Spectralux Corporation

EMC TEST REPORT FOR

Dlink+ w/CPDLC
Model: 14114

Tested to The Following Standards:

FCC Part 2 / 87 Subpart D

Report No.: 103643-5

Date of issue: March 27, 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

Testing the Future
CKC LABORATORIES, INC.

TABLE OF CONTENTS

ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Spectralux Corporation
12335 134th Court NE
Redmond WA 98052

Representative: Brian DeHart
Customer Reference Number: 120836

REPORT PREPARED BY:

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

Project Number: 103643

DATE OF EQUIPMENT RECEIPT: February 23, 2020
DATE(S) OF TESTING: February 23, 2020 - March 3 and 26, 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.
22116 23rd Drive S.E., Suite A
Canyon Park, Bothell, WA 98021

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) 2 / 87 Subpart D

Test Procedure	Description	Modifications	Results
2.1046 / 87.131	Power and Emissions	NA	Pass
2.1047	Modulation Characteristics	NA	NA1
2.1049 / 87.135	Bandwidth of Emission	NA	Pass
2.1051 / 87.139	Spurious Emissions at Antenna Terminals	NA	Pass
2.1053 / 87.139	Emission Limitations: Radiated	NA	Pass
2.1055 / 87.133	Frequency Stability	NA	NP

NA = Not Applicable
NA1 = Not applicable because the EUT doesn't meet any of the standard requirements for equipment type.
NP = CKC Laboratories was not contracted to perform test. See Conditions During Test for details.

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
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
Testing for permissive change. FCCID: R2H14114 Changes requiring PCII on transmitter circuitry needs to be the following. Matching network changes RF MOSFET obsolete part replacement

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.

Equipment Tested:

Device	Manufacturer	Model #	S/N
Dlink+ w/CPDLC	Spectralux Corporation	14114-1	1640

Support Equipment:

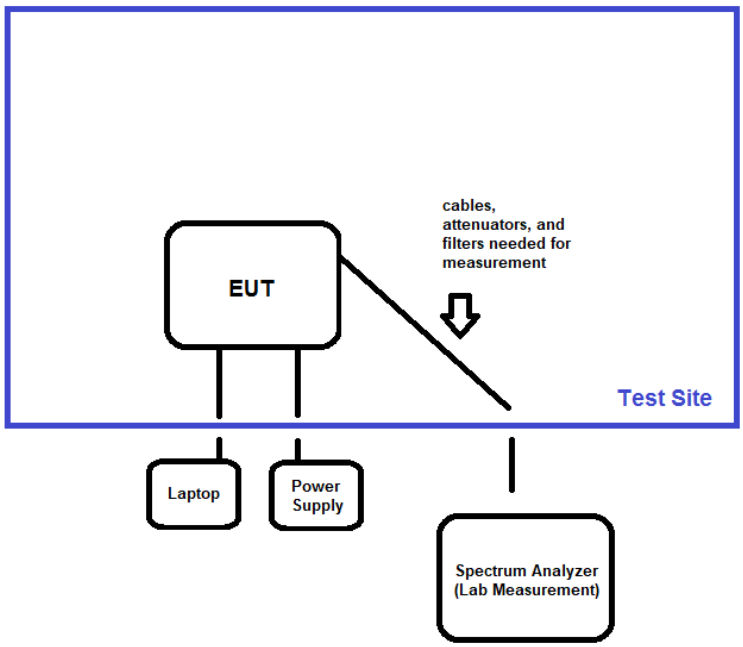
Device	Manufacturer	Model #	S/N
Power Supply	Power Ten	3100A-4010	P06998
Laptop	Dell	XPS 15 9570	Asset #101324

General Product Information:

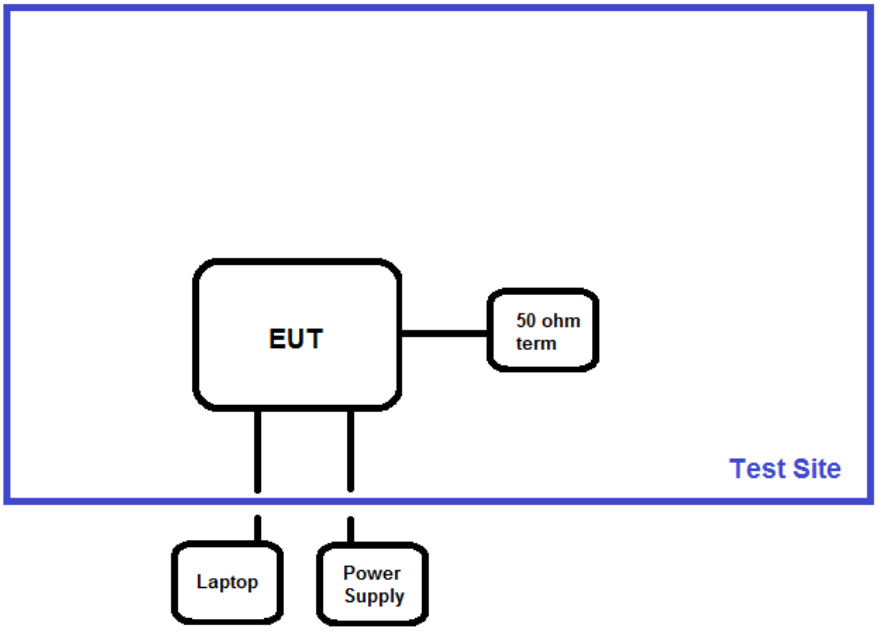
Product Information	Manufacturer-Provided Details
Equipment Type:	Stand Alone Equipment
Modulation Type(s):	A2D (Mode A), G1D (Mode 2)
Antenna Type(s) and Gain:	Omnidirectional, 0dBi
Antenna Connection Type:	External
Nominal Input Voltage:	28VDC
Firmware / Software used for Test:	Program on PC: DTS for Dlink 1.6.7 Software on Dlink (Flight Code): SBC Application CRC: A4CD VER: 5.82 DU Application CRC: B7B3 VER: 5.90 IO Application CRC: D825 VER: 5.72 VDL A CRC: A6BB VER: 5.2 VDL 2 CRC: 25DE VER: 5.21
Temperature Range	-15°C to 55°C
Manufacturer description of the operation	The Dlink data link product contains a radio transceiver capable of receiving and transmitting in the 118-136.975MHz VHF frequency range. The transmitter is a dual-mode radio that transmits data messages in Mode 2 (G1D), using D8PSK, and in Mode A (A2D), using AM-MSK. The transmitter output power is 15-17 watts in G1D and 10-17 watts in A2D. The Dlink transmitter employs a direct-conversion architecture that converts baseband modulation directly to the VHF carrier with no intermediate frequency. The modulation signals are fed to the modulator, which drives the HPA. The output from the HPA includes a feedback path back to the modulator. In Mode 2 operation, this feedback signal operates in real-time to help linearize the output and maintain constant output power. Several transmitter parameters are factory set, or tuned using digital potentiometers and constants stored in memory. These parameters include transmitter HPA bias current, as well as several receiver operating points, transmitter gain, modulation levels, phase offsets, DC offset and VSWR calibration. The software uses some of these stored parameters to provide the desired transmitter output.

Block Diagram(s) of Test Setup

Test Setup Block Diagram (Conducted)



Test Setup Block Diagram (Radiated)



FCC PART(S) 2 / 87

2.1046 / 87.131 Power and Emissions

Test Setup/Conditions			
Test Location:	Bothell Lab C3	Test Engineer:	S. Pittsford
Test Method:	FCC CFR 47 Part 87.131, TIA-603E	Test Date(s):	3/1/2020
Configuration:	1		
Test Setup:	Frequency Range: Fundamental EUT is connected to a laptop through an Ethernet cable. EUT is continuously transmitting with modulation. Then power meter is connected to the EUT's RF port through appropriate cables and attenuators. Values were then input into EMI test to account for the losses in the attenuator and cable.		

Environmental Conditions			
Temperature (ºC)	20-22	Relative Humidity (%):	30-40

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
P05362	Cable	Beldon	RG-214	9/6/2018	9/6/2020
P05503	Attenuator	Narda	766-10	7/30/2019	7/30/2021
03530	Power Sensor	ETS	7002-006	6/6/2019	6/6/2021
P07495	Attenuator	Pasternack	PE7389-3	9/26/2018	9/26/2020
P07496	Attenuator	Pasternack	PE7389-20	9/26/2018	9/26/2020

Test Data Summary Mode A					
Channel	**Frequency (MHz)**	**Measured Power (dBm)**	**Power Watts**	**Limit Watts**	**Results**
Low	118	41.5	14.1	55	Pass
Mid	128	41.5	14.1	55	
High	136.975	42.0	15.8	55	

*No change in readings during voltage variations.

Test Data Summary Mode 2					
Channel	**Frequency (MHz)**	**Measured Power (dBm)**	**Power Watts**	**Limit Watts**	**Results**
Low	118	41.7	14.8	50	Pass
Mid	128	41.9	15.5	50	
High	136.975	41.8	15.1	50	

*No change in readings during voltage variations $V_{Nominal}$, $V_{Minimum,}$ and $V_{Maximum}$.

Measurements performed at input voltage Vnominal ± 15%.

Parameter	Value
$V_{Nominal}$:	28VDC
$V_{Minimum}$:	23.8VDC
$V_{Maximum}$:	32.2VDC

Test Setup Photo(s)

2.1049 / 87.135 Bandwidth of Emission

Test Setup/Conditions			
Test Location:	Bothell Lab C3	Test Engineer:	S. Pittsford
Test Method:	FCC CFR 47 Part 87.135, TIA-603E	Test Date(s):	3/1/2020
Configuration:	1		
Test Setup:	Frequency Range: Fundamental EUT is connected to a laptop through an Ethernet cable. EUT is continuously transmitting with modulation. Spectrum analyzer is connected to the EUT's RF port through appropriate cables and attenuators and the built in 99% and -26dB OBW function of the analyzer was used to make measurements.		

