

Itron, Inc.

REVISED EMC TEST REPORT TO 102014-2

AMR Transceiver Device For Communicating With Utility Meters Model: IMRB

Tested To The Following Standards:

FCC Part 101 Subpart C

Report No.: 102014-2A

Date of issue: May 30, 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:

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

REPRESENTATIVE: Jay Holcomb
Customer Reference Number: 165609

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: 99513

December 12, 2018

December 12-17, 2018

Revision History

Original: Testing of the AMR Transceiver Device For Communicating With Utility Meters, Model: IMRB to FCC Part 101 Subpart C.

Revision A: To correct the model reference on the Title page to IMRB from a misspelled IMRA. Replaced plots in Section 2.1049 / 101.109 Bandwidth.

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.



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	5.03.02
EMITest Immunity	5.03.02

Site Registration & Accreditation Information

Location	NIST CB #	TAIWAN	CANADA	FCC	JAPAN
Canyon Park Bothell, WA	US0081	SL2-IN-E-1145R	3082C-1	US1022	A-0148

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

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 3

Equipment Tested:

Device	Manufacturer	Model #	S/N
AMR transceiver device for communicating with utility meters	Itron, Inc.	IMRB	IMR003024

Support Equipment:

Device	Manufacturer	Model #	S/N
Laptop	Dell	E6410	46TXXN1
AC Adapter for Laptop	Dell	DA130PE1-00	NA
AC Adapter	DVE	DV-51AR	NA

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Modulation Type(s):	OOK
Antenna Type(s) and Gain:	Internal PIFA 2.0dB
Antenna Connection Type:	Integral (External connector provided to facilitate testing)
Nominal Input Voltage:	120VAC, 60Hz
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

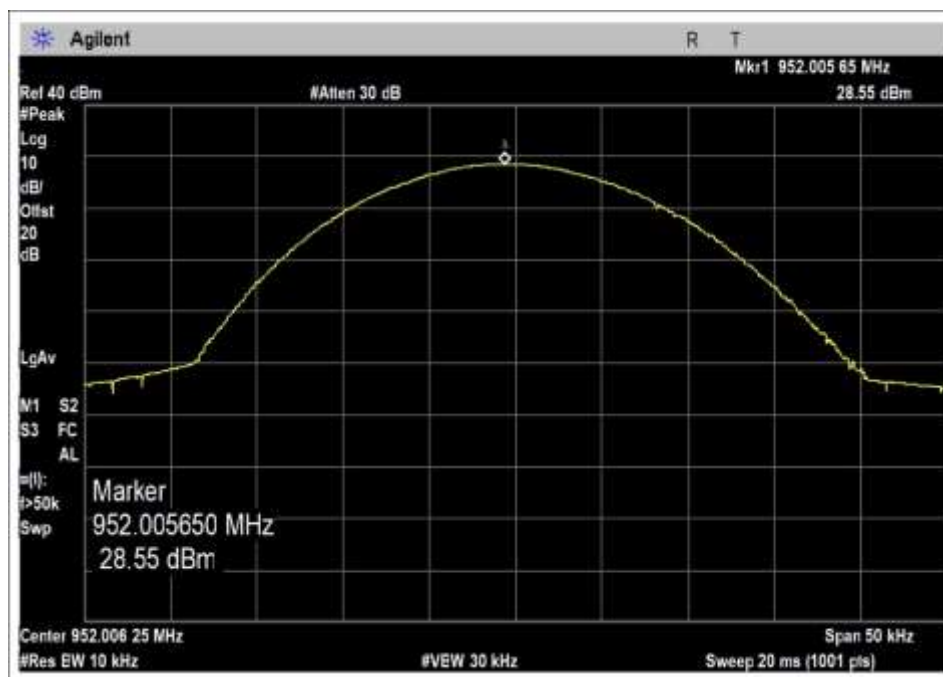
Test Setup/Conditions			
Test Location:	Bothell Lab C3	Test Engineer:	M. Harrison / S. Pittsford
Test Method:	FCC CFR 47 Part 101.113, TIA-603E	Test Date(s):	12/14/2018
Configuration:	3		
Test Setup:	Frequency Range: 952-959.85MHz Frequency tested: 952.006, 959.99MHz Firmware power setting: Max Power EUT Firmware: 5.71 Protocol /MCS/Modulation: OOK Antenna type: Internal PIFA Antenna Gain: 2.0 dBi Duty Cycle: 100% (Test Mode) Test Mode: Continuously transmitting Test Setup: EUT is transmitting through a temporary antenna connector and is attached directly to the spectrum analyzer. Multiple modulation tones investigated, only worst case reported. Modifications Added: None		

