FCC PART 101

TEST AND MEASUREMENT REPORT

For

Lightpointe Communications, Inc.

11696 Sorento Valley Road, Ste. 101,

San Diego, CA 92121, USA

FCC ID: PHVAK80

Report Type:	**Product Type:**
Original Report	Point to Point Wireless Bridge

Prepared By:	Jin Yang Test Engineer
Report Number:	R1701262-101
Report Date:	2017-04-13
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1701262-101	Original report	2017-04-13

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of Lightpointe Communications, Inc., and their product FCC ID: PHVAK80, models: AireLink 80 which will henceforth be referred to as the EUT (Equipment Under Test). The EUT is a point-to-point wireless bridge operates in 71-76 GHz and 81-86 GHz.

1.2 Mechanical Description of EUT

The EUT measures approximately *22cm (L) x 22cm (W) x 11cm (H)*, and weighs approximately *5.4 k*g.

The External Antenna measures approximately *100cm (L) x 100cm (W) x 28cm (H)*, and weighs approximately *11 k*g.

The test data gathered are from typical production sample provided by Lightpointe Communications, Inc. Serial number R1701262-1 assigned by BACL Sunnyvale.

1.3 Objective

This report is prepared on behalf of *Lightpointe Communications, Inc.* in accordance with Part 2, Subpart J, and Part 101, Subpart Q of the Federal Communication Commissions rules.

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of Federal Regulations Title 47 Part 2, Sub-part J as well as the Following parts:

Part 101-Subpart Q Service and Technical Rules for the 70/80/90 GHz Bands

Applicable Standards: TIA603-D.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 or 1 meters.

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR16-4-2:2011, The Treatment of Uncertainty in EMC Measurements, the values ranging from ±2.0 dB for Conducted Emissions tests and ±4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

1.7 Test Facility Registrations

BACLs test facilities that are used to perform Radiated and Conducted Emissions tests are currently recognized by the Federal Communications Commission as Accredited with NIST Designation Number US1129.

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Industry Canada under Registration Numbers: 3062A-1, 3062A-2, and 3062A-3.

BACL is a Chinese Taipei Bureau of Standards Metrology and Inspection (BSMI) validated Conformity Assessment Body (CAB), under Appendix B, Phase I Procedures of the APEC Mutual Recognition Arrangement (MRA). BACL's BSMI Lab Code Number is: SL2-IN-E-1002R

BACL's test facilities that are used to perform AC Line Conducted Emissions, Telecommunications Line Conducted Emissions, Radiated Emissions from 30 MHz to 1 GHz, and Radiated Emissions from 1 GHz to 6 GHz are currently recognized as Accredited in accordance with the Voluntary Control Council for Interference [VCCI] Article 15 procedures under Registration Number A-0027.

1.8 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- ***An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2005 by A2LA (Test Laboratory Accreditation Certificate Number 3279.02),*** in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2005 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report..

BACL's ISO/IEC 17025:2005 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

B- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3279.03)*** to certify

- For the USA (Federal Communications Commission):
  - 1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
  - 2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
  - 3- All Telephone Terminal Equipment within FCC Scope C.
- For the Canada (Industry Canada):
  - 1 All Scope 1-Licence-Exempt Radio Frequency Devices;
  - 2 All Scope 2-Licensed Personal Mobile Radio Services;
  - 3 All Scope 3-Licensed General Mobile & Fixed Radio Services;
  - 4 All Scope 4-Licensed Maritime & Aviation Radio Services;
  - 5 All Scope 5-Licensed Fixed Microwave Radio Services
  - 6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.
- For Singapore (Info-Communications Development Authority (IDA)):
  - 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2
  - 2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2
- For the Hong Kong Special Administrative Region:
  - 1 All Radio Equipment, per KHCA 10XX-series Specifications;
  - 2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
  - 3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
  - 1 MIC Telecommunication Business Law (Terminal Equipment):
    - All Scope A1 - Terminal Equipment for the Purpose of Calls;
    - All Scope A2 - Other Terminal Equipment
  - 2 Radio Law (Radio Equipment):
    - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
    - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
    - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

C- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3279.01)*** to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:

1 Electronics and Office Equipment:
- for Telephony (ver. 3.0)
- for Audio/Video (ver. 3.0)
- for Battery Charging Systems (ver. 1.1)
- for Set-top Boxes & Cable Boxes (ver. 4.1)
- for Televisions (ver. 6.1)
- for Computers (ver. 6.0)
- for Displays (ver. 6.0)
- for Imaging Equipment (ver. 2.0)
- for Computer Servers (ver. 2.0)

2 Commercial Food Service Equipment
- for Commercial Dishwashers (ver. 2.0)
- for Commercial Ice Machines (ver. 2.0)
- for Commercial Ovens (ver. 2.1)

- for Commercial Refrigerators and Freezers

3 Lighting Products
- For Decorative Light Strings (ver. 1.5)
- For Luminaires (including sub-components) and Lamps (ver. 1.2)
- For Compact Fluorescent Lamps (CFLs) (ver. 4.3)
- For Integral LED Lamps (ver. 1.4)

4 Heating, Ventilation, and AC Products
- for Residential Ceiling Fans (ver. 3.0)
- for Residential Ventilating Fans (ver. 3.2)

5 Other
- For Water Coolers (ver. 3.0)

D- ***A NIST Designated Phase-I and Phase-II Conformity Assessment Body (CAB) for the following economies and regulatory authorities under the terms of the stated MRAs/Treaties:***

- Australia: ACMA (Australian Communication and Media Authority) – APEC Tel MRA -Phase I;
- Canada: (Industry Canada - IC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
  - BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - Radio & Teleterminal Equipment (R&TTE) Directive 1995/5/EC
    US -EU EMC & Telecom MRA CAB
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA)
  APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Development Authority - IDA) APEC Tel MRA -Phase I & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
  - ENERGY STAR Recognized Test Laboratory – US EPA
  - Telecommunications Certification Body (TCB) – US FCC;
- Vietnam: APEC Tel MRA -Phase I;

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to TIA/EIA-603 D.

2.2 EUT Exercise Software

N/A, EUT is operating at normal mode.

2.3 Special Equipment

N/A

2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment

Equipment Description	Manufacturer	Model
Laptop PC	HP	--

2.6 Antenna information

Manufacturer	Antenna Type	Integrated/External	Frequency Band	Gain (dBi)
Cassegrain	1’ Parabolic	External	71-86 GHz	45.0
Cassegrain	2’ Parabolic	External	71-86 GHz	51.0
Cassegrain	3’ Parabolic	External	71-86 GHz	54.0

2.7 External I/O Cabling List

Type of I/O Ports	Description	Length
Ethernet Port	RJ 45	<3 m
Data input	Fiber Cable	< 3 m

2.8 Power Supply List and Details

Manufacturer	Description	Model	Serial Number
Cincon Electronics Co., Ltd.	POE	TRG60A-POE-L	000022

2.9 Test configurations

This unit support 17 channels, please refers to the channel list below.

Channel	Frequency (GHz)	Channel number	Frequency (GHz)	Channel number	Frequency (GHz)
1	**71.5/81.5**	7	73/83	13	74.5/84.5
2	71.75/81.75	8	73.25/83.25	14	74.75/84.75
3	72/82	**9**	**73.5/83.5**	15	75/85
4	72.25/82.25	10	73.75/83.75	16	75.25/85.25
5	72.5/82.5	11	74/84	**17**	**75.5/85.5**
6	72.75/82.75	12	74.25/84.25	-	-

Channel 1, 9, 17 was picked for testing.

2.10 Test equipment list

Conducted Test

Asset #	Instrument	Manufacturer	Part #	Serial #	Calibration date	Calibration Interval
01	Spectrum Analyzer	R & S	FSV30	1321.3008K30-103400-bZ	03-21-2016	2 years
02	Harmonic Mixer	R & S	FS-Z75	100980	1-25-2016	1 year
03	Harmonic Mixer	R & S	FS-Z90	101607	8-5-2016	1 year
04	Waveguide Attenuator	Mi-Wave	521E-30/387 DC:1532	-	N/A	N/A
05	Waveguide Transition	Mi-Wave	692V-E/385/387	-	N/A	N/A
06	Spectrum Analyzer	Agilent	ESA-E E4407B	SG43330230	3-18-2016	1 year
07	Harmonic Mixer	Agilent	11970W	2521A01736	8-8-2016	1 year

Radiated Test

Manufacturer	Description	Model No.	Serial No.	Calibration date	Calibration Interval
OML	Diplexer for Agilent Spectrum Analyzer	DPL.26	N/A	2017-02-01	1 year
OML	WR-12 Harmonic Mixer with Horn Antenna	M12HWD	130529-1	2017-02-01	1 year
OML	WR19 Harmonic Mixer with Horn Antenna	M19HWD	U60313-1	2017-02-01	1 year
OML	WR08 Harmonic Mixer with Horn Antenna	M08HWD	F60313-1	2017-02-01	1 year
OML	G Band Harmonic Mixer with Horn Antenna	M05HWD	G60106-1	2017-02-01	1 year
Wisewave	Horn Antenna	ARH-4223-02	10555-02	2016-09-20	1 year
Wisewave	Horn Antenna	ARH-4223-02	10555-01	2016-09-20	1 year
Wisewave	Horn Antenna	ARH-2823-02	10555-01	2016-09-20	1 year
Wisewave	Horn Antenna	ARH-2823-02	10555-02	2016-09-20	1 year
Sunol Sciences	Horn Antenna	DRH-118	A052704	2016-03-09	1 year
A.R.A	Horn Antenna	DRG-118/A	1132	2016-09-21	1 year
Wisewave	Amplifier, Low Noise	ALN-33144030-01	11424-01	2016-05-16	1 year
Hewlett	Pre-Amplifier	8449B	3008A01978	2016-05-22	1 year
Hewlett & Packard	Amplifier, Pre	8447D	2944A10187	2016-03-08	1 year
Sunol Science	System Controller	SC99V	011003-1	N/R	1 year
Sunol Sciences	Antenna, Biconi-Log	JB3	A020106-2	2016-07-11	1 year
COM-POWER	Diploe antenna	AD-100	721033DB1, 721033dB2, 721033DB3, 721033dB4	2017-02-13	1 year
Agilent	Analyzer, Spectrum	E4446A	MY48250238	2016-10-22	1 year
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100044	2016-06-24	1 year

Statement of Traceability: BACL attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.

3 Summary of Test Results

Results reported relate only to the product tested.

FCC Rules	Description of Test	Results
§101.1525, §2.1091	RF Exposure	Compliant
§101.113, §2.1046	RF Output Power (EIRP)	Compliant
§101.141, §2.1047	Modulation Characteristics	N/A[1]
§101.109, §2.1049	Occupied Bandwidth	Compliant
§101.111, §2.1053	Field Strength of Spurious Radiation	Compliant
§101.111, §2.1051	Conducted Spurious Radiation	Compliant
§101.107, §2.1055	Frequency stability vs. temperature Frequency stability vs. voltage	Compliant[2]

Note 1: As per FCC §2.1047 (d) and FCC §101.141, there is no requirement for transmitters operating at 70 and 80 GHz

Note 2: As per FCC §101.107 (a) 8, Equipment authorized to be operated in the 71,000-76,000 MHz, 81,000-86,000 MHz, 92,000-94,000 MHz and 94,100-95,000 MHz bands is exempt from the frequency tolerance requirement noted in the table of paragraph (a) of this section.

4 FCC §101.1525 & §2.1091 - RF Exposure

4.1 Applicable Standard

According to FCC §1.1307 (b) (1) and §101.1525, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

According to §1.1310 and §2.1091 RF exposure is calculated.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	* (100)	30
1.34-30	824/f	2.19/f	* ($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

4.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

4.3 MPE Results

Note: 41 dBi antenna just for MPE calculation use only, no plan to use 41dBi antenna for this submission yet.

45 dBi antenna

Maximum peak output power at antenna input terminal (dBm):	13
Maximum peak output power at antenna input terminal (mW):	19.95
Prediction distance (cm):	225
Prediction frequency (MHz):	71500
Maximum Antenna Gain, typical (dBi):	45
Maximum Antenna Gain (numeric):	31622.78
Power density of prediction frequency at 225 cm (mW/cm^2):	0.9919
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

51 dBi antenna

Maximum peak output power at antenna input terminal (dBm):	13
Maximum peak output power at antenna input terminal (mW):	19.95
Prediction distance (cm):	448
Prediction frequency (MHz):	71500
Maximum Antenna Gain, typical (dBi):	51
Maximum Antenna Gain (numeric):	125892.5
Power density of prediction frequency at 448 cm (mW/cm^2):	0.9925
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

54 dBi antenna

Maximum peak output power at antenna input terminal (dBm):	13
Maximum peak output power at antenna input terminal (mW):	19.95
Prediction distance (cm):	632
Prediction frequency (MHz):	71500
Maximum Antenna Gain, typical (dBi):	54
Maximum Antenna Gain (numeric):	251188.6
Power density of prediction frequency at 632 cm (mW/cm^2):	0.9989
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

41 dBi antenna

Maximum peak output power at antenna input terminal (dBm):	13
Maximum peak output power at antenna input terminal (mW):	19.95
Prediction distance (cm):	142
Prediction frequency (MHz):	71500
Maximum Antenna Gain, typical (dBi):	41
Maximum Antenna Gain (numeric):	12589.25
Power density of prediction frequency at 142 cm (mW/cm^2):	0.986
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

45 dBi antenna

The worst power density level at **225** cm is 0.9918 mW/cm^2 antenna, which is below the uncontrolled exposure limit of 1.0 mW/cm^2.

51 dBi antenna

The worst power density level at **448** cm is 0.9959 mW/cm^2 antenna, which is below the uncontrolled exposure limit of 1.0 mW/cm^2.

54 dBi antenna

The worst power density level at **632** cm is 0.9985 mW/cm^2 antenna, which is below the uncontrolled exposure limit of 1.0 mW/cm^2.

41 dBi antenna

The worst power density level at **142** cm is 0.9913 mW/cm^2 antenna, which is below the uncontrolled exposure limit of 1.0 mW/cm^2.

5 FCC §2.1046 & §101.113 - RF Output Power

5.1 Applicable Standards

FCC §2.1046 and §101.113.

(a) On any authorized frequency, the average power delivered to an antenna in this service must be the minimum amount of power necessary to carry out the communications desired. Application of this principle includes, but is not to be limited to, requiring a licensee who replaces one or more of its antennas with larger antennas to reduce its antenna input power by an amount appropriate to compensate for the increased primary lobe gain of the replacement antenna(s). In no event shall the average equivalent isotropically radiated power (EIRP), as referenced to an isotropic radiator, exceed the values specified below. In cases of harmful interference, the Commission may, after notice and opportunity for hearing, order a change in the effective radiated power of this station. Further, the output power of a transmitter on any authorized frequency in this service may not exceed the following:

71 – 76 and 81 – 86 GHz = +55 dBW/EIRP

5.2 Test Procedure

Conducted:

The transmitter output was connected to spectrum analyzer and the Output Power was calculated on a modulated carrier.
Output Power was measured under ambient conditions, nominal voltage for the applicable frequency channels.

5.3 Test Environmental Conditions

Temperature:	17-23 °C
Relative Humidity:	31-57 %
ATM Pressure:	999-1012 mbar

The testing was performed by Andrey Kirillov on 2017-01-12 to 01-31.

5.4 Test Results

45 dBi Antenna

Frequency (GHz)	Conducted Output Power (dBm)	EIRP (dBm)	EIRP (dBW)	Limit (dBW)	Margin (dB)
71.5	11.44	56.44	26.44	55	-28.56
73.5	11.24	56.24	26.24	55	-28.76
75.5	11.3	56.3	26.3	55	-28.7
81.5	7.7	52.7	22.7	55	-32.3
83.5	9.08	54.08	24.08	55	-30.92
85.5	7.46	52.46	22.46	55	-32.54

51 dBi Antenna

Frequency (GHz)	Conducted Output Power (dBm)	EIRP (dBm)	EIRP (dBW)	Limit (dBW)	Margin (dB)
71.5	11.44	62.44	32.44	55	-22.56
73.5	11.24	62.24	32.24	55	-22.76
75.5	11.3	62.3	32.3	55	-22.7
81.5	7.7	58.7	28.7	55	-26.3
83.5	9.08	60.08	30.08	55	-24.92
85.5	7.46	58.46	28.46	55	-26.54

54 dBi Antenna

Frequency (GHz)	Conducted Output Power (dBm)	EIRP (dBm)	EIRP (dBW)	Limit (dBW)	Margin (dB)
71.5	11.44	65.44	35.44	55	-19.56
73.5	11.24	65.24	35.24	55	-19.76
75.5	11.3	65.3	35.3	55	-19.7
81.5	7.7	61.7	31.7	55	-23.3
83.5	9.08	63.08	33.08	55	-21.92
85.5	7.46	61.46	31.46	55	-23.54

6 FCC §2.1049 & §101.109 - Occupied Bandwidth

6.1 Applicable Standards

According to FCC §101.109, the maximum bandwidth which will be authorized per frequency assigned is set out in the table that follows

Frequency band (MHz)	Maximum Authorized Bandwidth
/	/
/	/
71,000 to 76,000	5000 MHz
81,000 to 86,000	5000 MHz
/	/

6.2 Test Procedure

The RF output of the transmitter was connected to the spectrum analyzer through sufficient attenuation.

The resolution bandwidth of the spectrum analyzer was set at 1 MHz and the 6 dB bandwidth was recorded.

6.3 Test Environmental Conditions

Temperature:	17-23 °C
Relative Humidity:	31-57 %
ATM Pressure:	999-1012 mbar

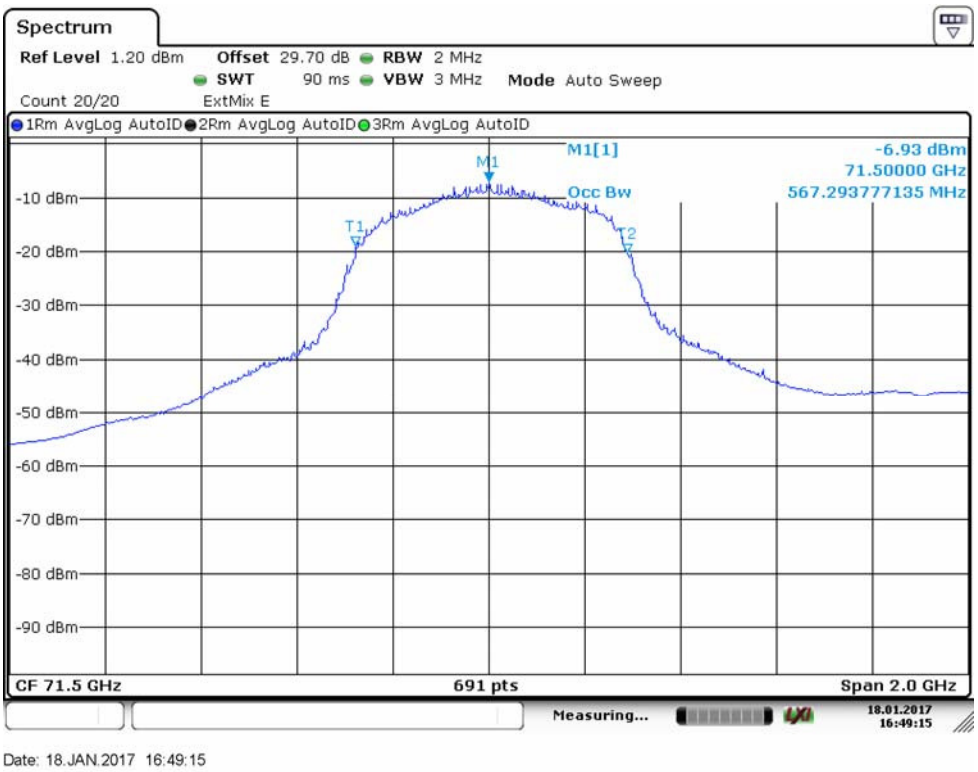
The testing was performed by Andrey Kirillov on 2017-01-12 to 01-31.

6.4 Test Results

Frequency (GHz)	Occupied Bandwidth (MHz)	Limit (MHz)	Result
70 GHz Band			
71.5	567.3	5000	Compliant
73.5	564.4	5000	Compliant
75.5	573.0	5000	Compliant
80 GHz Band			
81.5	561.5	5000	Compliant
83.5	581.7	5000	Compliant
85.5	558.6	5000	Compliant

Please refer to the following plots for more details.

