

TEST REPORT

Report Number: R14089411-E1

Applicant : Ademco Inc.
251 Little Falls Drive
Wilmington, DE 19808, USA

Model : CASPIAN

FCC ID : HS9-VBSP02L5

IC : 573R-VBSP02L5

HVIN : VB-SP02Y-002

EUT Description : Water Shutoff Actuator

Test Standard(s) : FCC 47 CFR PART 15 SUBPART C:2022
ISED RSS-247 ISSUE 2:2017
ISED RSS-GEN ISSUE 5 + A2:2021

Date Of Issue:
2022-12-06

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REPORT REVISION HISTORY

| Rev. | Issue Date | Revisions | Revised By |
|------|------------|----------------------|--------------|
| v1 | 2022-07-18 | Initial Issue | Brian Kiewra |
| V2 | 2022-10-12 | Added HVIN | Brian Kiewra |
| V3 | 2022-12-06 | Revised antenna gain | Brian Kiewra |

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Ademco Inc.
251 Little Falls Drive
Wilmington, DE 19808, USA

EUT DESCRIPTION: Water Shutoff Actuator

MODEL: CASPIAN

HVIN: VB-SP02Y-002

SERIAL NUMBER: 2129110263, 2201BAA00437

SAMPLE RECEIPT DATE: 2021-12-03

DATE TESTED: 2021-12-05 to 2021-12-06

| APPLICABLE STANDARDS | |
|--------------------------------|--------------|
| STANDARD | TEST RESULTS |
| CFR 47 Part 15 Subpart C:2022 | Complies |
| ISED RSS-247 Issue 2:2017 | Complies |
| ISED RSS-GEN Issue 5 + A2:2021 | Complies |

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.


This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by a2La, NIST, or any agency of the U.S. government.

Approved & Released
For UL LLC By:

Prepared By:



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Staff Engineer
Consumer Technology Division
UL LLC



Brian Kiewra
Project Engineer
Consumer Technology Division
UL LLC

2. TEST RESULTS SUMMARY

This report contains data provided by the applicant which can impact the validity of results. UL LLC is only responsible for the validity of results after the integration of the data provided by the customer.

| FCC Clause | ISED Clause | Requirement | Result | Comment |
|----------------|-------------------|------------------------------|-------------------------|--------------------------------------|
| See Comment | | Duty Cycle | Reporting purposes only | ANSI C63.10 Section 11.6. |
| - | RSS-GEN 6.7 | 99% OBW | Reporting purposes only | ANSI C63.10 Section 6.9.3. |
| 15.247 (a) (2) | RSS-247 5.2 (a) | 6dB BW | Compliant | None |
| 15.247 (b) (3) | RSS-247 5.4 (d) | Output Power | | |
| See Comment | | Average power | Reporting purposes only | Per ANSI C63.10, Section 11.9.2.3.2. |
| 15.247 (e) | RSS-247 5.2 (b) | PSD | Compliant | None |
| 15.247 (d) | RSS-247 5.5 | Conducted Spurious Emissions | | |
| 15.209, 15.205 | RSS-GEN 8.9, 8.10 | Radiated Emissions | | |
| 15.207 | RSS-Gen 8.8 | AC Mains Conducted Emissions | | |

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 414788 D01 Radiated Test Site v01r01, RSS-GEN Issue 5 + A1, and RSS-247 Issue 2.

4. FACILITIES AND ACCREDITATION

UL LLC is accredited by A2LA, certification # 0751.06, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

| | Address | ISED CABID | ISED Company Number | FCC Registration |
|-------------------------------------|--|------------|---------------------|------------------|
| <input type="checkbox"/> | Building: 12 Laboratory Dr RTP, NC 27709, U.S.A | US0067 | 2180C | 825374 |
| <input checked="" type="checkbox"/> | Building: 2800 Perimeter Park Dr. Suite B Morrisville, NC 27560, U.S.A | | 27265 | |

5. DECISION RULES AND MEASUREMENT UNCERTAINTY

5.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

5.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

5.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| PARAMETER | UNCERTAINTY |
|--|-----------------------------|
| Radio Frequency (Spectrum Analyzer) | 141.2 Hz |
| Occupied Channel Bandwidth | 1.22% |
| RF output power, conducted | 1.3 dB (PK) 0.45 dB (AV) |
| Power Spectral Density, conducted | 2.47 dB |
| Unwanted Emissions, conducted | 1.94 dB |
| All emissions, radiated | 6.01 dB |
| Conducted Emissions (0.150-30MHz) - LISN | 3.40 dB |
| Temperature | 0.57°C |
| Humidity | 3.39% |
| DC Supply voltages | 1.70% |
| Time | 3.39% |

Uncertainty figures are valid to a confidence level of 95%.

5.4. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
 $36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} = 28.9 \text{ dBuV/m}$

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
 $36.5 \text{ dBuV} + 0 \text{ dB} + 10.1 \text{ dB} + 0 \text{ dB} = 46.6 \text{ dBuV}$

6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a water shutoff actuator that supports BLE and 2.4GHz WLAN. This test report covers testing performed on BLE only.

6.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

| Frequency Range (MHz) | Mode | Output Power (dBm) | Output Power (mW) |
|-----------------------|------|--------------------|-------------------|
| 2402 - 2480 | BLE | 7.75 | 5.96 |

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a meander antenna with a maximum gain of -1.6 dBi.

6.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was v1.16.

6.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 1GHz, above 18GHz, and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to transmit at the highest power on low, middle and high channels.

The fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z, it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

EUT only supports data rate of 1Mbps

6.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

| Support Equipment List | | | | |
|------------------------|--------------|-------|---------------|--------|
| Description | Manufacturer | Model | Serial Number | FCC ID |
| Laptop | Lenovo | T450 | PC0AUQT | NA |

I/O CABLES

| I/O Cable List | | | | | | |
|----------------|-------|----------------------|----------------|---------------|------------------|---|
| Cable No. | Port | # of Identical Ports | Connector Type | Cable Type | Cable Length (m) | Remarks |
| 1 | Power | 1 | Barrel | Power | 1 | None |
| 2 | Data | 2 | Auxiliary | Communication | 1 | Used for test configuration purposes only |

SETUP DIAGRAMS

Please refer to R14089411-EP1 for setup diagrams

7. MEASUREMENT METHOD

Duty Cycle: ANSI C63.10 Subclause 11.6

6 dB BW: ANSI C63.10 Subclause -11.8.1

Occupied BW (99%): ANSI C63.10 Section 6.9.3

Output Power: ANSI C63.10 Subclause -11.9.1.3 Method PKPM1 Peak-reading power meter
Subclause -11.9.2.3.2 Method AVGPM-G (Measurement using a gated RF average-reading power meter)

PSD: ANSI C63.10 Subclause -11.10.2 Method PKPSD (peak PSD)

Emissions non-restricted frequency bands: ANSI C63.10 Subclause -11.11 and 6.10.4

Emissions restricted frequency bands: ANSI C63.10 Subclause -11.12.1 and 6.10.5

General Radiated Spurious Emissions: ANSI C63.10 Section 6.3-6.6

AC Power Line Conducted Emissions: ANSI C63.10 Section 6.2.

8. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville - North Chamber)

| Equipment ID | Description | Manufacturer/Brand | Model Number | Last Cal. | Next Cal. |
|---------------------------|---|----------------------|---------------------------|------------|------------|
| 0.009-30MHz | | | | | |
| AT0079) | Active Loop Antenna | ETS-Lindgren | 6502 | 2021-08-19 | 2022-08-19 |
| 30-1000 MHz | | | | | |
| AT0066 | Hybrid Broadband Antenna | Sunol Sciences Corp. | JB1 | 2021-02-19 | 2022-02-19 |
| 1-18 GHz | | | | | |
| AT0067 | Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz | ETS Lindgren | 3117 | 2021-05-13 | 2022-05-13 |
| 18-40 GHz | | | | | |
| AT0063 | Horn Antenna, 18-26.5GHz | ARA | MWH-1826/B | 2021-11-04 | 2022-11-04 |
| Gain-Loss Chains | | | | | |
| N-SAC01 | Gain-loss string: 0.009-30MHz | Various | Various | 2021-07-20 | 2022-07-20 |
| N-SAC02 | Gain-loss string: 25-1000MHz | Various | Various | 2021-07-20 | 2022-07-20 |
| N-SAC03 | Gain-loss string: 1-18GHz | Various | Various | 2021-07-20 | 2022-07-20 |
| N-SAC04 | Gain-loss string: 18-40GHz | Various | Various | 2021-07-20 | 2022-07-20 |
| Receiver & Software | | | | | |
| 197954 | Spectrum Analyzer | Rohde & Schwarz | ESW44 | 2021-03-30 | 2022-03-30 |
| SOFTEMI | EMI Software | UL | Version 9.5 (18 Oct 2021) | | |
| Additional Equipment used | | | | | |
| s/n 200037610 | Environmental Meter | Fisher Scientific | 06-662-4 | 2020-01-22 | 2022-01-22 |

Test Equipment Used - Wireless Conducted Measurement Equipment

| Equipment ID | Description | Manufacturer | Model Number | Last Cal. | Next Cal. |
|--------------|---|-----------------------|--------------------|------------|------------|
| SA0027 | Spectrum Analyzer | Keysight Technologies | N9030A | 2021-06-25 | 2022-06-25 |
| PWM005 | RF Power Meter | Keysight Technologies | N1912A | 2021-07-27 | 2022-07-27 |
| PWS002 | Peak and Avg Power Sensor, 50MHz to 18GHz | Keysight Technologies | N1921A | 2021-09-07 | 2022-09-07 |
| HI0090 | Environmental Meter | Fisher Scientific | 15-077-963 | 2021-07-12 | 2022-07-12 |
| SOFTEMI | Antenna Port Software | UL | Version 2021.11.03 | NA | NA |

Test Equipment Used - Line-Conducted Emissions – Voltage (Morrisville – Conducted 1)

| Equipment ID | Description | Manufacturer | Model Number | Last Cal. | Next Cal. |
|--------------|---|---------------------|---------------------------|------------|------------|
| CBL087 | Coax cable, RG223, N-male to BNC-male, 20-ft. | Pasternack | PE3W06143-240 | 2021-04-05 | 2022-04-05 |
| HI0094 | Environmental Meter | Fisher Scientific | 06-662-4 | 2020-01-21 | 2022-01-21 |
| LISN001 | LISN, 50-ohm/50-uH, 2-conductor, 25A | Fischer Custom Com. | FCC-LISN-50-25-2-01-550V | 2021-08-16 | 2022-08-16 |
| 75141 | EMI Test Receiver 9kHz-7GHz | Rohde & Schwarz | ESCI 7 | 2021-08-17 | 2022-08-17 |
| ATA222 | Transient Limiter, 0.009-100MHz | Electro-Metrics | EM-7600 | 2021-04-05 | 2022-04-05 |
| PS214 | AC Power Source | Elgar | CW2501M (s/n 1523A02396) | NA | NA |
| SOFTEMI | EMI Software | UL | Version 9.5 (18 Oct 2021) | | |
| CDECABLE001 | ANSI C63.4 1m extension cable. | UL | Per Annex B of ANSI C63.4 | 2021-09-13 | 2022-09-13 |

9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

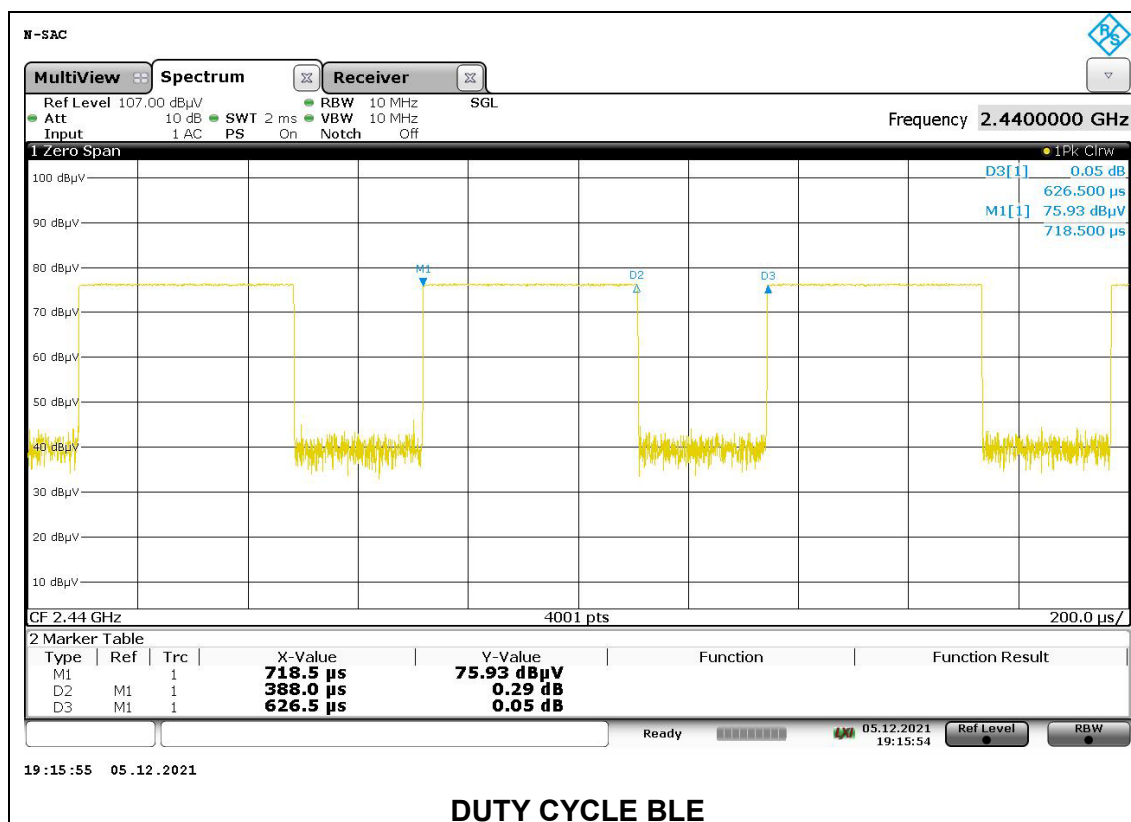
PROCEDURE

ANSI C63.10 Subclause 11.6

ON TIME AND DUTY CYCLE RESULTS

| Mode | ON Time B (msec) | Period (msec) | Duty Cycle x (linear) | Duty Cycle (%) | Duty Cycle Correction Factor (dB) | 1/B Minimum VBW (kHz) |
|-------------|------------------------|------------------|-----------------------------|----------------------|---|-----------------------------|
| 2.4GHz Band | | | | | | |
| BLE | 0.388 | 0.627 | 0.619 | 61.93% | 4.16 | 2.577 |

