Anywave Communication Technologies Inc.

EMC TEST REPORT FOR

1100W UHF PA-ATSC, Model: AMP-8_C_MH-C
8800W UHF ATSC Transmitter System, Model: TRN-5X-U-88-C
Controller Module, Model: CTL-M
5X+ Exciter, Model: EXC-5X+C
8,8KW LPF(Harmonic Filter), Model: LPF-U-318-8800H
12000W 8-Pole UHF CH22 (518-524MHz) BPF, Model: A-TF8D220C-A013

Tested to The Following Standards:

FCC Part 74 Subpart G

Report No.: 103031-15

Date of issue: March 17, 2020

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

TABLE OF CONTENTS

ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Anywave Communication Technologies Inc.
300 Knightsbridge Parkway, Suite 150
Lincolnshire, IL 60069

Representative:
Ted Karam - Anywave Communication Technologies Inc.
Erin Littell F-Squared Labs
Customer Reference Number: 4684R4

REPORT PREPARED BY:

Terri Rayle
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 103031

DATE OF EQUIPMENT RECEIPT: October 22, 2019
DATE(S) OF TESTING: October 22-26, 2019 and February 19-20, 2020

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.
110 Olinda Place
Brea, CA 92823

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.12
EMITest Immunity	5.03.10

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	Japan
Canyon Park, Bothell, WA	US0081	US1022	A-0136
Brea, CA	US0060	US1025	A-0136
Fremont, CA	US0082	US1023	A-0136
Mariposa, CA	US0103	US1024	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(s) 74 Subpart G

Test Procedure	Description	Modifications	Results
74.735(b)(2)	Power Limitations	NA	Pass
74.794(a)(2)(ii)	Occupied Bandwidth / Stringent Mask	NA	Pass
74.794(b)(1)	Radio Navigation Satellite Service Bands (GPS)	NA	Pass*
74.794(a)(2)(ii)	Spurious Emissions at Antenna Terminal	NA	Pass
74.794(a)(2)(ii)	Field Strength of Spurious Radiation	Mod. #1	Pass
74.761(a)/74.761(b)	Frequency Tolerance – Temperature / Voltage	NA	Pass

NA = Not applicable

* Manufacturer declares the filter response curve provided.

ISO/IEC 17025 Decision Rule
The declaration of pass or fail herein is based upon assessment to the specification(s) listed above, including where applicable, assessment 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
Modification #1 includes all of the following modifications to the EUT: 1 Enhance shielding in six locations inside each of the eight amplifiers. a – Copper tape applied to shield left-side-channel openings b – Copper mesh applied to shield rear left-side-channel rear-chassis opening c – Copper tape applied to shield right rear corner opening d – Copper tape applied to shield right side chassis seams e – Copper tape applied to shield rear chassis seam, cables, and right rear corner. f – Copper mesh applied to shield rear ventilation fans 2. Sealed amplifier top and bottom cover seams 3. Enhanced grounding on all panels of the main cabinet enclosure 4. Added cabinet front door with interior RF copper mesh screen 5. Rear door and side panel ventilation openings were sealed.
See Appendix A for details of modifications 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 Tested:

Device	Manufacturer	Model #	S/N
1100W UHF PA-ATSC	Anywave Communication Technologies, Inc	AMP-8_C_MH-C	AMP-8-U-MH-C(PA8)
1100W UHF PA-ATSC	Anywave Communication Technologies, Inc	AMP-8_C_MH-C	1907100015523448
1100W UHF PA-ATSC	Anywave Communication Technologies, Inc	AMP-8_C_MH-C	1907100015849772
1100W UHF PA-ATSC	Anywave Communication Technologies, Inc	AMP-8_C_MH-C	1907100016722507
1100W UHF PA-ATSC	Anywave Communication Technologies, Inc	AMP-8_C_MH-C	1907100015773510
1100W UHF PA-ATSC	Anywave Communication Technologies, Inc	AMP-8_C_MH-C	1907100015957646
1100W UHF PA-ATSC	Anywave Communication Technologies, Inc	AMP-8_C_MH-C	1907100016224204
1100W UHF PA-ATSC	Anywave Communication Technologies, Inc	AMP-8_C_MH-C	1907100016135751
Controller Module	Anywave Communication Technologies, Inc	CTL-M	1907100010340241
5X+ Exciter	Anywave Communication Technologies, Inc	EXC-5X+C	1812144030819
12000W 8-Pole UHF CH22 (518-524MHz) BPF	Com-Tech	A-TF8D220C-A013	1937-213775
8800W UHF ATSC Transmitter System	Anywave Communication Technologies, Inc	TRN-5X-U-88-C	1907100010395730
8,8KW LPF(Harmonic Filter)	Anywave Communication Technologies, Inc	LPF-U-318-8800H	1904777609054318

Support Equipment:

Device	Manufacturer	Model #	S/N
Router	Netgear	DS309	DS39A08000012
Coaxial Terminator	Termaline	8936-115	168

General Product Information:

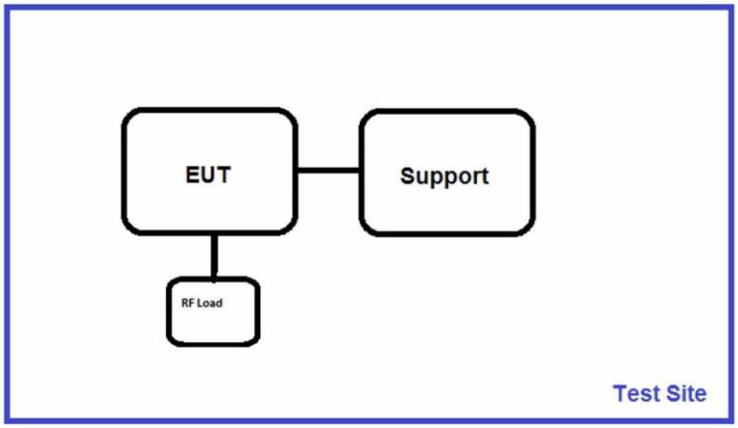
Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Modulation Type(s):	8VSB (ATSC)
Maximum Duty Cycle:	100%
Antenna Type(s) and Gain:	NA. Device is not sold with antenna.
Antenna Connection Type:	External Connector 3-1/8 EIA
Nominal Input Voltage:	Exciter and Controller, 120Vac 60Hz Power Amplifier, 208Vac 60Hz
Firmware / Software used for Test:	Controller code revision: MCU: V4.0-190522 Exciter code revisions: MCU: V5.2AW_190125, FPGA:V2.2A_I_161107

EUT Photo(s)

Support Equipment

Block Diagram of Test Setup

Test Setup Block Diagram



FCC PART(S) 74

General Test Setup

The EUT is placed on the turntable. SPL-2-U-1 RF in is connected to 60dB sampling input port of the Band pass filter SPL - 2-U -2 is connected to the 60dB sampling output port of the Band pass filter. Output of the Band pass filter is connected to a RF load.

Ethernet port is connected to a support router. Ethernet switch in the chassis and front LCD panel are not active. All other port left unpopulated as intended.

The manufacturer declares the highest EUT frequency generated or used is 40MHz
Fundamental Frequency: 521MHz

Power setting: 1100W and 8800W

Chassis is grounded.

Modification #1 was in place for Radiated emissions testing.

74.735(b)(2) Power Limitation

Test Setup/Conditions			
Test Location:	Brea Lab D	Test Engineer:	E. Wong
Test Method:	ANSI C63.26-2015 5.2.4.4	Test Date(s):	10/22/2019
Configuration:	1		

Environmental Conditions			
Temperature (ºC)	27	Relative Humidity (%):	22

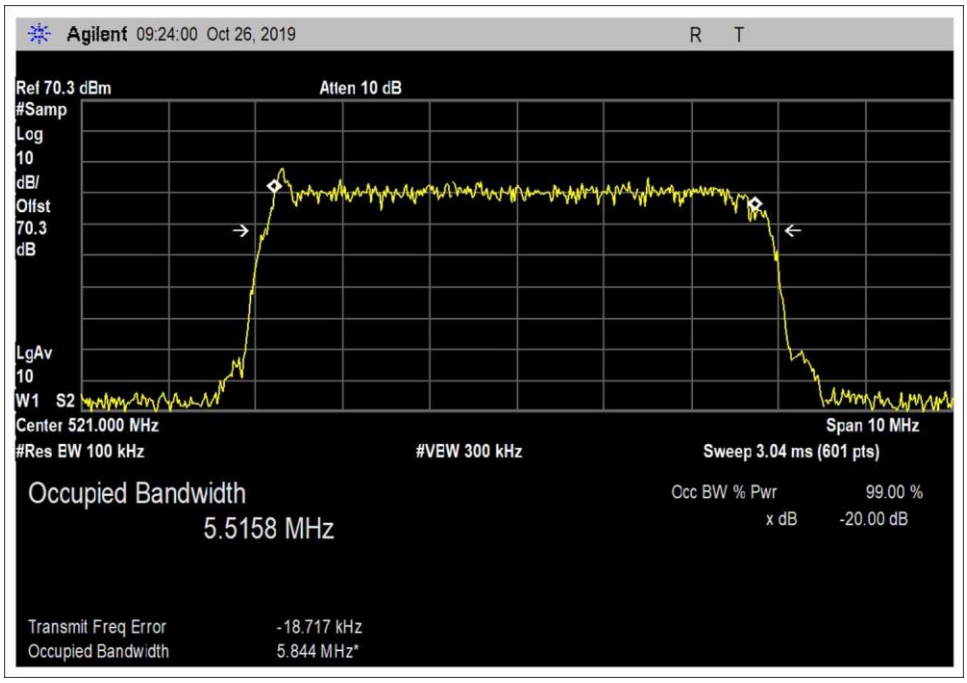
Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02869	Spectrum Analyzer	Agilent	E4440A	7/25/2019	7/25/2020
03432	Attenuator	Aeroflex/Weinschel	90-30-34	10/22/2019	10/22/2021
P07246	Cable	H&S	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
P07247	Cable	H&S	32022-29094K-29094K-24TC	7/5/2018	7/5/2020

Test Data Summary					
Frequency (MHz)	**Modulation**	**Rated Power (W/ dBm)**	**Measured (W/ dBm)**	**Limit (W/dBm)**	**Results**
521 (Ch22)	8VSB	1100 /60.4	1100/ 60.4	≤15000 /71.8	Pass
521 (Ch22)	8VSB	8800/ 69.4	8913/ 69.5	≤15000 /71.8	Pass

