ENGINEERING TEST REPORT

Bi-Directional Amplifier
Model No.: RBDA-PCS-1/25W-90-A
FCC ID: Q8KPCS25W90

Applicant:

G-Wave Incorporated
15 Ron's Edge Road, Springfield
New Jersey 07081 United States

Tested in Accordance With

Federal Communications Commission (FCC)
47 CFR, Part 2 & 24 (Subpart E - Broadband PCS)

UltraTech's File No.: GWAV-009FCC24

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: April 9, 2009	
Report Prepared by: Dharmajit Solanki Issued Date: April 9, 2009	Tested by: Hung Trinh, EMI/RFI Technician Test Dates: December 10, '08 – January 9, April 3, '09

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

UltraTech

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ANSI	FC	VCCI	Industry Canada / Industrie Canada	NVLAP	BSMI	Korea MIC-RRL
0685	31040/SIT	C-1376	46390-2049	200093-0	SL2-IN-E-1119R	2005-82 & 83

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 2 & 24 (Subpart E - Broadband PCS)
Title:	Telecommunication - Code of Federal Regulations, CFR 47, Part 2 & 24(Subpart E)
Purpose of Test:	To gain FCC Certification Authorization for Radio Amplifier operating in the Frequency Range 1850-1910 MHz (Uplink) and 1930-1990 MHz (Downlink)
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - 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.

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 80-End	2008	Code of Federal Regulations – Telecommunication
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
CISPR 16-1-1	2004	Specification for Radio Disturbance and Immunity measuring apparatus and methods
TIA/EIA 603, Edition C	2004	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	G-Wave Incorporated
Address:	15 Ron's Edge Road, Springfield, NJ 07081 United States
Contact Person:	Mr. Greg David Phone #: 201-343-3140 Fax #: 201-343-6390 Email Address: greg_d@gwaverf.com

MANUFACTURER	
Name:	G-Wave Incorporated
Address:	38 Leuning Street, South Hackensack, NJ 07606 United States
Contact Person:	Mr. Dino Giordano Phone #: 201-343-6388 Fax #: 201-343-6390 Email Address: dino_g@gwaverf.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	G-Wave Incorporated
Product Name:	Bi-Directional Amplifier
Model Name or Number:	RBDA-PCS-1/25W-90-A
Type of Equipment:	Non-broadcast RF Bi-Directional Amplifier
Power Supply:	100 -240 VAC auto-ranging 50 to 60 Hz
Transmitting/Receiving Antenna Type:	Non-Integral
Application of EUT:	Extends RF Coverage area of radio communications in buildings and shielded environments.

2.3. EUT'S TECHNICAL SPECIFICATIONS

BI-DIRECTIONAL AMPLIFIER	
Equipment Type:	Base station (fixed use)
Intended Operating Environment:	Commercial, Light Industry & Heavy Industry
RF Output Power Rating:	**UpLink**: • Single carrier: 25.00 dBm • 2 carriers: 20.25 dBm • 3 carriers: 18.25 dBm **DownLink**: • Single carrier: 37.00 dBm • 2 carriers: 33.25 dBm • 3 carriers: 30.25 dBm
Operating Frequency Range:	• 1850-1910 MHz (Uplink) • 1930-1990 MHz (Downlink)
RF Input/Output Impedance:	50 Ohms
Isolation between Up/Down Link	105 dB min
Pass Band Gain @ min attenuation:	+90 dB (typical)
Type of Modulation:	CDMA 2000, GSM
Occupied Bandwidth (99%):	EXTENDER (The 99% OBW of the rf output signal is the same as that of the rf input signal from a FCC certified transmitter)
Emission Designation:	GXW, F9W, DXW
Antenna Connector Type:	N-type Female
Antenna Description:	▪ Uplink Outdoor Antenna: Yagi or similar directional antenna with gain limit of 15 dBi. ▪ Downlink Outdoor Antenna: Yagi type or similar directional antenna with gain limit of 5 dBi.

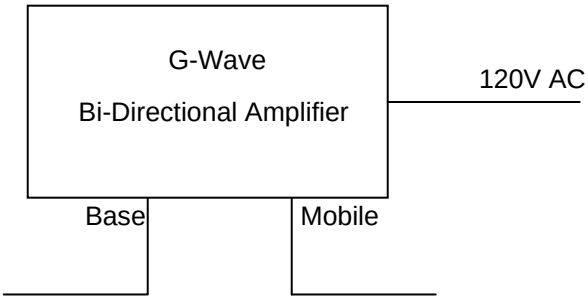
2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	AC Power Input	1	3-prong male plug	Non-shielded
2	Base	1	N-type Female	Shielded
3	Mobile	1	N-type Female	Shielded

2.5. ANCILLARY EQUIPMENT

None.

2.6. DRAWING OF TEST SETUP



(Downlink/Uplink Configuration)

- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	100 kPa
Power input source:	120 Vac 60 Hz

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	The amplifier was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	N/A
Special Hardware Used:	N/A
Transmitter Test Antenna:	The EUT is tested with the amplifier other antenna port terminated to a 50 Ohms RF Load.

Transmitter Test Signals	
Frequency Band(s): ▪ 1850-1910 MHz (Uplink) ▪ 1930-1990 MHz (Downlink)	Test Frequencies: ▪ 1851.25, 1880, 1908.75 (CDMA) & 1850.2, 1880, 1909.8 (GSM) MHz ▪ 1931.25, 1960, 1988.75 (CDMA) & 1930.2, 1960, 1989.8 (GSM) MHz
Transmitter Output Test Signals: Normal Test Modulation: Modulating signal source:	 GXW, F9W External

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Powerline Conducted Emissions were performed in Ultratech's shielded room, 16'(L) by 12'(W) by 12'(H).

- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site has been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049-1). Last Date of Site Calibration: May 17, 2007.

4.2. APPLICABILITY & SUMMARY OF EMISSION TEST RESULTS [FCC PARTS 2 & 24 (SUBPART E)]

FCC Paragraph(s)	Test Requirements	Applicability (Yes/No)
2.1046 & 24.232	RF Power Output	Yes
1.1307, 1.1310, 2.1091, 2.1093,	RF Exposure Limit	Yes
2.1055 & 24.135	Frequency Stability	N/A for Amplifier
2.1047(a)	Audio Frequency Response	N/A for Amplifier
2.1047(b)	Modulation Limiting	N/A for Amplifier
2.1049	Occupied Bandwidth	Yes
2.1051 & 24.238	Spurious Emissions at Antenna Terminal	Yes
2.1051 & 24.238	Field Strength of Spurious Emissions	Yes

***Note**: The device complies with FCC Part 15, Subpart B receiver & unintentional requirements.*

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

4.4. DEVIATION OF STANDARD TEST PROCEDURES

None.

EXHIBIT 5. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

5.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Exhibit 7 of this report

5.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Exhibit 6 for Measurement Uncertainties.

5.3. MEASUREMENT EQUIPMENT USED

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4:2003 and CISPR 16-1-1.

5.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER

The essential function of the EUT is to amplify and transmit voice/data to and from radios over RF link.

5.5. RF POWER OUTPUT & INTERMODULATION [§ 2.1046 & 24.232]

5.5.1. Limits

FCC 24.232: The effective isotropically radiated power (EIRP) and antenna height for base station transmitters must not exceed the limits in this section as per below:

Base Station Transmitters	Maximum ERP (Watts)
Base stations with an emission bandwidth of 1 MHz or less OR Base stations with an emission bandwidth of greater than 1 MHz	1640 Watts EIRP with an antenna height up to 300 meters HAAT
Base stations that are located in counties with population densities of 100 persons or fewer per square mile, based upon the most recently available population statistics from the Bureau of the Census	3280 Watts EIRP with an antenna height up to 300 meters HAAT

- Base station antenna heights may exceed 300 meters HAAT with a corresponding reduction in power; *see* Tables 1 & 2 (general) or Tables 3 & 4 (for counties) of this section.
- The service area boundary limits and microwave protection criteria specified in §§ 24.236 and 24.237 apply.
- Operation in counties as explained above must be coordinated in advance with all broadband PCS licensees authorized to operate on adjacent frequency blocks within 120 kilometers (75 miles) of the base station and is limited to base stations located more than 120 kilometers (75 miles) from the Canadian border and more than 75 kilometers (45 miles) from the Mexican border.

5.5.2. Method of Measurements

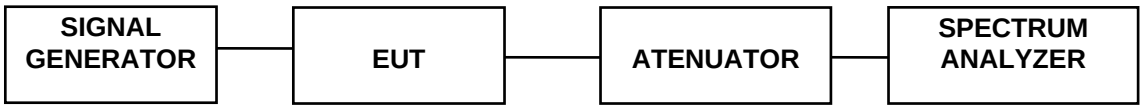
Refer to ULTRATECH Test Procedures, File # ULTR P001-2004 and TIA-603-C-2004

5.5.3. Test Equipment List

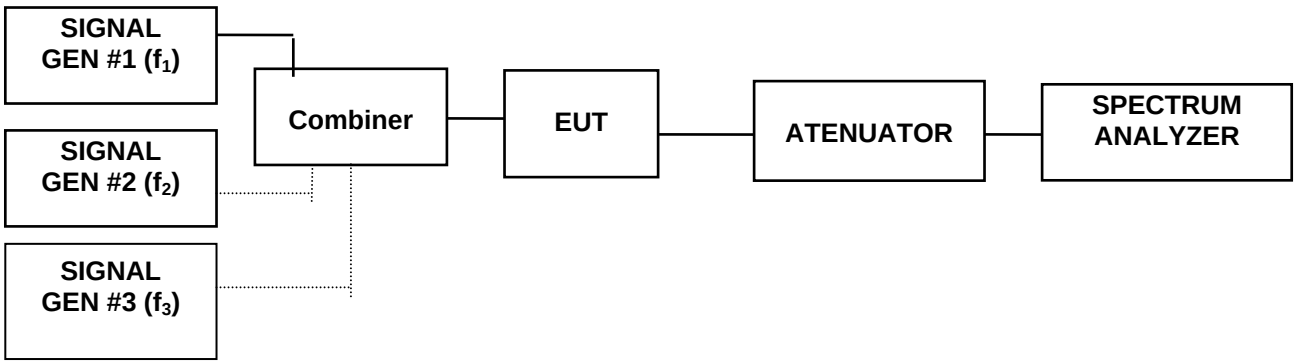
Please refer to Exhibit 6 for the details.

5.5.4. Test Arrangement

RF Conducted Output Power:



Multiple Channel Inputs:



- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

5.5.5. Test Data

5.5.5.1. RF Conducted Output Power

CDMA 2000 Sample	Frequency (MHz)	Max/Min Gain	Power Input (dBm)	Power Output (dBm)	O/P Power Rating (dBm)	Power Output (Watts)	O/P Power Rating (Watts)
BDA-PCS/A	1851.25	Max	-62	25.09	25	0.323	0.316
BDA-PCS/B	1880.00	Max	-62	24.98	25	0.315	0.316
BDA-PCS/C	1908.75	Max	-62	24.89	25	0.308	0.316
BDA-PCS/A	1931.25	Max	-50	36.41	37	4.375	5
BDA-PCS/B	1960.00	Max	-50	37.00	37	5.012	5
BDA-PCS/C	1988.75	Max	-50	36.81	37	4.797	5
BDA-PCS/A	1851.25	Min	-32	24.96	25	0.313	0.316
BDA-PCS/B	1880.00	Min	-32	24.99	25	0.316	0.316
BDA-PCS/C	1908.75	Min	-32	24.74	25	0.298	0.316
BDA-PCS/A	1931.25	Min	-20	36.21	37	4.178	5
BDA-PCS/B	1960.00	Min	-20	36.95	37	4.955	5
BDA-PCS/C	1988.75	Min	-20	36.80	37	4.786	5

GSM Sample	Frequency (MHz)	Max/Min Gain	Power Input (dBm)	Power Output (dBm)	O/P Power Rating (dBm)	Power Output (Watts)	O/P Power Rating (Watts)
BDA-PCS/A	1850.2	Max	-62	25.09	25	0.323	0.316
BDA-PCS/B	1880.0	Max	-62	24.87	25	0.307	0.316
BDA-PCS/C	1909.8	Max	-62	24.71	25	0.296	0.316
BDA-PCS/A	1930.2	Max	-50	35.90	37	3.890	5
BDA-PCS/B	1960.0	Max	-50	36.71	37	4.688	5
BDA-PCS/C	1989.8	Max	-50	36.51	37	4.477	5
BDA-PCS/A	1850.2	Min	-32	25.05	25	0.320	0.316
BDA-PCS/B	1880.0	Min	-32	24.89	25	0.308	0.316
BDA-PCS/C	1909.8	Min	-32	24.60	25	0.288	0.316
BDA-PCS/A	1930.2	Min	-20	35.79	37	3.793	5
BDA-PCS/B	1960.0	Min	-20	36.69	37	4.667	5
BDA-PCS/C	1989.8	Min	-20	36.50	37	4.467	5

Note: The power output was measured using this spectrum analyzers settings; (CDMA: RBW= 3 MHz, VBW= 10 MHz), (GSM: RBW= 1 MHz, VBW= 3 MHz), Detector: Average, maximum gain: attenuator set 0dB, minimum gain: attenuator set 30dB.

5.5.5.2. Inter-modulation Measurements

Inter-modulation of 2 Inputs:-

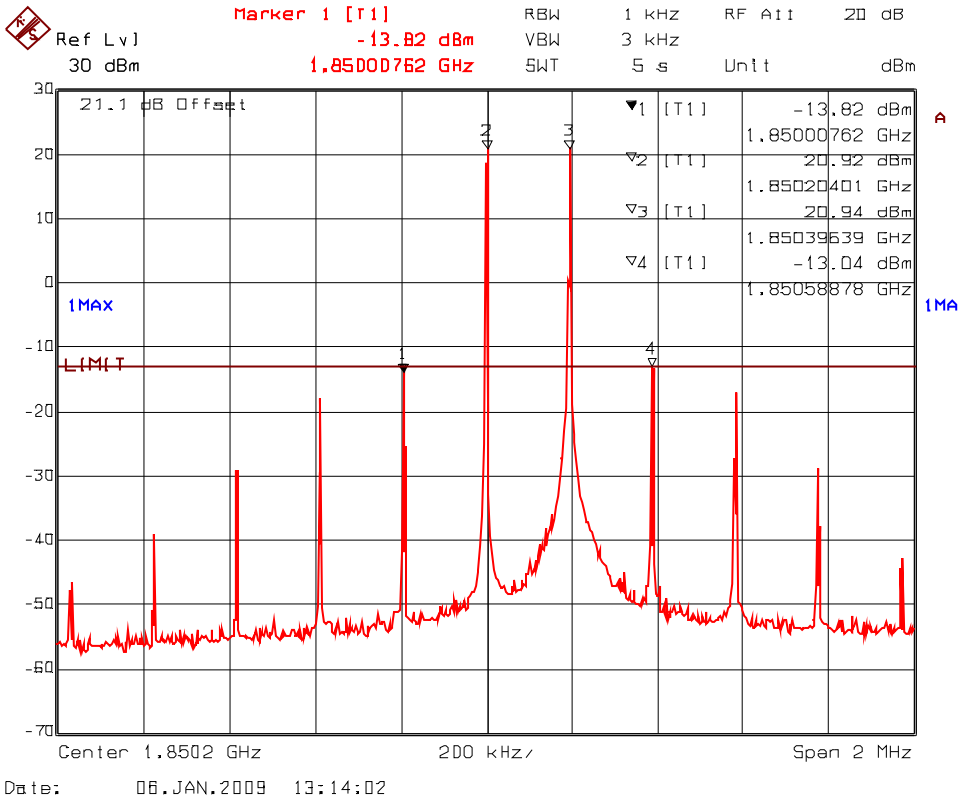
	Value @ S/G (Maximum Gain)	Value @ Analyzer (Maximum Gain)	Value @ S/G (Minimum Gain)	Value @ Analyzer (Minimum Gain)
1850.2 MHz	-24.4dBm	-41.01dBm	-4.4dBm	-18.66dBm
1850.4 MHz	-25.3dBm	-40.23dBm	-4.5dBm	-20.02dBm
1880.0 MHz	-35.9dBm	-52.16dBm	-1.4dBm	-18.13dBm
1880.2 MHz	-36.1dBm	-52.17dBm	-1.0dBm	-16.79dBm
1909.8 MHz	-34.2dBm	-50.41dBm	-3.0dBm	-18.89dBm
1909.6 MHz	-35.0dBm	-50.77dBm	-4.2dBm	-19.63dBm
1930.2 MHz	-41.0dBm	-57.17dBm	-10.7dBm	-26.61dBm
1930.4 MHz	-41.6dBm	-57.47dBm	-11.3dBm	-27.05dBm
1960.0 MHz	-42.9dBm	-59.25dBm	-13.6dBm	-29.76dBm
1960.2 MHz	-43.0dBm	-59.45dBm	-13.6dBm	-29.91dBm
1989.8 MHz	-41.9dBm	-57.99dBm	-11.5dBm	-27.11dBm
1989.6 MHz	-42.9dBm	-58.51dBm	-12.0dBm	-27.39dBm

Inter-modulation of 3 Inputs:-

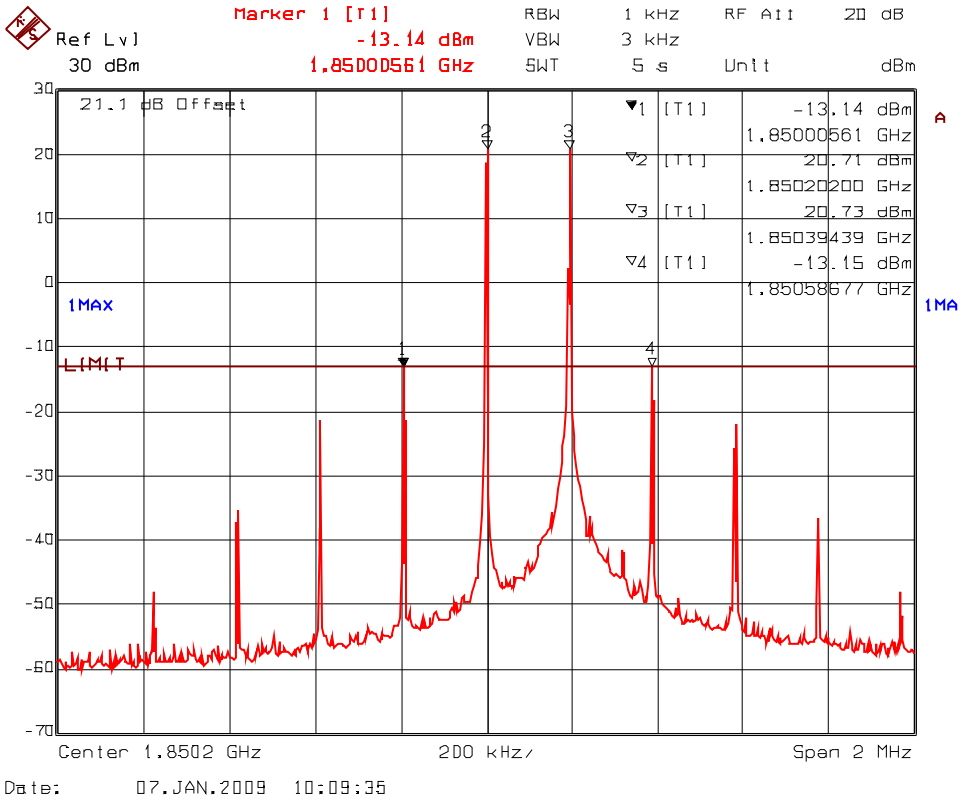
	Value @ S/G (Maximum Gain)	Value @ Analyzer (Maximum Gain)	Value @ S/G (Minimum Gain)	Value @ Analyzer (Minimum Gain)
1850.2 MHz	-36.8dBm	-52.53dBm	-6.0dBm	-21.74dBm
1850.4 MHz	-37.1dBm	-52.75dBm	-6.6dBm	-22.30dBm
1850.6 MHz	-40.7dBm	-53.47dBm	-10.0dBm	-22.84dBm
1880.0 MHz	-39.0dBm	-55.28dBm	-8.0dBm	-24.29dBm
1880.2 MHz	-39.2dBm	-55.07dBm	-8.2dBm	-24.14dBm
1880.4 MHz	-42.2dBm	-55.48dBm	-11.6dBm	-24.61dBm
1909.8 MHz	-44.6dBm	-60.86dBm	-3.3dBm	-19.21dBm
1909.6 MHz	-44.9dBm	-60.62dBm	-4.5dBm	-19.87dBm
1909.4 MHz	-48.3dBm	-61.53dBm	-8.1dBm	-21.78dBm
1930.2 MHz	-43.4dBm	-59.93dBm	-7.6dBm	-23.88dBm
1930.4 MHz	-43.8dBm	-60.02dBm	-8.0dBm	-24.03dBm
1930.6 MHz	-46.8dBm	-60.13dBm	-11.0dBm	-24.19dBm
1960.0 MHz	-40.3dBm	-56.49dBm	-9.6dBm	-25.59dBm
1960.2 MHz	-40.3dBm	-56.55dBm	-9.4dBm	-25.57dBm
1960.4 MHz	-43.6dBm	-56.47dBm	-12.3dBm	-25.47dBm
1989.8 MHz	-43.1dBm	-59.49dBm	-7.1dBm	-23.17dBm
1989.6 MHz	-43.9dBm	-59.79dBm	-7.6dBm	-23.52dBm
1989.4 MHz	-47.8dBm	-60.72dBm	-11.2dBm	-23.97dBm

5.5.5.2.1. Uplink Band 1850–1910 MHz

Plot 5.5.5.2.1.1 Intermodulation with 2 RF signal inputs/outputs
RF Inputs: 1850.2 & 1850.4 MHz (-41.01 & -40.23dBm), Max Gain

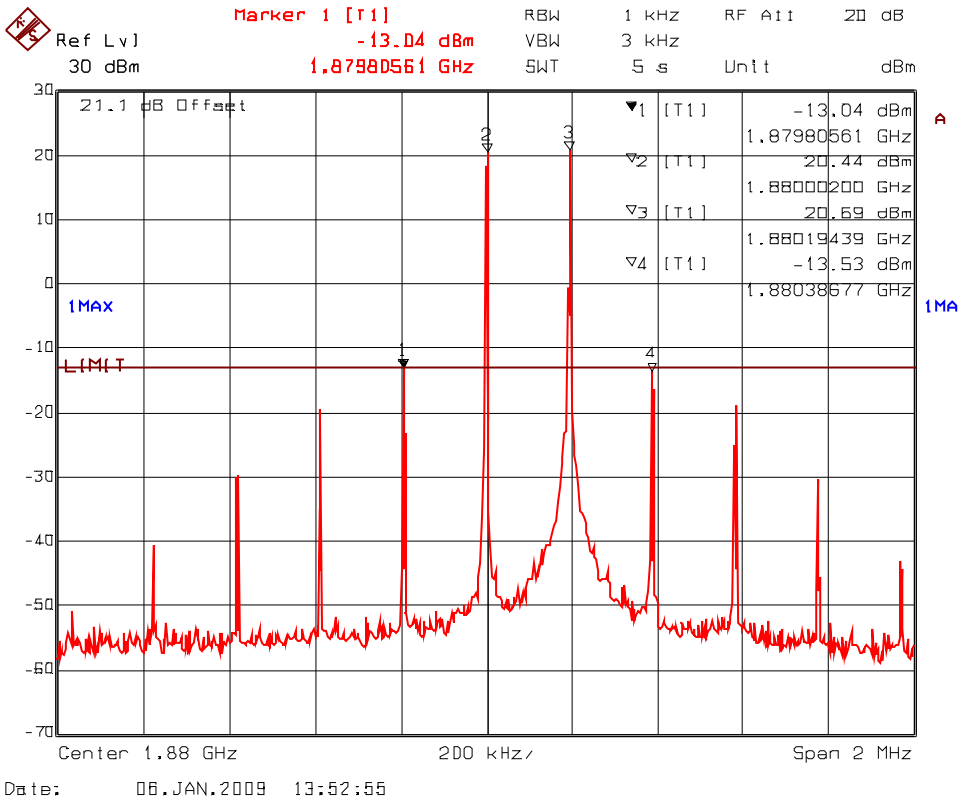


Plot 5.5.5.2.1.2 Intermodulation with 2 RF signal inputs/outputs
RF Inputs: 1850.2 & 1850.4 MHz (-18.66 & -20.02dBm), Min Gain

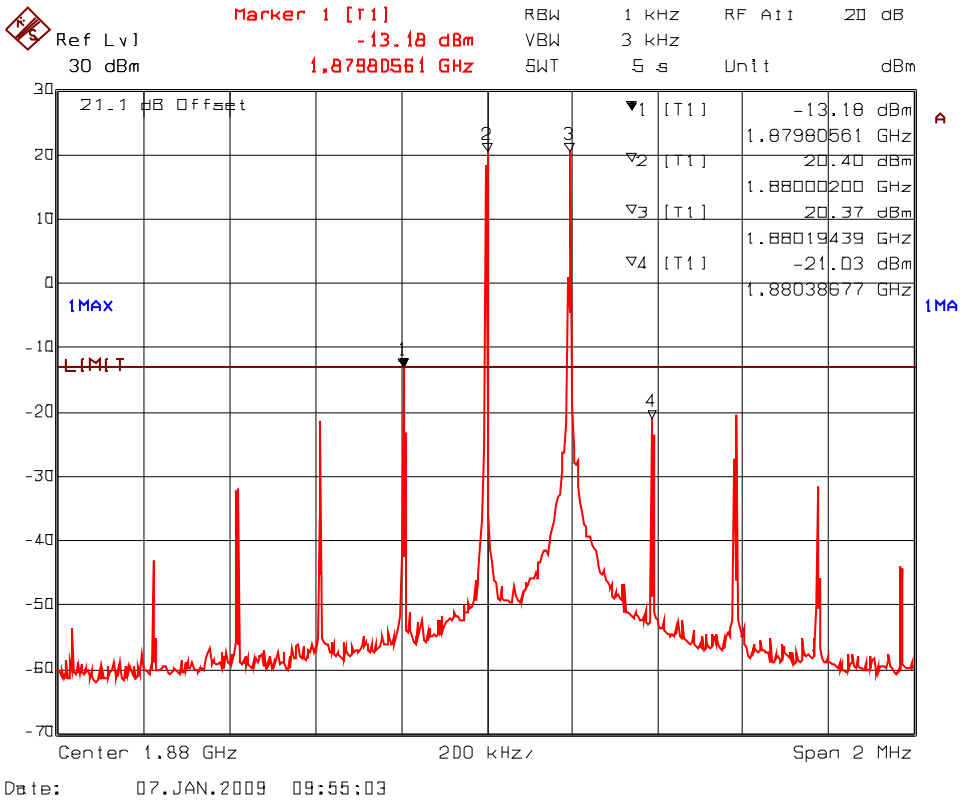


- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

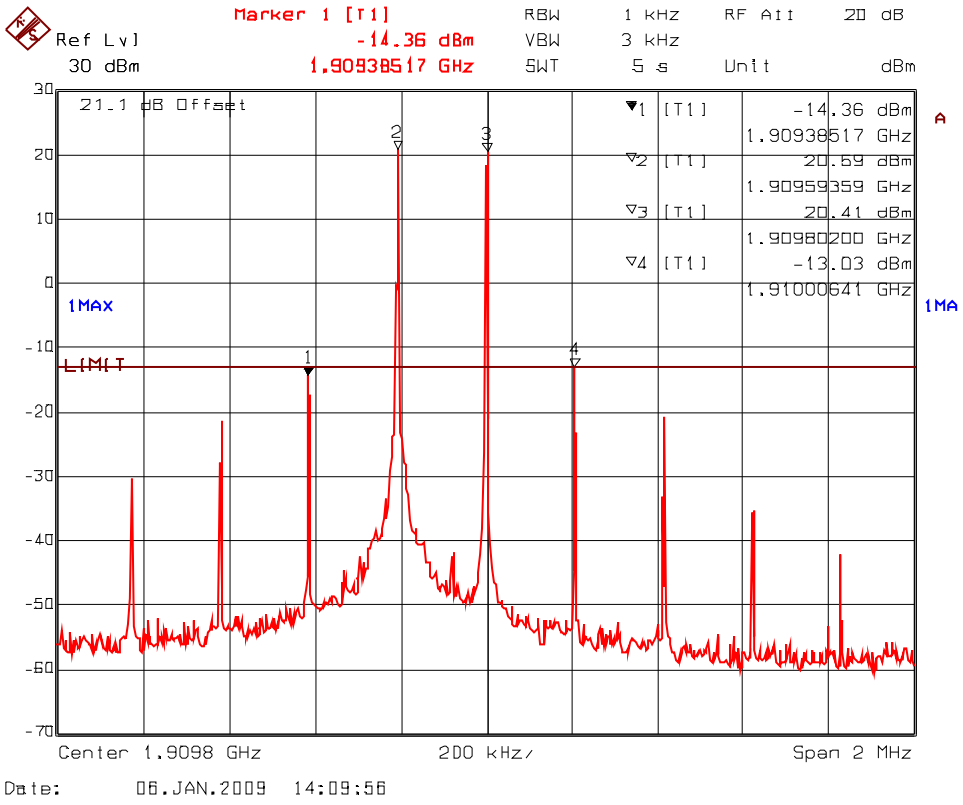
Plot 5.5.5.2.1.3 Intermodulation with 2 RF signal inputs/outputs
RF Inputs: 1880 & 1880.2 MHz (-52.16 & -52.17dBm), Max Gain



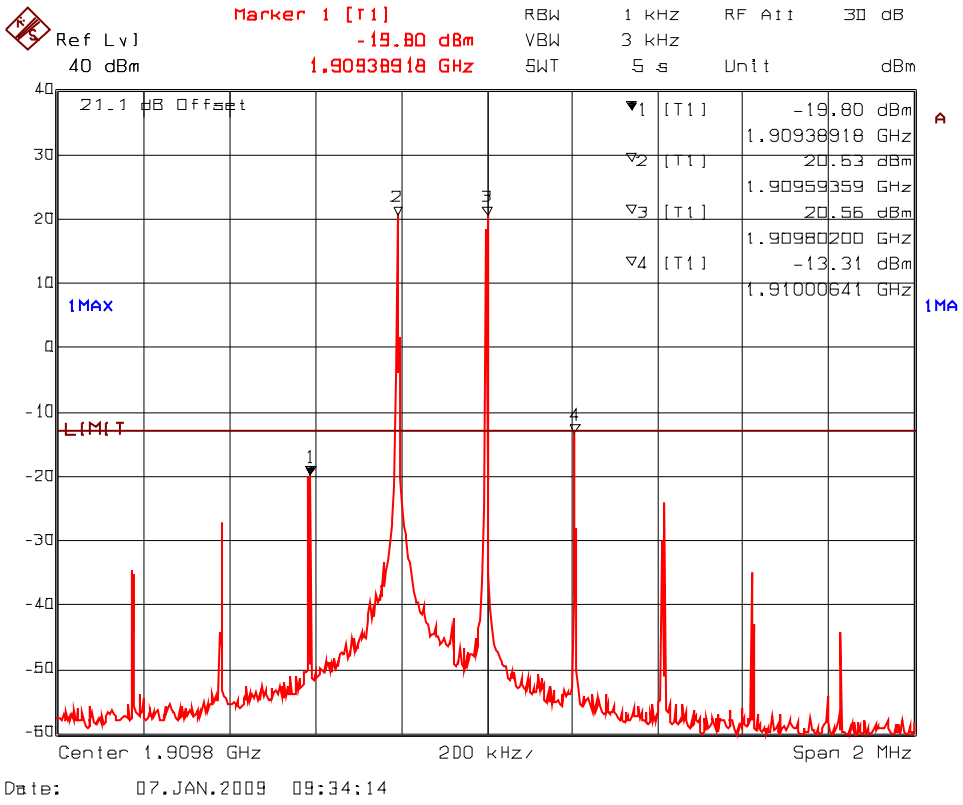
Plot 5.5.5.2.1.4 Intermodulation with 2 RF signal inputs/outputs
RF Inputs: 1880 & 1880.2 MHz (-18.13 & -16.79dBm), Min Gain



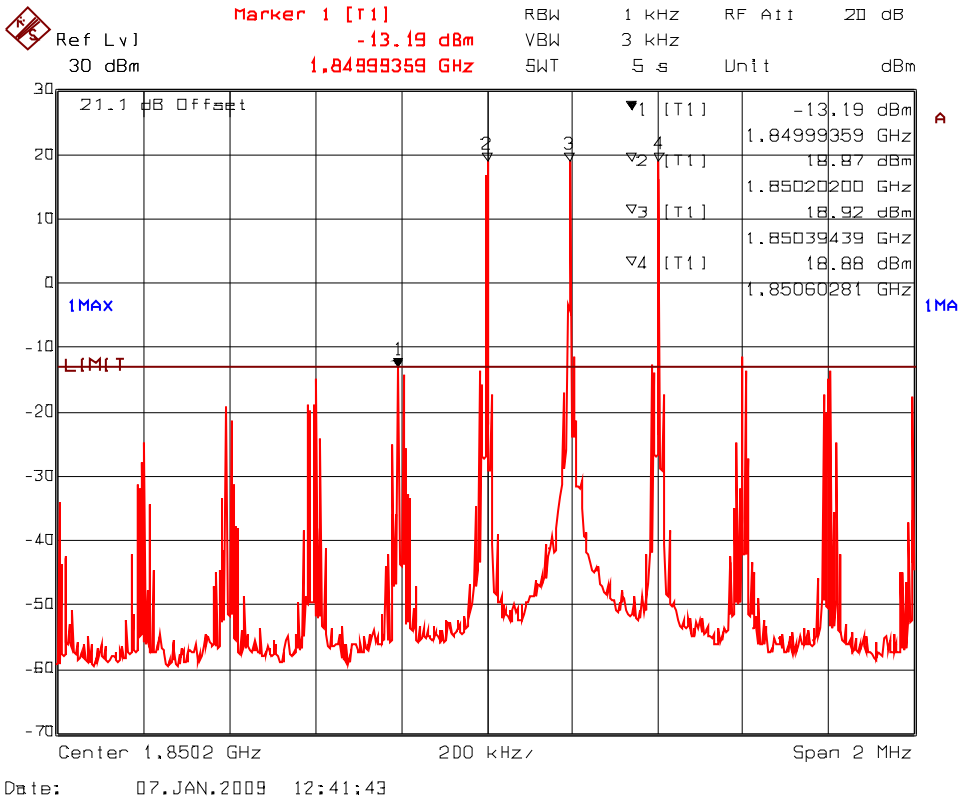
Plot 5.5.5.2.1.5 Intermodulation with 2 RF signal inputs/outputs
RF Inputs: 1909.8 & 1909.6 MHz (-50.41 & -50.77dBm), Max Gain



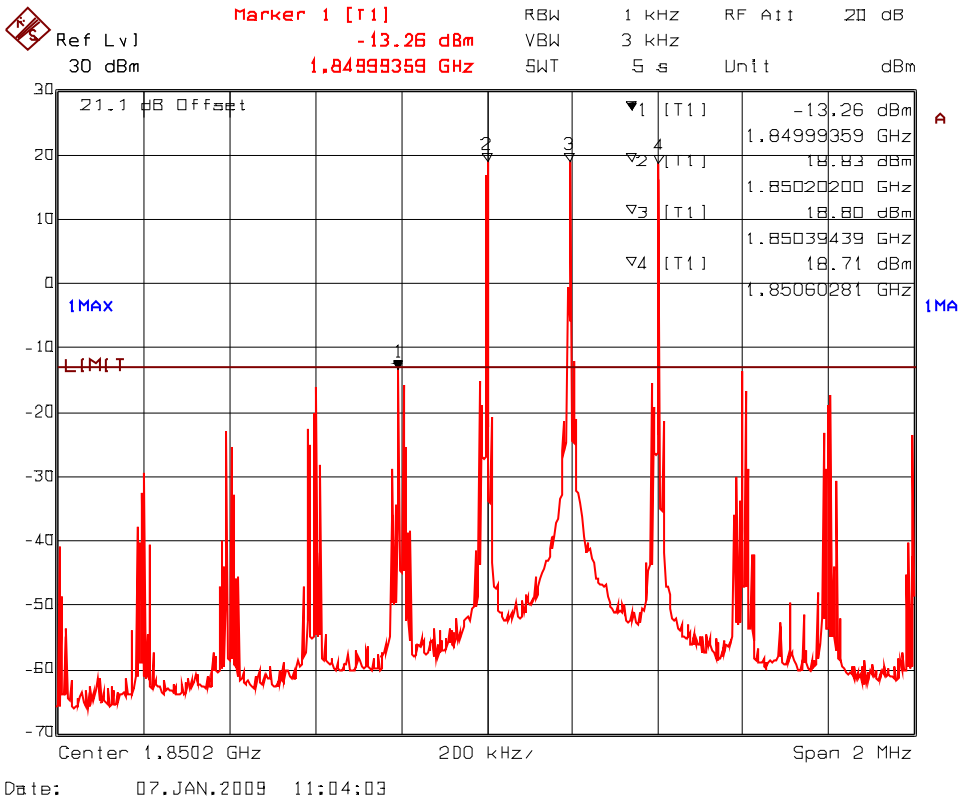
Plot 5.5.5.2.1.6 Intermodulation with 2 RF signal inputs/outputs
RF Inputs: 1909.8 & 1909.6 MHz (-18.89 & -19.63dBm), Min Gain



