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Electrical

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# ELECTROMAGNETIC EMISSION TEST REPORT

**ACCORDING TO 47CFR PART 15, SUBPART C § 15.249 and SUBPART B**

**for**

## Tadiran Telematics Ltd.

**EQUIPMENT UNDER TEST:**

## TransMeter Water

**model: TMW-H-25**





**Document ID: TADRAD_FCC.15046.doc**
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# Contents

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# 1 Project information

## Description of equipment under test

| | |
|---|---|
| Test items | : TransMeter Water |
| Manufacturer | : Tadiran-Telematics Ltd |
| Equipment serial number | : 13001086 |
| Types (Models) | : TMW-H-25 |
| Equipment FCC code[1] | : DXX |

## Applicant information

| | |
|---|---|
| Applicant's responsible person | : Mr. Uzi Erman |
| Company | : Tadiran-Telematics Ltd |
| Address | : 26 Hamelaha St. |
| Postal code | : 58117 |
| City | : Holon |
| Country | : Israel |
| Telephone number | : +972 (0) 3 5575755 |
| Telefax number | : +972 (0) 3 5575753 |

## Test performance

| | |
|---|---|
| Project Number: | : 15046 |
| Location | : Hermon Laboratories |
| Receipt date | : March 18, 2002 |
| Test started | : March 18, 2002 |
| Test completed | : April 4, 2002 |
| Purpose of test | : Apparatus compliance verification in accordance with emission requirements |
| Test specification(s) | : 47CFR Part 15, §15.249 and subpart B |

[1] FCC Equipment codes – see Appendix D

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# 2 Summary of tests

The tests listed in the table below were performed. The EUT was found complying with the limits of 47CFR Part 15, §15.249 and subpart B.

| Parameter | Subclause | C | NC | NT | NA | Tested by | Date tested | Remarks |
|---|---|---|---|---|---|---|---|---|
| **Transmitter characteristics** | | | | | | | | |
| Field strength of fundamental | (a) | **C** | | | | Mrs. Pitt, test engineer | April 4, 2002 | |
| Field strength of harmonics | (a) | **C** | | | | Mrs. Pitt, test engineer | April 4, 2002 | |
| Out of band spurious emissions (radiated) | (c) | **C** | | | | Mrs. Pitt, test engineer | April 4, 2002 | |
| **Unintentional radiation, §15.107, §15.109** | | | | | | | | |
| Conducted emissions | 15.107 | | | | **NA** | | | |
| Radiated emissions | 15.109 | **C** | | | | | | |
| **Receiver characteristics, §15.109** | | | | | | | | |
| Spurious radiated emissions | 15.109 | **C** | | | | Mrs. Pitt, test engineer | March 18, 2002 | |
| **General conditions under Part 15** | | | | | | | | |
| The Intentional radiator operates at 916.3 MHz | 15.249 | **C** | | | | | | |
| The intentional radiator has permanently attached antenna or antenna that uses a unique coupling to the intentional radiator. | 15.203 | **C** | | | | | | |
| The intentional radiator has a standard connector and must be professionally installed. To demonstrate that professional installation is required, the following three points must be addressed: (a) the application (or intended use) of the EUT; (b) the installation requirements of the EUT, and (c) the method by which the EUT will be marketed. | 15.203 | | | | **NA** | | | |

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| Parameter | Subclause | C | NC | NT | NA | Tested by | Date tested | Remarks |
|---|---|---|---|---|---|---|---|---|
| No antenna other than that furnished by the responsible party can be used with the device. | 15.203 | **C** | | | | | | |
| Antenna technical characteristics, as referred to in "Transmitter description" table in the test report | 15.204 | **C** | | | | | | |
| NOTE: C: The parameter is compliant with the requirements.<br>NC: The parameter is not compliant with the requirements.<br>NT: The parameter is not tested.<br>NA: The test of this parameter is not applicable. | | | | | | | | |

**Test report prepared by:** Mrs. V. Mednikov, certification engineer

**Test report approved by:** Mr. M. Nikishin, EMC group leader

Mr. A. Usoskin, QA manager

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# 3 EUT description

## 3.1 General description

The EUT, TMW-H, is a water meter with a built-in 2-way RF communicator. The RF capabilities enable transmission of meter readings and some extra information to a collecting unit.
The TMW-H consists of three parts: RF transmitter and receiver, that operate in ISM band (916.3 MHz), and a microcontroller with a digital logic, which controls the operational modes.
The device is intended for installation with antenna in horizontal position and powered by two internal 3.6 V lithium batteries.

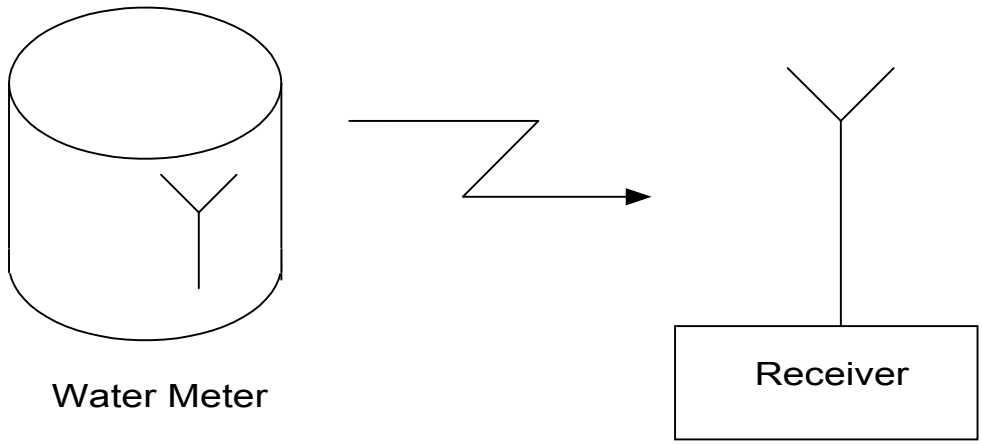
## 3.2 EUT test configuration

The EUT test configuration is shown in Figure 3.2.1, clock and oscillator frequencies are provided in Table 3.2.1.

**Table 3.2.1 EUT operating frequencies**

| Frequency | Card Id | | | | | |
|---|---|---|---|---|---|---|
| 852.33 MHz | LO | | | | | |
| 26.6353 | clock | | | | | |

**Figure 3.2.1**



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## 3.3 Transmitter description

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Type of equipment** | | | | | | | |
| **X** | Stand-alone (Equipment with or without its own control provisions) | | | | | | |
| | Combined equipment (Equipment where the radio part is fully integrated within another type of equipment) | | | | | | |
| | Plug-in card (Equipment intended for a variety of host systems) | | | | | | |
| | Other: | | | | | | |
| **Operating frequency** | 916.3 MHz | | | | | | |
| **Transmitter aggregate data rate** (bits per second) | 120 kBps | | | | | | |
| **Normal test signal** | FSK modulated signal | | | | | | |
| **Maximum rated output power** | | | | | | | |
| At transmitter permanent external 50 Ω rf output connector (dBm) | | | | | | | |
| Effective radiated power (for equipment with integral antenna) (dBm) | 18 | | | | | | |
| Is transmitter output power variable? | **X** | No | | | | | |
| | | Yes | | continuous variable | | | |
| | | | | stepped variable | | | |
| | | | | stepsize (dB):..... | | | |
| | | | | minimum RF power (dBm):..... | | | |
| | | | | maximum RF power (dBm):..... | | | |
| **Transmitter power source** | | | | | | | |
| | **Battery** | **Nominal rated voltage (VDC)** | | | | | |
| | Nickel Cadmium | | | | | | |
| **X** | Lithium | | | | | | |
| | Other | | | | | | |
| | **DC** | **Nominal rated voltage (VDC)** | | | | | |
| | **AC mains** | **Nominal rated voltage (VAC)** | | | | | |
| Is there common power source for transmitter and receiver | | | **X** | Yes | | | |
| **Antenna technical characteristics** | | | | | | | |
| | | | **Type** | **Manufacturer** | **Model number** | **Gain** | |
| Integral | | with temporary RF connector | **Planar inverted F** | **Arad Technologies** | **NA** | **2 dBi** | |
| | **X** | without temporary RF connector | | | | | |
| External | | | | | | | |
| **External antenna connection – NA** | | | | | | | |
| | standard connector SMA | | | unique coupling | | | |

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# 4 Tests results

## 4.1 Field strength of fundamental according to § 15.249 (a), §15.209

| | |
|---|---|
| METHOD OF MEASUREMENTS | ANSI 63.4 §13.1.4 |
| DATE: | May 22, 2002 |
| RELATIVE HUMIDITY: | 36% |
| AMBIENT TEMPERATURE: | 25°C |
| TEST PERFORMED IN: | ANECHOIC CHAMBER |
| TEST DISTANCE | 3 m |
| OPERATING FREQUENCY RANGE | 902-928 MHz |

**Quasi-peak detector**

| Carrier frequency, MHz | Field strength, dB(µV/m) | Specified limit, dB(µV/m) | Margin, dB | Reference to Plots in Appendix A |
|---|---|---|---|---|
| 916.309100 | 93.22 | 94 | 0.78 | A1 |
| Measurement uncertainty, dB | | +5.73.dB / -5.57 dB | | |

**TEST EQUIPMENT USED:**

| | | | | | | |
|---|---|---|---|---|---|---|
| HL 0465 | HL 0521 | HL 0604 | | | | |

**LIMIT**

| Operating frequency range, MHz | Field strength of fundamental, dB(µV/m) |
|---|---|
| 902-928 | 94 |
| 2400-2483.5 | 94 |
| 5275-5850 | 94 |
| 24000-24250 | 107.95 |

**TEST PROCEDURE**

The EUT inside the phantom was placed on the flush mounted turntable, as shown in Photographs 1.1 to 1.3. To find maximum radiation the turntable was rotated 360°, measuring antenna height was changed from 1 to 4 m, and the antenna polarization was changed from vertical to horizontal.

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## 4.2 Field strength of harmonics according to § 15.249 (a), §15.209

| | |
|---|---|
| METHOD OF MEASUREMENTS | ANSI 63.4 §13.1.4 |
| DATE: | April 4, 2002 |
| RELATIVE HUMIDITY: | 47% |
| AMBIENT TEMPERATURE: | 22°C |
| Rated carrier field strength | 112.89 dB(μV/m) |
| TEST PERFORMED IN: | ANECHOIC CHAMBER |
| TEST DISTANCE: | 3 m |
| FREQUENCY RANGE | 1000 – 9500 MHz |
| CARRIER FREQUENCY | 916.3 MHz |

**Peak detector**

| Harmonic, MHz | Field strength, dB(μV/m) | Peak limit, dB (μV/m) | Margin, dB | Reference to Plots in Appendix A |
|---|---|---|---|---|
| 1832.775 | 54.17 | 74 | 19.83 | A5 |
| 2748.71 | 67.55 | 74 | 6.45 | A6 |
| 4580.776 | 57.25 | 74 | 16.75 | A7 |
| Measurement uncertainty, dB | | +5.73 dB / -5.57 dB | | |

**Peak detector + Average factor**

| Carrier frequency, MHz | Field strength, dB(μV/m) | Average limit, dB(μV/m) | Margin, dB | Reference to Plots in Appendix A |
|---|---|---|---|---|
| 1832.775 | 28.97 | 54 | 25.03 | – |
| 2748.71 | 42.35 | 54 | 11.65 | – |
| 4580.776 | 32.05 | 54 | 21.95 | – |
| Measurement uncertainty, dB | | +5.73.dB / -5.57 dB | | |

### 4.2.1 Average factor calculation, §15.35

| Tx ON, ms | Duty cycle | Average factor, dB | Reference to Plots in Appendix A |
|---|---|---|---|
| **5.5*** | 0.055 | **-25.2** | **A3, A4** |
| Measurement uncertainty (1% of sweep time) | | **0.2 ms** | |

* The extended data transmission duration (declared by customer) was used for calculating the average factor, whereas the "regular" data transmission duration was 3.6 ms as shown in Plots A3, A4.

**TEST EQUIPMENT USED:**

| | | | | | | |
|---|---|---|---|---|---|---|
| HL 0041 | HL 0521 | HL 0589 | HL 0604 | HL 1004 | | |

**LIMIT**

| Operating frequency range, MHz | Field strength of harmonics, dB(μV/m) | |
|---|---|---|
| | Peak limit | Average limit |
| 902-928 | 74 | 54 |
| 2400-2483.5 | 94 | 74 |
| 5275-5850 | 94 | 74 |
| 24000-24250 | 107.95 | 87.95 |

**TEST PROCEDURE**

The EUT was placed on a wooden 80 cm height turntable. To find maximum radiation the turntable was rotated 360°, measuring antenna height was changed from 1 to 4 m, and the antenna polarization was changed from vertical to horizontal.

