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Electrical

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## **ELECTROMAGNETIC EMISSION TEST REPORT**

ACCORDING TO 47CFR PART 15, SUBPART C § 15.249, 15.209, 15.205 and SUBPART B  
for

**Hi-G-Tek Ltd.**

EQUIPMENT UNDER TEST:

**DataSeal transceiver**

**Model IG-RS-40-916**

This report is in conformity with and ISO/IEC 17025. The A2LA logo endorsement applies only to the test methods and the standards that are listed in the scope of Hermon Laboratories accreditation.  
The test results relate only to the items tested. **This test report must not be reproduced in any form except in full with the approval of Hermon Laboratories Ltd.**

Page 1 of 48

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## Contents

|          |                                                                           |           |
|----------|---------------------------------------------------------------------------|-----------|
| <b>1</b> | <b>PROJECT INFORMATION .....</b>                                          | <b>3</b>  |
| <b>2</b> | <b>SUMMARY OF TESTS.....</b>                                              | <b>4</b>  |
| <b>3</b> | <b>EUT DESCRIPTION .....</b>                                              | <b>6</b>  |
| 3.1      | GENERAL DESCRIPTION .....                                                 | 6         |
| 3.2      | EUT TEST CONFIGURATION .....                                              | 6         |
| 3.3      | TRANSMITTER DESCRIPTION.....                                              | 7         |
| <b>4</b> | <b>TESTS RESULTS .....</b>                                                | <b>8</b>  |
| 4.1      | FIELD STRENGTH OF FUNDAMENTAL ACCORDING TO § 15.249 (A), §15.209(A) ..... | 8         |
| 4.2      | FIELD STRENGTH OF HARMONICS ACCORDING TO § 15.249 (A) .....               | 10        |
| 4.3      | OUT OF BAND SPURIOUS EMISSIONS ACCORDING TO § 15.249 (d), §15.209 .....   | 11        |
| 4.4      | RECEIVER SPURIOUS EMISSIONS, ACCORDING TO §15.109 .....                   | 14        |
| 4.5      | UNINTENTIONAL RADIATED EMISSIONS TEST ACCORDING TO §15.109.....           | 15        |
|          | <b>APPENDIX A PLOTS.....</b>                                              | <b>17</b> |
|          | <b>APPENDIX B TEST SETUP PHOTOGRAPHS.....</b>                             | <b>35</b> |
|          | <b>APPENDIX C TEST EQUIPMENT USED FOR TESTS .....</b>                     | <b>39</b> |
|          | <b>APPENDIX D GENERAL INFORMATION.....</b>                                | <b>40</b> |
|          | TEST FACILITY DESCRIPTION .....                                           | 40        |
|          | ABBREVIATIONS AND ACRONYMS .....                                          | 40        |
|          | SPECIFICATION REFERENCES .....                                            | 40        |
|          | FCC EQUIPMENT CODES AND DESCRIPTIONS .....                                | 41        |
|          | <b>APPENDIX E TEST EQUIPMENT CORRECTION FACTORS .....</b>                 | <b>42</b> |



## 1 Project information

### Description of equipment under test

|                                 |                      |
|---------------------------------|----------------------|
| Test items                      | DataSeal transceiver |
| Manufacturer                    | Hi-G-Tek             |
| Type (Model)                    | IG-RS-40-916         |
| Equipment FCC code <sup>1</sup> | DSR                  |

### Applicant information

|                                |                              |
|--------------------------------|------------------------------|
| Applicant's responsible person | Mr. A Genin, project manager |
| Company                        | Hi-G-Tek                     |
| Address                        | 16 Haharoshet street,        |
| Postal code                    | 60375                        |
| City                           | Or-Yehuda                    |
| Country                        | Israel                       |
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### Test performance

|                     |                                                                            |
|---------------------|----------------------------------------------------------------------------|
| Project number:     | 14832                                                                      |
| Location            | Hermon Laboratories                                                        |
| Receipt date        | October 4, 2001                                                            |
| Test started        | October 4, 2001                                                            |
| Test completed      | February 26, 2002                                                          |
| Purpose of test     | Apparatus compliance verification in accordance with emission requirements |
| Test specifications | 47CFR Part 15, §15.249, 15.209, 15.205 and subpart B                       |

