NVLAP Lab Code 200087-0

APPLICATION SUBMITTAL REPORT

FOR
FCC And INDUSTRY CANADA
GRANT OF CERTIFICATION

FOR

Model: NanoStation M900
904-926 MHz
Broadband Digital Transmission System

FCC ID: SWX-M900L
IC: 6545A-M900L

FOR

Ubiquiti Networks, Inc.
91 E Tasman Dr.
San Jose, CA 95134

Test Report Number: 110427

Authorized Signatory: Scot D Rogers
Scot D. Rogers

NVLAP Lab Code 200087-0

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

Engineering Test Report
For Application Submittal for
Grant of Certification

FOR

CFR 47, PART 15C - Intentional Radiators Paragraph 15.247 and
Industry Canada, RSS-210
License Exempt Intentional Radiator

For

Ubiquiti Networks, Inc.

91 E Tasman Dr.
San Jose, CA 95134

Broadband Digital Transmission System
Model: M900
Frequency Range 904-926 MHz
FCC ID#: SWX-M900L
IC: 6545A-M900L

Test Date: April 27, 2011

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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The following information is submitted for consideration in obtaining Grant of Certification for License Exempt Digital Transmission System Intentional Radiator operating under CFR 47 Paragraph 15.247 and Industry Canada RSS-210.

Name of Applicant:
Ubiquiti Networks, Inc.
91 E Tasman Dr.
San Jose, CA 95134

Model: NanoStation M900

FCC I.D.: SWX-M900L IC: 6545A-M900L

Frequency Range: 904-926 MHz

Operating Power: 26.45 dBm (antenna port conducted single output) 29.45 dBm 2x2 MIMO operation, Occupied Bandwidth 1,907.1 kHz operating in HT2 mode, 8,766.03 kHz operating in HT10 mode, 17,211.54 kHz operating in HT20 mode, Receiver worst-case emission 37.7 dBµV/m

Opinion / Interpretation of Results

Test Performed	Minimum Margin (dB)	Results
Antenna requirement per CFR 47 15.203	N/A	Complies
Restricted Bands Emissions as per CFR 47 15.205 and RSS-210	-8.1	Complies
AC Line Conducted Emissions as per CFR 47 15.207	-10.3	Complies
Radiated Emissions as per CFR 47 15.209 and RSS-210	-5.8	Complies
Radiated Emissions per CFR 47 15.247 and RSS-210	-1.0	Complies
Receivers emissions per CFR 47 15.111 and RSS-210 and RSS-GEN	-5.8	Complies

Environmental Conditions

Ambient Temperature	23.7° C
Relative Humidity	32%
Atmospheric Pressure	1011.3 mb

Application for Certification

(1) Manufacturer: Ubiquiti Networks, Inc.
91 E Tasman Dr.
San Jose, CA 95134

(2) Identification: Model: NanoStation M900
FCC I.D.: SWX-M900L
IC: 6545A-M900L

(3) Instruction Book:

Refer to Exhibit for Instruction Manual.

(4) Description of Circuit Functions:

Refer to Exhibit of Operational Description.

(5) Block Diagram with Frequencies:

Refer to Exhibit of Operational Description.

(6) Report of Measurements:

Report of measurements follows in this Report.

(7) Photographs: Construction, Component Placement, etc.:

Refer to Exhibit for photographs of equipment.

(8) List of Peripheral Equipment Necessary for operation. The equipment operates from power received from the authorized POE and AC power adapter and was interfaced through network cable to POE and laptop computer during testing. Two antenna configurations were tested and data included for authorization purposes.

(9) Transition Provisions of 15.37 are not being requested.

(10) Not Applicable. The unit is not a scanning receiver.

(11) Not Applicable. The EUT does not operate in the 59 – 64 GHz frequency band.

(12) The equipment is not software defined and this section is not applicable.

Applicable Standards & Test Procedures

In accordance with the Federal Communications Code of Federal Regulations, dated October 1, 2010, Part 2, Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031 through 2.1057, and applicable parts of paragraph 15, Part 15C Paragraph 15.247 and Industry Canada standard RSS-210 the following information is submitted.

Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in the ANSI C63.4-2009, FCC documents DA00-1407 and DA00-705 and/or TIA/EIA 603-1. Testing for the AC line-conducted emissions were performed as defined in sections 7 and 13.1.3, testing of the radiated emissions was performed as defined in sections 8 and 13.1.4 of ANSI C63.4-2009. Testing of the intentional radiated emissions was performed as defined in section 13 of ANSI C63.4-2009.

Equipment Test Procedures

AC Line Conducted Emission Test Procedure

The EUT operates from DC power only and must be connected to an approved POE and AC adapter for operation. For testing purposes, the manufacturer supplied POE and AC power adapter was used to power the system. Testing for the AC line-conducted emissions testing was performed as defined in sections 7 and 13.1.3 of ANSI C63.4-2009. The test setup including the EUT was arranged in typical equipment configurations and placed on a 1 x 1.5-meter wooden bench, 0.8 meters high located in a screen room. The power lines of the system were isolated from the power source using a standard LISN with a 50 μHy choke. EMI was coupled to the spectrum analyzer through a 0.1 μF capacitor internal to the LISN. The LISN was positioned on the floor beneath the wooden bench supporting the EUT. The power lines and cables were draped over the back edge of the table.

Radiated Emission Test Procedure

The EUT was placed on a rotating 1 x 1.5-meter wooden platform, 0.8 meters above the ground plane at a distance of 3 meters from the FSM antenna. Testing for the radiated emissions was performed as defined in sections 8 and 13.1.4 of ANSI C63.4-2009. 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. Refer to photographs in the test setup exhibits for EUT placement during testing.

List of Test Equipment

A Rohde and Schwarz ESU40 and/or Hewlett Packard 8591EM was used as the measuring device for the emissions testing of frequencies below 1 GHz. A Rohde and Schwarz ESU40 and/or Hewlett Packard 8562A Spectrum Analyzer was used as the measuring device for testing the emissions at frequencies above 1 GHz. The analyzer settings used are described in the following table. Refer to the appendix for a complete list of test equipment.

HP 8591 EM Analyzer Settings		
Conducted Emissions		
RBW	AVG. BW	Detector Function
9 kHz	30 kHz	Peak / Quasi Peak
Radiated Emissions		
RBW	AVG. BW	Detector Function
120 kHz	300 kHz	Peak / Quasi Peak
HP 8562A Analyzer Settings		
RBW	Video BW	Detector Function
100 kHz	100 kHz	Peak
1 MHz	1 MHz	Peak / Average

Equipment	Manufacturer	Model	Calibration Date	Due
LISN	Comp. Design	FCC-LISN-2-MOD.CD	10/10	10/11
Antenna	ARA	BCD-235-B	10/10	10/11
Antenna	EMCO	3147	10/10	10/11
Antenna	EMCO	3143	5/10	5/11
Analyzer	HP	8591EM	5/10	5/11
Analyzer	HP	8562A	5/10	5/11
Analyzer	Rohde & Schwarz	ESU40	5/10	5/11

Test Site Locations

Conducted EMI	The AC power line conducted emissions testing performed in a shielded screen room located at Rogers Labs, Inc., 4405 W. 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 W. 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/m) - Gain (dB)

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to demonstrate compliance with the CFR47 Part 15C paragraph 15.205 emissions requirements. There were no deviations or exceptions to the specifications.

Equipment Tested

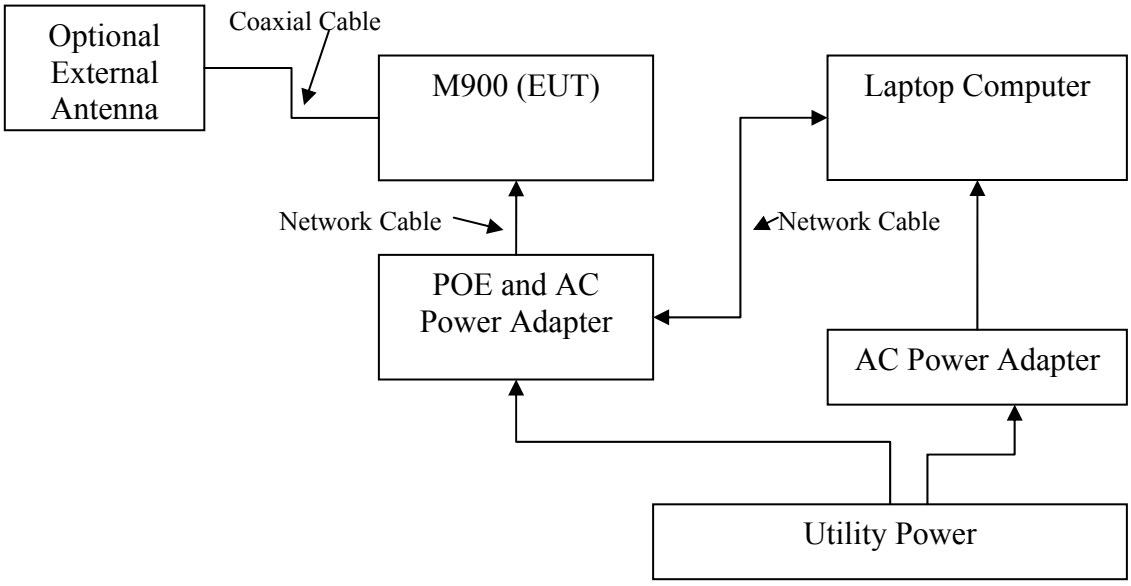
Equipment	Model	FCC I.D.#
EUT	M900	SWX-M900L
CPU	Dell Studio XPS	921LBN1
16 dBi Yagi	AMY-9M16	N/A
Integral Panel	N/A	N/A

Antennas (Integral panel, and 16 dBi Yagi)

Equipment Function and Configuration

The EUT is a 904-926 MHz Digital Transmission System transmitter used to transmit data in applications offering broadband wireless connectivity. The equipment is marketed for use to incorporate a wireless link to exchange data information from one point to another. For testing purposes the M900 transceiver was connected to the manufacturer supplied Power Over Ethernet (POE) and AC power adapter and communicating to the laptop computer allowing for operational control of the transmitter and communications over the network interface between the EUT and supporting computer system. The M900 receives power from the supplied POE AC power adapter connected to utility power systems. The EUT offers connection ports for optional external antenna and network only, no other interfacing options are provided. Preliminary testing investigation of all channel bandwidth modes of operation was performed. Testing of the M900 and support equipment was performed with the EUT powered from the AC power adapter and set to transmit in lowest, middle and highest available data modes. The device is marketed for professionally installed use with approved antenna structures as documented in this report and complies with the unique antenna connection requirements. Configuration software offers reduction of output power dependent on antenna installation and requirements to comply with power reduction restrictions for use of gain antennas greater than 6 dBi in compliance with requirements.

Equipment Configuration



Intentional Radiators

As per CFR47, Subpart C, paragraph 15.247 and RSS-210 the following information is submitted.

Antenna Requirements

The product is marketed for professional installation and use with approved antennas as described in accompanying documentation. The antenna connection point complies with the unique antenna connection requirements. The requirements are fulfilled and there are no deviations or exceptions to the specification.

Restricted Bands of Operation

Spurious emissions falling in the restricted frequency bands of operation were measured at a distance of three meters at the OATS. The EUT utilizes frequency, determining circuitry, which generates harmonics falling in the restricted bands. Emissions were measured at the OATS, using appropriate antennas or pyramidal horns, amplification stages, and a spectrum analyzer. No other significant emission was observed which fell into the restricted bands of operation.

Radiated Emissions in Restricted Bands Data (worst-case)

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
108.8	49.7	52.8	12.6	30	32.3	35.4	43.5
110.8	45.1	49.0	12.6	30	27.7	31.6	43.5
111.6	46.3	50.8	12.6	30	28.9	33.4	43.5
113.0	44.0	45.3	12.6	30	26.6	27.9	43.5
137.1	48.0	47.7	13.2	30	31.2	30.9	43.5
170.7	46.9	42.5	12.3	30	29.2	24.8	43.5
2712	18.5	17.9	29.0	25	22.5	21.9	54.0
2745	20.1	21.1	29.1	25	24.2	25.2	54.0
2775	30.0	22.9	29.2	25	34.2	27.1	54.0
3616	15.6	15.6	30.5	25	21.1	21.1	54.0
3660	15.7	15.7	30.7	25	21.4	21.4	54.0
3700	16.3	16.1	30.8	25	22.1	21.9	54.0
4520	16.5	16.5	32.5	25	24.0	24.0	54.0
4575	16.5	16.6	32.6	25	24.1	24.2	54.0
4625	17.1	17.0	32.7	25	24.8	24.7	54.0
5424	16.7	16.7	33.1	25	24.8	24.8	54.0

Other emissions present had amplitudes at least 20 dB below the limit.

Summary of Results for Radiated Emissions in Restricted Bands

The EUT demonstrated compliance with the radiated emissions requirements of CFR 47 Part 15C and RSS-210 Intentional Radiators. The EUT demonstrated a minimum margin of 8.1 dB below the requirements. Peak, Quasi-peak, and average amplitudes were checked for compliance with the regulations. Worst-case emissions are reported with other emissions found in the restricted frequency bands at least 20 dB below the requirements.

AC Line Conducted Emissions Procedure

The EUT was arranged in a typical equipment configuration and placed on a 1 x 1.5-meter wooden bench 80 cm above the conducting ground plane, floor of a screen room. The bench was positioned 40 cm away from the wall of the screen room. The LISN was positioned on the floor of the screen room 80-cm from the rear of the EUT. The manufacturer supplied AC power adapter for the EUT was connected to the LISN. A second LISN was positioned on the floor of the screen room 80-cm from the rear of the supporting equipment of the EUT. All power cords except the EUT were then powered from the second LISN. EMI was coupled to the spectrum analyzer through a 0.1 μF capacitor, internal to the LISN. Power line conducted emissions testing were carried out individually for each current carrying conductor of the EUT. The excess length of lead between the system and the LISN receptacle was folded back and forth to form a bundle not exceeding 40 cm in length. The screen room, conducting ground plane, analyzer, and LISN were bonded together to the protective earth ground. Preliminary testing was performed to identify the frequency of each radio frequency emission displaying the highest amplitude. The cables were repositioned to obtain maximum amplitude of measured EMI level. Once the worst-case configuration was identified, plots were made of the EMI from 0.15 MHz to 30 MHz then the data was recorded with maximum conducted emissions levels. Refer to figures one and two for plots of the EUT POE AC Power Line conducted emissions.

