

Ittron, Inc.

REVISED EMC TEST REPORT TO 100728-12

Mobile Collection Device, MC3Lite
Model: DCU-5310-3

Tested to The Following Standard:

FCC Part 101 Subpart C

Report No.: 100728-12A

Date of issue: May 3, 2018



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 EMC 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.

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Ittron, Inc.
2111 N. Molter Road
Liberty Lake, WA 99019

Representative: Jay Holcomb
Customer Reference Number: 138781

DATE OF EQUIPMENT RECEIPT:**DATE(S) OF TESTING:****REPORT PREPARED BY:**

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

Project Number: 100728

January 10, 2018

January 10-17, 2018

Revision History

Original: Testing of the Mobile Collection Device, MC3Lite, Model: DCU-5310-3 to FCC Part 101 Subpart C.

Revisions A: To correct the limit value and distance of measurement in the Test Summary table in Section 2.1053 / 101.111 Emissions Limitations – Radiated and add calculation Radiated Attenuation information.

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the sample equipment 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.

A handwritten signature in black ink that reads "Steve Behm".

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	5.03.11
EMITest Immunity	5.03.10

Site Registration & Accreditation Information

Location	NIST CB #	TAIWAN	CANADA	FCC	JAPAN
Brea A, CA	US0060	SL2-IN-E-1146R	3082D-1	US1025	A-0147

SUMMARY OF RESULTS

Standard / Specification: FCC Part 2 / 101

Test Procedure	Description	Modifications	Results
2.1055 / 101.107	Frequency Tolerance	NA	Pass
2.1049 / 101.109	Bandwidth	NA	Pass
2.1051 / 101.111	Emissions Limitations- Conducted	NA	Pass
2.1053 / 101.111	Emissions Limitations- Radiated	NA	Pass
2.1046 / 101.113	Transmitter Power Limitations	NA	Pass
2.1047	Modulation Characteristics	NA	NA1

NA = Not Applicable

NA1 = Not applicable because the EUT does not employ any modulation types outlined in the rules.

Modifications During Testing

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

Summary of Conditions
No modifications were made during testing.

Modifications listed above must be incorporated into all production units.

Conditions During Testing

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

Summary of Conditions
None

EQUIPMENT UNDER TEST (EUT)

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

Configuration 1

Equipment Tested:

Device	Manufacturer	Model #	S/N
Mobile Collection Device, MC3Lite	Itron, Inc.	DCU-5310-3	10000006
5dBi Antenna	PCTEL	Generic	NA
Tablet	Panasonic	FZ-M1	NA
Automobile Adapter	Lind Electronics, Inc.	PA1555-2155 FB	NA

Support Equipment:

Device	Manufacturer	Model #	S/N
Power Supply	Topward	6306D	988614

Configuration 2

Equipment Tested:

Device	Manufacturer	Model #	S/N
Mobile Collection Device, MC3Lite	Itron, Inc.	DCU-5310-3	10000006
5dBi Antenna	PCTEL	Generic	NA
Automobile Adapter	Lind Electronics, Inc.	PA1555-4190 X	NA
Tablet	Panasonic	FZ-G1	NA
Power Distribution Box	Itron, Inc.	Generic	NA

Support Equipment:

Device	Manufacturer	Model #	S/N
Power Supply	Topward	6306D	988614

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	FHSS
Operating Frequency Range:	952.0-959.85MHz
Number of Hopping Channels:	NA
Modulation Type(s):	24-60Hz AM
Maximum Duty Cycle:	100%
Number of TX Chains:	1
Antenna Gain:	5dbi
Beamforming Type:	NA
Antenna Connection Type:	External Connector
Nominal Input Voltage:	12.8Vdc from car battery
Firmware / Software used for Test:	MC3 SuperRaptor Test ver.4.0.2.2
FCC ID:	7" tablet – Panasonic FZ-M1 FCC ID: ACJ9TGWL15B IC: 216A-CFWL15B contains: FCC ID: ACJ9TGWW13B3 IC: 216A-CFWW13B 10" tablet – Panasonic FZ-G1 FCC ID: ACJ9TGWL15A IC: 216A-CFWL15A contains: FCC ID: ACJ9TGWW13B1 IC: 216A-CFWW13B

FCC PART(S) 2 / 101

2.1055 / 101.107 Frequency Tolerance

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.26 (2015), section 5.6	Test Date(s):	1/17/2018
Configuration:	1		
Test Setup:	The EUT is placed on test bench. Input voltage is 12.8Vdc from external power supply. GPS antenna port is connected to a GPS antenna. USB port is connected to a touchscreen computer. The computer is sending command to the EUT using software MC3 SuperRaptor Test ver.4.0.2.2. The EUT is set to continuously transmit in CW. Operating frequency: 952-959.85MHz Frequency range of measurement: 956MHz VBW=100Hz, VBW=300Hz		

Environmental Conditions			
Temperature (°C)	20	Relative Humidity (%):	42

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
01878	Temperature Chamber	Thermotron Corp.	S 1.2 Mini-Max	5/15/2017	5/15/2019
02672	Spectrum Analyzer	Agilent	E4446A	3/2/2017	3/2/2019
03432	Attenuator	Aeroflex/Weinschel	90-30-34	10/27/2017	10/27/2019
P06660	Cable	Gore	PHASEFLEX FJR01N01036.0	4/5/2016	4/5/2018
P01910	Cable	Harbor	RG-142	10/25/2017	10/25/2019

Test Data Summary					
Test Condition		Mid CH (MHz)	Tolerance Mid CH (%)	Limit (%)	Result
-30°C	V _{max} (12.8)V _{dc}	955.999583	-0.0000151	±0.00015	Pass
	V _{min} (11.9)V _{dc}	955.999583	-0.0000151	±0.00015	Pass
-20°C	V _{max} (12.8)V _{dc}	955.999723	-0.0000004	±0.00015	Pass
	V _{min} (11.9)V _{dc}	955.999723	-0.0000004	±0.00015	Pass
-10°C	V _{max} (12.8)V _{dc}	955.999733	0.0000006	±0.00015	Pass
	V _{min} (11.9)V _{dc}	955.999733	0.0000006	±0.00015	Pass
0°C	V _{max} (12.8)V _{dc}	955.999726	-0.0000001	±0.00015	Pass
	V _{min} (11.9)V _{dc}	955.999726	-0.0000001	-0.0000001	Pass
10°C	V _{max} (12.8)V _{dc}	955.999730	0.0000003	±0.00015	Pass
	V _{min} (11.9)V _{dc}	955.999730	0.0000003	±0.00015	Pass
20°C	V _{max} (12.8)V _{dc}	955.999727	0	±0.00015	Pass
	V _{min} (11.9)V _{dc}	955.999727	0	±0.00015	Pass
30°C	V _{max} (12.8)V _{dc}	955.999800	0.0000076	±0.00015	Pass
	V _{min} (11.9)V _{dc}	955.999800	0.0000076	±0.00015	Pass
40°C	V _{max} (12.8)V _{dc}	955.999693	-0.0000036	±0.00015	Pass
	V _{min} (11.9)V _{dc}	955.999693	-0.0000036	±0.00015	Pass
50°C	V _{max} (12.8)V _{dc}	955.999463	-0.0000276	±0.00015	Pass
	V _{min} (11.9)V _{dc}	955.999463	-0.0000276	±0.00015	Pass

Measurement Uncertainty: 1 °C

Test Setup Photos



Inside Temperature Chamber



Outside Temperature Chamber

2.1049 / 101.109 Bandwidth

Test Setup/Conditions

Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.26 (2015), section 5.4	Test Date(s):	1/10/2018
Configuration:	1		
Test Setup:	The EUT is placed on test bench. Input voltage is 12.8Vdc from external power supply. GPS antenna port is connected to a GPS antenna. USB port is connected to a touchscreen computer. The computer is sending command to the EUT using software MC3 SuperRaptor Test ver.4.0.2.2 The EUT is set to continuously transmit. Operating frequency: 952-959.85MHz Frequency range of measurement: 952-959.85MHz RBW=8.2Hz, VBW=24Hz (24Hz AM modulation) RBW=30Hz, VBW=91Hz (60Hz AM modulation)		