CHANNEL FREQUENCY 71.5 GHz



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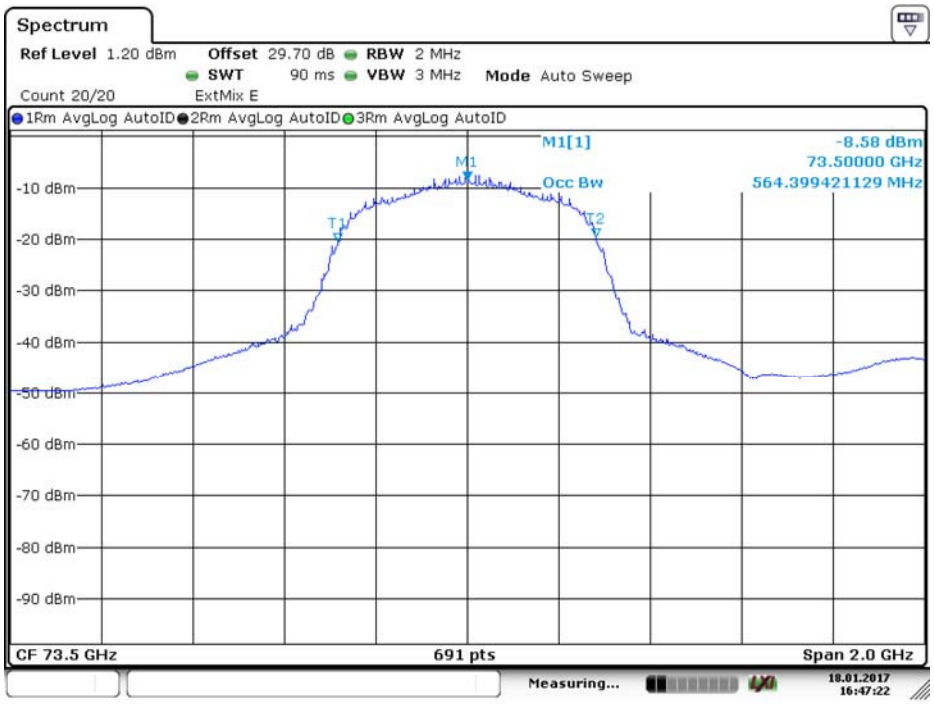
CHANNEL FREQUENCY 73.5 GHz



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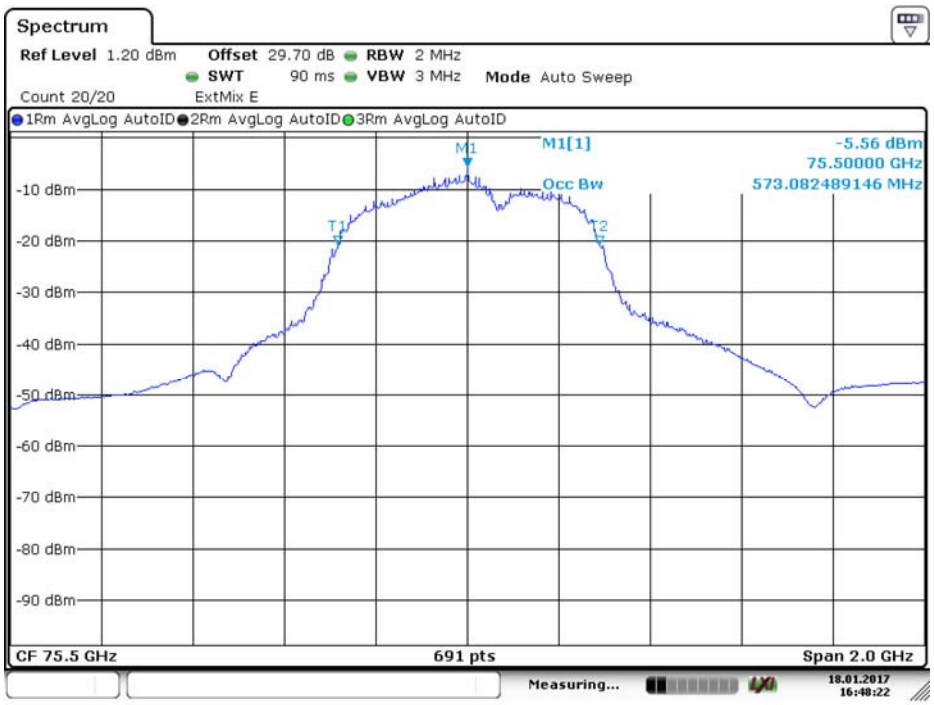
CHANNEL FREQUENCY 75.5 GHz



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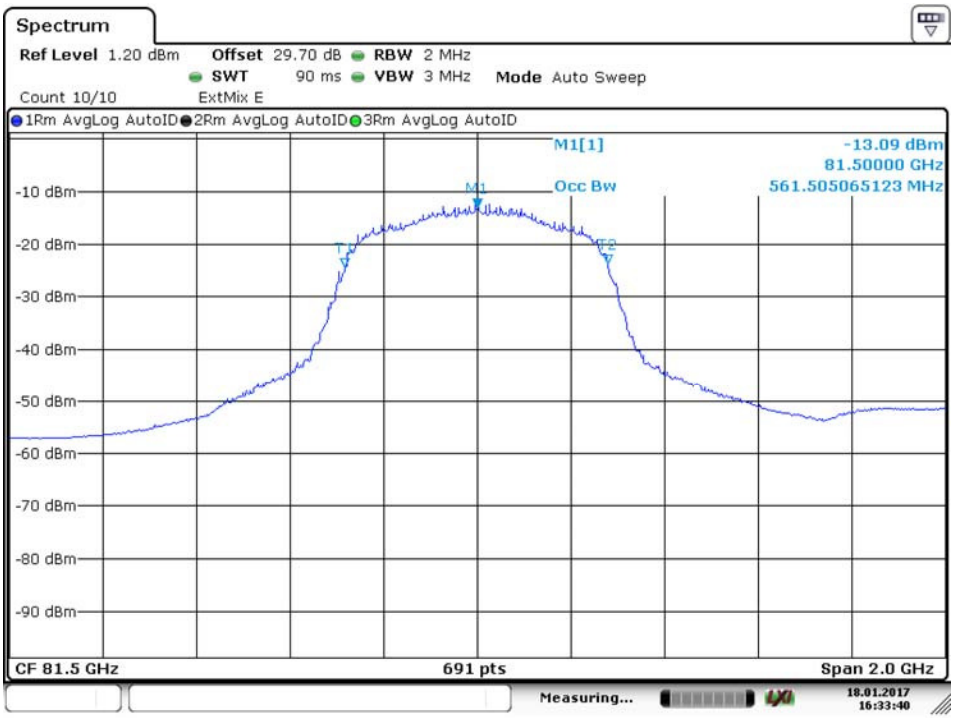
CHANNEL FREQUENCY 81.5 GHz



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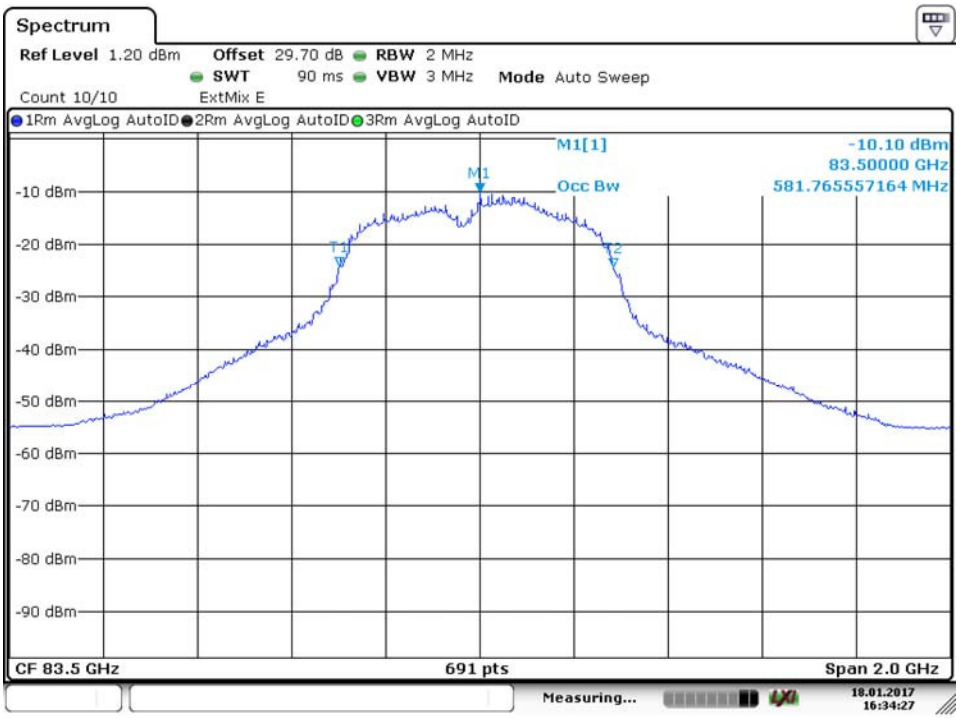
CHANNEL FREQUENCY 83.5 GHz



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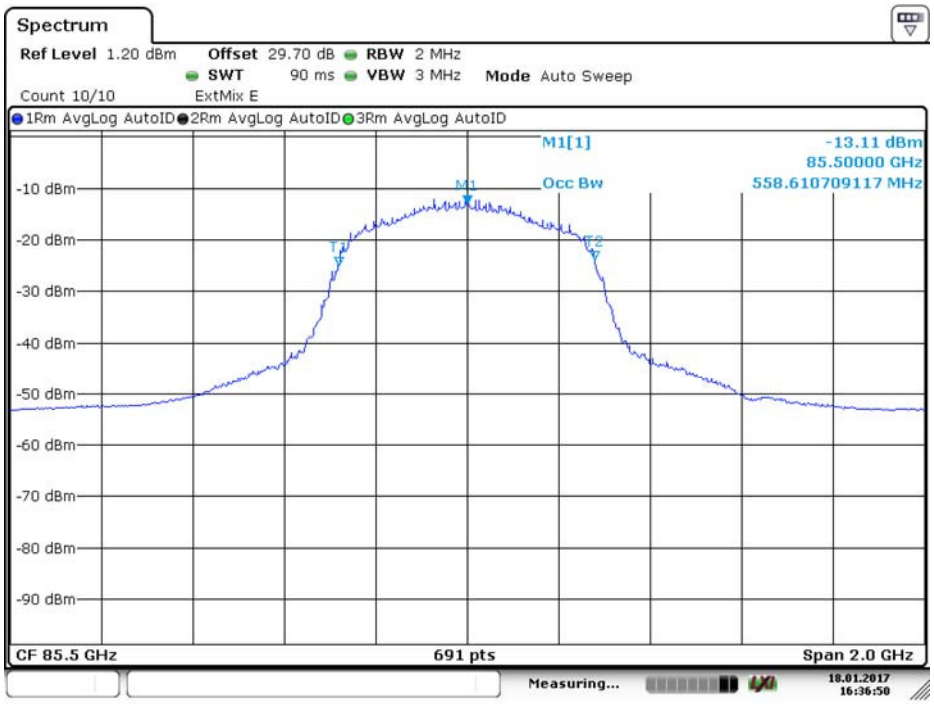
CHANNEL FREQUENCY 85.5 GHz



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7 FCC §2.1051 & §101.111 - Conducted Spurious Emission

7.1 Applicable Standards

According to ECFR §101.111

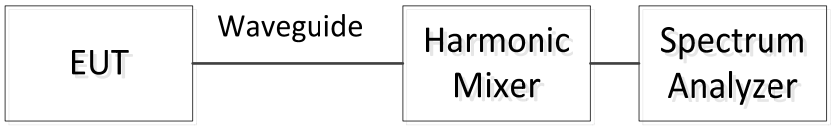
(ii) For operating frequencies above 15 GHz, in any 1 MHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 250 percent of the authorized bandwidth: As specified by the following equation but in no event less than 11 decibels:

A = 11 + 0.4(P−50) + 10 Log10 B.
(Attenuation greater than 56 decibels or to an absolute power of less than −13 dBm/1MHz is not required.)
(iii) In any 1 MHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 Log10 (the mean output power in watts) decibels, or 80 decibels, whichever is the lesser attenuation. The authorized bandwidth includes the nominal radio frequency bandwidth of an individual transmitter/modulator in block-assigned bands. Equipment licensed prior to April 1, 2005 shall only be required to meet this standard in any 4 kHz band.
(v) The emission mask for the 71-76 GHz, 81-86 GHz, 92-94 GHz, and 94.1-95 GHz bands used in the equation in paragraph (a)(2)(ii) of this section applies only to the edge of each channel, but not to sub-channels established by licensees. The value of P in the equation is for the percentage removed from the carrier frequency and assumes that the carrier frequency is the center of the actual bandwidth used. The value of B will always be 500 MHz. In the case where a narrower sub-channel is used within the assigned bandwidth, such sub-carrier will be located sufficiently far from the channel edges to satisfy the emission levels of the mask. The mean output power used in the calculation is the sum of the output power of a fully populated channel.

7.2 Test Procedure

The transmitter output was connected to a spectrum analyzer and the Occupied Bandwidth was measured with a modulated carrier.
Spectrum mask was measured under ambient conditions, nominal voltage for all modulations on the low, mid and high frequency channels of operation. The spectrum analyzer was set for a 1 MHz RBW and 3 MHz VBW which was based on spectrum bandwidth.

To position the mask relative to the output spectrum the EUT was initially set to transmit a CW (single) tone at the frequency of interest. The mask was then lined up with the peak of the CW tone. The EUT then was then set to modulate each modulation of interest and measurements reported.



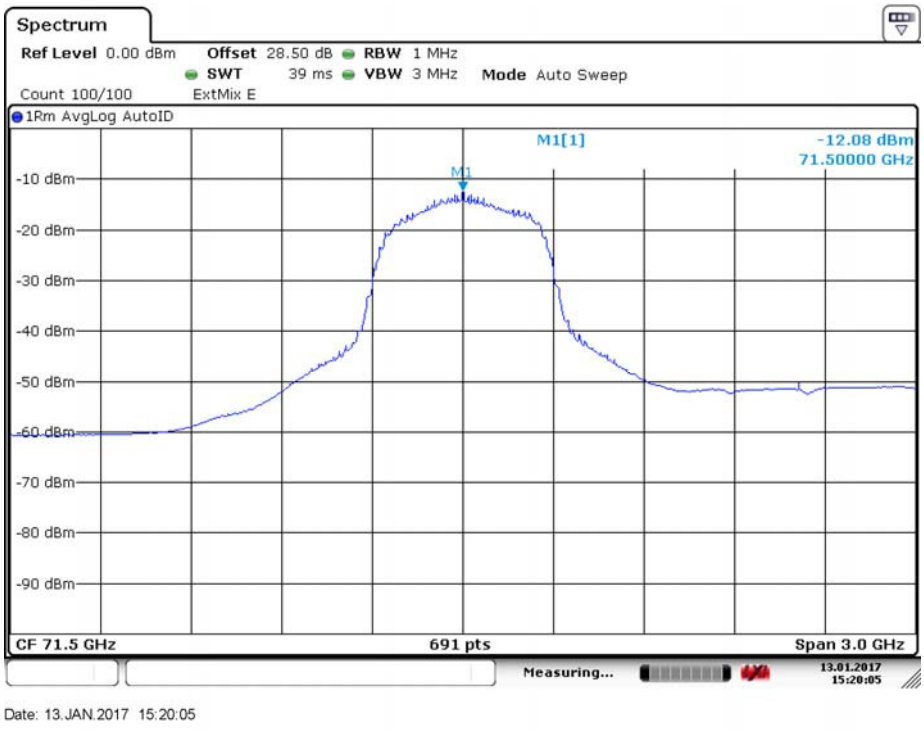
7.3 Test Environmental Conditions

Temperature:	17-23 °C
Relative Humidity:	31-57 %
ATM Pressure:	999-1012 mbar

The testing was performed by Andrey Kirillov on 2017-01-12 to 01-31.

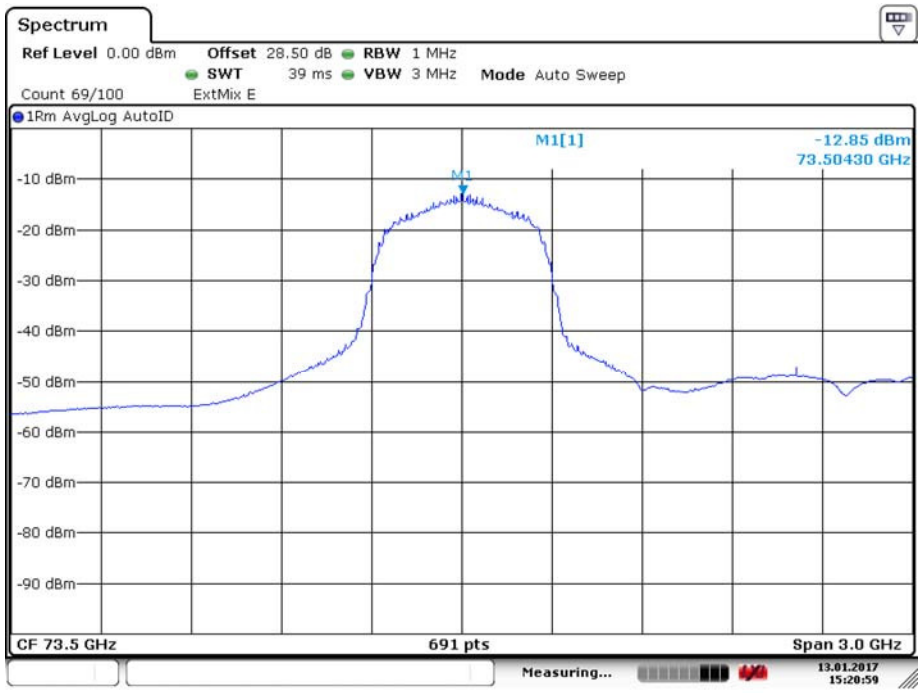
7.4 Test Results

CHANNEL FREQUENCY 71.5 GHz



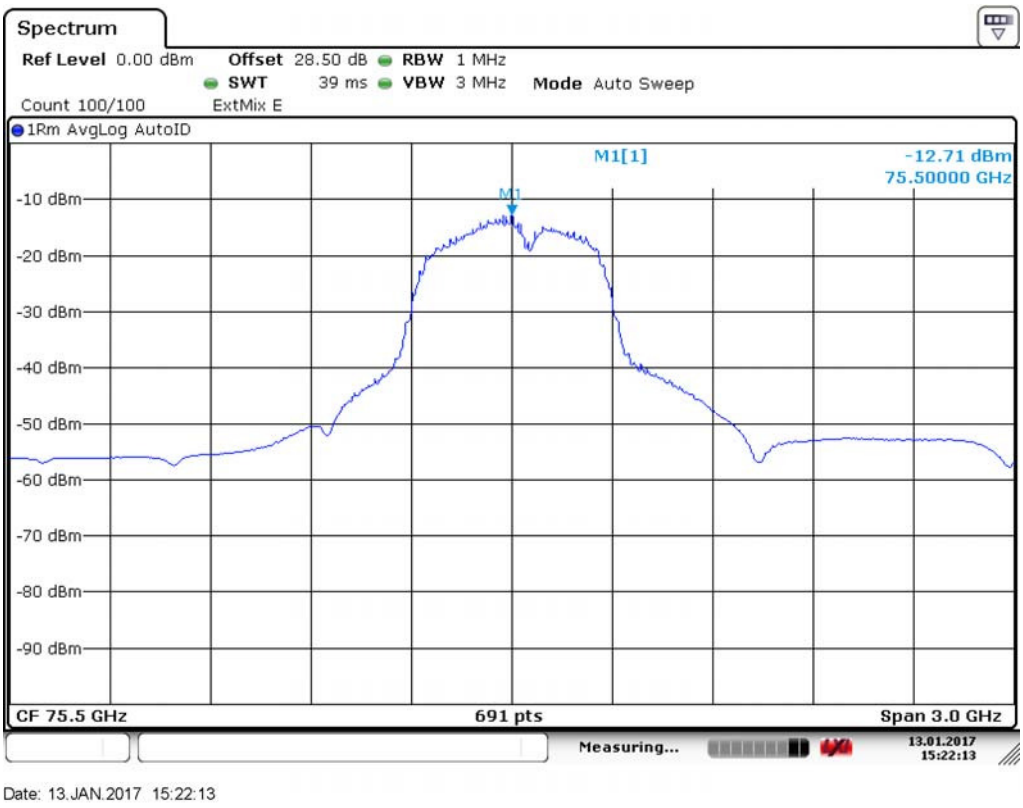
Emission Bandwidth (B) = 567.3 MHz
Limit at 50% Bandwidth = Power – Attenuation = 11.44 dBm – 37.9 dB attenuation = -26.5 dBm
Limit cannot be less than -13 dBm at 50% Bandwidth (283.65 MHz) = -13 dBm
Limit > 50% bandwidth = -13 dBm
Equipment complies with the emission mask criteria