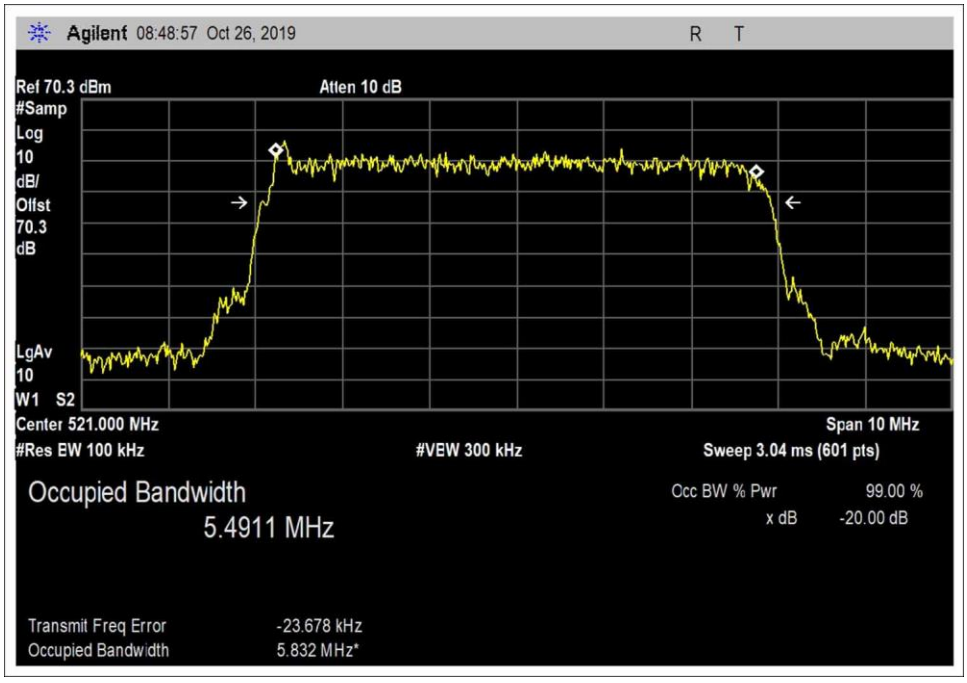
Reported power measured at the 40dB RF output sampling port of the band pass filter using channel power function of a spectrum analyzer. Attenuation of 40 dB sampling port at fundamental = 40.3dB.
Total correction 40.3+29.6+0.2+0.2 =70.3dB. Power level at 1100W and 8800W were evaluated

(b) The maximum ERP of a digital low power TV, TV translator, or TV booster station (average power) shall not exceed:
(1) 3 kW for VHF channels 2-13; and
(2) 15 kW for UHF channels 14-69.

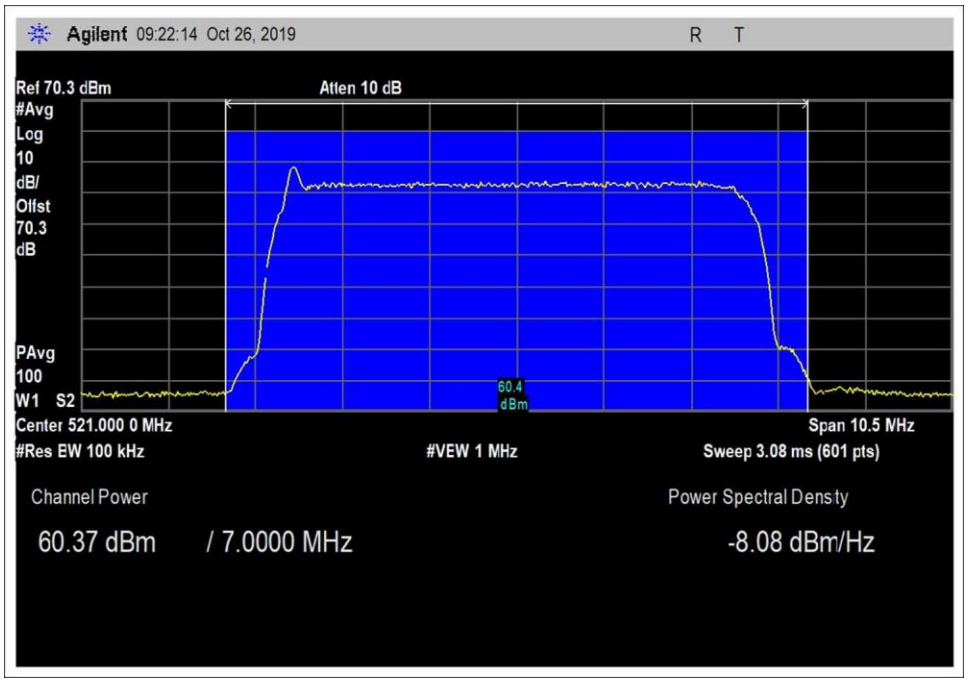
Test Data



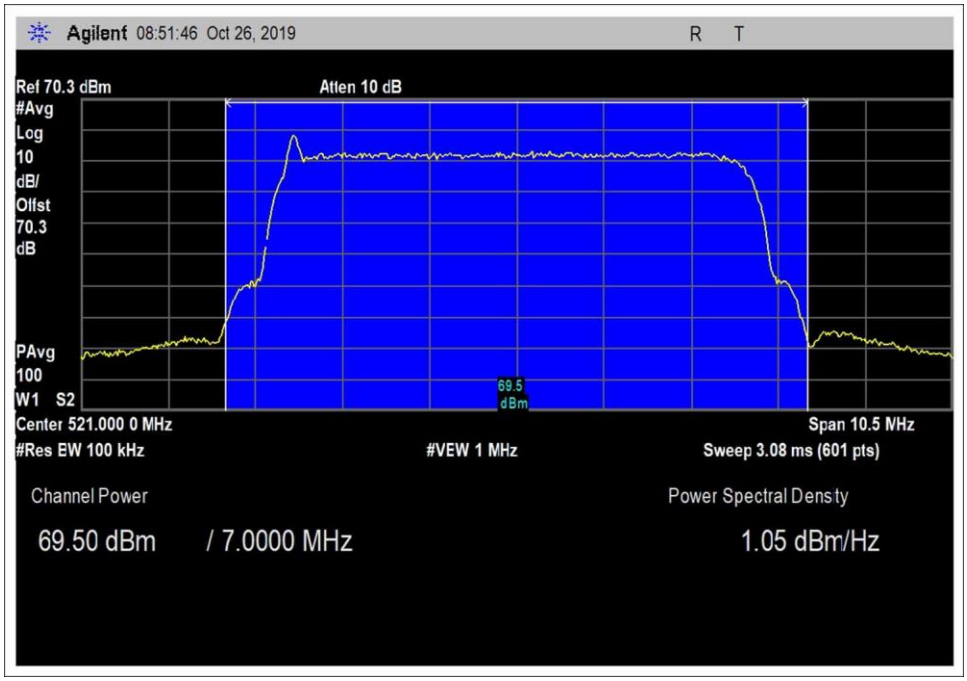
99%BW_1100W



99%BW_8800W

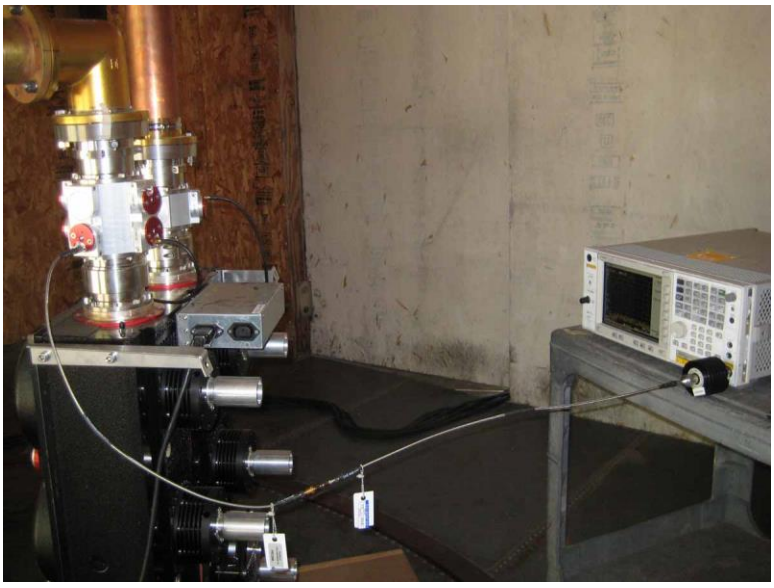


RF Power_1100W



RF Power_8800W

Test Setup Photo(s)



40dB

74.794(a)(2)(ii) Occupied Bandwidth / Stringent Mask

Test Setup/Conditions			
Test Location:	Brea Lab D	Test Engineer:	E. Wong
Test Method:	ANSI C63.26-2015 5.4.4 DA 05-1321-2005	Test Date(s):	10/22/2019
Configuration:	1		
Limit:	(ii) Stringent mask. In the first 500 kHz from the channel edges, emissions must be attenuated no less than 47 dB. More than 3 MHz from the channel edges, emissions must be attenuated no less than 76 dB. At any frequency between 0.5 and 3 MHz from the channel edges, emissions must be attenuated no less than the value determined by the following formula: A(dB) = 47 + 11.5 (Δf-0.5)		

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

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02869	Spectrum Analyzer	Agilent	E4440A	7/25/2019	7/25/2020
03432	Attenuator	Aeroflex/Weinschel	90-30-34	10/22/2019	10/22/2021
P07246	Cable	H&S	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
P07247	Cable	H&S	32022-29094K-29094K-24TC	7/5/2018	7/5/2020

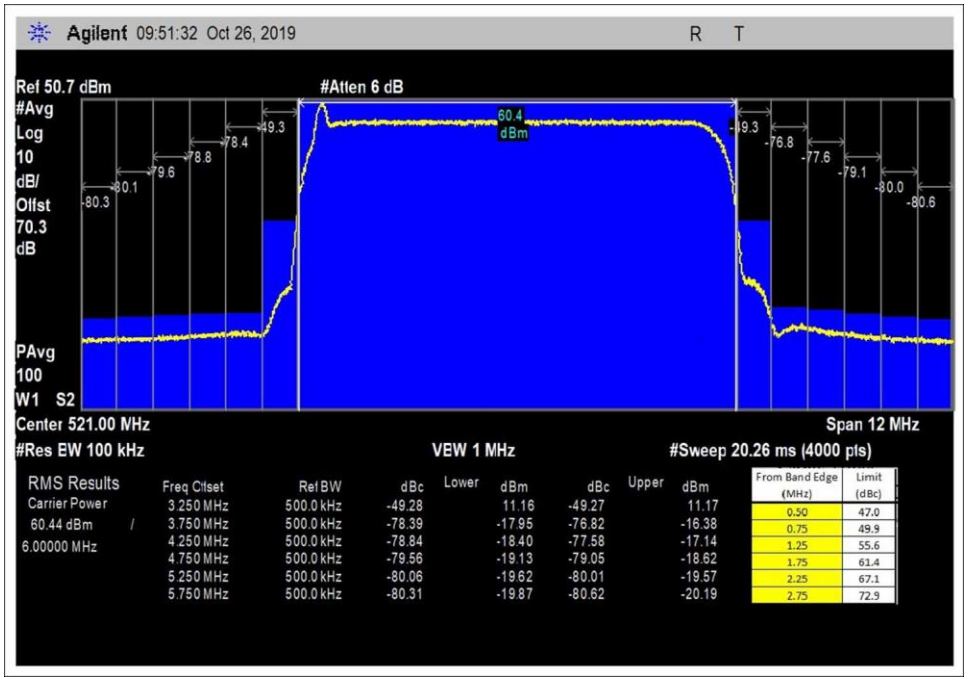
Reported occupied bandwidth/ mask was measured at the 40dB RF output sampling port of the band pass filter using adjacent channel power measurement of a spectrum analyzer. Attenuation of 40 dB sampling port at fundamental = 40.3dB. Total correction 40.3+29.6+0.2+0.2 =70.3dB . Stringent mask with power level set at 1100W and 8800W were evaluated, two plots per power level were presented to cover the frequency range of investigation, 0.5-2.75MHz and 3.25-5.75MHz from the channel edge. (3.25-5.75MHz, 6.25-8.75MHz from center of transmit frequency band to center of 500kHz integration bandwidth).

