Meteorcomm, LLC.

REVISED EMC TEST REPORT TO 109869-1

ITCR-NG Wayside
Model: 65010

Tested to The Following Standards:

FCC Part 80 Subpart E
217.6125-219.9875MHz

Report No.: 109869-1A

Date of issue: June 7, 2024

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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1201 SW 7th Street
Renton, WA 98057

Representative: George Stults
Customer Reference Number: PO31447

REPORT PREPARED BY:

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Project Number: 109869

DATE OF EQUIPMENT RECEIPT: May 3, 2024
DATE(S) OF TESTING: May 3, 6, 7, 8 & 10, 2024

Revision History

Original: Testing of ITCR-NG Wayside, Model: 65010 to FCC Part 80 Subpart E, 217.6125-219.9875MHz.
Revision A: Corrected typo on Conducted Spurious Emissions Specification title.

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.
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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 80 Subpart E

Test Procedure	Description	Modifications	Results
80.215 (c)(1), 80215 (h)(5), 2.1046	Power Output	NA	Pass
2.1049	Bandwidth	NA	Pass
80.209	Frequency Stability	NA	Pass
80.211 (f)	Conducted Spurious Emissions and Mask	NA	Pass
80.211 (f)	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: Meanwell DC supply

Equipment Under Test:

Device	Manufacturer	Model #	S/N
ITCR-NG Wayside	Meteorcomm, LLC	65010	65WR002010MC

Support Equipment:

Device	Manufacturer	Model #	S/N
ITCR-NG Wayside	Meteorcomm, LLC	65010	65WR000002HW
AC/DC Switching Adaptor	Mean Well	GST280A12-C6P	EC051B7718
AC/DC Switching Adaptor	Mean Well	GST280A12-C6P	EB96422312
Attenuator	Fairview Microwave	SA3N1007-30	NA
Attenuator	Fairview Microwave	SA3N1007-30	NA
Attenuator	Fairview Microwave	SA3N1007-30	NA
Vector Signal Generator	Rhode & Schwarz	SMBV100B	1423.1003K02-102044-an
Laptop	Panasonic	CF-30	T1260Z
Laptop	Dell	Latitude	8X7DMH2
GPS 4-way Splitter	GPSS	S14-SF	NA
USB Thumb Drive	Micro Center	64GB	NA
Prosafe 8-Port Gigabit Smart Switch	Netgear	GS108Tv2	29SE4C5302E60

Configuration 2: BK DC supply

Equipment Under Test:

Device	Manufacturer	Model #	S/N
ITCR-NG Wayside	Meteorcomm, LLC	65010	65WR002010MC

Support Equipment:

Device	Manufacturer	Model #	S/N
ITCR-NG Wayside	Meteorcomm, LLC	65010	65WR002010MC
Programmable DC Power Supply	BK Precision	XLN8018	351EL1073
AC/DC Switching Adaptor	Mean Well	GST280A12-C6P	EB96422312
Attenuator	Fairview Microwave	SA3N1007-30	NA
Attenuator	Fairview Microwave	SA3N1007-30	NA
Attenuator	Fairview Microwave	SA3N1007-30	NA
Vector Signal Generator	Rhode & Schwarz	SMBV100B	1423.1003K02-102044-an
Laptop	Panasonic	CF-30	T1260Z
Laptop	Dell	Latitude	8X7DMH2
GPS 4-way Splitter	GPSS	S14-SF	NA
USB Thumb Drive	Micro Center	64GB	NA
Prosafe 8-Port Gigabit Smart Switch	Netgear	GS108Tv2	29SE4C5302E60

Configuration 3: BK DC supply, no receiver support unit

Equipment Under Test:

Device	Manufacturer	Model #	S/N
ITCR-NG Wayside	Meteorcomm, LLC	65010	65WR002010MC

Support Equipment:

Device	Manufacturer	Model #	S/N
Programmable DC Power Supply	BK Precision	XLN8018	351EL1073
AC/DC Switching Adaptor	Mean Well	GST280A12-C6P	EB96422312
Vector Signal Generator	Rhode & Schwarz	SMBV100B	1423.1003K02-102044-an
Laptop	Panasonic	CF-30	T1260Z
Laptop	Dell	Latitude	8X7DMH2
GPS 4-way Splitter	GPSS	S14-SF	NA
USB Thumb Drive	Micro Center	64GB	NA
Prosafe 8-Port Gigabit Smart Switch	Netgear	GS108Tv2	29SE4C5302E60

General Product Information:

Description of EUT
Transmitter for rail applications

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
Modulation Type(s):	DQPSK Full Rate and Half 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 (1/2 wave dipole)
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 Photo(s)

Support Equipment Photo(s)

