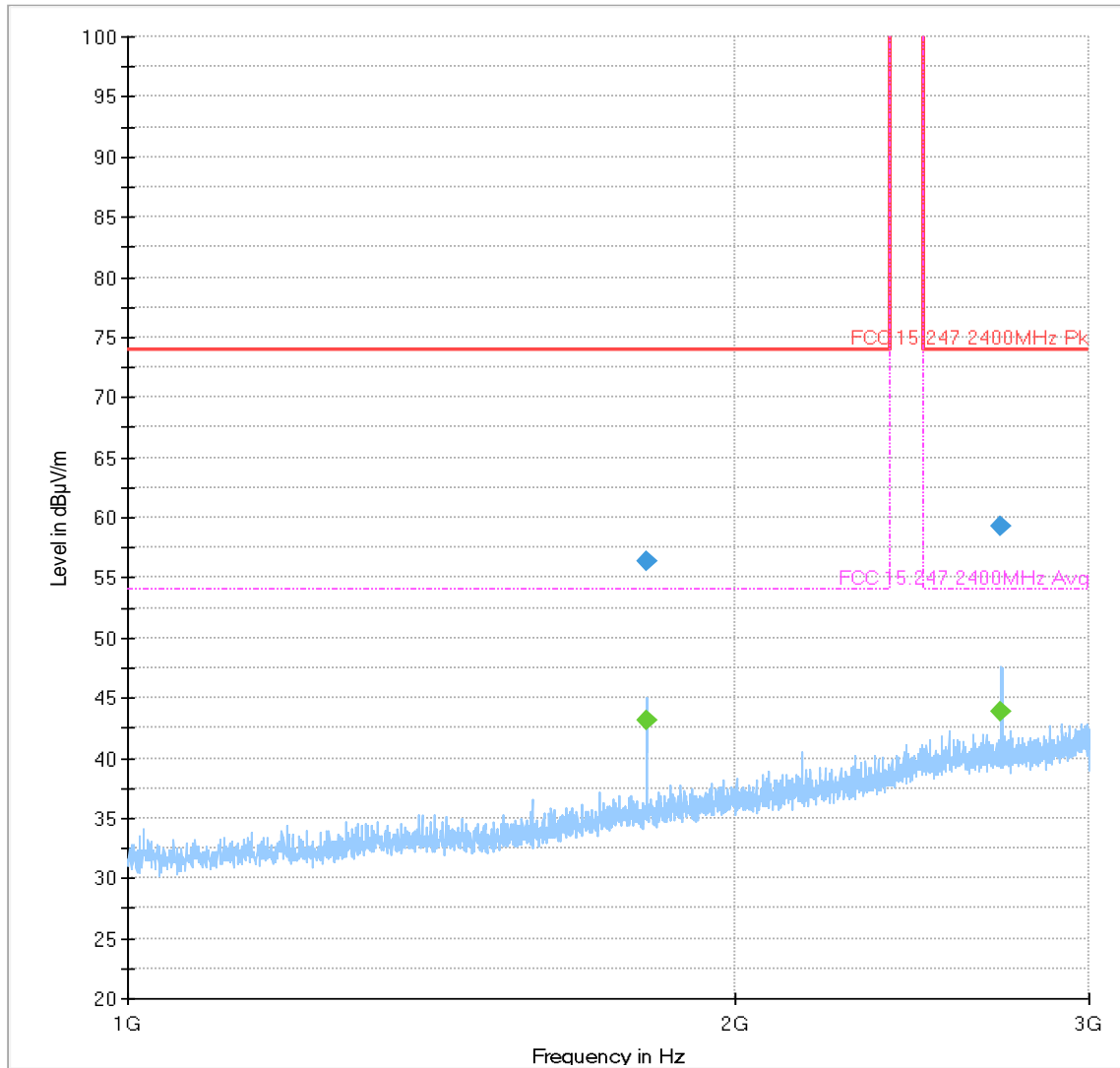




Plot # 3

Final_Result

| Frequency (MHz) | MaxPeak (dBμV/m) | CAverage (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) | Comment |
|-----------------|------------------|-------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|--------------|---------|
| 1810.500 | --- | 43.06 | 54.00 | 10.94 | 500.0 | 1000.0 | 164.0 | V | 242.0 | 31.5 | |
| 1810.500 | 56.30 | --- | 74.00 | 17.70 | 500.0 | 1000.0 | 164.0 | V | 242.0 | 31.5 | |
| 2714.500 | --- | 43.83 | 54.00 | 10.17 | 500.0 | 1000.0 | 166.0 | V | 342.0 | 35.4 | |
| 2714.500 | 59.22 | --- | 74.00 | 14.78 | 500.0 | 1000.0 | 166.0 | V | 342.0 | 35.4 | |



