Compliance Testing, LLC
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Test Report

Prepared for: Garmin International, Inc.

Model: A03547

Description: Short Range Transceiver

Serial Numbers: 3970647127b and 3970647198b

FCC ID: IPH-03547

To

FCC Part 95
Subpart J

Date of Issue: July 23, 2018

On the behalf of the applicant:	**Garmin International, Inc.** **1200 E. 151st Street** **Olathe, KS 66062**
Attention of:	**William H. Pertner, Lead Compliance Engineer** **Ph: (913) 440-5471** **Email: bill.pertner@garmin.com**

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Project No: p1850022

Kenneth Lee
Project Test Engineer

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All results contained herein relate only to the sample tested.

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	May 31, 2018	Kenneth Lee	Original Document
2.0	July 17, 2018	Kenneth Lee	Added attenuator is setup diagram on page 17, added Mask titles to mask plots.
3.0	July 20, 2018	Kenneth Lee	Removed 20 dB from Occupied Bandwidth Section, corrected typo on page 17 stating two spectrum Analyzers were used, this was updated to an Attenuator.

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ILAC / A2LA

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to the joint ISO-ILAC-IAF Communiqué dated January 2009).

The tests results contained within this test report all fall within our scope of accreditation, unless noted below.

Please refer to http://www.compliancetesting.com/labscope.html for current scope of accreditation.

Testing Certificate Number: **2152.01**

FCC Site Reg. #349717

IC Site Reg. #2044A-2

Non-accredited tests contained in this report:

N/A

The Applicant has been cautioned as to the following:

15.21: **Information to the User**

The user's manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

15.27(a): **Special Accessories**

Equipment marketed to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer, without an additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.

Test and Measurement Data

All tests and measurement data shown were performed in accordance with FCC Rules and Regulations, Volume II, Part 2, Subpart J, Sections 2.947, 2.1033(c), 2.1041, 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, and the following individual Parts: FCC Part 95.

Standard Test Conditions and Engineering Practices

Except as noted herein, the following conditions and procedures were observed during the testing.

In accordance with ANSI/TIA 603C, and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F) unless the particular equipment requirements specified testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Environmental Conditions		
Temp (ºC)	**Humidity (%)**	**Pressure (mbar)**
17-28	24-36	942-989

Measurement results, unless otherwise noted, are worst-case measurements.

EUT Description
Model: A03547
Description: Short Range Transceiver
Firmware: Main = v0.94, GPS = v2.10, Sensor Hub = v0.3
Software: Main = v0.94, GPS = v2.10, Sensor Hub = v0.3
Serial Numbers: 3970647127b and 3970647198b
Additional Information:
The battery voltage of the device is 3.7 VDC. The spurious emissions testing was performed using a CW signal.

EUT Operation during Tests
The EUT was set to transmit at the low, middle and highest channel of operation at the maximum available output power.

Accessories:

Qty	Description	Manufacturer	Model	S/N
1	Switching Power Supply	GARMIN	PSAA10R-050	N/A

Cables: None

Modifications: None

Test Result Summary

Specification	Test Name	Pass, Fail, N/A	Comments
2.1046 95.2767	Carrier Output Power	Pass	
95.2773 (b) (2)	Occupied Bandwidth	Pass	
2.1053	Field Strength of Spurious Radiation	Pass	
95.2765 2.1055	Frequency Stability (Temperature Variation)	Pass	
95.2765 2.1055	Frequency Stability (Voltage Variation)	Pass	
95.2779 (a) (b) 2.1051	Unwanted Emissions	Pass	

Carrier Output Power

Engineer: Kenneth Lee

Test Date: 5/24/2018

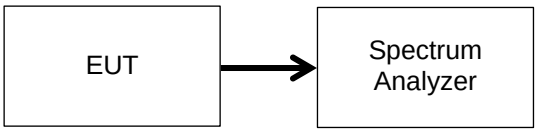
Measurement Procedure

The EUT was connected directly to a spectrum analyzer. The Spectrum Analyzer was set to the following:

RBW = 100 kHz
VBW ≥ 3 x RBW
Span ≥ 3 x RBW
Sweep time = auto couple
Detector = peak
Trace Mode = max hold

The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. The output power was measured using the spectrum analyzer's marker peak function

Test Setup



Output Power Results

Tuned Frequency (MHz)	Recorded Measurement (dBm)	Recorded Measurement (W)	Limit (W)	Result
151.82	32.85	1.93	2	Pass
151.94	32.91	1.95	2	Pass
154.6	32.97	1.98	2	Pass

Field Strength of Spurious Radiation

Engineer: Kenneth Lee

Test Date: 5/24/2018

Test Procedure

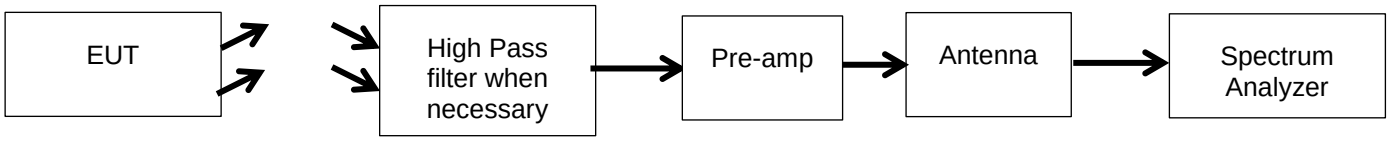
The Equipment under Test (EUT) was located in anechoic chamber at 3 meters away from receive antenna and was rotated through 360 degrees and the receive antenna height was varied from 1m to 4m so that maximum radiated emission level was captured. The output of the EUT was connected to a non-radiating load.