Environmental Conditions

Temperature (°C)	20	Relative Humidity (%):	53
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Test Equipment

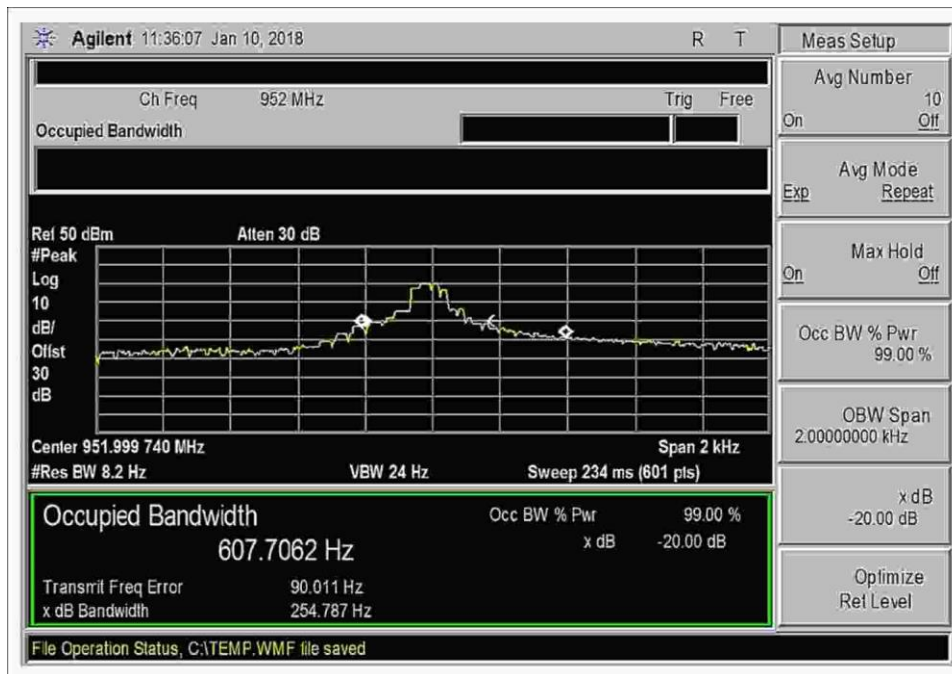
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02672	Spectrum Analyzer	Agilent	E4446A	3/2/2017	3/2/2019
03432	Attenuator	Aeroflex/Weinschel	90-30-34	10/27/2017	10/27/2019
P06660	Cable	Gore	PHASEFLEX FJR01N01036.0	4/5/2016	4/5/2018

Test Data Summary

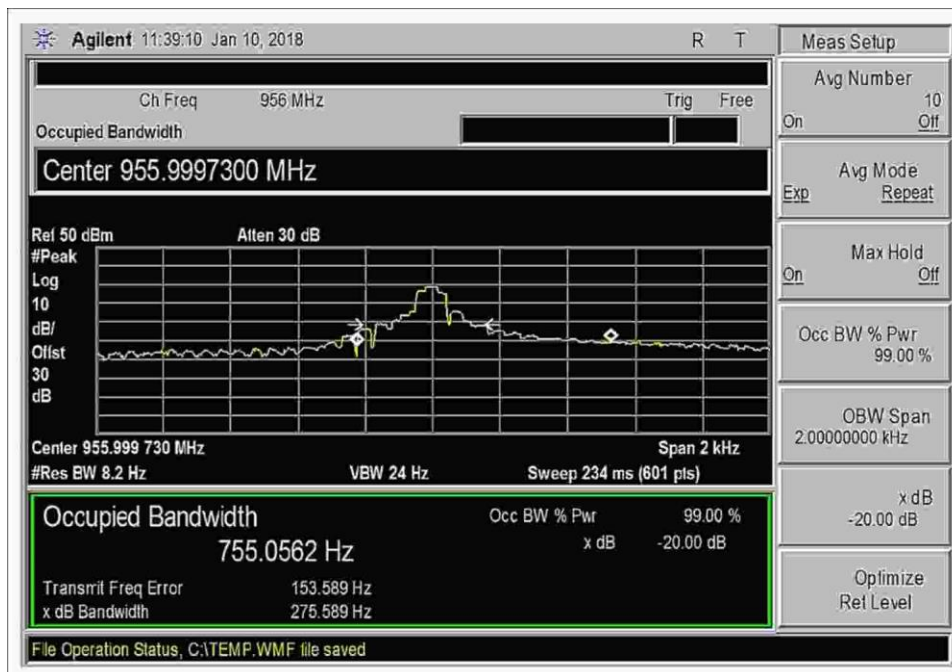
Modulation	Bandwidth Low CH (kHz)	Bandwidth Mid CH (kHz)	Bandwidth Hi CH (kHz)	Limit (kHz)	Result
24Hz AM	0.608	0.755	0.729	200	Pass
60Hz AM	1.755	2.002	2.248	200	Pass