Preview Result 1-PK+
Final_Result PK+

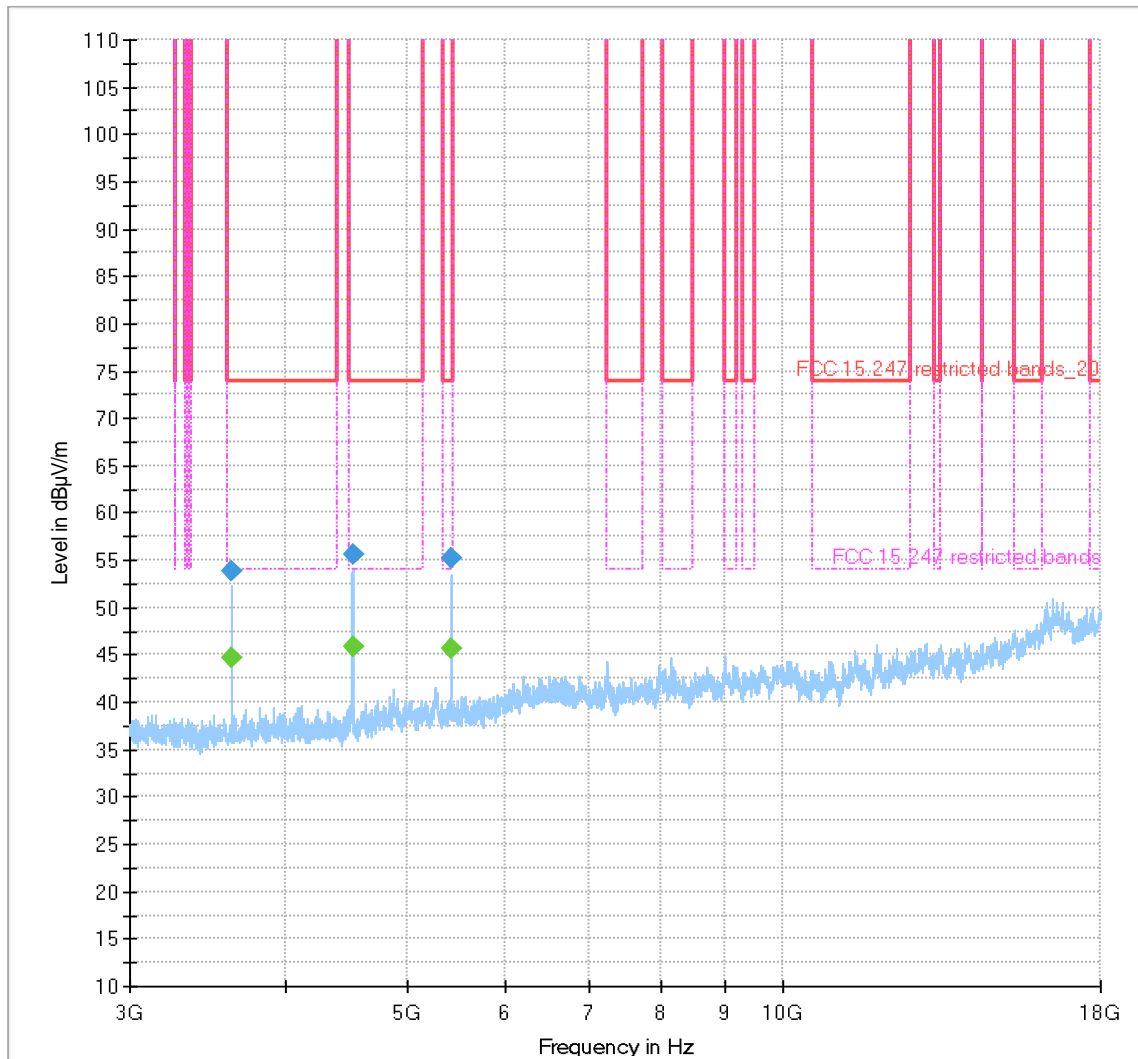
FCC 15.247 2400MHz Pk
Final_Result CAV

FCC 15.247 2400MHz Avg

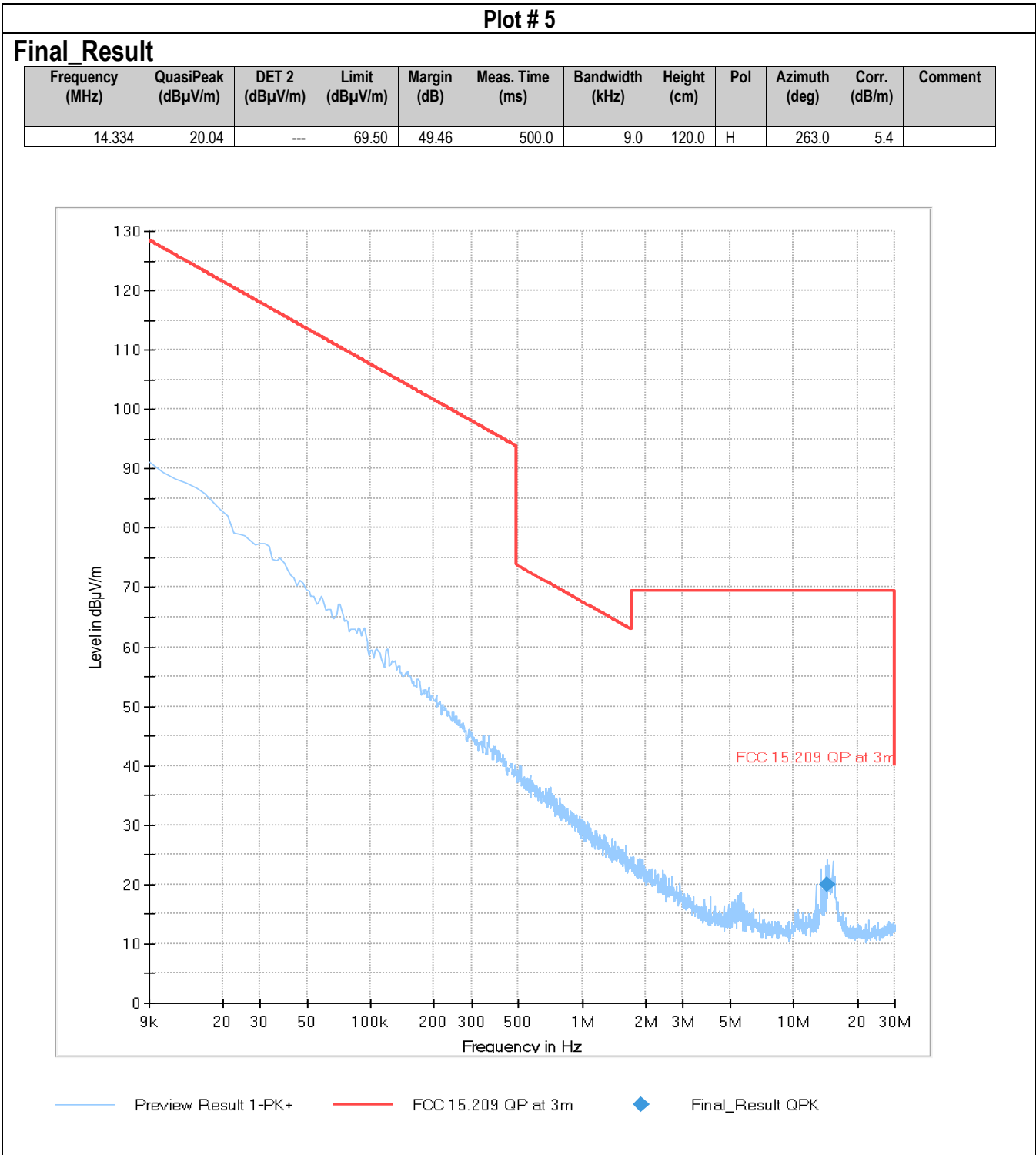
Plot # 4

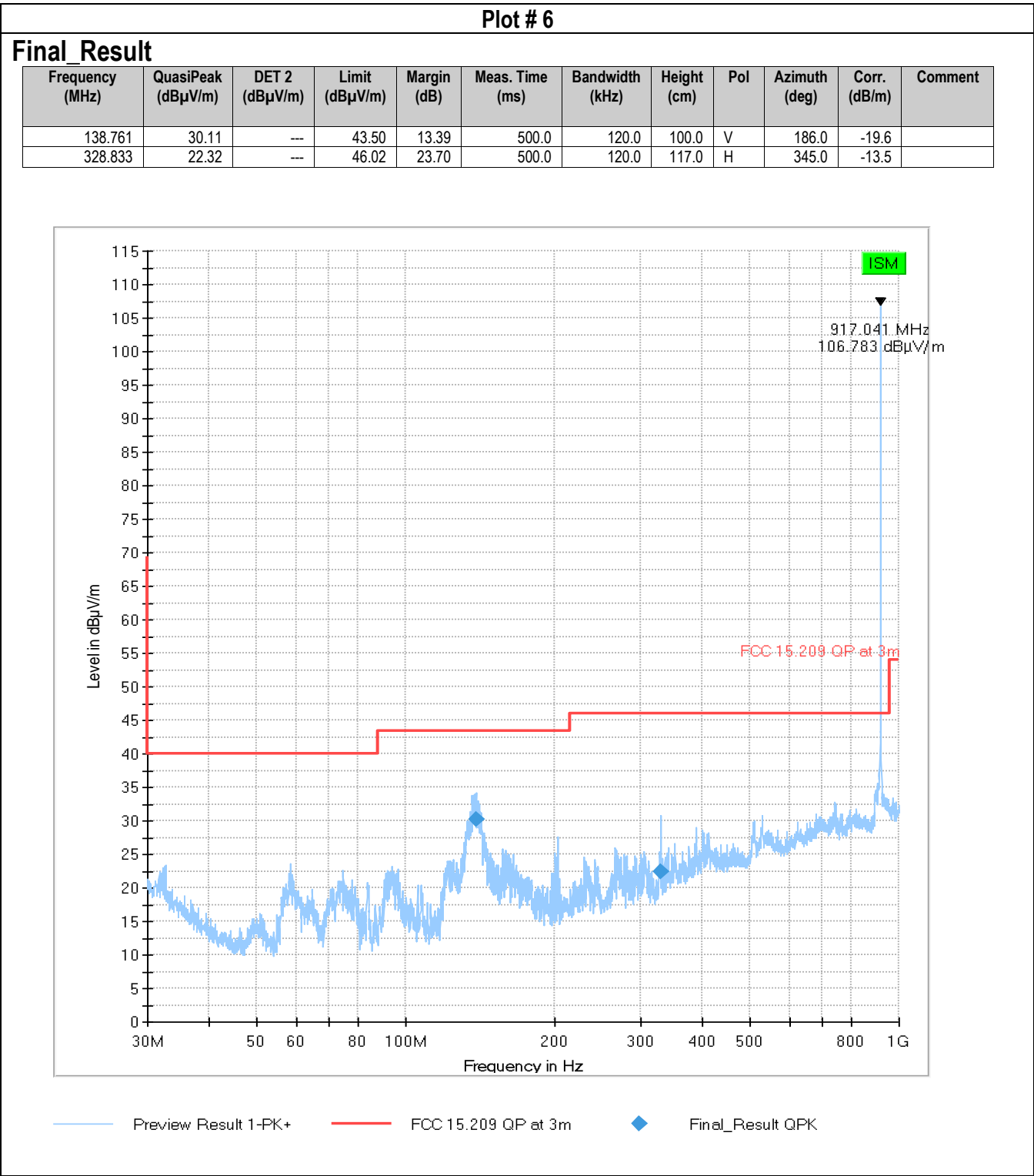
Final_Result

| Frequency (MHz) | MaxPeak (dBμV/m) | CAverage (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) | Comment |
|-----------------|------------------|-------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|--------------|---------|
| 3618.750 | --- | 44.63 | 53.98 | 9.35 | 500.0 | 1000.0 | 236.0 | V | 18.0 | -5.2 | |
| 3618.750 | 53.85 | --- | 73.98 | 20.13 | 500.0 | 1000.0 | 236.0 | V | 18.0 | -5.2 | |
| 4526.250 | --- | 45.78 | 53.98 | 8.20 | 500.0 | 1000.0 | 183.0 | V | 345.0 | -3.1 | |
| 4526.250 | 55.61 | --- | 73.98 | 18.37 | 500.0 | 1000.0 | 183.0 | V | 345.0 | -3.1 | |
| 5428.250 | --- | 45.58 | 53.98 | 8.40 | 500.0 | 1000.0 | 202.0 | V | 3.0 | -1.9 | |
| 5428.250 | 55.30 | --- | 73.98 | 18.68 | 500.0 | 1000.0 | 202.0 | V | 3.0 | -1.9 | |



— Preview Result 1-PK+ — FCC 15.247 restricted bands_20
— FCC 15.247 restricted bands ◆ Final_Result PK+
◆ Final_Result CAV

