TEST REPORT

Report Number. : R14354290-E1

Applicant	:	Qolsys Inc. 1900 The Alameda, Suite 420 San Jose, CA 95126, U.S.A
Model	:	QS-ZW8
FCC ID	:	2AAJXQS-ZW8
IC ID	:	11205A-QSZW8
EUT Description	:	Zwave 800 Radio Module
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C: 2022 ISED RSS-210 ISSUE 10+A1: 2020 ISED RSS-GEN ISSUE 5 + A2: 2021

Date Of Issue:
2022-09-06

Prepared by:
UL LLC
12 Laboratory Dr.
Research Triangle Park, NC 27709 U.S.A.
TEL: (919) 549-1400

ACCREDITED
CERT #0751.06

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	2022-09-06	Initial Issue	Noah Bennett

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Qolsys Inc.
1900 The Alameda, Suite 420
San Jose, CA 95126, U.S.A

EUT DESCRIPTION: Zwave Radio Module

MODEL: QS-ZW8

SERIAL NUMBER: QC908L1002209G00090, QPH023X032204G04447

SAMPLE RECEIPT DATE: 2022-06-16

DATE TESTED: 2022-08-29 to 2022-08-31

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C: 2022	Complies
ISED RSS-210 Issue 10+A1: 2020	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, or any agency of the U.S. government.

Approved & Released For
UL LLC. By:

Brian T. Kiewra
Project Engineer
Consumer Technology Division
UL LLC.

Prepared By:

Noah Bennett
Electrical Engineer
Consumer Technology Division
UL LLC.

2. TEST RESULTS SUMMARY

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.
15.249 (a)	RSS-210-B.10(a)	Fundamental Field Strength	Complies	None
15.205, 15.209, 15.249(a)	RSS-GEN 8.9, 8.10	Radiated Emissions	Complies	None.
15.207	RSS-GEN 8.8	AC Mains Conducted Emissions	Complies	None.

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.

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15: 2022, ANSI C63.10-2013, KDB 414788 D01 Radiated Test Site v01r01, RSS-GEN Issue 5 + A2: 2021, and RSS-210 Issue 10 + A1: 2020.

4. FACILITIES AND ACCREDITATION

UL LLC is accredited by A2LA, Laboratory Code 200246-0, 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
☐	Building: 12 Laboratory Dr RTP, NC 27709, U.S.A	US0067	2180C	703469
☒	Building: 2800 Perimeter Park Dr. Suite B Morrisville, NC 27560, U.S.A	US0067	27265	703469

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%
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	0.57%
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 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 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 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

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6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a Z wave radio module to be installed in a Home Maintenance hub.

6.2. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an ISM band loop antenna, with a maximum gain of 1.5 dBi.

6.3. SOFTWARE AND FIRMWARE

The EUT software installed during testing was msm8953_64-userdebug 9 PKQ1.190723.001

The test utility software used during testing was Android Debug Bridge v29.

6.4. WORST-CASE CONFIGURATION AND MODE

Radiated Emissions below 30 MHz and power line conducted emissions were performed with the EUT set to transmit at the channel with highest output fundamental field strength as worst-case scenario.

Radiated emissions and Equivalent Radiated Power below and above 1GHz were performed with the EUT set to transmit at 908.4 MHz, 908.42 MHz, 916 MHz, 919.8 MHz, and 921.4 MHz. The Power setting used for radiated spurious emissions and ERP was Powerlevel 5 raw.

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

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6.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	HP	15-p100dx	5CD43938XL	N/A
Host Device	Qolsys	IQ4 Hub	N/A	N/A

I/O CABLES

I/O Cable List						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	AC Power	1	Barrell	Shielded	<3m	Used to connect Host Device to AC Mains
2	Parallel	3	8 Pin	Shielded	<1m	Used to connect EUT to PCB Pins, while keeping Radio module external from Host Device

TEST SETUP

The EUT was connected to a test laptop and configured to transmit continuously before the tests.

SETUP DIAGRAM

See R14352490-EP1 for Setup Diagrams

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7. MEASUREMENT METHOD

Duty Cycle: ANSI C63.10-2013 Section 11.6

20dB Bandwidth: ANSI C63.10-2013 Section 6.9.2

Occupied Bandwidth: ANSI C63.10-2013 Subclause 6.9.3

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

General Radiated Spurious Emissions: ANSI C63.10-2013, Section 6.3, 6.5, 6.6

AC Power Line Conducted Emissions: ANSI C63.10-2013, Section 6.2.

Fundamental emission output power: ANSI C63.10-2013, Section 11.9

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8. TEST AND MEASUREMENT EQUIPMENT

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

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
HI0090	Environmental Meter	Fisher Scientific	15-077-963	2022-07-20	2023-07-20
SA0027	Spectrum Analyzer	Keysight Technologies	N9030A	2022-05-24	2023-05-24
SOFTEMI	Antenna Port Software	UL	Version 2022.5.4		

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	2022-04-05	2023-04-05
HI0091	Environmental Meter	Fisher Scientific	15-077-963	2022-07-20	2023-07-20
LISN003	LISN, 50-ohm/50-uH, 250uH 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50/250-25-2-01	2022-08-01	2023-08-01
75141	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2022-08-03	2023-08-03
ATA222	Transient Limiter, 0.009-100MHz	Electro-Metrics	EM-7600	2022-04-05	2023-04-05
PS214	AC Power Source	Elgar	CW2501M	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5 (04 Mar 2021)		

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville – Chamber 4)

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	0.009-30MHz				
AT0059	Active Loop Antenna	ETS-Lindgren	6502	2021-09-24	2022-09-24
	30-1000 MHz				
AT0081	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2021-12-08	2022-12-08
	1-18 GHz				
AT0067	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2022-05-24	2023-05-24
	Gain-Loss Chains				
C4-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2022-05-20	2023-05-20
C4-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2022-05-20	2023-05-20
C4-SAC03	Gain-loss string: 1-18GHz	Various	Various	2022-05-20	2023-05-20
	Receiver & Software				
206496	Spectrum Analyzer	Rohde & Schwarz	ESW44	2022-02-15	2023-02-15
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	Additional Equipment used				
21642	Environmental Meter	Fisher Scientific	15-077-963 (s/n 210701692)	2021-08-16	2023-08-16
BRF007	902-928MHz notch filter, 2W, F_{high} =1.5GHz	Micro-Tronics	BRC17691	2022-05-27	2023-05-27
HPF009	1GHz high-pass filter, 2W, F_{high} =10GHz	Micro-Tronics	HPM17672	2022-02-17	2023-02-17
HPF012	1GHz high-pass filter, 2W, F_{high} =18GHz	Micro-Tronics	HPM18129	2022-02-17	2023-02-17

9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

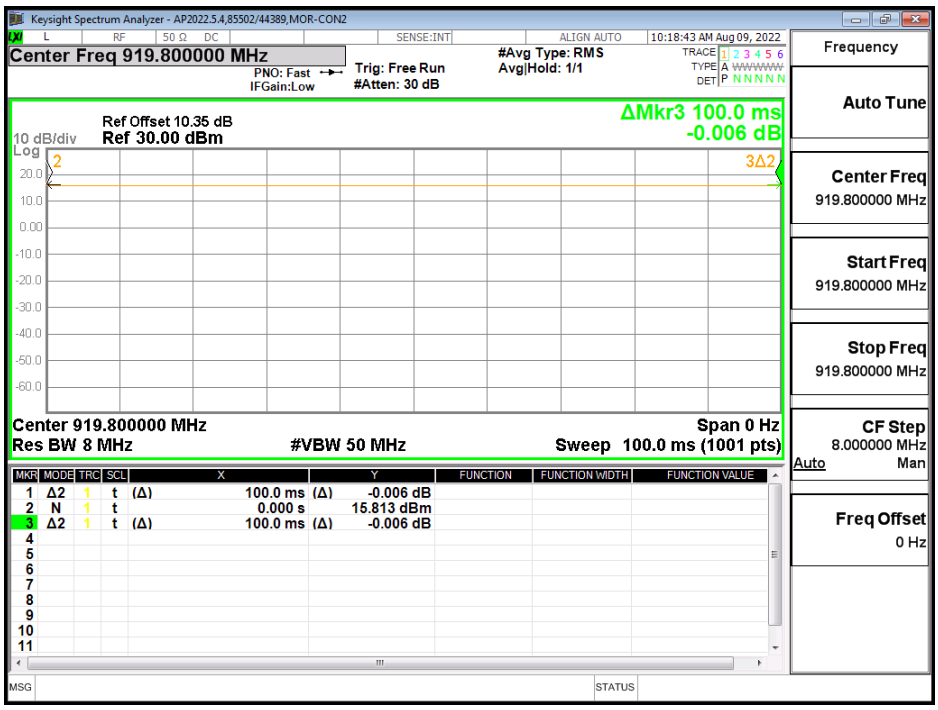
PROCEDURE

ANSI C63.10 Section 11.6
KDB 558074 Zero-Span Spectrum Analyzer Method.

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)
Z-wave- 919.8 MHz	100.000	100.000	1.000	100.00%	0.00	0.010

DUTY CYCLE PLOT



DUTY CYCLE Z-wave, 919.8 MHz

9.2. 99% AND 20dB BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

9.2.1. Z-WAVE

1TX Antenna 1 MODE

Channel	Frequency (MHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low 1	908.4	87.66	83.43
Low 2	908.42	65.52	61.82
Mid	916	122.30	113.63
High 1	919.8	121.70	113.28
High 2	921.4	87.04	83.33

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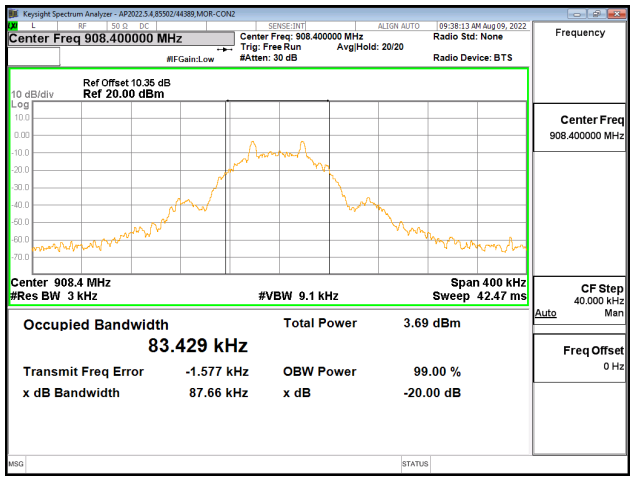
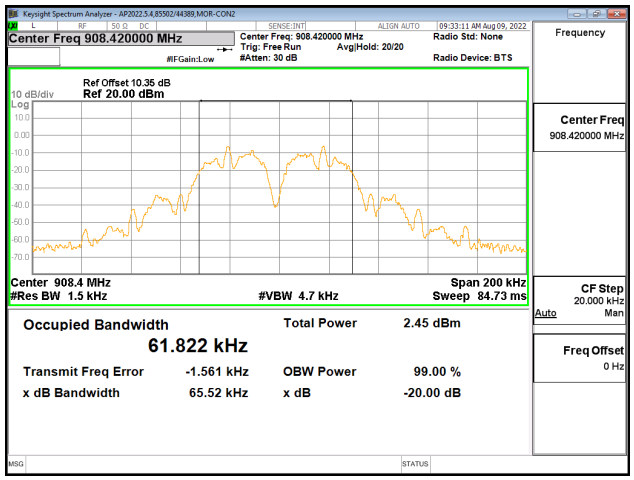
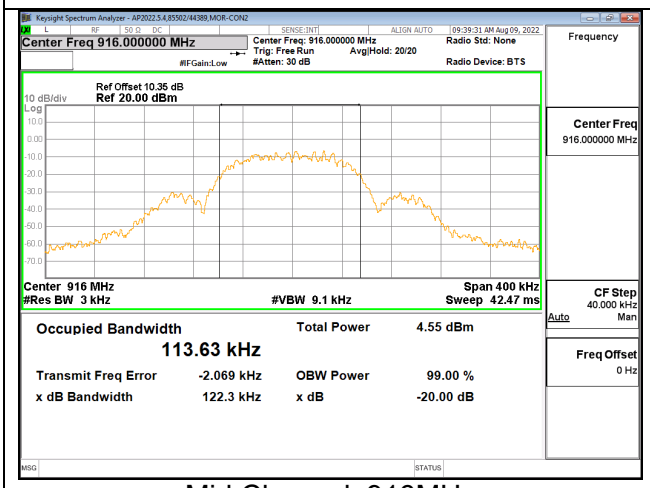


