



Electromagnetic Compatibility Test Report

Tests Performed on a Archangel Device LLC

Light with Radio Transciever, Model MCR-RF

Radiometrics Document RP-9855A



Product Detail:

FCC ID: 2BCAN-MCR-RF

IC: 31347-MCRRF

Equipment type: Security Device with Transceiver

Test Standards:

US CFR Title 47, Chapter I, FCC Part 15 Subpart C

FCC Part 15 CFR Title 47: 2023

Canada ISSED; RSS-210, Issue 10: 2019 as required for Category I Equipment

IC RSS-GEN Issue 5: 2018

This report concerns: Original Grant for Certification

FCC Part 15.249

Tests Performed For:

Archangel Device LLC

609 Deer Path

Sturtevant, WI 53177

Test Facility:

Radiometrics Midwest Corporation

12 Devonwood Avenue

Romeoville, IL 60446-1349

(815) 293-0772

Test Date(s):

September 13 to 26, 2023

Document RP-9855A Revisions:

Rev.	Issue Date	Revised By
0	October 3, 2023	



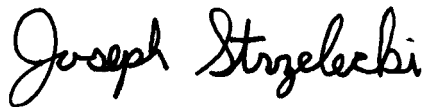
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1.0 ADMINISTRATIVE DATA

<i>Equipment Under Test:</i> A Archangel Device LLC, Light with Radio Model: MCR-RF; Serial Number: RMC1 This will be referred to as the EUT in this Report	
<i>Date EUT Received at Radiometrics:</i> September 12, 2023	<i>Test Date(s):</i> September 13 to 26, 2023
<i>Test Report Written and Authorized By:</i> Joseph Strzelecki Senior EMC Engineer	<i>Test Witnessed By:</i> The tests were not witnessed by personnel from Archangel Device LLC.
<i>Radiometrics' Personnel Responsible for Test:</i>  10/03/2023 Date Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE Chris D'Alessio EMC Technician	<i>EUT Checked By:</i> Joseph Strzelecki Chris D'Alessio Radiometrics

2.0 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a Light with Radio, Model MCR-RF, manufactured by Archangel Device LLC. The detailed test results are presented in a separate section. The following is a summary of the test results.

Emissions Tests Results

Environmental Phenomena	Frequency Range	Basic Standard	Test Result
RF Radiated Emissions	30-25,000 MHz	RSS-210 & FCC Part 15.249	Pass
Conducted Emissions, AC Mains	0.15 - 30 MHz	RSS-210 & FCC Part 15.207	Pass
Occupied Bandwidth Test	Fundamental Freq.	RSS-GEN & FCC Part 15	Pass

IEC 17025 Decision Rule:

The declaration of pass or fail is based on the specifications listed above. The declaration of pass or fail did not consider measurement uncertainty.



2.1 RF Exposure Compliance Requirements

Since the power output is less than 10 mW, the EUT meets the FCC requirement for RF exposure and it is exempt from RSS-102 SAR and RF exposure evaluations. There are no power level adjustments available to the end user. The antenna is permanently attached. The detailed calculations for RF Exposure are presented in a separate document.

3.0 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a Light with Radio, Model MCR-RF, manufactured by Archangel Device LLC. The EUT was in good working condition during the tests, with no known defects.

3.1.1 FCC Section 15.203 & RSS-GEN Antenna Requirements

The antenna is permanently attached to the printed circuit board. The antenna is internal to the EUT and it is not readily available to be modified by the end user. Therefore, it meets the 15.203 Requirements.

Since the measurements at the antenna port are used to determine the RF output power, RSS-GEN section 6.8 requires that the effective gain of the products antenna be stated, based on a measurement or on data from the antenna's manufacturer.

4.0 TESTED SYSTEM DETAILS

4.1 Tested System Configuration

The system was configured for testing in a typical fashion. The EUT was placed on an 80-cm or 150 cm high, nonconductive test stand. The testing was performed in conditions as close as possible to installed conditions. Wiring was consistent with manufacturer's recommendations.

The EUT was tested as a stand-alone device. Power was supplied with a new battery, or via a standard USB charger. The only cable connected to the EUT was a 1.5 meter long, shielded USB charging cable

The identification for all equipment, are:

Tested System Configuration List

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	Light with Radio	E	Archangel Device	MCR-RF	RMC1
2	USB power Supply (USB PS-02)	P	Apple	A1401	LPS 0012ADU00

* Type: E = EUT, P = Peripheral, S = Support Equipment; H = Host Computer

Type of modulation including the bit rate and symbol rate	FSK at 250kB/s
Name and version of the test software used to exercise the device	MicroRF-Test 09122023
Power settings used for the purpose of exercising the device	3 dBm
Firmware number of the transmitter	1.0



4.2 EUT Operating Modes

The transmit mode for all tests was continuous. The continuous mode produces a Duty Cycle of at least 99%.

The EUT was in its normal FSK modulation during the tests. It was tested as a stand-alone battery powered device, since that is the configuration in the final installation.

4.3 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

4.4 Equipment Modifications

No modifications were made to the EUT at Radiometrics' test facility in order to comply with the standards listed in this report.

5.0 TEST SPECIFICATIONS

Document	Date	Title
FCC CFR Title 47	2023	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices
IC RSS-210 Issue 10	2019	Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands) Category I Equipment
IC RSS-Gen Issue 5	2019	General Requirements and Information for the Certification of Radiocommunication Equipment (RSS-Gen)

6.0 TEST PROCEDURE DOCUMENTS

The tests were performed using the procedures from the following specifications:

Document	Date	Title
ANSI C63.4-2014	2014	Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10-2013	2013	American National Standard for Testing Unlicensed Wireless Devices
558074 D01 DTS Meas Guidance	2019	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247; v05r02

7.0 RADIOMETRICS' TEST FACILITIES

The results of these tests were obtained at Radiometrics Midwest Corp. in Romeoville, Illinois, USA. Radiometrics is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025: 2017 "General Requirements for the Competence of Calibration and Testing Laboratories". Radiometrics' Lab Code is 121191 and Certification Number is 1495.01. Radiometrics' scope of accreditation includes all of the test methods listed herein. A copy of the accreditation can be accessed on our web site (www.radiomet.com). Radiometrics accreditation status can be verified at A2LA's web site (www.a2la2.org).

The following is a list of shielded enclosures located in Romeoville, Illinois used during the tests:



Chamber E: Is a custom-made anechoic chamber that measures 52' L X 30' W X 18' H. The walls and ceiling are fully lined with RF absorbers. Pro-shield of Collinsville, Oklahoma manufactured the chamber. The floor has a 9' x 9' section of microwave absorber for testing above 1 GHz.

Test Station F: Is an area that measures 10' D X 12' W X 10' H. The floor and back wall are metal shielded. This area is used for conducted emissions measurements.

A separate ten-foot long, brass plated, steel ground rod attached via a 6-inch copper braid grounds each of the above chambers. Each enclosure is also equipped with low-pass power line filters.

The FCC has accepted these sites as test site number US1065. The FCC test site Registration Number is 732175. Details of the site characteristics are on file with the Industry Canada as site number IC 3124A with a CAB ID of US0224.

A complete list of the test equipment is provided herein. The calibration due dates are indicated on the equipment list. The equipment is calibrated in accordance to ANSI/NCSL Z540-1 with traceability to the National Institute of Standards and Technology (NIST).

8.0 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

9.0 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification and the data contained herein was taken with calibrated test equipment. The results relate only to the EUT listed herein.

10.0 TEST EQUIPMENT TABLE

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
AMP-05	RMC/Celeritek	Pre-amplifier	MW110G	1001	1.0-12GHz	12 Mo.	01/14/23
AMP-20	Avantek	Pre-amplifier	SF8-0652	15221	8-18GHz	12 Mo.	06/02/23
AMP-59	Amplitech	Pre-amplifier	APTMP44	AMP-59	18-26 GHz	12 Mo.	01/10/23
ANT-48	RMC	Std. Gain Horn	HW2020	1001	18-26.5 GHz	24 Mo.	11/23/22
ANT-66	ETS-Lindgren	Horn Antenna	3115	62580	1.0-18GHz	24 Mo.	03/16/23
ANT-68	EMCO	Log-Periodic Ant.	93146	9604-4456	200-1000MHz	24 Mo.	02/07/22
ANT-80	AH Systems	Bicon Antenna	SAS-540	294	20-330MHz	24 Mo.	01/26/23
HPF-01	Solar	High Pass Filter	7930-100	HPF-1	0.15-30MHz	24 Mo.	03/07/22
HPF-06	Mini-Circuits	High Pass Filter	VHF-3800+	31035	3-11 GHz	24 Mo.	05/23/22
LSN-17	EMCO	50 uH LISN	3810/2NM	9602-1356	0.15 - 30MHz	24 Mo.	05/02/23
REC-21	Agilent	Spectrum Analyzer	E7405A	MY45118341	9Hz-26.5 GHz	24 Mo.	02/24/22
REC-31	Agilent	Spectrum Analyzer	E7402A	US41160415	9kHz-3GHz	24 Mo.	06/23/23
REC-44	Agilent	Spectrum Analyzer	E4440A	US40420673	3Hz-26.5GHz	24 Mo.	03/31/22
THM-02	Fluke	Temp/Humid Meter	971	93490471	N/A	24 Mo.	11/22/22

Note: All calibrated equipment is subject to periodic checks.

