



Nemko Test Report: 5L0495RUS1

Applicant: Nokia, Inc.

Equipment Under Test: 2355

In Accordance With: **FCC Part 22, Subpart H**
Cellular Band Subscriber Services

Tested By: Nemko Dallas Inc.
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Lewisville, TX
75057-3136

Authorized By: 
Kevin Rose, Wireless Engineer

Date: October 5, 2005

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Section 1. Summary of Test Results

Manufacturer: Nokia, Inc.

Model No.: 2355

Type: RM-121

Serial No.: 033/03733325

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 FCC 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. None.

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Summary Of Test Data

NAME OF TEST	PARA. NO.	RESULT
RF Power Output	2.1046	Complies
Audio Frequency Response	2.1047	NA
Audio Low Pass Filter Response	2.1047	NA
Modulation Limiting	2.1047	NA
Occupied Bandwidth	2.1049	Complies
Spurious Emissions at Antenna Terminals	2.1051	Complies
Field Strength of Spurious Emissions	2.1053	Complies
Frequency Stability	2.1055	Complies

Footnotes [The handset is CDMA only.](#)

:

Measurement uncertainty for each test configuration is expressed to 95% probability.

.

Section 2. General Equipment Specification

Frequency Range: 824.70 to 848.31 MHz

Tunable Bands: 824.70 to 848.31 MHz

Necessary Bandwidth: 1.25 MHz CDMA

Emission Designator: 1M25F9W

Output Impedance: 50 ohms

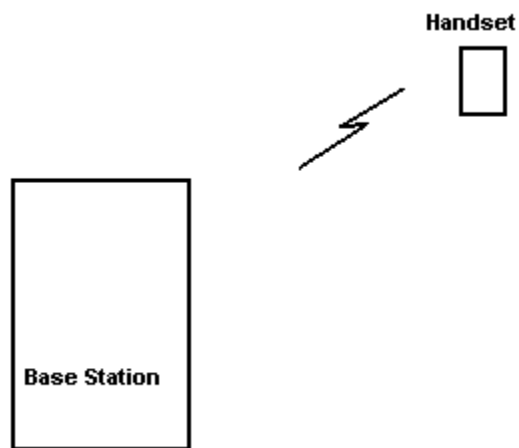
Operator Selection of Frequency: Software Controlled

Power Output Adjustment Capability:	Software Controlled
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Operational Description

CDMA handset operating in the 800 MHz cellular band

System Diagram



Section 3. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.1049
TESTED BY: David Light	DATE: 03 October 2005

Test Results: [Complies.](#)

Test Data: [See attached plots](#)

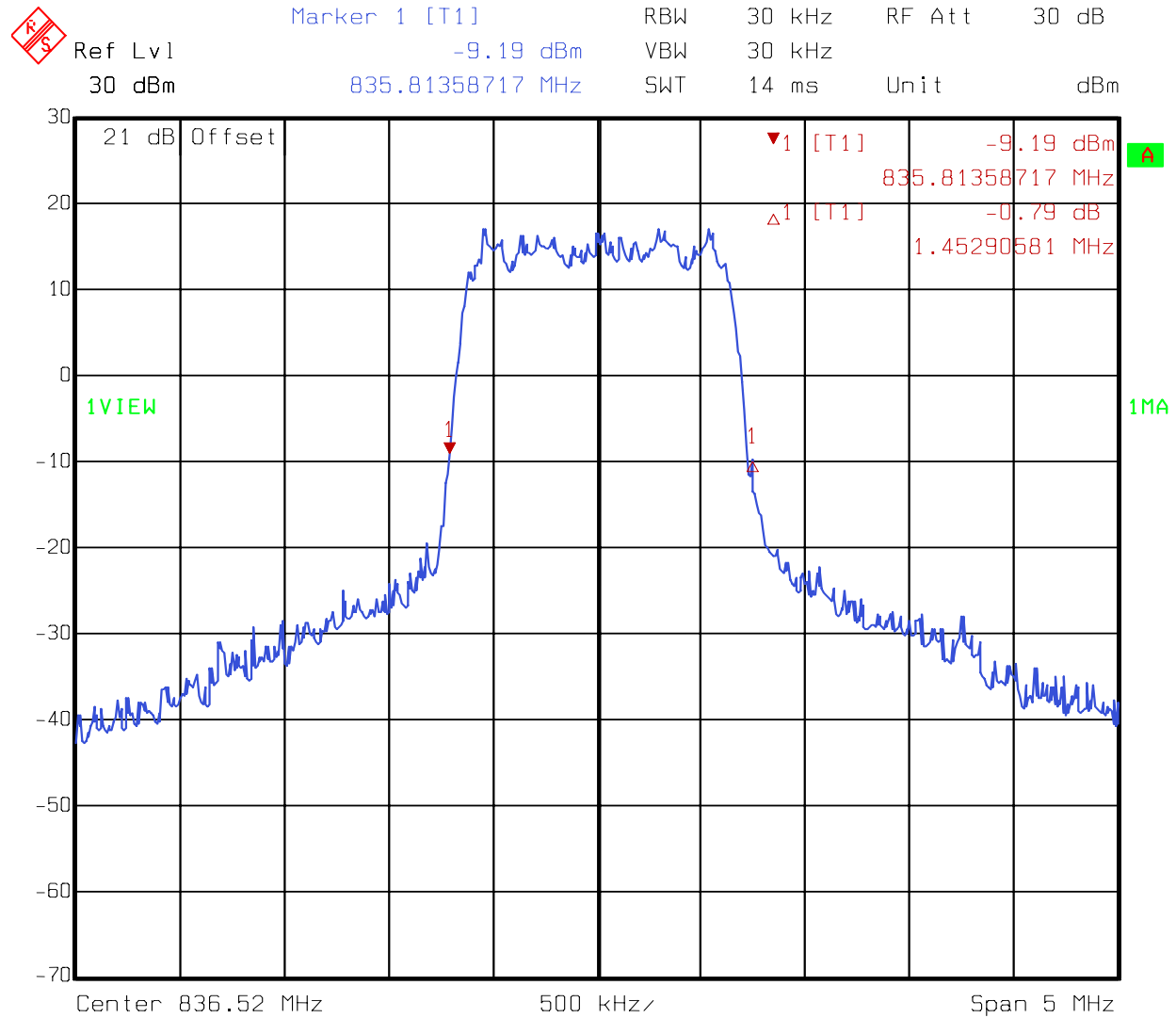
Equipment Used: [1082-1054-1036-HP8924C](#)