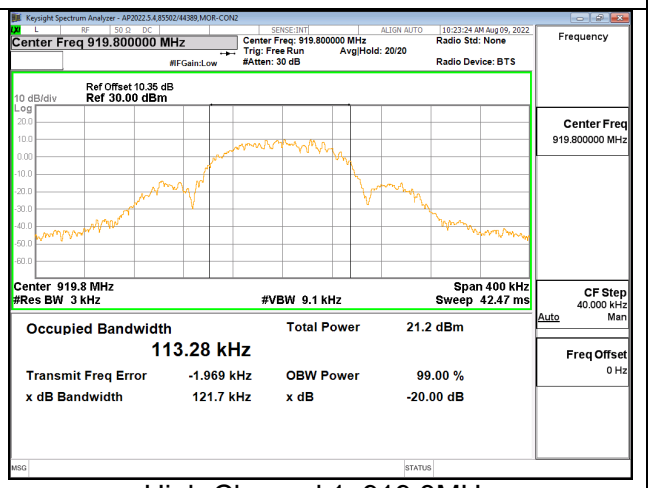
Low Channel 1: 908.4MHz



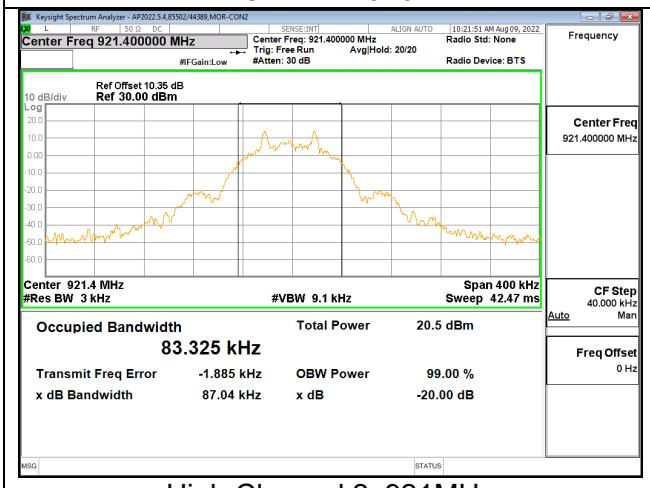
Low Channel 2: 908.42MHz



Mid Channel: 916MHz



High Channel 1: 919.8MHz



High Channel 2: 921MHz

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10. RADIATED TEST RESULTS

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

FCC 15.249(a), RSS-210 B.10(a)

Frequency Range (MHz)	Field Strength Limit of Fundamental (mV/m) at 3 m	Field Strength Limit of Harmonics (mV/m) at 3 m
902-928	50	.5

RSS-GEN, Section 8.9 and 8.10

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

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.

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz 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 linear voltage averaging measurements.

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.

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10.1. FUNDAMENTAL AND SPURIOUS EMISSIONS

10.1.1. FUNDAMENTAL (908.4 MHz)

Frequency (MHz)	Meter Reading (dBuV)	Det	AT0081 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Qp Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
908.4	77.16	Pk	29	-25.4	80.76	94	-13.24	338	121	V
908.42	78.09	Pk	29	-25.4	81.69	94	-12.31	19	102	H

Pk - Peak detector

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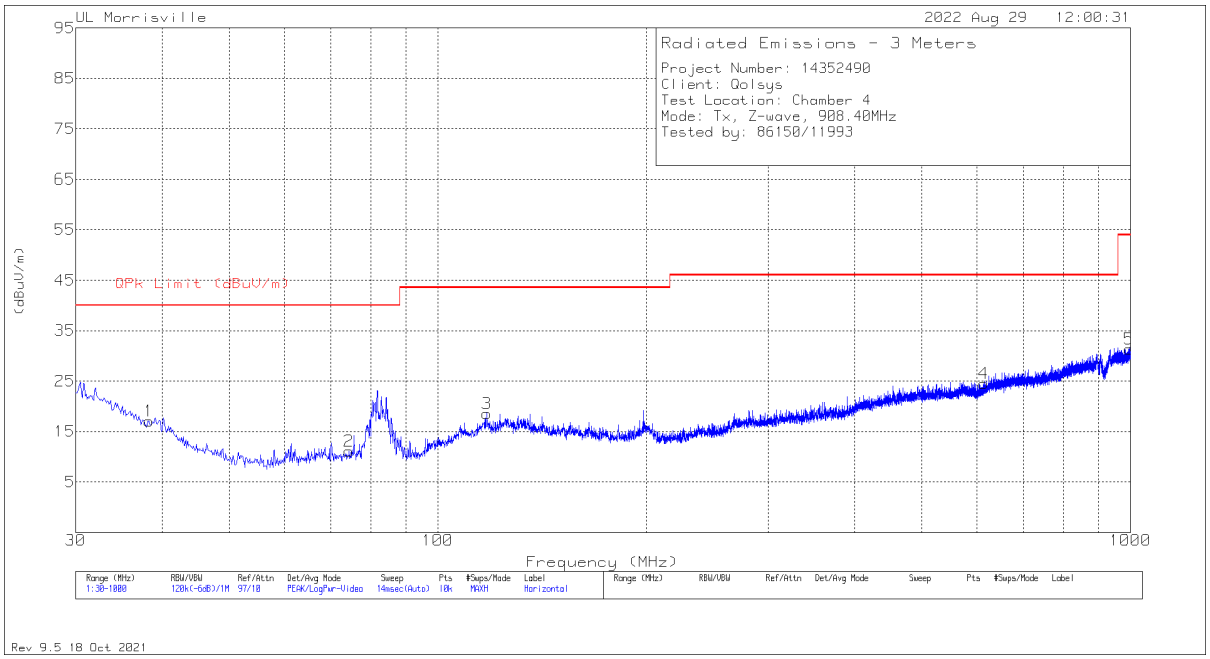
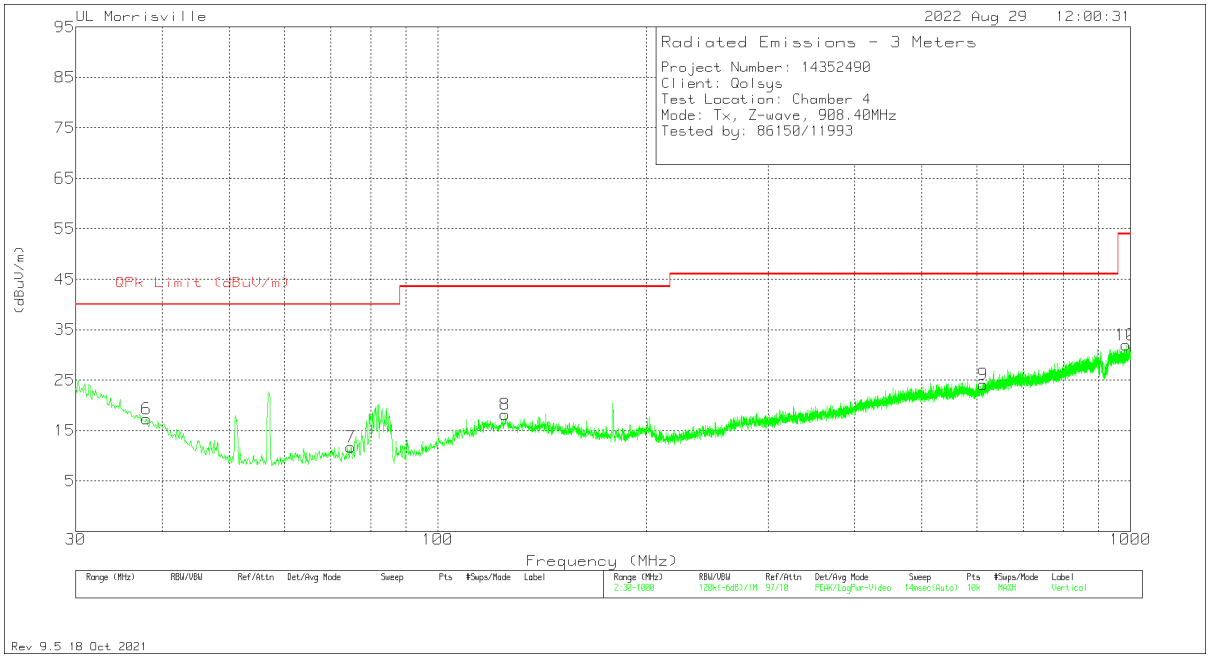
10.1.2. HARMONICS AND SPURIOUS EMISSIONS BELOW 1 GHz

LOW CHANNEL, 908.4 MHz RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0081 (dB/m)	Gain/Loss (dB)	Filter (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 38.245	27.33	Pk	21.3	-31.7	.1	0	17.03	40	-22.97	0-360	300	H
2	* ** 74.426	27.58	Pk	14.3	-31	.2	0	11.08	40	-28.92	0-360	300	H
3	* ** 117.591	28.86	Pk	19.9	-30.5	.3	0	18.56	43.52	-24.96	0-360	200	H
4	* ** 613.455	26.05	Pk	25.4	-27.6	.7	0	24.55	46.02	-21.47	0-360	300	H
5	* ** 995.441	24.66	Pk	29.9	-24.2	1	0	31.36	53.97	-22.61	0-360	300	H
6	* ** 37.954	27.49	Pk	21.5	-31.8	.1	0	17.29	40	-22.71	0-360	200	V
7	* ** 74.911	28.58	Pk	14.2	-31.2	.2	0	11.78	40	-28.22	0-360	100	V
8	* ** 125.06	28.02	Pk	20.2	-30.4	.4	0	18.22	43.52	-25.3	0-360	200	V
9	* ** 612.679	25.67	Pk	25.4	-27.6	.7	0	24.17	46.02	-21.85	0-360	200	V
10	* ** 985.062	25.59	Pk	29.7	-24.2	.9	0	31.99	53.97	-21.98	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

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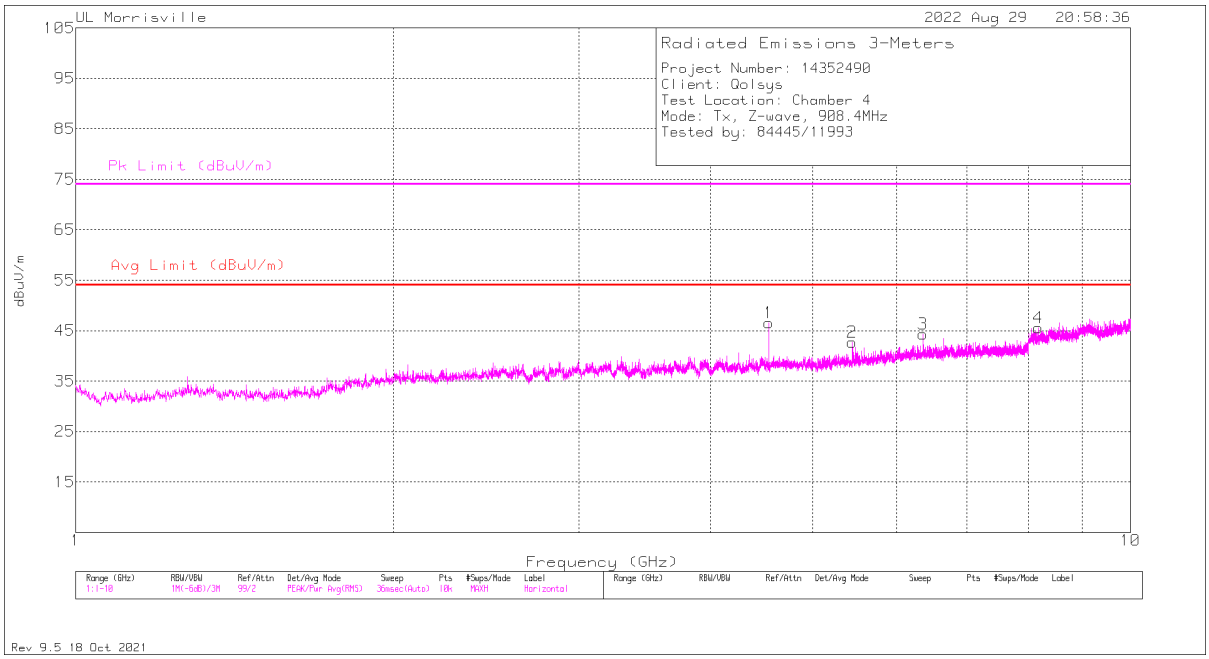
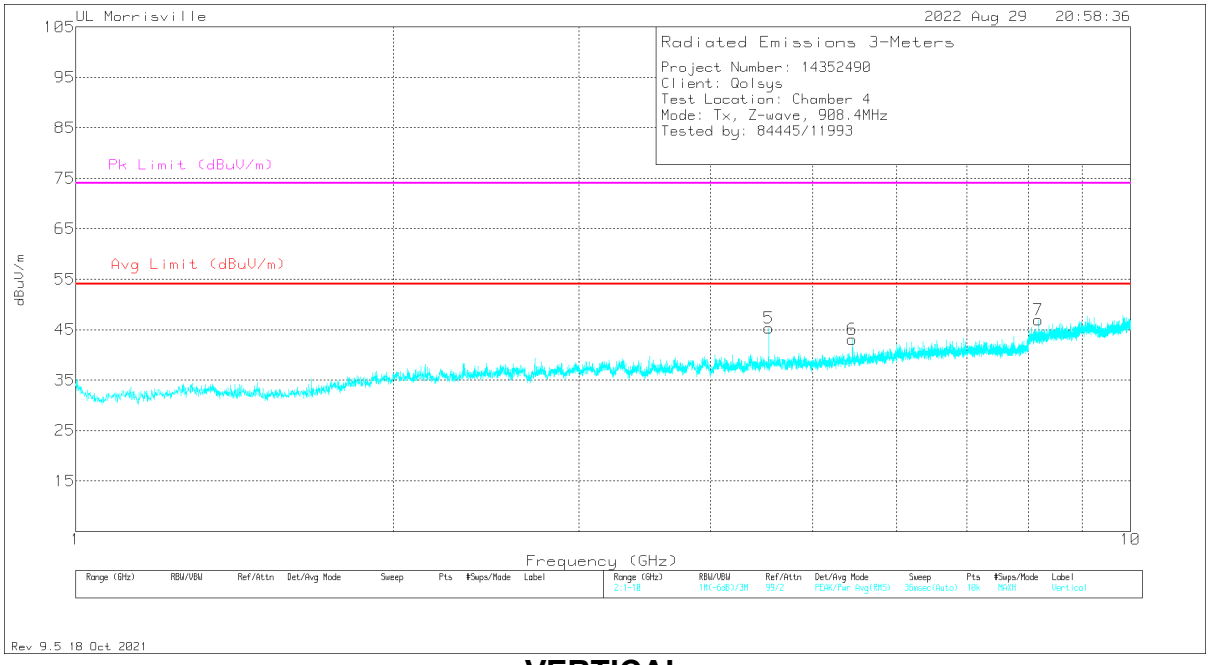
10.1.3. HARMONICS AND SPURIOUS EMISSIONS ABOVE 1 GHz