<sup>1</sup> FCC Equipment codes – see Appendix D



## 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, 15.209, 15.205 and subpart B.

| Parameter                                                                                                                                                                                                        |           | Subclause     | C | NC | NT | NA | Tested by                      | Date tested          | Remarks |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------------|---|----|----|----|--------------------------------|----------------------|---------|
| Transmitter characteristics, §15.249, 15.209                                                                                                                                                                     |           |               |   |    |    |    |                                |                      |         |
| Field strength of fundamental                                                                                                                                                                                    | 916.5 MHz | 15.249(a)     | C |    |    |    | Mrs. E. Pitt,<br>test engineer | February 26,<br>2002 |         |
|                                                                                                                                                                                                                  | 125 kHz   | 15.209(a)     | C |    |    |    |                                |                      |         |
| Field strength of harmonics for916.5 MHz fundamental                                                                                                                                                             |           | 15.249(a) (a) | C |    |    |    | Mrs. E. Pitt,<br>test engineer | February 26,<br>2002 |         |
| Out of band spurious emissions (radiated) for fundamental                                                                                                                                                        | 916.5 MHz | 15.249(c)     | C |    |    |    | Mrs. E. Pitt,<br>test engineer | February 26,<br>2002 |         |
|                                                                                                                                                                                                                  | 125 kHz   | 15.209(c)     | C |    |    |    |                                |                      |         |
| Unintentional radiation, §15.107, §15.109                                                                                                                                                                        |           |               |   |    |    |    |                                |                      |         |
| Conducted emissions                                                                                                                                                                                              |           | 15.107        |   |    |    | NA |                                |                      |         |
| Radiated emissions                                                                                                                                                                                               |           | 15.109        | C |    |    |    | Mrs. E. Pitt,<br>test engineer | February 26,<br>2002 |         |
| Receiver characteristics, §15.109                                                                                                                                                                                |           |               |   |    |    |    |                                |                      |         |
| Spurious radiated emissions                                                                                                                                                                                      |           | 15.109        | C |    |    |    | Mrs. E. Pitt,<br>test engineer | February 26,<br>2002 |         |
| 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. |           |               |   |    |    |    |                                |                      |         |



| Parameter                                                                                                                                                                                                                                                                                                                                              | Subclause      | C | NC | NT | NA | Remarks |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---|----|----|----|---------|
| <b>General conditions under Part 15</b>                                                                                                                                                                                                                                                                                                                |                |   |    |    |    |         |
| The Intentional radiator operates at 125 kHz and 916.5 MHz.                                                                                                                                                                                                                                                                                            | 15.209, 15.249 | C |    |    |    |         |
| The intentional radiator does not operate in the restricted bands of operation.                                                                                                                                                                                                                                                                        | 15.205         | 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 |         |
| No antenna other than that furnished by the responsible party can be used with the device.                                                                                                                                                                                                                                                             | 15.203         |   |    |    | NA |         |
| 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:** Ms. N. Averin, certification engineer

Mr. M. Nikishin, EMC group leader

**Test report approved by:** Mr. A. Usoskin, QA manager



### 3 EUT description

#### 3.1 General description

The EUT, DataSeal, model IG-RS-40-916, is a transceiver intended for automatic processing of secured cargoes and real time monitoring of cargoes in transit and in storage. The device includes a transmitter/receiver unit, a real-time clock, a processor, a memory and sensing circuitry for sealing verification. The sealing wire prevents any attempt of opening, bypassing or tampering with the seal without alerting the system and recording of the event. The DataSeal is capable of communicating its ID and status to 30 m distance. It transmits the information in reply to an interrogation by the DataReader. The DataSeal is a stand-alone unit, it has two RF channels, high frequency and low frequency. The device operates at 916.5 MHz and at 125 kHz.

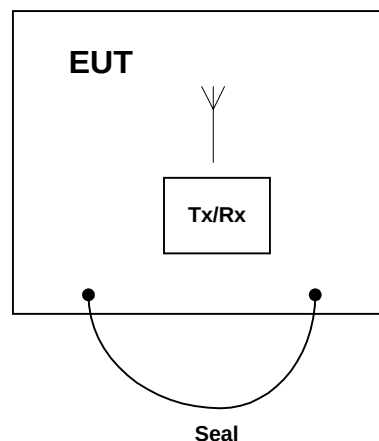
The EUT is powered from 3.6 V lithium battery.

Local oscillator frequencies are: 8 MHz and 28 MHz.

#### 3.2 EUT test configuration

The EUT test configuration is shown in Figure 3.2.1.