Per §74.794 Digital emissions.

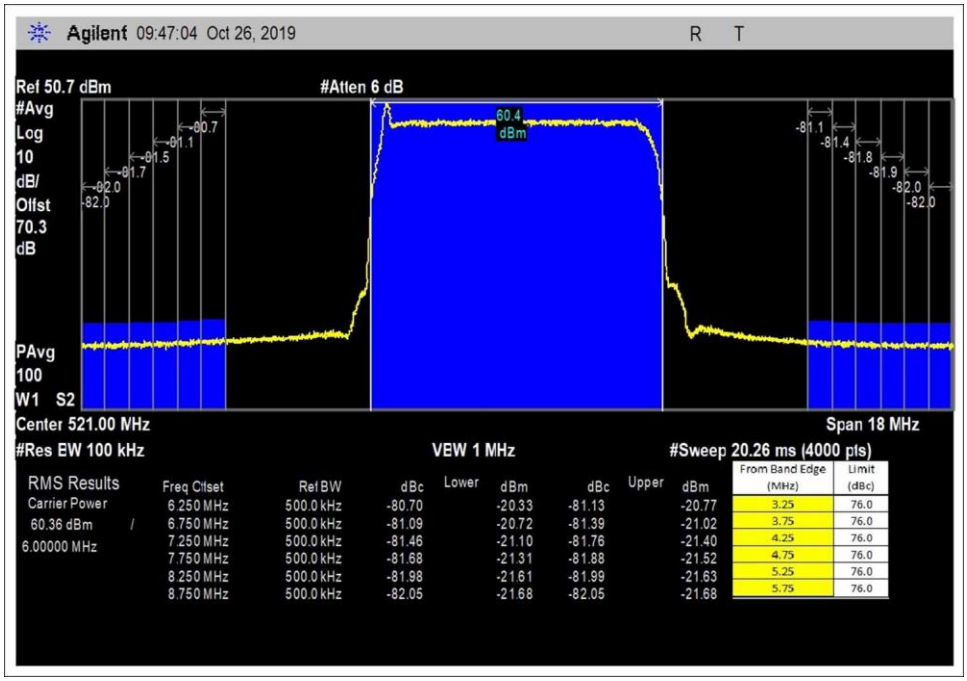
(a)(1) An applicant for a digital LPTV or TV translator station construction permit shall specify that the station will be constructed to confine out-of-channel emissions within one of the following emission masks: Simple, stringent or full service.

For this test, the provided plots shows compliance to the Stringent mask.

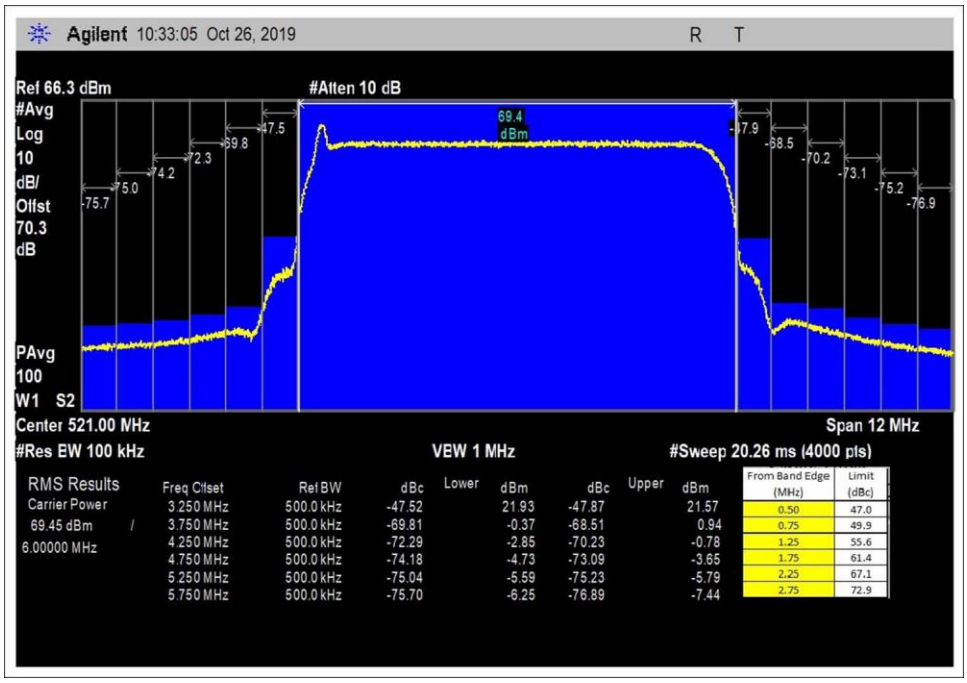
Test Data



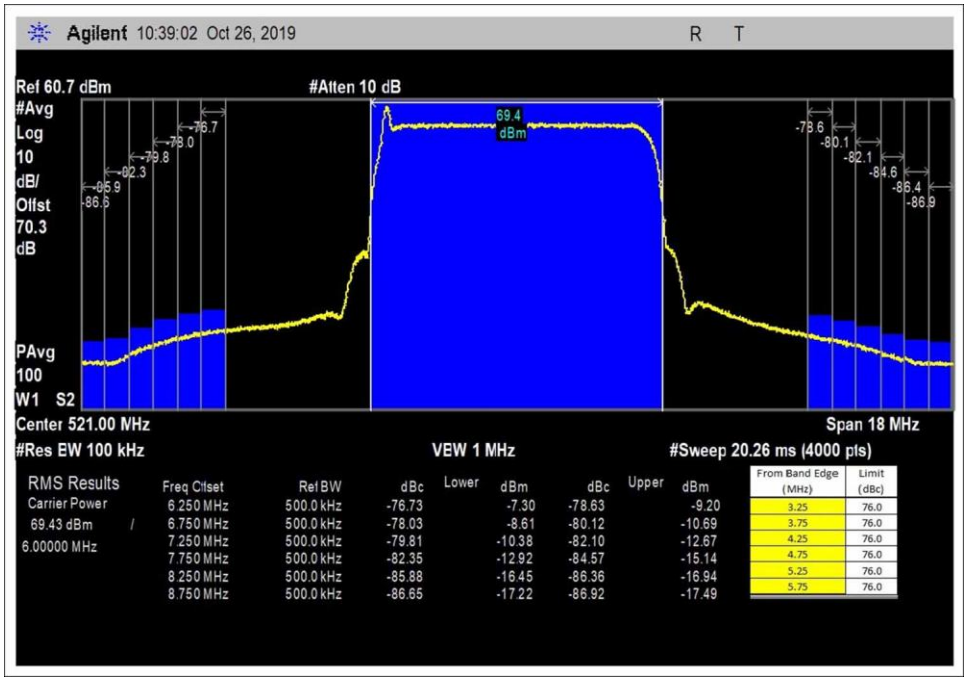
1100W



1100W

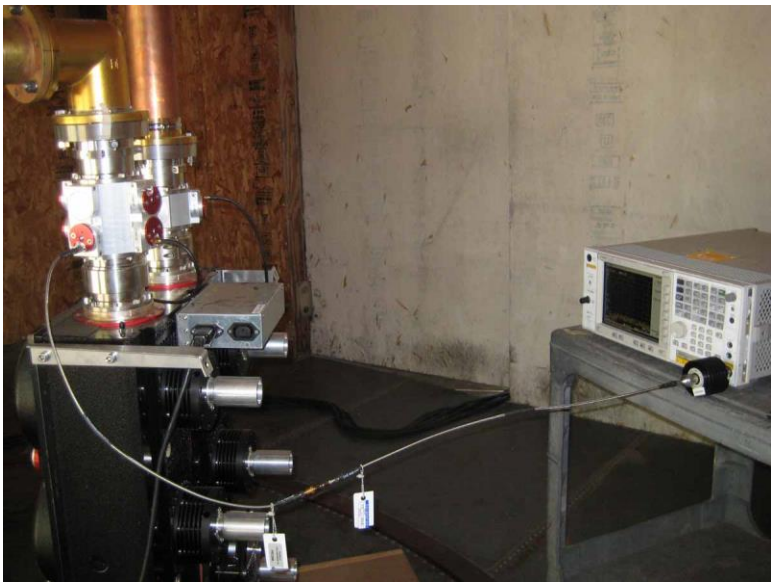

Agilent 10:33:05 Oct 26, 2019
R T
Ref 66.3 dBm
#Atten 10 dB
#Avg
Log
10
dB/
Offst
70.3
dB
69.4
dBm
-75.7
-75.0
-74.2
-72.3
-69.8
-47.5
-47.9
-68.5
-70.2
-73.1
-75.2
-76.9
PAvg
100
W1 S2
Center 521.00 MHz
Span 12 MHz
#Res EW 100 kHz
VEW 1 MHz
#Sweep 20.26 ms (4000 pts)
RMS Results
Carrier Power
69.45 dBm
6.00000 MHz
Freq Offset Ref BW dBc Lower dBm dBc Upper dBm
3.250 MHz 500.0 kHz -47.52 21.93 -47.87 21.57
3.750 MHz 500.0 kHz -69.81 -0.37 -68.51 0.94
4.250 MHz 500.0 kHz -72.29 -2.85 -70.23 -0.78
4.750 MHz 500.0 kHz -74.18 -4.73 -73.09 -3.65
5.250 MHz 500.0 kHz -75.04 -5.59 -75.23 -5.79
5.750 MHz 500.0 kHz -75.70 -6.25 -76.89 -7.44
From Band Edge (MHz) Limit (dBc)
0.50 47.0
0.75 49.9
1.25 55.6
1.75 61.4
2.25 67.1
2.75 72.9