Support EUT

Support Attenuators

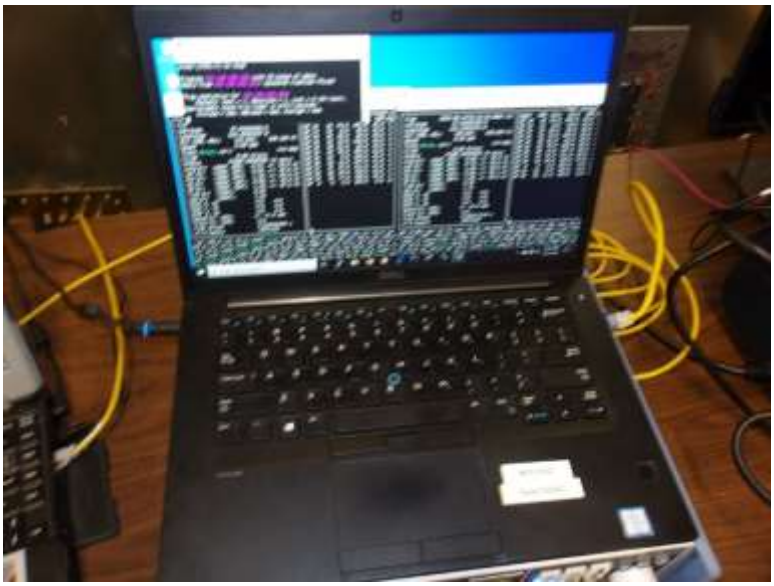
Support DC Power Supply

Support DC Power Supply, View 2

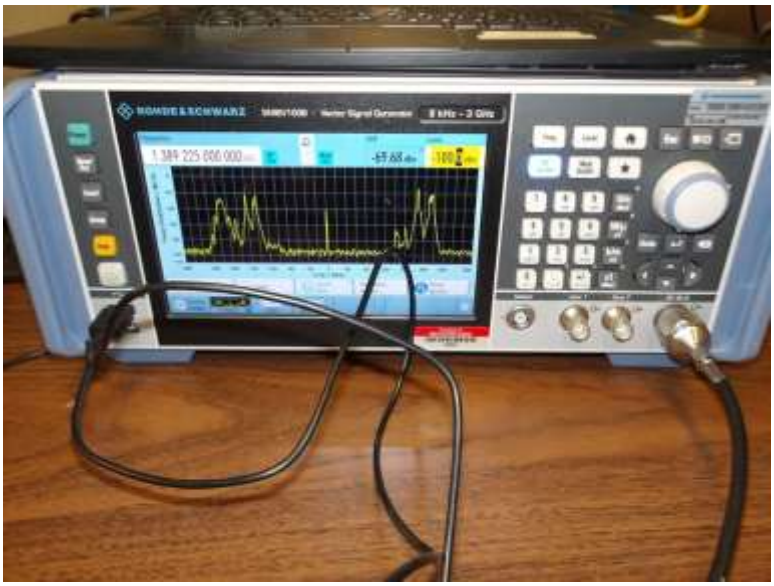
Support Ethernet Hub

Support GPS Splitter

Support Laptop 1



Support Laptop 2

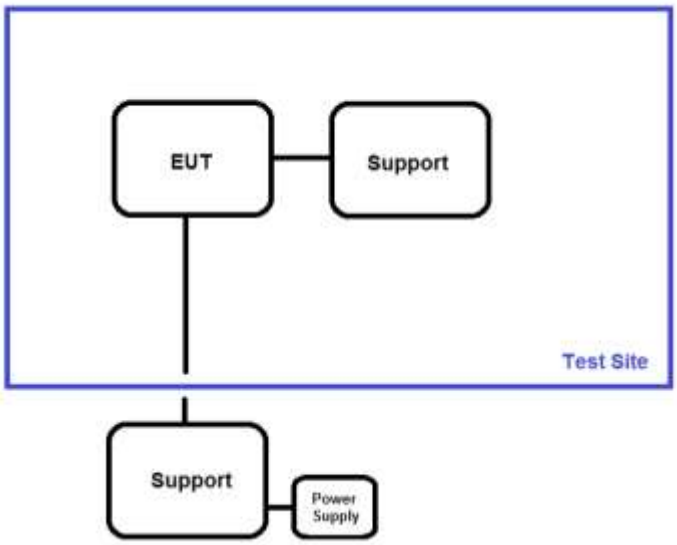


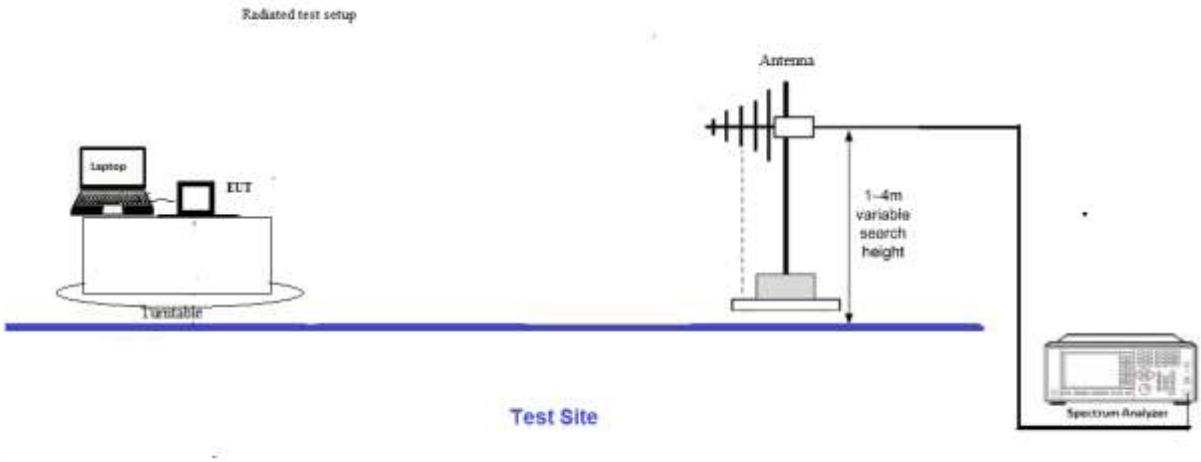
Support Signal Generator

Block Diagram(s) of Test Setup

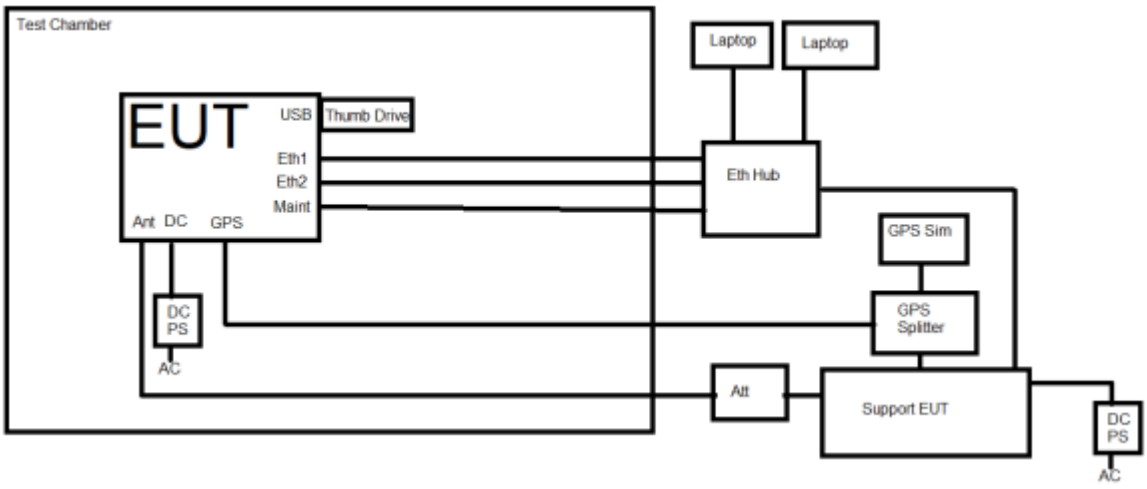
Config#	Setup Description of Block Diagram
1	EUT is connected to support Ethernet hub, laptops, support EUT and GPS simulator located outside the chamber. EUT is powered by an AC/DC power supply. USB port is populated with at thumb drive.

Test Setup Block Diagram

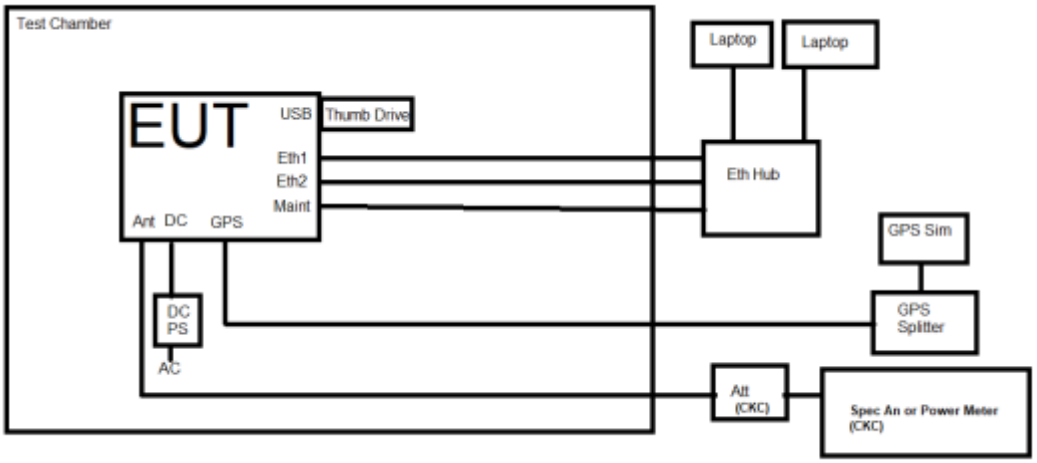




Radiated Spurious Emissions



Conducted Spurious Emissions and Mask



FCC PART 80 SUBPART E

80.215 (c)(1), 80215 (h)(5), 2.1046 - Power Output

Test Setup/Conditions			
Test Location:	Bothell Lab Bench	Test Engineer:	C. Plumadore
Test Method:	ANSI C63.26 (2015)	Test Date(s):	5/7/2024 -5/8/2024
Configuration:	3		
Test Setup:	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 peak power meter 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. Per the manufacturer, the fundamental power limit will change depending on the licensee and installation. For testing purposes, the limit is assumed to be 50W.		