LOW CHANNEL, 908.4 MHz RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Gain/Loss (dB)	Filter (dB)	Corrected Reading dBuV/m	Avg Limit (dBuV/m)	Margin (dB)	Pk Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 4.5415	44.58	Pk	34	-32.2	.2	46.58	54	-7.42	74	-27.42	0-360	200	H
2	* ** 5.4505	39.69	Pk	34.6	-31.9	.3	42.69	54	-11.31	74	-31.31	0-360	200	H
4	* ** 8.1757	37.59	Pk	35.7	-28	.3	45.59	54	-8.41	74	-28.41	0-360	200	H
5	* ** 4.5424	43.37	Pk	34	-32.3	.2	45.27	54	-8.73	74	-28.73	0-360	200	V
6	* ** 5.4505	40.05	Pk	34.6	-31.9	.3	43.05	54	-10.95	74	-30.95	0-360	200	V
7	* ** 8.1766	38.88	Pk	35.7	-28	.3	46.88	54	-7.12	74	-27.12	0-360	300	V
3	6.3586	37.87	Pk	35.5	-29.5	.4	44.27	-	-	-	-	0-360	100	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector

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10.2. FUNDAMENTAL AND SPURIOUS EMISSIONS

10.2.1. FUNDAMENTAL (908.42 MHz)

Frequency (MHz)	Meter Reading (dBuV)	Det	AT0081 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Qp Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
908.439	76.97	Pk	29	-25.4	80.57	94	-13.43	336	120	V
908.441	77.99	Pk	29	-25.4	81.59	94	-12.41	17	102	H

Pk - Peak detector

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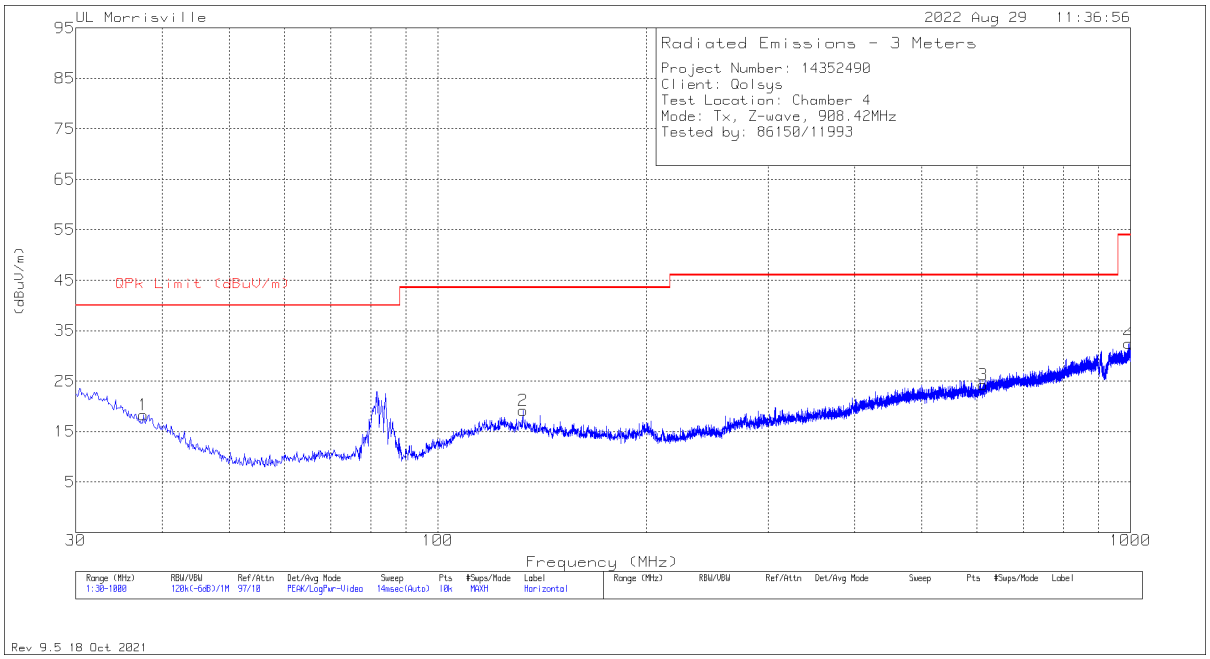
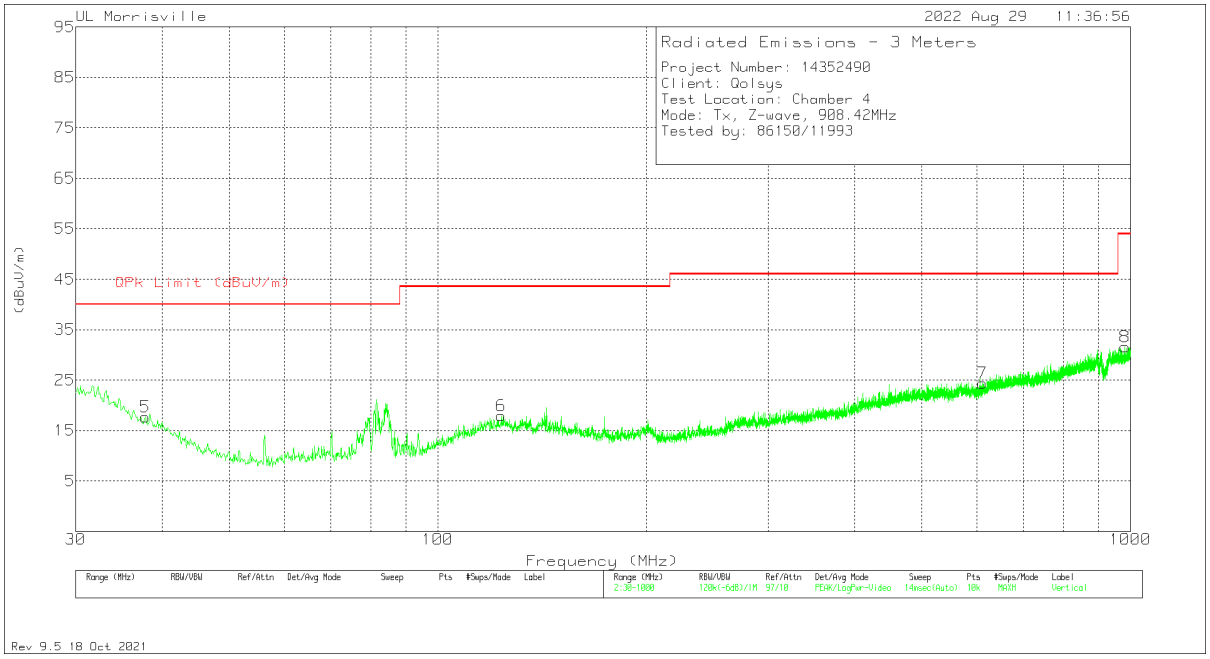
10.2.2. HARMONICS AND SPURIOUS EMISSIONS BELOW 1 GHz

LOW CHANNEL, 908.42 MHz RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0081 (dB/m)	Gain/Loss (dB)	Filter (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
6	* ** 123.508	27.82	Pk	20.2	-30.5	.4	0	17.92	43.52	-25.6	0-360	100	V
2	* ** 132.723	29.33	Pk	19.9	-30.4	.4	0	19.23	43.52	-24.29	0-360	200	H
1	* ** 37.566	28.07	Pk	21.8	-31.7	.1	0	18.27	40	-21.73	0-360	100	H
5	* ** 37.76	27.72	Pk	21.7	-31.8	.1	0	17.72	40	-22.28	0-360	100	V
7	* ** 611.03	25.95	Pk	25.4	-27.7	.7	0	24.35	46.02	-21.67	0-360	100	V
3	* ** 612.194	25.78	Pk	25.4	-27.6	.7	0	24.28	46.02	-21.74	0-360	100	H
8	* ** 982.346	25.27	Pk	29.6	-24.2	.9	0	31.57	53.97	-22.4	0-360	200	V
4	* ** 994.762	25.67	Pk	29.9	-24.1	1	0	32.47	53.97	-21.5	0-360	100	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector

UL LLC
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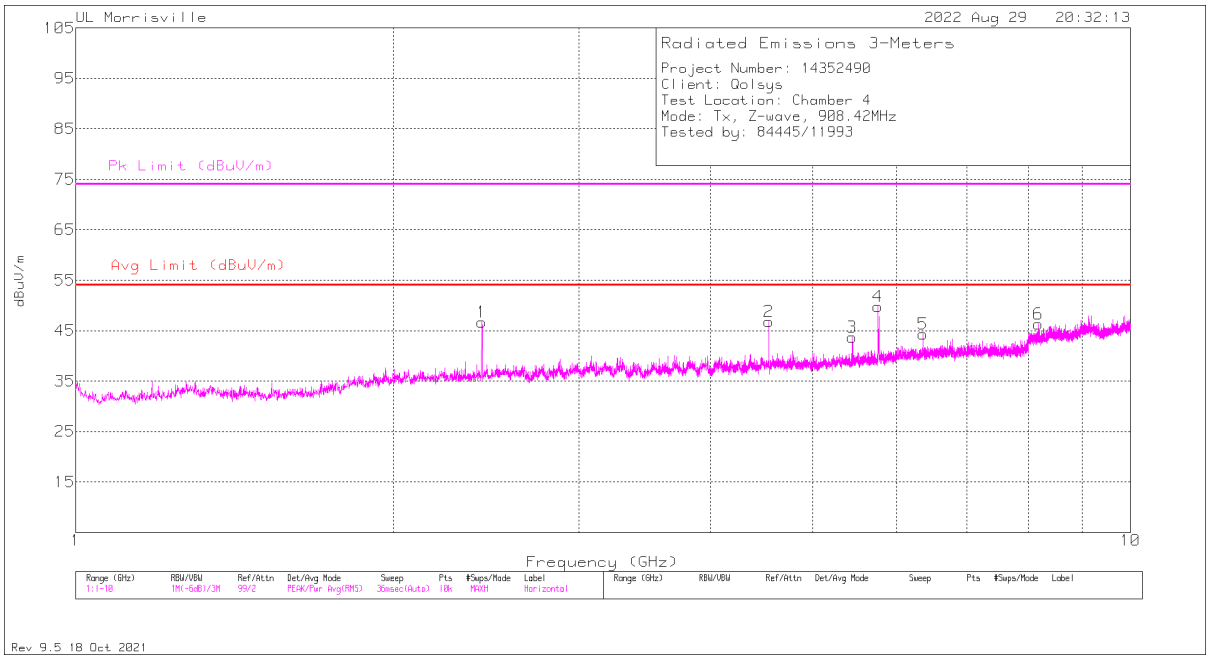
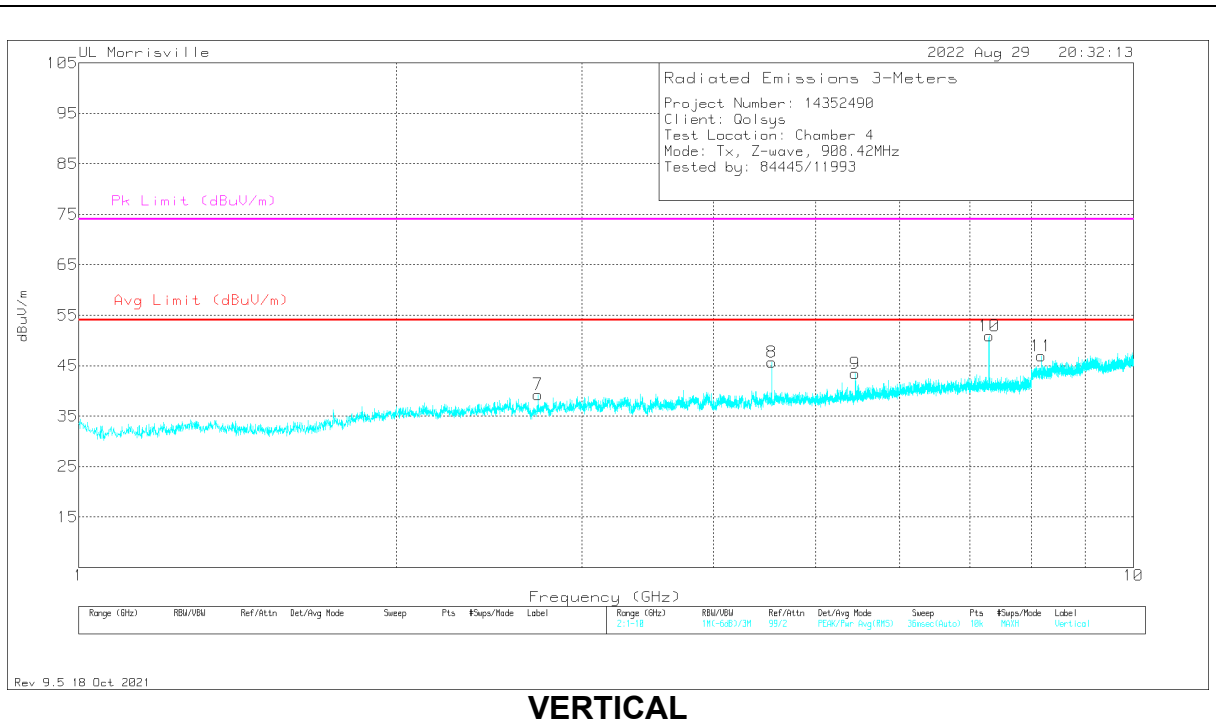
10.2.3. HARMONICS AND SPURIOUS EMISSIONS ABOVE 1 GHz

