



TEST REPORT

Report Number. : R13916296-E4

Applicant : Ademco Inc.
251 Little Falls Dr.
Wilmington, DE 19808, U.S.A

Model : ADTZWMX

FCC ID : CFS8DLWFZWX

IC : 573F-WFZWX

EUT Description : Radio Module

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

Date Of Issue:

2021-09-27

Prepared by:

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CERT #0751.06

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	2021-09-27	Initial Issue	Niklas Haydon

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Ademco Inc.
251 Little Falls Dr.
Wilmington, DE 19808, U.S.A

EUT DESCRIPTION: WiFi Module

MODEL: ADTZWMX

SERIAL NUMBER: 200-01939V3 REV C

SAMPLE RECEIPT DATE: 2021-08-03

DATE TESTED: 2021-08-09 to 2021-08-27

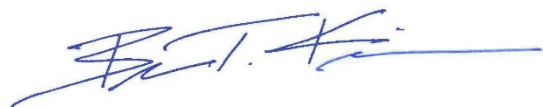
APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C: 2021	Refer to Section 2
ISED RSS-247 Issue 2: 2017	Refer to Section 2
ISED RSS-GEN Issue 5 + A2: 2021	Refer to Section 2

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.

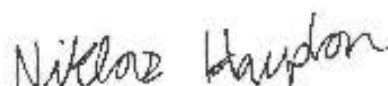
This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document.

Approved & Released For
UL LLC By:



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UL LLC

Prepared By:



Niklas Haydon
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	See note*	None.
15.247 (a) (2)	RSS-247 5.2 (a)	6dB BW		
15.247 (b) (3)	RSS-247 5.4 (d)	Output Power		
See Comment		Average power		
15.247 (e)	RSS-247 5.2 (b)	PSD		
15.247 (d)	RSS-247 5.5	Conducted Spurious Emissions	Complies	None
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions		
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions		

*Note – Radiated testing performed to investigate simultaneous transmission of 2.4GHz WLAN and ZWave radios.

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15: 2021, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 414788 D01 Radiated Test Site v01r01, RSS-GEN Issue 5 + A2: 2021, and RSS-247 Issue 2: 2017.

4. FACILITIES AND ACCREDITATION

UL LLC is accredited 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	703469
<input checked="" type="checkbox"/>	Building: 2800 Perimeter Park Dr. Suite B Morrisville, NC 27560	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	U_{Lab}
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.87 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	6.01 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.73 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.51 dB

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 radio module that supports 2.4 WLAN and Z-Wave. This report covers testing for simultaneous transmission of the 2.4 WLAN and Z-Wave radios.

6.2. MAXIMUM OUTPUT POWER

The transmitter output power was set by the manufacturer. Please refer to manufacturer provided test reports for these values.

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

The antenna(s) gain and type, as provided by the manufacturer' are as follows:

The 2.4 WLAN radio utilizes an two integrated PCB antennas, each with a maximum gain of 3.5 dBi for each and the Z-Wave radio utilizes an integrated PCB antenna with a maximum gain of 3.0dBi.

6.4. SOFTWARE AND FIRMWARE

The EUT software installed during testing was 01.006571-162.

The test utility software used during testing was MicroRF LinkX.

6.5. WORST-CASE CONFIGURATION AND MODE

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to the following modes:

802.11b 2422MHz antenna 1 + Z-Wave 908MHz

802.11b 2422MHz antenna 2 + Z-Wave 908MHz

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

Worst-case data rates as provided by the client were:

802.11b SISO mode: 11 Mbps

6.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	HP	14-dk1003dx	5CG016B3DL	-
Power Supply	Resideo	ADS-25STA-12C	300-11260	-

I/O CABLES

Cable No	Port	# of identical	Connector Type	Cable Type	Cable Length	Remarks
1	1	1	I/O	AC Mains	<3m	None

TEST SETUP

The EUT is installed in a host laptop computer during the tests. Test software exercised the radio card.

SETUP DIAGRAM

Please refer to R13916296-EP2 for setup diagrams.

