| | |
|---|---|
| **Nemko Test Report:** | 5L0403RUS1rev2 |
| **Applicant:** | Nokia, Inc. |
| **Equipment Under Test: (E.U.T.)** | 6155i |
| **In Accordance With:** | **FCC Part 22, Subpart H**<br>Cellular Band Subscriber Services |
| **Tested By:** | Nemko Dallas Inc.<br>802 N. Kealy<br>Lewisville, TX<br>75057-3136 |
| **Authorized By:** | Tom Tidwell, Frontline Group Manager |
| **Date:** | 22 September, 2005 |

# Table of Contents

## Section 1. Summary of Test Results

Manufacturer: Nokia, Inc.

Model No.: 6155i

Type: B3.0

Serial No.: 044/13202978

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.

## Summary Of Test Data

| NAME OF TEST | PARA. NO. | RESULT |
|---|---|---|
| RF Power Output | 2.1046 | Not Tested |
| Audio Frequency Response | 2.1047 | Not Tested |
| Audio Low Pass Filter Response | 2.1047 | Not Tested |
| Modulation Limiting | 2.1047 | Not Tested |
| 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**
**:**

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

.

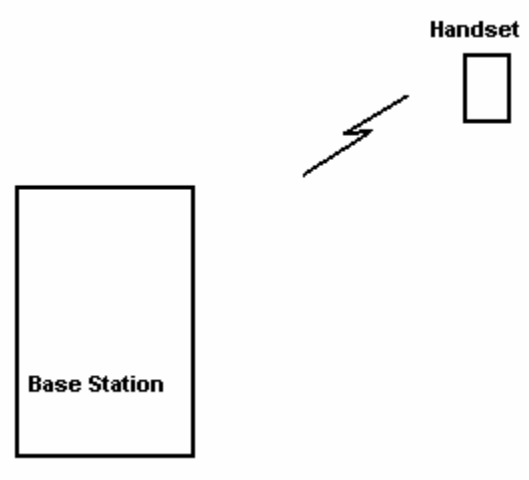
## Section 2. General Equipment Specification

| | |
|---|---|
| Frequency Range: | 824.04 to 848.97 MHz |
| Tunable Bands: | 824.04 to 849.97 MHz |
| Necessary Bandwidth: | 1.25 MHz CDMA<br>40 kHz Analog |
| Emission Designator: | 1M25F9W<br>40KF8W \ 40K0F1D |
| Output Impedance: | 50 ohms |
| Operator Selection of Frequency: | Software Controlled |
| Power Output Adjustment Capability: | Software Controlled |

## Operational Description

The phone is a dual band CDMA phone operating in the 800 MHz cellular band and 1900 PCS band. It also supports analog operation in the 800 MHz Band

## System Diagram



## Section 3. Occupied Bandwidth

| | |
|---|---|
| NAME OF TEST: Occupied Bandwidth | PARA. NO.: 2.1049 |
| TESTED BY: David Light | DATE: 7/25/2005 |

**Test Results:** Complies.

**Test Data:** See attached plots

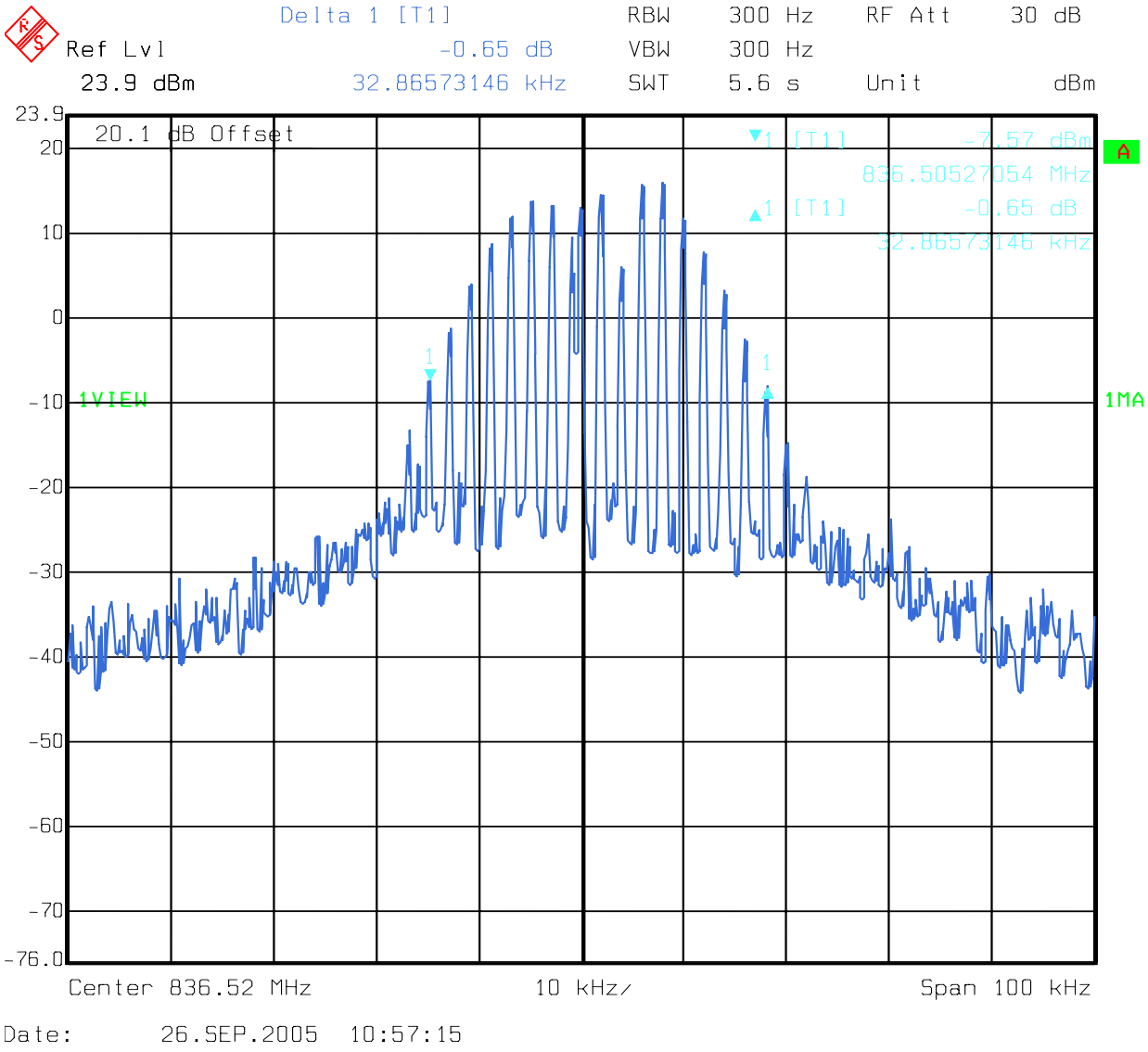
**Equipment Used:** 1082-1472-1659-1464

**Measurement Uncertainty:** +/- 1.6 dB

**Temperature:** 22 °C

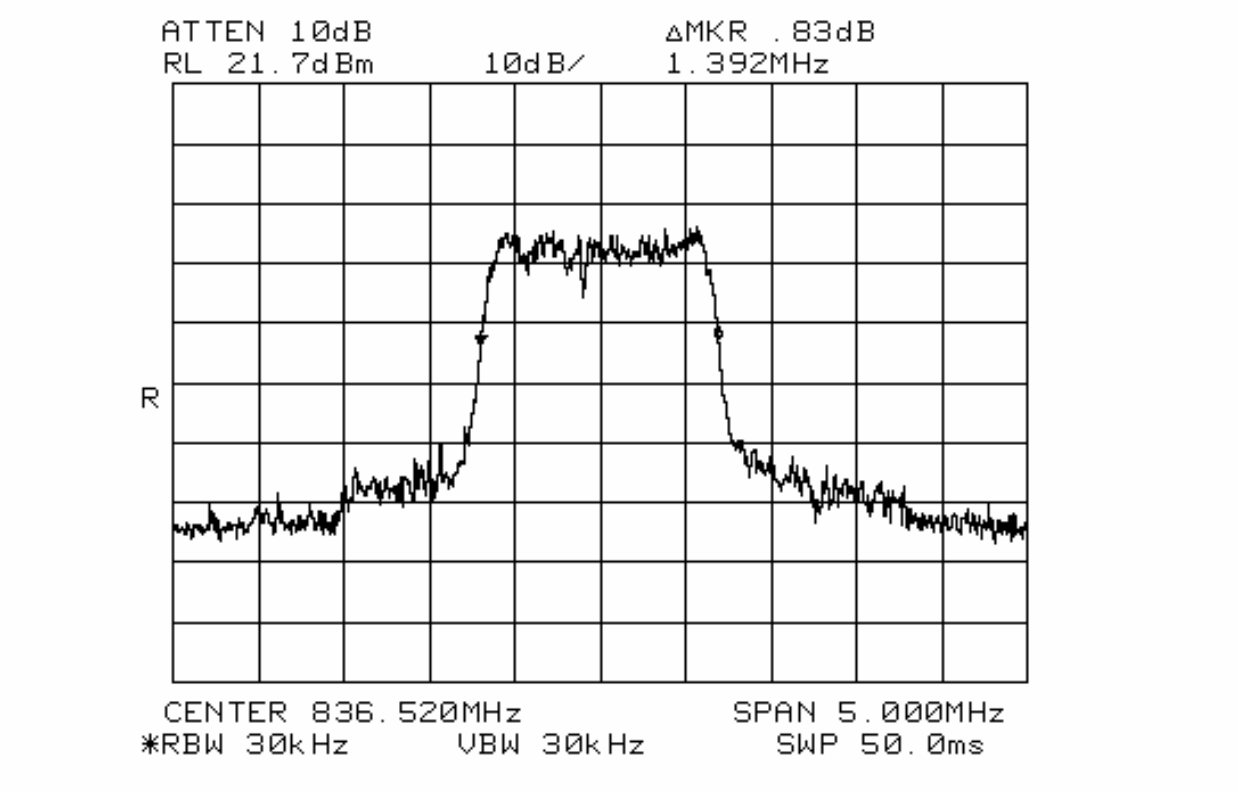
**Relative Humidity:** 45 %

## Test Data – Occupied Bandwidth (Voice & SAT)




2 kHz AF + 6 kHz SAT

**Test Data – Occupied Bandwidth (CDMA)**



## Section 4. Spurious Emissions at Antenna Terminals

| | |
|---|---|
| NAME OF TEST: Spurious Emissions @ Antenna Terminals | PARA. NO.: 2.1051 |
| TESTED BY: David Light | DATE: 8/2/2005 |