Measurement Uncertainty: 1%

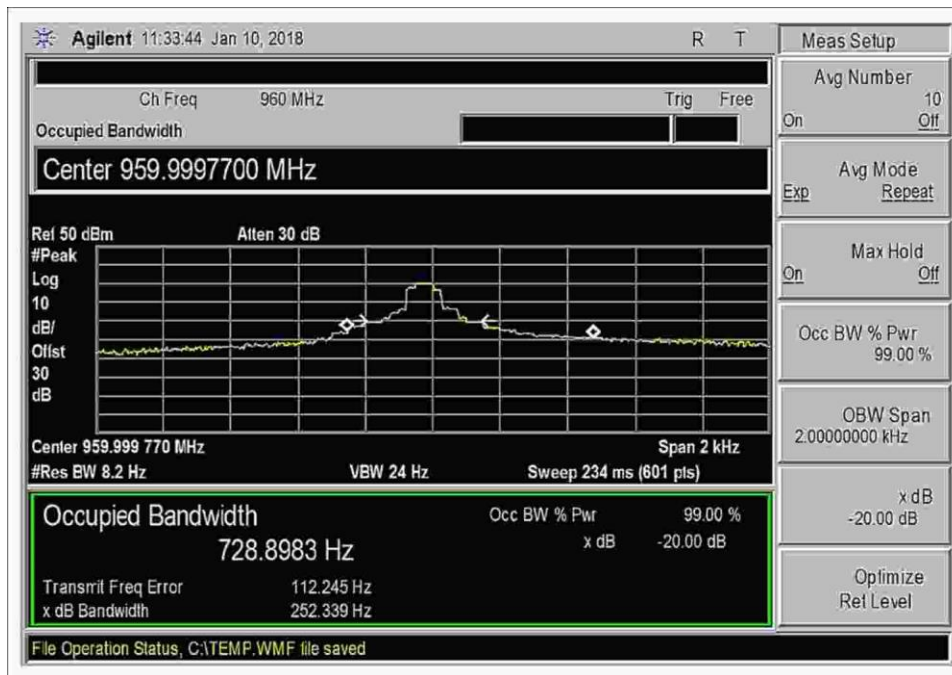
Plots



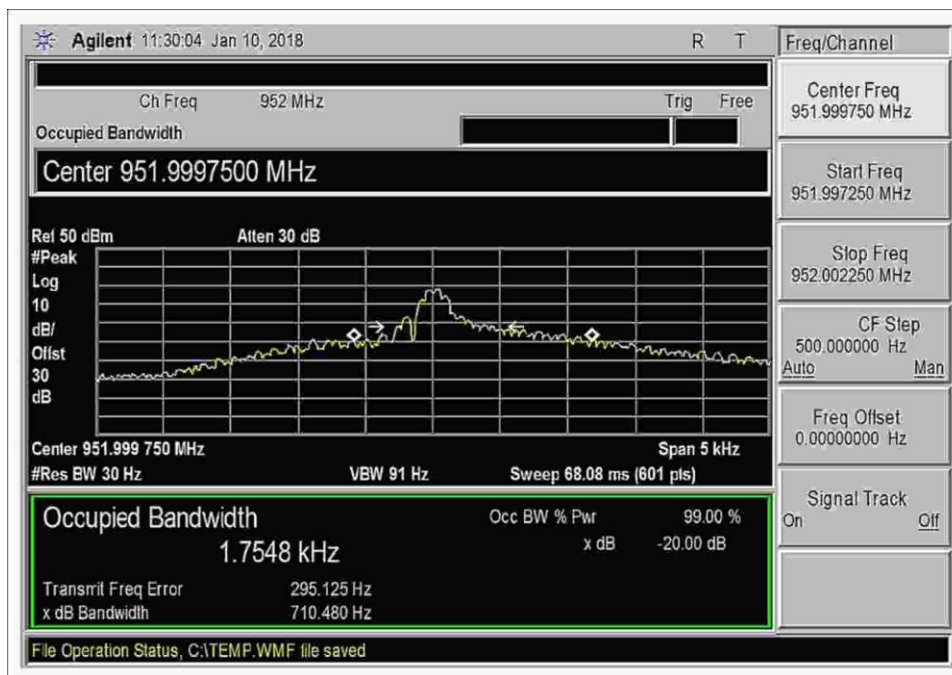
24Hz AM Low Channel



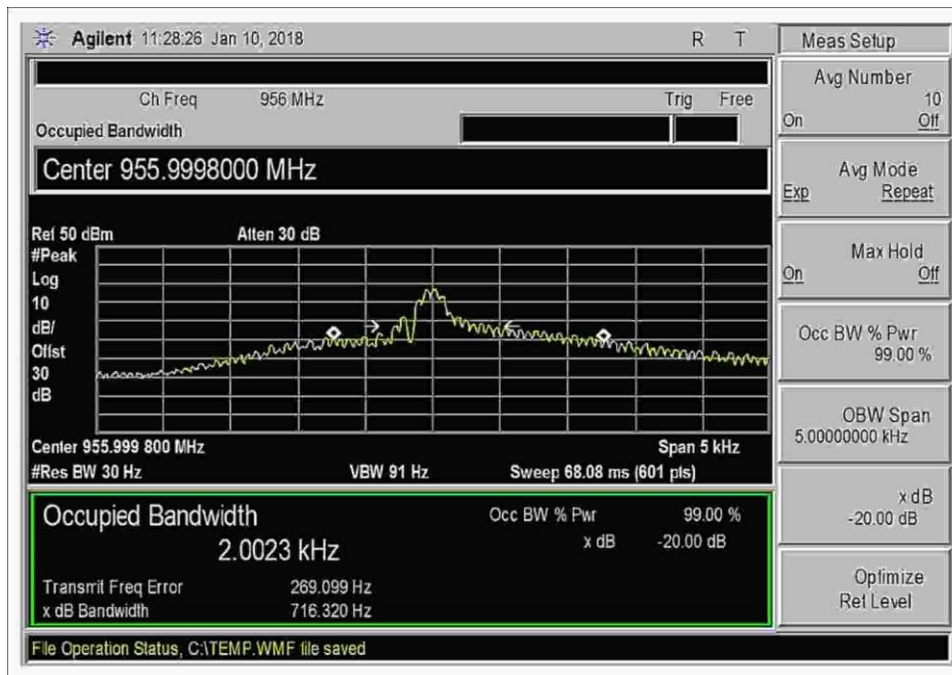
24Hz AM Middle Channel



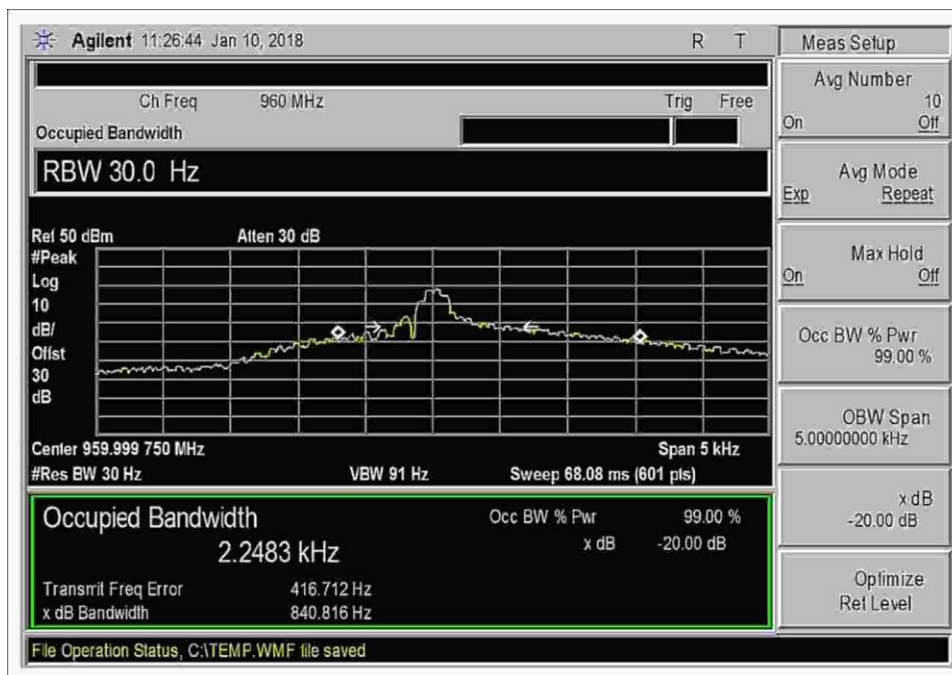
24Hz AM High Channel



60Hz AM Low Channel



60Hz AM Middle Channel



60Hz AM High Channel

Test Setup Photo



2.1051 / 101.111 Emissions Limitations - Conducted

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.26 (2015), section 5.7	Test Date(s):	1/10/2018
Configuration:	1		
Test Setup:	The EUT is placed on test bench. Input voltage is 12.8Vdc from external power supply. GPS antenna port is connected to a GPS antenna. USB port is connected to a touchscreen computer. The computer is sending command to the EUT using software MC3 SuperRaptor Test ver.4.0.2.2 The EUT is set to continuously transmit. Operating frequency: 952-959.85MHz Frequency range of measurement = 9kHz-10GHz RBW=100Hz, VBW=300Hz (within +/- 15kHz of authorized bandwidth) RBW=100kHz, VBW=300kHz (outside of +/-15kHz of authorized bandwidth, 9kHz-1000MHz) RBW=1MHz, VBW=3MHz (1-10GHz)		

