Section 5

Test Report

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5.1 Test Strategy

Verification of the performance of the Motorola, Inc. PCE*x*25100 transmitter was accomplished by implementation of the procedures contained within TIA/EIA-603 and FCC requirements. Performance results contained within this Test Report document represent operational modes that are considered to be worst case within a functional system. Verification of product performance is presented for three frequencies across the RF bandwidth, two channel bandwidths, and four modulation levels available within an operational system. The Motorola, Inc. PCE*x*25100 product has been tested with equipment that is generally available in the open market. Measurements performed on the PCE*x*25100 product were performed with an Agilent E4440A and a Rohde&Schwarz FSU spectrum analyzer.

The Expedience system protocol utilizes all subchannel carriers on each transmission burst. The Expedience system protocol does not make use of subchannelization. All carriers are utilized for each transmission. The Expedience system protocol does not allow for a mixed transmission within a single burst, i.e. all data is one modulation type (4-QAM, 16-QAM, 64-QAM, 16-QAM Lite). The same modulation must be transmitted for the entire burst. To facilitate the product development, a test mode configuration was developed. The test mode allows for the selection of channel frequency, modulation bandwidth, and modulation type. Within the test mode, a pseudo random bit sequence is used to generate the transmitted data.

The Motorola, Inc. Expedience system is based on a proprietary protocol. As such there are no existing standards that are applicable. The Motorola, Inc. Expedience system protocol makes use of Time Division Duplex (TDD) operation as allowed by the FCC rules contained in Part 2 and Part 27 for devices operating in the BRS and EBS frequency spectrum. Within the BRS and EBS frequency spectrum, channels are allocated in 5.5 MHz and 6.0 MHz single frequency blocks. Additional information is contained in the Technical Description document.

The Motorola, Inc. PCE*x*25100 product does not contain smart antenna technology. The integral antenna contained within the product is a slot edge radiator antenna. This antenna has a fixed gain and radiation pattern. The available accessory antenna, which utilizes a non-standard connector, is a single patch multi-element antenna that has a fixed gain and beamwidth.

5.2 Test Equipment List

Test Equipment	Description
DUT	Motorola ExpressCard Model No. PCEx25100 Serial Nos.: 40DA94 2E14 403988
Spectrum Analyzer	Agilent E4440A S/N: MY44022791 Calibrated: 05/21/2007 Calibration due: 05/21/2009
Spectrum Analyzer (Transmitter Power Only)	Rohde & Schwarz FSU S/N: 200256 Calibrated: 6/27/2006 Calibration Due: 6/27/2008
Test Cable Assembly	MCE/Weinshel Attenuators, Model 23-xx-34 10 dB, 10W S/N BT3845 (to analyzer Ext Trig) 40 dB, 10W S/N BT1498 (to analyzer RF in) Narda Microwave Bi-Directional Coaxial Coupler Model 3022, S/N 01231 (Above Equipment Calibrated By User) Log Detector Board, Analog Devices AD8319 (provides analyzer external trigger signal)
ExpressCard Adapter Board (harmonic and freq stability tests only)	Fabricated. Allows for Express Card device to be functional outside of laptop computer.
Filter/Attenuator Assembly (harmonic frequency test only)	High Pass Filter 4-18 GHz, P/N H04G18G2, S/N 89099 Microwave Circuits 2-10 dB, 10W Attenuators, MCE/Weinshel Model 23-20-34, S/N BS5614/BT3857 Calibrated by user
Horn Antenna 1	ETS-Lindgren Model 3115 S/N: 00052735 Calibrated: 01-13-2008 Calibration Due: 01-13-2009
Horn Antenna 2	NextNet Wireless Model 2233 S/N: 12071 Calibrated: 01-13-2008 Calibration Due: 01-13-2009
Laptop Computer (NN1303)	Dell Precision M65 S/N: CRFK 381 Calibration not required

Test Equipment	Description
Ethernet Switch	D-Link Model: DSS-5+ 5-port 10/100Mbps S/N: B20544C017136 Calibration not required
AC Power Source	Instek Model APS-9501 S/N EF844094
Digital Voltmeter	HP 34401A S/N: MY45001201 Calibrated: 05/04/2007 Calibration due: 05/04/2009
Temperature Chamber	Test Equity 1007H S/N: 61183
Temperature Sensor	Fluke 89 IV True RMS Multimeter S/N 87180024, with K-Type Thermocouple

5.3 RF Power Output

FCC Rules: 2.1046, 27.4, 27.50(h)(2), 27.50(i)

FCC Requirement: Mobile and other user stations. Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.

Standard: FCC Part 27.50(i)

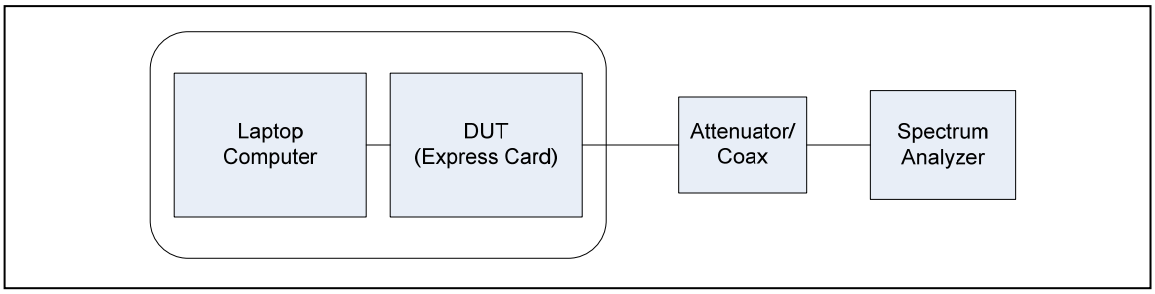
Test Procedure: The peak conducted RF output power is measured over an interval of continuous transmission using a spectrum analyzer that has been calibrated in terms of rms-equivalent voltage. The peak power was recorded by utilizing the power measurement function within the spectrum analyzer.

The conducted RF output of the transmitter was measured at the accessory antenna port. This signal is applied through a calibrated attenuator and coax to a spectrum analyzer input. The spectrum analyzer is setup to capture a single RF transmission burst. The spectrum analyzer is adjusted for a zero span, peak detector, 20 MHz resolution bandwidth, 30 MHz video bandwidth, maximum number of data points, and the RF trigger level is set to respond to an input RF level that is not influenced by the modulation peaks and dips. Peak power measurements are presented for three different Express Card devices. Minimum conducted power is presented for one Express Card device.

The radiated RF output from the integral antenna was measured at the 2.948 listed Dataradio COR Ltd 3 meter OATS facility located in Waseca, Minnesota, FCC Registration Number 152034. Measurements were performed on 2 February 2008. The transmitter radiated emission was maximized for peak level by rotation of the test unit and elevation of the measurement antenna. Verification of the peak EIRP level was accomplished by antenna substitution as detailed in the TIA-603-C specification clause 2.2.17.2. The spectrum analyzer is setup to capture a single RF transmission burst. The spectrum analyzer is adjusted for a zero span, peak detector, 20 MHz resolution bandwidth, 30 MHz video bandwidth, maximum number of data points, and the RF trigger level is set to respond to an input RF level that is not influenced by the modulation peaks and dips. Maximum equivalent isotropic radiated power (EIRP) measurements are presented for two Express Card devices.

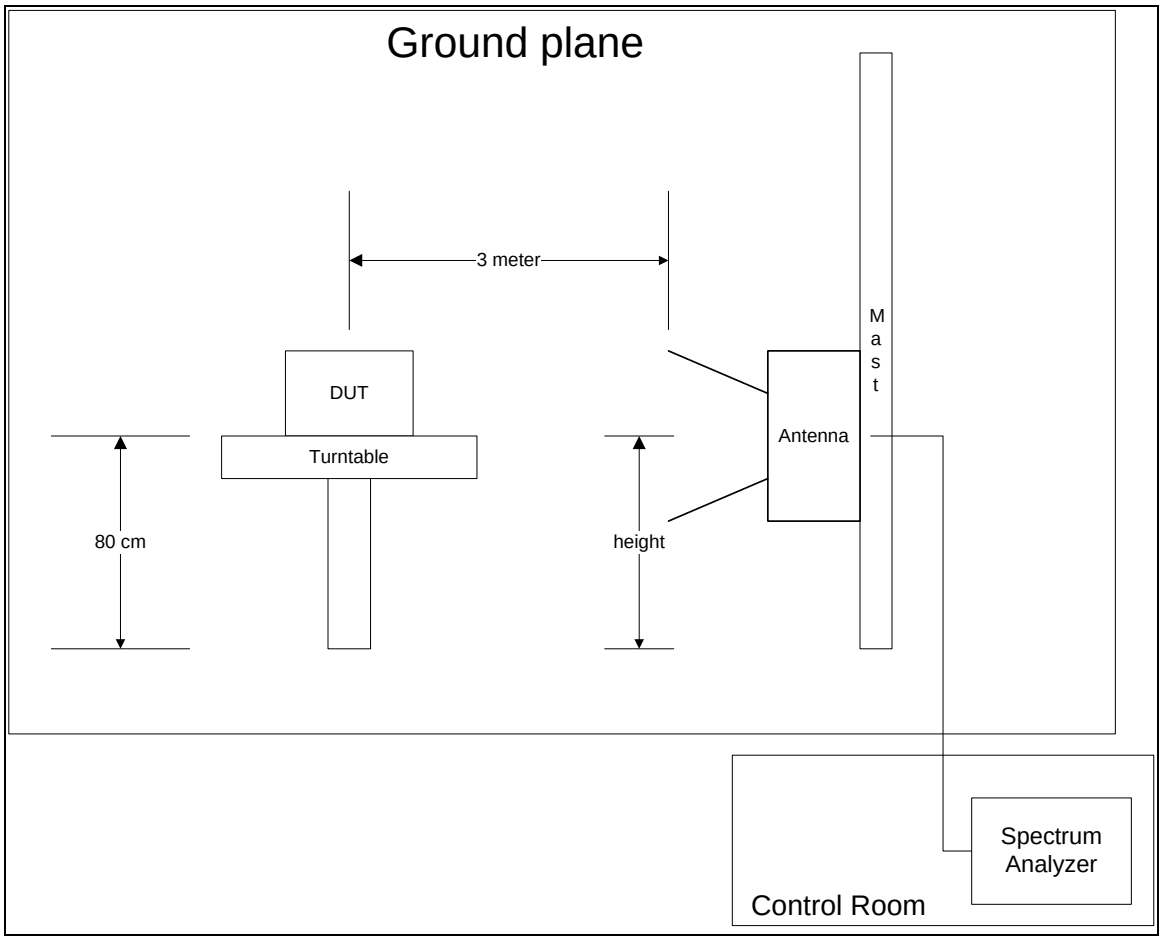
The transmitter is enabled in test mode and set to the minimum and maximum power level with the host computer. The RF loss of the attenuator(s) and coax was measured and is included in the spectrum analyzer offset level for the maximum and minimum RF power measurements. Measurements are performed at frequencies across the band and for the modulation formats available (4-, 16-, 64-, 16L-QAM) and channel bandwidths (5.5 and 6.0 MHz).

Test Conditions: **Conducted Power**
Test Frequencies: 2499, 2593, 2687 MHz (5.5 and 6.0 MHz bandwidth)
Temperature: 22°C
Supply Voltage: Nominal 120 VAC 60 Hz applied to computer power supply



Conducted RF Power Test Setup – measured at Accessory Antenna Port

Test Conditions: **Radiated Power**
Test Frequencies: 2499, 2593, 2687 MHz (5.5 and 6.0 MHz bandwidth)
Temperature: -6°C
Supply Voltage: Nominal 120 VAC 60 Hz applied to computer power supply



Radiated RF Power Test Setup – Integral Antenna EIRP

5.3.1 Conducted RF Output Power Test Results (Other User Stations)

Maximum Power Setting S/N: 40DA94									
Freq (MHz)	Bandwidth (MHz)	4 QAM		16 QAM		64 QAM		16 QAM Lite	
		(dBm)	(Watts)	(dBm)	(Watts)	(dBm)	(Watts)	(dBm)	(Watts)
2499	6.0	32.18	1.65	32.11	1.63	32.24	1.67	32.19	1.66
2593	6.0	31.48	1.41	31.65	1.46	31.61	1.45	31.54	1.43
2687	6.0	32.08	1.61	32.14	1.64	32.04	1.60	32.08	1.61
2499	5.5	32.01	1.59	32.00	1.58	32.02	1.59	32.08	1.61
2593	5.5	31.58	1.44	31.71	1.48	31.56	1.43	31.63	1.46
2687	5.5	32.14	1.64	32.22	1.67	32.09	1.62	32.13	1.63

Minimum Power Setting S/N: 40DA94									
Freq (MHz)	Bandwidth (MHz)	4 QAM		16 QAM		64 QAM		16 QAM Lite	
		(dBm)	(Watts)	(dBm)	(Watts)	(dBm)	(Watts)	(dBm)	(Watts)
2499	6.0	-0.52	0.00089	-0.45	0.00090	-0.42	0.00091	-0.48	0.00090
2593	6.0	-0.59	0.00087	-0.54	0.00088	-0.59	0.00087	-0.54	0.00088
2687	6.0	-0.03	0.00099	0.02	0.00100	0.03	0.00101	0.10	0.00102
2499	5.5	-0.18	0.00096	0.01	0.00100	-0.16	0.00096	-0.20	0.00095
2593	5.5	-0.43	0.00091	-0.39	0.00091	-0.36	0.00092	-0.40	0.00091
2687	5.5	0.07	0.00102	0.02	0.00100	0.04	0.00101	0.04	0.00101

Maximum Power Setting S/N: 403988							
Freq (MHz)	Bandwidth (MHz)	4 QAM		16 QAM		64 QAM	
		(dBm)	(Watts)	(dBm)	(Watts)	(dBm)	(Watts)
2499	6.0	31.36	1.37	31.27	1.34	31.28	1.34
2593	6.0	31.68	1.47	31.61	1.45	31.64	1.46
2687	6.0	31.46	1.40	31.46	1.40	31.55	1.43
2499	5.5	31.31	1.35	31.31	1.35	31.43	1.39
2593	5.5	31.82	1.52	31.88	1.54	31.75	1.50
2687	5.5	31.60	1.45	31.81	1.52	31.66	1.47

Maximum Power Setting S/N: 2E14							
Freq (MHz)	Bandwidth (MHz)	4 QAM		16 QAM		64 QAM	
		(dBm)	(Watts)	(dBm)	(Watts)	(dBm)	(Watts)
2499	6.0	32.23	1.67	32.11	1.63	32.17	1.65
2593	6.0	31.67	1.47	31.67	1.47	31.75	1.50
2687	6.0	32.00	1.58	31.97	1.57	32.10	1.62
2499	5.5	32.05	1.60	32.04	1.60	32.12	1.63
2593	5.5	31.84	1.53	31.71	1.48	31.84	1.53
2687	5.5	32.09	1.62	32.15	1.64	32.23	1.67

The maximum Peak conducted power was observed to be 32.23 dBm or 1.67 watts which is below the 2.0 watt other user station limitation.

5.3.2 Internal Antenna Radiated Output Power Test Results (Mobile Station)

Express Card S/N:		403988						
Frequency (MHz)	Channel Bandwidth (MHz)	DUT Spectrum Analyzer measured value (dBm)	Substitution Level from Signal Generator (dBm)	Substitution Horn Gain (dBi)	Measured Substitution Level (dBm)	Calibration Offset (dB)	Integral Antenna Radiated Power (dBm EIRP)	Integral Antenna Radiated Power (Watts EIRP)
2499	5.5	-14.09	0.0	19.016	-27.72	46.74	32.65	1.84
2593	5.5	-14.20	0.0	19.024	-27.68	46.70	32.50	1.78
2687	5.5	-14.00	0.0	19.360	-27.60	46.96	32.96	1.98
2499	6	-14.27	0.0	19.016	-27.72	46.74	32.47	1.76
2593	6	-14.11	0.0	19.024	-27.68	46.70	32.59	1.82
2687	6	-13.97	0.0	19.360	-27.60	46.96	32.99	1.99

Express Card S/N:		2E14						
Frequency (MHz)	Channel Bandwidth (MHz)	DUT Spectrum Analyzer measured value (dBm)	Substitution Level from Signal Generator (dBm)	Substitution Horn Gain (dBi)	Measured Substitution Level (dBm)	Calibration Offset (dB)	Integral Antenna Radiated Power (dBm EIRP)	Integral Antenna Radiated Power (Watts EIRP)
2499	5.5	-14.64	0.00	19.016	-27.72	46.74	32.10	1.62
2593	5.5	-13.97	0.00	19.024	-27.68	46.70	32.73	1.88
2687	5.5	-15.74	0.00	19.360	-27.60	46.96	31.22	1.32
2499	6	-15.02	0.00	19.016	-27.72	46.74	31.72	1.48
2593	6	-13.85	0.00	19.024	-27.68	46.70	32.85	1.93
2687	6	-15.95	0.00	19.360	-27.60	46.96	31.01	1.26

The maximum peak radiated power from the integrated antenna of the Express Card device was observed to be 1.99 Watts EIRP

An RF power level of 0 dBm from a signal Generator was applied to the input of the Motorola 2.2-3.3 GHz substitution horn antenna. The receiving antenna was adjusted up and down for the maximum received signal from the substitution horn. The received power level at the spectrum analyzer was recorded for each of the test frequencies. The calibration offset was then determined:

Cal Offset = Sub Level from Sig Gen (dBm) + Sub Horn gain (dBi) – Measured Spec Ana Level (dBm) = 0 + 19.016 - (-27.72) = 46.74 dB

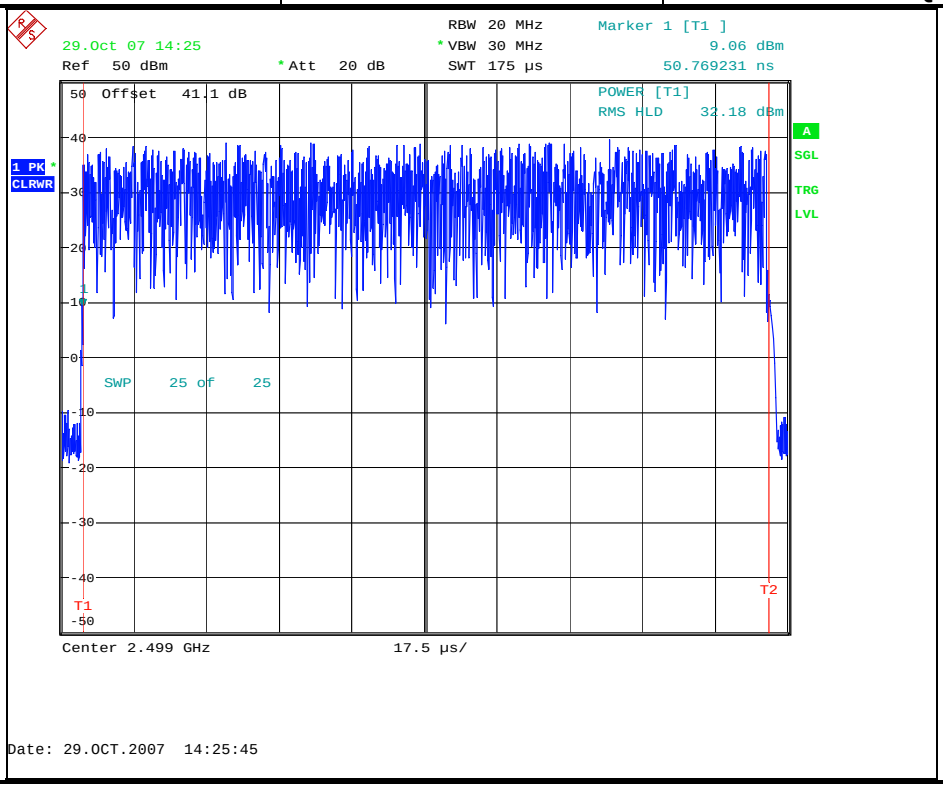
The calibration Offset level is then added to the DUT measured power level to obtain the maximum EIRP value.

Maximum radiated power = -13.97 dBm + 46.96 dB = 32.99 dBm EIRP = 1.99 watts EIRP

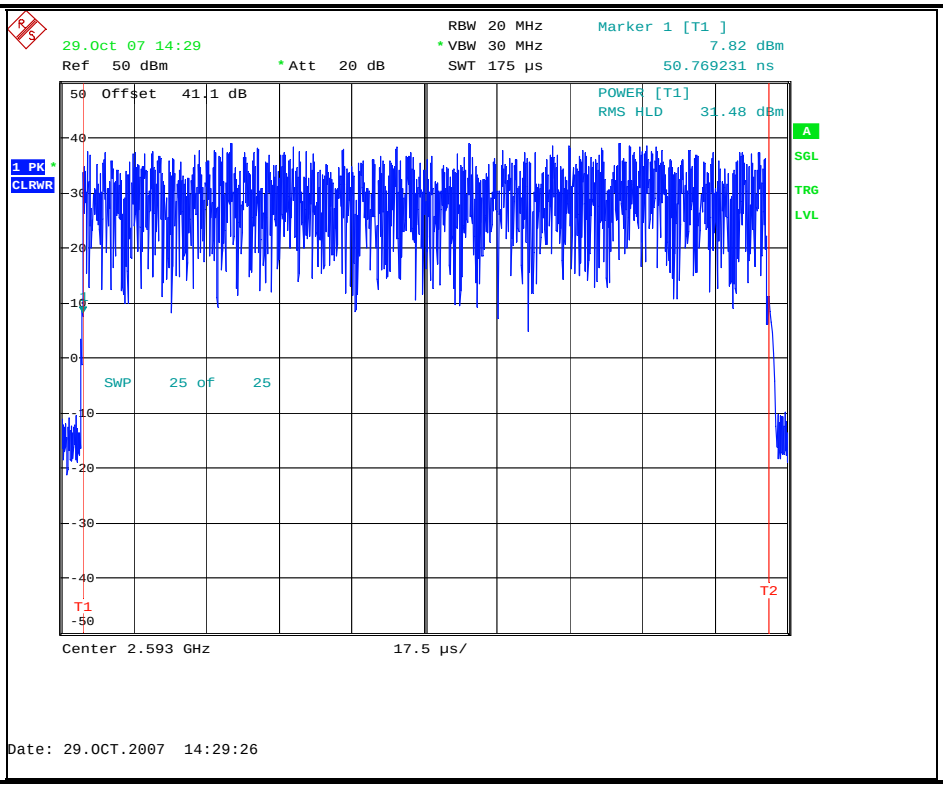
5.3.3 Conducted RF Power Output Plots

A sample of the spectrum analyzer plots for the Accessory Antenna Port of Card S/N 40DA94, 403988, and 2E14 are displayed on the following pages.

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 6.0 MHz	RF Power: 1.6 Watts	Modulation: 4 QAM

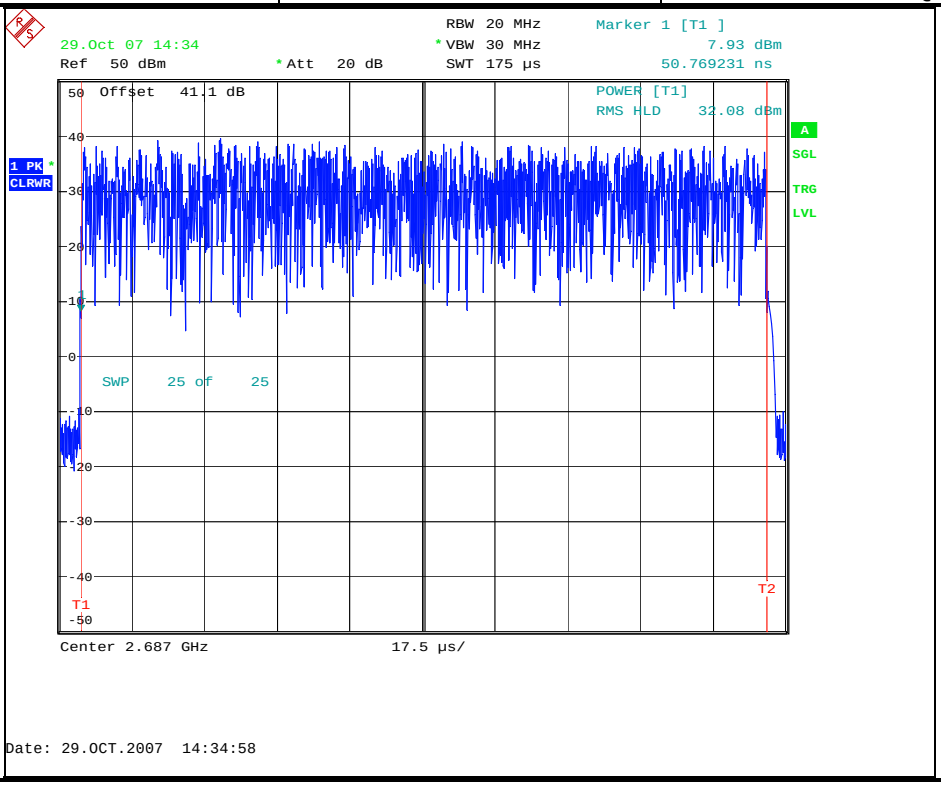


2499 MHz



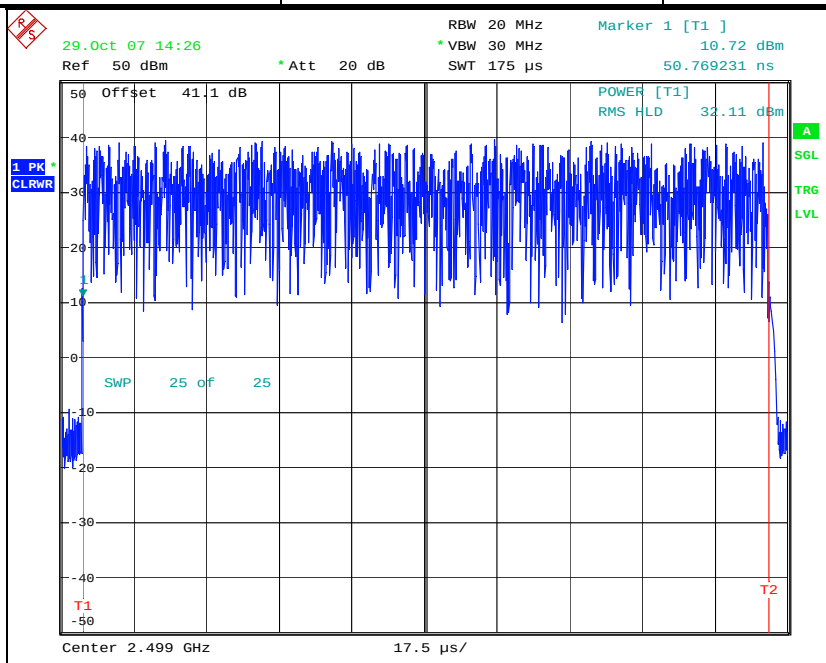
2593 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 6.0 MHz	RF Power: 1.6 Watts	Modulation: 4 QAM