Environmental Conditions			
Temperature (°C)	20-22	Relative Humidity (%):	30-36

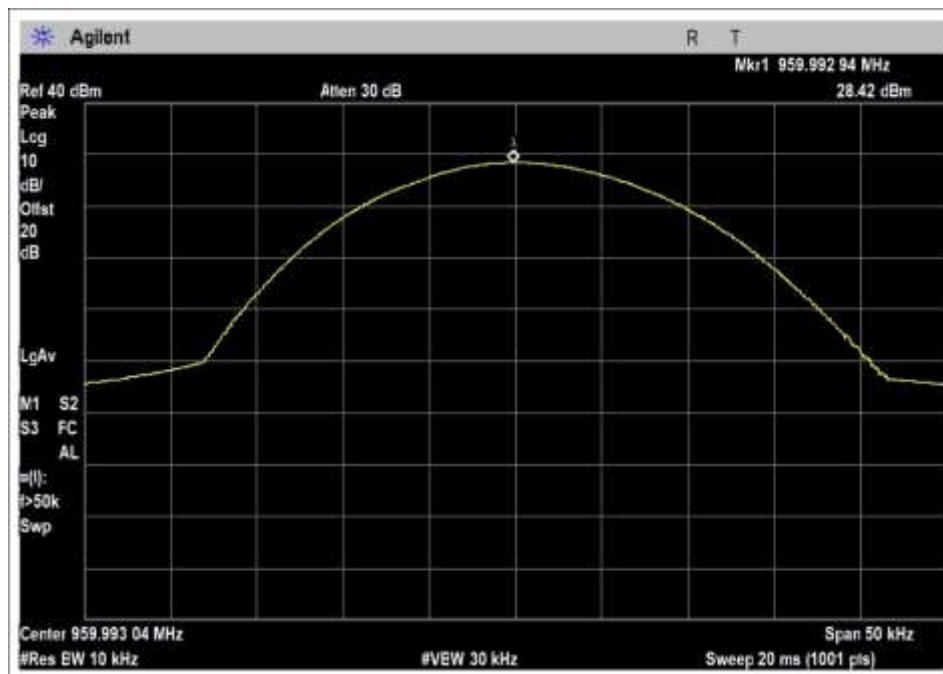
Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02673	Spectrum Analyzer	Agilent	E4446A	2/3/2017	2/3/2019
P07228	Attenuator	Pasternack	PE7004-20	11/30/2017	11/30/2019

Test Data Summary				
Frequency (MHz)	Measured Power (dBm)	Power Watts	Limit Watts	Results
952.006	28.55	0.716	25	Pass
959.99	28.42	0.695	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. Harrison / S. Pittsford
Test Method:	FCC CFR 47 Part 101.107, TIA-603E	Test Date(s):	12/17/2018
Configuration:	2		
Test Setup:	Frequency Range: 952-959.85MHz Frequency tested: 952.00625, 959.99375MHz Firmware power setting: Max Power EUT Firmware: 5.71 Protocol /MCS/Modulation: OOK Antenna type: Internal PIFA Antenna Gain: 2.0 dBi Duty Cycle: 100% (Test Mode) Test Mode: Continuously transmitting Test Setup: EUT is inside temperature chamber transmitting through a temporary antenna connector and is attached directly to the spectrum analyzer. Modifications Added: None		

