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**Anechoic chamber registration no.: 3463 (IC)**  
TCB ID: DE 0001



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German Accreditation Council  
DAR-Registration Number  
TTI-P-G 081/94-D0



Independent ETSI  
compliance test house



Accredited Bluetooth<sup>®</sup> Test Facility (BQTF)

|                             |          |                                        |
|-----------------------------|----------|----------------------------------------|
| <b>Test report no.</b>      | <b>:</b> | <b>4-1567-05-04/05</b>                 |
| <b>Applicant</b>            | <b>:</b> | <b>Sagem SA</b>                        |
| <b>Type</b>                 | <b>:</b> | <b>A2005a+ (Design R3)</b>             |
| <b>Test Standard</b>        | <b>:</b> | <b>FCC Part 22, 24<br/>RSS132, 133</b> |
| <b>FCC ID</b>               | <b>:</b> | <b>M9HA2005WR3</b>                     |
| <b>Certification No. IC</b> | <b>:</b> | <b>---</b>                             |

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**ANNEX A: PART 15 B TESTS**

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## 1 General information

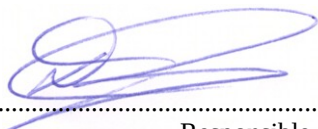
### 1.1. Administrative data of the test facility

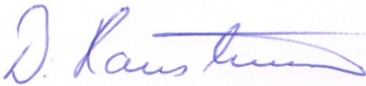
#### 1.1.1 Identification of the testing laboratory

|                                     |                                                                                                                                                      |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Company name:                       | Cetecom ICT Services GmbH                                                                                                                            |
| Address:                            | Untertürkheimerstr. 6-10<br>D-66117 Saarbruecken<br>Germany                                                                                          |
| Laboratory accreditation:           | DAR-Registration No. TTI-P-G081/94-D0<br>Bluetooth Qualification Test Facility (BQTF)<br>Federal Communications Commission (FCC)                     |
| Responsible for testing laboratory: | Identification/Registration No : 90462<br>Gillmann D. / Hausknecht D.<br>Phone: +49 681 598 0<br>Fax: +49 681 598 9075<br>email: info@ict.cetecom.de |

### 1.2. Notes

The test results of this test report relate exclusively to the test item specified in 1.5. The CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM ICT Services GmbH.

 /   
.....  
Responsible for testing laboratory  
(Gillmann D. / Hausknecht D.)

 /   
.....  
Responsible for test report  
(Gillmann D. / Hausknecht D.)

## 1.3 Details of Applicant

|         |   |                              |
|---------|---|------------------------------|
| Name    | : | Sagem SA                     |
| Address | : | 2-4, rue du Petit Albi       |
| City    | : | 95800 Cergy Saint-Christophe |
| Country | : | France                       |
| Phone   | : | + 33 1 34 25 37 37           |
| Fax     | : | + 33 1 34 25 74 16           |
| Contact | : | Jean Marquet                 |
| Phone   | : | + 33 1 34 25 37 37           |
| Fax     | : | + 33 1 34 25 74 16           |
| e-mail  | : | jean.marquet@sagem.com       |

## 1.4 Application Details

|                                |   |                          |
|--------------------------------|---|--------------------------|
| Date of receipt of application | : | 2005-01-26               |
| Date of receipt of EUT         | : | 2005-01-26               |
| Date(s) of test                | : | 2005-01-26 to 2004-11-28 |
| Date of report                 | : | 2005-01-28               |

## 1.5 Test Item

Type of equipment : Dual Band GSM850 / PCS 1900 Mobile Phone  
Type name : A2005a+ (Design R3)  
Manufacturer : Sagem SA  
Address : 2-4, rue du Petit Albi  
City : 95800 Cergy Saint-Christophe  
Country : France

Frequency : 1850.2 – 1909.8 MHz and 824.2 – 848.8 MHz  
Type of modulation : 300KGXW  
Number of channels : 300 (PCS1900) and 125 (PCS850)  
Antenna :  
Power supply (normal) : 3.9V DC  
Output power GSM 850 : cond.: 32.9 dBm Peak  
ERP: 29.8 dBm (Burst);  
Output power GSM 1900 : cond : 30.3 dBm Peak  
EIRP: 29.9 dBm (Burst)  
Transmitter Spurious (worst case) : - mW / dBm  
Receiver Spurious (worst case) : -  $\mu$ V/m @ 3 m

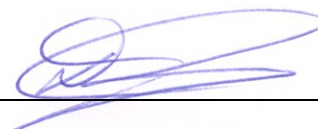
FCC ID : M9HA2005WR3  
Certification No. IC : ---  
Open Area Test Site IC No. : 3436  
IC Standards : RSS132, Issue 1, RSS133, Issue 2, Rev. 1

### ATTESTATION:

**DECLARATION OF COMPLIANCE:** I declare that the testing was performed or supervised by me; that the test measurements were made in accordance with the above-mentioned Industry Canada standard(s); and that the equipment identified in this application has been subjected to all the applicable test conditions specified in the Industry Canada standards and all of the requirements of the standard have been met.

### Laboratory Manager :

2005-01-28      RSC 8431      Gillmann, D.  
Date              Section          Name



## 1.6 Test Setup

Hardware : A2005\_V0x  
Software : J 3,VB

Mobile; (conducted measurements) : 010240.00.000 120.01  
Mobile; (radiated measurements) : 010240.00.000 133.01

Standard world wide charger  
The radiated measurements were performed with this AC charging unit.

## 1.7 Test Standards

|             |                                                            |
|-------------|------------------------------------------------------------|
| <b>FCC:</b> | <b>CFR Part 22 H</b><br><b>CFR Part 24 E</b>               |
| <b>IC:</b>  | <b>RSS 132, Issue 1</b><br><b>RSS 133, Issue 2, Rev. 1</b> |

## 2 Statement of Compliance

No deviations from the technical specification(s) were ascertained in the course of the tests performed.

### 2.1 Summary of Measurement Results

#### 2.1.1 PCS 1900

| Section in this Report | Test Name                    | Verdict |
|------------------------|------------------------------|---------|
| 3.1.1                  | RF Power Output              | pass    |
| 3.1.2                  | Frequency Stability          | pass    |
| 3.1.3                  | Radiated Emissions           | pass    |
| 3.1.4                  | Receiver Radiated Emissions  | pass    |
| 3.1.5                  | Conducted Spurious Emissions | pass    |
| 3.1.6                  | Block Edge Compliance        | pass    |
| 3.1.7                  | Occupied Bandwidth           | pass    |

#### 2.1.2 GSM 850

| Section in this Report | Test Name                    | Verdict |
|------------------------|------------------------------|---------|
| 3.2.1                  | RF Power Output              | pass    |
| 3.2.2                  | Frequency Stability          | pass    |
| 3.2.3                  | Radiated Emissions           | pass    |
| 3.2.4                  | Receiver Radiated Emissions  | pass    |
| 3.2.5                  | Conducted Spurious Emissions | pass    |
| 3.2.6                  | Block Edge Compliance        | pass    |
| 3.2.7                  | Occupied Bandwidth           | pass    |

### 3 Measurements and results

For Part 24/22 we use the substitution method ( TIA/EIA 603).

All measurements in this report are done in GSM mode. Device is able to transmit data in GPRS mode also. But because the current measurements are performed in PEAK mode no other results from GPRS mode are possible. The only different is the modulation average power, which is 3 dB higher (by using 2 timeslots in the Up-link ).

#### 3.1 PART PCS 1900

##### 3.1.1 RF Power Output

###### Reference

|      |                                       |
|------|---------------------------------------|
| FCC: | CFR Part 24.232, 2.1046               |
| IC:  | RSS 133, Issue 2, Rev. 1, Section 6.2 |

###### Summary:

This paragraph contains both average , peak output powers and EIRP measurements for the mobile station. In all cases, the peak output power is within the required mask (this mask is specified in the JTC standards, TIA PN3389 Vol. 1 Chap 7, and is no FCC requirement).

###### Method of Measurements:

The mobile was set up for the max. output power with pseudo random data modulation.

The power was measured with R&S Signal Analyzer FSIQ 26 ( peak and average)

This measurements were done at 3 frequencies, 1850.2 MHz, 1880.0 MHz and 1909.8 MHz (bottom, middle and top of operational frequency range)

###### Limits:

| Power Step | Nominal Peak Output Power (dBm) | Tolerance (dB) |
|------------|---------------------------------|----------------|
| 0          | +30                             | $\pm 2$        |

###### Test Results: Output Power (conducted)

| Frequency (MHz)         | Power Step | Peak Output Power (dBm) | Average Output Power (dBm) |
|-------------------------|------------|-------------------------|----------------------------|
| 1850.2                  | 0          | 30.3                    | 30.2                       |
| 1880.0                  | 0          | 30.1                    | 30.0                       |
| 1909.8                  | 0          | 30.2                    | 30.1                       |
| Measurement uncertainty |            | $\pm 0.5$ dB            |                            |



## EIRP Measurements

### Description:

This is the test for the maximum radiated power from the phone.

Rule Part 24.232(b) specifies that "Mobile/portable stations are limited to 2 watts e.i.r.p. peak power..." and 24.232(c) specifies that "Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage."

Measuring the EIRP of Spurious/Harmonic Emissions using Substitution Method

(a) The measurements was performed with full rf output power and modulation.

(b) Test was performed at listed 3m test site (listed with FCC, IC).

(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

$E \text{ (dBuV/m)} = \text{Reading (dBuV)} + \text{Total Correction Factor (dB/m)}$

(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° 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

## 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

$E \text{ (dBuV/m)} = \text{Reading (dBuV)} + \text{Total Correction Factor (dB/m)}$

(c) Select the frequency and E-field levels 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° 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:

$P = P1 - L1 = (P2 + L2) - L1 = P3 + A + L2 - L1$

$EIRP = P + G1 = P3 + L2 - L1 + A + G1$

$ERP = EIRP - 2.15 \text{ dB}$

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.

## Limits:

| Power Step | Burst PEAK EIRP (dBm) |
|------------|-----------------------|
| 0          | <33                   |

## Test Results: Output Power (radiated)

| Frequency (MHz)         | Power Step | BURST PEAK EIRP (dBm) |
|-------------------------|------------|-----------------------|
| 1850.2                  | 0          | 29.7                  |
| 1880.0                  | 0          | 29.8                  |
| 1909.8                  | 0          | 29.9                  |
| Measurement uncertainty | $\pm 3$ dB |                       |

## 3.1.2 Frequency Stability

### Reference

|      |                                     |
|------|-------------------------------------|
| FCC: | CFR Part 24.235, 2.1055             |
| IC:  | RSS 133, Issue 2, Rev. 1, Section 7 |

### Method of Measurement:

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the mobile station in a "call mode". This is accomplished with the use of a R&S CMU 200 DIGITAL RADIOCOMMUNICATION TESTER..

1. Measure the carrier frequency at room temperature.
2. Subject the mobile station to overnight soak at -30 C.
3. With the mobile station, powered with Vnom, connected to the CMU 200 and in a simulated call on channel 661 (center channel), measure the carrier frequency. These measurements should be made within 2 minutes of powering up the mobile station, to prevent significant self warming.
4. Repeat the above measurements at 10 C increments from -30 C to +60 C. Allow at least 1 1/2 hours at each temperature, un-powered, before making measurements.
5. Re-measure carrier frequency at room temperature with Vnom. Vary supply voltage from Vmin to Vmax, in 12 steps re-measuring carrier frequency at each voltage. Pause at Vnom for 1 1/2 hours un-powered , to allow any self heating to stabilize, before continuing.
6. Subject the mobile station to overnight soak at +60 C.
7. With the mobile station, powered with Vnom, connected to the CMU 200 and in a simulated call on channel 661(center channel), measure the carrier frequency. These measurements should be made within 2 minutes of powering up the mobile station, to prevent significant self warming.
8. Repeat the above measurements at 10 C increments from +60 C to -30 C. Allow at least 1 1/2 hours at each temperature, un-powered, before making measurements.
9. At all temperature levels hold the temperature to +/- 0.5 C during the measurement procedure.

### Measurement Limit:

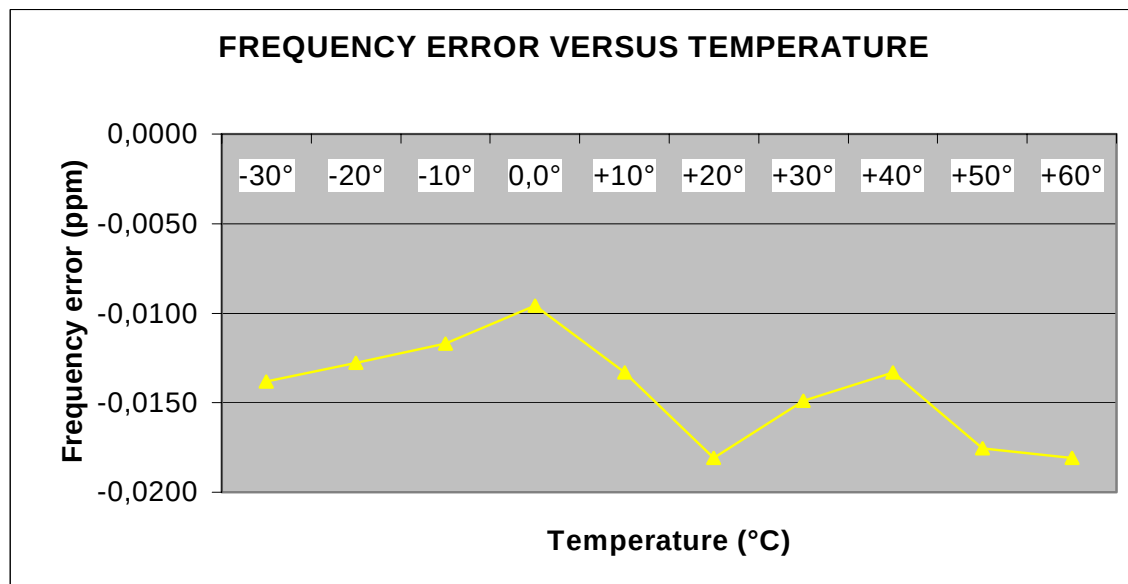
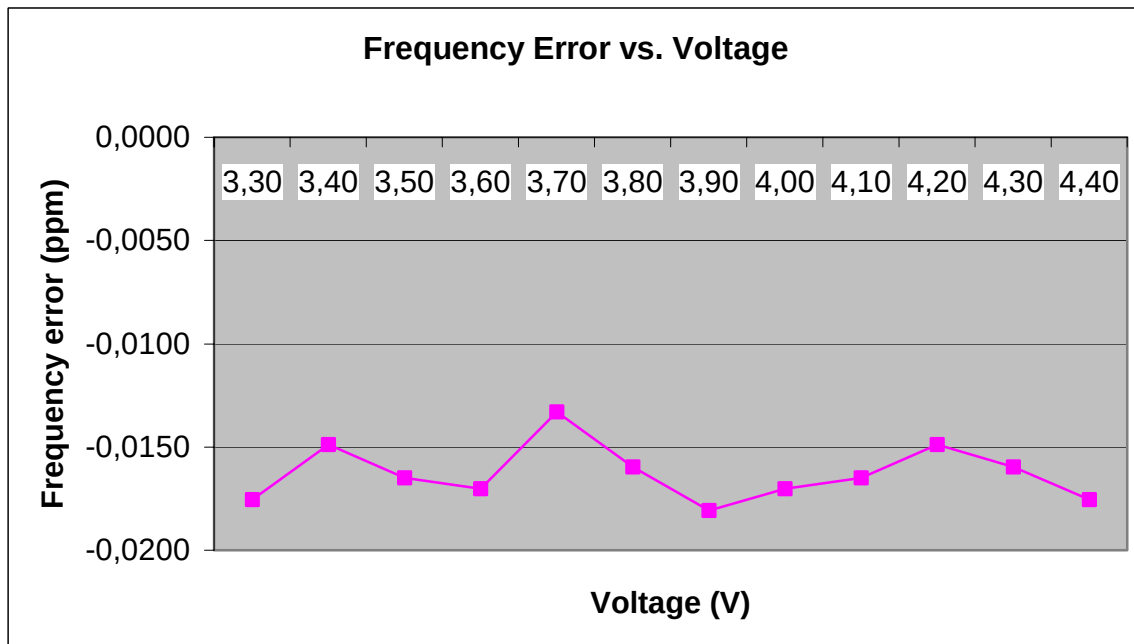
According to the JTC standard the frequency stability of the carrier shall be accurate to within 0.1 ppm of the received frequency from the base station. This accuracy is sufficient to meet Sec. 24.235, Frequency Stability. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block..

**Test Results: AFC FREQ ERROR vs. VOLTAGE**

| Voltage (V) | Frequency Error (Hz) | Frequency Error (%) | Frequency Error (ppm) |
|-------------|----------------------|---------------------|-----------------------|
| 3.3         | -33                  | -0,00000176         | -0,0176               |
| 3.4         | -28                  | -0,00000149         | -0,0149               |
| 3.5         | -31                  | -0,00000165         | -0,0165               |
| 3.6         | -32                  | -0,00000170         | -0,0170               |
| 3.7         | -25                  | -0,00000133         | -0,0133               |
| 3.8         | -30                  | -0,00000160         | -0,0160               |
| 3.9         | -34                  | -0,00000181         | -0,0181               |
| 4.0         | -32                  | -0,00000170         | -0,0170               |
| 4.1         | -31                  | -0,00000165         | -0,0165               |
| 4.2         | -28                  | -0,00000149         | -0,0149               |
| 4.3         | -30                  | -0,00000160         | -0,0160               |
| 4.4         | -33                  | -0,00000176         | -0,0176               |

**Test Results: AFC FREQ ERROR vs. TEMPERATURE**

| TEMPERATURE (°C) | Frequency Error (Hz) | Frequency Error (%) | Frequency Error (ppm) |
|------------------|----------------------|---------------------|-----------------------|
| -30              | -26                  | -0,00000138         | -0,0138               |
| -20              | -24                  | -0,00000128         | -0,0128               |
| -10              | -22                  | -0,00000117         | -0,0117               |
| ±0.0             | -18                  | -0,00000096         | -0,0096               |
| +10              | -25                  | -0,00000133         | -0,0133               |
| +20              | -34                  | -0,00000181         | -0,0181               |
| +30              | -28                  | -0,00000149         | -0,0149               |
| +40              | -25                  | -0,00000133         | -0,0133               |
| +50              | -33                  | -0,00000176         | -0,0176               |
| +60              | -34                  | -0,00000181         | -0,0181               |



### 3.1.3 Radiated Emissions

#### Reference

|      |                                       |
|------|---------------------------------------|
| FCC: | CFR Part 24.238, 2.1053               |
| IC:  | RSS 133, Issue 2, Rev. 1, Section 6.3 |

#### Measurement Procedure:

The following steps outline the procedure used to measure the radiated emissions from the mobile station. The site is constructed in accordance with ANSI C63.4:2003 requirements and is recognized by the FCC to be in compliance for a 3 and a 10 meter site. The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier that can be as high as 1910 MHz. This was rounded up to 20 GHz. The resolution bandwidth is set as outlined in Part 24.238. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the USPCS band.

The final open field emission ( here 10m semi-anechoic chamber listed by FCC) test procedure is as follows:

- The test item was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna.
- The antenna output was terminated in a 50 ohm load.
- A double ridged waveguide antenna was placed on an adjustable height antenna mast 3 meters from the test item for emission measurements.
- Detected emissions were maximized at each frequency by rotating the test item and adjusting the receive antenna height and polarization. The maximum meter reading was recorded. The radiated emission measurements of the harmonics of the transmit frequency through the 10th harmonic were measured with peak detector and 1 MHz bandwidth. If the harmonic could not be detected above the noise floor, the ambient level was recorded.
- Now each detected emissions were substituted by the Substitution method, in accordance with the TIA/EIA 603.

#### Measurement Limit:

Sec. 24.238 Emission Limits.

(a) On any frequency outside a licensee's frequency block (e.g. A, D, B, etc.) within the USPCS spectrum, the power of any emission shall be attenuated below the transmitter power (P, in Watts) by at least  $43 + 10 \log(P)$  dB. The specification that emissions shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log(P)$  dB, translates in the relevant power range (1 to 0.001 W) to -13 dBm. At 1 W the specified minimum attenuation becomes 43 dB and relative to a 30 dBm (1 W) carrier becomes a limit of -13 dBm. At 0.001 W (0 dBm) the minimum attenuation is 13 dB which again yields a limit of -13 dBm. In this way a translation of the specification from relative to absolute terms is carried out.

**Measurement Results: Radiated Emissions**

Radiated emissions measurements were made only at the upper, center, and lower carrier frequencies of the USPCS band (1850.2 MHz, 1879.8 MHz and 1909.8 MHz). It was decided that measurements at these three carrier frequencies would be sufficient to demonstrate compliance with emissions limits because it was seen that all the significant spurs occur well outside the band and no radiation was seen from a carrier in one block of the USPCS band into any of the other blocks. The equipment must still, however, meet emissions requirements with the carrier at all frequencies over which it is capable of operating and it is the manufacturer's responsibility to verify this.

The final open field radiated levels are presented on the next table.

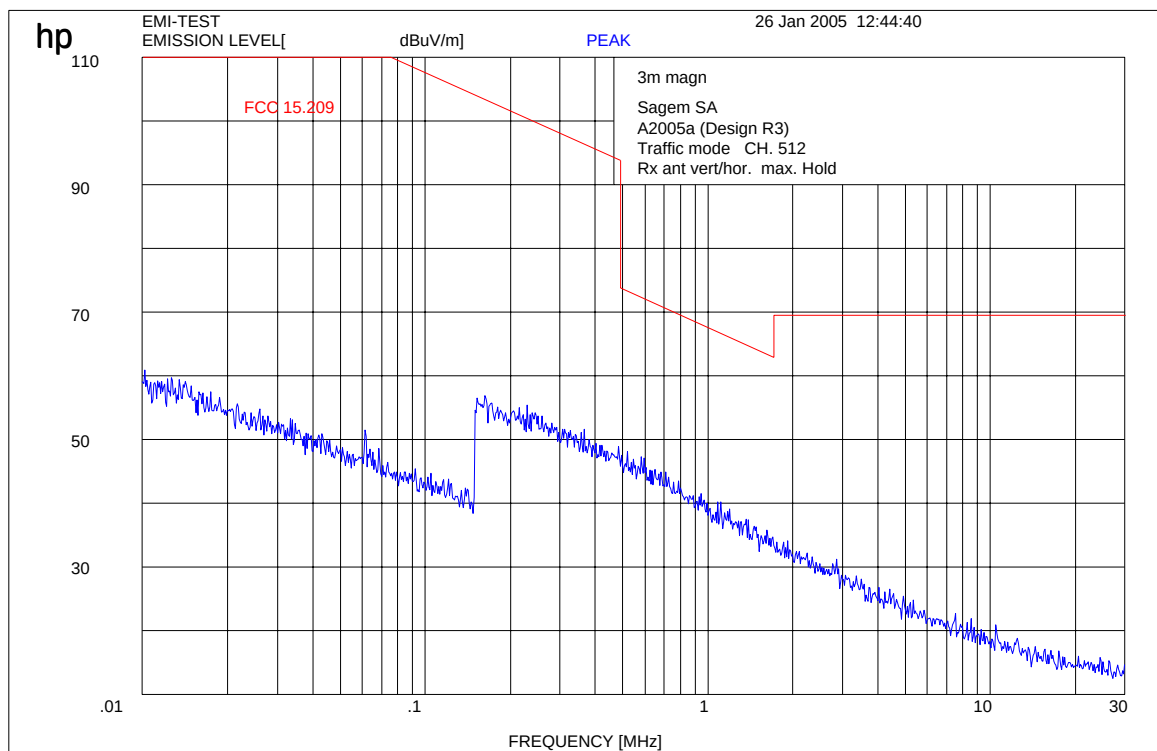
All measurements were done in horizontal and vertical polarization, the plots show the worst case. As can be seen from this data, the emissions from the test item were within the specification limit.

| Harmonic | Tx ch.-512<br>Freq. (MHz) | Level<br>(dBm) | Tx ch.-661<br>Freq. (MHz) | Level<br>(dBm) | Tx ch.-810<br>Freq. (MHz) | Level<br>(dBm) |
|----------|---------------------------|----------------|---------------------------|----------------|---------------------------|----------------|
| 2        | 3700.4                    | -              | 3760                      | -              | 3819.6                    | -              |
| 3        | 5550.6                    | -              | 5640                      | -              | 5729.4                    | -              |
| 4        | 7400.8                    | -              | 7520                      | -              | 7639.2                    | -              |
| 5        | 9251.0                    | -              | 9400                      | -              | 9549.0                    | -              |
| 6        | 11101.2                   | -              | 11280                     | -              | 11458.8                   | -              |
| 7        | 12951.4                   | -              | 13160                     | -              | 13368.6                   | -              |
| 8        | 14801.6                   | -              | 15040                     | -              | 15278.4                   | -              |
| 9        | 16651.8                   | -              | 16920                     | -              | 17188.2                   | -              |
| 10       | 18502.0                   | -              | 18800                     | -              | 19098.0                   | -              |

