



**Nemko Test Report:** 9372RUS2

**Applicant:** Andrew Corporation  
108 Rand Park Drive  
Garner, NC 27529  
USA

**Equipment Under Test:** TFAH-US5B  
**(E.U.T.)**

**In Accordance With:** **CFR 47, Part 22, Subpart H**  
Cellular Band Repeaters

**Tested By:** Nemko USA Inc.  
802 N. Kealy  
Lewisville, TX  
75057-3136

**TESTED BY:**

A handwritten signature in black ink that appears to read "David Light".

David Light, Senior Wireless Engineer

**DATE:** 09 January, 2008

**APPROVED BY:**

A handwritten signature in blue ink that appears to read "Tom Tidwell".

Tom Tidwell, Telecom Direct

**DATE:** 09 January, 2008

**Number of Pages:** 48

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**Section 1. Summary of Test Results**

Manufacturer Andrew Corporation

Model No.: TFAH-US5B

Serial No.: 074405615

General: **All measurements are traceable to national standards.**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with CFR 47, Part 22, Subpart H.



New Submission



Production Unit



Class II Permissive Change



Pre-Production Unit

**THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.**

**THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE.**

See "Summary of Test Data".



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**Summary Of Test Data**

NAME OF TEST	PARA. NO.	SPEC.	RESULT
RF Power Output	22.913(a)	500W ERP	Complies
Occupied Bandwidth	Not defined	Input/Output	Complies
Spurious Emissions at Antenna Terminals	22.917	-13 dBm	Complies
Field Strength of Spurious Emissions	22.917	-13 dBm E.I.R.P.	Complies
Frequency Stability	22.355	1.5 ppm	NA

**Footnotes:**

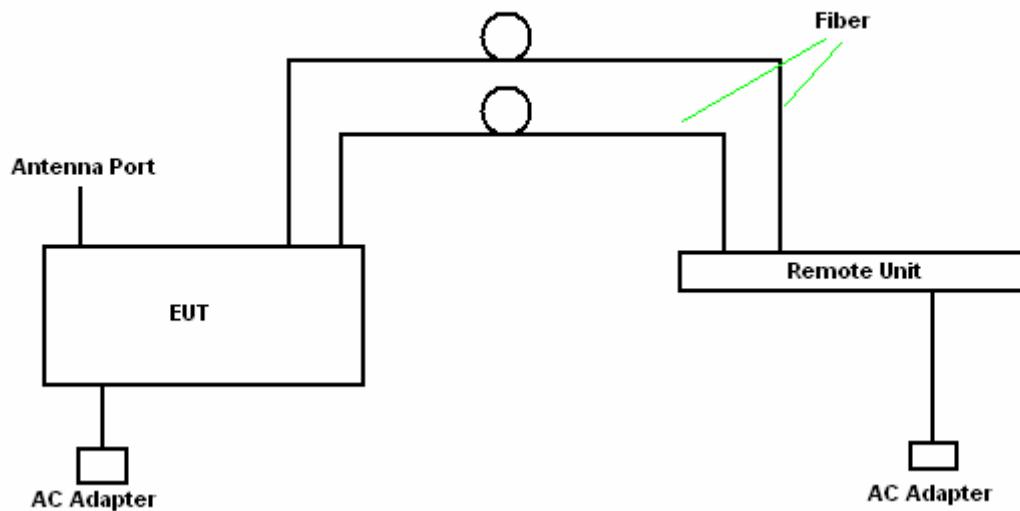
- (1) Modulation characteristics were not tested since the E.U.T. processes, but does not produce a modulated waveform.
- (2) Frequency stability was not tested since the E.U.T. does not perform frequency translation of the input signal.

**Section 2. General Equipment Specification**

<b>Supply Voltage Input:</b>	120 Vac				
<b>Frequency Range:</b>	Downlink: 869 to 894 MHz				
<b>Frequency Range:</b>	Uplink: NA				
<b>Type of Modulation and Designator:</b>	CDMA (F9W)    GSM (GXW)    Analog Cellular (F3E/F8W)    EDGE (G7W)    W-CDMA (F9W)				
<b>Output Impedance:</b>	50 ohms				
<b>RF Output (Rated):</b>	Downlink: 1.25 W (max) 31 dBm (max) Uplink: NA W NA dBm				
<b>Frequency Translation:</b>	F1-F1 <input checked="" type="checkbox"/> F1-F2 <input type="checkbox"/> N/A <input type="checkbox"/>				
<b>Band Selection:</b>	Software <input type="checkbox"/>	Duplexer Change <input type="checkbox"/>	Fullband Coverage <input checked="" type="checkbox"/>		

**Description of EUT**

The TFAH-US5B is a five band high power remote unit designed to distribute LMR800, Cellular850, LMR900, AWS1700, and Extended PCS1900 band signals along the same fiber.

**System Diagram**

**Section 3. RF Power Output**

NAME OF TEST: RF Power Output	PARA. NO.: 22.913
TESTED BY: David Light	DATE: 08 January 2008

**Test Results:** Complies.**Test Data:**

Direction	Modulation	Output per Channel (dBm)	Composite Power (dBm)	Composite Power (W)
Downlink	CDMA	26*	29	0.8
Downlink	Analog	28*	31	1.25
Downlink	EDGE	28*	31	1.25
Downlink	GSM	28*	31	1.25
Downlink	W-CDMA	25*	27	0.5

\* Based on two carriers

**Equipment Used:** 1036-1082-1471-1472**Measurement Uncertainty:** +/- 1.7 dB**Temperature:** 22 °C**Relative Humidity:** 35 %

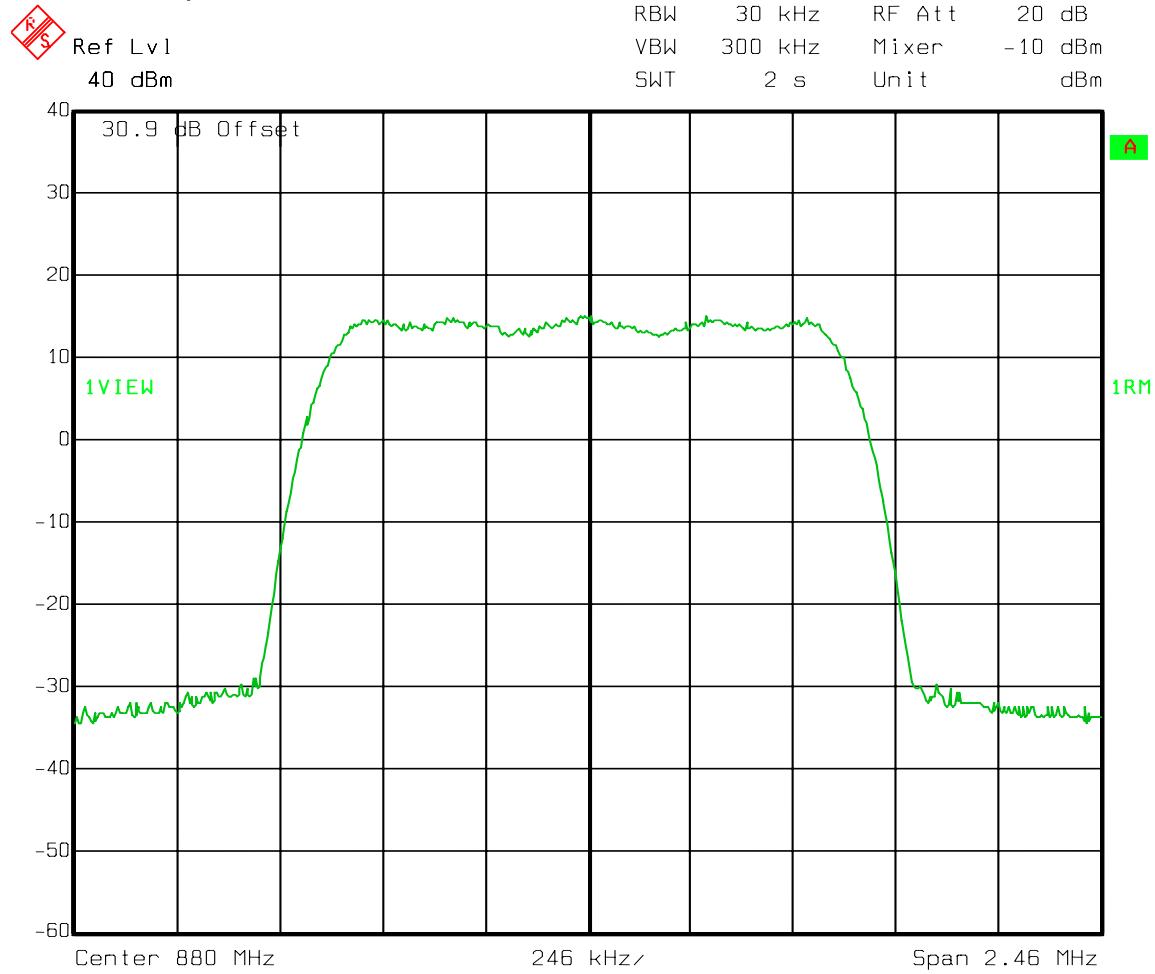
**Section 4. Occupied Bandwidth**

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.1049
TESTED BY: David Light	DATE: 08 January 2008

**Test Results:** Complies.**Test Data:** See attached plot(s).**Equipment Used:** 1036-1082-1471-1472**Measurement Uncertainty:** 1X10<sup>-7</sup> ppm**Temperature:** 22 °C**Relative Humidity:** 35 %