Environmental Conditions			
Temperature (°C)	20	Relative Humidity (%):	31

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02757	Temperature Chamber	Bemco	F100/350-8	1/2/2017	1/2/2019
02673	Spectrum Analyzer	Agilent	E4446A	2/3/2017	2/3/2019
P07228	Attenuator	Pasternack	PE7004-20	11/30/2017	11/30/2019
P07527	Variac	Simpson	NA	11/21/2018	11/21/2020
P06008	Cable	Andrew	Heliac	4/10/2018	4/10/2020
03029	Thermometer, Digital Infrared	Fluke	566	1/12/2017	1/12/2019

Test Data Summary					
Temperature (°C)	Voltage	Frequency (MHz)	Frequency Tolerance (%)	Limit (%)	Results
-30	V _{Nominal}	952.00557	0.00007	0.0005	Pass
-20	V _{Nominal}	952.00554	0.00008	0.0005	
-10	V _{Nominal}	952.00561	0.00007	0.0005	
0	V _{Nominal}	952.00561	0.00007	0.0005	
10	V _{Nominal}	952.00558	0.00007	0.0005	
20	V _{Minimum}	952.00546	0.00008	0.0005	
20	V _{Nominal}	952.00551	0.00008	0.0005	
20	V _{Maximum}	952.00546	0.00008	0.0005	
30	V _{Nominal}	952.00548	0.00008	0.0005	
40	V _{Nominal}	952.00559	0.00007	0.0005	
50	V _{Nominal}	952.00561	0.00007	0.0005	
Nominal Frequency:		952.00625			

Test Data Summary					
Temperature (°C)	Voltage	Frequency (MHz)	Frequency Tolerance (%)	Limit (%)	Results
-30	V _{Nominal}	959.99302	0.00008	0.0005	Pass
-20	V _{Nominal}	959.99289	0.00009	0.0005	
-10	V _{Nominal}	959.99303	0.00008	0.0005	
0	V _{Nominal}	959.99311	0.00007	0.0005	
10	V _{Nominal}	959.99308	0.00007	0.0005	
20	V _{Minimum}	959.99293	0.00009	0.0005	
20	V _{Nominal}	959.99293	0.00009	0.0005	
20	V _{Maximum}	959.99293	0.00009	0.0005	
30	V _{Nominal}	959.99300	0.00008	0.0005	
40	V _{Nominal}	959.99308	0.00007	0.0005	
50	V _{Nominal}	959.99311	0.00007	0.0005	
Nominal Frequency:		952.99375			

Parameter Definitions:

Measurements performed at input voltage V_{Nominal} ± 15%.

Parameter	Value
V _{Nominal} :	120VAC
V _{Minimum} :	102VAC
V _{Maximum} :	138VAC