8800W


Agilent 10:39:02 Oct 26, 2019
R T
Ref 60.7 dBm
#Atten 10 dB
#Avg
Log
10
dB/
Offst
70.3
dB
69.4
dBm
-86.9
-86.6
-82.3
-79.8
-78.0
-76.7
-78.6
-80.1
-82.1
-84.6
-86.4
-86.9
PAvg
100
W1 S2
Center 521.00 MHz
Span 18 MHz
#Res EW 100 kHz
VEW 1 MHz
#Sweep 20.26 ms (4000 pts)
RMS Results
Carrier Power
69.43 dBm
6.00000 MHz
Freq Offset Ref BW dBc Lower dBm dBc Upper dBm
6.250 MHz 500.0 kHz -76.73 -7.30 -78.63 -9.20
6.750 MHz 500.0 kHz -78.03 -8.61 -80.12 -10.69
7.250 MHz 500.0 kHz -79.81 -10.38 -82.10 -12.67
7.750 MHz 500.0 kHz -82.35 -12.92 -84.57 -15.14
8.250 MHz 500.0 kHz -85.88 -16.45 -86.36 -16.94
8.750 MHz 500.0 kHz -86.65 -17.22 -86.92 -17.49
From Band Edge (MHz) Limit (dBc)
3.25 76.0
3.75 76.0
4.25 76.0
4.75 76.0
5.25 76.0
5.75 76.0

8800W

Test Setup Photo(s)



40dB

74.794(b)(1) Radio Navigation Satellite Service Bands (GPS)

Test Setup/Conditions			
Test Location:	Brea Lab D	Test Engineer:	E. Wong
Test Method:	ANSI C63.26-2015 5.2.4.4	Test Date(s):	10/22/2019
Configuration:	1		

Environmental Conditions			
Temperature (ºC)	27	Relative Humidity (%):	22

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02869	Spectrum Analyzer	Agilent	E4440A	7/25/2019	7/25/2020
03432	Attenuator	Aeroflex/Weinschel	90-30-34	10/22/2019	10/22/2021
P07246	Cable	H&S	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
P07247	Cable	H&S	32022-29094K-29094K-24TC	7/5/2018	7/5/2020

Manufacturer provided the filter response curve of the low pass filter installed as presented in plot section below.

Test Data Summary				
Frequency (MHz)	**Modulation**	**Measured filter Attenuation (dB)**	**Limit (dB)**	**Results**
1100W				
1164-1215MHz	8VSB	167.6	≥85	Pass
1215-1240MHz	8VSB	180.3	≥85	Pass
1559-1610MHz	8VSB	96.9	≥85	Pass
8800W				
1164-1215MHz	8VSB	177.1	≥85	Pass
1215-1240MHz	8VSB	189.7	≥85	Pass
1559-1610MHz	8VSB	92.4	≥85	Pass

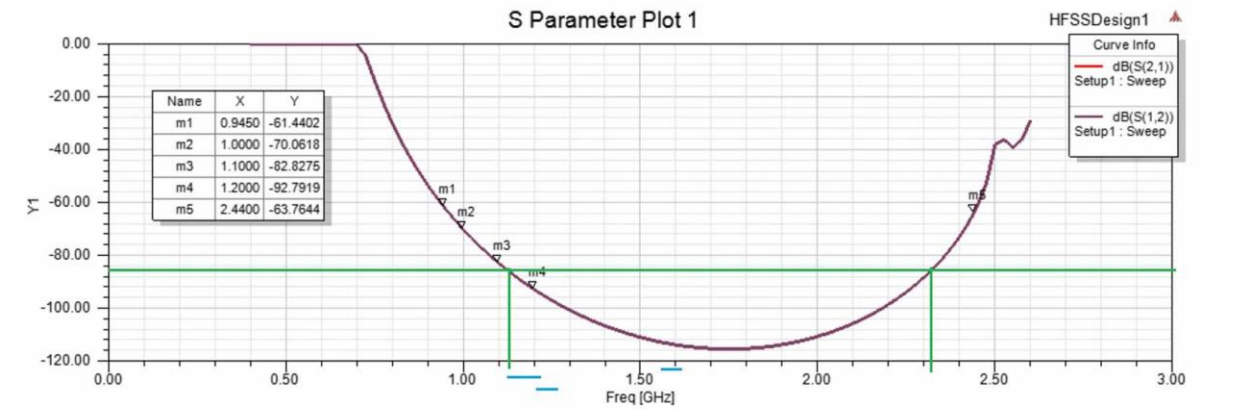
In addition to manufacture provided Filter response curve, the above worst-case attenuation in GPS band of interest with respect to fundamental power was measured. Measurement was made at 60dB sampling port at input port of the Band pass filter. The responses of the band pass filter and 60dB sampling port was characterized prior to testing and correction factor applied. (refer to conducted emission data) Attenuation with Power level set at 1100W and 8800W were evaluated

(b) In addition to meeting the emission attenuation requirements of the simple or stringent mask (including attenuation of radio frequency harmonics), digital low power TV and TV translator stations authorized to operate on TV channels 22-24, (518-536 MHz), 32-36 (578-608 MHz), 38 (614-620 MHz), and 65-69 (776-806 MHz) must provide specific “out of band” protection to Radio Navigation Satellite Services in the bands: L5 (1164-1215 MHz); L2 (1215-1240 MHz) and L1 (1559-1610 MHz).

(1) An FCC-certificated transmitter specifically certified for use on one or more of the above channels must include filtering with an attenuation of not less than 85 dB in the GPS bands, which will have the effect of reducing

harmonics in the GPS bands from what is produced by the digital transmitter, and this attenuation must be demonstrated as part of the certification application to the Commission.

Test Data



74.794(a)(2)(ii) Spurious Emissions at Antenna Terminal

Limit Line Attenuation

74.794(a)(2)(ii) Digital emissions. Stringent Mask.
Stringent mask. Emissions more than 3 MHz from the channel edges, emissions must be attenuated no less than 76 dB.

Conducted Spurious emission limit
dBm = 10 Log (P) where P is in mW
dBuV = dBm + 107

1100 Watts = 60.4 dBm
8800 Watts = 69.4 dBm

1100 Watts limit line = 60.4dBm – 76dB = -15.6 dBm = 91.4 dBuV
8800 Watts limit line = 69.4 dBm– 76dB = - 6.6 dBm = 100.4 dBuV

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc • 110 N. Olinda Place • Brea, CA • 714 993 6112		
Customer:	**Anywave Communication Technologies, Inc**		
Specification:	**47 CFR §74.794(A)(2)(ii) Spurious Emissions**		
Work Order #:	**103031**	Date:	10/26/2019
Test Type:	**Conducted Emissions**	Time:	12:18:44
Tested By:	E. Wong	Sequence#:	2
Software:	EMITest 5.03.12		208V60Hz 3Phase

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The EUT is placed on the turntable. SPL-2-U-1 RF in is connected to 60dB sampling input port of the Band pass filter SPL - 2-U -2 is connected to the 60dB sampling output port of the Band pass filter. Output of the Band pass filter is connected to a RF load.

Ethernet port is connected to a support router.

Chassis is grounded.

The 60dB sampling port of the directional coupler at the input end of the band pass filter of the amplifier is connected to the spectrum analyzer
Note: The band pass filter is NOT in the measurement path for this measurement. However Recorded measurement is corrected with respect to attenuation of the Band Pass Filter as determined from separate insertion loss measurement.

All measurement at the sampling port of the band pass filter has been corrected for coupling loss
Fundamental Frequency: 521MHz

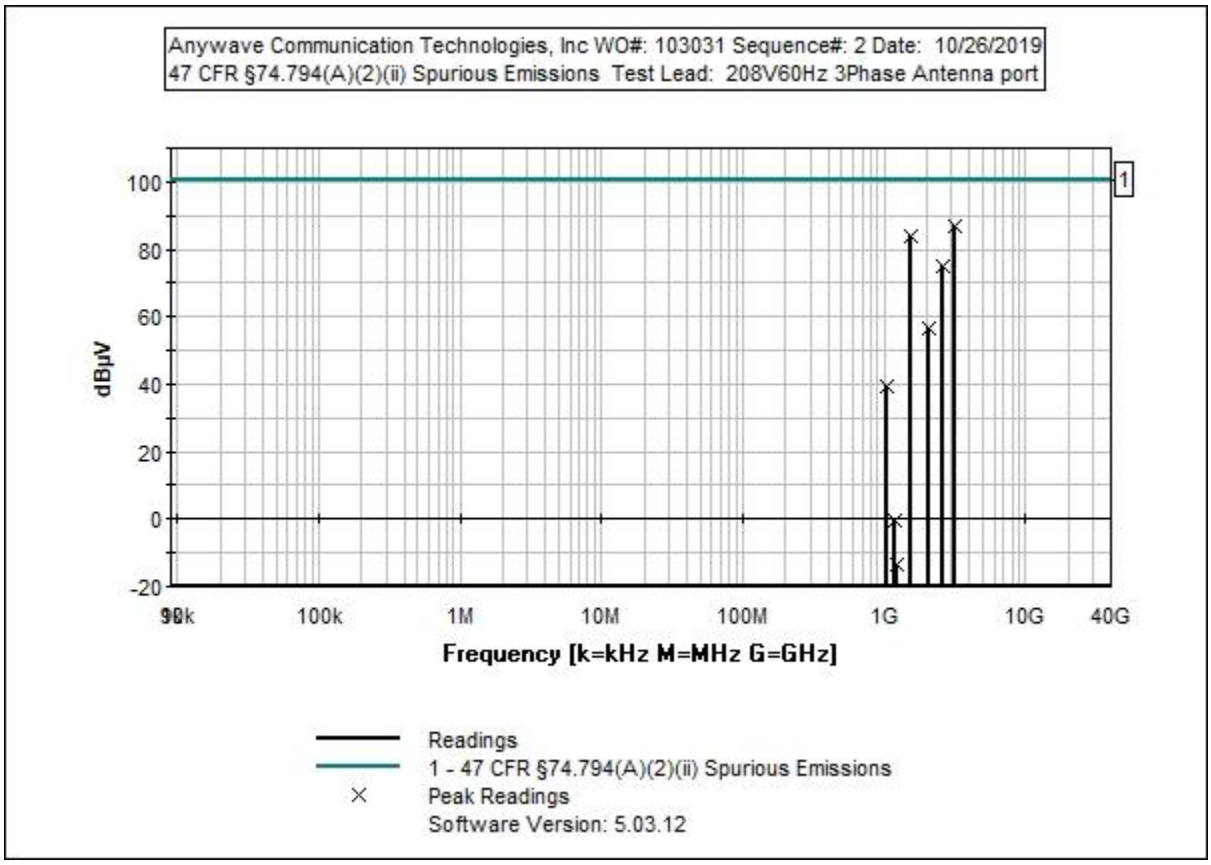
Operations at 8800W (69.4dBm)

Frequency range of measurement = 9 kHz- 6GHz.
RBW=510kHz, VBW-=1MHz

Test environment conditions: Temperature: 28°C, Relative Humidity: 16% Pressure: 98.9kPa

Site D
Test Method: ANSI C63.26-2015 5.7
DA 05-1321-2005

Compared to the fundamental power, the maximum measured readings in GPS band shows attenuation of at least 85dB