Measurement Uncertainty: [+/- 1.7](#) dB

Temperature: [22](#) °C

Relative Humidity: [45](#) %

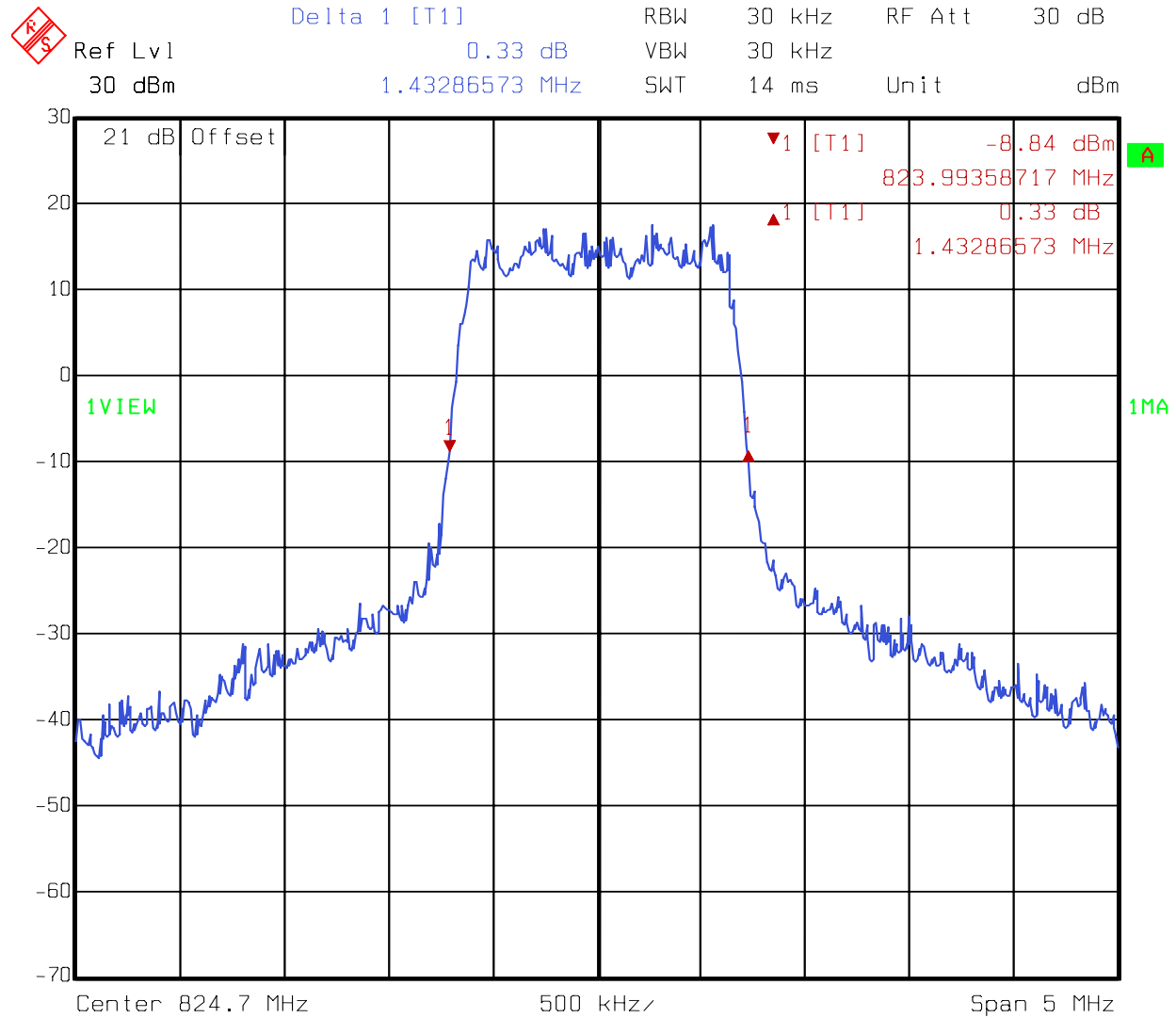
Test Data – Occupied Bandwidth



Date: 03.OCT.2005 08:45:22

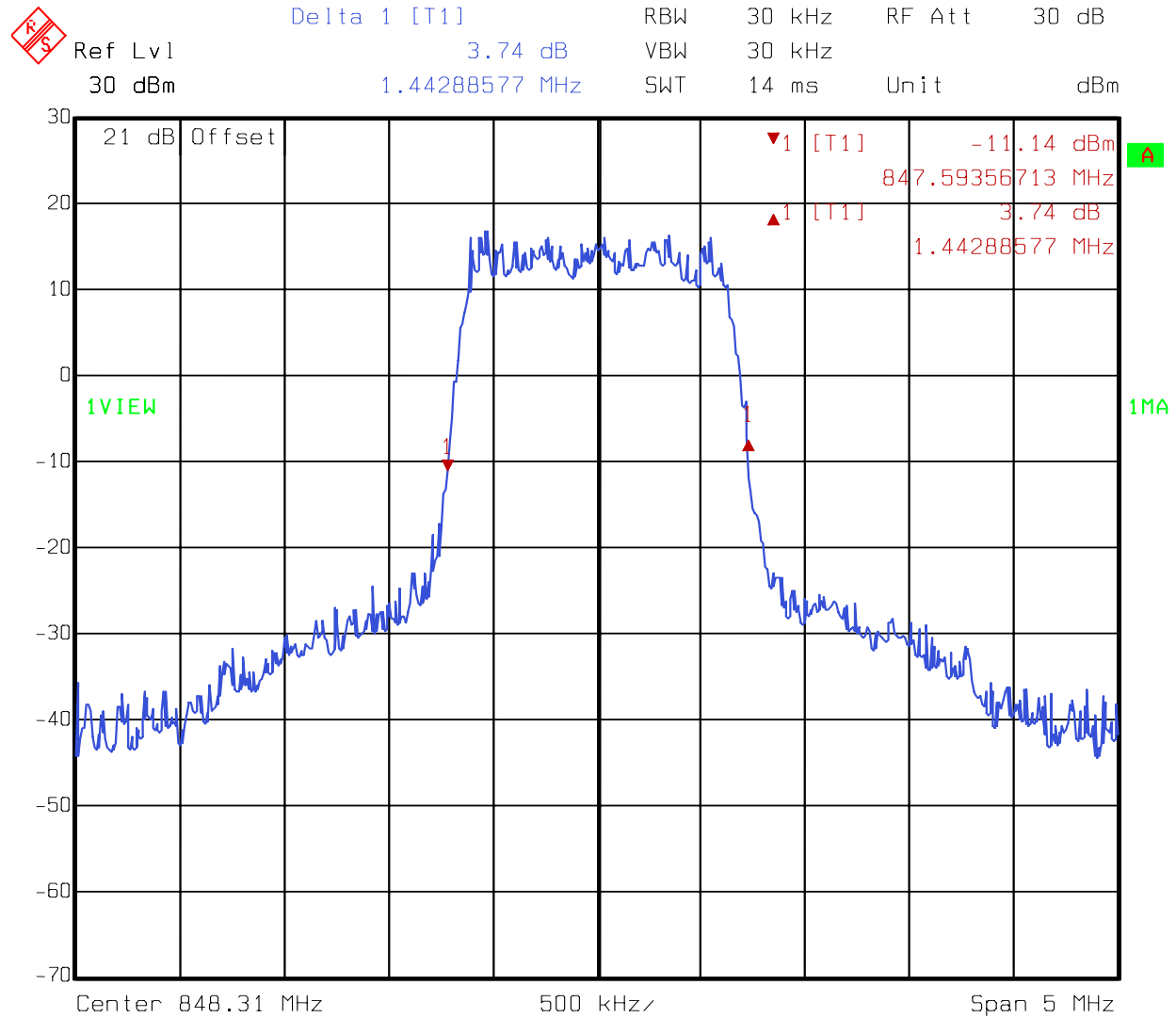
Channel 384

Test Data – Occupied Bandwidth



Date: 03.OCT.2005 08:47:48
Channel 1013

Test Data – Occupied Bandwidth



Date: 03.OCT.2005 09:06:18

Channel 777

Section 4. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.1051
TESTED BY: David Light	DATE: 03 October 2005

Test Results: [Complies.](#)

Test Data: [See attached plots](#)

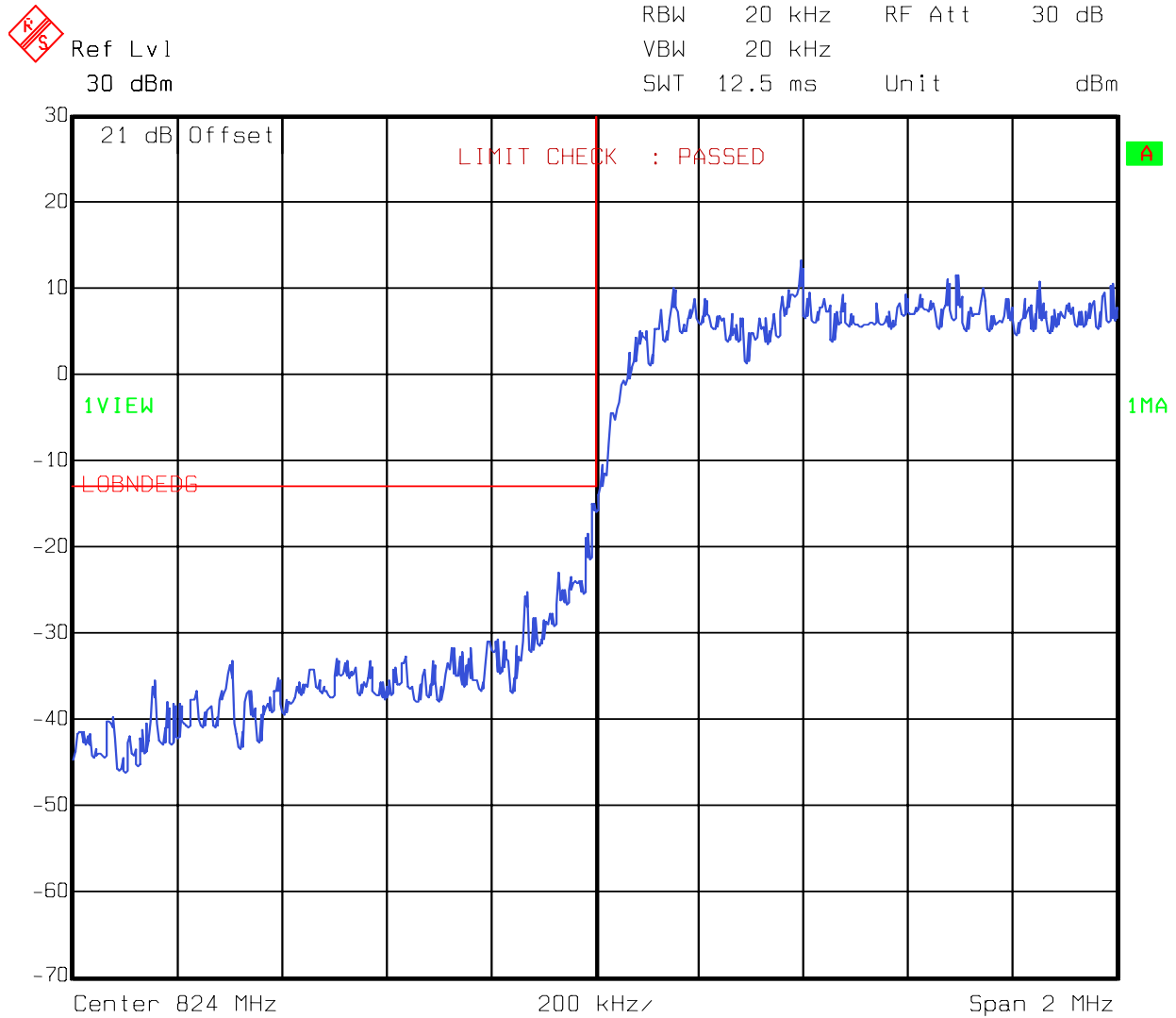
Equipment Used: [1082-1054-1055-1036-1058-HP8924C](#)

