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 Application for Certification 47CFR Part 27 and RSS-195 Issue 2 2305-2320 MHz & 2345-2360 MHz

Model: PhoeniX G2

FCC ID: W9Z-PHOENIXG2
IC: 8855A-PHOENIXG2

SAF Tehnika AS

24a, Ganibu dambis
Riga Latvia LV-1005

Test Report Number: 190528
FCC Designation: US5305
IC Test Site Registration: 3041A-1

Test Date: May 28, 2019

Authorized Signatory: Scot D Rogers

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

Table of Contents

TABLE OF CONTENTS 2

REVISIONS 5

FOREWORD 6

SUMMARY 6

ATTESTATIONS 6

OPINION / INTERPRETATION OF RESULTS 7

EQUIPMENT TESTED 7

EQUIPMENT FUNCTION AND CONFIGURATION 8

Equipment Configuration 9

APPLICANT COMPANY INFORMATION 10

EQUIPMENT INFORMATION 10

Product Details 10

APPLICATION FOR CERTIFICATION 11

APPLICABLE STANDARDS & TEST PROCEDURES 14

Radiated Emission Test Procedure 14

Antenna Port Conducted Emissions Test Procedure 14

Diagram 1 Test arrangement for Radiated emissions 15

Diagram 2 Test arrangement for Antenna Port Conducted emissions testing 16

LIST OF TEST EQUIPMENT 17

TEST SITE LOCATIONS 18

UNITS OF MEASUREMENTS 18

ENVIRONMENTAL CONDITIONS 18

TEST #1 POWER OUTPUT 19

§2.1046 Measurements required: RF power output. 19

§27.50 Power limits and duty cycle. 20

SRSP-516 paragraph 5.1 21

Methods of Measurement Conducted Output Power 21

Test Arrangement Output Power 22

Table 1 Output Power Data 23

Figure 1 Plot of Channel in Band (5MHz Channel, Low Power, Low Band) 24

Figure 2 Plot of Channel in Band (5MHz Channel, Low Power, High Band) 25

Figure 3 Plot of Channel in Band (5MHz Channel, High Power, Low Band) 26

Figure 4 Plot of Channel in Band (5MHz Channel, High Power, Low Band) 27

Figure 5 Plot of Channel in Band (10MHz Channel, Low Power, Low Band) 28

Figure 6 Plot of Channel in Band (10MHz Channel, Low Power, High Band) 29

Figure 7 Plot of Channel in Band (10MHz Channel, High Power, Low Band) 30

Figure 8 Plot of Channel in Band (10MHz Channel, High Power, High Band) 31

Figure 9 Plot of Complementary Cumulative Distribution Function (CCDF) (5 MHz Channel) 32

Figure 10 Plot of Complementary Cumulative Distribution Function (CCDF) (10 MHz Channel) 33

Figure 11 Plot of Antenna Port Power Output (5 MHz Channel, High Power, Low Band) 34

Figure 12 Plot of Antenna Port Power Output (5 MHz Channel, Low Power, Low Band) 34

Figure 13 Plot of Antenna Port Power Output (10 MHz Channel, High Power) 35

TEST #2 OCCUPIED BANDWIDTH, UNDESIRABLE CONDUCTED RADIATION AND EMISSION MASK COMPLIANCE 36

§2.1049 Measurements required: Occupied bandwidth. 36

RSS-195, Paragraph 5.6 Transmitter Unwanted Emissions 36

Methods of Measurement Occupied Bandwidth 37

Test Arrangement Occupied Bandwidth 37

Table 2 Occupied Bandwidth Data....38

Figure 14 Plot of 99% Occupied Bandwidth (5 MHz Channel, Low Band) 39

Figure 15 Plot of 26-dB Occupied Bandwidth (5 MHz Channel, Low Band)....40

Figure 16 Plot of 99% Occupied Bandwidth (5 MHz Channel, High Band)....41

Figure 17 Plot of 26-dB Occupied Bandwidth (5 MHz Channel, High Band) 42

Figure 18 Plot of 99% Occupied Bandwidth (10 MHz Channel, Low Band) 43

Figure 19 Plot of 26-dB Occupied Bandwidth (10 MHz Channel, Low Band)....44

Figure 20 Plot of 99% Occupied Bandwidth (10 MHz Channel, High Band)....45

Figure 21 Plot of 26-dB Occupied Bandwidth (10 MHz Channel, High Band) 46

TEST #3 SPECTRAL EMISSION MASK COMPLIANCE AND SPURIOUS CONDUCTED 47

§2.1051 Measurements required: Spurious emissions at antenna terminals. 47

§27.53 Emission limits.....47

RSS-195, Paragraph 5.6 Transmitter Unwanted Emissions....48

Methods of Measurement Spectral Emission Mask and Spurious Conducted 48

Test Arrangement Emission Mask and Spurious Conducted 49

Table 3 Spurious Emissions at Antenna Terminal Data (5 MHz Channel) 50

Table 4 Spurious Emissions at Antenna Terminal Data (10 MHz Channel) 51

Figure 22 Plot of Spectral Emission Mask (5 MHz Channel, Low Channel, Low Band) 52

Figure 23 Plot of Spectral Emission Mask (5 MHz Channel, High Channel, Low Band)....53

Figure 24 Plot of Spectral Emission Mask (5 MHz Channel, Low Channel, High Band)....54

Figure 25 Plot of Spectral Emission Mask (5 MHz Channel, High Channel, High Band)....55

Figure 26 Plot of Spectral Emission Mask (10 MHz Channel, Low Band)....56

Figure 27 Plot of Spectral Emission Mask (10 MHz Channel, High Band) 57

TEST #4 RADIATED SPURIOUS EMISSIONS 58

§2.1053 Measurements required: Field strength of spurious radiation. 58

§27.53 Emission limits. **59**

RSS-195, Paragraph 5.6 Transmitter Unwanted Emissions **59**

Methods of Measurement Spectral Emission Mask and Spurious **60**

Test Arrangement Radiated Spurious Emissions **61**

Table 5 Radiated Spurious Emissions 62

TEST #5 FREQUENCY STABILITY **63**

§2.1055 Measurements required: Frequency stability. **63**

§27.54 Frequency stability. **64**

RSS-195, Paragraph 5.4 Frequency Stability **64**

Methods of Measurement Frequency Stability **64**

Test Arrangement Frequency Stability **65**

Table 6 Frequency Stability vs. Temperature Results **66**

Table 7 Frequency Stability vs. Input Power Supply Voltage Results **66**

ANNEX **67**

Annex A Measurement Uncertainty Calculations **68**

Annex B Rogers Qualifications **69**

Annex C Rogers Labs Certificate of Accreditation **70**

Revisions

Revision 1 Issued November 11, 2019

Foreword

The following information is submitted for consideration in obtaining Equipment Grant of Certification for Licensed Wireless Communications Services (WCS) equipment for use in in frequency bands 2305-2320 MHz and 2345-2360 MHz.

Transmitter equipment operating under 47CFR Paragraphs 2 and 27 and Innovation, Science and Economic Development (ISED) RSS-195 Issue 2.

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: SAF Tehnika AS
24a, Ganibu dambis
Riga Latvia LV-1005

Model: PhoeniX G2 **PMN**: PhoeniX G2 **PN**: S02GHR08L and S02GHR08H

FCC ID: W9Z-PHOENIXG2 IC: 8855A-PHOENIXG2

Frequency Range: 2305-2320 MHz and 2345-2360 MHz

Maximum Power: 4 Watts Power reducible to 0.04 Watts

Attestations

This equipment has been tested in accordance with the standards identified in this report and determined in compliance with the referenced requirements and regulations. 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 17025:2017 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: May 28, 2019

Opinion / Interpretation of Results

Test Number	Measurement	FCC Rule	Pass/Fail
#1	Power Measurement	47CFR 2.1046, 27.50, SRSP-516 paragraph 5.1	Pass
#2	Occupied Bandwidth, Conducted Emissions Mask and Spurious Emissions	47CFR 2.1049, 2.1051, 27.53 RSS-195 5.6	Pass
#3	Radiated Spurious Emissions	47CFR 2.1051, 2.1053, RSS-195 5.6	Pass
#4	Frequency Stability	47CFR 2.1055, 27.54, RSS-195 5.4	Pass

Equipment Tested

Equipment	Model	Serial Number	FCC I.D.
EUT#1 (ODU)	PhoeniX G2	300540100019	W9Z-PHOENIXG2
EUT#2 (ODU)	PhoeniX G2	300550100020	W9Z-PHOENIXG2
IDU (In Door Unit)	PhoeniX G2-IDU	358880100034	N/A
IDU (In Door Unit)	PhoeniX G2-IDU	358880100035	N/A
AC Adapter	GST160A48-R7B	EB83953435	N/A
Laptop Computer	Dell E6520	6CB35Q1	N/A

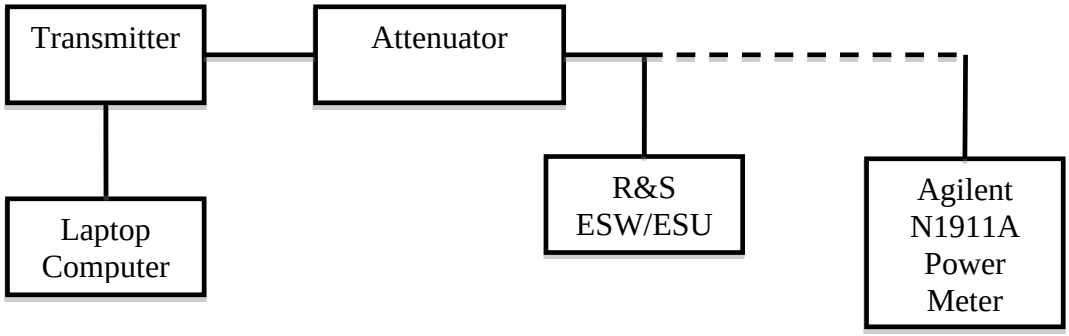
Test results in this report relate only to the items tested.

Firmware version: 403_03_p1

Equipment Function and Configuration

The EUT is a 2 GHz Digital Point-to-Point Wireless Communications Services (WCS) Transmission System. The design provides operational capabilities in the 2305-2320 MHz and 2345-2360 MHz band. The PhoeniX G2 is designed as Outdoor Unit (ODU) providing for long distance Point-to-Point, high data rate, digital communication transmissions. The design provides multiple modulation options to maintain the communications link. The design may auto-select modulation or it may be set during installation. The product offers two options for channel width wither 5 or 10 MHz channel providing high data rate and long-distance point-to-point configurations. The PhoeniX G2-IDU requires direct current power supplied from an AC/DC power supply. The PhoeniX G2 receives power form the IDU over the connected coaxial interface cable. A typical installation would use a low frequency transmitter and high frequency receiver at one location and high frequency transmitter and low frequency receiver at the next providing full duplex communications. All up and down conversions are processed in the EUT supplying the IDU with digital data. The IDU provides switching and monitoring of data and supplies the data to associated interface distribution network. Software was provided internal to the EUT which provided the ability to set test channel, modulation scheme and transmit power of the EUT. The software was accessed using the laptop computer and web browser software. The system provides single N-connector antenna port connection as documented in this report. For testing purposes, the EUT was connected to the manufacturer supplied IDU and associated AC/DC power supply. A laptop computer was connected to the IDU network port which provided communications and control to the EUT for testing purposes. This configuration provided operational control of the EUT and communications over the network interface between the EUT, IDU and supporting computer system. The EUT provides no other interfacing options than those presented in this report. As requested by the manufacturer and required by regulations, the equipment was tested for emissions compliance using the available configurations with the worst-case data presented. Test results in this report relate only to the products described in this report.

Equipment Configuration



Applicant Company information

Applicants Company	SAF Tehnika AS
Applicants Address	24a, Ganibu dambis Riga Latvia LV-1005
Identifier	FCC ID:W9Z-PHOENIXG2 and IC: 8855A-PHOENIXG2
Manufacturer Company	SAF Tehnika AS
Manufacturer Address	24a, Ganibu dambis Riga Latvia LV-1005

Equipment information

Brand Name	SAF Tehnika AS
Model Number	PhoeniX G2
Test Rule Part(s)	FCC CFR 2, 74
Test Frequency Range	2305-2320 MHz and 2345-2360 MHz
Project Number	190528
Submission Type	Certification

Product Details

Items	Description
Product Type	Licensed Transmitter
Radio Type	Transmitter
Power Type	Direct Current Power Provided from Indoor Unit and AC/DC power adapter
Frequency Range	2305-2320 MHz and 2345-2360 MHz
Modulation	Digital
Emissions Designation	5M00D7W or 10M0D7W
Channel Bandwidth	5 or 10 MHZ
Maximum Conducted Output Power	4 Watts

Application for Certification

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

SAF Tehnika AS 24a, Ganibu dambis Riga Latvia LV-1005

(2) FCC identifier. FCC ID: W9Z-PHOENIXG2 IC: 8855A-PHOENIXG2

(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 available online or furnished when available.

Refer to exhibit for Instruction Manual.

(4) Type or types of emission. 5M00D7W or 10M0D7W

(5) Frequency range. 2305-2320 MHz and 2345-2360 MHz

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

4 W nominal to 0.040 watts minimum. The output power is variable by digital control commands issued via connected computer.

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

Service for transmitter use is defined by average equivalent isotropically radiated (EIRP) not exceeding 2,000 Watts within any 5MHz megahertz of authorized bandwidth and must not exceed 400 watts within any 1 megahertz of authorized bandwidth. The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB.

(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.

Power delivered into final amplifier 28.0 Volts @ 1 amps (28.0 Watts) at maximum power and 28.0 Volts @ 0.4 amps (11.2 Watts) for minimum power operation.

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

Refer to Exhibit for Transmitter 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.

Refer to Exhibit for details of digital modulation

(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

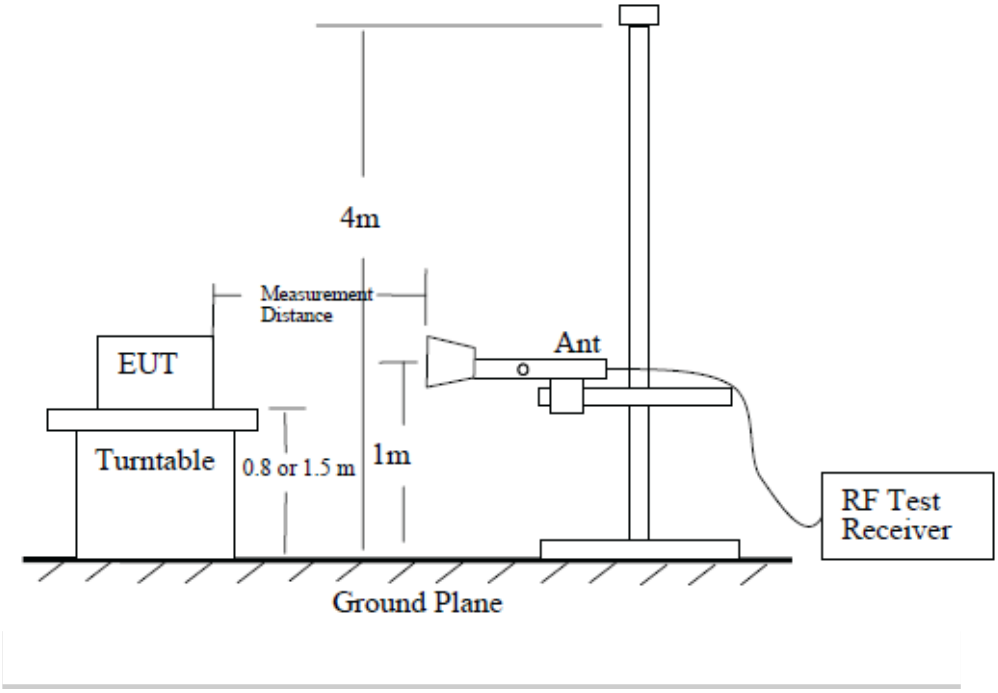
The following information is submitted in accordance with CFR dated May 28, 2019, Part 2, Subpart J, and Part 27, Subpart C. Test procedures used are the provided in ANSI C63.26-2015, CISPR 16-1-4:2010-04, and ANSI C63.4-2014.

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 ANSI C63.4-2014. 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 24,000 MHz was searched for during investigation. Refer to Diagram 1 showing typical test arrangement and photographs in the test setup exhibits for specific EUT placement during radiated emissions testing. A Rohde and Schwarz ESU40 was used as the measuring instrument for radiated emissions testing.

Antenna Port Conducted Emissions Test Procedure

The test configuration was placed on a 1 x 1.5-meter bench. Testing for the antenna port conducted emissions was performed as defined in ANSI C63.26-2015. The test sample antenna port was connected to appropriate attenuation and spectrum analyzer (or Power Meter) during measurements. Refer to Diagram 2 showing typical test arrangement and photographs in the test setup exhibits for specific EUT placement during Antenna Port Conducted emissions testing.



