

Meteorcomm LLC.

EMC TEST REPORT FOR

AR220DB
Model: 70010

Tested to The Following Standards:

FCC Part 90 Subpart T and Subpart K

217.6125-219.9875MHz
AND
220.0125-221.9875MHz

Report No.: 110562-3

Date of issue: January 23, 2025



This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of testing for CKC Laboratories, Inc.

We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

Test Certificate # 803.01

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Administrative Information

Test Report Information

REPORT PREPARED FOR:

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Representative: George Stults
Customer Reference Number: PO32312

REPORT PREPARED BY:

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CKC Laboratories, Inc.
5046 Sierra Pines Drive
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Project Number: 110562

DATE OF EQUIPMENT RECEIPT:

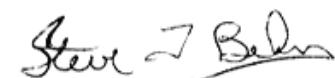
December 16, 2024

DATE(S) OF TESTING:

December 16, 17, 18, and 31, 2024

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the equipment provided by the client, tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.



Steve Behm
Director of Quality Assurance & Engineering Services
CKC Laboratories, Inc.

Test Facility Information



Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable, and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
22116 23rd Drive SE, Suite A
Bothell, WA 98021

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.20
EMITest Immunity	5.03.10

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	Canada	Japan
Canyon Park, Bothell, WA	US0103	US1024	3082C	A-0136
Brea, CA	US0103	US1024	3082D	A-0136
Fremont, CA	US0103	US1024	3082B	A-0136
Mariposa, CA	US0103	US1024	3082A	A-0136

*CKC's list of NIST designated countries can be found at: <https://standards.gov/cabs/designations.html>

Summary of Results

Standard / Specification: FCC Part 90 Subpart T and K

Test Procedure	Description	Modifications	Results
90.205, 90.723, 90.729, 90.259	Power Output	NA	PASS
90.209, 90.733 (d)	Occupied Bandwidth	NA	PASS
90.213	Frequency Stability	NA	PASS
90.210	Conducted Spurious Emissions and Mask	NA	PASS
90.210	Radiated Spurious Emissions	NA	PASS

NA = Not Applicable

ISO/IEC 17025 Decision Rule

The equipment sample utilized for testing is selected by the manufacturer. The declaration of pass or fail herein is a binary statement for simple acceptance rule (ILAC G8) based upon assessment to the specification(s) listed above, without consideration of measurement uncertainties. For performance related tests, equipment was monitored for specified criteria identified in that section of testing.

Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

Summary of Conditions

No modifications were made during testing.

Modifications listed above must be incorporated into all production units.

Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

Summary of Conditions

None

Equipment Under Test (EUT)

During testing numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

Configuration 1

Equipment Under Test:

Device	Manufacturer	Model #	S/N
AR220DB	Meteorcomm, LLC	70010	70DB001008NG

Support Equipment:

Device	Manufacturer	Model #	S/N
ITCR-NG Wayside	Meteorcomm, LLC	65010A	65WR000016MC
AC/DC Switching Adaptor	Mean Well	GST280A12-C6P	EC08104020
Attenuator	Fairview Microwave	SA3N1007-30	NA
Attenuator	Fairview Microwave	SA3N1007-30	NA
Attenuator	Fairview Microwave	SA3N1007-30	NA
Laptop	Dell	Latitude	8X7DMH2
Prosafe 8-Port Gigabit	Netgear	GS108Tv2	29SE4C5302E60
Smart Switch	NA	NA	NA

Configuration 2

Equipment Under Test:

Device	Manufacturer	Model #	S/N
AR220DB	Meteorcomm, LLC	70010	70DB001006NG

Support Equipment:

Device	Manufacturer	Model #	S/N
ITCR-NG Wayside	Meteorcomm, LLC	65010A	65WR000016MC
AC/DC Switching Adaptor	Mean Well	GST280A12-C6P	EC08104020
Attenuator	Fairview Microwave	SA3N1007-30	NA
Attenuator	Fairview Microwave	SA3N1007-30	NA
Attenuator	Fairview Microwave	SA3N1007-30	NA
Laptop	Dell	Latitude	8X7DMH2
Prosafe 8-Port Gigabit	Netgear	GS108Tv2	29SE4C5302E60
Smart Switch	NA	NA	NA

Configuration 3

Equipment Under Test:

Device	Manufacturer	Model #	S/N
AR220DB	Meteorcomm, LLC	70010	70DB001013NG

Support Equipment:

Device	Manufacturer	Model #	S/N
ITCR-NG Wayside	Meteorcomm, LLC	65010A	65WR000016MC
AC/DC Switching Adaptor	Mean Well	GST280A12-C6P	EC08104020
Attenuator	Fairview Microwave	SA3N1007-30	NA
Attenuator	Fairview Microwave	SA3N1007-30	NA
Attenuator	Fairview Microwave	SA3N1007-30	NA
Laptop	Dell	Latitude	8X7DMH2
Prosafe 8-Port Gigabit	Netgear	GS108Tv2	29SE4C5302E60
Smart Switch	NA	NA	NA

General Product Information:

Description of EUT	
Transceiver for railroad application	
Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Transmission System:	Proprietary for Locomotive
Operating Frequency Range(s):	217.6125-219.9875MHz AND 220.0125-221.9875MHz
Modulation Type(s):	DQPSK Full Rate
Maximum Duty Cycle:	10%, but may be increased for testing
Number of TX Chains:	1
Antenna Type(s) and Gain:	Not specified by manufacturer, but typical railroad antenna 4.55dBi
Beamforming Type:	NA
Antenna Connection Type:	External Connector
Nominal Input Voltage:	13.6VDC
Firmware / Software used for Test:	0.1.76 Linux 0.1.121 FPGA MobaXterm v23.2
The validity of results is dependent on the stated product details, the accuracy of which the manufacturer assumes full responsibility.	

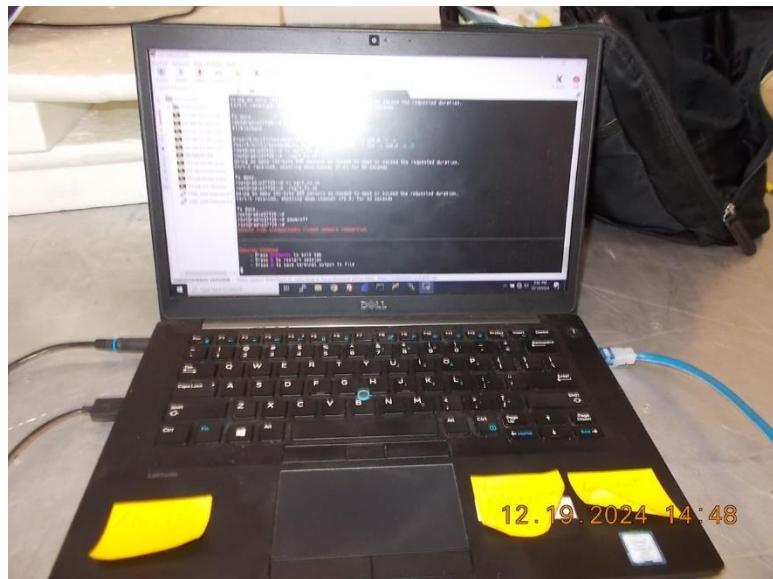
EUT and Accessory Photo(s)



Support Equipment Photo(s)