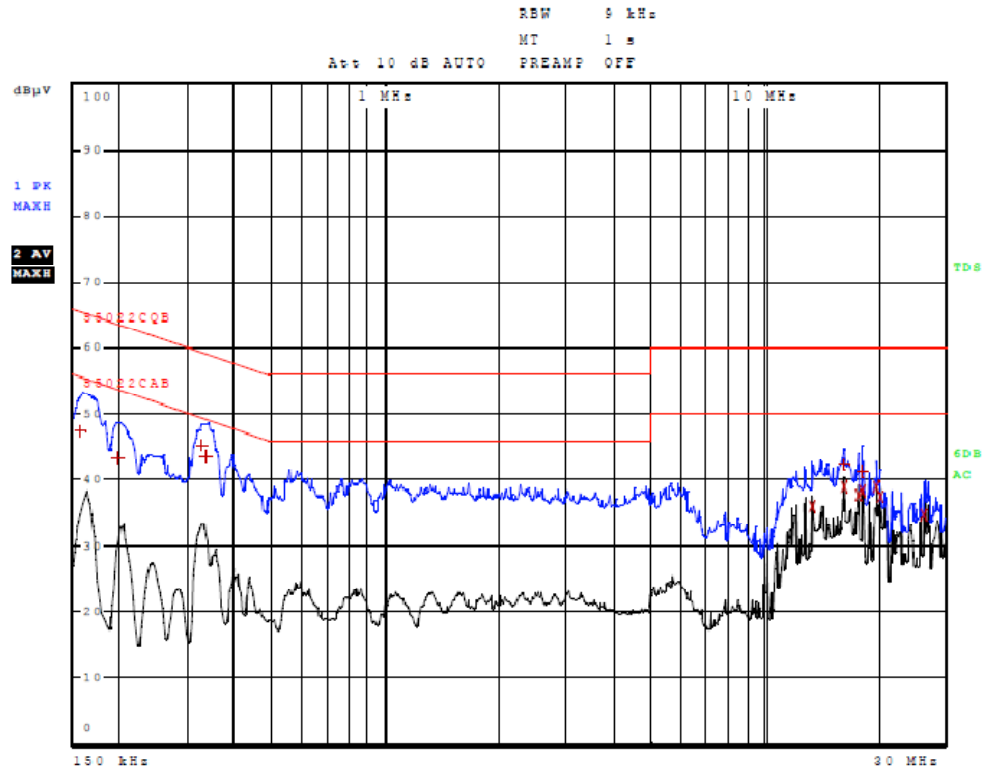


Figure One AC Line Conducted Emissions Line 1

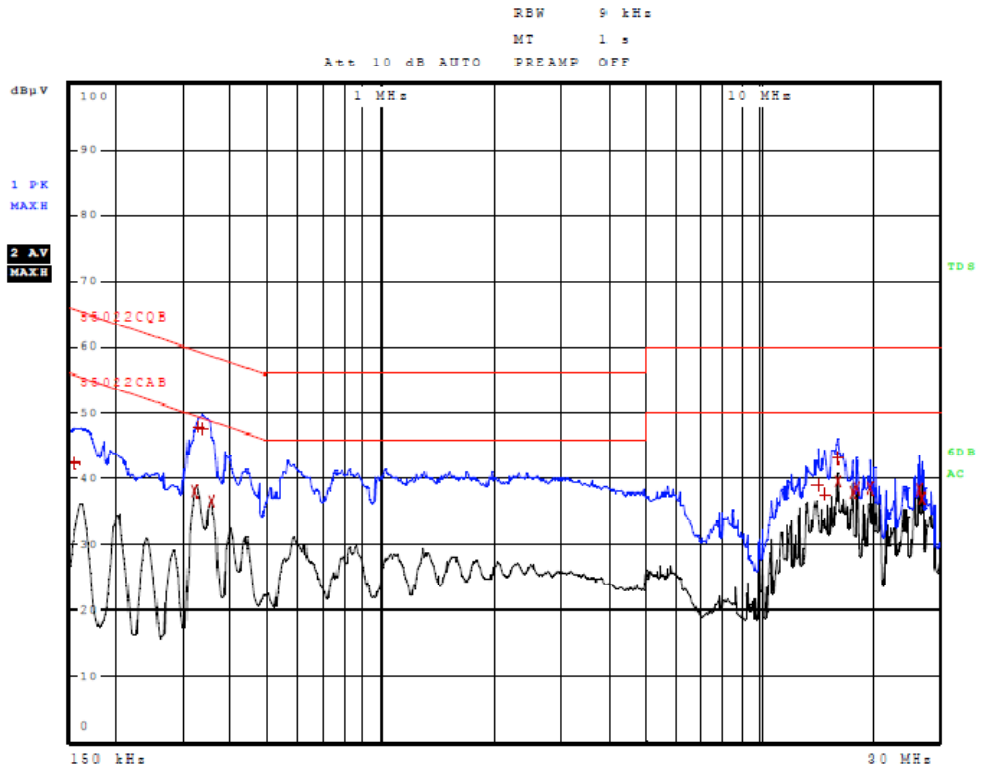


Figure Two AC Line Conducted Emissions Line 2

AC Line Conducted Emissions Data (7 Highest Emissions)

Line 1

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	158.000000000 kHz	47.36	Quasi Peak	-18.21
1	198.000000000 kHz	43.29	Quasi Peak	-20.40
1	330.000000000 kHz	45.22	Quasi Peak	-14.23
1	338.000000000 kHz	43.57	Quasi Peak	-15.68
2	13.420000000 MHz	35.96	Average	-14.04
2	16.228000000 MHz	38.97	Average	-11.03
1	16.228000000 MHz	42.39	Quasi Peak	-17.61
2	17.692000000 MHz	37.62	Average	-12.38
1	18.244000000 MHz	41.27	Quasi Peak	-18.73
2	18.244000000 MHz	38.43	Average	-11.57
2	19.708000000 MHz	38.94	Average	-11.06
2	20.256000000 MHz	37.56	Average	-12.44
2	26.488000000 MHz	34.81	Average	-15.19

Line 2

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	154.000000000 kHz	42.26	Quasi Peak	-23.52
2	322.000000000 kHz	38.12	Average	-11.54
1	330.000000000 kHz	47.75	Quasi Peak	-11.70
1	334.000000000 kHz	47.52	Quasi Peak	-11.84
2	354.000000000 kHz	36.62	Average	-12.25
1	14.272000000 MHz	38.93	Quasi Peak	-21.07
1	15.004000000 MHz	37.70	Quasi Peak	-22.30
1	16.228000000 MHz	43.14	Quasi Peak	-16.86
2	16.228000000 MHz	39.67	Average	-10.33
2	17.692000000 MHz	37.92	Average	-12.08
2	18.244000000 MHz	38.58	Average	-11.42
2	19.708000000 MHz	38.54	Average	-11.46
2	26.608000000 MHz	38.28	Average	-11.72
2	27.160000000 MHz	37.07	Average	-12.93

Other emissions present had amplitudes at least 20 dB below the limit.

Summary of Results for AC Line Conducted Emissions

The EUT demonstrated compliance with the conducted emissions requirements of CFR47 Part 15C and RSS-210 equipment. The EUT demonstrated minimum margin of -10.3 dB below the limit. Measurements were taken using the peak, quasi peak, and average, measurement function for each emissions amplitude and were below the limits stated in the specification. Other emissions were present with recorded data representing worst-case amplitudes.

Intentional Radiators Radiated Emissions Procedure

The EUT was arranged in a typical equipment configuration and operated through all available modes with worst-case data recorded. Preliminary testing was performed in a screen room with the EUT positioned 1 meter from the FSM. Radiated emissions measurements were performed to identify the frequencies, which produced the highest emissions. Plots were made of the radiated frequency spectrum from 30 MHz to 12,000 MHz for the preliminary testing. Refer to figures three through seven for plots of the general radiated emissions spectrum taken in a screen room. Each radiated emission was then maximized at the OATS location before final radiated emissions measurements were performed. Final data was taken with the EUT located at the OATS at a distance of 3 meters between the EUT and the receiving antenna. The frequency spectrum from 30 MHz to 25,000 MHz was searched for general radiated emissions. Measured emission levels were maximized by EUT placement on the table, rotating the turntable through 360 degrees, varying the antenna height between 1 and 4 meters above the ground plane and changing antenna position between horizontal and vertical polarization. Antennas used were Broadband Biconical from 30 to 200 MHz, Biconilog from 30 to 6000 MHz, Log Periodic from 200 MHz to 5 GHz and or double Ridge or pyramidal horns and mixers from 4 GHz to 40 GHz, notch filters and appropriate amplifiers and external mixers were utilized.

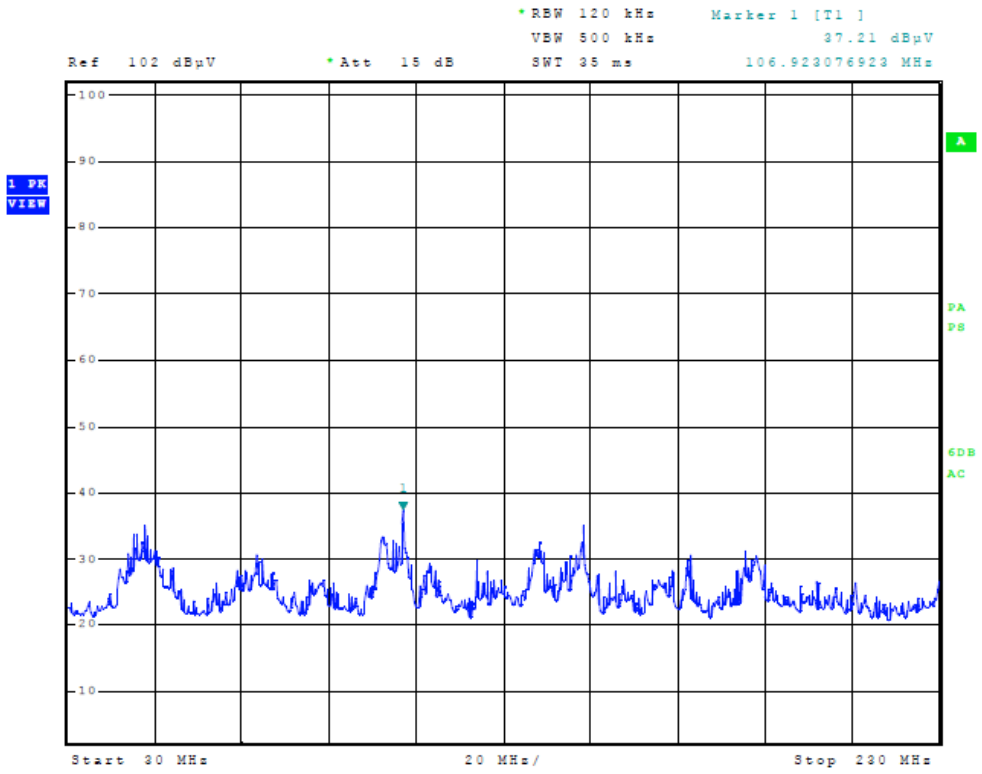


Figure Three General Radiated Emissions taken at 1 meter in screen room

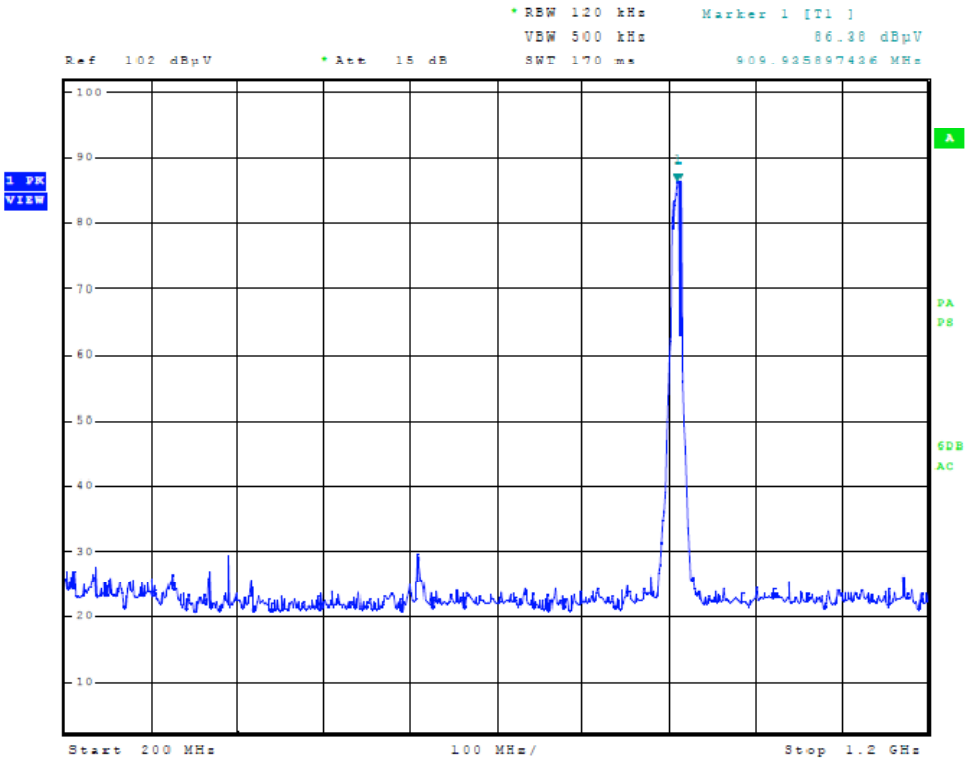


Figure Four General Radiated Emissions taken at 1 meter in screen room

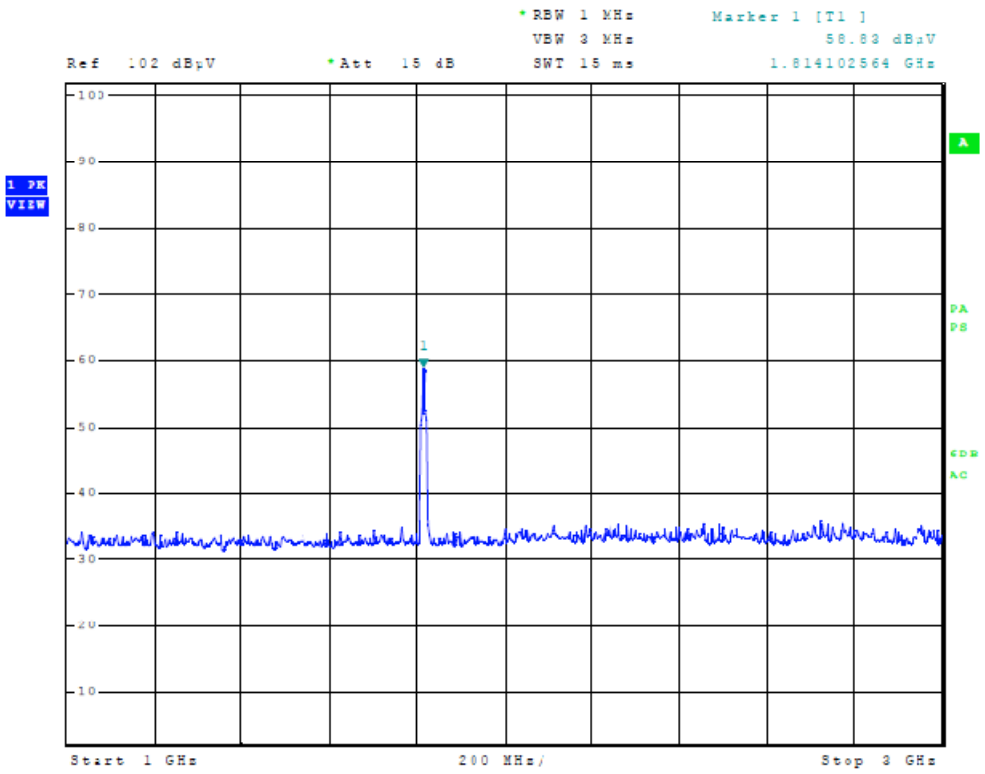


Figure Five General Radiated Emissions taken at 1 meter in screen room

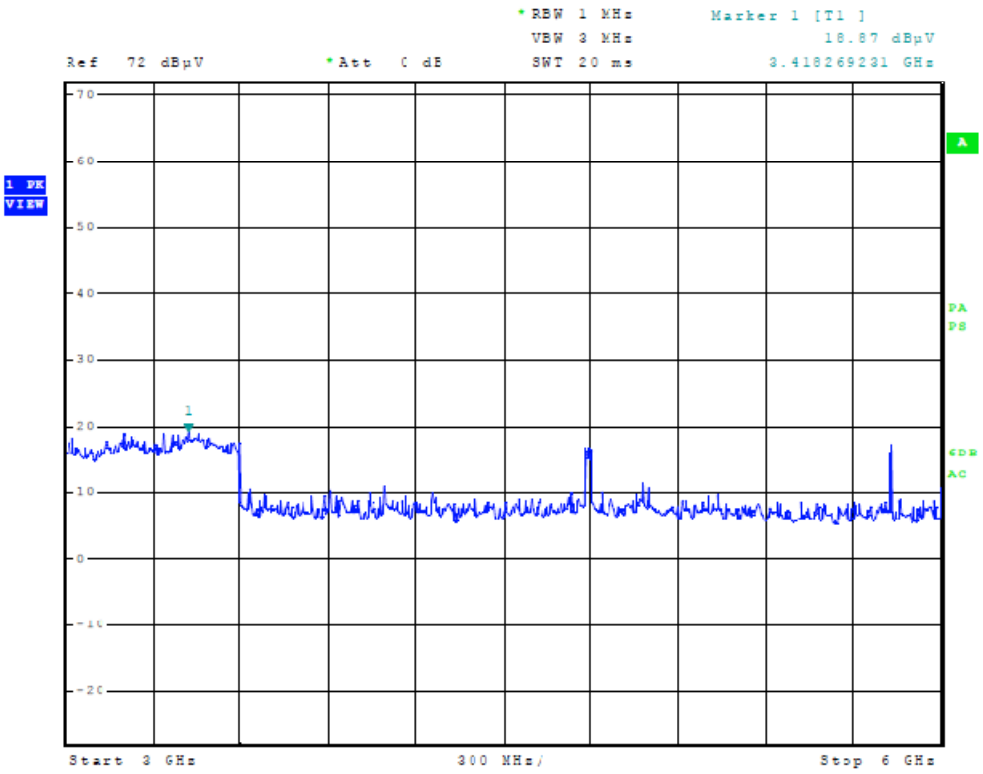


Figure Six General Radiated Emissions taken at 1 meter in screen room

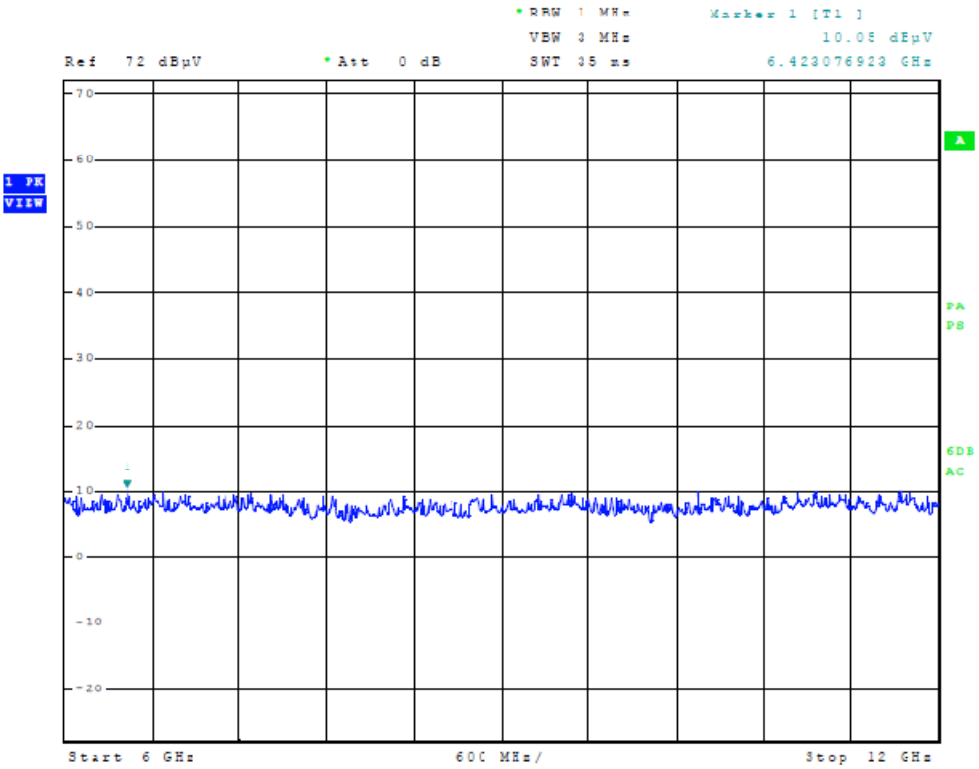


Figure Seven General Radiated Emissions taken at 1 meter in screen room

General Radiated Emissions from EUT Data (Highest Emissions)