Measurement Uncertainty: [+/- 1.7](#) dB

Temperature: [22](#) °C

Relative Humidity: [45](#) %

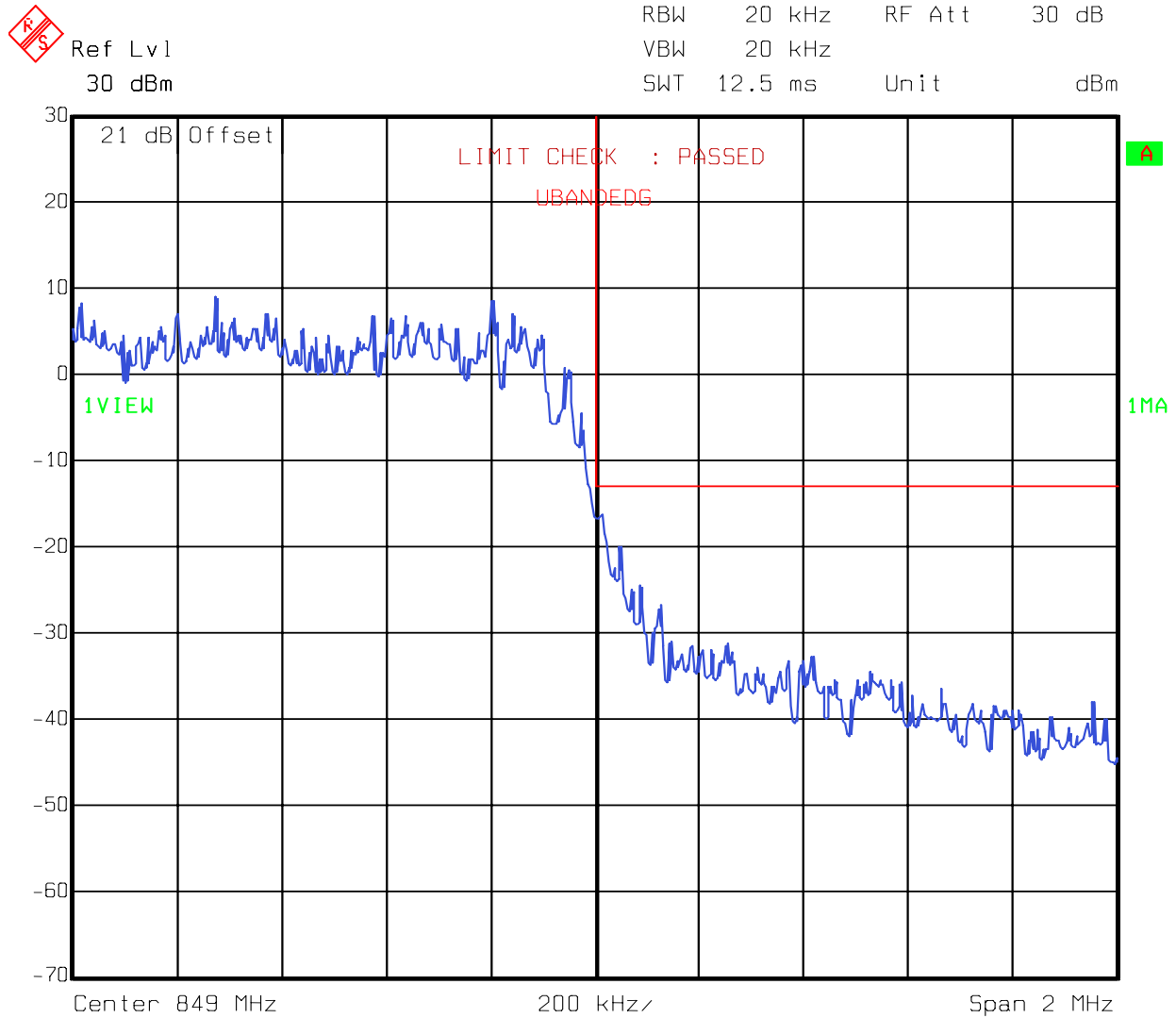
Test Data – Spurious Emissions



Date: 03.OCT.2005 08:59:22

Channel 1013

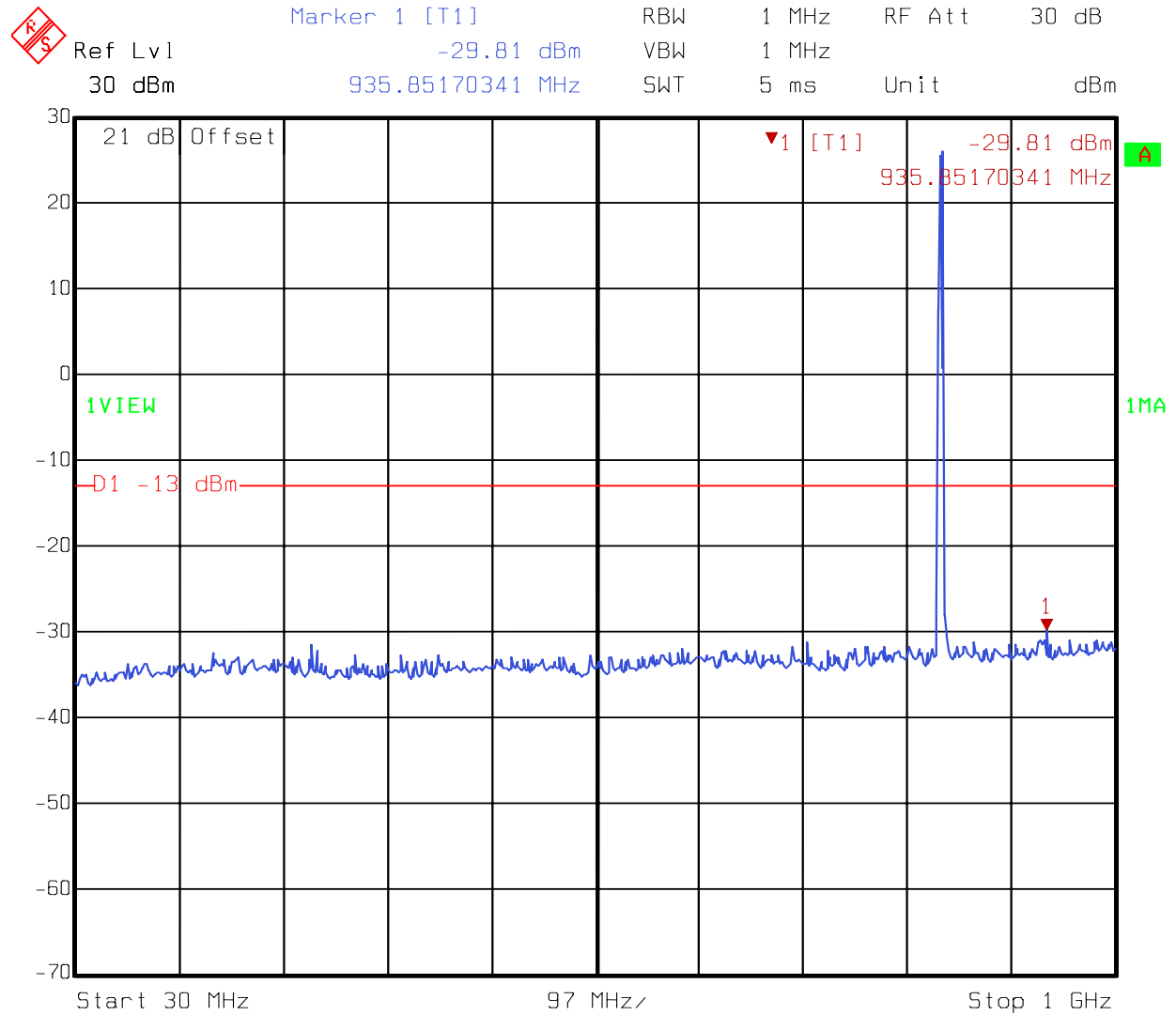
Test Data – Spurious Emissions



Date: 03.OCT.2005 09:02:55

Channel 777

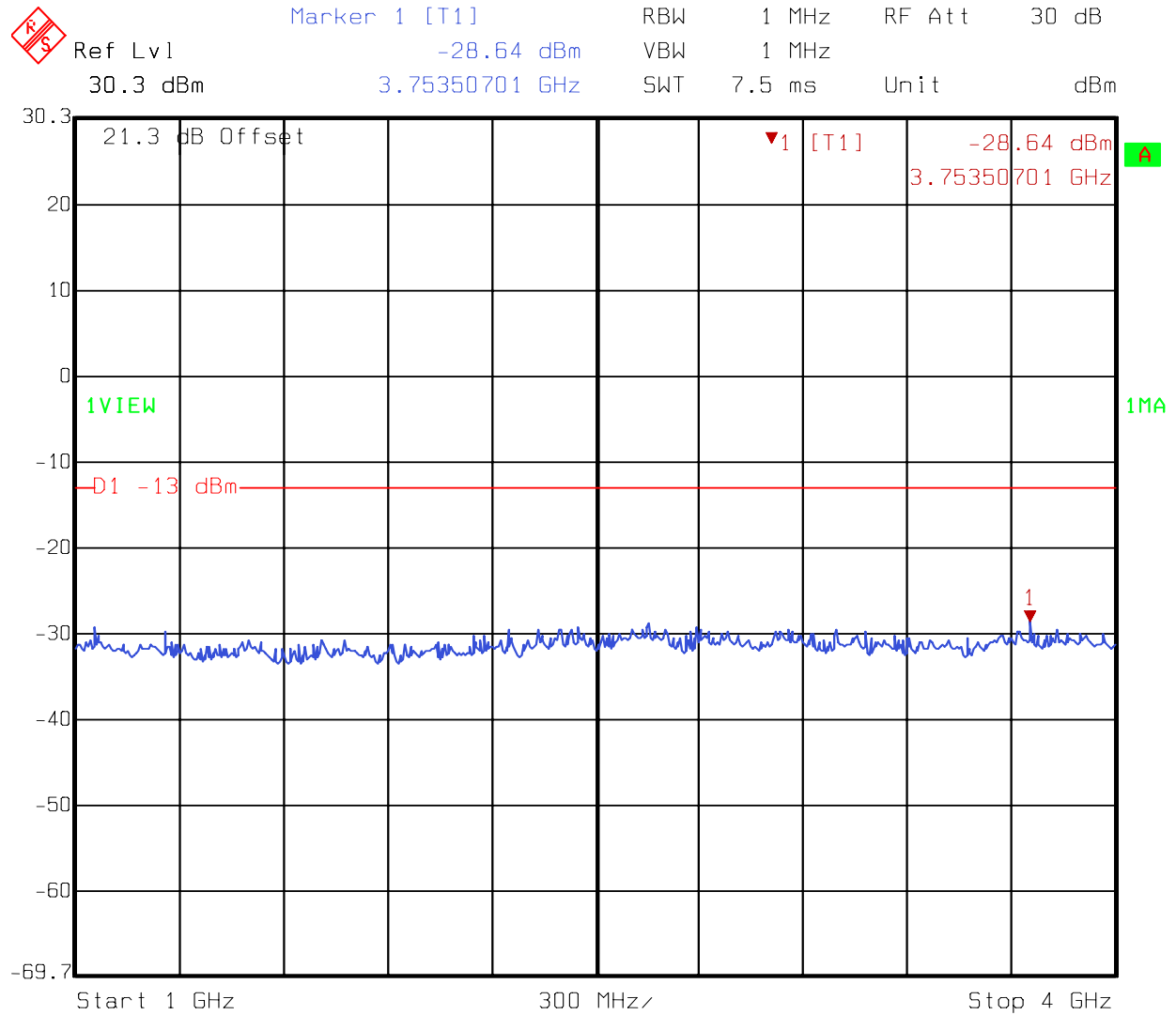
Test Data – Spurious Emissions



Date: 03.OCT.2005 09:11:21

Channel 384

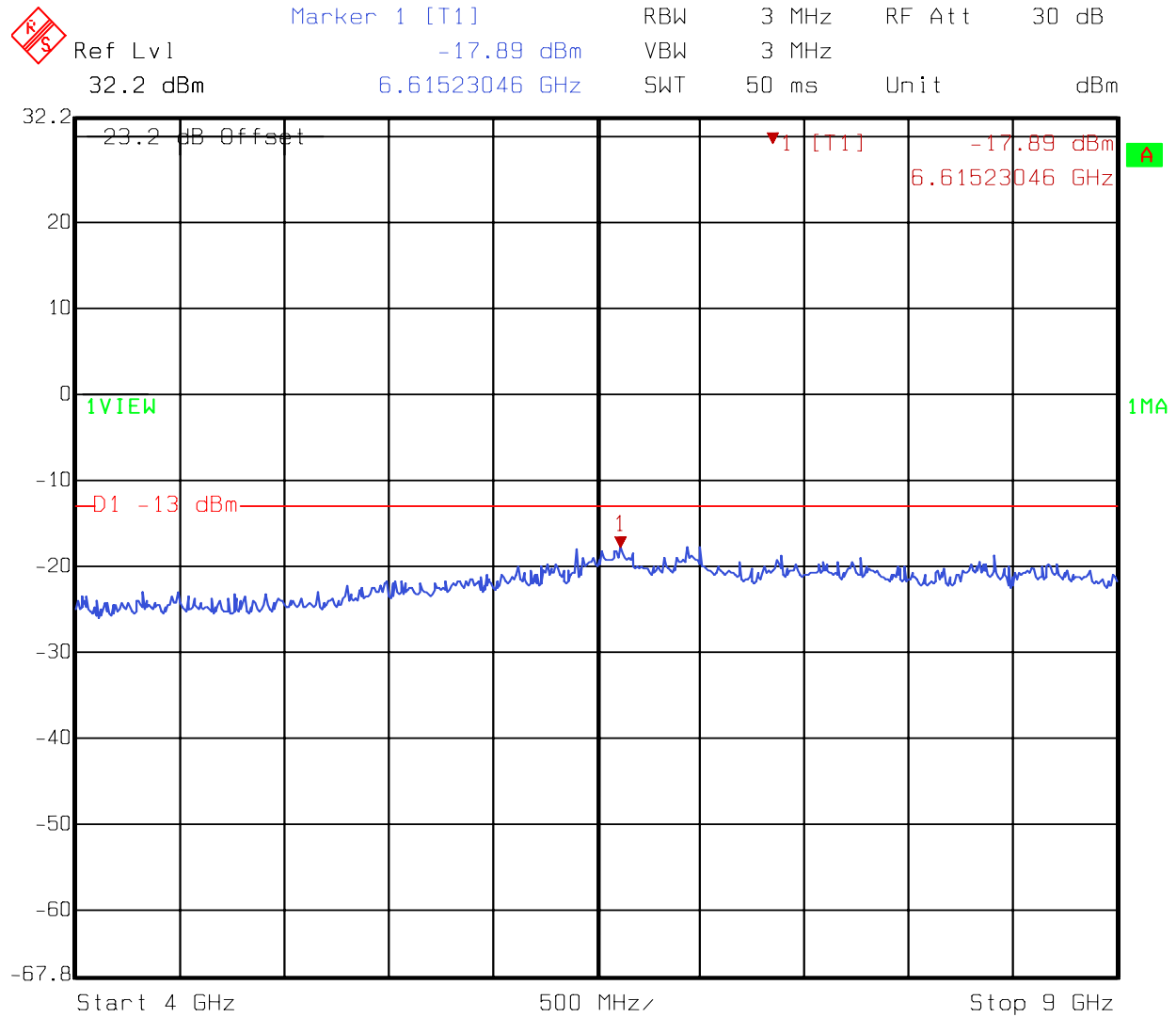
Test Data – Spurious Emissions



Date: 03.OCT.2005 09:17:21

Channel 384

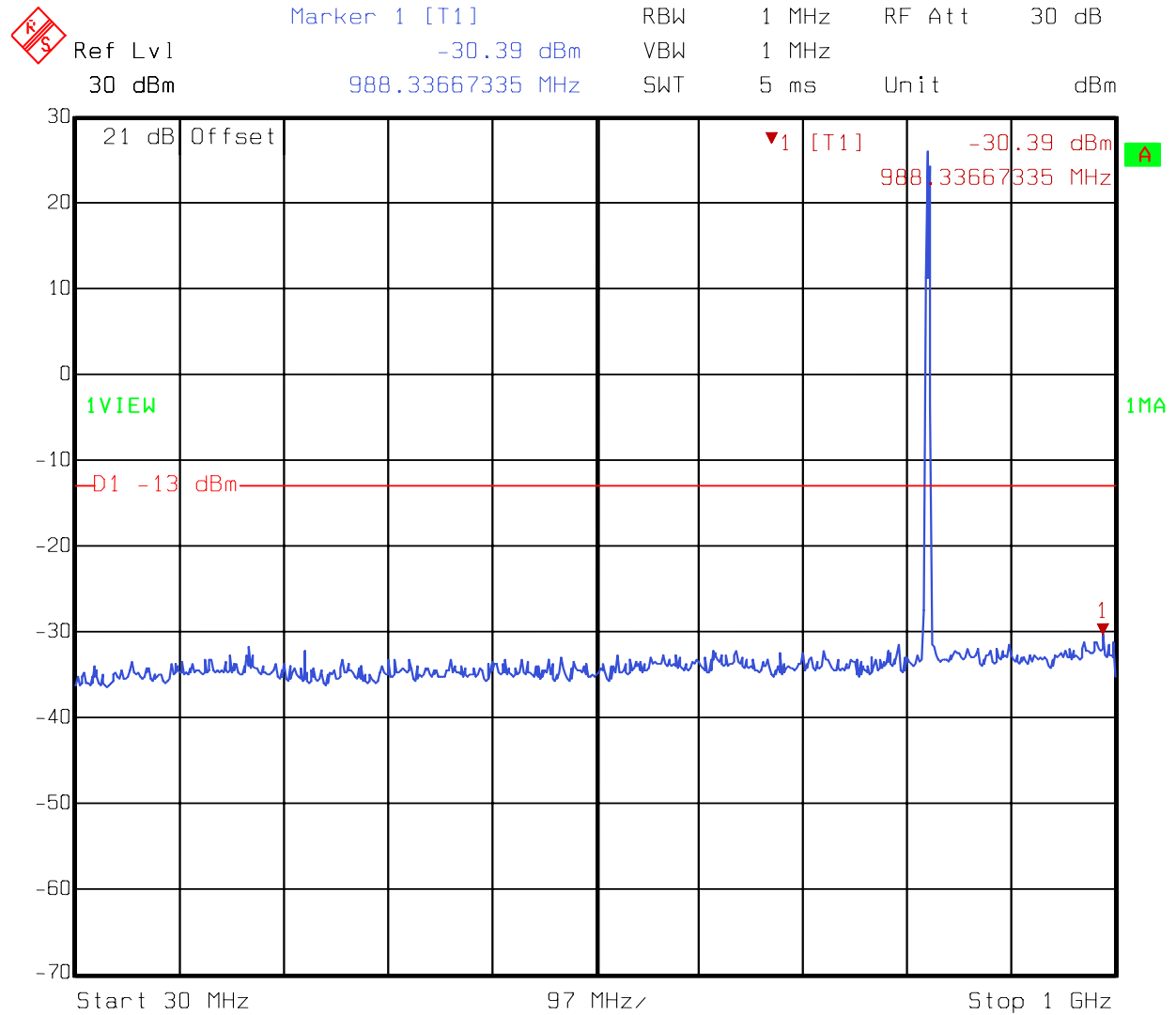
Test Data – Spurious Emissions



Date: 03.OCT.2005 09:23:50

Channel 384

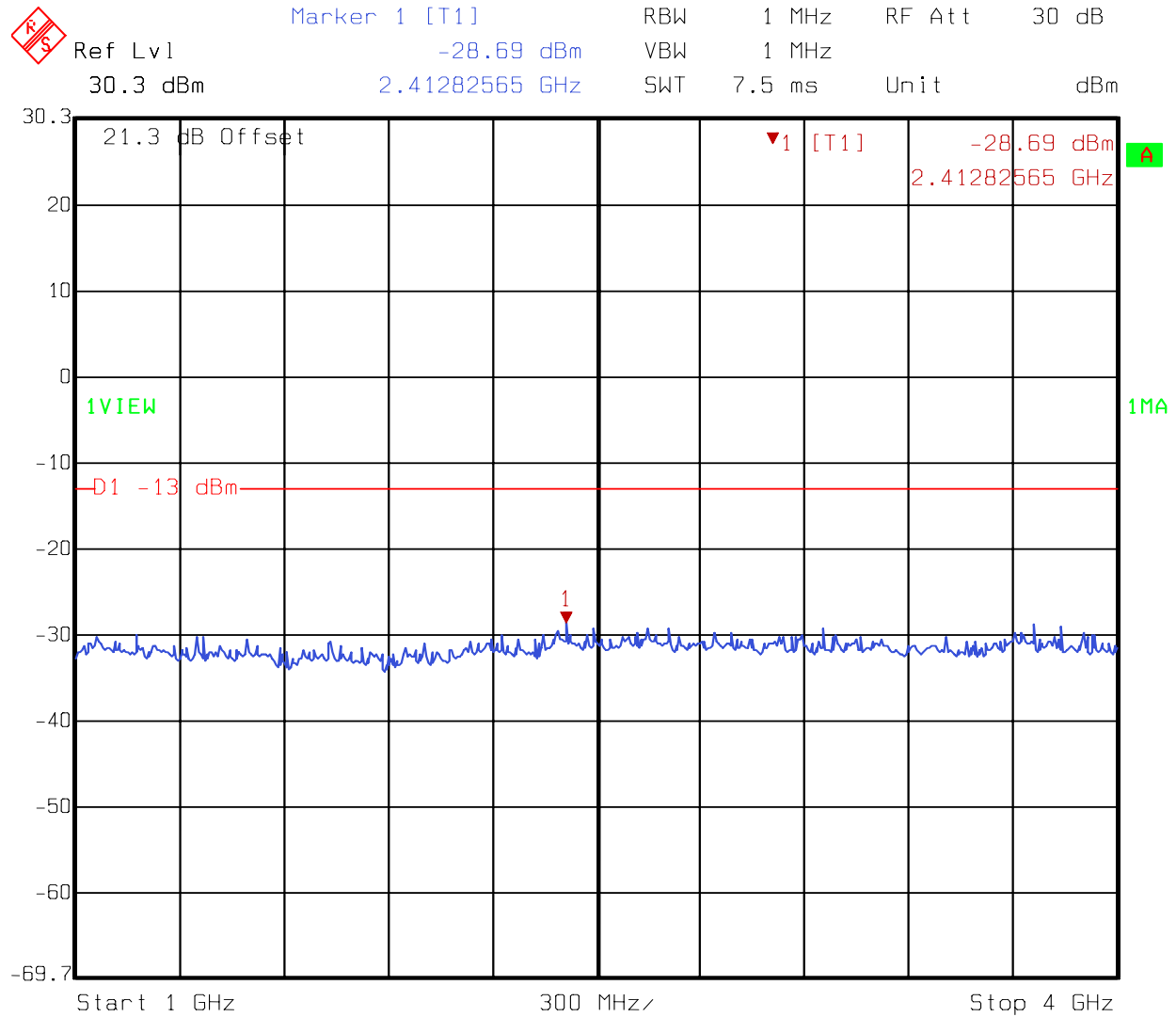
Test Data – Spurious Emissions



Date: 03.OCT.2005 09:12:01

Channel 1013

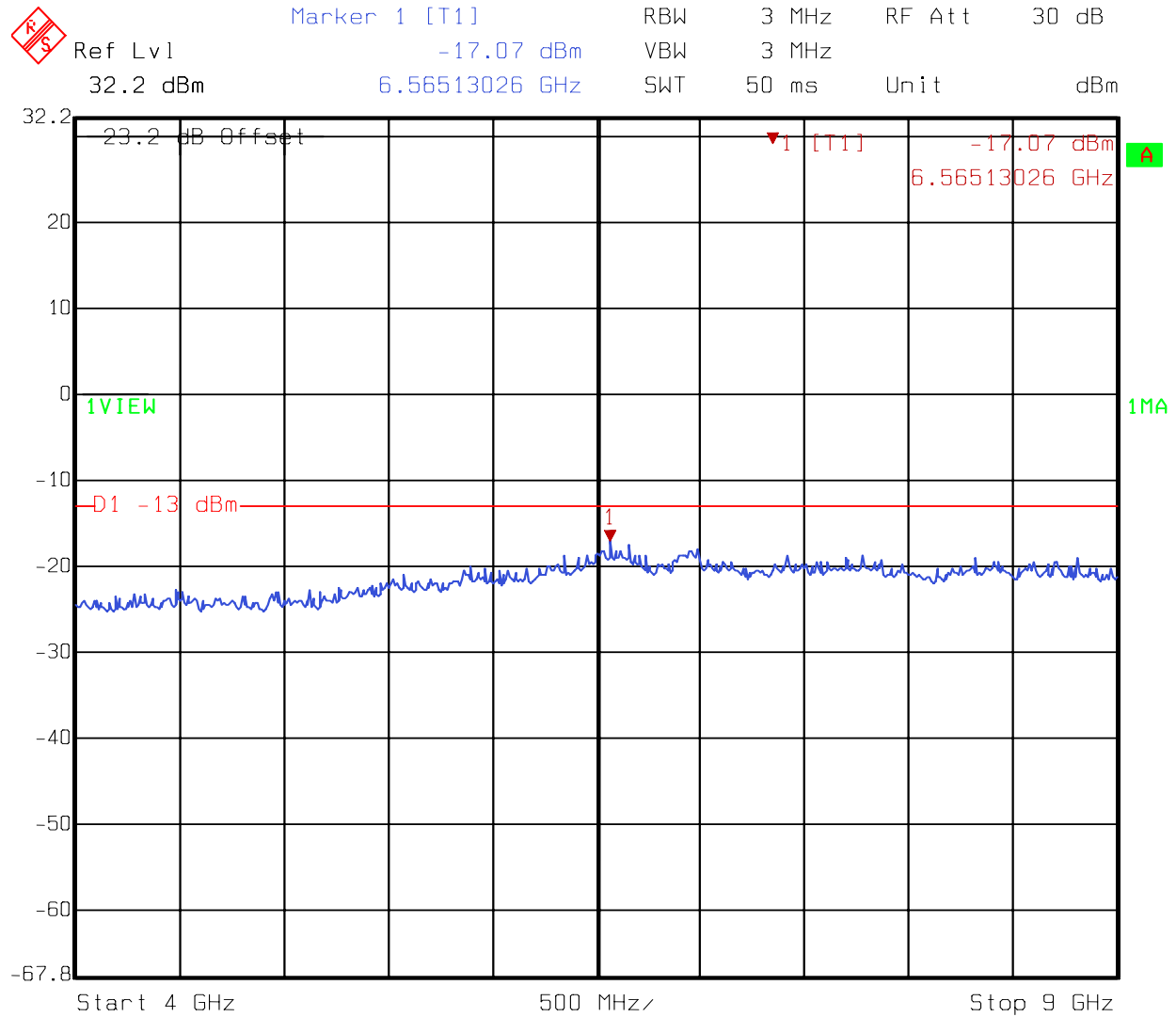
Test Data – Spurious Emissions



Date: 03.OCT.2005 09:17:59

Channel 1013

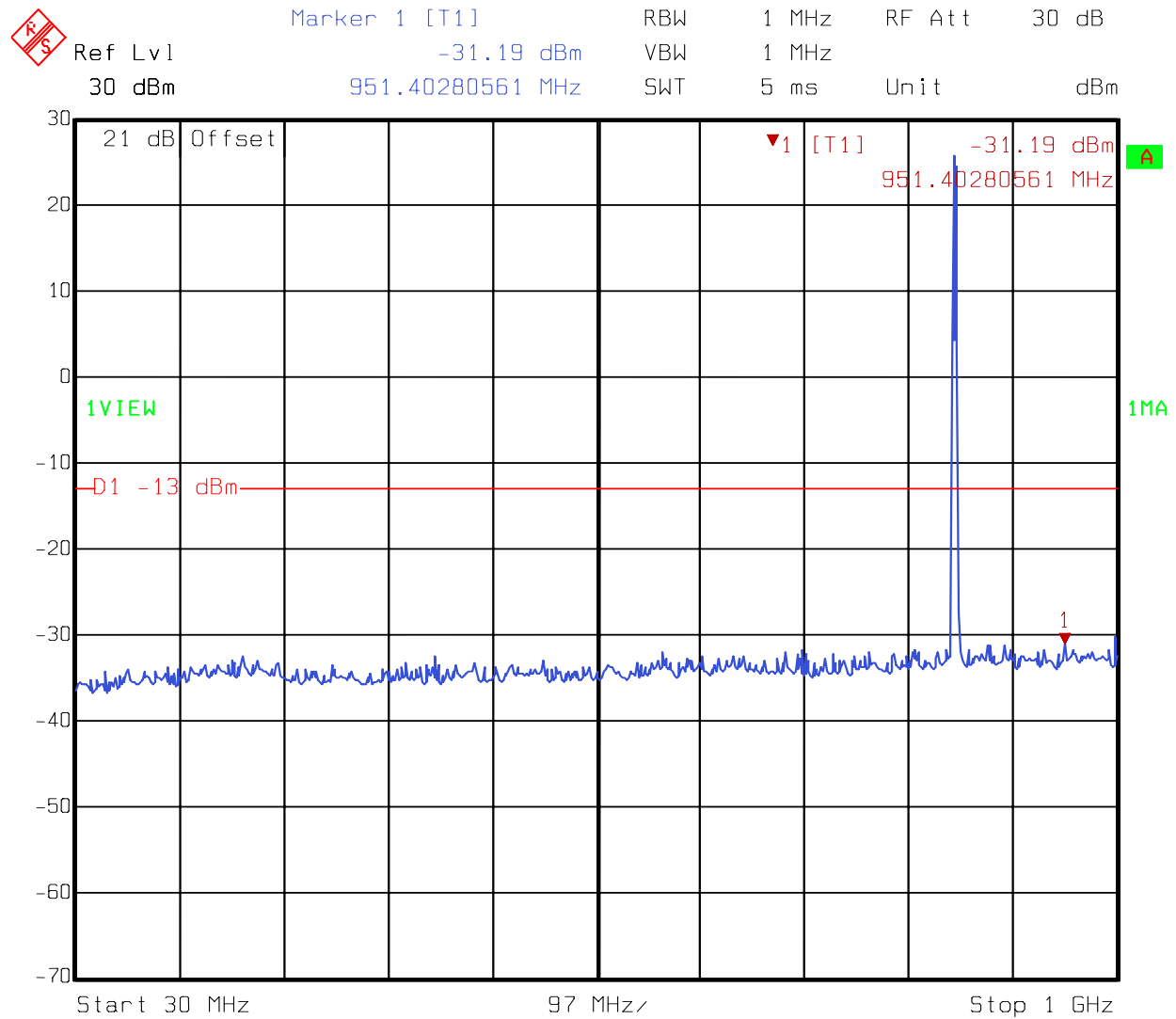
Test Data – Spurious Emissions



Date: 03.OCT.2005 09:24:27

Channel 1013

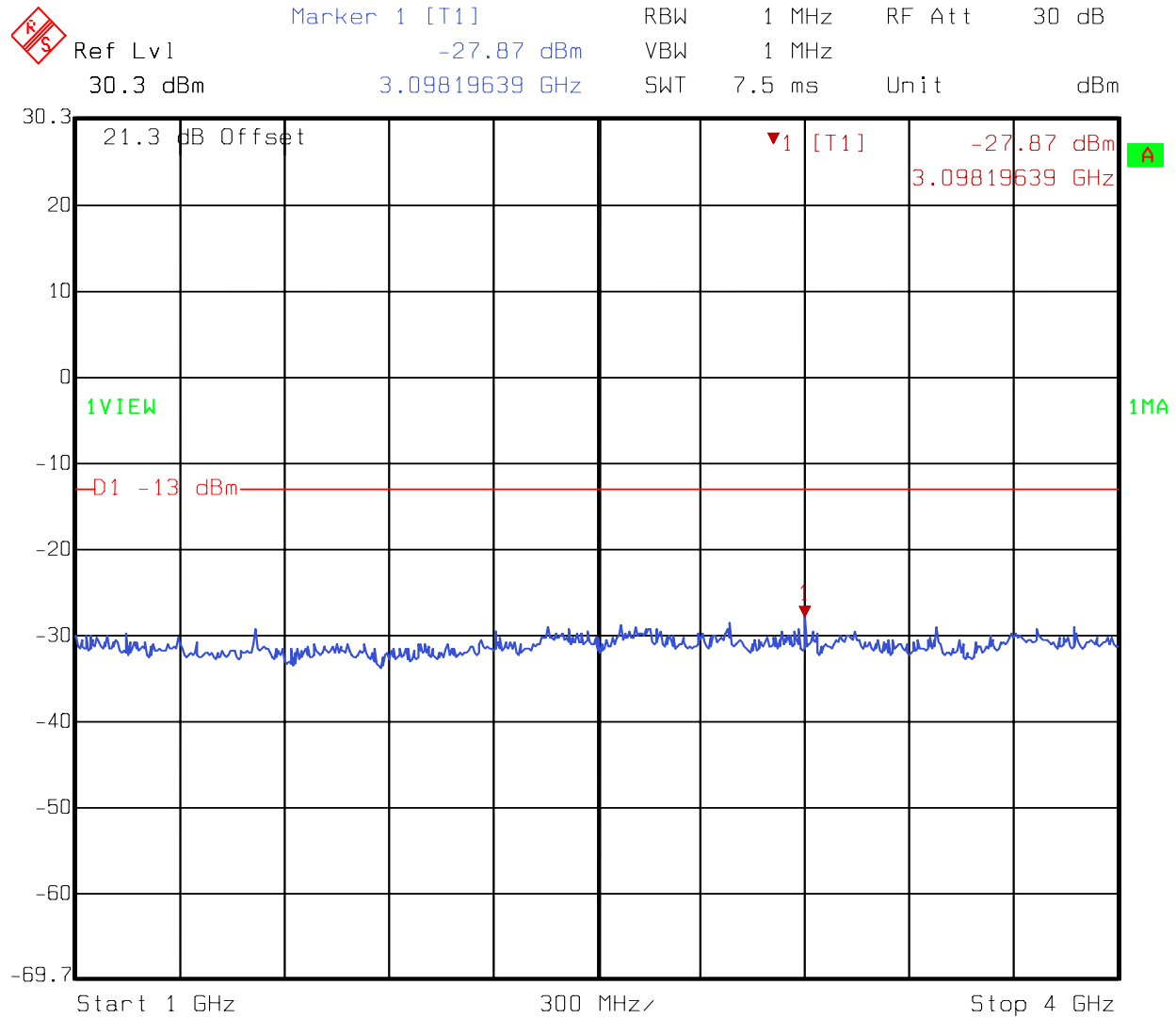
Test Data – Spurious Emissions



Date: 03.OCT.2005 09:12:49

Channel 777

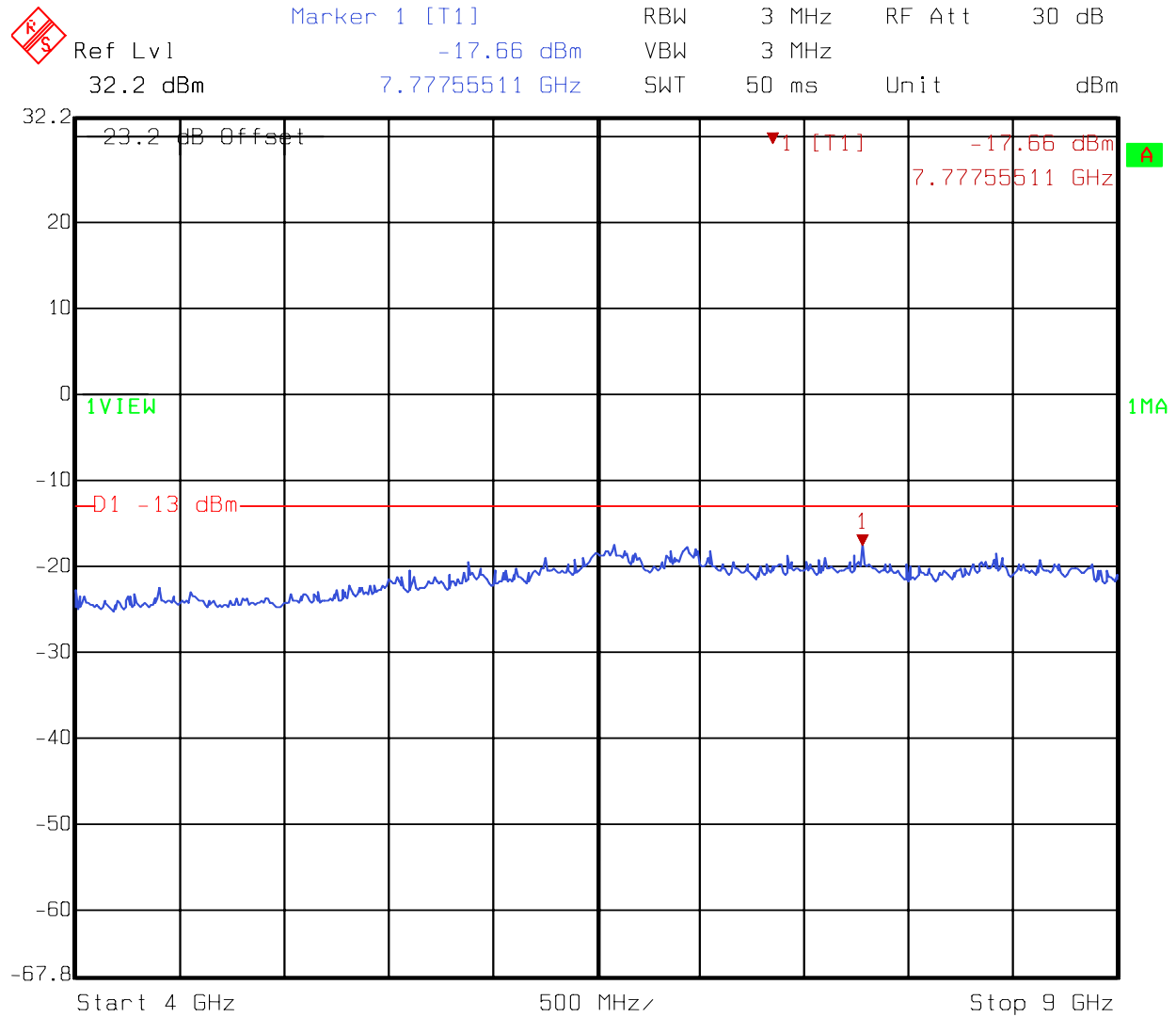
Test Data – Spurious Emissions



Date: 03.OCT.2005 09:18:39

Channel 777

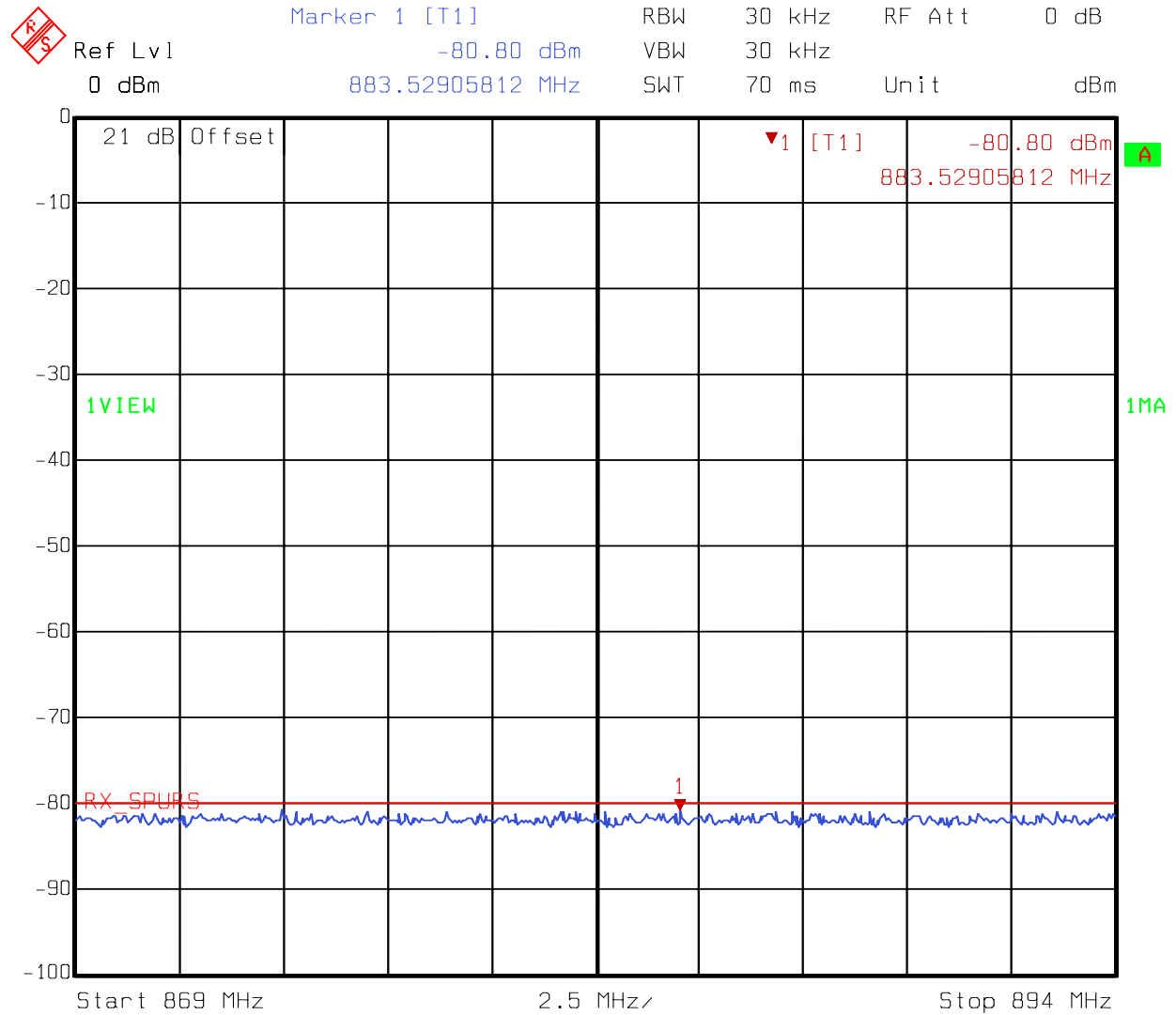
Test Data – Spurious Emissions



Date: 03.OCT.2005 09:25:24

Channel 777