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## 4.3 Out of band spurious emissions according to § 15.249 (c)

| | |
|---|---|
| METHOD OF MEASUREMENTS | ANSI 63.4 §13.1.4/ §13.1.5 |
| DATE: | April 4, 2002 |
| RELATIVE HUMIDITY: | 47% |
| AMBIENT TEMPERATURE: | 22°C |
| RATED CARRIER FIELD STRENGTH | 112.89 dB(μV/m) |
| TEST PERFORMED IN: | ANECHOIC CHAMBER |
| TEST DISTANCE | 3 m |
| OPERATING FREQUENCY RANGE | 902-928 |
| FREQUENCY RANGE | 9 kHz – 9.5 GHz |

**Peak detector**

| Frequency, MHz | Antenna polarization | Radiated emission, dB (μV/m) | Limit, dB (μV/m) | Margin, dB | Reference to Plots in Appendix A |
|---|---|---|---|---|---|
| 0.009 – 0.15 | All emissions were found more than 30 dB below limit | | | | A8 |
| 0.15 – 30 | All emissions were found more than 25 dB below limit | | | | A9 |
| 30 – 902 | All emissions were found more than 15 dB below limit | | | | A10 |
| 920 – 1000 | All emissions were found more than 10 dB below limit | | | | A11 |
| 1000 – 2000 | No spurious emissions except harmonics were found | | | | A12 |
| 2000 – 4000 | No spurious emissions except harmonics were found | | | | A13 |
| 4000 – 6500 | No spurious emissions except harmonics were found | | | | A14 |
| 6500 – 8000 | No spurious emissions were found | | | | A15 |
| 8000 - 9500 | No spurious emissions were found | | | | A16 |
| Measurement uncertainty, dB | +5.73 dB / -5.57 dB | | | | |

**Table abbreviations:**
Margin = dB below (negative if above) specification limit.

**TEST EQUIPMENT USED:**

| | | | | | | |
|---|---|---|---|---|---|---|
| HL 0041 | HL 0521 | HL 0554 | HL 0589 | HL 0604 | HL 1003 | HL 1200 |
| HL 1424 | HL 1915 | HL 1942 | | | | |

**LIMIT**

Radiated emissions, which fall in the restricted bands, must comply with §15.209(a) limits.

**TEST PROCEDURE**

**9 kHz – 30 MHz frequency range.** The EUT was placed on a wooden 80 cm height turntable. The loop antenna was positioned with its plane vertical. The loop center was 1 meter above the ground plane. To find maximum radiation the turntable was rotated 360° and the measuring antenna was rotated about its vertical axis.

**30 MHz – 9.5 GHz frequency range.** The EUT was placed on a wooden 80 cm height turntable. To find maximum radiation the turntable was rotated 360°, measuring antenna height was changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal.

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## 4.4 Receiver spurious emissions, according to §15.109

| | |
|---|---|
| METHOD OF MEASUREMENT: | ANSI 63.4 §11.6 / ANSI 63.4 §12.1.4 |
| DATE | March 18, 2002 |
| RELATIVE HUMIDITY | 46% |
| AMBIENT TEMPERATURE: | 23°C |
| TEST PERFORMED IN: | ANECHOIC CHAMBER |
| TEST DISTANCE: | 3 m |
| RECEIVER OPERATING FREQUENCIES | 916.3 |
| FREQUENCY RANGE: | 30 – 5000 MHz |

| **The EUT highest used frequency (not including operating frequency), MHz** | **Upper frequency of measurement range, MHz** |
|---|---|
| Below 1.705 | 30 |
| 1.705 – 108 | 1000 |
| 108 – 500 | 2000 |
| 500 – 1000 | 5000 |
| Above 1000 | 5th harmonic of the highest frequency or 40 GHz, whichever is lower |

| **Frequency, MHz** | **Radiated emissions, dB (µV/m)** | **Limit, dB (µV/m)** | **Margin, dB** | **Reference to Plots in Appendix A** |
|---|---|---|---|---|
| 30 – 1000 | All emissions were found more than 8 dB below limit | | | A17 |
| 1000 - 2000 | No spurious emissions were found | | | – |
| 2000 – 5000 | No spurious emissions were found | | | A18 |
| Measurement uncertainty, dB | +5.73 dB / -5.57 dB | | | |

**TEST EQUIPMENT USED:**

| | | | | | | |
|---|---|---|---|---|---|---|
| HL 0041 | HL 0521 | HL 0554 | HL 0589 | HL 0604 | HL 1003 | HL 1200 |
| HL 1424 | HL 1942 | | | | | |

**LIMIT**

**(§ 15.109)**

| **Frequency, MHz** | **Class A equipment @ 10 m dB (µV/m)** | **Class B equipment @ 3 m dB (µV/m)** |
|---|---|---|
| 30 – 88 | 39.0 | 40 |
| 88 – 216 | 43.5 | 43.5 |
| 216 – 960 | 46.4 | 46 |
| 960 – 5000 | 49.5 | 54 |

**TEST PROCEDURE**

The EUT was placed on a wooden 80 cm height turntable. To find maximum radiation the turntable was rotated 360°, measuring antenna height was changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal.

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## 4.5 Unintentional radiated emissions test according to §15.109

| | |
|---|---|
| METHOD OF MEASUREMENT: | ANSI 63.4 §11.6 / ANSI 63.4 §12.1.4 |
| DATE | March 18, 2002 |
| RELATIVE HUMIDITY | 46% |
| AMBIENT TEMPERATURE: | 23°C |
| TEST PERFORMED IN: | ANECHOIC CHAMBER/ OATS |
| TEST DISTANCE: | 3 m |
| THE EUT WAS TESTED AS: | TABLE-TOP |
| FREQUENCY RANGE: | 30 MHz – 1 GHz |
| DETECTOR TYPE: | QUASI-PEAK |

| The EUT highest used frequency (not including operating frequency), MHz | Upper frequency of measurement range, MHz |
|---|---|
| Below 1.705 | 30 |
| 1.705 – 108 | 1000 |
| 108 – 500 | 2000 |
| 500 – 1000 | 5000 |
| Above 1000 | 5th harmonic of the highest frequency or 40 GHz, whichever is lower |

**Refer to paragraph 4.4 – receiver spurious emissions.**

**TEST EQUIPMENT USED:**

| | | | | | | |
|---|---|---|---|---|---|---|
| HL 0041 | HL 0521 | HL 0554 | HL 0589 | HL 0604 | HL 1003 | HL 1200 |
| HL 1424 | HL 1942 | | | | | |

**LIMIT (§ 15.109)**

| Frequency, MHz | Class A equipment @ 10 m dB(μV/m) | Class B equipment @ 3 m dB(μV/m) |
|---|---|---|
| 30 - 88 | 39.0 | 40 |
| 88 - 216 | 43.5 | 43.5 |
| 216 - 960 | 46.4 | 46 |
| 960 - 5000 | 49.5 | 54 |

**TEST PROCEDURE**

The EUT was placed on a wooden 80 cm height turntable. To find maximum radiation the turntable was rotated 360°, measuring antenna height was changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal.

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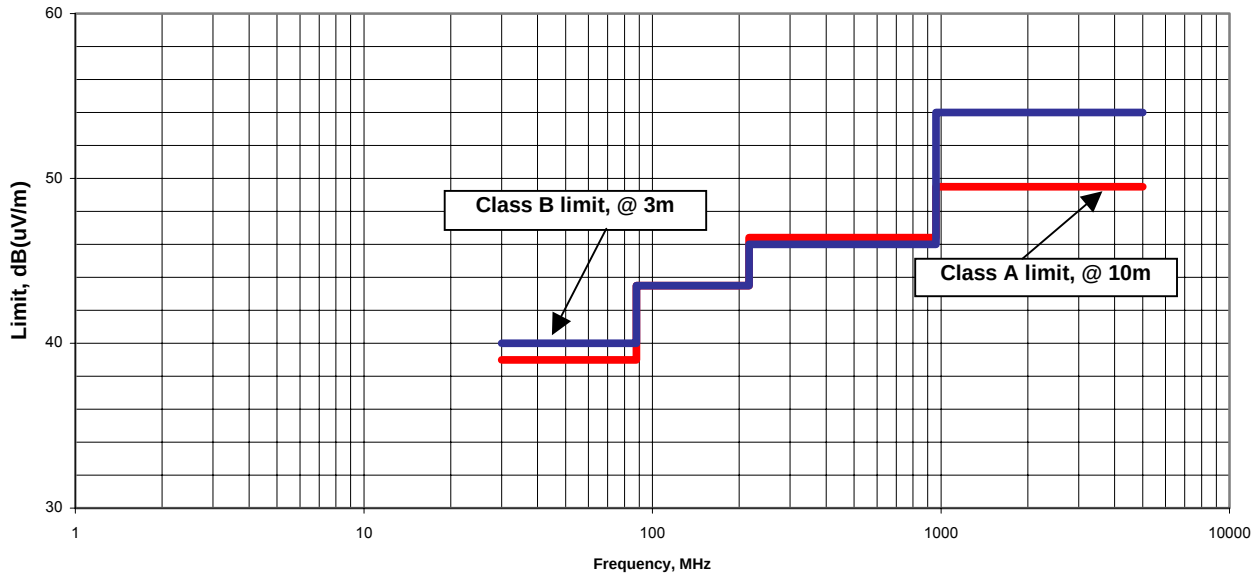
**Unintentional radiated emissions test according to §15.109**



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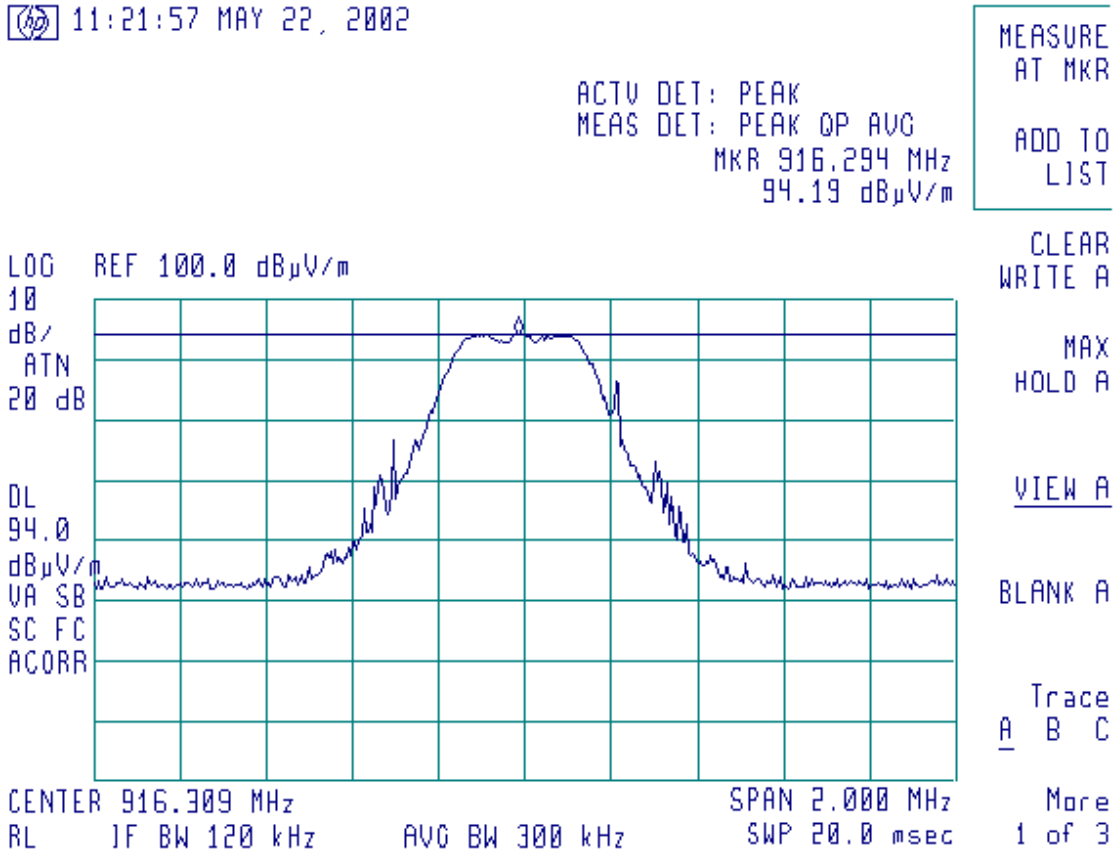
# Appendix A Plots