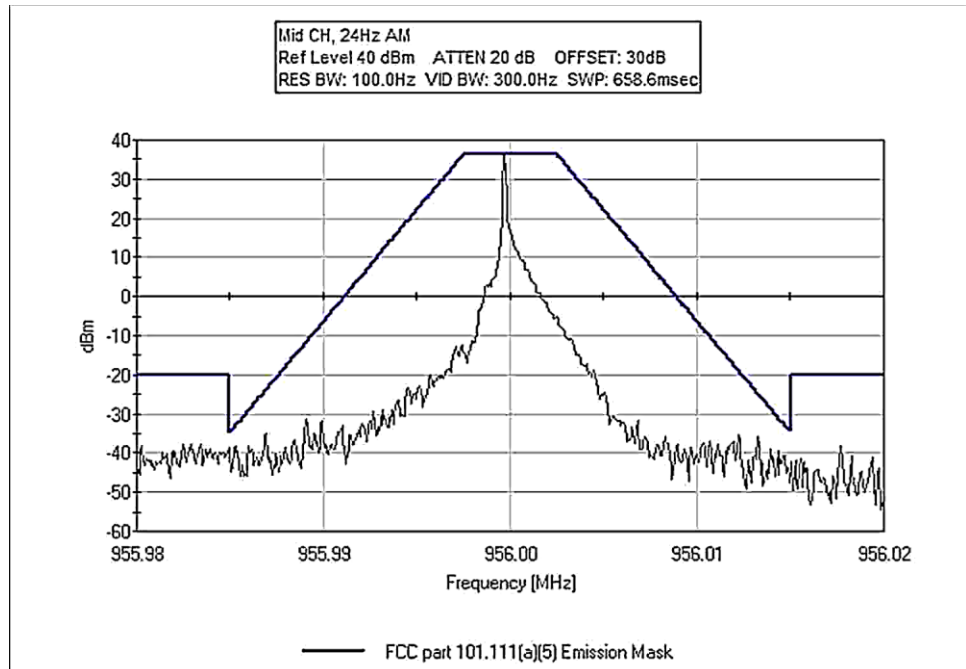
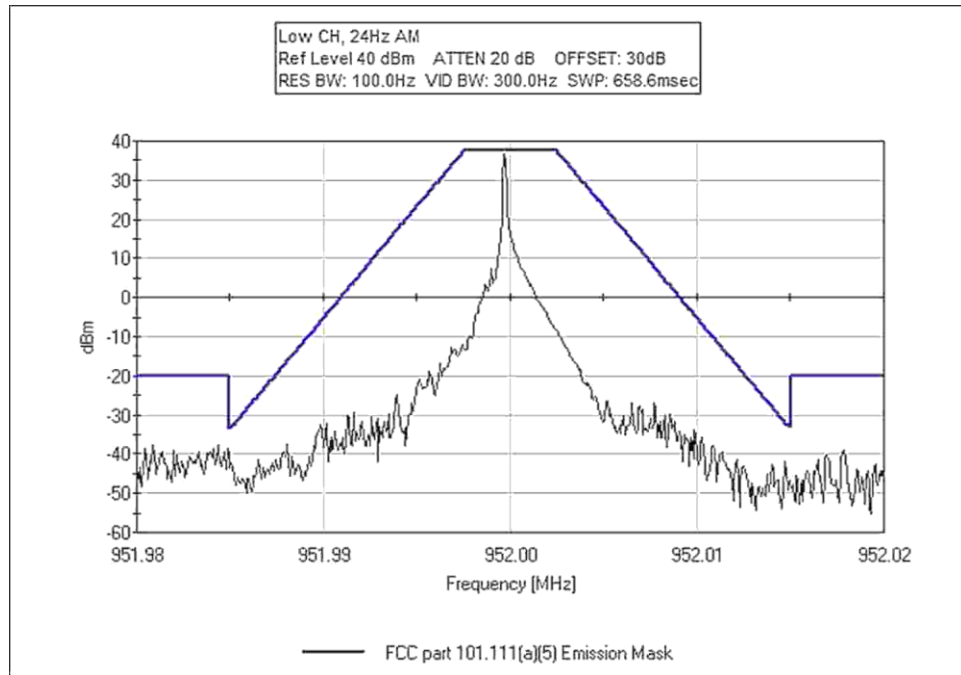
Environmental Conditions			
Temperature (°C)	22	Relative Humidity (%):	55

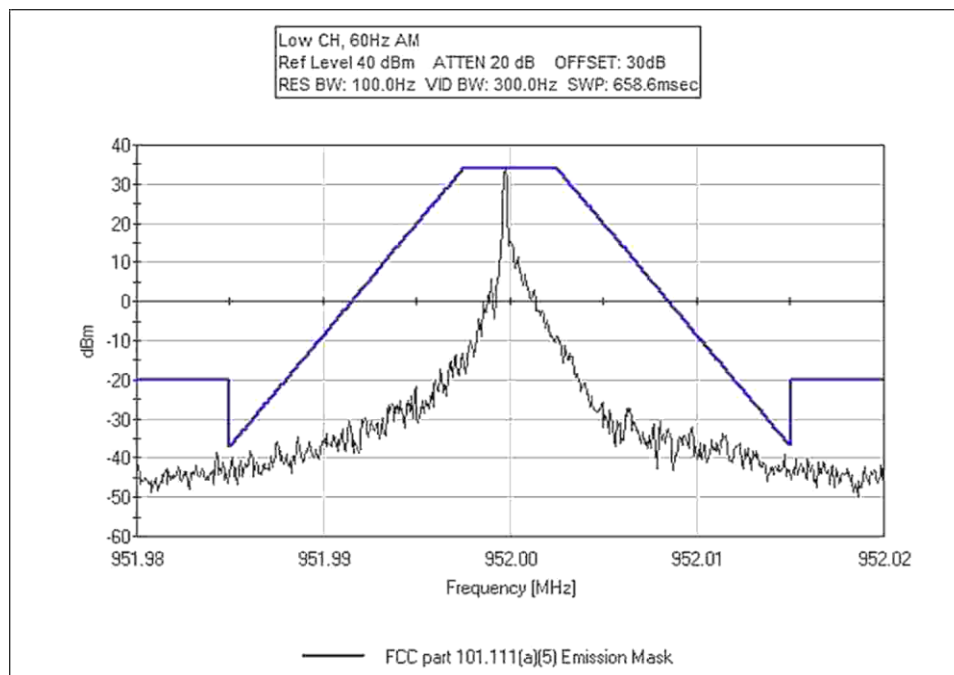
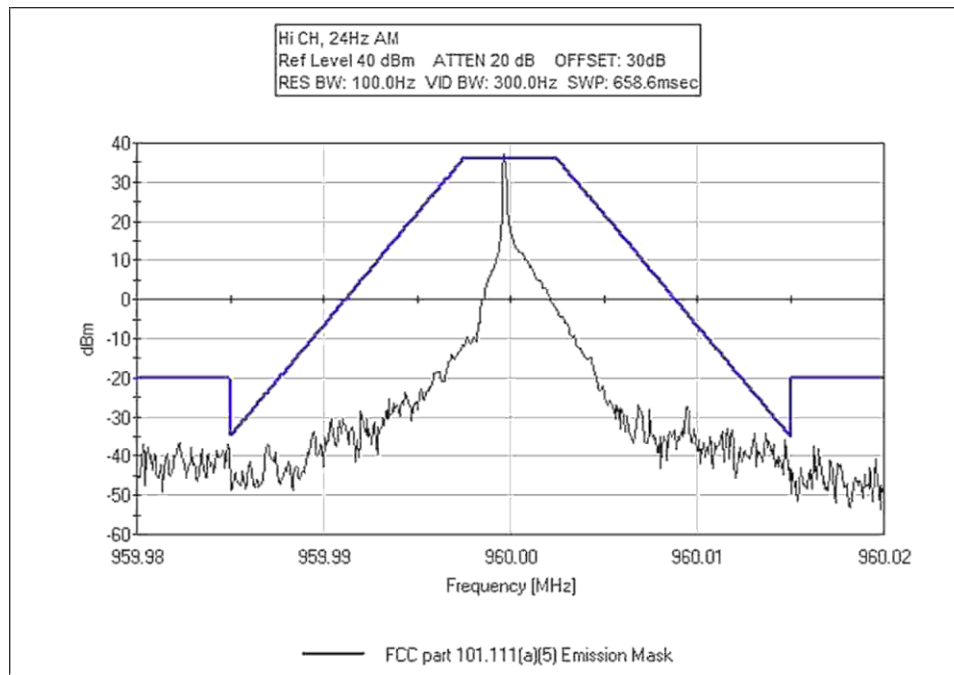
Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02672	Spectrum Analyzer	Agilent	E4446A	3/2/2017	3/2/2019
03432	Attenuator	Aeroflex/Weinschel	90-30-34	10/27/2017	10/27/2019
P06660	Cable	Gore	PHASEFLEX FJR01N01036.0	4/5/2016	4/5/2018