The following formula was used for calculating the limits:

Radiated Spurious Emissions Limit = P1 – (50+ 10Log(P2)) = -20dBm
P1 = power in dBm
P2 = power in Watts

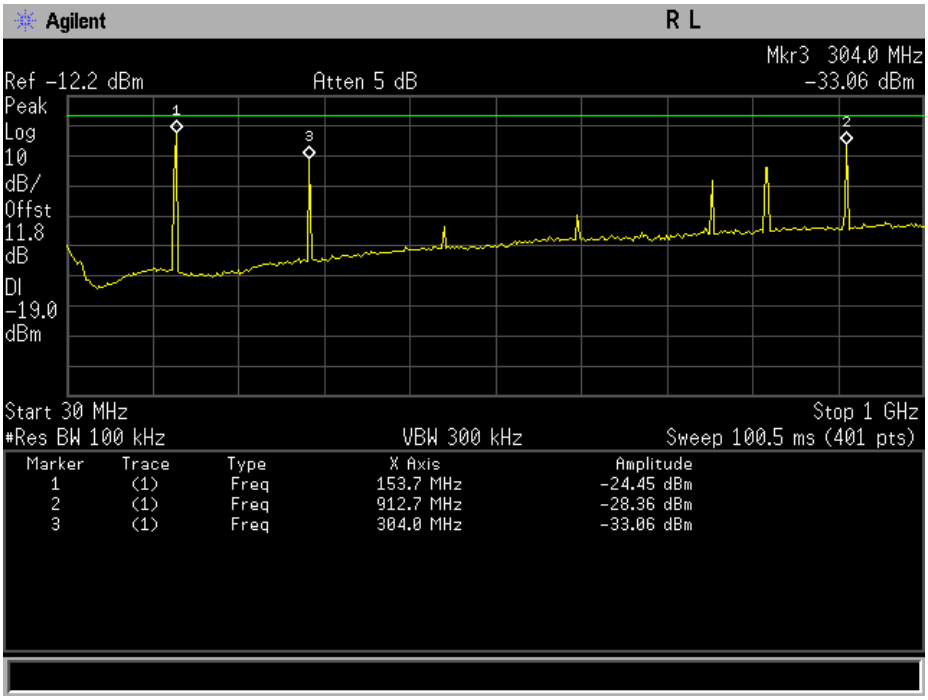
Cable, antenna and pre-amp factors were all included in the spectrum analyzer as correction factors.

