FCC PART 90.219

TEST AND MEASUREMENT REPORT

For

G-Way Microwave

38 Leuning Street,

South Hackensack, NJ 07606, USA

FCC ID: Q8KPS82070M

Report Type:	Product Type:
Original Report	Industrial Signal Booster

Prepared By:	Jose Martinez Test Engineer
Report Number:	R1705094-90
Report Date:	2017-10-18
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1705094-90	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, BDA-PS8NEPS-20/20-70-M, BDA-PS7W-20/20-70-M, FCC ID: Q8KPS82070M, which will henceforth be referred to as the EUT (Equipment under Test). The EUT is a Class B 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 equipment class B2I were reported in a separate Test Report. 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: 17051004(PS7), 17051003 (PS9), and 17051001 (PS8) 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 90 of the Federal Communication Commission's rules.

The objective is to determine compliance with FCC Part 90.219 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 24D Report: R1705094-24D for Equipment Class B2I.
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 Part 90.219 – Use of Signal Boosters and FCC KDB 935210 D05 v01r01 Measurement Guidance for Industrial and Non-consumer Signal Booster, Repeater, and Amplifier Devices.

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

None

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
§90.219(e)(1)	RF Output Power	Compliant
§90.219(e)(4)(i)&(ii)	Input-versus-output Signal Comparison: OBW	Compliant
§90.219 (e)(4)(iii) §90.210	Emission Mask	Compliant
§90.219 (e)(3) §90.210	Spurious Radiated Emissions	Compliant
§90.219 (e)(3) §90.210	Spurious Emissions at Antenna Terminals	Compliant
§90.219 (e)(3) §90.210	Intermodulation	Compliant
§90.219 (e)(2)	Noise Figure	Compliant
§90.219	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^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

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: 758-775 MHz

Maximum peak output power at antenna input terminal (dBm):	20.91
Maximum peak output power at antenna input terminal (mW):	123.31
Prediction distance (cm):	20
Prediction frequency (MHz):	766.5
Antenna Gain, typical (dBi):	2
Maximum Antenna Gain (numeric):	1.58
Power density at predication frequency and distance (mW/cm^2):	0.0388
FCC limit (mW/cm^2):	0.511

Uplink: 788-805 MHz

Maximum peak output power at antenna input terminal (dBm):	21.04
Maximum peak output power at antenna input terminal (mW):	127.06
Prediction distance (cm):	20
Prediction frequency (MHz):	796.5
Antenna Gain, typical (dBi):	2
Maximum Antenna Gain (numeric):	1.58
Power density at predication frequency and distance (mW/cm^2):	0.0401
FCC limit (mW/cm^2):	0.531

Downlink: 851-861 MHz

Maximum peak output power at antenna input terminal (dBm):	20.59
Maximum peak output power at antenna input terminal (mW):	114.55
Prediction distance (cm):	20
Prediction frequency (MHz):	856
Antenna Gain, typical (dBi):	2
Maximum Antenna Gain (numeric):	1.58
Power density at predication frequency and distance (mW/cm^2):	0.0361
FCC limit (mW/cm^2):	0.571

Uplink: 806-816 MHz

Maximum peak output power at antenna input terminal (dBm):	20.37
Maximum peak output power at antenna input terminal (mW):	108.89
Prediction distance (cm):	20
Prediction frequency (MHz):	811
Antenna Gain, typical (dBi):	2
Maximum Antenna Gain (numeric):	1.58
Power density at predication frequency and distance (mW/cm^2):	0.0343
FCC limit (mW/cm^2):	0.541

Downlink: 935-940 MHz

Maximum peak output power at antenna input terminal (dBm):	21.09
Maximum peak output power at antenna input terminal (mW):	128.53
Prediction distance (cm):	20
Prediction frequency (MHz):	937.5
Antenna Gain, typical (dBi):	2
Maximum Antenna Gain (numeric):	1.58
Power density at predication frequency and distance (mW/cm^2):	0.0405
FCC limit (mW/cm^2):	0.625

Uplink: 896-901 MHz

Maximum peak output power at antenna input terminal (dBm):	20.32
Maximum peak output power at antenna input terminal (mW):	107.65
Prediction distance (cm):	20
Prediction frequency (MHz):	898.5
Antenna Gain, typical (dBi):	2
Maximum Antenna Gain (numeric):	1.58
Power density at predication frequency and distance (mW/cm^2):	0.0339
FCC limit (mW/cm^2):	0.599

Conclusion

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

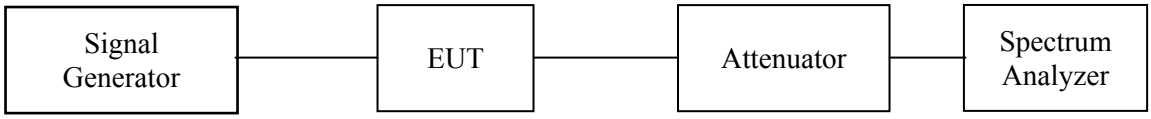
5 FCC §90.219 (e) - RF Output Power

5.1 Applicable Standards

According to FCC §90.219(e), the output power capability of a signal booster must be designed for deployments providing a radiated power not exceeding 5 Watts ERP for each retransmitted channel.

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[1]	Each Time[1]
-	SMA cable	-	C04	Each Time[1]	Each Time[1]
-	SMA cable	-	C09	Each Time[1]	Each Time[1]

[1]*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 2017-05-29 and 2017-06-30 in the RF Site.

5.5 Test Results

AGC	Input Power (dBm)	Conducted Output Power (dBm)	Booster Gain (dB)	Antenna Gain (dBi)	ERP (dBm)	Limit (dBm)	Results
Downlink: 758-775 MHz							
Off	-51.85	20.27	72.12	2	20.12	37	Compliant
On	-49.16	20.91	70.07	2	20.76	37	Compliant
Uplink: 788-805 MHz							
Off	-51.69	20.20	71.89	2	20.05	37	Compliant
On	-48.91	21.04	69.95	2	20.89	37	Compliant
Downlink: 851-861 MHz							
Off	-52.81	19.98	72.79	2	19.83	37	Compliant
On	-50.70	20.59	71.29	2	20.44	37	Compliant
Uplink: 806-816 MHz							
Off	-51.78	20.07	71.85	2	19.92	37	Compliant
On	-48.80	20.37	69.17	2	20.22	37	Compliant
Downlink: 935-940 MHz							
Off	-50.85	19.83	70.68	2	19.68	37	Compliant
On	-49.09	21.09	70.18	2	20.94	37	Compliant
Uplink: 896-901 MHz							
Off	-50.92	19.58	70.5	2	19.43	37	Compliant
On	-49.05	20.32	69.37	2	20.17	37	Compliant

Note 1: ERP = Measured Conducted Output Power (dBm) + Antenna Gain (dBi) -2.15 (dB)
Note 2: 5 Watts = 37 dBm

6 FCC §90.219 (e) (4) (ii) - Input-versus-output Signal Comparison: Occupied Bandwidth

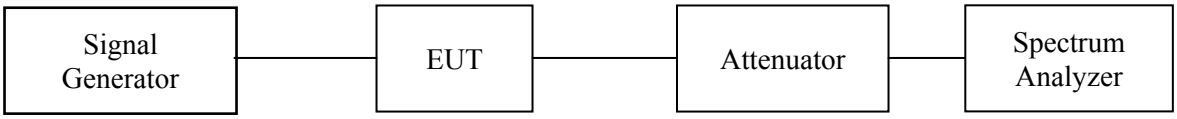
6.1 Applicable Standards

According to FCC §90.219 (e) (4) (ii), there is no change in the occupied bandwidth of the retransmitted signals.

6.2 Test Procedure

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

The resolution bandwidth of the spectrum analyzer was set to at least 1 to 5% of the anticipated 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	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[1]	Each Time[1]
-	SMA cable	-	C04	Each Time[1]	Each Time[1]
-	SMA cable	-	C09	Each Time[1]	Each Time[1]

[1]*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:	22-23° C
Relative Humidity:	32 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Jose Martinez 2017-06-08, 2017-06-19 and 2017-06-30 in the RF Site.

6.5 Test Results

Downlink: 758-775 MHz

Signal Type	AGC	Input		Output	
		99 % OBW (kHz)	26 dB OBW (kHz)	99 % OBW (kHz)	26 dB OBW (kHz)
4K00F1E	off	4.0009	4.330	4.0020	4.331
	on	4.0013	4.330	4.0010	4.330
11K3F3E	off	11.3245	14.330	11.3244	14.315
	on	11.3218	14.315	11.3186	14.310
16K0F3E	off	16.0367	18.563	16.0364	18.564
	on	16.0375	18.565	16.0340	18.563
C4FM	off	8.3723	12.150	8.4116	11.096
	on	8.3524	10.823	8.3753	11.066
AWGN	off	4129.2	4551	4125.5	4553
	on	4136.1	4525	4148.7	4557

Uplink: 788-805 MHz

Signal Type	AGC	Input		Output	
		99 % OBW (kHz)	26 dB OBW (kHz)	99 % OBW (kHz)	26 dB OBW (kHz)
4K00F1E	off	4.0023	4.331	4.0010	4.330
	on	4.0007	4.330	4.0009	4.330
11K3F3E	off	11.3234	14.326	11.3227	14.316
	on	11.3241	14.324	11.3207	14.316
16K0F3E	off	16.0359	18.565	16.0363	18.564
	on	16.0361	18.562	16.0365	18.564
C4FM	off	8.3049	11.792	8.3209	11.502
	on	8.3522	11.838	8.3609	10.938
AWGN	off	4136.9	4539	4117.1	4539
	on	4120.3	4533	4138.4	4694

Downlink: 851-861 MHz

Signal Type	AGC	Input		Output	
		99 % OBW (kHz)	26 dB OBW (kHz)	99 % OBW (kHz)	26 dB OBW (kHz)
4K00F1E	off	4.0123	4.334	4.0112	4.333
	on	4.0120	4.333	4.0121	4.334
11K3F3E	off	11.3150	14.191	11.3089	14.186
	on	11.3206	14.180	11.3050	14.185

Uplink: 806-816 MHz

Signal Type	AGC	Input		Output	
		99 % OBW (kHz)	26 dB OBW (kHz)	99 % OBW (kHz)	26 dB OBW (kHz)
4K00F1E	off	4.0123	4.334	4.0119	4.334
	on	4.0109	4.333	4.0118	4.334
11K3F3E	off	11.3327	14.197	11.3155	14.180
	on	11.3218	14.191	11.3143	14.183

Downlink: 935-940 MHz

Signal Type	AGC	Input		Output	
		99 % OBW (kHz)	26 dB OBW (kHz)	99 % OBW (kHz)	26 dB OBW (kHz)
4K00F1E	off	4.0261	4.335	4.0024	4.328
	on	4.0124	4.331	4.0024	4.328
11K3F3E	off	11.3207	14.188	11.3065	14.184
	on	11.3250	14.182	11.3149	14.186

Uplink: 896-901 MHz

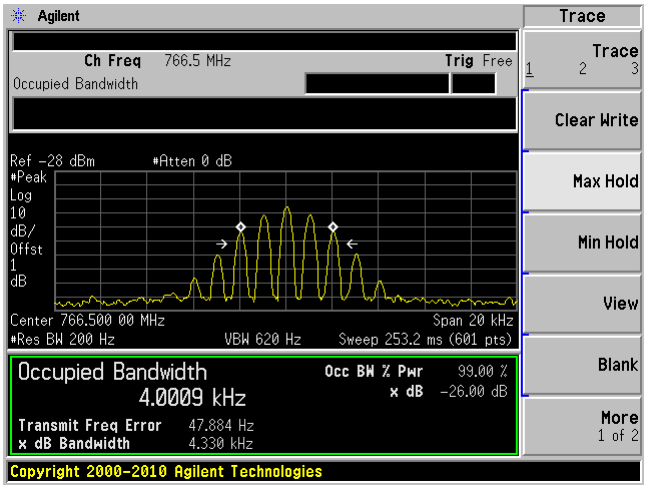
Signal Type	AGC	Input		Output	
		99 % OBW (kHz)	26 dB OBW (kHz)	99 % OBW (kHz)	26 dB OBW (kHz)
4K00F1E	off	4.0011	4.328	4.0002	4.328
	on	4.0001	4.328	3.9995	4.327
11K3F3E	off	11.3133	14.187	11.3096	14.185
	on	11.3277	14.163	11.3027	14.182

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

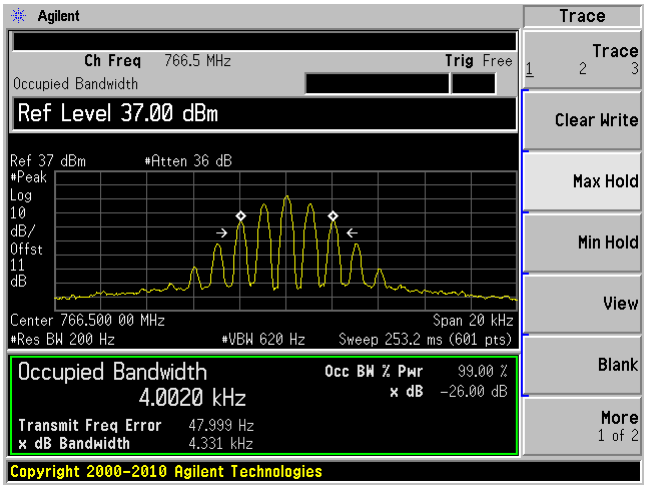
Downlink: 758-775 MHz

4K00F1E-AGC off

Input

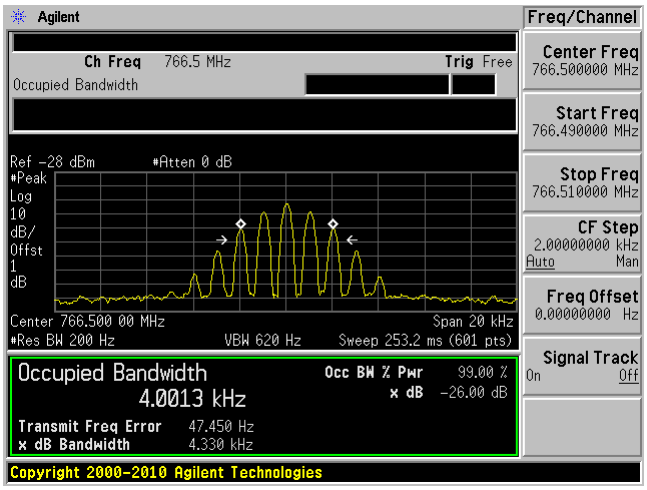


Output

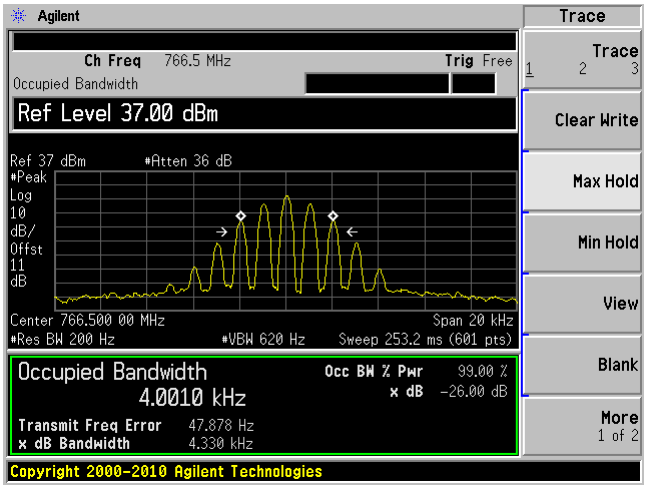


4K00F1E-AGC on

Input

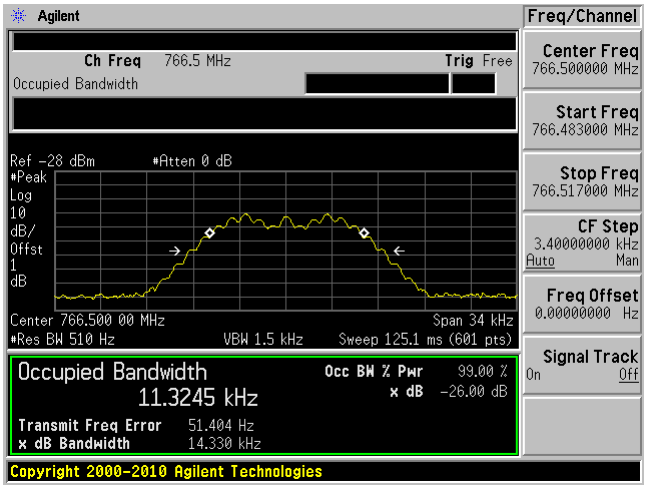


Output

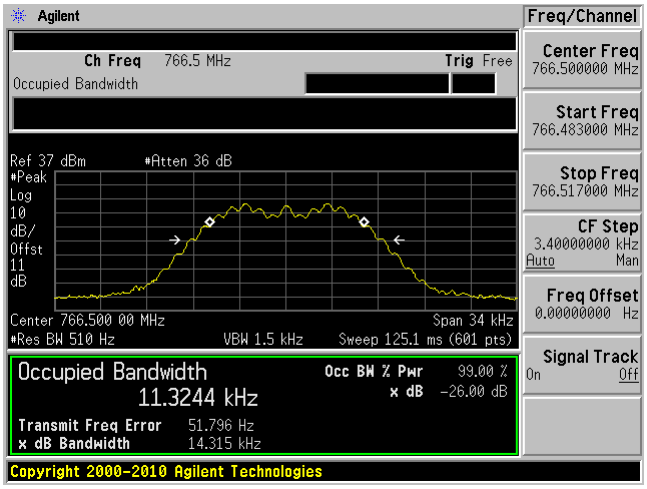


11K3F3E-AGC off

Input

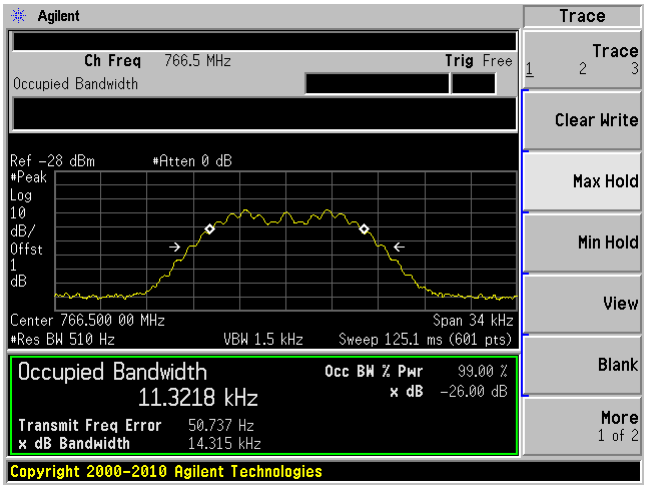


Output

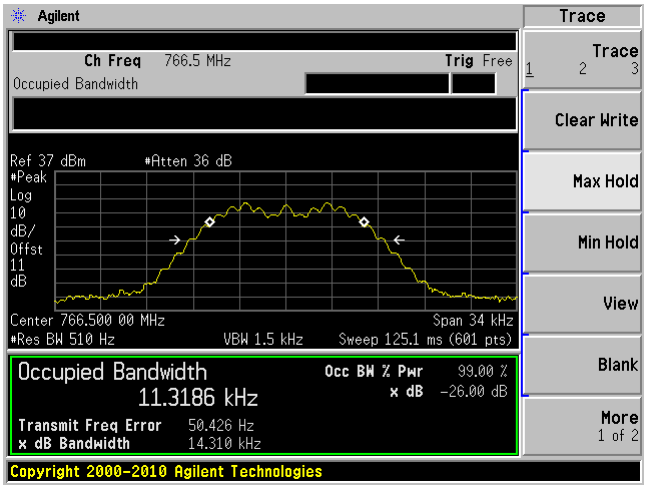


11K3F3E-AGC on

Input

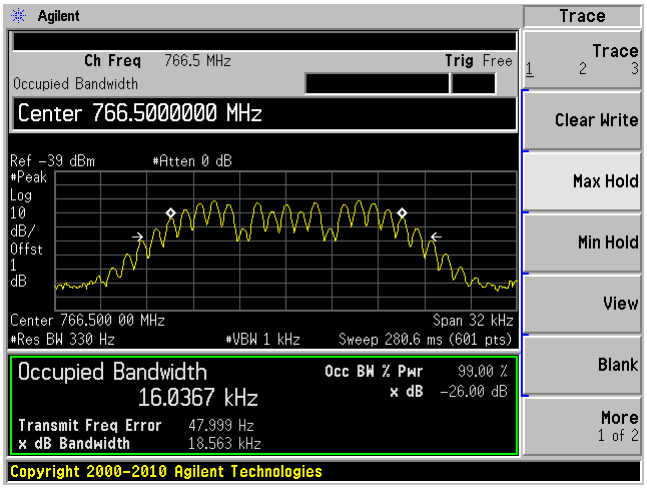


Output



16K0F3E-AGC off

Input



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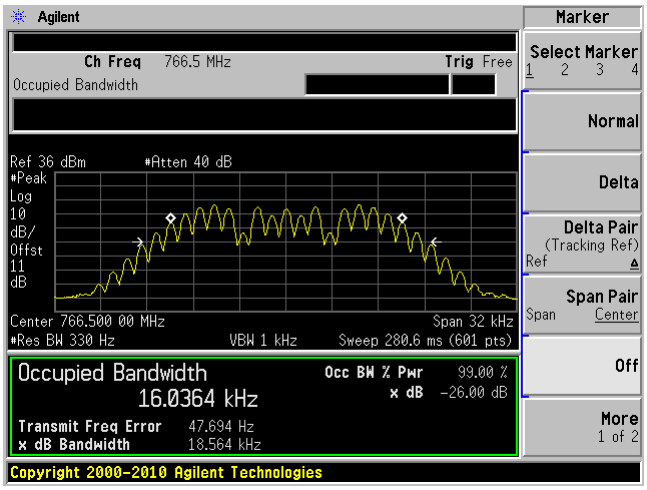

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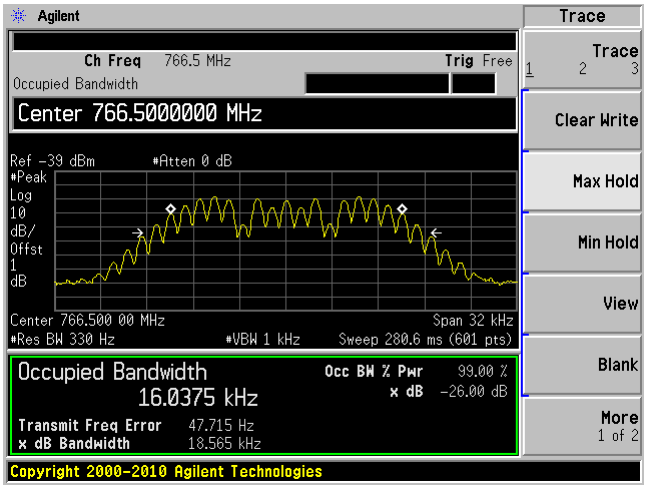
Input



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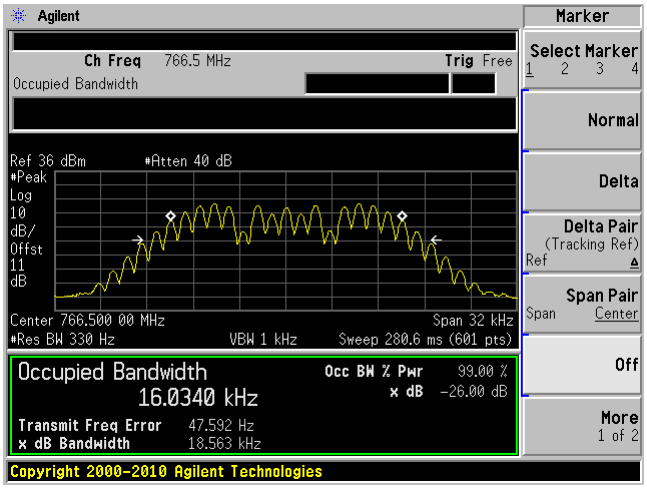
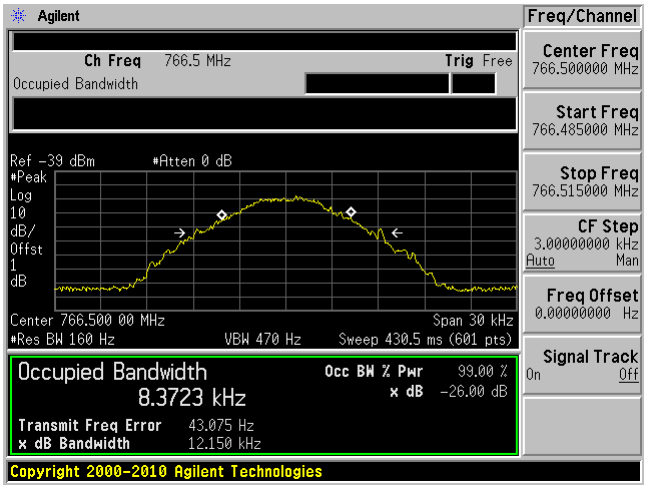


C4FM-AGC off

Input



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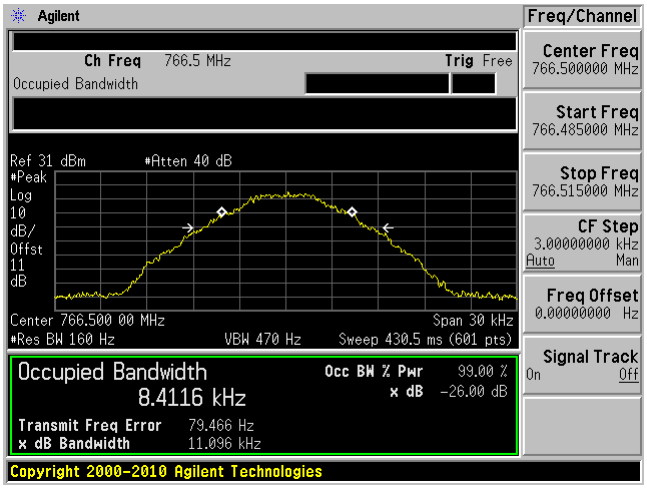

C4FM-AGC on

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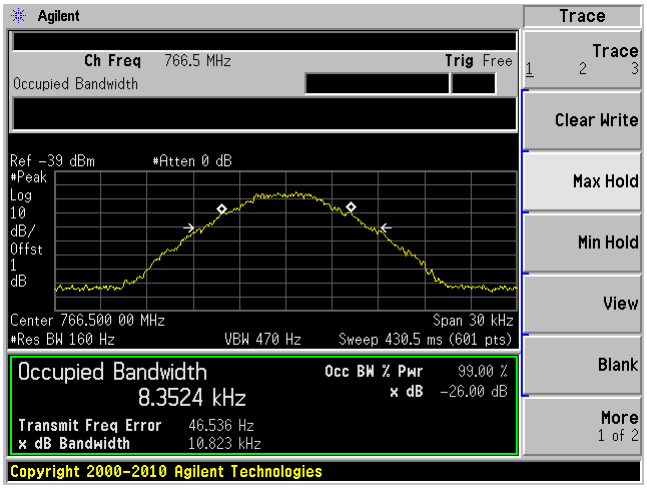

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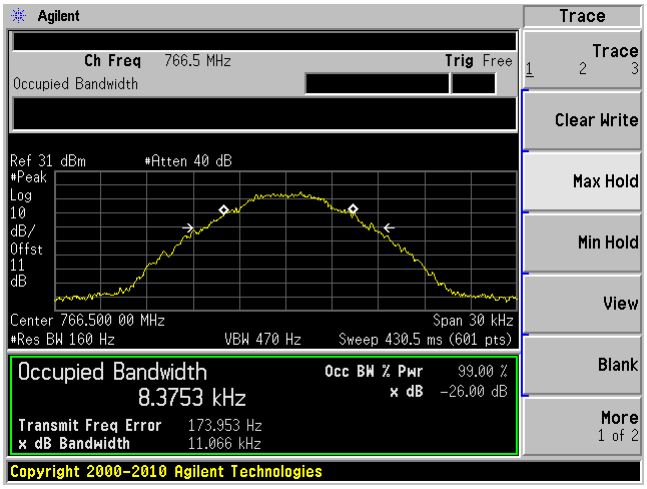
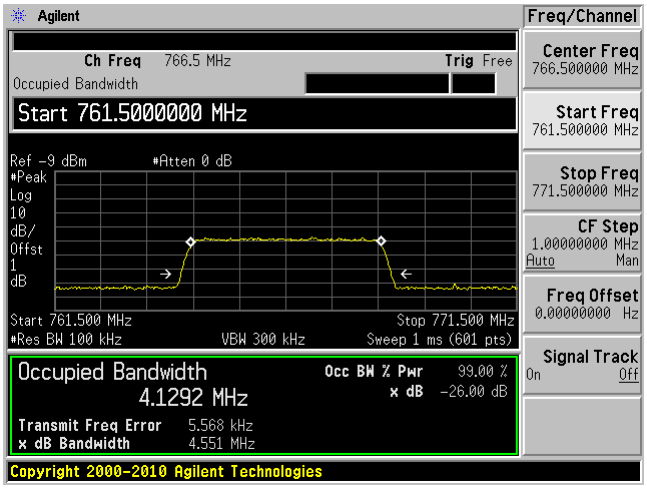


AWGN-AGC off

Input



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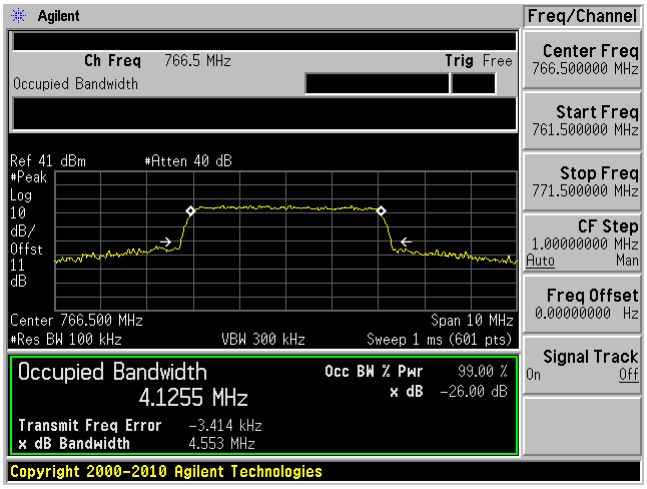
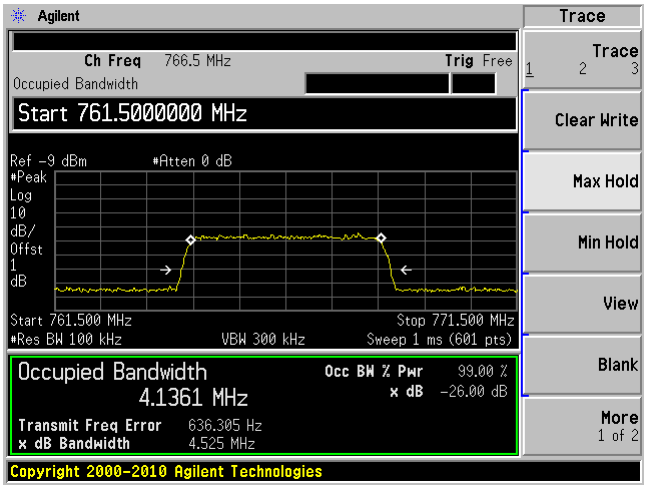
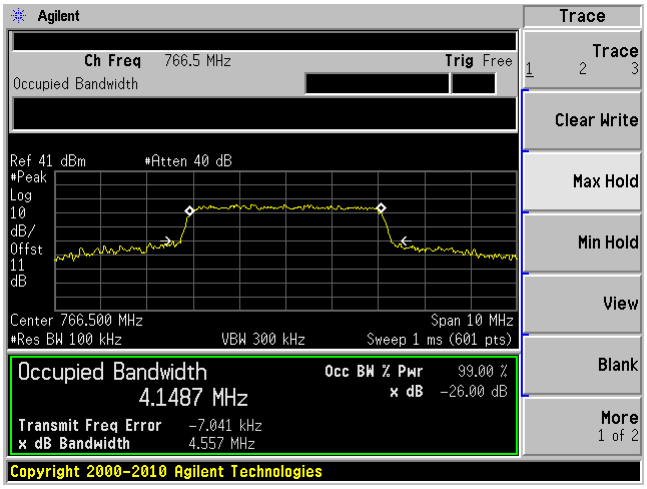


AWGN-AGC on

Input



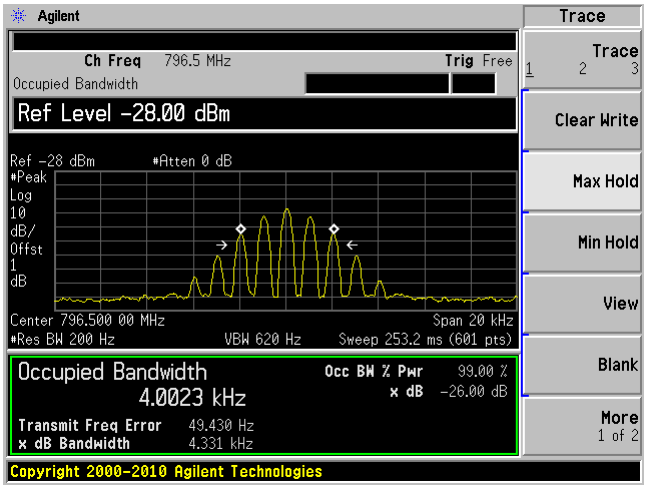
Output



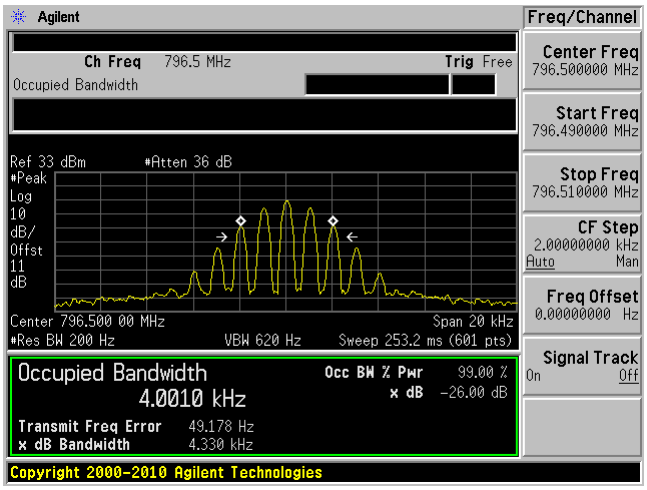
Uplink: 788-805 MHz

4K00F1E-AGC off

Input



Output



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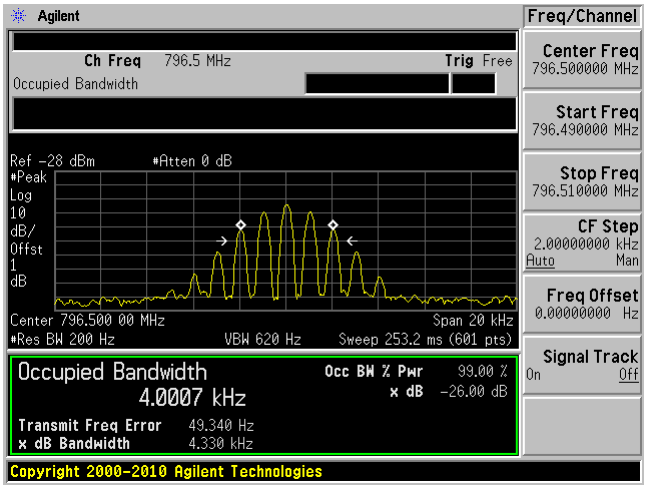
Input



