NVLAP
Testing
NVLAP Lab Code 200087-0

ROGERS LABS, INC.
4405 West 259th Terrace
Louisburg, KS 66053
Phone / Fax (913) 837-3214

Test Report for FCC Part 80E and RSS-182 Application for Certification 156.025-162.025 MHz

Model: A02087
FCC ID: IPH-02087
IC: 1792A-02087B

Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062

Test Report Number: 180808
FCC Designation: US5305
IC Test Site Registration: 3041A-1

Authorized Signatory: Scot D Rogers
Scot D. Rogers

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Engineering Test Report for

Application for Grant of Certification

FOR

FCC Part 80E and
RSS-182 Issue 5

Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062

Model: A02087
Frequency Range 156.025-162.025 MHz

FCC ID: IPH-02087
IC: 1792A-02087B

Test Date: August 8, 2018

Certifying Engineer: Scot D Rogers

Scot D. Rogers
Rogers Labs, Inc.
4405 West 259th Terrace
Louisburg, KS 66053
Telephone/Facsimile: (913) 837-3214

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Revisions

Revision 2 report Issued August 23, 2018 – corrected type errors page 24 and Figure 1 page 25
Revision 1 report Issued August 21, 2018

Foreword

The following information is submitted for consideration in obtaining Equipment Grant of Certification for Automatic Identification Systems (AIS) equipment for use in the 156.025-162.025 MHz Band.

Transmitter equipment operating under 47 CFR Paragraphs 2 and 80E and Industry Canada RSS-GEN Issue 5, and RSS-182 Issue 5.

Summary

☒ The device fulfills the general approval requirements of the referenced standards identified in this test report and requested by the customer.

☐ The device does not fulfill the general approval requirements of the referenced standards identified in this test report.

Name of Applicant: Garmin International, Inc. FRN: 0005088588
1200 East 151st Street
Olathe, KS 66062

Model: A02087 PMN: A02087
FCC ID: IPH-02087 **IC**: 1792A-02087B
Frequency Range: 156.025-162.025 MHz
Maximum Power: 5. -watt, 26-dB OBW 12.5 kHz

Attestations

This equipment has been tested in compliance with the standards identified in this report. To the best of my knowledge all testing was performed using the measurement procedures identified in this report.
All instrumentation and accessories used during compliance testing are calibrated and remain in a calibrated state in accordance with ISO 17025 requirements.
Further, I attest that all necessary measurements were completed at
Rogers Labs, Inc.
4405 West 259th Terrace
Louisburg, KS 66053

Scot D Rogers
Scot D. Rogers

Date: August 8, 2018

Opinion / Interpretation of Results

Test Number	Measurement	FCC Rule	Pass/Fail
#1	Power Measurement	47 CFR 2.1046, 80.215, RSS-GEN 6.12, RSS-182	Pass
#2	Modulation Requirements	47 CFR 2.1047, 80.213, RSS-182	Pass
#3	Occupied Bandwidth	47 CFR 2.1049, 80.205, RSS GEN 6.7, RSS-182	Pass
#4	Emission Limitations	47 CFR 2.1051, 80.211, RSS-182	Pass
#5	Conducted Spurious Emissions	47 CFR 2.1051, 80.211, RSS-182	Pass
#6	Radiated Spurious Emissions	47 CFR 2.1053, 80.211, RSS-182	Pass
#7	Frequency Stability	47 CFR 2.1000, 80.209, RSS GEN 6.11, RSS-182	Pass

Equipment Tested

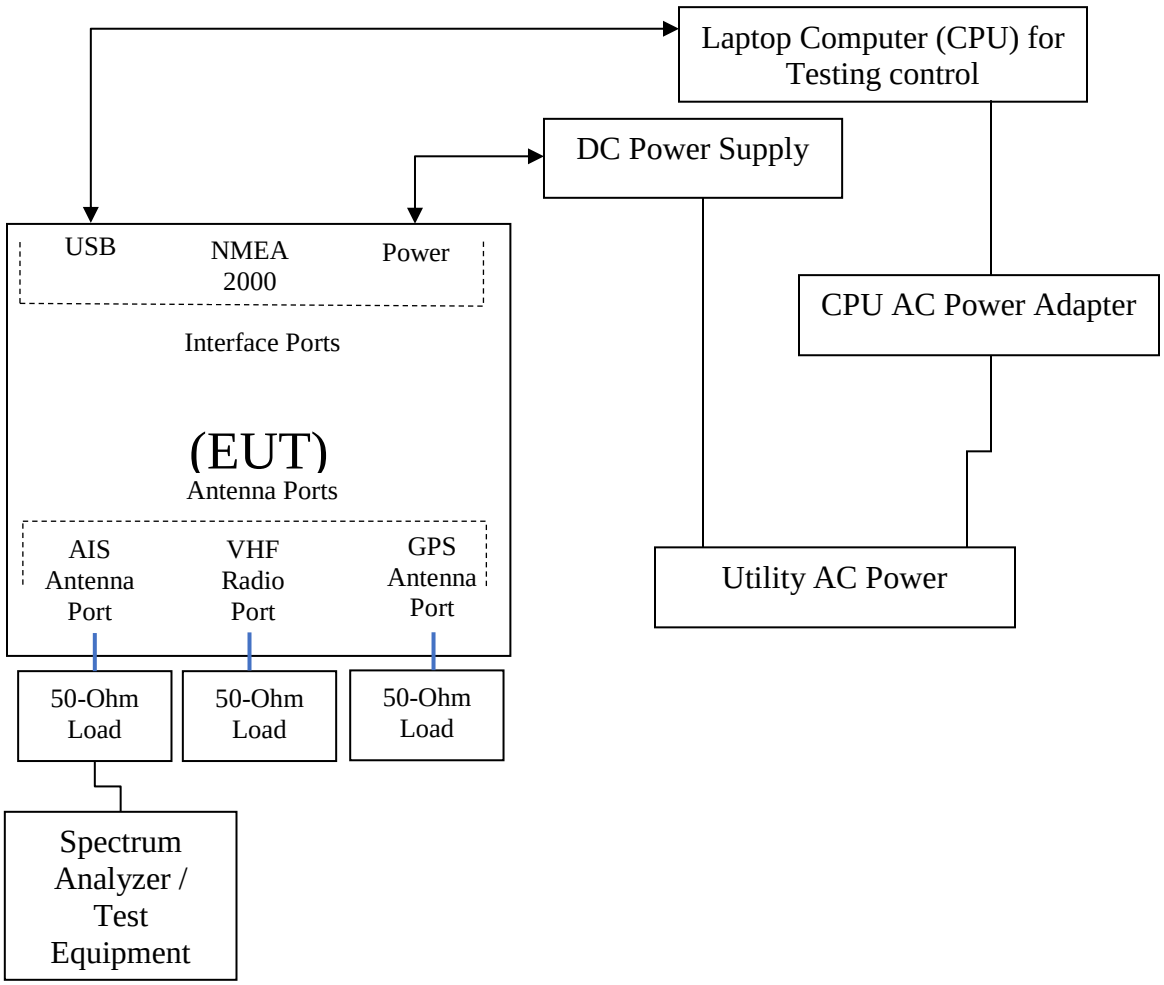
Equipment	Model	FCC I.D.
EUT	A02087	IPH-02087
DC Adapter	BK1670A	N96131 3540
Dell Latitude	E7440	00063713/A

Test results in this report relate only to the items tested.

Equipment Function and Configuration

The EUT is a Class-B SODTMA AIS Transceiver. Test results in this report relate only to the products described in this report.

Equipment Configuration



Applicant Company information

Applicants Company	Garmin International, Inc.
Applicants Address	1200 East 151st Street Olathe, KS 66062
FCC Identifier	IPH-02087
Industry Canada Identifier	1792A-02087B
Manufacturer Company	Garmin International, Inc.
Manufacturer Address	1200 East 151st Street Olathe, KS 66062

Equipment information

Product Marketing Name (PMN): The PMN is the name or model number under which the product will be marketed/offered for sale in Canada. If the product has PMN, it must be provided.	A02087
Unique Product Number (UPN): The applicant, made up of a maximum of 11 alphanumeric characters (A-Z, 0-9), assigns the UPN.	1792A-02087B
Hardware Version Identification Number (HVIN): The HVIN identifies hardware specifications of a product version. The HVIN replaces the ISED Model Number in the legacy E-filing System. An HVIN is required for all products for certification applications.	A02087
Host Marketing Name (HMN) (if applicable): The HMN is the name or model number of a final product, which contains a certified radio module.	
Brand Name	
Model Number	A02087
Test Rule Part(s)	80E
Test Frequency Range	156.025-162.025 MHz
Test Frequencies Investigated	156.025, 161.975, and 162.025 MHz
Project Number	180808
Submission Type	Certification

Product Details

Items	Description
Product Type	Maritime Services Class B Automatic Identification System (AIS) equipment
Radio Type	Transceiver
Power Type	Direct Current received from marine installation craft
Frequency Range	156.025-162.025 MHz
Modulation	AIS Standard test signals according to IEC 62287-2
Emissions Designation	12K7F1D
Channel Bandwidth	12,500 kHz
Maximum Conducted Output Power	5.11 Watts

Application for Certification

(1) The full name and mailing address of the manufacturer of the device and the applicant for certification.

Garmin International, Inc. 1200 East 151st Street Olathe, KS 66062

(2) FCC identifier. FCC I.D.: IPH-02087

(3) A copy of the installation and operating instructions to be furnished the user. A draft copy of the instructions may be submitted if the actual document is not available. The actual document shall be furnished to the FCC when it becomes available.

Refer to exhibit for Instruction Manual.

(4) Type or types of emission. 12K7F1D

(5) Frequency range. 156.025-162.025 MHz using 25 kHz channels spacing

(6) Range of operating power values or specific operating power levels, and description of any means provided for variation of operating power.

5 W or 1 W nominal

(7) Maximum power rating as defined in the applicable part(s) of the rules.

Maximum allowable power output of 25Watts per 47 CFR 80.215(e)(1) reducible to 1Watt per 47 CFR 80.215(g)(3).

(8) The dc voltages applied to and dc currents into the several elements of the final radio frequency amplifying device for normal operation over the power range.

Refer to Exhibit for Power delivered into final amplifier

(9) Tune-up procedure over the power range, or at specific operating power levels.

Refer to Exhibit for Transceiver Alignment Procedure.

(10) A schematic diagram and a description of all circuitry and devices provided for determining and stabilizing frequency, for suppression of spurious radiation, for limiting modulation, and for limiting power.

Refer to Exhibit for Circuit information and theory of operation.

(11) A photograph or drawing of the equipment identification plate or label showing the information to be placed thereon.

Refer to Exhibit for Photograph or Drawing.

(12) Photographs (8″ × 10″) of the equipment of sufficient clarity to reveal equipment construction and layout, including meters, if any, and labels for controls and meters and sufficient views of the internal construction to define component placement and chassis assembly. Insofar as these requirements are met by photographs or drawings contained in instruction manuals supplied with the certification request, additional photographs are necessary only to complete the required showing.

Refer to Exhibit for Drawings of Components Layout and Chassis Drawings.

(13) For equipment employing digital modulation techniques, a detailed description of the modulation system to be used, including the response characteristics (frequency, phase and amplitude) of any filters provided, and a description of the modulating wave train, shall be submitted for the maximum rated conditions under which the equipment will be operated.

Not applicable

(14) The data required by §§2.1046 through 2.1057, inclusive, measured in accordance with the procedures set out in §2.1041.

Data is contained in this application

(15) The application for certification of an external radio frequency power amplifier under part 97 of this chapter need not be accompanied by the data required by paragraph (b)(14) of this section. In lieu thereof, measurements shall be submitted to show compliance with the technical specifications in subpart C of part 97 of this chapter and such information as required by §2.1060 of this part.

Does not apply to this device or application.

(16) An application for certification of an AM broadcast stereophonic exciter-generator intended for interfacing with existing certified, or formerly type accepted or notified transmitters must include measurements made on a complete stereophonic transmitter. The instruction book must include complete specifications and circuit requirements for interconnecting with existing transmitters. The instruction book must also provide a full description of the equipment and measurement procedures to monitor modulation and to verify that the combination of stereo exciter-generator and transmitter meet the emission limitations of §73.44.

Does not apply to this device or application.

(17) Applications for certification required by §25.129 of this chapter shall include any additional equipment test data required by that section.

Does not apply to this device or application.

(18) An application for certification of a software defined radio must include the information required by §2.944.

Does not apply to this device or application.

(19) Applications for certification of equipment operating under part 27 of this chapter, that a manufacturer is seeking to certify for operation in the:
(i) 1755-1780 MHz, 2155-2180 MHz, or both bands shall include a statement indicating compliance with the pairing of 1710-1780 and 2110-2180 MHz specified in §§27.5(h) and 27.75 of this chapter.
(ii) 1695-1710 MHz, 1755-1780 MHz, or both bands shall include a statement indicating compliance with §27.77 of this chapter.
(iii) 600 MHz band shall include a statement indicating compliance with §27.75 of this chapter.

Does not apply to this device or application.

(20) Before equipment operating under part 90 of this chapter and capable of operating on the 700 MHz interoperability channels (See §90.531(b)(1) of this chapter) may be marketed or sold, the manufacturer thereof shall have a Compliance Assessment Program Supplier's Declaration of Conformity and Summary Test Report or, alternatively, a document detailing how the manufacturer determined that its equipment complies with §90.548 of this chapter and that the equipment is interoperable across vendors. Submission of a 700 MHz narrowband radio for certification will constitute a representation by the manufacturer that the radio will be shown, by testing, to be interoperable across vendors before it is marketed or sold.

Does not apply to this device or application.

(21) Contain at least one drawing or photograph showing the test set-up for each of the required types of tests applicable to the device for which certification is requested. These drawings or photographs must show enough detail to confirm other information contained in the test report. Any photographs used must be focused originals without glare or dark spots and must clearly show the test configuration used.

Data is contained in this application or application exhibits.

Applicable Standards & Test Procedures

The following information is submitted in accordance with 47 CFR dated August 8, 2018, Part 2, Subpart J, and Part 80E, Industry Canada RSS-182 Issue 5, and RSS-GEN Issue 5. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in EN 62287-2:2017, ANSI C63.26-2015, RSS-182 Issue 5, and RSS-GEN Issue 5.

Radiated Emission Test Procedure

Radiated emission testing was performed as required on a CISPR 16-1-4 compliant OATS and as specified in ANSI C63.26-2015 and RSS-182 Issue 5. The EUT was placed on a rotating 0.9 x 1.2-meter platform, elevated as required above the ground plane at a distance of 3 meters from the FSM antenna. The table permitted orientation of the EUT in each of three orthogonal axis positions if necessary. EMI energy was maximized by equipment placement, raising and lowering the FSM antenna, changing the antenna polarization, and by rotating the turntable. Each emission was maximized before data was taken using a spectrum analyzer. The frequency spectrum from 9 kHz to 1.63 GHz was searched for during preliminary investigation. Refer to diagram one showing typical test arrangement and photographs in the test setup exhibits for specific EUT placement during testing.

A Rohde and Schwarz ESU40 was used as the measuring instrument for radiated emissions testing of frequencies below 1 GHz. A Rohde and Schwarz ESU40 and/or ESW44 Spectrum Analyzer was used as the measuring instrument emissions above 1 GHz.

Antenna Port Conducted Emission Test Procedure

The EUT was assembled as required for operation placed on a benchtop. This configuration provided the ability to connect test equipment to the provided test antenna port Antenna Port conducted emissions testing was performed presented in the regulations and specified in ANSI C63. 26-2015. Testing was completed on a laboratory bench in a shielded room. The active antenna port of the device was connected to appropriate attenuation and the spectrum analyzer. Refer to diagram two showing typical test arrangement and photographs in the test setup exhibits for specific EUT placement during testing.