**Plot A1**
**Field strength of fundamental**



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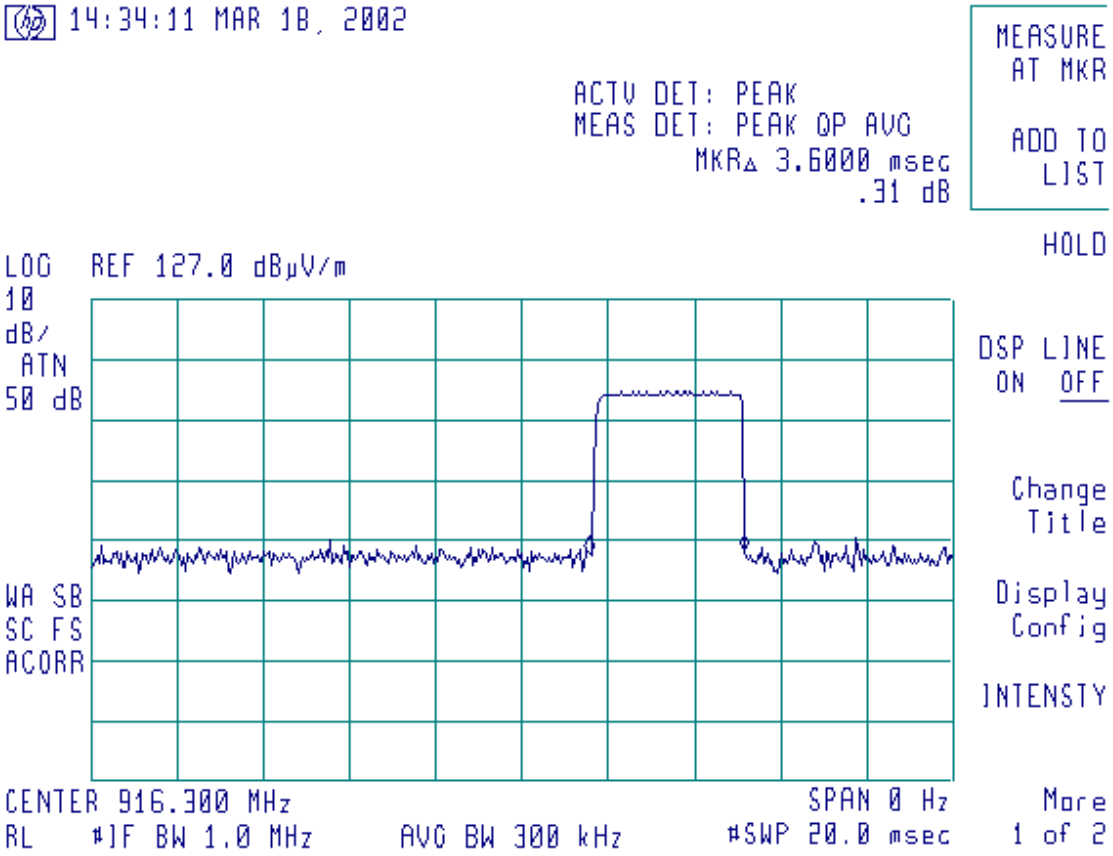
**Plot A2**
**Duty cycle measurements**
**One transmitter duration**



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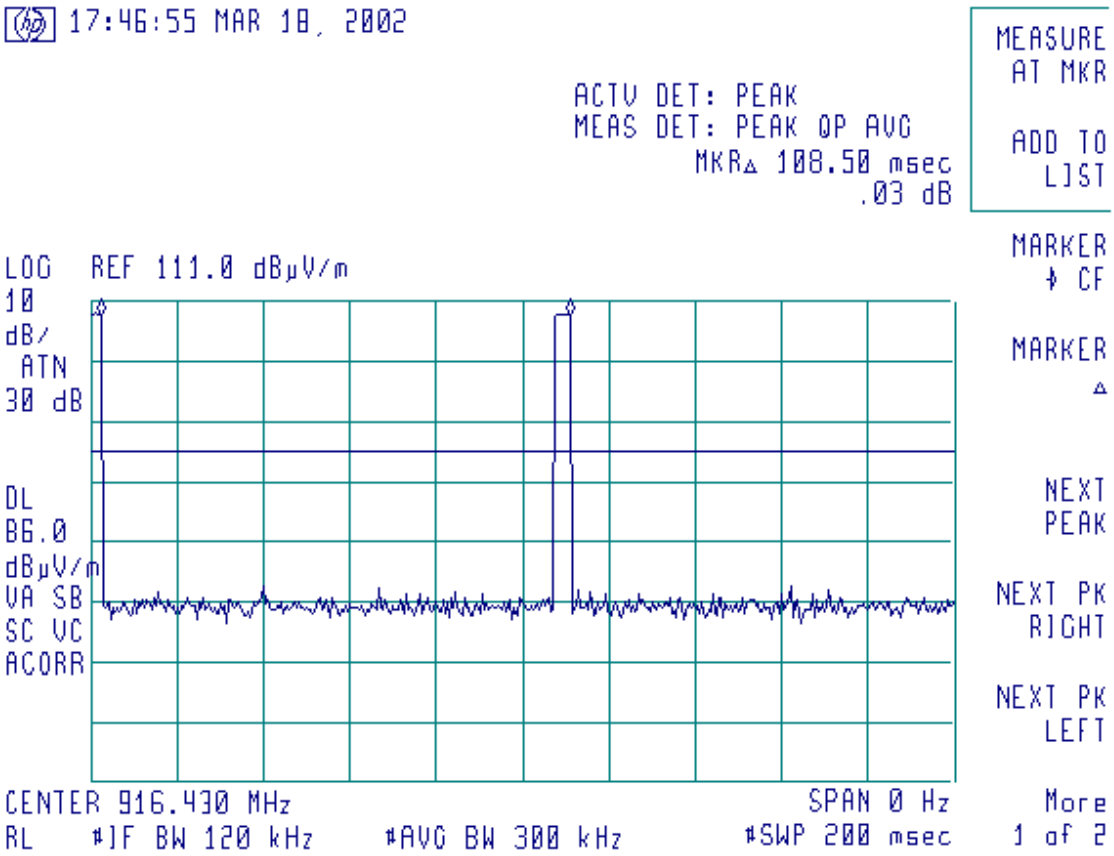
**Plot A3**
**Duty cycle measurements**
**Time interval between successive transmissions**



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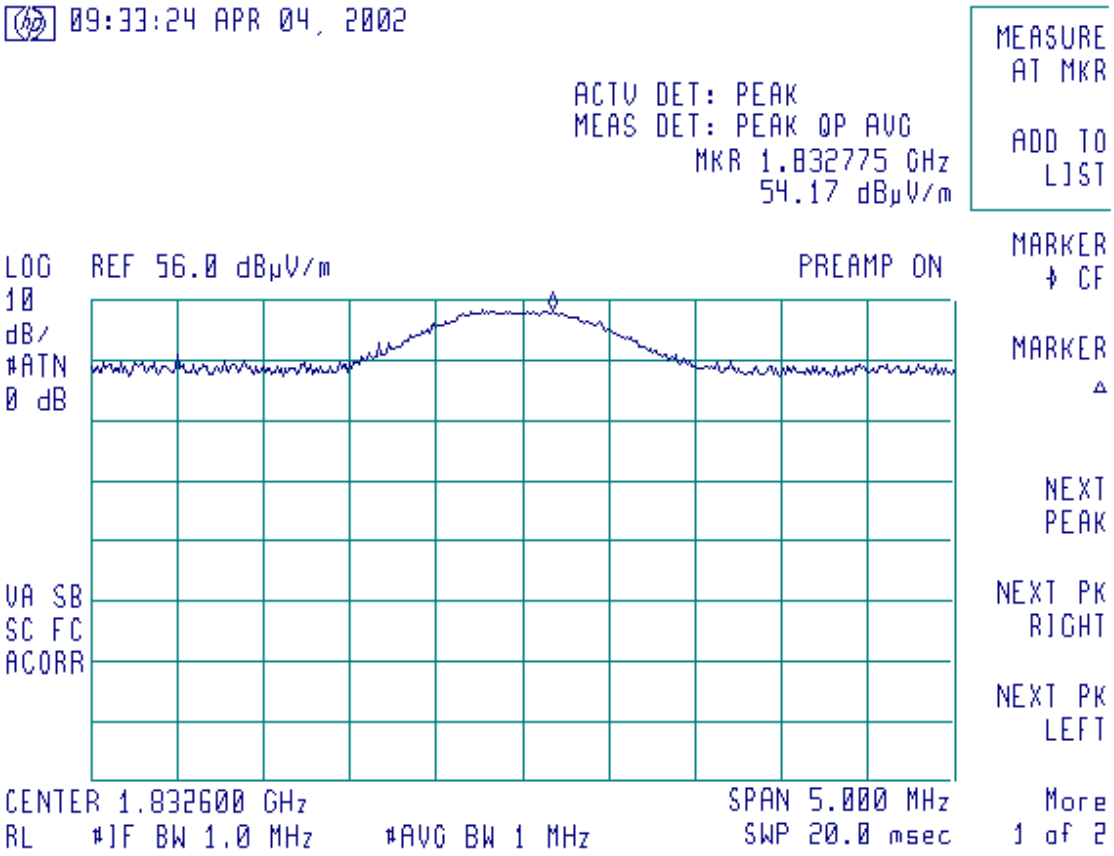
**Plot A4**
**Field strength of harmonics**
**2nd harmonic**



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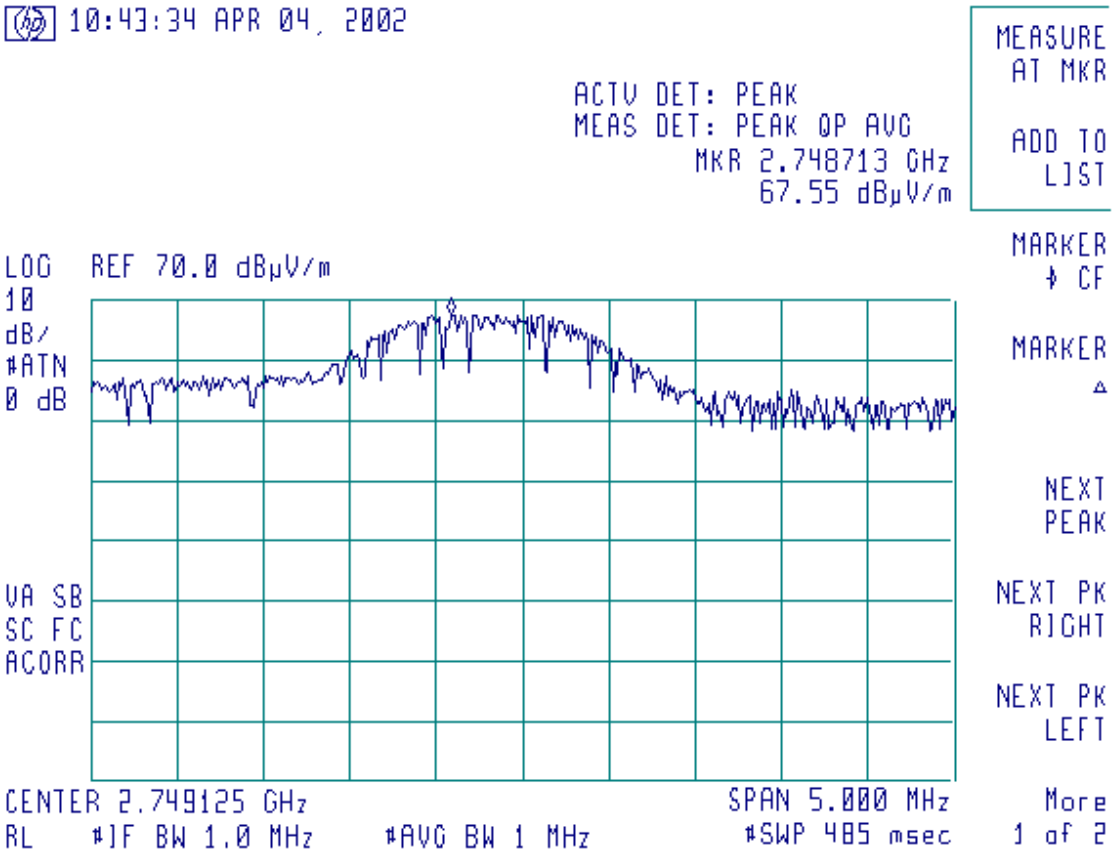
**Plot A5**
**Field strength of harmonics**
**3rd harmonic**