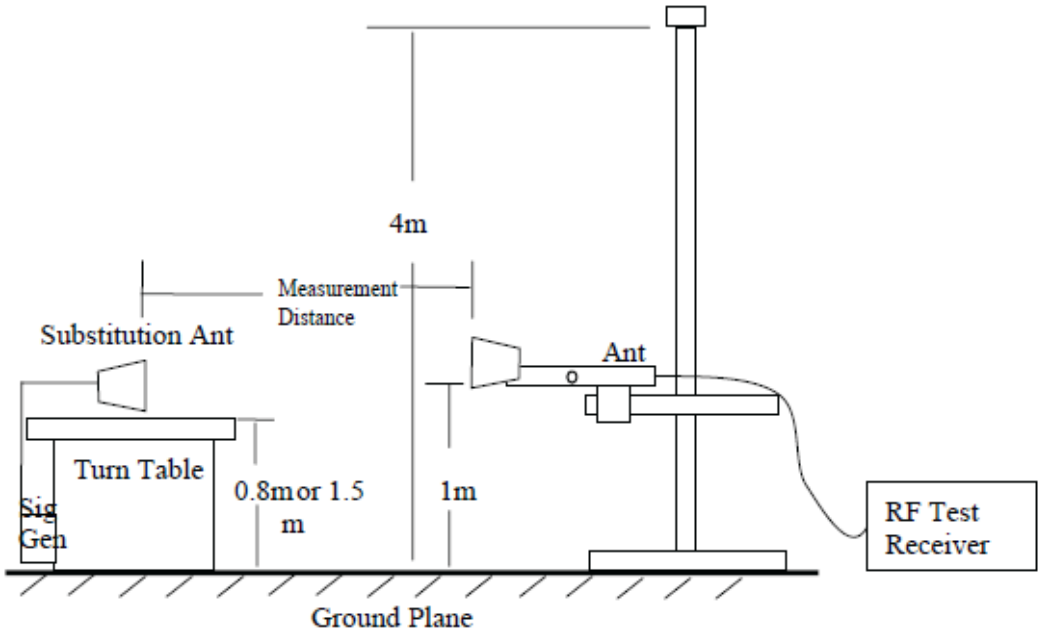


Diagram 1 Test arrangement for Radiated emissions

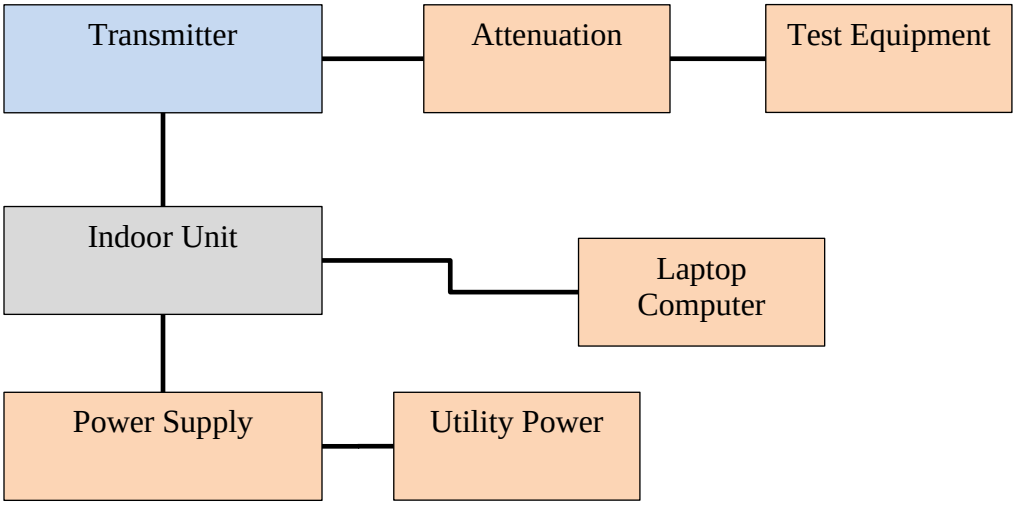


Diagram 2 Test arrangement for Antenna Port Conducted emissions testing

Testing
NVLAP Lab Code 200087-0

List of Test Equipment

Equipment	Manufacturer	Model (SN)	Band	Cal Date(m/d/y)	Due
☐ LISN	FCC	FCC-LISN-50-25-10(1PA) (160611)	.15-30MHz	4/18/2019	4/18/2020
☐ LISN	Compliance Design	FCC-LISN-2.Mod.cd,(126)	.15-30MHz	10/16/2018	10/16/2019
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)	9kHz-40 GHz	10/16/2018	10/16/2019
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	10/16/2018	10/16/2019
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303071)	9kHz-40 GHz	10/16/2018	10/16/2019
☐ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/16/2018	10/16/2019
☐ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/16/2018	10/16/2019
☐ Antenna	ARA	BCD-235-B (169)	20-350MHz	10/16/2018	10/16/2019
☐ Antenna	EMCO	3147 (40582)	200-1000MHz	10/16/2018	10/16/2019
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	5/2/2018	5/2/2020
☒ Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/16/2018	10/24/2019
☒ Antenna	Com Power	AH-840 (101046)	18-40 GHz	4/18/2019	4/18/2021
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	10/16/2018	10/16/2019
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/16/2018	10/16/2019
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	4/18/2019	4/18/2020
☒ Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	1/31/2019	1/31/2020
☐ Analyzer	Rohde & Schwarz	FS-Z60, 90, 140, and 220	40GHz-220GHz	12/22/2017	12/22/2019
☒ Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	10/16/2018	10/16/2019
☒ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/16/2018	10/16/2019
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/16/2018	10/16/2019
☒ Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	10/16/2018	10/16/2019
☒ Power Meter	Agilent	N1911A with N1921A	0.05-40 GHz	4/18/2019	4/18/2020
☒ Generator	Rohde & Schwarz	SMB100A6 (100150)	20Hz-6 GHz	4/18/2019	4/18/2020
☐ Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	4/18/2019	4/18/2020
☐ RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-1800 MHz	4/18/2019	4/18/2020
☐ RF Filter	Micro-Tronics	HPM50114 (017)1.5G HPF	30-18000 MHz	4/18/2019	4/18/2020
☐ RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	4/18/2019	4/18/2020
☐ RF Filter	Micro-Tronics	HPM50105 (059) 6G HPF	30-18000 MHz	4/18/2019	4/18/2020
☐ RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-1800 MHz	4/18/2019	4/18/2020
☐ RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-1800 MHz	4/18/2019	4/18/2020
☐ RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-1800 MHz	4/18/2019	4/18/2020
☒ Attenuator	Fairview	SA6NFNF100W-40 (1625)	30-1800 MHz	4/18/2019	4/18/2020
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1436)	30-6000 MHz	4/18/2019	4/18/2020
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	4/18/2019	4/18/2020
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	4/18/2019	4/18/2020
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1736)	30-6000 MHz	4/18/2019	4/18/2020
☒ Weather station	Davis	6312 (A81120N075)		10/26/2018	10/26/2019
☒ Antenna: Schwarzbeck Model: BBA 9106/VHBB 9124 (9124-627)				4/18/2019	4/18/2020
☒ Antenna: Schwarzbeck Model: VULP 9118 A (VULP 9118 A-534)				4/18/2019	4/18/2020
☐ Antenna: EMCO 6509				10/16/2018	10/16/2020
☐ Frequency Counter: Leader LDC-825 (8060153				4/18/2019	4/18/2020

Test Site Locations

Antenna port	Antenna port conducted emissions testing was performed in a shielded screen room located at Rogers Labs, Inc., 4405 West 259th Terrace, Louisburg, KS
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 presented in dBµV; dB referenced to one microvolt
Antenna port Conducted	Data is in dBm; dB referenced to one milliwatt
Radiated EMI	Data presented in dBµV/m; dB referenced to one microvolt per meter

Note: Radiated limit may be expressed for measurement in dBµV/m when the measurement is taken at a distance of 3 or 10 meters. Data taken for this report was taken at distance of 3 meters. Sample calculation demonstrates corrected field strength reading for Open Area Test Site using the measurement reading and correcting for receive antenna factor, cable losses, and amplifier gains.

Sample Calculation:

RFS = Radiated Field Strength, FSM = Field Strength Measured

A.F. = Receive antenna factor, Losses = attenuators/cable losses, Gain = amplification gains

RFS (dBµV/m @ 3m) = FSM (dBµV) + A.F. (dB/m) + Losses (dB) - Gain (dB)

Environmental Conditions

Ambient Temperature	24.0° C
Relative Humidity	47%
Atmospheric Pressure	1006.0 mb

TEST #1 Power Output

FCC Reference: 47CFR 2.1046, 27.50

ISED Reference: RSS-195 Paragraph 5.5

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

Results: Meets requirements

Notes:

1. The Antenna port was connected to 50-Ohm attenuation. Emissions were monitored at the attenuator using a coaxial cable to connect measurement equipment to the RF output port of the test setup.
2. The EUT was transmitting at maximum power allowed for modulation characteristic and at 100 % during testing. Testing was also conducted using minimum power setting.
3. A pseudo-random data pattern as defined internal to the test sample was used during testing.
4. No reduction in power was required to demonstrate compliance with regulations.

§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.

(b) For single sideband, independent sideband, and single channel, controlled carrier radiotelephone transmitters the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as follows. In all tests, the input level of the modulating signal shall be such as to develop rated peak envelope power or carrier power, as appropriate, for the transmitter.

(1) Single sideband transmitters in the A3A or A3J emission modes—by two tones at frequencies of 400 Hz and 1800 Hz (for 3.0 kHz authorized bandwidth), or 500 Hz and 2100 Hz (3.5 kHz authorized bandwidth), or 500 Hz and 2400 Hz (for 4.0 kHz authorized bandwidth), applied simultaneously, the input levels of the tones so adjusted that the two principal frequency components of the radio frequency signal produced are equal in magnitude.

(2) Single sideband transmitters in the A3H emission mode—by one tone at a frequency of 1500 Hz (for 3.0 kHz authorized bandwidth), or 1700 Hz (for 3.5 kHz authorized bandwidth), or 1900 Hz (for 4.0 kHz authorized bandwidth), the level of which is adjusted to produce a radio frequency signal component equal in magnitude to the magnitude of the carrier in this mode.

(3) As an alternative to paragraphs (b) (1) and (2) of this section other tones besides those specified may be used as modulating frequencies, upon a sufficient showing of need. However, any tones so chosen must not be harmonically related, the third and fifth order intermodulation products which occur must fall within the −25 dB step of the emission bandwidth limitation curve, the seventh and ninth order intermodulation product must fall within the 35 dB step of the referenced curve and the eleventh and all higher order products must fall beyond the −35 dB step of the referenced curve.

(4) Independent sideband transmitters having two channels by 1700 Hz tones applied simultaneously in both channels, the input levels of the tones so adjusted that the two principal frequency components of the radio frequency signal produced are equal in magnitude.

(5) Independent sideband transmitters having more than two channels by an appropriate signal or signals applied to all channels simultaneously. The input signal or signals shall simulate the input signals specified by the manufacturer for normal operation.

(6) Single-channel controlled-carrier transmitters in the A3 emission mode—by a 2500 Hz tone.

(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

§27.50 Power limits and duty cycle.

(a) The following power limits and related requirements apply to stations transmitting in the 2305-2320 MHz band or the 2345-2360 MHz band.

(1) *Base and fixed stations.* (i) For base and fixed stations transmitting in the 2305-2315 MHz band or the 2350-2360 MHz band:

(A) The average equivalent isotropically radiated power (EIRP) must not exceed 2,000 watts within any 5 megahertz of authorized bandwidth and must not exceed 400 watts within any 1 megahertz of authorized bandwidth.

(B) The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB. The PAPR measurements should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities to determine that PAPR will not exceed 13 dB for more than 0.1 percent of the time or other Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission.

(ii) For base and fixed stations transmitting in the 2315-2320 MHz band or the 2345-2350 MHz band, the peak EIRP must not exceed 2,000 watts.

SRSP-516 paragraph 5.1

5.1 Radiated Power Limits

5.1.1 Base and Fixed Stations

5.1.1.1 The equivalent isotropically radiated power (e.i.r.p.) of the base and fixed stations3 (with the exception of fixed subscriber stations) operating in the band 2305-2315 MHz or in the band 2350-2360 MHz shall not exceed 400 watts within any 1 MHz band; and shall not exceed 2000 W within any 5 MHz of bandwidth. The peak-to-average power ratio (PAPR) of these transmissions shall comply with the limits specified in RSS-195.

5.1.1.2 The e.i.r.p. of the base and fixed stations (with the exception of fixed subscriber stations) operating in the band 2315-2320 MHz or in the band 2345-2350 MHz shall not exceed 2000 W within either 5 MHz band.

Methods of Measurement Conducted Output Power

ANSI C63.26-2015

5.2 RF output power measurement procedures

This subclause provides guidance for performing the power measurements necessary to demonstrate compliance to the RF output power limits imposed by regulatory authorities on transmitters. In addition, these procedures can also be utilized to collect the data necessary to demonstrate compliance to regulatory limits placed on unwanted (out-of-band and spurious) emissions.

5.2.1 RF power measurement instrumentation considerations

There are several choices available with respect to instrumentation that can be used to perform the measurement of EUT output power, whether it be the output power associated with the fundamental emission or the power contained within unwanted (out-of-band and/or spurious) emissions. Typical instruments used to perform power measurements include RF power meters, spectrum analyzers, EMI receivers, and vector signal analyzers. Clause 4 provides detailed information regarding these instrumentation choices and the capabilities that are necessary for performing these measurements.

A power meter is widely recognized as the most accurate instrument for performing absolute power measurements; however, due to a lack of RF selectivity, limited modulation (video) bandwidth, and limited display capabilities, they typically do not offer much flexibility for use in performing more than just power measurements of the fundamental emission (i.e., they typically don't offer the capabilities necessary for measuring other compliance parameters such as OBW and PSD).

Most digital spectrum/signal analyzers and EMI receivers are equipped with a power averaging (rms) display detector that can provide near power meter accuracy while also offering the flexibility for use in collecting the data necessary to demonstrate compliance to most of the other regulatory requirements. Thus, spectrum analyzers, signal analyzers, and EMI receivers (with spectrum analyzer mode) have become the primary instruments of choice when performing compliance measurements, including RF output power measurements. Most contemporary versions of these instruments utilize digital displays and the display detector modes discussed in 4.2 are commonly implemented across these various platforms. Because older analog spectrum analyzers and EMI receivers typically do not offer the requisite display detectors specified in this standard, they are typically not suitable for use in performing average output power final measurements of noise-like signals.

Finally, it should be noted that many contemporary transmitters operate in network topologies in which client device transmission characteristics are controlled by a master server or base station. When measuring the maximum RF output power from such devices, control over the EUT must be provided either through special test software (provided by manufacturer specifically for compliance testing, but not accessible by an end user) or through use of a base station emulator, communications test set, call box, or similar

instrumentation that is capable of establishing a communications link with the EUT to enable control over variable parameters (e.g., output power, OBW, etc.). In some cases, these instruments also include basic digital spectrum analyzer and/or power meter capabilities that can be utilized to measure the RF output power if the specified detectors and requirements can be realized and the measurement functions have been calibrated.

Test Arrangement Output Power

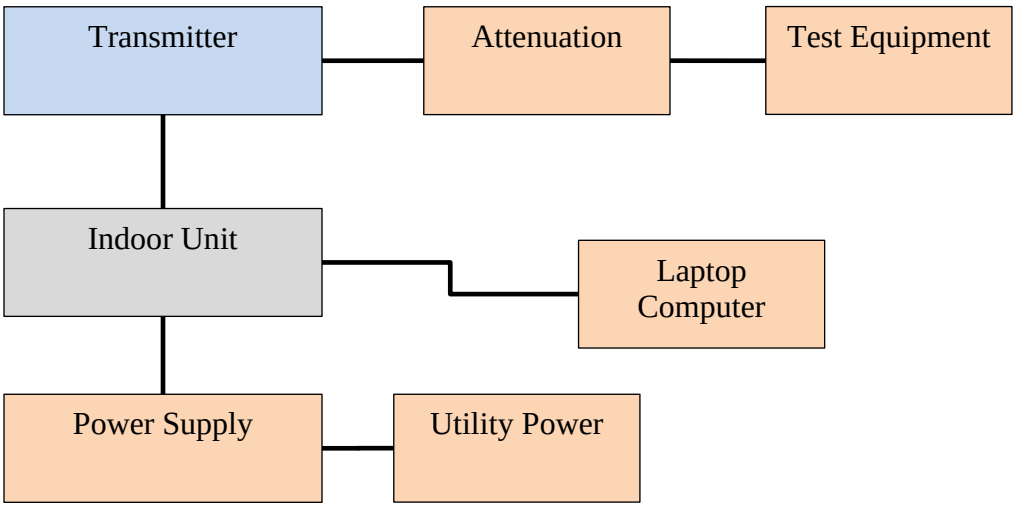


Table 1 Output Power Data

Frequency MHz	Conducted Antenna Port Peak Output Power (Watts)	Conducted Antenna Port Average Output Power (Watts)
5 MHz Channel, High Power		
2307.5	10.8	3.8
2312.5	10.6	3.7
2352.5	10.5	3.7
5 MHz Channel, Low Power		
2307.5	1.4	0.04
2312.5	1.4	0.04
2352.5	1.4	0.04
10 MHz Channel, High Power		
2310.0	10.7	3.6
2355.0	10.7	3.6
10 MHz Channel, Low Power		
2310.0	1.5	0.04
2355.0	1.5	0.04

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 the channel observed addressing the requirement.

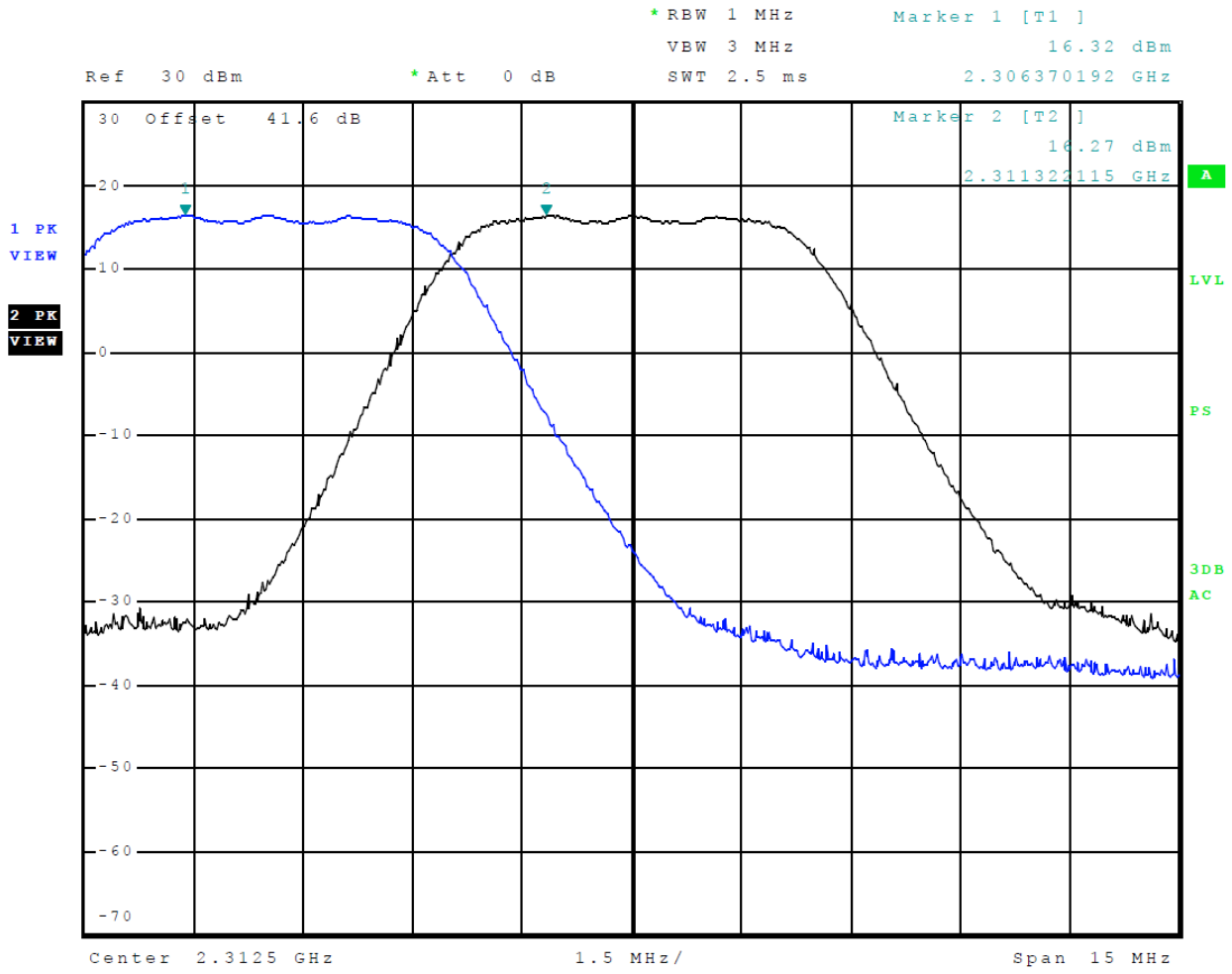


Figure 1 Plot of Channel in Band (5MHz Channel, Low Power, Low Band)

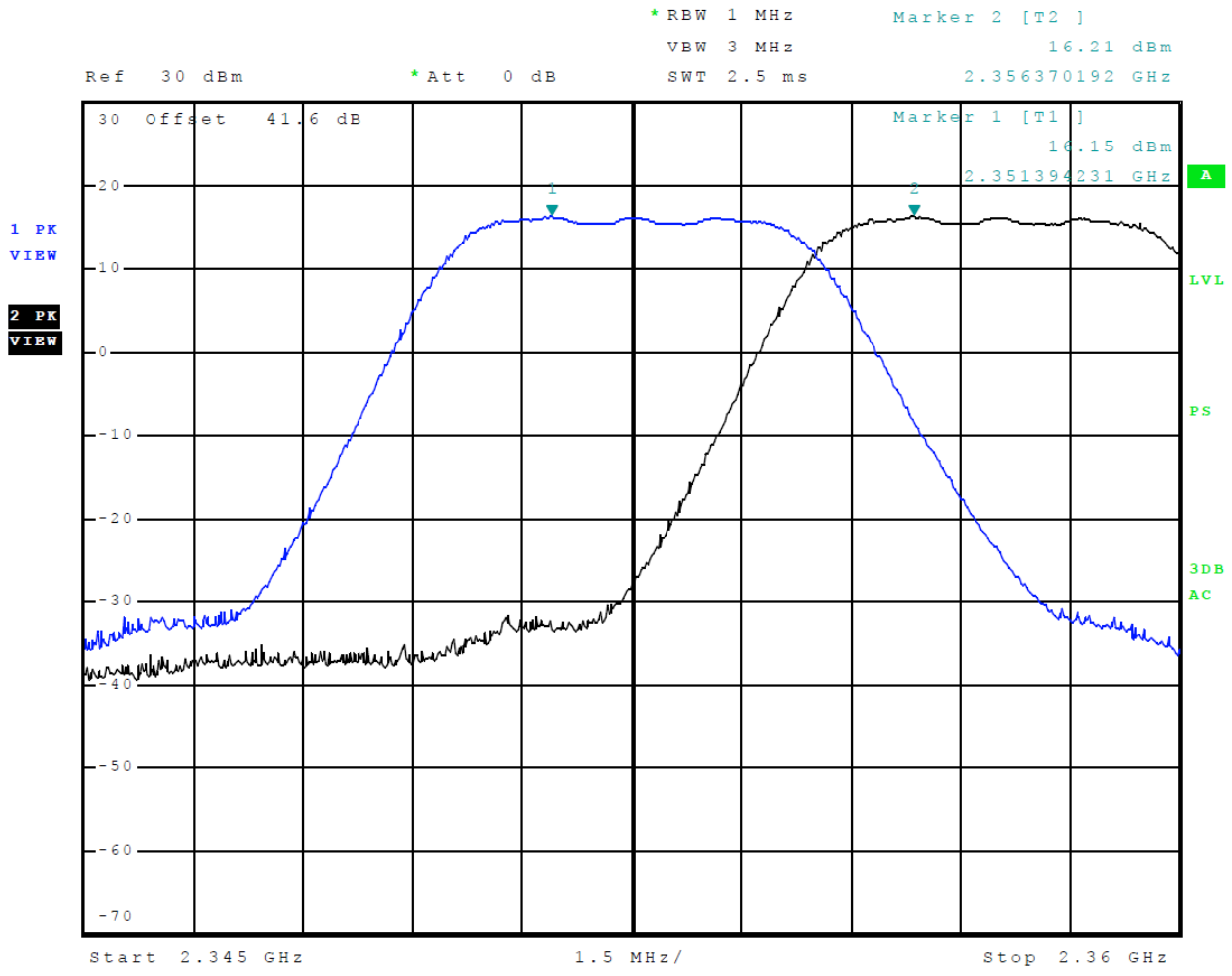


Figure 2 Plot of Channel in Band (5MHz Channel, Low Power, High Band)