Environmental Conditions			
Temperature (ºC)	20-24	Relative Humidity (%):	35-48

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03478	Power Sensor	Rohde & Schwarz	NRP-Z81	5/8/2023	5/8/2025
P07623	Attenuator	API Weinschel	47-20-34	3/16/2022	3/16/2024
P07628	Low Pass Filter	Mini-Circuits	NLP-90+	4/27/2022	4/27/2024
P06452	Cable	Andrews	Heliax	2/8/2023	2/8/2025
02757	Temperature Chamber	Bemco	F100/350-8	12/8/2022	12/8/2024
03029	Thermometer, Digital Infrared	Fluke	566	4/14/2023	4/14/2025
03514	Multimeter	Fluke	87	10/20/2022	10/20/2024

Test Data Summary - RF Conducted Measurement (Ch1)					
Frequency (MHz)	**Temperature (°C)**	**Voltage**	**Modulation**	**Conducted Power (Watts)**	**Results**
217.6125	-30	V_{Nom}	Half Rate	27.04	Pass
217.6125	-20	V_{Nom}	Half Rate	27.04	Pass
217.6125	-10	V_{Nom}	Half Rate	27.61	Pass
217.6125	0	V_{Nom}	Half Rate	27.93	Pass
217.6125	10	V_{Nom}	Half Rate	28.18	Pass
217.6125	20	V_{Nom}	Half Rate	28.51	Pass
217.6125	30	V_{Nom}	Half Rate	28.58	Pass
217.6125	40	V_{Nom}	Half Rate	28.77	Pass
217.6125	50	V_{Nom}	Half Rate	29.31	Pass
217.6125	20	V_{Min}	Half Rate	28.44	Pass
217.6125	20	V_{Max}	Half Rate	28.44	Pass

Test Data Summary - RF Conducted Measurement (Ch96)					
Frequency (MHz)	**Temperature (°C)**	**Voltage**	**Modulation**	**Conducted Power (Watts)**	**Results**
219.9875	-30	V_{Nom}	Half Rate	27.10	Pass
219.9875	-20	V_{Nom}	Half Rate	27.29	Pass
219.9875	-10	V_{Nom}	Half Rate	27.67	Pass
219.9875	0	V_{Nom}	Half Rate	27.86	Pass
219.9875	10	V_{Nom}	Half Rate	28.12	Pass
219.9875	20	V_{Nom}	Half Rate	28.18	Pass
219.9875	30	V_{Nom}	Half Rate	28.51	Pass
219.9875	40	V_{Nom}	Half Rate	28.77	Pass
219.9875	50	V_{Nom}	Half Rate	29.44	Pass
219.9875	20	V_{Min}	Half Rate	27.80	Pass
219.9875	20	V_{Max}	Half Rate	28.38	Pass

Test Data Summary - RF Conducted Measurement (Ch1)					
Frequency (MHz)	**Temperature (°C)**	**Voltage**	**Modulation**	**Conducted Power (Watts)**	**Results**
217.6125	-30	V_{Nom}	Full Rate	26.55	Pass
217.6125	-20	V_{Nom}	Full Rate	26.79	Pass
217.6125	-10	V_{Nom}	Full Rate	27.16	Pass
217.6125	0	V_{Nom}	Full Rate	27.35	Pass
217.6125	10	V_{Nom}	Full Rate	27.67	Pass
217.6125	20	V_{Nom}	Full Rate	27.99	Pass
217.6125	30	V_{Nom}	Full Rate	27.99	Pass
217.6125	40	V_{Nom}	Full Rate	28.31	Pass
217.6125	50	V_{Nom}	Full Rate	28.84	Pass
217.6125	20	V_{Min}	Full Rate	27.86	Pass
217.6125	20	V_{Max}	Full Rate	27.93	Pass

Test Data Summary - RF Conducted Measurement (Ch96)					
Frequency (MHz)	**Temperature (°C)**	**Voltage**	**Modulation**	**Conducted Power (Watts)**	**Results**
219.9875	-30	V_{Nom}	Full Rate	26.67	Pass
219.9875	-20	V_{Nom}	Full Rate	26.92	Pass
219.9875	-10	V_{Nom}	Full Rate	27.29	Pass
219.9875	0	V_{Nom}	Full Rate	27.48	Pass
219.9875	10	V_{Nom}	Full Rate	27.73	Pass
219.9875	20	V_{Nom}	Full Rate	27.99	Pass
219.9875	30	V_{Nom}	Full Rate	28.12	Pass
219.9875	40	V_{Nom}	Full Rate	28.25	Pass
219.9875	50	V_{Nom}	Full Rate	28.91	Pass
219.9875	20	V_{Min}	Full Rate	27.93	Pass
219.9875	20	V_{Max}	Full Rate	27.99	Pass

Parameter Definitions:

Measurements performed at input voltage Vnominal ± 15%.

Parameter	Value
V_{Nom}:	13.6VDC
V_{Min}:	11.56VDC
V_{Max}:	15.64VDC

Test Setup Photo(s)

Test Setup; View 1

Test Setup; View 2

2.1049 - Occupied Bandwidth

Test Setup/Conditions			
Test Location:	Bothell Lab Bench	Test Engineer:	C. Plumadore/S. Pittsford
Test Method:	ANSI C63.26 (2015)	Test Date(s):	5/6/2024
Configuration:	3		
Test Setup:	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 and half rate modulations investigated. Per the manufacturer, the bandwidth limitations are outside the scope of Part 80 based on the emission designator for this equipment, it will be up to the licensee to ensure the bandwidth/designator is used as appropriately licensed.		

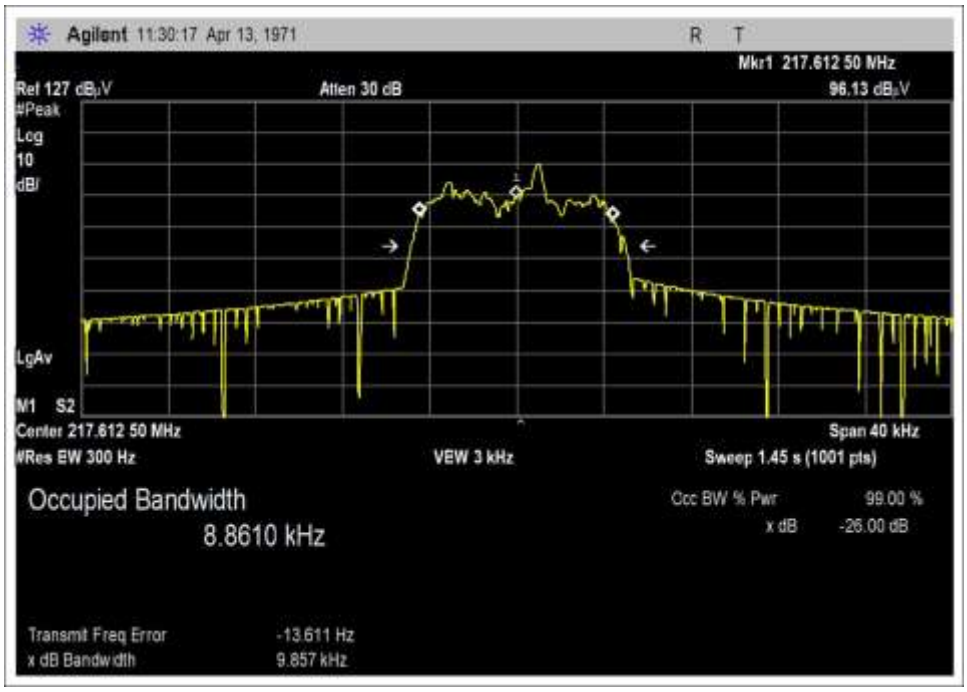
Environmental Conditions			
Temperature (ºC)	22.3	Relative Humidity (%):	39.9

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02673	Spectrum Analyzer	Agilent	E4446A	3/8/2024	3/8/2026
P07623	Attenuator	API Weinschel	47-20-34	2/27/2024	2/27/2026
P07638	Attenuator	API Weinschel	47-20-34	3/26/2024	3/26/2026
P06011	Cable	Andrew	Heliax	11/16/2023	11/16/2025
P06515	Cable	Andrews	Heliax	2/28/2024	2/28/2026