Test Setup Photos



Inside Temperature Chamber



Outside Temperature Chamber

2.1049 / 101.109 Bandwidth

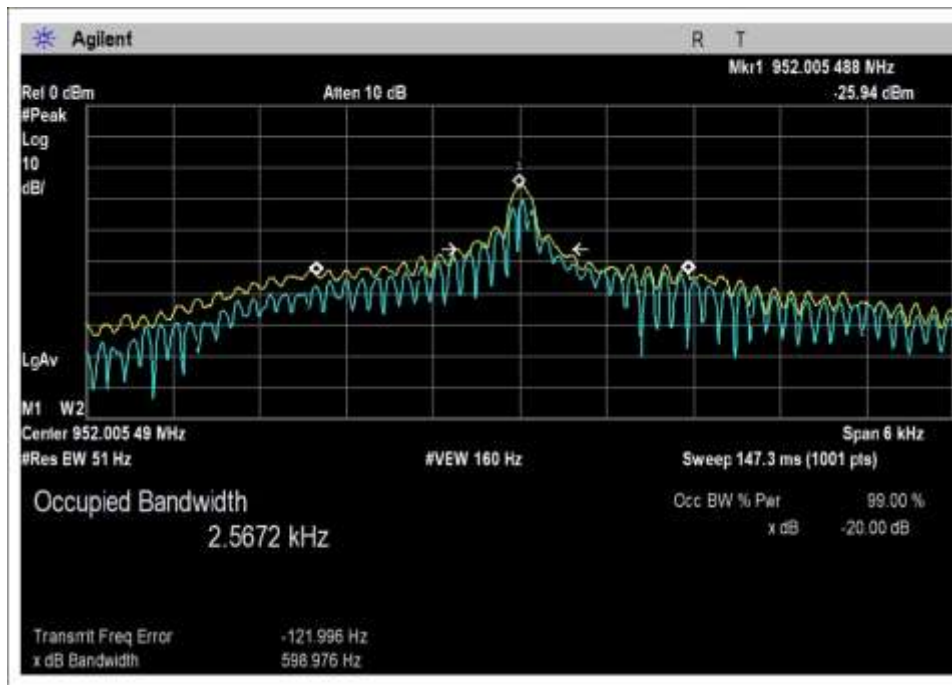
Test Setup/Conditions			
Test Location:	Bothell Lab C3	Test Engineer:	M. Harrison / S. Pittsford
Test Method:	FCC CFR 47 Part 101.109, TIA-603E	Test Date(s):	12/12/2018
Configuration:	3		
Test Setup:	Frequency Range: 952-959.85MHz Frequency tested: 952.006, 959.993MHz Firmware power setting: Max Power EUT Firmware: 5.71 Protocol /MCS/Modulation: OOK Antenna type: Internal PIFA Antenna Gain: 2.0 dBi Duty Cycle: 100% (Test Mode) Test Mode: Continuously transmitting Test Setup: EUT is transmitting through a temporary antenna connector and is attached directly to the spectrum analyzer. Multiple modulation tones investigated, only worst case reported. Modifications Added: None		

Environmental Conditions			
Temperature (°C)	20-22	Relative Humidity (%):	30-36

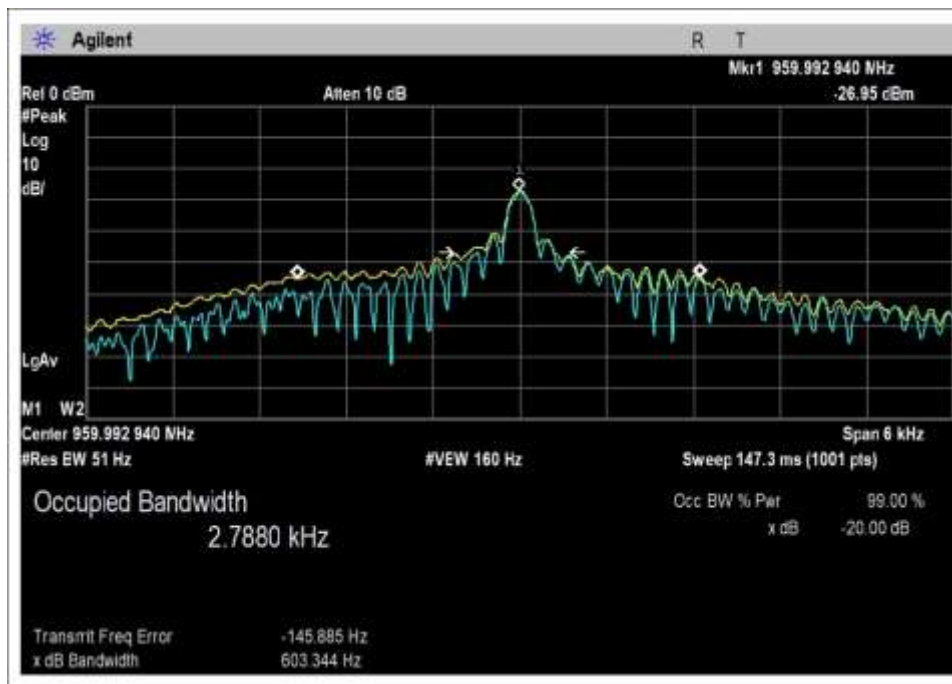
Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02673	Spectrum Analyzer	Agilent	E4446A	2/3/2017	2/3/2019
P07228	Attenuator	Pasternack	PE7004-20	11/30/2017	11/30/2019