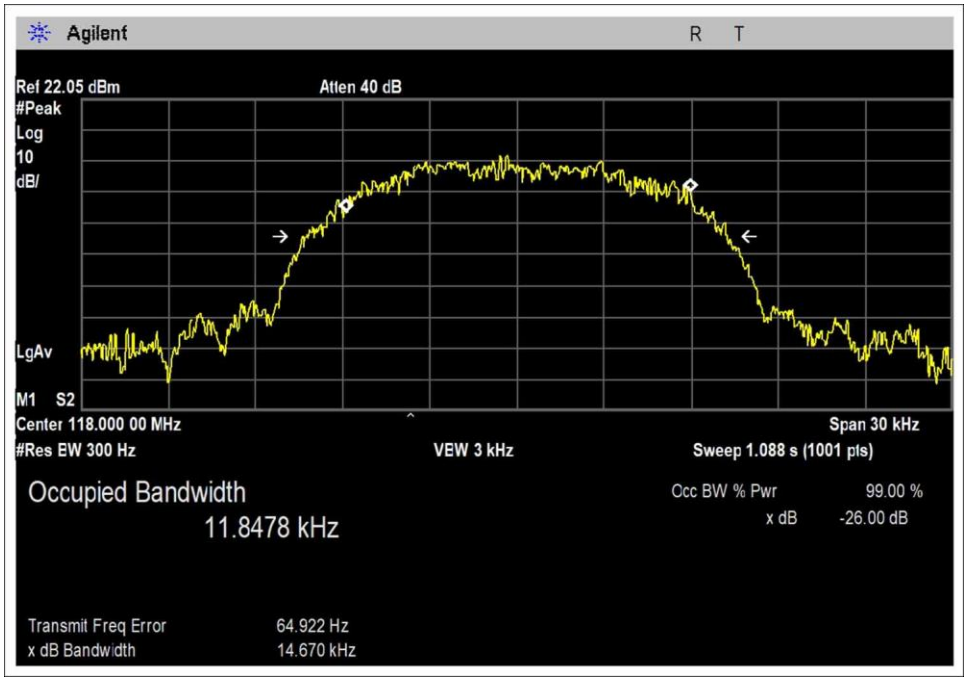
Environmental Conditions			
Temperature (ºC)	20-22	Relative Humidity (%):	30-4

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
P05362	Cable	Beldon	RG-214	9/6/2018	9/6/2020
P05503	Attenuator	Narda	766-10	7/30/2019	7/30/2021
02672	Spectrum Analyzer	Agilent	E4446A	3/13/2019	3/13/2021
P07495	Attenuator	Pasternack	PE7389-3	9/26/2018	9/26/2020
P07496	Attenuator	Pasternack	PE7389-20	9/26/2018	9/26/2020

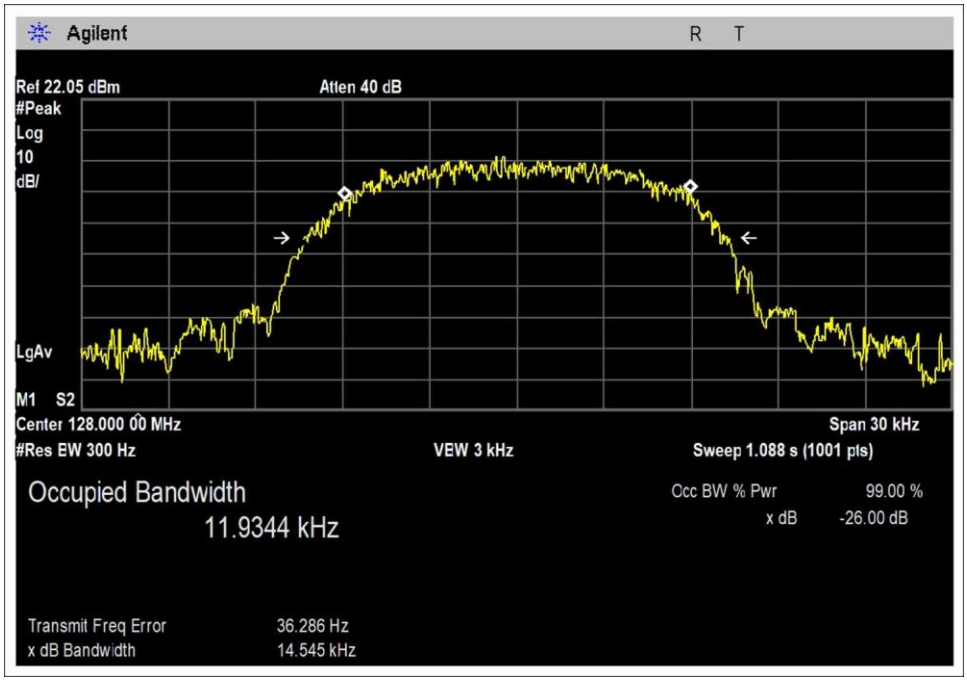
Test Data Summary Mode A					
Channel	**Frequency (MHz)**	**99% OBW (kHz)**	**-26dB OBW (kHz)**	**Limit (kHz)**	**Results**
Low	118	6.324	9.837	≤50	Pass
Mid	128	6.209	6.738	≤50	
High	136.975	6.147	6.680	≤50	

Test Data Summary Mode 2					
Channel	**Frequency (MHz)**	**99% OBW (kHz)**	**-26dB OBW (kHz)**	**Limit (kHz)**	**Results**
Low	118	11.848	14.670	≤25	Pass
Mid	128	11.934	14.545	≤25	
High	136.975	11.943	14.686	≤25	

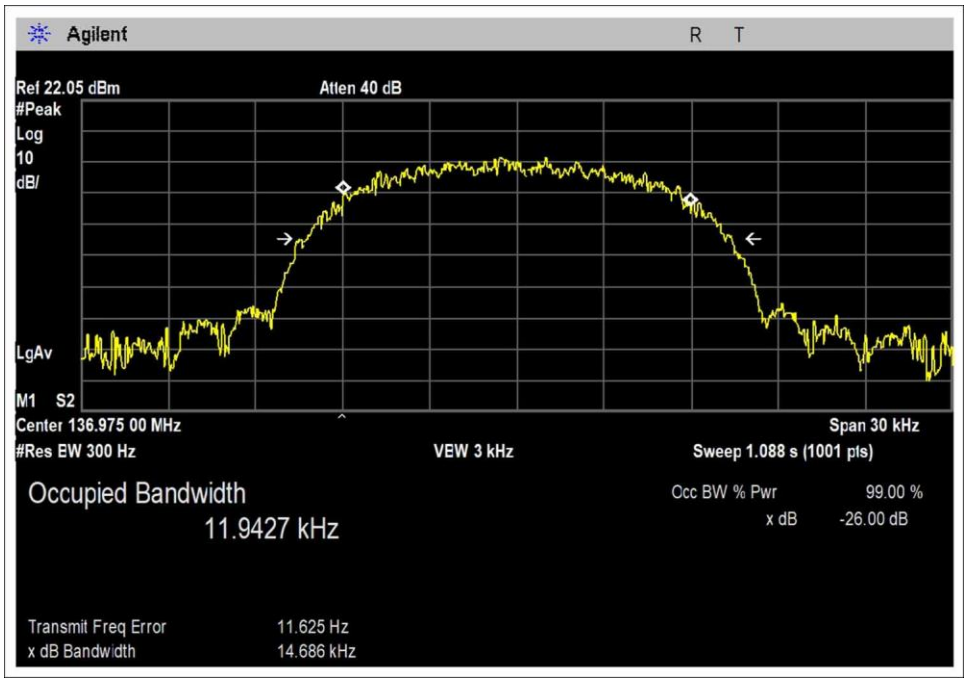
Plot(s)



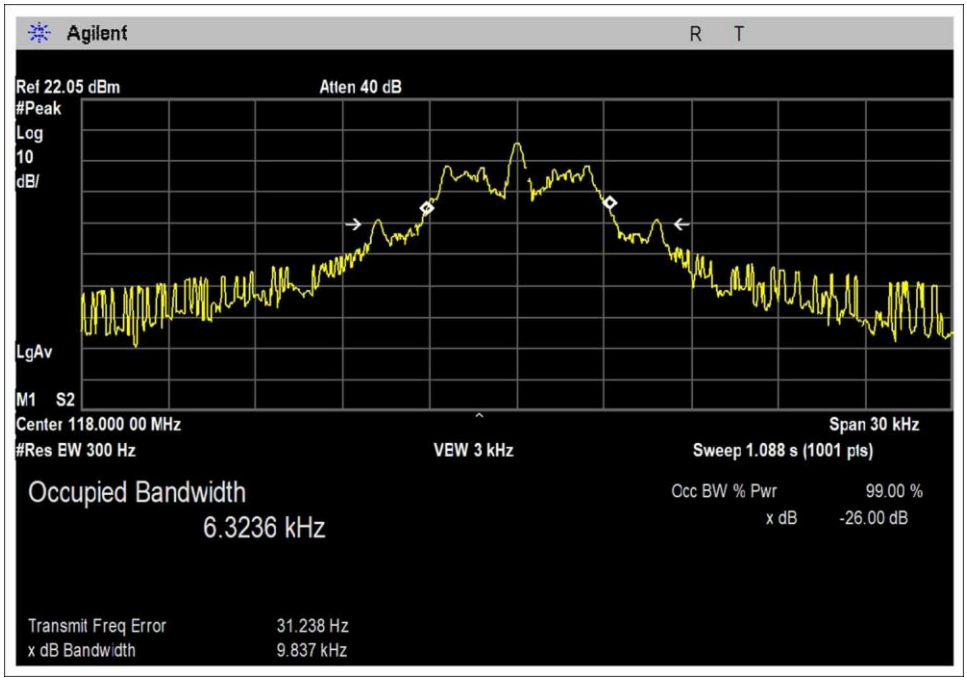
Mode 2 118MHz 99% & -26dB OBW



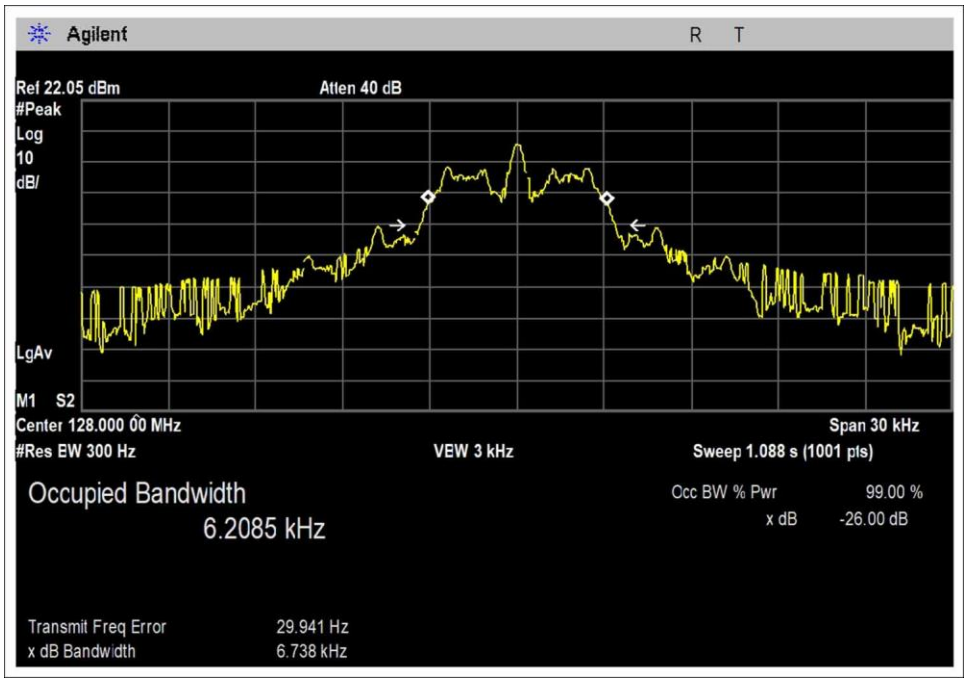
Mode 2 128MHz 99% & -26dB OBW



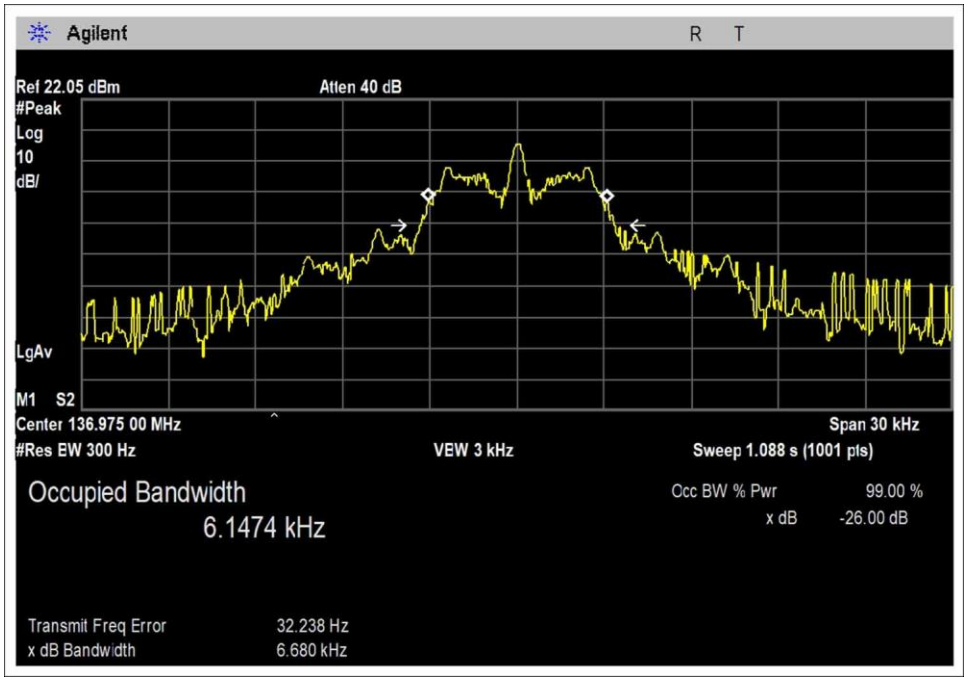
Mode 2 137MHz 99% & -26dB OBW



Mode A 118MHz 99% & -26dB OBW



Mode A 128MHz 99% & -26dB OBW



Mode A 137MHz 99% & -26dB OBW

Test Setup Photo(s)

