Electromagnetic Compatibility Test Report

Tests Performed on an Aclara Technologies, LLC

Synergize RF kV2c Meter Model Y84034-1

Radiometrics Document RP-9975

ACCREDITED
TESTING CERT #1495.01

Product Detail:	
FCC ID: LLBY84034-1 IC: 4546A-Y840341 Equipment type: 450-470 MHz Transceiver	
Test Standards:	
FCC Parts 2, 15, and 90 CFR Title 47: 2024 IC RSS-119 Issue 12: 2015 IC RSS-GEN Issue 5: 2018 This report concerns: Class II Permissive Change	
Tests Performed For:	*Test Facility:*
Aclara Technologies, LLC 77 Westport Plaza Drive, Suite 500 Saint Louis, MO 63146	**Radiometrics Midwest Corporation** 12 Devonwood Avenue Romeoville, IL 60446 Phone: (815) 293-0772
Test Dates:	
March 28 thru May 7, 2024	

Document RP-9975 Revisions:

Rev.	Issue Date	Revised By
0	July 18, 2024	

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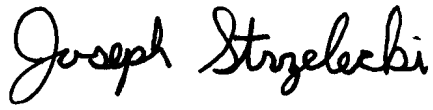
1.0 ADMINISTRATIVE DATA

Equipment Under Test: An Aclara Technologies LLC., KV2c Meter Model: Y84034-1; Serial Number: 001D240000A8C21 These will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics: March 27, 2024	*Test Dates:* March 28 thru May 7, 2024
Test Report Written and Authorized By: Joseph Strzelecki Senior EMC Engineer	*Test Witnessed By:* The tests were not witnessed by personnel from Aclara Technologies, LLC
Radiometrics' Personnel Responsible for Test:  07/18/2024 Date Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE Chris E. Dalessio EMC Technician	

2.0 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a KV2c Meter, Model Y84034-1, manufactured by Aclara Technologies, LLC. The detailed test results are presented in a separate section. The following is a summary of the test results.

Transmitter Requirements

Environmental Phenomena	Frequency Range	RSS 119 Section	Test Result
RF Power Output	450-470 MHz	5.4	Pass
Occupied Bandwidth Test; Emissions Masks	450-470 MHz	5.5	Pass
Spurious RF Conducted Emissions	1-4700 MHz	5.8	Pass
Field Strength of Spurious Radiation	30-4700 MHz	5.3	Pass
Frequency Vs. Temperature	450-470 MHz	5.3	Note 1
Frequency Vs. Voltage	450-470 MHz	5.3	Note 1
Transient Frequency Behavior	450-470 MHz	5.9	Note 1

Note 1: Not Performed since permissive change would not affect the test results

3.0 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a KV2c Meter. The EUT is a 450-470 MHz transceiver, manufactured by Aclara Technologies, LLC. The RF communications link is encrypted in both directions. The EUT was in good working condition during the tests, with no known defects.

Modulated Signal Parameters:

Modulated Signal Parameters	450-470 MHz Band
Data Rate (symbols/second)	5000
Inner Deviation (Hz)	800
Transmission Duration (seconds)	0.8528
Modulation Type	4GFSK
Encoding Type (Bits/Symbol)	2
Outer Deviation (Hz)	2400
Number of Data Bits	8528
Bit Rate (Bits/second)	10000
Licensed Bandwidth (Hz)	12500

Emissions Designator: 7k19F7D

3.2 Description of Permissive Change

We, Aclara Technologies, LLC. hereby declare that this version of the model Y84034-1 is electrically identical with the same electromagnetic emissions and electromagnetic compatibility characteristics as model, except for firmware, as the Originally certified product. We attest that the equipment is electrically identical. The new version uses the same printed circuit board assemblies and electronics. The clocks, tuning circuits, antennas, RF power remained unchanged.

The original protocol uses ALOHA with carrier detection to avoid collisions on a chosen, licensed channel. The network interface card (NIC) chooses a random channel from its list of licensed channels to transmit its message. After a channel is selected, a random wait time is chosen. After the wait time, the selected channel is monitored for a carrier. If no carrier is detected, the NIC immediately transmits its message on the chosen channel. If a carrier is detected, the NIC aborts for another random wait period and tries again.

The only changes are in software. The data rate was increased from 9600 to 10000. Also changed is is how the channels are used. The old version was random access aloha, the new version is a TDMA, so everything is slotted on all channels. The Deviation was Changed from 1000Hz to 800Hz.

The new protocol uses TDMA with carrier detection to avoid collisions on the assigned, licensed channel. The network interface card (NIC)is assigned a licensed channel and a time slot to transmit its message. At the beginning of its assigned time slot, the NIC monitors for a carrier on its assigned channel. If no carrier is detected, the NIC immediately transmits its message on its assigned channel. If a carrier is detected, the NIC aborts until its next assigned time slot and tries again.

4.0 TESTED SYSTEM DETAILS

4.1 Tested System Configuration

The system was configured for testing in a typical fashion. The testing was performed in conditions as close as possible to installed conditions. The wiring was consistent with the manufacturer's recommendations. The identification for all equipment, used in the tested system, is:

Tested System Configuration List

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	kV2c Meter	E	Aclara Technologies	Y84034-1	001D240000A8C21

Model Number	Firmware
Y84034-1	V4.00.64

The firmware of the EUT during the tests is identical to what would be released, except it allows for transmissions to continue for longer periods of time, as required for the regulatory tests.

4.2 Operating Conditions of EUT

The EUT was in a normal operating mode during the tests. All circuits were activated during the tests. Power was supplied at 120 VAC, 50 Hz.

The EUT operational software was Tera Term version 4.105 in conjunction with a windows PC. The settings used are as follows: The power setting was 29 and the modulation was set to 4GFSK.

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 AND RELATED DOCUMENTS

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
TIA-603-E	2016	Land Mobile FM or PM Communications Equipment – Measurement and Performance Standards
IC RSS-Gen Issue 5	2018	General Requirements and Information for the Certification of Radiocommunication Equipment (RSS-Gen)
IC RSS-119 Issue 12	2015	Radio Transmitters and Receivers Operating in the Land Mobile and Fixed Services in the Frequency Range 27.41-960 MHz
ANSI C63.26	2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services

6.0 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. 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 A: Is an anechoic chamber that measures 24' L X 12' W X 12' H. The walls and ceiling are fully lined with ferrite absorber tiles. The floor has a 10' x 10' section of ferrite absorber tiles located in the center. Panashield of Rowayton, Connecticut manufactured the chamber. The enclosure is NAMAS certified.

Chamber B: Is a shielded enclosure that measures 20' L X 12' W X 8' H. Erik A. Lindgren & Associates of Chicago, Illinois manufactured the enclosure.

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.

Test Station F: Is an area that measures approximately 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 IC3124A.

7.0 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

8.0 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification. The results relate only to the EUT listed herein. Any modifications made to the EUT subsequent to the indicated test date will invalidate the data and void this certification.

9.0 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.	01/31/24
ANT-13	EMCO	Horn Antenna	3115	2502	1.0-18GHz	24 Mo.	03/01/23
ANT-66	ETS-Lindgren	Horn Antenna	3115	62580	1.0-18GHz	24 Mo.	03/16/23
ANT-68	EMCO	Log Periodic Antenna	93146	9604-4456	200-1000MHz	24 Mo.	01/30/24
ANT-79	AH Systems	Bicon Antenna	SAS-540	793	20-330MHz	24 Mo.	01/26/23

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
ANT-80	AH Systems	Bicon Antenna	SAS-540	294	20-330MHz	24 Mo.	01/26/23
ATT-58	Weinschel	Attenuator (20 dB)	23-20-34	CG7866	DC-18 GHz	24 Mo	12/15/23
HPF-09	Mini-Circuits	High Pass Filter	SHP-700+	RUU75101737	700-5000MHz	24 Mo.	10/05/22
PWM-01	Boonton	Power Meter	4230	22503	50kHz-18GHz	24 Mo.	03/07/24
REC-11	HP / Agilent	Spectrum Analyzer	E7405A	US39110103	9Hz-26.5GHz	24 Mo.	05/05/22
REC-21	Agilent	Spectrum Analyzer	E7405A	MY45118341	9kHz-26.5 GHz	24 Mo.	04/24/24
REC-44	Agilent	Spectrum Analyzer	E4440A	US40420673	3Hz-26.5GHz	24 Mo.	03/31/22
SIG-21	HP / Agilent	Signal Generator	8341B	2910A02352	0.01-20 GHz	24 Mo.	12/18/23
SIG-31	Rohde Schwarz	Vector Signal Generator	SMJ 100A	101395	100kHz-6GHz	36 Mo.	09/22/23
THM-02	Fluke	Temp/Humid Meter	971	93490471	N/A	24 Mo.	11/22/22

Note: All calibrated equipment is subject to periodic checks.
NCR – No Calibration Required. Device monitored by calibrated equipment. N/A: Not Applicable.

All tests done with REC-44 were between March 28-29, 2024
All tests done with REC-21 were between April 29 and May 7, 2024

10.0 TEST SECTIONS

10.1 Peak Output Power

The peak power was measured by connecting the EUT antenna port to the power meter via a low loss coaxial cable and an appropiate power attenuator.