Test Data Summary				
Frequency (MHz)	Modulation	Measured (kHz)	Limit (kHz)	Results
952.006	OOK	2.5672	<12.5	Pass
959.99	OOK	2.7880	<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. Harrison / S. Pittsford
Test Method:	FCC CFR 47 Part 101.111, TIA-603E	Test Date(s):	12/14/2018
Configuration:	3		
Test Setup:	Frequency Range: 952-959.85MHz Frequency tested: 9kHz-10GHz Firmware power setting: Max Power EUT Firmware: 5.71 Protocol /MCS/Modulation: OOK Antenna type: Internal PIFA Antenna Gain: 2.0 dBi Duty Cycle: 100% (Test Mode) Test Mode: Continuously transmitting Test Setup: EUT is transmitting through a temporary antenna connector and is attached directly to the spectrum analyzer. Multiple modulation tones investigated, only worst case reported. Modifications Added: None		

Environmental Conditions			
Temperature (°C)	20-22	Relative Humidity (%):	30-36

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02673	Spectrum Analyzer	Agilent	E4446A	2/3/2017	2/3/2019
P07228	Attenuator	Pasternack	PE7004-20	11/30/2017	11/30/2019

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 $53 \log_{10} (fd/2.5)$ 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;

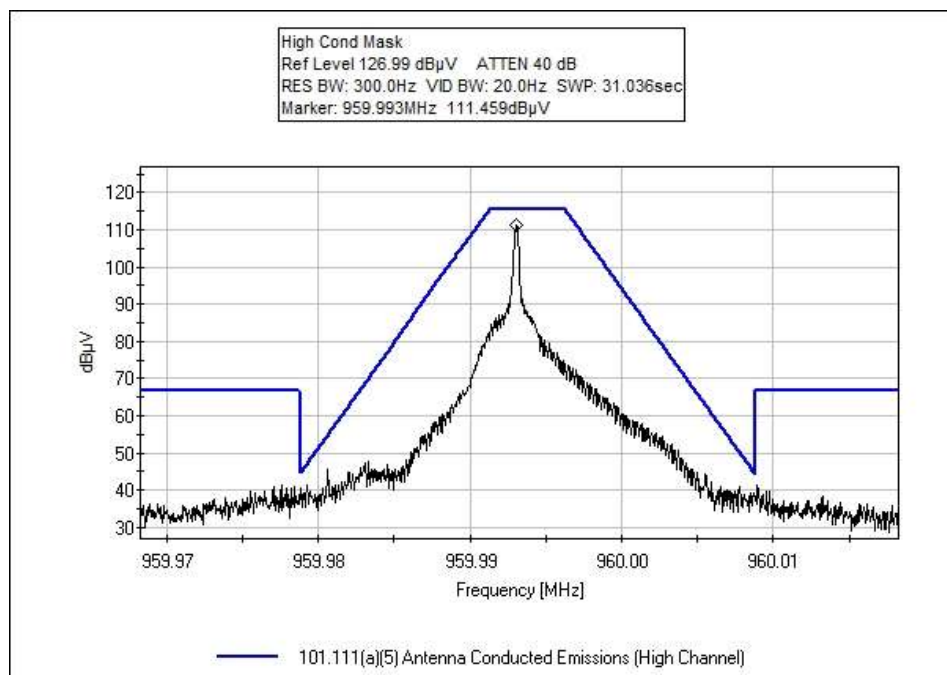
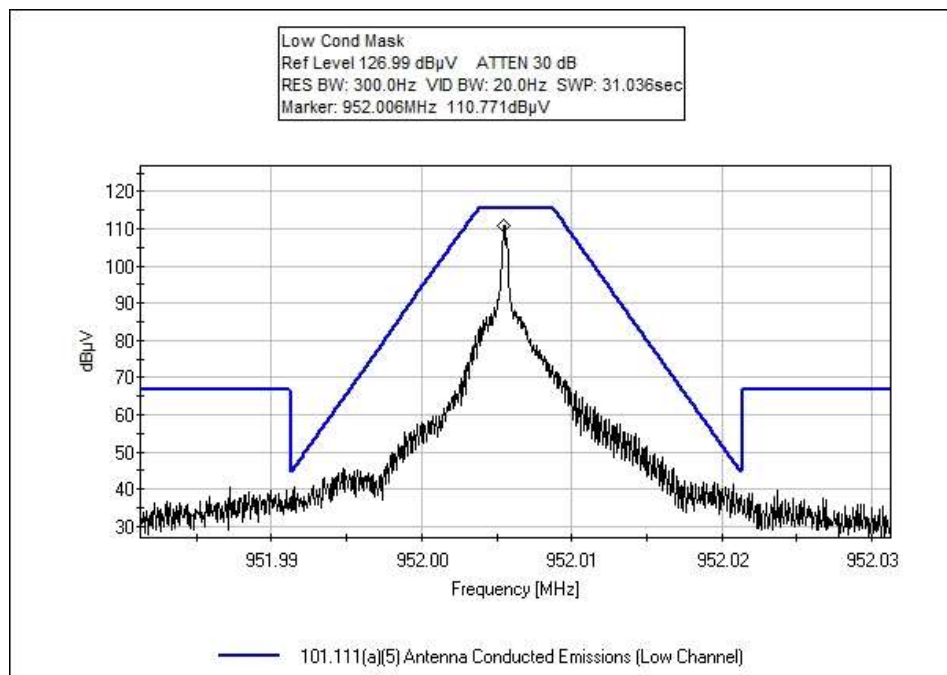
(iii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) of more than 9.5 KHz up to and including 15 KHz: At least $157 \log_{10} (fd/5.3)$ decibels; and

