



FCC PART 24E

TEST AND MEASUREMENT REPORT

For

Whoop Wireless, Inc.

5913 NW 31st Ave., Fort Lauderdale,
Germantown, FL 33309, USA

FCC ID: 2AEQJ-HE4-001

Report Type: Original Report	Product Type: Industrial Booster
Prepared By: Todd Moy Test Engineer <i>Todd Moy</i>	
Report Number: R1509101-24	
Report Date: 2015-11-03	
Reviewed By: Simon Ma RF Lead <i>Simon Ma</i>	
Bay Area Compliance Laboratories Corp. 1274 Anvilwood Avenue, Sunnyvale, CA 94089, USA Tel: (408) 732-9162 Fax: (408) 732 9164	

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

TABLE OF CONTENTS

1	GENERAL INFORMATION	5
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
2	SYSTEM TEST CONFIGURATION	8
2.1	JUSTIFICATION.....	8
2.2	EUT EXERCISE SOFTWARE.....	8
2.3	EQUIPMENT MODIFICATIONS	8
2.4	EUT INTERNAL CONFIGURATION	8
2.5	LOCAL SUPPORT EQUIPMENT LIST AND DETAILS	8
2.6	POWER SUPPLY AND LINE FILTERS.....	8
2.7	INTERFACE PORTS AND CABLING	8
3	SUMMARY OF TEST RESULTS.....	9
4	FCC §2.1091 - RF EXPOSURE	10
4.1	APPLICABLE STANDARDS	10
4.2	MPE PREDICTION	10
4.3	TEST RESULTS	10
5	FCC §2.1046 & §24.232(C) – EQUIVALENT ISOTROPIC RADIATED POWER.....	12
5.1	APPLICABLE STANDARDS	12
5.2	TEST PROCEDURE	12
5.3	TEST EQUIPMENT LIST AND DETAILS	12
5.4	TEST ENVIRONMENTAL CONDITIONS.....	12
5.5	TEST RESULTS	13
6	FCC §2.1049 & §24.238(B) – OCCUPIED BANDWIDTH.....	14
6.1	APPLICABLE STANDARDS	14
6.2	TEST PROCEDURE	14
6.3	TEST EQUIPMENT LIST AND DETAILS	14
6.4	TEST ENVIRONMENTAL CONDITIONS.....	14
6.5	TEST RESULTS	15
7	FCC §2.1053 & §24.238(A) - SPURIOUS RADIATED EMISSIONS	24
7.1	APPLICABLE STANDARDS	24
7.2	TEST PROCEDURE	24
7.3	TEST EQUIPMENT LIST AND DETAILS	24
7.4	TEST SETUP BLOCK DIAGRAM.....	25
7.5	TEST ENVIRONMENTAL CONDITIONS.....	25
7.6	TEST RESULTS	26
8	FCC §2.1051 & §24.238(A) - SPURIOUS EMISSIONS AT ANTENNA TERMINALS	27
8.1	APPLICABLE STANDARDS	27
8.2	TEST PROCEDURE	27
8.3	TEST EQUIPMENT LIST AND DETAILS	27
8.4	TEST ENVIRONMENTAL CONDITIONS.....	27
8.5	TEST RESULTS	27

9 FCC §24.238(A) - BAND EDGE & INTERMODULATION44

9.1 APPLICABLE STANDARDS44

9.2 TEST PROCEDURE44

9.3 TEST EQUIPMENT LIST AND DETAILS44

9.4 TEST ENVIRONMENTAL CONDITIONS44

9.5 TEST RESULTS44

10 FCC §20.21 – OUT OF BAND REJECTION61

10.1 APPLICABLE STANDARD61

10.2 TEST PROCEDURE61

10.3 TEST EQUIPMENT LIST AND DETAILS61

10.4 TEST ENVIRONMENTAL CONDITIONS61

10.5 TEST RESULTS61

11 EXHIBIT A - FCC ID LABELING REQUIREMENTS63

11.1 FCC ID LABEL REQUIREMENTS.....63

11.2 LABEL CONTENTS AND LOCATION.....63

12 EXHIBIT B - EUT SETUP PHOTOGRAPHS.....65

12.1 RADIATED EMISSION BELOW 1 GHz FRONT VIEW65

12.2 RADIATED EMISSION BELOW 1 GHz REAR VIEW.....65

12.3 RADIATED EMISSION ABOVE 1 GHz FRONT VIEW66

12.4 RADIATED EMISSION ABOVE 1 GHz REAR VIEW66

13 EXHIBIT C – EUT PHOTOGRAPHS.....67

13.1 EUT – TOP VIEW67

13.2 EUT – BOTTOM VIEW67

13.3 EUT – FRONT VIEW.....68

13.4 EUT – REAR VIEW68

13.5 EUT – PCB TOP VIEW.....69

13.6 EUT – PCB BOTTOM VIEW69

13.7 EUT – CELLULAR MODEM BOARD TOP VIEW70

13.8 EUT – CELLULAR MODEM BOARD BOTTOM VIEW.....70

13.9 EUT – POWER ADAPTER.....71

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1509101-24	Initial	2015-11-03

1 General Information

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *Whoop Wireless, Inc.* and their product model: HE4-001, FCC ID: 2AEQJ-HE4-001, which will henceforth be referred to as the EUT (Equipment under Test). The EUT was a dual-directional industrial amplifier. The EUT operated in the frequency band of 1900MHz for LTE, GSM, CDMA and WCDMA in uplink and downlink.

1.2 Mechanical Description

The EUT measured approximately 25.4 cm (L) x 21 cm (W) x 5.1 cm (H) and weighs 1.25 kg.

The test data gathered were from typical production sample, serial number: R1509101-1, assigned by BACL.

1.3 Objective

This type approval report was prepared on behalf of *Whoop Wireless, Inc.* in accordance with Part 2, Subpart J, Part 20.21, Part 24 Subpart E, of the Federal Communication Commission's rules.

The objective is to determine compliance with FCC/IC 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)

No Related Submittals

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 20.21 – Signal Boosters

Part 24 Subpart E – Broadband PCS

Applicable Standards: TIA/EIA603-D, FCC KDB 935210.

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.

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

Bay area compliance Laboratories Corp. (BACL) is:

1- An independent Commercial Test Laboratory accredited to **ISO 17025: 2005** by **A2LA**, in the fields of: Electromagnetic Compatibility & Telecommunications covering Emissions, Immunity, Radio, RF Exposure, Safety and Telecom. This includes NEBS (Network Equipment Building System), Wireless RF, Telecommunications Terminal Equipment (TTE); Network Equipment; Information Technology Equipment (ITE); Medical Electrical Equipment; Industrial, Commercial, and Medical Test Equipment; Professional Audio and Video Equipment; Electronic (Digital) Products; Industrial and Scientific Instruments; Cabled Distribution Systems and Energy Efficiency Lighting.

2- An ENERGY STAR Recognized Laboratory, for the LM80 Testing, a wide variety of Luminaires and Computers.

3- A NIST Designated Phase-I and Phase-II CAB including: ACMA (Australian Communication and Media Authority), BSMI (Bureau of Standards, Metrology and Inspection of Taiwan), IDA (Infocomm Development Authority of Singapore), IC(Industry Canada), Korea (Ministry of Communications Radio Research Laboratory), NCC (Formerly DGT; Directorate General of Telecommunication of Chinese Taipei) OFTA (Office of the Telecommunications Authority of Hong Kong), Vietnam, VCCI - Voluntary Control Council for Interference of Japan and a designated EU CAB (Conformity Assessment Body) (Notified Body) for the EMC and R&TTE Directives.

4- A Product Certification Body accredited to **ISO Guide 65:1996** by **A2LA** to certify:

- 1- Unlicensed, Licensed radio frequency devices and Telephone Terminal Equipment for the FCC. Scope A1, A2, A3, A4, B1, B2, B3, B4 & C.
2. Radio Standards Specifications (RSS) in the Category I Equipment Standards List and All Broadcasting Technical Standards (BETS) in Category I Equipment Standards List for Industry Canada.
3. Radio Communication Equipment for Singapore.
4. Radio Equipment Specifications, GMDSS Marine Radio Equipment Specifications, and Fixed Network Equipment Specifications for Hong Kong.
5. Japan MIC Telecommunication Business Law (A1, A2) and Radio Law (B1, B2 and B3).
6. Audio/Video, Battery Charging Systems, Computers, Displays, Enterprise Servers, Imaging Equipment, Set-Top Boxes, Telephony, Televisions, Ceiling Fans, CFLs (Including GU24s), Decorative Light Strings, Integral LED Lamps, Luminaires, Residential Ventilating Fans.

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997, and Article 8 of the VCCI regulations on December 25, 1997. The test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.4-2009, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: A-0027. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. is an American Association for Laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at

<http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b367816b>

2 System Test Configuration

2.1 Justification

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

Manufacturer	Description	Model	Serial Number
Zore Access Tech	-	HE4-001 REV A	-

2.5 Local Support Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers
Dell	Laptop	Latitude D600	CN-0X2034-48643-3A6-8307

2.6 Power Supply and Line Filters

Manufacturers	Descriptions	Models	Serial Numbers
-	AC/DC Adapter	KWT-0605000	-

2.7 Interface Ports and Cabling

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

3 Summary of Test Results

FCC Rules	Description of Tests	Results
§2.1091	RF Exposure	Compliant
§2.1046, §24.232(c)	Output Power	Compliant
§2.1049, §24.238(b)	26 dB Occupied Bandwidth	Compliant
§2.1053, §24.238(a)	Spurious Radiated Emissions	Compliant
§2.1053, §24.238(a)	Spurious Emissions at Antenna Terminals	Compliant
§2.1053, §24.238(a)	Band Edge & Intermodulation	Compliant
§2.1055, §24.235	Frequency Stability	N/A ¹
§20.21	Out of Band Rejection	Compliant

¹ The EUT was a signal booster.

4 FCC §2.1091 - RF Exposure

4.1 Applicable Standards

According to §2.1091 (Mobile Devices) 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 (minute)
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

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

Maximum peak output power at antenna input terminal (dBm): 14.31

Maximum peak output power at antenna input terminal (mW): 26.98

Prediction distance (cm): 30

Prediction frequency (MHz): 1945.25

Antenna Gain, typical (dBi): 10

Maximum Antenna Gain (numeric): 10

Power density at predication frequency and distance (mW/cm²): 0.0239

MPE limit for uncontrolled exposure at predication frequency (mW/cm²): 1.0

Uplink

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>22.11</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>162.55</u>
<u>Prediction distance (cm):</u>	<u>30</u>
<u>Prediction frequency (MHz):</u>	<u>1863.75</u>
<u>Antenna Gain, typical (dBi):</u>	<u>10</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>10</u>
<u>Power density at predication frequency and distance (mW/cm²):</u>	<u>0.1437</u>
<u>MPE limit for uncontrolled exposure at predication frequency (mW/cm²):</u>	<u>1.0</u>

Results

For uplink and downlink, the highest power density levels at 30 cm are below the MPE uncontrolled exposure limit.

5 FCC §2.1046 & §24.232(c) – Equivalent Isotropic Radiated Power

5.1 Applicable Standards

According to FCC §24.232 (c), Mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

5.2 Test Procedure

Conducted:

The EUT was connected to the spectrum analyzer and Signal Generator followed by 50Ω-75Ω matching pad.



5.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2014-10-24	1 year
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2014-09-18	2 years
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2014-07-15	2 years

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

5.4 Test Environmental Conditions

Temperature:	21-23° C
Relative Humidity:	42-48 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Todd Moy 2015-10-12 in the RF Site.

5.5 Test Results

Downlink

Signal Type	AGC	Input Power (dBm)	Output Power (dBm)	Gain (dB)	EIRP (dBm)
Broadband	Off	-47.52	14.31	61.83	24.31
	On	-44.27	14.44	58.71	24.44
Narrowband	Off	-50.35	11.57	61.92	21.57
	On	-46.89	10.76	57.65	20.76

Uplink

Signal Type	AGC	Input Power (dBm)	Output Power (dBm)	Gain (dB)	EIRP (dBm)
Broadband	Off	-48.09	21.19	69.28	31.19
	On	-44.85	19.84	64.69	29.84
Narrowband	Off	-47.35	22.11	69.46	32.11
	On	-45.08	21.45	66.53	31.45

Note: EIRP (dBm)=Conducted Output Power (dBm) + Antenna Gain (dBi)

6 FCC §2.1049 & §24.238(b) – Occupied Bandwidth

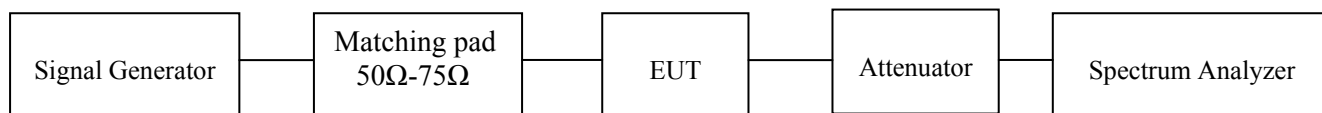
6.1 Applicable Standards

Requirements: §24.238(b)

6.2 Test Procedure

The EUT was connected to the spectrum analyzer and Signal Generator followed by 50Ω-75Ω matching pad.

The resolution bandwidth of the spectrum analyzer was set to at least 1 to 5% of the OBW and the 26 dB & 99% bandwidth was recorded.



6.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2014-10-24	1 year
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2014-09-18	2 years
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2014-07-15	2 years

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

6.4 Test Environmental Conditions

Temperature:	21-23 °C
Relative Humidity:	42-48 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Todd Moy 2015-10-9 in the RF Site.

6.5 Test Results

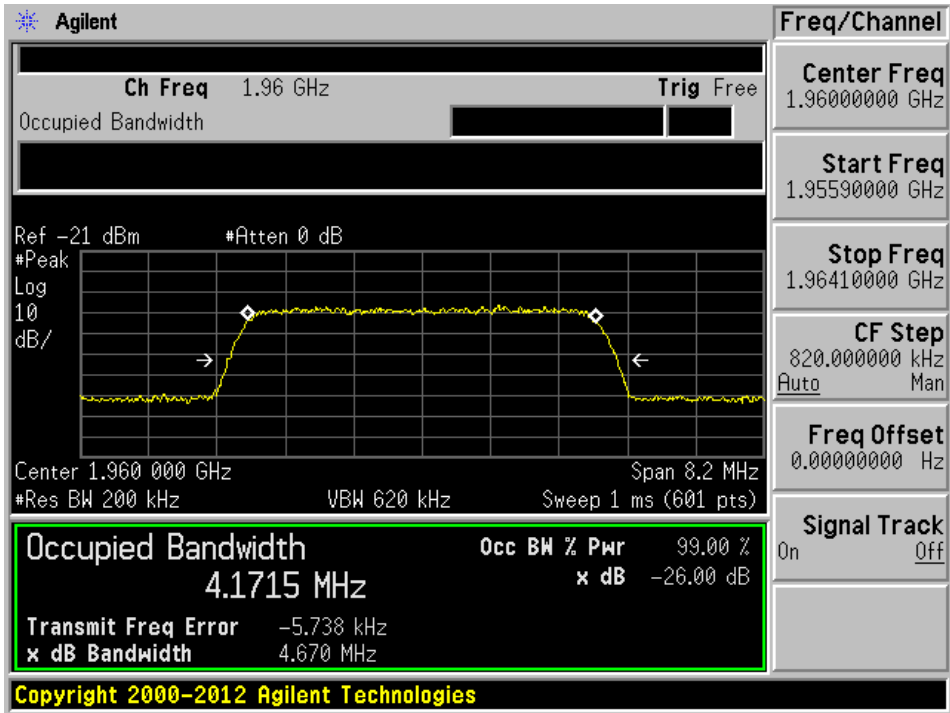
Please refer to the following tables and plots.

DL/UP	Signal Type	AGC	Input		Output	
			99 % OBW (kHz)	26 dB OBW (kHz)	99 % OBW (kHz)	26 dB OBW (kHz)
Downlink	Broadband	off	4171.5	4670	4173.4	4632
		on	4171.5	4670	4168.1	4631
	Narrowband	off	243.75	320.72	244.17	321.45
		on	243.75	320.72	240.77	323.49
Uplink	Broadband	off	4161.1	4623	4176.5	4651
		on	4161.1	4623	4183	4650
	Narrowband	off	241.71	313.44	242.58	317.32
		on	241.71	313.44	242.26	319.14