Ethernet Hub



Laptop

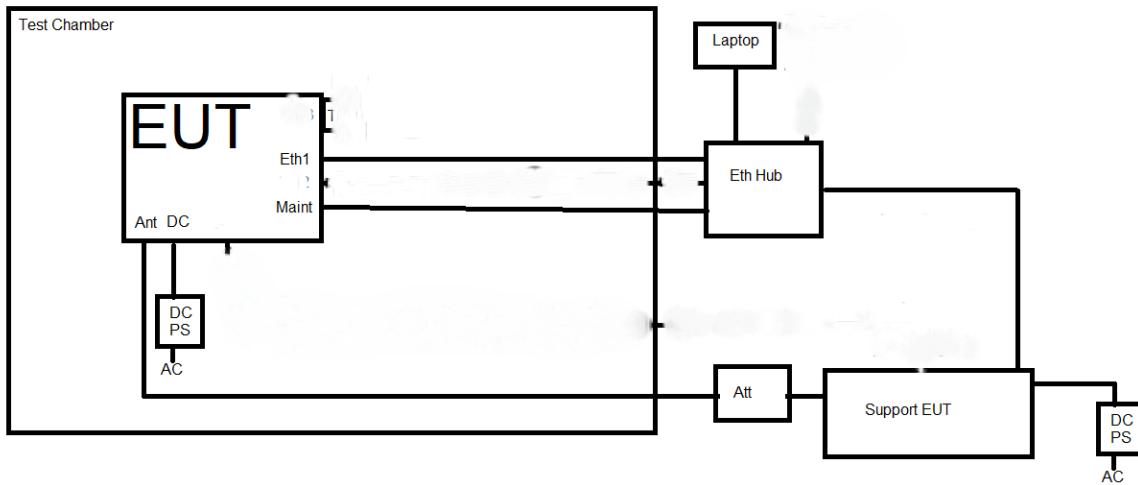


AC/DC Switching Adaptor

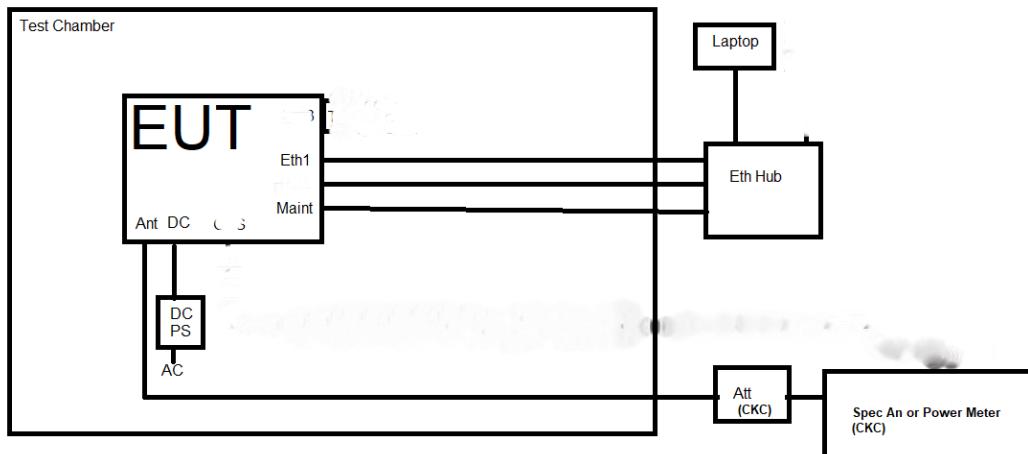
Block Diagram of Test Setup(s)

Config#	Setup Description of Block Diagram
Radiated	EUT connected to ethernet hub connect to laptop and support EUT. EUT connected to attenuator and support equipment.
Conducted	EUT connected to attenuator connected to spectrum analyzer EUT connected to ethernet hub connected to laptop

Radiated



Conducted



FCC Part 90 Subpart T and K

90.205, 90.723, 90.729, 90.259 Power Output

Test Setup/Conditions			
Test Location:	Bothell Lab Bench	Test Engineer:	S. Bernardo
Test Method:	ANSI C63.26 (2015)	Test Date(s):	12/31/2024
Configuration:	3		
Test Setup:	<p>The unit is in a temperature chamber for temperature variation. The voltage is varied. The EUT's RF port is connected to a spectrum analyzer with appropriate attenuation. The bandwidth settings are low enough to resolve the center frequency of the emission. Once the EUT transmitter is turned on, it is transmitting continuously with its normal duty cycle, full rate.</p> <p>The applicable limits are:</p> <ol style="list-style-type: none"> 1) 217-220MHz: up to 2W according to 90.259 2) 220-221MHz: up to 50W according to 90.729 3) 221-222MHz: up to 500W according to 90.723 <p>Per the manufacturer, the max power is recorded for all channels tested and the licensee must consider these limitations.</p>		

Environmental Conditions			
Temperature (°C)	21.5	Relative Humidity (%):	38.6

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
C00194	30db Attenuator	Fairview Microwave	SA3N1007-30	9/26/2024	9/26/2026
02757	Temperature Chamber	Bemco	F100/350-8	11/1/2024	11/1/2026
03803	Spectrum Analyzer	Agilent	E4440A	2/12/2024	2/12/2026
03029	Thermometer, Digital Infrared	Fluke	566	4/14/2023	4/14/2025

Test Data Summary - RF Conducted Measurement (Ch1)

Frequency (MHz)	Temperature (°C)	Voltage	Modulation	Conducted Power (dbm)	Conducted Power (Watts)	Results
217.6125	-30	V _{Nom}	Full Rate	44.40	27.54229	Pass
217.6125	-20	V _{Nom}	Full Rate	44.37	27.35269	Pass
217.6125	-10	V _{Nom}	Full Rate	44.33	27.10192	Pass
217.6125	0	V _{Nom}	Full Rate	44.30	26.91535	Pass
217.6125	10	V _{Nom}	Full Rate	44.52	28.31392	Pass
217.6125	20	V _{Nom}	Full Rate	44.4	27.54229	Pass
217.6125	30	V _{Nom}	Full Rate	44.52	28.31392	Pass
217.6125	40	V _{Nom}	Full Rate	44.50	28.18383	Pass
217.6125	50	V _{Nom}	Full Rate	44.36	27.28978	Pass
217.6125	20	V _{Min}	Full Rate	44.5	28.18383	Pass
217.6125	20	V _{Max}	Full Rate	44.51	28.2488	Pass

Test Data Summary - RF Conducted Measurement (Ch96)

Frequency (MHz)	Temperature (°C)	Voltage	Modulation	Conducted Power (dbm)	Conducted Power (Watts)	Results
219.9875	-30	V _{Nom}	Full Rate	44.34	27.16439	Pass
219.9875	-20	V _{Nom}	Full Rate	44.36	27.28978	Pass
219.9875	-10	V _{Nom}	Full Rate	44.38	27.41574	Pass
219.9875	0	V _{Nom}	Full Rate	44.40	27.54229	Pass
219.9875	10	V _{Nom}	Full Rate	44.52	28.31392	Pass
219.9875	20	V _{Nom}	Full Rate	44.40	27.54229	Pass
219.9875	30	V _{Nom}	Full Rate	44.45	27.86121	Pass
219.9875	40	V _{Nom}	Full Rate	44.50	28.18383	Pass
219.9875	50	V _{Nom}	Full Rate	44.49	28.11901	Pass
219.9875	20	V _{Min}	Full Rate	44.44	27.79713	Pass
219.9875	20	V _{Max}	Full Rate	44.33	27.10192	Pass

Test Data Summary - RF Conducted Measurement (Ch97)

Frequency (MHz)	Temperature (°C)	Voltage	Modulation	Conducted Power (dbm)	Conducted Power (Watts)	Results
220.0125	-30	V _{Nom}	Full Rate	44.33	27.10192	Pass
220.0125	-20	V _{Nom}	Full Rate	44.34	27.16439	Pass
220.0125	-10	V _{Nom}	Full Rate	44.38	27.41574	Pass
220.0125	0	V _{Nom}	Full Rate	44.44	27.79713	Pass
220.0125	10	V _{Nom}	Full Rate	44.35	27.22701	Pass
220.0125	20	V _{Nom}	Full Rate	44.46	27.92544	Pass
220.0125	30	V _{Nom}	Full Rate	44.50	28.18383	Pass
220.0125	40	V _{Nom}	Full Rate	44.50	28.18383	Pass
220.0125	50	V _{Nom}	Full Rate	44.55	28.51018	Pass
220.0125	20	V _{Min}	Full Rate	44.47	27.98981	Pass
220.0125	20	V _{Max}	Full Rate	44.47	27.98981	Pass

Test Data Summary - RF Conducted Measurement (Ch176)

Frequency (MHz)	Temperature (°C)	Voltage	Modulation	Conducted Power (dbm)	Conducted Power (Watts)	Results
221.9875	-30	V _{Nom}	Full Rate	43.97	26.85344	Pass
221.9875	-20	V _{Nom}	Full Rate	44.32	27.03958	Pass
221.9875	-10	V _{Nom}	Full Rate	44.35	27.22701	Pass
221.9875	0	V _{Nom}	Full Rate	44.38	27.41574	Pass
221.9875	10	V _{Nom}	Full Rate	44.40	27.54229	Pass
221.9875	20	V _{Nom}	Full Rate	44.38	27.41574	Pass
221.9875	30	V _{Nom}	Full Rate	44.50	28.18383	Pass
221.9875	40	V _{Nom}	Full Rate	44.44	27.79713	Pass
221.9875	50	V _{Nom}	Full Rate	44.52	28.31392	Pass
221.9875	20	V _{Min}	Full Rate	44.32	27.03958	Pass
221.9875	20	V _{Max}	Full Rate	44.41	27.60578	Pass

Parameter Definitions:

Measurements performed at input voltage according to manufacturer specification.