**Test Data – Occupied Bandwidth**

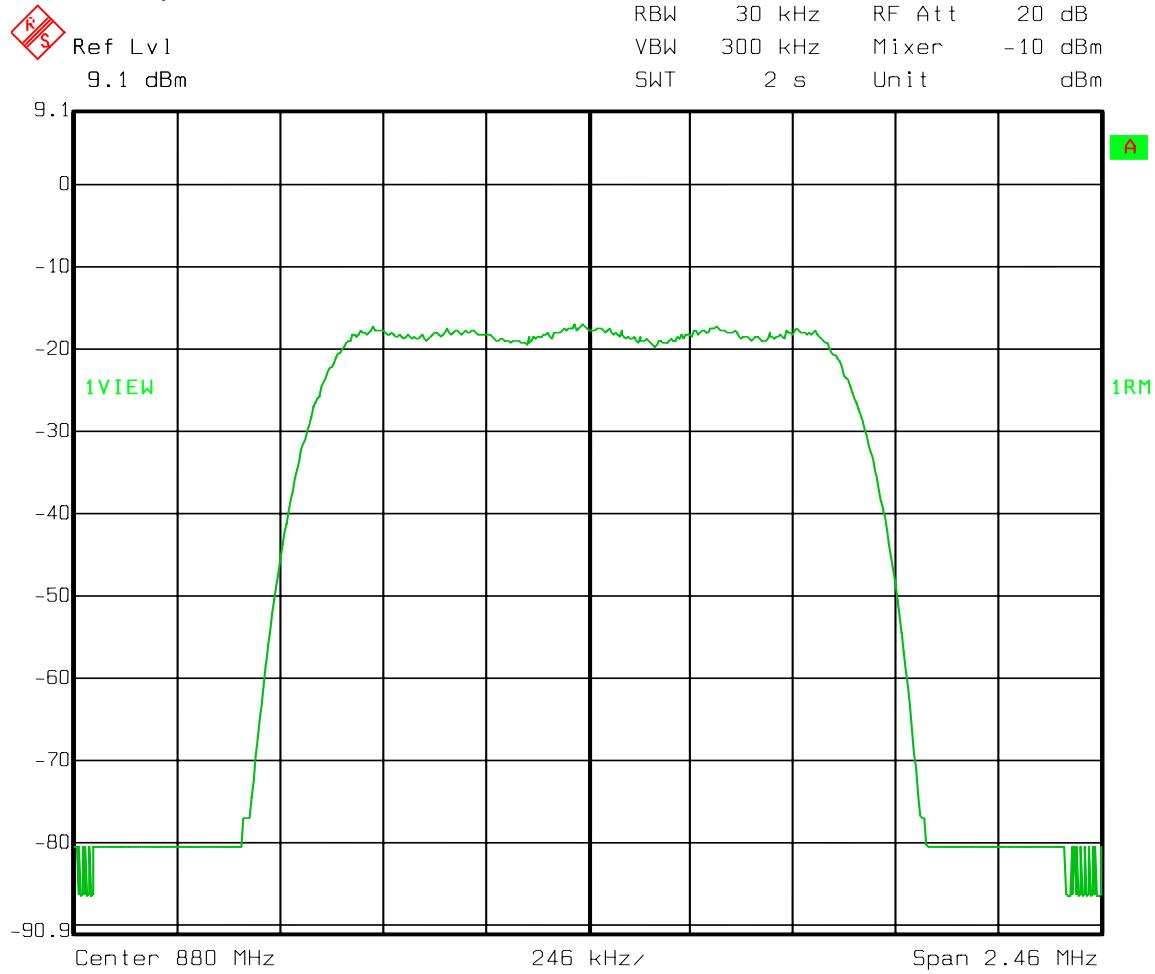
## CDMA - Output



Date: 07.JAN.2008 15:09:40

**Test Data – Occupied Bandwidth**

CDMA - Input

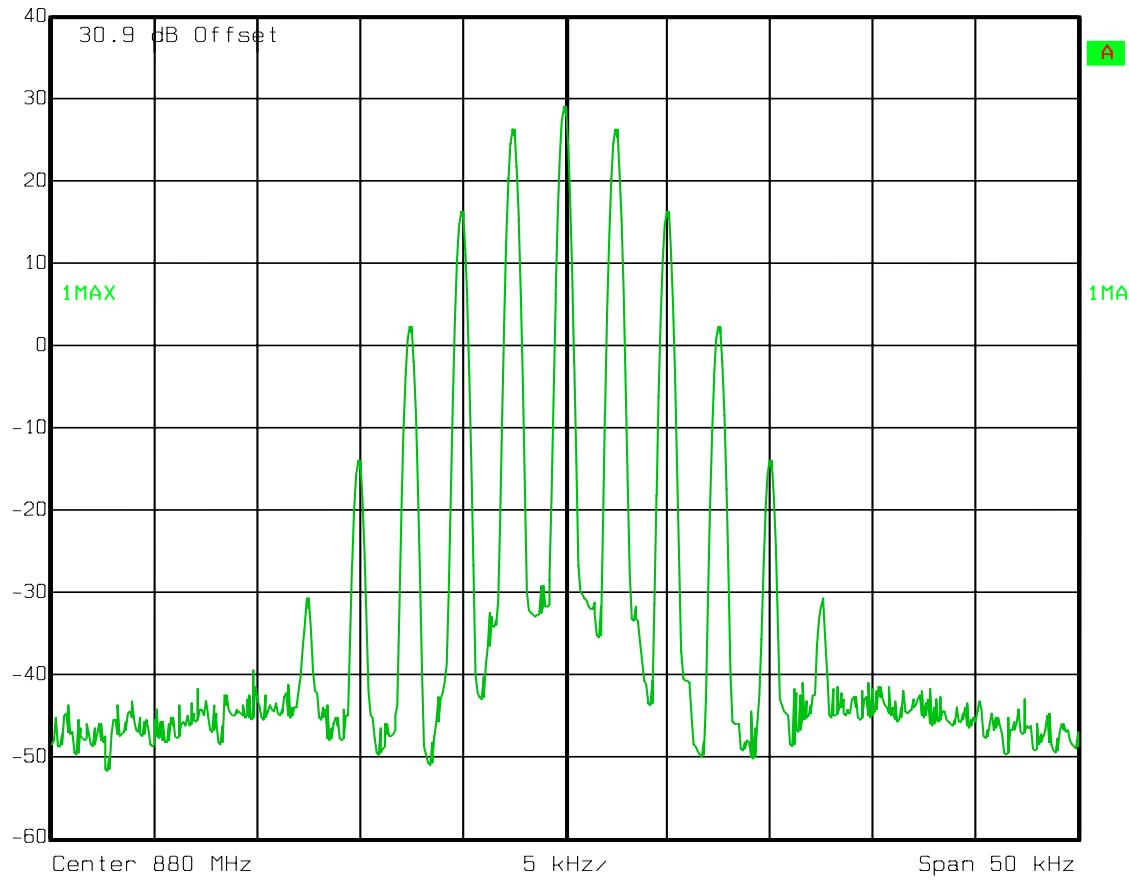


Date: 07.JAN.2008 15:11:09

**Test Data – Occupied Bandwidth**

Analog - Output

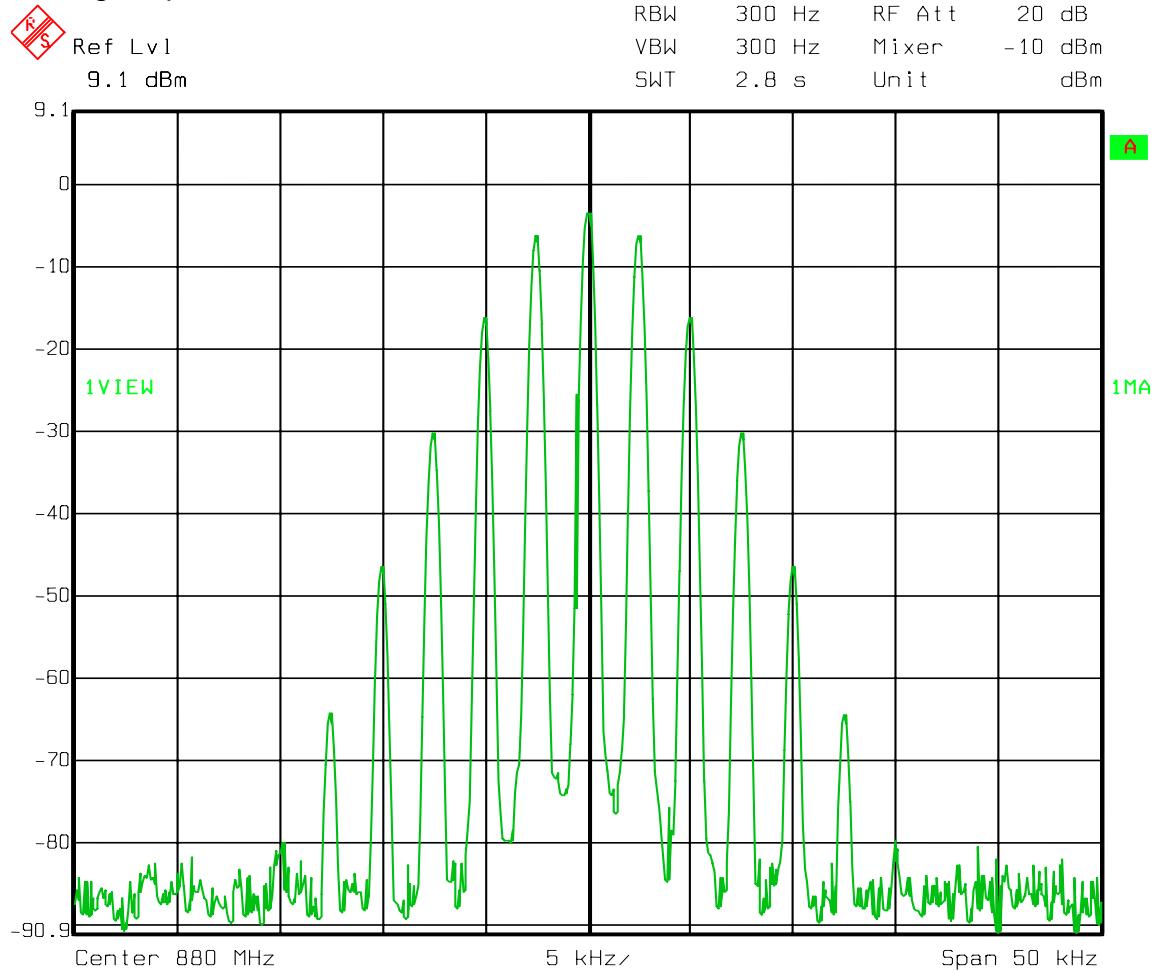
2.5 kHz tone / 3 kHz peak deviation

Ref Lvl  
40 dBmRBW 300 Hz RF Att 20 dB  
VBW 300 Hz Mixer -10 dBm  
SWT 2.8 s Unit dBm