Test Setup

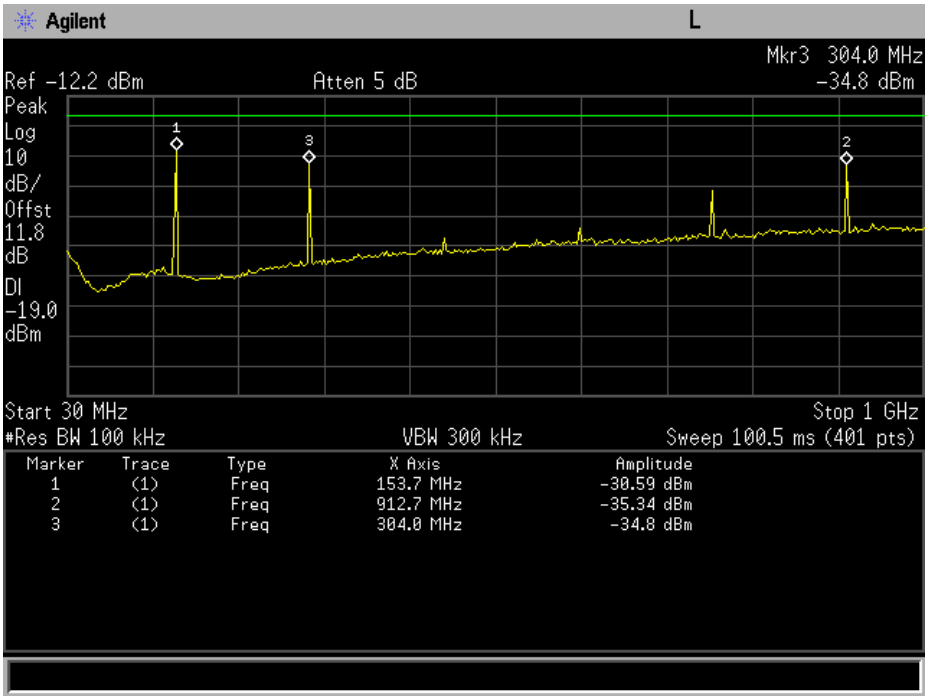


Test Results

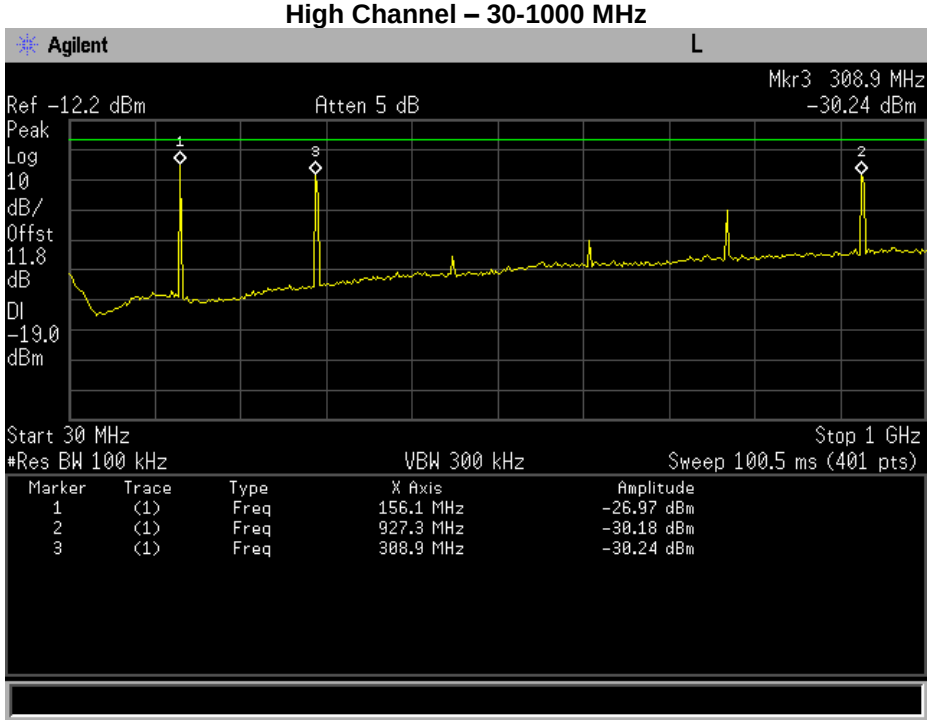
Low Channel – 30-1000 MHz



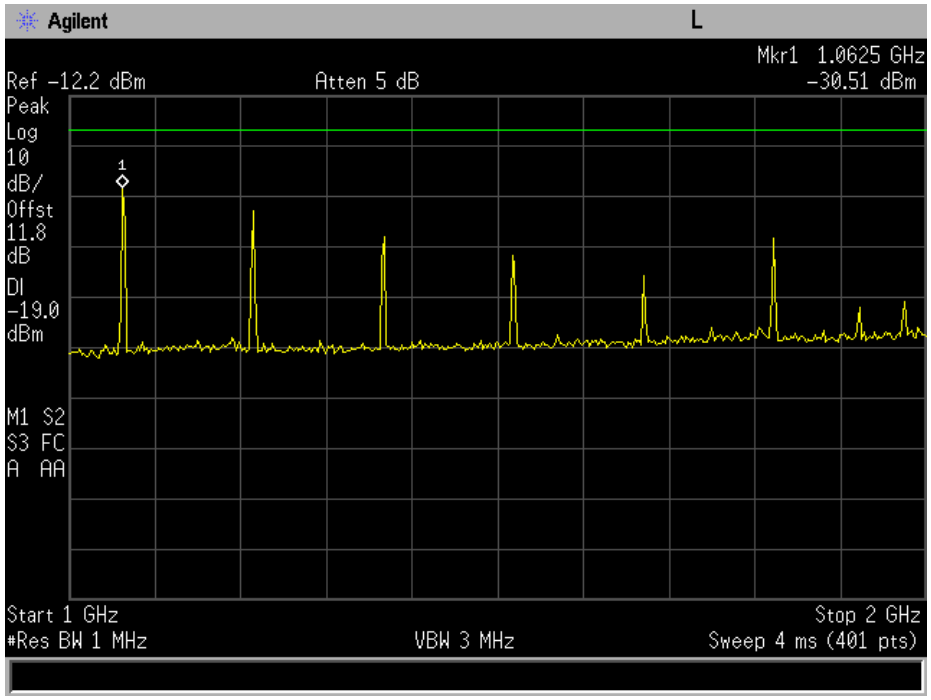
Mid Channel – 30-1000 MHz



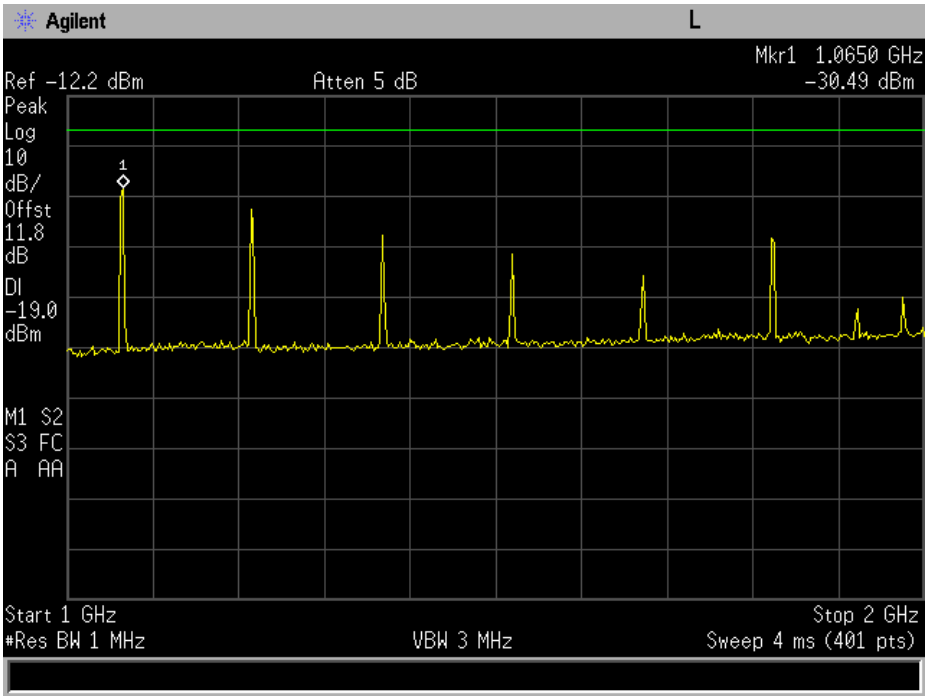
High Channel – 30-1000 MHz



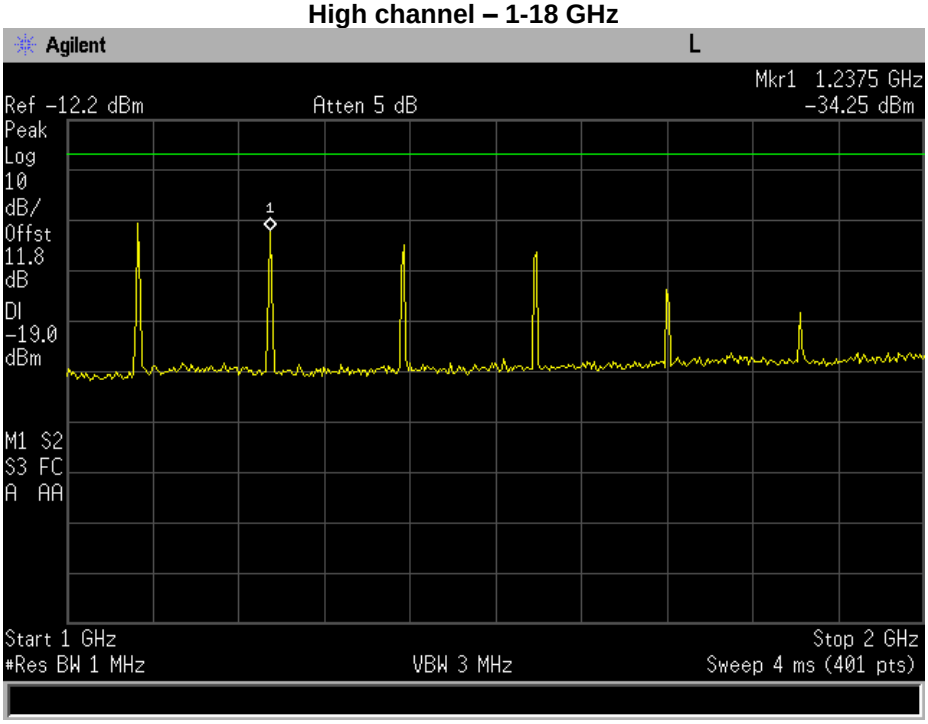
Low Channel – 1-18 GHz



Mid Channel – 1-18 GHz



High channel – 1-18 GHz



Radiated Spurious Emissions Worst Case Results

151.82 MHz

Measured Frequency (MHz)	Measured Value (dBm)	Limit (dBm)
304	-33.06	-20
912.7	-28.36	-20
1062.5	-30.51	-20

151.94 MHz

Measured Frequency (MHz)	Measured Value (dBm)	Limit (dBm)
304.8	-34.8	-20
912.7	-35.34	-20
1065	-30.49	-20

154.6 MHz