Parameter	Value
V _{Nom} :	12
V _{Min} :	10.9
V _{Max} :	15.5

Test Setup Photo(s)



View 1



View 2

90.209, 90.733 (d) Occupied Bandwidth

Test Setup/Conditions			
Test Location:	Bothell Lab Bench	Test Engineer:	C. Plumadore
Test Method:	ANSI C63.26 (2015)	Test Date(s):	12/16/2024
Configuration:	1		
Test Setup:	<p>The EUT's RF port is connected to a spectrum analyzer directly with appropriate attenuation. The EUT is transmitting continuously with its normal duty cycle, full rate.</p> <p>The bandwidth limitations are considered in 90.209 as well as 90.733 where channel aggregation is used, the authorized bandwidth is assumed to be 20kHz for the Full Rate modulation.</p>		

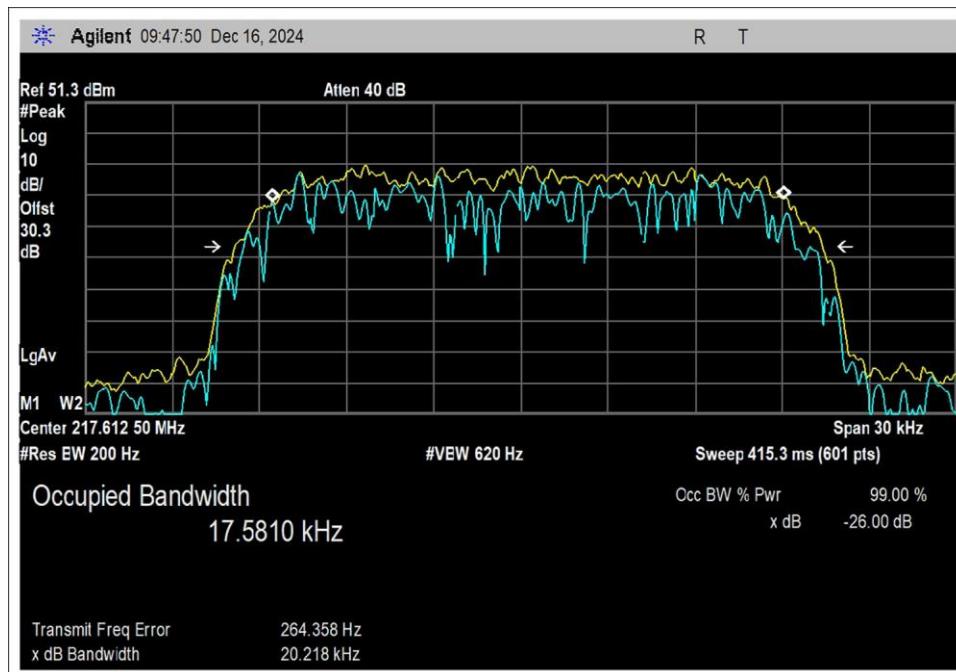
Environmental Conditions			
Temperature (°C)	21.5	Relative Humidity (%):	38.6

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
P06965	Cable	Andrews	Heliax	7/1/2024	7/1/2026
02673	Spectrum Analyzer	Agilent	E4446A	3/8/2024	3/8/2026
C00194	30db Attenuator	Fairview Microwave	SA3N1007-30	9/26/2024	9/26/2026

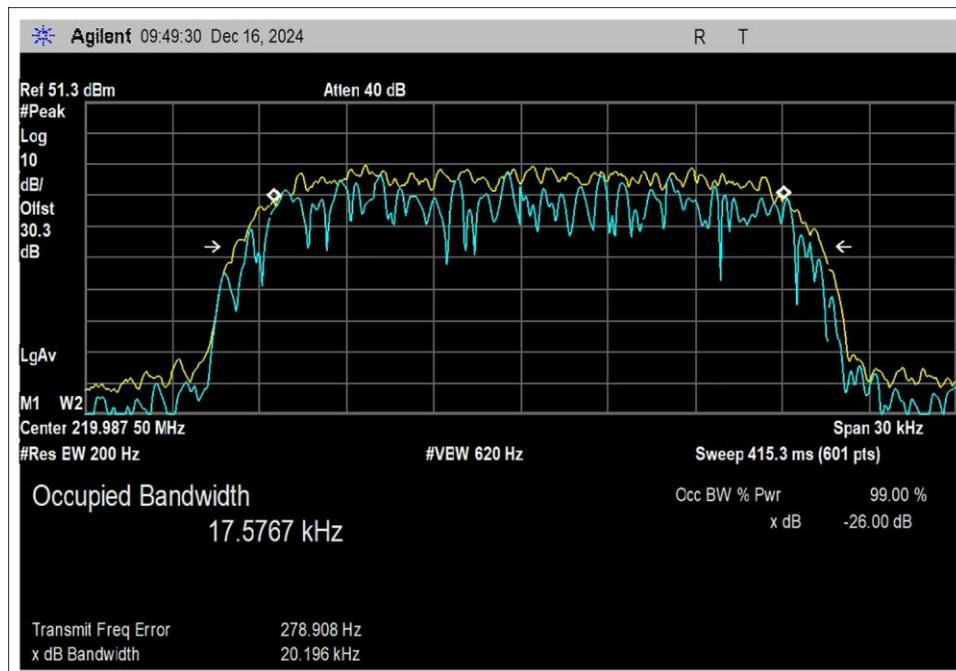
99% Occupied Bandwidth

Test Data Summary				
Frequency (MHz)	Modulation	Measured (kHz)	Limit (kHz)	Results
217.6125	Full Rate	17.5810	≤20	Pass
219.9875	Full Rate	17.5767	≤20	Pass
220.0125	Full Rate	17.6157	≤20	Pass
221.9875	Full Rate	17.5839	≤20	Pass

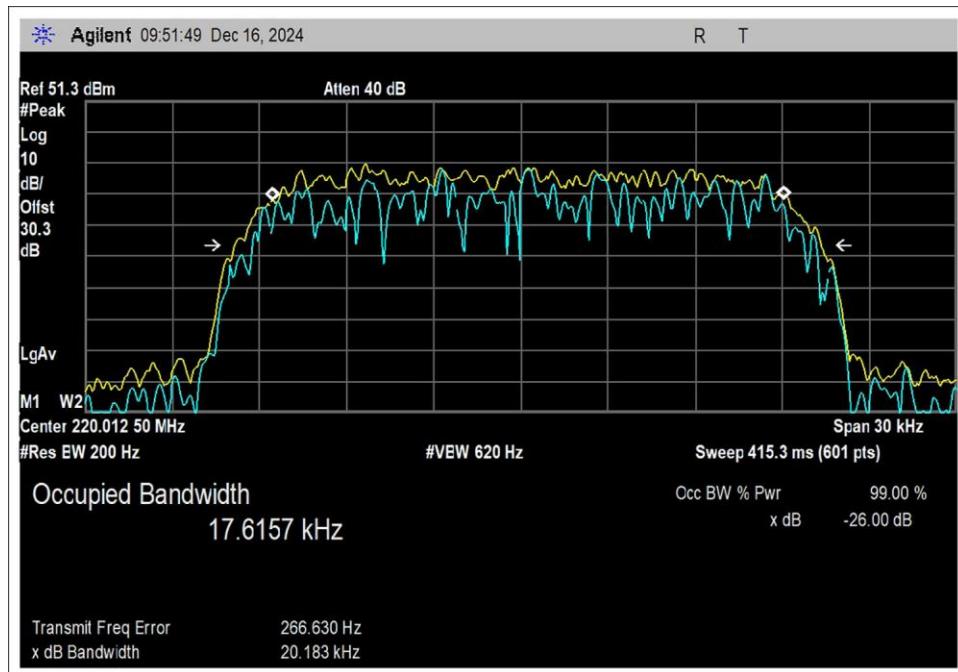
Plot(s)



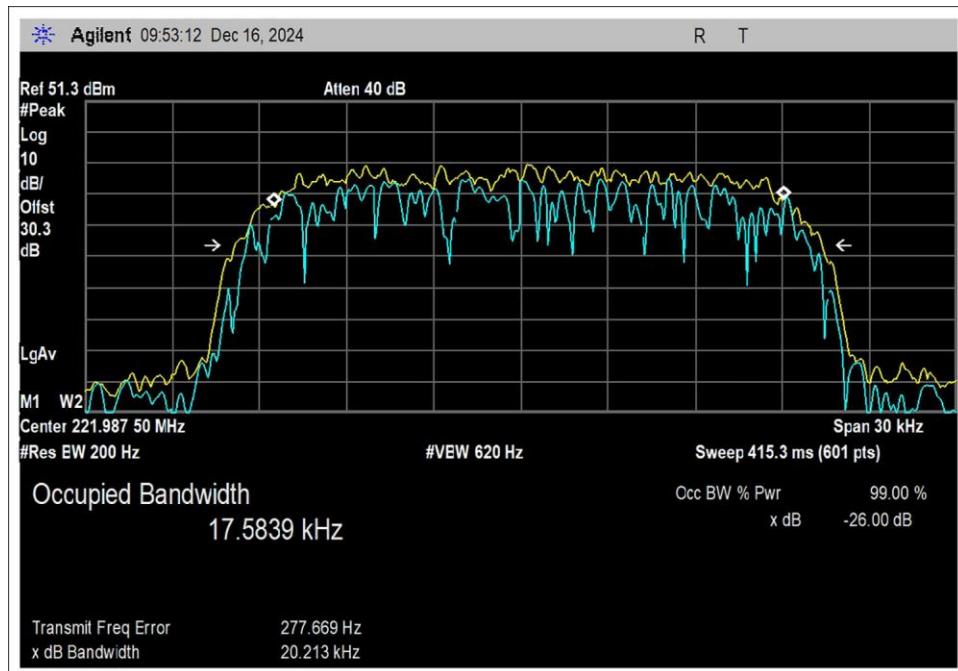
Channel 1 Full Rate



Channel 96 Full Rate



Channel 97 Full Rate



Channel 176 Full Rate

Test Setup Photo(s)



