

Ittron, Inc.

EMC TEST REPORT FOR

AMR Transceiver Device For Communicating With Utility Meters
Model: IMRB

Tested To The Following Standards:

FCC Part 101 Subpart C

Report No.: 102206-2

Date of issue: March 25, 2019



Test Certificate # 803.05

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.

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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: 170692

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: 102206

January 28, 2019

January 28-31, 2019

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, reading "Steve Behm", is written over a horizontal line.

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	5.03.11
EMITest Immunity	5.03.10

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	JAPAN
Canyon Park, Bothell, WA	US0081	US1022	A-0148

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

SUMMARY OF RESULTS

Standard / Specification: FCC Part 2 / 101

Test Procedure	Description	Modifications	Results
2.1046 / 101.113	Transmitter Power Limitations	NA	Pass
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
2.1047	Modulation Characteristics	NA	NA1

NA = Not Applicable

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

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

The device tested in this report is for the External Antenna version of model IMRB. The Internal Antenna version on the IMRB has been previously tested in a separate report.

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
AMR Transceiver Device For Communicating With Utility Meters	Itron, Inc.	IMRB	66031570

Support Equipment:

Device	Manufacturer	Model #	S/N
Laptop	Dell	E6410	3XG40P1
AC Adapter for Laptop	Dell	DA130PE1-00	NA
Power Supply	Triad	WDU12-1200	NA

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Modulation Type(s):	OOK
Antenna Type(s) and Gain:	External Monopole Vehicle Mounted, 5dBi gain and External Monopole Attached, 3dBi gain
Antenna Connection Type:	External
Nominal Input Voltage:	12VDC Nominal (7 to 18VDC), 120VAC 60Hz through AC Adapter
Firmware / Software used for Test:	DSP Version 85.75.00.02/FPGA Version 3.02 / MC3 Test v4.0.2.2
Temperature Range	-20C to 50C

FCC PART(S) 2 / 101

2.1046 / 101.113 Transmitter Power Limitations

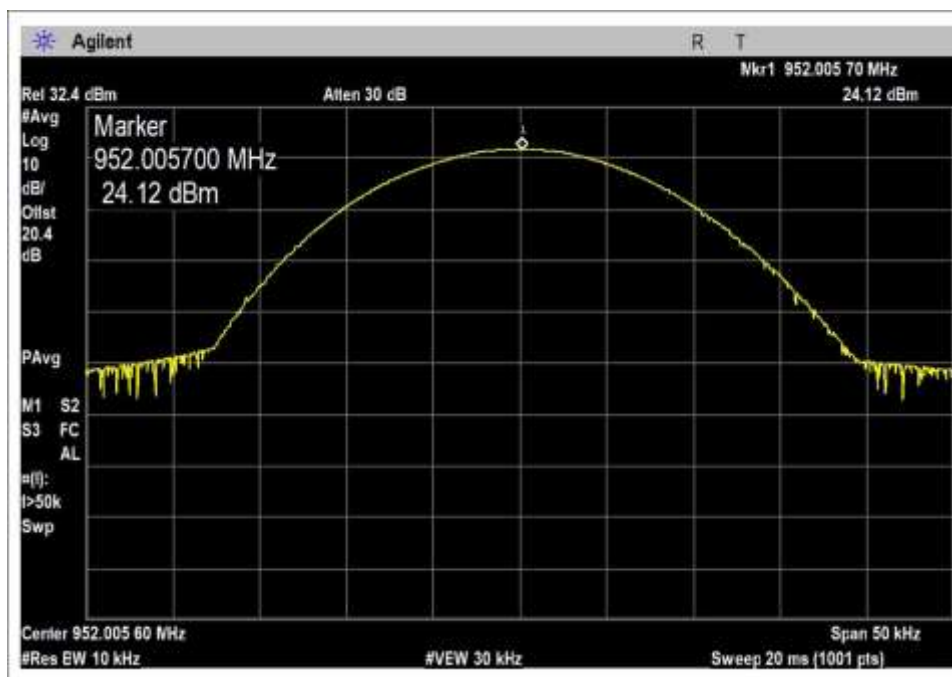
Test Setup/Conditions			
Test Location:	Bothell Lab C3	Test Engineer:	M. Atkinson
Test Method:	FCC CFR 47 Part 101.113, TIA-603E	Test Date(s):	1/28/2019
Configuration:	1		
Test Setup:	Frequency Range: 952-959.85MHz Frequency tested: 952, 959.85MHz Firmware power setting: Max Power Protocol /MCS/Modulation: OOK Duty Cycle: 100% (Test Mode) Test Mode: Continuously transmitting Test Setup: EUT is transmitting through the antenna port connector and is attached to the spectrum analyzer, insertion loss of other equipment is accounted for and programmed into the Spectrum Analyzer. Multiple modulation tones investigated, only worst case reported.		