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
45.3	46.9	50.0	10.9	30	27.8	30.9	40.0
45.7	46.4	50.4	10.9	30	27.3	31.3	40.0
47.8	47.3	52.8	10.9	30	28.2	33.7	40.0
106.8	52.9	56.1	11.6	30	34.5	37.7	43.5
108.8	49.7	52.8	12.6	30	32.3	35.4	43.5
110.8	45.1	49.0	12.6	30	27.7	31.6	43.5
111.6	46.3	50.8	12.6	30	28.9	33.4	43.5
113.0	44.0	45.3	12.6	30	26.6	27.9	43.5
137.1	48.0	47.7	13.2	30	31.2	30.9	43.5
143.0	47.1	46.4	13.1	30	30.2	29.5	43.5
144.1	45.4	46.0	13.1	30	28.5	29.1	43.5
145.3	50.2	49.2	13.1	30	33.3	32.3	43.5
146.7	49.9	46.8	13.1	30	33.0	29.9	43.5
148.1	50.3	49.8	13.0	30	33.3	32.8	43.5
170.7	46.9	42.5	12.3	30	29.2	24.8	43.5
206.2	46.2	39.4	12.1	30	28.3	21.5	43.5
276.6	47.8	41.2	13.7	30	31.5	24.9	46.0
300.0	44.1	35.4	14.0	30	28.1	19.4	46.0
390.0	48.5	42.2	15.8	30	34.3	28.0	46.0
415.5	45.4	43.7	16.4	30	31.8	30.1	46.0

Other emissions present had amplitudes at least 20 dB below the limit.

Summary of Results for General Radiated Emissions of Intentional Radiator

The EUT demonstrated compliance with the general radiated emissions requirements of CFR47 Part 15.247 and RSS-210. The EUT demonstrated a minimum margin of -5.8 dB below general radiated emissions requirements. There are no other significantly measurable emissions in the restricted bands other than those recorded in this report. Other emissions were present with amplitudes at least 20 dB below the requirements.

Operation in the Band 902 – 928 MHz

The power output was measured both at the antenna connection port and at the open area test site at a three-meter distance with the authorized antenna systems. Figures eight through eleven demonstrate worst-case antenna conducted emissions and compliance with the requirements of 15.247(c) and RSS-210. Figures twelve through fourteen demonstrate compliance with maximum output power requirements across the operational frequency band. Figures fifteen through twenty-one demonstrate compliance with the minimum 6 db bandwidth requirements. Figures twenty-two through twenty-eight demonstrate compliance to power spectral density requirements. Compliance to band edge requirements per 15.209, 15.247, and RSS-210 are demonstrated in restricted bands of operation radiated emissions as presented in data tables.

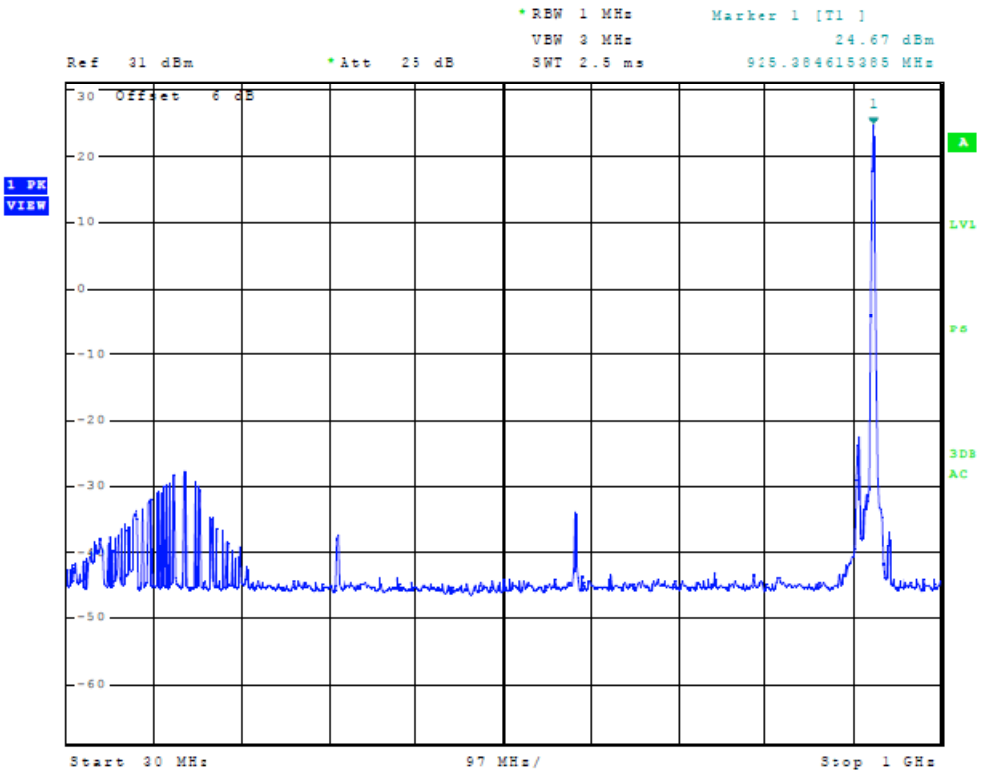


Figure Eight of Antenna Port Conducted Emissions

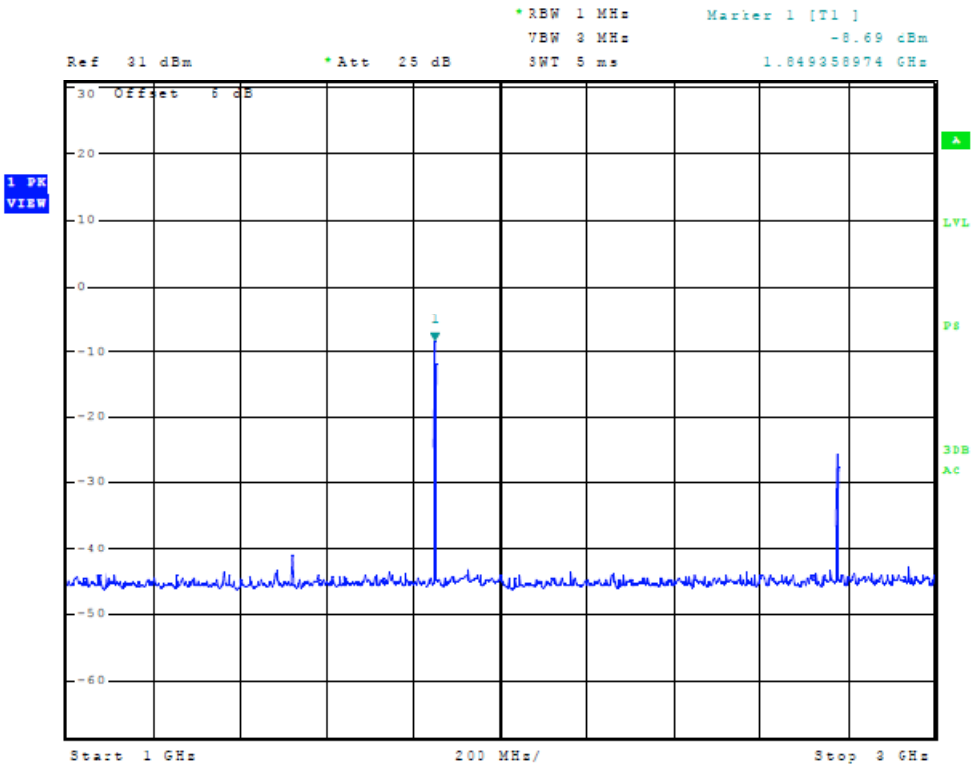


Figure Nine of Antenna Port Conducted Emissions

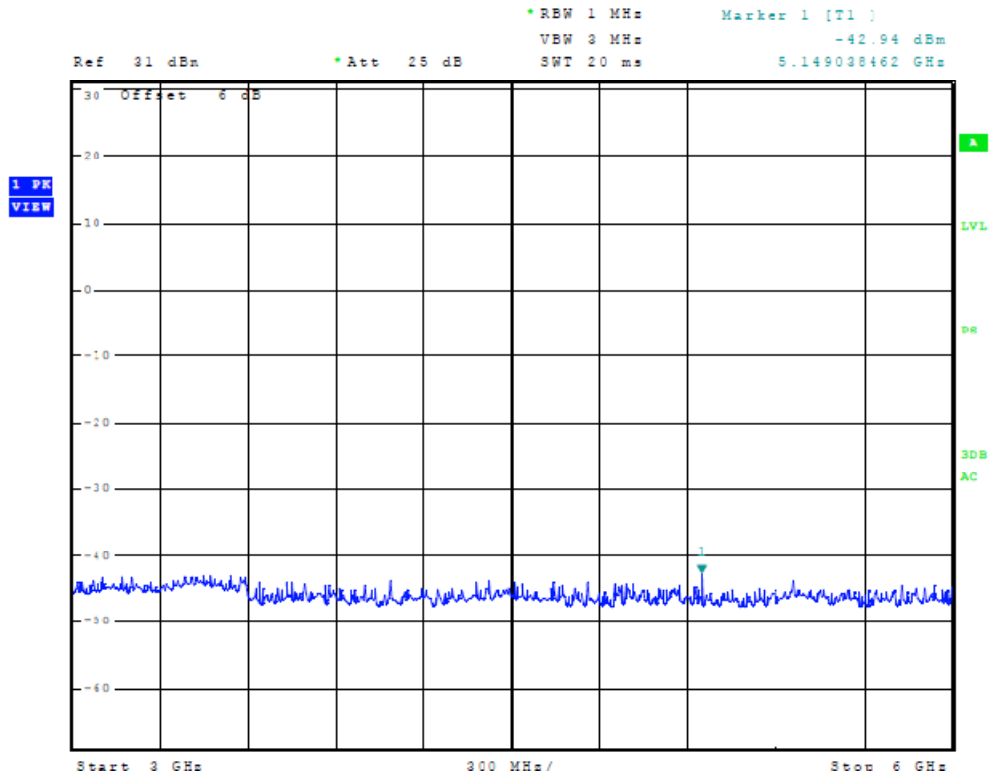


Figure Ten of Antenna Port Conducted Emissions

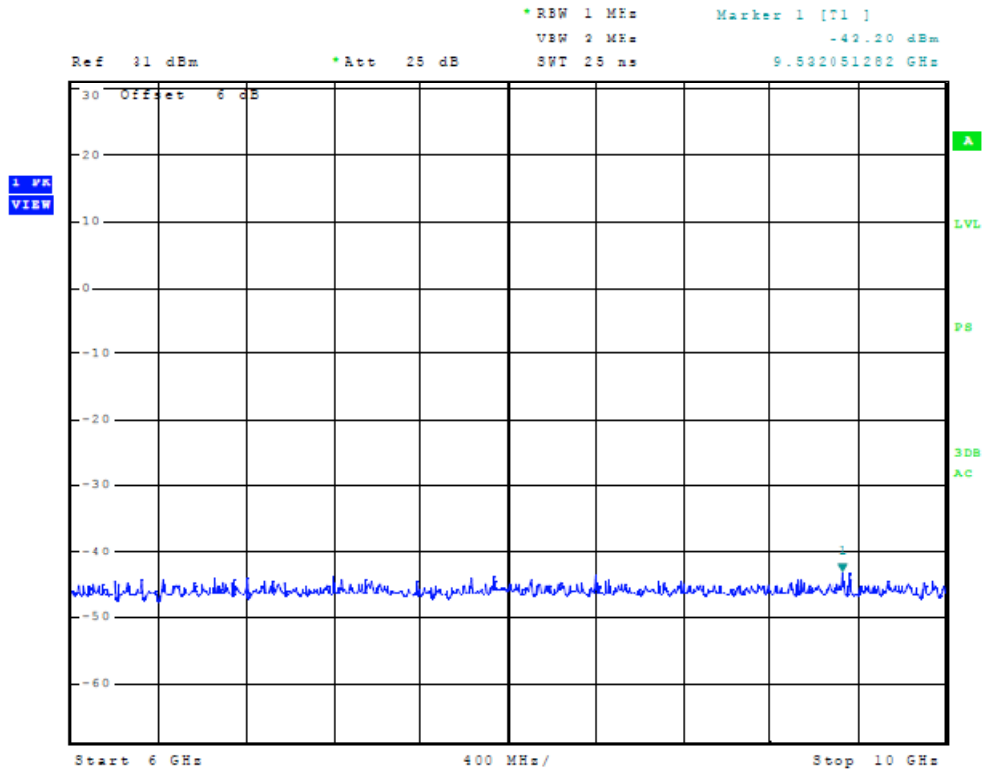


Figure Eleven of Antenna Port Conducted Emissions

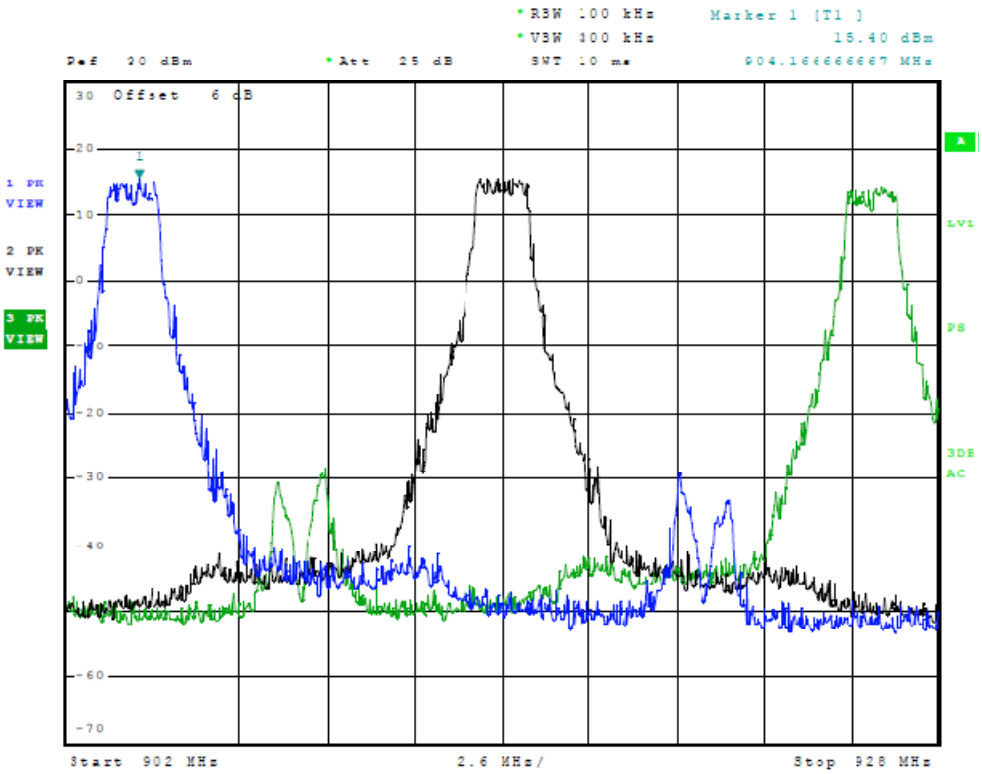


Figure Twelve Plot of Output Across Operational Band (HT2 Mode)