2.1051 / 87.139 Spurious Emissions at Antenna Terminals

Conducted

Test Setup /Conditions / Data

Test Location:	CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • (425) 402-1717		
Customer:	**Spectralux Corporation**		
Specification:	**87.139 Conducted Spurious Emissions Mask K (Low)**		
Work Order #:	**103643**	Date:	3/2/2020
Test Type:	**Conducted Emissions**	Time:	09:08:09
Tested By:	Steven Pittsford	Sequence#:	11
Software:	EMITest 5.03.12		28Vdc

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Frequency Investigated: 9kHz-1.5GHz
Temperature: 20-22°C
Relative Humidity: 30-40%

EUT is connected to a laptop through an Ethernet cable.

Spectrum analyzer is connected to the EUT's RF port through appropriate cables/attenuators/filters. EUT is continuously transmitting with modulation on low, mid and high channels in Mode 2 (G1D).

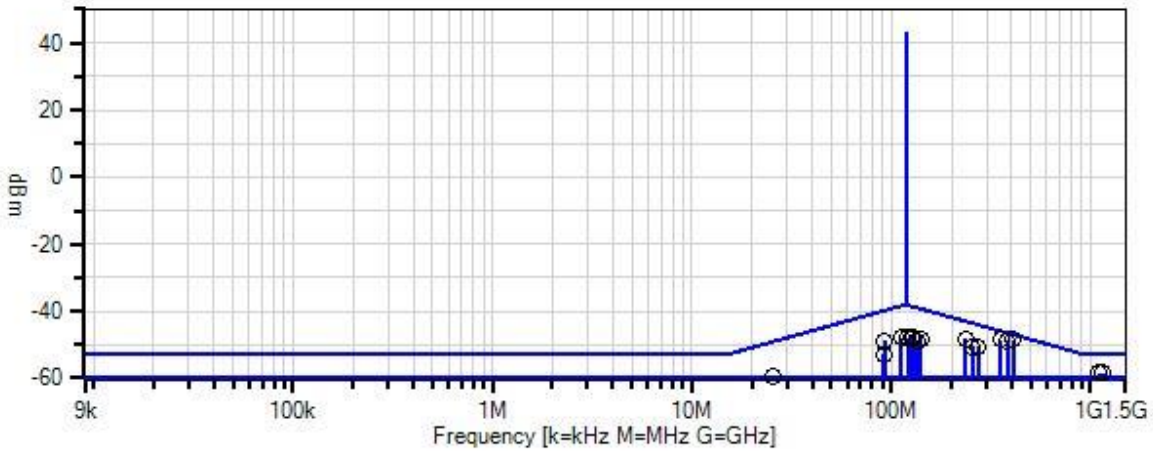
Note: Several different cable/attenuator/filter setups were used to investigate the emissions. It appears the autotuning function of the EUT was producing harmonics depending on the combination of the load connected to the antenna port (which includes the measurement cables, attenuators, and filter). After different configurations were investigated, the final data set was collected using the following configuration which produced passing results:
EUT antenna port -> 3dB pad->10dB pad-> ~ 6 foot heliax cable->20dB pad-> filter->Spectrum Analyzer.

Test Location: Bothell Lab B3
Test Method: FCC CFR 47 Part 87.139, TIA-603E

For mode 2, the appropriate limit selected is 87.139 (k).
87.139 (k) (1)
87.139 (k) (2) installed after January 1, 2002 (i) (ii) (iii)
87.139 (3)

Data collected is for spurious emissions only, no fundamental or fundamental mask measurement performed in this dataset, the mask shown is just provided to show the margin for harmonics and other spurious emissions. Adjacent Channel Power is shown in separate plot.

CKC Laboratories, Inc. Date: 3/2/2020 Time: 09:08:09 Spectralux Corporation WO#: 103643
87.139 Conducted Spurious Emissions Mask K (Low) Test Lead: Antenna Port Antenna Port Sequence#: 11 Ext ATTN: 0 dB



Sweep Data
Readings
Peak Readings
QP Readings
Average Readings
Ambient
Software Version: 5.03.12
1 - 87.139 Conducted Spurious Emissions Mask K (Low)

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP05503	Attenuator	766-10	7/30/2019	7/30/2021
T2	ANP07496	Attenuator	PE7389-20	9/26/2018	9/26/2020
T3	ANP07619	High Pass Filter	NHP-250+	1/6/2020	1/6/2022
T4	ANP05362	Cable	RG-214	9/6/2018	9/6/2020
T5	ANP07495	Attenuator	PE7389-3	9/26/2018	9/26/2020
T6	ANP07628	Low Pass Filter	NLP-90+	2/21/2020	2/21/2022
	AN02672	Spectrum Analyzer	E4446A	3/13/2019	3/13/2021

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

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBm	dB	dB	dB	dB	Table	dBm	dBm	dB	Ant
1	354.000M	-81.9	+10.1 +2.9	+19.8 +0.0	+0.4	+0.2	+0.0	-48.5	-45.9 Low	-2.6	Anten
2	410.938M	-82.0	+10.1 +2.9	+19.8 +0.0	+0.3	+0.3	+0.0	-48.6	-45.9 High	-2.7	Anten
3	384.000M	-82.2	+10.1 +2.9	+19.8 +0.0	+0.3	+0.3	+0.0	-48.8	-45.9 Mid	-2.9	Anten
4	235.993M	-81.8	+10.1 +2.9	+19.8 +0.0	+0.6	+0.2	+0.0	-48.2	-43.0 Low	-5.2	Anten
5	1152.000M	-81.8	+0.0 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-58.3	-53.0 Mid	-5.3	Anten
6	1095.813M	-81.8	+0.0 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-58.3	-53.0 High	-5.3	Anten
7	1180.000M	-83.7	+0.0 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-60.2	-53.0 Low	-7.2	Anten
8	256.000M	-84.0	+10.1 +2.9	+19.8 +0.0	+0.5	+0.2	+0.0	-50.5	-43.0 Mid	-7.5	Anten
9	273.963M	-84.0	+10.1 +2.9	+19.8 +0.0	+0.4	+0.2	+0.0	-50.6	-43.0 High	-7.6	Anten
10	1061.905M	-84.3	+0.0 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-60.8	-53.0 Low	-7.8	Anten
11	92.300M	-81.5	+10.1 +2.9	+19.7 +0.0	+0.0	+0.1	+0.0	-48.7	-40.4 Low	-8.3	Anten
12	943.884M	-95.2	+10.1 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-61.6	-53.0 Low	-8.6	Anten
13	112.300M	-80.8	+10.1 +2.9	+19.7 +0.0	+0.0	+0.1	+0.0	-48.0	-38.9 Low	-9.1	Anten
14	121.800M	-81.0	+10.1 +2.9	+19.8 +0.0	+0.0	+0.2	+0.0	-48.0	-38.4 Low	-9.6	Anten
15	125.100M	-80.9	+10.1 +2.9	+19.8 +0.0	+0.0	+0.2	+0.0	-47.9	-38.2 Low	-9.7	Anten
16	130.100M	-81.0	+10.1 +2.9	+19.8 +0.0	+0.0	+0.2	+0.0	-48.0	-38.1 Low	-9.9	Anten
17	896.096M	-95.5	+10.1 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-61.9	-52.0 Mid	-9.9	Anten
18	959.003M	-95.6	+10.1 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-62.0	-52.0 High	-10.0	Anten

19	140.300M	-81.5	+10.1 +2.9	+19.8 +0.0	+0.0	+0.2	+0.0	-48.5	-38.2 High	-10.3	Anten
20	25.730M	-92.4	+10.1 +2.9	+19.7 +0.2	+0.0	+0.1	+0.0	-59.4	-49.0	-10.4	Anten
21	133.800M	-81.7	+10.1 +2.9	+19.8 +0.0	+0.0	+0.2	+0.0	-48.7	-38.2 High	-10.5	Anten
22	1024.000M	-87.0	+0.0 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-63.5	-53.0 Mid	-10.5	Anten
23	825.899M	-96.2	+10.1 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-62.6	-52.0 Low	-10.6	Anten
24	768.100M	-95.2	+10.1 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-61.6	-50.9 Mid	-10.7	Anten
25	1232.788M	-87.6	+0.0 +3.0	+19.8 +0.0	+0.3	+0.5	+0.0	-64.0	-53.0 High	-11.0	Anten
26	821.817M	-95.6	+10.1 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-62.0	-50.9 High	-11.1	Anten
27	707.985M	-96.0	+10.1 +3.0	+19.8 +0.0	+0.3	+0.3	+0.0	-62.5	-50.9 Low	-11.6	Anten
28	684.991M	-94.8	+10.1 +3.0	+19.8 +0.0	+0.3	+0.3	+0.0	-61.3	-49.6 High	-11.7	Anten
29	589.975M	-96.1	+10.1 +3.0	+19.8 +0.0	+0.3	+0.3	+0.0	-62.6	-49.6 Low	-13.0	Anten
30	640.124M	-96.1	+10.1 +3.0	+19.8 +0.0	+0.3	+0.3	+0.0	-62.6	-49.6 Mid	-13.0	Anten
31	91.940M	-86.8	+10.1 +2.9	+19.8 +1.0	+0.0	+0.1	+0.0	-52.9	-39.8	-13.1	Anten
32	1279.900M	-89.9	+0.0 +3.0	+19.8 +0.0	+0.3	+0.5	+0.0	-66.3	-53.0 Mid	-13.3	Anten
33	1368.202M	-90.1	+0.0 +3.0	+19.8 +0.0	+0.3	+0.5	+0.0	-66.5	-53.0 High	-13.5	Anten
34	1296.595M	-90.3	+0.0 +3.0	+19.8 +0.0	+0.3	+0.5	+0.0	-66.7	-53.0 Low	-13.7	Anten
35	547.735M	-95.5	+10.1 +2.9	+19.8 +0.0	+0.3	+0.3	+0.0	-62.1	-48.0 High	-14.1	Anten
36	472.106M	-95.7	+10.1 +2.9	+19.8 +0.0	+0.3	+0.3	+0.0	-62.3	-48.0 Low	-14.3	Anten
37	512.199M	-96.0	+10.1 +2.9	+19.8 +0.0	+0.3	+0.3	+0.0	-62.6	-48.0 Mid	-14.6	Anten

Test Location:	CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • (425) 402-1717		
Customer:	**Spectralux Corporation**		
Specification:	**87.139 Conducted Spurious Emissions Mask D (Low)**		
Work Order #:	**103643**	Date:	3/2/2020
Test Type:	**Conducted Emissions**	Time:	09:14:56
Tested By:	Matthew Harrison	Sequence#:	12
Software:	EMITest 5.03.12		28Vdc

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Frequency Investigated: 9kHz-1.5GHz
Temperature: 20-22°C
Relative Humidity: 30-40%

EUT is connected to a laptop through an Ethernet cable.