CHANNEL FREQUENCY 73.5 GHz



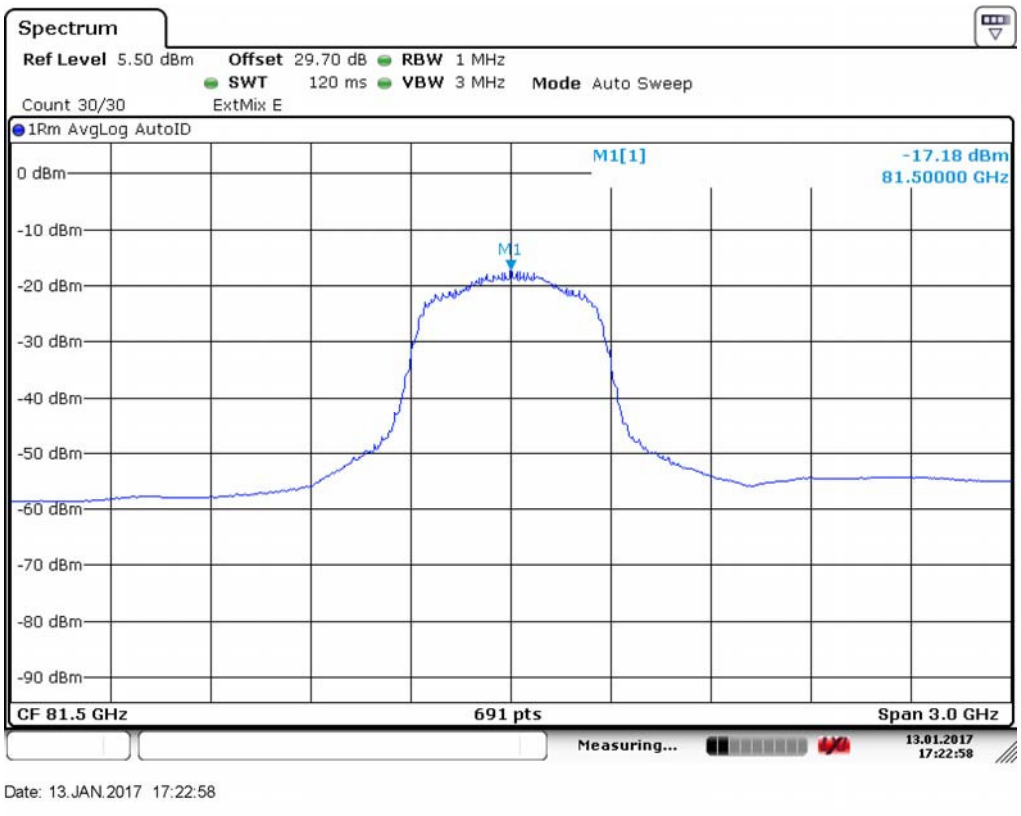
Emission Bandwidth (B) = 564.4 MHz
Limit at 50% Bandwidth = Power – Attenuation = 11.24 dBm – 37.9 dB attenuation = -26.7 dBm
Limit cannot be less than -13 dBm at 50% Bandwidth (282.2 MHz) = -13 dBm
Limit > 50% bandwidth = -13 dBm
Equipment complies with the emission mask criteria

CHANNEL FREQUENCY 75.5 GHz



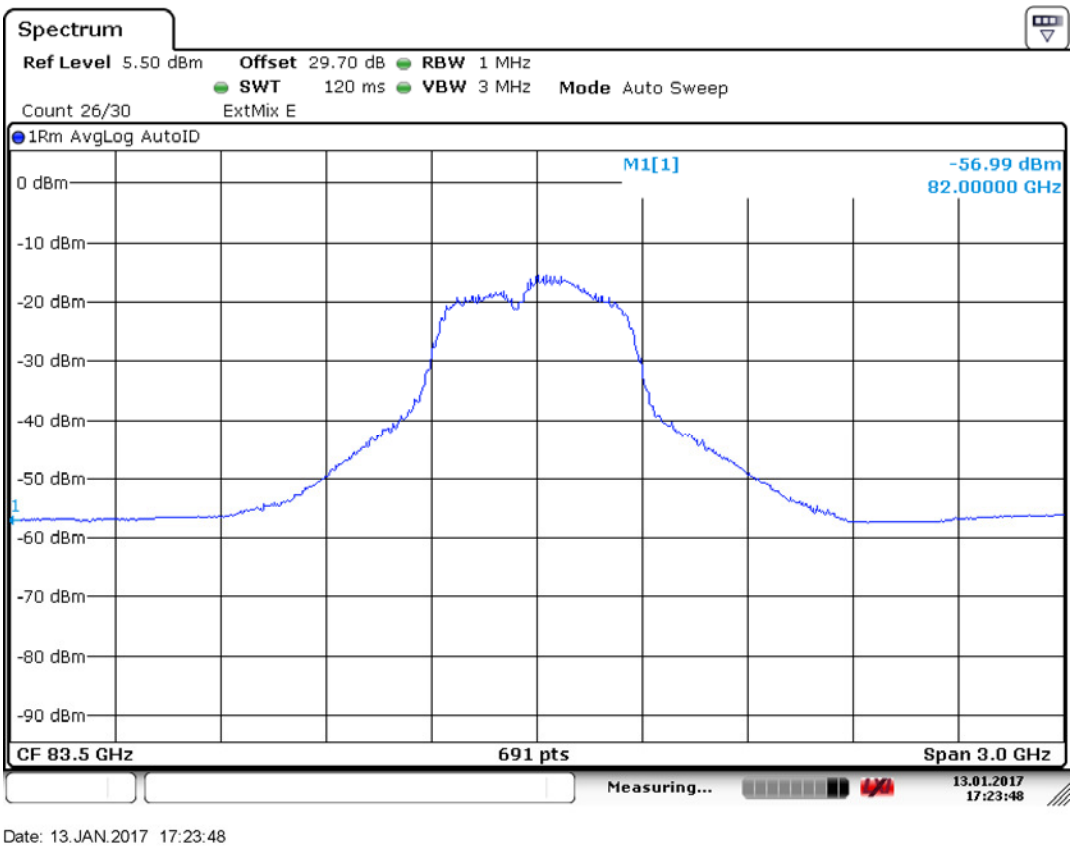
Emission Bandwidth (B) = 573 MHz
Limit at 50% Bandwidth = Power – Attenuation = 11.3 dBm – 37.9 dB attenuation = -26.6 dBm
Limit cannot be less than -13 dBm at 50% Bandwidth (286.5 MHz) = -13 dBm
Limit > 50% bandwidth = -13 dBm
Equipment complies with the emission mask criteria

CHANNEL FREQUENCY 81.5 GHz



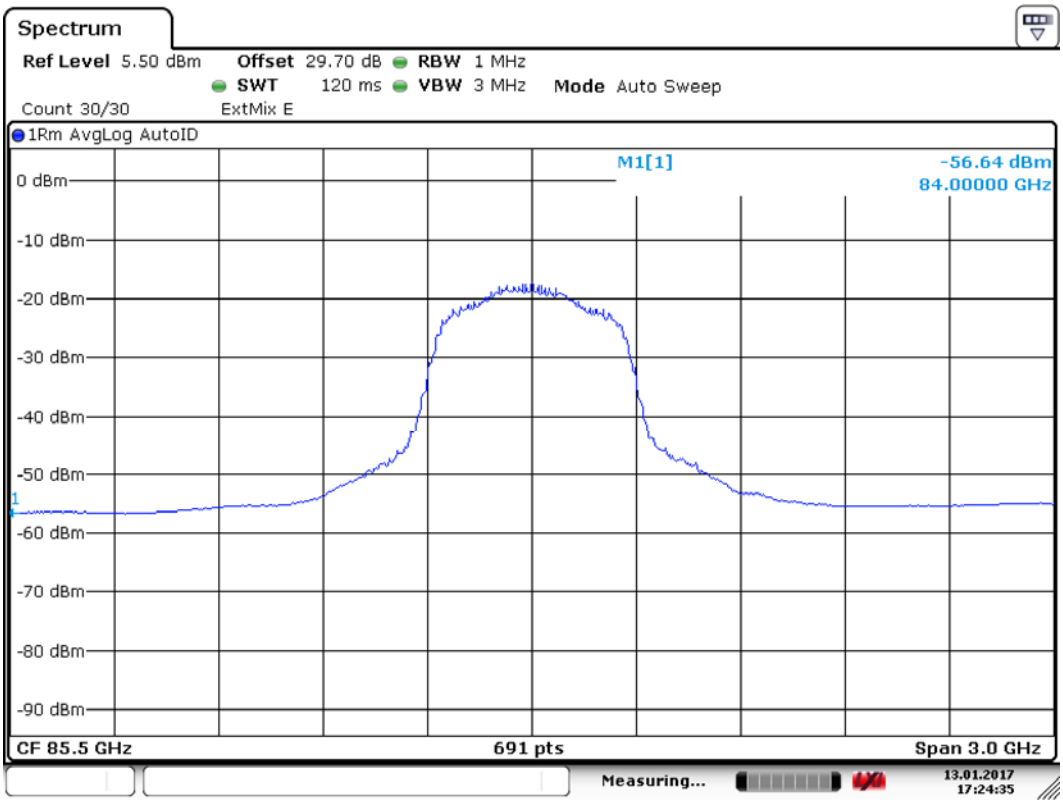
Emission Bandwidth (B) = 561.5 MHz
Limit at 50% Bandwidth = Power – Attenuation = 7.7 dBm – 37.9 dB attenuation = -30.2 dBm
Limit cannot be less than -13 dBm at 50% Bandwidth (280.75 MHz) = -13 dBm
Limit > 50% bandwidth = -13 dBm
Equipment complies with the emission mask criteria

CHANNEL FREQUENCY 83.5 GHz



Emission Bandwidth (B) = 581.7 MHz
Limit at 50% Bandwidth = Power – Attenuation = 9.08 dBm – 37.9 dB attenuation = -28.9 dBm
Limit cannot be less than -13 dBm at 50% Bandwidth (290.85 MHz) = -13 dBm
Limit > 50% bandwidth = -13 dBm
Equipment complies with the emission mask criteria

CHANNEL FREQUENCY 85.5 GHz

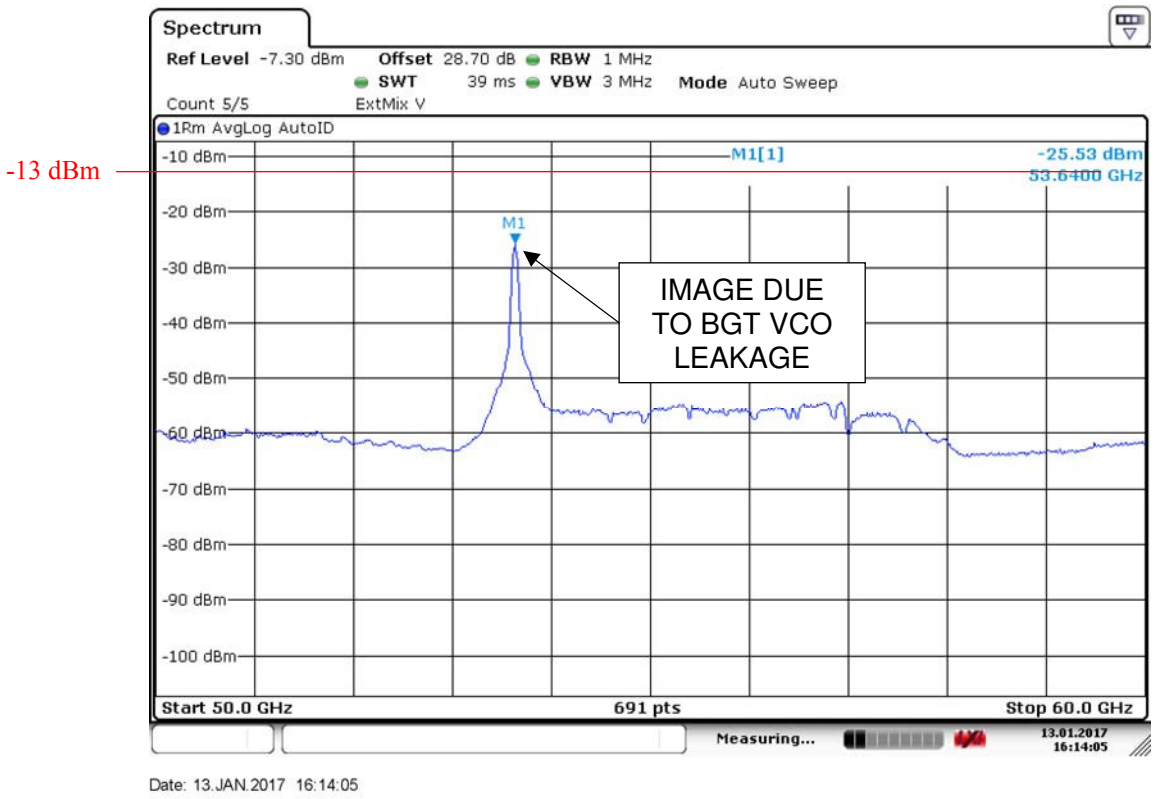


Date: 13.JAN.2017 17:24:35

Emission Bandwidth (B) = 558.6 MHz
Limit at 50% Bandwidth = Power – Attenuation = 7.46 dBm – 37.9 dB attenuation = -30.5 dBm
Limit cannot be less than -13 dBm at 50% Bandwidth (279.3 MHz) = -13 dBm
Limit > 50% bandwidth = -13 dBm
Equipment complies with the emission mask criteria

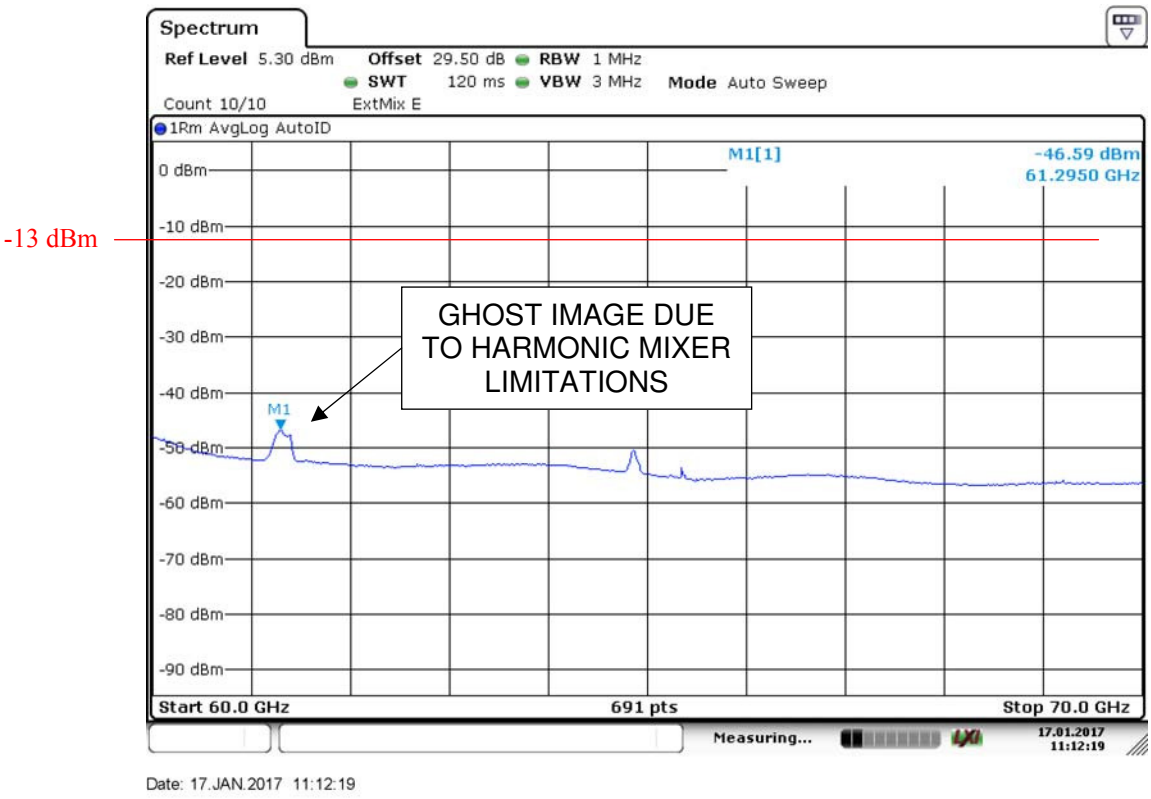
Note: Emissions from 30 MHz- 50 GHz are covered by radiated results.

Conducted Spurious Emissions 50 - 60 GHz Channel 71.5 GHz



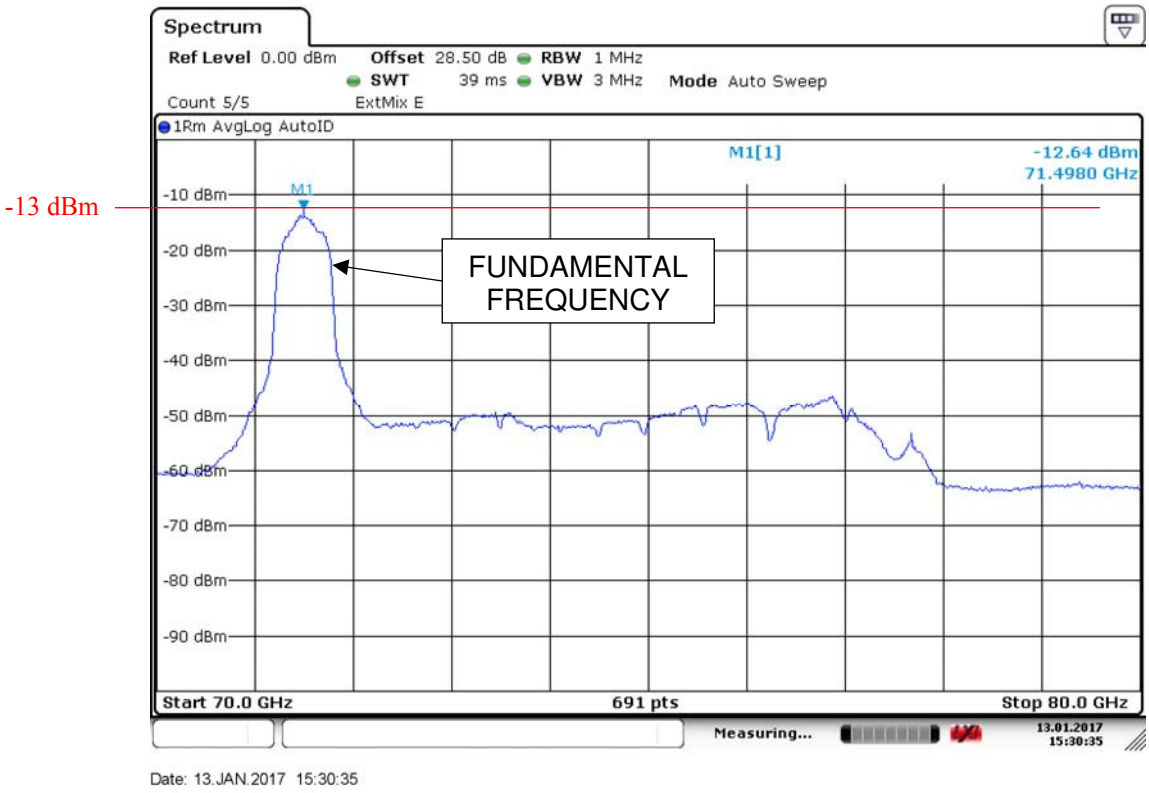
Harmonic Mixer (50 - 75 GHz)