Anywave Communication Technologies, Inc WO#: 103031 Sequence#: 2 Date: 10/26/2019
47 CFR §74.794(A)(2)(ii) Spurious Emissions Test Lead: 208V60Hz 3Phase Antenna port
dBµV
100
80
60
40
20
0
-20
1
9k
100k
1M
10M
100M
1G
10G
40G
Frequency [k=kHz M=MHz G=GHz]
Readings
1 - 47 CFR §74.794(A)(2)(ii) Spurious Emissions
Peak Readings
Software Version: 5.03.12

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02869	Spectrum Analyzer	E4440A	7/25/2019	7/25/2020
T2	AN03430	Attenuator	75A-10-12	12/19/2017	12/19/2019
	AN03432	Attenuator	90-30-34	10/22/2019	10/22/2021
T3	ANP07246	Cable	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
T4	ANP07247	Cable	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
T5	ANC00141	<-Select Sub Type->	RG-142	10/25/2019	10/25/2021
T6	ANC00140	Band Pass Filter	RG-142	10/25/2019	10/25/2021
T7	AN02749	High Pass Filter	9SH10-1000/T10000-O/O	7/15/2019	7/15/2021

Measurement Data: Reading listed by margin. Test Lead: Antenna port

#	Freq	Rdng	T1 T5	T2 T6	T3 T7	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV	dBµV	dB	Ant
1	3118.330M	17.3	+0.0 +68.9	+10.1 -11.2	+0.4 +0.7	+0.4	+0.0	86.6	100.4	-13.8	Anten
2	1563.330M	25.5	+0.0 +56.0	+10.1 -8.5	+0.2 +0.5	+0.2	+0.0	84.0	100.4 GPS band Measured Reading/500kHz is 92.4dB under fundamental 69.4dBm/6MHz	-16.4	Anten
3	2607.580M	19.3	+0.0 +50.0	+10.1 -5.5	+0.3 +0.7	+0.3	+0.0	75.2	100.4	-25.2	Anten
4	2082.080M	35.2	+0.0 +53.3	+10.0 -42.8	+0.3 +0.4	+0.3	+0.0	56.7	100.4	-43.7	Anten
5	1042.000M	21.7	+0.0 +59.8	+10.0 -53.2	+0.1 +0.8	+0.2	+0.0	39.4	100.4	-61.0	Anten
6	1187.250M	11.2	+0.0 +60.5	+10.0 -83.4	+0.2 +0.6	+0.2	+0.0	-0.7	100.4 GPS band	-101.1	Anten
7	1225.250M	11.6	+0.0 +60.2	+10.0 -96.1	+0.2 +0.6	+0.2	+0.0	-13.3	100.4 GPS band	-113.7	Anten

Test Location:	CKC Laboratories, Inc • 110 N. Olinda Place • Brea, CA • 714 993 6112		
Customer:	**Anywave Communication Technologies, Inc**		
Specification:	**47 CFR §74.794(A)(2)(ii) Spurious Emissions**		
Work Order #:	**103031**	Date:	10/26/2019
Test Type:	**Conducted Emissions**	Time:	12:59:31
Tested By:	E. Wong	Sequence#:	3
Software:	EMITest 5.03.12		208V60Hz 3Phase

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The EUT is placed on the turntable. SPL-2-U-1 RF in is connected to 60dB sampling input port of the Band pass filter SPL - 2-U -2 is connected to the 60dB sampling output port of the Band pass filter. Output of the Band pass filter is connected to a RF load.

Ethernet port is connected to a support router.

Chassis is grounded.

The 60dB sampling port of the directional coupler at the input end of the band pass filter of the amplifier is connected to the spectrum analyzer
Note: The band pass filter is NOT in the measurement path for this measurement. However Recoded measurement is corrected with respect to attenuation of the Band Pass Filter as determined from separate insertion loss measurement.

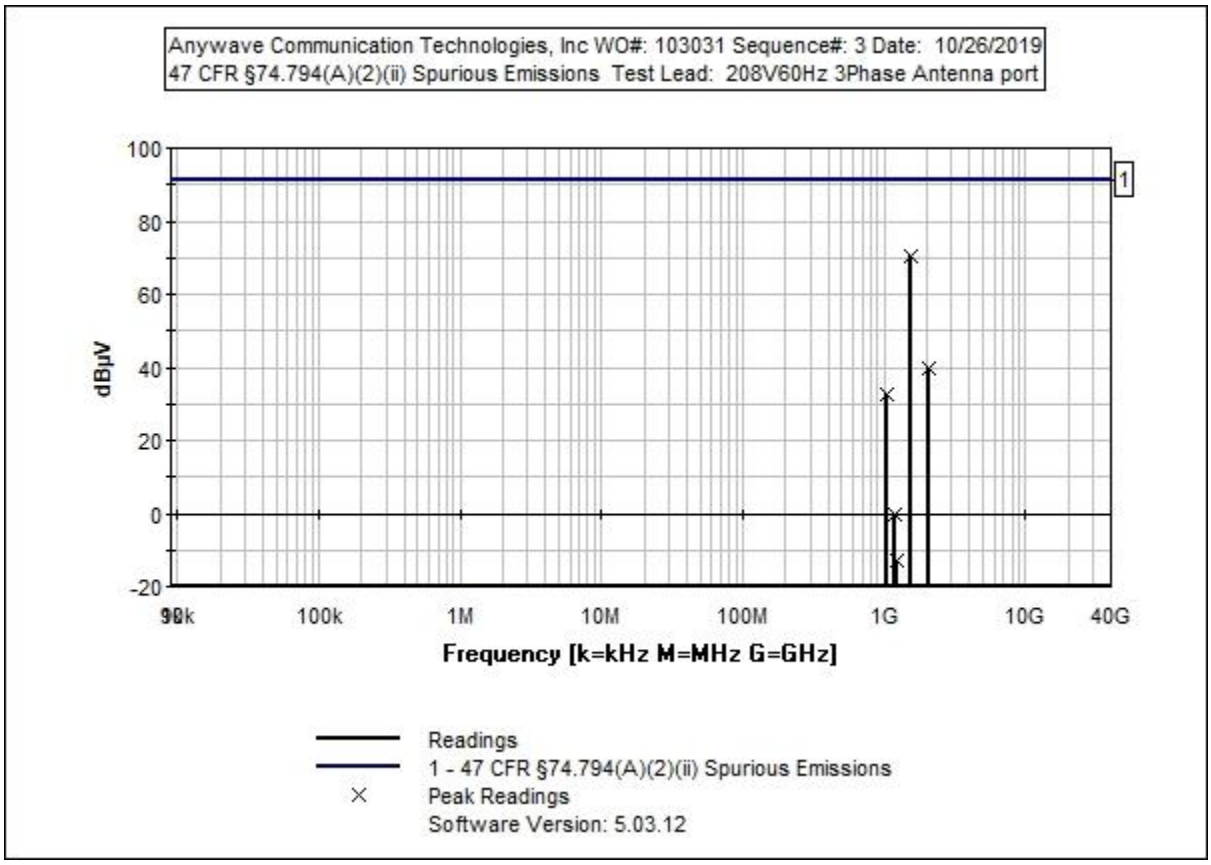
All measurement made at the sampling port of the band pass filter has been corrected for coupling loss
Fundamental Frequency: 521MHz

Operations at 1100W (60.4dBm)

Frequency range of measurement = 9 kHz- 6GHz.
RBW=510kHz, VBW-=1MHz

Test environment conditions: Temperature: 28°C, Relative Humidity: 16%, Pressure: 98.9kPa

Site D
Test Method: ANSI C63.26-2015 5.7
DA 05-1321-2005
Compared to the fundamental power, the maximum measured readings in GPS band shows attenuation of at least 85dB


Anywave Communication Technologies, Inc WO#: 103031 Sequence#: 3 Date: 10/26/2019
47 CFR §74.794(A)(2)(ii) Spurious Emissions Test Lead: 208V60Hz 3Phase Antenna port
100
80
60
40
20
0
-20
dBµV
1
90k
100k
1M
10M
100M
1G
10G
40G
Frequency [k=kHz M=MHz G=GHz]
Readings
1 - 47 CFR §74.794(A)(2)(ii) Spurious Emissions
Peak Readings
Software Version: 5.03.12

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02869	Spectrum Analyzer	E4440A	7/25/2019	7/25/2020
T2	AN03430	Attenuator	75A-10-12	12/19/2017	12/19/2019
	AN03432	Attenuator	90-30-34	10/22/2019	10/22/2021
T3	ANP07246	Cable	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
T4	ANP07247	Cable	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
T5	ANC00141	<-Select Sub Type->	RG-142	10/25/2019	10/25/2021
T6	ANC00140	Band Pass Filter	RG-142	10/25/2019	10/25/2021
T7	AN02749	High Pass Filter	9SH10-1000/T10000-O/O	7/15/2019	7/15/2021

Measurement Data: Reading listed by margin. Test Lead: Antenna port

#	Freq	Rdng	T1 T5	T2 T6	T3 T7	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV	dBµV	dB	Ant
1	1557.670M	15.8	+0.0 +56.1	+10.0 -12.3	+0.2 +0.5	+0.2	+0.0	70.5	91.4 GPS band Measured Reading/500kHz is 96.9dB under fundamental 60.4dBm/6MHz	-20.9	Anten
2	2081.830M	18.2	+0.0 +53.2	+10.0 -42.7	+0.3 +0.4	+0.3	+0.0	39.7	91.4	-51.7	Anten
3	1042.000M	14.8	+0.0 +59.8	+10.0 -53.2	+0.1 +0.8	+0.2	+0.0	32.5	91.4	-58.9	Anten
4	1186.830M	11.5	+0.0 +60.5	+10.0 -83.2	+0.2 +0.6	+0.2	+0.0	-0.2	91.4 GPS band	-91.6	Anten
5	1224.830M	12.0	+0.0 +60.2	+10.0 -96.1	+0.2 +0.6	+0.2	+0.0	-12.9	91.4 GPS band	-104.3	Anten

Test Setup Photo(s)

60dB

74.794(a)(2)(ii) Field Strength of Spurious Radiation

Limit Line Attenuation

74.794(a)(2)(ii) Digital emissions. Stringent Mask.
Stringent mask. Emissions more than 3 MHz from the channel edges, emissions must be attenuated no less than 76 dB.