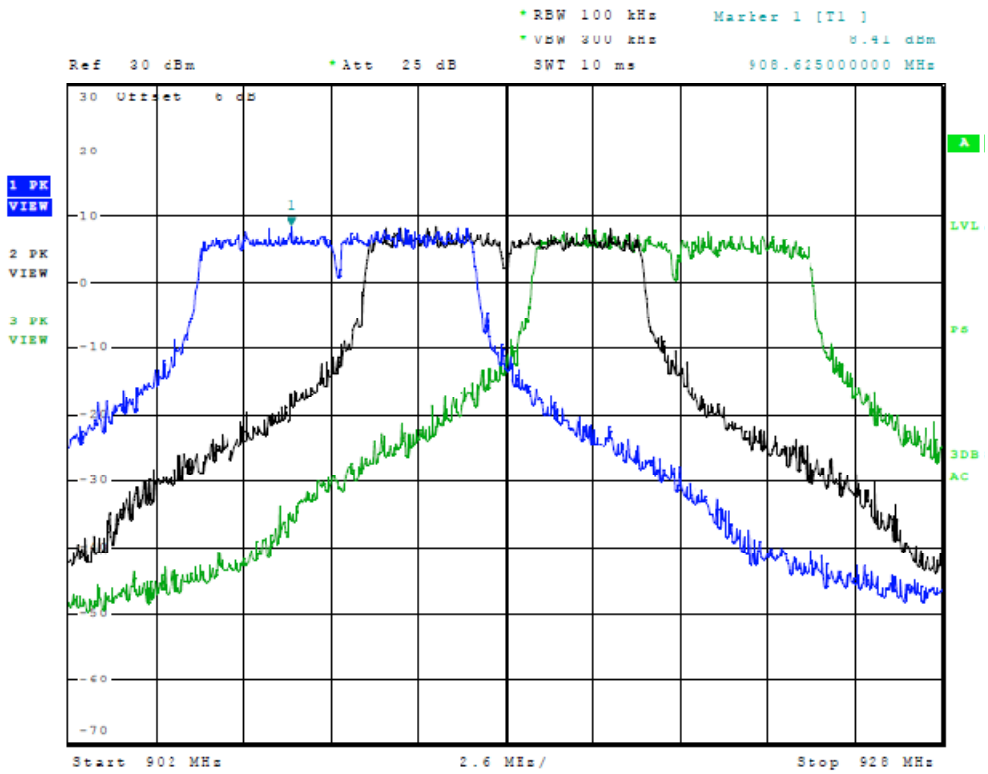


Figure Thirteen Plot of Output Across Operational Band (HT10 Mode)

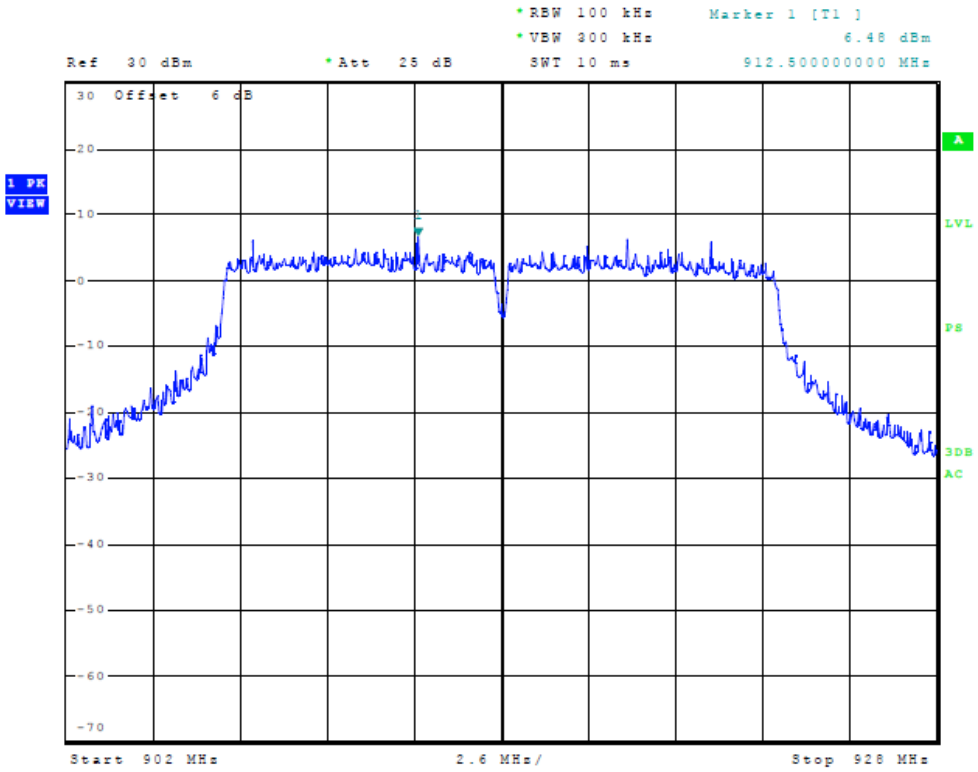


Figure Fourteen Plot of Output Across Operational Band (HT20 Mode)

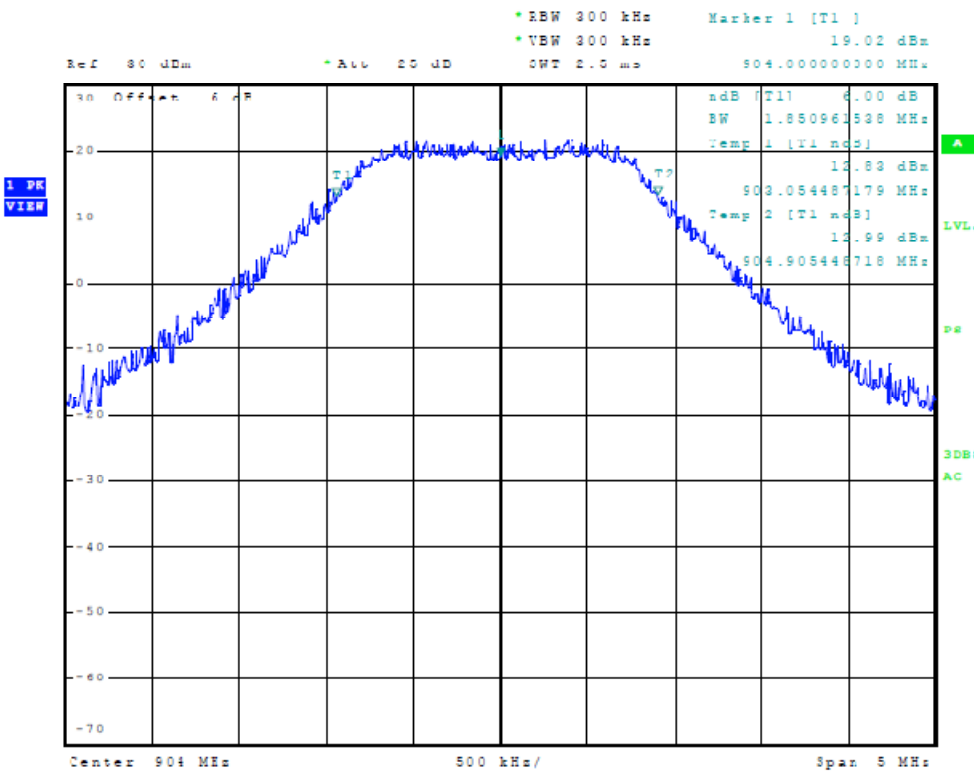


Figure Fifteen Plot of 6dB Band width (HT2 Mode)

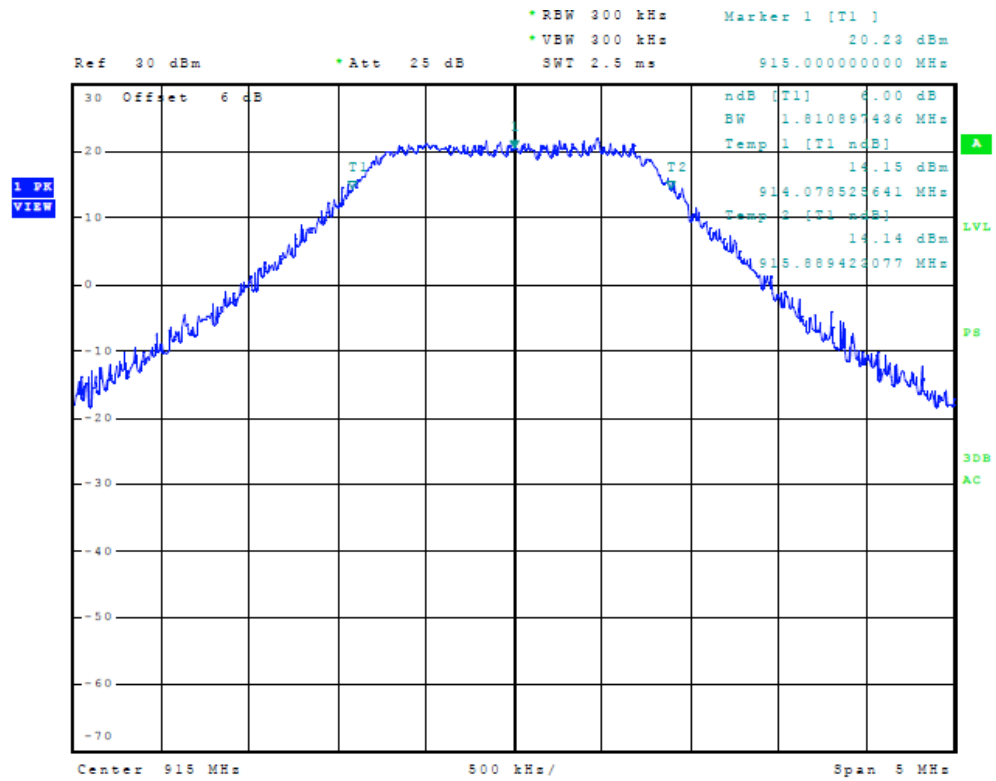


Figure Sixteen Plot of 6dB Band width (HT2 Mode)

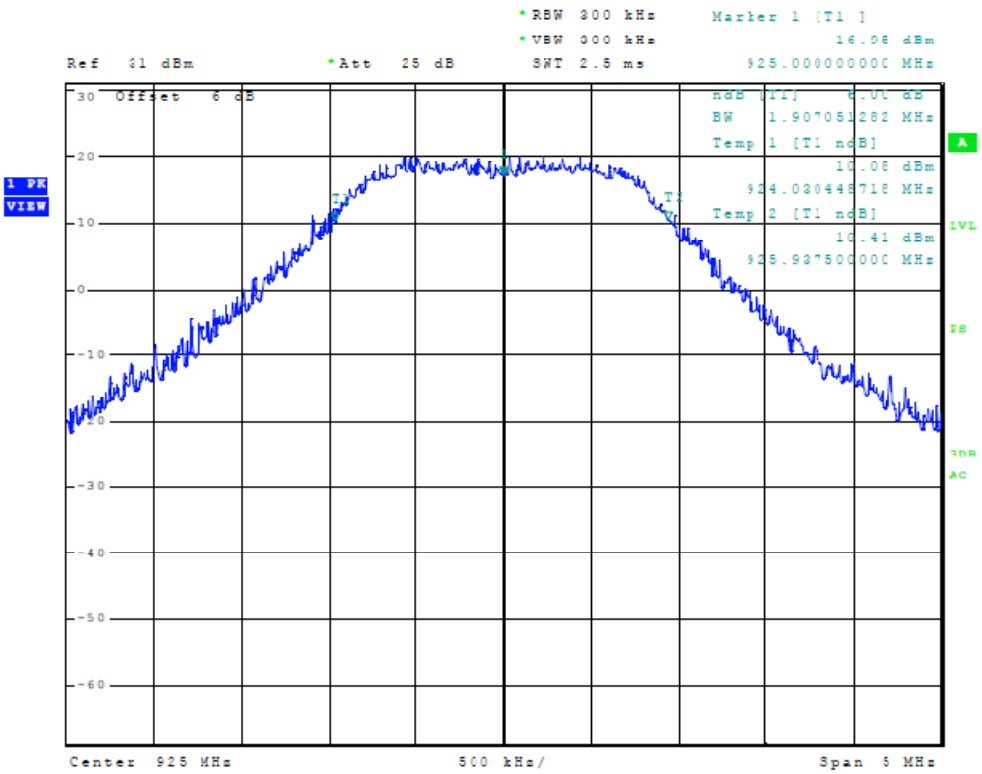


Figure Seventeen Plot of 6dB Band width (HT2 Mode)

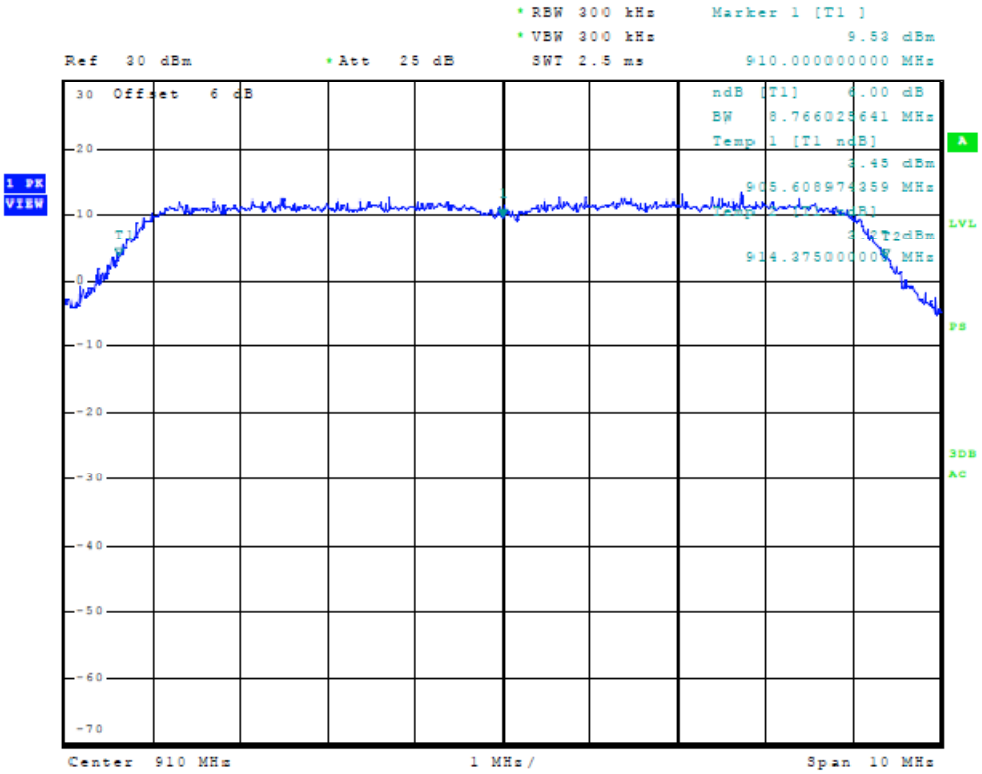


Figure Eighteen Plot of 6dB Band width (HT10 Mode)

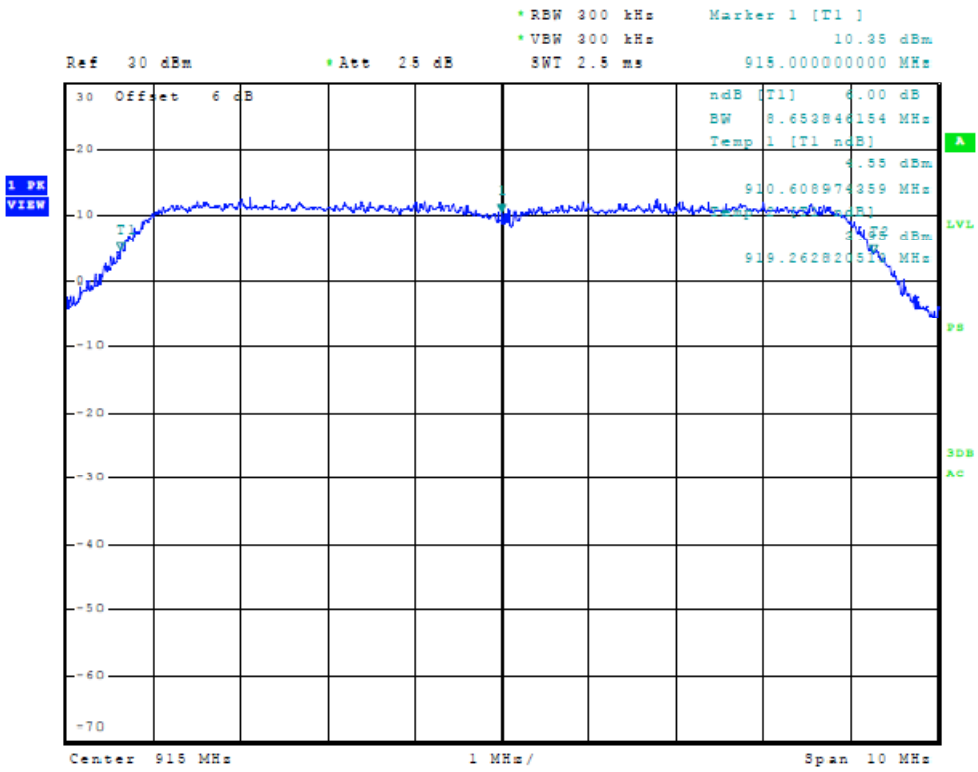


Figure Nineteen Plot of 6dB Band width (HT10 Mode)