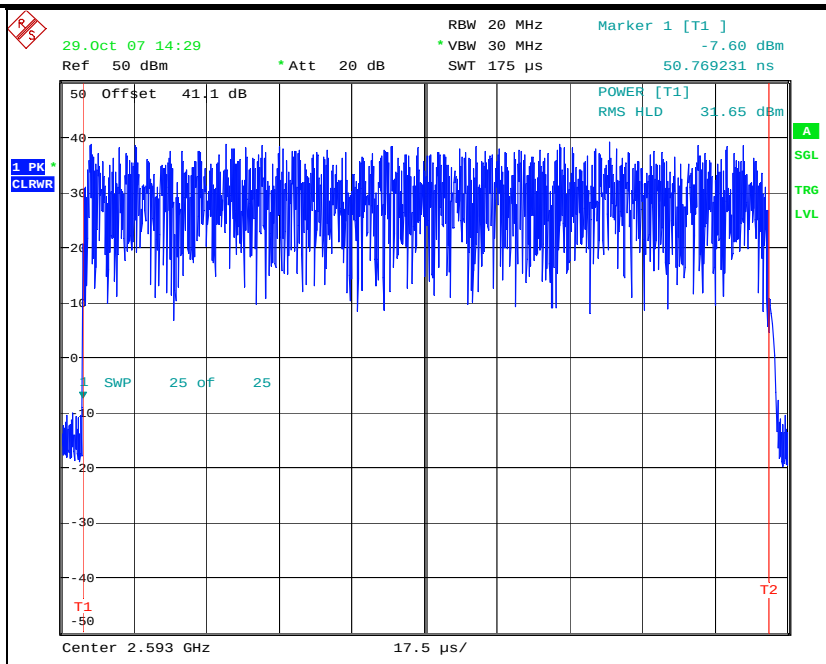


2687 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 6.0 MHz	RF Power: 1.6 Watts	Modulation: 16 QAM

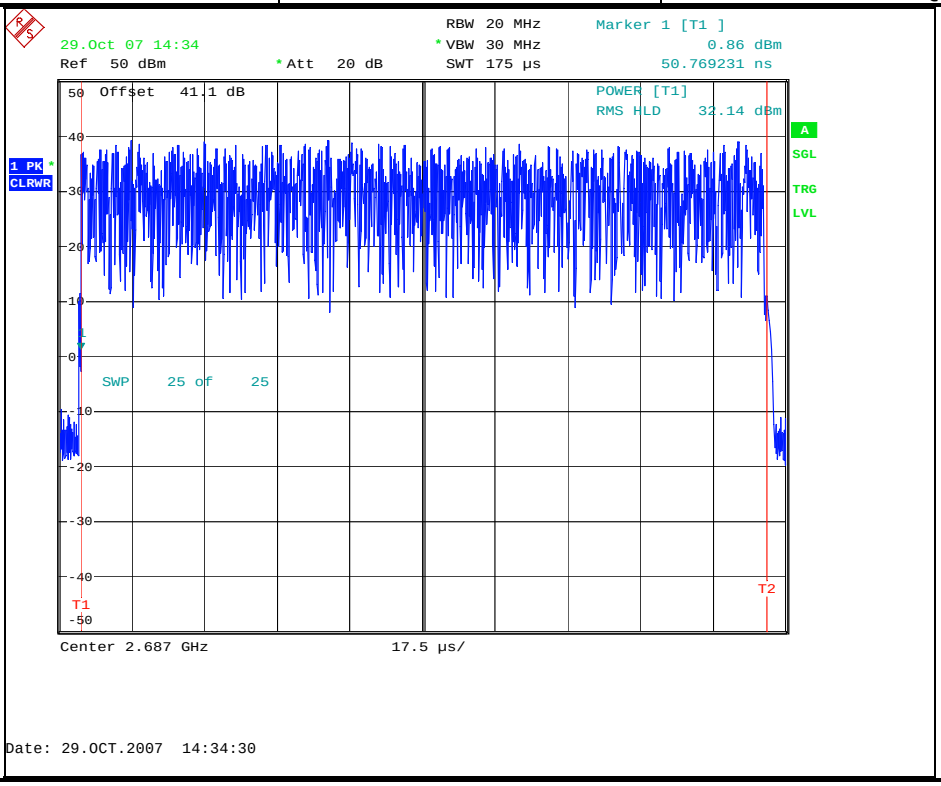


2499 MHz



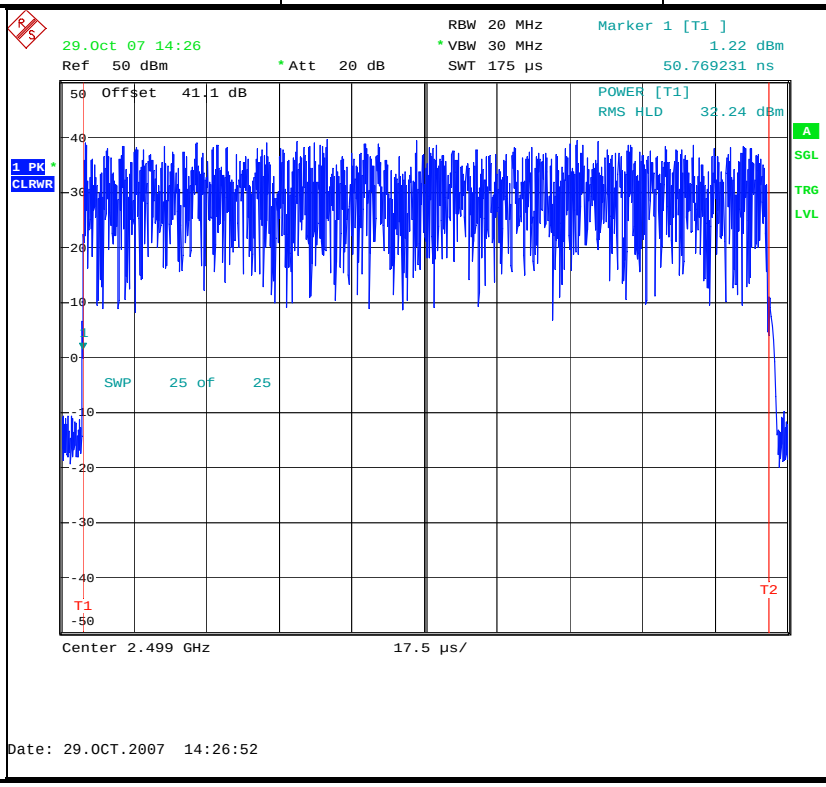
2593 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 6.0 MHz	RF Power: 1.6 Watts	Modulation: 16 QAM



2687 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 6.0 MHz	RF Power: 1.6 Watts	Modulation: 64 QAM



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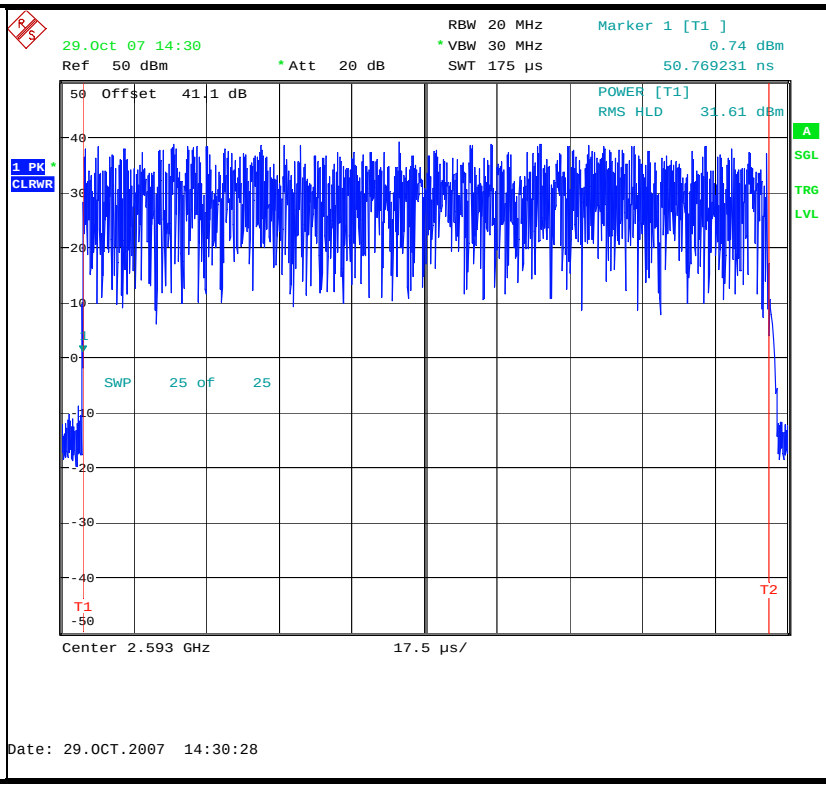
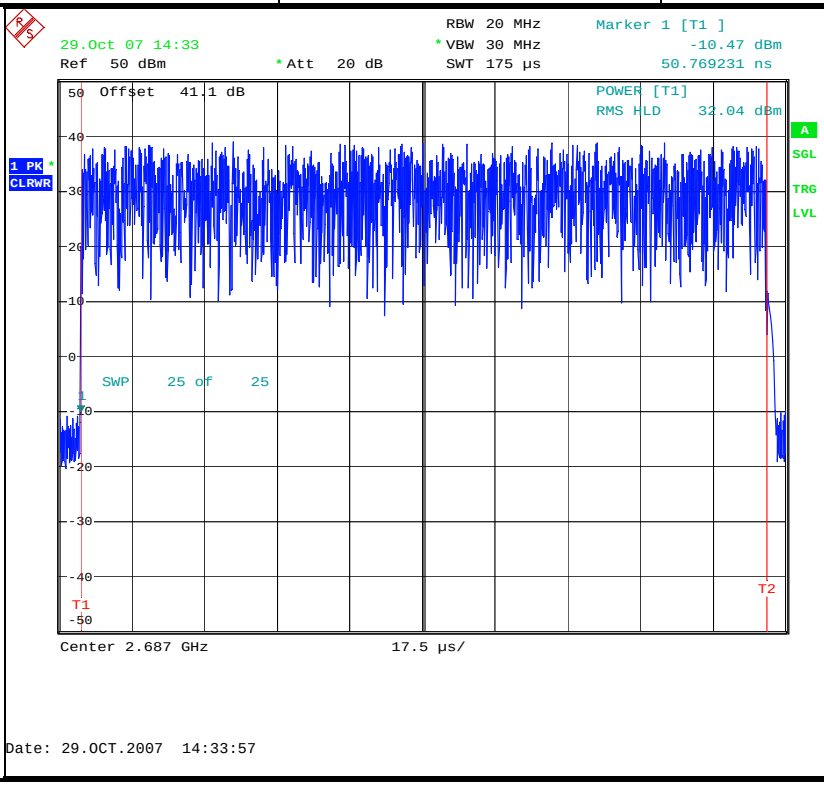


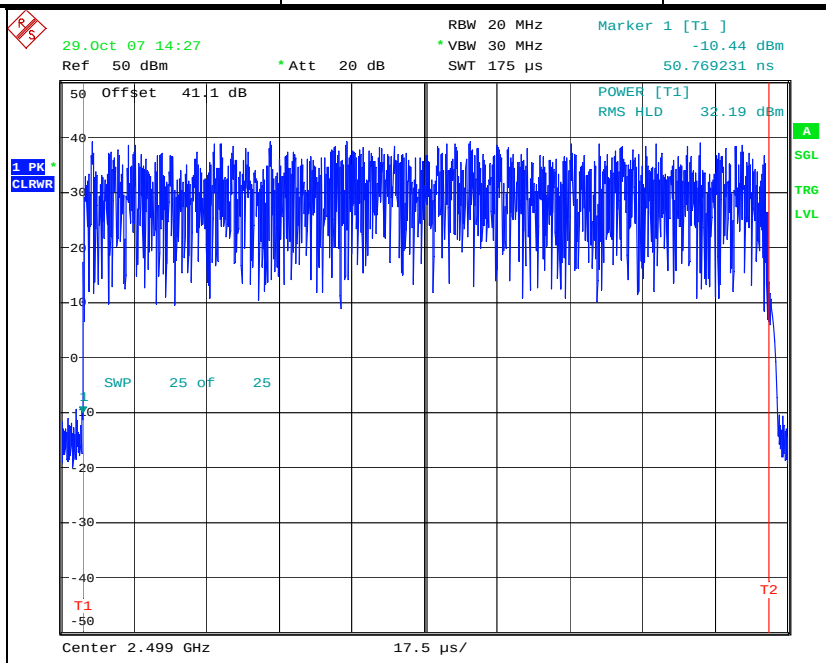
2593 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 6.0 MHz	RF Power: 1.6 Watts	Modulation: 64 QAM



2687 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 6.0 MHz	RF Power: 1.6 Watts	Modulation: 16 QAM Lite



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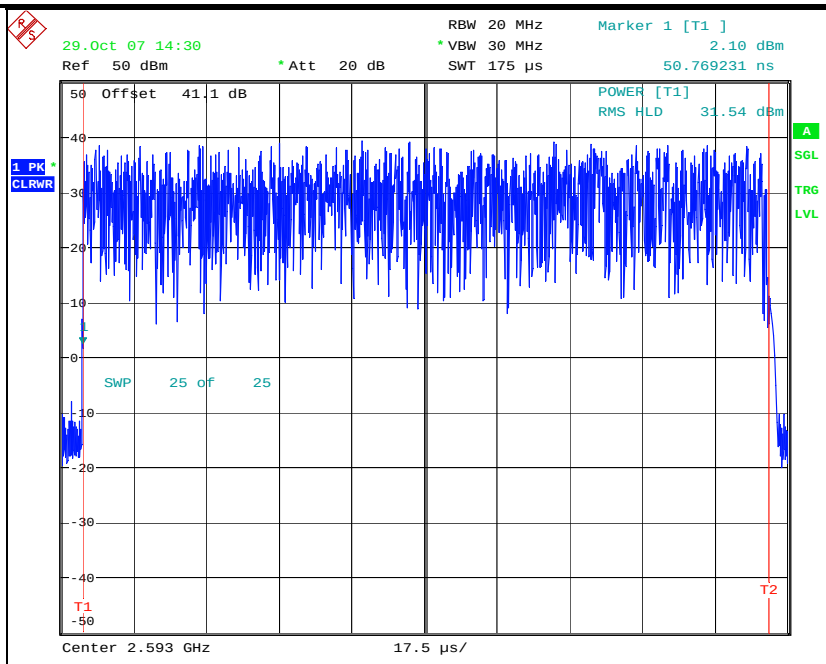
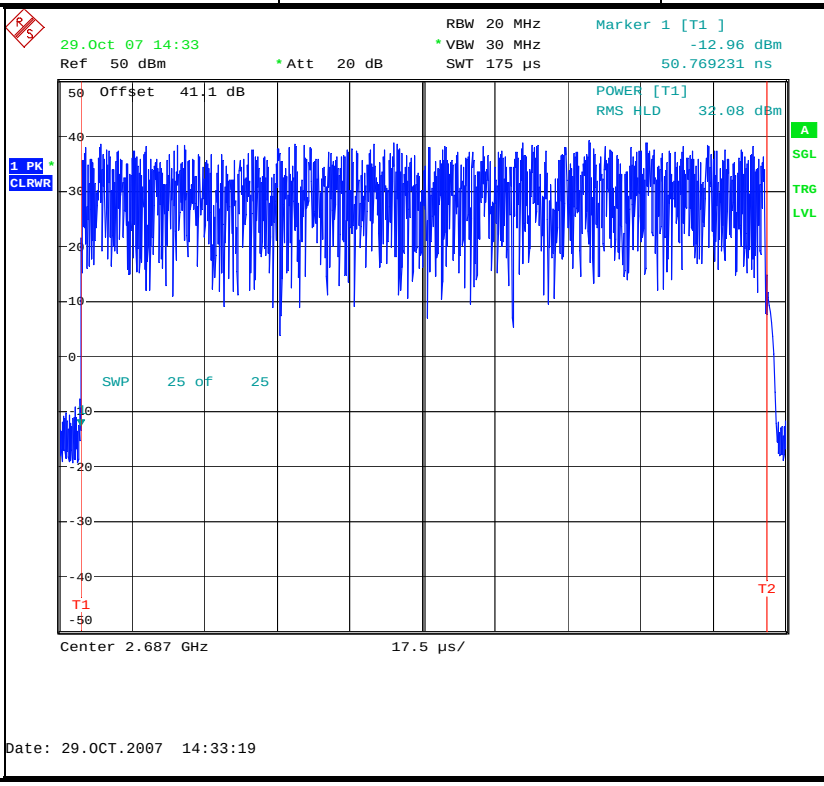


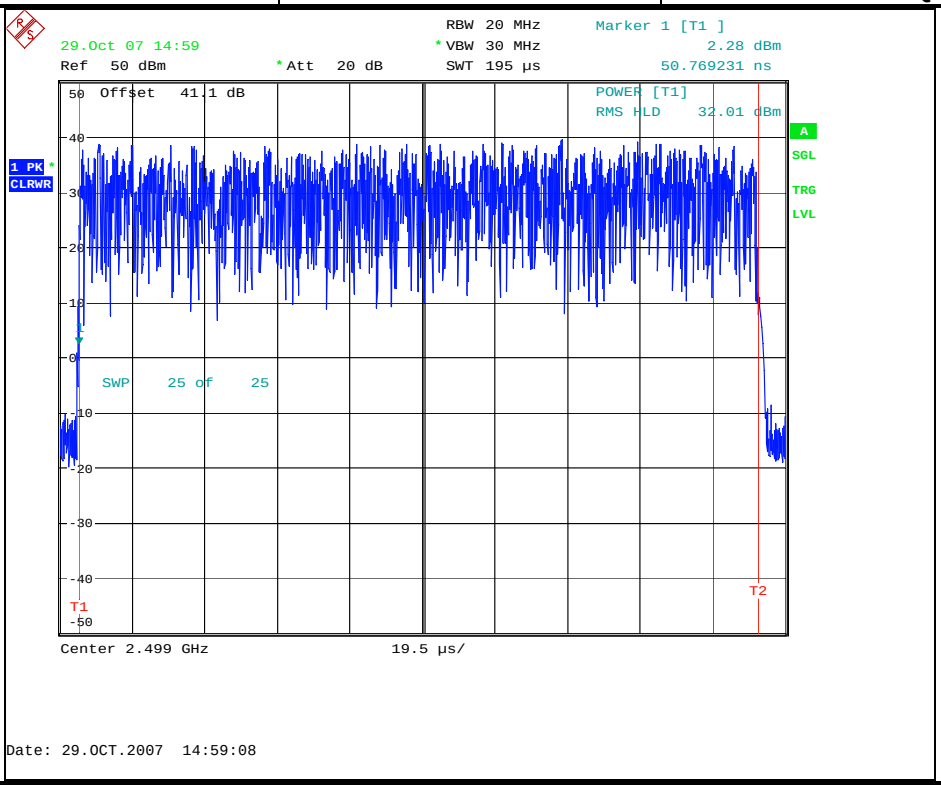
2593 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 6.0 MHz	RF Power: 1.6 Watts	Modulation: 16 QAM Lite



2687 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 5.5 MHz	RF Power: 1.6 Watts	Modulation: 4 QAM



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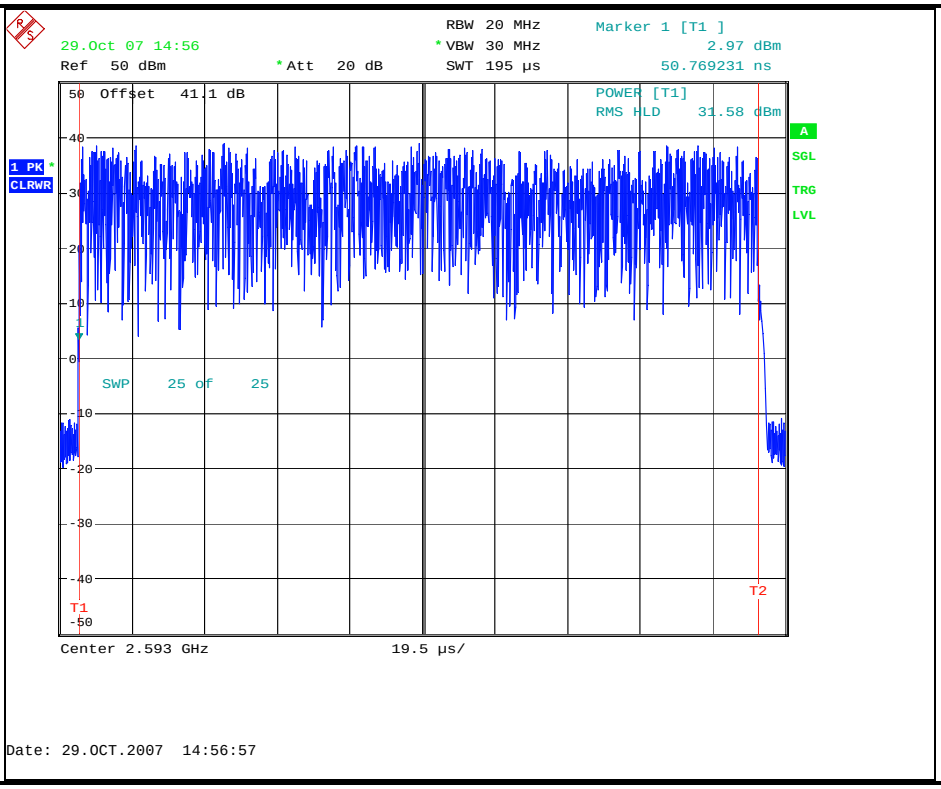
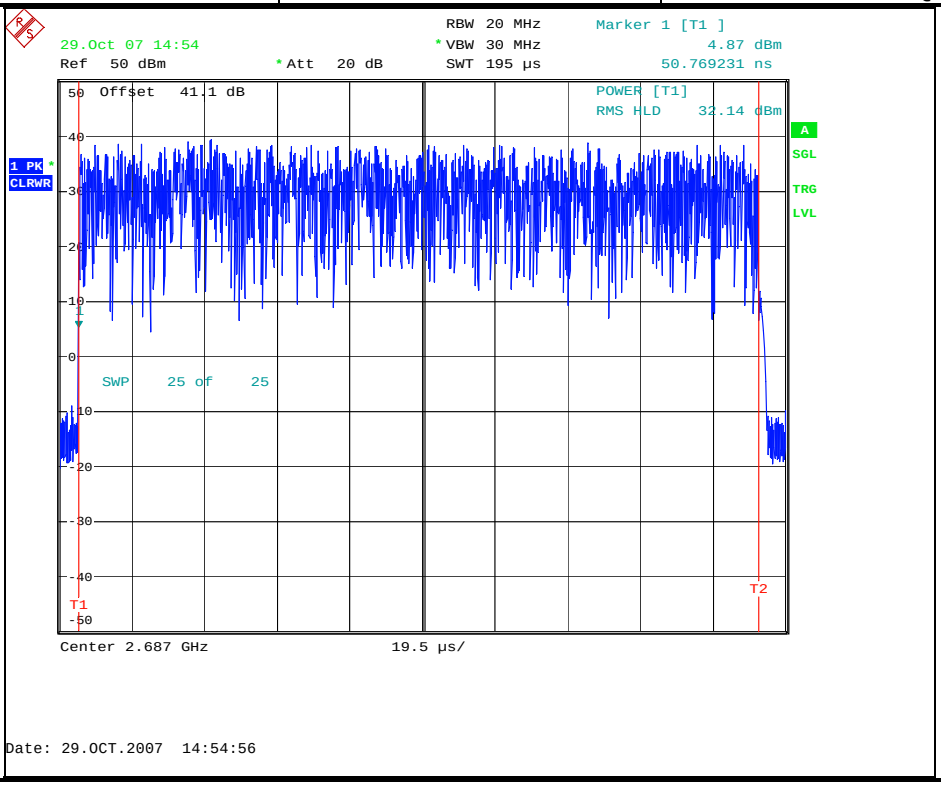


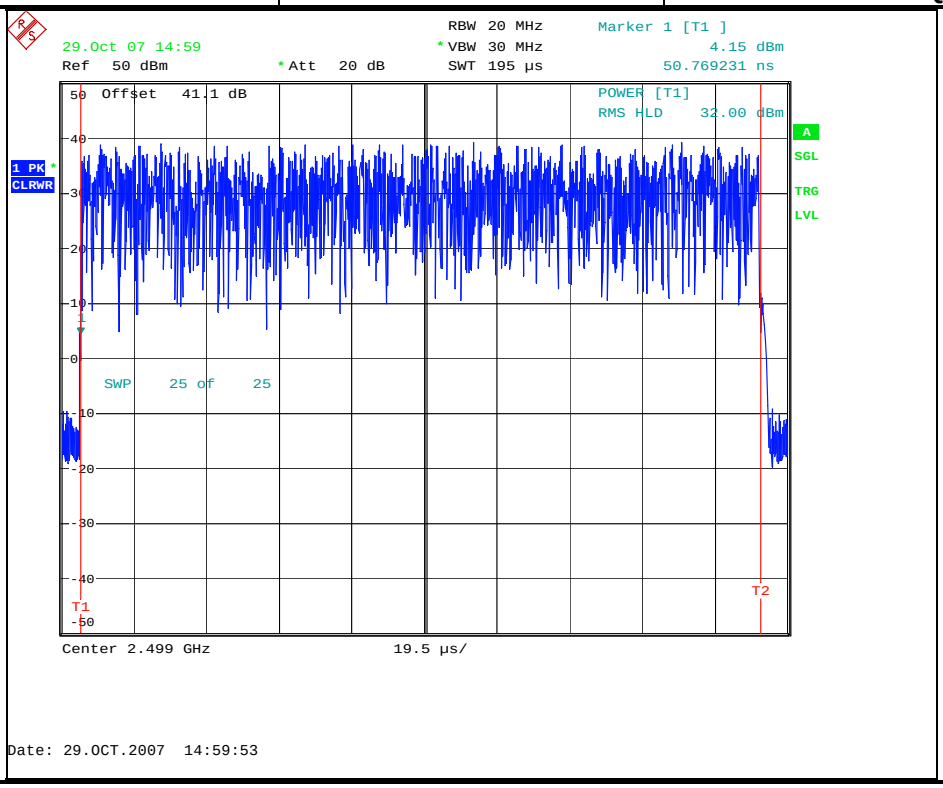
2593 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 5.5 MHz	RF Power: 1.6 Watts	Modulation: 4 QAM

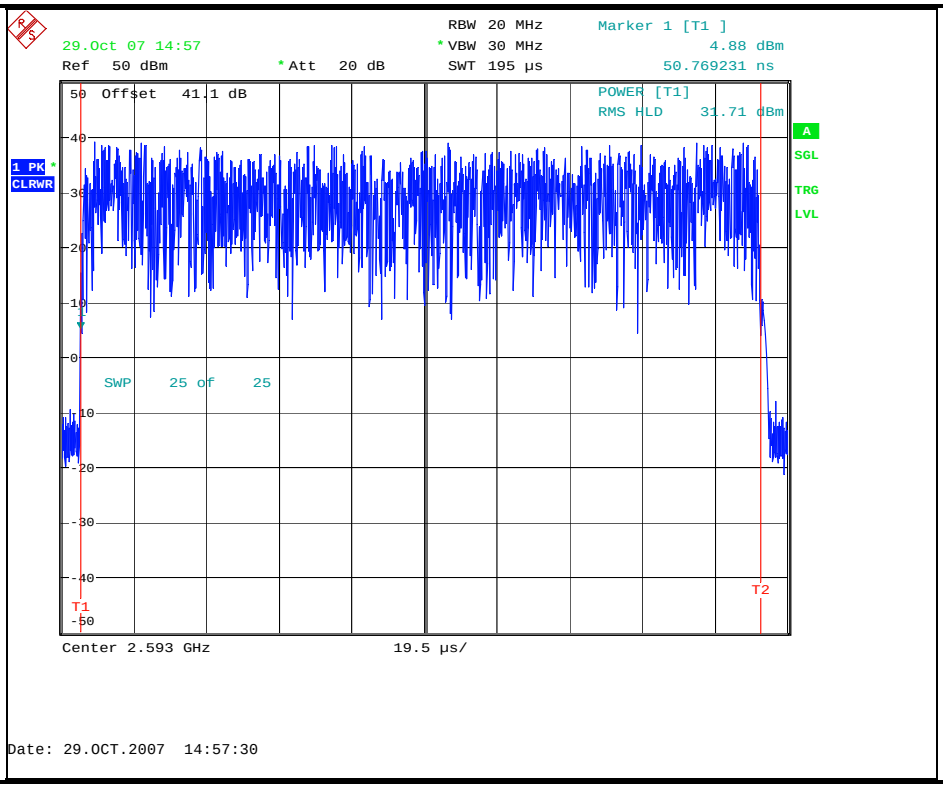


2687 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 5.5 MHz	RF Power: 1.6 Watts	Modulation: 16 QAM