Measured Frequency (MHz)	Measured Value (dBm)	Limit (dBm)
308.9	-30.24	-13
927.3	-30.18	-13
1237.5	-34.25	-13

Occupied Bandwidth

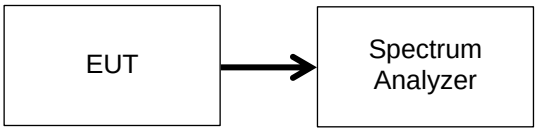
Engineer: Kenneth Lee

Test Date: 5/24/2018

The EUT was connected directly to a spectrum analyzer. The Span was set wide enough to capture the entire transmit spectrum and the resolution bandwidth was set to 1-5% of the span. The analyzer was set to max hold and when the entire spectrum was captured the 99% bandwidth was measured to verify the bandwidth met the specification.

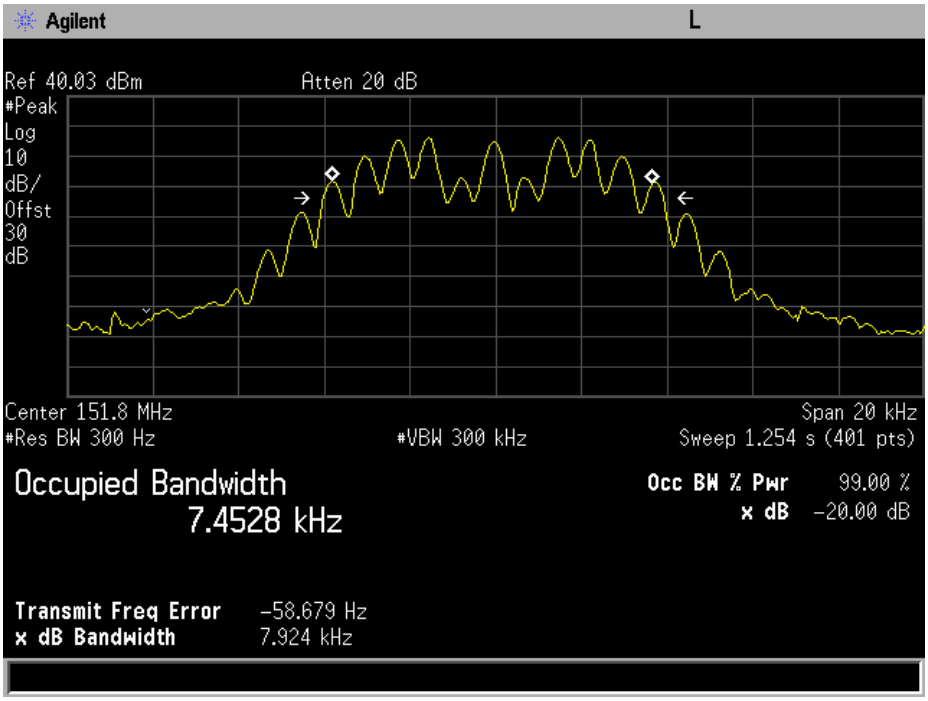
The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. The spectrum analyzer's automatic bandwidth capability was used.