90.213 Frequency Stability

Test Setup/Conditions			
Test Location:	Bothell Lab Bench	Test Engineer:	S. Bernardo
Test Method:	ANSI C63.26 (2015)	Test Date(s):	12/31/2024
Configuration:	3		
Test Setup:	<p>The unit is in a temperature chamber for temperature variation. The voltage is varied and measured with a DMM. The EUT's RF port is connected to a spectrum analyzer directly with appropriate attenuation. The bandwidth settings are low enough to resolve the center frequency of the emission. Once the EUT transmitter is turned on, it is transmitting continuously with its normal duty cycle, full rate and half rate modulations investigated.</p> <p>Per 90.213, the manufacturer declares the EUT is a mobile station, the limit in the table for frequencies falling in the band 216-220MHz is 1.0ppm, for band 220-222 MHz the limit is 1.5ppm.</p>		

Environmental Conditions			
Temperature (°C)	21.5	Relative Humidity (%):	38.6

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
C00194	30db Attenuator	Fairview Microwave	SA3N1007-30	9/26/2024	9/26/2026
02757	Temperature Chamber	Bemco	F100/350-8	11/1/2024	11/1/2026
03803	Spectrum Analyzer	Agilent	E4440A	2/12/2024	2/12/2026
03029	Thermometer, Digital Infrared	Fluke	566	4/14/2023	4/14/2025

Test Data Summary

Modulation: full Rate

Temp (°C)	Voltage	Ch 1 (PPM)	Ch 96 (PPM)	Ch 97 (PPM)	Ch176 (PPM)	Results
-30	V _{Nom}	0.91906	0.84096	0.79995	0.78383	Pass
-20	V _{Nom}	0.83635	0.79095	0.74541	0.72527	
-10	V _{Nom}	0.69849	0.65913	0.61360	0.59012	
0	V _{Nom}	0.49630	0.45912	0.43179	0.41444	
10	V _{Nom}	0.39979	0.37275	0.34998	0.52255	
20	V _{Nom}	0.34924	0.32729	0.31362	0.34236	
30	V _{Nom}	0.24815	0.23183	0.20908	0.18920	
40	V _{Nom}	0.02757	0.00909	0.05454	0.07208	
50	V _{Nom}	0.15624	0.15455	0.15454	0.15316	
20	V _{Min}	0.34924	0.32729	0.30907	0.78383	
20	V _{Max}	0.08272	0.22729	0.18181	0.72527	
Maximum Deviation		0.91906	0.84096	0.79995	0.78383	

Parameter Definitions:

Measurements performed at input voltage according to manufacturer specification.

Parameter	Value
V _{Nom} :	12
V _{Min} :	10.9
V _{Max} :	15.5

Test Setup Photo(s)



View 1



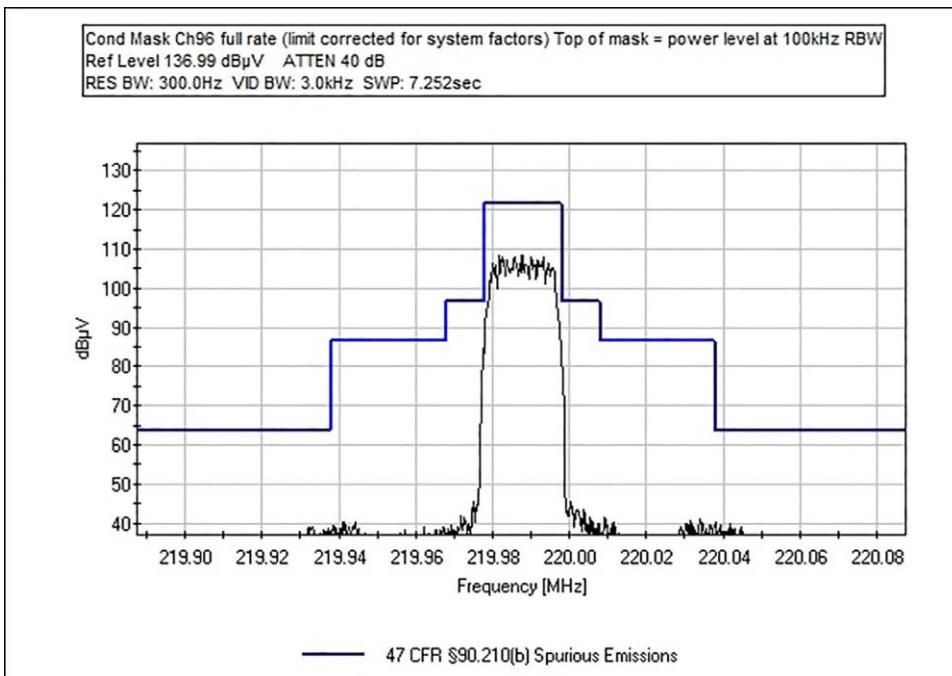
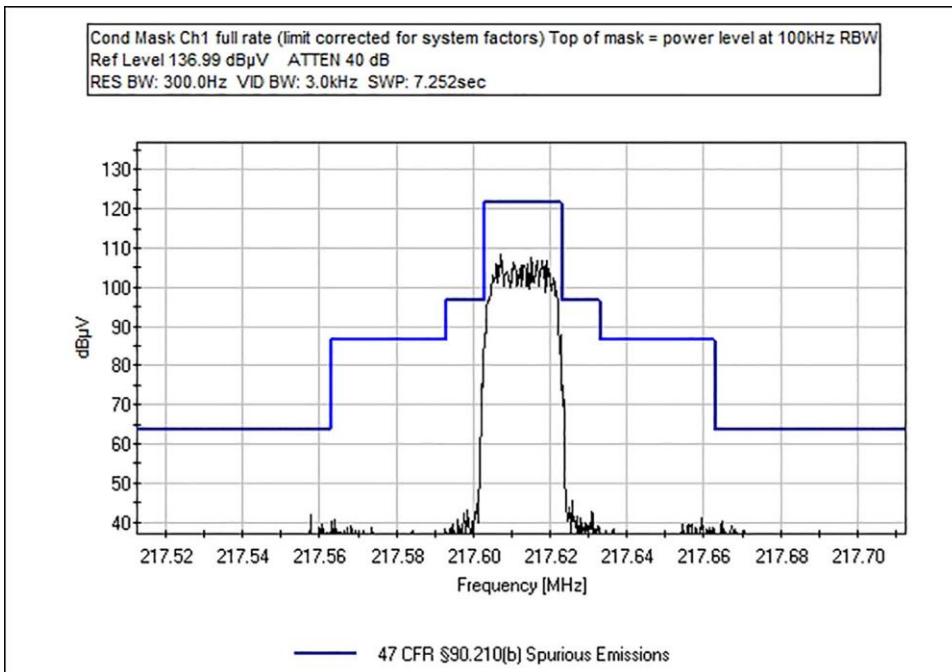
View 2