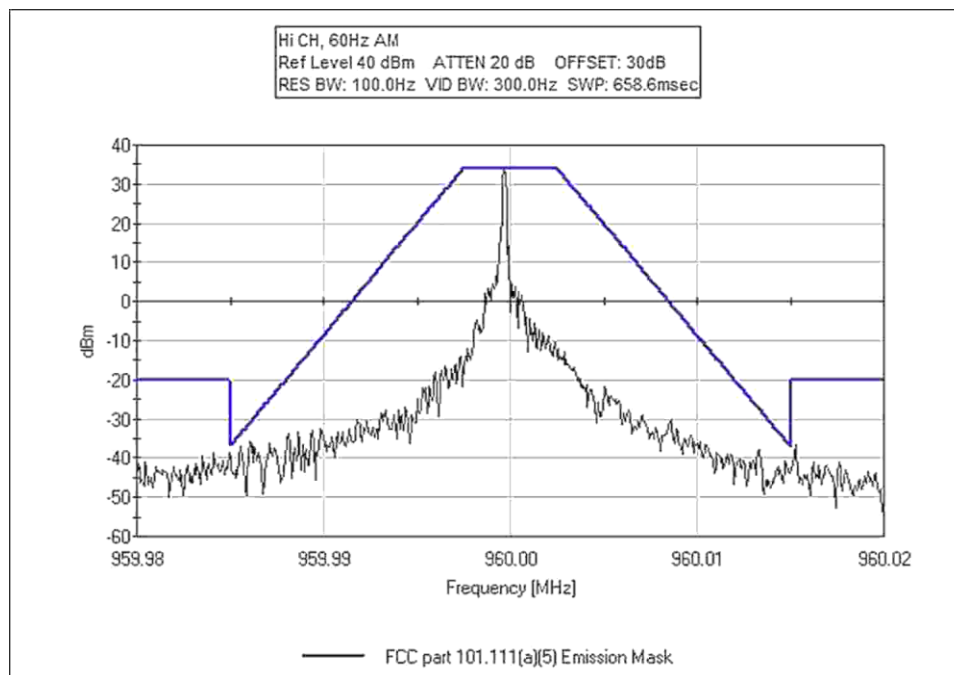
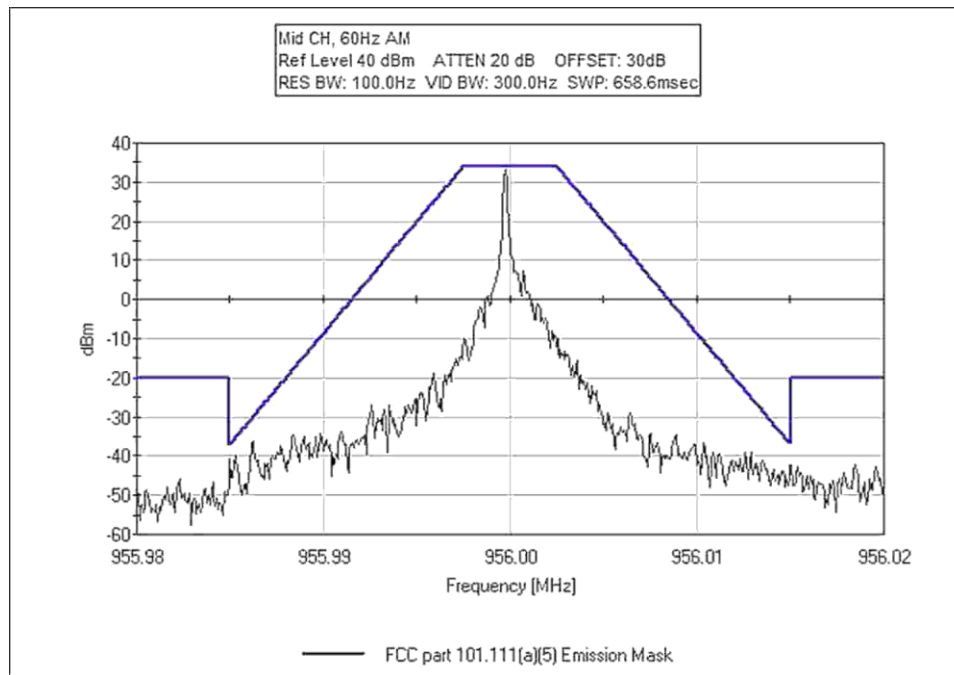
Test Data Summary			
Spurious emissions outside of +/- 15kHz of authorized bandwidth			
Frequency (MHz)	Measure power (dBm)	Limit (dbm)	Result
1904.02	-24.6	-20	Pass
1911.98	-26.4	-20	Pass
1920.03	-24.9	-20	Pass
2856.02	-28.1	-20	Pass
2867.98	-30.2	-20	Pass
2880.03	-27.0	-20	Pass
5712.18	-37.0	-20	Pass
5736.00	-37.8	-20	Pass
5760.00	-39.4	-20	Pass

Note: Data is recorded with the worst-case modulation.
Measurement Uncertainty: 0.67dB

Plots







Test Setup Photo



2.1053 / 101.111 Emissions Limitations - Radiated

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.26 (2015), section 5.5	Test Date(s):	1/10/2018
Configuration:	1 and 2		
Test Setup:	The EUT is placed on turn table. Input voltage is 12.8Vdc from external power supply. GPS port is connected to an external antenna. Main antenna port is terminated with 50ohm load. USB port is connected to a touchscreen computer. The computer is sending command to the EUT using software MC3 SuperRaptor Test ver.4.0.2.2 The EUT is set into receiver mode. The EUT is rotated in three orthogonal orientation. Data represents the worst case orientation. The antenna of the EUT is mounted to a 52" diameter aluminum plate to represent a vehicle roof. The aluminum plate is supported by foam blocks on the 80cm test table; the plate is ~ 129cm above the ground plane. The EUT is directly below the plate, on the test table. Operating frequency: 952-959.85MHz Frequency range of measurement = 9kHz-10GHz RBW=100kHz, VBW=300kHz (outside of +/-15kHz of authorized bandwidth, 9kHz-1000MHz) RBW=1MHz, VBW=3MHz (1-10GHz)		

Environmental Conditions			
Temperature (°C)	19	Relative Humidity (%):	42

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
00314	Loop Antenna	EMCO	6502	5/20/2016	5/20/2018
01995	Biconilog Antenna	Chase	CBL6111C	5/10/2016	5/10/2018
P05275	Attenuator	Weinschel	1W	5/5/2016	5/5/2018
P05198	Cable-Amplitude +15C to +45C (dB)	Belden	8268	12/7/2016	12/7/2018
00309	Preamplifier	HP	8447D	3/14/2016	3/14/2018
P05050	Cable	Pasternack	RG223/U	1/20/2017	1/20/2019
02672	Spectrum Analyzer	Agilent	E4446A	3/2/2017	3/2/2019
00786	Preamplifier	HP	83017A	5/9/2016	5/9/2018
00849	Horn Antenna	ETS	3115	3/4/2016	3/4/2018
P06544	Cable	Astro Steel	32026-29094K-29094K-36TC	12/21/2017	12/21/2019
03169	High Pass Filter	SMI	HM1155-11SS	6/15/2017	6/15/2019
P07138	Cable	Andrew	ANDL1-PNMMN-60	3/1/2017	3/1/2019

Test Data Summary				
Spurious emissions outside of +/-15kHz of authorized bandwidth				
Frequency (MHz)	Modulation	Measure power (dBuV/m)@3m	Limit (dBuV/m)@3m	Result
NED	24Hz AM	NED	75.23	Pass
NED	60Hz AM	NED	75.23	Pass

NED: No emission detected within 30dB of limit line

Measurement Uncertainty: 3.73dB

Limit Line for Spurious Radiated Emission

REQUIRED ATTENUATION = **50+10 LOG P (DB)**
 FOR RADIATED SPURIOUS EMISSION MEASURED AT 3 METER TEST DISTANCE,
 Required attenuation = 50+10 Log P_t at 3 meter dB
 Limit line (dBuV) = E_{dBuV} - Attenuation

E_{dBuV} = Measured field strength at 3 meter in dBuV/m

Power Density (Isotropic)

$$P_D = \frac{P_t}{4\pi r^2}$$

P_D = Power Density in Watts /m²

P_t = Average Transmit Power

r = Test distance

Field Intensity E (V/m)

$$E = \sqrt{P_D \times 377}$$

$$E = \frac{\sqrt{P_t \times 377}}{4\pi r^2}$$

$$E = \sqrt{\frac{P_t \times 30}{r^2}}$$

$$P_t = \left(\frac{E^2 \times r^2}{30} \right)$$

$$10 \log P_t = 10 \log E^2 (V/m) + 10 \log r^2 - 10 \log 30$$

$$10 \log P_t = 20 \log E (V/m) + 20 \log r - 10 \log 30$$

At 3 meter, $r = 3 \text{ m}$

$$10 \log P_t = 20 \log E (V/m) + 20 \log 3 - 10 \log 30$$

$$10 \log P_t = 20 \log E (V/m) + 9.54 - 14.77$$

$$10 \log P_t = 20 \log E (V/m) - 5.23$$

Since $20 \log E (V/m) = 20 \log E (\mu V/m) - 120$

$$10 \log P_t = 20 \log E (\mu V/m) - 120 - 5.23$$

$$10 \log P_t = 20 \log E (\mu V/m) - 125.23$$

$$\text{Limit line (dBuV) at 3 meter} = E_{dBuV} - \text{Attenuation}$$

$$= E_{dBuV} - (50 + 10 \log P_{t \text{ at 3 meter}})$$

$$= E_{dBuV} - 50 - 10 \log P_{t \text{ at 3 meter}}$$

$$= E_{dBuV} - 50 - (20 \log E (\mu V/m) - 125.23)$$

$$= E_{dBuV} - 50 - 20 \log E (\mu V/m) + 125.23$$

$$= E_{dBuV} - 20 \log E (\mu V/m) + 75.23$$

$$\text{Since } 20 \log E (\mu V/m) = E \text{ in dBuV/m} = E_{dBuV} - E_{dBuV} + 75.23$$

$$\text{Radiated Emission limit 3 meter} = 75.23 \text{ dBuV /m@3 m at any power level.}$$

