7. SPURIOUS AND HARMONIC EMISSION AT ANTENNA TERMINAL

Test Requirement(s): § 2.1051 Measurements required: Spurious emissions at antenna terminals:

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§24.238 Emission limitations for Broadband PCS equipment: The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service. § 24.238 (a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

Test Procedures: A modulated carrier generated by the signal generator carrier was connected to the Downlink RF port at a maximum level as determined by the Manufacturer. A spectrum analyzer was connected to the Downlink port depending on the circuitry being measured.
The spectrum was investigated from 30 MHz to the 26.5 GHz of the carrier.

Test Results:

* Measure and add 10log(N) data (N=2)

Modulation	Channel	Frequency	Measured data (dBm)			Measure and sum (dBm)	
			30 MHz ~ 1 GHz	1 GHz ~ 26.5 GHz		30 MHz ~ 1 GHz	1 GHz ~ 26.5 GHz
QPSK	Low	1931.25	-37.336	-16.826	10*log(N)	-34.326	-13.816
	Middle	1962.5	-37.364	-16.813		-34.354	-13.803
	High	1993.75	-37.231	-17.077		-34.221	-14.067
16QAM	Low	1931.25	-37.363	-17.07		-34.353	-14.060
	Middle	1962.5	-37.214	-16.661		-34.204	-13.651
	High	1993.75	-37.295	-16.949		-34.285	-13.939

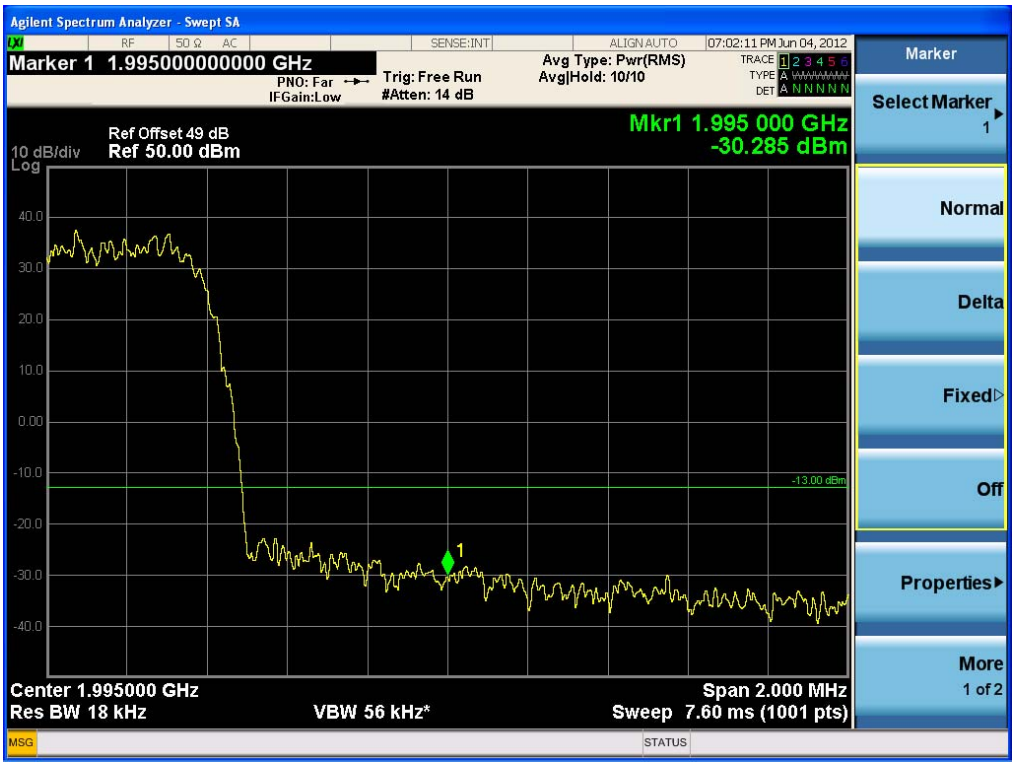
Plots of BAND EDGE [MCA1]

(Low CH-QPSK)

(High CH-QPSK)

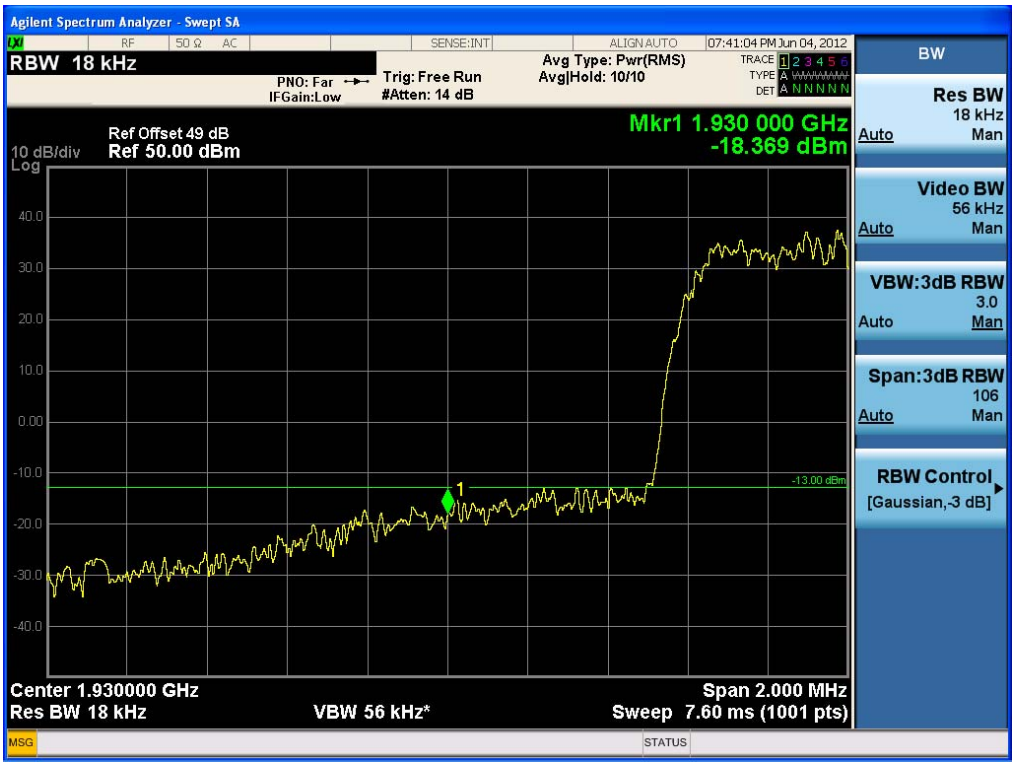
(Low CH-16QAM)

(High CH-16QAM)

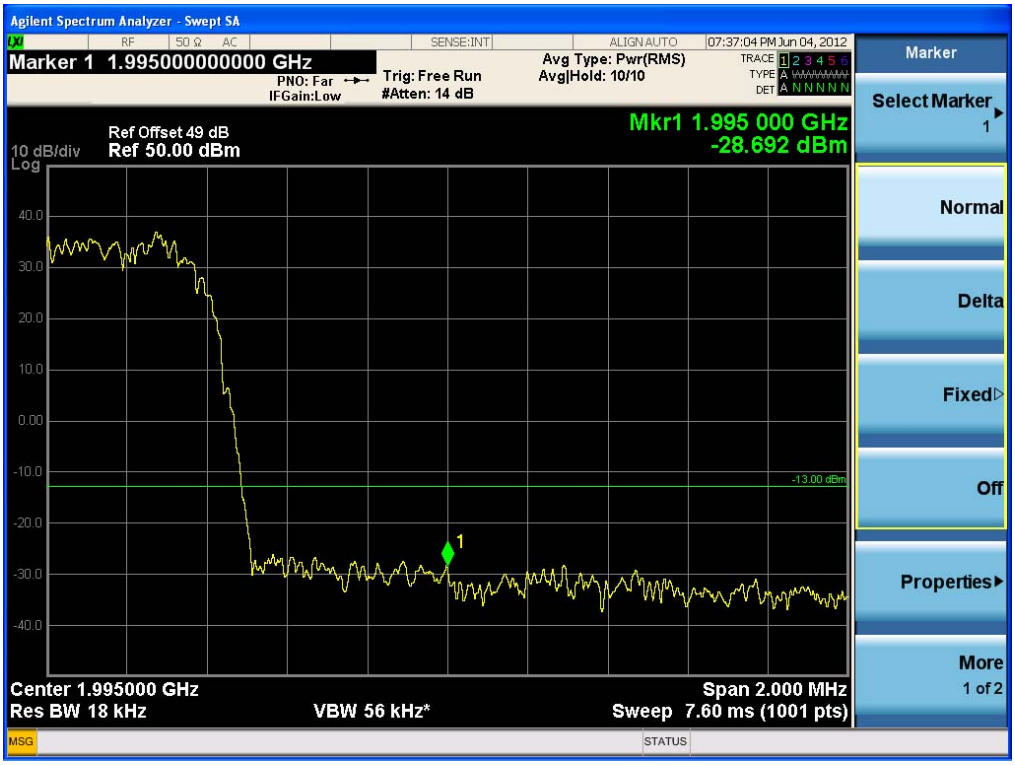


Plots of BAND EDGE [MCA2]

(Low CH-QPSK)



(High CH-QPSK)