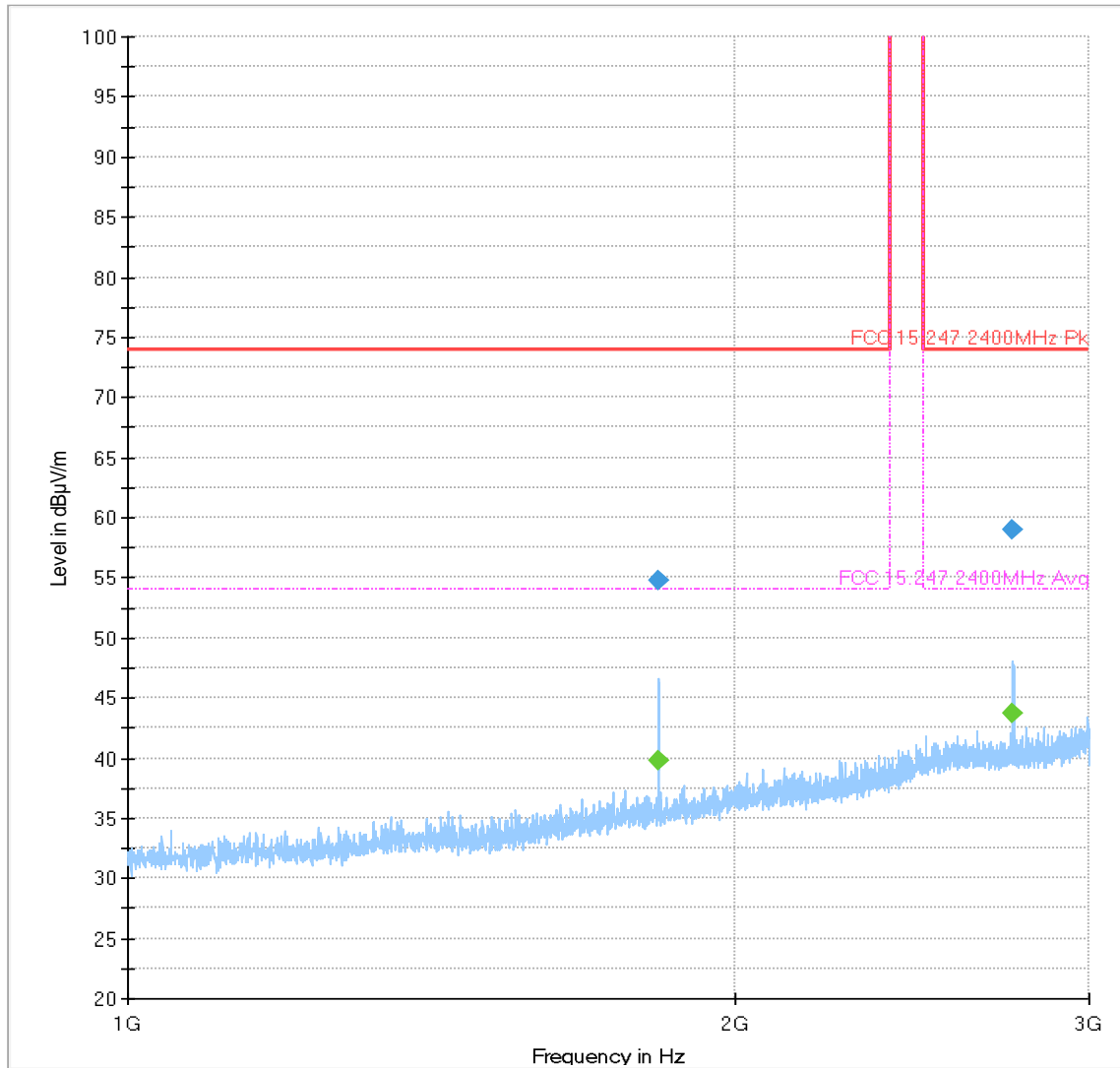




Plot # 7

Final_Result

| Frequency (MHz) | MaxPeak (dBμV/m) | CAverage (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) | Comment |
|-----------------|------------------|-------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|--------------|---------|
| 1833.000 | 54.69 | --- | 74.00 | 19.31 | 500.0 | 1000.0 | 142.0 | V | 228.0 | 31.6 | |
| 1833.000 | --- | 39.76 | 54.00 | 14.24 | 500.0 | 1000.0 | 142.0 | V | 228.0 | 31.6 | |
| 2749.500 | 59.01 | --- | 74.00 | 14.99 | 500.0 | 1000.0 | 118.0 | V | 61.0 | 35.5 | |
| 2749.500 | --- | 43.73 | 54.00 | 10.27 | 500.0 | 1000.0 | 118.0 | V | 61.0 | 35.5 | |