Environmental Conditions			
Temperature (°C)	20-22	Relative Humidity (%):	30-35

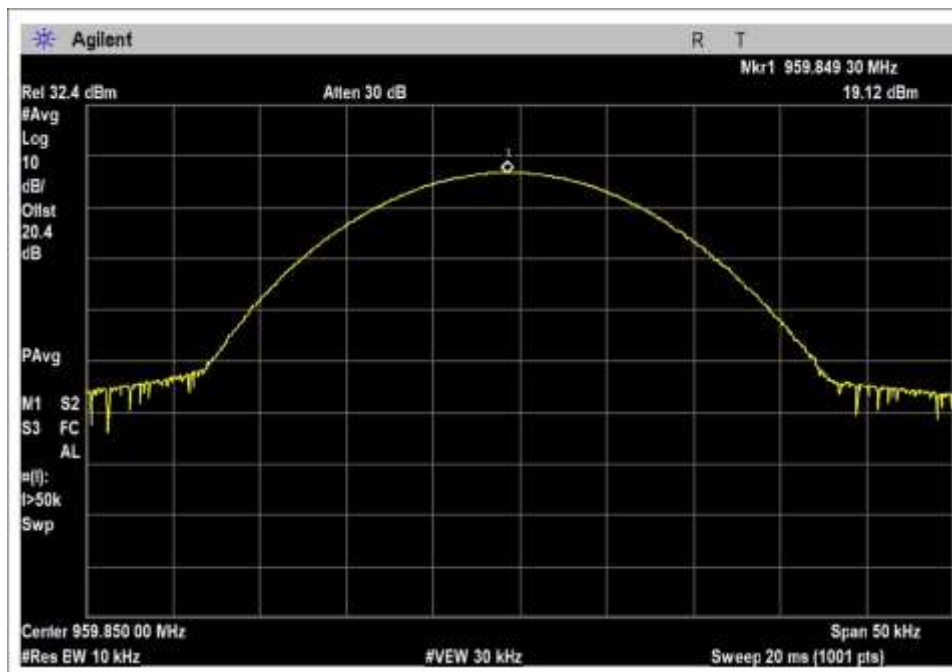
Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02673	Spectrum Analyzer	Agilent	E4446A	2/3/2017	2/3/2019
P07229	Attenuator	Pasternack	PE7004-20	12/1/2017	12/1/2019
P06927	Cable	Andrews	Helix 1/4	8/28/2018	8/28/2020

Test Data Summary				
Frequency (MHz)	Measured Power (dBm)	Power Watts	Limit Watts	Results
952.0	24.12	0.258	25	Pass
959.85	19.12	0.082	25	

Plots



Low Channel



High Channel

Test Setup Photo



2.1055 / 101.107 Frequency Tolerance

Test Setup/Conditions

Test Location:	Bothell Lab Bench 2	Test Engineer:	M. Atkinson / M. Harrison
Test Method:	FCC CFR 47 Part 101.107, TIA-603E	Test Date(s):	1/31/2019
Configuration:	1		
Test Setup:	Frequency Range: 952-959.85MHz Frequency tested: 952, 959.85MHz Firmware power setting: Max Power Protocol /MCS/Modulation: OOK Duty Cycle: 100% (Test Mode) Test Mode: Continuously transmitting Test Setup: EUT is in temperature chamber. EUT is transmitting through the antenna port connector and is attached to the spectrum analyzer. AC input varied when EUT using AC adapter, DC power also directly varied to the device.		