Model	Y84034-1 S/N: 001D240000A8C21	Specification	RSS-119 Section 5.4 & FCC Part 90.205
Test Location	Chamber B	Test Date	May 6, 2024
Test Personnel	Joseph Strzelecki		
Test Equipment	Power meter PWM-01; ATT-58		

TX Freq MHz	Reading dBm	Atten & Cable	Total dBm	Peak Power Watts	Antenna Gain dBi	ERP Watts
450.0250	9.0	20.2	29.2	0.832	3.0	1.012
460.0000	9.0	20.2	29.2	0.832	3.0	1.012
469.9750	9.2	20.2	29.4	0.871	3.0	1.059

Judgement: Pass
The fundamental emission ERP limit is 100 watts (50 dBm) for an 8 km service area radius.

Note that in decibel units:
ERP = EIRP - 2.15 = P+G-2.15
where:
P = transmitter output power in dB(W)
G = Gain of the transmitting antenna in dBi
3 dBi is the maximum gain allowed by the product specification.

10.2 Emissions Masks

Model	Y84034-1 S/N: 001D240000A8C21	Specification	RSS-119 Section 5.5 & FCC Part 90.210
Test Location	Chamber B	Test Date	May 7, 2024
Test Personnel	Joseph Strzelecki		
Test Equipment	Spectrum Analyzer (REC-21), ATT-58		

The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The EUT was transmitting at its maximum data rate. The trace was allowed to stabilize. All Channels are 12.5 kHz. The emissions Mask D is from FCC part 90.210.

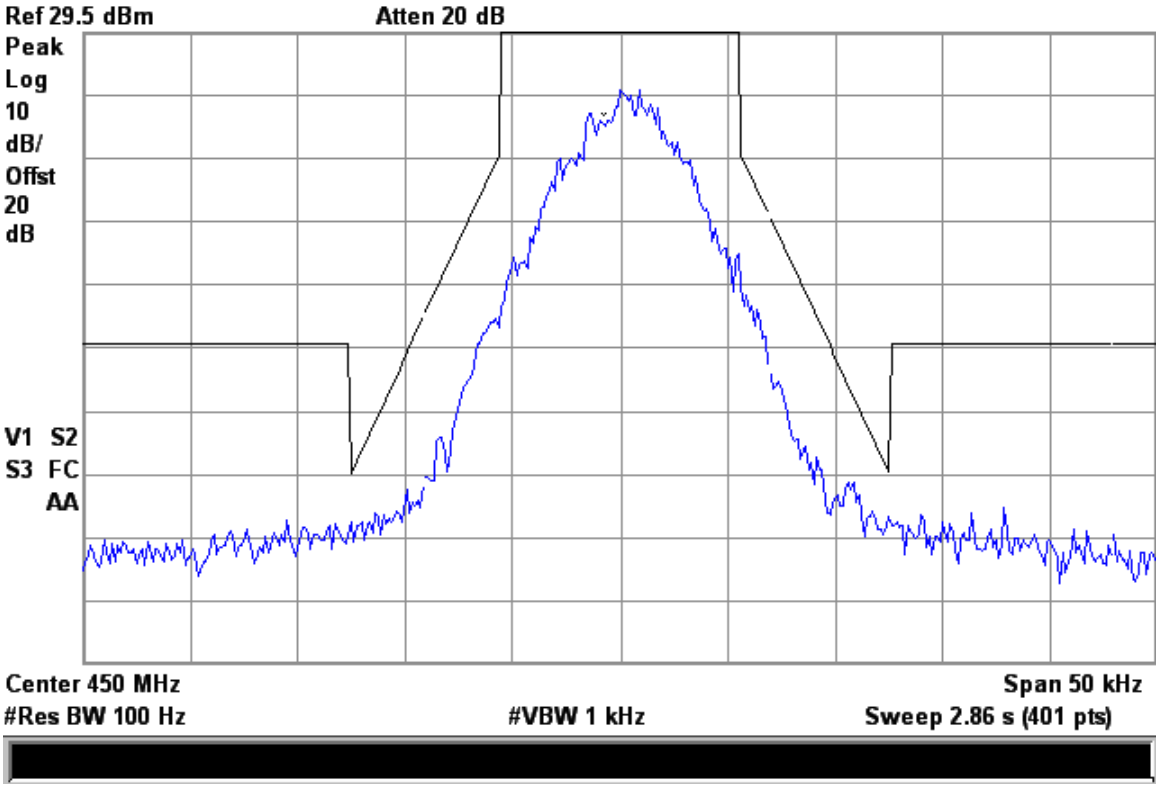
(1) On any frequency from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.

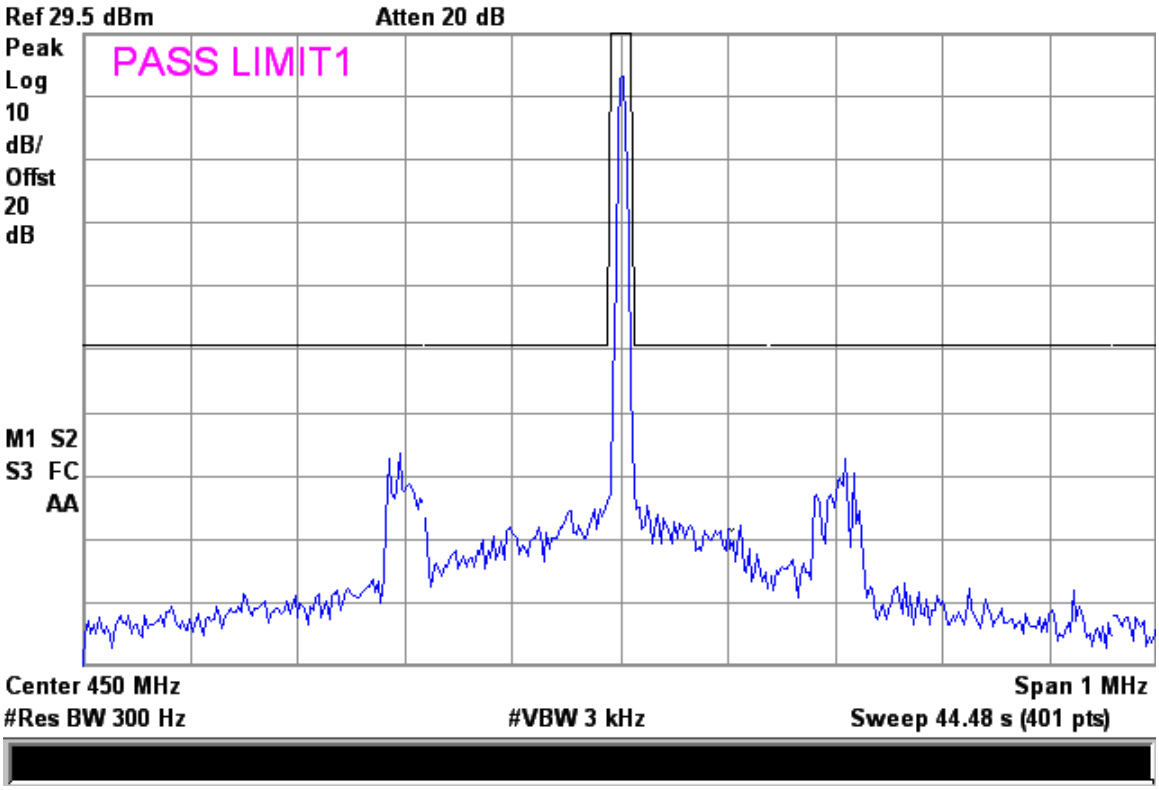
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(fd −2.88 kHz) dB.

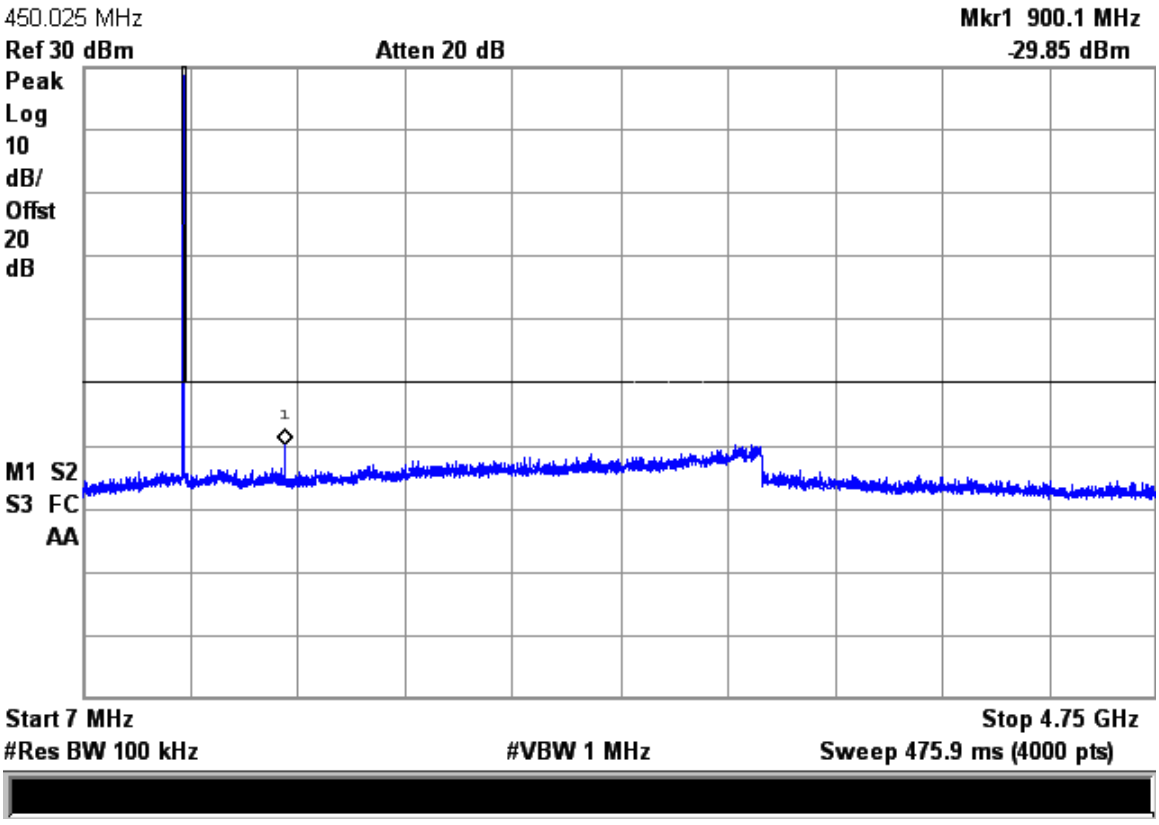
(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB.