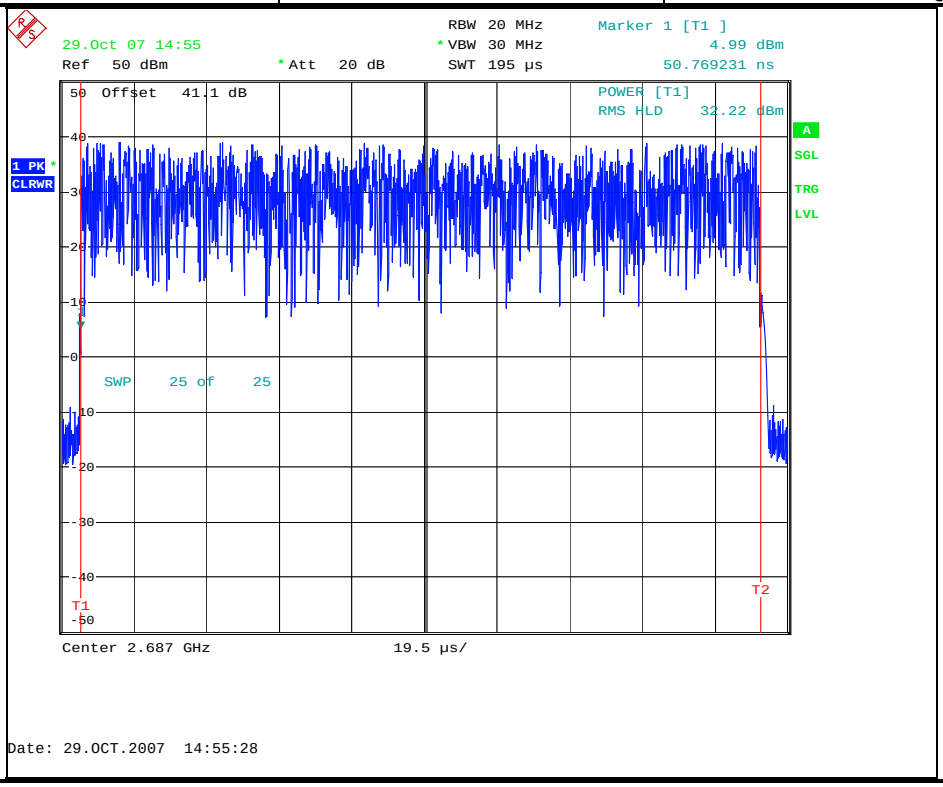


2499 MHz



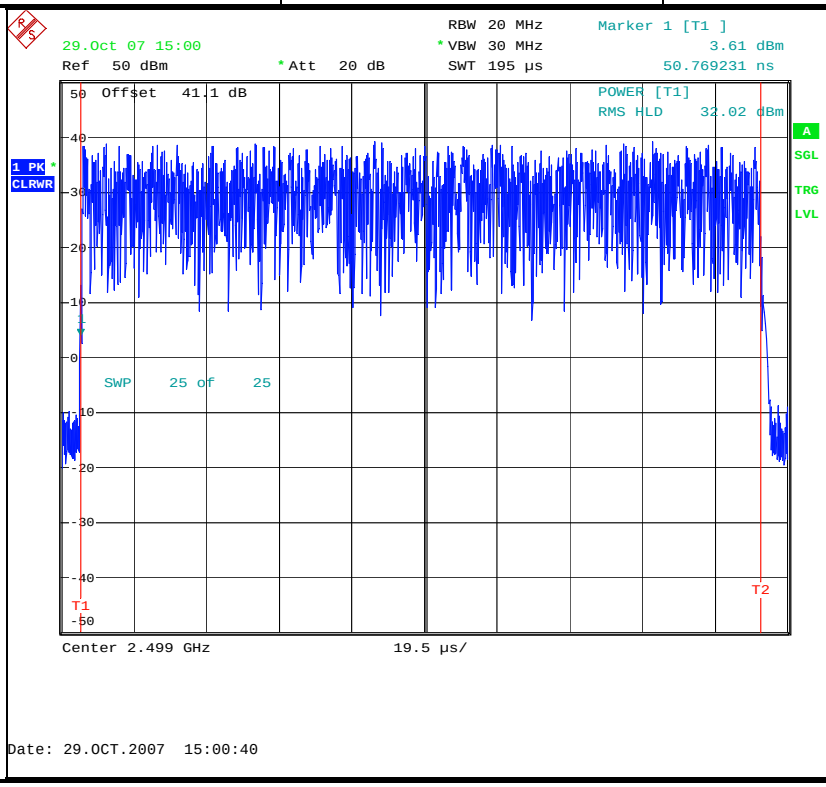
2593 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 5.5 MHz	RF Power: 1.6 Watts	Modulation: 16 QAM

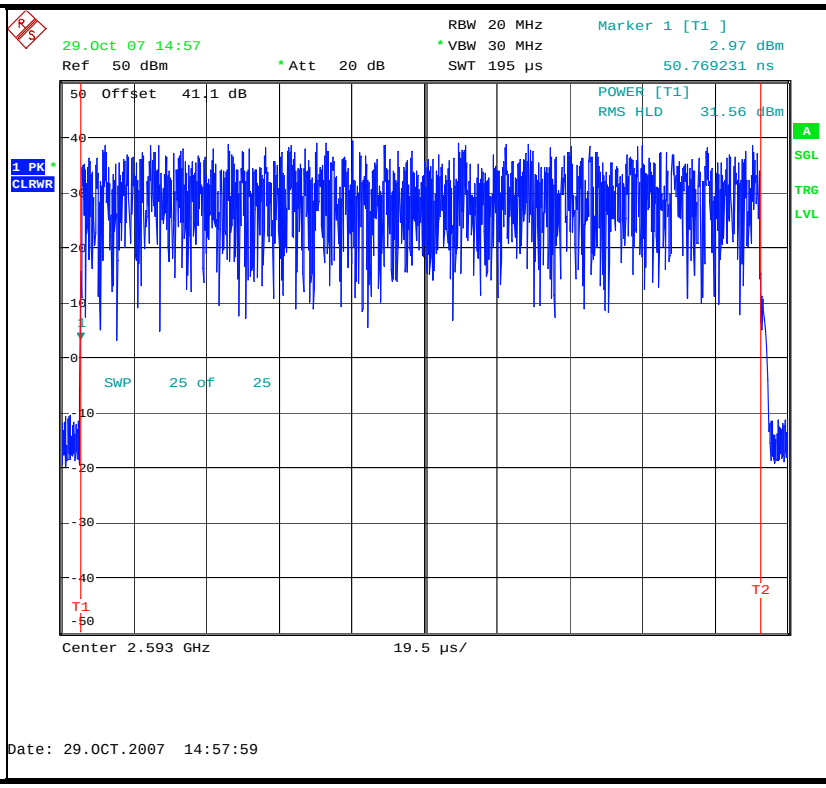


2687 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 5.5 MHz	RF Power: 1.6 Watts	Modulation: 64 QAM

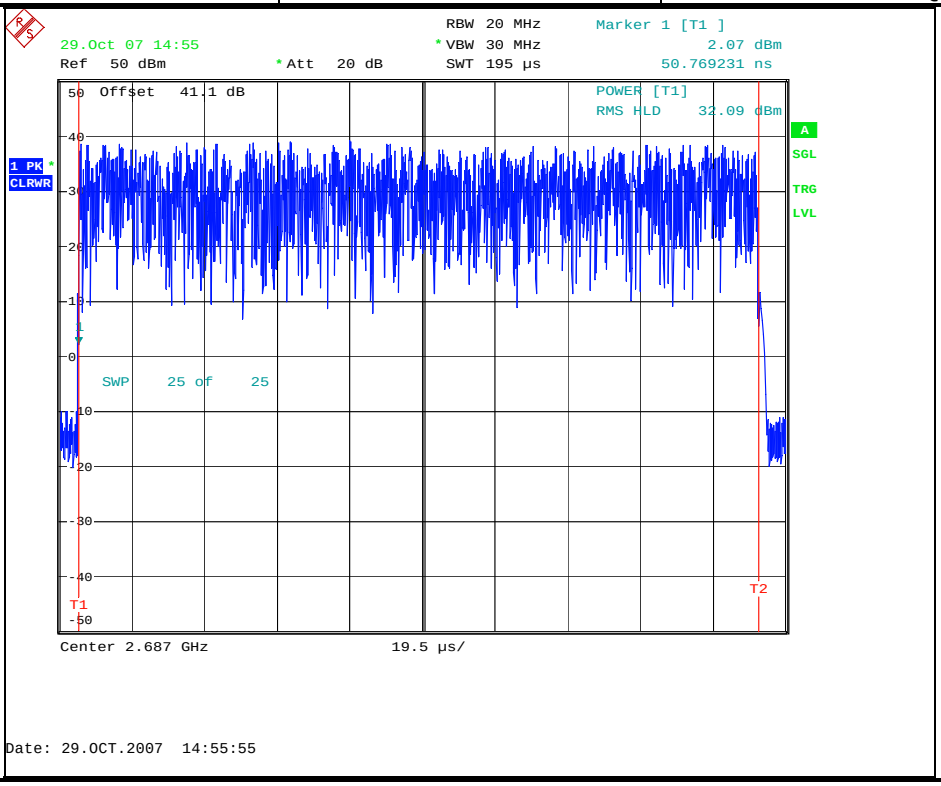


2499 MHz



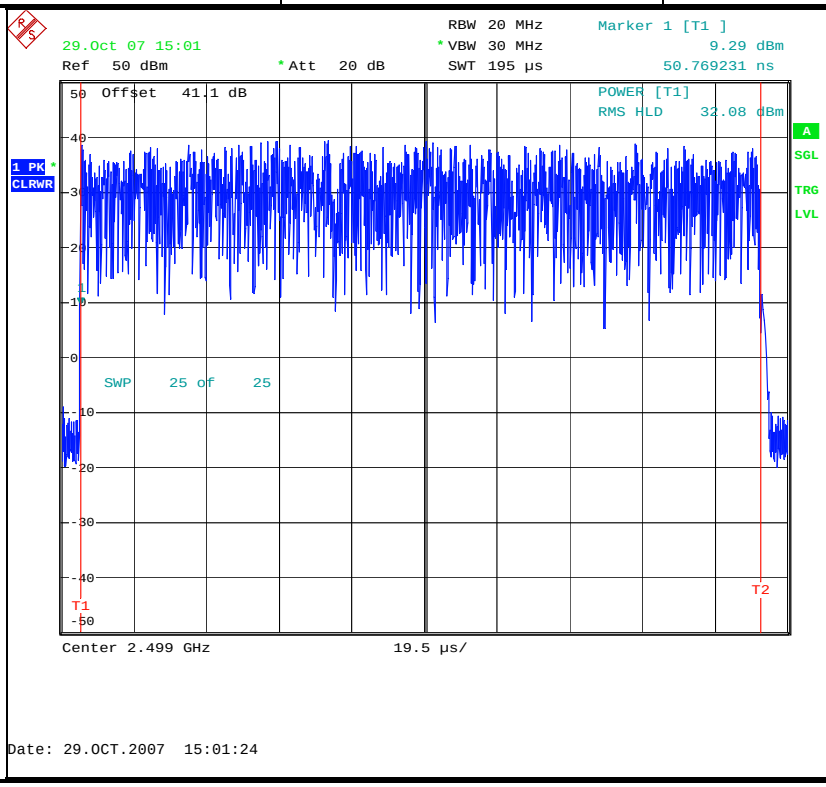
2593 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 5.5 MHz	RF Power: 1.6 Watts	Modulation: 64 QAM

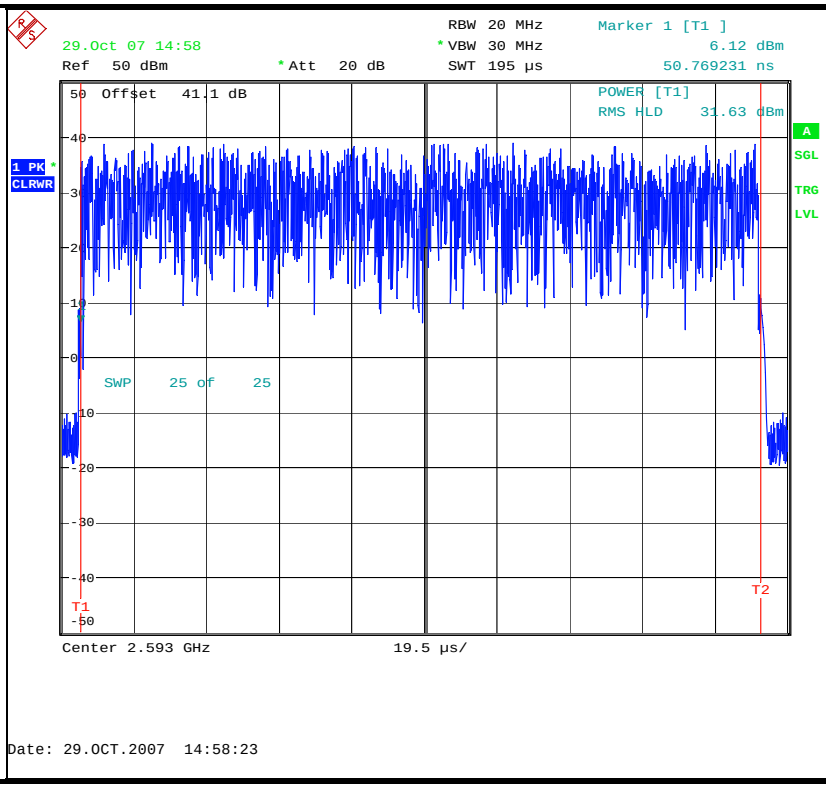


2687 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 5.5 MHz	RF Power: 1.6 Watts	Modulation: 16 QAM Lite

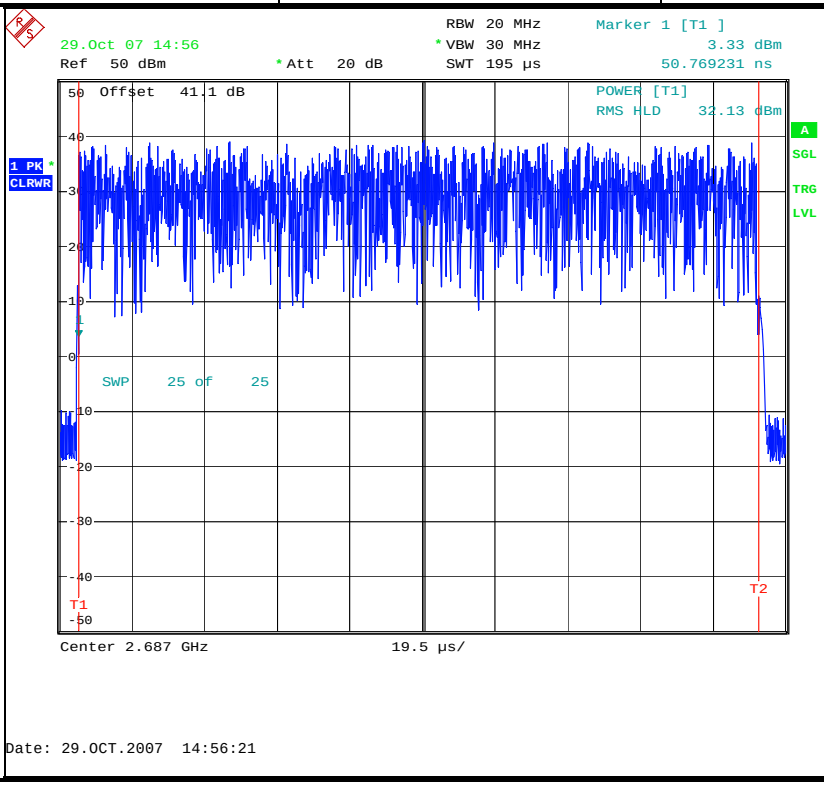


2499 MHz



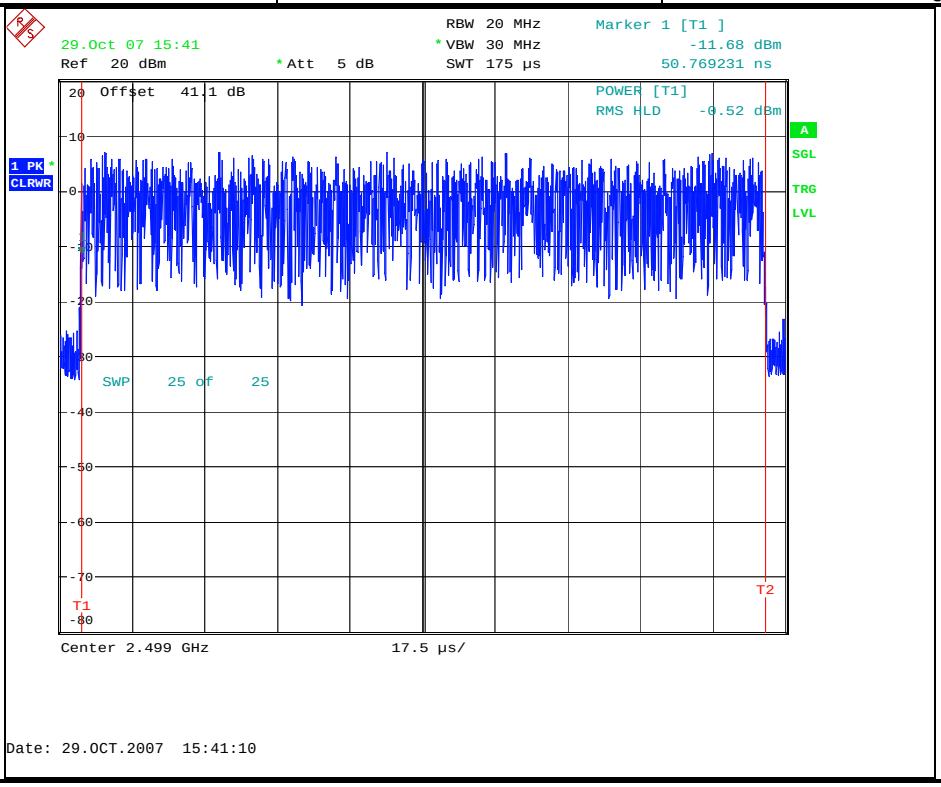
2593 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 5.5 MHz	RF Power: 1.6 Watts	Modulation: 16 QAM Lite

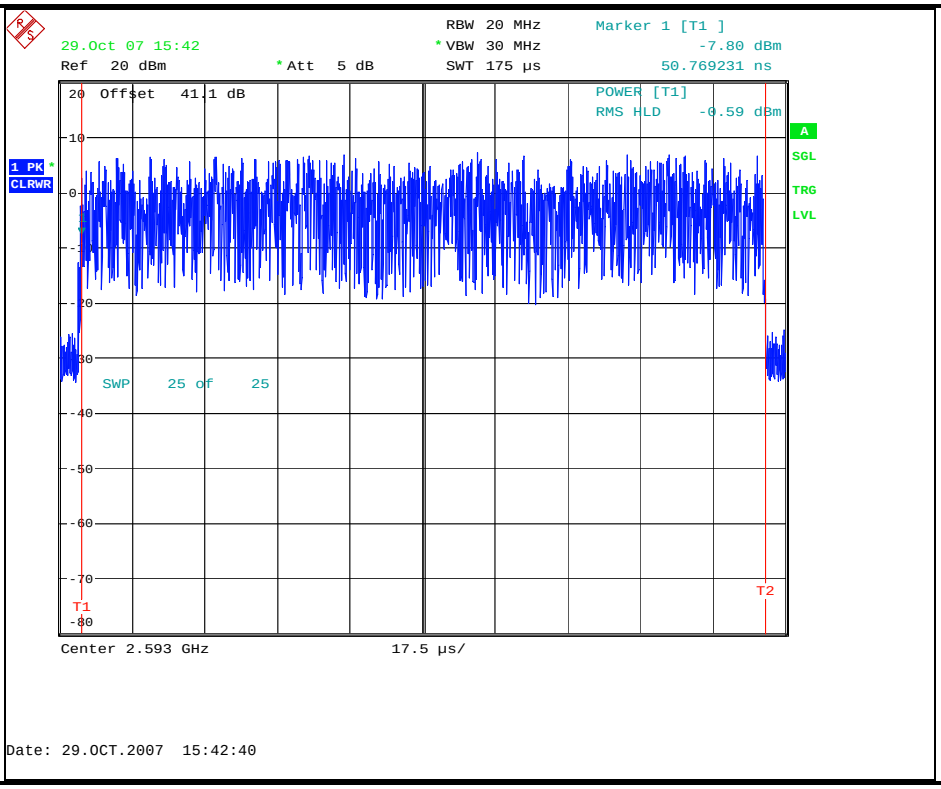


2687 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 6.0 MHz	RF Power: 0.001 Watt	Modulation: 16 QAM

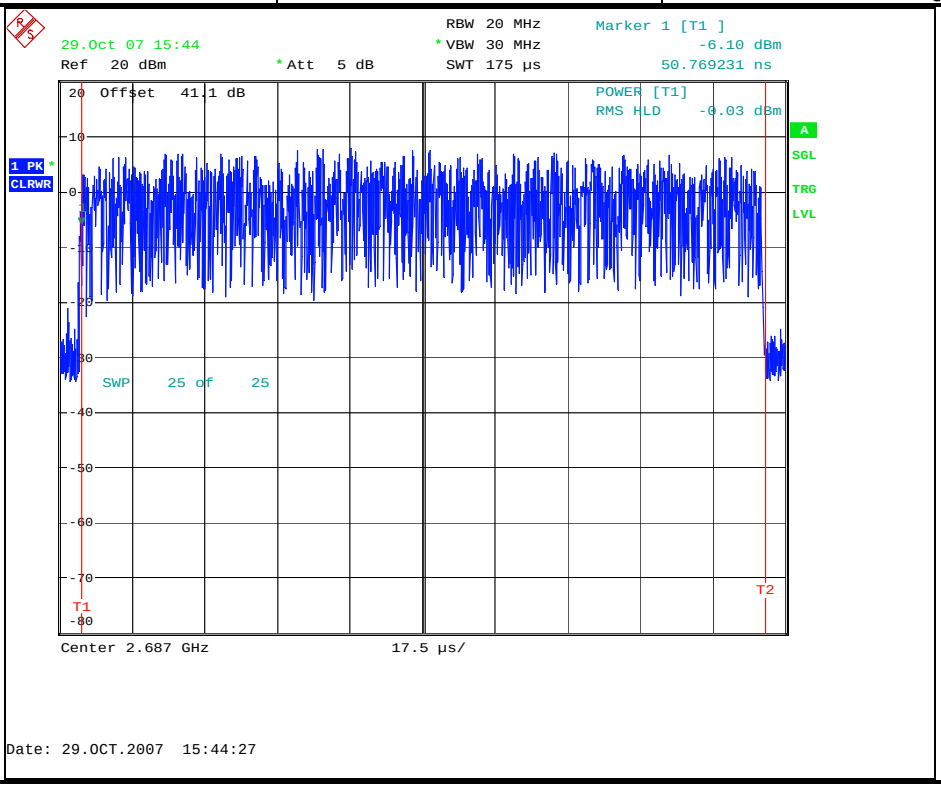


2499 MHz



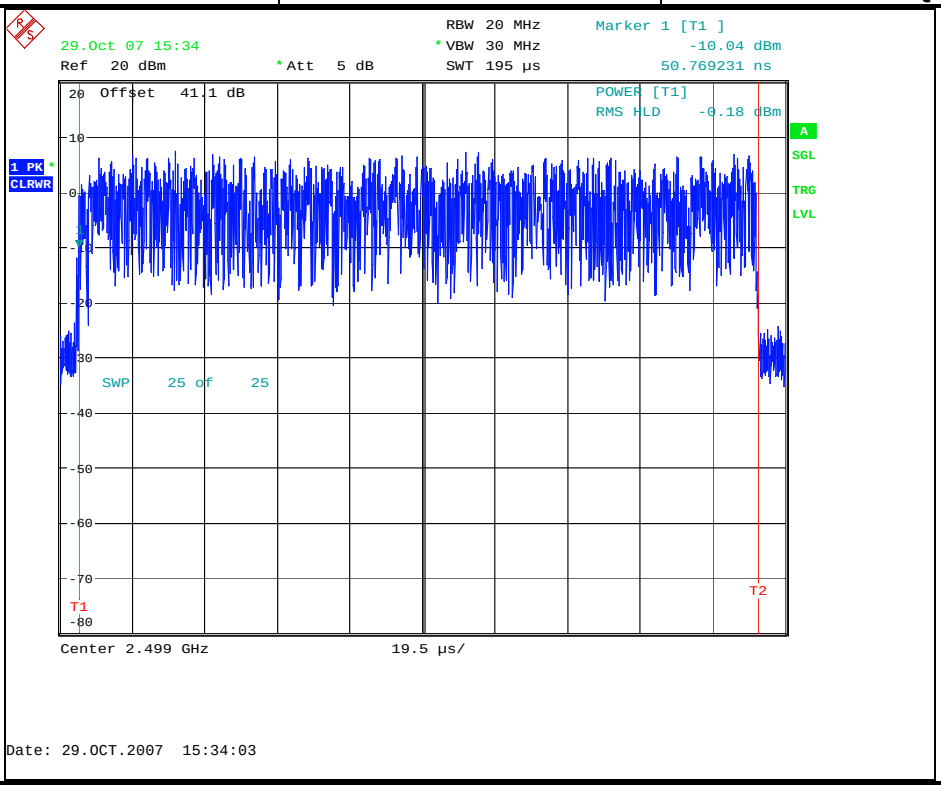
2593 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 6.0 MHz	RF Power: 0.001 Watt	Modulation: 16 QAM