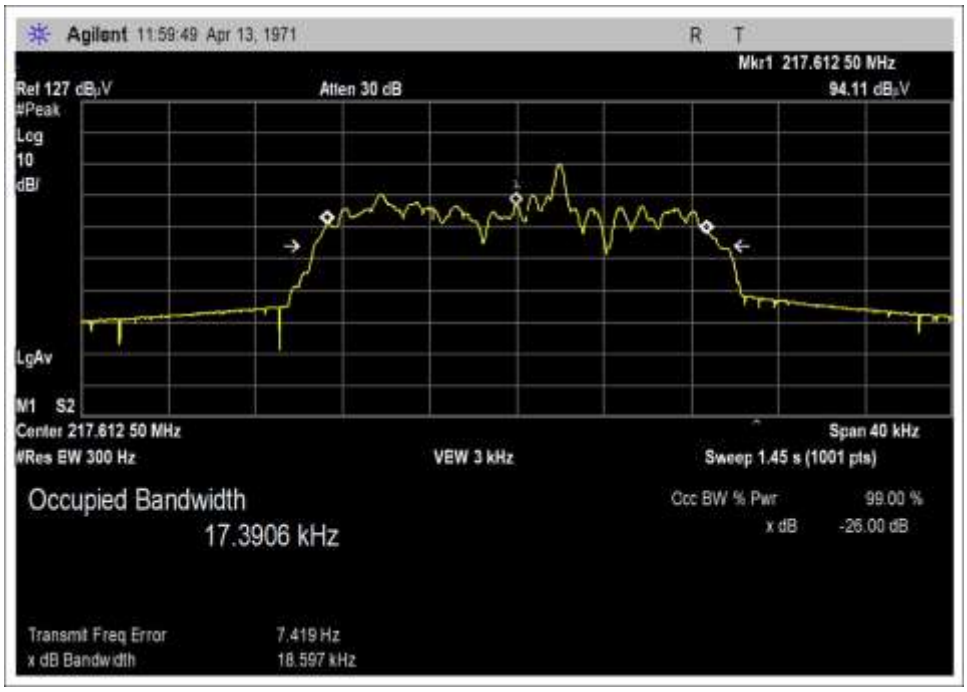
99% Occupied Bandwidth

Test Data Summary				
Frequency (MHz)	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
217.6125	Full Rate	17.3906	20kHz	Pass
219.9875	Full Rate	17.3797	20kHz	Pass
217.6125	Half Rate	8.8610	11.25kHz	Pass
219.9875	Half Rate	8.8666	11.25kHz	Pass

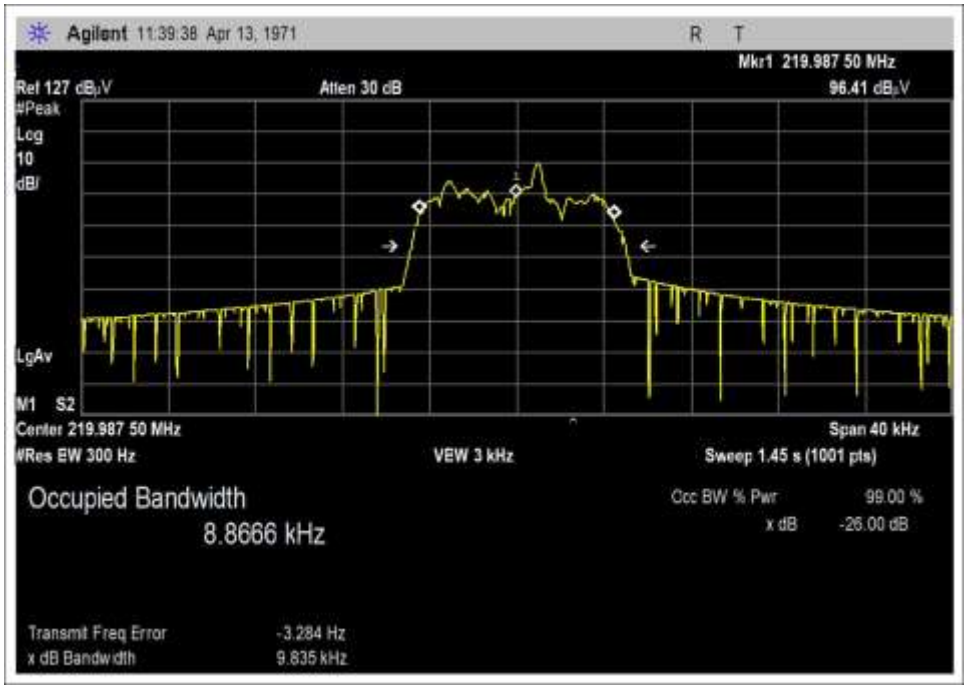
Test Plots



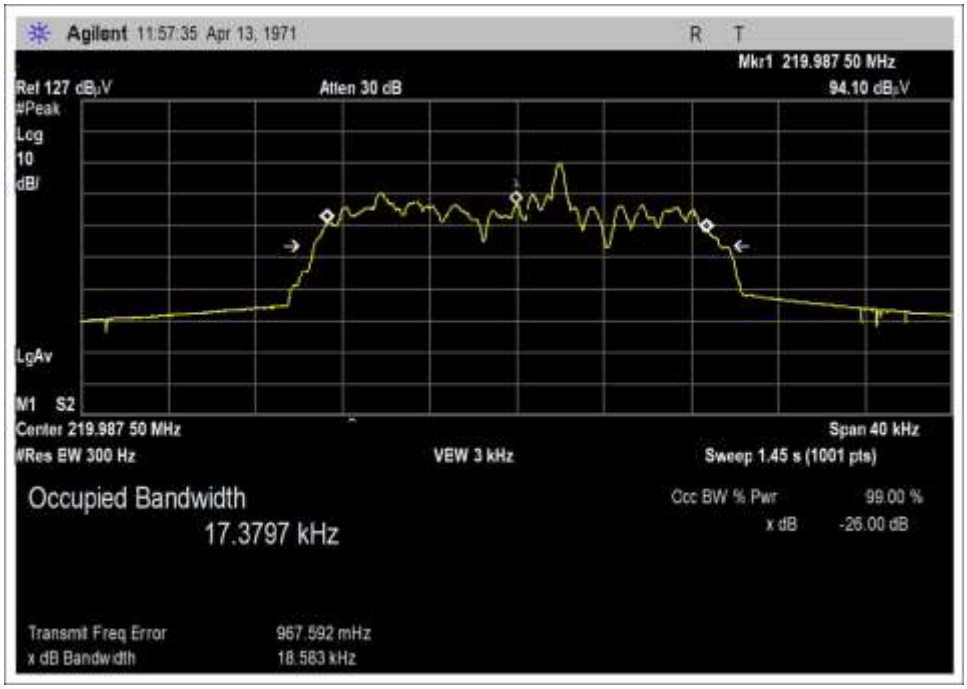
CH1, Half Rate



CH1, Full Rate



CH96, Half Rate



CH96, Full Rate

Test Setup Photo(s)

80.209 - Frequency Stability

Test Setup/Conditions			
Test Location:	Bothell Lab Bench	Test Engineer:	C. Plumadore/S. Pittsford
Test Method:	ANSI C63.26 (2015)	Test Date(s):	5/7/2024 -5/8/2024
Configuration:	3		
Test Setup:	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. The limit is assumed as 5ppm from 80.209 (6) Band 216-220MHz.		