Radiated Spurious emission limit
Per Annex C of ANSI 63.26, Clause C.2

$$\text{EIRP} = p_t \times g_t = (E \times d)^2 / 30$$

where

p_t	transmitter output power in W
g_t	numeric gain of the transmitting antenna (dimensionless)
E	electric field strength in V/m
d	measurement distance in m

Electric field at 3 meters with numeric gain of 1
$P_t \times 1 = (E \times 3)^2 / 30$
$E = (30 \times P_t) / 3$
$E = \sqrt{30 \; x \; pt \;)} / 3$

At 1100W
$E = \sqrt{30 \; x \; 1100 \;)} / 3$ = 60.6V/m@3m = 20 Log (60.6 /1x 10^{-6}) = 155.7dBuV/m@3m

At 8800W
$E = \sqrt{30 \; x \; 8800 \;)} / 3$ = 171.3V/m@3m = 20 Log (171.3 /1x 10^{-6}) = 164.7dBuV/m@3m

1000 Watts radiated spurious limit at test distance of 3 meter
= 155.7dBuV/m@3m – 76dB = 79.7 dBuV/m @3m

8800 Watts radiated spurious limit at test distance of 3 meter
= 164.7dBuV/m@3m – 76dB = 88.7dBuV/m @3m

Test Conditions / Setup / Data

Test Location:	CKC Laboratories, Inc • 110 N. Olinda Place • Brea, CA • 714 993 6112		
Customer:	**Anywave Communication Technologies, Inc**		
Specification:	**74.794(a)(2)(ii) Radiated Spurious Emissions**		
Work Order #:	**103031**	Date:	2/19/2020
Test Type:	**Radiated Scan**	Time:	16:26:05
Tested By:	E. Wong	Sequence#:	11
Software:	EMITest 5.03.12		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

The EUT is placed on the turntable. SPL-2-U-1 RF in is connected to 60dB sampling input port of the Band pass filter SPL - 2-U -2 is connected to the 60dB sampling output port of the Band pass filter. Output of the Band pass filter is connected to a RF load.

Ethernet port is connected to a support router. Ethernet switch in the chassis, and front LCD panel are not active.
All other port left unpopulated as intended.
The manufacturer declares the highest EUT frequency generated or used is 40MHz
Chassis is grounded.

The EUT is operational worst-case output power. Operations at 8800W (69.4dBm)

Fundamental Frequency: 521MHz

Frequency range of measurement = 9 kHz- 6 GHz.
9kHz -150kHz;RBW=200 Hz,VBW=600 Hz;150 kHz-30MHz;RBW=9kHz,VBW=27kHz;30MHz-1000 MHz;RBW=120 kHz,VBW=360 kHz,1000 MHz-6000 MHz;RBW=510kHz,VBW=1.5 MHz.

Test environment conditions: Temperature: 20.2°C, Relative Humidity: 51 %, Pressure: 98.9kPa

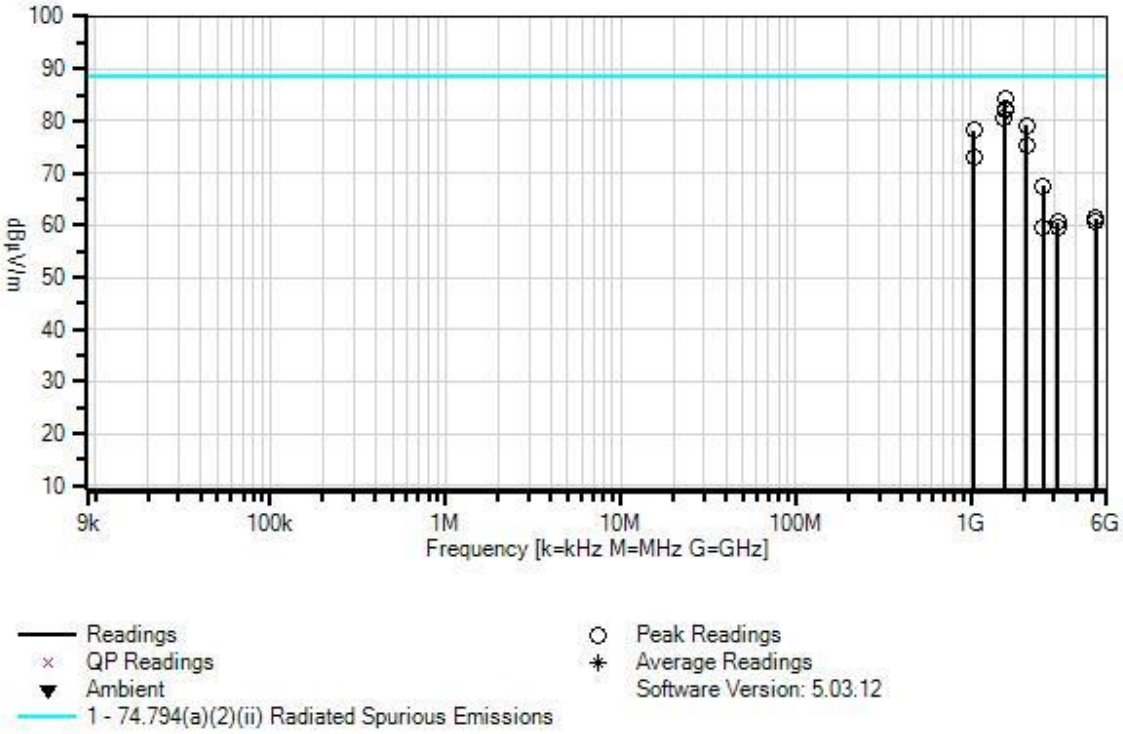
Site D
Test Method: ANSI C63.26-2015 5.5
DA 05-1321-2005

Note; bandwidth correction per 74.794 (a)(3) is applied to readings below 1GHz.
10 log (BWalternate/500) = 10 log (120/500) = 6.2dB

No emission found below 1 GHz that is within 20dB of the limit.
Additional measurement: Worse case 3 meter reading remeasured at 10 meter.

Modification: #1 was in place during testing.

Anywave Communication Technologies, Inc WO#: 103031 Sequence#: 11 Date: 2/19/2020
74.794(a)(2)(ii) Radiated Spurious Emissions Test Distance: 3 Meters Vert



Test Equipment:

ID	Asset #	Description	Model	Cal Date	Cal Due Date
T1	AN02672	Spectrum Analyzer	E4446A	3/13/2019	3/13/2021
	AN01994	Biconilog Antenna	CBL6111C	4/23/2018	4/23/2020
	ANP05283	Attenuator	ATT-0218-06-NNN-02	4/5/2018	4/5/2020
	ANP05569	Cable-Amplitude +15C to +45C (dB)	RG-214/U	12/24/2018	12/24/2020
	AN00010	Preamp	8447D	1/2/2020	1/2/2022
	ANP06978	Cable	Sucoflex 104A	3/31/2018	3/31/2020
	AN00314	Loop Antenna	6502	5/13/2018	5/13/2020
	AN74.794 (a)(3)	Test Data Adjustment		8/24/2018	8/24/2022
T2	ANP04382	Cable	LDF-50	6/2/2018	6/2/2020
T3	ANP07138	Cable	ANDL1-PNMNM-60	3/4/2019	3/4/2021
T4	AN00787	Preamp	83017A	5/31/2019	5/31/2021
T5	ANP07246	Cable	32022-29094K-29094K-24TC	7/5/2018	7/5/2020
T6	AN02749	High Pass Filter	9SH10-1000/T10000-O/O	7/15/2019	7/15/2021
T7	AN03432	Attenuator	90-30-34	10/22/2019	10/22/2021
T8	AN01646	Horn Antenna	3115	3/14/2018	3/14/2020

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2 T6	T3 T7	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	1562.230M	50.1	+0.0 +0.2	+4.4 +0.5	+3.1 +29.6	-39.9 +25.7	+10.5	84.2	88.7	-4.5	Vert
2	1562.623M	48.3	+0.0 +0.2	+4.4 +0.5	+3.1 +29.6	-39.9 +25.6	+10.5	82.3	88.7	-6.4	Horiz
3	1561.670M	58.3	+0.0 +0.2	+4.4 +0.5	+3.1 +29.6	-39.9 +25.7	+0.0	81.9	88.7	-6.8	Horiz
4	1559.430M	56.8	+0.0 +0.2	+4.4 +0.5	+3.1 +29.6	-39.9 +25.7	+0.0	80.4	88.7	-8.3	Vert
5	2083.970M	52.0	+0.0 +0.3	+5.2 +0.4	+3.7 +29.6	-39.8 +27.8	+0.0	79.2	88.7	-9.5	Horiz
6	1041.830M	58.2	+0.0 +0.1	+3.6 +0.8	+2.4 +29.6	-41.5 +24.9	+0.0	78.1	88.7	-10.6	Horiz
7	2085.400M	47.9	+0.0 +0.3	+5.2 +0.4	+3.7 +29.6	-39.8 +27.8	+0.0	75.1	88.7	-13.6	Vert
8	1042.000M	53.0	+0.0 +0.1	+3.6 +0.8	+2.4 +29.6	-41.5 +24.9	+0.0	72.9	88.7	-15.8	Vert

9	2603.340M	38.2	+0.0 +0.3	+5.6 +0.7	+4.2 +29.7	-39.9 +28.8	+0.0	67.6	88.7	-21.1	Horiz
10	5203.300M	22.1	+0.0 +0.3	+8.7 +0.4	+6.1 +29.8	-39.8 +33.7	+0.0	61.3	88.7	-27.4	Horiz
11	3125.200M	27.9	+0.0 +0.5	+6.3 +0.6	+4.6 +29.7	-40.1 +31.1	+0.0	60.6	88.7	-28.1	Vert
12	5205.870M	21.4	+0.0 +0.3	+8.7 +0.4	+6.1 +29.8	-39.8 +33.7	+0.0	60.6	88.7	-28.1	Vert
13	2604.030M	30.2	+0.0 +0.3	+5.6 +0.7	+4.2 +29.7	-39.9 +28.8	+0.0	59.6	88.7	-29.1	Vert
14	3122.630M	26.8	+0.0 +0.5	+6.2 +0.7	+4.6 +29.7	-40.1 +31.0	+0.0	59.4	88.7	-29.3	Horiz

Test Setup Photo(s)

General Test Setup

General Test Setup

Below 1GHz

Below 1GHz

Above 1GHz

Above 1GHz

74.761(a)/74.761(b) Frequency Tolerance – Temperature / Voltage

Test Setup/Conditions			
Test Location:	Brea Lab D	Test Engineer:	E. Wong
Test Method:	Part 74.761(a)/ Part 74.761(b) Part 2.1055	Test Date(s):	2/20/2020
Configuration:	1		
Limit:	74.761 (a) The visual carrier shall be maintained to within 0.02 percent of the assigned visual carrier frequency for transmitters rated at not more than 100 watts peak visual power. 74.761 (b) The visual carrier shall be maintained to within 0.002 percent of the assigned visual carrier frequency for transmitters rated at more than 100 watts peak visual power. * Frequency measurement taken at -6dB point of the pilot tone signal. Evaluation performed at the RF monitor port of the Exciter (signal source)		

Environmental Conditions			
Temperature (ºC)	27	Relative Humidity (%):	22

Test Equipment - Voltage					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02869	Spectrum Analyzer	Agilent	E4440A	7/25/2019	7/25/2020
P07164	Multimeter	Fluke	8845A/G	7/30/2019	7/30/2021
02476	AC Power Supply	California Instruments	1251WP	3/18/2019	3/18/2021
01379	Variac	Superior Electric	1256D	12/12/2019	12/12/2020

Test Equipment - Temperature					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
02869	Spectrum Analyzer	Agilent	E4440A	7/25/2019	7/25/2020
P05947	Thermometer	Fluke	51	5/11/2018	5/11/2020
SN9126	Temperature chamber	Thermaltron	SM8	NA*	NA*

*Note: Temperature measurement made in chamber SN9126 was recorded with CKC property AN05947

Parameter Definitions:

Measurements performed at input voltage Vnominal ± 15%.