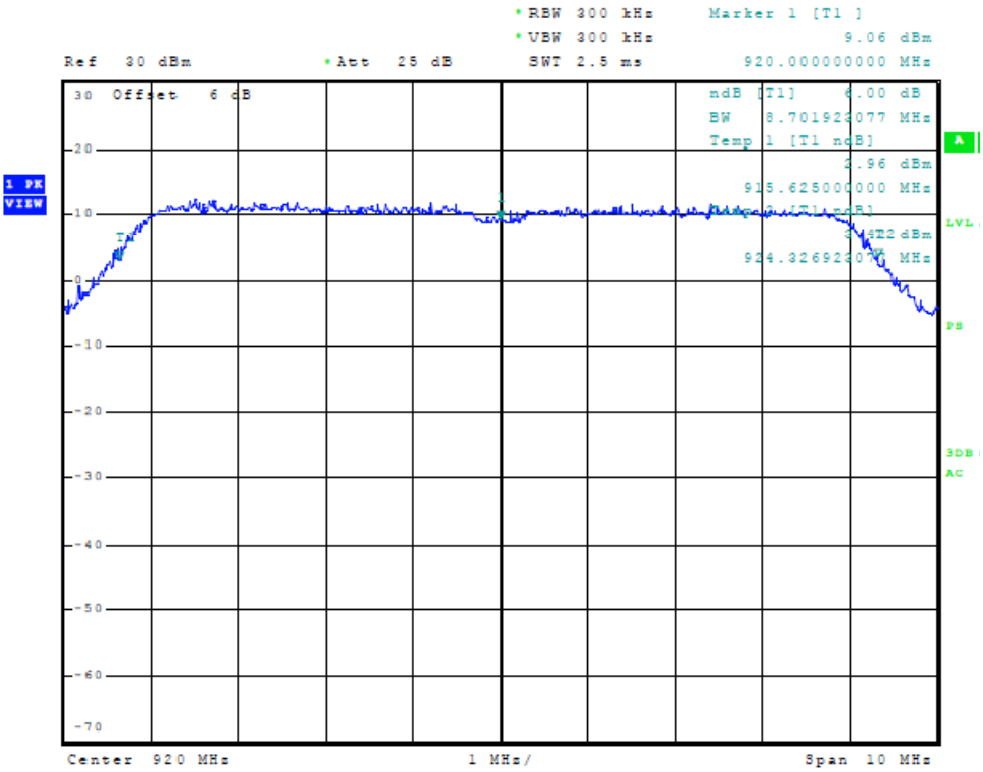


Figure Twenty Plot of 6dB Band width (HT10 Mode)

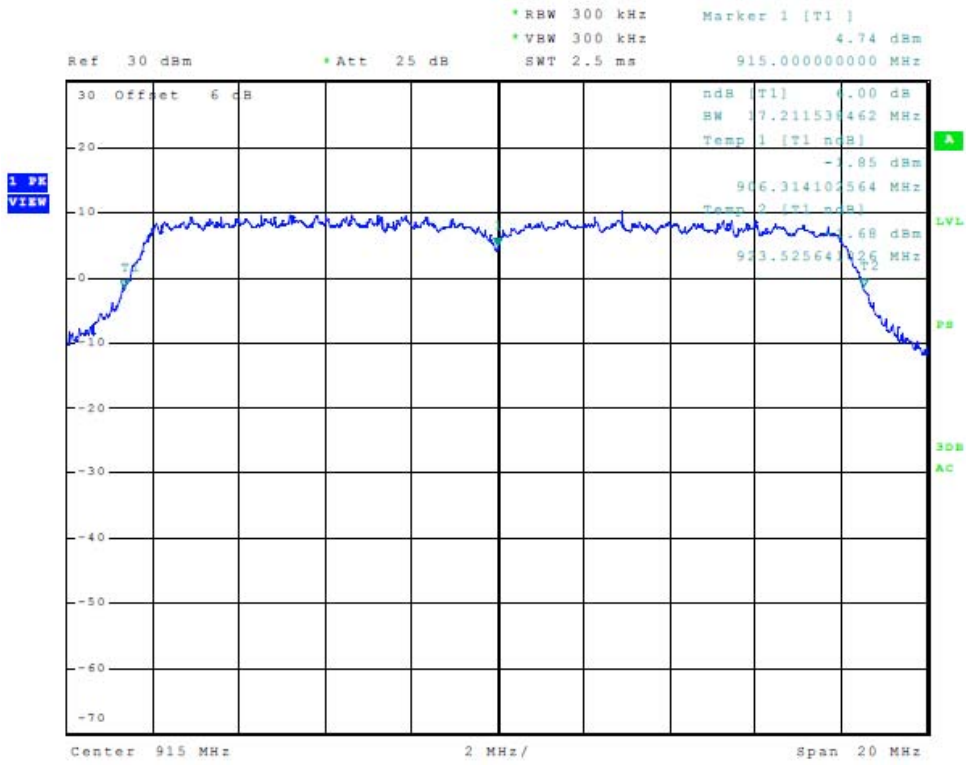


Figure Twenty-one Plot of 6dB Band width (HT20 Mode)

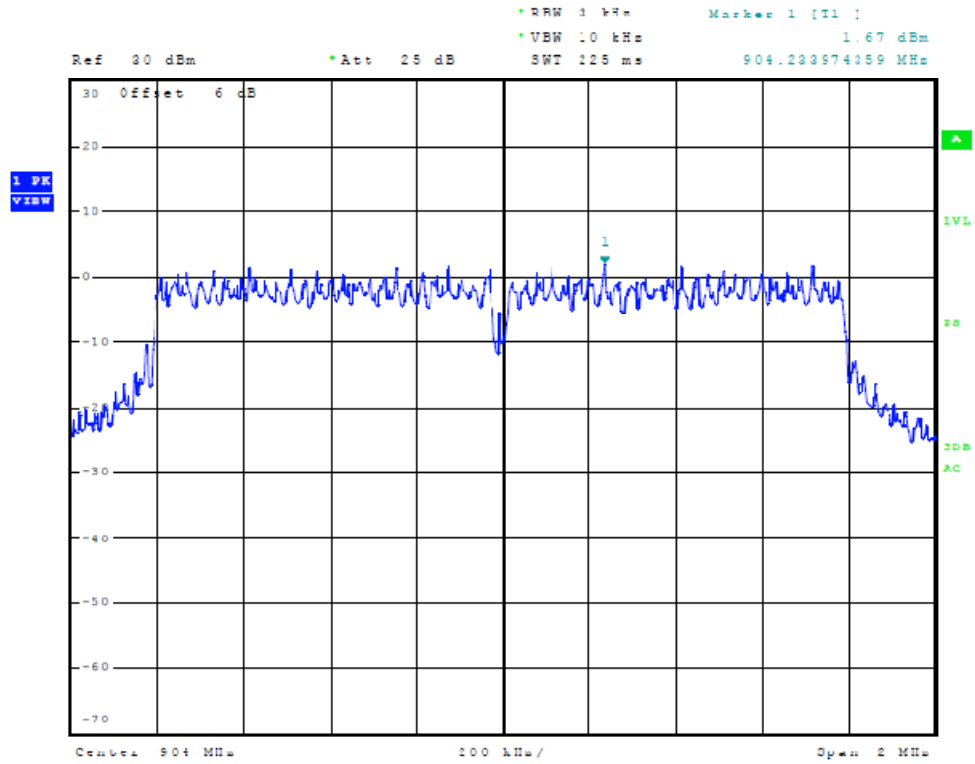


Figure Twenty-two Plot of Power Spectral Density (HT2 Mode)

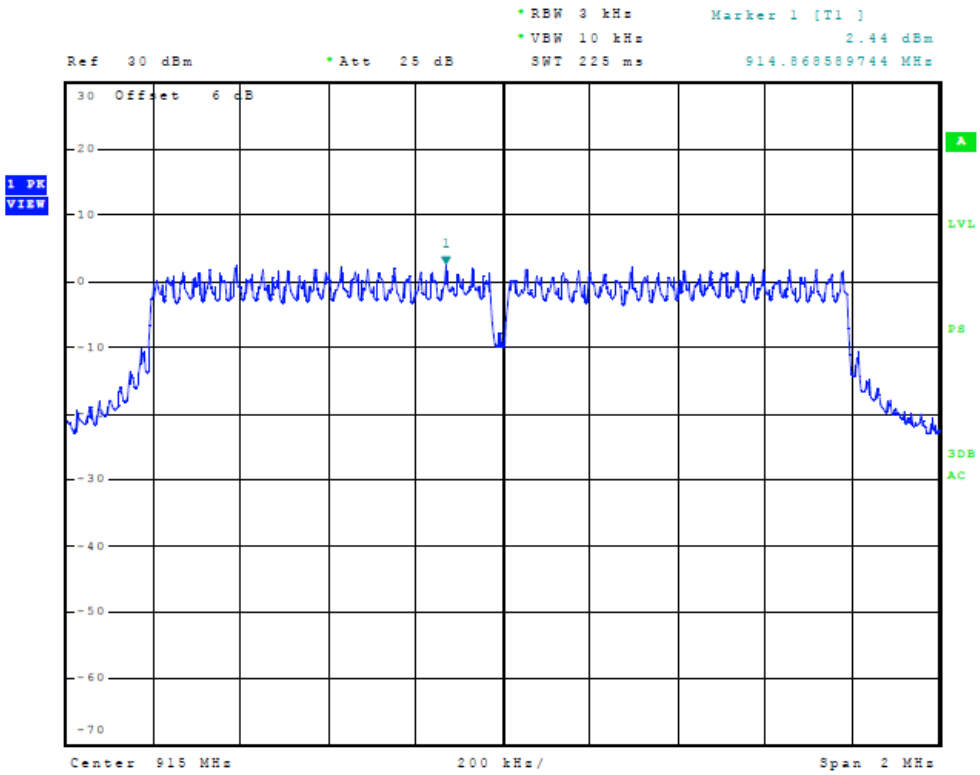


Figure Twenty-three Plot of 6dB Band width (HT2 Mode)

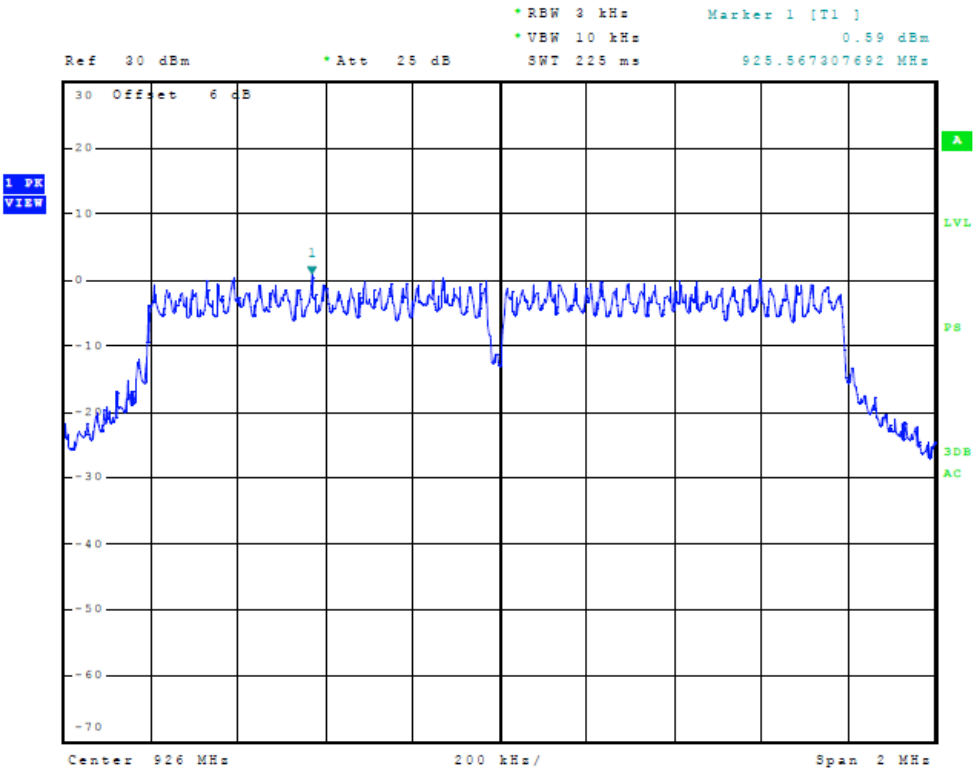


Figure Twenty-four Plot of 6dB Band width (HT2 Mode)

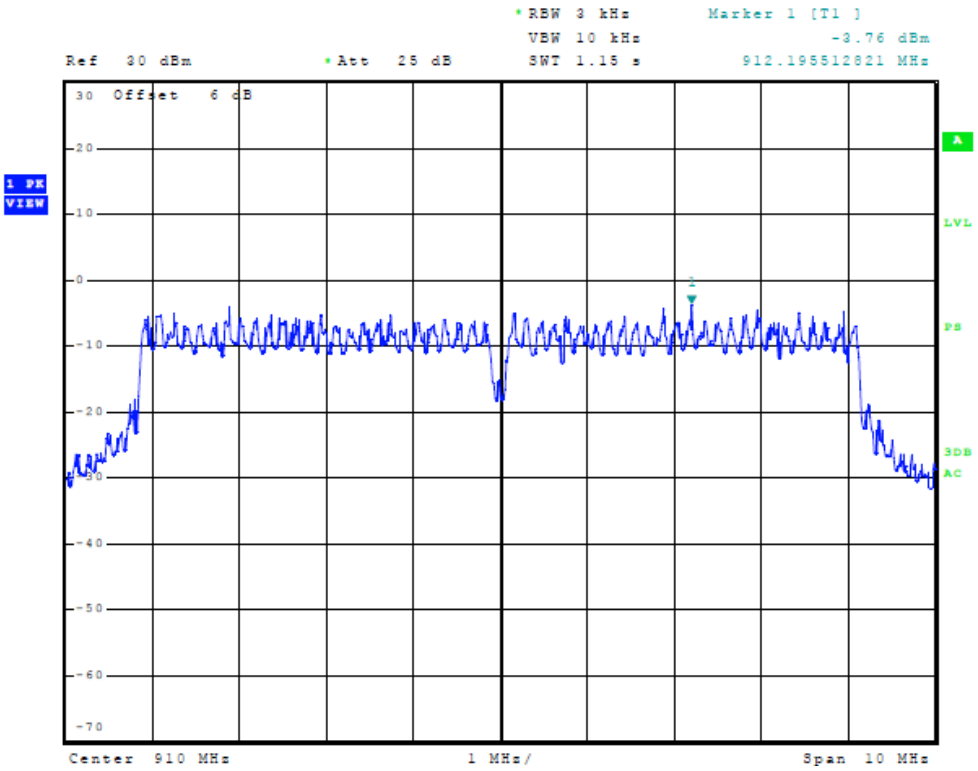


Figure Twenty-five Plot of 6dB Band width (HT10 Mode)