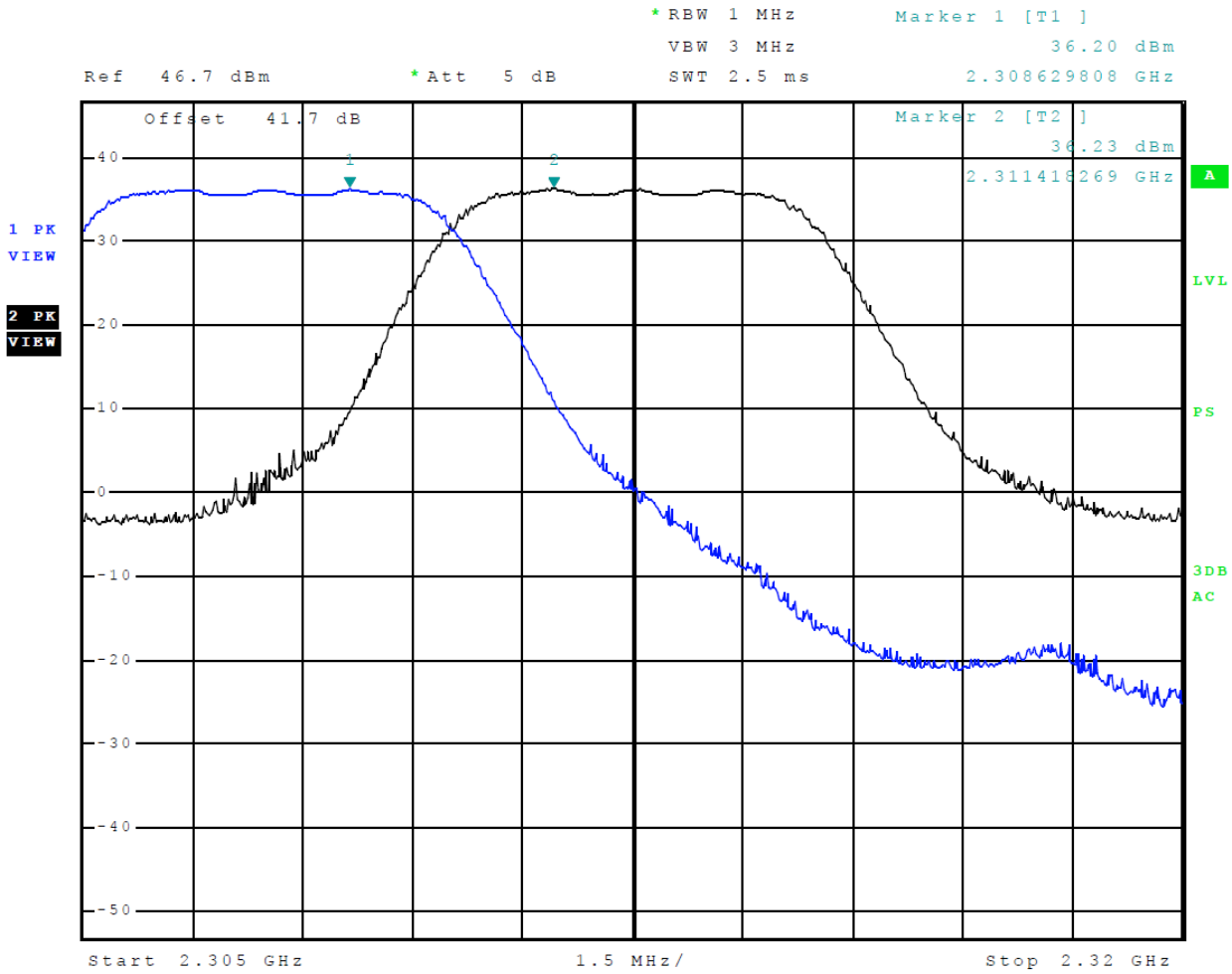


Figure 3 Plot of Channel in Band (5MHz Channel, High Power, Low Band)

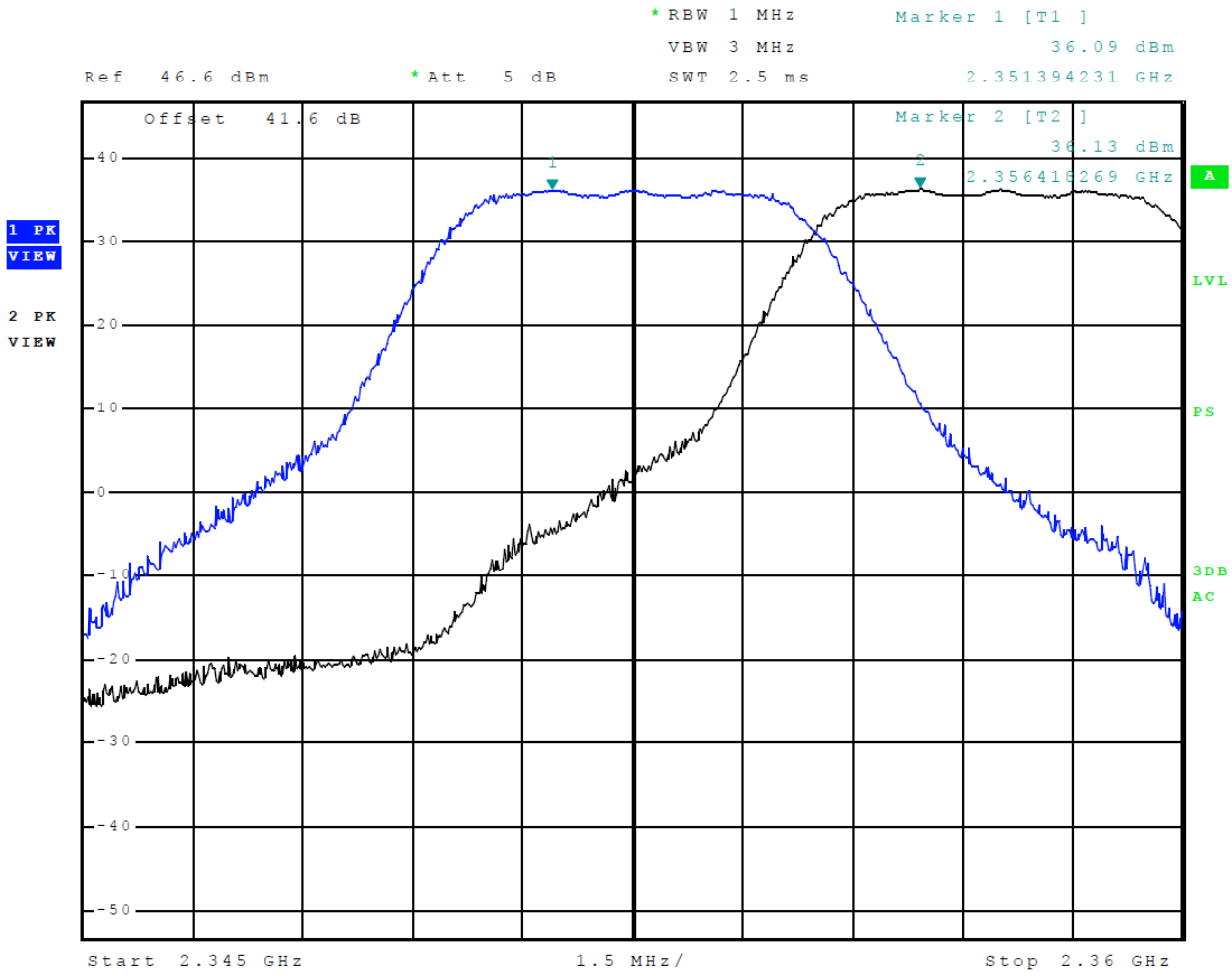


Figure 4 Plot of Channel in Band (5MHz Channel, High Power, Low Band)

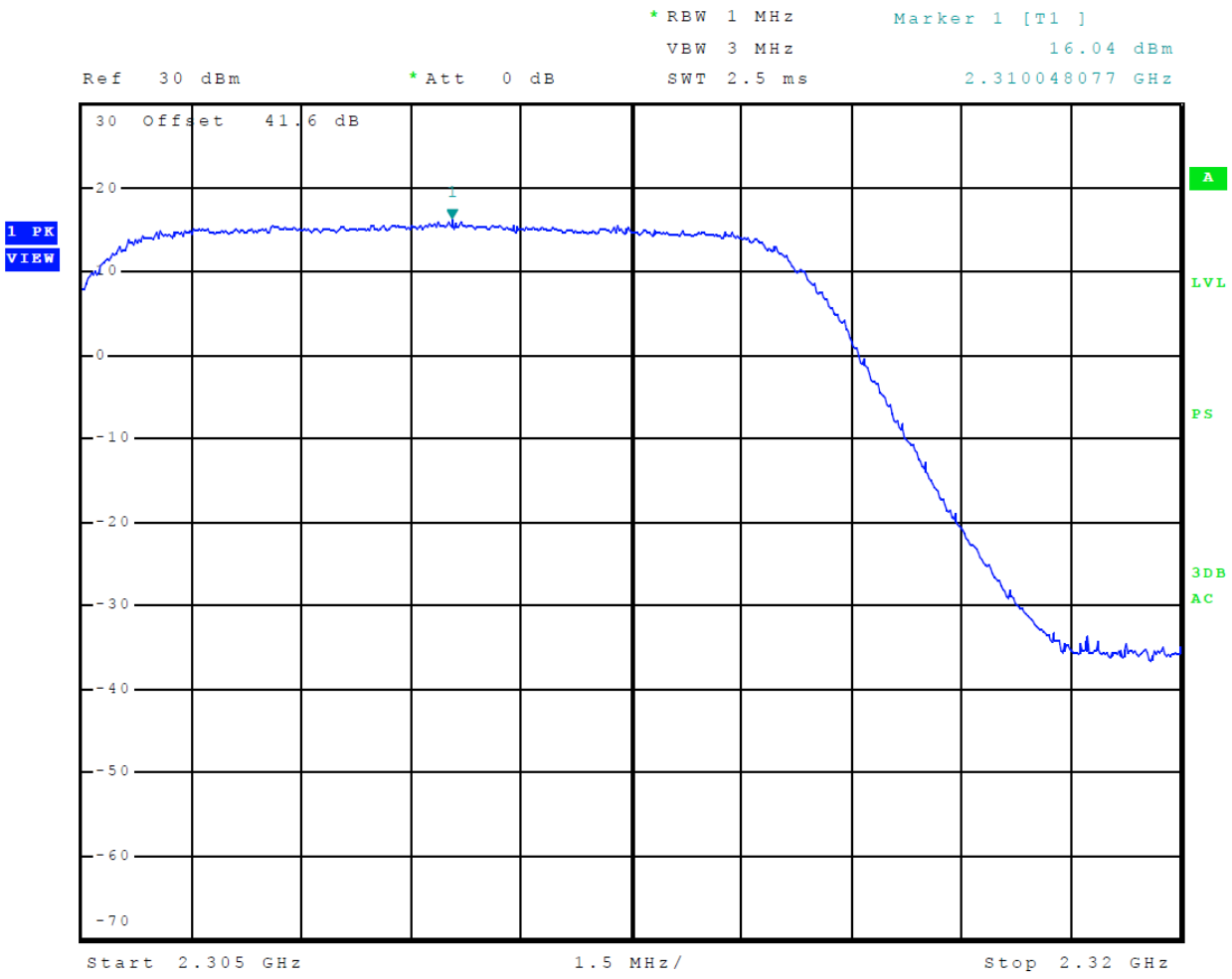


Figure 5 Plot of Channel in Band (10MHz Channel, Low Power, Low Band)

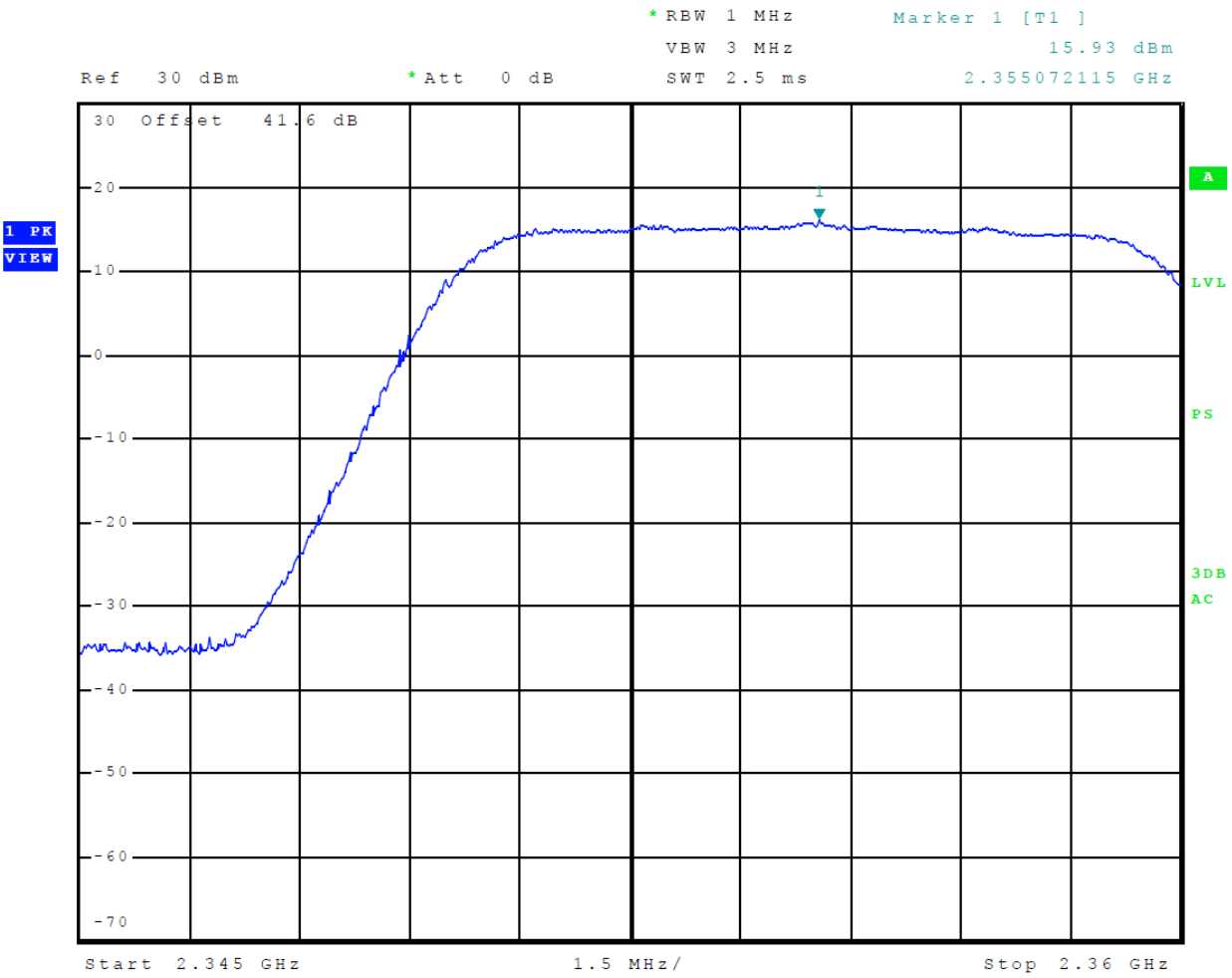


Figure 6 Plot of Channel in Band (10MHz Channel, Low Power, High Band)

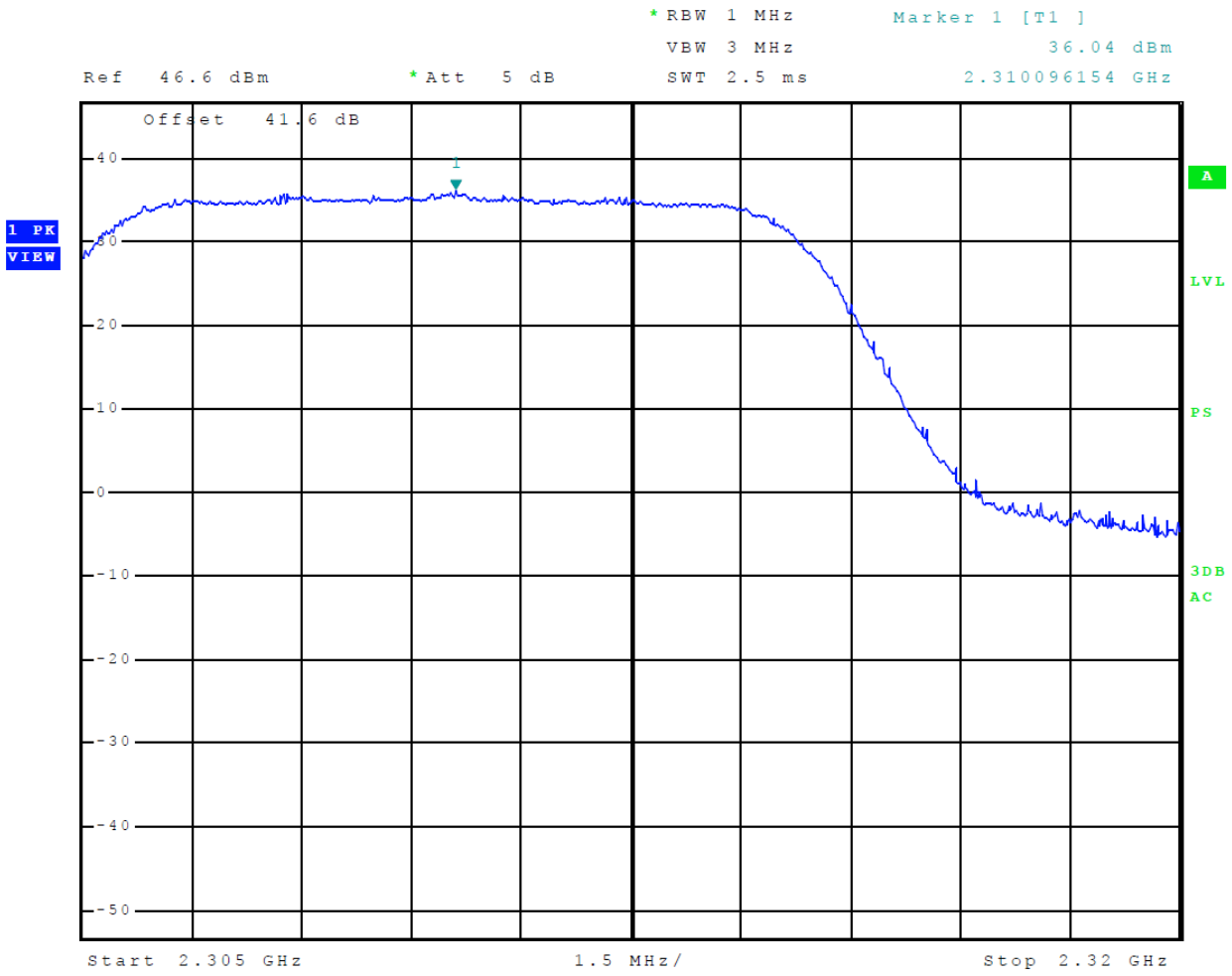


Figure 7 Plot of Channel in Band (10MHz Channel, High Power, Low Band)