Parameter	Value
$V_{Nominal}$:	120 VAC
$V_{Minimum}$:	102.00 VAC
$V_{Maximum}$:	138.00 VAC

Measurements performed according to manufacturer specification.

Parameter	Value
$T_{Nominal}$:	+20C
$T_{Minimum}$:	-10C
$T_{Maximum}$:	+50C

Test Data – Voltage and Temperature

Temperature Variations

Channel Frequency:		Channel 1 (MHz) 518.309142000	Dev(%)
Temp (C)	Voltage		
-10	120	518.309149000	-0.0000014
0	120	518.309152000	-0.0000019
10	120	518.309152000	-0.0000019
20	120	518.309142000	0.0000000
30	120	518.309149000	-0.0000014
40	120	518.309142000	0.0000000
50	120	518.309139000	0.0000006

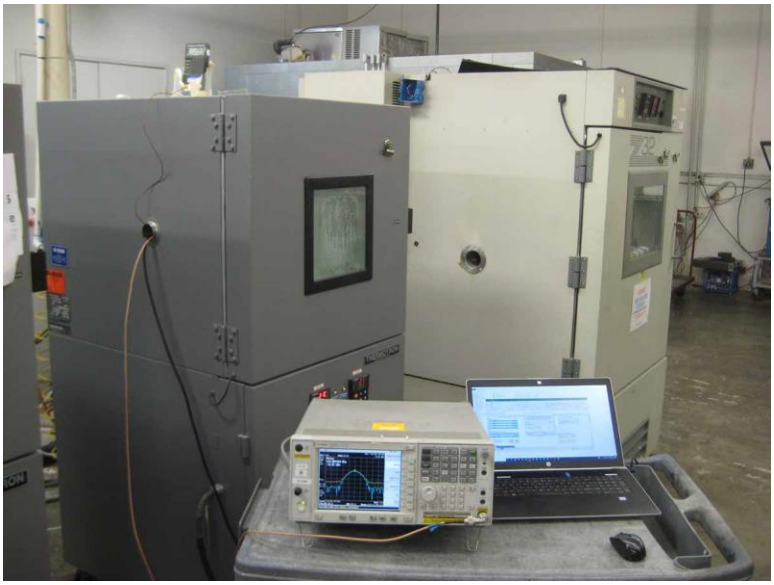
Voltage Variations (±15%)

Temp (C)	Voltage	Channel 1 (MHz)	Dev (%)
20	102.0	518.309136000	0.0000012
20	120.0	518.309142000	0.0000000
20	138.0	518.309138000	0.0000008

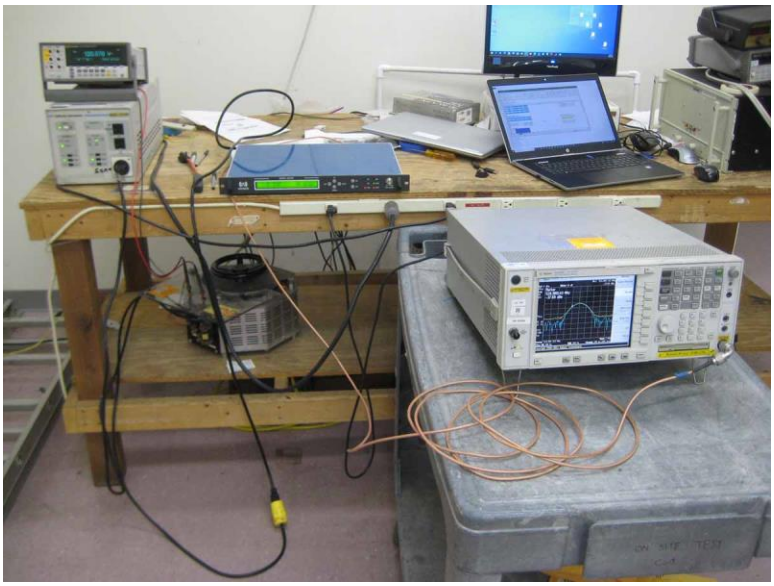
Max Deviation (%)	**+**	**0.0000012**
Max Deviation (%)	**-**	**0.0000019**
		PASS

Test Setup Photo(s)

Temperature Test Setup, View #1



Temperature Test Setup, View #2



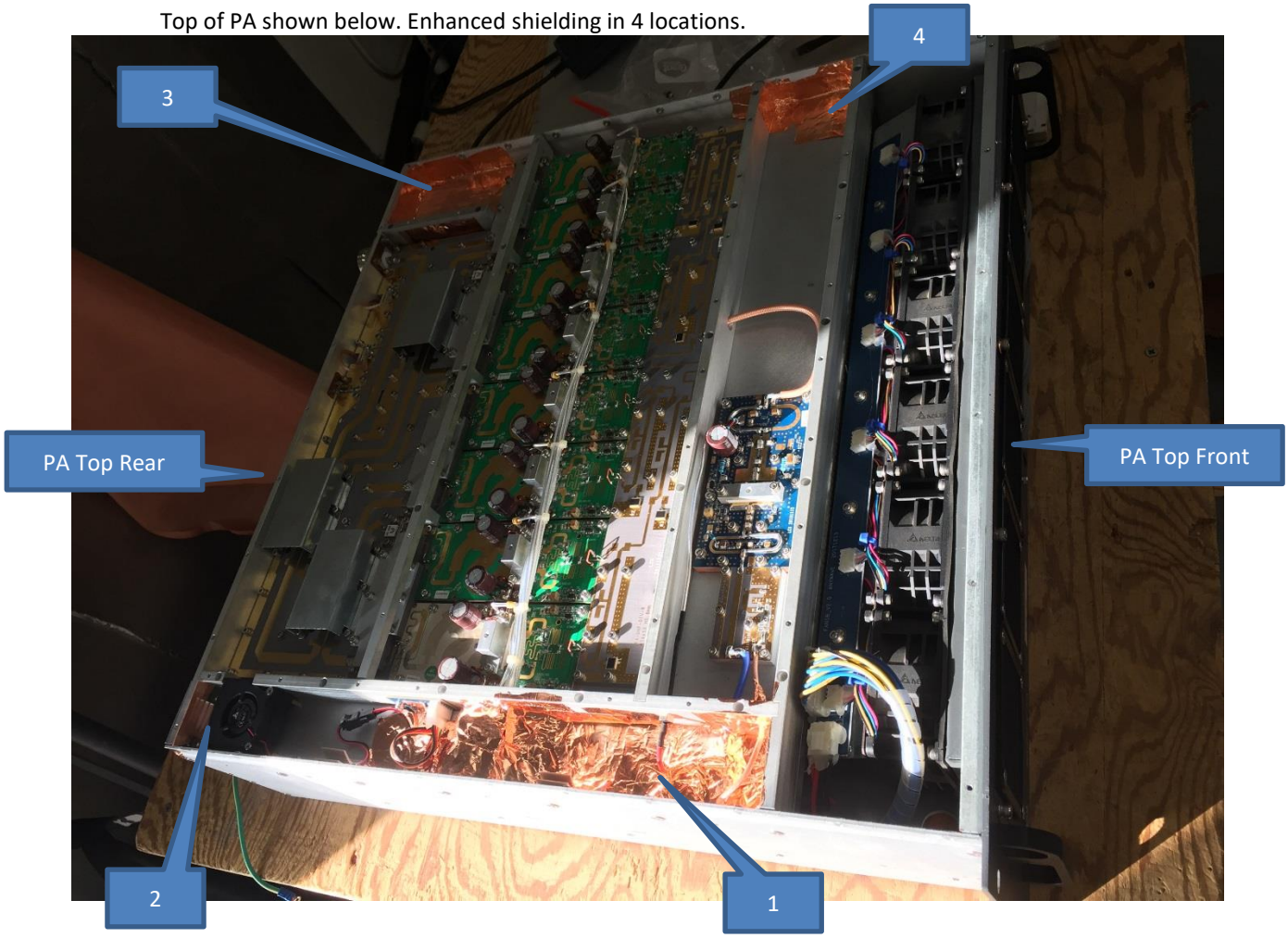
Voltage Variation Test Setup

Appendix A: Modifications Made During Testing

The following modifications were made to the TX for cabinet radiated emissions.

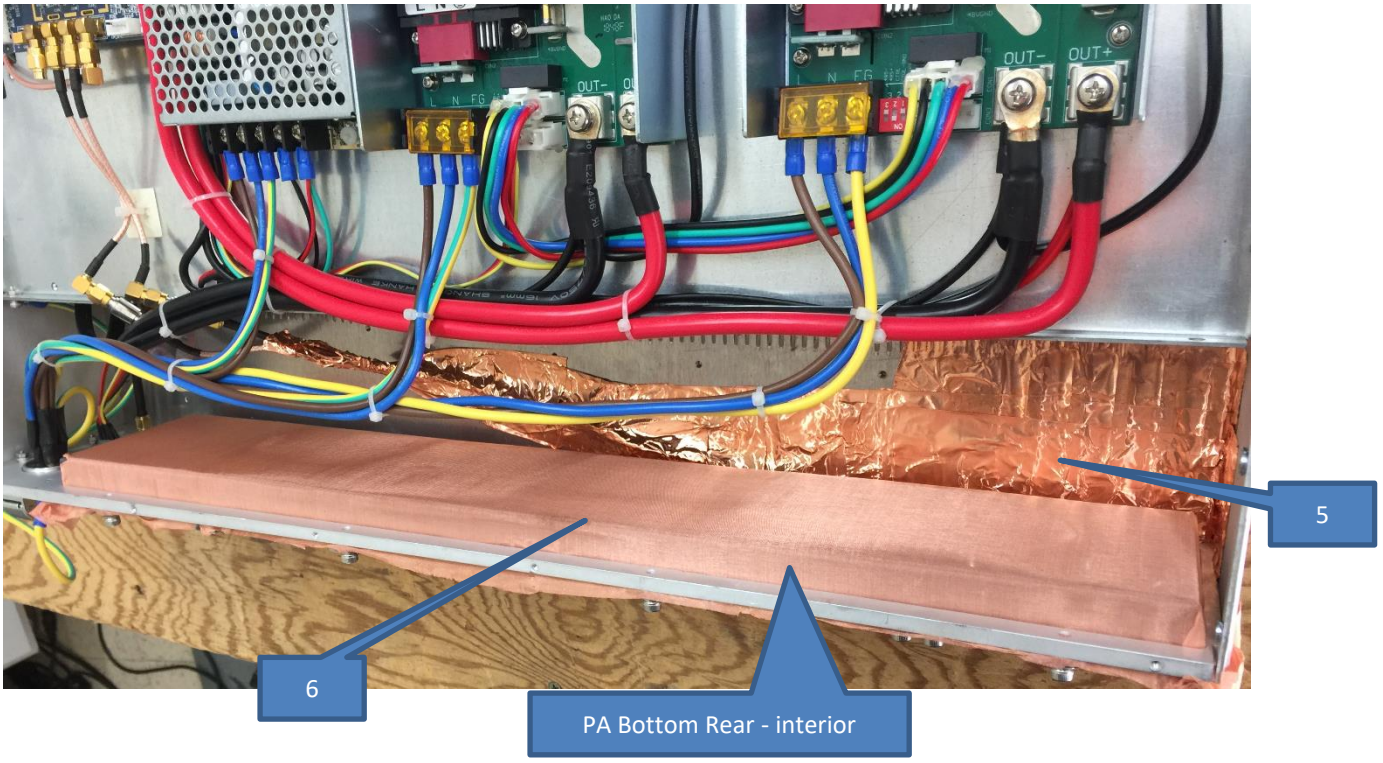
1. Enhance shielding in six locations inside each of the eight amplifiers.

