NVLAP Lab Code 200087-0

SUBMITTAL APPLICATION REPORT

FOR GRANT OF CERTIFICATION

FOR

Model: F52N-PRO
5735-5815 MHz
Unlicensed National Information Infrastructure Device
FCC ID: VKV-F52N
IC: 9820A-F52N

FOR

DBII LTD

16F-3, 482 Zhongxiao East Rd, Sec 5
Taipei 11083 Taiwan

Test Report Number: 110711 15E

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
Grant of Certification Application

FOR

CFR 47, PART 15E - Intentional Radiators
CFR 47 Paragraph 15.407
Unlicensed National Information Infrastructure

For

DBII LTD

16F-3, 482 Zhongxiao East Rd, Sec 5
Taipei 11083 Taiwan

MIMO Broadband Digital Transmission System
Model: F52N-PRO
Frequency Range 5735-5815 MHz
FCC ID#: VKV-F52N
IC: 9820A-F52N

Test Date: July 11, 2011

Certifying Engineer: Scot D Rogers

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Forward

The following information is submitted for consideration in obtaining Grant of Certification for Unlicensed National Information Infrastructure Intentional Radiator operating under CFR 47 Paragraph 15.407.

Name of Applicant: Dbii Ltd
16F-3, 482 Zhongxiao East Rd, Sec 5
Taipei 11083 Taiwan

Model: F52N-PRO

FCC I.D.: VKV-F52N FRN: 0016 81 8056 IC: 9820A-F52N

Frequency Range: 5735-5815 MHz

Operating Power: 24.2 dBm, 0.3 Watts (single channel), 27.0 dBm, 0.5 Watts (MIMO operation), Receiver emissions 29.9 dBµV/m @ 3m

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, KDB 662911, Part 15E Paragraph 15.407, and 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 Document, FCC documents KDB 662911 MIMO, 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.

Environmental Conditions

Ambient Temperature	25.9° C
Relative Humidity	49%
Atmospheric Pressure	1011.5 mb

Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Emissions as per CFR 47 paragraphs2, 15.205	-0.2	Complies
Emissions as per CFR 47 paragraphs2, 15.207	-11.7	Complies
Emissions as per CFR 47 paragraphs 2, 15.209	-0.2	Complies
Emissions as per CFR 47 paragraphs2, 15.407	-1.1	Complies
Emissions as per CFR 47 paragraphs 2, 15.111	-16.1	Complies

Equipment Tested

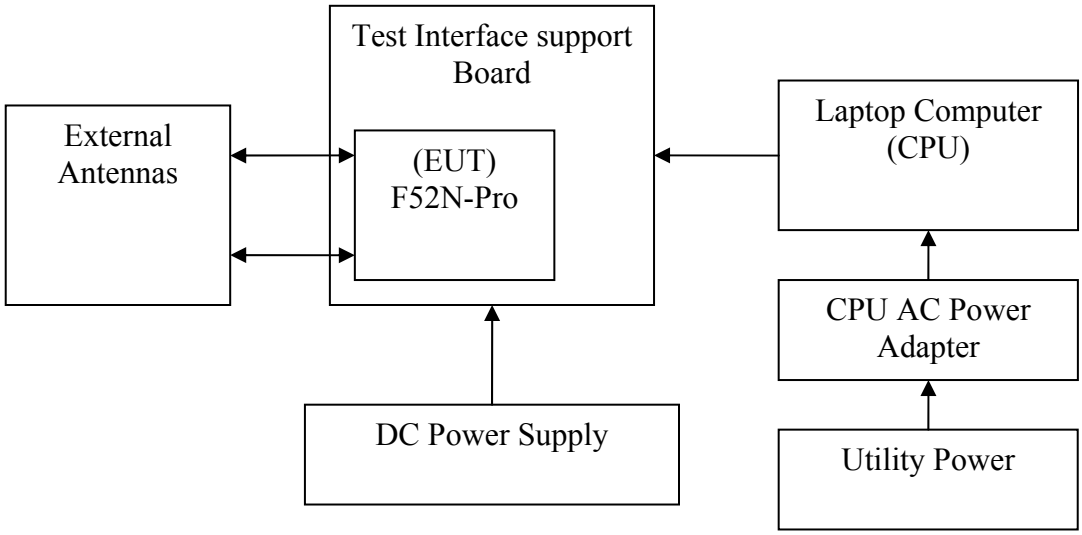
Equipment	Model	FCC I.D.
EUT	F52N-PRO	VKV-F52N
Interface Support Board	DBii	N/A
Dell Latitude Laptop	PP02X	N/A
DC Power supply	1670A	N/A

Antenna/Type	Model	Gain
Dipole	USI05-220170	5 dBi
Omni Directional	65812 ODN	12 dBi
Panel	MA-WA55-30	30 dBi
Sector	MA-WB55-20	20 dBi
Dish	PX3F-52-N7	33.5 dBi

Equipment Function and Configuration

The EUT is a 5735-5815 MHz, 2x2 Multiple Input Multiple Output (MIMO) Digital Transmission System transmitters 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 F52N-PRO transceiver was connected to the manufacturer supplied interface board and laptop computer allowing for operational control of the transmitter. The F52N-PRO receives power from the externally provided DC sources only and offers no provision for connection to utility AC power systems. For testing purposes, the F52N-PRO was powered from external DC supply, interfaced with laptop computer for control, and set to transmit in available data modes. The EUT design incorporates modulation limiting, power regulation, shielding, and MMCX antenna connection points. Worst-case data presented in this report. The device is marketed for professional installation and antenna connection and options comply with the unique antenna connection requirements.

Equipment Configuration



Application for Certification

(1) Manufacturer: Dbii Ltd
16F-3, 482 Zhongxiao East Rd, Sec 5
Taipei 11083 Taiwan

(2) Identification: Model: F52N-PRO

FCC I.D.: VKV-F52N IC: 9820A-F52N

(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 EUT module requires interface support system for operation. The manufacturer provided support interface board to power the EUT. The EUT operates from 3.3 and 5-volt DC only and must be interface with digital support equipment for operation. The test support board provided PCMCIA interface for connection to supporting laptop during testing. The EUT offers connection ports for antennas and miniPCI interface only. During testing the EUT was connected to test support board, CPU, antennas (or appropriate loads), and power supplied from external DC supply.

(9) Transition Provisions of CFR47 15.37 are not 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.

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) - Gain (dB)

Test Procedures

AC Line Conducted Emission Test Procedure

The EUT operates from DC power only and offers no provision for connection to utility AC power systems. For testing purposes AC line conducted emissions testing was performed on the supporting laptop computer. 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.

AC Line Conducted Emissions (0.150 -30 MHz)		
RBW	AVG. BW	Detector Function
9 kHz	30 kHz	Peak / Quasi Peak
Emissions (30-1000 MHz)		
RBW	AVG. BW	Detector Function
120 kHz	300 kHz	Peak / Quasi Peak
Emissions (Above 1000 MHz)		
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	5/11	5/12
Analyzer	HP	8591EM	5/11	5/12
Analyzer	HP	8562A	5/11	5/12
Analyzer	Rohde & Schwarz	ESU40	5/11	5/12

Intentional Radiator

As per CFR47, Subpart C, paragraph 15E, Unlicensed National Information Infrastructure (U-NII) Equipment, and RSS-210 the following information is submitted.

Antenna Requirements

The EUT offers MMCX type connection points for use with authorized antenna systems only. The design is marketed modular design for incorporation into products for professional installation and use as described in accompanying documentation. The antenna connection point complies with the unique antenna connection requirements. The requirements of 15.203 are fulfilled; 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 on 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 (5dBi Dipole configuration presented)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
124.5	41.6	30.3	N/A	32.4	21.2	N/A	43.5
125.4	45.3	33.3	N/A	35.2	23.7	N/A	43.5
127.3	43.7	31.6	N/A	30.6	20.7	N/A	43.5
130.2	44.8	34.5	N/A	32.1	22.4	N/A	43.5
134.4	45.5	35.9	N/A	31.4	21.2	N/A	43.5
135.8	46.4	38.0	N/A	33.5	22.9	N/A	43.5
135.9	45.4	35.8	N/A	33.7	20.8	N/A	43.5
166.5	49.5	40.4	N/A	41.0	33.7	N/A	43.5
245.2	47.3	33.5	N/A	39.0	27.9	N/A	46.0
247.7	42.1	34.6	N/A	35.7	29.6	N/A	46.0
276.1	52.2	36.6	N/A	42.4	31.1	N/A	46.0
11470.0	63.6	N/A	43.2	55.1	N/A	39.6	54.0
11550.0	62.7	N/A	43.4	55.2	N/A	40.5	54.0
11630.0	65.5	N/A	45.6	59.0	N/A	40.8	54.0
22940.0	38.9	N/A	27.2	38.4	N/A	27.4	54.0

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Radiated Emissions in Restricted Bands Data (12dBi Omni configuration presented)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
74.2	33.1	22.2	N/A	44.5	33.3	N/A	40.0
124.2	56.1	42.7	N/A	51.9	39.5	N/A	43.5
125.6	57.5	42.7	N/A	54.9	41.4	N/A	43.5
126.5	48.3	38.4	N/A	47.0	37.3	N/A	43.5
127.3	56.0	41.1	N/A	49.2	40.1	N/A	43.5
128.5	50.1	41.0	N/A	50.4	41.4	N/A	43.5
129.9	53.3	41.3	N/A	56.9	40.2	N/A	43.5
131.4	57.1	42.6	N/A	48.9	42.3	N/A	43.5
131.9	58.1	42.8	N/A	55.9	42.3	N/A	43.5
166.1	47.3	40.1	N/A	49.0	39.9	N/A	43.5
166.4	49.1	41.8	N/A	51.7	42.6	N/A	43.5
240.0	38.9	28.7	N/A	42.1	34.6	N/A	46.0
243.7	37.3	27.4	N/A	38.2	30.5	N/A	46.0
248.7	33.3	25.2	N/A	39.5	28.9	N/A	46.0
299.6	37.9	28.1	N/A	35.3	27.5	N/A	46.0
11470.0	67.7	N/A	47.1	60.0	N/A	44.7	54.0
11550.0	66.7	N/A	48.4	60.2	N/A	44.5	54.0
11630.0	70.5	N/A	50.6	69.0	N/A	45.6	54.0
22940.0	38.9	N/A	27.1	38.3	N/A	27.2	54.0

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Radiated Emissions in Restricted Bands Data (20dBi Sector configuration presented)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
74.2	33.5	22.6	N/A	44.8	33.5	N/A	40.0
124.2	55.6	42.5	N/A	53.5	39.6	N/A	43.5
125.6	57.5	42.9	N/A	54.8	42.0	N/A	43.5
126.5	48.1	37.9	N/A	45.0	35.3	N/A	43.5
127.3	56.0	43.2	N/A	49.2	40.1	N/A	43.5
128.5	50.1	41.2	N/A	50.6	41.0	N/A	43.5
129.9	56.9	43.2	N/A	56.6	43.0	N/A	43.5
131.4	57.1	43.2	N/A	47.2	43.1	N/A	43.5
131.9	57.4	43.2	N/A	57.8	43.1	N/A	43.5
166.1	46.0	39.6	N/A	48.7	39.9	N/A	43.5
166.4	48.8	40.7	N/A	50.0	42.3	N/A	43.5
240.0	38.6	28.9	N/A	39.6	34.6	N/A	46.0
243.7	37.9	28.1	N/A	37.8	30.4	N/A	46.0
248.7	33.6	24.9	N/A	39.5	29.9	N/A	46.0
299.6	38.8	28.9	N/A	35.9	28.1	N/A	46.0
11470.0	65.7	N/A	52.4	62.4	N/A	49.4	54.0
11550.0	71.4	N/A	52.7	69.3	N/A	51.6	54.0
11630.0	68.3	N/A	52.2	68.5	N/A	52.6	54.0
22940.0	37.9	N/A	35.8	38.5	N/A	36.5	54.0

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Radiated Emissions in Restricted Bands Data (30dBi Panel configuration presented)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
74.2	33.4	22.5	N/A	44.8	33.4	N/A	40.0
124.2	56.1	43.1	N/A	53.8	39.9	N/A	43.5
125.6	57.0	42.7	N/A	54.1	41.6	N/A	43.5
126.5	47.1	37.2	N/A	45.2	35.1	N/A	43.5
127.3	54.3	43.0	N/A	49.0	39.5	N/A	43.5
128.5	50.0	41.1	N/A	48.9	41.0	N/A	43.5
129.9	56.8	42.9	N/A	55.8	42.6	N/A	43.5
131.4	56.1	43.2	N/A	47.1	43.1	N/A	43.5
131.9	58.3	43.1	N/A	57.4	43.1	N/A	43.5
166.1	47.0	39.7	N/A	49.2	39.6	N/A	43.5
166.4	49.0	41.5	N/A	51.6	42.6	N/A	43.5
240.0	38.8	28.7	N/A	39.8	34.4	N/A	46.0
243.7	37.1	27.0	N/A	37.8	30.5	N/A	46.0
248.7	33.1	24.7	N/A	38.8	28.4	N/A	46.0
299.6	37.8	N/A	51.7	35.2	N/A	51.7	54.0
11470.0	66.4	N/A	51.7	66.6	N/A	51.8	54.0
11550.0	67.1	N/A	52.7	68.2	N/A	52.9	54.0
11630.0	66.8	N/A	35.9	66.6	N/A	36.2	54.0

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Radiated Emissions in Restricted Bands Data (33.5dBi Dish configuration presented)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
74.2	33.6	22.7	N/A	45.1	33.7	N/A	40.0
124.2	56.3	43.2	N/A	54.0	40.1	N/A	43.5
125.6	57.9	43.3	N/A	55.2	41.8	N/A	43.5
126.5	48.4	38.0	N/A	45.2	35.5	N/A	43.5
127.3	56.3	43.3	N/A	49.4	40.3	N/A	43.5
128.5	50.2	41.3	N/A	50.7	41.2	N/A	43.5
129.9	57.2	43.3	N/A	57.0	43.1	N/A	43.5
131.4	57.3	43.3	N/A	47.2	43.3	N/A	43.5
131.9	58.3	43.3	N/A	57.9	43.2	N/A	43.5
166.1	47.4	40.1	N/A	49.6	40.0	N/A	43.5
166.4	49.2	41.7	N/A	51.9	42.7	N/A	43.5
240.0	38.8	28.8	N/A	40.0	34.5	N/A	46.0
243.7	37.3	27.2	N/A	38.1	30.8	N/A	46.0
248.7	33.4	25.0	N/A	39.7	29.4	N/A	46.0
299.6	38.1	N/A	51.5	35.4	N/A	52.5	54.0
11470.0	67.8	N/A	52.1	68.6	N/A	53.2	54.0
11550.0	67.2	N/A	51.7	69.0	N/A	52.9	54.0
11630.0	66.7	N/A	53.9	66.7	N/A	53.1	54.0
22980.0	38.9	N/A	36.1	39.3	N/A	36.1	54.0

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Summary of Results for Radiated Emissions in Restricted Bands

The EUT demonstrated compliance with the radiated emissions requirements of CFR 47 Part 15C Intentional Radiators. The EUT demonstrated a minimum margin of -0.2 dB below the radiated emissions requirements in restricted frequency bands. 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 the testing configuration, emulating a typical 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 test support interface board was powered from DC supply and laptop powered from AC power adapter. The AC adapter for the laptop was connected to the LISN for AC line conducted emissions testing. 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 powered by AC adapter, AC Power Line conducted emissions.

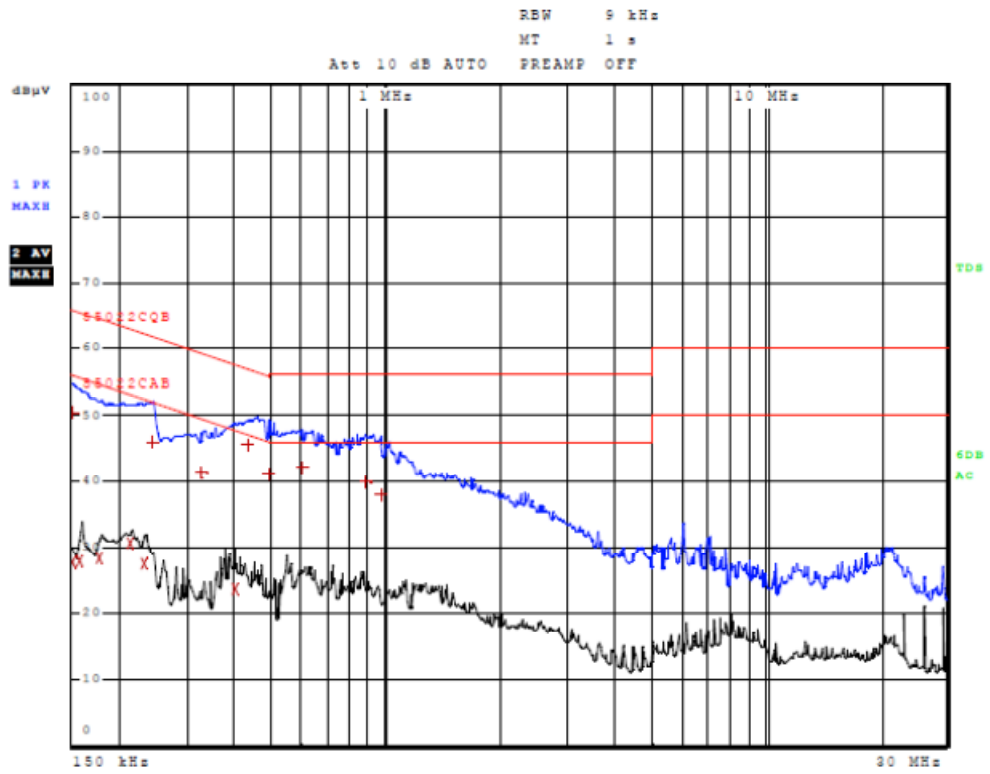


Figure 1 AC Line Conducted Emissions Line 1

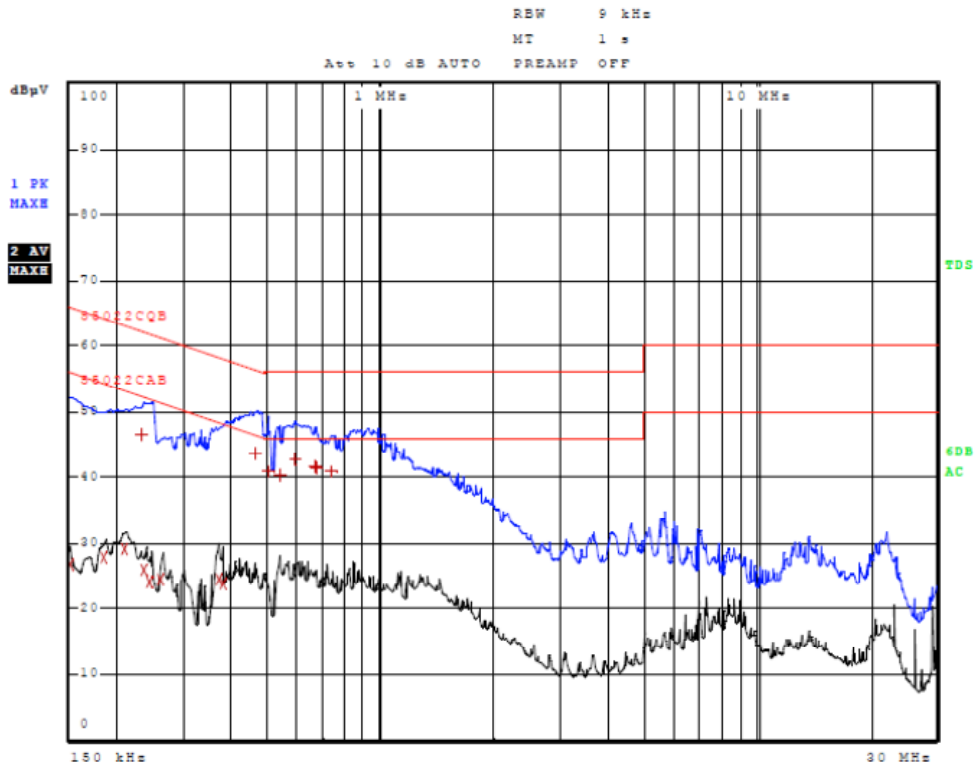


Figure 2 AC Line Conducted Emissions Line 2

AC Line Conducted Emissions Data (Highest Emissions)

Line 1

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	150.000000000 kHz	50.36	Quasi Peak	-15.64
2	150.000000000 kHz	27.60	Average	-28.40
2	158.000000000 kHz	27.79	Average	-27.78
2	178.000000000 kHz	28.34	Average	-26.24
2	214.000000000 kHz	30.54	Average	-22.50
2	234.000000000 kHz	27.42	Average	-24.89
1	246.000000000 kHz	45.85	Quasi Peak	-16.04
1	330.000000000 kHz	41.31	Quasi Peak	-18.14
2	398.000000000 kHz	23.71	Average	-24.18
1	430.000000000 kHz	45.53	Quasi Peak	-11.73
1	490.000000000 kHz	40.99	Quasi Peak	-15.18
1	602.000000000 kHz	42.21	Quasi Peak	-13.79
1	878.000000000 kHz	39.75	Quasi Peak	-16.25
1	966.000000000 kHz	37.95	Quasi Peak	-18.05

Line 2

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	150.000000000 kHz	26.71	Average	-29.29
2	186.000000000 kHz	27.74	Average	-26.47
2	210.000000000 kHz	29.11	Average	-24.10
1	234.000000000 kHz	46.63	Quasi Peak	-15.67
2	238.000000000 kHz	25.96	Average	-26.21
2	246.000000000 kHz	23.96	Average	-27.93
2	262.000000000 kHz	24.55	Average	-26.82
2	370.000000000 kHz	24.56	Average	-23.94
2	378.000000000 kHz	23.91	Average	-24.41
1	466.000000000 kHz	43.57	Quasi Peak	-13.01
1	502.000000000 kHz	40.90	Quasi Peak	-15.10
1	538.000000000 kHz	40.13	Quasi Peak	-15.87
1	590.000000000 kHz	42.72	Quasi Peak	-13.28
1	662.000000000 kHz	41.75	Quasi Peak	-14.25
1	670.000000000 kHz	41.40	Quasi Peak	-14.60
1	734.000000000 kHz	40.78	Quasi Peak	-15.22

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

Summary of Results for AC Line Conducted Emissions

The EUT demonstrated compliance to the conducted emissions requirements of CFR47 Part 15C equipment. The EUT demonstrated minimum margin of -11.7 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.

General Radiated Emissions Procedure

The EUT was arranged in the testing configuration, emulating typical equipment configuration, with antenna ports loaded with 50-ohm restive loads 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 40,000 MHz for the preliminary testing. Refer to figures three through eleven 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 60,000 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 60 GHz, notch filters and appropriate amplifiers and external mixers were utilized.