Date: 07.JAN.2008 15:39:37

**Test Data – Occupied Bandwidth**

## Analog - Input



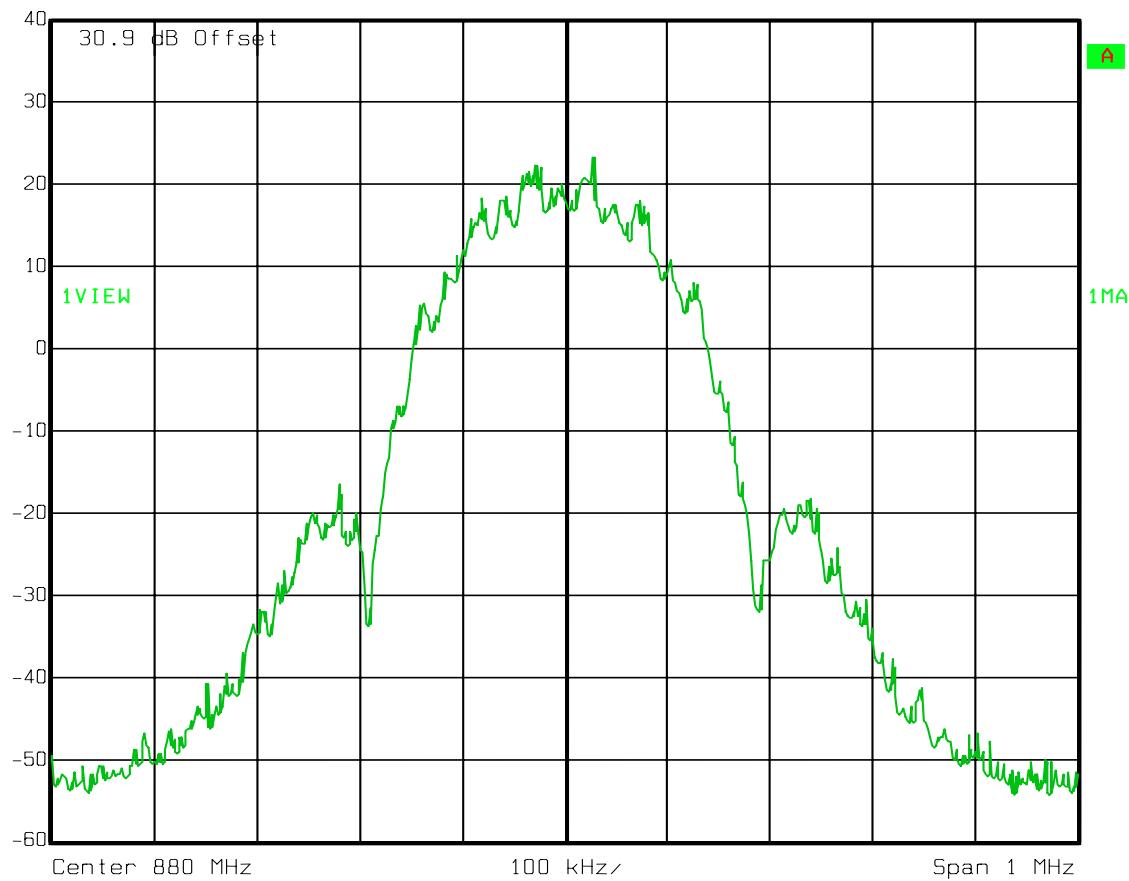
Date: 07.JAN.2008 15:38:37

**Test Data – Occupied Bandwidth**

EDGE - Output

Ref Lvl  
40 dBmRBW 3 kHz  
VBW 3 kHz  
SWT 280 ms

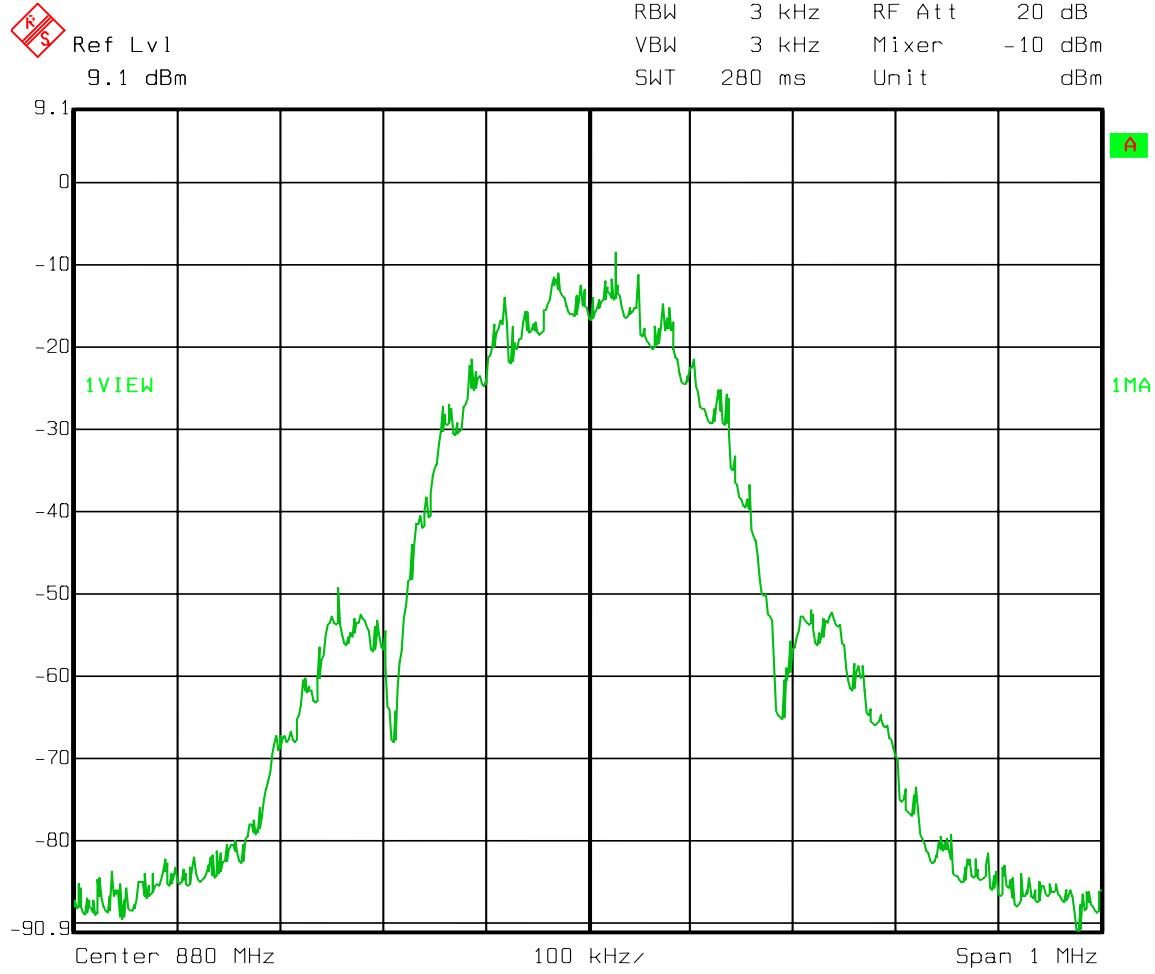
RF Att Mixer Unit

20 dB  
-10 dBm  
dBm

Date: 07.JAN.2008 14:56:51

**Test Data – Occupied Bandwidth**

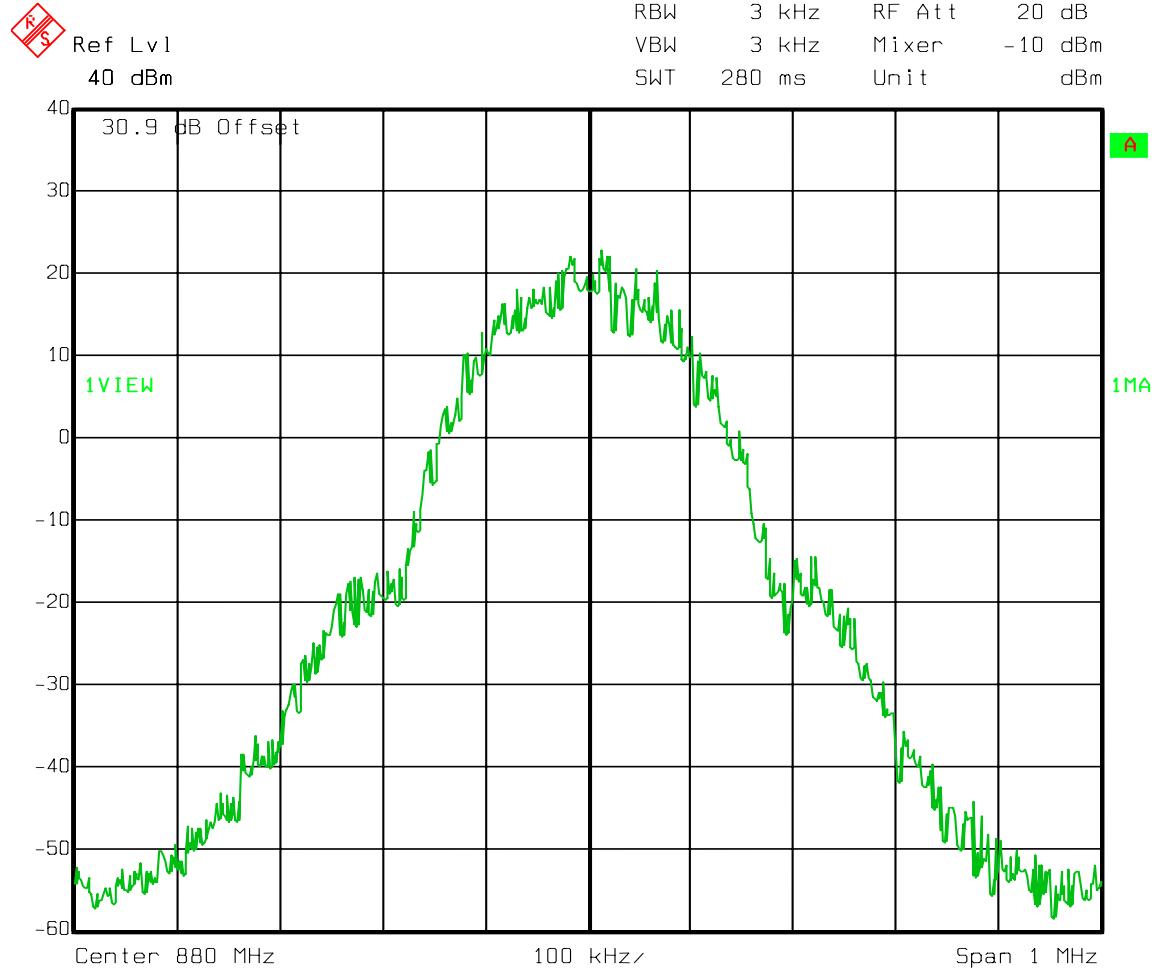
EDGE - Input



Date: 07.JAN.2008 14:58:04

**Test Data – Occupied Bandwidth**

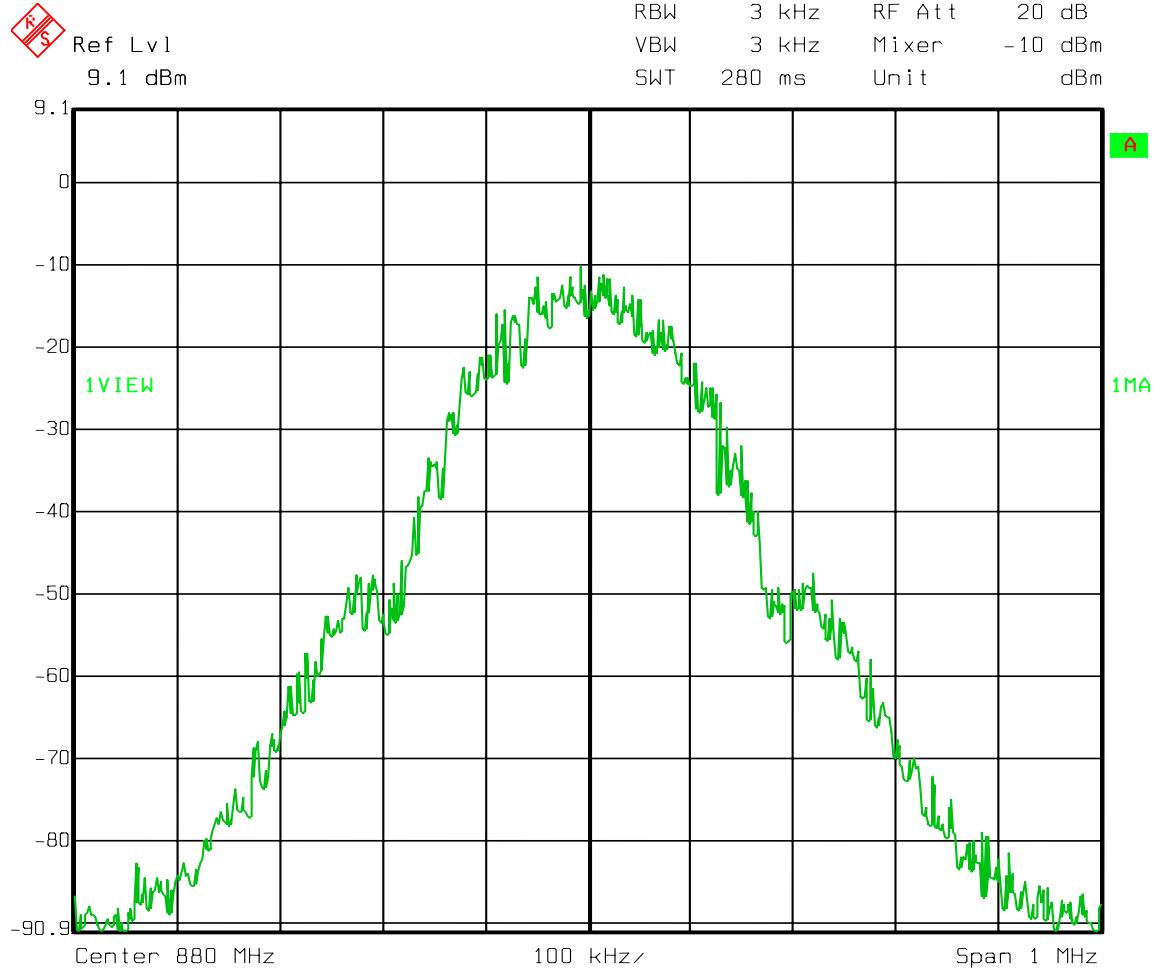
GSM - Output



Date: 07.JAN.2008 15:00:07

**Test Data – Occupied Bandwidth**

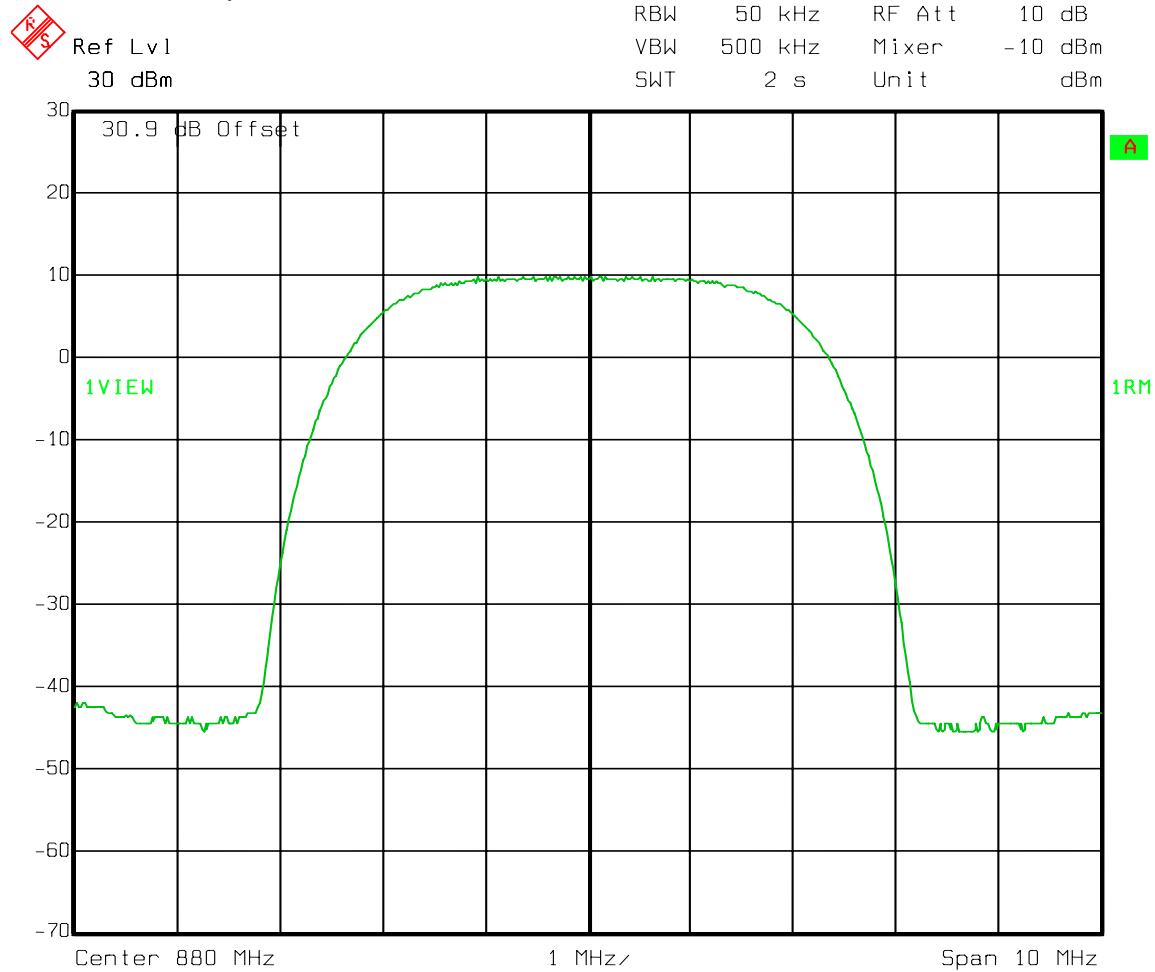
GSM - Input



Date: 07.JAN.2008 15:01:33

**Test Data – Occupied Bandwidth**

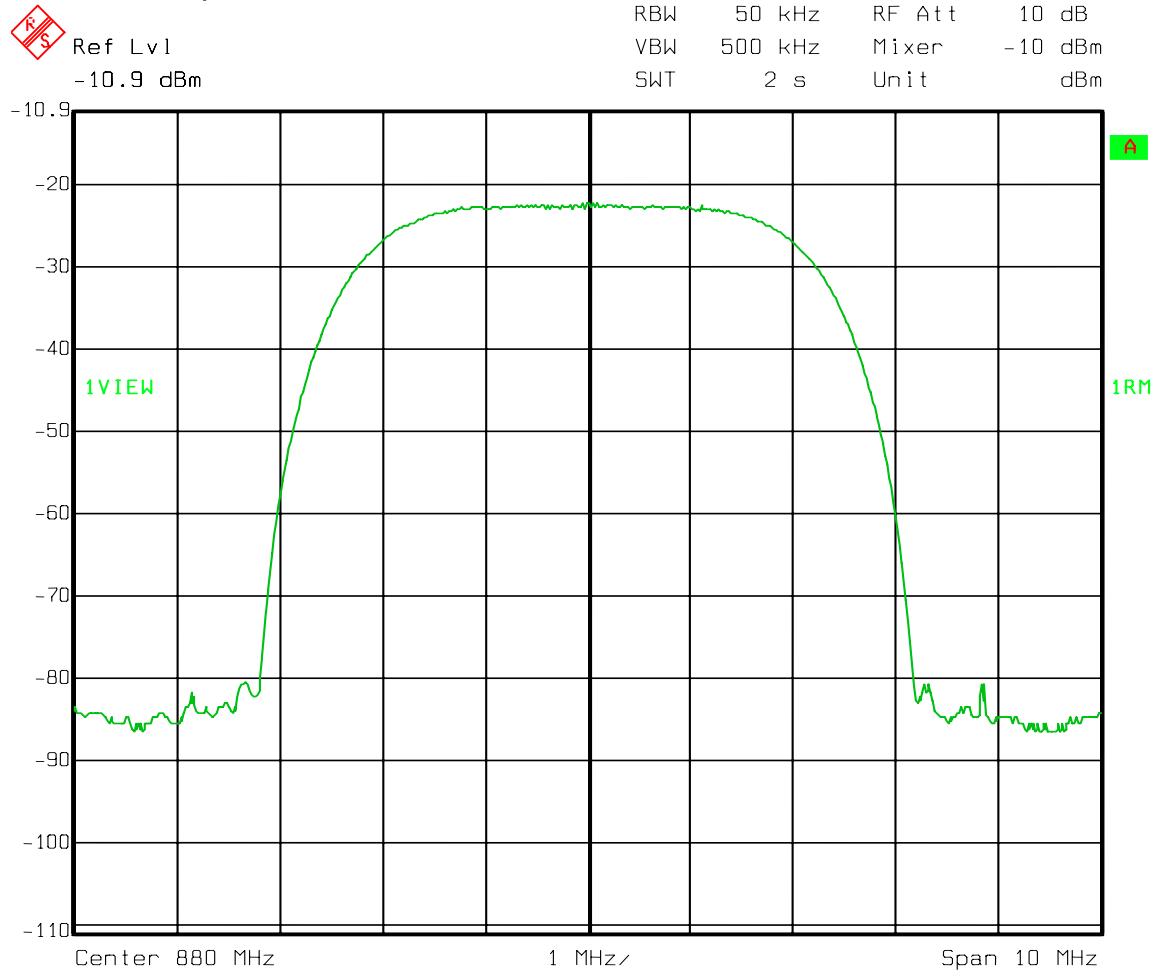
## W-CDMA - Output



Date: 08.JAN.2008 13:33:26

**Test Data – Occupied Bandwidth**

W-CDMA - Input



Date: 08.JAN.2008 13:34:31

**Section 5. Spurious Emissions at Antenna Terminals**

NAME OF TEST: Spurious Emissions @ Antenna Port	PARA. NO.: 22.917
TESTED BY: David Light	DATE: 08 January 2008