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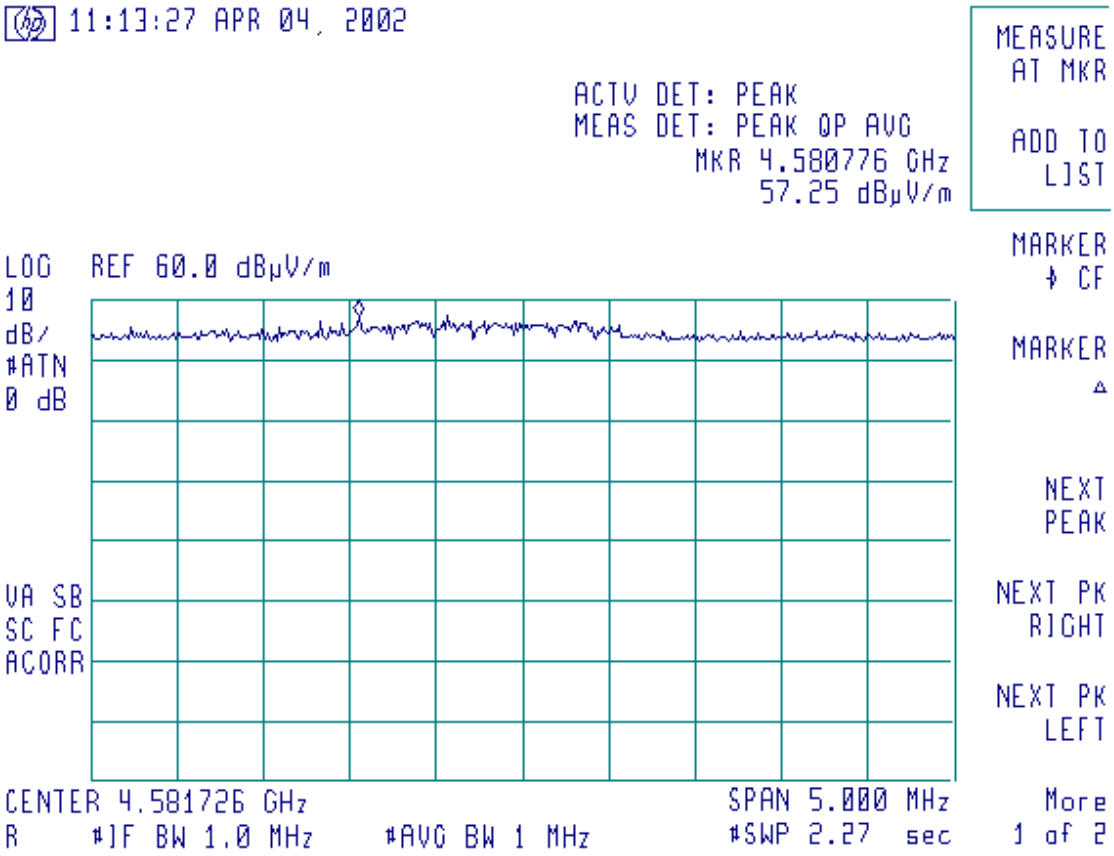
**Plot A6**
**Field strength of harmonics**
**5th harmonic**



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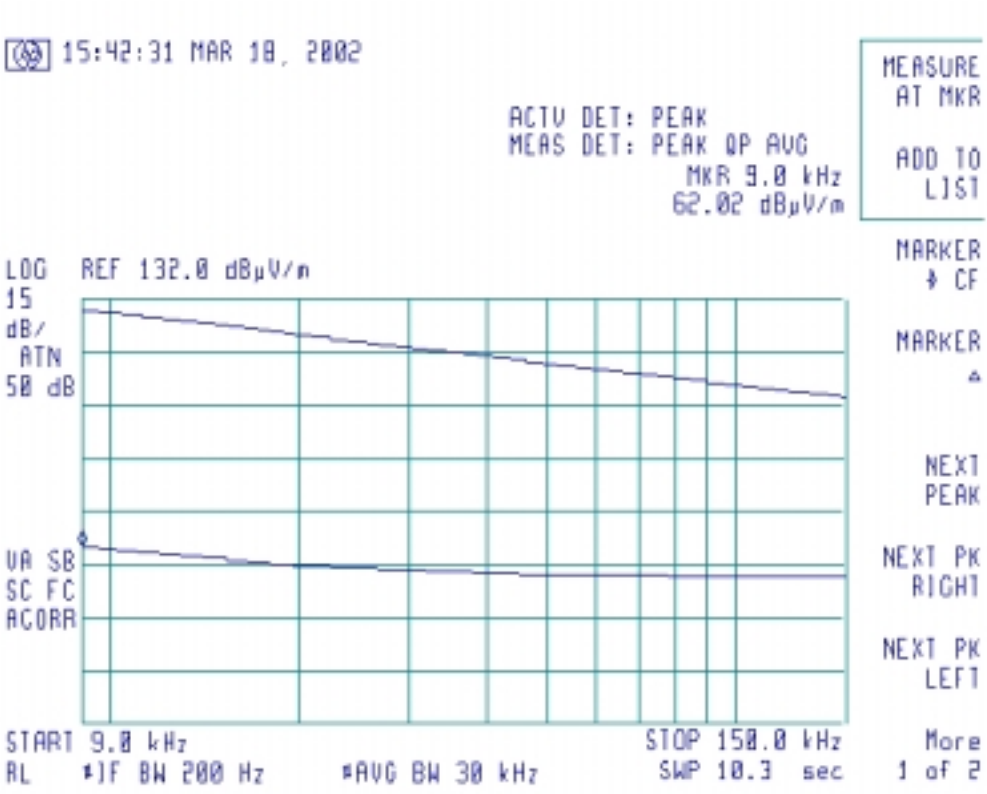
**Plot A7**
**Spurious emissions measurements**
**9 kHz – 150 kHz frequency range**



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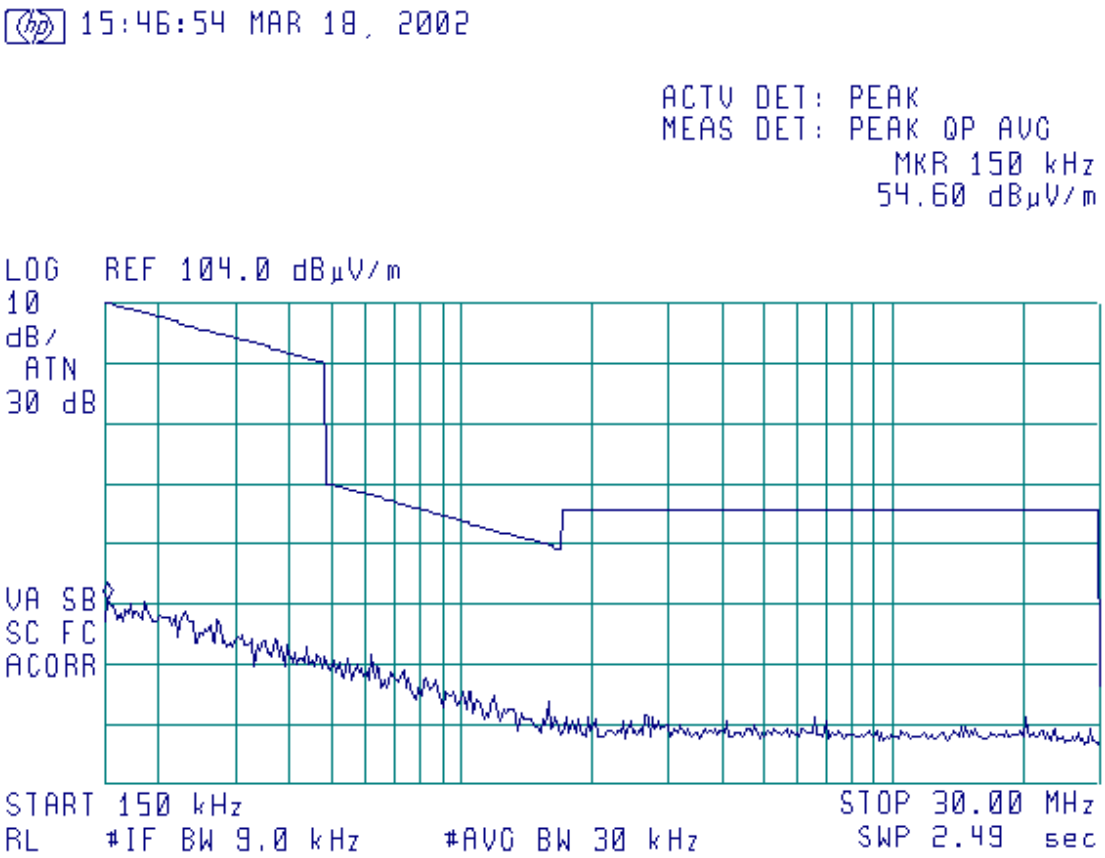
**Plot A8**
**Spurious emissions measurements**
**150 kHz – 30 MHz frequency range**



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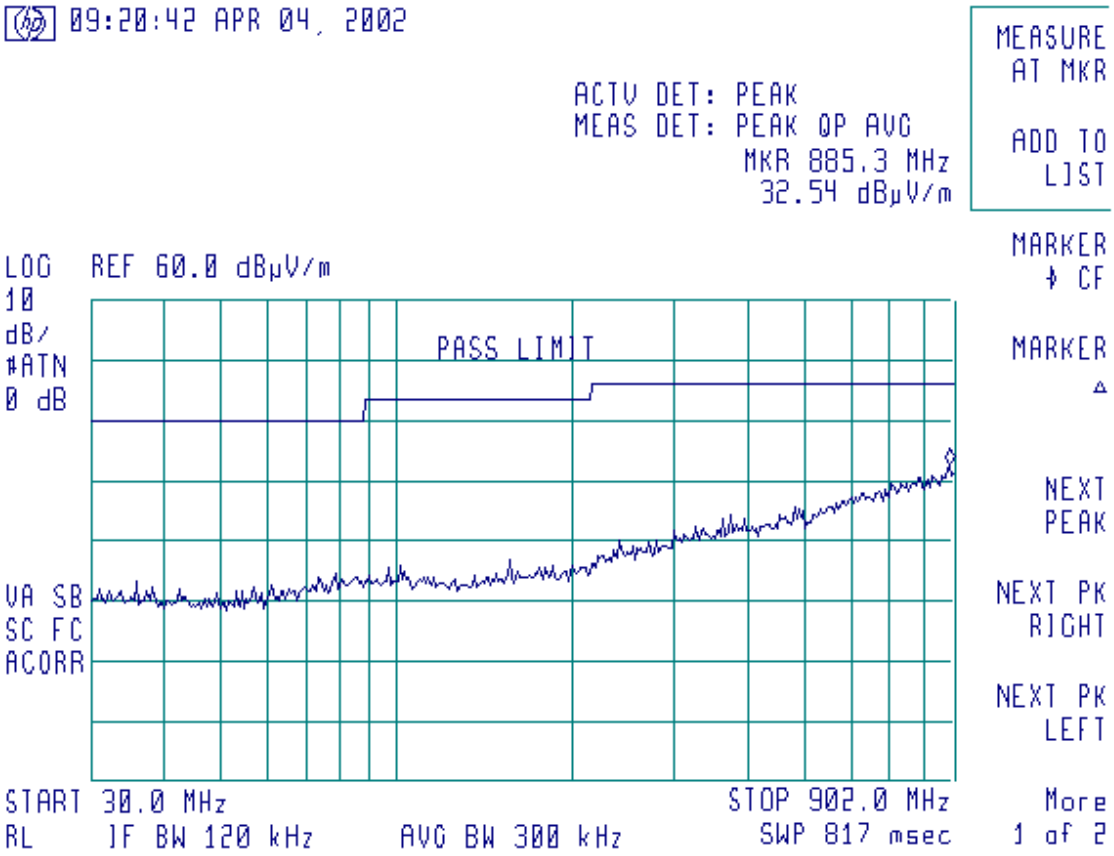
**Plot A9**
**Spurious emissions measurements**
**30 MHz – 902 MHz frequency range**



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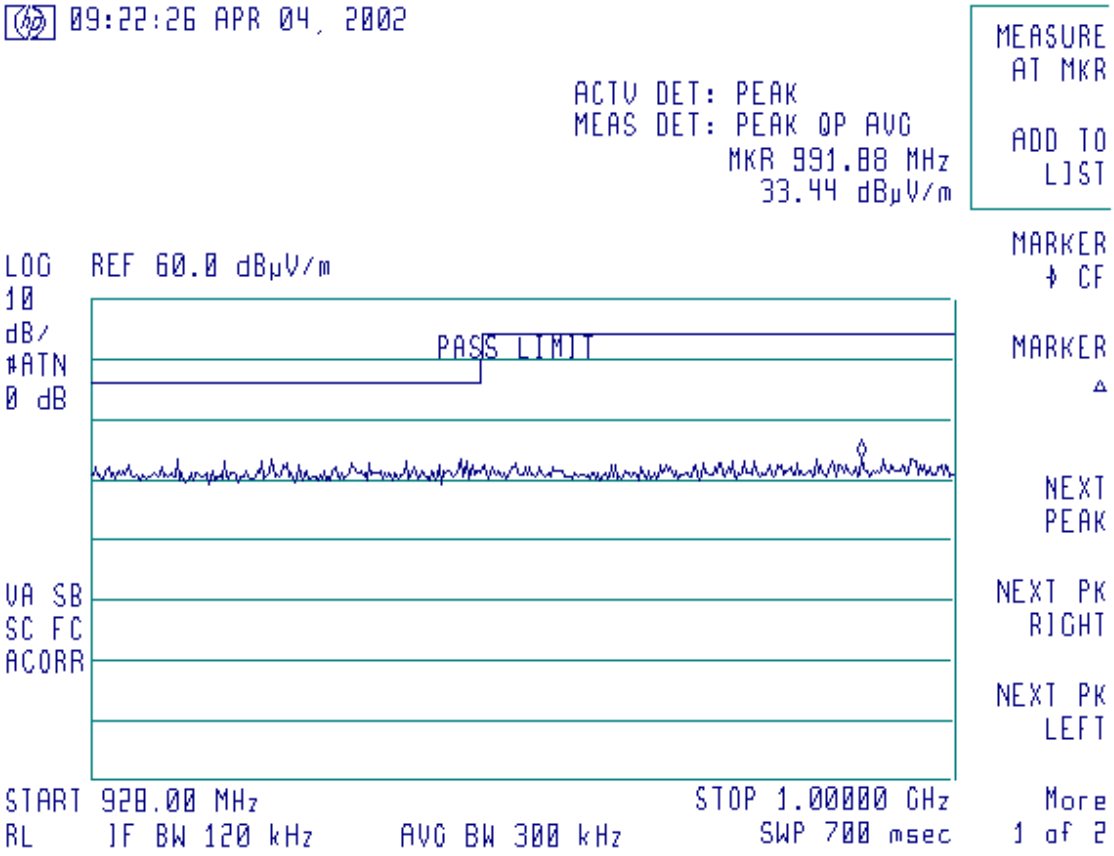
**Plot A10**
**Spurious emissions measurements**
**920 MHz – 1000 MHz frequency range**