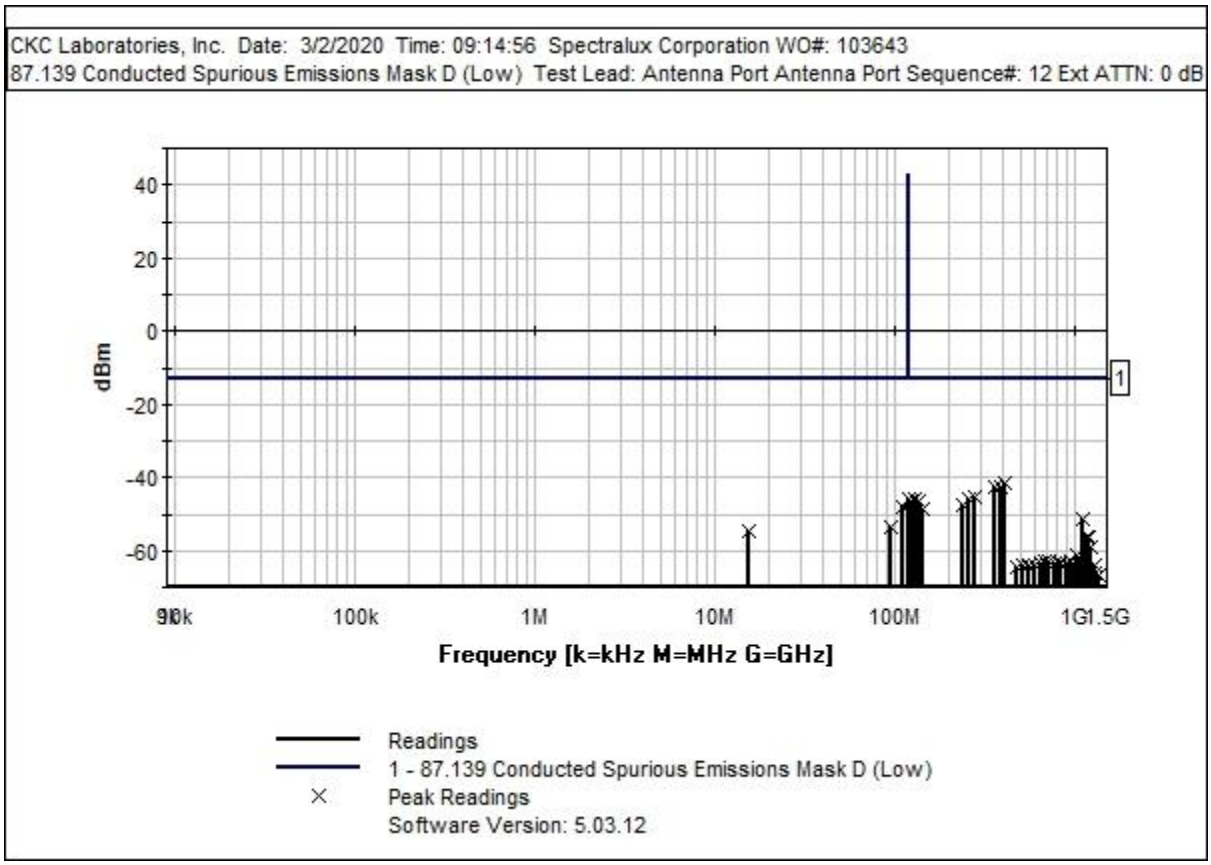
Spectrum analyzer is connected to the EUT's RF port through appropriate cables/attenuators/filters. EUT is continuously transmitting with modulation on low, mid and high Channels in Mode A (A2D).

Note: Several different cable/attenuator/filter setups were used to investigate the emissions. It appears the autotuning function of the EUT was producing harmonics depending on the combination of the load connected to the antenna port (which includes the measurement cables, attenuators, and filter). After different configurations were investigated, the final data set was collected using the following configuration which produced passing results:
EUT antenna port -> 3dB pad->10dB pad-> ~ 6 foot heliax cable->20dB pad-> filter->Spectrum Analyzer.

Test Location: Bothell Lab C3
Test Method: FCC CFR 47 Part 87.139, TIA-603E
For mode A, the appropriate limit selected is 87.139 (d)

Data collected is for spurious emissions only, no fundamental or fundamental mask measurement performed in this dataset, the mask shown is just provided to show the margin for harmonics and other spurious emissions.

Mask is shown in separate plot where limit line is corrected for all cable and attenuator factors. RBW for mask is only used for immediate band edge.


CKC Laboratories, Inc. Date: 3/2/2020 Time: 09:14:56 Spectralux Corporation WO#: 103643
87.139 Conducted Spurious Emissions Mask D (Low) Test Lead: Antenna Port Antenna Port Sequence#: 12 Ext ATTN: 0 dB
40
20
0
-20
-40
-60
dBm
1
100k
1M
10M
100M
1G
1.5G
Frequency [k=kHz M=MHz G=GHz]
Readings
1 - 87.139 Conducted Spurious Emissions Mask D (Low)
Peak Readings
Software Version: 5.03.12

Test Equipment:

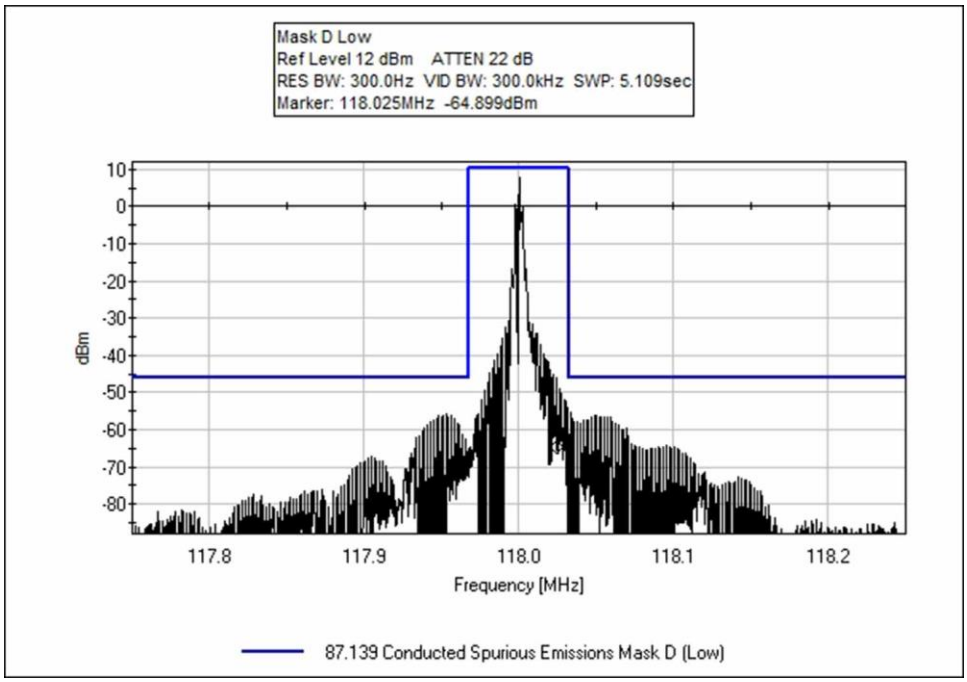
ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP05503	Attenuator	766-10	7/30/2019	7/30/2021
T2	ANP07496	Attenuator	PE7389-20	9/26/2018	9/26/2020
T3	ANP07619	High Pass Filter	NHP-250+	1/6/2020	1/6/2022
T4	ANP05362	Cable	RG-214	9/6/2018	9/6/2020
T5	ANP07495	Attenuator	PE7389-3	9/26/2018	9/26/2020
T6	ANP07628	Low Pass Filter	NLP-90+	2/21/2020	2/21/2022
	AN02672	Spectrum Analyzer	E4446A	3/13/2019	3/13/2021

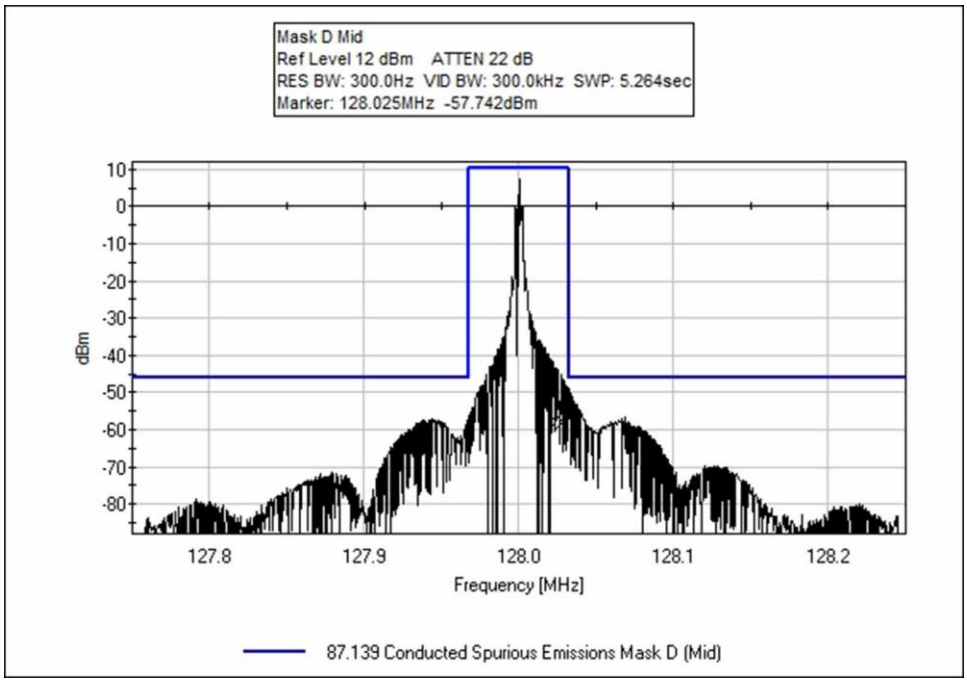
Measurement Data: Reading listed by margin. Test Lead: Antenna Port