**Test Results:** Complies.

**Test Data:** See attached plots

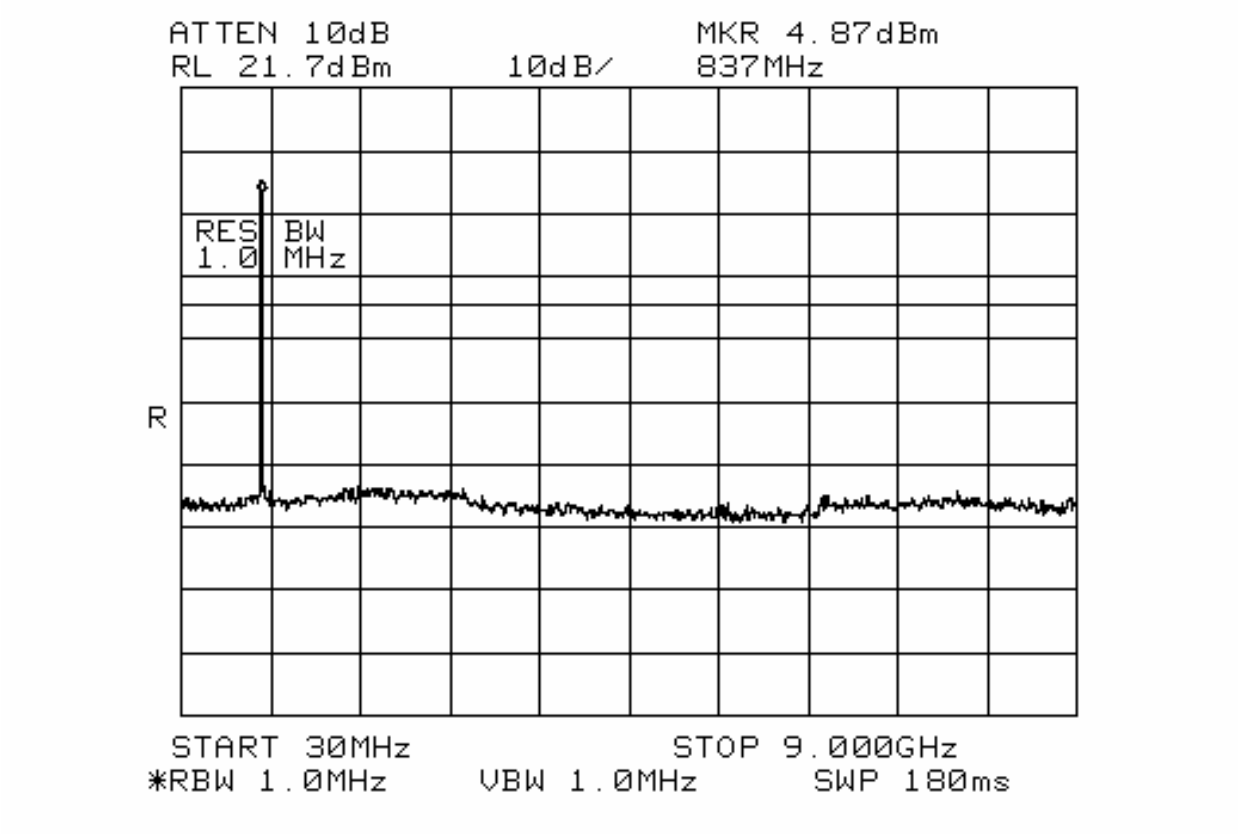
**Equipment Used:** 1082-1472-1464-1659

**Measurement Uncertainty:** +/- 1.6 dB

**Temperature:** 22 °C

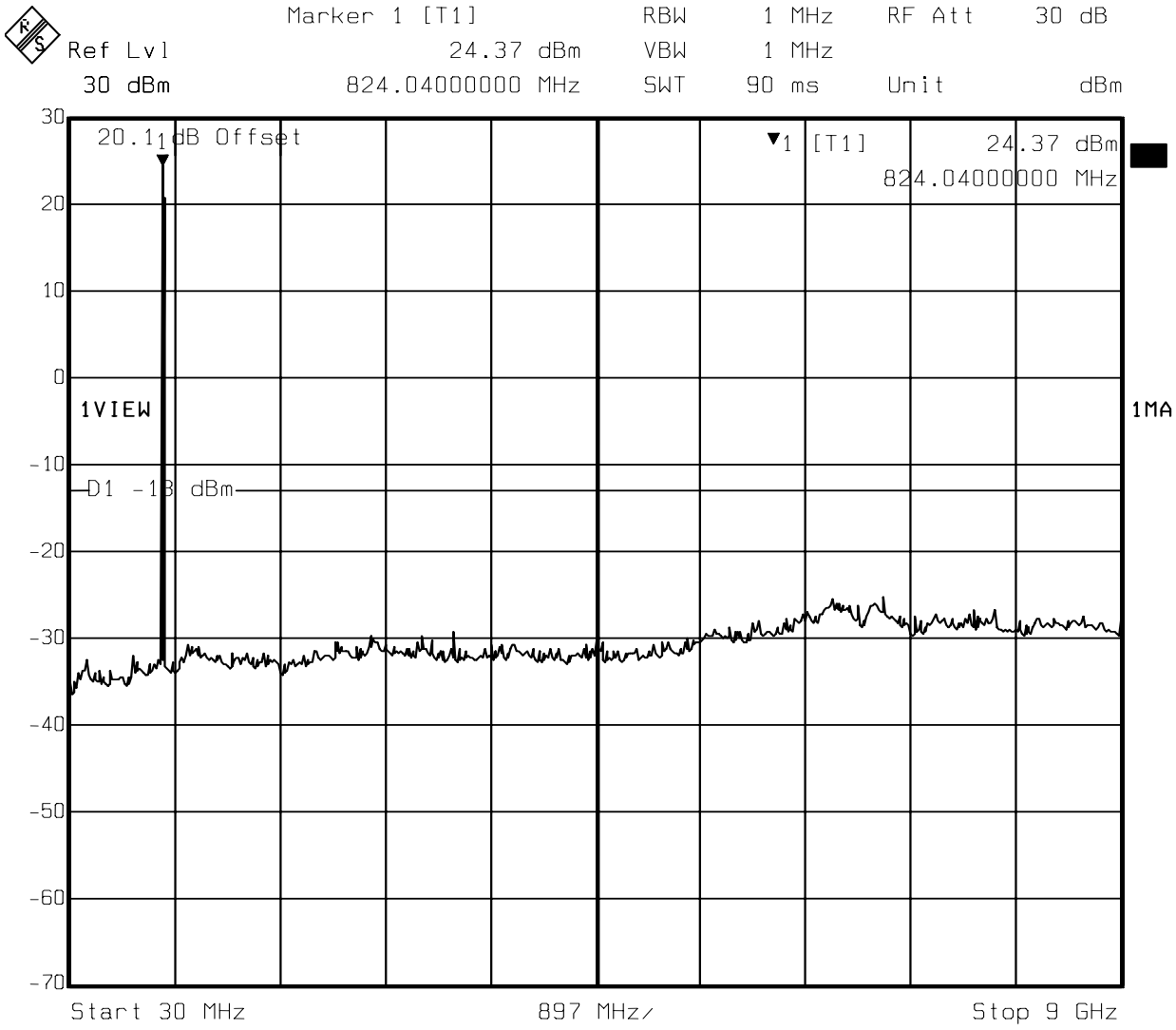
**Relative Humidity:** 45 %

**Test Data – Spurious Emissions (Analog)**



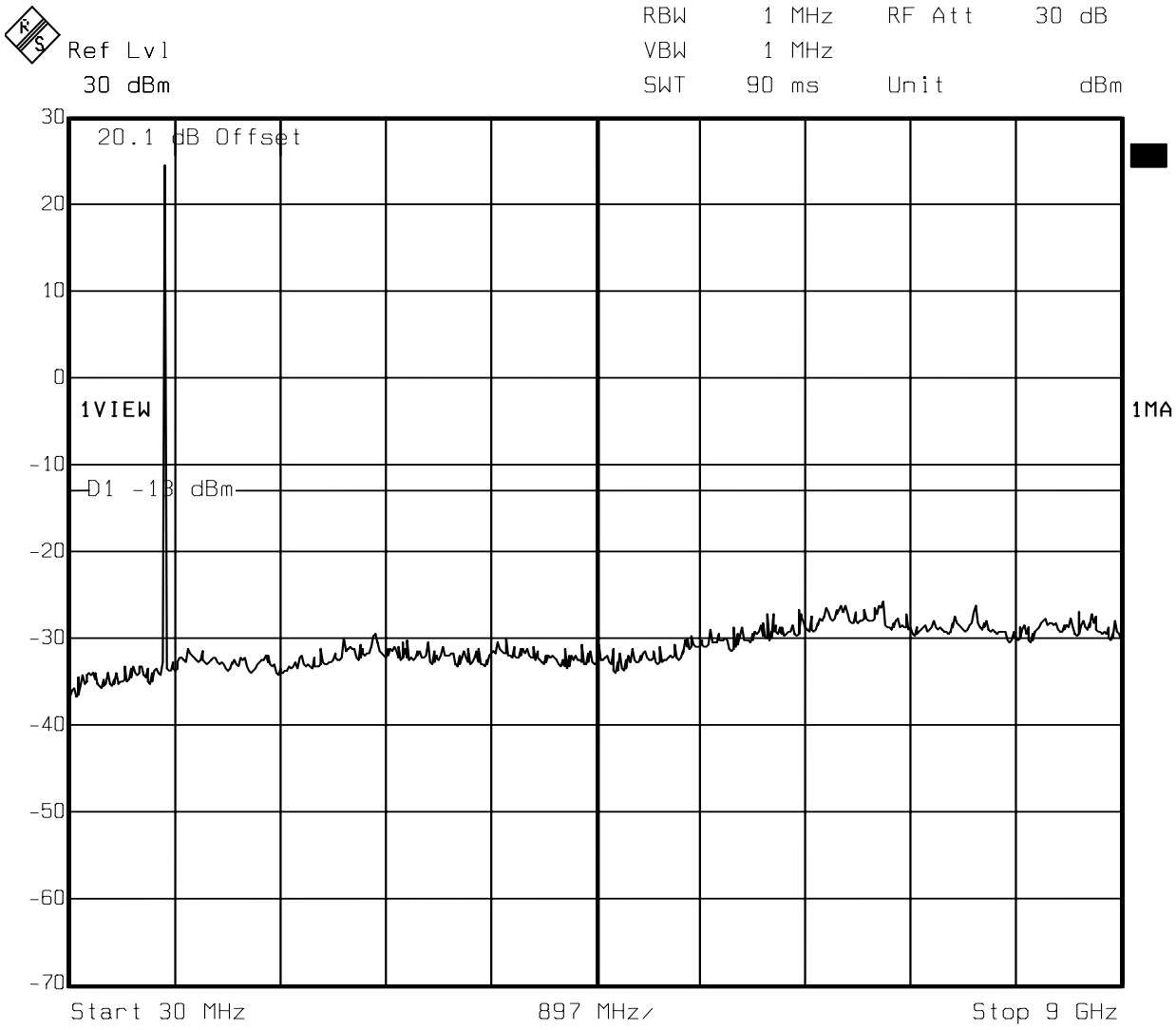

Channel 384

## Test Data – Spurious Emissions (Analog)



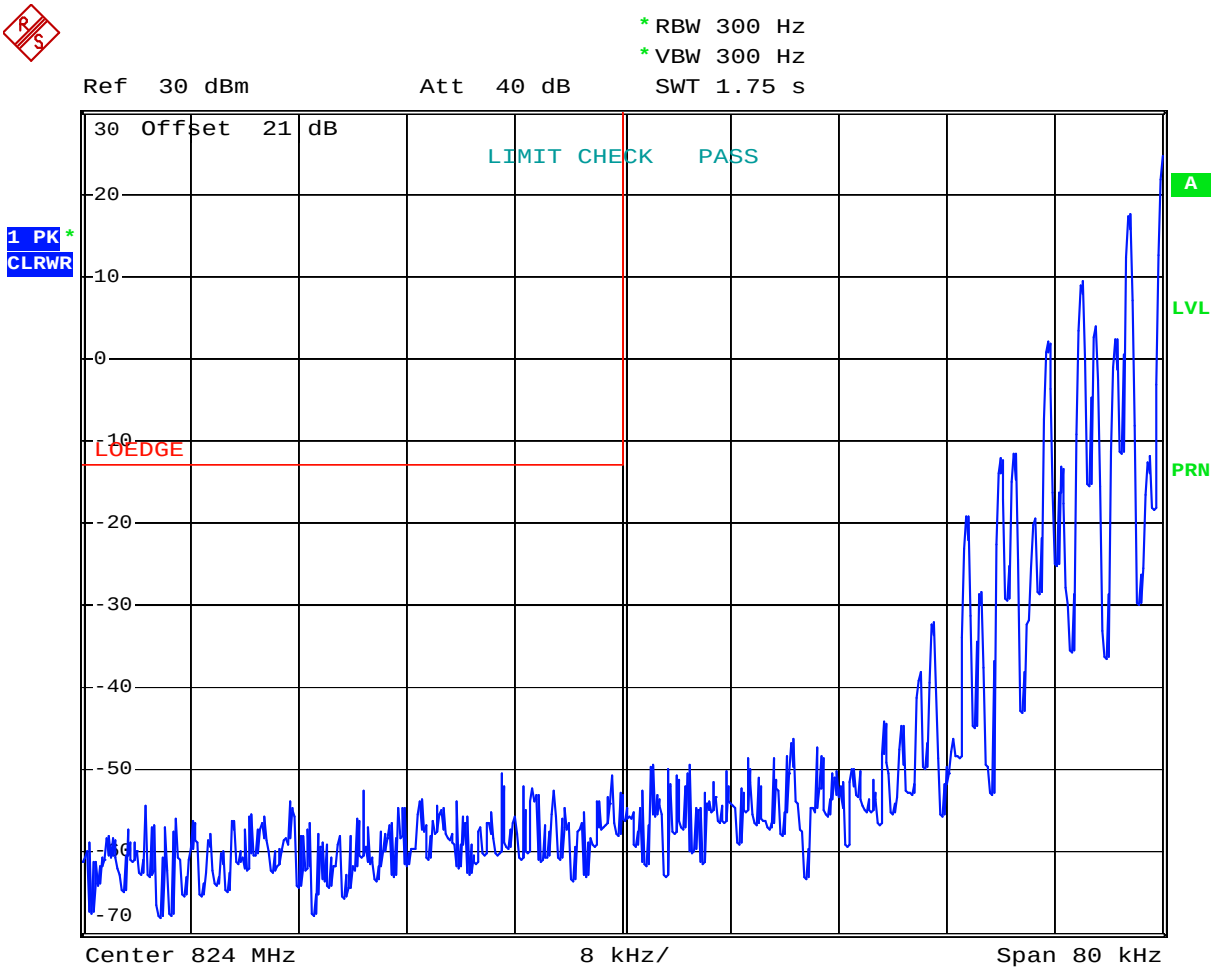

Channel 991

## Test Data – Spurious Emissions (Analog)




Channel 799

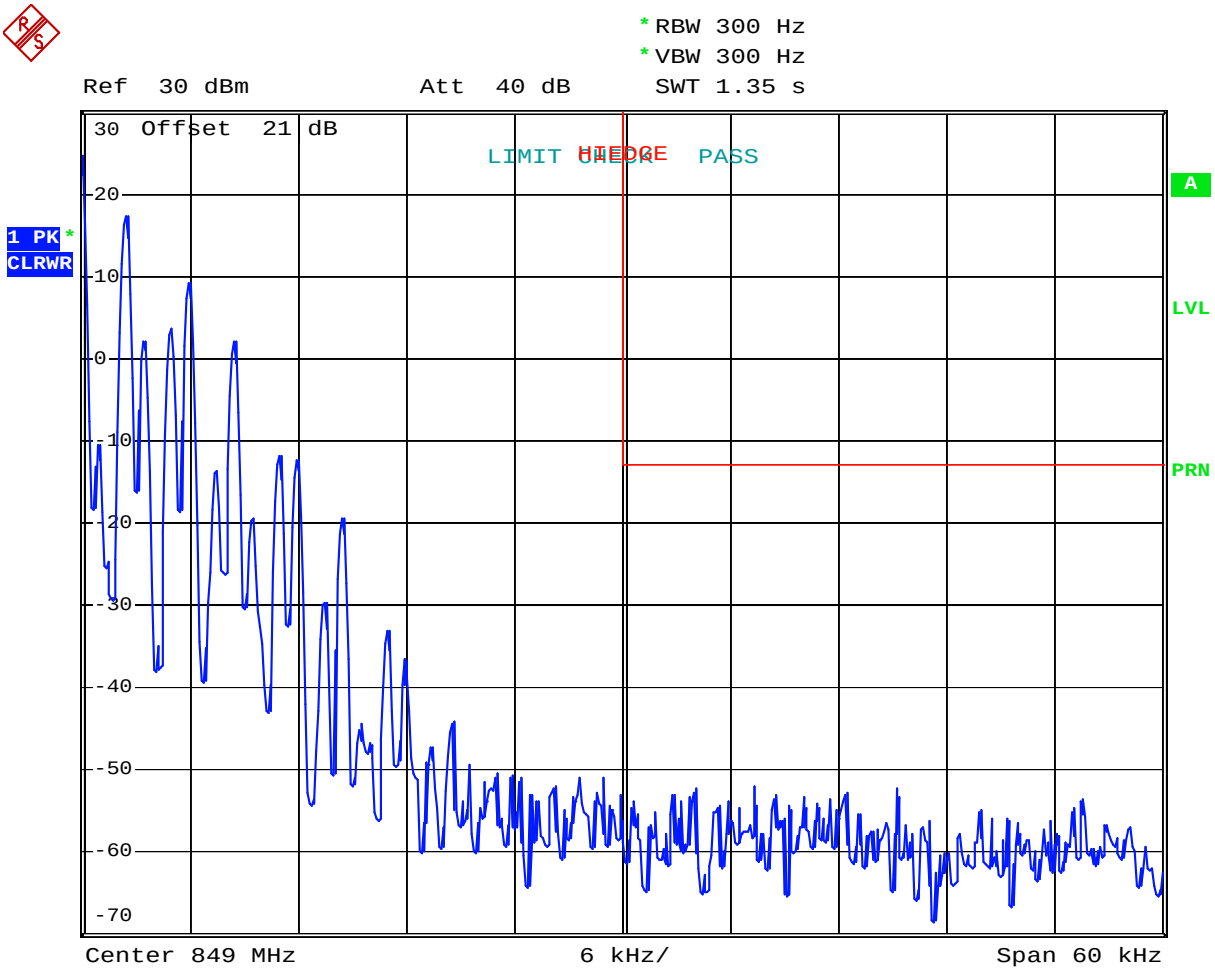
## Test Data – Spurious Emissions (Analog)