Environmental Conditions

Temperature (°C)	21-23	Relative Humidity (%):	20-30
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Test Equipment

Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02549	Data Acquisition	HP	34970A	2/22/2017	2/22/2019
02757	Temperature Chamber	Bemco	F100/350-8	12/20/2018	12/20/2020
02872	Spectrum Analyzer	Agilent	E4440A	11/3/2017	11/3/2019
P06927	Cable	Andrews	Helix 1/4	8/28/2018	8/28/2020
P07229	Attenuator	Pasternack	PE7004-20	12/1/2017	12/1/2019
D06056	Type T Thermocouple	Hi-Watt	TSK-TZ048-6	11/13/2018	11/13/2020
03515	Multimeter	Fluke	87	12/7/2018	12/7/2020

Test Data Summary					
Temperature (°C)	Voltage	Frequency (MHz)	Frequency Tolerance (%)	Limit (%)	Results
-30	V _{Nominal}	952.00555	0.00000	0.0005	Pass
-20	V _{Nominal}	952.00527	0.00003	0.0005	
-10	V _{Nominal}	952.00519	0.00004	0.0005	
0	V _{Nominal}	952.00527	0.00003	0.0005	
10	V _{Nominal}	952.00537	0.00002	0.0005	
20	V _{Minimum AC}	952.00552	0.00000	0.0005	
20	V _{Nominal AC}	952.00557	0.00001	0.0005	
20	V _{Maximum AC}	952.00560	0.00001	0.0005	
20	V _{Minimum DC}	952.00558	0.00001	0.0005	
20	V _{Nominal DC}	952.00555	0.00000	0.0005	
20	V _{Maximum DC}	952.00559	0.00001	0.0005	
30	V _{Nominal}	952.00545	0.00001	0.0005	
40	V _{Nominal}	952.00555	0.00000	0.0005	
50	V _{Nominal}	952.00527	0.00003	0.0005	
Nominal Frequency:		952.00552			

Test Data Summary					
Temperature (°C)	Voltage	Frequency (MHz)	Frequency Tolerance (%)	Limit (%)	Results
-30	V _{Nominal}	959.84924	0.00001	0.0005	Pass
-20	V _{Nominal}	959.84902	0.00002	0.0005	
-10	V _{Nominal}	959.84894	0.00003	0.0005	
0	V _{Nominal}	959.84896	0.00002	0.0005	
10	V _{Nominal}	959.84923	0.00000	0.0005	
20	V _{Minimum AC}	959.849186	0.00000	0.0005	
20	V _{Nominal AC}	959.84932	0.00001	0.0005	
20	V _{Maximum AC}	959.84935	0.00002	0.0005	
20	V _{Minimum DC}	959.84934	0.00002	0.0005	
20	V _{Nominal DC}	959.84934	0.00002	0.0005	
20	V _{Maximum DC}	959.84934	0.00002	0.0005	
Nominal Frequency:		959.849186			

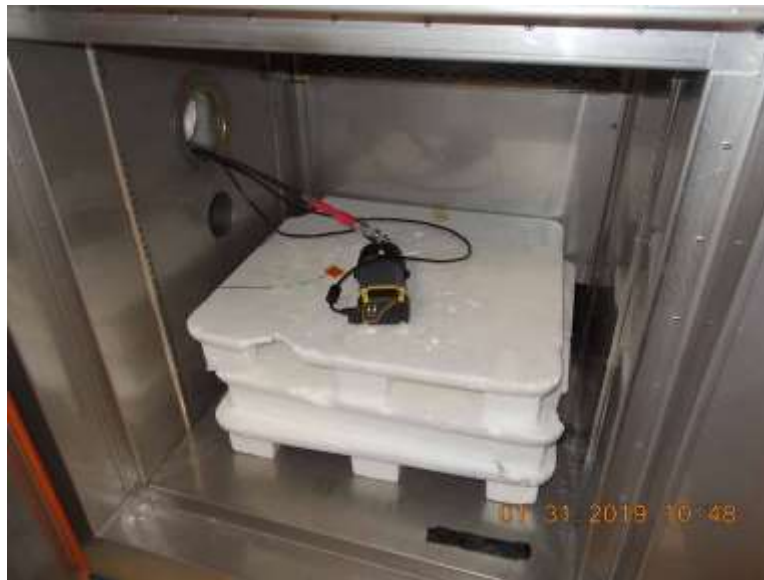
Parameter Definitions:

Measurements performed at input voltage V_{nominal} ± 15%. (AC Input)