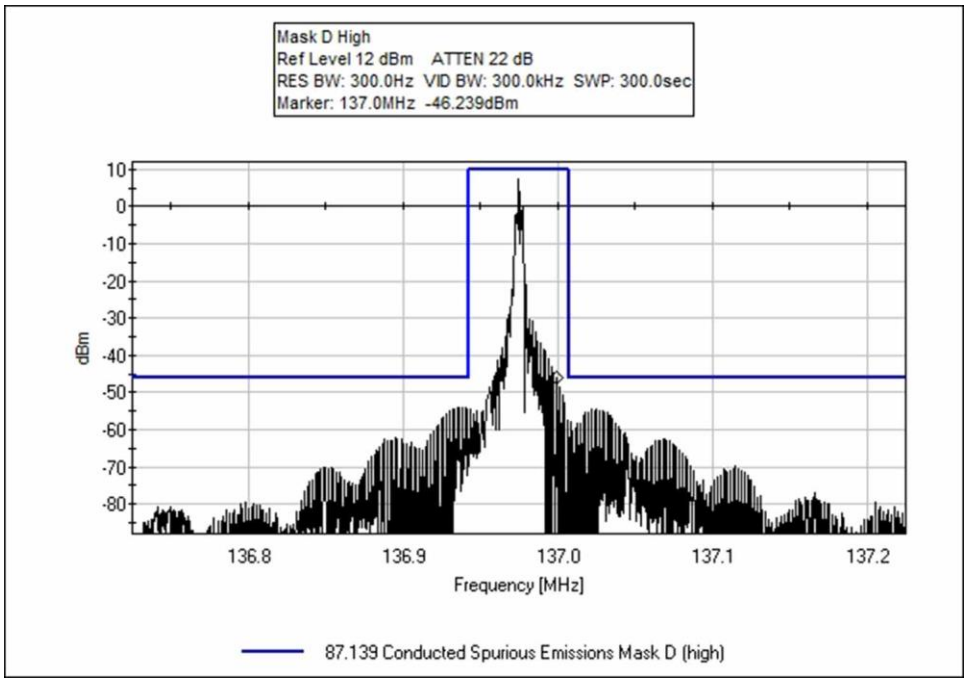
#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBm	dB	dB	dB	dB	Table	dBm	dBm	dB	Ant
1	410.924M	-75.0	+10.1 +2.9	+19.8 +0.0	+0.3	+0.3	+0.0	-41.6	-13.0 High	-28.6	Anten
2	384.005M	-75.9	+10.1 +2.9	+19.8 +0.0	+0.3	+0.3	+0.0	-42.5	-13.0 Mid	-29.5	Anten
3	353.999M	-76.0	+10.1 +2.9	+19.8 +0.0	+0.4	+0.2	+0.0	-42.6	-13.0 Low	-29.6	Anten
4	273.946M	-78.8	+10.1 +2.9	+19.8 +0.0	+0.4	+0.2	+0.0	-45.4	-13.0 High	-32.4	Anten
5	119.800M	-78.8	+10.1 +2.9	+19.8 +0.0	+0.0	+0.2	+0.0	-45.8	-13.0 Low	-32.8	Anten
6	128.400M	-78.9	+10.1 +2.9	+19.8 +0.0	+0.0	+0.2	+0.0	-45.9	-13.0 High	-32.9	Anten
7	255.998M	-79.4	+10.1 +2.9	+19.8 +0.0	+0.5	+0.2	+0.0	-45.9	-13.0 Mid	-32.9	Anten
8	123.000M	-79.3	+10.1 +2.9	+19.8 +0.0	+0.0	+0.2	+0.0	-46.3	-13.0 Mid	-33.3	Anten
9	136.400M	-79.4	+10.1 +2.9	+19.8 +0.0	+0.0	+0.2	+0.0	-46.4	-13.0 Low	-33.4	Anten
10	133.700M	-79.9	+10.1 +2.9	+19.8 +0.0	+0.0	+0.2	+0.0	-46.9	-13.0 Mid	-33.9	Anten
11	236.001M	-81.1	+10.1 +2.9	+19.8 +0.0	+0.6	+0.2	+0.0	-47.5	-13.0 Low	-34.5	Anten
12	110.600M	-80.9	+10.1 +2.9	+19.7 +0.0	+0.0	+0.1	+0.0	-48.1	-13.0 Low	-35.1	Anten
13	141.900M	-81.5	+10.1 +2.9	+19.8 +0.0	+0.0	+0.2	+0.0	-48.5	-13.0 High	-35.5	Anten
14	1095.785M	-74.6	+0.0 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-51.1	-13.0 High	-38.1	Anten
15	93.770M	-87.8	+10.1 +2.9	+19.7 +1.6	+0.0	+0.1	+0.0	-53.4	-13.0	-40.4	Anten
16	15.500M	-87.4	+10.1 +2.9	+19.8 +0.0	+0.0	+0.1	+0.0	-54.5	-13.0	-41.5	Anten
17	1180.035M	-79.8	+0.0 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-56.3	-13.0 Low	-43.3	Anten
18	1151.985M	-79.9	+0.0 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-56.4	-13.0 Mid	-43.4	Anten

19	1232.665M	-82.8	+0.0 +3.0	+19.8 +0.0	+0.3	+0.5	+0.0	-59.2	-13.0 High	-46.2	Anten
20	1024.005M	-84.6	+0.0 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-61.1	-13.0 Mid	-48.1	Anten
21	1062.000M	-86.1	+0.0 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-62.6	-13.0 Low	-49.6	Anten
22	684.907M	-96.2	+10.1 +3.0	+19.8 +0.0	+0.3	+0.3	+0.0	-62.7	-13.0 High	-49.7	Anten
23	944.008M	-96.6	+10.1 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-63.0	-13.0 Low	-50.0	Anten
24	708.006M	-96.5	+10.1 +3.0	+19.8 +0.0	+0.3	+0.3	+0.0	-63.0	-13.0 Low	-50.0	Anten
25	958.834M	-96.9	+10.1 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-63.3	-13.0 High	-50.3	Anten
26	768.005M	-96.9	+10.1 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-63.3	-13.0 Mid	-50.3	Anten
27	639.998M	-96.9	+10.1 +3.0	+19.8 +0.0	+0.3	+0.3	+0.0	-63.4	-13.0 Mid	-50.4	Anten
28	821.861M	-97.1	+10.1 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-63.5	-13.0 High	-50.5	Anten
29	896.002M	-97.2	+10.1 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-63.6	-13.0 Mid	-50.6	Anten
30	826.006M	-97.2	+10.1 +3.0	+19.8 +0.0	+0.3	+0.4	+0.0	-63.6	-13.0 Low	-50.6	Anten
31	590.005M	-97.4	+10.1 +3.0	+19.8 +0.0	+0.3	+0.3	+0.0	-63.9	-13.0 Low	-50.9	Anten
32	1280.015M	-87.5	+0.0 +3.0	+19.8 +0.0	+0.3	+0.5	+0.0	-63.9	-13.0 Mid	-50.9	Anten
33	512.005M	-97.4	+10.1 +2.9	+19.8 +0.0	+0.3	+0.3	+0.0	-64.0	-13.0 Mid	-51.0	Anten
34	547.906M	-97.6	+10.1 +2.9	+19.8 +0.0	+0.3	+0.3	+0.0	-64.2	-13.0 High	-51.2	Anten
35	472.001M	-97.8	+10.1 +2.9	+19.8 +0.0	+0.3	+0.3	+0.0	-64.4	-13.0 Low	-51.4	Anten
36	1298.100M	-89.6	+0.0 +3.0	+19.8 +0.0	+0.3	+0.5	+0.0	-66.0	-13.0 Low	-53.0	Anten
37	1369.890M	-90.2	+0.0 +3.0	+19.8 +0.0	+0.3	+0.5	+0.0	-66.6	-13.0 High	-53.6	Anten

Emissions Mask D Plot(s)






Mask D High
Ref Level 12 dBm ATTEN 22 dB
RES BW: 300.0Hz VID BW: 300.0kHz SWP: 300.0sec
Marker: 137.0MHz -46.239dBm
10
0
-10
-20
-30
-40
-50
-60
-70
-80
dBm
136.8
136.9
137.0
137.1
137.2
Frequency [MHz]
87.139 Conducted Spurious Emissions Mask D (high)

Adjacent Channel Power Mask K

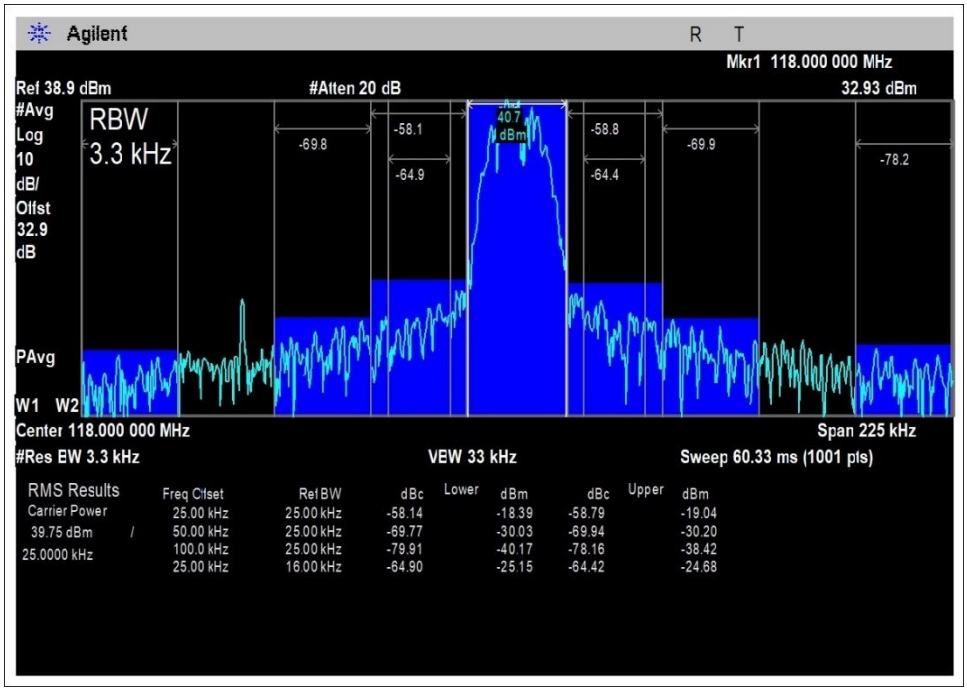
Test Setup/Conditions			
Test Location:	Bothell Lab C3	Test Engineer:	S. Pittsford
Test Method:	FCC CFR 47 Part 87.139, TIA-603E	Test Date(s):	3/26/2020
Configuration:	1		
Test Setup:	Measurements were taken Mode 2 (G1D) with appropriate limits applied. Systems losses are added into the spectrum analyzer measurements. EUT is connected to a laptop through an Ethernet cable. Spectrum analyzer is connected to the EUT's RF port through appropriate cables/attenuators/filters. EUT is continuously transmitting with modulation on low, mid and high channels in Mode 2 (G1D). Test Location: Bothell Lab B1 For mode 2, the appropriate limit selected is 87.139 (k). 87.139 (k) (1) 87.139 (k) (2) installed after January 1, 2002 (i) (ii) (iii) 87.139 (3)		

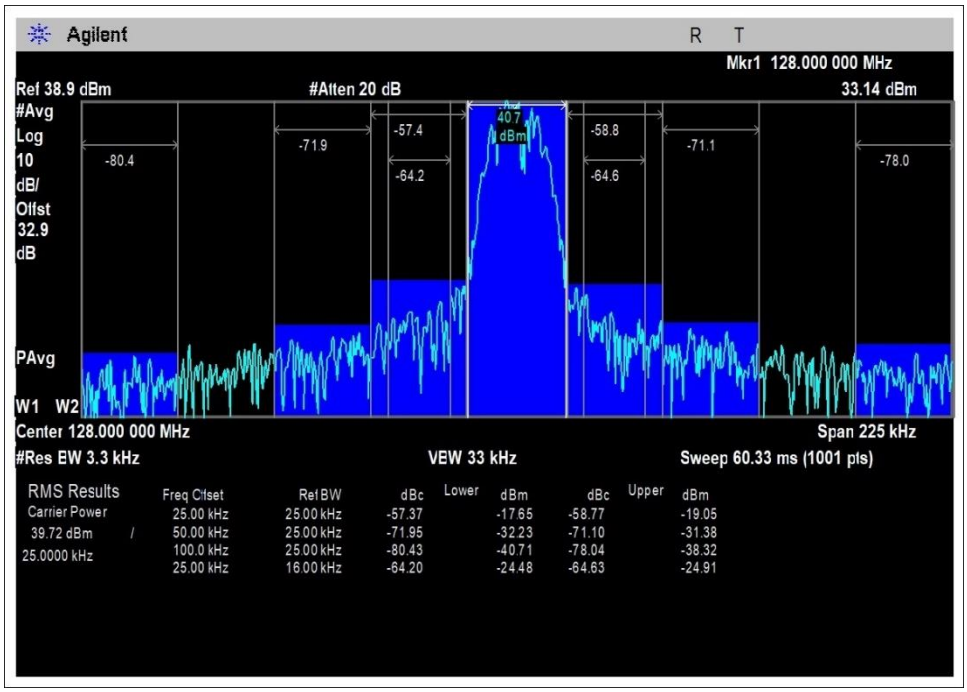
Environmental Conditions			
Temperature (ºC)	20-22	Relative Humidity (%):	30-40