For all Frequencies beyond 25 kHz from the center of the transmit frequency, the worst-case limit was used. The dark line is a 50-dB reduction from carrier based on 1 watt.

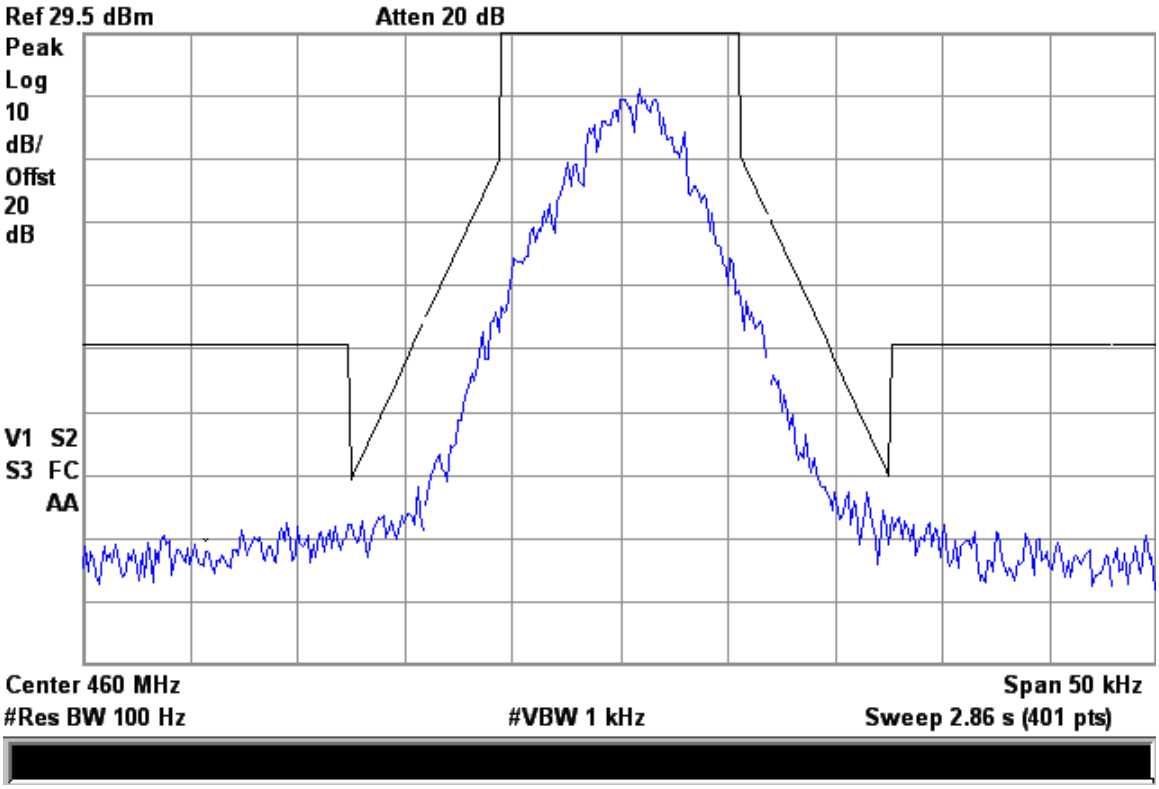
D Mask; 450.025 MHz

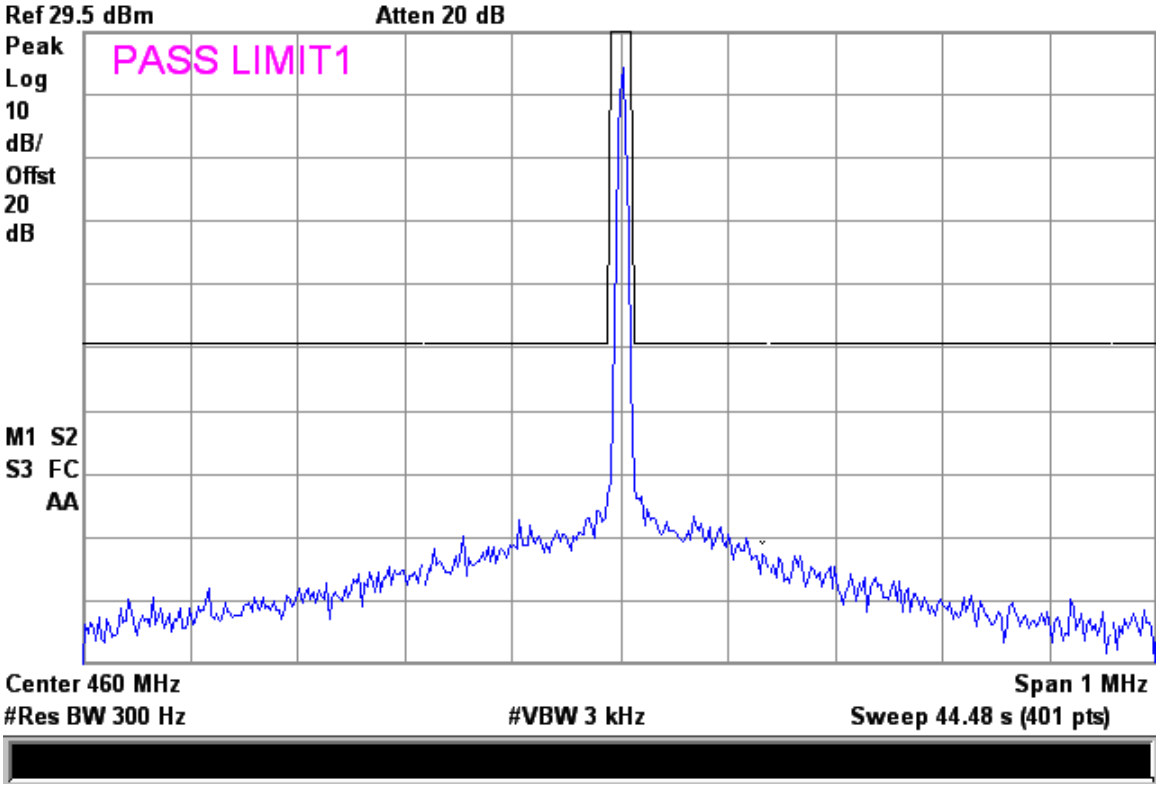


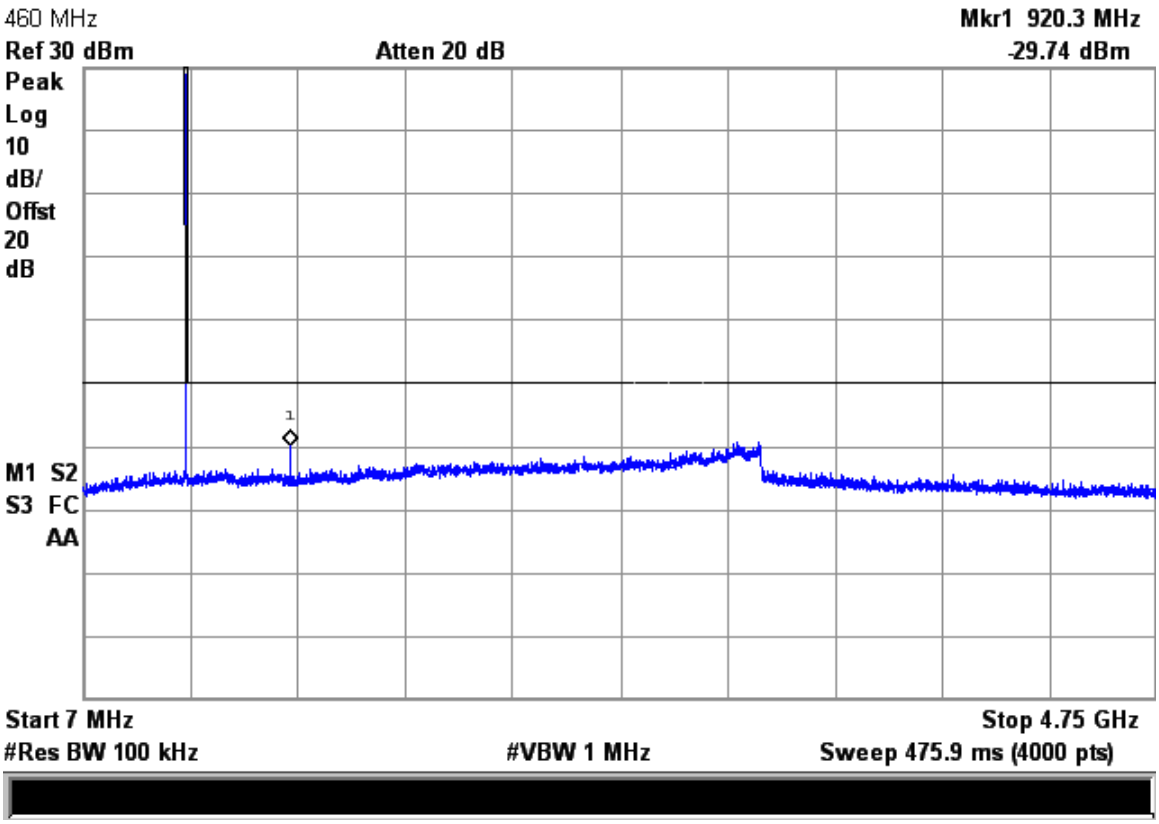

Ref 29.5 dBm
Atten 20 dB
Peak
Log
10
dB/
Offst
20
dB
PASS LIMIT1
M1 S2
S3 FC
AA
Center 450 MHz
Span 1 MHz
#Res BW 300 Hz
#VBW 3 kHz
Sweep 44.48 s (401 pts)


450.025 MHz
Mkr1 900.1 MHz
-29.85 dBm
Ref 30 dBm
Atten 20 dB
Peak
Log
10
dB/
Offst
20
dB
M1 S2
S3 FC
AA
Start 7 MHz
Stop 4.75 GHz
#Res BW 100 kHz
#VBW 1 MHz
Sweep 475.9 ms (4000 pts)