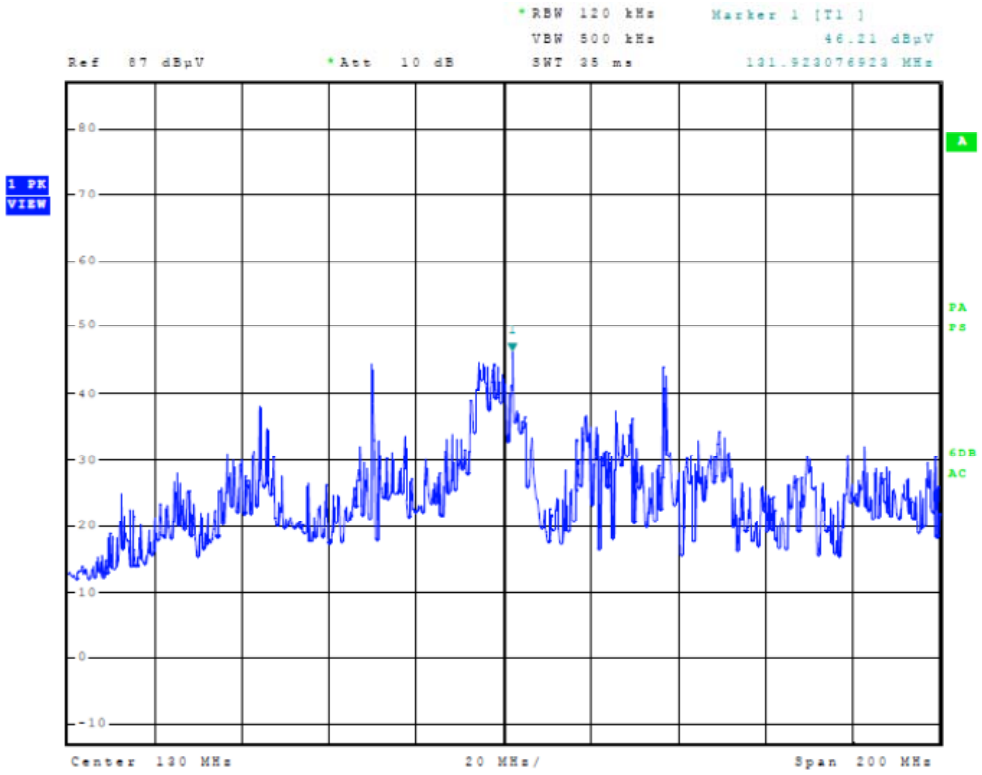


Figure 3 General Radiated Emissions taken at 1 meter in screen room

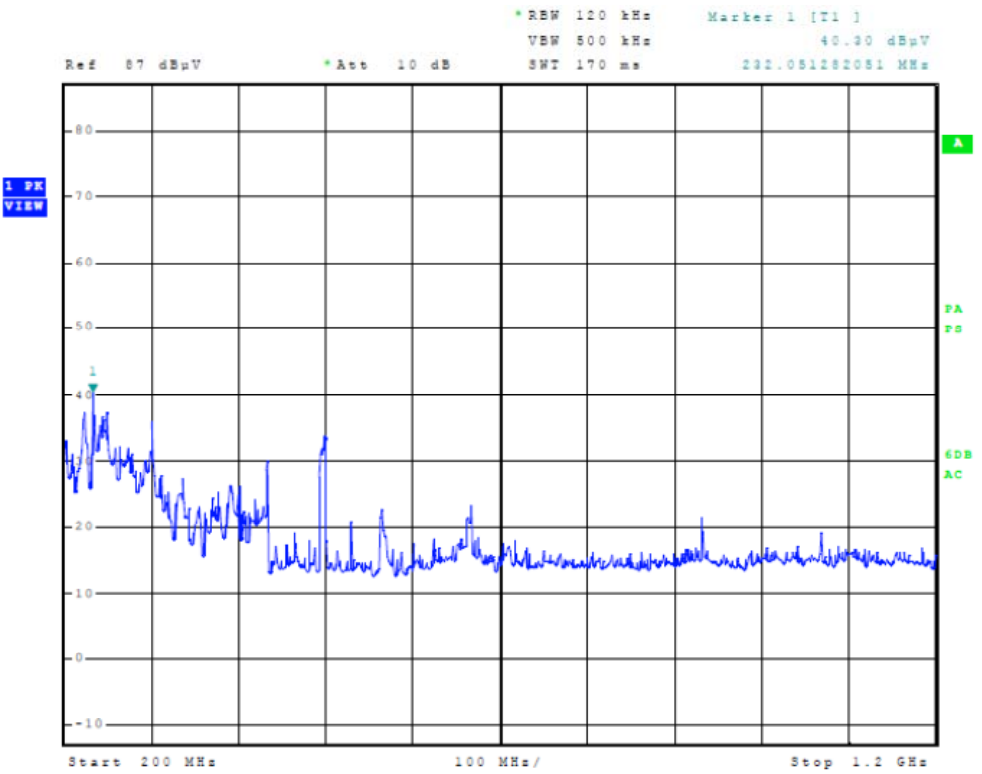


Figure 4 General Radiated Emissions taken at 1 meter in screen room

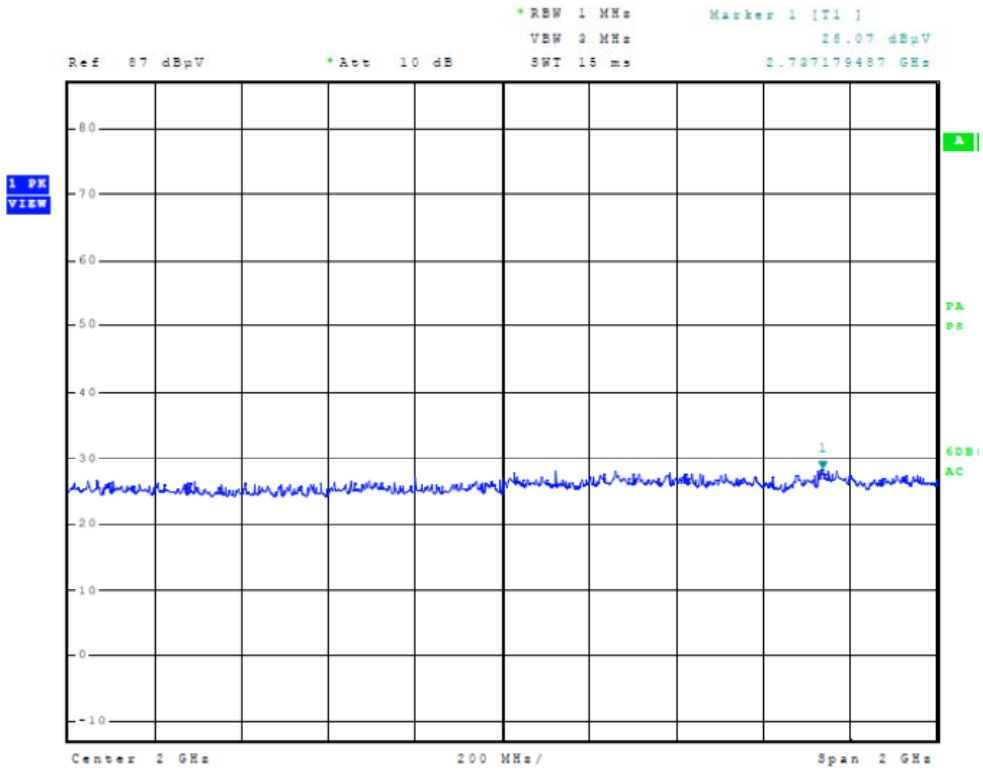


Figure 5 General Radiated Emissions taken at 1 meter in screen room

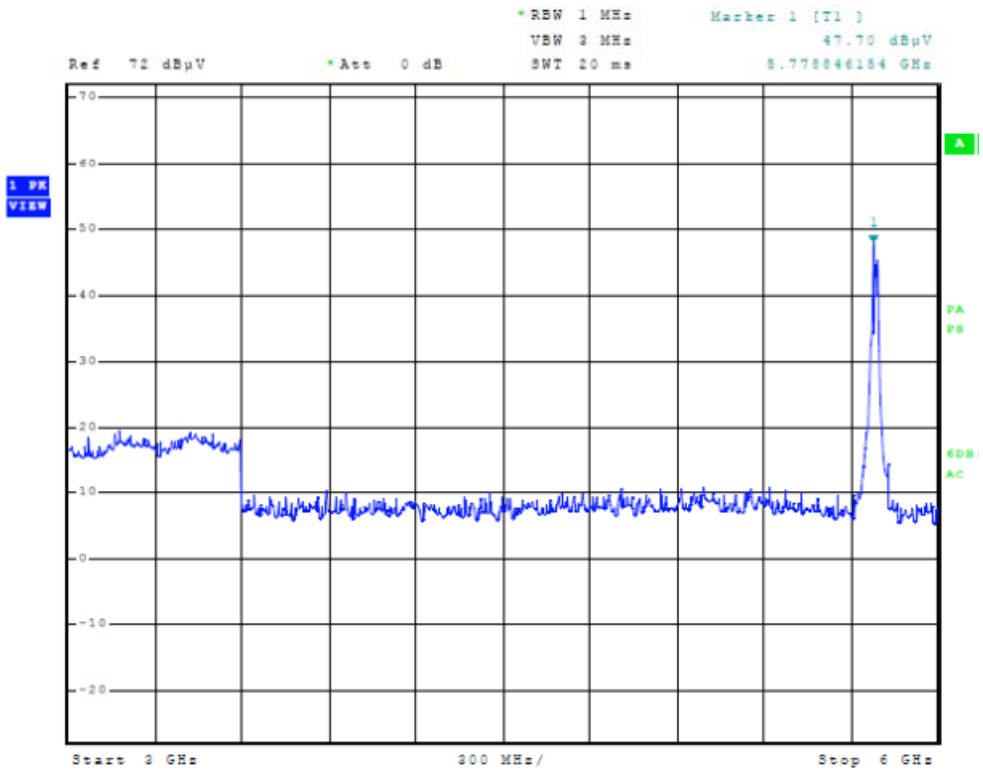


Figure 6 General Radiated Emissions taken at 1 meter in screen room

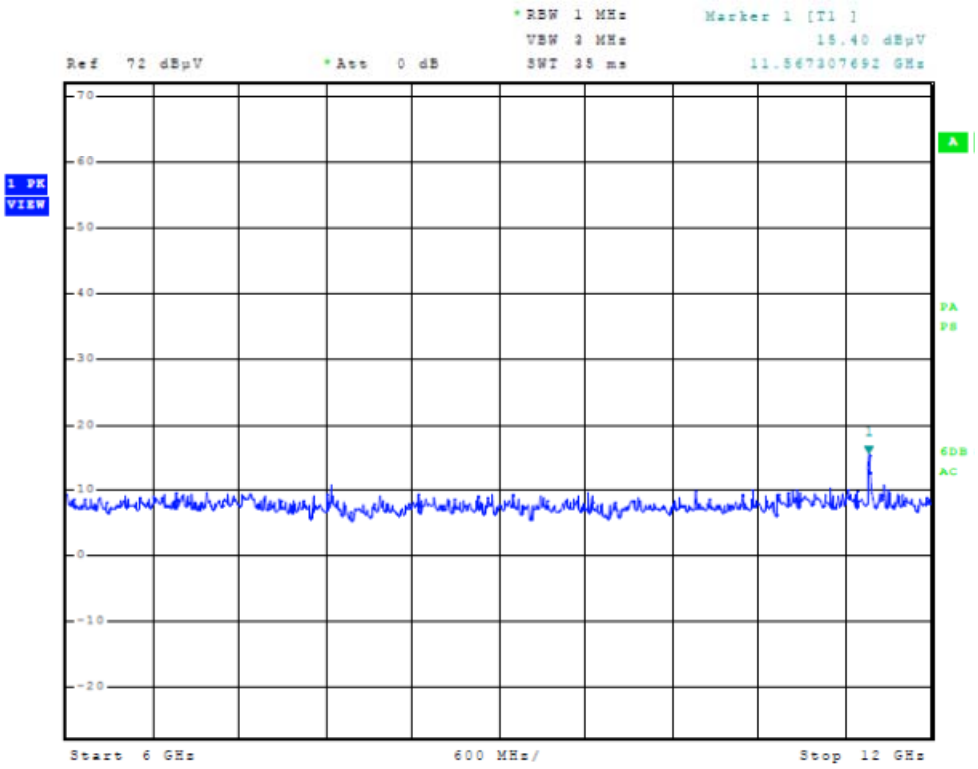


Figure 7 General Radiated Emissions taken at 1 meter in screen room

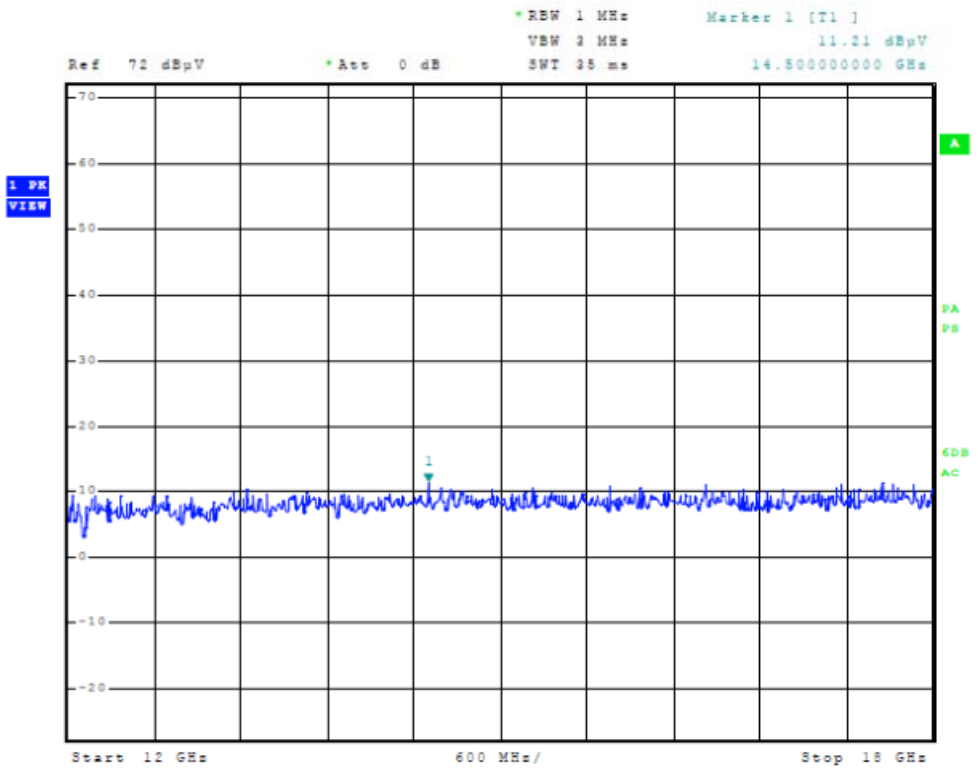


Figure 8 General Radiated Emissions taken at 1 meter in screen room

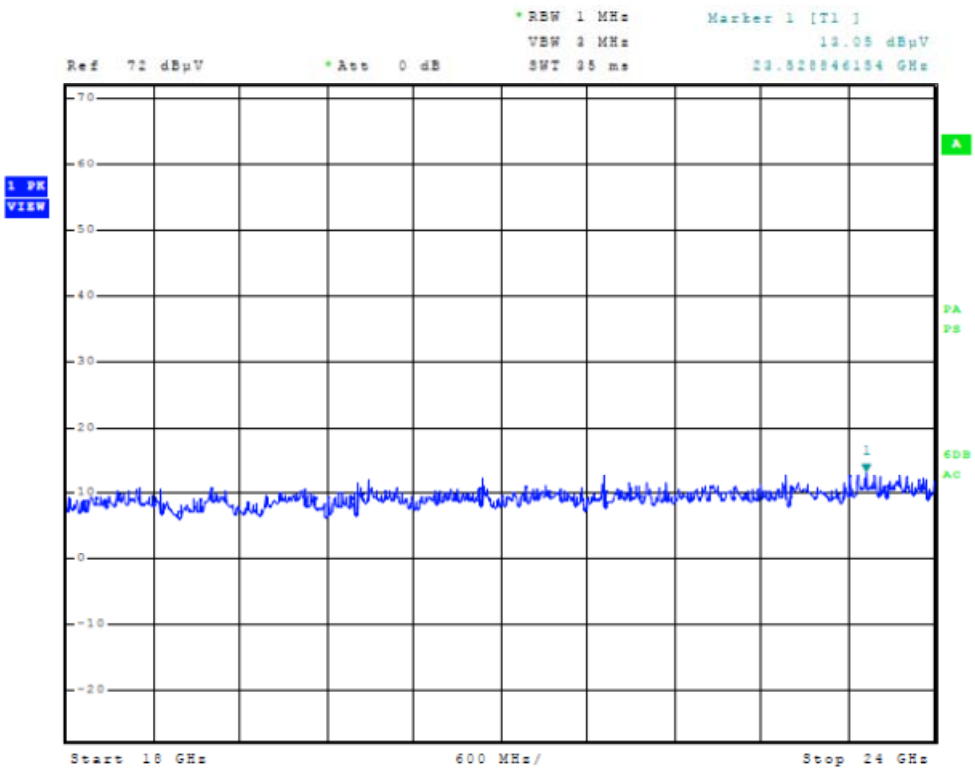


Figure 9 General Radiated Emissions taken at 1 meter in screen room

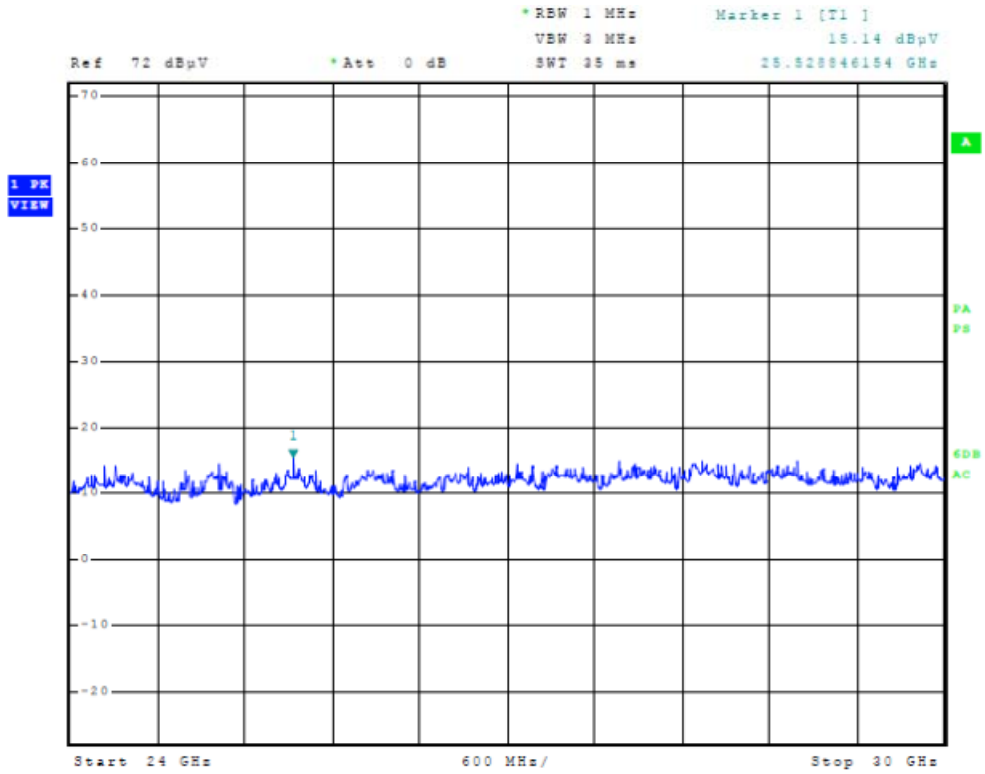


Figure 10 General Radiated Emissions taken at 1 meter in screen room

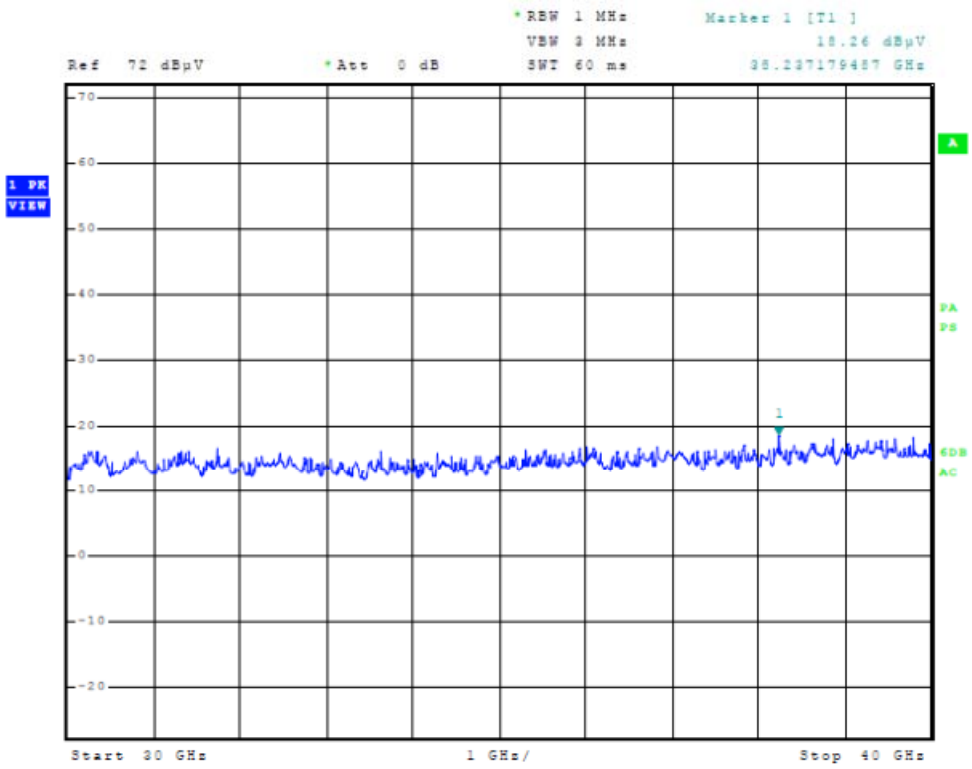


Figure 11 General Radiated Emissions taken at 1 meter in screen room

General Radiated Emissions from EUT Data (General Emissions 5 dBi Dipole)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµ/mV)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
124.5	41.6	30.3	N/A	32.4	21.2	N/A	43.5
125.4	45.3	33.3	N/A	35.2	23.7	N/A	43.5
127.3	43.7	31.6	N/A	30.6	20.7	N/A	43.5
130.2	44.8	34.5	N/A	32.1	22.4	N/A	43.5
134.4	45.5	35.9	N/A	31.4	21.2	N/A	43.5
135.8	46.4	38.0	N/A	33.5	22.9	N/A	43.5
135.9	45.4	35.8	N/A	33.7	20.8	N/A	43.5
149.6	43.4	33.6	N/A	38.5	26.1	N/A	43.5
151.2	41.5	33.9	N/A	36.4	29.0	N/A	43.5
166.5	49.5	40.4	N/A	41.0	33.7	N/A	43.5
224.6	48.1	35.3	N/A	38.4	23.5	N/A	46.0
232.6	47.1	40.0	N/A	41.7	34.3	N/A	46.0
245.2	47.3	33.5	N/A	39.0	27.9	N/A	46.0
247.7	42.1	34.6	N/A	35.7	29.6	N/A	46.0
276.1	52.2	36.6	N/A	42.4	31.1	N/A	46.0
305.4	36.7	28.9	N/A	41.8	29.4	N/A	46.0

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

General Radiated Emissions from EUT Data (General Emissions 12 dBi Omni)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
74.2	33.1	22.2	N/A	44.5	33.3	N/A	40.0
122.5	47.6	40.4	N/A	45.1	37.5	N/A	43.5
124.2	56.1	42.7	N/A	51.9	39.5	N/A	43.5
125.6	57.5	42.7	N/A	54.9	41.4	N/A	43.5
126.5	48.3	38.4	N/A	47.0	37.3	N/A	43.5
127.3	56.0	41.1	N/A	49.2	40.1	N/A	43.5
128.5	50.1	41.0	N/A	50.4	41.4	N/A	43.5
129.9	53.3	41.3	N/A	56.9	40.2	N/A	43.5
131.4	57.1	42.6	N/A	48.9	42.3	N/A	43.5
131.9	58.1	42.8	N/A	55.9	42.3	N/A	43.5
158.7	45.8	34.6	N/A	39.4	30.9	N/A	43.5
166.1	47.3	40.1	N/A	49.0	39.9	N/A	43.5
166.4	49.1	41.8	N/A	51.7	42.6	N/A	43.5
222.0	37.2	28.1	N/A	36.7	27.6	N/A	46.0
233.6	42.3	34.3	N/A	47.0	36.7	N/A	46.0
237.6	39.3	30.6	N/A	41.5	32.0	N/A	46.0
240.0	38.9	28.7	N/A	42.1	34.6	N/A	46.0
243.7	37.3	27.4	N/A	38.2	30.5	N/A	46.0
248.7	33.3	25.2	N/A	39.5	28.9	N/A	46.0
299.6	37.9	28.1	N/A	35.3	27.5	N/A	46.0

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

General Radiated Emissions from EUT Data (General Emissions 20 dBi Sector)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
74.2	33.5	22.6	N/A	44.8	33.5	N/A	40.0
122.5	47.4	40.4	N/A	45.0	37.4	N/A	43.5
124.2	55.6	42.5	N/A	53.5	39.6	N/A	43.5
125.6	57.5	42.9	N/A	54.8	42.0	N/A	43.5
126.5	48.1	37.9	N/A	45.0	35.3	N/A	43.5
127.3	56.0	43.2	N/A	49.2	40.1	N/A	43.5
128.5	50.1	41.2	N/A	50.6	41.0	N/A	43.5
129.9	56.9	43.2	N/A	56.6	43.0	N/A	43.5
131.4	57.1	43.2	N/A	47.2	43.1	N/A	43.5
131.9	57.4	43.2	N/A	57.8	43.1	N/A	43.5
158.7	45.6	34.2	N/A	39.2	31.0	N/A	43.5
166.1	46.0	39.6	N/A	48.7	39.9	N/A	43.5
166.4	48.8	40.7	N/A	50.0	42.3	N/A	43.5
222.0	37.8	28.7	N/A	37.7	28.0	N/A	46.0
233.6	41.9	34.2	N/A	46.0	36.9	N/A	46.0
237.6	39.5	30.0	N/A	41.2	30.9	N/A	46.0
240.0	38.6	28.9	N/A	39.6	34.6	N/A	46.0
243.7	37.9	28.1	N/A	37.8	30.4	N/A	46.0
248.7	33.6	24.9	N/A	39.5	29.9	N/A	46.0
299.6	38.8	28.9	N/A	35.9	28.1	N/A	46.0

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

General Radiated Emissions from EUT Data (General Emissions 30 dBi Panel)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
74.2	33.4	22.5	N/A	44.8	33.4	N/A	40.0
122.5	47.7	40.6	N/A	45.4	39.0	N/A	43.5
124.2	56.1	43.1	N/A	53.8	39.9	N/A	43.5
125.6	57.0	42.7	N/A	54.1	41.6	N/A	43.5
126.5	47.1	37.2	N/A	45.2	35.1	N/A	43.5
127.3	54.3	43.0	N/A	49.0	39.5	N/A	43.5
128.5	50.0	41.1	N/A	48.9	41.0	N/A	43.5
129.9	56.8	42.9	N/A	55.8	42.6	N/A	43.5
131.4	56.1	43.2	N/A	47.1	43.1	N/A	43.5
131.9	58.3	43.1	N/A	57.4	43.1	N/A	43.5
158.7	45.9	34.7	N/A	39.7	30.8	N/A	43.5
166.1	47.0	39.7	N/A	49.2	39.6	N/A	43.5
166.4	49.0	41.5	N/A	51.6	42.6	N/A	43.5
222.0	37.2	28.2	N/A	37.0	28.1	N/A	46.0
233.6	41.0	33.6	N/A	45.8	36.8	N/A	46.0
237.6	39.1	30.2	N/A	41.6	31.0	N/A	46.0
240.0	38.8	28.7	N/A	39.8	34.4	N/A	46.0
243.7	37.1	27.0	N/A	37.8	30.5	N/A	46.0
248.7	33.1	24.7	N/A	38.8	28.4	N/A	46.0
299.6	37.8	29.1	N/A	35.2	27.8	N/A	46.0

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

General Radiated Emissions from EUT Data (General Emissions 33.5 dBi Dish)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
74.2	33.6	22.7	N/A	45.1	33.7	N/A	40.0
122.5	47.7	40.7	N/A	45.3	37.8	N/A	43.5
124.2	56.3	43.2	N/A	54.0	40.1	N/A	43.5
125.6	57.9	43.3	N/A	55.2	41.8	N/A	43.5
126.5	48.4	38.0	N/A	45.2	35.5	N/A	43.5
127.3	56.3	43.3	N/A	49.4	40.3	N/A	43.5
128.5	50.2	41.3	N/A	50.7	41.2	N/A	43.5
129.9	57.2	43.3	N/A	57.0	43.1	N/A	43.5
131.4	57.3	43.3	N/A	47.2	43.3	N/A	43.5
131.9	58.3	43.3	N/A	57.9	43.2	N/A	43.5
158.7	45.7	34.5	N/A	39.5	30.8	N/A	43.5
166.1	47.4	40.1	N/A	49.6	40.0	N/A	43.5
166.4	49.2	41.7	N/A	51.9	42.7	N/A	43.5
222.0	37.1	28.0	N/A	36.9	27.7	N/A	46.0
233.6	42.3	34.4	N/A	46.2	37.1	N/A	46.0
237.6	39.2	30.2	N/A	41.5	32.1	N/A	46.0
240.0	38.8	28.8	N/A	40.0	34.5	N/A	46.0
243.7	37.3	27.2	N/A	38.1	30.8	N/A	46.0
248.7	33.4	25.0	N/A	39.7	29.4	N/A	46.0
299.6	38.1	29.0	N/A	35.4	27.3	N/A	46.0

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Summary of Results for General Radiated Emissions

The EUT demonstrated compliance with the radiated emissions requirements of CFR47 Part 15C paragraph 15.209 Intentional Radiators. The EUT demonstrated a minimum margin of -0.2 dB below the requirements. Other emissions were present with amplitudes at least 20 dB below the Limits.

Operation in the Frequency Band of 5725 – 5825 MHz

The power output and emissions were measured at the antenna port in compliance with regulation. EUT emissions were also measured on the open area test site at a three-meter distance. The EUT and test configurations were placed on a wooden turntable 0.8 meters above the ground plane at a distance of 3 meters from the FSM antenna. The peak and quasi-peak amplitude of the frequencies below 1000 MHz were measured using a spectrum analyzer. The peak and average amplitude of emissions above 1000 MHz including were measured using a spectrum analyzer. Data was recorded from the analyzer measurement result. Plots were made of transmitter antenna port conducted performance taken in a screen room. Refer to figures twelve through thirty-three showing plots of the EUT chain 1emissions performance displaying compliance with the specifications. Refer to figures thirty-four through fifty-five showing plots of the EUT chain21emissions performance displaying compliance with the specifications.