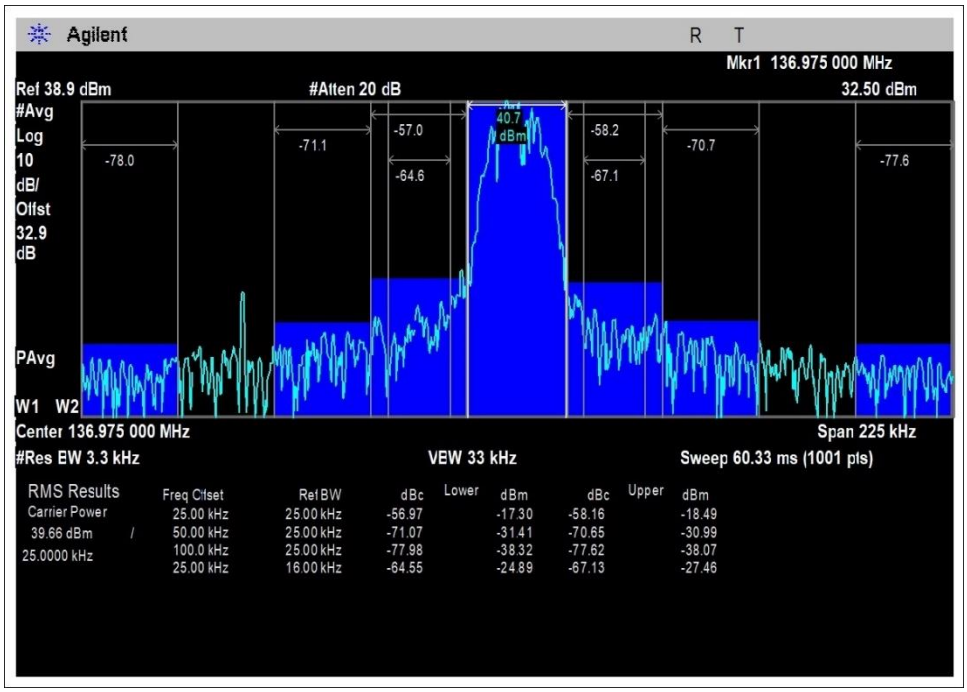
Test Equipment Mask K Adjacent Channel Power					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
P05363	Cable	Belden	RG-214	3/6/2019	3/6/2021
P05503	Attenuator	Narda	766-10	7/30/2019	7/30/2021
P07495	Attenuator	Pasternack	PE7389-3	9/26/2018	9/26/2020
P07496	Attenuator	Pasternack	PE7389-20	9/26/2018	9/26/2020
02673	Spectrum Analyzer	Agilent	E4446A	2/22/2019	2/22/2021

Mode 2 (G1D) Mask K							
	118MHz		128MHz		136.975MHz		
	Lower dBm	Upper dBm	Lower dBm	Upper dBm	Lower dBm	Upper dBm	LIMIT
87.139(k)(1)	-18.39	-19.04	-17.65	-19.05	-17.30	-18.49	2dBm
87.139(k)(2)(i)	-30.03	-30.20	-32.23	-31.38	-31.41	-30.99	-28dBm
87.139(k)(2)(ii)	-40.17	-38.42	-40.71	-38.32	-38.32	-38.07	-38dBm
87.139(k)(3)	-25.15	-24.68	-24.48	-24.91	-24.89	-27.46	-18dBm

Plots (s)




Agilent
R T
Mkr1 128.000 000 MHz
Ref 38.9 dBm
#Atten 20 dB
33.14 dBm
#Avg
Log
10
dB/
Offst
32.9
dB
-80.4
-71.9
-57.4
-64.2
40.7
dBm
-58.8
-64.6
-71.1
-78.0
PAvg
W1 W2
Center 128.000 000 MHz
Span 225 kHz
#Res EW 3.3 kHz
VEW 33 kHz
Sweep 60.33 ms (1001 pts)
RMS Results
Carrier Power
39.72 dBm
25.0000 kHz
Freq Offset
25.00 kHz
50.00 kHz
100.0 kHz
25.00 kHz
Ref BW
25.00 kHz
25.00 kHz
25.00 kHz
16.00 kHz
dBc
-57.37
-71.95
-80.43
-64.20
Lower
dBm
-17.65
-32.23
-40.71
-24.48
dBc
-58.77
-71.10
-78.04
-64.63
Upper
dBm
-19.05
-31.38
-38.32
-24.91


Agilent
R T
Mkr1 136.975 000 MHz
Ref 38.9 dBm
#Atten 20 dB
32.50 dBm
#Avg
Log
10
dB/
Offst
32.9
dB
-78.0
-71.1
-57.0
-64.6
40.7
dBm
-58.2
-67.1
-70.7
-77.6
PAvg
W1 W2
Center 136.975 000 MHz
Span 225 kHz
#Res EW 3.3 kHz
VEW 33 kHz
Sweep 60.33 ms (1001 pts)
RMS Results
Carrier Power
39.66 dBm
25.0000 kHz
Freq Offset
25.00 kHz
50.00 kHz
100.0 kHz
25.00 kHz
Ref BW
25.00 kHz
25.00 kHz
25.00 kHz
16.00 kHz
dBc
-56.97
-71.07
-77.98
-64.55
Lower
dBm
-17.30
-31.41
-38.32
-24.89
dBc
-58.16
-70.65
-77.62
-67.13
Upper
dBm
-18.49
-30.99
-38.07
-27.46

Test Setup Photo(s)

2.1053 / 87.139 Emission Limitations

Radiated

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • (425) 402-1717		
Customer:	**Spectralux Corporation**		
Specification:	**87.139 Radiated Spurious Emissions Mask K (Low)**		
Work Order #:	**103643**	Date:	3/1/2020
Test Type:	**Maximized Emissions**	Time:	11:27:32
Tested By:	Matthew Harrison	Sequence#:	7
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:

Frequency Investigated: 9kHz-1.5GHz
Temperature: 20-22°C
Relative Humidity: 25-30%

EUT is connected to a laptop through an Ethernet cable.

EUT is continuously transmitting with modulation on low mid and high Channels in Mode 2 (G1D). EUT antenna port is terminated into 50ohm load. 3 x orthogonal measurement antenna axes investigated below 30MHz, for above 30MHz horizontal and vertical antenna polarities investigated, worst case reported.

For mode 2, the appropriate limit selected is 87.139 (k)
The mask limit was built from the worst case of the following, centered on mid channel:
87.139 (k) (1)
87.139 (k) (2) installed after January 1, 2002 (i) (ii) (iii)
87.139 (3)

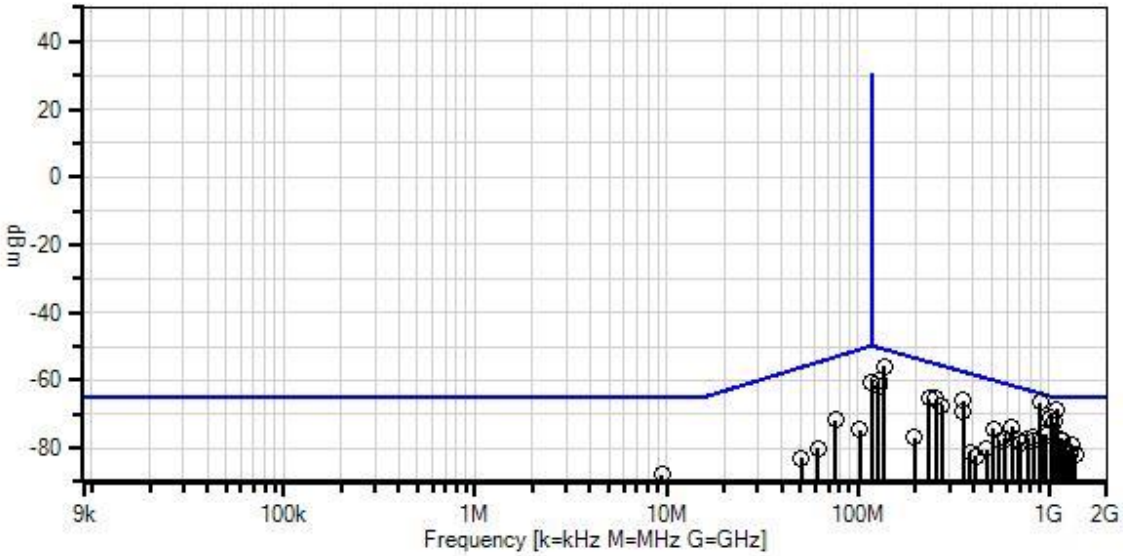
Test Location: Bothell Lab C3
Test Method: FCC CFR 47 Part 87.139, TIA-603E

The radiated emission limit is built by converting to EIRP limit of dBm at 3m. The following equation is used (where d=3m, G=1):
E(dBµV/m) = P(dBm) - 20LOG(d) + G + 104.77

This was then converted to dBm/m with the following equation: E(dBm/m) = E(dBµV)/m) - 107

Data collected is for spurious emissions only, no fundamental or fundamental mask measurement performed in this dataset, the mask shown is just provided to show the margin for harmonics and other spurious emissions.

CKC Laboratories, Inc. Date: 3/1/2020 Time: 11:27:32 Spectralux Corporation WO#: 103643
87.139 Radiated Spurious Emissions Mask K (Low) Test Distance: 3 Meters Vert Sequence#: 7 Ext ATTN: 0 dB



Readings
QP Readings
Ambient
1 - 87.139 Radiated Spurious Emissions Mask K (Low)
Peak Readings
Average Readings
Software Version: 5.03.12

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02307	Preamp	8447D	1/10/2020	1/10/2022
T2	AN03628	Biconilog Antenna	3142E	6/11/2019	6/11/2021
T3	ANP06123	Attenuator	18N-6	4/5/2019	4/5/2021
T4	ANP05305	Cable	ETSI-50T	9/6/2019	9/6/2021
T5	ANP06540	Cable	Heliax	8/23/2019	8/23/2021
T6	AN02673	Spectrum Analyzer	E4446A	2/22/2019	2/22/2021
T7	ANP05360	Cable	RG214	2/3/2020	2/3/2022
T8	AN03540	Preamp	83017A	5/13/2019	5/13/2021
T9	AN01467	Horn Antenna-ANSI C63.5 Calibration	3115	7/5/2019	7/5/2021
T10	ANP06515	Cable	Heliax	6/29/2018	6/29/2020
T11	ANP07504	Cable	CLU40-KMKM-02.00F	1/17/2019	1/17/2021
T12	AN00052	Loop Antenna	6502	5/7/2018	5/7/2020