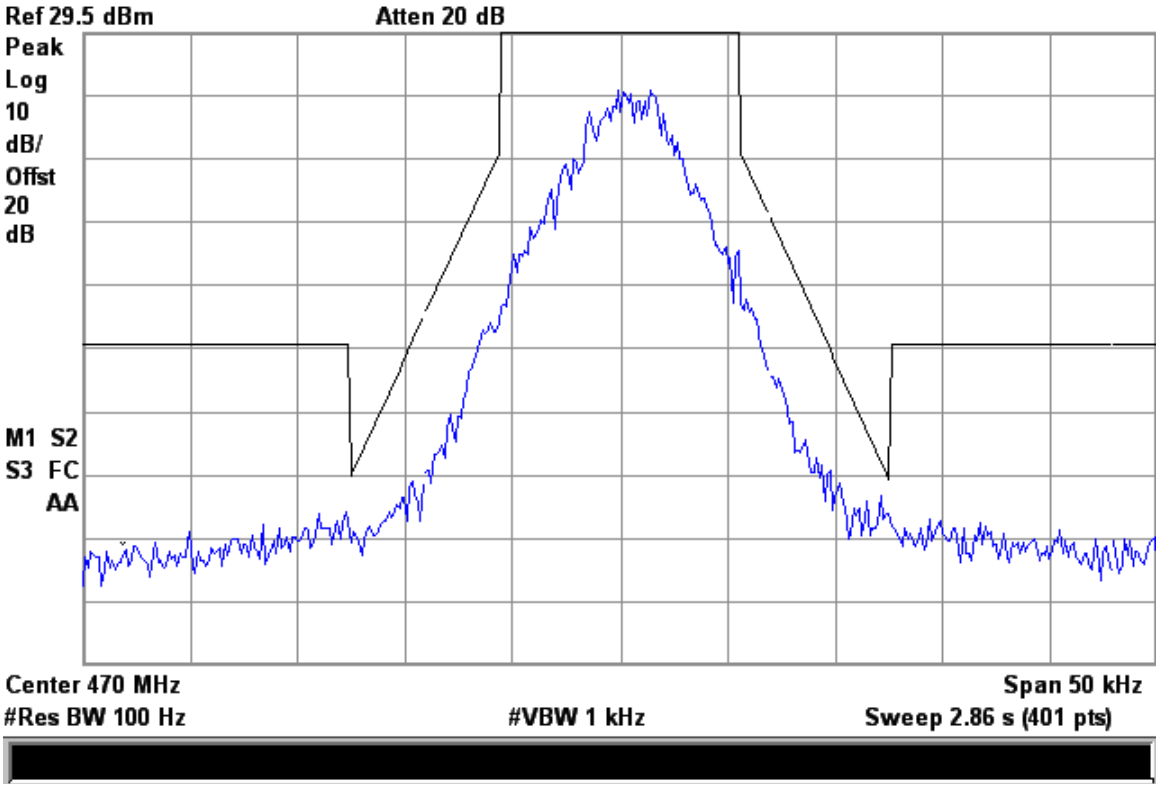
D Mask: 460 MHz

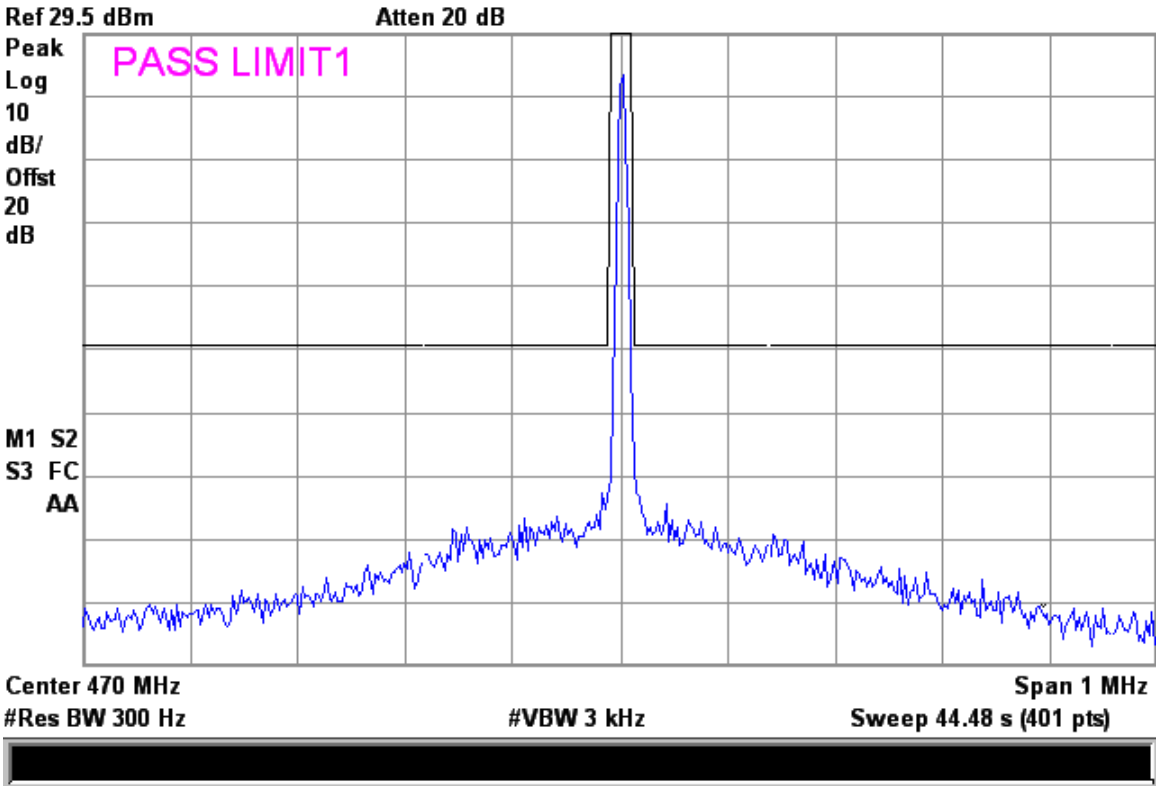


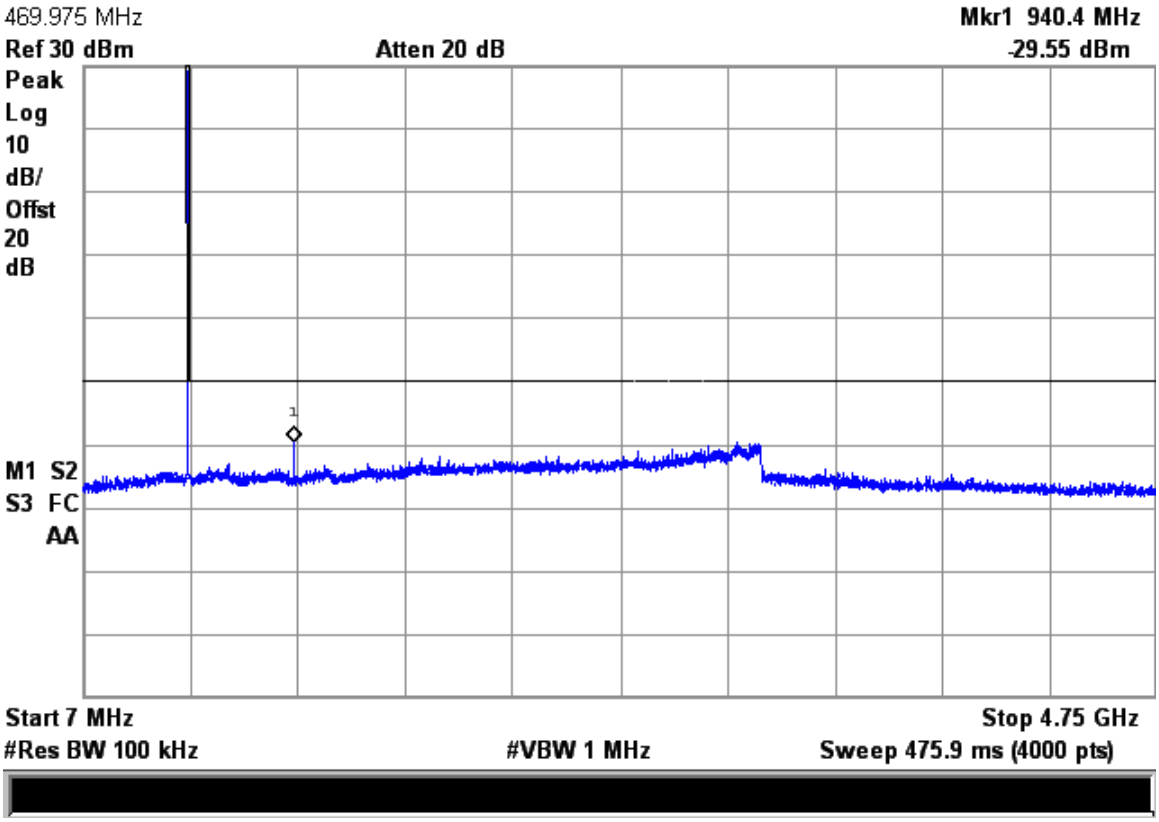



460 MHz
Mkr1 920.3 MHz
Ref 30 dBm
Atten 20 dB
-29.74 dBm
Peak
Log
10
dB/
Offst
20
dB
M1 S2
S3 FC
AA
Start 7 MHz
Stop 4.75 GHz
#Res BW 100 kHz
#VBW 1 MHz
Sweep 475.9 ms (4000 pts)

469.975 MHz


Ref 29.5 dBm
Atten 20 dB
Peak
Log
10
dB/
Offst
20
dB
M1 S2
S3 FC
AA
Center 470 MHz
Span 50 kHz
#Res BW 100 Hz
#VBW 1 kHz
Sweep 2.86 s (401 pts)





Judgement: Pass

10.2.1 Conducted Spurious Emissions

Model	Y84034-1	Specification	RSS-119 Section 5.5 & FCC Part 90.210
Serial Number	001D240000A8C21	Test Date	April 29, 2024
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver (REC-21); High pass fiiter (HPF-09)		

This is a direct measurement from the Antenna port to the EMI Receiver

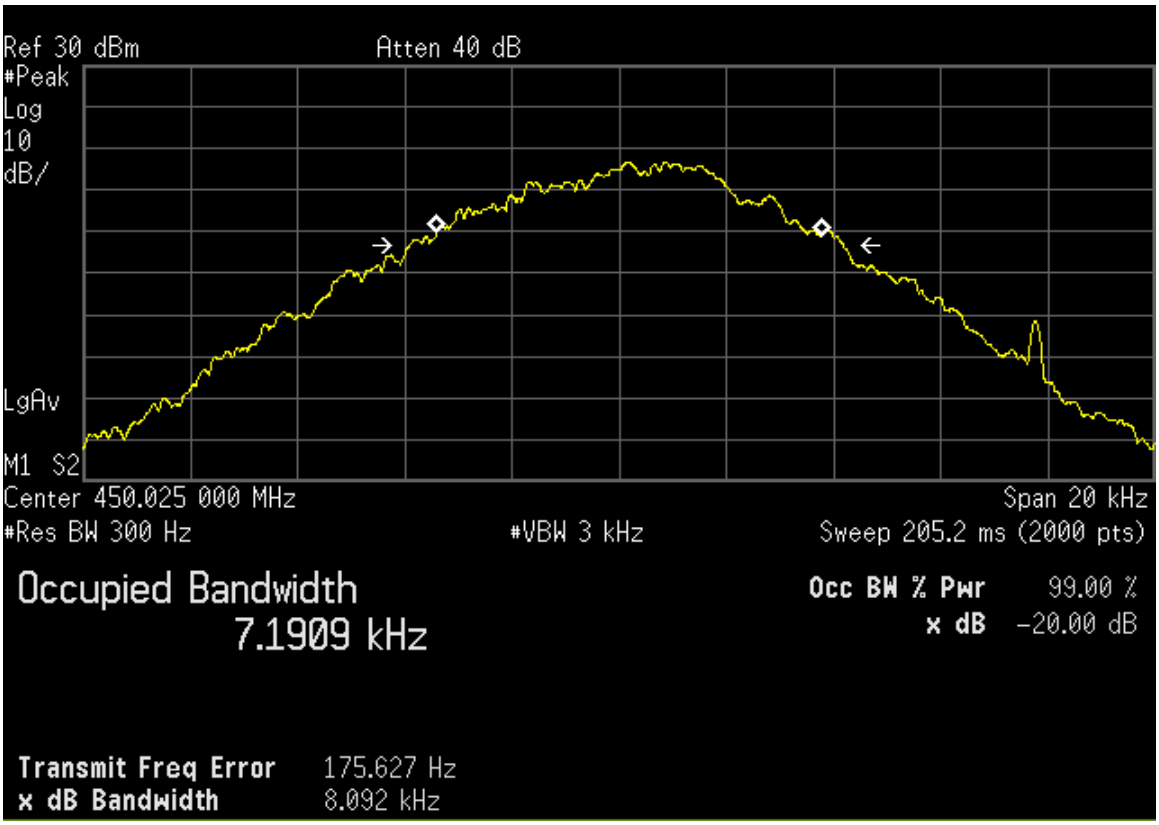
Freq. Tx	Harm	Tested Freq.	Rec Reading	HPF Attn. Factor	Ext. Atten. Factor	Cable Loss	Total Power	Power Limit	Margin Under Limit
MHz	#	MHz	dBm	dB	dB	dB	dBm	dBm	dB
450.0250	2	900.0500	-57.2	0.4	19.9	0.3	-36.6	-20.0	16.6
450.0250	3	1350.0750	-67.5	0.4	19.9	0.4	-46.8	-20.0	26.8
450.0250	4	1800.1000	-67.1	0.4	19.9	0.5	-46.3	-20.0	26.3
450.0250	5	2250.1250	-68.3	0.5	19.9	0.5	-47.4	-20.0	27.4