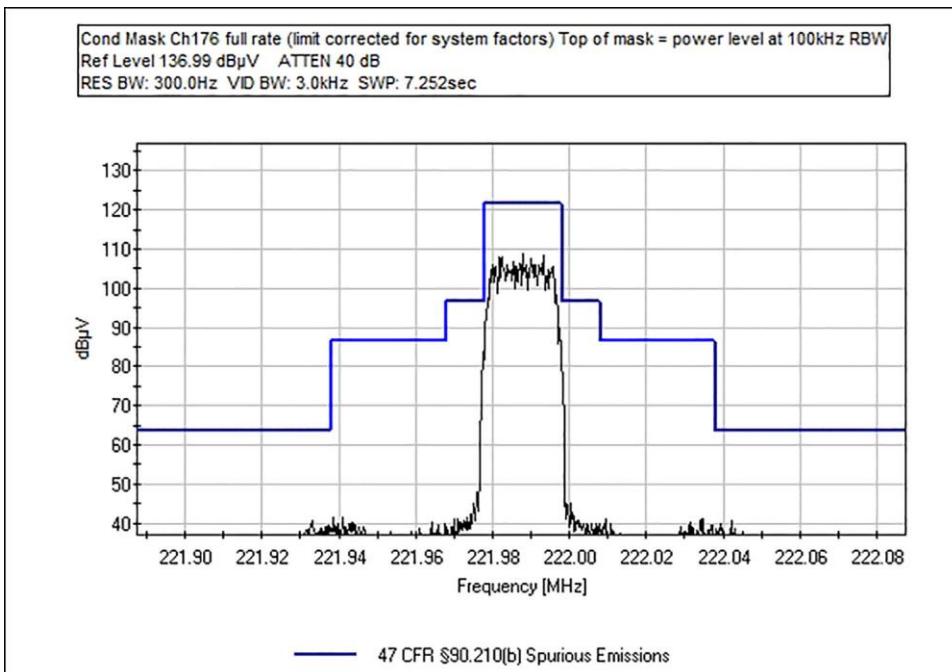
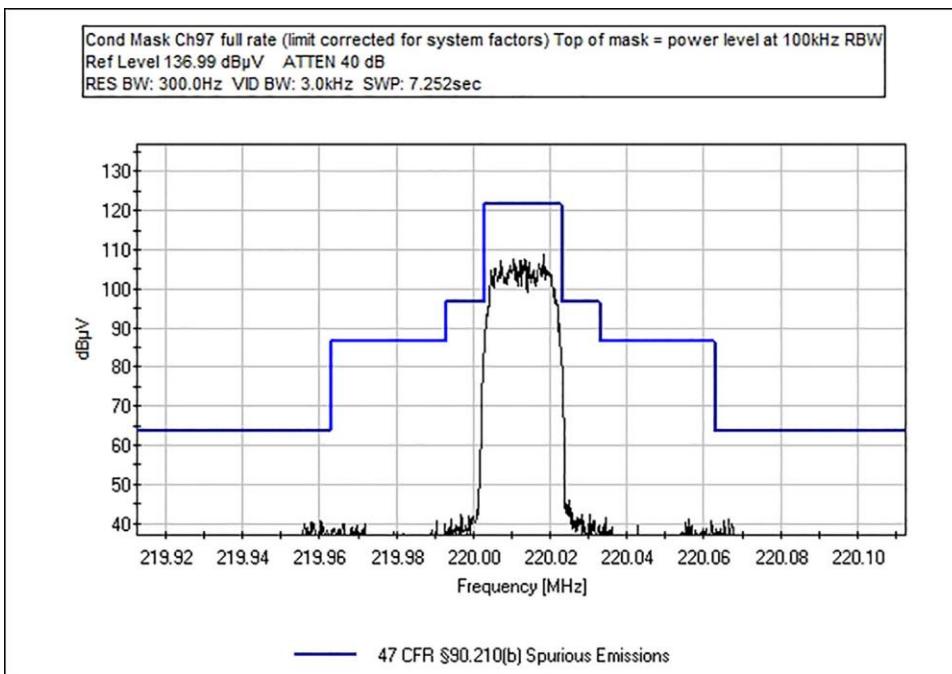
90.210 Conducted Emission Mask and Spurs

Test Setup/Conditions			
Test Location:	Bothell Lab Bench	Test Engineer:	C. Plumadore
Test Method:	ANSI C63.26 (2015)	Test Date(s):	12/16/2024
Configuration:	3		
Test Setup:	<p>The EUT's RF port is connected to a spectrum analyzer directly with appropriate attenuation. The EUT is transmitting continuously with its normal duty cycle, full rate.</p> <p>Outside of the span shown in the emission mask plots, the following bandwidths were used:</p> <p>9kHz-150kHz: 200Hz RBW 150kHz-30MHz: 9kHz RBW 30-1000MHz: 100kHz RBW 1000MHz and above: 1MHz RBW</p> <p>Average values as indicated on datasheet are RMS.</p> <p>Per the manufacturer, a 20kHz ABW for Full Rate was used to build 90.210B masks accordingly, it will be up the licensee to ensure the mask applicability.</p>		

Environmental Conditions			
Temperature (°C)	22.3	Relative Humidity (%):	40.2

Plot(s)





Test Data

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • (425) 402-1717
 Customer: **Meteorcomm LLC**
 Specification: **47 CFR §90.210(b) Spurious Emissions**
 Work Order #: **110562** Date: 12/16/2024
 Test Type: **Conducted Emissions** Time: 11:42:01
 Tested By: C. Plumadore Sequence#: 2
 Software: EMITest 5.03.20 12VDC

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

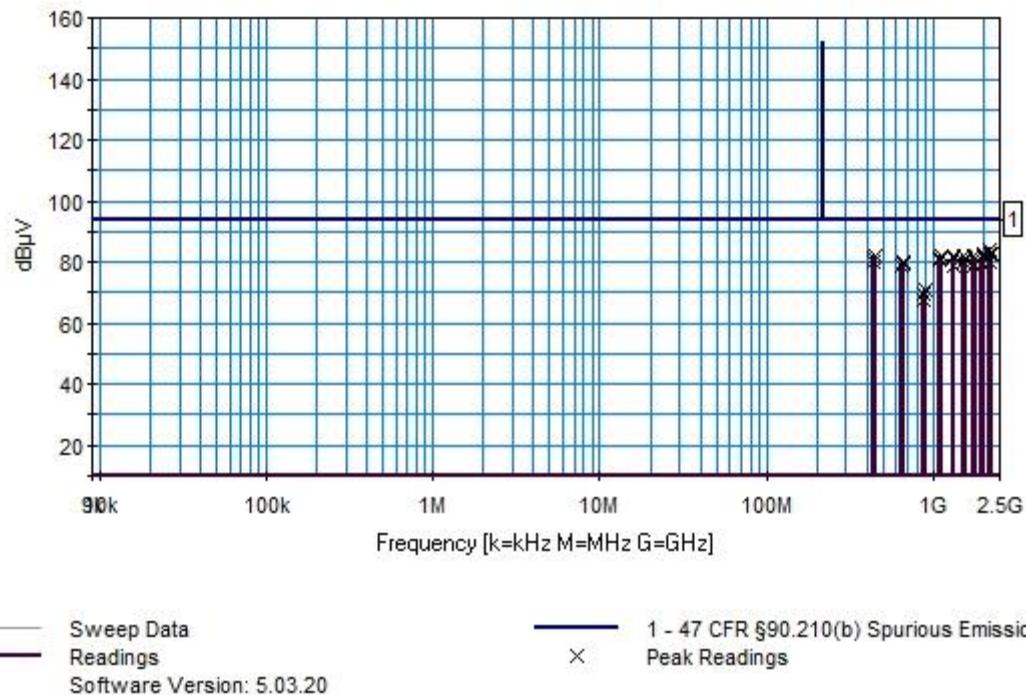
Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Test Environment Conditions:
Temperature: 21.5°C
Pressure: 101.0kPa
Humidity: 38.6%
Frequency: 9kHz-2.5GHz
Test Method: ANSI C63.26
Test Set up: EUT powered by Mean Well power supply. EUT connected to laptop through Ethernet.



Meteorcomm LLC. WO#: 110562 Sequence#: 2 Date: 12/16/2024
 47 CFR §90.210(b) Spurious Emissions Test Lead: 12VDC ANT



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANC00194	Attenuator	SA3N1007-30	9/26/2024	9/26/2026
T2	ANP06965	Cable	Heliax	7/1/2024	7/1/2026
	AN02673	Spectrum Analyzer	E4446A	3/8/2024	3/8/2026