DUTY CYCLE PLOTS



Tested By: 23567/11993

9.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|---------------------|
| Low | 2402 | 1.0557 |
| Middle | 2440 | 1.0592 |
| High | 2480 | 1.0617 |



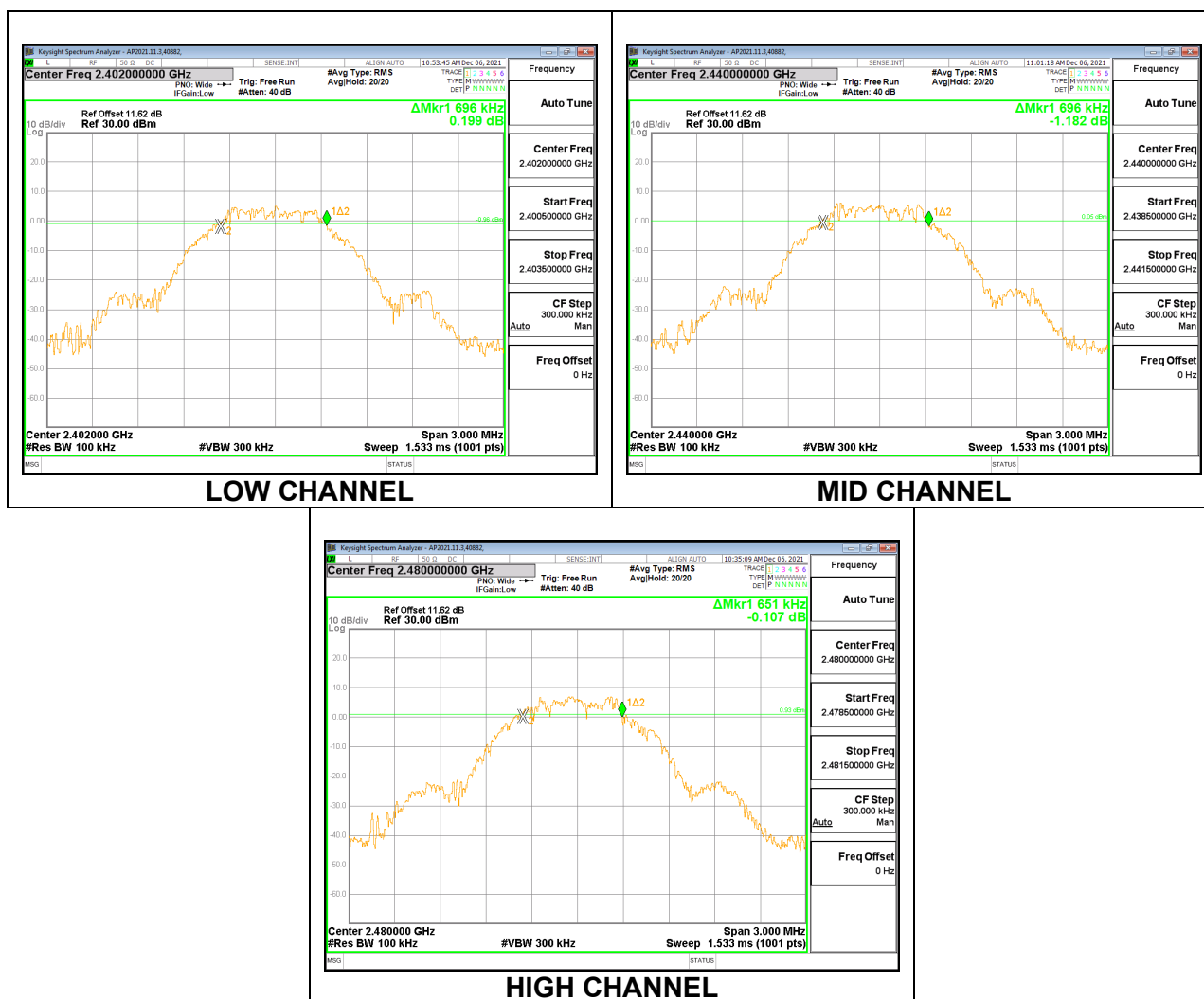
9.3. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)
RSS-247 5.2 (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low | 2402 | 0.696 | 0.5 |
| Middle | 2440 | 0.696 | 0.5 |
| High | 2480 | 0.651 | 0.5 |



9.4. OUTPUT POWER

LIMITS

FCC §15.247 (b) (3)
RSS-247 5.4 (d)

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11.62 dB (including 9.79 dB pad and 1.83 dB cable) was entered as an offset in the power meter.

| | |
|-------------------|------------|
| Tested By: | 40882 |
| Date: | 2021-12-06 |

| Channel | Frequency (MHz) | Peak Power Reading (dBm) | Limit (dBm) | Margin (dB) |
|----------------|----------------------------|---|------------------------|------------------------|
| Low | 2402 | 6.790 | 30 | -23.210 |
| Middle | 2440 | 6.870 | 30 | -23.130 |
| High | 2480 | 7.750 | 30 | -22.250 |

9.5. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a gated average power meter.

The cable assembly insertion loss of 11.62 dB (including 9.79 dB pad and 1.83 dB cable) was entered as an offset in the power meter.

| | |
|-------------------|------------|
| Tested By: | 40882 |
| Date: | 2021-12-06 |

| Channel | Frequency (MHz) | AV power (dBm) |
|----------------|----------------------------------|---------------------------------|
| Low | 2402 | 6.59 |
| Middle | 2440 | 6.67 |
| High | 2480 | 7.59 |

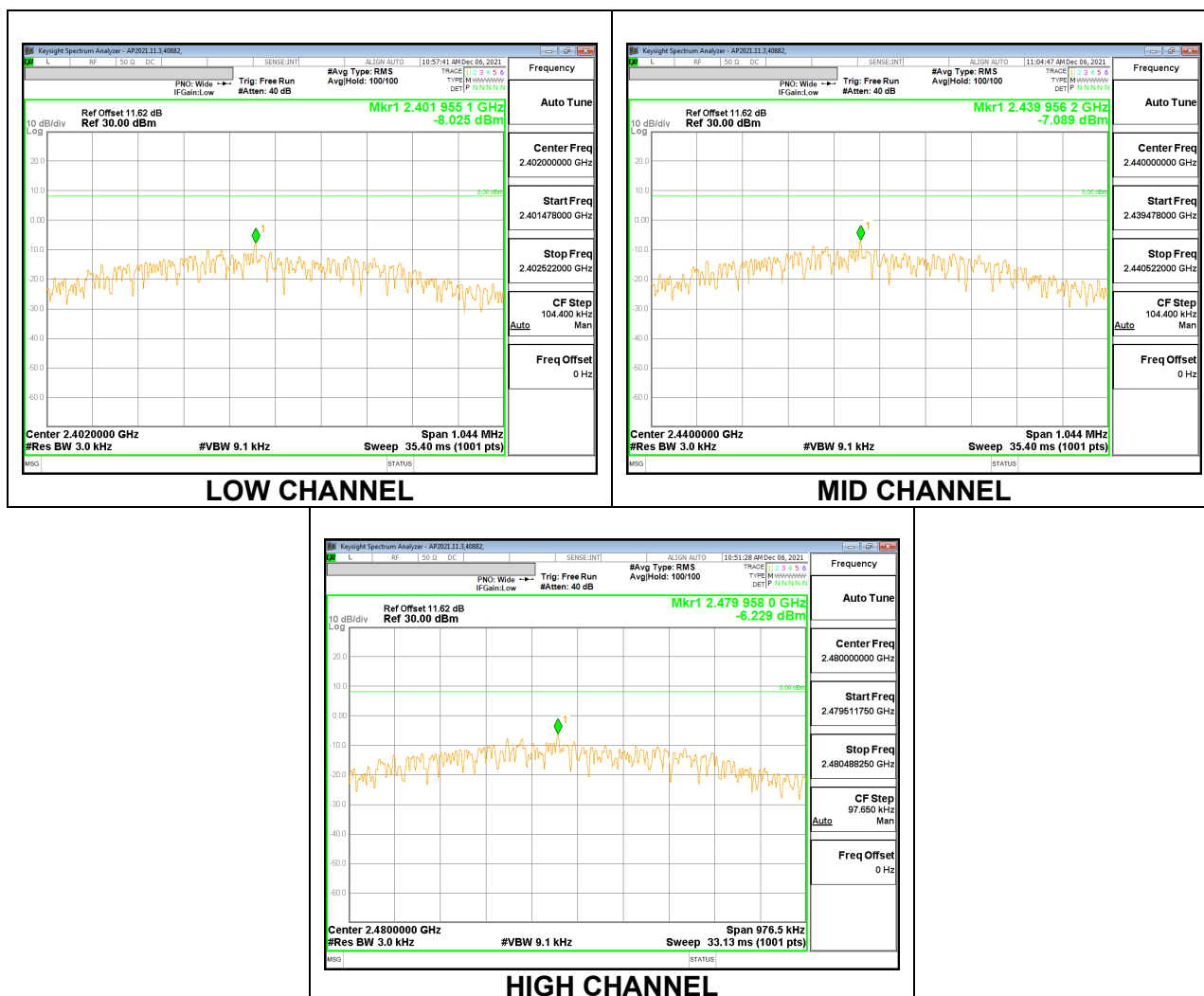
9.6. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)
RSS-247 (5.2) (b)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

| Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Margin (dB) |
|---------|-----------------|----------------|------------------|-------------|
| Low | 2402 | -8.025 | 8 | -16.03 |
| Middle | 2440 | -7.089 | 8 | -15.09 |
| High | 2480 | -6.229 | 8 | -14.23 |



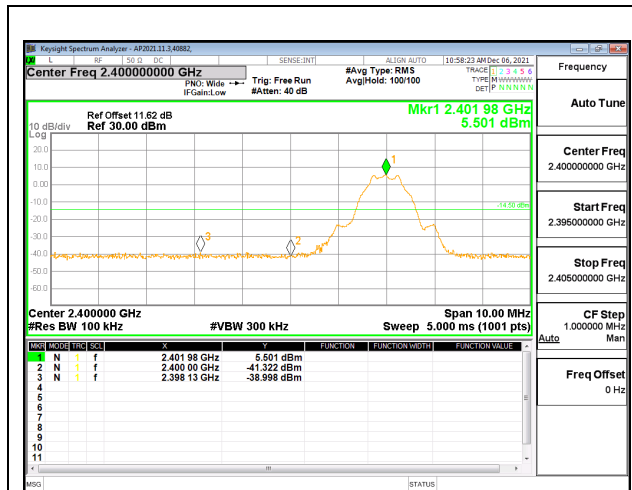
9.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

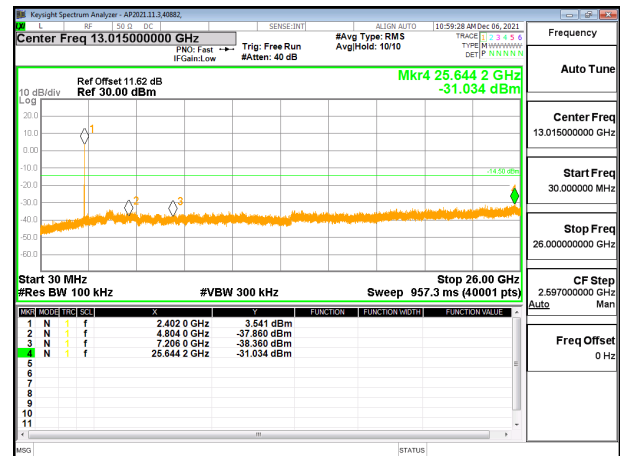
FCC §15.247 (d)

RSS-247 5.5

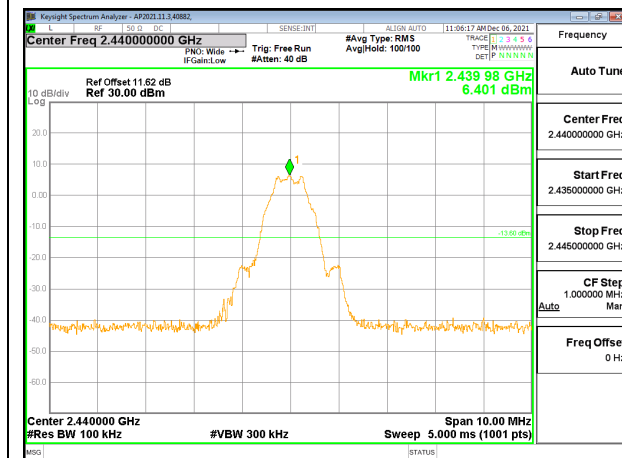
Output power was measured based on the use of a peak measurement, therefore the required attenuation is -20dBc.