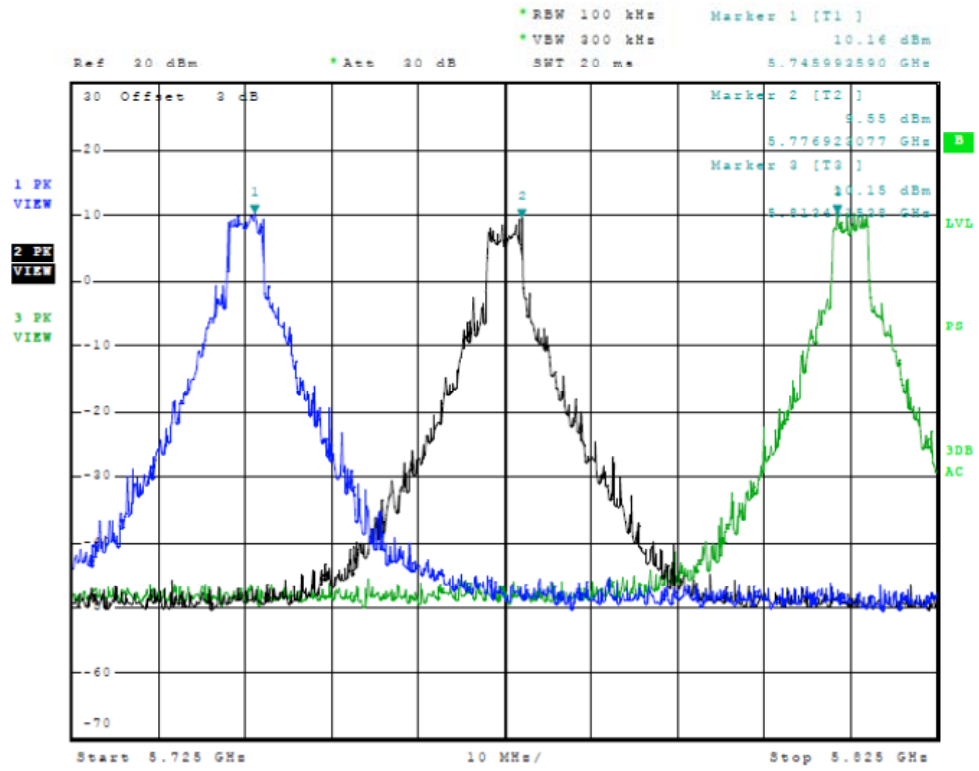


Figure 12 Plot of Antenna Port Conducted (chain 1, 5 MHz Mode)

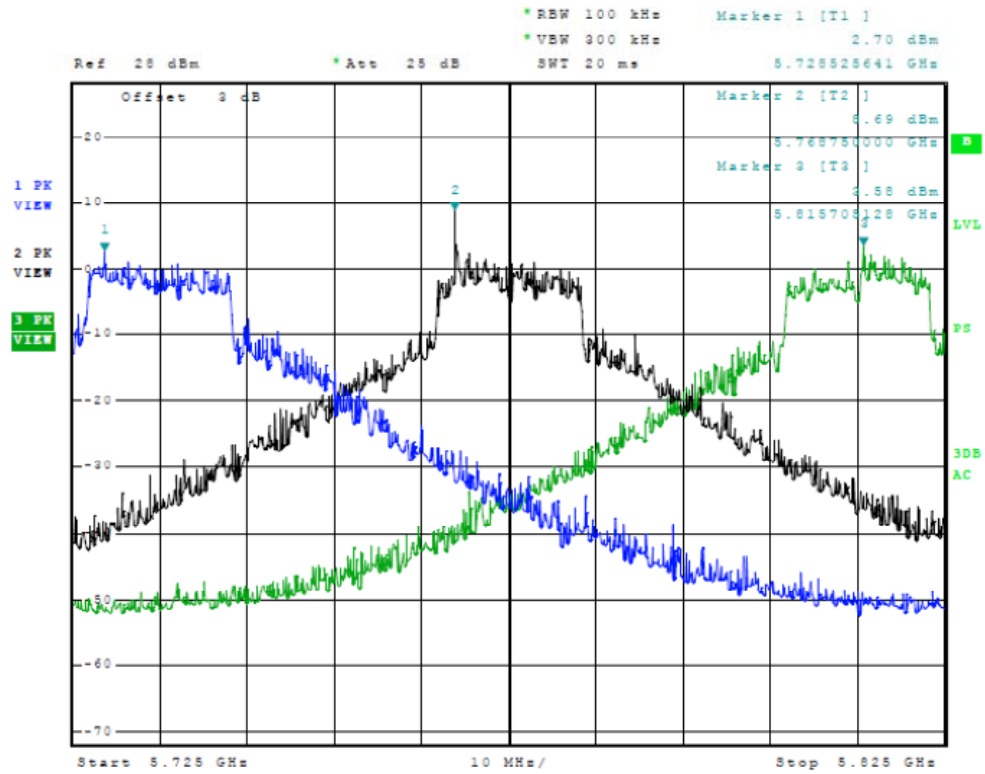


Figure 13 Plot of Antenna Port Conducted (chain 1, 20 MHz Mode)

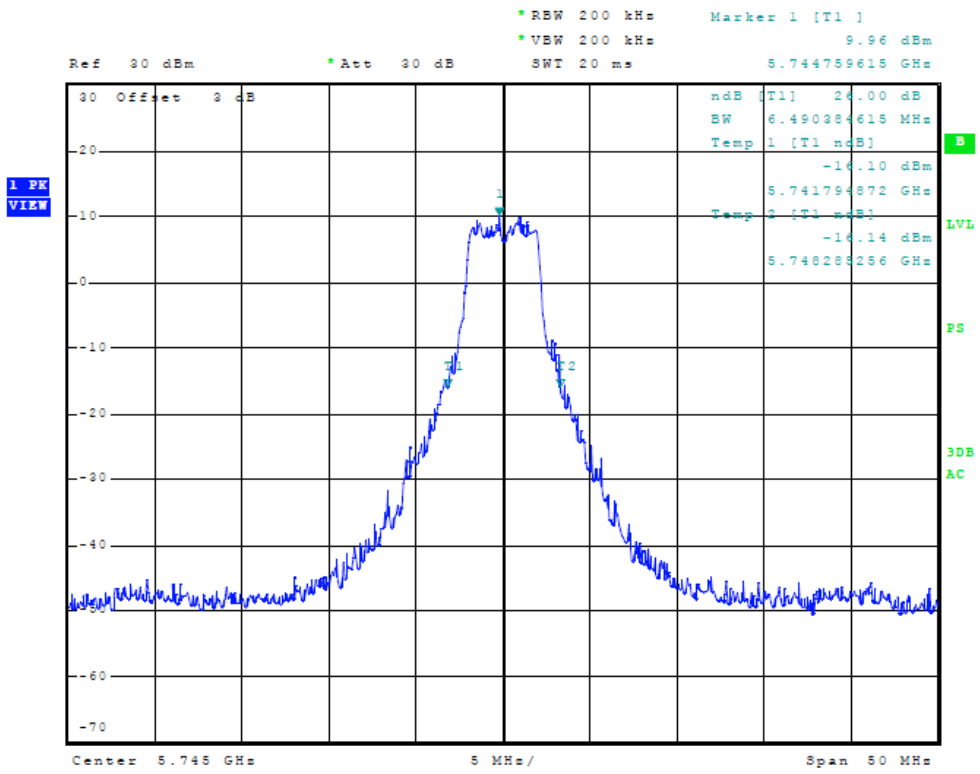


Figure 14 Plot of Antenna Port Conducted 26dB Band width (chain 1, 5745 MHz, 5 MHz Mode)

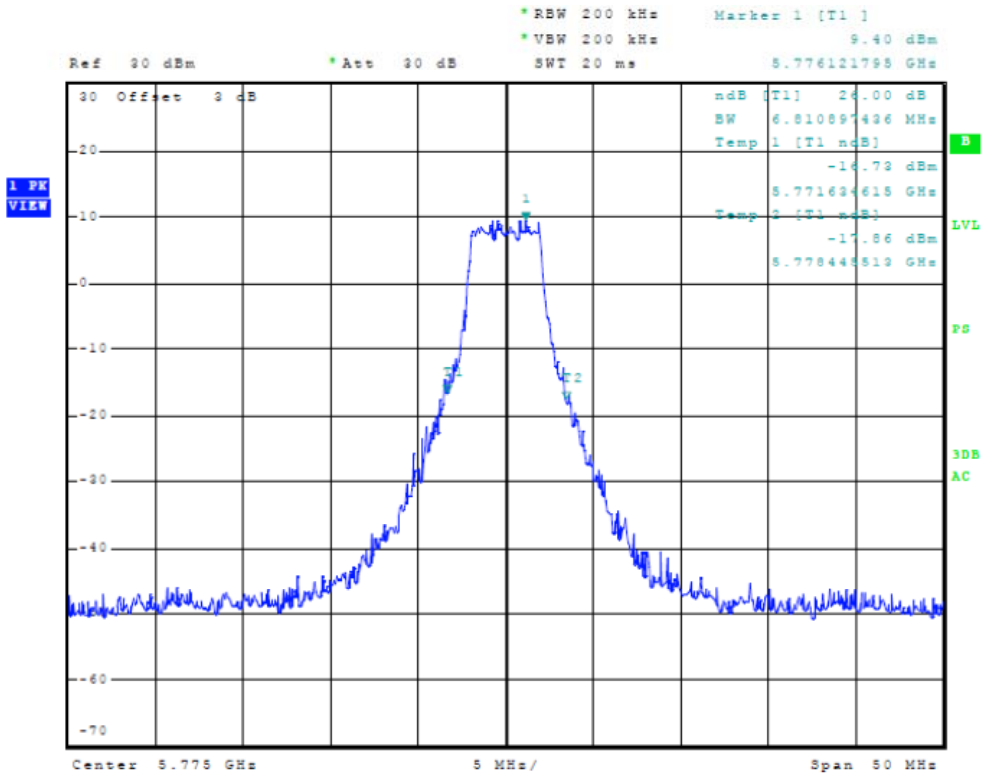


Figure 15 Plot of Antenna Port Conducted 26dB Band width (chain 1, 5775 MHz, 5 MHz Mode)

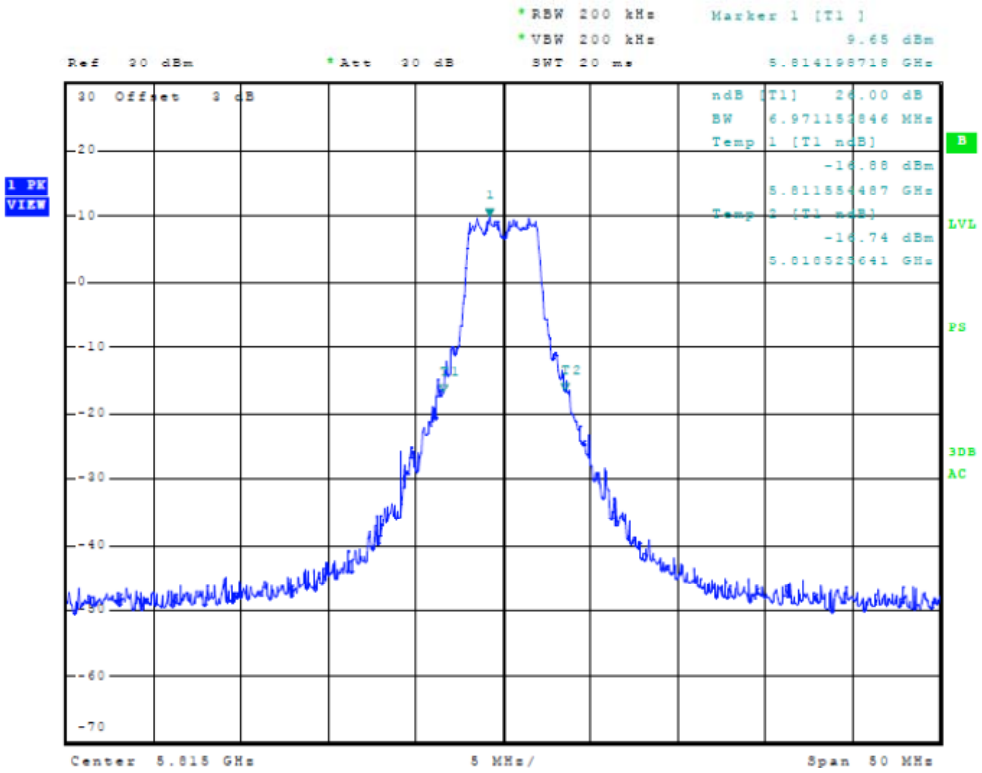


Figure 16 Plot of Antenna Port Conducted 26dB Band width (chain 1, 5815 MHz, 5 MHz Mode)

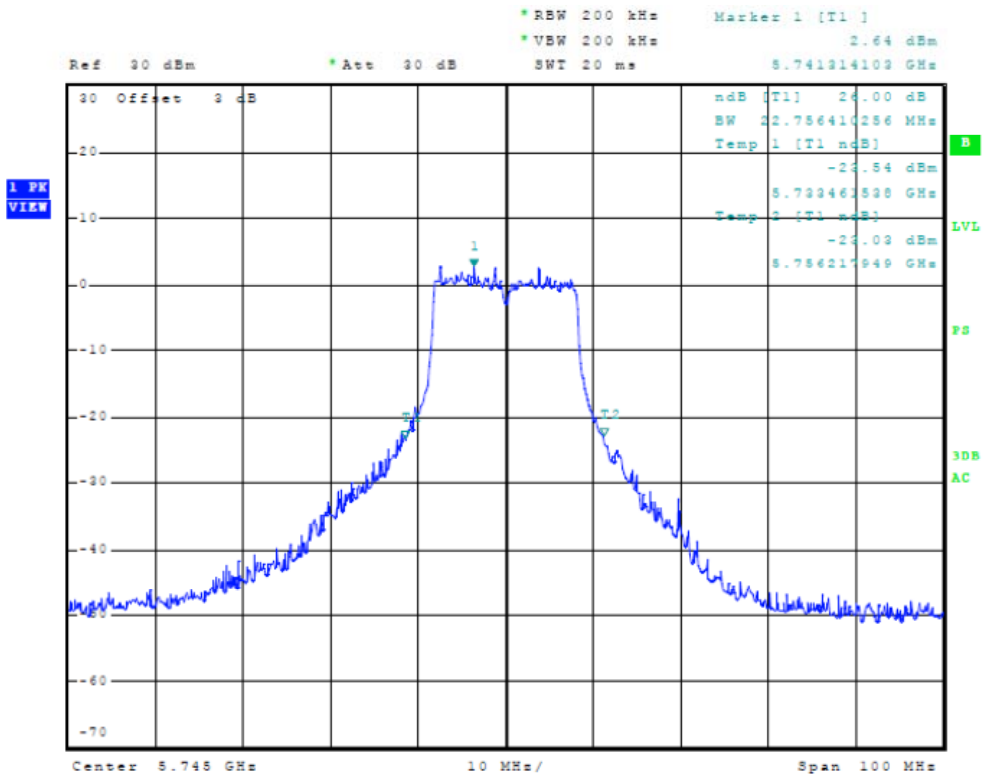


Figure 17 Plot of Antenna Port Conducted 26dB Band width (chain 1, 5745 MHz, 20 MHz Mode)

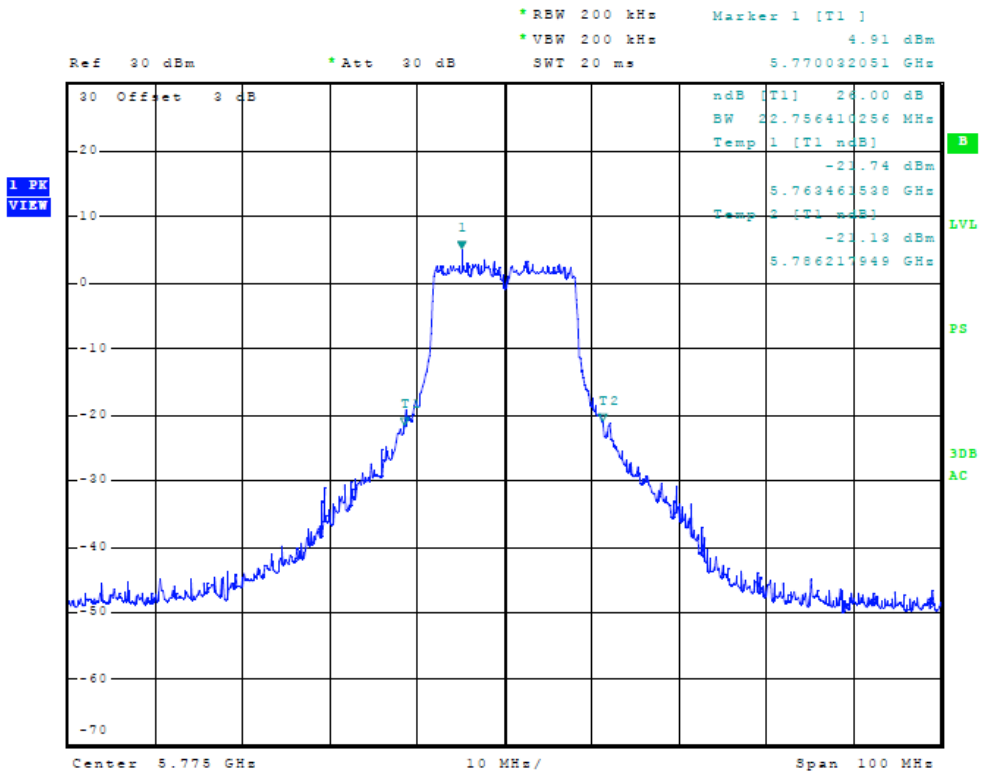


Figure 18 Plot of Antenna Port Conducted 26dB Band width (chain 1, 5775 MHz, 20 MHz Mode)

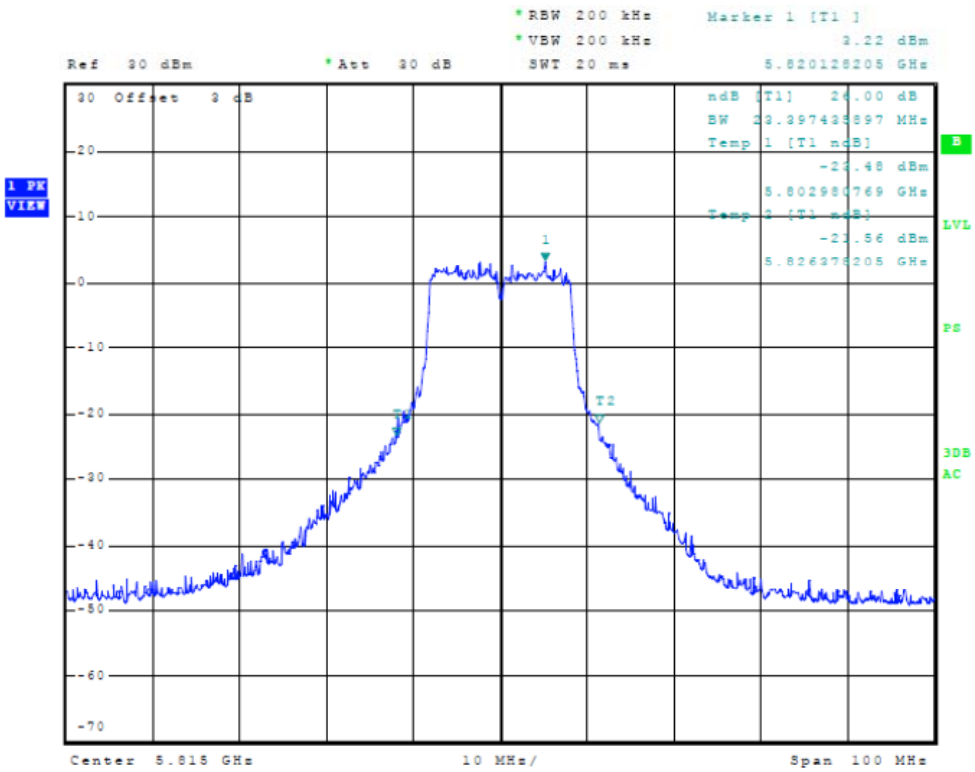


Figure 19 Plot of Antenna Port Conducted 26dB Band width (chain 1, 5815 MHz, 20 MHz Mode)

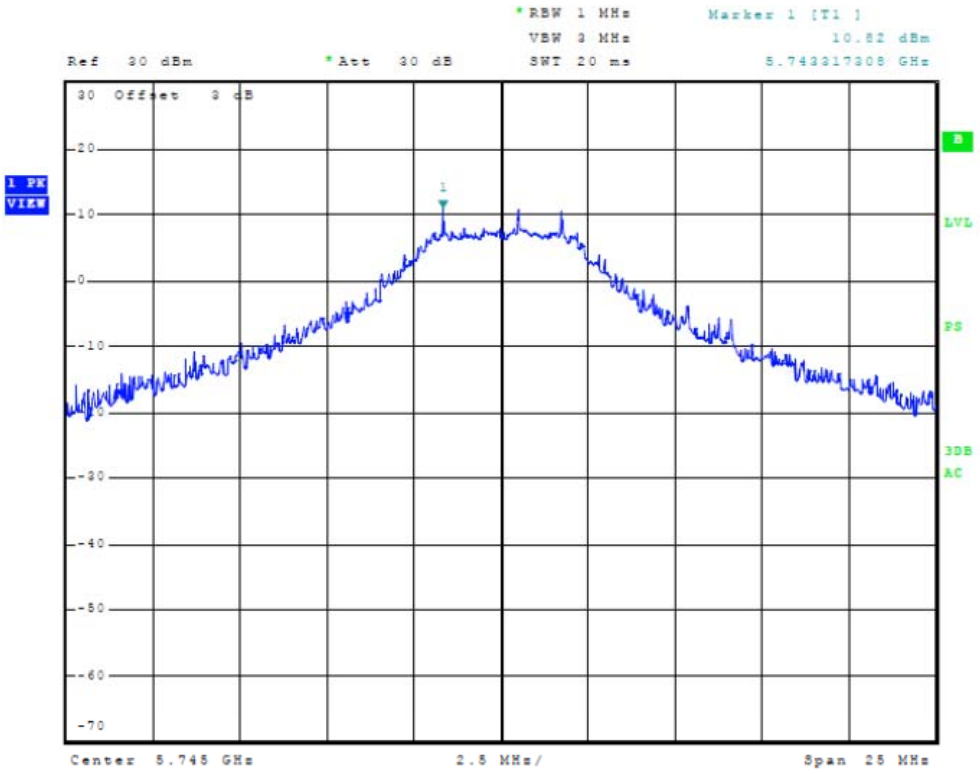


Figure 20 Plot of Antenna Port Conducted Power Spectral Density (chain 1, 5745 MHz, 5 MHz Mode)

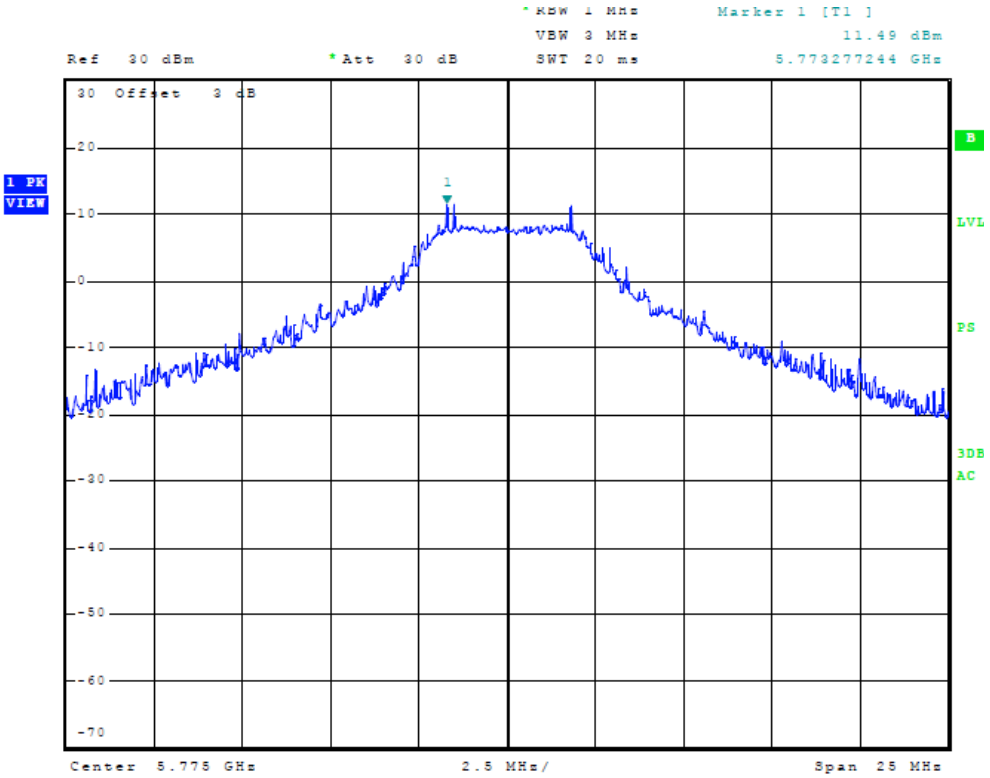


Figure 21 Plot of Antenna Port Conducted Power Spectral Density (chain 1, 5775 MHz, 5 MHz Mode)

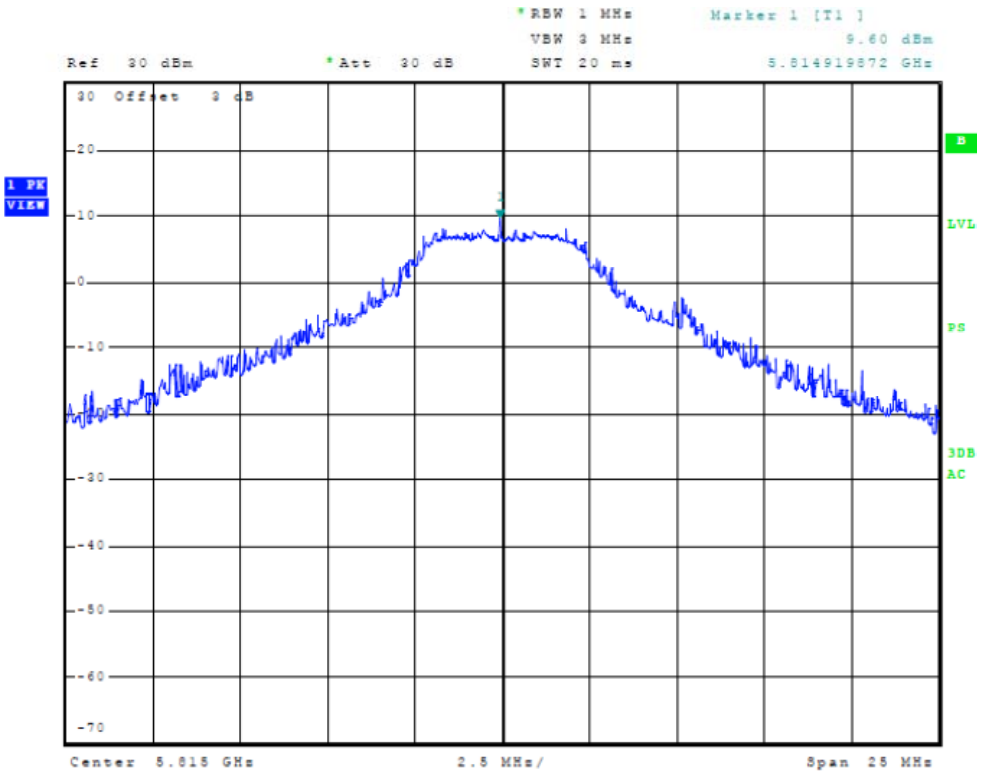


Figure 22 Plot of Antenna Port Conducted Power Spectral Density (chain 1, 5815 MHz, 5 MHz Mode)