(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 (dBuV)	Limit (dBuV)	Margin (dB)	Results
1904.012	56.4	87	-30.6	Pass
1905	53.5	87	-33.5	Pass
2856.018	57.1	87	-29.9	Pass
2857.5	57.5	87	-29.5	Pass
3808.024	56.5	87	-30.5	Pass
3810	52.7	87	-34.3	Pass
4760.03	51.9	87	-35.1	Pass
4762.475	53.4	87	-33.6	Pass
7616.598	60.9	87	-26.1	Pass
7622.03	61.0	87	-26.0	Pass

Plots



Test Setup Photo



2.1053 / 101.111 Emissions Limitations - Radiated

Test Setup/Conditions			
Test Location:	Bothell Lab C3	Test Engineer:	M. Harrison / S. Pittsford
Test Method:	FCC CFR 47 Part 101.111, TIA-603E	Test Date(s):	12/12/2018
Configuration:	3		
Test Setup:	Frequency Range: 952-959.85MHz Frequency tested: 9kHz-10GHz Firmware power setting: Max Power EUT Firmware: 5.71 Protocol /MCS/Modulation: OOK Antenna type: Internal PIFA Antenna Gain: 2.0 dBi Duty Cycle: 100% (Test Mode) Test Mode: Continuously transmitting Test Setup: EUT has temporary antenna connector and is connected to termination. Multiple modulation tones investigated, only worst case reported. Modifications Added: None		

Environmental Conditions			
Temperature (°C)	20-22	Relative Humidity (%):	30-36

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02307	Preamp	HP	8447D	1/15/2018	1/15/2020
P05305	Cable	Andrews	ETSI-50T	10/24/2017	10/24/2019
P05360	Cable	Belden	RG214	1/31/2018	1/31/2020
02673	Spectrum Analyzer	Agilent	E4446A	2/3/2017	2/3/2019
P06123	Attenuator	Aeroflex	18N-6	5/5/2017	5/5/2019
P06540	Cable	Andrews	Heliac	10/30/2017	10/30/2019
03628	Biconilog Antenna	ETS	3142E	6/7/2017	6/7/2019
01467	Horn Antenna	EMCO	3115	7/21/2017	7/21/2019
02611	High Pass Filter	TTE	HE9615-150K-50-720B	1/15/2018	1/15/2020
P06219	Attenuator	Narda	768-10	4/13/2018	4/13/2020
P06503	Cable	Astrolab	32026-29801-29801-36	3/13/2018	3/13/2020
P06515	Cable	Andrews	Heliac	6/29/2018	6/29/2020
03540	Preamp	HP	83017A	5/2/2017	5/2/2019
00052	Loop Antenna	EMCO	6502	5/7/2018	5/7/2020