Test Setup Photos



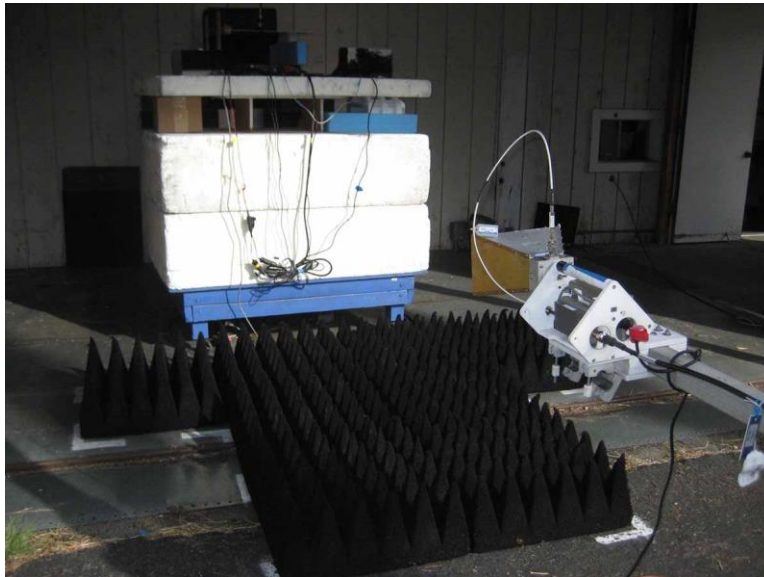
Configuration 1, Below 1GHz



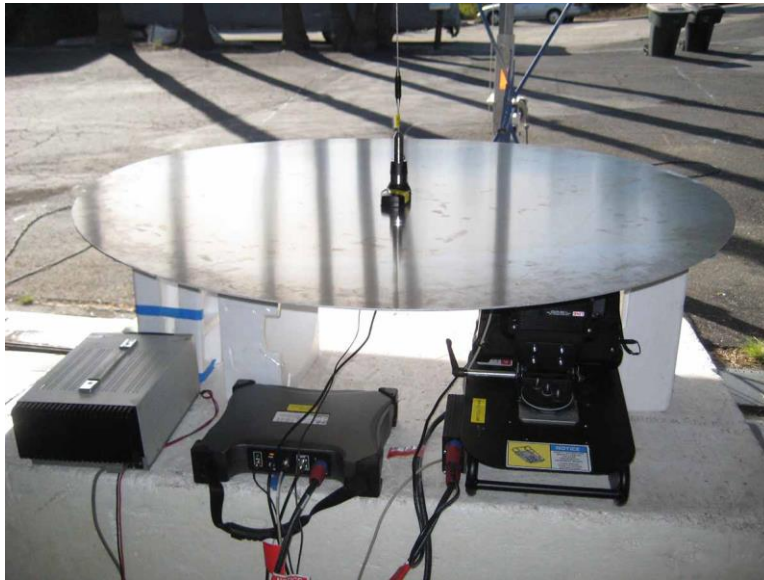
Configuration 1, Below 1GHz



Configuration 1, Above 1GHz Cone placement



Configuration 1, Above 1GHz Cone placement



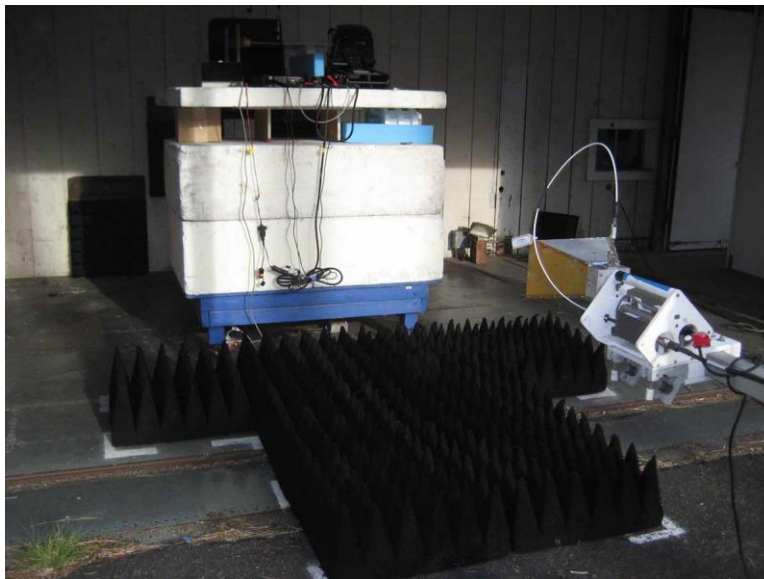
Configuration 2, Below 1GHz



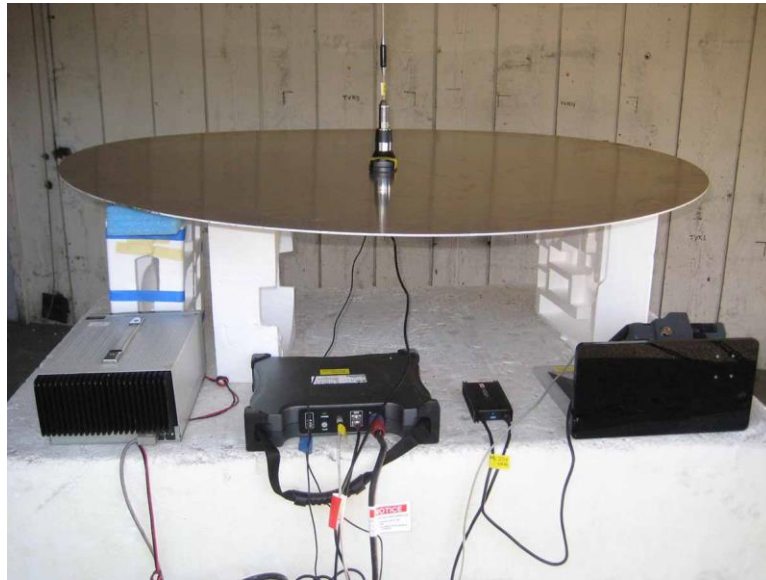
Configuration 2, Below 1GHz



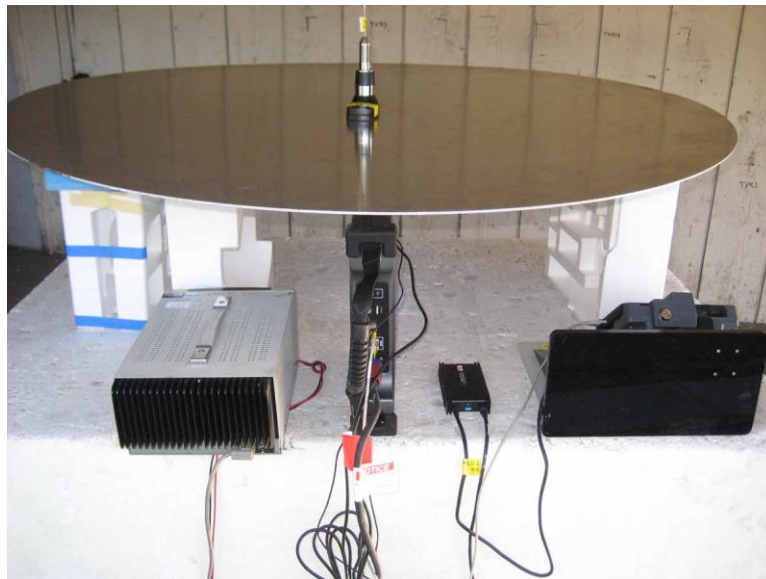
Configuration 2, Above 1GHz Cone placement