Conducted Spurious Emissions 60 - 70 GHz Channel 71.5 GHz



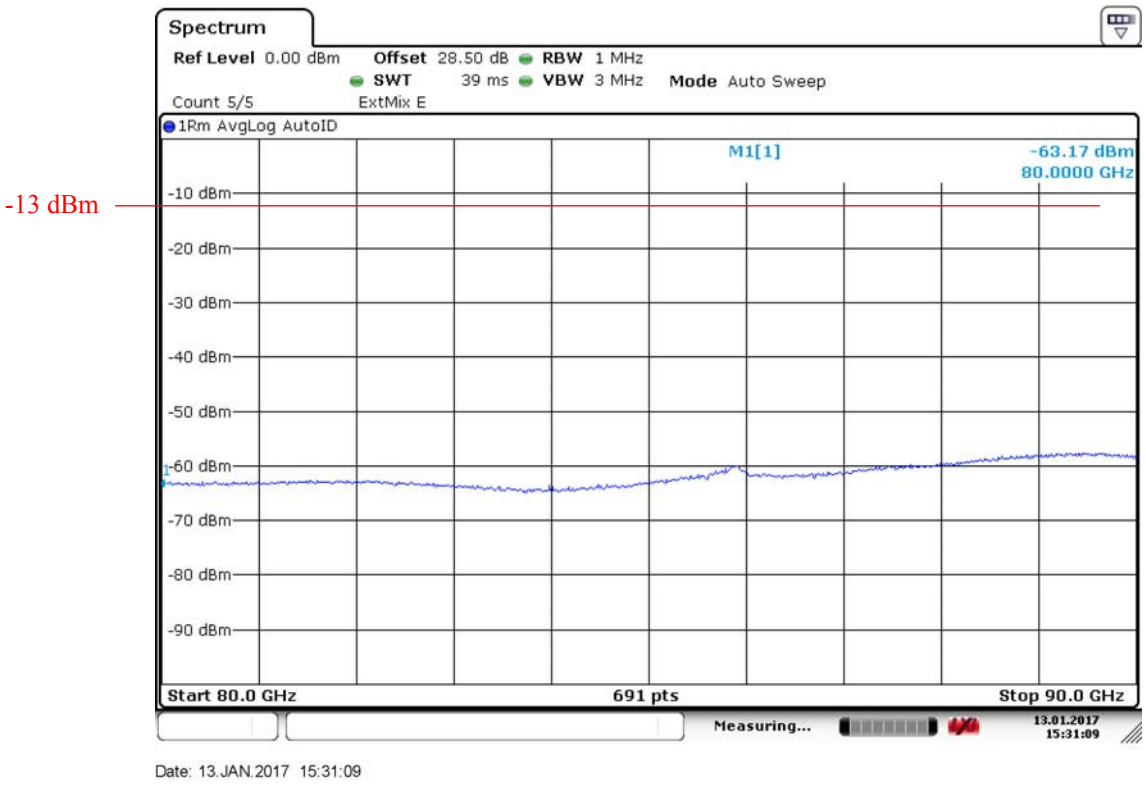
Harmonic Mixer (60 - 90 GHz)

Conducted Spurious Emissions 70 - 80 GHz Channel 71.5 GHz



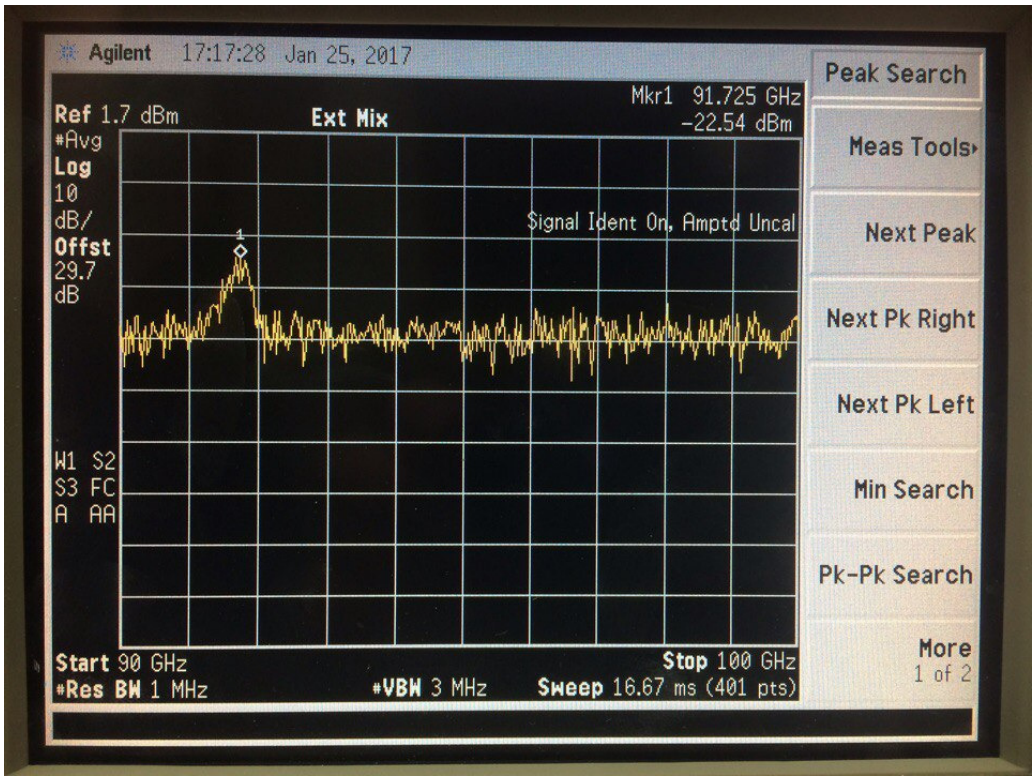
Harmonic Mixer (60 - 90 GHz)

Conducted Spurious Emissions 80 - 90 GHz Channel 71.5 GHz



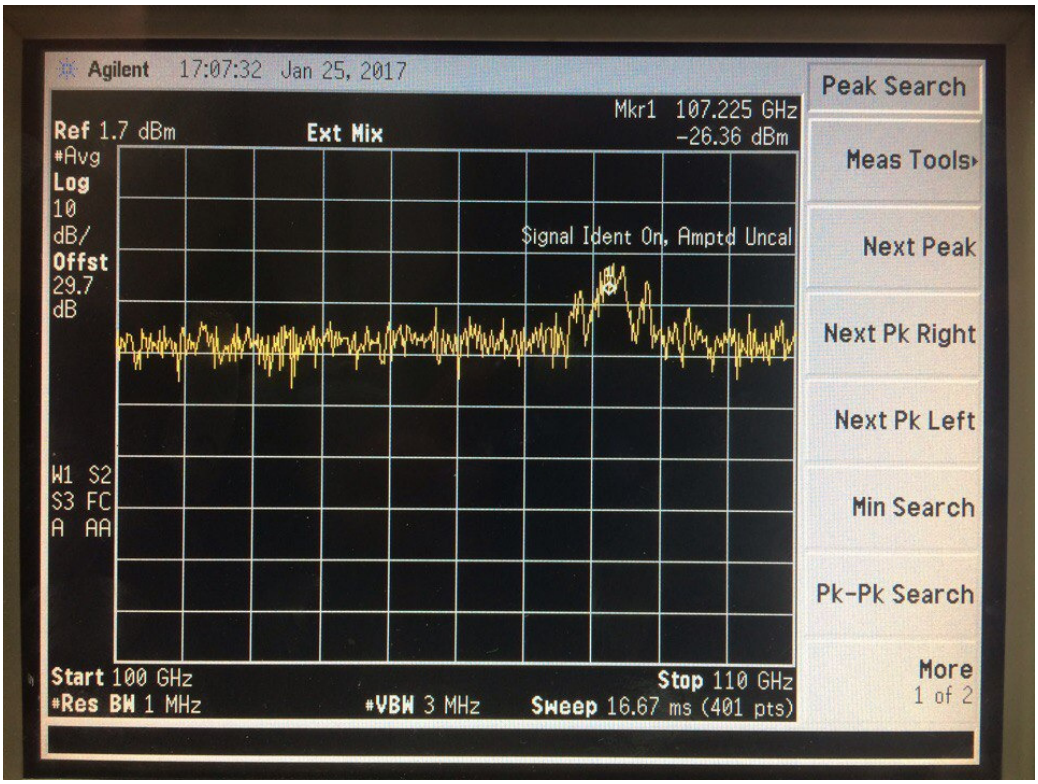
Harmonic Mixer (60 - 90 GHz)

Conducted Spurious Emissions 90 - 100 GHz Channel 71.5 GHz



Harmonic Mixer (75 - 110 GHz)

Conducted Spurious Emissions 100 - 110 GHz Channel 71.5 GHz

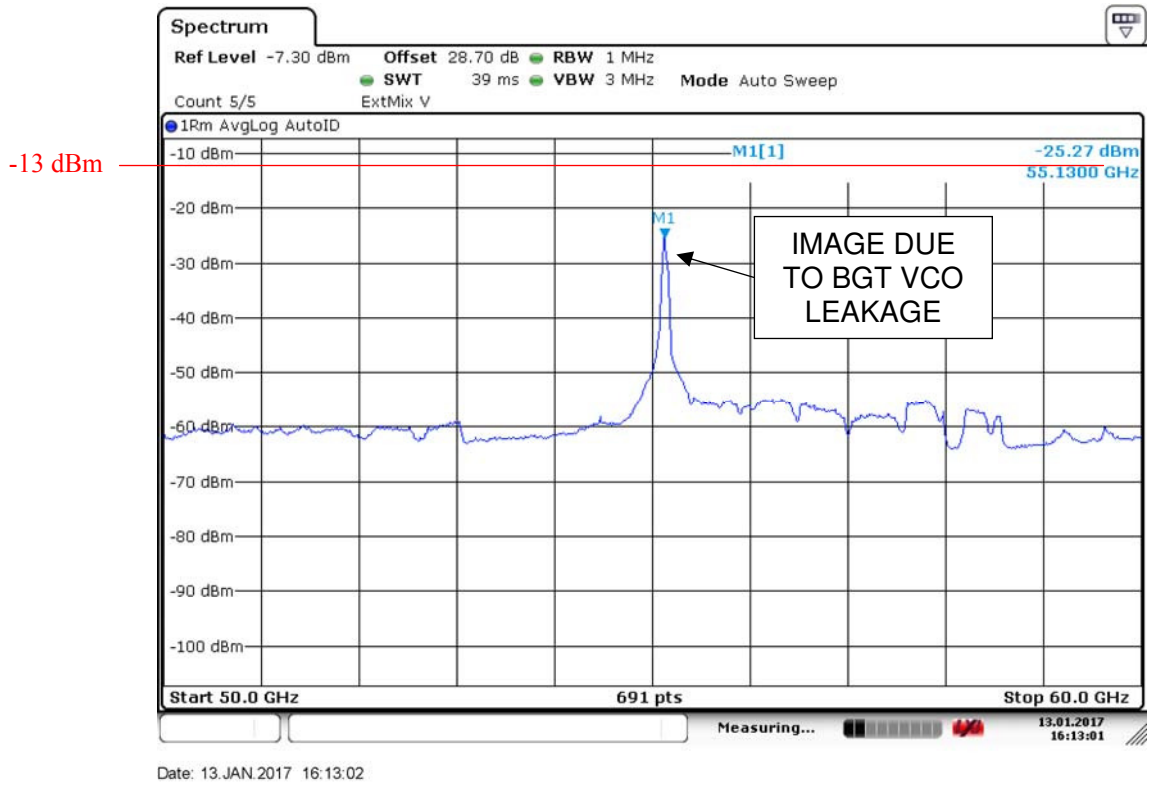


Harmonic Mixer (75 - 110 GHz)

Note: only noise floor found above 110 GHz

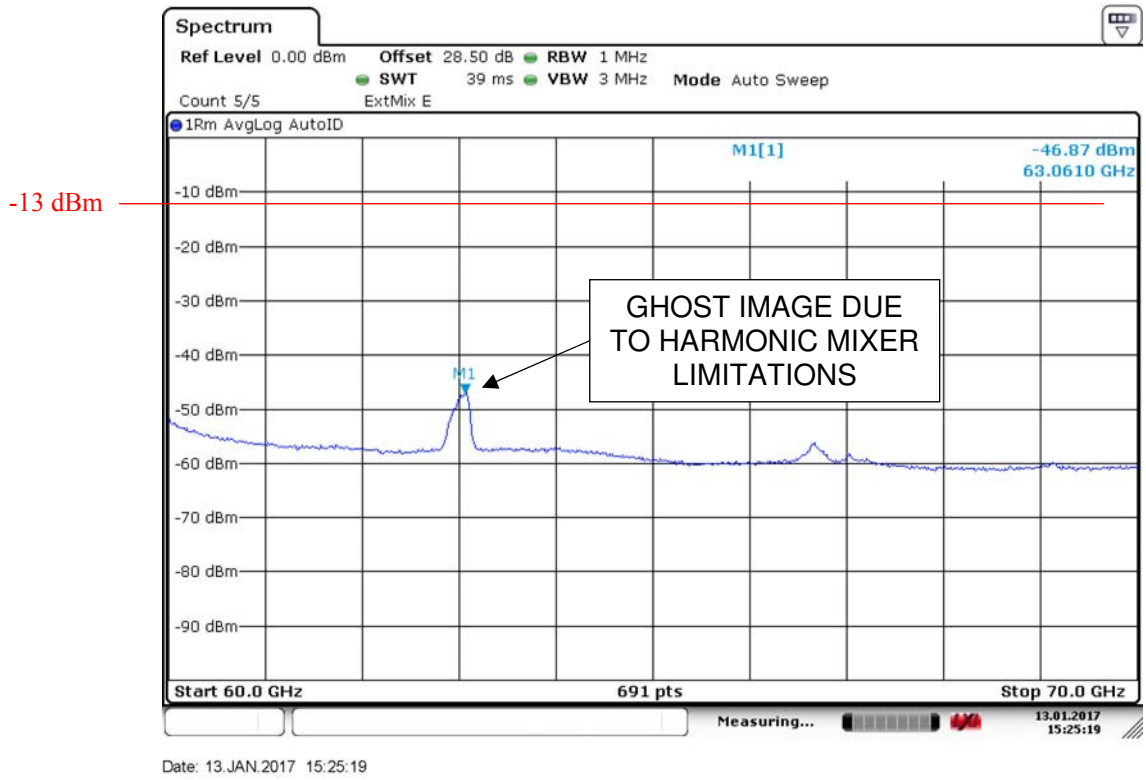
Note: Emissions from 30 MHz- 50 GHz are covered by radiated results.

Conducted Spurious Emissions 50 - 60 GHz Channel 73.5 GHz



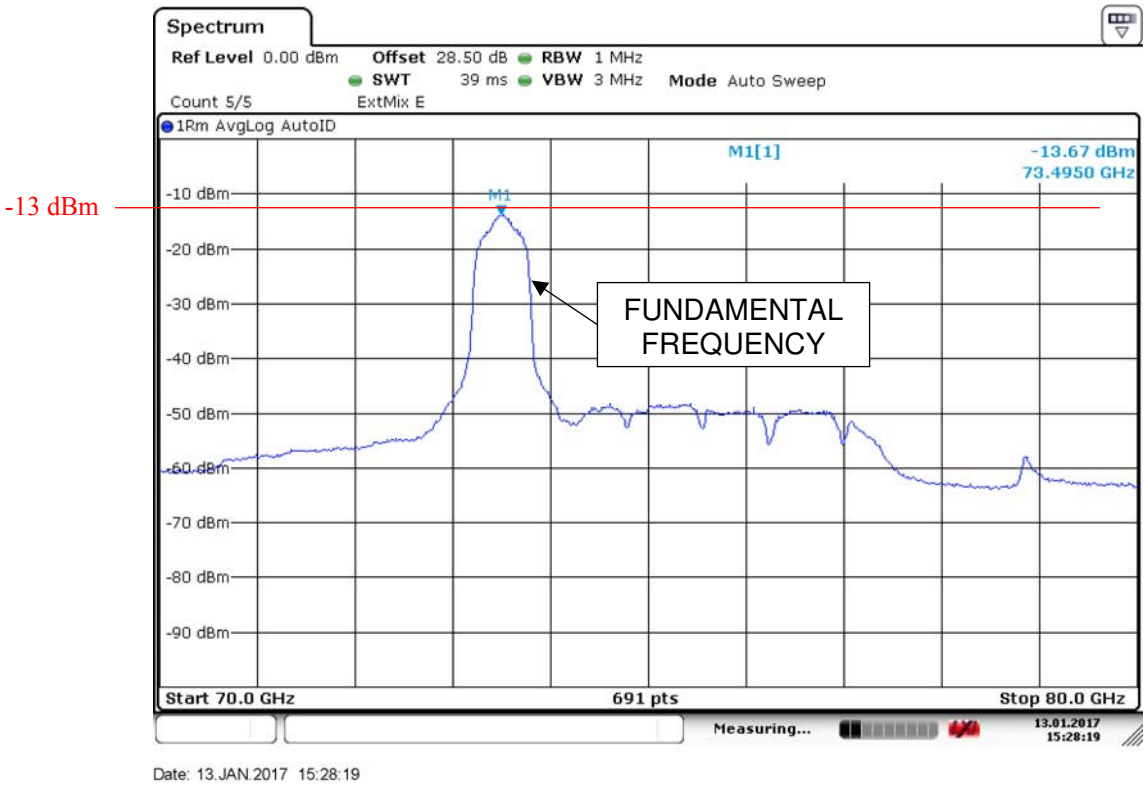
Harmonic Mixer (50 - 75 GHz)

Conducted Spurious Emissions 60 - 70 GHz Channel 73.5 GHz



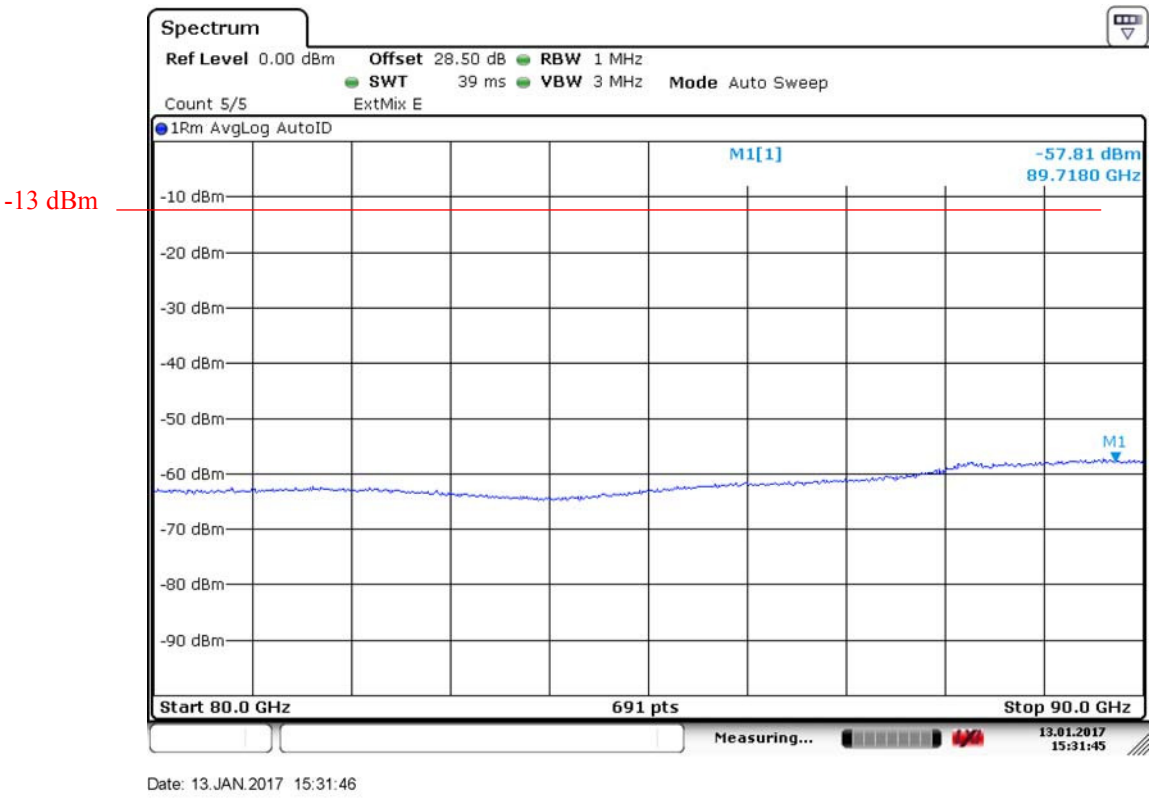
Harmonic Mixer (60 - 90 GHz)