LOW CHANNEL, 908.42 MHz RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Gain/Loss (dB)	Filter (dB)	Corrected Reading dBuV/m	Avg Limit (dBuV/m)	Margin (dB)	Pk Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* ** 4.5424	44.95	Pk	34	-32.3	.2	46.85	54	-7.15	74	-27.15	0-360	200	H
3	* ** 5.4505	40.68	Pk	34.6	-31.9	.3	43.68	54	-10.32	74	-30.32	0-360	100	H
6	* ** 8.1757	38.29	Pk	35.7	-28	.3	46.29	54	-7.71	74	-27.71	0-360	200	H
7	* ** 2.7253	42.59	Pk	32.3	-36	.4	39.29	54	-14.71	74	-34.71	0-360	200	V
8	* ** 4.5424	43.79	Pk	34	-32.3	.2	45.69	54	-8.31	74	-28.31	0-360	200	V
9	* ** 5.4505	40.4	Pk	34.6	-31.9	.3	43.4	54	-10.6	74	-30.6	0-360	300	V
10	* ** 7.2951	46.78	PK2	35.7	-28.8	.4	54.08	-	-	74	-19.92	348	272	V
	* ** 7.29454	25.75	ADV	35.7	-28.8	.4	33.05	54	-20.95	-	-	348	272	V
11	* ** 8.1757	38.94	Pk	35.7	-28	.3	46.94	54	-7.06	74	-27.06	0-360	200	V
1	2.4265	50.26	Pk	32.3	-36.3	.4	46.66	-	-	-	-	0-360	200	H
4	5.7646	45.7	Pk	34.8	-31.1	.4	49.8	-	-	-	-	0-360	200	H
5	6.3595	37.86	Pk	35.5	-29.4	.4	44.36	-	-	-	-	0-360	100	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
PK2 - Maximum Peak
ADV - Linear Voltage Average

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10.3. FUNDAMENTAL AND SPURIOUS EMISSIONS

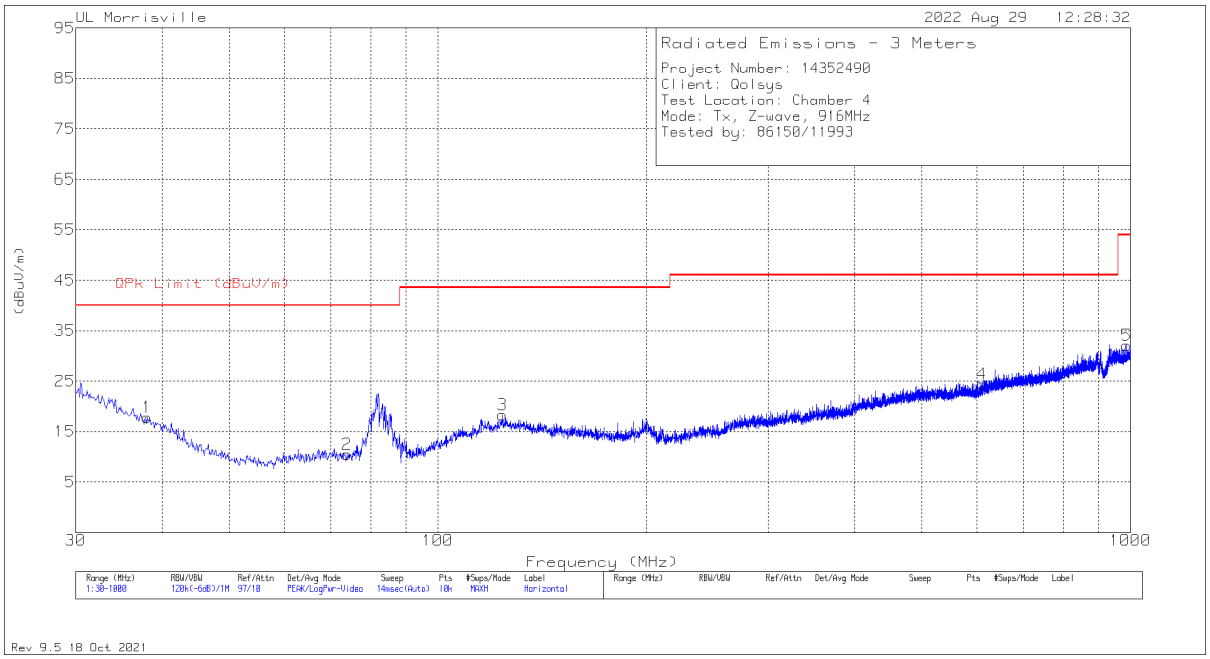
10.3.1. FUNDAMENTAL (916 MHz)

Frequency (MHz)	Meter Reading (dBuV)	Det	AT0081 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Qp Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
915.971	78.31	Pk	29	-25.4	81.91	94	-12.09	339	120	V
916.03	78.63	Pk	29	-25.4	82.23	94	-11.77	28	102	H

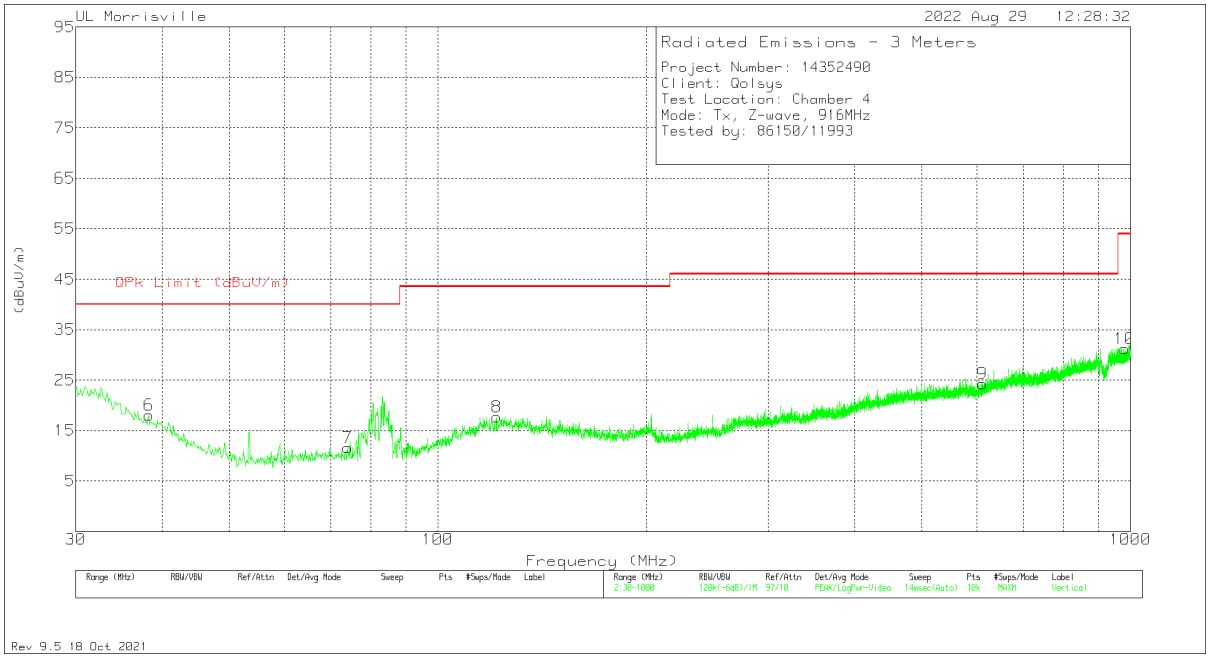
Pk - Peak detector

10.3.2. HARMONICS AND SPURIOUS EMISSIONS BELOW 1 GHz

MID CHANNEL, 916 MHz RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0081 (dB/m)	Gain/Loss (dB)	Filter (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 38.051	27.89	Pk	21.5	-31.7	.1	0	17.79	40	-22.21	0-360	100	H
2	* ** 73.941	26.99	Pk	14.3	-31	.2	0	10.49	40	-29.51	0-360	200	H
3	* ** 123.896	28.22	Pk	20.2	-30.5	.4	0	18.32	43.52	-25.2	0-360	200	H
4	* ** 610.739	26.04	Pk	25.4	-27.8	.7	0	24.34	46.02	-21.68	0-360	100	H
5	* ** 987.584	25.65	Pk	29.7	-24.2	.9	0	32.05	53.97	-21.92	0-360	100	H
6	* ** 38.245	28.36	Pk	21.3	-31.7	.1	0	18.06	40	-21.94	0-360	100	V
7	* ** 74.038	28.12	Pk	14.3	-31	.2	0	11.62	40	-28.38	0-360	100	V
8	* ** 121.568	27.84	Pk	20.1	-30.6	.4	0	17.74	43.52	-25.78	0-360	200	V
9	* ** 611.515	25.8	Pk	25.4	-27.6	.7	0	24.3	46.02	-21.72	0-360	100	V
10	* ** 981.57	24.9	Pk	29.6	-24.2	.9	0	31.2	53.97	-22.77	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