Test Setup

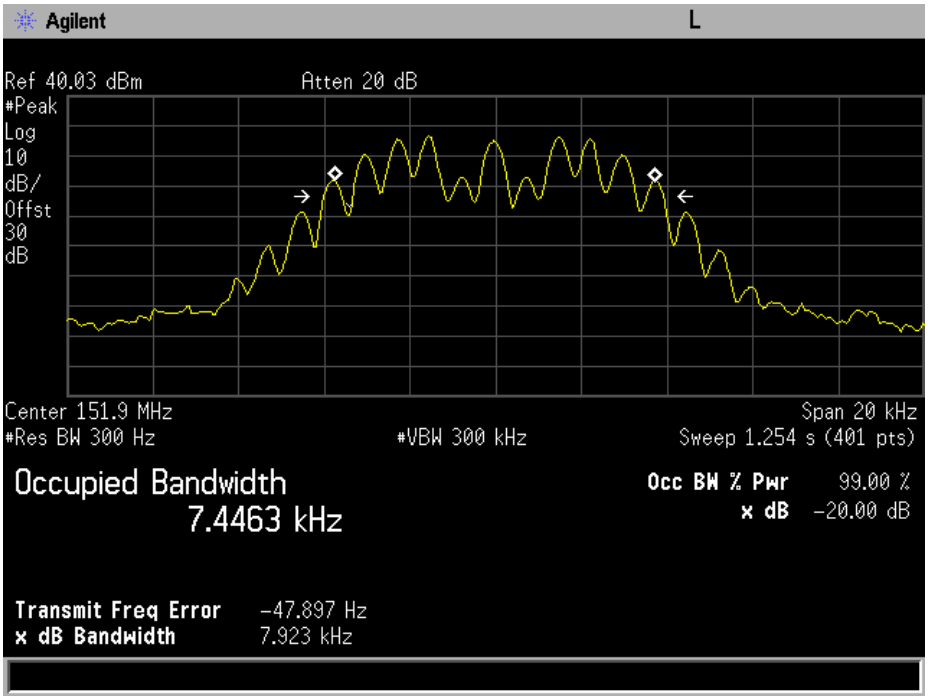


Occupied Bandwidth Plots

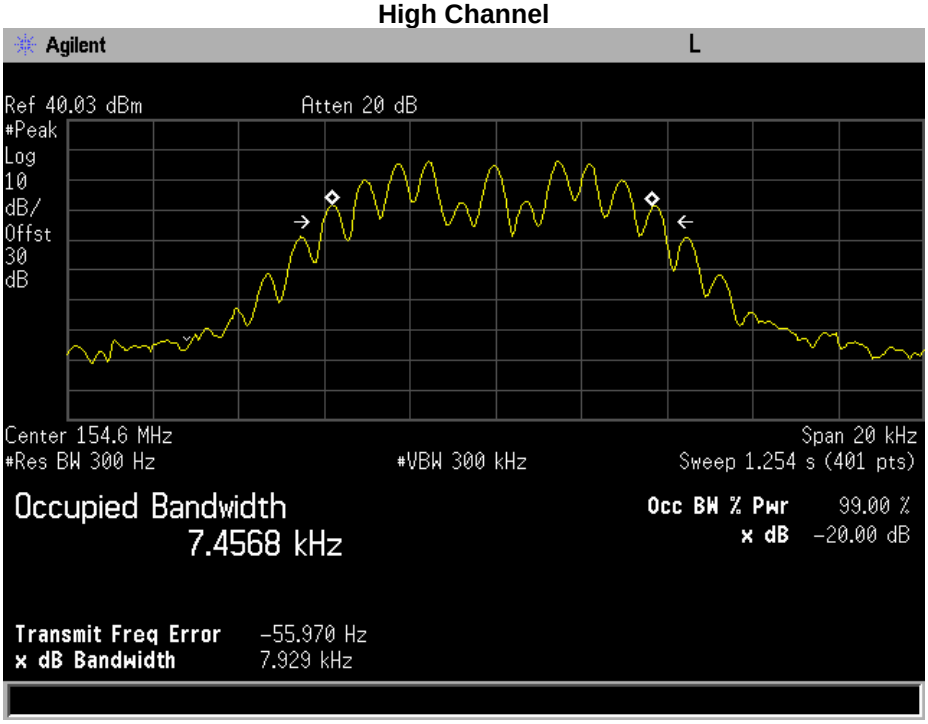
Low Channel



Mid Channel



High Channel



Frequency Stability (Temperature and Voltage Variation)

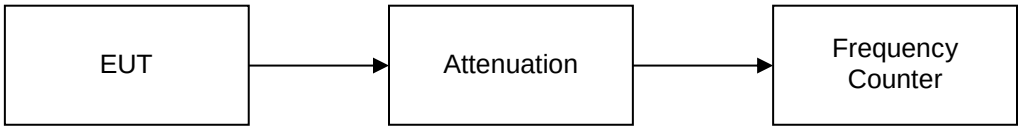
Engineer: Kenneth Lee

Test Date: 5/24/2018

Measurement Procedure

The EUT was placed in an environmental test chamber and the RF output was connected directly to a spectrum analyzer. The temperature was varied from -30°C to 50°C in 10°C increments. After a sufficient time for temperature stabilization the RF output frequency was measured. At 20°C the power supply voltage to the EUT was varied from 85% to 115% of the nominal value and the RF output was measured.