Measurements performed at input voltage according to manufacturer specification. (DC Input)

Parameter	Value
V _{Nominal AC} :	97.0 VAC
V _{Minimum AC} :	115.0 VAC
V _{Maximum AC} :	133.0 VAC
Parameter	Value
V _{Nominal DC} :	12 VDC
V _{Minimum DC} :	7 VDC
V _{Maximum DC} :	18 VDC

Test Setup Photo



2.1049 / 101.109 Bandwidth

Test Setup/Conditions

Test Location:	Bothell Lab C3	Test Engineer:	M. Atkinson
Test Method:	FCC CFR 47 Part 101.109, TIA-603E, ANSI C63.26 (2015)	Test Date(s):	1/29/2019
Configuration:	1		
Test Setup:	Frequency Range: 952-959.85MHz Frequency tested: 952, 959.85MHz Firmware power setting: Max Power Protocol /MCS/Modulation: OOK Duty Cycle: 100% (Test Mode) Test Mode: Continuously transmitting Test Setup: EUT is transmitting through the antenna port connector and is attached to the spectrum analyzer. Multiple modulation tones investigated, only worst case reported.		

Environmental Conditions

Temperature (°C)	20-22	Relative Humidity (%):	25-30
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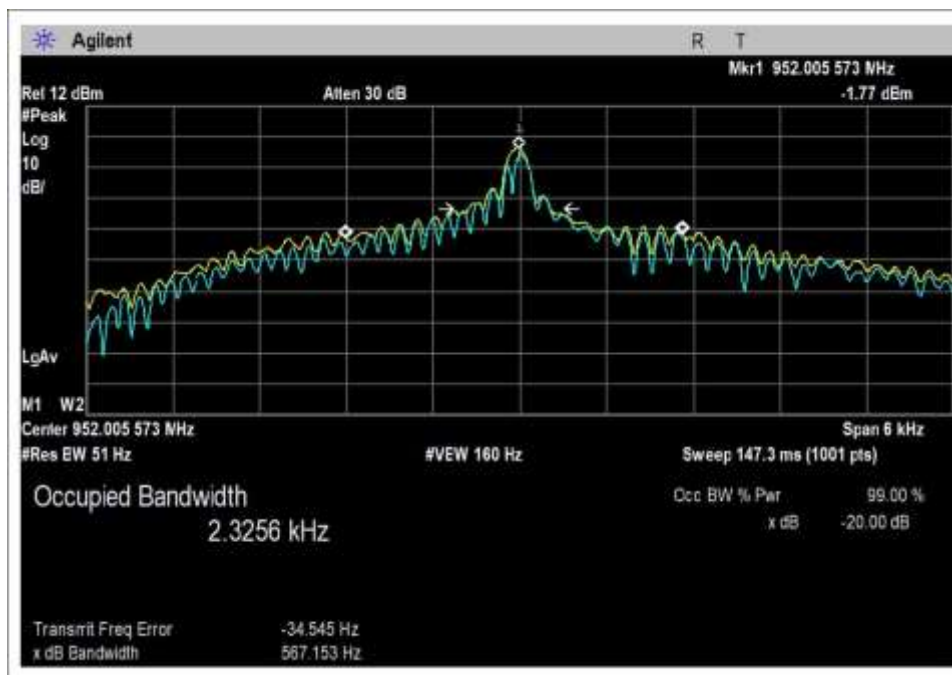
Test Equipment

Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02673	Spectrum Analyzer	Agilent	E4446A	2/3/2017	2/3/2019
P07229	Attenuator	Pasternack	PE7004-20	12/1/2017	12/1/2019
P06927	Cable	Andrews	Helix 1/4	8/28/2018	8/28/2020