Date: 2.AUG.2005 15:51:14

Channel 991

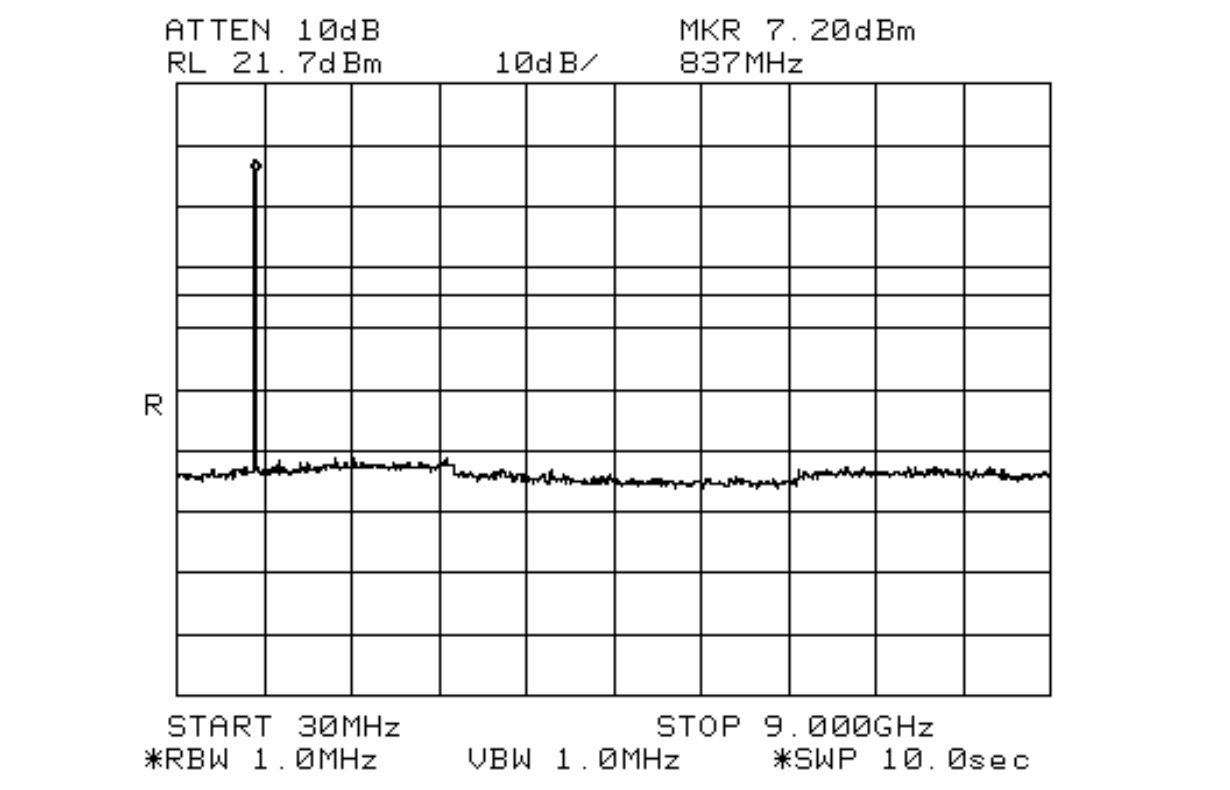
## Test Data – Spurious Emissions (Analog)