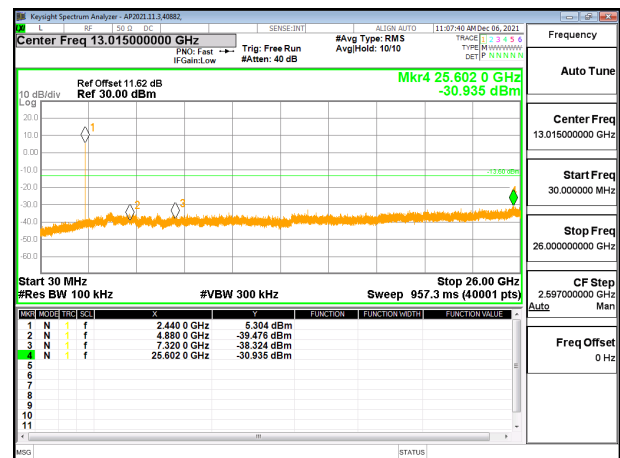
LOW CHANNEL BANDEDGE



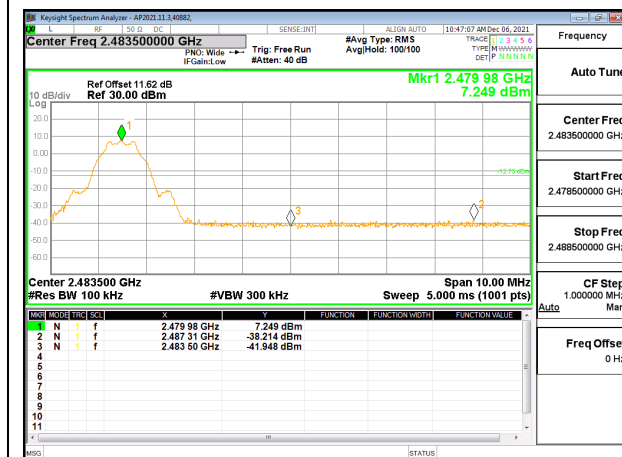
OUT-OF-BAND LOW CHANNEL



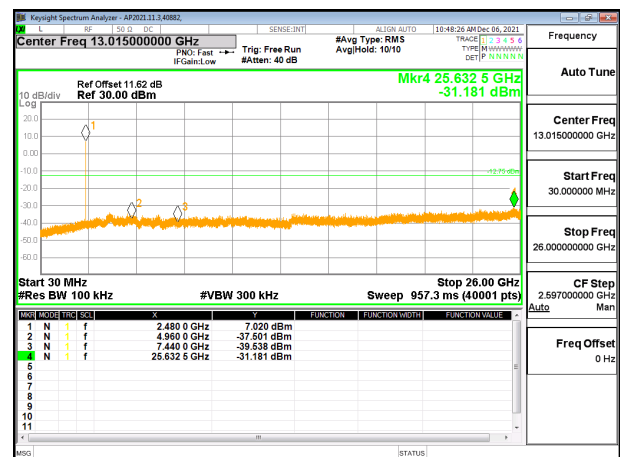
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

10. RADIATED TEST RESULTS

10.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

| Frequency Range (MHz) | Field Strength Limit (uV/m) at 3 m | Field Strength Limit (dBuV/m) at 3 m |
|-----------------------|------------------------------------|--------------------------------------|
| 0.009-0.490 | 2400/F(kHz) @ 300 m | - |
| 0.490-1.705 | 24000/F(kHz) @ 30 m | - |
| 1.705 - 30 | 30 @ 30m | - |
| 30 - 88 | 100 | 40 |
| 88 - 216 | 150 | 43.5 |
| 216 - 960 | 200 | 46 |
| Above 960 | 500 | 54 |

RSS-GEN, Section 8.9 and 8.10.

| Frequency Range (MHz) | Field Strength Limit (uA/m) at 3 m | Field Strength Limit (dBuA/m) at 3 m |
|-----------------------|------------------------------------|--------------------------------------|
| 0.009-0.490 | 6.37/F(kHz) @ 300 m | - |
| 0.490-1.705 | 63.7/F(kHz) @ 30 m | - |
| 1.705 - 30 | 0.08 @ 30m | - |
| Frequency Range (MHz) | Field Strength Limit (uV/m) at 3 m | Field Strength Limit (dBuV/m) at 3 m |
| 30 - 88 | 100 | 40 |
| 88 - 216 | 150 | 43.5 |
| 216 - 960 | 200 | 46 |
| Above 960 | 500 | 54 |

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements in the 30-1000MHz range, 9kHz for peak and/or quasi-peak detection measurements in the 0.15-30MHz range and 200Hz for peak and/or quasi-peak detection measurements in the 9 to 150kHz range. Peak detection is used unless otherwise noted as quasi-peak or average (9-90kHz and 110-490kHz).

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3MHz for peak measurements.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements. In this case linear voltage averaging is used.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

3D antenna use - For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel).

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

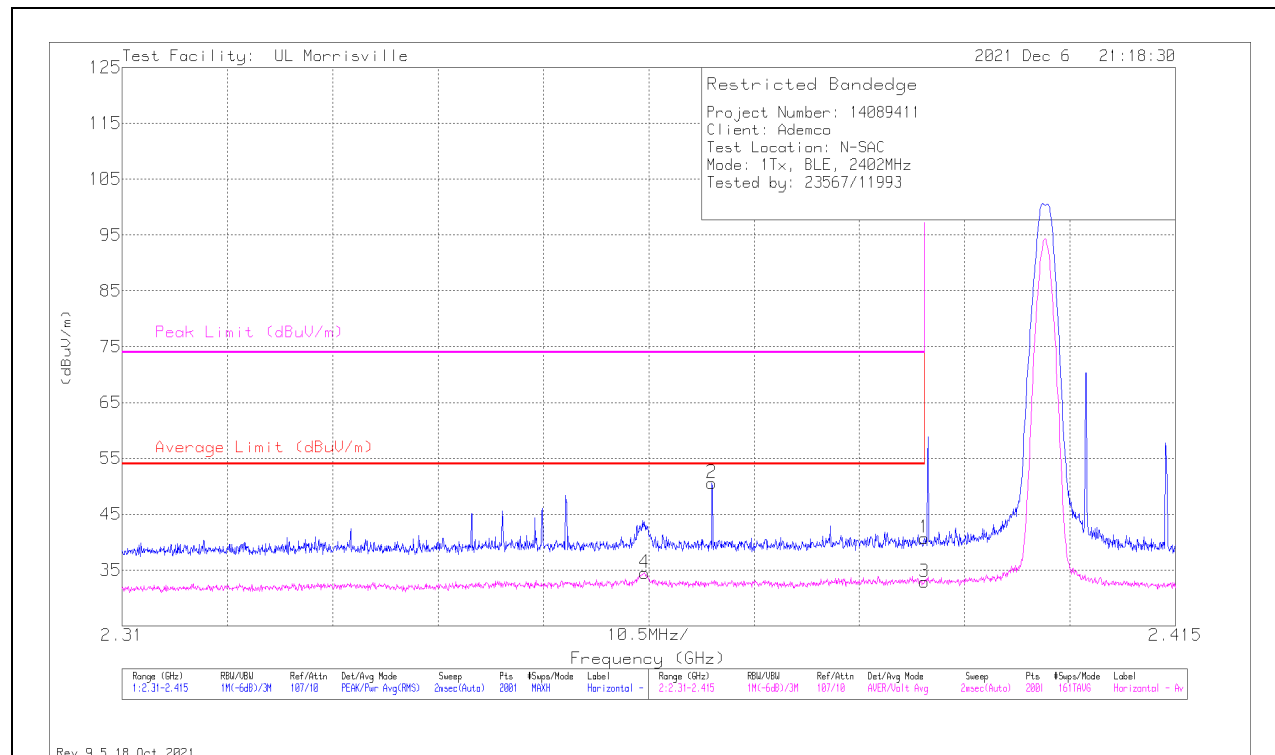
KDB 414788 Open Field Site(OFS) and Chamber Correlation Justification

OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

10.2. TRANSMITTER ABOVE 1 GHz

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AT0067 (dB/m) | Amp/Cbl/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|---------------|------------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1 | *** 2.38996 | 32.85 | Pk | 32.2 | -24.3 | 0 | 40.75 | - | - | 74 | -33.25 | 38 | 112 | H |
| 2 | ** 2.3688 | 42.98 | Pk | 32.2 | -24.6 | 0 | 50.58 | - | - | 74 | -23.42 | 38 | 112 | H |
| 3 | *** 2.38996 | 20.81 | ADV | 32.2 | -24.3 | 4.16 | 32.87 | 54 | -21.13 | - | - | 38 | 112 | H |
| 4 | *** 2.36208 | 22.65 | ADV | 32.2 | -24.5 | 4.16 | 34.51 | 54 | -19.49 | - | - | 38 | 112 | H |

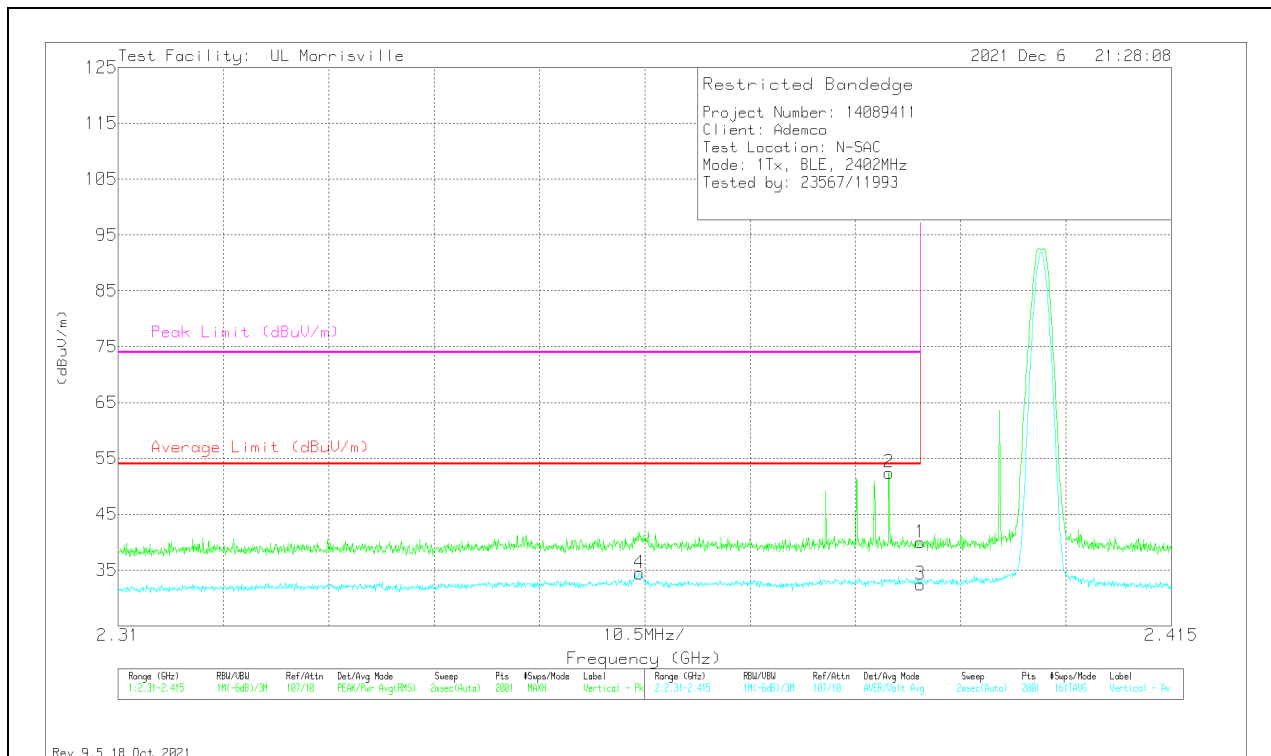
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

VERTICAL RESULT



| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AT0067 (dB/m) | Amp/Cbl/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|---------------|------------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1 | *** 2.38996 | 32.04 | Pk | 32.2 | -24.3 | 0 | 39.94 | - | - | 74 | -34.06 | 287 | 103 | V |
| 2 | *** 2.38686 | 44.55 | Pk | 32.2 | -24.3 | 0 | 52.45 | - | - | 74 | -21.55 | 287 | 103 | V |
| 3 | *** 2.38996 | 20.38 | ADV | 32.2 | -24.3 | 4.16 | 32.44 | 54 | -21.56 | - | - | 287 | 103 | V |
| 4 | *** 2.36198 | 22.58 | ADV | 32.2 | -24.5 | 4.16 | 34.44 | 54 | -19.56 | - | - | 287 | 103 | V |