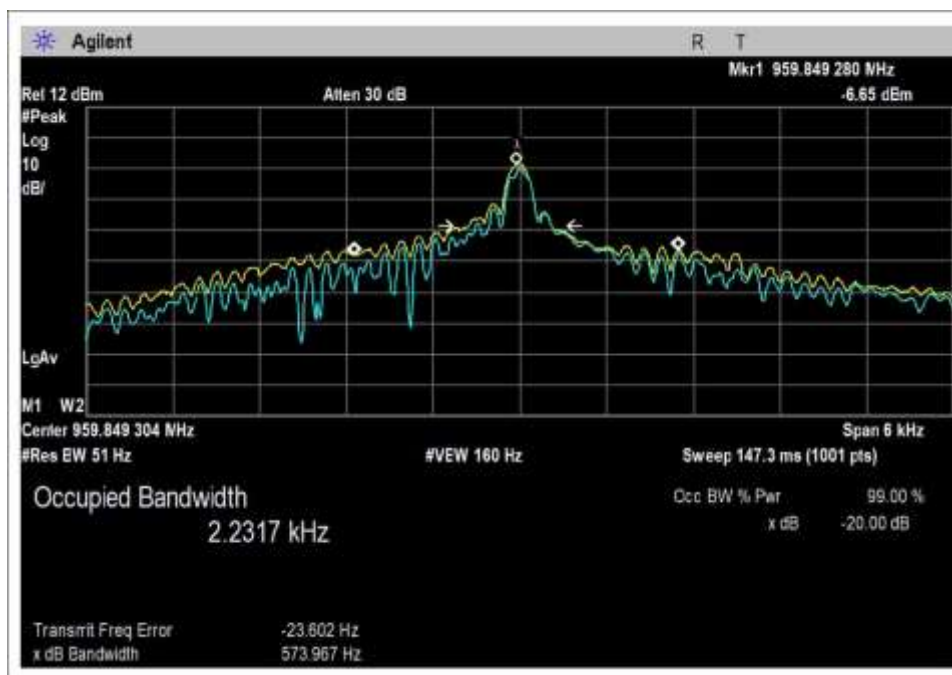
Test Data Summary

Frequency (MHz)	Modulation	Measured (kHz)	Limit (kHz)	Results
952.0	OOK	2.3	<12.5	Pass
959.85	OOK	2.2	<12.5	Pass

Plots



Low Channel



High Channel

Test Setup Photo



2.1051 / 101.111 Emissions Limitations - Conducted

Test Setup/Conditions			
Test Location:	Bothell Lab C3	Test Engineer:	M. Atkinson
Test Method:	FCC CFR 47 Part 101.111, TIA-603E	Test Date(s):	1/28/2019-1/29/2019
Configuration:	1		
Test Setup:	Frequency Range: 952-959.85MHz Frequency tested: 9kHz-10GHz Firmware power setting: Max Power Protocol /MCS/Modulation: OOK Duty Cycle: 100% (Test Mode) Test Mode: Continuously transmitting Test Setup: EUT is transmitting through the antenna port connector and is attached to the spectrum analyzer. Multiple modulation tones investigated, only worst case reported. Low and High channel investigated, only worst case reported.		

Environmental Conditions			
Temperature (°C)	20-22	Relative Humidity (%):	25-35

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02673	Spectrum Analyzer	Agilent	E4446A	2/3/2017	2/3/2019
P07229	Attenuator	Pasternack	PE7004-20	12/1/2017	12/1/2019
P06927	Cable	Andrews	Helix 1/4	8/28/2018	8/28/2020

Test Data Summary

Limit applied: Part 101.111 (a) (5)

(i) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) of more than 2.5 KHz up to and including 6.25 KHz: At least $53 \log_{10} (fd/2.5)$ decibels;