Software Company	Test Software Name	Version	Applicable Tests
Radiometrics	EN550XX0	07.16.19	RF Conducted Emissions (FCC Part 15 & EN 55032)
Radiometrics	REREC11D	07.16.19	RF Radiated Emissions (FCC Part 15 & EN 55032)
Agilent	PSA/ESA-E/L/EMC	2.4.0.42	Bandwidth and screen shots



11.0 TEST SECTIONS

11.1 AC Conducted Emissions

The tests and limits are in accordance with FCC section 15.207 and RSS Gen section 8.8.

A computer-controlled analyzer was used to perform the conducted emissions measurements. The frequency range was divided into 500 subranges equally spaced on a logarithmic scale. The computer recorded the peak of each subrange. This data was then plotted on a semi-log graph generated by the computer. Adjusting the positions of the cables and orientation of the test system then maximizes the highest emissions.

Mains Conducted emission measurements were performed using a 50 Ohm/50 uH Line Impedance Stabilization Network (LISN) as the pick-up device. Measurements were repeated on both leads within the power cord. If the EUT power cord exceeded 80 cm in length, the excess length of the power cord was made into a 30 to 40 cm bundle near the center of the cord. The LISN was placed on the floor at the base of the test platform and electrically bonded to the ground plane.

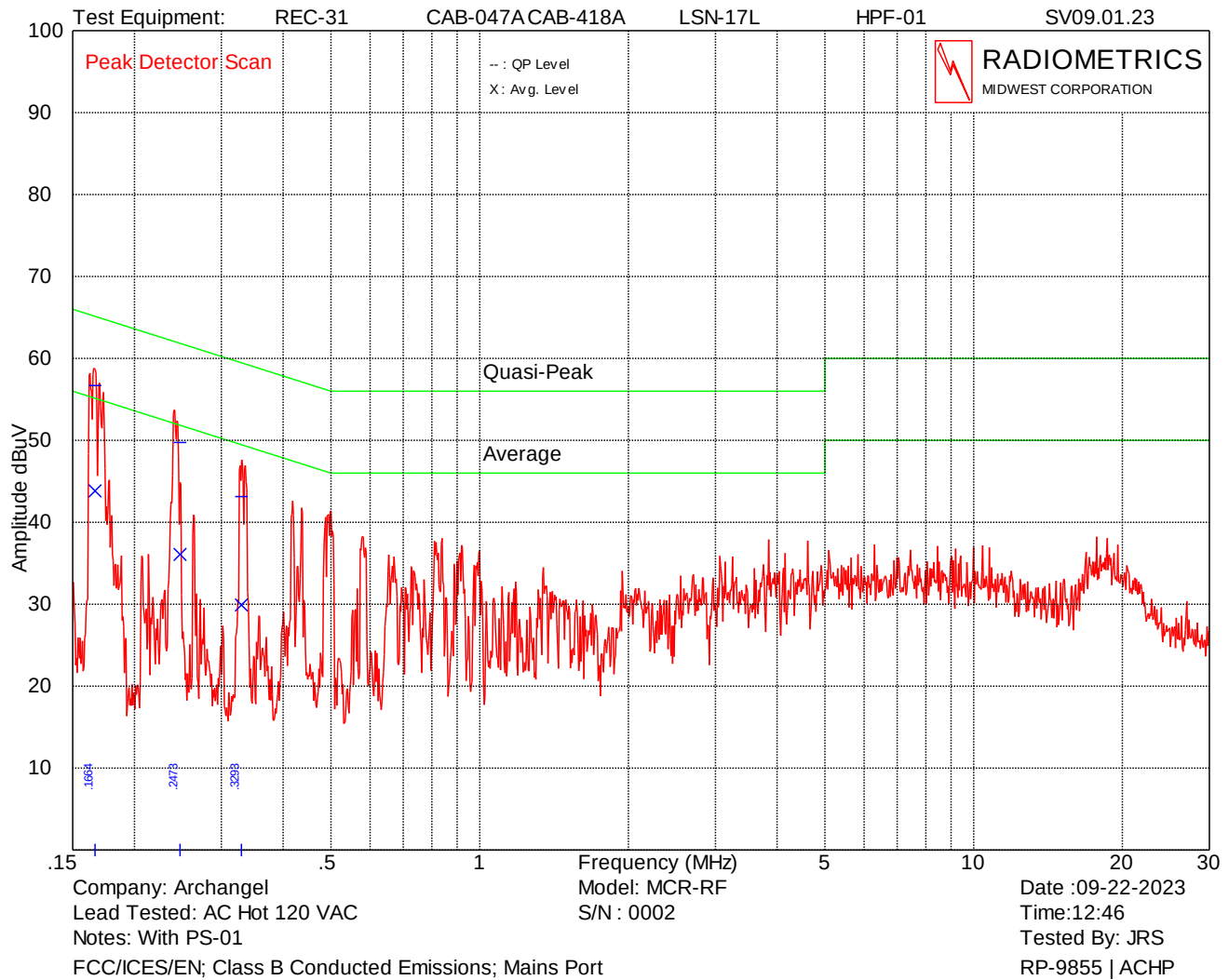
FCC Limits of Conducted Emissions at the AC Mains Ports

Frequency Range (MHz)	Class B Limits (dBuV)	
	Quasi-Peak	Average
0.150 - 0.50*	66 - 56	56 - 46
0.5 – 5.0	56	46
5.0 - 30	60	50
* The limit decreases linearly with the logarithm of the frequency in this range.		

The initial step in collecting conducted data is a peak detector scan and the plotting of the measurement range. Significant peaks are then marked as shown on the following table, and these signals are then measured with the quasi-peak detector. The following represents the worst case emissions from the host computer (with the EUT connected) power cord, after testing all modes of operation.

Test Date : September 13 to 26, 2023

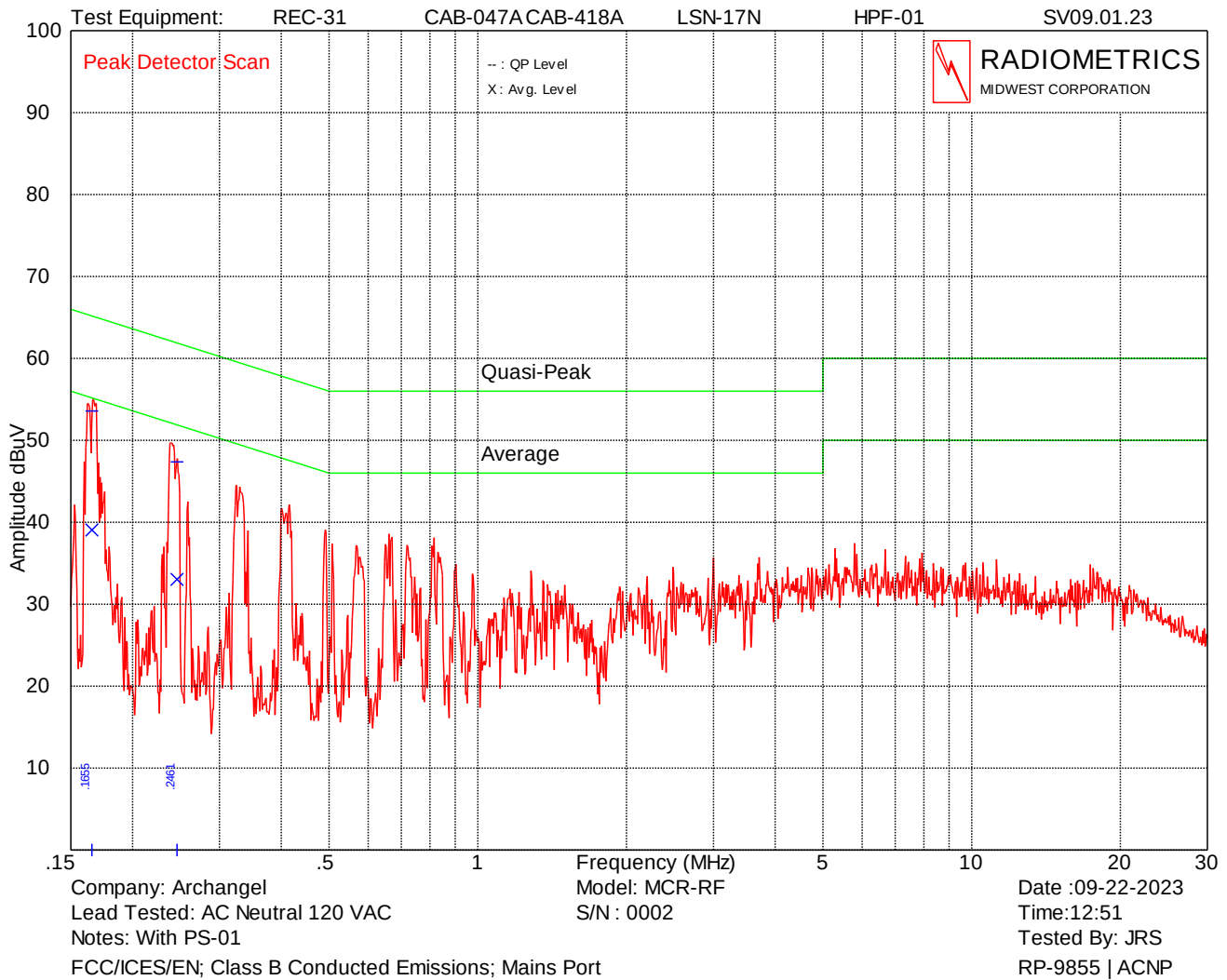
The Amplitude is the final corrected value with cable and LISN Loss.