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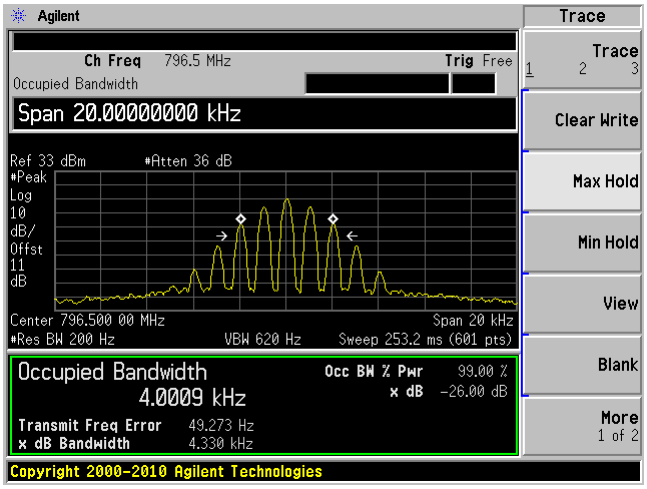
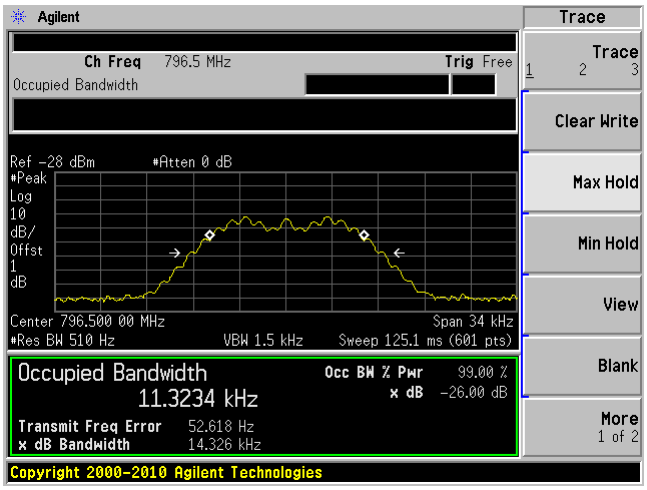


11K3F3E-AGC off

Input



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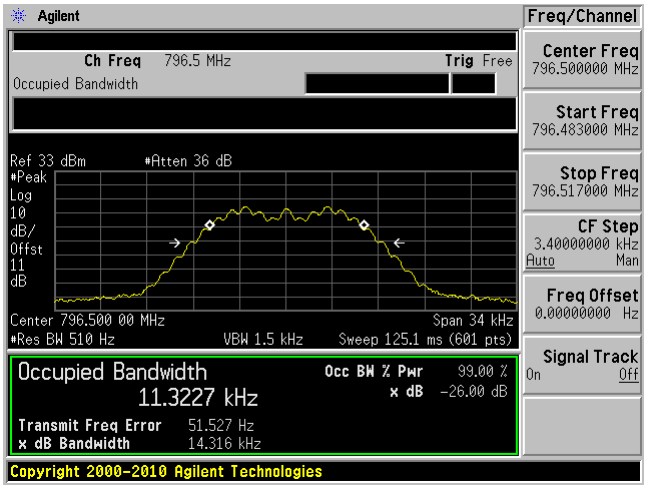
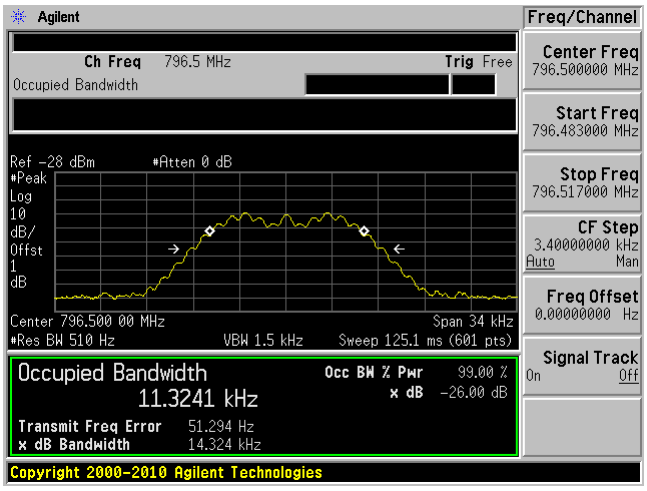
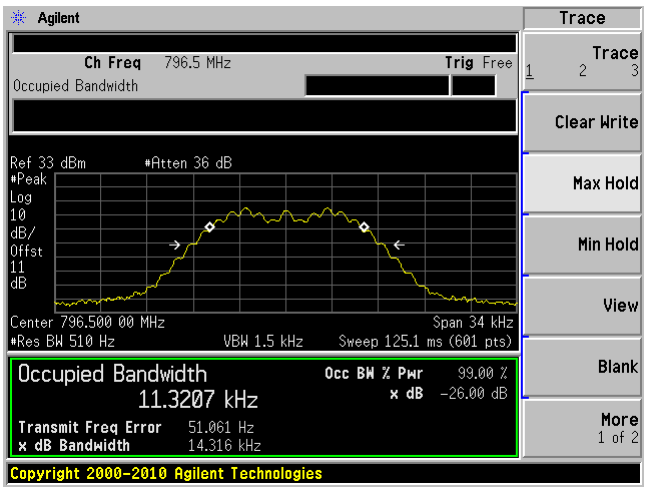


11K3F3E-AGC on

Input

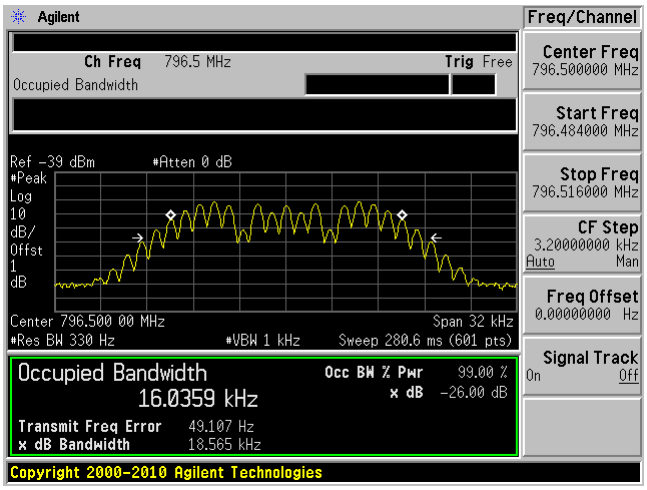


Output

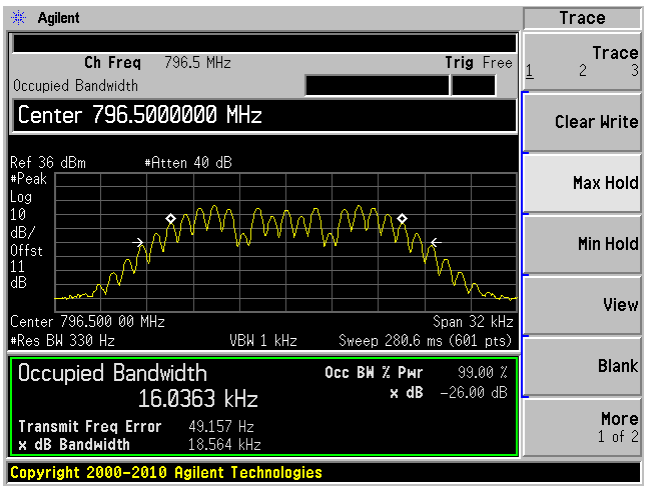


16K0F3E-AGC off

Input



Output



16K0F3E-AGC on

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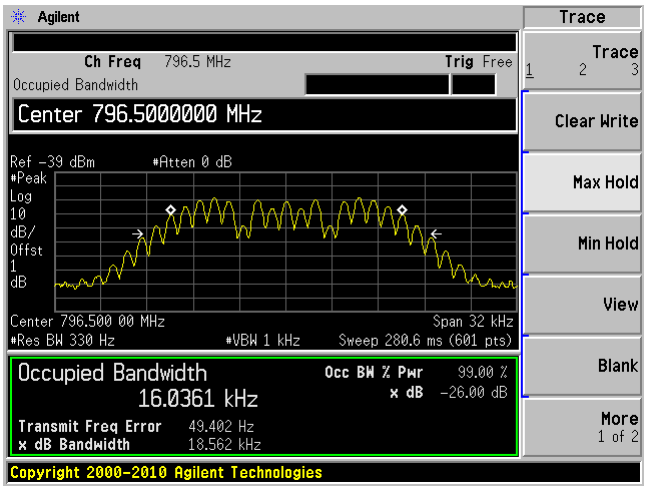

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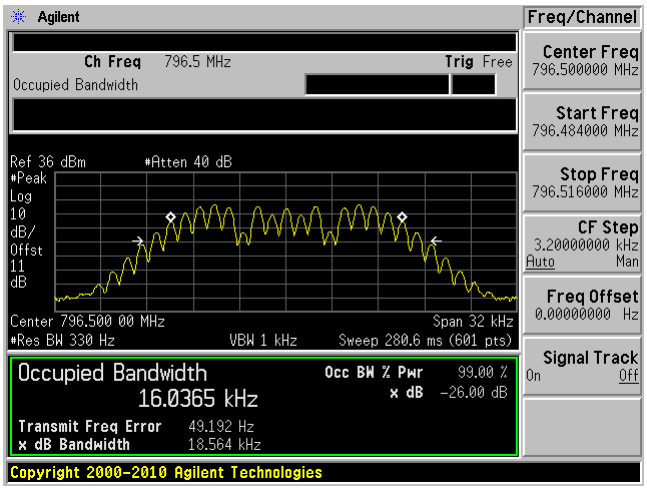
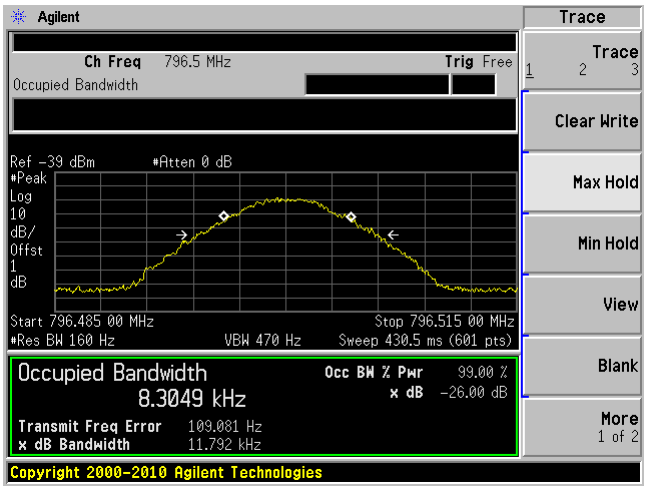


C4FM-AGC off

Input



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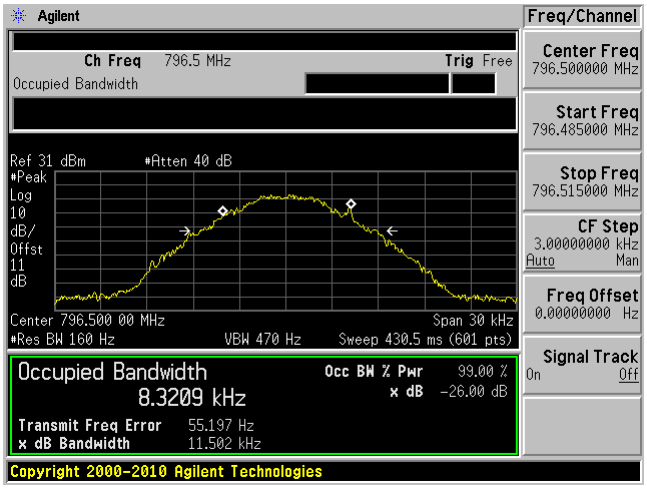

C4FM-AGC on

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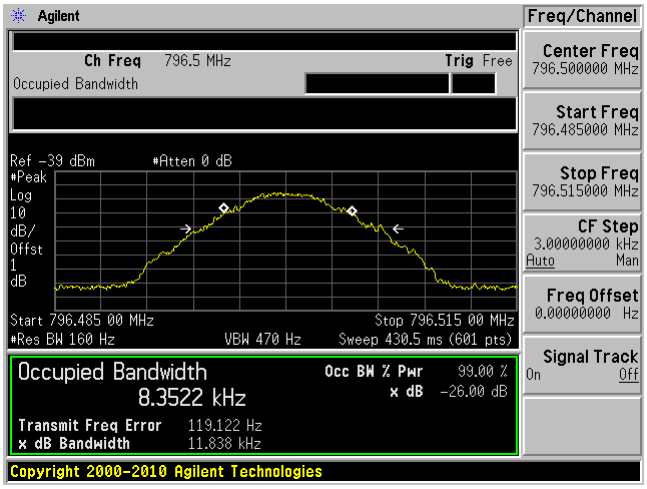

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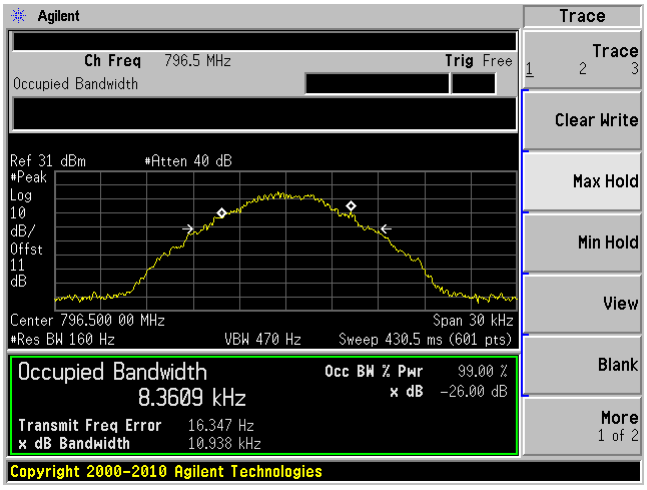
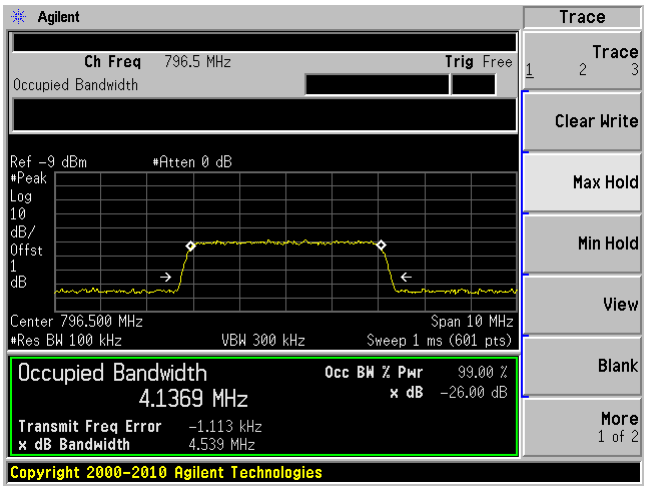


AWGN-AGC off

Input



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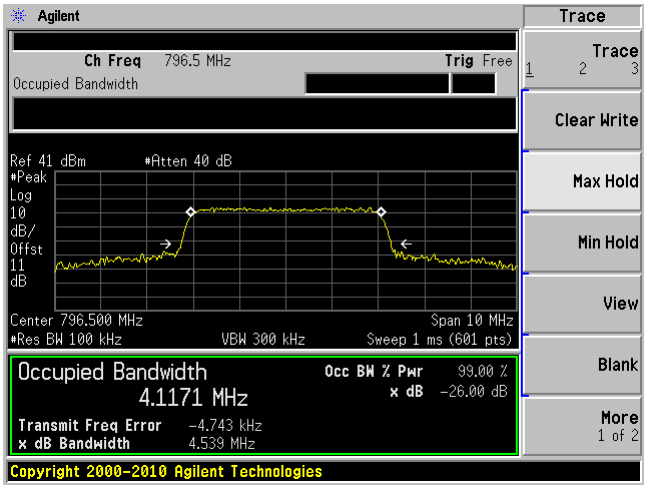
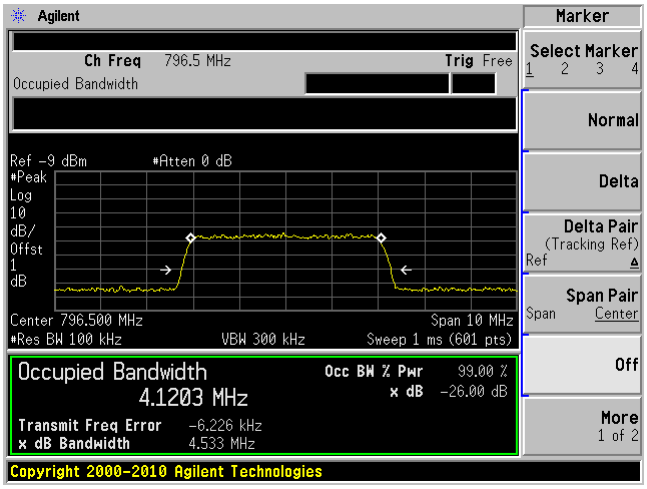
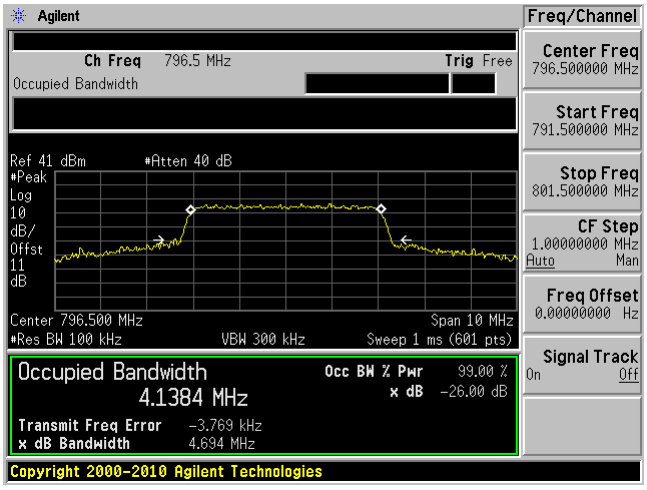