7. MEASUREMENT METHOD

Duty Cycle: ANSI C63.10-2013 Section 11.6

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

Radiated emissions restricted frequency bands: ANSI C63.10 Subclause -11.12.1

Radiated Spurious Emissions: ANS C63.10-2013 Sections 6.3, 6.5

AC Power Line Conducted Emissions: ANSI C63.10-2013, 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	Model Number	Last Cal.	Next Cal.
	0.009-30MHz				
AT0059	Active Loop Antenna	EMCO	6502	2020-08-06	2021-08-31
	30-1000 MHz				
AT0066	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB1	2021-02-19	2022-02-19
	1-18 GHz				
AT0078	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2020-11-19	2021-11-19
	18-40 GHz				
AT0063	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2020-10-30	2021-10-30
	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 (24 Jun 2021)		
	Additional Equipment used				
s/n 181474341	Environmental Meter	Fisher Scientific	15-077-963	2020-08-06	2021-08-06

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
HI0091	Environmental Meter	Fisher Scientific	15-077-963	2021-07-12	2022-07-12
SA0025	Spectrum Analyzer	Keysight Technologies	N9030A	2021-04-01	2022-04-21
SOFTEMI	Antenna Port Software	UL	Version 2021.05.28		

9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

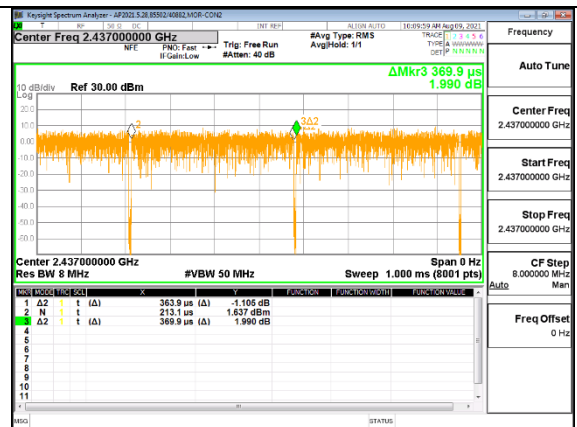
KDB 558074 Zero-Span Spectrum Analyzer Method.
 ANSI C63.10 Section 11.6

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)
802.11b	1.778	1.784	0.997	99.66%	0.00	0.010
802.11g	0.364	0.370	0.984	98.38%	0.00	0.010
802.11n HT20	5.064	5.072	0.998	99.84%	0.00	0.010



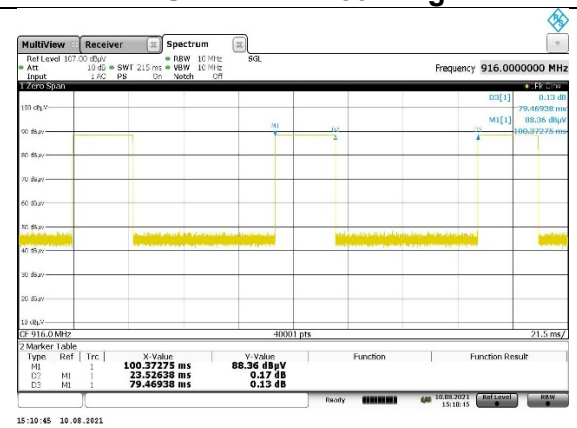
DUTY CYCLE 802.11b



DUTY CYCLE 802.11g



DUTY CYCLE 802.11n HT20



DUTY CYCLE Z-wave, 916 MHz

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

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 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 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.