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03803	Spectrum Analyzer	Agilent	E4440A	2/23/2022	2/23/2024
P07623	Attenuator	API Weinschel	47-20-34	3/16/2022	3/16/2024
P07628	Low Pass Filter	Mini-Circuits	NLP-90+	4/27/2022	4/27/2024
P06452	Cable	Andrews	Heliax	2/8/2023	2/8/2025
02757	Temperature Chamber	Bemco	F100/350-8	12/8/2022	12/8/2024
03029	Thermometer, Digital Infrared	Fluke	566	4/14/2023	4/14/2025
03514	Multimeter	Fluke	87	10/20/2022	10/20/2024

Test Data Summary				
Modulation: Half Rate				
Temp (ºC)	**Voltage**	**Ch 1 (PPM)**	**Ch 96 (PPM)**	**Results**
-30	V_{Nom}	0.22057	0.16819	Pass
-20	V_{Nom}	0.02757	0.02727	
-10	V_{Nom}	0.14245	0.27729	
0	V_{Nom}	0.31248	0.30456	
10	V_{Nom}	0.28031	0.33184	
20	V_{Nom}	0.00000	0.00000	
30	V_{Nom}	0.05514	0.30456	
40	V_{Nom}	0.25274	0.19546	
50	V_{Nom}	0.30789	0.25001	
20	V_{Min}	0.02757	0.00000	
20	V_{Max}	0.00020	0.02727	
Maximum Deviation		0.31248	0.33184	

Test Data Summary				
Modulation: Full Rate				
Temp (ºC)	**Voltage**	**Ch 1 (PPM)**	**Ch 96 (PPM)**	**Results**
-30	V_{Nom}	0.08731	0.08637	Pass
-20	V_{Nom}	0.13786	0.08182	
-10	V_{Nom}	0.28031	0.30456	
0	V_{Nom}	0.36303	0.35911	
10	V_{Nom}	0.33546	0.38638	
20	V_{Nom}	0.00000	0.00000	
30	V_{Nom}	0.02757	0.02727	
40	V_{Nom}	0.19760	0.16819	
50	V_{Nom}	0.25274	0.19546	
20	V_{Min}	0.02757	0.00545	
20	V_{Max}	0.00000	0.00545	
Maximum Deviation		0.36303	0.38638	

Parameter Definitions:

Measurements performed at input voltage Vnominal ± 15%.

Parameter	Value
V_{Nom}:	13.6VDC
V_{Min}:	11.56VDC
V_{Max}:	15.64VDC

Test Setup Photo(s)

Test Setup; View 1

Test Setup; View 2

80.211(f) - Conducted Emission Mask and Spurs

Test Setup/Conditions			
Test Location:	Bothell Lab Bench	Test Engineer:	C. Plumadore/S. Pittsford
Test Method:	ANSI C63.26 (2015)	Test Date(s):	5/10/2024
Configuration:	3		
Test Setup:	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 and half rate modulations investigated in separate datasheets. The emission mask was built with an RMS Average measurement of the fundamental, with the lowest value selected from an investigation on Ch1 and Ch96. The worst case low RMS average for full rate was 26.1W, half rate was 26.3W. Outside of the span shown in the emission mask plots, the following bandwidths were used: 9kHz-150kHz: 200Hz RBW 150kHz-30MHz: 9kHz RBW 30-1000MHz: 100kHz RBW 1000MHz and above: 1MHz RBW Average values as indicated on datasheet are RMS. Per the manufacturer the masks are built with 80.211(f), with an assumed 20kHz ABW for Full Rate and 11.25kHz ABW for Half Rate, it will be the responsibility of the licensee to ensure mask applicability. Conducted spurious emissions performed at ambient temperature and nominal voltage using the same setup also used for temperature testing.		

Test Data

Test Location:	CKC Laboratories • 22116 23rd Drive SE, Suite A • Bothell, WA. 98021 • 1-800-500-4EMC (4362)		
Customer:	**Meteorcomm LLC**		
Specification:	**47 CFR §80.211(f) Spurious Emissions**		
Work Order #:	**109869**	Date:	5/10/2024
Test Type:	**Conducted Emissions**	Time:	13:34:38
Tested By:	C. Plumadore	Sequence#:	13
Software:	EMITest 5.03.20		120V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

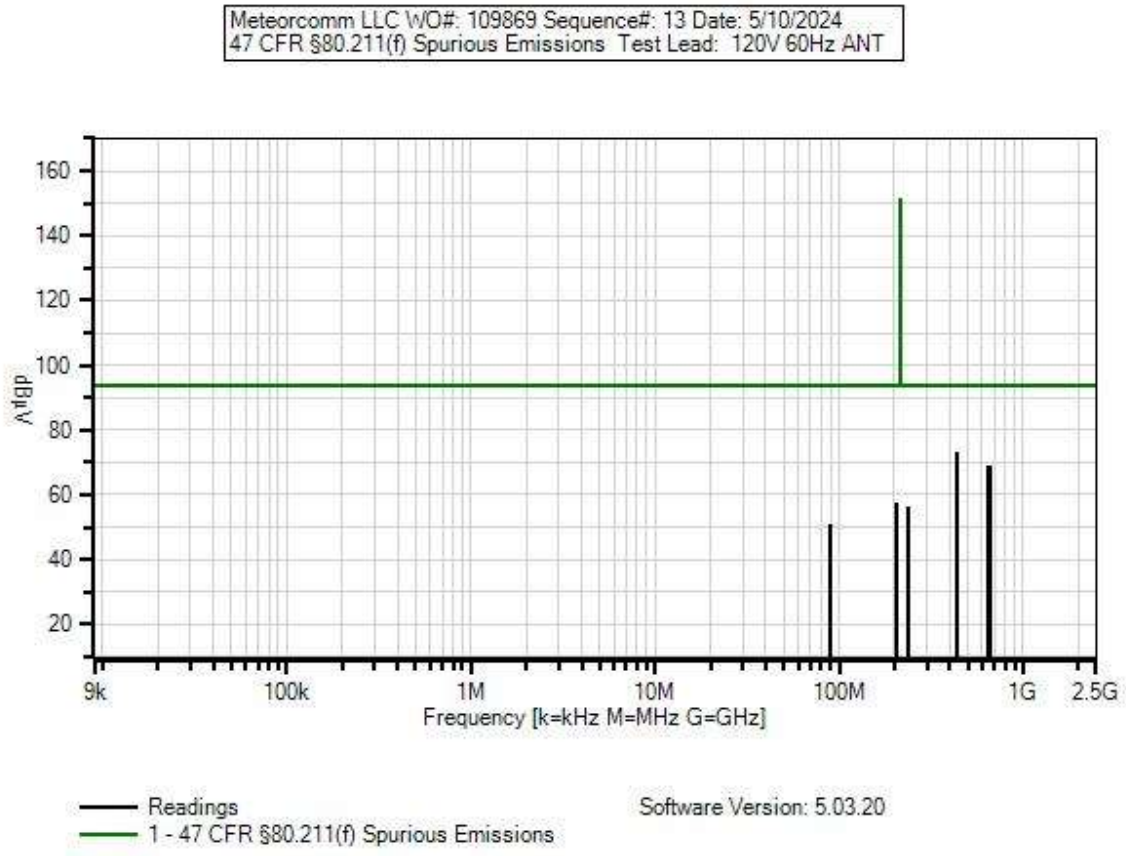
Test Conditions / Notes:

Test Environment Conditions:
Temperature: 21.4°C
Humidity: 40.5%
Pressure: 100.9kPa

Method: ANSI C63.26 (2015)

Frequency: Fundamental

Note: Half Rate



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07623	Attenuator	47-20-34	2/27/2024	2/27/2026
T2	ANP07638	Attenuator	47-20-34	3/26/2024	3/26/2026
T3	ANP06011	Cable	Heliax	11/16/2023	11/16/2025
T4	ANP06515	Cable	Heliax	2/28/2024	2/28/2026
T5	AN02673	Spectrum Analyzer	E4446A	3/8/2024	3/8/2026