AWGN-AGC on

Input



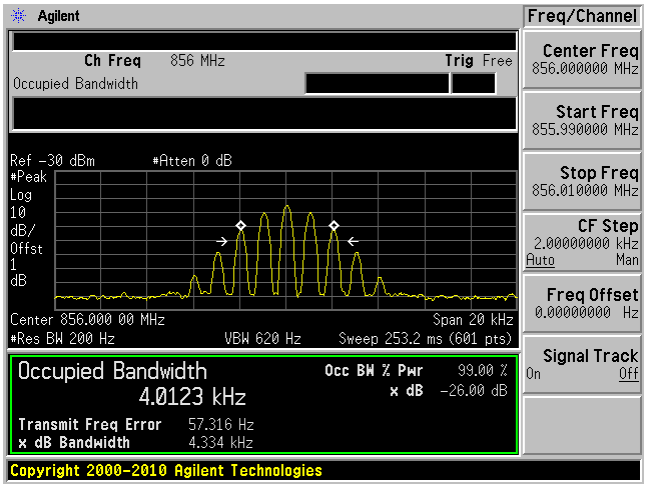
Output



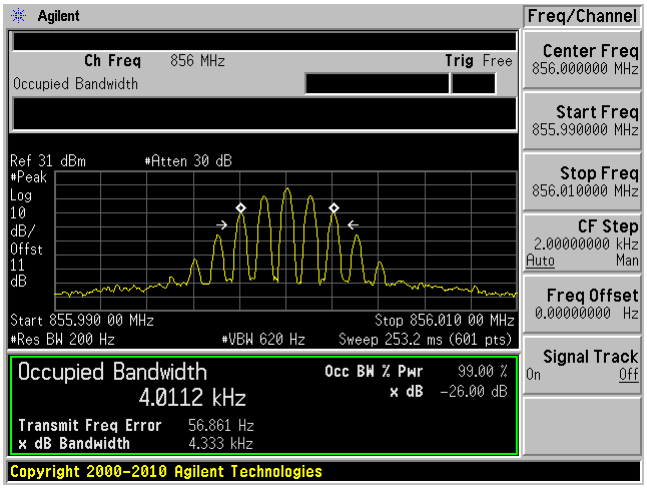
Downlink: 851-861 MHz

4K00F1E-AGC off

Input

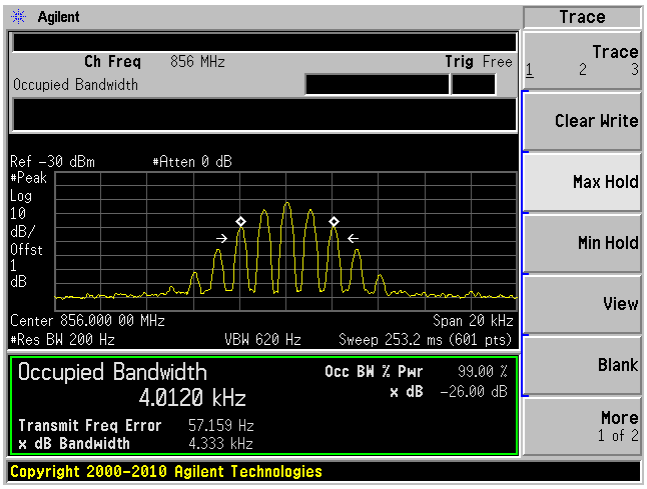


Output

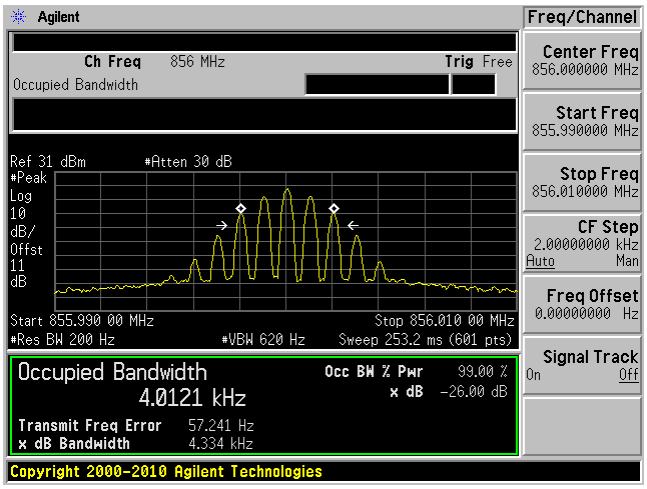


4K00F1E-AGC on

Input

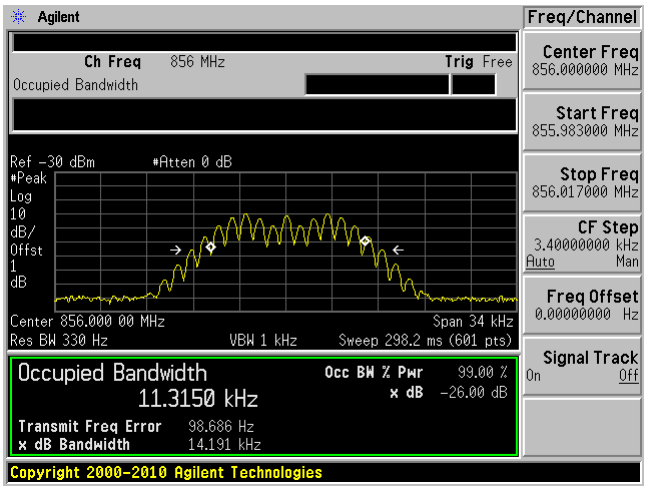


Output

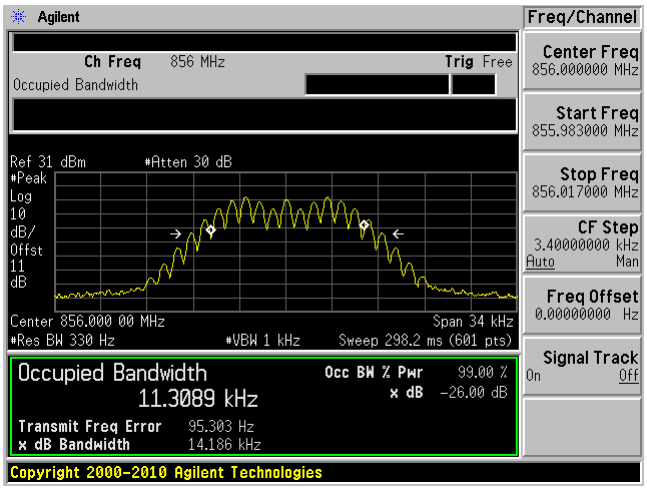


11K3F3E-AGC off

Input

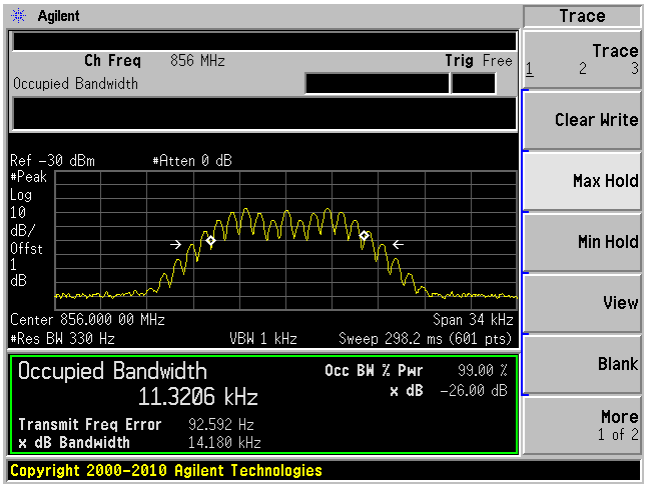


Output

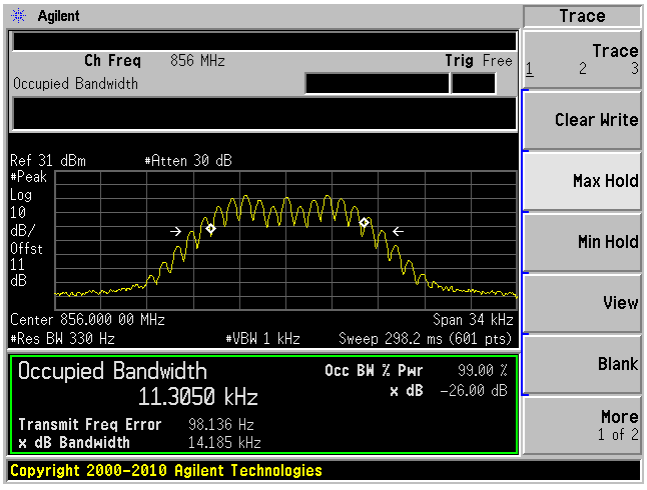


11K3F3E-AGC on

Input



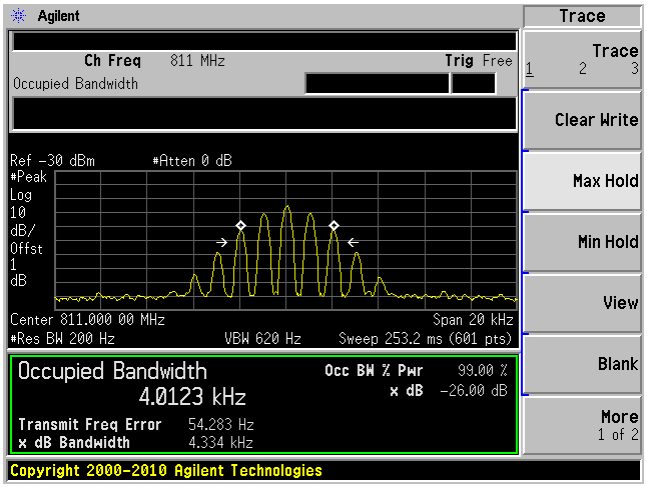
Output



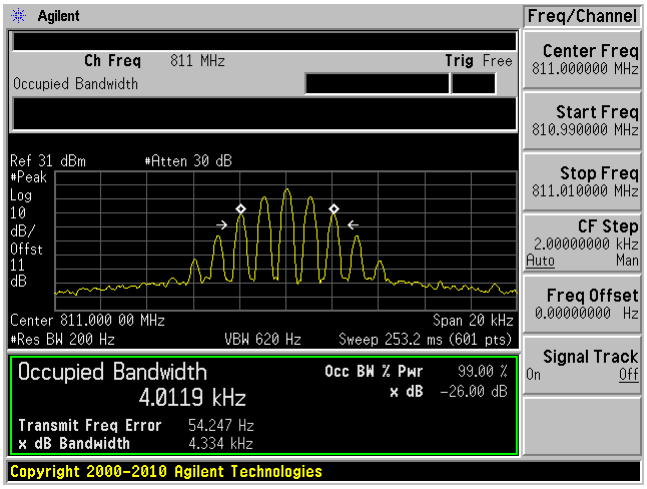
Uplink: 806-816 MHz

4K00F1E-AGC off

Input

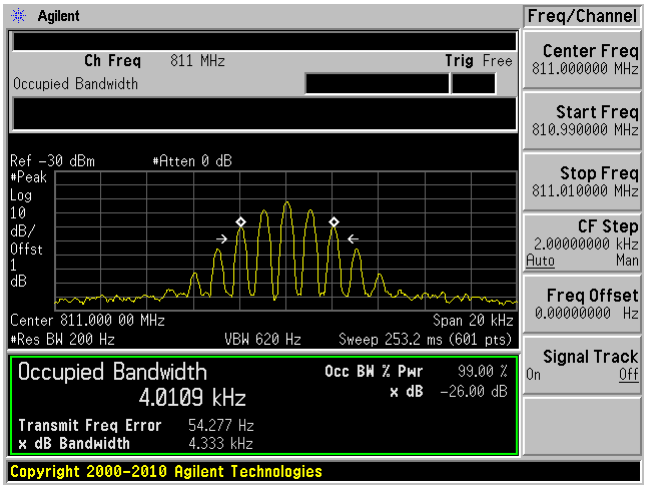


Output

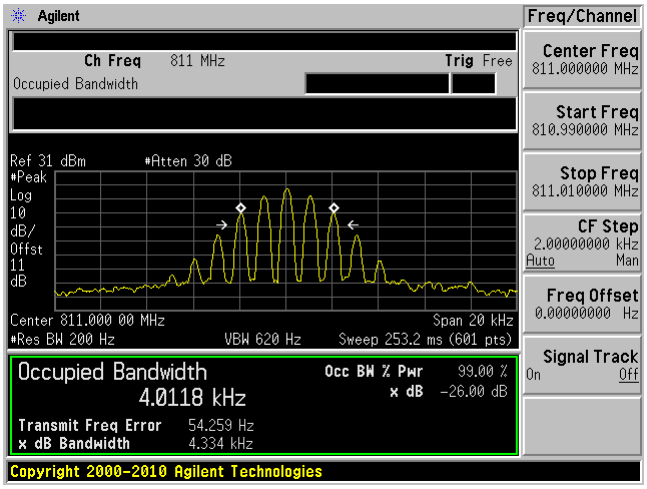


4K00F1E-AGC on

Input

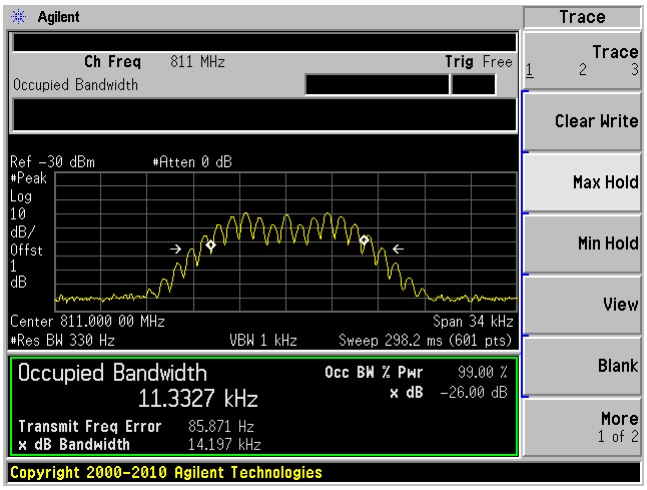


Output

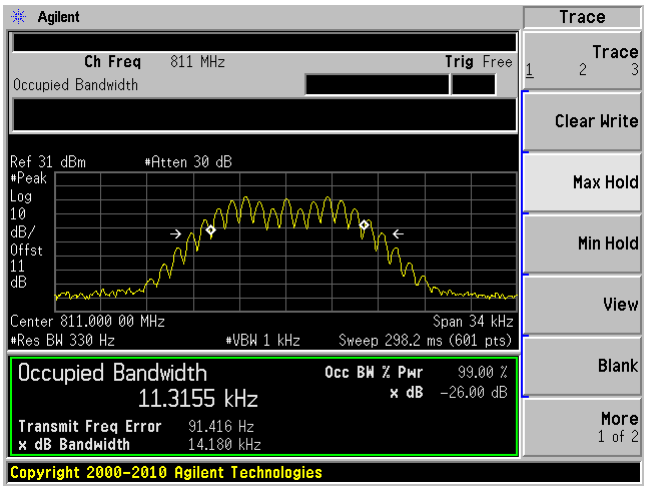


11K3F3E-AGC off

Input

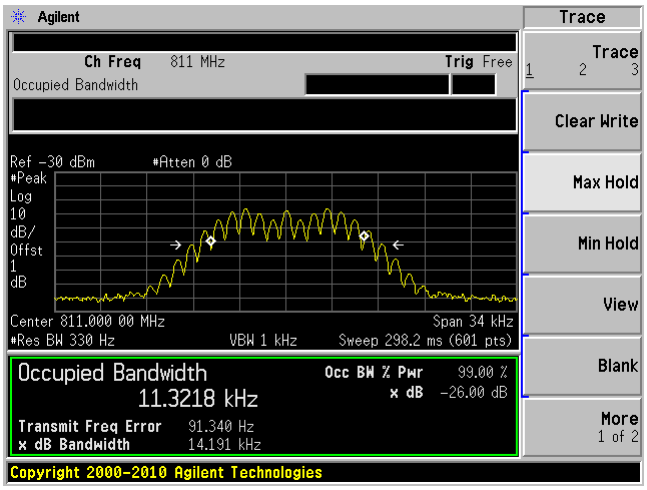


Output

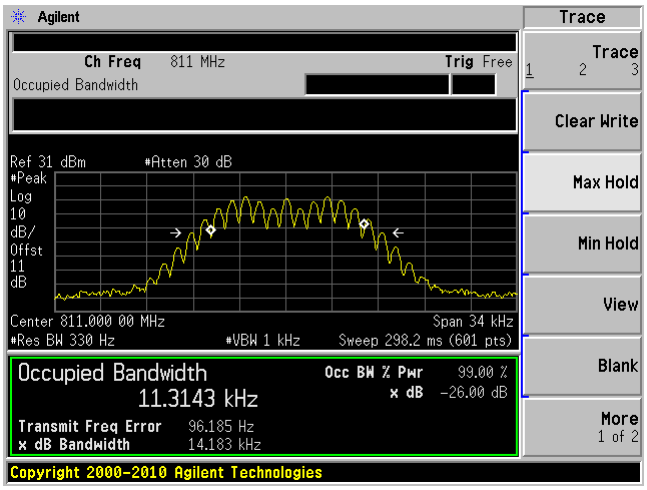


11K3F3E-AGC on

Input



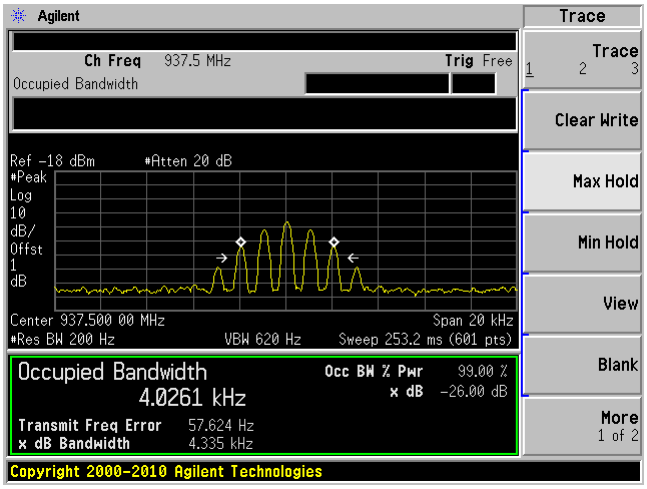
Output



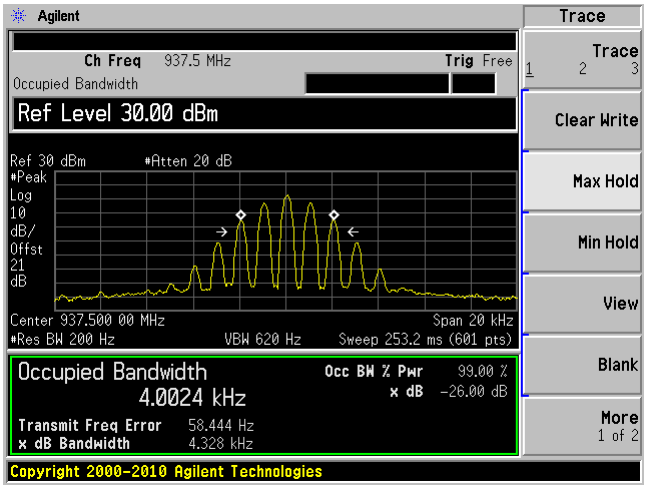
Downlink: 935-940 MHz

4K00F1E-AGC off

Input

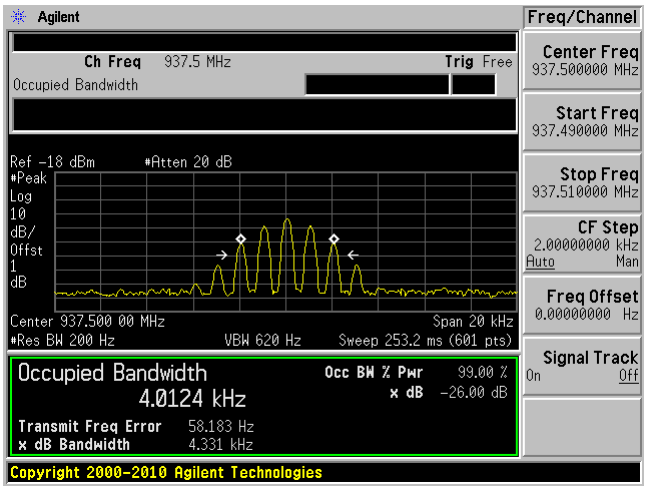


Output

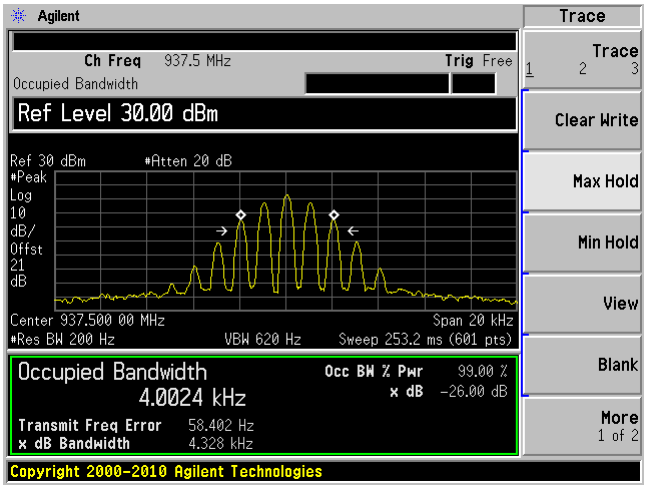


4K00F1E-AGC on

Input

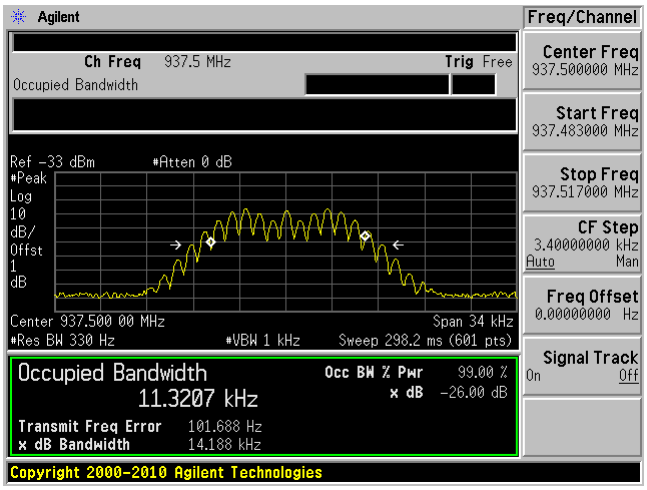


Output

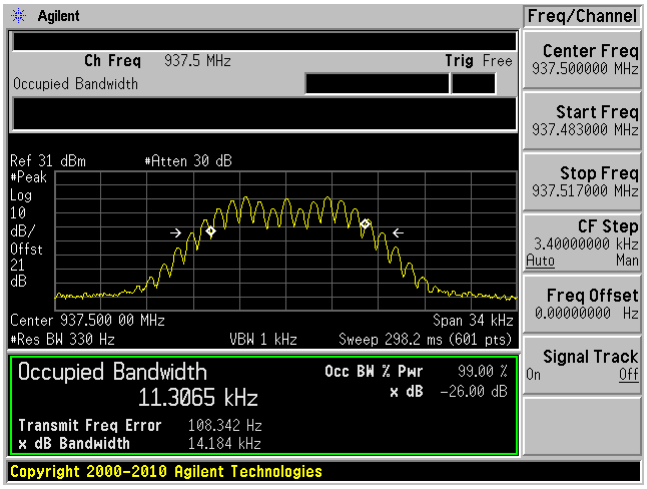


11K3F3E-AGC off

Input



Output



11K3F3E-AGC on

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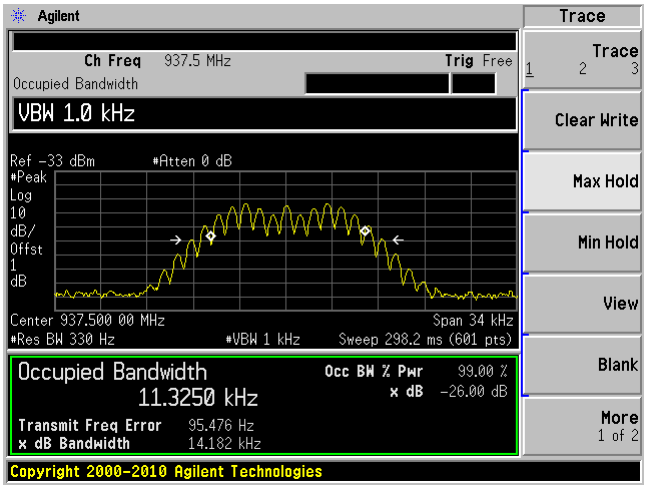
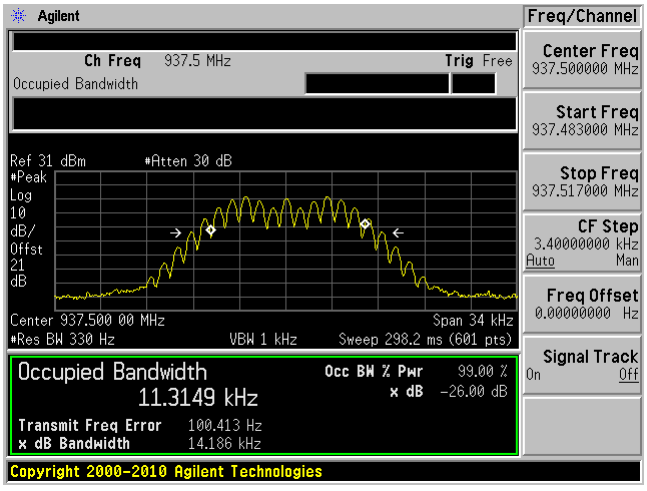


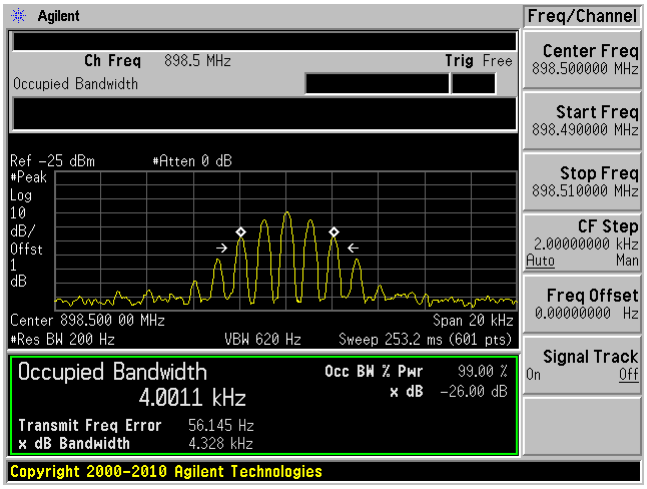
Output



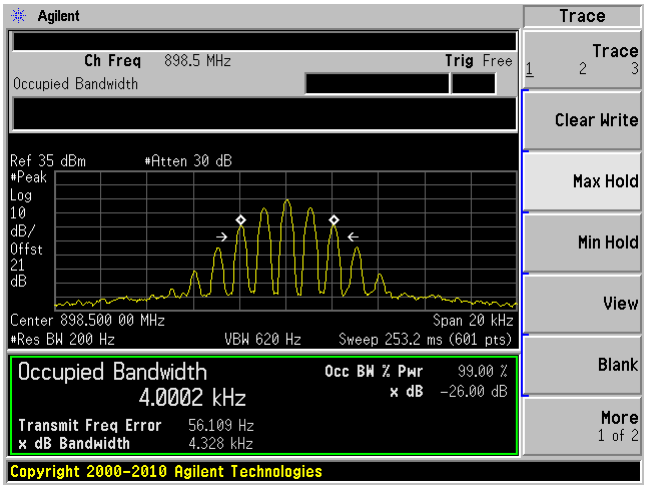
Uplink: 896-901 MHz

4K00F1E-AGC off

Input

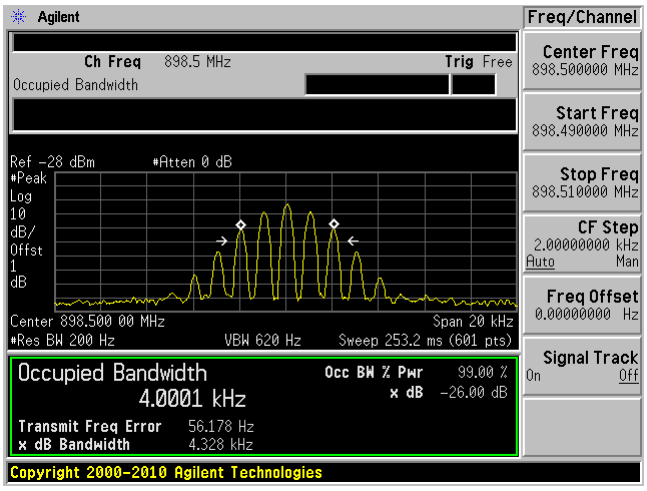


Output

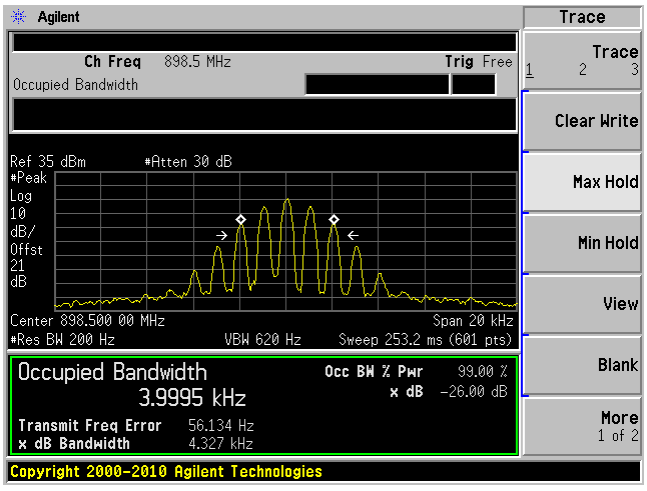


4K00F1E-AGC on

Input

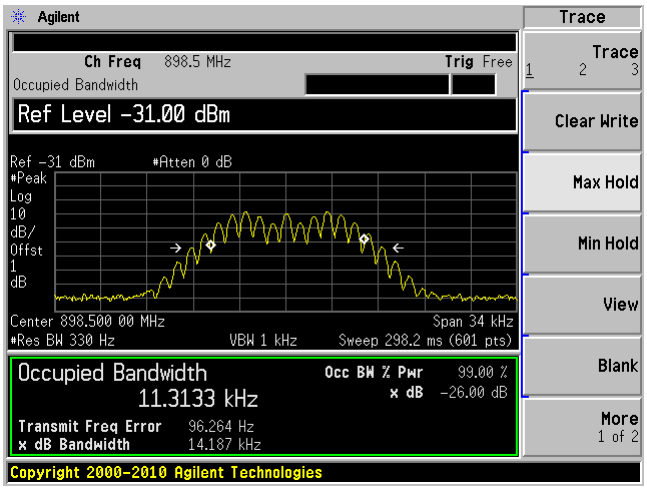


Output

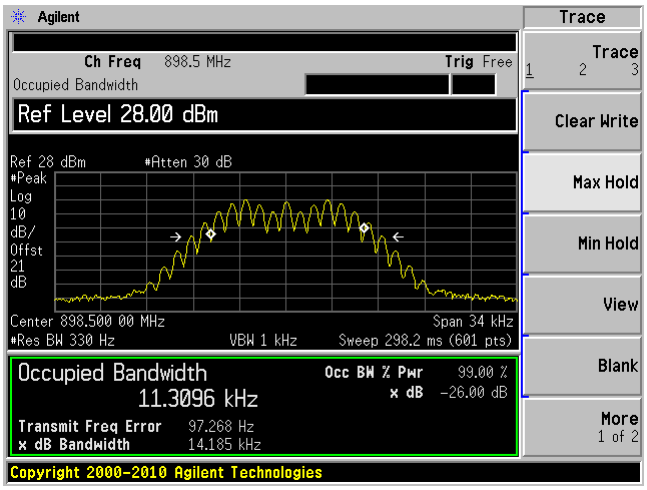


11K3F3E-AGC off

Input

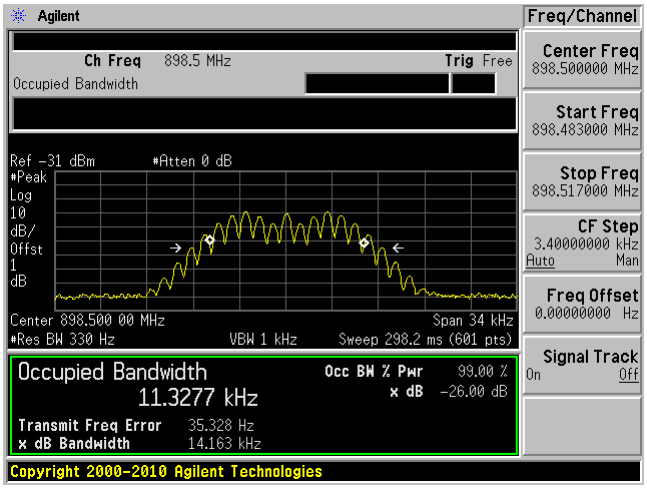


Output

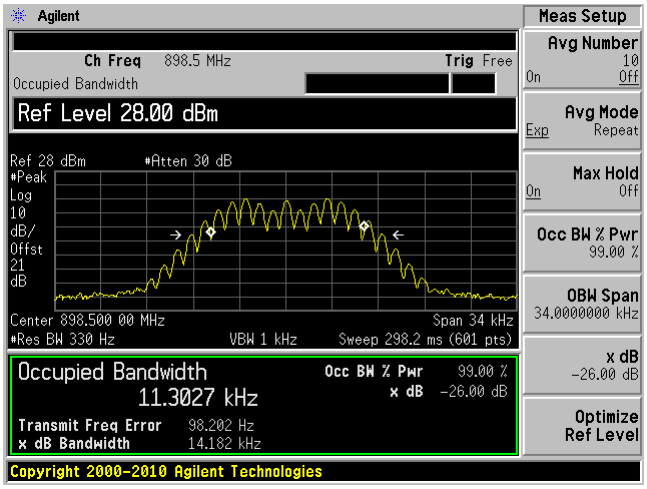


11K3F3E-AGC on

Input



Output



7 FCC §90.219 (e) (4) (iii) & §90.210 - Emission Mask

7.1 Applicable Standards

According to FCC §90.219 (e) (4) (iii), the retransmitted signals continue to meet the unwanted emissions limits of §90.210 applicable to the corresponding received signals (assuming that these received signals meet the applicable unwanted emissions limits by a reasonable margin).

According to FCC §90.210, except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (o) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating under this part.

APPLICABLE EMISSION MASKS

Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
Below 25[1]	A or B	A or C
25-50	B	C
72-76	B	C
150-174[2]	B, D, or E	C, D or E
150 paging only	B	C
220-222	F	F
421-512[2 5]	B, D, or E	C, D, or E
450 paging only	B	G
806-809/851-854[8]	B	H
809-824/854-869[3 5]	B	G
896-901/935-940	I	J
902-928	K	K
929-930	B	G
4940-4990 MHz	L or M	L or M
5850-5925[4]		
All other bands	B	C

Emission Mask C For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5 kHz, but not more than 10 kHz: At least 83 log (fd/5) dB;

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: At least 29 log (fd2/11) dB or 50 dB, whichever is the lesser attenuation;

(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

(4) In the 1427-1432 MHz band, licensees are encouraged to take all reasonable steps to ensure that unwanted emissions power does not exceed the following levels in the 1400-1427 MHz band:

(i) For stations of point-to-point systems in the fixed service: −45 dBW/27 MHz.

(ii) For stations in the mobile service: −60 dBW/27 MHz.

Emission Mask J For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power of the transmitter (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 2.5 kHz, but no more than 6.25 kHz: At least 53 log (fd/2.5) dB;

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 6.25 kHz, but no more than 9.5 kHz: At least 103 log (fd/3.9) dB;

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 9.5 kHz: At least 157 log (fd/5.3) dB, or 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

Emission Mask G. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but no more than 250 percent of the authorized bandwidth: At least 116 log (fd/6.1) dB, or 50 + 10 log (P) dB, or 70 dB, whichever is the lesser attenuation;

(2) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

Emission Mask H For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of 4 kHz or less: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 4 kHz, but no more than 8.5 kHz: At least 107 log (fd/4) dB;

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 8.5 kHz, but no more than 15 kHz: At least 40.5 log (fd/1.16) dB;

(4) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 15 kHz, but no more than 25 kHz: At least 116 log (fd/6.1) dB;

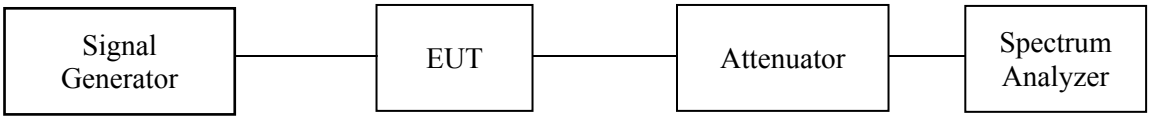
(5) On any frequency removed from the center of the authorized bandwidth by more than 25 kHz: At least 43 + 10 log (P) dB.

[3]Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of §90.691 of this chapter.

[6]Transmitters utilizing analog emissions that are equipped with an audio low-pass filter must meet Emission Mask B. All transmitters utilizing digital emissions and those transmitters using analog emissions without an audio low-pass filter must meet Emission Mask H.

7.2 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.



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
-	10 dB attenuator	-	-	Each Time[1]	Each Time[1]
-	SMA cable	-	C04	Each Time[1]	Each Time[1]
-	SMA cable	-	C09	Each Time[1]	Each Time[1]

[1]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:	22-23° C
Relative Humidity:	32 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Jose Martinez 2017-06-08 and 2017-07-03 in the RF Site.

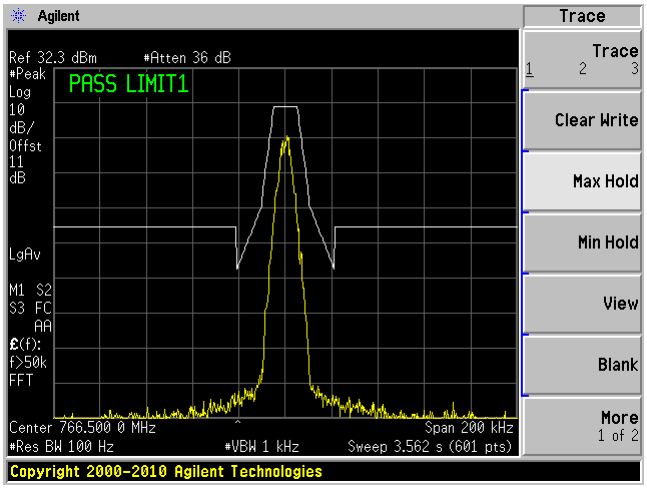
7.5 Test Results

Please refer to the following plots.

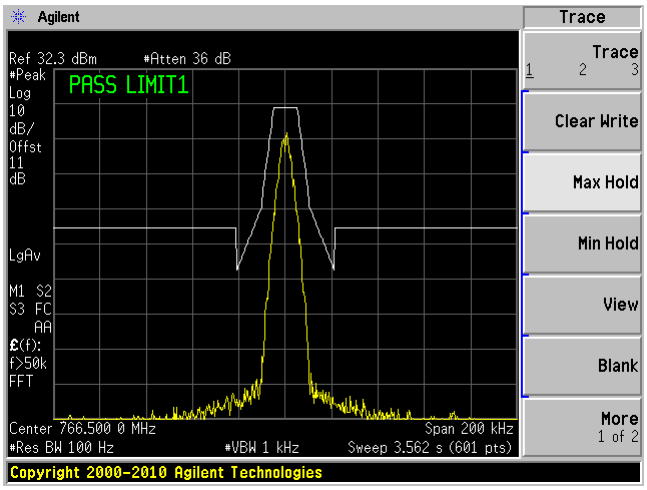
Downlink: 758-775 MHz

Emission Mask C: C4FM

AGC off

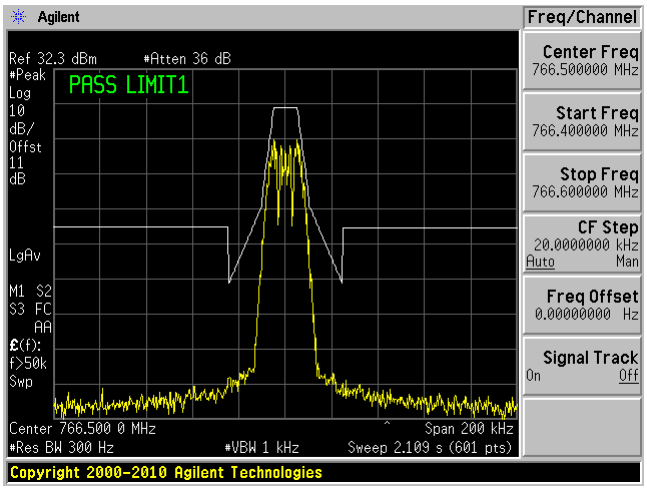


AGC on

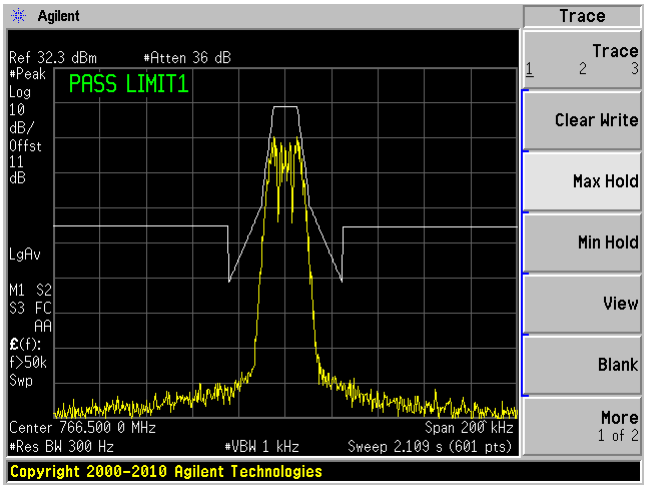


Emission Mask C: 16K0F3E

AGC off

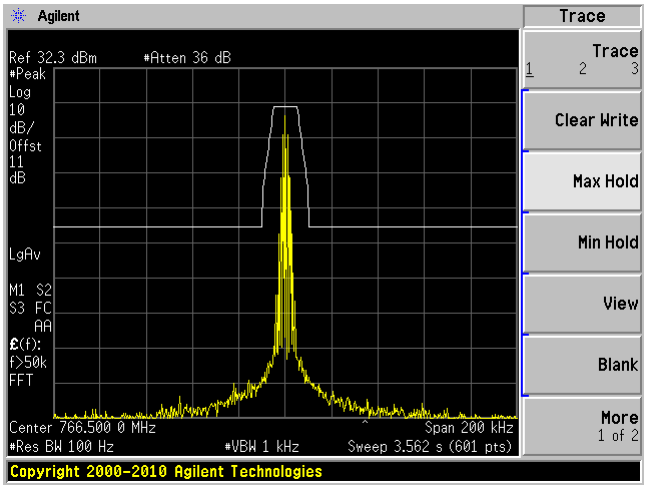


AGC on

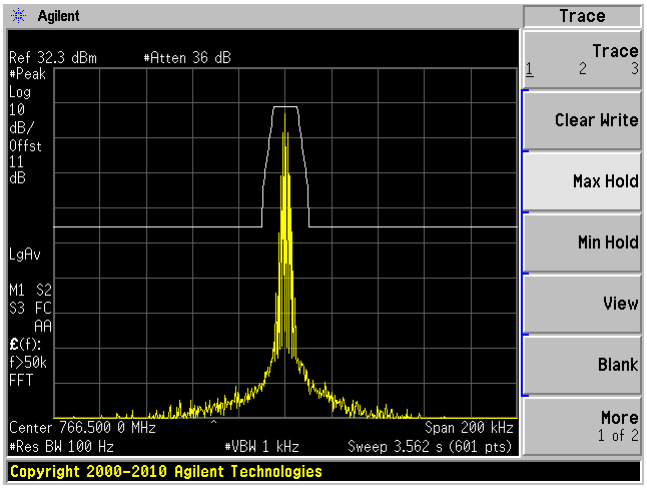


Emission Mask C: 4K00F1E

AGC off



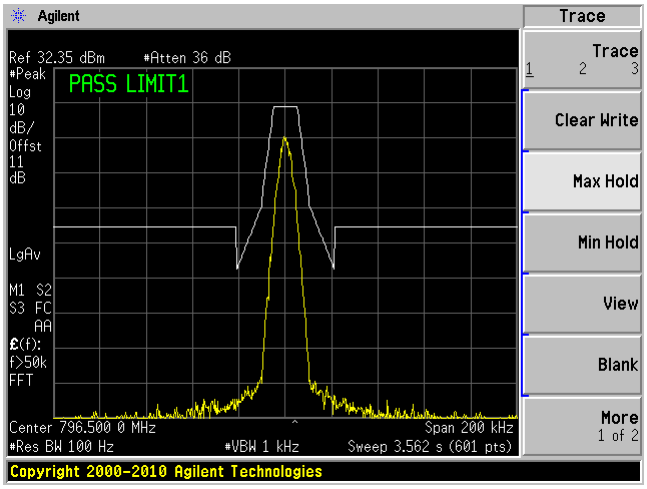
AGC on



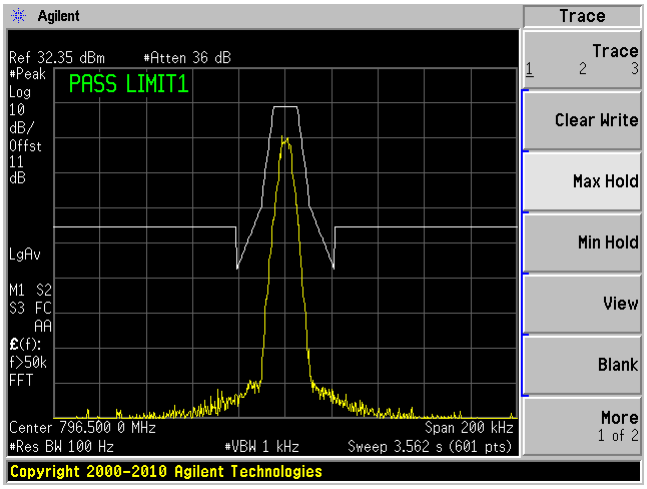
Uplink: 788-805 MHz

Emission Mask C: C4FM

AGC off

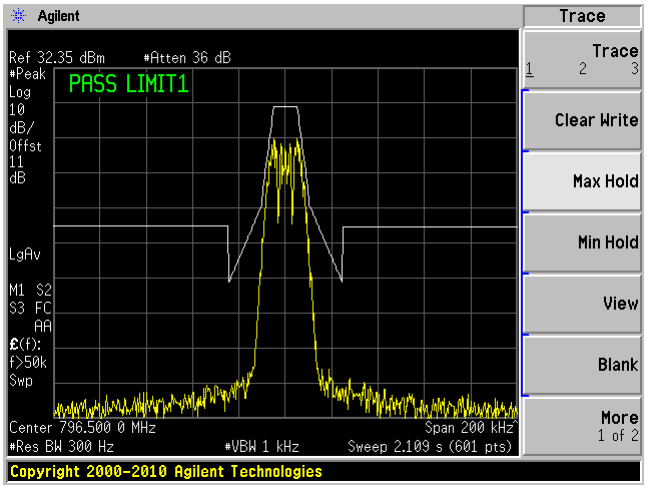


AGC on



Emission Mask C: 16K0F3E

AGC off



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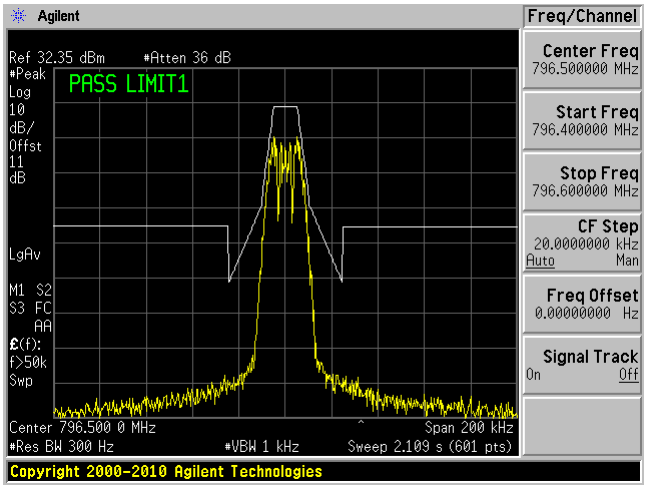
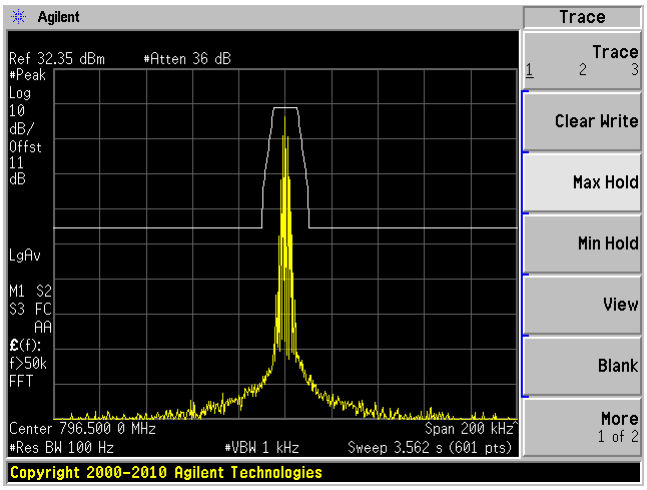
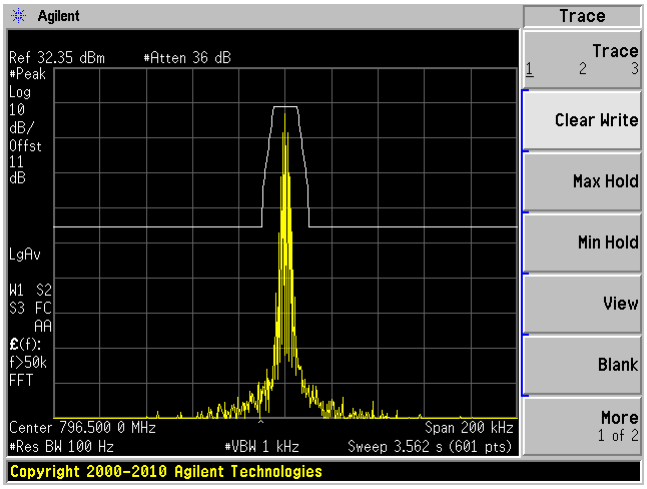