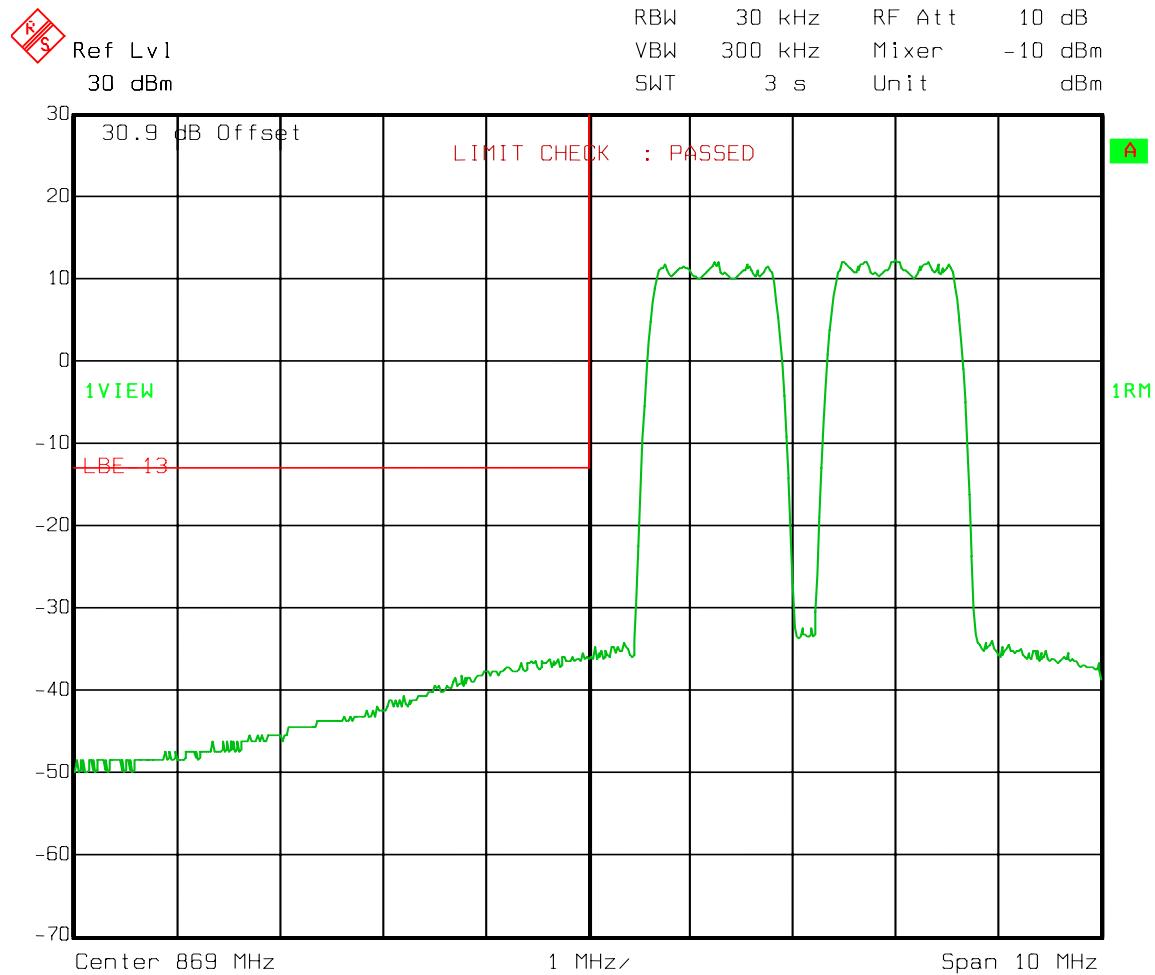
**Test Results:** Complies.**Test Data:** See attached plot(s).**Equipment Used:** 1036-1082-1471-1472**Measurement Uncertainty:**  +/- 1.7  dB**Temperature:**  22  °C**Relative Humidity:**  35  %

**Test Data – Spurious Emissions at Antenna Terminals**

Lower Bandedge Intermodulation

CDMA

Downlink



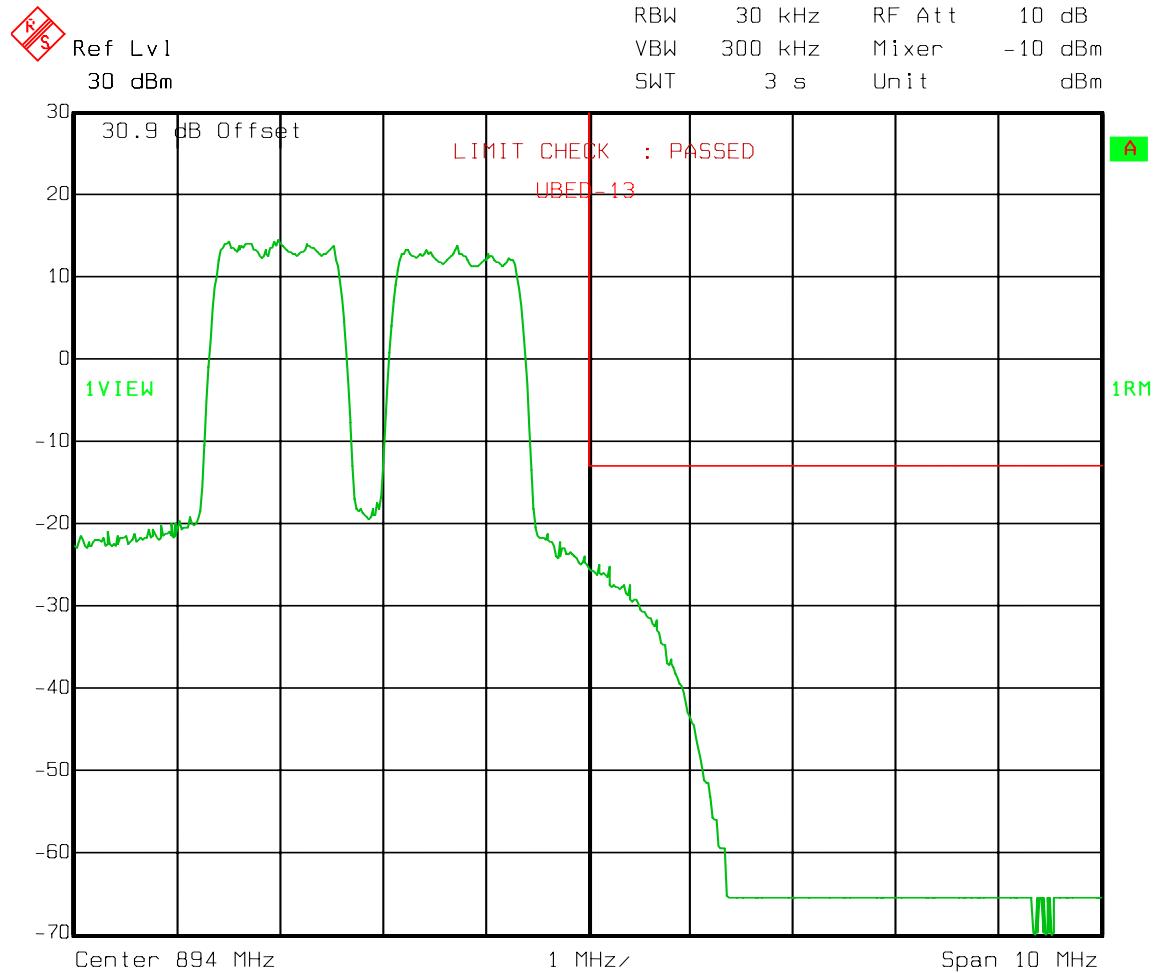
Date: 07.JAN.2008 15:17:34

**Test Data – Spurious Emissions at Antenna Terminals**

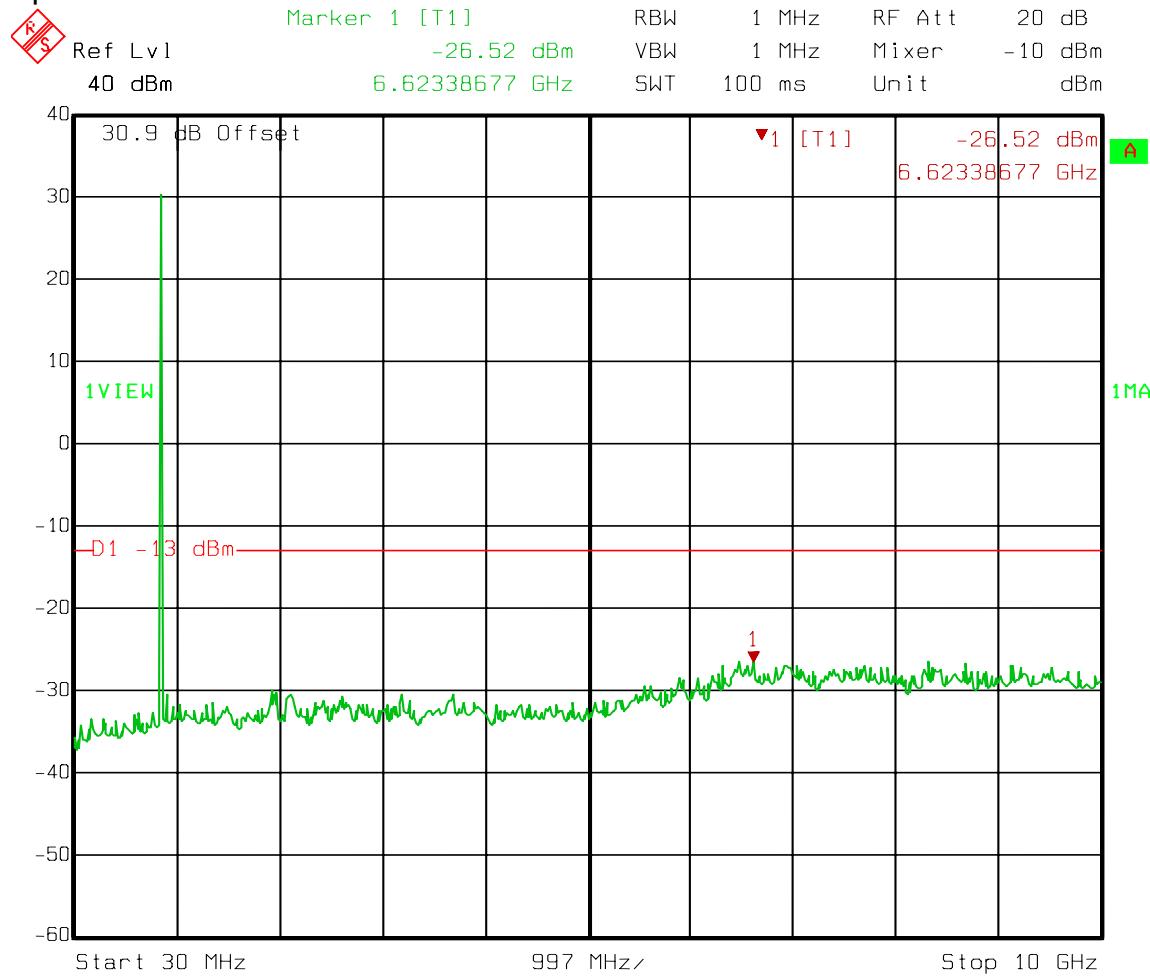
Upper Bandedge Intermodulation

CDMA

Downlink



Date: 07.JAN.2008 15:22:46

**Test Data – Spurious Emissions at Antenna Terminals****Spurs – CDMA - Downlink**

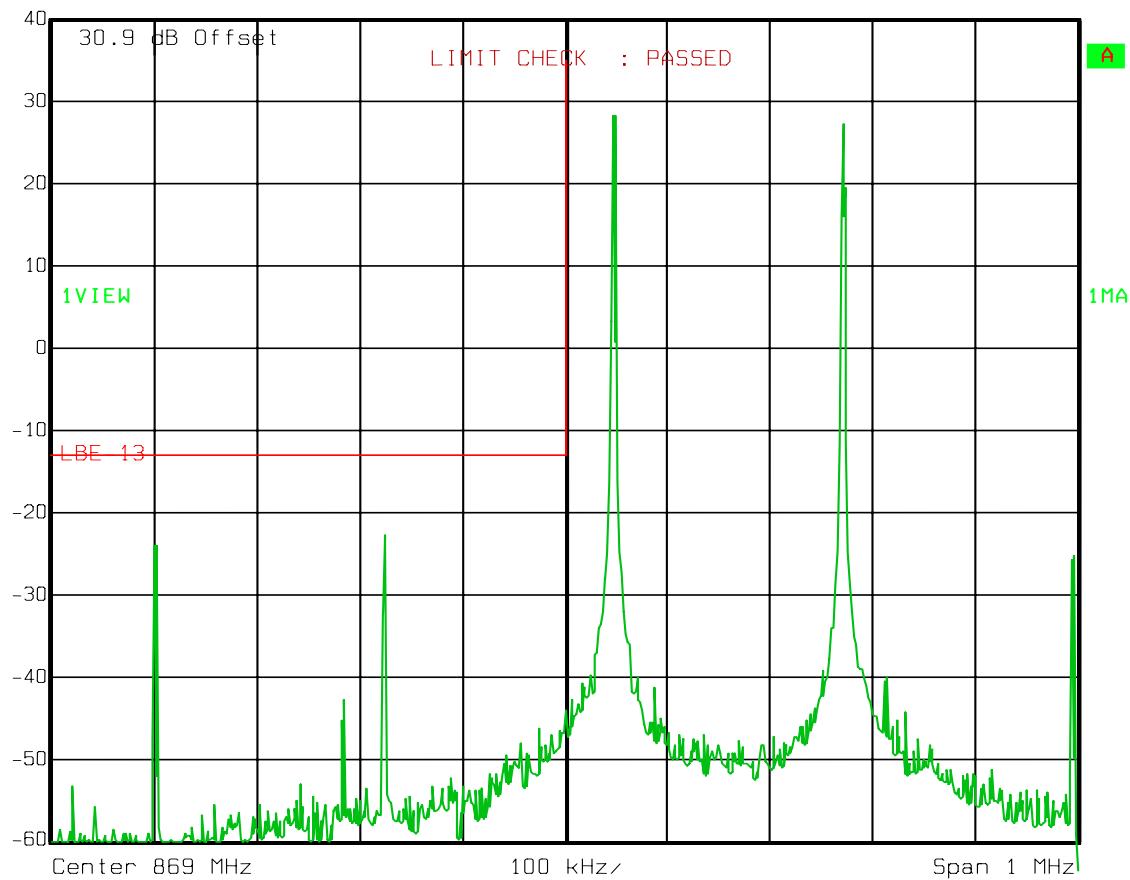
Date: 07.JAN.2008 15:12:50

**Test Data – Spurious Emissions at Antenna Terminals**

Lower Bandedge Intermodulation

Analog

Downlink

Ref Lvl  
40 dBmRBW 1 kHz RF Att 20 dB  
VBW 1 kHz Mixer -10 dBm  
SWT 2.5 s Unit dBm