450.0250	6	2700.1500	-67.5	0.6	19.9	0.6	-46.4	-20.0	26.4
450.0250	7	3150.1750	-67.6	0.5	19.9	0.7	-46.5	-20.0	26.5
450.0250	8	3600.2000	-67.1	0.8	19.9	0.7	-45.7	-20.0	25.7
450.0250	9	4050.2250	-68.5	1.0	19.9	0.8	-46.8	-20.0	26.8
450.0250	10	4500.2500	-67.6	1.0	19.9	0.8	-45.9	-20.0	25.9
460.0000	2	920.0000	-61.1	0.4	19.9	0.3	-40.5	-20.0	20.5
460.0000	3	1380.0000	-67.7	0.4	19.9	0.4	-47.0	-20.0	27.0
460.0000	4	1840.0000	-68.4	0.4	19.9	0.5	-47.6	-20.0	27.6
460.0000	5	2300.0000	-68.3	0.5	19.9	0.5	-47.4	-20.0	27.4
460.0000	6	2760.0000	-67.3	0.6	19.9	0.6	-46.2	-20.0	26.2
460.0000	7	3220.0000	-67.8	0.5	19.9	0.7	-46.7	-20.0	26.7
460.0000	8	3680.0000	-67.4	0.8	19.9	0.7	-46.0	-20.0	26.0
460.0000	9	4140.0000	-68.8	1.0	19.9	0.8	-47.1	-20.0	27.1
460.0000	10	4600.0000	-67.0	1.0	19.9	0.8	-45.3	-20.0	25.3
469.9750	2	939.9500	-62.2	0.4	19.9	0.3	-41.6	-20.0	21.6
469.9750	3	1409.9250	-68.0	0.4	19.9	0.4	-47.3	-20.0	27.3
469.9750	4	1879.9000	-68.0	0.4	19.9	0.5	-47.2	-20.0	27.2
469.9750	5	2349.8750	-67.0	0.5	19.9	0.5	-46.1	-20.0	26.1
469.9750	6	2819.8500	-67.7	0.6	19.9	0.6	-46.6	-20.0	26.6
469.9750	7	3289.8250	-68.0	0.5	19.9	0.7	-46.9	-20.0	26.9
469.9750	8	3759.8000	-66.9	0.8	19.9	0.7	-45.5	-20.0	25.5
469.9750	9	4229.7750	-68.5	1.0	19.9	0.8	-46.8	-20.0	26.8
469.9750	10	4699.7500	-67.0	1.0	19.9	0.8	-45.3	-20.0	25.3