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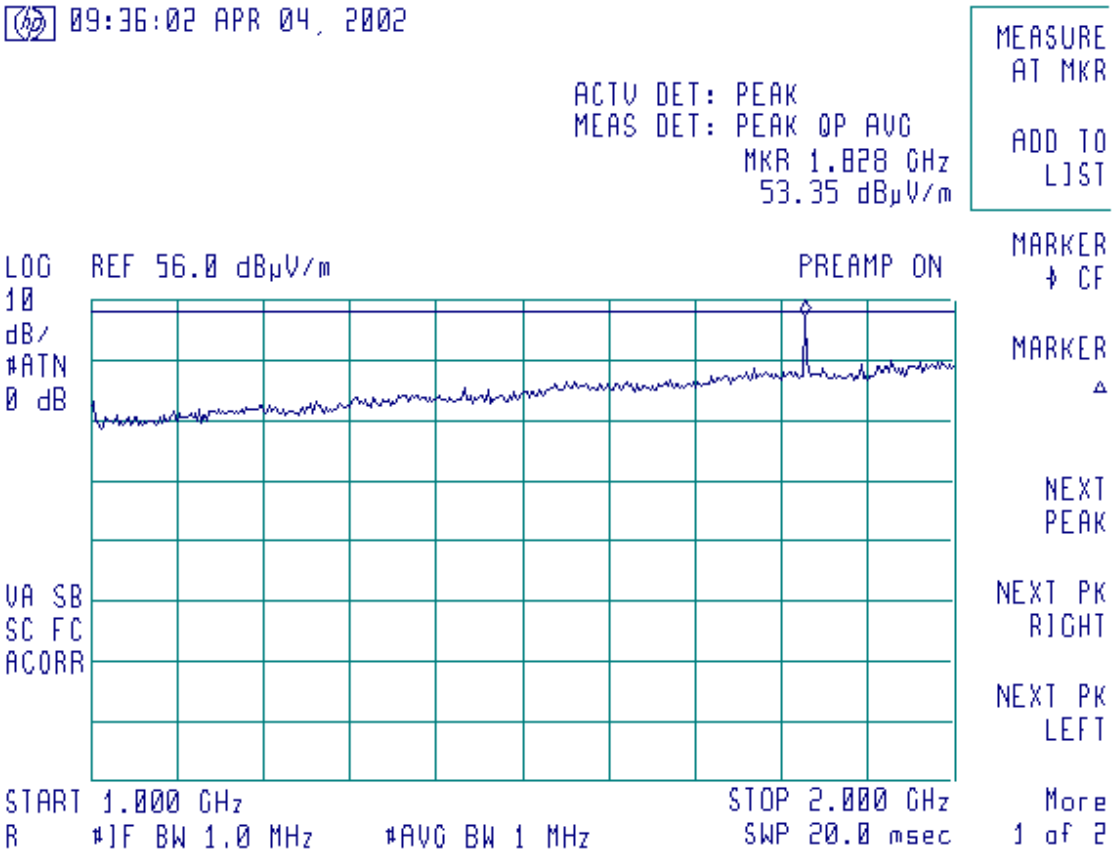
**Plot A11**
**Spurious emissions measurements**
**1000 MHz – 2000 MHz frequency range**



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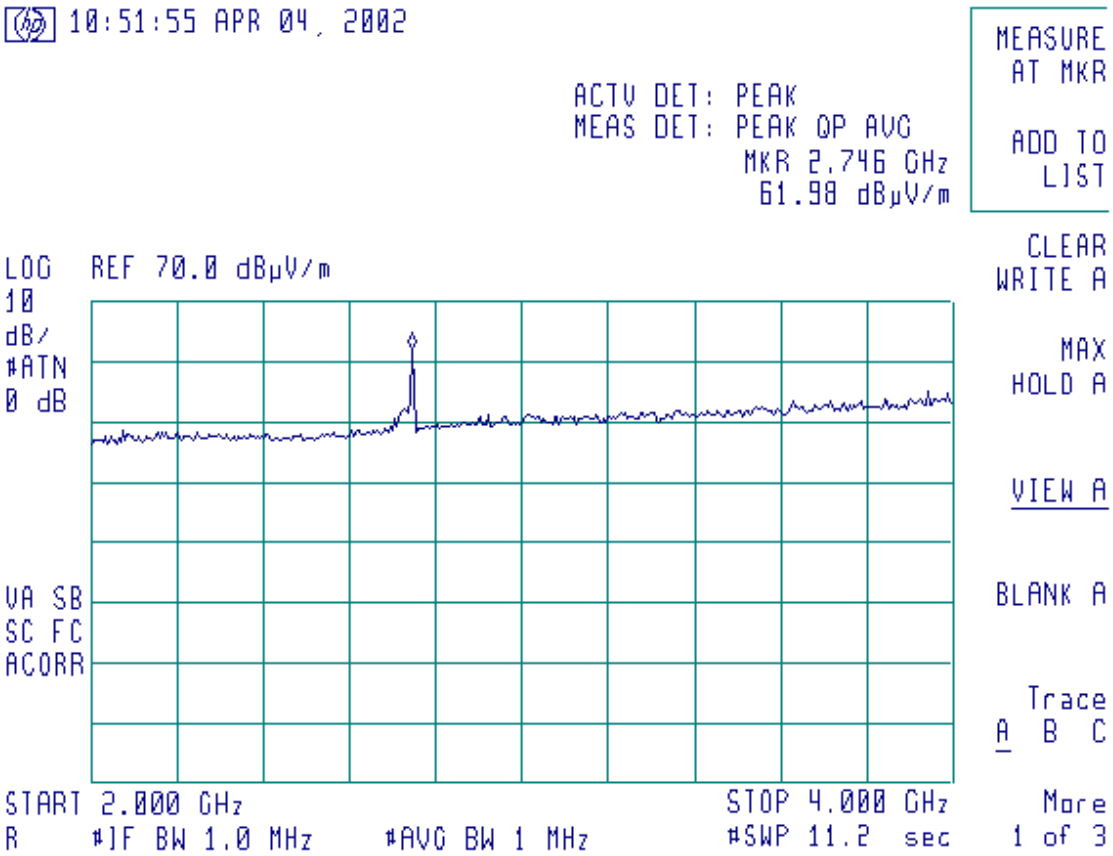
**Plot A12**
**Spurious emissions measurements**
**2000 MHz – 4000 MHz frequency range**



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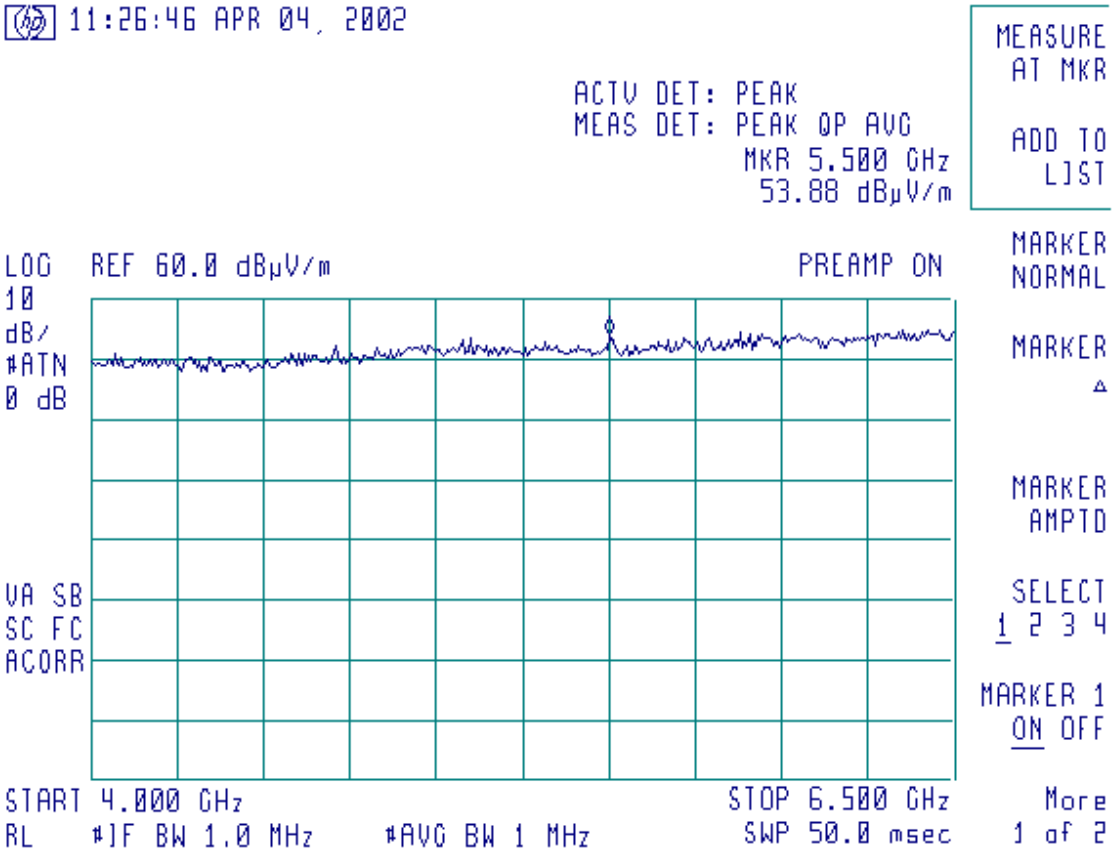
**Plot A13**
**Spurious emissions measurements**
**4000 MHz – 6500 MHz frequency range**



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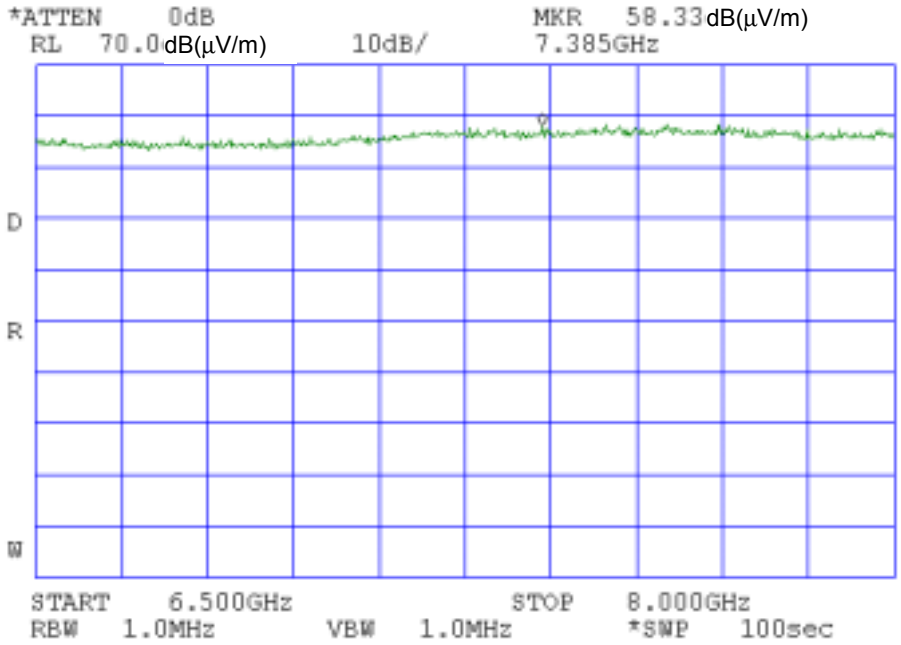
**Plot A14**
**Spurious emissions measurements**
**6500 MHz – 8000 MHz frequency range**



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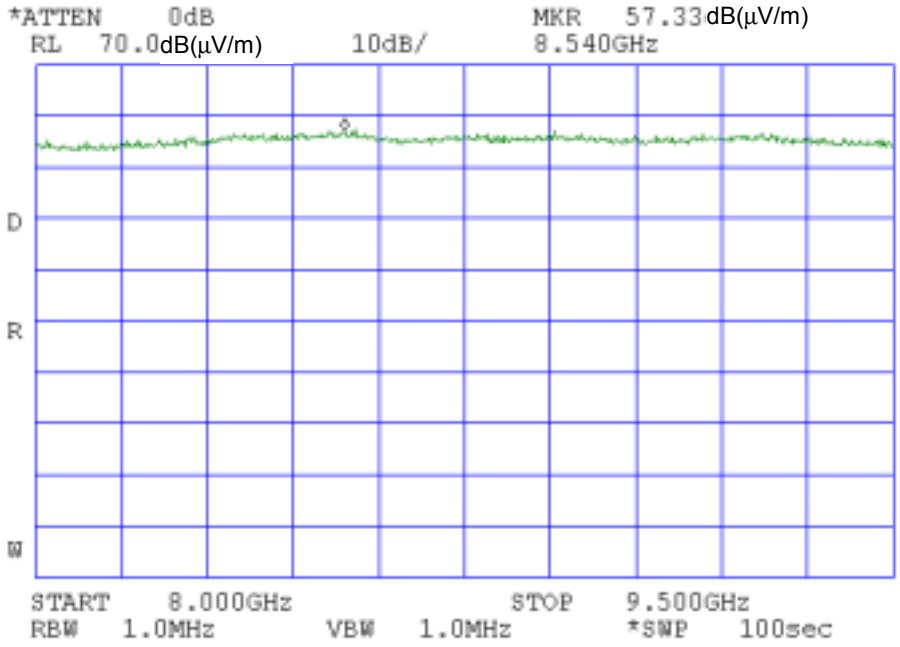
**Plot A15**
**Spurious emissions measurements**
**8000 MHz – 9500 MHz frequency range**



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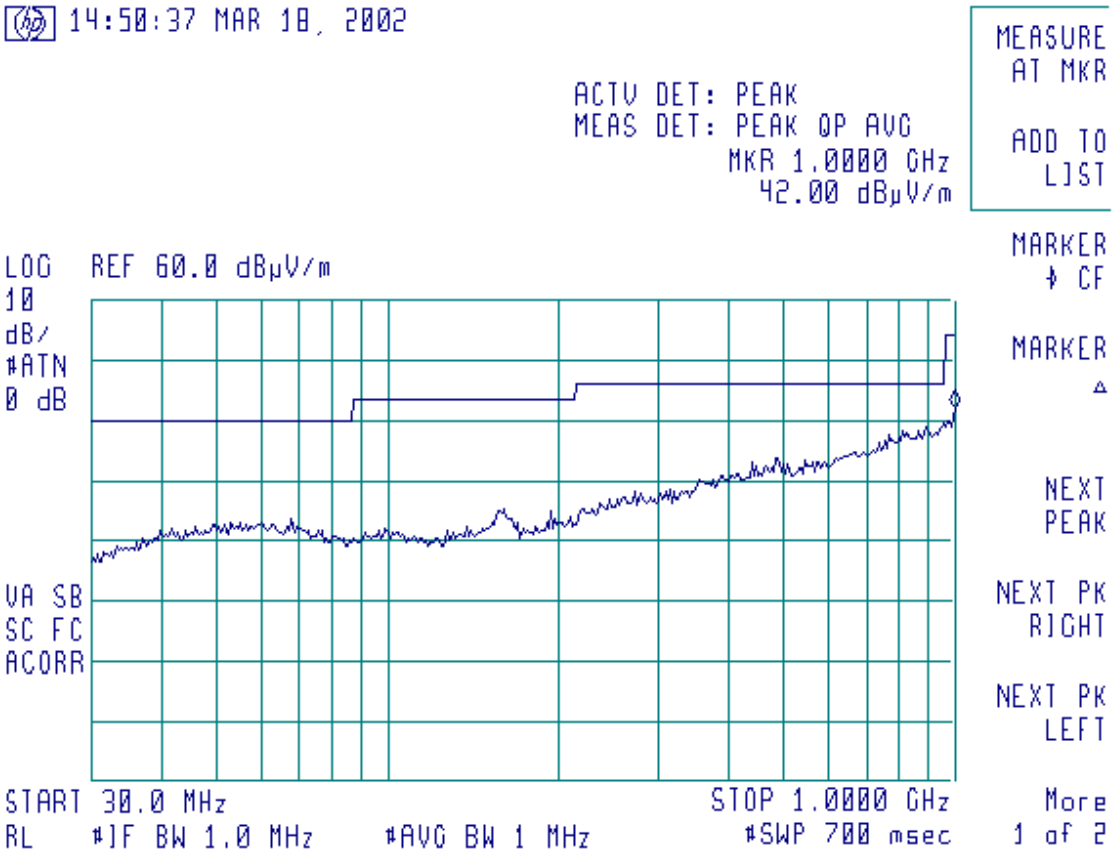
**Plot A16**
**Receiver spurious emissions measurements**
**30 MHz – 1000 MHz frequency range**



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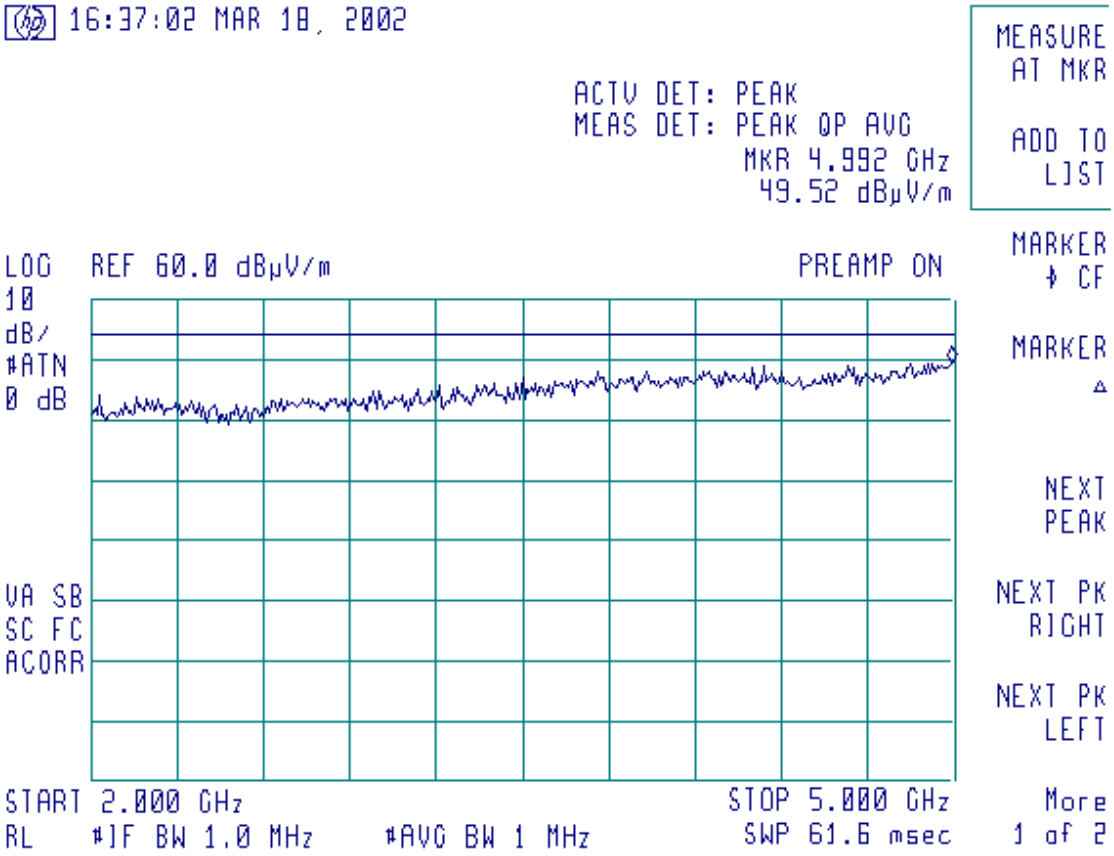
**Plot A17**
**Receiver spurious emissions measurements**
**1000 MHz – 5000 MHz frequency range**



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# Appendix B Test setup photographs

**Photograph 1.1**
**Field strength of fundamental setup**

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**Photograph 1.2**
**Field strength of fundamental setup**

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**Photograph 1.3**
**Field strength of fundamental setup**

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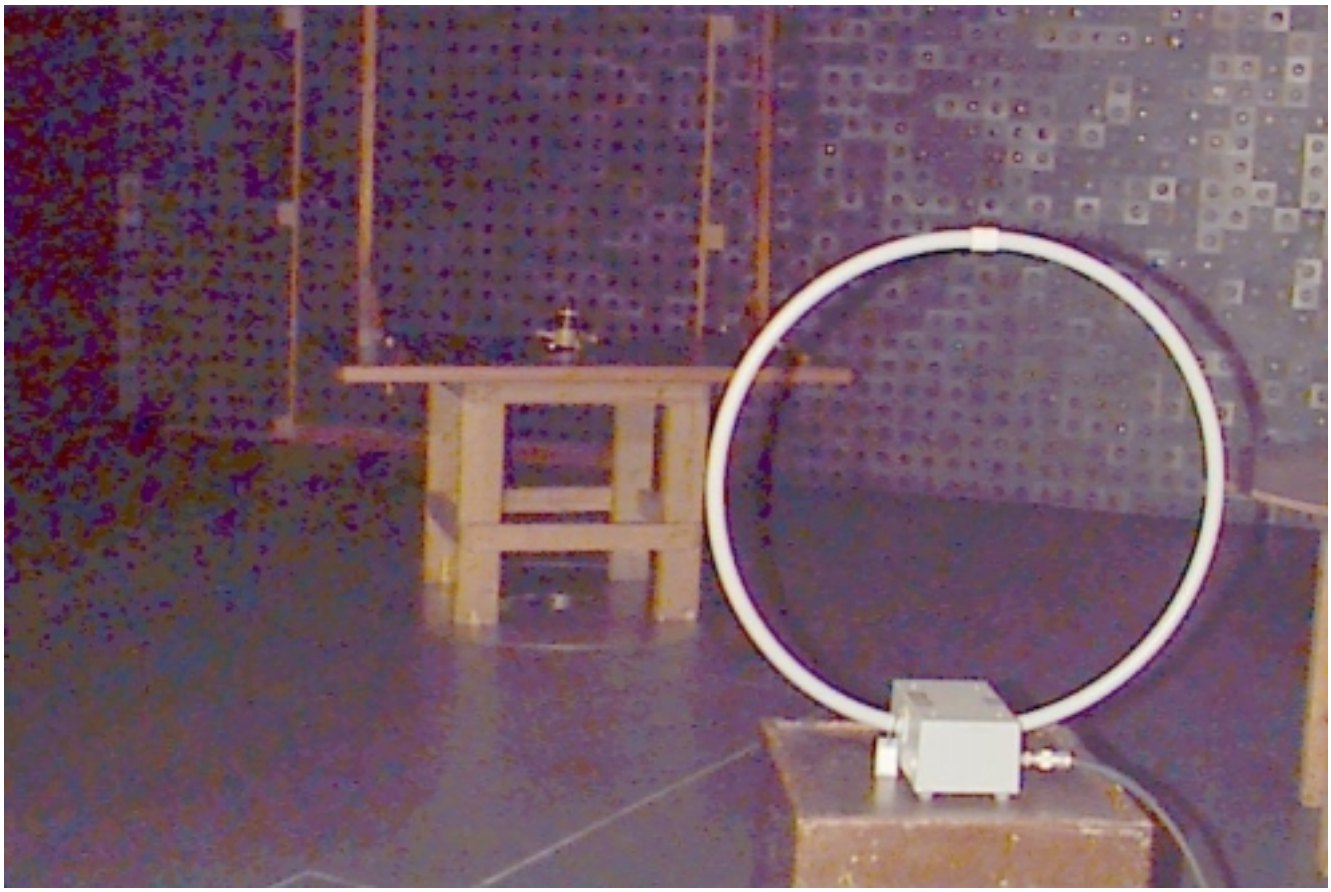
**RADIATED EMISSION MEASUREMENTS**
**WITH LOOP ANTENNA**
**9 kHz – 30 MHz frequency range**