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

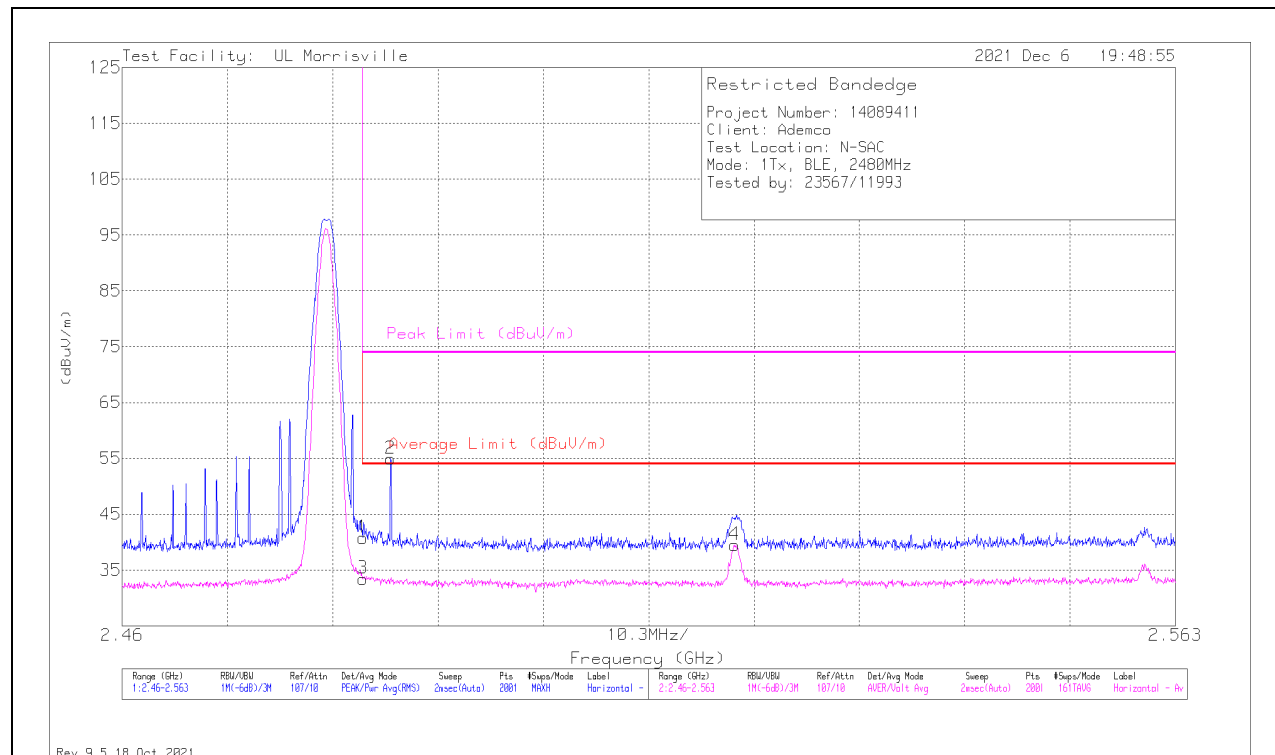
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

BANEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AT0067 (dB/m) | Amp/Cbl/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|---------------|------------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1 | *** 2.48354 | 33.08 | Pk | 32.3 | -24.6 | 0 | 40.78 | - | - | 74 | -33.22 | 60 | 219 | H |
| 2 | *** 2.48627 | 47.23 | Pk | 32.3 | -24.6 | 0 | 54.93 | - | - | 74 | -19.07 | 60 | 219 | H |
| 3 | *** 2.48354 | 21.58 | ADV | 32.3 | -24.6 | 4.16 | 33.44 | 54 | -20.56 | - | - | 60 | 219 | H |
| 4 | ** 2.51989 | 27.25 | ADV | 32.5 | -24.4 | 4.16 | 39.51 | 54 | -14.49 | - | - | 60 | 219 | H |

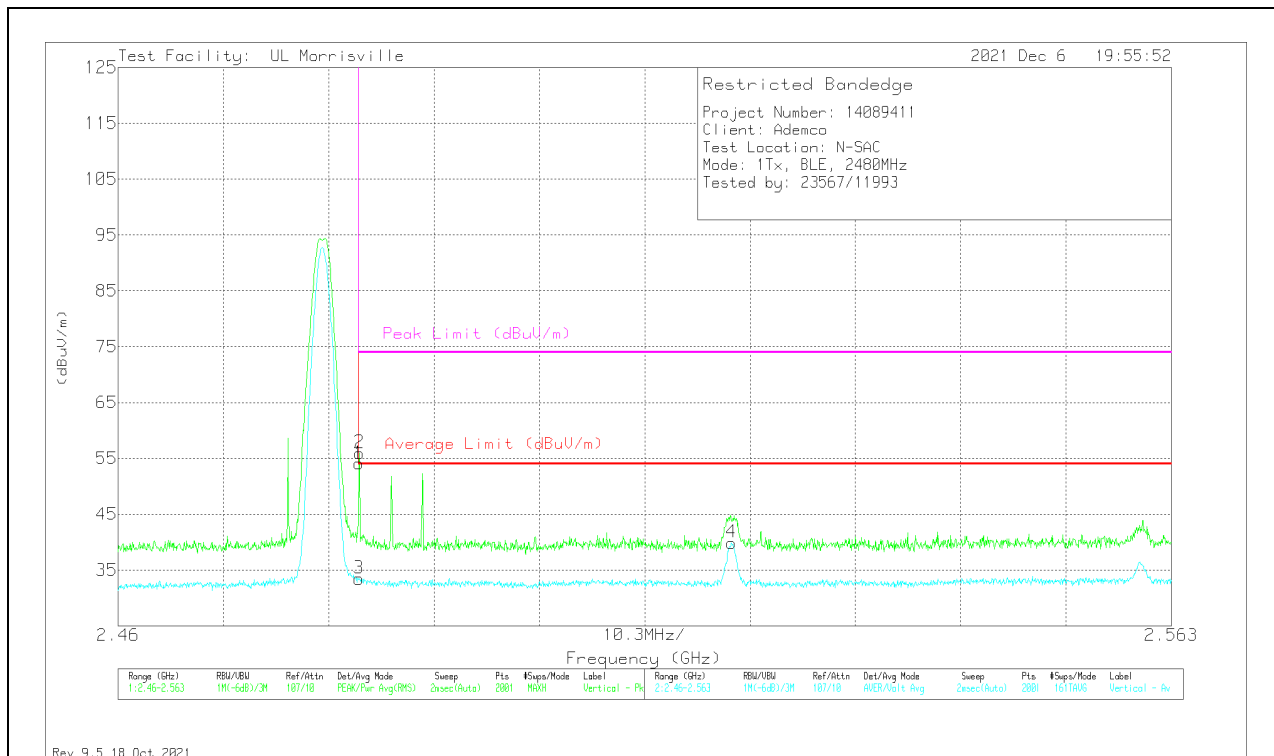
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

VERTICAL RESULT



| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AT0067 (dB/m) | Amp/Cbl/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|---------------|------------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1 | *** 2.48354 | 46.37 | Pk | 32.3 | -24.6 | 0 | 54.07 | - | - | 74 | -19.93 | 187 | 168 | V |
| 2 | *** 2.48359 | 48.25 | Pk | 32.3 | -24.6 | 0 | 55.95 | - | - | 74 | -18.05 | 187 | 168 | V |
| 3 | *** 2.48354 | 21.61 | ADV | 32.3 | -24.6 | 4.16 | 33.47 | 54 | -20.53 | - | - | 187 | 168 | V |
| 4 | ** 2.52 | 27.64 | ADV | 32.5 | -24.4 | 4.16 | 39.9 | 54 | -14.1 | - | - | 187 | 168 | V |

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

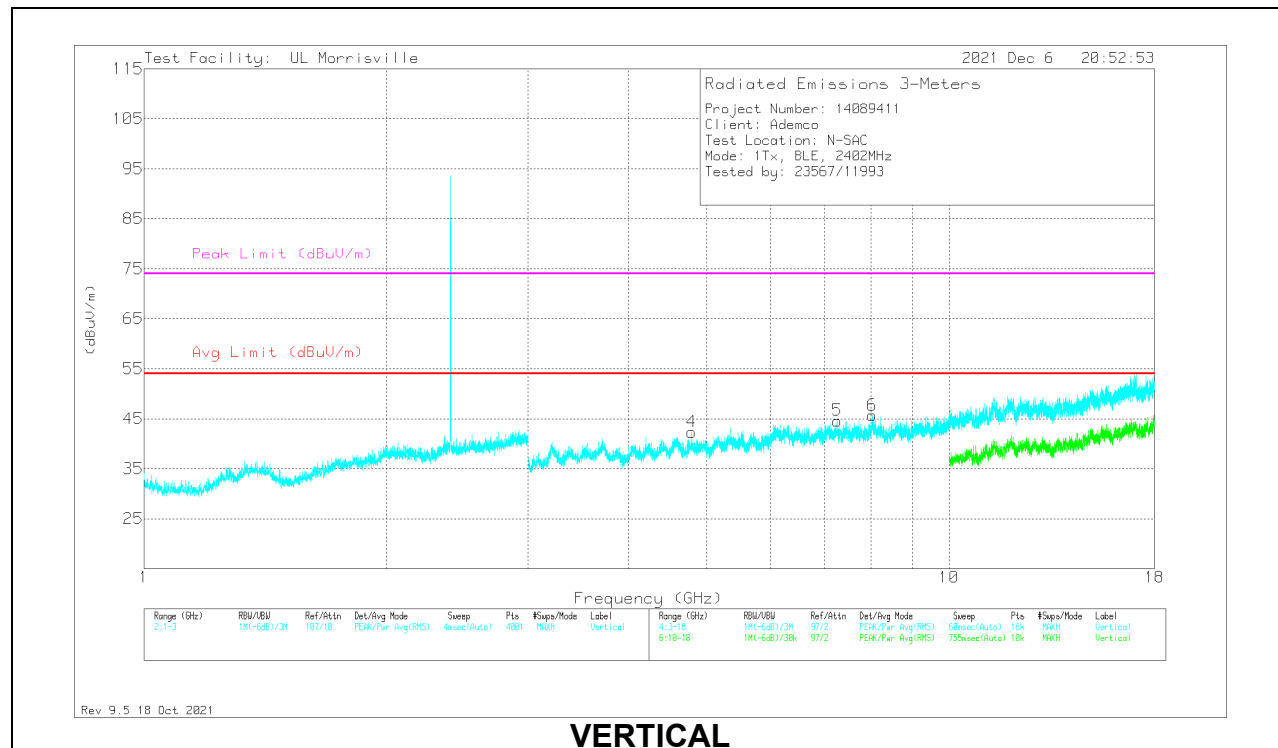
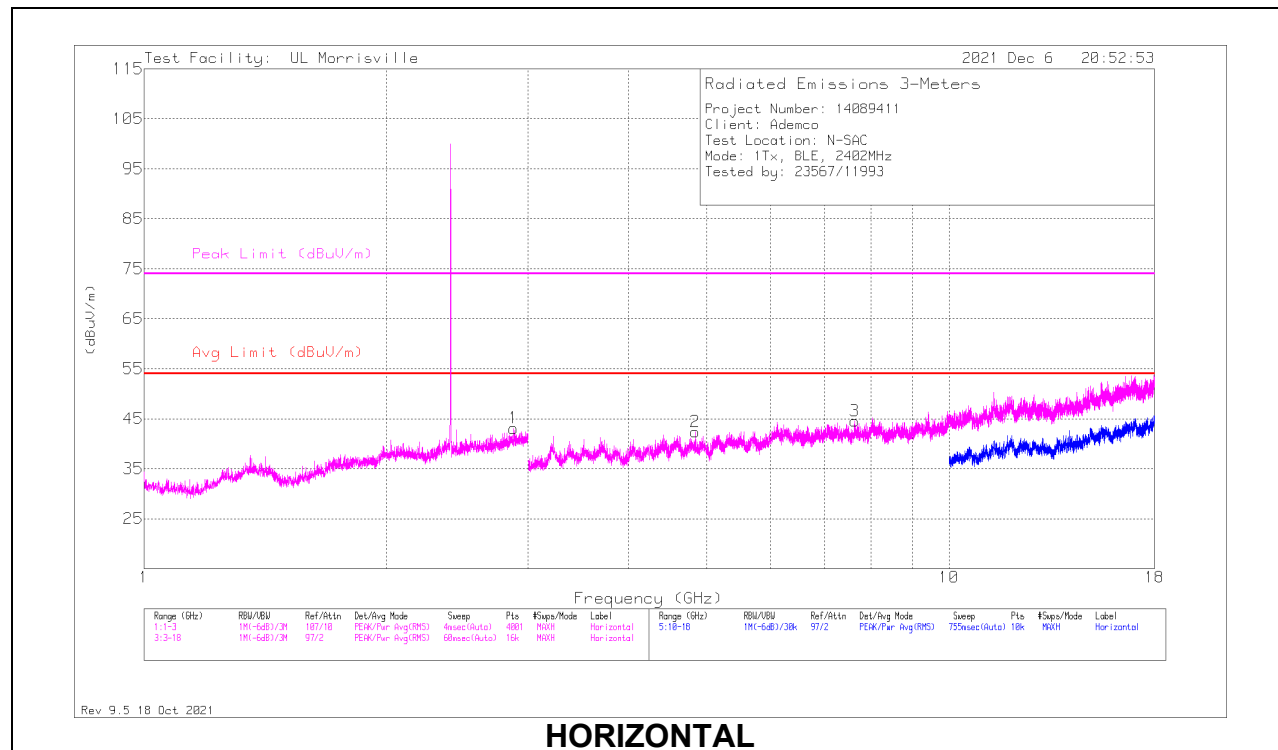
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