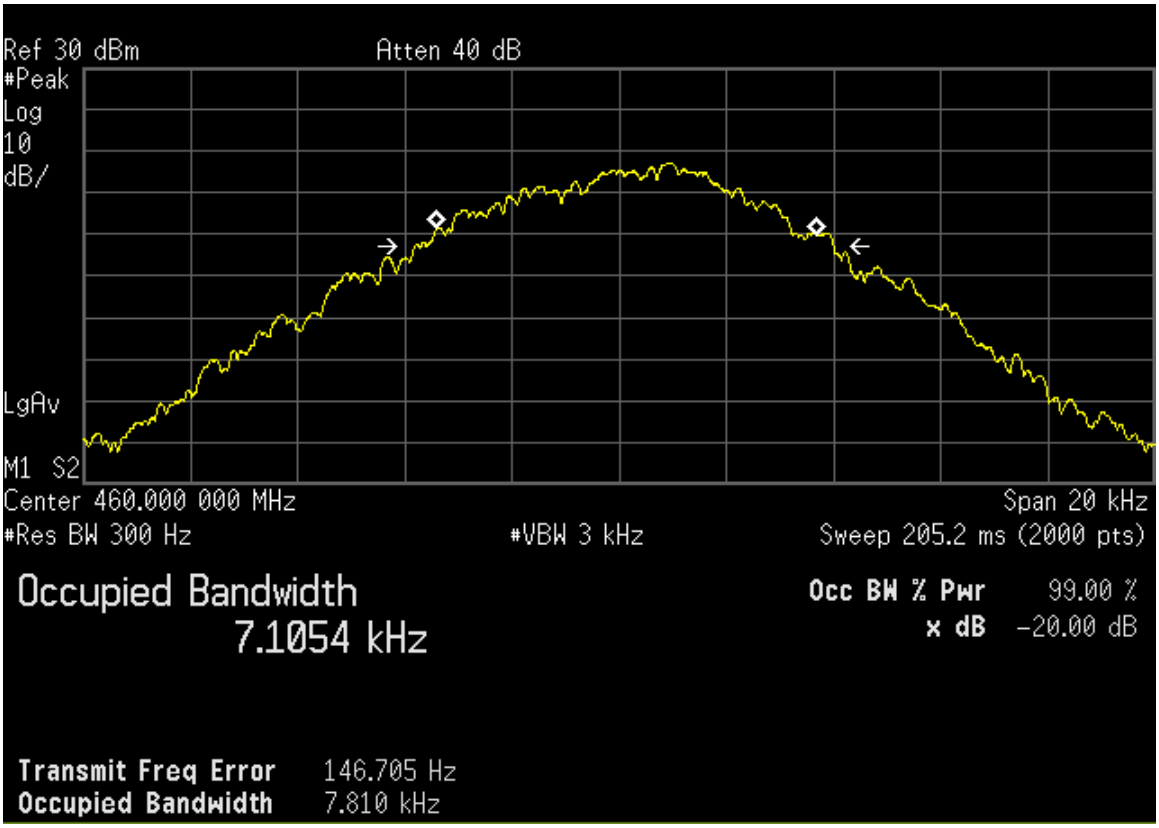
Judgment: Passed by at least 10 dB.

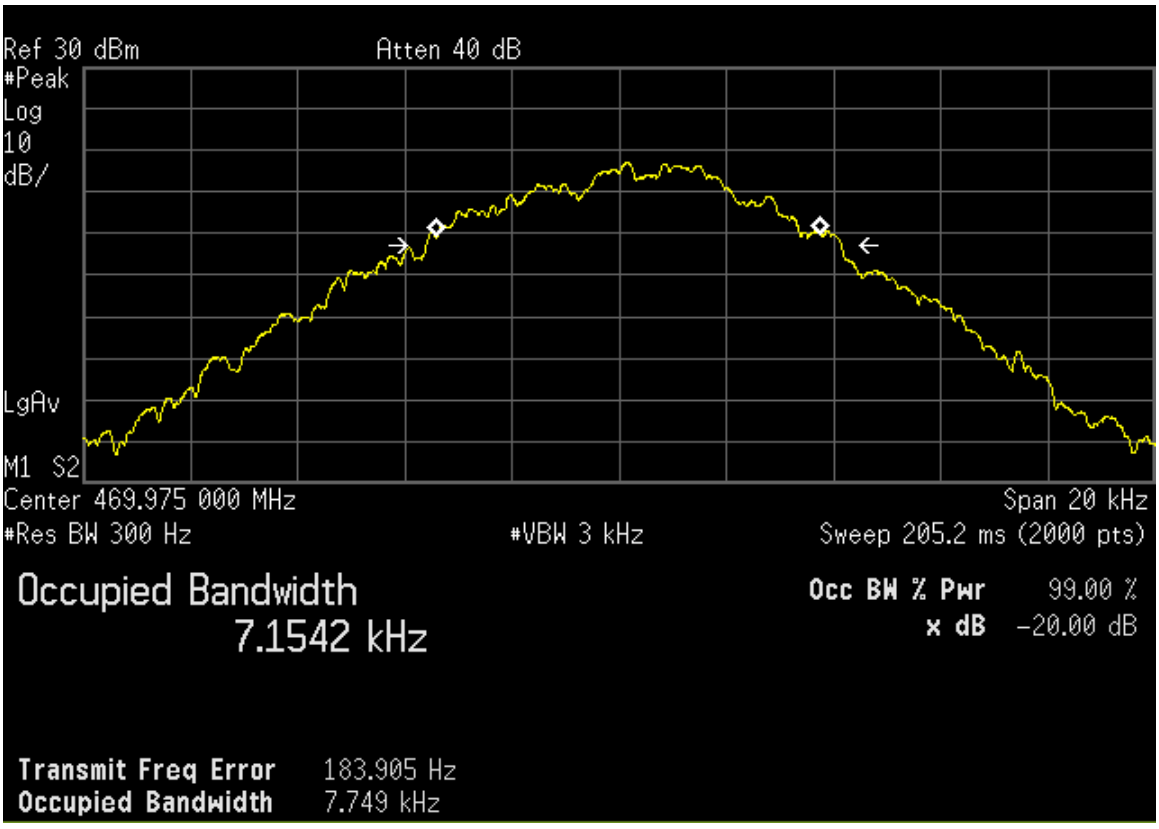
10.3 Occupied Bandwidth

Model	Y84034-1	Specification	RSS-GEN Section 6.7 & FCC Part 90
Serial Number	001D240000A8C21	Test Date	March 28, 2024
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver (REC-44)		

	99% OBW (kHz)
Channel	kHz
450.025 MHz	7.1909
460.000 MHz	7.1054
469.975 MHz	7.1542




Ref 30 dBm
Atten 40 dB
#Peak
Log
10
dB/
LgAv
M1 S2
Center 460.000 000 MHz
Span 20 kHz
#Res BW 300 Hz
#VBW 3 kHz
Sweep 205.2 ms (2000 pts)
Occupied Bandwidth
7.1054 kHz
Occ BW % Pwr 99.00 %
x dB -20.00 dB
Transmit Freq Error 146.705 Hz
Occupied Bandwidth 7.810 kHz


Ref 30 dBm
Atten 40 dB
#Peak
Log
10
dB/
LgAv
M1 S2
Center 469.975 000 MHz
Span 20 kHz
#Res BW 300 Hz
#VBW 3 kHz
Sweep 205.2 ms (2000 pts)
Occupied Bandwidth
7.1542 kHz
Occ BW % Pwr 99.00 %
x dB -20.00 dB
Transmit Freq Error 183.905 Hz
Occupied Bandwidth 7.749 kHz

10.4 Field Strength of Unwanted Spurious Radiation

10.4.1 Test Procedures

Radiated emission measurements in the Restricted bands were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists. From 30 to 4700 MHz, a spectrum analyzer with a preselector was used for measurement. Radiated emissions measurements were performed at the anechoic chamber at a test distance of 3 meters. The entire frequency range from 30 to 4700 MHz was slowly scanned and the emissions in the restricted frequency bands were recorded. Measurements were performed using the peak detector function.