Date: 2.AUG.2005 15:48:39

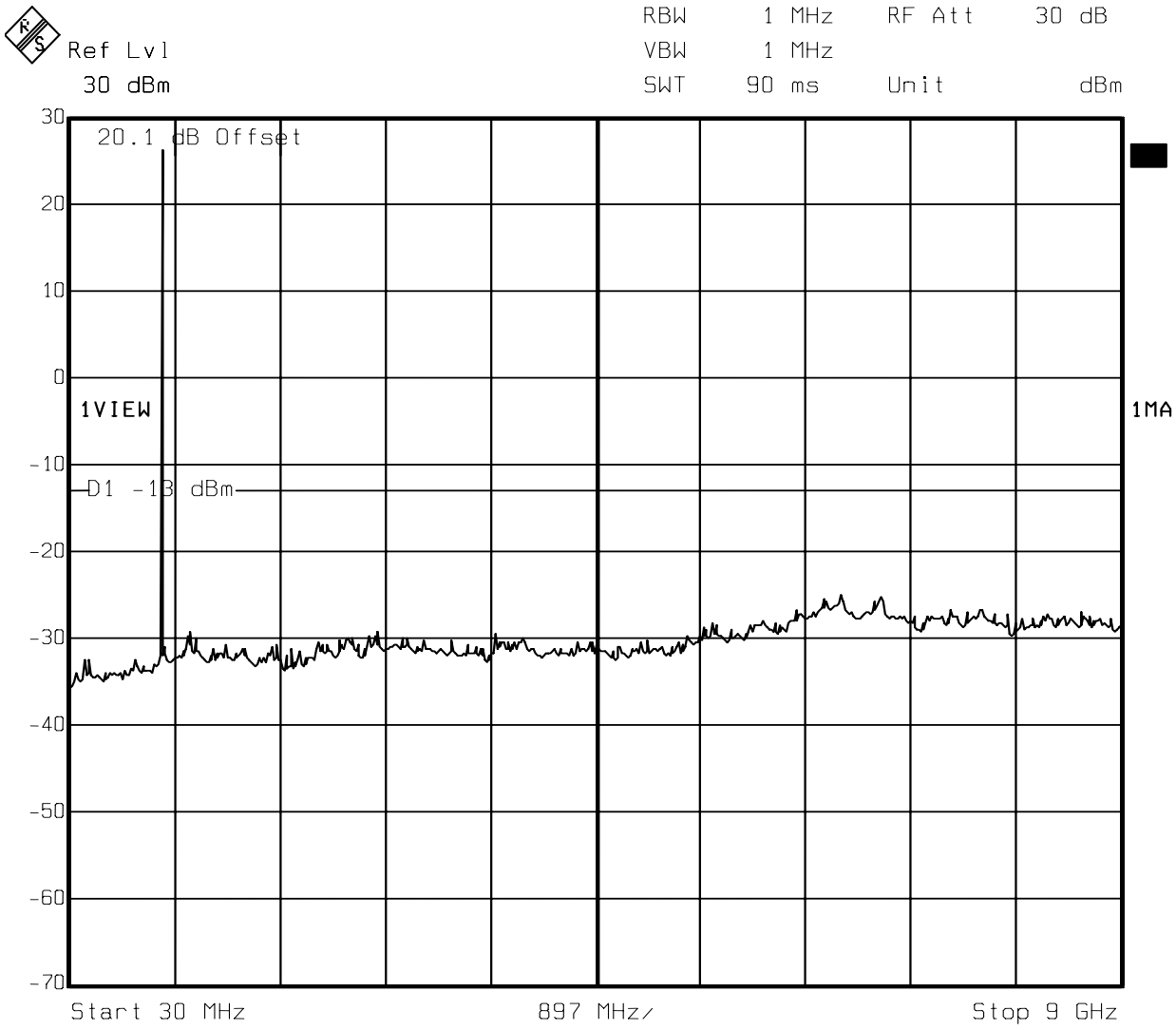
Channel 799

**Test Data – Spurious Emissions (CDMA)**



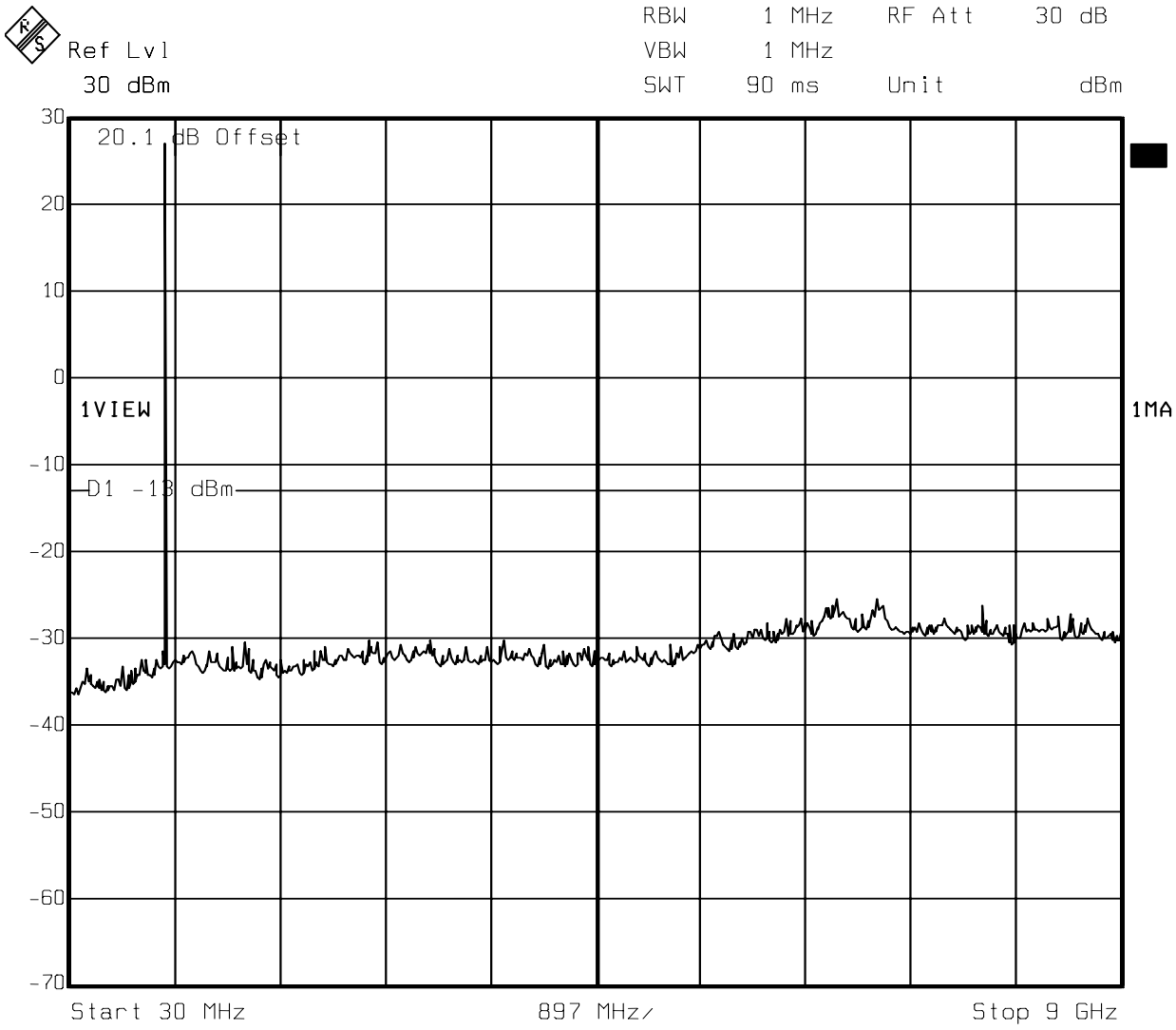

Channel 384

## Test Data – Spurious Emissions (CDMA)



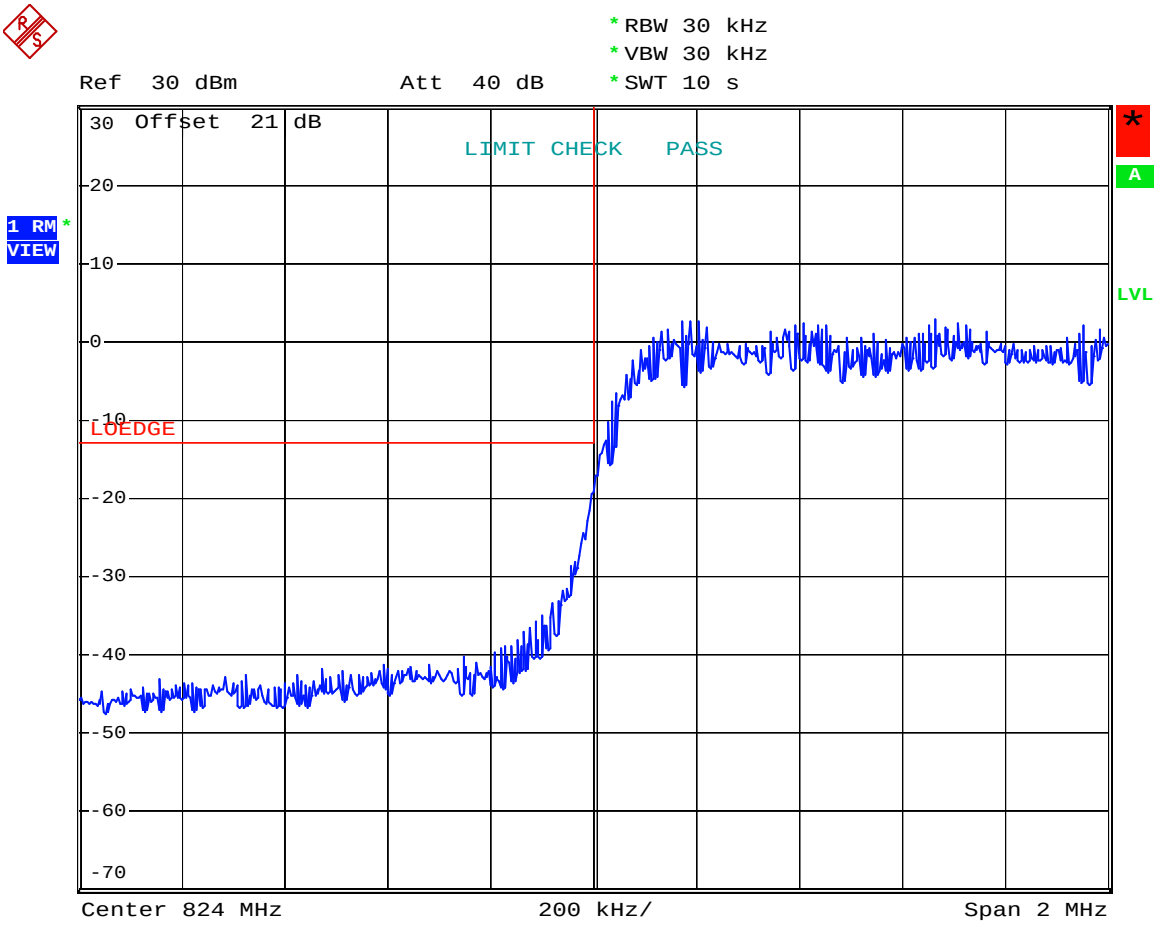

Channel 1013

## Test Data – Spurious Emissions (CDMA)



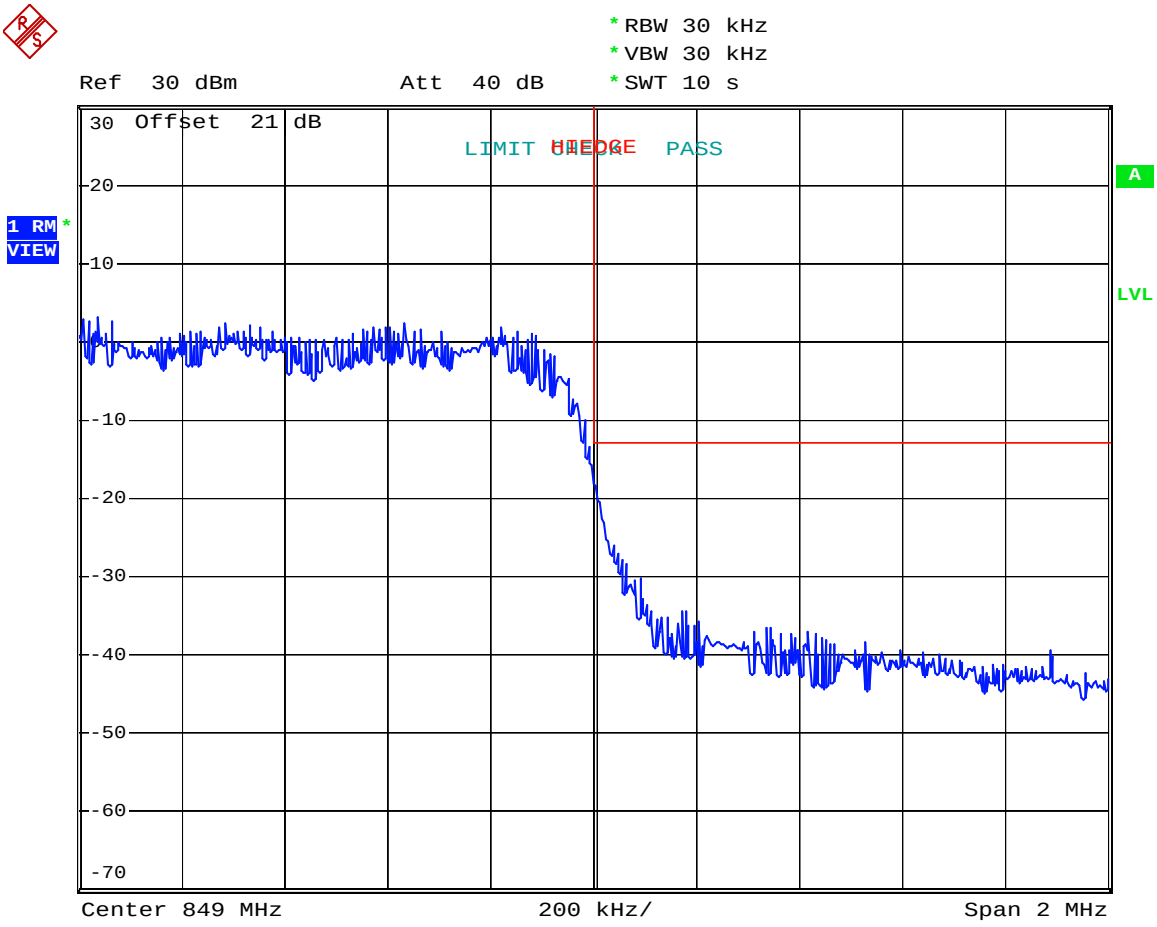

Channel 777

## Test Data – Spurious Emissions (CDMA)




Channel 1013

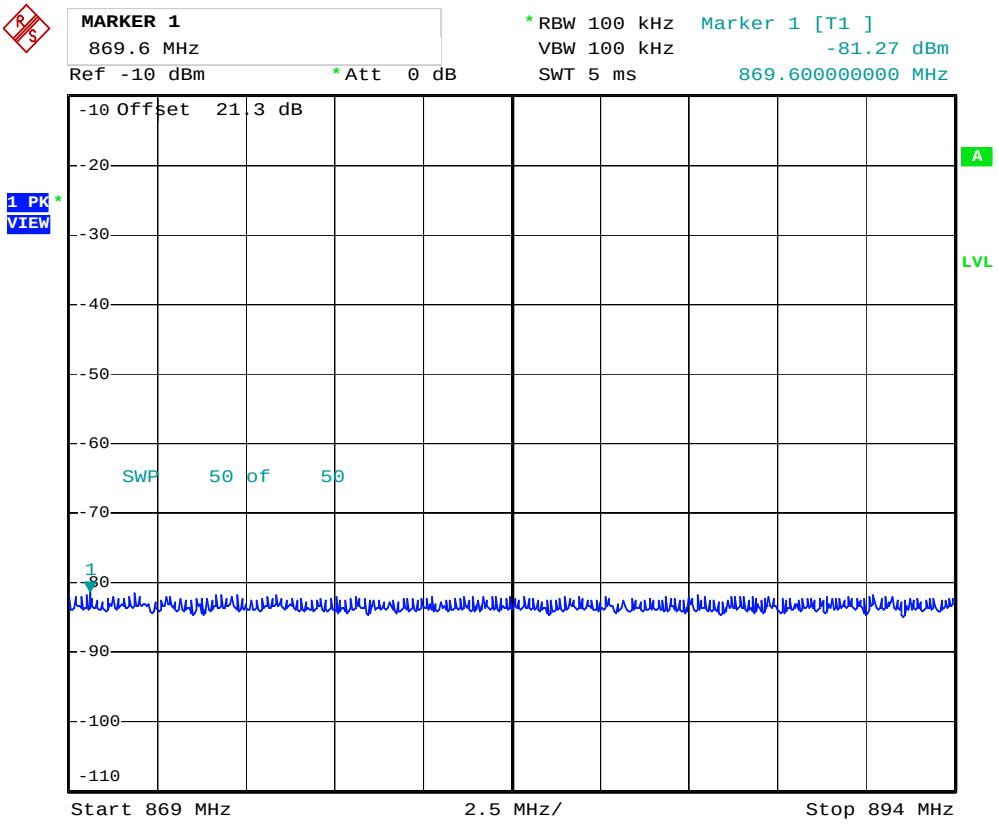
## Test Data – Spurious Emissions (CDMA)