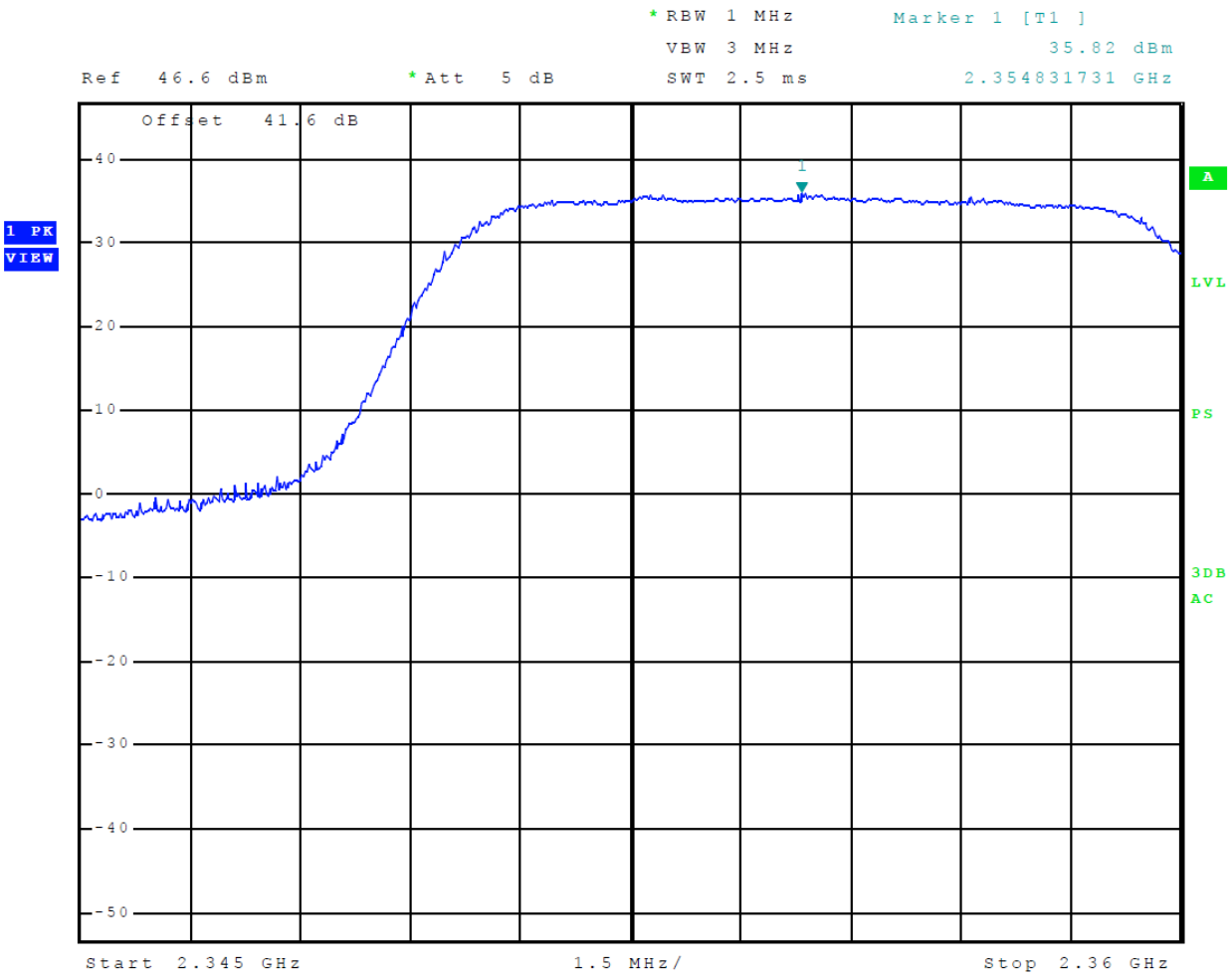


Figure 8 Plot of Channel in Band (10MHz Channel, High Power, High Band)

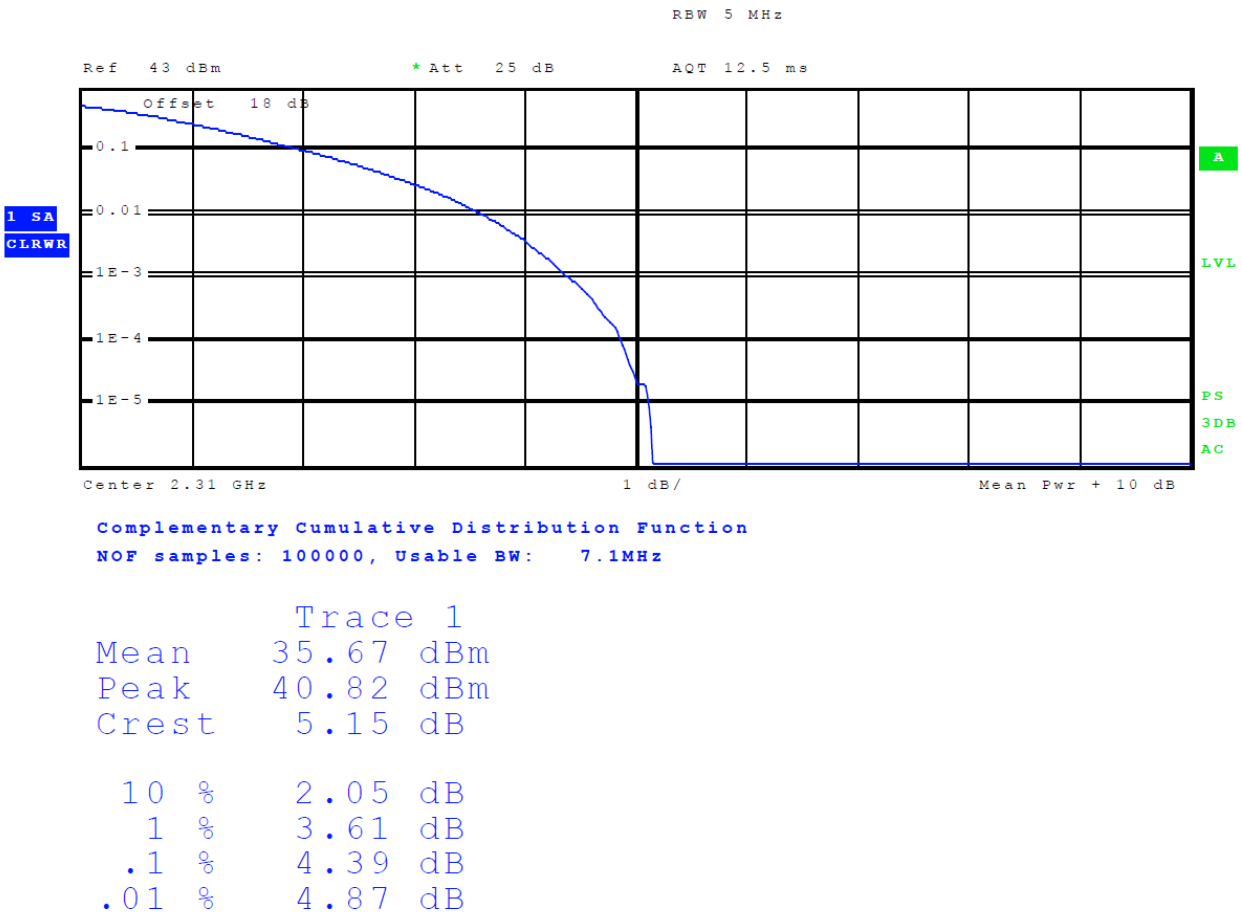


Figure 9 Plot of Complementary Cumulative Distribution Function (CCDF) (5 MHz Channel)

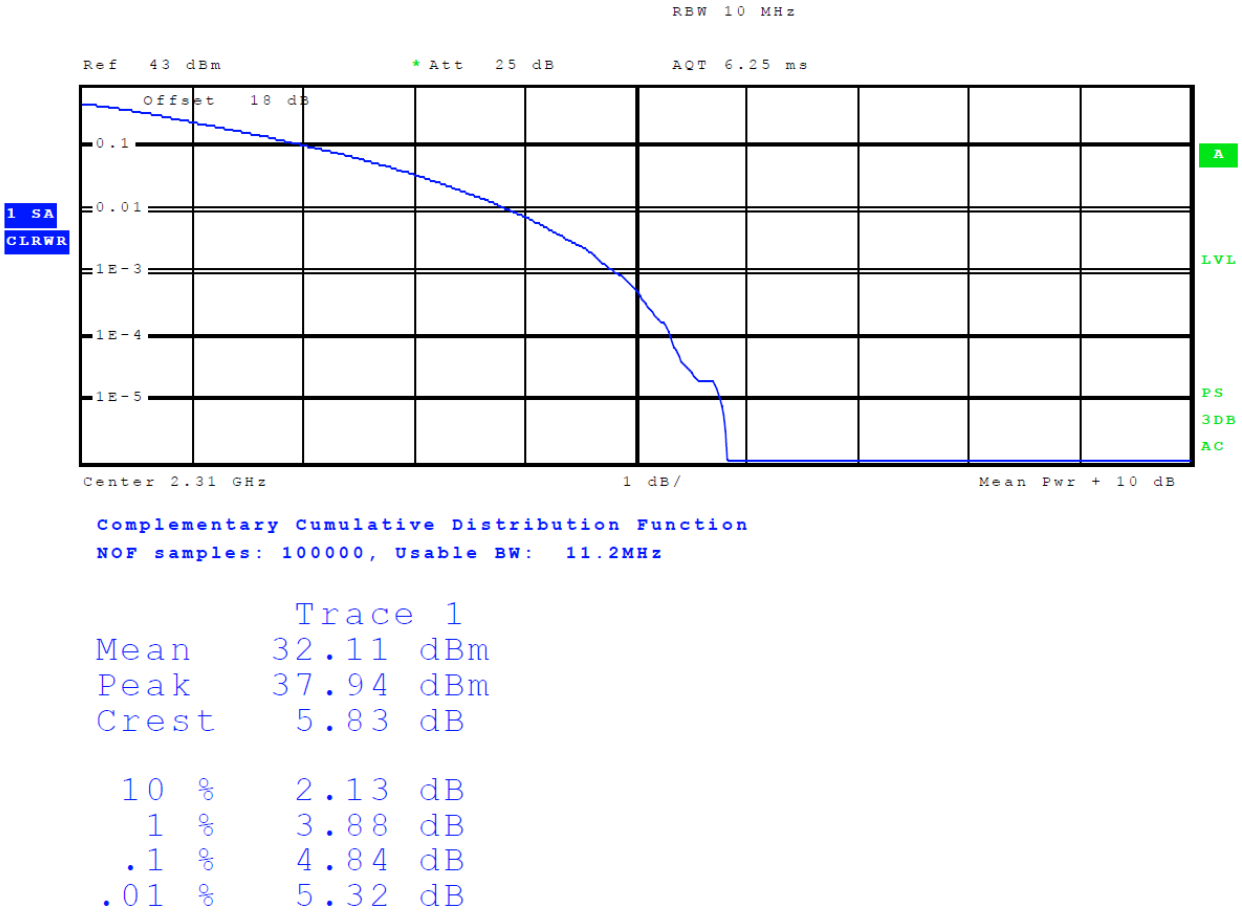


Figure 10 Plot of Complementary Cumulative Distribution Function (CCDF) (10 MHz Channel)

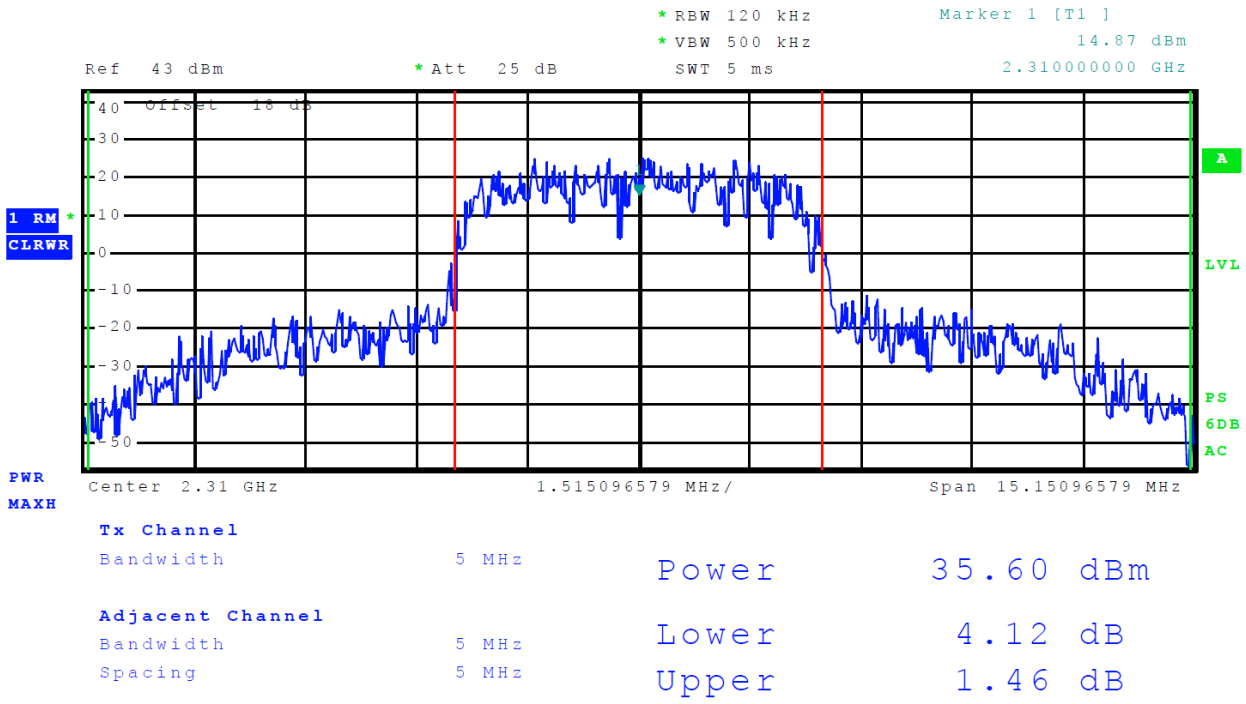


Figure 11 Plot of Antenna Port Power Output (5 MHz Channel, High Power, Low Band)

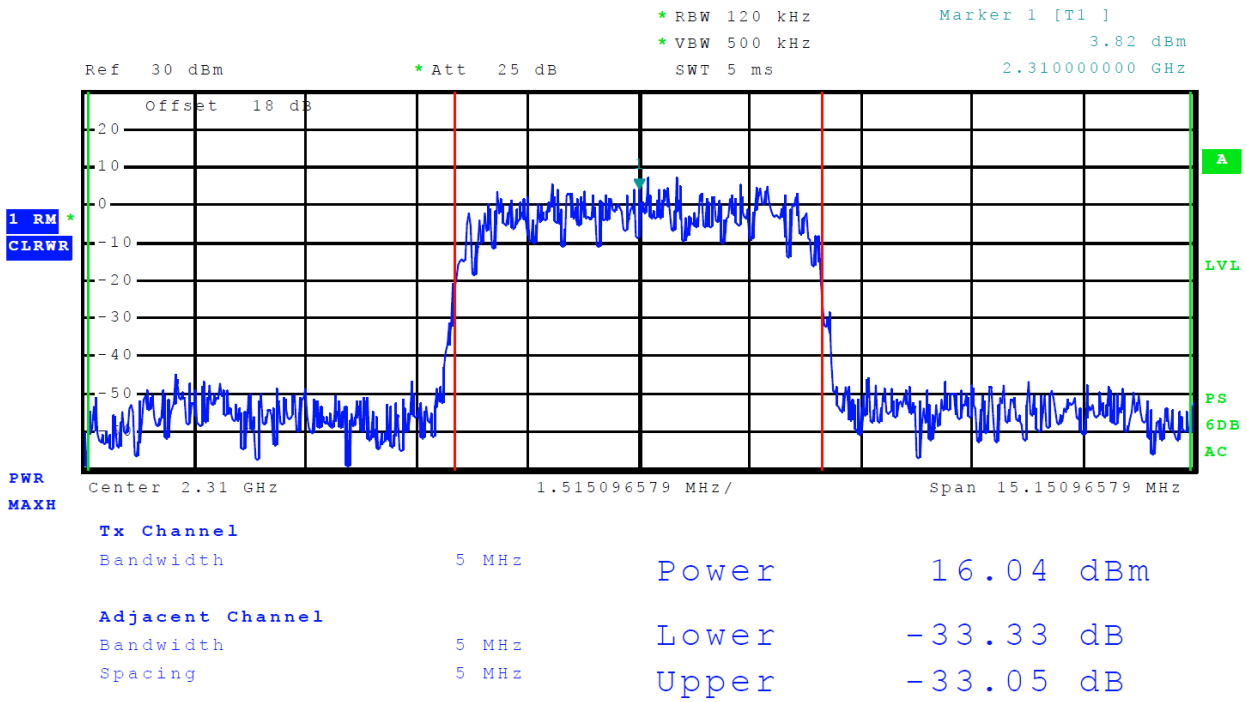


Figure 12 Plot of Antenna Port Power Output (5 MHz Channel, Low Power, Low Band)

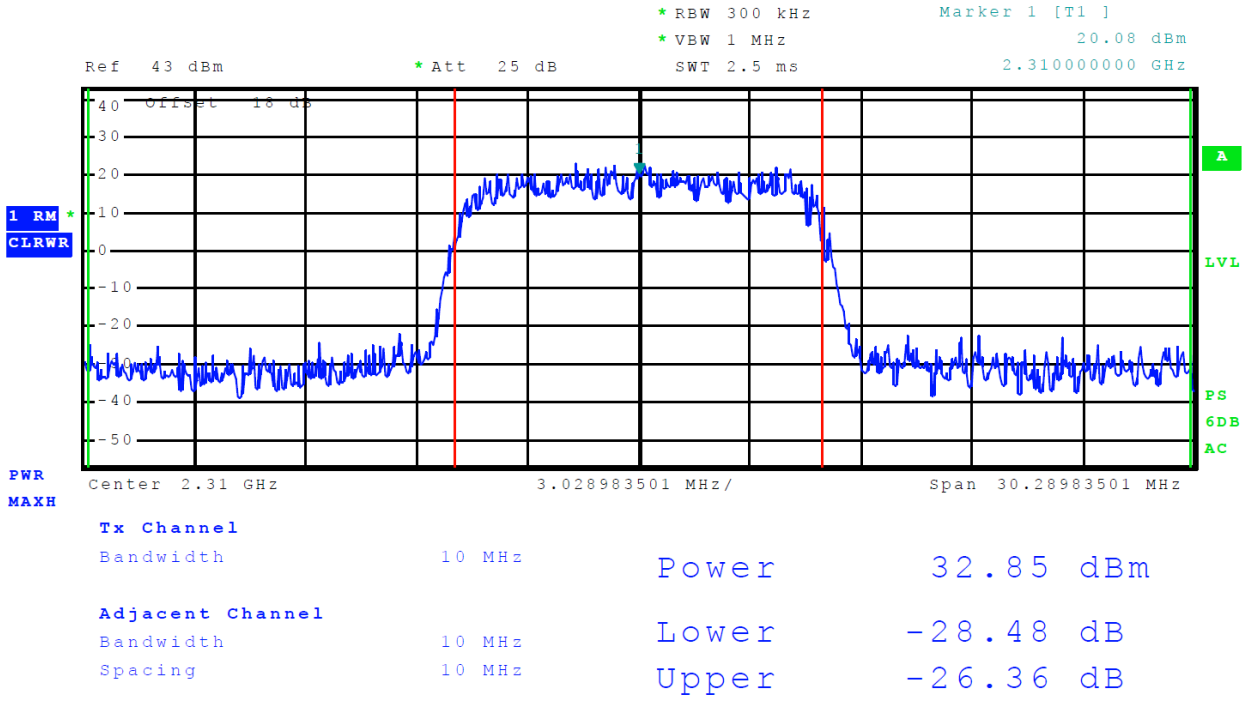


Figure 13 Plot of Antenna Port Power Output (10 MHz Channel, High Power)

Test #2 Occupied Bandwidth, Undesirable Conducted Radiation And Emission Mask Compliance

FCC Reference: 47CFR 2.1049 27.53

ISED Reference: RSS-195 Paragraph 5.6

Test Method: ANSI C63.26-2015, Section 5.4 and Notes Below

Results: Meets requirements

Notes:

1. The Antenna port was connected to 50-Ohm attenuation. Emissions were monitored at the attenuator using a coaxial cable to connect measurement equipment to the RF output port of the test setup.
2. The EUT was transmitting at maximum power allowed for modulation characteristic and at 100 % during testing. Testing was also conducted using minimum power setting.
3. A pseudo-random data pattern as defined internal to the test sample was used during testing.
4. No reduction in power was required to demonstrate compliance with regulations.