Frequency (MHz)	QP Amplitude (dBuV)	QP Limit (dBuV)	Average Amplitude (dBuV)	Average Limit (dBuV)	Margin (dB)
0.166	56.7	65.1	43.8	55.1	8.4
0.247	49.7	61.8	36.1	51.8	12.1
0.329	43.1	59.5	29.9	49.5	16.3

The above are the worst case results with three frequencies test for each EUT

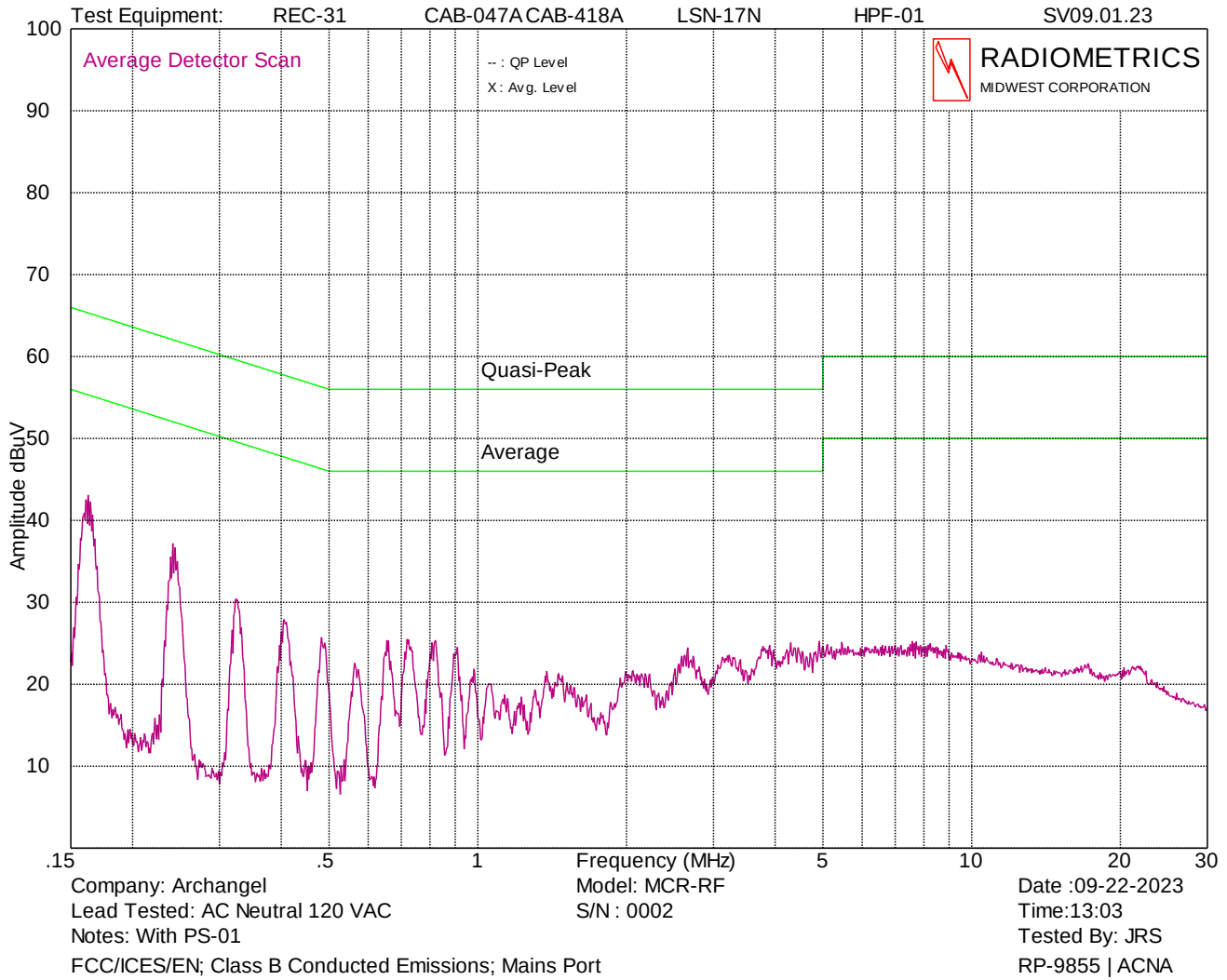
* QP readings are quasi-peak with a 9 kHz bandwidth and no video filter.



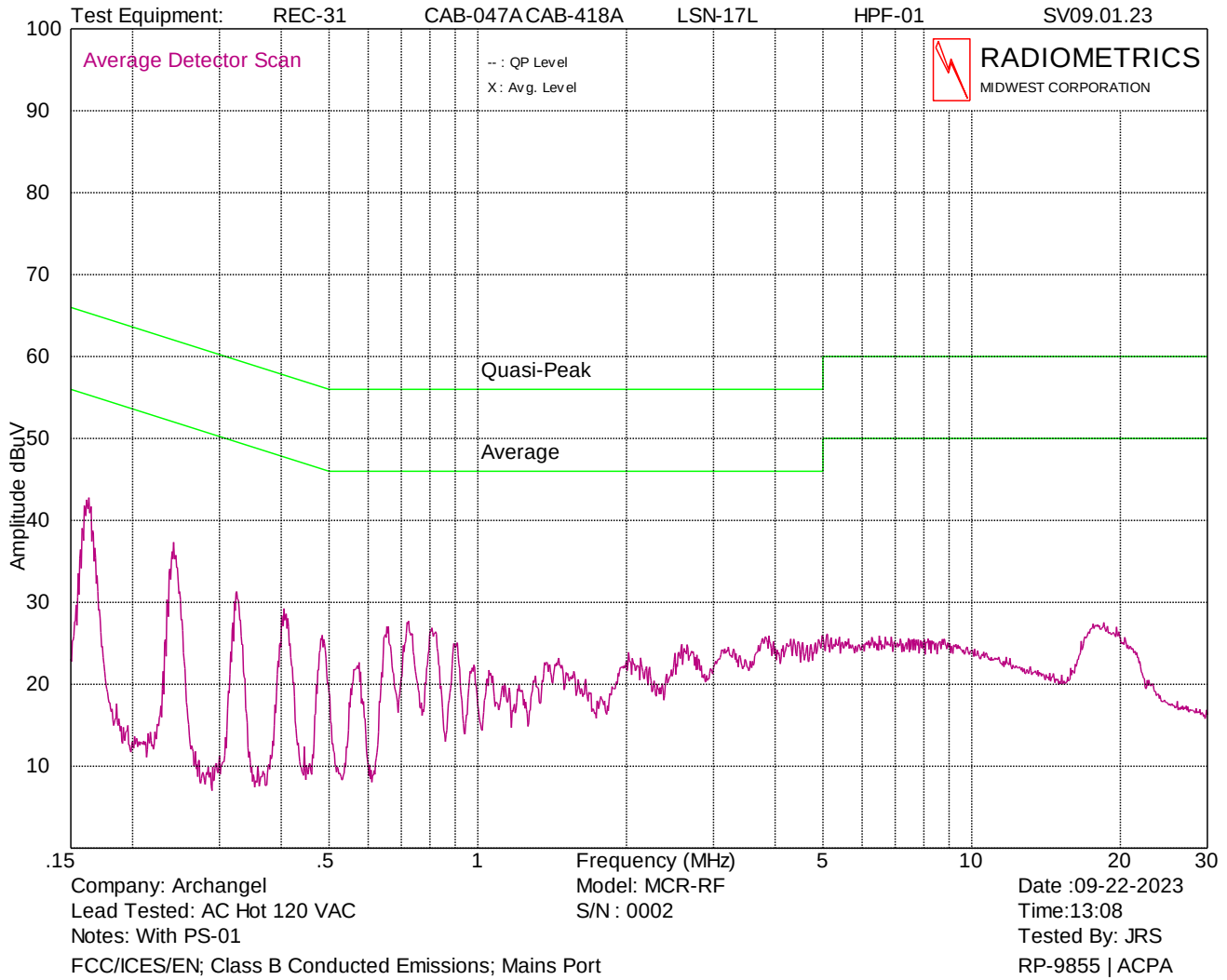
Frequency (MHz)	QP Amplitude (dBuV)	QP Limit (dBuV)	Average Amplitude (dBuV)	Average Limit (dBuV)	Margin (dB)
0.166	53.6	65.2	39.1	55.2	11.6
0.246	47.4	61.9	33.0	51.9	14.5