Measurement Data:			Reading listed by margin.			Test Lead: ANT				
#	Freq MHz	Rdng dB μ V	T1 dB	T2 dB	dB	Dist Table	Corr dB μ V	Spec dB μ V	Margin dB	Polar Ant
1	2200.247M	52.2	+30.2	+1.3		+0.0	83.7	94.0	-10.3	ANT
							ch 97			
2	2200.561M	51.3	+30.2	+1.3		+0.0	82.8	94.0	-11.2	ANT
							CH 96			
3	2220.059M	51.3	+30.2	+1.3		+0.0	82.8	94.0	-11.2	ANT
							CH176			
4	1997.514M	51.1	+30.2	+1.2		+0.0	82.5	94.0	-11.5	ANT
							CH176			
5	1980.496M	50.9	+30.2	+1.2		+0.0	82.3	94.0	-11.7	ANT
							ch 97			
6	1980.272M	50.9	+30.2	+1.2		+0.0	82.3	94.0	-11.7	ANT
							CH 96			
7	1759.344M	50.7	+30.2	+1.1		+0.0	82.0	94.0	-12.0	ANT
							CH 96			
8	1109.188M	51.0	+30.0	+0.9		+0.0	81.9	94.0	-12.1	ANT
							CH176			
9	1759.212M	50.5	+30.2	+1.1		+0.0	81.8	94.0	-12.2	ANT
							ch 97			
10	1319.659M	50.7	+30.1	+1.0		+0.0	81.8	94.0	-12.2	ANT
							ch 97			
11	1540.148M	50.7	+30.1	+1.0		+0.0	81.8	94.0	-12.2	ANT
							ch 97			
12	443.971M	51.2	+30.0	+0.6		+0.0	81.8	94.0	-12.2	ANT
							CH176			
13	1099.908M	50.8	+30.0	+0.9		+0.0	81.7	94.0	-12.3	ANT
							ch 97			
14	440.015M	51.0	+30.0	+0.6		+0.0	81.6	94.0	-12.4	ANT
							ch 97			
15	439.987M	51.0	+30.0	+0.6		+0.0	81.6	94.0	-12.4	ANT
							CH 96			
16	1332.283M	50.5	+30.1	+1.0		+0.0	81.6	94.0	-12.4	ANT
							CH176			
17	1775.614M	50.2	+30.2	+1.1		+0.0	81.5	94.0	-12.5	ANT
							CH176			
18	1553.038M	50.4	+30.1	+1.0		+0.0	81.5	94.0	-12.5	ANT
							CH176			
19	1540.516M	50.3	+30.1	+1.0		+0.0	81.4	94.0	-12.6	ANT
							CH 96			
20	1319.667M	50.2	+30.1	+1.0		+0.0	81.3	94.0	-12.7	ANT
							CH 96			
21	1100.848M	50.1	+30.0	+0.9		+0.0	81.0	94.0	-13.0	ANT
							CH 96			
22	1088.076M	49.7	+30.0	+0.9		+0.0	80.6	94.0	-13.4	ANT
							CH1			
23	435.195M	49.7	+30.0	+0.6		+0.0	80.3	94.0	-13.7	ANT
							CH1			
24	2176.139M	48.6	+30.2	+1.3		+0.0	80.1	94.0	-13.9	ANT
							CH1			

25	665.940M	49.3	+30.0	+0.7	+0.0	80.0	94.0	-14.0	ANT
						CH176			
26	1523.302M	48.8	+30.1	+1.0	+0.0	79.9	94.0	-14.1	ANT
						CH1			
27	660.058M	48.7	+30.0	+0.7	+0.0	79.4	94.0	-14.6	ANT
						ch 97			
28	659.952M	48.7	+30.0	+0.7	+0.0	79.4	94.0	-14.6	ANT
						CH 96			
29	1958.526M	47.9	+30.2	+1.2	+0.0	79.3	94.0	-14.7	ANT
						CH1			
30	1740.914M	47.6	+30.2	+1.1	+0.0	78.9	94.0	-15.1	ANT
						CH1			
31	652.838M	48.1	+30.0	+0.6	+0.0	78.7	94.0	-15.3	ANT
						CH1			
32	1305.689M	47.5	+30.1	+1.0	+0.0	78.6	94.0	-15.4	ANT
						CH1			
33	887.498M	40.0	+30.0	+0.8	+0.0	70.8	94.0	-23.2	ANT
						CH176			
34	880.306M	39.0	+30.0	+0.8	+0.0	69.8	94.0	-24.2	ANT
						ch 97			
35	870.450M	37.1	+30.0	+0.8	+0.0	67.9	94.0	-26.1	ANT
						CH1			

Test Setup Photo(s)



90.210 Radiated Spurious Emissions

Test Setup/Conditions				
Test Location:	Bothell Lab C3	Test Engineer:	C. Plumadore	
Test Method:	ANSI C63.26 (2015)	Test Date(s):	12/19/2024	
Configuration:	2 and 3			
Test Setup:	<p>Outside of the span shown in the emission mask plots, the following bandwidths were used:</p> <p>9kHz-150kHz: 200Hz RBW 150kHz-30MHz: 9kHz RBW 30-1000MHz: 100kHz RBW 1000MHz and above: 1MHz RBW</p> <p>For the final tabular converted to dBm uses equation (d) from ANSI C63.26 (2015) 5.2.7:</p> <p>$EIRP (dBm) = E (dB \mu V/m) + 20\log(D) - 104.8$; where D is the measurement distance (in the far field region) in m.</p> <p>Per 80.211f:</p> <ul style="list-style-type: none"> (1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB; (2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus $10\log_{10}$ (mean power in watts) dB. <p>Limit = Power – Required Attenuation</p> $ \begin{aligned} &= 10 \log P - (43 + 10 \log P) \\ &= 10 \log P - 43 - 10 \log P \\ &= -43 \text{ dBW} \\ &= 0.00005 \text{W (0.05mW)} \\ &= 10 \log 0.00005 / 0.001 \\ &= -13 \text{dBm (94dB}\mu\text{V) at any power level.} \end{aligned} $			

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
03824	Biconilog Antenna	ETS-Lindgren	3142E	5/9/2023	5/9/2025
P05333	Cable	Andrews	Heliax	8/8/2023	8/8/2025
P05360	Cable	Belden	RG214	8/8/2023	8/8/2025
P06011	Cable	Andrew	Heliax	11/16/2023	11/16/2025
03803	Spectrum Analyzer	Agilent	E4440A	2/12/2024	2/12/2026
02307	Preamp	HP	8447D	8/9/2023	8/9/2025
00052	Loop Antenna	EMCO	6502	4/19/2024	4/19/2026
02374ANSI	Horn Antenna	Electrometrics	RGA-60	5/26/2023	5/26/2025
03540	Preamp	HP	83017A	3/24/2023	3/24/2025
P06515	Cable	Andrews	Heliax	2/28/2024	2/28/2026
P07504	Cable	TMS	CLU40-KMKM-02.00F	1/19/2024	1/19/2026

Test Data Summary (Above 1GHz)				
Frequency (MHz)	Measured (dB μ V/m) @ 3m	Convert to EIRP (dBm)	Limit (dBm)	Results
1088.221	57.9	-37.3	-13	Pass
1099.754	60	-35.2	-13	Pass
1100.204	61.2	-34	-13	Pass
1110.012	61.8	-33.4	-13	Pass
1305.575	54.7	-40.5	-13	Pass
1319.95	59.7	-35.5	-13	Pass
1320.108	59.4	-35.8	-13	Pass
1331.808	59.9	-35.3	-13	Pass
1523.104	54.9	-40.3	-13	Pass
1539.896	52.3	-42.9	-13	Pass
1540.071	51.4	-43.8	-13	Pass
1553.879	59	-36.2	-13	Pass
1740.817	60.9	-34.3	-13	Pass
1759.883	57.4	-37.8	-13	Pass
1760.275	57.4	-37.8	-13	Pass
1775.875	60.6	-34.6	-13	Pass
1958.746	46.8	-48.4	-13	Pass
1979.521	45.8	-49.4	-13	Pass
1980.138	44.6	-50.6	-13	Pass
1997.921	51.6	-43.6	-13	Pass
2175.867	53.7	-41.5	-13	Pass
2199.642	46.2	-49	-13	Pass
2199.983	47.1	-48.1	-13	Pass
2219.717	49.9	-45.3	-13	Pass
2219.717	49.9	-45.3	-13	Pass
2219.717	49.9	-45.3	-13	Pass

Test Data Summary (30-1000MHz)				
Frequency (MHz)	Measured (dB μ V/m) @ 3m	Convert to EIRP (dBm)	Limit (dBm)	Results
435.205	47	-48.2	-13	Pass
439.956	49.1	-46.1	-13	Pass
440.026	50.3	-44.9	-13	Pass
443.966	46.5	-48.7	-13	Pass
652.829	40.2	-55	-13	Pass
659.944	36.9	-58.3	-13	Pass
660.025	34.5	-60.7	-13	Pass
665.942	35.1	-60.1	-13	Pass
870.471	44.2	-51	-13	Pass
879.96	41.6	-53.6	-13	Pass
880.022	41	-54.2	-13	Pass
887.927	34.8	-60.4	-13	Pass

Test Data Summary (9kHz-30MHz)				
Frequency (MHz)	Measured (dB μ V/m) @ 3m	Convert to EIRP (dBm)	Limit (dBm)	Results
0.021	45.8	-49.4	-13	Pass
0.021	38.9	-56.3	-13	Pass
0.021	35.5	-59.7	-13	Pass
0.051	45.2	-50	-13	Pass
0.051	43.2	-52	-13	Pass
0.073	38.8	-56.4	-13	Pass
27.61	18.6	-76.6	-13	Pass
29.9	25.2	-70	-13	Pass