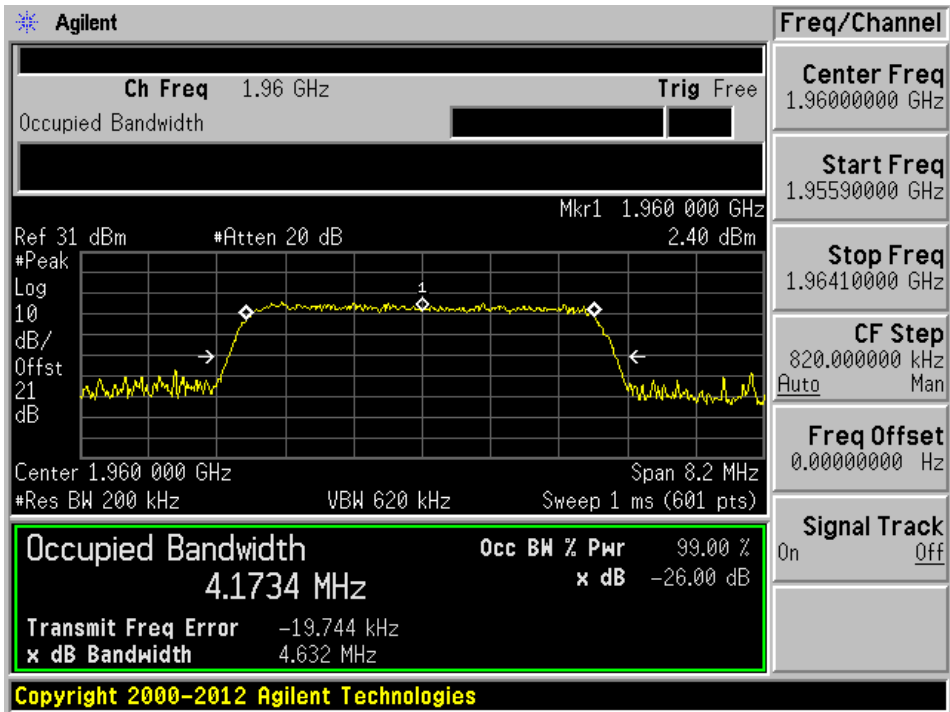
AGC off

Downlink: Broadband Signal

Input

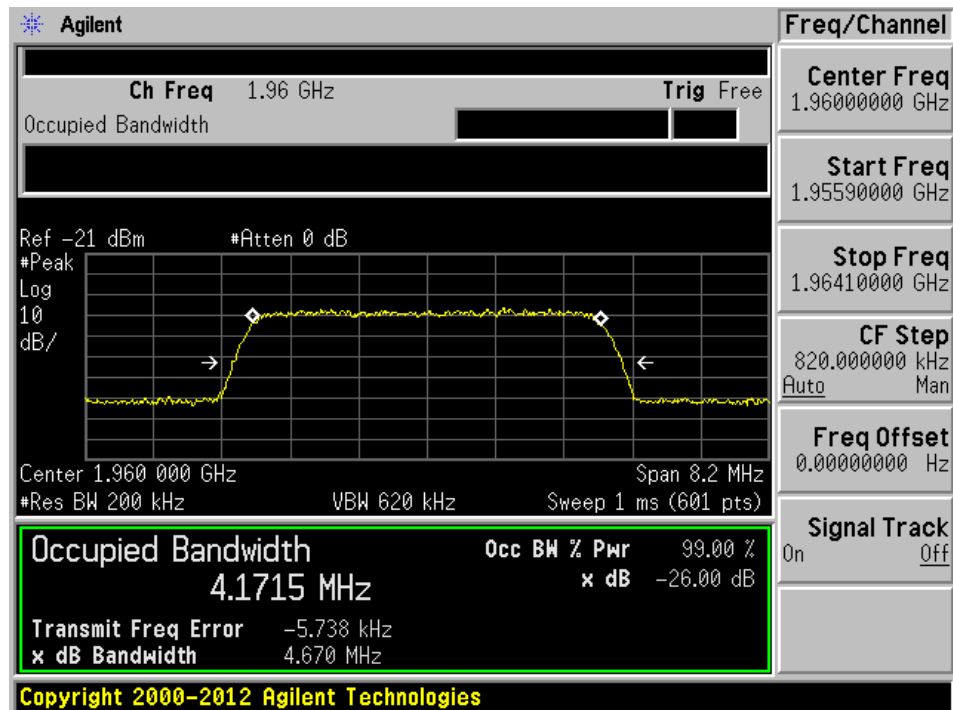


Output

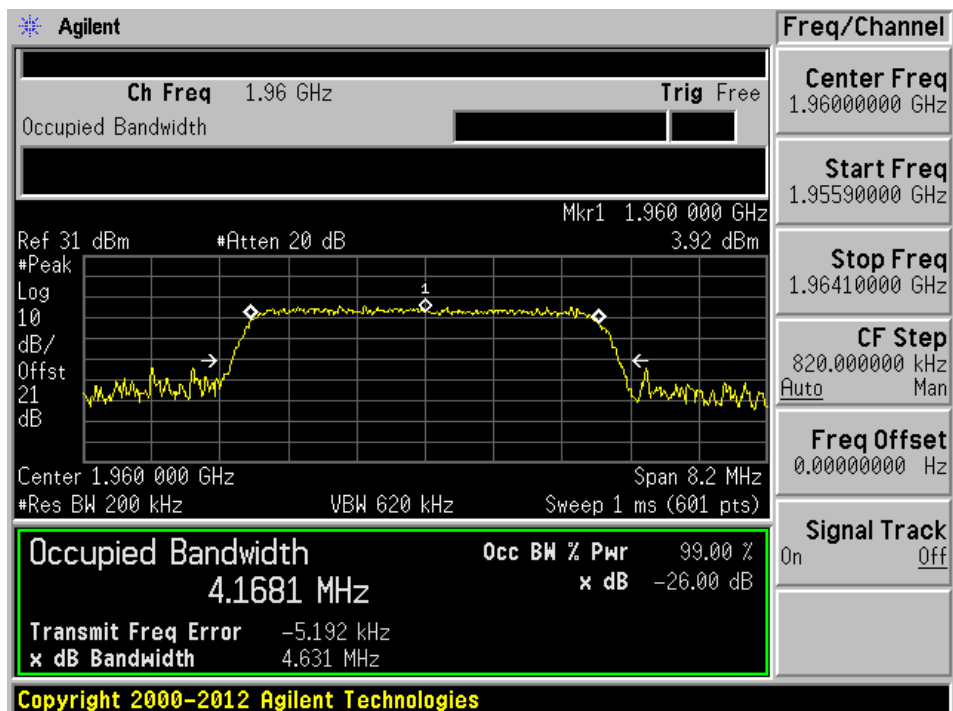


AGC on

Input



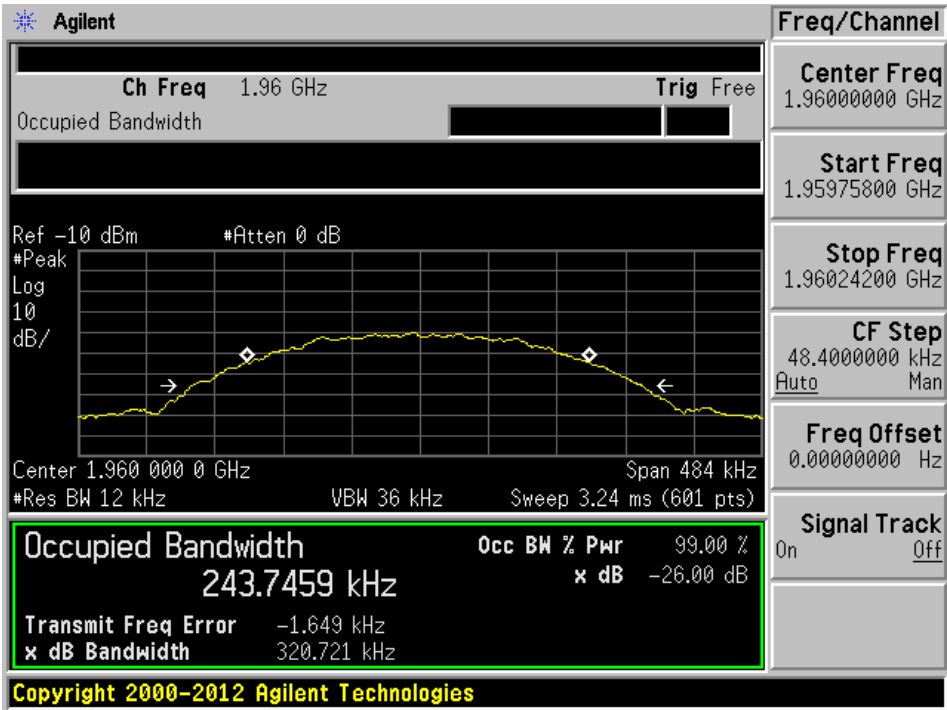
Output



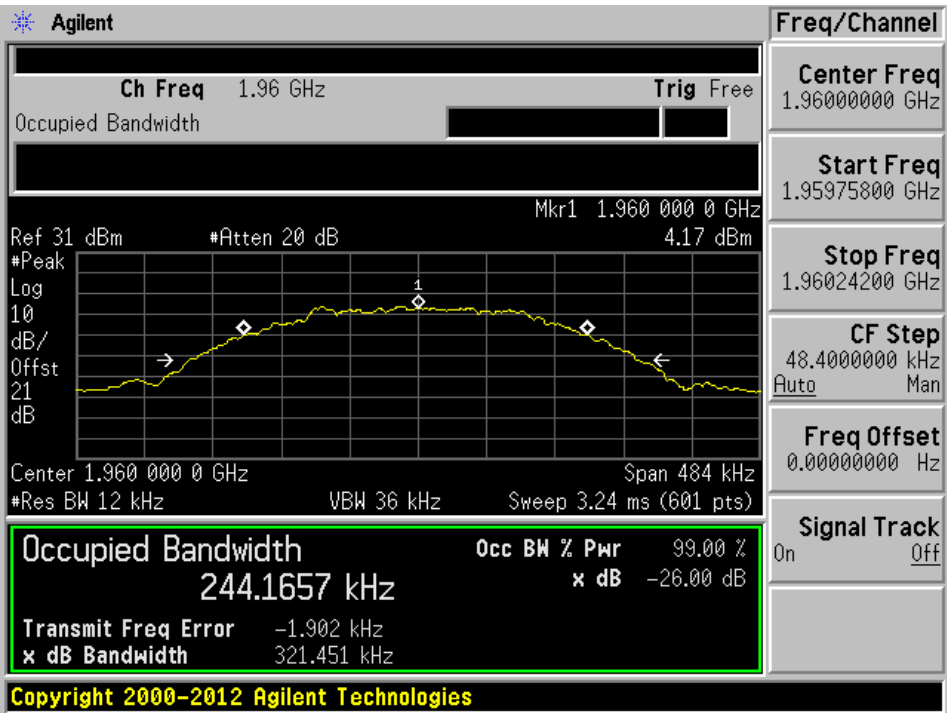
AGC off

Downlink: Narrowband Signal

Input

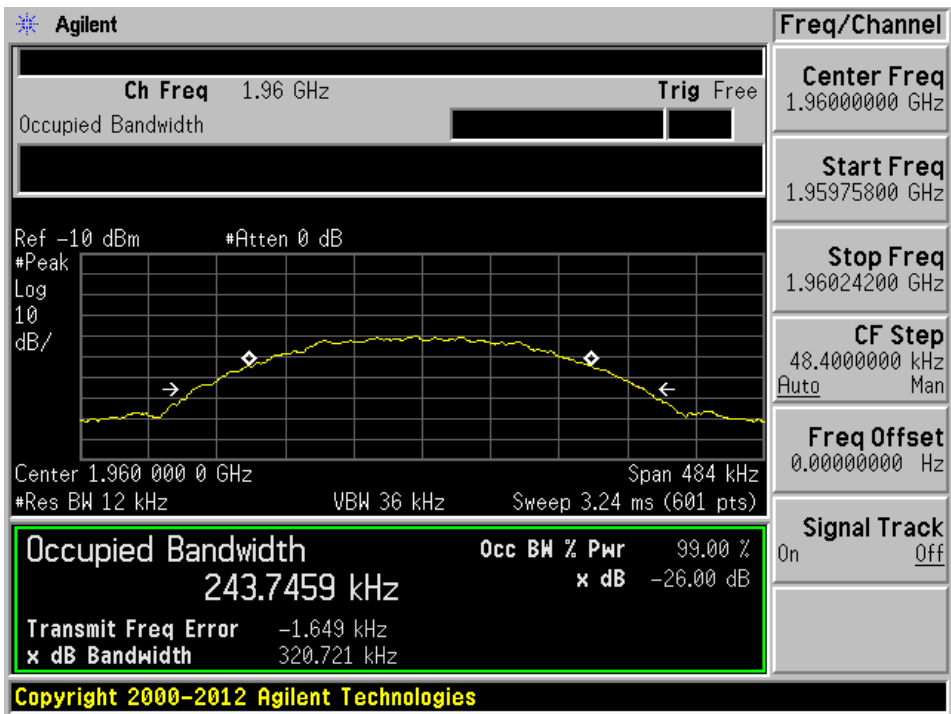


Output

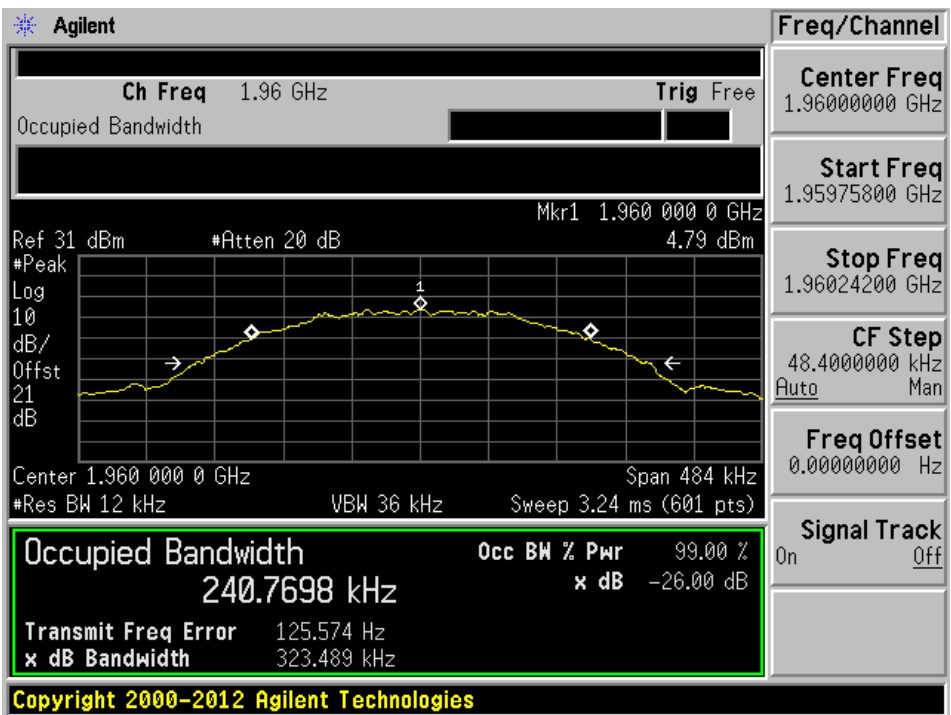


AGC on

Input



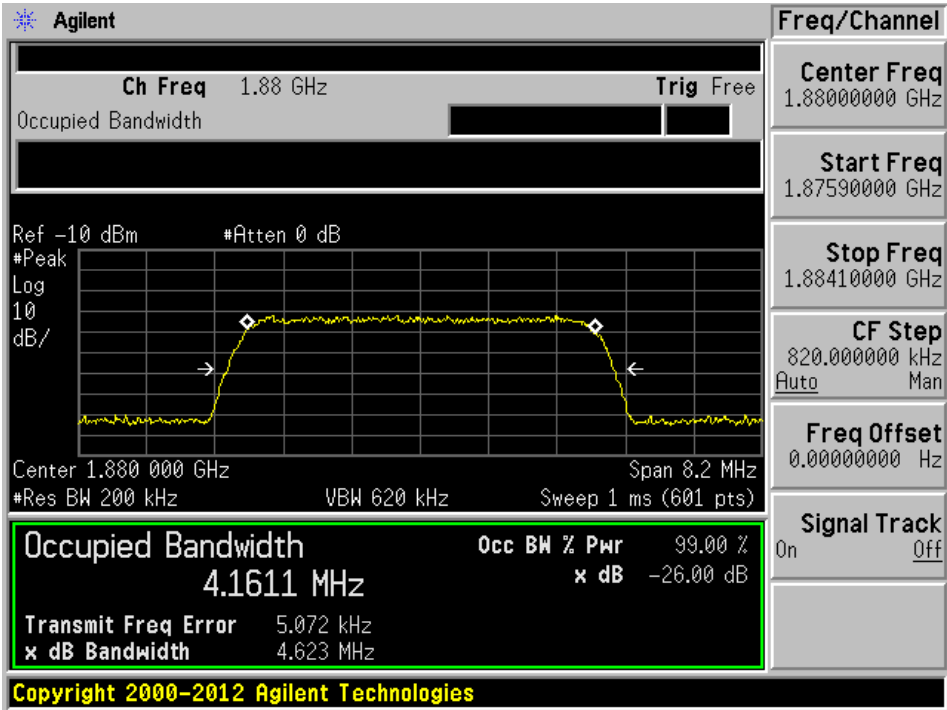
Output



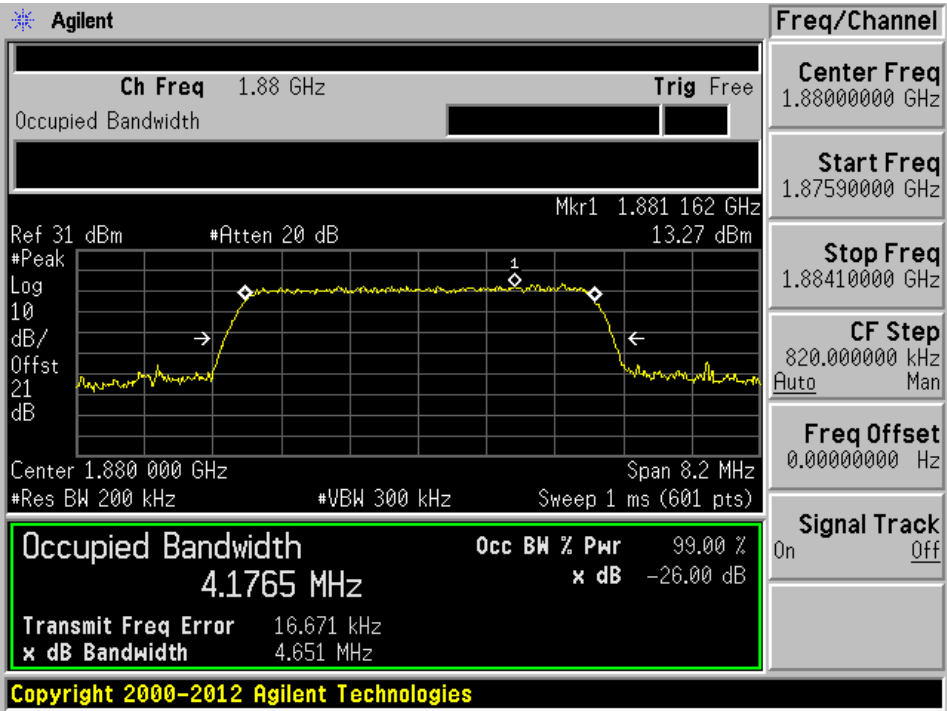
AGC off

Uplink: Broadband Signal

Input

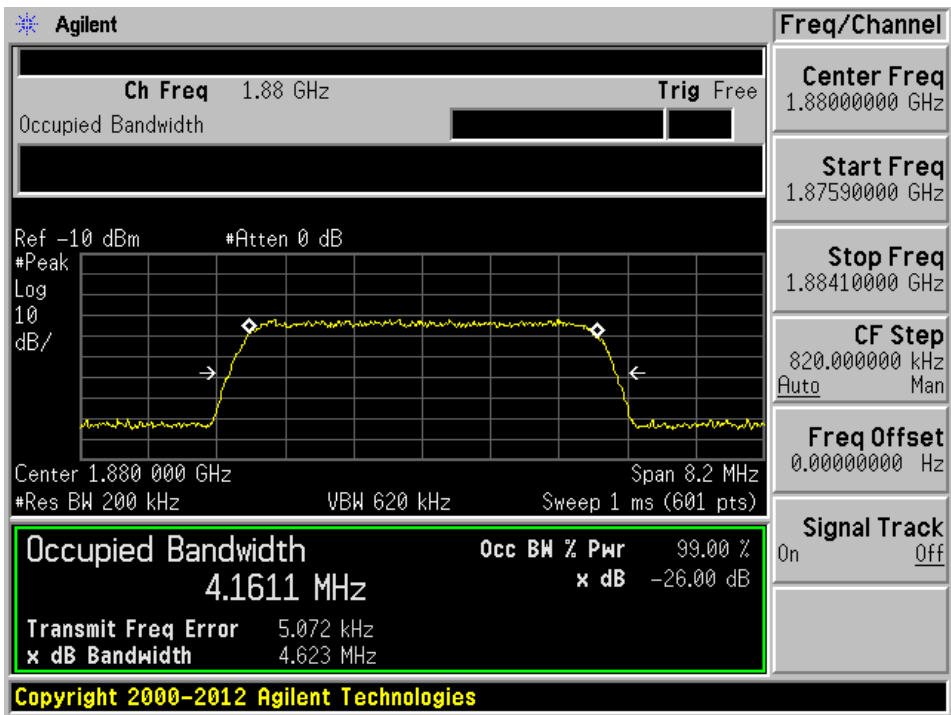


Output

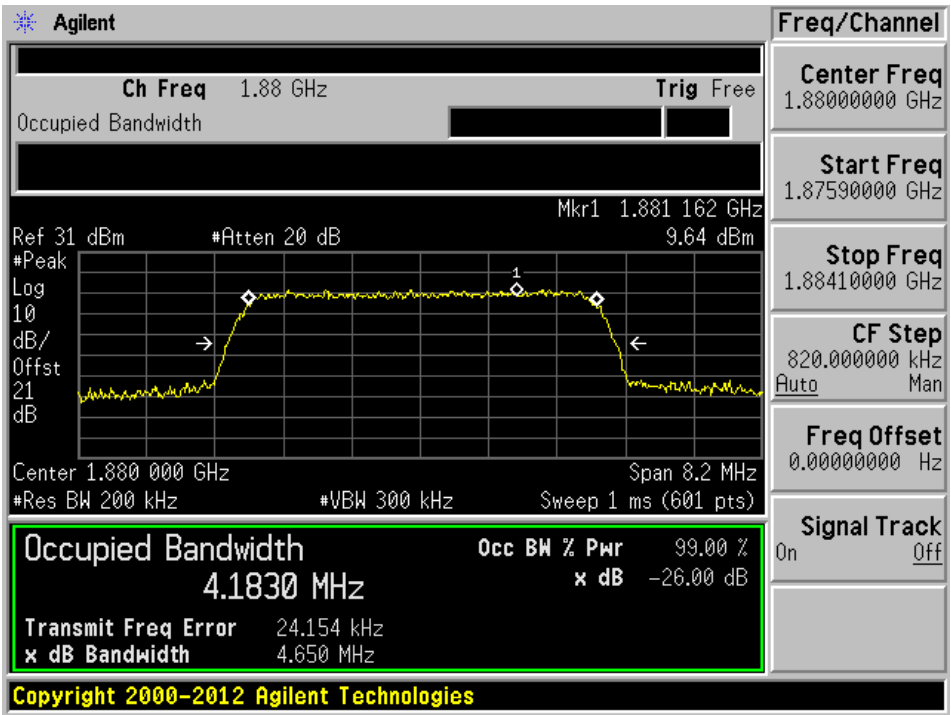


AGC on

Input



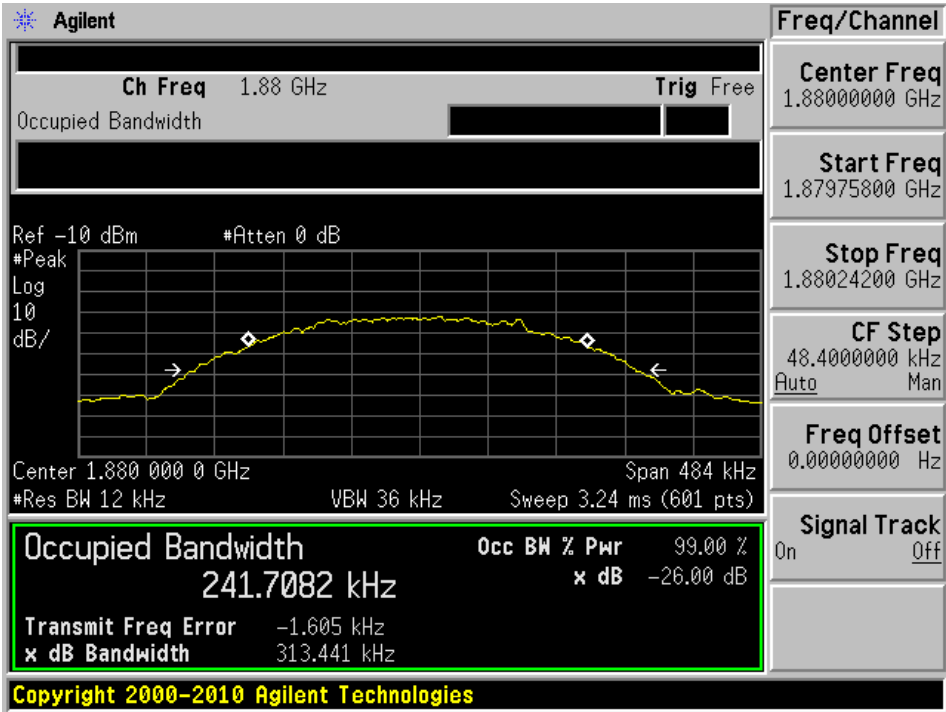
Output



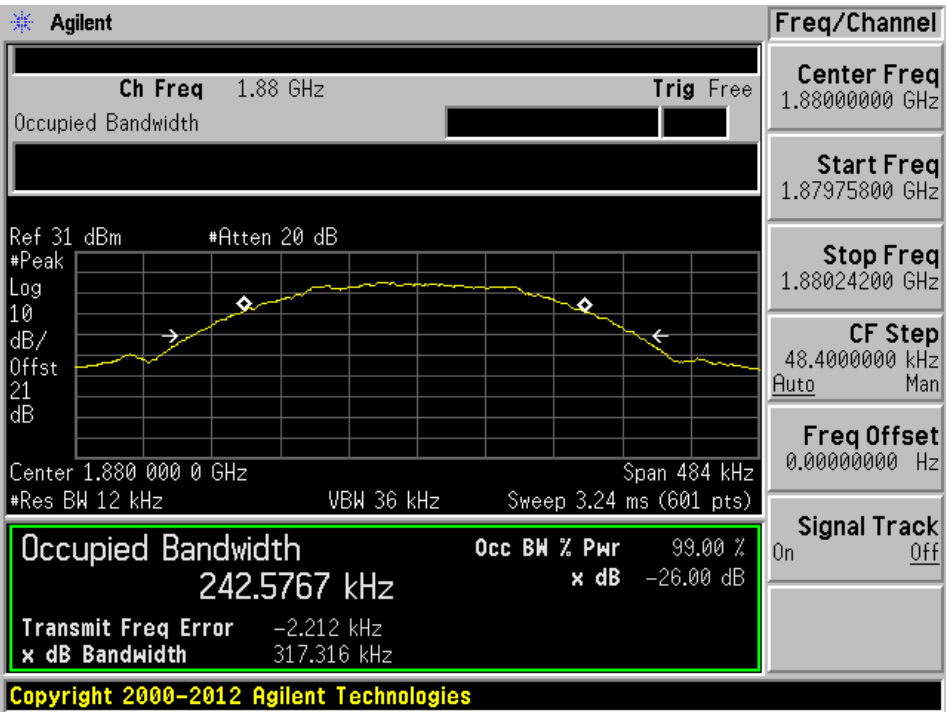
Uplink: Narrowband Signal

AGC off

Input

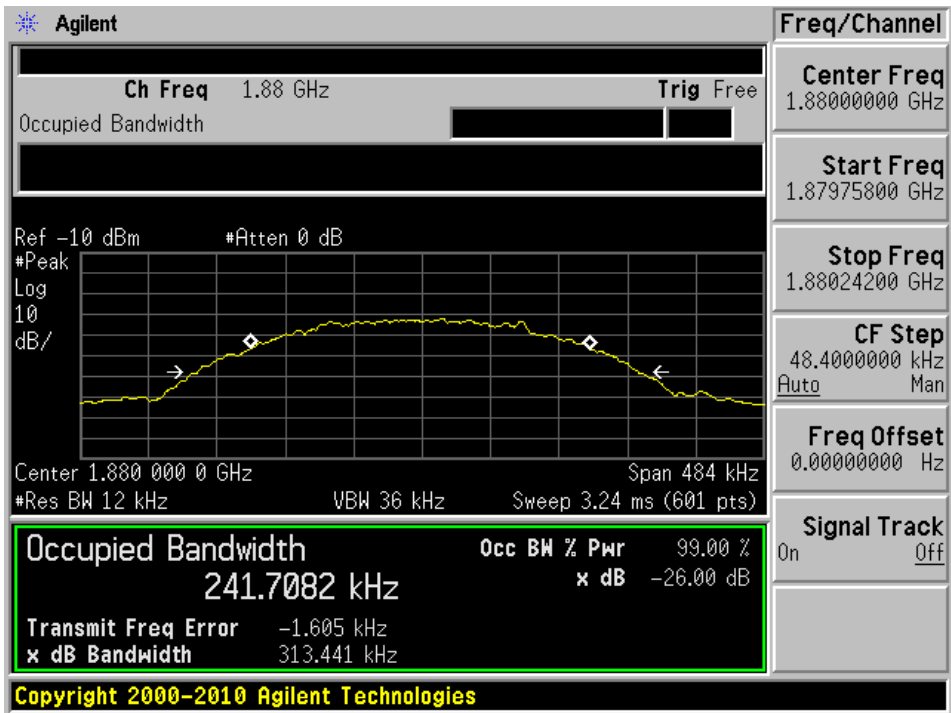


Output

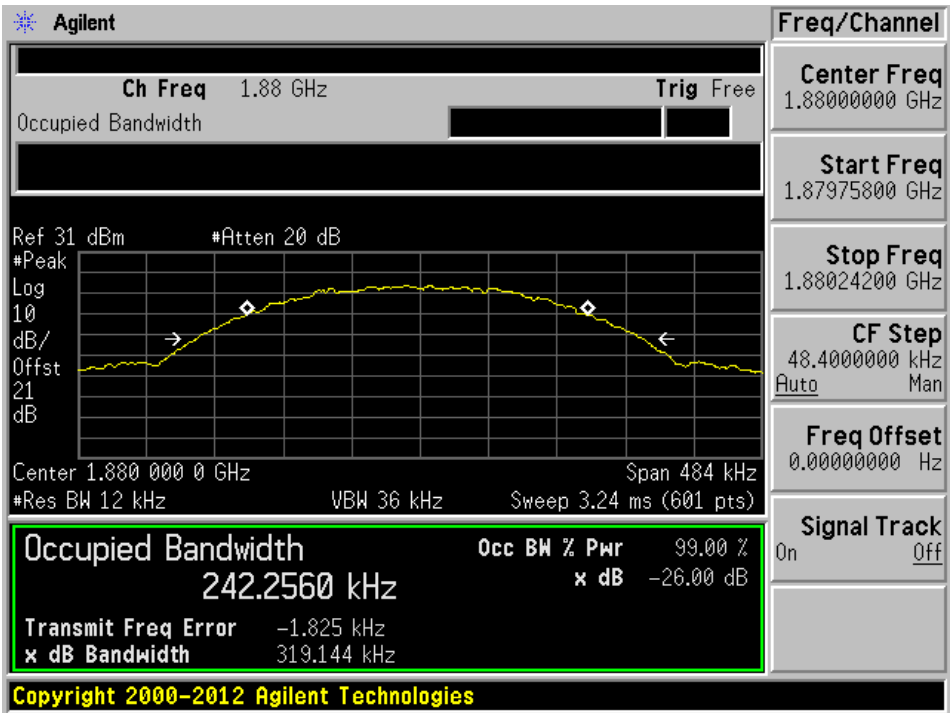


AGC on

Input



Output



7 FCC §2.1053 & §24.238(a) - Spurious Radiated Emissions

7.1 Applicable Standards

According to FCC §24.238(a) the power of any emissions outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

7.2 Test Procedure

The transmitter was placed on the turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

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. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

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

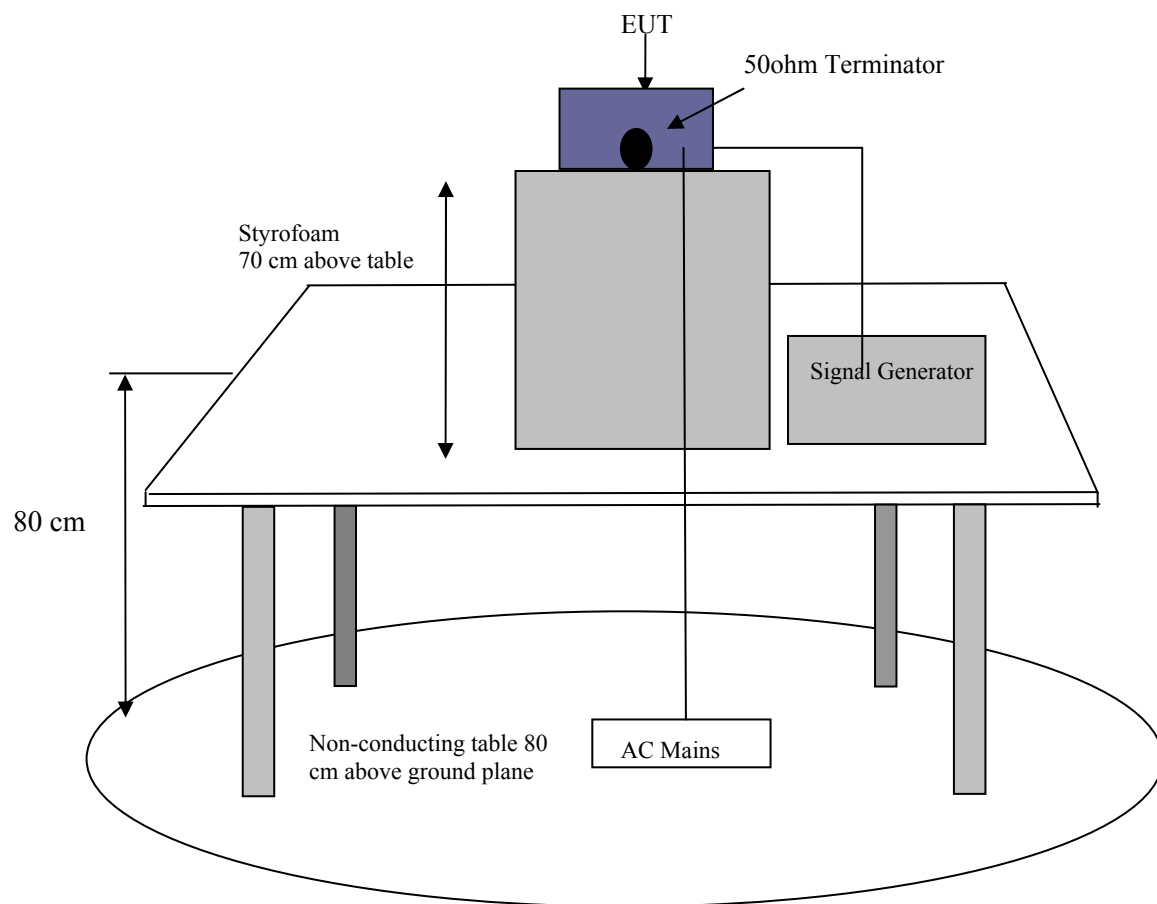
7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2015-06-22	1 year
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Sciences	Antenna, Biconi-Log	JB3	A020106-2	2015-07-11	2 years
Hewlett Packard	Pre-amplifier	8447D	2944A10187	2015-03-20	1 year
HP/ Agilent	Pre Amplifier	8449B OPT HO2	3008A0113	2015-03-11	1year
EMCO	Antenna, Horn	3115	9511-4627	2015-01-15	1 year
A.R.A.	Antenna, Horn	DRG-118/A	1132	2015-09-21	2 years
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2014-09-18	2 years
COM-POWER	Antenna, Dipole	AD-100	721033DB1, 2, 3, 4	2014-11-03	2 years

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

7.4 Test Setup Block Diagram

Radiated Emissions Testing



7.5 Test Environmental Conditions

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

The testing was performed by Todd Moy on 2015- 10-23 in 5 Meter Chamber 3.