The above are the worst case results with three frequencies test for each EUT

* QP readings are quasi-peak with a 9 kHz bandwidth and no video filter.

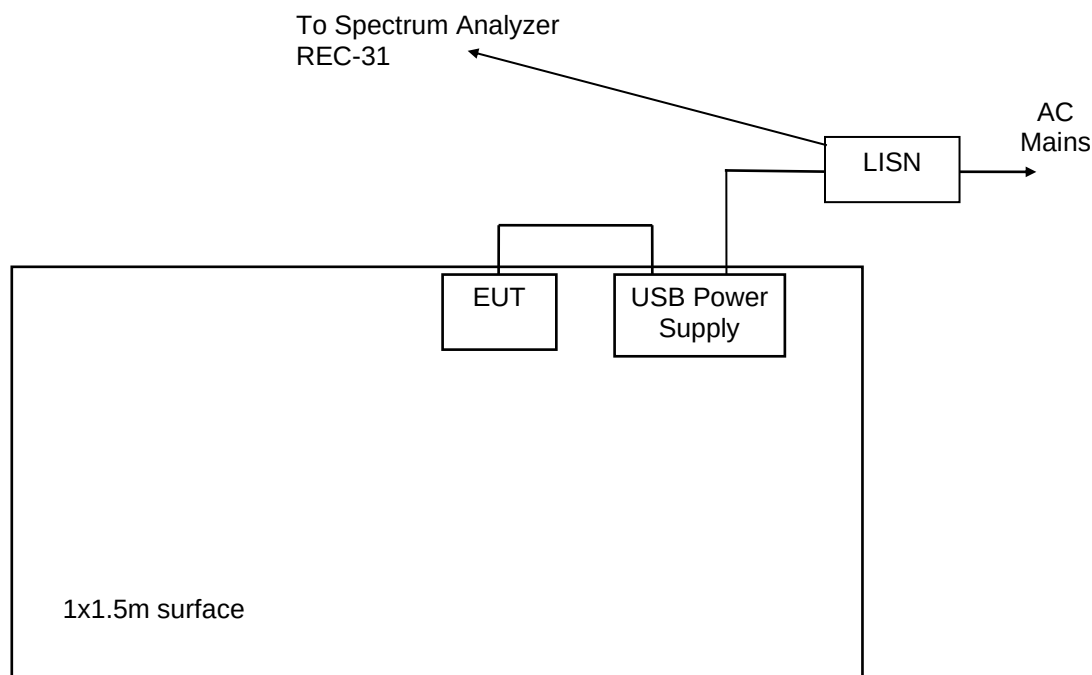


This is a plot with an average detector. It is used to compare to the Average limit only.



This is a plot with an average detector. It is used to compare to the Average limit only.

Judgment: Passed by 8.4 dB

**Figure 1. Conducted Emissions Test Setup****Notes:**

- LISN at least 80 cm from EUT chassis
- Vertical conductive plane 40 cm from rear of table top

11.2 Radiated RF Emissions

Radiated emission measurements were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. The radiated emission measurements were performed with a spectrum analyzer. The bandwidth used from 150 kHz to 30 MHz is 9 or 10 kHz and the bandwidth from 30 MHz to 1000 MHz is 100 or 120 kHz. Above 1 GHz, a 1 MHz bandwidth is used. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists. Figure 4 herein lists the details of the test equipment used during radiated emissions tests.

In addition, a high pass filter was used to reduce the fundamental emission. High pass filters were not needed above 10 GHz, since the preamplifiers attenuated the fundamental emission.

The EUT was rotated through three orthogonal axis as per 5.10.1 of ANSI C63.10 during the radiated tests.

Final radiated emissions measurements were performed inside of an anechoic chamber at a test distance of 3 meters. The anechoic chamber is designated as Chamber E. This Chamber meets the Site Attenuation requirements of ANSI C63.4. Chamber E is located at 12 Devonwood Ave. Romeoville, Illinois EMI test lab.



The entire frequency range from 30 to 25000 MHz was slowly scanned. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst case emissions were recorded. All measurements may be performed using either the peak, average or quasi-peak detector functions. If the peak detector data exceeds or is marginally close to the limits, the measurements are repeated using a quasi-peak detector or average function as required by the specification for final determination of compliance. The QP and average detectors have a linear response.

The detected emission levels were maximized by rotating the EUT, adjusting the positions of all cables, and by scanning the measurement antenna from 1 to 4 meters above the ground.

Radiated Emissions Field Strength Limits

Frequency Range (MHz)	Test Distance (meters)	Non-Fundamental Limits	
		uV/m	dB(uV/m)
30 - 88	3	100	40.0
88 - 216	3	150	43.5
216 - 960	3	200	46.0
Above 960	3	500	54.0

The emission limits shown in the above table are based on measurements using a CISPR quasi-peak detector below 1 GHz. Above 1 GHz, the radiated emission limits are based on measurements employing an average detector. Above 1 GHz peak emissions shall not be more than 20 dB above the average limits.

The fundamental limit is 94 dBuV/m for Average and 114 dBuV/m for Peak detection.