UL LLC
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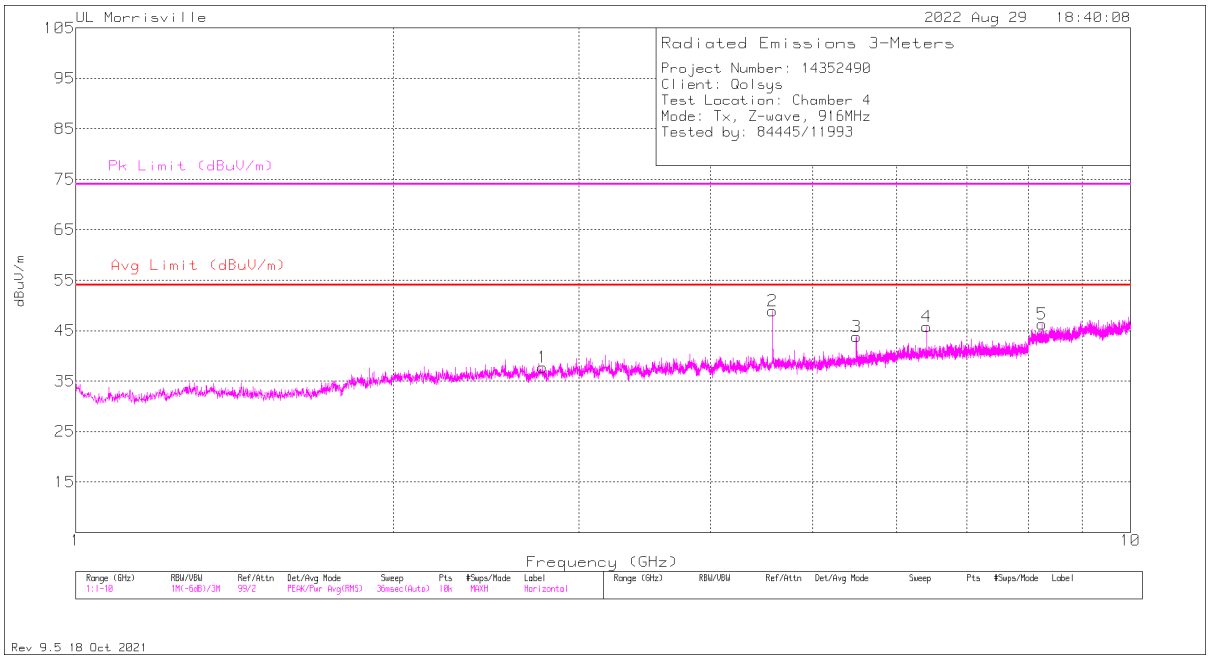
10.3.3. HARMONICS AND SPURIOUS EMISSIONS ABOVE 1 GHz

MID CHANNEL, 916 MHz RESULTS



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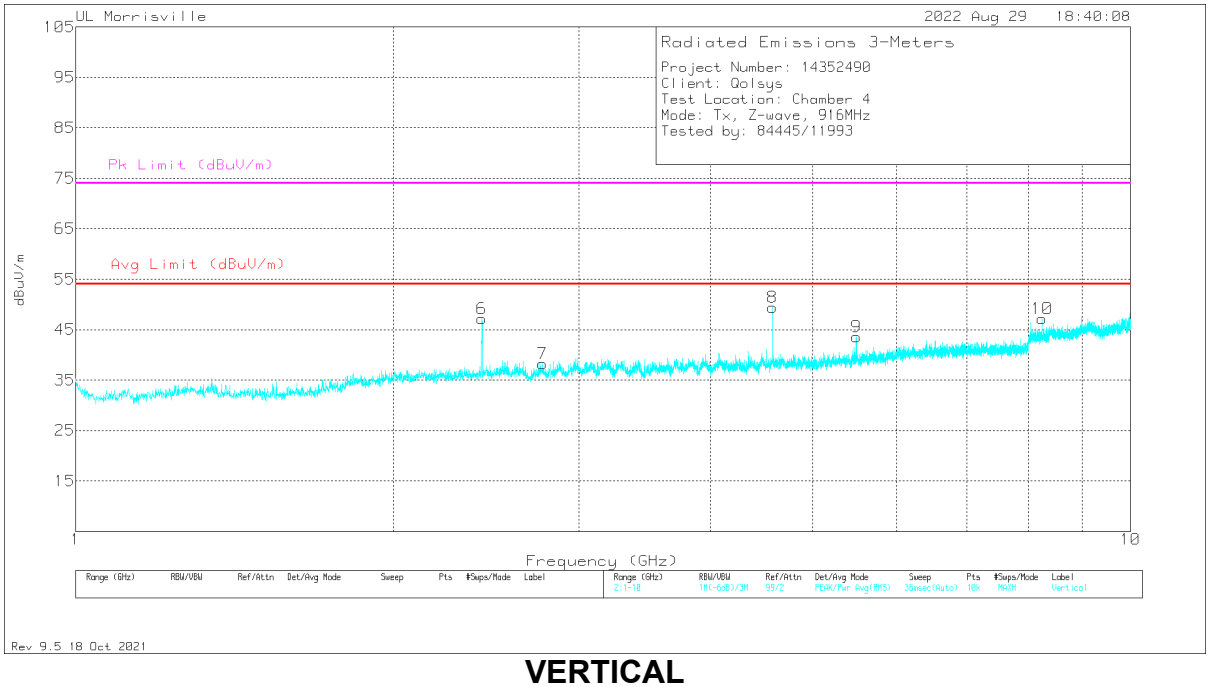

VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Gain/Loss (dB)	Filter (dB)	Corrected Reading dBuV/m	Avg Limit (dBuV/m)	Margin (dB)	Pk Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.7694	40.85	Pk	32.5	-36.1	.5	37.75	54	-16.25	74	-36.25	0-360	100	H
2	* ** 4.58001	50.74	PK2	34.1	-32.4	.2	52.64	-	-	74	-21.36	291	225	H
	* ** 4.58006	47.37	ADV	34.1	-32.4	.2	49.27	54	-4.73	-	-	291	225	H
5	* ** 8.245	38.06	Pk	35.7	-28	.5	46.26	54	-7.74	74	-27.74	0-360	100	H
7	* ** 2.7712	41.25	Pk	32.5	-36	.5	38.25	54	-15.75	74	-35.75	0-360	100	V
8	* ** 4.58017	51.51	PK2	34.1	-32.4	.2	53.41	-	-	74	-20.59	8	100	V
	* ** 4.58	48.45	ADV	34.1	-32.4	.2	50.35	54	-3.65	-	-	8	100	V
10	* ** 8.2441	38.95	Pk	35.7	-28	.5	47.15	54	-6.85	74	-26.85	0-360	100	V
6	2.4274	50.8	Pk	32.3	-36.3	.4	47.2	-	-	-	-	0-360	100	V
3	5.4964	40.79	Pk	34.6	-31.9	.3	43.79	-	-	-	-	0-360	200	H
9	5.4964	40.59	Pk	34.6	-31.9	.3	43.59	-	-	-	-	0-360	100	V
4	6.4117	39.8	Pk	35.6	-29.9	.3	45.8	-	-	-	-	0-360	200	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
PK2 - Maximum Peak
ADV - Linear Voltage Average

10.4. FUNDAMENTAL AND SPURIOUS EMISSIONS

10.4.1. FUNDAMENTAL (919.8 MHz)

Frequency (MHz)	Meter Reading (dBuV)	Det	AT0081 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Qp Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
919.772	77.53	Pk	28.9	-25.1	81.33	94	-12.67	339	118	V
919.829	77.98	Pk	28.9	-25.1	81.78	94	-12.22	35	102	H

Pk - Peak detector
Av - Average detection

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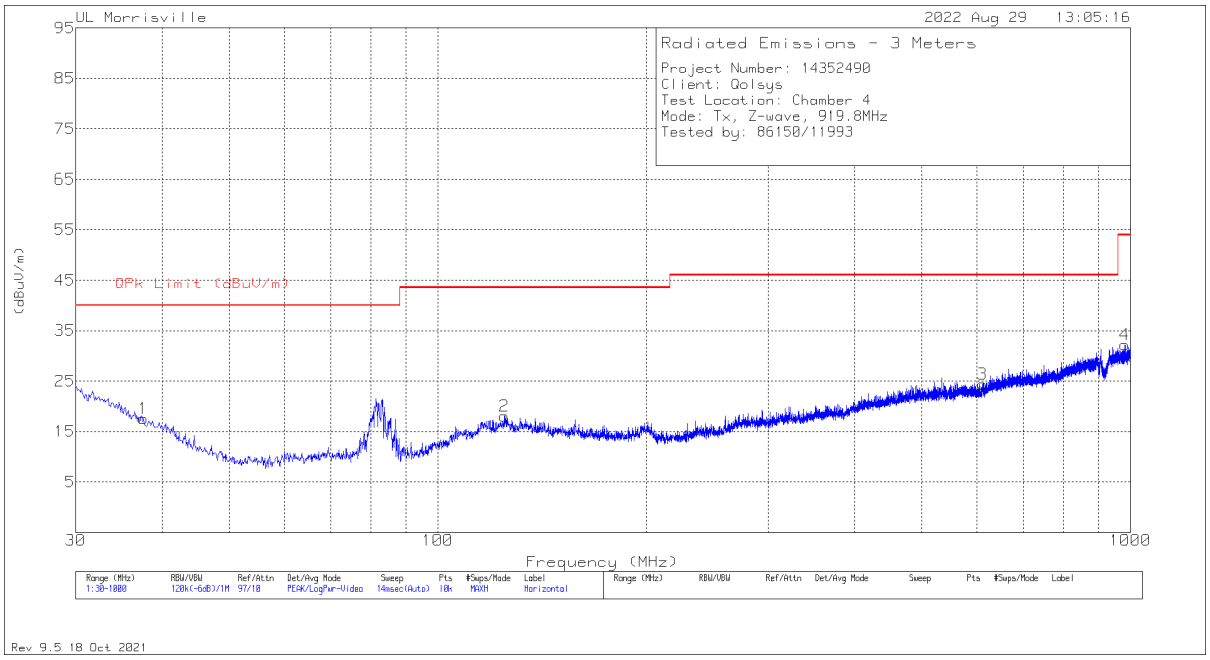
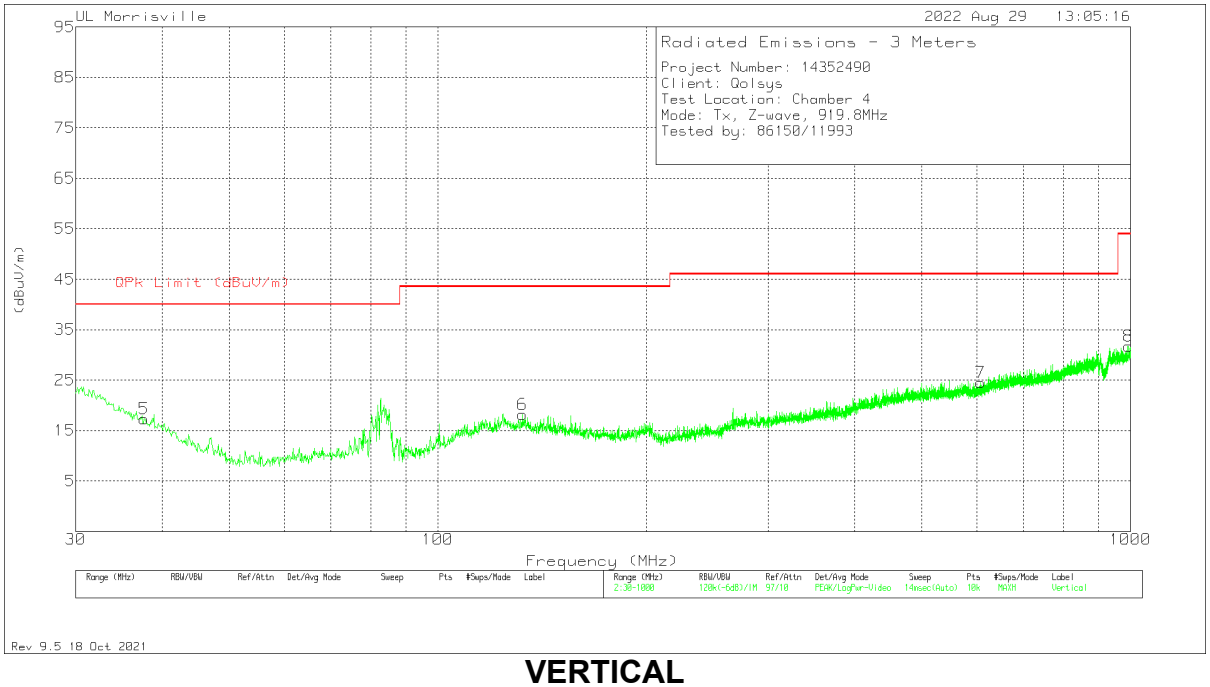
10.4.2. HARMONICS AND SPURIOUS EMISSIONS BELOW 1 GHz

MID CHANNEL, 919.8 MHz RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0081 (dB/m)	Gain/Loss (dB)	Filter (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 37.566	27.32	Pk	21.8	-31.7	.1	0	17.52	40	-22.48	0-360	200	H
2	* ** 124.769	27.91	Pk	20.2	-30.4	.4	0	18.11	43.52	-25.41	0-360	100	H
3	* ** 611.127	25.98	Pk	25.4	-27.7	.7	0	24.38	46.02	-21.64	0-360	200	H
4	* ** 980.6	26.12	Pk	29.6	-24.4	.9	0	32.22	53.97	-21.75	0-360	100	H
5	* ** 37.663	27.27	Pk	21.7	-31.8	.1	0	17.27	40	-22.73	0-360	100	V
6	* ** 132.626	28.25	Pk	19.9	-30.4	.4	0	18.15	43.52	-25.37	0-360	200	V
7	* ** 608.314	26.35	Pk	25.2	-27.7	.7	0	24.55	46.02	-21.47	0-360	200	V
8	* ** 992.919	24.93	Pk	29.9	-24.1	1	0	31.73	53.97	-22.24	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