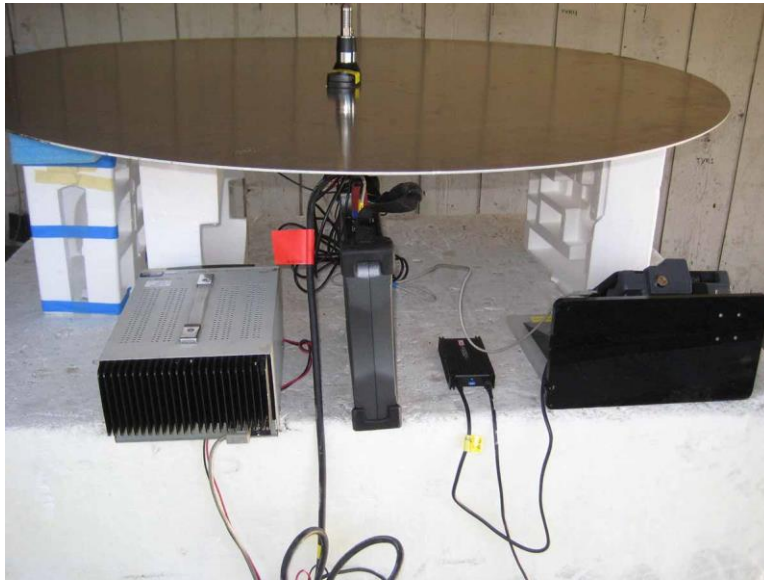
Configuration 2, Above 1GHz Cone placement



X Axis



Y Axis



Z Axis

2.1046 / 101.113 Transmitter Power Limitations

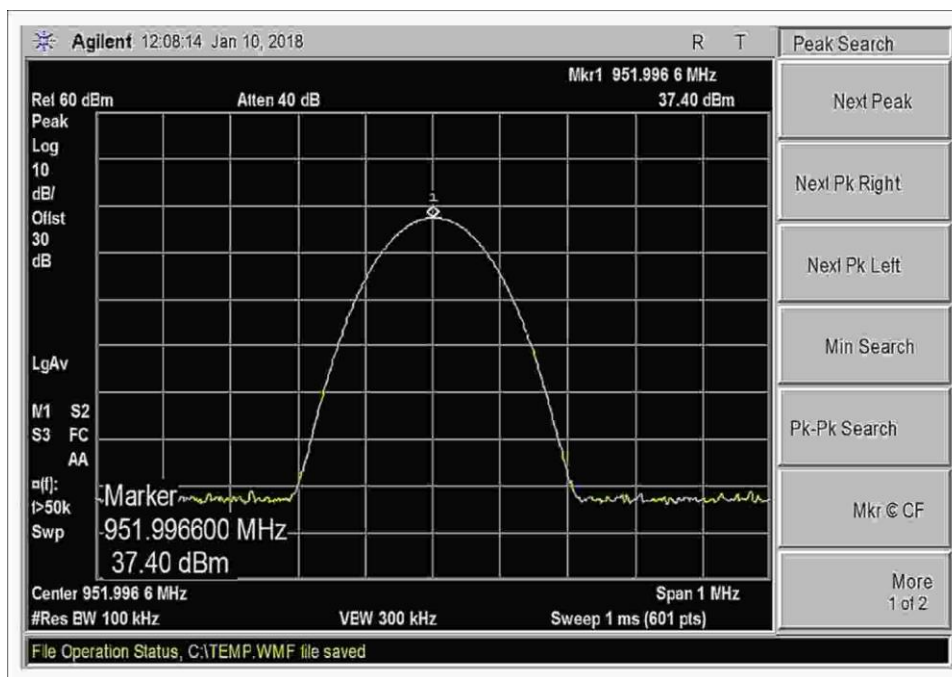
Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	Don Nguyen
Test Method:	ANSI C63.26 (2015), section 5.2	Test Date(s):	1/10/2018
Configuration:	1		
Test Setup:	The EUT is placed on test bench. Input voltage is 12.8Vdc from external power supply. GPS antenna port is connected to a GPS antenna. USB port is connected to a touchscreen computer. The computer is sending command to the EUT using software MC3 SuperRaptor Test ver.4.0.2.2 The EUT is set to continuously transmit. Operating frequency: 952-959.85MHz Frequency of measurement: 952-959.85MHz RBW=100kHz, VBW=300kHz		

Environmental Conditions			
Temperature (°C)	22	Relative Humidity (%):	52

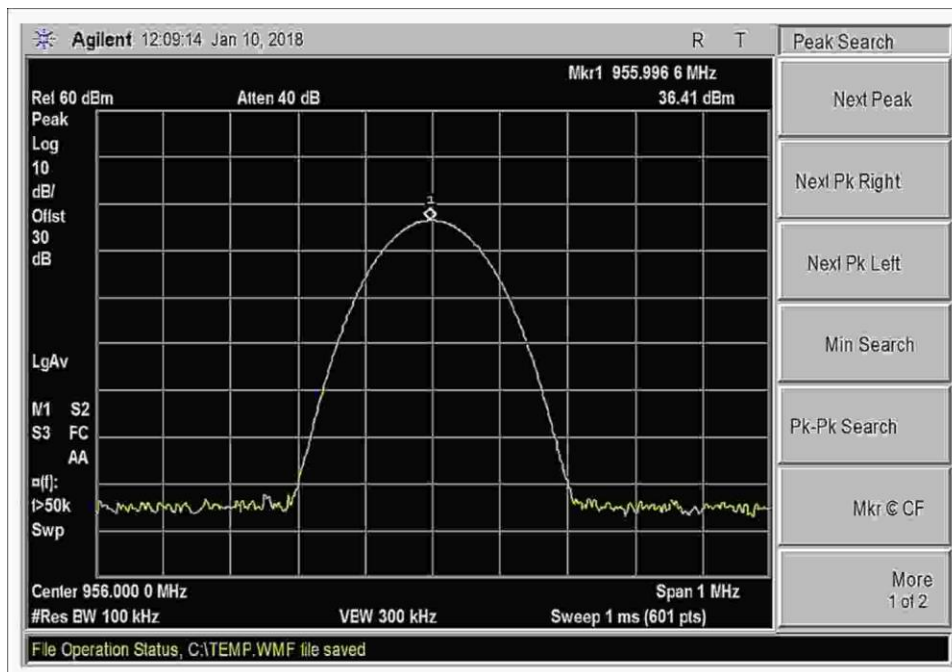
Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02672	Spectrum Analyzer	Agilent	E4446A	3/2/2017	3/2/2019
03432	Attenuator	Aeroflex/Weinschel	90-30-34	10/27/2017	10/27/2019
P06660	Cable	Gore	PHASEFLEX FJR01N01036.0	4/5/2016	4/5/2018

Test Data						
Modulation	RF Power + 5dBi antenna gain 952.0MHz (dBm)	RF Power + 5dBi antenna gain 956.0 MHz (dBm)	RF Power + 5dBi antenna gain 959.85MHz (dBm)	Limit (dBm)	Limit (dBW)	Result
24Hz AM	42.40	41.41	42.38	44	14	Pass
60Hz AM	42.23	41.25	42.28	44	14	Pass
Measurement Uncertainty: 0.67dB						