Emission Mask C: 4K00F1E

AGC off



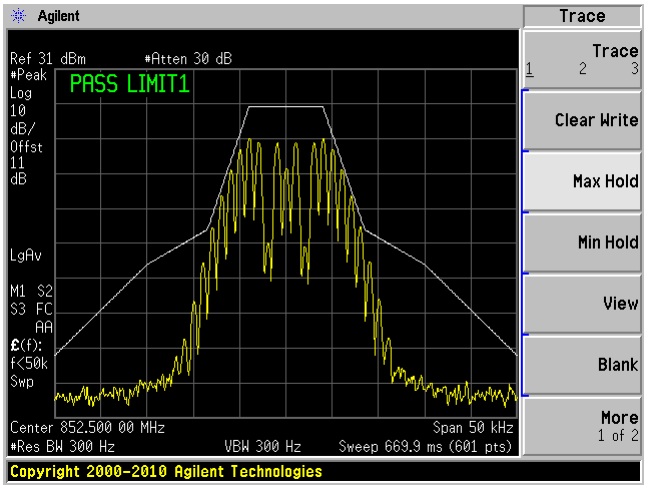
AGC on



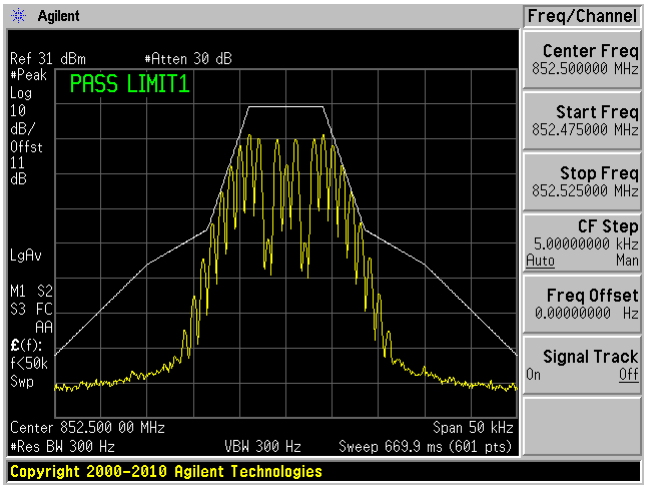
Downlink: 851-854 MHz

Emission Mask H: 16K0F3E

AGC off



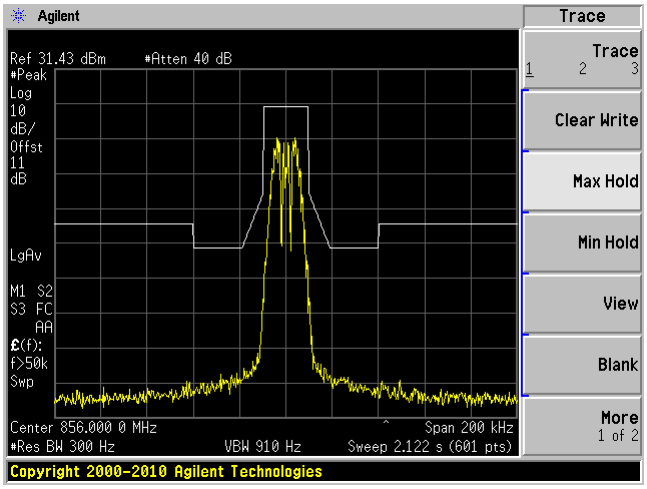
AGC on



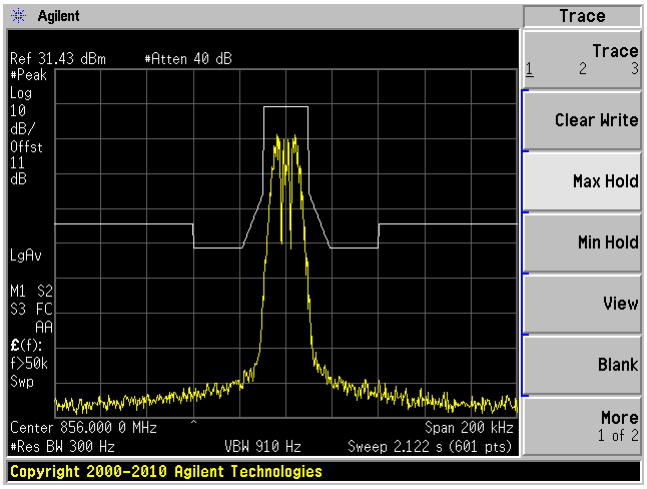
Downlink: 854-861 MHz

Emission Mask G: 16K0F3E

AGC off



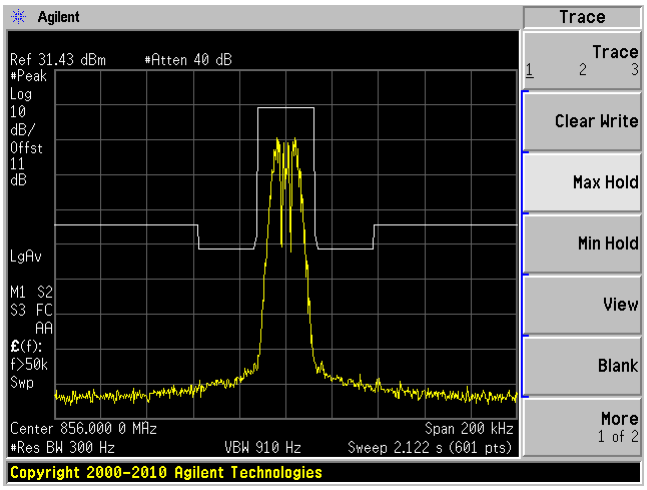
AGC on



Downlink: 854-861 MHz

Emission Mask 90.691: 16K0F3E

AGC off



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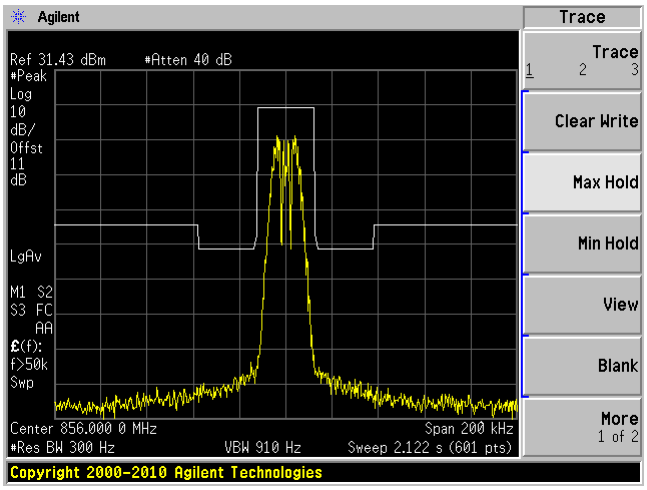
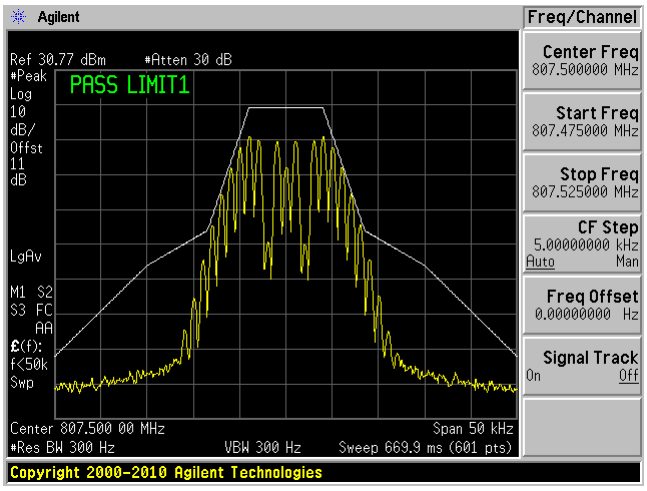


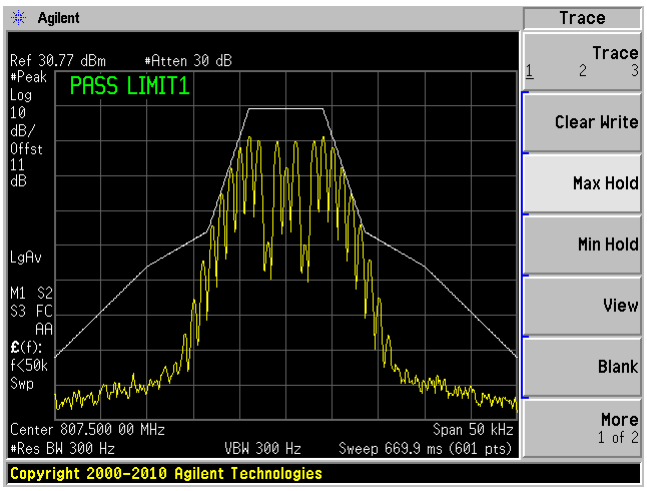
Uplink: 806-809 MHz

Emission Mask H: 16K0F3E

AGC off



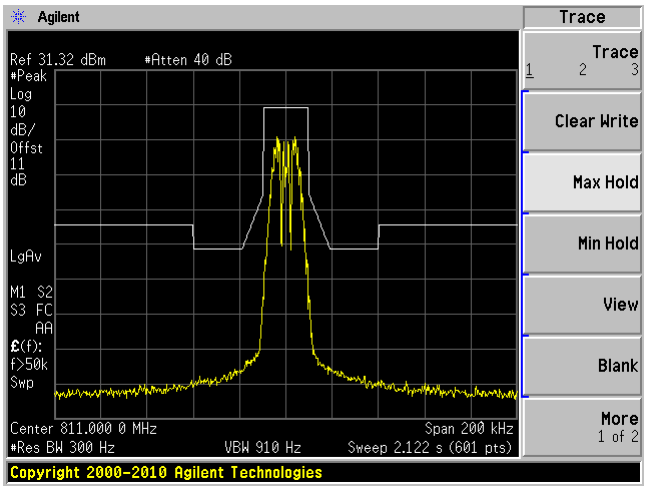
AGC on



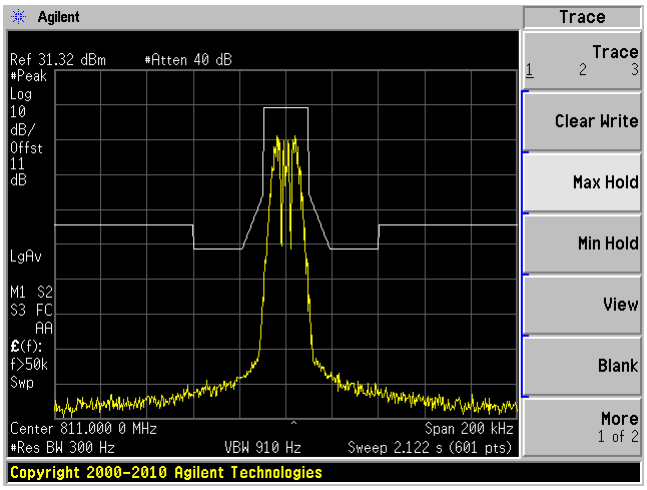
Uplink: 809-816 MHz

Emission Mask G: 16K0F3E

AGC off



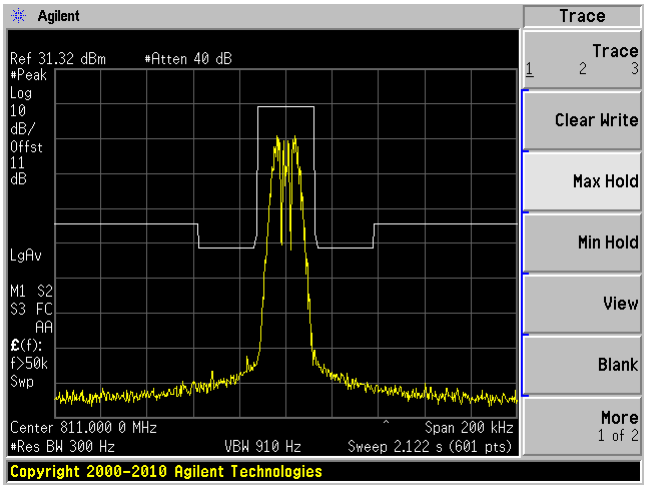
AGC on



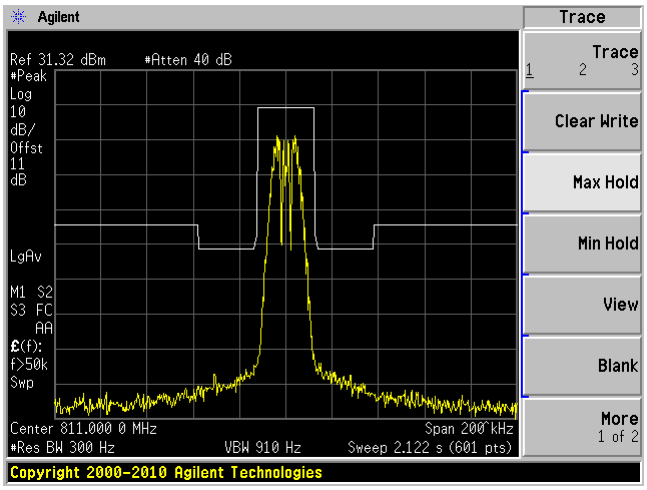
Uplink: 809-816 MHz

Emission Mask 90.691: 16K0F3E

AGC off



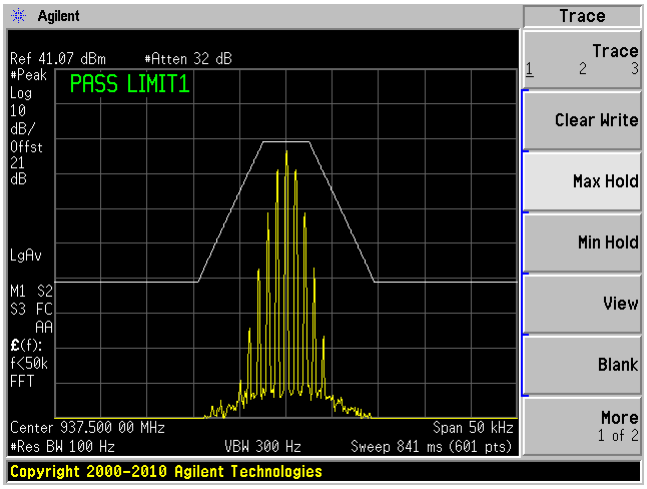
AGC on



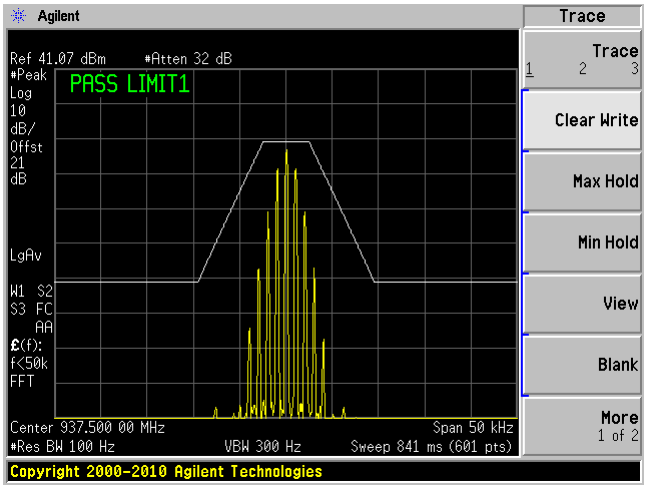
Downlink: 935-940 MHz

Emission Mask J: 4K00F1E

AGC off

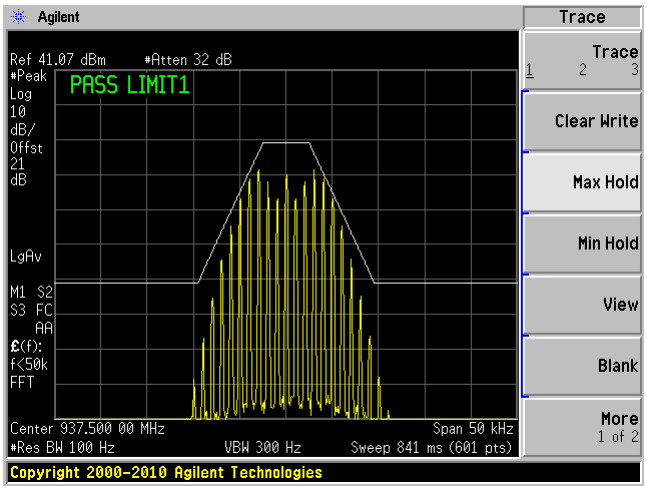


AGC on

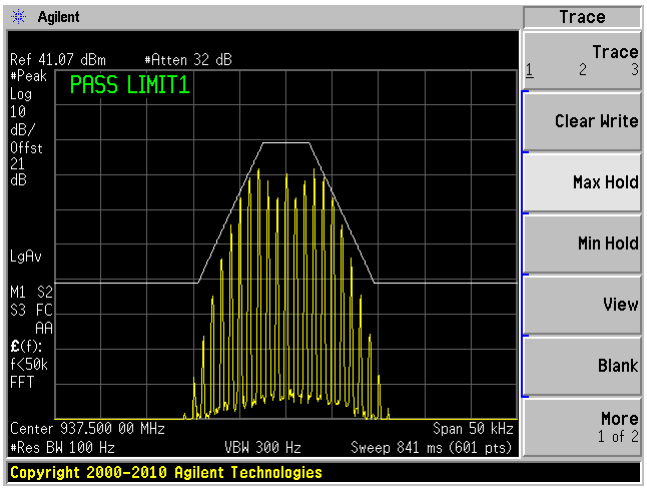


Emission Mask J: 11K3F3E

AGC off



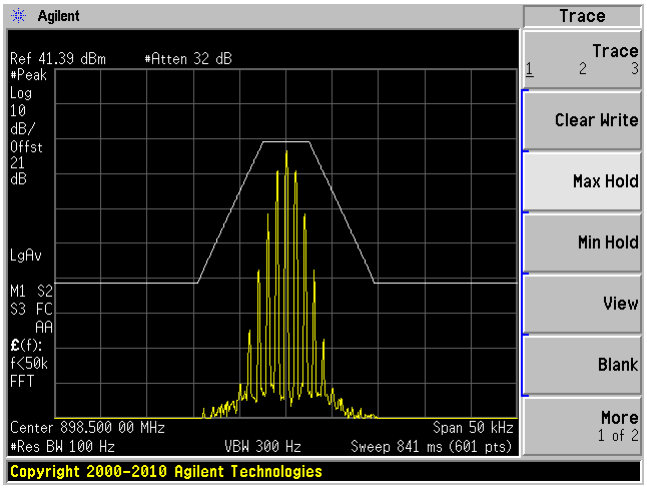
AGC on



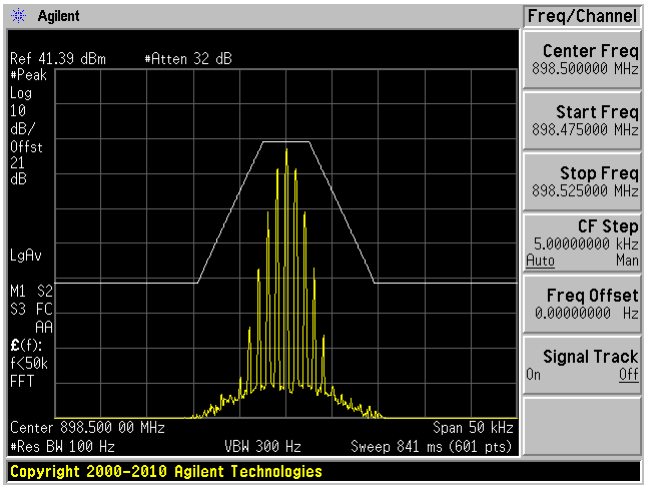
Uplink: 896-901 MHz

Emission Mask J: 4K00F1E

AGC off

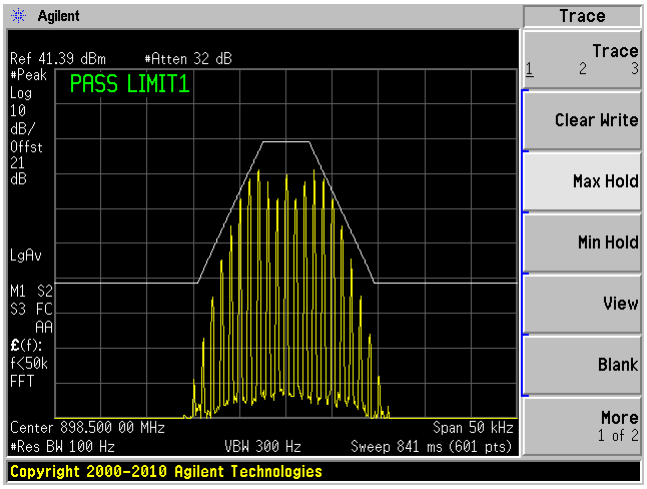


AGC on

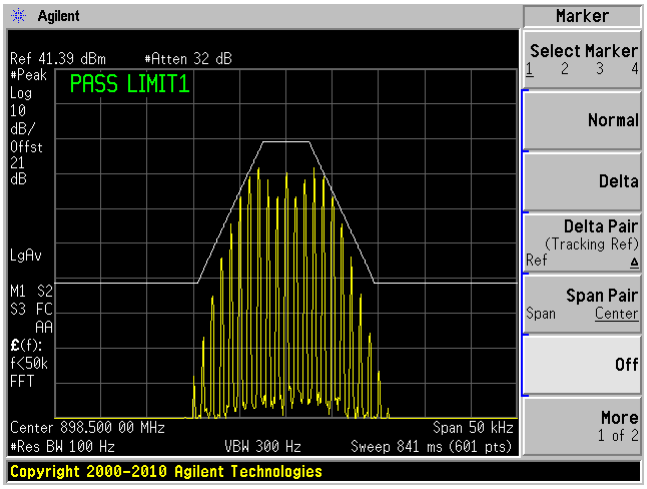


Emission Mask J: 11K3F3E

AGC off



AGC on



8 FCC §90.219(e) (3) & §90.210 - Spurious Radiated Emissions

8.1 Applicable Standards

According to FCC §90.219 (e) (3), Spurious emissions from a signal booster must not exceed −13 dBm within any 100 kHz measurement bandwidth.

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 in Watts/0.001) – the absolute level
Spurious attenuation limit in dB = 43 + 10 Log_{10} (power out in Watts)

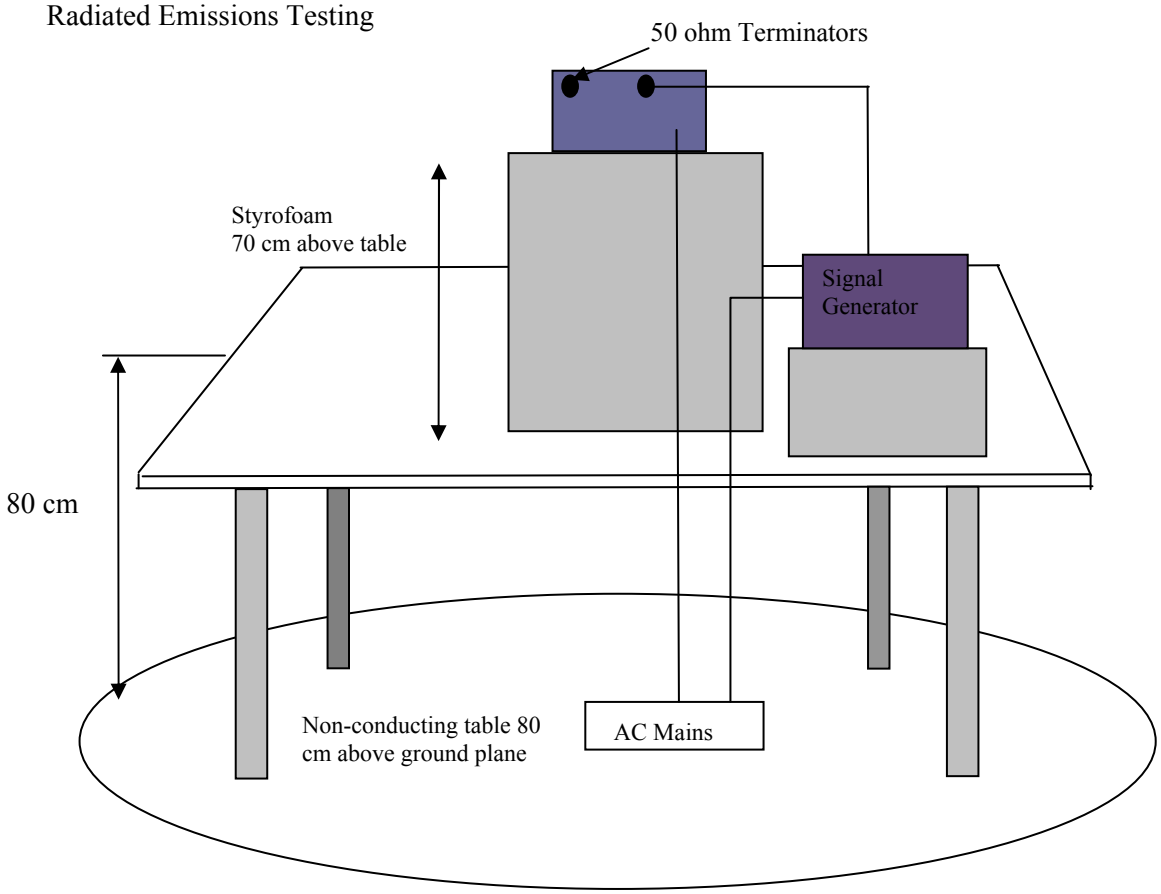
8.3 Test Equipment List and Details

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	2015-07-11	2 years
Agilent	Amplifier, Pre	8447D	2944A10187	2016-07-05	1 year
Agilent	Pre-Amplifier	8449B	3008A01978	2016-10-06	1year
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[1]	Each Time[1]
-	SMA cable	-	C09	Each Time[1]	Each Time[1]

[1]*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".

8.4 Test Setup Block Diagram

Radiated Emissions Testing



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- 06-11 and 2017-06-19 in 5 Meter Chamber 3.

8.6 Test Results

Downlink (758-775 MHz) Worst Margin: **-37.28 dB** at **80 MHz** in the **Horizontal** polarization.
Uplink (788-805 MHz) Worst Margin: **- -37.50** at **80 MHz** in the **Horizontal** polarization.

Downlink (851-861 MHz) Worst Margin: **-37.28 dB** at **80 MHz** in the **Horizontal** polarization.
Uplink (806-816 MHz) Worst Margin: **-37.50 dB** at **80 MHz** in the **Horizontal** polarization.

Downlink (935-940 MHz) Worst Margin: **-20.67 dB** at **1240 MHz** in the **Horizontal** polarization.
Uplink (896-901 MHz) Worst Margin: **- 29.74 dB** at **141.6 MHz** in the **Vertical** polarization.

Please refer to the following tables.

Downlink: 758-775 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 (dBi/dBd)	Cable Loss (dB)	Absolute Level (dBm)		
80	52.75	130	220	H	80	-49.36	0	0.28	-49.64	-13	-36.64
80	47.69	327	100	V	80	-52.19	0	0.28	-52.47	-13	-39.47
140	32.26	150	200	H	140	-67.85	0	0.37	-68.22	-13	-55.22
140	35.61	100	100	V	140	-60.28	0	0.37	-60.65	-13	-47.65
1000	52.69	220	100	H	1000	-60.02	6.14	0.2	-54.08	-13	-41.08
1000	52.04	0	100	V	1000	-60.96	6.14	0.2	-55.02	-13	-42.02
2643	49.75	0	100	H	2643	-55.73	9.05	0.7	-47.38	-13	-34.38
2643	49.3	266	120	V	2643	-56.57	9.05	0.7	-48.22	-13	-35.22

Uplink: 788-805 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 (dBi/dBd)	Cable Loss (dB)	Absolute Level (dBm)		
80	52.49	130	220	H	80	-49.62	0	0.28	-49.9	-13	-36.9
80	47.41	327	100	V	80	-52.47	0	0.28	-52.75	-13	-39.75
140	31.92	150	200	H	140	-68.19	0	0.37	-68.56	-13	-55.56
140	35.41	100	100	V	140	-60.48	0	0.37	-60.85	-13	-47.85
1105	52.02	360	100	H	1105	-59.84	6.87	0.2	-53.17	-13	-40.17
1105	52.66	0	100	V	1105	-59.97	6.87	0.2	-53.3	-13	-40.3
2995	49.59	140	100	H	2995	-53.38	9.64	0.7	-44.44	-13	-31.44
2995	49.22	0	100	V	2995	-54.11	9.64	0.7	-45.17	-13	-32.17

Downlink: 851-861 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 (dBd/dBi)	Cable Loss (dB)	Absolute Level (dBm)		
80	52.11	130	220	H	80	-50	0	0.28	-50.28	-13	-37.28
80	47.28	327	100	V	80	-52.6	0	0.28	-52.88	-13	-39.88
140	31.96	150	200	H	140	-68.15	0	0.37	-68.52	-13	-55.52
140	35.11	100	100	V	140	-60.78	0	0.37	-61.15	-13	-48.15
1030	52.35	70	100	H	1030	-60.54	6.58	0.2	-54.16	-13	-41.16
1030	52.33	40	100	V	1030	-60.52	6.58	0.2	-54.14	-13	-41.14
1615	51	0	100	H	1615	-60.94	9.07	0.4	-52.27	-13	-39.27
1615	51.61	0	100	V	1615	-60.08	9.07	0.4	-51.41	-13	-38.41

Uplink: 806-816 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 (dBd/dBi)	Cable Loss (dB)	Absolute Level (dBm)		
80	51.89	103	100	H	80	-50.22	0	0.28	-50.5	-13	-37.5
80	46.63	0	100	V	80	-53.25	0	0.28	-53.53	-13	-40.53
140	33.25	0	100	H	140	-66.86	0	0.37	-67.23	-13	-54.23
140	36.03	45	100	V	140	-59.86	0	0.37	-60.23	-13	-47.23
1075	52.89	0	100	H	1075	-59.9	6.87	0.2	-53.23	-13	-40.23
1075	52	0	100	V	1075	-60.55	6.87	0.2	-53.88	-13	-40.88
1615	50.64	72	100	H	1615	-61.3	9.07	0.4	-52.63	-13	-39.63
1615	50.6	40	100	V	1615	-61.09	9.07	0.4	-52.42	-13	-39.42

Downlink: 935-940 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	35.28	150	200	H	80	-66.83	0	0.28	-67.11	-13	-54.11
80	49.98	273	100	V	80	-49.9	0	0.28	-50.18	-13	-37.18
144.8	52.13	130	120	H	144.8	-47.66	0	0.45	-48.11	-13	-35.11
144.8	48.23	147	100	V	144.8	-47.34	0	0.45	-47.79	-13	-34.79
1000	54.98	145	211	H	1000	-57.93	6.135	0.2	-51.995	-13	-39.00
1000	56.49	230	120	V	1000	-57.12	6.135	0.2	-51.185	-13	-38.19
1240	72.41	280	100	H	1240	-40.28	6.871	0.26	-33.669	-13	-20.67
1240	66.75	310	100	V	1240	-46.92	6.871	0.26	-40.309	-13	-27.31

Uplink: 896-901 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	34.86	135	180	H	80	-67.25	0	0.28	-67.53	-13	-54.53
80	49.01	210	100	V	80	-50.87	0	0.28	-51.15	-13	-38.15
141.6	48.4	86	100	H	141.6	-50.6	0	0.37	-50.97	-13	-37.97
141.6	52.16	115	160	V	141.6	-42.37	0	0.37	-42.74	-13	-29.74
1000	55.64	135	100	H	1000	-57.27	6.135	0.2	-51.335	-13	-38.34
1000	54.38	240	100	V	1000	-59.23	6.135	0.2	-53.295	-13	-40.30
1165	51.41	190	100	H	1165	-61.92	6.871	0.25	-55.299	-13	-42.30
1165	51.96	175	100	V	1165	-61.66	6.874	0.25	-55.036	-13	-42.04

9 FCC §90.219(e) (3), §90.210, §90.543 (e) (1) & §90.543 (f) - Spurious Emissions at Antenna Terminals

9.1 Applicable Standards

According to FCC §90.219(e) (3), Spurious emissions from a signal booster must not exceed −13 dBm within any 100 kHz measurement bandwidth.

According to FCC §90.543 (e), for operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

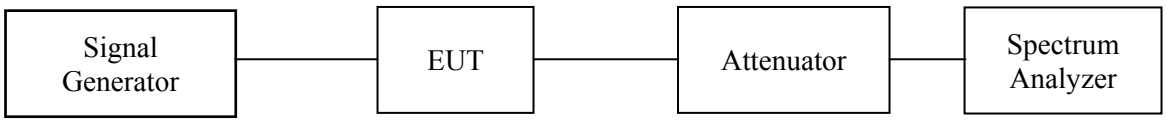
(1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations.

According to FCC §90.543 (f), for operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

9.2 Test Procedure

Section 4.7.3 of KDB 935210 D05 v01r01. The signal generator output was connected to the EUT input. The output of the EUT was connected to a spectrum analyzer through appropriate attenuation.

The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.



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[1]	Each Time[1]
-	10 dB attenuator	-	-	Each Time[1]	Each Time[1]
-	SMA cable	-	C04	Each Time[1]	Each Time[1]
-	SMA cable	-	C09	Each Time[1]	Each Time[1]

[1]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

Temperature:	22-23° C
Relative Humidity:	32 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Jose Martinez 2017-06-09 and 2017-07-03 in the RF Site.

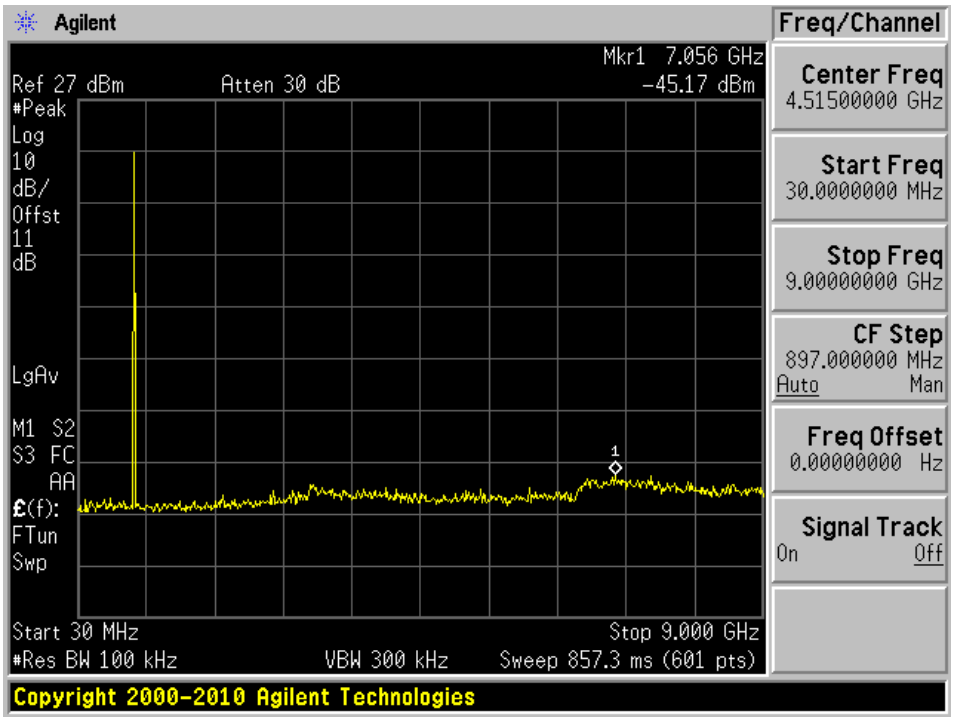
9.5 Test Results

Please refer to the following plots.