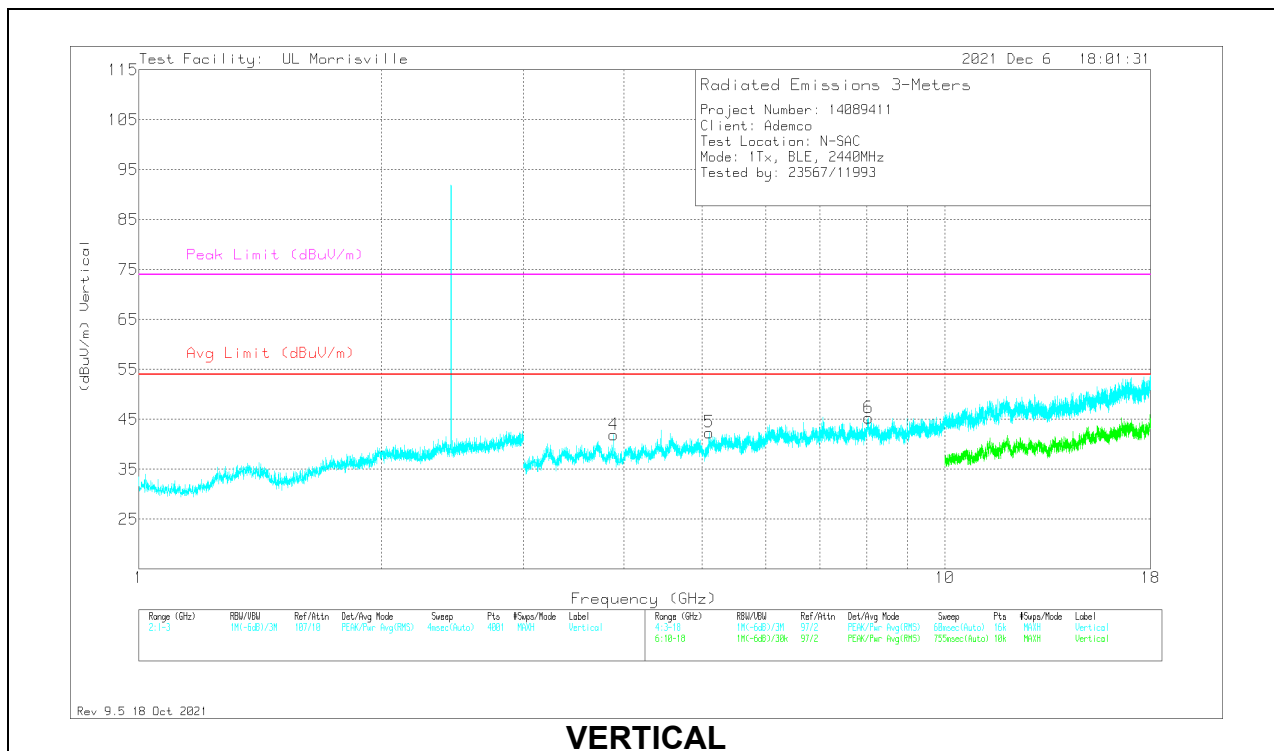
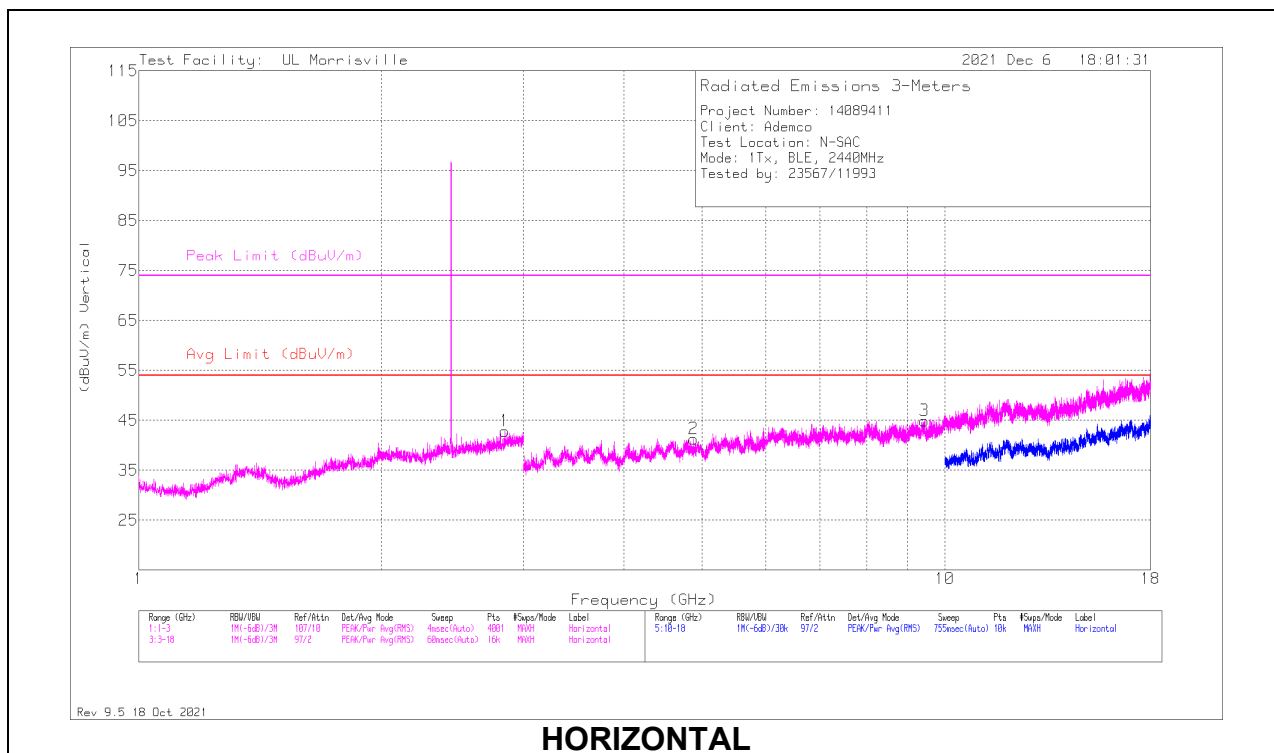
| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AT0067 (dB/m) | Amp/Cbl/Filtr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|---------------|--------------------|----------------------------|--------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1 | * ** 2.876 | 33.99 | Pk | 32.7 | -23.6 | 43.09 | 54 | -10.91 | 74 | -30.91 | 0-360 | 199 | H |
| 4 | * ** 4.78781 | 39.83 | Pk | 33.9 | -31.4 | 42.33 | 54 | -11.67 | 74 | -31.67 | 0-360 | 101 | V |
| 2 | * ** 4.84125 | 39.37 | Pk | 34 | -31 | 42.37 | 54 | -11.63 | 74 | -31.63 | 0-360 | 101 | H |
| 5 | * ** 7.26281 | 38.01 | Pk | 35.6 | -29 | 44.61 | 54 | -9.39 | 74 | -29.39 | 0-360 | 200 | V |
| 3 | * ** 7.63688 | 37.35 | Pk | 35.7 | -28.5 | 44.55 | 54 | -9.45 | 74 | -29.45 | 0-360 | 199 | H |
| 6 | * ** 8.03156 | 38.17 | Pk | 35.7 | -28.2 | 45.67 | 54 | -8.33 | 74 | -28.33 | 0-360 | 200 | V |

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

MID CHANNEL RESULTS



RADIATED EMISSIONS

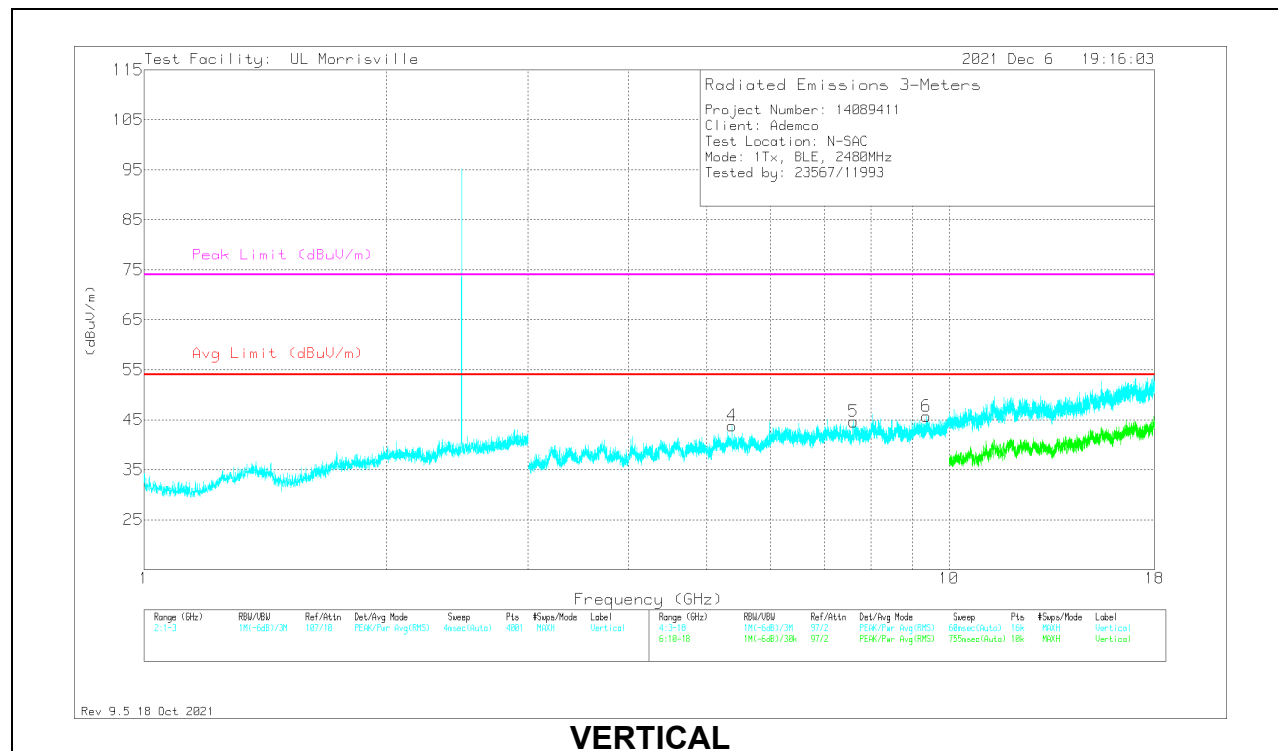
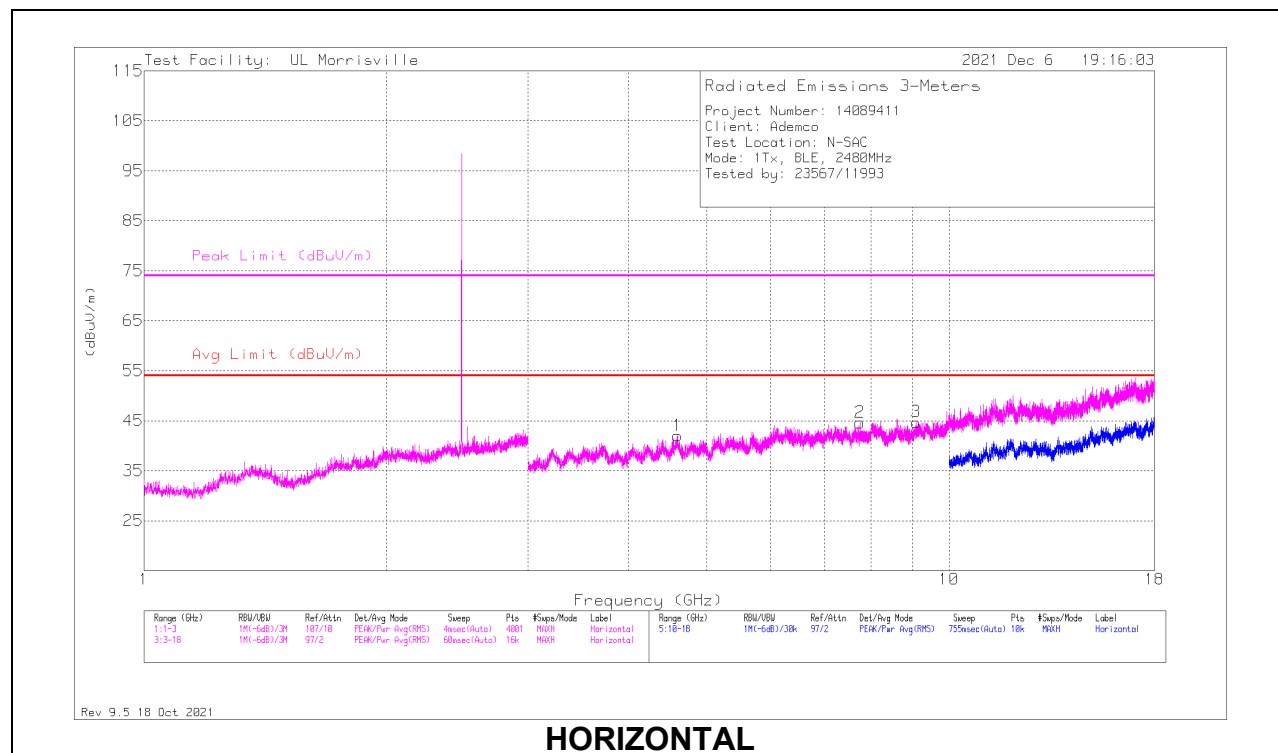
| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AT0067 (dB/m) | Amp/Cbl/Filtr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|---------------|--------------------|----------------------------|--------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 4 | *** 3.88313 | 40.18 | Pk | 33.4 | -31.7 | 41.88 | 54 | -12.12 | 74 | -32.12 | 0-360 | 200 | V |
| 2 | *** 4.87969 | 39.02 | Pk | 33.9 | -31.6 | 41.32 | 54 | -12.68 | 74 | -32.68 | 0-360 | 200 | H |
| 5 | *** 5.10563 | 39.59 | Pk | 34 | -31.2 | 42.39 | 54 | -11.61 | 74 | -31.61 | 0-360 | 101 | V |
| 6 | *** 8.04281 | 37.79 | Pk | 35.7 | -28.2 | 45.29 | 54 | -8.71 | 74 | -28.71 | 0-360 | 200 | V |
| 3 | *** 9.42938 | 36.44 | Pk | 36.4 | -27.9 | 44.94 | 54 | -9.06 | 74 | -29.06 | 0-360 | 200 | H |
| 1 | *** 2.8475 | 34.1 | Pk | 32.5 | -23.8 | 42.8 | 54 | -11.2 | 74 | -31.2 | 0-360 | 101 | H |