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 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)

$$EIRP\left(\frac{dBuV}{m}\right) = P(dBm) - 20LOG(d) + 104.77 = -20dBm - 20LOG(3) + 104.77 = \frac{75.2dBuV}{m} @ 3 meters$$

Where d is distance in meters.

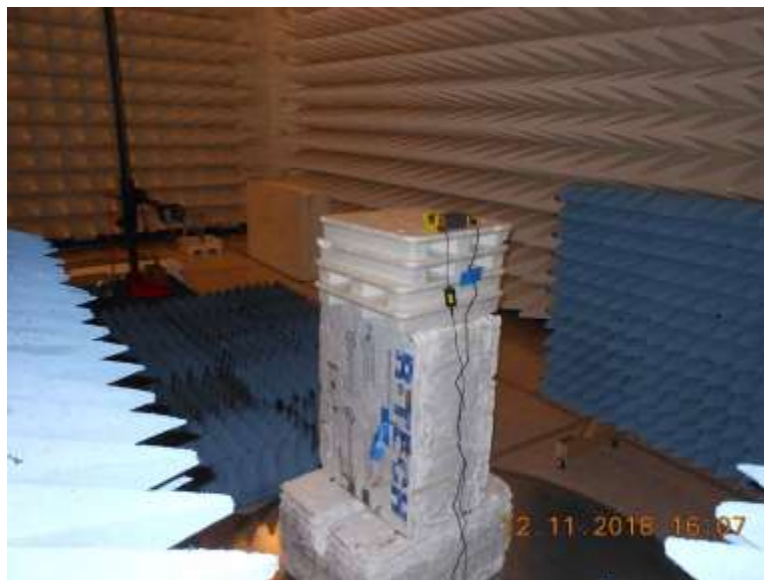
Note: The limit and measurements were recorded and corrected for dBμV/m at 3m using correction factors based on known measurement system losses.

Frequency (MHz)	Measured (dBμV/m at 3m)	Limit (dBμV/m at 3m)	Margin (dB)	Results
28.448	39.2	75.2	-36	Pass
34.495	44.7	75.2	-30.5	Pass
35.945	43.9	75.2	-31.3	Pass
47.835	43.1	75.2	-32.1	Pass
60.015	42.9	75.2	-32.3	Pass
72.195	40	75.2	-35.2	Pass
162.53	32	75.2	-43.2	Pass
1904.2	57.2	75.2	-18	Pass
1919.92	57.3	75.2	-17.9	Pass
2855.94	54	75.2	-21.2	Pass
2880.03	54.2	75.2	-21	Pass
3808.92	53	75.2	-22.2	Pass
3839.71	51	75.2	-24.2	Pass
4760.92	51.2	75.2	-24	Pass
4799.7	52.2	75.2	-23	Pass
5712.93	54.6	75.2	-20.6	Pass
5759.69	56.7	75.2	-18.5	Pass
6664.93	56.9	75.2	-18.3	Pass
6720.25	60.8	75.2	-14.4	Pass
7616.93	58.7	75.2	-16.5	Pass
7680.24	58.6	75.2	-16.6	Pass
8568.77	60.4	75.2	-14.8	Pass
8640.23	58.8	75.2	-16.4	Pass
9520.77	59.5	75.2	-15.7	Pass
9600.22	59.8	75.2	-15.4	Pass

Test Setup Photo(s)



Below 1GHz



Above 1GHz



X Axis



Y Axis



Z Axis