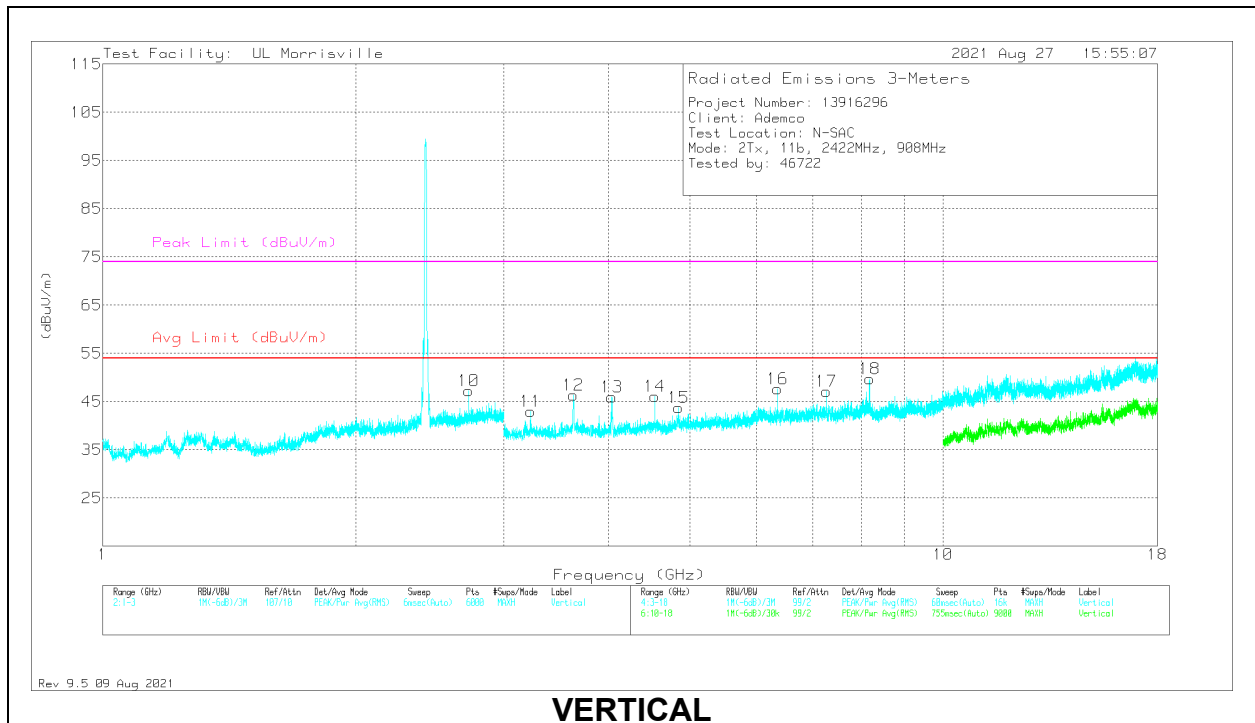
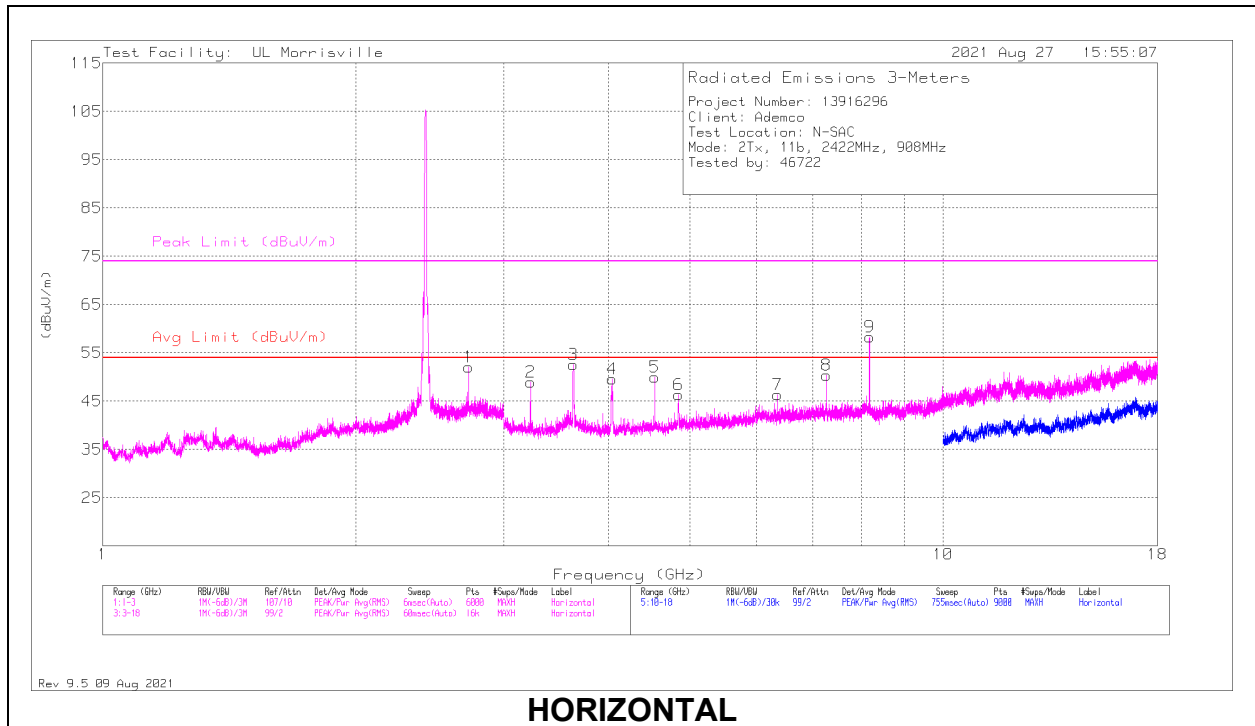
The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

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.