Measurement Setup



Measurement Results

Frequency Versus Temperature

Tuned Frequency (MHz)	Frequency Tolerance PPM	Upper Limit (MHz)	Lower Limit (MHz)	Temperature centigrade	Measured Frequency (MHz)	Upper Margin (MHz)	Lower Margin (MHz)
151.820	5.0	151.820759	151.819241				
		151.820759	151.819241	-30	151.819700	-0.001059	0.000459
		151.820759	151.819241	-20	151.819967	-0.000792	0.000726
		151.820759	151.819241	-10	151.819967	-0.000792	0.000726
		151.820759	151.819241	0	151.819958	-0.000801	0.000717
		151.820759	151.819241	10	151.819973	-0.000786	0.000732
		151.820759	151.819241	20	151.819975	-0.000784	0.000734
		151.820759	151.819241	30	151.819982	-0.000777	0.000741
		151.820759	151.819241	40	151.819981	-0.000778	0.000740
		151.820759	151.819241	50	151.819958	-0.000801	0.000717

Frequency Versus voltage

Tuned Frequency (MHz)	Frequency Tolerance PPM	Upper Limit (MHz)	Lower Limit (MHz)	Nominal Voltage	Voltage	Measured Frequency (MHz)	Upper Margin (MHz)	Lower Margin (MHz)
151.820	5.0	151.820759	151.819241	3.70	3.15	151.819975	-0.000784	0.000734
		151.820759	151.819241		3.70	151.820000	-0.000759	0.000759
		151.820759	151.819241		4.26	151.819975	-0.000784	0.000734

Unwanted Emissions

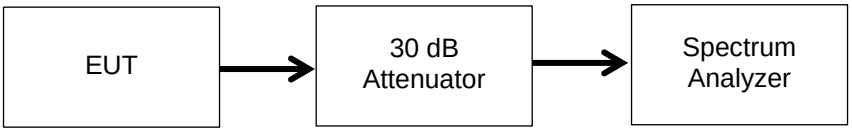
Engineer: Kenneth Lee

Test Date: 5/31/2018

Procedure for Conducted Spurious Emissions

The EUT was connected directly to a spectrum analyzer. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. The span of the spectrum analyzer was set to encompass the entire range of the EUT, up to at least the 10th harmonic. All Plots were taken using a 1 MHz RBW to ensure worst case emissions throughout the range.

Test Setup

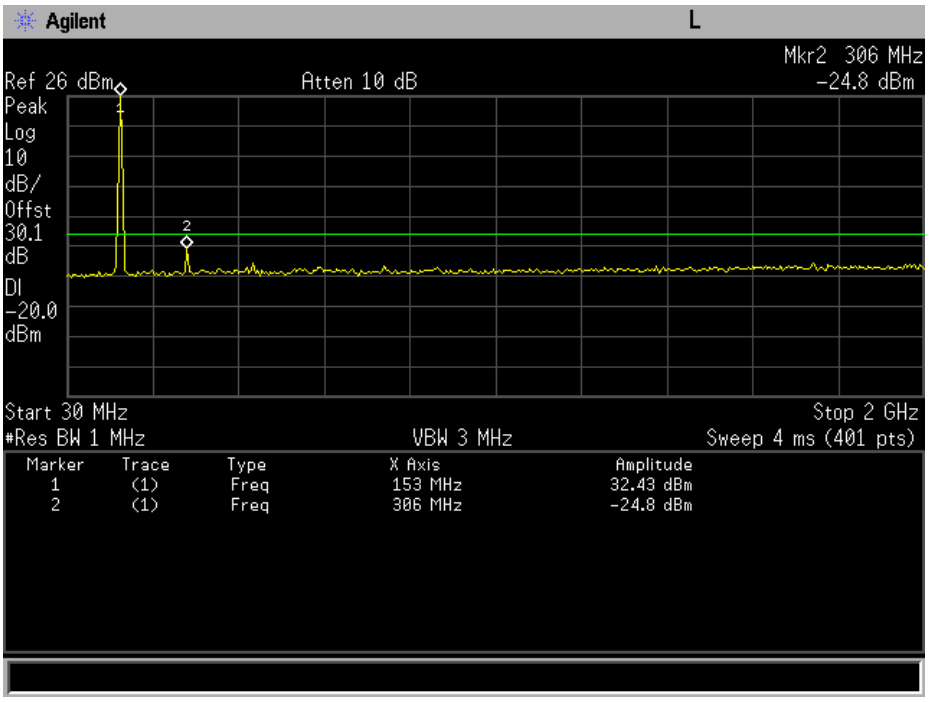


Procedure for Masks

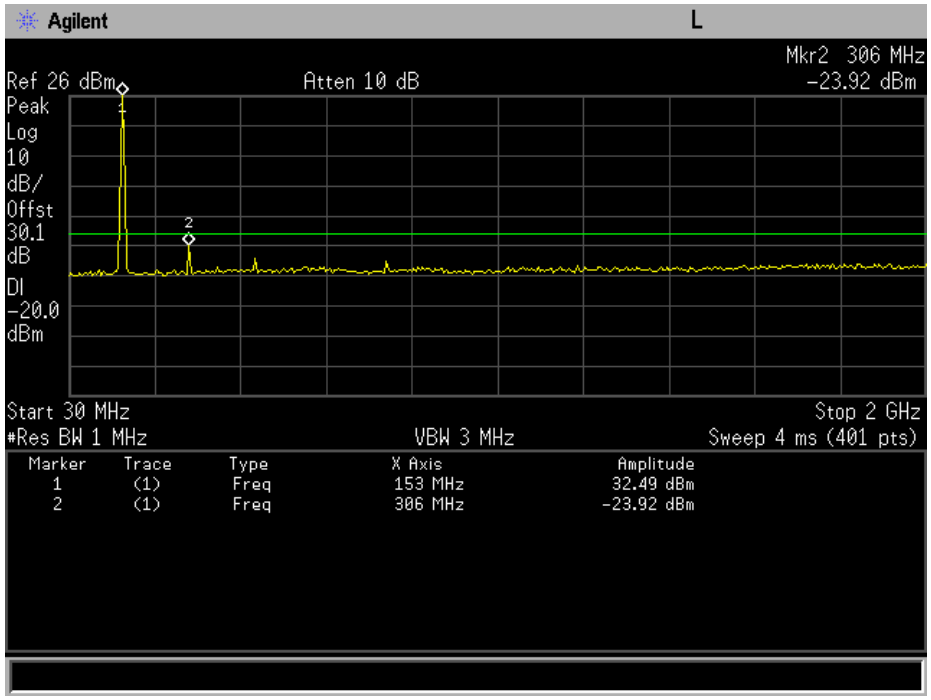
The EUT was connected directly to a spectrum analyzer. The EUT was set to transmit on the lowest, middle and highest frequencies at the maximum power level. The masks were all taken using a 300 Hz RBW, the outer points of the span were measure at 300 Hz, and a resolution correction was used to show compliance at 30 kHz RBW.