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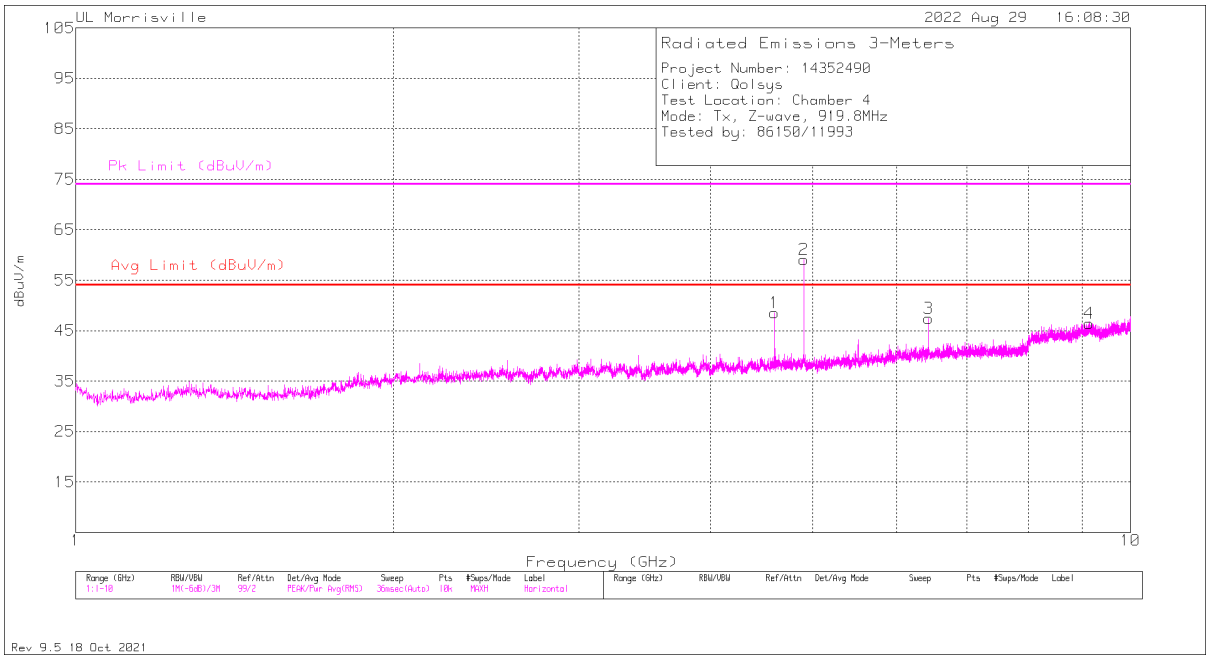
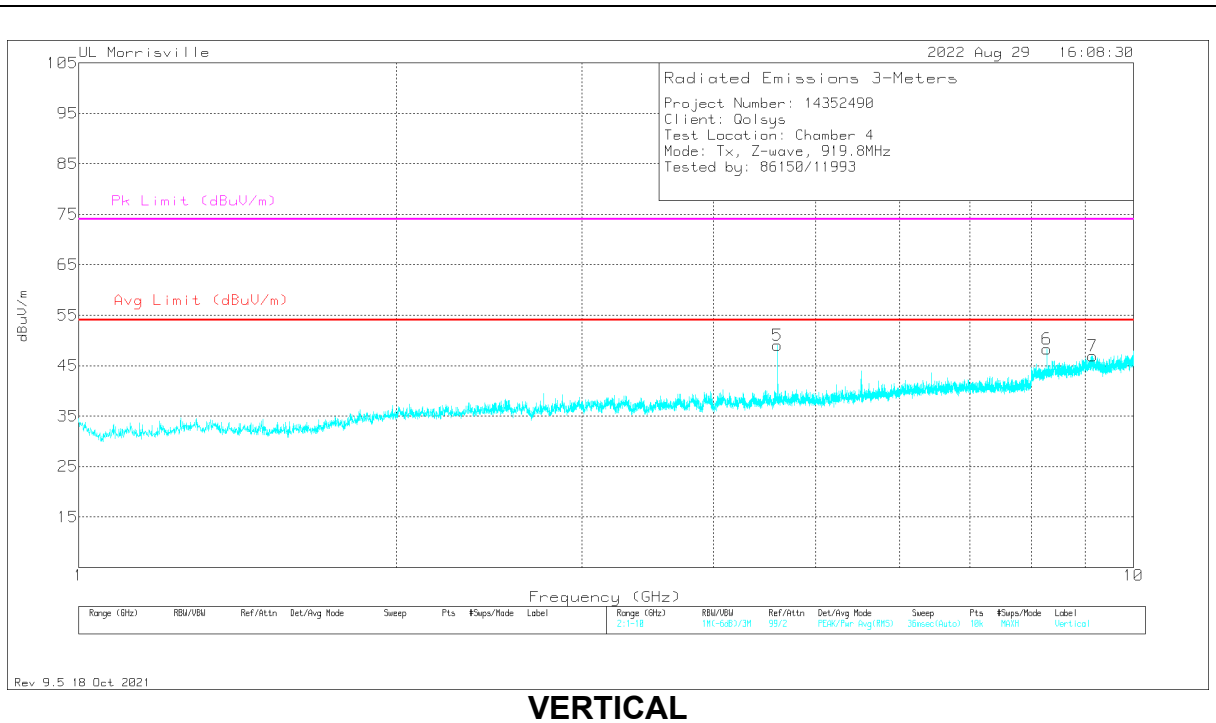
10.4.3. HARMONICS AND SPURIOUS EMISSIONS ABOVE 1 GHz

MID CHANNEL, 919.8 MHz RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Gain/Loss (dB)	Filter (dB)	Corrected Reading dBuV/m	Avg Limit (dBuV/m)	Margin (dB)	Pk Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 4.59888	50.72	PK2	34.1	-32.6	.4	52.62	-	-	74	-21.38	297	310	H
	* ** 4.59902	47.93	ADV	34.1	-32.6	.4	49.83	54	-4.17	-	-	297	310	H
2	* ** 4.904	41.1	PK2	34	-32.2	.4	43.3	-	-	74	-30.7	281	155	H
	* ** 4.90662	28.46	ADV	34	-32.3	.4	30.56	54	-23.44	-	-	281	155	H
4	* ** 9.1342	36.27	Pk	36.2	-26.5	.5	46.47	54	-7.53	74	-27.53	0-360	300	H
5	* ** 4.59896	47.38	PK2	34.1	-32.6	.4	49.28	-	-	74	-24.72	246	175	V
	* ** 4.59904	42.91	ADV	34.1	-32.6	.4	44.81	54	-9.19	-	-	246	175	V
6	* ** 8.27795	40.39	PK2	35.7	-27.7	.4	48.79	-	-	74	-25.21	355	256	V
	* ** 8.27815	31.76	ADV	35.7	-27.7	.4	40.16	54	-13.84	-	-	355	256	V
7	* ** 9.145	36.88	Pk	36.2	-26.5	.4	46.98	54	-7.02	74	-27.02	0-360	400	V
3	6.4387	40.98	Pk	35.6	-29.5	.3	47.38	-	-	-	-	0-360	200	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
PK2 - Maximum Peak
ADV - Linear Voltage Average

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10.5. FUNDAMENTAL AND SPURIOUS EMISSIONS

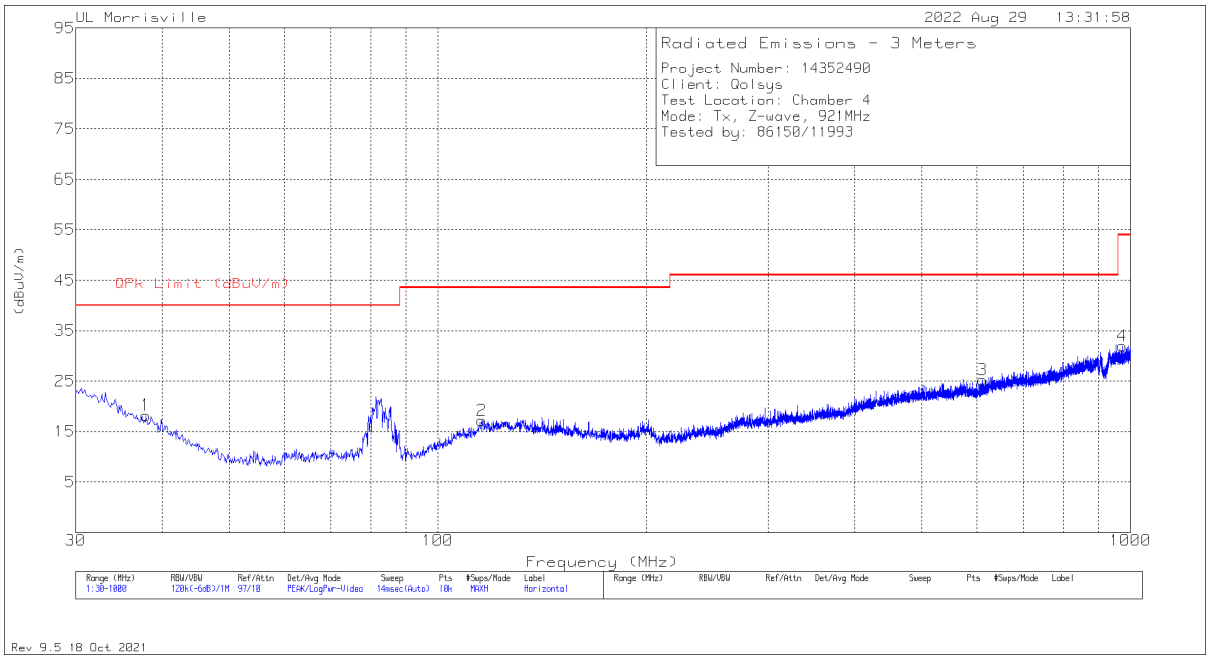
10.5.1. FUNDAMENTAL (921.4 MHz)

Frequency (MHz)	Meter Reading (dBuV)	Det	AT0081 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Qp Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
921.379	77.36	Pk	29	-25.1	81.26	94	-12.74	25	102	H
921.379	77.01	Pk	29	-25.1	80.91	94	-13.09	339	118	V

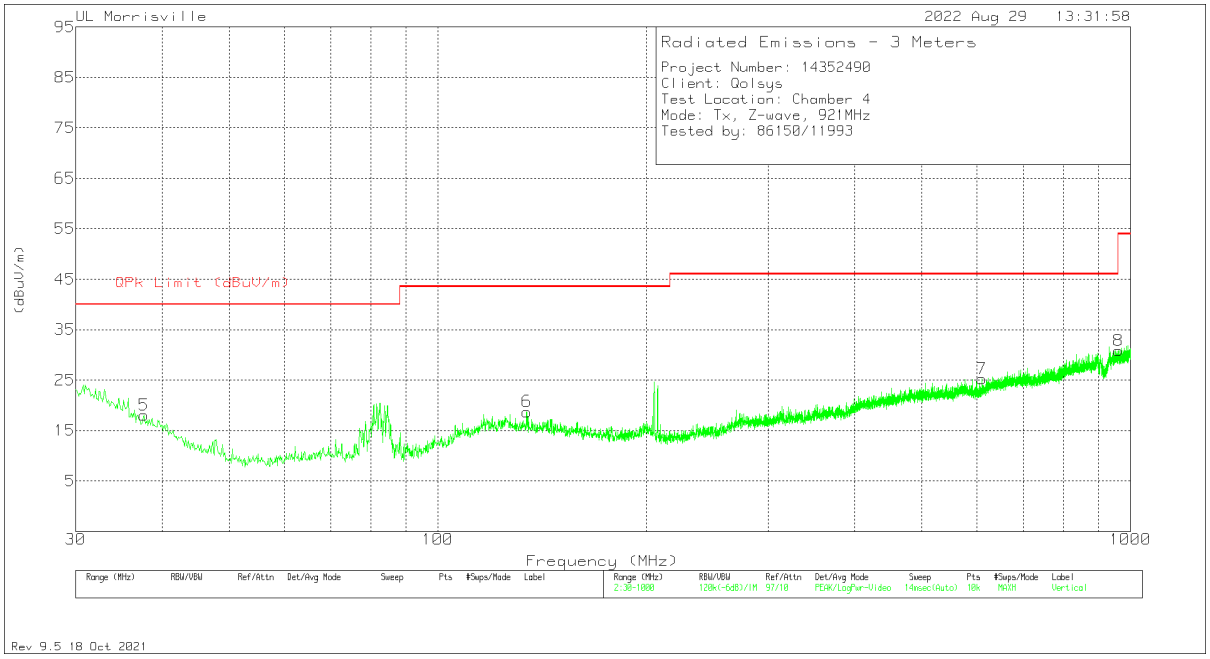
Pk - Peak detector

10.5.2. HARMONICS AND SPURIOUS EMISSIONS BELOW 1 GHz

MID CHANNEL, 921.4 MHz RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0081 (dB/m)	Gain/Loss (dB)	Filter (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 37.857	28.34	Pk	21.6	-31.8	.1	0	18.24	40	-21.76	0-360	100	H
2	* ** 115.651	27.77	Pk	19.6	-30.5	.3	0	17.17	43.52	-26.35	0-360	300	H
3	* ** 611.127	26.83	Pk	25.4	-27.7	.7	0	25.23	46.02	-20.79	0-360	100	H
4	* ** 973.907	25.77	Pk	29.6	-24.4	1	0	31.97	53.97	-22	0-360	300	H
5	* ** 37.663	28.03	Pk	21.7	-31.8	.1	0	18.03	40	-21.97	0-360	100	V
6	* ** 134.372	29.04	Pk	19.8	-30.5	.4	0	18.74	43.52	-24.78	0-360	100	V
7	* ** 610.545	26.92	Pk	25.4	-27.8	.7	0	25.22	46.02	-20.8	0-360	100	V
8	* ** 960.23	24.8	Pk	29.6	-24.5	1	0	30.9	53.97	-23.07	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