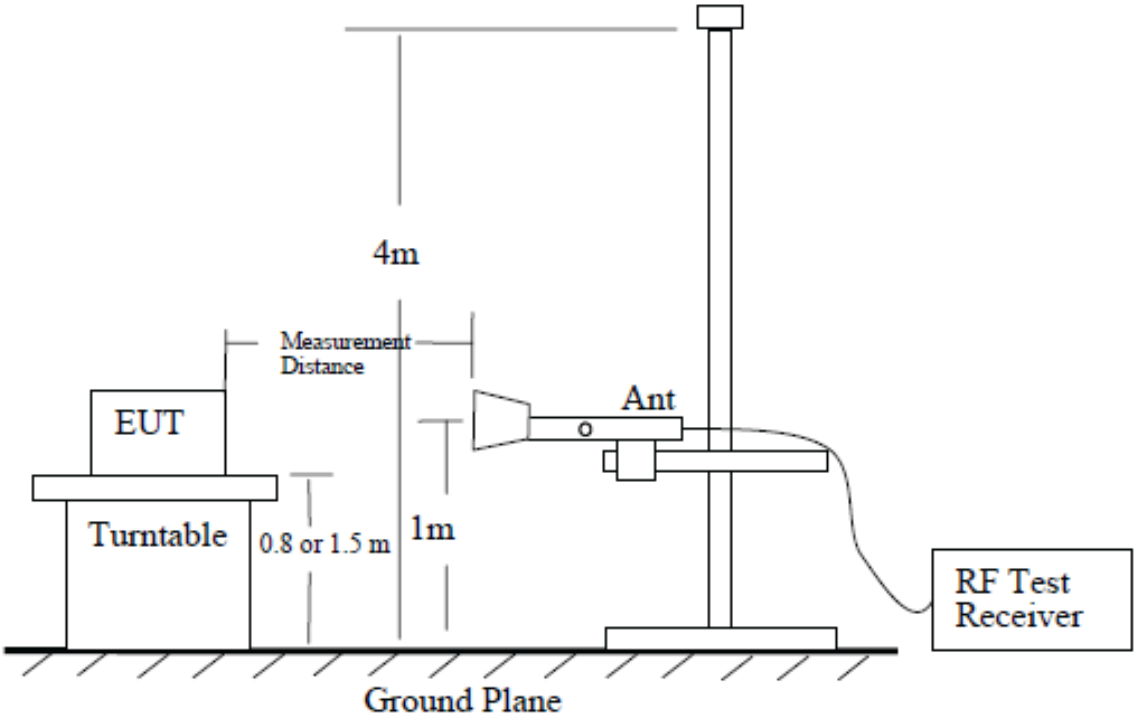


Figure 6—Test site-up for radiated ERP and/or EIRP measurements

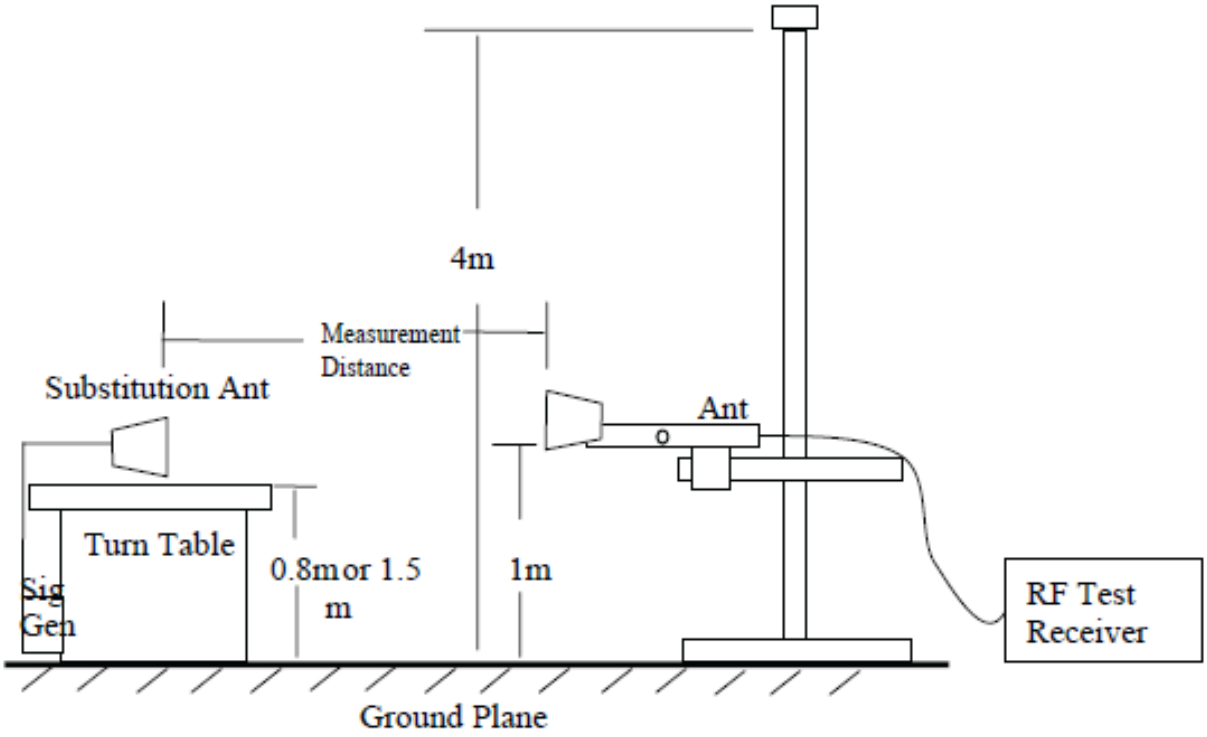


Diagram 1 Test arrangement for Radiated emissions

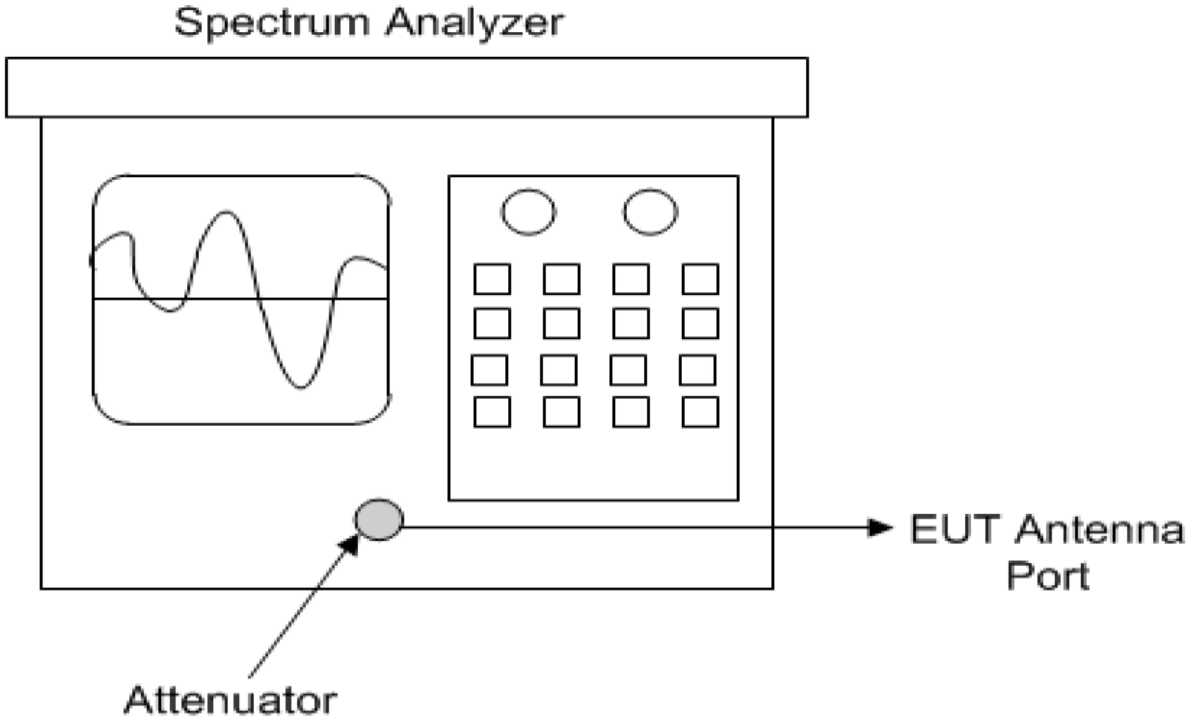


Diagram 2 Test arrangement for Antenna Port Conducted emissions

List of Test Equipment

Equipment	Manufacturer	Model (SN)	Band	Cal Date(m/d/y)	Due
☐ LISN	FCC	FCC-LISN-50-2-10(1PA) (160611)	.15-30MHz	5/2/2018	5/2/2019
☐ LISN	Compliance Design	FCC-LISN-2.Mod.cd,	.15-30MHz	10/24/2017	10/24/2018
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)	9kHz-40 GHz	10/24/2017	10/24/2018
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	10/24/2017	10/24/2018
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303071)	9kHz-40 GHz	10/24/2017	10/24/2018
☐ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/24/2017	10/24/2018
☐ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/24/2017	10/24/2018
☒ Antenna	ARA	BCD-235-B (169)	20-350MHz	10/24/2017	10/24/2018
☐ Antenna	EMCO	3147 (40582)	200-1000MHz	10/24/2017	10/24/2018
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	5/2/2018	5/2/2020
☐ Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/24/2017	10/24/2019
☐ Antenna	Com Power	AH-840 (101046)	18-40 GHz	5/15/2017	5/15/2019
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	10/24/2017	10/24/2018
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/24/2017	10/24/2018
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	5/2/2018	5/2/2019
☒ Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	12/22/2017	12/22/2018
☐ Analyzer	Rohde & Schwarz	FS-Z60, 90, 140, and 220	40GHz-220GHz	12/22/2017	12/22/2019
☐ Analyzer	HP	8591EM (3628A00871)	9kHz-1.8GHz	5/2/2018	5/2/2019
☐ Analyzer	HP	8562A (3051A05950)	9kHz-125GHz	5/2/2018	5/2/2019
☐ Analyzer	HP External Mixers	11571, 11970	25GHz-110GHz	5/2/2018	5/2/2019
☒ Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	10/24/2017	10/24/2018
☒ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/24/2017	10/24/2018
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/24/2017	10/24/2018
☐ Power Meter	Agilent	N1911A with N1921A	0.05-40 GHz	5/2/2018	5/2/2019
☐ Generator	Rohde & Schwarz	SMB100A6 (100150)	20Hz-6 GHz	5/2/2018	5/2/2019
☐ Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-1800 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	HPM50114 (017)1.5G HPF	30-18000 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	HPM50105 (059) 6G HPF	30-18000 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-1800 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-1800 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-1800 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	BRC17663 (001) 9G notch	30-1800 MHz	5/2/2018	5/2/2019
☐ Attenuator	Fairview	SA6NFNF100W-14 (1625)	30-1800 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1735)	30-6000 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1436)	30-6000 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-3W2+ (14362)	30-6000 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-3W2+ (14452)	30-6000 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1736)	30-6000 MHz	5/2/2018	5/2/2019
☒ Attenuator	Texscan	50FHHFP 50/20	30-18000 MHz	5/2/2018	5/2/2019
☒ Attenuator	JFW Industries	50FH-010-10 (1)	30-18000 MHz	5/2/2018	5/2/2019
☒ Generator	Rohde & Schwarz	SMB100A6 (100623)	30-6000 MHz	5/2/2018	5/2/2019
☒ Weather station	Davis	6312 (A70927D44N)		10/24/2017	10/24/2018

Test Site Locations

Radiated EMI	The radiated emissions tests were performed at the 3 meters, Open Area Test Site (OATS) located at Rogers Labs, Inc., 4405 West 259th Terrace, Louisburg, KS
Site Registration	Refer to Annex for Site Registration Letters
NVLAP Accreditation	Lab code 200087-0

Units of Measurements

Conducted EMI	Data is in dBµV; dB referenced to one microvolt
Radiated EMI	Data is in dBµV/m; dB/m referenced to one microvolt per meter

Sample Calculation:

RFS = Radiated Field Strength, FSM = Field Strength Measured
A.F. = Receive antenna factor, Gain = amplification gains and/or cable losses
RFS (dBµV/m @ 3m) = FSM (dBµV) + A.F. (dB) - Gain (dB)

Environmental Conditions

Ambient Temperature	24.3° C
Relative Humidity	41%
Atmospheric Pressure	1014.9 mb

TEST #1 Power Output

FCC Reference: 47 CFR 2.1046, 80.215

IC Reference: RSS-182 Section 7 RSS-GEN Section 6.12

Test Method: ANSI C63.26-2015 section 5.2 and Notes Below

Results: Meets requirements

Notes:

1. 20-dB, 50-Ohm external attenuator was placed on the RF Antenna Port connection to connect measurement equipment to the RF output port of the test sample.
2. The EUT was transmitting at maximum and minimum power.

§2.1046 Measurements required: RF power output.

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in §2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

§80.215 Transmitter power.

(e) *Ship stations frequencies above 27500 kHz.* The maximum power must not exceed the values listed below.

(1) Ship stations 156-162 MHz—25W[6]

[6]Reducible to 1 watt or less, except for transmitters limited to public correspondence channels and used in an automated system.

RSS-182 Section 7.6 Transport Canada Specifications

Transport Canada's operational requirements for VHF radio equipment are summarized in Table 4.
VHF DSC equipment that meets the European standard EN 301 025 or IEC standard 62238 is certified as GMDSS-*compatible* but *not* GMDSS-*compliant,* as it does not fully meet the relevant IMO standards.
All VHF radiotelephone models, with the exception of portable equipment, shall be GMDSS-compliant or meet the requirements of either IEC 62238 or EN 301 025 (GMDSS-compatible).

Table 4 - Transport Canada Requirements for Marine VHF Radio Equipment[1]

Equipment Designator	Type of Marine VHF Radio Equipment	Applicable International or ETSI Standards[2]
G	VHF radiotelephone capable of DSC and GMDSS *compliant* (International SOLAS)	IMO A.803 and A.694 and IEC 61097-7 for Radiotelephone IEC 61097-3 for DSC IEC 61097-8 for Watchreceivers or EN 300 338 for DSC EN 301 033 for Watchreceivers ETS 300 162 for Radiotelephone
	VHF radiotelephone for survival craft (GMDSS type)	IMO MSC 149(77), IMO A.694 and IEC 61097-12 tested under IEC 60945 or ETS 300 225
D	VHF radiotelephone with DSC and *compatible* with the GMDSS (allowed on domestic ships, but does not meet SOLAS standards)	EN 301 025 or IEC 62238
n/a	Portable VHF radiotelephone capable of distress alerting on VHF channel 70	IMO MSC/Circ.862, ITU-R M.493 and IEC 61162
n/a	Portable VHF radiotelephone (voice only)	Portable VHF radiotelephone not capable of DSC
A	AIS VHF transponder Class A	ITU 1371, IEC 61993-2 IMO Resolution MSC.74, Annex 3
B	AIS VHF transponder Class B	IEC 62287-1 or IEC 62287-2 and ITU 1371

Test Arrangement Antenna Power Output

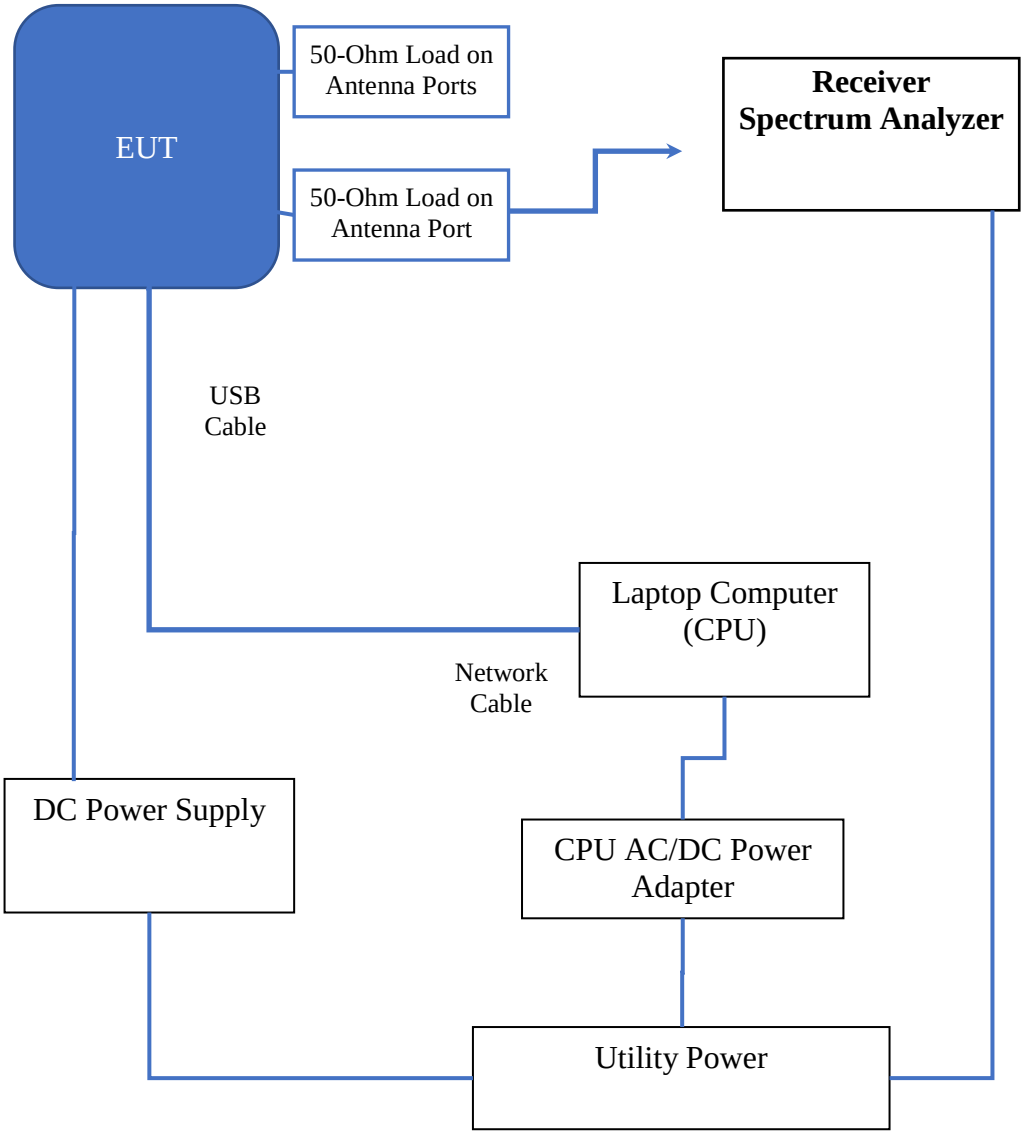


Table 1 Maximum Conducted Output Power Data

Frequency MHz	Conducted Antenna Port Output Power (dBm)	Conducted Antenna Port Output Power (Watts)
Low Power		
156.025	29.72	0.94
161.975	29.98	1.00
162.025	29.98	1.00
High power		
156.025	36.82	4.81
161.975	37.09	5.11
162.025	37.09	5.11

Plots were produced for graphical presentation of operation and demonstration of compliance. The EUT operates on single channel defined by installation. Plots were produced using traces for each channel observed addressing the requirement for presenting lowest channel, middle of band, and highest operational channels in the band.