Preview Result 1-PK+
Final_Result PK+

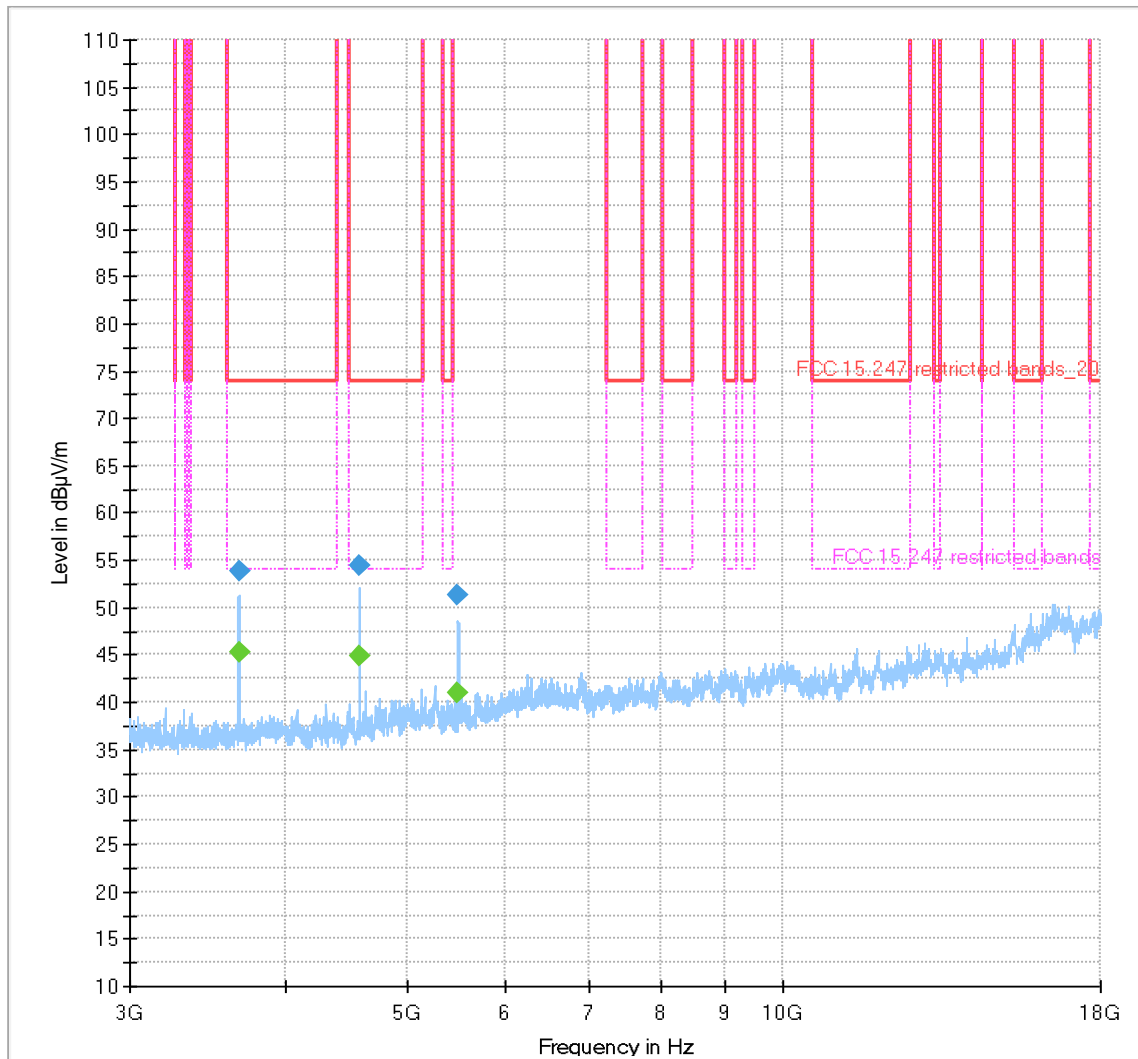
FCC 15.247 2400MHz Pk
Final_Result CAV

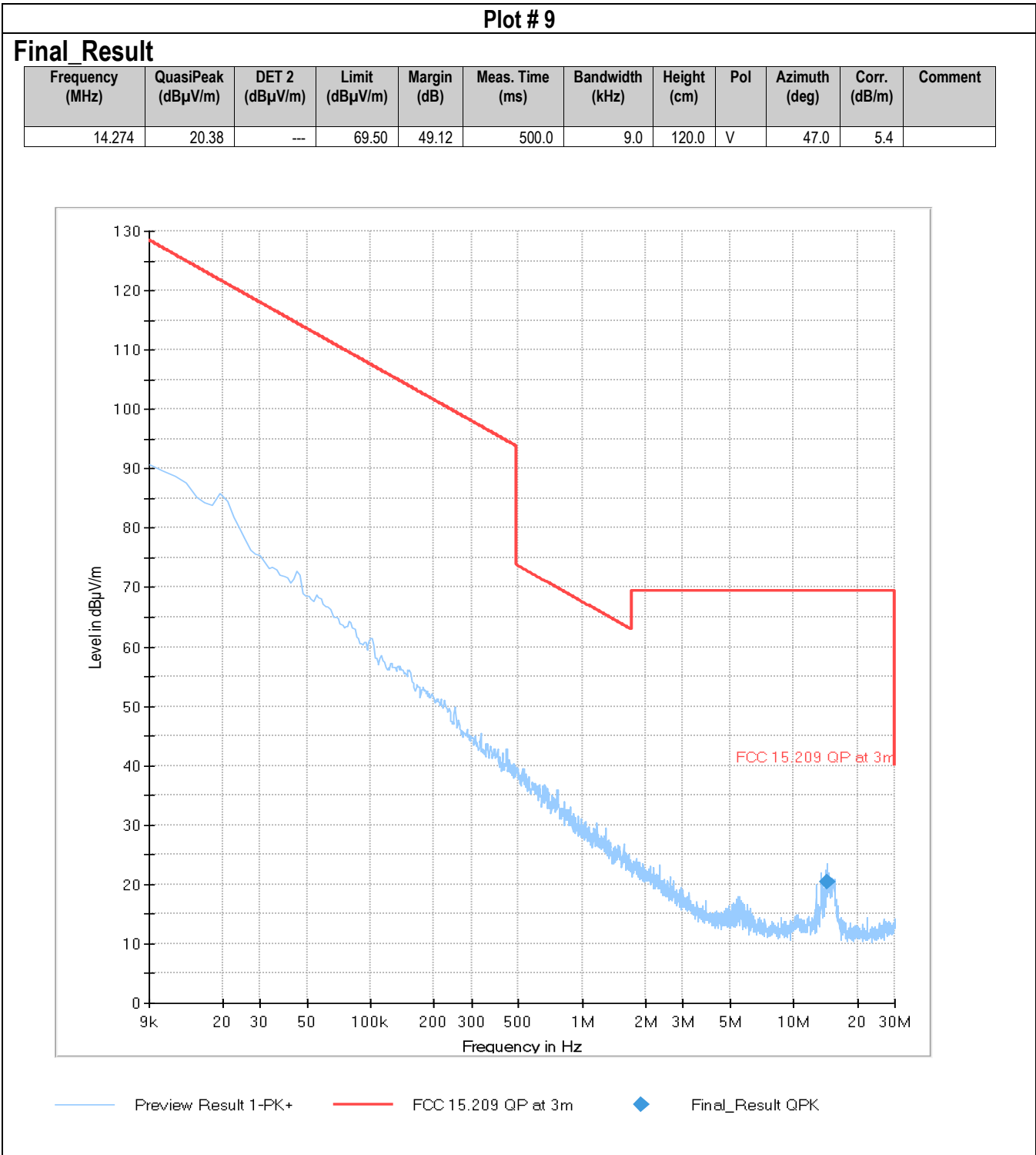
FCC 15.247 2400MHz Avg

Plot # 8

Final_Result

| Frequency (MHz) | MaxPeak (dBμV/m) | CAverage (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) | Comment |
|-----------------|------------------|-------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|--------------|---------|
| 3668.000 | 53.83 | --- | 73.98 | 20.15 | 500.0 | 1000.0 | 205.0 | V | 4.0 | -5.0 | |
| 3668.000 | --- | 45.21 | 53.98 | 8.77 | 500.0 | 1000.0 | 205.0 | V | 4.0 | -5.0 | |
| 4582.500 | 54.41 | --- | 73.98 | 19.57 | 500.0 | 1000.0 | 184.0 | V | 3.0 | -2.9 | |
| 4582.500 | --- | 44.95 | 53.98 | 9.03 | 500.0 | 1000.0 | 184.0 | V | 3.0 | -2.9 | |
| 5499.000 | --- | 41.09 | 500.00 | 458.91 | 500.0 | 1000.0 | 228.0 | V | 11.0 | -2.4 | |
| 5499.000 | 51.38 | --- | 520.00 | 468.62 | 500.0 | 1000.0 | 228.0 | V | 11.0 | -2.4 | |