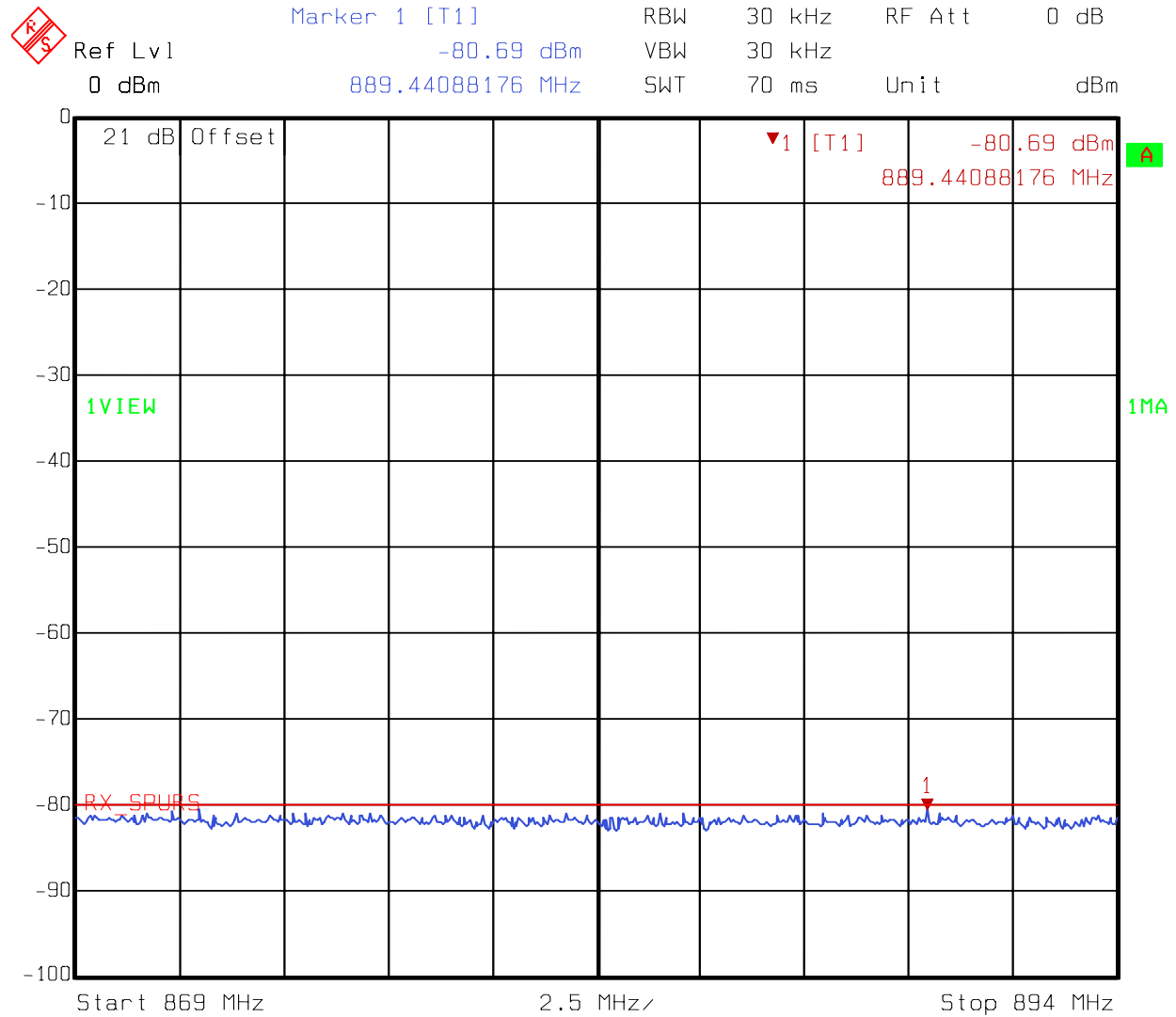
Test Data – Spurious Emissions (Rx Band)



Date: 03.OCT.2005 10:36:12

Channel 384

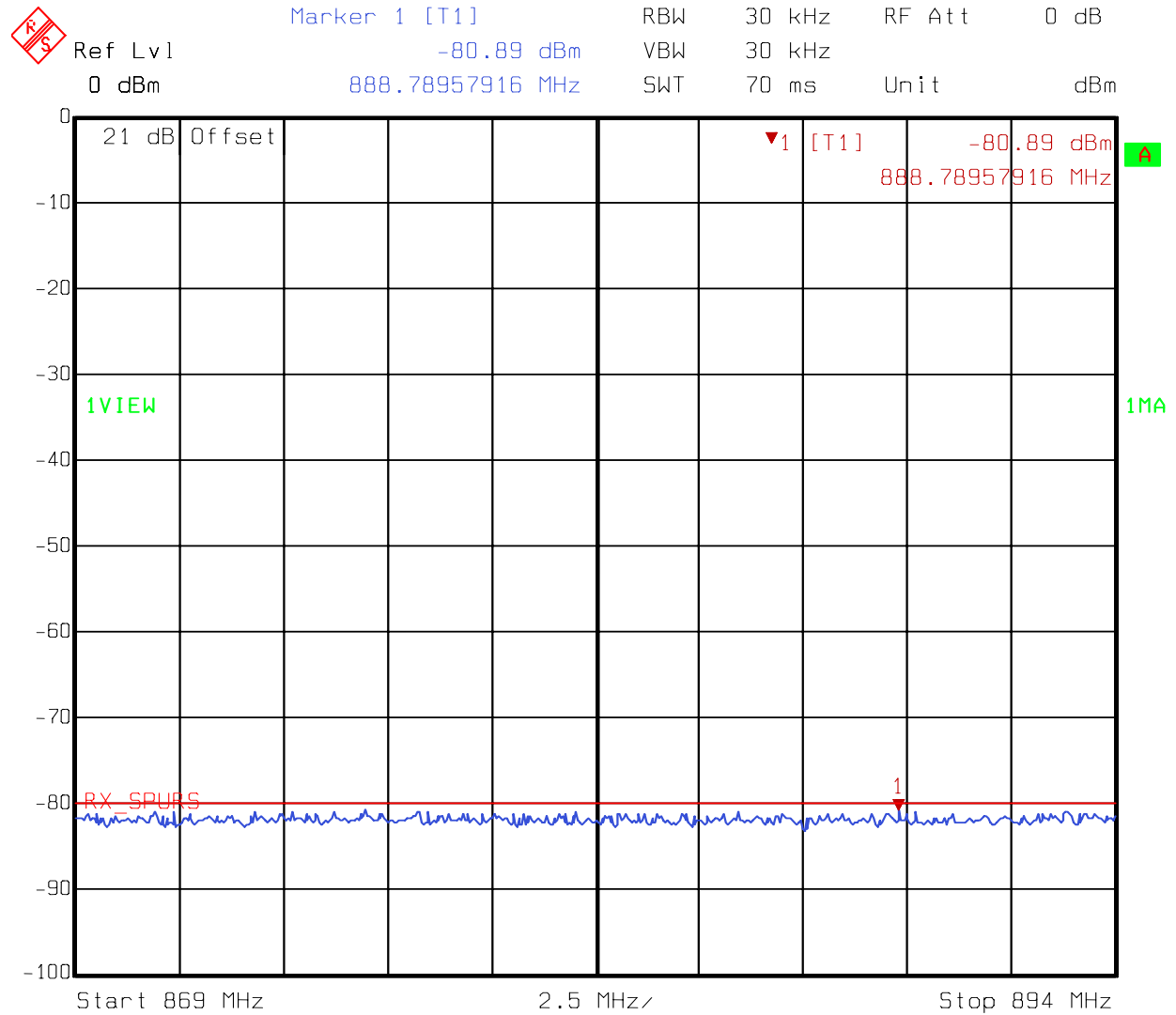
Test Data – Spurious Emissions



Date: 03.OCT.2005 10:39:41

Channel 1013

Test Data – Spurious Emissions



Date: 03.OCT.2005 10:41:50

Channel 777

Section 5. Field Strength of Spurious

NAME OF TEST: Field Strength of Spurious	PARA. NO.: 2.1053
TESTED BY: David Light	DATE: 03 October 2005

Test Results: [Complies.](#)**Test Data:** [Refer to attached data](#)

The handset was tested on three orthogonal axis'. The upright position pictured was determined to be worse case.

Equipment Used: [1304-1016-1481-1464-1484-1485-1311-791-760-HP8924C](#)**Measurement
Uncertainty:** [+/- 1.7](#) dB**Temperature:** [22](#) °C**Relative
Humidity:** [45](#) %

Test Data – Field Strength of Spurious Emissions

Field Strength of Spurious										
Page <u>1</u> of <u>1</u>						Complete <u>X</u>				
Job No.: <u>5L0495</u>		Date: <u>10/03/2005</u>				Preliminary _____				
Specification: <u>Part 22</u>		Temperature(°C): <u>22</u>								
Tested By: <u>David Light</u>		Relative Humidity(%) <u>45</u>								
E.U.T.: <u>850 MHz CDMA Handset</u>										
Configuration: <u>Tx in upright position</u>										
Sample No: <u>1</u>										
Location: <u>AC 3</u>		RBW: <u>1 MHz</u>				Measurement				
Detector Type: <u>Peak</u>		VBW: <u>1 MHz</u>				Distance: <u>3</u> m				