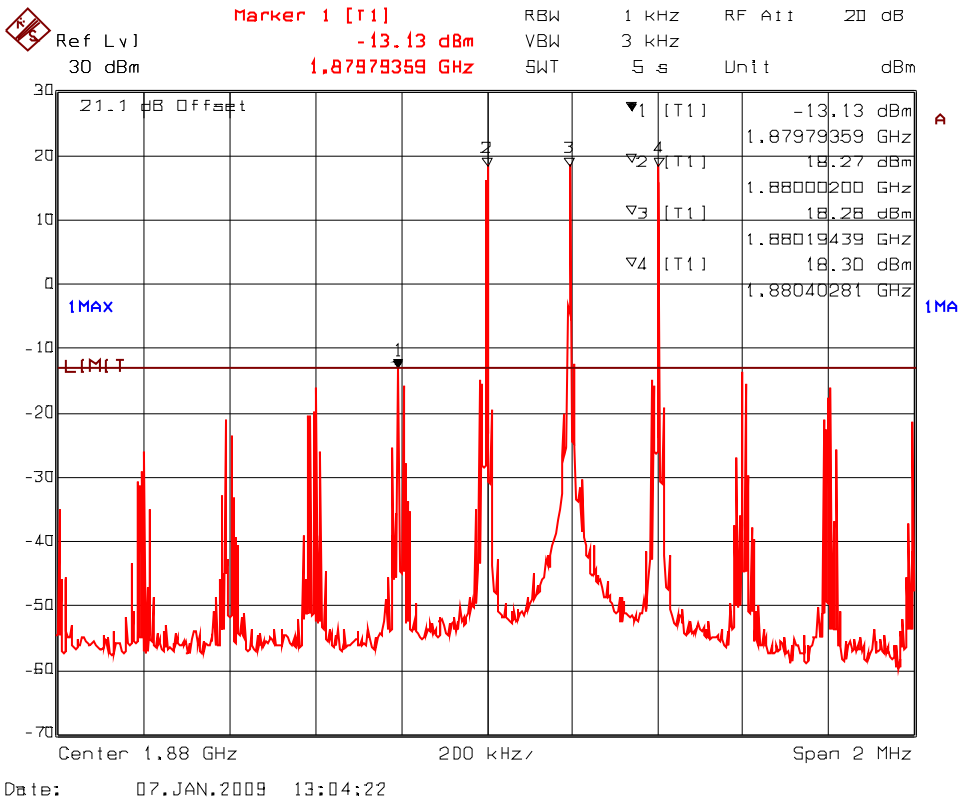
Plot 5.5.5.2.1.7 Intermodulation with 3 RF signal inputs/outputs
RF Inputs: 1850.2, 1850.4 & 1850.6 MHz (-52.53, -52.75 & -53.47dBm), Max Gain



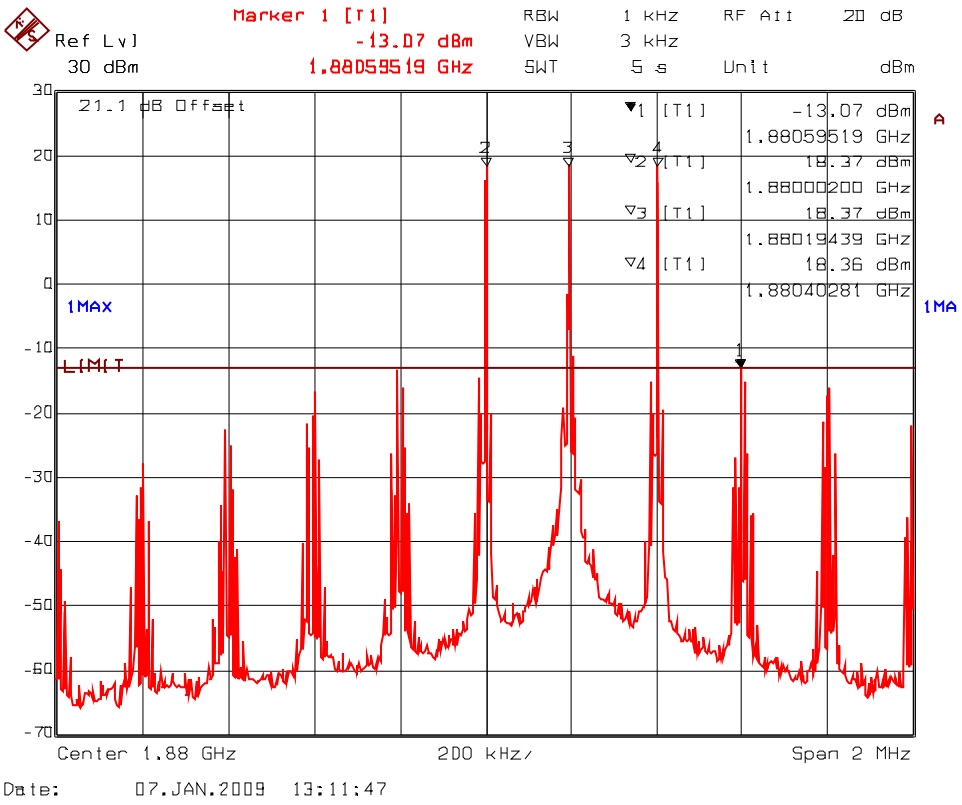
Plot 5.5.5.2.1.8 Intermodulation with 3 RF signal inputs/outputs
RF Inputs: 1850.2, 1850.4 & 1850.6 MHz (-21.74, -222.30 & -22.84dBm), Min Gain



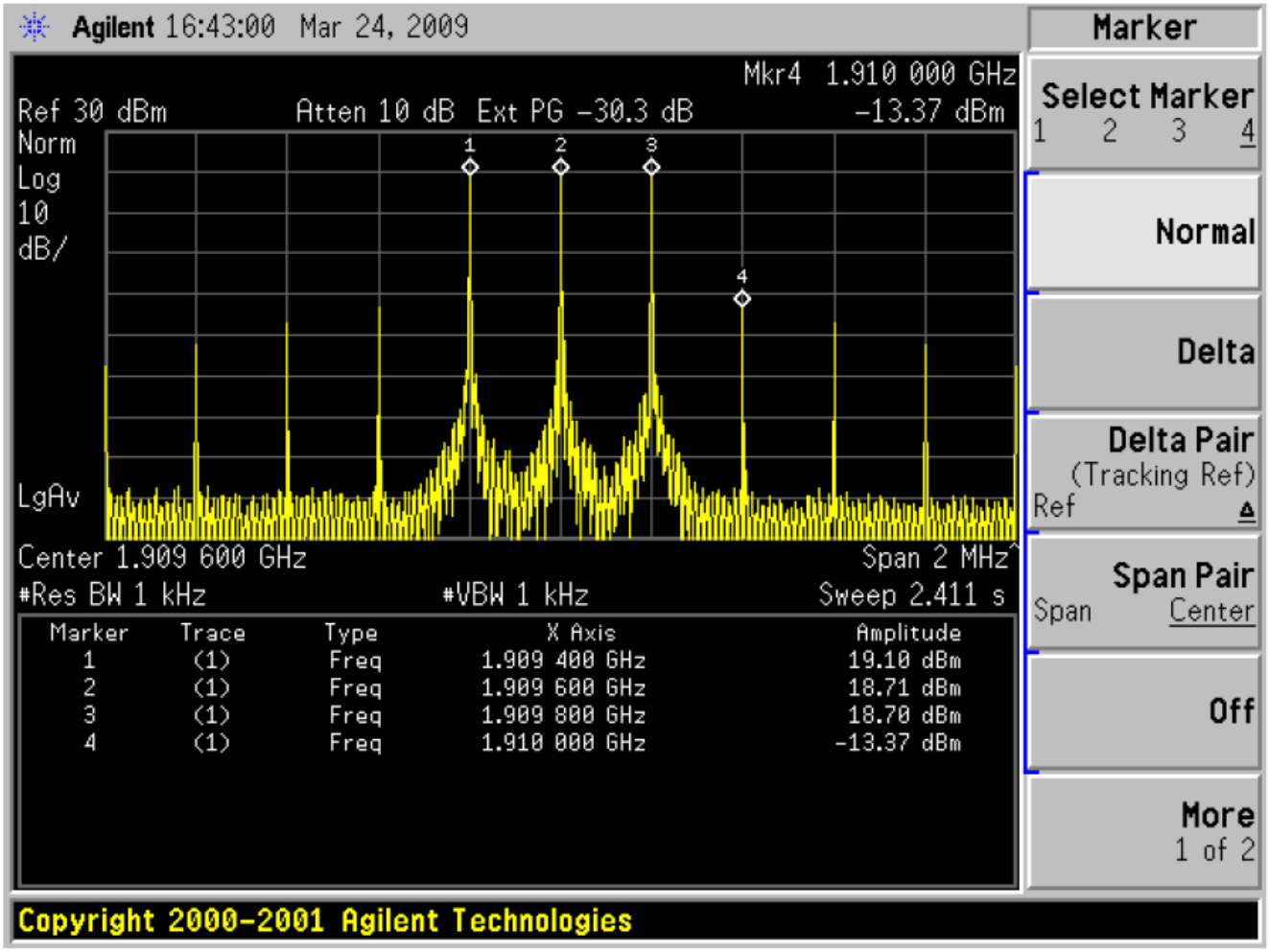
Plot 5.5.5.2.1.9 Intermodulation with 3 RF signal inputs/outputs
RF Inputs: 1880, 1880.2 & 1880.4 MHz (-55.28, -55.07 & -55.48dBm), Max Gain



Plot 5.5.5.2.1.10 Intermodulation with 3 RF signal inputs/outputs
RF Inputs: 1880, 1880.2 & 1880.4 MHz (-24.29, -24.14 & -24.61dBm), Min Gain



Plot 5.5.5.2.1.11 Intermodulation with 3 RF signal inputs/outputs
RF Inputs: 1909.8, 1909.6 & 1909.4 MHz, Max Gain

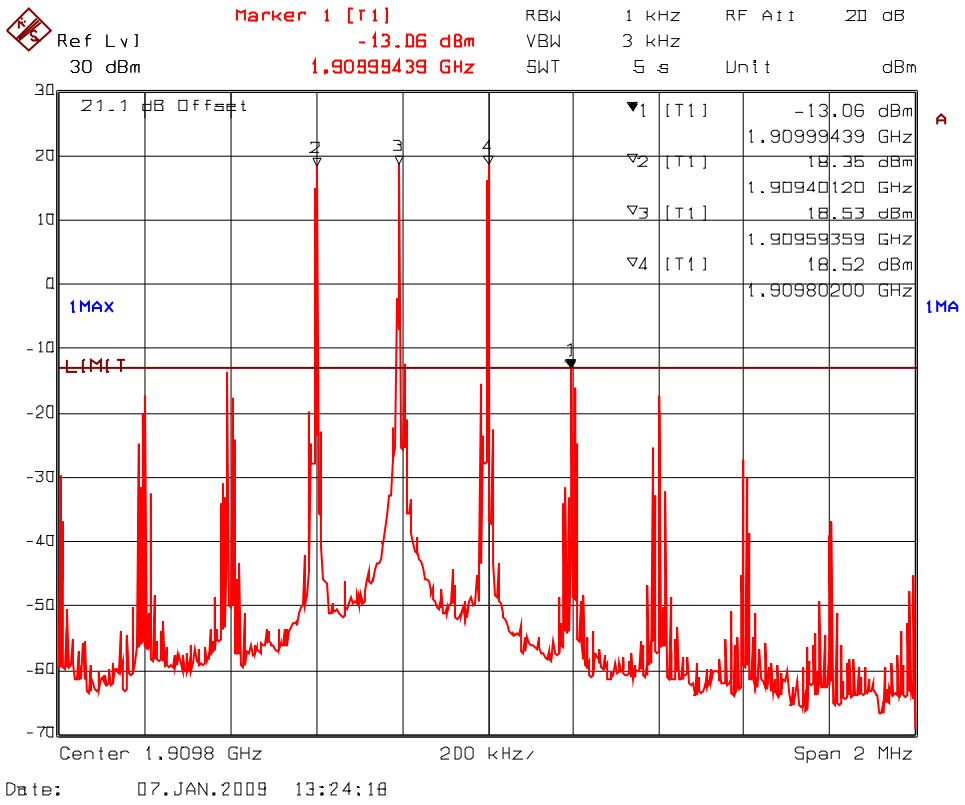


Uplink Unit #2

Three-Tones RF signals @ 1909.4, 1909.6, & 1909.8 - @ Maximum Gain

- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

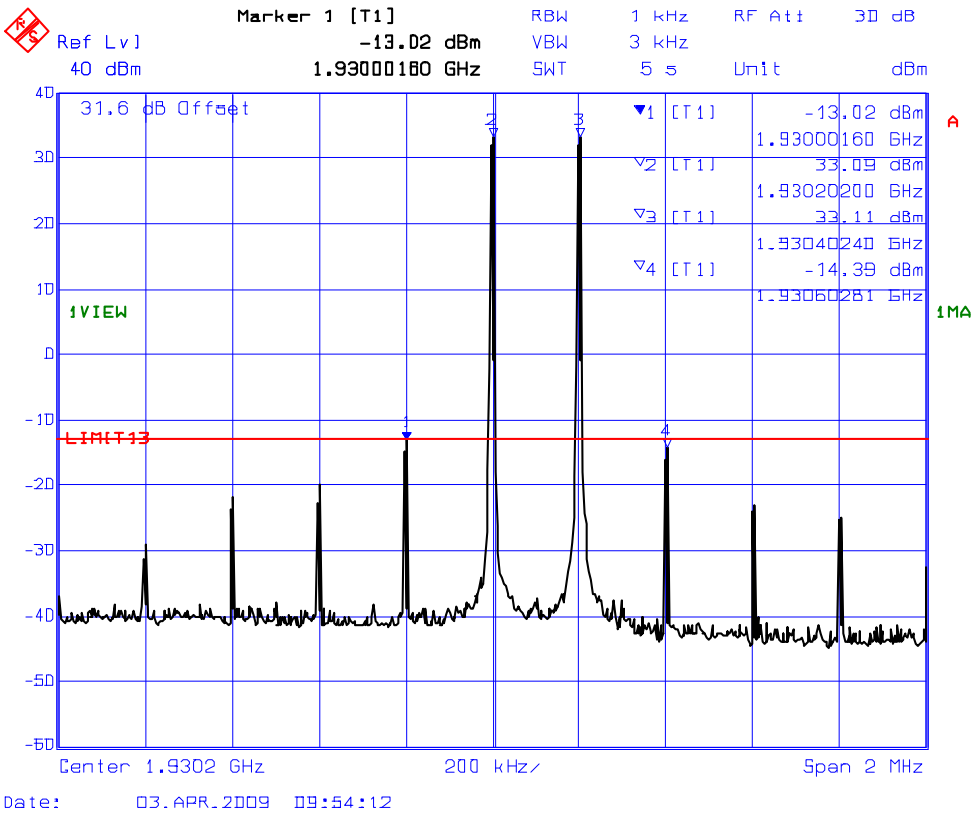
Plot 5.5.5.2.1.12 Intermodulation with 3 RF signal inputs/outputs
RF Inputs: 1909.8, 1909.6 & 1909.4 MHz (-19.21, -19.87 & -21.78dBm), Min Gain



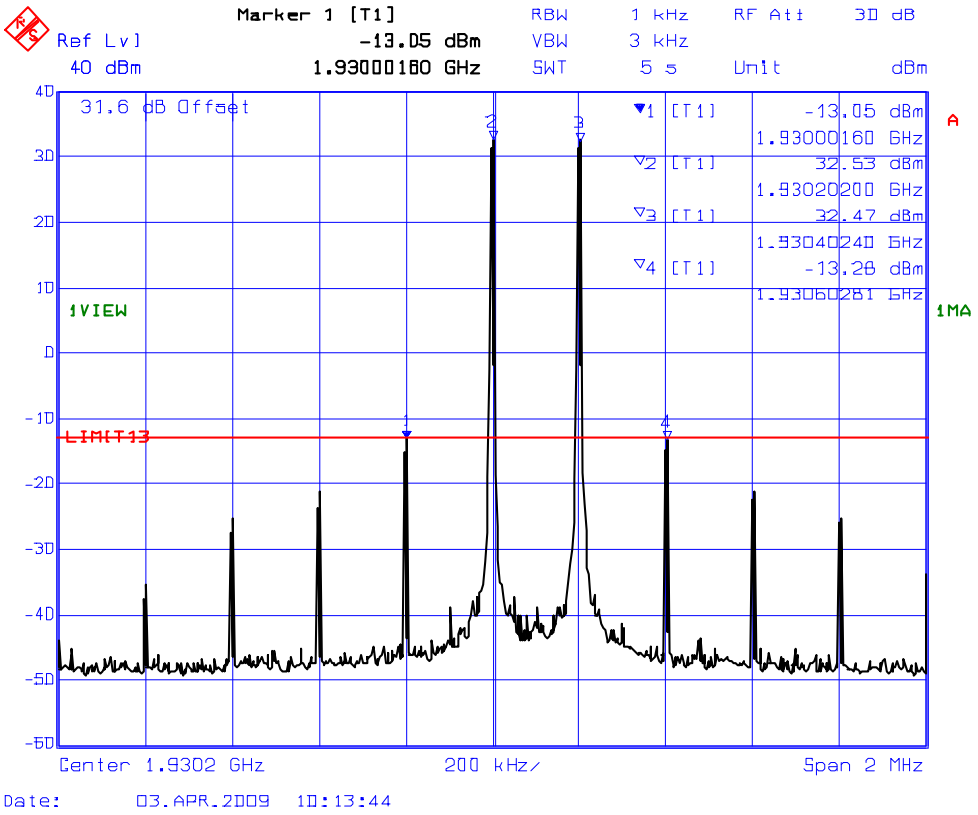
Note: Some of the Downlink Inter-modulation measurements were performed by the applicant and later verified by us as acceptable results. The plots are inserted in this test report to show compliance with FCC requirement.

5.5.5.2.2. Downlink Bands 1930–1990 MHz

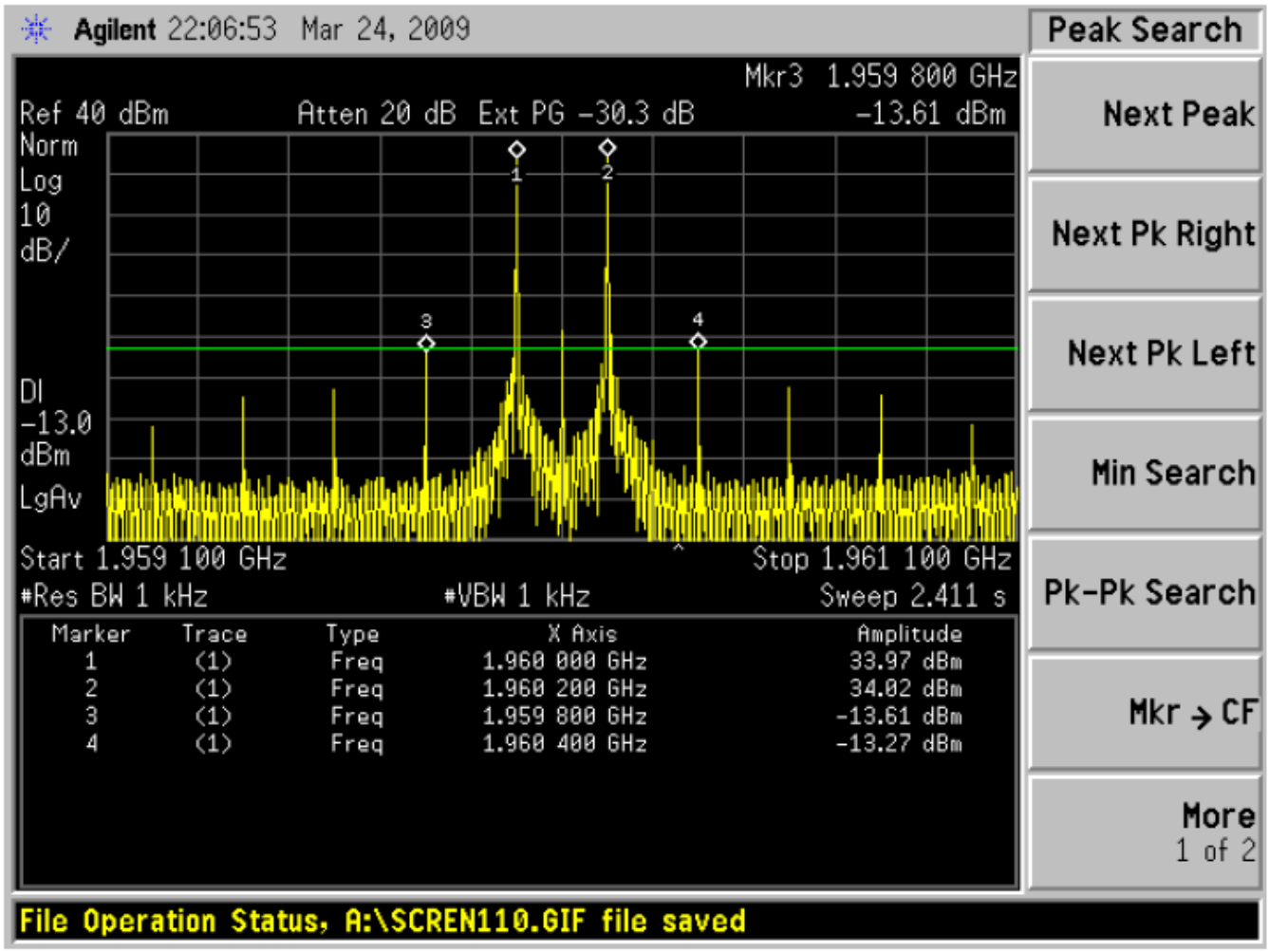
Plot 5.5.5.2.2.1 Intermodulation with 2 RF signal inputs/outputs
RF Inputs: 1930.2 & 1930.4 MHz (-54.19 & -53.95dBm), Max Gain



Plot 5.5.5.2.2.2 Intermodulation with 2 RF signal inputs/outputs
RF Inputs: 1930.2 & 1930.4 MHz (-24.41 & -24.79dBm), Min Gain



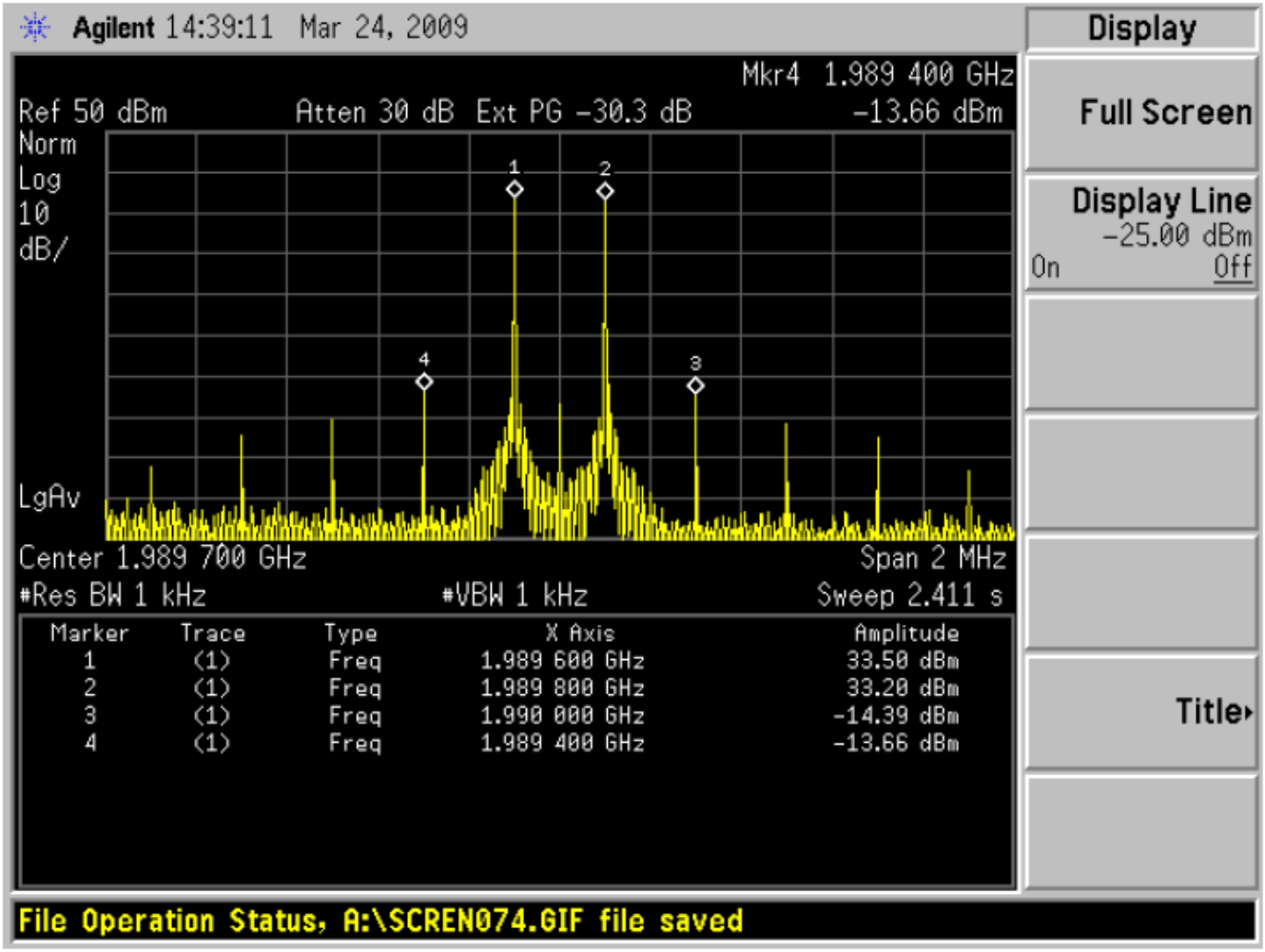
Plot 5.5.5.2.2.3 Intermodulation with 2 RF signal inputs/outputs
RF Inputs: 1960.2 & 1960.4 MHz, Max Gain



Downlink Unit PCS B

Two-Tones RF signals @ 1960.2 & 1960.4 - @ Maximum Gain

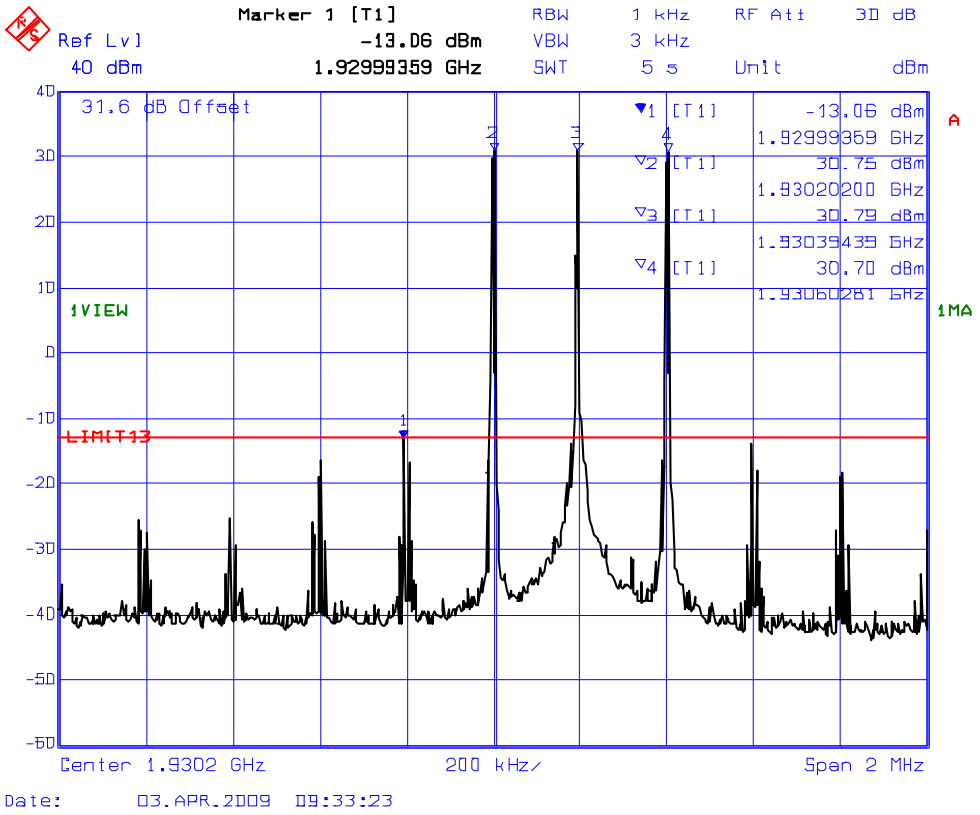
Plot 5.5.5.2.2.4 Intermodulation with 2 RF signal inputs/outputs
RF Inputs: 1989.8 & 1989.6 MHz, Max Gain



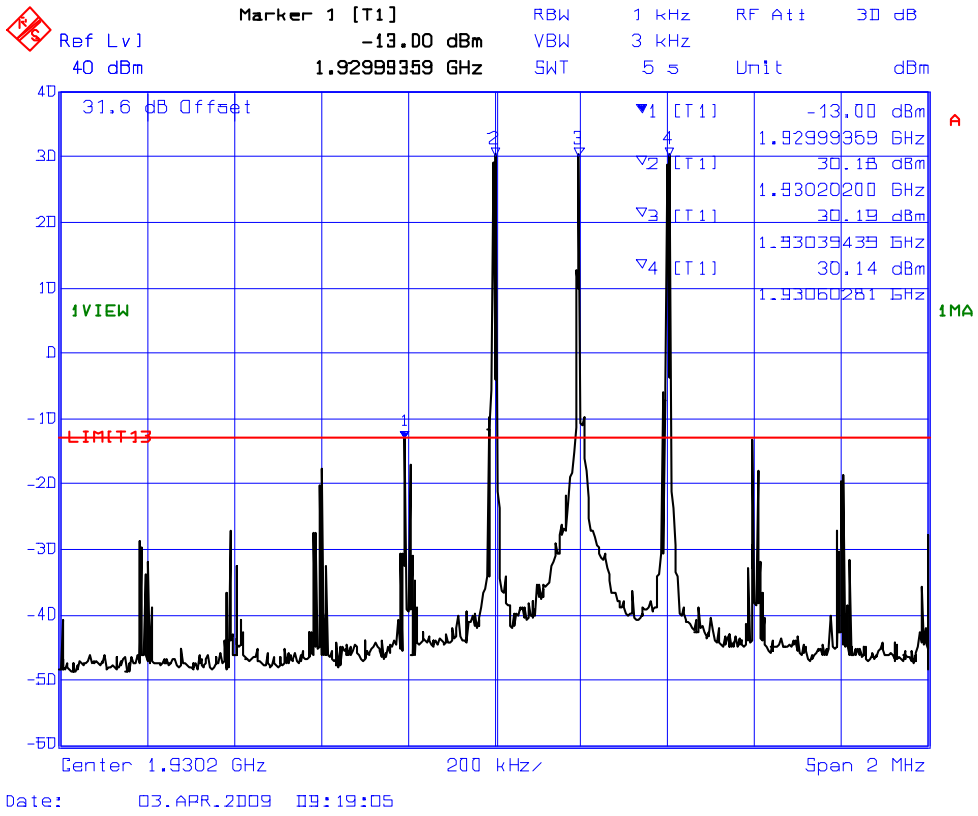
Downlink Unit PCS C

Two-Tones RF signals @ 1989.6 & 1989.8 - @ Maximum Gain

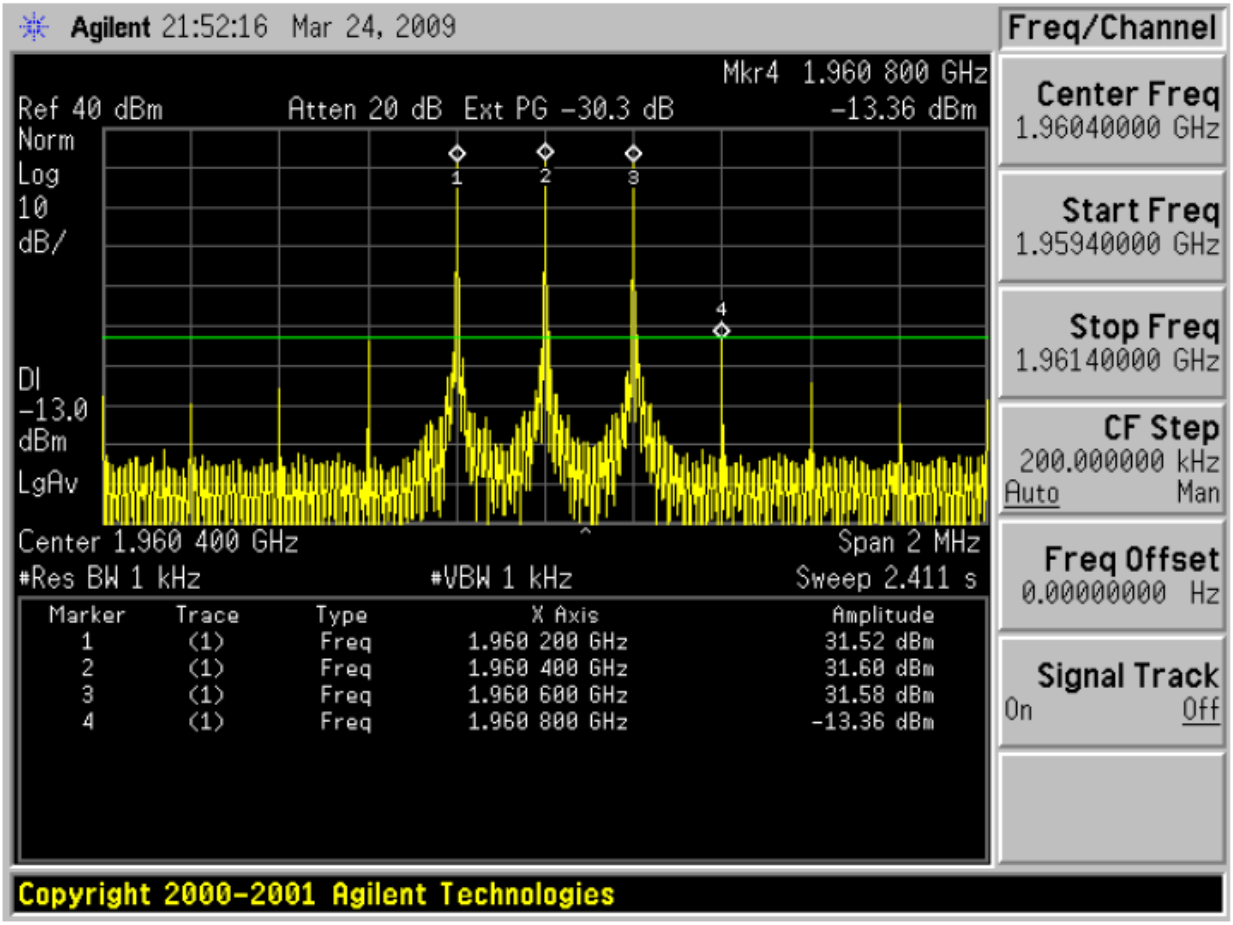
Plot 5.5.5.2.2.5 Intermodulation with 3 RF signal inputs/outputs
RF Inputs: 1930.2, 1930.4 & 1930.6 MHz (-56.13, -56.02 & -56.13dBm), Max Gain



Plot 5.5.5.2.2.6 Intermodulation with 3 RF signal inputs/outputs
RF Inputs: 1930.2, 1930.4 & 1930.6 MHz (-26.27, -26.62 & -26.90dBm), Min Gain



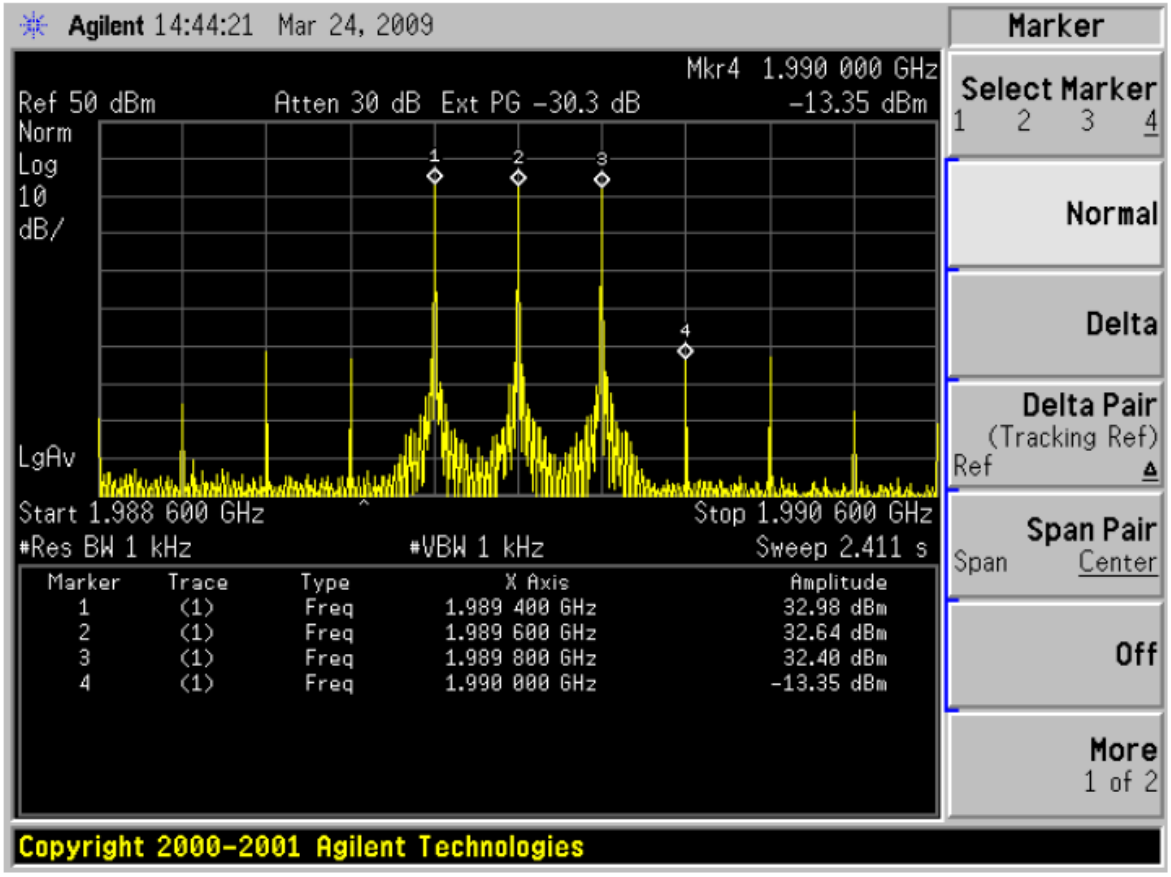
Plot 5.5.5.2.2.7 Intermodulation with 3 RF signal inputs/outputs
RF Inputs: 1960.2, 1960.4 & 1960.6 MHz, Max Gain



Downlink Unit PCS B

Three-Tones RF signals @ 1960.2, 1960.4, & 1960.6 - @ Maximum Gain

Plot 5.5.5.2.2.8 Intermodulation with 3 RF signal inputs/outputs
RF Inputs: 1989.8, 1989.6 & 1989.4 MHz, Max Gain



Downlink Unit PCS C
Three-Tones RF signals @ 1989.4, 1989.6, & 1989.8 - @ Maximum Gain

5.6. RF EXPOSURE REQUIREMENTS [§§ 1.1310 & 2.1091]

5.6.1. Limits

- **FCC 1.1310:**- The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (minutes)
(A) Limits for Occupational/Control Exposures				
1500-100,000	...	...	5.0	6
(B) Limits for General Population/Uncontrolled Exposure				
1500-100,000	...	...	1.0	30

5.6.2. Method of Measurements

Refer to FCC @ 1.1310 and 2.1091

- In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed:

(1) Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.
(2) Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement
(3) Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits
(4) Any other RF exposure related issues that may affect MPE compliance

Calculation Method of RF Safety Distance:

$S = PG/4\Pi r^2 = EIRP/4\Pi r^2$

Where: P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power.
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

$r = \sqrt{PG/4\Pi S}$

- For portable transmitters (see Section 2.1093), or devices designed to operate next to a person's body, compliance is determined with respect to the SAR limit (define in the body tissues) for near-field exposure conditions. If the maximum average output power, operating condition configurations and exposure conditions are comparable to those of existing cellular and PCS phones, an SAR evaluation may be required in order to determine if such a device complies with SAR limit. When SAR evaluation data is not available, and the additional supporting information cannot assure compliance, the Commission may request that an SAR evaluation be performed, as provided for in Section 1.1307(d)

5.6.3. Test Data

Antenna Gain Limit specified by Manufacturer:

- Downlink: 5 dBi (Indoor Omni type or similar antenna)
- Uplink: 15 dBi (Outdoor Yagi or similar type directional antenna)

Frequency Band (MHz)	Highest Conducted Power at the Antenna Terminal (dBm)	Maximum Antenna Gain (dBi)	Maximum EIRP (dBm)	Minimum RF Safety Distance r (cm)
Downlink				
1930 – 1990	37.00	5	42.00	35.51
Uplink				
1850 – 1910	25.09	15	40.09	28.50

Remarks:

(1) The calculation is based on the lowest frequency and the highest conducted power in the frequency band for the worst case.
(2) The minimum separation distance between the antenna and bodies of users are calculated using the following equation:

RF EXPOSURE DISTANCE LIMITS: $r = (PG/4\Pi S)^{1/2} = (EIRP/4\Pi S)^{1/2}$

Sample calculation: $EIRP = 42.00\ dBm = 10^{(42.00/10)}\ mW = 15849\ mW$
$S = 1\ mW/cm^2$ (General Population/ Uncontrolled Exposure)

$r = (EIRP/4\Pi S)^{1/2} = (15849 / 4\Pi)^{1/2} = 35.51\ cm$

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	**Compliance with FCC Rules**
Minimum calculated separation distance between antenna and persons required: **35.51 cm (Downlink) & 28.50 cm (Uplink)**	Manufacturer' instruction for separation distance between antenna and persons required: **36 cm (Downlink) & 29 cm (Uplink)**
Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement	See User's Manual for details.
Caution statements and/or warning labels that are necessary in order to comply with the exposure limits	See User's Manual for RF Exposure Information.
Any other RF exposure related issues that may affect MPE compliance	None.