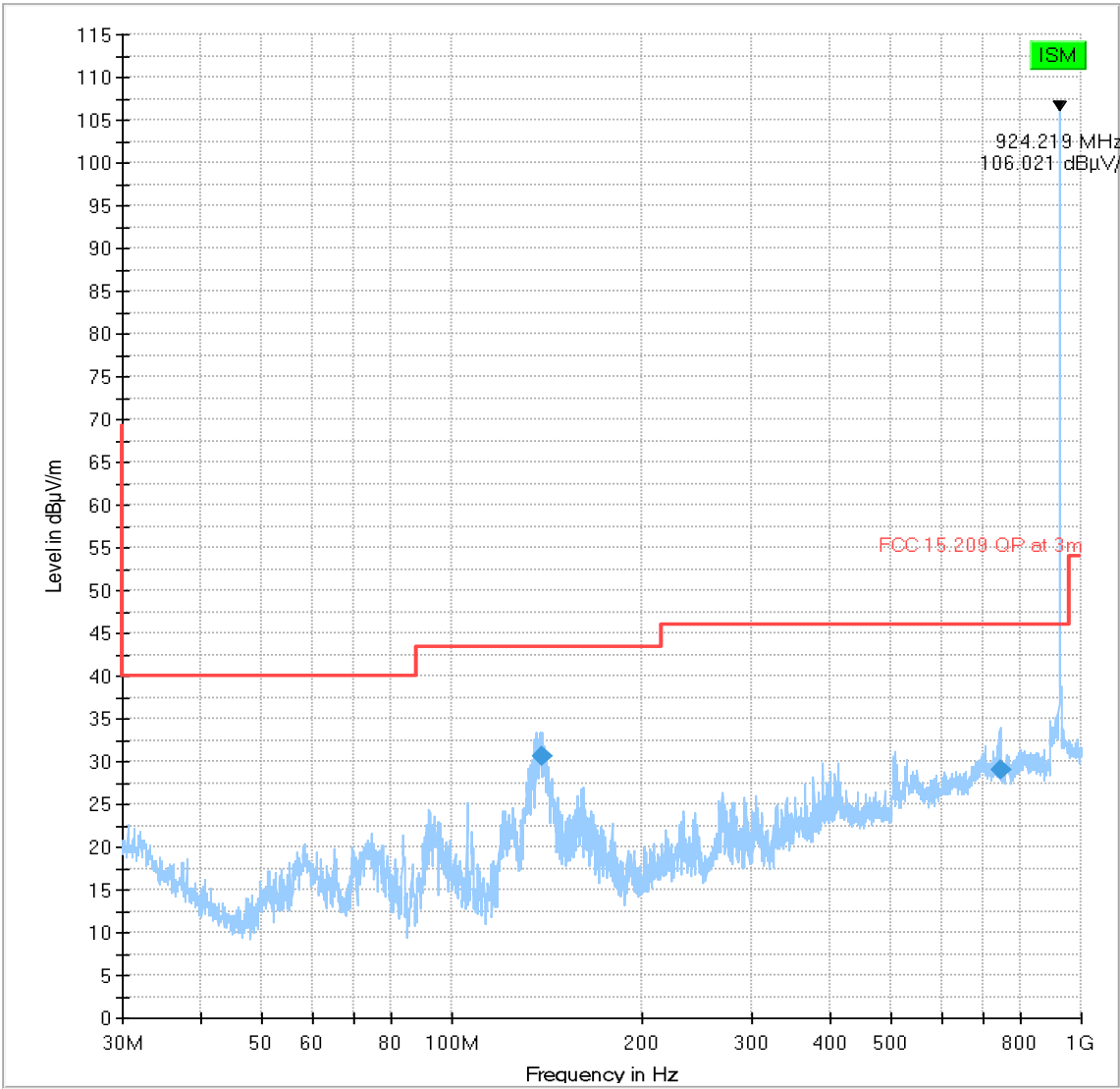




Plot # 10

Final_Result

| Frequency (MHz) | QuasiPeak (dBμV/m) | DET 2 (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) | Comment |
|-----------------|--------------------|----------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|--------------|---------|
| 139.101 | 30.51 | --- | 43.50 | 12.99 | 500.0 | 120.0 | 100.0 | V | 167.0 | -19.7 | |
| 743.241 | 28.98 | --- | 46.02 | 17.05 | 500.0 | 120.0 | 254.0 | H | 17.0 | -3.3 | |