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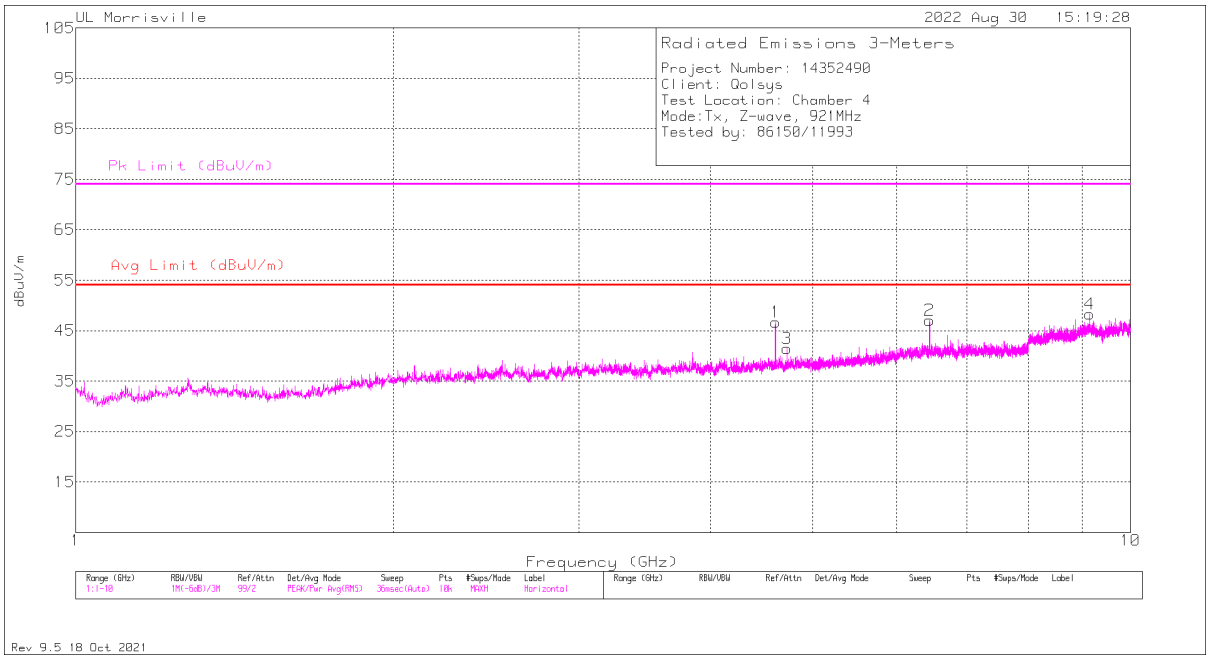
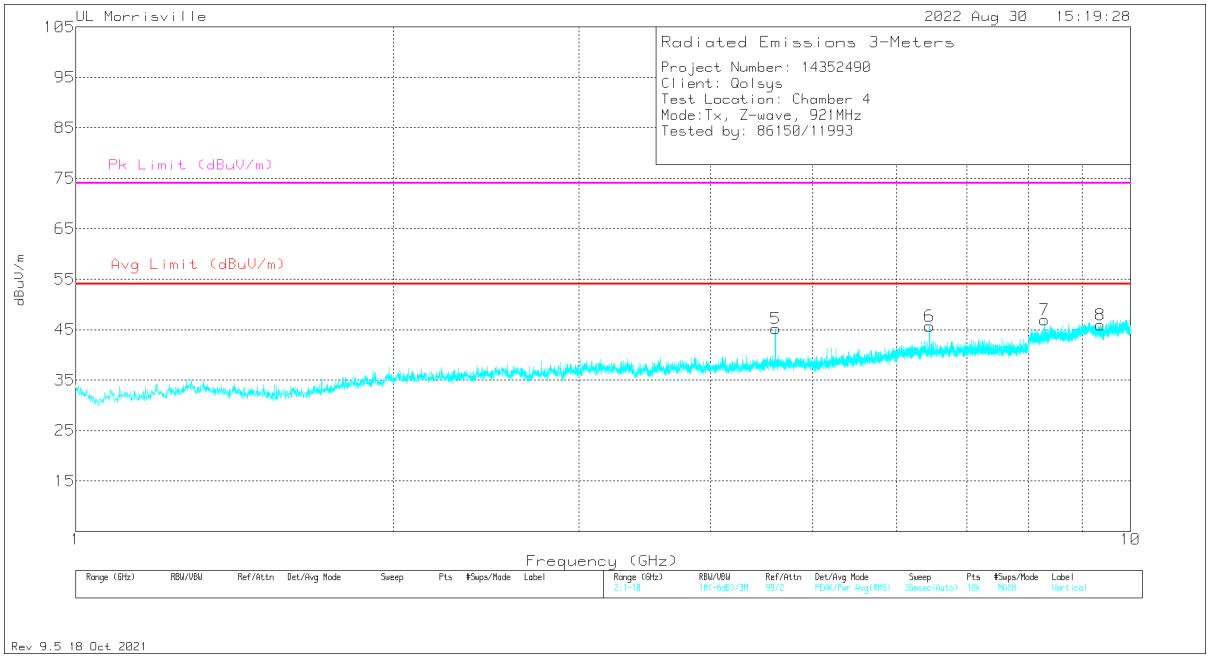
10.5.3. HARMONICS AND SPURIOUS EMISSIONS ABOVE 1 GHz

MID CHANNEL, 921.4 MHz RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Gain/Loss (dB)	Filter (dB)	DC Corr (dB)	Corrected Reading dBuV/m	Avg Limit (dBuV/m)	Margin (dB)	Pk Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 4.6072	44.63	Pk	34.1	-32.4	.3	0	46.63	54	-7.37	74	-27.37	0-360	100	H
3	* ** 4.7251	39.34	Pk	34	-32.2	.3	0	41.44	54	-12.56	74	-32.56	0-360	200	H
4	* ** 9.14733	37.21	PK2	36.2	-26.6	.5	0	47.31	-	-	74	-26.69	344	399	H
	* ** 9.14981	24.94	ADV	36.2	-26.6	.5	0	35.04	54	-18.96	-	-	344	399	H
5	* ** 4.6072	43.17	Pk	34.1	-32.4	.3	0	45.17	54	-8.83	74	-28.83	0-360	200	V
7	* ** 8.2927	38.46	Pk	35.7	-27.7	.5	0	46.96	54	-7.04	74	-27.04	0-360	300	V
8	* ** 9.3673	35.27	Pk	36.4	-26.5	.8	0	45.97	54	-8.03	74	-28.03	0-360	200	V
2	6.4495	40.3	Pk	35.6	-29.4	.6	0	47.1	-	-	-	-	0-360	200	H
6	6.4495	38.94	Pk	35.6	-29.4	.6	0	45.74	-	-	-	-	0-360	400	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
PK2 - Maximum Peak
ADV - Linear Voltage Average

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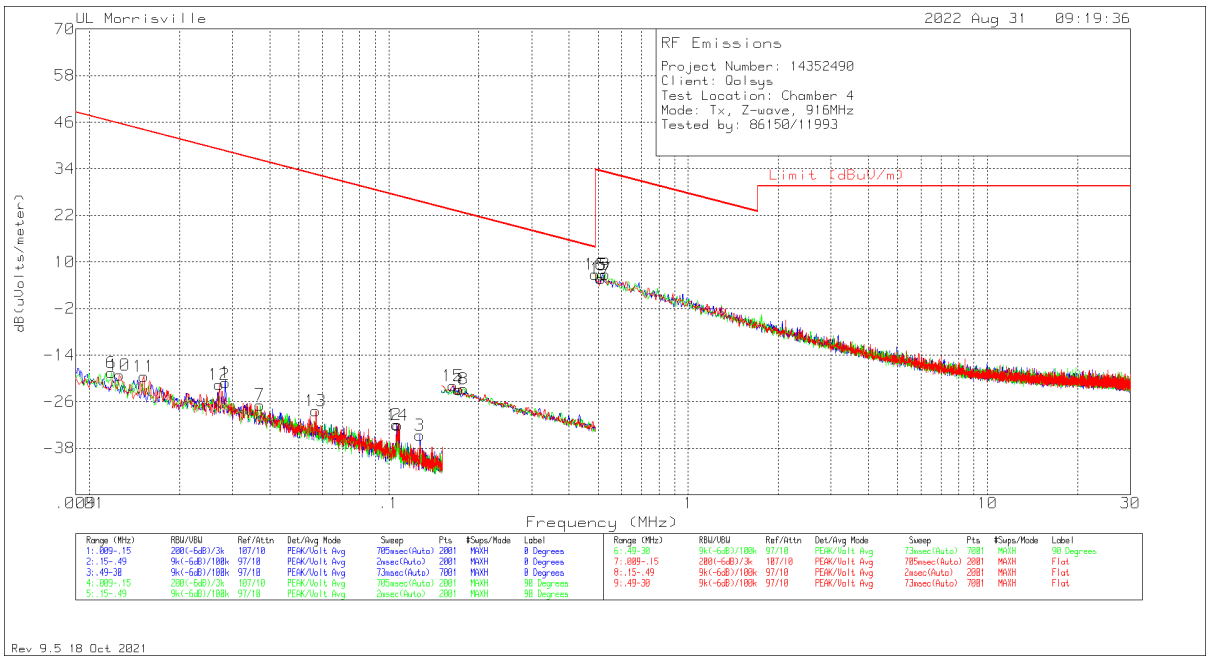
10.6. SPURIOUS EMISSIONS BELOW 30 MHz

WORST-CASE CONFIGURATION

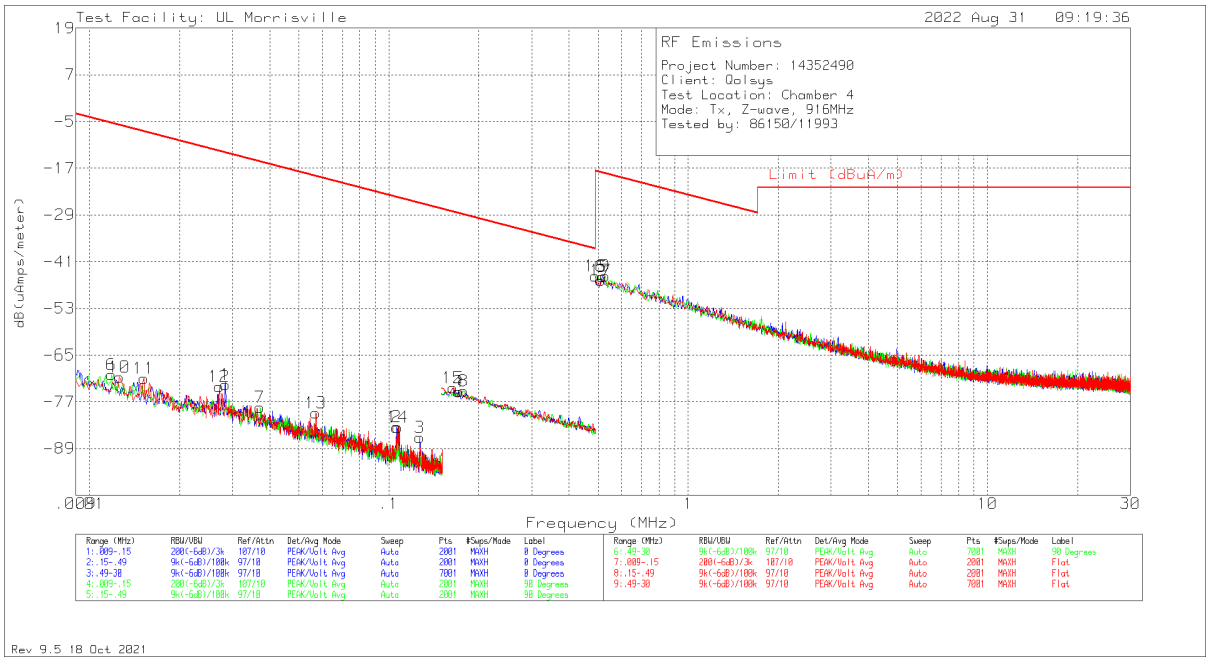
Note for below 30 MHz scans: All measurements were made at a test distance of 3 m. The measured data was extrapolated from the test distance (3m) to the specification distance (300 m from 9-490 kHz and 30 m from 490 kHz – 30 MHz) to clearly show the relative levels of fundamental and spurious emissions 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). Emissions were applied to the QP/AV limits as worst case.