7.6 Test Results

Carrier Wave Signal

Downlink

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)		
47.8	43.81	0	100	V	47.8	-41.75	0	0.05	-41.8	-13	-28.8
300	30.25	174	198	H	300	-71.77	0	0.07	-71.84	-13	-58.84
300	30.23	164	100	V	300	-71.79	0	0.07	-71.86	-13	-58.86
374.4	28.43	161	100	H	374.4	-70.5	0	0.08	-70.58	-13	-57.58
374.4	28.16	129	100	V	374.4	-70.77	0	0.08	-70.85	-13	-57.85
1039	48.888	0	100	H	1039	-61.222	6.122	0.49	-55.59	-13	-42.59
1039	48.74	0	100	V	1039	-62.98	6.279	0.49	-57.191	-13	-44.191
2253	47	0	100	H	2253	-60.53	9.205	0.69	-52.015	-13	-39.015
2253	50.94	0	100	V	2253	-57.03	9.506	0.69	-48.214	-13	-35.214

Uplink

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)		
47.8	45.14	0	100	V	47.8	-40.42	0	0.05	-40.47	-13	-27.47
300	29.74	89	100	H	300	-72.28	0	0.07	-72.35	-13	-59.35
300	30	246	100	V	300	-72.02	0	0.07	-72.09	-13	-59.09
374.4	26.97	121	100	H	374.4	-71.96	0	0.08	-72.04	-13	-59.04
374.4	29.86	322	100	V	374.4	-69.07	0	0.08	-69.15	-13	-56.15
1039	43.68	0	100	H	1039	-66.43	6.122	0.49	-60.798	-13	-47.798
1039	43.69	0	100	V	1039	-68.03	6.279	0.49	-62.241	-13	-49.241
2253	49.54	0	100	H	2253	-57.99	9.205	0.69	-49.475	-13	-36.475
2253	50.67	0	100	V	2253	-57.3	9.506	0.69	-48.484	-13	-35.484

8 FCC §2.1051 & §24.238(a) - Spurious Emissions at Antenna Terminals

8.1 Applicable Standards

According to FCC §24.238(a) and §2.1051 the power of any emissions outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB

8.2 Test Procedure

The EUT was connected to the spectrum analyzer and Signal Generator followed by 50Ω-75Ω matching pad.

The resolution bandwidth of the spectrum analyzer was set at 1MHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.



8.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2014-10-24	1 year
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2014-09-18	2 years
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2014-07-15	2 years

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

8.4 Test Environmental Conditions

Temperature:	21-23° C
Relative Humidity:	42-48 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Todd Moy 2015-10-08 in the RF Site.

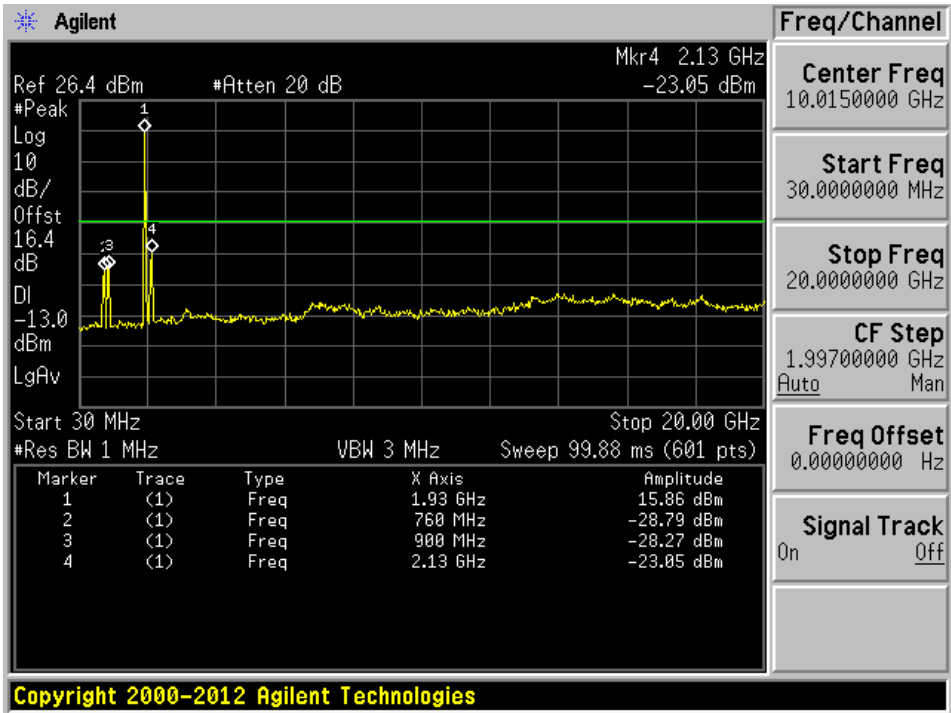
8.5 Test Results

Please refer to the following plots.