The spectrum analyzer was adjusted for the following settings:

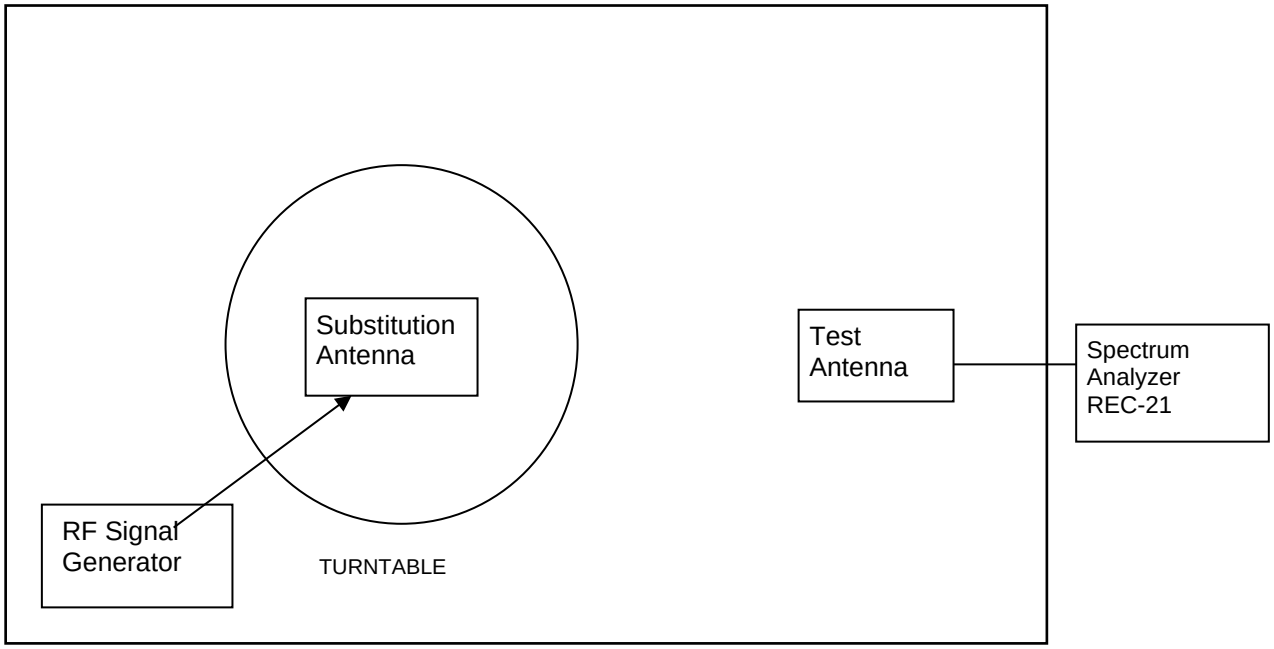
1) Resolution Bandwidth = 120 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1GHz.
2) Video Bandwidth = 300 kHz for spurious emissions below 1 GHz, and 3 MHz for spurious emissions above 1 GHz.
3) Sweep Speed slow enough to maintain measurement calibration.
4) Detector Mode = Positive Peak.

The transmitter to be tested was placed on the turntable in the standard test site, or an FCC listed site compliant with ANSI C63.4. The transmitter is transmitting into a non-radiating load that is placed on the turntable. Measurements were made from the lowest radio frequency generated in the equipment to the tenth harmonic of the carrier. The transmitter was keyed during the tests.

For each spurious frequency, the test antenna was raised and lowered from 1 m to 4m to obtain a maximum reading on the spectrum analyzer with the test antenna at horizontal polarity. Then the turntable was rotated 360° to determine the maximum reading. This procedure was repeated to obtain the highest possible reading. This maximum reading was recorded.

Each measurement was repeated for each spurious frequency with the test antenna polarized vertically.

Figure 1. Drawing of Radiated Emissions Setup



ANSI C63.4 Listed Test Site

Notes:
- Test Antenna height varied from 1 to 4 meters
- Distance from antenna to tested system is 3 meters
- Not to Scale

Frequency MHz	Test Antenna	Substitution Antenna	Receiver to Coupler	Signal Generator
30 - 200	ANT-80	ANT-79	REC-21	SIG-21
200 - 1000	ANT-68	ANT-06	REC-21	SIG-21
1000-5000	ANT-36	ANT-13	REC-21	SIG-21

The transmitter was removed and replaced with a broadband substitution antenna. The substitution antenna is calibrated so that the gain relative to a dipole is known. The center of the substitution antenna was approximately at the same location as the center of the transmitter.

The substitution antenna was fed at the transmitter end with a signal generator connected to the antenna by means of a non-radiating cable. With the antennas at both ends horizontally polarized, and with the signal generator tuned to a particular spurious frequency, the test antenna was raised and lowered to obtain a maximum reading at the spectrum analyzer. The level of the signal generator output was adjusted until the previously recorded maximum reading for this set of conditions was obtained.

The measurements were repeated with both antennas horizontally and vertically polarized for each spurious frequency.

The power in dBm into a was calculated by reducing the substitution readings obtained above by the loss in the cable between the generator and the antenna, and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna by the following formula:

Pd(dBm) = *Pg*(dBm) – *cable loss* (dB) + *antenna gain* (dB)

where:
Pd is the dipole equivalent power and
Pg is the generator output power into the substitution antenna.

10.4.2 Test Limits

Any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB.

Since by mathematical definition, P(dBm) – (50+10xLOG(P(W))) = -20 dBm, the limit for spurious emissions was set to -20 dBm equivalent radiated power. P(W) = Power in watts.

10.4.3 Spurious Radiated Emissions Test Results

Model	Y84034-1	Specification	RSS-119 Section 5.8 & FCC Part 90.210
Serial Number	001D240000A8C21	Test Date	April 29-30, 2024
Test Distance	3 Meters	Notes	Transmit Mode
Test Personnel	Chris Dalessio		

	Tx	Measured	Equivalent Radiated power into Dipole			Margin Under Limit	
Harmonic	Freq	Freq	Vertical	Horizontal	Limit	Vertical	Horizontal
#	MHz	MHz	dBm	dBm	dBm	dB	dB
2	450.0250	900.05	-39.4	-34.1	-20.0	19.4	14.1
3	450.0250	1350.08	-47.8	-51.6	-20.0	27.8	31.6
4	450.0250	1800.10	-51.9	-53.0	-20.0	31.9	33.0
5	450.0250	2250.13	-56.2	-56.8	-20.0	36.2	36.8
6	450.0250	2700.15	-56.2	-57.4	-20.0	36.2	37.4
7	450.0250	3150.18	-55.6	-54.9	-20.0	35.6	34.9
8	450.0250	3600.20	-54.2	-54.4	-20.0	34.2	34.4
9	450.0250	4050.23	-53.0	-53.2	-20.0	33.0	33.2
10	450.0250	4500.25	-51.6	-51.4	-20.0	31.6	31.4
2	460.0000	920.00	-34.8	-37.5	-20.0	14.8	17.5
3	460.0000	1380.00	-45.6	-46.3	-20.0	25.6	26.3
4	460.0000	1840.00	-50.8	-50.1	-20.0	30.8	30.1
5	460.0000	2300.00	-53.9	-53.5	-20.0	33.9	33.5
6	460.0000	2760.00	-57.8	-57.3	-20.0	37.8	37.3
7	460.0000	3220.00	-55.3	-54.8	-20.0	35.3	34.8
8	460.0000	3680.00	-55.0	-54.7	-20.0	35.0	34.7
9	460.0000	4140.00	-52.9	-53.7	-20.0	32.9	33.7
10	460.0000	4600.00	-52.7	-52.8	-20.0	32.7	32.8
2	469.9750	939.95	-31.7	-33.3	-20.0	11.7	13.3
3	469.9750	1409.93	-48.1	-44.4	-20.0	28.1	24.4
4	469.9750	1879.90	-47.5	-50.2	-20.0	27.5	30.2
5	469.9750	2349.88	-52.8	-52.9	-20.0	32.8	32.9
6	469.9750	2819.85	-54.7	-54.8	-20.0	34.7	34.8
7	469.9750	3289.83	-55.2	-55.0	-20.0	35.2	35.0
8	469.9750	3759.80	-51.1	-51.7	-20.0	31.1	31.7

	Tx	Measured	Equivalent Radiated power into Dipole			Margin Under Limit	
Harmonic	Freq	Freq	Vertical	Horizontal	Limit	Vertical	Horizontal
#	MHz	MHz	dBm	dBm	dBm	dB	dB
9	469.9750	4229.78	-52.5	-51.1	-20.0	32.5	31.1
10	469.9750	4699.75	-52.5	-52.2	-20.0	32.5	32.2

Non-Harmonic frequencies

Freq MHz	Detector	Ant Pol	EUT dBm	Limit dBm	Margin dB
36.9	P	H	-64.4	-20.0	44.4
177.8	P	H	-60.3	-20.0	40.3
200.2	P	H	-56.9	-20.0	36.9
245.7	P	H	-51.8	-20.0	31.8
480.3	P	H	-49.2	-20.0	29.2
687.7	P	H	-46.2	-20.0	26.2
756.8	P	H	-47.1	-20.0	27.1
803.8	P	H	-46.6	-20.0	26.6
866.4	P	H	-44.5	-20.0	24.5
968.0	P	H	-45.5	-20.0	25.5
1078.1	P	H	-44.7	-20.0	24.7
1266.3	P	H	-43.2	-20.0	23.2
1594.6	P	H	-41.0	-20.0	21.0
30.7	P	V	-69.2	-20.0	49.2
152.1	P	V	-60.5	-20.0	40.5
315.6	P	V	-44.7	-20.0	24.7
379.7	P	V	-44.2	-20.0	24.2
439.5	P	V	-42.7	-20.0	22.7
481.1	P	V	-41.1	-20.0	21.1
771.8	P	V	-46.4	-20.0	26.4
839.8	P	V	-45.8	-20.0	25.8
966.0	P	V	-42.7	-20.0	22.7
1112.1	P	V	-44.9	-20.0	24.9
1458.5	P	V	-41.6	-20.0	21.6

No other radiated emissions were detected within 10 dB of the limits from 30 MHz to 4.7 GHz.

Judgment: Passed by at least 10 dB.

10.5 Radiated Emissions (Receive Mode)

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 resolution bandwidth used 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 the start of testing, in order to determine if an overload condition exists.