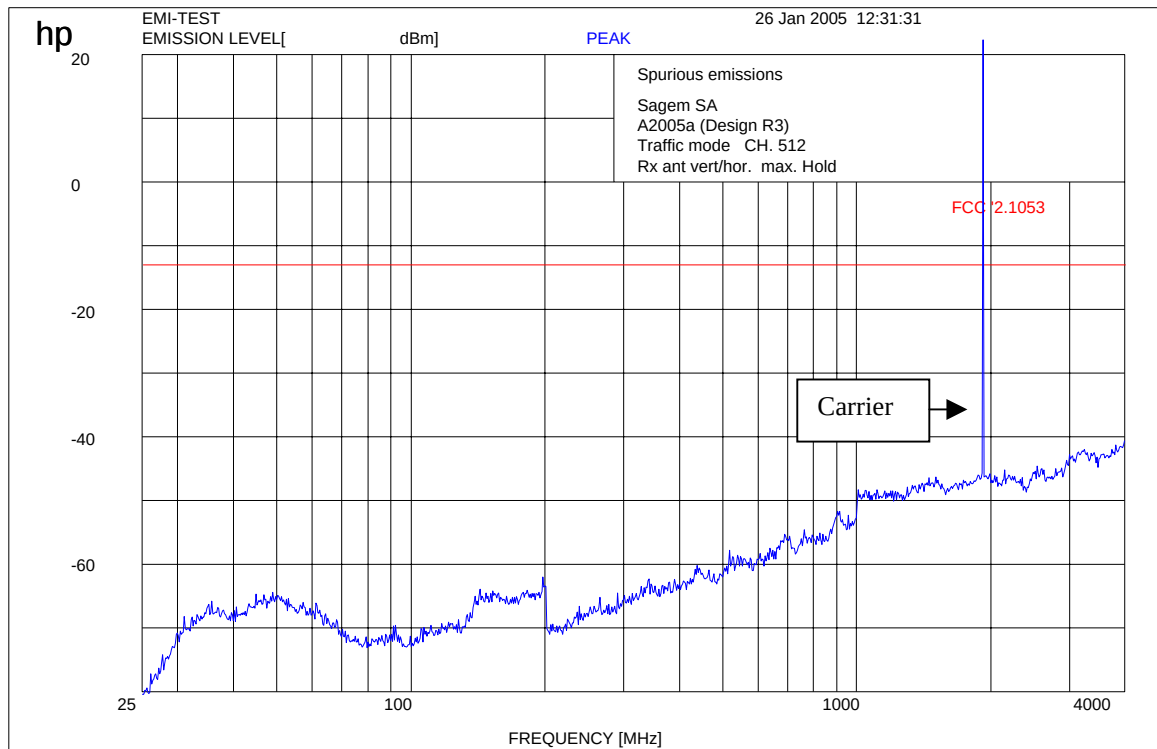
**No peaks found < 20 dB below limit.**



## Traffic mode up to 30 MHz (Valid for all 3 channels)



## Channel 512 (30 MHz - 4 GHz)

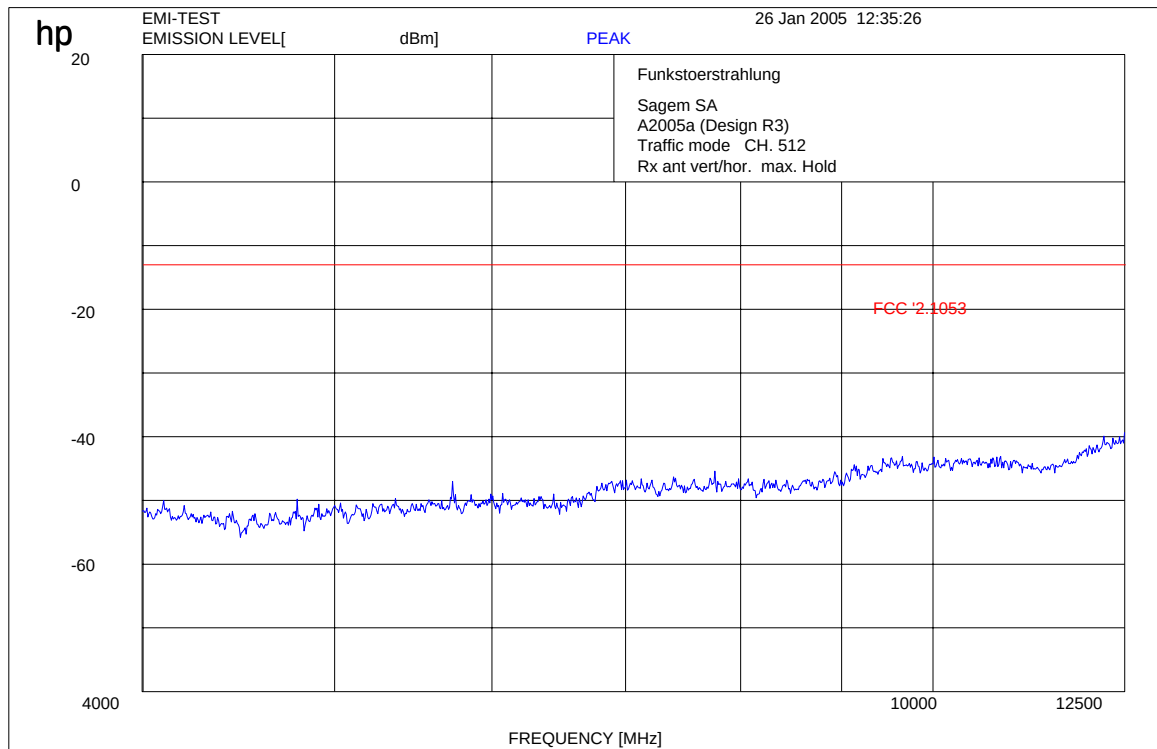


$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW / VBW 1 MHz

Carrier suppressed with a rejection filter

## Channel 512 (4 GHz – 12.5 GHz)

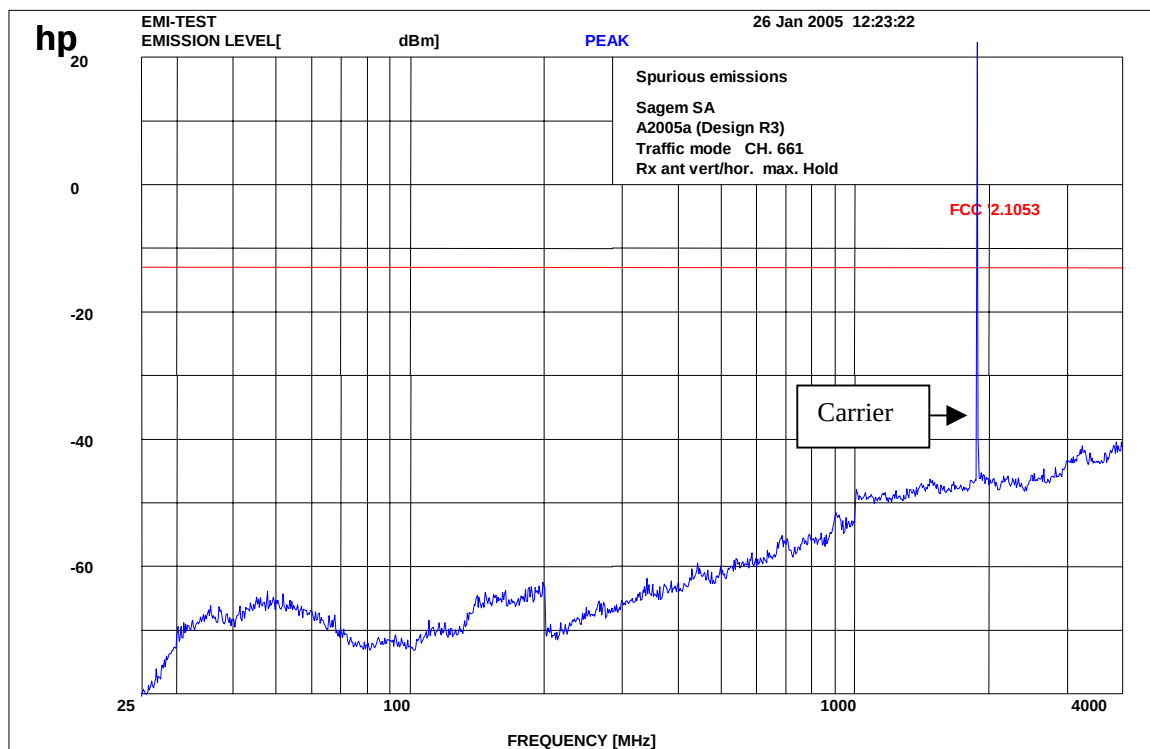


1 GHz : RBW/VBW: 100 kHz

$f \geq 1\text{GHz}$  : RBW / VBW 1 MHz

Carrier suppressed with a rejection filter

## Channel 661 (30 MHz - 4 GHz)

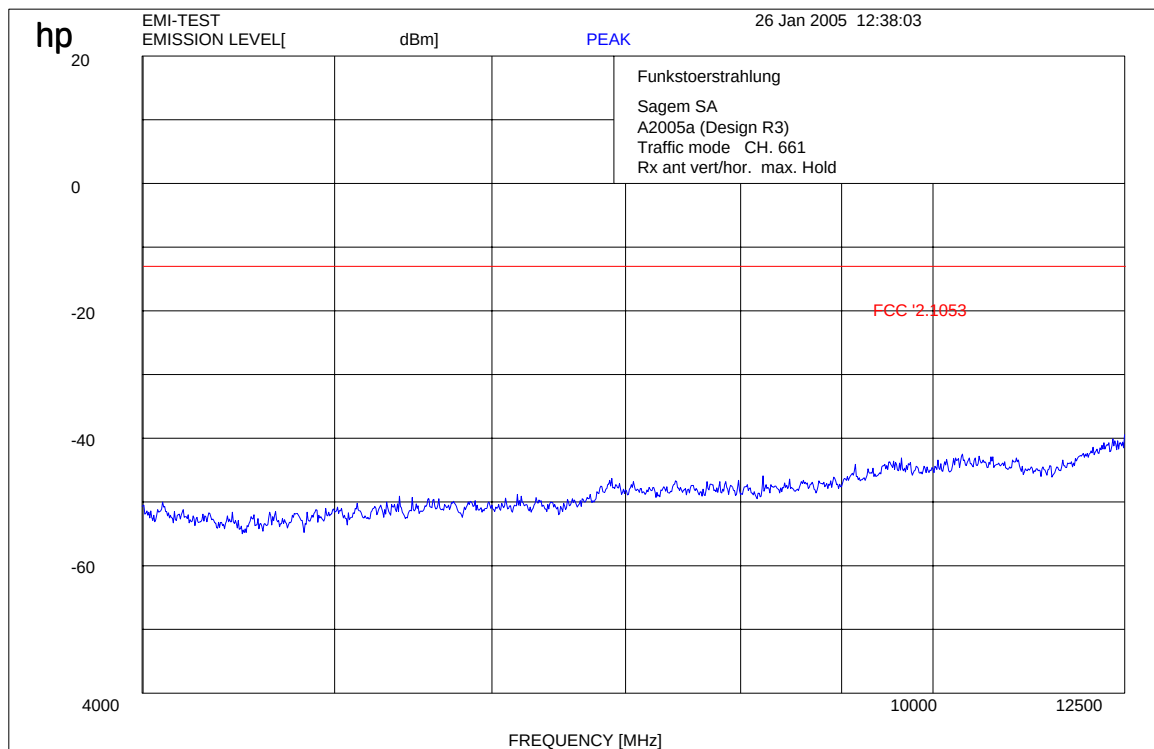


$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW / VBW 1 MHz

Carrier suppressed with a rejection filter

## Channel 661 (4 GHz – 12.5 GHz)

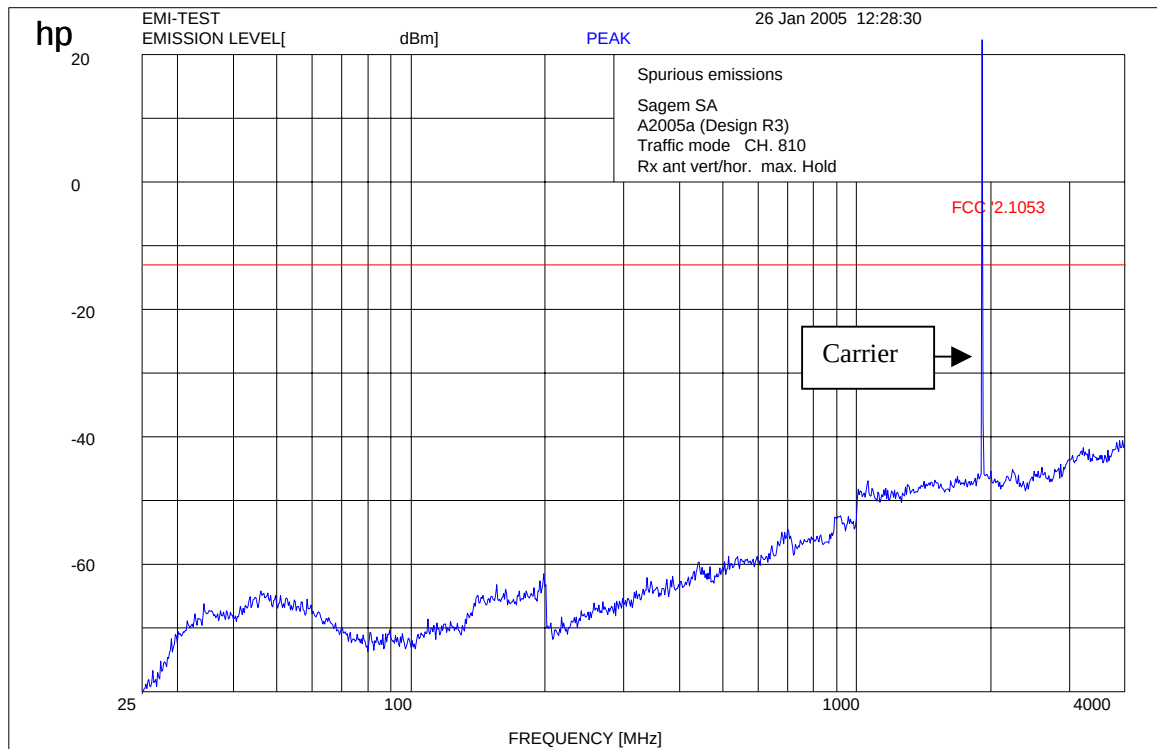


$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW / VBW 1 MHz

Carrier suppressed with a rejection filter

## Channel 810 (30 MHz - 4 GHz)

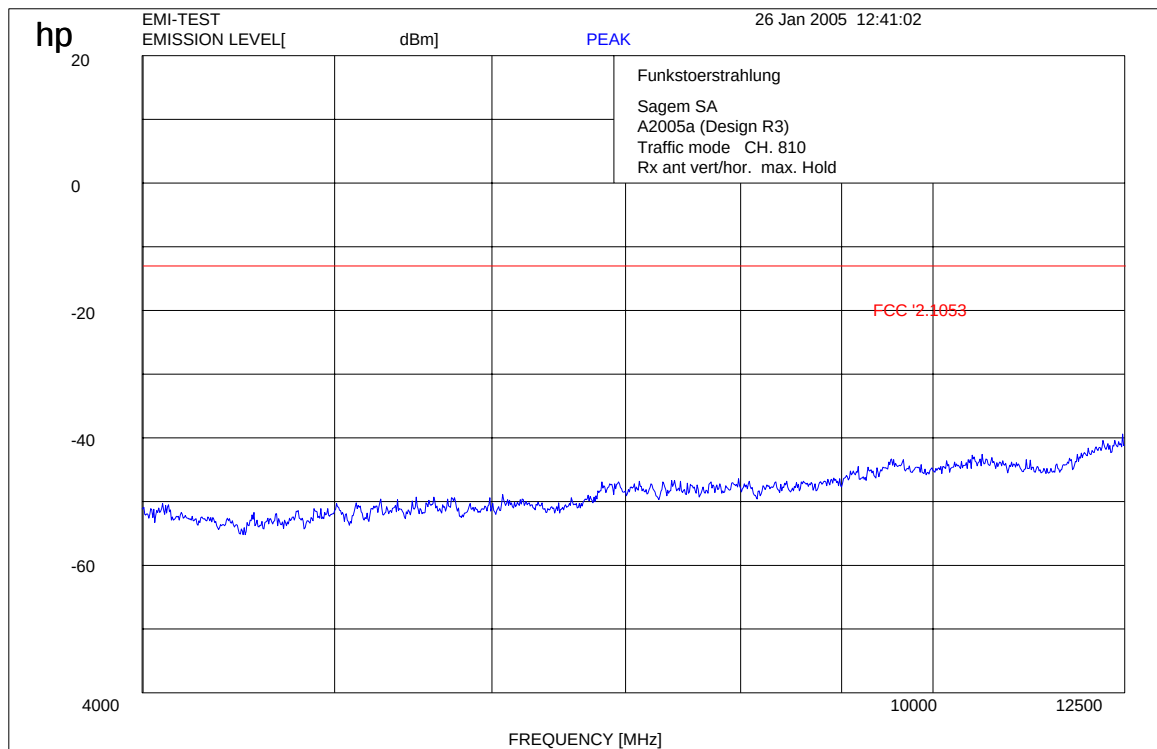


$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW / VBW 1 MHz

Carrier suppressed with a rejection filter

## Channel 810 (4 GHz – 12.5 GHz)



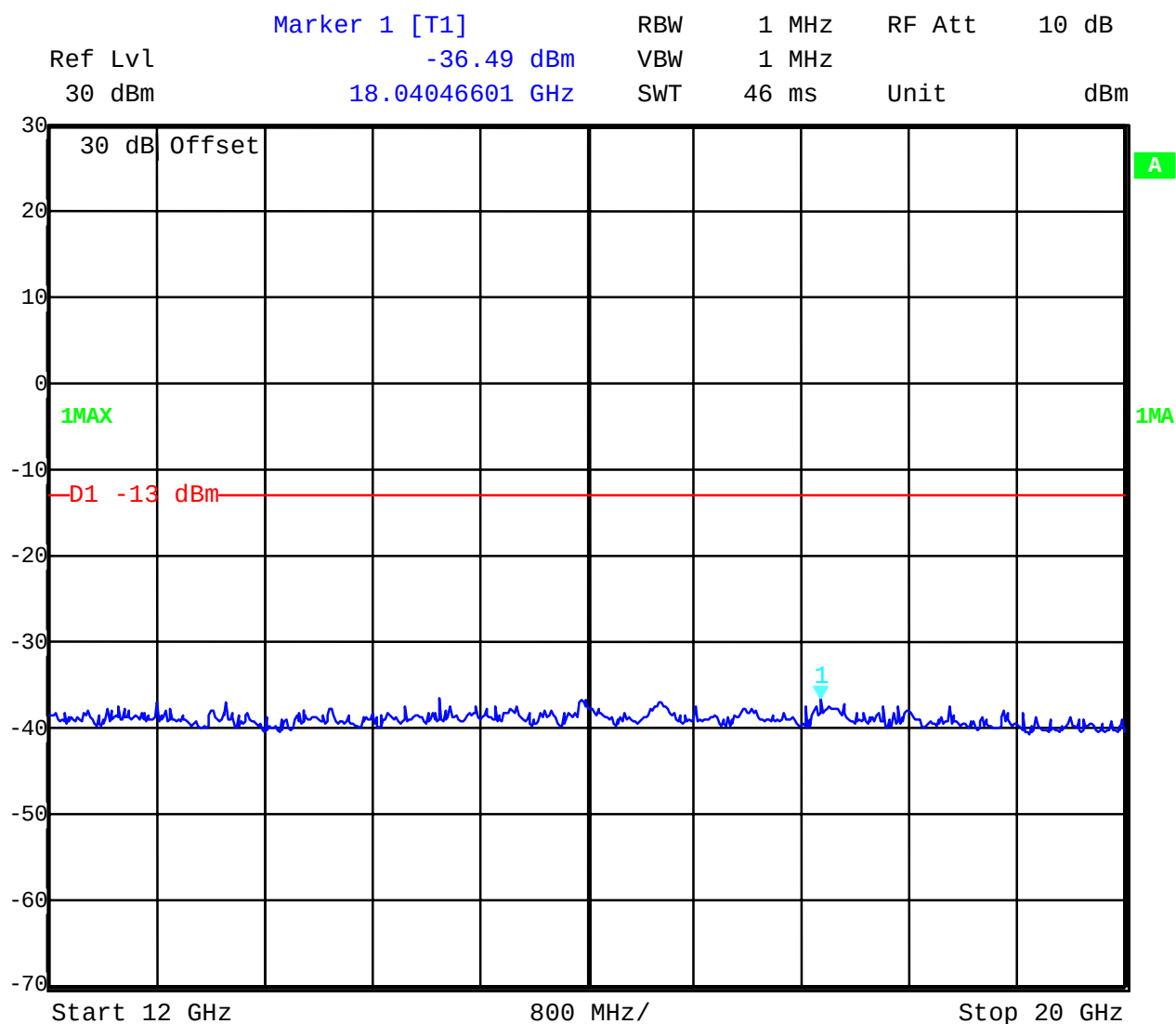
$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW / VBW 1 MHz

Carrier suppressed with a rejection filter

**This plot is valid for all 3 channels (worst case)**

**12 GHz – 20 GHz**



Date: 27.JAN.2005 13:23:09



## 3.1.4 Receiver Radiated Emissions

### Reference

|      |                                       |
|------|---------------------------------------|
| FCC: | CFR Part 15.109, 2.1053               |
| IC:  | RSS 133, Issue 2, Rev. 1, Section 6.3 |

### Measurement Results

| SPURIOUS EMISSIONS LEVEL ( $\mu\text{V/m}$ ) |          |                           |            |          |                           |         |          |                           |
|----------------------------------------------|----------|---------------------------|------------|----------|---------------------------|---------|----------|---------------------------|
| Idle mode                                    |          |                           |            |          |                           |         |          |                           |
| f (MHz)                                      | Detector | Level ( $\mu\text{V/m}$ ) | f (MHz)    | Detector | Level ( $\mu\text{V/m}$ ) | f (MHz) | Detector | Level ( $\mu\text{V/m}$ ) |
| no                                           | peaks    | found                     |            |          |                           |         |          |                           |
|                                              |          |                           |            |          |                           |         |          |                           |
|                                              |          |                           |            |          |                           |         |          |                           |
|                                              |          |                           |            |          |                           |         |          |                           |
|                                              |          |                           |            |          |                           |         |          |                           |
|                                              |          |                           |            |          |                           |         |          |                           |
|                                              |          |                           |            |          |                           |         |          |                           |
|                                              |          |                           |            |          |                           |         |          |                           |
| Measurement uncertainty                      |          |                           | $\pm 3$ dB |          |                           |         |          |                           |

$f < 1$  GHz : RBW/VBW: 100 kHz

$f \geq 1$  GHz : RBW/VBW: 1 MHz

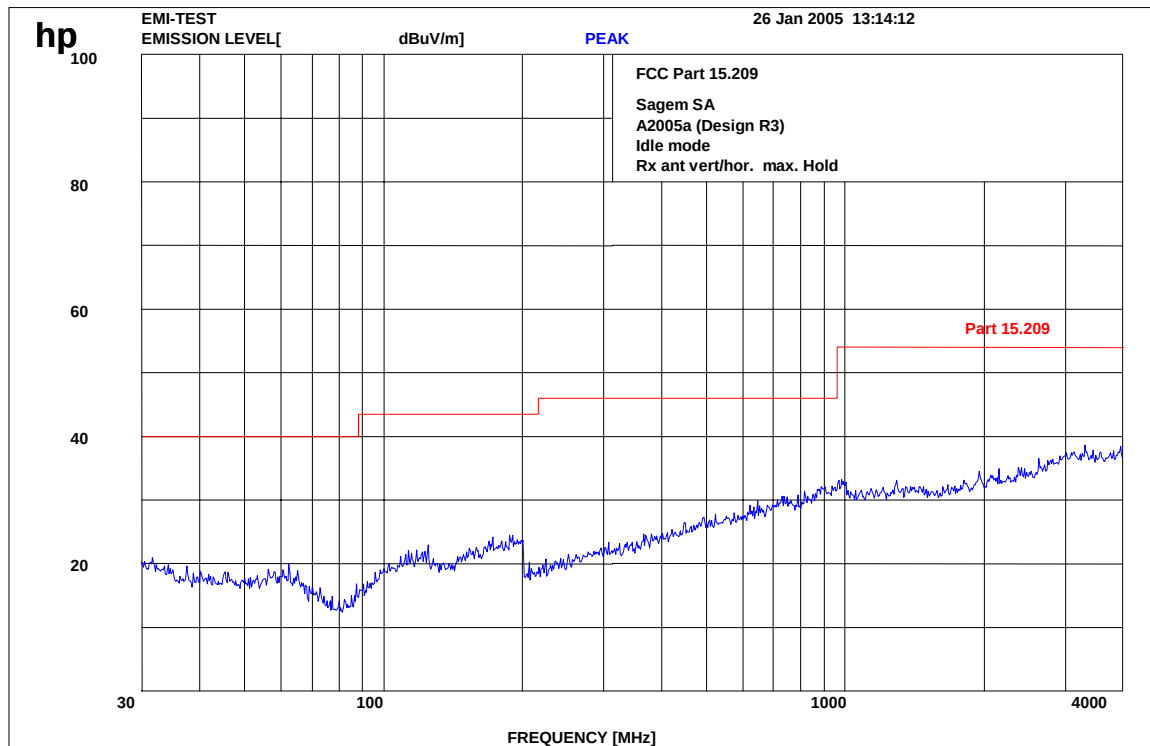
H = Horizontal ; V= Vertical

For measurement distance see table below

**Limits:** § 15.109

| Frequency (MHz) | Field strength ( $\mu\text{V/m}$ ) | Measurement distance (m) |
|-----------------|------------------------------------|--------------------------|
| 30 - 88         | 100                                | 3                        |
| 88 - 216        | 150                                | 3                        |
| 216 - 960       | 200                                | 3                        |
| above 960       | 500                                | 3                        |