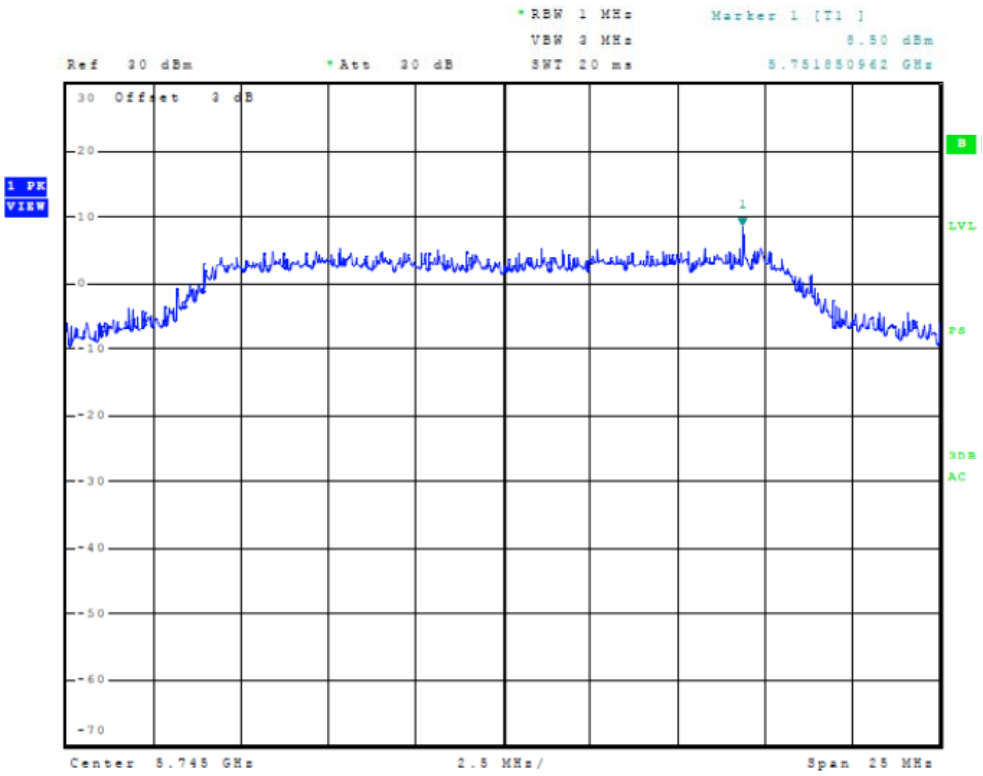


Figure 23 Plot of Antenna Port Conducted Power Spectral Density (chain 1, 5745 MHz, 20 MHz Mode)

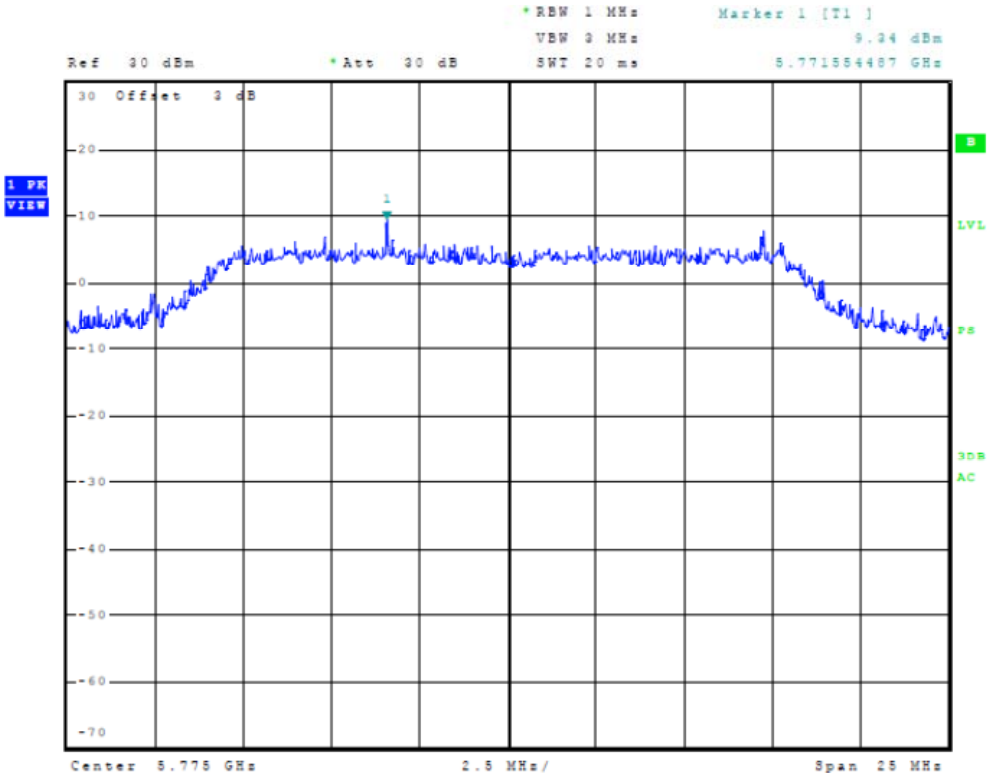


Figure 24 Plot of Antenna Port Conducted Power Spectral Density (chain 1, 5775 MHz, 20 MHz Mode)

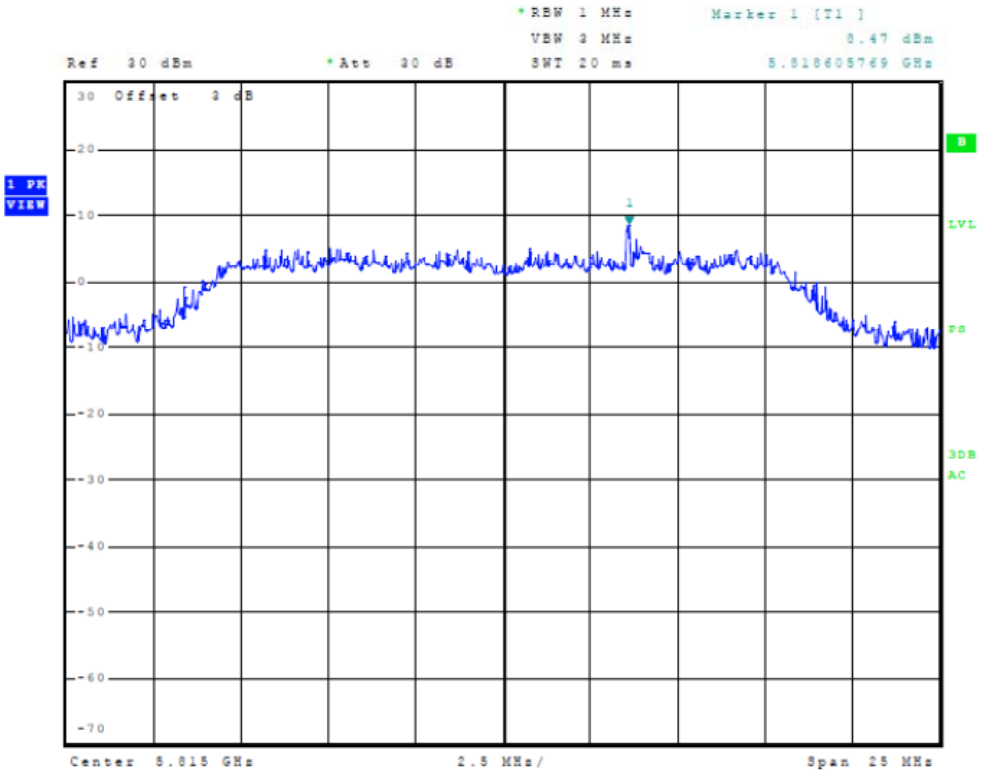


Figure 25 Plot of Antenna Port Conducted Power Spectral Density (chain 1, 5815 MHz, 20 MHz Mode)

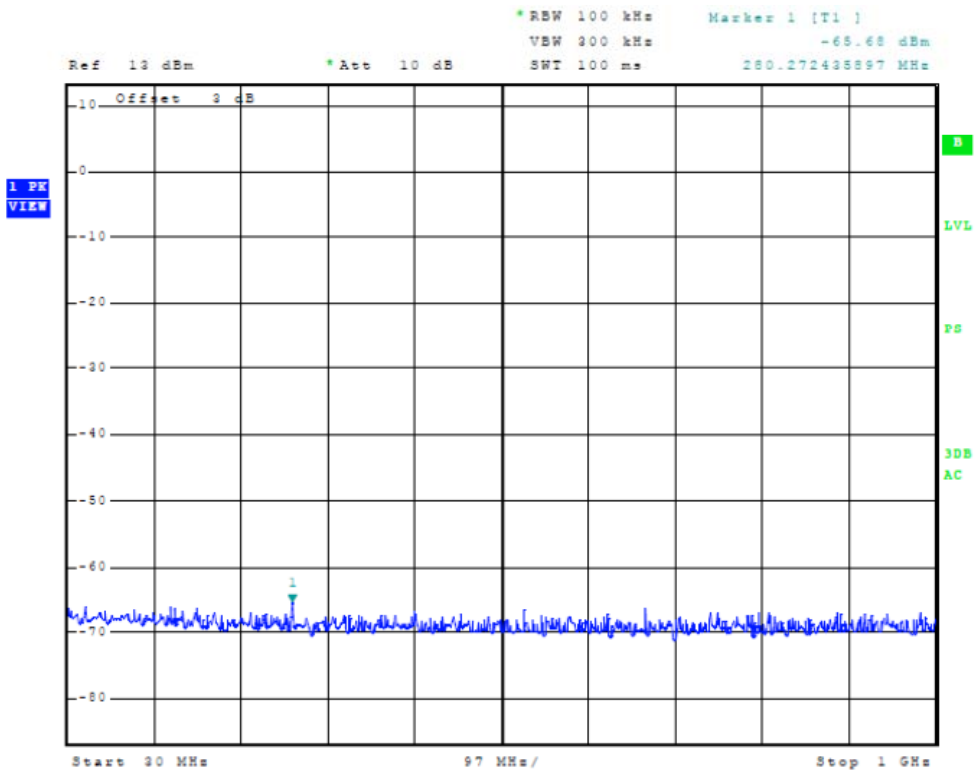


Figure 26 Plot of Antenna Port Conducted Emissions (chain 1)

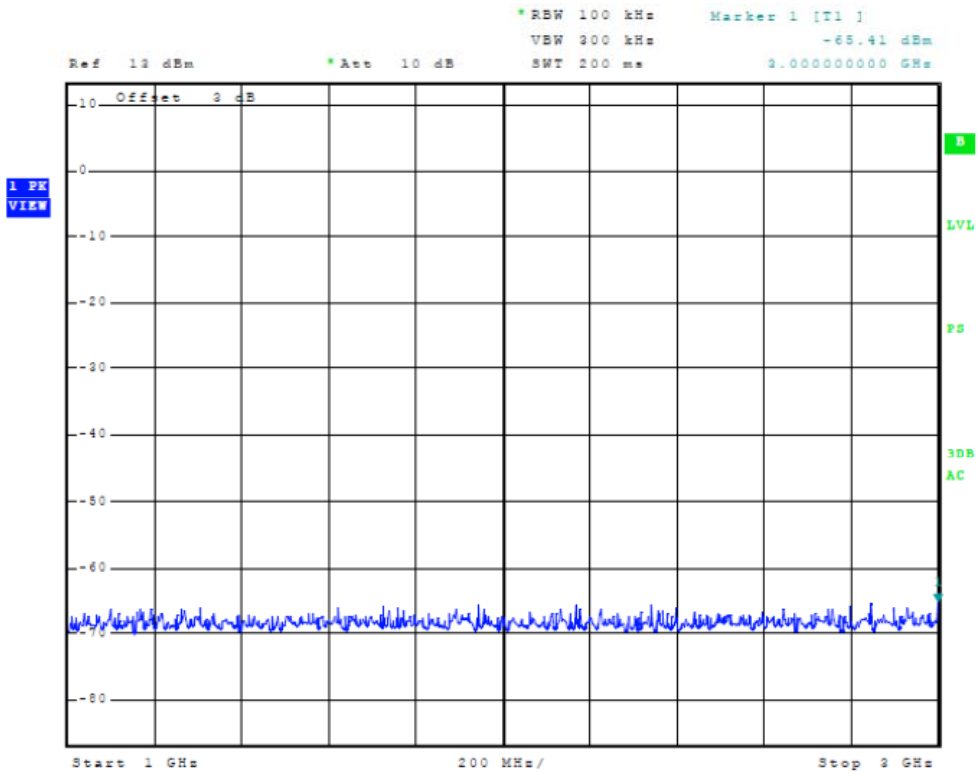


Figure 27 Plot of Antenna Port Conducted Emissions (chain 1)

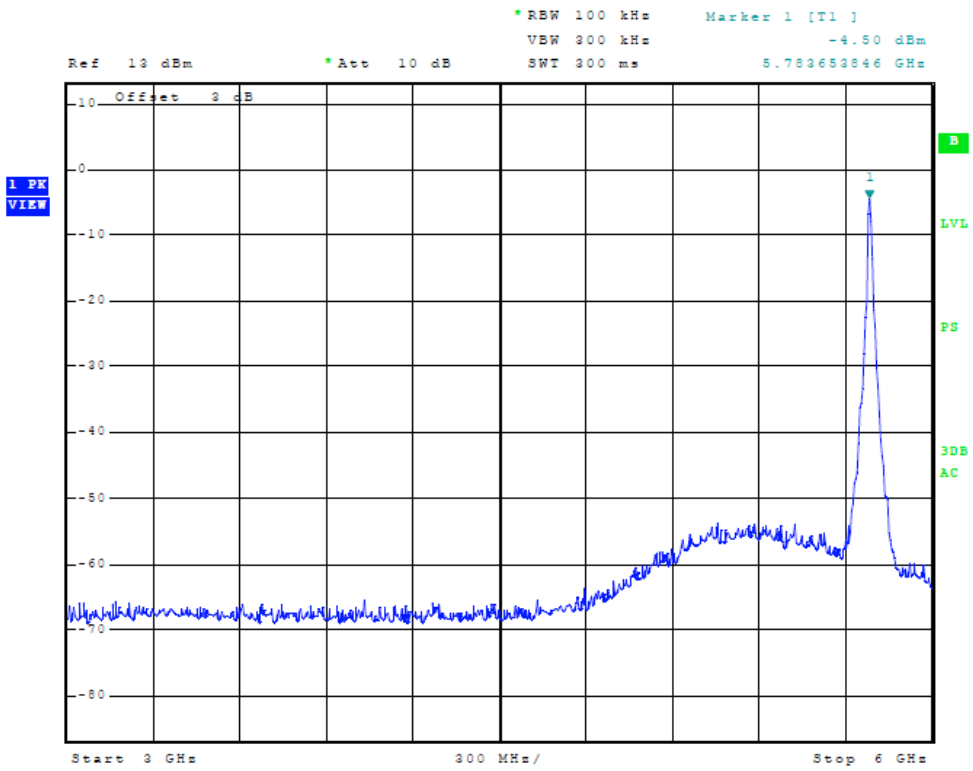


Figure 28 Plot of Antenna Port Conducted Emissions (chain 1)

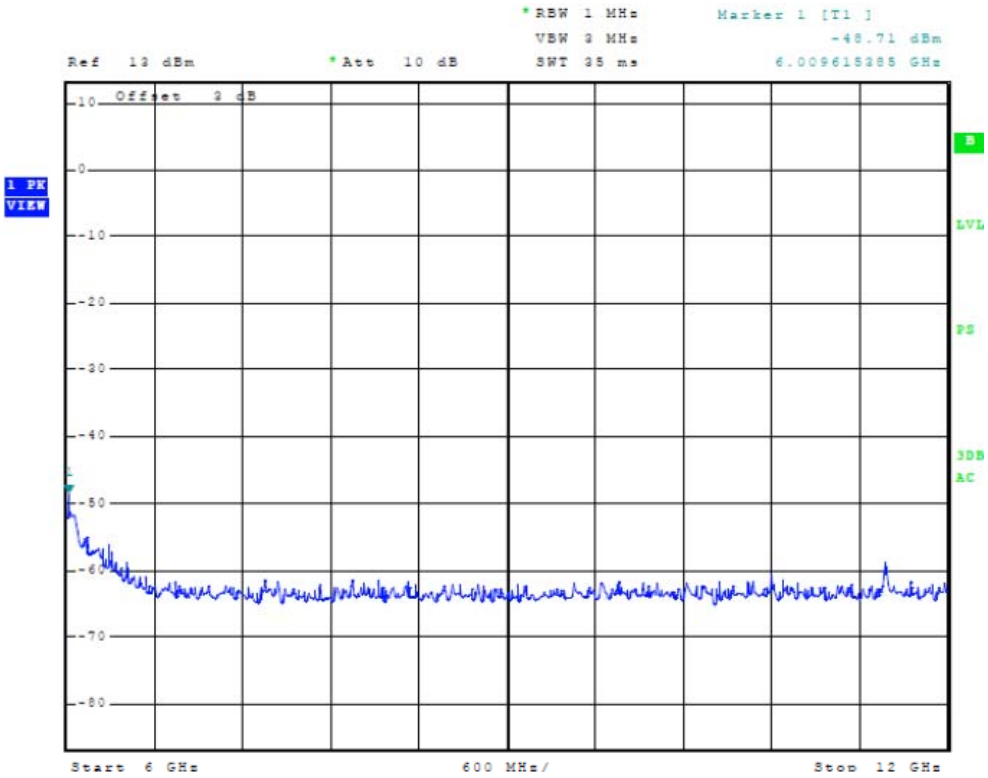


Figure 29 Plot of Antenna Port Conducted Emissions (chain 1)

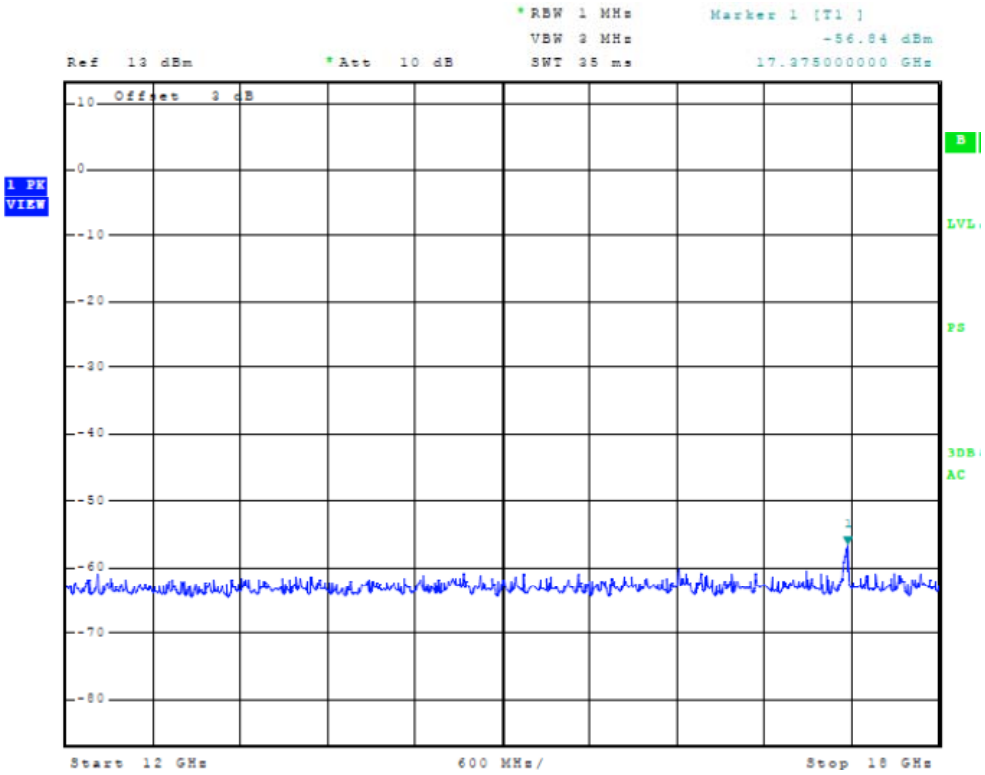


Figure 30 Plot of Antenna Port Conducted Emissions (chain 1)

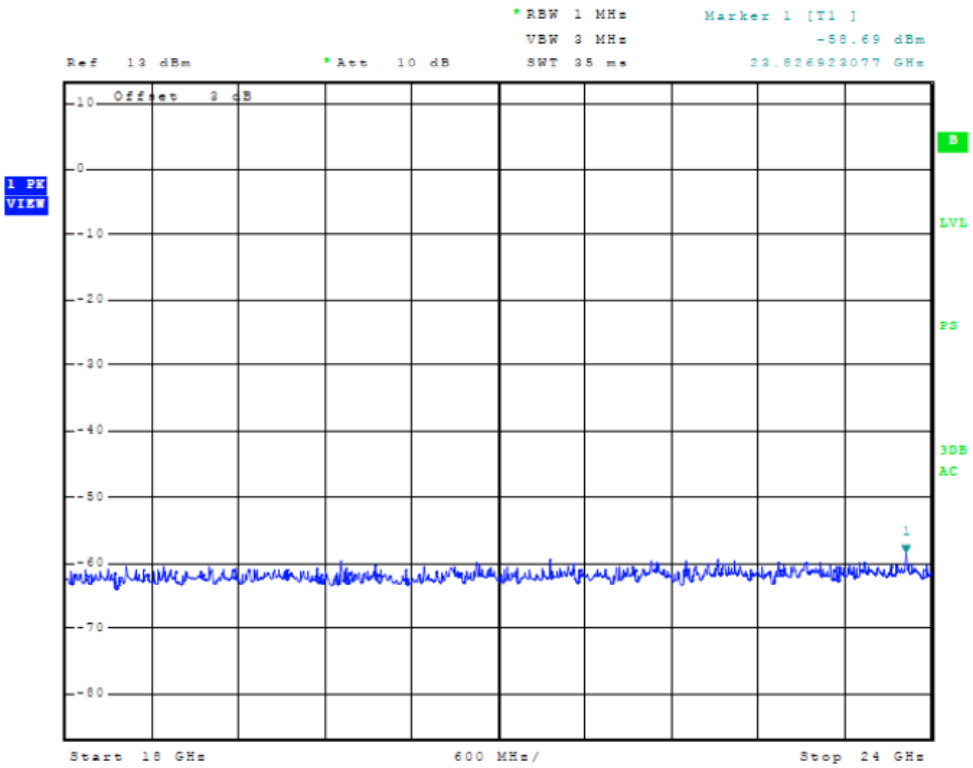


Figure 31 Plot of Antenna Port Conducted Emissions (chain 1)

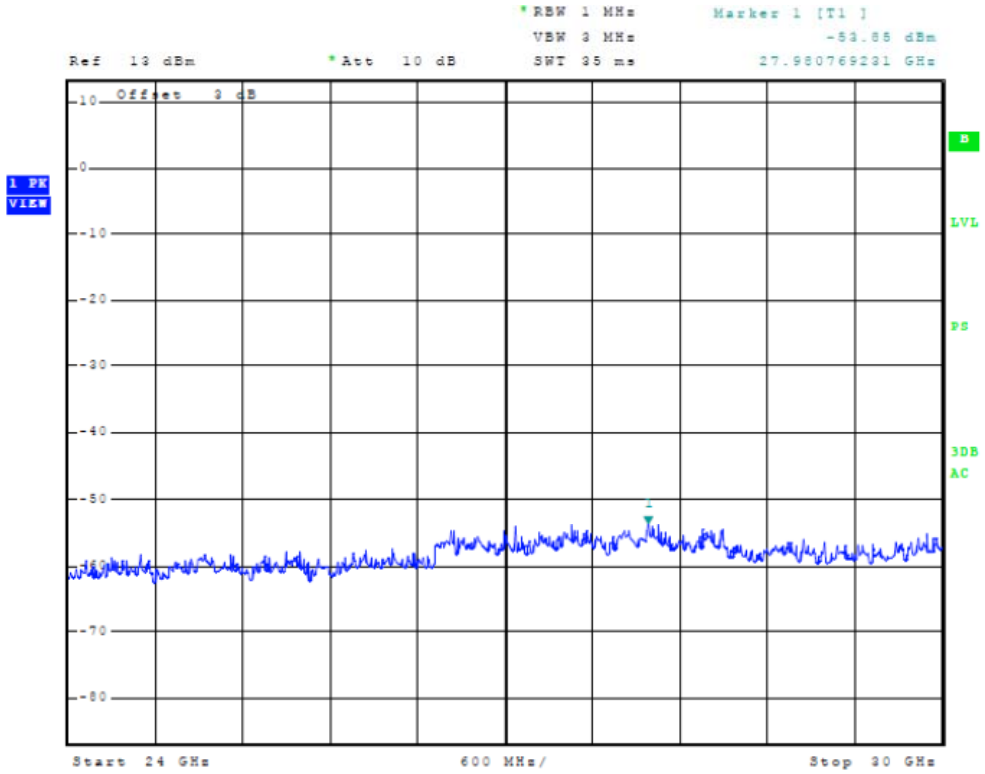


Figure 32 Plot of Antenna Port Conducted Emissions (chain 1)

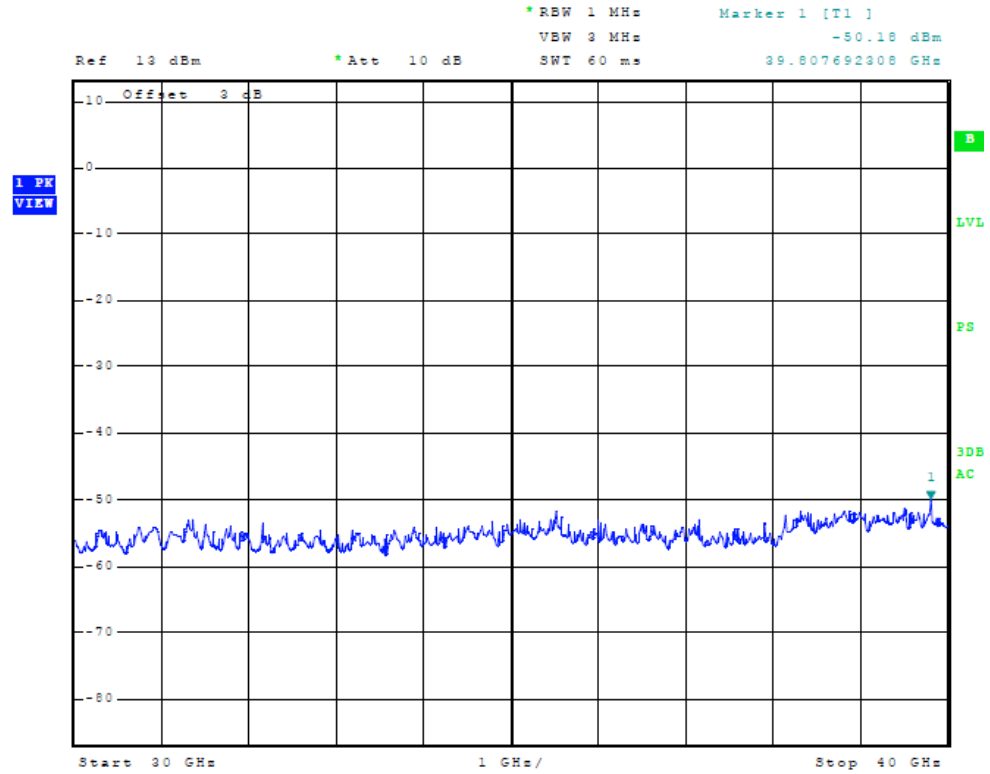


Figure 33 Plot of Antenna Port Conducted Emissions (chain 1)