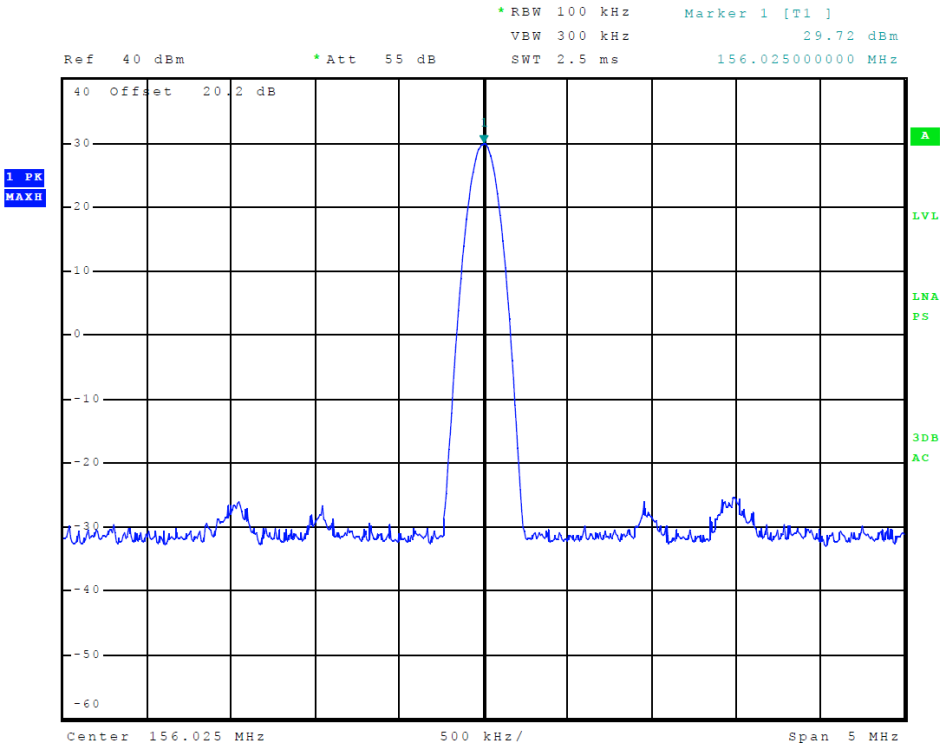


Figure 1 Plot of Antenna Port Power Output (Low Power, Low Channel)

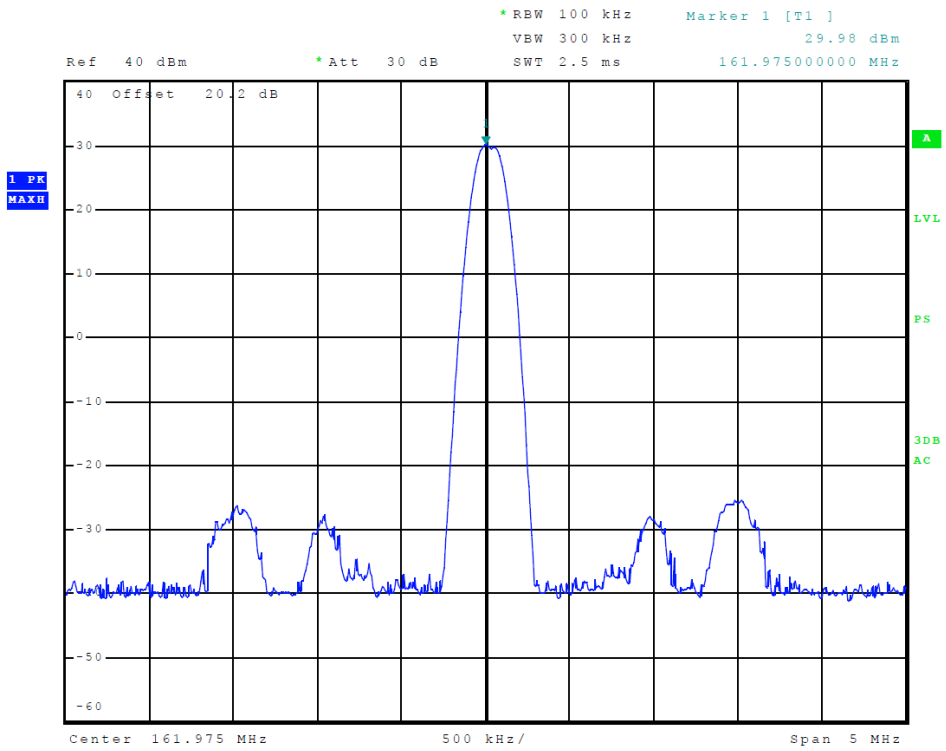


Figure 2 Plot of Antenna Port Power Output (Low Power, Middle Channel)

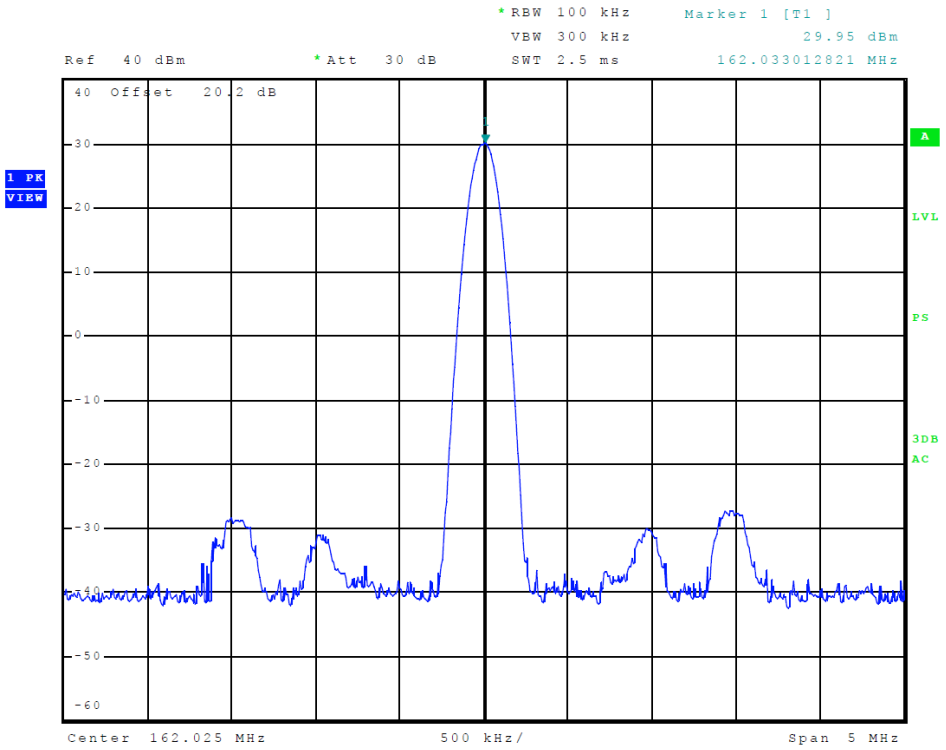


Figure 3 Plot of Antenna Port Power Output (Low Power, High Channel)

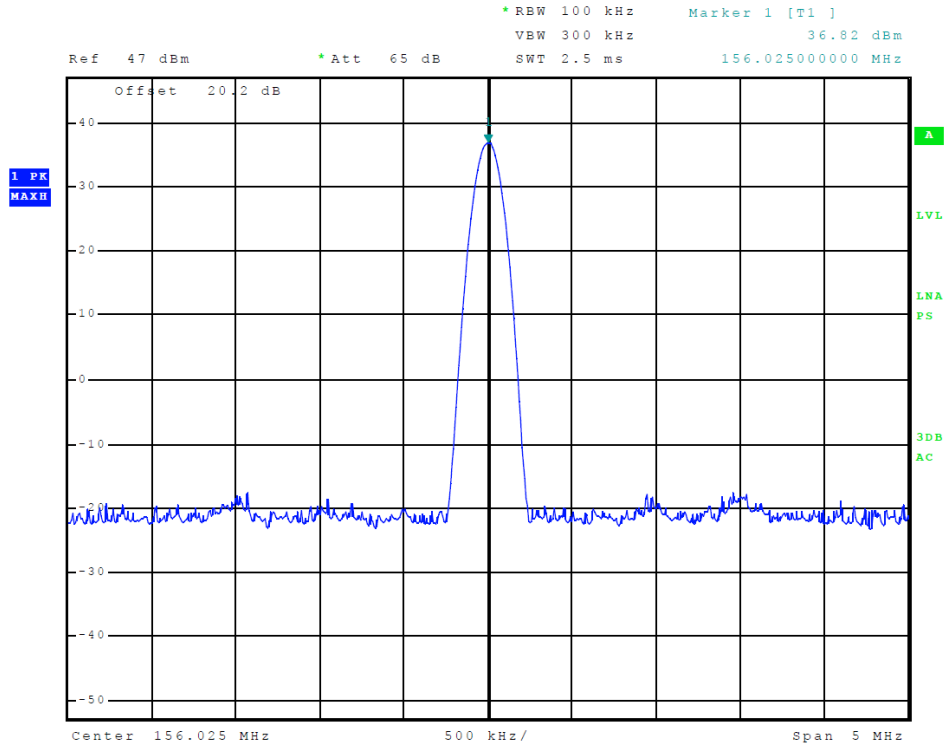


Figure 4 Plot of Antenna Port Power Output (High Power, Low Channel)

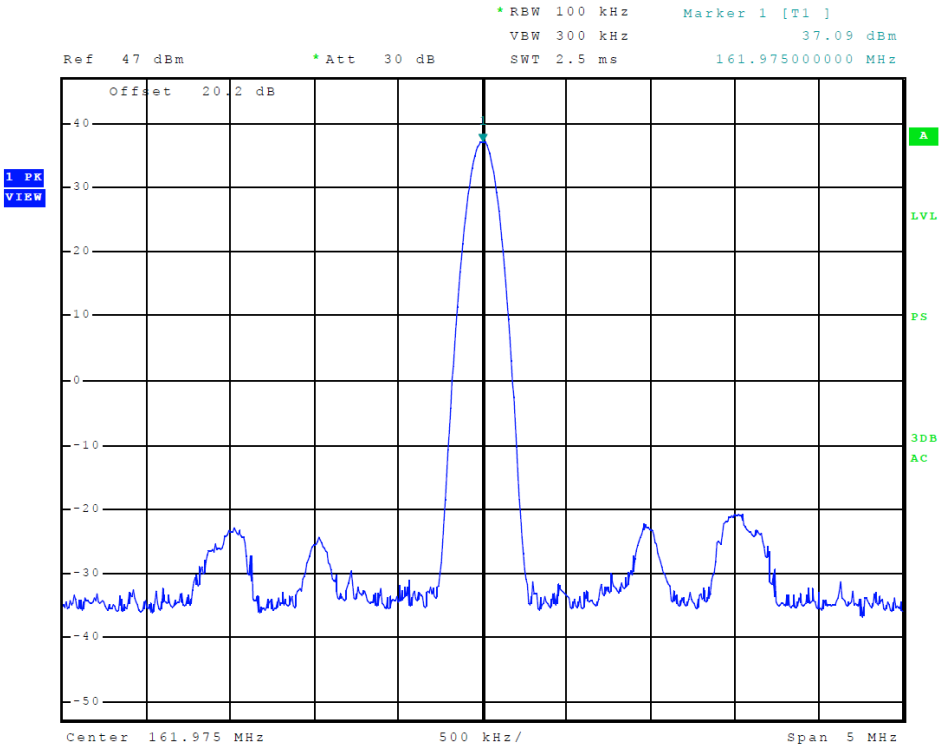


Figure 5 Plot of Antenna Port Power Output (High Power, Middle Channel)

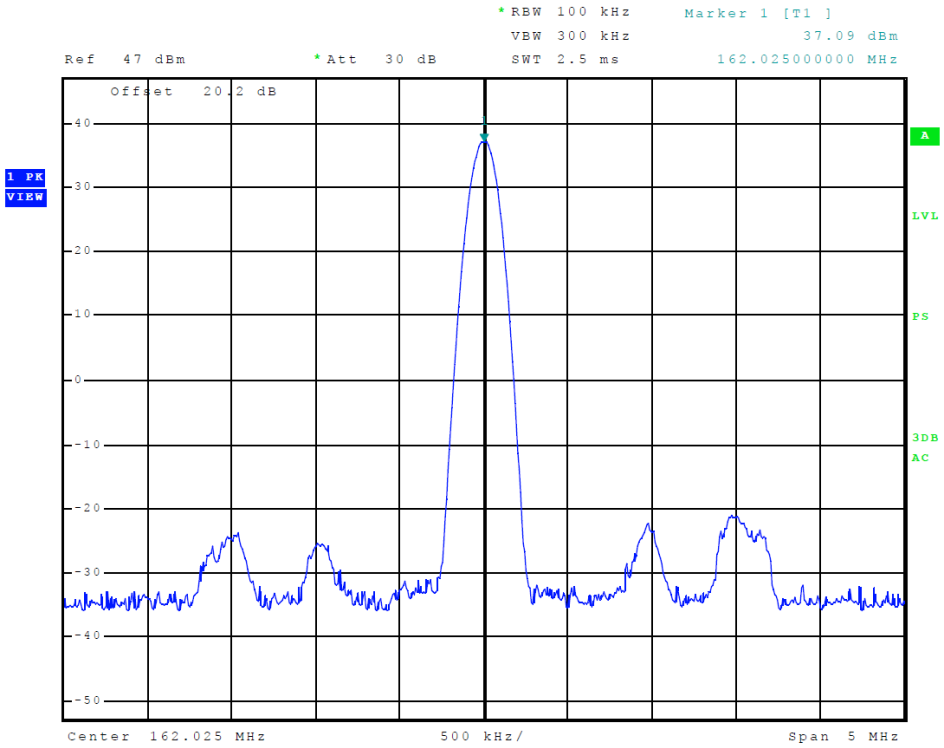


Figure 6 Plot of Antenna Port Power Output (High Power, High Channel)

Test #2 Modulation Requirements

FCC Reference: 47 CFR 2.1047, 80.213

IC Reference: RSS-182

Test Method: EN 62287-2:2017 and Notes Below

Results: Meets requirements as presented in the EN 62287-2:2017 test report

Notes:

1. 20-dB, 50-Ohm external attenuator was placed on the RF Antenna Port connection to connect measurement equipment to the RF output port of the test sample.
2. The EUT was transmitting at maximum and minimum power.

§2.1047 Measurements required: Modulation characteristics.

(a) *Voice modulated communication equipment.* A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

(b) *Equipment which employs modulation limiting.* A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

(c) *Single sideband and independent sideband radiotelephone transmitters which employ a device or circuit to limit peak envelope power.* A curve showing the peak envelope power output versus the modulation input voltage shall be supplied. The modulating signals shall be the same in frequency as specified in paragraph (c) of §2.1049 for the occupied bandwidth tests.

(d) *Other types of equipment.* A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

Test #3 Occupied Bandwidth

FCC Reference: 47 CFR 2.1049, 80.205

IC Reference: RSS-GEN, RSS-182 Section 7.9

Test Method: ANSI C63.26-2015 section 5.4, RSS-GEN 6.7, and Notes Below

Results: Meets requirements

Notes:

1. 20-dB, 50-Ohm external attenuator was placed on the RF Antenna Port connection to connect measurement equipment to the RF output port of the test sample.
2. The EUT was transmitting at maximum and minimum power.

§2.1049 Measurements required: Occupied bandwidth.

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:
(h) Transmitters employing digital modulation techniques—when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.

§80.205 Bandwidths.

(a) An emission designator shows the necessary bandwidth for each class of emission of a station except that in ship earth stations it shows the occupied or necessary bandwidth, whichever is greater. The following table gives the class of emission and corresponding emission designator and authorized bandwidth:

Class of emission	Emission designator	Authorized bandwidth (kHz)
F1D[12]	16K0F1D	20.0

[12]Applicable to radiolocation and associated telecommand ship stations operating on 154.585 MHz, 159.480 MHz, 160.725 MHz. 160.785 MHz, 454.000 MHz, and 459.000 MHz; emergency position indicating radiobeacons operating in the 406.000-406.1000 MHz frequency bank; and data transmissions in the 156-162 MHz band.

RSS-182 Section 7.9 Equipment's Transmit Output Power and Channel Bandwidth

7.9.1 Emission Mask B for Equipment with 25 kHz Channel Spacing

This mask is for FM or PM modulation equipment with 25 kHz channel spacing, an authorized bandwidth of 16 kHz for voice or 20 kHz for data, and equipped with or without an audio low-pass filter. The power of any emission shall be attenuated below the transmitter output power (P, in dBW) as follows:

(a) on any frequency removed from the carrier frequency by more than 50%, but not more than 100% of the authorized bandwidth: at least 25 dB, measured with a bandwidth of 300 Hz;

(b) on any frequency removed from the carrier frequency by more than 100%, but not more than 250% of the authorized bandwidth: at least 35 dB, measured with a bandwidth of 300 Hz; and

(c) on any frequency removed from the carrier frequency by more than 250% of the authorized bandwidth: at least $43 + 10 \log_{10} p(\text{watts})$ dB, measured with a bandwidth of 30 kHz.