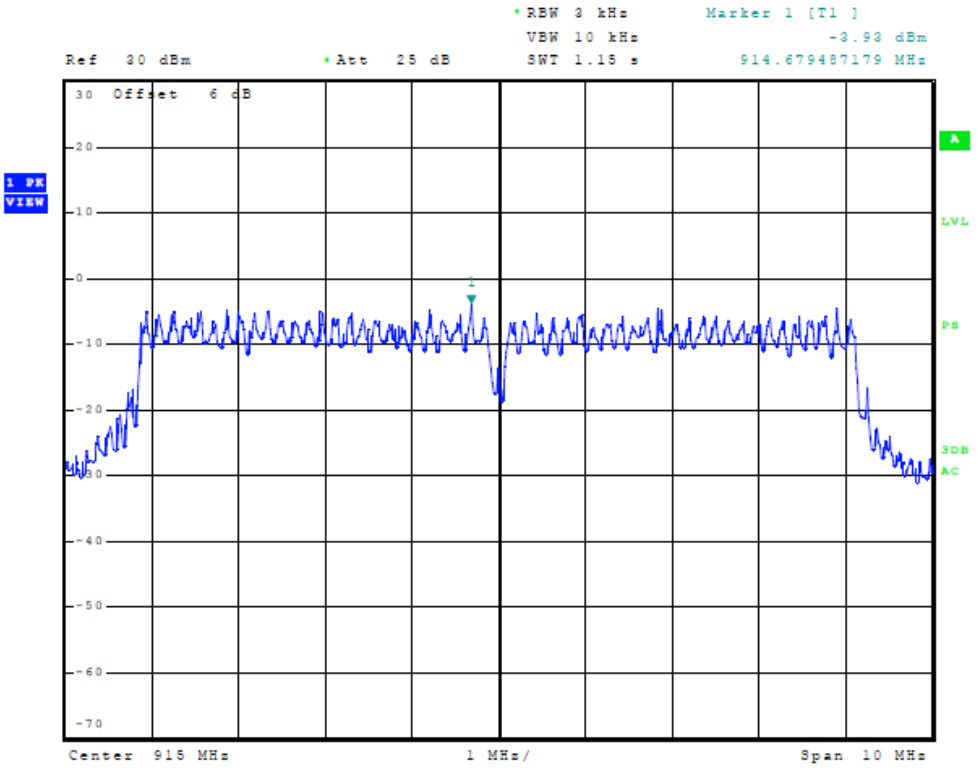


Figure Twenty-six Plot of 6dB Band width (HT10 Mode)

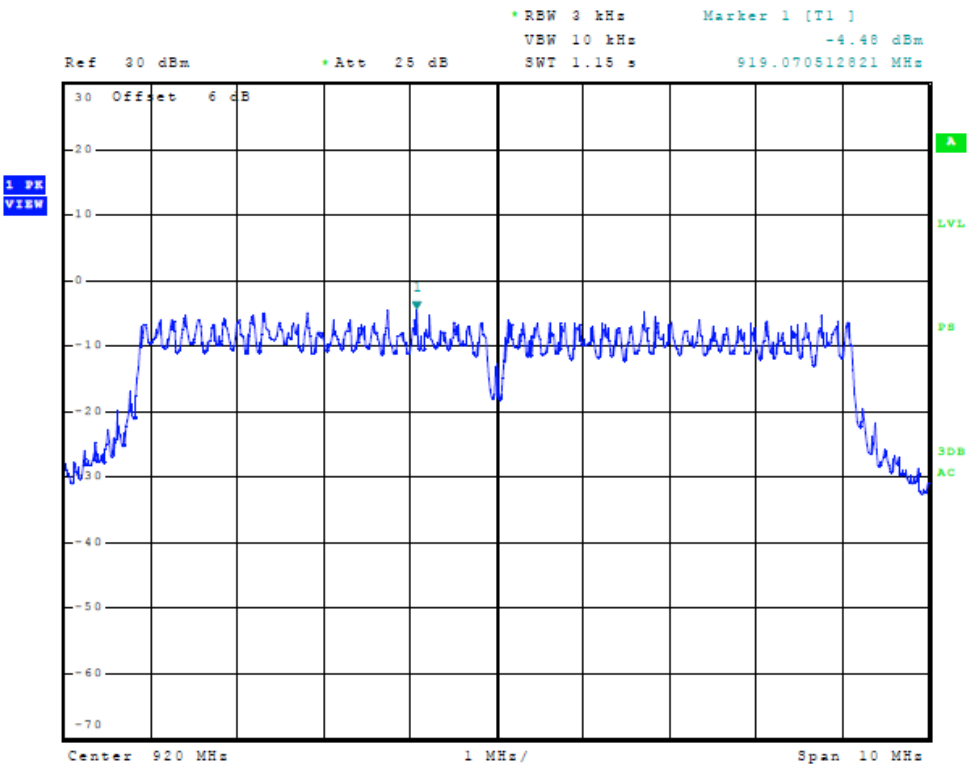


Figure Twenty-seven Plot of 6dB Band width (HT10 Mode

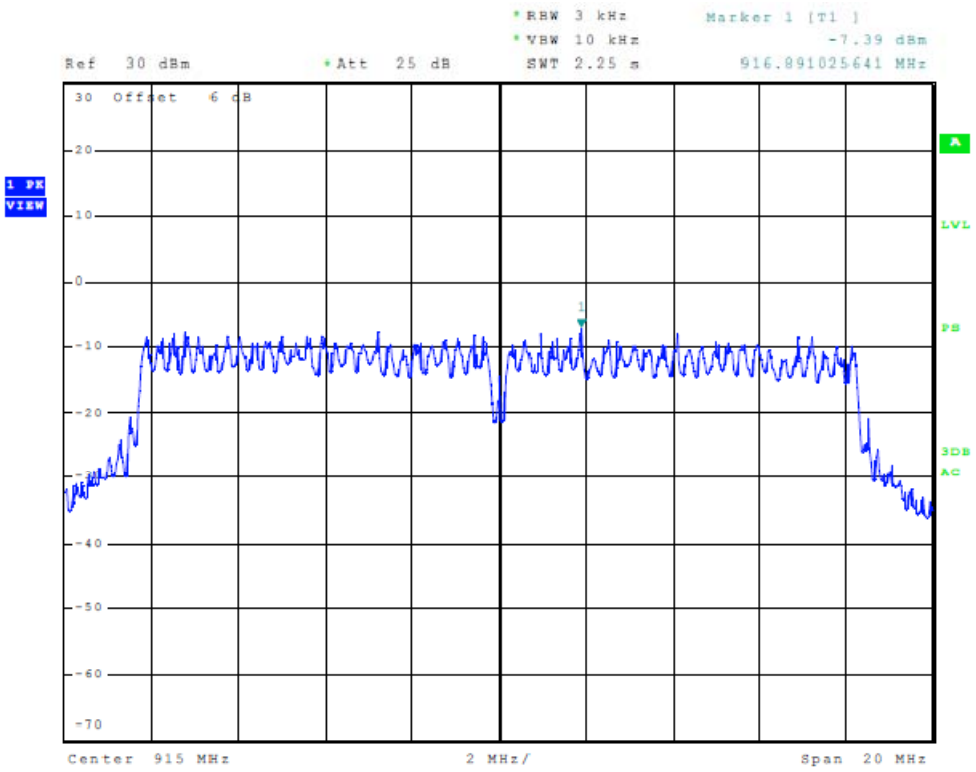


Figure Twenty–eight Plot of 6dB Band width (HT20 Mode)

Transmitter Antenna Conducted Emissions Data

The antenna conducted output power, power spectral density, and 6-dB bandwidth were measured while operating in lowest, middle and highest available channel width modes. The data reported below represents the worst-case operational conditions.

Frequency MHz	Antenna Conducted Output Power dBm	Occupied Bandwidth kHz	Power Spectral Density dBm
HT2 Mode			
904.0	26.45	1,850.96	1.67
915.0	26.45	1,810.89	2.44
926.0	26.26	1,907.05	0.59
HT10 Mode			
910.0	24.11	8,766.03	-3.76
915.0	24.29	8,655.84	-3.93
920.0	23.47	8,701.92	-4.48
HT20 Mode			
915.0	24.26	17,211.54	-7.39

Transmitter Radiated Emissions Data

Transmitter Radiated Emission Integral Antenna (Worst-Case)

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
904.0	116.9	113.5	22.6	25	114.5	111.1	--
1808.0	38.8	35.8	24.8	25	38.6	35.6	54.0
2712.0	18.5	17.9	29.0	25	22.5	21.9	54.0
3616.0	15.6	15.6	30.5	25	21.1	21.1	54.0
4520.0	16.5	16.5	32.5	25	24.0	24.0	54.0
5424.0	16.7	16.7	33.1	25	24.8	24.8	54.0
915.0	116.6	114.3	22.7	25	114.3	112.0	--
1830.0	53.0	43.2	24.8	25	52.8	43.0	54.0
2745.0	20.1	21.1	29.1	25	24.2	25.2	54.0
3660.0	15.7	15.7	30.7	25	21.4	21.4	54.0
4575.0	16.5	16.6	32.6	25	24.1	24.2	54.0
5490.0	15.6	15.5	33.1	25	23.7	23.6	54.0
926.0	114.7	110.0	22.8	25	112.5	107.8	--
1852.0	53.2	47.9	24.8	25	53.0	47.7	54.0
2778.0	30.0	22.9	29.2	25	34.2	27.1	54.0
3704.0	16.3	16.1	30.8	25	22.1	21.9	54.0
4630.0	17.1	17.0	32.7	25	24.8	24.7	54.0
5556.0	15.9	15.9	33.1	25	24.0	24.0	54.0

Other emissions present had amplitudes at least 20 dB below the limit.

Transmitter Radiated Emission 16 dBi Yagi Antenna (Worst-Case)

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
904.0	119.6	115.8	22.6	25	117.2	113.4	--
1808.0	34.1	30.1	24.8	25	33.9	29.9	54.0
2712.0	16.6	16.2	29.0	25	20.6	20.2	54.0
3616.0	15.6	15.6	30.5	25	21.1	21.1	54.0
4520.0	16.7	16.4	32.5	25	24.2	23.9	54.0
5424.0	16.9	16.9	33.1	25	25.0	25.0	54.0
915.0	119.8	116.2	22.7	25	117.5	113.9	--
1830.0	16.6	19.5	24.8	25	16.4	19.3	54.0
2745.0	17.1	16.5	29.1	25	21.2	20.6	54.0
3660.0	15.6	15.6	30.7	25	21.3	21.3	54.0
4575.0	17.0	17.1	32.6	25	24.6	24.7	54.0
5490.0	15.8	15.8	33.1	25	23.9	23.9	54.0
926.0	119.8	116.5	22.8	25	117.6	114.3	--
1852.0	27.8	31.7	24.8	25	27.6	31.5	54.0
2778.0	16.5	17.3	29.2	25	20.7	21.5	54.0
3704.0	15.8	15.3	30.8	25	21.6	21.1	54.0
4630.0	17.1	17.1	32.7	25	24.8	24.8	54.0
5556.0	15.4	15.4	33.1	25	23.5	23.5	54.0

Other emissions present had amplitudes at least 20 dB below the limit.

Summary of Results for Radiated Emissions of Intentional Radiator

The EUT demonstrated antenna conducted output power of 442 milliwatt (at single antenna port), 892 mW in MIMO operation. The EUT demonstrated compliance with the radiated emissions requirements of CFR47 Part 15.247 and RSS-210 with highest radiated emission level measured of 122.2 dBµV/m (16 dBi Yagi). The EUT demonstrated a minimum margin of -1.0 dB below the harmonic emissions requirements. The EUT demonstrated compliance with the radiated emissions requirements for CFR47 Part 15.247 and RSS-210 Intentional Radiators. There are no other significantly measurable emissions were observed in restricted bands other than those recorded in this report. Other emissions were present with amplitudes at least 20 dB below the requirements. The EUT demonstrated compliance with the specifications of CFR47 15.247 and RSS-210. There were no deviations or exceptions to the requirements.

Receiver Spurious Emissions

Receiver Antenna Power Conduction Limits

Receivers which provide terminals for the connection of an external receiving antenna may be tested to demonstrate compliance with the provisions of 15.109 and RSS-210 with the antenna terminals shielded and terminated with a termination equal to the impedance specified for the antenna, provided these receivers also comply with the following: With the receiver antenna terminal connected to a resistive termination equal to the impedance specified or employed for the antenna, the power at the antenna terminal at any frequency within the range of measurements specified shall not exceed 2.0 nanowatts (-57 dBm). The antenna port was connected to a spectrum analyzer for testing the antenna-conducted emissions. The antenna connection under test was connected to the spectrum analyzer through a short coaxial cable. The spectrum analyzer provided the 50-ohm load for the antenna port. The frequency spectrum was investigated at the antenna port with the worst case data presented. Refer to figures twenty-nine through thirty-two showing the spectrum analyzer display of worst-case receiver antenna conduction emissions. Antenna Port conducted emissions data is shown below. Compliance to receiver radiated emissions requirements were tested both at antenna port and 3 meter OATS with worst-case data presented.