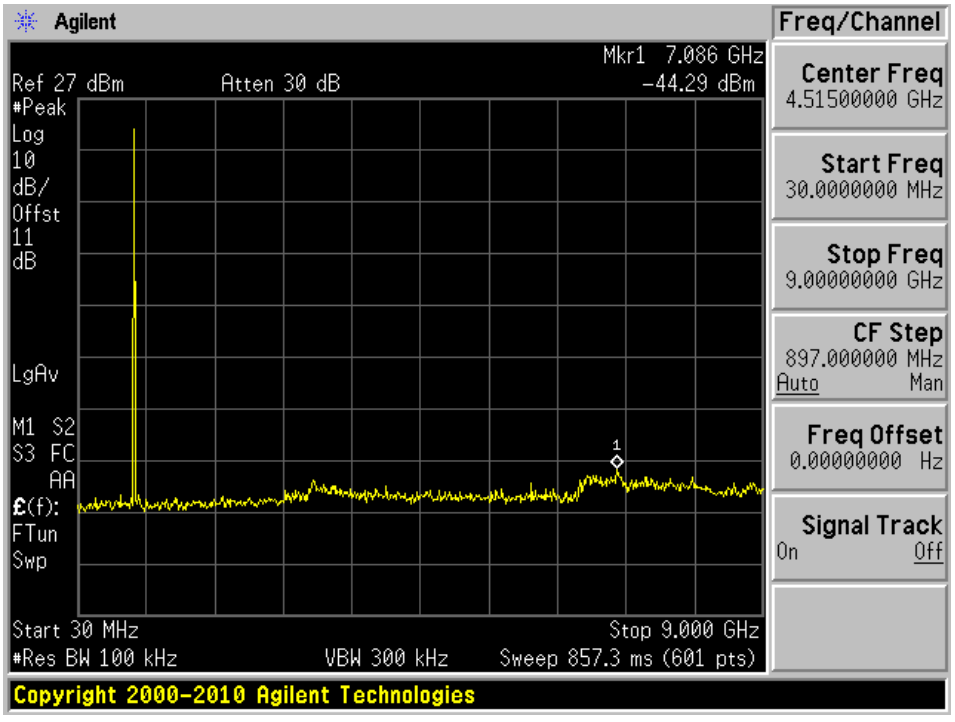
Spurious Emission from 30 MHz to 9 GHz

Downlink: 758-775 MHz

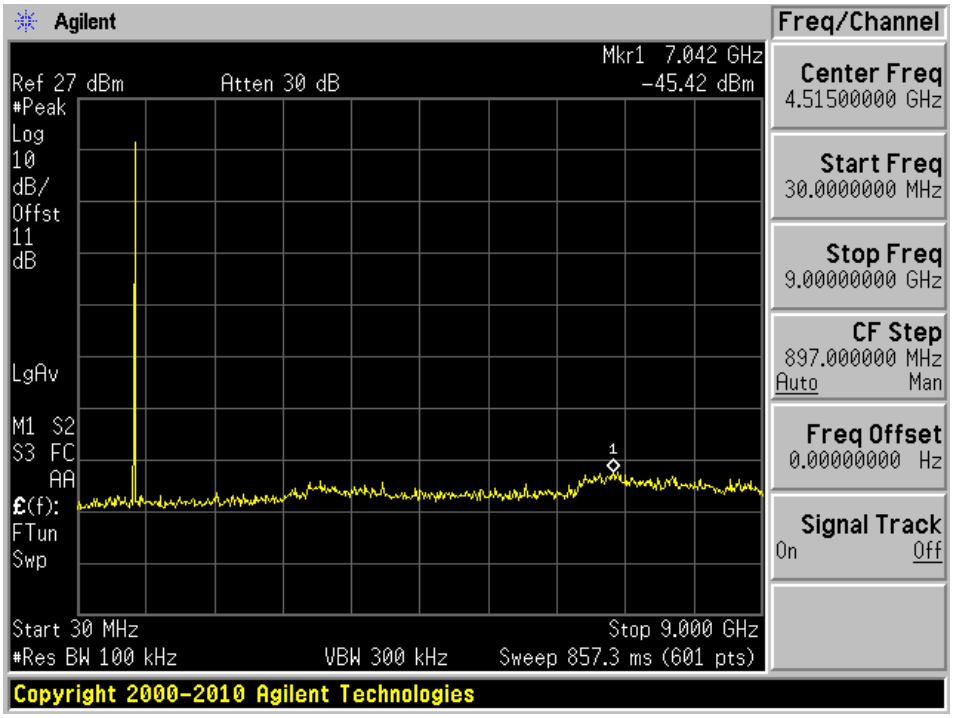
Low Channel



Middle Channel

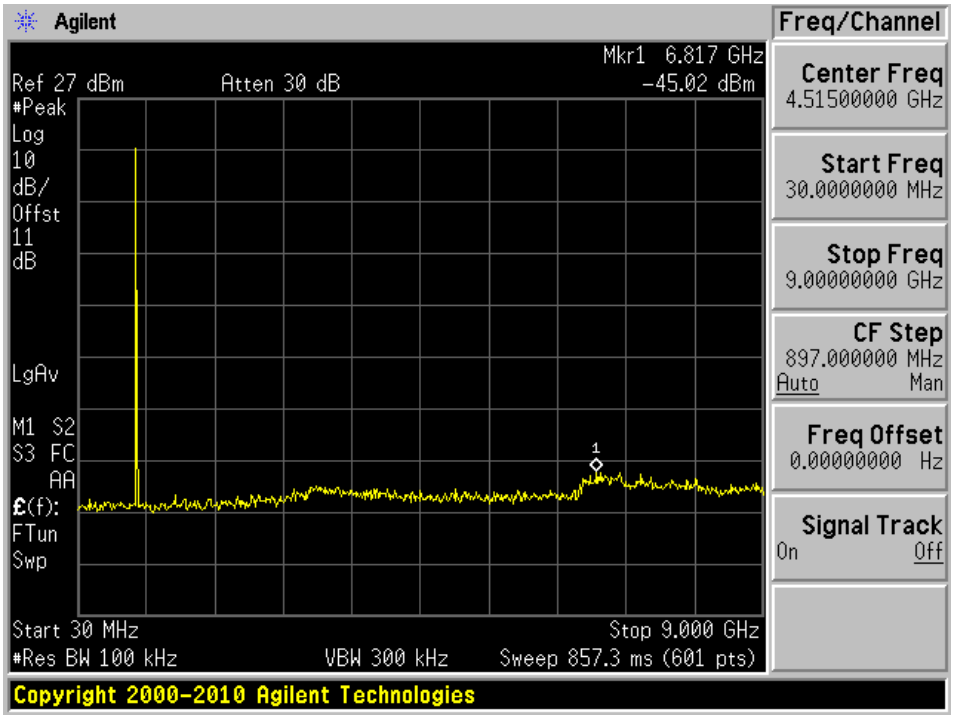


High Channel

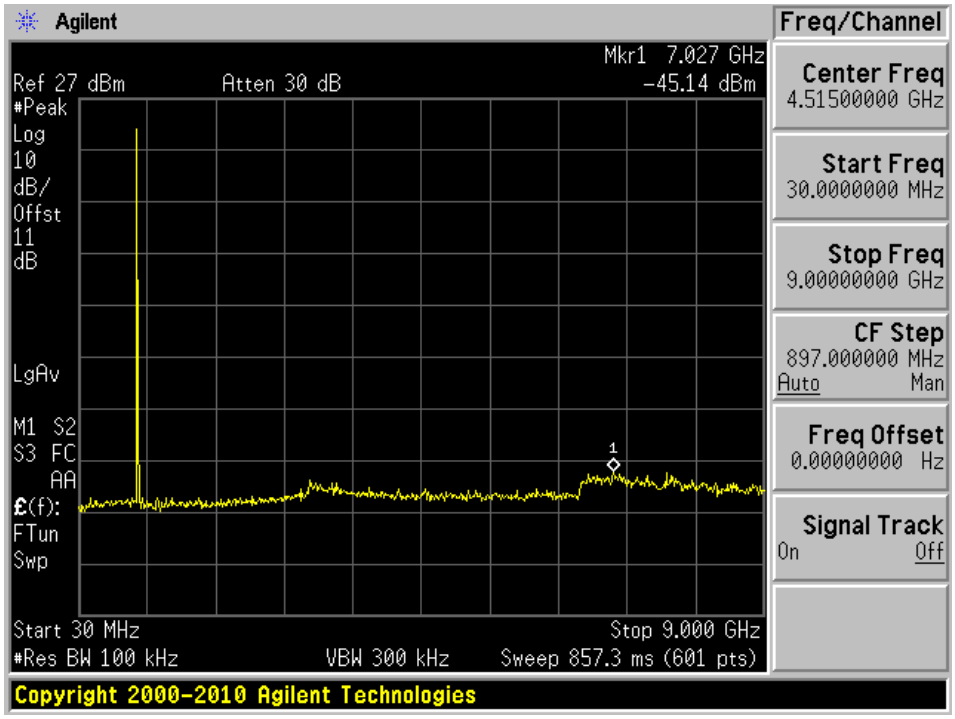


Uplink: 788-805 MHz

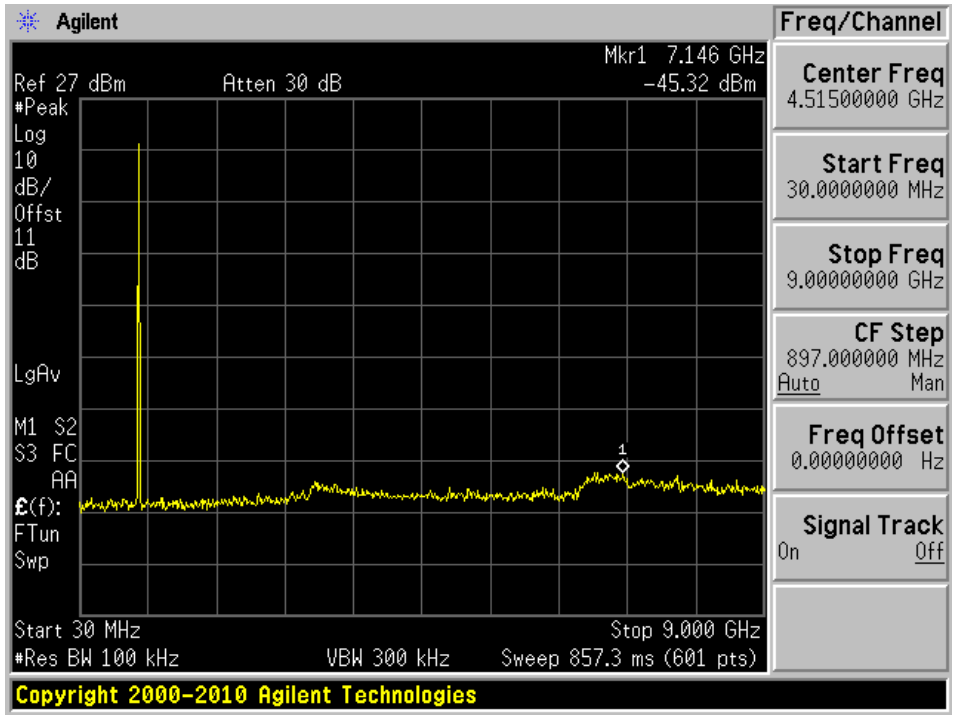
Low Channel



Middle Channel

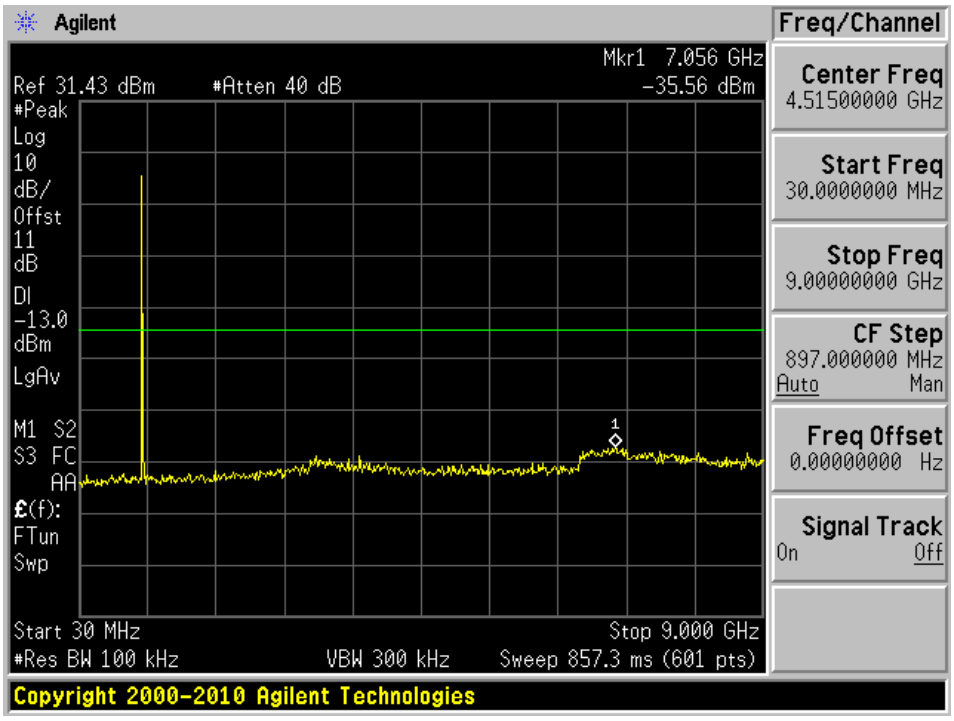


High Channel

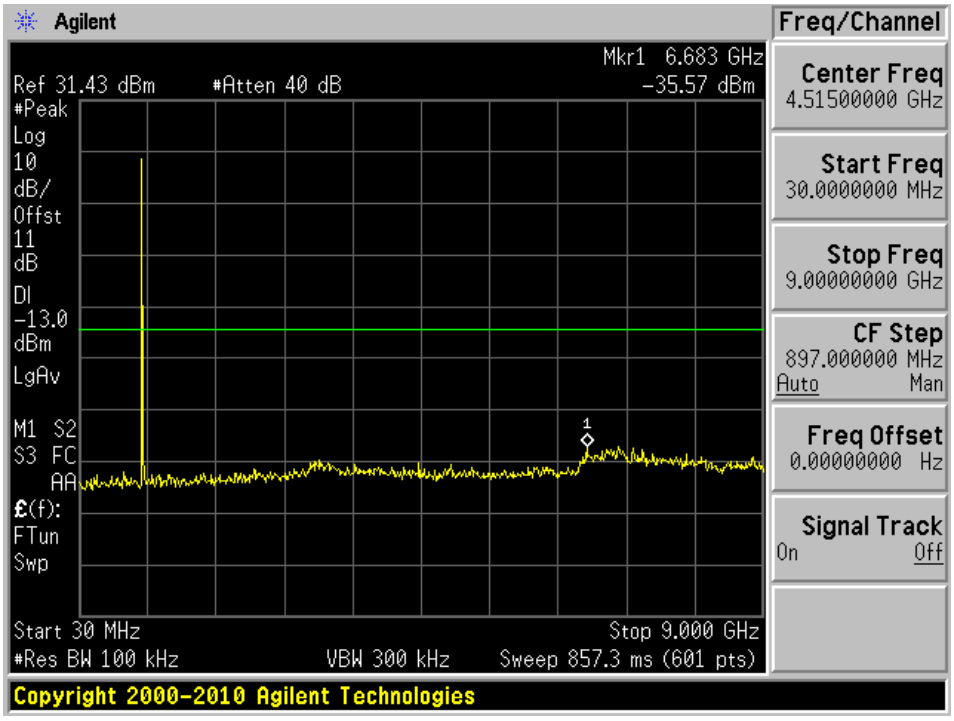


Downlink: 851-861 MHz

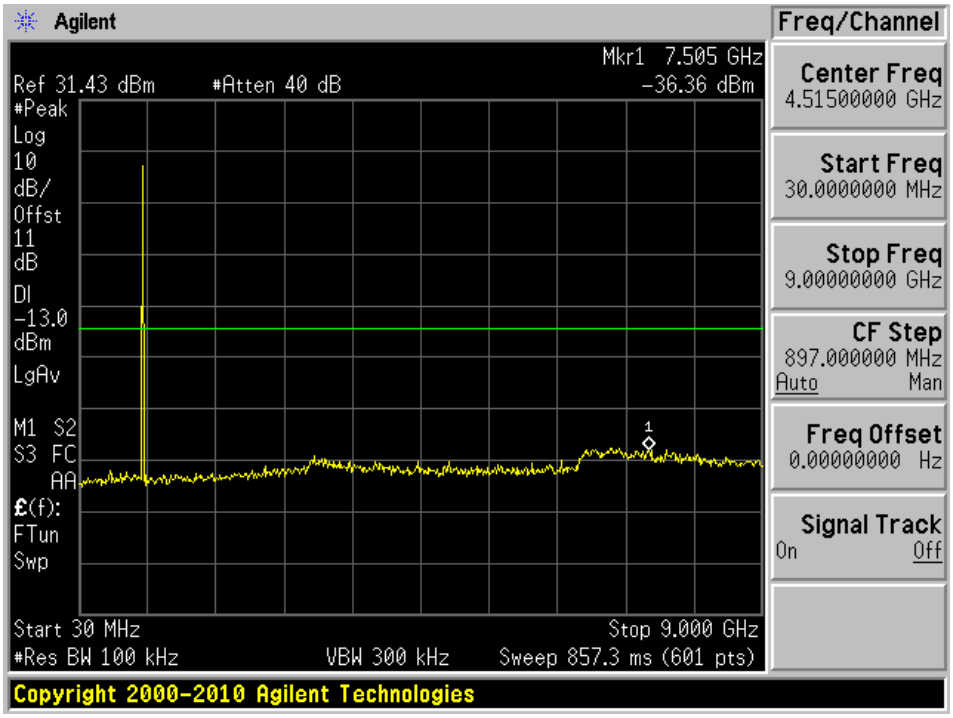
Low Channel



Middle Channel

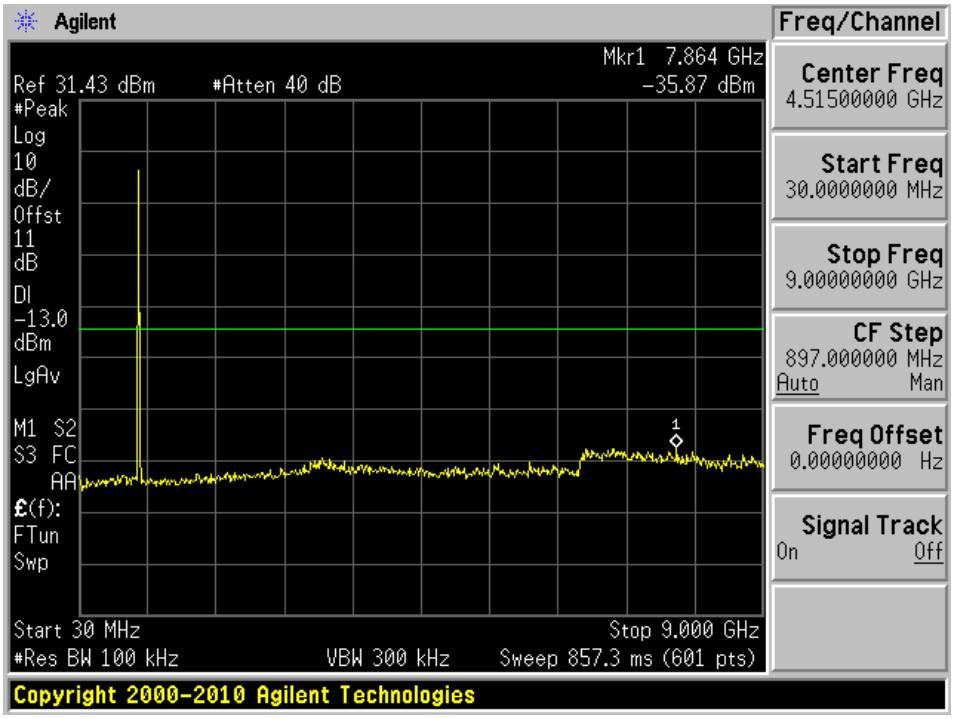


High Channel

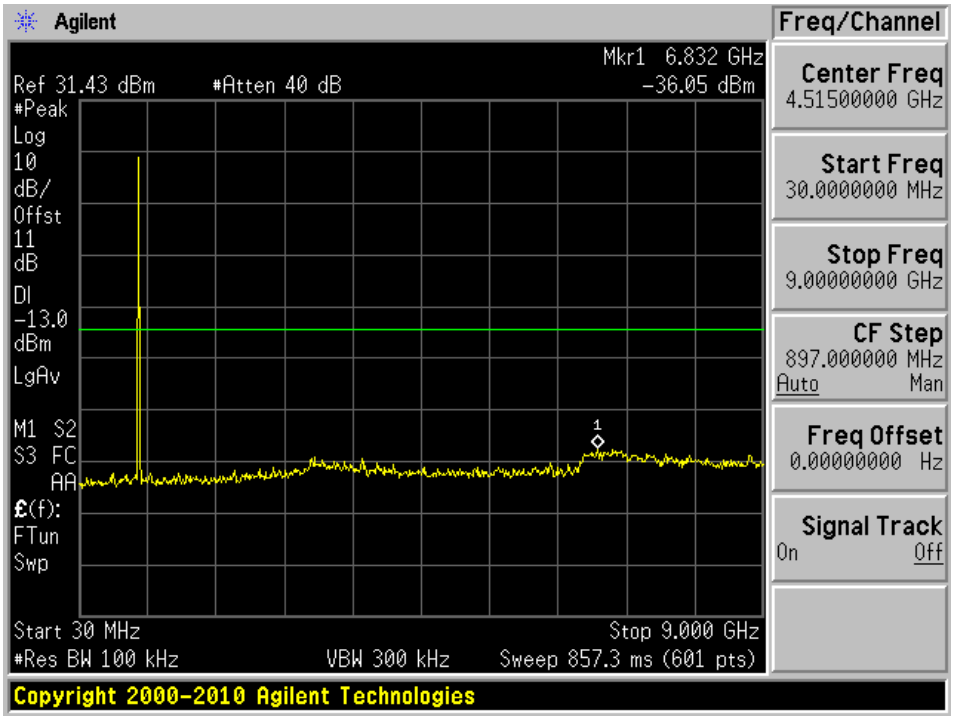


Uplink: 806-816 MHz

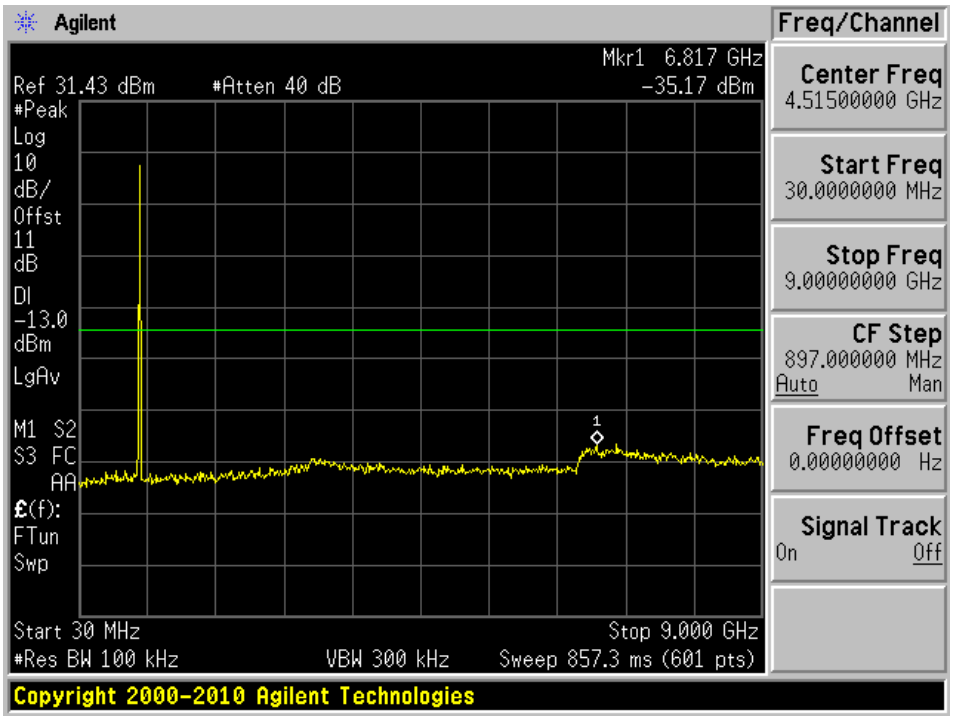
Low Channel



Middle Channel

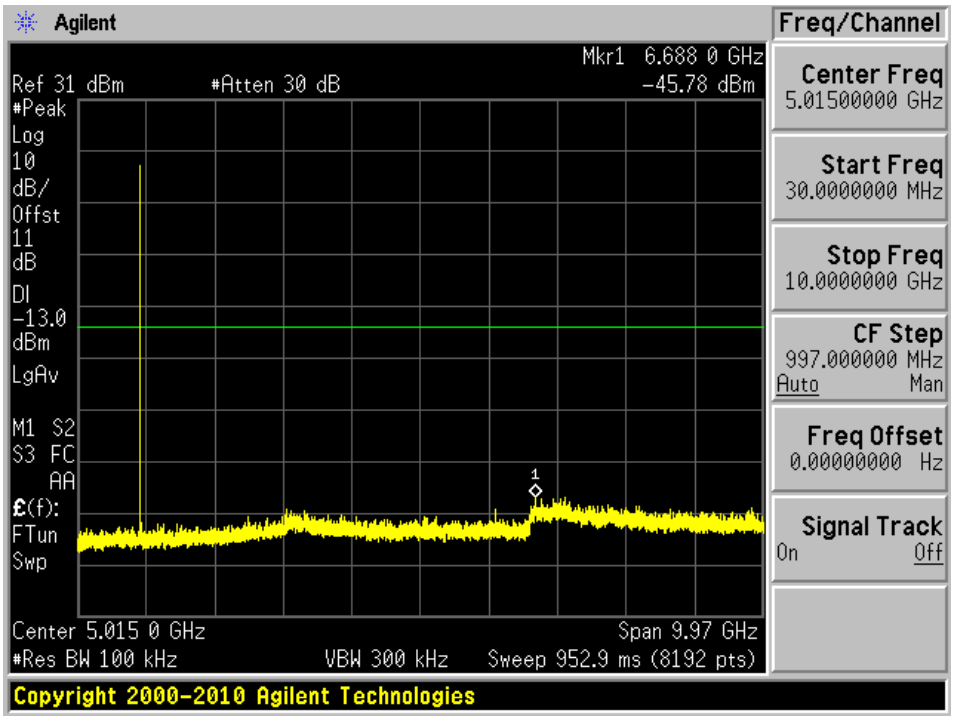


High Channel

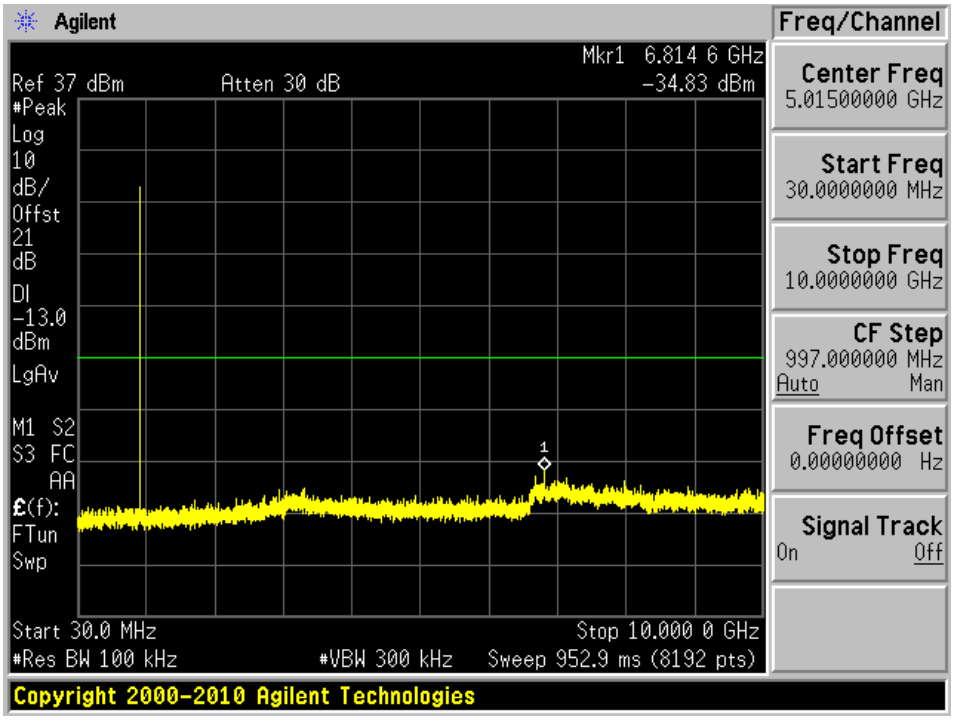


Downlink: 935-940 MHz

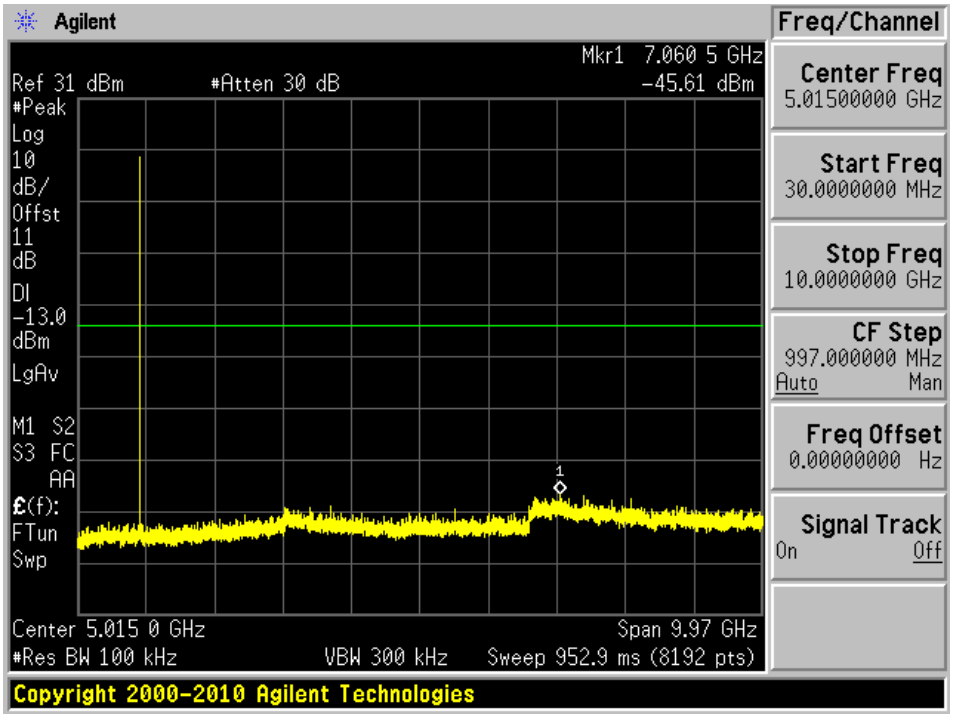
Low Channel



Middle Channel

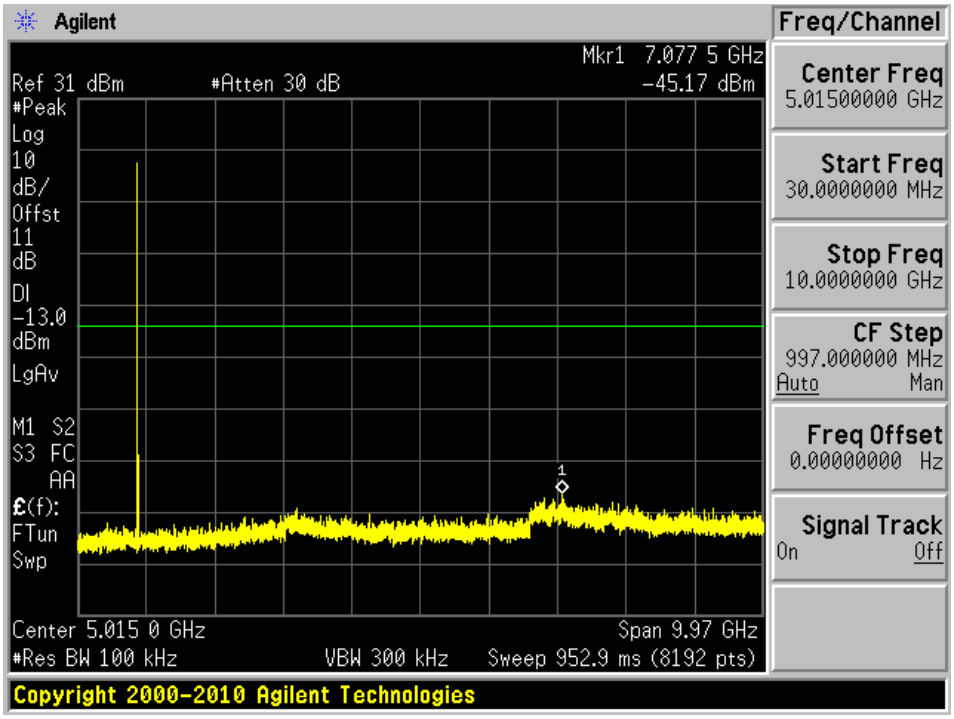


High Channel

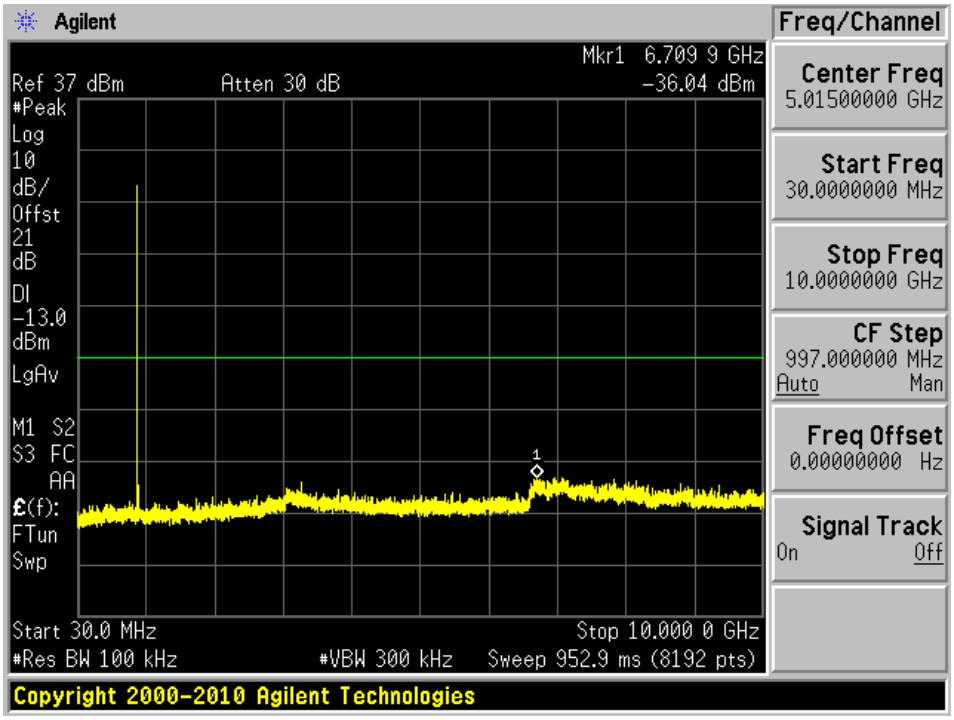


Uplink: 896-901 MHz

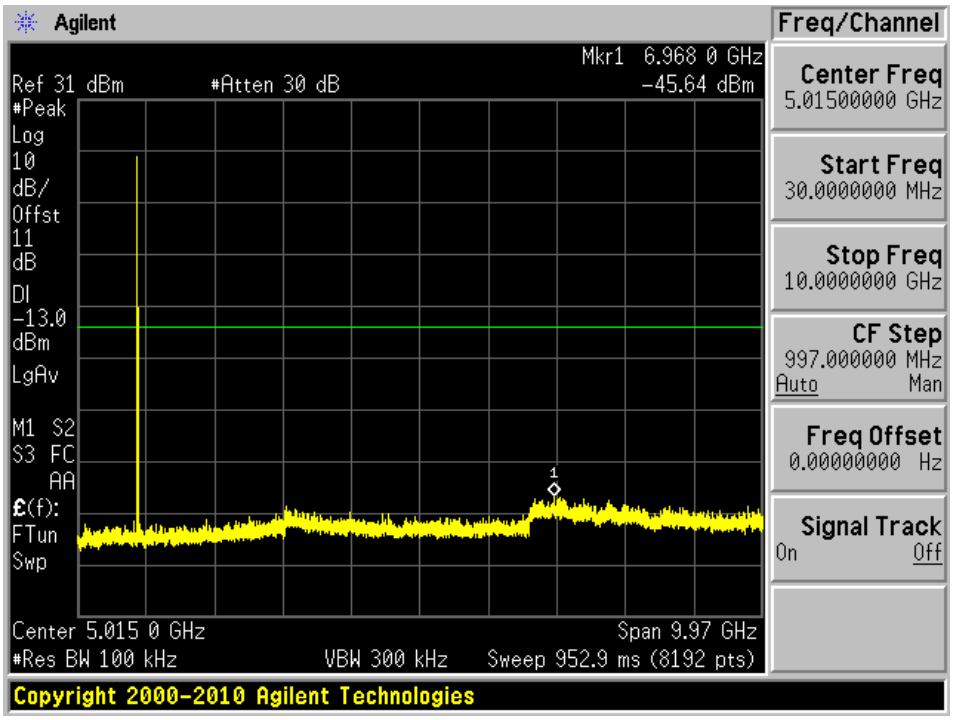
Low Channel



Middle Channel



High Channel



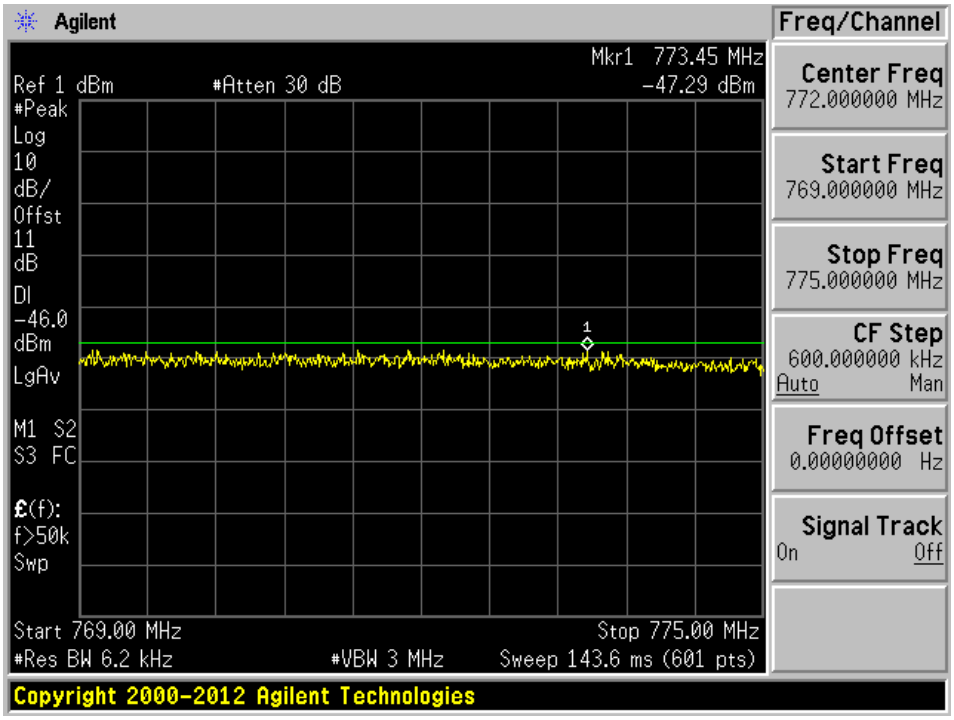
Note: Emissions over the limit line as shown in above plots were the fundamental signals from the EUT.