Test Arrangement Occupied Bandwidth

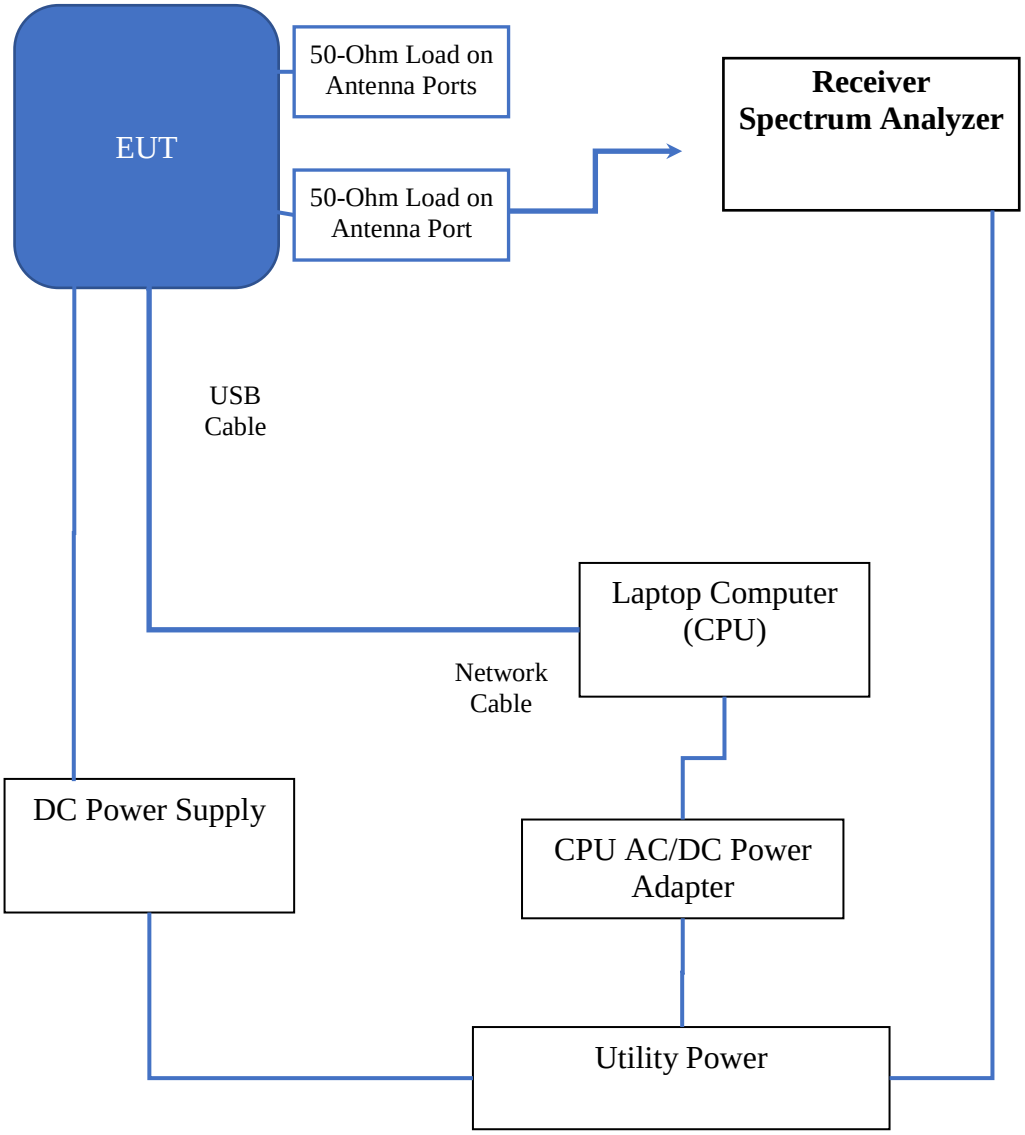


Table 2 Occupied Bandwidth Measurement Results

Frequency MHz	Occupied Bandwidth (kHz)
Low Power	
156.025	11.94
161.975	12.58
162.025	12.66
High Power	
156.025	11.94
161.975	12.42
162.025	12.66

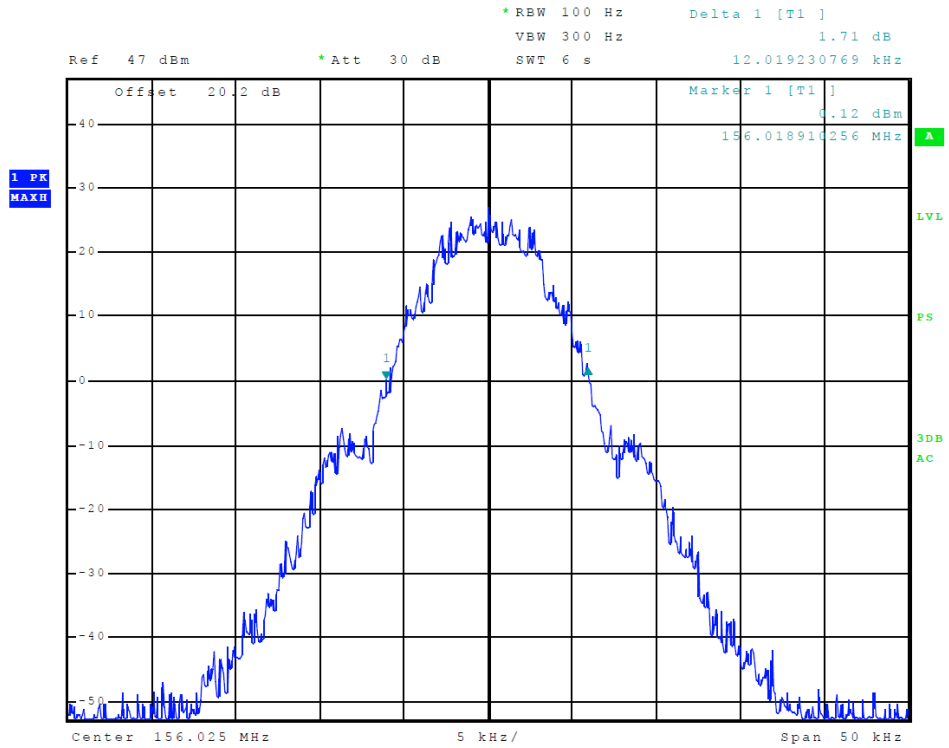


Figure 7 Plot of Occupied Bandwidth (Low Power, Low Channel)

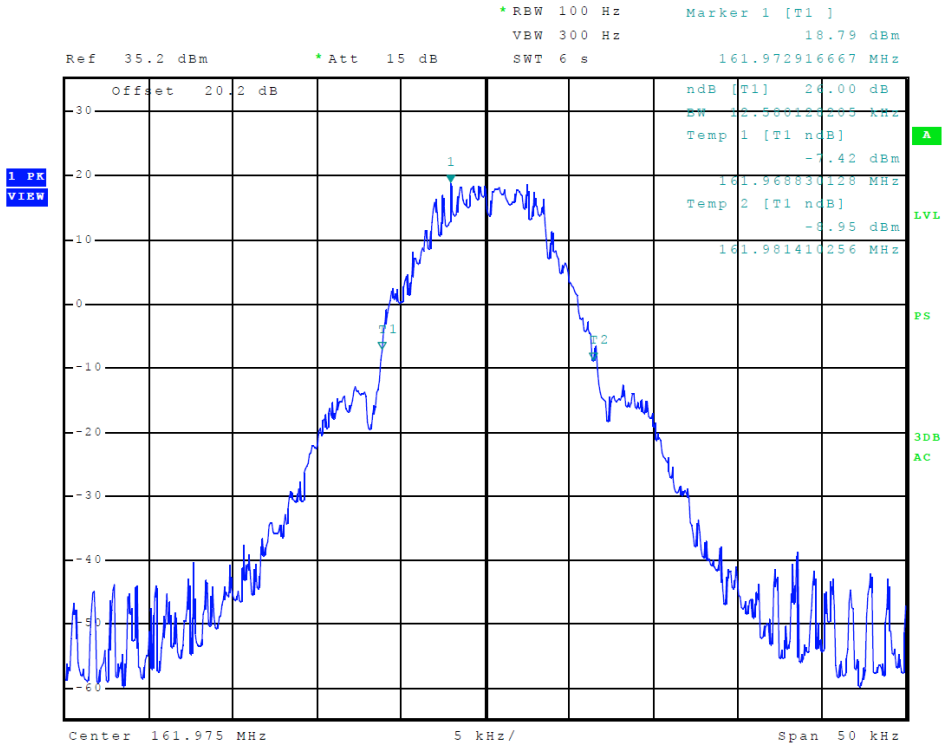


Figure 8 Plot of Occupied Bandwidth (Low Power, Middle Channel)

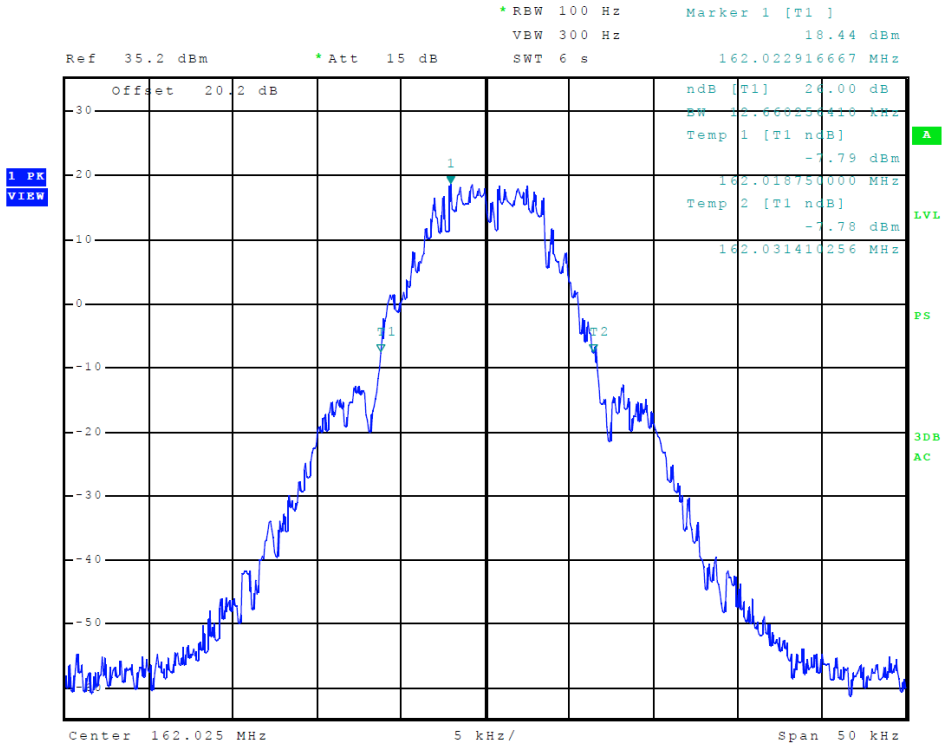


Figure 9 Plot of Occupied Bandwidth (Low Power, High Channel)

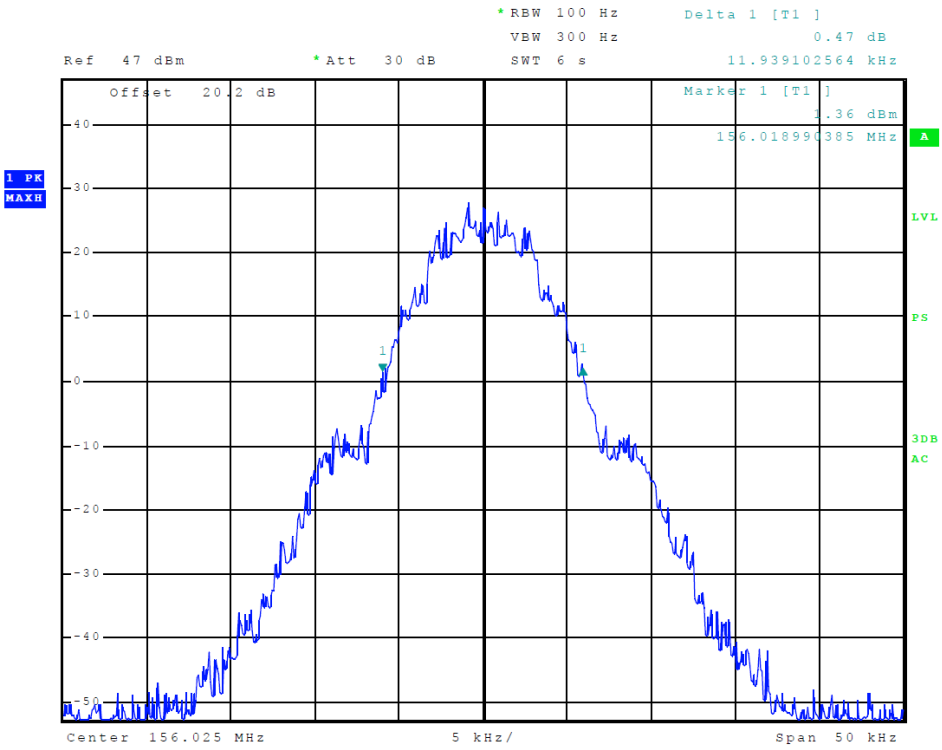


Figure 10 Plot of Occupied Bandwidth (High Power, Low Channel)

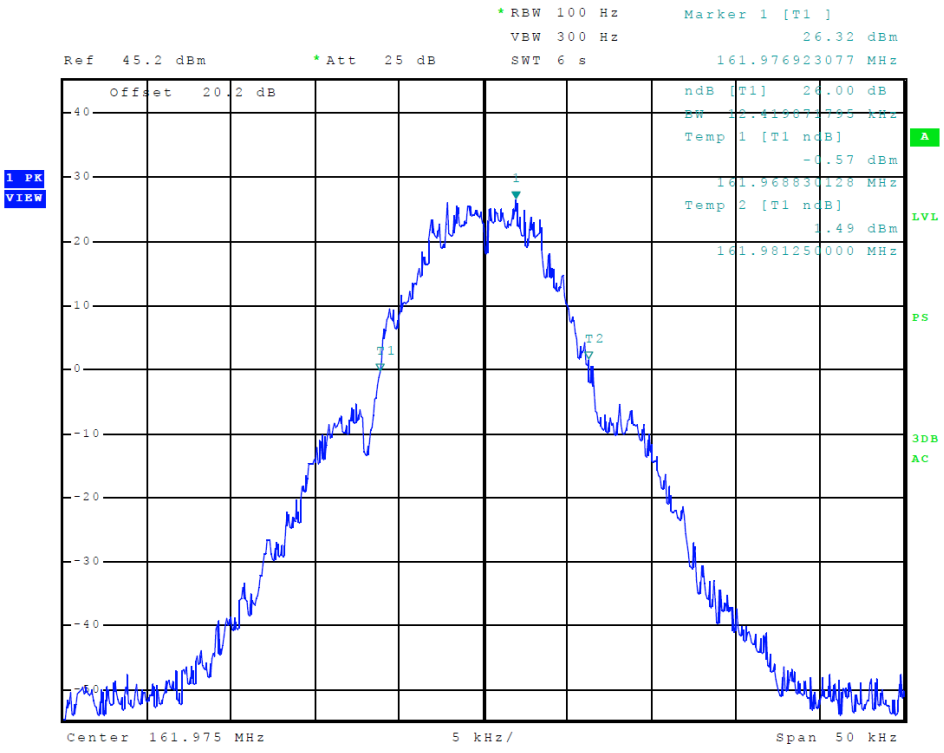


Figure 11 Plot of Occupied Bandwidth (High Power, Middle Channel)

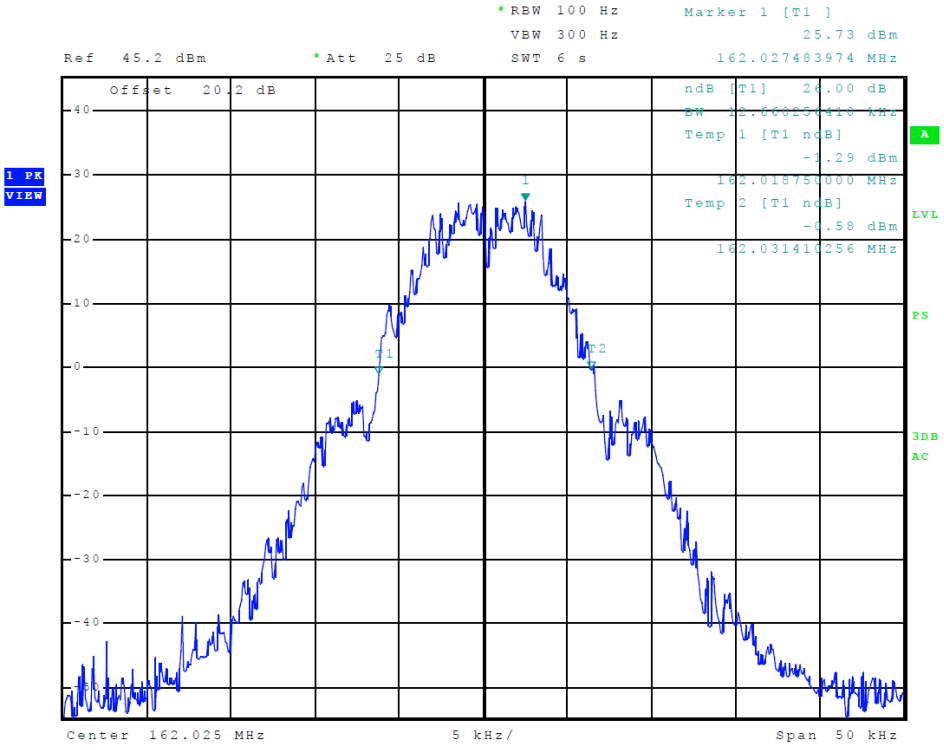


Figure 12 Plot of Occupied Bandwidth (High Power, High Channel)

TEST #4 Emission Limitations

FCC Reference: 47 CFR 2.1049, 80.205

IC Reference: RSS-GEN, RSS-182 Section 7.9

Test Method: ANSI C63.26-2015 section 5.7, RSS-GEN 6.13, and Notes Below

Results: Meets requirements

Notes:

1. 20-dB, 50-Ohm external attenuator was placed on the RF Antenna Port connection to connect measurement equipment to the RF output port of the test sample.
2. The EUT was transmitting at maximum and minimum power.