E-Field

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0059 (dB/m)	Gain/Loss (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uVolts/meter)	QP/AV Limit (dBuV/m)	PK Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Loop Angle
6	.01184	43.42	Pk	18	0	-80	-18.58	46.14	66.14	-64.72	0-360	400	90 degs
10	.01262	43.19	Pk	17.6	0	-80	-19.21	45.58	65.58	-64.79	0-360	400	Flat
11	.01518	44.04	Pk	16.4	0	-80	-19.56	43.98	63.98	-63.54	0-360	400	Flat
12	.02718	44.96	Pk	13.5	0	-80	-21.54	38.92	58.92	-60.46	0-360	400	Flat
1	.02853	45.54	Pk	13.4	0	-80	-21.06	38.5	58.5	-59.56	0-360	400	0 degs
7	.03719	40.75	Pk	12.4	0	-80	-26.85	36.2	56.2	-63.05	0-360	400	90 degs
13	.05707	40.38	Pk	11.1	.1	-80	-28.42	32.48	52.48	-60.9	0-360	400	Flat
2	.10634	37.61	Pk	10.3	.1	-80	-31.99	27.07	-	-59.06	0-360	400	0 degs
14	.10726	37.53	Pk	10.3	.1	-80	-32.07	27	-	-59.07	0-360	400	Flat
3	.12686	34.95	Pk	10.3	.1	-80	-34.65	25.54	45.54	-60.19	0-360	400	0 degs
15	.16403	47.79	Pk	10.2	.1	-80	-21.91	23.31	43.31	-45.22	0-360	400	Flat
4	.17108	46.76	Pk	10.2	.1	-80	-22.94	22.94	42.94	-45.88	0-360	400	0 degs
8	.17763	46.98	Pk	10.2	.1	-80	-22.72	22.61	42.61	-45.33	0-360	400	90 degs
16	.49	36.48	Pk	10.2	.1	-40	6.78	13.8	33.80	-7.02	0-360	400	Flat
17	.51108	35.39	Pk	10.2	.1	-40	5.69	33.43	-	-27.74	0-360	400	Flat
5	.5153	36.28	Pk	10.2	.1	-40	6.58	33.36	-	-26.78	0-360	400	0 degs
9	.52794	36.45	Pk	10.2	.1	-40	6.75	33.15	-	-26.4	0-360	400	90 degs

Pk - Peak detector



H-Field

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0059 (dB/m)	Gain/Loss (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uAmps/meter)	QP/AV Limit (dBuA/m)	PK Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Loop Angle
6	.01184	43.42	Pk	-33.5	0	-80	-70.08	-5.36	15.36	-64.72	0-360	400	90 degs
10	.01262	43.19	Pk	-33.9	0	-80	-70.71	-5.92	15.92	-64.79	0-360	400	Flat
11	.01518	44.04	Pk	-35.1	0	-80	-71.06	-7.52	12.48	-63.54	0-360	400	Flat
12	.02718	44.96	Pk	-38	0	-80	-73.04	-12.58	7.42	-60.46	0-360	400	Flat
1	.02853	45.54	Pk	-38.1	0	-80	-72.56	-13	7	-59.56	0-360	400	0 degs
7	.03719	40.75	Pk	-39.1	0	-80	-78.35	-15.3	4.7	-63.05	0-360	400	90 degs
13	.05707	40.38	Pk	-40.4	.1	-80	-79.92	-19.02	0.98	-60.9	0-360	400	Flat
2	.10634	37.61	Pk	-41.2	.1	-80	-83.49	-24.43	-	-59.06	0-360	400	0 degs
14	.10726	37.53	Pk	-41.2	.1	-80	-83.57	-24.5	-	-59.07	0-360	400	Flat
3	.12686	34.95	Pk	-41.2	.1	-80	-86.15	-25.96	-5.96	-60.19	0-360	400	0 degs
15	.16403	47.79	Pk	-41.3	.1	-80	-73.41	-28.19	-8.19	-45.22	0-360	400	Flat
4	.17108	46.76	Pk	-41.3	.1	-80	-74.44	-28.56	-8.56	-45.88	0-360	400	0 degs
8	.17763	46.98	Pk	-41.3	.1	-80	-74.22	-28.89	-8.89	-45.33	0-360	400	90 degs
16	.49	36.48	Pk	-41.3	.1	-40	-44.72	-37.7	-17.70	-7.02	0-360	400	Flat
17	.51108	35.39	Pk	-41.3	.1	-40	-45.81	-18.07	-	-27.74	0-360	400	Flat
5	.5153	36.28	Pk	-41.3	.1	-40	-44.92	-18.14	-	-26.78	0-360	400	0 degs
9	.52794	36.45	Pk	-41.3	.1	-40	-44.75	-18.35	-	-26.4	0-360	400	90 degs

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 EUT is configured in accordance with ANSI C63.10.

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

Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

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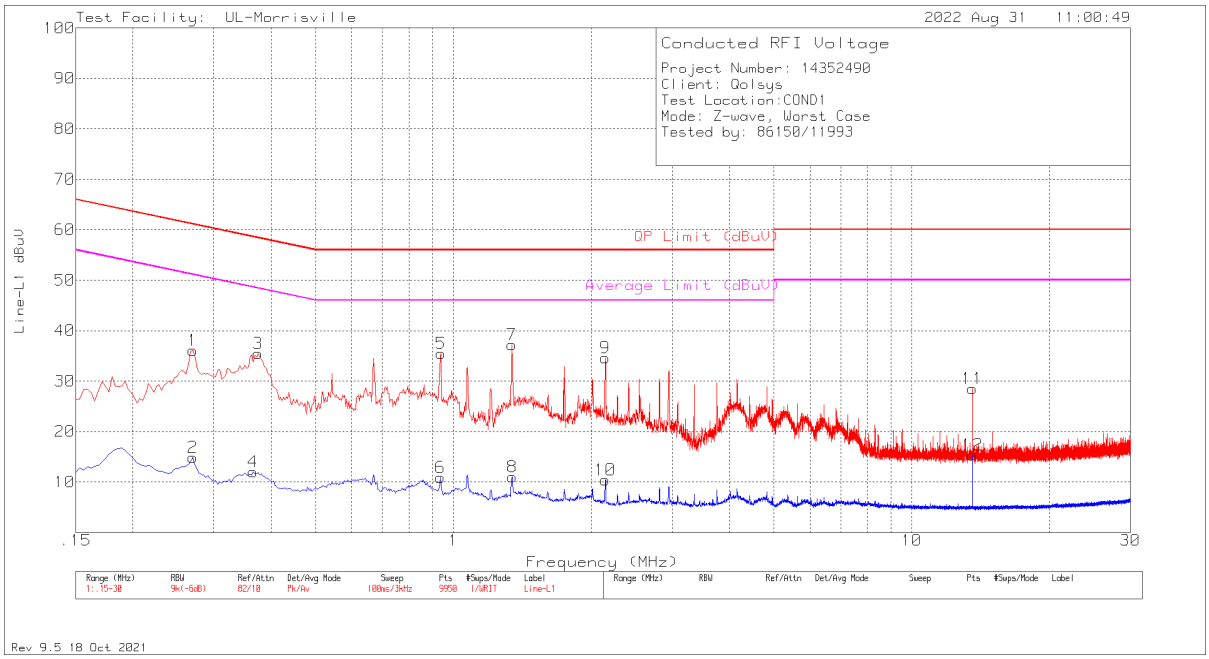
11.1.1. AC Power Line

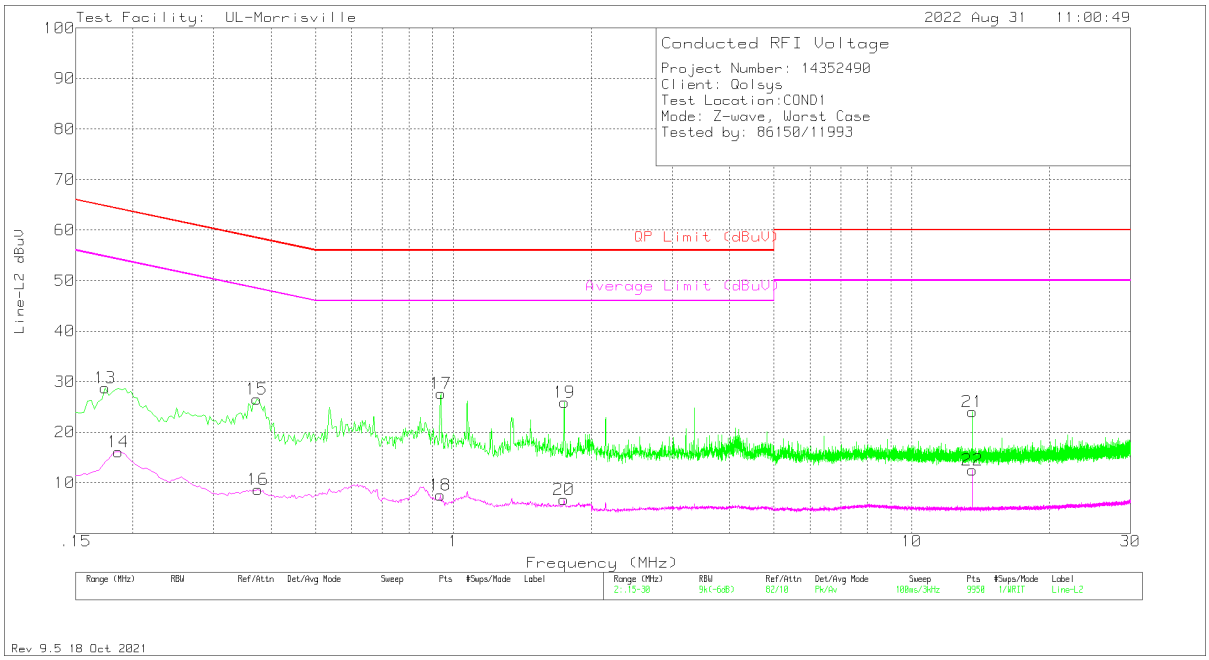
LINE 1 RESULTS



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	.27	26.15	Pk	.1	9.8	36.05	61.12	-25.07	-	-
2	.27	4.96	Av	.1	9.8	14.86	-	-	51.12	-36.26
4	.366	2.12	Av	.1	9.8	12.02	-	-	48.59	-36.57
3	.375	25.57	Pk	.1	9.8	35.47	58.39	-22.92	-	-
6	.936	1.06	Av	0	9.8	10.86	-	-	46	-35.14
5	.939	25.63	Pk	0	9.8	35.43	56	-20.57	-	-
7	1.341	27.4	Pk	0	9.8	37.2	56	-18.8	-	-
8	1.344	1.21	Av	0	9.8	11.01	-	-	46	-34.99
9	2.145	24.78	Pk	0	9.8	34.58	56	-21.42	-	-
10	2.145	.57	Av	0	9.8	10.37	-	-	46	-35.63
11	13.56	18.46	Pk	.1	10	28.56	60	-31.44	-	-
12	13.56	5.27	Av	.1	10	15.37	-	-	50	-34.63

Pk - Peak detector
Av - Average detection

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	.174	18.72	Pk	.2	9.8	28.72	64.77	-36.05	-	-
14	.186	6.15	Av	.2	9.8	16.15	-	-	54.21	-38.06
15	.372	16.63	Pk	.1	9.8	26.53	58.46	-31.93	-	-
16	.375	-1.26	Av	.1	9.8	8.64	-	-	48.39	-39.75
18	.936	-2.27	Av	0	9.8	7.53	-	-	46	-38.47
17	.939	17.87	Pk	0	9.8	27.67	56	-28.33	-	-
20	1.743	-3.08	Av	0	9.8	6.72	-	-	46	-39.28
19	1.746	16.12	Pk	0	9.8	25.92	56	-30.08	-	-
21	13.56	13.92	Pk	.1	10	24.02	60	-35.98	-	-
22	13.56	2.45	Av	.1	10	12.55	-	-	50	-37.45

Pk - Peak detector
Av - Average detection

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12. SETUP PHOTOS

See R14352490-EP1 for Setup Photos.

END OF TEST REPORT