## IDLE MODE (30 MHz - 4 GHz)

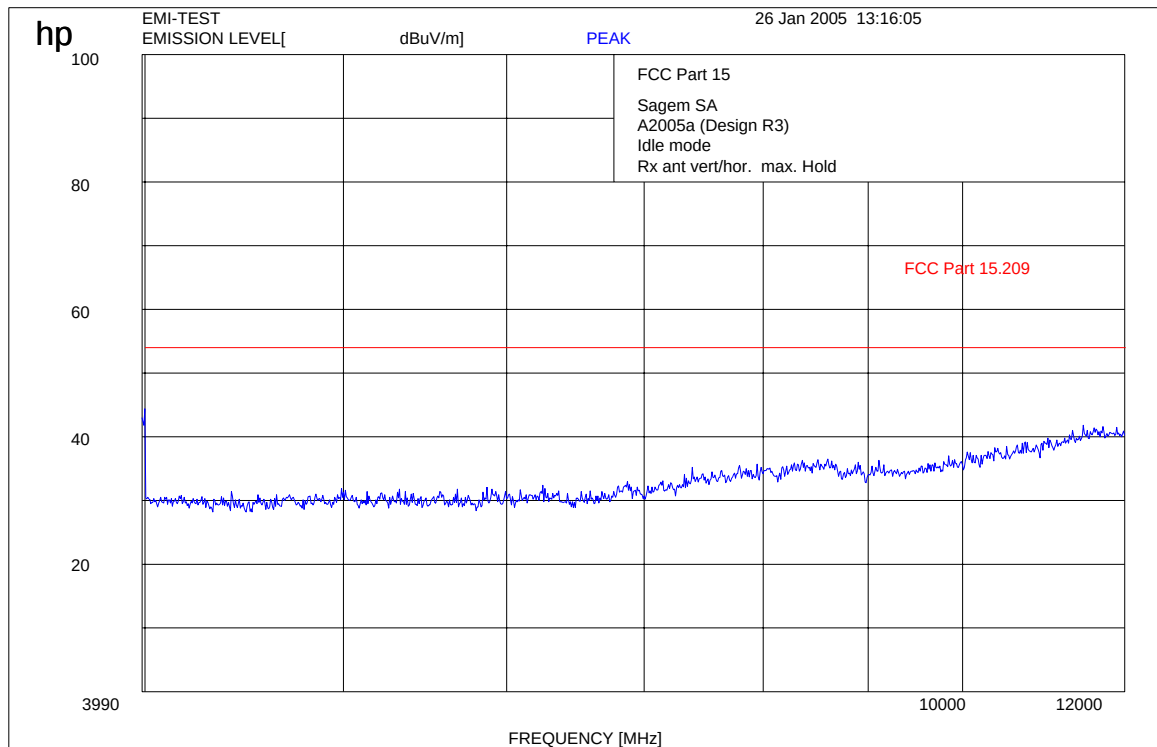


1 GHz : RBW/VBW: 100 kHz

$f \geq 1\text{GHz}$  : RBW / VBW 1 MHz

Carrier suppressed with a rejection filter

## Idle Mode (4 GHz – 12.0 GHz)

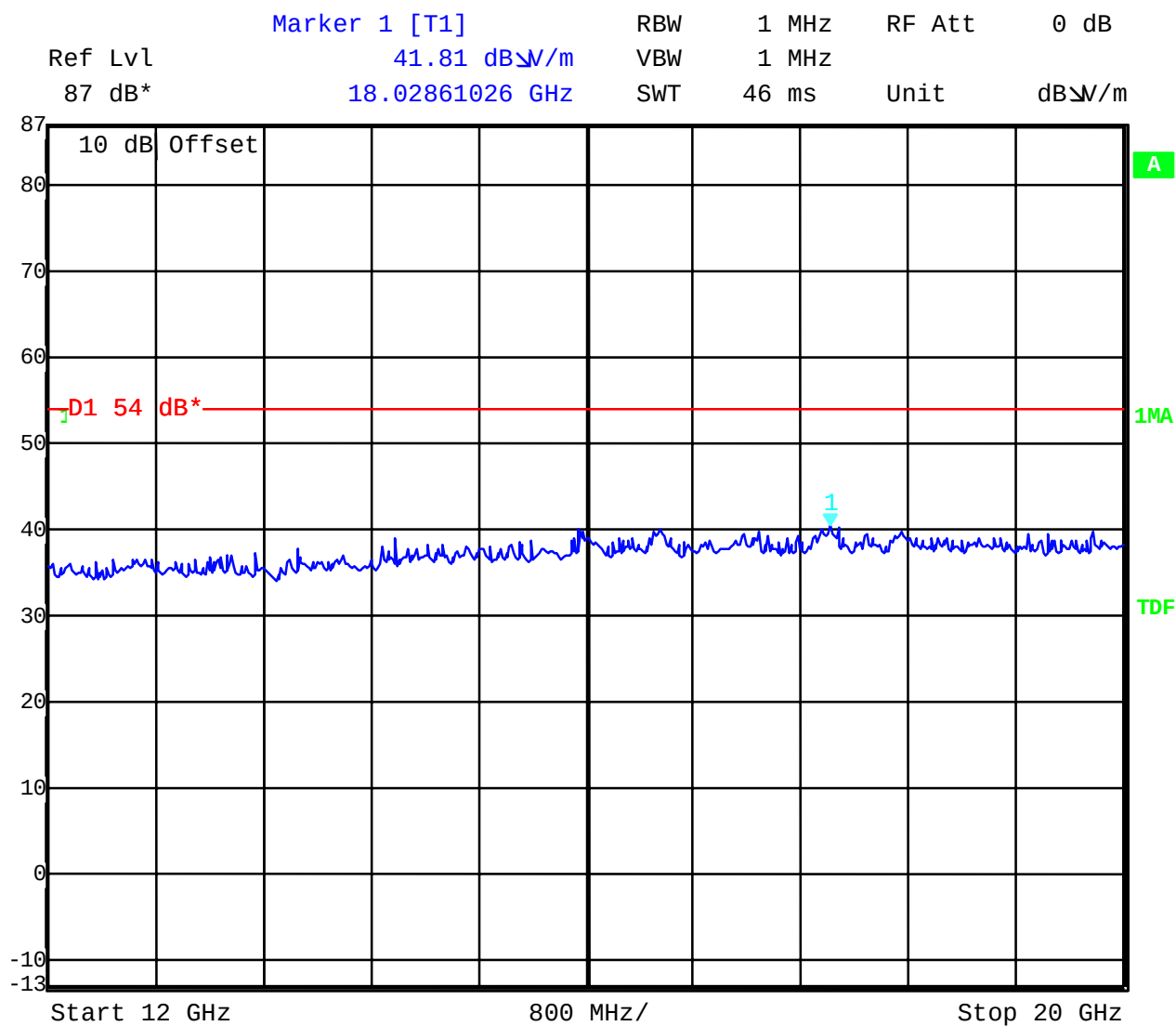


$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW / VBW 1 MHz

Carrier suppressed with a rejection filter

## Idle Mode (12 GHz - 20 GHz)



Date: 27. JAN. 2005 11:28:13

### 3.1.5 Conducted Spurious Emissions

#### Reference

|      |                                       |
|------|---------------------------------------|
| FCC: | CFR Part 24.238, 2.10.51              |
| IC:  | RSS 133, Issue 2, Rev. 1, Section 6.3 |

#### Measurement Procedure:

The following steps outline the procedure used to measure the conducted emissions from the mobile station.

1. Determine frequency range for measurements: From CFR 2.1057 the spectrum should be investigated from the lowest radio frequency generated in the equipment up to at least the 10th harmonic of the carrier frequency.

For the mobile station equipment tested, this equates to a frequency range of 13 MHz to 19.1 GHz, data taken from 10 MHz to 20 GHz.

2. Determine mobile station transmit frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

USPCS Transmitter Channel Frequency:

512 1850.2 MHz

661 1880.0 MHz

810 1909.8 MHz

#### Measurement Limit:

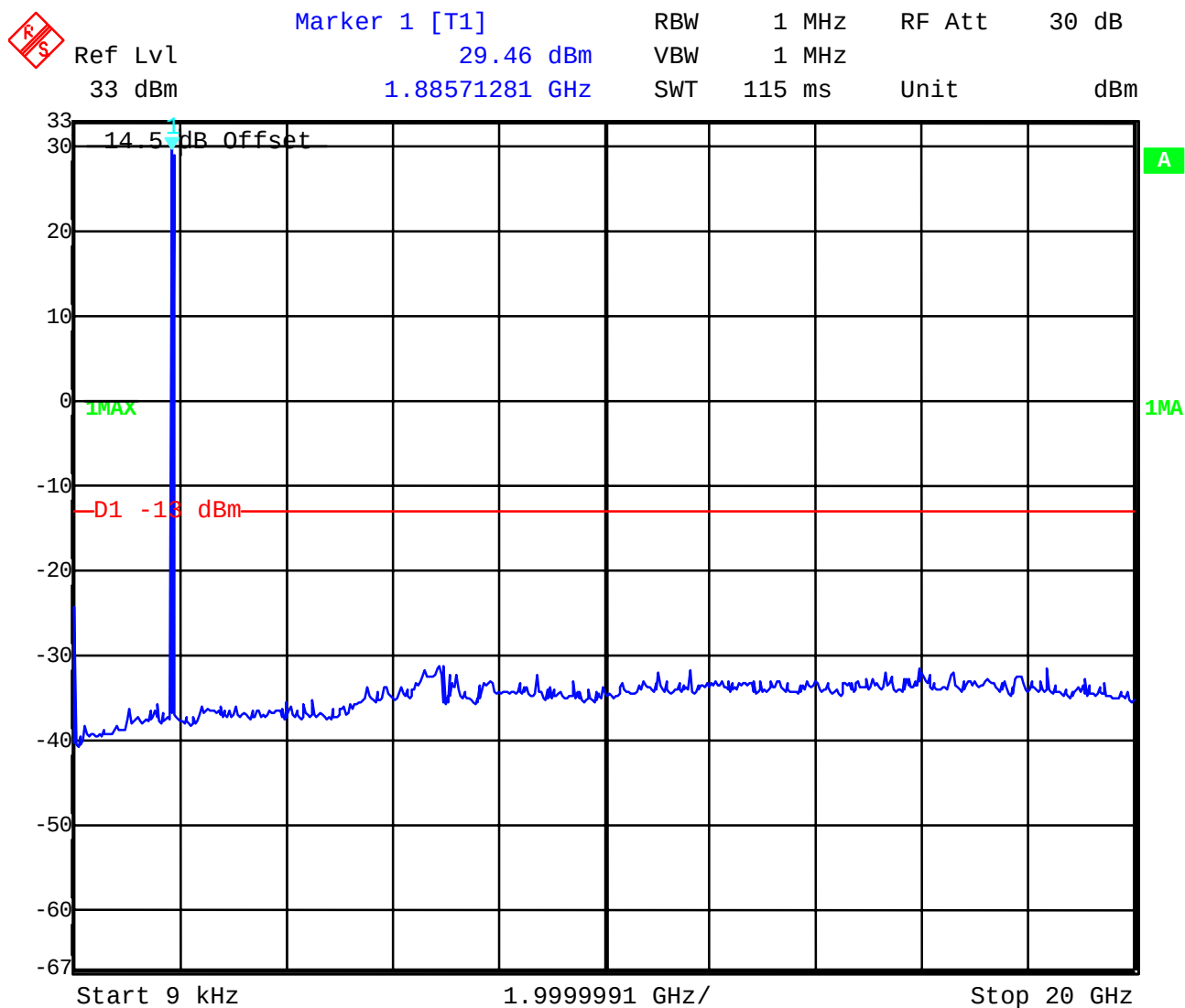
(a) On any frequency outside frequency band of the USPCS spectrum, the power of any emission shall be attenuated below the transmitter power (P, in Watts) by at least  $43+10\log(P)$  dB. For all power levels +30 dBm to 0 dBm, this becomes a constant specification limit of -13 dBm.

#### Measurement Results:

| Harmonic | Tx ch.-512<br>Freq. (MHz) | Level<br>(dBm) | Tx ch.-661<br>Freq. (MHz) | Level<br>(dBm) | Tx ch.-810<br>Freq. (MHz) | Level<br>(dBm) |
|----------|---------------------------|----------------|---------------------------|----------------|---------------------------|----------------|
|          | 848.2                     | -              | 848.2                     | -              | 848.2                     | -              |
| 2        | 3700.4                    | -              | 3760                      | -              | 3819.6                    | -              |
| 3        | 5550.6                    | -              | 5640                      | -              | 5729.4                    | -              |
| 4        | 7400.8                    | -              | 7520                      | -              | 7639.2                    | -              |
| 5        | 9251.0                    | -              | 9400                      | -              | 9549.0                    | -              |
| 6        | 11101.2                   | -              | 11280                     | -              | 11458.8                   | -              |
| 7        | 12951.4                   | -              | 13160                     | -              | 13368.6                   | -              |
| 8        | 14801.6                   | -              | 15040                     | -              | 15278.4                   | -              |
| 9        | 16651.8                   | -              | 16920                     | -              | 17188.2                   | -              |
| 10       | 18502.0                   | -              | 18800                     | -              | 19098.0                   | -              |

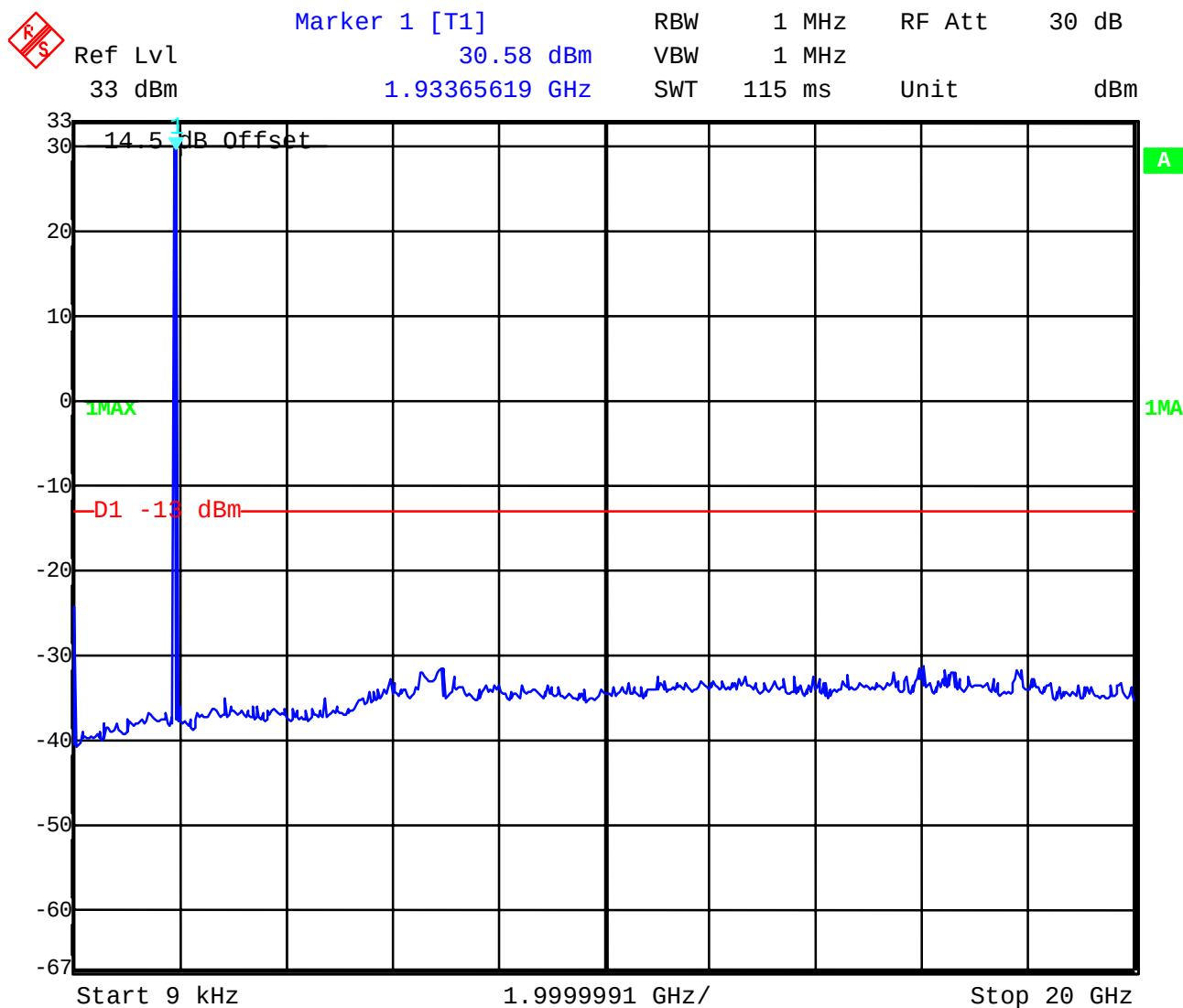
Date: 27.JAN.2005 13:19:26

## Channel 661



Date: 27. JAN. 2005 13:33:18

## Channel 810



Date: 27.JAN.2005 13:43:51



## 3.1.6 Block Edge Compliance

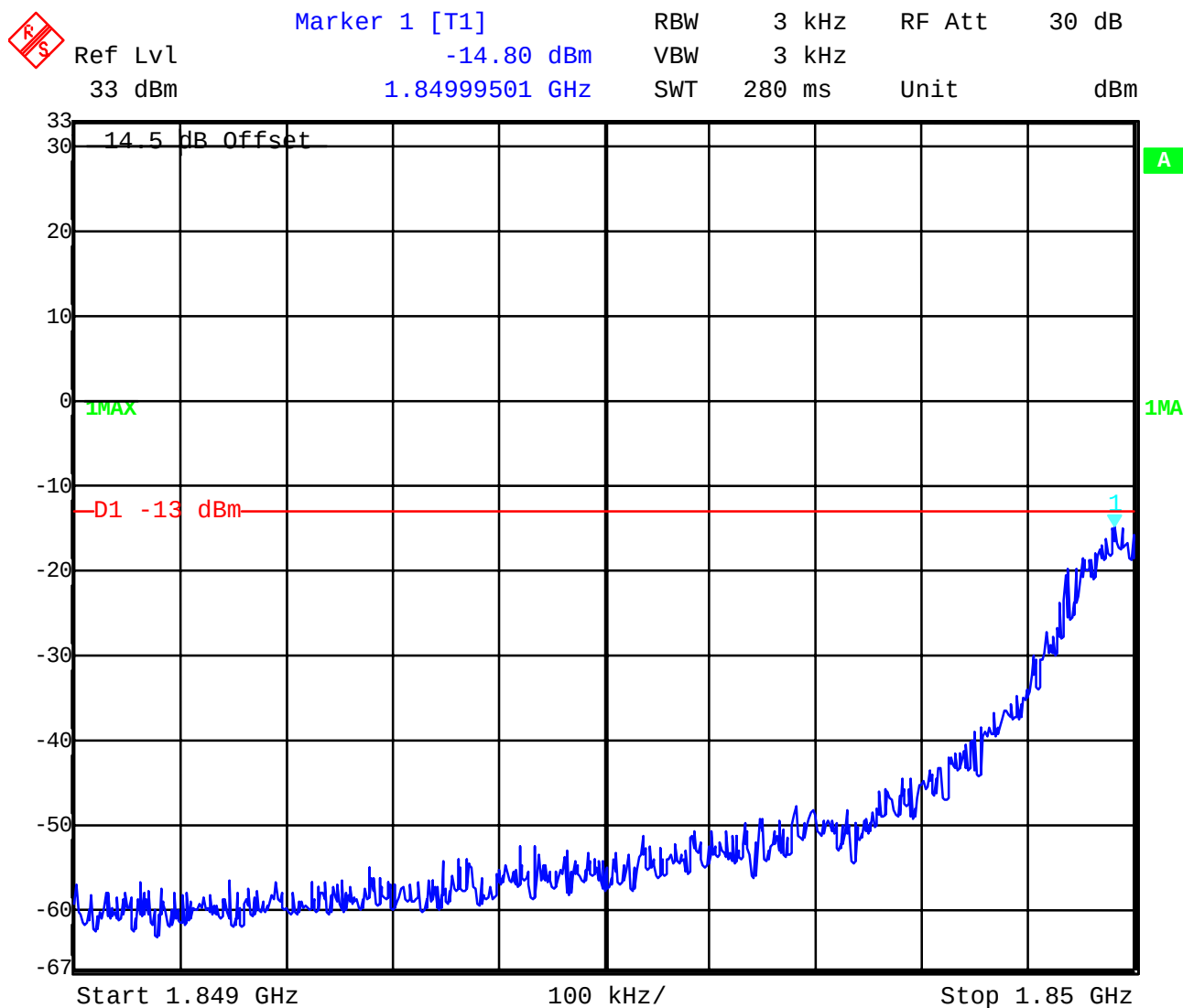
### Reference

|      |                                       |
|------|---------------------------------------|
| FCC: | CFR Part 24.238                       |
| IC:  | RSS 133, Issue 2, Rev. 1, Section 6.3 |

### Measurement Limit:

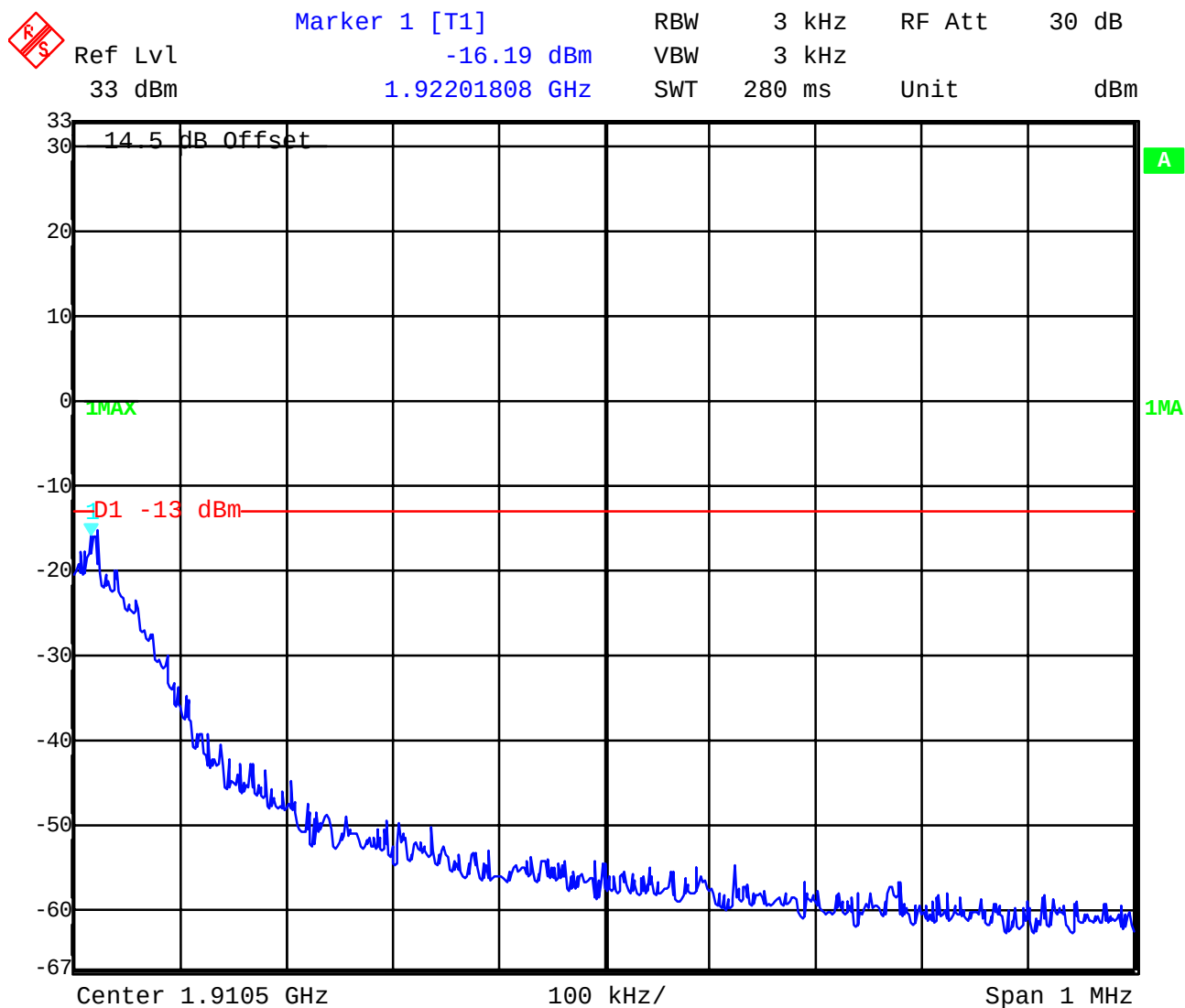
(a) On any frequency outside frequency band of the USPCS spectrum, the power of any emission shall be attenuated below the transmitter power (P, in Watts) by at least  $43+10\log(P)$  dB. For all power levels +30 dBm to 0 dBm, this becomes a constant specification limit of -13 dBm.