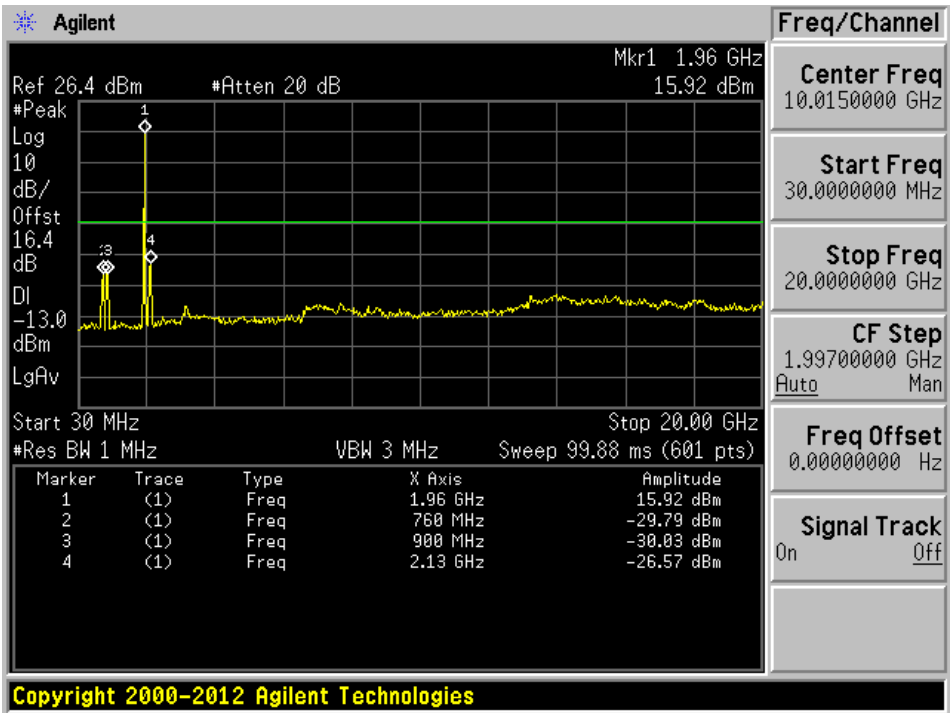
Downlink: Broadband Signal

AGC Off

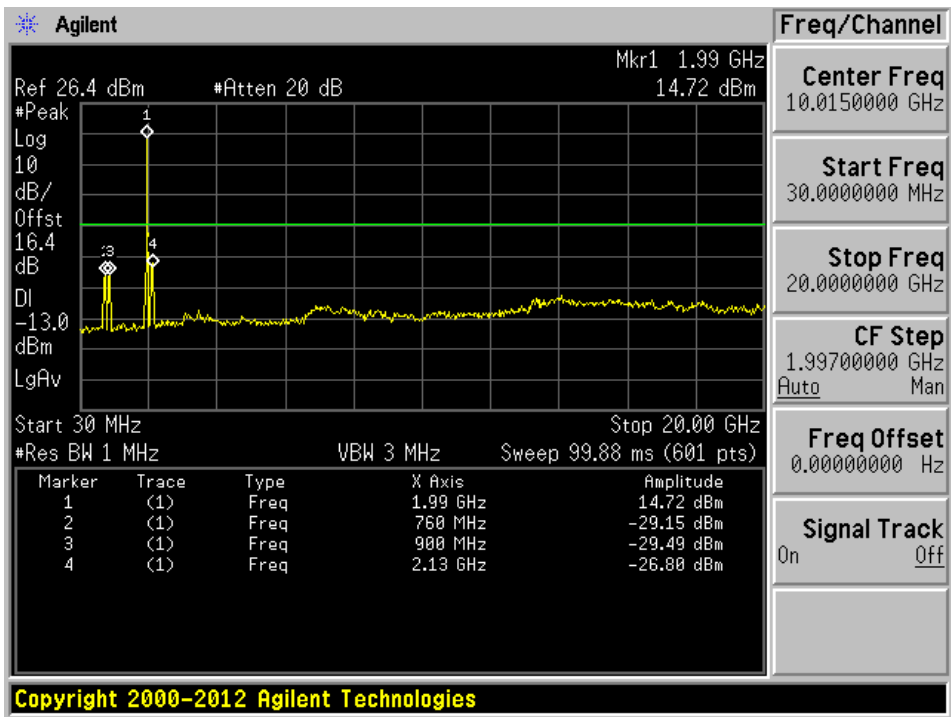
Low Channel: 1932.5 MHz



Middle Channel: 1960 MHz

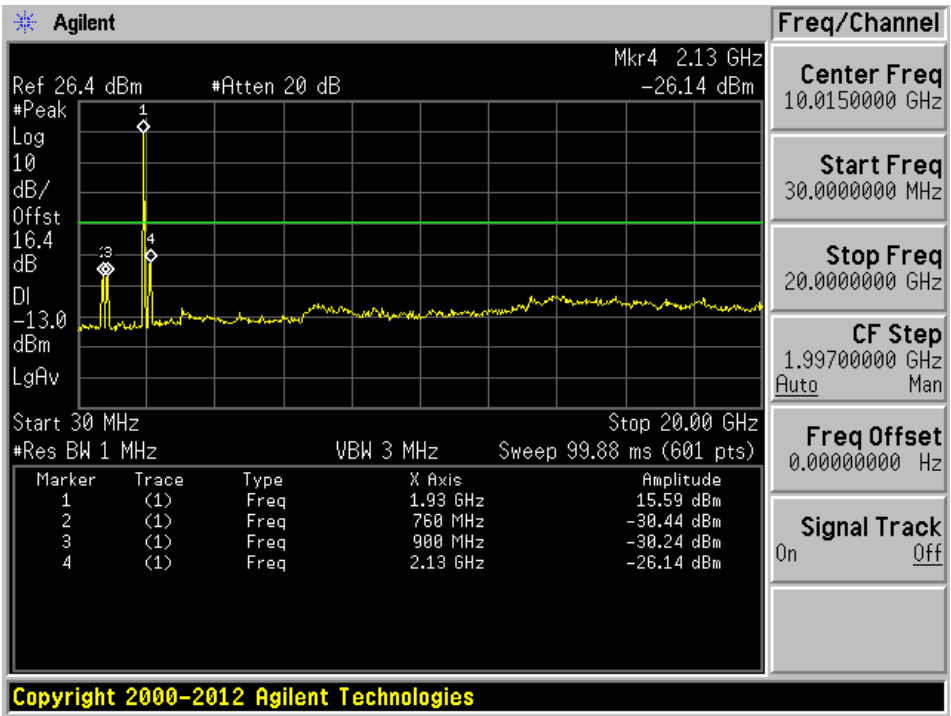


High Channel: 1987.5 MHz

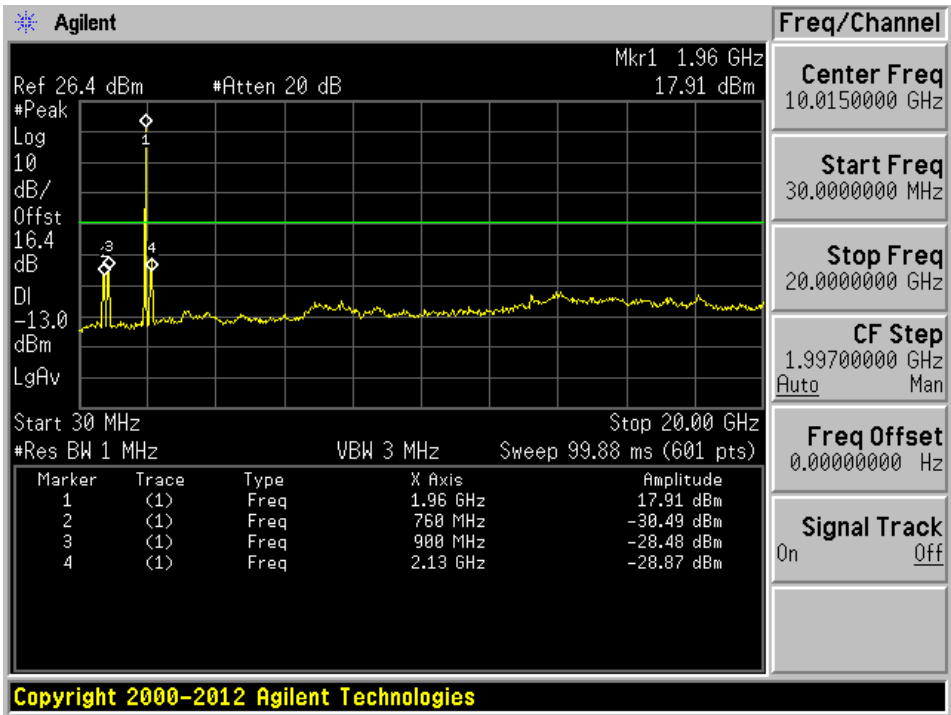


AGC On

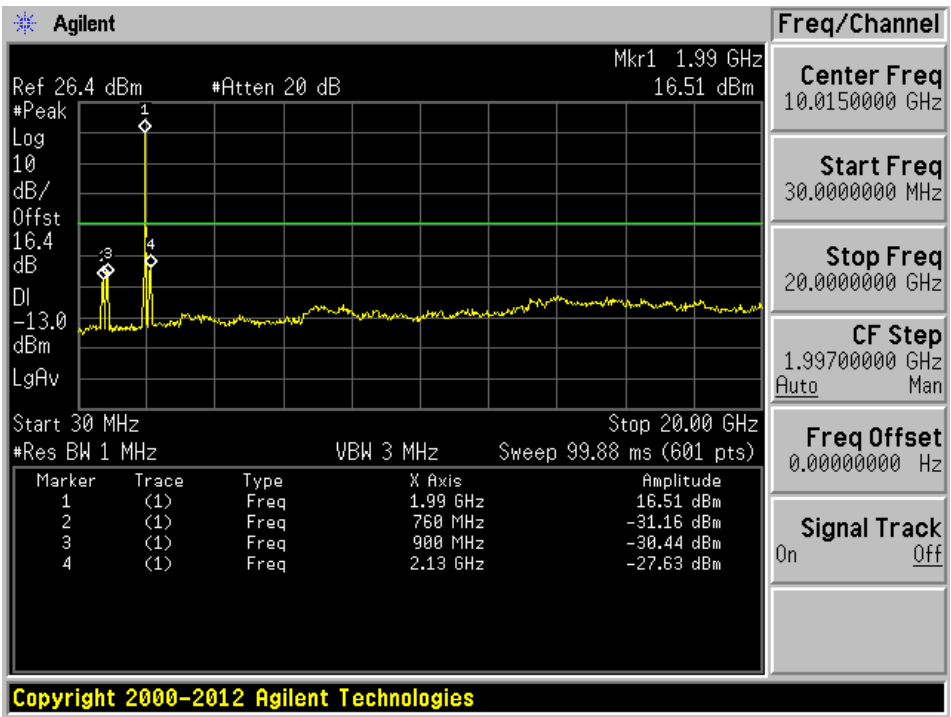
Low Channel: 1932.5 MHz



Middle Channel: 1960 MHz



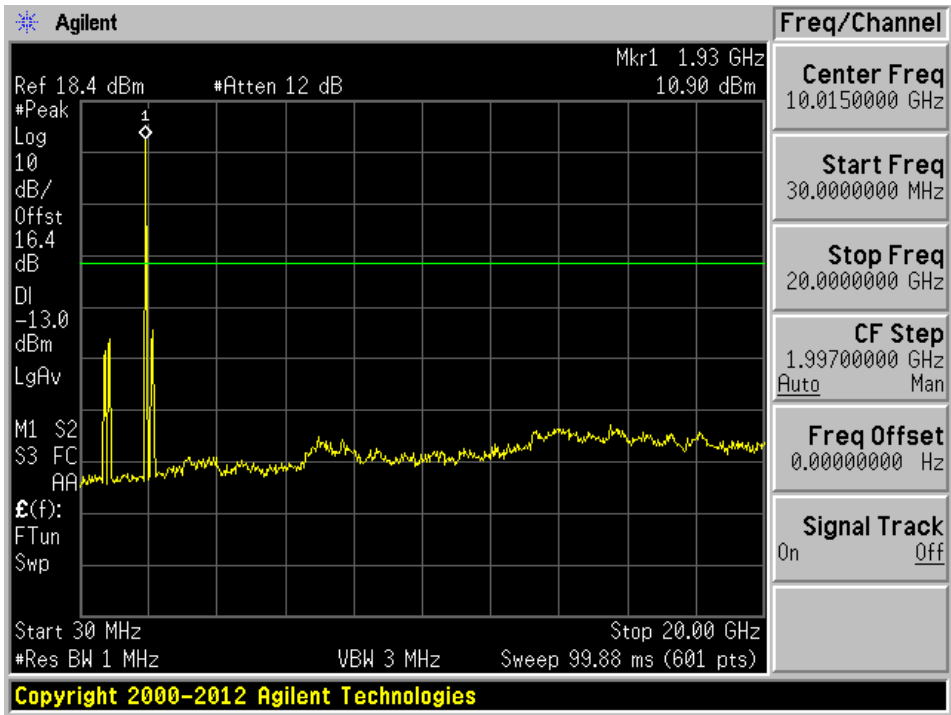
High Channel: 1987.5 MHz



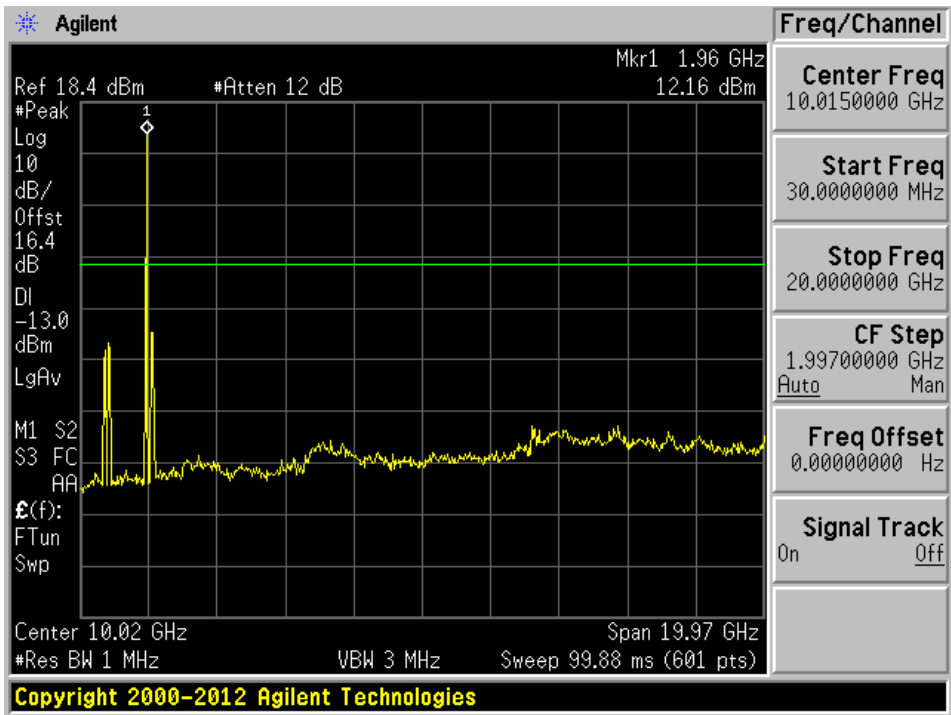
Downlink: Narrowband signal

AGC Off

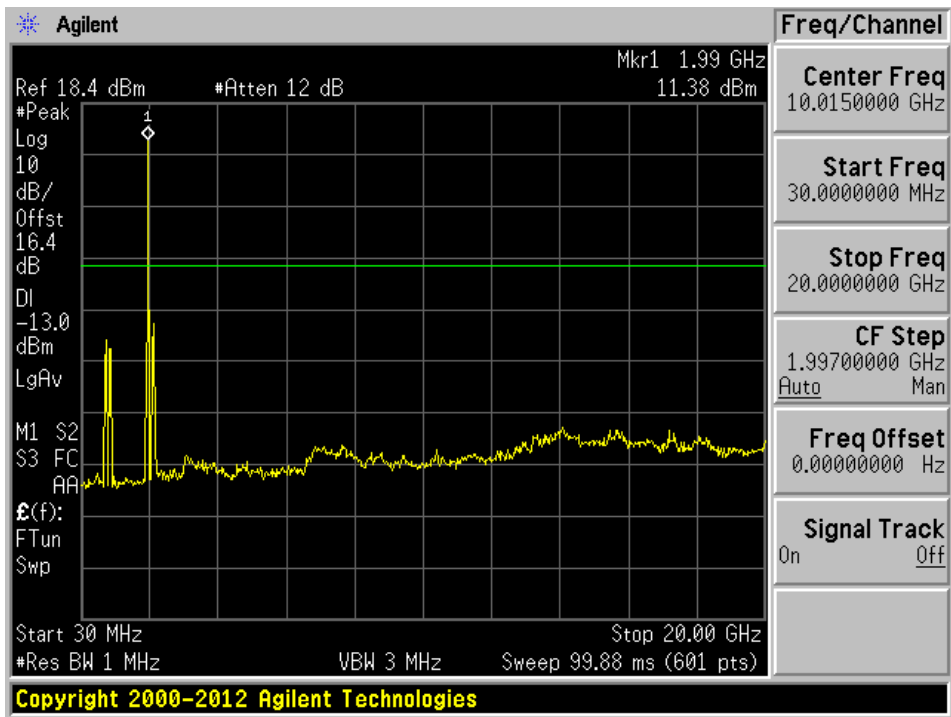
Low Channel: 1930.2 MHz



Middle Channel: 1960 MHz

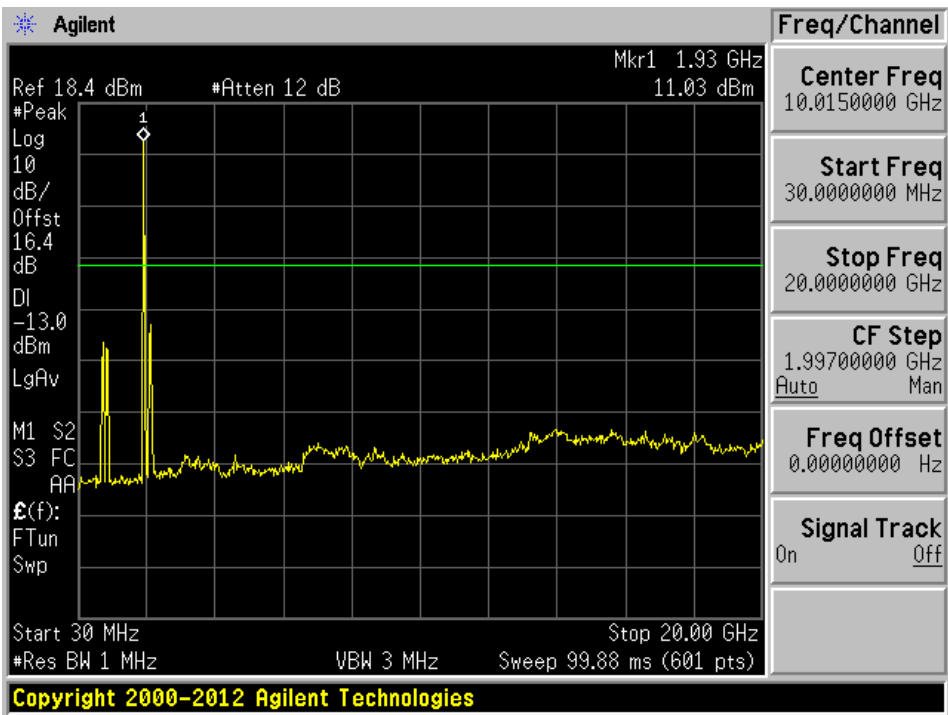


High Channel: 1989.8 MHz

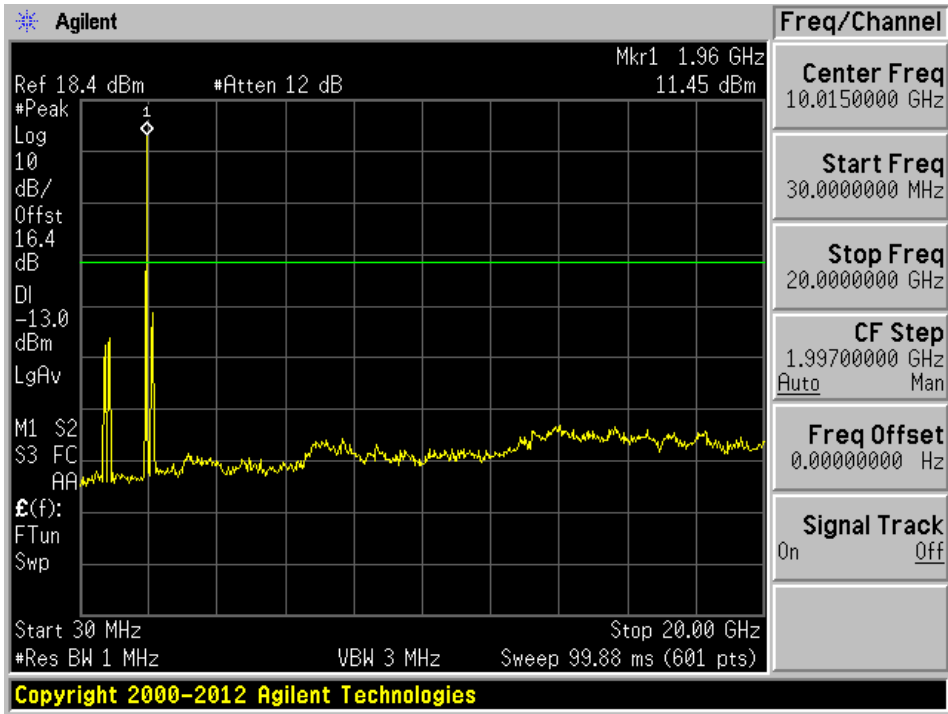


AGC On

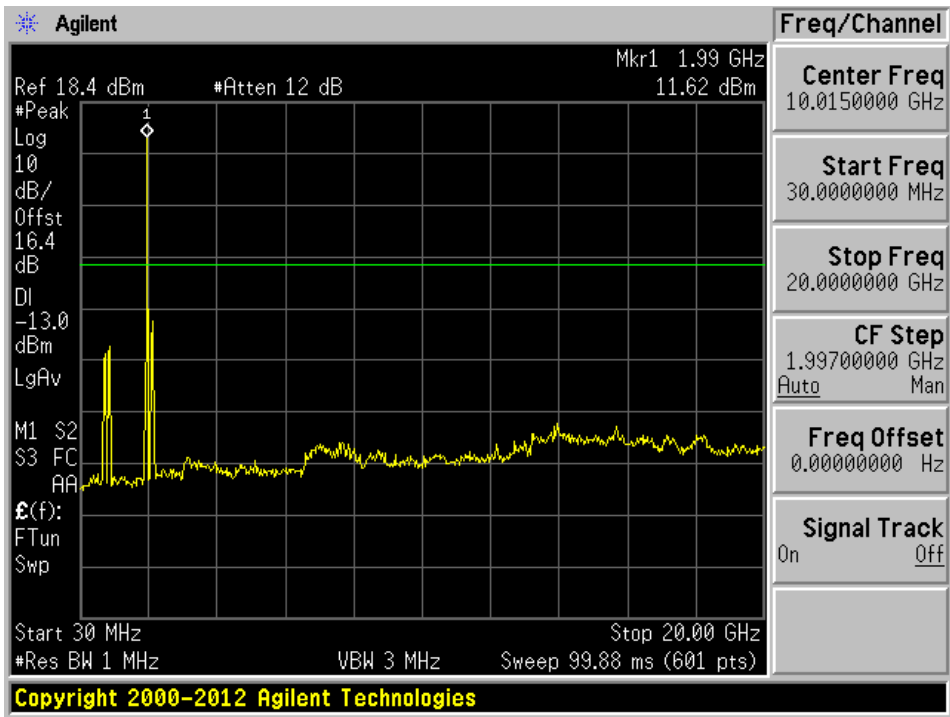
Low Channel: 1930.2 MHz



Middle Channel: 1960 MHz



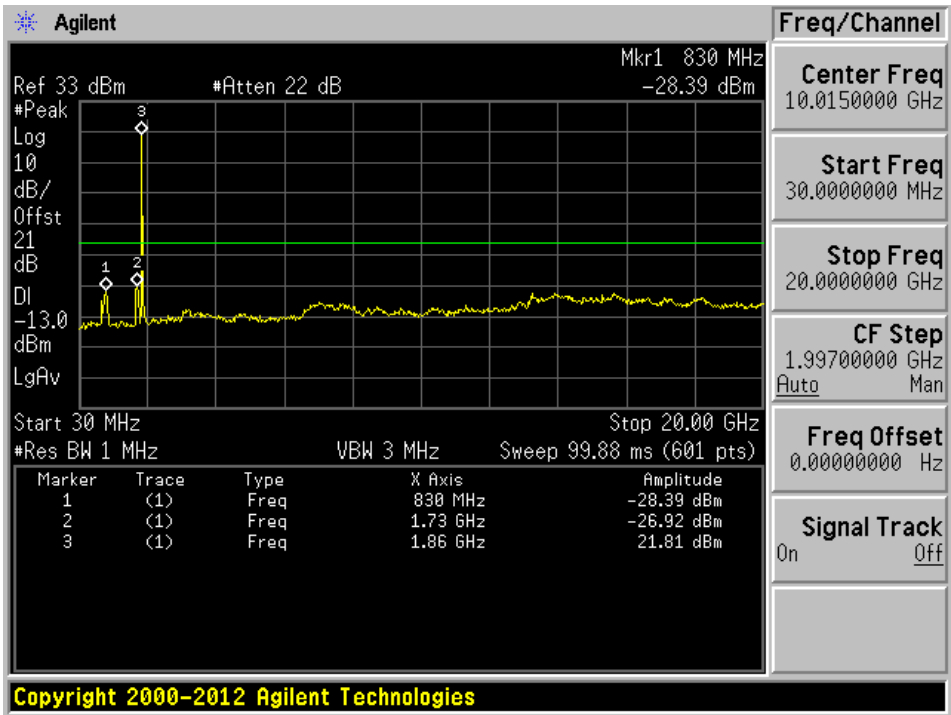
High Channel: 1989.8 MHz



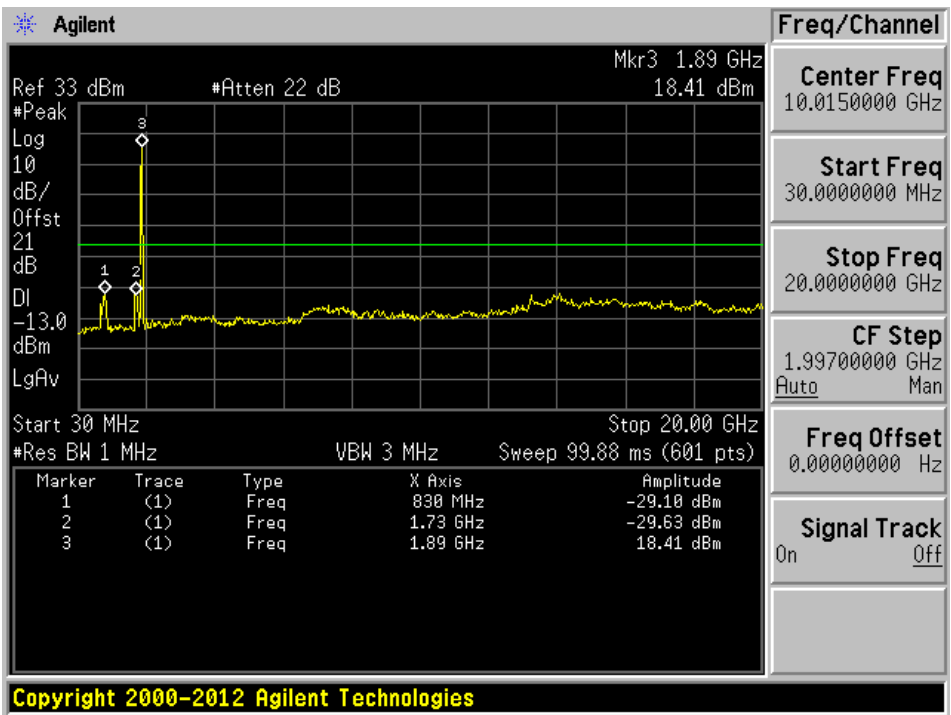
Uplink: Broadband Signal

AGC Off

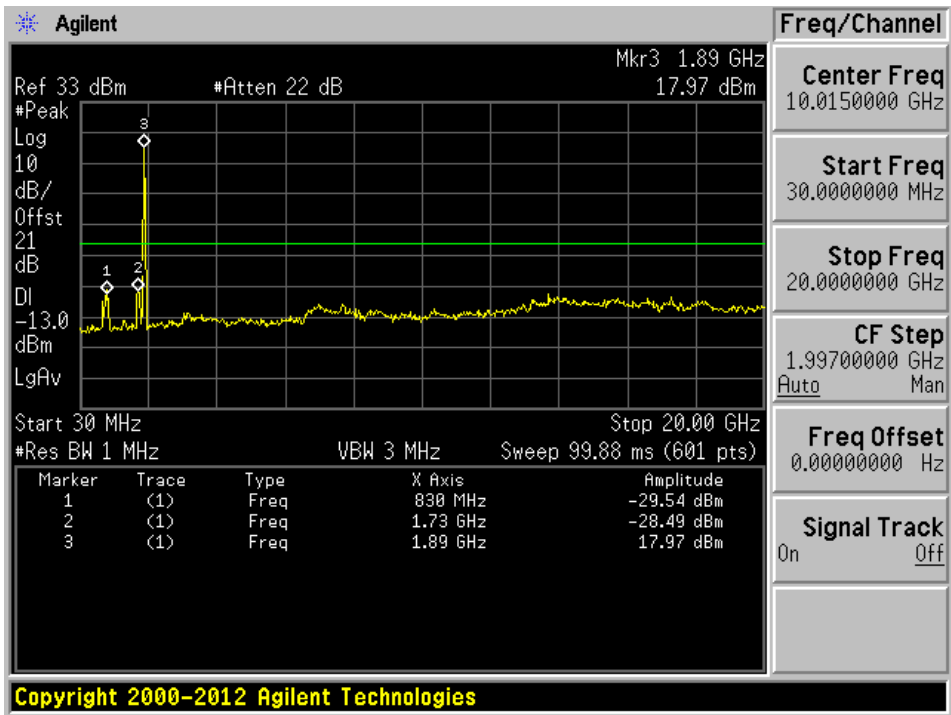
Low Channel: 1852.5 MHz



Middle Channel: 1880 MHz

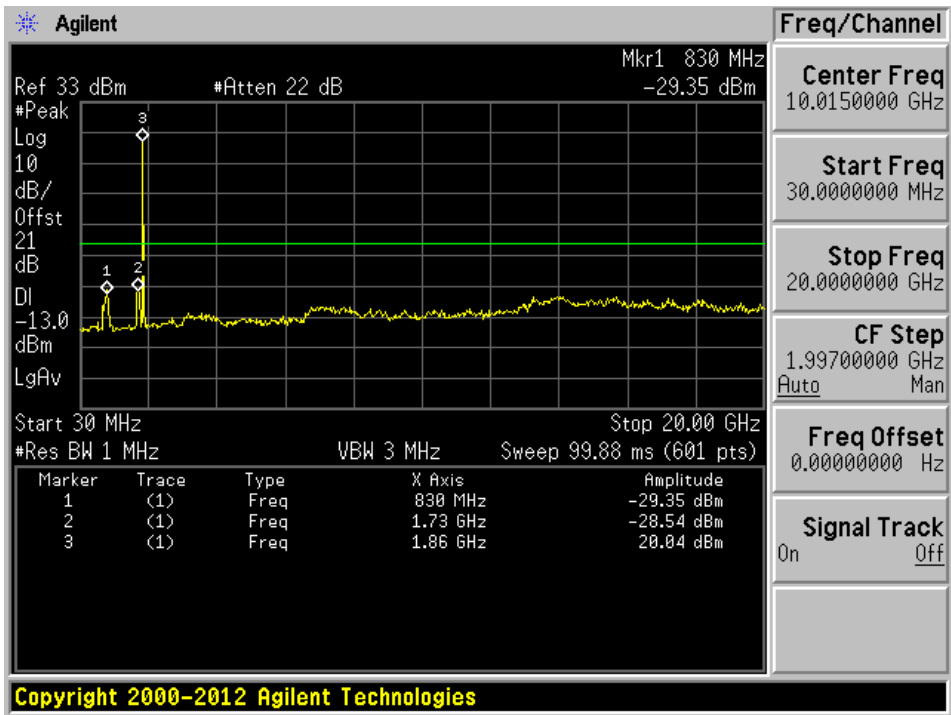


High Channel: 1907.5 MHz

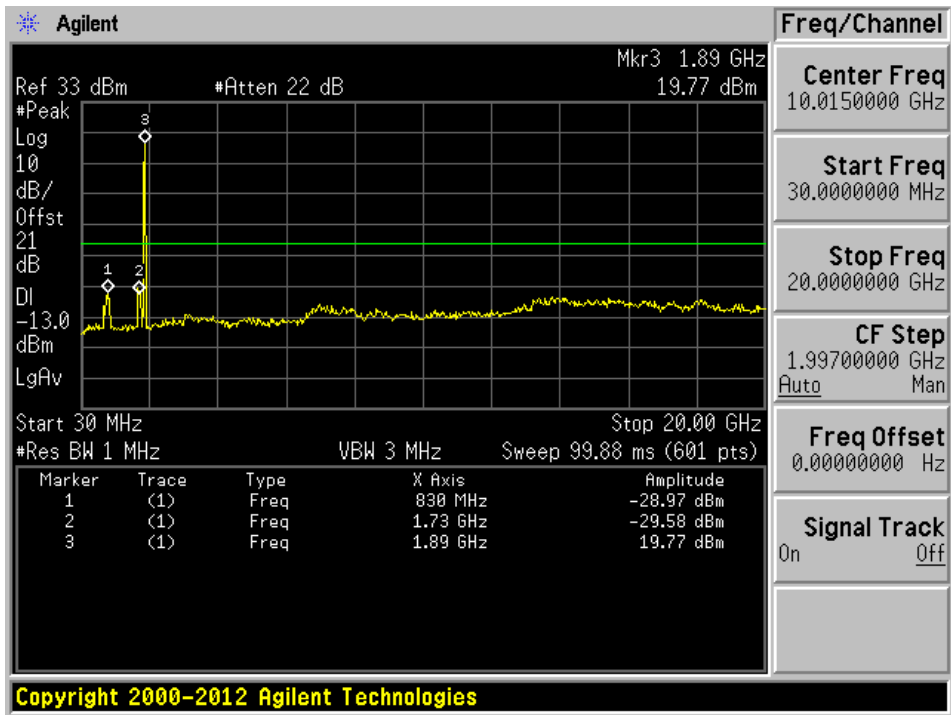


AGC On

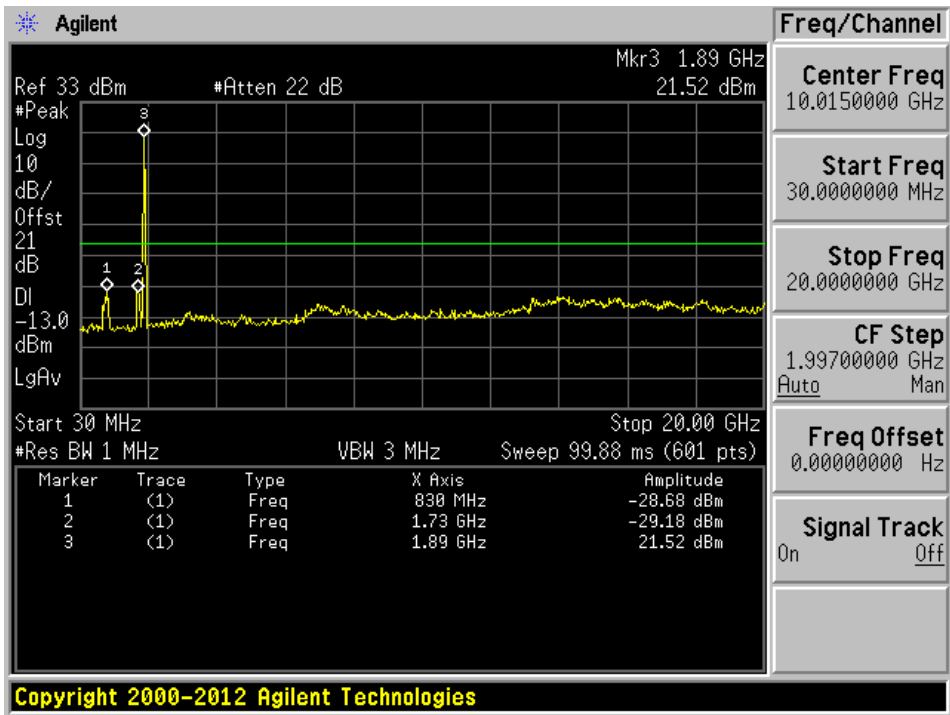
Low Channel: 1852.5 MHz



Middle Channel: 1880 MHz



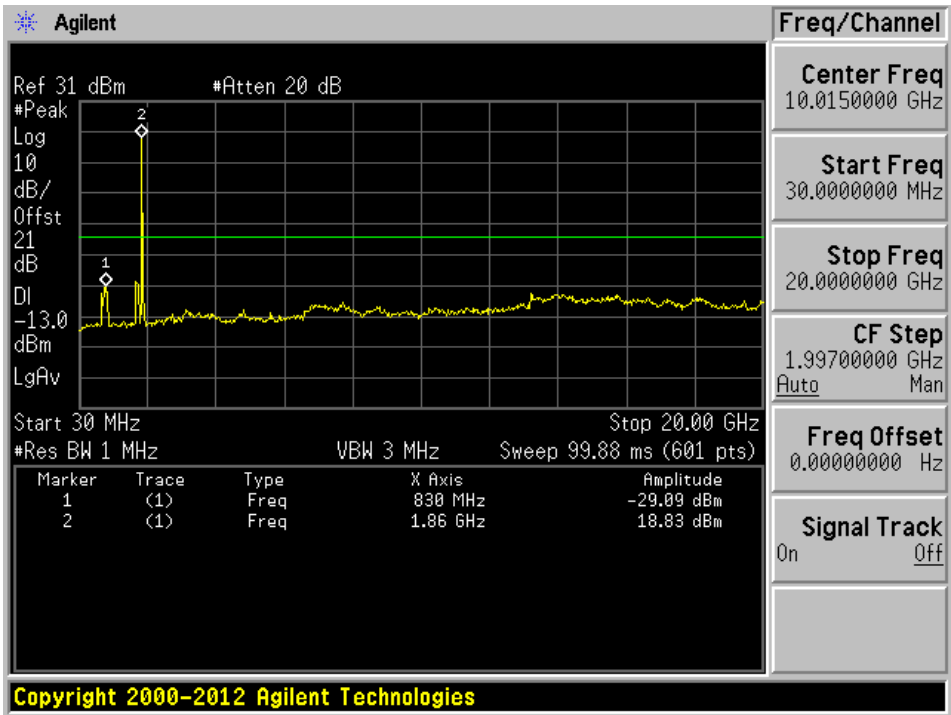
High Channel: 1907.5 MHz



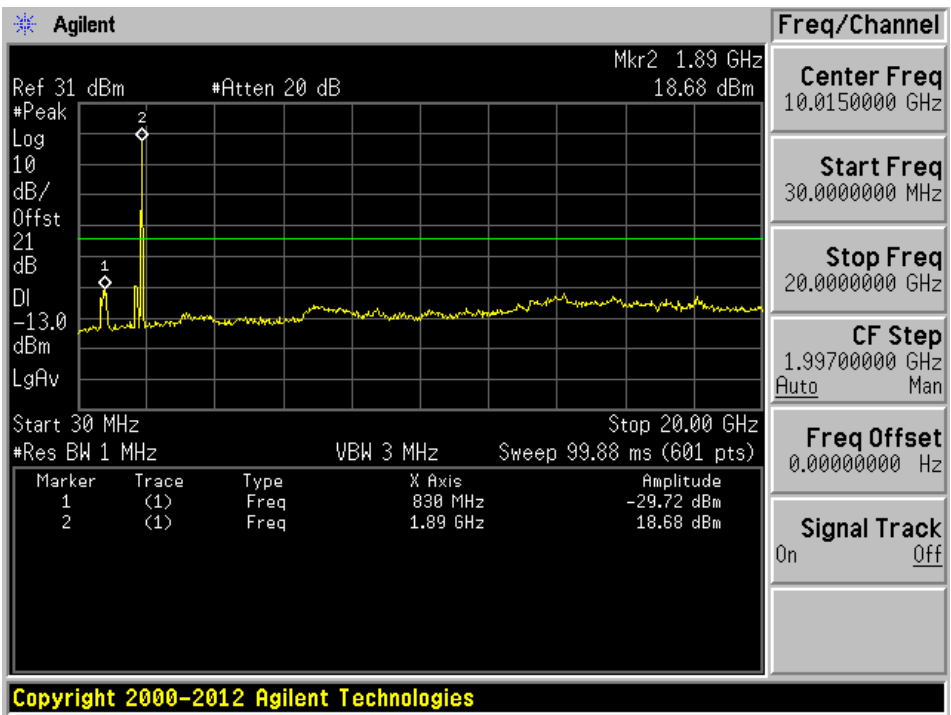
Uplink: Narrowband Signal

AGC Off