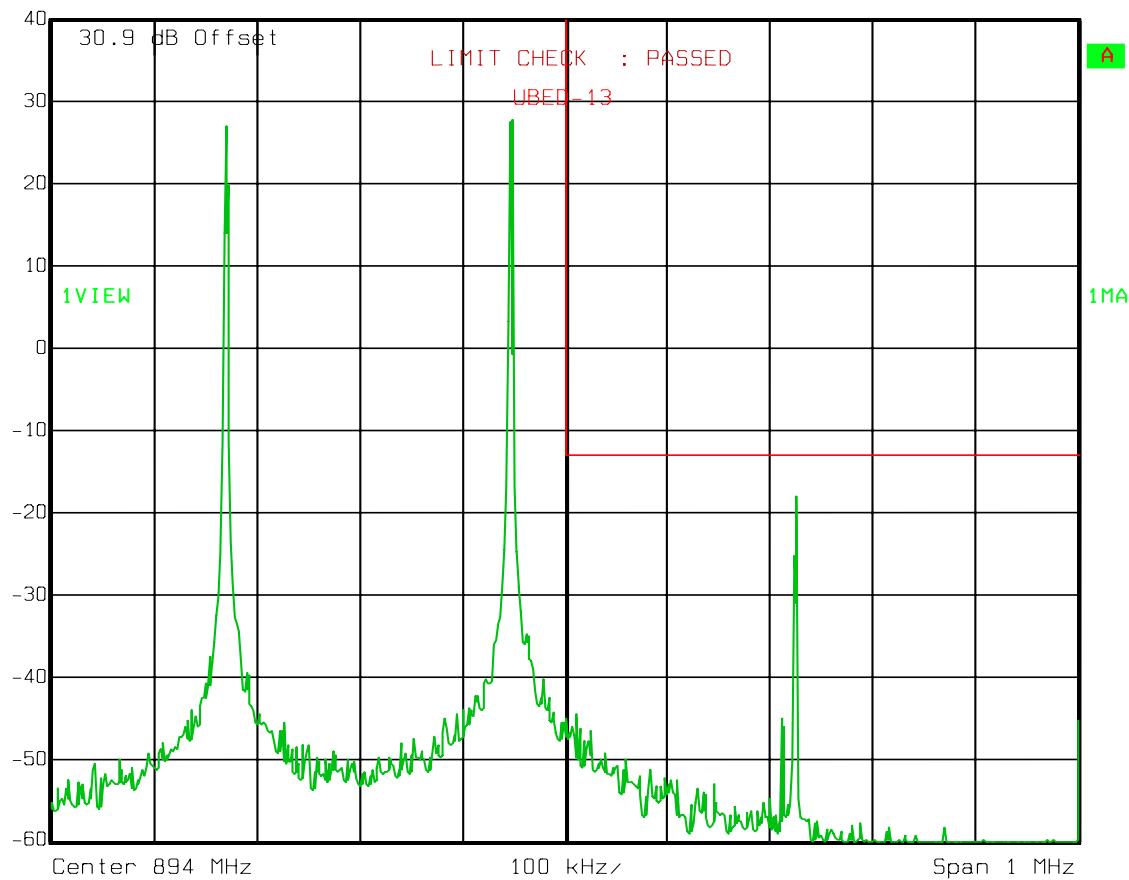
Date: 07.JAN.2008 15:44:18

**Test Data – Spurious Emissions at Antenna Terminals**

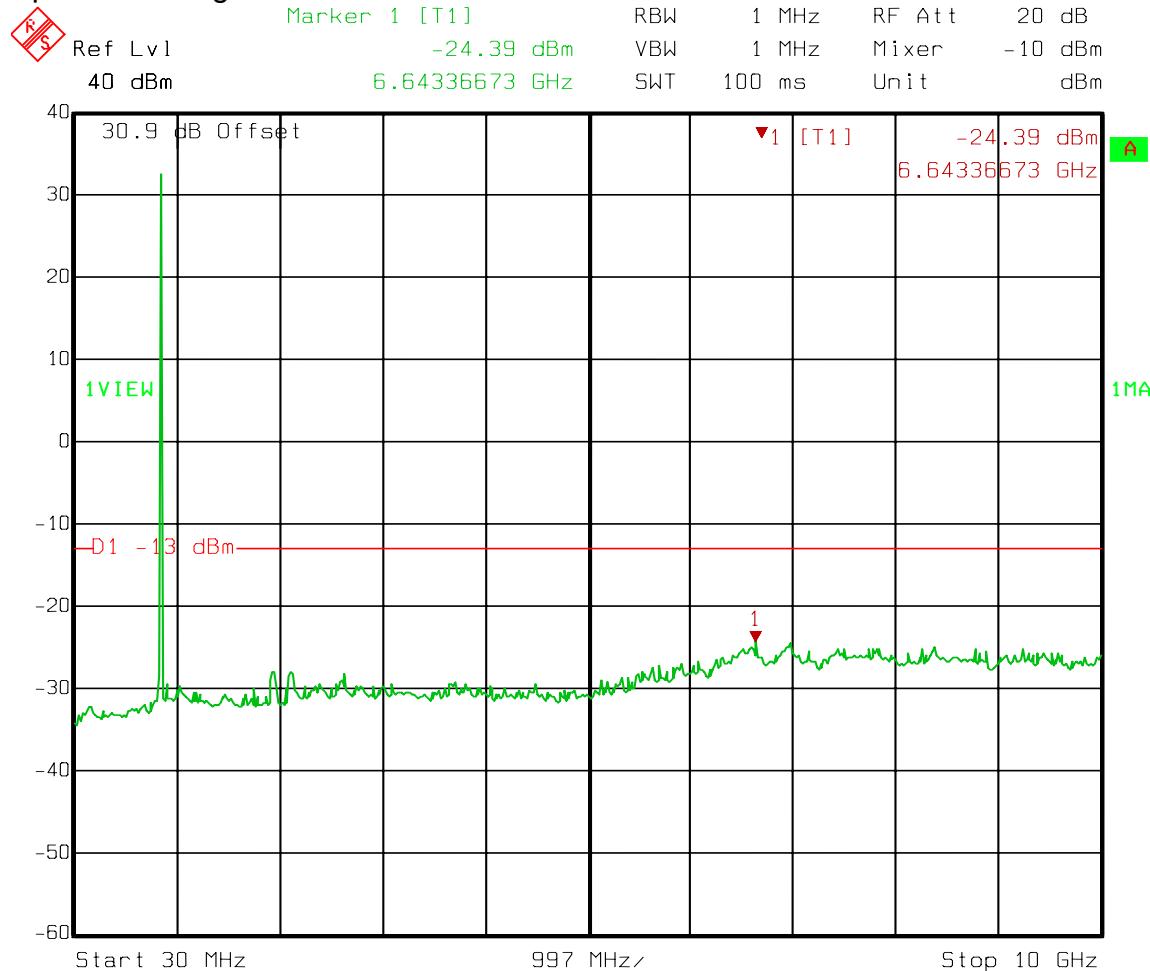
Upper Bandedge Intermodulation

Analog

Downlink

Ref Lvl  
40 dBmRBW 1 kHz RF Att 20 dB  
VBW 1 kHz Mixer -10 dBm  
SWT 2.5 s Unit dBm

Date: 07.JAN.2008 15:46:05

**Test Data – Spurious Emissions at Antenna Terminals****Spurs – Analog - Downlink**

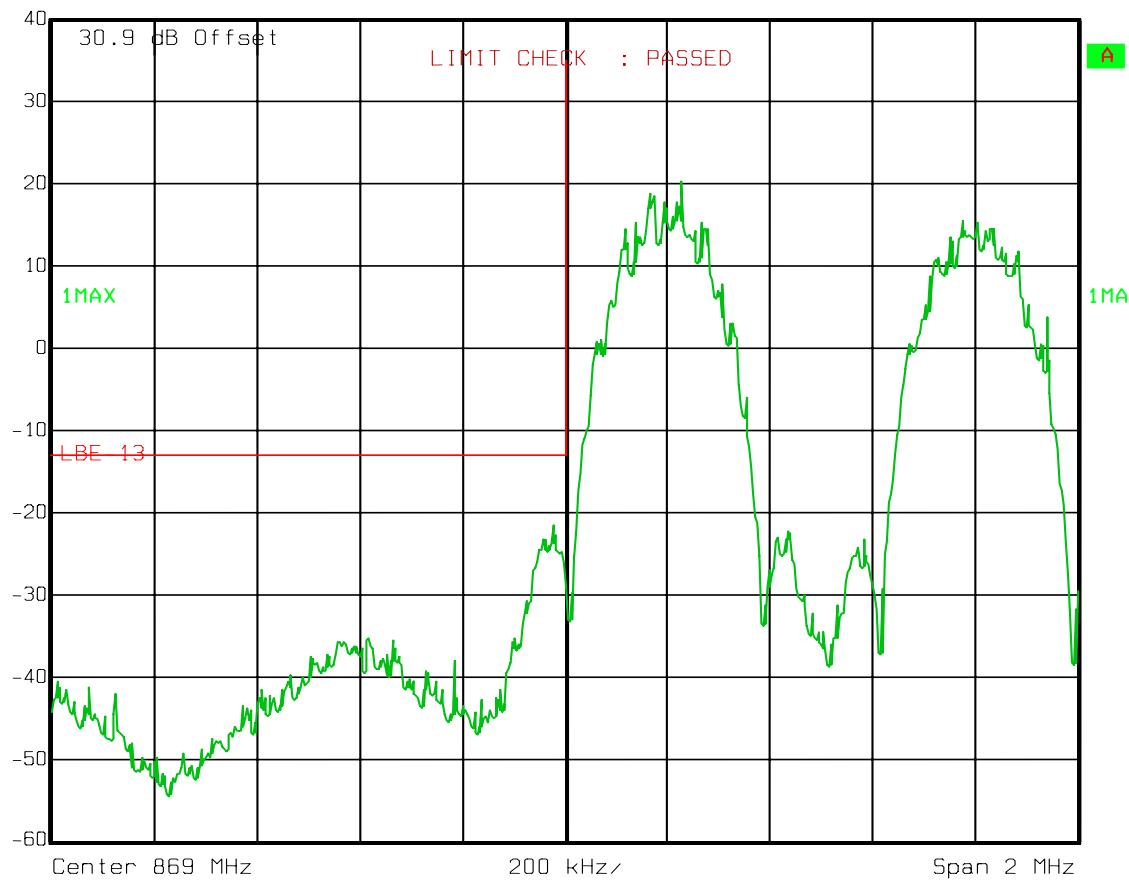
Date: 07.JAN.2008 15:41:12

**Test Data – Spurious Emissions at Antenna Terminals**

Lower Bandedge Intermodulation

EDGE

Downlink

Ref Lvl  
40 dBmRBW 3 kHz RF Att 20 dB  
VBW 3 kHz Mixer -10 dBm  
SWT 560 ms Unit dBm