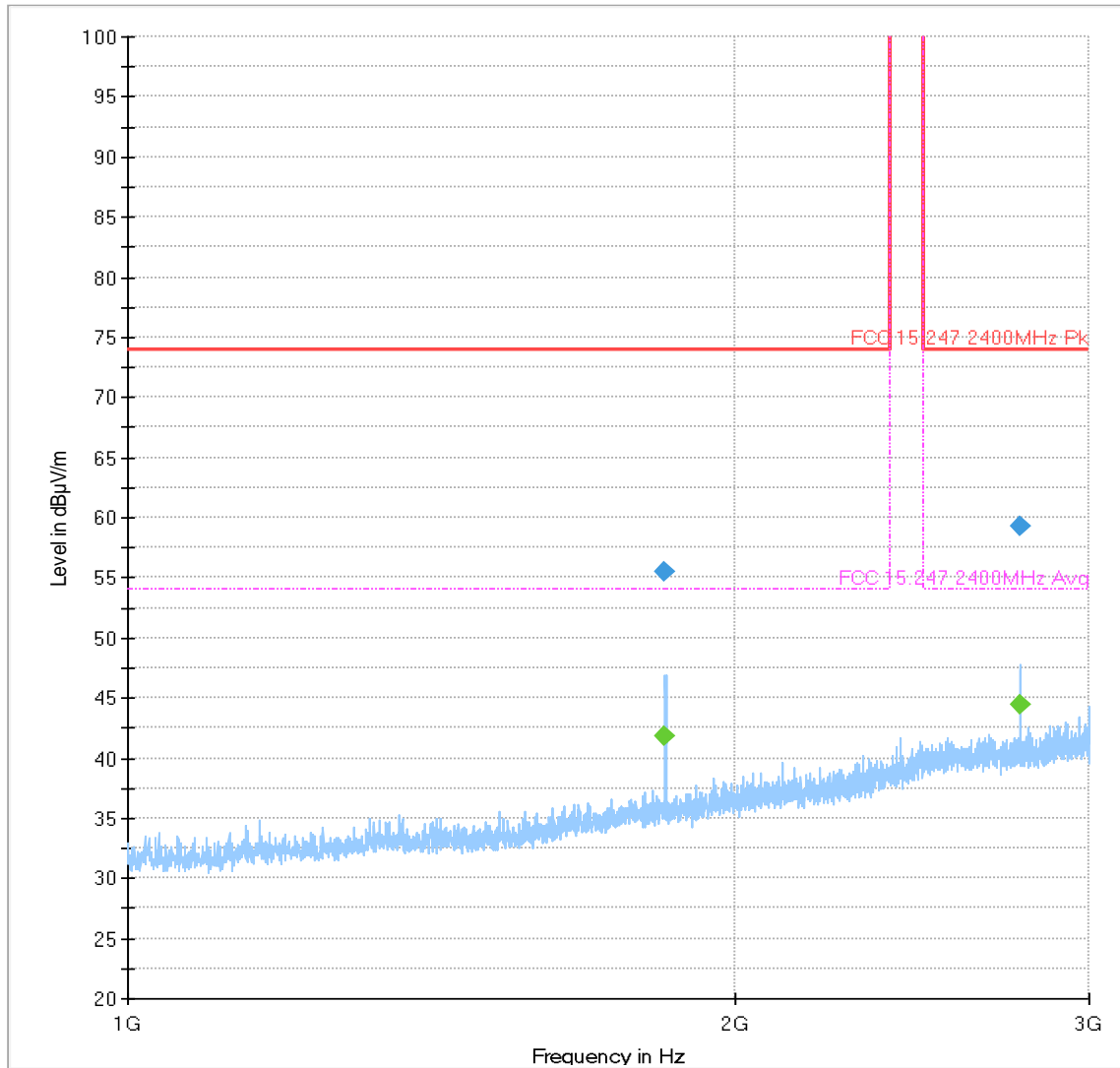


Preview Result 1-PK+ FCC 15.209 QP at 3m Final_Result QPK

Plot # 11

Final_Result

| Frequency (MHz) | MaxPeak (dBμV/m) | CAverage (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) | Comment |
|-----------------|------------------|-------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|--------------|---------|
| 1848.500 | 55.43 | --- | 74.00 | 18.57 | 500.0 | 1000.0 | 130.0 | V | 268.0 | 31.7 | |
| 1848.500 | --- | 41.82 | 54.00 | 12.18 | 500.0 | 1000.0 | 130.0 | V | 268.0 | 31.7 | |
| 2773.000 | 59.33 | --- | 74.00 | 14.67 | 500.0 | 1000.0 | 235.0 | V | 10.0 | 35.5 | |
| 2773.000 | --- | 44.42 | 54.00 | 9.58 | 500.0 | 1000.0 | 235.0 | V | 10.0 | 35.5 | |