§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.

RSS-195, Paragraph 5.6 Transmitter Unwanted Emissions

The transmitter unwanted emissions shall be measured with a resolution bandwidth of 1 MHz. A smaller resolution bandwidth is permitted provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz. However, in the 1 MHz bands immediately adjacent to the edges of the frequency range(s) in which the equipment is allowed to operate, a resolution bandwidth of as close as possible to, without being less than 1% of the occupied

bandwidth, shall be employed provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz.

Methods of Measurement Occupied Bandwidth

ANSI C63.26-2015

5.4 Occupied bandwidth

The following procedures shall be used for measuring the OBW of the fundamental frequencies of certain transmitters, when required.

5.4.1 General OBW requirements

A spectrum analyzer or other instrument providing a spectral display is recommended for these measurements. The VBW shall be set to a value at least three times greater than the resolution/measurement bandwidth, to avoid the introduction of amplitude smoothing. Video filtering or averaging shall not be used when performing OBW tests.

The applicable regulatory requirements should be consulted to determine which measurement method should be employed. There can be a need to utilize more than one measurement method.

Test Arrangement Occupied Bandwidth

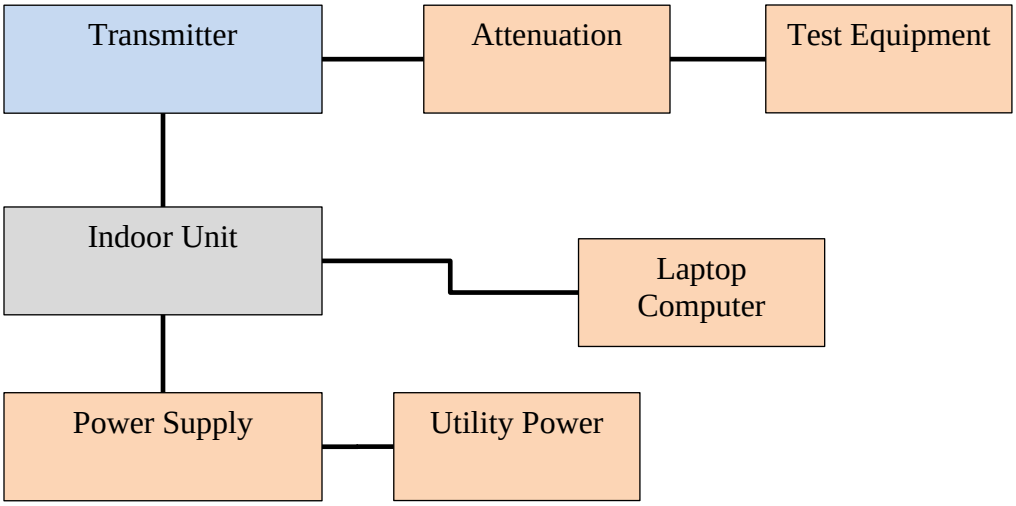


Table 2 Occupied Bandwidth Data

Frequency MHz	99% Occupied Bandwidth	26-dB Occupied Bandwidth
5 MHz Channel, High Power		
2307.5	4,198.7	4,647.4
2312.5	4,198.7	4,647.4
2352.5	4,198.7	4,647.4
10 MHz Channel, Low Power		
2310.0	8,782.1	9,743.6
2355.0	8,814.1	9,743.6

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 the channel observed addressing the requirement.

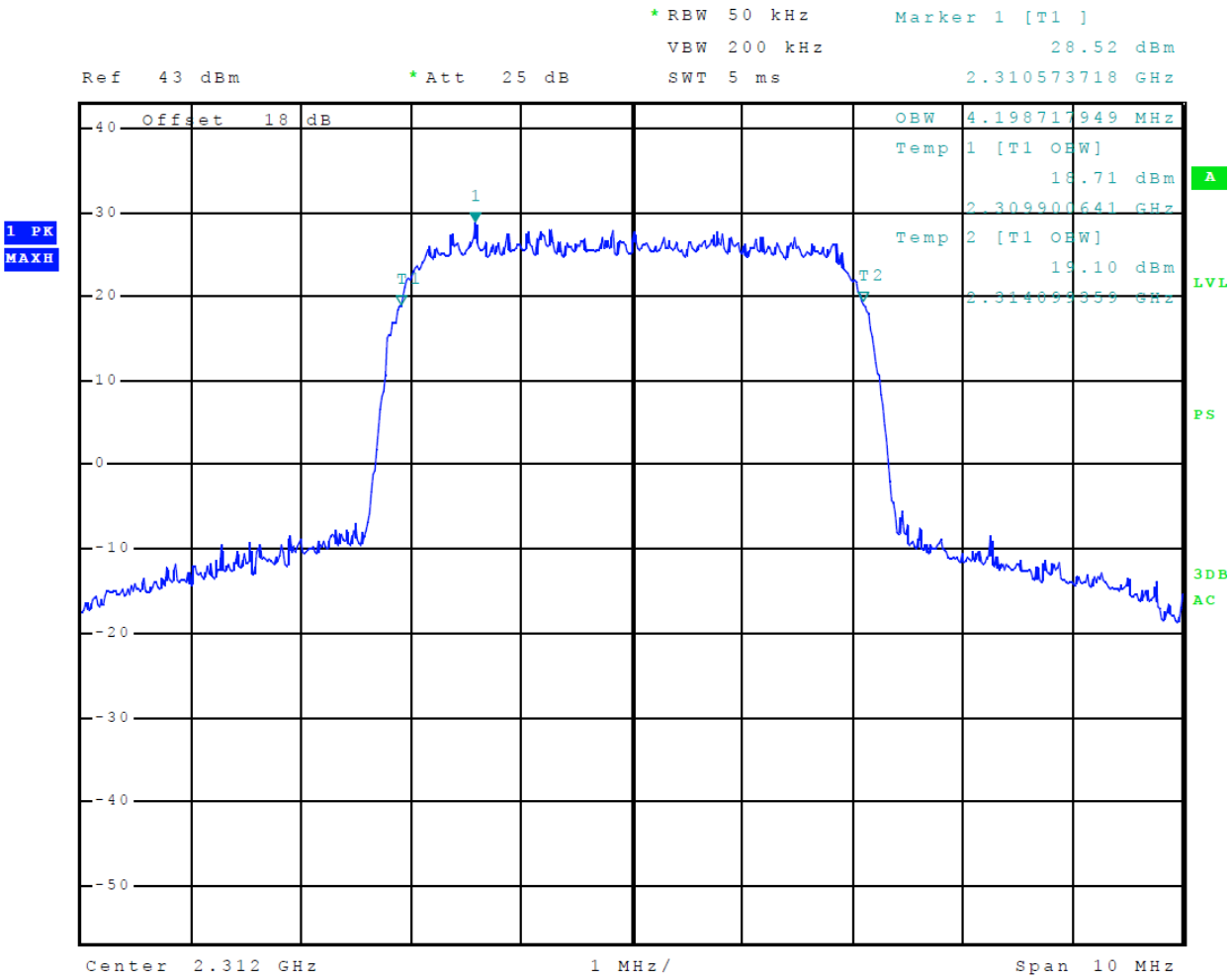


Figure 14 Plot of 99% Occupied Bandwidth (5 MHz Channel, Low Band)

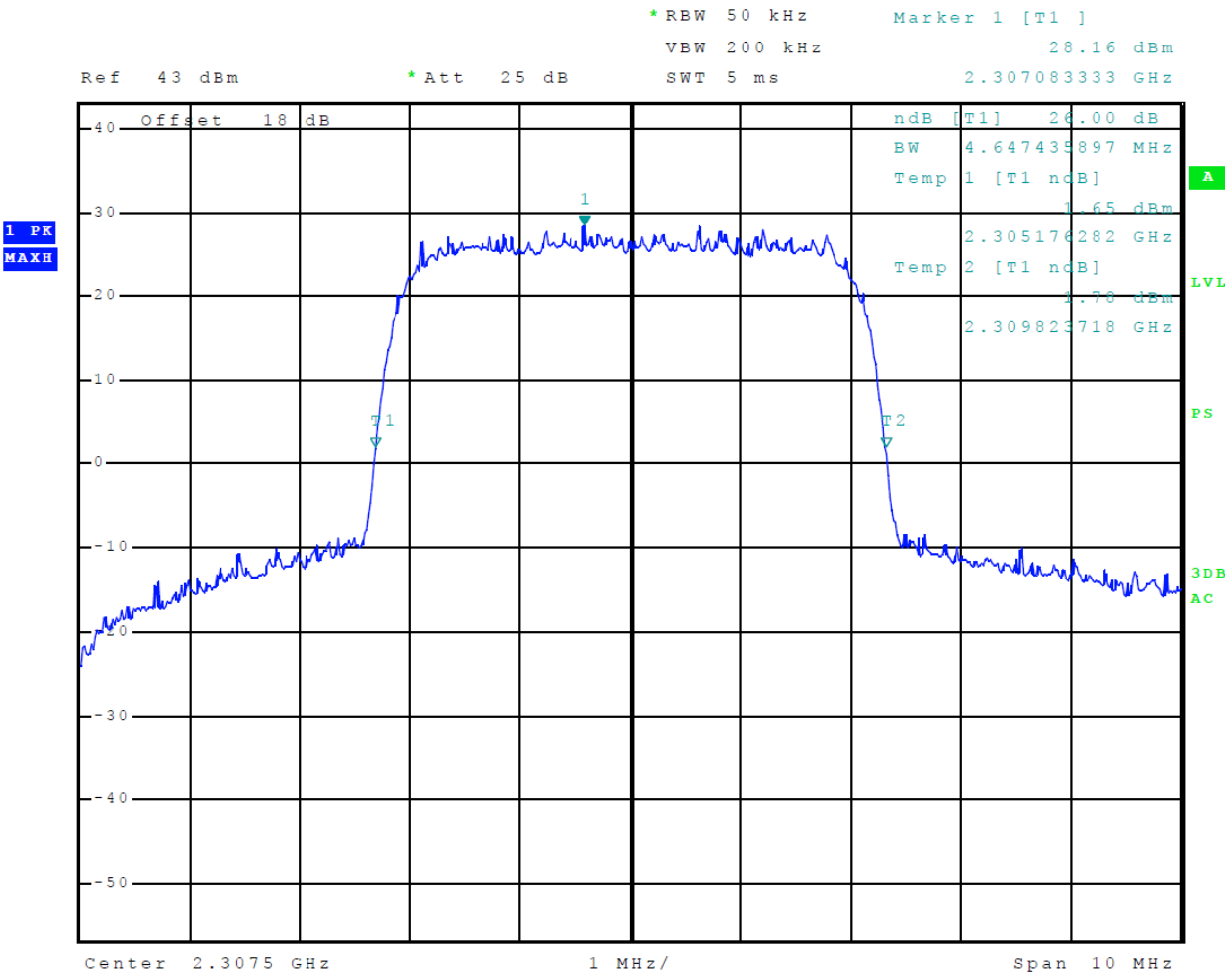


Figure 15 Plot of 26-dB Occupied Bandwidth (5 MHz Channel, Low Band)

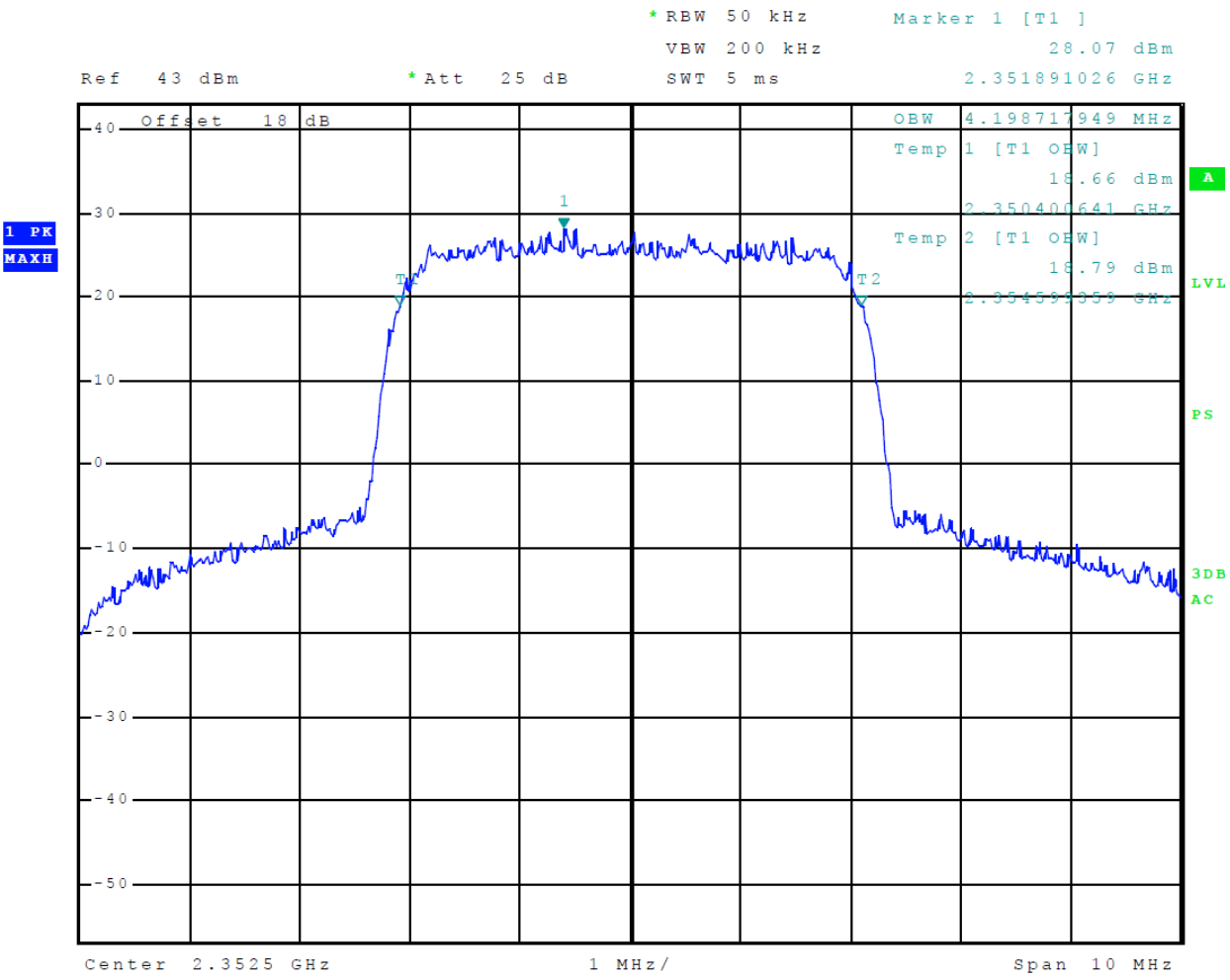


Figure 16 Plot of 99% Occupied Bandwidth (5 MHz Channel, High Band)

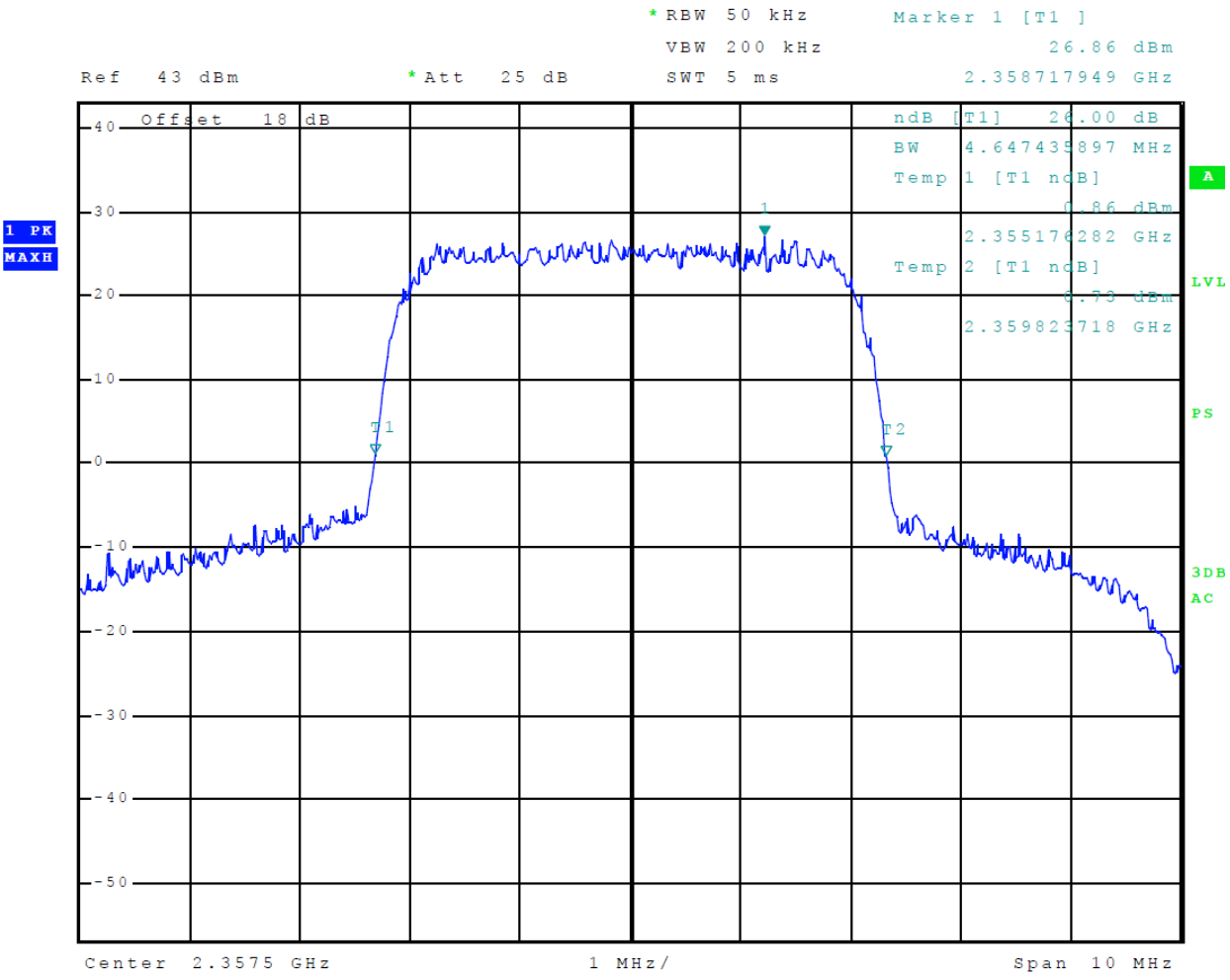


Figure 17 Plot of 26-dB Occupied Bandwidth (5 MHz Channel, High Band)