Conducted Spurious Emissions 70 - 80 GHz Channel 73.5 GHz



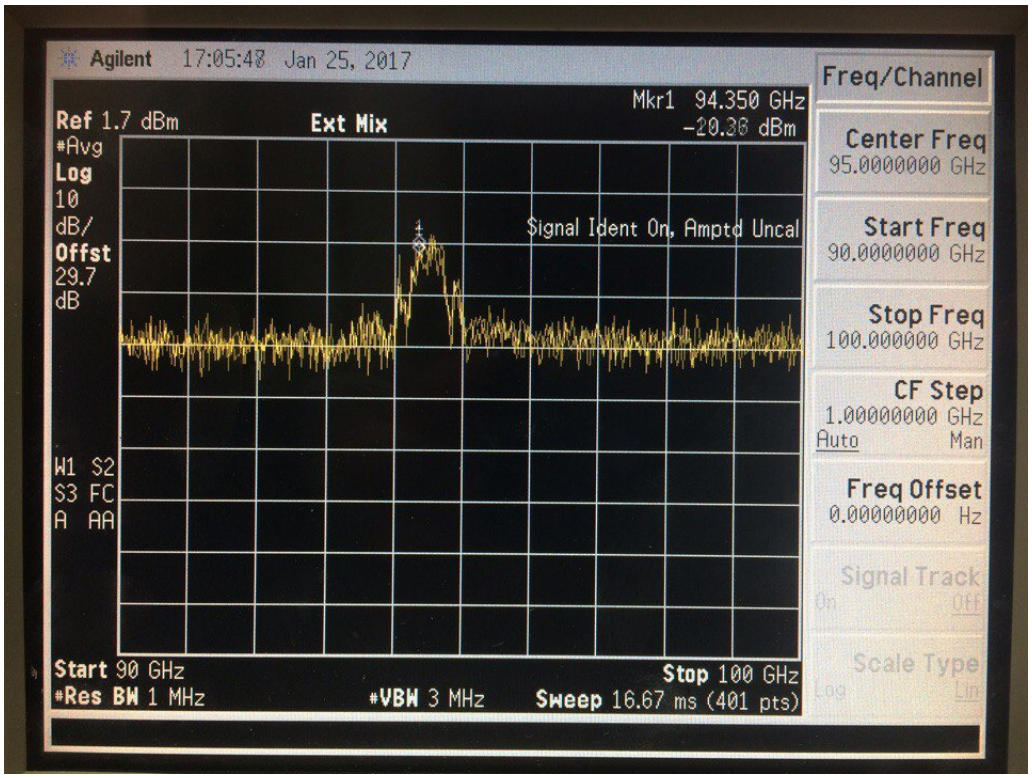
Harmonic Mixer (60 - 90 GHz)

Conducted Spurious Emissions 80 - 90 GHz Channel 73.5 GHz



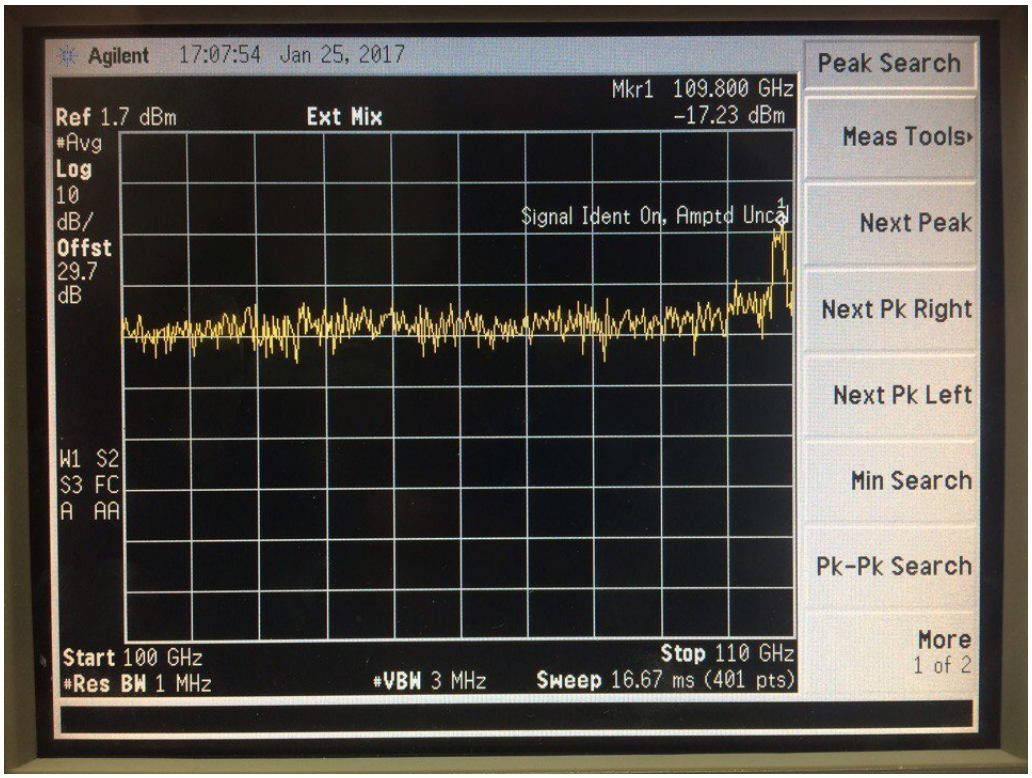
Harmonic Mixer (60 - 90 GHz)

Conducted Spurious Emissions 90 - 100 GHz Channel 73.5 GHz



Harmonic Mixer (75 - 110 GHz)

Conducted Spurious Emissions 100 - 110 GHz Channel 73.5 GHz

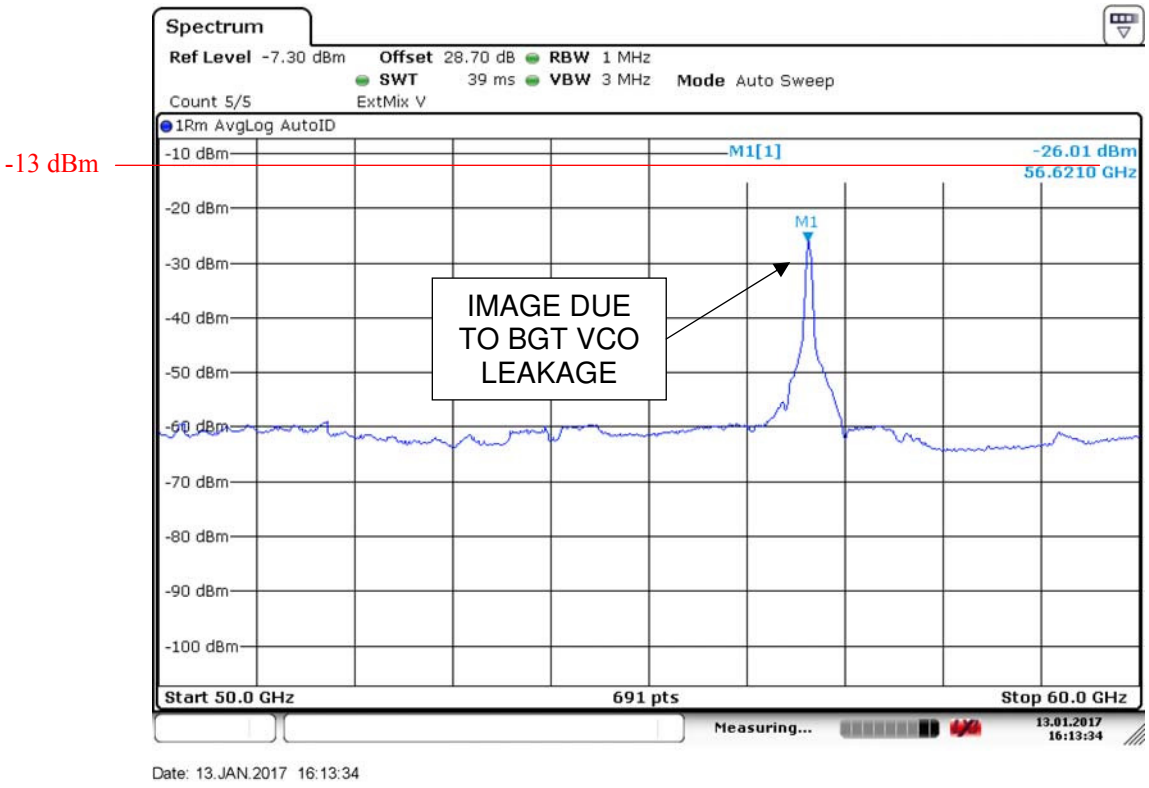


Harmonic Mixer (75 - 110 GHz)

Note: only noise floor found above 110 GHz

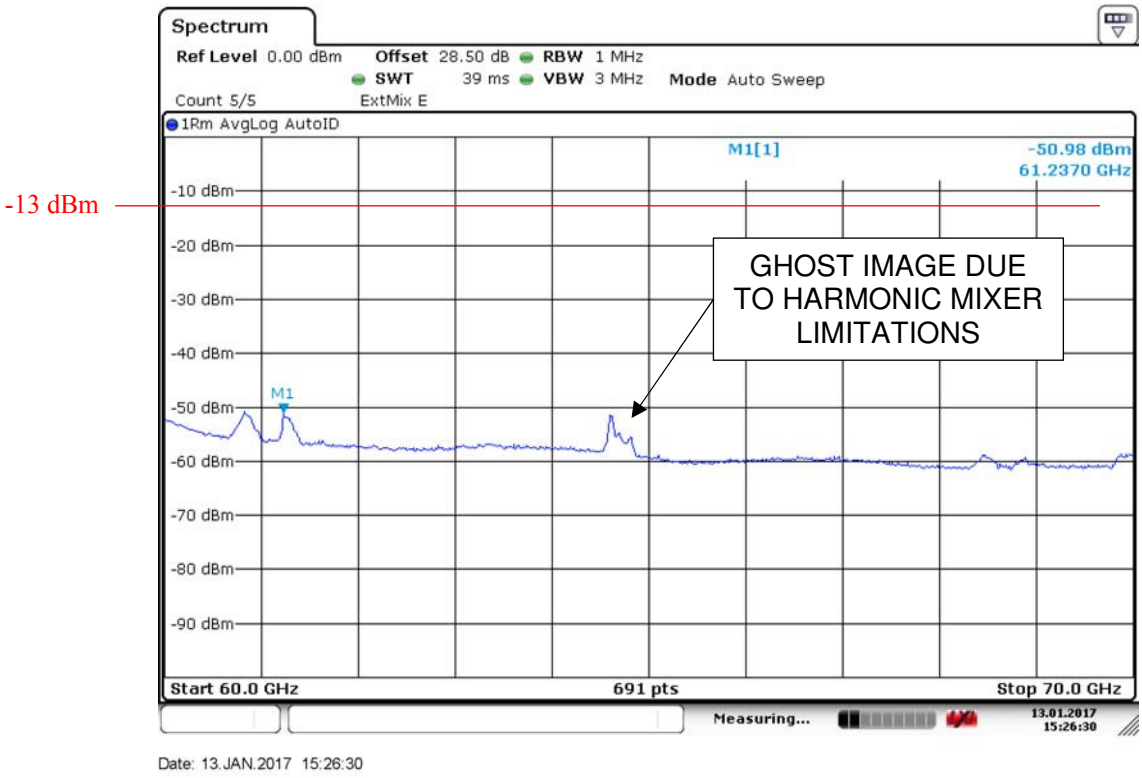
Note: Emissions from 30 MHz- 50 GHz are covered by radiated results.

Conducted Spurious Emissions 50 - 60 GHz Channel 75.5 GHz



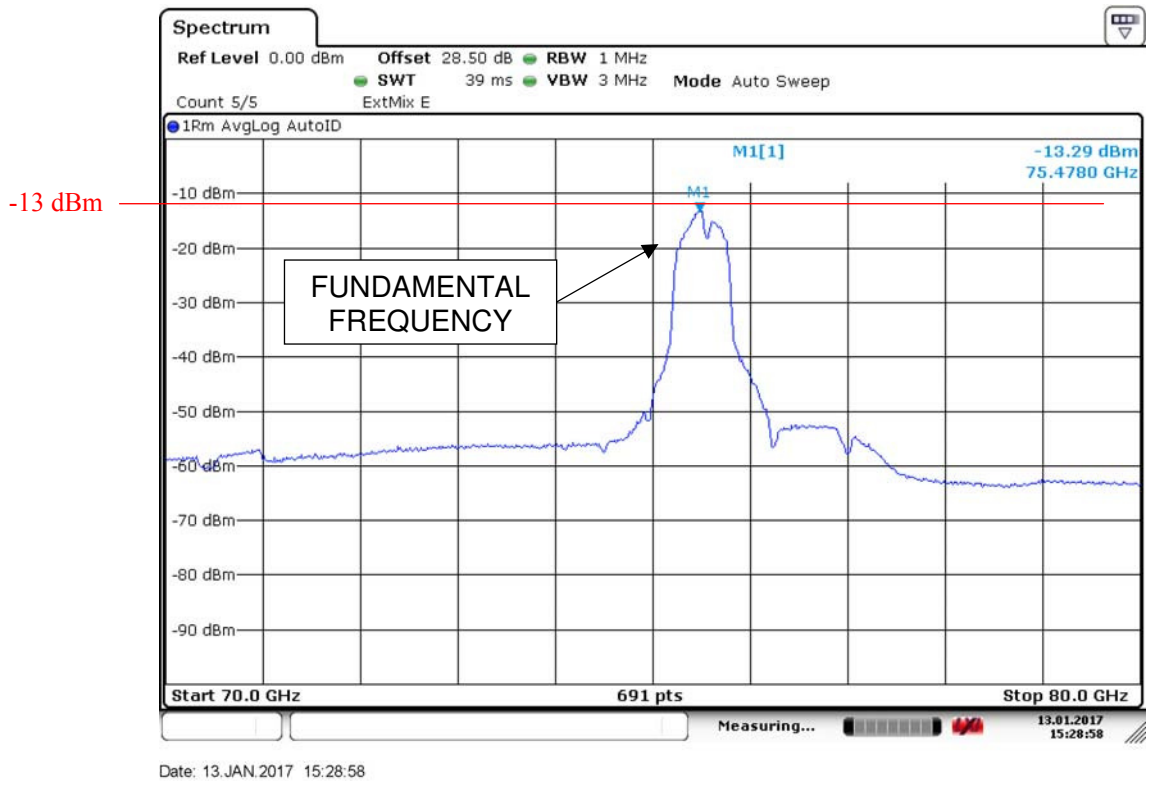
Harmonic Mixer (50 - 75 GHz)

Conducted Spurious Emissions 60 - 70 GHz Channel 75.5 GHz



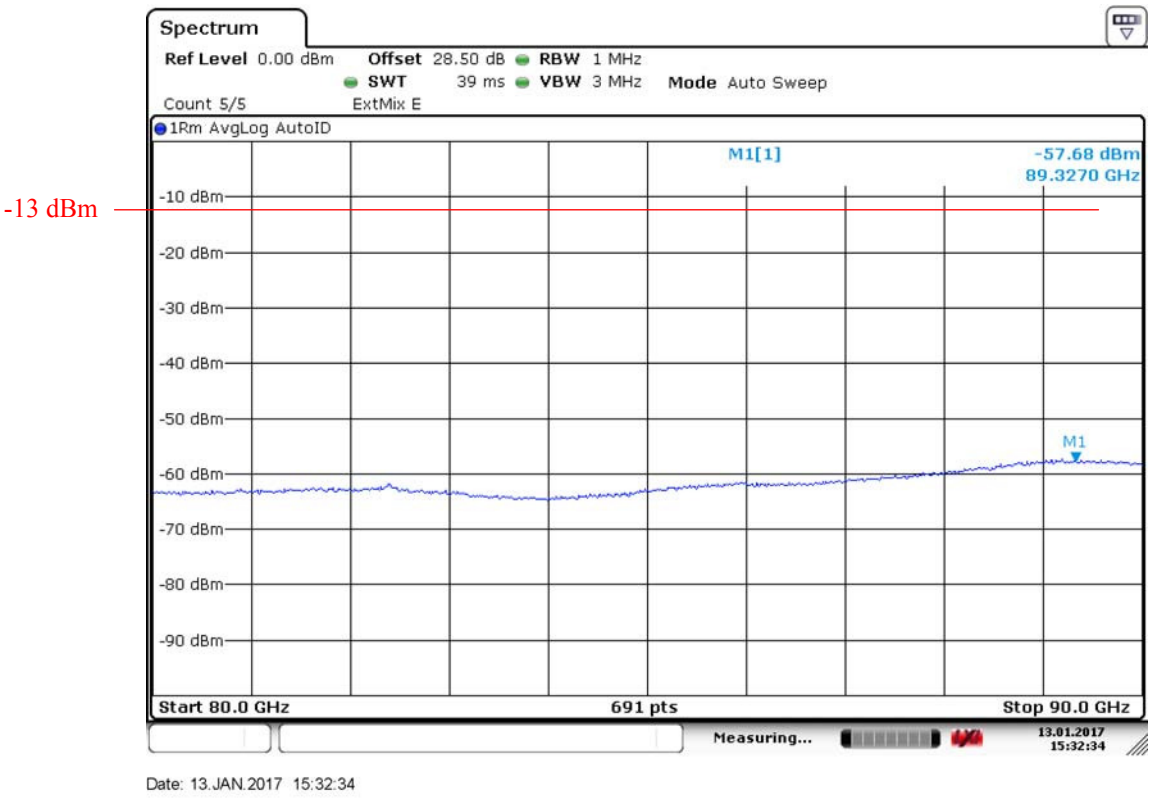
Harmonic Mixer (60 - 90 GHz)

Conducted Spurious Emissions 70 - 80 GHz Channel 75.5 GHz



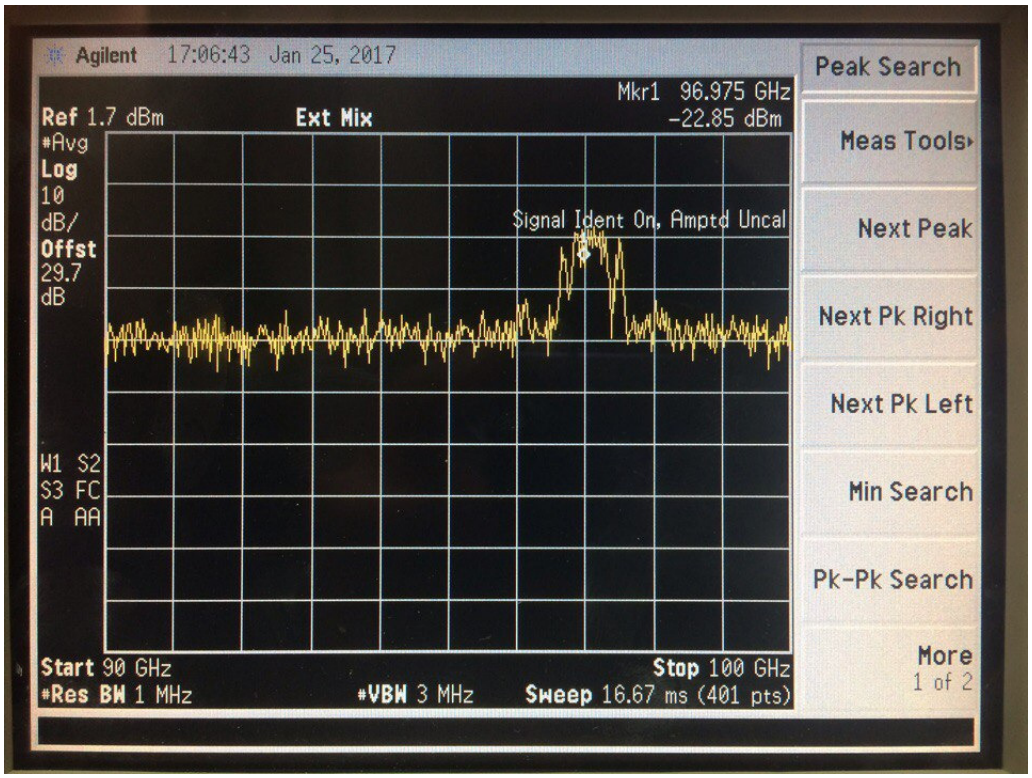
Harmonic Mixer (60 - 90 GHz)

Conducted Spurious Emissions 80 - 90 GHz Channel 75.5 GHz



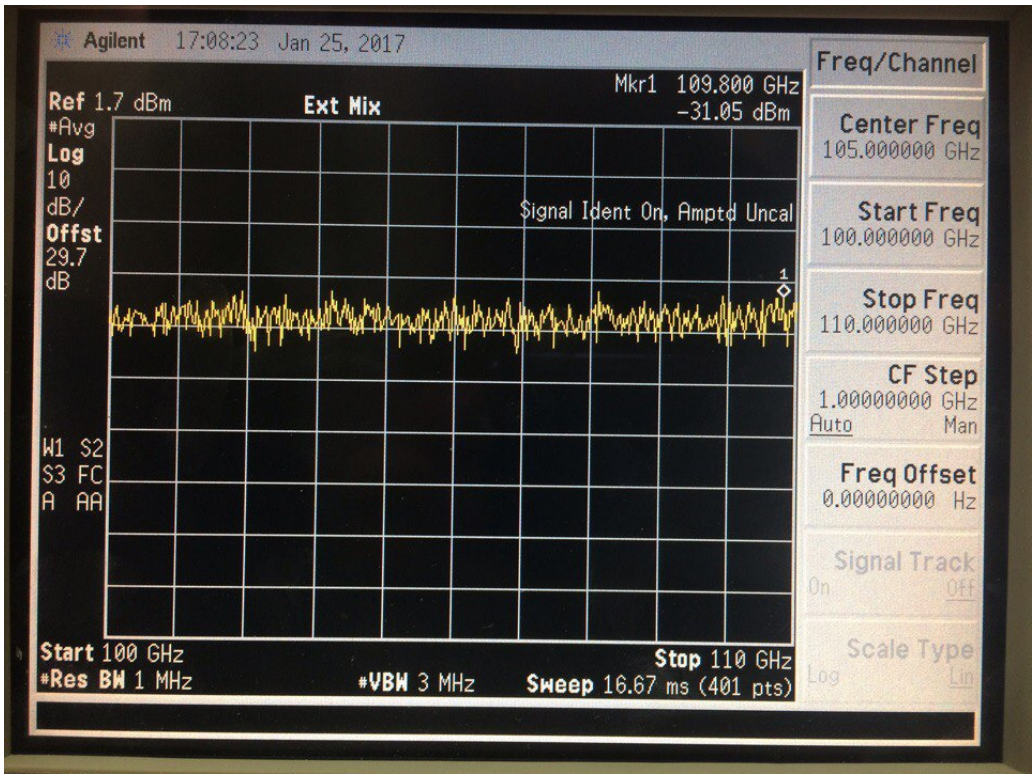
Harmonic Mixer (60 - 90 GHz)

Conducted Spurious Emissions 90 - 100 GHz Channel 75.5 GHz



Harmonic Mixer (75 - 110 GHz)

Conducted Spurious Emissions 100 - 110 GHz Channel 75.5 GHz

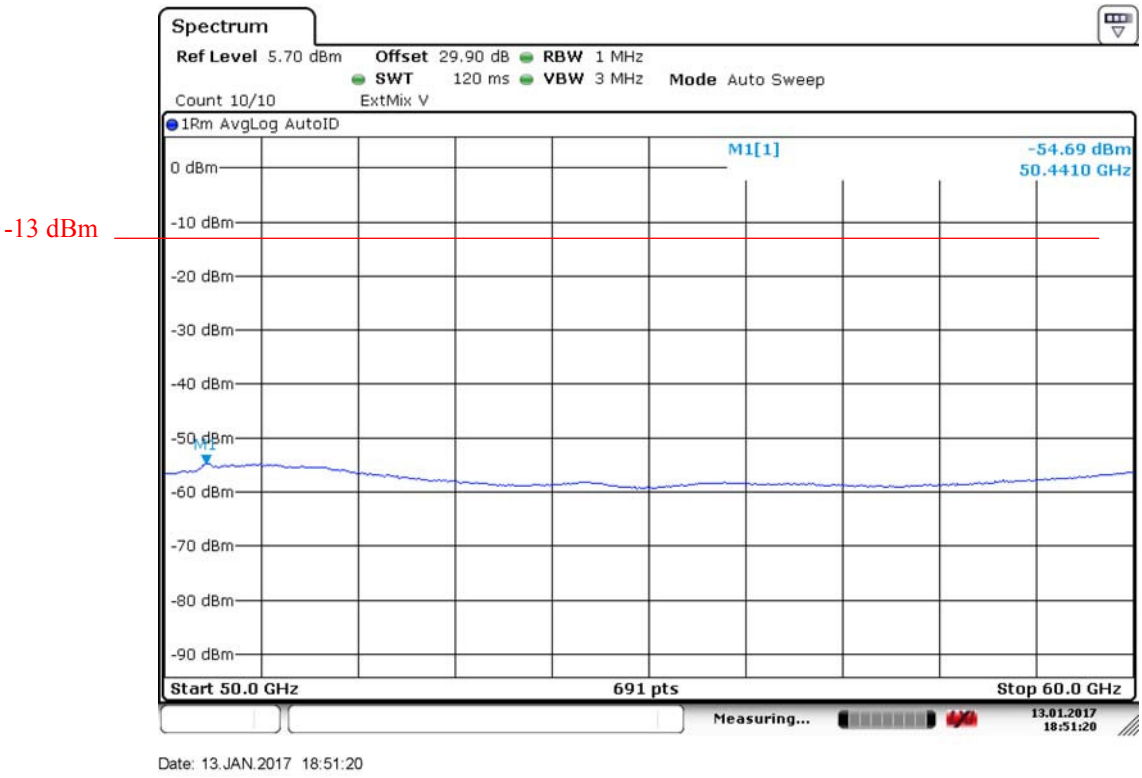


Harmonic Mixer (75 - 110 GHz)

Note: only noise floor found above 110 GHz

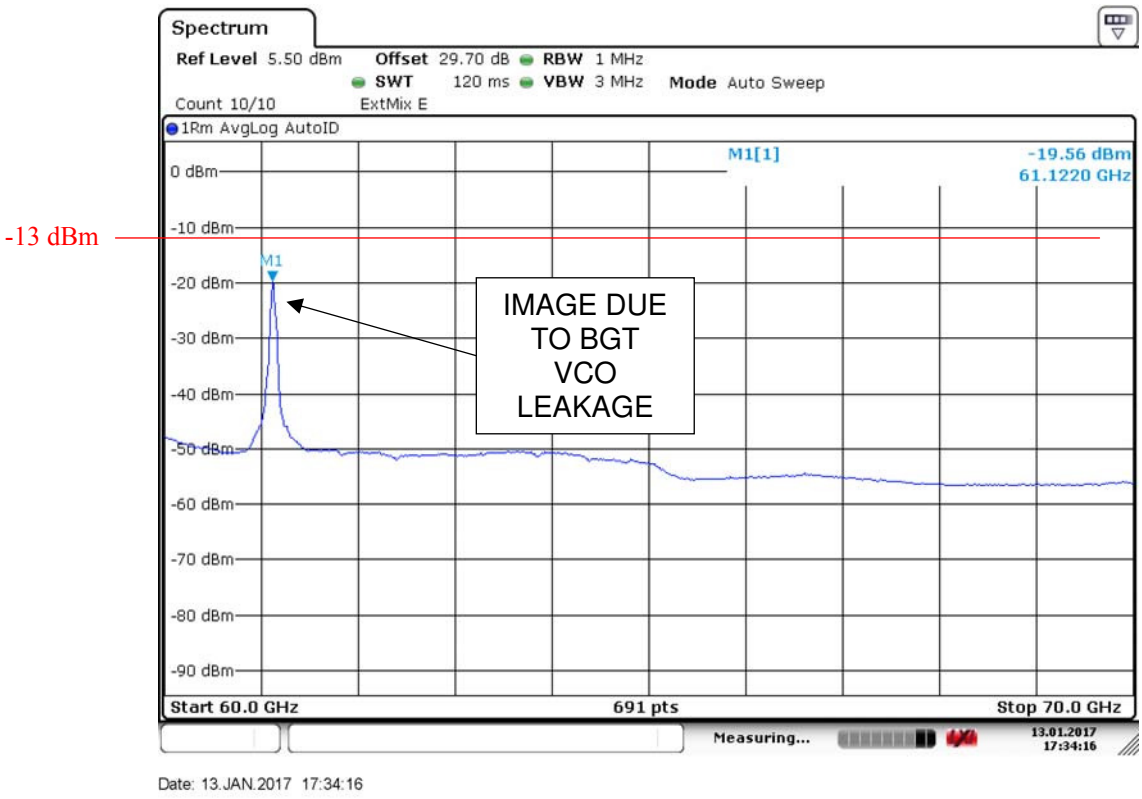
Note: Emissions from 30 MHz- 50 GHz are covered by radiated results.

Conducted Spurious Emissions 50 - 60 GHz Channel 81.5 GHz



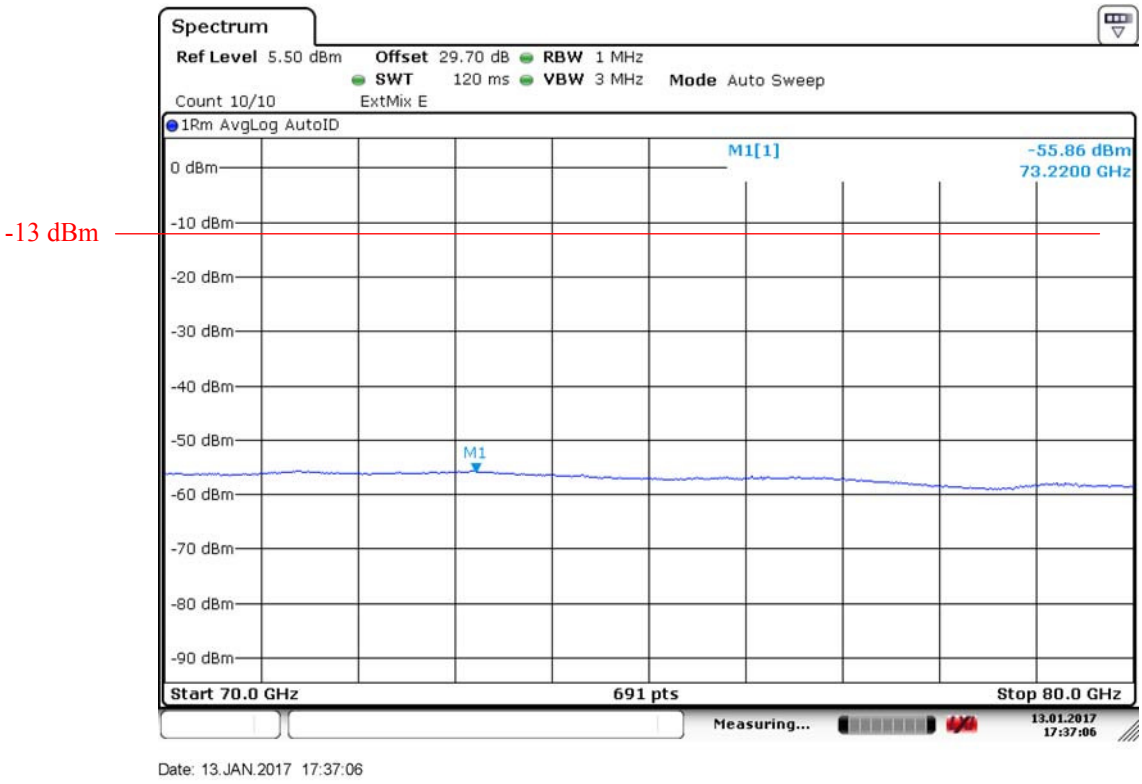
Harmonic Mixer (50 - 75 GHz)

Conducted Spurious Emissions 60 - 70 GHz Channel 81.5 GHz



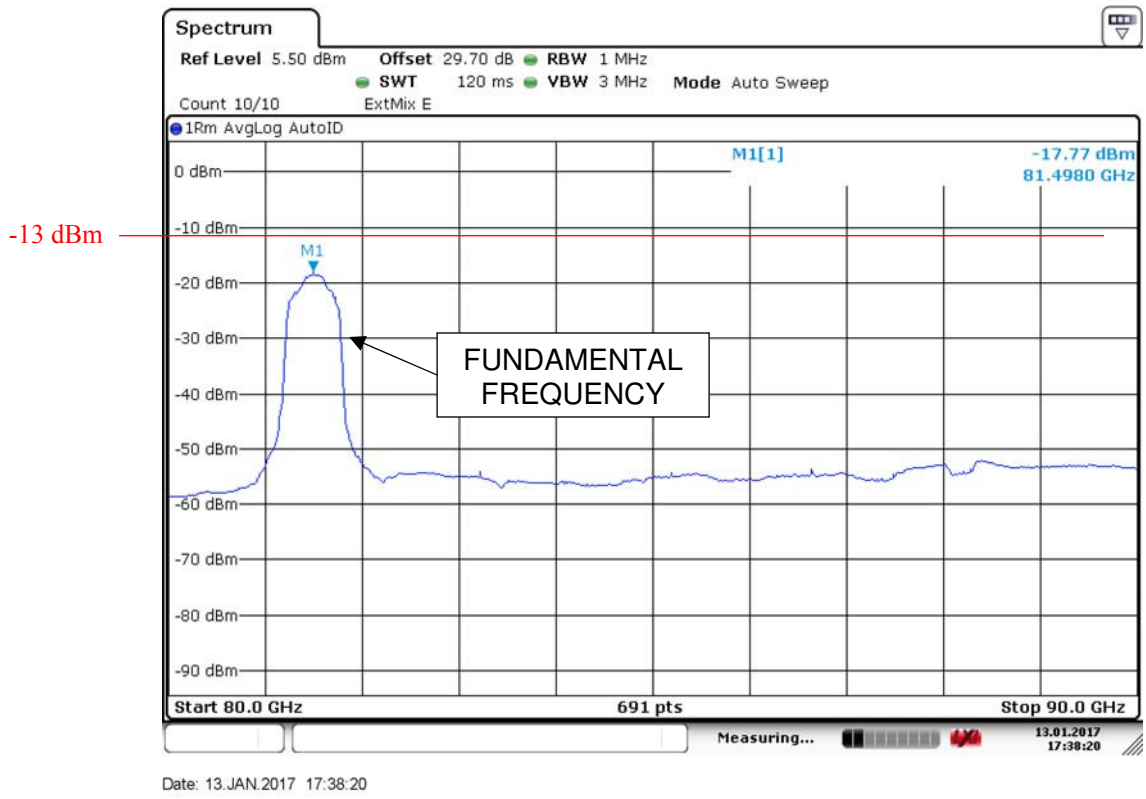
Harmonic Mixer (60 - 90 GHz)

Conducted Spurious Emissions 70 - 80 GHz Channel 81.5 GHz



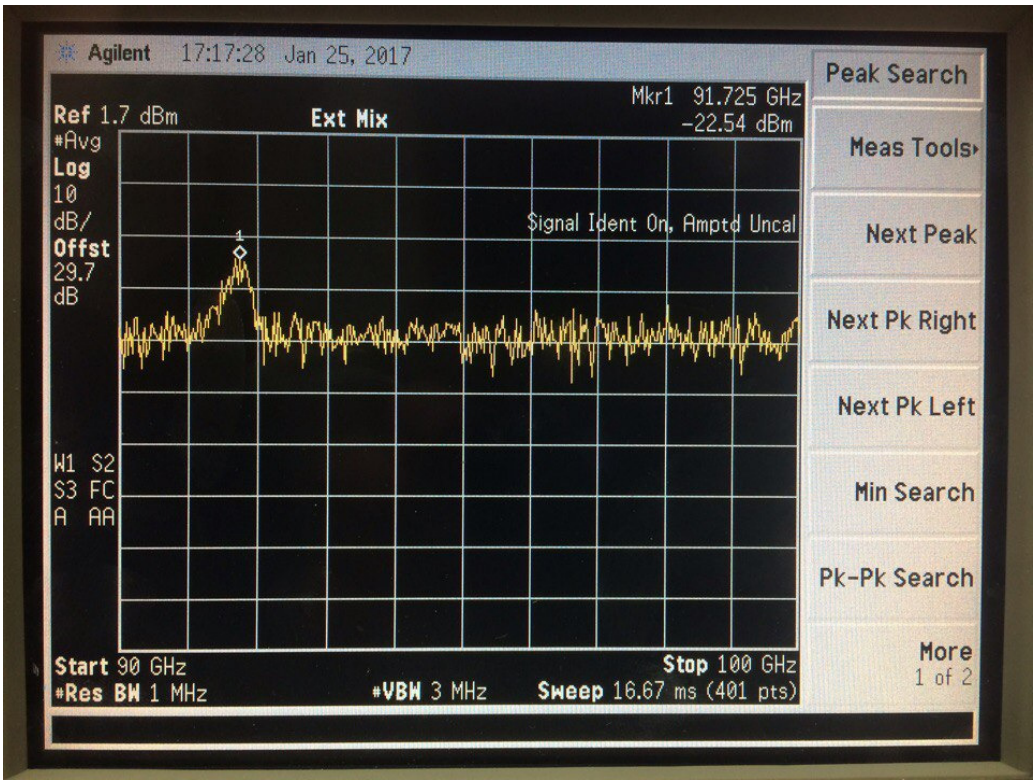
Harmonic Mixer (60 - 90 GHz)

Conducted Spurious Emissions 80 - 90 GHz Channel 81.5 GHz



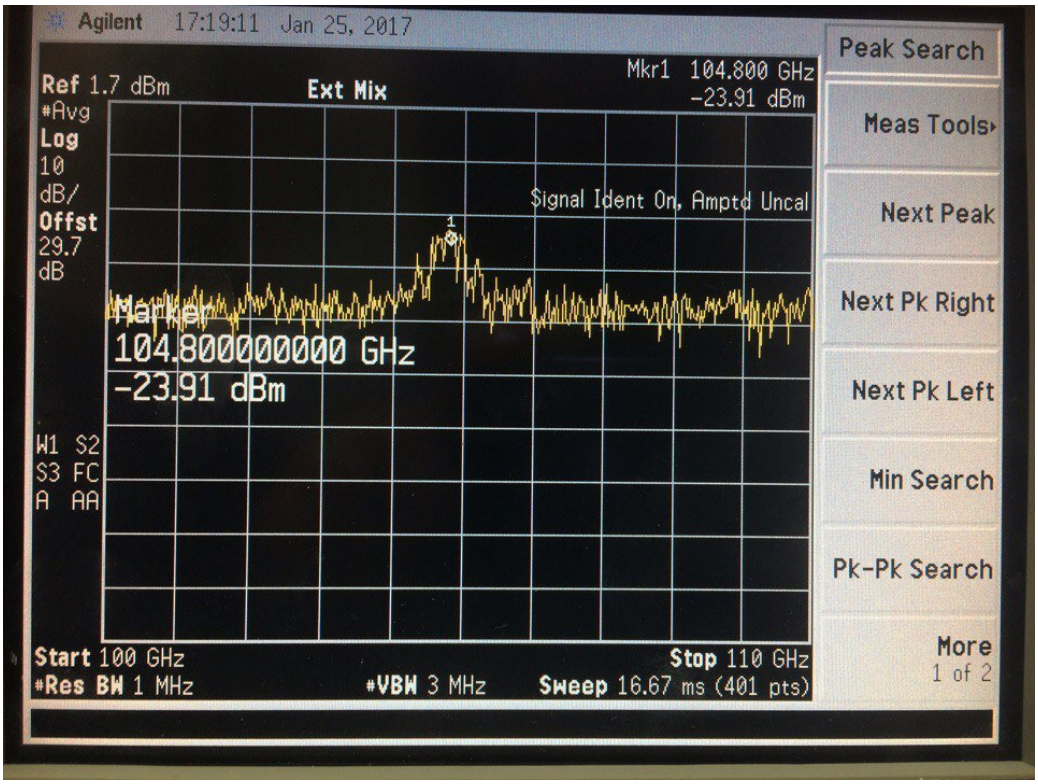
Harmonic Mixer (60 - 90 GHz)

Conducted Spurious Emissions 90 - 100 GHz Channel 81.5 GHz



Harmonic Mixer (75 - 110 GHz)

Conducted Spurious Emissions 100 - 110 GHz Channel 81.5 GHz

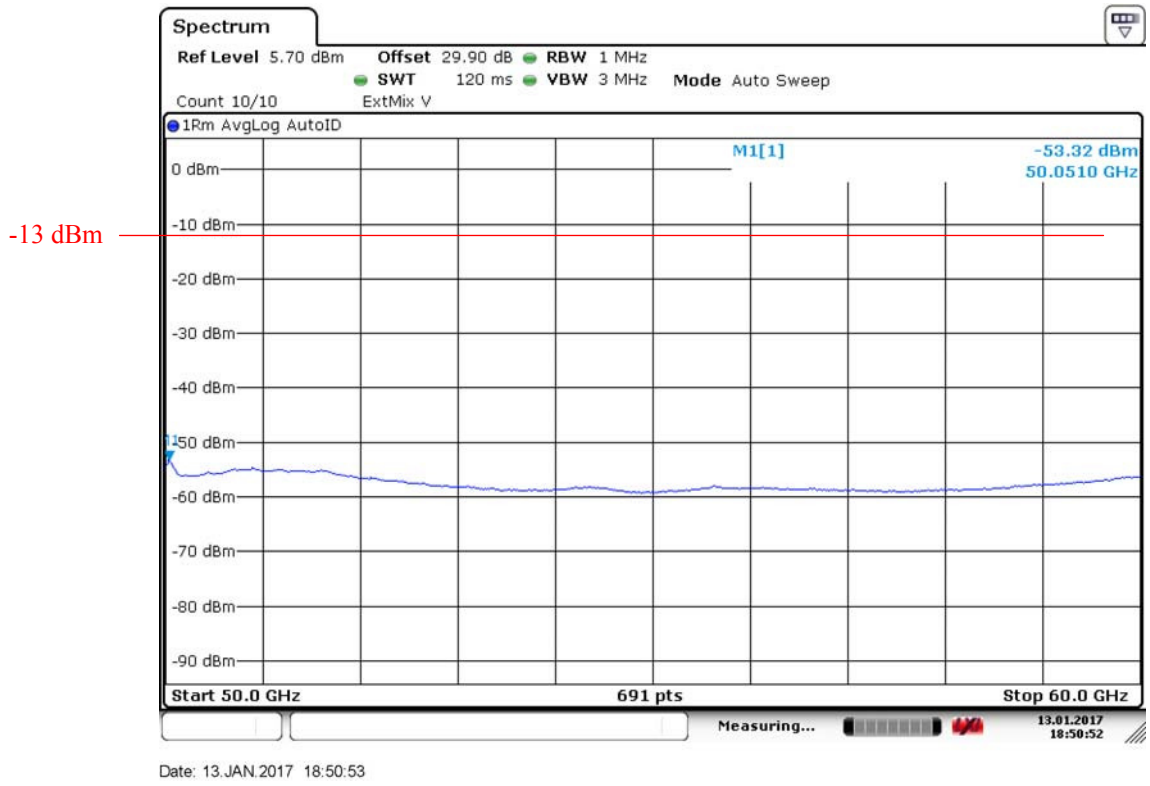


Harmonic Mixer (75 - 110 GHz)