11.2.1 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

$$FS = RA + AF + CF - AG + HPF + PKA$$

Where: FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

HPF = High pass Filter Loss

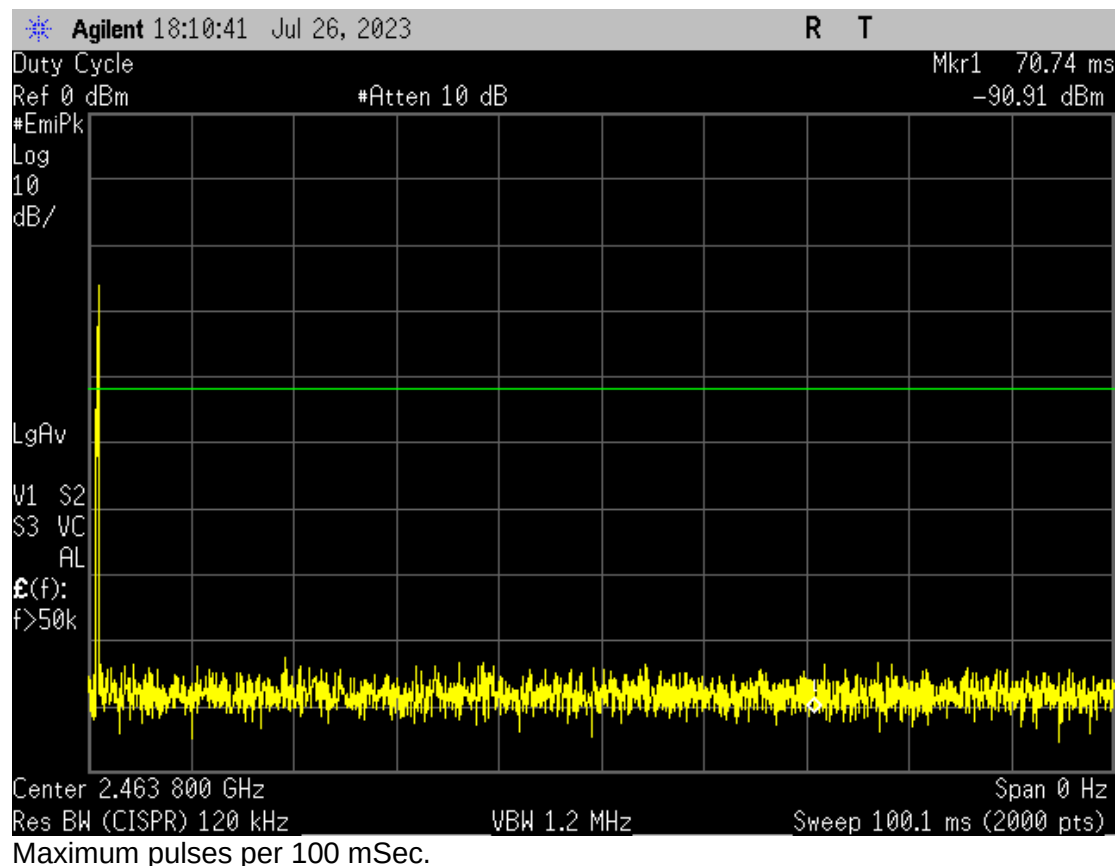
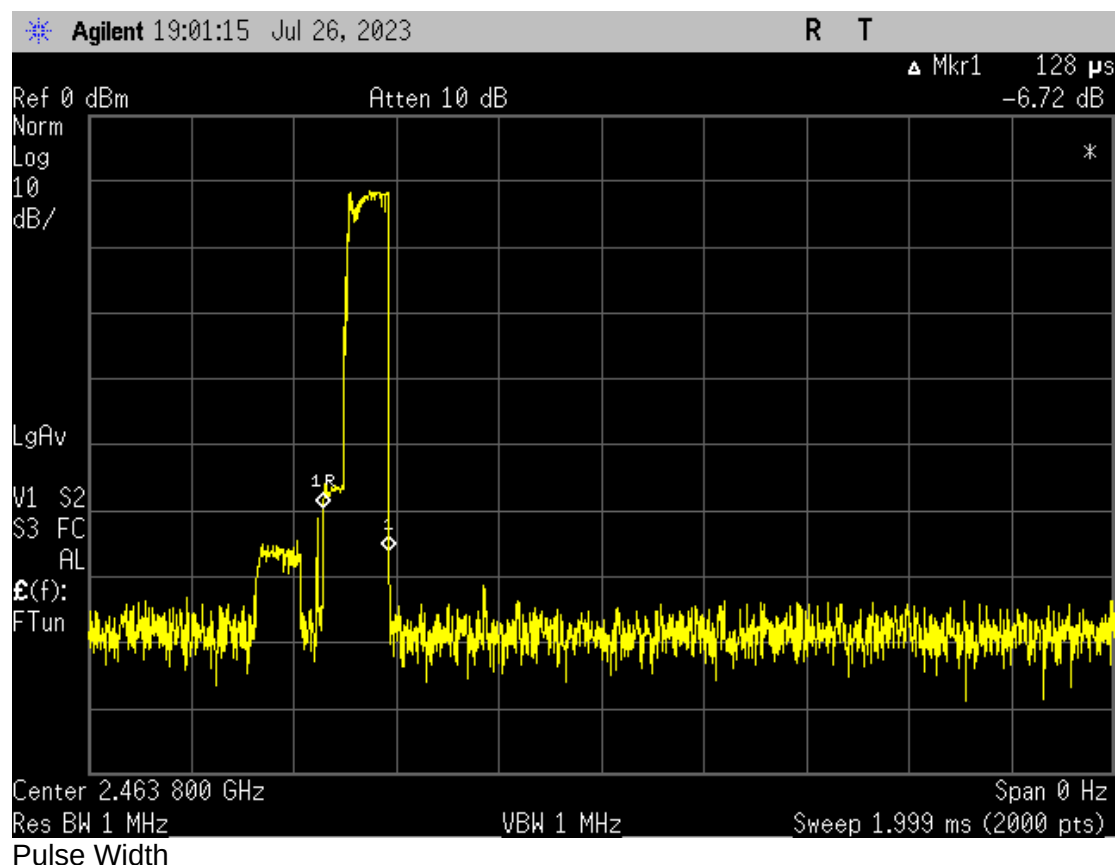
PKA = Peak to Average Factor (This is only used for average measurements above 1 GHz)

The Peak to average factor is used when average measurements are required. It is calculated by the highest duty cycle in percent over any 100mS transmission.

11.2.2 Duty Cycle

The Peak to average factor is calculated by the highest duty cycle in percent over any 100mS transmission. The factor in dB is $20 * \text{Log}(\text{Duty cycle}/100)$. The transmitter operates for a maximum duration of less than 1 ms in any 100 ms interval for a 10% maximum duty cycle. $20 \text{ Log}(1 \text{ mSec}/100\text{mSec}) = -40 \text{ dB}$ Peak to average Correction factor.

Since the difference between the peak and the average limits are 20 dB, there is no need to use a correction factor of more than 20 dB. Therefore, a 20 dB factor was used.



**11.2.3 Radiated Emissions Test Results**

Emissions Below 1 GHz

Test Date	September 15, 2023
Test Distance	3 Meters
Specification	FCC Part 15 Subpart C & RSS-210 Section B.10
Notes	
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; P = peak; Q = QP
Configuration	The EUT is in the transmit mode with the receiver on

This table includes all emissions except Fundamental, Band edge and harmonics emissions.

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor dB/m	Cbl/amp Factors	Dist Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB	Note
34.9	14.8	P	H	12.0	0.6	0.0	27.4	40.0	12.6	
42.4	13.5	P	H	10.4	0.7	0.0	24.6	40.0	15.4	
48.1	13.3	P	H	9.2	0.7	0.0	23.2	40.0	16.8	
62.1	13.5	P	H	9.1	0.8	0.0	23.4	40.0	16.6	
84.6	13.7	P	H	9.1	1.0	0.0	23.8	40.0	16.2	
119.8	14.1	P	H	11.5	1.2	0.0	26.8	43.5	16.7	
151.9	14.0	P	H	12.7	1.3	0.0	28.0	43.5	15.5	
207.9	15.5	P	H	14.5	1.6	0.0	31.6	43.5	11.9	
221.8	15.8	P	H	14.8	1.6	0.0	32.2	46.0	13.8	
232.4	14.7	P	H	15.0	1.7	0.0	31.4	46.0	14.6	
262.6	10.2	P	H	12.4	1.8	0.0	24.4	46.0	21.6	
338.5	12.3	P	H	14.3	2.0	0.0	28.6	46.0	17.4	
450.5	12.8	P	H	16.5	2.3	0.0	31.6	46.0	14.4	
513.4	10.7	P	H	18.5	2.5	0.0	31.7	46.0	14.3	
623.9	10.8	P	H	19.1	2.8	0.0	32.7	46.0	13.3	
730.8	8.6	P	H	21.0	3.0	0.0	32.6	46.0	13.4	
775.2	7.9	P	H	21.0	3.1	0.0	32.0	46.0	14.0	
850.4	7.9	P	H	22.3	3.3	0.0	33.5	46.0	12.5	
962.1	9.4	P	H	23.4	3.5	0.0	36.3	54.0	17.7	
33.1	13.3	P	V	12.3	0.6	0.0	26.2	40.0	13.8	
47.3	14.3	P	V	9.6	0.7	0.0	24.6	40.0	15.4	
66.9	14.4	P	V	9.1	0.8	0.0	24.3	40.0	15.7	
90.4	13.8	P	V	9.6	1.0	0.0	24.4	43.5	19.1	
123.6	13.4	P	V	11.7	1.2	0.0	26.3	43.5	17.2	
193.7	14.2	P	V	14.0	1.5	0.0	29.7	43.5	13.8	
242.4	15.6	P	V	15.1	1.7	0.0	32.4	46.0	13.6	
275.0	11.7	P	V	12.8	1.8	0.0	26.3	46.0	19.7	
295.2	11.7	P	V	13.7	1.9	0.0	27.3	46.0	18.7	
373.6	10.6	P	V	14.6	2.1	0.0	27.3	46.0	18.7	
433.4	11.9	P	V	16.0	2.3	0.0	30.2	46.0	15.8	
483.1	11.5	P	V	17.1	2.5	0.0	31.1	46.0	14.9	
517.2	9.3	P	V	18.6	2.6	0.0	30.5	46.0	15.5	
628.1	9.9	P	V	19.2	2.8	0.0	31.9	46.0	14.1	
726.5	10.2	P	V	20.9	3.0	0.0	34.1	46.0	11.9	
765.6	8.6	P	V	21.0	3.1	0.0	32.7	46.0	13.3	
902.9	10.1	P	V	22.8	3.4	0.0	36.3	46.0	9.7	
984.9	8.8	P	V	23.8	3.6	0.0	36.2	54.0	17.8	