## Block 1 Channel 512



Date: 27. JAN. 2005 13:48:19

## Block 6 Channel 810



Date: 27. JAN. 2005 13:52:40

## 3.1.7 Occupied Bandwidth

### Reference

|      |                                       |
|------|---------------------------------------|
| FCC: | CFR Part 24.238, 2.1049               |
| IC:  | RSS 133, Issue 2, Rev. 1, Section 5.6 |

### Occupied Bandwidth Results

Similar to conducted emissions, occupied bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the extreme and mid frequencies of the USPCS frequency band. Table 8.2 below lists the measured 99% power and -26dBc occupied bandwidths. Spectrum analyzer plots are included on the following pages.

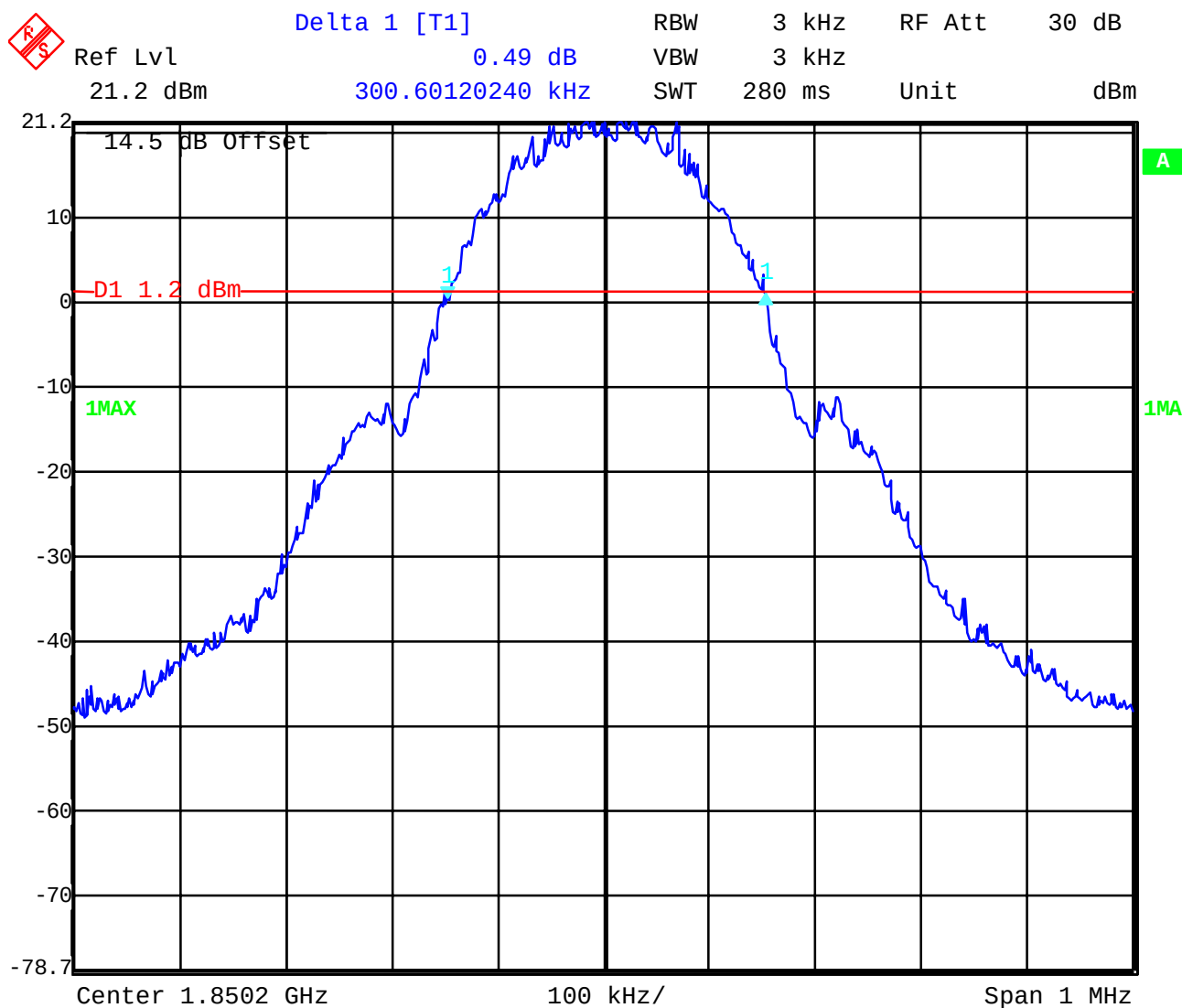
#### Normal mode

| Frequency  | 99% Occupied Bandwidth<br>kHz | -26 dBc Bandwidth<br>kHz |
|------------|-------------------------------|--------------------------|
| 1850.2 MHz | 300.601                       | 334.669                  |
| 1880.0 MHz | 298.597                       | 332.665                  |
| 1909.8 MHz | 296.593                       | 328.657                  |

Part 24.238 (a) requires a measurement bandwidth of at least 1% of the occupied bandwidth. For ca. 300.0 kHz, this equates to a resolution bandwidth of at least 3.0 kHz. For this testing, a resolution bandwidth 3.0 kHz was used.

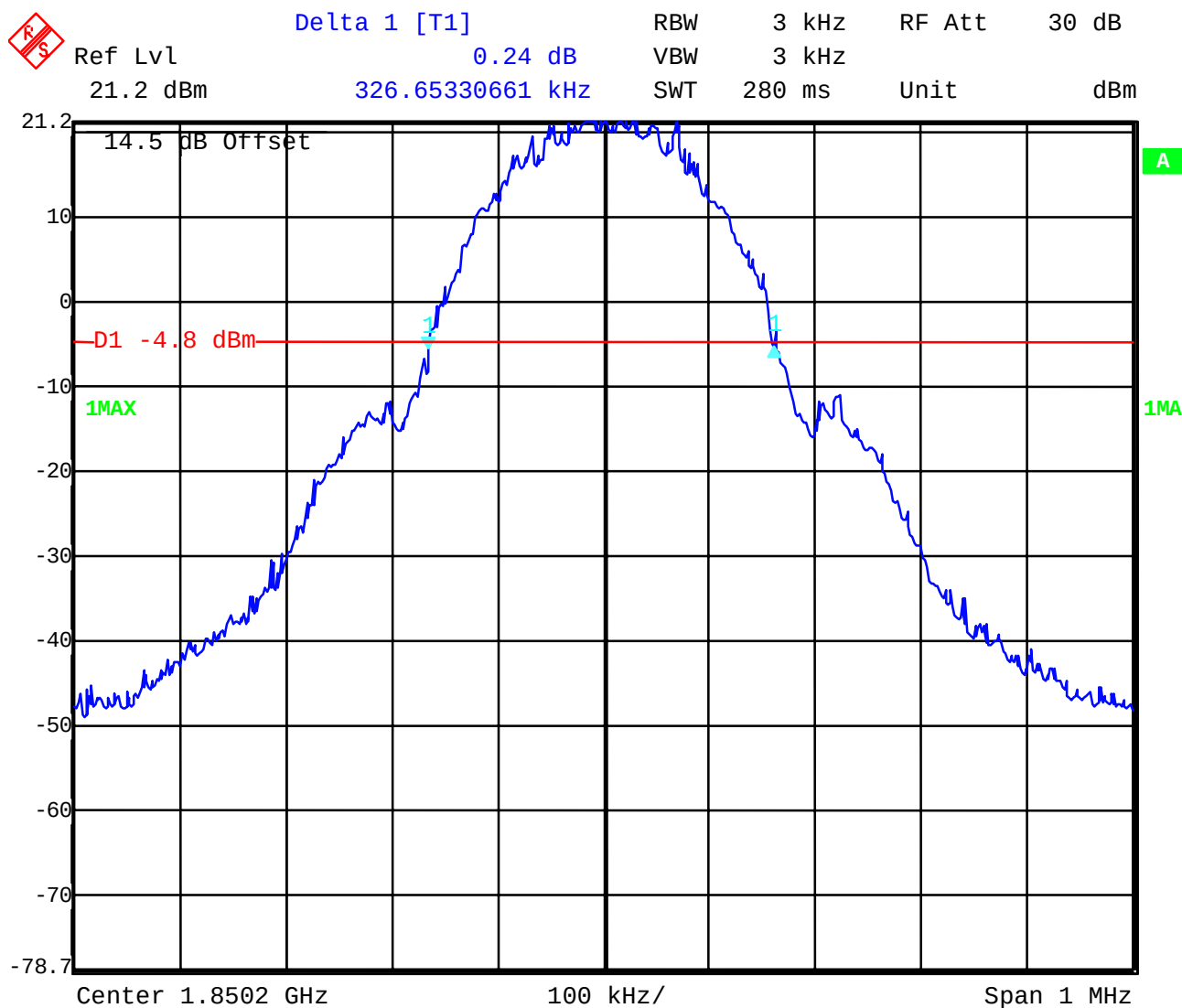
## Channel 512

99% (-20 dB) Occupied Bandwidth



Date: 27. JAN. 2005 13:55:21

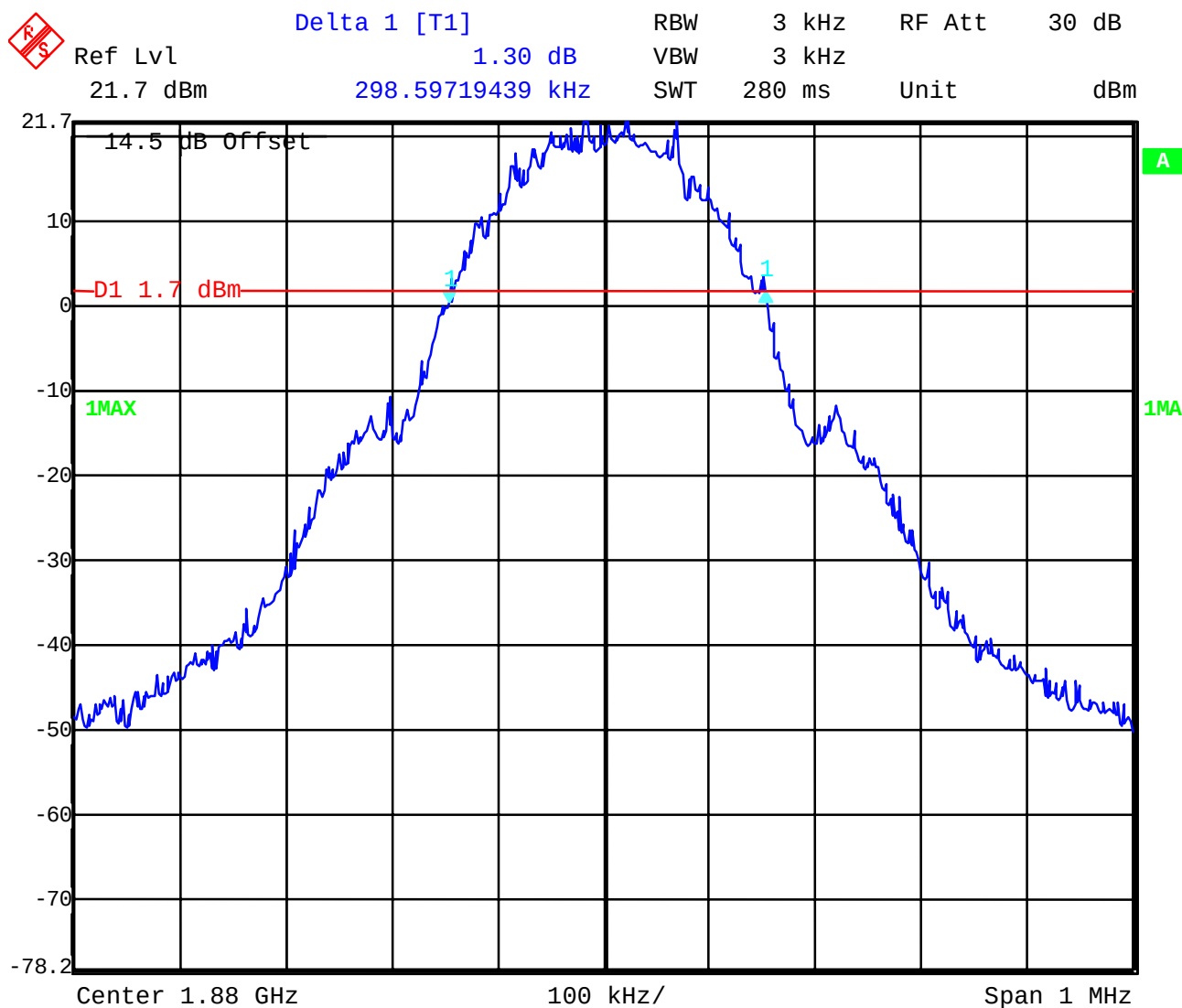
## Channel 512 -26 dBc Bandwidth



Date: 27. JAN. 2005 13:41:28

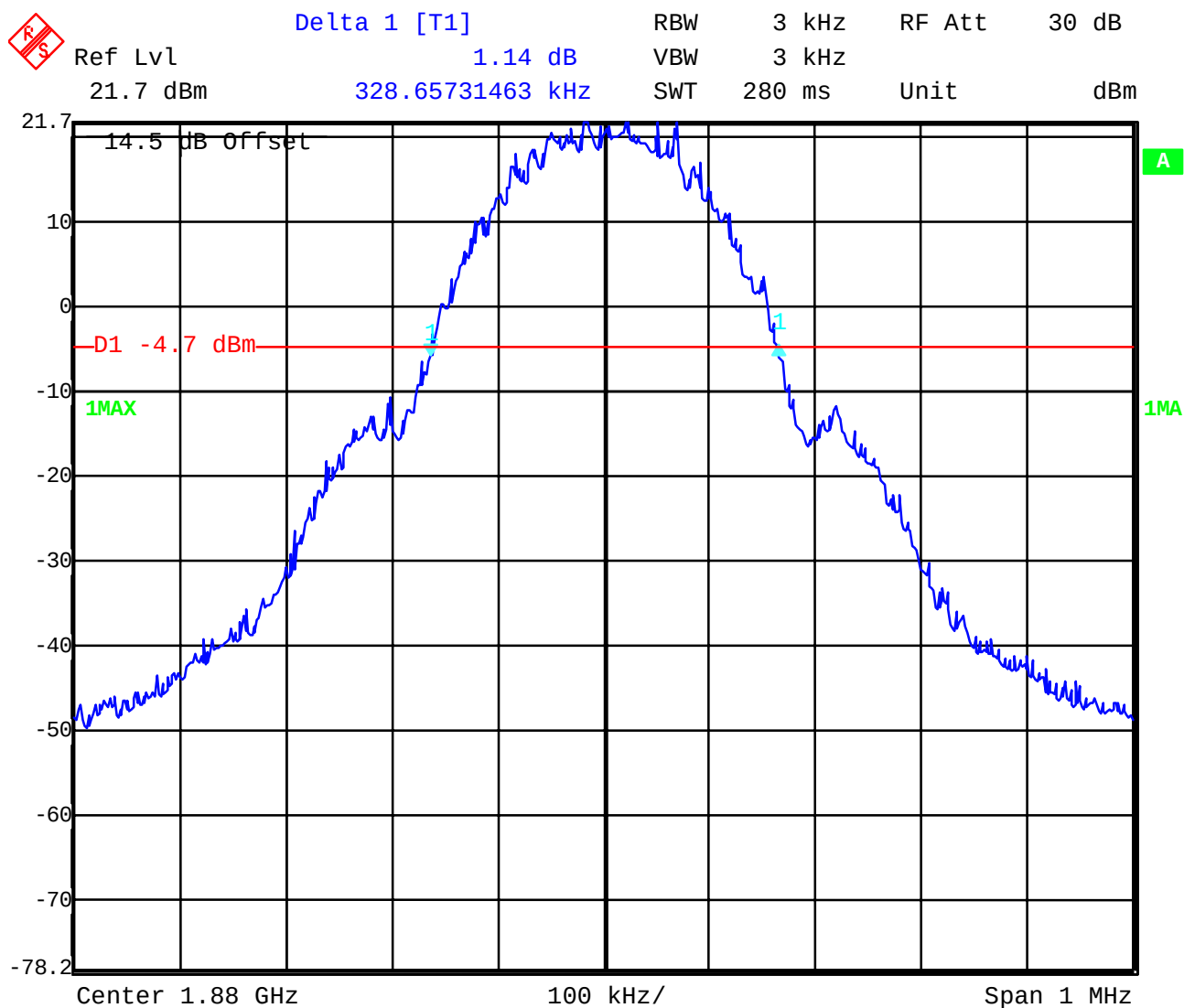
## Channel 661

### 99% (-20 dB) Occupied Bandwidth



Date: 27. JAN. 2004 14:12:50

## Channel 661 -26 dBc Bandwidth

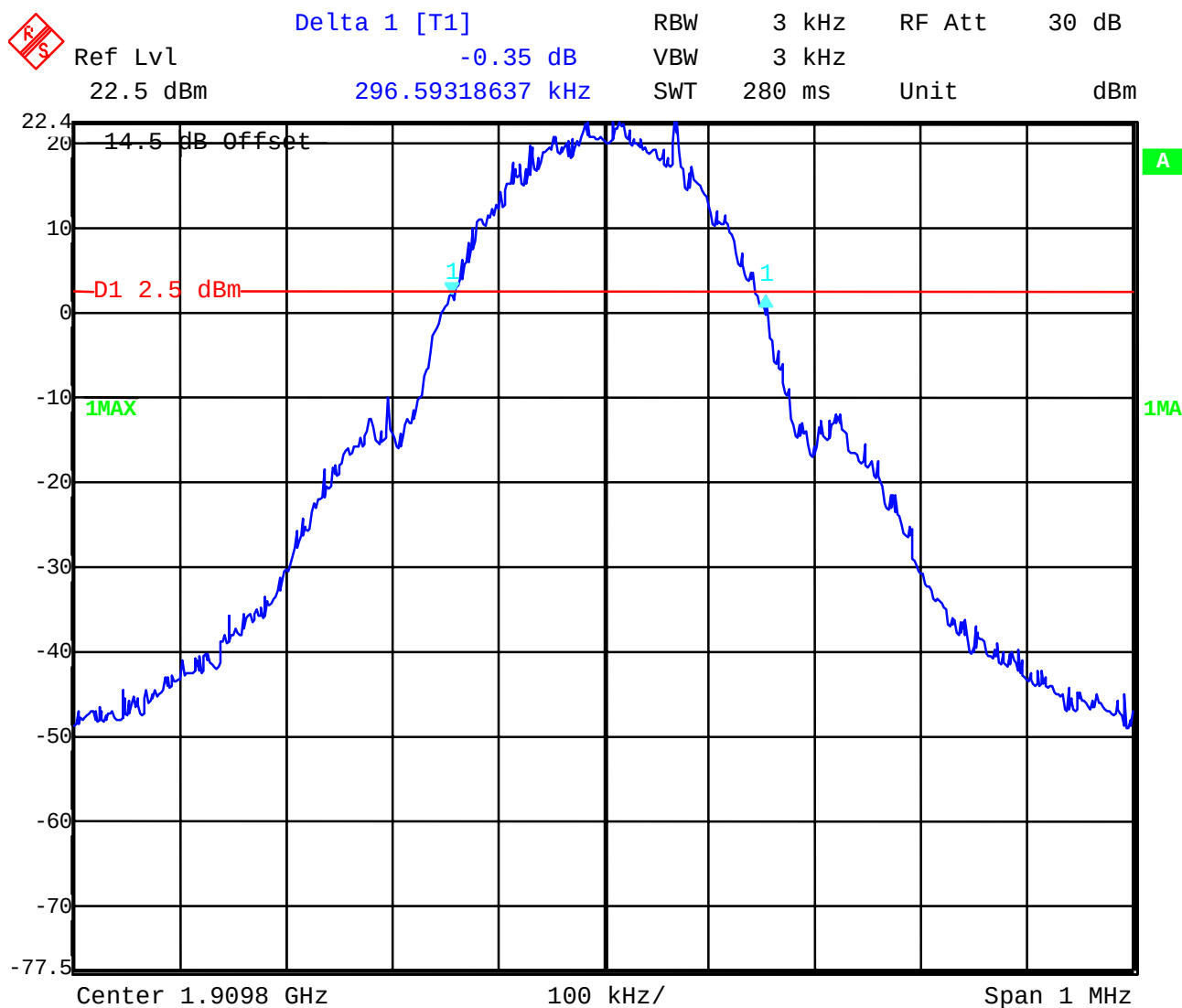


Date: 27. JAN. 2005 14:31:57



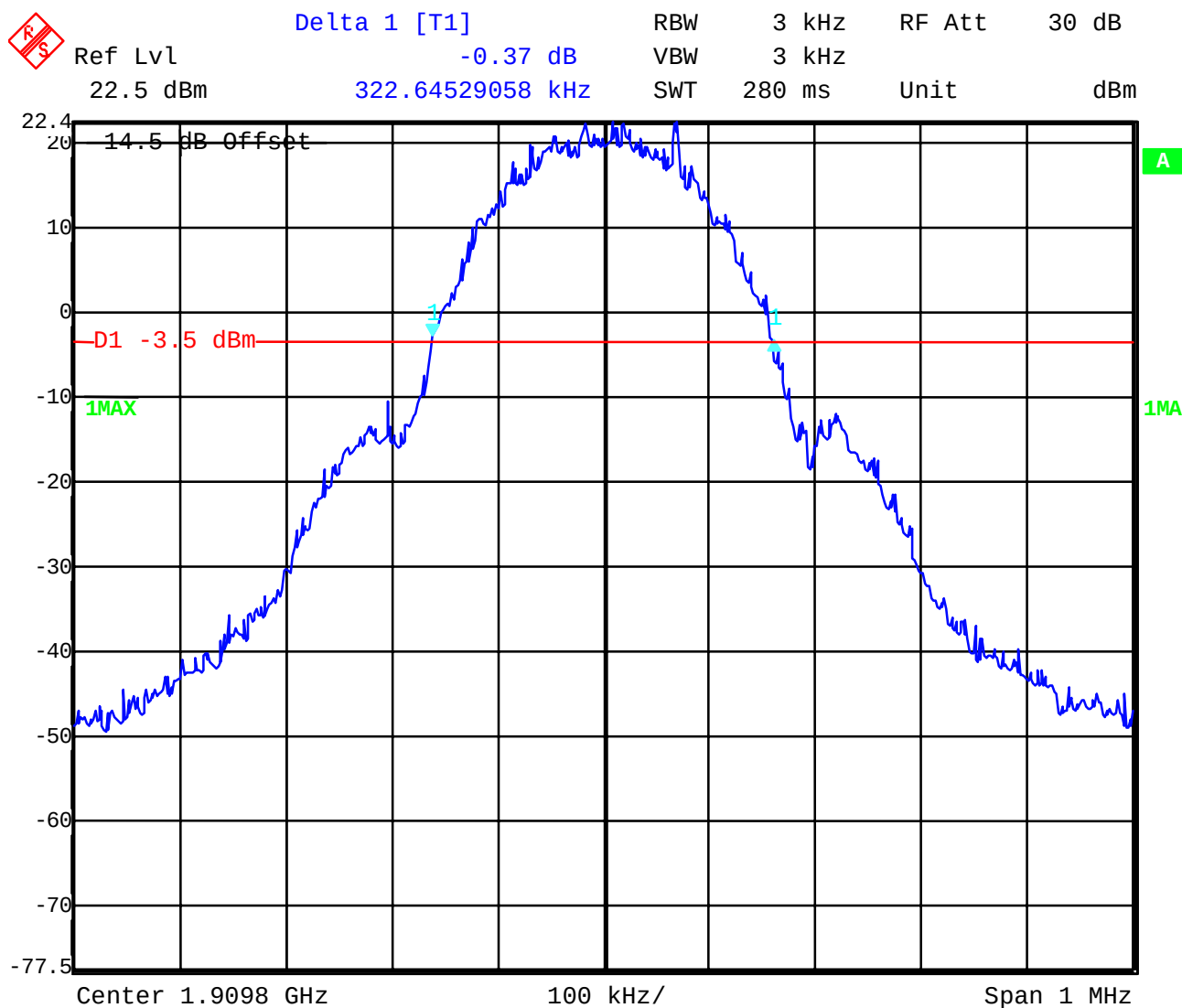
## Channel 810

99% (-20 dB) Occupied Bandwidth



Date: 27. JAN. 2005 14:38:44

## Channel 810 -26 dBc Bandwidth



Date: 27. JAN. 2005 14:56:19

## 3.2 PART GSM 850

### 3.2.1 RF Power Output

#### Reference

|      |                                       |
|------|---------------------------------------|
| FCC: | CFR Part 22.9.1.3, 2.1046             |
| IC:  | RSS 132, Issue 1, Section 4.4 and 6.4 |

#### Summary:

This paragraph contains both average , peak output powers and EIRP measurements for the mobile station.  
In all cases, the peak output power is within the required mask (this mask is specified in the JTC standards, TIA PN3389 Vol. 1 Chap 7, and is no FCC requirement).