Test Equipment Used										
Antenna: <u>993</u>		Directional Coupler: _____								
Pre-Amp: <u>1016</u>		Cable #1: <u>1484</u>								
Filter: <u>1481</u>		Cable #2: <u>1485</u>								
Receiver: <u>1464</u>		Cable #3: _____								
Attenuator #1: _____		Cable #4: _____								
Attenuator #2: _____		Mixer: _____								
Additional equipment used: <u>791</u> <u>1311</u> <u>760</u>										
Measurement Uncertainty: <u>+/-1.7 dB</u>										
Frequency (MHz)	Meter Reading (dBm)	Correction Factor (dB)		Pre-Amp Gain (dB)	Substitution Antenna Gain (dBd)		ERP (dBm)	ERP (mW)	Polarity	Comments
										Tx at 836.52
1673.04	-69.0	31.1		0	4.0		-33.9	0.00	V	
										Tx at 824.7 MHz
1649.4	-68.0	31.1		0	4.0		-32.9	0.0005	V	
										Tx at 848.31 MHz
1696.62	-68.4	31.1		0	4.0		-33.3	0.0005	V	Noise floor
Notes: <u>The handset was tested with a fully charged battery</u>										

The spectrum was searched from 30 MHz to 9 GHz.

All emissions and noise floor readings within 20 dB of the specification limit of -13 dBm ERP are reported.

Test Setup Photo



Section 6. Frequency Stability

NAME OF TEST: Frequency Stability	PARA. NO.: 2.1055
TESTED BY: David Light	DATE: 04 October 2005

Test Results: [Complies.](#)**Test Data:** [See attached table.](#)
Standard Test Frequency: [836.52](#) MHz