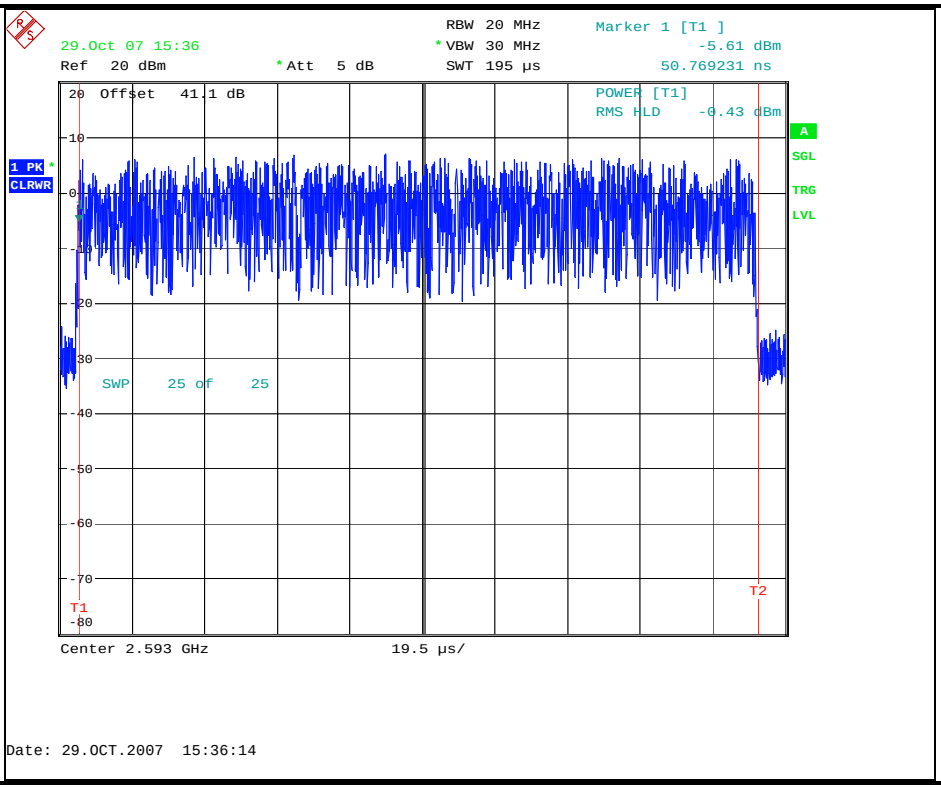


2687 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 5.5 MHz	RF Power: 0.001 Watt	Modulation: 4 QAM

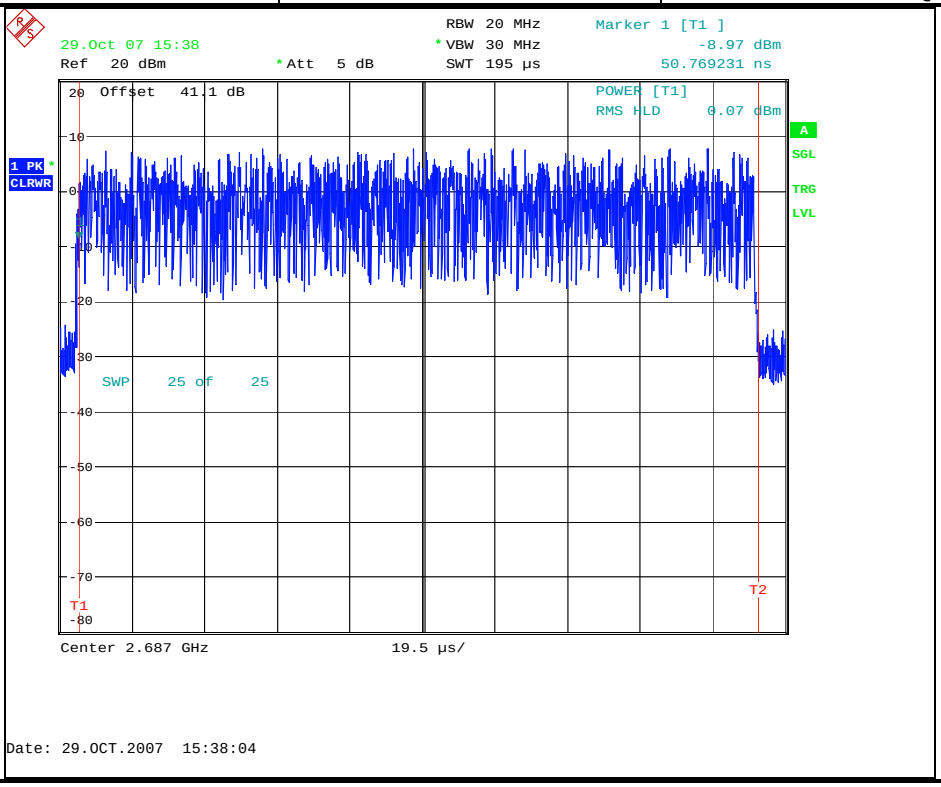


2499 MHz



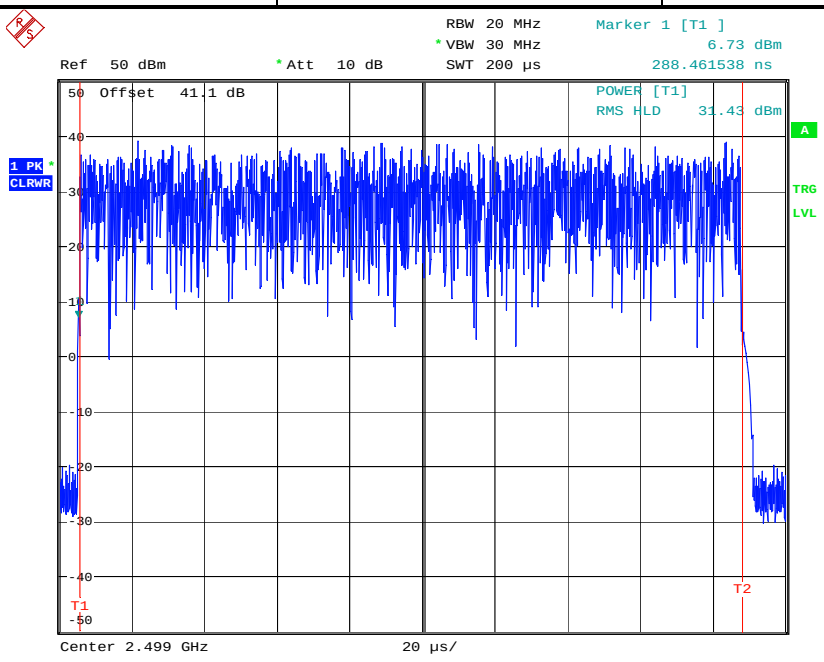
2593 MHz

Accessory Antenna Port	S/N: 40DA94	
Bandwidth: 5.5 MHz	RF Power: 0.001 Watt	Modulation: 4 QAM



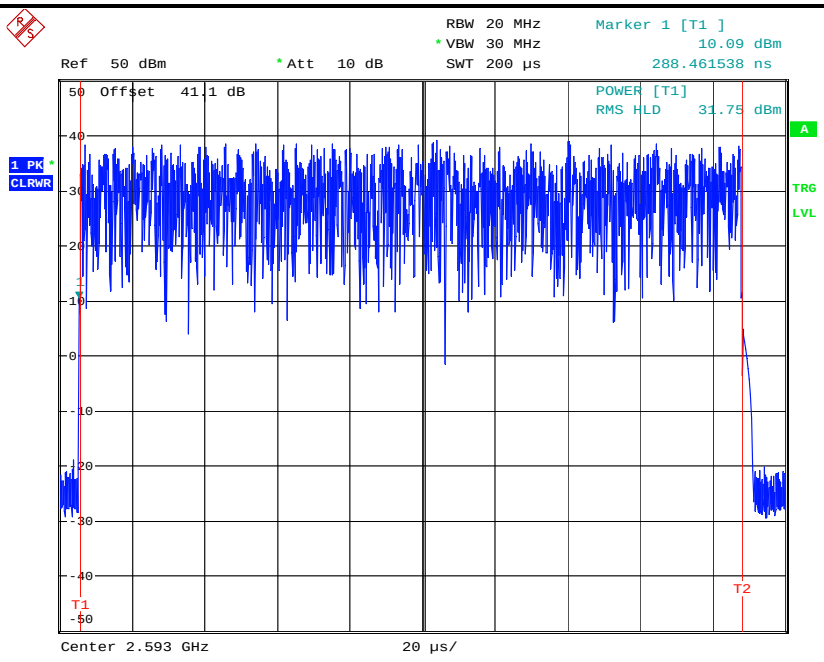
2687 MHz

Accessory Antenna Port	S/N: 403988	
Bandwidth: 5.5 MHz	RF Power: 1.6 Watts	Modulation: 64 QAM



Date: 6.FEB.2008 09:13:35

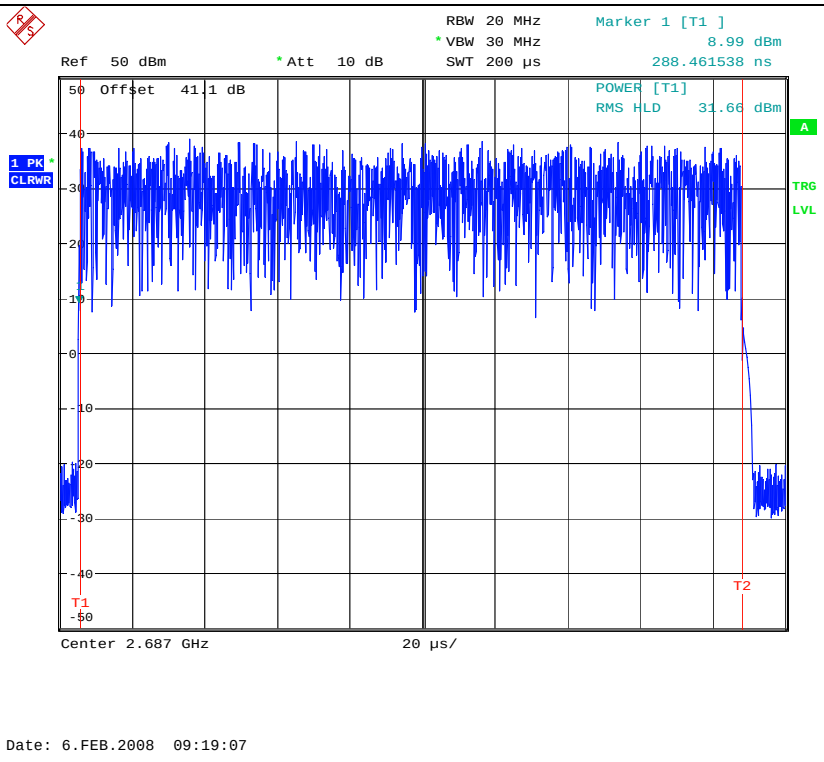
2499 MHz



Date: 6.FEB.2008 09:16:37

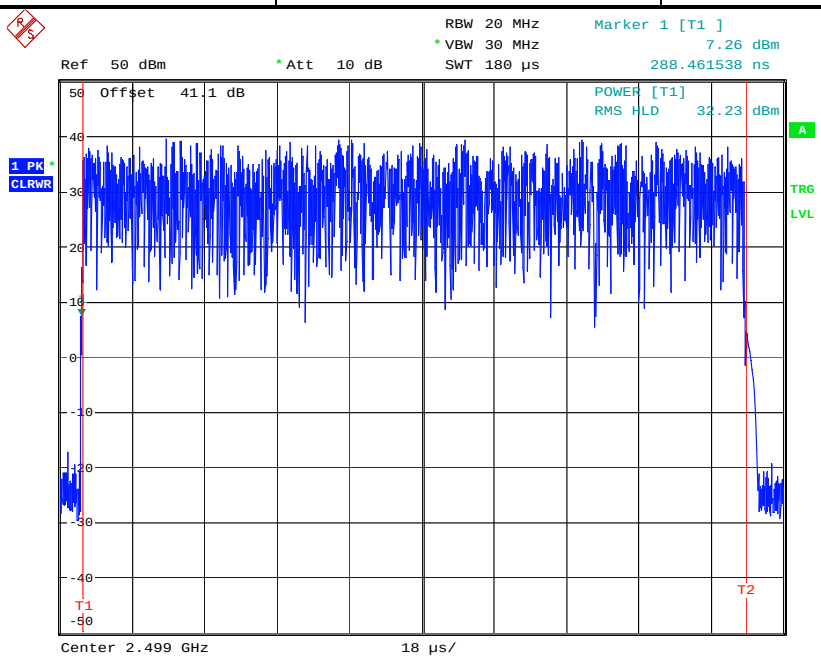
Accessory Antenna Port	S/N: 403988	
Bandwidth: 5.5 MHz	RF Power: 1.6 Watts	Modulation: 64 QAM

2593 MHz



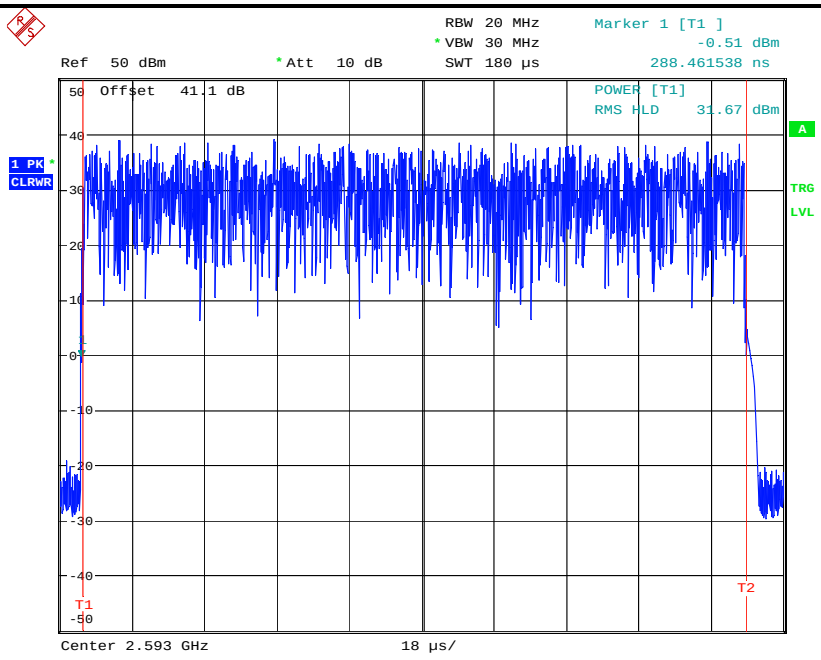
2687 MHz

Accessory Antenna Port	S/N: 2E14	
Bandwidth: 6.0 MHz	RF Power: 1.6 Watts	Modulation: 4 QAM



Date: 6.FEB.2008 09:59:12

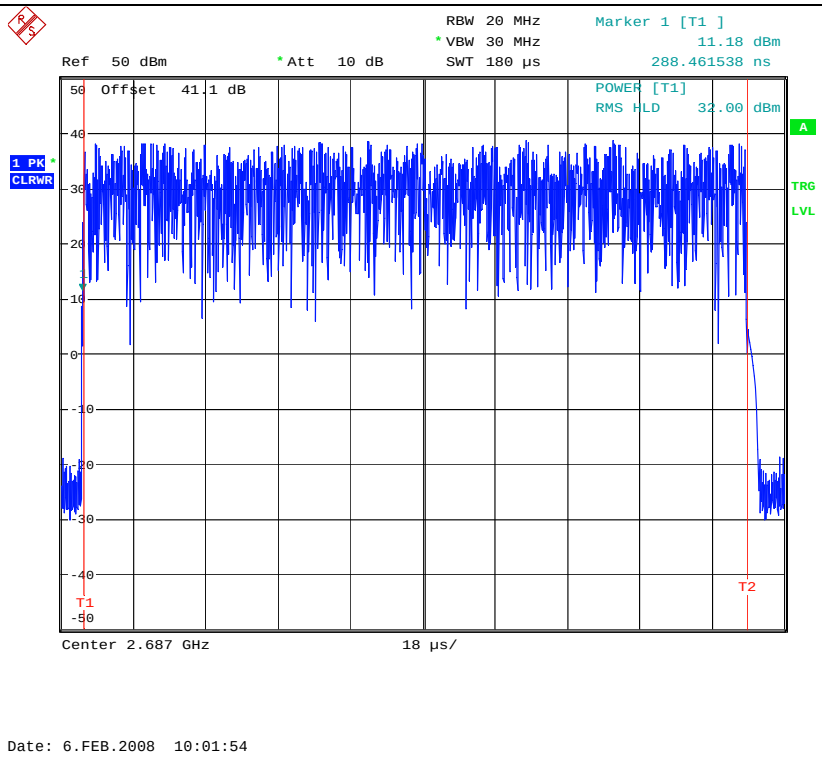
2499 MHz



Date: 6.FEB.2008 10:00:00

Accessory Antenna Port	S/N: 2E14	
Bandwidth: 6.0 MHz	RF Power: 1.6 Watts	Modulation: 4 QAM

2593 MHz

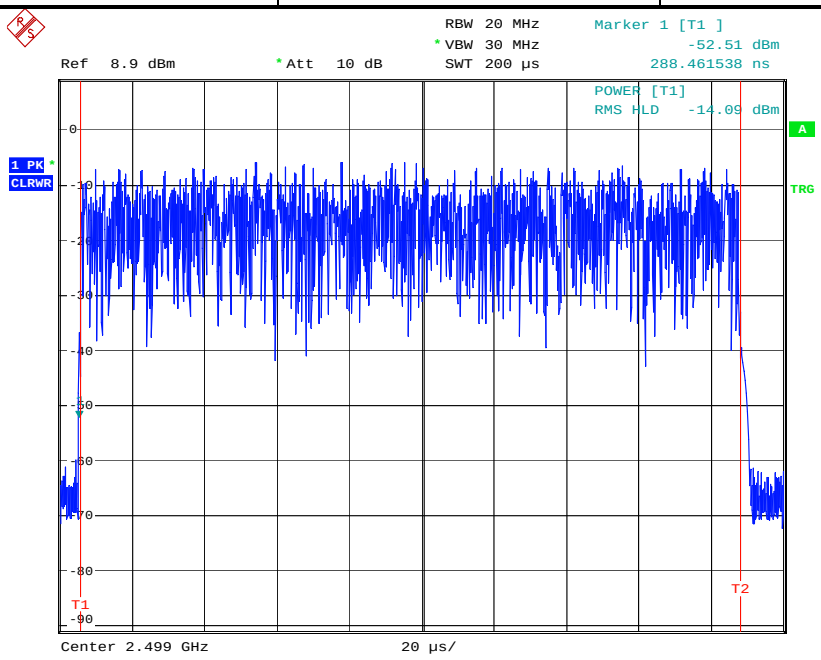


2687 MHz

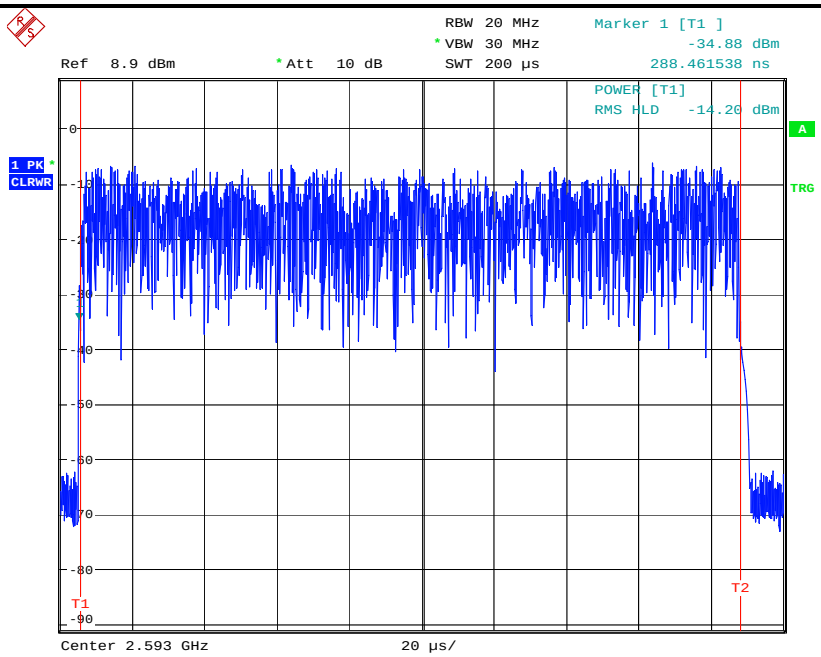
5.3.4 Internal Antenna Radiated Output Power Plots

The spectrum analyzer plots from the integrated antenna radiated power measurements from card S/N 403988 and 2E14 are displayed on the following pages.

Accessory Antenna Port	S/N: 403988	
Bandwidth: 5.5 MHz	RF Power: 2 Watts EIRP	Modulation: 4 QAM

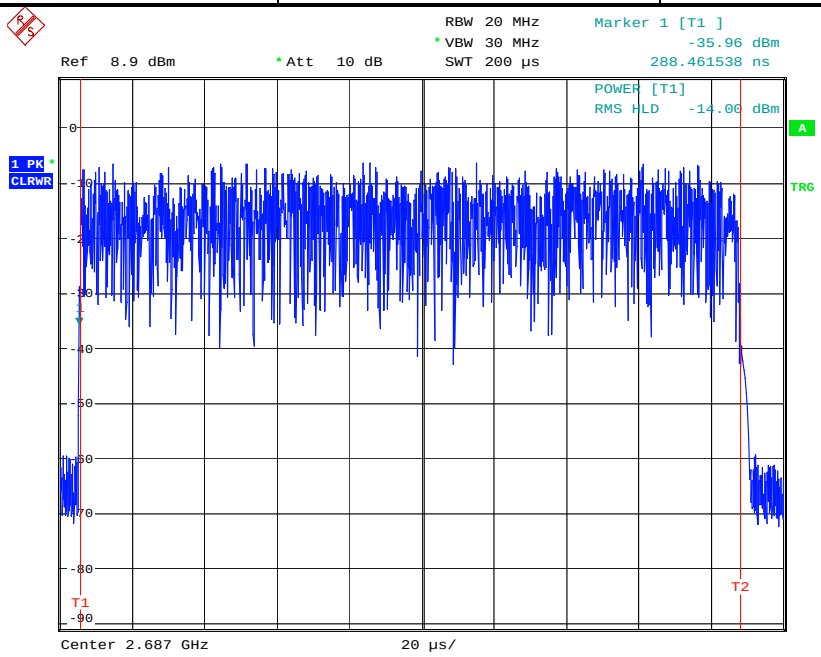


2499 MHz



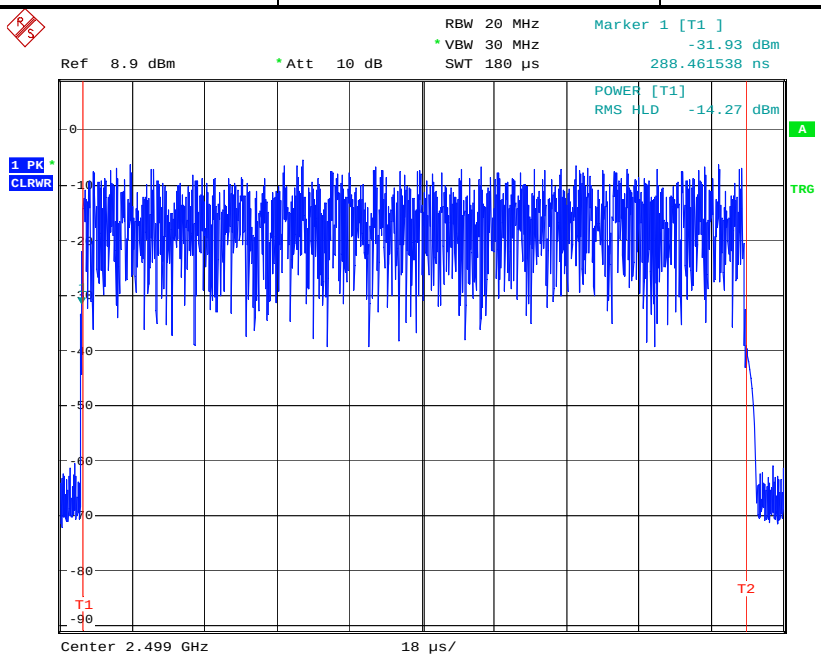
2593 MHz

Accessory Antenna Port	S/N: 403988	
Bandwidth: 5.5 MHz	RF Power: 2 Watts EIRP	Modulation: 4 QAM

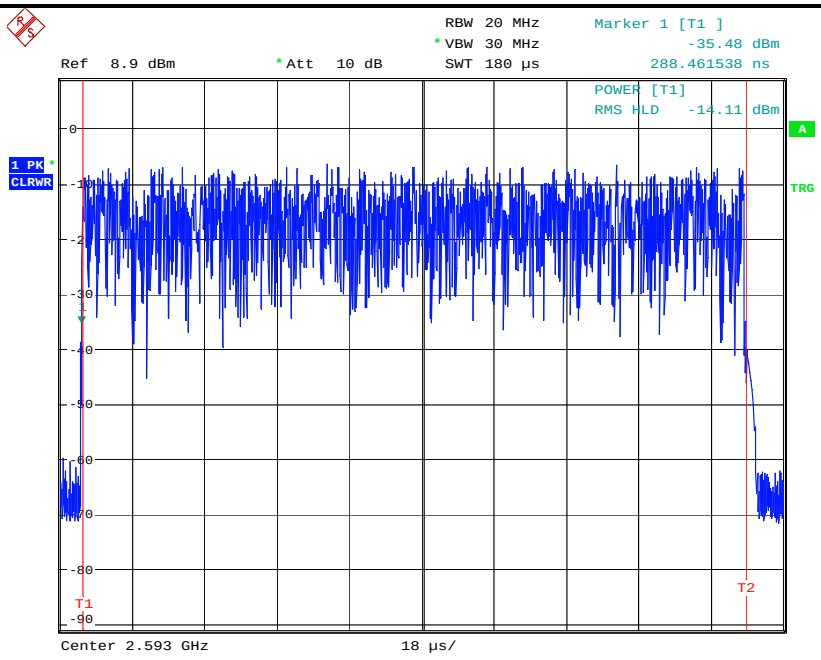


2687 MHz

Accessory Antenna Port	S/N: 403988	
Bandwidth: 6.0 MHz	RF Power: 2 Watts EIRP	Modulation: 4 QAM

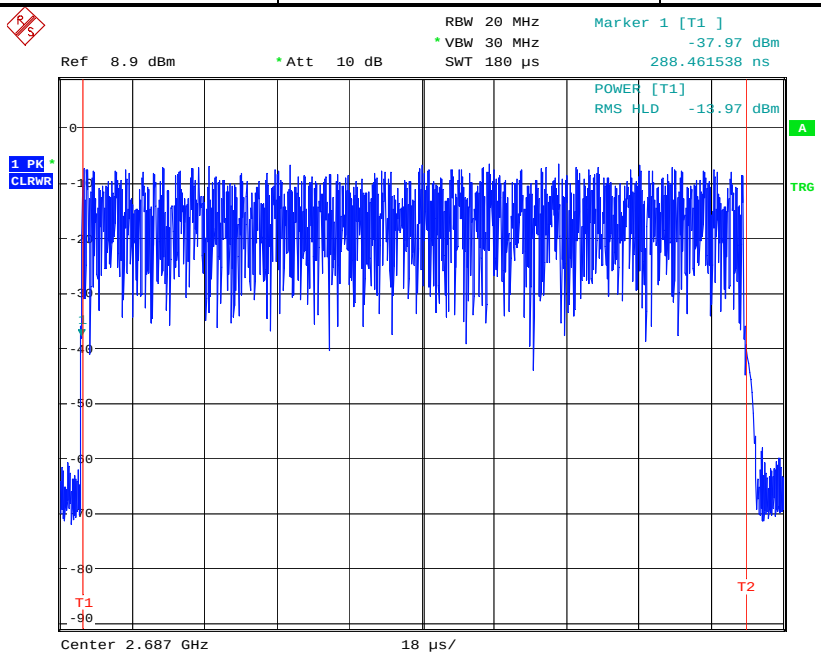


2499 MHz



2593 MHz

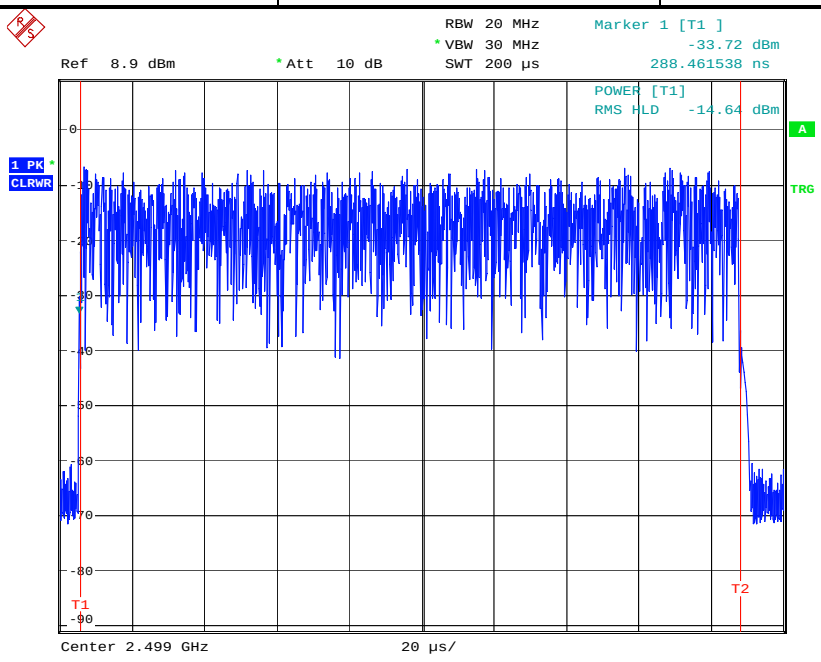
Accessory Antenna Port	S/N: 403988	
Bandwidth: 6.0 MHz	RF Power: 2 Watts EIRP	Modulation: 4 QAM



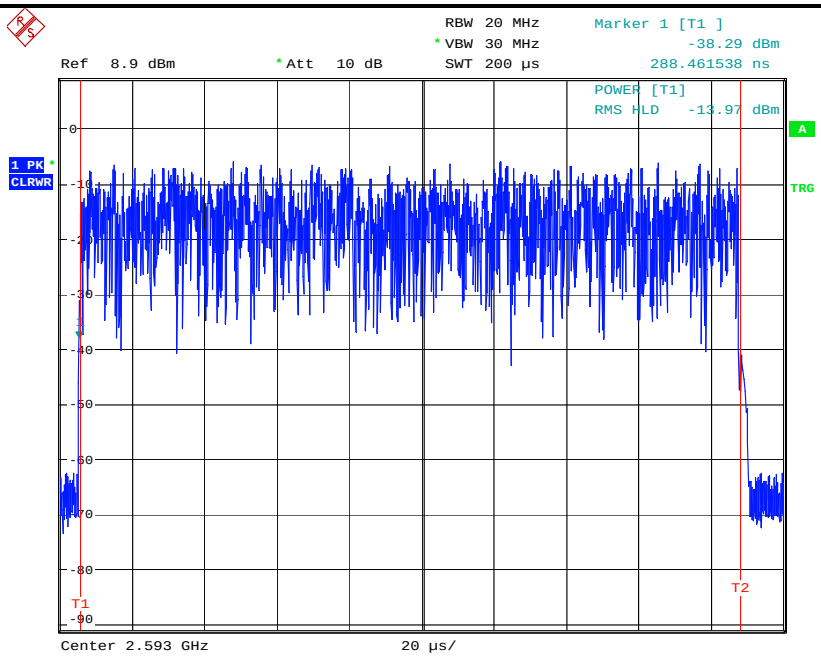
Date: 7.FEB.2008 14:37:43

2687 MHz

Accessory Antenna Port	S/N: 2E14	
Bandwidth: 5.5 MHz	RF Power: 2 Watts EIRP	Modulation: 4 QAM

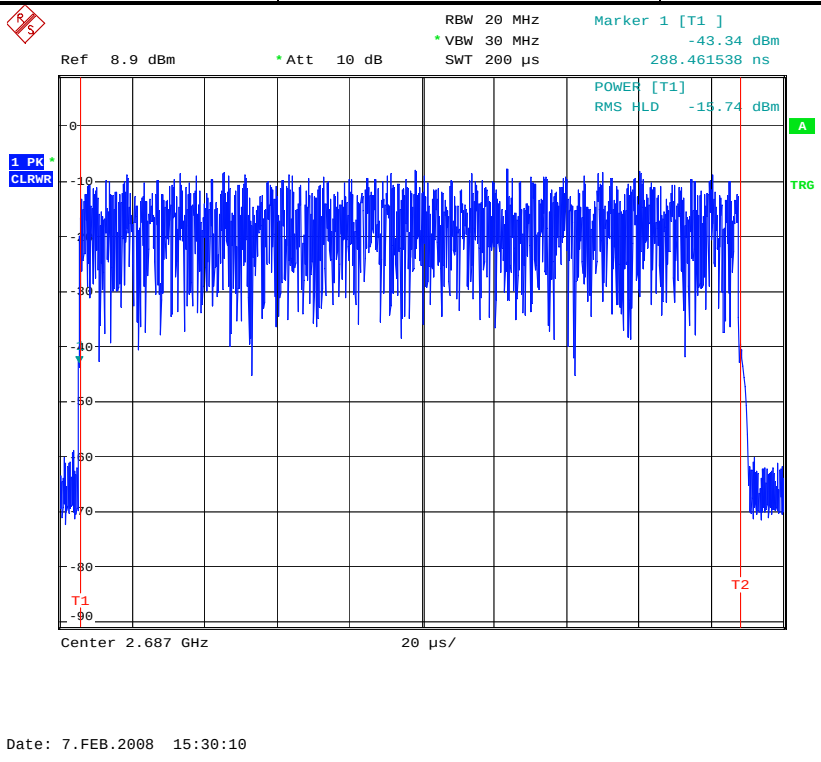


2499 MHz



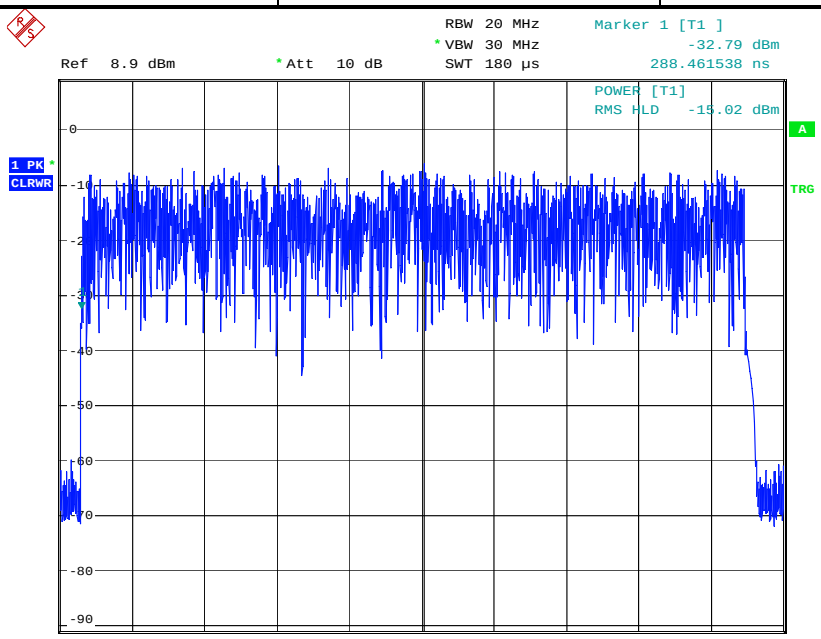
2593 MHz

Accessory Antenna Port	S/N: 2E14	
Bandwidth: 5.5 MHz	RF Power: 2 Watts EIRP	Modulation: 4 QAM



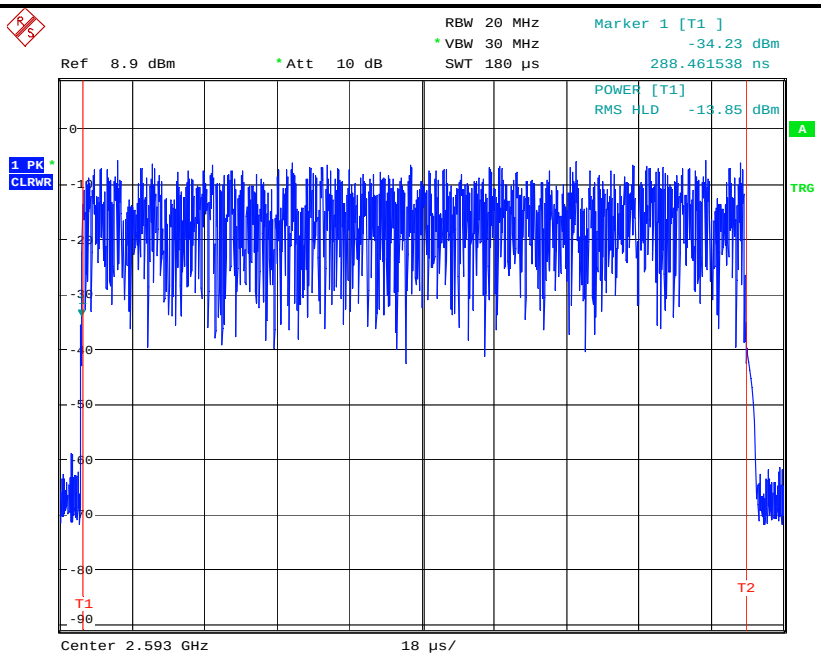
2687 MHz

Accessory Antenna Port	S/N: 2E14	
Bandwidth: 6.0 MHz	RF Power: 2 Watts EIRP	Modulation: 4 QAM



Date: 7.FEB.2008 16:02:09

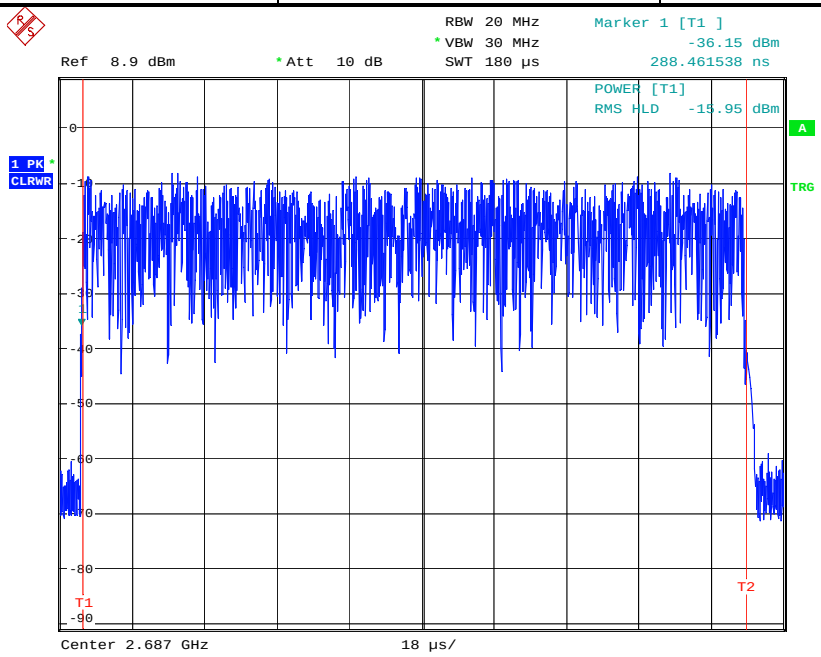
2499 MHz



Date: 7.FEB.2008 15:51:32

2593 MHz

Accessory Antenna Port	S/N: 2E14	
Bandwidth: 6.0 MHz	RF Power: 2 Watts EIRP	Modulation: 4 QAM



Date: 7.FEB.2008 15:48:08

2687 MHz

Modulation Characteristics

FCC Rules: 2.1047(d), 27.53(m)(4), 27.53(m)(6)

FCC requirement: Mobile Digital Stations
Attenuation at band edge
= 43 + 10*log(P), P= 1.6 watts
= 43 + 10*log(1.6) = 43 + 2
= 45 dB (equates to -13 dBm)
Attenuation from 5.5 MHz from band edge
= 55 + 10*log(P), P=1.6 watts
= 55 + 10*log(1.6) = 55 + 2
= 57 dB (equates to -25 dBm)

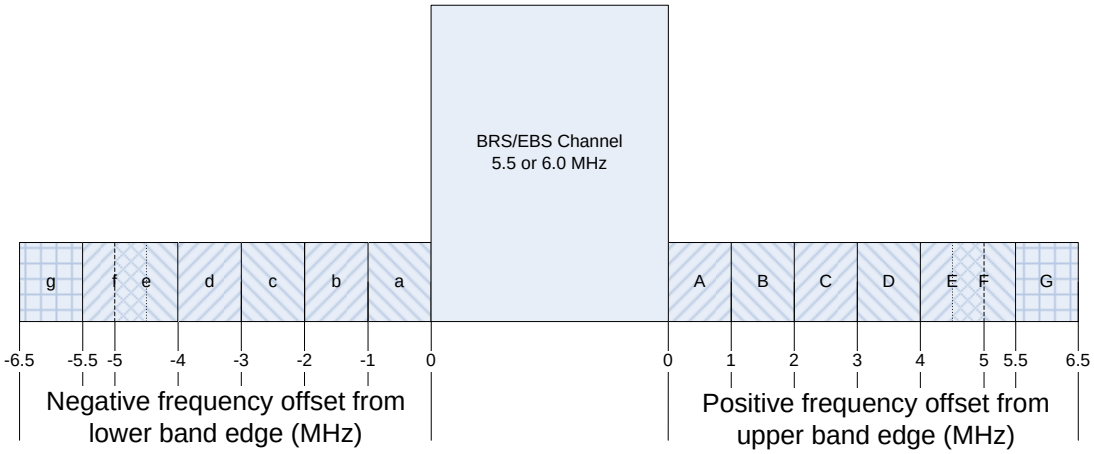
Standard: 47CFR27.53(m)(4)

Test Procedure: The Orthogonal Frequency Division Multiple Access (OFDMA) modulated Time Division Duplex (TDD) RF signal from the test unit is applied to a spectrum analyzer. A detector that has been calibrated in terms of rms-equivalent voltage is used to measure the power of the out of band emission. The emissions have been recorded and show compliance to the -13 dBm and –25 dBm requirement. As allowed per the FCC rules, a measurement bandwidth of 100 kHz (1% or greater of the emissions bandwidth) was used for the test.

The Motorola PCEx25100 transmitter has been designed to comply with the mobile mask requirements of 27.53(m)(4). As such, the FCC mask for the BRS/EBS rules requires the spectral emissions to be less than –13 dBm in any 1 MHz of spectrum from the channel edge to 5.5 MHz from the channel edge, and –25 dBm in a 1 MHz bandwidth beginning at 5.5 MHz from the channel edge.

The first 1 MHz of spectral power outside of the channel must be less than –13 dBm when measured with a resolution bandwidth that is at least 1% of the transmitted signal emissions bandwidth.

All other emissions, shown as bins b/B thru g/G, must be measured with a 1 MHz resolution bandwidth or at least a 1% resolution bandwidth and then integrate the spectral power over a 1 MHz frequency span. The worst case emission for the –13 dBm limit is found at bins b/B. The –25 dBm limit at +/– 5.5 MHz from the channel edge is shown on the plots as bins g/G. The table in section 5.3.5 contains a summary of the plot information for the test configurations.



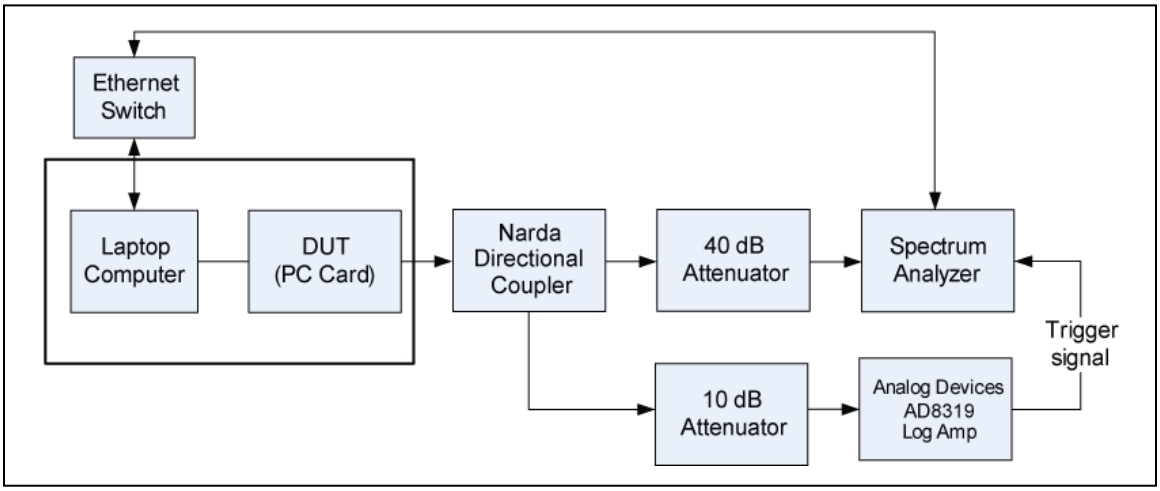
The PCEx25100 transmitter is enabled in test mode by the attached computer. The RF loss of the attenuators and coax was measured and is included in the spectrum analyzer amplitude offset and is noted in the block diagram which follows.

Measurements are performed at the same frequencies, bandwidths, and modulation types as used to measure power output. The tested combinations are as follows:

- Frequencies = low, mid, and high channels of band
- Bandwidths = 5.5 and 6.0 MHz
- Modulation Types = QPSK, 16 QAM, 64 QAM, 16 QAM Lite

Test Conditions:

Test Unit S/N: 40DA94
Test Frequencies: 2499, 2593, 2687 MHz (5.5 and 6.0 MHz bandwidth)
Temperature: 22 °C
Supply Voltage: Nominal 120 VAC 60 Hz applied to computer power supply
Power Out: 1.6 watt (32 dBm) maximum



Modulation Characteristics Test Setup

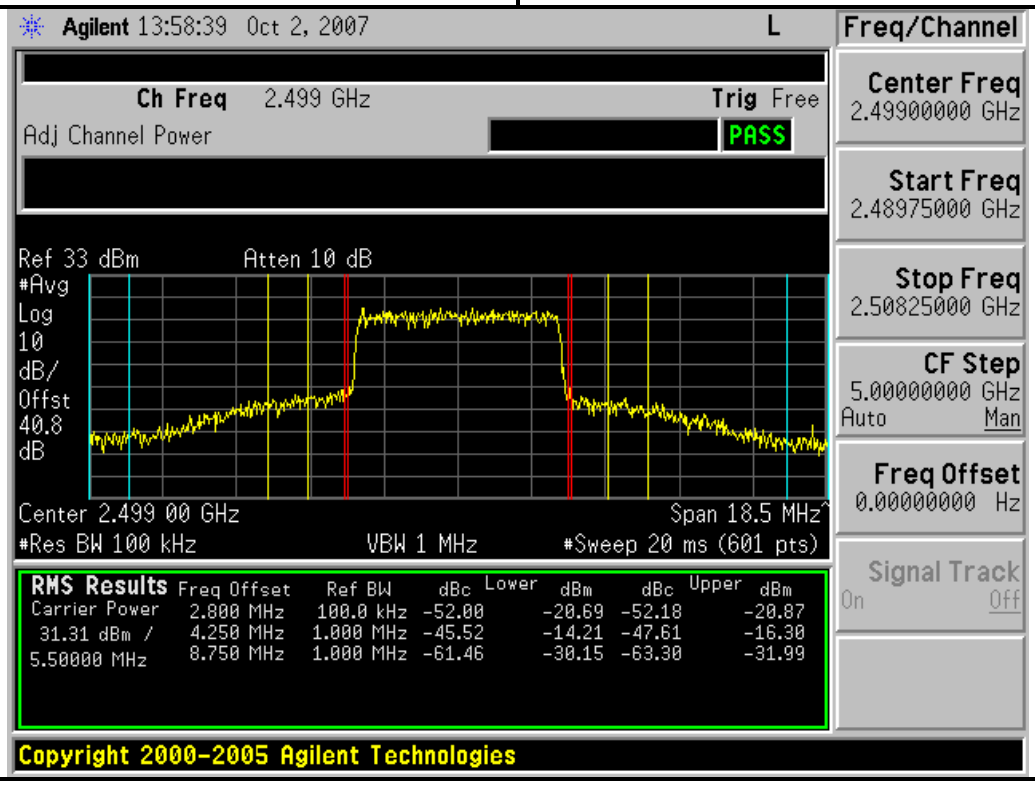
5.3.5 Modulation Characteristics Test Results Summary

QPSK									
Fo (MHz)	Channel	a	A	b	B	Margin to -13	g	G	Margin to -25
2499	5.5	-20.69	-20.87	-14.21	-16.30	1.21	-30.15	-31.99	5.15
2593	5.5	-23.56	-23.15	-18.35	-21.83	5.35	-31.10	-30.46	5.46
2687	5.5	-25.22	-22.09	-18.89	-19.03	5.89	-31.24	-30.97	5.97
2499	6	-19.64	-21.10	-13.80	-16.53	0.80	-29.02	-29.67	4.02
2593	6	-19.77	-23.94	-15.82	-18.48	2.82	-27.01	-25.74	0.74
2687	6	-23.92	-25.55	-17.15	-16.68	3.68	-29.17	-30.11	4.17
16 QAM									
Fo (MHz)	Channel	a	A	b	B	Margin to -13	g	G	Margin to -25
2499	5.5	-19.43	-24.66	-14.08	-16.43	1.08	-30.88	-31.17	5.88
2593	5.5	-25.08	-27.12	-18.03	-20.79	5.03	-29.70	-29.35	4.35
2687	5.5	-26.29	-22.48	-19.33	-18.69	5.69	-30.92	-30.90	5.90
2499	6	-20.64	-18.76	-13.60	-16.38	0.60	-28.90	-29.58	3.90
2593	6	-24.02	-24.50	-17.29	-19.44	4.29	-27.79	-26.88	1.88
2687	6	-20.51	-21.10	-16.89	-16.66	3.66	-28.89	-29.76	3.89
64 QAM									
Fo (MHz)	Channel	a	A	b	B	Margin to -13	g	G	Margin to -25
2499	5.5	-20.62	-19.12	-14.04	-17.23	1.04	-30.63	-31.17	5.63
2593	5.5	-23.50	-24.02	-18.44	-20.45	5.44	-29.75	-29.22	4.22
2687	5.5	-25.14	-22.06	-19.29	-18.31	5.31	-30.76	-31.40	5.76
2499	6	-17.86	-20.72	-13.87	-16.00	0.87	-28.04	-29.78	3.04
2593	6	-21.76	-28.82	-17.71	-20.13	4.71	-28.49	-27.55	2.55
2687	6	-21.25	-20.80	-17.13	-15.95	2.95	-28.94	-30.07	3.94
16 QAM Lite									
Fo (MHz)	Channel	a	A	b	B	Margin to -13	g	G	Margin to -25
2499	5.5	-20.29	-19.66	-14.52	-16.88	1.52	-31.04	-31.93	6.04
2593	5.5	-22.55	-25.46	-18.29	-20.91	5.29	-30.99	-29.69	4.69
2687	5.5	-25.57	-24.40	-19.55	-19.19	6.19	-31.05	-32.00	6.05
2499	6	-20.46	-20.64	-13.96	-16.40	0.96	-28.87	-28.90	3.87
2593	6	-20.35	-27.59	-17.91	-21.41	4.91	-27.99	-28.28	2.99
2687	6	-20.70	-21.10	-16.63	-16.66	3.63	-30.16	-30.21	5.16

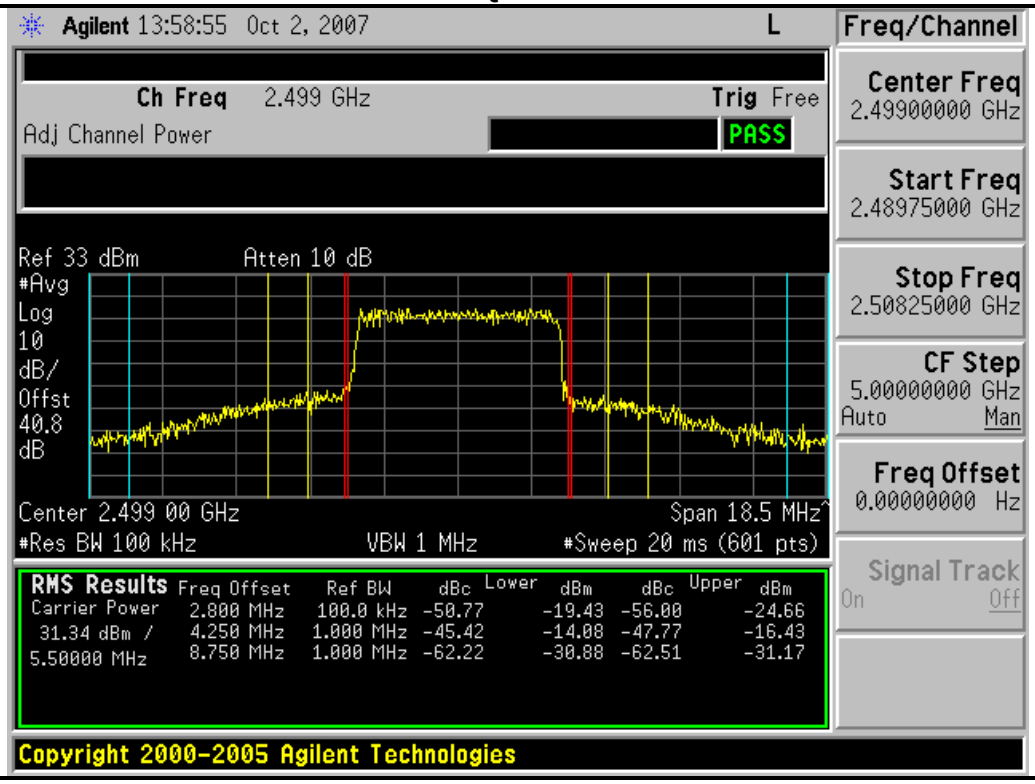
5.3.6 Modulation Characteristics Data Plots

The spectrum analyzer plots follows for the channel/bandwidth combination with the worst case margin from the preceding table. This is the low channel (2499 MHz) at both 5.5 and 6.0 MHz bandwidth. The plots for the other channels are not shown but are similar.