Preview Result 1-PK+
Final_Result PK+

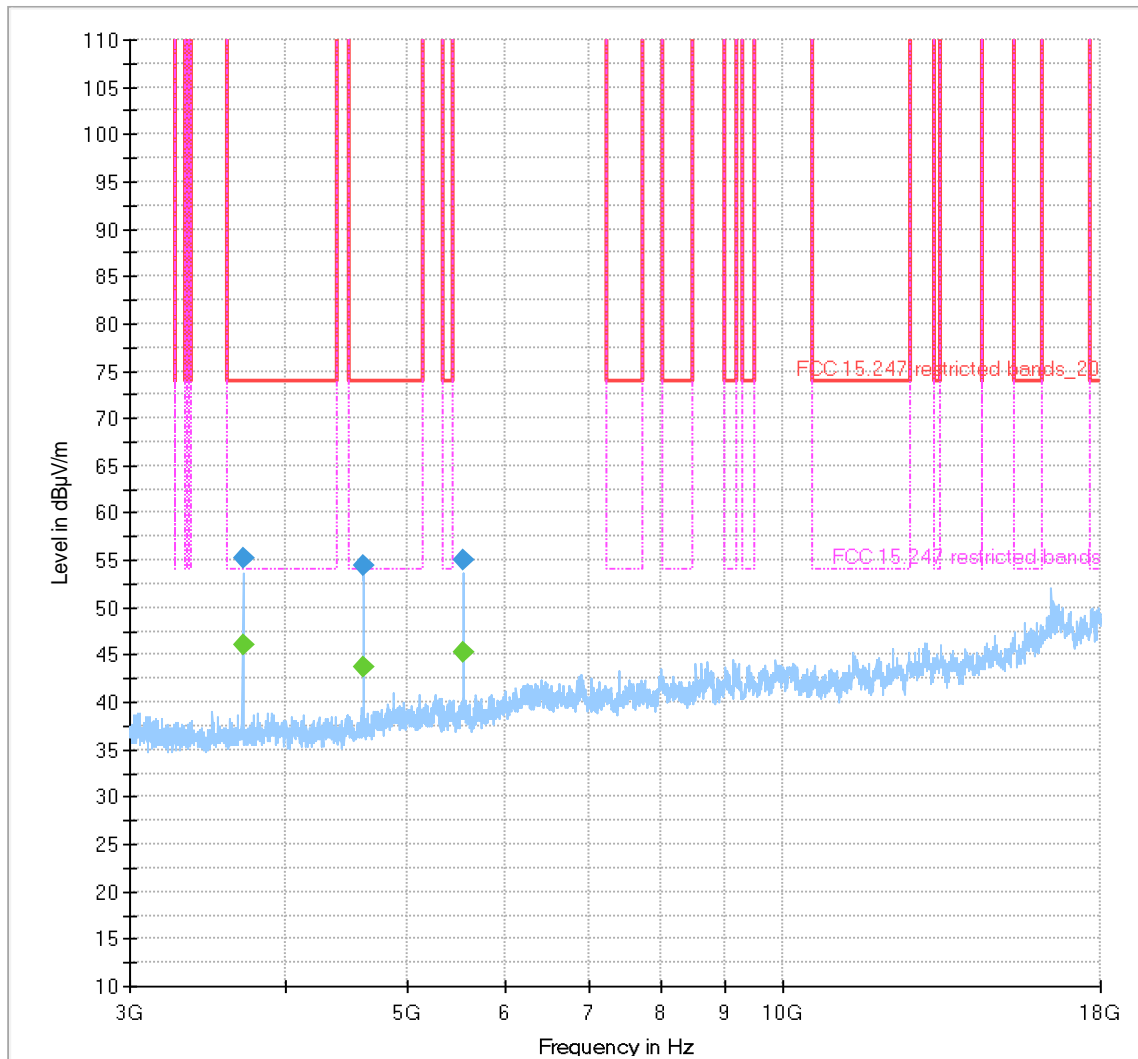
FCC 15.247 2400MHz Pk
Final_Result CAV

FCC 15.247 2400MHz Avg

Plot # 12

Final_Result

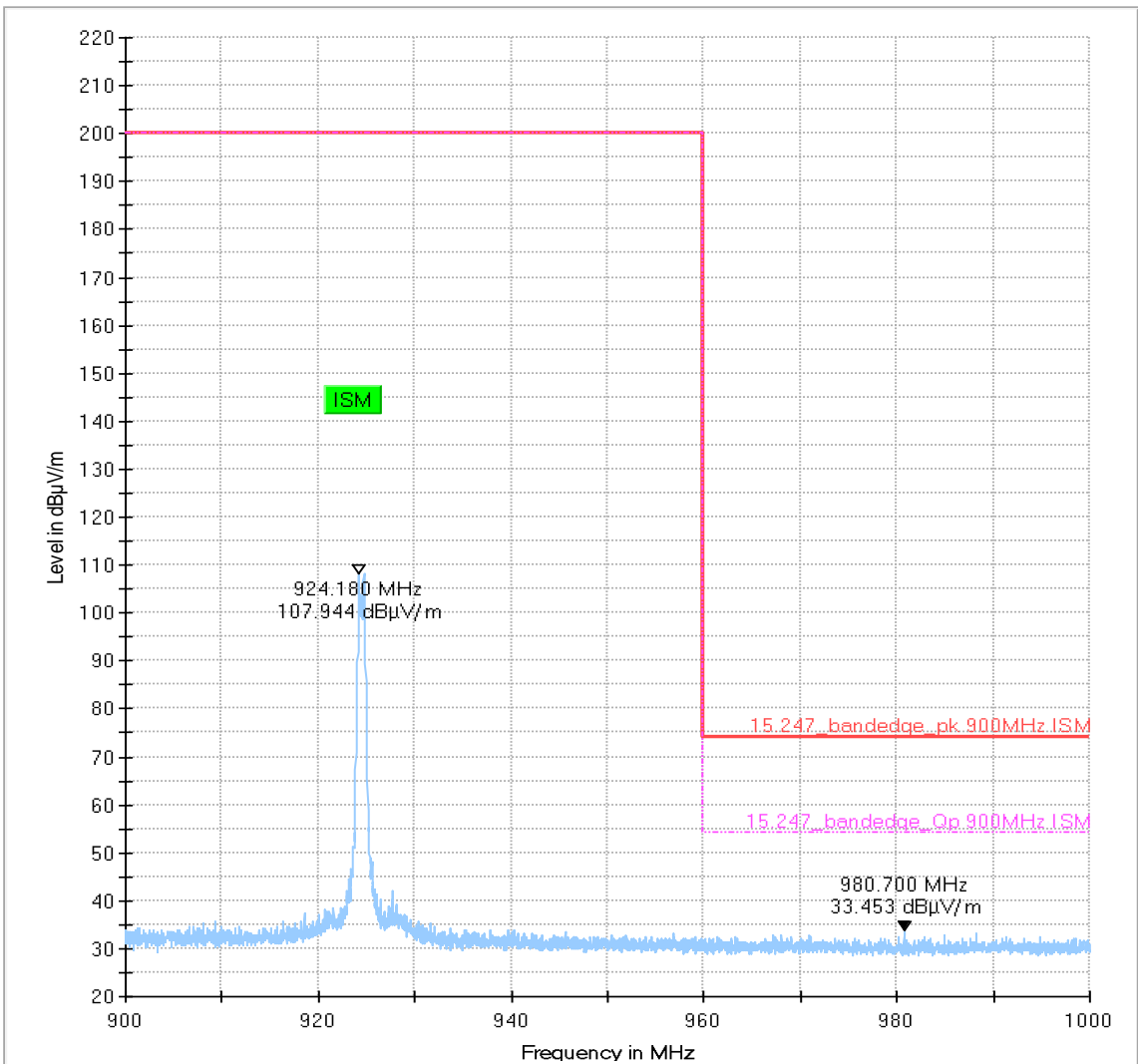
| Frequency (MHz) | MaxPeak (dBμV/m) | CAverage (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) | Comment |
|-----------------|------------------|-------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|--------------|---------|
| 3696.750 | --- | 46.12 | 53.98 | 7.86 | 500.0 | 1000.0 | 201.0 | V | 5.0 | -4.9 | |
| 3696.750 | 55.15 | --- | 73.98 | 18.83 | 500.0 | 1000.0 | 201.0 | V | 5.0 | -4.9 | |
| 4620.750 | 54.46 | --- | 73.98 | 19.52 | 500.0 | 1000.0 | 164.0 | V | -7.0 | -3.1 | |
| 4620.750 | --- | 43.69 | 53.98 | 10.29 | 500.0 | 1000.0 | 164.0 | V | -7.0 | -3.1 | |
| 5545.250 | 54.93 | --- | 520.00 | 465.07 | 500.0 | 1000.0 | 215.0 | V | 0.0 | -1.7 | |
| 5545.250 | --- | 45.33 | 500.00 | 454.67 | 500.0 | 1000.0 | 215.0 | V | 0.0 | -1.7 | |



Preview Result 1-PK+
FCC 15.247 restricted bands
Final_Result CAV

FCC 15.247 restricted bands_20
Final_Result PK+

Plot # 13



Preview Result 1-PK+
15.247_bandedge_pk 900MHz ISM
Final_Result QPK

* Critical_Freqs PK+
15.247_bandedge_Qp 900MHz ISM

9 Test setup photos

Setup photos are included in supporting file name: "EMC_TELUL_118_23001_FCC_15_247_Setup_Photos"

10 Test Equipment And Ancillaries Used For Testing

| Equipment Type | Manufacturer | Model | Serial # | Calibration Cycle | Last Calibration Date |
|---------------------|-----------------|------------------|------------|-------------------|-----------------------|
| LOOP ANTENNA | ETS LINDGREN | 6507 | 00161344 | 3 Years | 08/13/2024 |
| BILOG ANTENNA | ETS.LINDGREN | 3142E | 00166067 | 3 Years | 08/01/2024 |
| HORN ANTENNA | EMCO | 3115 | 00035114 | 3 Years | 09/13/2023 |
| HORN ANTENNA | ETS.LINDGREN | 3117 | 00215984 | 3 Years | 10/26/2023 |
| TEST RECEIVER | R&S | ESW44 | 103143 | 2 Years | 09/12/2024 |
| DIGITAL THERMOMETER | CONTROL COMPANY | 4410,90080-03 | 230713059 | 3 Years | 10/18/2023 |
| Multimeter | Fluke | 115 | 56090717MV | 3 Years | 09/26/2023 |
| Software | EMC32 | Version 11.40.00 | - | - | - |
| Spectrum Analyzer | ROHDE & SCHWARZ | FSU | 200302 | 3 Years | 01/25/2024 |

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.

Test Report #: EMC_TELUL_118_23001_FCC_15_247_Rev1 **FCC ID:** MTFST1001

Date of Report 2025-04-28 **Page 41 of 41** **ISED:** 2175D-ST1001

11 History

| Date | Report Name | Changes to report | Prepared by |
|------------|-------------------------------------|---|-------------------|
| 2025-02-20 | EMC_TELUL_118_23001_FCC_15_247 | Initial Version | Art Thammanavarat |
| 2025-04-28 | EMC_TELUL_118_23001_FCC_15_247_Rev1 | Report Revised 1. Section 10: Added Equipment 2. Updated FCC ID & ISED | Art Thammanavarat |
| | | | |

<<< The End >>>