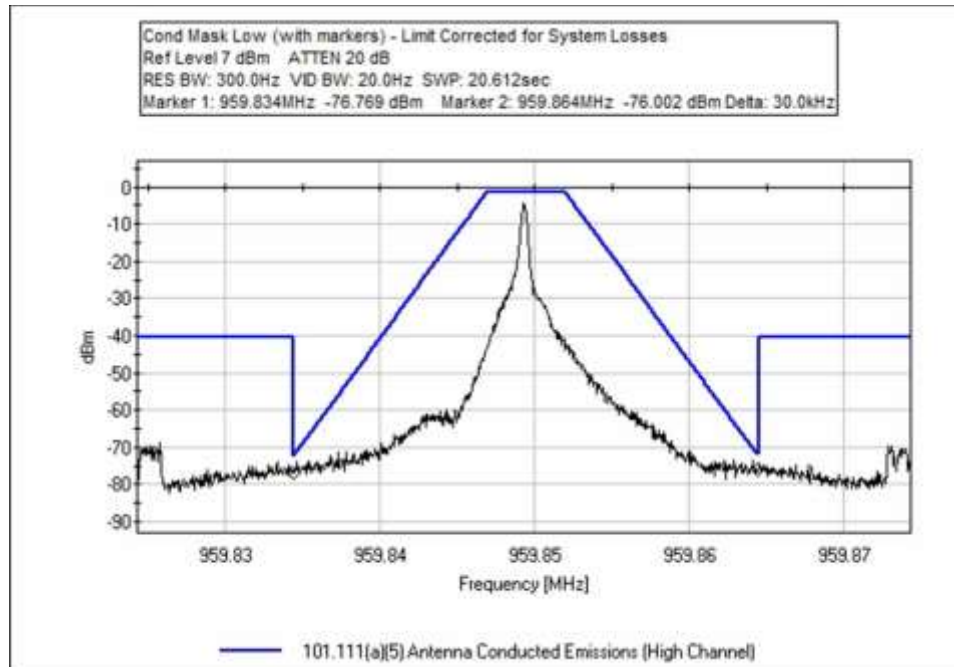
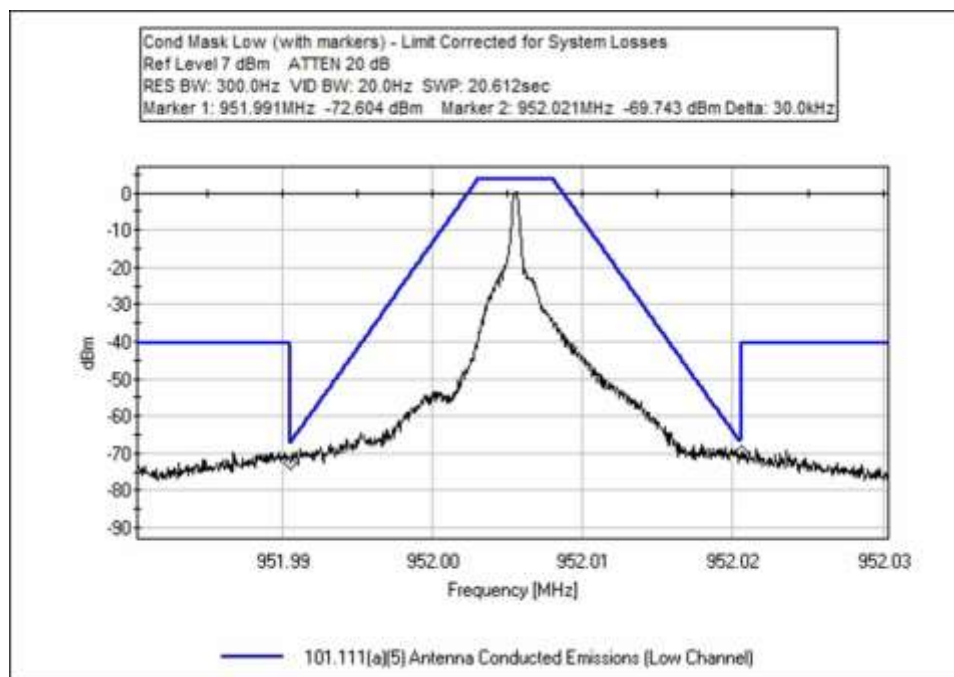
(ii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) of more than 6.25 KHz up to and including 9.5 KHz: At least $103 \log_{10} (fd/3.9)$ decibels;

(iii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) of more than 9.5 KHz up to and including 15 KHz: At least $157 \log_{10} (fd/5.3)$ decibels; and

(iv) On any frequency removed from the center of the authorized bandwidth by a displacement frequency greater than 15 KHz: At least 50 plus $10 \log_{10}(P)$ or 70 decibels, whichever is the lesser attenuation.
 $(50 + 10 \log_{10}(0.716W)) = 48.55$ (28.55dBm output power attenuated by 48.55dB = -20dBm +107= 87dBuV)

Frequency (MHz)	Measured (dBm)	Limit (dBm)	Margin (dB)	Results
951.991	-56.6	-20	-36.6	Pass
952.021	-52.2	-46.8	-5.4	Pass
959.835	-49.3	-46.8	-2.5	Pass
959.864	-56.4	-51.8	-4.6	Pass
1904.01	-55.6	-51.8	-3.8	Pass
1919.68	-48.9	-20	-28.9	Pass
2856.02	-50.5	-20	-30.5	Pass
2879.4	-45.2	-20	-25.2	Pass
6663.64	-46.6	-20	-26.6	Pass
6718.75	-46.3	-20	-26.3	Pass