Judgment: Passed by 9.7 dB



Fundamental and Harmonic Emissions FCC 15.249; Three axis

	Tx	Spectrum Analyzer Readings dBuV									EUT	Peak	Ave	Peak	Ave	Margin
hrm	Freq	Peak				Ave				Corr.	Emission	Tot. FS		Limit		Under
#	MHz	Vertical Polarization				Horizontal Polarization				Fact dB/m	Freq MHz	dBuV/m		dBuV/m		Limit dB
		X	Y	Z	Max	X	Y	Z	Max							
1	2463	83.8	97.2	95.5	77.2	95.7	93.6	100.2	80.2	-5.0	2463.0	95.2	75.2	114	94	18.8
BE	2463	35.0	35.6	36.4	16.4	35.5	38.2	36.1	18.2	-5.0	2400.0	33.2	13.2	74	54	40.8
BE	2480	37.8	39.6	40.0	20.0	37.2	38.3	37.8	18.3	-4.9	2483.5	35.1	15.1	74	54	38.9
2	2463	55.6	53.2	56.2	36.2	53.8	50.6	54.1	34.1	3.6	4926.0	59.8	39.8	74	54	14.2
3	2463	48.7	49.4	49.2	29.4	49.5	47.8	47.6	29.5	8.4	7389.0	57.9	37.9	74	54	16.1
4	2463	38.6	40.9	40.4	20.9	40.1	38.8	42.1	22.1	13.1	9852.0	55.2	35.2	74	54	18.8
Column numbers (see below for explanations)																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

Column #1. hrm = Harmonic; BE = Band Edge emissions

Column #2. Frequency of Transmitter.

Column #3. Uncorrected readings from the spectrum analyzer with First Axis Rotation.

Column #4. Uncorrected readings from the spectrum analyzer with Second Axis Rotation.

Column #5. Uncorrected readings from the spectrum analyzer with Third Axis Rotation.

Column #6. Average Reading based on peak reading reduced by the Duty cycle correction

Column #7. Uncorrected readings from the spectrum analyzer with First Axis Rotation.

Column #8. Uncorrected readings from the spectrum analyzer with Second Axis Rotation.

Column #9. Uncorrected readings from the spectrum analyzer with Third Axis Rotation.

Column #10. Average Reading based on peak reading reduced by the Duty cycle correction

Column #11. Corr. Factors = Cable Loss – Preamp Gain + Antenna Factor

Column #12. Frequency of Tested Emission

Column #13. Highest peak field strength at listed frequency.

Column #14. Highest Average field strength at listed frequency.

Column #15. Peak Limit.

Column #16. Average Limit.

Column #17. The margin (last column) is the worst-case margin under the peak or average limits for that row.

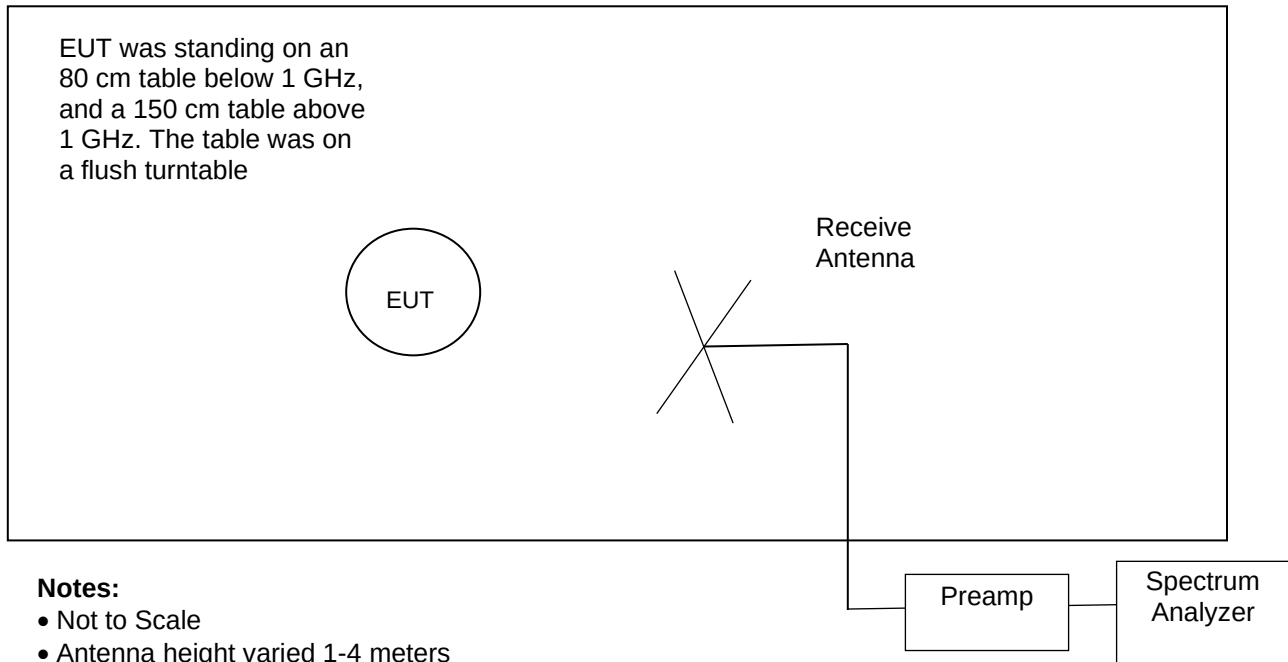
Overall Judgment: Passed by at least 9.7 dB

No other Emissions were detected from 30 to 25,000 MHz within 10 dB of the limits.



Figure 2. Drawings of Radiated Emissions Setup

Chamber E, anechoic



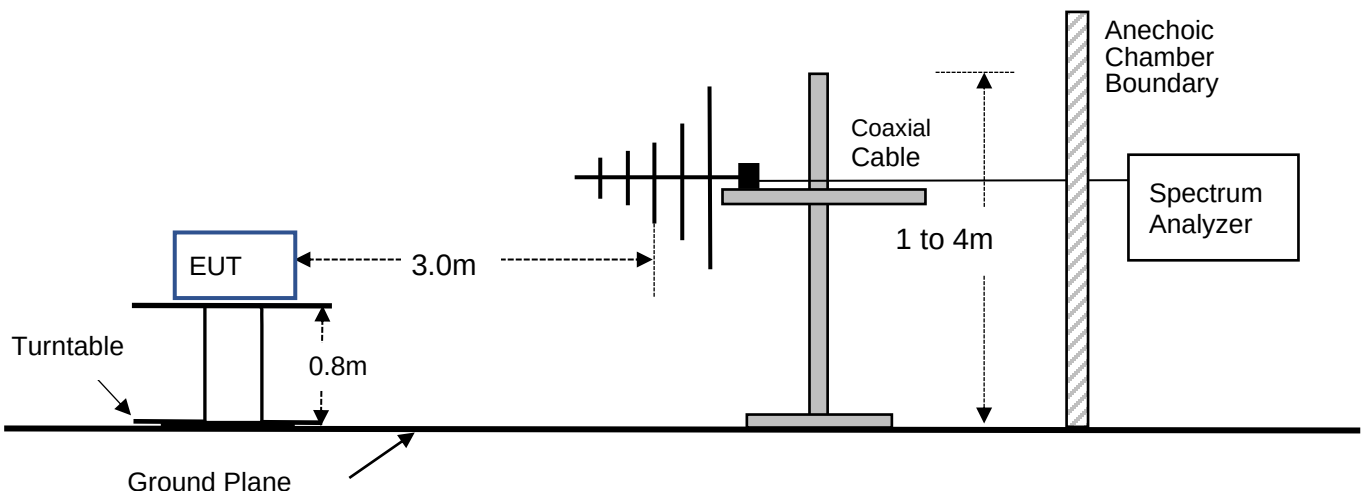
Notes:

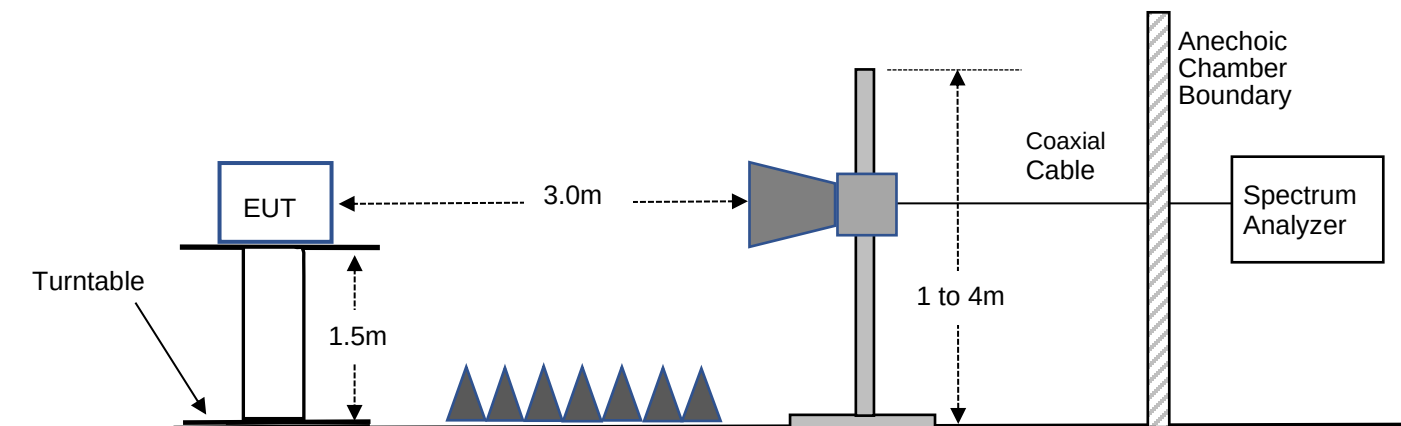
- Not to Scale
- Antenna height varied 1-4 meters
- Distance from antenna to tested system is 3 meters
- AC cords not shown. They are connected to AC outlet with low-pass filter on turntable

Frequency Range	Receive Antenna	Pre-Amplifier	Spectrum Analyzer	High Pass Filter
30 to 200 MHz	ANT-80	None	REC-21	None*
200 to 1000 MHz	ANT-68	None	REC-21	None*
1 to 10 GHz	ANT-66	AMP-05	REC-21	HPF-06
10 to 18 GHz	ANT-66	AMP-20	REC-21	None*

* A high pass filter was not needed since the fundamental frequency was outside of the amplifiers pass band.

Radiated Emissions Test Setup for Frequencies from 30MHz to 1000MHz (Side View)



**Radiated Emissions Test Setup for Frequencies over 1000MHz (Side View)****11.3 Occupied Bandwidth Data**

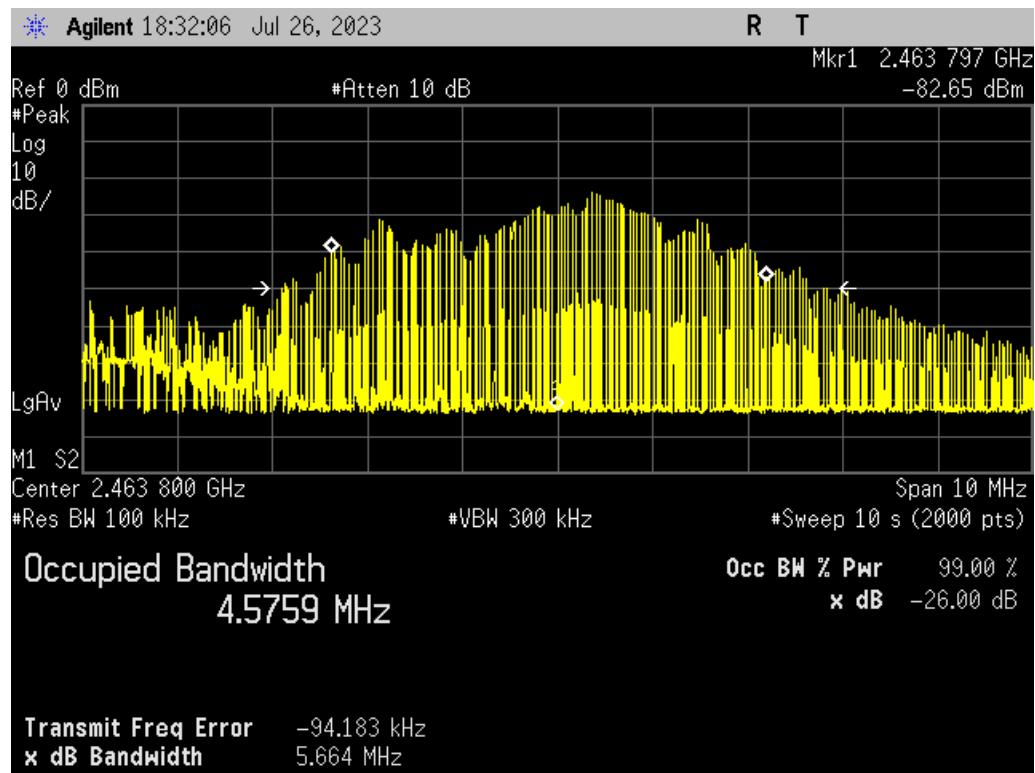
The occupied bandwidth of the RF output was measured using a spectrum analyzer. The bandwidth was measured using the peak detector function. The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The marker-to-peak function was set to the peak of the emission. Then the marker-delta function was used to measure 20 dB down one side of the emission. The marker-delta function was reset and then moved to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the bandwidth of the emission. The plots of the occupied bandwidth for the EUT are supplied on the following pages.

The 20 dB OBW is within the allowed 2400 to 2483.5 MHz authorized band.

20 dB OBW MHz	99% EBW MHz
5.664	4.5759



Figure 3. Occupied Bandwidth Plot



11.4 Unintentional Emissions (Receive Mode)

Manufacturer	Archangel Device LLC	Specification	FCC Part 15.209 & RSS-GEN
Model	MCR-RF	Test Date	September 15, 2023
Serial Number	RMC1	Test Distance	3 Meters
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; P = peak; Q = QP		
Notes	Corr. Factors = Cable Loss – Preamp Gain		
Configuration	Receive mode		

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor dB/m	Cbl/amp Factors dB	Dist Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB	Note
36.2	14.4	P	H	11.4	0.6	0.0	26.4	40.0	13.6	
48.8	12.8	P	H	9.2	0.7	0.0	22.7	40.0	17.3	
65.6	13.2	P	H	9.0	0.8	0.0	23.0	40.0	17.0	
85.5	12.7	P	H	9.2	1.0	0.0	22.9	40.0	17.1	
110.1	14.0	P	H	10.8	1.1	0.0	25.9	43.5	17.6	
131.1	14.1	P	H	12.1	1.2	0.0	27.4	43.5	16.1	
155.7	13.8	P	H	12.7	1.4	0.0	27.9	43.5	15.6	
193.3	14.6	P	H	14.0	1.5	0.0	30.1	43.5	13.4	
221.8	14.0	P	H	14.8	1.6	0.0	30.4	46.0	15.6	
296.7	6.9	P	H	13.8	1.9	0.0	22.6	46.0	23.4	
345.6	7.6	P	H	14.4	2.0	0.0	24.0	46.0	22.0	
382.4	7.9	P	H	14.9	2.2	0.0	25.0	46.0	21.0	
432.6	8.4	P	H	16.0	2.3	0.0	26.7	46.0	19.3	
477.3	9.3	P	H	17.1	2.4	0.0	28.8	46.0	17.2	
575.1	9.6	P	H	18.5	2.7	0.0	30.8	46.0	15.2	
653.7	8.1	P	H	19.9	2.8	0.0	30.8	46.0	15.2	



Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor dB/m	Cbl/amp Factors dB	Dist Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB	Note
739.7	7.7	P	H	20.9	3.1	0.0	31.7	46.0	14.3	
842.8	8.4	P	H	22.1	3.3	0.0	33.8	46.0	12.2	
944.9	8.3	P	H	23.2	3.5	0.0	35.0	46.0	11.0	
37.1	17.0	P	V	11.3	0.6	0.0	28.9	40.0	11.1	
51.9	12.9	P	V	9.1	0.8	0.0	22.8	40.0	17.2	
59.6	14.2	P	V	8.8	0.8	0.0	23.8	40.0	16.2	
76.2	12.6	P	V	8.8	0.9	0.0	22.3	40.0	17.7	
101.0	12.7	P	V	10.1	1.1	0.0	23.9	43.5	19.6	
118.5	12.8	P	V	11.4	1.2	0.0	25.4	43.5	18.1	
139.1	13.1	P	V	12.3	1.3	0.0	26.7	43.5	16.8	
166.1	13.2	P	V	12.9	1.4	0.0	27.5	43.5	16.0	
191.9	13.6	P	V	13.9	1.5	0.0	29.0	43.5	14.5	
222.0	14.7	P	V	14.8	1.6	0.0	31.1	46.0	14.9	
294.1	8.0	P	V	13.7	1.9	0.0	23.6	46.0	22.4	
341.6	8.1	P	V	14.4	2.0	0.0	24.5	46.0	21.5	
384.7	8.8	P	V	14.9	2.2	0.0	25.9	46.0	20.1	
438.7	9.3	P	V	16.2	2.3	0.0	27.8	46.0	18.2	
480.8	10.3	P	V	17.1	2.5	0.0	29.9	46.0	16.1	
584.1	8.0	P	V	18.7	2.7	0.0	29.4	46.0	16.6	
661.7	8.3	P	V	20.4	2.9	0.0	31.6	46.0	14.4	
762.8	7.5	P	V	21.0	3.1	0.0	31.6	46.0	14.4	
854.9	8.9	P	V	22.4	3.3	0.0	34.6	46.0	11.4	
949.9	8.2	P	V	23.4	3.5	0.0	35.1	46.0	10.9	