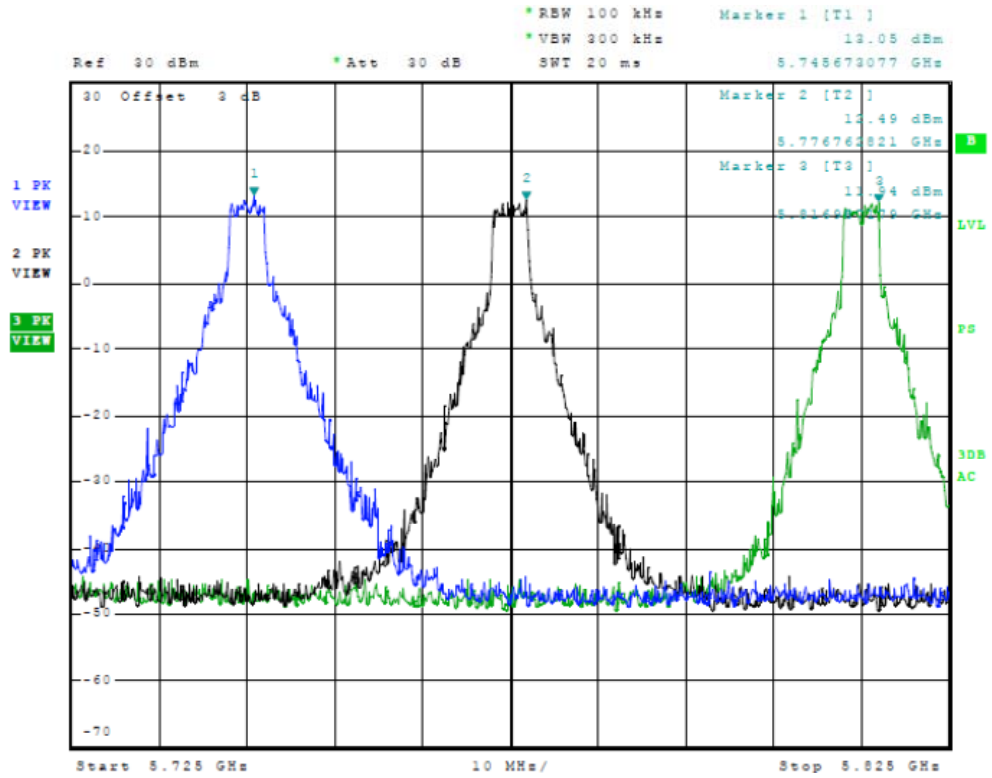


Figure 34 Plot of Antenna Port Conducted (chain 2, 5 MHz Mode)

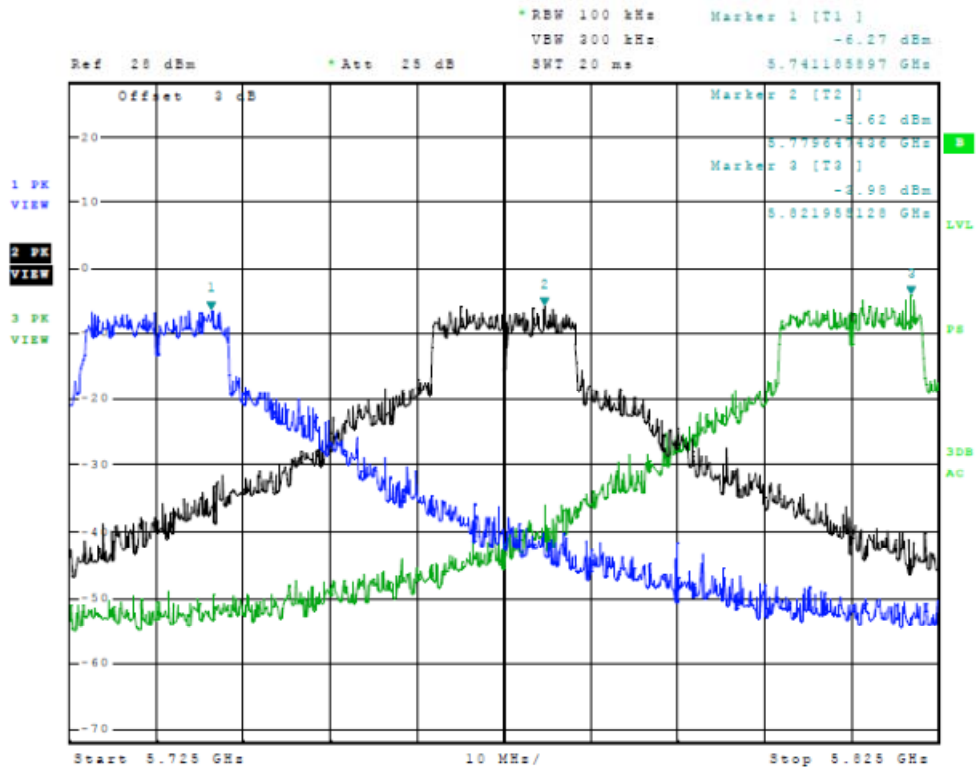


Figure 35 Plot of Antenna Port Conducted (chain 2, 20 MHz Mode)

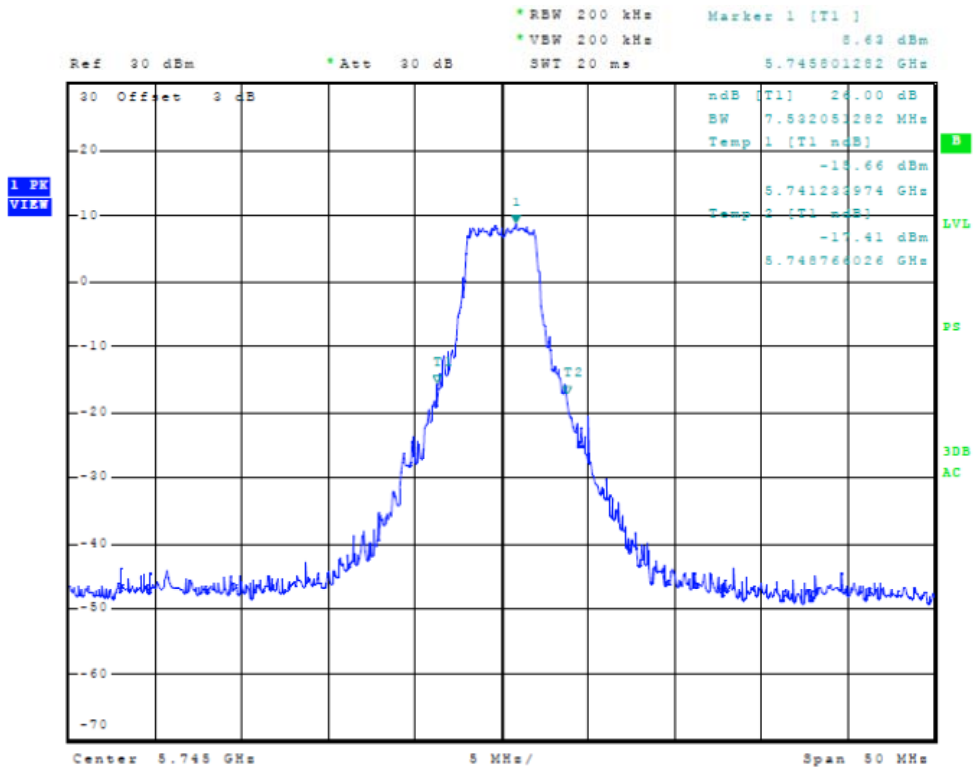


Figure 36 Plot of Antenna Port Conducted 26dB Band width (chain 2, 5745 MHz, 5 MHz Mode)

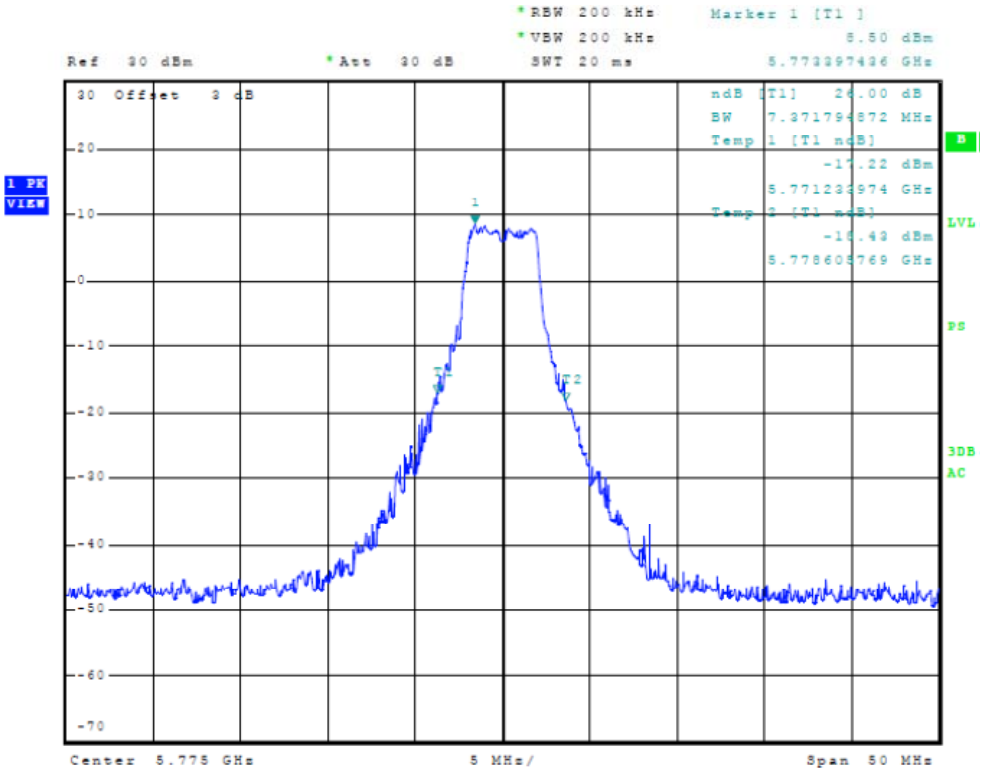


Figure 37 Plot of Antenna Port Conducted 26dB Band width (chain 2, 5775 MHz, 5 MHz Mode)

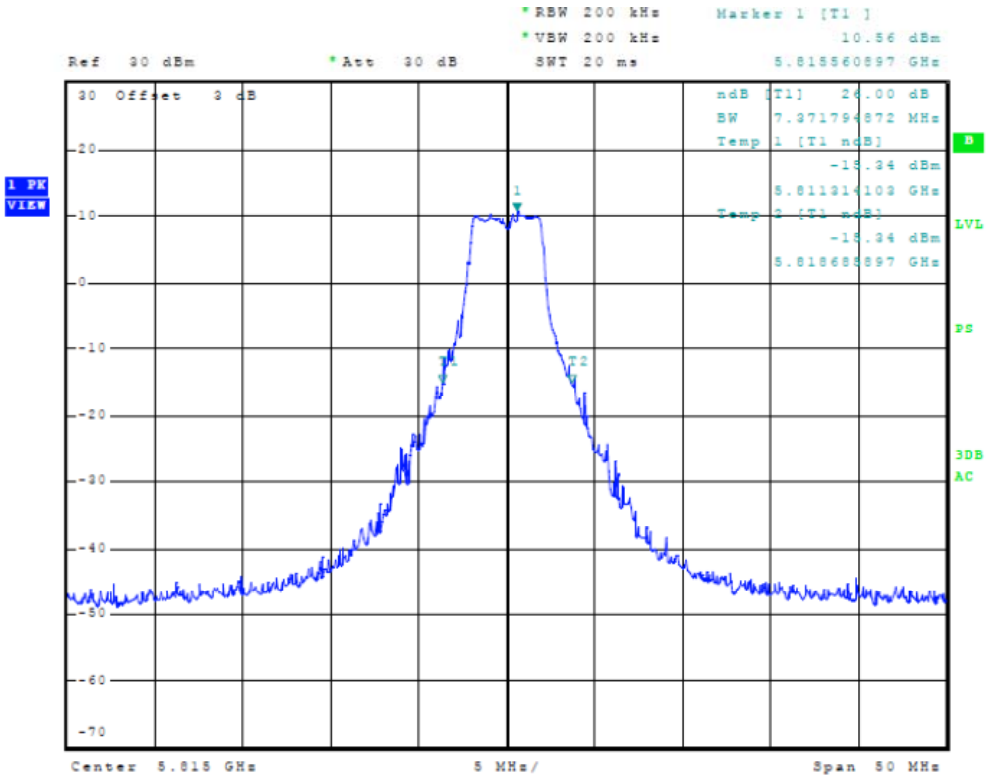


Figure 38 Plot of Antenna Port Conducted 26dB Band width (chain 2, 5815 MHz, 5 MHz Mode)

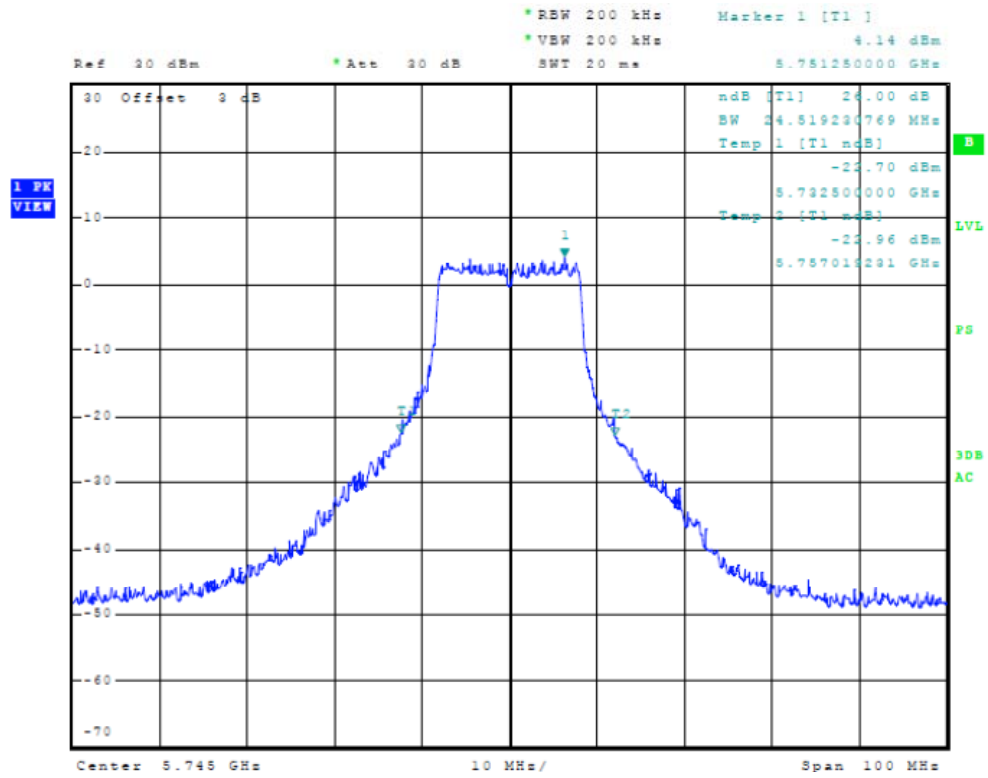


Figure 39 Plot of Antenna Port Conducted 26dB Band width (chain 2, 5745 MHz, 20 MHz Mode)

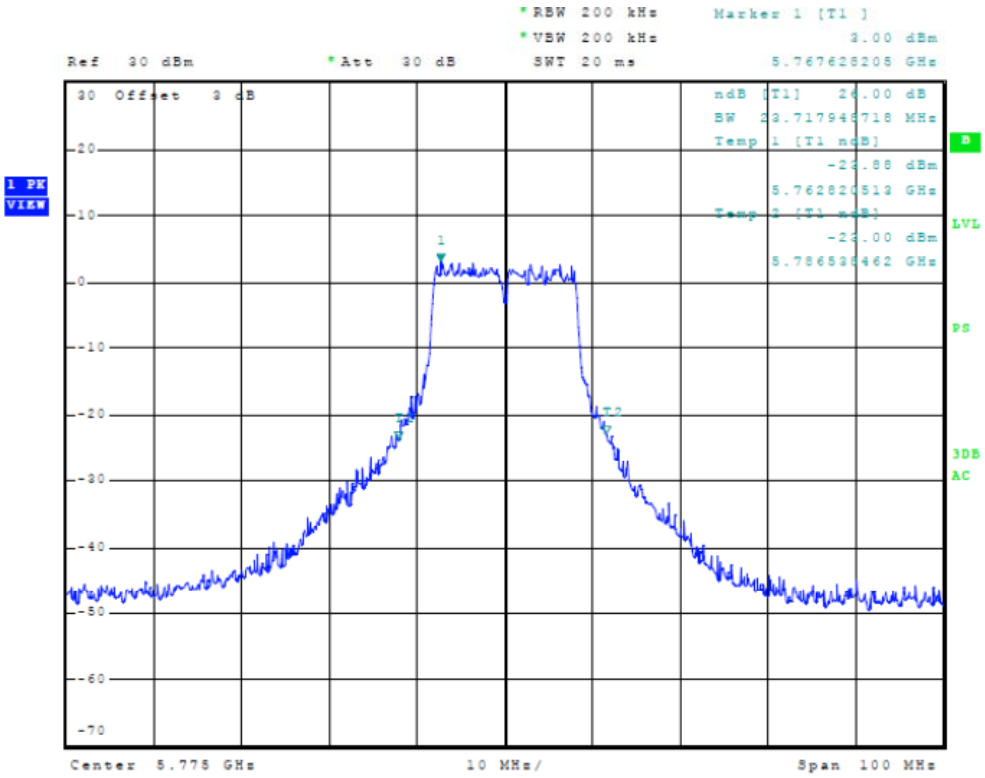


Figure 40 Plot of Antenna Port Conducted 26dB Band width (chain 2, 5775 MHz, 20 MHz Mode)

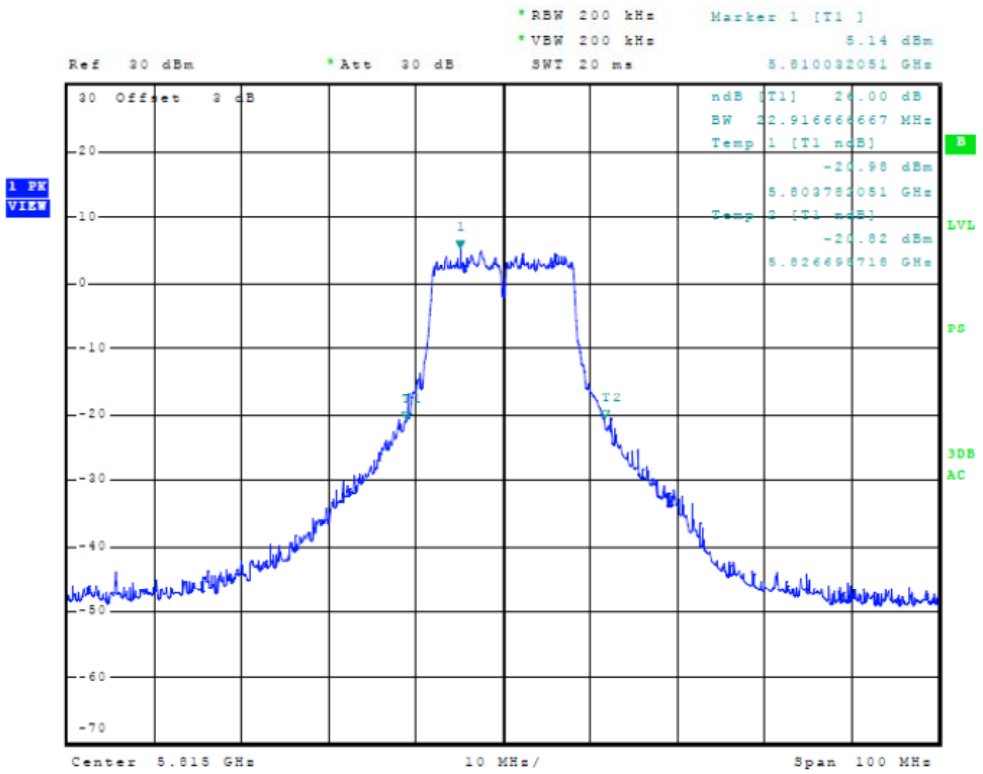


Figure 41 Plot of Antenna Port Conducted 26dB Band width (chain 2, 5815 MHz, 20 MHz Mode)

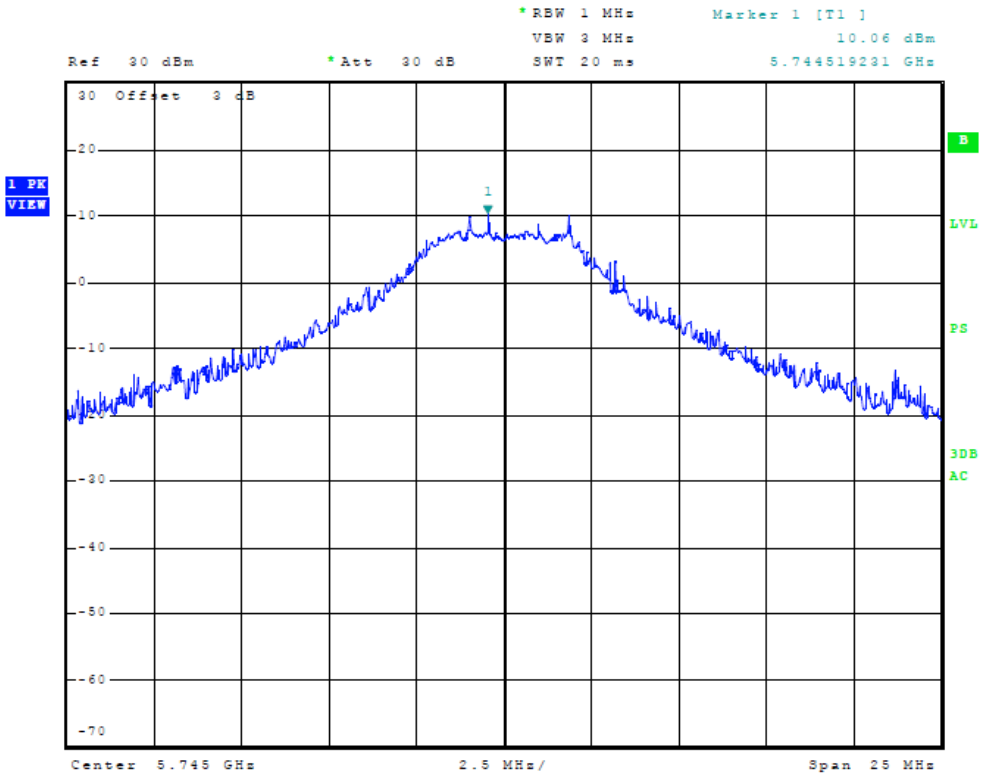


Figure 42 Plot of Antenna Port Conducted Power Spectral Density (chain 2, 5745 MHz, 5 MHz Mode)

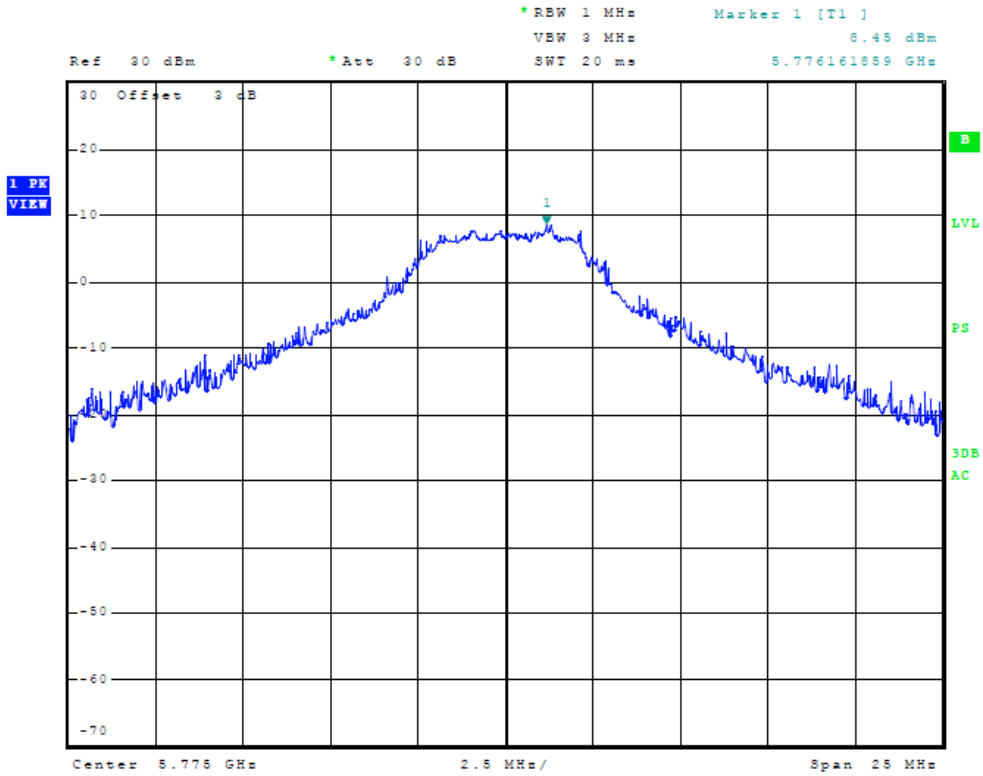


Figure 43 Plot of Antenna Port Conducted Power Spectral Density (chain 2, 5775 MHz, 5 MHz Mode)

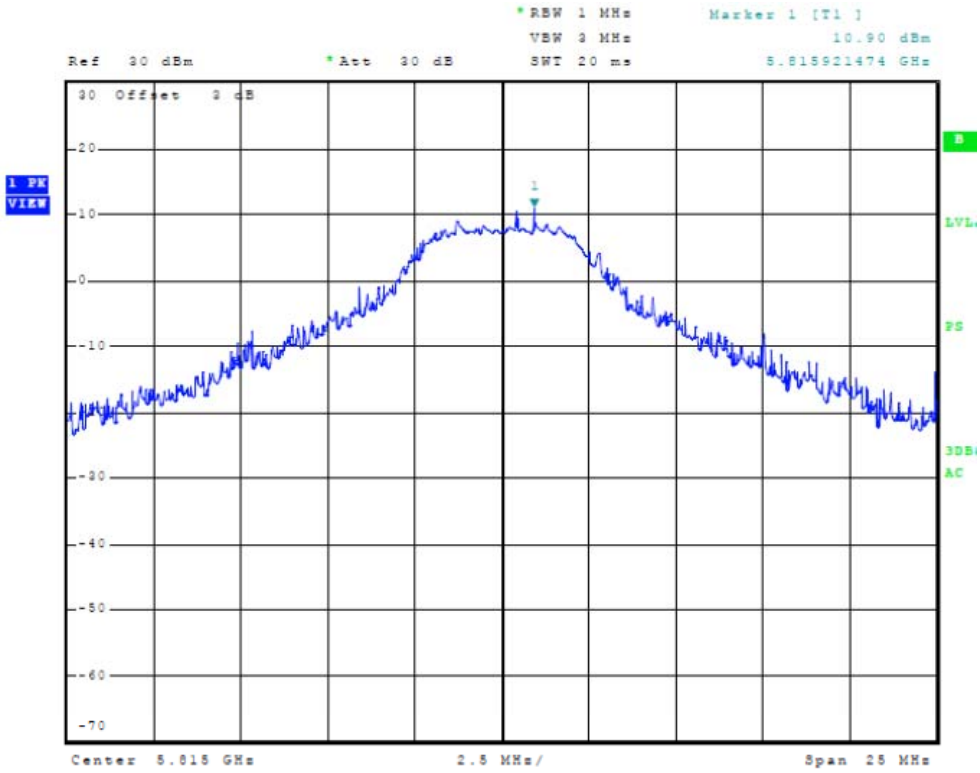


Figure 44 Plot of Antenna Port Conducted Power Spectral Density (chain 2, 5815 MHz, 5 MHz Mode)