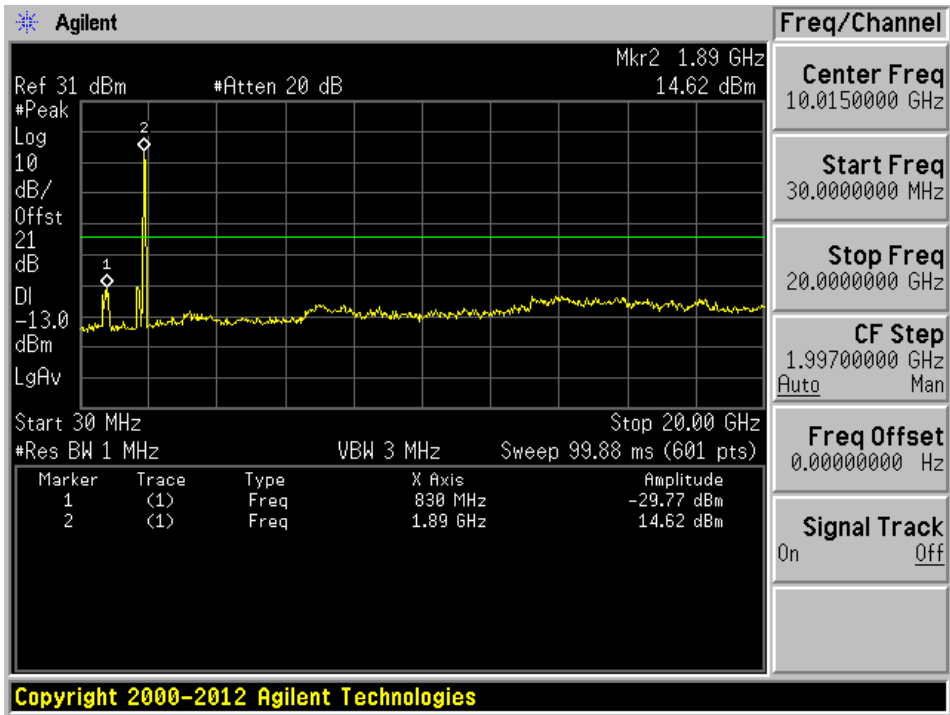
Low Channel: 1850.2 MHz



Middle Channel: 1880 MHz

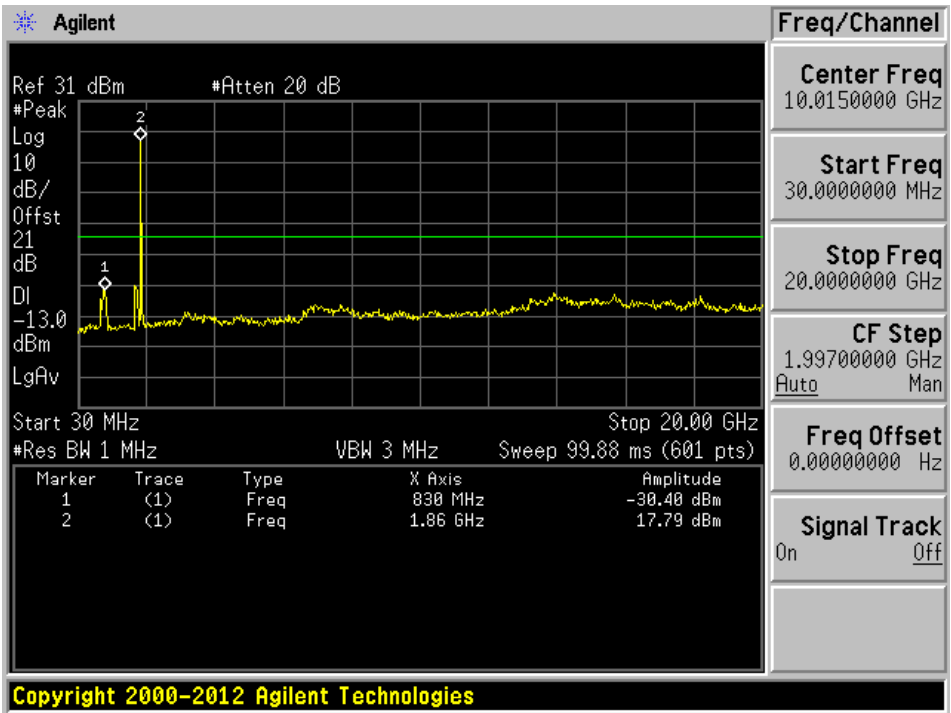


High Channel: 1909.8 MHz

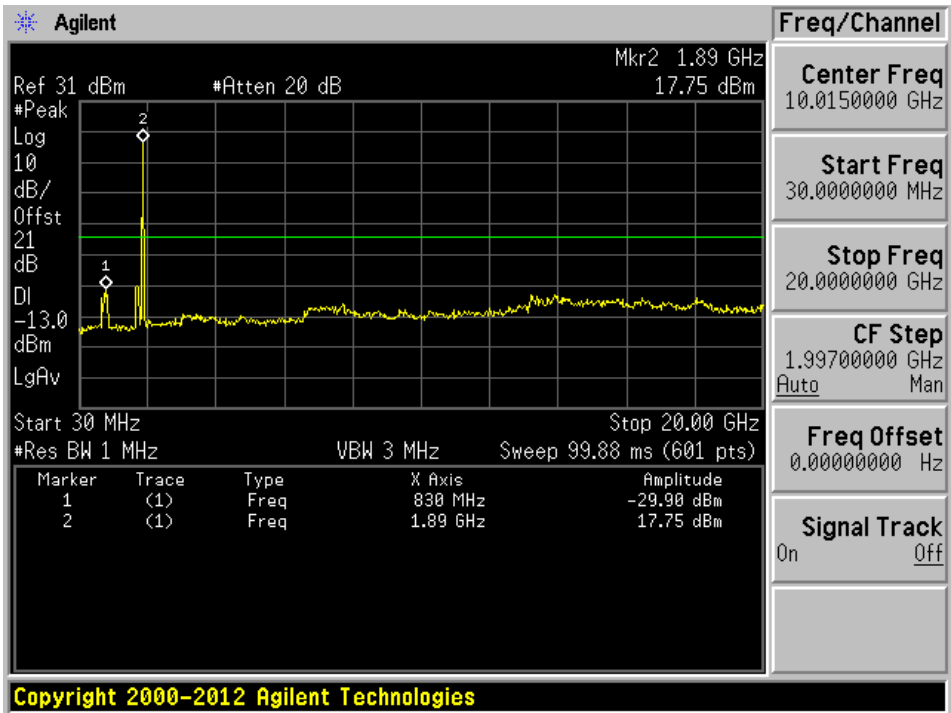


AGC On

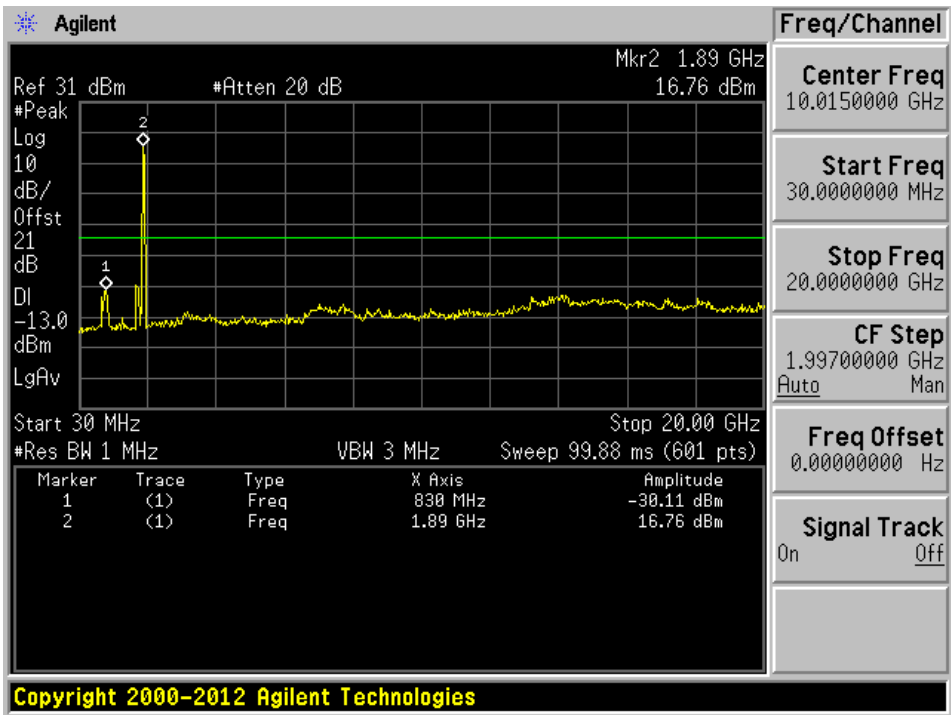
Low Channel: 1850.2 MHz



Middle Channel: 1880 MHz



High Channel: 1909.8 MHz



9 FCC §24.238(a) - Band Edge & Intermodulation

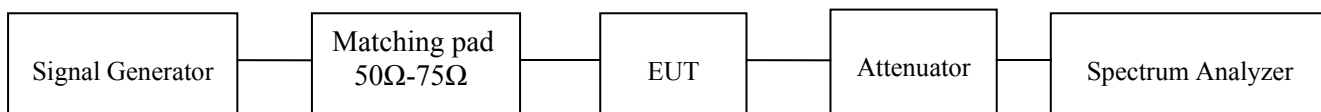
9.1 Applicable Standards

According to FCC §24.238(a) the power of any emissions outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB

9.2 Test Procedure

The EUT was connected to the spectrum analyzer and Signal Generator followed by 50Ω-75Ω matching pad.

The center of the spectrum analyzer was set according to center frequency of the EUT to be transmitted and resolution bandwidth was set to at least 1MHz or 1% of the emission bandwidth



9.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Analyzer, Spectrum	E4446A	US44300386	2014-10-24	1 year
Keysight Technologies	Vector Signal Generator	N5182B	MY51350070	2014-09-18	2 years
Rohde & Schwarz	Generator, Signal	SMIQ03	849192/0085	2014-07-15	2 years

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

9.4 Test Environmental Conditions

Temperature:	21-23° C
Relative Humidity:	42-48 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Todd Moy 2015-10-10 in the RF Site.

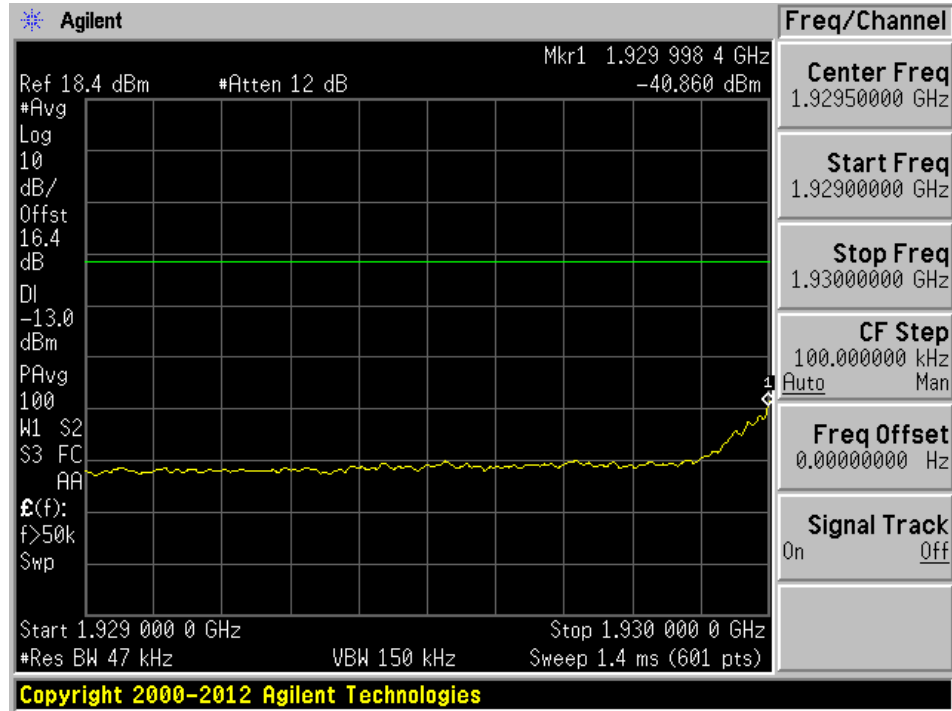
9.5 Test Results

Please refer to the following plots.