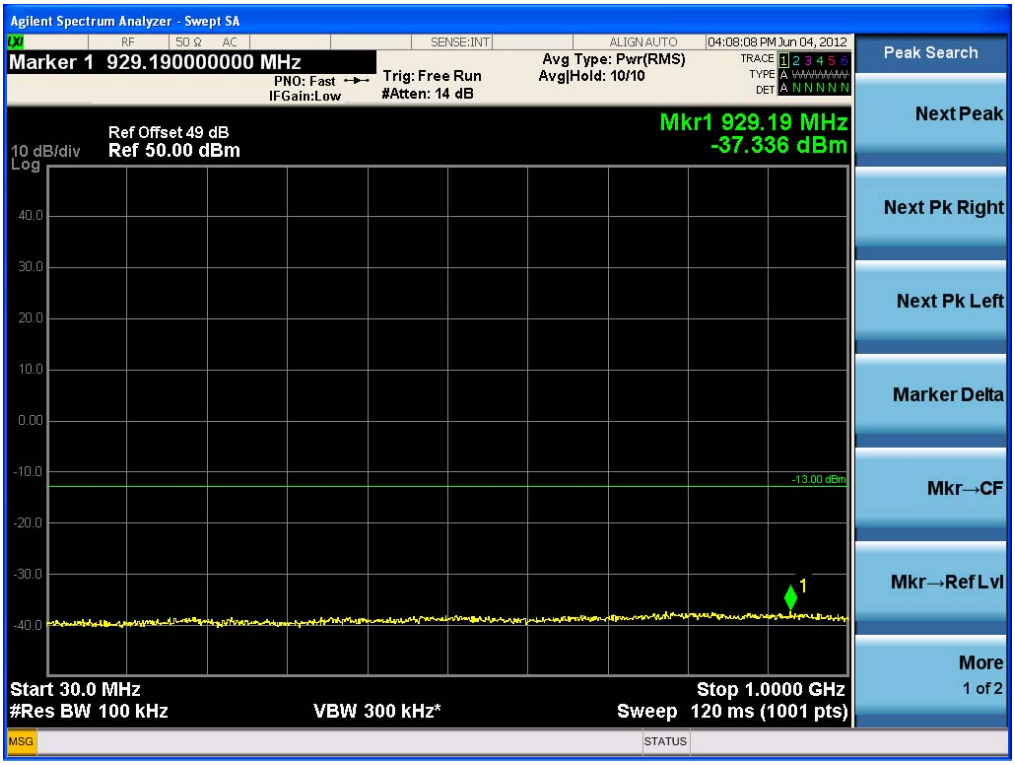


(Low CH-16QAM)

(High CH-16QAM)

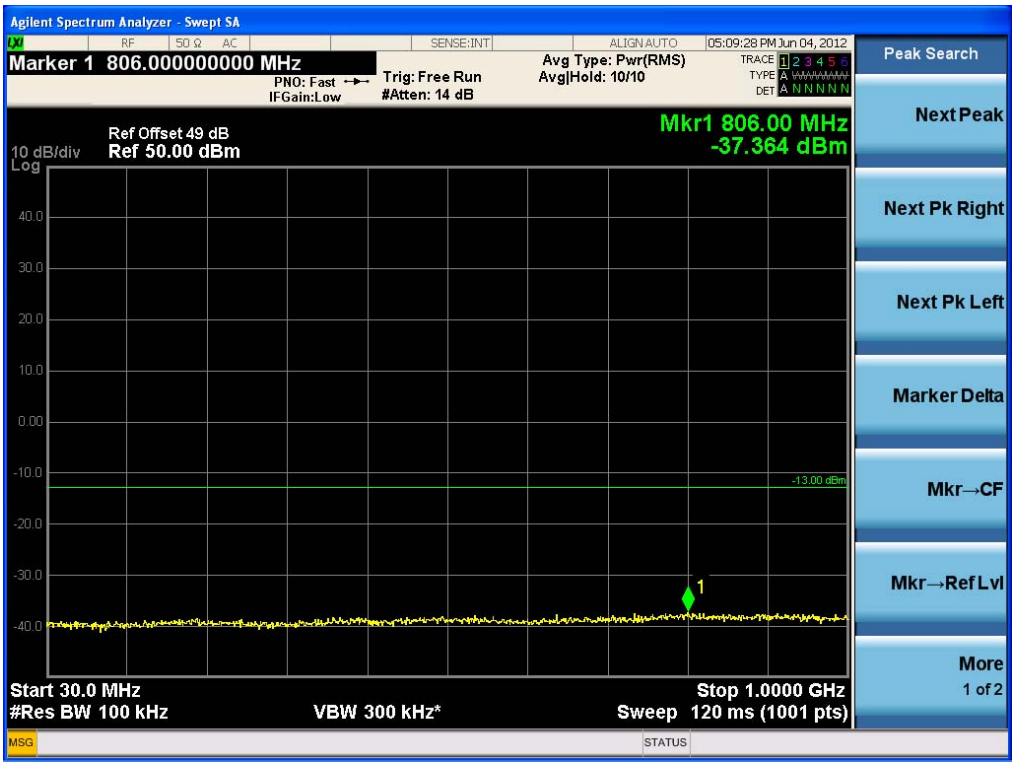
Plots of Spurious Emission [MCA1]

Low CH-QPSK (30 MHz – 1 GHz)



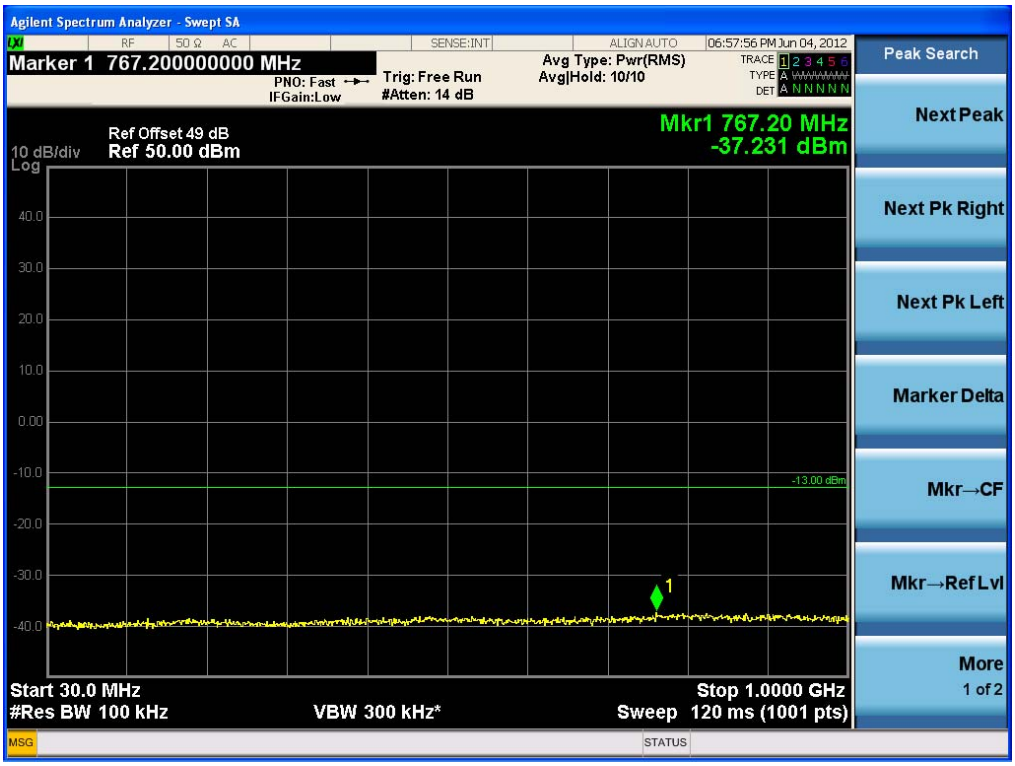
Low CH-QPSK (1 GHz – 26.5 GHz)

Mid CH-QPSK (30 MHz – 1 GHz)



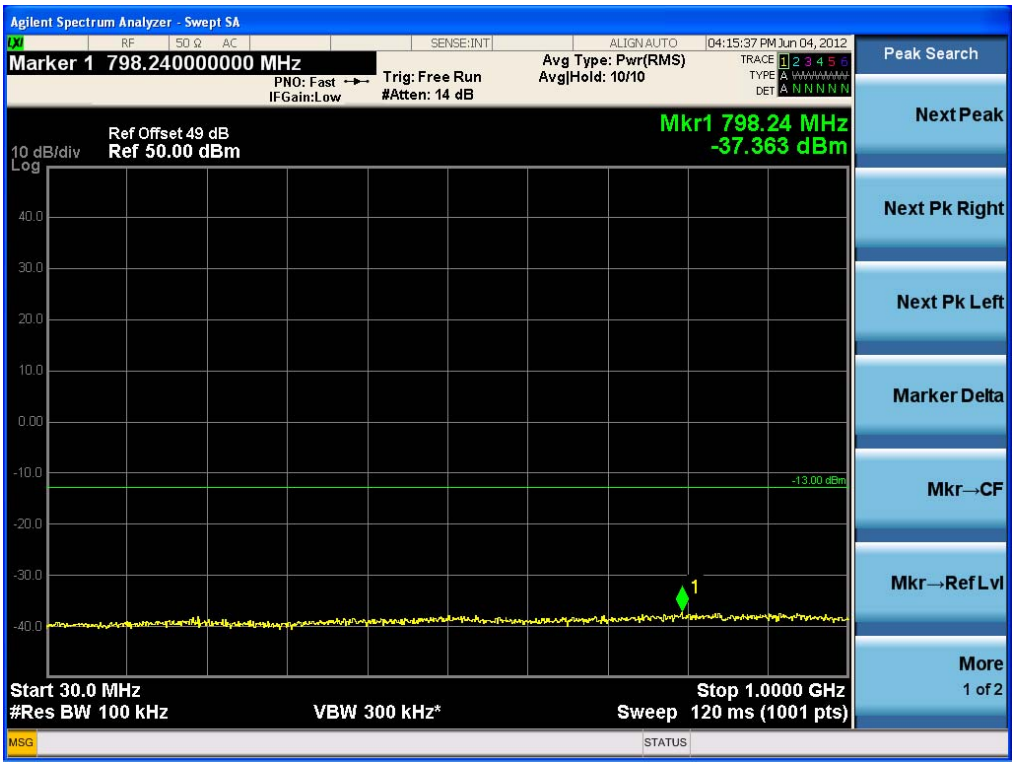
Mid CH-QPSK (1 GHz – 26.5 GHz)