Standard Test Voltage: [3.7](#) Vdc**Equipment Used:** [1082-619-283-HP8924C](#)**Measurement Uncertainty:** [+/- 1 x 10⁻⁷](#) ppm**Temperature:** [22](#) °C**Relative Humidity:** [45](#) %

Test Data – Frequency Stability

<u>Frequency Stability</u>							
Page <u>1</u> of <u>1</u>							
Job No.: 5L0495		Date: 10/4/2005					
Specification: Part 22		Temperature(°C): <u>22</u>					
Tested By: <u>David Light</u>		Relative Humidity(%) <u>45</u>					
E.U.T.: _____		800 MHz CDMA handset					
Configuration: _____		TX					
Sample Number: <u>1</u>							
<u>Test Equipment Used</u>							
Antenna: _____							
Pre-Amp: _____							
Chamber <u>283</u>							
Receiver: <u>HP8924C</u>							
Cable <u>1082</u>							
Thermometer <u>619</u>							
Measurement Uncertainty: <u>1x10⁻¹⁷ ppm</u>							
Standard Test Frequency <u>836.520000</u> MHz							
Temp (°C)	Measured Frequency (MHz)	Rho	Test Voltage	Frequency Error (Hz)	Limit (+/-Hz)	Error (ppm)	Comment
20	836.519987	0.993	3.7 Vdc	-13	836.5	-0.0152	
20	836.519979	0.991	4.2 Vdc	-21	836.5	-0.0251	
20	836.519998	0.993	3.3 Vdc	-2	836.5	-0.0024	Battery cutoff
50	836.520003		3.7 Vdc	3	836.5	0.0036	
40	836.519985		3.7 Vdc	-15	836.5	-0.0179	
30	836.520012		3.7 Vdc	12	836.5	0.0143	
10	836.519987		3.7 Vdc	-13	836.5	-0.0155	
0	836.519986		3.7 Vdc	-14	836.5	-0.0167	
-10	836.519994		3.7 Vdc	-6	836.5	-0.0072	
-20	836.520007		3.7 Vdc	7	836.5	0.0084	
-30	836.519986		3.7 Vdc	-14	836.5	-0.0167	
Notes: _____							