Frequency: 2499 MHz	Bandwidth: 5.5 MHz

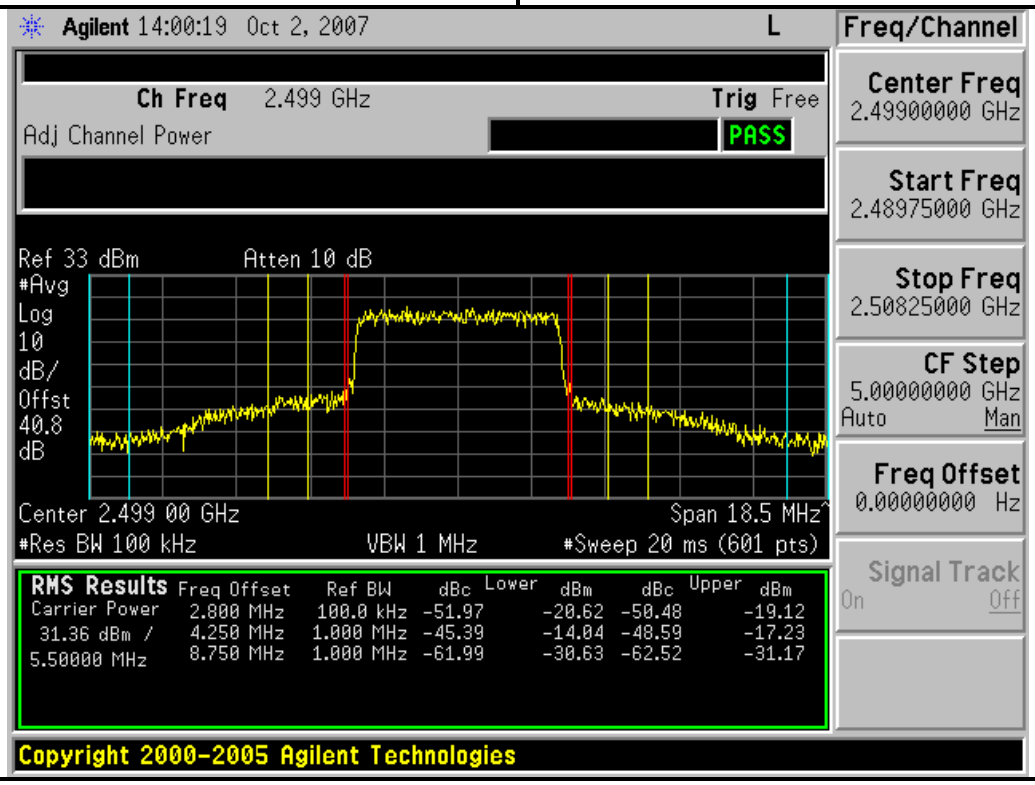


QPSK

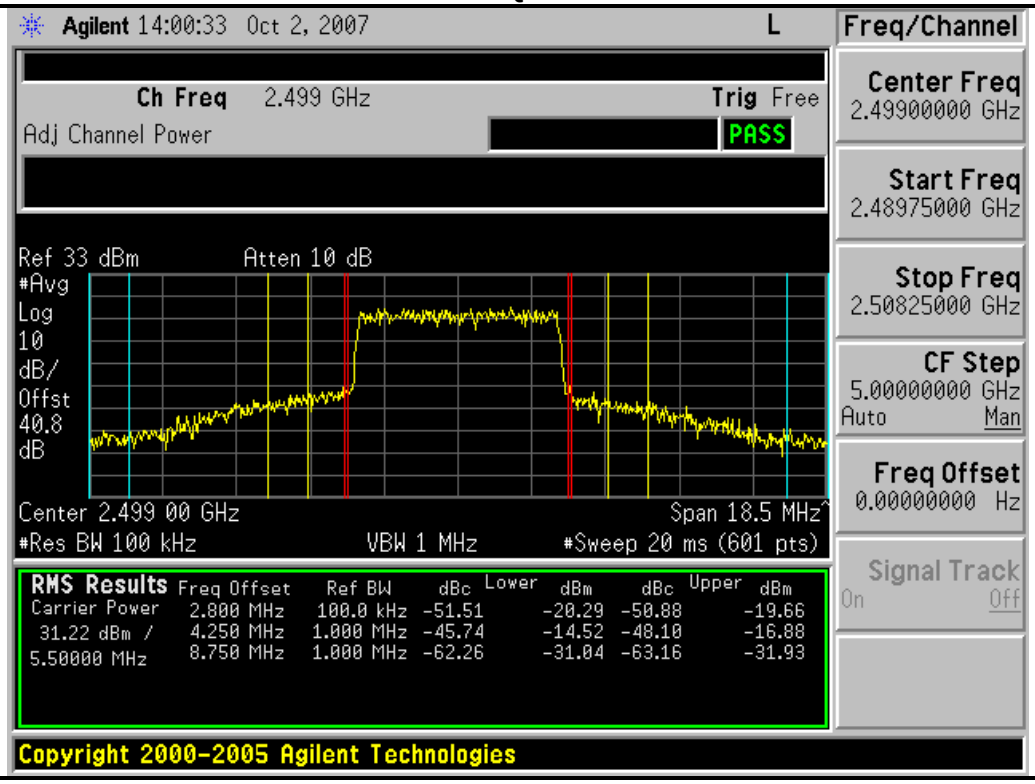


16 QAM

Frequency: 2499 MHz	Bandwidth: 5.5 MHz

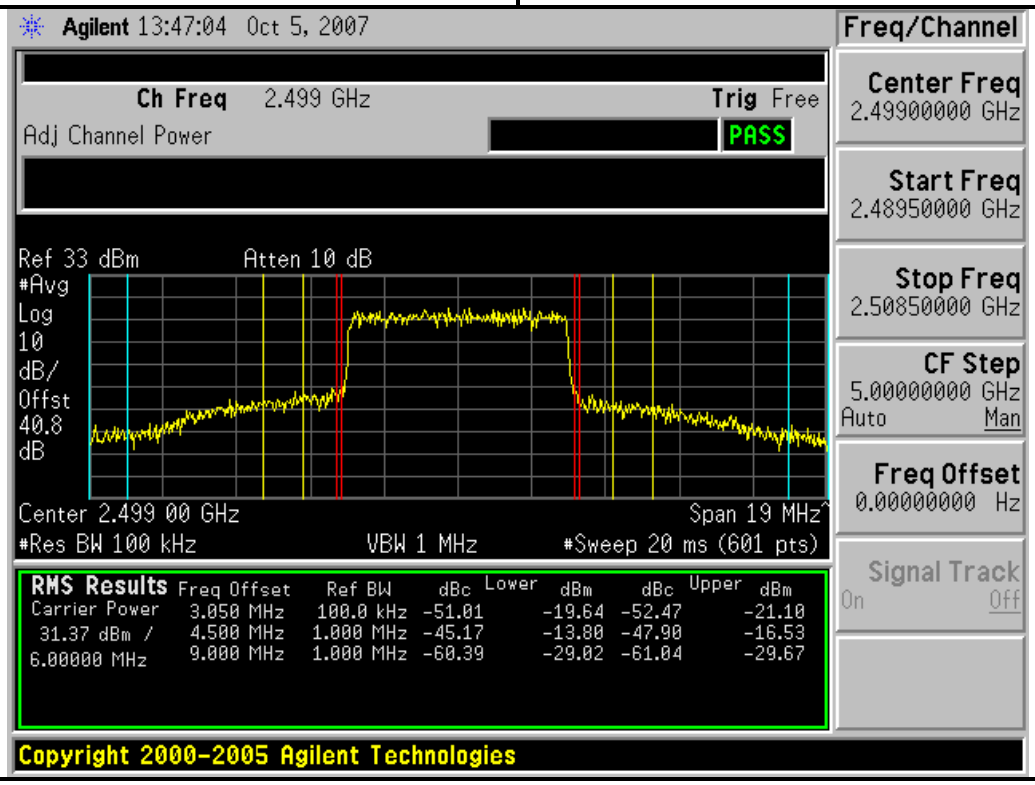


64 QAM

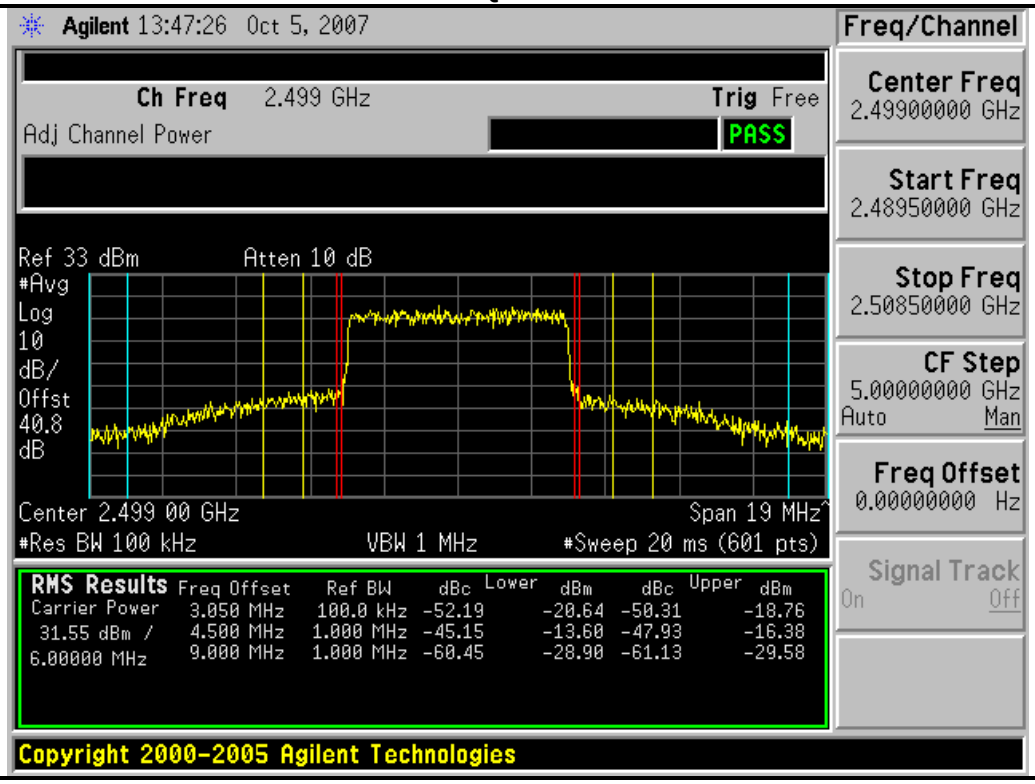


16 QAM Lite

Frequency: 2499 MHz	Bandwidth: 6.0 MHz

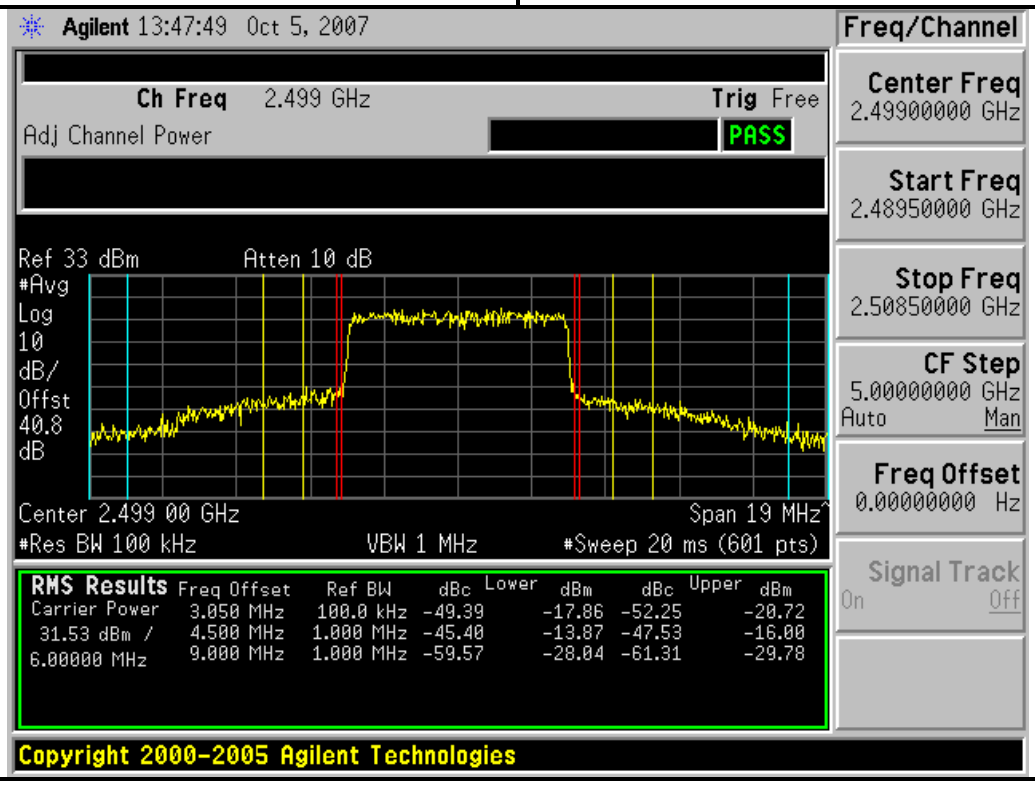


QPSK

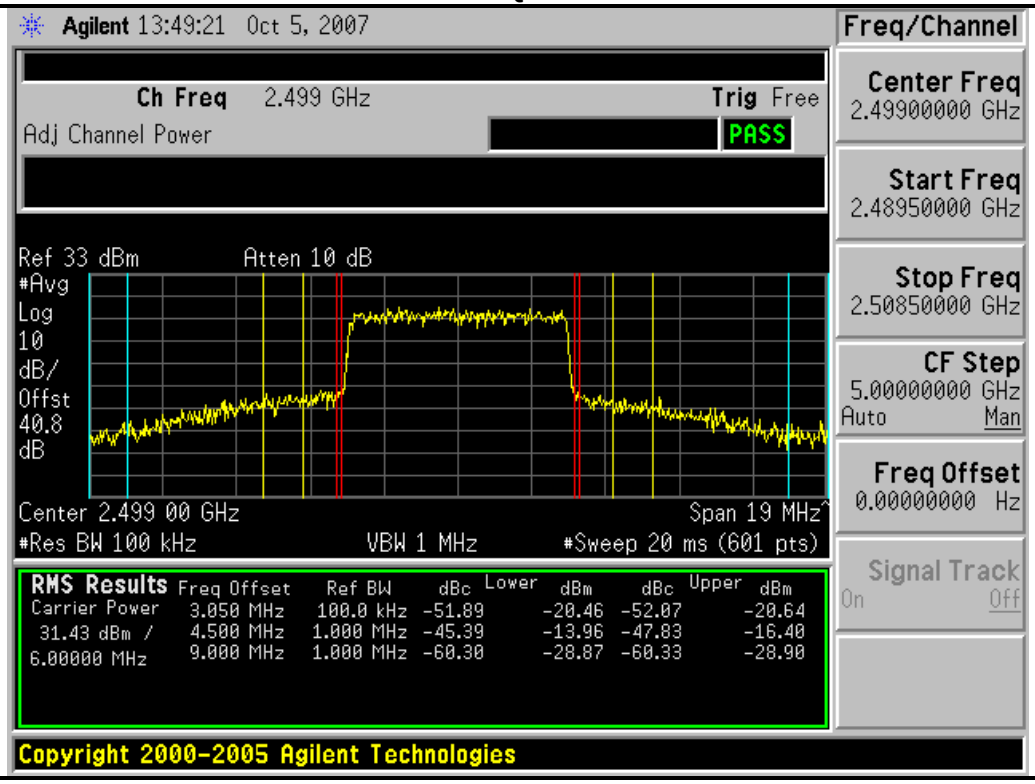


16 QAM

Frequency: 2499 MHz	Bandwidth: 6.0 MHz



64 QAM



16 QAM Lite

5.4 Occupied and Emission Bandwidth

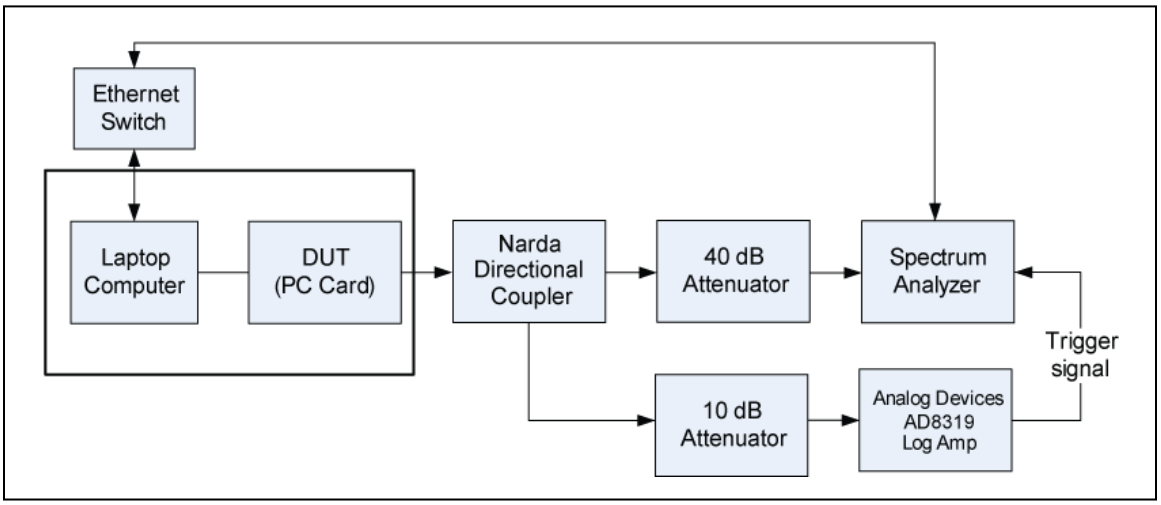
FCC Rules: 2.1049, 27.53(m)(6)

FCC Requirements: Report Results

Standard: ANSI C63.4-2003
American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

Test Procedure: The Orthogonal Frequency Division Multiplexing (OFDM) modulated Time Division Duplex (TDD) RF signal from the test unit is applied to a spectrum analyzer. The bandwidth of the signal is recorded by measuring the modulation bandwidth with the built in measurement function in the spectrum analyzer. The transmitter is enabled in test mode with the attached computer. The RF loss of the attenuators and coax has been measured and is included in the spectrum analyzer offset level. Measurements are performed at three frequencies across the band, for each of the modulation formats available (4, 16, 64, and 16 Lite QAM) and channel bandwidths (5.5 MHz and 6 MHz).

Test Conditions: **Test Unit S/N:** 40DA94
Test Frequencies: 2499, 2593, 2687 MHz (5.5 and 6.0 MHz bandwidth)
Temperature: 22°C
Supply Voltage: Nominal 120 VAC 60 Hz applied to computer power supply



Occupied/Emission Bandwidth Test Setup

5.4.1 Occupied and Emission Bandwidth Test Results Summary

Occupied Bandwidth (MHz) for 99.0% (-20 dB)					
Freq (MHz)	**Bandwidth (MHz)**	**4 QAM**	**16 QAM**	**64 QAM**	**16 QAM Lite**
2499	6.0	5.4887	5.4860	5.4895	5.4932
2593	6.0	5.4912	5.4904	5.4857	5.4905
2687	6.0	5.4875	5.4899	5.4914	5.4875
2499	5.5	4.9709	4.9727	4.9623	4.9750
2593	5.5	4.9695	4.9709	4.9717	4.9689
2687	5.5	4.9722	4.9723	4.9695	4.9708

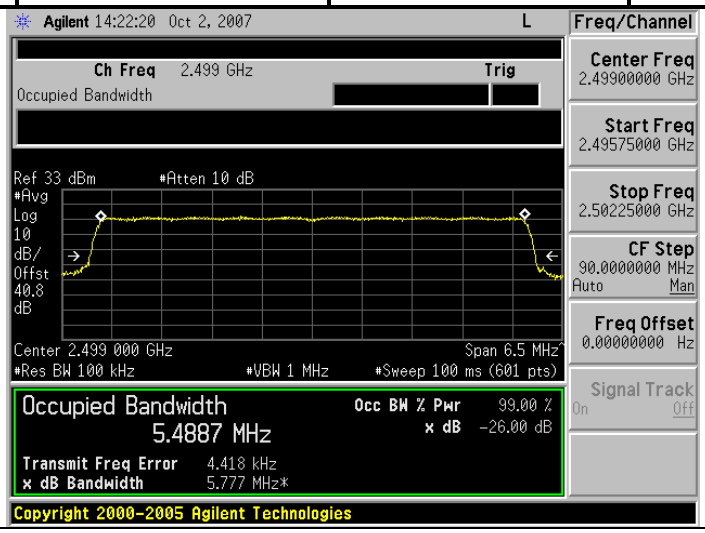
Emission Bandwidth (MHz) for 99.75% (-26 dB)					
Freq (MHz)	**Bandwidth (MHz)**	**4 QAM**	**16 QAM**	**64 QAM**	**16 QAM Lite**
2499	6.0	5.777	5.773	5.772	5.768
2593	6.0	5.770	5.767	5.757	5.768
2687	6.0	5.773	5.772	5.769	5.769
2499	5.5	5.247	5.242	5.237	5.244
2593	5.5	5.244	5.238	5.233	5.232
2687	5.5	5.247	5.247	5.233	5.237

5.4.2 Occupied/Emission Bandwidth Spectrum Analyzer Plots

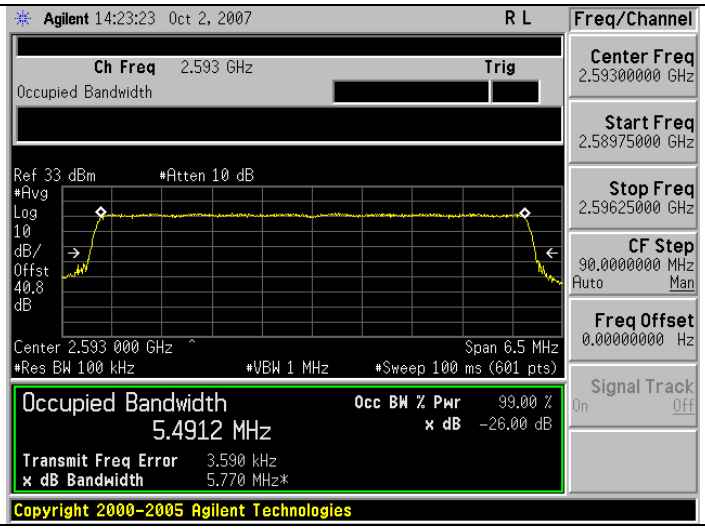
The following are spectrum analyzer plots of the 4 QAM data in the preceding tables. The plots for the 16, 64, and 16 Lite QAM modulation levels are not shown but are similar.

Both Occupied and Emission Bandwidth is shown in the same plot. The 99% Occupied Bandwidth is displayed in large type under “Occupied Bandwidth”, and the –26 x dB Emission Bandwidth is displayed in smaller type to the right of “x dB Bandwidth”.

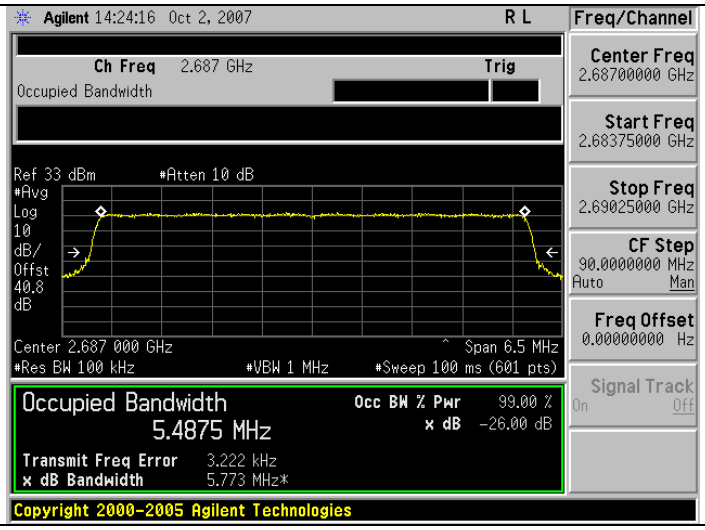
Occ/Emiss BW	Bandwidth: 6.0 MHz	RF Power: 1.6 Watts	Modulation: 4 QAM



2499 MHz

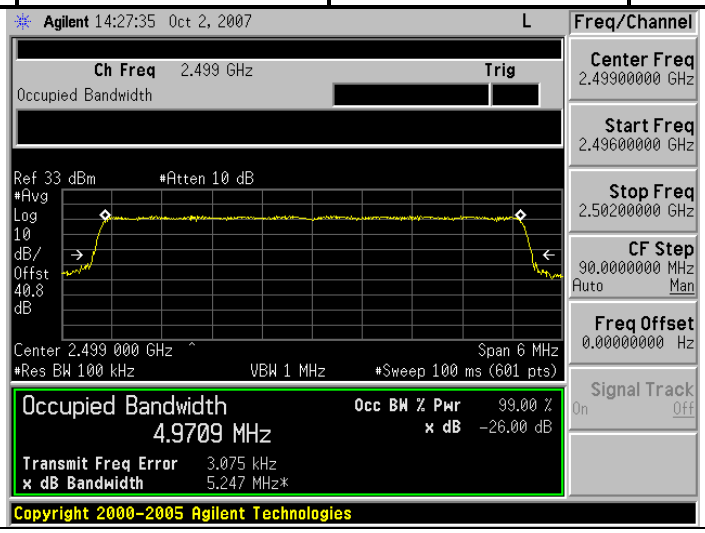


2593 MHz

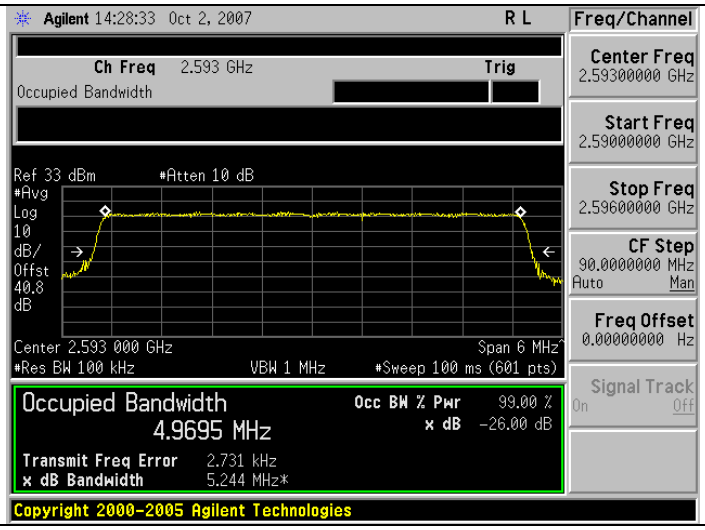


2687 MHz

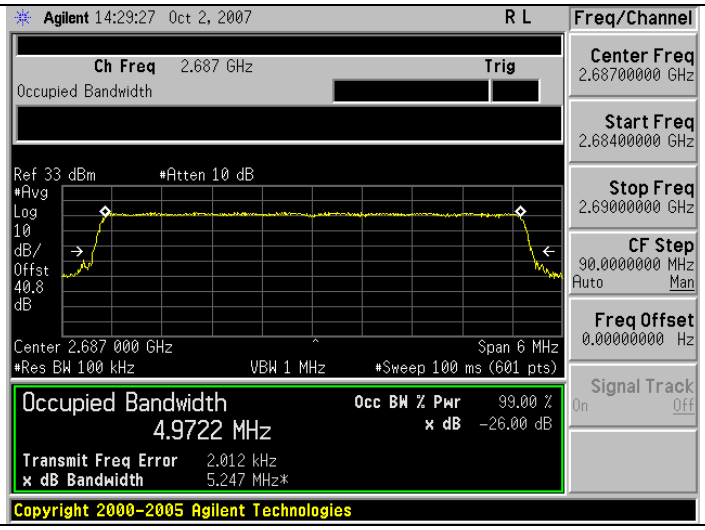
Occ/Emiss BW	Bandwidth: 5.5 MHz	RF Power: 1.6 Watts	Modulation: 4 QAM



2499 MHz



2593 MHz



2687 MHz

5.5 Transmitter Spurious Emissions

FCC Rules: 2.1051, 2.1049, 2.1057, 27.53(m)(4), 27.53(m)(6)

Standard: FCC 27.53(m)

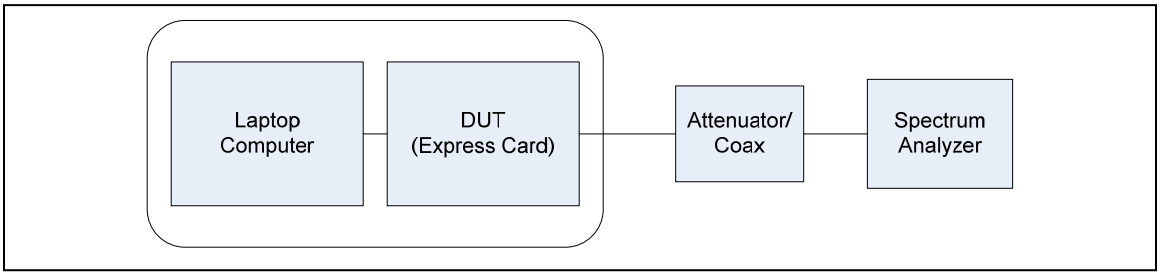
Test Procedure: The RF output of the transmitter was measured at the accessory antenna port. This signal is applied to the spectrum analyzer RF input through a calibrated coaxial cable and attenuator.