High CH-QPSK (30 MHz – 1 GHz)



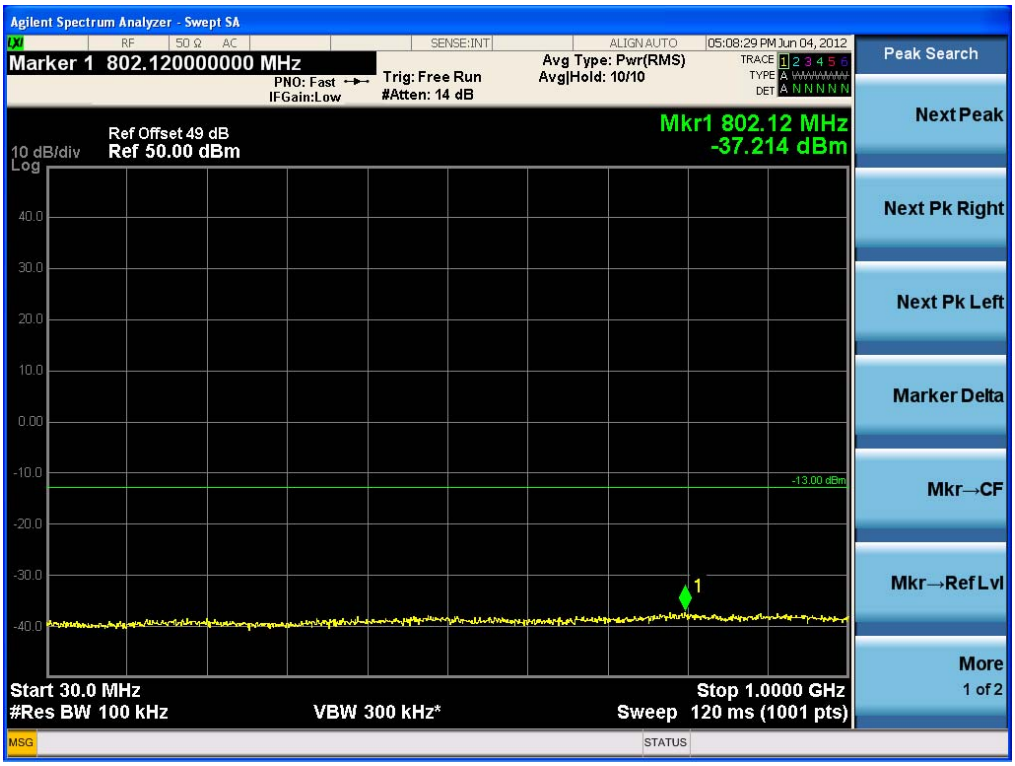
High CH-QPSK (1 GHz – 26.5 GHz)

Low CH-16QAM (30 MHz – 1 GHz)



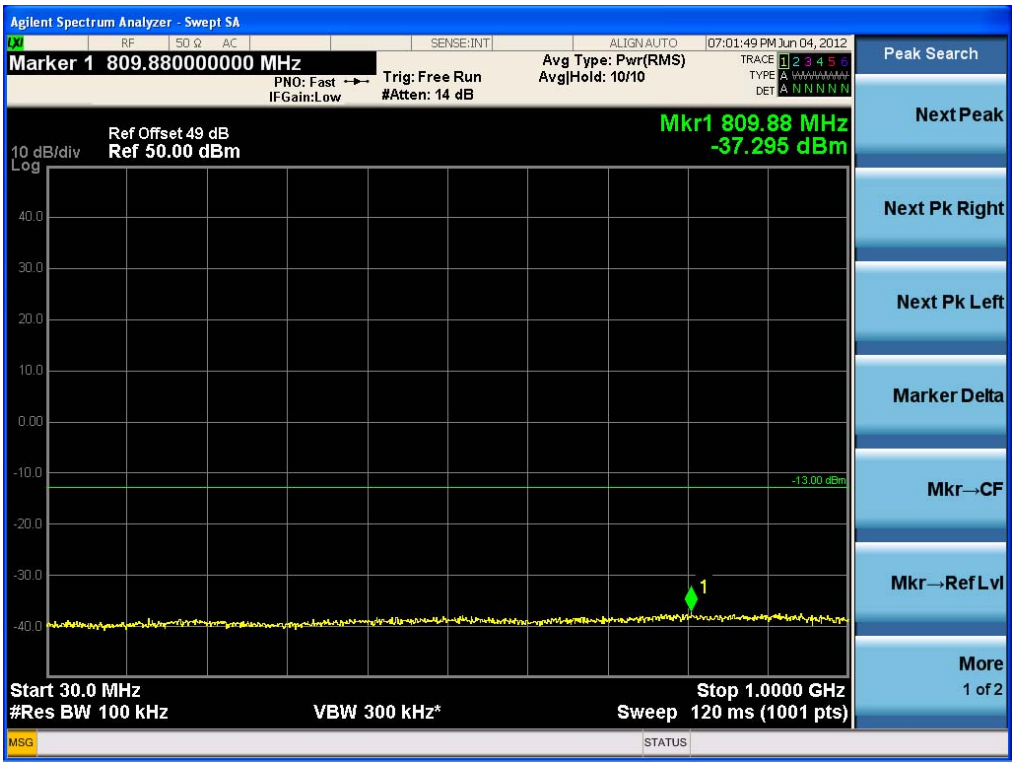
Low CH-16QAM (1 GHz – 26.5 GHz)

Mid CH-16QAM (30 MHz – 1 GHz)



Mid CH-16QAM (1 GHz – 26.5 GHz)

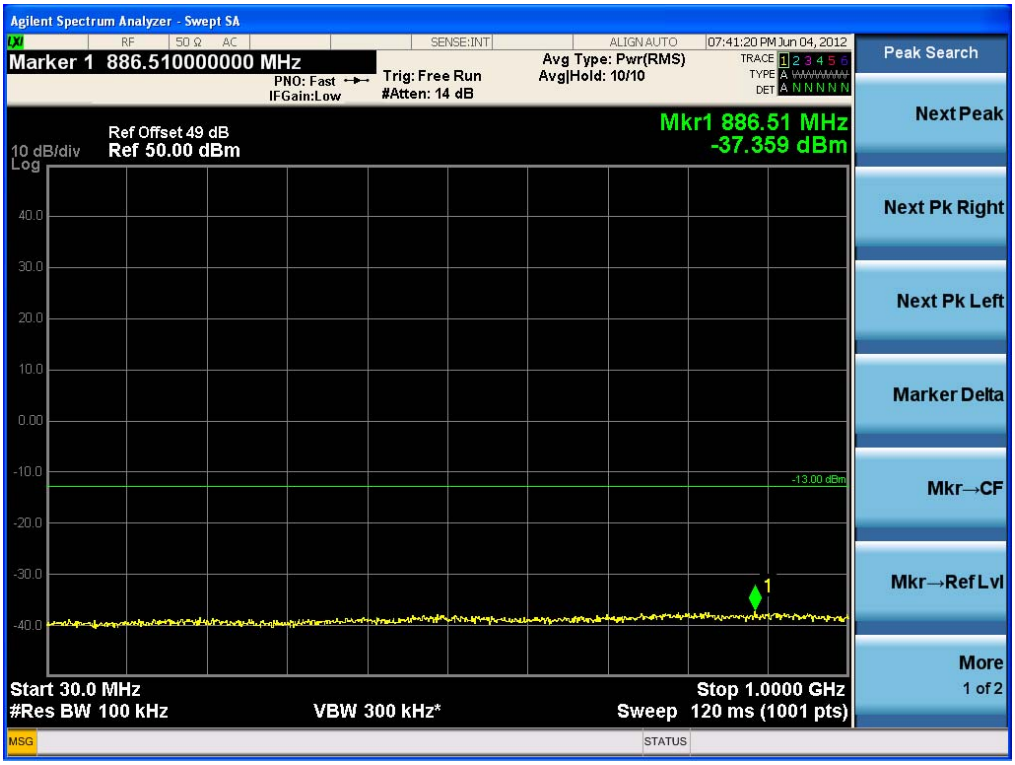
High CH-16QAM (30 MHz – 1 GHz)



High CH-16QAM (1 GHz – 26.5 GHz)