§2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§80.211 Emission limitations.

The emissions must be attenuated according to the following schedule.

(f) The mean power when using emissions other than those in paragraphs (a), (b), (c) and (d) of this section:

(1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;

(2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus $10\log_{10}$ (mean power in watts) dB.

RSS-182 Section 7.9 Transmitter Unwanted Emissions

Equipment with 25 kHz channel spacing (equipment designator G and D) shall comply with emission mask B. Radio equipment with 12.5 kHz channel spacing, with or without an audio low-pass filter, shall comply with emission mask C.

7.9.1 Emission Mask B for Equipment with 25 kHz Channel Spacing

This mask is for FM or PM modulation equipment with 25 kHz channel spacing, an authorized bandwidth of 16 kHz for voice or 20 kHz for data, and equipped with or without an audio low-pass filter. The power of any emission shall be attenuated below the transmitter output power (P, in dBW) as follows:
(a) on any frequency removed from the carrier frequency by more than 50%, but not more than 100% of the authorized bandwidth: at least 25 dB, measured with a bandwidth of 300 Hz;
(b) on any frequency removed from the carrier frequency by more than 100%, but not more than 250% of the authorized bandwidth: at least 35 dB, measured with a bandwidth of 300 Hz; and
(c) on any frequency removed from the carrier frequency by more than 250% of the authorized bandwidth: at least $43 + 10 \log_{10} p(\text{watts})$ dB, measured with a bandwidth of 30 kHz.

Methods of Measurement Emission Limitations

ANSI C63-26:2017 Section 5.7.2 Basic guidelines for unwanted emissions conducted measurements

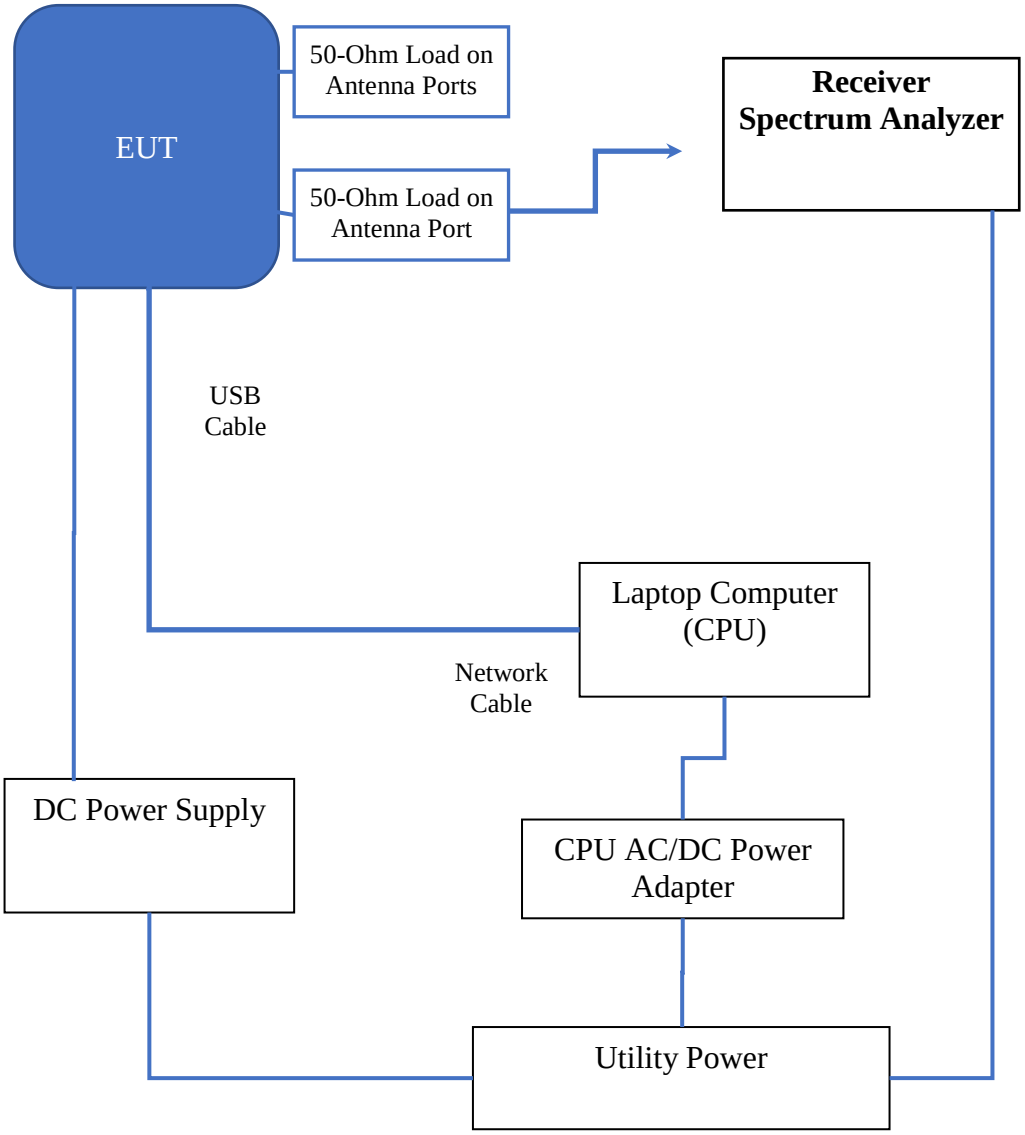
a) For improvement of the accuracy in the measurement of the average power of a noise-like emission, a RBW narrower than the specified reference bandwidth can be used (generally limited to no less than 1% of the OBW), provided that a subsequent integration is performed over the full required measurement bandwidth. This integration should be performed using the spectrum analyzer's channel power, adjacent channel power, or band power functions. When using the integration method at the channel/block/band edge, the starting frequency of the integration shall be centered at one-half of the RBW away from the band/channel/block edge. As an alternative, the highest power level measured in a narrower RBW (relative to the specified reference bandwidth) can be scaled by applying a correction factor determined from: 10 log [(reference bandwidth) / (resolution or measurement bandwidth)]. This scaling can be applied to both peak-detected and average measurement results, but is limited to cases where the measurement bandwidth used to perform the measurement is less than the reference bandwidth (i.e., the scaling cannot be applied when measurements are made with a bandwidth wider than the reference bandwidth). The bandwidth correction factor discussed above applies only to noise-like broadband emissions with relatively flat spectral characteristics within the passband of the resolution filter. Even in this case the starting frequency of measurement shall be centered at one-half of the RBW away from the band/channel/block edge. Power integration using the measurement instrument is the preferred method as it typically yields more accurate results.
b) Measurement instrumentation considerations and reference level settings as discussed in 5.2.1 and 5.2.2 shall be considered. In particular, the reference level should be set based on the anticipated power level of the signal to be measured.
c) Connect the EUT antenna output port to the spectrum analyzer via an appropriate RF cable. Insert external attenuation as necessary and adjust the spectrum analyzer settings to account for the corresponding insertion loss.
d) The EUT must either be configured to transmit continuously at full power while the compliance measurement is performed, or the measurement instrumentation must be configured to acquire data only over durations when the EUT is actively transmitting at full power. See items d2), d3), and d4) of 5.7.3, when the EUT cannot transmit continuously.
e) To show compliance for a given EBW, where permitted by a regulatory authority, it is sufficient to perform the measurements just for the worst case modulation type producing the highest emission. A technical rationale supporting the identification of "worst case" operational modes, along with technical data verifying the stated rationale, shall be provided in the test report. Regardless of the test reduction methods used, regulations typically require a device to comply with all the applicable rule parts under all modes of operation.
f) Set the RBW as required by applicable regulations. This setting may differ for out-of-band (bandedge) emissions (adjacent to frequency block, channel edge, or allocated frequency band) and spurious emissions measurements. See also a) of this subclause regarding power integration when using a measurement bandwidth smaller than the specified bandwidth.

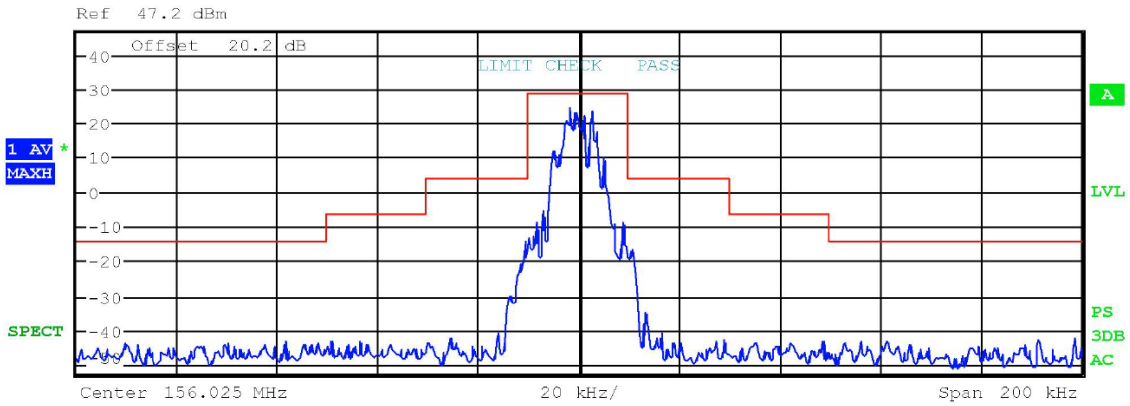
g) The measurement of emissions immediately outside the block/band/channel shall account for the width of the window that the instrument uses to perform the measurement. If the measurement is performed with the RBW centered exactly at the band edge frequency, then one-half of the measurement bandwidth RBW will capture power contained within the block/band/channel, and thus bias the measurement. For this reason, the frequency range that must be examined begins at an offset of RBW/2 relative to both the upper and lower band edge frequencies. This can be accomplished either by setting start/stop frequencies that are offset by the factor RBW/2 relative to the block/band/channel edge or by adjusting the mask to be a factor of RBW/2 wider at the lowermost and uppermost frequencies. Set the VBW to a value □ 3 × RBW. Video filtering is not allowed.
h) Select detector type as required by applicable regulation [i.e., power averaging (rms) detector or peak detector]. See the relevant text of 5.2 for further guidance regarding standardized emission measurement procedures.
i) For transmitters utilizing multiple output ports, if power equivalence can be demonstrated between the output ports, and such a demonstration is supported by coherent technical rationale and/or test data within the report, then the compliance measurements may be performed on a random output port while applying the guidelines provided in 6.4.
j) Band-edge measurements are typically performed using a conducted test set-up, but when necessary (e.g., EUT with integral antenna) they may be performed in a radiated test configuration on a test site satisfying the requirements in 4.6. The measurement instrumentation shall meet the requirements specified in 4.1 using the detectors specified in 4.3.2.

1) When performing radiated measurements, the measurement antenna(s) shall satisfy the requirements specified in 4.4. The EUT shall be connected to its antenna and operated at the highest power settings following procedures in 5.5.2.4.

2) The same methods and instrument settings specified for conducted band edge measurements shall be utilized, except that the radiated emissions measurement procedures provided in 5.5 shall apply, including the procedures for maximizing the radiated emissions on the test site and the procedures for radiated emissions measurements of 5.5 shall be used to determine maximum EIRP or ERP, as appropriate

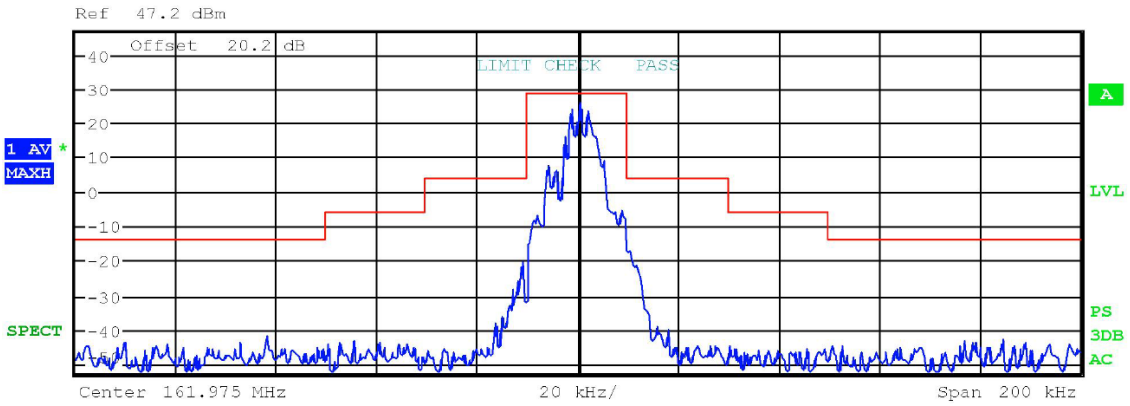
Test Arrangement Occupied Bandwidth





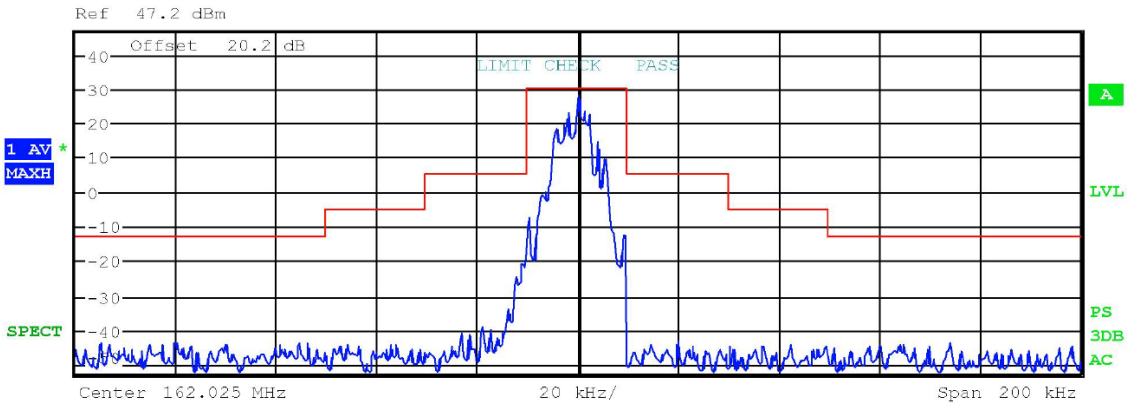
Tx Channel			Part80_SEM_1			
Bandwidth		20 kHz	Power			28.65 dBm
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	PwrRel [dBc]	ΔLimit [dB]
-100.000 k	-50.000 k	1.00 k	155.966667 M	-43.60	-72.25	-29.25
-50.000 k	-30.000 k	1.00 k	155.981410 M	-43.67	-72.31	-37.31
-30.000 k	-10.000 k	1.00 k	156.014423 M	-14.67	-43.32	-18.32
10.000 k	30.000 k	1.00 k	156.035577 M	-16.93	-45.58	-20.58
30.000 k	50.000 k	1.00 k	156.073397 M	-43.67	-72.31	-37.31
50.000 k	100.000 k	1.00 k	156.123718 M	-42.57	-71.21	-28.21

Figure 13 Plot of Spectral Emission Mask (Low Power, Low Chanel)



Tx Channel			Part80_SEM_1			
Bandwidth		20 kHz	Power			28.75 dBm
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	PwrRel [dBc]	ΔLimit [dB]
-100.000 k	-50.000 k	1.00 k	161.913141 M	-42.05	-70.80	-27.80
-50.000 k	-30.000 k	1.00 k	161.930449 M	-43.55	-72.30	-37.30
-30.000 k	-10.000 k	1.00 k	161.964103 M	-20.47	-49.22	-24.22
10.000 k	30.000 k	1.00 k	161.985577 M	-17.02	-45.77	-20.77
30.000 k	50.000 k	1.00 k	162.005128 M	-45.18	-73.93	-38.93
50.000 k	100.000 k	1.00 k	162.059615 M	-42.96	-71.71	-28.71

Figure 14 Plot of Spectral Emission Mask (Low Power, Middle Channel)

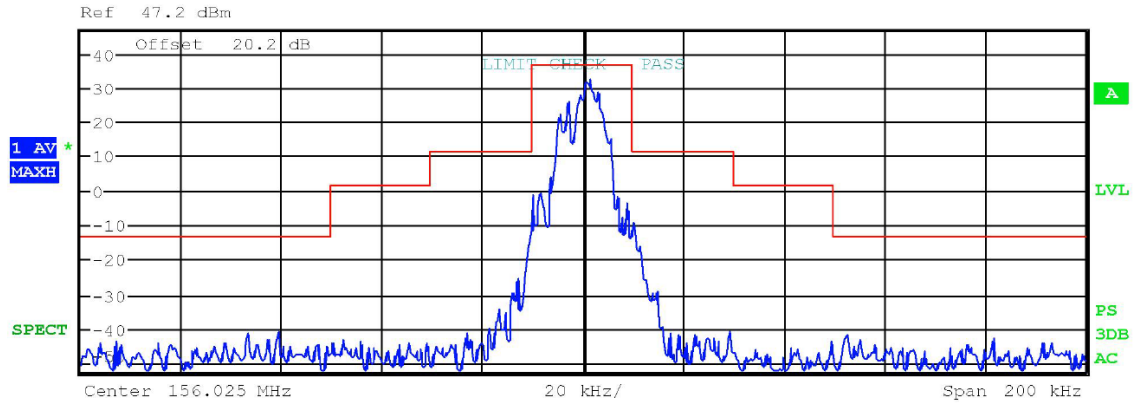


Tx Channel **Part80_SEM_1**

Bandwidth 20 kHz Power 30.01 dBm

Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	PwrRel [dBc]	ΔLimit [dB]
-100.000 k	-50.000 k	1.00 k	161.930128 M	-44.06	-74.08	-31.08
-50.000 k	-30.000 k	1.00 k	161.979167 M	-44.41	-74.42	-39.42
-30.000 k	-10.000 k	1.00 k	162.014744 M	-17.70	-47.72	-22.72
10.000 k	30.000 k	1.00 k	162.044872 M	-43.56	-73.57	-48.57
30.000 k	50.000 k	1.00 k	162.067308 M	-44.79	-74.81	-39.81
50.000 k	100.000 k	1.00 k	162.099038 M	-44.25	-74.26	-31.26