#### Method of Measurements:

The mobile was set up for the max. output power with pseudo random data modulation.  
The power was measured with R&S Signal Analyzer FSIQ 26 ( peak and average)  
This measurements were done at 3 frequencies, 824.2 MHz, 836.2 MHz and 848.8 MHz (bottom, middle and top of operational frequency range).

#### Limits:

| Power Step | Nominal Peak Output Power (dBm) | Tolerance (dB) |
|------------|---------------------------------|----------------|
| 5          | +33                             | $\pm 2$        |

#### Measurements Results Output Power (conducted)

| Frequency (MHz)         | Power Step | Peak Output Power (dBm) | Average Output Power (dBm) |
|-------------------------|------------|-------------------------|----------------------------|
| 824.2                   | 5          | 32.9                    | 32.8                       |
| 836.4                   | 5          | 32.5                    | 32.4                       |
| 848.8                   | 5          | 32.7                    | 32.6                       |
| Measurement uncertainty |            | $\pm 0.5$ dB            |                            |

## ERP Measurements

Description: This is the test for the maximum radiated power from the phone.

Rule Part 22.913 specifies that "Mobile/portable stations are limited to 7 watts ERP.

Measuring the EIRP of Spurious/Harmonic Emissions using Substitution Method

- (a) The measurements was performed with full rf output power and modulation.
- (b) Test was performed at listed 3m test site (listed with FCC, IC).
- (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  
 $E \text{ (dBuV/m)} = \text{Reading (dBuV)} + \text{Total Correction Factor (dB/m)}$
- (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° 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

## Measuring the ERP of Spurious/Harmonic Emissions using Substitution Method

- (a) Set the EMI Receiver (for measuring E-Field) and Receiver #2 (for measuring ERP) 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  
 $E \text{ (dBuV/m)} = \text{Reading (dBuV)} + \text{Total Correction Factor (dB/m)}$
- (c) Select the frequency and E-field levels 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° 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:

$$P = P_1 - L_1 = (P_2 + L_2) - L_1 = P_3 + A + L_2 - L_1$$

$$EIRP = P + G_1 = P_3 + L_2 - L_1 + A + G_1$$

$$ERP = EIRP - 2.15 \text{ dB}$$

$$\text{Total Correction factor in EMI Receiver \# 2} = L_2 - L_1 + G_1$$

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.

## Limits:

| Power Step | Burst Peak (dBm) |
|------------|------------------|
| 0          | <33              |

## Measurement Results Output Power ( Radiated )

| Frequency (MHz)               | Power Step | BURST Peak (dBm) |
|-------------------------------|------------|------------------|
|                               |            | ERP              |
| 824.2                         | 5          | 28.8             |
| 836.4                         | 5          | 29.2             |
| 848.8                         | 5          | 29.8             |
| Measurement uncertainty: 1.5% |            |                  |

## 3.2.2 Frequency Stability

### Reference

|      |                                       |
|------|---------------------------------------|
| FCC: | CFR Part 22.355, 2.1055               |
| IC:  | RSS 132, Issue 1, Section 4.3 and 6.3 |

### Method of Measurement:

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the mobile station in a "call mode". This is accomplished with the use of a R&S CMU 200 DIGITAL RADIOCOMMUNICATION TESTER..

1. Measure the carrier frequency at room temperature.
2. Subject the mobile station to overnight soak at -30 C.
3. With the mobile station, powered with 3.7 Volts, connected to the CMU 200 and in a simulated call on channel 661 (centre channel), measure the carrier frequency. These measurements should be made within 2 minutes of powering up the mobile station, to prevent significant self warming.
4. Repeat the above measurements at 10 C increments from -30 C to +60 C. Allow at least 1 1/2 hours at each temperature, un-powered, before making measurements.
5. Re-measure carrier frequency at room temperature with nominal 3.7 Volts. Vary supply voltage from minimum 3.3 Volts to maximum 4.4 Volts, in 13 steps re-measuring carrier frequency at each voltage. Pause at 3.7 V ac Volts for 1 1/2 hours un-powered, to allow any self heating to stabilize, before continuing.
6. Subject the mobile station to overnight soak at +60 C.
7. With the mobile station, powered with 3.7 Volts, connected to the CMU 200 and in a simulated call on channel 661(center channel), measure the carrier frequency. These measurements should be made within 2 minutes of powering up the mobile station, to prevent significant self warming.
8. Repeat the above measurements at 10 C increments from +60 C to -30 C. Allow at least 1 1/2 hours at each temperature, un-powered, before making measurements.
9. At all temperature levels hold the temperature to +/- 0.5 C during the measurement procedure.

### Measurement Limit:

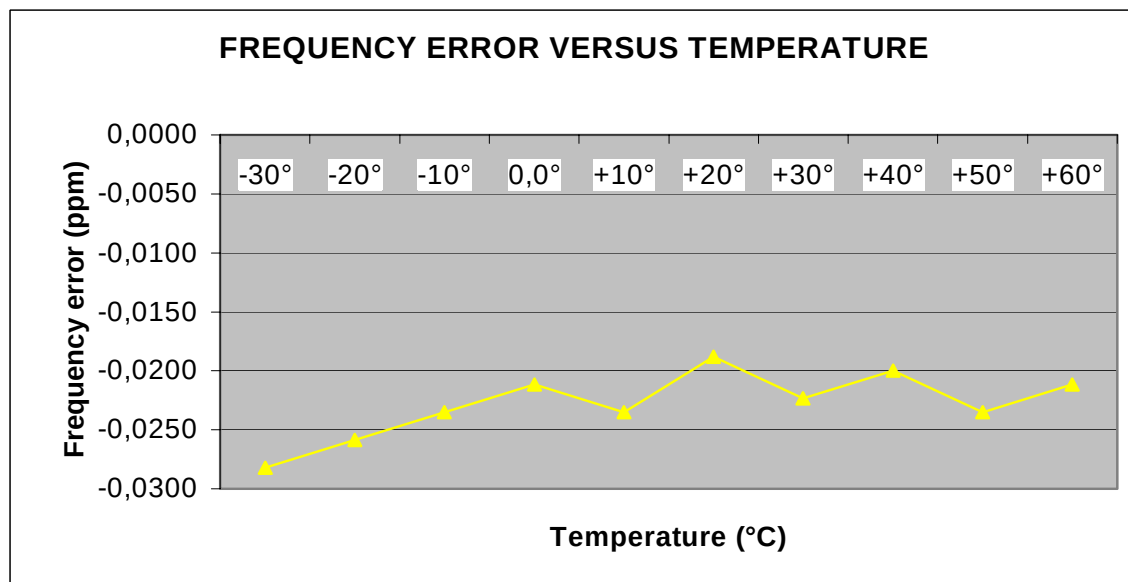
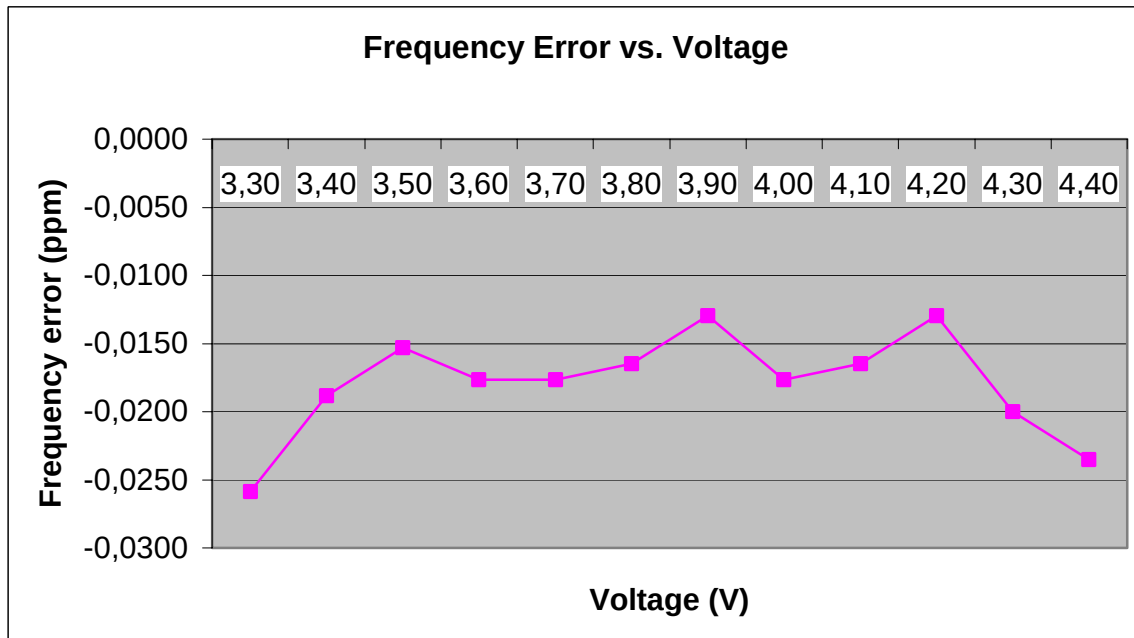
According to the JTC standard the frequency stability of the carrier shall be accurate to within 0.1 ppm of the received frequency from the base station. This accuracy is sufficient to meet Sec. 22.355, Frequency Stability. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.. This transceiver is specified to operate with an input voltage of between 3.3 V dc and 4.4 V dc, with a nominal voltage of 3.7 V dc.

## Measurement Results: AFC FREQ ERROR vs. VOLTAGE

| Voltage (V) | Frequency Error (Hz) | Frequency Error (%) | Frequency Error (ppm) |
|-------------|----------------------|---------------------|-----------------------|
| 3.3         | -22                  | -0,00000259         | -0,0259               |
| 3.4         | -16                  | -0,00000188         | -0,0188               |
| 3.5         | -13                  | -0,00000153         | -0,0153               |
| 3.6         | -15                  | -0,00000176         | -0,0176               |
| 3.7         | -15                  | -0,00000176         | -0,0176               |
| 3.8         | -14                  | -0,00000165         | -0,0165               |
| 3.9         | -11                  | -0,00000129         | -0,0129               |
| 4.0         | -15                  | -0,00000176         | -0,0176               |
| 4.1         | -14                  | -0,00000165         | -0,0165               |
| 4.2         | -11                  | -0,00000129         | -0,0129               |
| 4.3         | -17                  | -0,00000200         | -0,0200               |
| 4.4         | -20                  | -0,00000235         | -0,0235               |

## Measurement Results: AFC FREQ ERROR vs. TEMPERATURE

| TEMPERATURE (°C) | Frequency Error (Hz) | Frequency Error (%) | Frequency Error (ppm) |
|------------------|----------------------|---------------------|-----------------------|
| -30              | -24                  | -0,00000282         | -0,0282               |
| -20              | -22                  | -0,00000259         | -0,0259               |
| -10              | -20                  | -0,00000235         | -0,0235               |
| ±0.0             | -18                  | -0,00000212         | -0,0212               |
| +10              | -20                  | -0,00000235         | -0,0235               |
| +20              | -16                  | -0,00000188         | -0,0188               |
| +30              | -19                  | -0,00000224         | -0,0224               |
| +40              | -17                  | -0,00000200         | -0,0200               |
| +50              | -20                  | -0,00000235         | -0,0235               |
| +60              | -18                  | -0,00000212         | -0,0212               |





### 3.2.3 Radiated Emissions

#### Reference

|      |                                       |
|------|---------------------------------------|
| FCC: | CFR Part 22.917, 2.1053               |
| IC:  | RSS 132, Issue 1, Section 4.5 and 6.5 |

#### Measurement Procedure:

The following steps outline the procedure used to measure the radiated emissions from the mobile station. The site is constructed in accordance with ANSI C63.4:2003 requirements and is recognized by the FCC to be in compliance for a 3 and a10 meter site. The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier that can be as high as 848.8 MHz. This was rounded up to 12 GHz. The resolution bandwidth is set as outlined in Part 22.917. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the USPCS band.

The final open field emission ( here 10m semi-anechoic chamber listed by FCC) test procedure is as follows:

- The test item was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna.
- The antenna output was terminated in a 50 ohm load.
- A double ridged wave guide antenna was placed on an adjustable height antenna mast 3 meters from the test item for emission measurements.
- Detected emissions were maximized at each frequency by rotating the test item and adjusting the receive antenna height and polarization. The maximum meter reading was recorded. The radiated emission measurements of the harmonics of the transmit frequency through the 10th harmonic were measured with peak detector and 1 MHz bandwidth. If the harmonic could not be detected above the noise floor, the ambient level was recorded. The equivalent power into a dipole antenna was calculated from the field intensity levels measured at 3 meters using the equation shown below:
- Now each detected emissions were substituted by the Substitution method, in accordance with the TIA/EIA 603 .

#### Measurement Limit:

Sec. 22.917 Emission Limits.

(a) On any frequency outside a licensee' s frequency block (e.g. A, D, B, etc.) within the USPCS spectrum, the power of any emission shall be attenuated below the transmitter power (P, in Watts) by at least  $43+10\log(P)$  dB.

The specification that emissions shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB, translates in the relevant power range (1 to 0.001 W) to -13 dBm. At 1 W the specified minimum attenuation becomes 43 dB and relative to a 30 dBm (1 W) carrier becomes a limit of -13 dBm. At 0.001 W (0 dBm) the minimum attenuation is 13 dB which again yields a limit of -13 dBm. In this way a translation of the specification from relative to absolute terms is carried out.

## Measurement Results:

Radiated emissions measurements were made only at the upper, center, and lower carrier frequencies of the USPCS band (824.2 MHz, 836.2 MHz and 848.8 MHz). It was decided that measurements at these three carrier frequencies would be sufficient to demonstrate compliance with emissions limits because it was seen that all the significant spurs occur well outside the band and no radiation was seen from a carrier in one block of the USPCS band into any of the other blocks. The equipment must still, however, meet emissions requirements with the carrier at all frequencies over which it is capable of operating and it is the manufacturer's responsibility to verify this.

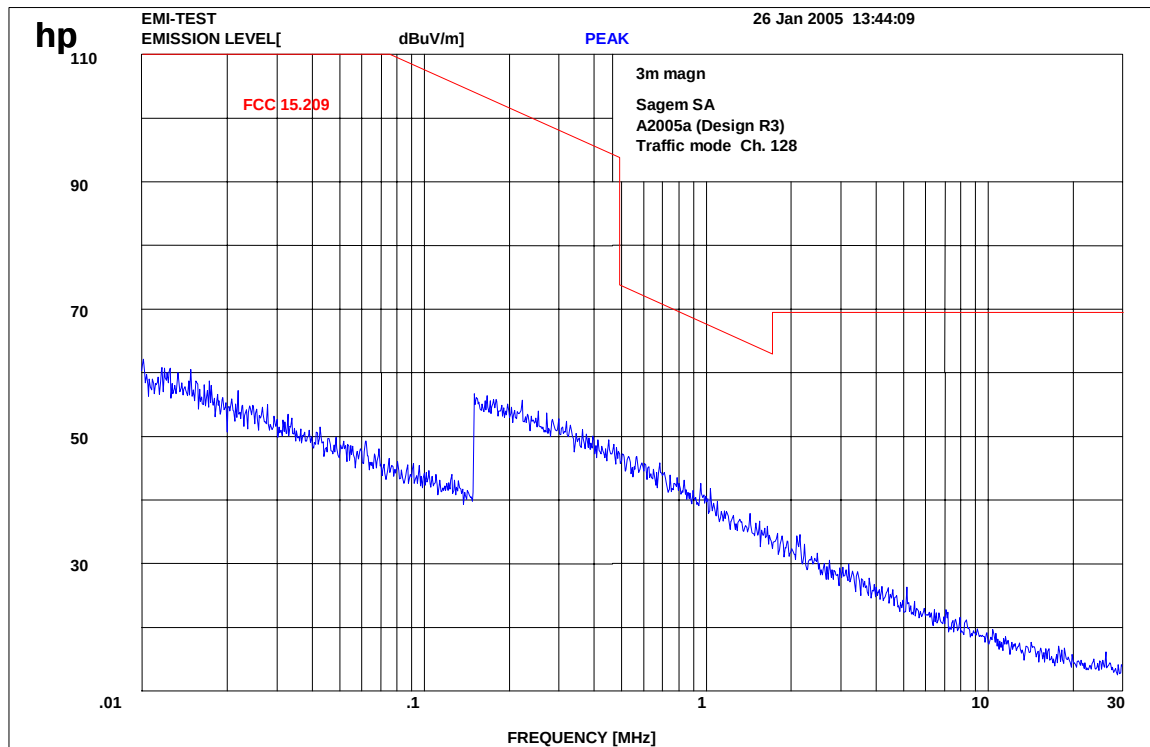
The final open field radiated levels are presented on the next pages.

All measurements were done in horizontal and vertical polarization, the plots shows the worst case.

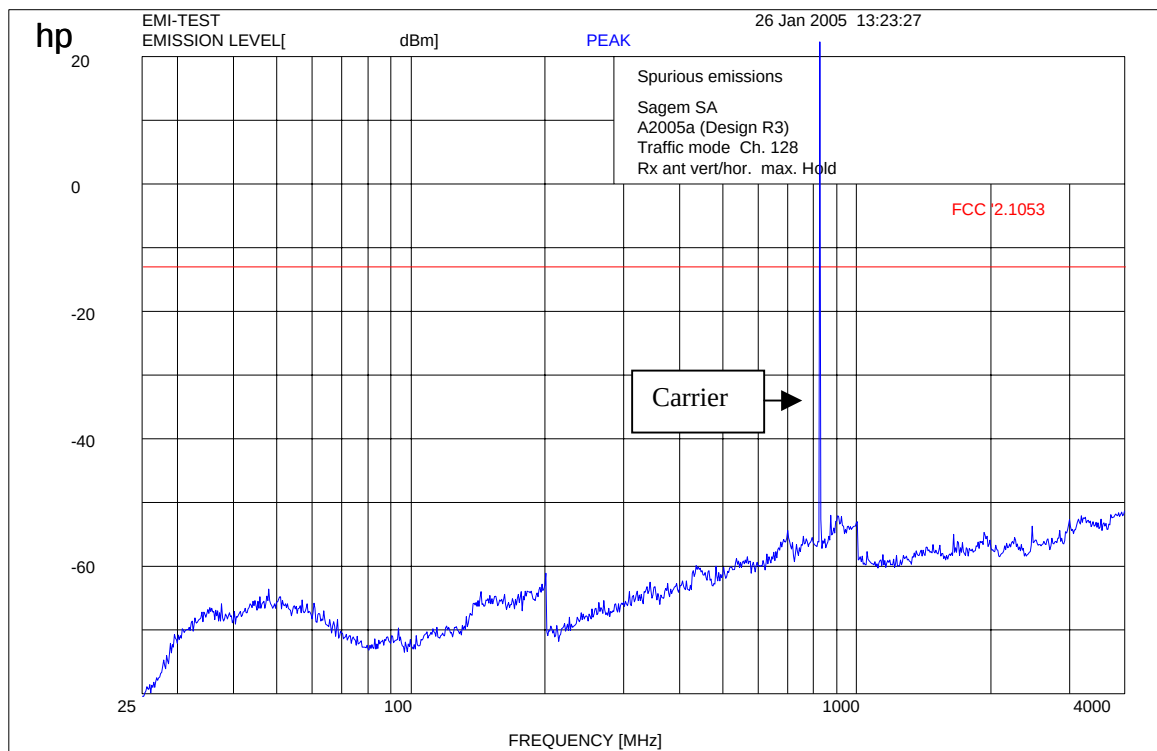
As can be seen from this data, the emissions from the test item were within the specification limit.

| Harmonic | Tx ch.-128<br>Freq. (MHz) | Level<br>(dBm) | Tx ch.-189<br>Freq. (MHz) | Level<br>(dBm) | Tx ch.-251<br>Freq. (MHz) | Level<br>(dBm) |
|----------|---------------------------|----------------|---------------------------|----------------|---------------------------|----------------|
| 2        | 1648.4                    | -              | 1673.2                    | -              | 1697.6                    | -              |
| 3        | 2472.6                    | -              | 2509.8                    | -              | 2546.4                    | -              |
| 4        | 3296.8                    | -              | 3346.4                    | -              | 3395.2                    | -              |
| 5        | 4121.0                    | -              | 4183.0                    | -              | 4244.0                    | -              |
| 6        | 4945.2                    | -              | 5019.6                    | -              | 5092.8                    | -              |
| 7        | 5769.4                    | -              | 5856.2                    | -              | 5941.6                    | -              |
| 8        | 6593.6                    | -              | 6692.8                    | -              | 6790.4                    | -              |
| 9        | 7417.8                    | -              | 7529.4                    | -              | 7639.2                    | -              |
| 10       | 8242.0                    | -              | 8366.0                    | -              | 8488.0                    | -              |