10.1. TRANSMITTER ABOVE 1 GHz

HARMONICS AND SPURIOUS EMISSIONS

2.4 WLAN Antenna 1 + Z-wave

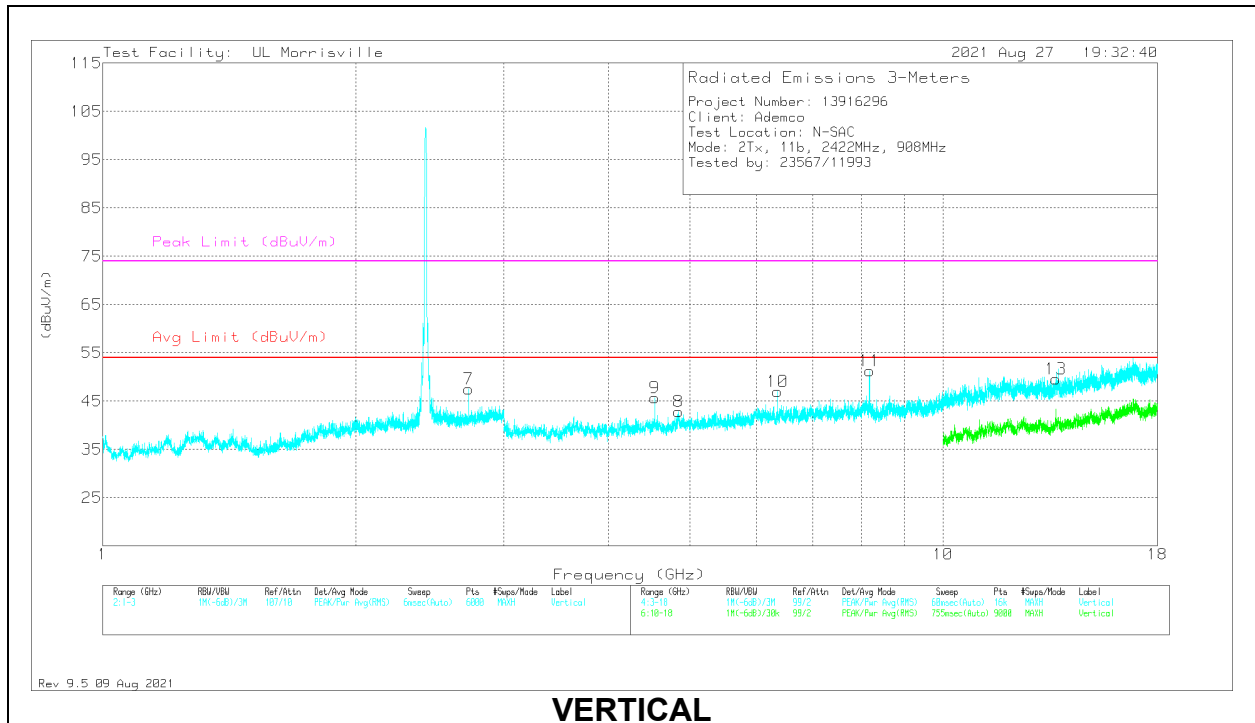
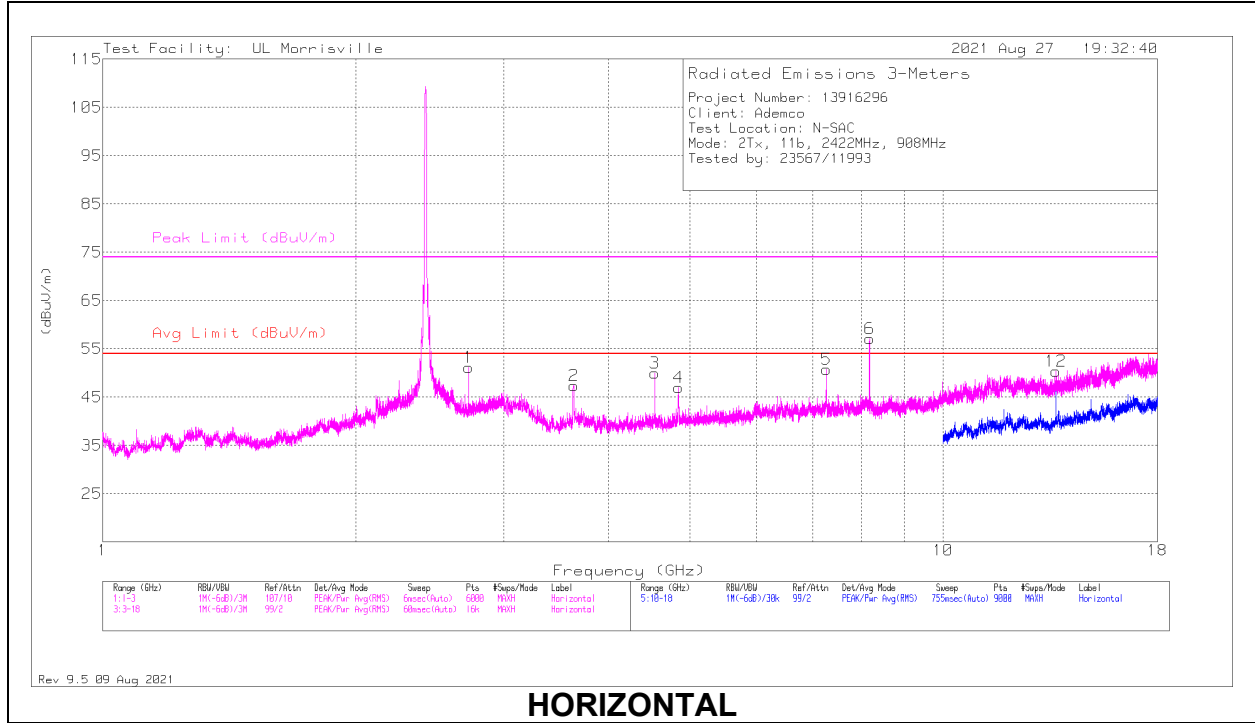


RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0078 (db/m)	Amp/Cbl/Filtr (dB)	Filter (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	*** 3.63113	44	V1TV	33.4	-31.7	0	45.7	54	-8.3	-	-	185	114	H
	*** 3.63288	54.32	PK2	33.4	-31.7	0	56.02	-	-	74	-17.98	185	114	H
12	*** 3.63371	40.61	V1TV	33.4	-31.7	0	42.31	54	-11.69	-	-	253	390	V
	*** 3.63394	52	PK2	33.4	-31.7	0	53.7	-	-	74	-20.3	253	390	V
13	*** 4.03591	37.04	V1TV	33.2	-32.3	0	37.94	54	-16.06	-	-	240	380	V
	*** 4.03665	50.23	PK2	33.2	-32.3	0	51.13	-	-	74	-22.87	240	380	V
4	*** 4.03668	52.12	PK2	33.2	-32.3	0	53.02	-	-	74	-20.98	189	132	H
	*** 4.03922	39.14	V1TV	33.2	-32.3	0	40.04	54	-13.96	-	-	189	132	H
5	*** 4.54226	50.5	PK2	34	-31.9	0	52.6	-	-	74	-21.4	356	112	H
	*** 4.54209	42.54	V1TV	34	-31.9	0	44.64	54	-9.36	-	-	356	112	H
14	*** 4.54226	48.06	PK2	34	-31.9	0	50.16	-	-	74	-23.84	309	344	V
	*** 4.5421	40.37	V1TV	34	-31.9	0	42.47	54	-11.53	-	-	309	344	V
15	*** 4.84403	47.26	PK2	34.1	-31	0	50.36	-	-	74	-23.64	278	364	V
	*** 4.84338	30.46	V1TV	34.1	-31	0	33.56	54	-20.44	-	-	278	364	V
6	*** 4.84399	46.8	PK2	34.1	-31	0	49.9	-	-	74	-24.1	19	104	H
	*** 4.84344	30.63	V1TV	34.1	-31	0	33.73	54	-20.27	-	-	19	104	H
17	*** 7.26745	45.52	PK2	35.7	-29	0	52.22	-	-	74	-21.78	263	274	V
	*** 7.26737	36.93	V1TV	35.7	-29	0	43.63	54	-10.37	-	-	263	274	V
8	*** 7.26746	46.27	PK2	35.7	-29	0	52.97	-	-	74	-21.03	104	181	H
	*** 7.26738	37.61	V1TV	35.7	-29	0	44.31	54	-9.69	-	-	104	181	H
9	*** 8.17553	52.86	PK2	35.9	-28.8	0	59.96	-	-	74	-14.04	191	148	H
	*** 8.17579	44.69	V1TV	35.9	-28.8	0	51.79	54	-2.21	-	-	191	148	H
18	*** 8.17572	47.83	PK2	35.9	-28.8	0	54.93	-	-	74	-19.07	330	249	V
	*** 8.17577	39.84	V1TV	35.9	-28.8	0	46.94	54	-7.06	-	-	330	249	V
1	*** 2.72536	45.5	PK2	32.5	-24	.5	54.5	-	-	74	-19.5	175	135	H
	*** 2.72526	37.39	V1TV	32.5	-24	.5	46.39	54	-7.61	-	-	175	135	H
10	*** 2.72509	40.25	PK2	32.5	-24.1	.5	49.15	-	-	74	-24.85	149	176	V
	*** 2.72526	31.77	V1TV	32.5	-24	.5	40.77	54	-13.23	-	-	149	176	V
2	3.22875	48.78	Pk	32.9	-32.7	0	48.98	-	-	-	-	0-360	101	H
11	3.22875	42.74	Pk	32.9	-32.7	0	42.94	-	-	-	-	0-360	101	V
16	6.35813	41.78	Pk	35.6	-29.7	0	47.68	-	-	-	-	0-360	101	V
7	6.35906	40.49	Pk	35.6	-29.7	0	46.39	-	-	-	-	0-360	101	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
 ** - indicates frequency in Taiwan NCC LP0002 Restricted Band
 PK2 - Maximum Peak
 V1TV - VB=1/Ton, Linear Voltage Average where: Ton is packet duration
 Pk - Peak detector