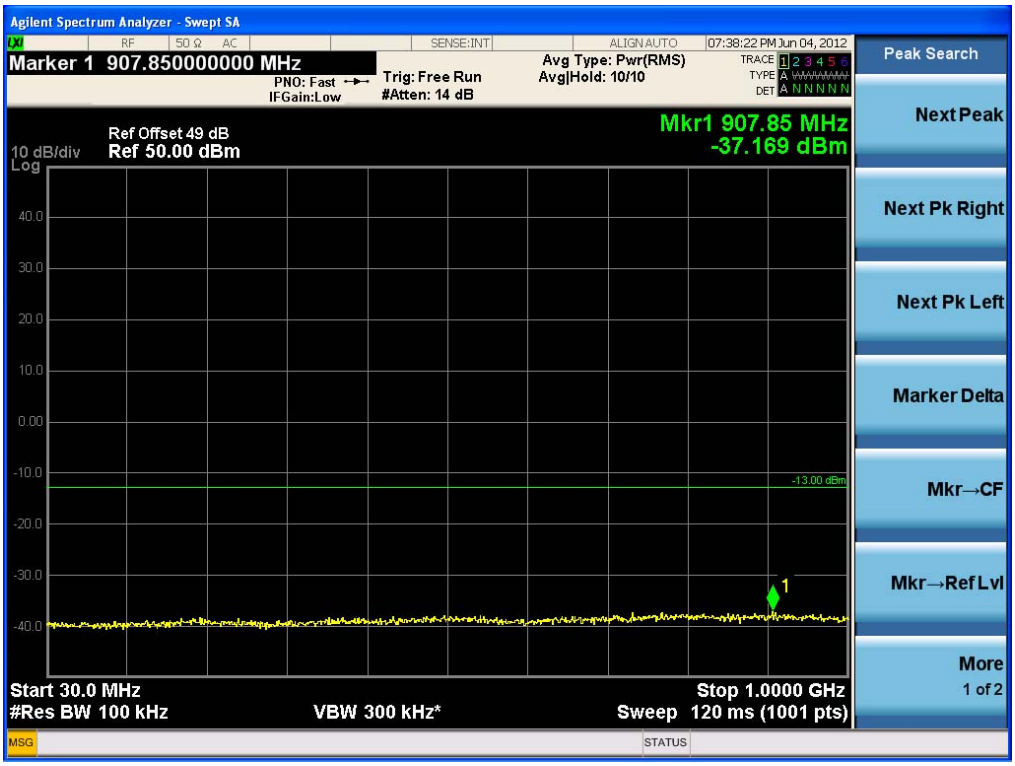
Plots of Spurious Emission [MCA2]

Low CH-QPSK (30 MHz – 1 GHz)



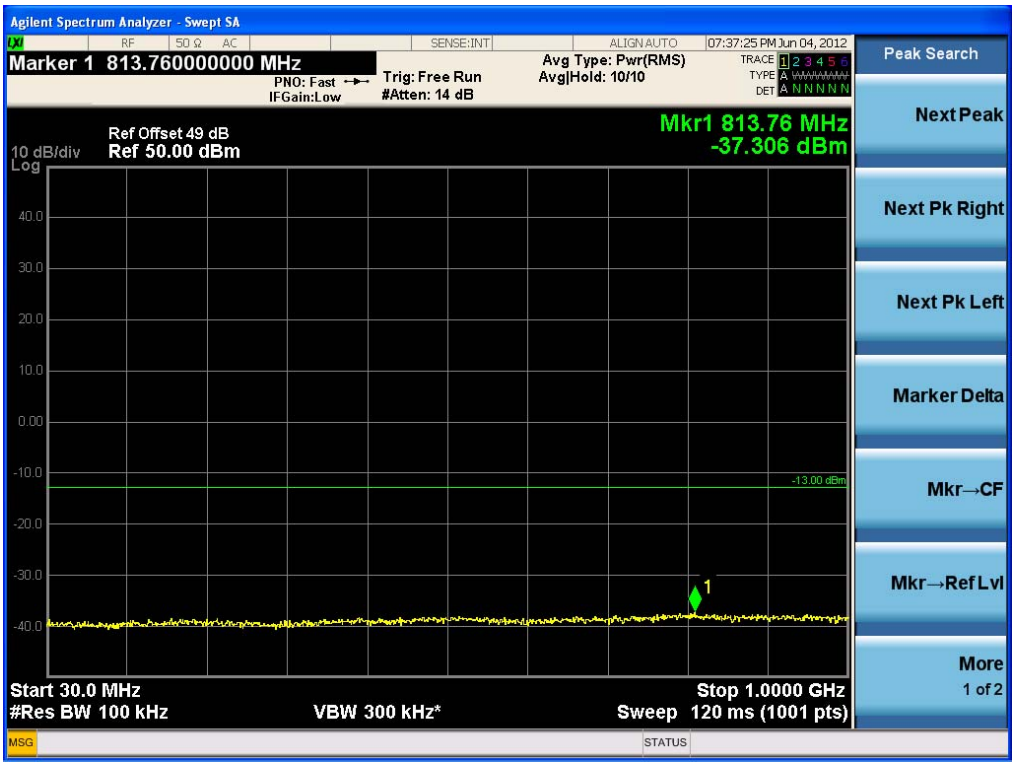
Low CH-QPSK (1 GHz – 26.5 GHz)

Mid CH-QPSK (30 MHz – 1 GHz)



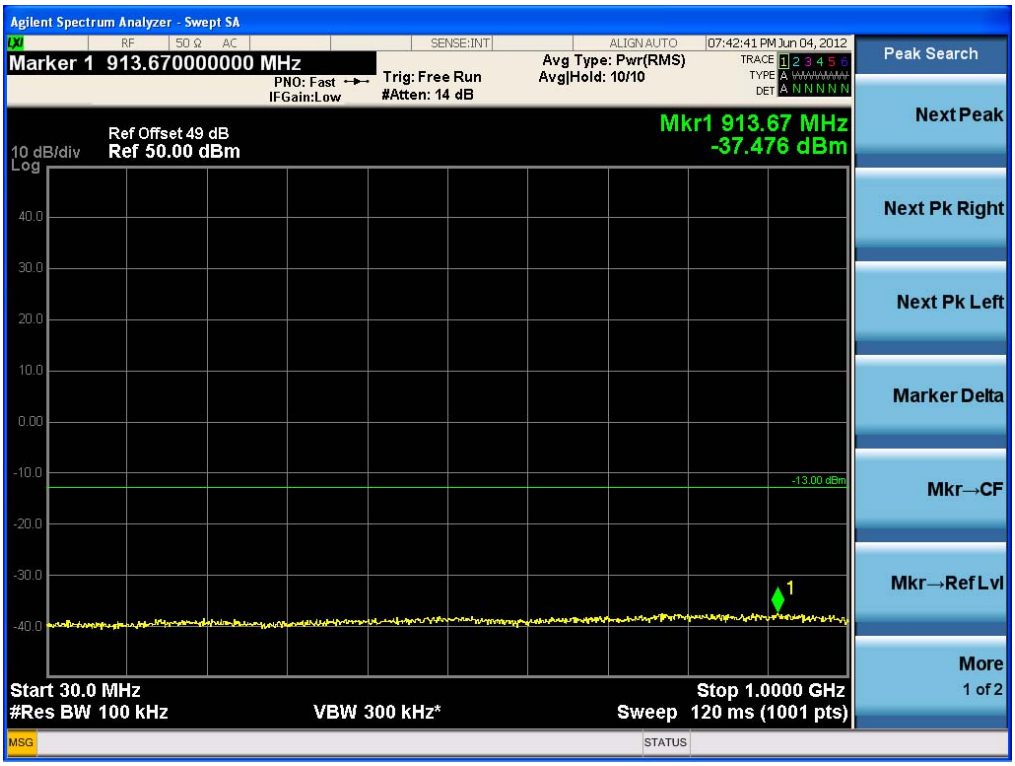
Mid CH-QPSK (1 GHz – 26.5 GHz)

High CH-QPSK (30 MHz – 1 GHz)



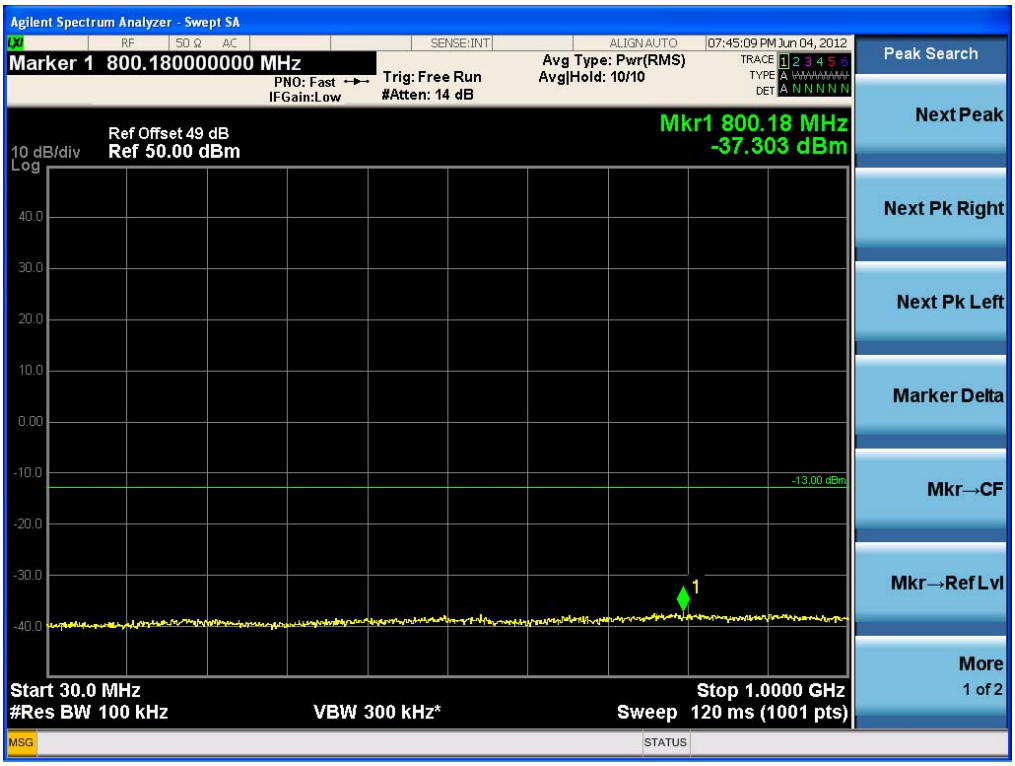
High CH-QPSK (1 GHz – 26.5 GHz)