Configuration Charging mode

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor dB/m	Cbl/amp Factors dB	Dist Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB	Note
33.5	13.5	P	H	12.3	0.6	0.0	26.4	40.0	13.6	
46.1	8.9	P	H	9.9	0.7	0.0	19.5	40.0	20.5	
67.8	9.0	P	H	8.9	0.9	0.0	18.8	40.0	21.2	
84.4	12.2	P	H	9.1	1.0	0.0	22.3	40.0	17.7	
105.7	9.5	P	H	10.5	1.1	0.0	21.1	43.5	22.4	
129.5	10.1	P	H	11.9	1.2	0.0	23.2	43.5	20.3	
145.7	10.6	P	H	12.5	1.3	0.0	24.4	43.5	19.1	
170.9	10.1	P	H	13.0	1.4	0.0	24.5	43.5	19.0	
197.0	11.4	P	H	14.1	1.5	0.0	27.0	43.5	16.5	
220.0	10.3	P	H	14.8	1.6	0.0	26.7	46.0	19.3	
297.7	9.0	P	H	13.9	1.9	0.0	24.8	46.0	21.2	
345.4	8.1	P	H	14.4	2.0	0.0	24.5	46.0	21.5	
387.0	9.0	P	H	15.0	2.2	0.0	26.2	46.0	19.8	
447.3	8.4	P	H	16.4	2.3	0.0	27.1	46.0	18.9	
625.1	8.1	P	H	19.1	2.8	0.0	30.0	46.0	16.0	
710.7	7.2	P	H	21.2	3.0	0.0	31.4	46.0	14.6	
763.8	8.0	P	H	21.0	3.1	0.0	32.1	46.0	13.9	
847.3	9.2	P	H	22.2	3.3	0.0	34.7	46.0	11.3	
929.9	7.9	P	H	23.1	3.4	0.0	34.4	46.0	11.6	
1070.1	41.8	P	H	24.4	-33.8	0.0	32.4	74.0	41.6	1
1355.4	41.1	P	H	25.0	-34.0	0.0	32.1	74.0	41.9	1
1764.8	42.4	P	H	26.7	-33.9	0.0	35.2	74.0	38.8	1
1969.0	42.5	P	H	27.2	-33.8	0.0	35.9	74.0	38.1	1
2119.1	41.0	P	H	27.6	-33.7	0.0	34.9	74.0	39.1	1



Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor dB/m	Cbl/amp Factors dB	Dist Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB	Note
2406.4	42.8	P	H	28.3	-33.4	0.0	37.7	74.0	36.3	1
2910.9	41.9	P	H	29.6	-32.9	0.0	38.6	74.0	35.4	1
3018.0	40.5	P	H	30.1	-32.8	0.0	37.8	74.0	36.2	1
3455.5	39.7	P	H	31.2	-32.3	0.0	38.6	74.0	35.4	1
3968.0	39.7	P	H	32.7	-31.9	0.0	40.5	74.0	33.5	1
4073.1	37.6	P	H	32.5	-31.7	0.0	38.4	74.0	35.6	1
4948.9	35.7	P	H	33.5	-30.6	0.0	38.6	74.0	35.4	1
33.3	15.2	P	V	12.3	0.6	0.0	28.1	40.0	11.9	
39.7	13.0	P	V	10.7	0.7	0.0	24.4	40.0	15.6	
47.0	12.3	P	V	9.7	0.7	0.0	22.7	40.0	17.3	
68.5	9.4	P	V	8.8	0.9	0.0	19.1	40.0	20.9	
89.3	10.4	P	V	9.4	1.0	0.0	20.8	43.5	22.7	
102.8	14.4	P	V	10.4	1.1	0.0	25.9	43.5	17.6	
124.7	10.1	P	V	11.7	1.2	0.0	23.0	43.5	20.5	
143.9	10.3	P	V	12.5	1.3	0.0	24.1	43.5	19.4	
159.4	10.1	P	V	12.8	1.4	0.0	24.3	43.5	19.2	
177.6	9.5	P	V	13.3	1.5	0.0	24.3	43.5	19.2	
191.7	10.1	P	V	13.9	1.5	0.0	25.5	43.5	18.0	
217.6	10.5	P	V	14.7	1.6	0.0	26.8	46.0	19.2	
239.3	10.5	P	V	15.0	1.7	0.0	27.2	46.0	18.8	
298.4	6.3	P	V	13.9	1.9	0.0	22.1	46.0	23.9	
341.1	7.1	P	V	14.4	2.0	0.0	23.5	46.0	22.5	
379.7	8.2	P	V	14.8	2.1	0.0	25.1	46.0	20.9	
423.6	8.0	P	V	15.7	2.3	0.0	26.0	46.0	20.0	
468.7	8.7	P	V	17.1	2.4	0.0	28.2	46.0	17.8	
569.6	7.6	P	V	18.4	2.7	0.0	28.7	46.0	17.3	
669.2	14.4	P	V	20.7	2.9	0.0	38.0	46.0	8.0	
755.3	8.6	P	V	20.9	3.1	0.0	32.6	46.0	13.4	
838.8	8.4	P	V	22.0	3.3	0.0	33.7	46.0	12.3	
940.9	7.9	P	V	23.2	3.5	0.0	34.6	46.0	11.4	
1041.0	39.6	P	V	24.2	-33.8	0.0	30.0	74.0	44.0	1
1296.3	42.0	P	V	25.0	-34.1	0.0	32.9	74.0	41.1	1
1378.4	42.4	P	V	25.0	-34.0	0.0	33.4	74.0	40.6	1
1513.5	43.1	P	V	25.2	-34.0	0.0	34.3	74.0	39.7	1
1633.6	41.9	P	V	25.7	-34.0	0.0	33.6	74.0	40.4	1
1847.8	42.7	P	V	27.0	-33.9	0.0	35.8	74.0	38.2	1
1952.0	40.6	P	V	27.2	-33.8	0.0	34.0	74.0	40.0	1
2108.1	37.6	P	V	27.6	-33.7	0.0	31.5	74.0	42.5	1
2405.4	37.6	P	V	28.3	-33.4	0.0	32.5	74.0	41.5	1
2935.9	38.5	P	V	29.7	-32.9	0.0	35.3	74.0	38.7	1
3057.1	39.8	P	V	30.3	-32.7	0.0	37.4	74.0	36.6	1
3555.6	36.4	P	V	31.3	-32.2	0.0	35.5	74.0	38.5	1
3962.0	37.7	P	V	32.8	-31.9	0.0	38.6	74.0	35.4	1
4047.0	38.6	P	V	32.6	-31.7	0.0	39.5	74.0	34.5	1
4902.9	36.4	P	V	33.5	-30.6	0.0	39.3	74.0	34.7	1

Note 1: All Peak readings above 1 GHz were under the Average limits, so average readings are not required.

No other Emissions were detected from 30 to 12,500 MHz within 10 dB of the limits.

Judgment: Passed by 8.0 dB



11.4.1 Measurement Instrumentation Uncertainty

Measurement	Uncertainty
Conducted Emissions, LISN method, 150 kHz to 30 MHz	3.1 dB
Radiated Emissions, E-field, 3 meters, 30 to 200 MHz	4.8 dB
Radiated Emissions, E-field, 3 meters, 200 to 1000 MHz	4.6 dB
Radiated Emissions, E-field, 3 meters, 1 to 6 GHz	5.0 dB
Radiated Emissions, E-field, 3 meters, 6 to 18 GHz	5.5 dB
Radiated Emissions, E-field, 3 meters, 18 to 26 GHz	5.9 dB
Bandwidth using marker delta method at a span of 10 MHz	4 kHz
99% Occupied Bandwidth using REC-44	1% of frequency span
Temperature THM-02	0.6 Deg C

The uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2 in accordance with CISPR 16-4-2.

12.0 REVISION HISTORY

Document RP-9855A Revisions:			
Rev.	Affected Sections	Description	Rationale