2.4 WLAN Antenna 1 + Z-wave



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0078 (db/m)	Amp/Cbl/Fitr (dB)	Filter (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
9	* ** 4.5421	41.76	V1TV	34	-31.9	0	43.86	54	-10.14	-	-	0	378	H
	* ** 4.54215	49.77	PK2	34	-31.9	0	51.87	-	-	74	-22.13	0	378	H
5	* ** 7.26722	48.24	PK2	35.7	-29	0	54.94	-	-	74	-19.06	108	168	H
	* ** 7.26735	38.93	V1TV	35.7	-29	0	45.63	54	-8.37	-	-	108	168	H
6	* ** 8.17565	52.17	PK2	35.9	-28.8	0	59.27	-	-	74	-14.73	188	118	H
	* ** 8.17578	44.21	V1TV	35.9	-28.8	0	51.31	54	-2.69	-	-	188	118	H
11	* ** 8.17582	37.46	V1TV	35.9	-28.8	0	44.56	54	-9.44	-	-	241	373	V
	* ** 8.17599	45.9	PK2	35.9	-28.8	0	53	-	-	74	-21	241	373	V
1	* ** 2.72528	44.33	PK2	32.5	-24	.5	53.33	-	-	74	-20.67	358	117	H
	* ** 2.72523	36.21	V1TV	32.5	-24	.5	45.21	54	-8.79	-	-	358	117	H
2	* ** 3.63469	45.58	Pk	33.4	-31.6	0	47.38	54	-6.62	74	-26.62	0-360	200	H
9	* ** 4.54125	43.64	Pk	34	-31.9	0	45.74	54	-8.26	74	-28.26	0-360	101	V
8	* ** 4.84313	39.7	Pk	34.1	-31	0	42.8	54	-11.2	74	-31.2	0-360	200	V
4	* ** 4.84406	43.93	Pk	34.1	-31	0	47.03	54	-6.97	74	-26.97	0-360	101	H
7	* ** 2.72529	38.57	Pk	32.5	-24	.5	47.57	54	-6.43	74	-26.43	0-360	200	V
12	13.62656	39.18	Pk	38.7	-27.5	0	50.38	-	-	-	-	0-360	101	H
13	13.63313	38.27	Pk	38.7	-27.4	0	49.57	-	-	-	-	0-360	200	V
10	6.35906	41.13	Pk	35.6	-29.7	0	47.03	-	-	-	-	0-360	101	V

11. SETUP PHOTOS

Please refer to R13916296-EP2 for setup photos.

END OF TEST REPORT