5.7. OCCUPIED BANDWIDTH [§§ 2.1049]

5.7.1. Limits

The spectral shape of the output should look similar to input for all modulations.

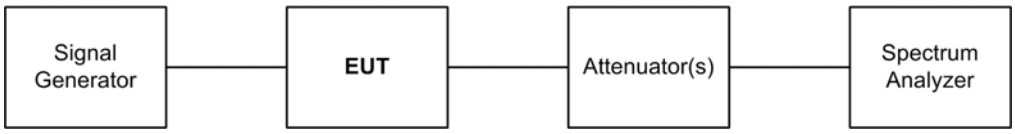
5.7.2. Method of Measurements

Refer to ULTRATECH Test Procedures, File # ULTR P001-2004

5.7.3. Test Equipment List

Please refer to Exhibit 6 for the details.

5.7.4. Test Arrangement



- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

5.7.5. Test Data

CDMA 2000 Modulation:

Sample Type	Frequency (MHz)	Max/Min Gain	Power Input (dBm)	Signal Input (MHz)	Signal Output (MHz)
BDA-PCS/A	1851.25	Max	-62	1.286	1.281
BDA-PCS/B	1880.00	Max	-62	1.286	1.281
BDA-PCS/C	1908.75	Max	-62	1.292	1.275
BDA-PCS/A	1931.25	Max	-50	1.275	1.281
BDA-PCS/B	1960.00	Max	-50	1.281	1.275
BDA-PCS/C	1988.75	Max	-50	1.281	1.281
BDA-PCS/A	1851.25	Min	-32	1.268	1.281
BDA-PCS/B	1880.00	Min	-32	1.281	1.281
BDA-PCS/C	1908.75	Min	-32	1.268	1.275
BDA-PCS/A	1931.25	Min	-20	1.275	1.281
BDA-PCS/B	1960.00	Min	-20	1.281	1.281
BDA-PCS/C	1988.75	Min	-20	1.281	1.275

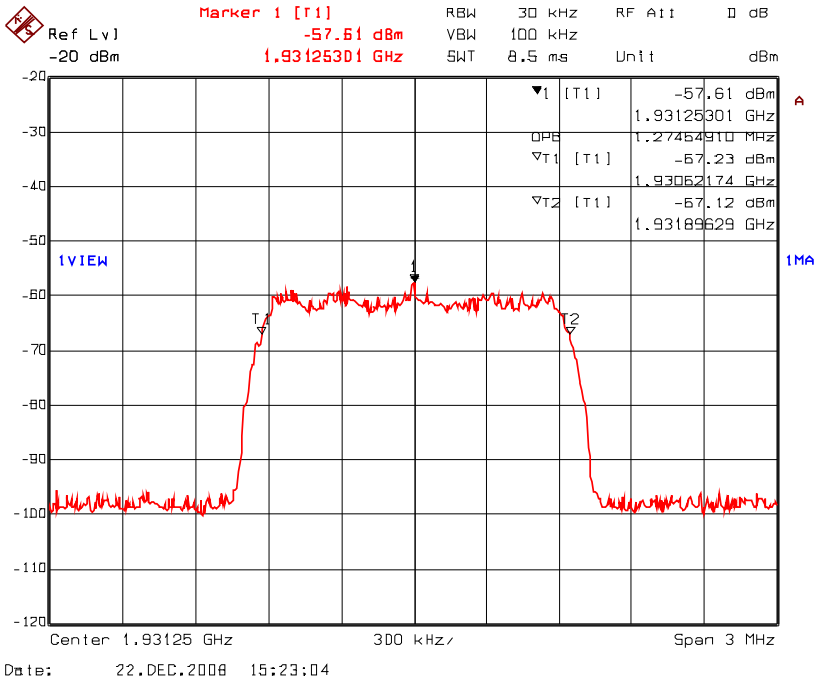
GSM Modulation:

Sample Type	Frequency (MHz)	Max/Min Gain	Power Input (dBm)	Signal Input (kHz)	Signal Output (kHz)
BDA-PCS/A	1850.2	Max	-62	244.48	245.49
BDA-PCS/B	1880.0	Max	-62	245.49	244.49
BDA-PCS/C	1909.8	Max	-62	245.49	244.49
BDA-PCS/A	1930.2	Max	-50	244.49	243.49
BDA-PCS/B	1960.0	Max	-50	244.49	243.48
BDA-PCS/C	1989.8	Max	-50	244.48	243.48
BDA-PCS/A	1850.2	Min	-32	244.48	244.48
BDA-PCS/B	1880.0	Min	-32	243.48	245.49
BDA-PCS/C	1909.8	Min	-32	244.48	245.49
BDA-PCS/A	1930.2	Min	-20	243.48	243.48
BDA-PCS/B	1960.0	Min	-20	244.48	243.48
BDA-PCS/C	1989.8	Min	-20	244.48	244.48

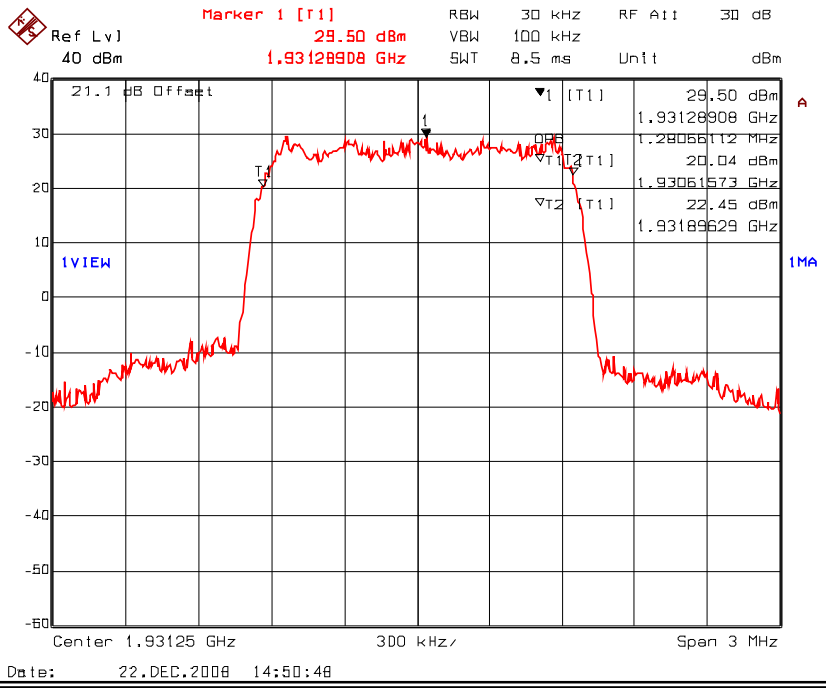
5.7.5.1. Downlink Bands (1930-1990 MHz)

CDMA 2000:-

Plot 5.7.5.1.1a 99% Occupied Bandwidth
RF Input Signal: 1931.25 MHz, Max Gain

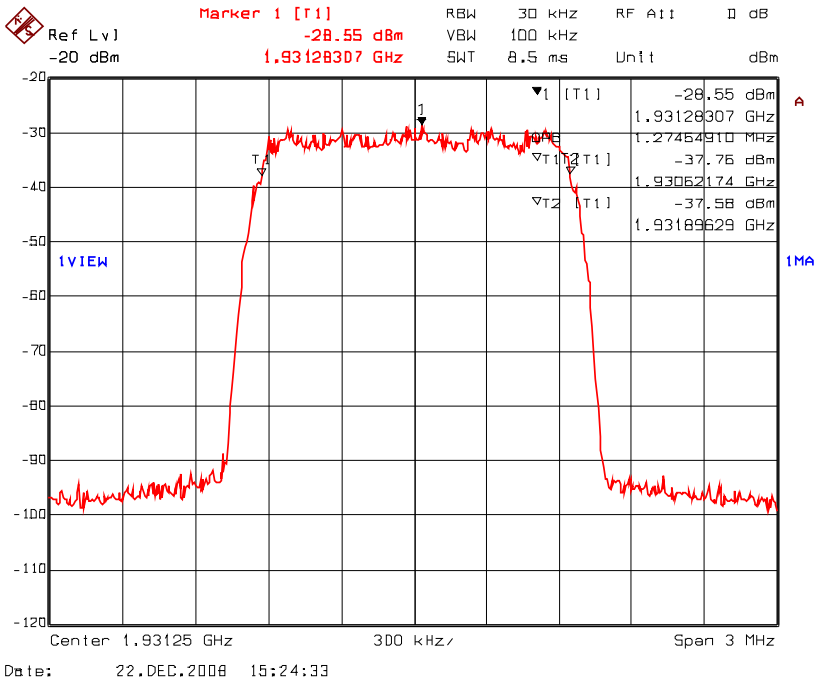


Plot 5.7.5.1.1b 99% Occupied Bandwidth
RF Output Signal: 1931.25 MHz, Max Gain

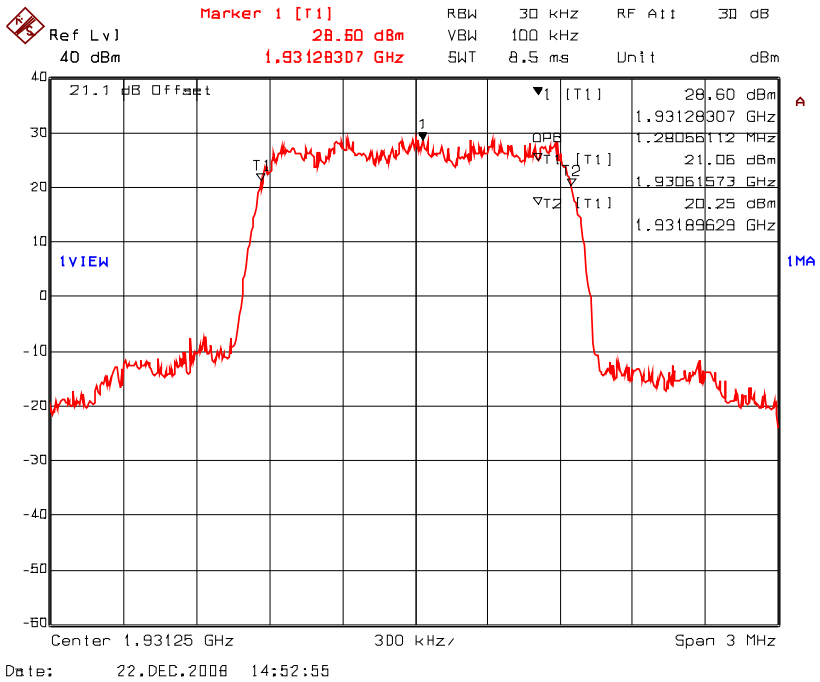


- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

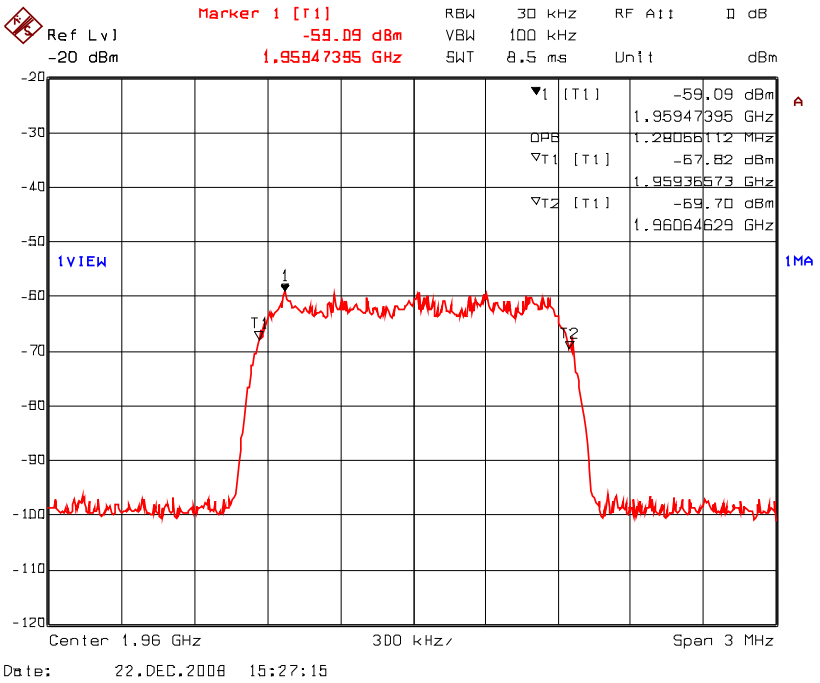
Plot 5.7.5.1.2a 99% Occupied Bandwidth
RF Input Signal: 1931.25 MHz, Min Gain



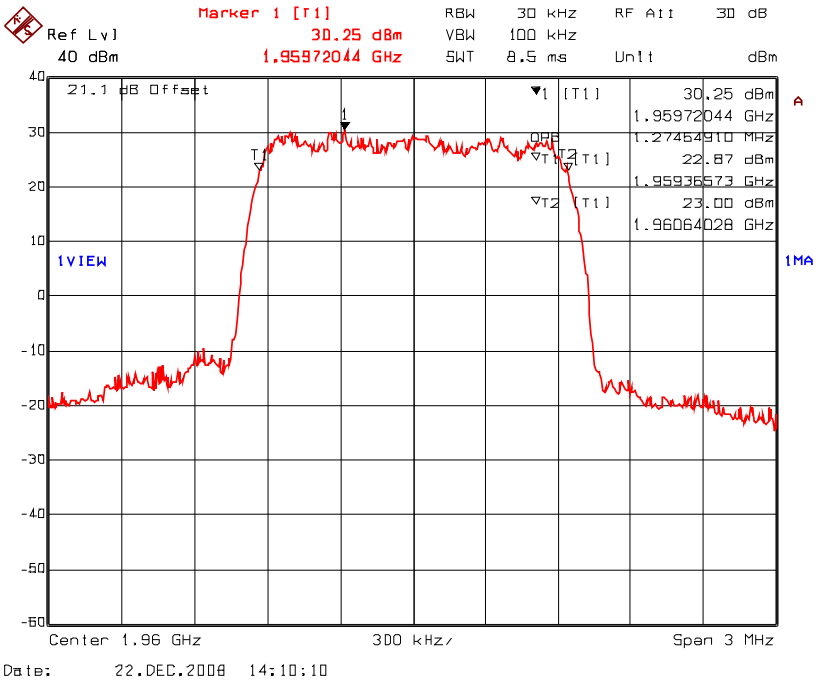
Plot 5.7.5.1.2b 99% Occupied Bandwidth
RF Output Signal: 1931.25 MHz, Min Gain



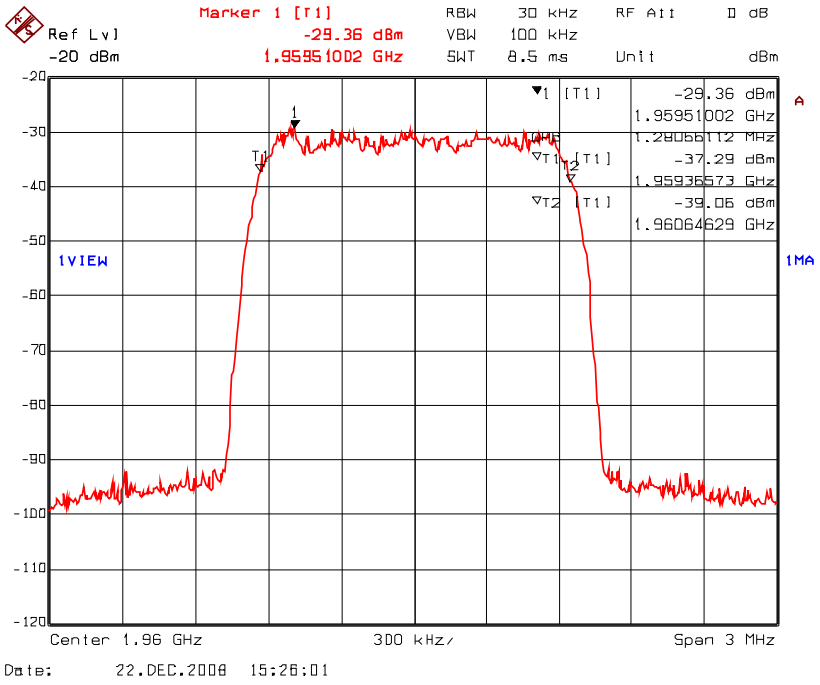
Plot 5.7.5.1.3a 99% Occupied Bandwidth
RF Input Signal: 1960.00 MHz, Max Gain



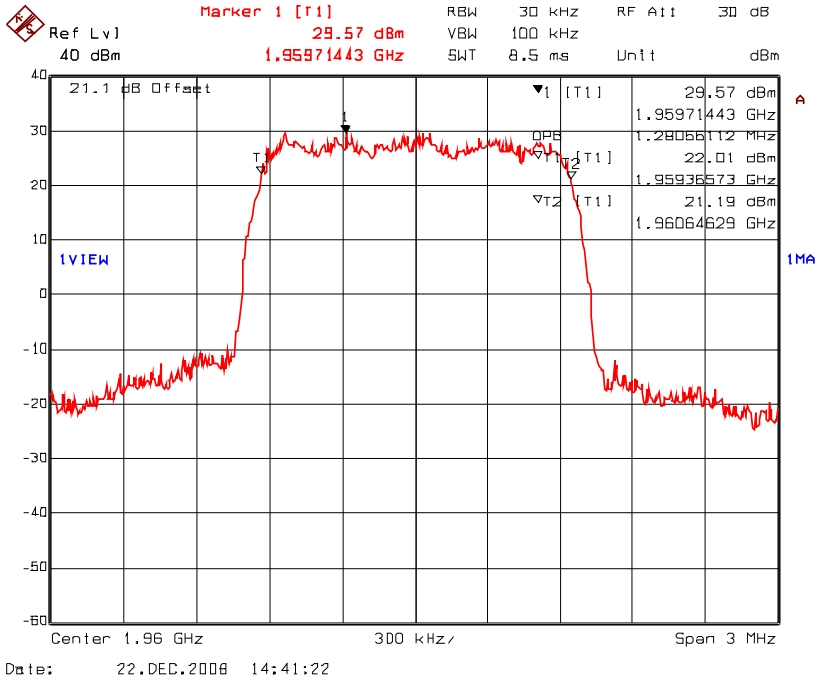
Plot 5.7.5.1.3b 99% Occupied Bandwidth
RF Output Signal: 1960.00 MHz, Max Gain



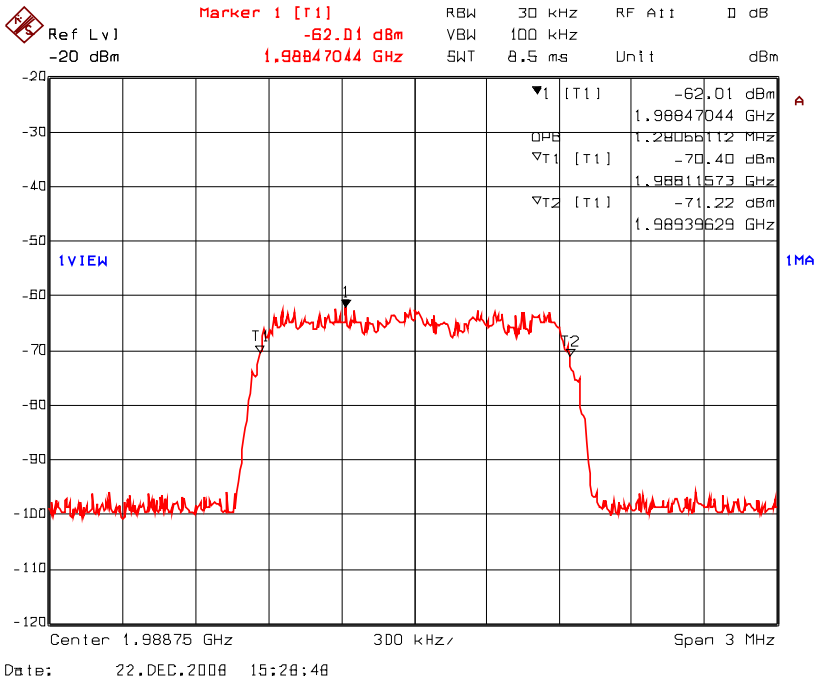
Plot 5.7.5.1.4a 99% Occupied Bandwidth
RF Input Signal: 1960.00 MHz, Min Gain



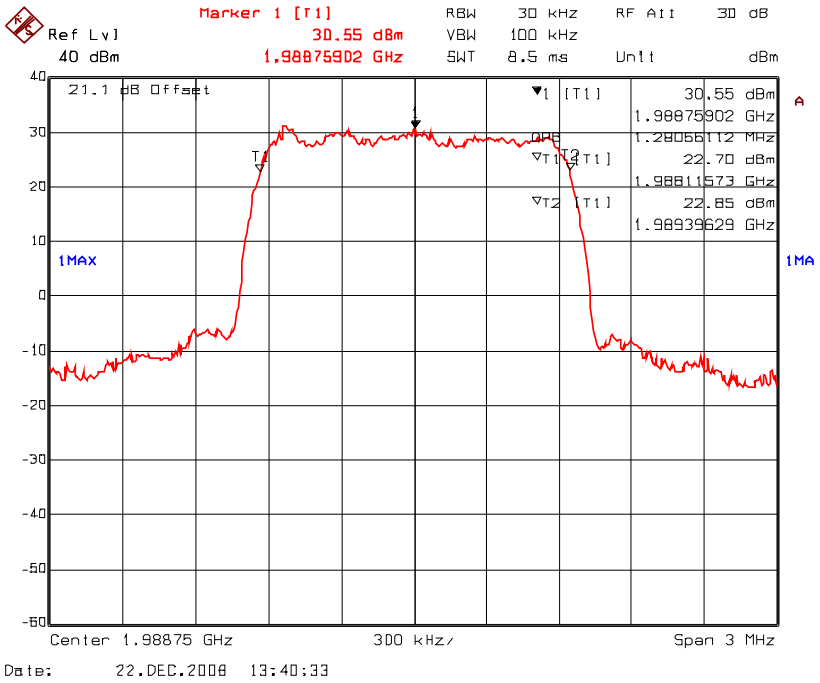
Plot 5.7.5.1.4b 99% Occupied Bandwidth
RF Output Signal: 1960.00 MHz, Min Gain



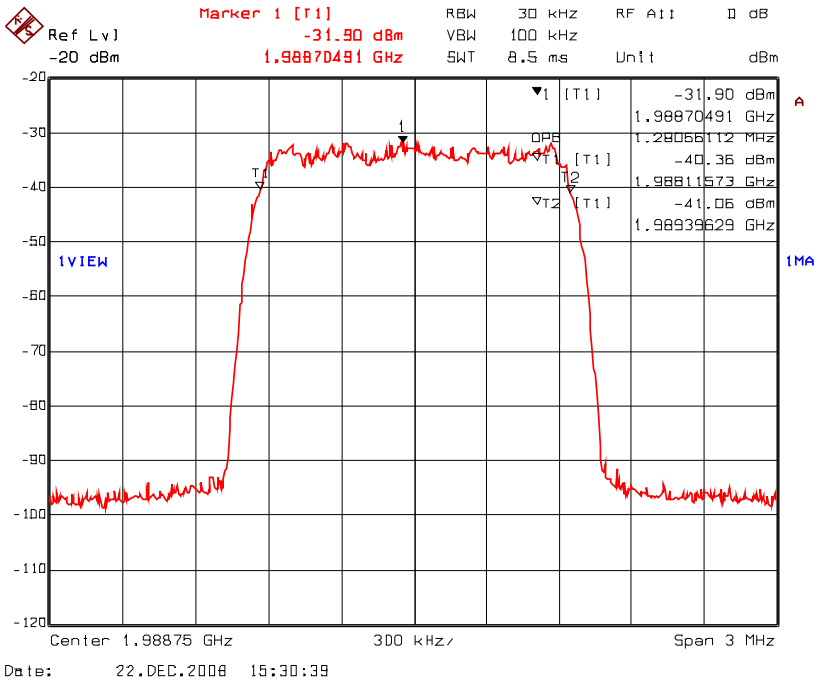
Plot 5.7.5.1.5a 99% Occupied Bandwidth
RF Input Signal: 1988.75 MHz, Max Gain



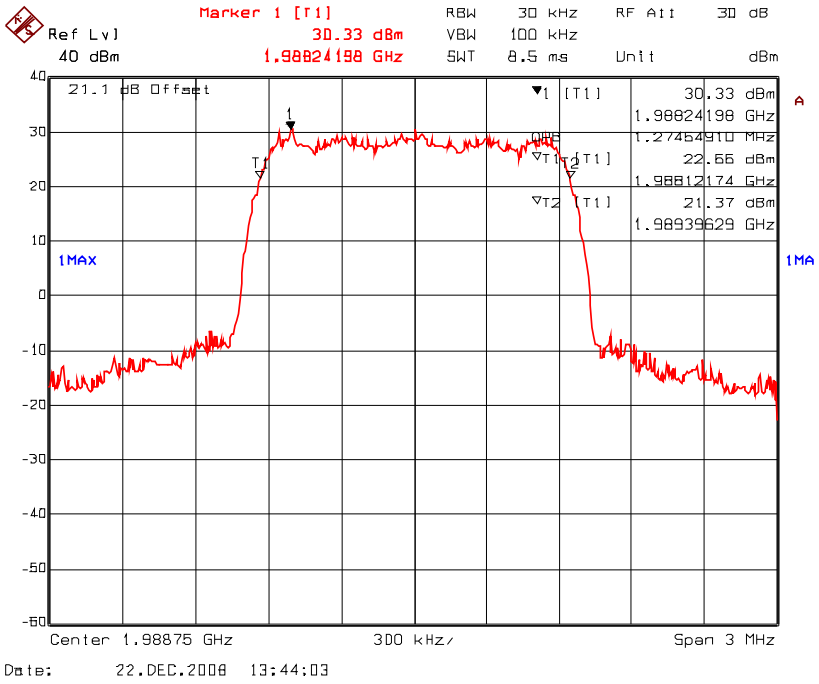
Plot 5.7.5.1.5b 99% Occupied Bandwidth
RF Output Signal: 1988.75 MHz, Max Gain



Plot 5.7.5.1.6a 99% Occupied Bandwidth
RF Input Signal: 1988.75 MHz, Min Gain



Plot 5.7.5.1.6b 99% Occupied Bandwidth
RF Output Signal: 1988.75 MHz, Min Gain



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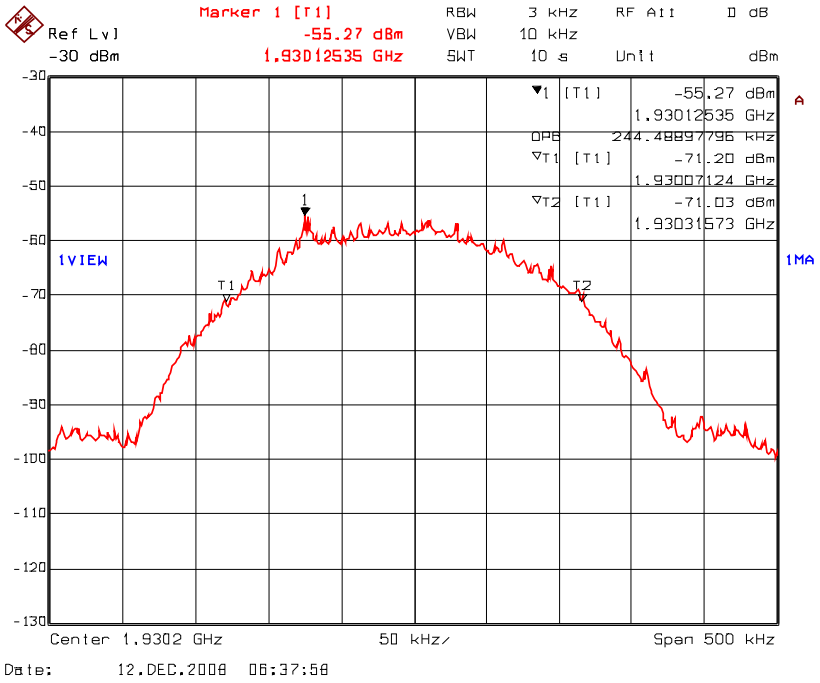
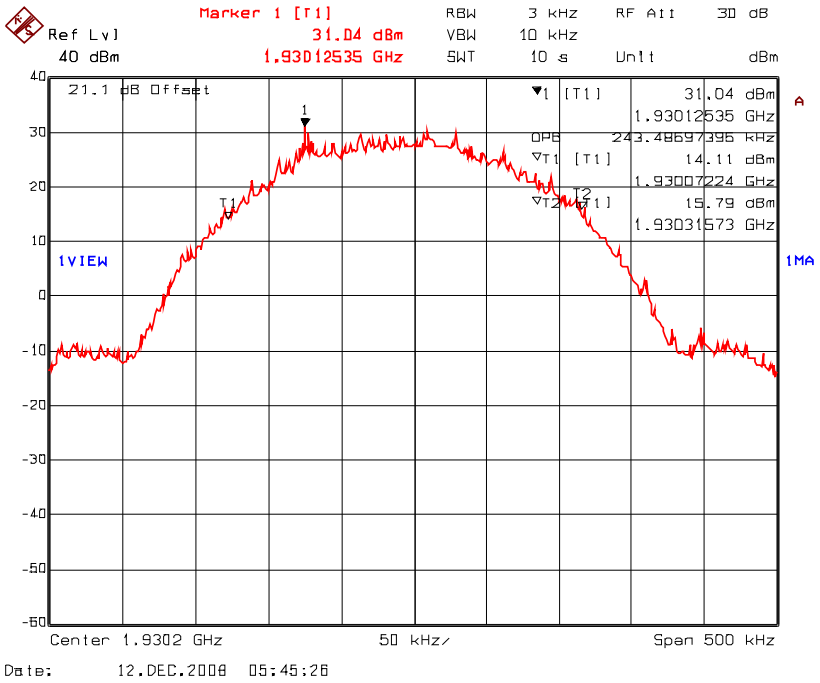
GSM Modulation:-

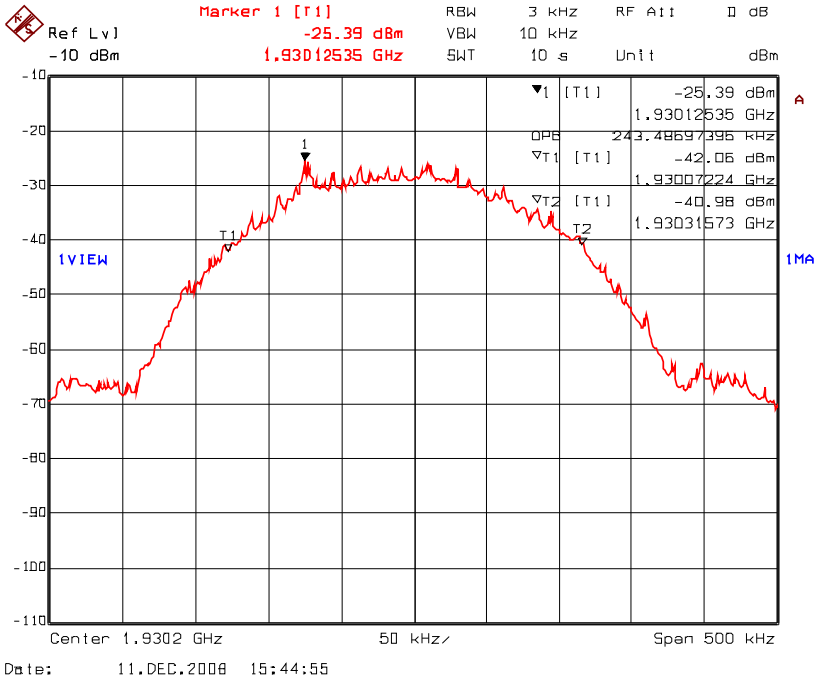
Plot 5.7.5.1.7a 99% Occupied Bandwidth
RF Input Signal: 1930.2 MHz, Max Gain



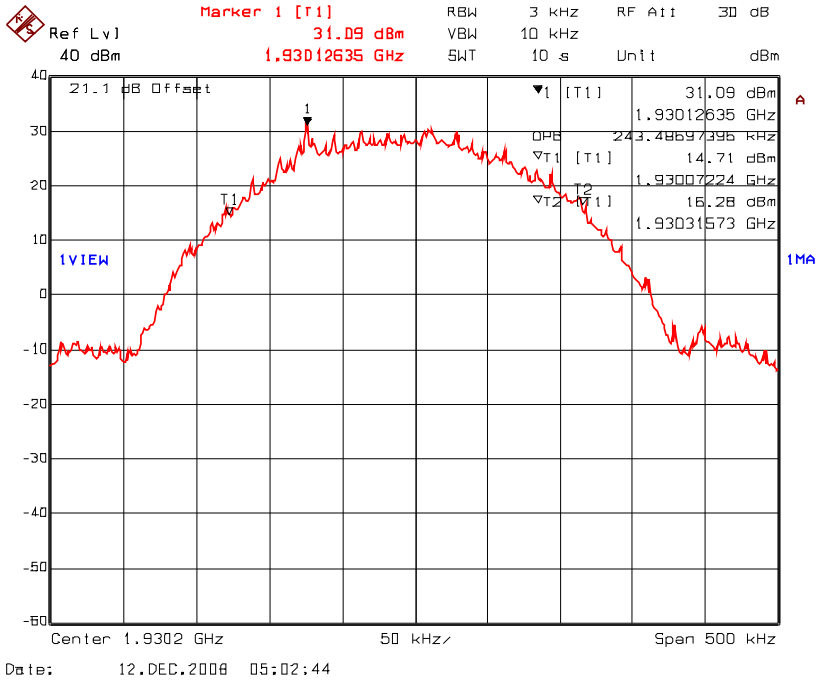
Plot 5.7.5.1.7b 99% Occupied Bandwidth
RF Output Signal: 1930.2 MHz, Max Gain



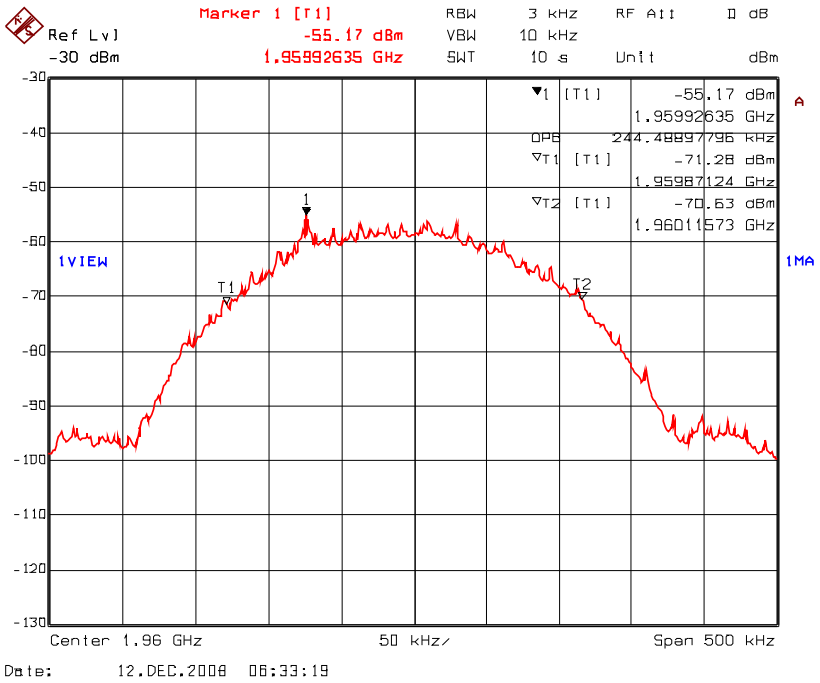
Plot 5.7.5.1.8a 99% Occupied Bandwidth
RF Input Signal: 1930.2 MHz, Min Gain



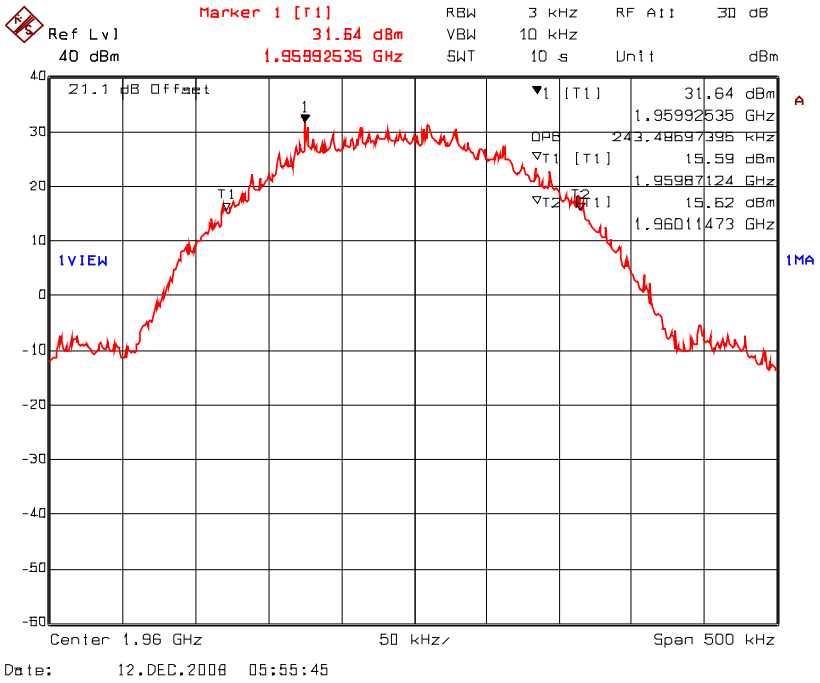
Plot 5.7.5.1.8b 99% Occupied Bandwidth
RF Output Signal: 1930.2 MHz, Min Gain



Plot 5.7.5.1.9a 99% Occupied Bandwidth
RF Input Signal: 1960.0 MHz, Max Gain

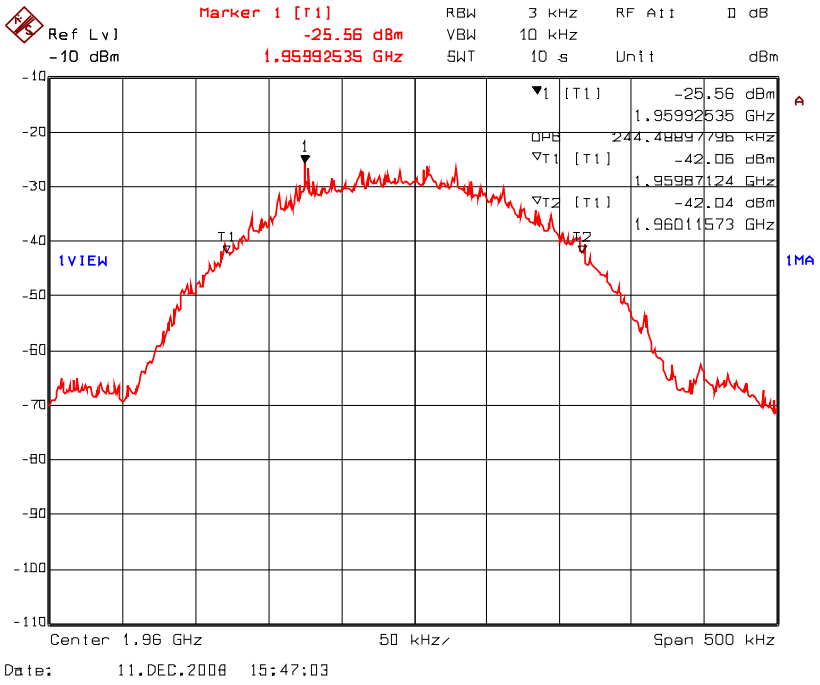


Plot 5.7.5.1.9b 99% Occupied Bandwidth
RF Output Signal: 1960.0 MHz, Max Gain

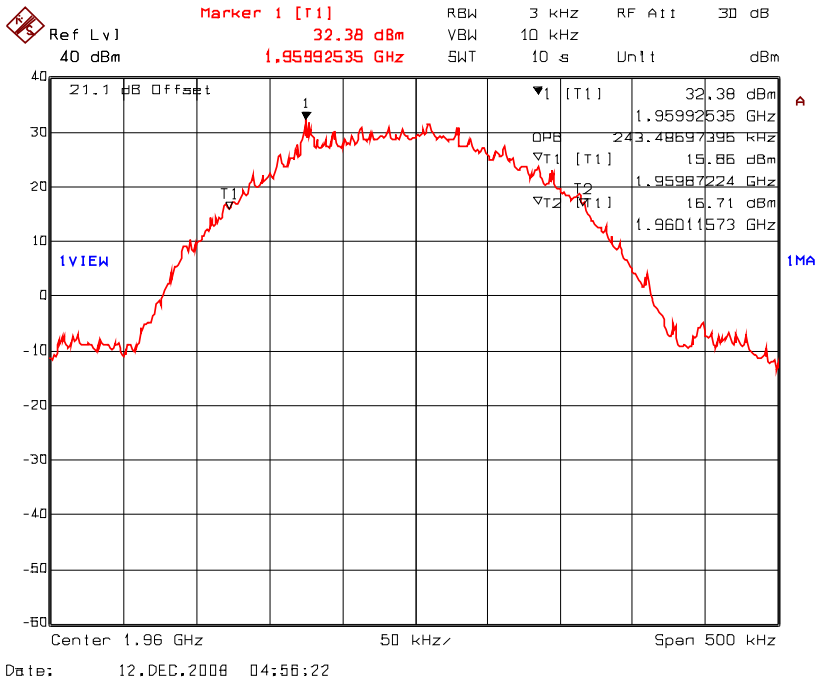


- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

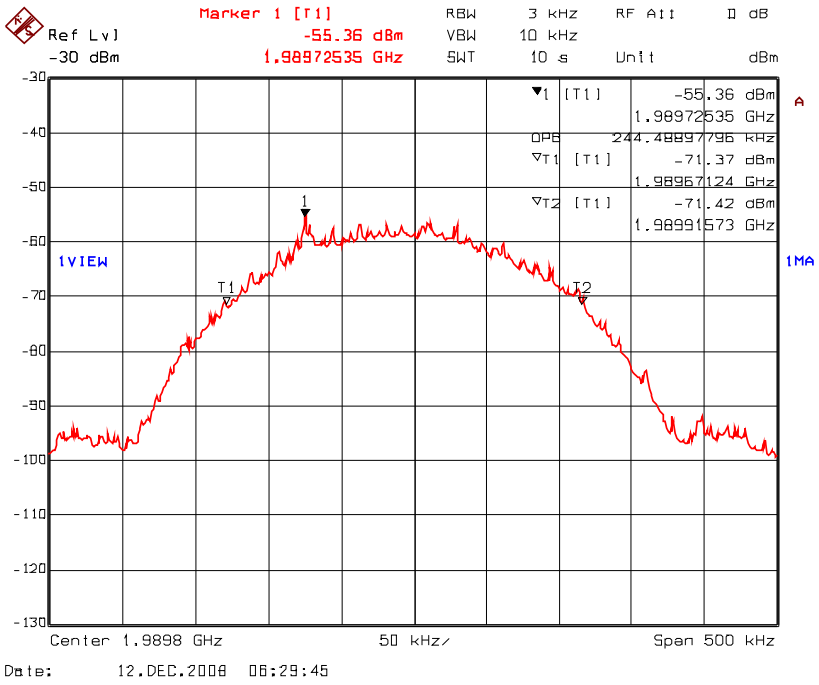
Plot 5.7.5.1.10a 99% Occupied Bandwidth
RF Input Signal: 1960.0 MHz, Min Gain



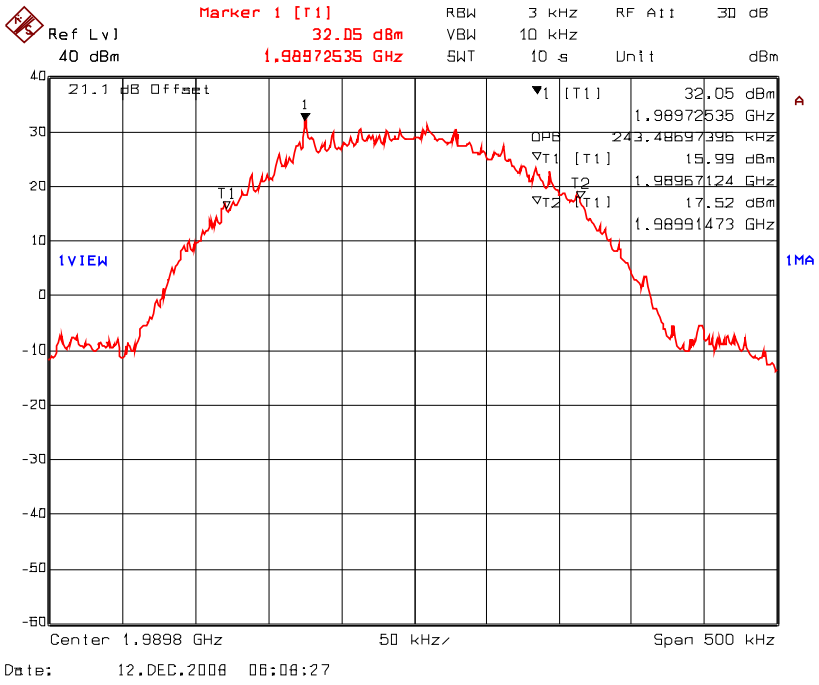
Plot 5.7.5.1.10b 99% Occupied Bandwidth
RF Output Signal: 1960.0 MHz, Min Gain



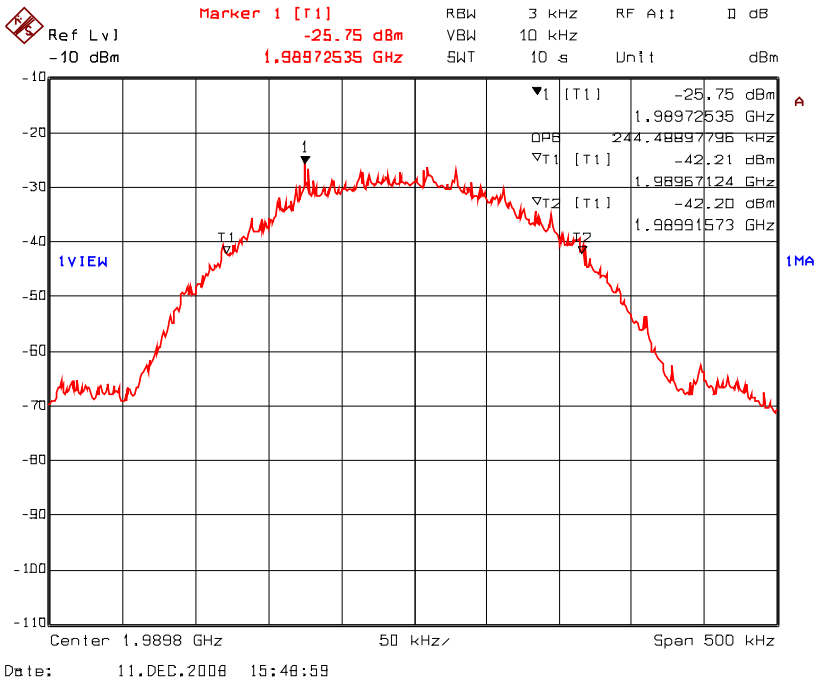
Plot 5.7.5.1.11a 99% Occupied Bandwidth
RF Input Signal: 1989.8 MHz, Max Gain



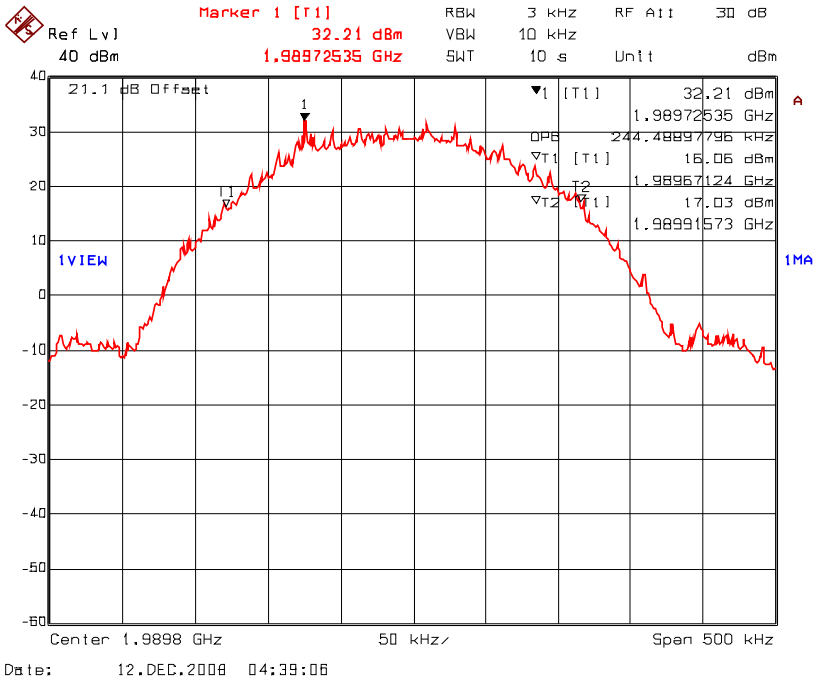
Plot 5.7.5.1.11b 99% Occupied Bandwidth
RF Output Signal: 1989.8 MHz, Max Gain



Plot 5.7.5.1.12a 99% Occupied Bandwidth
RF Input Signal: 1989.8 MHz, Min Gain



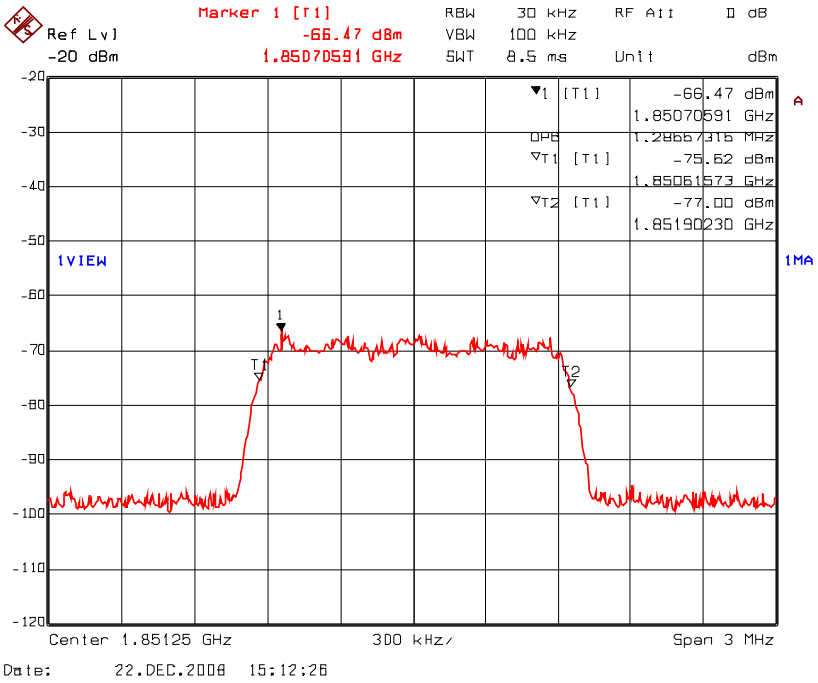
Plot 5.7.5.1.12b 99% Occupied Bandwidth
RF Output Signal: 1989.8 MHz, Min Gain



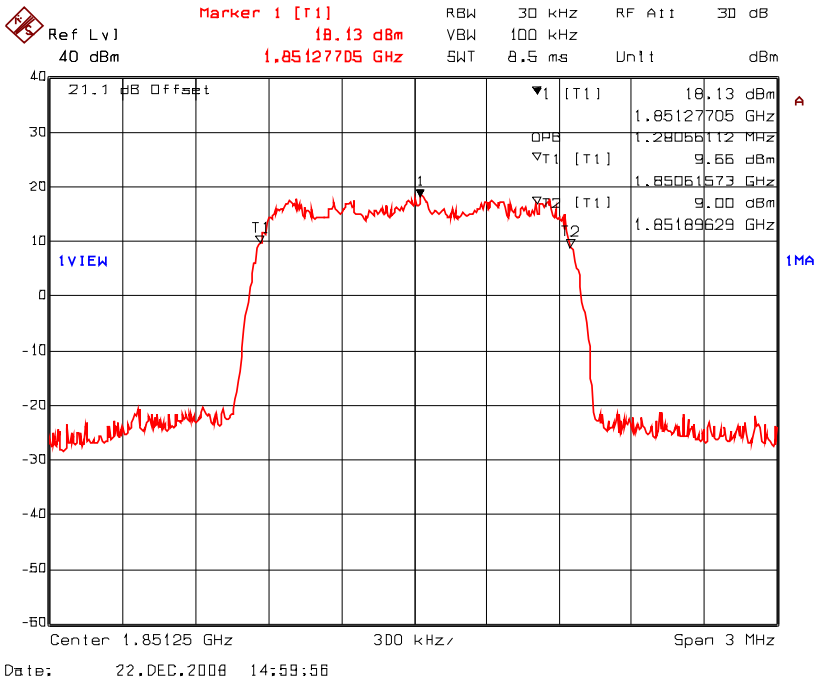
5.7.5.2. Uplink Bands (1850-1910 MHz)

CDMA 2000:-

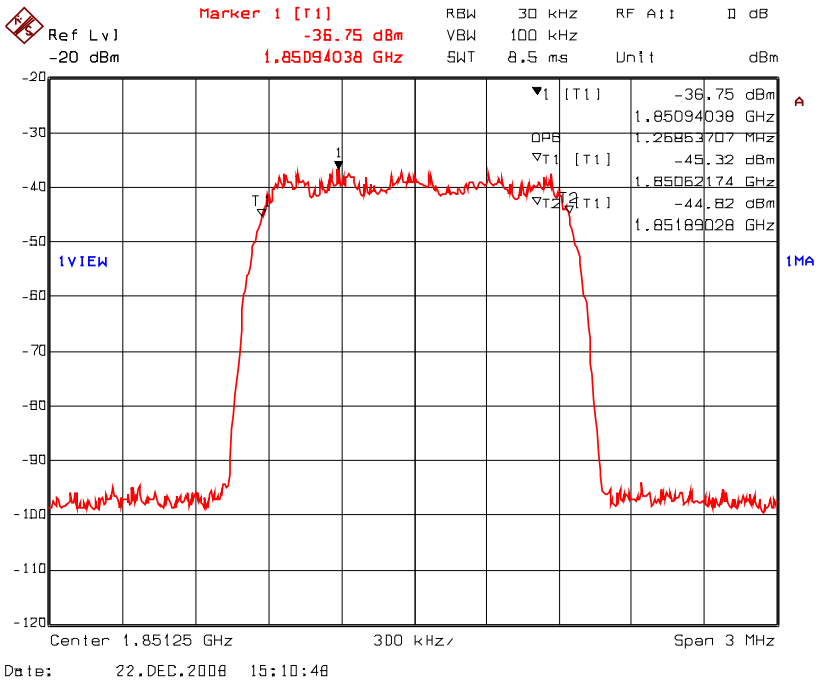
Plot 5.7.5.1.13a 99% Occupied Bandwidth
RF Input Signal: 1851.25 MHz, Max Gain



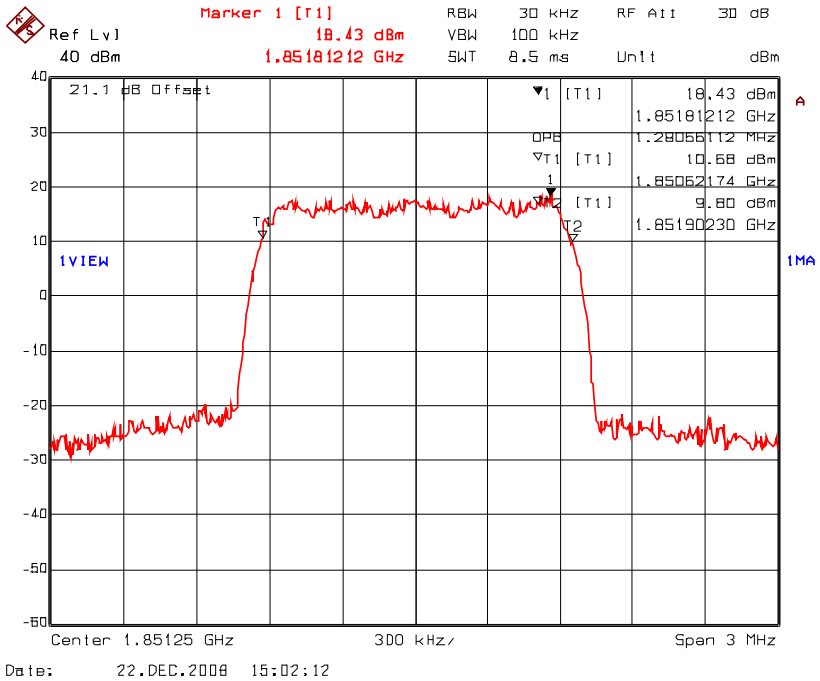
Plot 5.7.5.1.13b 99% Occupied Bandwidth
RF Output Signal: 1851.25 MHz, Max Gain



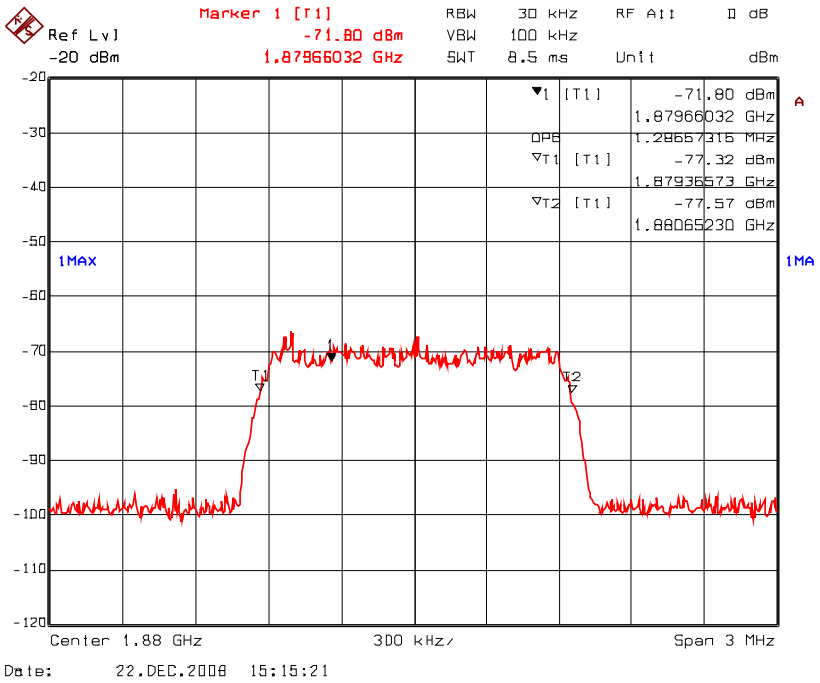
Plot 5.7.5.1.14a 99% Occupied Bandwidth
RF Input Signal: 1851.25 MHz, Min Gain



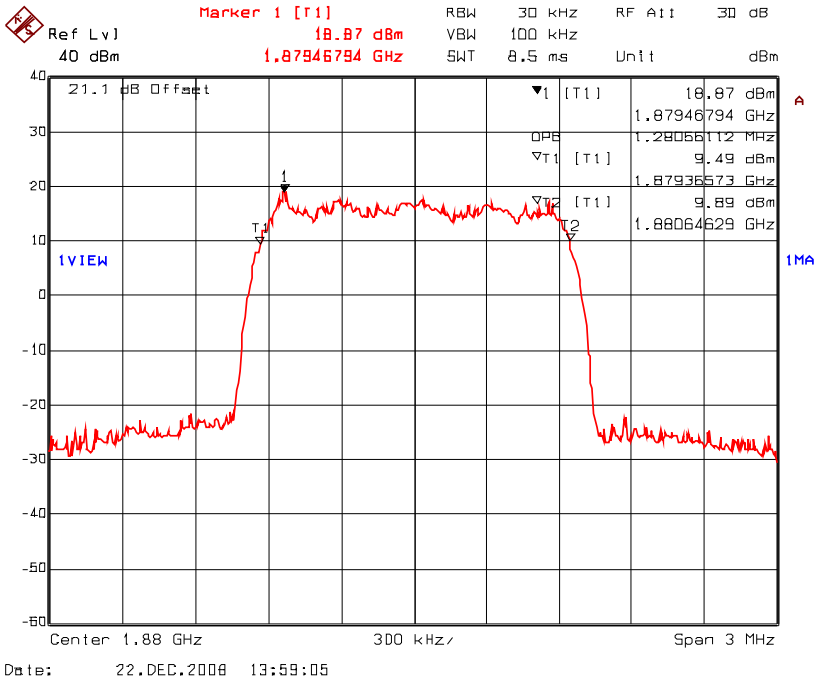
Plot 5.7.5.1.14b 99% Occupied Bandwidth
RF Output Signal: 1851.25 MHz, Min Gain



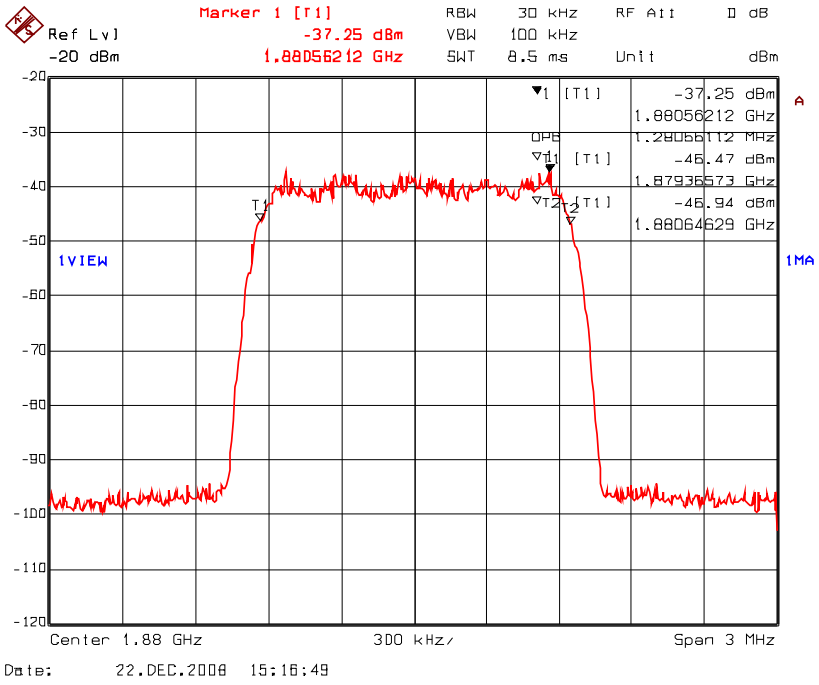
Plot 5.7.5.1.15a 99% Occupied Bandwidth
RF Input Signal: 1880.00 MHz, Max Gain



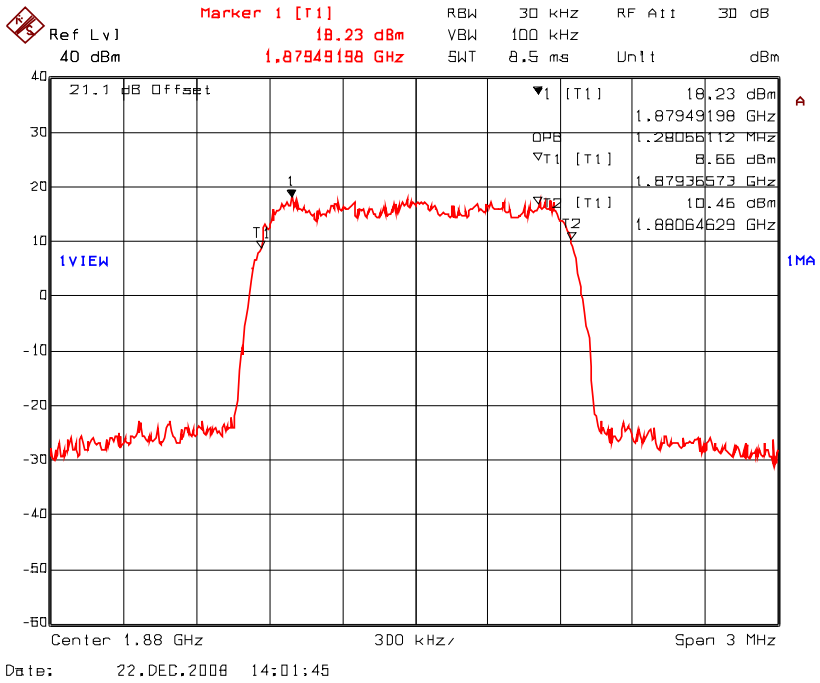
Plot 5.7.5.1.15b 99% Occupied Bandwidth
RF Output Signal: 1880.00 MHz, Max Gain



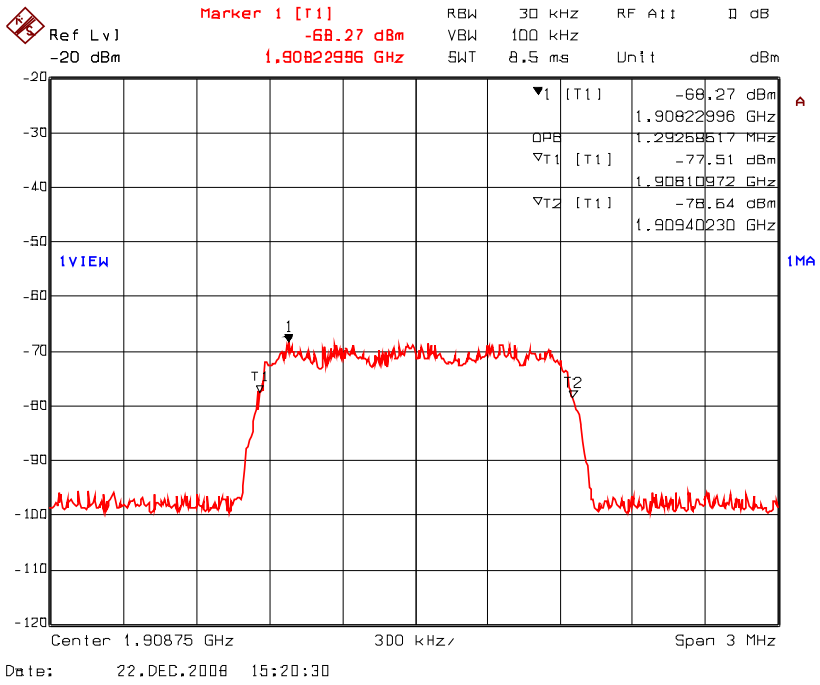
Plot 5.7.5.1.16a 99% Occupied Bandwidth
RF Input Signal: 1880.00 MHz, Min Gain



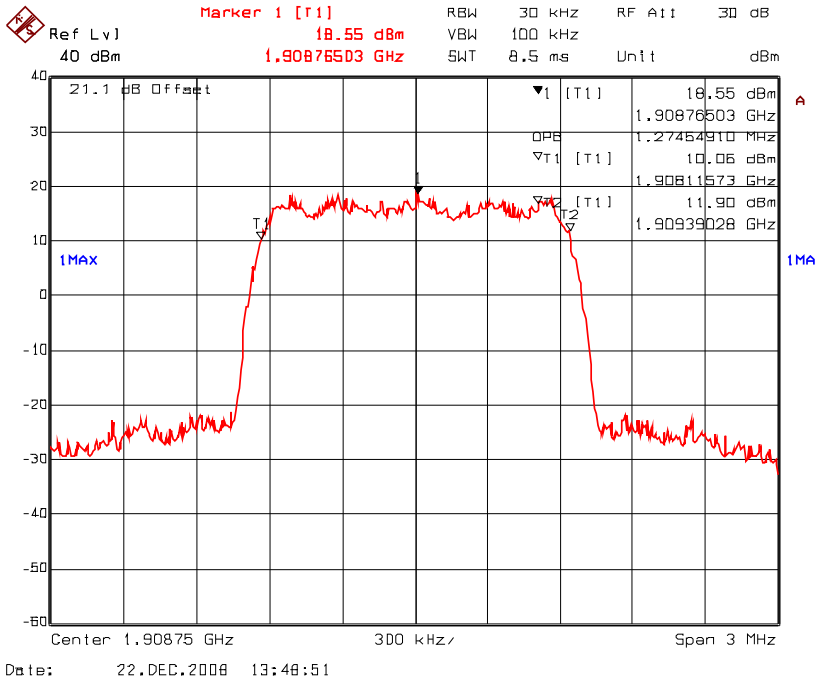
Plot 5.7.5.1.16b 99% Occupied Bandwidth
RF Output Signal: 1880.00 MHz, Min Gain



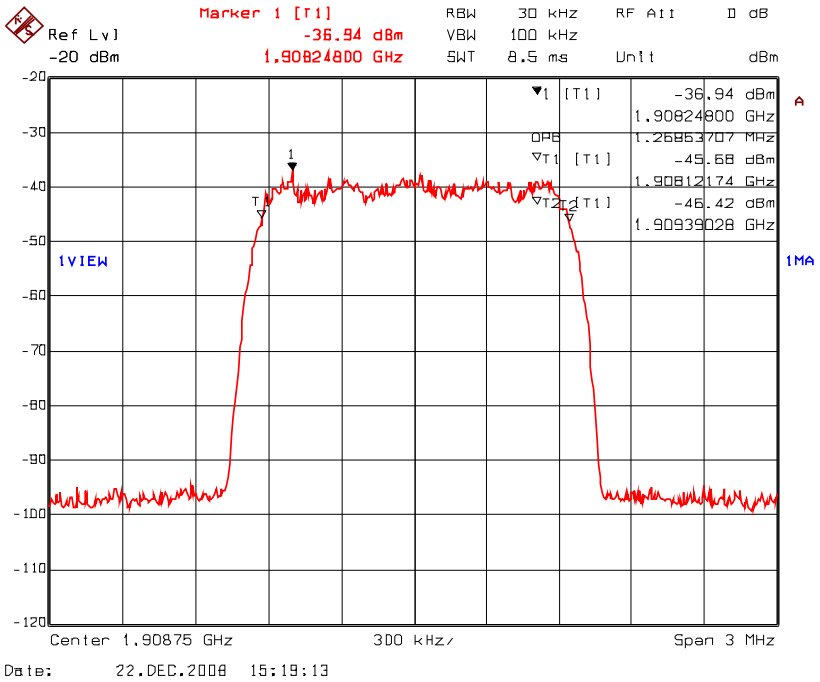
Plot 5.7.5.1.17a 99% Occupied Bandwidth
RF Input Signal: 1908.75 MHz, Max Gain



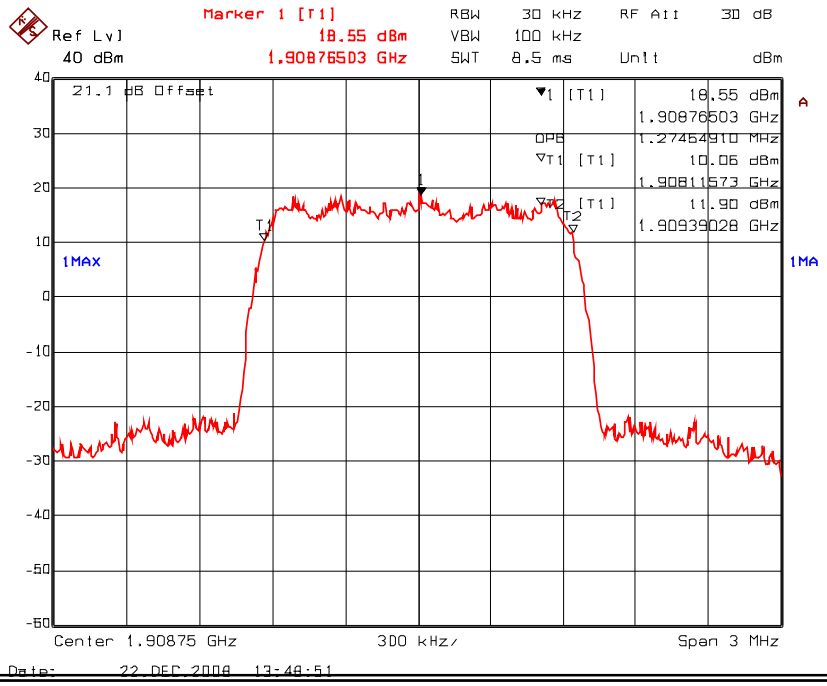
Plot 5.7.5.1.17b 99% Occupied Bandwidth
RF Output Signal: 1908.75 MHz, Max Gain



Plot 5.7.5.1.18a 99% Occupied Bandwidth
RF Input Signal: 1908.75 MHz, Min Gain

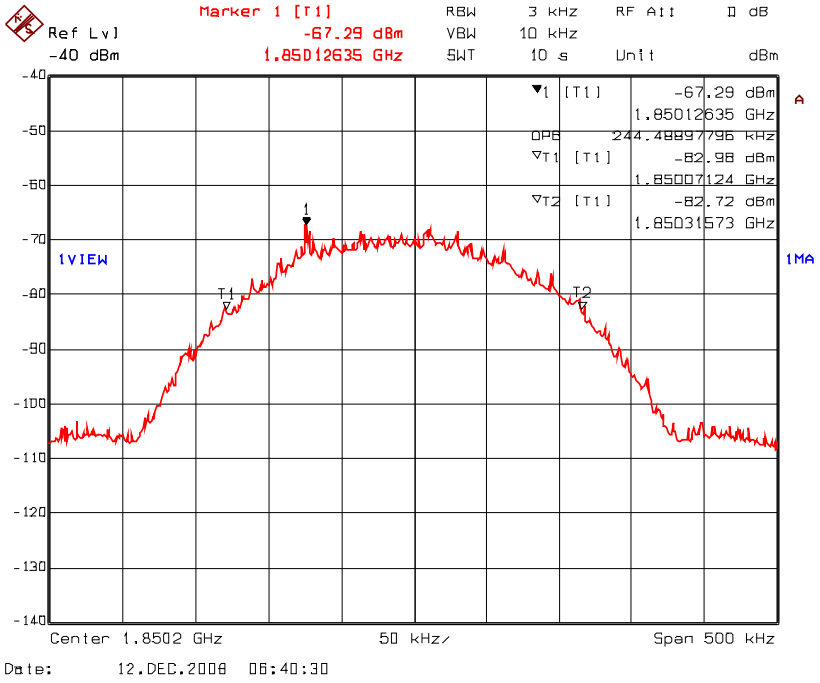


Plot 5.7.5.1.18b 99% Occupied Bandwidth
RF Output Signal: 1908.75 MHz, Min Gain

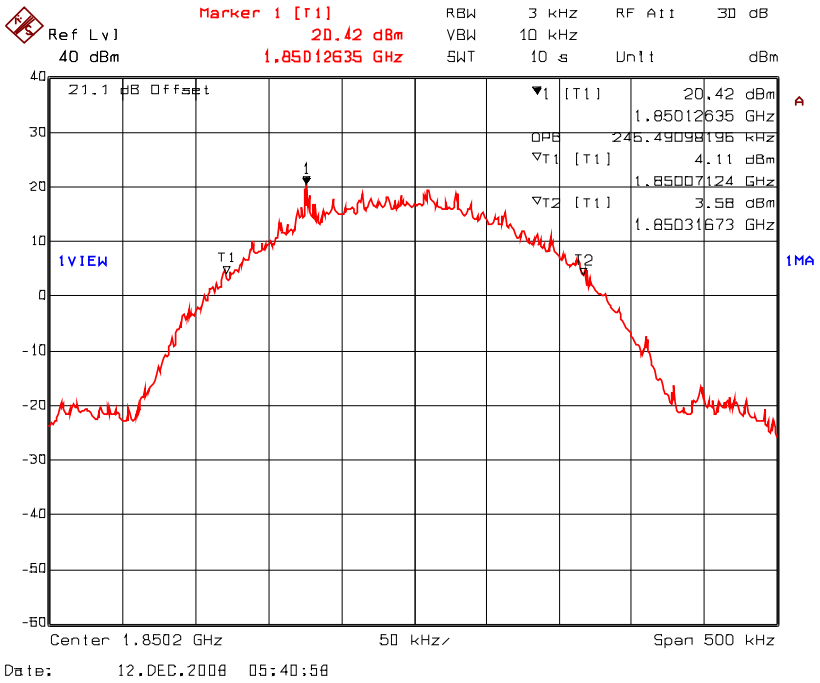


GSM Modulation:-

Plot 5.7.5.1.19a 99% Occupied Bandwidth
RF Input Signal: 1850.2 MHz, Max Gain

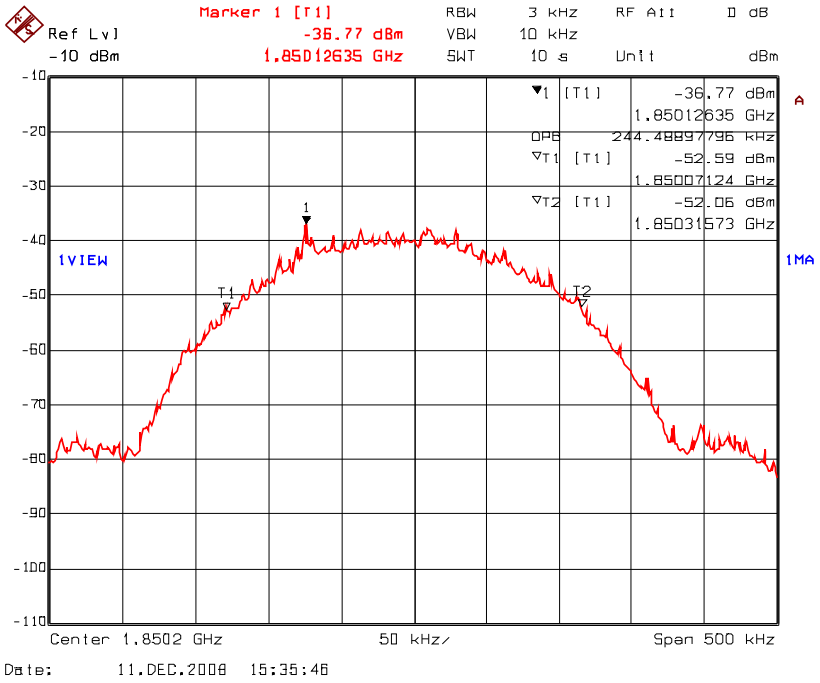


Plot 5.7.5.1.19b 99% Occupied Bandwidth
RF Output Signal: 1850.2 MHz, Max Gain

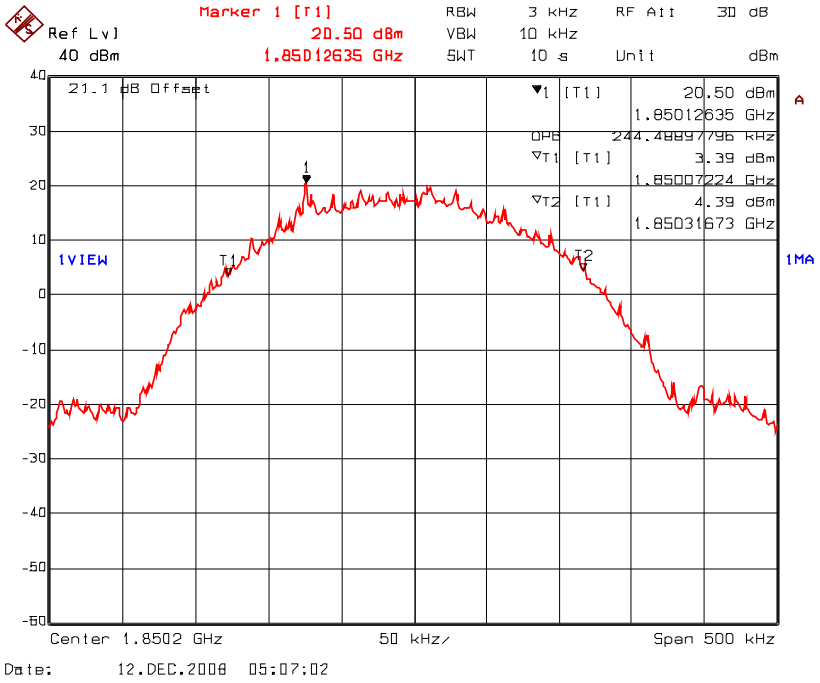


- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

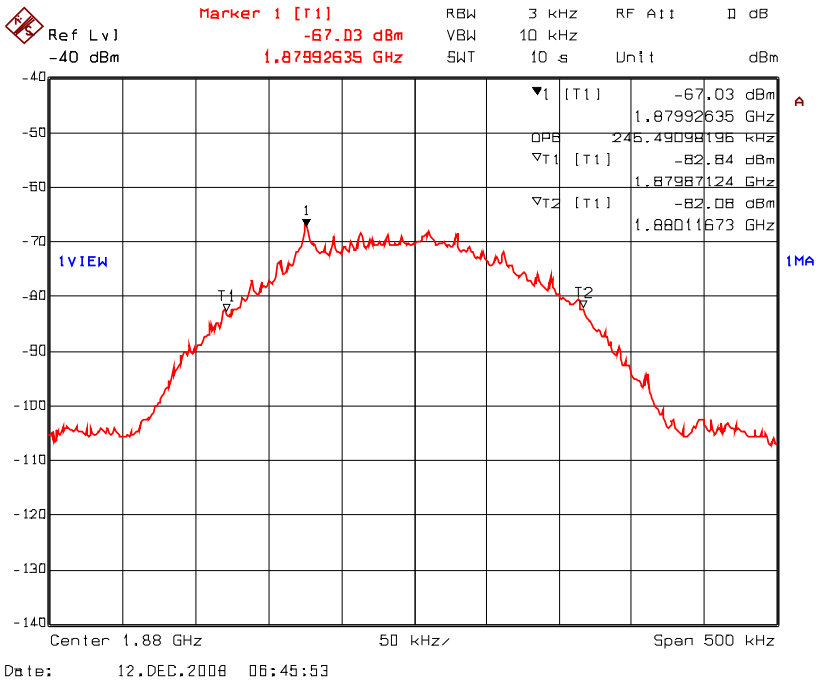
Plot 5.7.5.1.20a 99% Occupied Bandwidth
RF Input Signal: 1850.2 MHz, Min Gain



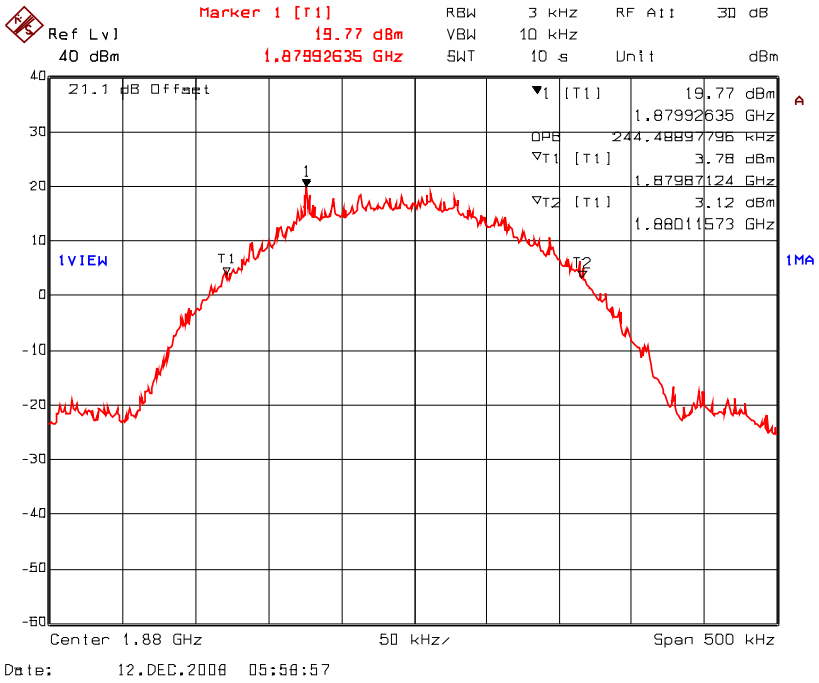
Plot 5.7.5.1.20b 99% Occupied Bandwidth
RF Output Signal: 1850.2 MHz, Min Gain



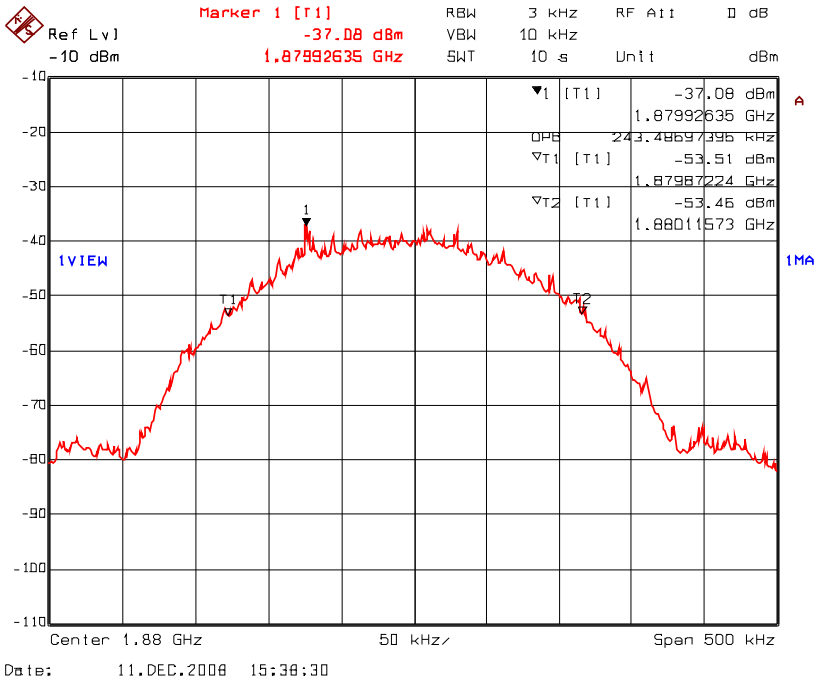
Plot 5.7.5.1.21a 99% Occupied Bandwidth
RF Input Signal: 1880.0 MHz, Max Gain



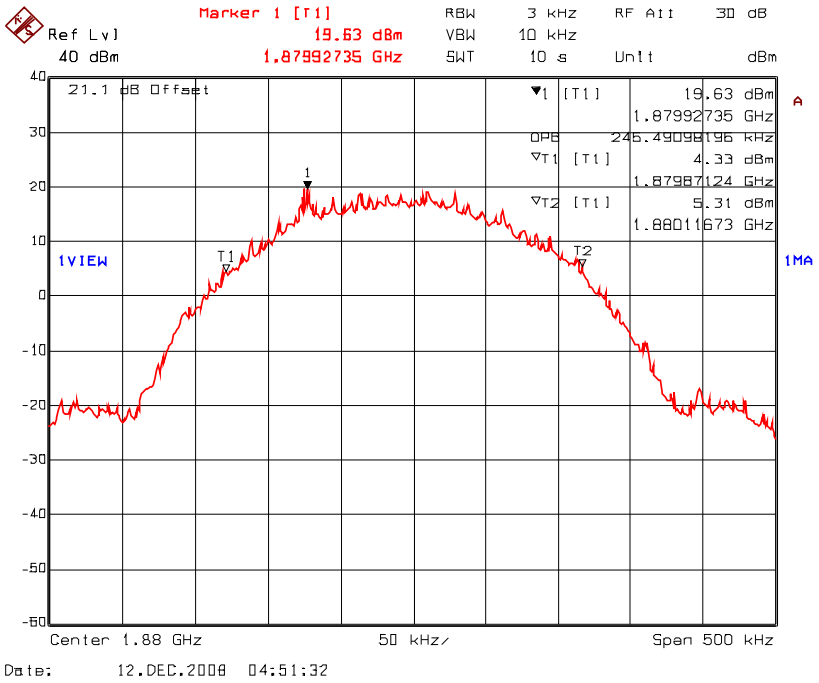
Plot 5.7.5.1.21b 99% Occupied Bandwidth
RF Output Signal: 1880.0 MHz, Max Gain



Plot 5.7.5.1.22a 99% Occupied Bandwidth
RF Input Signal: 1880.0 MHz, Min Gain

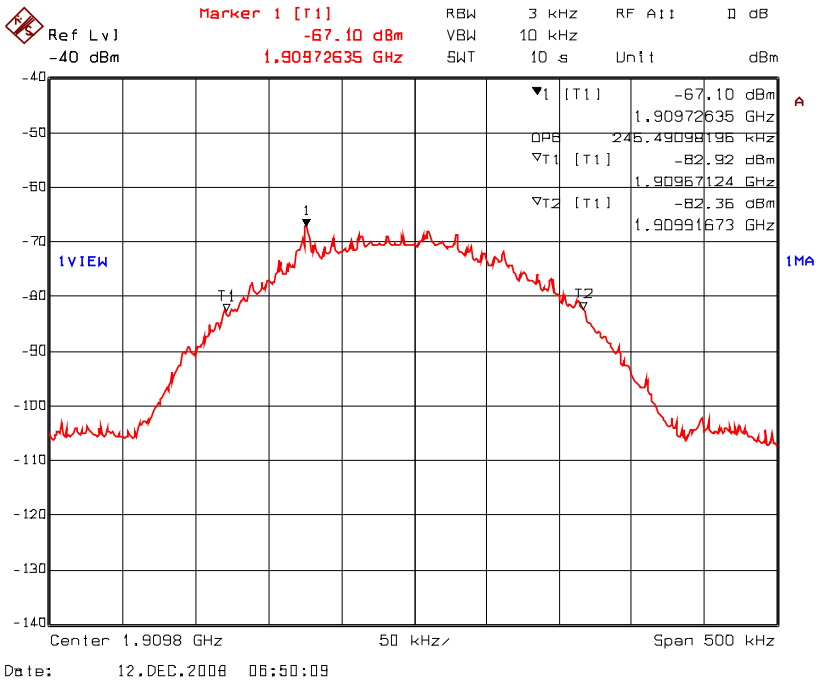


Plot 5.7.5.1.22b 99% Occupied Bandwidth
RF Output Signal: 1880.0 MHz, Min Gain

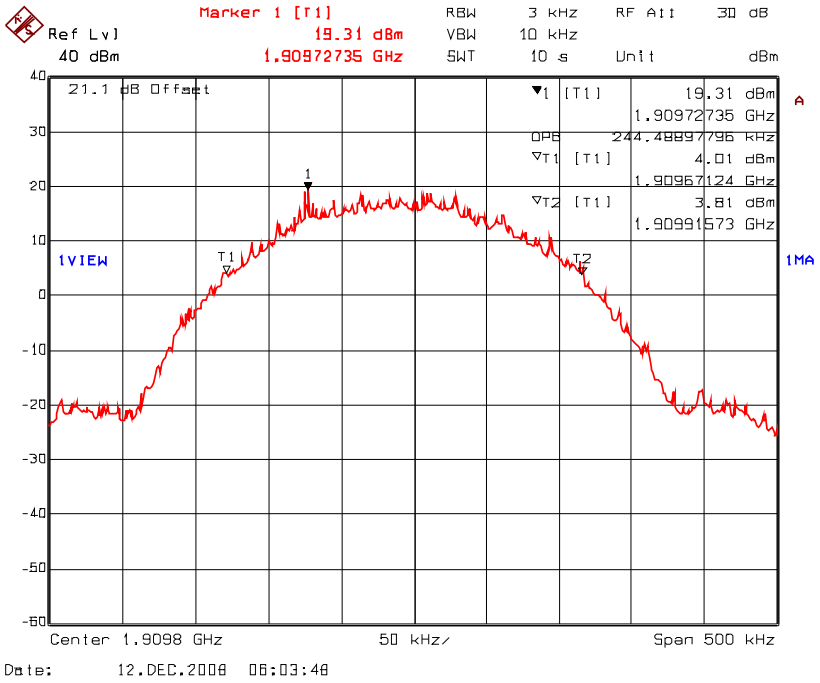


- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

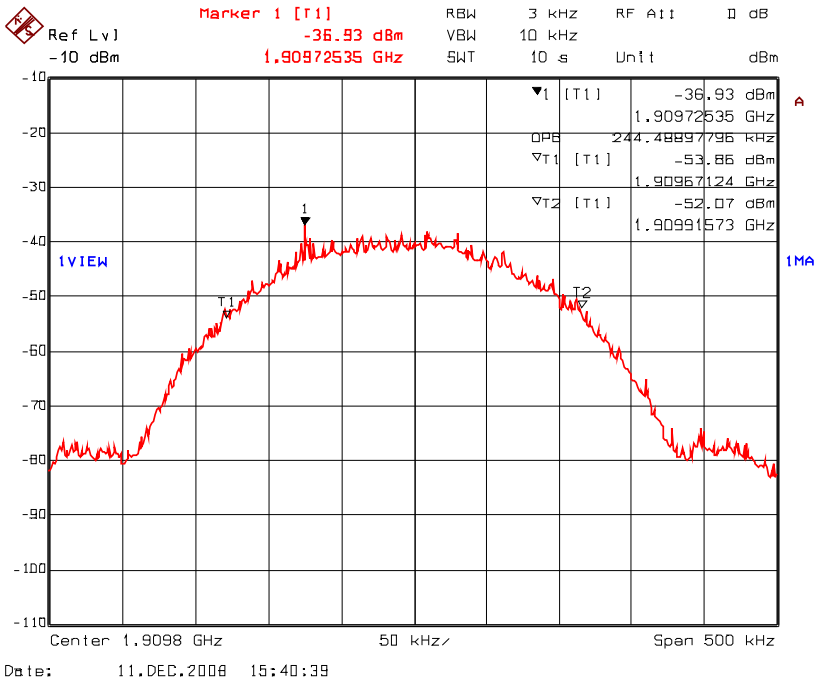
Plot 5.7.5.1.23a 99% Occupied Bandwidth
RF Input Signal: 1909.8 MHz, Max Gain



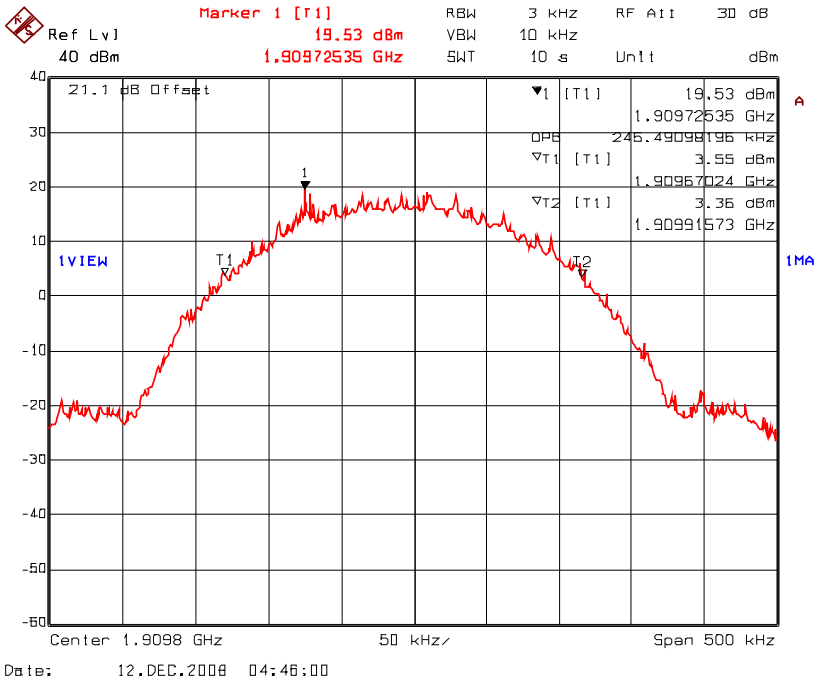
Plot 5.7.5.1.23b 99% Occupied Bandwidth
RF Output Signal: 1909.8 MHz, Max Gain



Plot 5.7.5.1.24a 99% Occupied Bandwidth
RF Input Signal: 1909.8 MHz, Min Gain



Plot 5.7.5.1.24b 99% Occupied Bandwidth
RF Output Signal: 1909.8 MHz, Min Gain



5.8. SPURIOUS EMISSIONS AT ANTENNA TERMINAL [§§ 24.238, 2.1057 & 2.1051]

5.8.1. Limits

The most stringent limit of 43+10*log(P in Watts) dBc is applied for worst case.

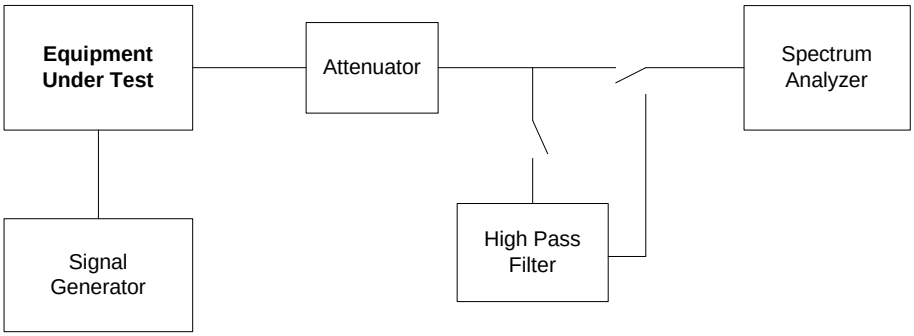
5.8.2. Method of Measurements

Refer to ULTRATECH Test Procedures, File # ULTR P001-2004

5.8.3. Test Equipment List

Please refer to Exhibit 6 for the details.

5.8.4. Test Arrangement



5.8.5. Test Data

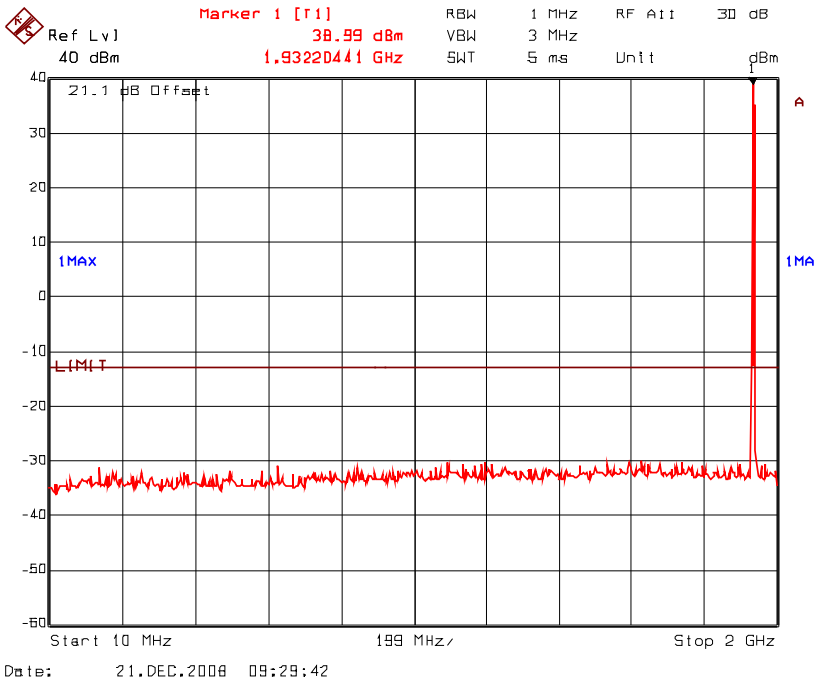
Note:

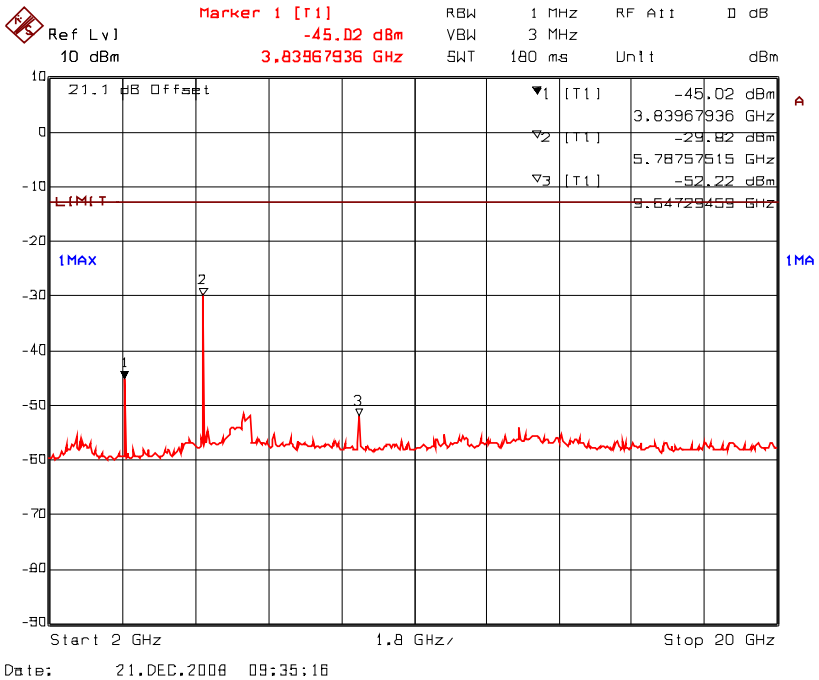
(1) The rf emissions were scanned for both modulations with maximum and minimum gain setting. The spurious emissions found for both settings are very similar (within ± 2dB) hence only maximum gain setting plots are recorded in the report to show compliance.