Low CH-16QAM (30 MHz – 1 GHz)



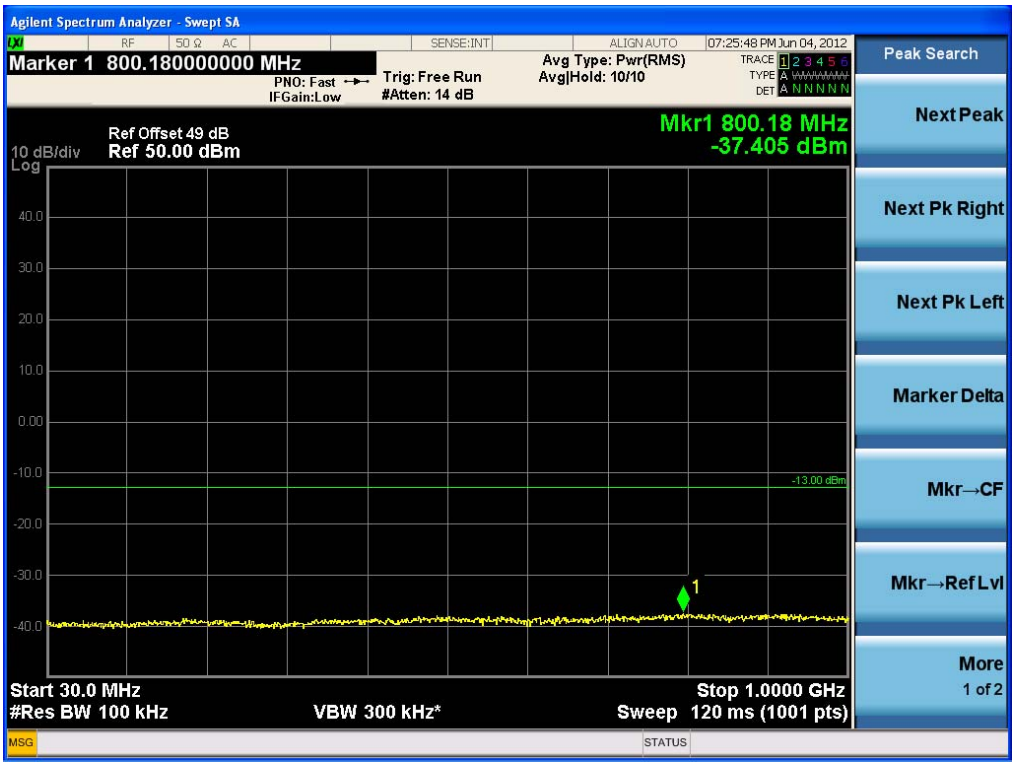
Low CH-16QAM (1 GHz – 26.5 GHz)

Mid CH-16QAM (30 MHz – 1 GHz)



Mid CH-16QAM (1 GHz – 26.5 GHz)

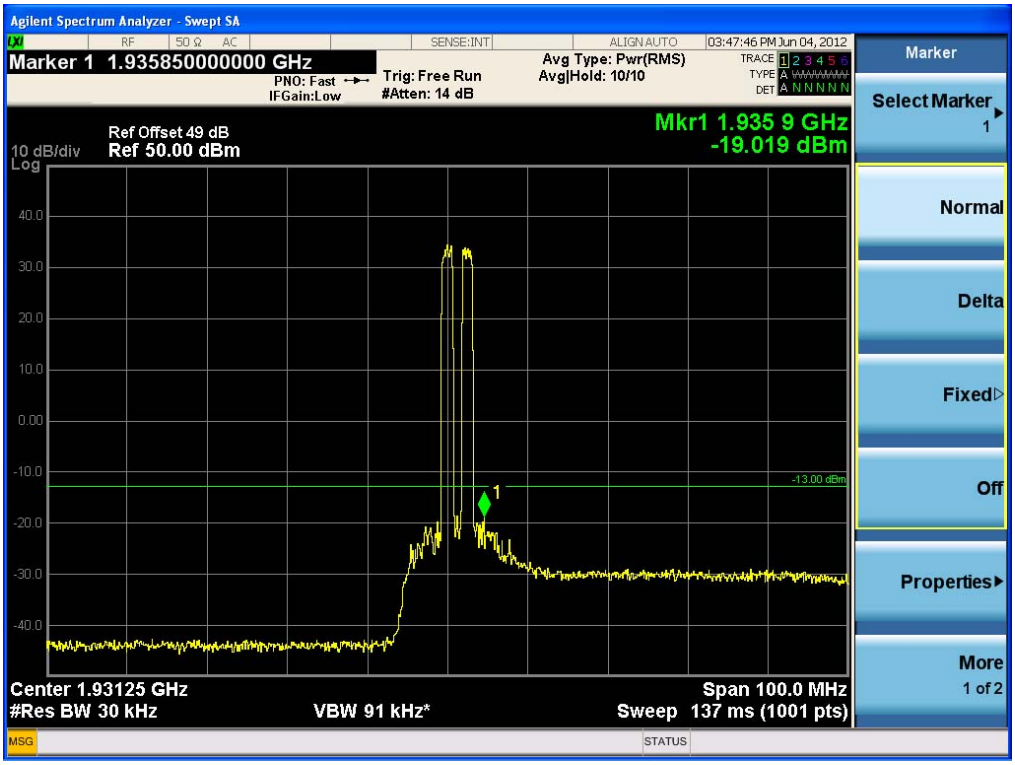
High CH-16QAM (30 MHz – 1 GHz)



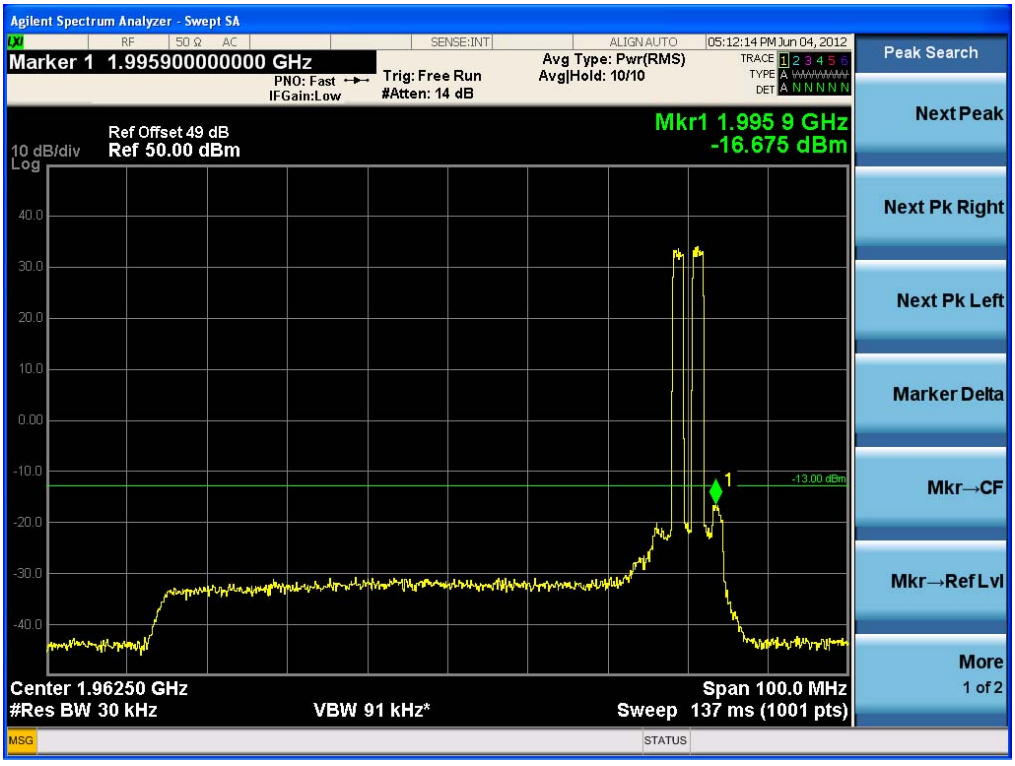
High CH-16QAM (1 GHz – 26.5 GHz)

Intermodulation [MCA1]