Conducted Spurious Emissions Plots

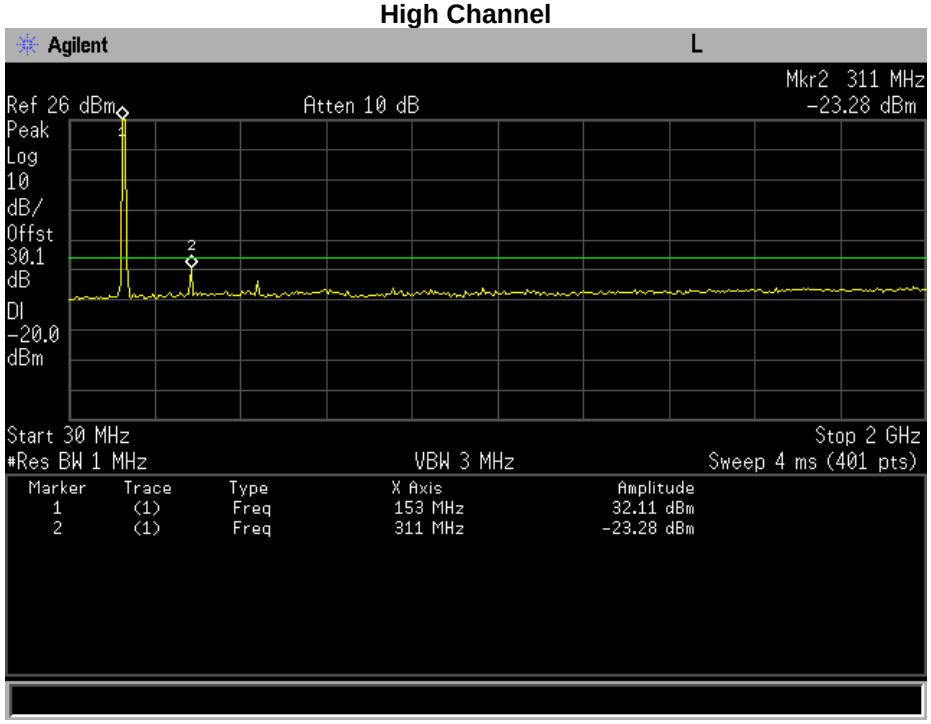
Low Channel



Middle Channel

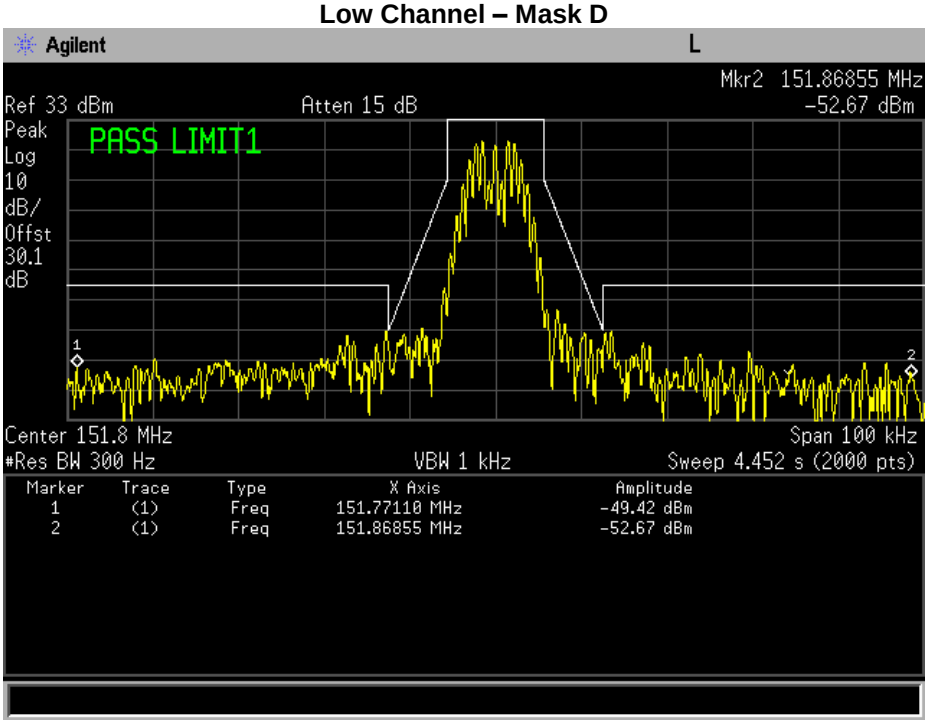


High Channel

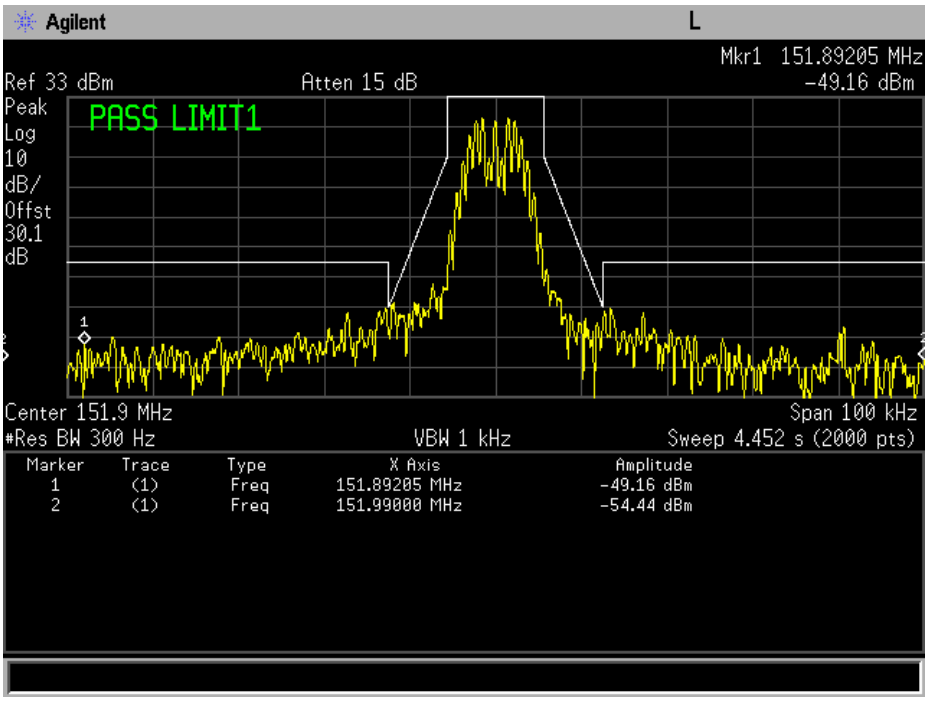


Mask Plots

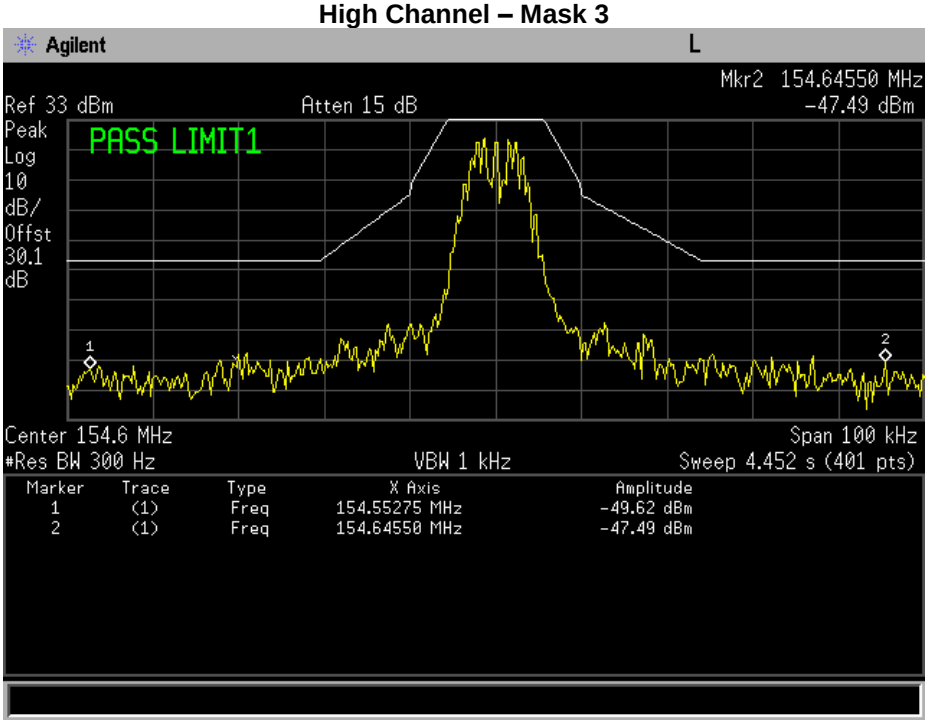
Low Channel – Mask D



Middle Channel – Mask D



High Channel – Mask 3



Resolution Bandwidth Correction per ANSI C63.26 Section 5.7.2
10 Log(30000/300) = 20

Low Channel

Frequency (MHz)	Measured Value (dBm)	Correction Factor (dB)	Corrected Value (dBm)	Limit (dBm)	Result
151.7711	-49.42	20	-29.42	-20	Pass
151.86855	-52.67	20	-32.67	-20	Pass

Middle Channel

Frequency (MHz)	Measured Value (dBm)	Correction Factor (dB)	Corrected Value (dBm)	Limit (dBm)	Result
151.89205	-49.16	20	-29.16	-20	Pass
151.99	-54.44	20	-34.44	-20	Pass

High Channel

Frequency (MHz)	Measured Value (dBm)	Correction Factor (dB)	Corrected Value (dBm)	Limit (dBm)	Result
154.55275	-49.62	20	-29.62	-20	Pass
154.6455	-47.49	20	-27.49	-20	Pass

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Horn Antenna	ARA	DRG-118/A	i00271	6/16/16	6/16/18
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	6/9/17	6/9/18
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	8/3/16	8/3/18
EMI Analyzer	Agilent	E7405A	i00379	2/13/18	2/13/19
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	8/15/16	8/15/19
Spectrum Analyzer	Agilent	E4407B	i00331	11/21/17	11/21/18
Preamplifier for 1-18GHz horn antenna	Miteq	AFS44 00101 400 23-10P-44	i00509	N/A	N/A

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT