



TESTING LABORATORY  
CERTIFICATE NUMBER: 3297.02



# FCC PART 24D

## TEST AND MEASUREMENT REPORT

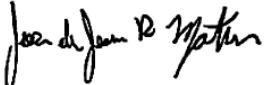
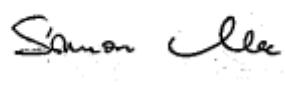
For

### G-Way Microwave

38 Leuning Street,

South Hackensack, NJ 07606, USA

**FCC ID: Q8KPS82070M**

<b>Report Type:</b> Original Report	<b>Product Type:</b> Industrial Signal Booster
<b>Prepared By:</b> <u>Jose Martinez</u> 	
<b>Report Number:</b> <u>R1705094-24D</u>	
<b>Report Date:</b> <u>2017-10-18</u>	
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**Note:** This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. This report **must not** be used by the customer to claim product certification, approval, or endorsement by A2LA\* or any agency of the Federal Government.

\* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk

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## TABLE OF CONTENTS

<b>1 GENERAL INFORMATION .....</b>	<b>5</b>
1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT).....	5
1.2 MECHANICAL DESCRIPTION .....	5
1.3 OBJECTIVE.....	5
1.4 RELATED SUBMITTAL(S)/GRANT(S).....	5
1.5 TEST METHODOLOGY .....	5
1.6 MEASUREMENT UNCERTAINTY.....	6
1.7 TEST FACILITY.....	6
<b>2 SYSTEM TEST CONFIGURATION .....</b>	<b>9</b>
2.1 JUSTIFICATION .....	9
2.2 EUT EXERCISE SOFTWARE .....	9
2.3 EQUIPMENT MODIFICATIONS .....	9
2.4 LOCAL SUPPORT EQUIPMENT LIST AND DETAILS .....	9
2.5 POWER SUPPLY AND LINE FILTERS.....	9
2.6 INTERFACE PORTS AND CABLING .....	9
<b>3 SUMMARY OF TEST RESULTS.....</b>	<b>10</b>
<b>4 FCC §2.1091 - RF EXPOSURE .....</b>	<b>11</b>
4.1 APPLICABLE STANDARDS .....	11
4.2 MPE PREDICTION .....	11
4.3 TEST RESULTS .....	12
<b>5 FCC §24.132 (A) (C) - RF OUTPUT POWER .....</b>	<b>13</b>
5.1 APPLICABLE STANDARDS .....	13
5.2 TEST PROCEDURE .....	13
5.3 TEST EQUIPMENT LIST AND DETAILS .....	13
5.4 TEST ENVIRONMENTAL CONDITIONS.....	13
5.5 TEST RESULTS .....	14
<b>6 FCC §24.131 - INPUT-VERSUS-OUTPUT SIGNAL COMPARISON: OCCUPIED BANDWIDTH .....</b>	<b>15</b>
6.1 APPLICABLE STANDARDS .....	15
6.2 TEST PROCEDURE .....	15
6.3 TEST EQUIPMENT LIST AND DETAILS .....	15
6.4 TEST ENVIRONMENTAL CONDITIONS.....	15
6.5 TEST RESULTS .....	16
<b>7 FCC §24.133(A) (1) (I) - EMISSION MASK .....</b>	<b>19</b>
7.1 APPLICABLE STANDARDS .....	19
7.2 TEST PROCEDURE .....	19
7.3 TEST EQUIPMENT LIST AND DETAILS .....	19
7.4 TEST ENVIRONMENTAL CONDITIONS.....	20
7.5 TEST RESULTS .....	20
<b>8 FCC §24.133 (A) (1) (II) - SPURIOUS RADIATED EMISSIONS .....</b>	<b>21</b>
8.1 APPLICABLE STANDARDS .....	21
8.2 TEST PROCEDURE .....	21
8.3 TEST SETUP BLOCK DIAGRAM.....	22
8.4 TEST EQUIPMENT LIST AND DETAILS .....	23
8.5 TEST ENVIRONMENTAL CONDITIONS.....	23
8.6 TEST RESULTS .....	23
<b>9 FCC §24.133 (A) (1) (II) - SPURIOUS EMISSIONS AT ANTENNA TERMINALS .....</b>	<b>25</b>
9.1 APPLICABLE STANDARDS .....	25

9.2	TEST PROCEDURE .....	25
9.3	TEST EQUIPMENT LIST AND DETAILS .....	25
9.4	TEST ENVIRONMENTAL CONDITIONS.....	26
9.5	TEST RESULTS .....	26
<b>10</b>	<b>FCC §24.133 - INTERMODULATION .....</b>	<b>34</b>
10.1	APPLICABLE STANDARDS .....	34
10.2	TEST PROCEDURE .....	34
10.3	TEST EQUIPMENT LIST AND DETAILS .....	35
10.4	TEST ENVIRONMENTAL CONDITIONS.....	36
10.5	TEST RESULTS .....	36
<b>11</b>	<b>FCC §20.21 - OUT OF BAND REJECTION.....</b>	<b>38</b>
11.1	APPLICABLE STANDARD .....	38
11.2	TEST PROCEDURE .....	38
11.3	TEST EQUIPMENT LIST AND DETAILS .....	38
11.4	TEST ENVIRONMENTAL CONDITIONS.....	38
11.5	TEST RESULTS .....	39

**DOCUMENT REVISION HISTORY**

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1705094-24D	Original Report	2017-10-18

## 1 General Information

### 1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *G-Way Microwave* and their product model: BDA-PS9-20/20-70-M, FCC ID: Q8KPS82070M, which will henceforth be referred to as the EUT (Equipment under Test). The EUT is an Industrial Signal Booster. The operating frequency range is shown below,

Model Number	Downlink	Uplink	Equipment Class
BDA-PS7W-20/20-70-M	758-775 MHz	788-805 MHz	B9B*
BDA-PS8NEPS-20/20-70-M	851-861 MHz	806-816 MHz	B9B*
BDA-PS9-20/20-70-M	935-940 MHz	896-901 MHz	B9B* & B2I*
	940-941 MHz	901-902 MHz	B2I

*\*measurements for these operating frequencies were reported in separate Test Reports. Please refer to Section 1.4 of this Test Report for details.*

### 1.2 Mechanical Description

The EUT measured approximately 25.4 cm (L) x 15.75 cm (W) x 7.62 cm (H) and weighs 2.08 kg.

*The test data gathered are from production sample. Serial number: 17051003 provided by G-Way Microwave.*

### 1.3 Objective

This type approval report was prepared on behalf of *G-Way Microwave* in accordance with Part 2, Subpart J, Part 24-D of the Federal Communication Commission's rules.

The objective is to determine compliance with FCC Part 24-D rules for RF output power, occupied bandwidth, spurious emissions at antenna terminal, field strength of spurious radiation, and band edge.

### 1.4 Related Submittal(s)/Grant(s)

FCC Part 90 Report: R1705094-90 for Equipment Class B9B.

FCC Part 90S Report: R1705094-90S for Equipment Class B2I.

### 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, Subpart J as well as the following parts:

Part 24D – Narrowband PCS

Applicable Standards: FCC KDB 935210 D05 Indus Booster Basic Meas v01r0, KDB 971168 D01 Power Meas License Digital Systems v02r02

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 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.

Parameter	Measurement uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.57 dB
Unwanted Emissions, conducted	±1.57dB
All emissions, radiated	±4.0 dB
Temperature	±2 °C
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

## 1.7 Test Facility

Bay Area Compliance Laboratories Corp. (BACL) is:

**A- An independent, 3<sup>rd</sup>-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 Clause 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**

- - 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):
  - o BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - o NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - o EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
  - o Radio & Teleterminal Equipment (R&TTE) Directive 1995/5/EC US -EU EMC & Telecom MRA CAB (NB)
  - o Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
  - o Low Voltage Directive (LVD) 2014/35/EU
- 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:
  - o ENERGY STAR Recognized Test Laboratory – US EPA
  - o Telecommunications Certification Body (TCB) – US FCC;
  - o Nationally Recognized Test Laboratory (NRTL) – US OSHA
- Vietnam: APEC Tel MRA -Phase I;

## 2 System Test Configuration

### 2.1 Justification

The EUT was configured for testing according to KDB 935210 D05 V01r01. The final qualification test was performed with the EUT operating at normal mode.

### 2.2 EUT Exercise Software

There was no exercise software with the EUT; signal was sent through EUT using a signal generator.

### 2.3 Equipment Modifications

No modifications were made to the EUT.

### 2.4 Local Support Equipment List and Details

N/A

### 2.5 Power Supply and Line Filters

Manufacturers	Descriptions	Models	Serial Numbers
-	-	TRH25150-A-12E03 VI	-

### 2.6 Interface Ports and Cabling

Cable Description	Length (m)	From	To
RF cable	< 1	Signal Generator	EUT Input
RF cable	< 1	EUT Output	Spectrum Analyzer

### 3 Summary of Test Results

FCC Rules	Description of Tests	Results
§2.1091	RF Exposure	Compliant
§24.132 (a) & (c)	RF Output Power	Compliant
§24.131	Input-versus-output Signal Comparison: OBW	Compliant
§24.133 (a) (1) (i)	Input-versus-output Signal Comparison: Emission Mask	Compliant
§24.133 (a) (1) (ii)	Spurious Radiated Emissions	Compliant
§24.133 (a) (1) (ii)	Spurious Emissions at Antenna Terminals	Compliant
§24.133 (a) (1) (ii)	Intermodulation	Compliant
§20.21	Out of Band Rejection	Compliant

## 4 FCC §2.1091 - RF Exposure

### 4.1 Applicable Standards

FCC §2.1091, (a) Requirements of this section are a consequence of Commission responsibilities under the National Environmental Policy Act to evaluate the environmental significance of its actions. See subpart I of part 1 of this chapter, in particular §1.1307(b).

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 <sup>2</sup> )	Averaging Time (minute)
<b>Limits for General Population/Uncontrolled Exposure</b>				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

Note: 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 Test Results

#### Downlink: 940-941 MHz

Maximum peak output power at antenna input terminal (dBm): 19.93  
Maximum peak output power at antenna input terminal (mW): 98.4011  
Prediction distance (cm): 20  
Prediction frequency (MHz): 940.5  
Antenna Gain, typical (dBi): 2  
Maximum Antenna Gain (numeric): 1.5849  
Power density at predication frequency and distance (mW/cm<sup>2</sup>): 0.031  
FCC limit (mW/cm<sup>2</sup>): 0.627

#### Uplink: 901-902 MHz

Maximum peak output power at antenna input terminal (dBm): 20.20  
Maximum peak output power at antenna input terminal (mW): 104.71  
Prediction distance (cm): 20  
Prediction frequency (MHz): 901.5  
Antenna Gain, typical (dBi): 2  
Maximum Antenna Gain (numeric): 1.5849  
Power density at predication frequency and distance (mW/cm<sup>2</sup>): 0.033  
FCC limit (mW/cm<sup>2</sup>): 0.601

### Conclusion

The highest power density levels at 20 cm are below the MPE uncontrolled exposure limit.

## 5 FCC §24.132 (a) (c) - RF Output Power

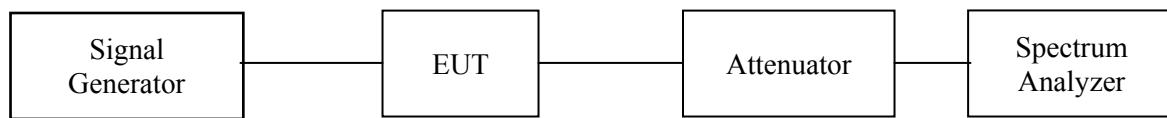
### 5.1 Applicable Standards

According to FCC §24.132 (a), stations transmitting in the 901-902 MHz band are limited to 7 watts e.r.p.

According to FCC §24.132 (c), Base stations transmitting in the 930-931 MHz and 940-941 MHz bands are limited to 3500 watts e.r.p. per authorized channel and are unlimited in antenna height except as provided in paragraph (d) of this section.

### 5.2 Test Procedure

The signal generator output was connected to the EUT input. The output of the EUT was connected to a spectrum analyzer through appropriate attenuation.



### 5.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2017-02-24	1 year
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2016-07-29	2 years
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2017-01-06	1 year
-	20 dB attenuator	-	-	Each Time <sup>1</sup>	Each Time <sup>1</sup>
-	SMA cable	-	C04	Each Time <sup>1</sup>	Each Time <sup>1</sup>
-	SMA cable	-	C09	Each Time <sup>1</sup>	Each Time <sup>1</sup>

<sup>1</sup>Note: This equipment was calibrated for each test.

**Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

### 5.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	32 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Jose Martinez 2017-05-12 in the RF Site.

## 5.5 Test Results

Downlink, 940-941 MHz

Signal Type	AGC	Input Power (dBm)	Conducted Output Power (dBm)	Booster Gain (dB)	Antenna Gain (dBi)	ERP (dBm)	Limit (dBm)	Results
16 QAM	Off	-52.95	19.58	72.53	2	19.43	65	Compliance
	On	-50.14	19.93	70.07	2	19.78	65	Compliance

Uplink, 901-902 MHz

Signal Type	AGC	Input Power (dBm)	Conducted Output Power (dBm)	Booster Gain (dB)	Antenna Gain (dBi)	ERP (dBm)	Limit (dBm)	Results
16 QAM	Off	-50.93	19.91	70.84	2	19.76	38.5	Compliance
	On	-50.62	20.20	70.82	2	20.05	38.5	Compliance

ERP = Measured Conducted Output Power (dBm) + Antenna Gain (dBi) -2.15 (dB)

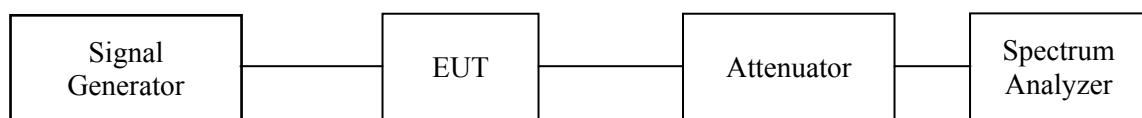
## 6 FCC §24.131 - Input-versus-output Signal Comparison: Occupied Bandwidth

### 6.1 Applicable Standards

According to FCC §24.131, The authorized bandwidth of narrowband PCS channels will be 10 kHz for 12.5 kHz channels and 45 kHz for 50 kHz channels. For aggregated adjacent channels, a maximum authorized bandwidth of 5 kHz less than the total aggregated channel width is permitted.

### 6.2 Test Procedure

The signal generator was connected to the support equipment and the support equipment was connected to the EUT through a fiber cable. The output of the EUT was connected to a spectrum analyzer through appropriate attenuation.



### 6.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2017-02-24	1 year
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2016-07-29	2 years
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2017-01-06	1 year
-	20 dB attenuator	-	-	Each Time <sup>1</sup>	Each Time <sup>1</sup>
-	SMA cable	-	C04	Each Time <sup>1</sup>	Each Time <sup>1</sup>
-	SMA cable	-	C09	Each Time <sup>1</sup>	Each Time <sup>1</sup>

<sup>1</sup>Note: This equipment was calibrated for each test.

**Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

### 6.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	32 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Jose Martinez 2017-06-05 in the RF Site.

## 6.5 Test Results

Please refer to the following table and plots.

Downlink: 940-941 MHz

Signal Type	AGC	Input		Output	
		99 % OBW (kHz)	26 dB OBW (kHz)	99 % OBW (kHz)	26 dB OBW (kHz)
16 QAM	off	28.1225	32.600	28.0197	32.577
	on	28.0599	32.527	28.0501	32.614

Uplink: 901-902 MHz

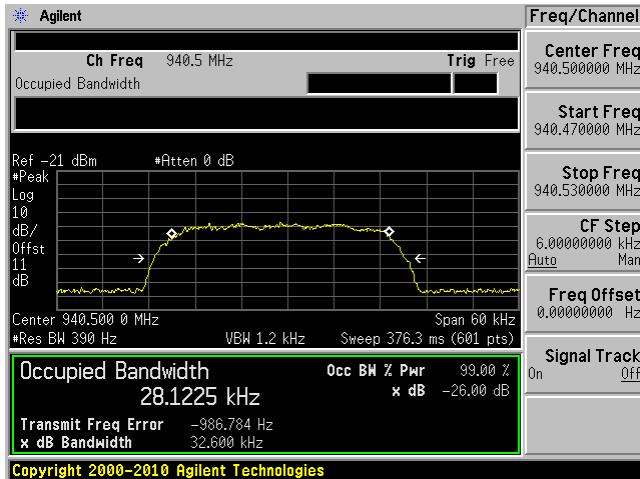
Signal Type	AGC	Input		Output	
		99 % OBW (kHz)	26 dB OBW (kHz)	99 % OBW (kHz)	26 dB OBW (kHz)
16 QAM	off	28.1483	32.690	27.9532	32.675
	on	28.0328	32.419	28.0628	32.609

Note: The 99 % occupied bandwidth was used to compare the input and output signal.

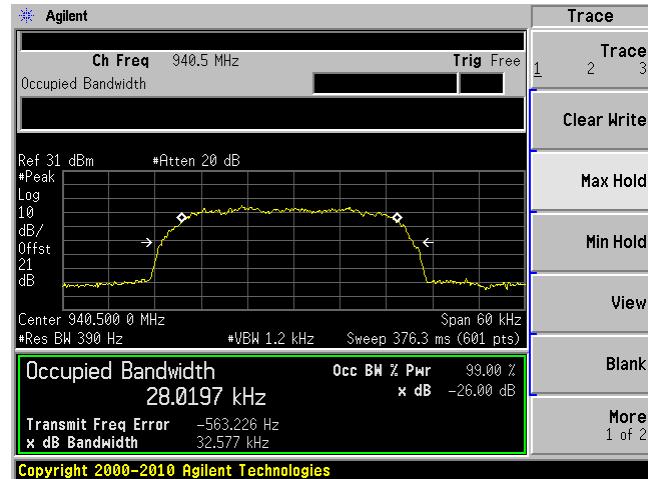
## Downlink: 940-941 MHz

AGC off

Input

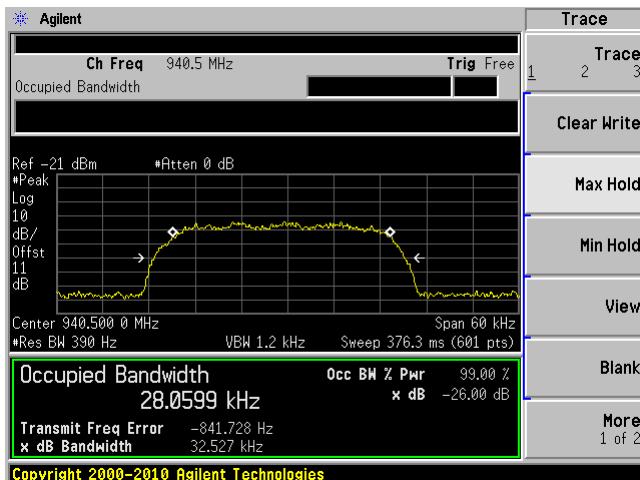


Output

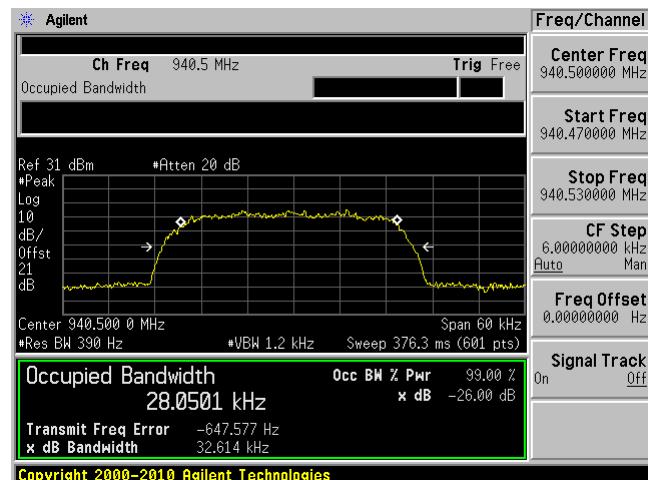


AGC on

Input



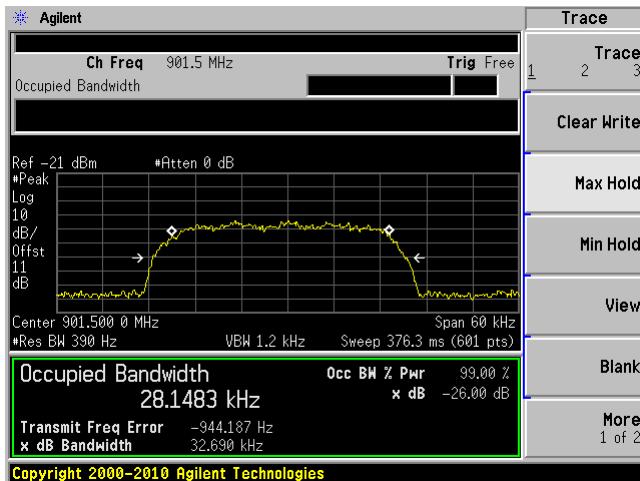
Output



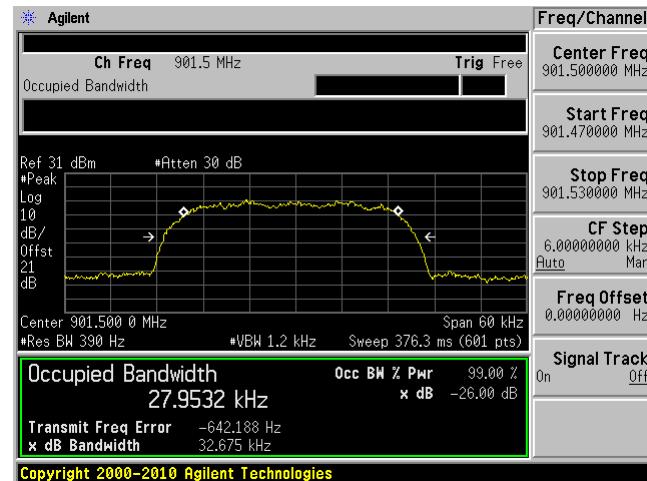
## Uplink: 901-902 MHz

AGC off

Input

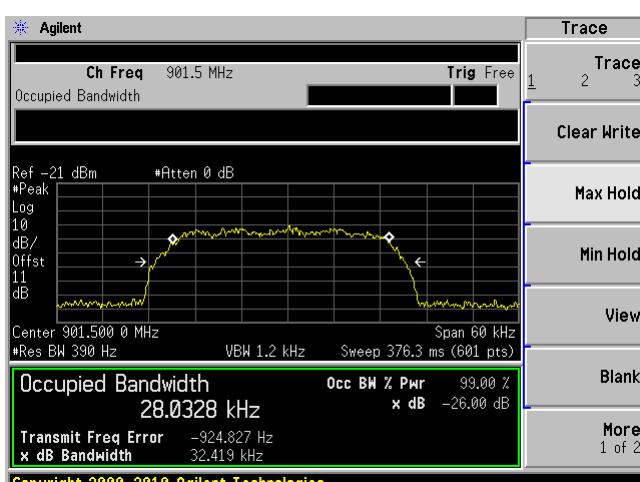


Output

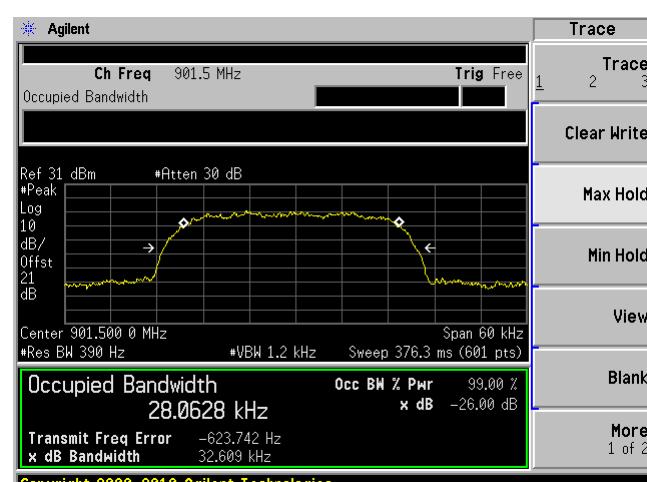


AGC on

Input



Output



## 7 FCC §24.133(a) (1) (i) - Emission Mask

### 7.1 Applicable Standards

According to FCC §24.133(a), the power of any emission shall be attenuated below the transmitter power (P), as measured in accordance with §24.132(f), in accordance with the following schedule:

(1) For transmitters authorized a bandwidth greater than 10 kHz:

(i) On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (fd in kHz) of up to and including 40 kHz: at least  $116 \log_{10}((fd + 10)/6.1)$  decibels or 50 plus  $10 \log_{10}(P)$  decibels or 70 decibels, whichever is the lesser attenuation;

(ii) On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 40 kHz: at least  $43 + 10 \log_{10}(P)$  decibels or 80 decibels, whichever is the lesser attenuation.

### 7.2 Test Procedure

According to FCC §24.133(d), the following minimum spectrum analyzer resolution bandwidth settings were used: 300 Hz when showing compliance with paragraphs (a)(1)(i); and 30 kHz when showing compliance with paragraphs (a)(1)(ii).

The signal generator output was connected to the EUT input. The output of the EUT was connected to a spectrum analyzer through appropriate attenuation.



### 7.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2017-02-24	1 year
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2016-07-29	2 years
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2017-01-06	1 year
-	20 dB attenuator	-	-	Each Time <sup>1</sup>	Each Time <sup>1</sup>
-	SMA cable	-	C04	Each Time <sup>1</sup>	Each Time <sup>1</sup>
-	SMA cable	-	C09	Each Time <sup>1</sup>	Each Time <sup>1</sup>

<sup>1</sup>Note: This equipment was calibrated for each test.

**Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

## 7.4 Test Environmental Conditions

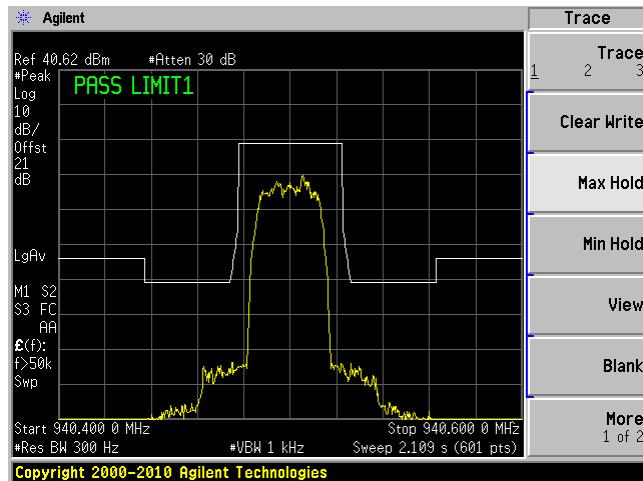
Temperature:	23° C
Relative Humidity:	32 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Jose Martinez 2017-06-05 in the RF Site.

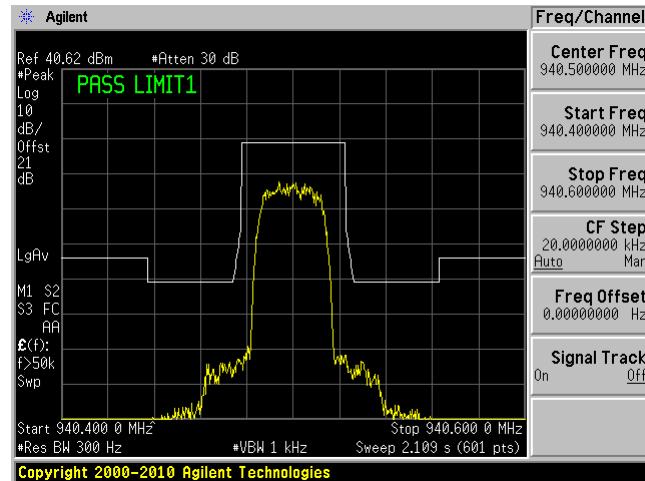
## 7.5 Test Results

### Downlink: 940-941 MHz

16 QAM Signal-AGC off

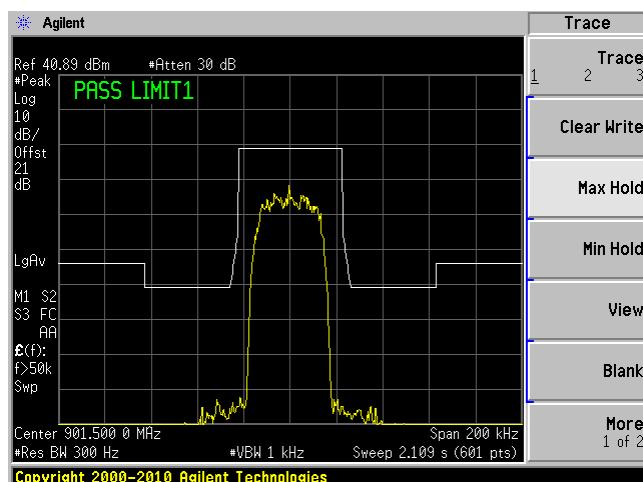


16 QAM Signal-AGC on

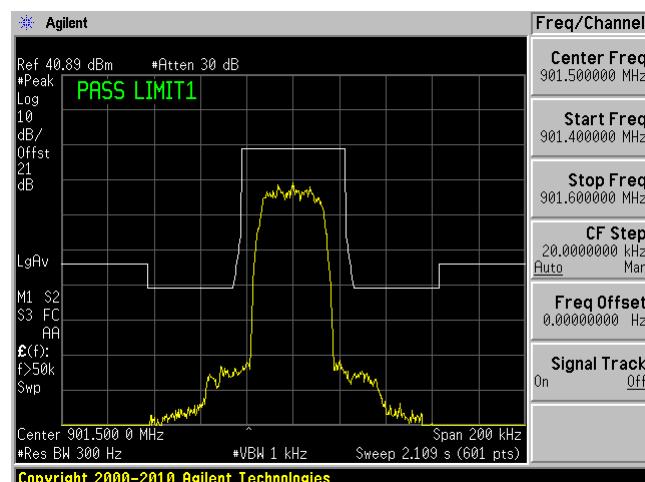


### Uplink: 901-902 MHz

16 QAM Signal-AGC off



16 QAM Signal-AGC on



## 8 FCC §24.133 (a) (1) (ii) - Spurious Radiated Emissions

### 8.1 Applicable Standards

According to FCC §24.133(a), The power of any emission shall be attenuated below the transmitter power (P), as measured in accordance with §24.132(f), in accordance with the following schedule:

(1) For transmitters authorized a bandwidth greater than 10 kHz:

(i) On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (fd in kHz) of up to and including 40 kHz: at least  $116 \log_{10}((fd + 10)/6.1)$  decibels or 50 plus  $10 \log_{10}(P)$  decibels or 70 decibels, whichever is the lesser attenuation;

(ii) On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 40 kHz: at least  $43 + 10 \log_{10}(P)$  decibels or 80 decibels, whichever is the lesser attenuation.

### 8.2 Test Procedure

The transmitter was place onto a Styrofoam block. The unit was normally transmitting with a 50 ohm terminator connected to the antenna terminal.

The measurement antenna was placed at a distance of 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.

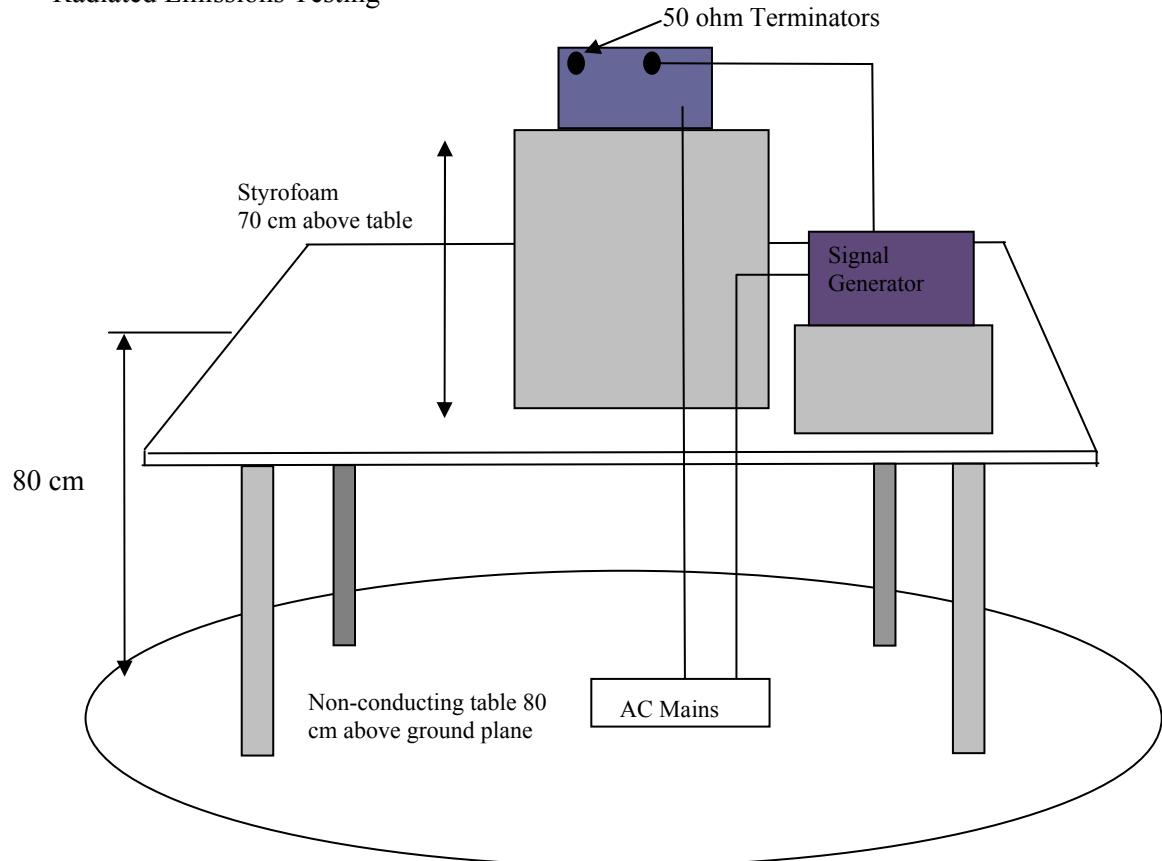
Emissions were investigated up to the tenth harmonic of the fundamental frequency.

After the emissions were found, the EUT was removed and replaced by a substituting antenna. A signal generator was connected to the substituting antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB =  $10 \lg (TXpwr \text{ in Watts}/0.001)$  – the absolute level  
Spurious attenuation limit in dB =  $43 + 10 \log_{10}(\text{power out in Watts})$

### 8.3 Test Setup Block Diagram

Radiated Emissions Testing



## 8.4 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2017-02-24	1 year
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Sciences	Antenna, Biconi-Log	JB3	A020106-2	2015-08-11	2 years
Agilent	Amplifier, Pre	8447D	2944A10187	2016-06-05	1 year
Agilent	Pre-Amplifier	8449B	3008A01978	2016-10-06	1 year
EMCO	Antenna, Horn	3115	9511-4627	2016-01-28	2 years
A.R.A.	Antenna, Horn	DRG-118/A	1132	2015-09-21	2 years
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2017-01-06	1 year
COM-POWER	Antenna, Dipole	AD-100	721033DB1/2/3/4	2017-02-13	2 years
-	SMA cable	-	C04	Each Time <sup>1</sup>	Each Time <sup>1</sup>
-	SMA cable	-	C09	Each Time <sup>1</sup>	Each Time <sup>1</sup>

<sup>1</sup>*Note: This equipment was calibrated for each test.*

**Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

## 8.5 Test Environmental Conditions

Temperature:	20-21°C
Relative Humidity:	47-49 %
ATM Pressure:	101.4-101.6 kPa

The testing was performed by Jose Martinez on 2017-06-15 in 5 Meter Chamber 3.

## 8.6 Test Results

Downlink Worst Margin: **-39.32 dB** at **144.80 MHz** in the **Horizontal** polarization.

Uplink Worst Margin: **- 36.16 dB** at **141.6 MHz** in the **Vertical** polarization.

**Downlink: 940-941 MHz**

Middle Channel

Indicated		Azimuth (degree)	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Frequency (MHz)	S.A. Amp. (dBuV)		Height (cm)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Gain Correction (dB)	Cable Loss (dB)	Absolute Level (dBm)		
80.00	47.69	100.00	170.00	H	80.00	-54.42	0.00	0.28	-54.70	-13.00	-41.70
80.00	43.92	270.00	100.00	V	80.00	-55.96	0.00	0.28	-56.24	-13.00	-43.24
144.80	47.92	300.00	100.00	H	144.80	-51.87	0.00	0.45	-52.32	-13.00	-39.32
144.80	42.65	70.00	170.00	V	144.80	-52.92	0.00	0.45	-53.37	-13.00	-40.37
1060.00	52.56	0.00	100.00	H	1060.00	-60.35	6.14	0.20	-54.42	-13.00	-41.42
1060.00	52.48	45.00	270.00	V	1060.00	-61.13	6.14	0.20	-55.20	-13.00	-42.20
1735.00	51.25	0.00	0.00	H	1735.00	-61.44	6.87	0.26	-54.83	-13.00	-41.83
1735.00	51.74	75.00	100.00	V	1735.00	-61.93	6.87	0.26	-55.32	-13.00	-42.32

**Uplink: 901-902 MHz**

Middle Channel

Indicated		Azimuth (degree)	Test Antenna		Substituted					Limit (dBm)	Margin (dB)
Frequency (MHz)	S.A. Amp. (dBuV)		Height (cm)	Polarity (H/V)	Frequency (MHz)	Level (dBm)	Ant. Gain Correction (dB)	Cable Loss (dB)	Absolute Level (dBm)		
80.00	45.97	90.00	200.00	H	80.00	-56.14	0.00	0.28	-56.42	-13.00	-43.42
80.00	44.95	140.00	172.00	V	80.00	-54.93	0.00	0.28	-55.21	-13.00	-42.21
141.60	47.22	300.00	210.00	H	141.60	-51.78	0.00	0.37	-52.15	-13.00	-39.15
141.60	45.74	140.00	190.00	V	141.60	-48.79	0.00	0.37	-49.16	-13.00	-36.16
1030.00	51.94	180.00	100.00	H	1030.00	-60.97	6.14	0.20	-55.04	-13.00	-42.04
1030.00	52.66	180.00	100.00	V	1030.00	-60.95	6.14	0.20	-55.02	-13.00	-42.02
1540.00	51.51	330.00	100.00	H	1540.00	-61.82	6.87	0.25	-55.20	-13.00	-42.20
1540.00	50.96	220.00	100.00	V	1540.00	-62.66	6.87	0.25	-56.04	-13.00	-43.04

## 9 FCC §24.133 (a) (1) (ii) - Spurious Emissions at Antenna Terminals

### 9.1 Applicable Standards

According to FCC §24.133(a), The power of any emission shall be attenuated below the transmitter power (P), as measured in accordance with §24.132(f), in accordance with the following schedule:

(1) For transmitters authorized a bandwidth greater than 10 kHz:

(i) On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (fd in kHz) of up to and including 40 kHz: at least  $116 \log_{10}((fd + 10)/6.1)$  decibels or 50 plus  $10 \log_{10}(P)$  decibels or 70 decibels, whichever is the lesser attenuation;

(ii) On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 40 kHz: at least  $43 + 10 \log_{10}(P)$  decibels or 80 decibels, whichever is the lesser attenuation.

### 9.2 Test Procedure

According to FCC §24.133(d), the following minimum spectrum analyzer resolution bandwidth settings were used: 300 Hz when showing compliance with paragraphs (a)(1)(i); and 30 kHz when showing compliance with paragraphs (a)(1)(ii).

The signal generator output was connected to the EUT input. The output of the EUT was connected to a spectrum analyzer through appropriate attenuation.



### 9.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2017-02-24	1 year
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2016-07-29	2 years
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2017-01-06	1 year
-	20 dB attenuator	-	-	Each Time <sup>1</sup>	Each Time <sup>1</sup>
-	10 dB attenuator	-	-	Each Time <sup>1</sup>	Each Time <sup>1</sup>
-	SMA cable	-	C04	Each Time <sup>1</sup>	Each Time <sup>1</sup>
-	SMA cable	-	C09	Each Time <sup>1</sup>	Each Time <sup>1</sup>

<sup>1</sup>Note: This equipment was calibrated for each test.

**Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

#### 9.4 Test Environmental Conditions

<b>Temperature:</b>	23° C
<b>Relative Humidity:</b>	32 %
<b>ATM Pressure:</b>	101.4-102 kPa

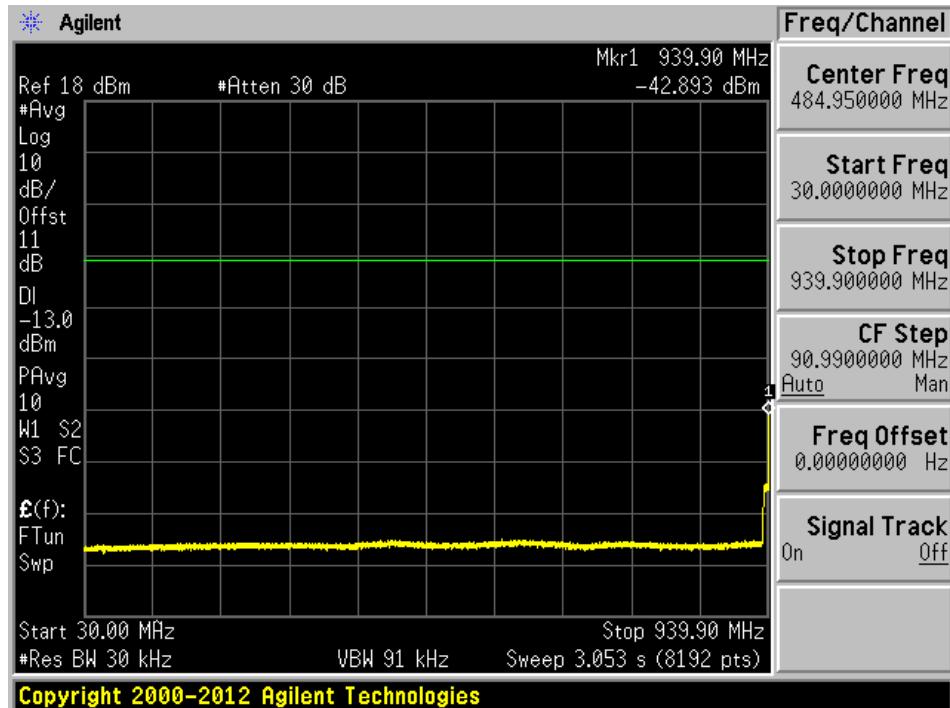
*The testing was performed by Jose Martinez 2017-06-27 in the RF Site.*

#### 9.5 Test Results

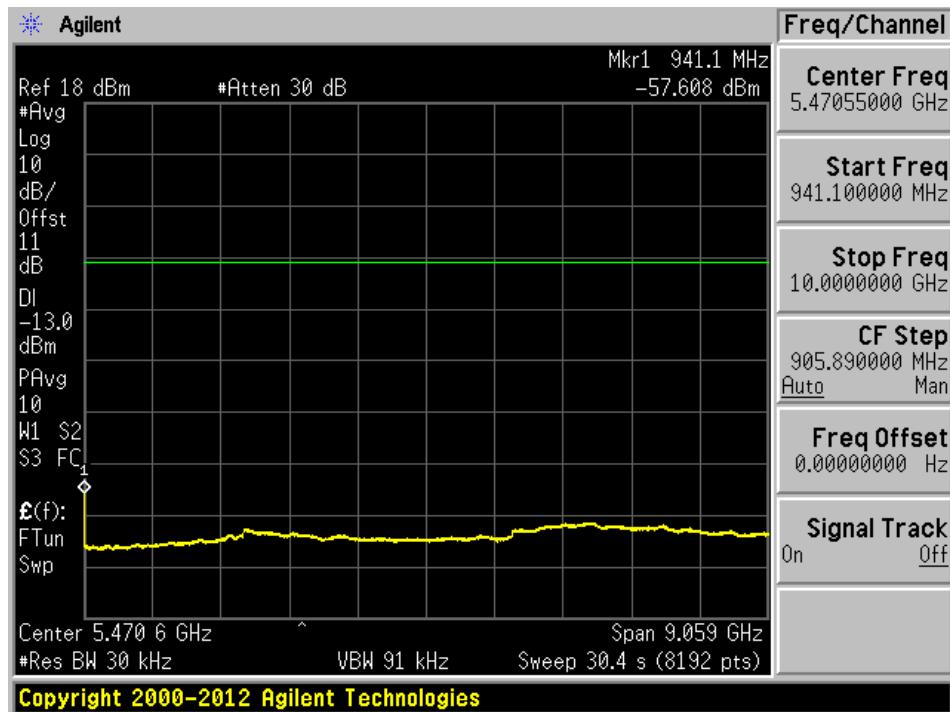
Please refer to the following plots.

**Downlink: 940-941 MHz**

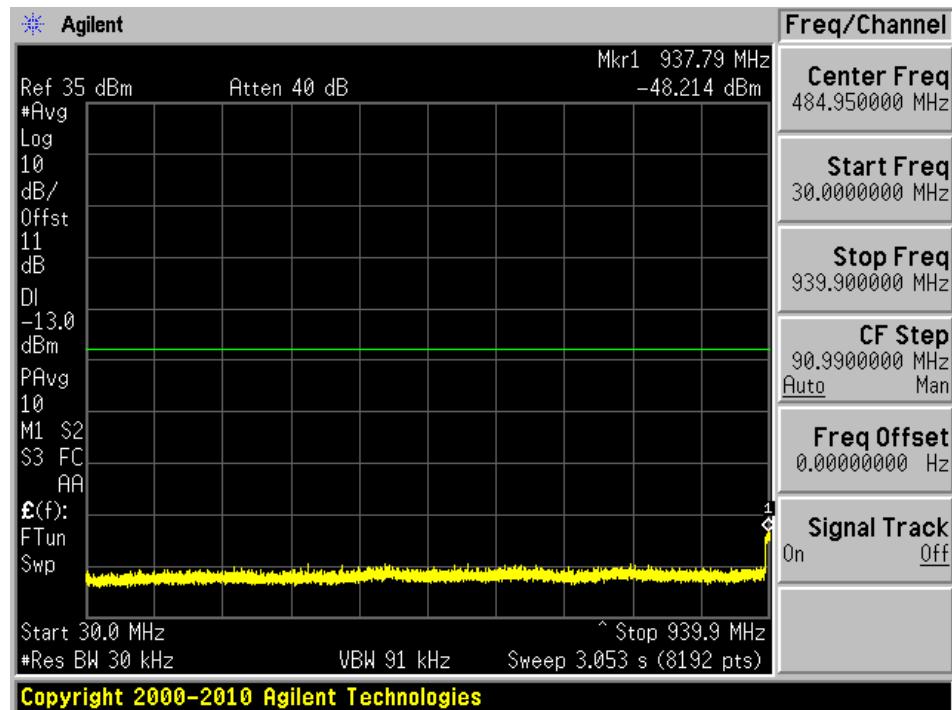
Low Channel 30MHz-939.9MHz



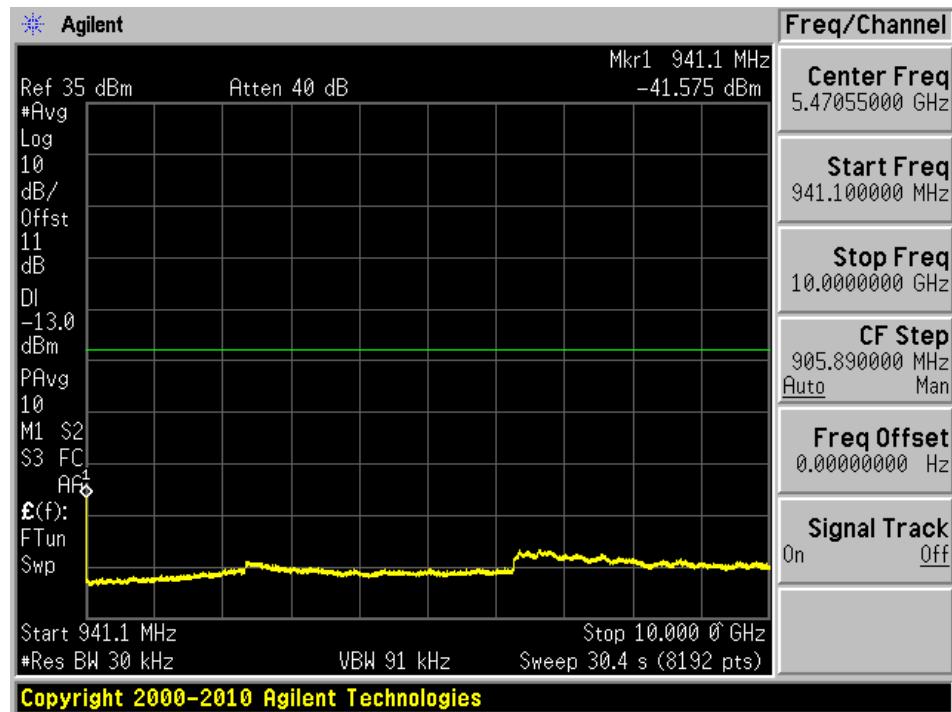
Low Channel 941.1MHz-10GHz



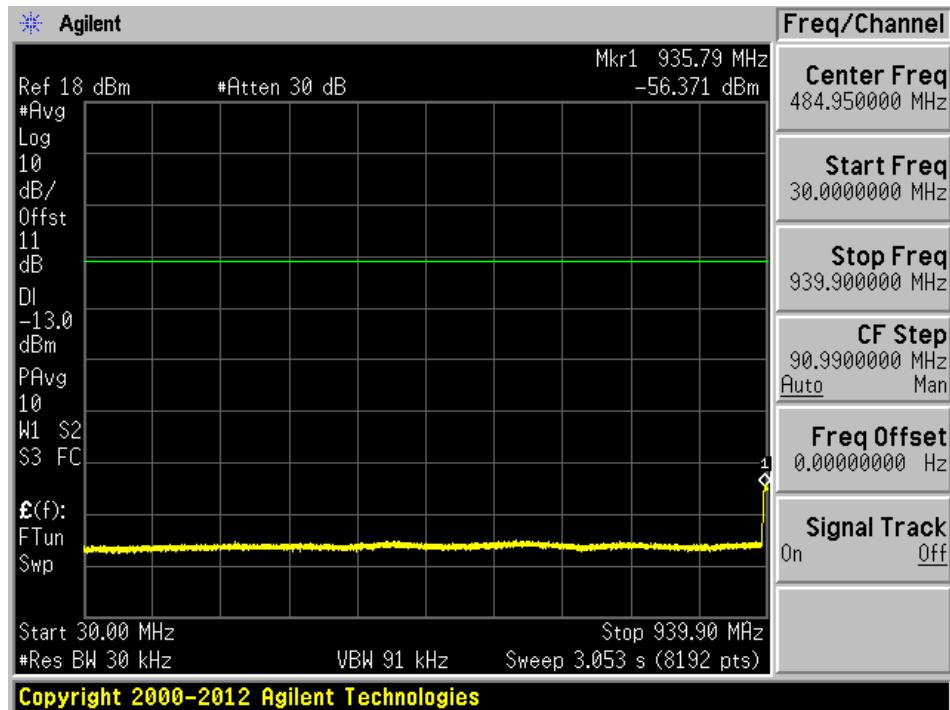
## Middle Channel 30MHz-939.9MHz



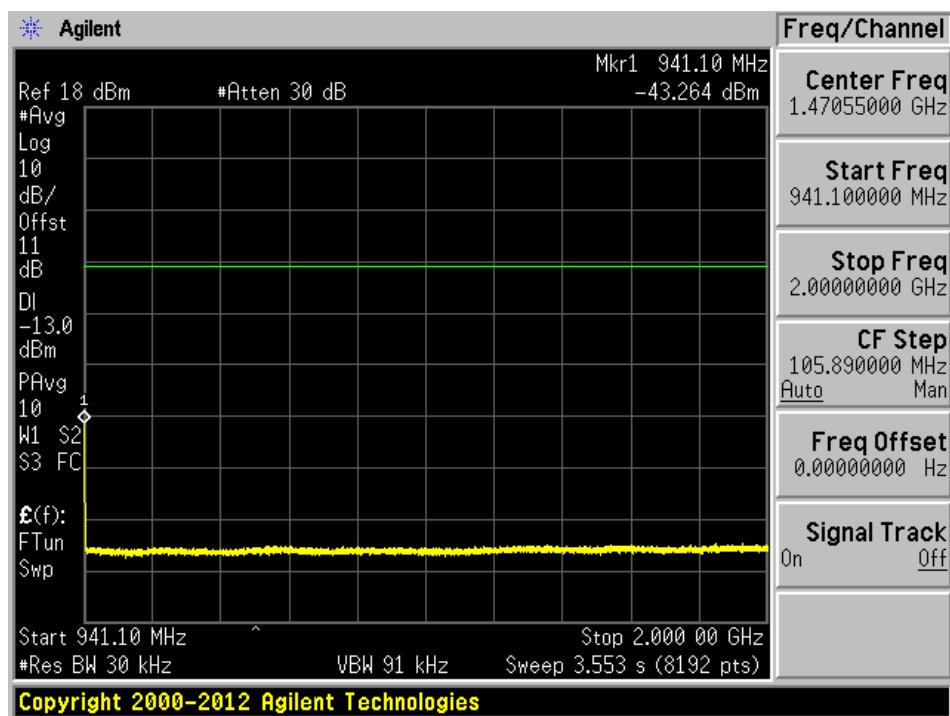
## Middle Channel 941.1MHz-10GHz



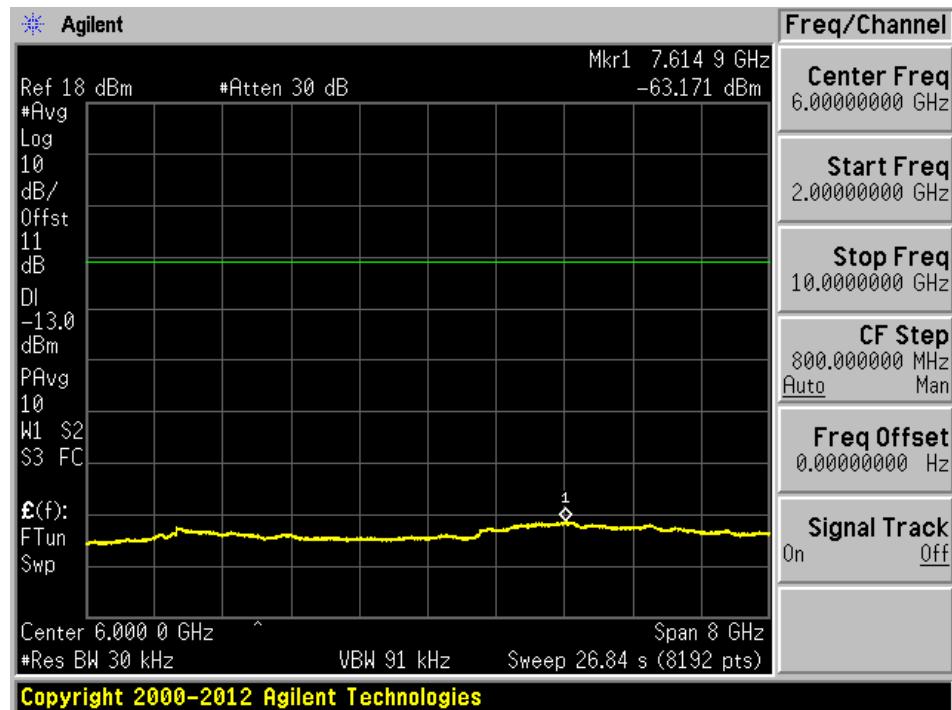
## High Channel 30MHz-939.9MHz



## High Channel 941.1MHz-10GHz

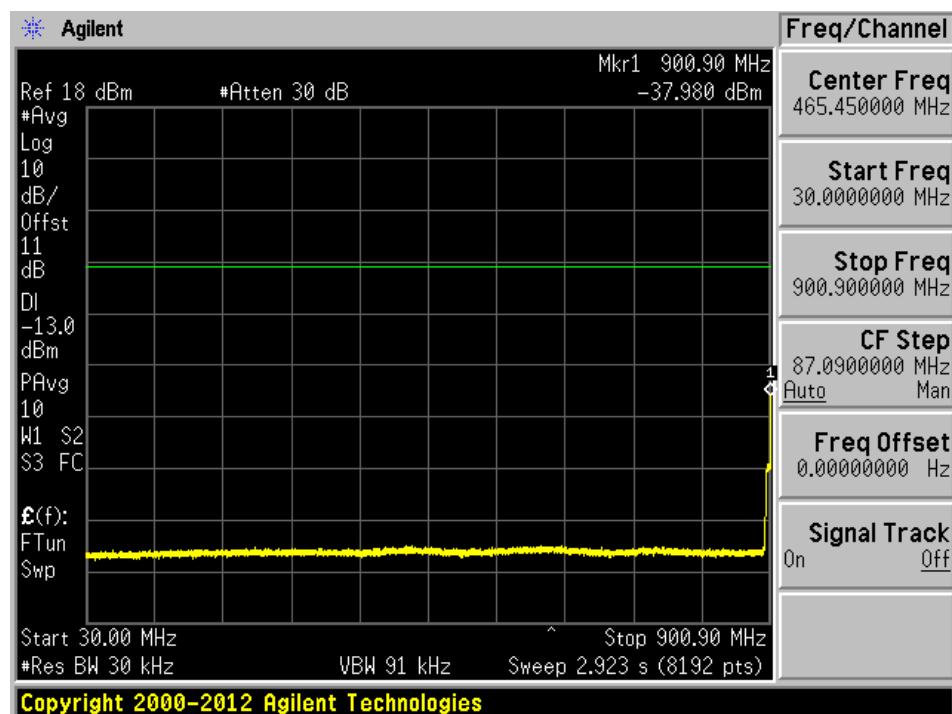


## High Channel 941.1MHz-10GHz

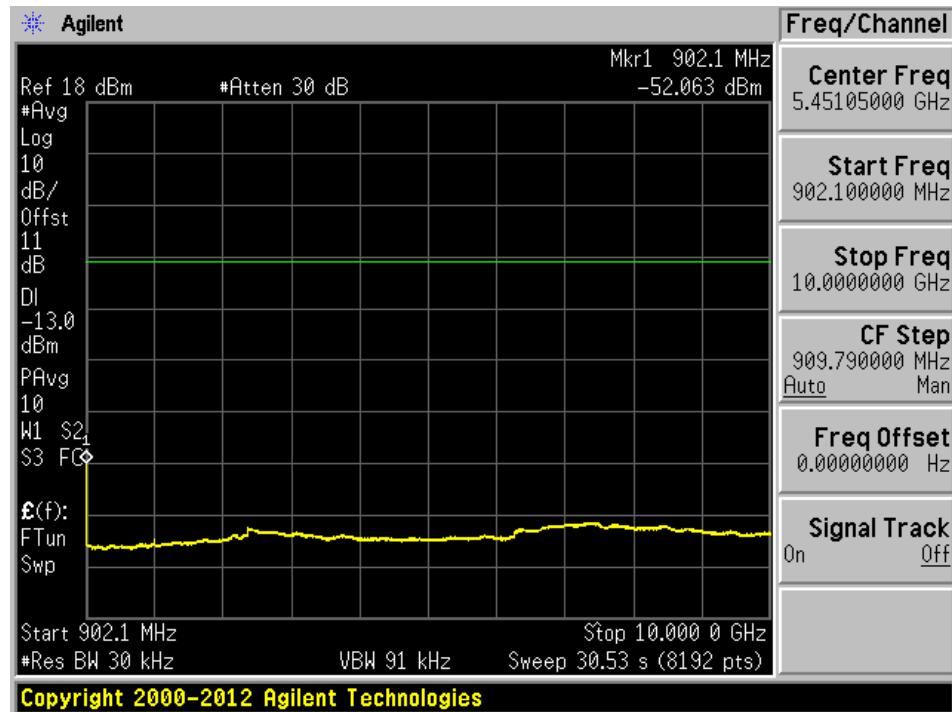


## Uplink: 901-902 MHz

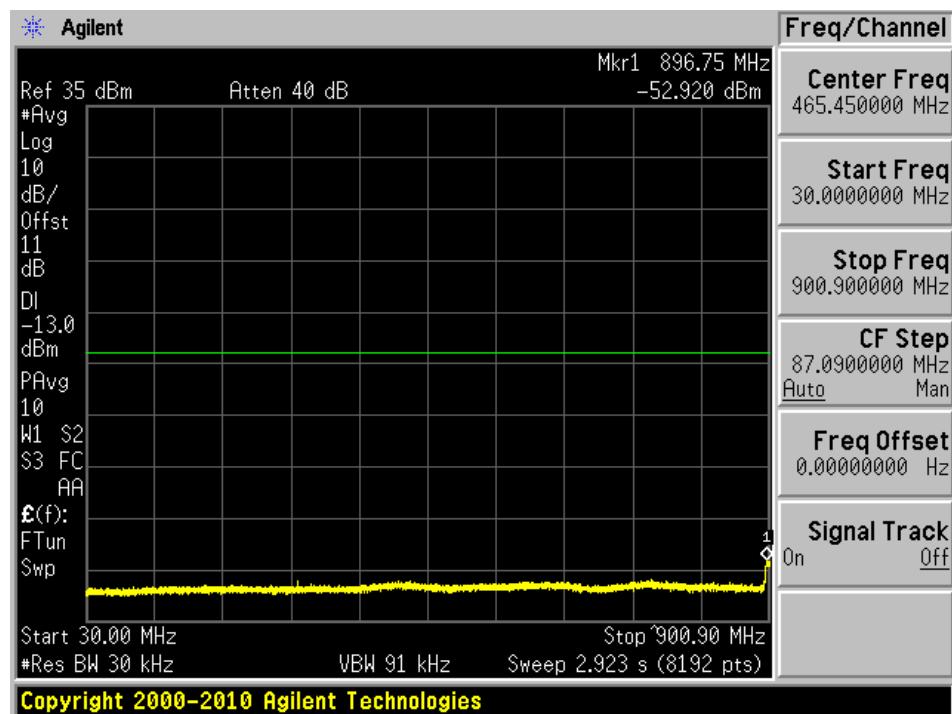
## Low Channel 30MHz-900.9 MHz



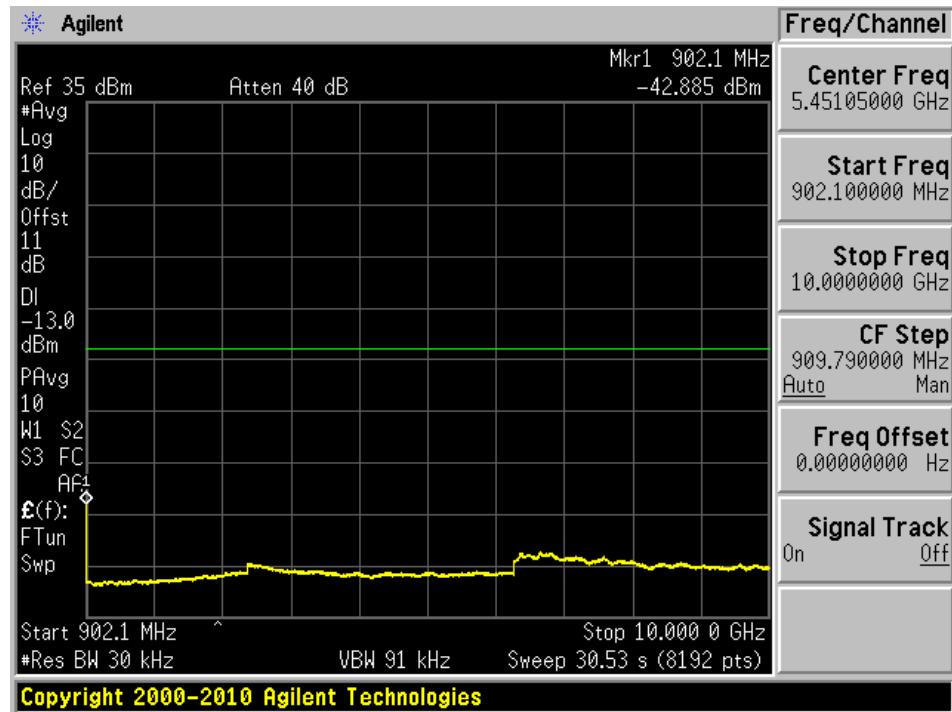
## Low Channel 902.1 MHz-10GHz



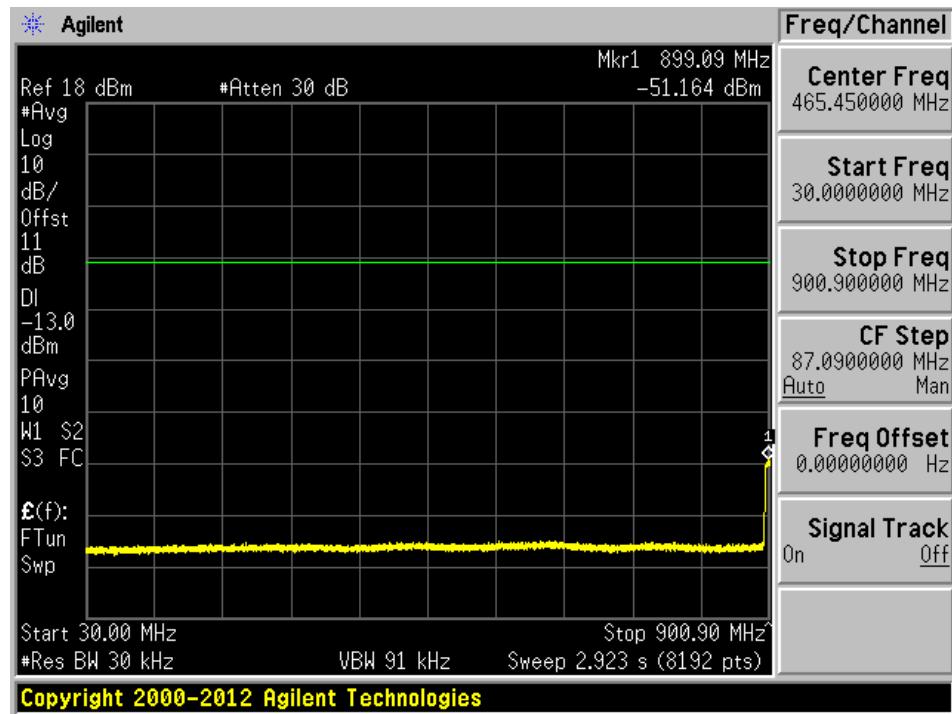
## Middle Channel 30MHz-900.9MHz



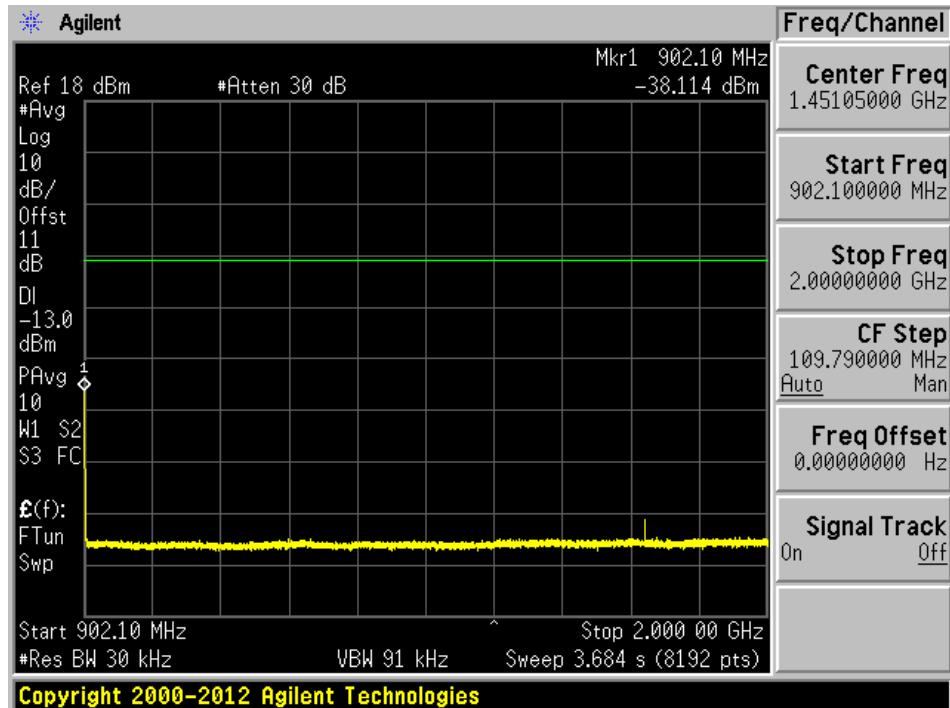
## Middle Channel 902.1MHz-10GHz



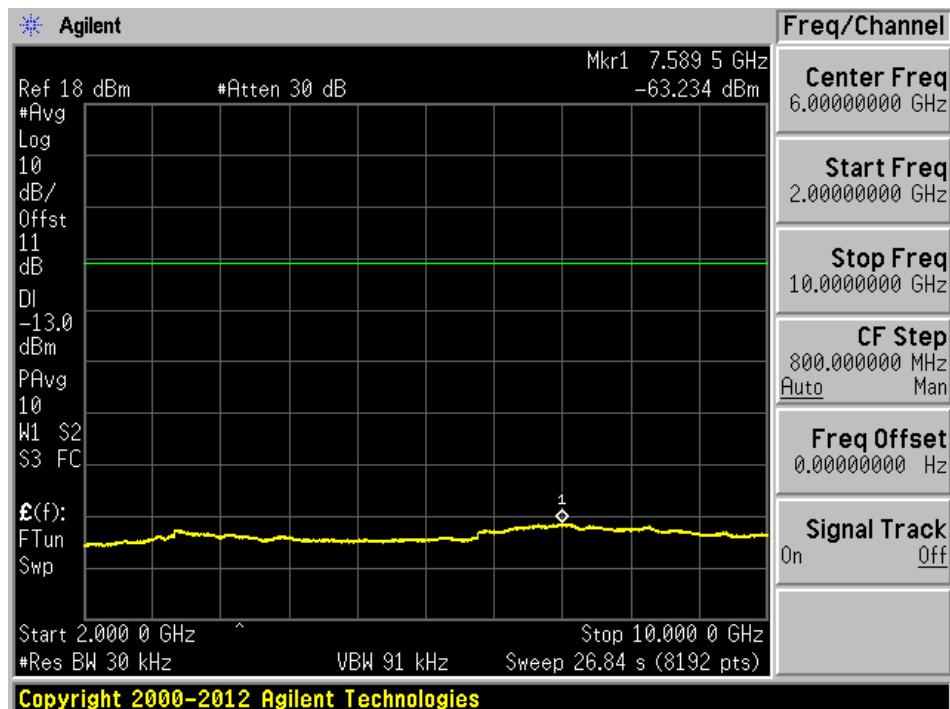
## High Channel 30MHz-900.9MHz



## High Channel 902.1MHz-2GHz



## High Channel 2GHz-10GHz



## 10 FCC §24.133 - Intermodulation

### 10.1 Applicable Standards

According to FCC §24.133(a), The power of any emission shall be attenuated below the transmitter power (P), as measured in accordance with §24.132(f), in accordance with the following schedule:

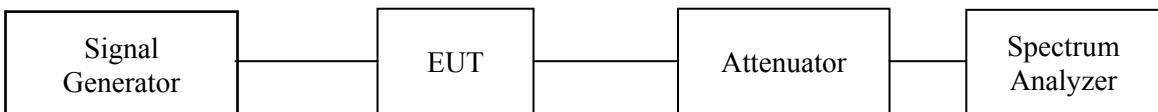
- (1) For transmitters authorized a bandwidth greater than 10 kHz:
  - (i) On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (fd in kHz) of up to and including 40 kHz: at least  $116 \log_{10}((fd + 10)/6.1)$  decibels or 50 plus 10  $\log_{10}(P)$  decibels or 70 decibels, whichever is the lesser attenuation;
  - (ii) On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 40 kHz: at least  $43 + 10 \log_{10}(P)$  decibels or 80 decibels, whichever is the lesser attenuation.
- (2) For transmitters authorized a bandwidth of 10 kHz:
  - (i) On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (fd in kHz) of up to and including 20 kHz: at least  $116 \times \log_{10}((fd + 5)/3.05)$  decibels or 50 plus 10  $\times \log_{10}(P)$  decibels or 70 decibels, whichever is the lesser attenuation;
  - (ii) On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 20 kHz: at least  $43 + 10 \log_{10}(P)$  decibels or 80 decibels, whichever is the lesser attenuation.

### 10.2 Test Procedure

Section 3.6.2 of KDB 935210 D05 v01r01,

- a) Connect a signal generator to the input of the EUT. If the signal generator is not capable of generating two modulated carriers simultaneously, then two discrete signal generators can be connected with an appropriate combining network to support this two-signal test.
- b) Set the signal generator to produce two AWGN signals as previously described (e.g., 4.1 MHz OBW).
- c) Set the center frequencies such that the AWGN signals occupy adjacent channels, as defined by industry standards such as 3GPP or 3GPP2, at the upper edge of the frequency band or block under test.
- d) Set the composite power levels such that the input signal is just below the AGC threshold (see 3.2), but not more than 0.5 dB below. The composite power can be measured using the procedures provided in KDB Publication 971168 [R8], but it will be necessary to expand the power integration bandwidth so as to include both of the transmit channels. Alternatively, the composite power can be measured using an average power meter as described in KDB Publication 971168 [R8].
- e) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.
- f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band (typically 1 % of the EBW or 100 kHz or 1 MHz)
- g) Set the VBW =  $3 \times RBW$ .
- h) Set the detector to power averaging (rms) detector.

- i) Set the Sweep time = auto-couple.
- j) Set the spectrum analyzer start frequency to the upper block edge frequency, and the stop frequency to the upper block edge frequency plus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively.
- k) Trace average at least 100 traces in power averaging (rms) mode.
- l) Use the marker function to find the maximum power level.
- m) Capture the spectrum analyzer trace of the power level for inclusion in the test report.
- n) Repeat steps k) to m) with the composite input power level set to 3 dB above the AGC threshold.
- o) Reset the frequencies of the input signals to the lower edge of the frequency block or band under test.
- p) Reset the spectrum analyzer start frequency to the lower block edge frequency minus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively, and the stop frequency to the lower band or block edge frequency.
- q) Repeat steps k) to n).
- r) Repeat steps a) to q) with the signal generator configured for a single test signal tuned as close as possible to the block edges.
- s) Repeat steps a) to r) with the narrowband test signal.
- t) Repeat steps a) to s) for all authorized frequency bands or blocks used by the EUT.



*Note: 16QAM was generated by the signal generator instead of the test signal specified in Section 3.1 of KDB 935210 D05 v01r01.*

### 10.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2017-02-24	1 year
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2016-07-29	2 years
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2017-01-06	1 year
-	10 dB attenuator	-	-	Each Time <sup>1</sup>	Each Time <sup>1</sup>
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2016-07-29	2 years
-	SMA cable	-	C04	Each Time <sup>1</sup>	Each Time <sup>1</sup>
-	SMA cable	-	C09	Each Time <sup>1</sup>	Each Time <sup>1</sup>

<sup>1</sup>*Note: This equipment was calibrated for each test.*

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

## 10.4 Test Environmental Conditions

<b>Temperature:</b>	23° C
<b>Relative Humidity:</b>	32 %
<b>ATM Pressure:</b>	101.4-102 kPa

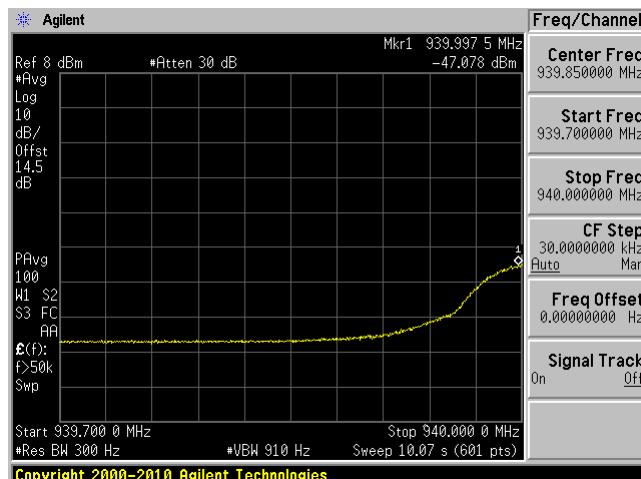
The testing was performed by Jose Martinez 2017-05-08 in the RF Site.

## 10.5 Test Results

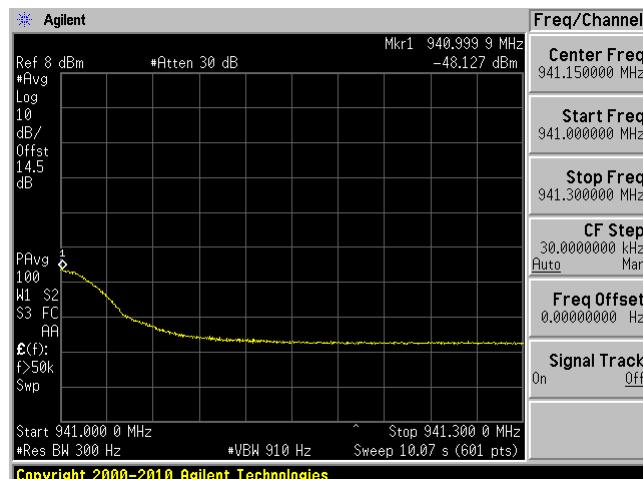
### Downlink, 940-941 MHz

AGC Off

Lower Band Edge

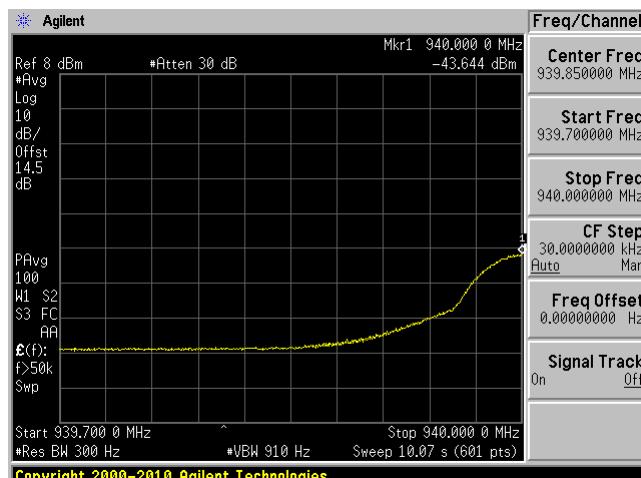


Upper Band Edge

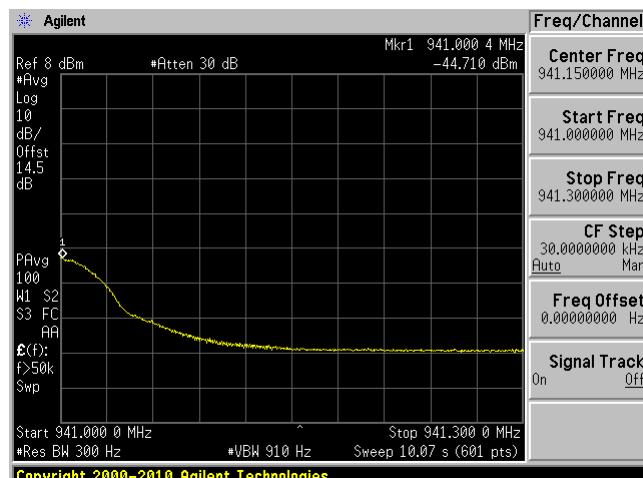


AGC on

Lower Band Edge



Upper Band Edge

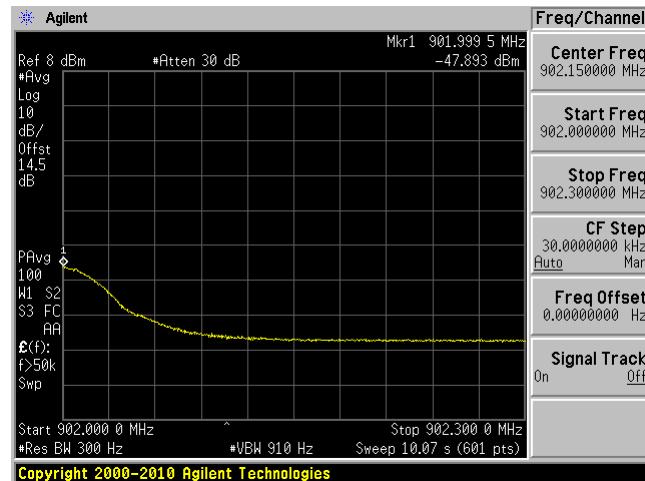
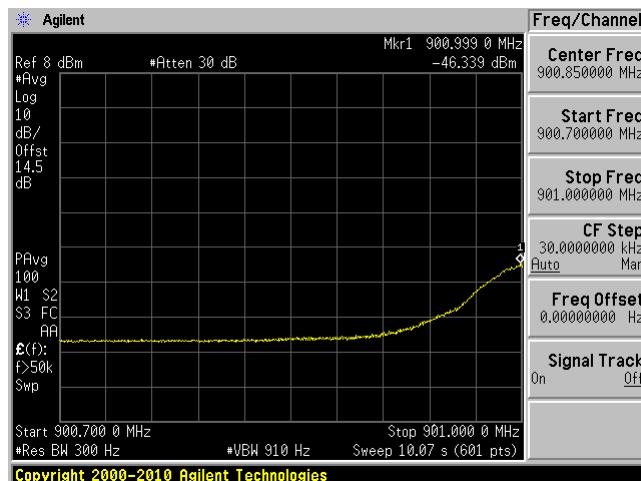


## Uplink, 901-902 MHz

AGC Off

Lower Band Edge

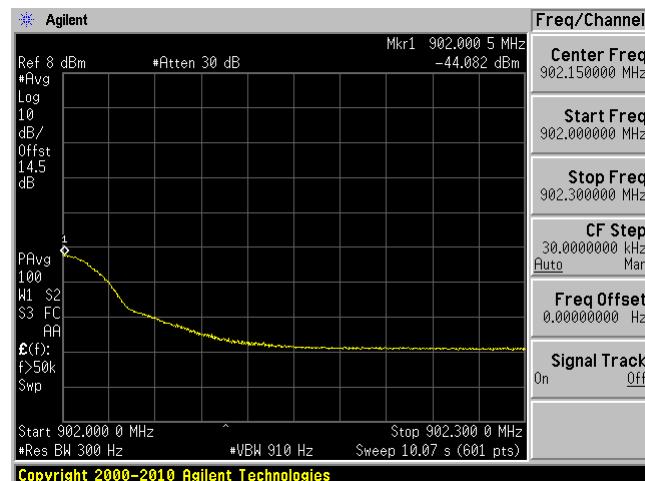
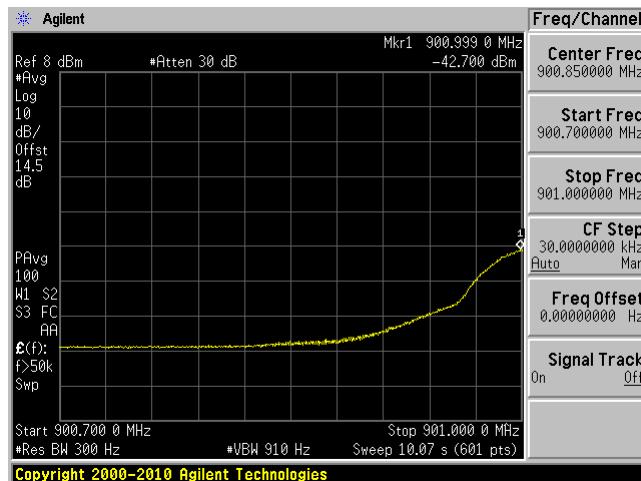
Upper Band Edge



AGC on

Lower Band Edge

Upper Band Edge



## 11 FCC §20.21 - Out of Band Rejection

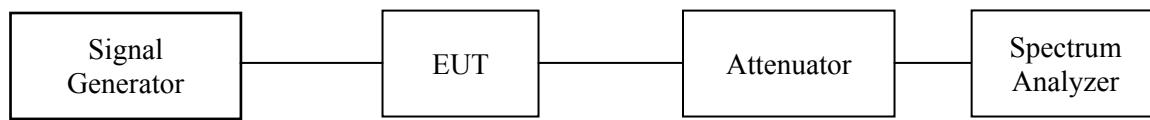
### 11.1 Applicable Standard

According to FCC Part 20.21, a frequency selective booster shall have  $-20$  dB at the band edge referenced to the gain in the center of the pass band of the booster, where band edge is the end of the licensee's allocated spectrum.

### 11.2 Test Procedure

KDB 935210 D05, Section 3.3.

The signal generator output was connected to the EUT input. The output of the EUT was connected to a spectrum analyzer through appropriate attenuation.



### 11.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	US45303156	2017-02-24	1 year
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2016-07-29	2 years
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2017-01-06	1 year
-	20 dB attenuator	-	-	Each Time <sup>1</sup>	Each Time <sup>1</sup>
-	SMA cable	-	C04	Each Time <sup>1</sup>	Each Time <sup>1</sup>
-	SMA cable	-	C09	Each Time <sup>1</sup>	Each Time <sup>1</sup>

<sup>1</sup>Note: This equipment was calibrated for each test.

**Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 9 June 2016) "A2LA Policy on Metrological Traceability".

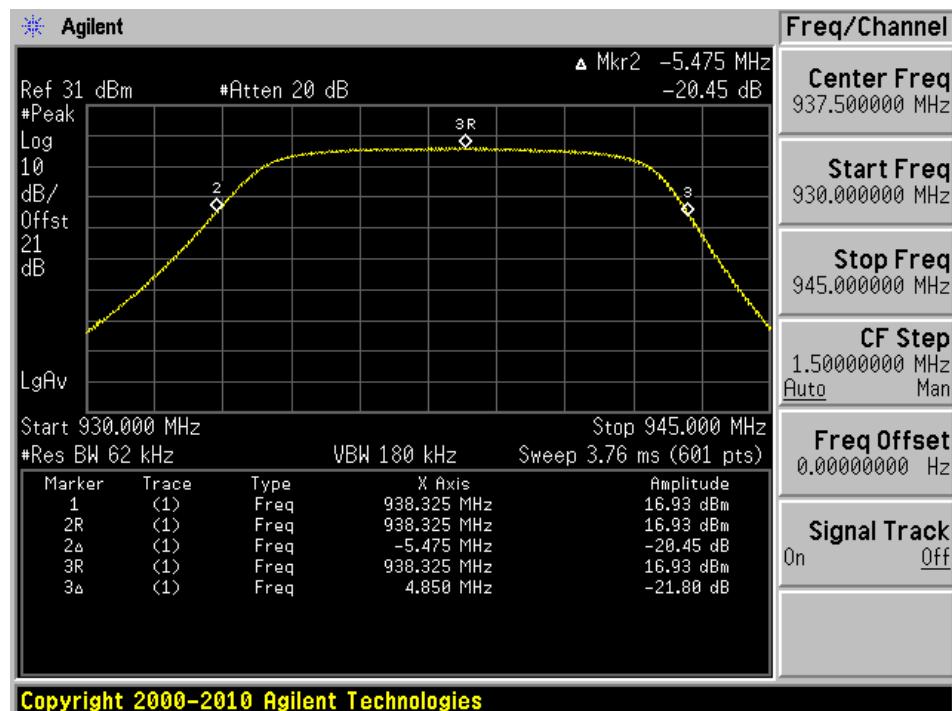
### 11.4 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	32 %
ATM Pressure:	101.4-102 kPa

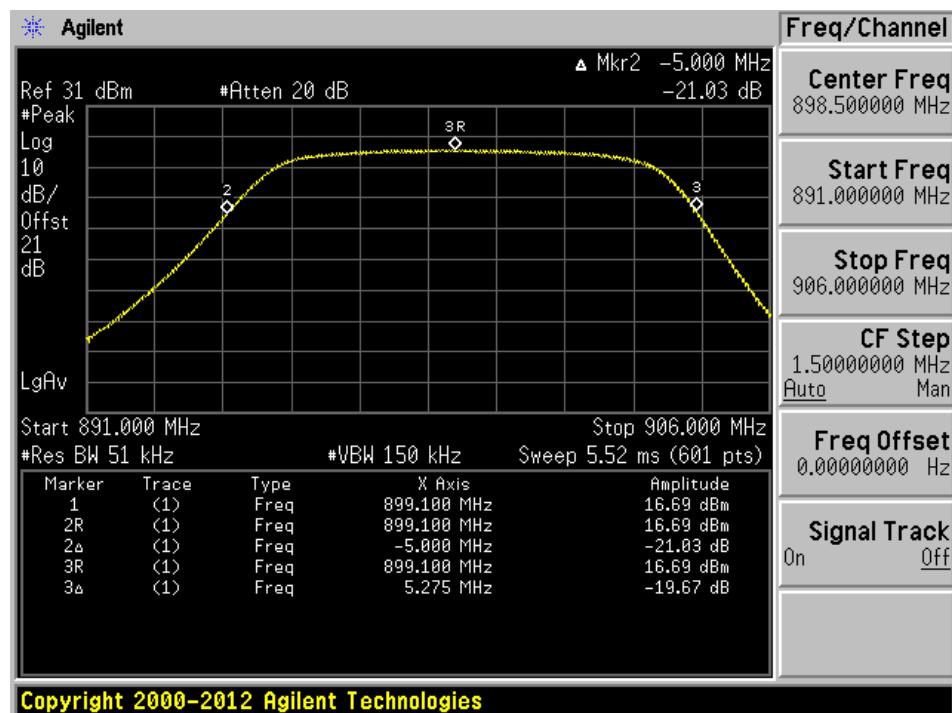
The testing was performed by Jose Martinez on 2017-05-29 in the RF Site.

## 11.5 Test Results

Downlink



Uplink



--- END OF REPORT ---