Plots



Test Setup Photo



2.1053 / 101.111 Emissions Limitations - Radiated

Test Setup/Conditions			
Test Location:	Bothell Lab C3	Test Engineer:	M. Atkinson
Test Method:	FCC CFR 47 Part 101.111, TIA-603E	Test Date(s):	1/29/2019
Configuration:	1		
Test Setup:	Frequency Range: 952-959.85MHz Frequency tested: 9kHz-10GHz Firmware power setting: Max Power Protocol /MCS/Modulation: OOK Duty Cycle: 100% (Test Mode) Test Mode: Continuously transmitting Test Setup: EUT is transmitting with antenna port terminated. Multiple modulation tones investigated, only worst case reported. Low and High channel investigated, only worst case reported. X, Y, Z EUT axes investigated, only worst case reported. Below 30MHz there were 3 orthogonal measurement antenna axes investigated, worst case reported. Above 30MHz Horizontal and Vertical measurement antenna polarities investigated, worst case reported.		

Environmental Conditions			
Temperature (°C)	20-22	Relative Humidity (%):	25-30

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02673	Spectrum Analyzer	Agilent	E4446A	2/3/2017	2/3/2019
P06540	Cable	Andrews	Heliac	10/30/2017	10/30/2019
P06515	Cable	Andrews	Heliac	6/29/2018	6/29/2020
03540	Preamp	HP	83017A	5/2/2017	5/2/2019
P06503	Cable	Astrolab	32026-29801-29801-36	3/13/2018	3/13/2020
01467	Horn Antenna	EMCO	3115	7/21/2017	7/21/2019
00052	Loop Antenna	EMCO	6502	5/7/2018	5/7/2020
P05305	Cable	Andrews	ETSI-50T	10/24/2017	10/24/2019
02307	Preamp	HP	8447D	1/15/2018	1/15/2020
P05360	Cable	Belden	RG214	1/31/2018	1/31/2020
P06123	Attenuator	Aeroflex	18N-6	5/5/2017	5/5/2019
03628	Biconilog Antenna	ETS	3142E	6/7/2017	6/7/2019

Test Data Summary

Limit applied: Part 101.111 (a) (5)

(i) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) of more than 2.5 KHz up to and including 6.25 KHz: At least 53 log10 (fd/2.5) decibels;

(ii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) of more than 6.25 KHz up to and including 9.5 KHz: At least 103 log10 (fd/3.9) decibels;

(iii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) of more than 9.5 KHz up to and including 15 KHz: At least 157 log10 (fd/5.3) decibels; and

(iv) On any frequency removed from the center of the authorized bandwidth by a displacement frequency greater than 15 KHz: At least 50 plus 10 log10(P) or 70 decibels, whichever is the lesser attenuation.
(50+10log10(0.716W) = 48.55) (28.55dBm output power attenuated by 48.55dB = -20dBm)

Conversion to EIRP limit (dBuV/m at 3m):

$$E(dBuV/m) = P(dBm) - 20LOG(d) + G + 104.77$$

Note: The limit and measurements were recorded and corrected for dBuV/m at 3m using correction factors based on known measurement system losses.

Frequency (MHz)	Measured (dBuV/m at 3m)	Limit (dBuV/m at 3m)	Margin (dB)	Results
27.07	37.2	75.2	-38.0	Pass
46.5	41.8	75.2	-33.4	Pass
59.82	41.7	75.2	-33.5	Pass
60.1	47.1	75.2	-28.1	Pass
126.925	37.9	75.2	-37.3	Pass
131.8	46.6	75.2	-28.6	Pass
153.2	42.6	75.2	-32.6	Pass
223	46.5	75.2	-28.7	Pass
308.4	46.5	75.2	-28.7	Pass
1919.76	49.2	75.2	-26.0	Pass
4760.033	51.3	75.2	-23.9	Pass
6664.02	65.3	75.2	-9.9	Pass
6716.5	65.4	75.2	-9.8	Pass

Test Setup Photo(s)



Below 1GHz



Above 1GHz



X Axis



Y Axis



Z Axis