Additional Conducted Spurious Emissions Evaluations in accordance with §90.543 (e) (1)

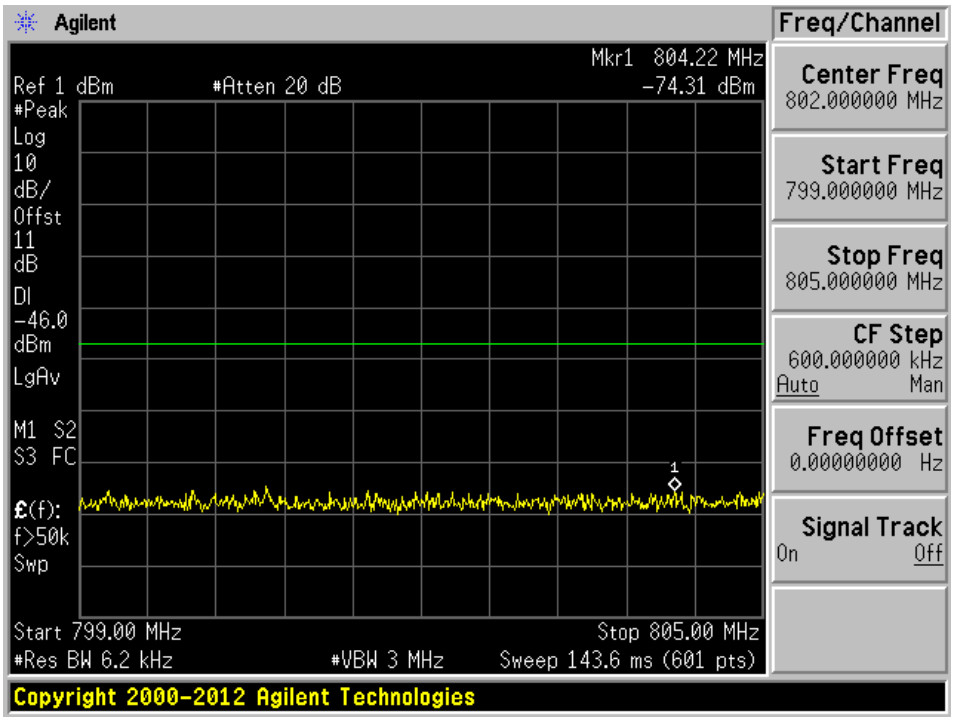
Downlink: 758-775 MHz

Frequency Range (MHz)	Measured Frequency (MHz)	Measured Value (dBm)	Limit (dBm)	Margin (dB)
769-775	772.46	-47.16	-46	-1.16
799-805	801.49	-73.47	-46	-27.47

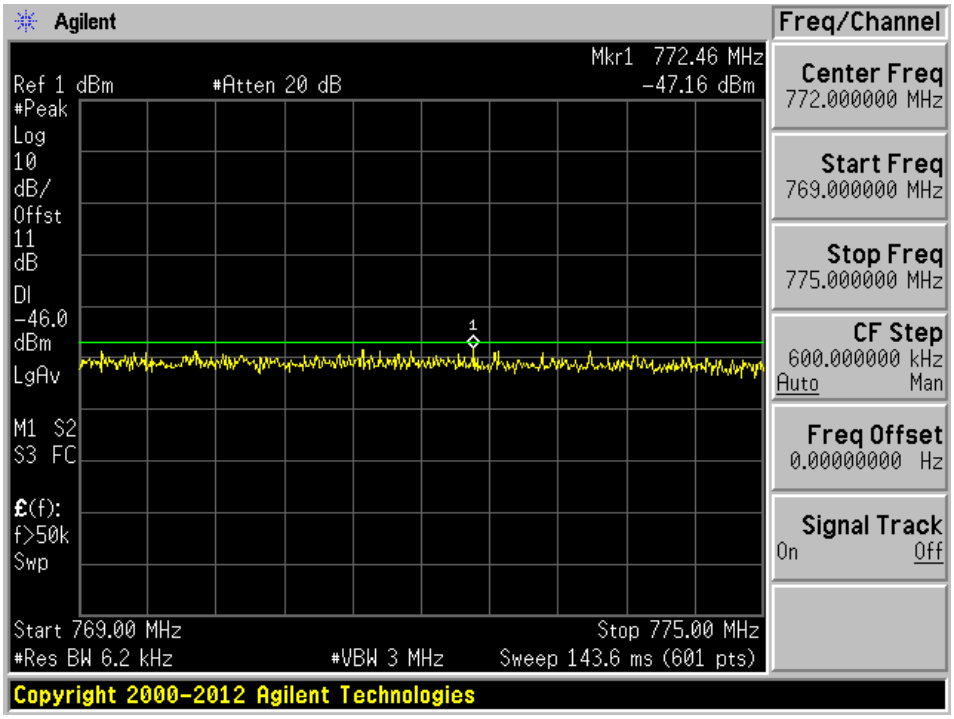
Low Channel: 769-775 MHz



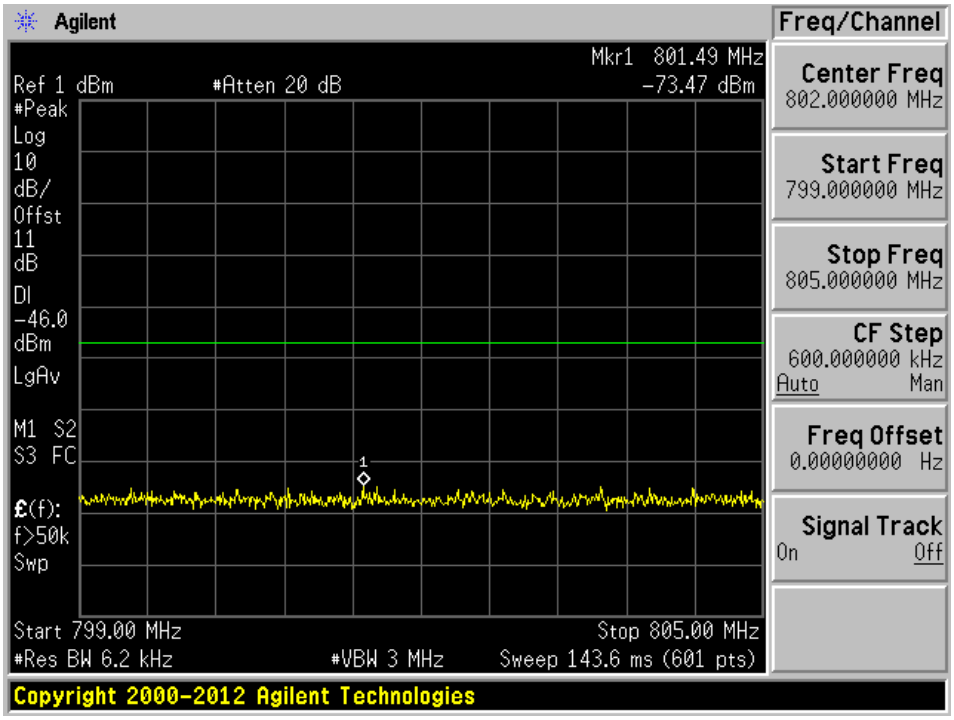
Low Channel: 799-805 MHz



Middle Channel: 769-775 MHz



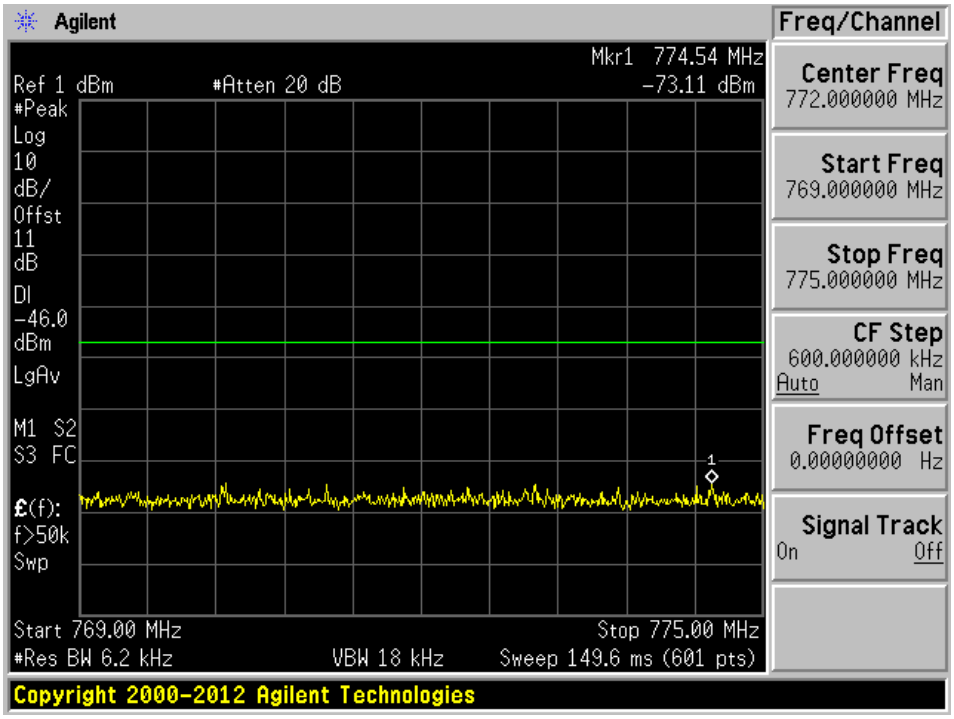
Middle Channel: 799-805 MHz



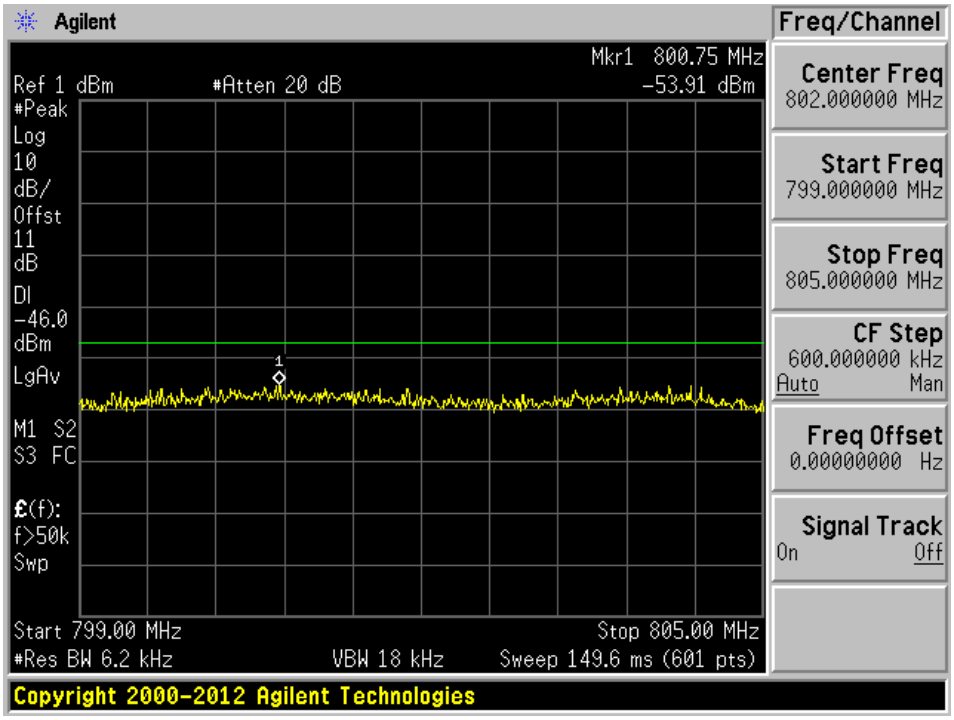
Uplink: 788-805 MHz

Frequency Range (MHz)	Measured Frequency (MHz)	Measured Value (dBm)	Limit (dBm)	Margin (dB)
769-775	769.44	-73.00	-46	-27
799-805	804.14	-53.82	-46	-7.82

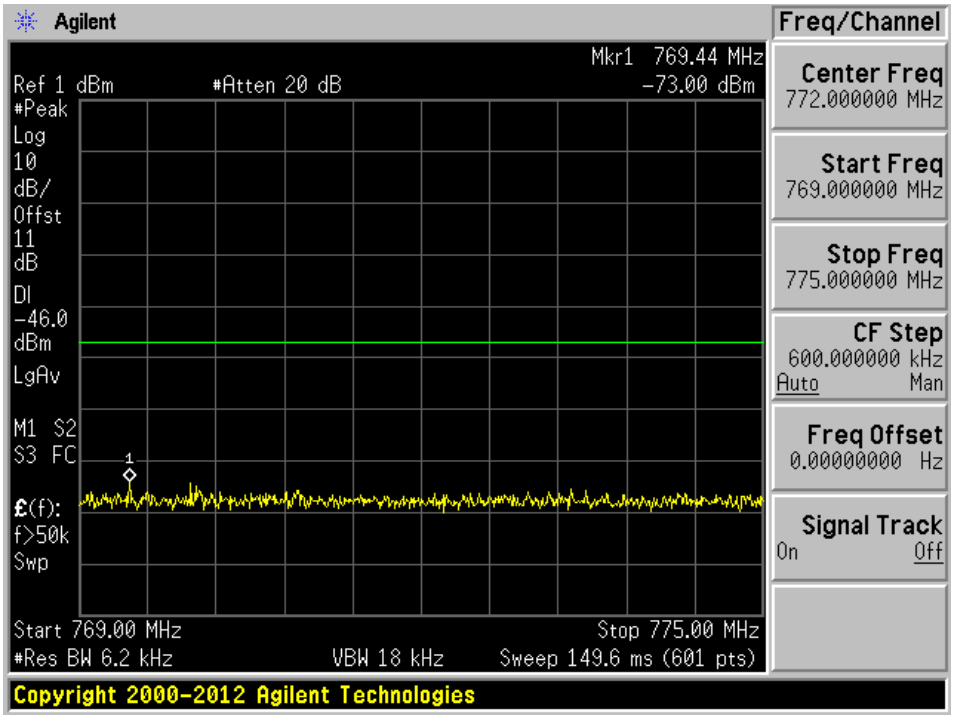
Low Channel: 769-775 MHz



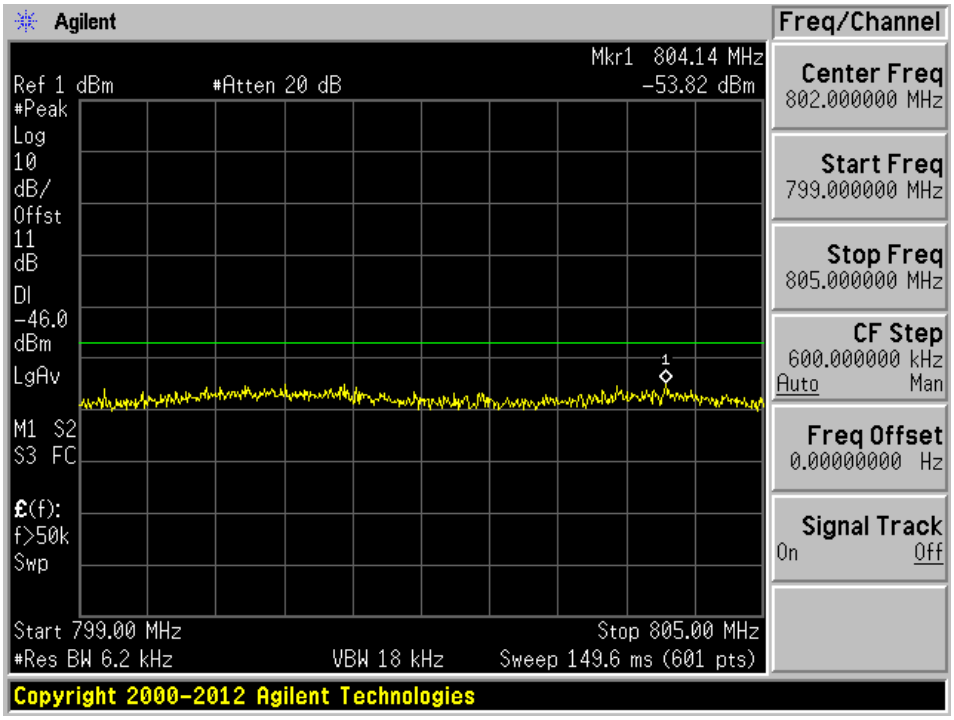
Low Channel: 799-805 MHz



Middle Channel: 769-775 MHz



Middle Channel: 799-805 MHz

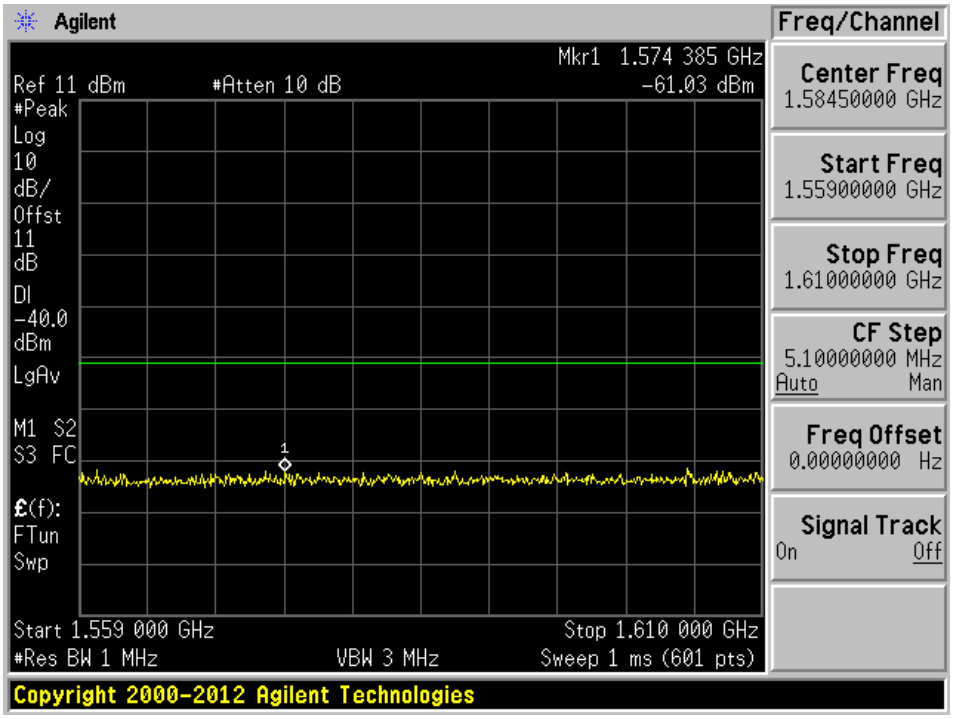


Additional Conducted Spurious Emissions Evaluations in accordance with §90.543 (f)

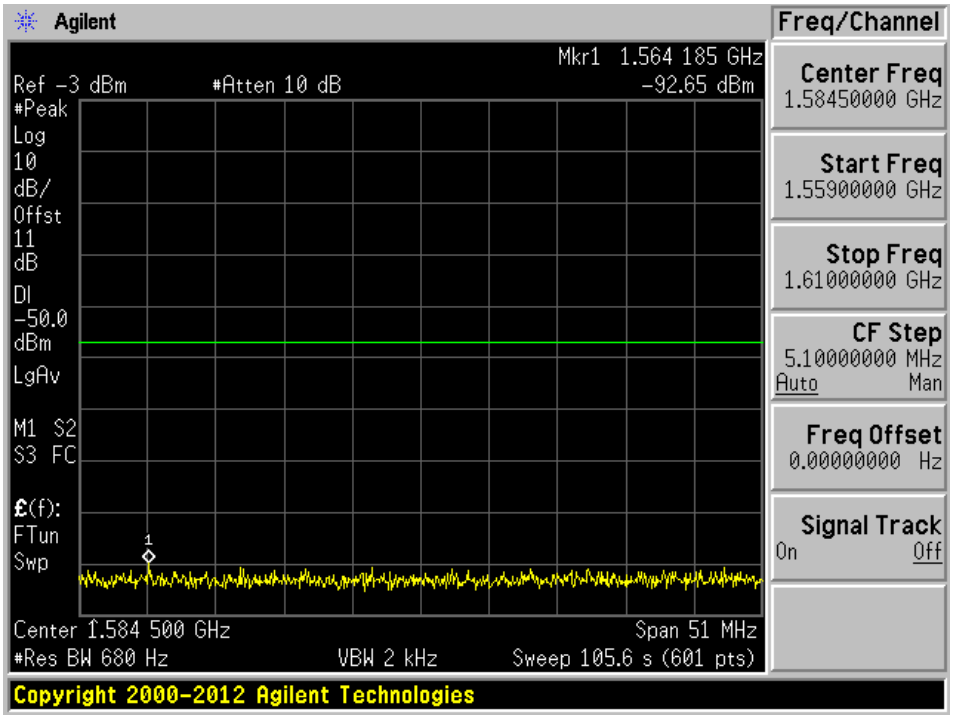
Downlink: 758-775 MHz

Frequency Range (MHz)	Measured Frequency (MHz)	Measured Value	Antenna Gain (dBi)	e.i.r.p	Limit	Margin (dB)
1559-1610 (Wideband)	1598.0	-59.49 dBm/MHz	2	-57.49 dBm/MHz	-40 dBm/MHz	-17.49
1559-1610 (Narrowband)	1564.2	-92.65 dBm	2	-90.65 dBm	-50 dBm	-40.65

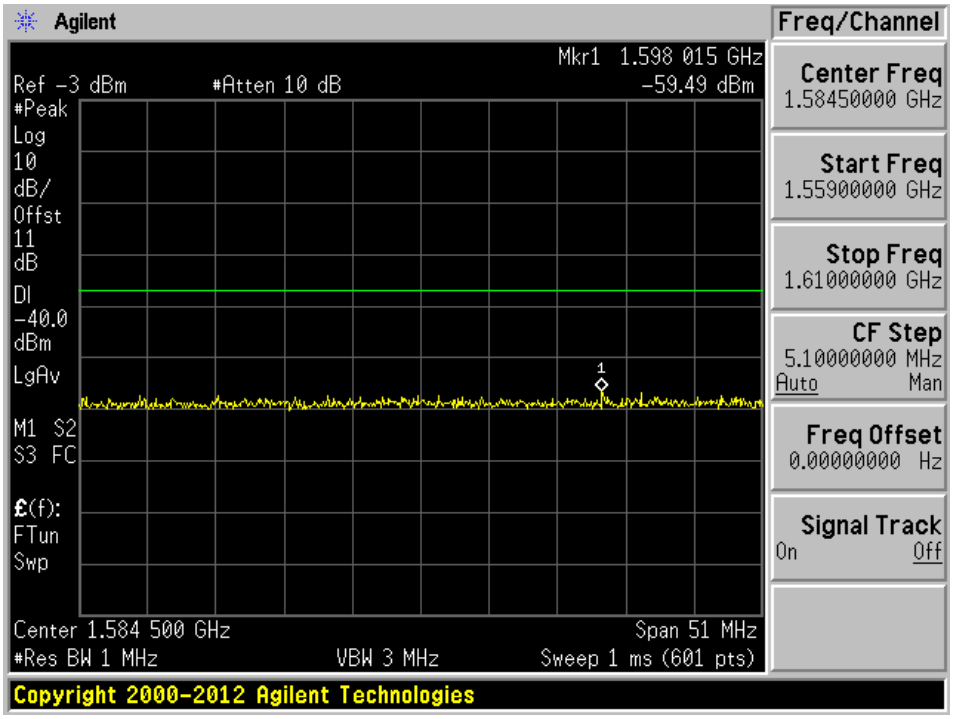
Low Channel Wideband Signal



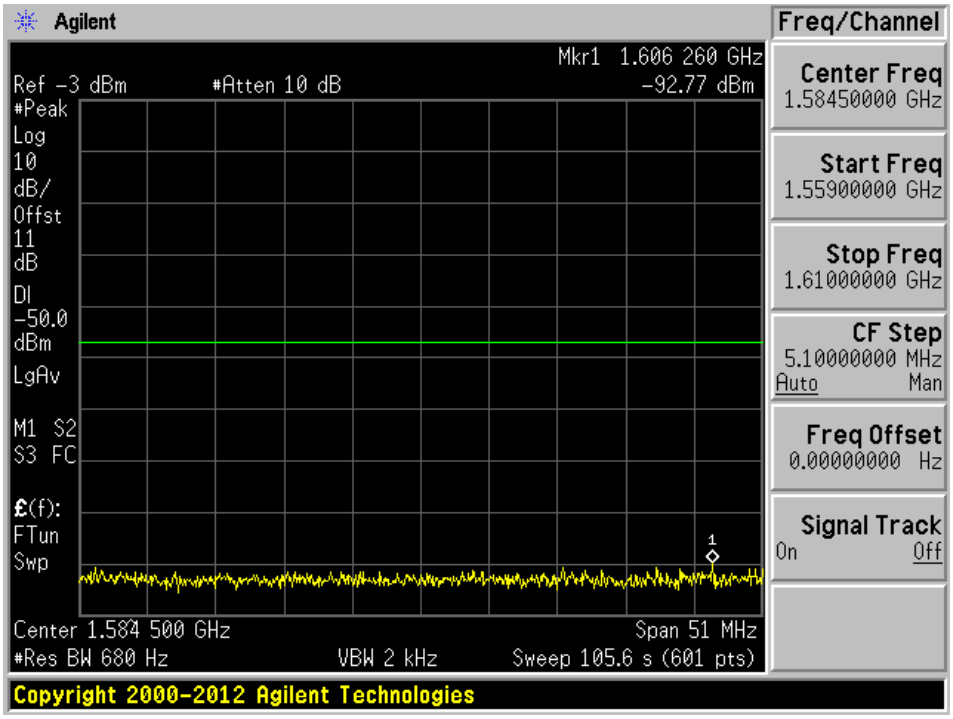
Low Channel Narrowband Signal



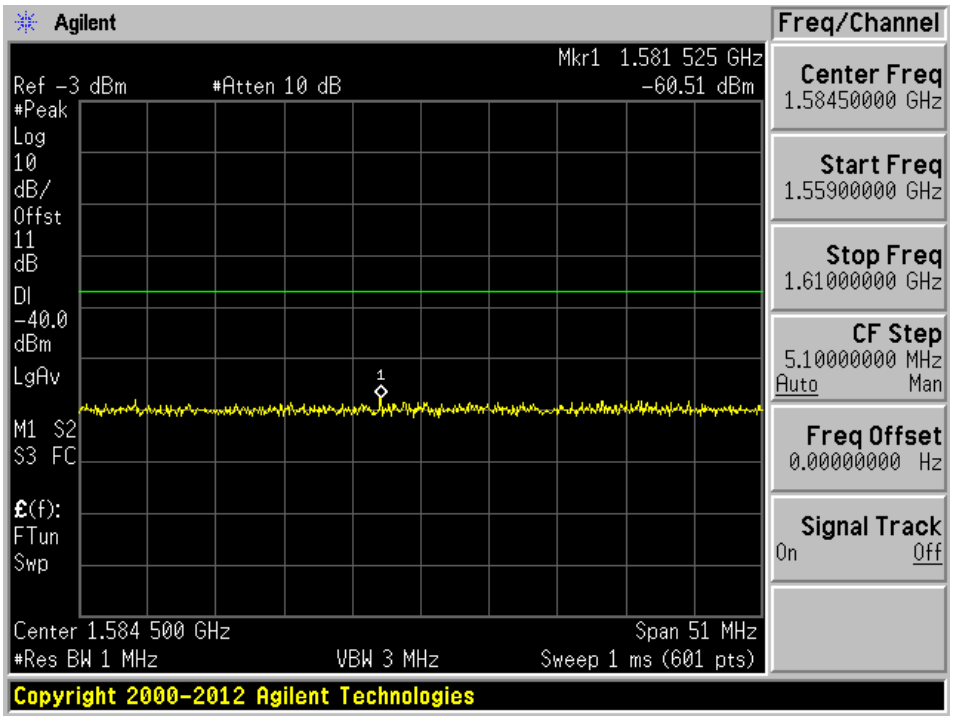
Middle Channel Wideband Signal



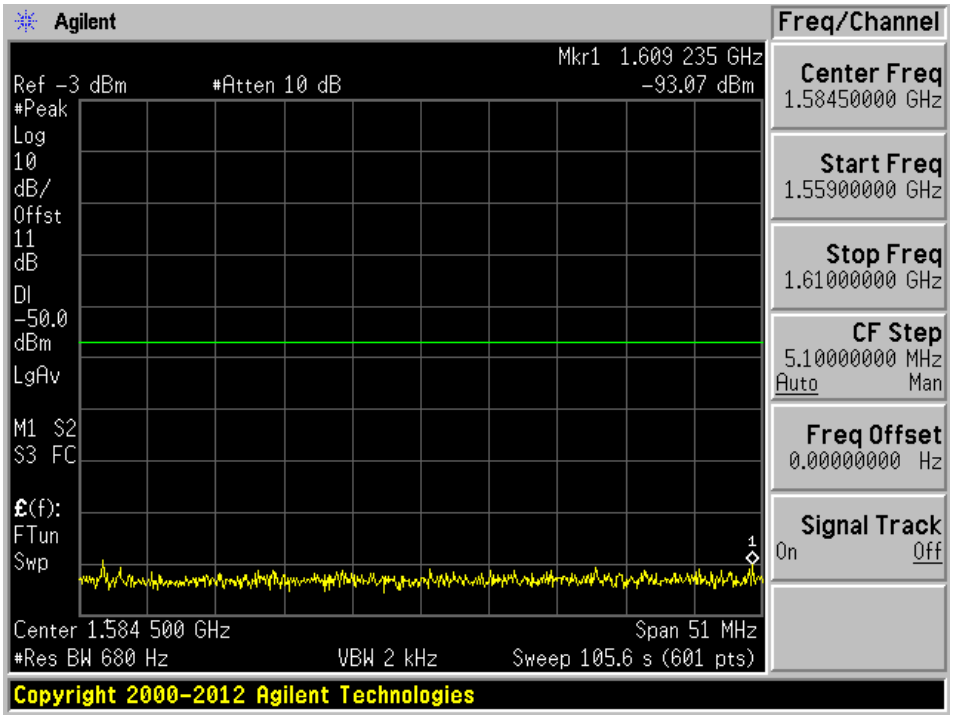
Middle Channel Narrowband Signal



High Channel Wideband Signal



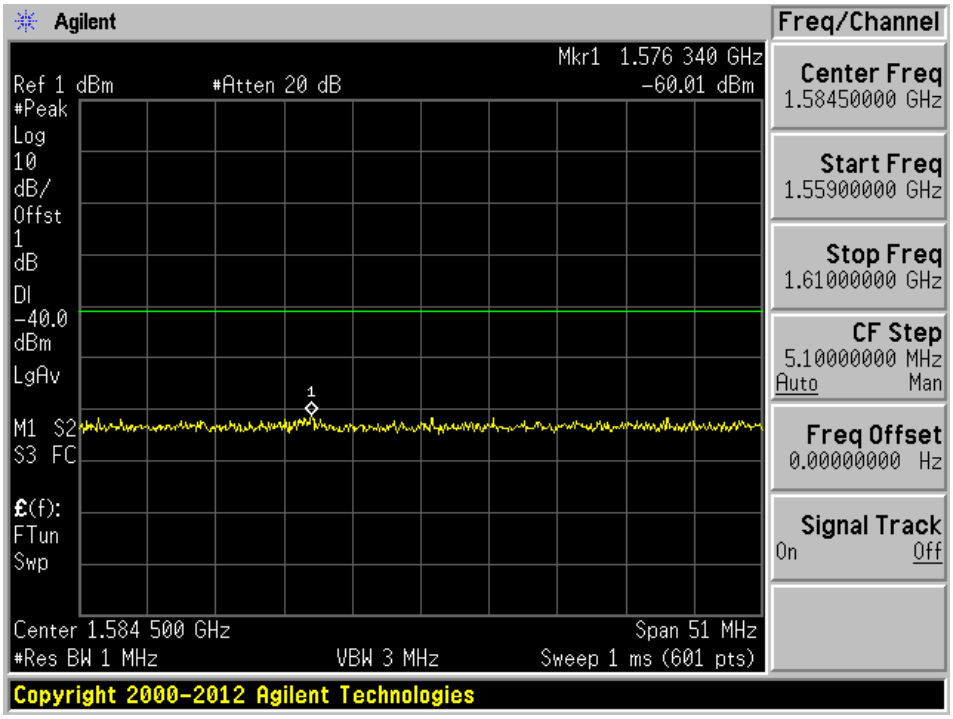
High Channel Narrowband Signal



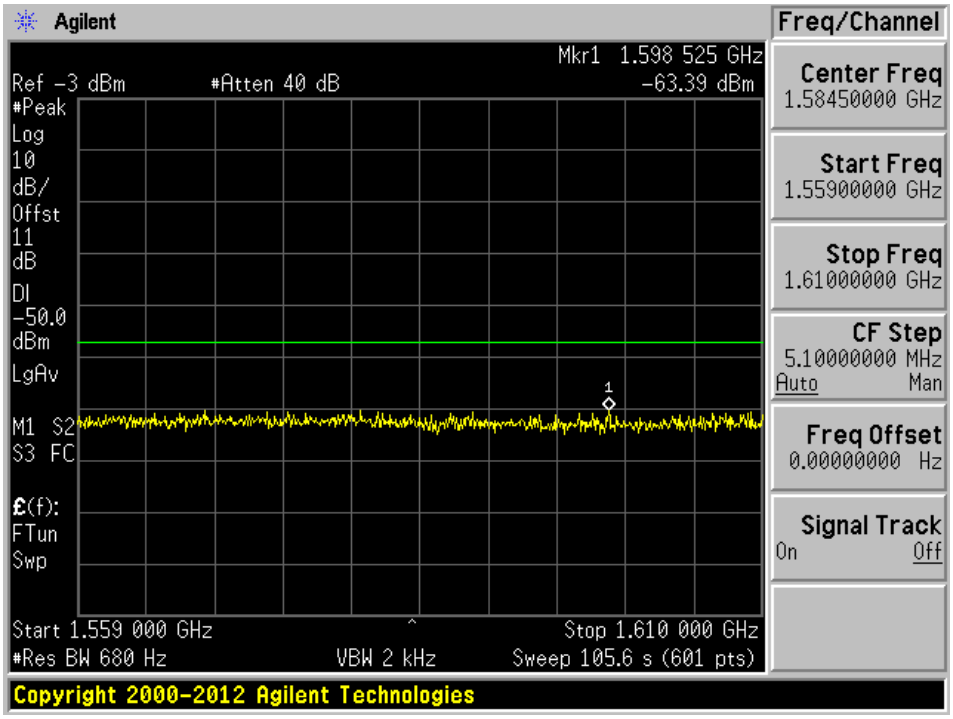
Uplink: 788-805 MHz

Frequency Range (MHz)	Measured Frequency (MHz)	Measured Value	Antenna Gain (dBi)	e.i.r.p	Limit	Margin (dB)
1559-1610 (Wideband)	1576.1	-58.37 dBm/MHz	2	-56.37 dBm/MHz	-40 dBm/MHz	-16.37
1559-1610 (Narrowband))	1607.6	-62.09 dBm	2	-60.09 dBm	-50 dBm	-10.09