Measurement Data: Reading listed by margin. Test Lead: ANT

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV	dBµV	dB	Ant
1	439.971M	32.8	+19.6	+19.7	+0.3	+1.0	+0.0	73.4	94.0	-20.6	ANT
	Ave		+0.0						219.9875		
^	439.971M	51.1	+19.6	+19.7	+0.3	+1.0	+0.0	91.7	94.0	-2.3	ANT
			+0.0						219.9875		
3	435.216M	32.5	+19.6	+19.7	+0.3	+1.0	+0.0	73.1	94.0	-20.9	ANT
	Ave		+0.0						217.6125		
^	435.232M	51.1	+19.6	+19.7	+0.3	+1.0	+0.0	91.7	94.0	-2.3	ANT
			+0.0						217.6125		
5	652.827M	27.9	+19.6	+19.7	+0.3	+1.3	+0.0	68.8	94.0	-25.2	ANT
	Ave		+0.0						217.6125		
^	652.834M	46.8	+19.6	+19.7	+0.3	+1.3	+0.0	87.7	94.0	-6.3	ANT
			+0.0						217.6125		
7	659.960M	27.9	+19.6	+19.7	+0.3	+1.3	+0.0	68.8	94.0	-25.2	ANT
	Ave		+0.0						219.9875		
^	659.960M	46.5	+19.6	+19.7	+0.3	+1.3	+0.0	87.4	94.0	-6.6	ANT
			+0.0						219.9875		
9	203.562M	17.8	+19.5	+19.6	+0.2	+0.7	+0.0	57.8	94.0	-36.2	ANT
	Ave		+0.0								
^	203.562M	67.3	+19.5	+19.6	+0.2	+0.7	+0.0	107.3	94.0	+13.3	ANT
			+0.0								
11	239.642M	16.2	+19.5	+19.7	+0.2	+0.8	+0.0	56.4	94.0	-37.6	ANT
	Ave		+0.0								
^	239.642M	63.9	+19.5	+19.7	+0.2	+0.8	+0.0	104.1	94.0	+10.1	ANT
			+0.0								
13	88.640M	11.1	+19.5	+19.6	+0.1	+0.4	+0.0	50.7	94.0	-43.3	ANT
	Ave		+0.0								
^	88.640M	46.3	+19.5	+19.6	+0.1	+0.4	+0.0	85.9	94.0	-8.1	ANT
			+0.0								

Test Location:	CKC Laboratories • 22116 23rd Drive SE, Suite A • Bothell, WA. 98021 • 1-800-500-4EMC (4362)		
Customer:	**Meteorcomm LLC**		
Specification:	**47 CFR §80.211(f) Spurious Emissions**		
Work Order #:	**109869**	Date:	5/10/2024
Test Type:	**Conducted Emissions**	Time:	13:55:30
Tested By:	C. Plumadore	Sequence#:	12
Software:	EMITest 5.03.20		120V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

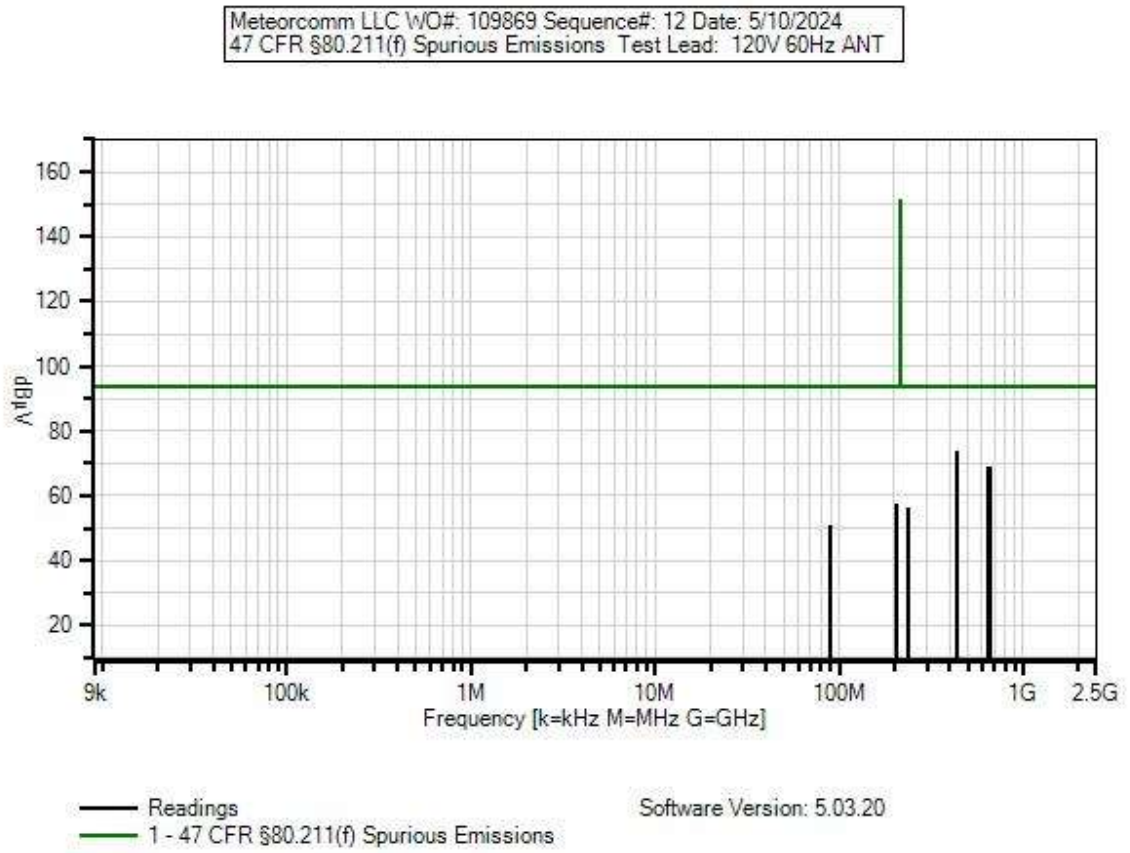
Test Conditions / Notes:

Test Environment Conditions:
Temperature: 21.4°C
Humidity: 40.5%
Pressure: 100.9kPa

Method: ANSI C63.26 (2015)

Frequency: Fundamental

Note: Full Rate



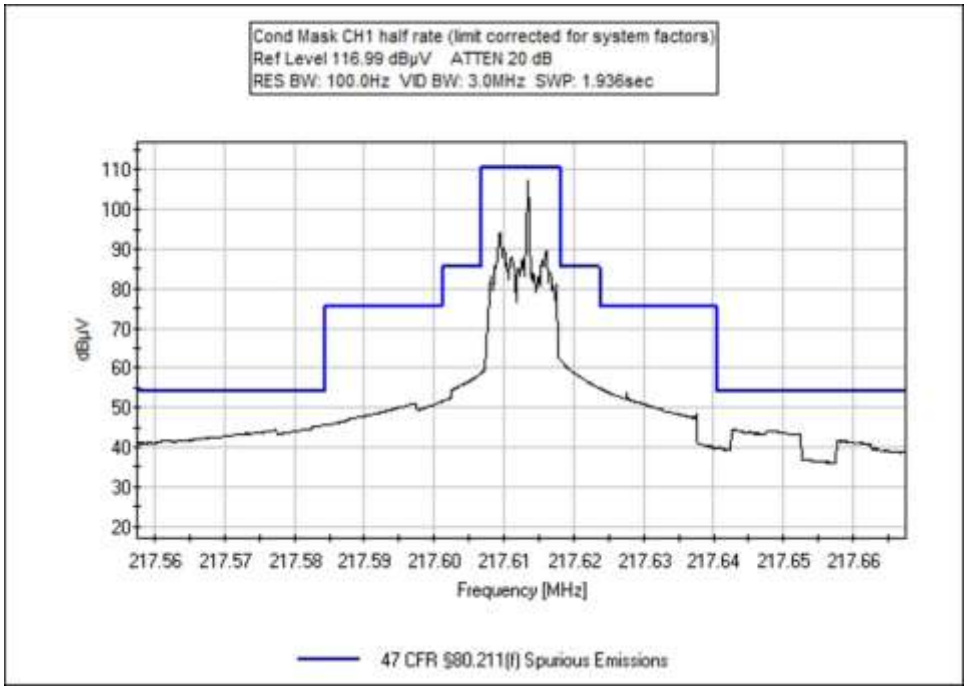
Test Equipment:

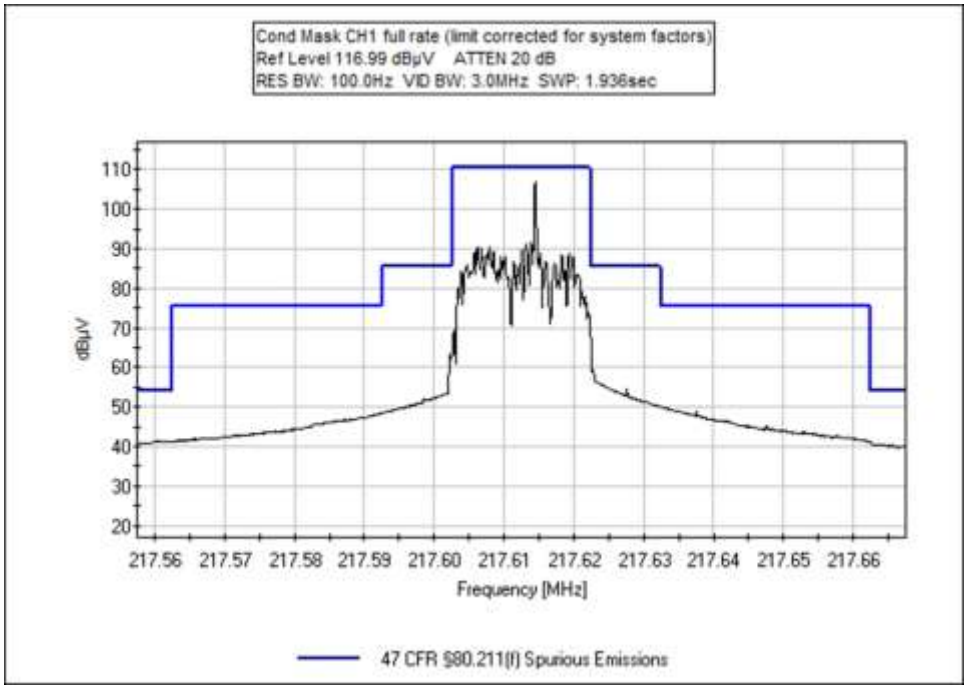
ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07623	Attenuator	47-20-34	2/27/2024	2/27/2026
T2	ANP07638	Attenuator	47-20-34	3/26/2024	3/26/2026
T3	ANP06011	Cable	Heliax	11/16/2023	11/16/2025
T4	ANP06515	Cable	Heliax	2/28/2024	2/28/2026
	AN02673	Spectrum Analyzer	E4446A	3/8/2024	3/8/2026

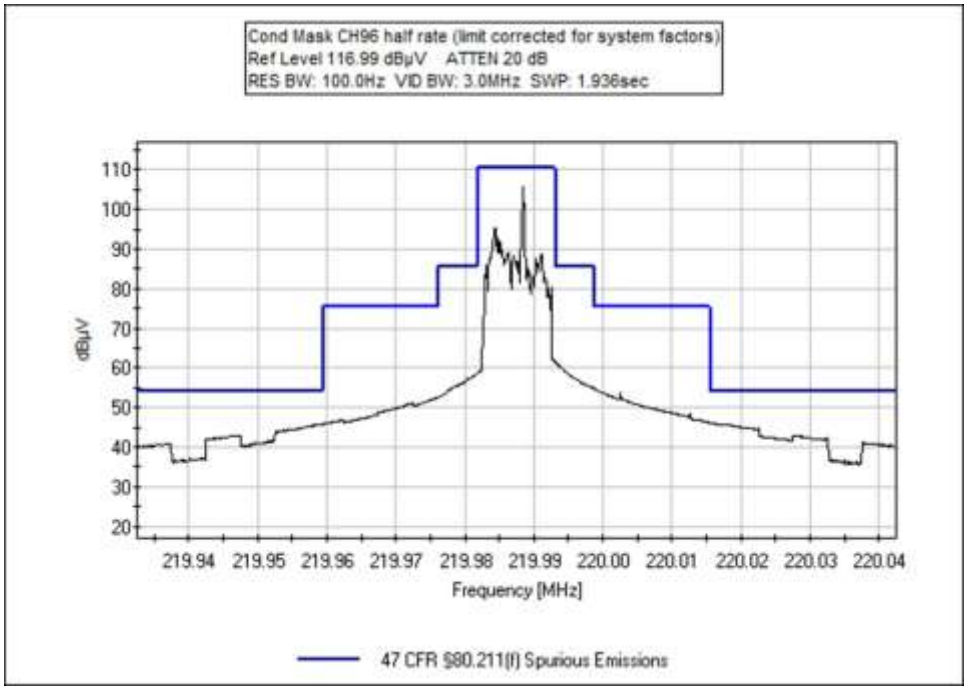
Measurement Data: Reading listed by margin. Test Lead: ANT

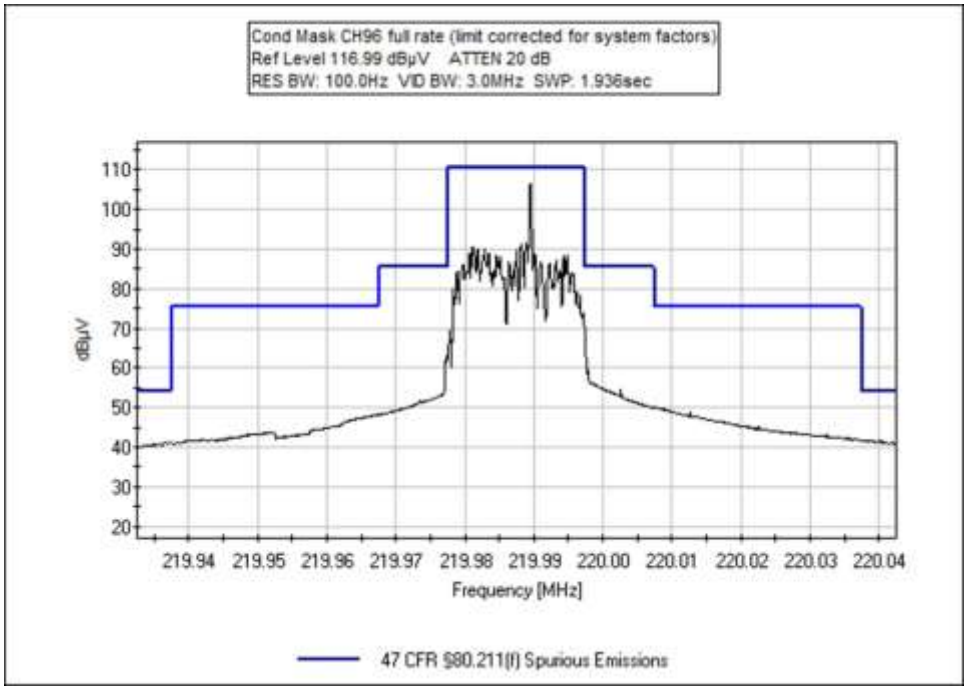
#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	435.227M Ave	33.1	+19.6	+19.7	+0.3	+1.0	+0.0	73.7	94.0 217.6125	-20.3	ANT
^	435.227M	51.0	+19.6	+19.7	+0.3	+1.0	+0.0	91.6	94.0 217.6125	-2.4	ANT
3	439.974M Ave	33.0	+19.6	+19.7	+0.3	+1.0	+0.0	73.6	94.0 219.9875	-20.4	ANT
^	439.974M	51.0	+19.6	+19.7	+0.3	+1.0	+0.0	91.6	94.0 219.9875	-2.4	ANT
5	652.834M Ave	28.3	+19.6	+19.7	+0.3	+1.3	+0.0	69.2	94.0 217.6125	-24.8	ANT
^	652.834M	46.5	+19.6	+19.7	+0.3	+1.3	+0.0	87.4	94.0 217.6125	-6.6	ANT
7	659.970M Ave	28.2	+19.6	+19.7	+0.3	+1.3	+0.0	69.1	94.0 219.9875	-24.9	ANT
^	659.970M	46.3	+19.6	+19.7	+0.3	+1.3	+0.0	87.2	94.0 219.9875	-6.8	ANT
9	203.562M Ave	17.8	+19.5	+19.6	+0.2	+0.7	+0.0	57.8	94.0	-36.2	ANT
^	203.562M	67.3	+19.5	+19.6	+0.2	+0.7	+0.0	107.3	94.0	+13.3	ANT
11	239.642M Ave	16.2	+19.5	+19.7	+0.2	+0.8	+0.0	56.4	94.0	-37.6	ANT
^	239.642M	63.9	+19.5	+19.7	+0.2	+0.8	+0.0	104.1	94.0	+10.1	ANT
13	88.640M Ave	11.1	+19.5	+19.6	+0.1	+0.4	+0.0	50.7	94.0	-43.3	ANT
^	88.640M	46.3	+19.5	+19.6	+0.1	+0.4	+0.0	85.9	94.0	-8.1	ANT