The spectrum analyzer is setup for peak detection with a 1 MHz resolution bandwidth. The sweep rate of the spectrum analyzer is adjusted to a sweep speed that will ensure that all peak emissions will be recorded.

The transmitter is enabled in test mode and set to the maximum power level with the host computer. The transmission is recorded from 9 kHz to 26.5 GHz in multiple plots. The RF loss of the attenuators and coax is included in the spectrum analyzer offset level. Measurements are performed at frequencies across the band and both channel bandwidths (5.5 MHz and 6 MHz). A modulation level of 4 QAM was used for all measurements.

Test Conditions: **Test Unit S/N:** 403988
Channels: 2499, 2593, and 2687 MHz (5.5 and 6.0 MHz bandwidth)
Temperature: 22°C
Supply Voltage: Nominal 120 VAC 60 Hz applied to computer power supply

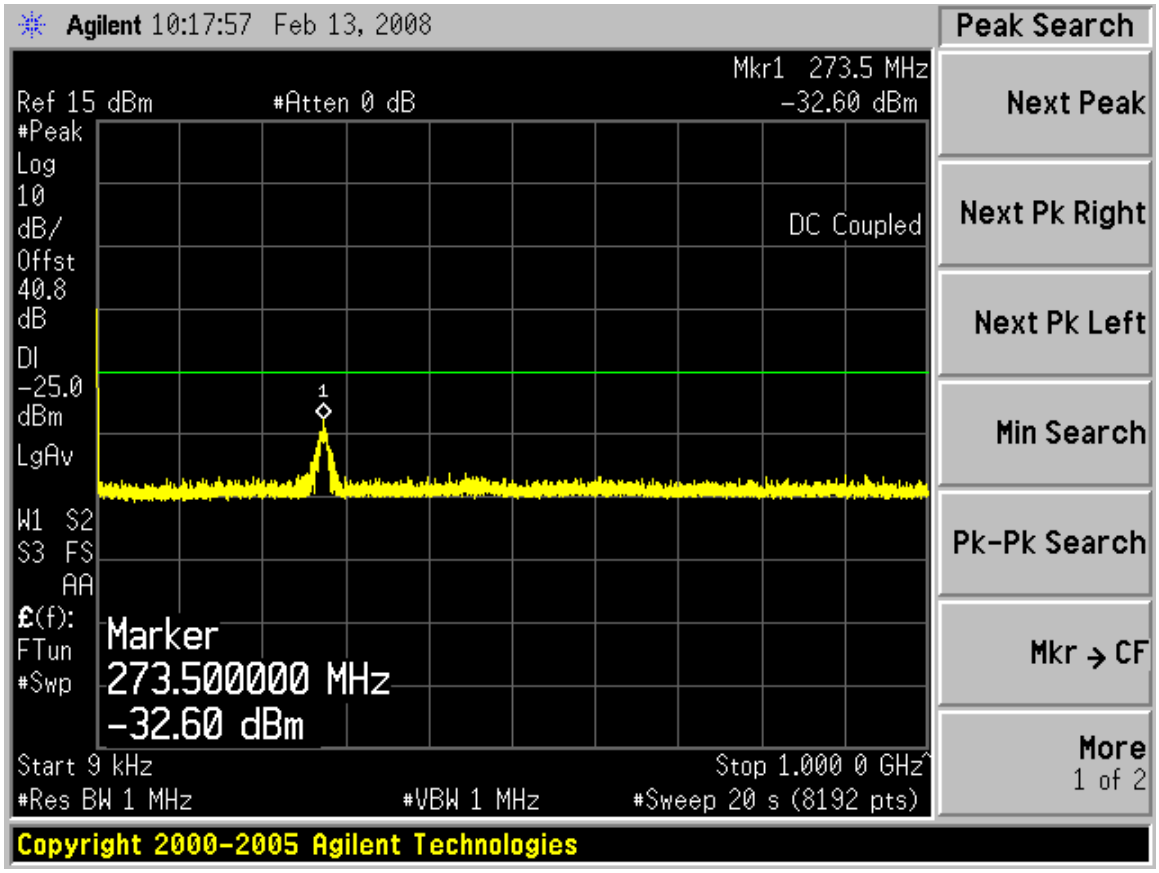
Test Results: Passes conducted emissions from 9 kHz to 26.5 GHz. All emissions were below the –25 dBm limit.



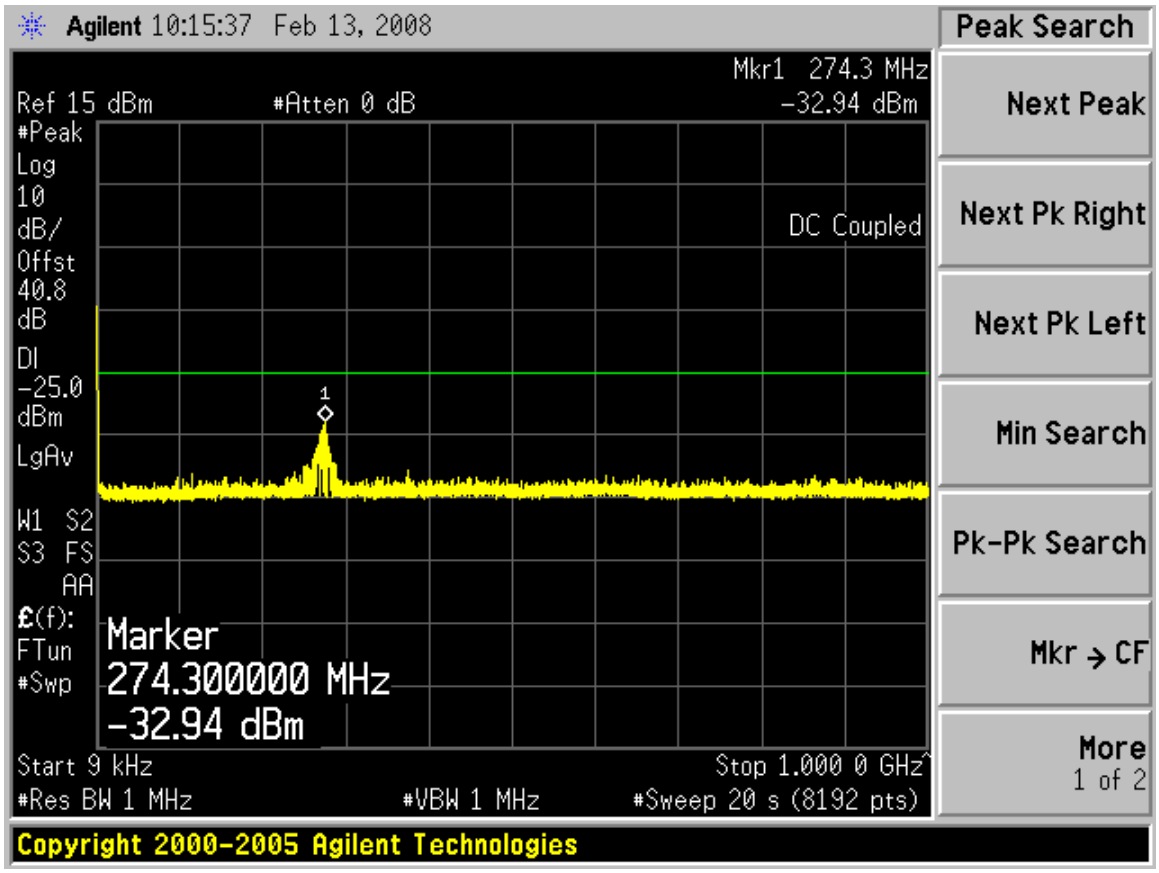
Spurious Emissions Test Setup

5.5.1 Transmitter Spurious Emissions Plots

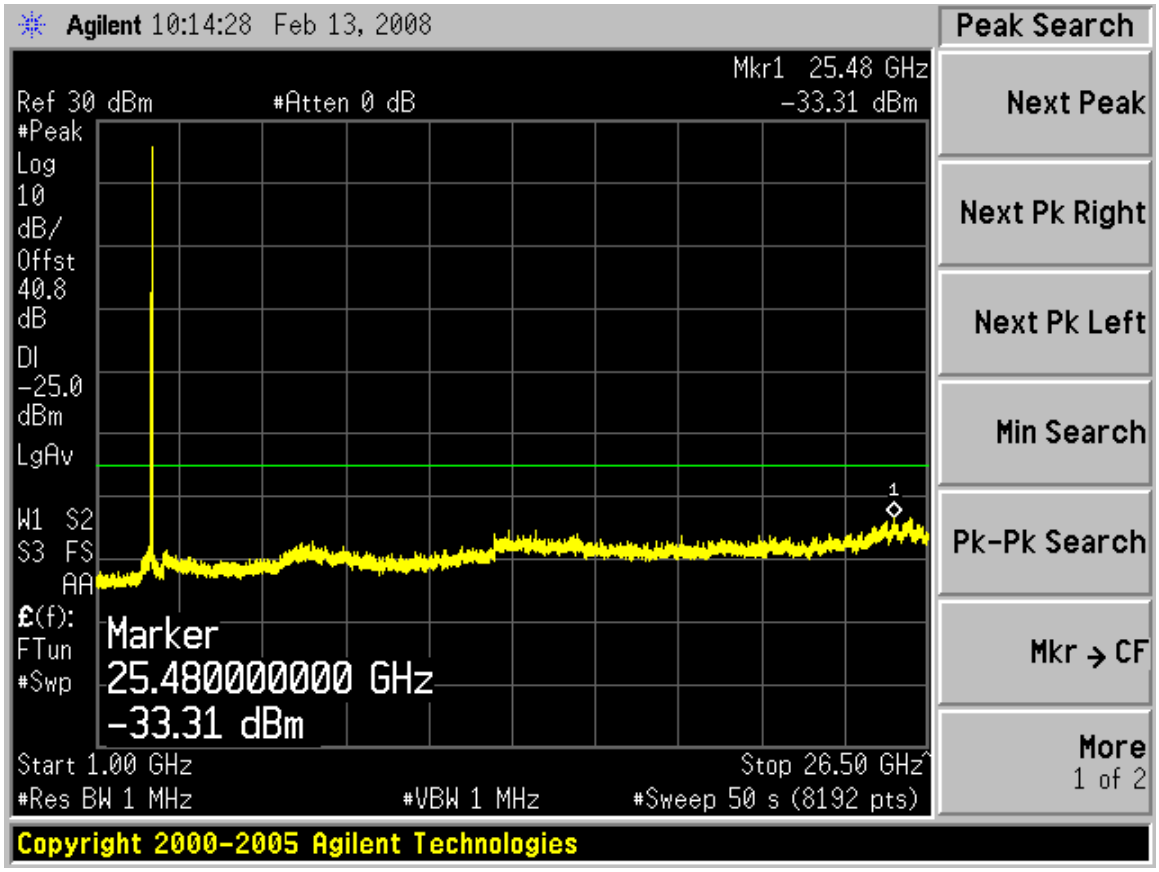
The worst case plots for each of the two channel bandwidths are shown on the following pages.



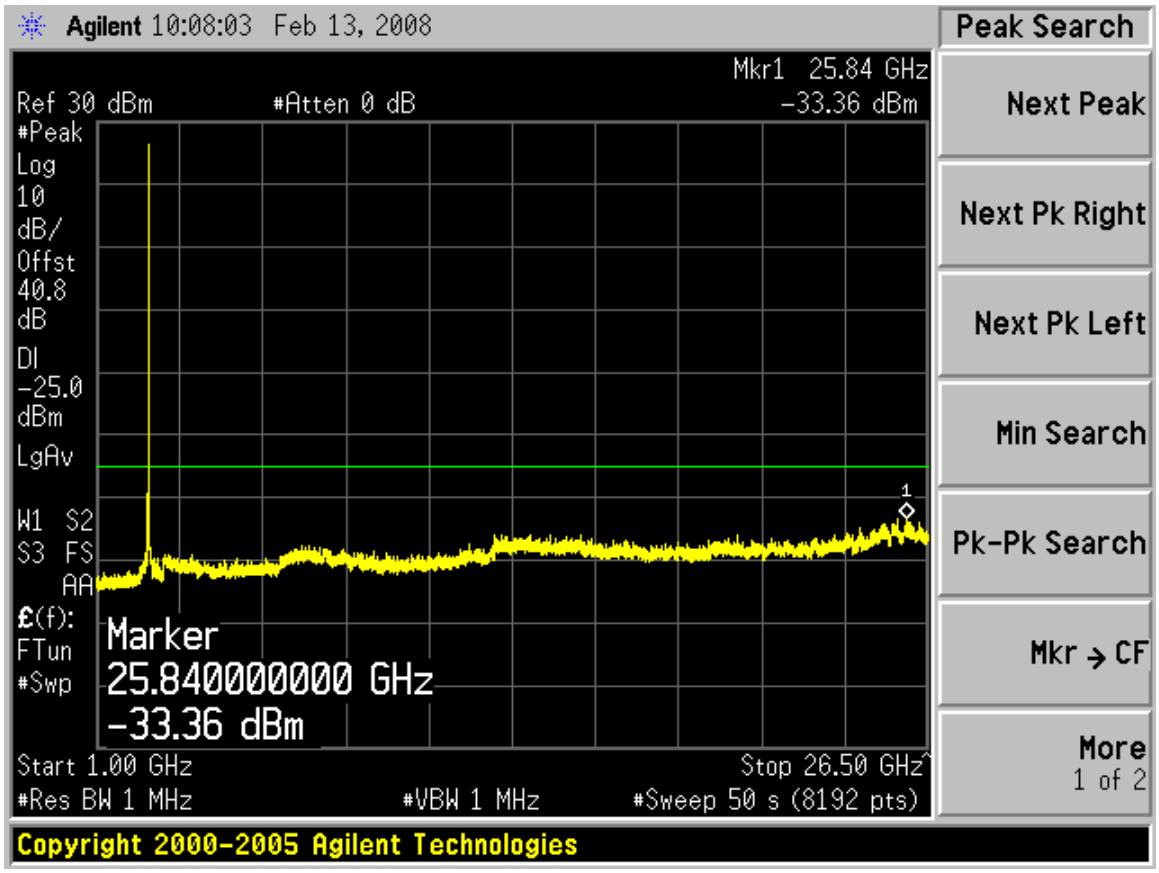
9 kHz – 1 GHz (2499 MHz, 6 MHz Channel)



9 kHz – 1 GHz (2499 MHz, 5.5 MHz Channel)



1 GHz – 26.5 GHz (2687 MHz, 5.5 MHz Channel)



1 GHz – 26.5 GHz (2593 MHz, 6 MHz Channel)

5.6 Field Strength of Spurious Radiation

FCC Rules: 2.1053, 2.1049, 2.1057, 27.53(m)(4)

FCC Requirement: Emissions to be 55+10log(P) below the channel power or an absolute level of -25 dBm

Frequency Range = 30 MHz to 26.5 GHz
Case Radiation Attenuation = 55+10logP = –25 dBm maximum

Standards: TIA-603-C
TIA Standard, Land Mobile FM or PM Communications Equipment, Measurement and Performance Standards

ANSI C63.4-2003 clause 5.4 Radiated Emissions Tests.
American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

Test Procedure: The field strength of spurious radiation was measured at an open area test site with the applicable measurement antennas, low noise amplifiers, and spectrum analyzers. This test was performed with the transmitter/receiver internal ports being terminated with each ports respective load, the integral antenna and the external accessory antenna. The transmitter signal was applied to the integral antenna for all radiated emissions measurements. Measurements were performed by TUV America located in Taylors Falls, Minnesota on October 22nd, 23rd, and 24th, 2007. Spurious signals were maximized for peak level by rotation of the test unit and elevation of the measurement antenna. Verification of compliance to the emissions limit was accomplished by antenna substitution as detailed in the TIA-603-C specification. TUV America-Product Service FCC registration number: 90983

Test Conditions: **Frequency**: 2500, 2590, 2687 MHz
Channel bandwidths: 5.0 MHz, 5.5 MHz, and 6.0 MHz
Temperature: 25°C
Supply Voltage: Nominal 120 VAC 60 Hz applied to computer power supply

Test Results: Passes Field Strength of Spurious Radiation
Refer to attached TUV Test Report: 5B EMC Test Report.pdf

5.7 Frequency Stability Test

FCC Rules: 2.1055, 27.53(m)(4), 27.53(m)(6), 27.54

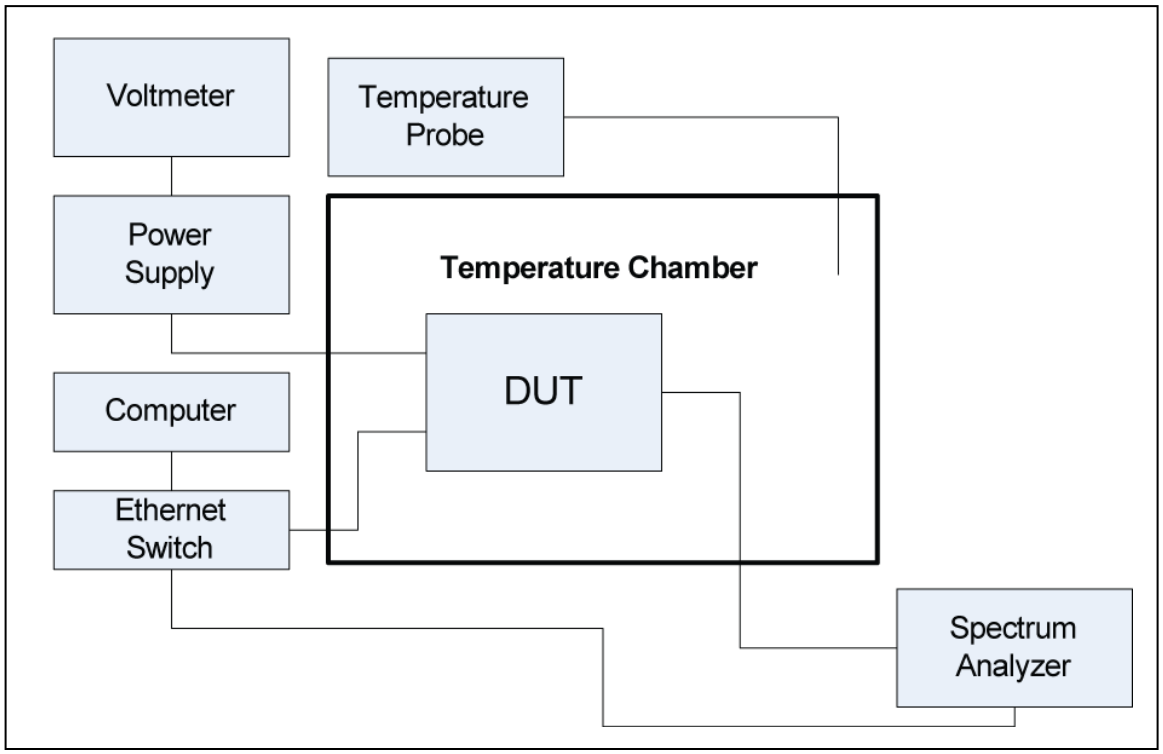
FCC Requirement: The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

Standard: TIA-603-C

Test Procedure: The frequency stability of the Motorola, Inc. PCEx25100 test unit fundamental oscillator is derived from the on board 40 MHz TCXO. Since each radio channel operating frequency is synthesized and referenced to the 40 MHz TCXO, only one channel will be reported for frequency stability as all channels will have the same frequency stability characteristics.

The emissions contained within 1 MHz bins below and above the channel bandwidth were recorded to show compliance to the emissions limit of 47CFR27.53(m)(4).

Test Set-Up:



Frequency Stability Test Setup

5.7.1 Temperature Variation Test Results

Test Conditions: **Test Unit S/N:** 40DA94
Frequency: 2593 MHz (5.5 and 6.0 MHz channel bandwidths)
Supply Voltage: 120 VAC / 60 Hz Nominal to DUT Power Supply
Temperature: –30º C to +50º C in 10º C increments

Test Results: Pass Temperature Variation
The table which follows summarizes the information from the plots contained in this section.

5.7.2 Supply Voltage Variation Test Results

Test Conditions: Frequency = 2593 MHz
Temperature = 20° C

Supply Voltage Variation

Source Input Voltage Specification: 120.0 VAC / 60 Hz Nominal
Test Voltage Range = 0.85 x 120 = 102 VAC / 60 Hz lower limit
1.15 x 120 = 138 VAC / 60 Hz upper limit

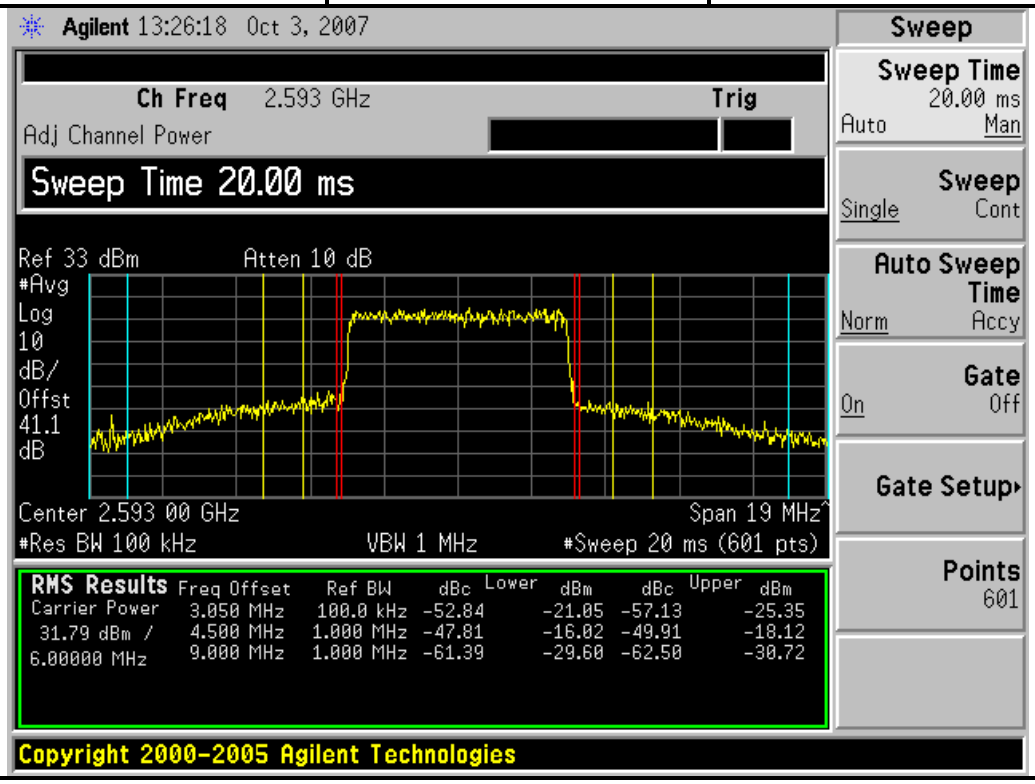
Test Results: Supply Voltage Variation
The table which follows summarizes the information from the plots contained in this section.

Freq: 2593 MHz									
Temp (° C)	Bandwidth	a	A	b	B	Margin to -13 dBm limit	g	G	Margin to -25 dBm limit
-30	5.5	-23.34	-21.60	-15.97	-18.69	2.97	-31.25	-31.88	6.25
	6.0	-21.05	-25.35	-16.02	-18.12	3.02	-29.60	-30.72	4.60
-20	5.5	-23.80	-23.52	-17.81	-20.10	4.81	-33.80	-33.86	8.80
	6.0	-21.17	-24.19	-17.16	-19.87	4.16	-31.82	-32.50	6.82
-10	5.5	-23.43	-23.84	-16.46	-19.16	3.46	-32.61	-30.96	5.96
	6.0	-20.85	-23.97	-15.63	-18.39	2.63	-31.34	-30.71	5.71
0	5.5	-25.61	-22.50	-17.79	-19.25	4.79	-32.94	-33.08	7.94
	6.0	-20.44	-27.51	-16.45	-18.96	3.45	-31.63	-31.50	6.50
10	5.5	-21.87	-23.65	-16.43	-18.92	3.43	-32.75	-30.85	5.85
	6.0	-20.87	-23.08	-17.81	-19.73	4.81	-31.18	-30.10	5.10
20	5.5	-25.13	-24.12	-16.30	-19.58	3.30	-29.31	-29.29	4.29
	6.0	-22.73	-24.20	-16.16	-19.87	3.16	-29.17	-29.02	4.02
30	5.5	-24.19	-25.57	-18.16	-21.49	5.16	-31.98	-31.24	6.24
	6.0	-23.20	-27.65	-18.01	-21.74	5.01	-30.41	-30.36	5.36
40	5.5	-24.37	-25.08	-18.23	-21.15	5.23	-30.72	-29.22	4.22
	6.0	-23.03	-23.20	-17.28	-19.59	4.28	-28.90	-27.54	2.54
50	5.5	-24.29	-27.13	-17.92	-22.00	4.92	-31.00	-31.06	6.00
	6.0	-20.72	-24.46	-18.70	-21.37	5.70	-30.42	-29.65	4.65
Voltage (VAC)	Temp: 20° C								
102	5.5	-24.7	-22.28	-17.7	-20.37	4.70	-31.02	-29.92	4.92
	6.0	-21.7	-25.47	-16.83	-20.13	3.83	-30.11	-29.40	4.40
120	5.5	-22.85	-24.20	-16.99	-19.48	3.99	-31.14	-30.40	5.40
	6.0	-22.73	-24.50	-17.75	-19.99	4.75	-29.44	-29.62	4.44
138	5.5	-23.40	-21.36	-17.08	-20.13	4.08	-30.30	-29.90	4.90
	6.0	-22.67	-24.74	-17.86	-19.86	4.86	-29.26	-28.61	3.61

5.7.3 Temperature and Voltage Variation Spectrum Analyzer Plots

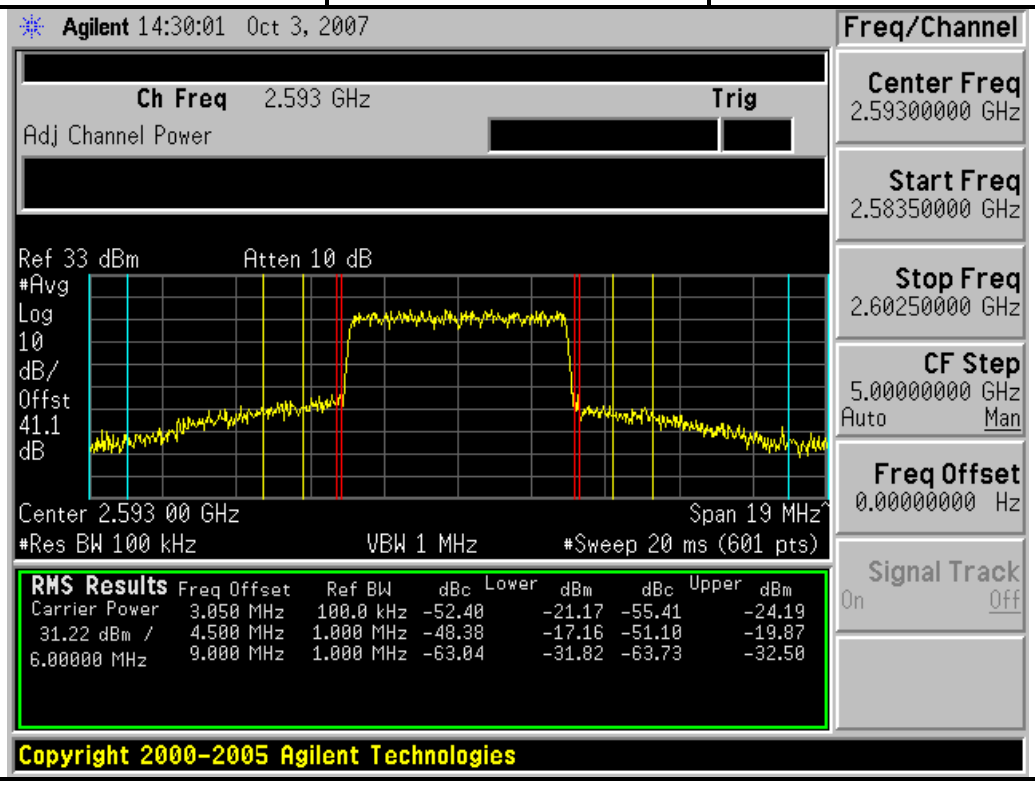
Spectrum analyzer plots of the 6.0 MHz bandwidth measurements follow. The plots for the 5.5 MHz bandwidth channels are not shown but are similar.