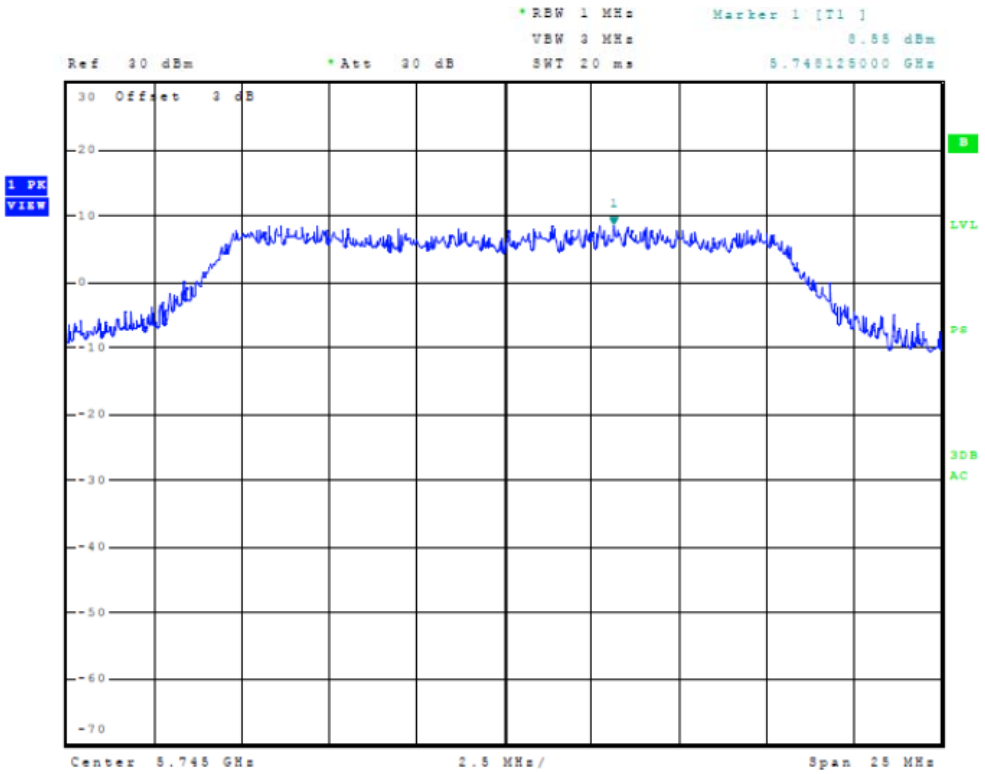


Figure 45 Plot of Antenna Port Conducted Power Spectral Density (chain 2, 5745 MHz, 20 MHz Mode)

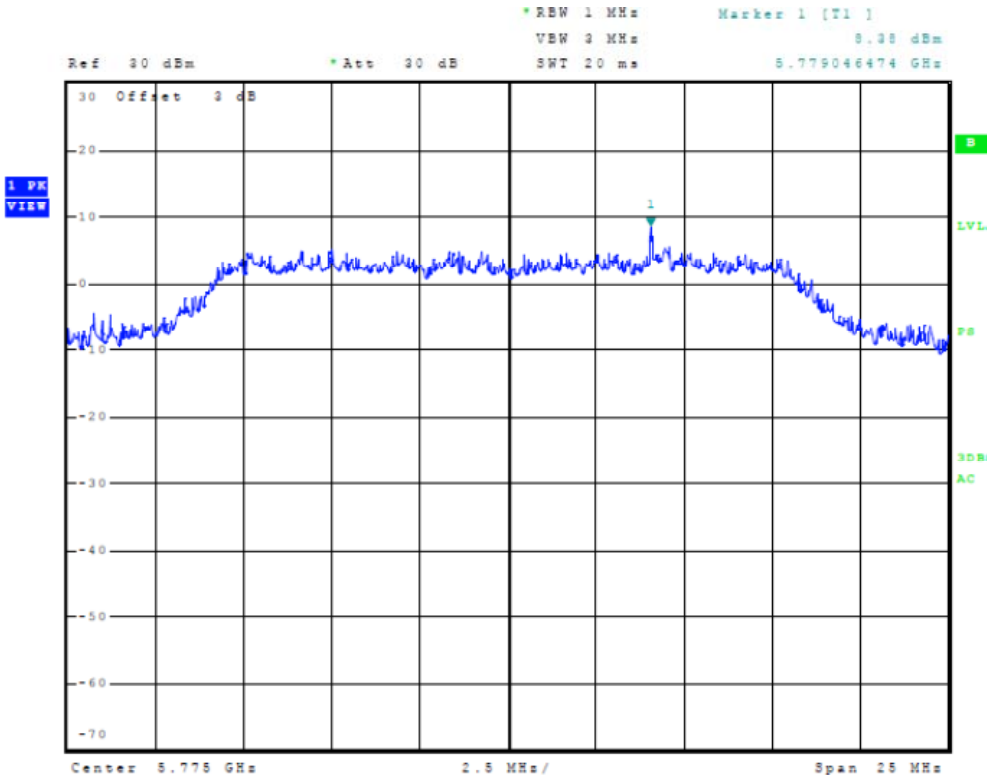


Figure 46 Plot of Antenna Port Conducted Power Spectral Density (chain 2, 5775 MHz, 20 MHz Mode)

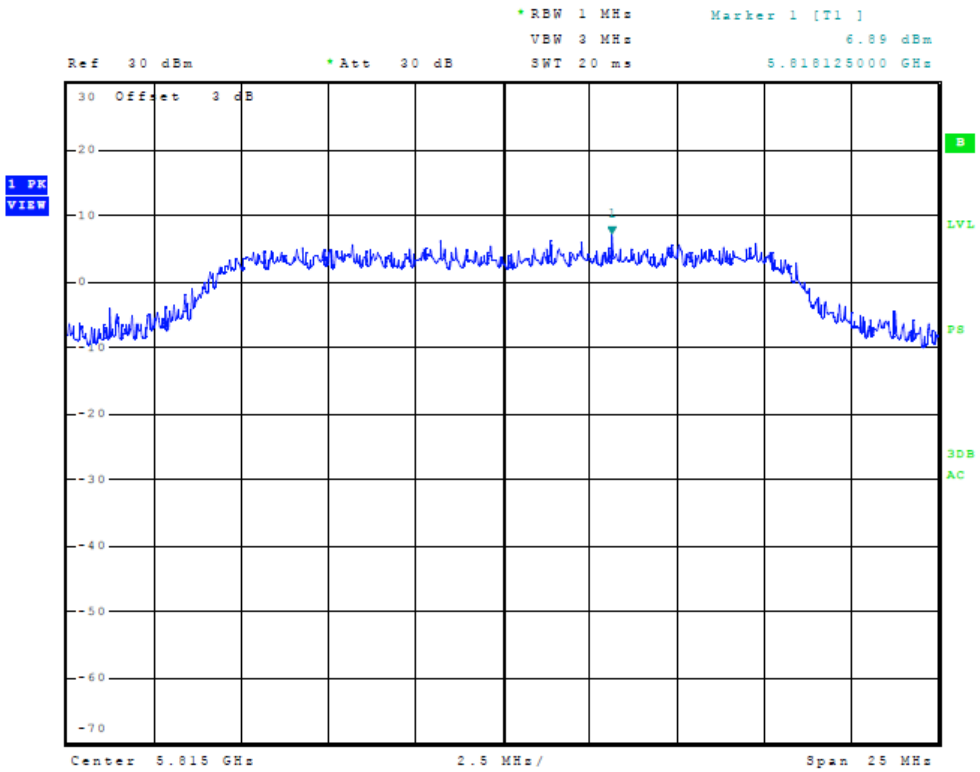


Figure 47 Plot of Antenna Port Conducted Power Spectral Density (chain 2, 5815 MHz, 20 MHz Mode)

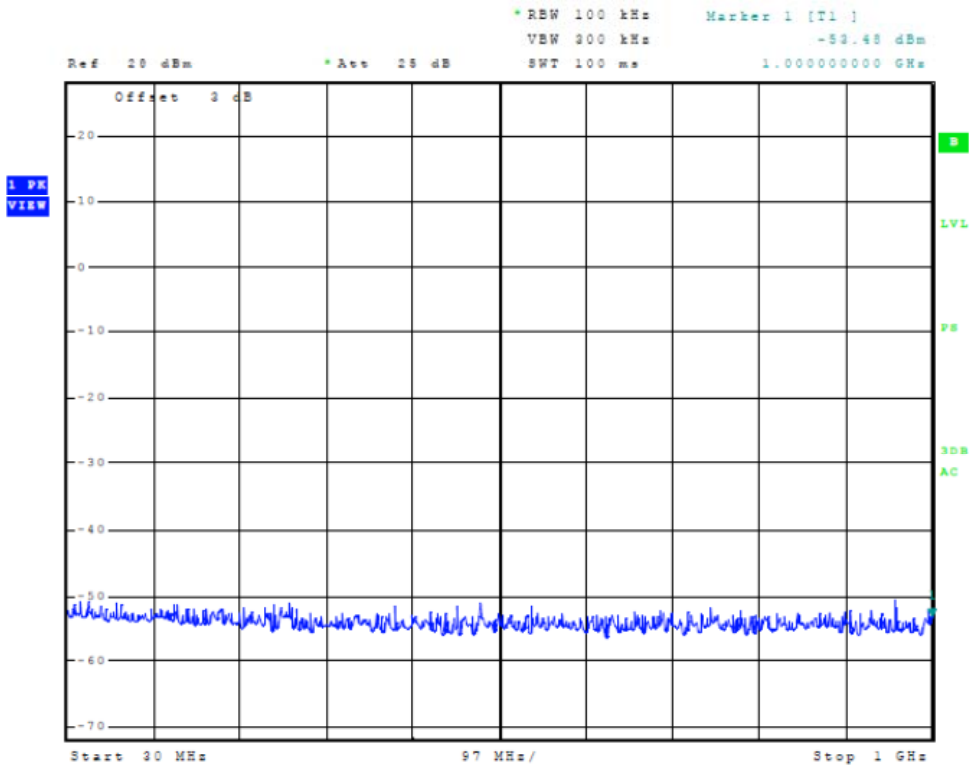


Figure 48 Plot of Antenna Port Conducted Emissions (chain 2)

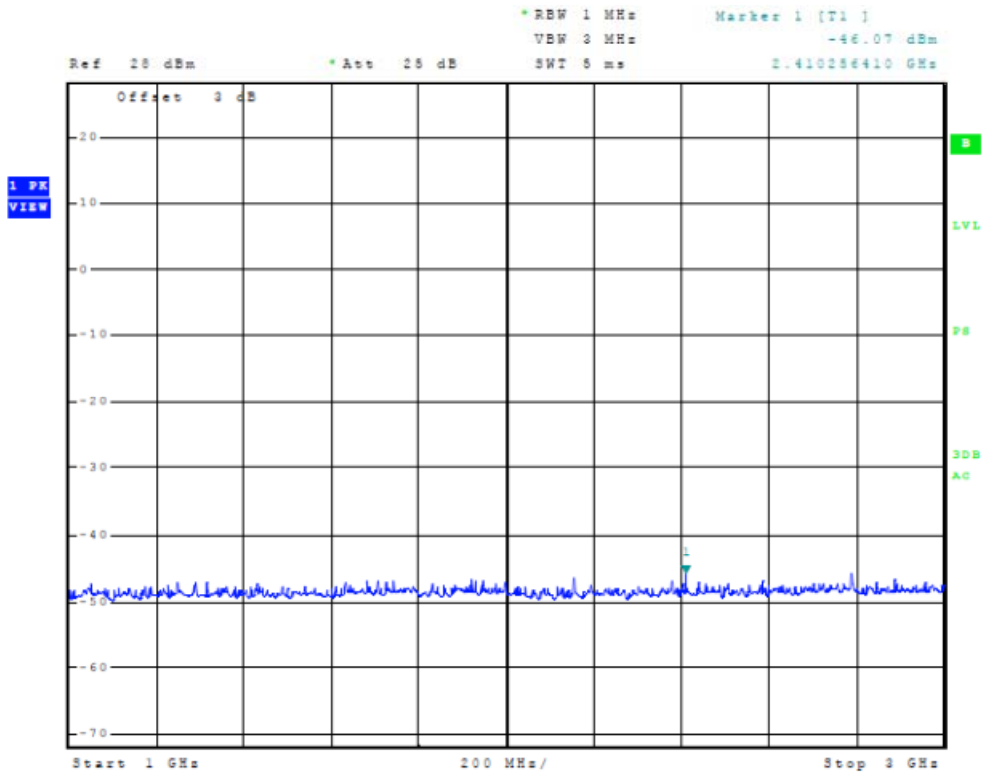


Figure 49 Plot of Antenna Port Conducted Emissions (chain 2)

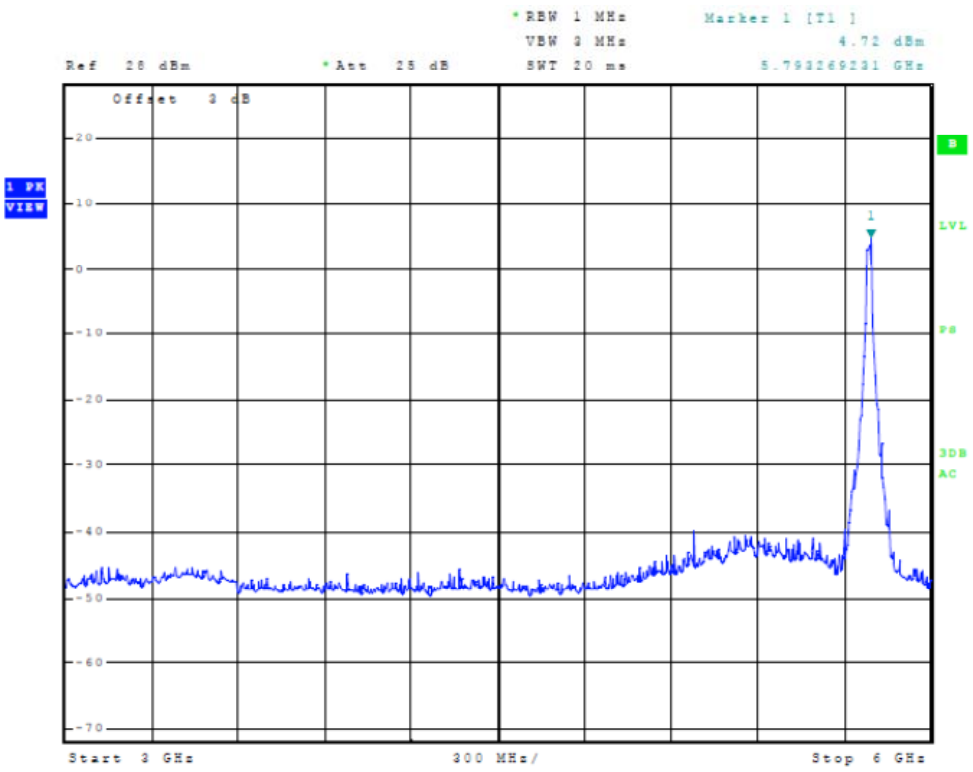


Figure 50 Plot of Antenna Port Conducted Emissions (chain 2)

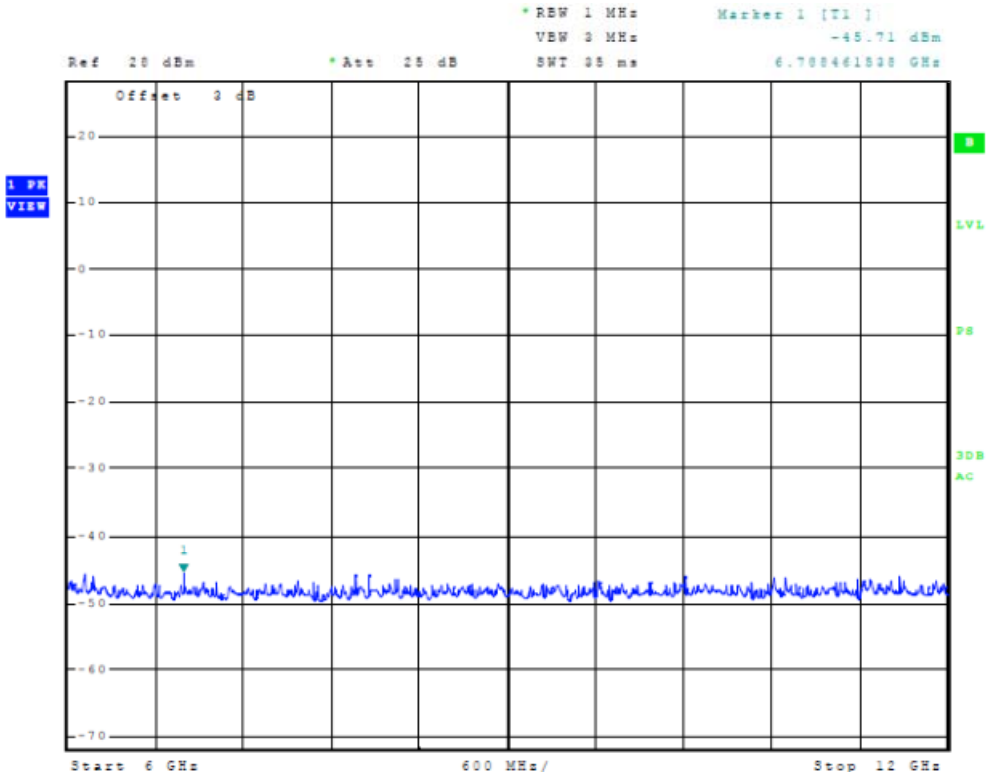


Figure 51 Plot of Antenna Port Conducted Emissions (chain 2)

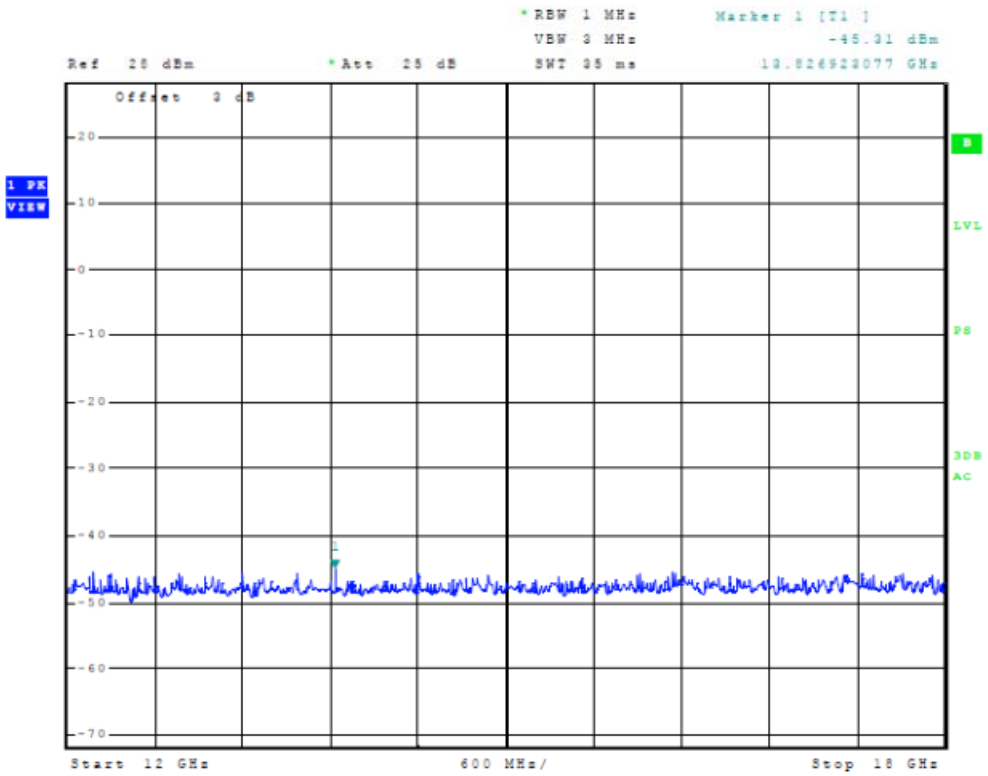


Figure 52 Plot of Antenna Port Conducted Emissions (chain 2)

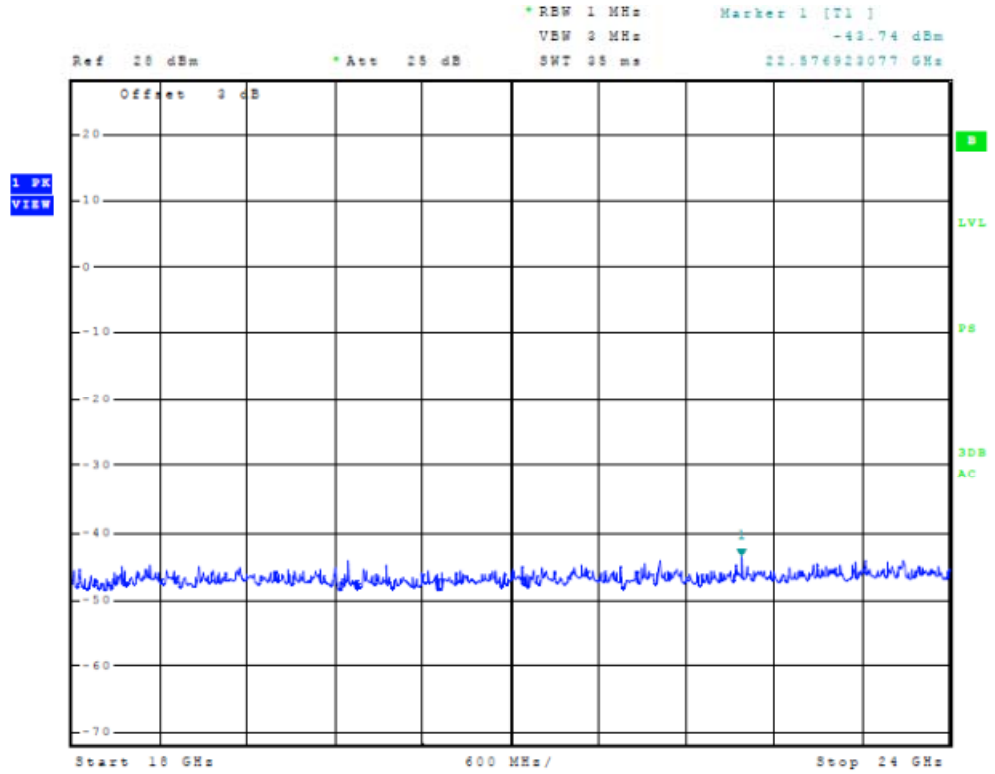


Figure 53 Plot of Antenna Port Conducted Emissions (chain 2)

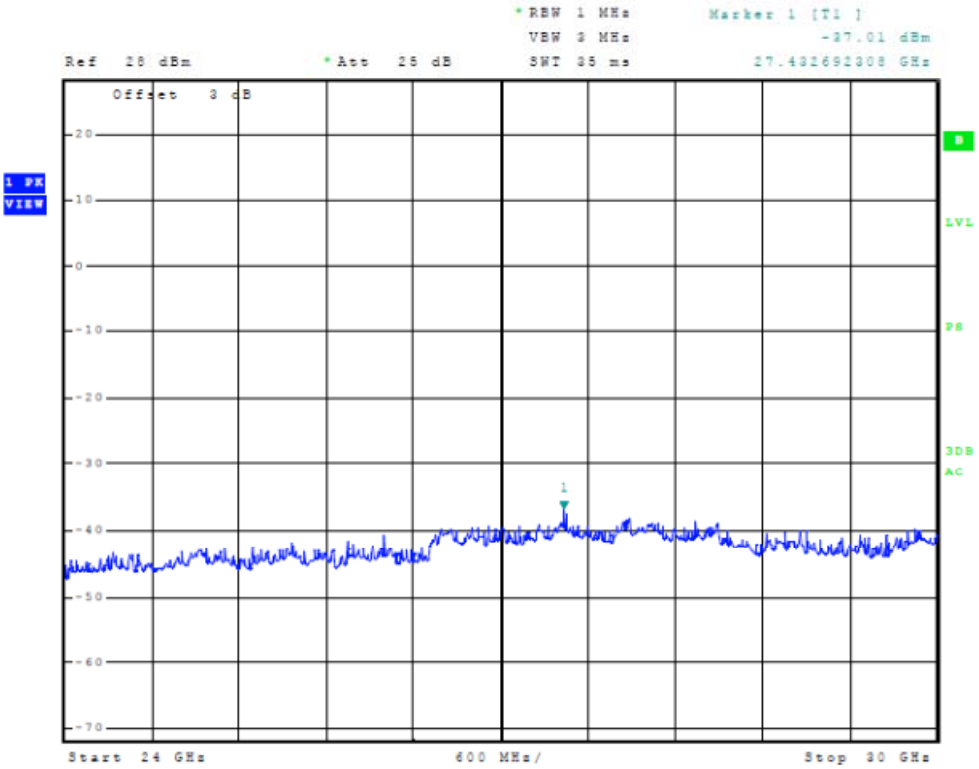


Figure 54 Plot of Antenna Port Conducted Emissions (chain 2)

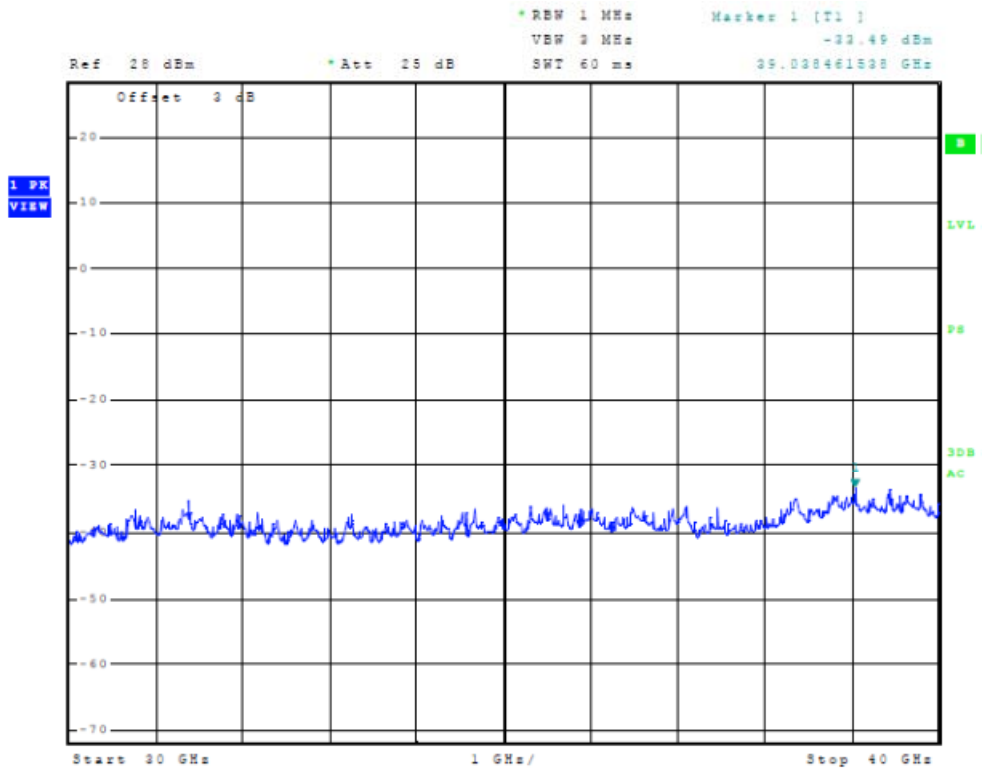


Figure 55 Plot of Antenna Port Conducted Emissions (chain 2)