5.8.5.1. Downlink Band (1930-1990 MHz)

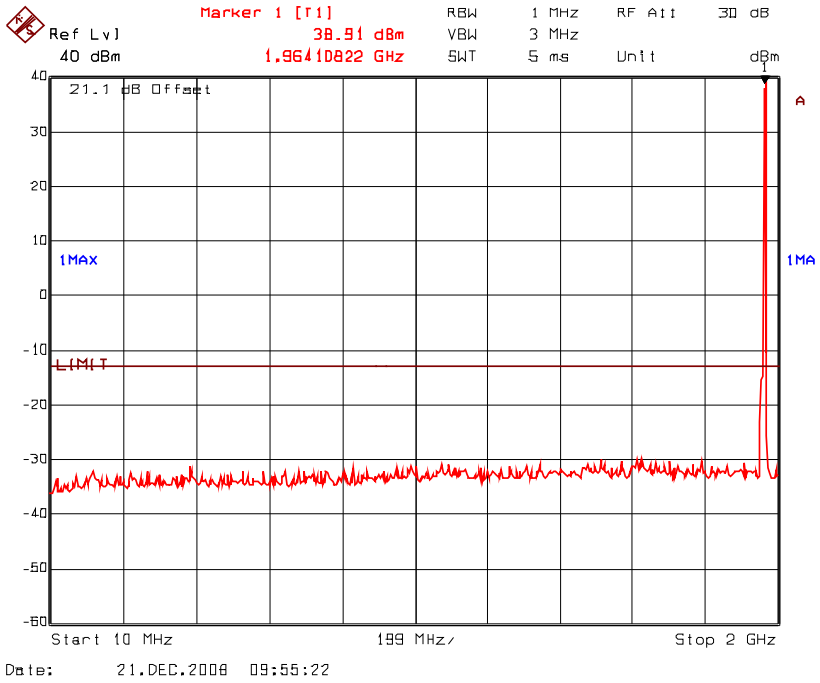
CDMA 2000:-

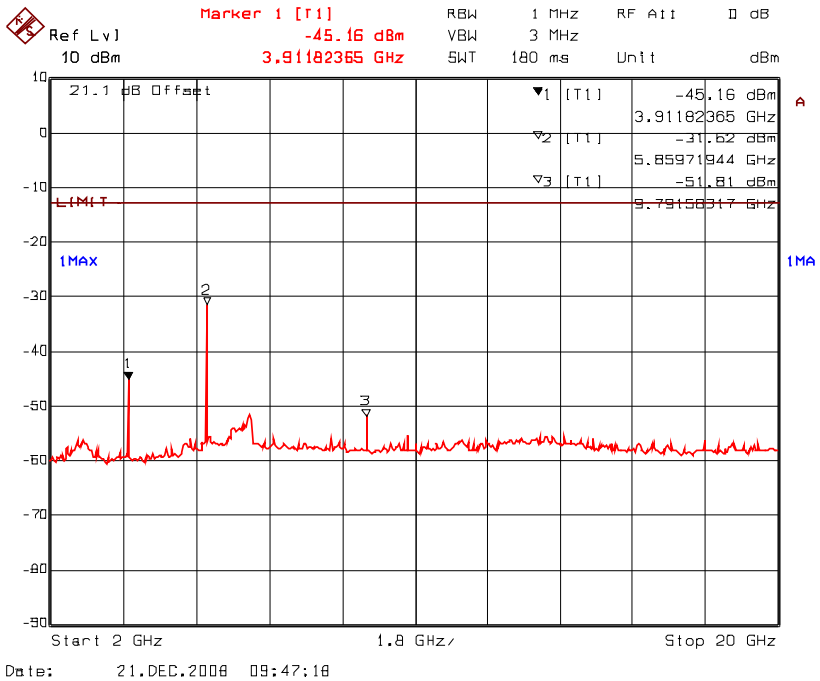
Plot 5.8.5.1.1 Spurious Emissions at Antenna Terminal
Test Frequency: 1931.25 MHz, Max Gain Setting



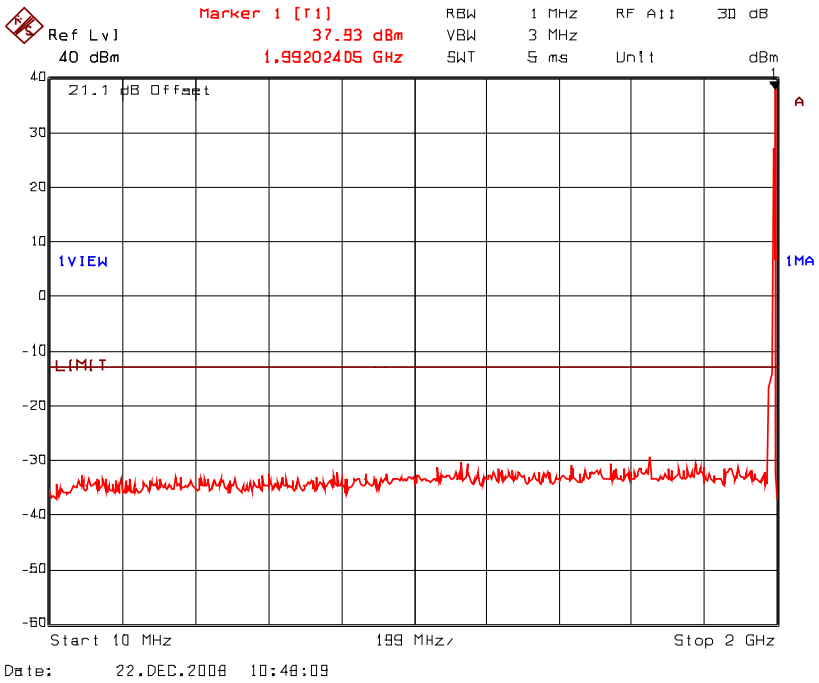


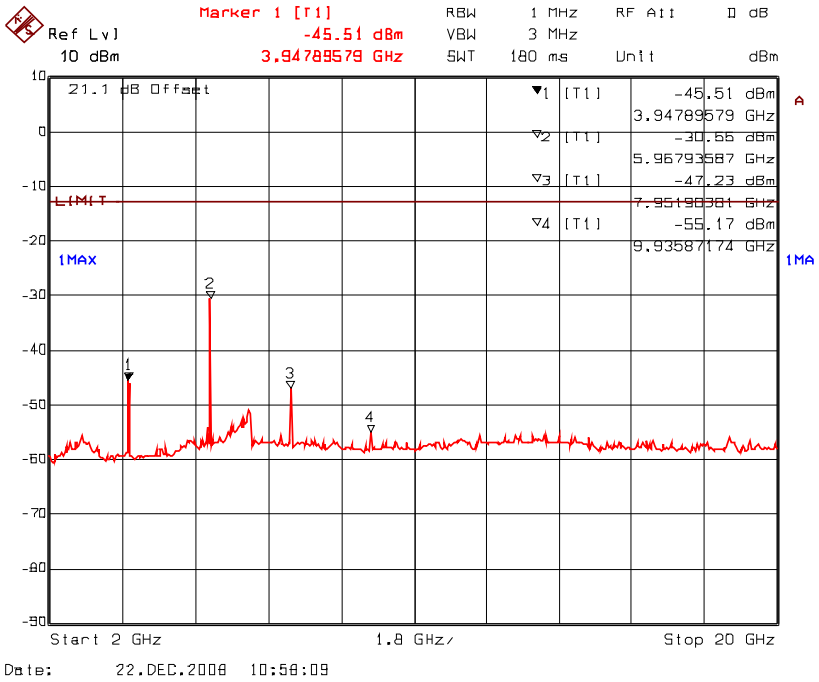
Plot 5.8.5.1.2 Spurious Emissions at Antenna Terminal
Test Frequency: 1960.00 MHz, Max Gain Setting





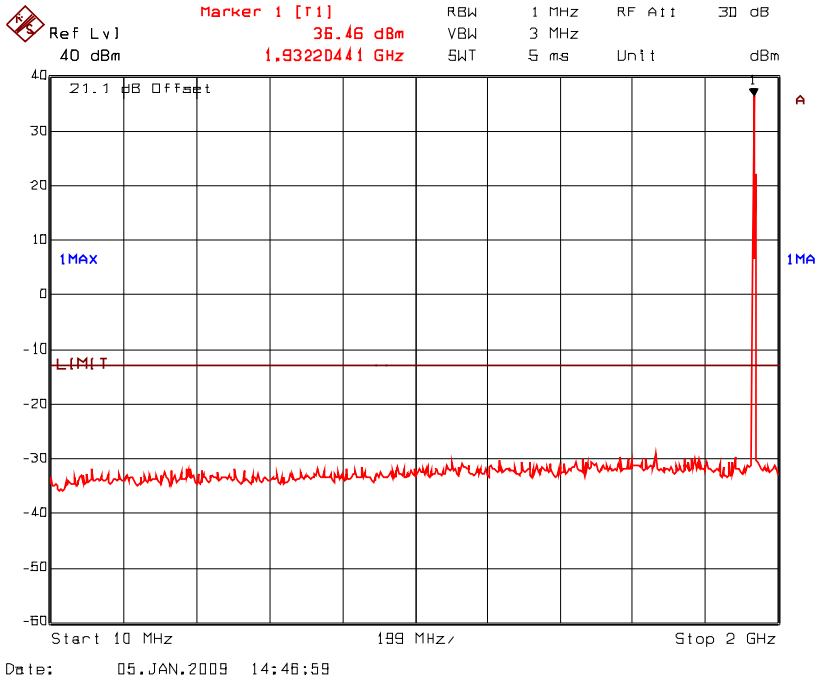
Plot 5.8.5.1.3 Spurious Emissions at Antenna Terminal
Test Frequency: 1988.75 MHz, Max Gain Setting

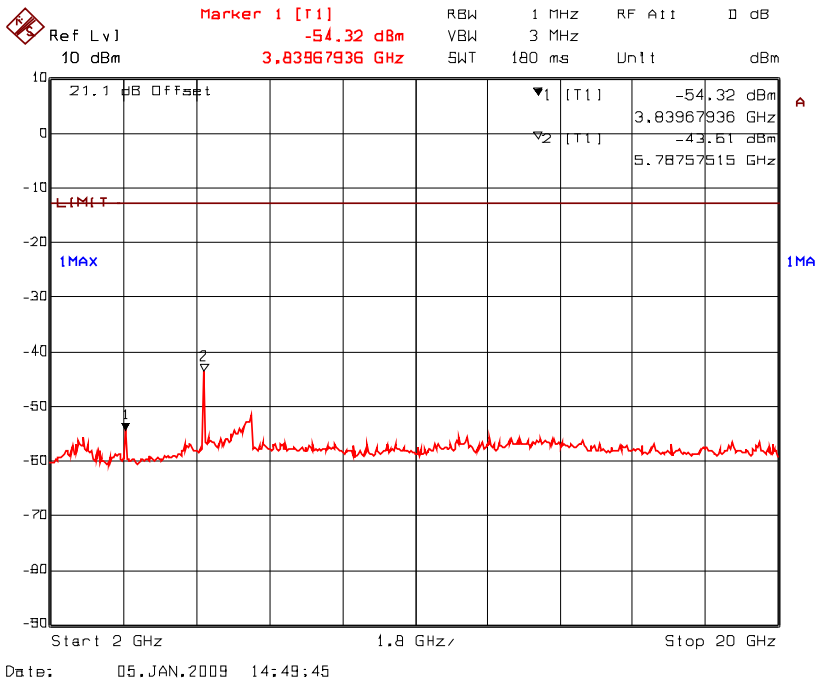




GSM Modulation:-

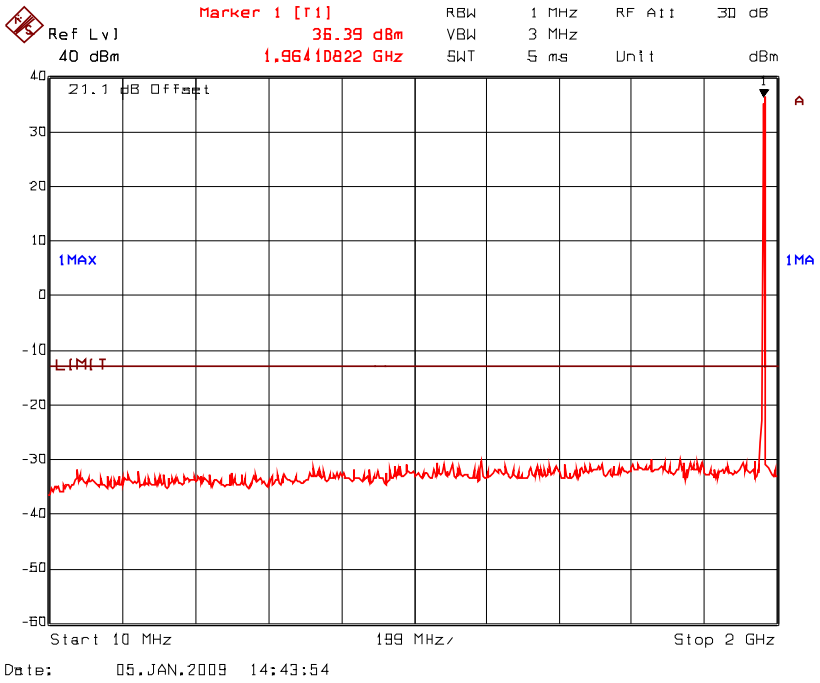
Plot 5.8.5.1.4 Spurious Emissions at Antenna Terminal
Test Frequency: 1930.2 MHz, Max Gain Setting

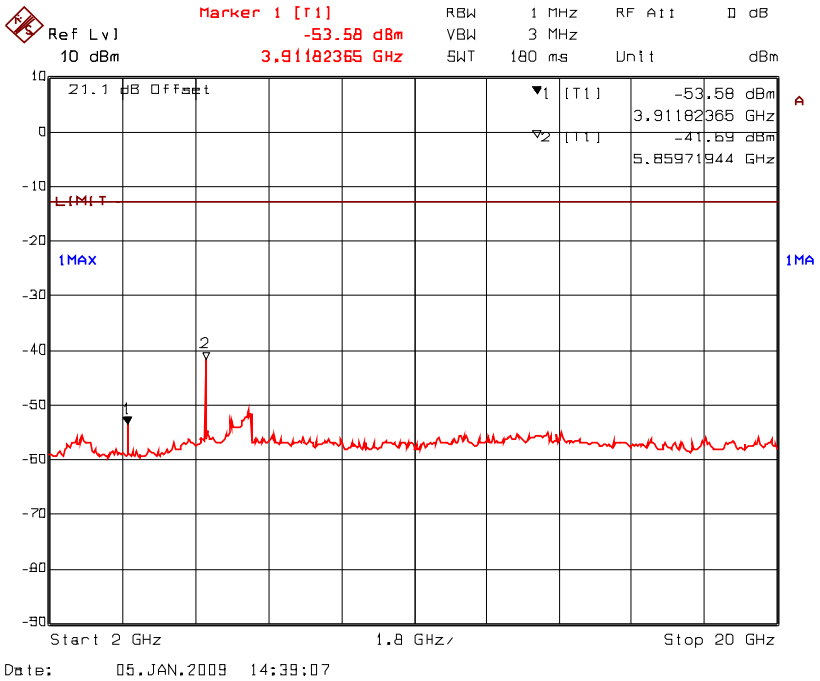




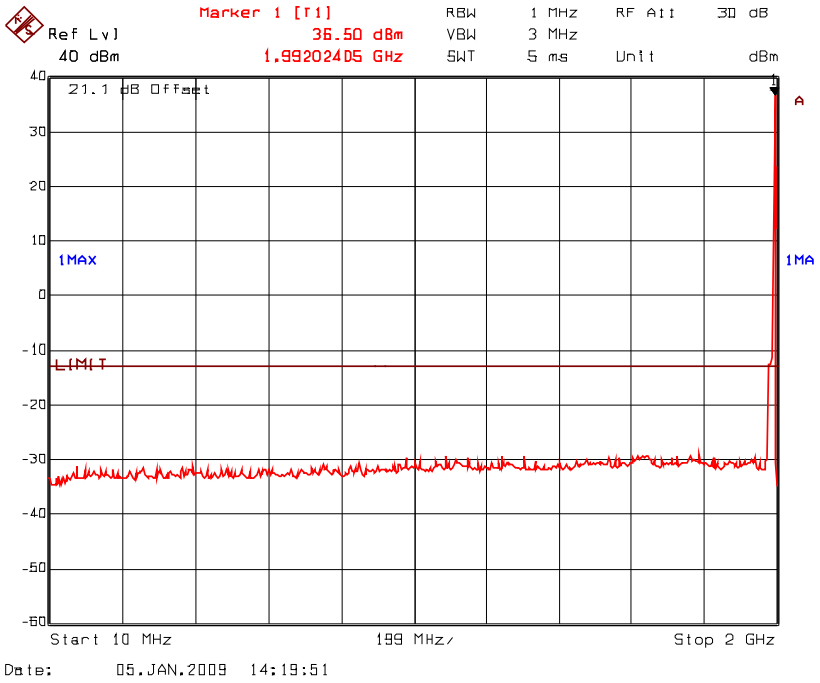
- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

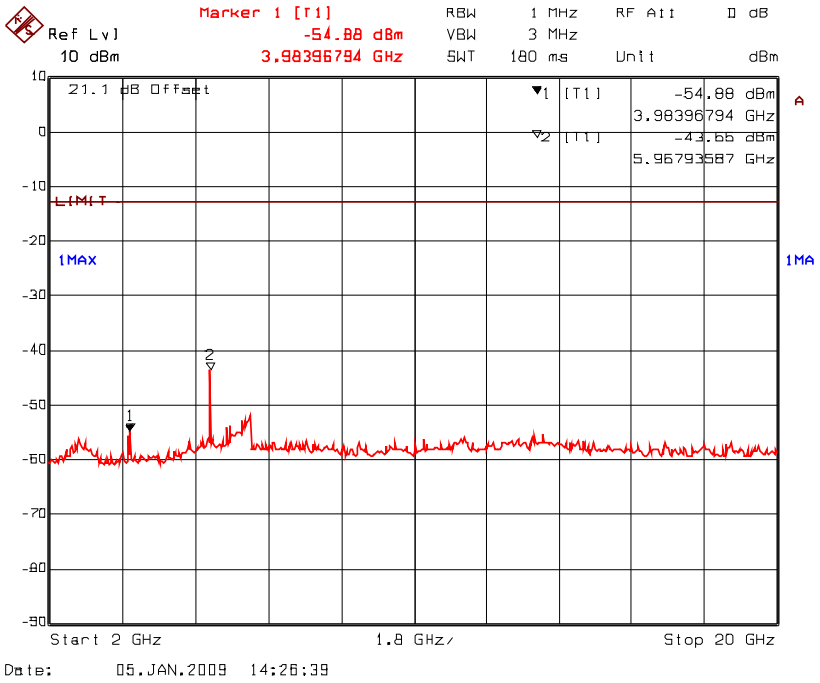
Plot 5.8.5.1.5 Spurious Emissions at Antenna Terminal
Test Frequency: 1960.0 MHz, Max Gain Setting





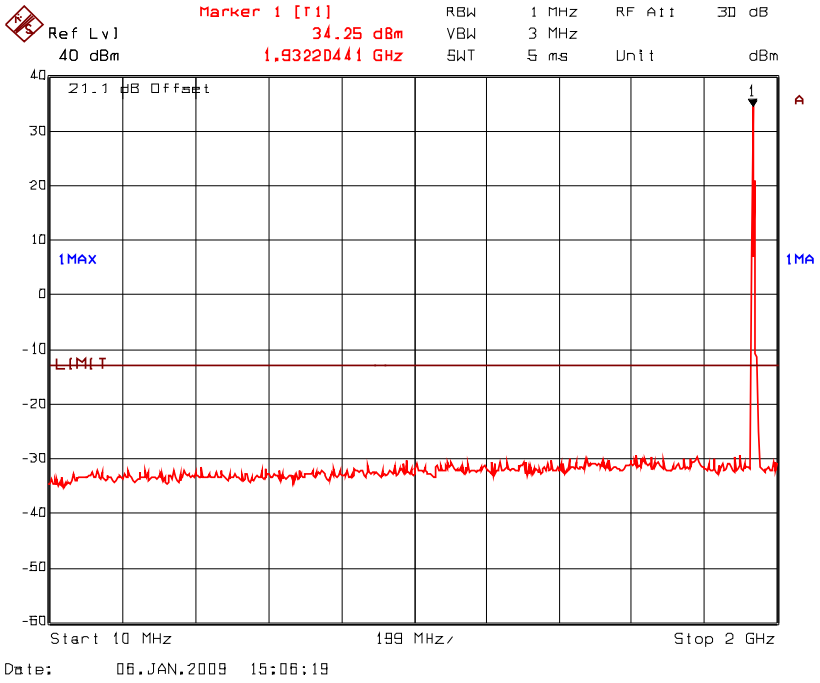
Plot 5.8.5.1.6 Spurious Emissions at Antenna Terminal
Test Frequency: 1989.8 MHz, Max Gain Setting

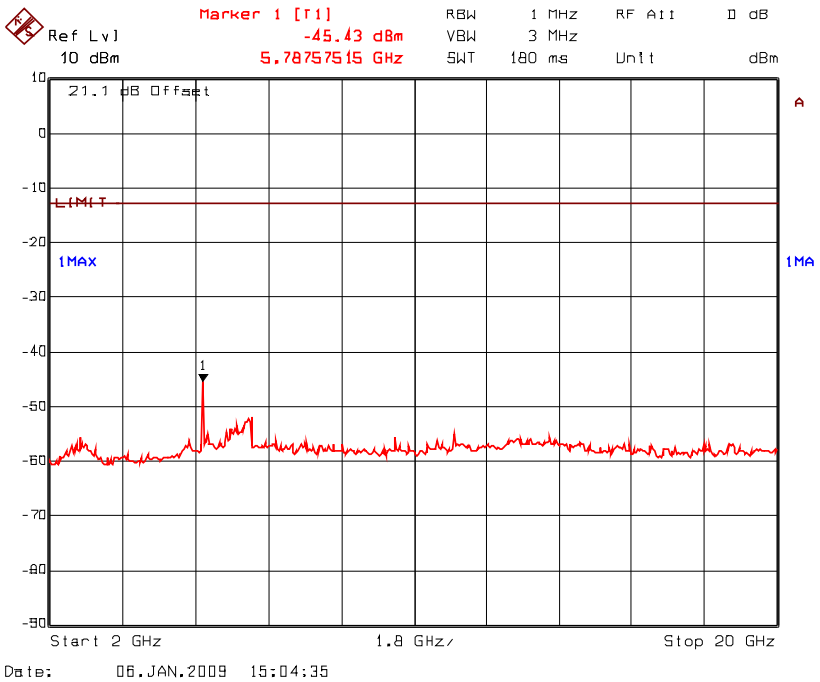




2 Inputs:-

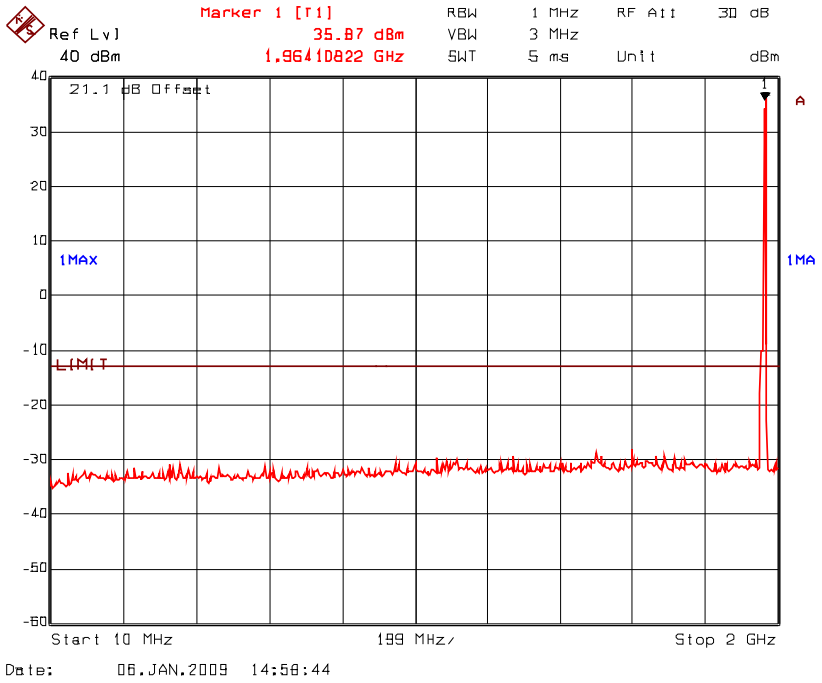
Plot 5.8.5.1.7 Spurious Emissions at Antenna Terminal with 2 Inputs
Test Frequency: 1930.2 & 1930.4 MHz, Max Gain Setting

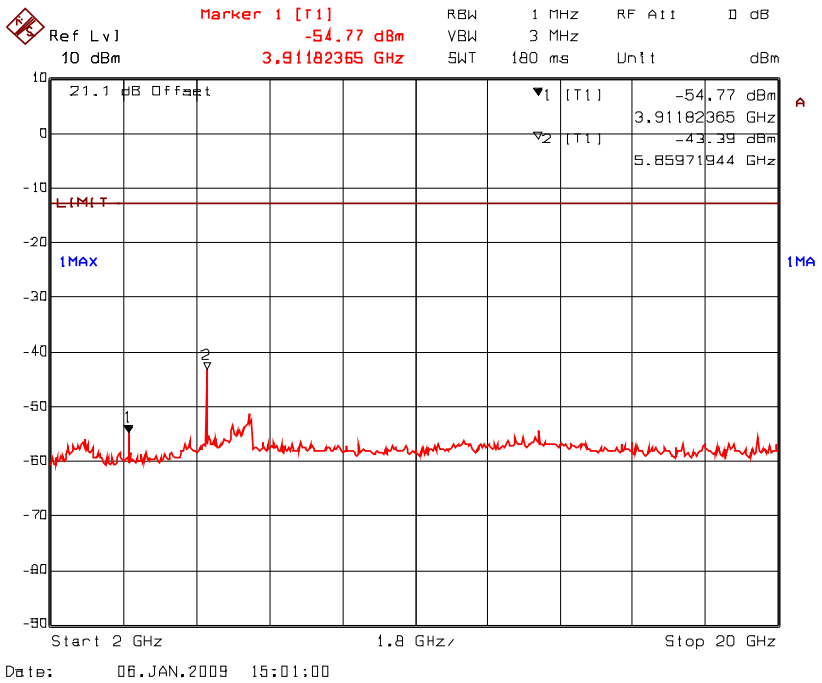




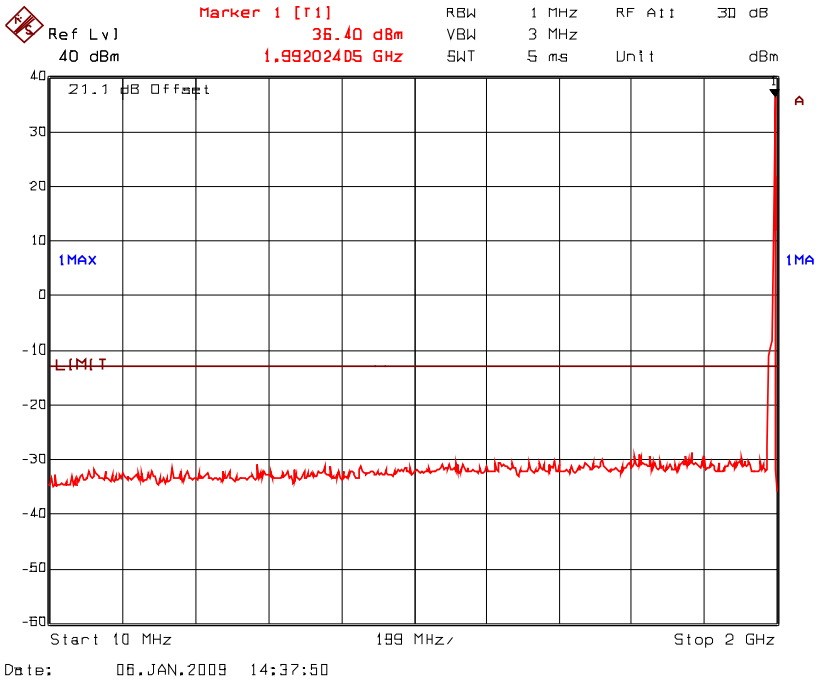
- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

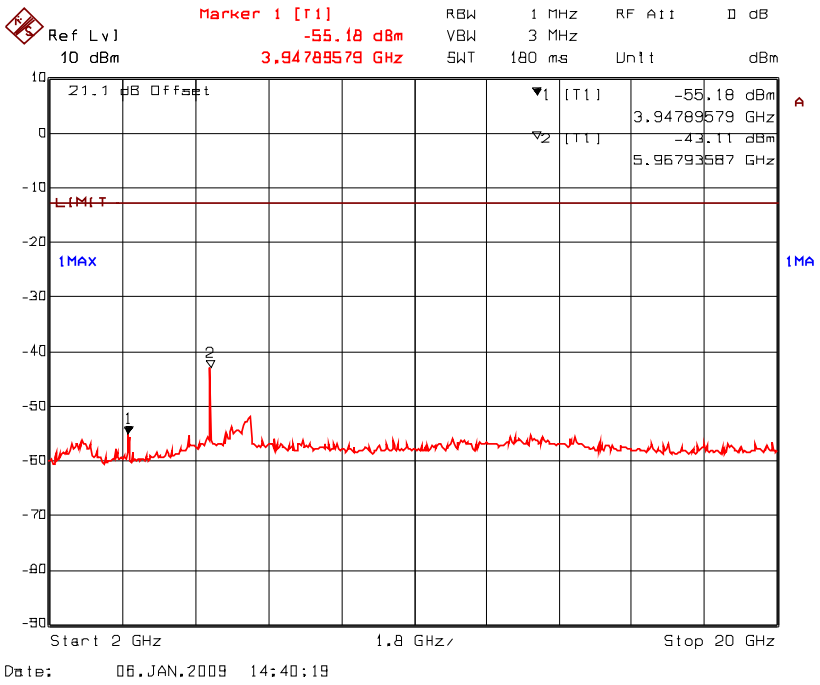
Plot 5.8.5.1.8 Spurious Emissions at Antenna Terminal with 2 Inputs
Test Frequency: 1960.0 & 1960.2 MHz, Max Gain Setting





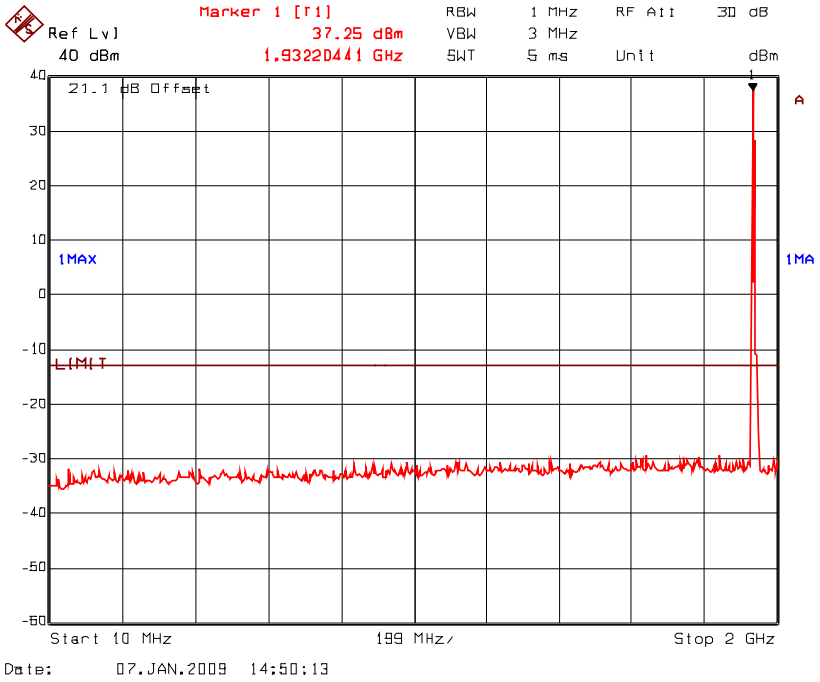
Plot 5.8.5.1.9 Spurious Emissions at Antenna Terminal with 2 Inputs
Test Frequency: 1989.8 & 1989.6 MHz, Max Gain Setting

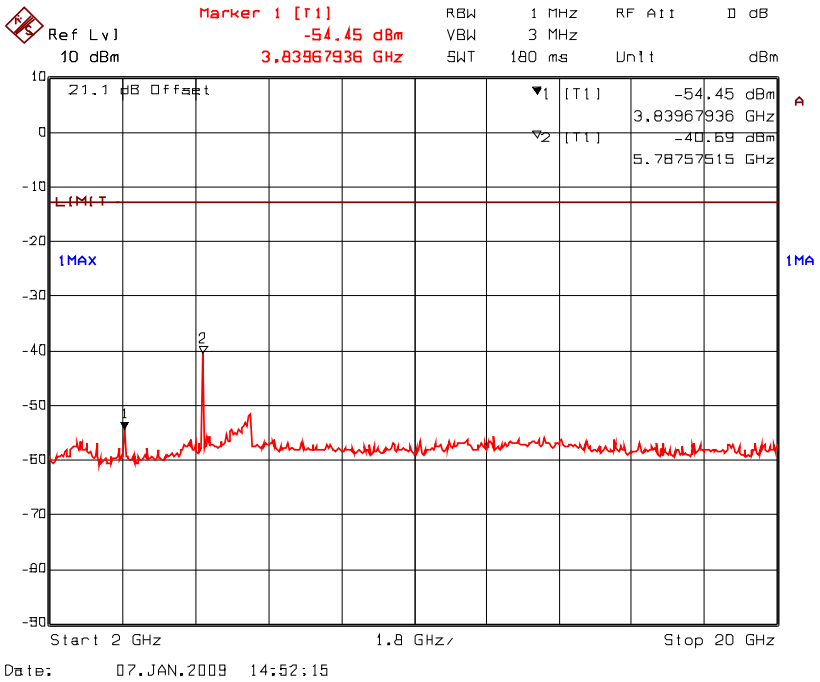




3 Inputs:-

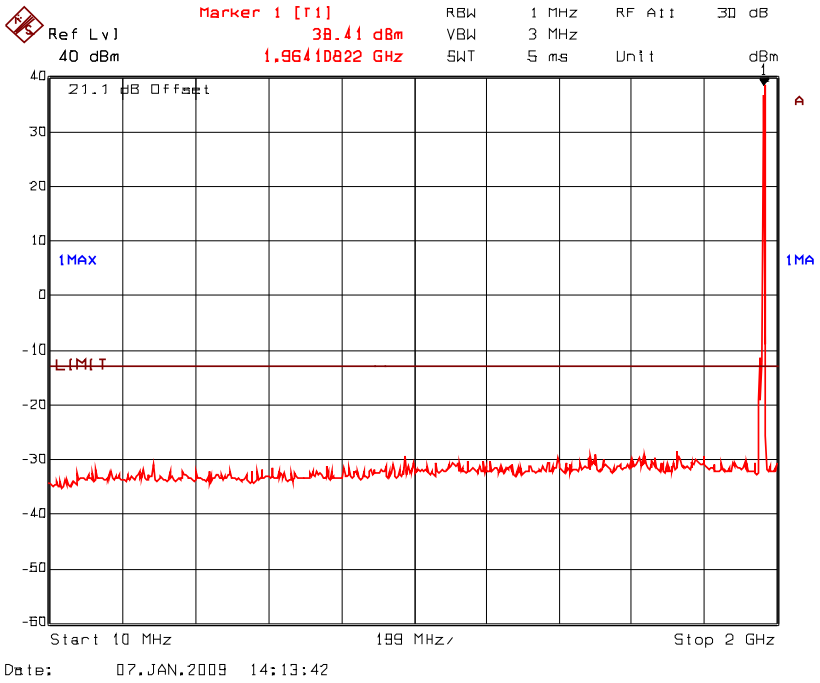
Plot 5.8.5.1.10 Spurious Emissions at Antenna Terminal with 3 Inputs
Test Frequency: 1930.2, 1930.4 & 1930.6 MHz, Max Gain Setting

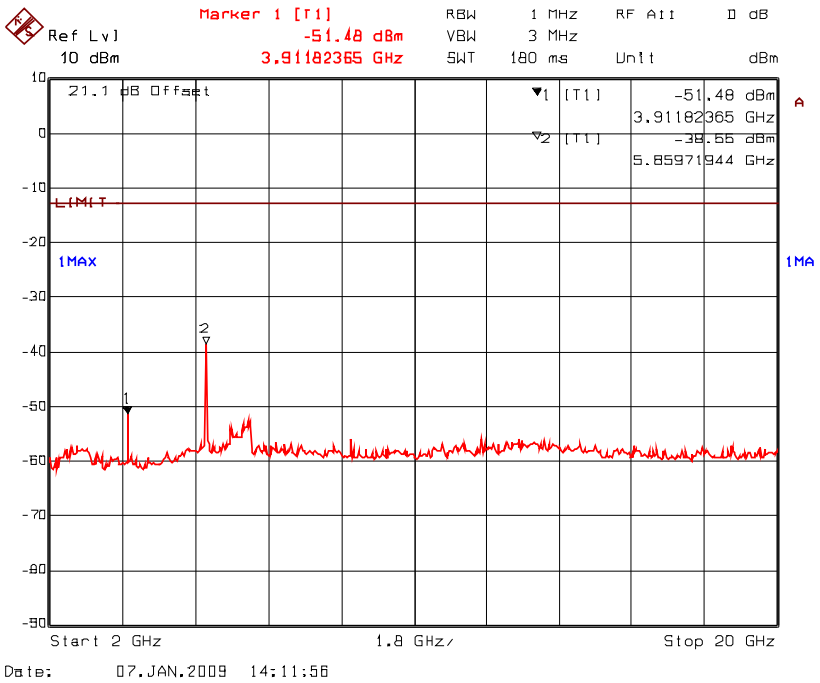




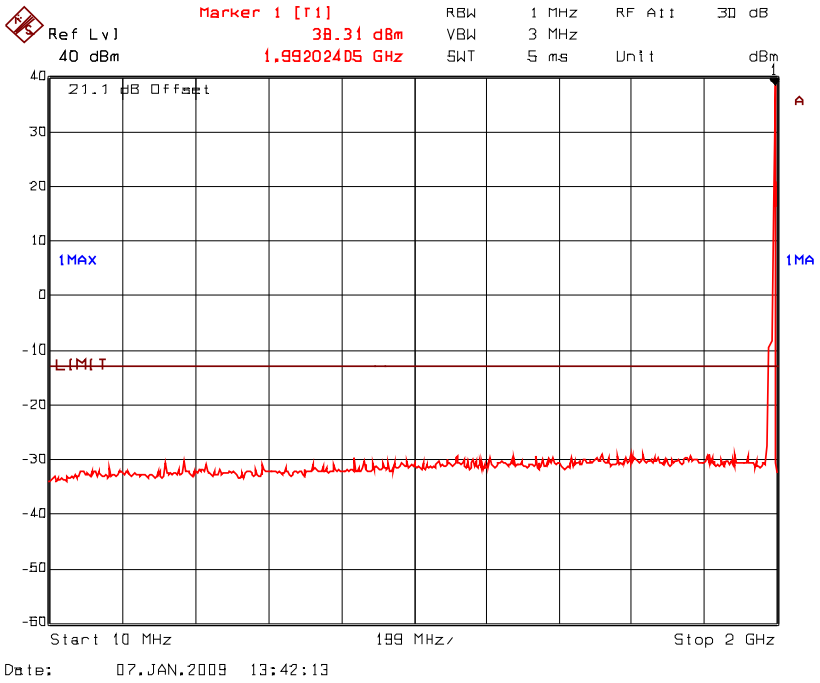
- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

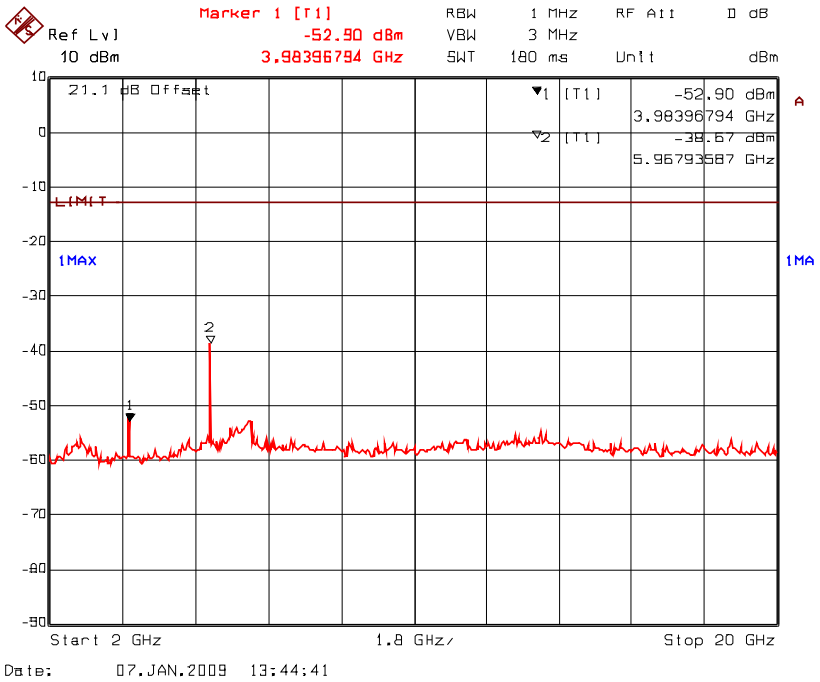
Plot 5.8.5.1.11 Spurious Emissions at Antenna Terminal with 3 Inputs
Test Frequency: 1960.0, 1960.2 & 1960.4 MHz, Max Gain Setting





Plot 5.8.5.1.12 Spurious Emissions at Antenna Terminal with 3 Inputs
Test Frequency: 1989.8, 1989.6 & 1989.4 MHz, Max Gain Setting