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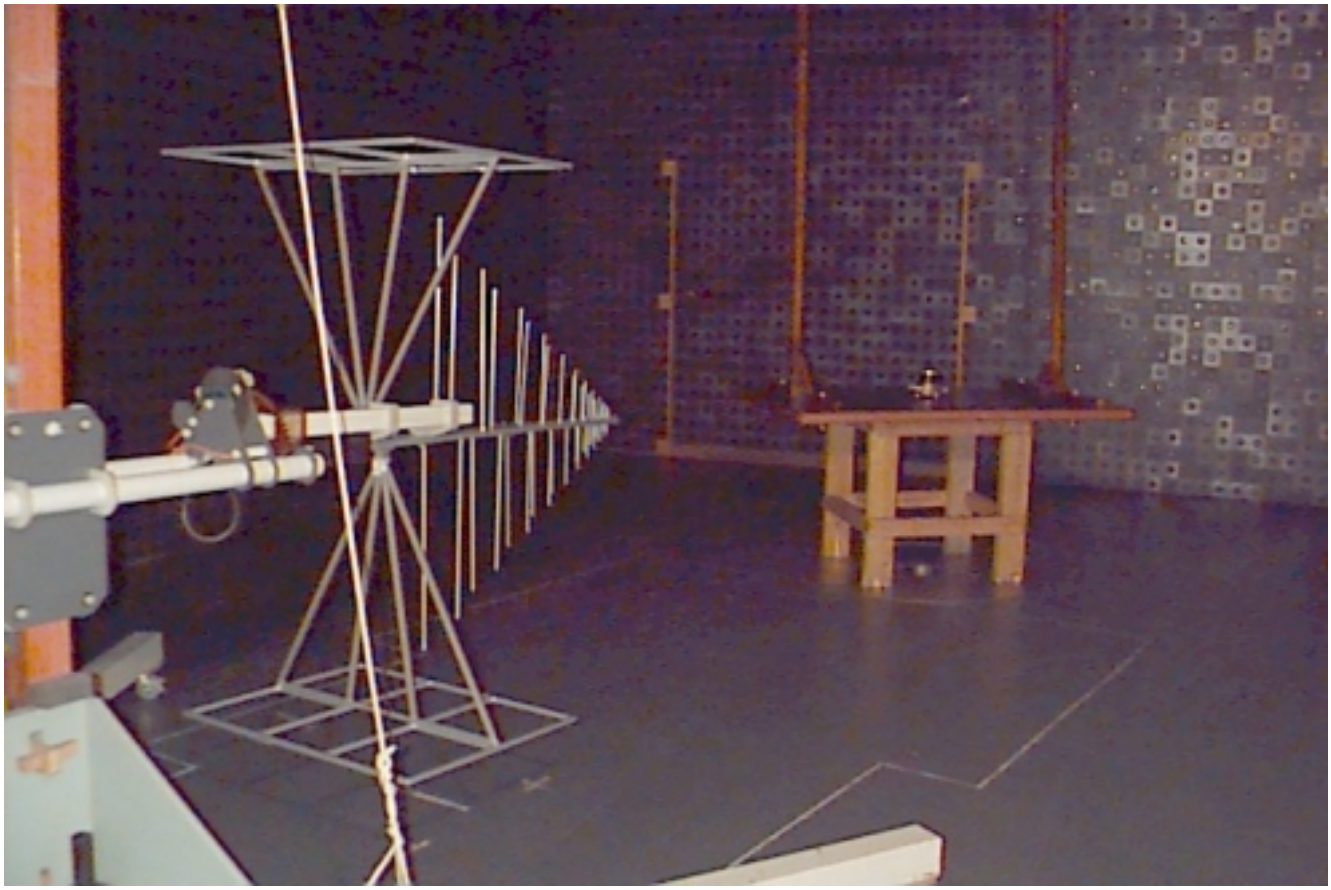
**RADIATED EMISSION MEASUREMENTS**
**WITH BICONILOG ANTENNA**
**30 – 1000 MHz frequency range**



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**RADIATED EMISSION MEASUREMENTS**
**WITH DOUBLE RIDGED GUIDE ANTENNA**
**1000 – 9500 MHz frequency range**

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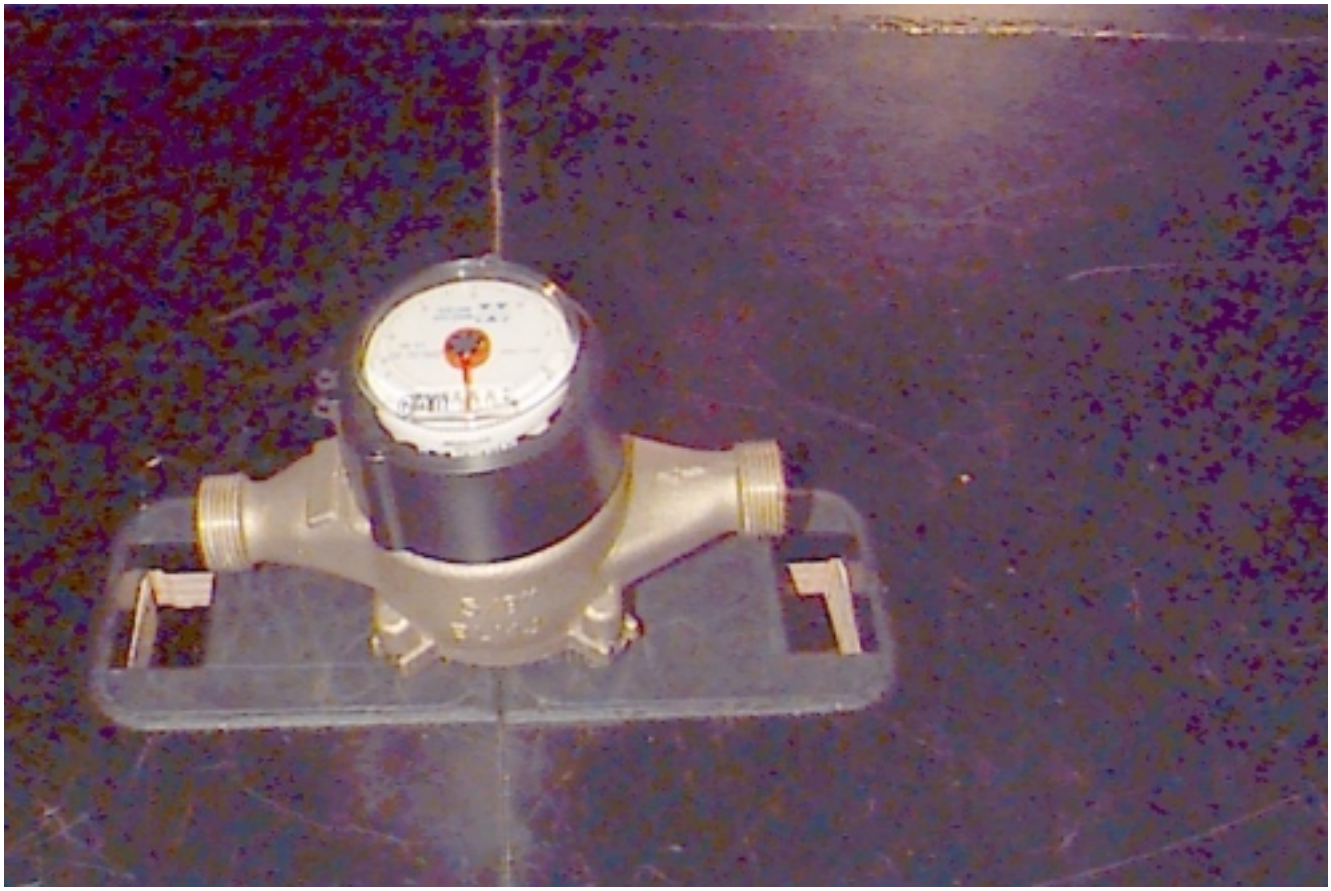
**RADIATED EMISSION MEASUREMENTS**
**EUT SETUP**



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# Appendix C Test equipment used for tests

| HL Serial No. | Description | Manufacturer information | | | Due Calibr. Month/ year |
|---|---|---|---|---|---|
| | | Name | Model No. | Serial No. | |
| 0041 | Double ridged guide antenna, 1-18 GHz | Electro-Metrics | RGA 50/60 | 2811 | 8/02 |
| 0465 | Anechoic Chamber 9 (L) x 6.5 (W) x 5.5 (H) m | Hermon Labs | AC-1 | 023 | 11/02 check |
| 0521 | Spectrum Analyzer with RF filter section (EMI Receiver 9 kHz - 6.5 GHz) | Hewlett Packard | 8546A | 0319 | 7/02 |
| 0554 | Amplifier, 2 – 18 GHz RF | Miteq | AFD-4 | 4300 | 12/02 |
| 0589 | Cable Coaxial, GORE A2POL118, 2.3 m | Hermon Labs | GORE-3 | 589 | 11/02 |
| 0604 | Antenna Biconilog Log-Periodic/T Bow-Tie, 26 - 2000 MHz | EMCO | 3141 | 9611-1011 | 12/02 |
| 1003 | Cable coaxial, M17/164, 10 m | Hermon Labs | C17164-10 | 161 | 11/02 |
| 1004 | Cable coaxial, ANDREW PSWJ4, 6 m | Hermon Labs | ANDREW-6 | 163 | 12/02 |
| 1200 | Quadruplexer | Elettronica | UE 84 | 0240 | 4/02 check |
| 1424 | Spectrum analyzer, 30 Hz - 40 GHz | Agilent Technologies | 8564EC | 3946A00219 | 9/02 |
| 1915 | Active receiving loop antenna, 1 kHz – 30 MHz | EMC test systems | 6507 | 1457 | 06/02 |
| 1942 | Cable 18 GHz, 4 m, blue | Rhophase Microwave Ltd | SPS-1803A-4000-NPS | T4658 | 10/02 |

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# Appendix D General information

## Test facility description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private EMC, Safety and Telecommunication testing facility. Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47) and by Industry Canada for electromagnetic emissions (file numbers IC 2186-1 for OATS and IC 2186-2 for anechoic chamber), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, C-845 for conducted emissions site), assessed by TNO Certification EP&S (Netherlands) for a number of EMC, Telecommunications, Safety standards, and by AMTAC (UK) for safety of Medical Devices. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for Electromagnetic Compatibility, Product Safety, Telecommunications Testing and Environmental Simulation (for exact scope please refer to Certificate No. 839.01).

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Person for contact: Mr. Alex Usoskin, QA manager.

## Abbreviations and acronyms

The following abbreviations and acronyms are applicable to this test report:

| | |
|---|---|
| AC | alternating current |
| AE | auxiliary equipment |
| cm | centimeter |
| dB | decibel |
| dBm | decibel referred to one milliwatt |
| dB(μV) | decibel referred to one microvolt |
| dB(μV/m) | decibel referred to one microvolt per meter |
| EMC | electromagnetic compatibility |
| EUT | equipment under test |
| GHz | gigahertz |
| H | height |
| Hz | hertz |
| kHz | kilohertz |
| kV | kilovolt |
| L | length |
| LISN | line impedance stabilization network |
| m | meter |
| MHz | megahertz |
| NA | not applicable |
| QP | quasi-peak |
| RF | radio frequency |
| RE | radiated emission |
| rms | root mean square |
| s | second |
| V | volt |
| W | width |

## Specification references

| | |
|---|---|
| 47CFR part 15: 2001 | Radio Frequency Devices |
| ANSI C63.2:96 | American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications. |
| ANSI C63.4:92 | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz. |

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## FCC Equipment codes and descriptions

| | |
|---|---|
| CYY | Communications Receiver used w/ P.15 transmitter |
| DCD | Part 15 Low Power transmitter Below 1705 kHz |
| DSC | Part 15 Security/Remote Control Transmitter |
| DSR | Part 15 Remote Control/Security Device Transceiver |
| DSS | Part 15 Spread Spectrum Transmitter |
| DXX | Part 15 Low Power Communication Device Transmitter |
| EAV | Part 15 Automatic Vehicle Identification System |
| ETB | Part 15 Cordless Telephone Base Transceiver |
| ETR | Part 15 Cordless Telephone Remote Transceiver |
| ETS | Part 15 Cordless telephone system |
| FAP | Part 15 Anti-Pilferage Device |
| FDS | Part 15 Field Disturbance Sensor |
| GAT | Part 15 Auditory Assistance Device (Transmitter) |
| HID | Part 15 TV Interface Device |
| JBC | Part 15 Class B Computing Device/ Personal Computer |
| JBP | Part 15 Class B Computing Device Peripheral |
| PUB | Part 15 Unlicensed PCS base station |
| PUE | Part 15 Unlicensed PCS portable Tx held to ear |
| PUF | Part 15 Unlicensed PCS portable Tx held to face |
| PUT | Part 15 Unlicensed PCS portable Tx worn on body |

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# Appendix E Test equipment correction factors

**Antenna Factors for Loop Antenna**
**Manufactured by EMC Test Systems**
**Model Number: 6507 Serial Number: 1457**

| Frequency (MHz) | Magnetic Antenna Factor (dBS/m) | Electric Antenna Factor (dB) |
|---|---|---|
| 0.001 | -0.8 | 50.7 |
| 0.002 | -6.1 | 45.4 |
| 0.003 | -10.0 | 41.5 |
| 0.005 | -15.3 | 36.2 |
| 0.007 | -18.5 | 33.0 |
| 0.009 | -20.8 | 30.7 |
| 0.010 | -21.9 | 29.7 |
| 0.020 | -27.1 | 24.5 |
| 0.050 | -31.0 | 20.5 |
| 0.075 | -31.7 | 19.8 |
| 0.100 | -31.9 | 19.6 |
| 0.150 | -32.1 | 19.4 |
| 0.250 | -32.3 | 19.2 |
| 0.500 | -32.6 | 18.9 |
| 0.750 | -32.7 | 18.8 |
| 1.000 | -32.8 | 18.7 |
| 2.000 | -33.2 | 18.3 |
| 3.000 | -33.5 | 18.0 |
| 4.000 | -33.9 | 17.6 |
| 5.000 | -34.1 | 17.4 |
| 10.000 | -34.8 | 16.7 |
| 15.000 | -35.3 | 16.3 |
| 20.000 | -35.3 | 16.3 |
| 25.000 | -35.8 | 15.7 |
| 30.000 | -35.9 | 15.7 |