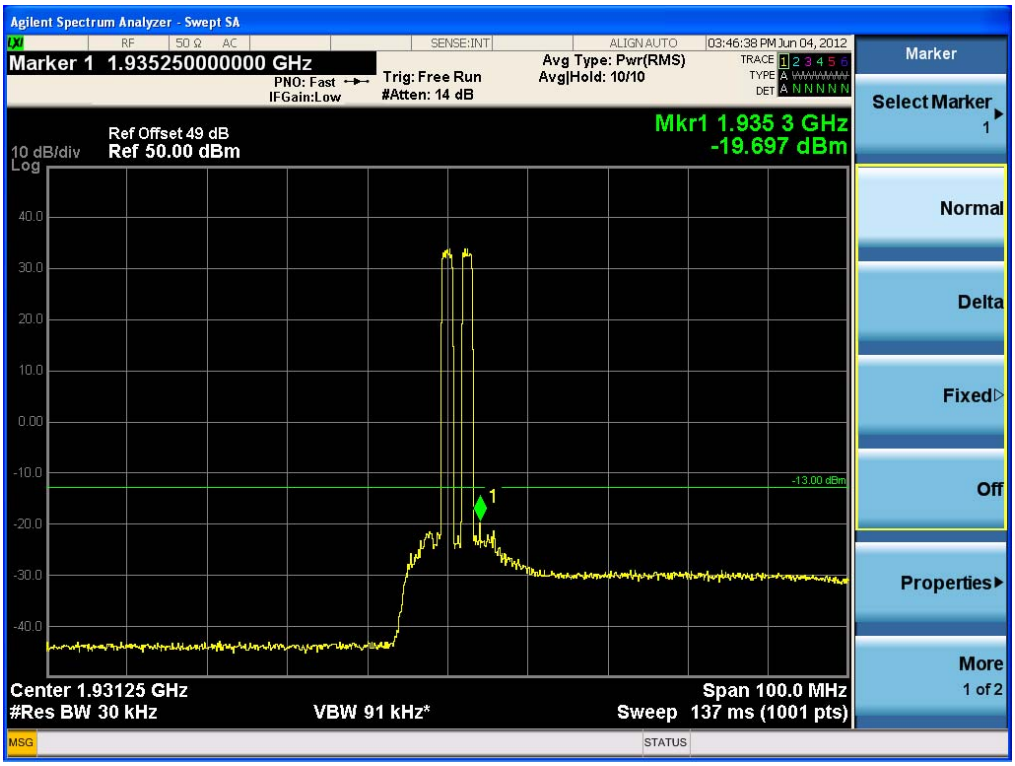
Low CH (QPSK)



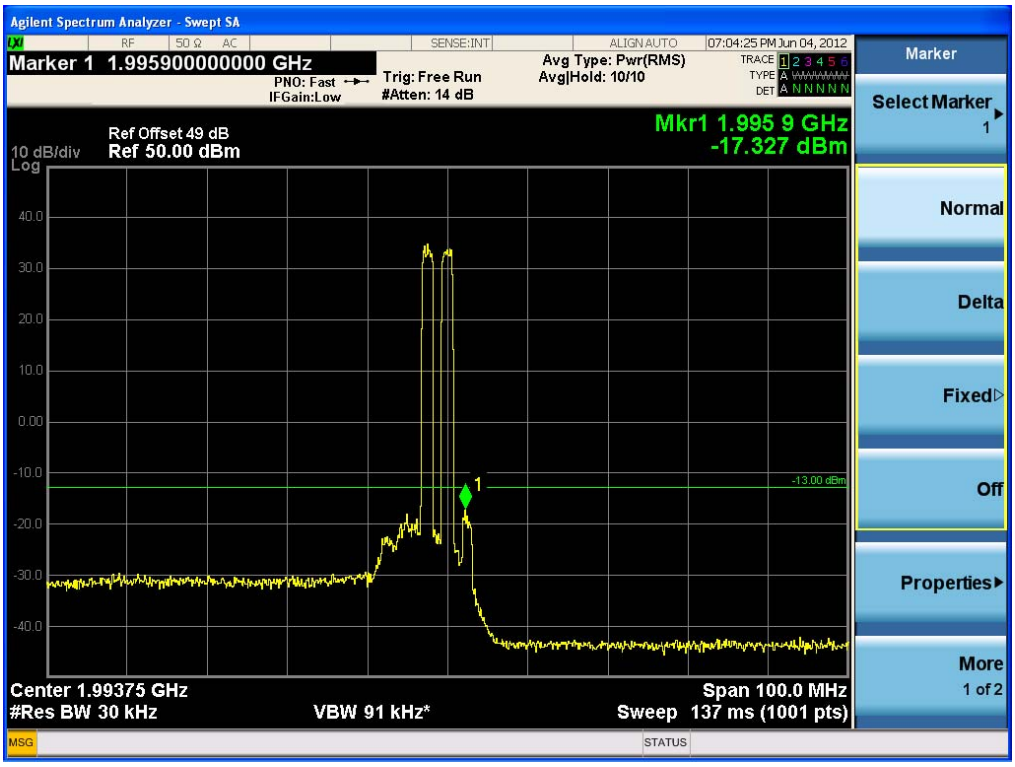
High CH (QPSK)



Low CH (16QAM)

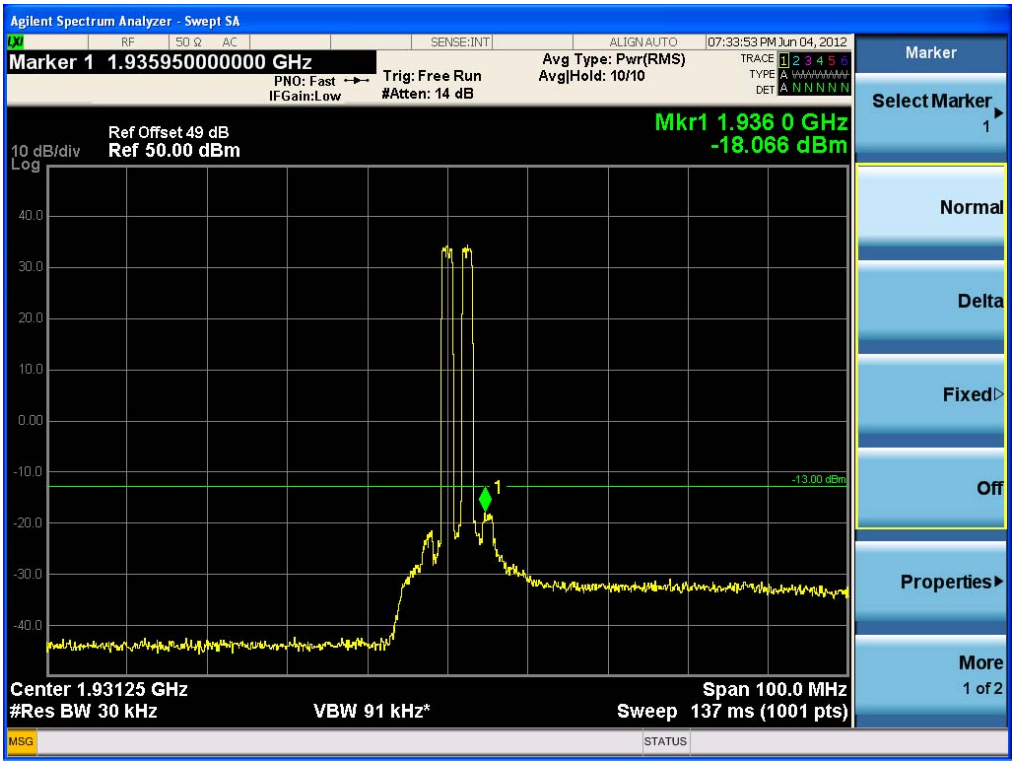


High CH (16QAM)

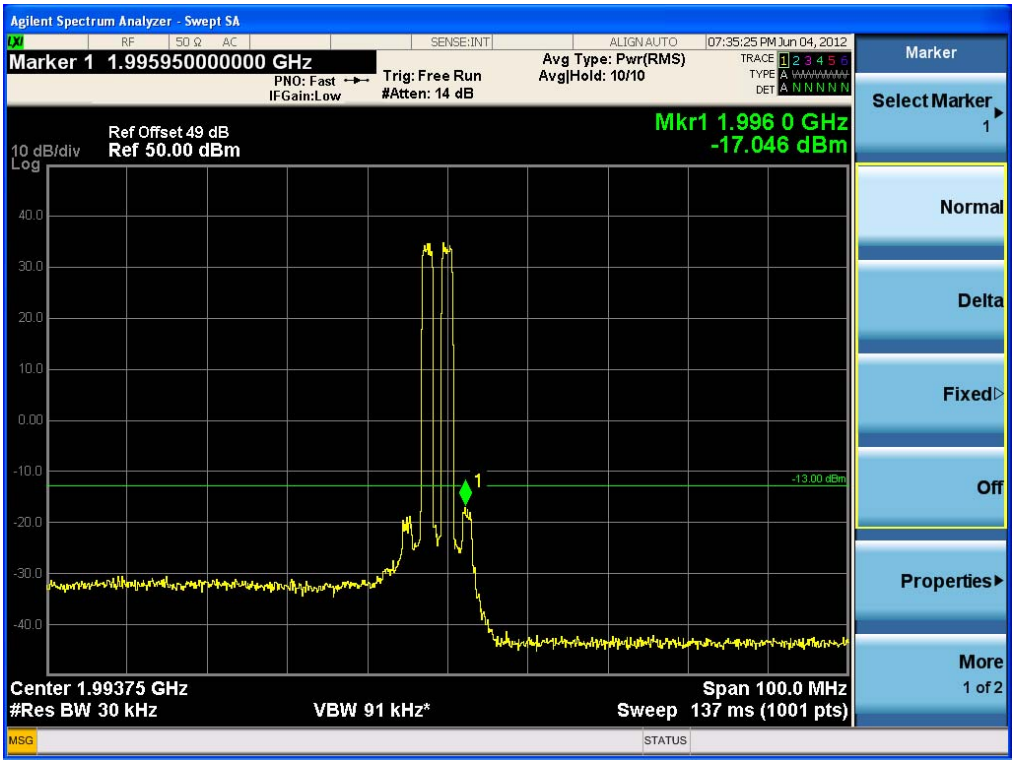


Intermodulation [MCA2]