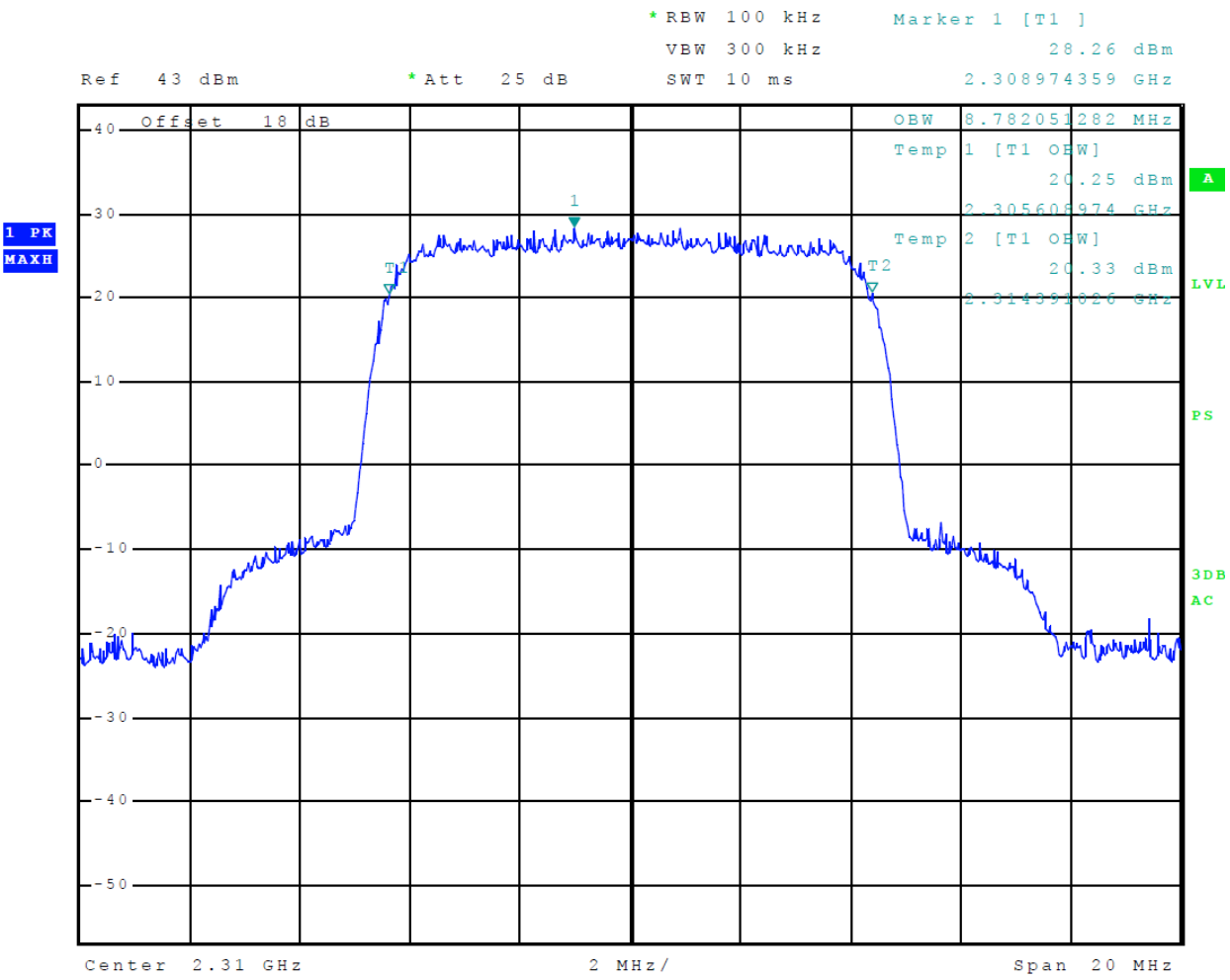


Figure 18 Plot of 99% Occupied Bandwidth (10 MHz Channel, Low Band)

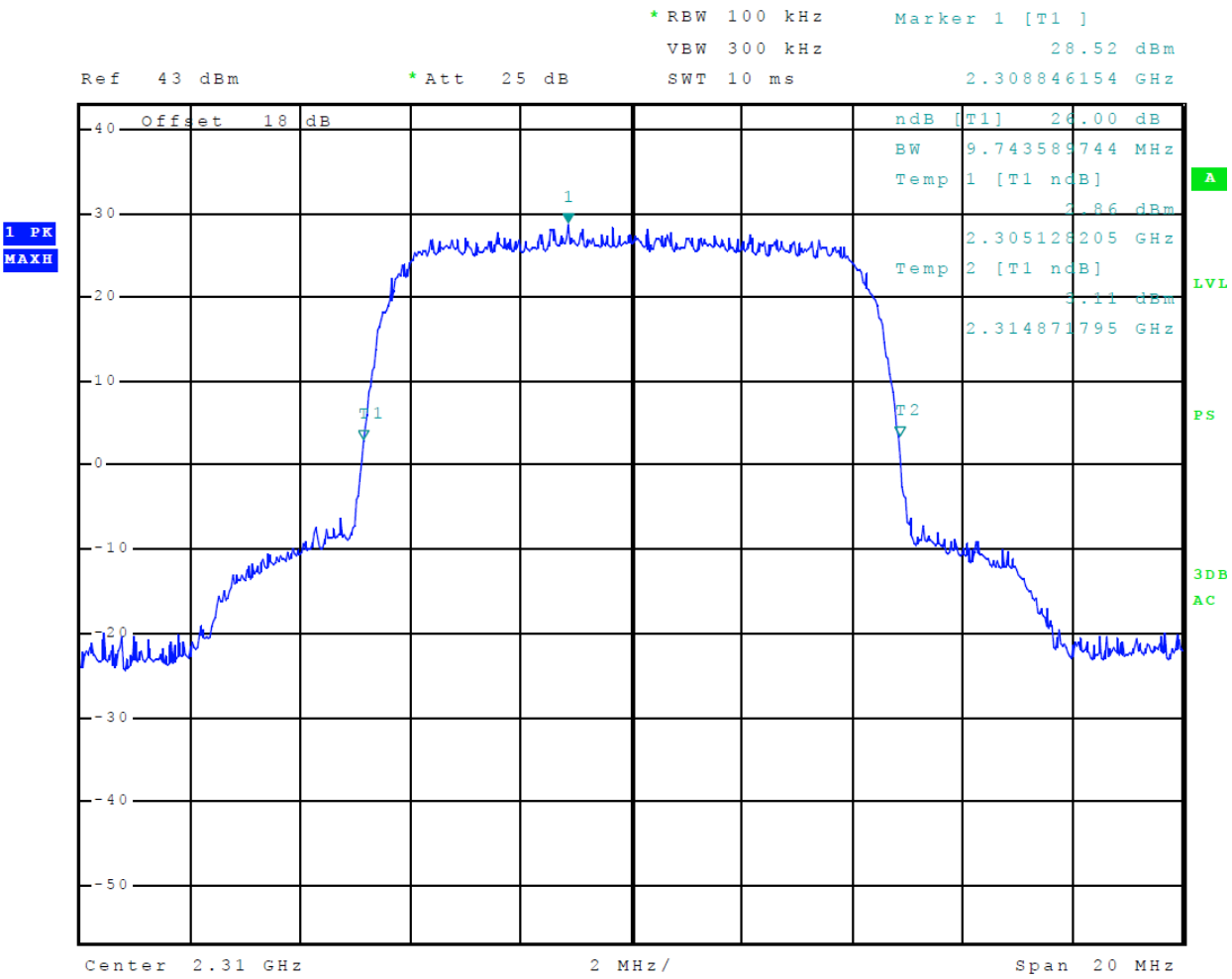


Figure 19 Plot of 26-dB Occupied Bandwidth (10 MHz Channel, Low Band)

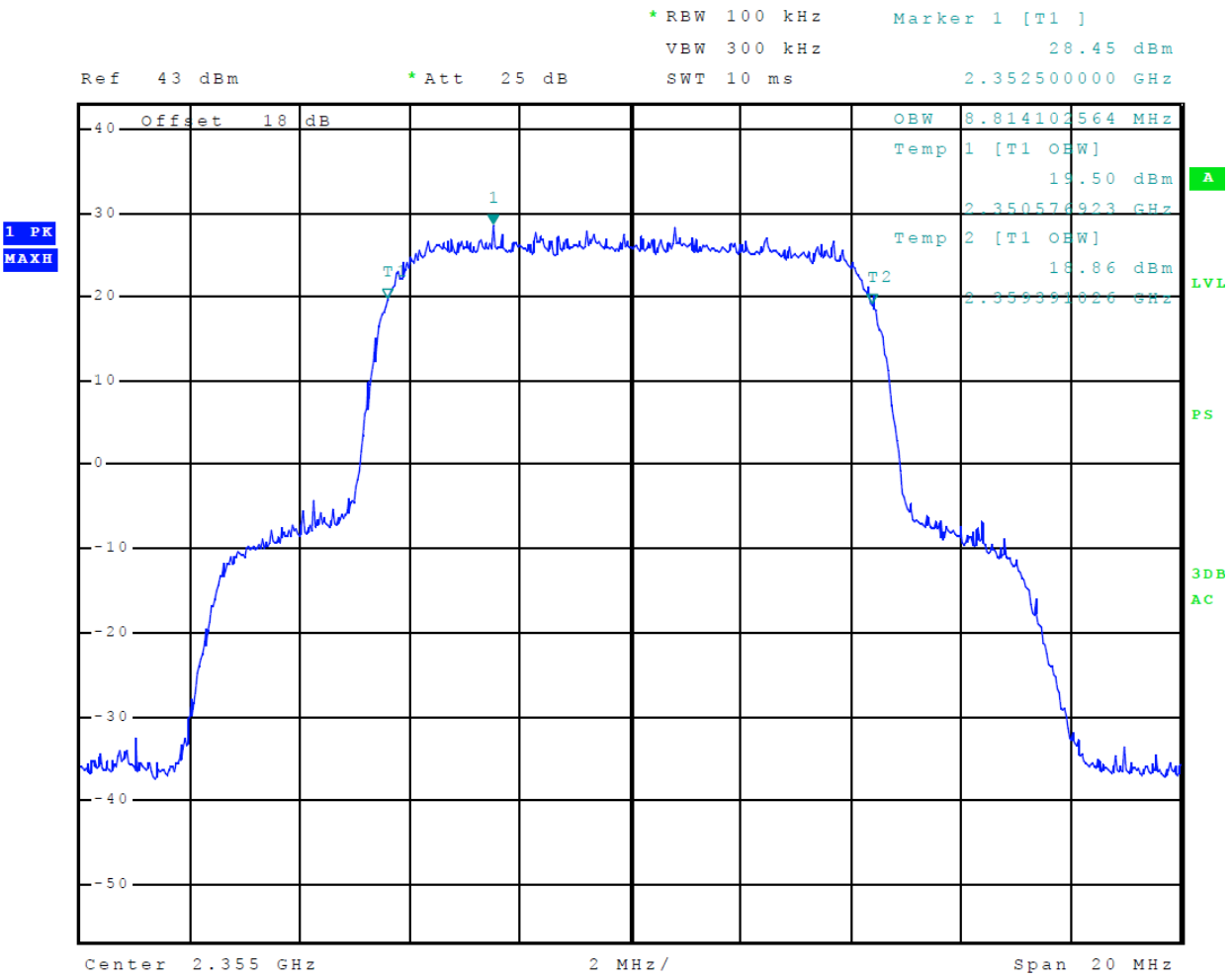


Figure 20 Plot of 99% Occupied Bandwidth (10 MHz Channel, High Band)

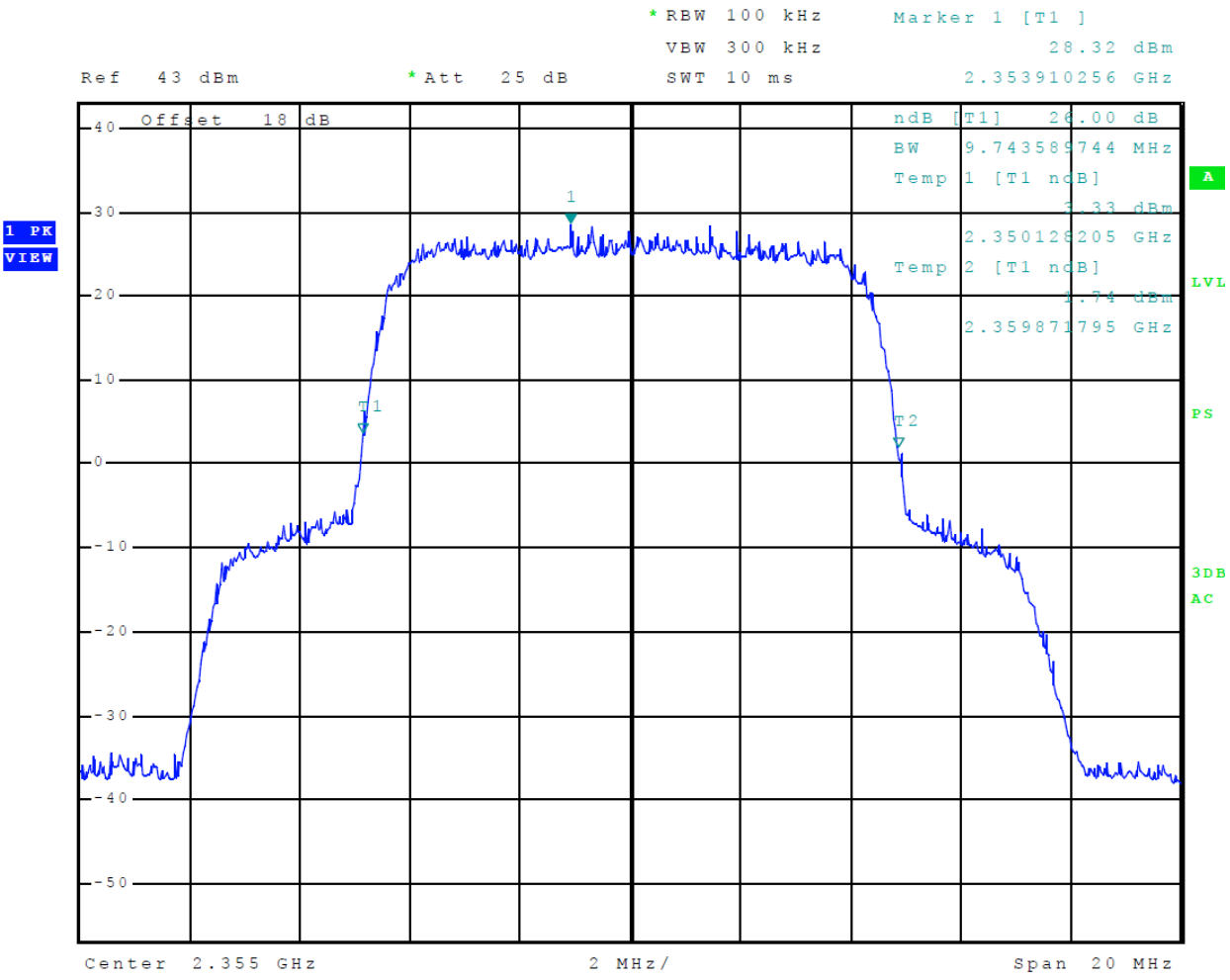


Figure 21 Plot of 26-dB Occupied Bandwidth (10 MHz Channel, High Band)

Test #3 Spectral Emission Mask Compliance and Spurious Conducted

FCC Reference: 47CFR 2.1051, 27.53

ISED Reference: RSS-195 Paragraph 5.6

Test Method: ANSI C63.26-2015, Section 5.7 and Notes Below

Results: Meets requirements

Notes:

1. The Antenna port was connected to 50-Ohm attenuation. Emissions were monitored at the attenuator using a coaxial cable to connect measurement equipment to the RF output port of the test setup.
2. The EUT was transmitting at maximum power allowed for modulation characteristic and at 100 % during testing. Testing was also conducted using minimum power setting.
3. A pseudo-random data pattern as defined internal to the test sample was used during testing.
4. No reduction in power was required to demonstrate compliance with regulations.

§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.

§27.53 Emission limits.

(a) For operations in the 2305-2320 MHz band and the 2345-2360 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power P (with averaging performed only during periods of transmission) within the licensed band(s) of operation, in watts, by the following amounts:

(1) For base and fixed stations' operations in the 2305-2320 MHz band and the 2345-2360 MHz band:

(i) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, and not less than 75 + 10 log (P) dB on all frequencies between 2320 and 2345 MHz;

(ii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2300 and 2305 MHz, 70 + 10 log (P) dB on all frequencies between 2287.5 and 2300 MHz, 72 + 10 log (P) dB on all frequencies between 2285 and 2287.5 MHz, and 75 + 10 log (P) dB below 2285 MHz;

(iii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2360 and 2362.5 MHz, 55 + 10 log (P) dB on all frequencies between 2362.5 and 2365 MHz, 70 + 10 log (P) dB on all frequencies between 2365 and 2367.5 MHz, 72 + 10 log (P) dB on all frequencies between 2367.5 and 2370 MHz, and 75 + 10 log (P) dB above 2370 MHz.

RSS-195, Paragraph 5.6 Transmitter Unwanted Emissions

The transmitter unwanted emissions shall be measured with a resolution bandwidth of 1 MHz. A smaller resolution bandwidth is permitted provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz. However, in the 1 MHz bands immediately adjacent to the edges of the frequency range(s) in which the equipment is allowed to operate, a resolution bandwidth of as close as possible to, without being less than 1% of the occupied bandwidth, shall be employed provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz.

Methods of Measurement Spectral Emission Mask and Spurious Conducted

ANSI C63.26-2015
5.7 Unwanted (out-of-band and spurious) conducted emissions measurement procedures (conducted test at antenna port)
5.7.1 General
Unwanted emissions limits are often specified differently at frequencies immediately adjacent to the channel, block, or band edge than they are for emissions at frequencies well removed from the band edge. The limits for emissions close to the authorized channel, band, or block, often referred to as out-of-band emissions (OOBE) or band-edge emissions, may be specified in terms of a reference bandwidth (i.e., constituting a PSD limit) and/or an emission limit that varies with the frequency offset from the edge of the channel, band, or block. At frequencies well removed from the channel, band, or block edge, the limit is typically fixed. In such cases, two separate sets of measurements will be required to demonstrate compliance to the applicable limit(s); one set to examine emissions within the frequency range immediately adjacent to the channel, block, or band edge (i.e., band-edge or out-of-band emissions) which will likely require finer resolution, and a second set to examine the remaining unwanted emissions (i.e., spurious emissions) on all remaining frequencies. It is not necessary to duplicate the measurement of unwanted emissions over the out-of-band emissions range when performing the separate spurious emissions measurement.