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AT0067 (dB/m) | Amp/Cbl/Filtr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|---------------|--------------------|----------------------------|--------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1 | *** 4.59938 | 39.99 | Pk | 34 | -32 | 41.99 | 54 | -12.01 | 74 | -32.01 | 0-360 | 101 | H |
| 2 | *** 7.74938 | 37.92 | Pk | 35.7 | -29 | 44.62 | 54 | -9.38 | 74 | -29.38 | 0-360 | 101 | H |
| 3 | *** 9.10688 | 36.53 | Pk | 36.1 | -27.9 | 44.73 | 54 | -9.27 | 74 | -29.27 | 0-360 | 199 | H |
| 4 | *** 5.37188 | 40.4 | Pk | 34.3 | -30.9 | 43.8 | 54 | -10.2 | 74 | -30.2 | 0-360 | 200 | V |
| 5 | *** 7.60969 | 38.04 | Pk | 35.7 | -29.1 | 44.64 | 54 | -9.36 | 74 | -29.36 | 0-360 | 101 | V |
| 6 | *** 9.37594 | 37.08 | Pk | 36.3 | -27.7 | 45.68 | 54 | -8.32 | 74 | -28.32 | 0-360 | 200 | V |

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

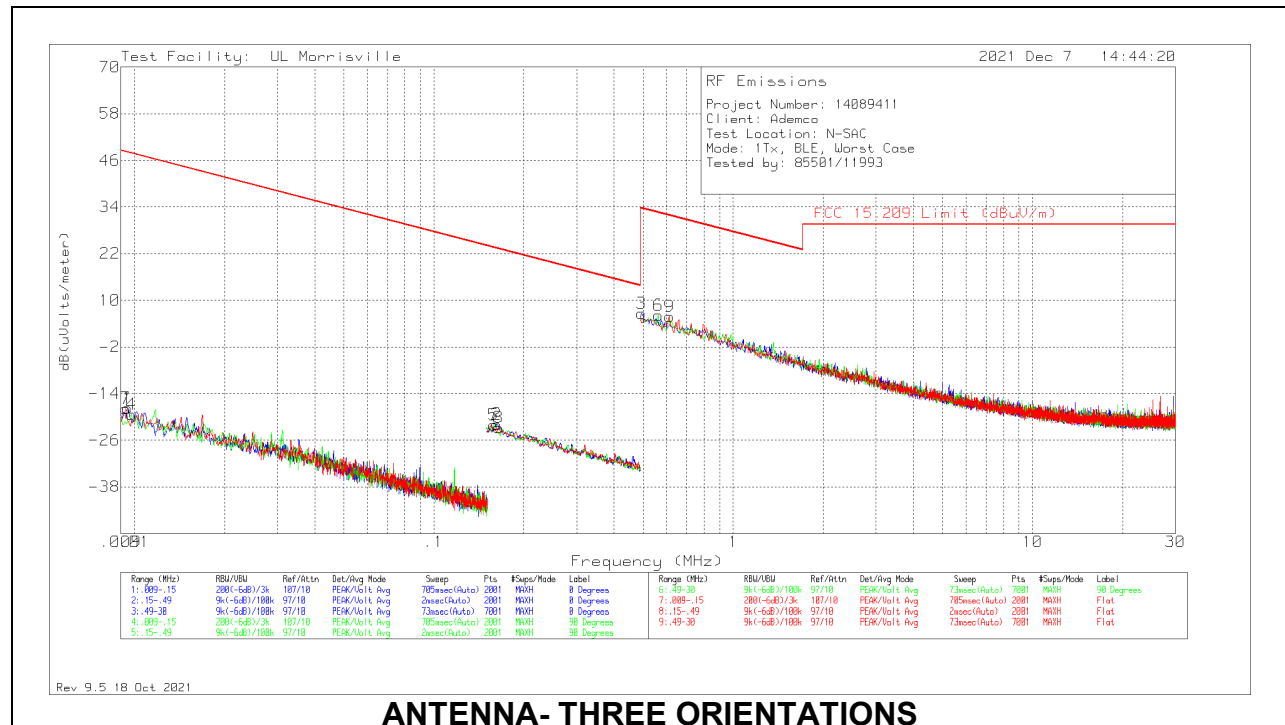
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

10.3. WORST CASE BELOW 30MHZ

Note for below 30 MHz scans: All measurements were made at a test distance of 3 m. The measured data was extrapolated from the test distance (3m) to the specification distance (300 m from 9-490 kHz and 30 m from 490 kHz – 30 MHz) to clearly show the relative levels of fundamental and spurious emissions and demonstrate compliance with the requirement that the level of any spurious emissions be below the level of the intentionally transmitted signal. The extrapolation factor for the limits were 40*Log (test distance / specification distance).

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION E-FIELD)

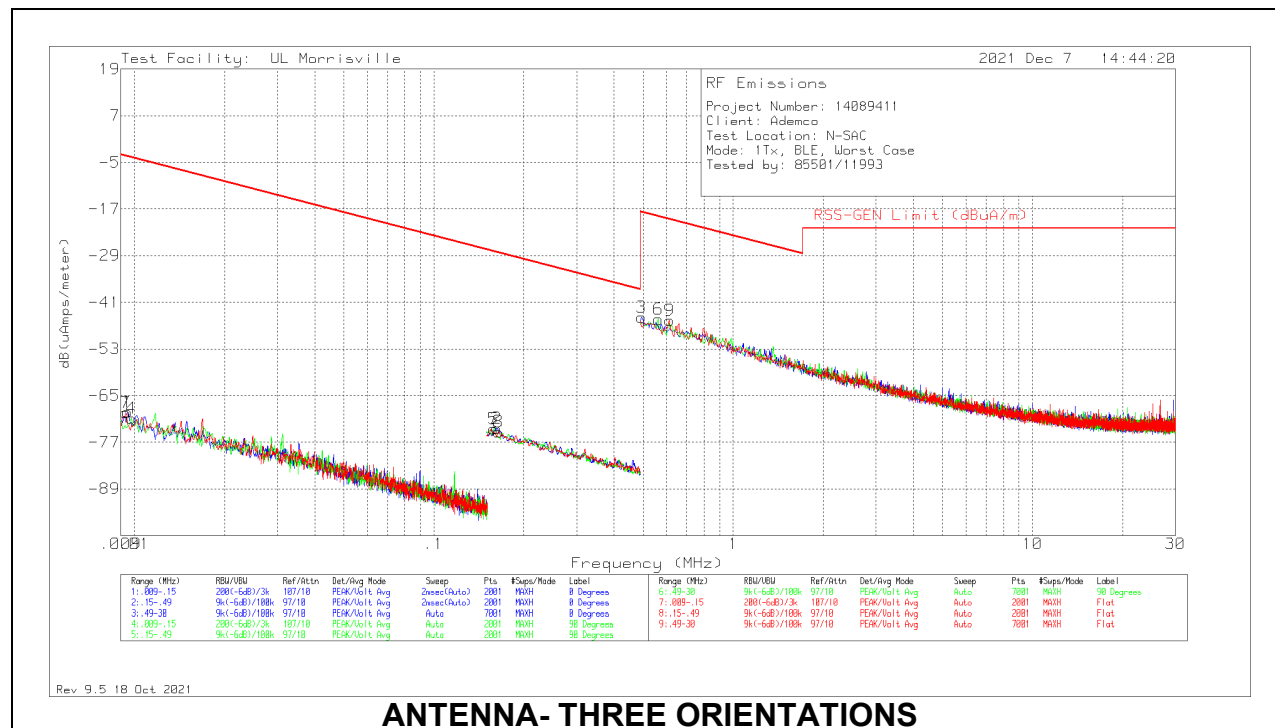


ANTENNA- THREE ORIENTATIONS

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | AT0079 (dB/m) | Cbl (dB) | Dist. Corr. Factor (dB) | Corrected Reading dB(uVolts/meter) | FCC 15.209 QP/AV Limit (dBuV/m) | FCC 15.209 PK Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Loop Angle |
|--------|-----------------|----------------------|-----|---------------|----------|-------------------------|------------------------------------|---------------------------------|------------------------------|-------------|----------------|------------|
| 7 | .00936 | 43.09 | Pk | 19 | .1 | -80 | -17.81 | 48.18 | 48.18 | -65.99 | 0-360 | Flat |
| 1 | .0095 | 43.23 | Pk | 18.9 | .1 | -80 | -17.77 | 48.05 | 48.05 | -65.82 | 0-360 | 0 degs |
| 4 | .00978 | 42.02 | Pk | 18.6 | .1 | -80 | -19.28 | 47.8 | 47.8 | -67.08 | 0-360 | 90 degs |
| 5 | .1585 | 46.65 | Pk | 11.2 | .1 | -80 | -22.05 | 23.6 | 23.6 | -45.65 | 0-360 | 90 degs |
| 2 | .16233 | 46.85 | Pk | 11.2 | .1 | -80 | -21.85 | 23.4 | 23.4 | -45.25 | 0-360 | 0 degs |
| 8 | .16437 | 45.9 | Pk | 11.2 | .1 | -80 | -22.8 | 23.29 | 23.29 | -46.09 | 0-360 | Flat |
| 3 | .49422 | 35.24 | Pk | 11.2 | .2 | -40 | 6.64 | 33.73 | - | -27.09 | 0-360 | 0 degs |
| 6 | .56167 | 34.69 | Pk | 11.2 | .2 | -40 | 6.09 | 32.61 | - | -26.52 | 0-360 | 90 degs |
| 9 | .61226 | 34.38 | Pk | 11.2 | .2 | -40 | 5.78 | 31.87 | - | -26.09 | 0-360 | Flat |

Pk - Peak detector

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION H-FIELD)