Channel 777

## Test Data – Spurious Emissions in Rx Band

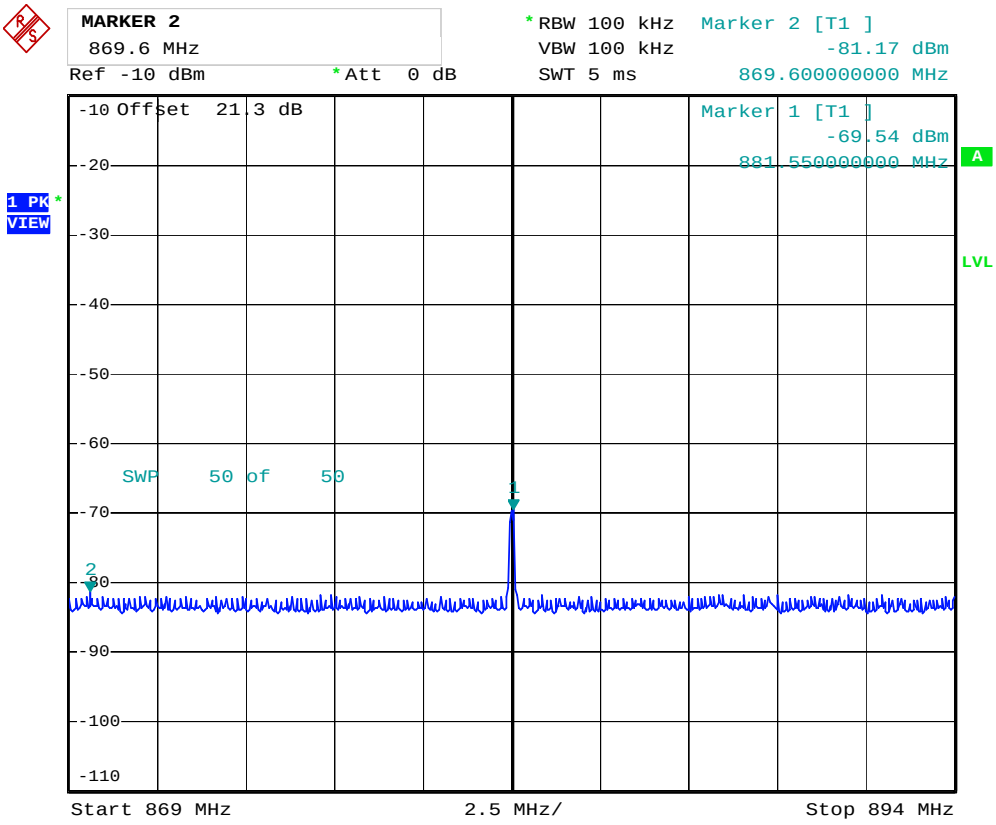
CDMA Mode




22.917
Channel 384

## Test Data – Spurious Emissions in Rx Band

Analog mode




22.917
Marker 1 is from base station simulator
Marker 2 is highest emission
Channel 384

## Section 5. Field Strength of Spurious

| | |
|---|---|
| NAME OF TEST: Field Strength of Spurious | PARA. NO.: 2.1053 |
| TESTED BY: David Light | DATE: 8/9/2005 |

**Test Results:** Complies. There were no emissions detected above the noise floor. The spectrum was searched from 30 MHz to 9 GHz.

**Test Data:** There were no emissions detected above the noise floor. The spectrum was searched from 30 MHz to 9 GHz. The highest noise floor reading was -26 dBm @ 1673.04 MHz. All other noise floor readings were greater than 20 dBc below the specification limit of -13 dBm ERP

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

**Measurement Uncertainty:** +/- 1.7 dB

**RBW=VBW=1 MHz: CDMA Mode**
**RBW=VBW= 1 kHz Analog Mode**

**Temperature:** 22 °C

**Relative Humidity:** 45 %

**Test Setup Photo**

## Section 6. Frequency Stability

| NAME OF TEST: Frequency Stability | PARA. NO.: 2.1055 |
|---|---|
| TESTED BY: | DATE: |

**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 Analog

**Frequency Stability**

Page 1 of 1

Job No.: 5L0403 Date: 8/3/2005
Specification: PT22 Temperature(°C): 22
Tested By: David Light Relative Humidity(%) 45
E.U.T.: 6155i
Configuration: Tx - Linked to base station - Analog mode
Sample Number: 1

**Test Equipment Used**

Antenna: Directional Coupler:
Pre-Amp: Cable #1:
Filter: Cable #2:
Receiver: HP8924C
Attenuator #1 1082
Attenuator #2:

Measurement Uncertainty: $1x10^{-17}$ppm **Standard Test Frequency 836.520000 MHz**

| Temp (°C) | Measured Frequency (MHz) | Rho | Test Voltage | Freqeuncy Error (Hz) | Limit (+/-Hz) | Error (ppm) | Comment |
|---|---|---|---|---|---|---|---|
| 20 | 836.520130 | | 3.7 | 130 | 836.5 | 0.2 | |
| 20 | 836.520130 | | 4.3 | 130 | 836.5 | 0.2 | |
| 20 | 836.520129 | | 2.9 | 129 | 836.5 | 0.2 | |
| | | | | | | | |
| 50 | 836.520200 | | 3.7 | 200 | 836.5 | 0.2 | |
| 40 | 836.520185 | | 3.7 | 185 | 836.5 | 0.2 | |
| 30 | 836.520200 | | 3.7 | 200 | 836.5 | 0.2 | |
| | | | | | | | |
| 10 | 836.520212 | | 3.7 | 212 | 836.5 | 0.3 | |
| 0 | 836.520205 | | 3.7 | 205 | 836.5 | 0.2 | |
| -10 | 836.520200 | | 3.7 | 200 | 836.5 | 0.2 | |
| -20 | 836.520215 | | 3.7 | 215 | 836.5 | 0.3 | |
| -30 | | | | | 836.5 | | |

Notes: The handset ceased operation at -20 degrees C.

## Test Data – Frequency Stability CDMA

**Frequency Stability**

Page 1 of 1

Job No.: 5L0403 Date: 8/3/2005
Specification: PT22 Temperature(°C): 22
Tested By: David Light Relative Humidity(%) 45
E.U.T.: 6155i
Configuration: Tx - Linked to base station - CDMA mode
Sample Number: 1

**Test Equipment Used**

Antenna: Directional Coupler:
Pre-Amp: Cable #1:
Filter: Cable #2:
Receiver: HP8924C
Attenuator #1 1082
Attenuator #2:

Measurement Uncertainty: $1x10^{-17}$ppm **Standard Test Frequency 836.520000 MHz**

| Temp (°C) | Measured Frequency (MHz) | Rho | Test Voltage | Freqeuncy Error (Hz) | Limit (+/-Hz) | Error (ppm) | Comment |
|---|---|---|---|---|---|---|---|
| 20 | 836.520002 | 0.994 | 3.7 | 2 | 836.5 | 0.0 | |
| 20 | 836.520002 | 0.990 | 4.3 | 2 | 836.5 | 0.0 | |
| 20 | 836.520002 | 0.995 | 2.9 | 2 | 836.5 | 0.0 | Battery end point |
| | | | | | | | |
| 50 | 836.520003 | 0.995 | 3.7 | 3 | 836.5 | 0.0 | |
| 40 | 836.520002 | 0.995 | 3.7 | 2 | 836.5 | 0.0 | |
| 30 | 836.520002 | 0.992 | 3.7 | 2 | 836.5 | 0.0 | |
| | | | | | | | |
| 10 | 836.520004 | 0.994 | 3.7 | 4 | 836.5 | 0.0 | |
| 0 | 836.520003 | 0.996 | 3.7 | 3 | 836.5 | 0.0 | |
| -10 | 836.520004 | 0.996 | 3.7 | 4 | 836.5 | 0.0 | |
| -20 | 836.520002 | 0.995 | 3.7 | 2 | 836.5 | 0.0 | |
| -30 | | | | | 836.5 | | |

Notes: The handset ceased operation at -20 degrees C.

## Section 7. Test Equipment List

| Nemko ID | Description | Manufacturer Model Number | Serial Number | Calibration Date | Calibration Due |
|---|---|---|---|---|---|
| 1304 | HORN ANTENNA | ELECTRO METRICS RGA-60 | 6151 | 09/22/03 | 09/22/05 |
| 1016 | Pre-Amp | HEWLETT PACKARD 8449A | 2749A00159 | 11/12/04 | 11/12/05 |
| 1482 | Band Pass Filter | K & L 11SH10-4000/T12000-0/0 | 2 | 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 | 08/26/04 | 08/26/05 |
| 1485 | Cable 2.0-18.0 Ghz | Storm PR90-010-216 | N/A | 08/02/04 | 08/02/05 |
| 1082 | CABLE 2m | Astrolab 32027-2-29094-72TC | N/A | CBU | N/A |
| 1472 | 20db Attenuator DC 18 Ghz | Omni Spectra 20600-20db | NONE | CBU | N/A |
| Nokia | Cell Site Simulator | HP 8924C | US38283285 | 07/18/05 | 07/18/07 |
| 283 | Environmental Chamber with controller # 1189006 | ENVIROTRONICS SH27 & 2030-22844 | 129010083 | 09/16/04 | 09/16/05 |
| 619 | THERMOMETER | FLUKE 51 | 4520028 | 09/16/04 | 09/16/05 |

# 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:
If the antenna is not detachable from the circuit then the Peak Power Output is derived from the peak radiated field strength of the fundamental emission by using the plane wave relation $GP/4\pi R^2 = E^2/120\pi$ and proceeding as follows:

$$P = \frac{E^2 R^2}{30G} = \frac{E^2 3^2}{30G}$$

where,

P = the equivalent isotropic radiated power in watts
E = the maximum measured field strength in V/m
R = the measurement range (3 meters)
G = the numeric gain of the transmit antenna in relation to an isotropic radiator

**NAME OF TEST: Occupied Bandwidth (Voice & SAT) PARA. NO.: 2.1049**

**Minimum Standard:** 22.917(c) The mean power of any emission removed from the carrier frequency by a displacement frequency ($f_d$ in kHz) must be attenuated below the mean power of the unmodulated carrier (P) as follows:

(i) On any frequency removed from the carrier frequency by more than 12 kHz but not more than 20 kHz:

at least 117 log ($f_d$/12)

(ii) On any frequency removed from the carrier frequency by more than 20 kHz, up to the first multiple of the carrier frequency:

at least 100 log ($f_d$/11) dB or 43 + 10 log (P) dB, whichever is the lesser attenuation.

**Method Of Measurement:**

Spectrum Analyzer Settings:

RBW: 300 Hz
VBW: ≥ RBW
Span: 100 kHz
Sweep: Auto

Input Signal Characteristics (F3E/F3D):

RF level: Maximum recommended by manufacturer
AF1 frequency: 6 kHz
AF1 level: sufficient to produce 2 kHz deviation
AF2 frequency: 2.5 kHz
AF2 level: sufficient to produce 12 kHz deviation.

**NAME OF TEST: Occupied Bandwidth (WB Data) PARA. NO.: 2.1049**

**Minimum Standard:** 22.917(c) The mean power of any emission removed from the carrier frequency by a displacement frequency ($f_d$ in kHz) must be attenuated below the mean power of the unmodulated carrier (P) as follows:

(1) On any frequency removed from the carrier frequency by more than 20 kHz but not more than 45 kHz:

at least 26 dB

(2) On any frequency removed from the carrier frequency by more than 45 kHz but not more than 90 kHz:

at least 45 dB

(3) On any frequency removed from the carrier frequency by more than 90 kHz, up to the first multiple of the carrier frequency:

at least 60 dB or 43 + 10 log (P) dB, whichever is the lesser attenuation.