Test Conditions / Setup

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • (425) 402-1717
 Customer: **Meteorcomm LLC.**
 Specification: **47 CFR §90.210(b) Spurious Emissions**
 Work Order #: **110562** Date: 12/18/2024
 Test Type: **Radiated Scan** Time: 11:00:43
 Tested By: C. Plumadore Sequence#: 6
 Software: EMITest 5.03.20

Equipment Tested:

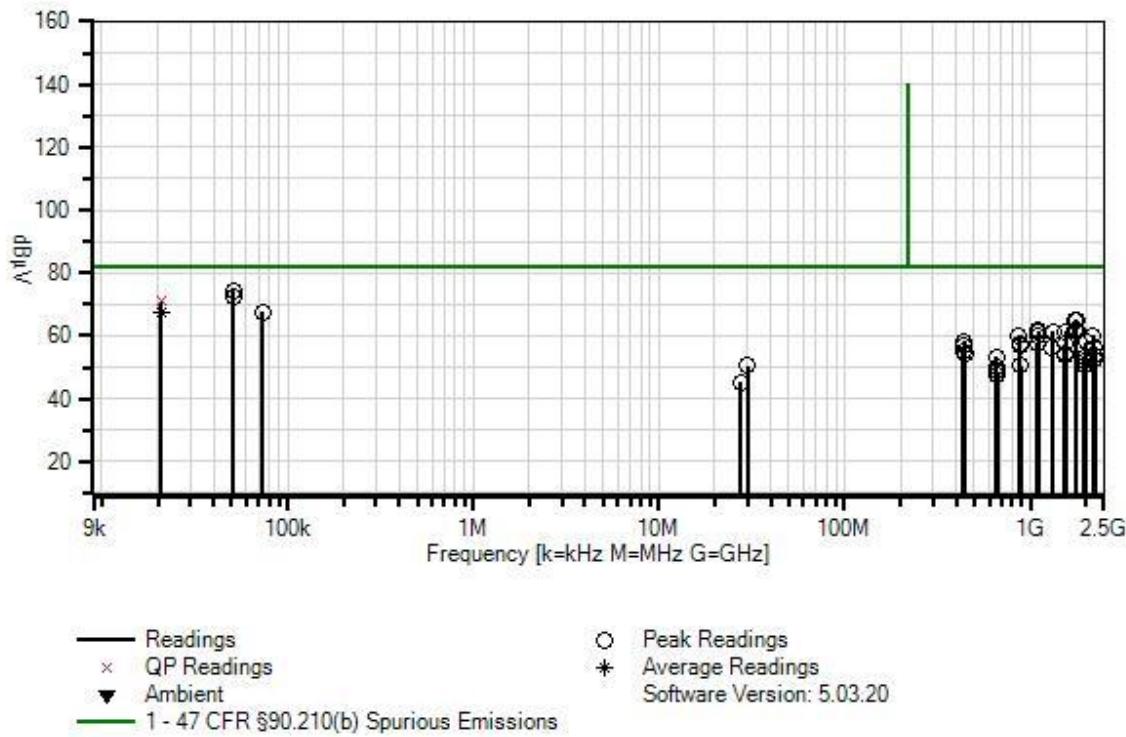
Device	Manufacturer	Model #	S/N
Configuration 2 & Configuration 3			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2 & Configuration 3			

Test Conditions / Notes:

Test Environment Conditions:
Temperature: 21.5°C
Pressure: 101.0kPa
Humidity: 38.6%
Frequency: 9kHz-2.5GHz
Test Method: ANSI C63.4
Test set up:
EUT powered by Mean Well power supply
EUT connected to laptop through ethernet outside of chamber
Traffic on ethernet lines
Transmitter on 10% duty cycle
Power set to 44.96

Meteorcomm LLC. WO#: 110562 Sequence#: 6 Date: 12/18/2024
 47 CFR §90.210(b) Spurious Emissions Test Distance: 3 Meters Vert

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN03824	Biconilog Antenna	3142E	5/9/2023	5/9/2025
T2	ANP05333	Cable	Heliax	8/8/2023	8/8/2025
T3	ANP05360	Cable	RG214	8/8/2023	8/8/2025
T4	ANP06011	Cable	Heliax	11/16/2023	11/16/2025
T5	AN03803	Spectrum Analyzer	E4440A	2/12/2024	2/12/2026
T6	AN02307	Preamp	8447D	8/9/2023	8/9/2025
T7	AN00052	Loop Antenna	6502	4/19/2024	4/19/2026
T8	AN02374ANSI	Horn Antenna	RGA-60	5/26/2023	5/26/2025
T9	AN03540	Preamp	83017A	3/24/2023	3/24/2025
T10	ANP06515	Cable	Heliax	2/28/2024	2/28/2026
T11	ANP07504	Cable	CLU40-KMKM-02.00F	1/19/2024	1/19/2026

Measurement Data:			Reading listed by margin.				Test Distance: 3 Meters				
#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5	T6	T7	T8	Table	dB μ V	dB μ V	dB	Ant
	MHz	dB μ V	dB	dB	dB	dB	Table	dB μ V	dB μ V	dB	Ant
1	50.830k	45.2	+0.0	+0.0	+0.0	+0.0	+19.1	74.5	82.2	-7.7	paral
			+0.0	+0.0	+10.2	+0.0					
			+0.0	+0.0	+0.0						
2	51.300k	43.2	+0.0	+0.0	+0.0	+0.0	+19.1	72.5	82.2	-9.7	perp
			+0.0	+0.0	+10.2	+0.0					
			+0.0	+0.0	+0.0						
3	20.750k	38.9	+0.0	+0.0	+0.0	+0.0	+19.1	70.9	82.2	-11.3	perp
	QP		+0.0	+0.0	+12.9	+0.0					
			+0.0	+0.0	+0.0						
4	73.390k	38.8	+0.0	+0.0	+0.0	+0.0	+19.1	67.7	82.2	-14.5	paral
			+0.0	+0.0	+9.8	+0.0					
			+0.0	+0.0	+0.0						
5	20.750k	35.5	+0.0	+0.0	+0.0	+0.0	+19.1	67.5	82.2	-14.7	perp
	Ave		+0.0	+0.0	+12.9	+0.0					
			+0.0	+0.0	+0.0						
^	20.750k	45.8	+0.0	+0.0	+0.0	+0.0	+19.1	77.8	82.2	-4.4	perp
			+0.0	+0.0	+12.9	+0.0					
			+0.0	+0.0	+0.0						
7	1775.875M	60.6	+0.0	+0.0	+0.0	+0.6	+9.5	65.2	82.2	-17.0	Vert
			+0.0	+0.0	+0.0	+27.0					
			-35.1	+2.2	+0.4			CH 176			
8	1740.817M	60.9	+0.0	+0.0	+0.0	+0.6	+9.5	64.9	82.2	-17.3	Vert
			+0.0	+0.0	+0.0	+26.5					
			-35.2	+2.2	+0.4			CH 1			
9	1759.883M	57.4	+0.0	+0.0	+0.0	+0.6	+9.5	61.8	82.2	-20.4	Vert
			+0.0	+0.0	+0.0	+26.8					
			-35.1	+2.2	+0.4			CH 96			
10	1760.275M	57.4	+0.0	+0.0	+0.0	+0.6	+9.5	61.8	82.2	-20.4	Vert
			+0.0	+0.0	+0.0	+26.8					
			-35.1	+2.2	+0.4			CH 97			
11	1110.012M	61.8	+0.0	+0.0	+0.0	+0.4	+9.5	61.6	82.2	-20.6	Vert
			+0.0	+0.0	+0.0	+24.8					
			-36.9	+1.7	+0.3			CH 176			
12	1331.808M	59.9	+0.0	+0.0	+0.0	+0.5	+9.5	61.5	82.2	-20.7	Vert
			+0.0	+0.0	+0.0	+25.4					
			-36.0	+1.9	+0.3			CH 176			
13	1553.879M	59.0	+0.0	+0.0	+0.0	+0.5	+9.5	61.3	82.2	-20.9	Vert
			+0.0	+0.0	+0.0	+25.4					
			-35.5	+2.0	+0.4			CH 176			
14	1319.950M	59.7	+0.0	+0.0	+0.0	+0.5	+9.5	61.3	82.2	-20.9	Vert
			+0.0	+0.0	+0.0	+25.4					
			-36.0	+1.9	+0.3			CH 96			