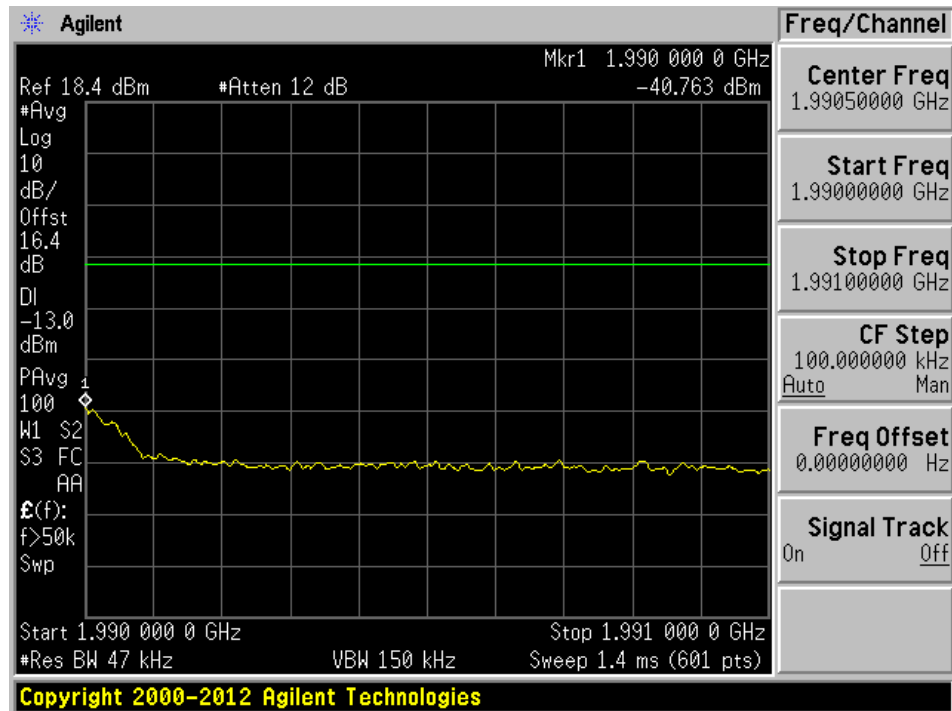
Band Edge**Downlink: Broadband Signal**

AGC Off

Lower Band Edge

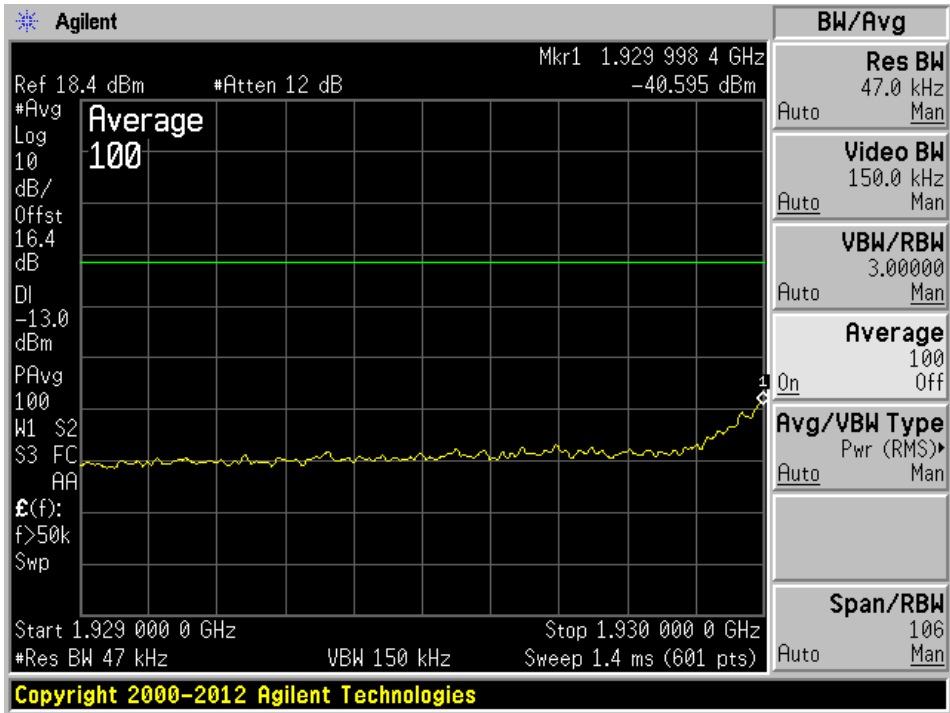


Upper Band Edge

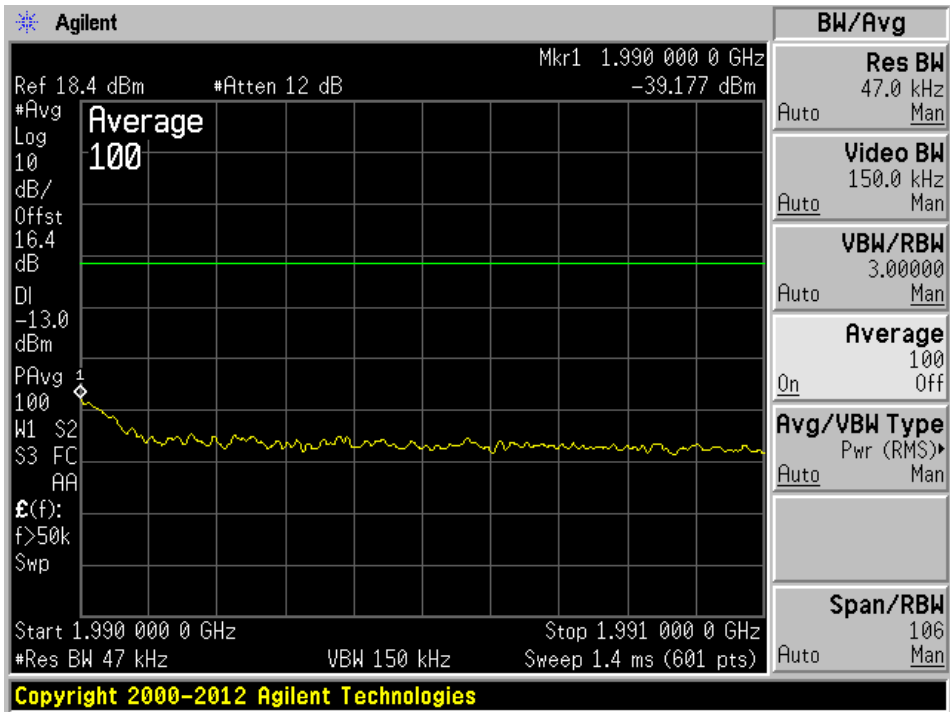


AGC On

Lower Band Edge



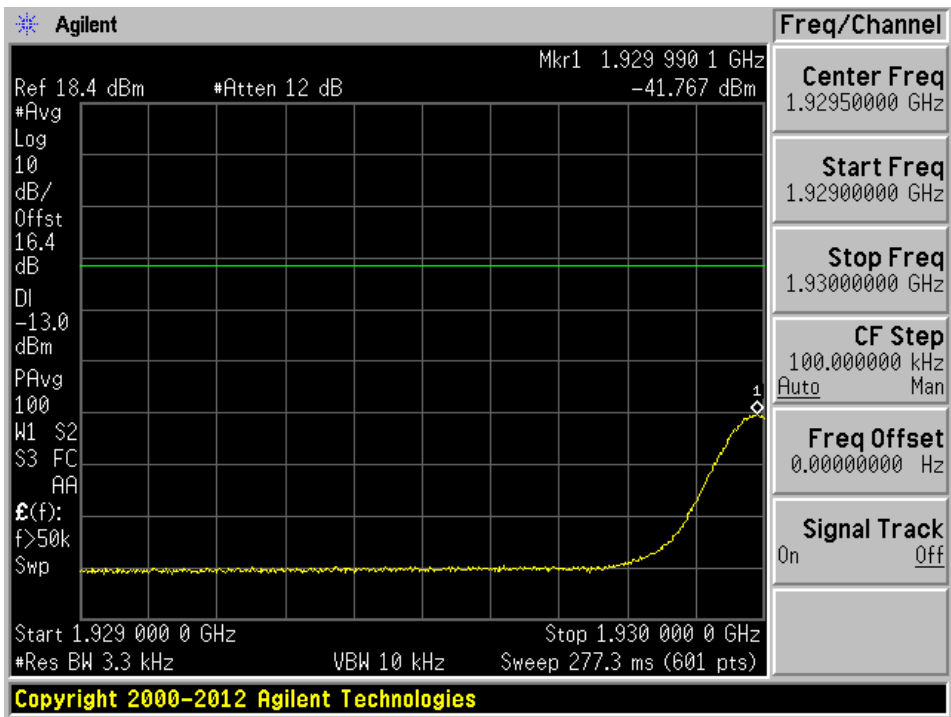
Upper Band Edge



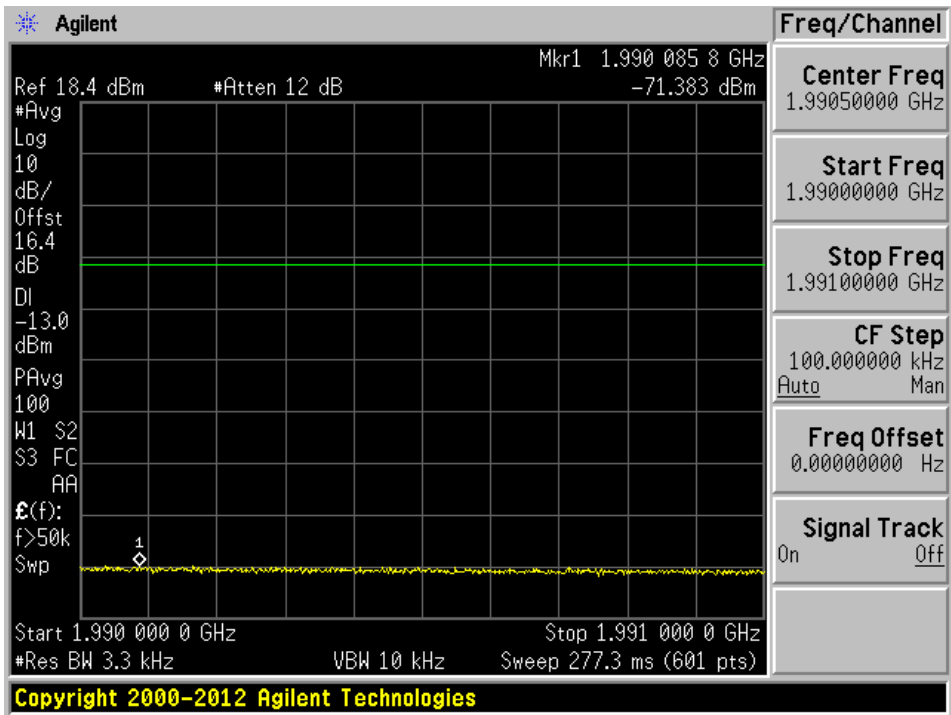
Downlink: Narrowband Signal

AGC Off

Lower Band Edge

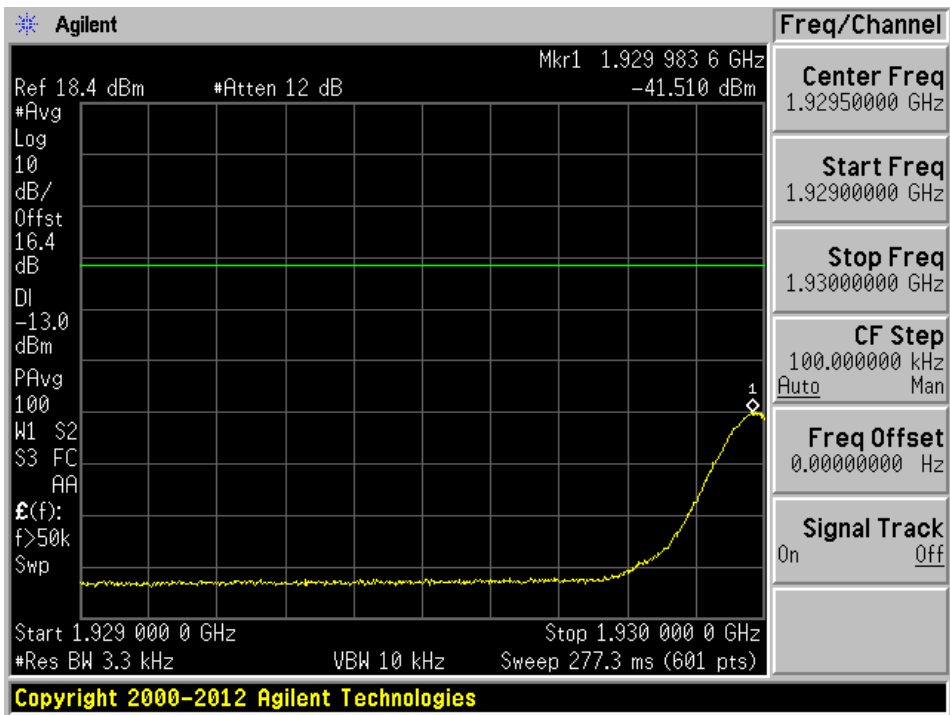


Upper Band Edge

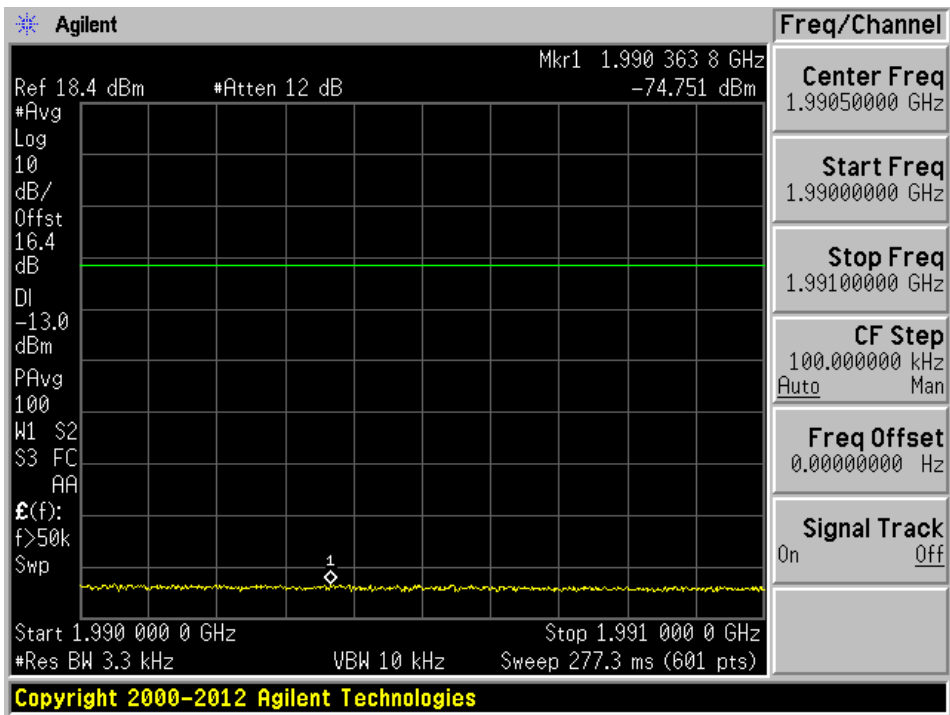


AGC On

Lower Band Edge



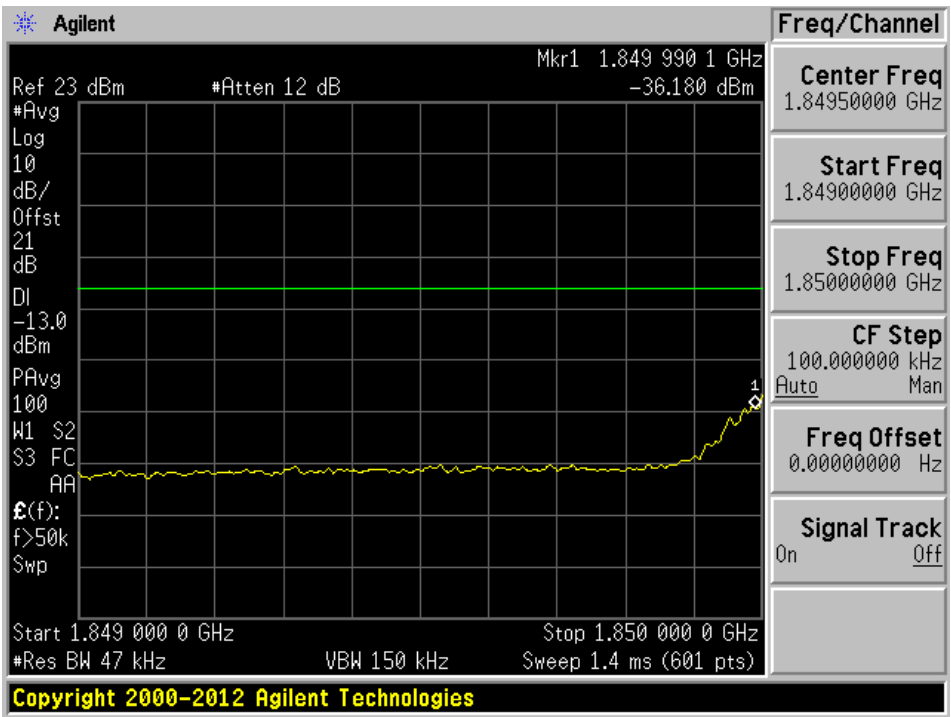
Upper Band Edge



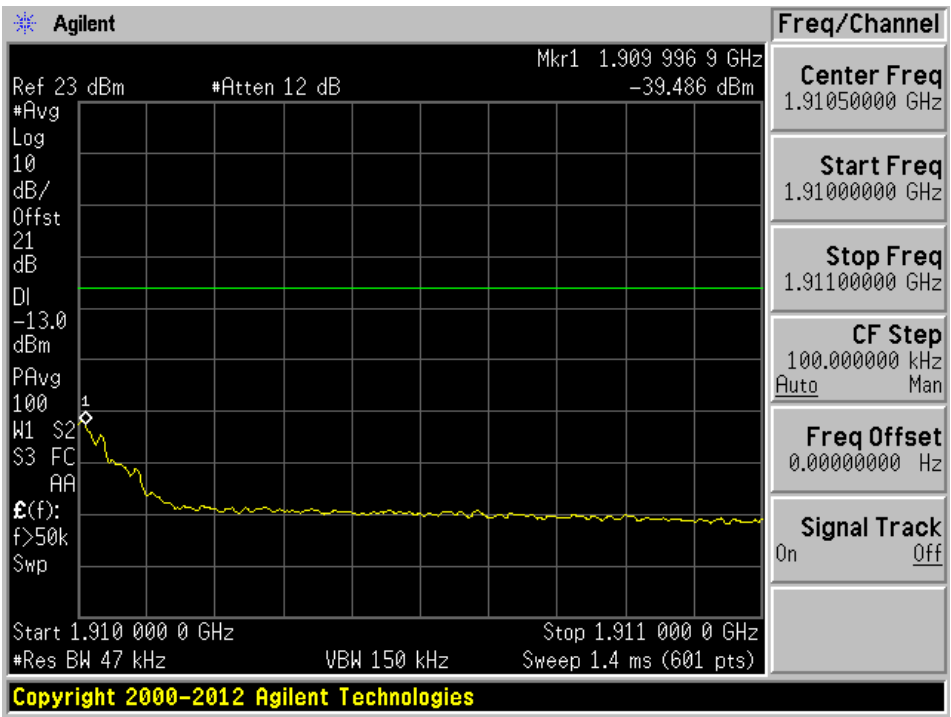
Uplink: Broadband Signal

AGC Off

Lower Band Edge

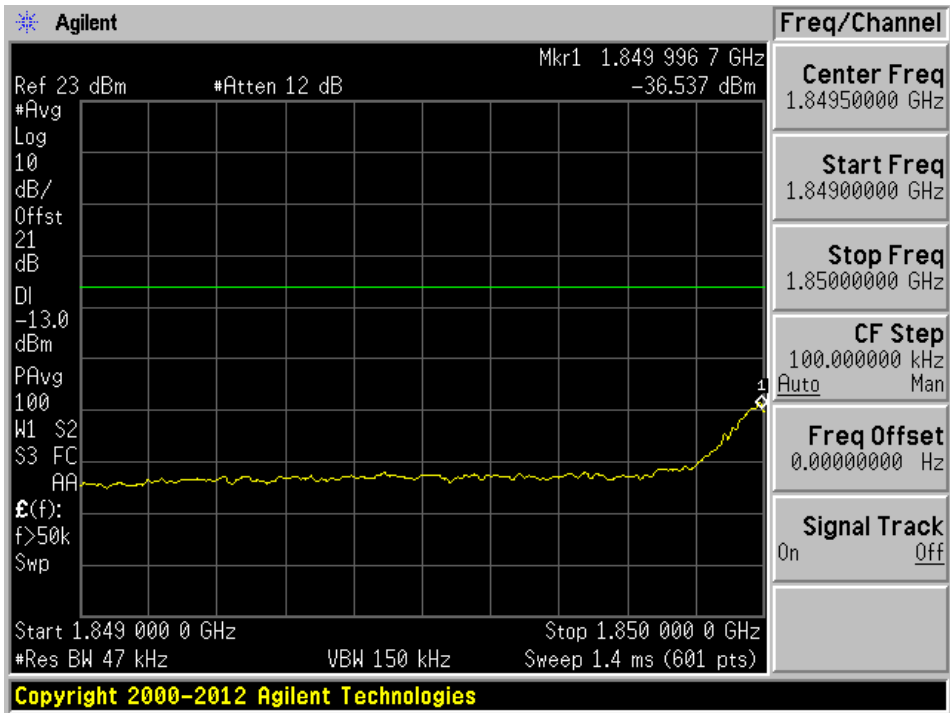


Upper Band Edge

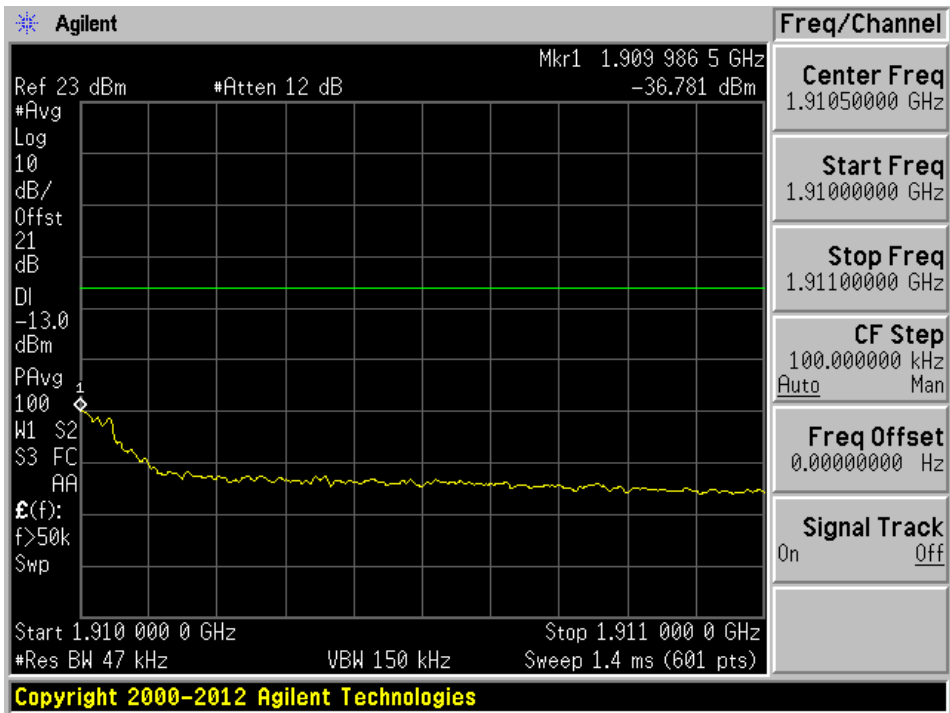


AGC On

Lower Band Edge



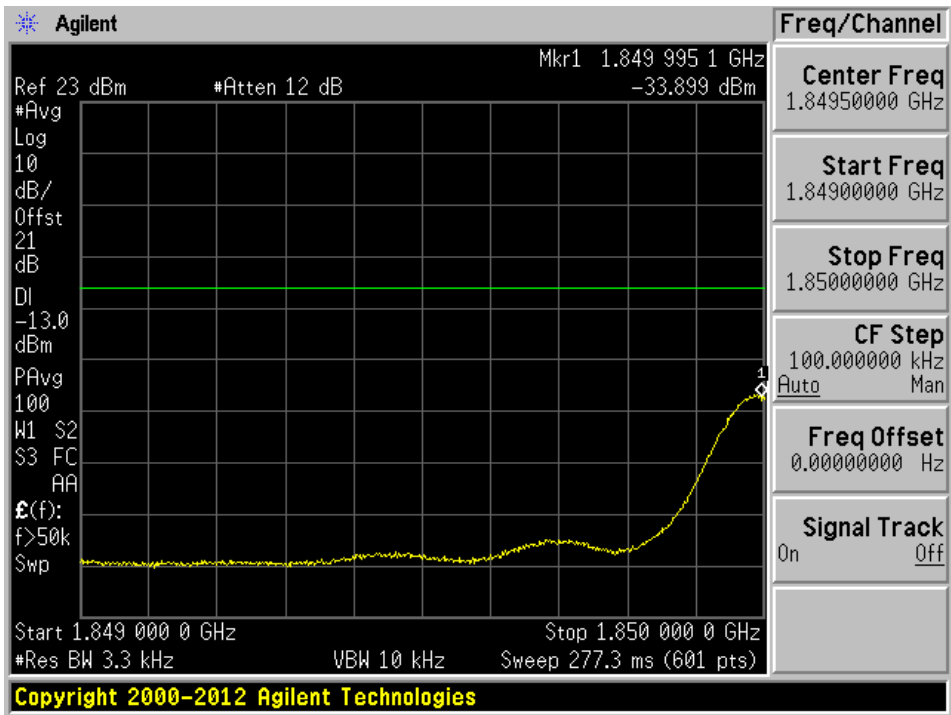
Upper Band Edge



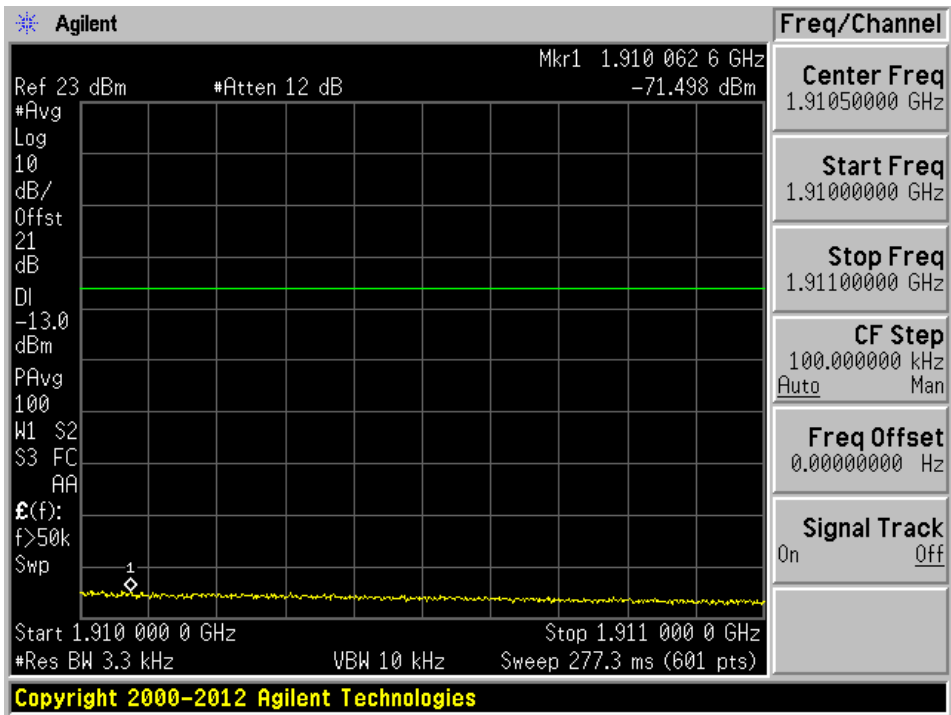
Uplink: Narrowband Signal

AGC Off

Lower Band Edge

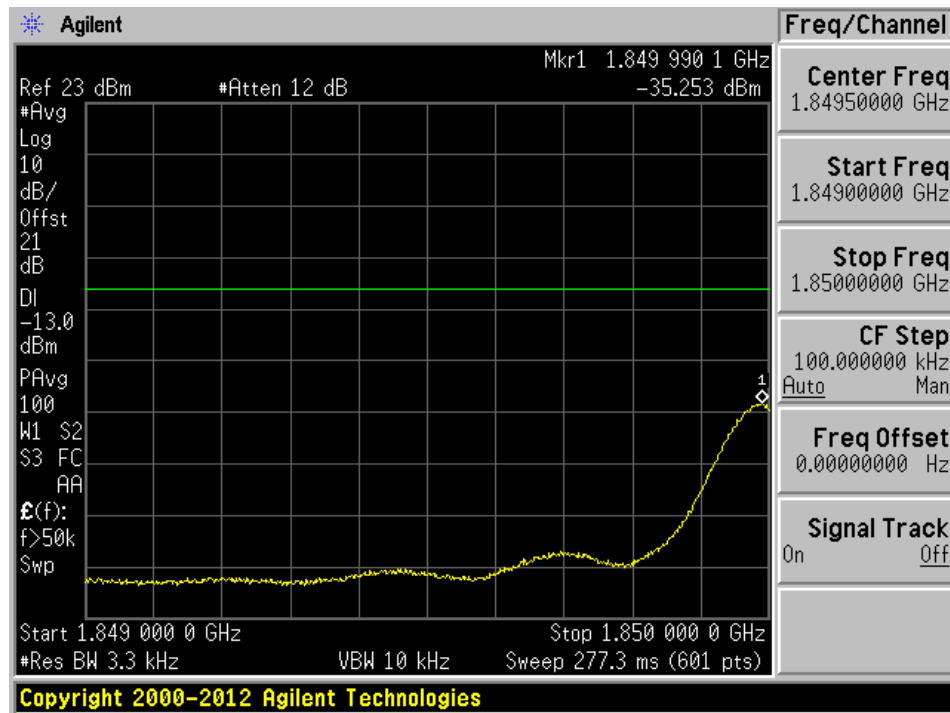


Upper Band Edge