Bandwidth: 6.0 MHz	RF Power: 1.6 Watts	Frequency: 2593 MHz

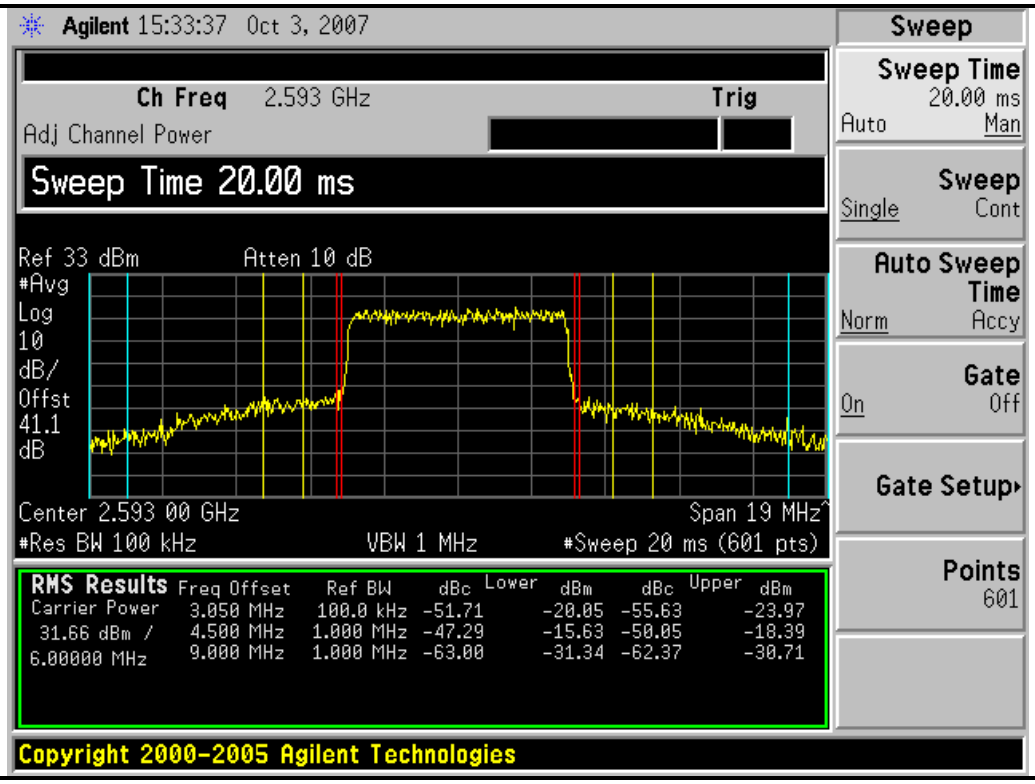


–30° C

Bandwidth: 6.0 MHz	RF Power: 1.6 Watts	Frequency: 2593 MHz

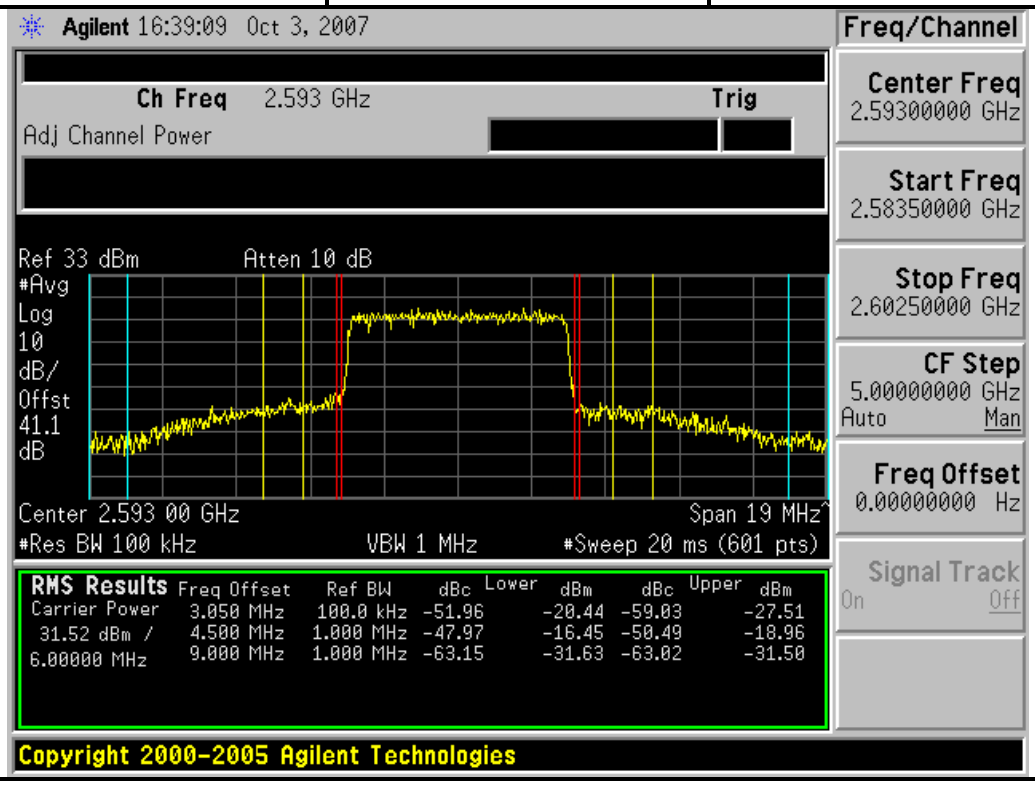


–20° C

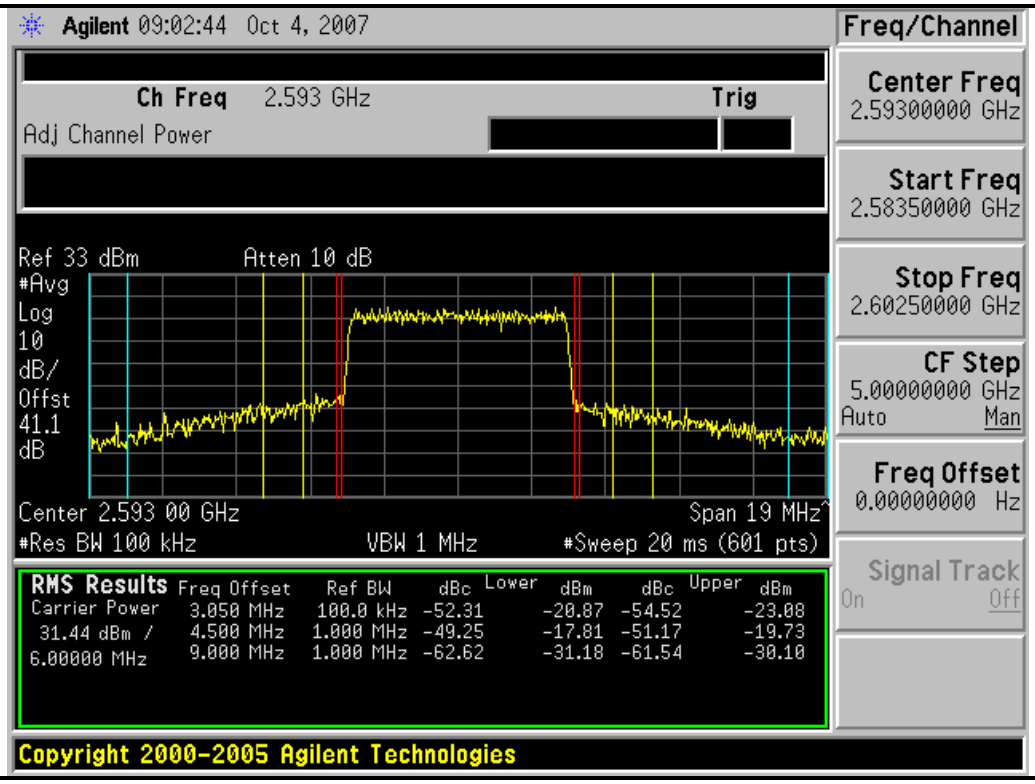


–10° C

Bandwidth: 6.0 MHz	RF Power: 1.6 Watts	Frequency: 2593 MHz

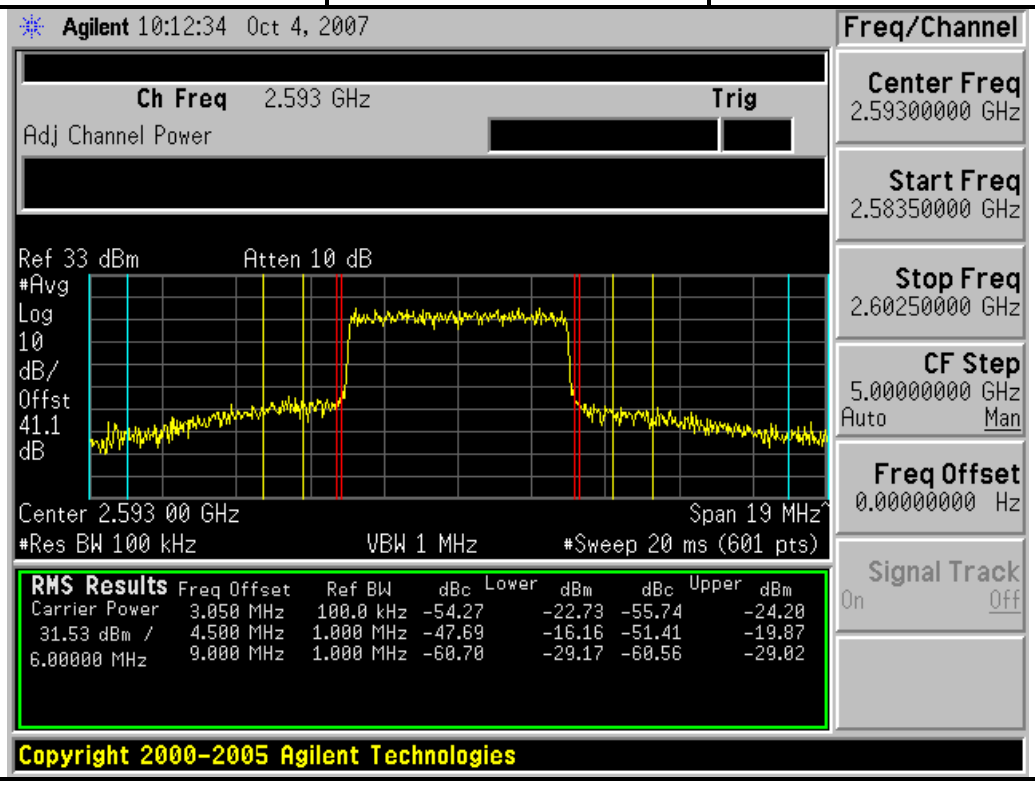


0° C

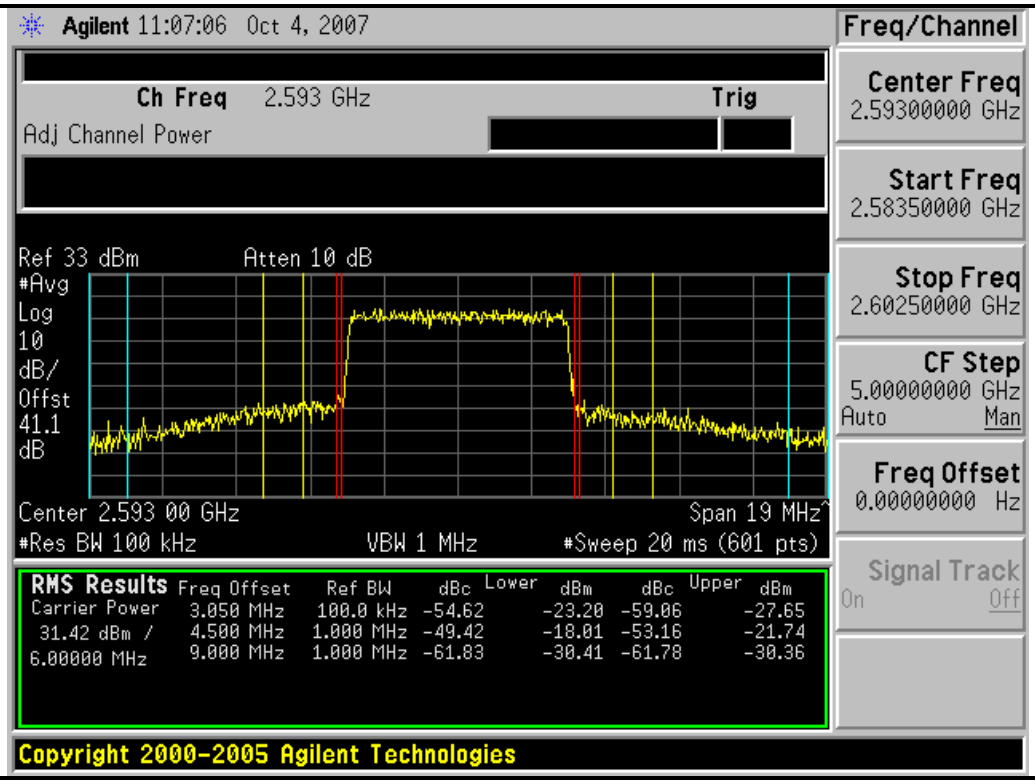


+10° C

Bandwidth: 6.0 MHz	RF Power: 1.6 Watts	Frequency: 2593 MHz

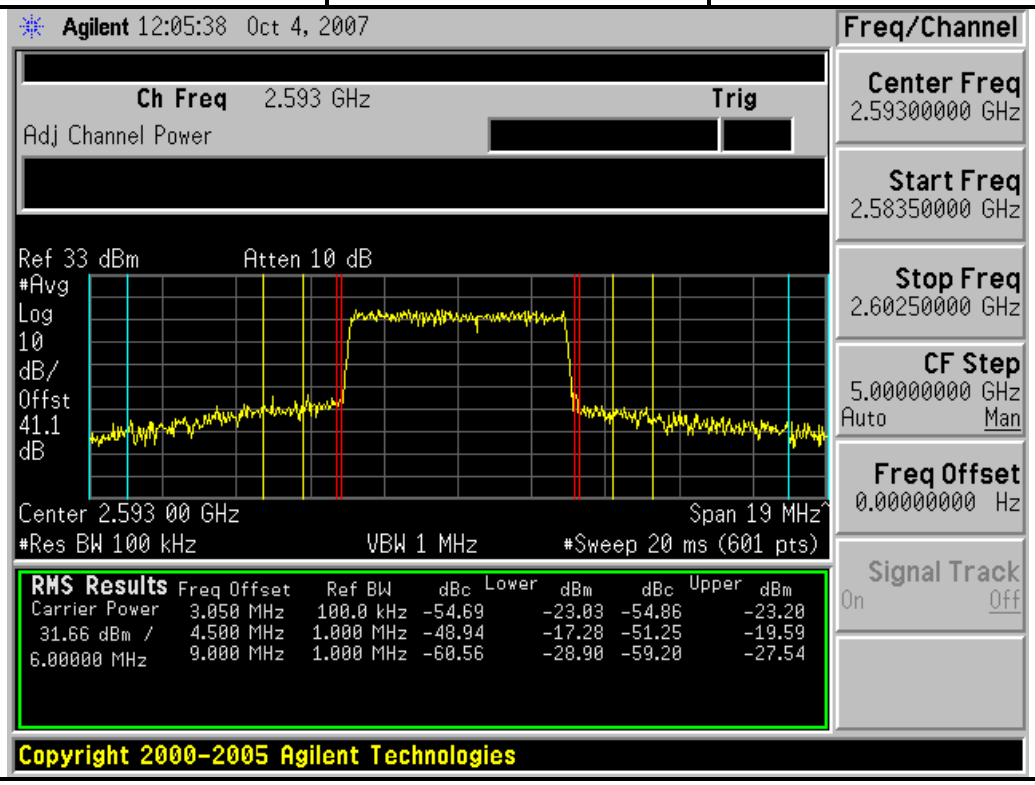


+20° C

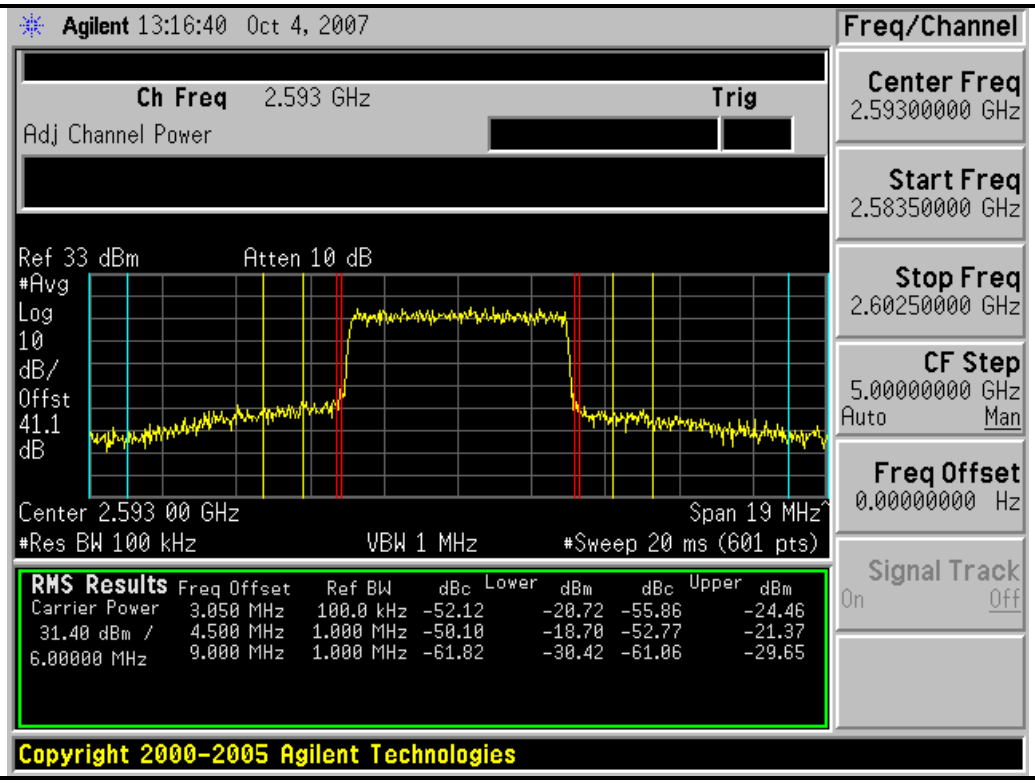


+30° C

Bandwidth: 6.0 MHz	RF Power: 1.6 Watts	Frequency: 2593 MHz

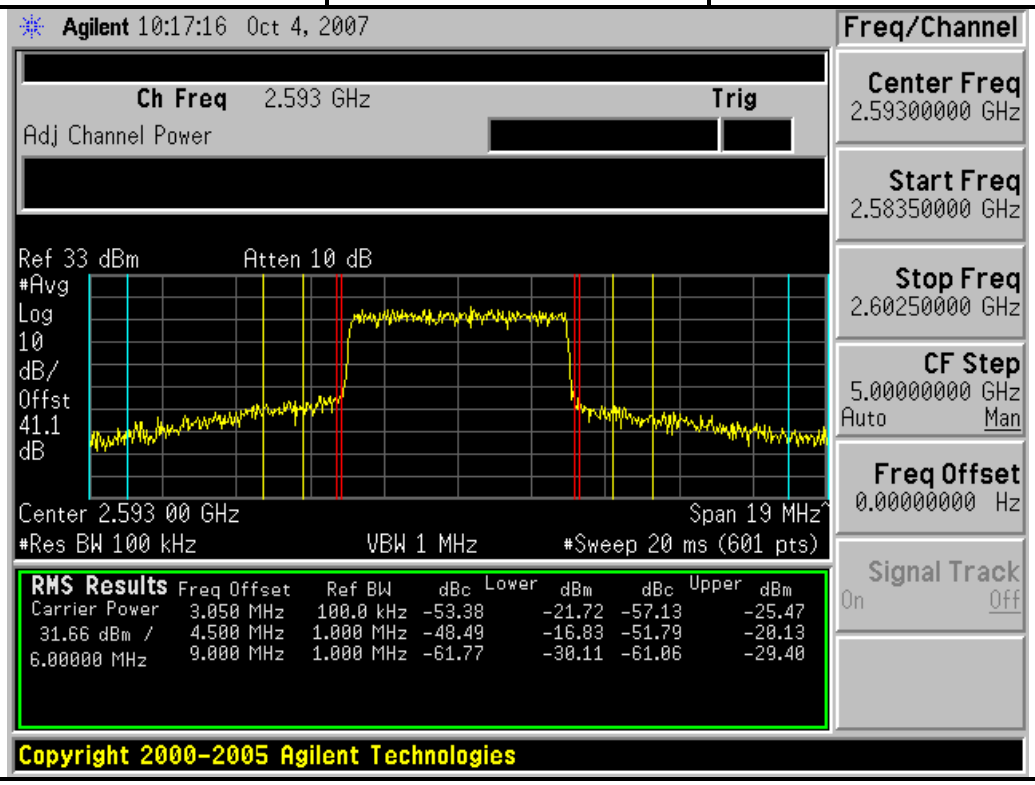


+40° C

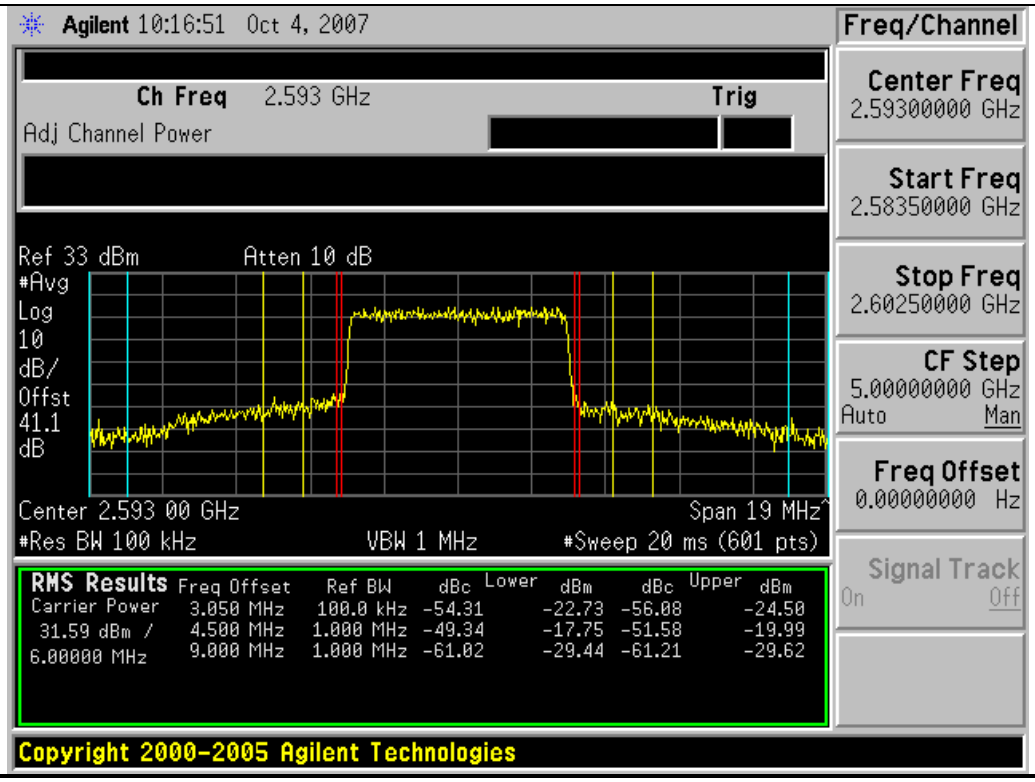


+50° C

Bandwidth: 6.0 MHz	RF Power: 1.6 Watts	Frequency: 2593 MHz

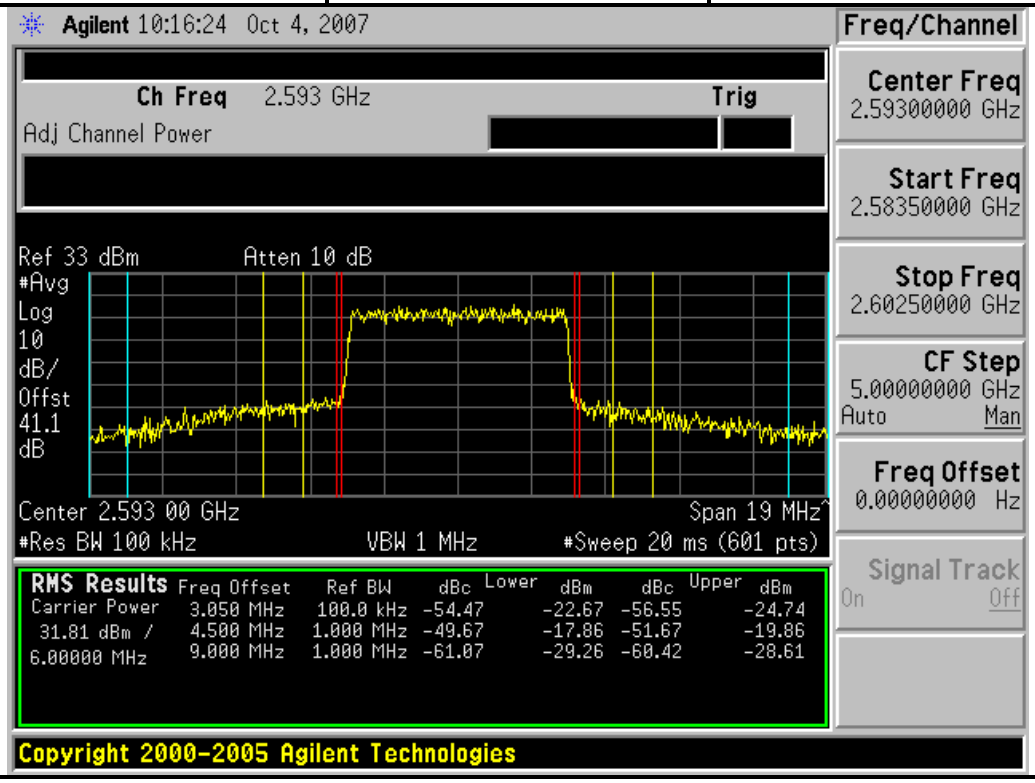


102 VDC / +20° C



120 VDC / +20° C

Bandwidth: 6.0 MHz	RF Power: 1.6 Watts	Frequency: 2593 MHz



138 VDC / +20° C