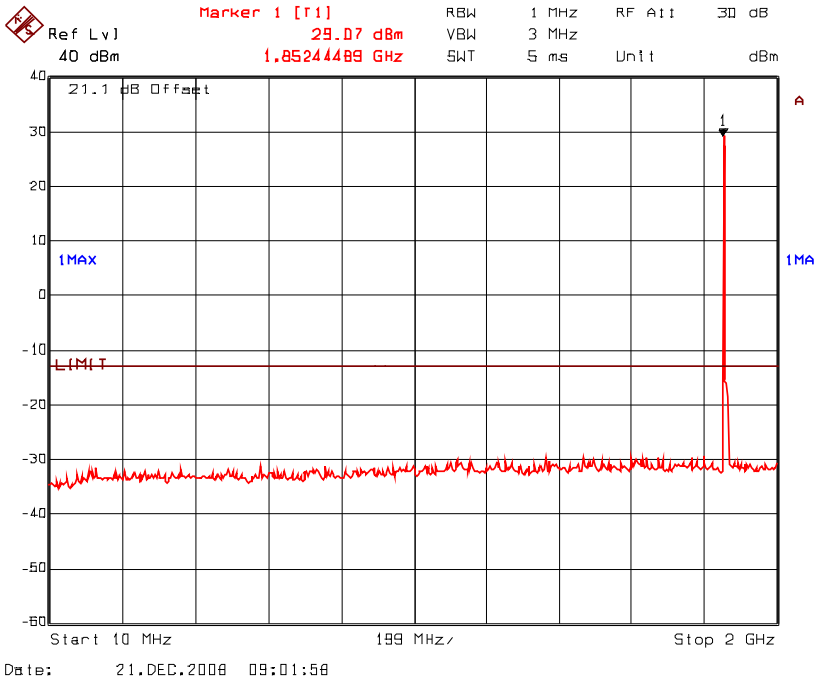


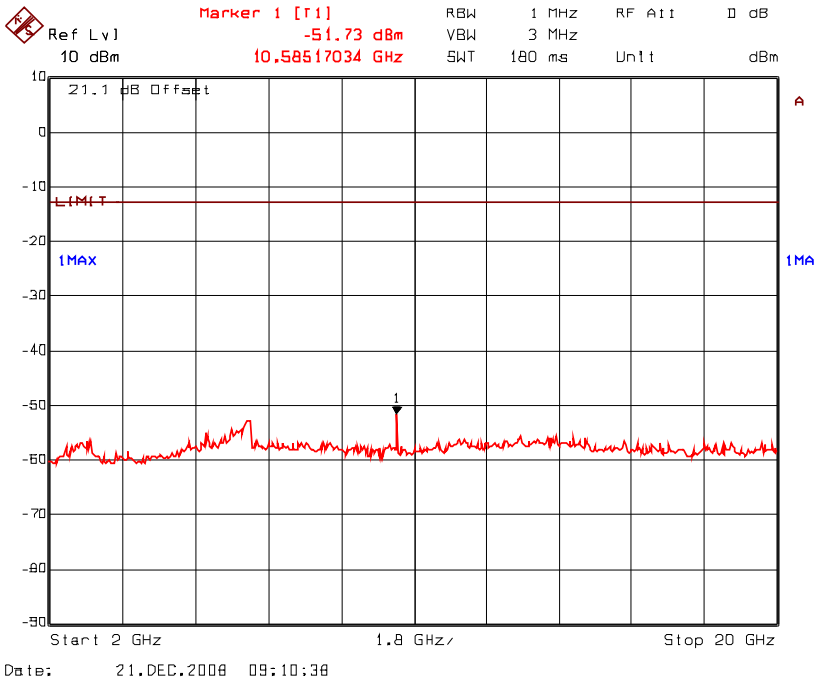


5.8.5.2. Uplink Band (1850-1910 MHz)

CDMA 2000:-

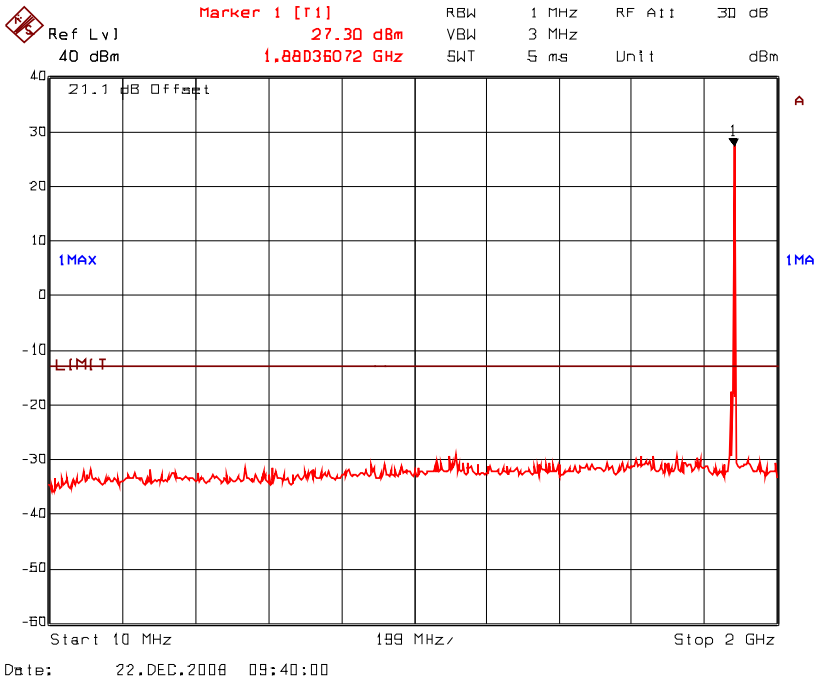
Plot 5.8.5.2.1 Spurious Emissions at Antenna Terminal
Test Frequency: 1951.25 MHz, Max Gain Setting

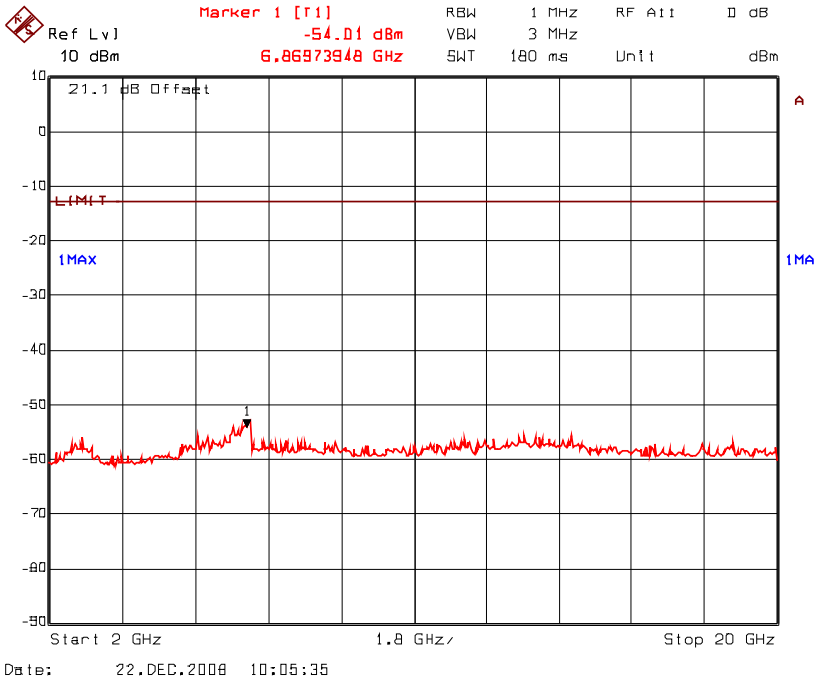




- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

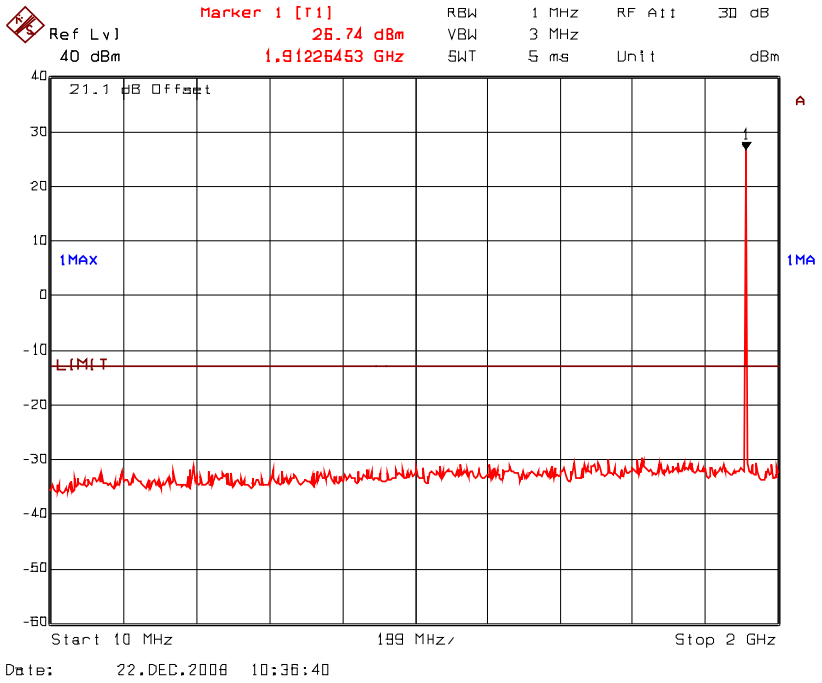
Plot 5.8.5.2.2 Spurious Emissions at Antenna Terminal
Test Frequency: 1880.00 MHz, Max Gain Setting

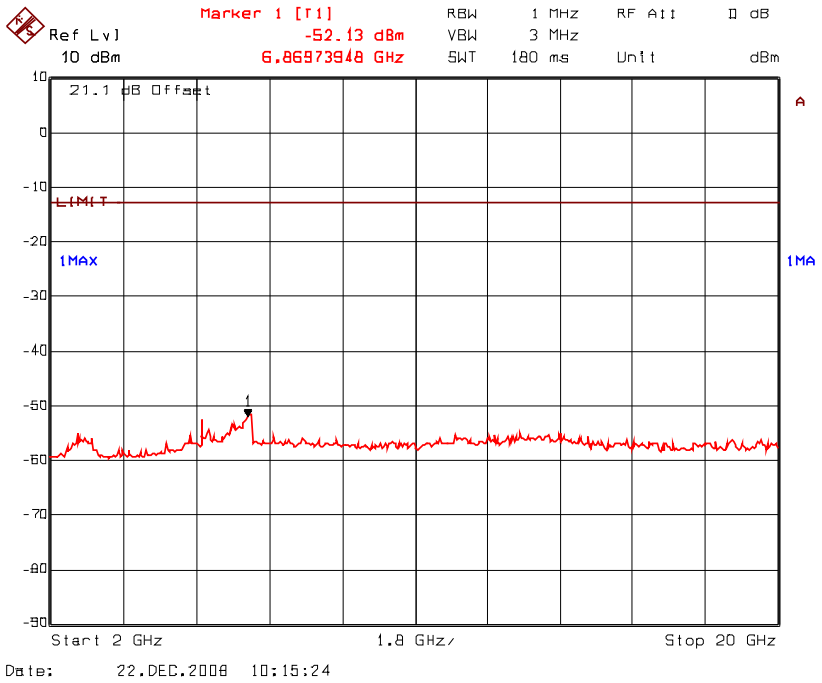




- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

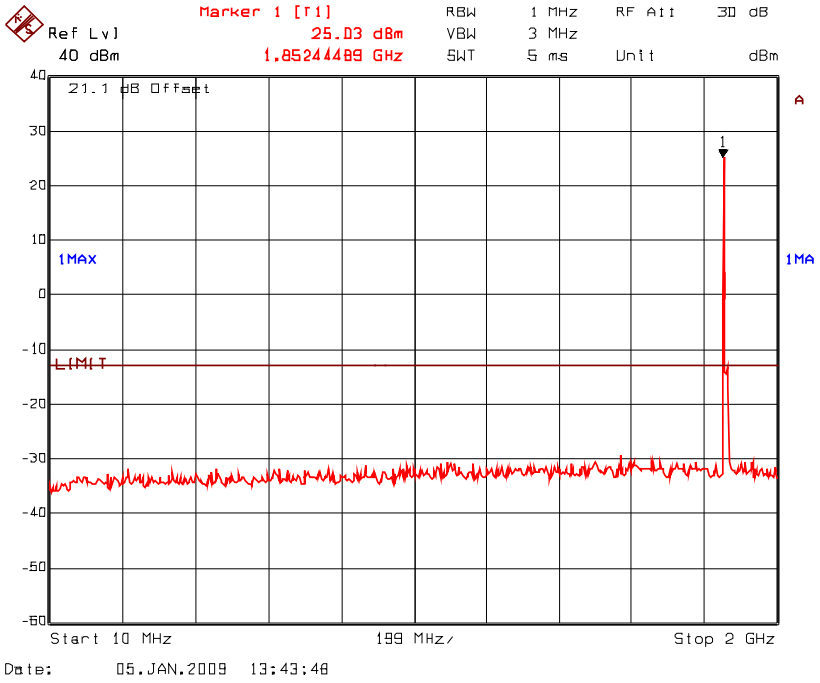
Plot 5.8.5.2.3 Spurious Emissions at Antenna Terminal
Test Frequency: 1908.75 MHz, Max Gain Setting

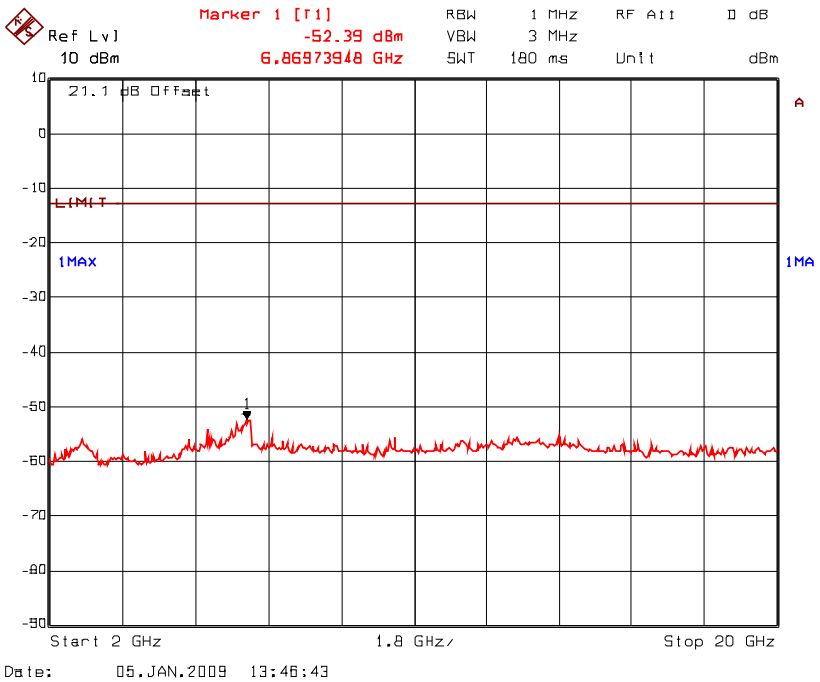




GSM Modulation:-

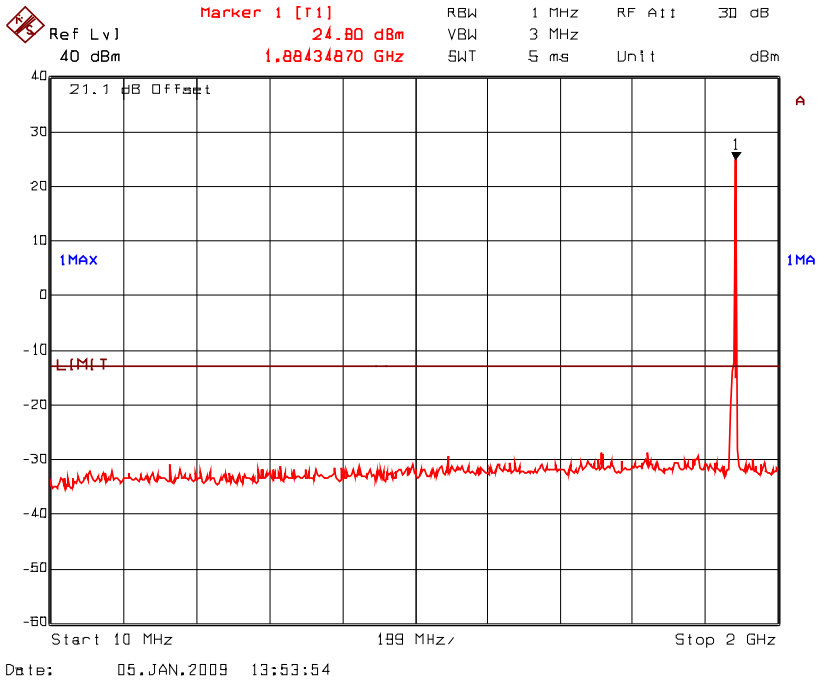
Plot 5.8.5.2.4 Spurious Emissions at Antenna Terminal
Test Frequency: 1850.2 MHz, Max Gain Setting

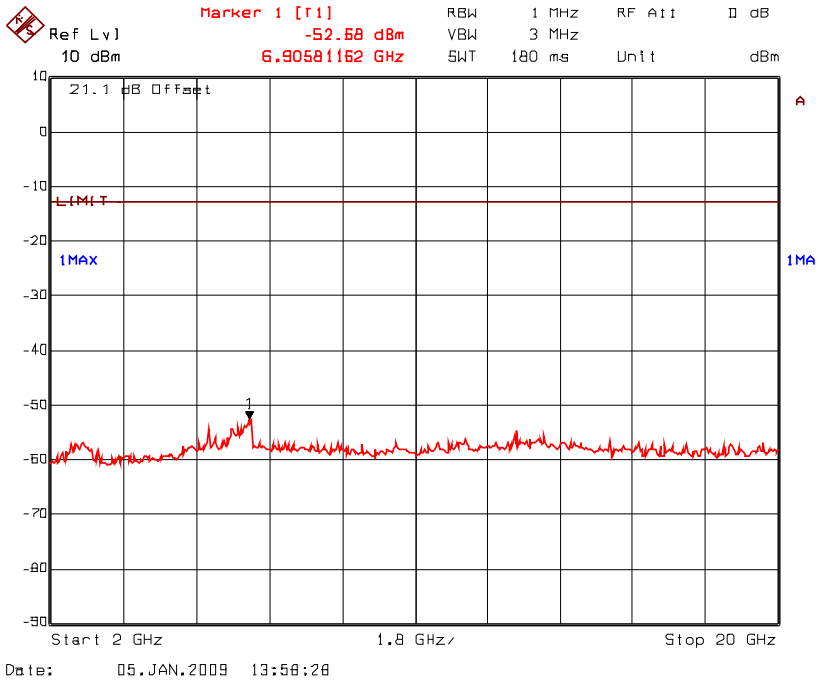




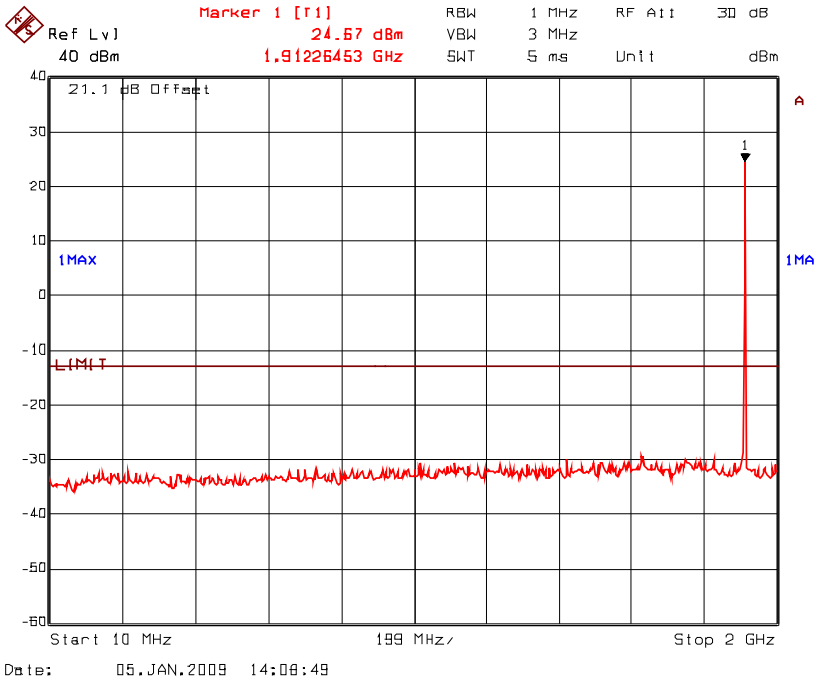
- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

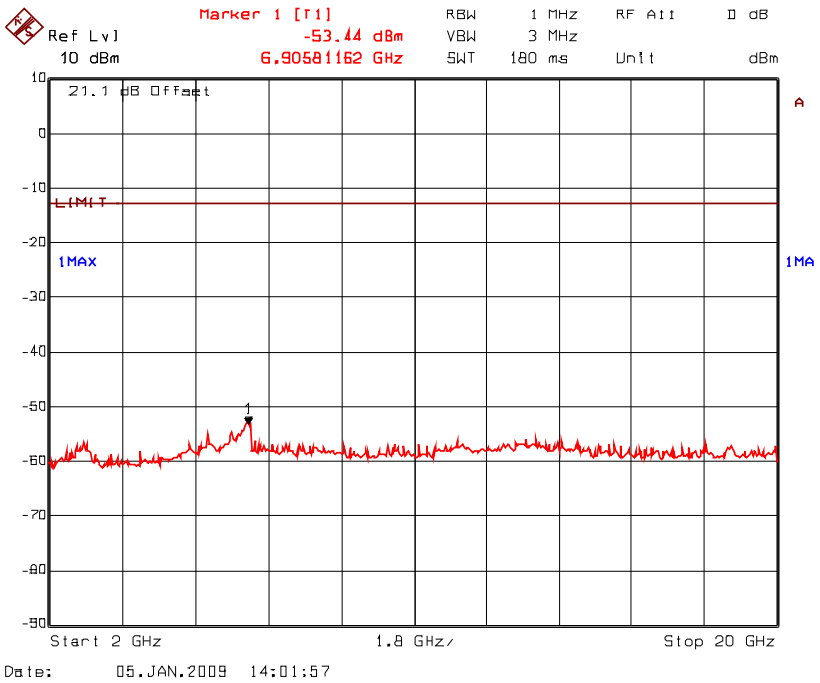
Plot 5.8.5.2.5 Spurious Emissions at Antenna Terminal
Test Frequency: 1880.0 MHz, Max Gain Setting





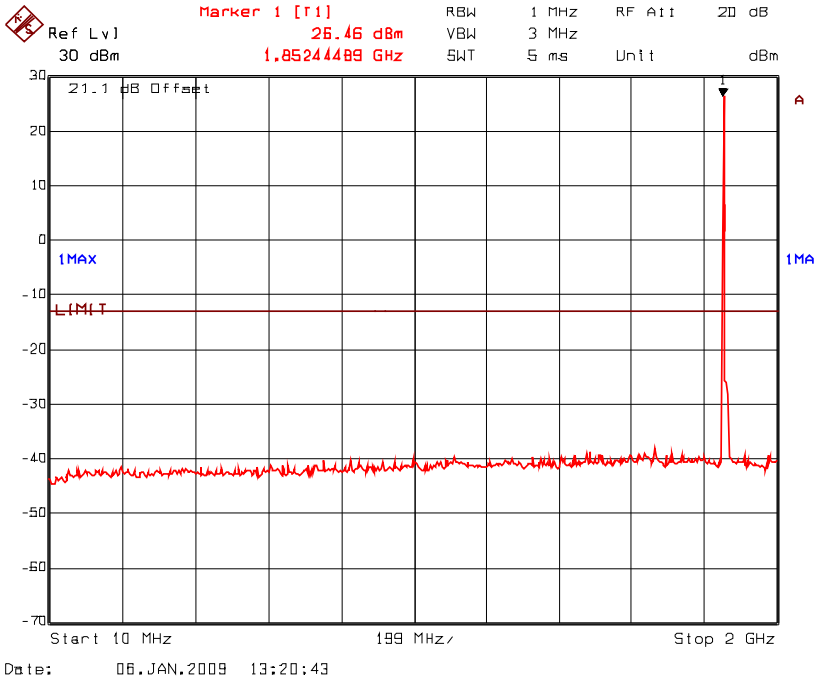
Plot 5.8.5.2.6 Spurious Emissions at Antenna Terminal
Test Frequency: 1909.8 MHz, Max Gain Setting

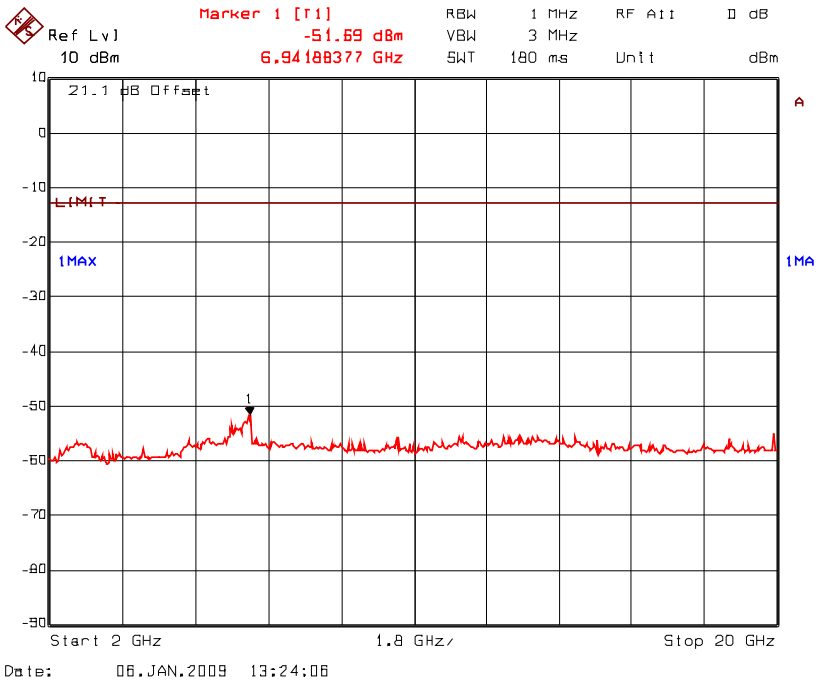




2 Inputs:-

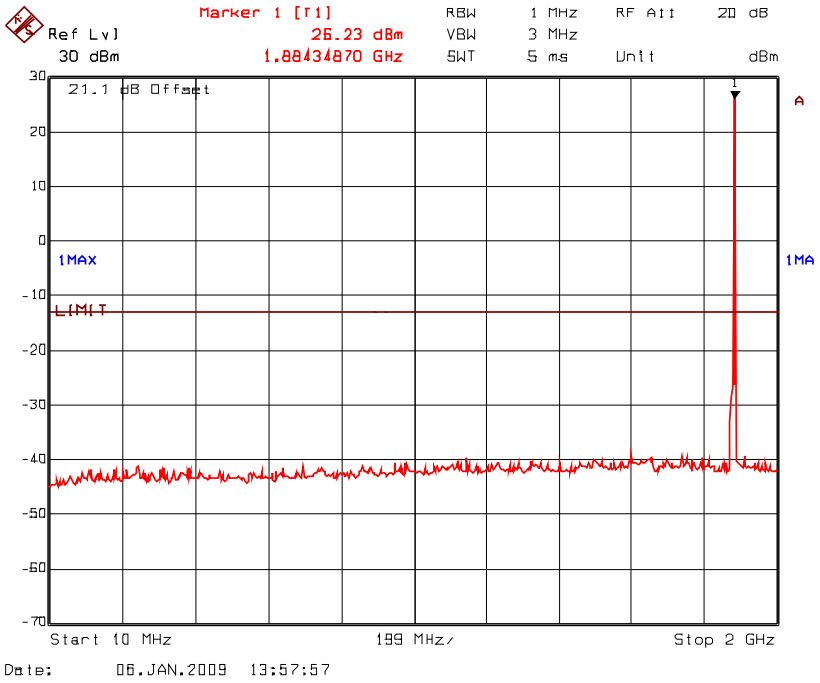
Plot 5.8.5.2.7 Spurious Emissions at Antenna Terminal with 2 Inputs
Test Frequency: 1850.2 & 1850.4 MHz, Max Gain Setting

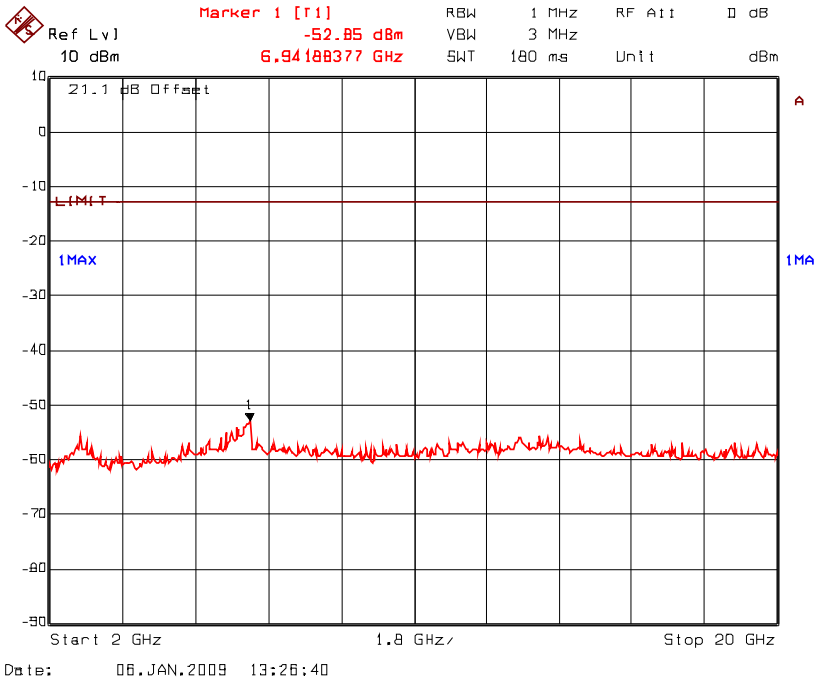




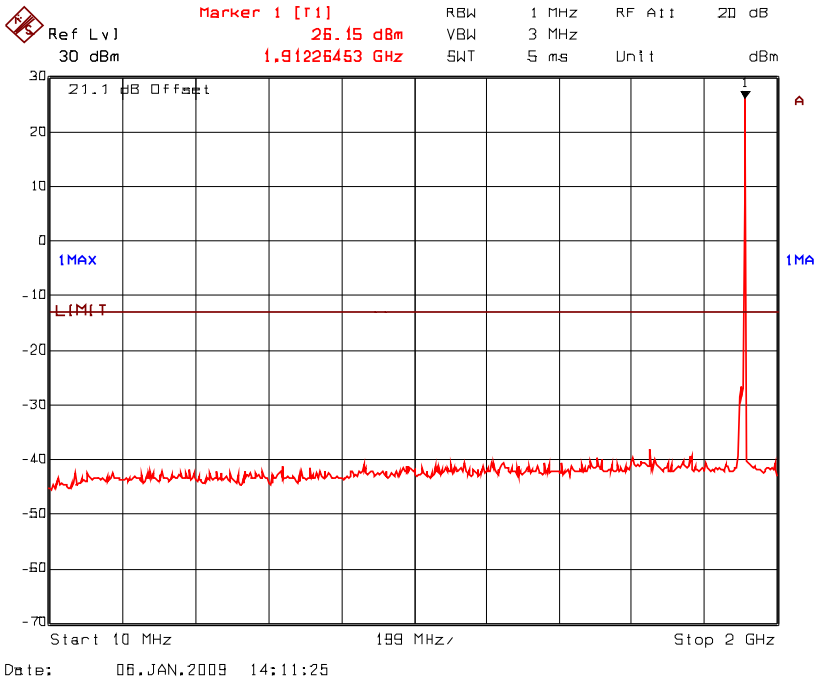
- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

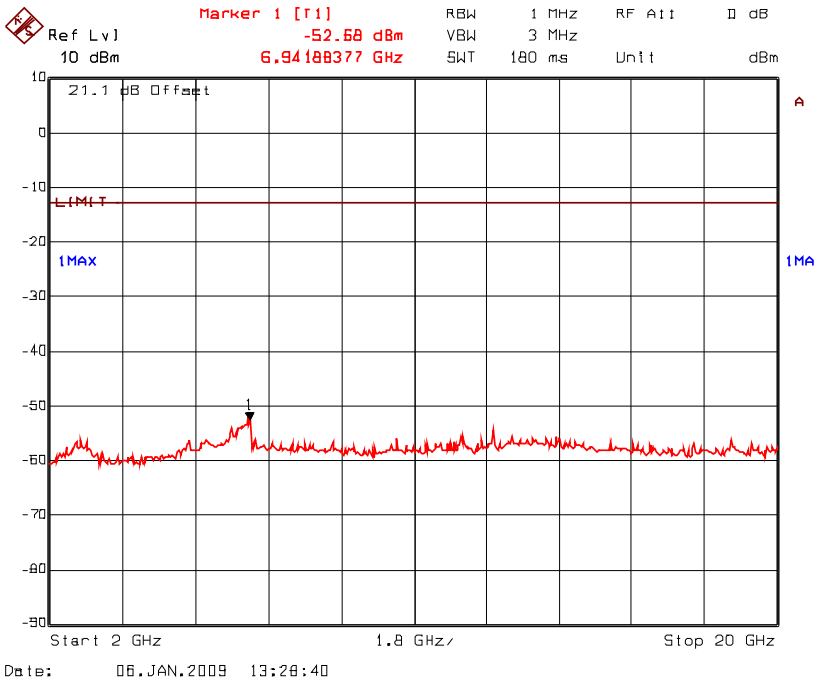
Plot 5.8.5.2.8 Spurious Emissions at Antenna Terminal with 2 Inputs
Test Frequency: 1880.0 & 1880.2 MHz, Max Gain Setting





Plot 5.8.5.2.9 Spurious Emissions at Antenna Terminal with 2 Inputs
Test Frequency: 1909.8 & 1909.6 MHz, Max Gain Setting

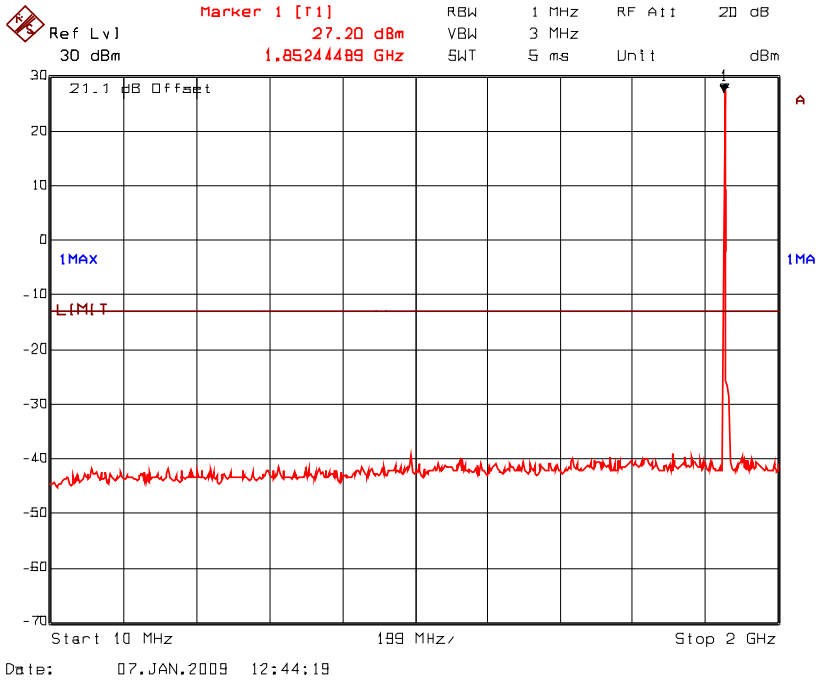


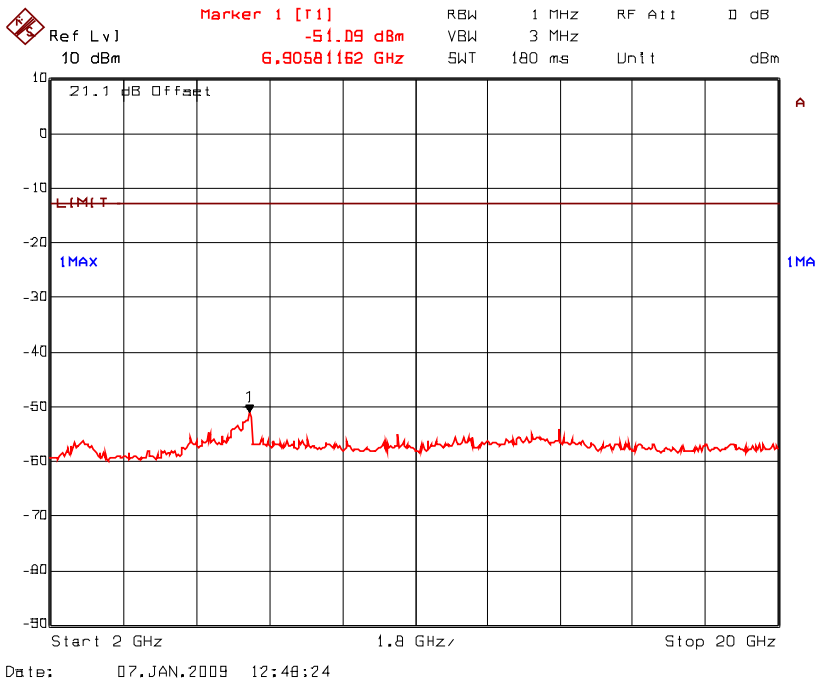


- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

3 Inputs:-

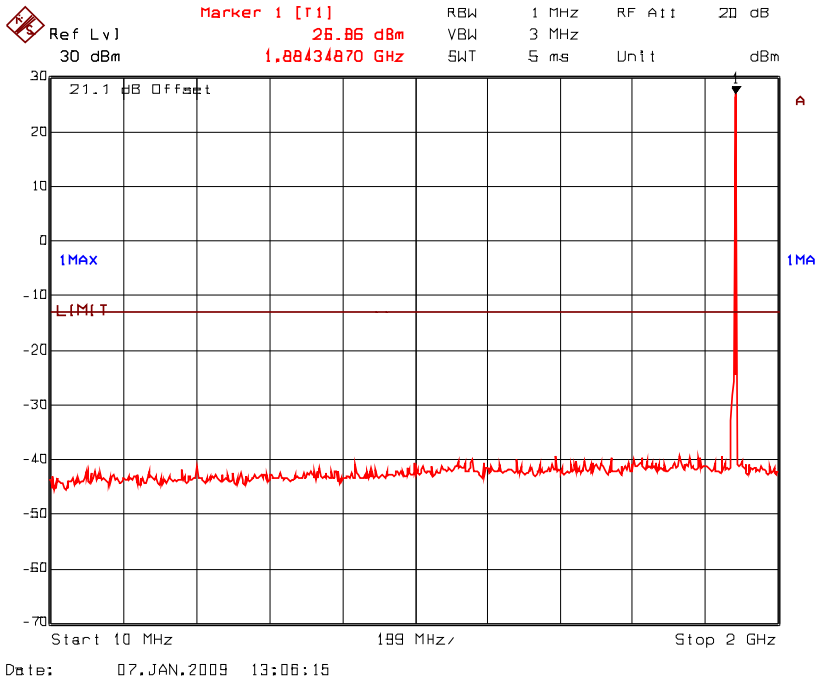
Plot 5.8.5.2.10 Spurious Emissions at Antenna Terminal with 3 Inputs
Test Frequency: 1850.2, 1850.4 & 1850.6 MHz, Max Gain Setting