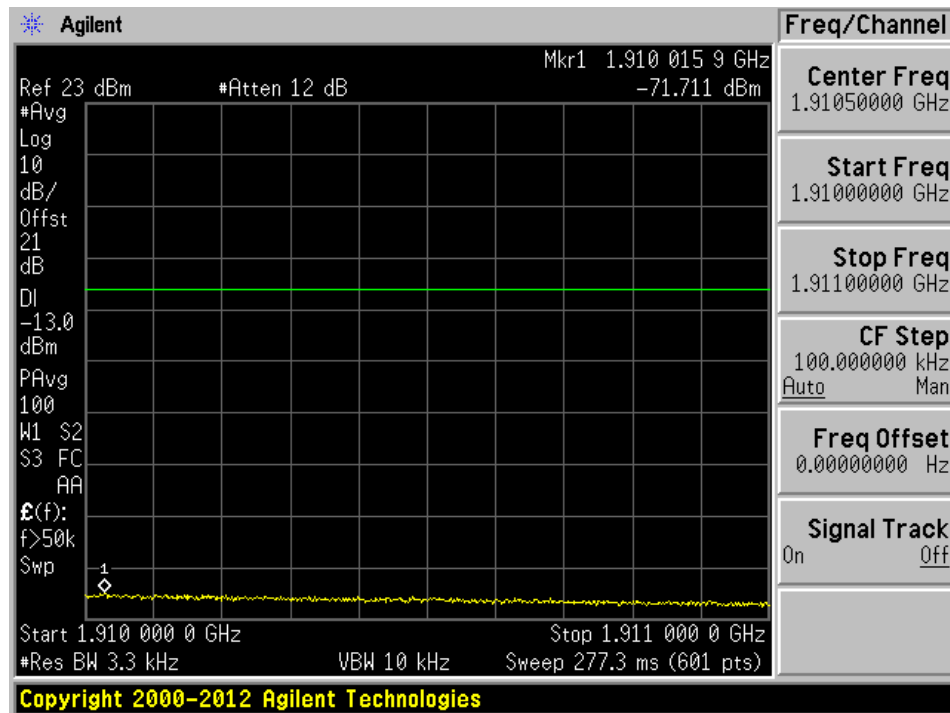


AGC On

Lower Band Edge



Upper Band Edge

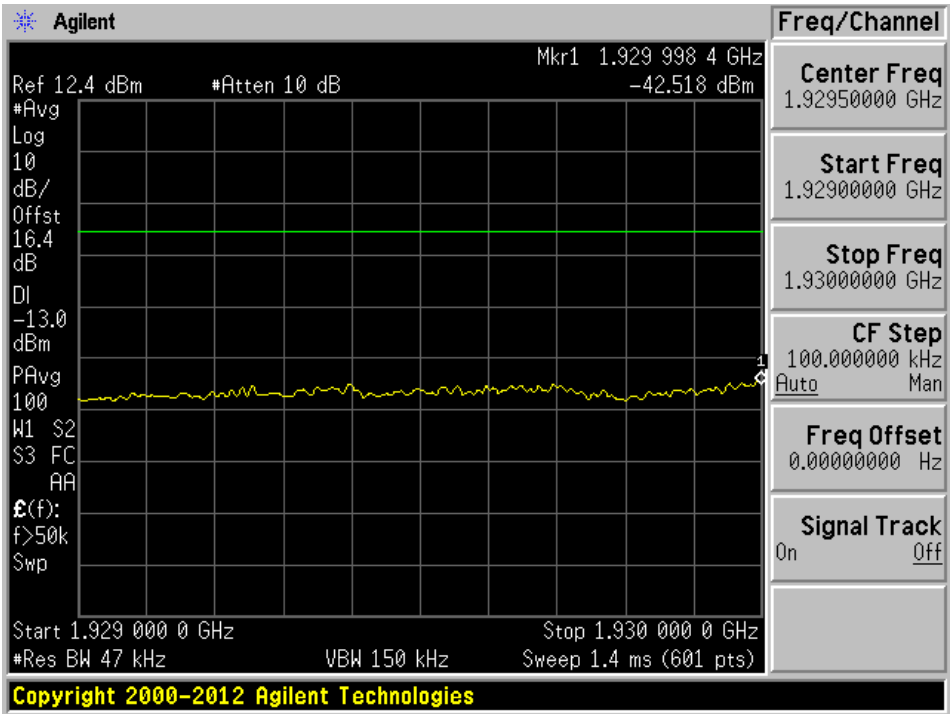


Intermodulation

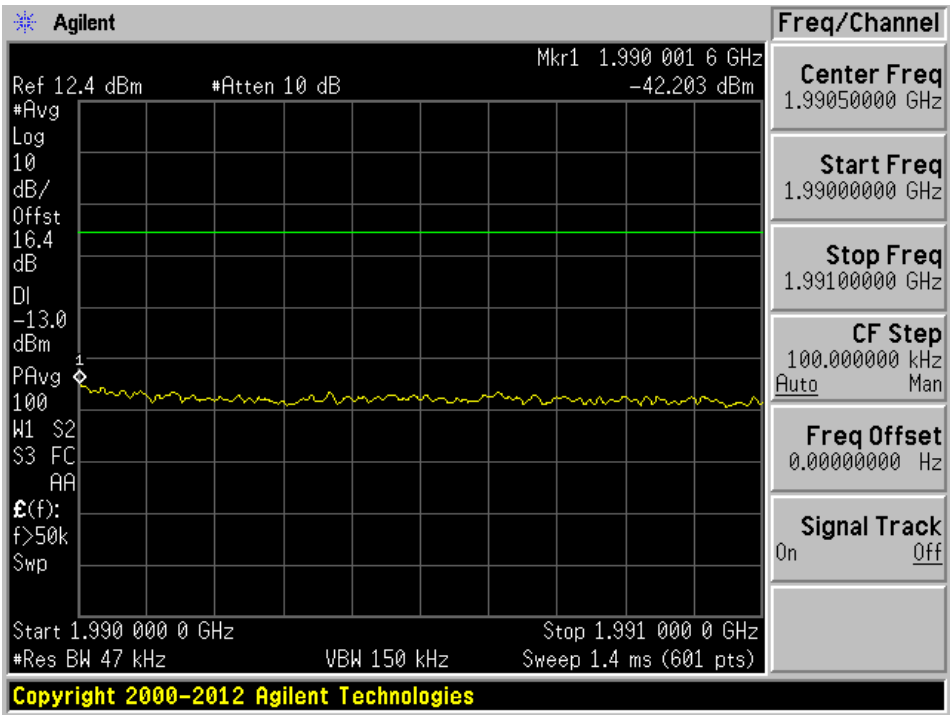
Downlink: Broadband Signal

AGC Off

Low Channel

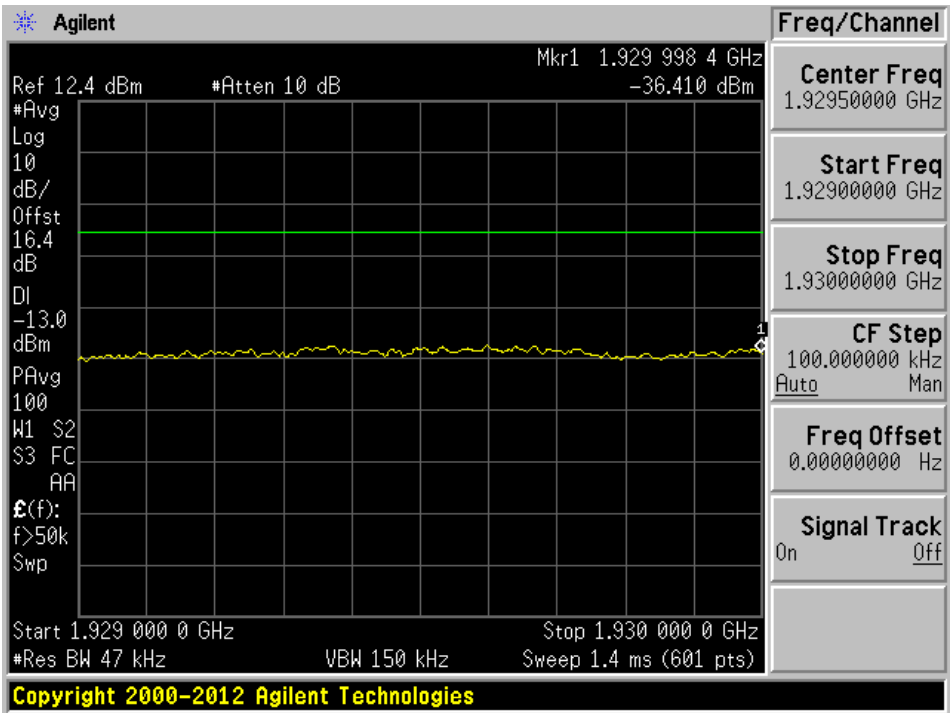


High Channel

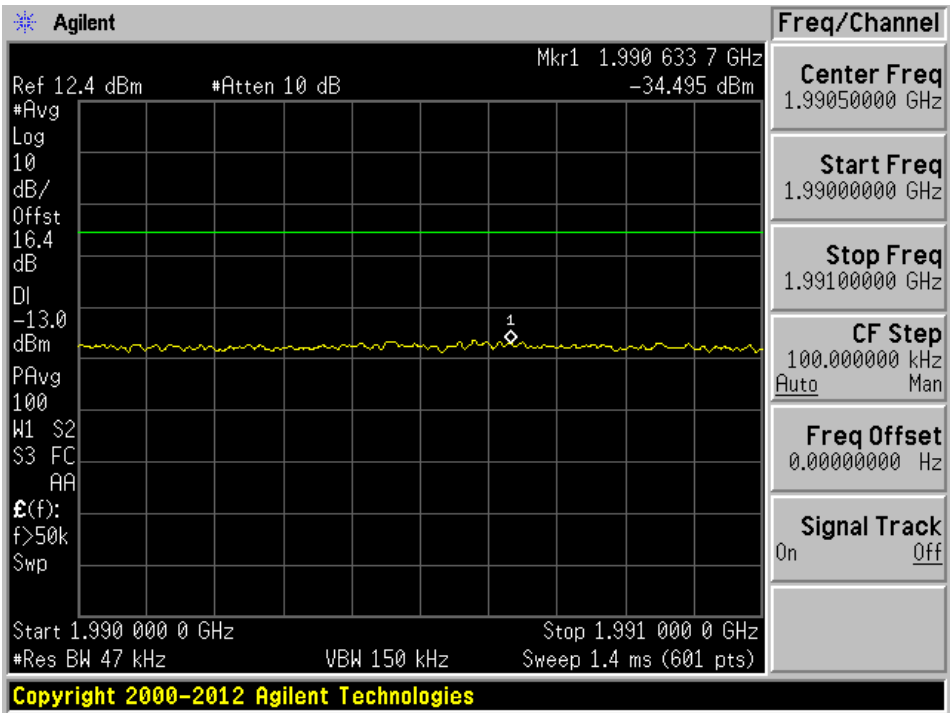


AGC On

Low Channel



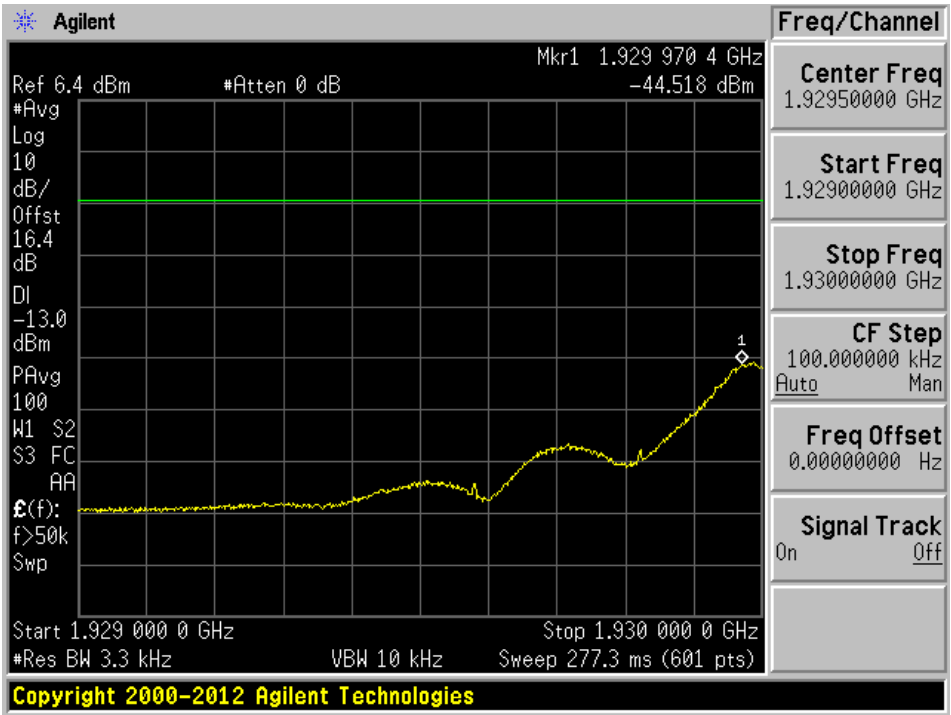
High Channel



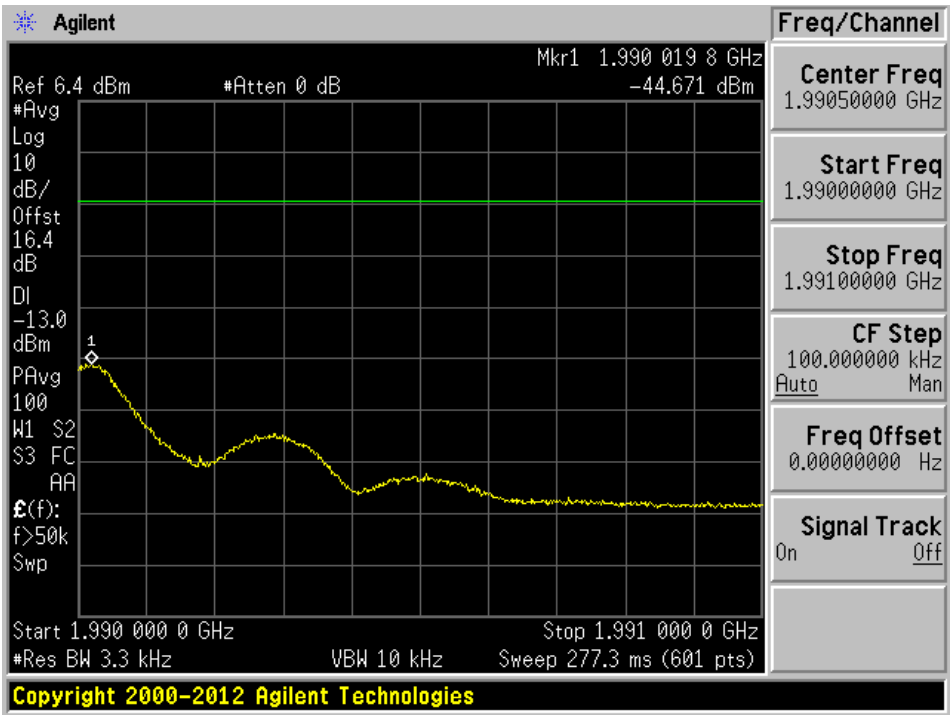
Downlink: Narrowband signal

AGC Off

Low Channel

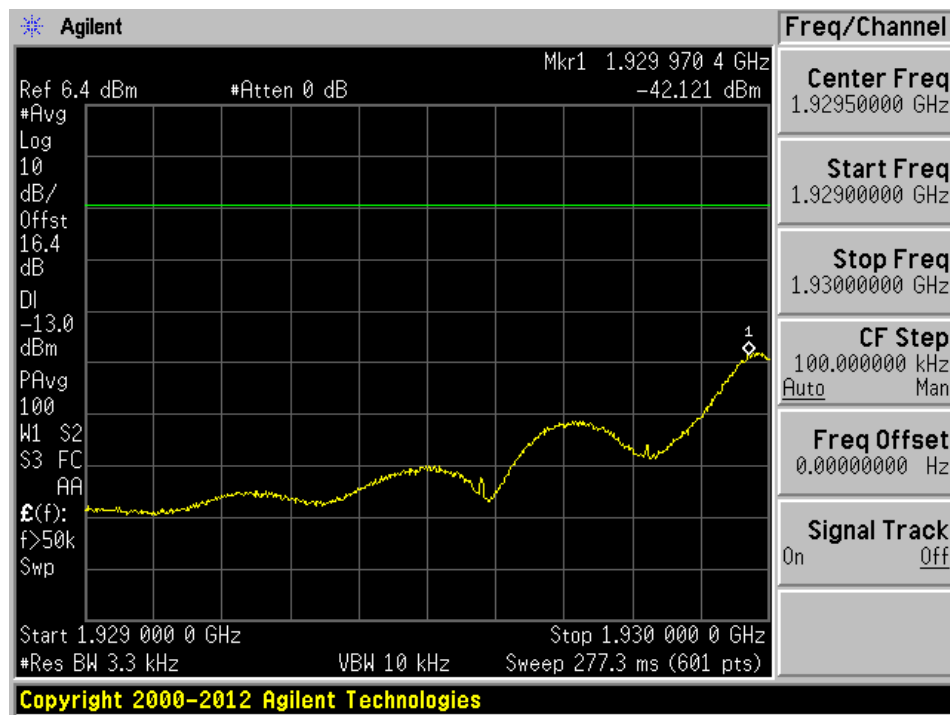


High Channel

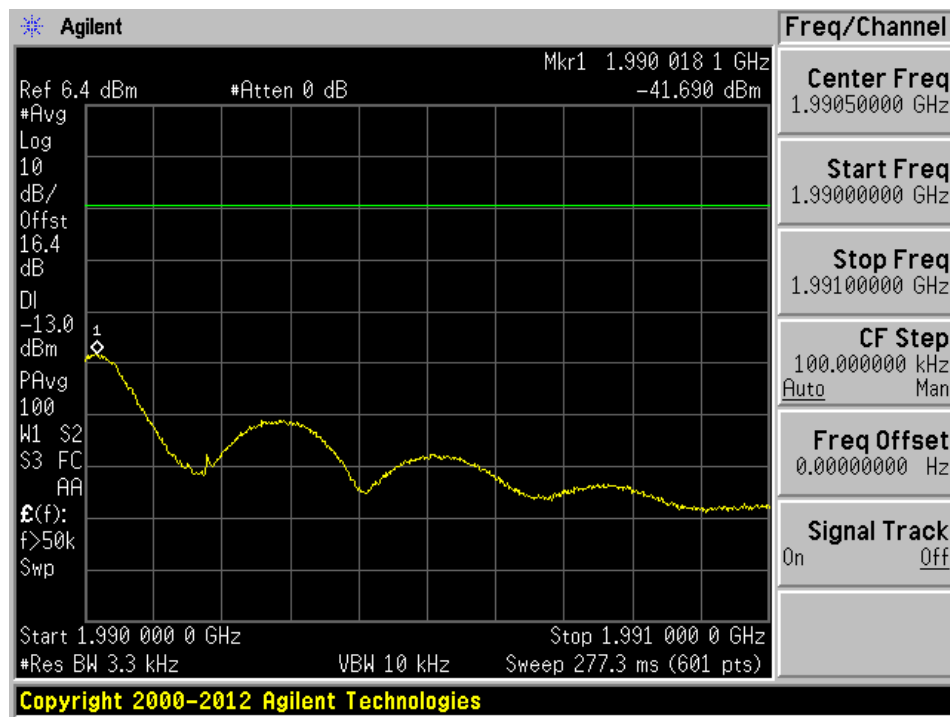


AGC On

Low Channel



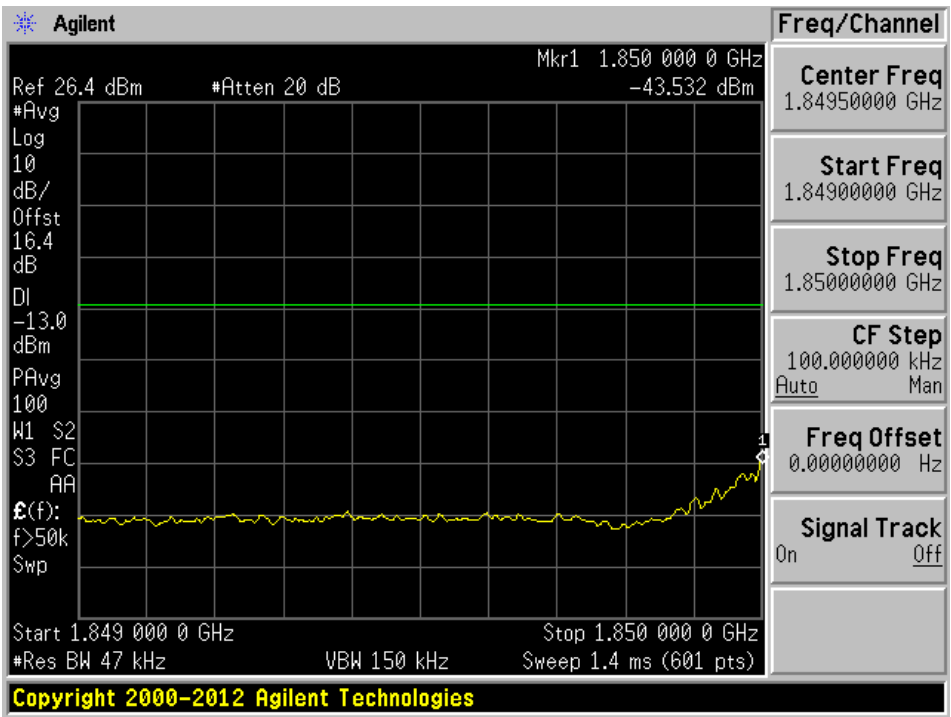
High Channel



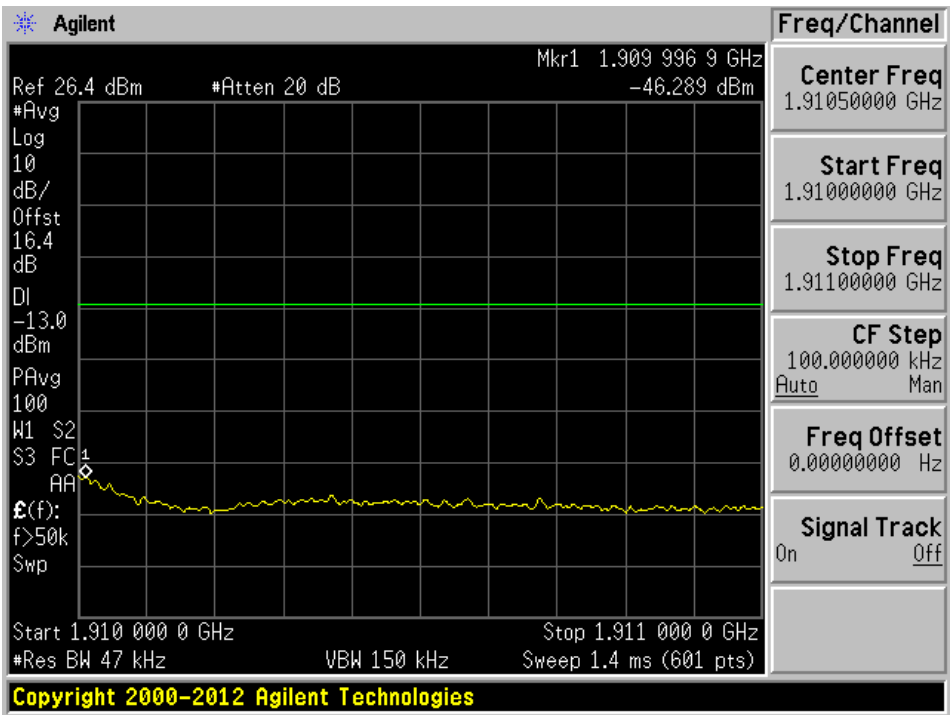
Uplink: Broadband Signal

AGC Off

Low Channel

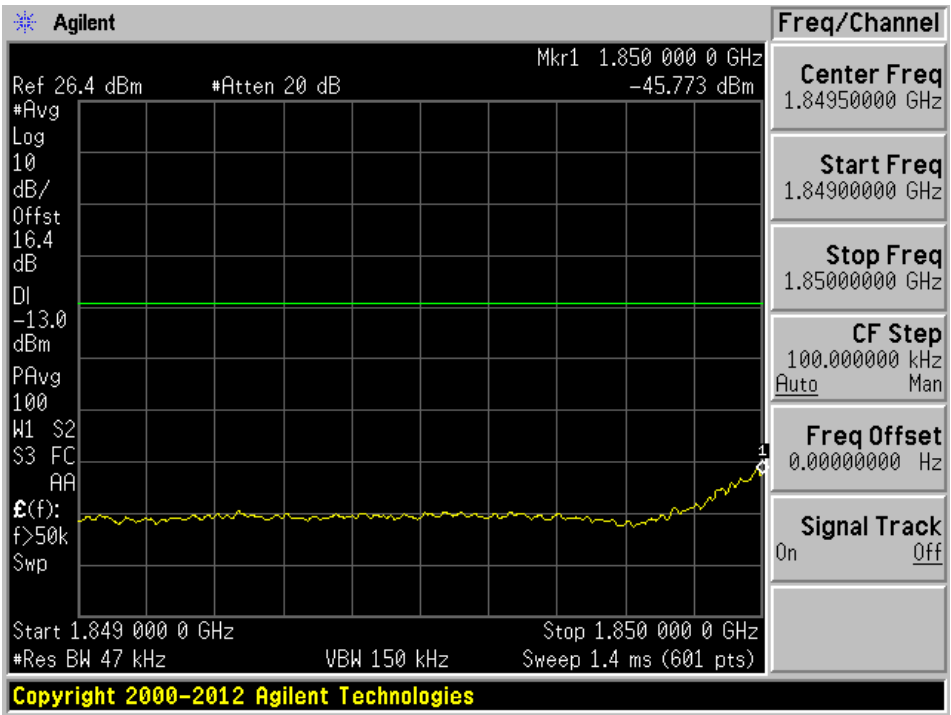


High Channel

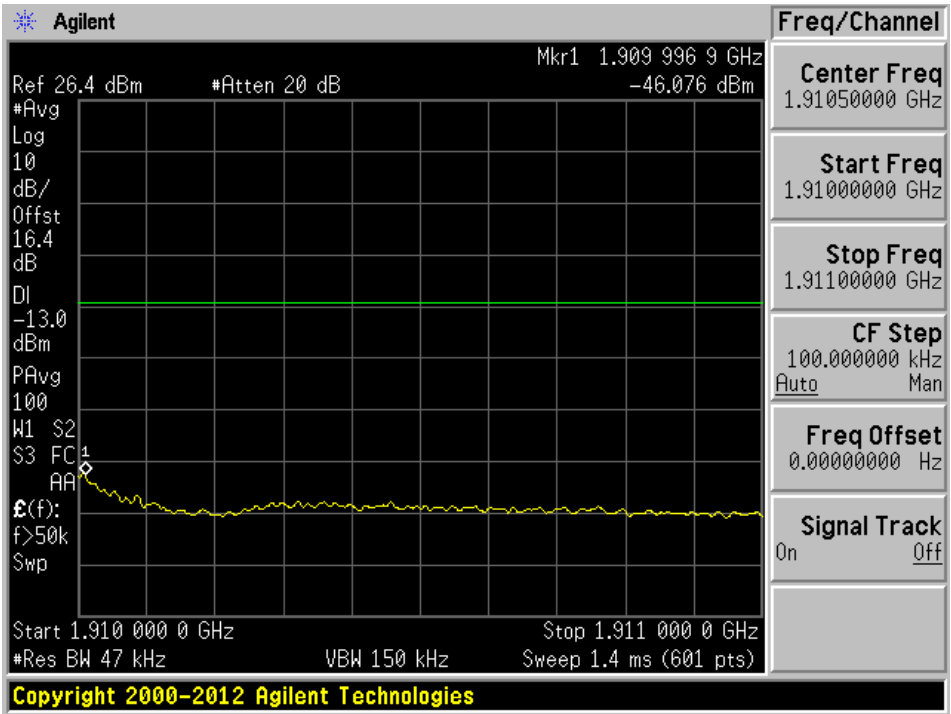


AGC On

Low Channel



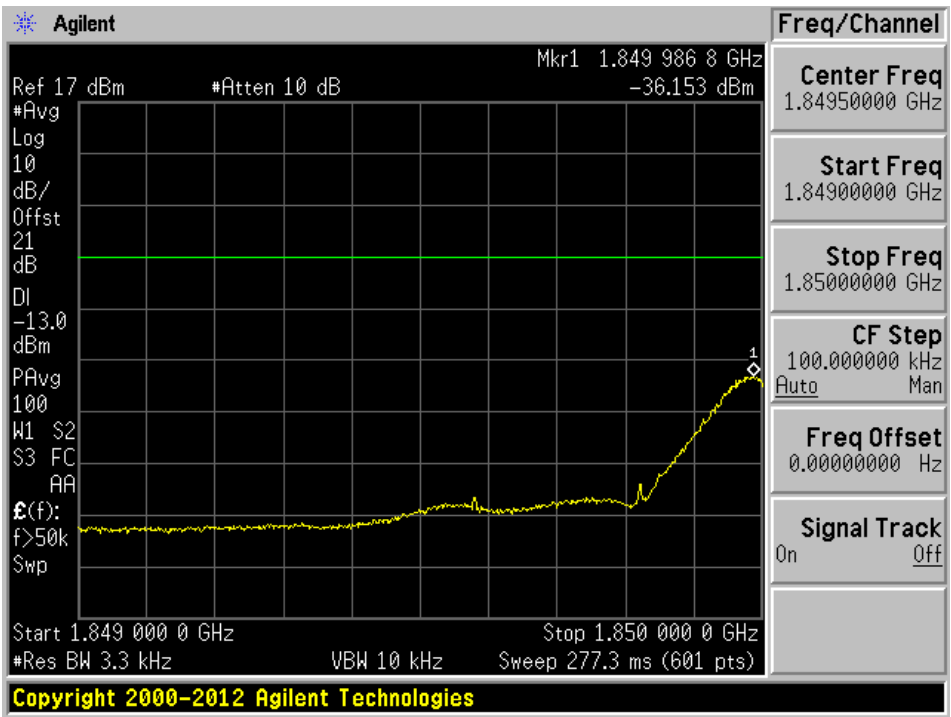
High Channel



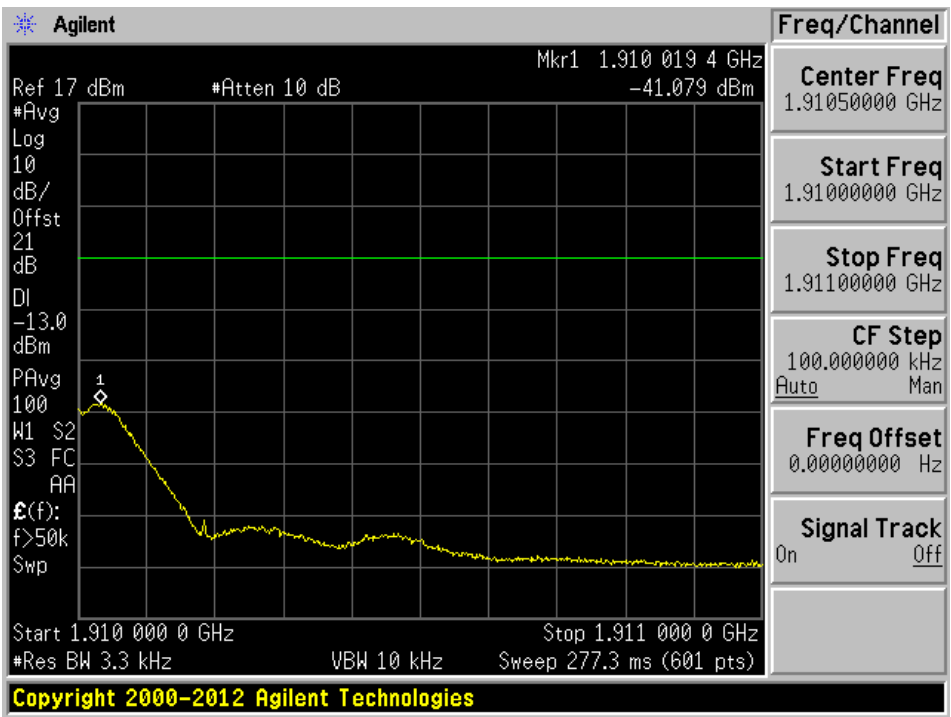
Uplink: Narrowband Signal