**Method Of Measurement:**

Spectrum Analyzer Settings:
RBW: 300 Hz
VBW: ≥ RBW
Span: 200 kHz
Sweep: Auto

Input Signal Characteristics:
RF level: Maximum recommended by manufacturer
AF1 frequency: 10 kHz, random bit sequence
AF1 level: sufficient to produce 8 kHz deviation

**NAME OF TEST: Occupied Bandwidth (ST) PARA. NO.: 2.1049**

**Minimum Standard:** 22.917(c) The mean power of any emission removed from the carrier frequency by a displacement frequency ($f_d$ in kHz) must be attenuated below the mean power of the unmodulated carrier (P) as follows:

(1) On any frequency removed from the carrier frequency by more than 20 kHz but not more than 45 kHz:

at least 26 dB

(2) On any frequency removed from the carrier frequency by more than 45 kHz but not more than 90 kHz:

at least 45 dB

(3) On any frequency removed from the carrier frequency by more than 90 kHz, up to the first multiple of the carrier frequency:

at least 60 dB or 43 + 10 log (P) dB, whichever is the lesser attenuation.

**Method Of Measurement:**

Spectrum Analyzer Settings:
RBW: 300 Hz
VBW: ≥ RBW
Span: 200 kHz
Sweep: Auto

Input Signal Characteristics:
RF level: Maximum recommended by manufacturer
AF1 frequency: 10 kHz tone
AF1 level: sufficient to produce 8 kHz deviation

**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: ≥ 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**

**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: ≥ 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 ($5 \times 10^{-5}$ 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)

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

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

For emissions > 1 GHz:

G = 1 (Isotropic Gain)
P = $1 \times 10^{-5}$ Watts (Maximum spurious output power)
R = 3m (Measurement Distance)

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

***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 ≤ 3 W |
|---|---|---|---|
| 821 to 896 | 1.5 | 2.5 | 2.5 |

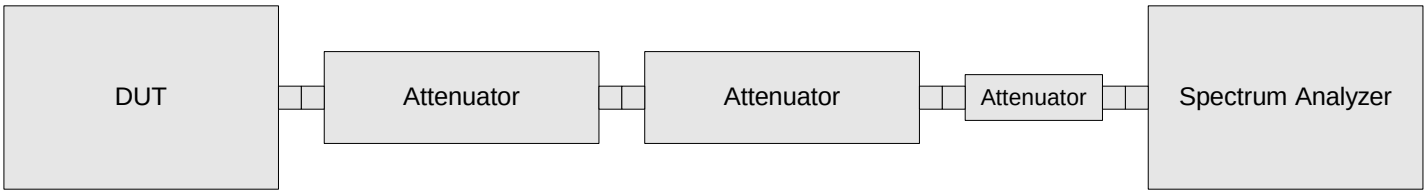
**Method Of Measurement:**

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.

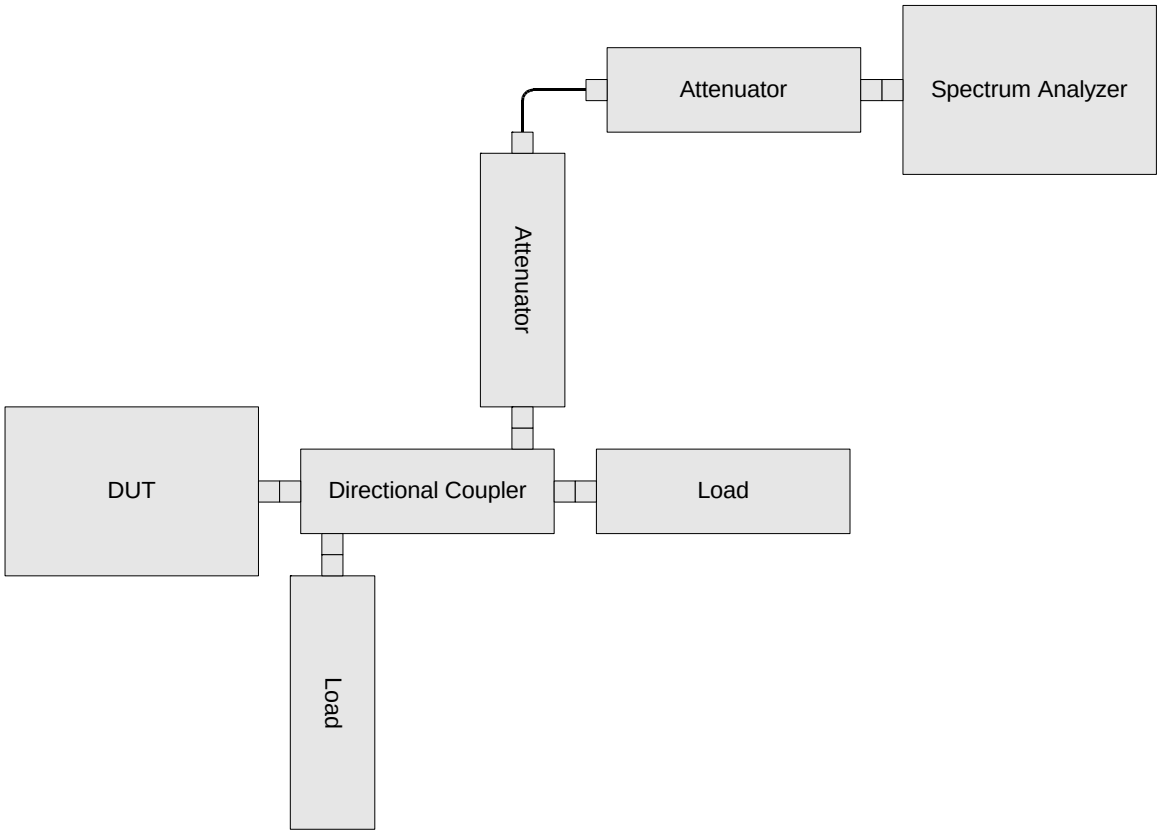
Frequency Stability With Temperature Variation:
The input voltage to the E.U.T. is set to S.T.V. and the temperature of the environmental chamber is varied in 10 degree steps from -30 degrees C to +50 degrees C. The E.U.T. is allowed to stabilize at each temperature and the frequency is measured in 30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

# ANNEX B - TEST DIAGRAMS

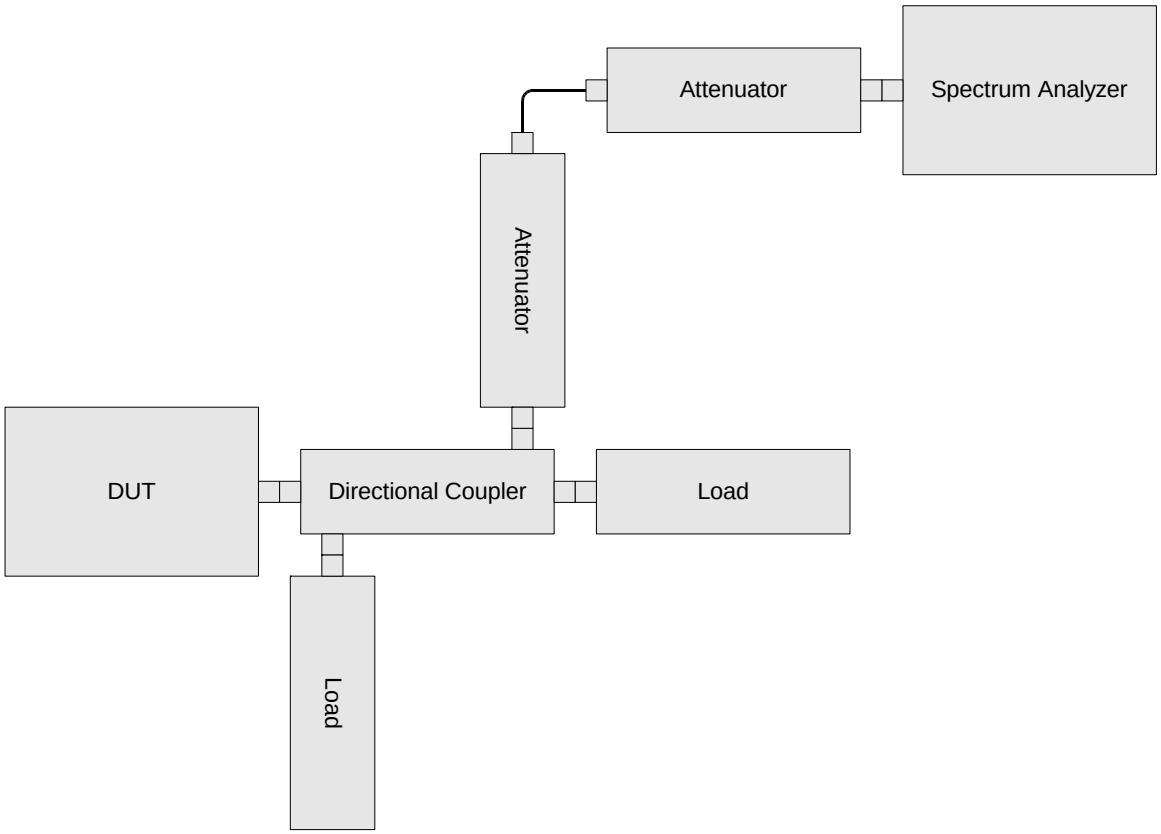
**Para. No. 2.1046 - R.F. Power Output**