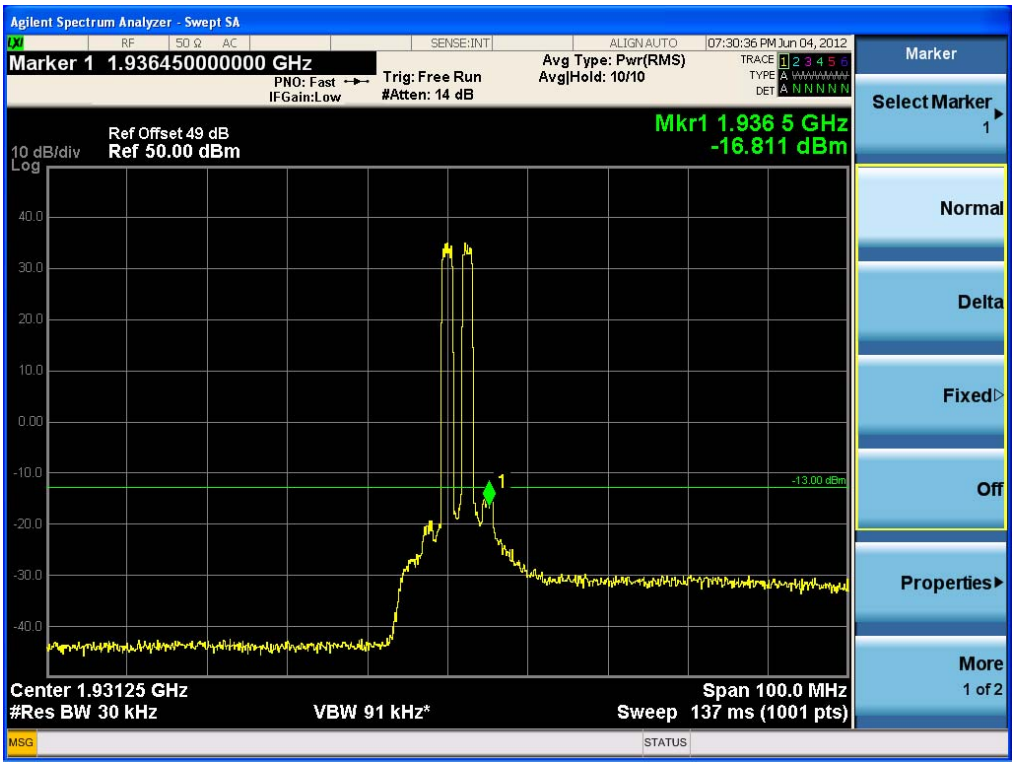
Low CH (QPSK)



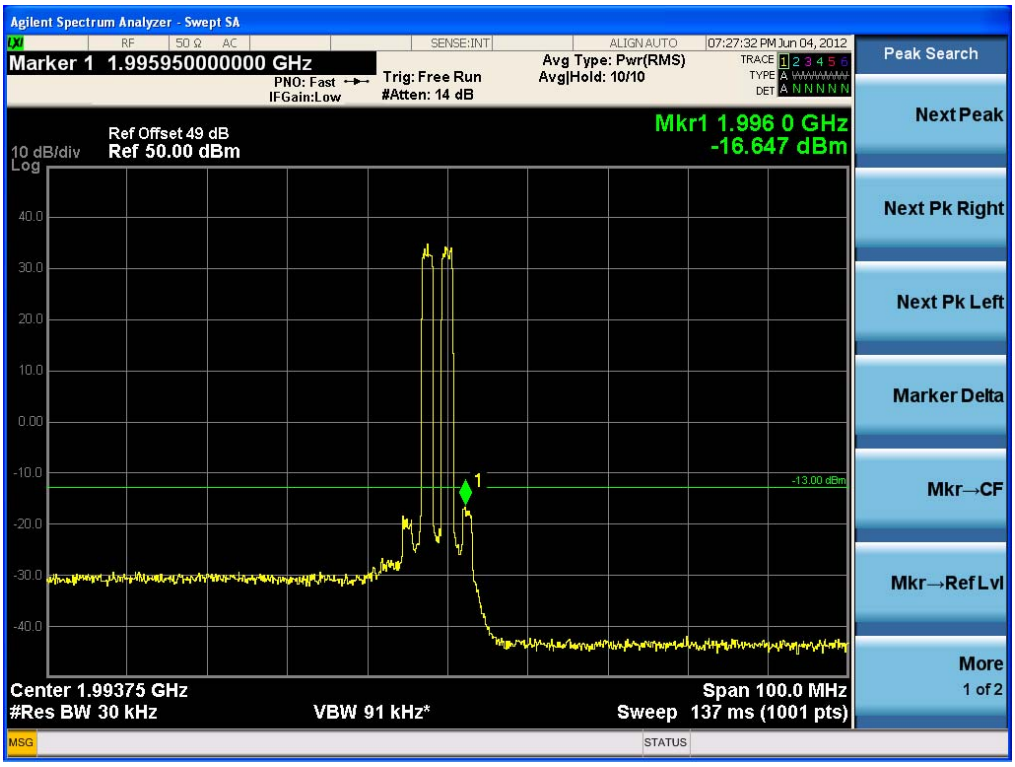
High CH (QPSK)



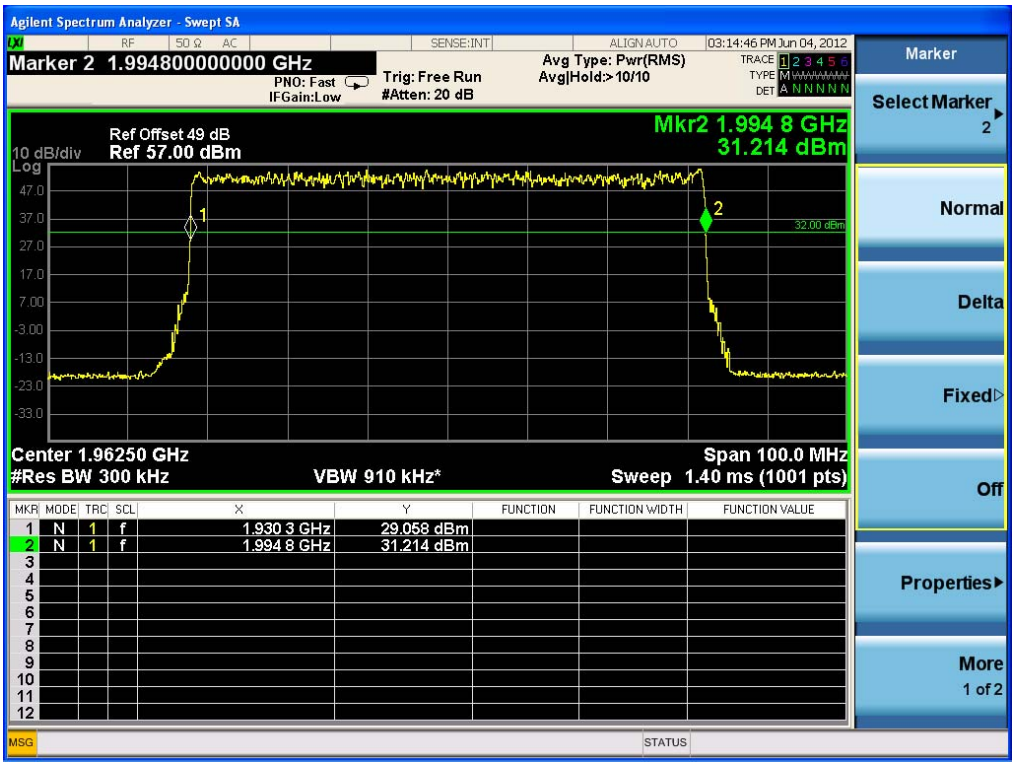
Low CH (16QAM)



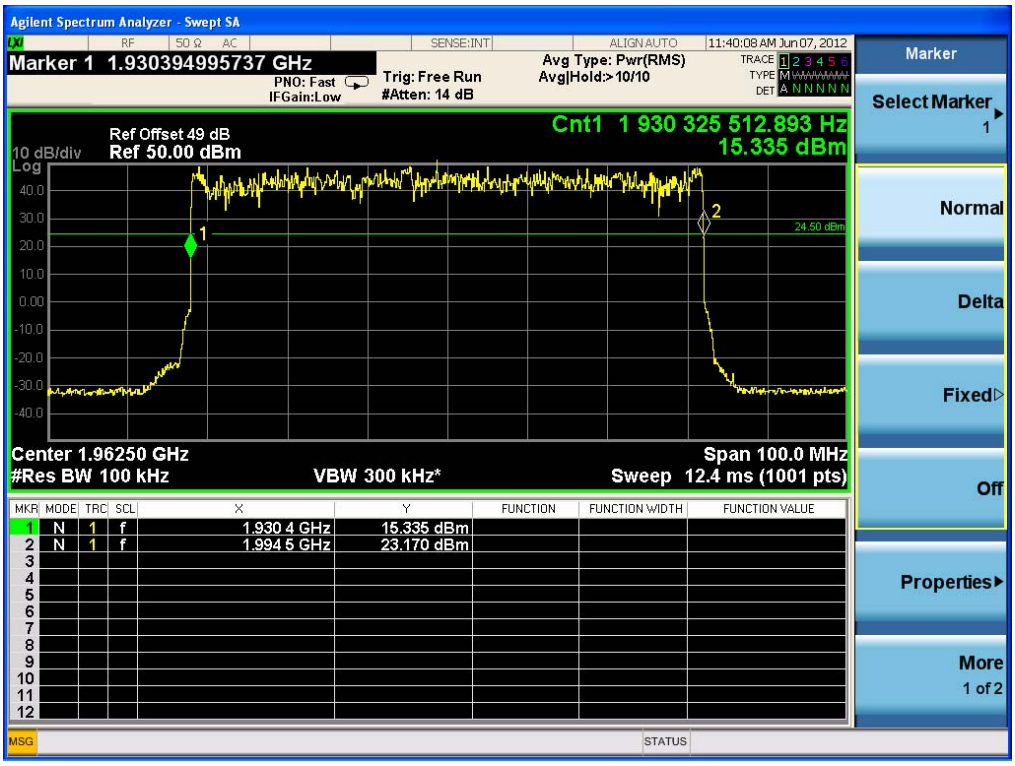
High CH (16QAM)



Out of Band Rejection [MCA1]



Out of Band Rejection [MCA2]



8. RADIATED SPURIOUS EMISSIONS

Test Requirement(s): § 2.1053 Measurements required: Field strength of spurious radiation.