Figure 15 Plot of Spectral Emission Mask (Low Power, High Channel)

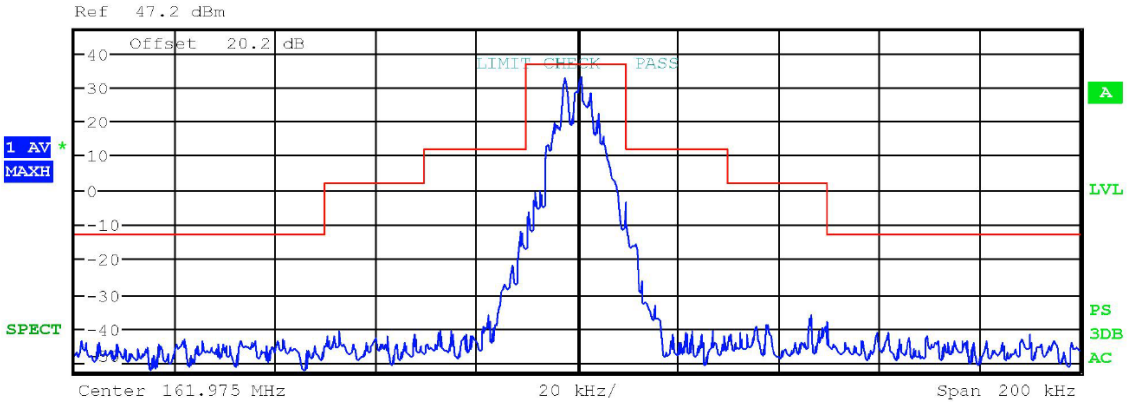


Tx Channel **Part80_SEM_5W**

Bandwidth 20 kHz Power 36.50 dBm

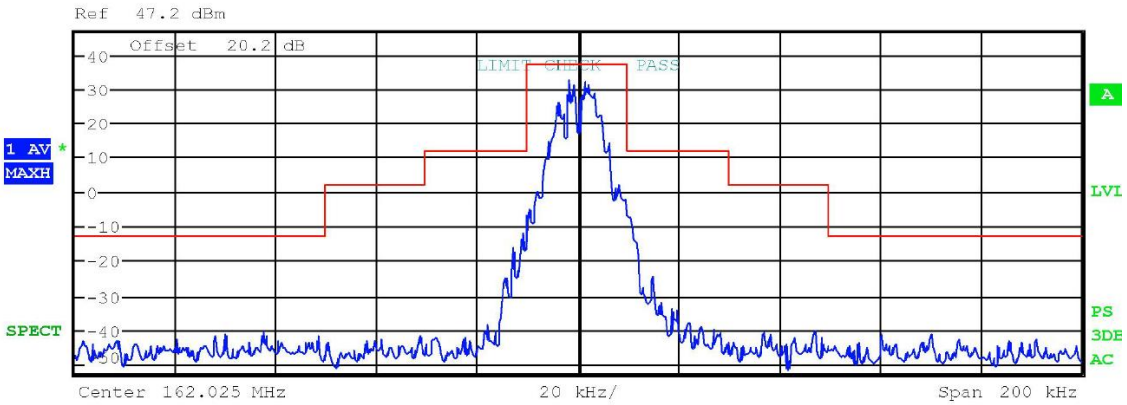
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	PwrRel [dBc]	ΔLimit [dB]
-100.000 k	-50.000 k	1.00 k	155.964423 M	-41.43	-77.93	-27.93
-50.000 k	-30.000 k	1.00 k	155.993910 M	-44.44	-80.93	-45.93
-30.000 k	-10.000 k	1.00 k	156.014744 M	-11.64	-48.14	-23.14
10.000 k	30.000 k	1.00 k	156.035000 M	-9.43	-45.93	-20.93
30.000 k	50.000 k	1.00 k	156.074359 M	-44.05	-80.55	-45.55
50.000 k	100.000 k	1.00 k	156.077564 M	-42.05	-78.55	-28.55

Figure 16 Plot of Spectral Emission Mask (High Power, Low Chanel)



Tx Channel				Part80_SEM_5W		
Bandwidth		20 kHz	Power	36.70 dBm		
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	PwrRel [dBc]	ΔLimit [dB]
-100.000 k	-50.000 k	1.00 k	161.896795 M	-43.42	-80.12	-30.12
-50.000 k	-30.000 k	1.00 k	161.927564 M	-41.09	-77.79	-42.79
-30.000 k	-10.000 k	1.00 k	161.963782 M	-12.26	-48.96	-23.96
10.000 k	30.000 k	1.00 k	161.985000 M	-10.95	-47.65	-22.65
30.000 k	50.000 k	1.00 k	162.021474 M	-36.80	-73.50	-38.50
50.000 k	100.000 k	1.00 k	162.036859 M	-41.87	-78.57	-28.57

Figure 17 Plot of Spectral Emission Mask (High Power, Middle Channel)



Tx Channel				Part80_SEM_5W		
Bandwidth		20 kHz	Power	36.96 dBm		
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	PwrRel [dBc]	ΔLimit [dB]
-100.000 k	-50.000 k	1.00 k	161.962500 M	-41.34	-78.30	-28.30
-50.000 k	-30.000 k	1.00 k	161.993590 M	-42.16	-79.12	-44.12
-30.000 k	-10.000 k	1.00 k	162.014744 M	-7.07	-44.03	-19.03
10.000 k	30.000 k	1.00 k	162.035000 M	-7.36	-44.33	-19.33
30.000 k	50.000 k	1.00 k	162.072115 M	-40.82	-77.79	-42.79
50.000 k	100.000 k	1.00 k	162.085256 M	-41.79	-78.75	-28.75

Figure 18 Plot of Spectral Emission Mask (High Power, High Channel)

TEST #5 Conducted Spurious Emissions

FCC Reference: 47 CFR 2.1051, 80.211

IC Reference: RSS-GEN, RSS-182 Section 7.9

Test Method: ANSI C63.26-2015 section 5.7, RSS-GEN 6.13, and Notes Below

Results: Meets requirements

Notes:

1. 20-dB, 50-Ohm external attenuator was placed on the RF Antenna Port connection to connect measurement equipment to the RF output port of the test sample.
2. The EUT was transmitting at maximum and minimum power.

§2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§80.211 Emission limitations.

The emissions must be attenuated according to the following schedule.

(f) The mean power when using emissions other than those in paragraphs (a), (b), (c) and (d) of this section:

(1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;

(2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus $10\log_{10}$ (mean power in watts) dB.

RSS-182 Section 7.9 Transmitter Unwanted Emissions

Equipment with 25 kHz channel spacing (equipment designator G and D) shall comply with emission mask B. Radio equipment with 12.5 kHz channel spacing, with or without an audio low-pass filter, shall comply with emission mask C.

Methods of Measurement Conducted Spurious Emissions

ANSI C63-26:2017 Section 5.7.4 Spurious unwanted emission measurements

a) Set the spectrum analyzer start frequency to the lowest frequency generated by the EUT, without going below 9 kHz, and the stop frequency to the lower frequency covered by the measurements previously performed in 5.7.3. As an alternative, the stop frequency can be set to the value specified in 5.1.1, depending on the EUT operating range, if the resulting plot can clearly demonstrate compliance for all frequencies not addressed by the out-of-band emissions measurements performed as per 5.7.3.
b) When using an average power (rms) detector, ensure that the number of points in the sweep ≥ 2 × (span / RBW). This may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the spectrum analyzer capabilities. This requirement does not apply to peak-detected power measurements. When average power is specified by the applicable regulation, a peak-detector can be utilized for preliminary measurements to accommodate wider frequency spans. Any emissions found in the preliminary measurement to exceed the applicable limit(s) shall be further examined using a power averaging (rms) detector with the minimum number of measurement points as defined above.
c) The sweep time should be set to auto-couple for performing peak-detector measurements. For measurements that use a power averaging (rms) detector, the sweep time shall be set as described for out-of-band emissions measurements in item d) of 5.7.3.
d) Identify and measure the highest spurious emission levels in each frequency range. It is not necessary to re-measure the out-of-band emissions as a part of this test. Record the frequencies and amplitudes corresponding to the measured emissions and capture the data plots.
e) Repeat step b) through step d) for the upper spurious emission frequency range if not already captured by a wide span measurement performed as per the alternative provided in step a). The upper frequency for this measurement is defined in 5.1.1 as a function of the EUT operating range.
f) Compare the results with the corresponding limit in the applicable regulation.
g) The test report shall include the data plots of the measuring instrument display and the measured data.

Test Arrangement Occupied Bandwidth

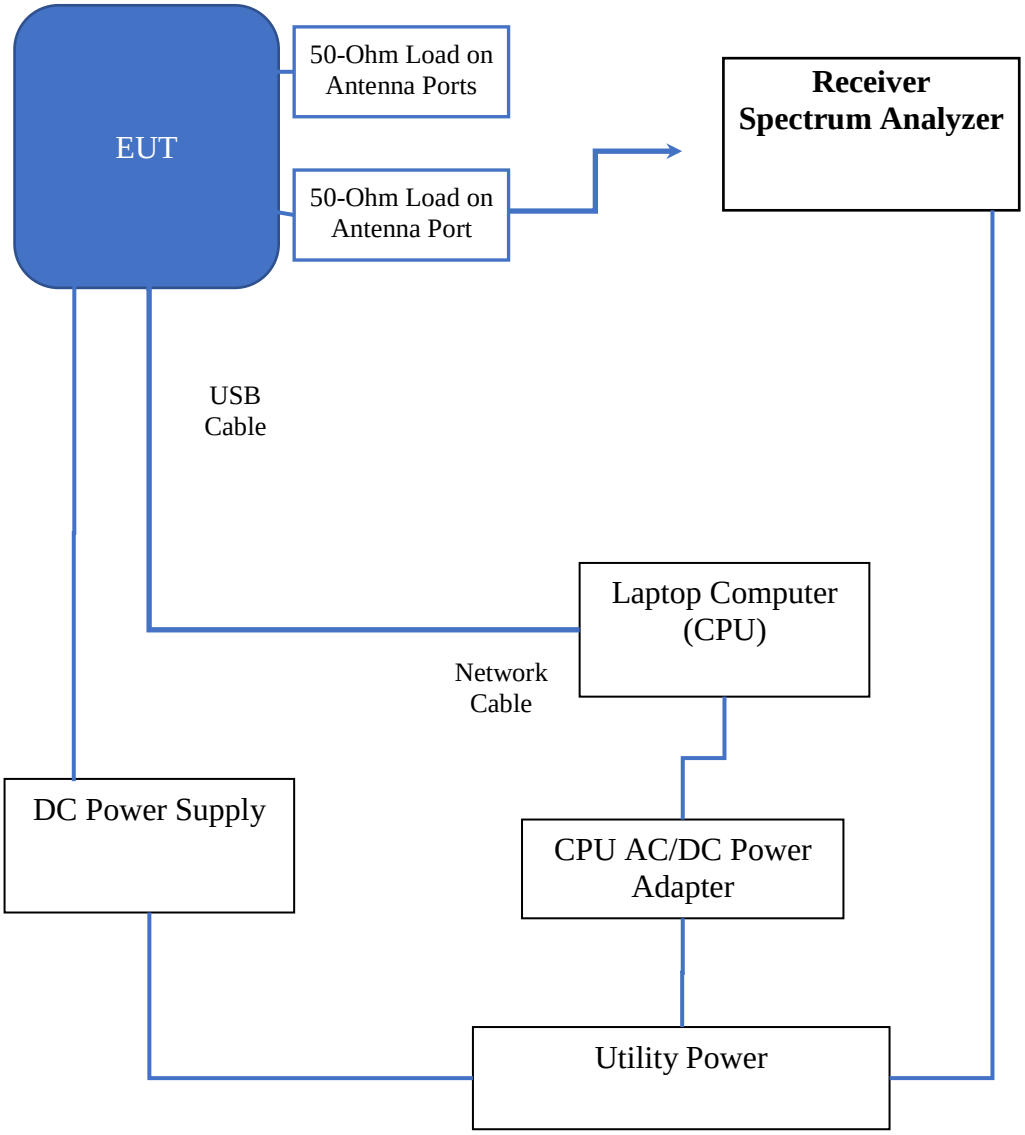


Table 3 Conducted Spurious Emissions (Low Power)

Channel MHz	Spurious Freq. (MHz)	Measured Level (dBm)	Level Below Carrier (dBc)
156.025	312.050	-50.09	79.8
	468.075	-52.43	82.2
	624.100	-50.02	79.7
	780.125	-50.47	80.2
	936.150	-50.43	80.2
	1092.175	-52.93	82.7
161.975	323.950	-35.00	65.0
	485.925	-48.90	78.9
	647.900	-48.60	78.6
	809.875	-48.60	78.6
	971.850	-47.70	77.7
	1133.825	-48.00	78.0
162.025	324.050	-35.10	65.1
	486.075	-49.30	79.3
	648.100	-48.80	78.8
	810.125	-47.90	77.9
	972.150	-48.30	78.3
	1134.175	-48.20	78.2

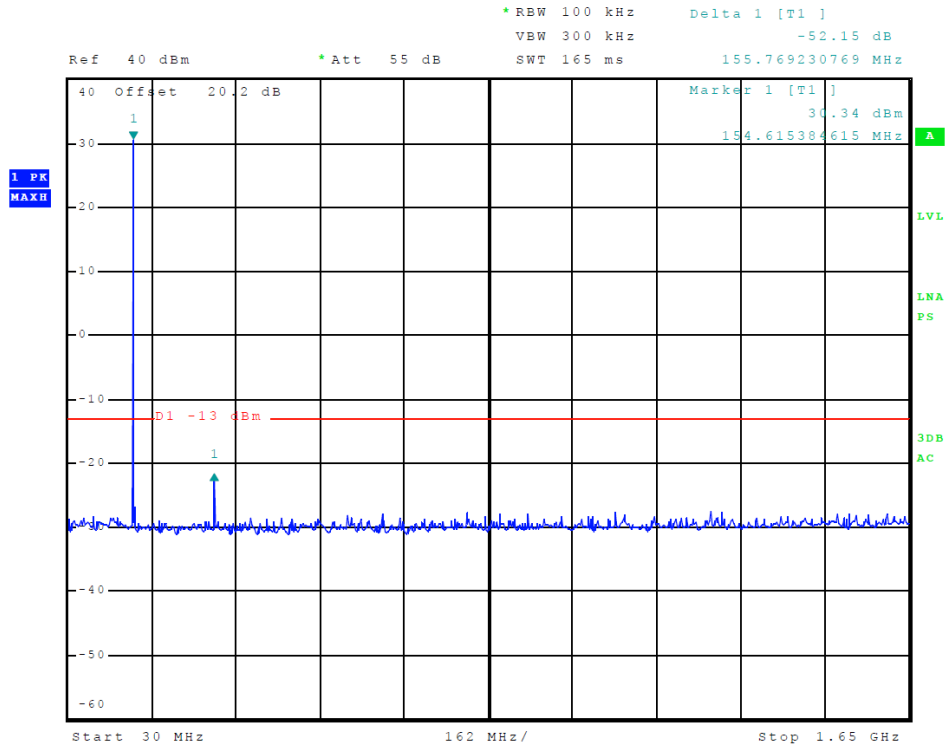


Figure 19 Plot of Conducted Spurious Emissions (Low Power, Low Channel)

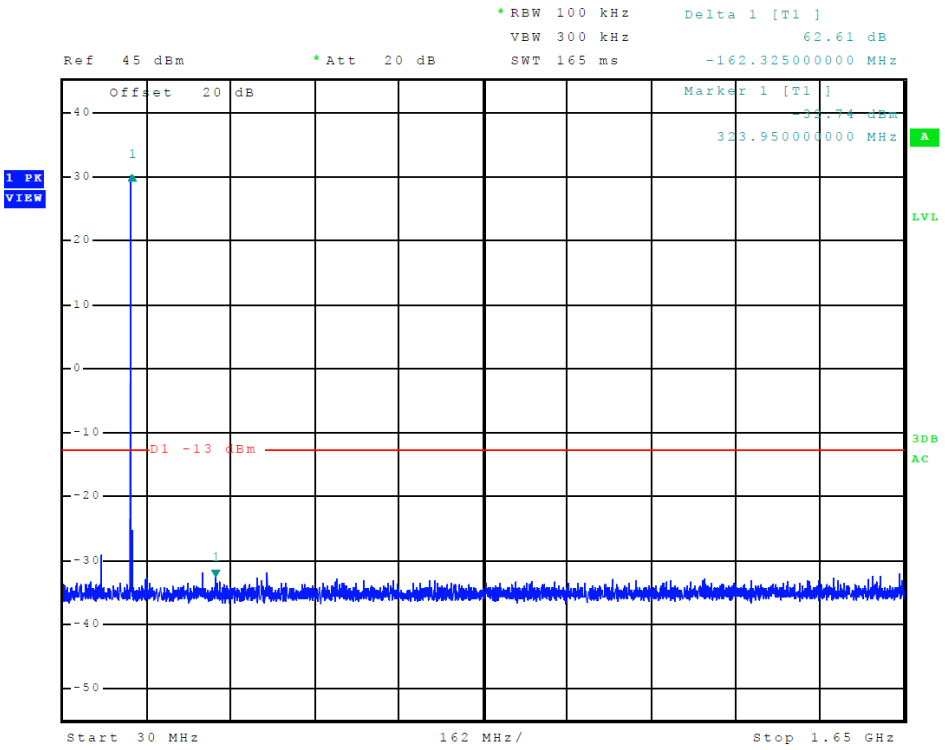


Figure 20 Plot of Conducted Spurious Emissions (Low Power, Middle Channel)