AGC Off

Low Channel

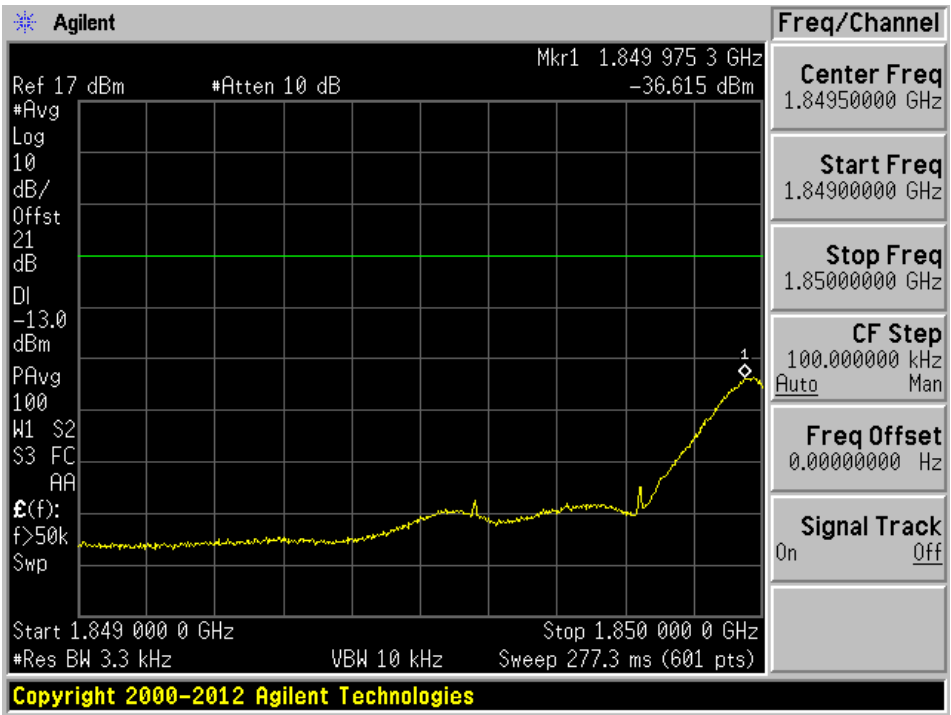


High Channel

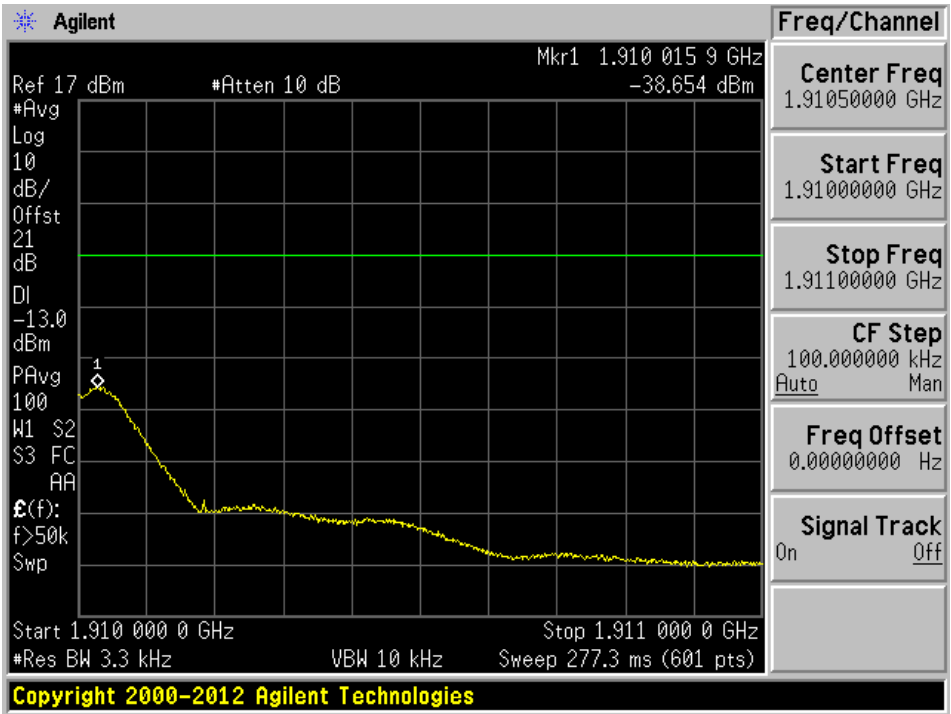


AGC On

Low Channel



High Channel



10 FCC §20.21 – Out of Band Rejection

10.1 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.

10.2 Test Procedure

KDB 935210 D05, Section 3.3.

The RF output of the transceiver was connected to a spectrum analyzer through appropriate attenuation. The span of the spectrum analyzer was set to be wide enough in order to capture the spectrum of entire operating band.

10.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	MY44303352	2014-10-16	1 year
Agilent	Signal Generator	E4438C	MY45091309	2014-07-15	1 year

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

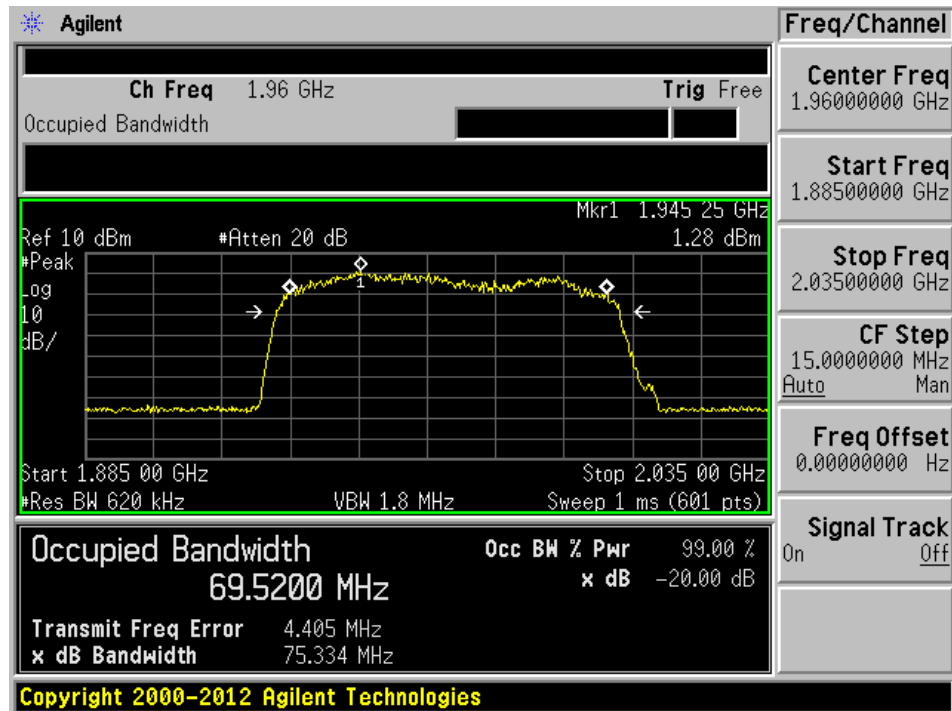
Temperature:	21-23° C
Relative Humidity:	42-48 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Todd Moy on 2015-09-21 in the RF Site.

10.5 Test Results

Please refer to the following plot,

Downlink, 1930 – 1990 MHz



Uplink, 1850 – 1910 MHz