§ 2.1053 (a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of § 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.

§ 2.1053 (b): The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.

(2) All equipment operating on frequencies higher than 25 MHz.

(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.

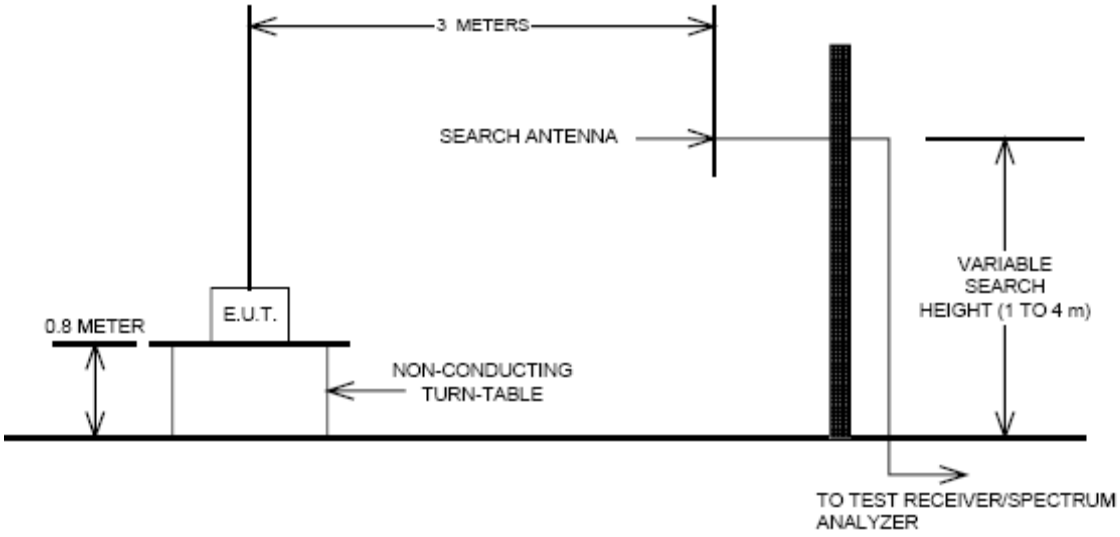
(4) Other types of equipment as required, when deemed necessary by the Commission.

Test Procedures: As required by 47 CFR 2.1053, *field strength of radiated spurious measurements* were made in accordance with the procedures of TIA/EIA-603-C-2004 "Land Mobile FM or PM Communications Equipment Measurement and Performance Standards".

Radiated emission measurements were performed inside a 3 meter semi-anechoic chamber. The EUT was set at a distance of 3m from the receiving antenna. The EUT's RF ports were terminated to 50ohm load. The EUT was set to transmit at the low, mid and high channels of the transmitter frequency range at its maximum power level. The EUT was rotated about 360 and the receiving antenna scanned from 1-3m in order to capture the maximum emission. A calibrated antenna source was positioned in place of the EUT and the previously recorded signal

was duplicated. The maximum EIRP of the emission was calculated by adding the forward power to the calibrated source plus its appropriate gain value. These steps were carried out with the receiving antenna in both vertical and horizontal polarization. Harmonic emissions up to the 10th or 40GHz, whichever was the lesser, were investigated.

Radiated Spurious Emissions Test Setup



Test Results:

Frequency	Freq.(MHz)	Measured Level [dBm]	Ant. Gain (dBd)	C.L	SigGen Level [dBm]	Pol.	ERP (dBm)	Margin (dB)
1962.5	3925.00	-70.29	10.52	8.57	-32.45	H	-30.50	-17.50
	5887.50	-76.77	10.94	10.40	-33.85	V	-33.31	-20.31
	7850.00	-73.83	9.02	12.40	-36.88	V	-40.26	-27.26
1993.75	3987.50	-70.15	10.56	8.70	-32.00	V	-30.13	-17.13
	5981.25	-77.32	10.96	10.50	-34.17	V	-33.72	-20.72
	7975.00	-74.08	9.09	12.46	-37.06	V	-40.43	-27.43

9. FREQUENCY STABILITY OVER TEMPERATURE AND VOLTAGE VARIATIONS

Test Requirement(s):

§2.1055(a)(1) §22.355, §24.235 The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

Test Procedures:

As required by 47 CFR 2.1055, *Frequency Stability measurements* were made at the RF output terminals using a Spectrum Analyzer.

The EUT was placed in the Environmental Chamber.

A CW signal was injected into the EUT at the appropriate RF level. The frequency counter option

on the Spectrum Analyzer was used to measure frequency deviations.

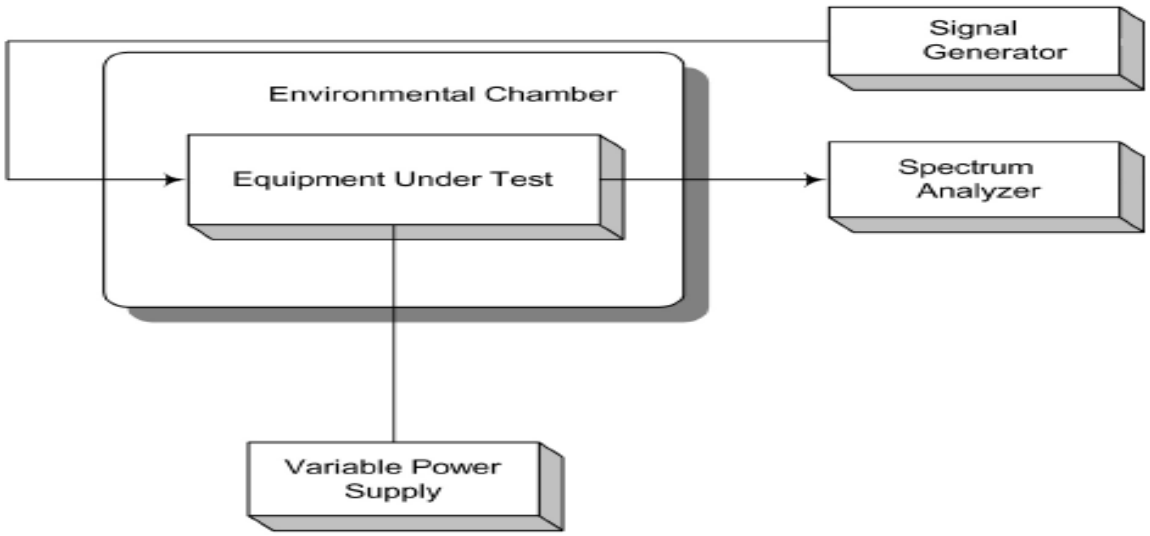
The frequency drift was investigated for every 10 ℃ increment until the unit is stabilized then recorded the reading in tabular format with the temperature range of -30 to 50 ℃.

Voltage supplied to EUT is 220 Vac reference temperature was done at 20℃. The voltage was varied by ± 15 % of nominal

Test Results:

The E.U.T was found in compliance for Frequency Stability and Voltage Test

Test Setup:



Frequency Stability and Voltage Test Results

Voltage (%)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (Hz)	ppm
100%	+20(Ref)	1962 500 000	-0.5	0.0	0.0000
	-30	1962 500 000	-0.2	0.3	0.0002
	-20	1962 500 000	-0.4	0.1	0.0001
	-10	1962 500 000	-0.3	0.2	0.0001
	0	1962 499 999	-0.6	-0.1	-0.0001
	+10	1962 500 000	-0.2	0.3	0.0002
	+30	1962 500 000	-0.1	0.4	0.0002
	+40	1962 500 000	-0.3	0.2	0.0001
	+50	1962 500 000	-0.4	0.1	0.0001
115%	+20	1962 500 000	-0.5	0.0	0.0000
85%	+20	1962 499 999	-0.6	-0.1	-0.0001

(Mid CH)

10. RF EXPOSURE STATEMENT

1. LIMITS

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

(B) Limits for General Population/Uncontrolled Exposures

Frequency range (MHz)	Electric field Strength (V/m)	Magnetic field Strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
0.3 - 1.34.....	614	1.63	*(100)	30
1.34 - 30.....	824/f	2.19/f	*(180/ f^2)	30
30 - 300.....	27.5	0.073	0.2	30
300 - 1500.....	.....	.....	f/1500	30
1500 - 100.000.....	.....	.....	1.0	30

F = frequency in MHz

* = Plane-wave equivalent power density

2. MAXIMUM PERMISSIBLE EXPOSURE Prediction

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

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

S = Power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

Max Peak output Power at antenna input terminal	52.04000	dBm
Max Peak output Power at antenna input terminal	159.95580	W
Prediction distance	1200.00000	cm
Prediction frequency	1962.50000	MHz
Antenna Gain(typical)	20.00000	dBi
Antenna Gain(numeric)	100.00000	–
Power density at prediction frequency (S)	0.88395	mW/cm^2
MPE limit for uncontrolled exposure at prediction frequency	1.00000	mW/cm^2

3. RESULTS

The power density level at 1200 cm is 0.883950 mW/cm², which is below the uncontrolled exposure limit of 1.0 mW/cm² at 1930 MHz ~ 1995 MHz

Warning: In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, it must also have a minimum distance of 1200 cm from the body during normal operation.