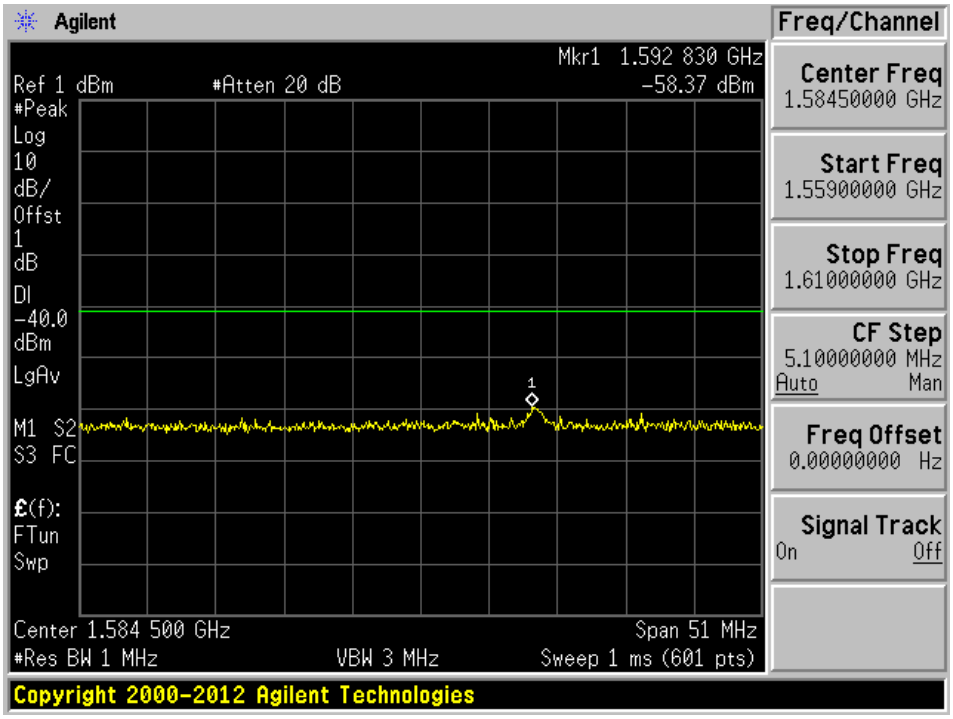
Low Channel Wideband Signal



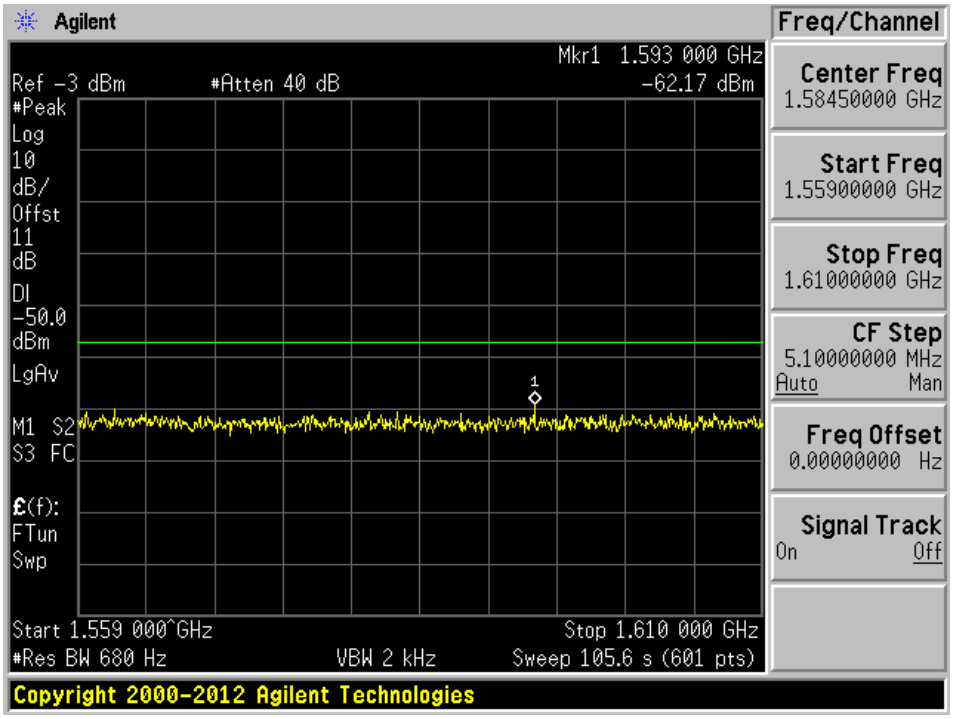
Low Channel Narrowband Signal



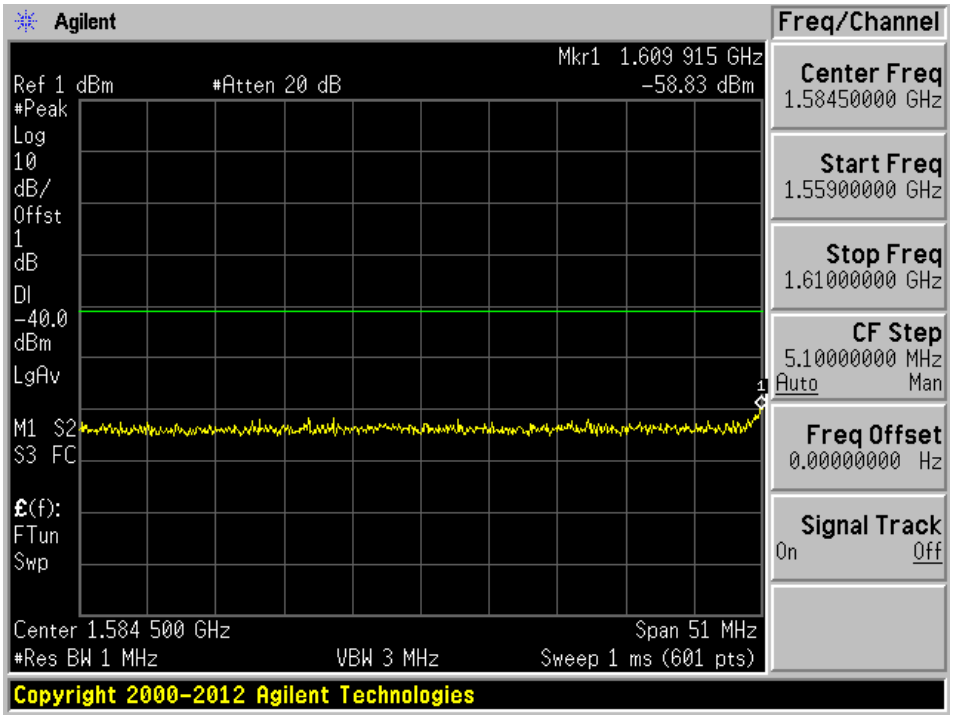
Middle Channel Wideband Signal



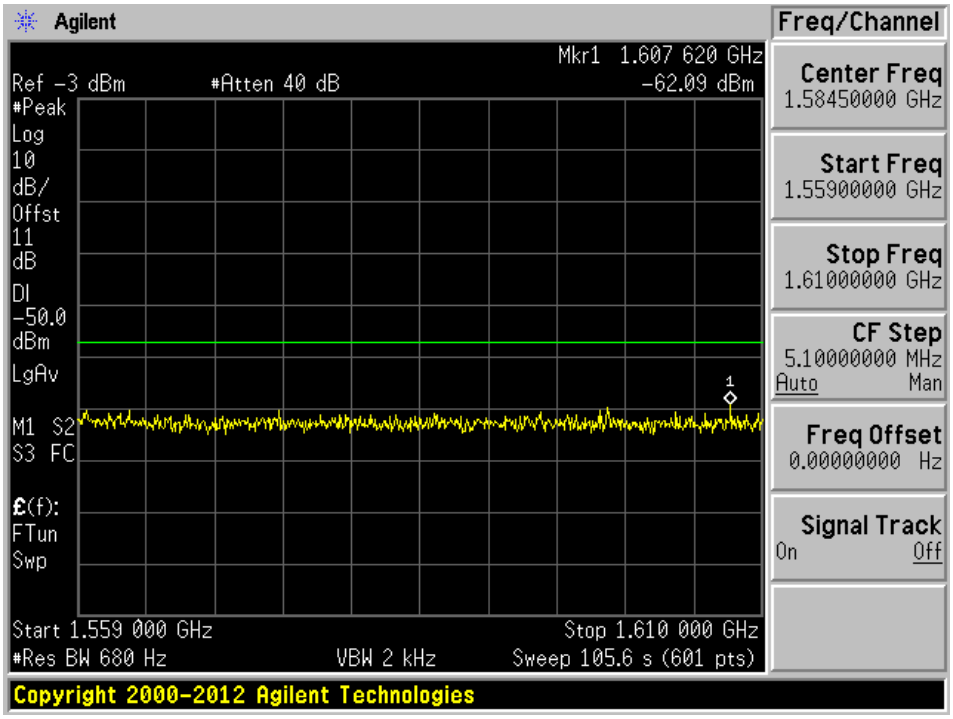
Middle Channel Narrowband Signal



High Channel Wideband Signal



High Channel Narrowband Signal



10 FCC §90.219(e) (3) & §90.210 - Intermodulation

10.1 Applicable Standards

According to FCC §90.219(e) (3), Spurious emissions from a signal booster must not exceed −13 dBm within any 100 kHz measurement bandwidth.

10.2 Test Procedure

a) Connect a signal generator to the input of the EUT.
If the signal generator is not capable of producing two independent modulated carriers simultaneously, then two discrete signal generators can be connected, with an appropriate combining network to support the two-signal test.
b) Configure the two signal generators to produce CW on frequencies spaced consistent with 4.7.1, with amplitude levels set to just below the AGC threshold (see 4.2).

c) Connect a spectrum analyzer through appropriate attenuation to the EUT output.

d) Set the span to 100 kHz.

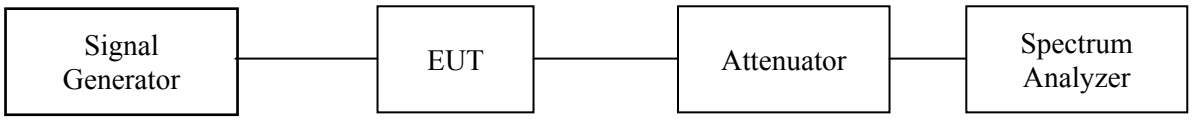
e) Set RBW = 300 Hz with VBW ≥ 3 × RBW.
f) Set the detector to power averaging (rms).

g) Place a marker on highest intermodulation product amplitude.

h) Capture the plot for inclusion in the test report.

i) Repeat steps c) to h) with the composite input power level set to 3 dB above the AGC threshold.

j) Repeat steps b) to i) for all operational bands.



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[1]	Each Time[1]
-	SMA cable	-	C04	Each Time[1]	Each Time[1]
-	SMA cable	-	C09	Each Time[1]	Each Time[1]

[1]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".*

10.4 Test Environmental Conditions

Temperature:	22-23° C
Relative Humidity:	32 %
ATM Pressure:	101.4-102 kPa

The testing was performed by Jose Martinez 2017-06-20 and 2017-07-20 in the RF Site.

10.5 Test Results

Frequency (MHz)	AGC	Channel Spacing (kHz)	Measured Value (dBm)	BW Correction Factor* (dB)	Corrected Value (dBm)	FCC Limit (dBm)	Results
Downlink 758-775	Off	6.25	-43.84	20	-23.84	-13	Compliant
	On	6.25	-36.70	20	-16.7	-13	Compliant
Downlink 758-775	Off	12.5	-44.07	20	-24.07	-13	Compliant
	On	12.5	-34.89	20	-14.89	-13	Compliant
Downlink 758-775	Off	25	-41.64	20	-21.64	-13	Compliant
	On	25	-35.79	20	-15.79	-13	Compliant
Uplink 788-805	Off	6.25	-48.20	20	-28.2	-13	Compliant
	On	6.25	-37.39	20	-17.39	-13	Compliant
Uplink 788-805	Off	12.5	-48.20	20	-28.2	-13	Compliant
	On	12.5	-36.08	20	-16.08	-13	Compliant
Uplink 788-805	Off	25	-48.84	20	-28.84	-13	Compliant
	On	25	-38.41	20	-18.41	-13	Compliant

*The measurement was made with RBW of 1 kHz, however, the limitation of intermodulation products are -13 dBm/100 kHz. Thus, a correction factor was applied to the spectrum analyzer readings. The factor was calculated by following the equation below,

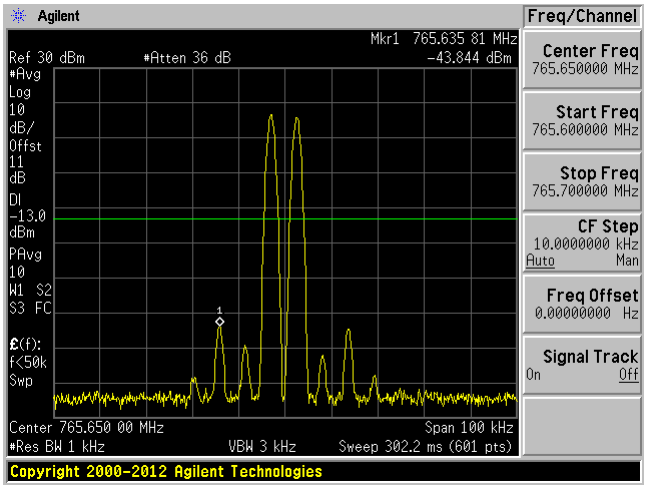
$$\text{BW correction Factor} = 10*\log_{10}(\text{Specified RBW/Measured RBW})$$

Please refer to the following plots.

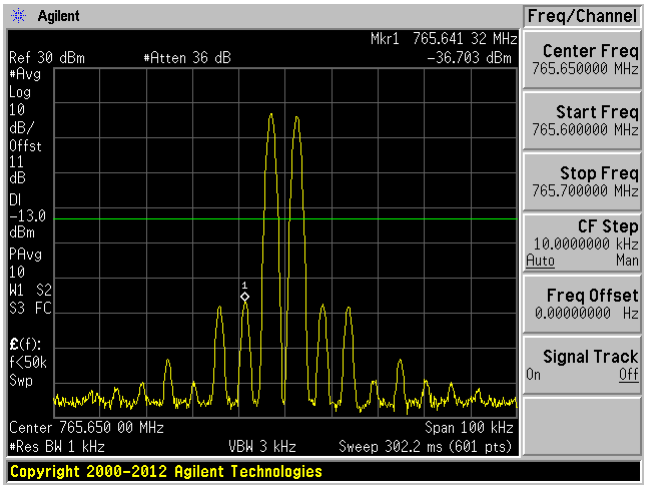
Downlink: 758-775 MHz

6.25 kHz Spacing

AGC off

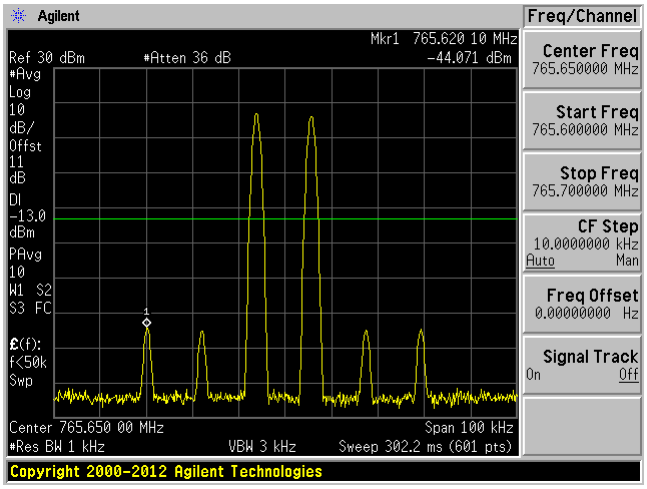


AGC on

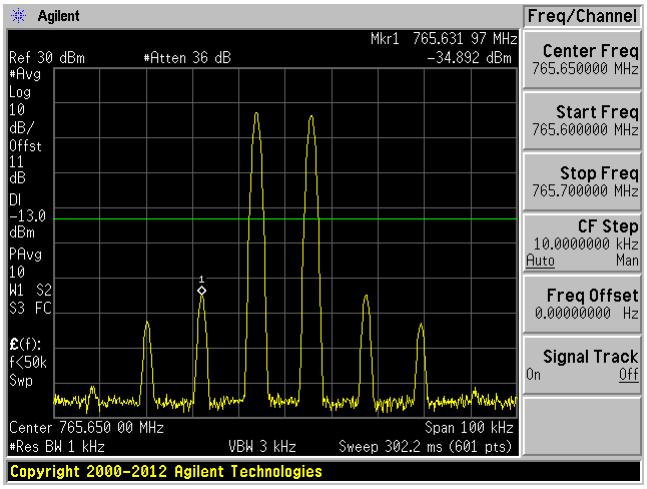


12.5 kHz Spacing

AGC off

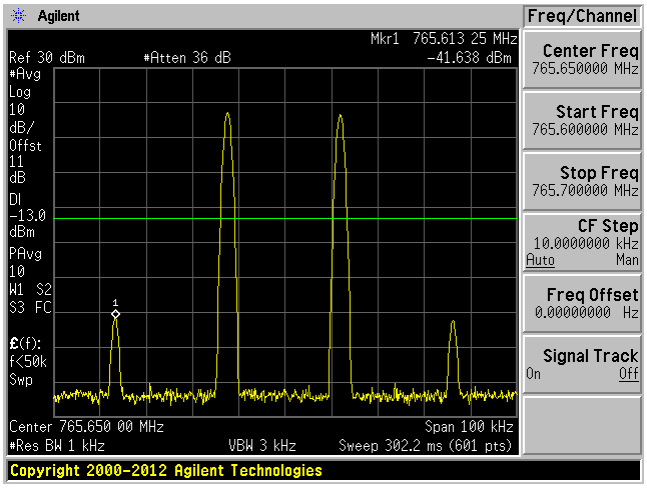


AGC on

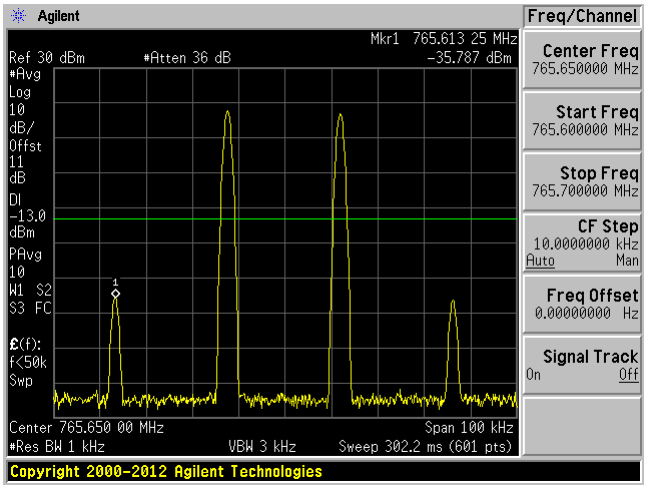


25 kHz Spacing

AGC off



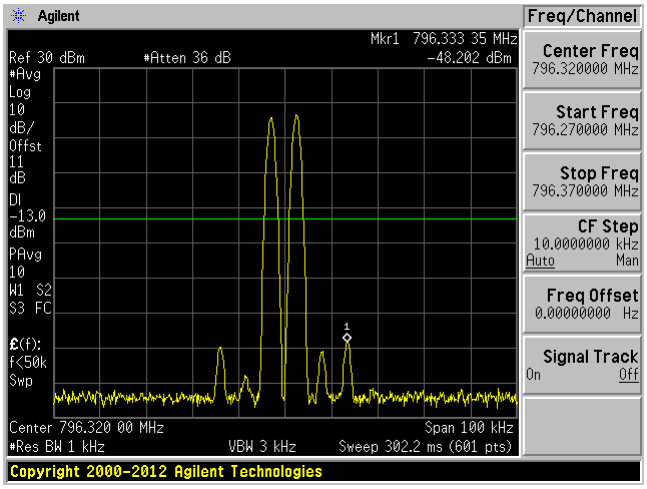
AGC on



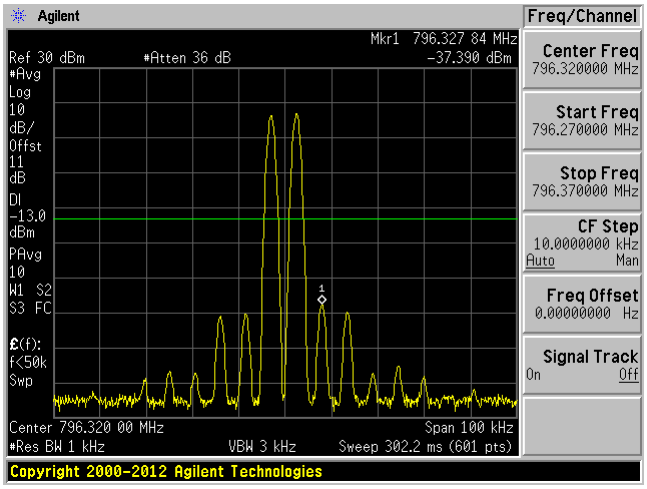
Uplink: 788-805 MHz

6.25 kHz Spacing

AGC off

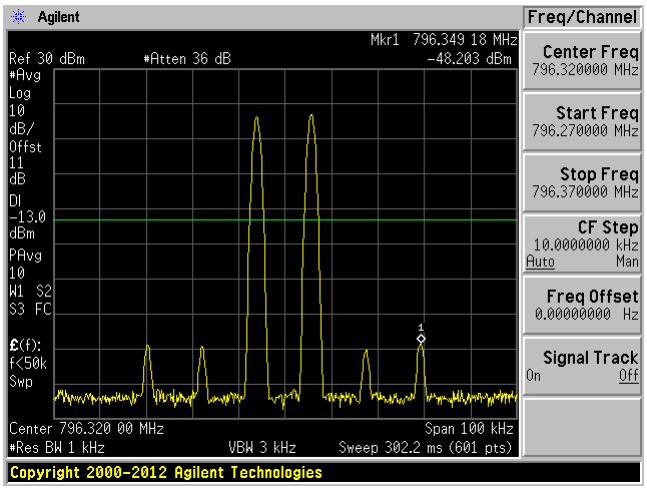


AGC on

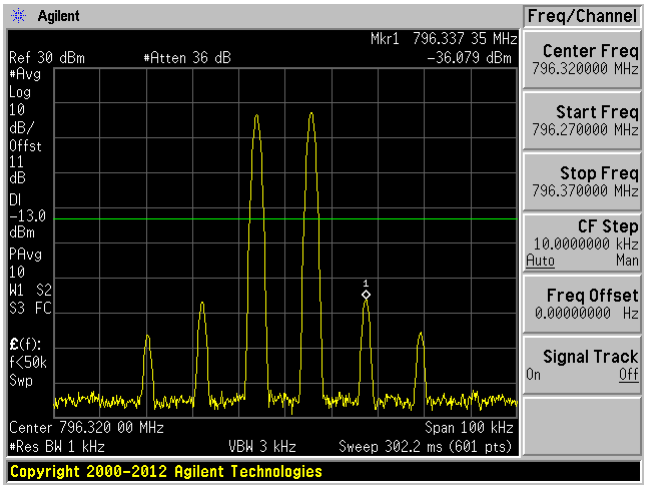


12.5 kHz Spacing

AGC off

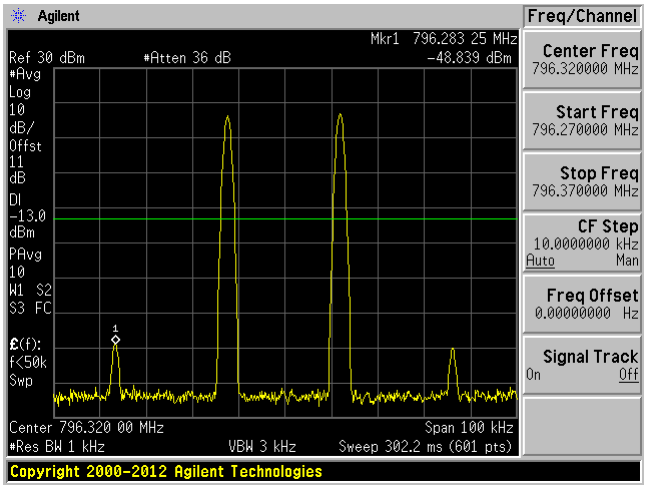


AGC on

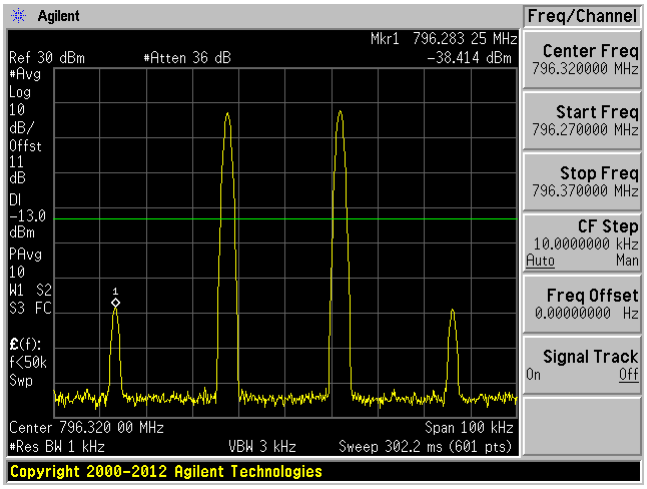


25 kHz Spacing

AGC off



AGC on



Frequency (MHz)	AGC	Channel Spacing (kHz)	Measured Value (dBm)	BW Correction Factor* (dB)	Corrected Value (dBm)	FCC Limit (dBm)
Downlink 851-861	Off	6.25	-43.00	20	-23	-13
	On	6.25	-37.38	20	-17.38	-13
	Off	12.5	-37.04	15.23	-21.81	-13
	On	12.5	-32.07	15.23	-16.84	-13
	Off	25	-34.81	15.23	-19.58	-13
	On	25	-32.07	15.23	-16.84	-13
Uplink 806-816	Off	6.25	-40.47	20	-20.47	-13
	On	6.25	-33.77	20	-13.77	-13
	Off	12.5	-43.82	20	-23.82	-13
	On	12.5	-44.60	20	-24.6	-13
	Off	25	-42.90	20	-22.9	-13
	On	25	-49.09	20	-29.09	-13

*Bandwidth correction factor was applied to the spectrum analyzer readings in order to compare the intermodulation product level with the FCC limit, which is -13 dBm within any 100 kHz bandwidth. The factor was calculated by following the equation below,

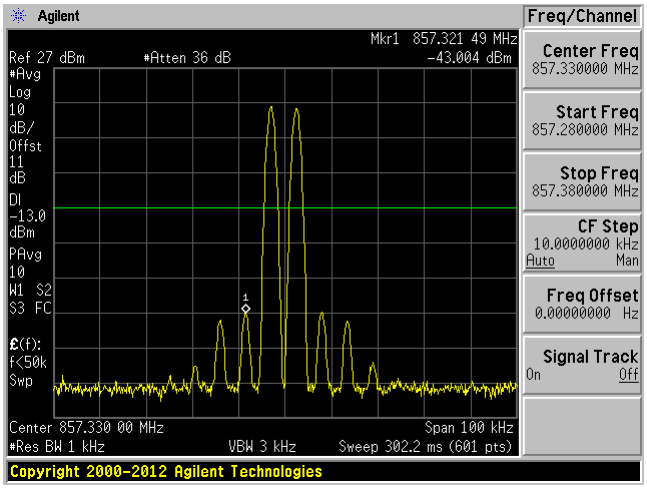
$$\text{BW correction Factor} = 10*\log_{10}(\text{Specified RBW/Measured RBW})$$

Please refer to the following plots.

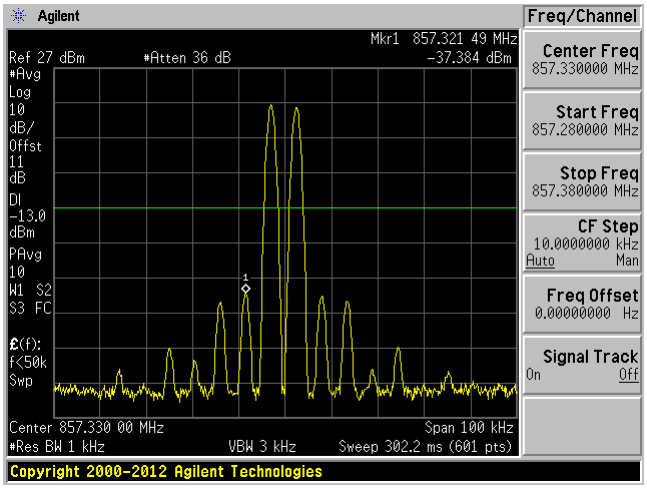
Downlink: 851-861 MHz

6.25 kHz Spacing

AGC off

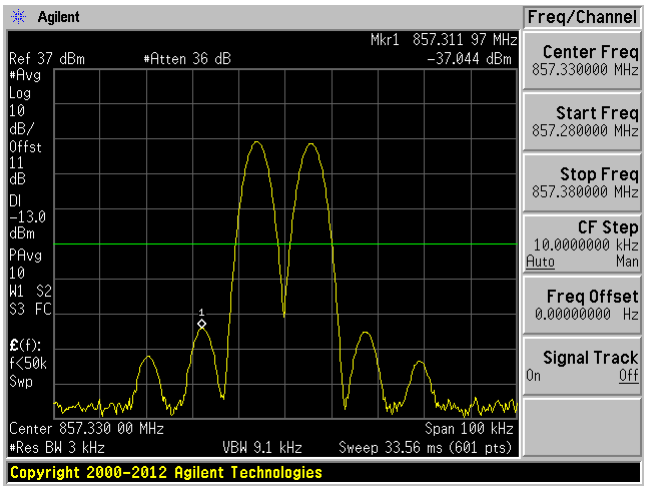


AGC on

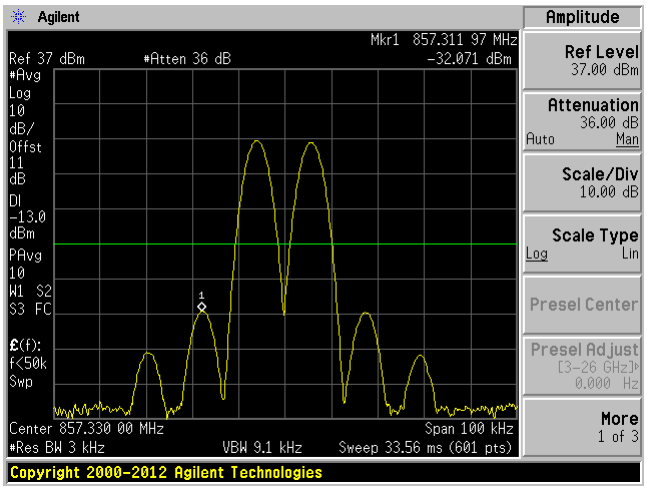


12.5 kHz Spacing

AGC off

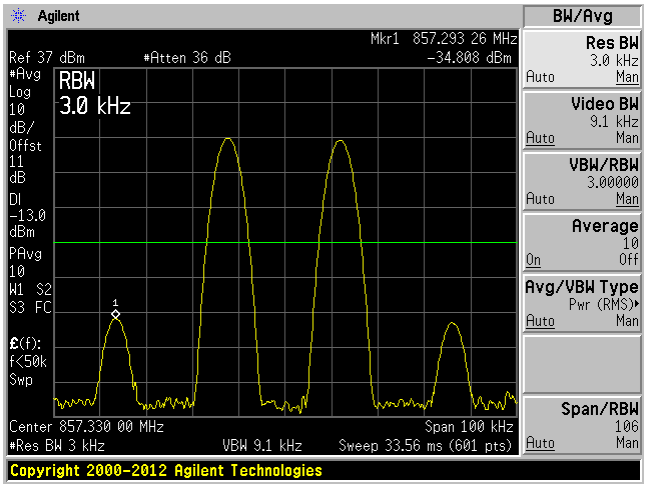


AGC on

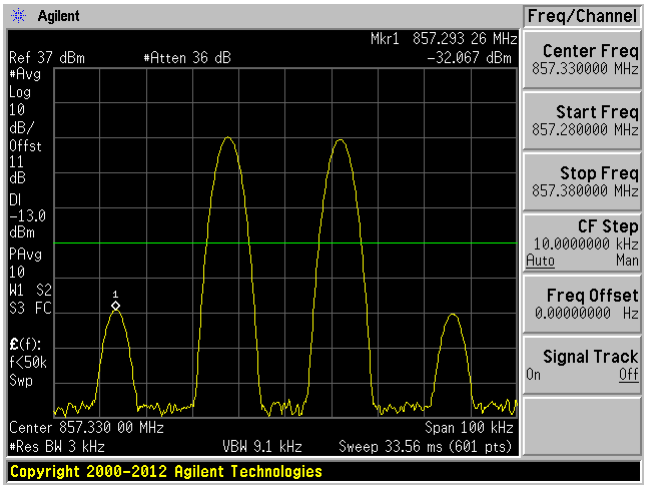


25 kHz Spacing

AGC off



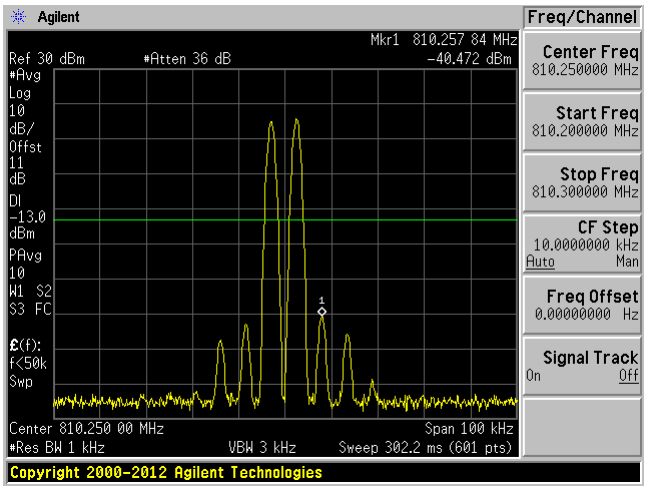
AGC on



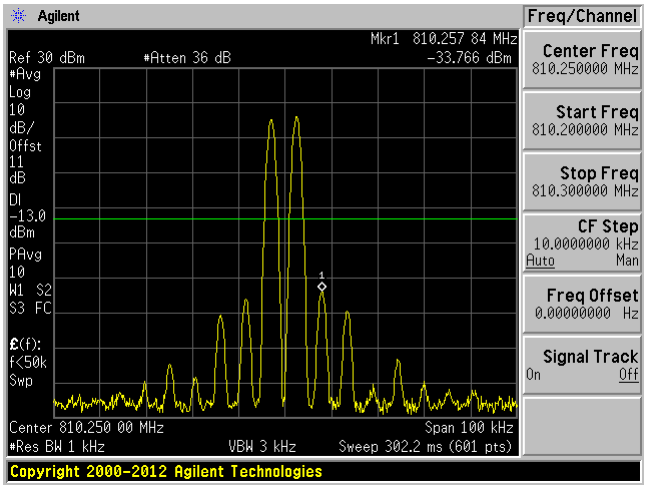
Uplink: 806-816 MHz

6.25 kHz Spacing

AGC off

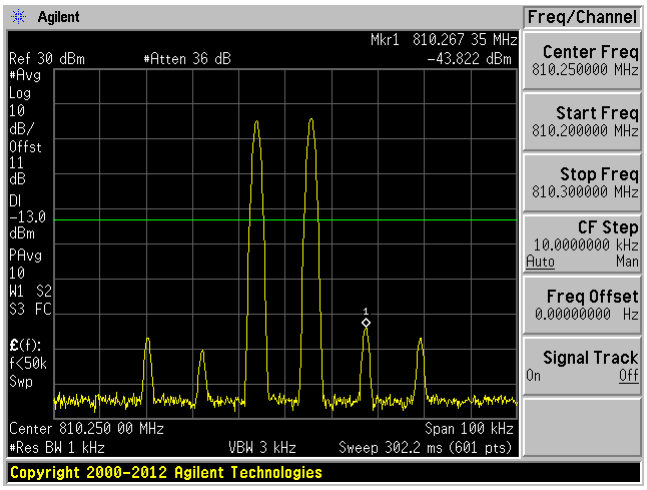


AGC on

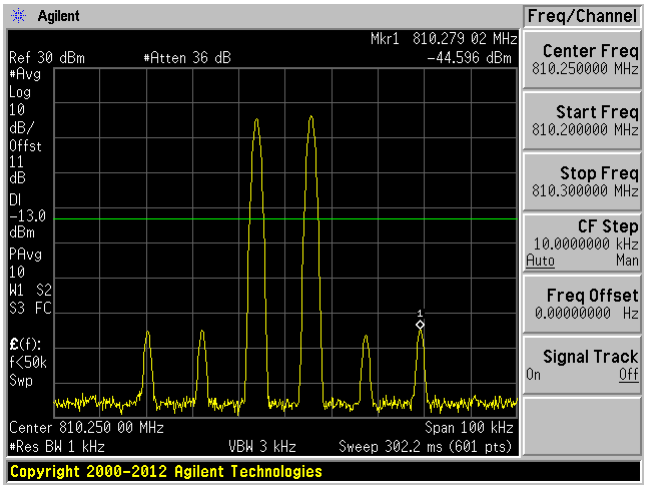


12.5 kHz Spacing

AGC off

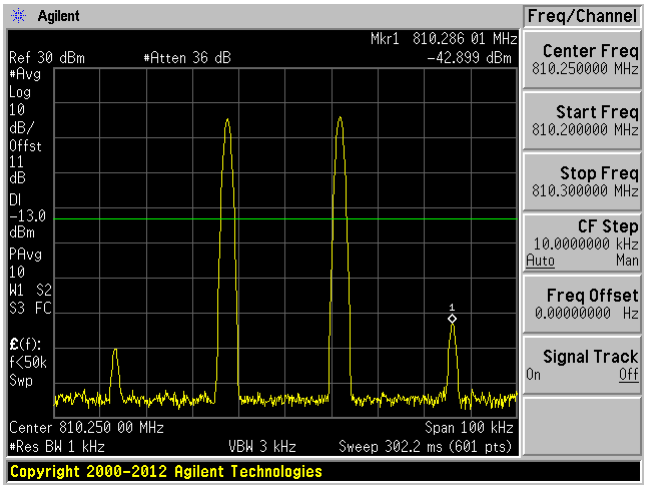


AGC on

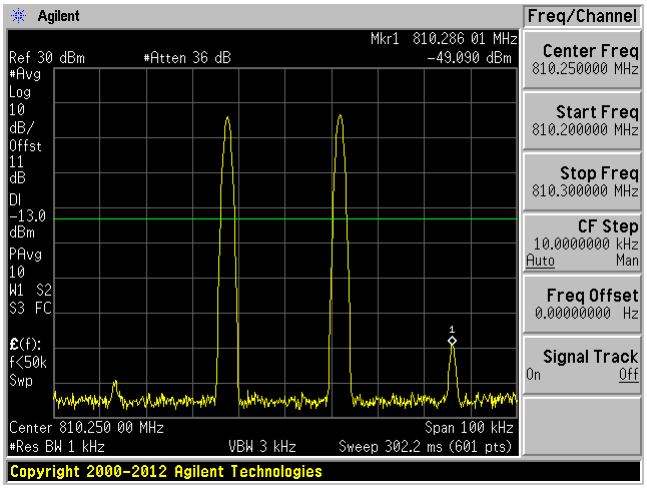


25 kHz Spacing

AGC off AGC off



AGC on



Frequency (MHz)	AGC	Channel Spacing (kHz)	Measured Value (dBm)	BW Correction Factor* (dB)	Corrected Value (dBm)	FCC Limit (dBm)	Results
Downlink 935-940	Off	6.25	-40.76	20	-20.76	-13	Pass
	On	6.25	-33.47	20	-13.47	-13	Pass
	Off	12.5	-37.89	15.23	-22.66	-13	Pass
	On	12.5	-31.62	15.23	-16.39	-13	Pass
Uplink 896-901	Off	6.25	-38.53	20	-18.53	-13	Pass
	On	6.25	-33.45	20	-13.45	-13	Pass
	Off	12.5	-35.08	15.23	-19.85	-13	Pass
	On	12.5	-30.07	15.23	-14.84	-13	Pass