## Traffic mode up to 30 MHz (Valid for all 3 channels)



## Channel 128 (30 MHz - 4 GHz)

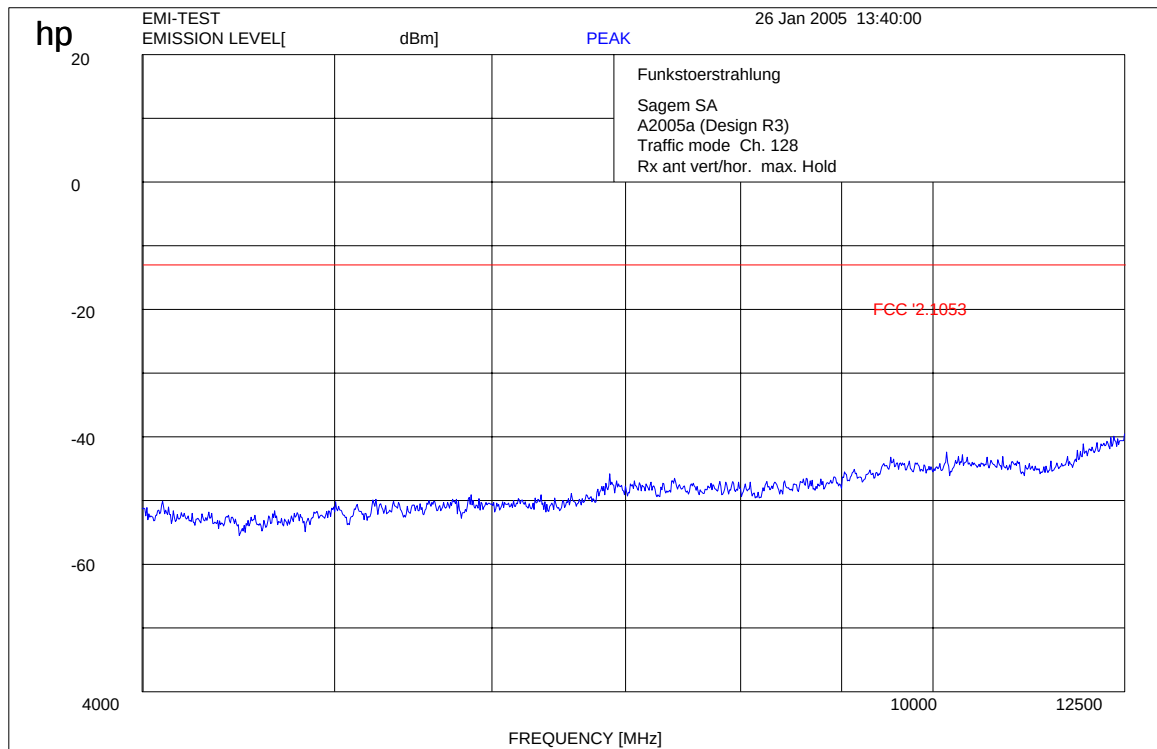


$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW / VBW 1 MHz

Carrier suppressed with a rejection filter

## Channel 128 (4 GHz – 12.5 GHz)

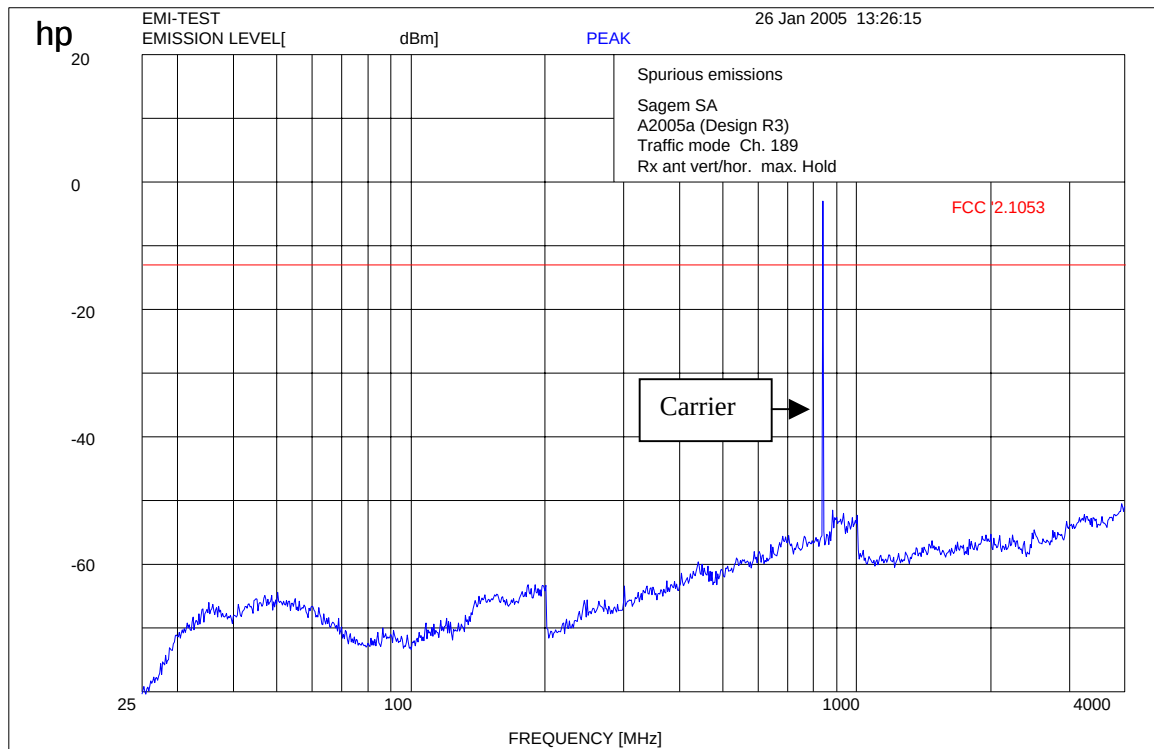


$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW / VBW 1 MHz

Carrier suppressed with a rejection filter

## Channel 189 (30 MHz - 4 GHz)

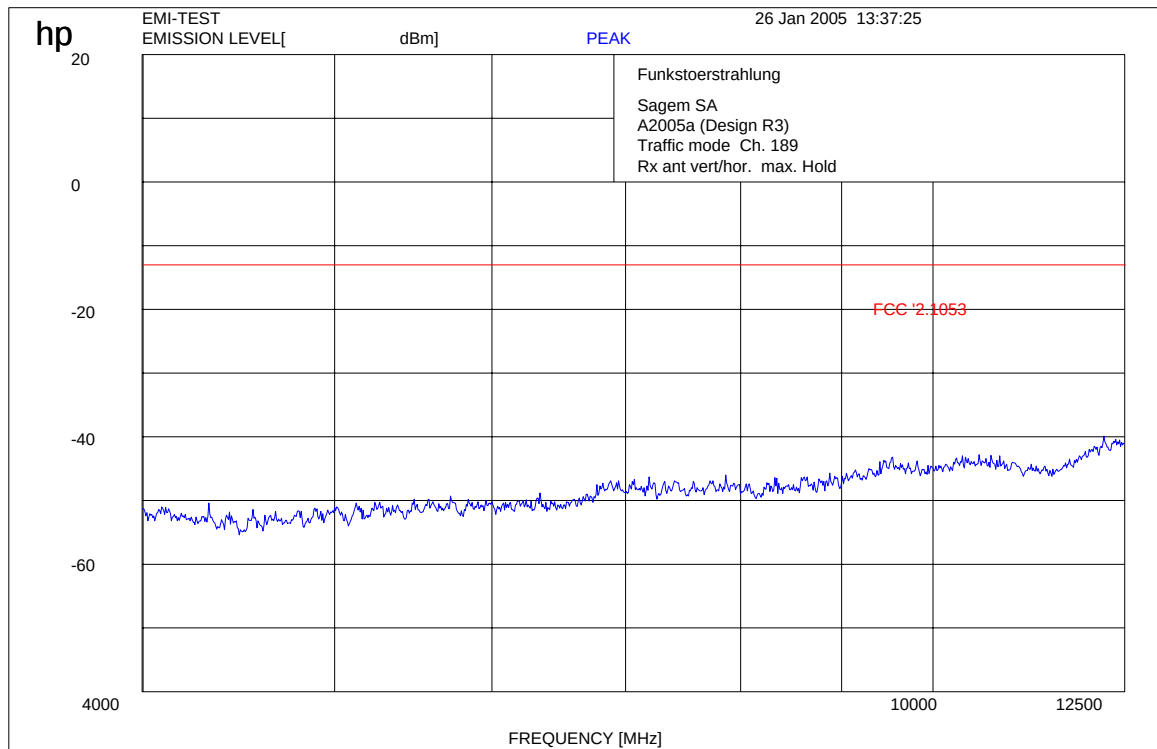


$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW / VBW 1 MHz

Carrier suppressed with a rejection filter

## Channel 189 (4 GHz – 12.5 GHz)

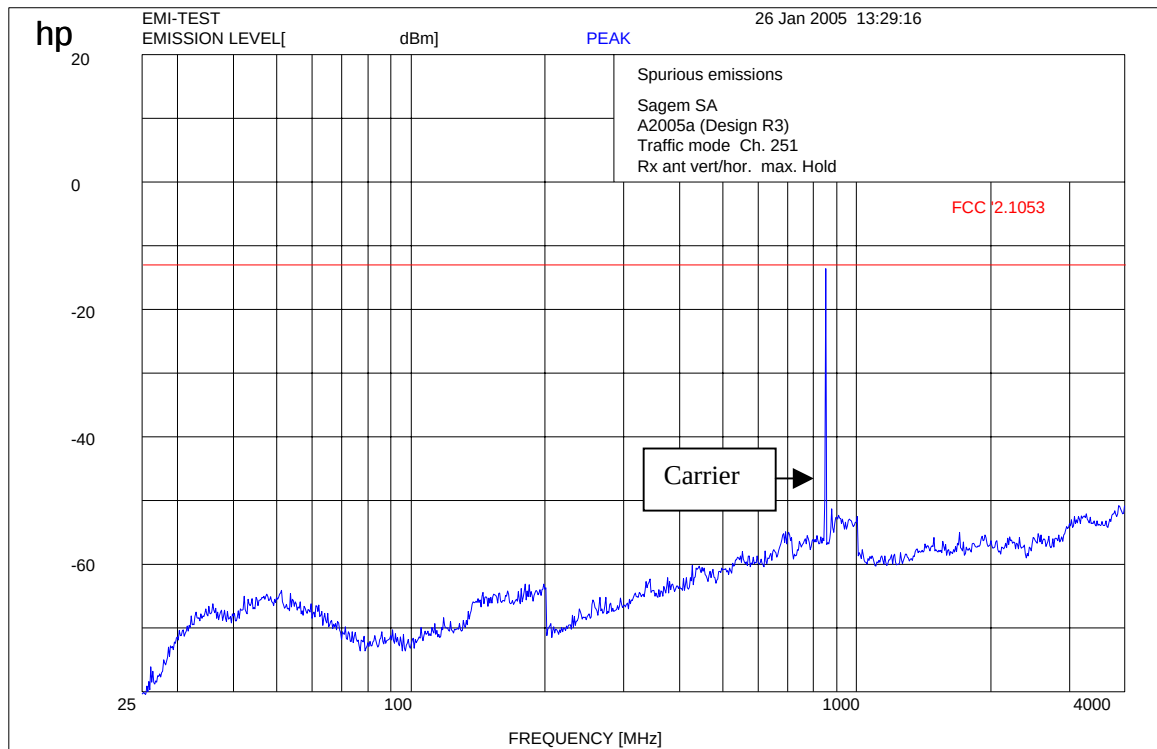


$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW / VBW 1 MHz

Carrier suppressed with a rejection filter

## Channel 251 (30 MHz - 4 GHz)



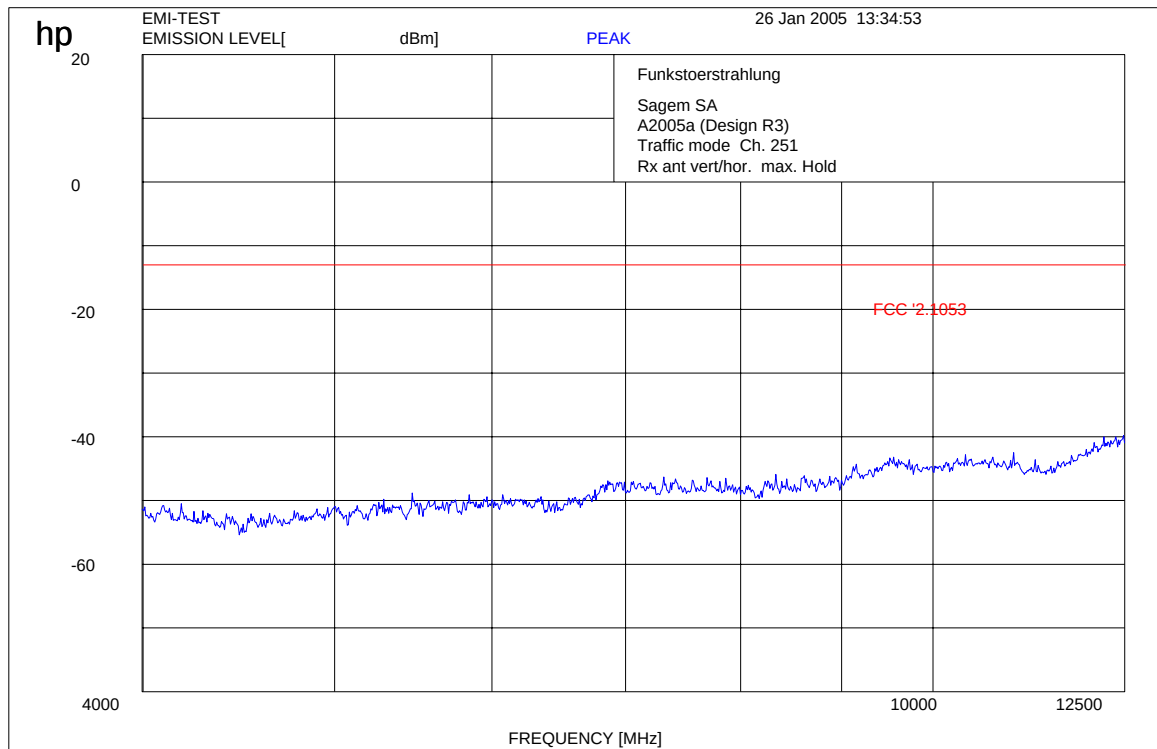
$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW / VBW 1 MHz

Carrier suppressed with a rejection filter



## Channel 251 (4 GHz – 12.5 GHz)



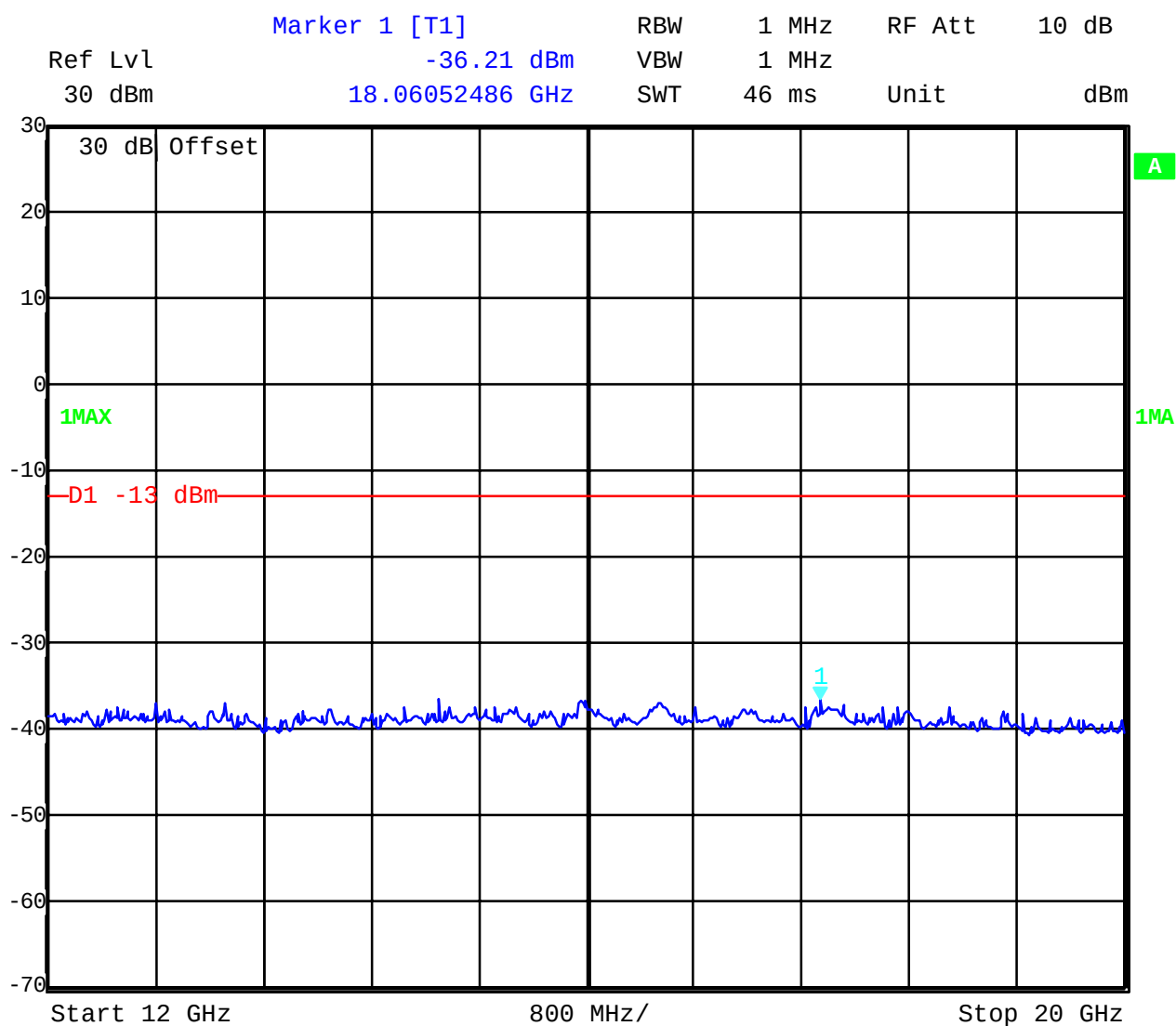
$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW / VBW 1 MHz

Carrier suppressed with a rejection filter

**This plot is valid for all 3 channels (worst case)**

**12 GHz – 20 GHz**



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## 3.2.4 Receiver Radiated Emissions

### Reference

|      |                                       |
|------|---------------------------------------|
| FCC: | CFR Part 15.109, 2.1053               |
| IC:  | RSS 132, Issue 1, Section 4.6 and 6.6 |

| SPURIOUS EMISSIONS LEVEL ( $\mu\text{V/m}$ ) |          |                              |            |          |                              |            |          |                              |
|----------------------------------------------|----------|------------------------------|------------|----------|------------------------------|------------|----------|------------------------------|
| CH 128                                       |          |                              | CH 189     |          |                              | CH 251     |          |                              |
| f<br>(MHz)                                   | Detector | Level<br>( $\mu\text{V/m}$ ) | f<br>(MHz) | Detector | Level<br>( $\mu\text{V/m}$ ) | f<br>(MHz) | Detector | Level<br>( $\mu\text{V/m}$ ) |
| -                                            | -        | -                            | -          | -        | -                            | -          | -        | -                            |
| -                                            | -        | -                            | -          | -        | -                            | -          | -        | -                            |
| -                                            | -        | -                            | -          | -        | -                            | -          | -        | -                            |
| -                                            | -        | -                            | -          | -        | -                            | -          | -        | -                            |
| -                                            | -        | -                            | -          | -        | -                            | -          | -        | -                            |
| -                                            | -        | -                            | -          | -        | -                            | -          | -        | -                            |
| -                                            | -        | -                            | -          | -        | -                            | -          | -        | -                            |
| -                                            | -        | -                            | -          | -        | -                            | -          | -        | -                            |
| -                                            | -        | -                            | -          | -        | -                            | -          | -        | -                            |
| -                                            | -        | -                            | -          | -        | -                            | -          | -        | -                            |
| -                                            | -        | -                            | -          | -        | -                            | -          | -        | -                            |
| -                                            | -        | -                            | -          | -        | -                            | -          | -        | -                            |
| Measurement uncertainty                      |          |                              | $\pm 3$ dB |          |                              |            |          |                              |

$f < 1$  GHz : RBW/VBW: 100 kHz

$f \geq 1$  GHz : RBW/VBW: 1 MHz

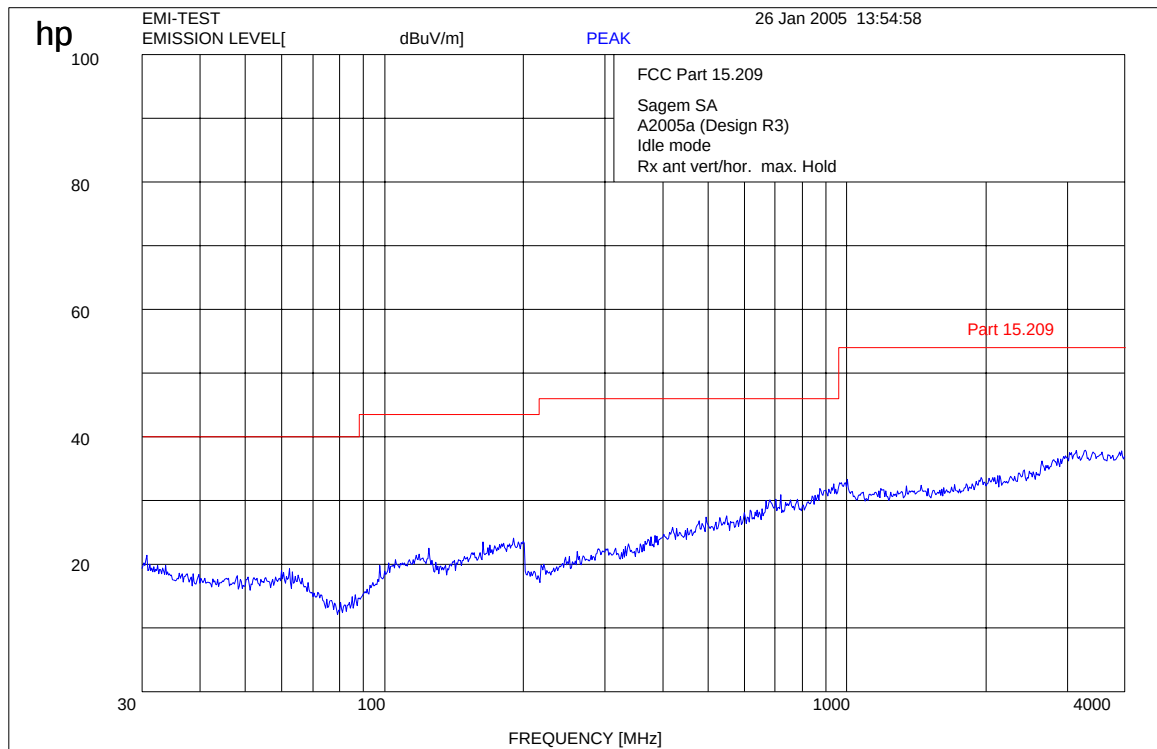
H = Horizontal ; V= Vertical

Measurement distance see table

### Limits: § 15.109

| Frequency (MHz) | Field strength ( $\mu\text{V/m}$ ) | Measurement distance (m) |
|-----------------|------------------------------------|--------------------------|
| 30 - 88         | 100                                | 3                        |
| 88 - 216        | 150                                | 3                        |
| 216 - 960       | 200                                | 3                        |
| above 960       | 500                                | 3                        |

## Idle-Mode (30 MHz - 4 GHz)

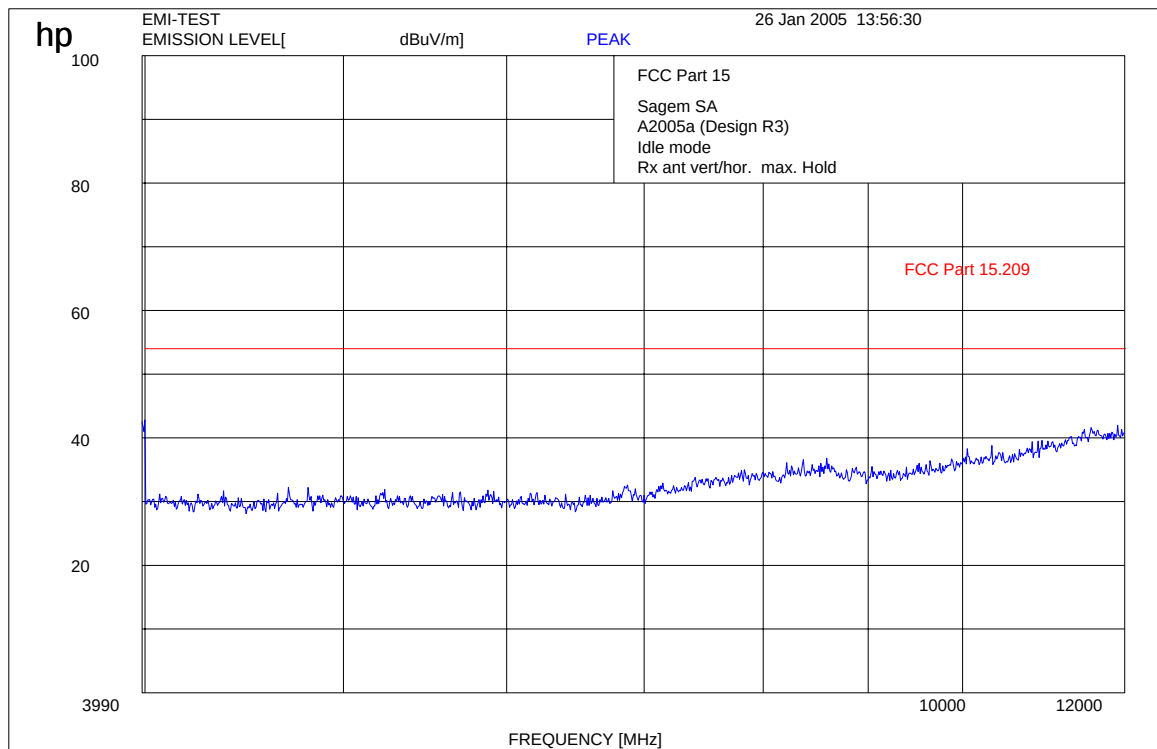


$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW / VBW 1 MHz

Carrier suppressed with a rejection filter

## IDLE-MODE (4 GHz - 12 GHz)



$f < 1 \text{ GHz}$  : RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$  : RBW / VBW 1 MHz

Carrier suppressed with a rejection filter

### 3.2.5 Conducted Spurious Emissions

#### Reference

|      |                                       |
|------|---------------------------------------|
| FCC: | CFR Part 22.917, 1.1051               |
| IC:  | RSS 132, Issue 1, Section 4.5 and 6.5 |

#### Measurement Procedure

The following steps outline the procedure used to measure the conducted emissions from the mobile station.

1. Determine frequency range for measurements: From CFR 2.1057 the spectrum should be investigated from the lowest radio frequency generated in the equipment up to at least the 10th harmonic of the carrier frequency. For the mobile station equipment tested, this equates to a frequency range of 13 MHz to 19.1 GHz, data taken from 10 MHz to 20 GHz.
2. Determine mobile station transmit frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

USPCS Transmitter Channel Frequency

128 824.2 MHz

189 836.2 MHz

251 848.8 MHz

#### Measurement Limit

(a) On any frequency outside frequency band of the USPCS spectrum, the power of any emission shall be attenuated below the transmitter power (P, in Watts) by at least  $43+10\log(P)$  dB. For all power levels +30 dBm to 0 dBm, this becomes a constant specification limit of -13 dBm.