Section 7. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 2.1046
TESTED BY: David Light	DATE: 03 October 2005

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

Frequency (MHz)	Modulation Type	RF Power Output (dBm)	RF Power Output (Watts)
824.70	CDMA	23.90	0.245
836.52	CDMA	23.68	0.233
848.31	CDMA	23.50	0.224

Equipment Used: HP8924C-993-1484-1485**Measurement
Uncertainty:** +/- 1.7 dB**Temperature:** 22 °C**Relative
Humidity:** 45 %

Test Data – RF Power Output Radiated

<u>ERP</u>										
Page <u>1</u> of <u>1</u>						Complete <u>X</u>				
Job No.: 5L0495		Date: 10/3/05				Preliminary _____				
Specification: Part 22		Temperature(°C): 22								
Tested By: David Light		Relative Humidity(%) 45								
E.U.T.: 800 MHz CDMA handset										
Configuration: TX										
Sample No: 1										
Location: AC 3						Measurement Distance: 3 m				
Detector Type: Channel power										
Test Equipment Used										
Antenna: 993				Directional Coupler: _____						
Pre-Amp: _____				Cable #1: 1484						
Filter: _____				Cable #2: 1485						
Receiver: HP 8924C				Cable #3: _____						
Attenuator #1: _____				Cable #4: _____						
Attenuator #2: _____				Mixer: _____						
Additional equipment used: _____										
Measurement Uncertainty: +/-1.7 dB										
Frequency (MHz)	Meter Reading (dBm)	Correction Factor (dB)		Pre-Amp Gain (dB)	Substitution Antenna Gain (dBd)		ERP (dBm)	ERP (mW)	Polarity	Comments
836.52	-16.5	33.2		0	0.5		17.2	52.48	V	
824.70	-14.9	33.2		0	0.5		18.8	75.86	V	
848.31	-16.3	33.2		0	0.5		17.4	54.95	V	
Notes: _____										

Section 8. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
993	Horn antenna	A.H. Systems SAS-200/571	XXX	08/01/05	08/02/07
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	11/12/04	11/12/05
1481	Microwave Highpass Filter	K & L 3DH1-2000/T8000-0/0	4	Cal B4 Use	N/A
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	01/14/05	01/15/07
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	CBU	N/A
1485	Cable 2.0-18.0 Ghz	Storm PR90-010-216	N/A	CBU	N/A
1311	ANTENNA, LOG PERIODIC	EMCO 3146	1753	08/02/05	08/02/06
791	PREAMP, 25dB	ICC LNA25	398	11/12/04	11/12/05
760	Antenna biconical	Electro Metrics MFC-25	477	08/04/05	08/04/06
1082	CABLE 2m	Astrolab 32027-2-29094-72TC	N/A	CBU	N/A
1054	DUAL DIRECTIONAL COUPLER	NARDA 3020A	34366	Cal Not Req	N/A
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	03/22/04	03/23/06
1055	DUAL DIRECTIONAL COUPLER	NARDA 3022	73393	Cal Not Req	N/A
1058	DUAL DIRECTIONAL COUPLER	HEWLETT PACKARD 11692D	1212A03366	Cal Not Req	N/A
619	THERMOMETER	FLUKE 51	4520028	09/26/05	09/26/06
283	Environmental Chamber with controller # 1189006	ENVIROTRONICS SH27 & 2030-22844	129010083	NA	NA
Nokia	Cell Site Simulator	HP 8924C	US38283285	07/05/05	07/05/07

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 an in-line peak power meter. Power output is measured with the maximum rated input level.

Integral Antenna:

TIA/EIA-603-1992, Section 2.2.12

The antenna substitution method was used to determine the equivalent radiated power at spurious frequencies. The spurious emissions were measured at a distance of 3 meters. The EUT was then replaced with a reference substitution antenna with a known gain referenced to a dipole. This antenna was fed with a signal at the spurious frequency. The level of the signal was 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 (Digital Modulation) PARA. NO.: 2.1049

Minimum Standard: Not defined by FCC. Input vs. Output.

Method Of Measurement:

Spectrum Analyzer Settings:

RBW: CDMA (30 kHz), GSM (30 kHz), NADC (1 kHz) and CDPD (1 kHz)

VBW: $\geq$ RBW

Span: As required

Sweep: Auto

Input Signal Characteristics:

RF level: Maximum recommended by manufacturer

NAME OF TEST: Spurious Emission at Antenna Terminals	PARA. NO.: 2.1051
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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:

Spectrum Analyzer Settings:

RBW: 30 kHz (AMPS). As required for digital modulations.

VBW: $\geq$ RBW

Start Frequency: 0 MHz

Stop Frequency: 10 GHz

Sweep: Auto

NAME OF TEST: Field Strength of Spurious Radiation**PARA. NO.: 2.1053**

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.

Calculation Of Field Strength Limit:

An example of attenuation requirement of $43 + 10 \log P$ is equivalent to -13 dBm (5×10^{-5} Watts) at the antenna terminal. We determine the field strength limit by using the plane wave relation.

$$GP/4\pi R^2 = E^2/120\pi$$

For emissions ≤ 1 GHz:

$G = 1.64$ (Dipole Gain)

$P = 10^{-5}$ Watts (Maximum spurious output power)

$R = 3m$ (Measurement Distance)

$$E = \frac{\sqrt{30GP}}{R}$$

$$E = \frac{\sqrt{30 \times 1.64 \times 5 \times 10^{-5}}}{3} = 0.016533 \text{ V / m} = 84.4 \text{ dB}\mu\text{V / m}$$

For emissions > 1 GHz:

$G = 1$ (Isotropic Gain)

$P = 1 \times 10^{-5}$ Watts (Maximum spurious output power)

$R = 3m$ (Measurement Distance)

$$E = 84.4 - 20 \log \sqrt{1.64} = 82.3 \text{ dB}\mu\text{V / m@3m}$$

The spectrum is searched to 10 GHz.

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

Freq. Range (MHz)	Base, fixed	Mobile > 3 W	Mobile $\leq$ 3 W
821 to 896	1.5	2.5	2.5

Method Of Measurement:Frequency Stability With Voltage Variation:

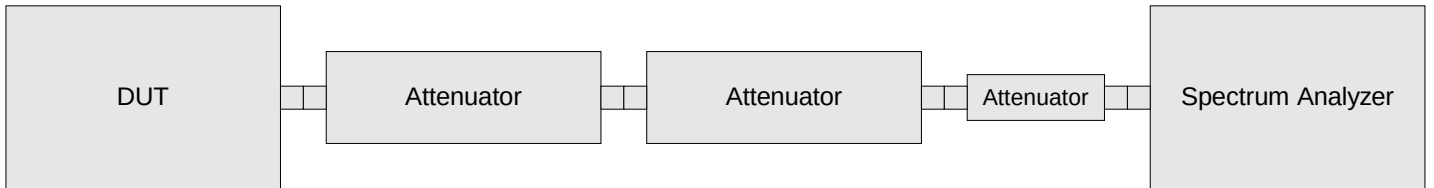
The E.U.T. is placed in an environmental chamber and allowed to stabilize at +20 degrees Celsius for at least 15 minutes. The frequency counter and signal generator are phase locked with the same 10 MHz reference frequency by connecting the 10 MHz ref. out of the counter to the 10 MHz ref. in of the 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:

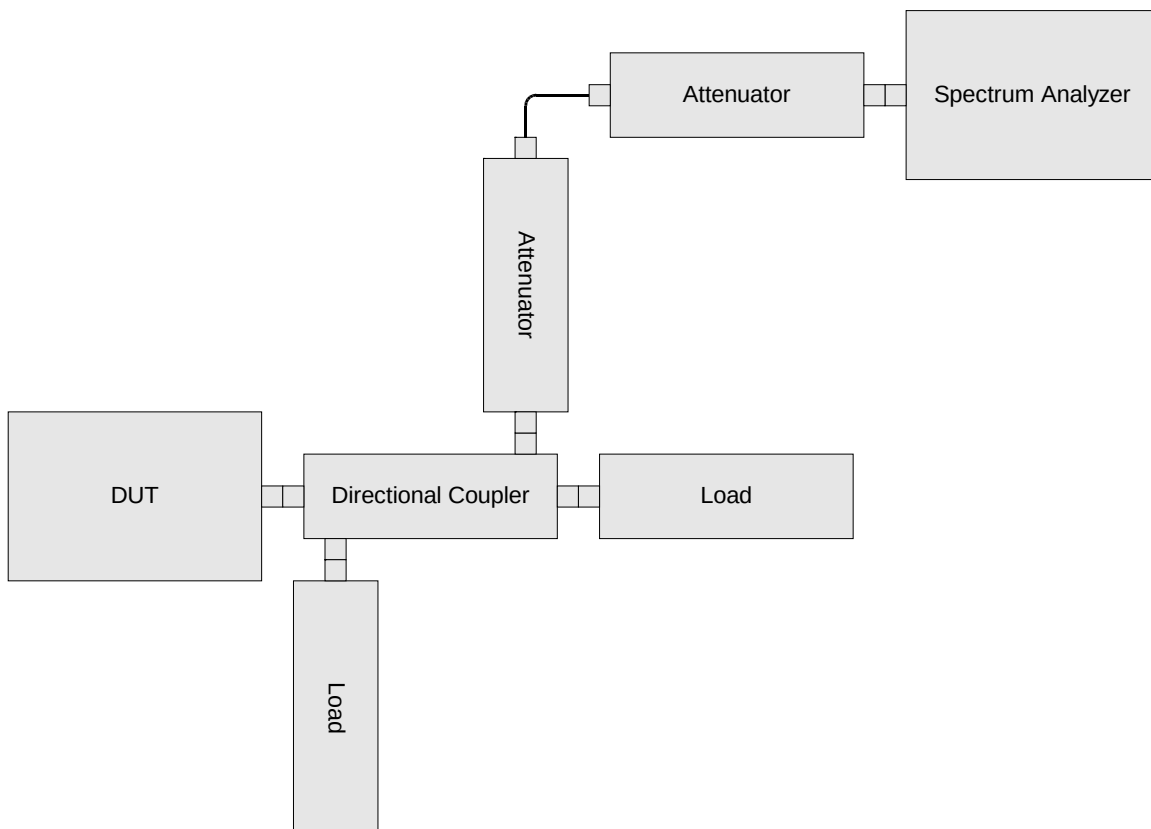
The input voltage to the E.U.T. is set to S.T.V. and the temperature of the environmental chamber is varied in 10 degree steps from -30 degrees C to +50 degrees C. The E.U.T. is allowed to stabilize at each temperature and the frequency is measured in 30 second intervals for a period of 5 minutes.