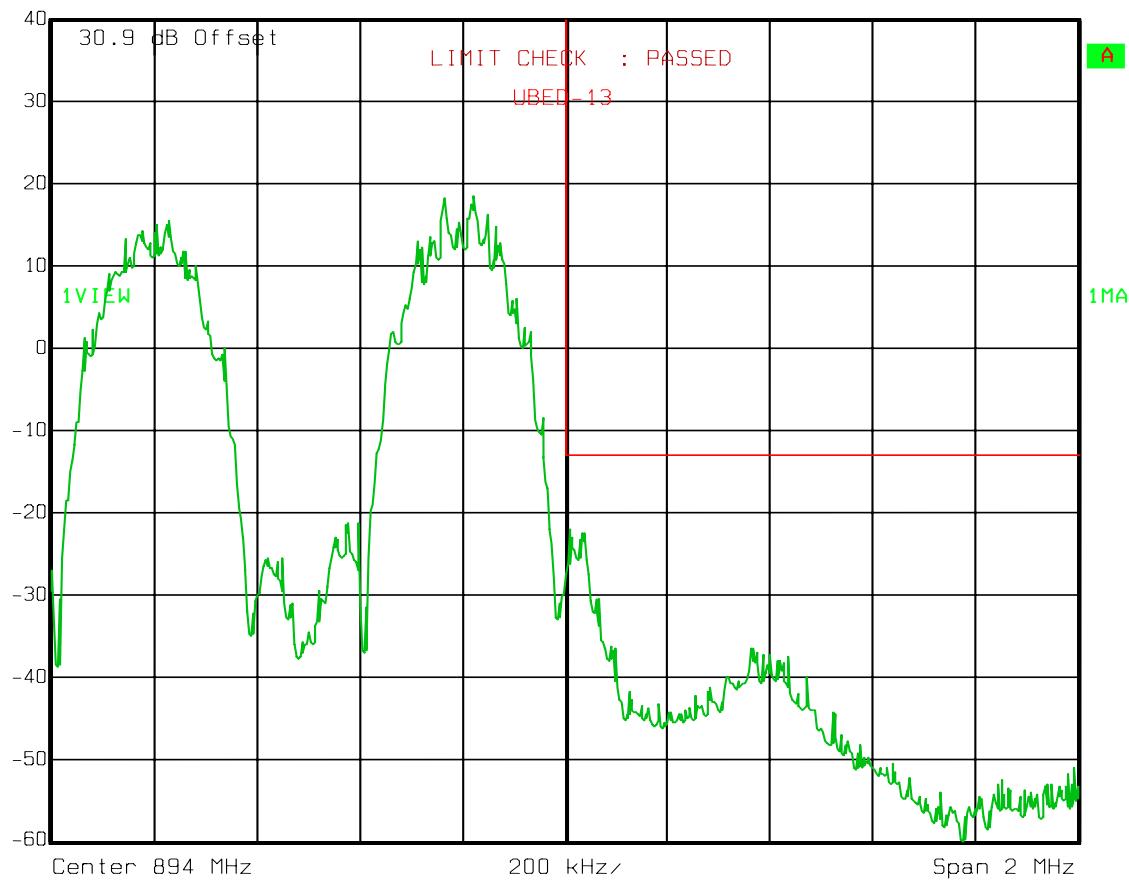
Date: 07.JAN.2008 14:54:46

**Test Data – Spurious Emissions at Antenna Terminals**

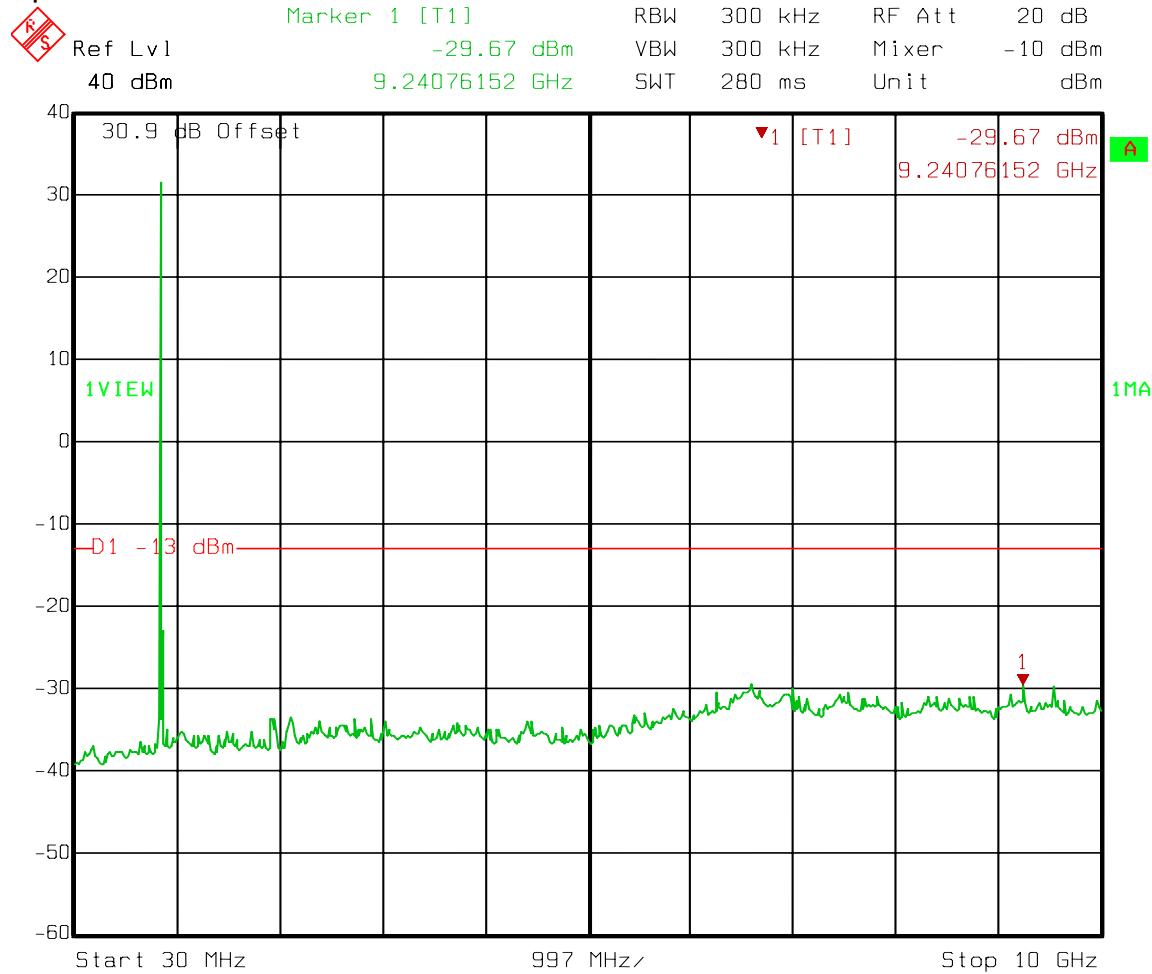
Upper Bandedge Intermodulation

EDGE

Downlink

Ref Lvl  
40 dBmRBW 3 kHz RF Att 20 dB  
VBW 3 kHz Mixer -10 dBm  
SWT 560 ms Unit dBm