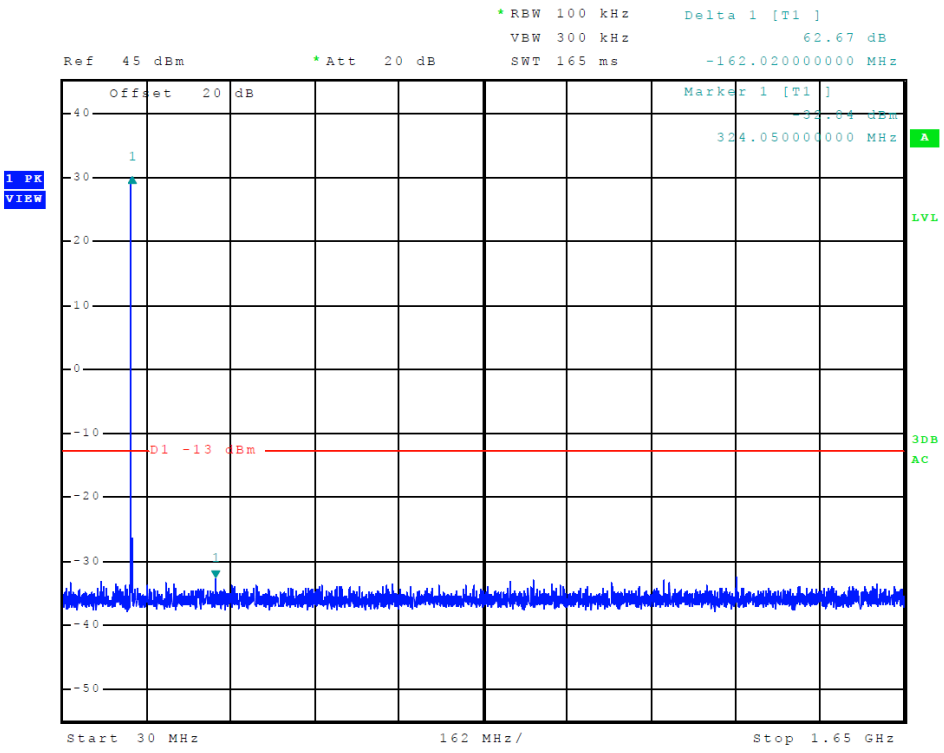


Figure 21 Plot of Conducted Spurious Emissions (Low Power, High Channel)

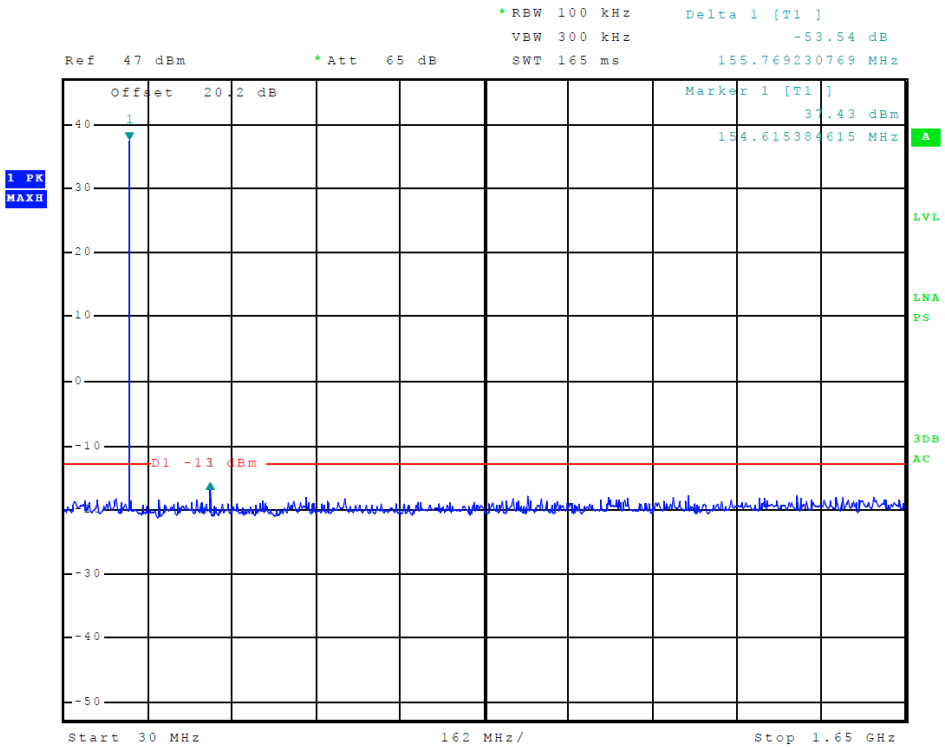


Figure 22 Plot of Conducted Spurious Emissions (High Power, Low Channel)

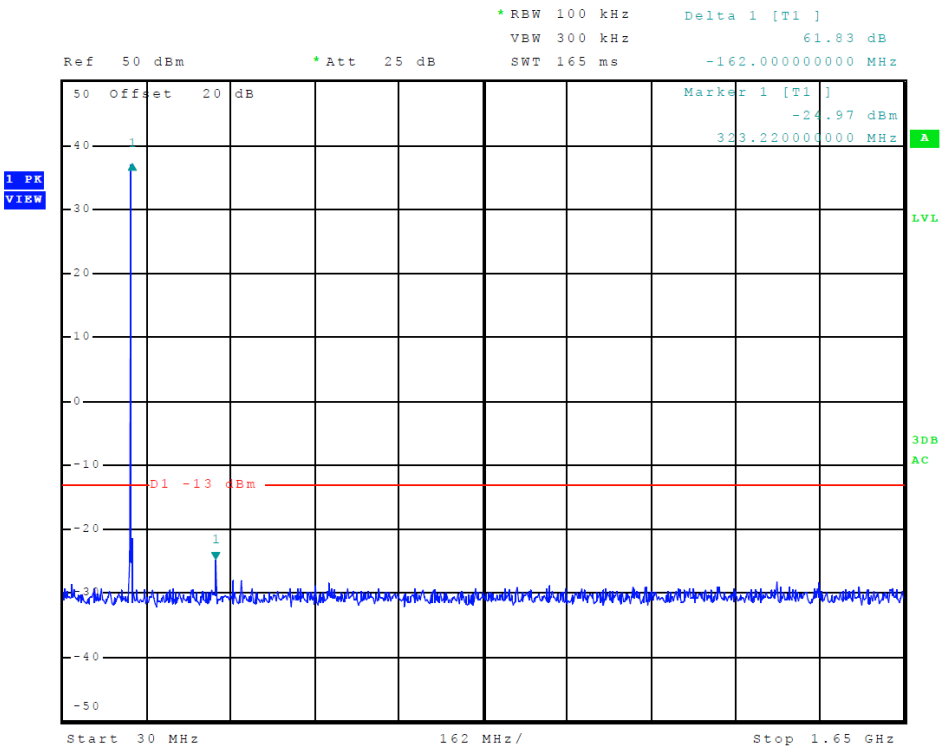


Figure 23 Plot of Conducted Spurious Emissions (High Power, Middle Channel)

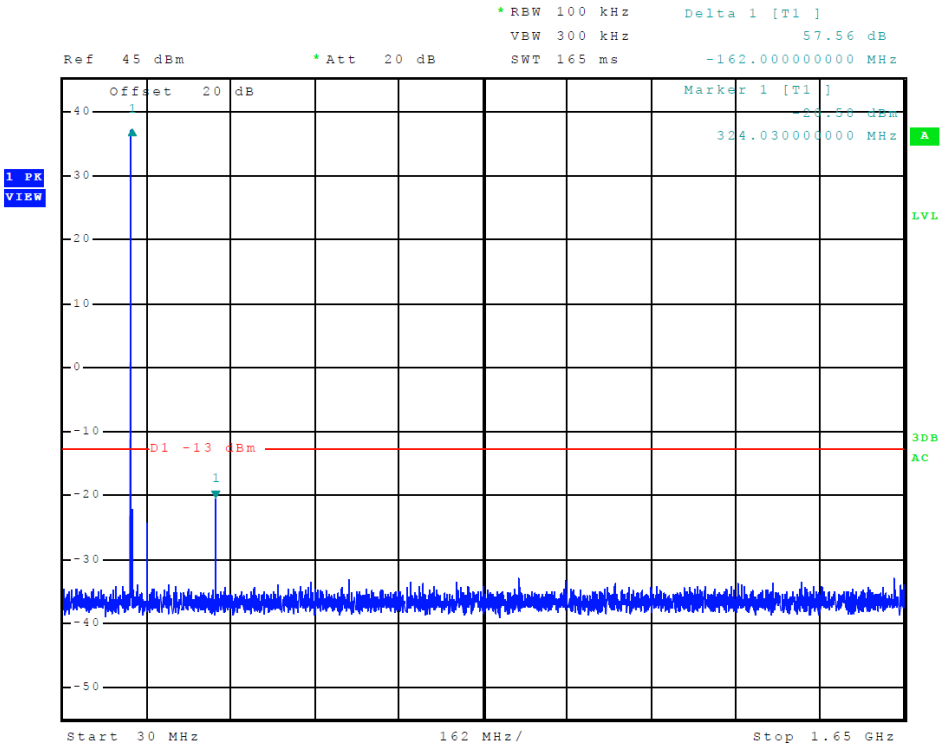


Figure 24 Plot of Conducted Spurious Emissions (High Power, High Channel)

TEST #6 Radiated Spurious Emissions

FCC Reference: 47 CFR 2.1053, 80.211

IC Reference: RSS-GEN, RSS-182 Section 7.9, RSS-GEN Section 6.1.3

Test Method: ANSI C63.26-2015 section 5.7, RSS-GEN 6.13, and Notes Below

Results: Meets requirements

Notes:

1. 20-dB, 50-Ohm external attenuator was placed on the RF Antenna Port connection to connect measurement equipment to the RF output port of the test sample.
2. The EUT was transmitting at maximum and minimum power.
3. Radiated Emissions Measurements were conducted on the Open Area Test Site with the test sample configured and operational defined as above in the Radiated Emission Test Procedure

§2.1053 Measurements required: Field strength of spurious radiation.

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.

(2) All equipment operating on frequencies higher than 25 MHz.

(3) All equipment where the antenna is an integral part of and attached directly to the transmitter.

(4) Other types of equipment as required, when deemed necessary by the Commission.

§80.211 Emission limitations.

The emissions must be attenuated according to the following schedule.

(f) The mean power when using emissions other than those in paragraphs (a), (b), (c) and (d) of this section:

(1) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;

(2) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB; and

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus $10\log_{10}$ (mean power in watts) dB.

RSS-182 Section 7.9 Transmitter Unwanted Emissions

Equipment with 25 kHz channel spacing (equipment designator G and D) shall comply with emission mask B. Radio equipment with 12.5 kHz channel spacing, with or without an audio low-pass filter, shall comply with emission mask C.

RSS-GEN Issue 5 Section 6.13 Transmitter Unwanted Emissions

The measurement method shall be described in the test report. When the applicable unwanted emissions limits are defined in relative terms, the same parameter, peak power or average power, used for the transmitter's output power measurement shall also be used for the unwanted emission measurements.
In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given below:
(a) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
(b) If the equipment operates at or above 10 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.
Particular attention should be paid to harmonics and sub-harmonics of the carrier frequency, as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.
The amplitude of spurious emissions attenuated more than 20 dB below the permissible value need not be reported.
When limits are expressed in absolute terms, compliance with the emission limits below 1000 MHz shall be demonstrated using a CISPR quasi-peak detector and the related measurement

bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limits can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater measurement bandwidth relative to the applicable CISPR quasi-peak bandwidth.
Above 1000 MHz, compliance with the emission limits shall be demonstrated using an average detector with a minimum resolution bandwidth of 1 MHz.

Methods of Measurement Radiated Spurious Emissions

ANSI C63-26:2017 Section 5.5.3 Measurement of spurious emissions using substitution method

5.5.3.1 General

Radiated measurements shall be performed using the test arrangement shown in Figure 6. After a direct field strength measurement of the maximum emission amplitude level (maximized as described previously), a signal generator and transmit antenna are substituted in place of the EUT, as shown in Figure 7. The output power of the signal generator is adjusted to replicate the maximized signal amplitude measured in the direct field strength measurement. The signal generator power setting is then used to determine the ERP or EIRP of the EUT spurious emission(s). These measurements shall be performed in accordance with the common requirements specified in 5.5.2 and the specific requirements provided in this subclause.
An impedance mismatch at the input of the transmitting antenna can result in cable reflections that can cause errors, which can be avoided with the use of attenuators at the input of the transmitting antenna. Attenuator values of 6 dB are typically adequate, but values as low as 3 dB can be used.
For vertically polarized antennas, it is important to maintain cables leaving the antennas in the same horizontal plane as the center of the antenna directly behind the antenna for a minimum distance of 1 m. The use of ferrite beads on the transmit antenna cable close to the antenna can help to eliminate common mode signals that can contribute to measurement errors.
The effects of the signal generator when located in the measurement field should be known, because the signal generator can influence the measured RF signal. Whenever possible, the signal generator should be located below the ground reference plane or outside of the measurement field region.
NOTE—Annex B describes an alternative procedure to characterize the path loss of a test site, which allows the calculation of a correction factor that can then be used to adjust the EUT emission data obtained from a direct field strength measurement, in lieu of the two-step substitution method. Acceptance of results obtained with this alternative procedure for compliance purposes is at the discretion of a regulatory authority (i.e., some regulatory agencies will not accept data collected with this method).

Test Arrangement Radiated Spurious Emissions

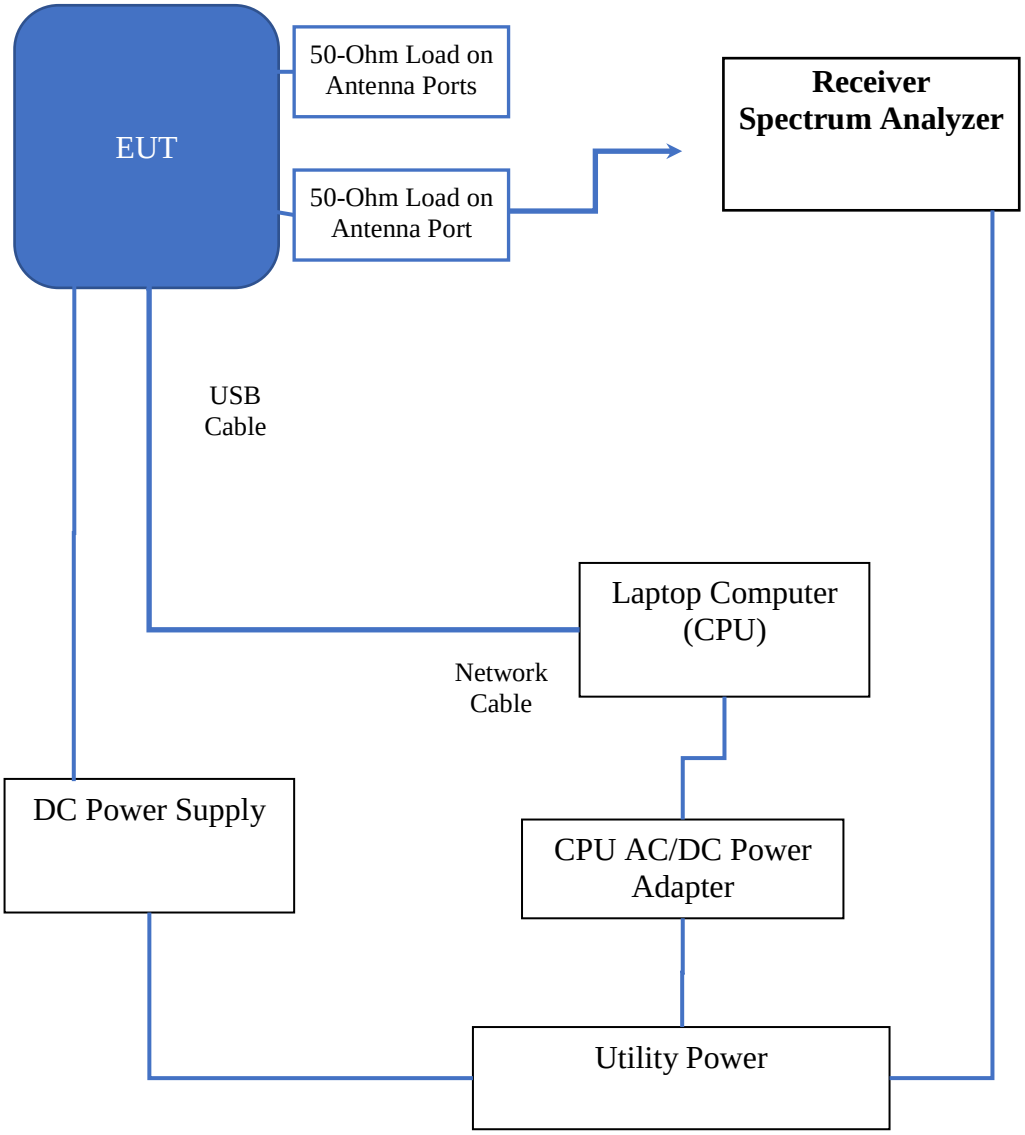


Table 4 Radiated Spurious Emissions (General Emissions From Cabinet and Cabling)

Frequency	Amplitude of Emission (dBµV)		Signal Level to dipole required to Reproduce(dBm)		Limit (dBm)	Emission level below carrier (dBc)	
MHz	Horizontal	Vertical	Horizontal	Vertical		Horizontal	Vertical
120.0	37.1	32.0	-58.13	-63.23	-13	45.1	50.2
130.0	28.3	19.1	-66.93	-76.13	-13	53.9	63.1
160.5	29.5	21.2	-65.73	-74.03	-13	52.7	61.0
163.5	32.6	21.9	-62.63	-73.33	-13	49.6	60.3
191.2	20.7	13.6	-74.53	-81.63	-13	61.5	68.6
360.0	44.5	30.6	-50.73	-64.63	-13	37.7	51.6
408.0	29.1	24.6	-66.13	-70.63	-13	53.1	57.6
504.0	34.0	32.1	-61.23	-63.13	-13	48.2	50.1

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequencies below 1000 MHz. Peak and Average amplitude emissions are recorded above for frequencies above 1000 MHz.