ANNEX B - TEST DIAGRAMS

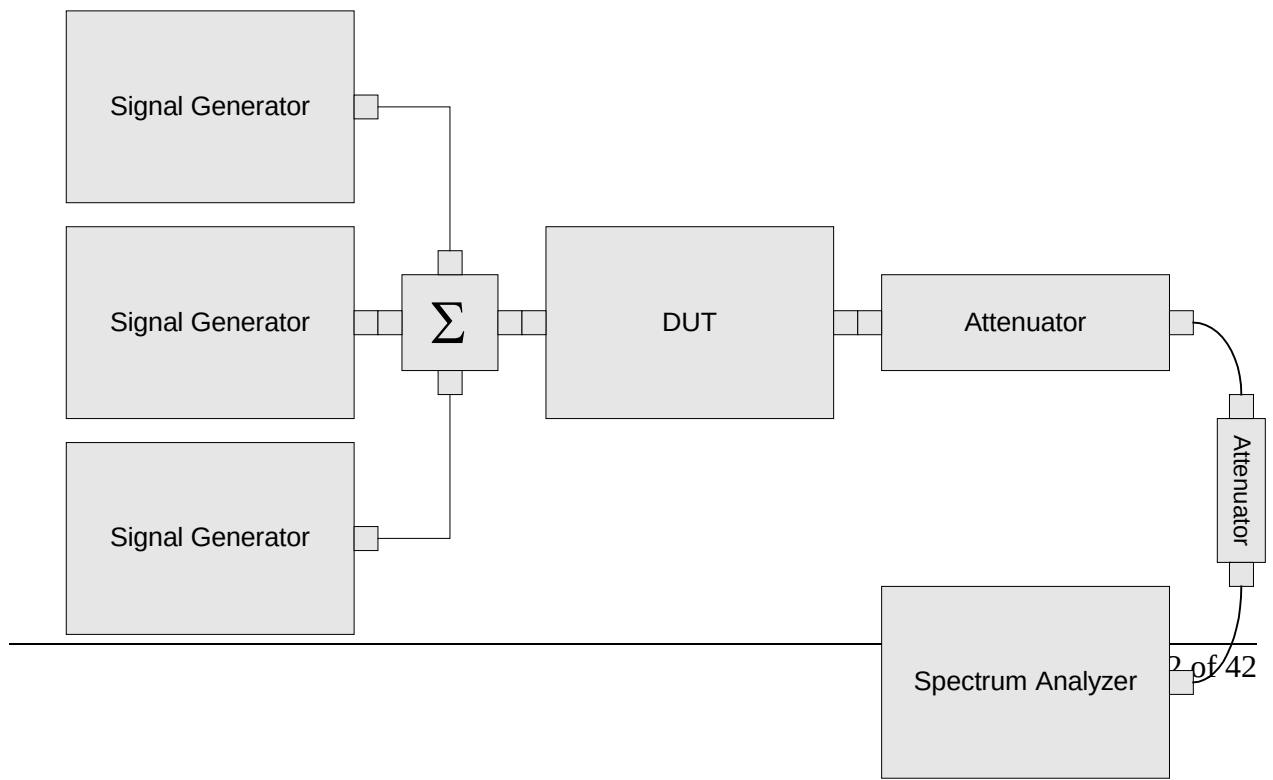
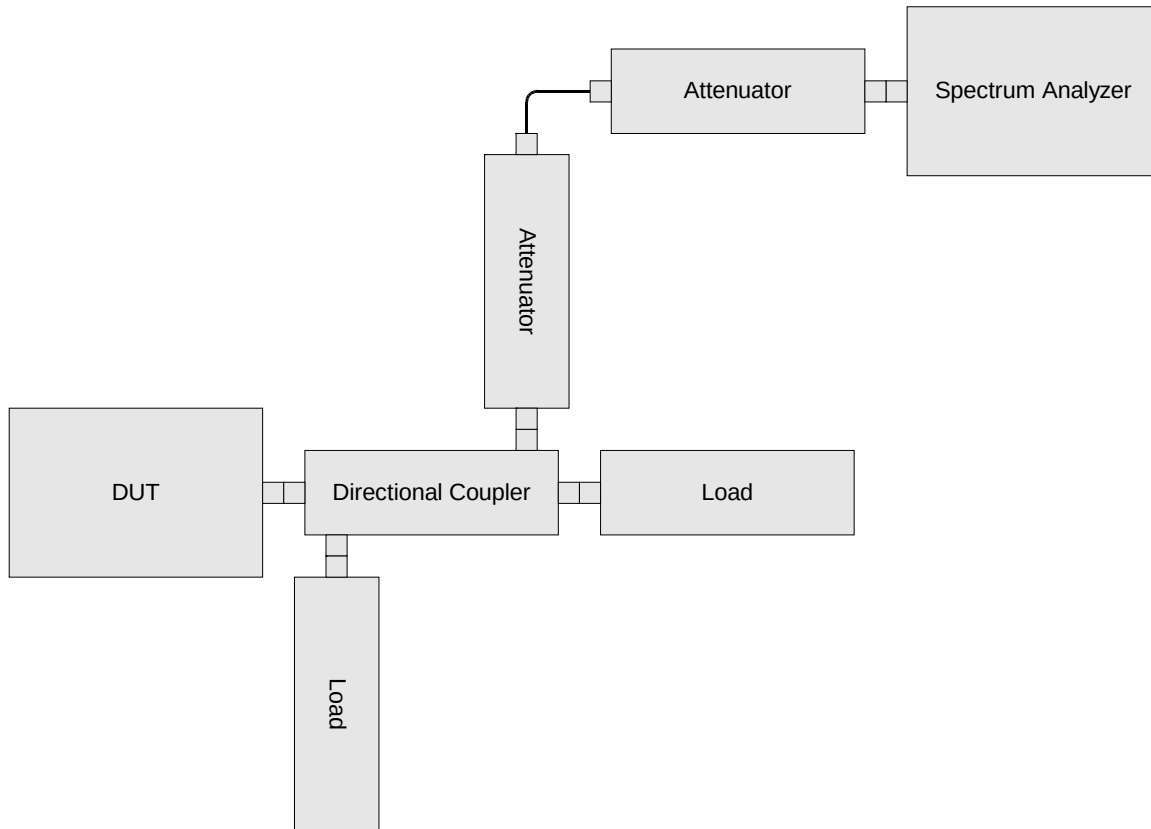
Para. No. 2.1046 - R.F. Power Output



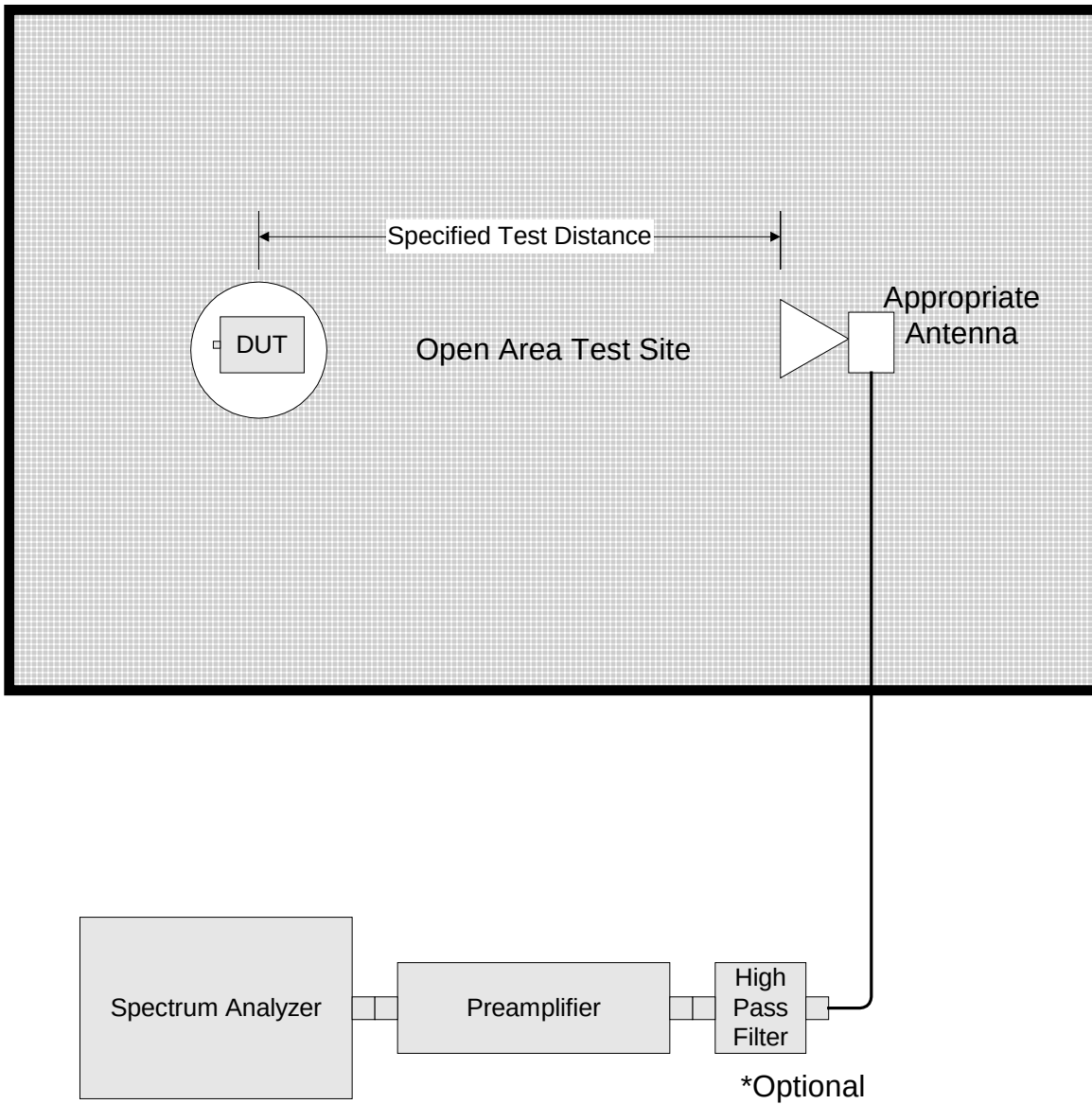
Para. No. 2.1049 - Occupied Bandwidth

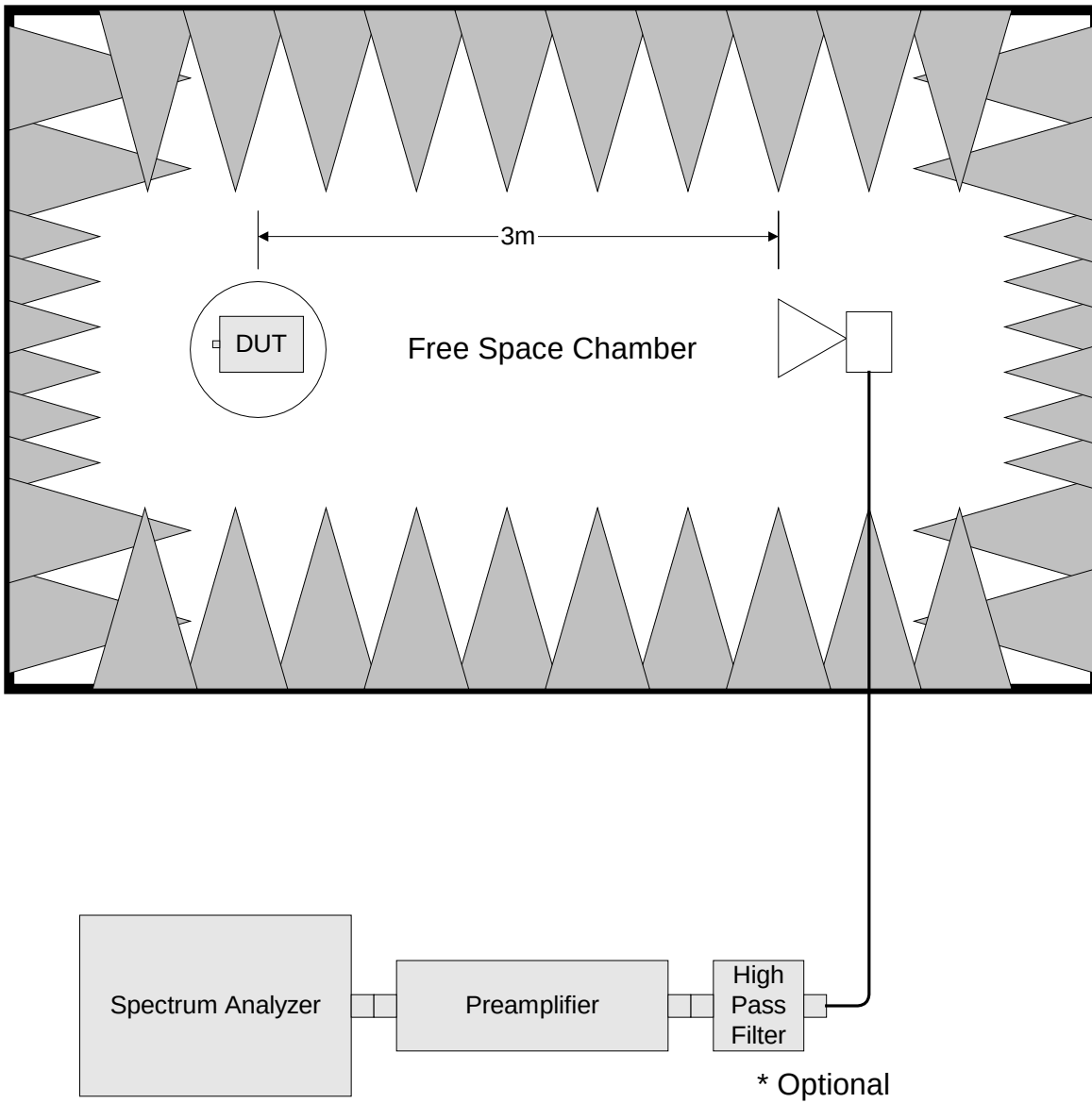


Para. No. 2.1051 Spurious Emissions at Antenna Terminals



Para. No. 2.1053 - Field Strength of Spurious Radiation





Para. No. 2.1055 - Frequency Stability