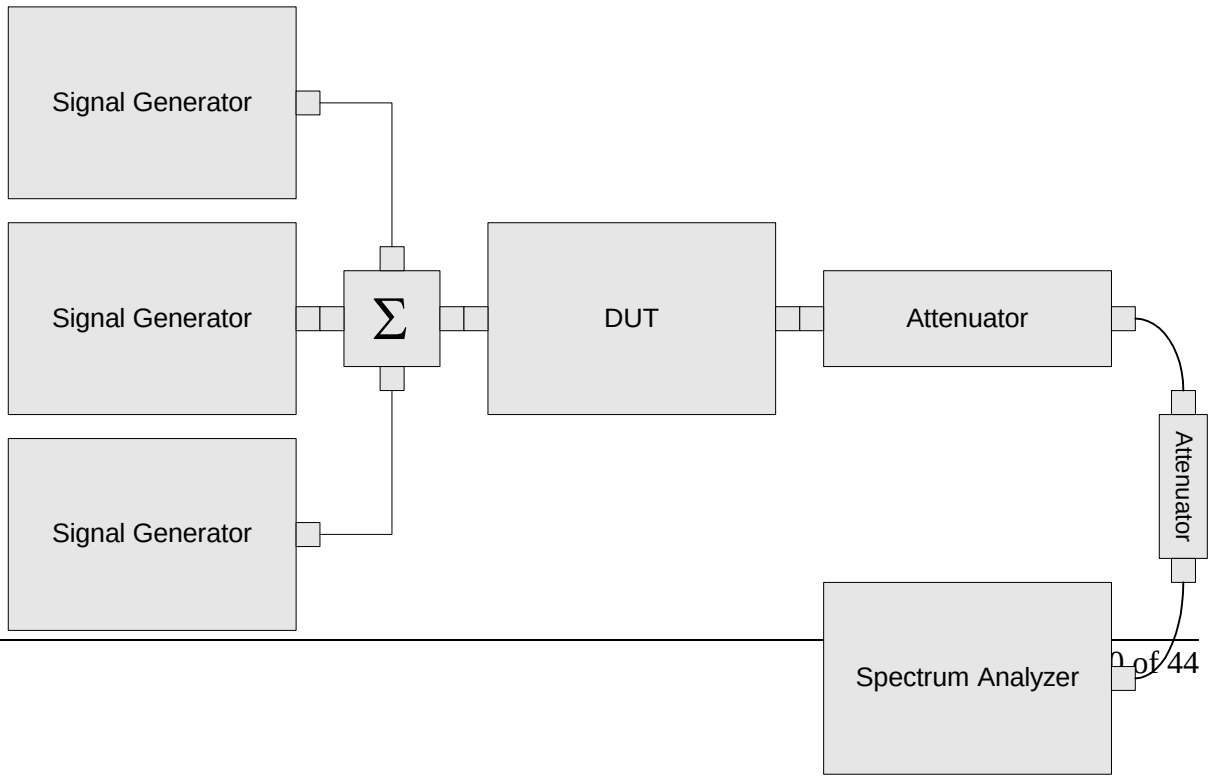



**Para. No. 2.1049 - Occupied Bandwidth**

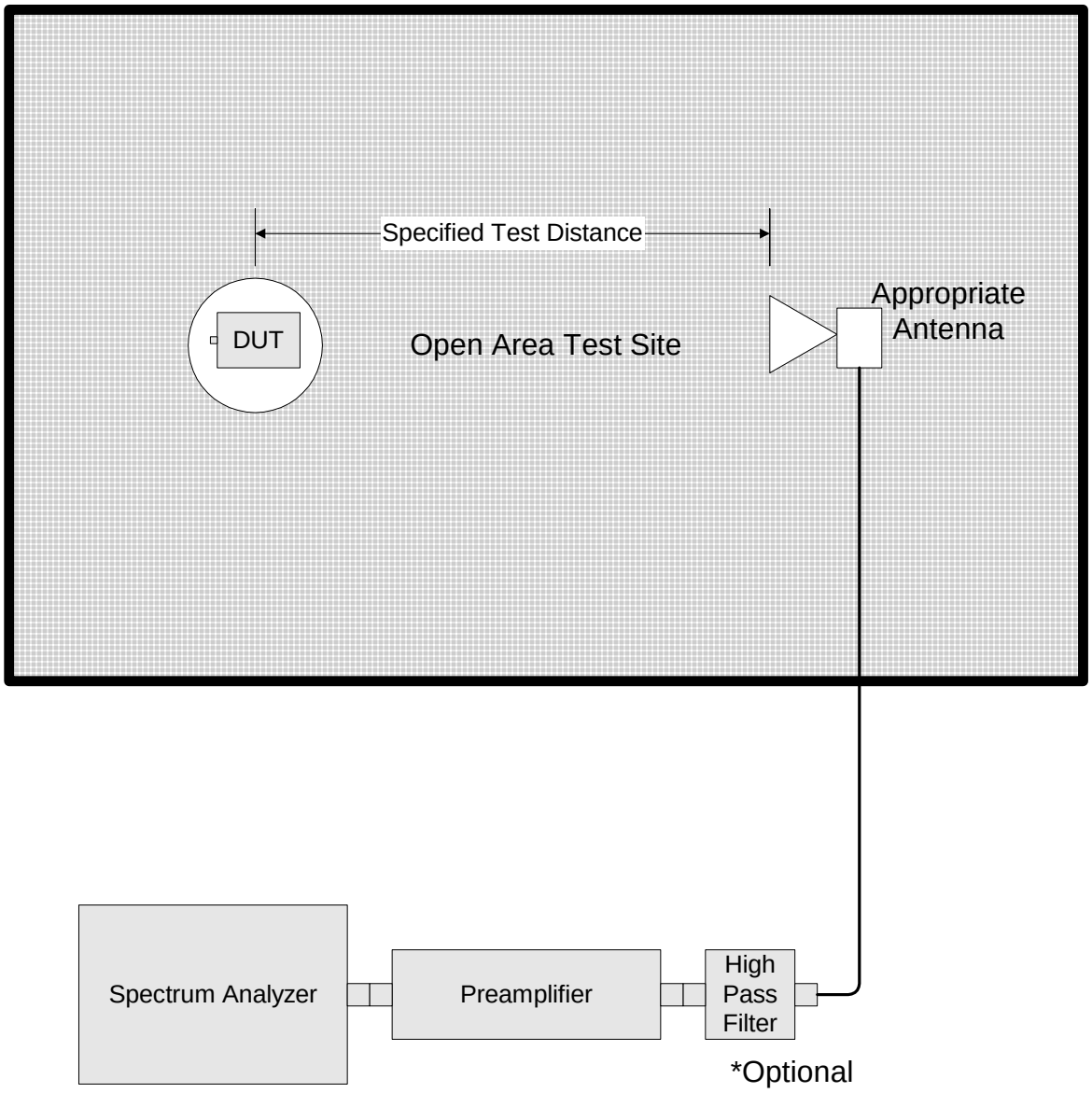


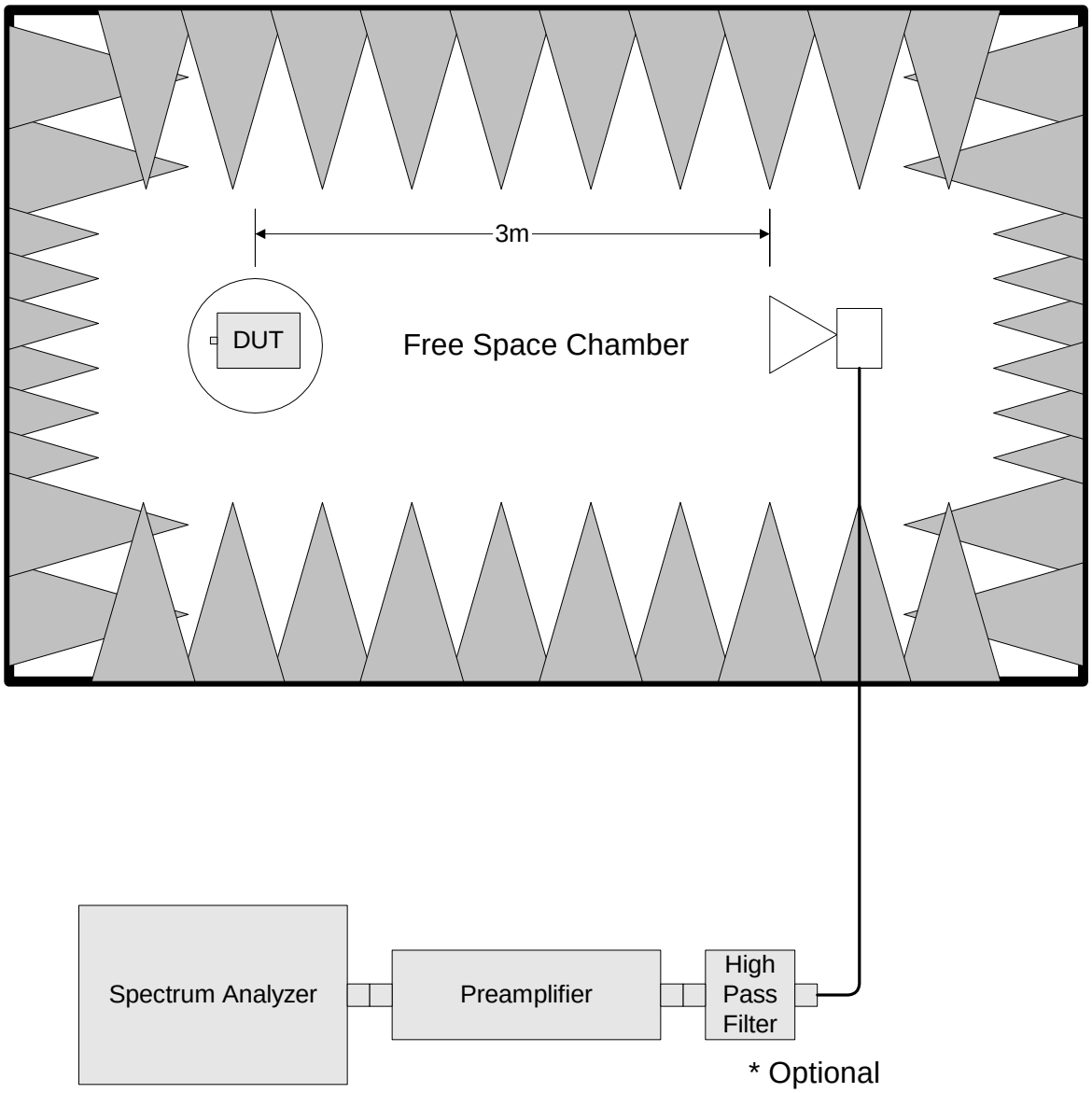
**Para. No. 2.1051 Spurious Emissions at Antenna Terminals**



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




3m
DUT
Free Space Chamber
Spectrum Analyzer
Preamplifier
High Pass Filter
* Optional

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