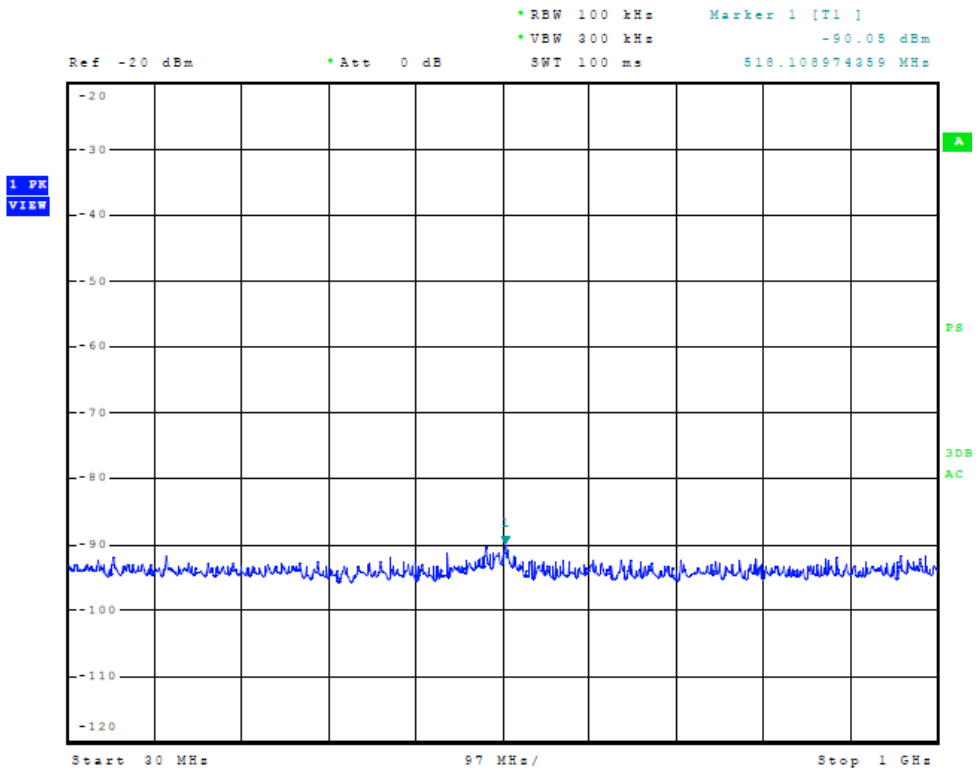


Figure Twenty-nine Receiver Antenna Port Conducted Emissions

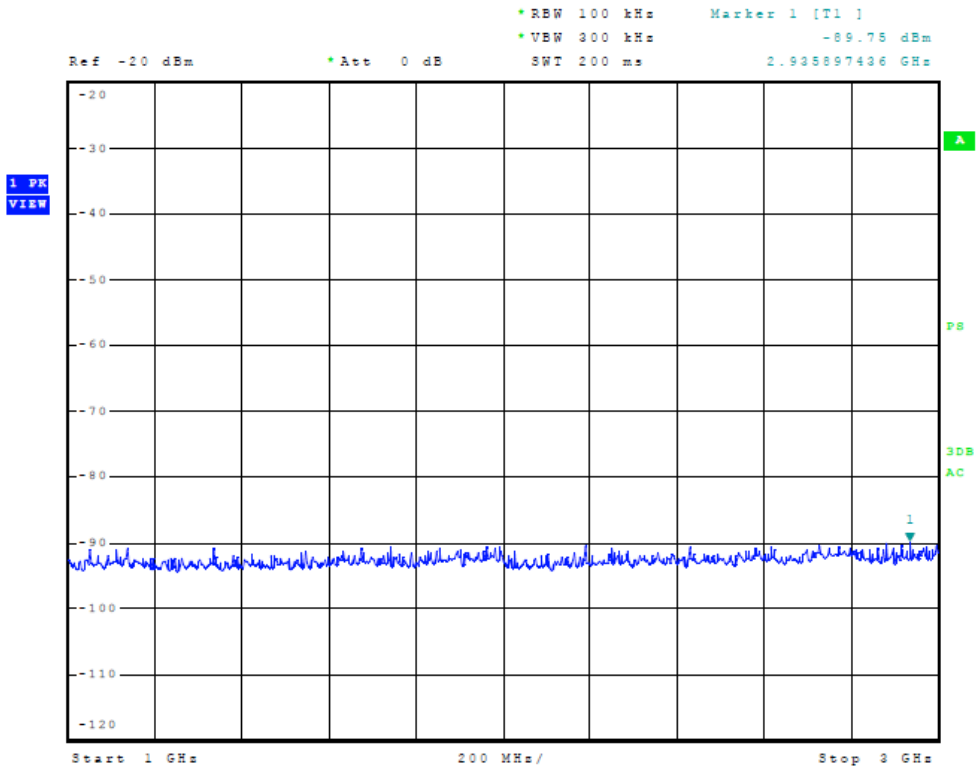


Figure Thirty Receiver Antenna Port Conducted Emissions

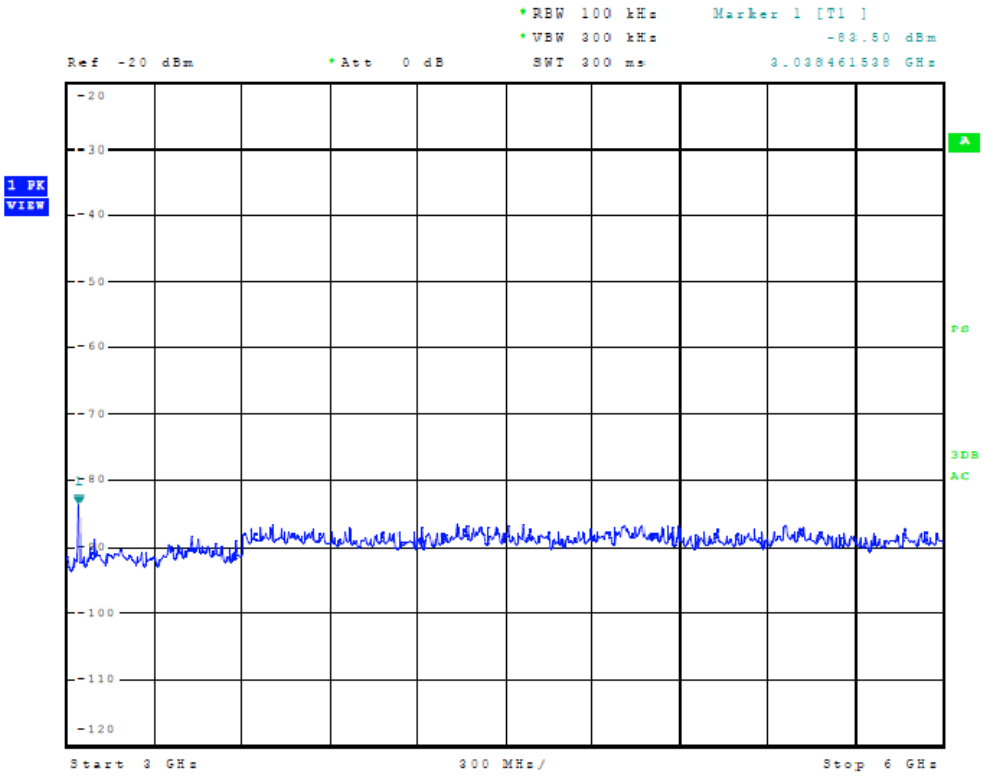


Figure Thirty-one Receiver Antenna Port Conducted Emissions

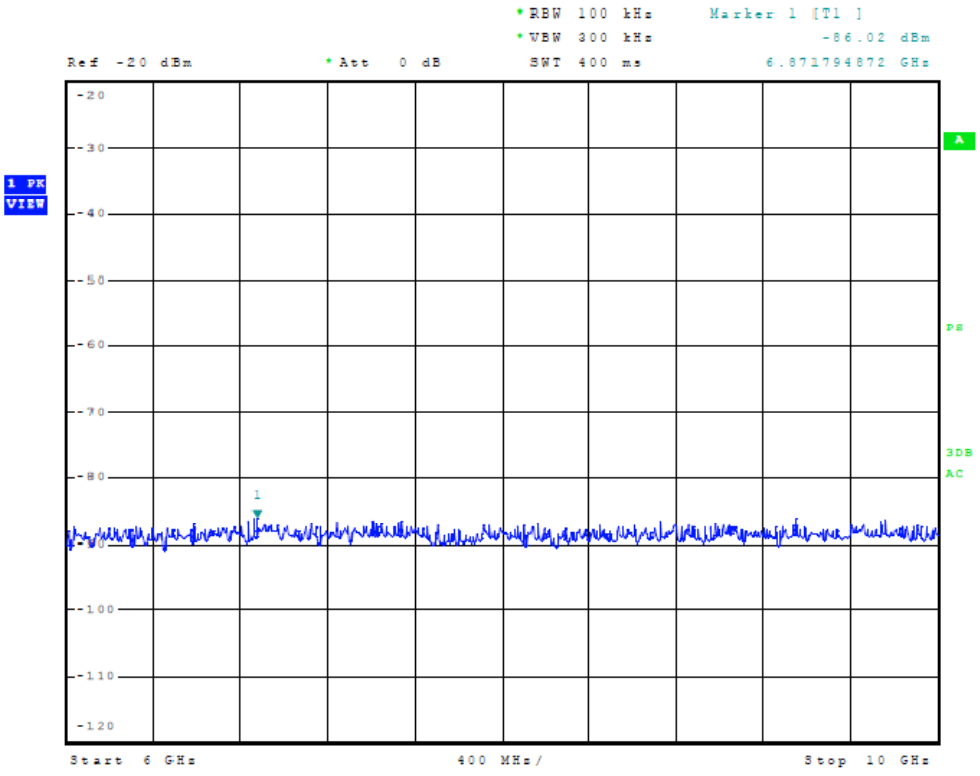


Figure Thirty-two Receiver Antenna Port Conducted Emissions

Receiver Radiated Spurious Emissions

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. The test setup was assembled in a screen room for preliminary screening. The transmitter was placed on a wooden turntable 0.8 meters above the ground plane and at a distance of 1 meter from the receive antenna, plots were taken of the radiated emissions. Refer to figures thirty-three though thirty-eight showing plots of the spectrum analyzer display of the receiver radiated emissions frequency spectrum taken in the screen room.

Final radiated emissions testing were performed with the transmitter placed on a wooden turntable 0.8 meters above the ground plane and at a distance of 3 meters from the Field Strength Measuring (FSM) antenna. The EUT was operational and radiating into the standard antenna as no antenna port connection is provided. The receiving antenna was raised and lowered from 1m to 4m in height to obtain the maximum reading of spurious radiation from the EUT. The turntable was rotated though 360 degrees to locate the position registering the highest amplitude of emission. The frequency spectrum was then searched for spurious emissions generated from the transmitter, interface cabling, and test setup. The amplitude of each spurious emission was maximized by raising and lowering the FSM antenna, and rotating the turntable before final data was recorded. The frequency spectrum from 30 MHz to 12,000 MHz was investigated during radiated emissions testing. A Biconilog antenna was used for frequency measurements of 30 to 6,000 MHz. A double-ridge horn antenna was used for frequencies of 5,000 MHz to 12,000 MHz. Emission levels were measured and recorded from the spectrum analyzer in dBµV. Data was taken at the Rogers Labs, Inc. 3 meters open area test site (OATS). A description of the test facility is on file with the FCC and Industry Canada (refer to annex for site registration letters).

The EUT was operated in all available test modes emulating worst-case operation while radiated emissions testing were performed. The amplitude of each spurious emission was maximized and amplitude levels recorded while operating at the open area test site at a distance of 3-meters.

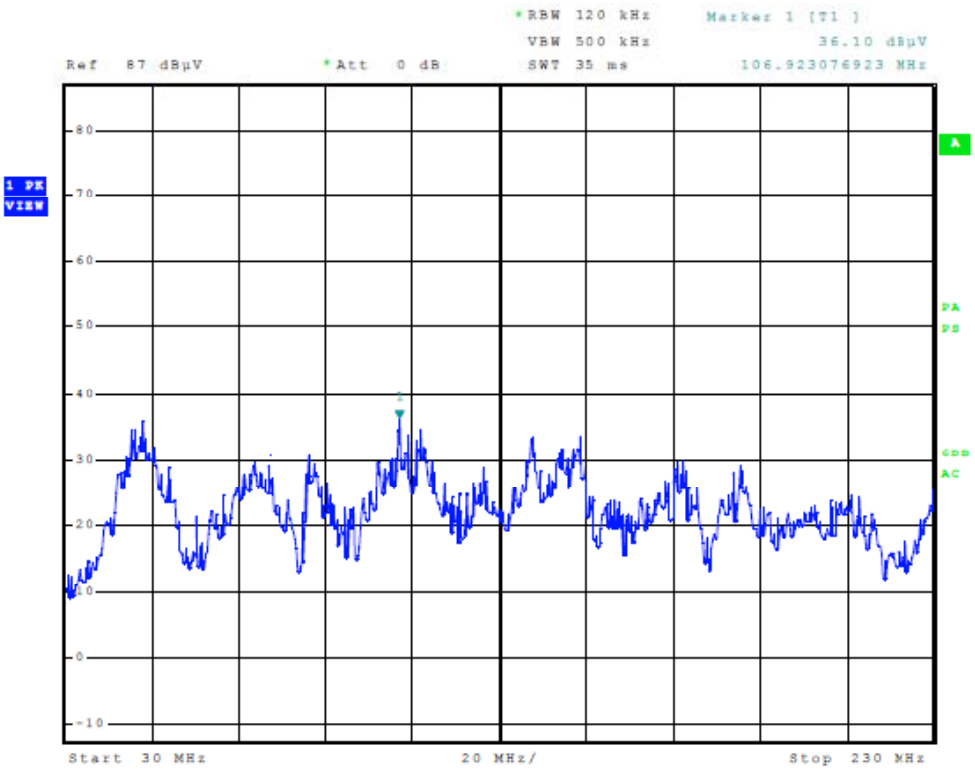


Figure Thirty-three Plot of Receiver Radiated Spurious Emissions taken at 1 meter