Date: 07.JAN.2008 14:52:57

**Test Data – Spurious Emissions at Antenna Terminals****Spurs – EDGE - Downlink**

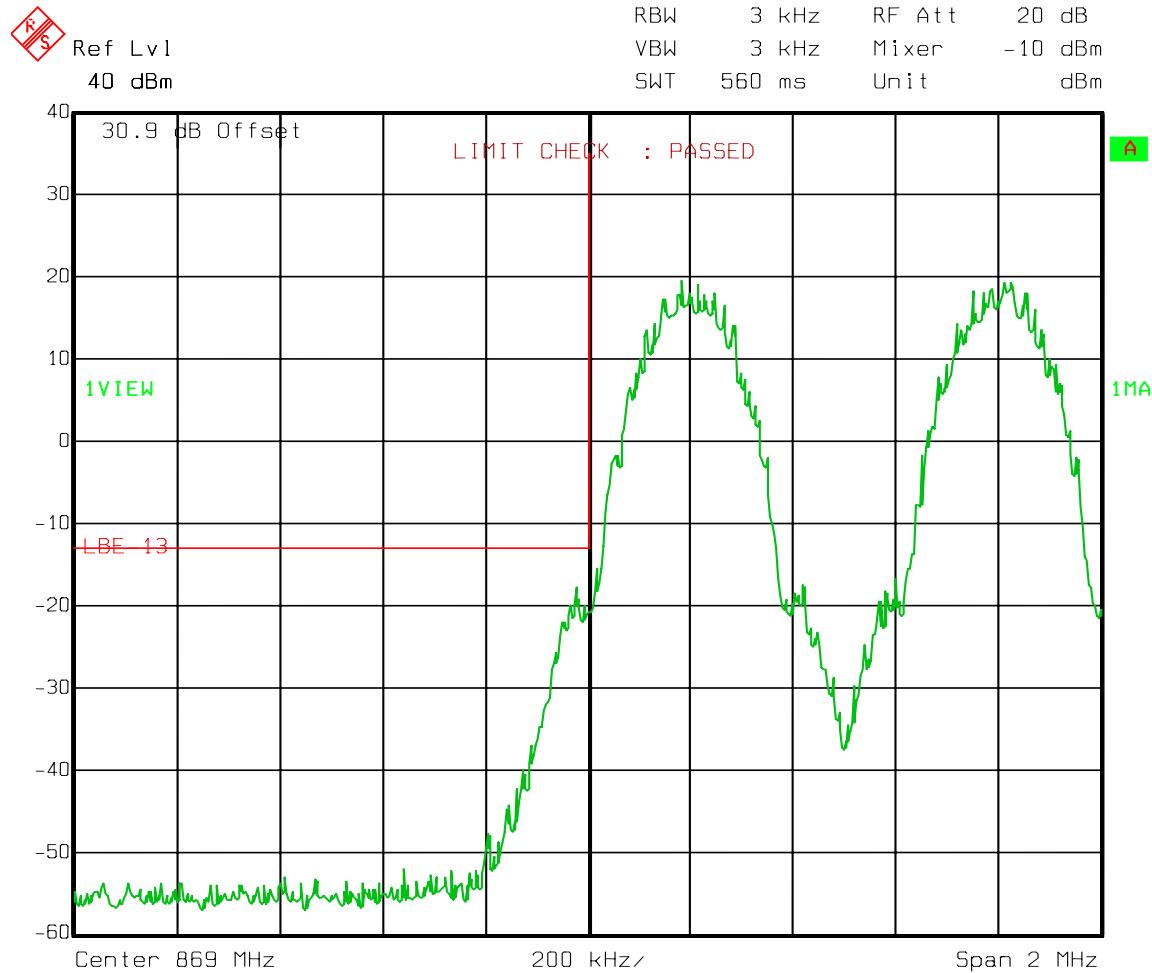
Date: 07.JAN.2008 14:56:12

**Test Data – Spurious Emissions at Antenna Terminals**

Lower Bandedge Intermodulation

GSM

Downlink

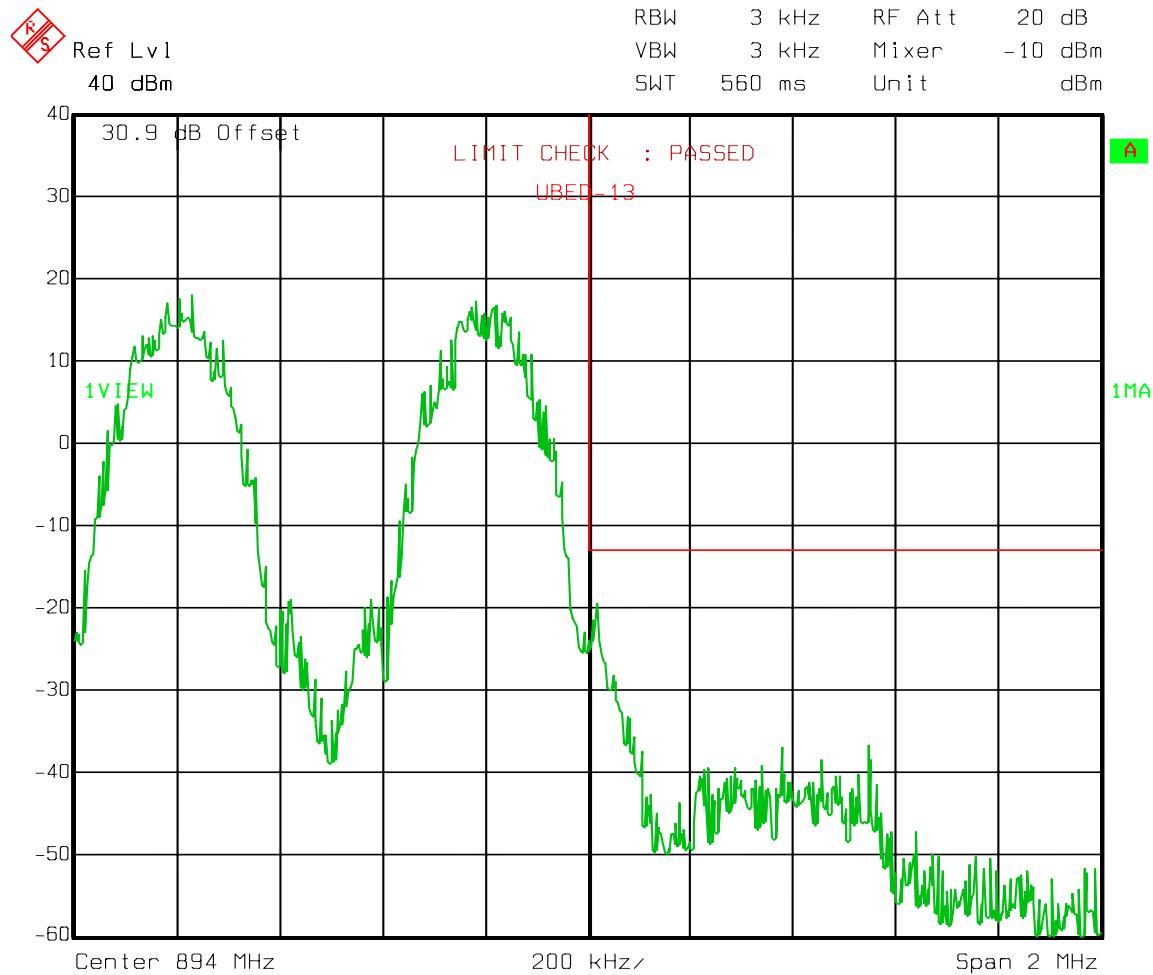


**Test Data – Spurious Emissions at Antenna Terminals**

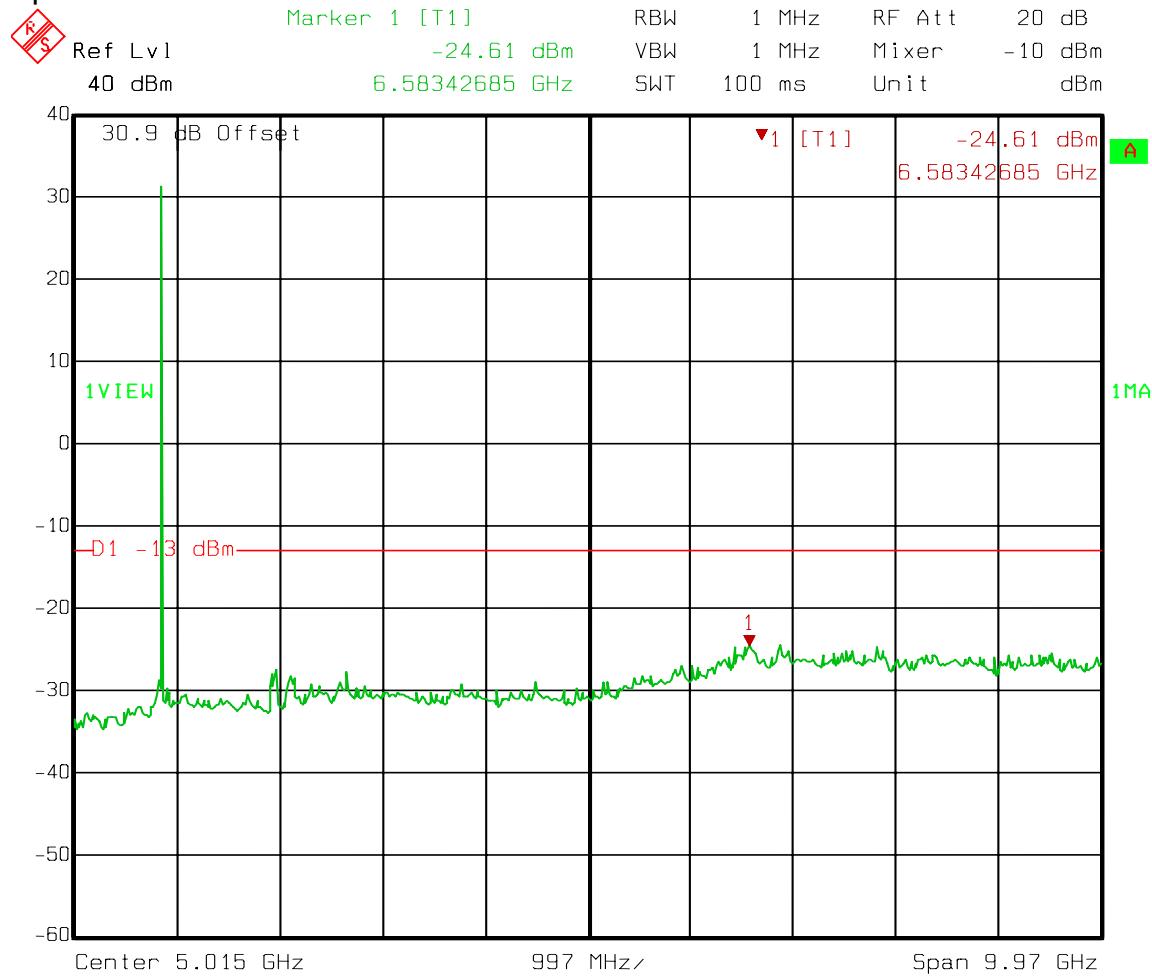
Upper Bandedge Intermodulation

GSM

Downlink



Date: 07.JAN.2008 15:06:49

**Test Data – Spurious Emissions at Antenna Terminals****Spurs – GSM - Downlink**

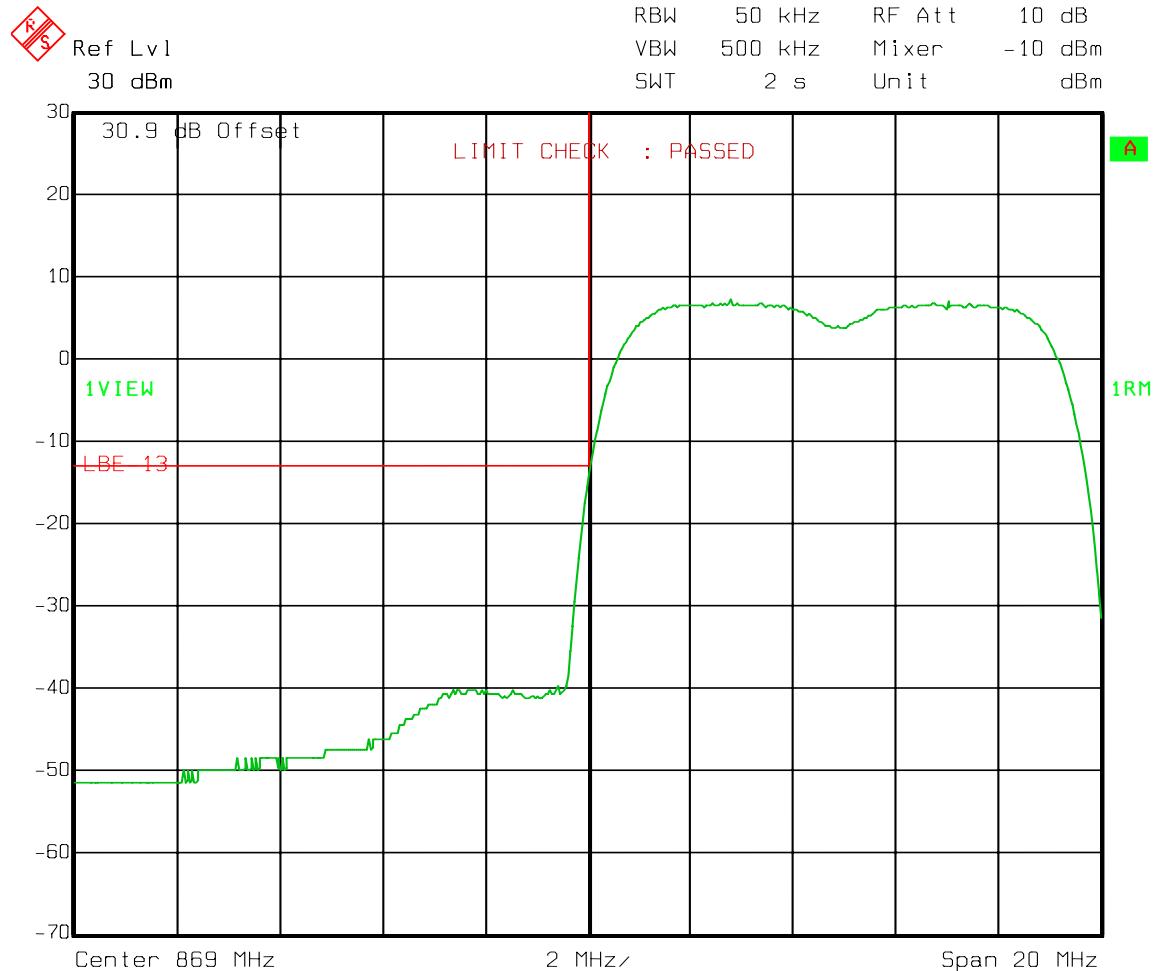
Date: 07.JAN.2008 15:02:54

**Test Data – Spurious Emissions at Antenna Terminals**

Lower Bandedge Intermodulation

W-CDMA

Downlink



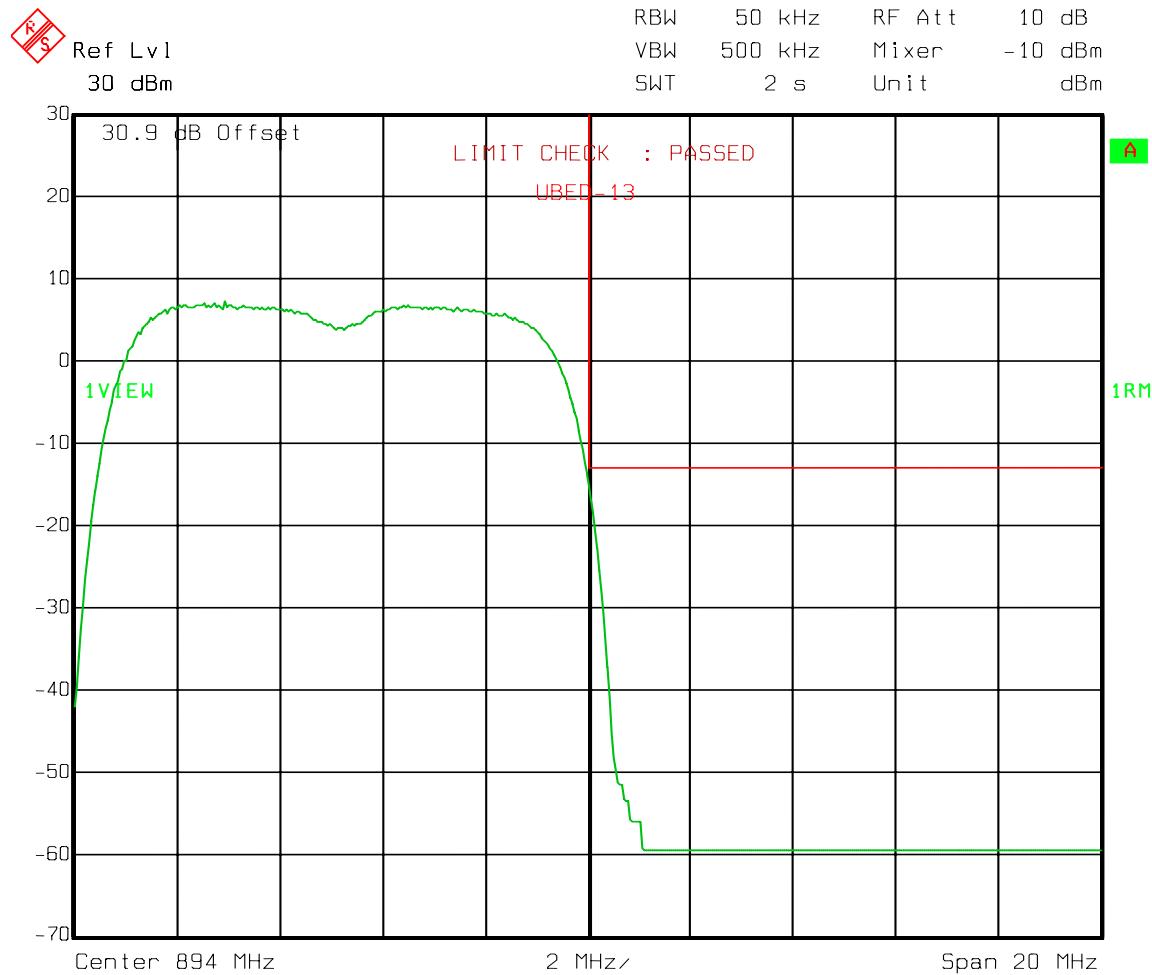
Date: 08.JAN.2008 13:39:25

**Test Data – Spurious Emissions at Antenna Terminals**

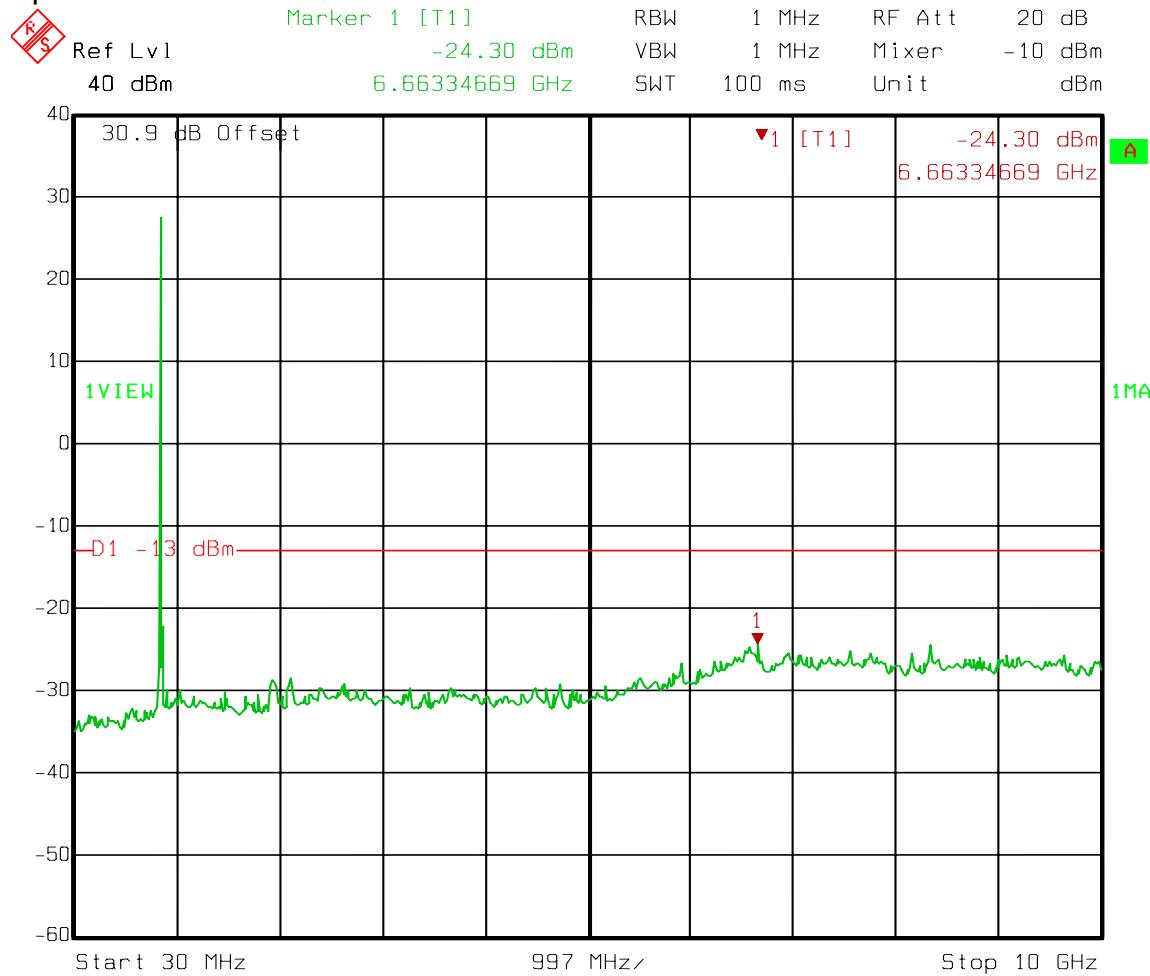
Upper Bandedge Intermodulation

W-CDMA

Downlink



Date: 08.JAN.2008 13:41:52

**Test Data – Spurious Emissions at Antenna Terminals****Spurs – W-CDMA - Downlink**

Date: 08.JAN.2008 13:35:54

**Section 6. Field Strength of Spurious**

NAME OF TEST: Field Strength of Spurious	PARA. NO.: 22.917
TESTED BY: David Light	DATE: 08 January 2008

**Test Results:** Complies.**Test Data:** There were no emissions detected above the noise floor which was at least 20 dB below the specification limit.**Equipment Used:** 1464-1484-1485-791-1016-759-760-993**Measurement Uncertainty:** +/-1.7 dB**Temperature:** 22 °C**Relative Humidity:** 35 %

**Section 7. Test Equipment List**

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	05/26/06	05/26/08
1082	CABLE 2m	Astrolab 32027-2-29094-72TC	N/A	CBU	N/A
1471	10 db Attenuator DC 18 Ghz	MCL Inc. BW-S10W2 10db-2WDC	NONE	CBU	N/A
1472	20db Attenuator DC 18 Ghz	Omni Spectra 20600-20db	NONE	CBU	N/A
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	01/24/07	01/24/09
1484	Cable	Storm PR90-010-072	N/A	05/02/07	05/01/08
1485	Cable	Storm PR90-010-216	N/A	05/02/07	05/01/08
791	PREAMP, 25dB	Nemko USA, Inc. LNA25	398	05/01/07	04/30/08
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	05/01/07	04/30/08
759	ANTENNA, LOG PERIODIC	A.H. SYSTEMS SAS-200/510	556	03/30/07	03/29/08
760	Antenna biconical	Electro Metrics MFC-25	477	01/19/07	01/19/08
993	Horn antenna	A.H. Systems SAS-200/571	XXX	08/31/07	08/30/08

**Nemko USA, Inc.**

**CFR 47, PART 22, SUBPART H**  
**CELLULAR BAND REPEATERS**

*EQUIPMENT:* **TFAH-US5B**

**REPORT NO.: 9372RUS2**

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**ANNEX A - TEST DETAILS**

**NAME OF TEST: RF Power Output****PARA. NO.: 2.1046**

**Minimum Standard:** Para. No. 22.913(a). The maximum effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 watts.

**Method Of Measurement:****Detachable Antenna:**

The peak power at antenna terminals is measured using spectrum analyzer. The resolution bandwidth and video bandwidth of the spectrum analyzer is set to a value greater than the 20 dB bandwidth of the rf signal. Power output is measured with the maximum rated input level. When the 20 dB bandwidth of the rf waveform is greater than the maximum RBW setting of the spectrum analyzer, the channel power measurement function of the spectrum analyzer is used. This function integrates the power of the waveform over the channel bandwidth for the specified rf signal.

**Integral Antenna:**

The antenna substitution method is used to determine the equivalent radiated power at spurious frequencies. The spurious emissions are measured at a distance of 3 meters. The EUT is then replaced with a reference substitution antenna with a known gain referenced to a dipole. This antenna is fed with a signal at the spurious frequency. The level of the signal is adjusted to repeat the previously measured level. The resulting erp is the signal level fed to the reference antenna corrected for gain referenced to a dipole.

**NAME OF TEST: Occupied Bandwidth****PARA. NO.: 2.1049****Minimum Standard:** Not defined (Input/Output)**Method Of Measurement:**

The E.U.T. is operated at maximum gain and a modulated waveform is fed to the input to produce maximum rated rf output power. A plot is made of both the input signal and the output signal and the two are compared to determine if the E.U.T. introduces any distortion into the rf input.

<b>NAME OF TEST: Spurious Emission at Antenna Terminals</b>	<b>PARA. NO.: 2.1051</b>
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**Minimum Standard:** Para. No. 22.917(e). The mean power of emissions must be attenuated below the mean power of the unmodulated carrier on any frequency twice or more than twice the fundamental emission by at least  $43 + 10 \log P$ . This is equivalent to -13 dBm absolute power.

**Method Of Measurement:****Method Of Measurement:**

Spectrum analyzer settings:

**CDMA**

RBW: 1 MHz (> 1 MHz from Band Edge)  
RBW: 30 kHz (< 1MHz from Band Edge)  
VBW:  $\geq$  RBW  
Sweep: Auto  
Video Avg: 6 Sweeps

**GSM / EDGE**

RBW: 1 MHz (> 1 MHz from Band Edge)  
RBW: 3 kHz (< 1 MHz from Band Edge)  
VBW:  $\geq$  RBW  
Sweep: Auto  
Video Avg: Disabled

**Analogue**

RBW: 1 MHz (> 1 MHz from Band Edge)  
RBW: 300 Hz (< 1 MHz from Band Edge)  
VBW:  $\geq$  RBW  
Sweep: Auto  
Video Avg: Disabled

**W-CDMA**

RBW: 1 MHz (> 1 MHz from Band Edge)  
RBW: 50 kHz (< 1MHz from Band Edge)  
VBW:  $\geq$  RBW  
Sweep: Auto  
Video Avg: 6 Sweeps

<b>NAME OF TEST: Field Strength of Spurious Radiation</b>	<b>PARA. NO.: 2.1053</b>
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**Minimum Standard:** Para. No. 22.917(e). The mean power of emissions must be attenuated below the mean power of the unmodulated carrier on any frequency twice or more than twice the fundamental emission by at least  $43 + 10 \log P$ . This is equivalent to -13 dBm absolute power.