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

#	Freq	Rdng	T1 T5 T9	T2 T6 T10	T3 T7 T11	T4 T8 T12	Dist	Corr	Spec	Margin	Polar
	MHz	dBm	dB	dB	dB	dB	Table	dBm	dBm	dB	Ant
1	896.000M	-72.7	-27.3 +0.3 +0.0	+23.8 +0.0 +0.0	+5.8 +2.1 +0.0	+1.4 +0.0 +0.0	+0.0	-66.6	-63.8 Mid	-2.8	Vert
2	1095.757M	-59.0	+0.0 +0.4 +24.7	+0.0 +0.0 +1.8	+0.0 +0.0 +0.1	+0.0 -36.7 +0.0	+0.0	-68.7	-64.8 High	-3.9	Vert
3	1024.170M	-60.3	+0.0 +0.4 +24.4	+0.0 +0.0 +1.8	+0.0 +0.0 +0.1	+0.0 -37.1 +0.0	+0.0	-70.7	-64.8 Mid	-5.9	Vert
4	1062.048M	-62.2	+0.0 +0.4 +24.5	+0.0 +0.0 +1.8	+0.0 +0.0 +0.1	+0.0 -36.9 +0.0	+0.0	-72.3	-64.8 Low	-7.5	Vert
5	353.963M	-62.4	-27.3 +0.2 +0.0	+15.6 +0.0 +0.0	+5.8 +1.2 +0.0	+0.9 +0.0 +0.0	+0.0	-66.0	-57.4 Low	-8.6	Horiz
6	236.002M	-57.5	-27.1 +0.2 +0.0	+11.6 +0.0 +0.0	+5.8 +0.9 +0.0	+0.8 +0.0 +0.0	+0.0	-65.3	-54.6 Low	-10.7	Vert
7	255.998M	-58.6	-27.0 +0.2 +0.0	+12.3 +0.0 +0.0	+5.8 +1.0 +0.0	+0.8 +0.0 +0.0	+0.0	-65.5	-54.8 Mid	-10.7	Vert
8	943.988M	-82.8	-27.2 +0.4 +0.0	+24.4 +0.0 +0.0	+5.8 +2.2 +0.0	+1.5 +0.0 +0.0	+0.0	-75.7	-64.2 Low	-11.5	Vert
9	354.000M	-65.5	-27.3 +0.2 +0.0	+15.6 +0.0 +0.0	+5.8 +1.2 +0.0	+0.9 +0.0 +0.0	+0.0	-69.1	-57.1 Low	-12.0	Vert

10	958.585M	-83.3	-27.1	+24.6	+5.8	+1.5	+0.0	-75.9	-63.8	-12.1	Vert
			+0.4	+0.0	+2.2	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					
11	640.003M	-76.1	-28.2	+21.7	+5.8	+1.2	+0.0	-73.6	-61.4	-12.2	Horiz
			+0.3	+0.0	+1.7	+0.0			Mid		
			+0.0	+0.0	+0.0	+0.0					
12	1152.055M	-67.8	+0.0	+0.0	+0.0	+0.0	+0.0	-77.1	-64.8	-12.3	Vert
			+0.4	+0.0	+0.0	-36.5			Mid		
			+24.9	+1.8	+0.1	+0.0					
13	273.935M	-61.0	-27.0	+12.7	+5.8	+0.8	+0.0	-67.5	-54.8	-12.7	Horiz
			+0.2	+0.0	+1.0	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					
14	1179.758M	-68.8	+0.0	+0.0	+0.0	+0.0	+0.0	-77.8	-64.8	-13.0	Vert
			+0.4	+0.0	+0.0	-36.3			Low		
			+25.0	+1.8	+0.1	+0.0					
15	821.740M	-82.2	-27.6	+23.7	+5.8	+1.4	+0.0	-76.7	-62.7	-14.0	Vert
			+0.3	+0.0	+1.9	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					
16	1298.235M	-70.5	+0.0	+0.0	+0.0	+0.0	+0.0	-78.8	-64.8	-14.0	Vert
			+0.4	+0.0	+0.0	-35.9			Low		
			+25.2	+1.9	+0.1	+0.0					
17	767.994M	-82.0	-27.8	+23.4	+5.8	+1.3	+0.0	-77.1	-62.7	-14.4	Vert
			+0.3	+0.0	+1.9	+0.0			Mid		
			+0.0	+0.0	+0.0	+0.0					
18	826.075M	-83.3	-27.6	+23.7	+5.8	+1.4	+0.0	-77.8	-63.3	-14.5	Vert
			+0.3	+0.0	+1.9	+0.0			Low		
			+0.0	+0.0	+0.0	+0.0					
19	511.985M	-73.7	-28.2	+18.8	+5.8	+1.1	+0.0	-74.4	-59.8	-14.6	Vert
			+0.3	+0.0	+1.5	+0.0			Mid		
			+0.0	+0.0	+0.0	+0.0					
20	1232.953M	-71.9	+0.0	+0.0	+0.0	+0.0	+0.0	-80.6	-64.8	-15.8	Vert
			+0.4	+0.0	+0.0	-36.1			High		
			+25.1	+1.8	+0.1	+0.0					
21	684.883M	-80.9	-28.1	+22.4	+5.8	+1.2	+0.0	-77.5	-61.4	-16.1	Horiz
			+0.3	+0.0	+1.8	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					
22	589.882M	-78.6	-28.2	+20.7	+5.8	+1.2	+0.0	-77.2	-61.0	-16.2	Vert
			+0.3	+0.0	+1.6	+0.0			Low		
			+0.0	+0.0	+0.0	+0.0					
23	707.856M	-82.4	-28.0	+22.8	+5.8	+1.3	+0.0	-78.4	-62.2	-16.2	Vert
			+0.3	+0.0	+1.8	+0.0			Low		
			+0.0	+0.0	+0.0	+0.0					
24	1280.041M	-73.4	+0.0	+0.0	+0.0	+0.0	+0.0	-81.7	-64.8	-16.9	Vert
			+0.4	+0.0	+0.0	-35.9			Mid		
			+25.2	+1.9	+0.1	+0.0					
25	1369.732M	-74.0	+0.0	+0.0	+0.0	+0.0	+0.0	-81.9	-64.8	-17.1	Vert
			+0.5	+0.0	+0.0	-35.7			High		
			+25.1	+2.0	+0.2	+0.0					
26	76.320M	-57.6	-27.8	+6.9	+5.8	+0.4	+0.0	-71.7	-54.0	-17.7	Vert
			+0.1	+0.0	+0.5	+0.0			High		
			+0.0	+0.0	+0.0	+0.0					

27	547.870M	-78.1	-28.2 +0.3 +0.0	+19.7 +0.0 +0.0	+5.8 +1.5 +0.0	+1.1 +0.0 +0.0	+0.0	-77.9	-59.8 High	-18.1	Vert
28	471.987M	-79.2	-28.0 +0.3 +0.0	+18.2 +0.0 +0.0	+5.8 +1.4 +0.0	+1.1 +0.0 +0.0	+0.0	-80.4	-59.4 Low	-21.0	Horiz
29	102.480M	-61.9	-27.7 +0.1 +0.0	+8.1 +0.0 +0.0	+5.8 +0.6 +0.0	+0.5 +0.0 +0.0	+0.0	-74.5	-51.9 High	-22.6	Vert
30	9.486M	-97.1	+0.0 +0.0 +0.0	+0.0 +0.0 +0.2	+0.0 +0.0 +0.0	+0.0 +0.0 +9.2	+0.0	-87.7	-64.8	-22.9	Horiz
31	383.998M	-78.8	-27.5 +0.2 +0.0	+16.9 +0.0 +0.0	+5.8 +1.3 +0.0	+1.0 +0.0 +0.0	+0.0	-81.1	-57.7 Mid	-23.4	Vert
32	196.332M	-66.9	-27.2 +0.2 +0.0	+9.8 +0.0 +0.0	+5.8 +0.8 +0.0	+0.7 +0.0 +0.0	+0.0	-76.8	-52.4 High	-24.4	Vert
33	61.740M	-66.6	-27.8 +0.1 +0.0	+7.6 +0.0 +0.0	+5.8 +0.5 +0.0	+0.4 +0.0 +0.0	+0.0	-80.0	-55.5 High	-24.5	Vert
34	410.916M	-80.6	-27.7 +0.2 +0.0	+17.6 +0.0 +0.0	+5.8 +1.3 +0.0	+1.0 +0.0 +0.0	+0.0	-82.4	-57.7 High	-24.7	Vert
35	50.590M	-68.9	-27.9 +0.1 +0.0	+7.3 +0.0 +0.0	+5.8 +0.4 +0.0	+0.4 +0.0 +0.0	+0.0	-82.8	-57.0 High	-25.8	Vert
36	127.987M	-47.6	-27.6 +0.1 +0.0	+7.9 +0.0 +0.0	+5.8 +0.7 +0.0	+0.5 +0.0 +0.0	+0.0	-60.2	-29.8 Mid	-30.4	Horiz
37	118.015M	-47.8	-27.6 +0.1 +0.0	+8.0 +0.0 +0.0	+5.8 +0.6 +0.0	+0.5 +0.0 +0.0	+0.0	-60.4	-29.8 Low	-30.6	Vert
38	128.018M	-49.0	-27.6 +0.1 +0.0	+7.9 +0.0 +0.0	+5.8 +0.7 +0.0	+0.5 +0.0 +0.0	+0.0	-61.6	-29.8 Mid	-31.8	Vert
39	136.975M	-43.9	-27.6 +0.1 +0.0	+8.4 +0.0 +0.0	+5.8 +0.7 +0.0	+0.5 +0.0 +0.0	+0.0	-56.0	30.3 High	-86.3	Horiz

Test Location:	CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • (425) 402-1717		
Customer:	**Spectralux Corporation**		
Specification:	**87.139 Radiated Spurious Emissions Mask D**		
Work Order #:	**103643**	Date:	3/1/2020
Test Type:	**Maximized Emissions**	Time:	09:52:42
Tested By:	Steven Pittsford	Sequence#:	8
Software:	EMITest 5.03.12		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Config 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Config 1			

Test Conditions / Notes:

Frequency Investigated: 9kHz-1.5GHz
Temperature: 20-22°C
Relative Humidity: 25-30%

EUT is connected to a laptop through an Ethernet cable.

EUT is continuously transmitting with modulation on low mid and high Channels in Mode A (A2D). EUT antenna port is terminated into 50ohm load. 3 x orthogonal measurement antenna axes investigated below 30MHz, for above 30MHz horizontal and vertical antenna polarities investigated, worst case reported.

For mode A, the appropriate limit selected is 87.139 (d)

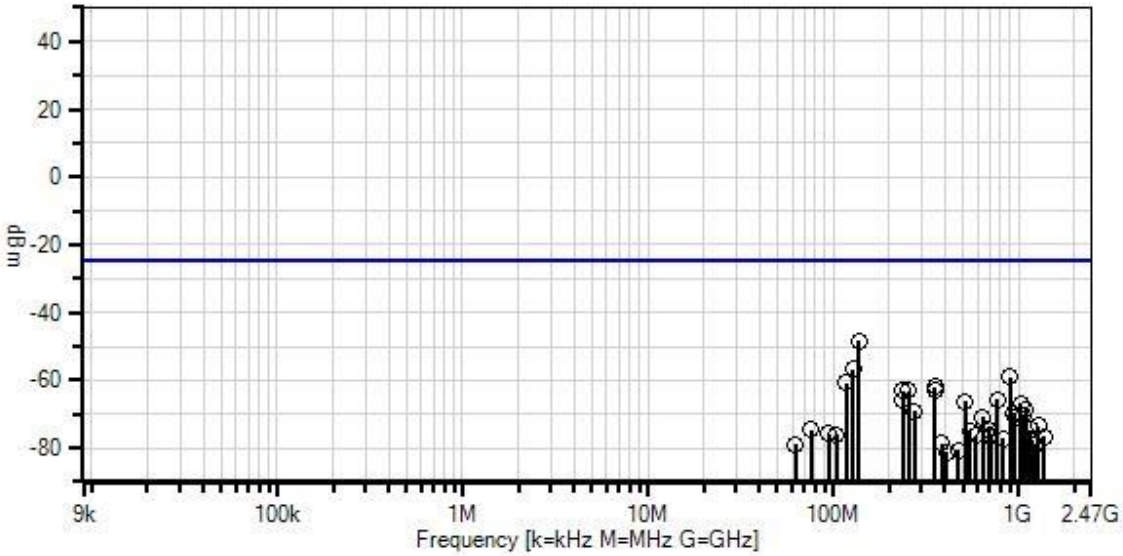
Test Location: Bothell Lab C3
Test Method: FCC CFR 47 Part 87.139, TIA-603E

The radiated emission limit is built by converting to EIRP limit of dBm at 3m. The following equation is used (where d=3m, G=1):
E(dBµV/m) = P(dBm) - 20LOG(d) + G + 104.77

This was then converted to dBm/m with the following equation: E(dBm/m) = E(dBµV)/m) - 107

Data collected is for spurious emissions only, no fundamental or fundamental mask measurement performed in this dataset, the mask shown is just provided to show the margin for harmonics and other spurious emissions.