Transmitter Emissions Data

Transmitter Antenna port Conducted Emissions Data (5 MHz Channel)

Channel MHz	Spurious Freq (MHz)	Measured Level (dBm)	Level Below Carrier (dB)
Chain 1			
5745.0	11490.0	-52.97	-76.2
	17235.0	-53.17	-76.4
	22980.0	-53.79	-77.0
	28725.0	-50.17	-73.4
	34470.0	-46.79	-70.0
5775.0	11550.0	-55.73	-79.3
	17325.0	-53.84	-77.4
	23100.0	-53.51	-77.1
	28875.0	-50.12	-73.7
	34650.0	-46.69	-70.3
5805.0	11610.0	-54.60	-78.5
	17415.0	-54.72	-78.6
	23220.0	-56.03	-80.2
	29025.0	-50.06	-74.0
	34830.0	-47.47	-71.4
Chain 2			
5745.0	11490.0	-55.33	-78.4
	17235.0	-54.65	-77.7
	22980.0	-53.34	-76.4
	28725.0	-50.95	-74.0
	34470.0	-46.47	-69.5
5775.0	11550.0	-55.40	-79.5
	17325.0	-54.31	-78.4
	23100.0	-53.49	-77.6
	28875.0	-49.55	-73.6
	34650.0	-47.26	-71.3
5805.0	11610.0	-53.61	-77.4
	17415.0	-53.26	-77.1
	23220.0	-53.52	-77.3
	29025.0	-50.33	-74.2
	34830.0	-47.19	-71.0

Transmitter Antenna port Conducted Emissions Data (20 MHz Channel)

Channel MHz	Spurious Freq (MHz)	Measured Level (dBm)	Level Below Carrier (dB)
Chain 1			
5735.0	11470.0	-50.52	-74.7
	17205.0	-49.91	-74.1
	22940.0	-50.01	-74.2
	28675.0	-48.42	-72.6
	34410.0	-46.60	-70.8
5775.0	11550.0	-49.91	-72.9
	17325.0	-49.29	-72.2
	23100.0	-49.94	-72.9
	28875.0	-47.48	-70.4
	34650.0	-45.73	-68.7
5815.0	11630.0	-50.01	-73.6
	17445.0	-50.08	-73.7
	23260.0	-49.62	-73.2
	29075.0	-47.78	-71.4
	34890.0	-46.42	-70.0
Chain 2			
5735.0	11470.0	-50.14	-74.3
	17205.0	-49.41	-73.5
	22940.0	-51.23	-75.4
	28675.0	-48.37	-72.5
	34410.0	-46.60	-70.7
	11470.0	-50.14	-74.3
5775.0	11550.0	-49.74	-72.7
	17325.0	-50.28	-73.2
	23100.0	-50.67	-73.6
	28875.0	-47.48	-70.4
	34650.0	-46.37	-69.3
	11630.0	-49.74	-72.7
5815.0	17445.0	-50.01	-73.6
	23260.0	-50.17	-73.8
	29075.0	-49.25	-72.8
	34890.0	-47.82	-71.4
	11550.0	-46.38	-70.0

Transmitter Antenna port Conducted Emissions Data (2x2 MIMO Total power)

5 GHz operation

Channel Mode	Total Output Power (mW / Watts)	Total Power Spectral Density (dBm)
5 MHz	500 / 0.5	14.22
20 MHz	518 / 0.5	11.97

Transmitter Radiated Emission 5 GHz operation (5 dBi Dipole, Worst-case)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
5745.0	75.5	60.5	100.9	89.9	--
11490.0	63.6	43.2	55.1	39.6	54.0
17235.0	56.1	40.4	56.0	41.4	54.0
22980.0	38.9	27.2	38.4	27.4	54.0
28725.0	37.5	26.6	37.7	26.6	54.0
5775.0	75.9	60.5	100.9	90.1	--
11550.0	62.7	43.4	55.2	40.5	54.0
17325.0	56.7	41.1	57.6	41.9	54.0
23100.0	38.0	27.0	38.1	26.9	54.0
28875.0	36.7	25.9	37.0	26.2	54.0
5805.0	75.4	60.0	101.2	89.7	--
11610.0	65.5	45.6	59.0	40.8	54.0
17415.0	59.4	42.8	59.3	43.7	54.0
23220.0	37.4	26.9	37.8	27.6	54.0
29025.0	37.0	26.6	38.2	26.7	54.0

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Transmitter Radiated Emission 5 GHz operation (12 dBi Omni, Worst-case)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
5745.0	81.2	66.5	107.6	95.1	--
11490.0	67.7	47.1	60.0	44.7	54.0
17235.0	60.5	44.9	60.0	45.4	54.0
22980.0	38.9	27.1	38.3	27.2	54.0
28725.0	37.6	26.5	37.7	26.6	54.0
5775.0	79.9	66.4	106.9	96.2	--
11550.0	66.7	48.4	60.2	44.5	54.0
17325.0	61.7	46.2	62.6	46.9	54.0
23100.0	38.0	26.9	38.2	26.6	54.0
28875.0	37.7	25.8	41.0	26.4	54.0
5805.0	79.4	65.0	107.2	95.7	--
11610.0	70.5	50.6	69.0	45.6	54.0
17415.0	63.4	47.7	66.3	48.7	54.0
23220.0	37.2	27.2	37.8	27.8	54.0
29025.0	37.3	26.7	38.2	27.5	54.0

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Transmitter Radiated Emission 5 GHz operation (20 dBi Sector, Worst-case)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
5745.0	93.8	79.9	119.1	105.1	--
11490.0	65.7	52.4	62.4	49.4	54.0
17235.0	63.3	47.9	57.0	48.2	54.0
22980.0	37.9	35.8	38.5	36.5	54.0
28725.0	38.7	34.1	39.0	35.1	54.0
5775.0	94.0	80.4	117.3	103.3	--
11550.0	71.4	52.7	69.3	51.6	54.0
17325.0	57.8	45.5	58.2	46.7	54.0
23100.0	38.4	35.3	39.3	34.9	54.0
28875.0	37.7	35.0	37.8	35.2	54.0
5805.0	94.4	81.8	117.8	103.4	--
11610.0	68.3	52.2	68.5	52.6	54.0
17415.0	66.3	49.5	61.8	47.7	54.0
23220.0	36.2	32.6	37.1	33.7	54.0
29025.0	37.3	34.0	37.0	34.4	54.0

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Transmitter Radiated Emission 5 GHz operation (30 dBi Panel, Worst-case)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
5745.0	94.3	83.3	94.4	88.9	--
11490.0	66.4	51.7	66.6	51.7	54.0
17235.0	58.0	45.3	58.2	45.9	54.0
22980.0	39.0	35.9	39.4	36.2	54.0
28725.0	38.1	35.7	38.8	36.2	54.0
5775.0	94.2	82.1	94.5	88.1	--
11550.0	67.1	51.7	68.2	51.8	54.0
17325.0	55.9	44.6	56.1	45.0	54.0
23100.0	38.5	34.9	38.9	33.6	54.0
28875.0	37.8	34.7	38.3	35.5	54.0
5805.0	93.8	81.7	94.0	88.1	--
11610.0	66.8	52.7	66.6	52.9	54.0
17415.0	56.6	45.9	59.6	46.4	54.0
23220.0	35.9	33.7	35.9	34.0	54.0
29025.0	37.0	34.2	37.1	34.3	54.0

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Transmitter Radiated Emission 5 GHz operation (33.5 dBi Dish, Worst-case)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
5745.0	119.6	106.4	119.1	106.6	--
11490.0	68.6	51.5	69.7	52.5	54.0
17235.0	68.1	50.0	67.5	48.7	54.0
22980.0	52.4	27.9	56.7	31.6	54.0
28725.0	42.1	27.9	43.0	31.0	54.0
5775.0	118.8	106.2	119.1	105.6	--
11550.0	73.5	52.4	73.7	52.3	54.0
17325.0	66.9	50.8	68.1	52.2	54.0
23100.0	48.2	28.6	57.7	31.3	54.0
28875.0	45.0	27.8	45.5	30.5	54.0
5805.0	118.7	105.8	118.8	105.5	--
11610.0	71.6	52.4	72.2	52.9	54.0
17415.0	66.7	51.9	67.7	52.8	54.0
23220.0	53.5	31.3	57.3	41.4	54.0
29025.0	43.3	30.8	45.9	40.6	54.0

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Summary of Results for Transmitter Radiated Emissions of Intentional Radiator

The EUT demonstrated compliance with the conducted and radiated emissions requirements of CFR47 Part 15E. Conducted antenna port power of 24.2 dBm, 0.3 Watts (single channel), 0.5 Watts (total power) was measured. The EUT demonstrated a minimum radiated emission margin of -1.1 dB below the harmonic emission 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. The specifications of 15E were met; there are no deviations or exceptions to the requirements.

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to demonstrate compliance with the CFR47 Part 15E emissions standards. There were no deviations to the specifications.

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 fifty-six through sixty-three showing the spectrum analyzer display of receiver antenna port worst-case emissions. Below Antenna Port, plots and conducted emissions data are presented. Compliance to receiver radiated emissions requirements were tested at both antenna port and 3 meter OATS with worst-case data presented.

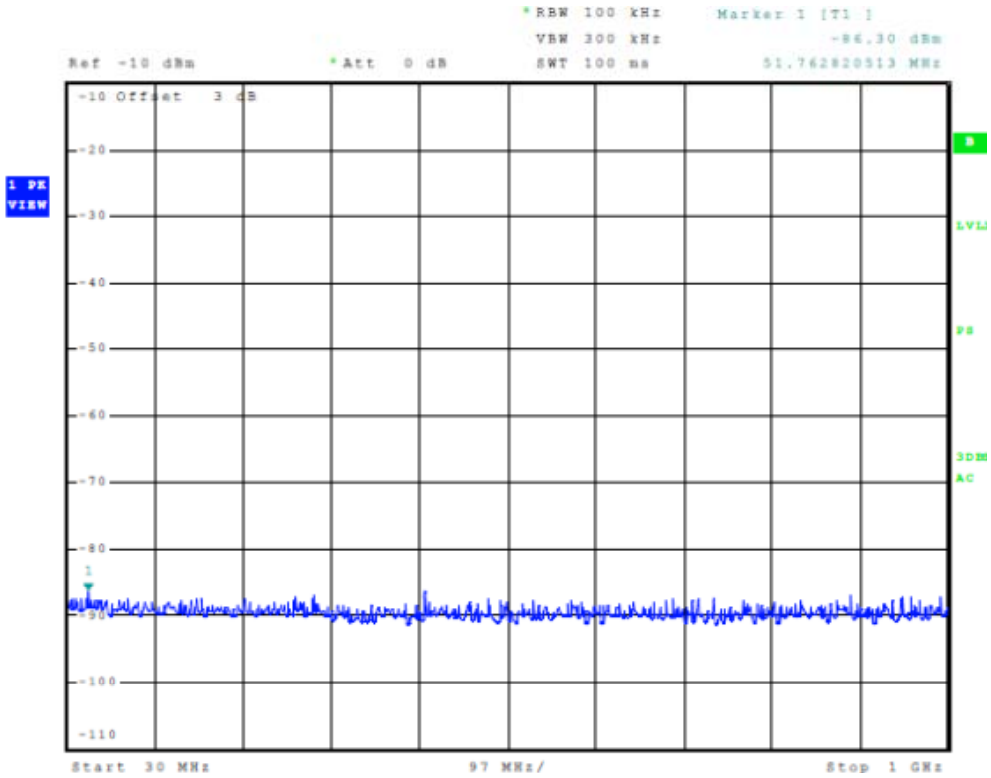


Figure 56 Plot of Receiver Antenna Port Conducted Emissions

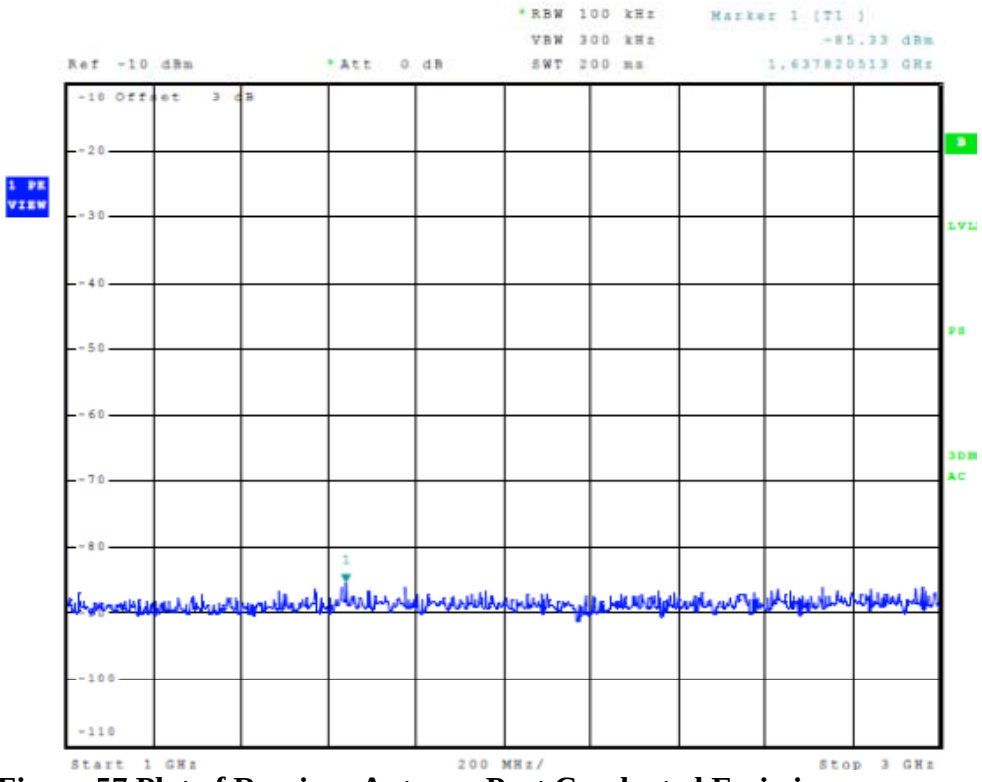


Figure 57 Plot of Receiver Antenna Port Conducted Emissions

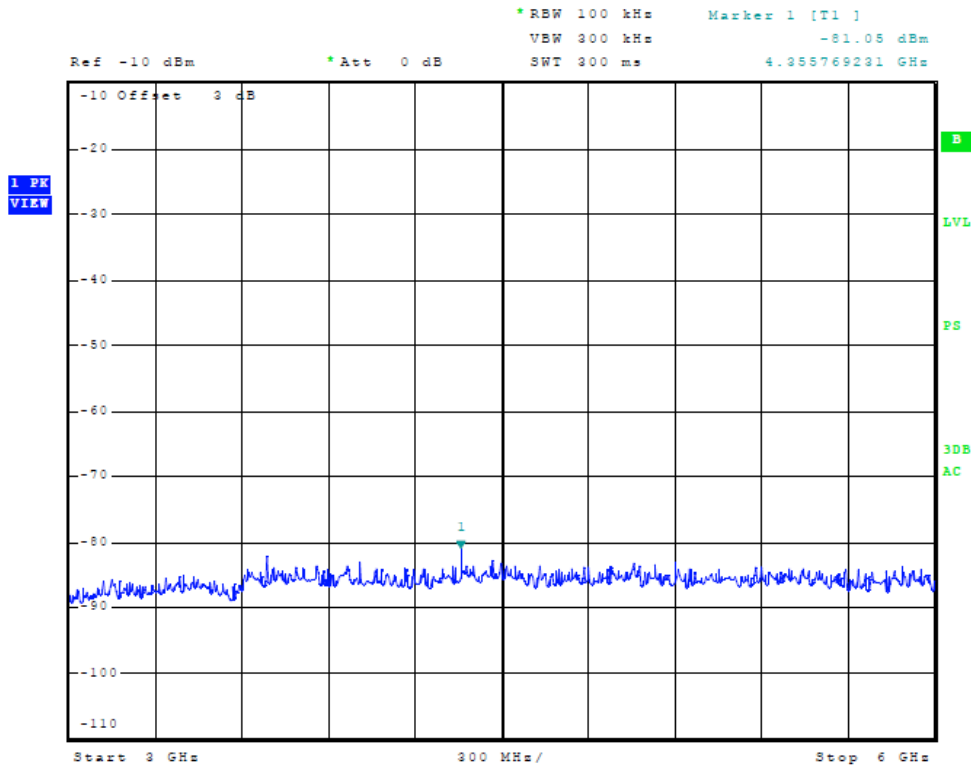


Figure 58 Plot of Receiver Antenna Port Conducted Emissions

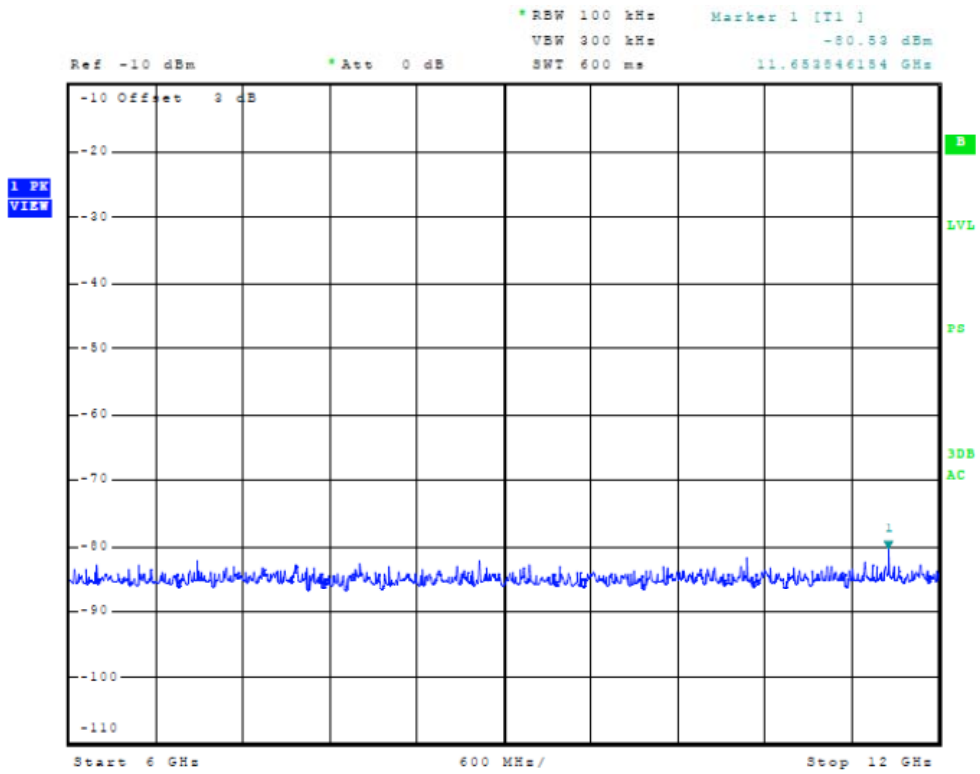


Figure 59 Plot of Receiver Antenna Port Conducted Emissions

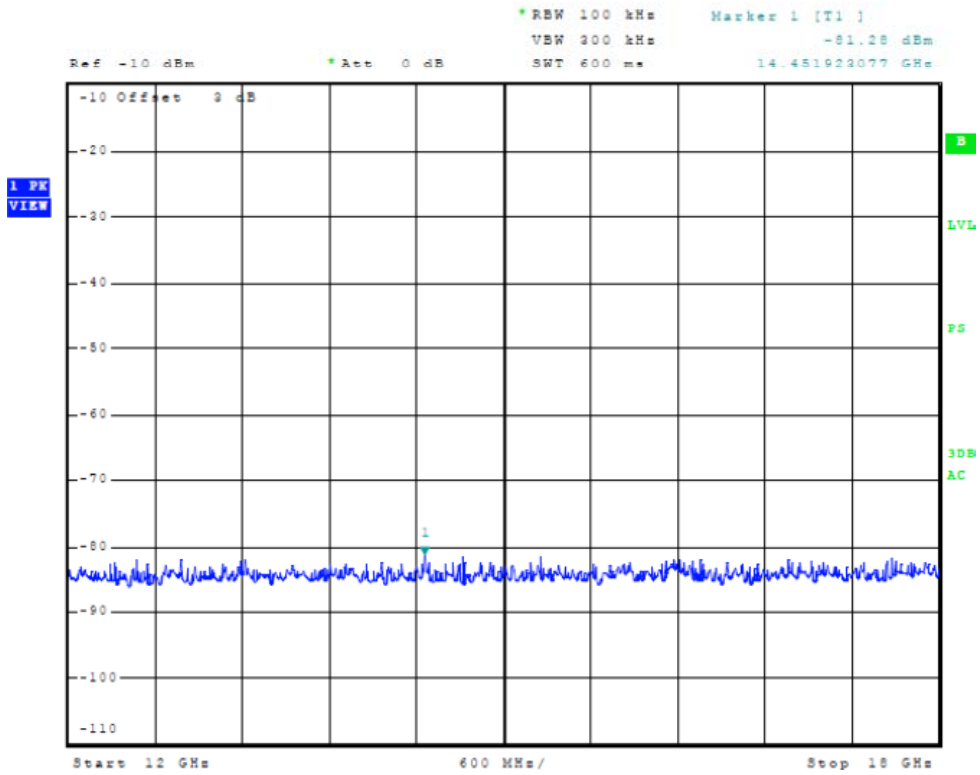


Figure 60 Plot of Receiver Antenna Port Conducted Emissions

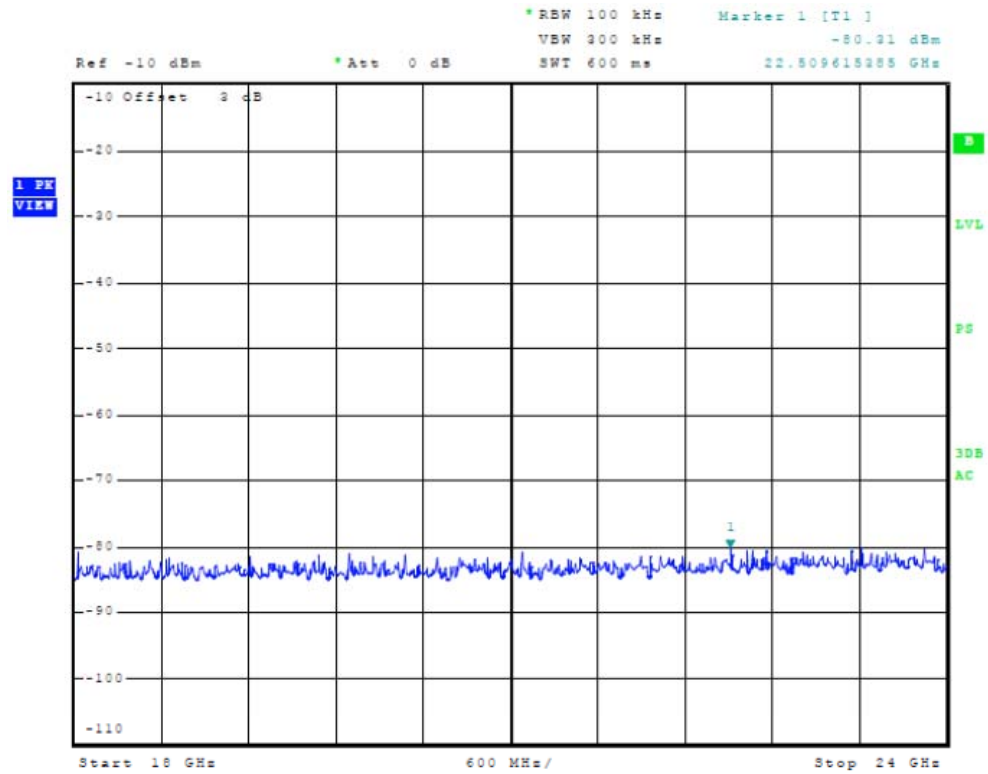


Figure 61 Plot of Receiver Antenna Port Conducted Emissions

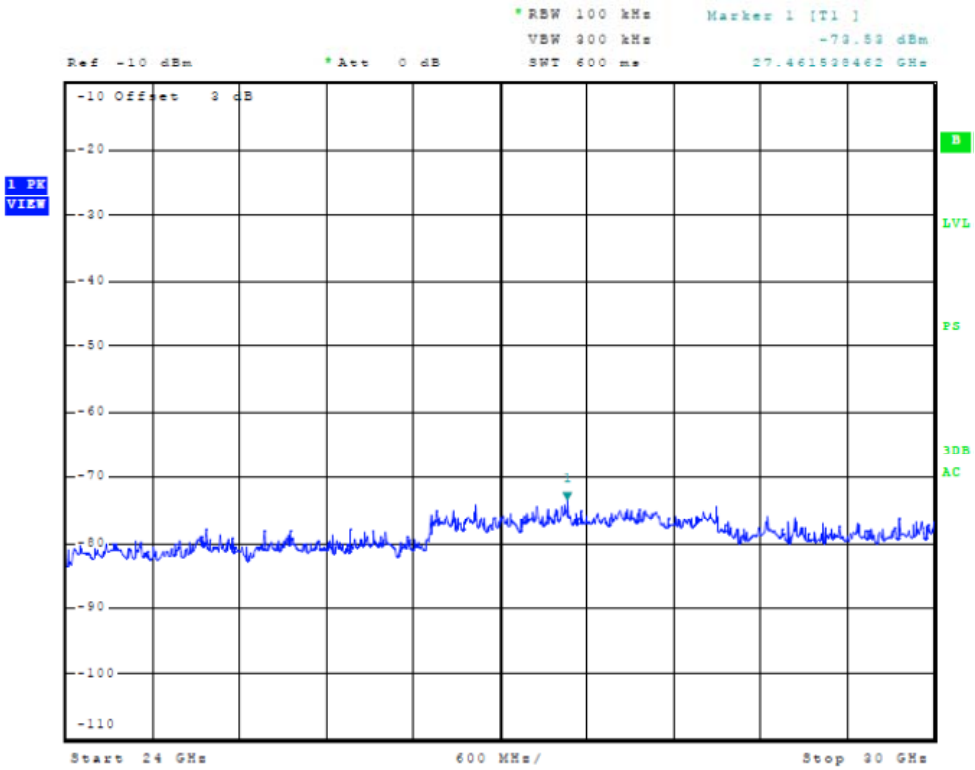


Figure 62 Plot of Receiver Antenna Port Conducted Emissions

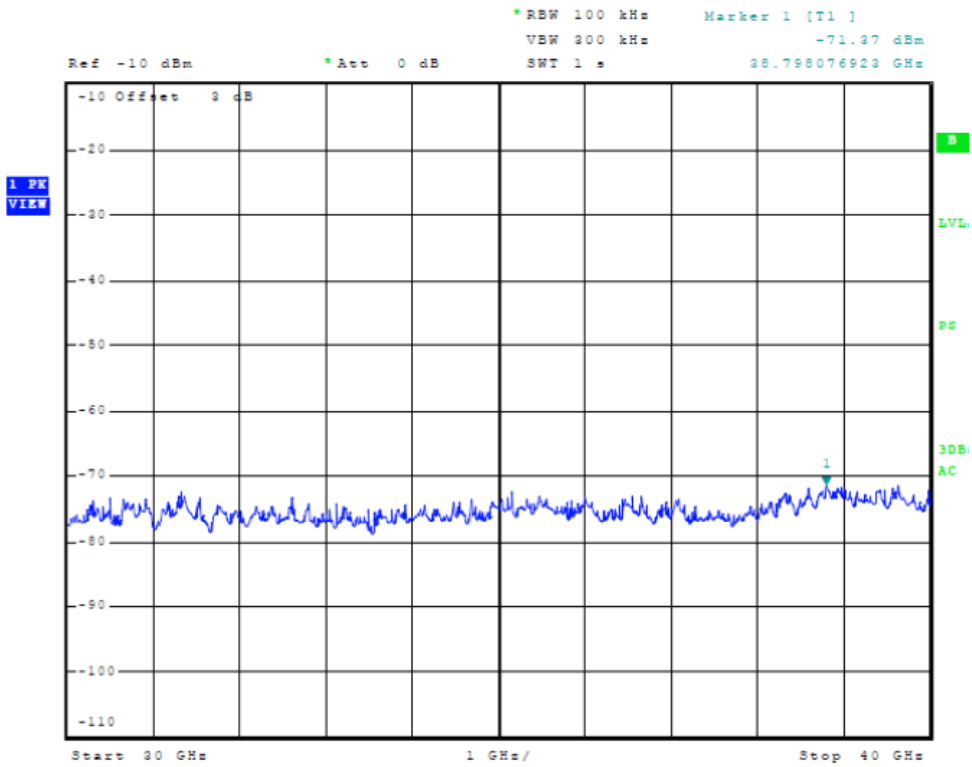


Figure 63 Plot of Receiver Antenna Port Conducted Emissions

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 sixty-four though seventy-two 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.