Note: only noise floor found above 110 GHz

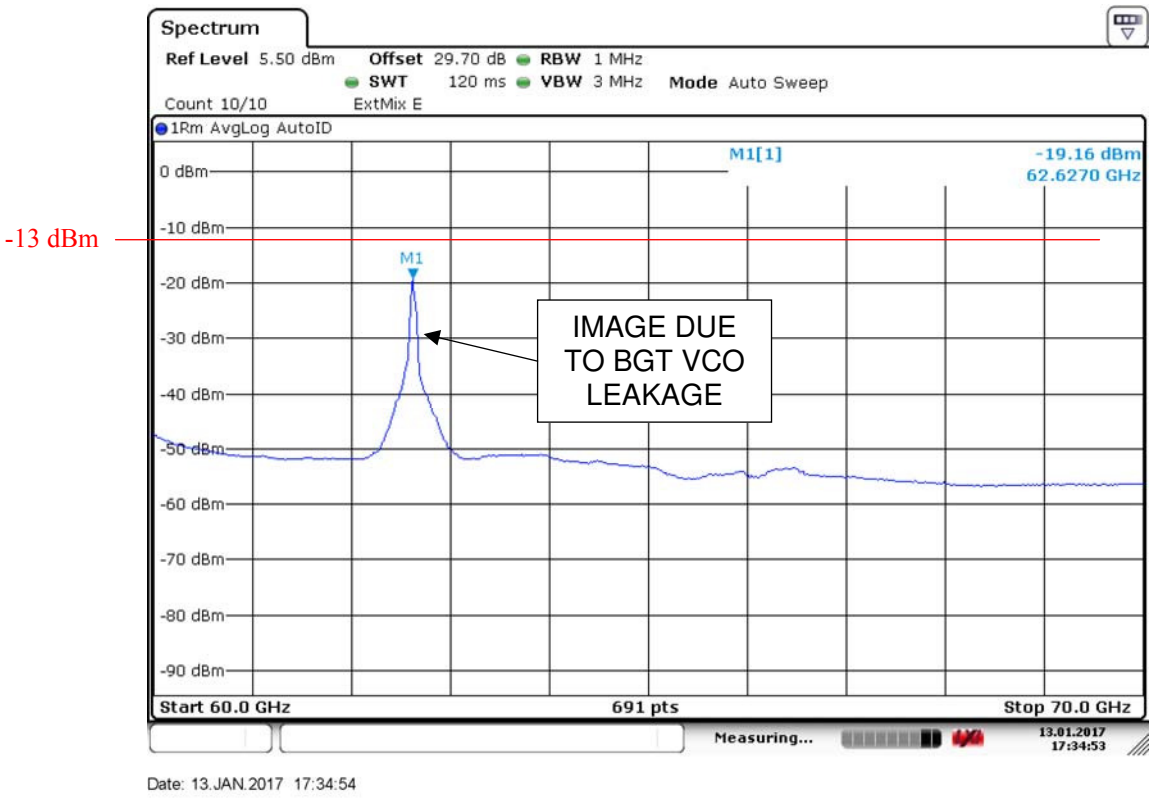
Note: Emissions from 30 MHz- 50 GHz are covered by radiated results.

Conducted Spurious Emissions 50 - 60 GHz Channel 83.5 GHz



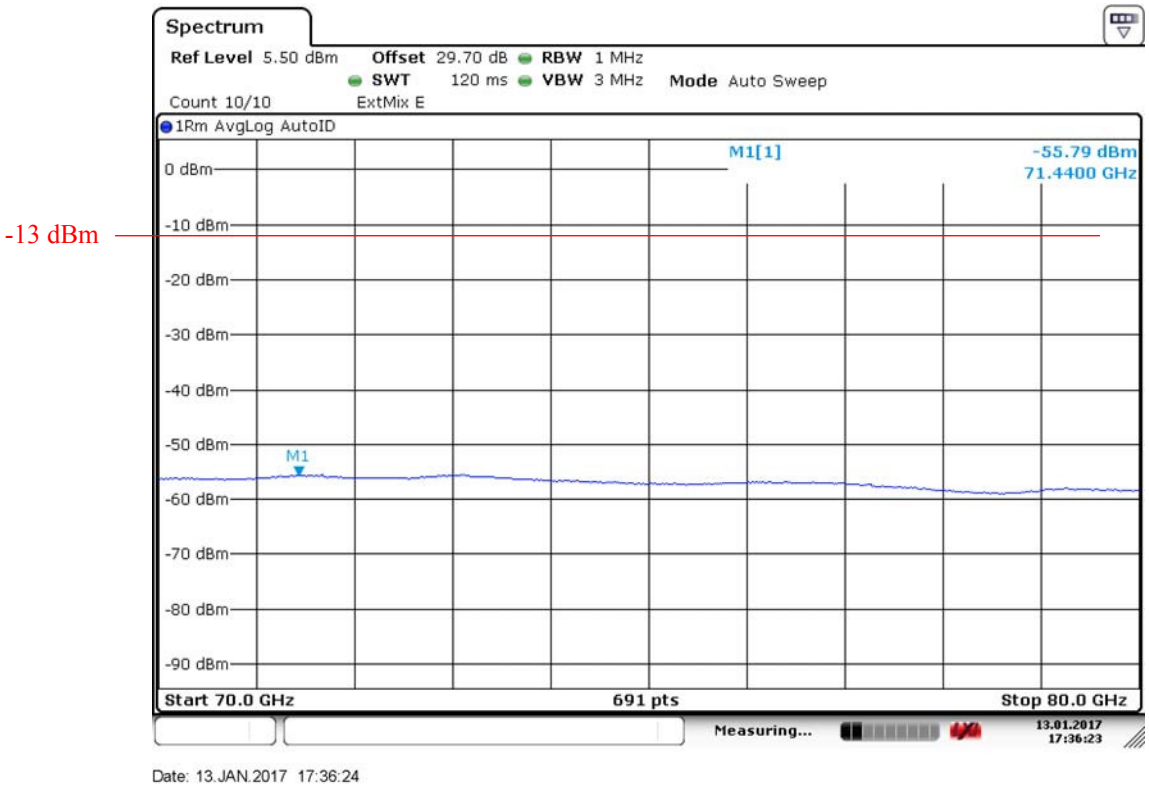
Harmonic Mixer (50 - 75 GHz)

Conducted Spurious Emissions 60 - 70 GHz Channel 83.5 GHz



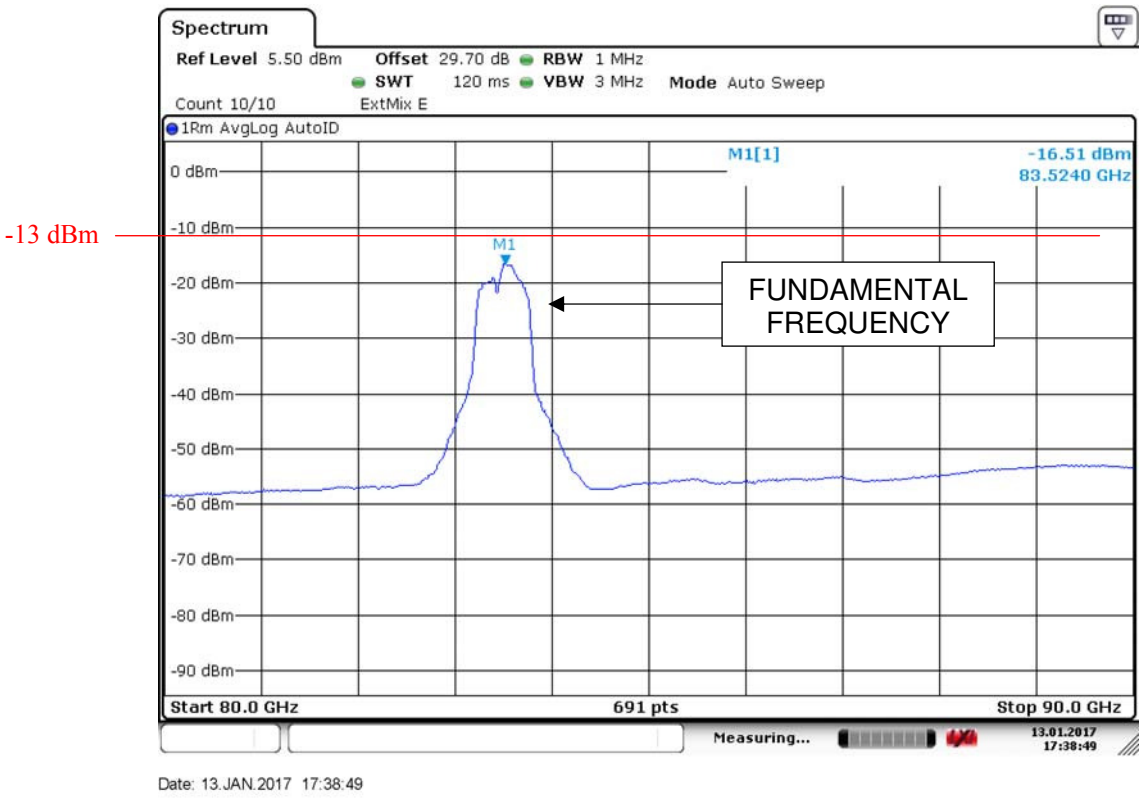
Harmonic Mixer (60 - 90 GHz)

Conducted Spurious Emissions 70 - 80 GHz Channel 83.5 GHz



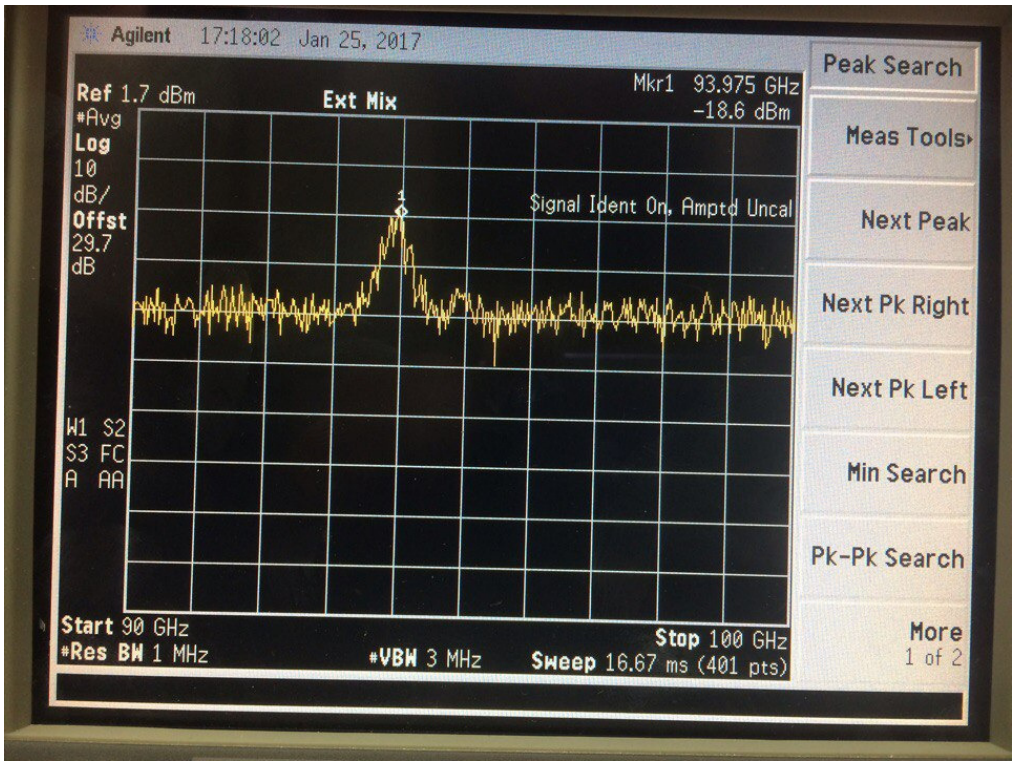
Harmonic Mixer (60 - 90 GHz)

Conducted Spurious Emissions 80 - 90 GHz Channel 83.5 GHz



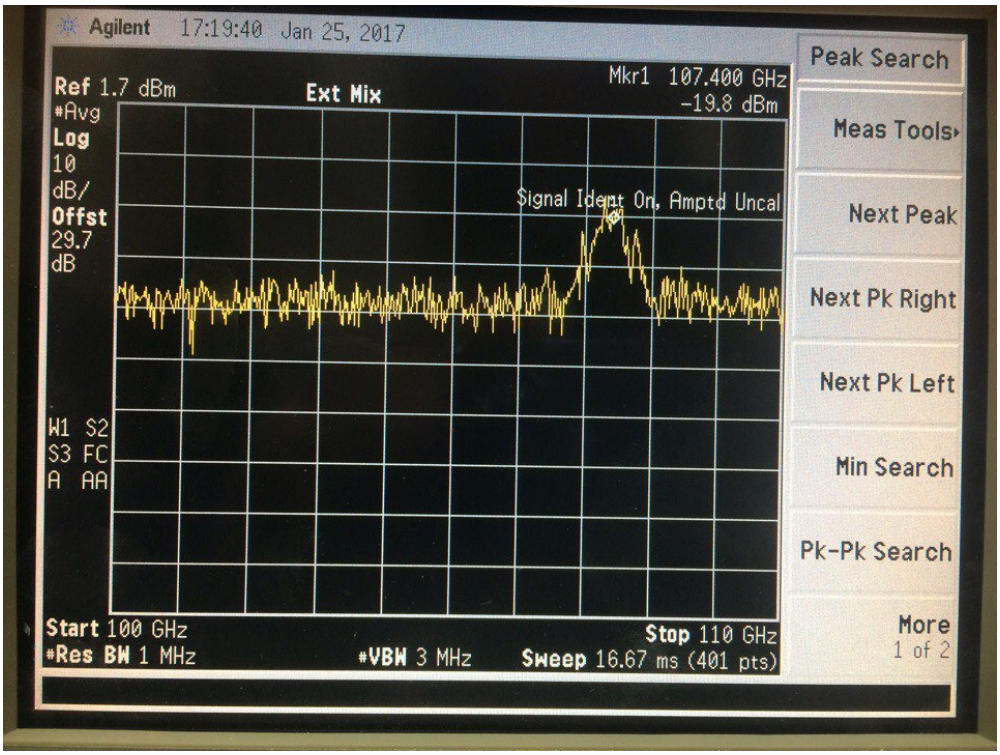
Harmonic Mixer (60 - 90 GHz)

Conducted Spurious Emissions 90 - 100 GHz Channel 83.5 GHz



Harmonic Mixer (75 - 110 GHz)

Conducted Spurious Emissions 100 - 110 GHz Channel 83.5 GHz

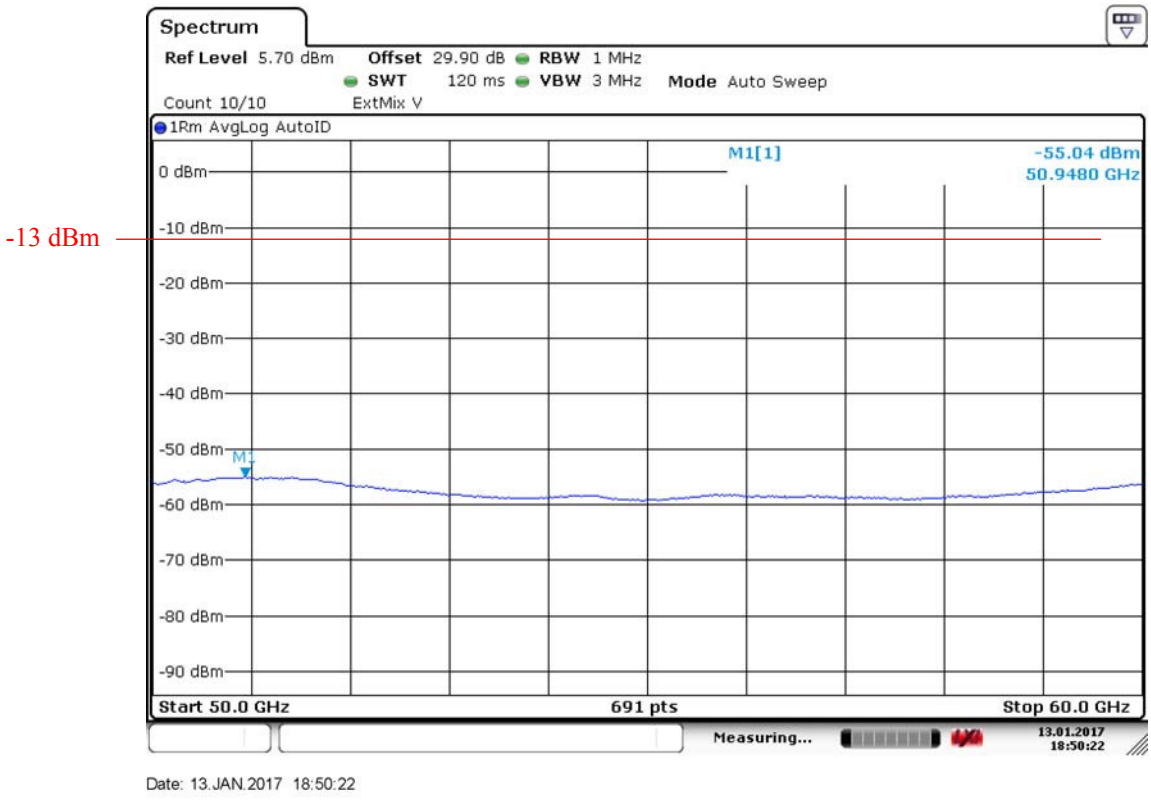


Harmonic Mixer (75 - 110 GHz)

Note: only noise floor found above 110 GHz

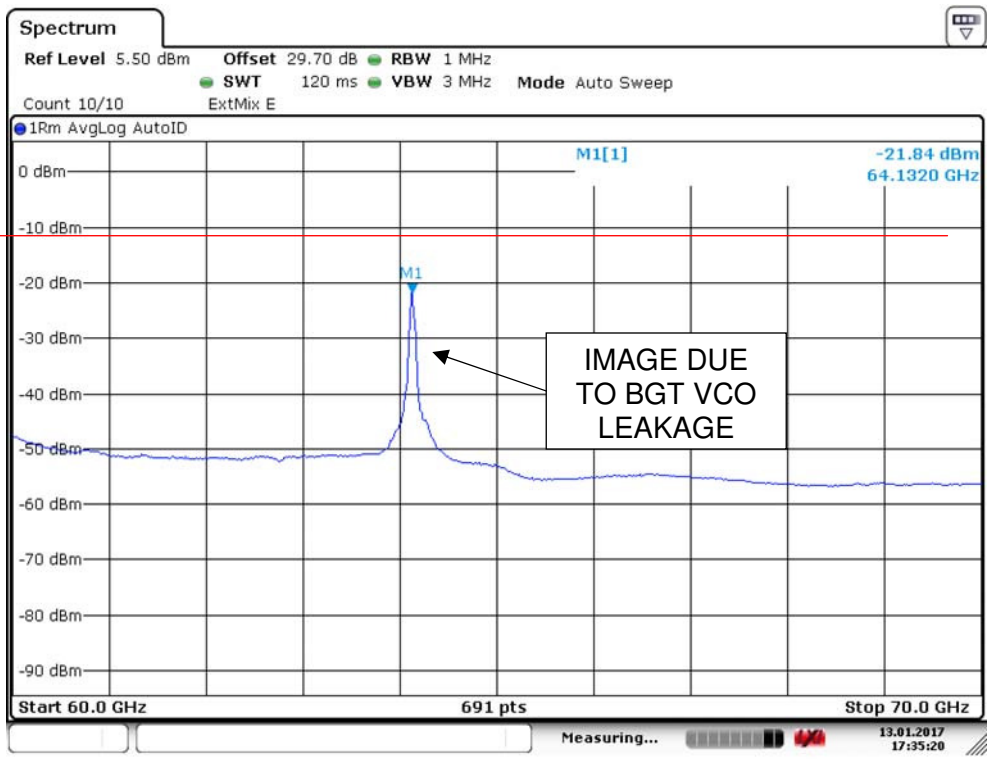
Note: Emissions from 30 MHz- 50 GHz are covered by radiated results.

Conducted Spurious Emissions 50 - 60 GHz Channel 85.5 GHz



Harmonic Mixer (50 - 75 GHz)

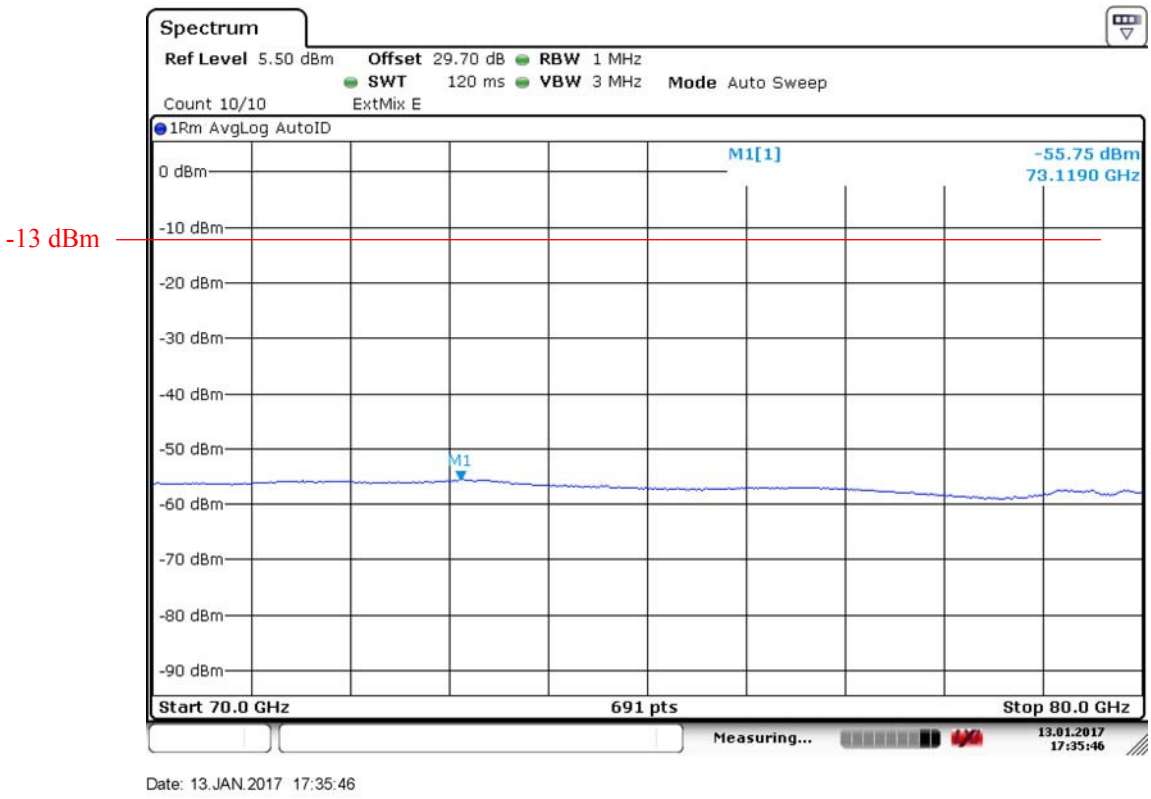
Conducted Spurious Emissions 60 - 70 GHz Channel 85.5 GHz



-13 dBm

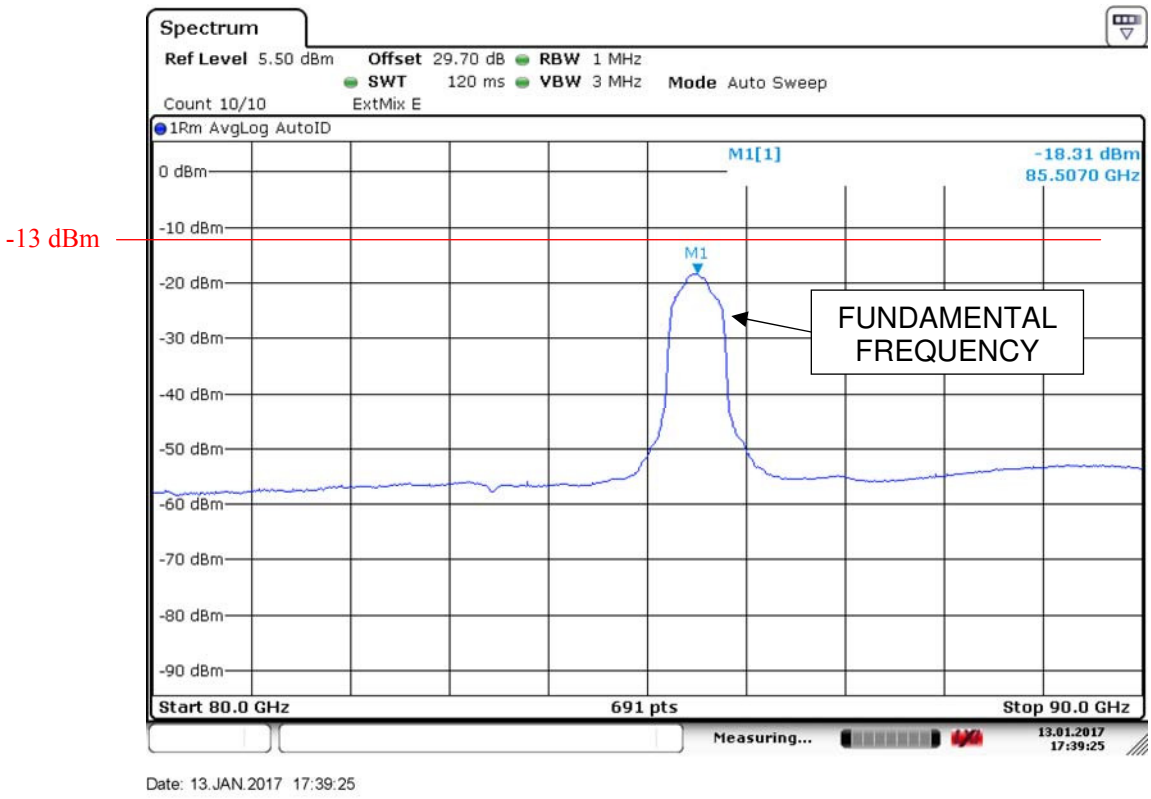
Harmonic Mixer (60 - 90 GHz)

Conducted Spurious Emissions 70 - 80 GHz Channel 85.5 GHz



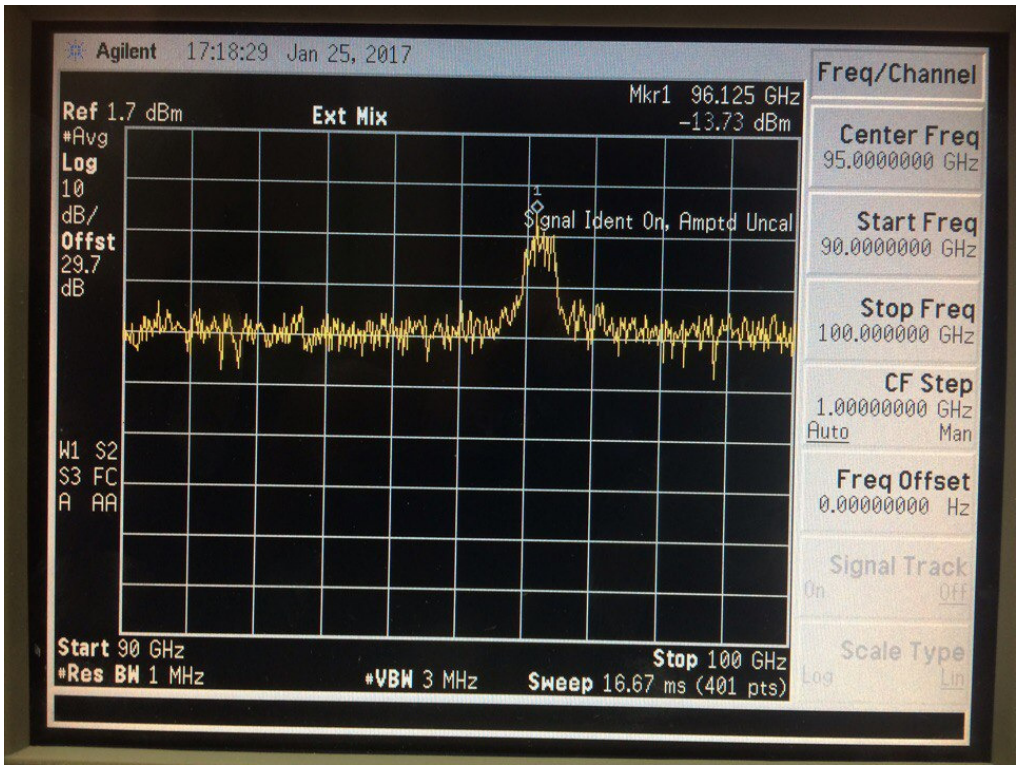
Harmonic Mixer (60 - 90 GHz)

Conducted Spurious Emissions 80 - 90 GHz Channel 85.5 GHz



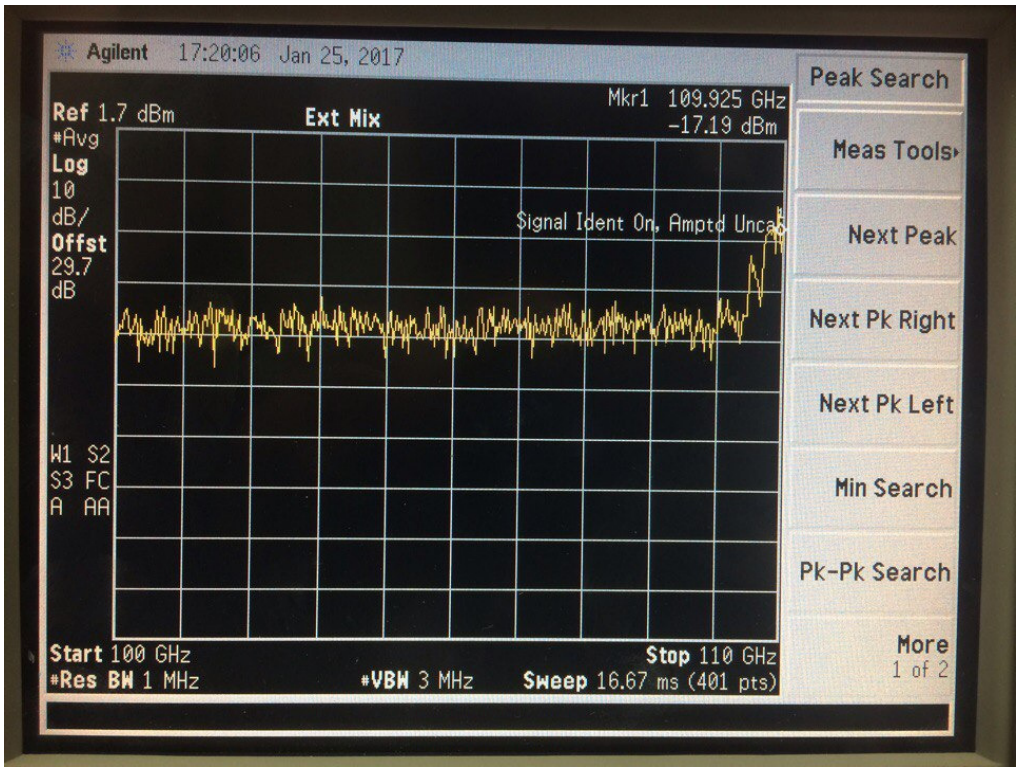
Harmonic Mixer (60 - 90 GHz)

Conducted Spurious Emissions 90 - 100 GHz Channel 85.5 GHz



Harmonic Mixer (75 - 110 GHz)

Conducted Spurious Emissions 100 - 110 GHz Channel 85.5 GHz



Harmonic Mixer (75 - 110 GHz)

Note: only noise floor found above 110 GHz

8 FCC §2.1055 & §101.107 - Frequency Stability

8.1 Applicable Standards

(a) The carrier frequency of each transmitter authorized in these services must be maintained within the following percentage of the reference frequency except as otherwise provided in paragraph (b) of this section or in the applicable subpart of this part (unless otherwise specified in the instrument of station authorization the reference frequency will be deemed to be the assigned frequency):

Frequency band (MHz)	Frequency tolerance (percent)
/	/
/	/
71,000 to 76,000	Note 8
81,000 to 86,000	Note 8
/	/

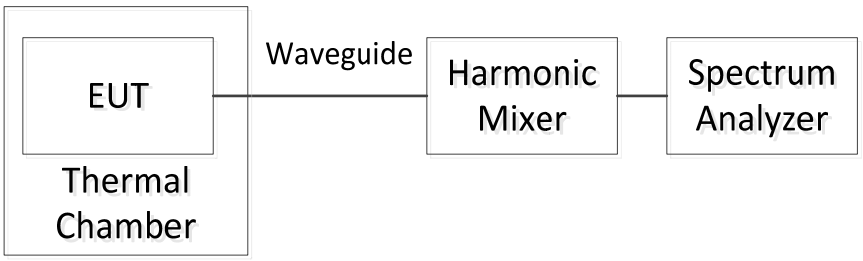
Note 8 Equipment authorized to be operated in the 71,000-76,000 MHz, 81,000-86,000 MHz, and 92,000-94,000 MHz and 94,100-95,000 MHz bands is exempt from the frequency tolerance requirement noted in the table of paragraph (a) of this section.

8.2 Test Procedure

The EUT was placed inside an environmental chamber. The transmitter output was connected to a spectrum analyzer via a pre-selector mixer and the frequency stability was measured using a modulated carrier. A thermocouple was used to monitor chamber temperature. The EUT was attached to a variable power supply providing the primary supply voltage.
Frequency stability was measured through the extremes of temperature and voltage on the mid channel. Before measurements were taken at each temperature the equipment waited until thermal balance was obtained.
The delta marker method was used to measure frequency stability. A marker was placed on the rising edge of the occupied bandwidth at 10 dB below the peak of the spectrum. A delta marker was placed on the falling edge of the occupied bandwidth and the center frequency fc calculated by using the following equation;

fc = Marker 1 + (½ * Delta Marker)

At +20°C the primary voltage was varied ±10% and measurements were taken at each voltage level.



Test Environmental Conditions

Temperature:	17-23 °C
Relative Humidity:	31-57 %
ATM Pressure:	999-1012 mbar

The testing was performed by Andrey Kirillov on 2017-01-12 to 01-31.

8.3 Test Results

73.5 GHz

Temperature (°C)	Voltage (Vdc)	Marker 1 (GHz)	Delta Marker 1 (GHz)	Calculated Center Frequency (GHz)	Frequency Error (%)
-40	48.0	73.4459	0.1071	73.4994	0.0008
-30	48.0	73.4459	0.1071	73.4994	0.0008
-20	48.0	73.4462	0.1071	73.4997	0.0004
-10	48.0	73.4462	0.1071	73.4997	0.0004
0	48.0	73.4462	0.1071	73.4997	0.0004
10	48.0	73.4462	0.1071	73.4997	0.0004
20	48.0	73.4459	0.1074	73.4996	0.0006
20	43.2	73.4459	0.1074	73.4996	0.0006
20	52.8	73.4459	0.1074	73.4996	0.0006
30	48.0	73.4459	0.1071	73.4994	0.0008
40	48.0	73.4459	0.1071	73.4994	0.0008
50	48.0	73.4459	0.1071	73.4994	0.0008
60	48.0	73.4459	0.1071	73.4994	0.0008

83.5 GHz

Temperature (°C)	Voltage (Vdc)	Marker 1 (GHz)	Delta Marker 1 (GHz)	Calculated Center Frequency (GHz)	Frequency Error (%)
-40	48.0	83.4462	0.1071	83.4997	0.0003
-30	48.0	83.4462	0.1071	83.4997	0.0003
-20	48.0	83.4462	0.1071	83.4997	0.0003
-10	48.0	83.4462	0.1071	83.4997	0.0003
0	48.0	83.4462	0.1071	83.4997	0.0003
10	48.0	83.4462	0.1071	83.4997	0.0003
20	48.0	83.4459	0.1074	83.4996	0.0005
20	43.2	83.4459	0.1074	83.4996	0.0005
20	52.8	83.4459	0.1074	83.4996	0.0005
30	48.0	83.4459	0.1071	83.4994	0.0007
40	48.0	83.4459	0.1071	83.4994	0.0007
50	48.0	83.4459	0.1071	83.4994	0.0007
60	48.0	83.4459	0.1071	83.4994	0.0007

9 FCC §2.1053 & §101.111 – Field Strength of Spurious Radiation

9.1 Applicable Standards

Requirements: FCC §2.1053 and §101.111

(ii) For operating frequencies above 15 GHz, in any 1 MHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 250 percent of the authorized bandwidth: As specified by the following equation but in no event less than 11 decibels:

$$A = 11 + 0.4(P-50) + 10 \text{ Log10 } B.$$

Where;
A = Attenuation (in decibels) below the mean output power level.
P = Percent removed from the center frequency of the transmitter bandwidth.
B = Authorized bandwidth in MHz.
(Attenuation greater than 56 decibels or to an absolute power of less than -13 dBm/1MHz is not required).
(iii) In any 1 MHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 Log10 (the mean output power in watts) decibels, or 80 decibels, whichever is the lesser attenuation.

9.2 Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into antenna which was also placed on the turntable.

The measurements antenna was placed at a distance of 1 or 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to 200 GHz.

9.3 Test Environmental Conditions

Temperature:	22-25° C
Relative Humidity:	45-50 %
ATM Pressure:	101-102.2 kPa

The testing was performed by Jin Yang on 2017-02-20~24 at 5m chamber 3

9.4 Test Results

Note: 51 dBi antenna and 54 dBi antenna has same power setting; therefore, only the worst case (54 dBi antenna) was performed.

Note: after pre-scan, vertical polarization gives the worst emission level, therefore, only vertical test data was listed in the result table.

45 dBi antenna

71.5 GHz

Freq. (MHz)	S.A. Amp. (dBµV)	Polar (H/V)	Substitution				Absolute Level (dBm)	Result	
			Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
209.5	56	V	209.5	-42	0	1.26	-43.26	-13	-30.26
34	55.8	V	34	-43.8	0	1.5	-45.3	-13	-32.3
1714.117	64.25	V	1714.117	-34.75	8.682	1.56	-27.628	-13	-14.628
3428.665	53.15	V	3428.665	-40.85	9.889	1	-31.961	-13	-18.961
39830	51.29	V	39830	-38.71	23.139	4.32	-19.891	-13	-6.891

83.5 GHz

Freq. (MHz)	S.A. Amp. (dBµV)	Polar (H/V)	Substitution				Absolute Level (dBm)	Result	
			Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
210	57.59	V	210	-40.41	0	1.26	-41.67	-13	-28.67
34.596	56.88	V	34.596	-42.72	0	1.5	-44.22	-13	-31.22
1715.07	65.29	V	1715.07	-33.71	8.682	1.56	-26.588	-13	-13.588
3429.58	55.71	V	3429.58	-38.29	9.889	1	-29.401	-13	-16.401
39827	53.07	V	39827	-36.93	23.139	4.32	-18.111	-13	-5.111

54 dBi antenna

71.5 GHz Band

Freq. (MHz)	S.A. Amp. (dBµV)		Substitution				Absolute Level (dBm)	Result	
		Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
212.2	56.17	V	212.2	-41.83	0	1.26	-43.09	-13	-30.09
34.87	59.51	V	34.87	-40.09	0	1.5	-41.59	-13	-28.59
1715.68	63.28	V	1715.68	-35.72	8.682	1.56	-28.598	-13	-15.598
4999.98	54.8	V	4999.98	-36.2	10.258	1.87	-27.812	-13	-14.812
39841	54.29	V	39841	-35.71	23.139	4.32	-16.891	-13	-3.891

83.5 GHz Band

Freq. (MHz)	S.A. Amp. (dBµV)		Substitution				Absolute Level (dBm)	Result	
		Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dB)	Cable Loss (dB)		Limit (dBm)	Margin (dB)
209.25	55.29	V	209.25	-42.71	0	1.26	-43.97	-13	-30.97
33.49	60.19	V	33.49	-39.41	0	1.5	-40.91	-13	-27.91
1375.8	62.44	V	1375.8	-35.56	8.521	1.32	-28.359	-13	-15.359
5000.18	58.74	V	5000.18	-32.26	10.258	1.87	-23.872	-13	-10.872
39805	52.19	V	39805	-37.81	23.139	4.32	-18.991	-13	-5.991

Note: *All other emissions are at the noise floor and/or more than 20 dB below the limit.*