Table 5 Radiated Spurious Emissions (General Emissions From Cabinet and Cabling)

Frequency	Amplitude of Emission (dBµV)		Signal Level to dipole required to Reproduce(dBm)		Limit (dBm)	Emission level below carrier (dBc)	
MHz	Horizontal	Vertical	Horizontal	Vertical		Horizontal	Vertical
Low Channel							
312.1	64.6	44.1	-30.63	-51.13	-13	17.6	38.1
468.1	65.0	46.1	-30.23	-49.13	-13	17.2	36.1
624.1	56.3	36.6	-38.93	-58.63	-13	25.9	45.6
780.1	43.5	27.5	-51.73	-67.73	-13	38.7	54.7
936.2	39.1	23.1	-56.13	-72.13	-13	43.1	59.1
1092.2	31.3	20.4	-63.93	-74.83	-13	50.9	61.8
1248.2	37.6	29.0	-57.63	-66.23	-13	44.6	53.2
1404.2	24.3	17.7	-70.93	-77.53	-13	57.9	64.5
High Channel							
318.1	63.8	39.9	-31.43	-55.33	-13	18.4	42.3
474.1	64.1	43.8	-31.13	-51.43	-13	18.1	38.4
630.1	53.3	30.4	-41.93	-64.83	-13	28.9	51.8
786.1	42.1	27.7	-53.13	-67.53	-13	40.1	54.5
942.2	36.5	35.3	-58.73	-59.93	-13	45.7	46.9
1098.2	30.6	21.0	-64.63	-74.23	-13	51.6	61.2
1254.2	37.5	25.4	-57.73	-69.83	-13	44.7	56.8
1410.2	24.9	23.1	-70.33	-72.13	-13	57.3	59.1

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequencies below 1000 MHz. Peak and Average amplitude emissions are recorded above for frequencies above 1000 MHz.

TEST #7 Frequency Stability

FCC Reference: 47 CFR 2.1055, 80.209

IC Reference: RSS-GEN Section 6.11, RSS-182 Section 5.2

Test Method: KDB 971168 D01, Section 7 and Notes Below

Results: Meets requirements

Notes:

1. 20-dB, 50-Ohm external attenuator was placed on the RF Antenna Port connection to connect measurement equipment to the RF output port of the test sample.
2. The EUT was transmitting at maximum and minimum power.

§2.1055 Measurements required: Frequency stability.

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From −30° to + 50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

(2) From −20° to + 50° centigrade for equipment to be licensed for use in the Maritime Services under part 80 of this chapter, except for Class A, B, and S Emergency Position Indicating Radiobeacons (EPIRBS), and equipment to be licensed for use above 952 MHz at operational fixed stations in all services, stations in the Local Television Transmission Service and Point-to-Point Microwave Radio Service under part 21 of this chapter, equipment licensed for use aboard aircraft in the Aviation Services under part 87 of this chapter, and equipment authorized for use in the Family Radio Service under part 95 of this chapter.

(3) From 0° to + 50° centigrade for equipment to be licensed for use in the Radio Broadcast Services under part 73 of this chapter.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

(c) In addition to all other requirements of this section, the following information is required for equipment incorporating heater type crystal oscillators to be used in mobile stations, for which type

acceptance is first requested after March 25, 1974, except for battery powered, hand carried, portable equipment having less than 3 watts mean output power.

(1) Measurement data showing variation in transmitter output frequency from a cold start and the elapsed time necessary for the frequency to stabilize within the applicable tolerance. Tests shall be made after temperature stabilization at each of the ambient temperature levels; the lower temperature limit, 0° centigrade and + 30° centigrade with no primary power applied.

(2) Beginning at each temperature level specified in paragraph (c)(1) of this section, the frequency shall be measured within one minute after application of primary power to the transmitter and at intervals of no more than one minute thereafter until ten minutes have elapsed or until sufficient measurements are obtained to indicate clearly that the frequency has stabilized within the applicable tolerance, whichever time period is greater. During each test, the ambient temperature shall not be allowed to rise more than 10° centigrade above the respective beginning ambient temperature level.

(3) The elapsed time necessary for the frequency to stabilize within the applicable tolerance from each beginning ambient temperature level as determined from the tests specified in this paragraph shall be specified in the instruction book for the transmitter furnished to the user.

(4) When it is impracticable to subject the complete transmitter to this test because of its physical dimensions or power rating, only its frequency determining and stabilizing portions need be tested.

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

(e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c), and (d) of this section. (For example measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment.)

§80.209 Transmitter frequency tolerances.

(a) The frequency tolerance requirements applicable to transmitters in the maritime services are shown in the following table. Tolerances are given as parts in 10^6 unless shown in Hz.

Frequency bands and categories of stations	Tolerances[1]
(5) Band 156-162 MHz:	
(i) Coast stations:	
For carriers licensed to operate with a carrier power:	
Below 3 watts	10.
3 to 100 watts	5.[7]
(ii) Ship stations	10.[4]

[4]For transmitters in the radiolocation and associated telecommand service operating on 154.584 MHz, 159.480 MHz, 160.725 MHz and 160.785 MHz the frequency tolerance is 15 parts in 10^6.

RSS-182 Section 7.4

7.4 Frequency Stability

With the exception of DSC emissions, the RF carrier frequency shall not depart from the reference frequency in excess of the limits listed in Table 2.

Table 2 - Frequency Stability Limits

Type of Equipment	Frequency Stability Limit
Coast stations	±10.0 ppm for transmitter power less than 3 watts ±.0 ppm for transmitter power between 3 and 100 watts ±2.5 ppm for transmitter power exceeding 100 watts
Ship stations	±10 ppm

Methods of Measurement Frequency Stability

ANSI C63-26:2017 5.6.3 Procedure for frequency stability testing

Frequency stability is a measure of the frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at +20 ˚C and rated supply voltage. The operating carrier frequency shall be set up in accordance with the manufacturer's published operation and instruction manual prior to the commencement of these tests. No adjustment of any frequency determining circuit element shall be made subsequent to this initial set-up. Frequency stability is tested:

a) At 10 ˚C intervals of temperatures between -30 ˚C and +50 ˚C at the manufacturer's rated supply voltage, and
b) At +20 ˚C temperature and ±15% supply voltage variations. If a product is specified to operate over a range of input voltage then the ±15% variation is applied to the lower most voltage and the +15% is applied to the uppermost voltage.

During the test all necessary settings, adjustments and control of the EUT have to be performed without disturbing the test environment, i.e., without opening the environmental chamber. The frequency stabilities can be maintained to a lesser temperature range provided that the transmitter is automatically inhibited from operating outside the lesser temperature range. For handheld equipment that is only capable of operating from internal batteries and the

supply voltage cannot be varied, the frequency stability tests shall be performed at the nominal battery voltage and the battery end point voltage specified by the manufacturer. An external supply voltage can be used and set at the internal battery nominal voltage, and again at the battery operating end point voltage which shall be specified by the equipment manufacturer.
If an unmodulated carrier is not available, the mean frequency of a modulated carrier can be obtained by using a frequency counter with gating time set to an appropriately large multiple of bit periods (gating time depending on the required accuracy). Full details on the choice of values shall be included in the test report.

Test Arrangement antenna port conducted

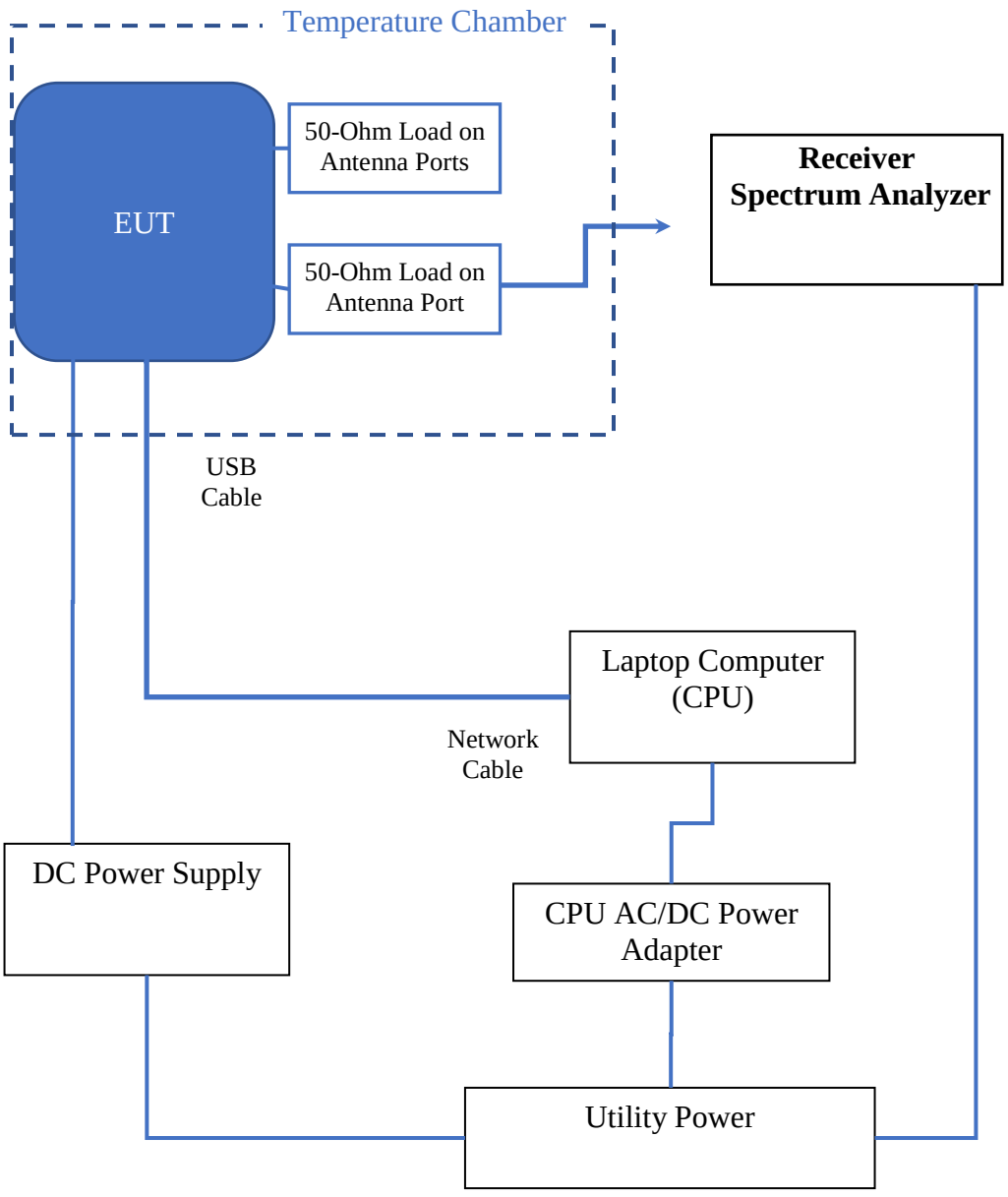


Table 6 Frequency Stability vs. Temperature data

Frequency Stability Vs. Temperature Ambient Frequency 161.975080128 MHz									
Temperature °C	-30	-20	-10	0	+10	+20	+30	+40	+50
Change (Hz)	0	0	0	0	0	0	0	0	0
PPM	-0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 7 Frequency Stability vs. Input Power Supply Voltage data

Frequency Stability Vs. Voltage Variation 12 or 24 DC volts nominal Ambient Frequency 161.975080128 MHz			
Voltage V_{dc}	10.8	24.0	28.2
Change (Hz)	0	0	0
PPM	-0.001	0.000	0.000
%	0.000	0.000	0.000

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to demonstrate compliance with the 47 CFR Parts 2 or 80E and Industry Canada RSS-182 Issue 5 emissions requirements. There were no deviations or modifications to the specifications.

Annex

- Annex A Measurement Uncertainty Calculations
- Annex B Rogers Labs Test Equipment List
- Annex C Rogers Qualifications
- Annex D Rogers Labs Certificate of Accreditation

Annex A Measurement Uncertainty Calculations

The measurement uncertainty was calculated for all measurements listed in this test report according To CISPR 16–4. Result of measurement uncertainty calculations are recorded below. Component and process variability of production devices similar to those tested may result in additional deviations. The manufacturer has the sole responsibility of continued compliance.

Measurement	Expanded Measurement Uncertainty $U_{(lab)}$
3 Meter Horizontal 0.009-1000 MHz Measurements	4.16
3 Meter Vertical 0.009-1000 MHz Measurements	4.33
3 Meter Measurements 1-18 GHz	5.14
3 Meter Measurements 18-40 GHz	5.16
10 Meter Horizontal Measurements 0.009-1000 MHz	4.15
10 Meter Vertical Measurements 0.009-1000 MHz	4.32
AC Line Conducted	1.75
Antenna Port Conducted power	1.17
Frequency Stability	1.00E-11
Temperature	1.6˚C
Humidity	3%

Annex B Rogers Labs Test Equipment List

List of Test Equipment	Calibration Date (m/d/y)	Due
Antenna: Schwarzbeck Model: BBA 9106/VHBB 9124 (9124-627)	5/2/2018	5/2/2019
Antenna: Schwarzbeck Model: VULP 9118 A (VULP 9118 A-534)	5/2/2018	5/2/2019
Antenna: EMCO 6509	10/24/2016	10/24/2018
Antenna: EMCO 3143 (9607-1277) 20-1200 MHz	5/2/2018	5/2/2019
Antenna: EMCO Dipole Set 3121C	2/23/2018	2/23/2019
Antenna: C.D. B-101	2/23/2018	2/23/2019
Antenna: Solar 9229-1 & 9230-1	2/23/2018	2/23/2019
Cable: Belden 8268 (L3)	10/24/2017	10/24/2018
Cable: Time Microwave: 4M-750HF290-750	10/24/2017	10/24/2018
Frequency Counter: Leader LDC-825 (8060153	5/2/2018	5/2/2019
Oscilloscope Scope: Tektronix 2230	2/23/2018	2/23/2019
Wattmeter: Bird 43 with Load Bird 8085	2/23/2018	2/23/2019
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/23/2018	2/23/2019
R.F. Generator: SMB100A6 s/n 100623	5/2/2018	5/2/2019
R.F. Generator: SBMBV100A s/n: 260771	5/2/2018	5/2/2019
R.F. Generators: HP 606A, HP 8614A, HP 8640B	2/23/2018	2/23/2019
R.F. Power Amp 65W Model: 470-A-1010	2/23/2018	2/23/2019
R.F. Power Amp 50W M185- 10-501	2/23/2018	2/23/2019
R.F. Power Amp A.R. Model: 10W 1010M7	2/23/2018	2/23/2019
R.F. Power Amp EIN Model: A301	2/23/2018	2/23/2019
LISN: Compliance Eng. Model 240/20	5/2/2018	15/50/19
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08	5/2/2018	5/2/2019
Audio Oscillator: H.P. 201CD	2/23/2018	2/23/2019
ESD Test Set 2010i	2/23/2018	2/23/2019
Oscilloscope Scope: Tektronix MDO 4104	2/23/2018	2/23/2019
EMC Transient Generator HVT TR 3000	2/23/2018	2/23/2019
AC Power Source (Ametech, California Instruments)	2/23/2018	2/23/2019
Fast Transient Burst Generator Model: EFT/B-101	2/23/2018	2/23/2019
Field Intensity Meter: EFM-018	2/23/2018	2/23/2019
KEYTEK Ecat Surge Generator	2/23/2018	2/23/2019
ESD Simulator: MZ-15	2/23/2018	2/23/2019
Shielded Room not required		

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 27 years' experience in the field of electronics. Engineering experience includes six years in the automated controls industry and remaining years working with the design, development and testing of radio communications and electronic equipment.

Positions Held

Systems Engineer: A/C Controls Mfg. Co., Inc. 6 Years

Electrical Engineer: Rogers Consulting Labs, Inc. 5 Years

Electrical Engineer: Rogers Labs, Inc. Current

Educational Background

1) Bachelor of Science Degree in Electrical Engineering from Kansas State University.

2) Bachelor of Science Degree in Business Administration Kansas State University.

3) Several Specialized Training courses and seminars pertaining to Microprocessors and Software programming.

Scot D Rogers

Scot D. Rogers

Annex D Rogers Labs Certificate of Accreditation

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 200087-0

Rogers Labs, Inc.
Louisburg, KS

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Electromagnetic Compatibility & Telecommunications

This laboratory is 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 joint ISO-ILAC-IAF Communique dated January 2009).

2018-02-21 through 2019-03-31
Effective Dates

For the National Voluntary Laboratory Accreditation Program