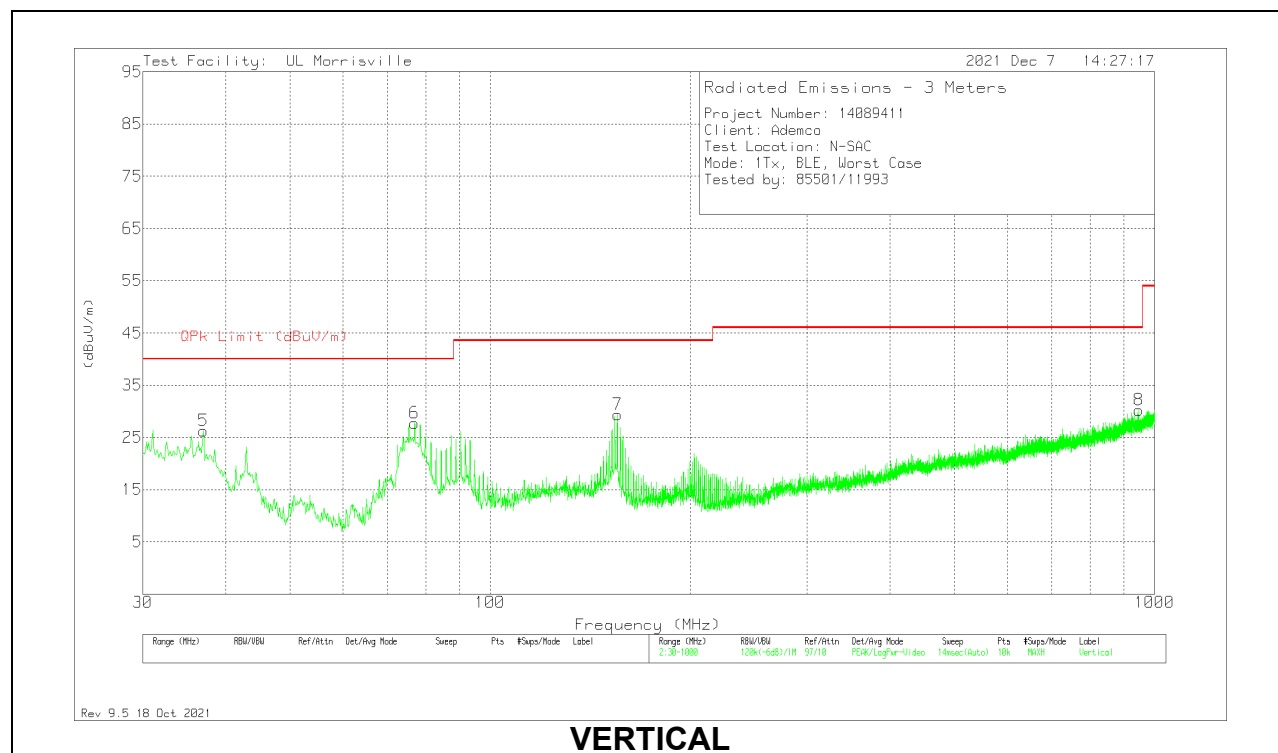
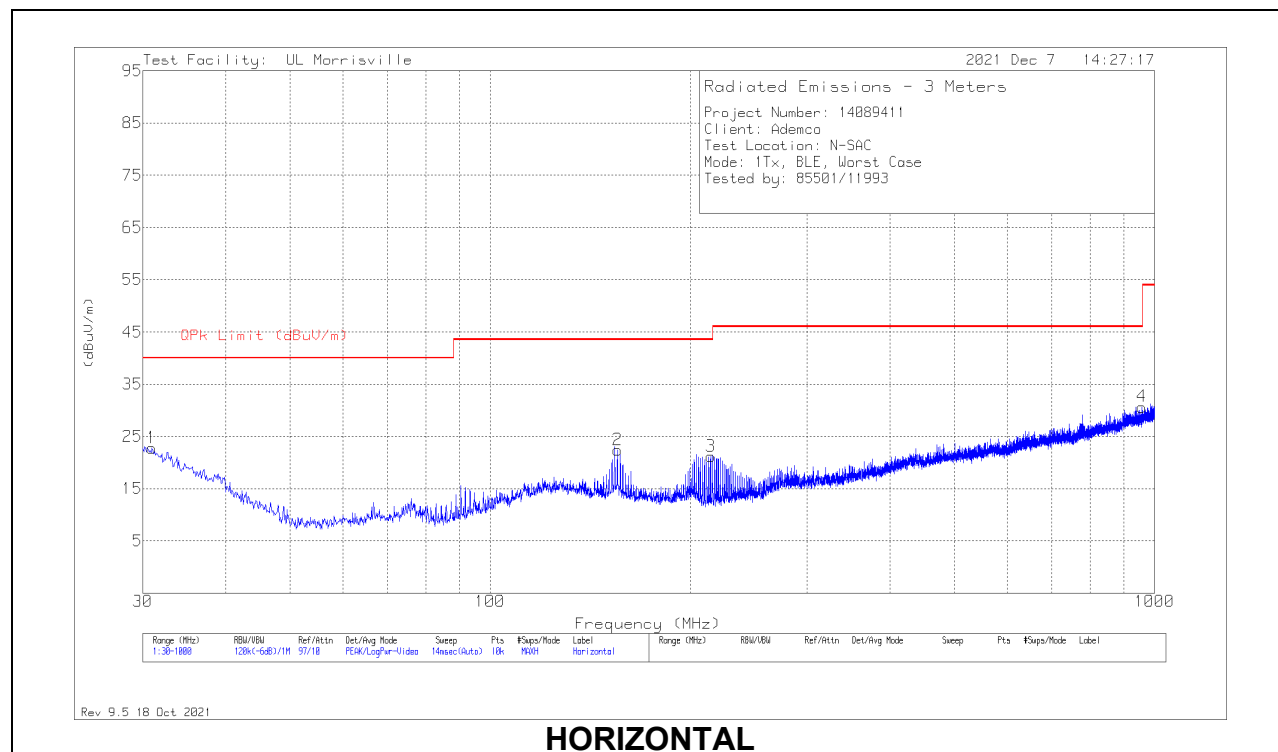


ANTENNA- THREE ORIENTATIONS

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | AT0079 (dB/m) | Cbl (dB) | Dist. Corr. Factor (dB) | Corrected Reading dB(uAmps/meter) | RSS-GEN Limit AV/ QP (dBuA/m) | RSS-GEN Limit PK (dBuA/m) | Margin (dB) | Azimuth (Degs) | Loop Angle |
|--------|-----------------|----------------------|-----|---------------|----------|-------------------------|-----------------------------------|-------------------------------|---------------------------|-------------|----------------|------------|
| 7 | .00936 | 43.09 | Pk | -32.5 | .1 | -80 | -69.31 | -3.32 | 16.68 | -65.99 | 0-360 | Flat |
| 1 | .0095 | 43.23 | Pk | -32.6 | .1 | -80 | -69.27 | -3.45 | 16.55 | -65.82 | 0-360 | 0 degs |
| 4 | .00978 | 42.02 | Pk | -32.9 | .1 | -80 | -70.78 | -3.7 | 16.70 | -67.08 | 0-360 | 90 degs |
| 5 | .1585 | 46.65 | Pk | -40.3 | .1 | -80 | -73.55 | -27.9 | -7.9 | -45.65 | 0-360 | 90 degs |
| 2 | .16233 | 46.85 | Pk | -40.3 | .1 | -80 | -73.35 | -28.1 | -8.1 | -45.25 | 0-360 | 0 degs |
| 8 | .16437 | 45.9 | Pk | -40.3 | .1 | -80 | -74.3 | -28.21 | -8.21 | -46.09 | 0-360 | Flat |
| 3 | .49422 | 35.24 | Pk | -40.3 | .2 | -40 | -44.86 | -17.77 | - | -27.09 | 0-360 | 0 degs |
| 6 | .56167 | 34.69 | Pk | -40.3 | .2 | -40 | -45.41 | -18.89 | - | -26.52 | 0-360 | 90 degs |
| 9 | .61226 | 34.38 | Pk | -40.3 | .2 | -40 | -45.72 | -19.63 | - | -26.09 | 0-360 | Flat |

Pk - Peak detector

10.4. WORST CASE BELOW 1 GHZ



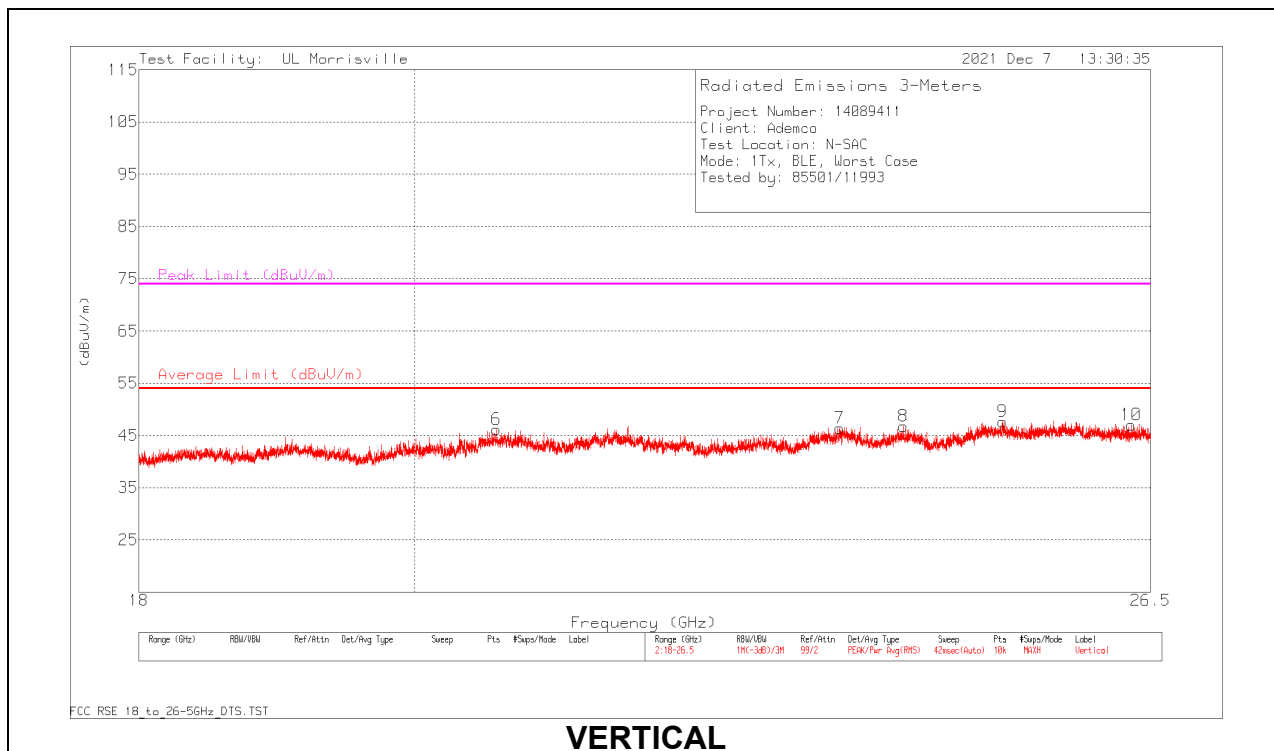
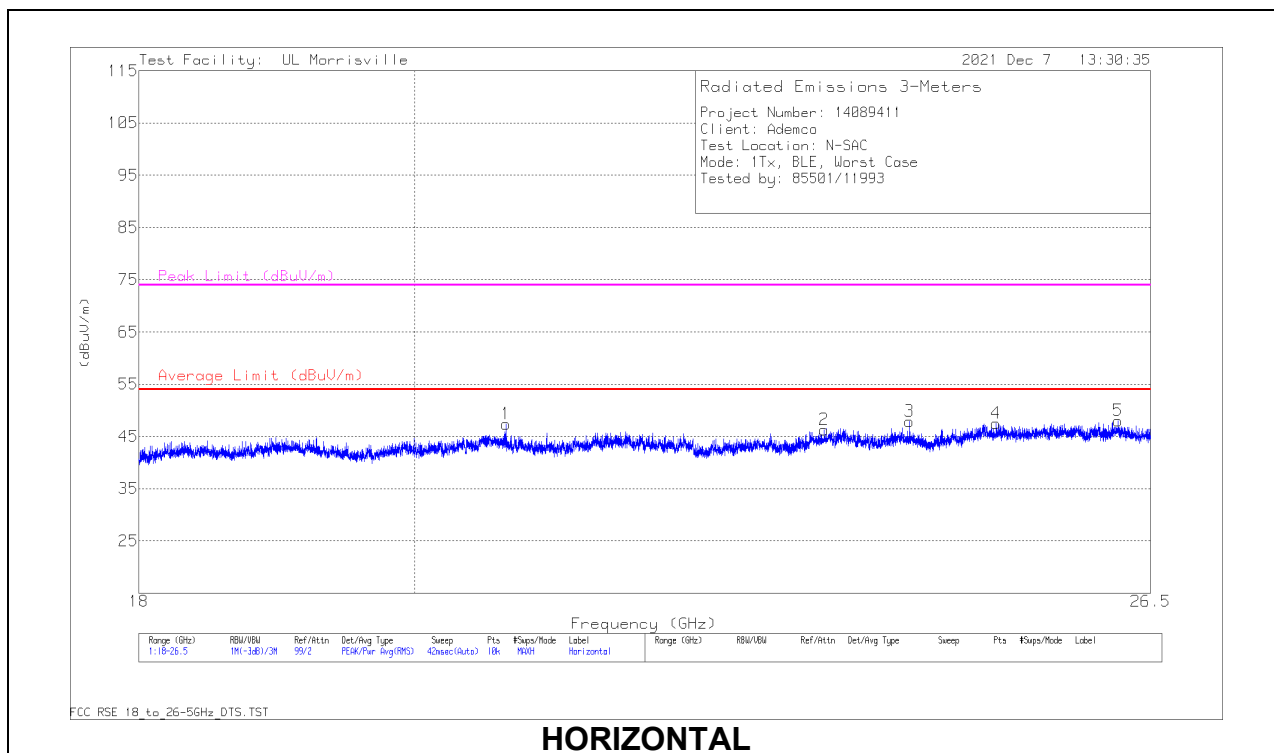
| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | AT0066 (dB/m) | Amp/Cbl (dB) | Corrected Reading (dBuV/m) | QPk Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|---------------|--------------|----------------------------|--------------------|-------------|----------------|-------------|----------|
| 4 | ** 957.126 | 25.36 | Pk | 29.2 | -23.9 | 30.66 | 46.02 | -15.36 | 0-360 | 399 | H |
| 8 | ** 947.523 | 25.23 | Pk | 29.1 | -24.1 | 30.23 | 46.02 | -15.79 | 0-360 | 100 | V |
| 1 | 30.97 | 27.45 | Pk | 26.6 | -31.3 | 22.75 | 40 | -17.25 | 0-360 | 300 | H |
| 5 | 36.984 | 35.15 | Pk | 22.5 | -31.4 | 26.25 | 40 | -13.75 | 0-360 | 100 | V |
| 6 | 76.948 | 44.4 | Pk | 14 | -30.7 | 27.7 | 40 | -12.3 | 0-360 | 100 | V |
| 7 | 155.421 | 40.86 | Pk | 18.3 | -29.8 | 29.36 | 43.52 | -14.16 | 0-360 | 100 | V |
| 2 | 155.518 | 33.89 | Pk | 18.3 | -29.8 | 22.39 | 43.52 | -21.13 | 0-360 | 300 | H |
| 3 | 214.688 | 33.62 | Pk | 16.6 | -29.1 | 21.12 | 43.52 | -22.4 | 0-360 | 199 | H |

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

10.5. WORST CASE 18-26 GHZ



| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | 204704 (dB/m) | Amp/Cbl (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|---------------|--------------|----------------------------|------------------------|-------------|---------------------|-------------|----------------|-------------|----------|
| 1 | * ** 20.71378 | 53.5 | Pk | 33.9 | -40 | 47.4 | 54 | -6.6 | 74 | -26.6 | 0-360 | 200 | H |
| 6 | * ** 20.63814 | 51.19 | Pk | 33.9 | -39 | 46.09 | 54 | -7.91 | 74 | -27.91 | 0-360 | 300 | V |
| 2 | 23.39101 | 50.28 | Pk | 35.2 | -39.2 | 46.28 | 54 | -7.72 | 74 | -27.72 | 0-360 | 149 | H |
| 7 | 23.5287 | 49.92 | Pk | 35.4 | -38.9 | 46.42 | 54 | -7.58 | 74 | -27.58 | 0-360 | 300 | V |
| 8 | 24.11259 | 50.24 | Pk | 35.2 | -38.7 | 46.74 | 54 | -7.26 | 74 | -27.26 | 0-360 | 101 | V |
| 3 | 24.16698 | 51.4 | Pk | 35.2 | -38.7 | 47.9 | 54 | -6.1 | 74 | -26.1 | 0-360 | 149 | H |
| 4 | 24.9795 | 50 | Pk | 35.7 | -38.2 | 47.5 | 54 | -6.5 | 74 | -26.5 | 0-360 | 300 | H |
| 9 | 25.0424 | 49.87 | Pk | 35.8 | -38.1 | 47.57 | 54 | -6.43 | 74 | -26.43 | 0-360 | 101 | V |
| 5 | 26.17278 | 49.18 | Pk | 35.7 | -36.9 | 47.98 | 54 | -6.02 | 74 | -26.02 | 0-360 | 149 | H |
| 10 | 26.30537 | 48.22 | Pk | 35.8 | -37 | 47.02 | 54 | -6.98 | 74 | -26.98 | 0-360 | 250 | V |

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

11. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)
RSS-Gen 8.8

| Frequency of Emission (MHz) | Conducted Limit (dBuV) | |
|-----------------------------|------------------------|-----------------------|
| | 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.

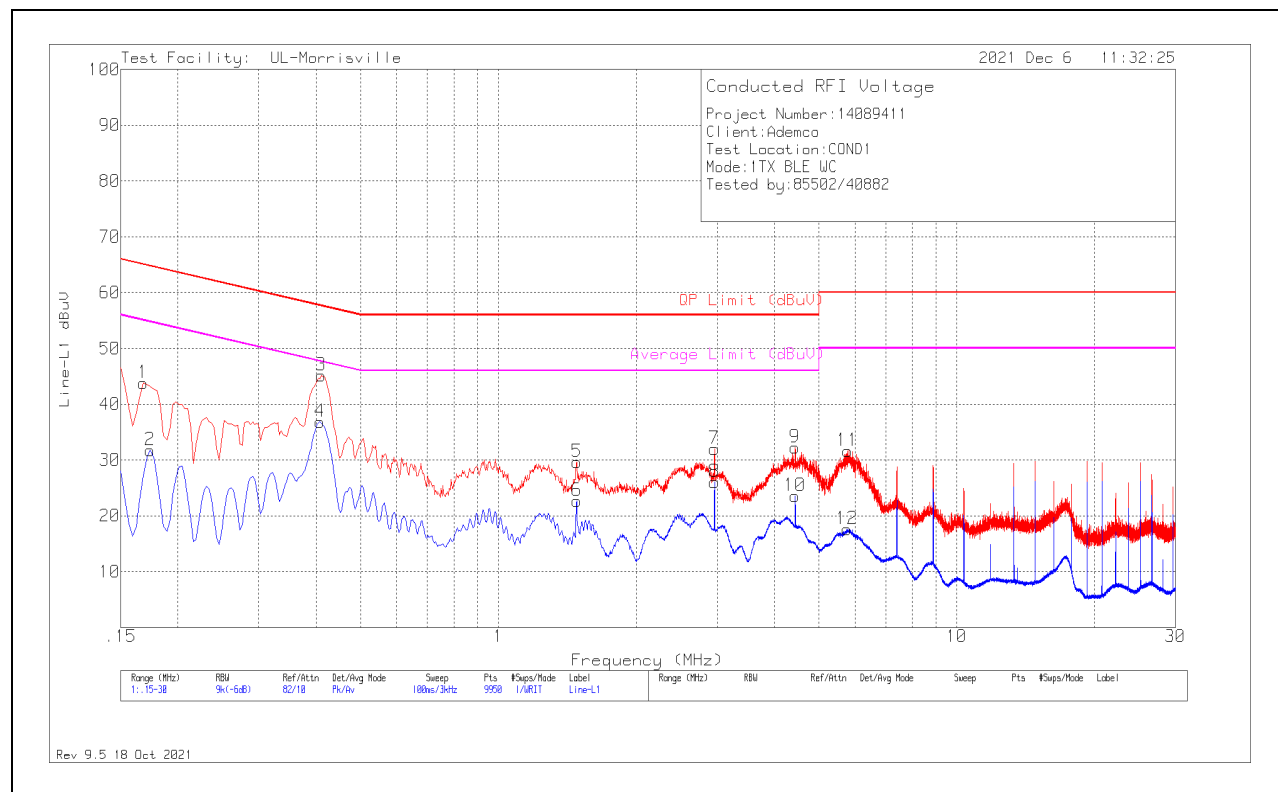
TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane.

The analyzer is set to a resolution bandwidth of 9 kHz above 150kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both lines.

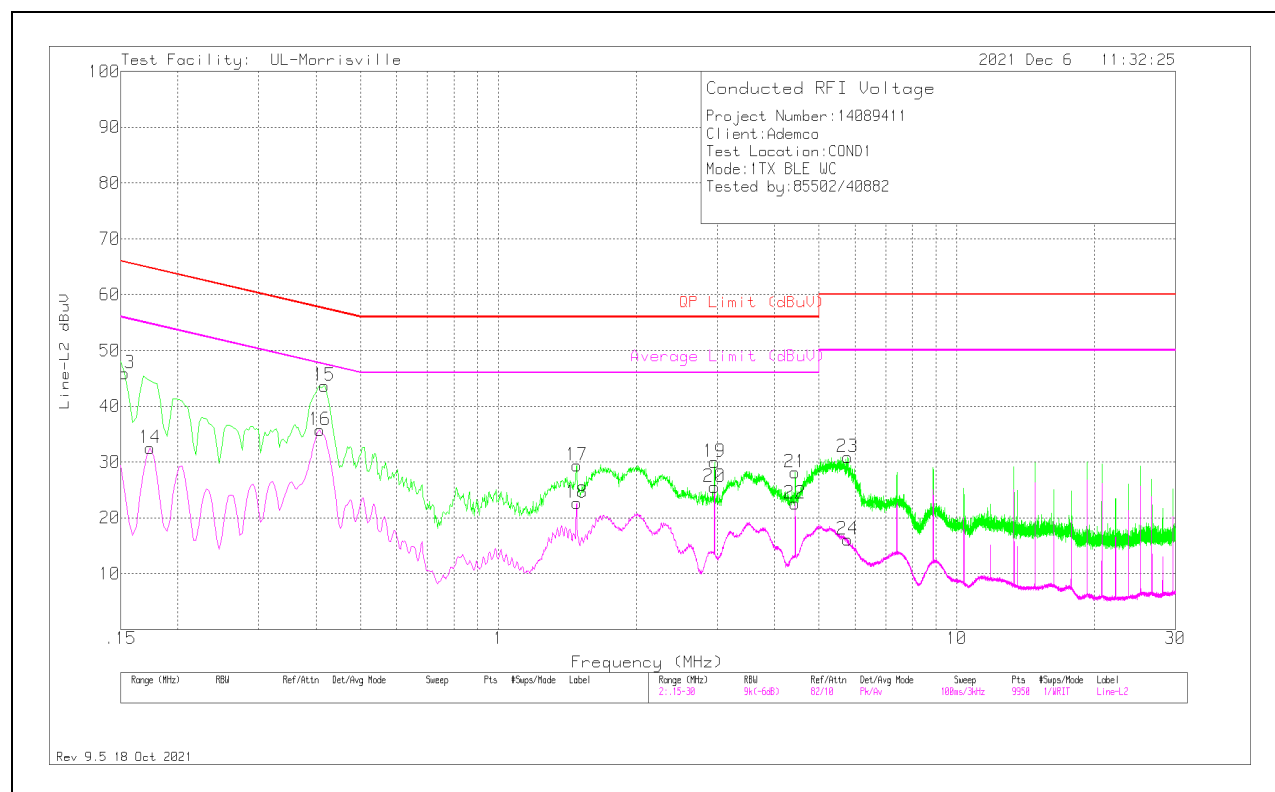
LINE 1 RESULTS



| Range 1: Line-L1 .15 - 30MHz | | | | | | | | | | |
|------------------------------|-----------------|----------------------|-----|---------------|------------------|------------------------|-----------------|-------------|----------------------|-------------|
| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | LISN VCF (dB) | Cbl/Limiter (dB) | Corrected Reading dBuV | QP Limit (dBuV) | Margin (dB) | Average Limit (dBuV) | Margin (dB) |
| 1 | .168 | 33.81 | Pk | .2 | 9.8 | 43.81 | 65.06 | -21.25 | - | - |
| 2 | .174 | 21.71 | Av | .2 | 9.8 | 31.71 | - | - | 54.77 | -23.06 |
| 4 | .408 | 26.89 | Av | .1 | 9.8 | 36.79 | - | - | 47.69 | -10.9 |
| 3 | .411 | 35.29 | Pk | .1 | 9.8 | 45.19 | 57.63 | -12.44 | - | - |
| 5 | 1.482 | 19.85 | Pk | 0 | 9.8 | 29.65 | 56 | -26.35 | - | - |
| 6 | 1.482 | 12.93 | Av | 0 | 9.8 | 22.73 | - | - | 46 | -23.27 |
| 7 | 2.961 | 22.18 | Pk | 0 | 9.8 | 31.98 | 56 | -24.02 | - | - |
| 8 | 2.961 | 16.21 | Av | 0 | 9.8 | 26.01 | - | - | 46 | -19.99 |
| 9 | 4.44 | 22.35 | Pk | 0 | 9.9 | 32.25 | 56 | -23.75 | - | - |
| 10 | 4.443 | 13.6 | Av | 0 | 9.9 | 23.5 | - | - | 46 | -22.5 |
| 12 | 5.769 | 7.67 | Av | 0 | 9.9 | 17.57 | - | - | 50 | -32.43 |
| 11 | 5.778 | 21.78 | Pk | 0 | 9.9 | 31.68 | 60 | -28.32 | - | - |

AV – Average Detector
PK – PK Detector

LINE 2 RESULTS



| Range 2: Line-L2 .15 - 30MHz | | | | | | | | | | |
|------------------------------|-----------------|----------------------|-----|---------------|------------------|------------------------|-----------------|-------------|----------------------|-------------|
| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | LISN VCF (dB) | Cbl/Limiter (dB) | Corrected Reading dBuV | QP Limit (dBuV) | Margin (dB) | Average Limit (dBuV) | Margin (dB) |
| 13 | .153 | 35.91 | Pk | .2 | 9.8 | 45.91 | 65.84 | -19.93 | - | - |
| 14 | .174 | 22.45 | Av | .2 | 9.8 | 32.45 | - | - | 54.77 | -22.32 |
| 16 | .408 | 25.79 | Av | .1 | 9.8 | 35.69 | - | - | 47.69 | -12 |
| 15 | .417 | 33.76 | Pk | .1 | 9.8 | 43.66 | 57.51 | -13.85 | - | - |
| 17 | 1.482 | 19.56 | Pk | 0 | 9.8 | 29.36 | 56 | -26.64 | - | - |
| 18 | 1.482 | 12.93 | Av | 0 | 9.8 | 22.73 | - | - | 46 | -23.27 |
| 19 | 2.961 | 20.21 | Pk | 0 | 9.8 | 30.01 | 56 | -25.99 | - | - |
| 20 | 2.961 | 15.79 | Av | 0 | 9.8 | 25.59 | - | - | 46 | -20.41 |
| 21 | 4.443 | 18.25 | Pk | 0 | 9.9 | 28.15 | 56 | -27.85 | - | - |
| 22 | 4.443 | 12.7 | Av | 0 | 9.9 | 22.6 | - | - | 46 | -23.4 |
| 24 | 5.775 | 6.16 | Av | 0 | 9.9 | 16.06 | - | - | 50 | -33.94 |
| 23 | 5.784 | 20.99 | Pk | 0 | 9.9 | 30.89 | 60 | -29.11 | - | - |

AV – Average Detector
PK – PK Detector

12. SETUP PHOTOS

Please refer to R14089411-EP1 for setup diagrams

END OF TEST REPORT