#### Measurement Results

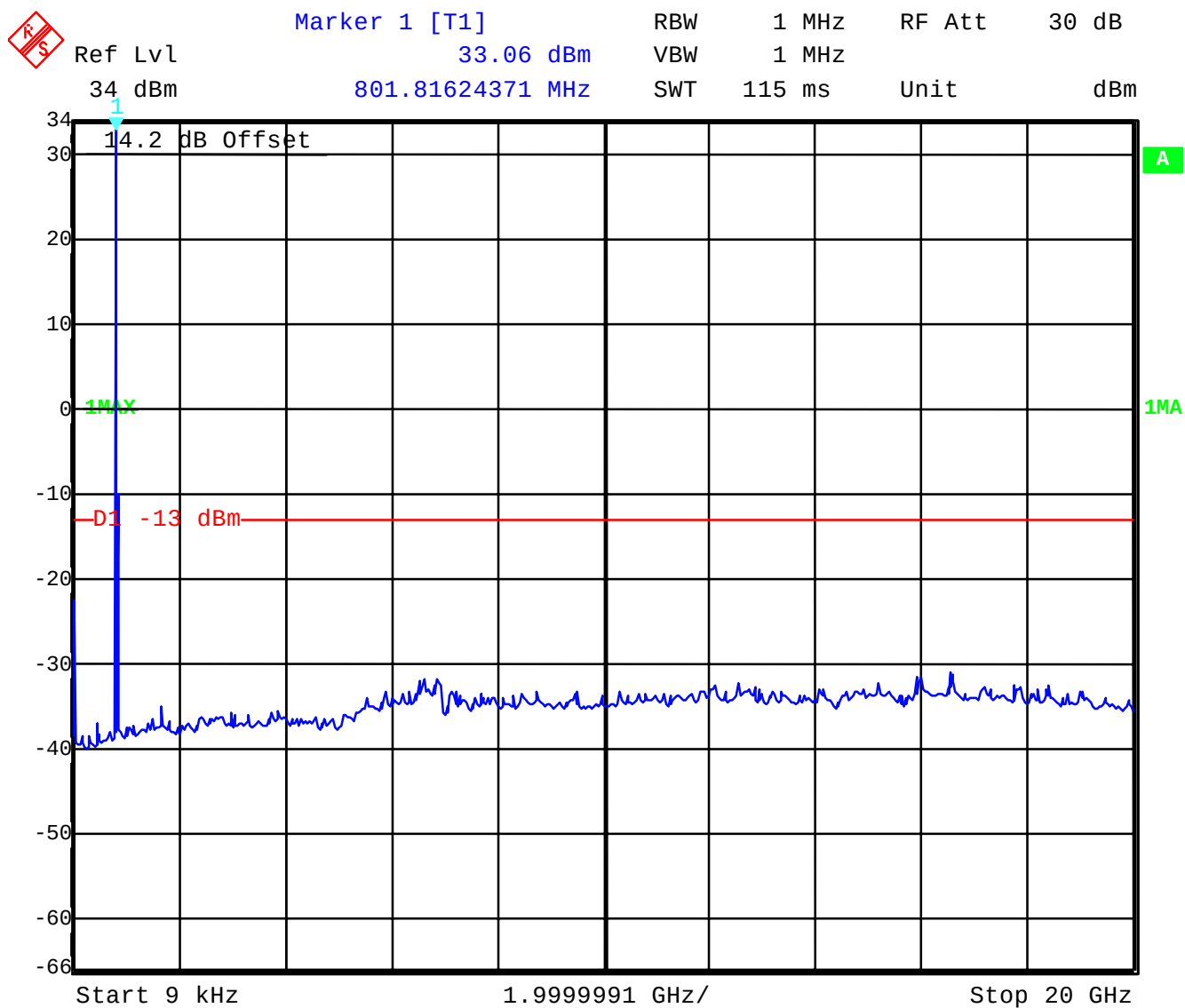
| Harmonic | Tx CH.-128<br>Freq. (MHz) | Level<br>(dBm) | Tx CH.-190<br>Freq. (MHz) | Level<br>(dBm) | Tx CH.-251<br>Freq. (MHz) | Level<br>(dBm) |
|----------|---------------------------|----------------|---------------------------|----------------|---------------------------|----------------|
| 2        | 1648.4                    | -              | 1673.2                    | -              | 1697.6                    | -              |
| 3        | 2472.6                    | -              | 2509.8                    | -              | 2546.4                    | -              |
| 4        | 3296.8                    | -              | 3346.4                    | -              | 3395.2                    | -              |
| 5        | 4121.0                    | -              | 4183.0                    | -              | 4244.0                    | -              |
| 6        | 4945.2                    | -              | 5019.6                    | -              | 5092.8                    | -              |
| 7        | 5769.4                    | -              | 5856.2                    | -              | 5941.6                    | -              |
| 8        | 6593.6                    | -              | 6692.8                    | -              | 6790.4                    | -              |
| 9        | 7417.8                    | -              | 7529.4                    | -              | 7639.2                    | -              |
| 10       | 8242.0                    | -              | 8366.0                    | -              | 8488.0                    | -              |

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## Channel: 128



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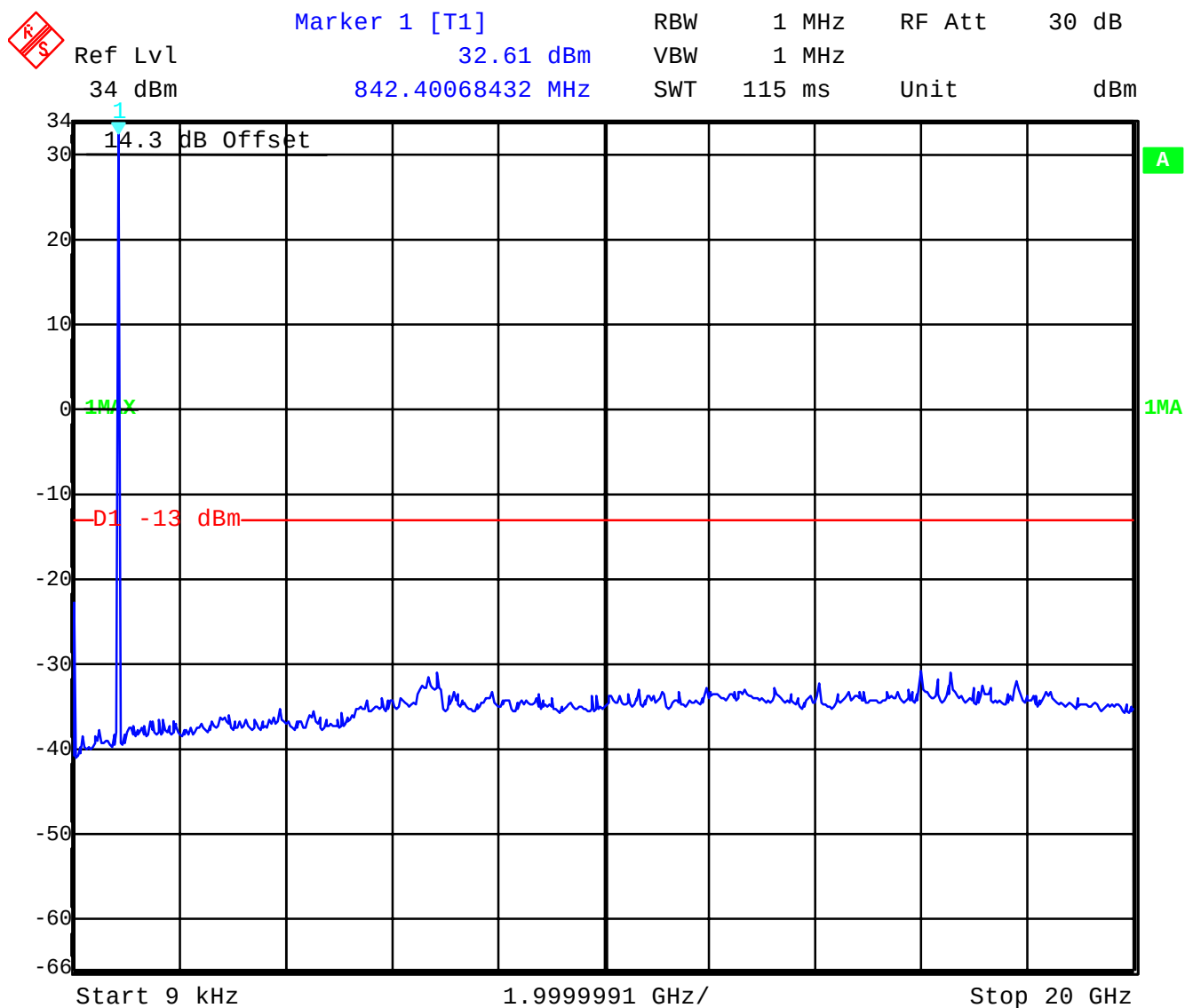
## Channel 189



Date: 27.JAN.2005 14:41:18



## Channel 251



Date: 27.JAN.2005 14:51:43

## 3.2.6 Block Edge Compliance

### Reference

|      |                               |
|------|-------------------------------|
| FCC: | CFR Part 22.917               |
| IC:  | RSS 132, Issue 1, Section 6.5 |

### Measurement Limit:

Sec. 22.917(b) Emission Limits.

(a) On any frequency outside frequency band of the USPCS spectrum, the power of any emission shall be attenuated below the transmitter power (P, in Watts) by at least  $43+10\log(P)$  dB. For all power levels +33 dBm to 0 dBm, this becomes a constant specification limit of -13 dBm.

## Block 1 Channel 128



Date: 27.JAN.2005 15:04:31

## Block 4 Channel 251



Date: 27.JAN.2005 15:12:24

## 3.2.7 Occupied Bandwidth

### Reference

|      |                               |
|------|-------------------------------|
| FCC: | CFR Part 22.917, 2.1049       |
| IC:  | RSS 132, Issue 1, Section 4.2 |

### Occupied Bandwidth Results

Similar to conducted emissions, occupied bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the extreme and mid frequencies of the USPCS frequency band. Table below lists the measured 99% power and -26dBc occupied bandwidths. Spectrum analyzer plots are included on the following pages.

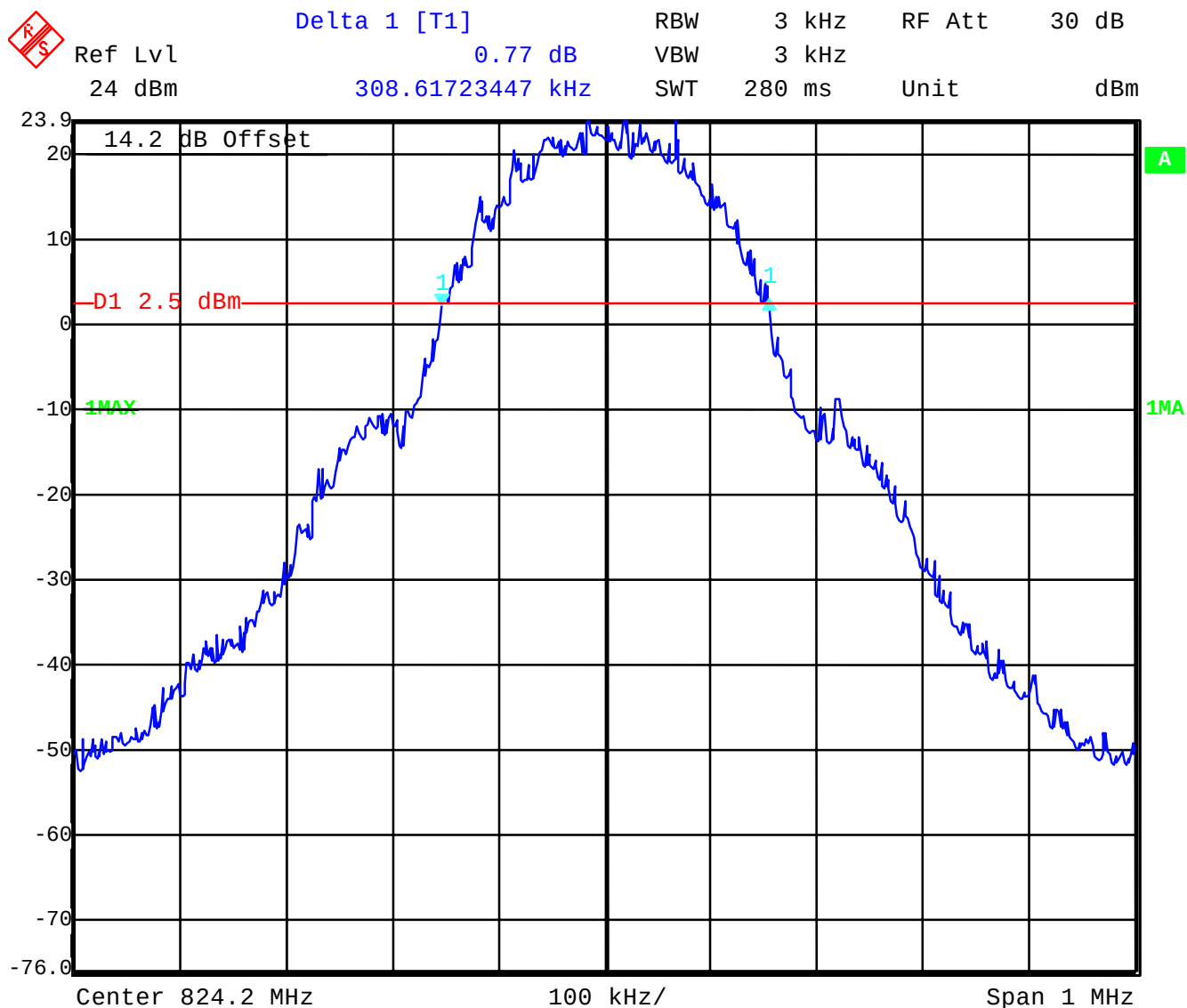
Normal mode

| Frequency | 99% Occupied Bandwidth<br>(kHz) | -26 dBc Bandwidth<br>(kHz) |
|-----------|---------------------------------|----------------------------|
| 824.2 MHz | 308.617                         | 334.669                    |
| 836.4 MHz | 304.609                         | 332.665                    |
| 848.8 MHz | 306.613                         | 328.657                    |

Part 22 requires a measurement bandwidth of at least 1% of the occupied bandwidth. For ca. 300 kHz, this equates to a resolution bandwidth of at least 3 kHz. For this testing, a resolution bandwidth 3.0 kHz was used.