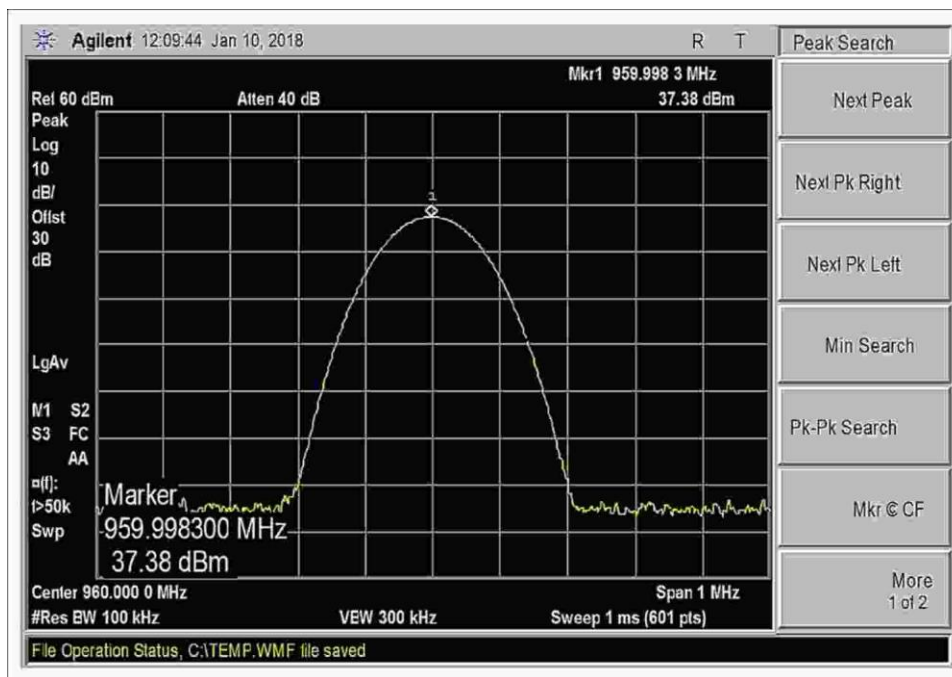
Plots



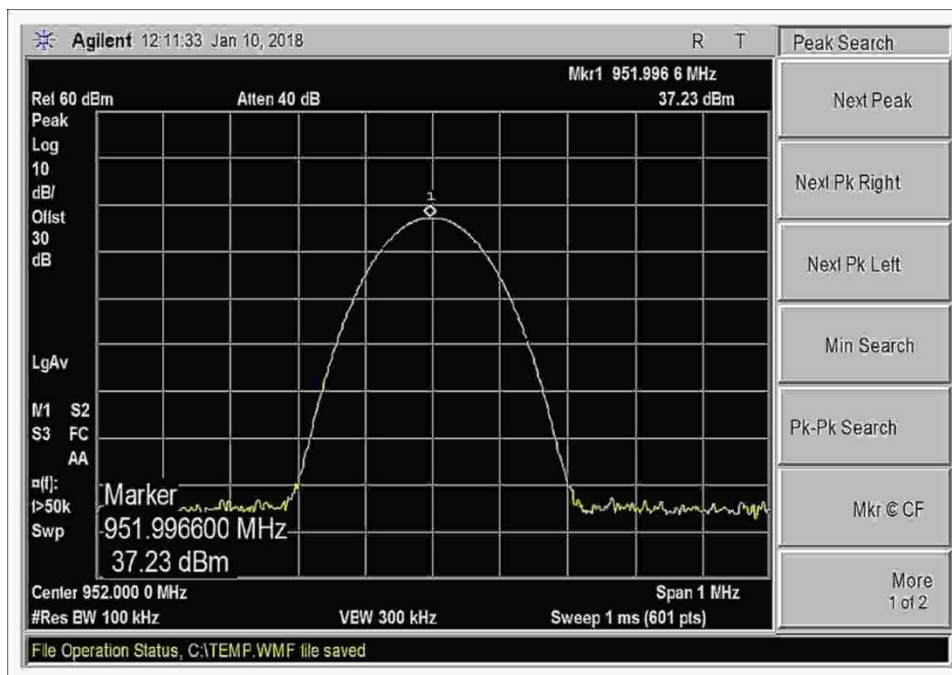
24Hz AM Low Channel



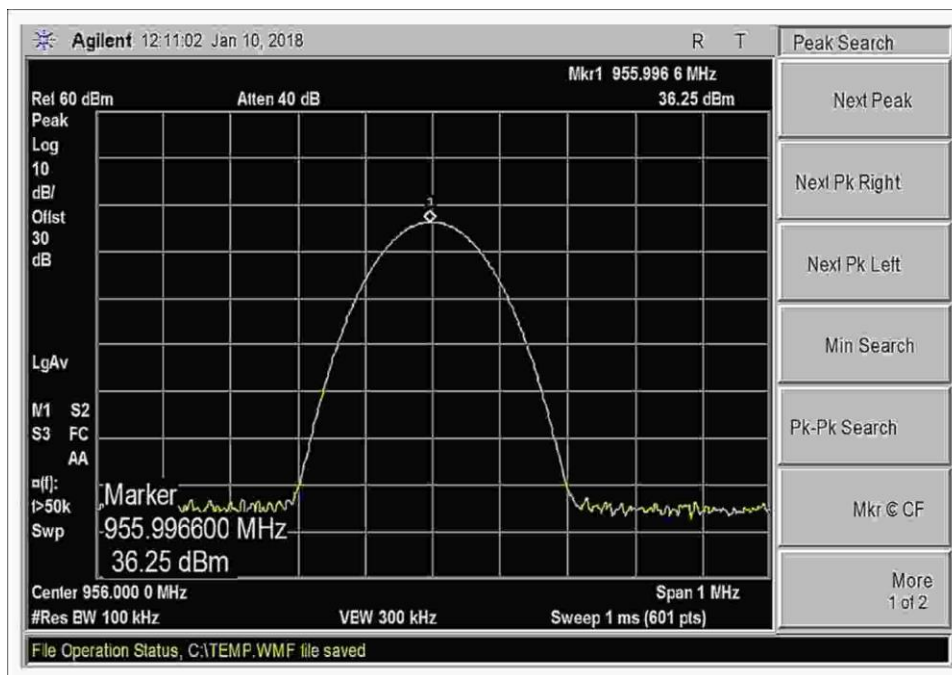
24Hz AM Middle Channel



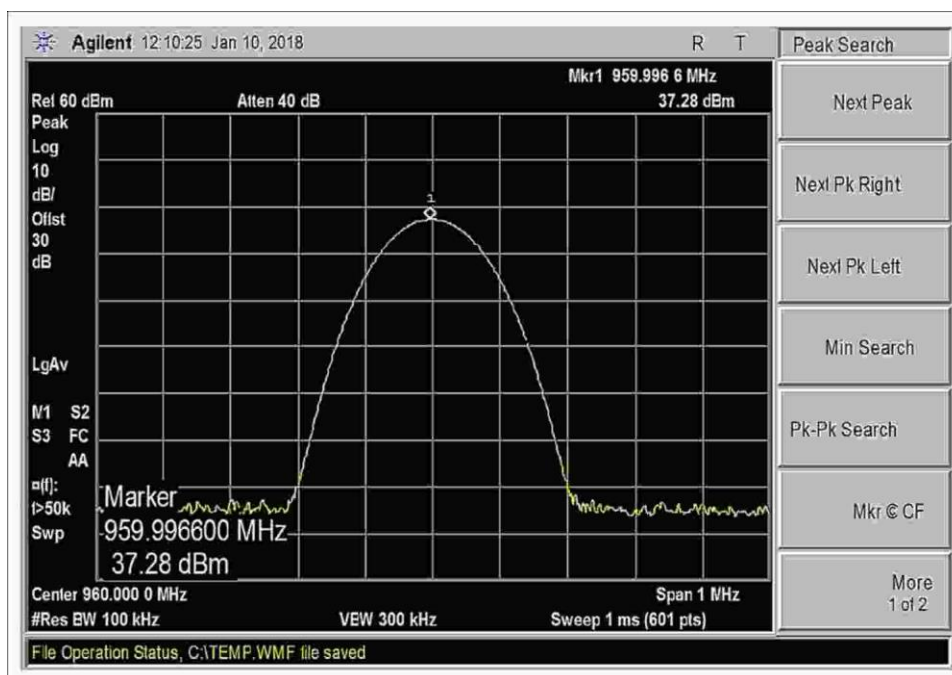
24Hz AM High Channel



60Hz AM Low Channel



60Hz AM Middle Channel



60Hz AM High Channel

Test Setup Photo



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.