Test Plots


Cond Mask CH1 half rate (limit corrected for system factors)
Ref Level 116.99 dBµV ATTEN 20 dB
RES BW: 100.0Hz VID BW: 3.0MHz SWP: 1.936sec
dBµV
110
100
90
80
70
60
50
40
30
20
217.56 217.57 217.58 217.59 217.60 217.61 217.62 217.63 217.64 217.65 217.66
Frequency [MHz]
47 CFR §80.211(f) Spurious Emissions


Cond Mask CH1 full rate (limit corrected for system factors)
Ref Level 116.99 dBµV ATTEN 20 dB
RES BW: 100.0Hz VID BW: 3.0MHz SWP: 1.936sec
dBµV
110
100
90
80
70
60
50
40
30
20
217.56 217.57 217.58 217.59 217.60 217.61 217.62 217.63 217.64 217.65 217.66
Frequency [MHz]
47 CFR §80.211(f) Spurious Emissions


Cond Mask CH96 half rate (limit corrected for system factors)
Ref Level 116.99 dBµV ATTEN 20 dB
RES BW: 100.0Hz VID BW: 3.0MHz SWP: 1.936sec
dBµV
110
100
90
80
70
60
50
40
30
20
219.94 219.95 219.96 219.97 219.98 219.99 220.00 220.01 220.02 220.03 220.04
Frequency [MHz]
47 CFR §80.211(f) Spurious Emissions


Cond Mask CH96 full rate (limit corrected for system factors)
Ref Level 116.99 dBµV ATTEN 20 dB
RES BW: 100.0Hz VID BW: 3.0MHz SWP: 1.936sec
dBµV
110
100
90
80
70
60
50
40
30
20
219.94 219.95 219.96 219.97 219.98 219.99 220.00 220.01 220.02 220.03 220.04
Frequency [MHz]
47 CFR §80.211(f) Spurious Emissions

Test Setup Photo(s)

80.211(f) - Radiated Emissions

Test Setup/Conditions			
Test Location:	Bothell Lab C3	Test Engineer:	C. Plumadore/S. Pittsford
Test Method:	ANSI C63.26 (2015)	Test Date(s):	5/10/2024
Configuration:	1		
Test Setup:	The emission mask was built with an RMS Average measurement of the fundamental, with the lowest value selected from an investigation on Ch1 and Ch96. The mask was then converted in terms of field strength for a 3m measurement in the plotted datasheets. Outside of the span shown in the emission mask plots, the following bandwidths were used: 9kHz-150kHz: 200Hz RBW 150kHz-30MHz: 9kHz RBW 30-1000MHz: 100kHz RBW 1000MHz and above: 1MHz RBW For the final tabular converted to dBm uses equation (d) from ANSI C63.26 (2015) 5.2.7: EIRP (dBm) = E (dBµV/m) + 20log(D) − 104.8; where D is the measurement distance (in the far field region) in m. Per 80.211f: (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. Limit = Power – Required Attenuation = 10 Log P – (43 +10Log P) = 10 Log P – 43 – 10Log P = -43 dBW = 0.00005W (0.05mW) = 10 Log 0.00005/0.001 = -13dBm (94dBµV) at any power level.		

Environmental Conditions			
Temperature (ºC)	22	Relative Humidity (%):	46

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02673	Spectrum Analyzer	Agilent	E4446A	3/8/2024	3/8/2026
P06011	Cable	Andrew	Heliax	11/16/2023	11/16/2025
P06515	Cable	Andrews	Heliax	2/28/2024	2/28/2026
03540	Preamp	HP	83017A	3/24/2023	3/24/2025
02374ANSI	Horn Antenna	Electrometrics	RGA-60	5/26/2023	5/26/2025
P07504	Cable	TMS	CLU40-KMKM-02.00F	1/19/2024	1/19/2026
02307	Preamp	HP	8447D	8/9/2023	8/9/2025
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
00052	Loop Antenna	EMCO	6502	5/11/2022	5/11/2024

Test Data Summary (9kHz-30MHz)				
Frequency (MHz)	**Measured (dBµV/m) @ 3m**	**Convert to EIRP (dBm)**	**Limit (dBm)**	**Results**
20.508	27.5	-67.7	-13	Pass
20.508	27.5	-67.7	-13	Pass
20.508	27.5	-67.7	-13	Pass

Test Data Summary (30-1000MHz)				
Frequency (MHz)	**Measured (dBµV/m) @ 3m**	**Convert to EIRP (dBm)**	**Limit (dBm)**	**Results**
652.785	51.5	-43.7	-13	Pass
660.006	47.8	-47.4	-13	Pass
665.977	46.6	-48.6	-13	Pass
660.031	46.3	-48.9	-13	Pass
880.051	44.3	-50.9	-13	Pass
870.419	42.6	-52.6	-13	Pass
879.936	41.6	-53.6	-13	Pass
887.957	39	-56.2	-13	Pass
443.993	36.1	-59.1	-13	Pass
439.984	35.9	-59.3	-13	Pass
440.026	35.8	-59.4	-13	Pass
435.285	33.4	-61.8	-13	Pass

Test Data Summary (Above 1GHz)				
Frequency (MHz)	Measured (dBµV/m) @ 3m	Convert to EIRP (dBm)	Limit (dBm)	Results
1088.029	63.5	-39.9	-13	Pass
1305.654	55.3	-44.6	-13	Pass
1109.764	50.6	-48	-13	Pass
1523.226	47.2	-50.4	-13	Pass
1100.013	44.8	-50.8	-13	Pass
1099.948	44.4	-52	-13	Pass
1741.318	43.2	-52.7	-13	Pass
1320.073	42.5	-54.3	-13	Pass
1319.935	40.9	-55.7	-13	Pass
1958.597	39.5	-56.3	-13	Pass
1539.856	38.9	-58.3	-13	Pass
1760.079	36.9	-58.3	-13	Pass
1540.111	36.9	-58.9	-13	Pass
1775.851	36.3	-59.1	-13	Pass
2176.12	36.1	-60.4	-13	Pass
2200.119	34.8	-60.5	-13	Pass
2219.871	34.7	-61.1	-13	Pass
1979.894	34.1	-61.3	-13	Pass
1331.975	33.9	-61.3	-13	Pass
2199.869	33.9	-61.6	-13	Pass
1980.109	33.6	-62.2	-13	Pass
1997.478	33	-62.4	-13	Pass
1759.921	32.8	-63.5	-13	Pass
1553.861	31.7	-95.2	-13	Pass

Test Setup Photo(s)

Below 1GHz

Above 1GHz

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 dBµV/m, the spectrum analyzer reading in dBµV 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	(dBµV)
+	Antenna Factor	(dB/m)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dBµV/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