   Top of PA shown below. Enhanced shielding in 4 locations.

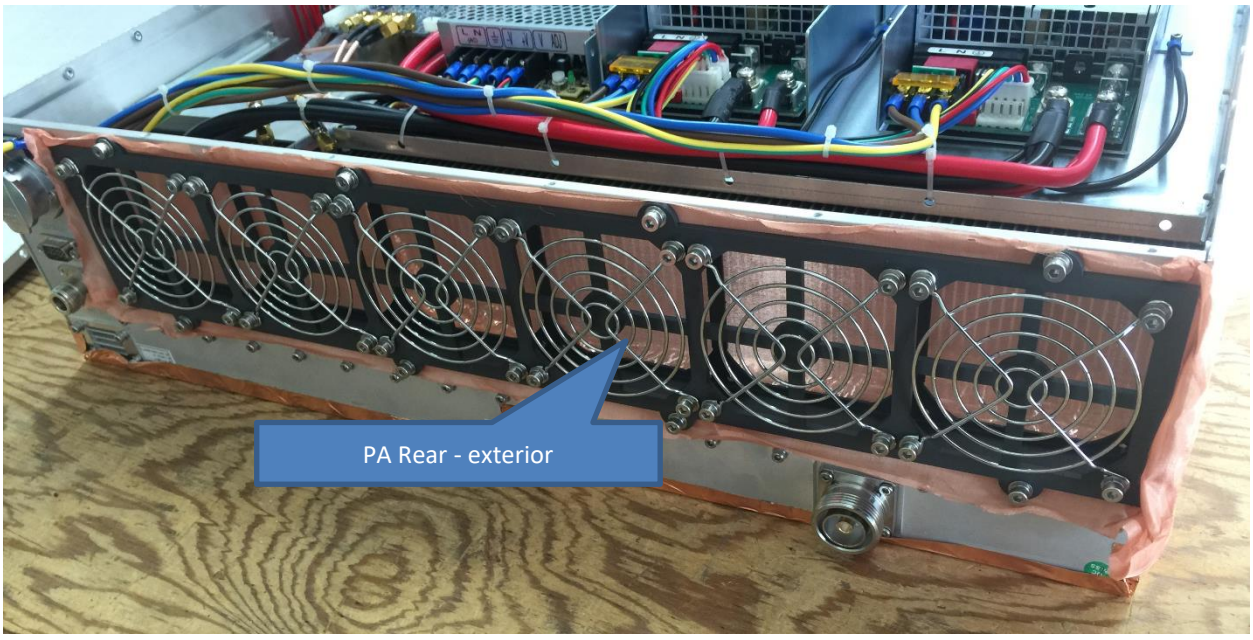


1 – Copper tape applied to shield left-side-channel openings
2 – Copper mesh applied to shield rear left-side-channel rear-chassis opening
3 – Copper tape applied to shield right rear corner opening
4 – Copper tape applied to shield right side chassis seams

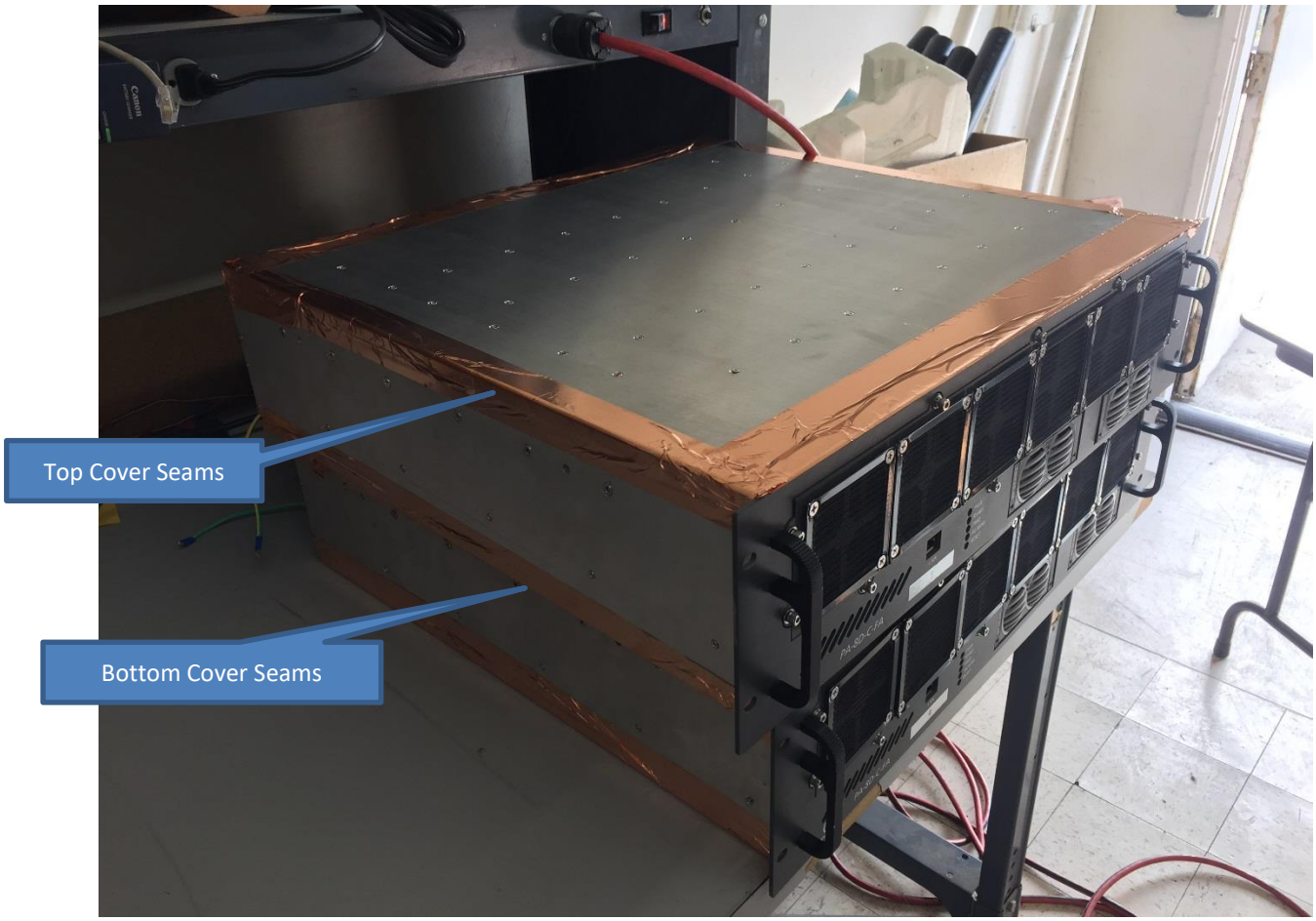
Bottom of PA shown below. Enhanced shielding in 2 location.



5 – Copper tape applied to shield rear chassis seam, cables, and right rear corner.
6 – Copper mesh applied to shield rear ventilation fans



2. Sealed amplifier top and bottom cover seams



3. Enhanced grounding on all panels of the main cabinet enclosure
4. Added cabinet front door with interior RF copper mesh screen

Front Door - Exterior

Front Door - Interior

5. Rear door and side panel ventilation openings were sealed.

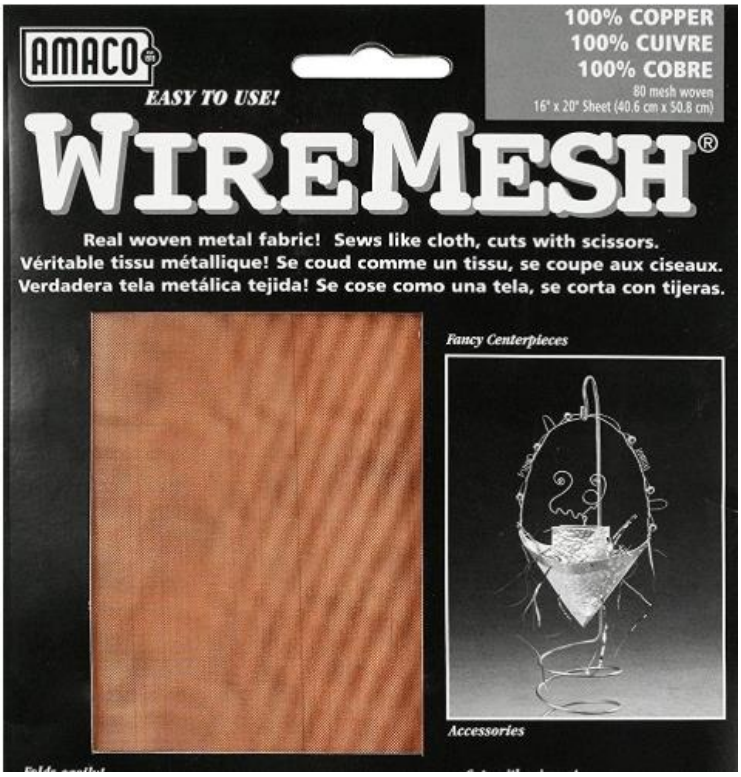
Front – without door

Front – with door

Side and Rear panel

Rear panel

Copper Tape and Copper Mesh used for modifications



HGB7001A UHF Low Pass Filter (80)

Feature:

- ◆Rigid Line design
- ◆Harmonic suppression over 2nd, 3rd, 4th
- ◆Low insertion loss and VSWR

Specification	
Pass Band	470-610 MHz
Impedance	50 Ohm
Max. input Power	12KW rms (below 2000 meter)
Insertion loss	≤0.1dB
Rejection	≥60dB@946-2440MHz
VSWR	≤1.06
Connector	EIA 3-1/8"
Working temperature	-10°C ~+55°C
Dimension	682.8 mm
Weight	approx 5 kg

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

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.