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**Antenna factor**
**Biconilog antenna EMCO, model 3141**
**Ser.No.1011**

| Frequency, MHz | Antenna Factor, dB(1/m) | Frequency, MHz | Antenna Factor, dB(1/m) |
|---|---|---|---|
| 26 | 7.8 | 940 | 24.0 |
| 28 | 7.8 | 960 | 24.1 |
| 30 | 7.8 | 980 | 24.5 |
| 40 | 7.2 | 1000 | 24.9 |
| 60 | 7.1 | 1020 | 25.0 |
| 70 | 8.5 | 1040 | 25.2 |
| 80 | 9.4 | 1060 | 25.4 |
| 90 | 9.8 | 1080 | 25.6 |
| 100 | 9.7 | 1100 | 25.7 |
| 110 | 9.3 | 1120 | 26.0 |
| 120 | 8.8 | 1140 | 26.4 |
| 130 | 8.7 | 1160 | 27.0 |
| 140 | 9.2 | 1180 | 27.0 |
| 150 | 9.8 | 1200 | 26.7 |
| 160 | 10.2 | 1220 | 26.5 |
| 170 | 10.4 | 1240 | 26.5 |
| 180 | 10.4 | 1260 | 26.5 |
| 190 | 10.3 | 1280 | 26.6 |
| 200 | 10.6 | 1300 | 27.0 |
| 220 | 11.6 | 1320 | 27.8 |
| 240 | 12.4 | 1340 | 28.3 |
| 260 | 12.8 | 1360 | 28.2 |
| 280 | 13.7 | 1380 | 27.9 |
| 300 | 14.7 | 1400 | 27.9 |
| 320 | 15.2 | 1420 | 27.9 |
| 340 | 15.4 | 1440 | 27.8 |
| 360 | 16.1 | 1460 | 27.8 |
| 380 | 16.4 | 1480 | 28.0 |
| 400 | 16.6 | 1500 | 28.5 |
| 420 | 16.7 | 1520 | 28.9 |
| 440 | 17.0 | 1540 | 29.6 |
| 460 | 17.7 | 1560 | 29.8 |
| 480 | 18.1 | 1580 | 29.6 |
| 500 | 18.5 | 1600 | 29.5 |
| 520 | 19.1 | 1620 | 29.3 |
| 540 | 19.5 | 1640 | 29.2 |
| 560 | 19.8 | 1660 | 29.4 |
| 580 | 20.6 | 1680 | 29.6 |
| 600 | 21.3 | 1700 | 29.8 |
| 620 | 21.5 | 1720 | 30.3 |
| 640 | 21.2 | 1740 | 30.8 |
| 660 | 21.4 | 1760 | 31.1 |
| 680 | 21.9 | 1780 | 31.0 |
| 700 | 22.2 | 1800 | 30.9 |
| 720 | 22.2 | 1820 | 30.7 |
| 740 | 22.1 | 1840 | 30.6 |
| 760 | 22.3 | 1860 | 30.6 |
| 780 | 22.6 | 1880 | 30.6 |
| 800 | 22.7 | 1900 | 30.6 |
| 820 | 22.9 | 1920 | 30.7 |
| 840 | 23.1 | 1940 | 30.9 |
| 860 | 23.4 | 1960 | 31.2 |
| 880 | 23.8 | 1980 | 31.6 |
| 900 | 24.1 | 2000 | 32.0 |
| 920 | 24.1 | | |

Antenna factor is to be added to receiver meter reading in dB(μV) to convert to field intensity in dB(μV/meter)

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**Antenna Factor**
**Double Ridged Guide Antenna**
**Model RGA-50/60**
**S/N 2811**

| Frequency, MHz | Antenna Factor, dB |
|---|---|
| 1000 | 24.3 |
| 1500 | 25.4 |
| 2000 | 28.4 |
| 2500 | 29.2 |
| 3000 | 30.5 |
| 3500 | 31.6 |
| 4000 | 33.7 |
| 4500 | 32.2 |
| 5000 | 34.5 |
| 5500 | 34.5 |
| 6000 | 34.6 |
| 6500 | 35.3 |
| 7000 | 35.5 |
| 7500 | 35.9 |
| 8000 | 36.6 |
| 8500 | 37.3 |
| 9000 | 37.7 |
| 9500 | 37.7 |
| 10000 | 38.2 |
| 10500 | 38.5 |
| 11000 | 39.0 |
| 11500 | 40.1 |
| 12000 | 40.2 |
| 12500 | 39.3 |
| 13000 | 39.9 |
| 13500 | 40.6 |
| 14000 | 41.1 |
| 14500 | 40.5 |
| 15000 | 39.9 |
| 15500 | 37.8 |
| 16000 | 39.1 |
| 16500 | 41.1 |
| 17000 | 41.7 |
| 17500 | 45.1 |
| 18000 | 44.3 |

Antenna factor is to be added to receiver meter reading in dB(μV) to convert to field intensity in dB(μV)/meter

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**Cable coaxial M17/164**
**Model: C17164-10, s/n 161 (HL 1003)**
**Calibration data**

| No. | Parameter | SET, MHz | Measured, dB | Deviation, dB | Tolerance (Specification), dB | Meas. Uncert., dB | Notes |
|---|---|---|---|---|---|---|---|
| 1 | Insertion | 30 | 0.41 | - | ≤ 12.5 | ±0.12 | |
| 2 | Loss | 50 | 0.52 | - | | | |
| 3 | | 100 | 0.75 | - | | | |
| 4 | | 300 | 1.45 | - | | | |
| 5 | | 500 | 2.01 | - | | | |
| 6 | | 800 | 2.71 | - | | | |
| 7 | | 1000 | 3.14 | - | | | |
| 8 | | 1200 | 3.56 | - | | | |
| 9 | | 1400 | 3.93 | - | | | |
| 10 | | 1600 | 4.31 | - | | | |
| 11 | | 1800 | 4.63 | - | | | |
| 12 | | 2000 | 4.97 | - | | | |
| 13 | | 2200 | 5.32 | - | | | |
| 14 | | 2400 | 5.65 | - | | | |
| 15 | | 2600 | 6.01 | - | | | |
| 16 | Insertion | 2800 | 6.42 | - | ≤ 12.5 | ±0.12 | |
| 17 | Loss | 3000 | 6.76 | - | | | |
| 18 | | 3300 | 7.12 | - | | | |
| 19 | | 3600 | 7.53 | - | | | |
| 20 | | 3900 | 7.95 | - | | | |
| 21 | | 4200 | 8.32 | - | | ±0.17 | |
| 22 | | 4500 | 8.72 | - | | | |
| 23 | | 4800 | 9.14 | - | | | |
| 24 | | 5100 | 9.59 | - | | | |
| 25 | | 5400 | 10.00 | - | | | |
| 26 | | 5700 | 10.49 | - | | | |
| 27 | | 6000 | 11.07 | - | | | |
| 28 | | 6500 | 11.80 | - | | | |

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**Cable Coaxial, GORE A2P01POL118, 2.3 m, model:GORE-3, s/n 176 (HL 0589)**
**+ Cable Coaxial, ANDREW PSWJ4, 6m, model: ANDREW-6, s/n 163 (HL 1004)**
**Calibration data**

| No. | Parameter | SET, MHz | Measured, dB | Deviation, dB | Tolerance (Specification), dB | Meas. Uncert., dB | Notes |
|---|---|---|---|---|---|---|---|
| 1 | Insertion | 30 | 0.33 | - | | | |
| 2 | Loss | 50 | 0.40 | - | | | |
| 3 | | 100 | 0.57 | - | | | |
| 4 | | 300 | 0.97 | - | | | |
| 5 | | 500 | 1.25 | - | | | |
| 6 | | 800 | 1.59 | - | | | |
| 7 | | 1000 | 1.81 | - | | | |
| 8 | | 1200 | 1.97 | - | ≤ 6.5 | ±0.12 | |
| 9 | | 1400 | 2.15 | - | | | |
| 10 | | 1600 | 2.28 | - | | | |
| 11 | | 1800 | 2.43 | - | | | |
| 12 | | 2000 | 2.61 | - | | | |
| 13 | | 2200 | 2.75 | - | | | |
| 14 | | 2400 | 2.89 | - | | | |
| 15 | | 2600 | 2.97 | - | | | |
| 16 | Insertion | 2800 | 3.21 | - | ≤ 6.5 | ±0.12 | |
| 17 | Loss | 3000 | 3.32 | - | | | |
| 18 | | 3300 | 3.47 | - | | | |
| 19 | | 3600 | 3.62 | - | | | |
| 20 | | 3900 | 3.84 | - | | | |
| 21 | | 4200 | 3.92 | - | | ±0.17 | |
| 22 | | 4500 | 4.07 | - | | | |
| 23 | | 4800 | 4.36 | - | | | |
| 24 | | 5100 | 4.62 | - | | | |
| 25 | | 5400 | 4.78 | - | | | |
| 26 | | 5700 | 5.16 | - | | | |
| 27 | | 6000 | 5.67 | - | | | |
| 28 | | 6500 | 5.99 | - | | | |

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**Cable 18GHz, 4 m, blue, model: SPS-1803A-4000-NPS, s/nT4658 (HL 1942)**
**Calibration data**

| Frequency, GHz | Insertion Loss, dB |
|---|---|
| | HL1942 |
| 0.03 | 0.21 |
| 0.05 | 0.26 |
| 0.10 | 0.36 |
| 0.20 | 0.50 |
| 0.30 | 0.61 |
| 0.40 | 0.70 |
| 0.50 | 0.78 |
| 0.60 | 0.85 |
| 0.70 | 0.93 |
| 0.80 | 0.99 |
| 0.90 | 1.04 |
| 1.00 | 1.10 |
| 1.10 | 1.16 |
| 1.20 | 1.22 |
| 1.30 | 1.26 |
| 1.40 | 1.31 |
| 1.50 | 1.35 |
| 1.60 | 1.41 |
| 1.70 | 1.45 |
| 1.80 | 1.49 |
| 1.90 | 1.53 |
| 2.00 | 1.57 |
| 2.10 | 1.61 |
| 2.20 | 1.65 |
| 2.30 | 1.69 |
| 2.40 | 1.72 |
| 2.50 | 1.76 |
| 2.60 | 1.79 |
| 2.70 | 1.83 |
| 2.80 | 1.87 |
| 2.90 | 1.90 |
| 3.10 | 1.97 |
| 3.30 | 2.04 |
| 3.50 | 2.11 |
| 3.70 | 2.18 |
| 3.90 | 2.24 |
| 4.10 | 2.31 |
| 4.30 | 2.38 |
| 4.50 | 2.43 |
| 4.70 | 2.53 |
| 4.90 | 2.53 |
| 5.10 | 2.63 |
| 5.30 | 2.65 |
| 5.50 | 2.72 |
| 5.70 | 2.76 |
| 5.90 | 2.79 |

| Frequency, GHz | Insertion Loss, dB |
|---|---|
| | HL1942 |
| 6.10 | 2.88 |
| 6.30 | 2.90 |
| 6.50 | 2.97 |
| 6.70 | 3.02 |
| 6.90 | 3.04 |
| 7.10 | 3.07 |
| 7.30 | 3.12 |
| 7.50 | 3.13 |
| 7.70 | 3.19 |
| 7.90 | 3.24 |
| 8.10 | 3.30 |
| 8.30 | 3.36 |
| 8.50 | 3.45 |
| 8.70 | 3.41 |
| 8.90 | 3.45 |
| 9.10 | 3.42 |
| 9.30 | 3.55 |
| 9.50 | 3.48 |
| 9.70 | 3.58 |
| 9.90 | 3.61 |
| 10.10 | 3.66 |
| 10.30 | 3.68 |
| 10.50 | 3.70 |
| 10.70 | 3.70 |
| 10.90 | 3.75 |
| 11.10 | 3.78 |
| 11.30 | 3.86 |
| 11.50 | 3.98 |
| 11.70 | 4.10 |
| 11.90 | 4.12 |
| 12.10 | 4.09 |
| 12.40 | 4.13 |
| 13.00 | 4.23 |
| 13.50 | 4.35 |
| 14.00 | 4.40 |
| 14.50 | 4.44 |
| 15.00 | 4.57 |
| 15.50 | 4.66 |
| 16.00 | 4.64 |
| 16.50 | 4.66 |
| 17.00 | 4.75 |
| 17.50 | 4.85 |
| 18.00 | 4.93 |