*The measurement was made with RBW of 1 kHz and 3 kHz for 6.25 kHz and 12.5 kHz channel spacing configurations respectively. However, the limitation of intermodulation products are -13 dBm within any 100 kHz measurement bandwidth. Thus, a correction factor was applied to the spectrum analyzer readings. The factor was calculated by following the equation below,

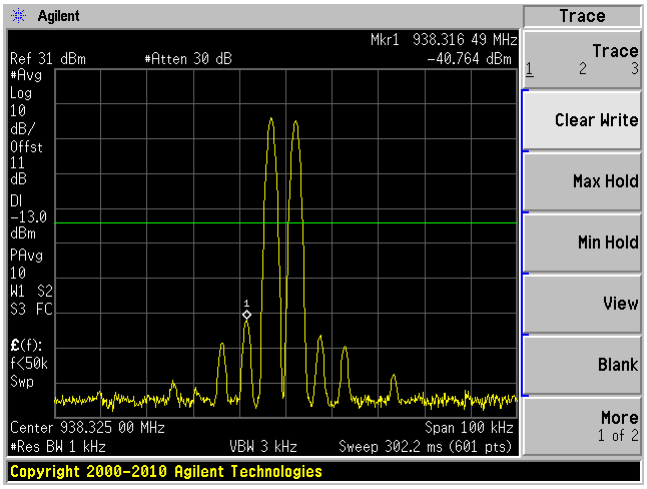
$$\text{BW correction Factor} = 10*\log_{10}(\text{Specified RBW/Measured RBW})$$

Please refer to the following plots.

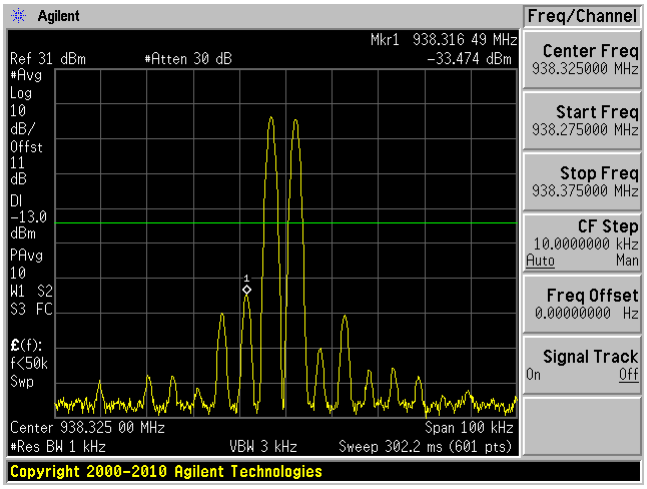
Downlink: 935-940 MHz

6.25 kHz Spacing

AGC off



AGC on



12.5 kHz Spacing

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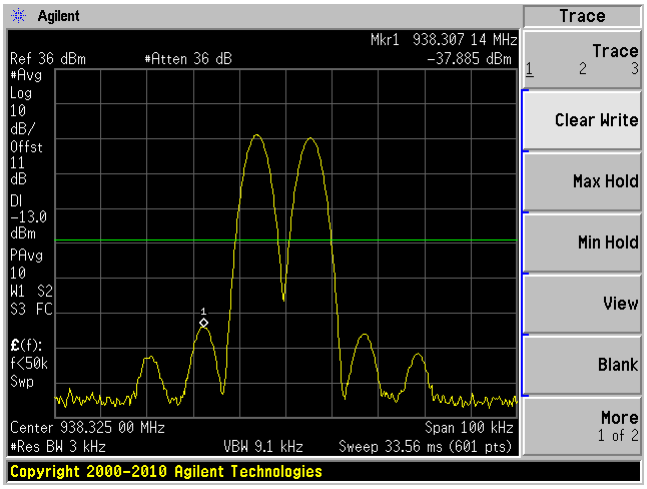

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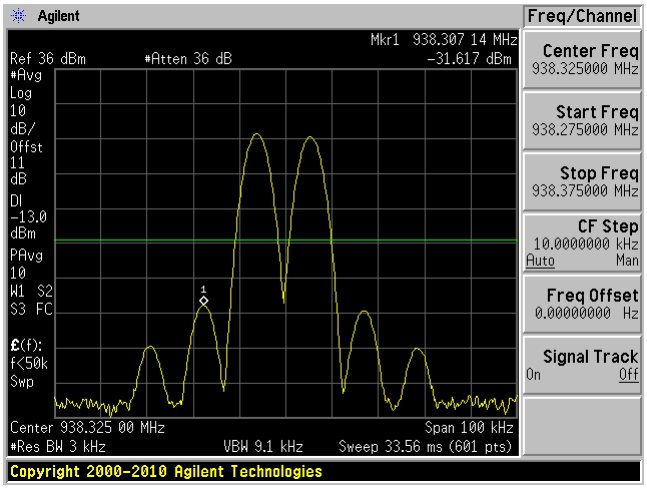
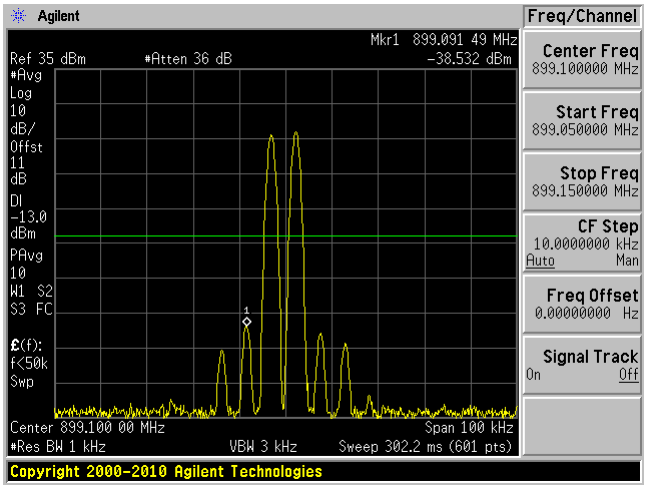


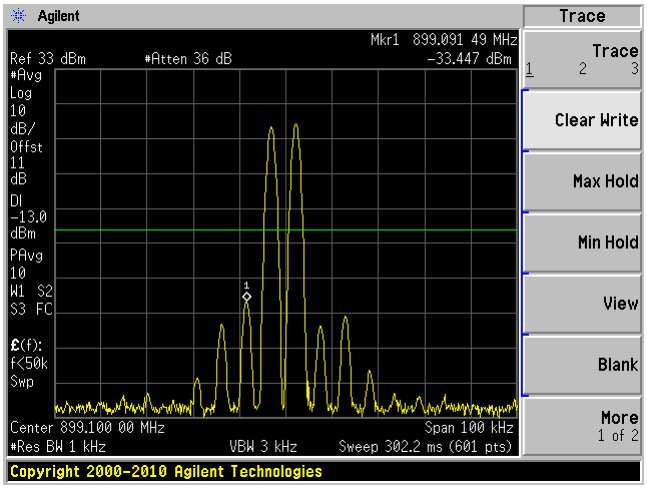
Uplink: 896-901 MHz

6.25 kHz Spacing

AGC off

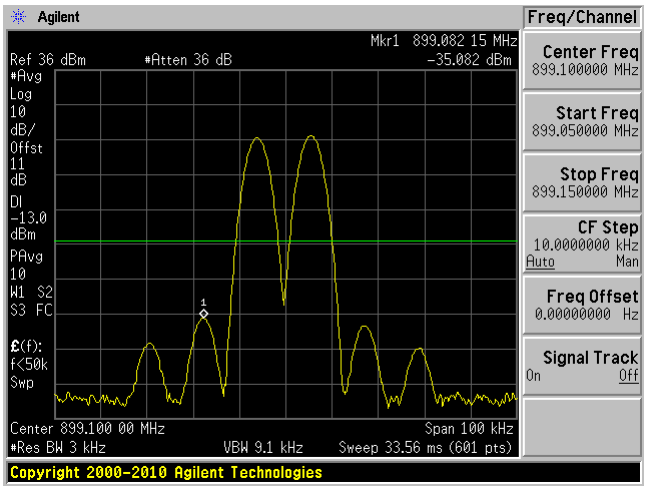


AGC on

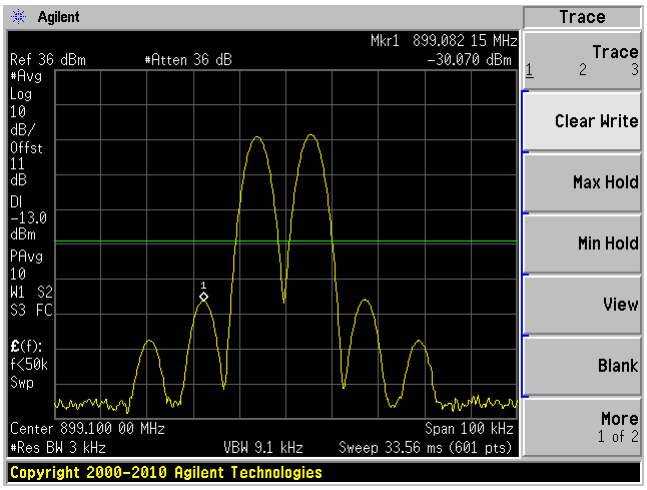


12.5 kHz Spacing

AGC off



AGC on



11 FCC §90.219 - Noise Figure

11.1 Applicable Standard

According to FCC §90.219(e) (2), the noise figure of a signal booster must not exceed 9 dB in either direction.

11.2 Test Procedure

a) A spectrum analyzer was connected to the downlink output of the amplifier
b) The Uplink was terminated
c) The spectrum analyzer was set to 100 trace average in the RMS average mode.
d) A peak reading was recorded
e) The noise figure was calculated using the following formula
$NF = P_{NOUT} – (-174dBm/Hz +10*LOG_{10}(RBW) + Gain)$
Notes:
P_{NOUT} = Output noise of the amplifier in dBm
174 = Thermal noise for 1 Hz RBW at room temperature
The thermal noise for 1 MHz RBW = $-174 + 10*LOG_{10}(1E6)$
RBW = Resolution Bandwidth of Spectrum analyzer in Hz
Gain = Gain of amplifier in dB
f) Repeat steps a) to e) with spectrum analyzer connected to uplink output and downlink terminated.

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
-	10 dB attenuator	-	-	Each Time[1]	Each Time[1]
-	SMA cable	-	C04	Each Time[1]	Each Time[1]
-	SMA cable	-	C09	Each Time[1]	Each Time[1]

[1]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:	22-23° C
Relative Humidity:	32 %
ATM Pressure:	101.4-102 kPa

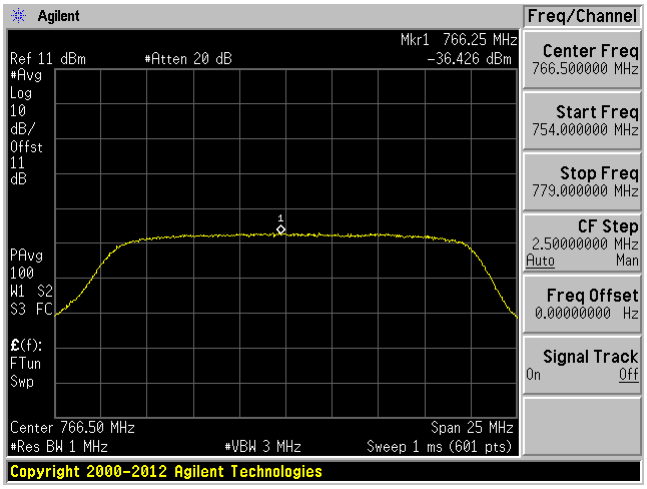
The testing was performed by Jose Martinez on 2017-06-28 and 2017-07-03 in the RF Site.

11.5 Test Results

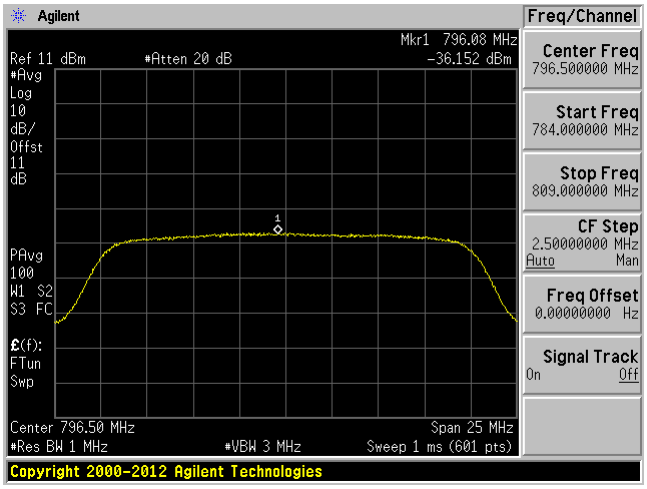
Analyzer Settings			Max Reading (dBm/MHz)	Booster Gain (dB)	Thermal Noise (dBm/MHz)	Noise Figure (dB)	Limit (dB)
Center Frequency (MHz)	RBW (MHz)	VBW (MHz)					
766.5	1	3	-36.43	72.12	-114	5.45	9
796.5	1	3	-36.15	71.89	-114	5.96	9
856	1	3	-35.64	72.79	-114	5.57	9
811	1	3	-36.50	71.85	-114	5.65	9
937.5	1	3	-39.82	70.68	-114	3.5	9
898.5	1	3	-40.45	70.5	-114	3.05	9

Please refer to the following plots.

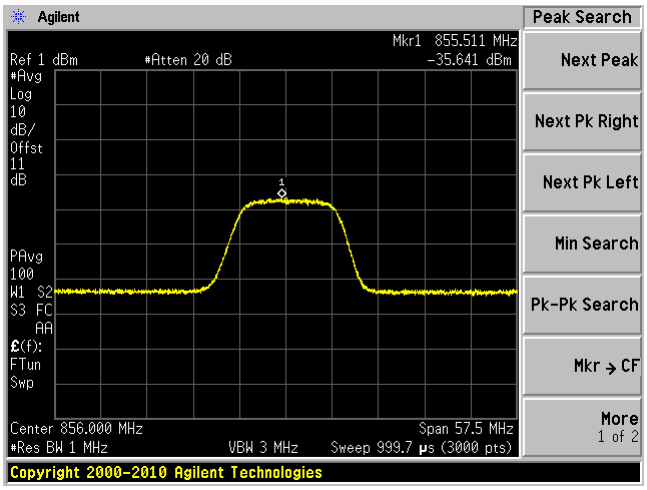
Downlink: 758-775 MHz



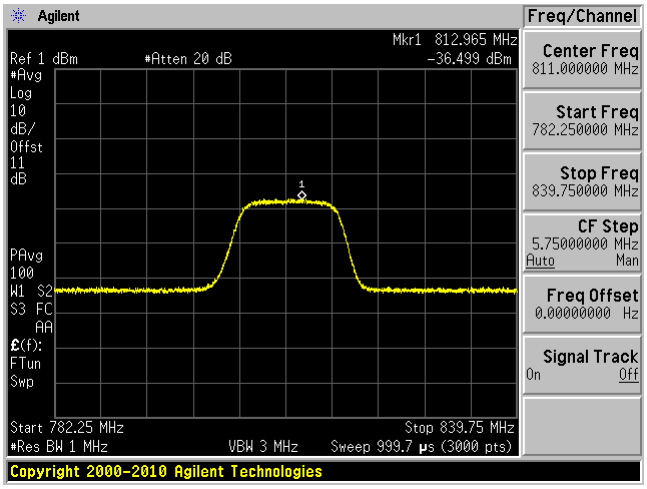
Uplink: 788-805 MHz



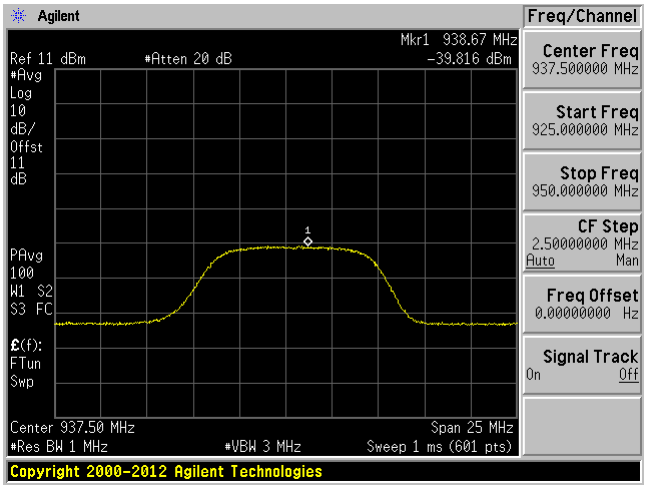
Downlink: 851-861 MHz



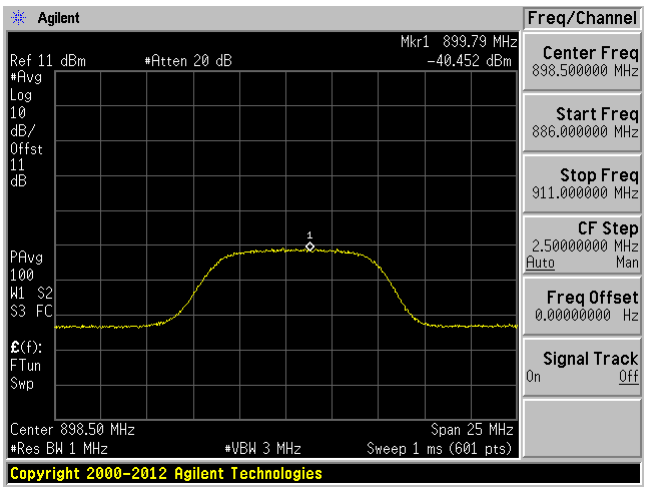
Uplink: 806-816 MHz



Downlink: 935-940 MHz



Uplink: 896-901 MHz



12 FCC §90.219 - Out of Band Rejection

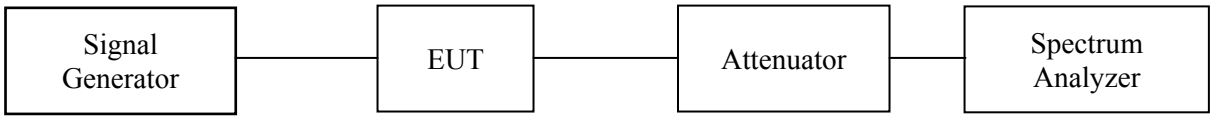
12.1 Applicable Standard

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.

12.2 Test Procedure

KDB 935210 D05, Section 4.3.

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



12.3 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[1]	Each Time[1]
-	SMA cable	-	C04	Each Time[1]	Each Time[1]
-	SMA cable	-	C09	Each Time[1]	Each Time[1]

[1]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".

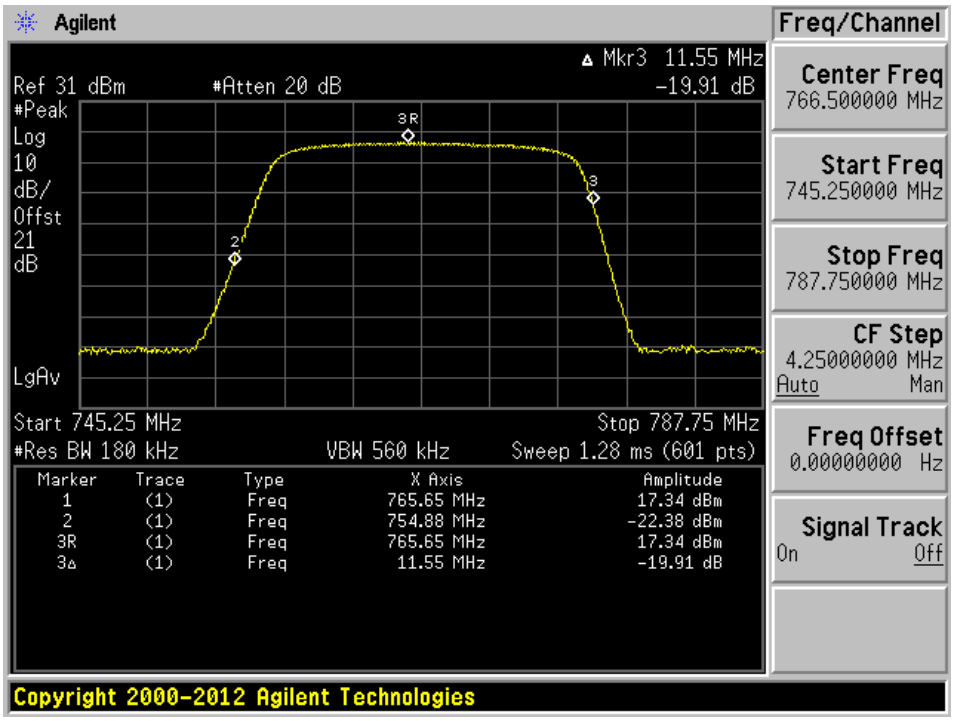
12.4 Test Environmental Conditions

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

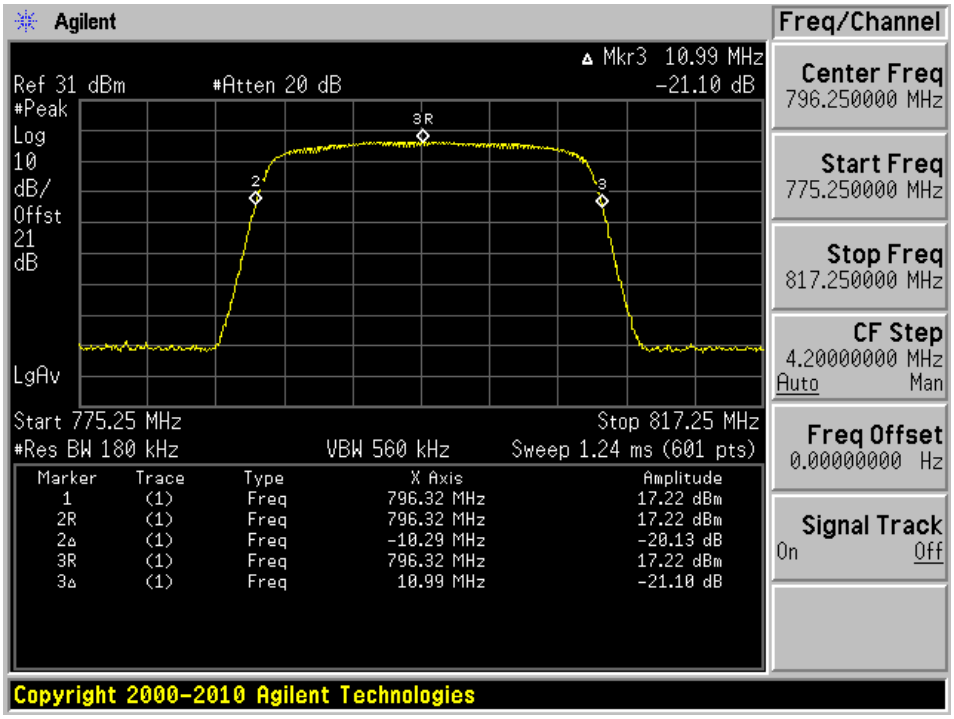
The testing was performed by Jose Martinez on 2017-05-29 and 2017-06-30 in the RF Site.

12.5 Test Results

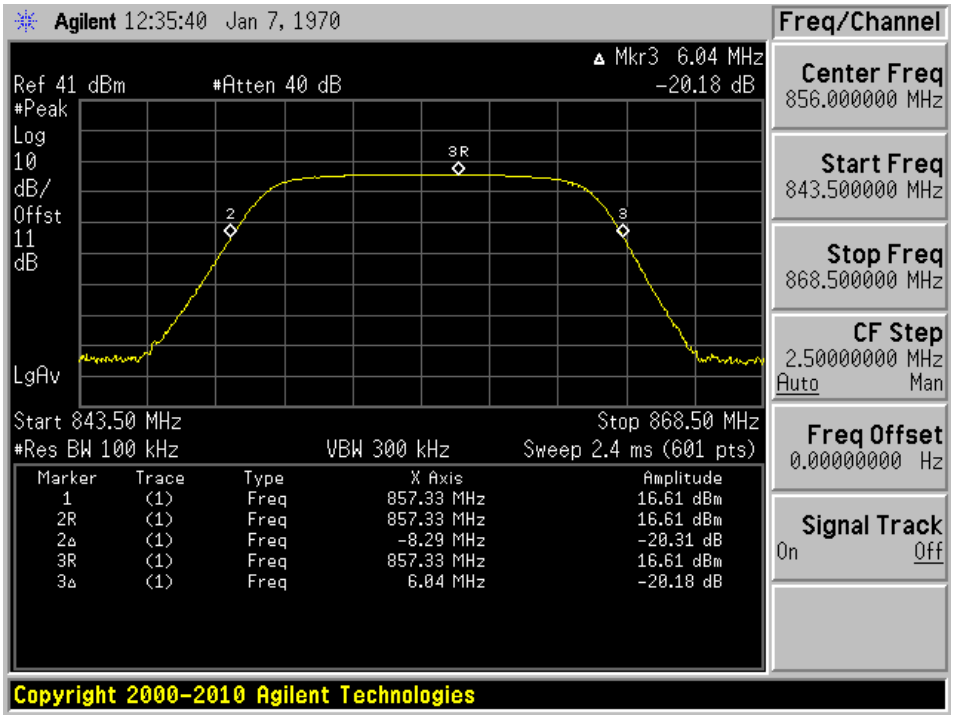
Downlink: 758-775 MHz



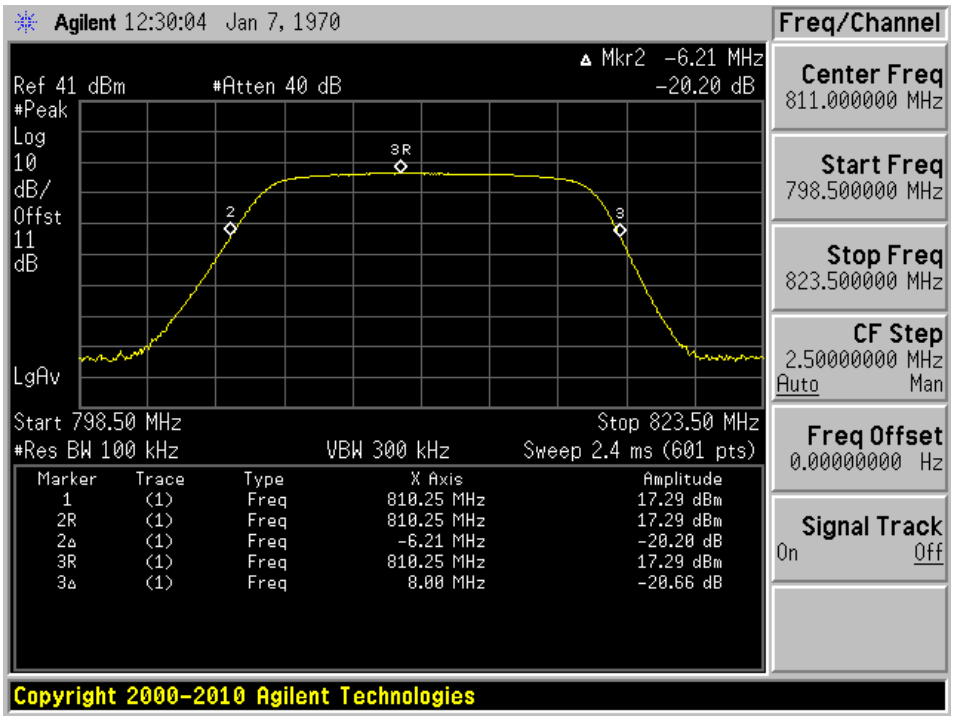
Uplink: 788-805 MHz



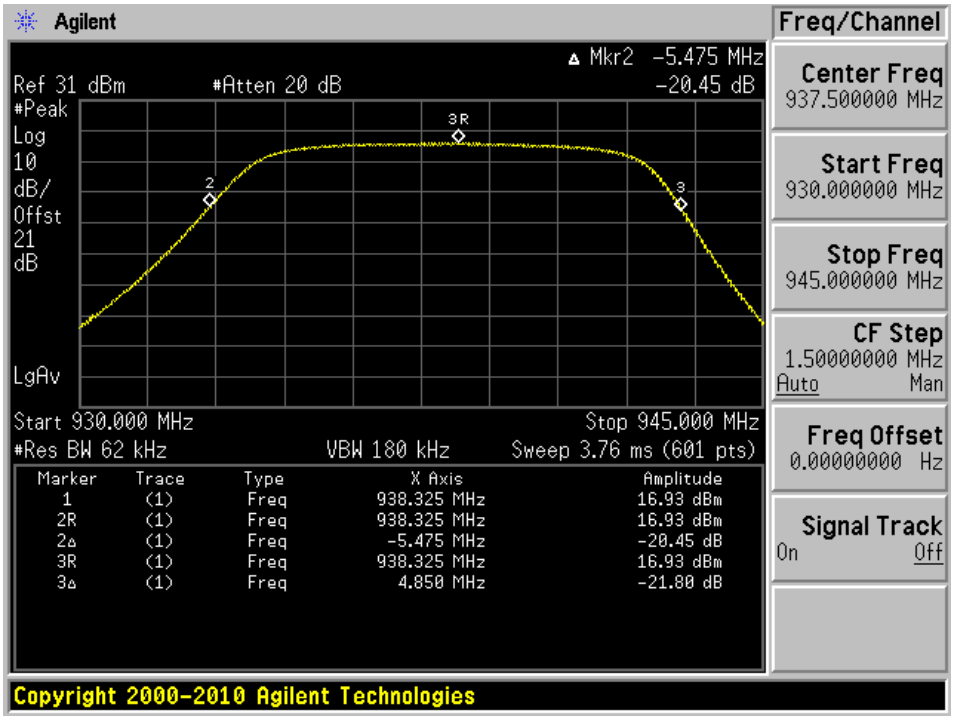
Downlink: 851-861 MHz



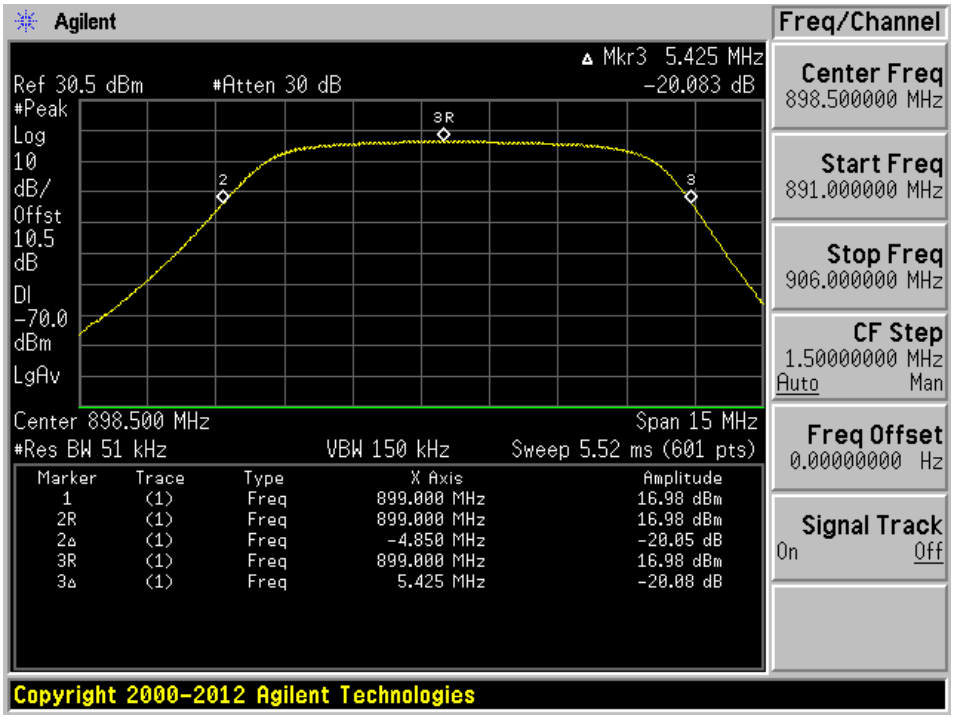
Uplink: 806-816 MHz



Downlink: 935-940 MHz



Uplink: 896-901 MHz



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