CKC Laboratories, Inc. Date: 3/1/2020 Time: 09:52:42 Spectralux Corporation WO#: 103643
87.139 Radiated Spurious Emissions Mask D Test Distance: 3 Meters Vert Sequence#: 8 Ext ATTN: 0 dB



Readings
QP Readings
Ambient
1 - 87.139 Radiated Spurious Emissions Mask D
Peak Readings
Average Readings
Software Version: 5.03.12

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02307	Preamp	8447D	1/10/2020	1/10/2022
T2	AN03628	Biconilog Antenna	3142E	6/11/2019	6/11/2021
T3	ANP06123	Attenuator	18N-6	4/5/2019	4/5/2021
T4	ANP05305	Cable	ETSI-50T	9/6/2019	9/6/2021
T5	ANP06540	Cable	Heliax	8/23/2019	8/23/2021
T6	AN02673	Spectrum Analyzer	E4446A	2/22/2019	2/22/2021
T7	ANP05360	Cable	RG214	2/3/2020	2/3/2022
T8	AN03540	Preamp	83017A	5/13/2019	5/13/2021
T9	AN01467	Horn Antenna-ANSI C63.5 Calibration	3115	7/5/2019	7/5/2021
T10	ANP06515	Cable	Heliax	6/29/2018	6/29/2020
T11	ANP07504	Cable	CLU40-KMKM-02.00F	1/17/2019	1/17/2021
	AN00052	Loop Antenna	6502	5/7/2018	5/7/2020

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

#	Freq	Rdng	T1 T5 T9	T2 T6 T10	T3 T7 T11	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBm	dB	dB	dB	dB	Table	dBm	dBm	dB	Ant
1	136.976M	-49.2	+0.0 +0.1 +0.0	+0.0 +0.0 +0.6	+0.0 +0.0 +0.0	+0.0 +0.0	+0.0	-48.5	-24.8 High	-23.7	Vert
2	128.000M	-44.0	-27.6 +0.1 +0.0	+7.9 +0.0 +0.0	+5.8 +0.7 +0.0	+0.5 +0.0	+0.0	-56.6	-24.8 Mid	-31.8	Horiz
3	896.000M	-65.2	-27.3 +0.3 +0.0	+23.8 +0.0 +0.0	+5.8 +2.1 +0.0	+1.4 +0.0	+0.0	-59.1	-24.8 Mid	-34.3	Horiz
4	118.000M	-48.1	-27.6 +0.1 +0.0	+8.0 +0.0 +0.0	+5.8 +0.6 +0.0	+0.5 +0.0	+0.0	-60.7	-24.8 Low	-35.9	Horiz
5	353.566M	-58.4	-27.3 +0.2 +0.0	+15.6 +0.0 +0.0	+5.8 +1.2 +0.0	+0.9 +0.0	+0.0	-62.0	-24.8 Mid	-37.2	Vert
6	353.530M	-59.2	-27.3 +0.2 +0.0	+15.6 +0.0 +0.0	+5.8 +1.2 +0.0	+0.9 +0.0	+0.0	-62.8	-24.8 Mid	-38.0	Horiz
7	236.021M	-55.3	-27.1 +0.2 +0.0	+11.6 +0.0 +0.0	+5.8 +0.9 +0.0	+0.8 +0.0	+0.0	-63.1	-24.8 Mid	-38.3	Horiz
8	256.002M	-56.2	-27.0 +0.2 +0.0	+12.3 +0.0 +0.0	+5.8 +1.0 +0.0	+0.8 +0.0	+0.0	-63.1	-24.8 Mid	-38.3	Horiz
9	767.998M	-70.6	-27.8 +0.3 +0.0	+23.4 +0.0 +0.0	+5.8 +1.9 +0.0	+1.3 +0.0	+0.0	-65.7	-24.8 Mid	-40.9	Vert

10	236.149M	-58.2	-27.1 +0.2 +0.0	+11.6 +0.0 +0.0	+5.8 +0.9 +0.0	+0.8 +0.0	+0.0	-66.0	-24.8 Mid	-41.2	Vert
11	512.000M	-65.6	-28.2 +0.3 +0.0	+18.8 +0.0 +0.0	+5.8 +1.5 +0.0	+1.1 +0.0	+0.0	-66.3	-24.8 Mid	-41.5	Horiz
12	1024.163M	-58.6	+0.0 +0.4 +24.4	+0.0 +0.0 +1.8	+0.0 +2.3 +0.1	+0.0 -37.1	+0.0	-66.7	-24.8 Mid	-41.9	Vert
13	1095.830M	-61.6	+0.0 +0.4 +24.7	+0.0 +0.0 +1.8	+0.0 +2.4 +0.1	+0.0 -36.7	+0.0	-68.9	-24.8 High	-44.1	Vert
14	273.950M	-62.7	-27.0 +0.2 +0.0	+12.7 +0.0 +0.0	+5.8 +1.0 +0.0	+0.8 +0.0	+0.0	-69.2	-24.8 High	-44.4	Horiz
15	943.986M	-76.8	-27.2 +0.4 +0.0	+24.4 +0.0 +0.0	+5.8 +2.2 +0.0	+1.5 +0.0	+0.0	-69.7	-24.8 Mid	-44.9	Vert
16	944.008M	-77.0	-27.2 +0.4 +0.0	+24.4 +0.0 +0.0	+5.8 +2.2 +0.0	+1.5 +0.0	+0.0	-69.9	-24.8 Mid	-45.1	Horiz
17	1061.981M	-62.7	+0.0 +0.4 +24.5	+0.0 +0.0 +1.8	+0.0 +2.4 +0.1	+0.0 -36.9	+0.0	-70.4	-24.8 Low	-45.6	Vert
18	640.010M	-73.2	-28.2 +0.3 +0.0	+21.7 +0.0 +0.0	+5.8 +1.7 +0.0	+1.2 +0.0	+0.0	-70.7	-24.8 Mid	-45.9	Vert
19	958.824M	-78.1	-27.1 +0.4 +0.0	+24.6 +0.0 +0.0	+5.8 +2.2 +0.0	+1.5 +0.0	+0.0	-70.7	-24.8 High	-45.9	Horiz
20	1280.000M	-67.7	+0.0 +0.4 +25.2	+0.0 +0.0 +1.9	+0.0 +2.6 +0.1	+0.0 -35.9	+0.0	-73.4	-24.8 Mid	-48.6	Vert
21	684.864M	-77.9	-28.1 +0.3 +0.0	+22.4 +0.0 +0.0	+5.8 +1.8 +0.0	+1.2 +0.0	+0.0	-74.5	-24.8 High	-49.7	Vert
22	76.350M	-60.5	-27.8 +0.1 +0.0	+6.9 +0.0 +0.0	+5.8 +0.5 +0.0	+0.4 +0.0	+0.0	-74.6	-24.8	-49.8	Horiz
23	1152.000M	-67.7	+0.0 +0.4 +24.9	+0.0 +0.0 +1.8	+0.0 +2.4 +0.1	+0.0 -36.5	+0.0	-74.6	-24.8 Mid	-49.8	Vert
24	547.900M	-75.2	-28.2 +0.3 +0.0	+19.7 +0.0 +0.0	+5.8 +1.5 +0.0	+1.1 +0.0	+0.0	-75.0	-24.8 High	-50.2	Horiz
25	94.260M	-62.4	-27.7 +0.1 +0.0	+7.5 +0.0 +0.0	+5.8 +0.6 +0.0	+0.5 +0.0	+0.0	-75.6	-24.8	-50.8	Vert
26	103.980M	-63.4	-27.7 +0.1 +0.0	+8.1 +0.0 +0.0	+5.8 +0.6 +0.0	+0.5 +0.0	+0.0	-76.0	-24.8	-51.2	Vert

27	589.999M	-77.6	-28.2 +0.3 +0.0	+20.7 +0.0 +0.0	+5.8 +1.6 +0.0	+1.2 +0.0	+0.0	-76.2	-24.8 Mid	-51.4	Horiz
28	708.005M	-80.4	-28.0 +0.3 +0.0	+22.8 +0.0 +0.0	+5.8 +1.8 +0.0	+1.3 +0.0	+0.0	-76.4	-24.8 Mid	-51.6	Vert
29	1369.688M	-71.3	+0.0 +0.5 +25.1	+0.0 +0.0 +2.0	+0.0 +2.7 +0.2	+0.0 -35.7	+0.0	-76.5	-24.8 High	-51.7	Vert
30	707.981M	-80.9	-28.0 +0.3 +0.0	+22.8 +0.0 +0.0	+5.8 +1.8 +0.0	+1.3 +0.0	+0.0	-76.9	-24.8 Mid	-52.1	Horiz
31	826.005M	-82.7	-27.6 +0.3 +0.0	+23.7 +0.0 +0.0	+5.8 +1.9 +0.0	+1.4 +0.0	+0.0	-77.2	-24.8 Mid	-52.4	Horiz
32	1180.129M	-71.3	+0.0 +0.4 +25.0	+0.0 +0.0 +1.8	+0.0 +2.5 +0.1	+0.0 -36.3	+0.0	-77.8	-24.8 Low	-53.0	Vert
33	383.996M	-76.3	-27.5 +0.2 +0.0	+16.9 +0.0 +0.0	+5.8 +1.3 +0.0	+1.0 +0.0	+0.0	-78.6	-24.8 Mid	-53.8	Horiz
34	1232.588M	-72.6	+0.0 +0.4 +25.1	+0.0 +0.0 +1.8	+0.0 +2.5 +0.1	+0.0 -36.1	+0.0	-78.8	-24.8 High	-54.0	Vert
35	62.580M	-65.4	-27.8 +0.1 +0.0	+7.6 +0.0 +0.0	+5.8 +0.5 +0.0	+0.4 +0.0	+0.0	-78.8	-24.8	-54.0	Vert
36	471.999M	-79.3	-28.0 +0.3 +0.0	+18.2 +0.0 +0.0	+5.8 +1.4 +0.0	+1.1 +0.0	+0.0	-80.5	-24.8 Mid	-55.7	Horiz
37	410.927M	-79.5	-27.7 +0.2 +0.0	+17.6 +0.0 +0.0	+5.8 +1.3 +0.0	+1.0 +0.0	+0.0	-81.3	-24.8 High	-56.5	Vert
38	7.237M	-94.9	+0.0 +0.0 +0.0	+0.0 +0.0 +0.1	+0.0 +0.1 +0.0	+0.0 +0.0	+0.0	-94.7	-24.8	-69.9	Vert

Test Setup Photo(s)

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.