15	1320.108M	59.4	+0.0	+0.0	+0.0	+0.5	+9.5	61.0	82.2	-21.2	Vert
			+0.0	+0.0	+0.0	+25.4			CH 97		
			-36.0	+1.9	+0.3						
16	1100.204M	61.2	+0.0	+0.0	+0.0	+0.4	+9.5	60.9	82.2	-21.3	Vert
			+0.0	+0.0	+0.0	+24.7			CH 97		
			-36.9	+1.7	+0.3						
17	2175.867M	53.7	+0.0	+0.0	+0.0	+0.7	+9.5	60.0	82.2	-22.2	Vert
			+0.0	+0.0	+0.0	+28.0			CH1		
			-34.8	+2.5	+0.4						
18	870.471M	44.2	+29.0	+1.5	+2.5	+0.4	+9.5	59.9	82.2	-22.3	Horiz
			+0.0	-27.2	+0.0	+0.0			CH 1		
			+0.0	+0.0	+0.0						
19	1099.754M	60.0	+0.0	+0.0	+0.0	+0.4	+9.5	59.7	82.2	-22.5	Vert
			+0.0	+0.0	+0.0	+24.7			CH 96		
			-36.9	+1.7	+0.3						
20	440.026M	50.3	+23.0	+1.0	+1.7	+0.3	+9.5	58.2	82.2	-24.0	Vert
			+0.0	-27.6	+0.0	+0.0			CH 97		
			+0.0	+0.0	+0.0						
21	1997.921M	51.6	+0.0	+0.0	+0.0	+0.7	+9.5	57.9	82.2	-24.3	Vert
			+0.0	+0.0	+0.0	+28.2			CH 176		
			-34.9	+2.4	+0.4						
22	1088.221M	57.9	+0.0	+0.0	+0.0	+0.4	+9.5	57.5	82.2	-24.7	Vert
			+0.0	+0.0	+0.0	+24.7			CH1		
			-37.0	+1.7	+0.3						
23	879.960M	41.6	+28.9	+1.5	+2.5	+0.4	+9.5	57.2	82.2	-25.0	Vert
			+0.0	-27.2	+0.0	+0.0			CH 96		
			+0.0	+0.0	+0.0						
24	1523.104M	54.9	+0.0	+0.0	+0.0	+0.5	+9.5	57.2	82.2	-25.0	Vert
			+0.0	+0.0	+0.0	+25.4			CH1		
			-35.5	+2.0	+0.4						
25	439.956M	49.1	+23.0	+1.0	+1.7	+0.3	+9.5	57.0	82.2	-25.2	Vert
			+0.0	-27.6	+0.0	+0.0			CH 96		
			+0.0	+0.0	+0.0						
26	880.022M	41.0	+28.9	+1.5	+2.5	+0.4	+9.5	56.6	82.2	-25.6	Vert
			+0.0	-27.2	+0.0	+0.0			CH 97		
			+0.0	+0.0	+0.0						
27	2219.717M	49.9	+0.0	+0.0	+0.0	+0.7	+9.5	56.4	82.2	-25.8	Vert
			+0.0	+0.0	+0.0	+28.1			CH 176		
			-34.7	+2.5	+0.4						
28	2219.717M	49.9	+0.0	+0.0	+0.0	+0.7	+9.5	56.4	82.2	-25.8	Vert
			+0.0	+0.0	+0.0	+28.1			CH 176		
			-34.7	+2.5	+0.4						
29	2219.717M	49.9	+0.0	+0.0	+0.0	+0.7	+9.5	56.4	82.2	-25.8	Vert
			+0.0	+0.0	+0.0	+28.1			CH 176		
			-34.7	+2.5	+0.4						
30	1305.575M	54.7	+0.0	+0.0	+0.0	+0.5	+9.5	56.1	82.2	-26.1	Vert
			+0.0	+0.0	+0.0	+25.4			CH1		
			-36.1	+1.8	+0.3						

31	435.205M	47.0	+23.1	+1.0	+1.7	+0.3	+9.5	55.0	82.2	-27.2	Horiz
			+0.0	-27.6	+0.0	+0.0				CH 1	
			+0.0	+0.0	+0.0						
32	1539.896M	52.3	+0.0	+0.0	+0.0	+0.5	+9.5	54.6	82.2	-27.6	Vert
			+0.0	+0.0	+0.0	+25.4				CH 96	
			-35.5	+2.0	+0.4						
33	443.966M	46.5	+23.1	+1.0	+1.7	+0.3	+9.5	54.4	82.2	-27.8	Vert
			+0.0	-27.7	+0.0	+0.0				CH 176	
			+0.0	+0.0	+0.0						
34	1540.071M	51.4	+0.0	+0.0	+0.0	+0.5	+9.5	53.7	82.2	-28.5	Vert
			+0.0	+0.0	+0.0	+25.4				CH 97	
			-35.5	+2.0	+0.4						
35	2199.983M	47.1	+0.0	+0.0	+0.0	+0.7	+9.5	53.6	82.2	-28.6	Vert
			+0.0	+0.0	+0.0	+28.1				CH 97	
			-34.7	+2.5	+0.4						
36	652.829M	40.2	+27.6	+1.3	+2.4	+0.3	+9.5	53.4	82.2	-28.8	Vert
			+0.0	-27.9	+0.0	+0.0				CH 1	
			+0.0	+0.0	+0.0						
37	1958.746M	46.8	+0.0	+0.0	+0.0	+0.7	+9.5	53.0	82.2	-29.2	Vert
			+0.0	+0.0	+0.0	+28.1				CH 1	
			-34.9	+2.4	+0.4						
38	2199.642M	46.2	+0.0	+0.0	+0.0	+0.7	+9.5	52.7	82.2	-29.5	Vert
			+0.0	+0.0	+0.0	+28.1				CH 96	
			-34.7	+2.5	+0.4						
39	1979.521M	45.8	+0.0	+0.0	+0.0	+0.7	+9.5	52.0	82.2	-30.2	Vert
			+0.0	+0.0	+0.0	+28.1				CH 96	
			-34.9	+2.4	+0.4						
40	1980.138M	44.6	+0.0	+0.0	+0.0	+0.7	+9.5	50.9	82.2	-31.3	Vert
			+0.0	+0.0	+0.0	+28.2				CH 97	
			-34.9	+2.4	+0.4						
41	29.900M	25.2	+0.0	+0.3	+0.0	+0.0	+19.1	50.4	82.2	-31.8	paral
			+0.0	+0.0	+5.8	+0.0					
			+0.0	+0.0	+0.0						
42	887.927M	34.8	+28.9	+1.5	+2.5	+0.4	+9.5	50.4	82.2	-31.8	Vert
			+0.0	-27.2	+0.0	+0.0				CH 176	
			+0.0	+0.0	+0.0						
43	659.944M	36.9	+27.7	+1.3	+2.4	+0.3	+9.5	50.2	82.2	-32.0	Vert
			+0.0	-27.9	+0.0	+0.0				CH 96	
			+0.0	+0.0	+0.0						
44	665.942M	35.1	+27.8	+1.3	+2.4	+0.3	+9.5	48.5	82.2	-33.7	Vert
			+0.0	-27.9	+0.0	+0.0				CH 176	
			+0.0	+0.0	+0.0						
45	660.025M	34.5	+27.7	+1.3	+2.4	+0.3	+9.5	47.8	82.2	-34.4	Vert
			+0.0	-27.9	+0.0	+0.0				CH 97	
			+0.0	+0.0	+0.0						
46	27.610M	18.6	+0.0	+0.3	+0.0	+0.0	+19.1	45.1	82.2	-37.1	perp
			+0.0	+0.0	+7.1	+0.0					
			+0.0	+0.0	+0.0						

Test Setup Photo(s)



Below 1GHz



Above 1GHz, 1.5m

Supplemental Information

Measurement Uncertainty

Uncertainty Value	Parameter
5.77 dB	Radiated Emissions
0.673 dB	RF Conducted Measurements
5.77×10^{-10}	Frequency Deviation
0.00005 s	Time Deviation
3.18 dB	Mains Conducted Emissions

Uncertainties reported are worst case for all CKC Laboratories' sites and represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of $k=2$. Compliance is deemed to occur provided measurements are below the specified limits.

Emissions Test Details

TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in $\text{dB}\mu\text{V}/\text{m}$, the spectrum analyzer reading in $\text{dB}\mu\text{V}$ was corrected by using the following formula. This reading was then compared to the applicable specification limit. Individual measurements were compared with the displayed limit value in the margin column. The margin was calculated based on subtracting the limit value from the corrected measurement value; a positive margin represents a measurement exceeding the limit, while a negative margin represents a measurement less than the limit.

SAMPLE CALCULATIONS	
Meter reading	($\text{dB}\mu\text{V}$)
+ Antenna Factor	(dB/m)
+ Cable Loss	(dB)
- Distance Correction	(dB)
- Preamplifier Gain	(dB)
= Corrected Reading	($\text{dB}\mu\text{V}/\text{m}$)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	9 kHz	150 kHz	200 Hz
RADIATED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or caret ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point, the measuring device is set into the linear mode and the scan time is reduced.

End of Report