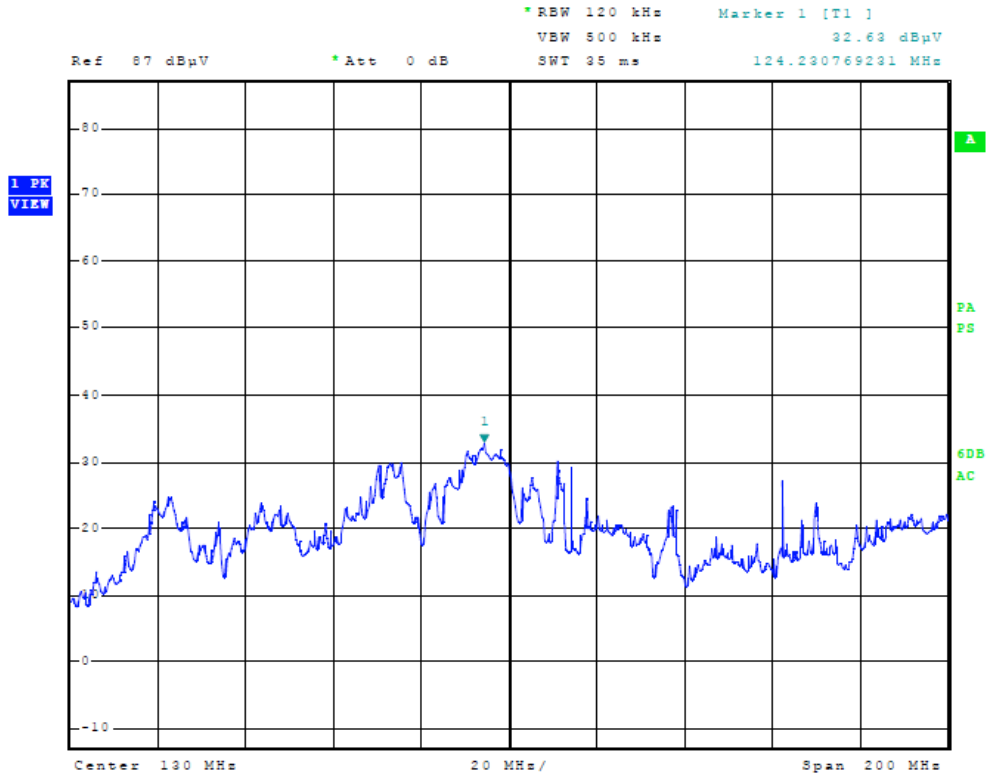


Figure 64 Plot of Receiver Radiated Spurious Emissions taken at 1 meter

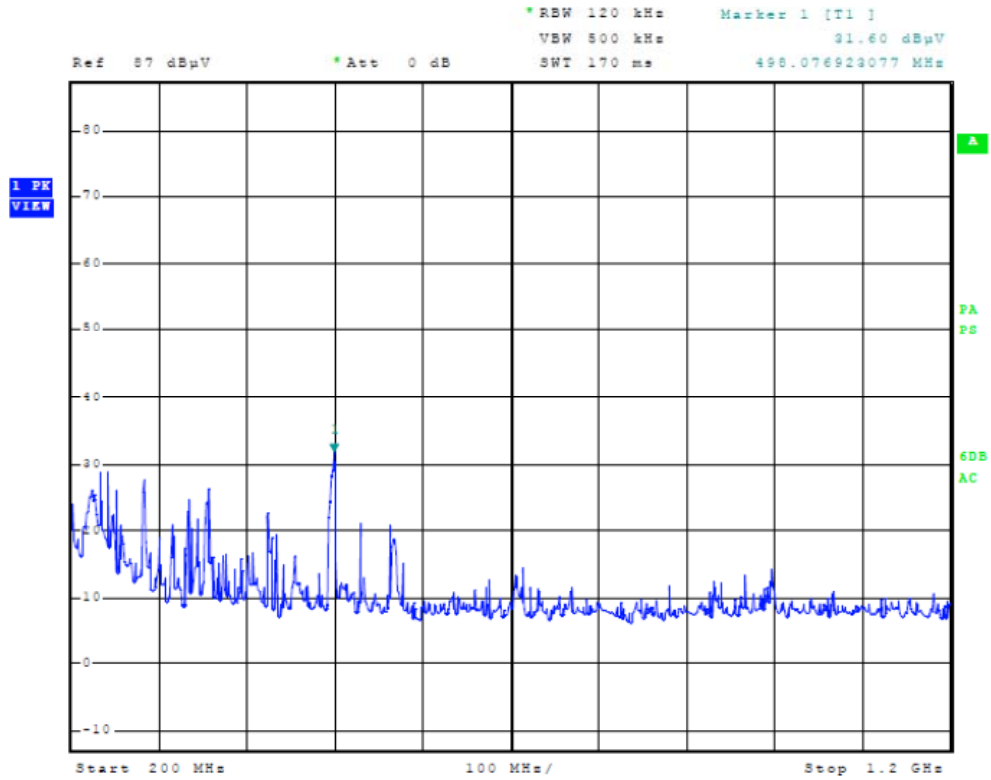


Figure 65 Plot of Receiver Radiated Spurious Emissions taken at 1 meter

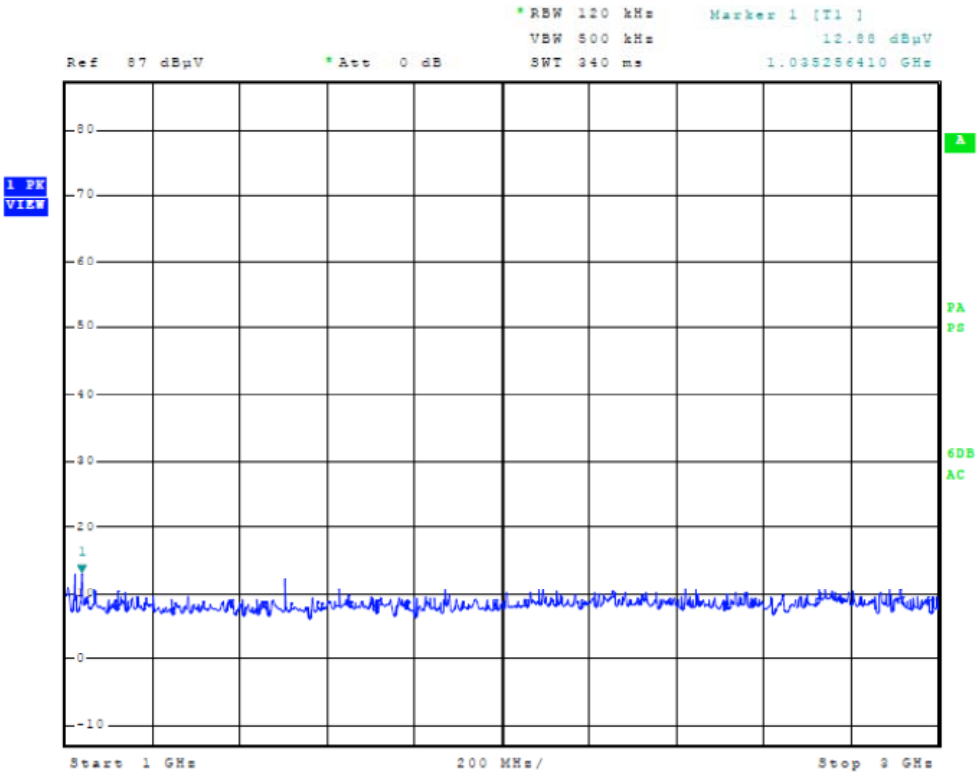


Figure 66 Plot of Receiver Radiated Spurious Emissions taken at 1 meter

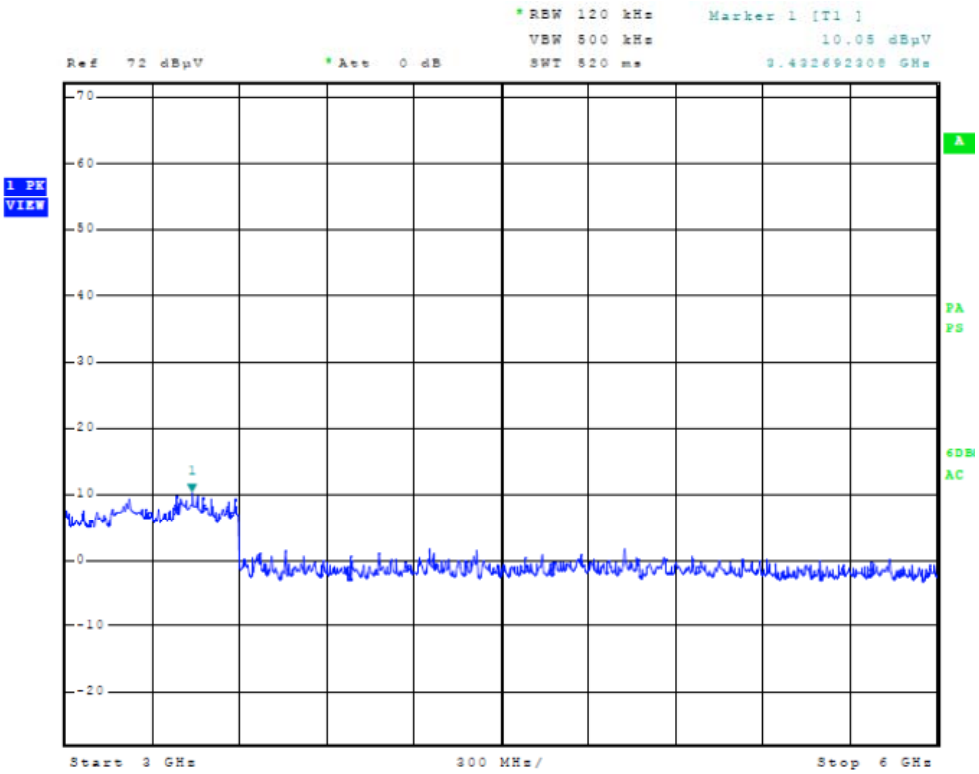


Figure 67 Plot of Receiver Radiated Spurious Emissions taken at 1 meter

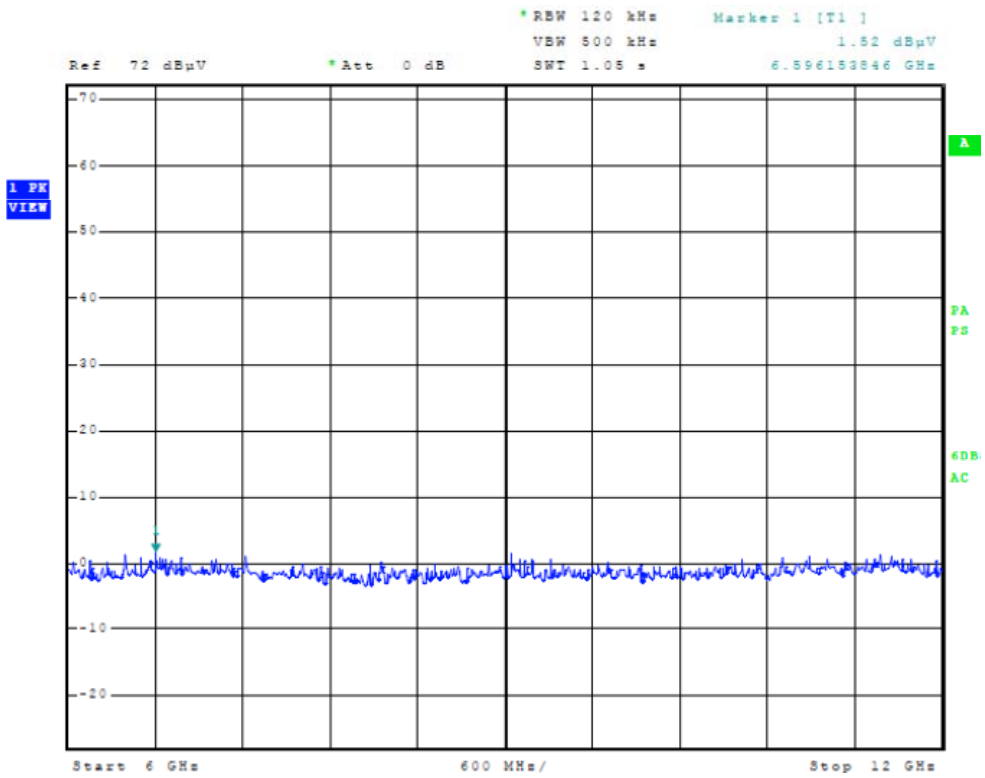


Figure 68 Plot of Receiver Radiated Spurious Emissions taken at 1 meter

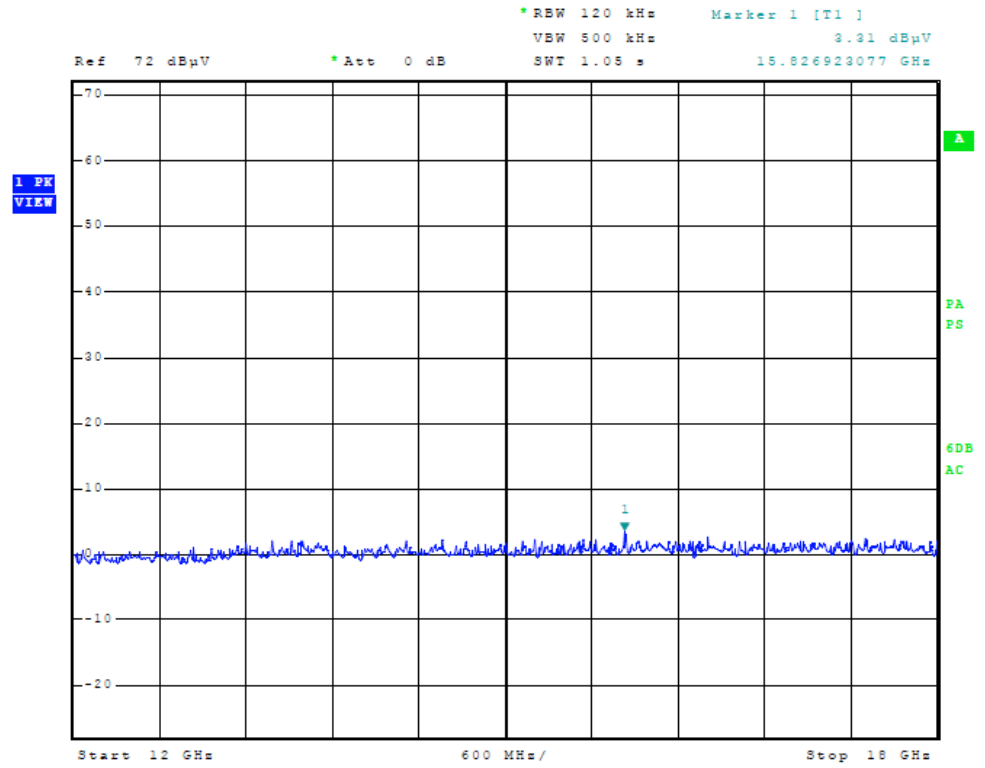


Figure 69 Plot of Receiver Radiated Spurious Emissions taken at 1 meter

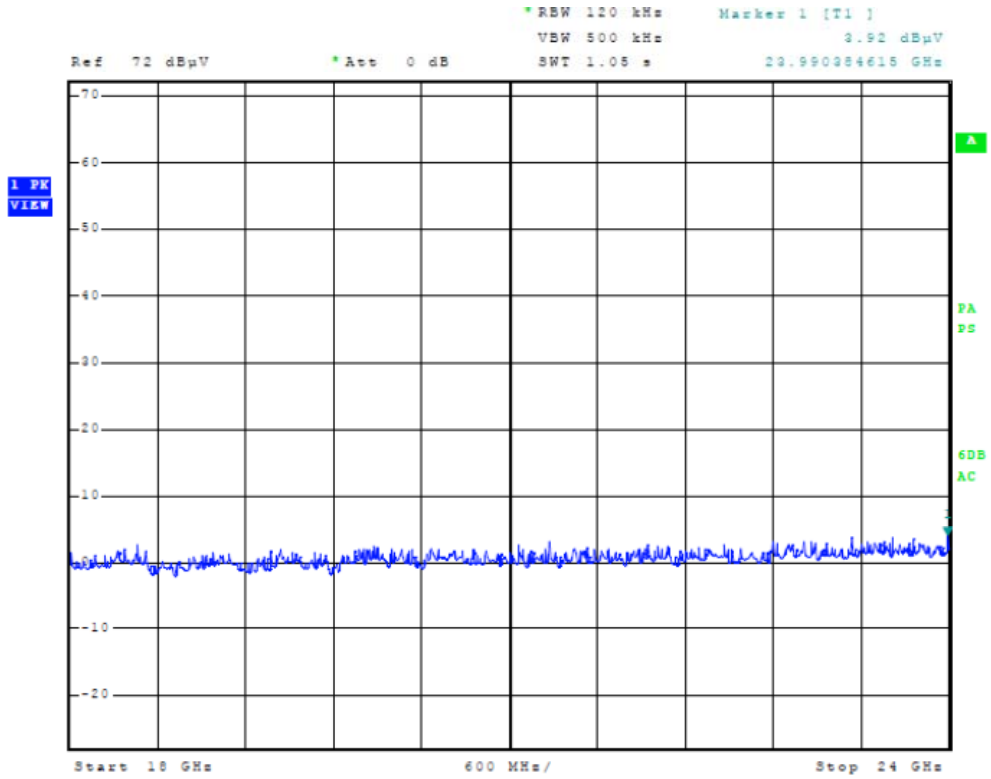


Figure 70 Plot of Receiver Radiated Spurious Emissions taken at 1 meter

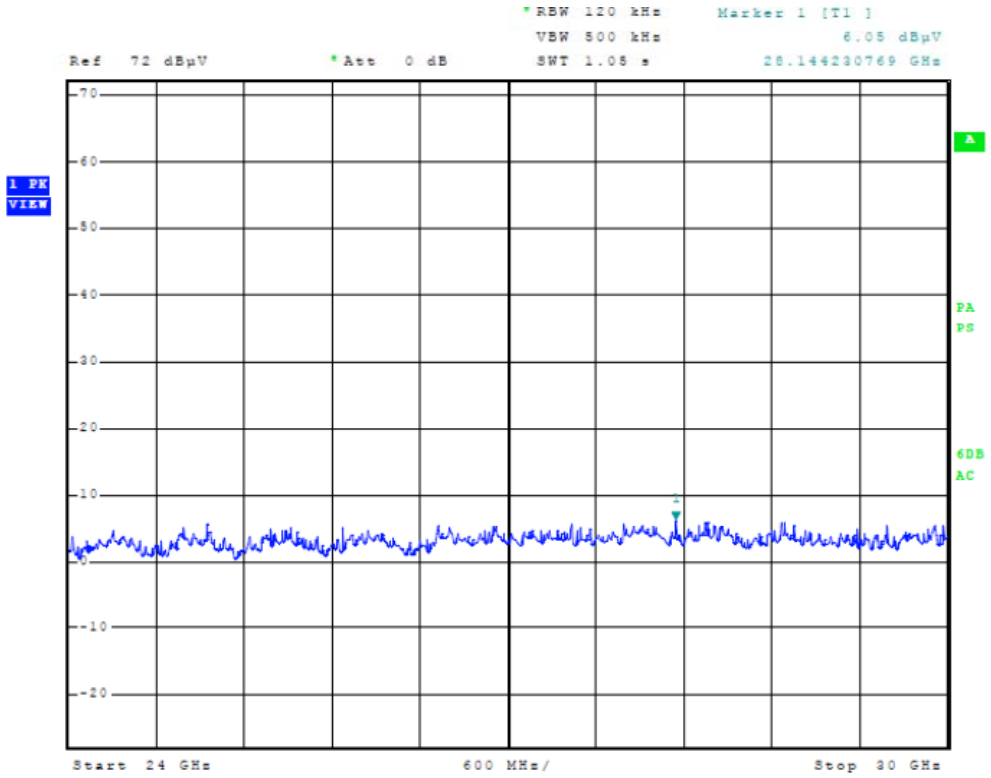


Figure 71 Plot of Receiver Radiated Spurious Emissions taken at 1 meter

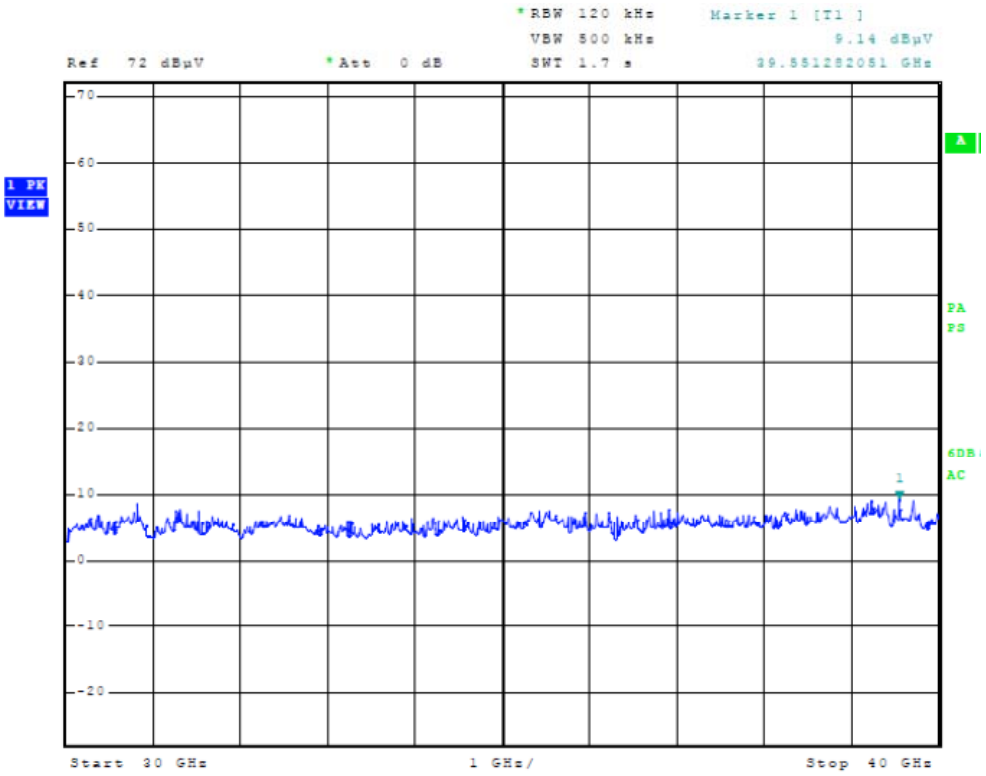


Figure 72 Plot of Receiver Radiated Spurious Emissions taken at 1 meter

Receiver Radiated Emissions Data

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
119.9	41.8	20.3	N/A	27.6	20.9	N/A	43.5
120.4	36.2	24.3	N/A	29.5	25.9	N/A	43.5
123.7	34.7	17.4	N/A	31.4	26.7	N/A	43.5
125.2	35.4	22.1	N/A	29.2	22.0	N/A	43.5
133.4	32.8	18.3	N/A	34.3	23.4	N/A	43.5
140.8	38.7	21.4	N/A	32.2	25.6	N/A	43.5
220.5	32.3	29.9	N/A	24.1	16.7	N/A	46.0
352.0	29.0	21.1	N/A	35.8	26.8	N/A	46.0
497.6	33.4	28.6	N/A	34.2	28.3	N/A	46.0

Other emissions present had amplitudes at least 20 dB below the limit.
Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz.
Average amplitude emissions are recorded above for frequency range above 1000 MHz.

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.

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 -16.1 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 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
Spectrum Analyzer: Rohde & Schwarz ESU40	5/11
Spectrum Analyzer: HP 8562A, HP Adapters: 11518, 11519, and 11520 Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W	5/11
Spectrum Analyzer: HP 8591EM	5/11
Antenna: EMCO Biconilog Model: 3143	5/11
Antenna: Sunol Biconilog Model: JB6	10/10
Antenna: EMCO Log Periodic Model: 3147	10/10
Antenna: Antenna Research Biconical Model: BCD 235	10/10
LISN: Compliance Design Model: FCC-LISN-2.Mod.cd, 50 µHy/50 ohm/0.1 µf	10/10
R.F. Preamp CPPA-102	10/10
Attenuator: HP Model: HP11509A	10/10
Attenuator: Mini Circuits Model: CAT-3	10/10
Attenuator: Mini Circuits Model: CAT-3	10/10
Cable: Belden RG-58 (L1)	10/10
Cable: Belden RG-58 (L2)	10/10
Cable: Belden 8268 (L3)	10/10
Cable: Time Microwave: 4M-750HF290-750	10/10
Cable: Time Microwave: 10M-750HF290-750	10/10
Frequency Counter: Leader LDC825	2/11
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
R.F. Generators: HP 606A, HP 8614A, HP 8640B	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. Power Amp A.R. Model: 10W 1010M7	2/11
R.F. Power Amp EIN Model: A301	2/11
LISN: Compliance Eng. Model 240/20	2/11
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08	2/11
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
Audio Oscillator: H.P. 201CD	2/11
Peavey Power Amp Model: IPS 801	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
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
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
Fax. No. (613) 990-4752