Test Arrangement Emission Mask and Spurious Conducted

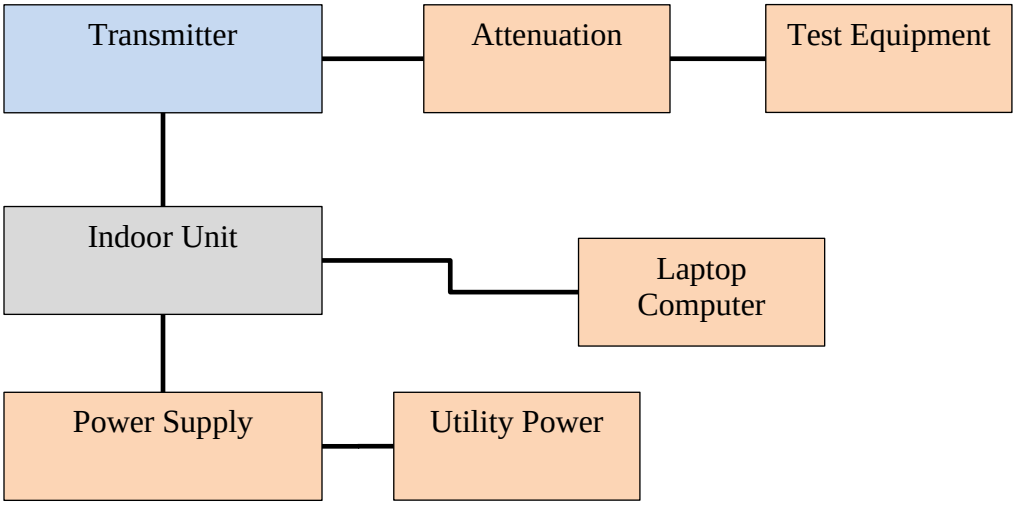
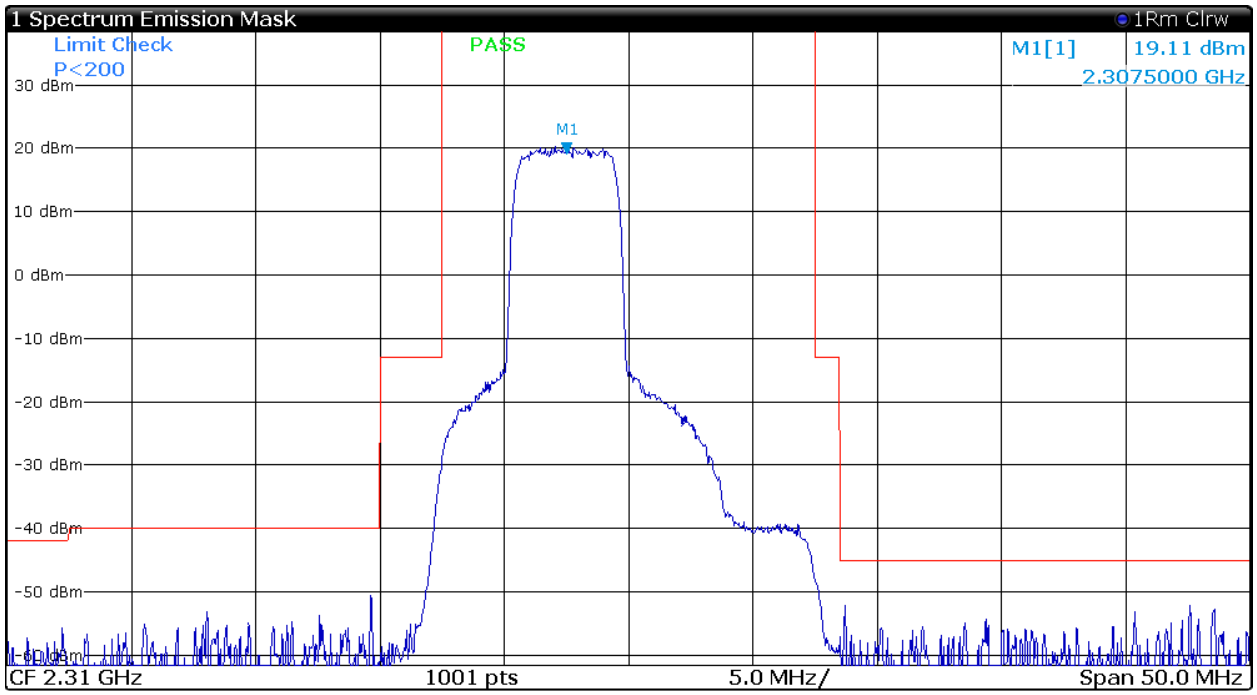


Table 3 Spurious Emissions at Antenna Terminal Data (5 MHz Channel)

Channel MHz	Spurious Freq. (MHz)	Measured Level (dBm)	Level Below Carrier (dBc)
2307.5	4615.0	-51.80	-87.3
	6922.5	-54.50	-90.0
	9230.0	-53.50	-89.0
	11537.5	-55.10	-90.6
	13845.0	-58.00	-93.5
2312.5	4625.0	-51.70	-87.2
	6937.5	-58.50	-94.0
	9250.0	-58.60	-94.1
	11562.5	-59.60	-95.1
	13875.0	-58.30	-93.8
2352.5	4705.0	-51.30	-86.7
	7057.5	-59.80	-95.2
	9410.0	-59.90	-95.3
	11762.5	-59.90	-95.3
	14115.0	-59.80	-95.2
2357.5	4715.0	-51.30	-86.8
	7072.5	-60.30	-95.8
	9430.0	-60.50	-96.0
	11787.5	-59.40	-94.9
	14145.0	-59.10	-94.6

Table 4 Spurious Emissions at Antenna Terminal Data (10 MHz Channel)

Channel MHz	Spurious Freq. (MHz)	Measured Level (dBm)	Level Below Carrier (dBc)
2310.0	4620.0	-51.70	-87.3
	6930.0	-55.40	-91.0
	9240.0	-53.70	-89.3
	11550.0	-58.00	-93.6
	13860.0	-59.20	-94.8
2355.0	4710.0	-50.80	-86.4
	7065.0	-55.50	-91.1
	9420.0	-55.00	-90.6
	11775.0	-58.60	-94.2
	14130.0	-59.40	-95.0



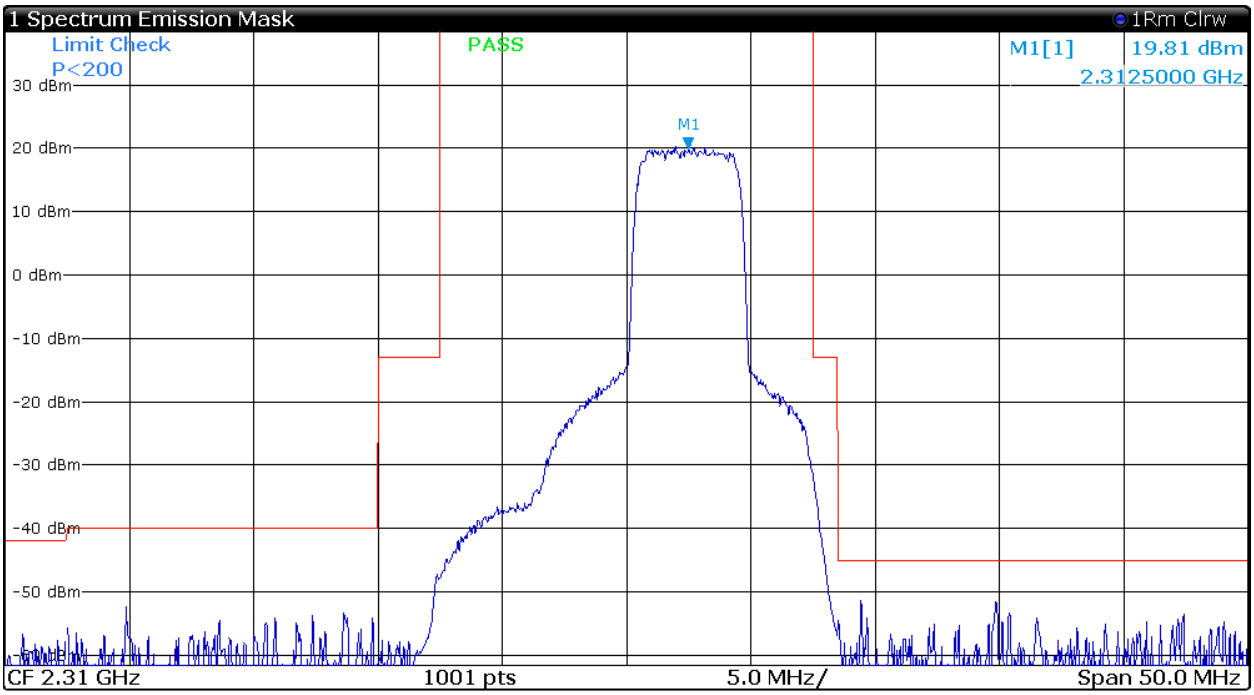
Sub Block A **Standard: SAF SEM Low 27_53 191016**

Center: 2.31 GHz Tx Power: 32.49 dBm

RBW: 100 kHz Tx Bandwidth: 5 MHz

Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	Delta Limit
-25 MHz	-22.55 MHz	100 kHz	2.286 GHz	-54.66 dBm	-87.15 dB	-12.66 dB
-22.5 MHz	-10 MHz	100 kHz	2.299 GHz	-51.58 dBm	-84.08 dB	-11.58 dB
-10 MHz	-8.5 MHz	100 kHz	2.3 GHz	-55.66 dBm	-88.15 dB	-42.66 dB
-8.5 MHz	-7.5 MHz	100 kHz	2.302 GHz	-30.94 dBm	-63.43 dB	-17.94 dB
7.5 MHz	8.5 MHz	100 kHz	2.318 GHz	-47.93 dBm	-80.42 dB	-34.93 dB
8.5 MHz	25 MHz	100 kHz	2.33 GHz	-53.65 dBm	-86.15 dB	-8.654 dB

Figure 22 Plot of Spectral Emission Mask (5 MHz Channel, Low Channel, Low Band)



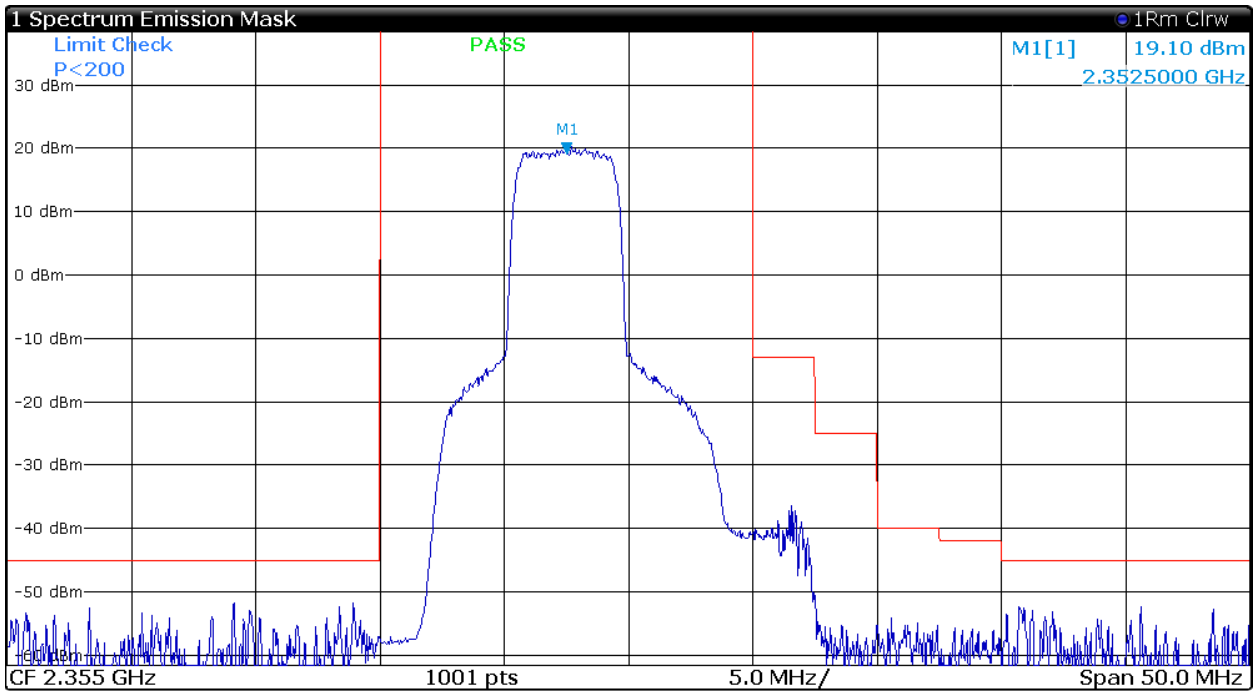
Sub Block A **Standard: SAF SEM Low 27_53 191016**

Center: 2.31 GHz Tx Power: 32.3 dBm

RBW: 100 kHz Tx Bandwidth: 5 MHz

Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	Delta Limit
-25 MHz	-22.55 MHz	100 kHz	2.285 GHz	-55.74 dBm	-88.04 dB	-13.74 dB
-22.5 MHz	-10 MHz	100 kHz	2.294 GHz	-52.77 dBm	-85.08 dB	-12.77 dB
-10 MHz	-8.5 MHz	100 kHz	2.301 GHz	-56.84 dBm	-89.15 dB	-43.84 dB
-8.5 MHz	-7.5 MHz	100 kHz	2.302 GHz	-46.97 dBm	-79.28 dB	-33.97 dB
7.5 MHz	8.5 MHz	100 kHz	2.318 GHz	-32.45 dBm	-64.75 dB	-19.45 dB
8.5 MHz	25 MHz	100 kHz	2.319 GHz	-52.31 dBm	-84.61 dB	-7.307 dB

Figure 23 Plot of Spectral Emission Mask (5 MHz Channel, High Channel, Low Band)



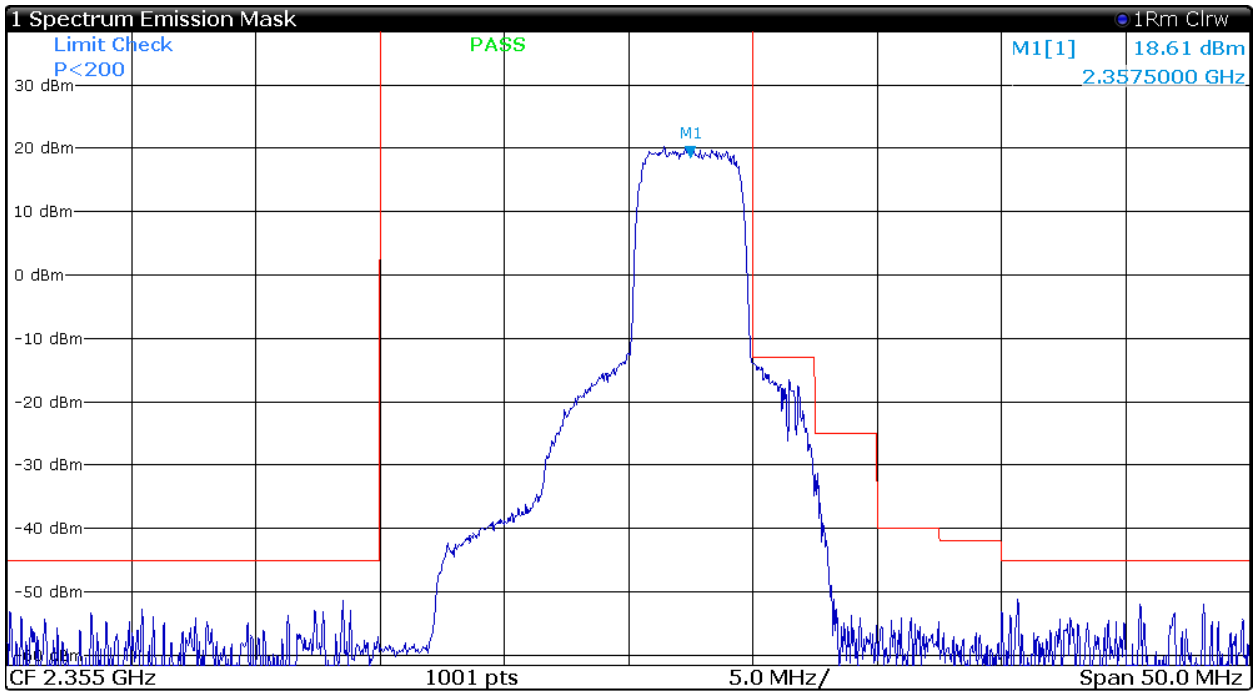
Sub Block A **Standard: 27_53 high SEM 191016**

Center: 2.355 GHz Tx Power: 32.13 dBm

RBW: 100 kHz Tx Bandwidth: 5 MHz

Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	Delta Limit
-25 MHz	-11 MHz	100 kHz	2.343 GHz	-56.2 dBm	-88.33 dB	-6.991 dB
-11 MHz	-10 MHz	100 kHz	2.344 GHz	-58.87 dBm	-91 dB	-9.524 dB
-10 MHz	-5 MHz	100 kHz	2.35 GHz	-12.46 dBm	-44.59 dB	-62.46 dB
5 MHz	6 MHz	100 kHz	2.361 GHz	-40.12 dBm	-72.25 dB	-27.12 dB
6 MHz	7.5 MHz	100 kHz	2.362 GHz	-38.11 dBm	-70.24 dB	-25.11 dB
7.5 MHz	10 MHz	100 kHz	2.363 GHz	-49.4 dBm	-81.53 dB	-24.4 dB
10 MHz	12.5 MHz	100 kHz	2.365 GHz	-54.62 dBm	-86.75 dB	-14.62 dB
12.5 MHz	15 MHz	100 kHz	2.368 GHz	-54.27 dBm	-86.4 dB	-12.27 dB
15 MHz	25 MHz	100 kHz	2.379 GHz	-52.74 dBm	-84.87 dB	-7.738 dB

Figure 24 Plot of Spectral Emission Mask (5 MHz Channel, Low Channel, High Band)



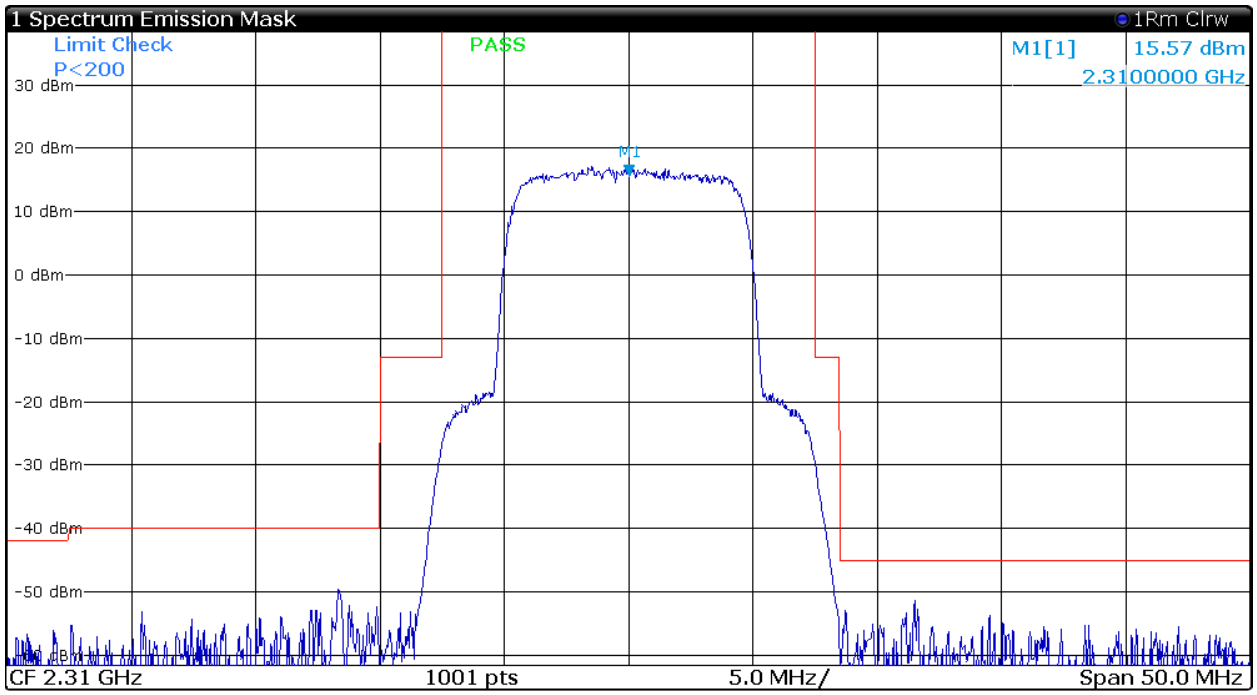
Sub Block A **Standard: 27_53 high SEM 191016**