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 and CISPR 16-1. Chamber E is located at 12 Devonwood Ave. Romeoville, Illinois EMI test lab.

The frequency range from 30 to 2000 MHz was slowly scanned with attention paid to those frequency ranges which were within 10 dB of the limit. 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 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.

10.5.1 Radiated Emissions Field Strength Sample 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

Where: FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain

10.5.2 Spurious Radiated Emissions Test Results (Receive Mode)

Model	Y84034-1 S/N: 001D240000A8C21	Specification	RSS-Gen Section 7.3 & FCC Part 15
Test Distance	3 Meters	Test Date	April 30, 2024
Tested by	Chris E. Dalessio		
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	Cable & Amp Factors	Dist. Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB	Note
56.8	19.2	P	H	8.8	0.8	0.0	28.8	40.0	11.2	
68.7	15.2	P	H	8.8	0.9	0.0	24.9	40.0	15.1	
78.7	14.6	P	H	9.2	1.0	0.0	24.8	40.0	15.2	
90.8	14.4	P	H	9.6	1.0	0.0	25.0	43.5	18.5	
103.9	14.3	P	H	10.4	1.1	0.0	25.8	43.5	17.7	
113.2	15.0	P	H	11.0	1.1	0.0	27.1	43.5	16.4	
121.1	18.9	P	H	11.5	1.2	0.0	31.6	43.5	11.9	
133.8	15.7	P	H	12.1	1.3	0.0	29.1	43.5	14.4	
142.8	14.8	P	H	12.4	1.3	0.0	28.5	43.5	15.0	
156.8	14.8	P	H	12.8	1.4	0.0	29.0	43.5	14.5	
167.6	15.5	P	H	13.0	1.4	0.0	29.9	43.5	13.6	
194.6	16.2	P	H	14.1	1.5	0.0	31.8	43.5	11.7	
218.0	15.6	P	H	14.7	1.6	0.0	31.9	46.0	14.1	
238.6	16.0	P	H	15.0	1.7	0.0	32.7	46.0	13.3	

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor	Cable & Amp Factors	Dist. Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB	Note
273.0	8.7	P	H	13.0	1.8	0.0	23.5	46.0	22.5	
302.7	9.6	P	H	15.1	1.9	0.0	26.6	46.0	19.4	
331.2	10.3	P	H	14.2	2.0	0.0	26.5	46.0	19.5	
374.6	11.1	P	H	14.8	2.1	0.0	28.0	46.0	18.0	
406.1	10.6	P	H	15.4	2.2	0.0	28.2	46.0	17.8	
429.1	10.6	P	H	16.0	2.3	0.0	28.9	46.0	17.1	
469.7	10.5	P	H	16.9	2.4	0.0	29.8	46.0	16.2	
568.1	9.9	P	H	18.3	2.6	0.0	30.8	46.0	15.2	
568.6	9.9	P	H	18.3	2.7	0.0	30.9	46.0	15.1	
627.6	9.6	P	H	19.4	2.8	0.0	31.8	46.0	14.2	
693.7	10.0	P	H	21.3	2.9	0.0	34.2	46.0	11.8	
757.3	9.7	P	H	20.9	3.1	0.0	33.7	46.0	12.3	
821.3	9.8	P	H	21.7	3.3	0.0	34.8	46.0	11.2	
885.9	9.1	P	H	22.8	3.4	0.0	35.3	46.0	10.7	
960.0	9.2	P	H	23.4	3.5	0.0	36.1	46.0	9.9	
1024.0	35.7	P	H	24.1	-31.5	0.0	28.3	74.0	45.7	1
1251.3	36.3	P	H	24.9	-31.6	0.0	29.6	74.0	44.4	1
1497.5	37.0	P	H	25.2	-31.3	0.0	30.9	74.0	43.1	1
1897.9	36.9	P	H	27.1	-30.7	0.0	33.3	74.0	40.7	1
1934.9	40.2	P	H	27.2	-30.7	0.0	36.7	74.0	37.3	1
1970.0	37.9	P	H	27.2	-30.6	0.0	34.5	74.0	39.5	1
2053.1	36.0	P	H	27.4	-30.5	0.0	32.9	74.0	41.1	1
2370.4	31.9	P	H	28.2	-29.9	0.0	30.2	74.0	43.8	1
2385.4	35.2	P	H	28.2	-29.9	0.0	33.5	74.0	40.5	1
2699.7	34.1	P	H	29.0	-29.4	0.0	33.7	74.0	40.3	1
2827.8	36.0	P	H	29.3	-29.2	0.0	36.1	74.0	37.9	1
2964.0	37.1	P	H	29.8	-28.9	0.0	38.0	74.0	36.0	1
37.2	13.7	P	V	11.3	0.6	0.0	25.6	40.0	14.4	
51.0	14.9	P	V	9.3	0.8	0.0	25.0	40.0	15.0	
58.9	14.4	P	V	9.0	0.8	0.0	24.2	40.0	15.8	
68.7	15.0	P	V	8.8	0.9	0.0	24.7	40.0	15.3	
78.8	15.5	P	V	9.2	1.0	0.0	25.7	40.0	14.3	
90.3	14.7	P	V	9.6	1.0	0.0	25.3	43.5	18.2	
101.0	14.8	P	V	10.1	1.1	0.0	26.0	43.5	17.5	
113.6	15.5	P	V	11.0	1.1	0.0	27.6	43.5	15.9	
125.5	14.8	P	V	11.7	1.2	0.0	27.7	43.5	15.8	
152.3	15.2	P	V	12.7	1.3	0.0	29.2	43.5	14.3	
172.4	15.6	P	V	13.1	1.4	0.0	30.1	43.5	13.4	
197.4	15.9	P	V	14.2	1.5	0.0	31.6	43.5	11.9	
218.4	16.6	P	V	14.7	1.6	0.0	32.9	46.0	13.1	
237.9	15.9	P	V	15.0	1.7	0.0	32.6	46.0	13.4	
288.1	9.6	P	V	13.9	1.8	0.0	25.3	46.0	20.7	
330.7	9.7	P	V	14.2	2.0	0.0	25.9	46.0	20.1	
371.1	9.7	P	V	14.7	2.1	0.0	26.5	46.0	19.5	
413.2	10.2	P	V	15.5	2.2	0.0	27.9	46.0	18.1	
445.2	10.7	P	V	16.3	2.3	0.0	29.3	46.0	16.7	
475.5	10.7	P	V	17.1	2.4	0.0	30.2	46.0	15.8	
550.6	9.7	P	V	18.1	2.6	0.0	30.4	46.0	15.6	
640.1	9.5	P	V	19.7	2.8	0.0	32.0	46.0	14.0	
715.7	11.2	P	V	21.1	3.0	0.0	35.3	46.0	10.7	
778.8	10.1	P	V	21.1	3.1	0.0	34.3	46.0	11.7	
847.3	9.0	P	V	22.3	3.3	0.0	34.6	46.0	11.4	
908.4	8.8	P	V	22.9	3.4	0.0	35.1	46.0	10.9	

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor	Cable & Amp Factors	Dist. Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB	Note
963.0	10.0	P	V	23.5	3.5	0.0	37.0	54.0	17.0	
1054.1	39.9	P	V	24.3	-31.6	0.0	32.6	74.0	41.4	1
1244.2	40.9	P	V	24.9	-31.6	0.0	34.2	74.0	39.8	1
1448.4	38.3	P	V	25.1	-31.3	0.0	32.1	74.0	41.9	1
1549.5	39.4	P	V	25.3	-31.1	0.0	33.6	74.0	40.4	1
1634.6	42.4	P	V	25.7	-31.0	0.0	37.1	74.0	36.9	1
1677.7	38.9	P	V	26.1	-31.0	0.0	34.0	74.0	40.0	1
1952.0	39.4	P	V	27.2	-30.6	0.0	36.0	74.0	38.0	1
2049.0	36.1	P	V	27.4	-30.5	0.0	33.0	74.0	41.0	1
2121.1	38.2	P	V	27.6	-30.4	0.0	35.4	74.0	38.6	1
2337.3	36.6	P	V	28.1	-30.0	0.0	34.7	74.0	39.3	1
2724.7	37.0	P	V	29.0	-29.4	0.0	36.6	74.0	37.4	1
2954.0	36.6	P	V	29.8	-29.0	0.0	37.4	74.0	36.6	1

Note 1; Peak reading meeting the average limit, so the average reading is not required.
Judgment: Pass by 9.9 dB

Radiated emissions in a graphical format. The following chart is the same data as the previous table. The peak limit is not shown, since the peak readings meet the lower average limit.

11.0 MEASUREMENT INSTRUMENTATION UNCERTAINTY

Measurement	Uncertainty
Radiated Emissions, E-field, 3 meters, 30 to 200 MHz	3.3 dB
Radiated Emissions, E-field, 3 meters, 200 to 1000 MHz	4.9 dB
Radiated Emissions, E-field, 3 meters, 1 to 18 GHz	4.8 dB
99% Occupied Bandwidth using REC-43	1% of frequency span
Conducted power PWM-01 at 460 MHz	0.14 dB
Amplitude measurement 1-5000 MHz	1.5 dB
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

RP-9975 Revisions:			
Rev.	Affected Sections	Description	Rationale