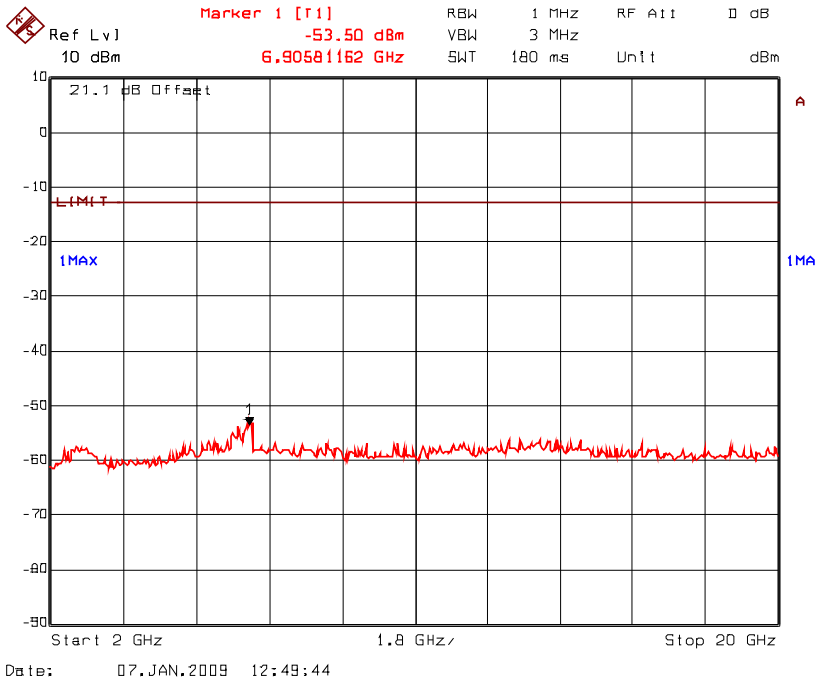




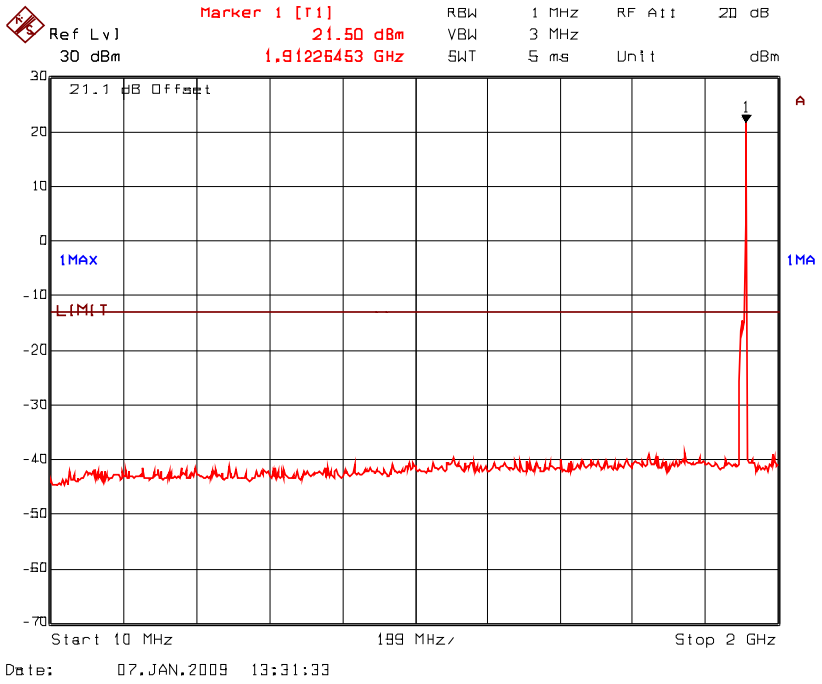
- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

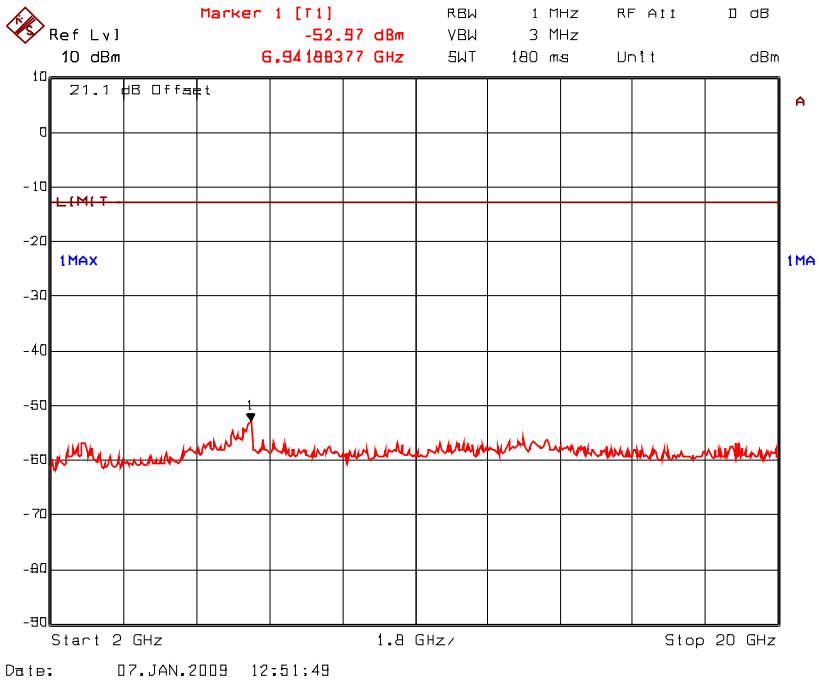
Plot 5.8.5.2.11 Spurious Emissions at Antenna Terminal with 3 Inputs
Test Frequency: 1880.0, 1880.2 & 1880.4 MHz, Max Gain Setting





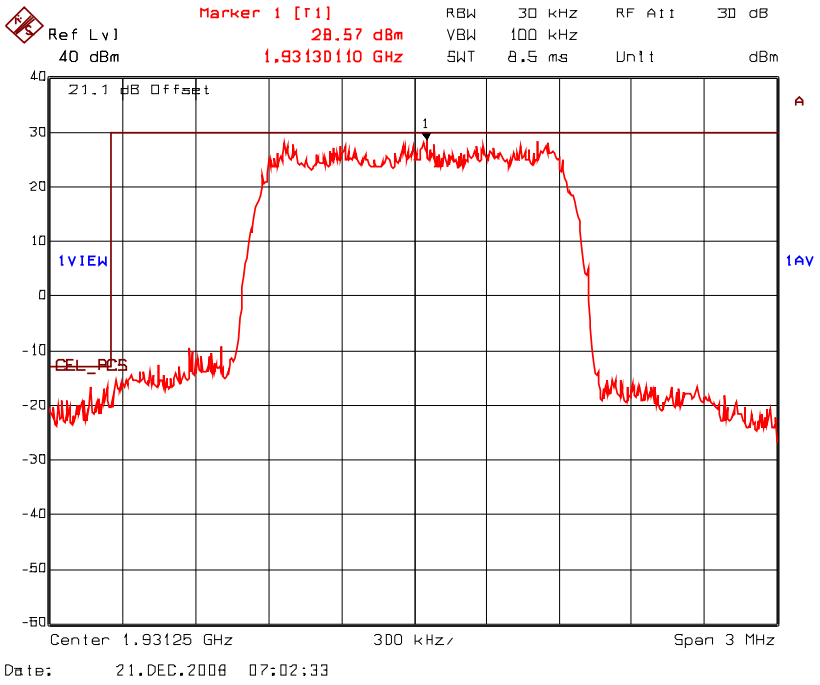
Plot 5.8.5.2.12 Spurious Emissions at Antenna Terminal with 3 Inputs
Test Frequency: 1909.8, 1909.6 & 1909.4 MHz, Max Gain Setting

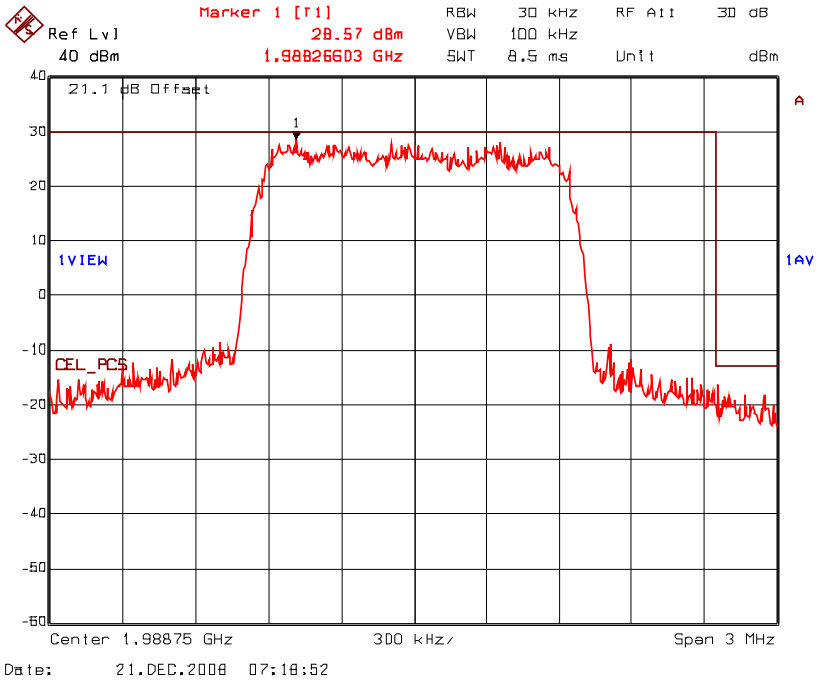




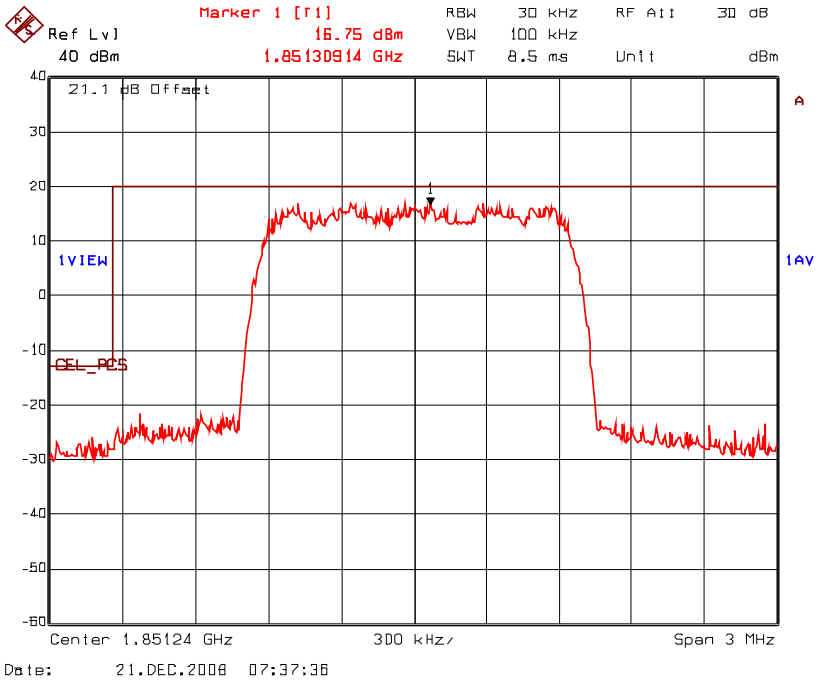
5.8.5.3. Band Edge Emmissions

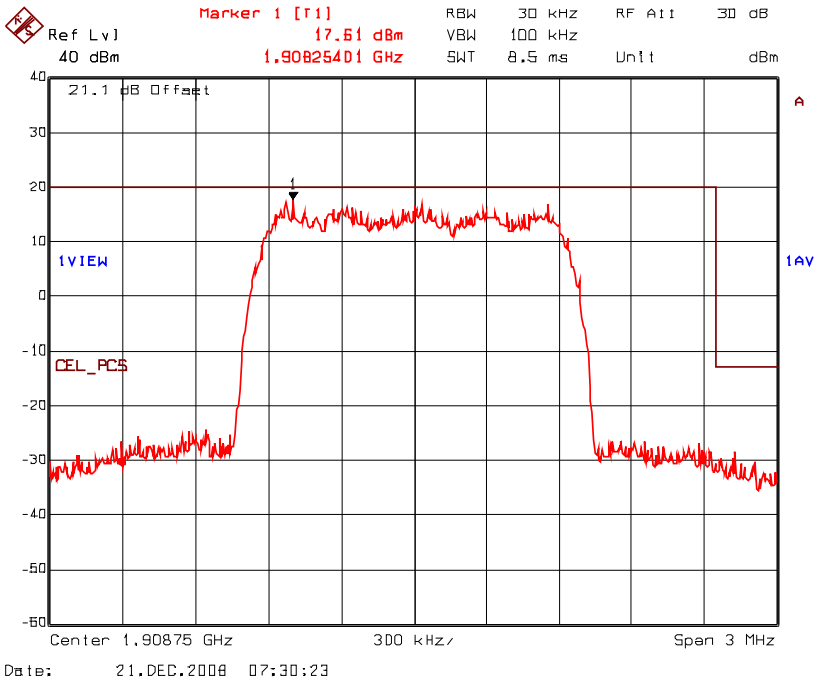
Plot 5.8.5.3.1 Conducted Band Edge Emissions
Test Frequency: 1931.25 & 1988.75 MHz, CDMA Modulation, Max Gain



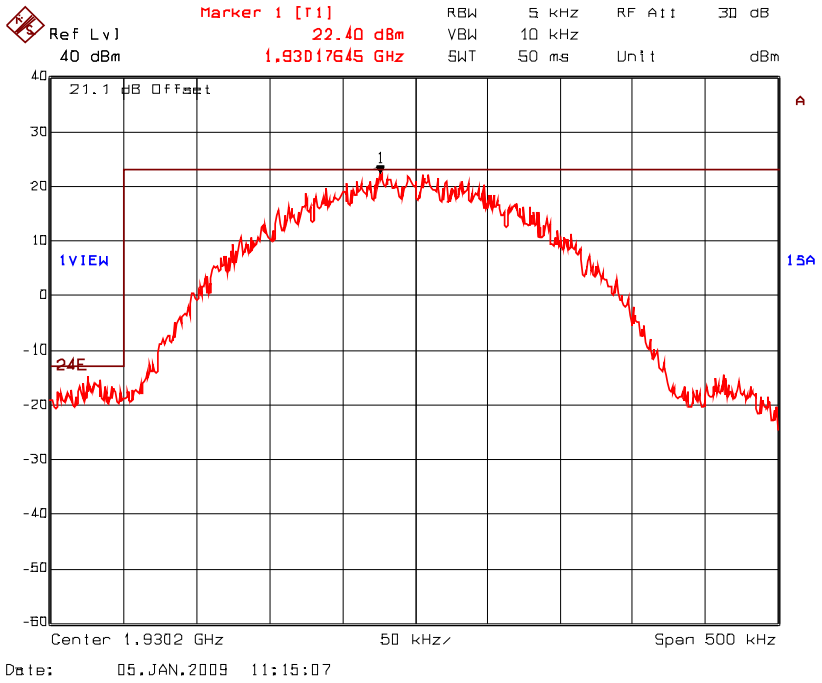


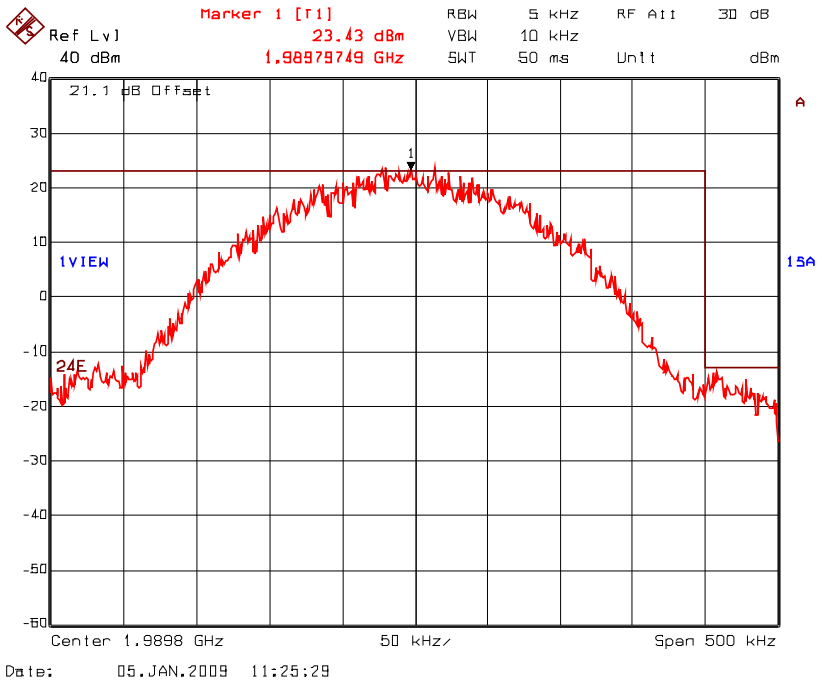
Plot 5.8.5.3.2 Conducted Band Edge Emissions
Test Frequency: 1851.25 & 1908.75 MHz, CDMA Modulation, Max Gain



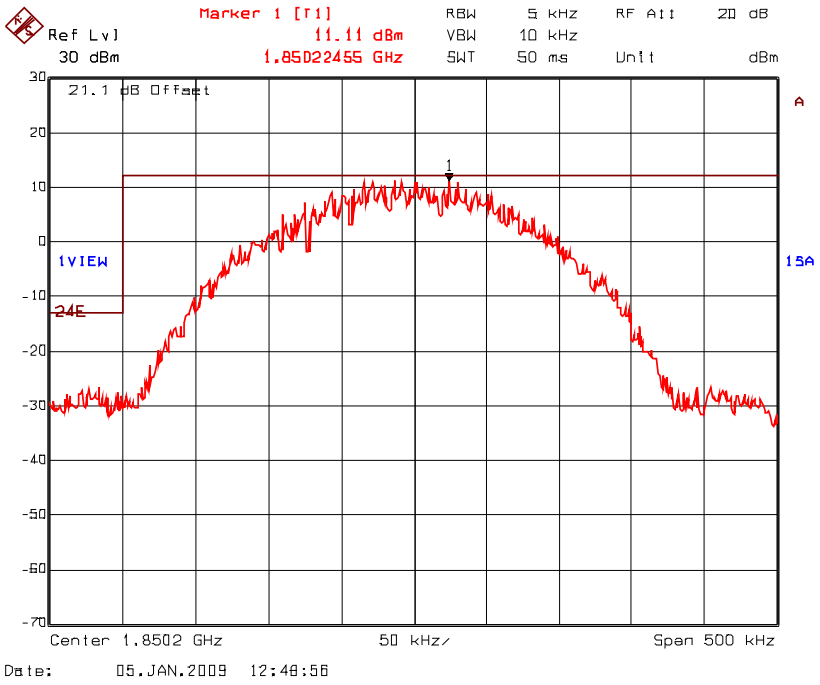


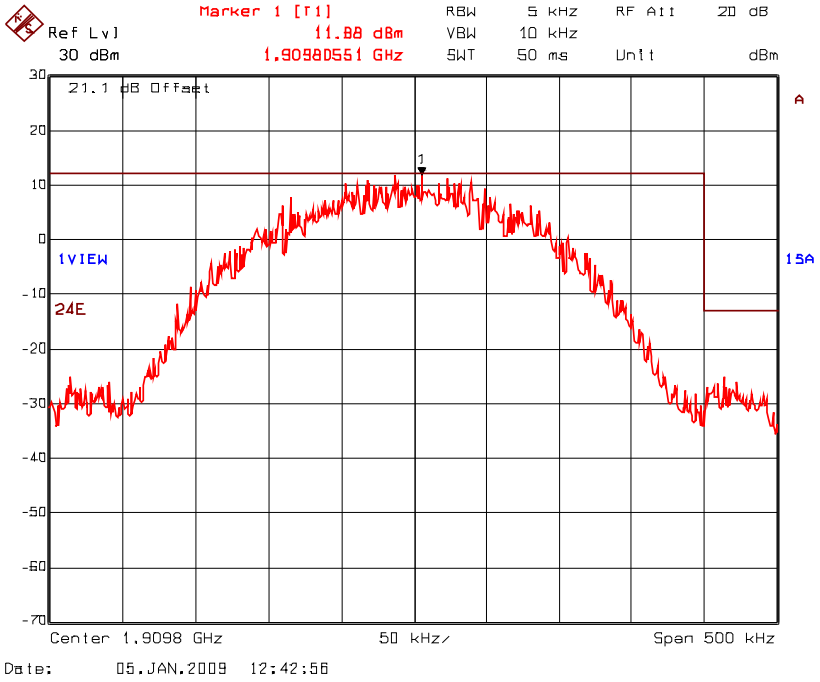
Plot 5.8.5.3.3 Conducted Band Edge Emissions
Test Frequency: 1930.2 & 1989.8 MHz, GSM Modulation, Max Gain





Plot 5.8.5.3.4 Conducted Band Edge Emissions
Test Frequency: 1850.2 & 1909.8 MHz, GSM Modulation, Max Gain





5.9. FIELD STRENGHT OF SPURIOUS EMISSIONS [24.238 & 2.1053]

5.9.1. Limits

The most stringent limit of 43+10*log(P in Watts) dBc is applied for all sub-bands for worst case.

5.9.2. Method of Measurements

The spurious/harmonic ERP measurements are using substitution method specified in Exhibit 8, Section 8.2 of this report and its value in dBc is calculated as follows:

(1) If the transmitter's antenna is an integral part of the EUT, the ERP is measured using substitution method.
(2) If the transmitter's antenna is non-integral and diverse, the lowest ERP of the carrier with 0 dBi antenna gain is used for calculation of the spurious/harmonic emissions in dBc:
Lowest ERP of the carrier = EIRP – 2.15 dB = Pc + G - 2.15 dB = Pc dBm (conducted) + 0 dBi – 2.15 dB
(3) Spurious /harmonic emissions levels expressed in dBc (dB below carrier) are as follows:

ERP of spurious/harmonic (dBc) = ERP of carrier (dBm) – ERP of spurious/harmonic emission (dBm)

5.9.3. Test Equipment List

Please refer to Exhibit 6 for the details.

5.9.4. Test Data

Remarks:

- The radiated emissions were performed at 3 meters distance.
- The emissions were scanned from 30 MHz to 10 GHz; all emissions that are within 20 dB below the limit are recorded.
- Limit = 43+10*log(P) dBc = -13 dBm

5.9.4.1. Downlink Bands (1930-1990 MHz)

Frequency (MHz)	E-Field Level @3m (dBµV/m)	Antenna Plane (H/V)	EMI Receiver Detector (Peak/QP)	ERP measured by Substitution Method		Limit (dBm)	Margin (dB)
				(dBm)	(dBc)		
Carrier Frequency: 1930.2 MHz							
30 – 20000	--	V & H	Peak	--	--	-13	Note (1)
Carrier Frequency: 1960.0 MHz							
30 – 20000	--	V & H	Peak	--	--	-13	Note (1)
Carrier Frequency: 1989.8 MHz							
30 – 20000	--	V & H	Peak	--	--	-13	Note (1)

Note (1) The emissions were scanned from 30 MHz to 20 GHz and all emissions found are more than 20 dB below the permissible limit.

5.9.4.2. Uplink Band (1850-1910 MHz)

Frequency (MHz)	E-Field Level @3m (dBµV/m)	Antenna Plane (H/V)	EMI Receiver Detector (Peak/QP)	ERP measured by Substitution Method		Limit (dBm)	Margin (dB)
				(dBm)	(dBc)		
Carrier Frequency: 1850.2 MHz							
30 – 20000	--	V & H	Peak	--	--	-13	Note (1)
Carrier Frequency: 1880.0 MHz							
30 – 20000	--	V & H	Peak	--	--	-13	Note (1)
Carrier Frequency: 1909.8 MHz							
30 – 20000	--	V & H	Peak	--	--	-13	Note (1)

Note (1) The emissions were scanned from 30 MHz to 20 GHz, all emissions are more than 20 dB below the permissible limit.

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No. or P/N	Serial No.	Frequency Range
EMI Receiver	Rohde & Schwarz	ESU40	100037	20 Hz- 40 GHz
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20 Hz- 40 GHz
Biconilog Antenna	Emco	3142	10005	0.03 – 2 GHz
Biconilog Antenna	Emco	3142C	26873	0.03 – 2 GHz
Horn Antenna	Emco	3155	9701-5061	1 – 18 GHz
Horn Antenna	Emco	3155	9911-5955	1 – 18 GHz
RF Amplifier	Hewlett Packard	8447F	2944A04098	1 MHz – 2 GHz
RF Amplifier	Hewlett Packard	8449B	3008A00769	1 – 26.5 GHz
High Pass Filter	K & L	11SH10-3000/T18000	4	Cut off 1.9 GHz
Signal Generator	Hewlett Packard	83752B	3610A00457	0.01 – 20 GHz
Vector Modulator	IFR	2029	202901/023	800 MHz – 2.51 GHz
Signal Generator	Gigatronics	9000S	91026	10 MHz – 26 GHz
Signal Generator	IFR	2025	202304/137	9 kHz – 2.51 GHz
Power Divider	Mini-Circuit	15542-3	0105	1 MHz – 4 GHz
Attenuator	Weinschel Corp	23-20-34	BH7876	DC-18 GHz
Attenuator	Weinschel Corp	24-10-34	BK8612	DC-8.5 GHz

- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994)

7.1. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (± dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	±1.0	±1.0
Cable Loss Calibration	Normal (k=2)	±0.3	±0.5
EMI Receiver specification	Rectangular	±1.5	±1.5
Antenna Directivit	Rectangular	+0.5	+0.5
Antenna factor variation with height	Rectangular	±2.0	±0.5
Antenna phase center variation	Rectangular	0.0	±0.2
Antenna factor frequency interpolation	Rectangular	±0.25	±0.25
Measurement distance variation	Rectangular	±0.6	±0.4
Site imperfections	Rectangular	±2.0	±2.0
Mismatch: Receiver VRC Γ_1 = 0.2 Antenna VRC Γ_R = 0.67(Bi) 0.3 (Lp) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	U-Shaped	+1.1 -1.25	±0.5
System repeatability	Std. Deviation	±0.5	±0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k = 2 is used:

$U = 2u_c(y) = 2x(+2.19) = +4.38$ dB And $U = 2u_c(y) = 2x(-2.21) = -4.42$ dB

- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

EXHIBIT 8. MEASUREMENT METHODS

8.1. CONDUCTED POWER MEASUREMENTS

- The following shall be applied to the combination(s) of the radio device and its intended antenna(e).
- I f the RF level is user adjustable; all measurements shall be made with the highest power level available to the user for that combination.
- The following method of measurement shall apply to both conducted and radiated measurements.
- The radiated measurements are performed at the Ultratech Calibrated Open Field Test Site.
- The measurement shall be performed using normal operation of the equipment with modulation.

Test procedure shall be as follows:

Step 1: Duty Cycle measurements if the transmitter's transmission is transient

- Using a EMI Receiver with the frequency span set to 0 Hz and the sweep time set at a suitable value to capture the envelope peaks and the duty cycle of the transmitter output signal;
- The duty cycle of the transmitter, x = Tx on / (Tx on + Tx off) with 0<x<1, is measure and recorded in the test report. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal or more than 0.1.

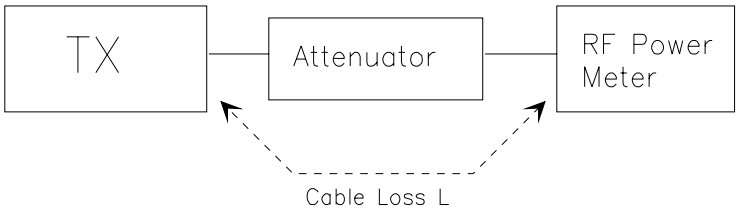
Step 2: Calculation of Average EIRP. See Figure 1

- The average output power of the transmitter shall be determined using a wideband, calibrated RF average power meter with the power sensor with an integration period that exceeds the repetition period of the transmitter by a factor 5 or more. The observed value shall be recorded as "A" (in dBm);
- The e.i.r.p. shall be calculated from the above measured power output "A", the observed duty cycle x, and the applicable antenna assembly gain "G" in dBi, according to the formula:

EIRP = A + G + 10log(1/x)

{ X = 1 for continuous transmission => 10log(1/x) = 0 dB }

Figure 1.



8.2. RADIATED POWER MEASUREMENTS (ERP & EIRP) USING SUBSTITUTION METHOD

8.2.1. Maximizing RF Emission Level (E-Field)

(a) The measurements was performed with full rf output power and modulation.
(b) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
(c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
(d) The BICONILOG antenna (20 MHz to 1 GHz) or HORN antenna (1 GHz to 18 GHz) was used for measuring.
(e) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(f) Set the EMI Receiver and #2 as follows:

Center Frequency:	test frequency
Resolution BW:	100 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(g) The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
(h) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(i) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
(j) The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.
(k) The above steps were repeated with both transmitters' antenna and test receiving antenna placed in vertical and horizontal polarization. Both readings with the antennas placed in vertical and horizontal polarization shall be recorded.
(l) Repeat for all different test signal frequencies

8.2.2. Measuring the EIRP of Spurious/Harmonic Emissions using Substitution Method

(a) Set the EMI Receiver (for measuring E-Field) and Receiver #2 (for measuring EIRP) as follows:

Center Frequency:	equal to the signal source
Resolution BW:	10 kHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(b) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(c) Select the frequency and E-field levels obtained in the Section 8.2.1 for ERP/EIRP measurements.
(d) Substitute the EUT by a signal generator and one of the following transmitting antenna (substitution antenna):
- ♦ DIPOLE antenna for frequency from 30-1000 MHz or
- ♦ HORN antenna for frequency above 1 GHz }.

(e) Mount the transmitting antenna at 1.5 meter high from the ground plane.
(f) Use one of the following antenna as a receiving antenna:
- ♦ DIPOLE antenna for frequency from 30-1000 MHz or
- ♦ HORN antenna for frequency above 1 GHz }.

(g) If the DIPOLE antenna is used, tune it's elements to the frequency as specified in the calibration manual.
(h) Adjust both transmitting and receiving antenna in a VERTICAL polarization.
(i) Tune the EMI Receivers to the test frequency.
(j) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(k) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(l) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(m) Adjust input signal to the substitution antenna until an equal or a known related level to that detected from the transmitter was obtained in the test receiver.
(n) Record the power level read from the Average Power Meter and calculate the ERP/EIRP as follows:

P = P1 - L1 = (P2 + L2) – L1 = P3 + A + L2 - L1
EIRP = P + G1 = P3 + L2 - L1 + A + G1
ERP = EIRP – 2.15 dB
Total Correction factor in EMI Receiver # 2 = L2 – L1 + G1

Where:	P:	Actual RF Power fed into the substitution antenna port after corrected.
	P1:	Power output from the signal generator
	P2:	Power measured at attenuator A input
	P3:	Power reading on the Average Power Meter
	EIRP:	EIRP after correction
	ERP:	ERP after correction

(o) Adjust both transmitting and receiving antenna in a HORIZONTAL polarization, then repeat step (k) to (o)
(p) Repeat step (d) to (o) for different test frequency
(q) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.
(r) Actual gain of the EUT's antenna is the difference of the measured EIRP and measured RF power at the RF port. Correct the antenna gain if necessary.

Figure 2

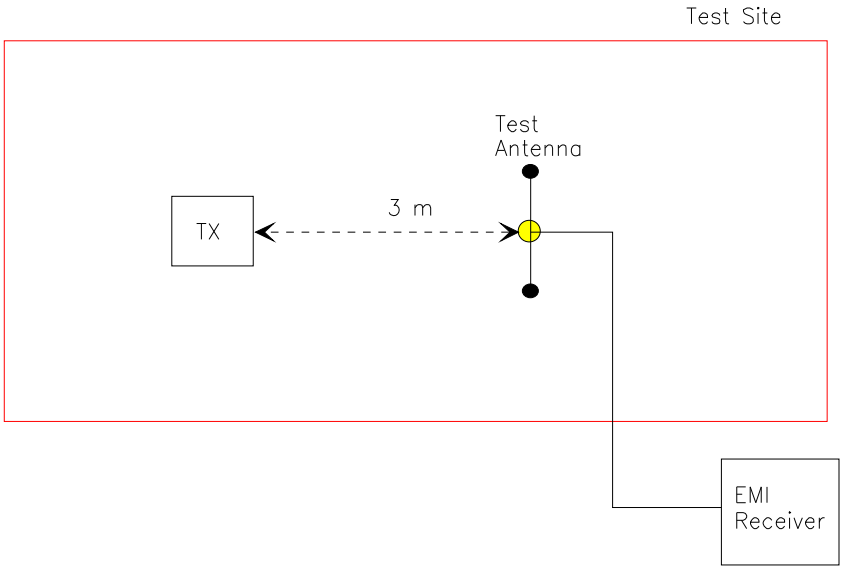
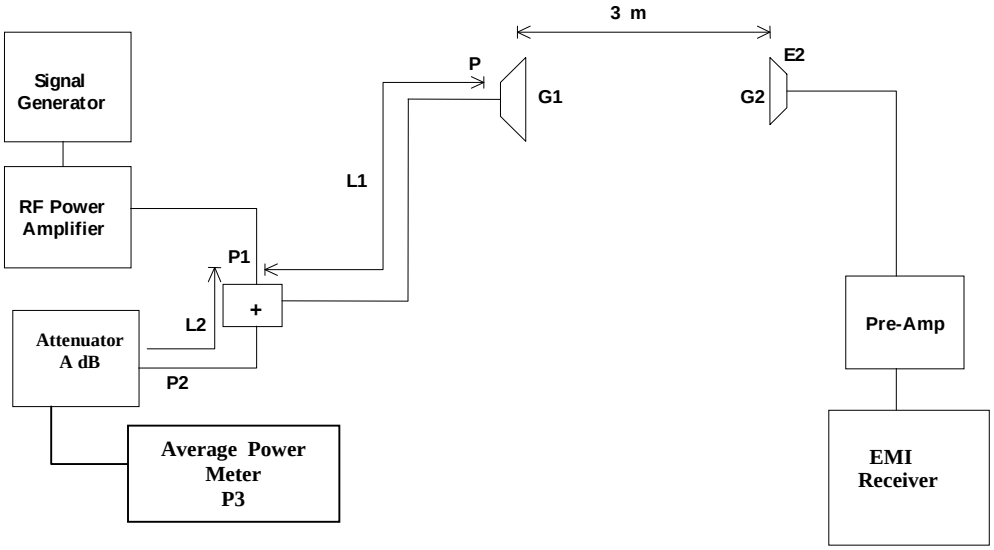


Figure 3



- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*