**Method of Measurement** TIA/EIA-603C

The antenna substitution method is used to determine the equivalent radiated power at spurious frequencies. The spurious emissions are measured at a distance of 3 meters. The EUT is then replaced with a reference substitution antenna with a known gain referenced to a dipole. This antenna is fed with a signal at the spurious frequency. The level of the signal is adjusted to repeat the previously measured level. The resulting erp is the signal level fed to the reference antenna corrected for gain referenced to a dipole.

**NAME OF TEST: Frequency Stability****PARA. NO.: 2.1055**

**Minimum Standard:** Para. No. 22.355. The transmitter carrier frequency shall remain within the tolerances given in Table C-1.

**Table C-1**

<b>Freq. Range (MHz)</b>	<b>Base, fixed</b>	<b>Mobile &gt; 3 W</b>	<b>Mobile <math>\leq</math> 3 W</b>
821 to 896	1.5	2.5	2.5

**Method Of Measurement:****Frequency Stability With Voltage Variation:**

The E.U.T. is placed in an environmental chamber and allowed to stabilize at +20 degrees Celsius for at least 15 minutes. The frequency counter and signal generator are phase locked with the same 10 MHz reference frequency by connecting the 10 MHz ref. out of the counter to the 10 MHz ref, in of the signal generator. With the voltage input to the E.U.T. set to 85% S.T.V., the frequency is measured in 30 second intervals for a period of 5 minutes. This procedure is repeated at 100% S.T.V. and 115% S.T.V.

**Frequency Stability With Temperature Variation:**

The input voltage to the E.U.T. is set to S.T.V. and the temperature of the environmental chamber is varied in 10 degree steps from -30 degrees C to +50 degrees C. The E.U.T. is allowed to stabilize at each temperature and the frequency is measured in 30 second intervals for a period of 5 minutes.

**Nemko USA, Inc.**

**CFR 47, PART 22, SUBPART H**  
**CELLULAR BAND REPEATERS**

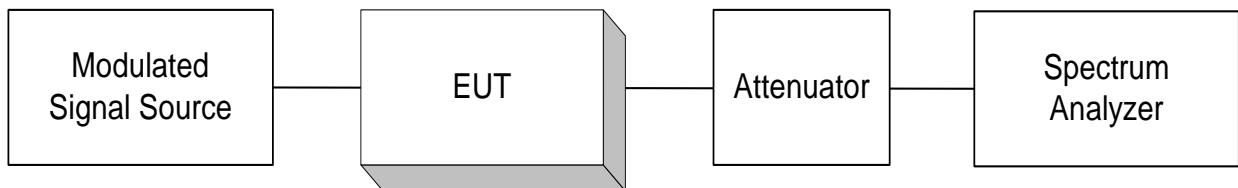
*EQUIPMENT:* **TFAH-US5B**

**REPORT NO.: 9372RUS2**

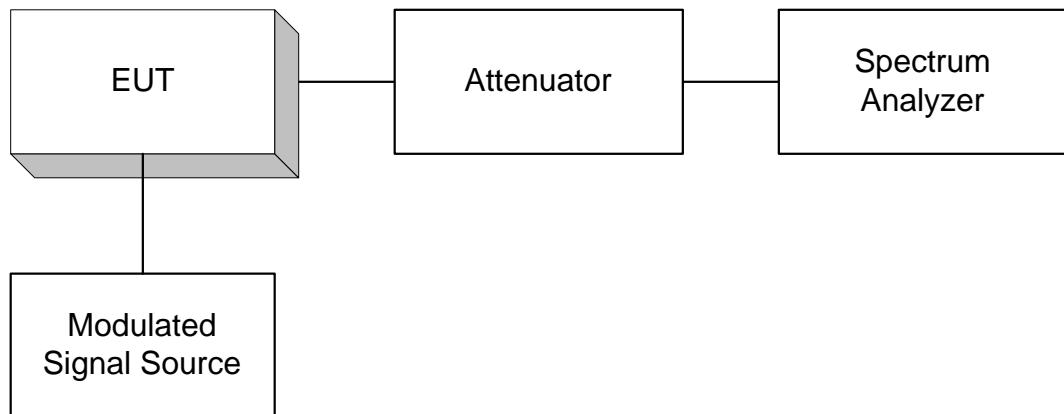
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**ANNEX B - TEST DIAGRAMS**

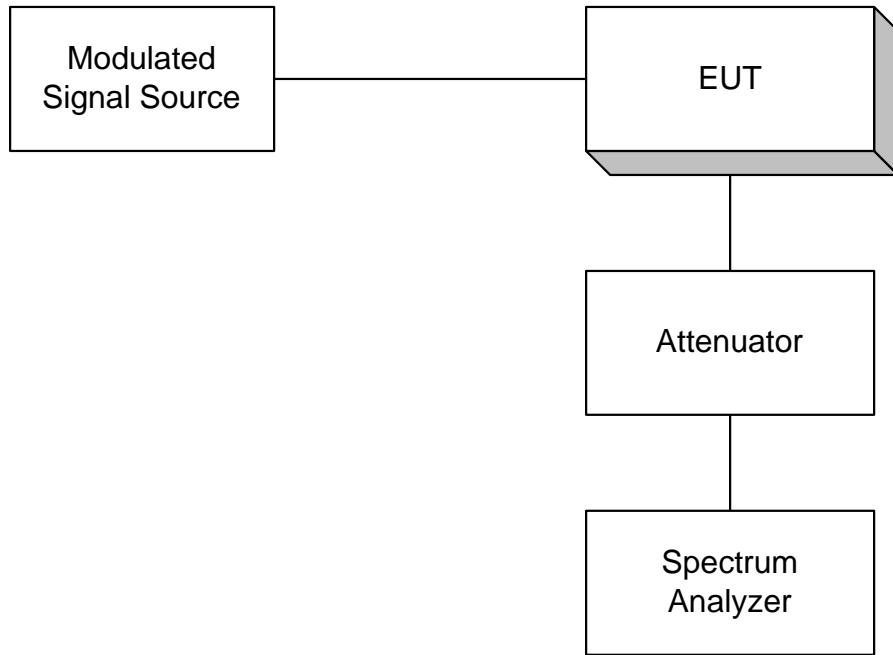
**Para. No. 2.1046 - R.F. Power Output**



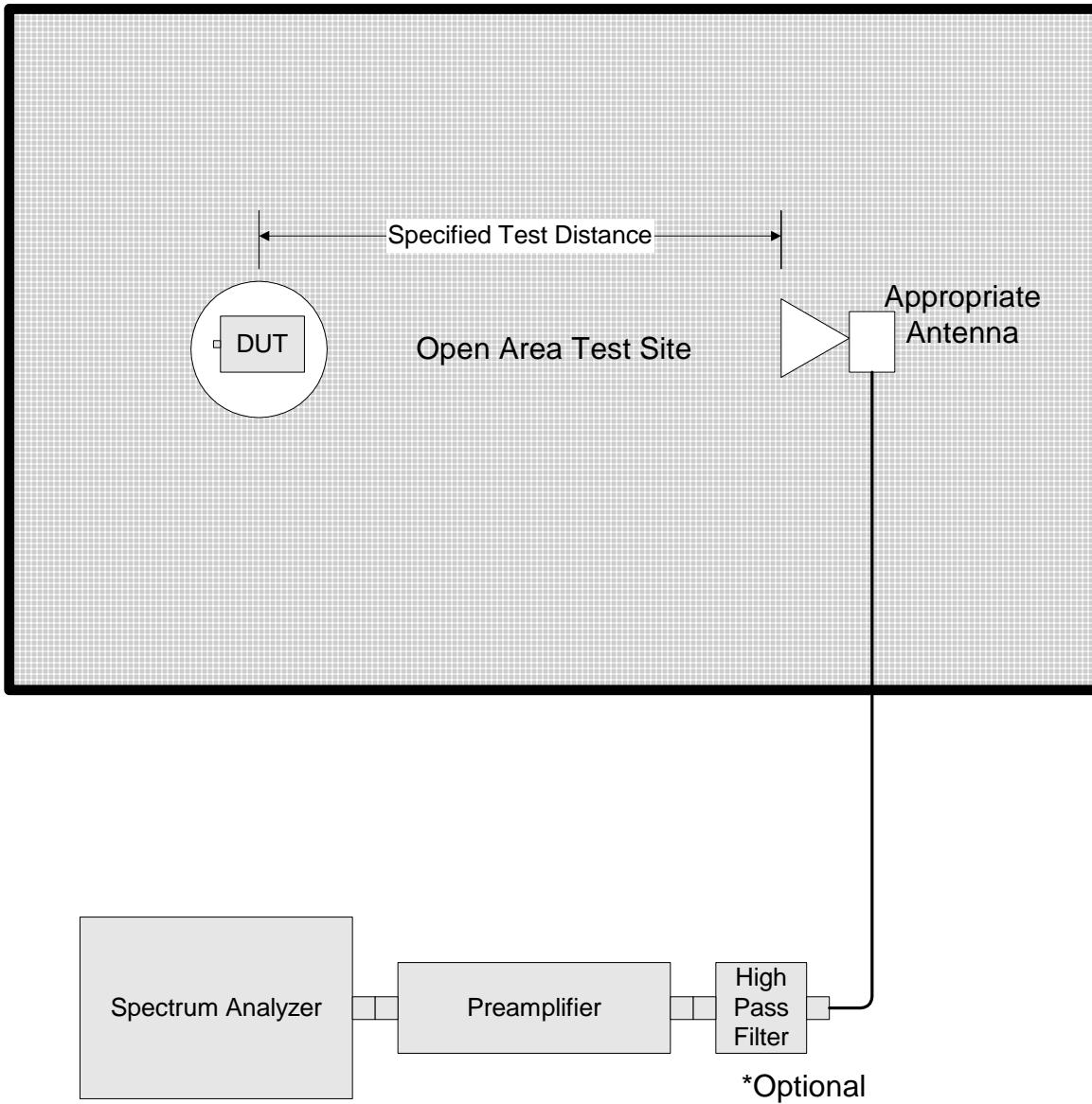
**Para. No. 2.1049 - Occupied Bandwidth**

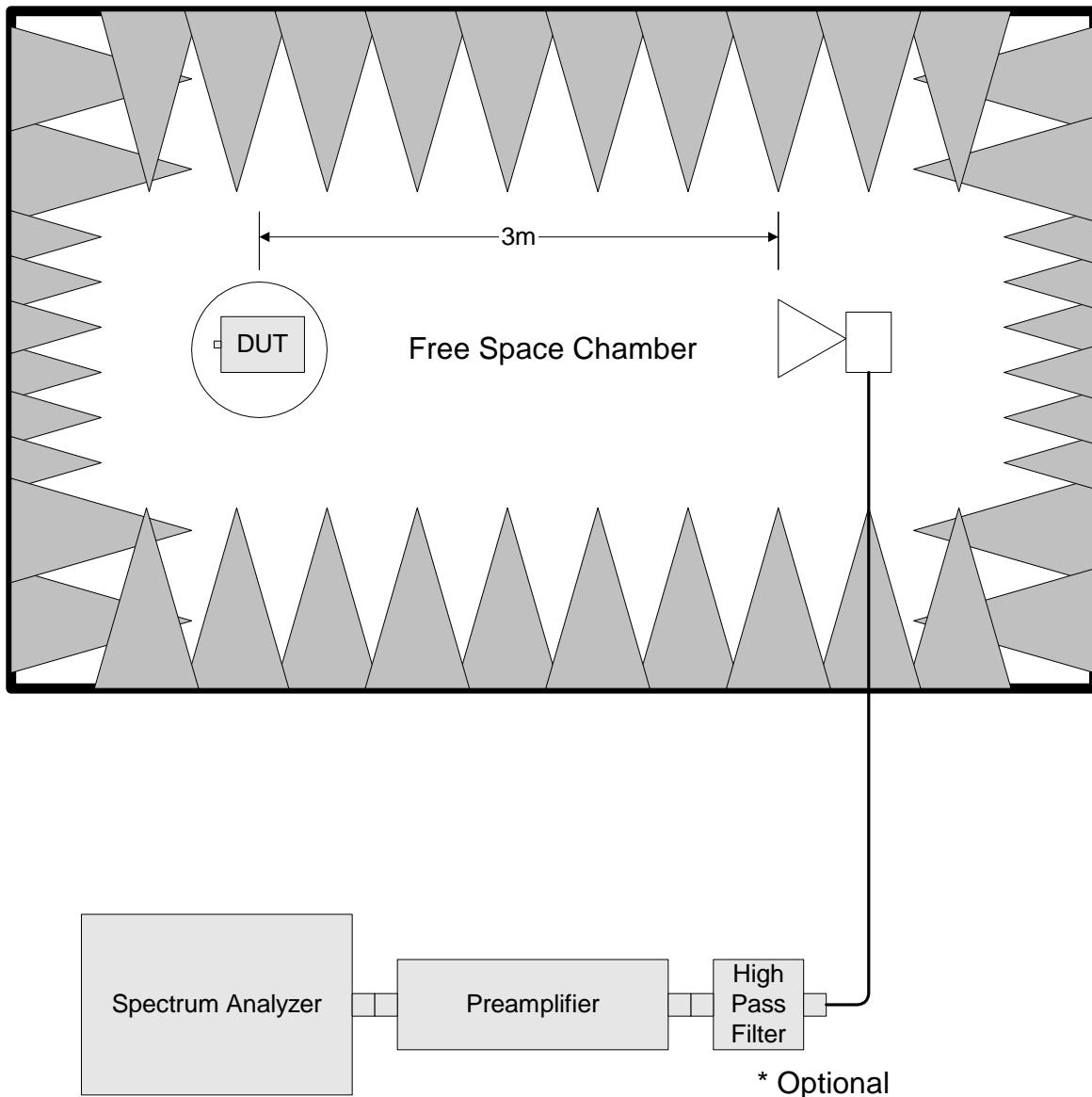


**Para. No. 2.1051 Spurious Emissions at Antenna Terminals**



**Para. No. 2.1053 - Field Strength of Spurious Radiation**





**Para. No. 2.1055 - Frequency Stability**