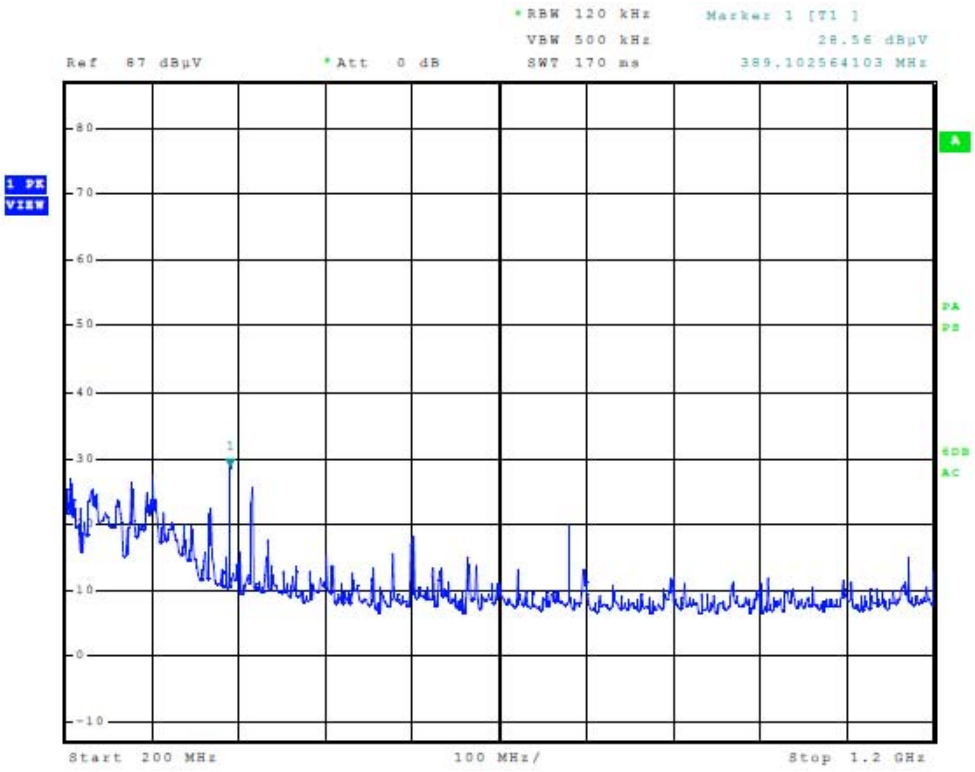


Figure Thirty-four Plot of Receiver Radiated Spurious Emissions taken at 1 meter

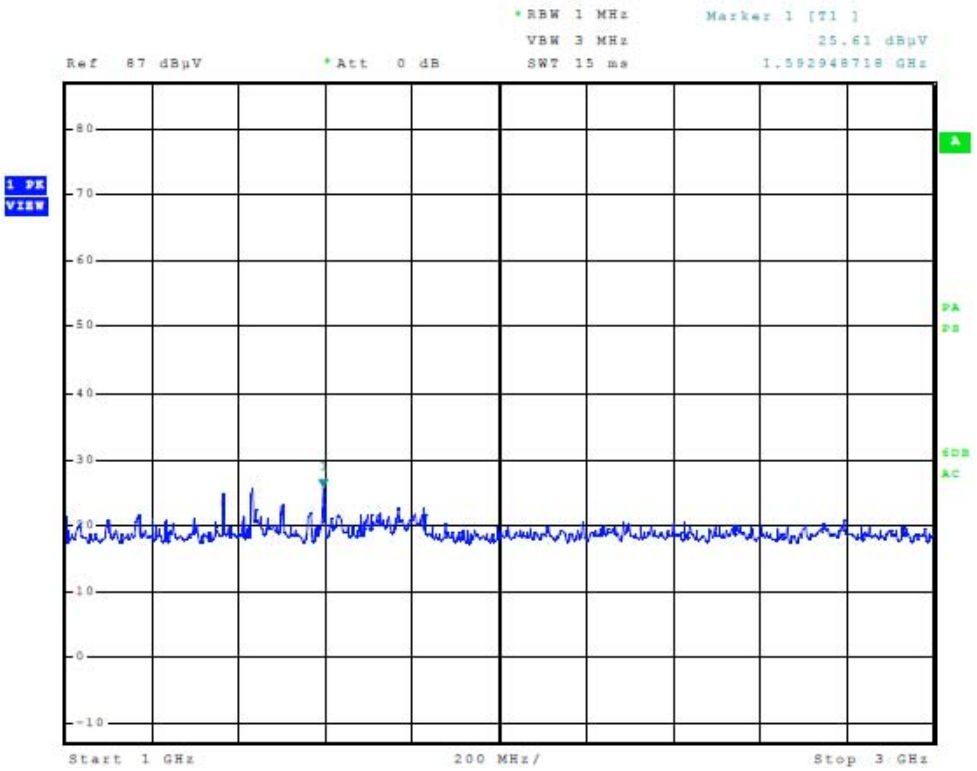


Figure Thirty-five Plot of Receiver Radiated Spurious Emissions taken at 1 meter

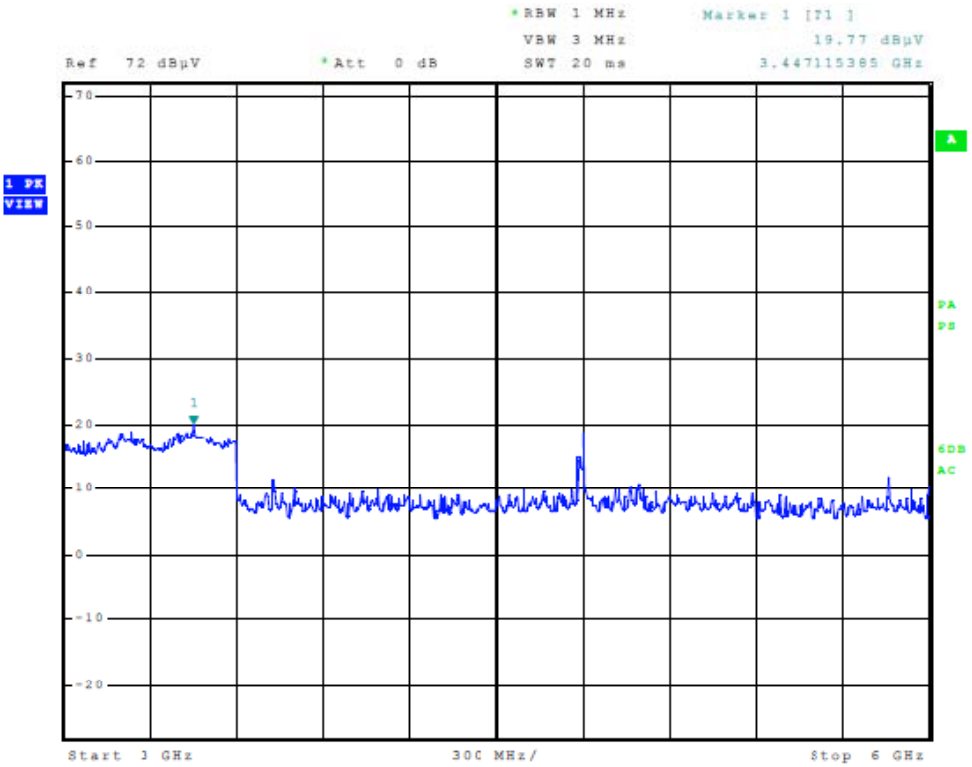


Figure Thirty-six Plot of Receiver Radiated Spurious Emissions taken at 1 meter

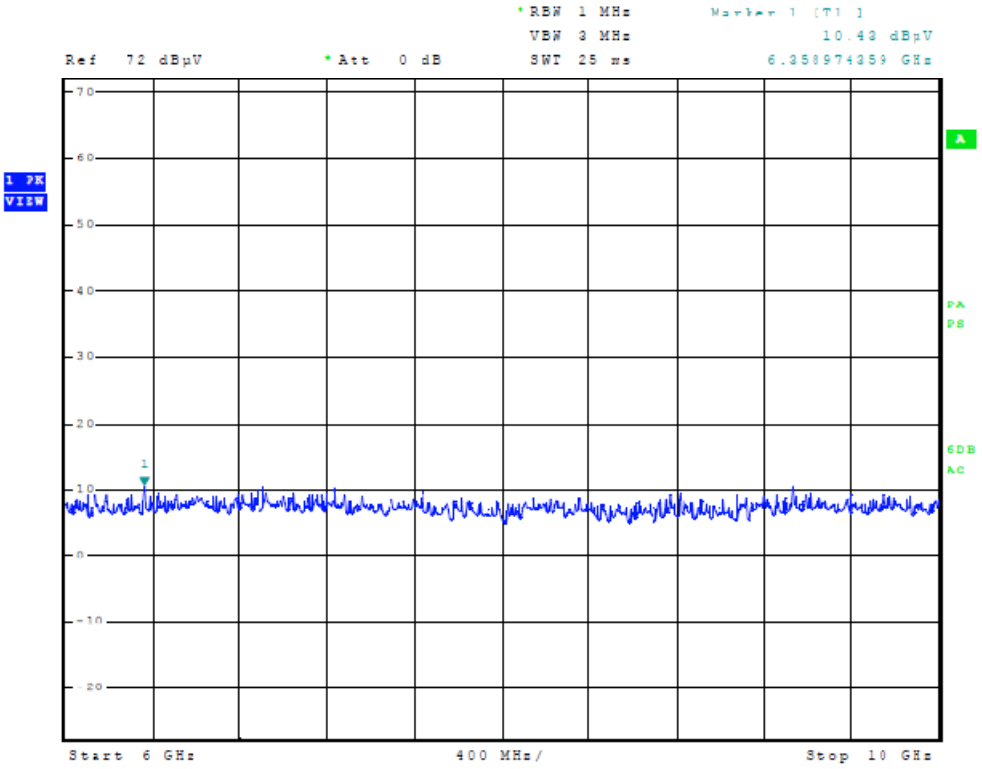


Figure Thirty-seven Plot of Receiver Radiated Spurious Emissions taken at 1 meter

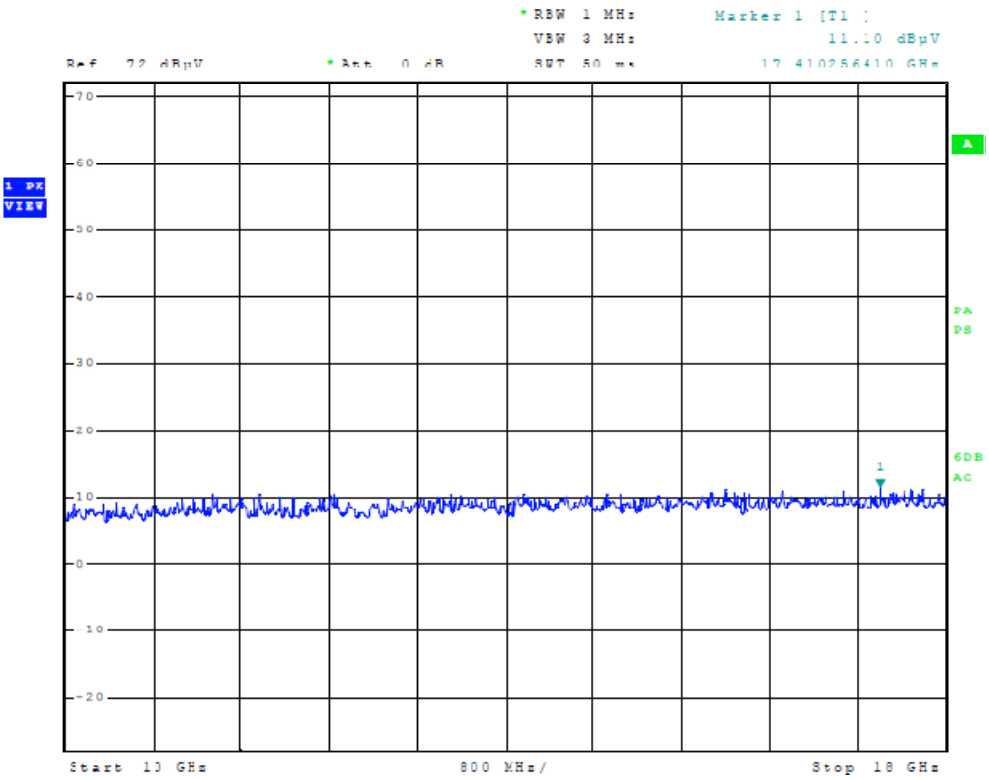


Figure Thirty-eight Plot of Receiver Radiated Spurious Emissions taken at 1 meter

Receiver Antenna Conducted Emissions Data

Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)
		-57.0	

Other emissions present had amplitudes at least 20 dB below the limit.

Receiver Radiated Emissions Data

Emission Freq. (MHz)	FSM Horz. (dBµV)	FSM Vert. (dBµV)	Ant. Factor (dB)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
45.3	47.0	49.5	10.9	30	27.9	30.4	40.0
45.7	46.9	50.6	10.9	30	27.8	31.5	40.0
47.8	46.5	52.4	10.9	30	27.4	33.3	40.0
106.8	53.5	56.1	11.6	30	35.1	37.7	43.5
108.8	49.9	52.2	12.6	30	32.5	34.8	43.5
110.8	48.3	49.1	12.6	30	30.9	31.7	43.5
111.6	49.3	49.9	12.6	30	31.9	32.5	43.5
113.0	45.7	44.3	12.6	30	28.3	26.9	43.5
137.1	50.3	46.1	13.2	30	33.5	29.3	43.5
143.0	46.9	47.3	13.1	30	30.0	30.4	43.5
144.1	44.0	45.0	13.1	30	27.1	28.1	43.5
145.3	49.6	51.4	13.1	30	32.7	34.5	43.5
146.7	48.6	50.8	13.1	30	31.7	33.9	43.5
148.1	49.3	53.1	13.0	30	32.3	36.1	43.5
170.7	46.2	41.8	12.3	30	28.5	24.1	43.5
206.2	44.2	42.9	12.1	30	26.3	25.0	43.5
276.6	47.4	36.9	13.7	30	31.1	20.6	46.0
300.0	44.3	36.2	14.0	30	28.3	20.2	46.0
390.0	46.3	46.2	15.8	30	32.1	32.0	46.0
415.5	37.6	43.4	16.4	30	24.0	29.8	46.0

Other emissions were present with amplitudes at least 20 dB below limits.

Summary of Results for Receiver Emissions

The EUT demonstrated compliance with the antenna conducted emissions requirements of CFR 47 Part 15B, RSS-210, and RSS-GEN with an antenna port conducted minimum margin of at least 20 dB below requirements. The EUT demonstrated compliance with the radiated emissions requirements of CFR 47 Part 15B, RSS-210, and RSS-GEN with a minimum -5.8 dB margin below requirements. Other emissions were present with amplitudes at least 20 dB below the CFR 47 15B and RSS-GEN limits.

Annex

- Annex A Measurement Uncertainty Calculations
- Annex B Rogers Labs Test Equipment List
- Annex C Rogers Qualifications
- Annex D FCC Site Registration Letter
- Annex E Industry Canada Site Registration Letter

Annex A Measurement Uncertainty Calculations

Radiated Emissions Measurement Uncertainty Calculation

Measurement of vertically polarized radiated field strength over the frequency range 30 MHz to 1 GHz on an open area test site at 3m and 10m includes following uncertainty:

Contribution	Probability Distribution	Uncertainty (dB)
Antenna factor calibration	normal (k = 2)	±0.58
Cable loss calibration	normal (k = 2)	±0.2
Receiver specification	rectangular	±1.0
Antenna directivity	rectangular	±0.1
Antenna factor variation with height	rectangular	±2.0
Antenna factor frequency interpolation	rectangular	±0.1
Measurement distance variation	rectangular	±0.2
Site Imperfections	rectangular	±1.5

Combined standard uncertainty $u_c(y)$ is

$$U_c(y) = \pm \sqrt{\left[\frac{1.0}{2}\right]^2 + \left[\frac{0.2}{2}\right]^2 + \left[\frac{1.0^2 + 0.1^2 + 2.0^2 + 0.1^2 + 0.2^2 + 1.5^2}{3}\right]}$$

$U_c(y) = \pm 1.6$ dB

It is probable that $u_c(y) / s(q_k) > 3$, where $s(q_k)$ is estimated standard deviation from a sample of n readings unless the repeatability of the EUT is particularly poor, and a coverage factor of k = 2 will ensure that the level of confidence will be approximately 95%, therefore:

$$s(q_k) = \sqrt{\frac{1}{(n-1)} \sum_{k-1}^{n} (q_k - \bar{q})^2}$$

$U = 2\ U_c(y) = 2 \times \pm 1.6$ dB $= \pm 3.2$ dB

Notes:

1.1 Uncertainties for the antenna and cable were estimated, based on a normal probability distribution with k = 2.

1.2 The receiver uncertainty was obtained from the manufacturer's specification for which a rectangular distribution was assumed.

1.3 The antenna factor uncertainty does not take account of antenna directivity.

1.4 The antenna factor varies with height and since the height was not always the same in use as when the antenna was calibrated an additional uncertainty is added.

1.5 The uncertainty in the measurement distance is relatively small but has some effect on the received signal strength. The increase in measurement distance as the antenna height is increased is an inevitable consequence of the test method and is therefore not considered a contribution to uncertainty.

1.6 Site imperfections are difficult to quantify but may include the following contributions:
-Unwanted reflections from adjacent objects.
-Ground plane imperfections: reflection coefficient, flatness, and edge effects.
-Losses or reflections from "transparent" cabins for the EUT or site coverings.
-Earth currents in antenna cable (mainly effect biconical antennas).

The specified limits for the difference between measured site attenuation and the theoretical value (± 4 dB) were not included in total since the measurement of site attenuation includes uncertainty contributions already allowed for in this budget, such as antenna factor.

Conducted Measurements Uncertainty Calculation

Measurement of conducted emissions over the frequency range 9 kHz to 30 MHz includes following uncertainty:

Contribution	Probability Distribution	Uncertainty (dB)
Receiver specification	rectangular	±1.5
LISN coupling specification	rectangular	±1.5
Cable and input attenuator calibration	normal (k=2)	±0.5

Combined standard uncertainty $u_c(y)$ is

$$U_c(y) = \pm \sqrt{\left[\frac{0.5}{2}\right]^2 + \frac{1.5^2 + 1.5^2}{3}}$$

$U_c(y) = \pm 1.2$ dB

As with radiated field strength uncertainty, it is probable that $u_c(y) / s(q_k) > 3$ and a coverage factor of k = 2 will suffice, therefore:

$U = 2\ U_c(y) = 2 \times \pm 1.2$ dB $= \pm 2.4$ dB

Annex B Rogers Labs Test Equipment List

The test equipment used is maintained in calibration and good operating condition. Use of this calibrated equipment ensures measurements are traceable to national standards.

List of Test Equipment	Calibration Date
Oscilloscope Scope: Tektronix 2230	2/11
Wattmeter: Bird 43 with Load Bird 8085	2/11
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/11
H/V Power Supply: Fluke Model: 408B (SN: 573)	2/11
R.F. Generator: HP 606A	2/11
R.F. Generator: HP 8614A	2/11
R.F. Generator: HP 8640B	2/11
Spectrum Analyzer: Rohde & Schwarz ESU40	2/11
Spectrum Analyzer: HP 8562A, HP Adapters: 11518, 11519, 11520 Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W	5/10
Spectrum Analyzer: HP 8591EM	5/10
Frequency Counter: Leader LDC825	2/11
Antenna: Sunol Biconilog Model: JB6	5/10
Antenna: EMCO Biconilog Model: 3143	5/10
Antenna: EMCO Log Periodic Model: 3147	10/10
Antenna: Antenna Research Biconical Model: BCD 235	10/10
Antenna: EMCO Dipole Set 3121C	2/11
Antenna: C.D. B-101	2/11
Antenna: Solar 9229-1 & 9230-1	2/11
Antenna: EMCO 6509	2/11
Antenna: Large Loop Antenna	2/11
Audio Oscillator: H.P. 201CD	2/11
R.F. Power Amp 65W Model: 470-A-1010	2/11
R.F. Power Amp 50W M185- 10-501	2/11
R.F. Preamp CPPA-102	2/11
LISN 50 µHy/50 ohm/0.1 µf	10/10
LISN Compliance Eng. 240/20	2/11
LISN Fischer Custom Communications FCC-LISN-50-16-2-08	2/11
Peavey Power Amp Model: IPS 801	2/11
Power Amp A.R. Model: 10W 1010M7	2/11
Power Amp EIN Model: A301	2/11
ELGAR Model: 1751	2/11
ELGAR Model: TG 704A-3D	2/11
ESD Test Set 2010i	2/11
Fast Transient Burst Generator Model: EFT/B-101	2/11
Current Probe: Singer CP-105	2/11
Current Probe: Solar 9108-1N	2/11
Field Intensity Meter: EFM-018	2/11
KEYTEK Ecat Surge Generator	2/11
Shielded Room 5 M x 3 M x 3.0 M	

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 17 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

NVLAP Lab Code 200087-0

Annex D FCC Site Registration Letter

FEDERAL COMMUNICATIONS COMMISSION

Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

May 18, 2010

Registration Number: 90910

Rogers Labs, Inc.
4405 West 259th Terrace,
Louisburg, KS 66053

Attention: Scot Rogers,

Re: Measurement facility located at Louisburg
~~3 & 10 meter site~~
Date of Renewal: May 18, 2010

Dear Sir or Madam:

Your request for renewal of the registration of the subject measurement facility has been received. The information submitted has been placed in your file and the registration has been renewed. The name of your organization will remain on the list of facilities whose measurement data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Please note that the file must be updated for any changes made to the facility and the registration must be renewed at least every three years.

Measurement facilities that have indicated that they are available to the public to perform measurement services on a fee basis may be found on the FCC website www.fcc.gov under E-Filing, OET Equipment Authorization Electronic Filing, Test Firms.

Sincerely,

Phyllis Parrish
Industry Analyst

NVLAP Lab Code 200087-0

Annex E Industry Canada Site Registration Letter

Industry Canada Industrie Canada

May 26, 2010

OUR FILE: 46405-3041
Submission No: 140719

Rogers Labs Inc.
4405 West 259th Terrace
Louisburg, KY, 66053
USA

Attention: Mr. Scot D. Rogers

Dear Sir/Madame:

The Bureau has received your application for the renewal of a 3/10m OATS. Be advised that the information received was satisfactory to Industry Canada. The following number(s) is now associated to the site(s) for which registration / renewal was sought **(3041A-1).** Please reference the appropriate site number in the body of test reports containing measurements performed on the site. In addition, please keep for your records the following information;

- Your primary code is: **3041**

- The company number associated to the site(s) located at the above address is: **3041A**

Furthermore, to obtain or renew a unique site number, the applicant shall demonstrate that the site has been accredited to ANSI C63.4-2003 or later. A scope of accreditation indicating the accreditation by a recognized accreditation body to ANSI C63.4-2003 or later shall be accepted. Please indicate in a letter the previous assigned site number if applicable and the type of site (example: 3 metre OATS or 3 metre chamber). If the test facility is not accredited to ANSI C63.4-2003 or later, the test facility shall submit test data demonstrating full compliance with the ANSI standard. The Bureau will evaluate the filing to determine if recognition shall be granted.

The frequency for re-validation of the test site and the information that is required to be filed or retained by the testing party shall comply with the requirements established by the accrediting organization. However, in all cases, test site re-validation shall occur on an interval not to exceed two years. There is no fee or form associated with an OATS filing. OATS submissions are encouraged to be submitted electronically to the Bureau using the following URL;
http://strategis.ic.gc.ca/epic/internet/inceb-bhst.nsf/en/h_tt00052e.html.

If you have any questions, you may contact the Bureau by e-mail at certification.bureau@ic.gc.ca Please reference our file and submission number above for all correspondence.

Yours sincerely,

Dalwinder Gill

Dalwinder Gill
For: Wireless Laboratory Manager
Certification and Engineering Bureau
3701 Carling Ave., Building 94
P.O. Box 11490, Station "H"
Ottawa, Ontario K2H 8S2
Email: dalwinder.gill@ic.gc.ca
Tel. No. (613) 998-8363
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