Center: 2.355 GHz Tx Power: 32.08 dBm

RBW: 100 kHz Tx Bandwidth: 5 MHz

Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	Delta Limit
-25 MHz	-11 MHz	100 kHz	2.331 GHz	-62.9 dBm	-94.98 dB	-6.15 dB
-11 MHz	-10 MHz	100 kHz	2.344 GHz	-60.77 dBm	-92.84 dB	-12.6 dB
-10 MHz	-5 MHz	100 kHz	2.35 GHz	-38.77 dBm	-70.85 dB	-88.77 dB
5 MHz	6 MHz	100 kHz	2.36 GHz	-13.42 dBm	-45.5 dB	-0.4234 dB
6 MHz	7.5 MHz	100 kHz	2.361 GHz	-14.84 dBm	-46.92 dB	-1.842 dB
7.5 MHz	10 MHz	100 kHz	2.363 GHz	-31.66 dBm	-63.74 dB	-6.665 dB
10 MHz	12.5 MHz	100 kHz	2.367 GHz	-54.27 dBm	-86.35 dB	-14.27 dB
12.5 MHz	15 MHz	100 kHz	2.368 GHz	-52.94 dBm	-85.02 dB	-10.94 dB
15 MHz	25 MHz	100 kHz	2.376 GHz	-52.05 dBm	-84.12 dB	-7.047 dB

Figure 25 Plot of Spectral Emission Mask (5 MHz Channel, High Channel, High Band)



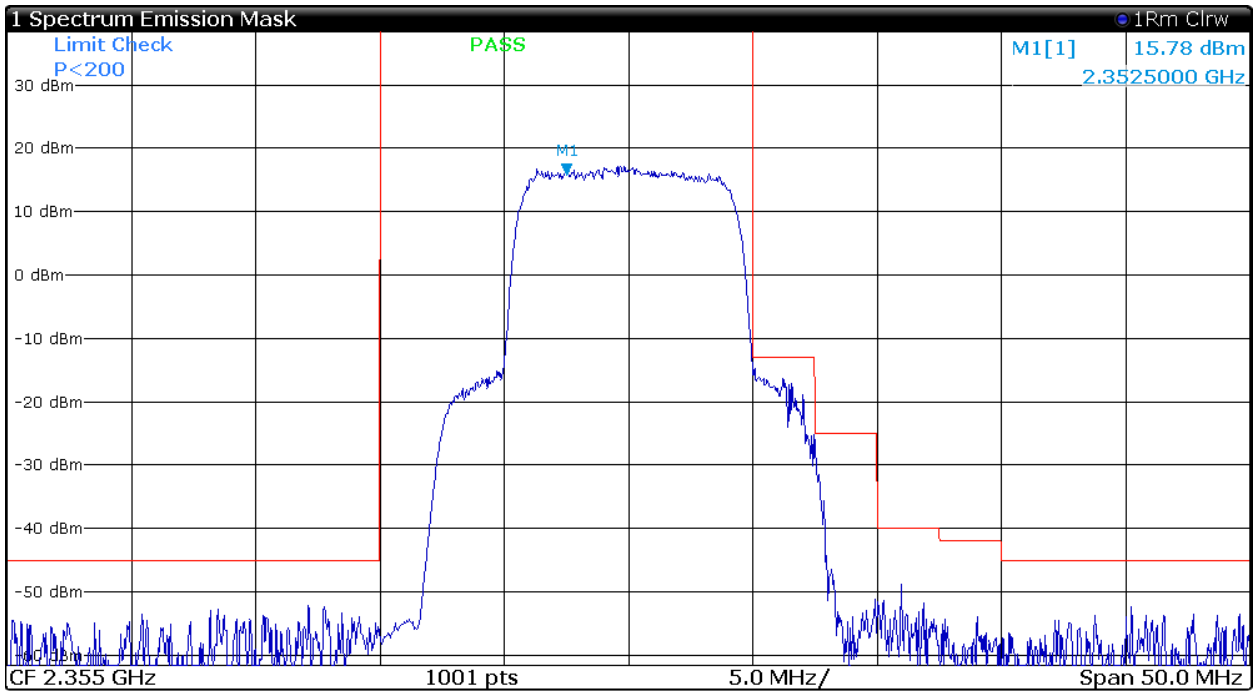
Sub Block A **Standard: SAF SEM Low 27_53 191016**

Center: 2.31 GHz Tx Power: 33 dBm

RBW: 100 kHz Tx Bandwidth: 5 MHz

Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	Delta Limit
-25 MHz	-22.55 MHz	100 kHz	2.285 GHz	-56.32 dBm	-89.33 dB	-14.32 dB
-22.5 MHz	-10 MHz	100 kHz	2.298 GHz	-50.72 dBm	-83.73 dB	-10.72 dB
-10 MHz	-8.5 MHz	100 kHz	2.301 GHz	-53.81 dBm	-86.81 dB	-40.81 dB
-8.5 MHz	-7.5 MHz	100 kHz	2.302 GHz	-27.41 dBm	-60.42 dB	-14.41 dB
7.5 MHz	8.5 MHz	100 kHz	2.318 GHz	-30.72 dBm	-63.72 dB	-17.72 dB
8.5 MHz	25 MHz	100 kHz	2.32 GHz	-50.9 dBm	-83.9 dB	-5.896 dB

Figure 26 Plot of Spectral Emission Mask (10 MHz Channel, Low Band)



Sub Block A **Standard: 27_53 high SEM 191016**

Center: 2.355 GHz Tx Power: 33.1 dBm

RBW: 100 kHz Tx Bandwidth: 5 MHz

Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	Delta Limit
-25 MHz	-11 MHz	100 kHz	2.343 GHz	-53.19 dBm	-86.29 dB	-4.477 dB
-11 MHz	-10 MHz	100 kHz	2.344 GHz	-54.87 dBm	-87.97 dB	-9.653 dB
-10 MHz	-5 MHz	100 kHz	2.35 GHz	-14.33 dBm	-47.43 dB	-64.33 dB
5 MHz	6 MHz	100 kHz	2.36 GHz	-15.29 dBm	-48.39 dB	-2.286 dB
6 MHz	7.5 MHz	100 kHz	2.361 GHz	-16.33 dBm	-49.43 dB	-3.329 dB
7.5 MHz	10 MHz	100 kHz	2.363 GHz	-33.45 dBm	-66.55 dB	-8.455 dB
10 MHz	12.5 MHz	100 kHz	2.366 GHz	-50.75 dBm	-83.85 dB	-10.75 dB
12.5 MHz	15 MHz	100 kHz	2.369 GHz	-54.47 dBm	-87.57 dB	-12.47 dB
15 MHz	25 MHz	100 kHz	2.375 GHz	-51.1 dBm	-84.21 dB	-6.105 dB

Figure 27 Plot of Spectral Emission Mask (10 MHz Channel, High Band)

TEST #4 Radiated Spurious Emissions

FCC Reference: 47CFR 2.1053, 27.53

ISED Reference: RSS-195 Paragraph 5.6

Test Method: ANSI C63.26-2015, Section 5.5 and Notes Below

Results: Meets requirements

Notes:

1. The Antenna port was connected to 50-Ohm attenuation. Emissions were monitored at the attenuator using a coaxial cable to connect measurement equipment to the RF output port of the test setup.
2. The EUT was transmitting at maximum power allowed for modulation characteristic and at 100 % during testing. Testing was also conducted using minimum power setting.
3. A pseudo-random data pattern as defined internal to the test sample was used during testing.
4. No reduction in power was required to demonstrate compliance with regulations.

§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.

§27.53 Emission limits.

(a) For operations in the 2305-2320 MHz band and the 2345-2360 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power P (with averaging performed only during periods of transmission) within the licensed band(s) of operation, in watts, by the following amounts:

(1) For base and fixed stations' operations in the 2305-2320 MHz band and the 2345-2360 MHz band:

(i) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, and not less than 75 + 10 log (P) dB on all frequencies between 2320 and 2345 MHz;

(ii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2300 and 2305 MHz, 70 + 10 log (P) dB on all frequencies between 2287.5 and 2300 MHz, 72 + 10 log (P) dB on all frequencies between 2285 and 2287.5 MHz, and 75 + 10 log (P) dB below 2285 MHz;

(iii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2360 and 2362.5 MHz, 55 + 10 log (P) dB on all frequencies between 2362.5 and 2365 MHz, 70 + 10 log (P) dB on all frequencies between 2365 and 2367.5 MHz, 72 + 10 log (P) dB on all frequencies between 2367.5 and 2370 MHz, and 75 + 10 log (P) dB above 2370 MHz.

RSS-195, Paragraph 5.6 Transmitter Unwanted Emissions

The transmitter unwanted emissions shall be measured with a resolution bandwidth of 1 MHz. A smaller resolution bandwidth is permitted provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz. However, in the 1 MHz bands immediately adjacent to the edges of the frequency range(s) in which the equipment is allowed to operate, a resolution bandwidth of as close as possible to, without being less than 1% of the occupied bandwidth, shall be employed provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz.

5.5 Radiated emissions testing

5.5.1 General

The primary necessity for radiated emissions testing is to demonstrate that any spurious emissions radiating from the EUT cabinet, control circuitry, power leads, or intermediate circuit elements, which would be missed in a totally dedicated conducted test, comply with the applicable limits. Such a test can only be performed in a radiated test configuration. In addition, many contemporary portable transmitters utilize integral antennas, precluding access to an antenna output port from which to perform conducted compliance measurements. For these types of transmitters, all of the data necessary to demonstrate compliance must be measured in a radiated test configuration. The procedures provided in this subclause Traditionally, radiated emissions measurements performed on a transmitter have required that substitution techniques, such as described in 5.5.3, be used to determine the radiated power or field strength level for comparison to the applicable limit. Substitution is a legacy methodology that in essence provides a means to characterize the RF propagation path(s) associated with the test site, in place of the site validation requirement specified in 4.6.3.2.

Due to recent trends in which many wireless products combine multiple radios within a single enclosure, and that such combination products typically incorporate both licensed and unlicensed transmitters, at least a portion of the required compliance (i.e., the unlicensed radio components) tests must be performed on a validated test site, in accordance with ANSI C63.10, to satisfy unlicensed intentional radiator compliance measurement requirements. For these types of combination products, conversion of a field strength measurement (or received power measurement) to an equivalent EIRP or ERP value based on the equations in 5.2.7 without using the substitution method is acceptable provided that they are performed on a test site that is validated to the requirements of ANSI C63.10. If a validated test site is not used when performing the requisite radiated measurements on a licensed transmitter, then substitution techniques shall be applied. In situations where there can be a dispute over the resulting data, the relevant regulatory agency may determine at its discretion whether test results obtained using the substitution method take precedence.

All radiated emissions measurements shall conform to the common requirements in specified in 5.5.2 and to the specific requirements listed in 5.5.3 when substitution methods are required, or to the specific requirements listed in 5.5.4 when the field strength method is used.

Test Arrangement Radiated Spurious Emissions

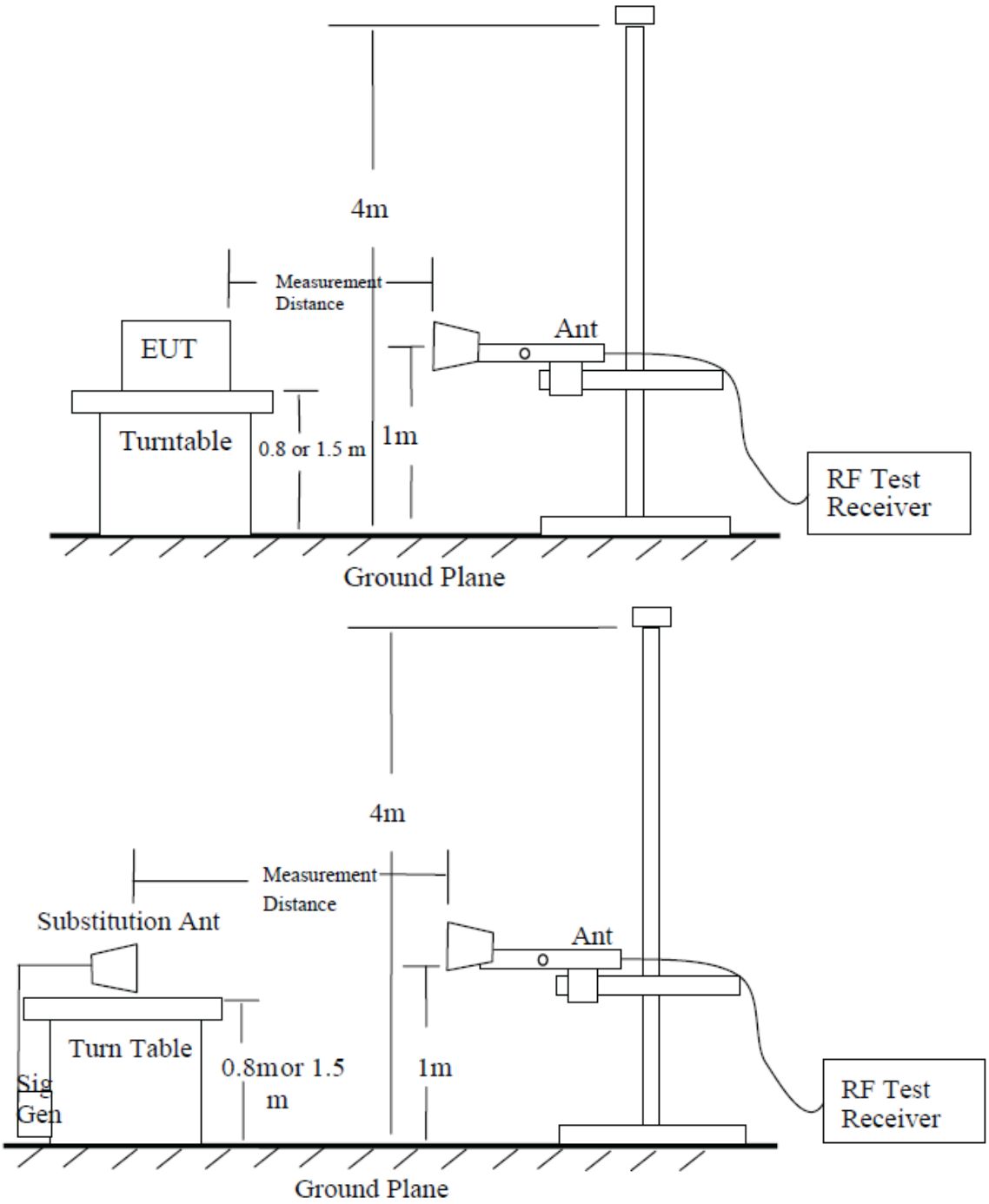


Table 5 Radiated Spurious Emissions

Frequency (MHz)	Horizontal ERP (dBm)	Vertical ERP (dBm)	Limit (dBm)	Horizontal Level below (dBc)	Vertical Level below (dBc)
125.0	-48.13	-49.33	-45	-3.1	-4.3
131.6	-63.53	-62.93	-45	-18.5	-17.9
135.0	-67.23	-64.63	-45	-22.2	-19.6
164.2	-60.73	-62.63	-45	-15.7	-17.6
172.7	-63.73	-69.43	-45	-18.7	-24.4
175.0	-56.93	-62.93	-45	-11.9	-17.9
192.3	-57.83	-61.53	-45	-12.8	-16.5
197.4	-62.93	-65.13	-45	-17.9	-20.1
216.3	-55.73	-64.63	-45	-10.7	-19.6
219.8	-53.23	-69.73	-45	-8.2	-24.7
226.8	-56.83	-67.53	-45	-11.8	-22.5
234.6	-59.63	-65.03	-45	-14.6	-20.0
244.8	-48.73	-59.33	-45	-3.7	-14.3
250.0	-46.13	-50.63	-45	-1.1	-5.6
258.3	-56.33	-63.73	-45	-11.3	-18.7
285.7	-55.93	-61.43	-45	-10.9	-16.4
291.2	-57.03	-61.63	-45	-12.0	-16.6
375.0	-46.03	-46.63	-45	-1.0	-1.6

Other emissions present had amplitudes at least 20 dB below the limit. Emission amplitudes are recorded above for frequency range of 0.009-24,000 MHz.

TEST #5 Frequency Stability

FCC Reference: 47CFR 2.1055, 27.54

ISED Reference: RSS-195 Paragraph 5.4

Test Method: ANSI C63.26-2015, Section 5.6 and Notes Below

Results: Meets requirements

Notes:

1. The Antenna port was connected to 50-Ohm attenuation. Emissions were monitored at the attenuator using a coaxial cable to connect measurement equipment to the RF output port of the test setup.
2. The EUT was transmitting at maximum power allowed for modulation characteristic and at 100 % during testing. Testing was also conducted using minimum power setting.
3. A pseudo-random data pattern as defined internal to the test sample was used during testing.
4. No reduction in power was required to demonstrate compliance with regulations.

§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.

§27.54 Frequency stability.

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

RSS-195, Paragraph 5.4 Frequency Stability

The applicant shall ensure frequency stability by showing that the occupied bandwidth is maintained within the range of the operating frequency blocks when testing under the temperature and supply voltage variations specified for the frequency stability measurement in RSS-Gen.

Methods of Measurement Frequency Stability

ANSI C63.26-2015

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 lowermost 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 Frequency Stability

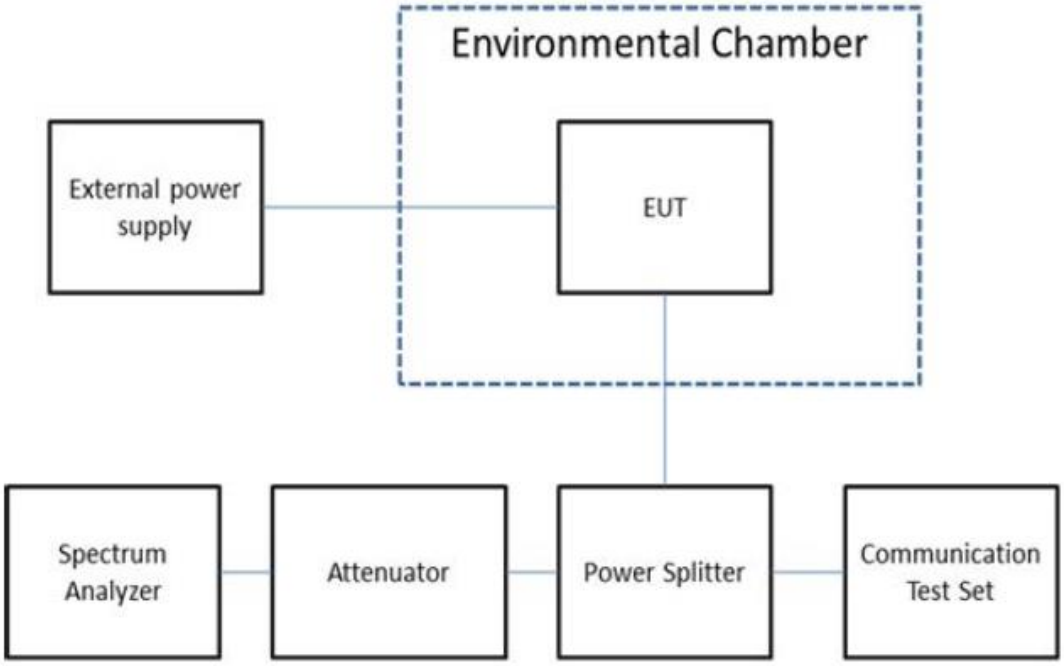


Table 6 Frequency Stability vs. Temperature Results

Frequency 2352.504916 (MHz)	Frequency Stability Vs. Temperature Ambient Frequency (2352.504916 MHz)								
Temperature °C	-30	-20	-10	0	+10	+20	+30	+40	+50
Change (Hz)	592	-2,273	-2,045	-455	-17	34	374	-689	-1,318
PPM	0.252	-0.966	-0.869	-0.193	-0.007	0.014	0.159	-0.293	-0.560
%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Limit (PPM)	-	-	-	-	-	-	-	-	-

Table 7 Frequency Stability vs. Input Power Supply Voltage Results

Frequency (2352.504916 MHz)	Frequency Stability Vs. Voltage Variation 120 volts nominal; Results in Hz change		
Voltage V_{dc}	102	120	138
Change (Hz)	0	0	0
PPM	0	0	0
%	0	0	0
Limit (PPM)	-	-	-

Annex

- Annex A Measurement Uncertainty Calculations
- Annex B Rogers Qualifications
- Annex C 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 Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 32 years' experience in the field of electronics. Work experience includes six years working 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.

Annex C 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).

2019-03-27 through 2020-03-31
Effective Dates

For the National Voluntary Laboratory Accreditation Program