## Channel 128

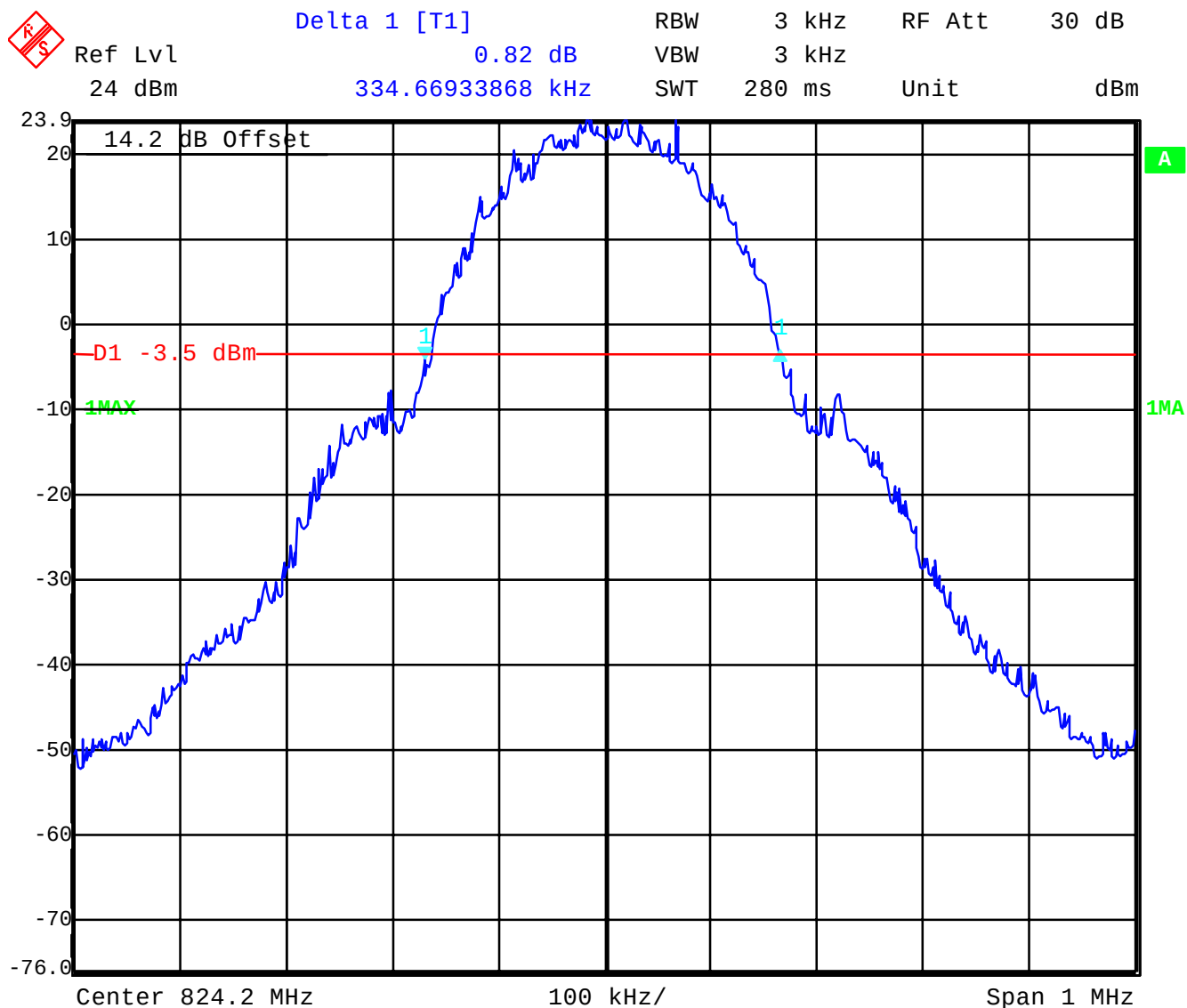
99% (-20 dB) Occupied Bandwidth



Date: 27.JAN.2005 15:32:44

## Channel 128

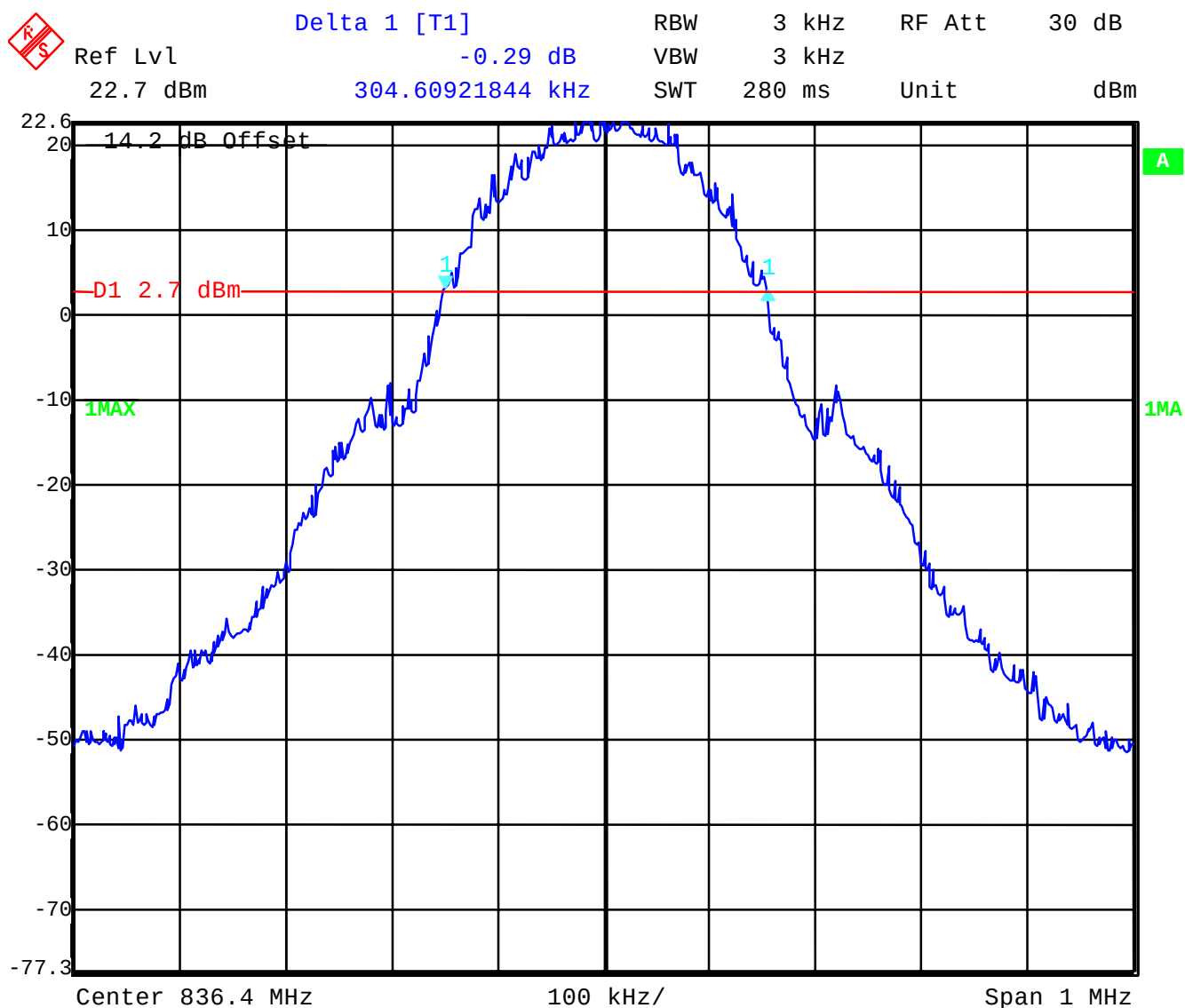
-26 dBc Bandwidth



Date: 27.JAN.2005 15:48:48

## Channel 189

99% (-20 dB) Occupied Bandwidth

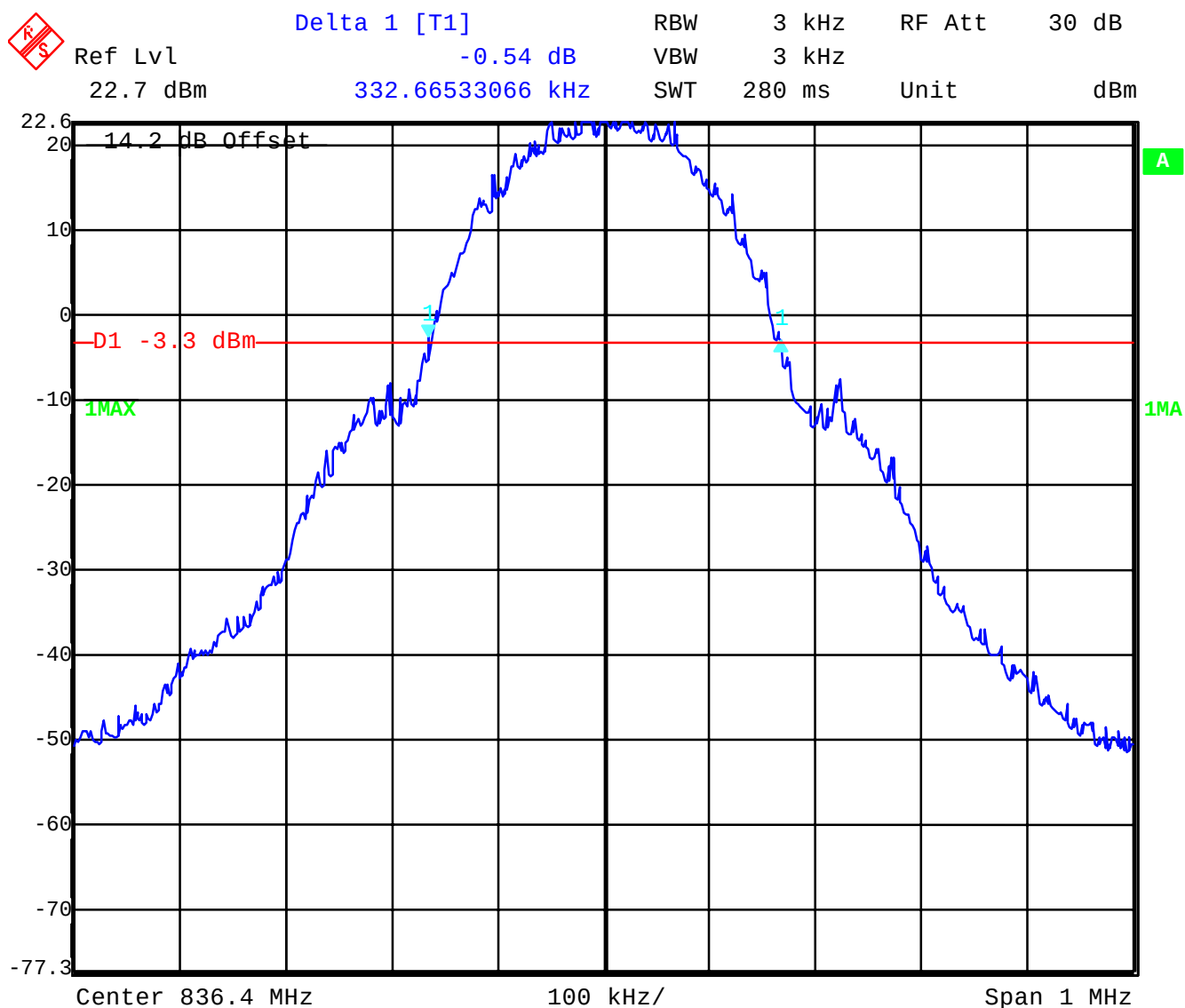


Date: 27.JAN.2005 15:52:36



## Channel 189

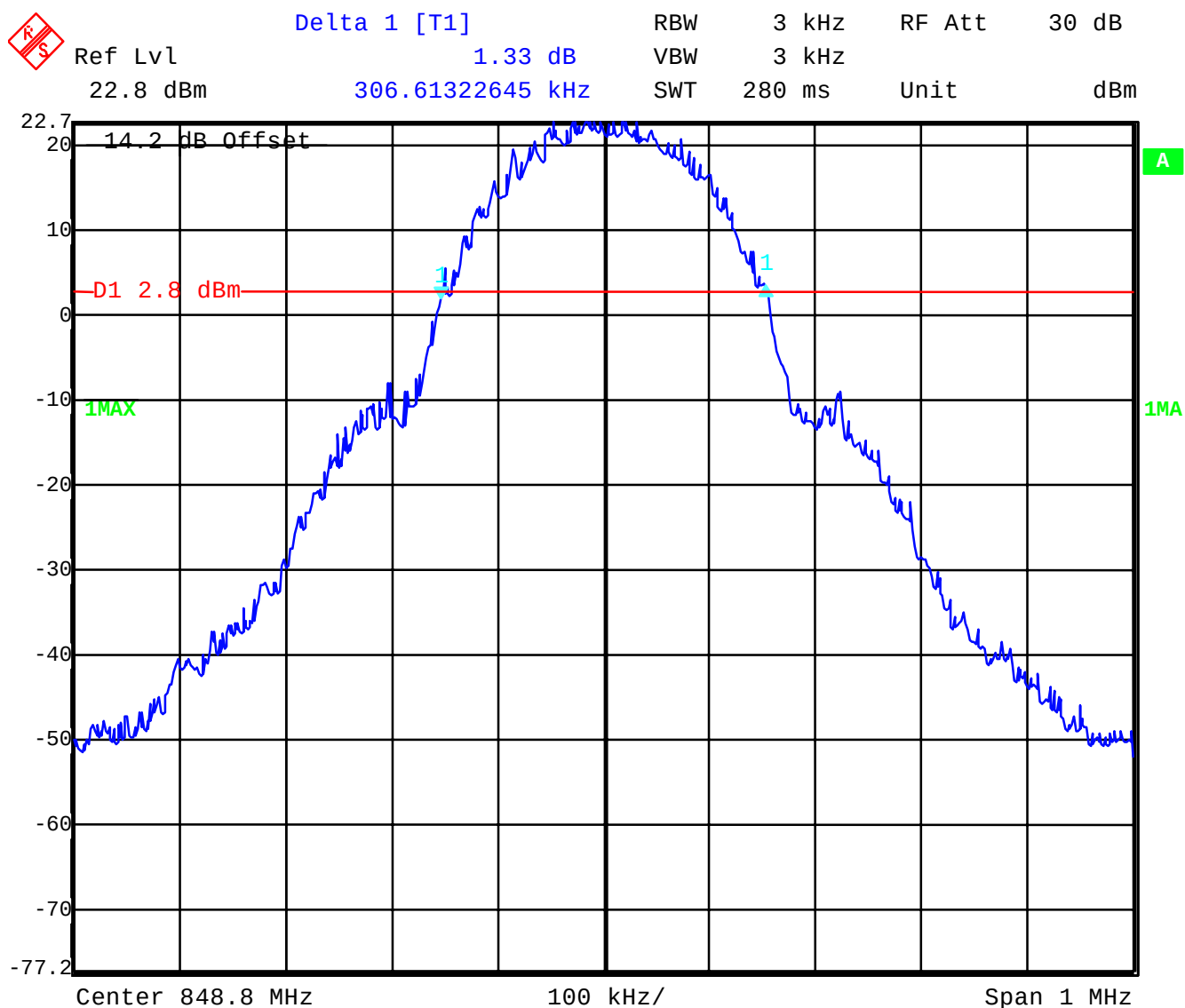
-26 dBc Bandwidth



Date: 27.JAN.2005 15:55:15

## Channel 251

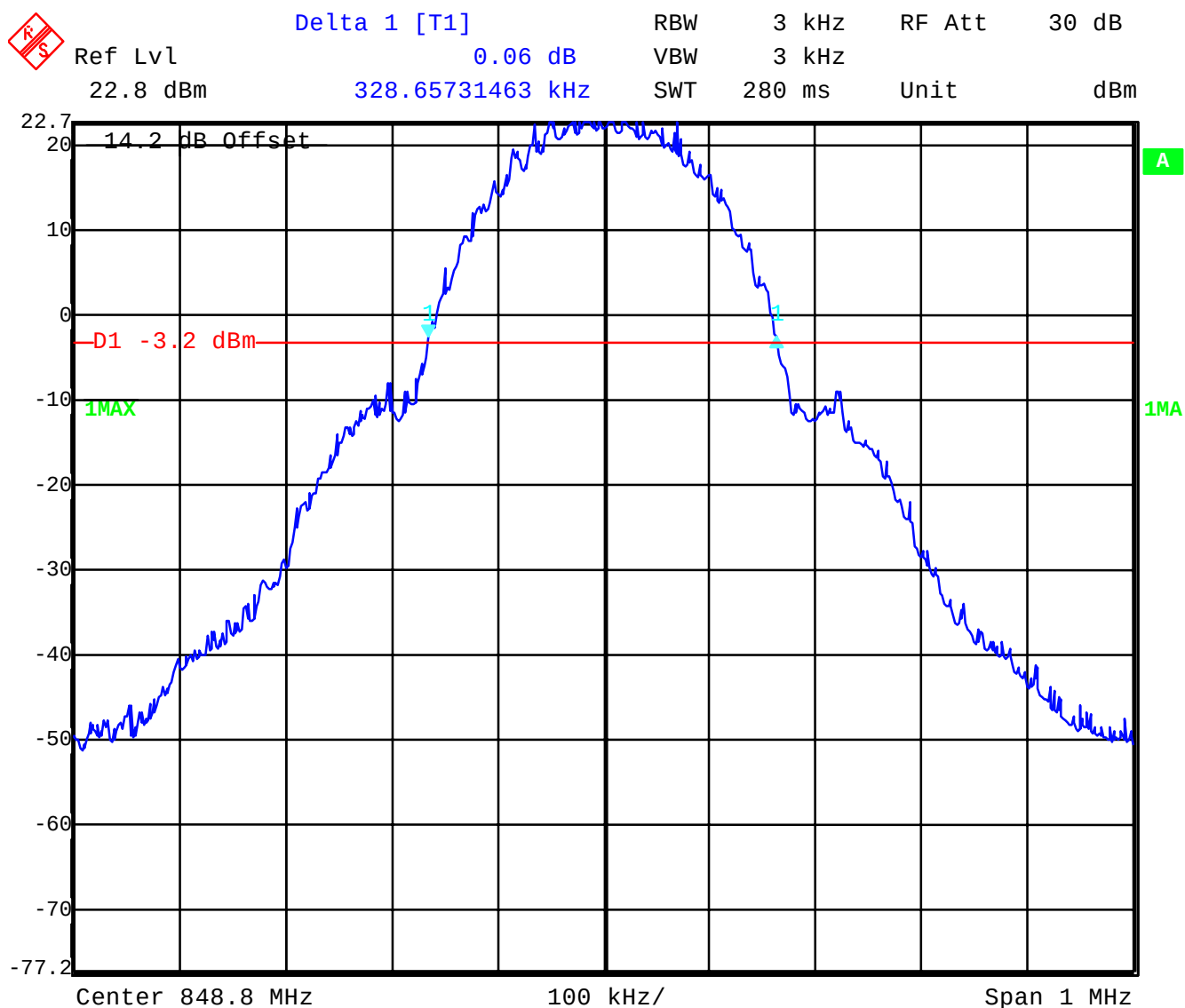
99% (-20 dB) Occupied Bandwidth



Date: 27.JAN.2005 16:03:35

## Channel 251

-26 dBc Bandwidth



Date: 27.JAN.2005 16:10:17

## 4 Used Testequipment

### Anechoic chamber C:

| Device                    | Manufacturer | Type      | S/N Number | Inv. No. Cetecom |
|---------------------------|--------------|-----------|------------|------------------|
| Spektrum Analyser         | HP           | 8566B     | 2747A05306 | 300001000        |
| Spektrum Analyser Display | HP           | 85662A    | 2816A16541 | 300002297        |
| Quasi-Peak-Adapter        | HP           | 85650A    | 2811A01131 | 300000999        |
| Power Dupply              | HP           | 6032A     | 2818A03450 | 300001040        |
| Power Attenuator          | Byrd         | 8325      | 1530       | 300001595        |
| Bikonical Antenna         | EMCO         | 3104      | 3758       | 300001602        |
| Log. Period. Antenna      | EMCO         | 3146      | 2130       | 300001603        |
| Double Ridged Antenna     | EMCO         | HP 3115P  | 3088       | 300001032        |
| Active Loop Antenna       | EMCO         | 6502      | 2210       | 300001015        |
| Antenna VDE/FCC           |              | HP11965B  |            | 300002298        |
| SRM-Drive                 | HP           | 9144A     | 2823e46556 | 300001044        |
| Software                  | HP           | EMI       |            | 300000983        |
| Busisolator               | Kontron      |           |            | 300001056        |
| Absorberhalle             | MWB          |           | 87400/02   | 300000996        |
| Salzsäule                 | Kontron      |           |            | 300001055        |
| Antenna                   | R&S          | HMO20     | 832211/003 | 300002243        |
| Indukt.Tast Antenna       | R&S          | HFH 2 Z4  | 881468/026 | 300001464        |
| System-Rack               | HP I.V.      | 85900     | *          | 300000222        |
| Spectrum Analyzer         | HP           | 8566B     | 2747A05275 | 300000219        |
| Quasi-Peak-Adapter        | HP           | 85650A    | 2811A01135 | 300000216        |
| RF-Preselector            | HP           | 85685A    | 2837A00779 | 300000218        |
| Rahmen Antenne            | R&S          | HFH2-Z2   | 891847-35  | 300001169        |
| Leitungsteiler            | HP           | 11850C    |            | 300000997        |
| Breitband-Hornantenne EMI | HP           | 35155P    |            | 300002300        |
| PC                        | HP           | Vectra VL |            | 300001688        |
| VHF Meßantenne            | Schwarzbeck  | VHA 9103  |            | 300001778        |
| Spectrum Analyzer Display | HP           | 85662A    | 2816A16497 | 300001690        |
| VHF Meßantenna            | Schwarzbeck  | VHA 9103  |            | 300001780        |
| Biconical Antenna         | EMCO         | 3104 C    | 9909-4868  | 300002590        |

### SRD Laboratory:

| Device                          | 300001207 | Type           | S/N Number | Inv. No. Cetecom |
|---------------------------------|-----------|----------------|------------|------------------|
| Spectrum Analyzer               | 300001208 | 494AP          | B010241    | 300000863        |
| Spectrum Analyzer               | HP        | 71210A (70000) | 2731A02347 | 300000321        |
| Spectrum Analyzer Display       | HP        | 70206A         | 2840A01553 | 300002017        |
| Reference Frequency             | HP        | 70310A         | 2736A00707 | 300002018        |
| Local Oscillator                | HP        | 70900A         | 2842A02221 | 300002019        |
| ZF-Modul 10Hz-300 kHz           | HP        | 70902A         | 2840A02145 | 300002020        |
| ZF-Modul 100 kHz-3 MHz          | HP        | 70903A         | 2835A01069 | 300002021        |
| HF-Teil für 71210A 100Hz- 22GHz | HP        | 70908A         |            | 300002022        |
| Spectrum Analyzer 2             | HP        | 85660B         | 3138A07614 |                  |
| Spectrum Analyzer Display 2     | HP        | 85662A         | 3144A20627 |                  |

|                                |                 |           |            |           |
|--------------------------------|-----------------|-----------|------------|-----------|
| Signal Generator DC-600 KHz    | HP              | 8904A     | 2822A01213 | 300001157 |
| Signal Generator DC-600 KHz    | HP              | 8904A     | 2822A01214 | 300001158 |
| Powersupply                    | HP              | 6038A     | 3122A11097 | 300001204 |
| Netznachbildung                | R&S             | ESH3-Z5   | 828576/020 | 300001210 |
| Amplituden Controller          | R&S             | SMDU-Z2   | 871829/051 | 300002309 |
| Trenntrafo                     | Erfi            | 913501    |            | 300001205 |
| Trenntrafo                     | Grundig         | RT5A      | 9242       | 300001627 |
| Relais Matrix                  | HP              | 3488A     | 2719A15013 | 300001156 |
| Multimeter                     | Siemens         | Multizet  |            | 300001102 |
| Peak Power Calibrator          | HP              | 8900B     |            | 300001084 |
| Schallgeber                    | Schomandl       | SG 1      | 10159      | 300001209 |
| Schallgeber                    | Schomandl       | SG 2      | 10176      | 300002473 |
| Filter                         | FSY Microwave   |           |            | 300001206 |
| Attenuatorer                   | Pro Nova        |           |            | 300002476 |
| Klimaschrank                   | Heraeus Voetsch | VUK04/500 |            | 300001012 |
| Spectrum Analyzer 3            | HP              | 8566A     | 1925A00257 | 300001098 |
| Spectrum Analyzer Display 3    | HP              | 85662     | 1925A00860 | 300002306 |
| Oszilloscope                   | Tektronix       | 2432      | 110261     | 300001165 |
| Radiocom. Analyzer             | R&S             | CMTA 54   | 894043/010 | 300001175 |
| Powersupply                    | HP              | 6038A     | 2848A07027 | 300001174 |
| Signal Generator 0.01-1280 MHz | HP              | 8662A     | 2224A01012 | 300001110 |
| Signal Generator (Funktionen)  | R&S             | AFGU      | 862490/032 | 300001201 |
| Trenntrafo                     | Erfi            | MPL       | 91350      | 300001155 |
| Relais Matrix                  | R&S             | PSU       | 893285/020 | 300001173 |
| Power Meter                    | HP              | 436A      | 2101A12378 | 300001136 |
| Powersensor                    | HP              | 8484A     | 2237A10156 | 300001140 |
| Powersensor                    | HP              | 8482A     | 2237A06016 | 300001139 |
| Relais Matrix                  | R&S             | PSU       | 282628/004 | 300001214 |
| Powersupply                    | Zentro          |           | 2007       | 300001109 |
| Oszilloscope                   | Tektronix       | 7633      |            | 300001111 |
| Klimaschrank                   | Heraeus Voetsch | VUK04/500 | 32926      | 300001500 |
| Quasi-Peak Adapter             | HP              | 85650A    | 2811A01204 | 300002308 |
| Radiocom. Analyzer             | R&S             | CMTA 84   | 894199/012 | 300001176 |
| Oszilloscope                   | HP              | 54510A    | 3022A02062 | 300001202 |
| Funkmeßplatz                   | Schomandl       | FD1000    | 34982      | 300001115 |
| Signal Generator               | R&S             | SMPC      | 882416/019 | 300001162 |
| Frequency counter              | HP              | 5340A     | 2116A08138 | 300001104 |
| Power Meter                    | HP              | 436A      | 2031U01461 | 300001105 |
| Powersensor                    | HP              | 8482A     |            | 300001106 |
| Powersensor                    | HP              | 8484A     |            | 300001107 |
| Powersensor                    | HP              | 8485A     |            | 300001108 |
| Powersupply                    | HP              | 6038A     | 2752A04866 | 300001161 |
| Reflectionsmeter               | R&S             | NAP       | 879191     | 300001132 |
| Signal Generator NF            | R&S             | SPN       | 880139/068 | 300001142 |
| Trenntrafo                     | Erfi            | MPL       | 91350      | 300001151 |
| Attenuator                     | JFW             | 30 db     | 1350h/104  | 300001703 |
| Attenuator                     | JFW             | 10 db     | 1350h/103  | 300001704 |
| Attenuator                     | JFW             | 20 db     | 1350h/106  | 300001705 |
| Attenuator                     | JFW             | 20 db     | 1350h/105  | 300001766 |
| Filter                         | Spinner         | 153755    |            | 300001791 |

|                                |                 |           |            |           |
|--------------------------------|-----------------|-----------|------------|-----------|
| Powersensor                    | HP              | 8484A     | 2237A10494 | 300001666 |
| Powersupply                    | HP              | 6038A     | 3122A11097 | 300001204 |
| Netznachbildung                | R&S             | ESH3-Z5   | 828576/020 | 300001210 |
| Amplituden Controller          | R&S             | SMDU-Z2   | 871829/051 | 300002309 |
| Trenntrafo                     | Erfi            | 913501    |            | 300001205 |
| Trenntrafo                     | Grundig         | RT5A      | 9242       | 300001627 |
| Relais Matrix                  | HP              | 3488A     | 2719A15013 | 300001156 |
| Multimeter                     | Siemens         | Multizet  |            | 300001102 |
| Peak Power Calibrator          | HP              | 8900B     |            | 300001084 |
| Schallgeber                    | Schomandl       | SG 1      | 10159      | 300001209 |
| Schallgeber                    | Schomandl       | SG 2      | 10176      | 300002473 |
| Filter                         | FSY Microwave   |           |            | 300001206 |
| Attenuatorer                   | Pro Nova        |           |            | 300002476 |
| Klimaschrank                   | Heraeus Voetsch | VUK04/500 |            | 300001012 |
| Spectrum Analyzer 3            | HP              | 8566A     | 1925A00257 | 300001098 |
| Spectrum Analyzer Display 3    | HP              | 85662     | 1925A00860 | 300002306 |
| Oszilloscope                   | Tektronix       | 2432      | 110261     | 300001165 |
| Radiocom. Analyzer             | R&S             | CMTA 54   | 894043/010 | 300001175 |
| Powersupply                    | HP              | 6038A     | 2848A07027 | 300001174 |
| Signal Generator 0.01-1280 MHz | HP              | 8662A     | 2224A01012 | 300001110 |
| Signal Generator (Funkions)    | R&S             | AFGU      | 862490/032 | 300001201 |
| Trenntrafo                     | Erfi            | MPL       | 91350      | 300001155 |
| Relais Matrix                  | R&S             | PSU       | 893285/020 | 300001173 |
| Power Meter                    | HP              | 436A      | 2101A12378 | 300001136 |
| Powersensor                    | HP              | 8484A     | 2237A10156 | 300001140 |
| Powersensor                    | HP              | 8482A     | 2237A06016 | 300001139 |
| Relais Matrix                  | R&S             | PSU       | 282628/004 | 300001214 |
| Powersupply                    | Zentro          |           | 2007       | 300001109 |
| Oszilloscope                   | Tektronix       | 7633      |            | 300001111 |
| Klimaschrank                   | Heraeus Voetsch | VUK04/500 | 32926      | 300001500 |
| Quasi-Peak Adapter             | HP              | 85650A    | 2811A01204 | 300002308 |
| Radiocom. Analyzer             | R&S             | CMTA 84   | 894199/012 | 300001176 |
| Oszilloscope                   | HP              | 54510A    | 3022A02062 | 300001202 |
| Funkmeßplatz                   | Schomandl       | FD1000    | 34982      | 300001115 |
| Signal Generator               | R&S             | SMPC      | 882416/019 | 300001162 |
| Frequency counter              | HP              | 5340A     | 2116A08138 | 300001104 |
| Power Meter                    | HP              | 436A      | 2031U01461 | 300001105 |
| Powersensor                    | HP              | 8482A     |            | 300001106 |
| Powersensor                    | HP              | 8484A     |            | 300001107 |
| Powersensor                    | HP              | 8485A     |            | 300001108 |
| Powersupply                    | HP              | 6038A     | 2752A04866 | 300001161 |
| Reflectionsmeter               | R&S             | NAP       | 879191     | 300001132 |
| Signal Generator NF            | R&S             | SPN       | 880139/068 | 300001142 |
| Trenntrafo                     | Erfi            | MPL       | 91350      | 300001151 |
| Attenuator                     | JFW             | 30 db     | 1350h/104  | 300001703 |
| Attenuator                     | JFW             | 10 db     | 1350h/103  | 300001704 |
| Attenuator                     | JFW             | 20 db     | 1350h/106  | 300001705 |
| Attenuator                     | JFW             | 20 db     | 1350h/105  | 300001766 |
| Filter                         | Spinner         | 153755    |            | 300001791 |
| Powersensor                    | HP              | 8484A     | 2237A10494 | 300001666 |

|                               |                    |                          |            |           |
|-------------------------------|--------------------|--------------------------|------------|-----------|
| Powersensor                   | HP                 | 8485A                    | 2238A00849 | 300001668 |
| Bandfilter                    | Telonic            | TTF7255EE                | 20293-11   | 300001300 |
| Bandfilter                    | Telonic            | TTF12555EE               | 20292-6    | 300001302 |
| Bandfilter                    | Telonic            | TTF25055EE               | 20291-8    | 300001304 |
| Bandfilter                    | Telonic            | TTF50055EE               | 20290-7    | 300001305 |
| Bandfilter                    | Telonic            | TTF100055EE              | 20289-7    | 300001307 |
| Bandfilter                    | Telonic            | TTA300055EESN            | 20370-2    | 300001312 |
| Bandstop                      | Telonic            | TTR3753EE1               | 30013-1    | 300001314 |
| Bandstop                      | Telonic            | TTR723EE                 | 20417-2    | 300001316 |
| Bandstop                      | Telonic            | TTR95-3EE                | 20372-4    | 300001318 |
| Bandstop                      | Telonic            | TTR1903EE                | 30036-4    | 300001320 |
| Bandstop                      | Telonic            | TTR3753EE                | 20369-5    | 300001321 |
| Bandstop                      | Telonic            | TTR750-3EE1              | 90177-1    | 300002387 |
| Highpass                      | Pro Nova           | HDP120-6GG               | ohne       | 300001348 |
| Highpass                      | Pro Nova           | HMC500-6AA               | HJ67-01?   | 300001350 |
| Highpass                      | Narda              | NHP 9000                 | 0004       | 300001362 |
| Highpass                      | Narda              | HDP16-6GH                | JV70-01    | 300001364 |
| Highpass                      | RSD                | HDP50-6GH,<br>HDP200-6GG |            | 300001371 |
| Highpass                      | RSD                | 2099-02-01               |            | 300000370 |
| Signal Generator 0.1-2060 MHz | HP                 | 8657A                    | 2838U00736 | 300001009 |
| Radio Code Analyzer           | Schlumberger       | SL4922                   |            | 300001038 |
| Signal Analyzer               | B&K                | 2033                     |            | 300001047 |
| Frequency counter             | HP                 | 5386A                    | 2704A01243 | 300000998 |
| Laufzeitelement               | WR-Elektronik      |                          |            | 300001036 |
| Powersupply Stromversorgung   | Systron            | M5P 40/15A               | 828233     | 300001291 |
| Powersupply                   | Heiden             | 1108-32                  | 1701       | 300001392 |
| Powersupply                   | Heiden             | 1108-32                  | 1802       | 300001383 |
| Powersupply                   | Heiden             | 1108-32                  | 003202     | 300001187 |
| Powersupply                   | Zentro             | LA 2x30/5GB1             | 2011       | 300001276 |
| Powersupply                   | Zentro             | LA 2x30/5GB2             | 2012       | 300001275 |
| Powersupply                   | Zentro             | LA 30/5GA                | 2041,2042  | 300001287 |
| Trenntrafo                    | Grundig            | RT5A                     | 8781       | 300001277 |
| Trenntrafo                    | Grundig            | RT5A                     | 9242       | 300001263 |
| Multimeter                    | Goerz Elektro      | Unigor 6e P              | 911 355    | 300001625 |
| Multimeter                    | Goerz Elektro      | Unigor 6e P              | 911 391    | 300001281 |
| Climatic Box                  | Heraeus Voetsch    | VUK04/500                | 32679      | 300000299 |
| Powersensor + Att.            | HP                 | 8482B                    | 2703A02586 | 300001492 |
| Attenuator 30 dB              | HP                 | 8498A                    | 1801A02445 | 300001475 |
| Signal Generator NF           | HP                 |                          | 2822A01203 | 300001004 |
| Attenuator                    | Spinner            | BN 534171 D              | 51881      | 300001516 |
| Attenuator coaxial            | Bird               | 8325                     | 2429       | 300001513 |
| Impulsbegrenzer               | R&S                | ESH 3 Z2                 |            | 300001460 |
| 4Port Box                     | R&S                | 4Port Box                | 860457/005 | 300001472 |
| Signal Generator 0.1-4200 MHz | HP                 | 8665A                    | 2833A0011  | 300002299 |
| NF-Spektrumanalyzer           | B&K                | 2033A                    |            | 300002301 |
| Swissphone Freifeld-Messbox   | Swissphone Schweiz |                          |            | 300002302 |
| Trenntrafo regelbar           | Grundig            | RT5H                     | 9242       | 300001628 |
| Signal Generator              | HP                 | 8111A                    | 2215G00867 | 300001117 |