Figure 3.2.1 EUT test configuration





### 3.3 Transmitter description

|                                                                         |                                                                                                          |                                     |                         |                                    |                            |                     |                                     |     |                          |    |
|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-------------------------------------|-------------------------|------------------------------------|----------------------------|---------------------|-------------------------------------|-----|--------------------------|----|
| <b>Type of equipment</b>                                                |                                                                                                          |                                     |                         |                                    |                            |                     |                                     |     |                          |    |
| <input checked="" type="checkbox"/>                                     | Stand-alone (Equipment with or without its own control provisions)                                       |                                     |                         |                                    |                            |                     |                                     |     |                          |    |
| <input type="checkbox"/>                                                | Combined equipment (Equipment where the radio part is fully integrated within another type of equipment) |                                     |                         |                                    |                            |                     |                                     |     |                          |    |
| <input type="checkbox"/>                                                | Plug-in card (Equipment intended for a variety of host systems)                                          |                                     |                         |                                    |                            |                     |                                     |     |                          |    |
| <input type="checkbox"/>                                                | Other:                                                                                                   |                                     |                         |                                    |                            |                     |                                     |     |                          |    |
| <b>Operating frequency</b>                                              |                                                                                                          |                                     |                         |                                    | A: 916.5 MHz<br>B: 125 kHz |                     |                                     |     |                          |    |
| <b>Transmitter aggregate data rate</b> (bits per second)                |                                                                                                          |                                     |                         |                                    |                            |                     | A: 15625<br>B: 4000                 |     |                          |    |
| <b>Normal test signal</b>                                               |                                                                                                          |                                     |                         |                                    |                            |                     | Transmit carrier & transmit message |     |                          |    |
| <b>Maximum rated output power</b>                                       |                                                                                                          |                                     |                         |                                    |                            |                     |                                     |     |                          |    |
| At transmitter permanent external 50 $\Omega$ rf output connector (dBm) |                                                                                                          |                                     |                         |                                    |                            |                     |                                     |     |                          |    |
| Effective radiated power (for equipment with integral antenna) (dBm)    |                                                                                                          |                                     |                         |                                    | A: -7<br>B: -25            |                     |                                     |     |                          |    |
| Is transmitter output power variable?                                   |                                                                                                          | <input checked="" type="checkbox"/> | No                      |                                    |                            |                     |                                     |     |                          |    |
|                                                                         |                                                                                                          | <input type="checkbox"/>            | Yes                     |                                    |                            |                     |                                     |     |                          |    |
|                                                                         |                                                                                                          |                                     |                         |                                    | continuous variable        |                     |                                     |     |                          |    |
|                                                                         |                                                                                                          |                                     |                         |                                    | stepped variable           |                     |                                     |     |                          |    |
|                                                                         |                                                                                                          |                                     |                         |                                    | stepsize (dB):             |                     |                                     |     |                          |    |
|                                                                         |                                                                                                          |                                     | minimum RF power (dBm): |                                    |                            |                     |                                     |     |                          |    |
|                                                                         |                                                                                                          |                                     | maximum RF power (dBm): |                                    |                            |                     |                                     |     |                          |    |
| <b>Transmitter power source</b>                                         |                                                                                                          |                                     |                         |                                    |                            |                     |                                     |     |                          |    |
| <input checked="" type="checkbox"/>                                     | <b>Battery</b>                                                                                           |                                     |                         | <b>Nominal rated voltage (VDC)</b> |                            |                     | 3.6                                 |     |                          |    |
|                                                                         | Nickel Cadmium                                                                                           |                                     |                         |                                    |                            |                     |                                     |     |                          |    |
| <input checked="" type="checkbox"/>                                     | Lithium                                                                                                  |                                     |                         |                                    |                            |                     |                                     |     |                          |    |
|                                                                         | Other                                                                                                    |                                     |                         |                                    |                            |                     |                                     |     |                          |    |
|                                                                         | <b>DC</b>                                                                                                |                                     |                         | <b>Nominal rated voltage (VDC)</b> |                            |                     |                                     |     |                          |    |
|                                                                         | <b>AC mains</b>                                                                                          |                                     |                         | <b>Nominal rated voltage (VAC)</b> |                            |                     |                                     |     |                          |    |
| Is there common power source for transmitter and receiver               |                                                                                                          |                                     |                         |                                    |                            |                     | <input checked="" type="checkbox"/> | yes | <input type="checkbox"/> | no |
| <b>Antenna technical characteristics</b>                                |                                                                                                          |                                     |                         |                                    |                            |                     |                                     |     |                          |    |
|                                                                         |                                                                                                          |                                     |                         | <b>Type</b>                        | <b>Manufacturer</b>        | <b>Model number</b> | <b>Gain</b>                         |     |                          |    |
| Integral                                                                | <input type="checkbox"/>                                                                                 | with temporary RF connector         |                         |                                    |                            |                     |                                     |     |                          |    |
|                                                                         | <input checked="" type="checkbox"/>                                                                      | without temporary RF connector      |                         | A: Path<br>B: Ferrite              | HI-G-TEK                   | SA47062<br>FR0640A1 | -5dBi<br>NA                         |     |                          |    |
| External                                                                |                                                                                                          |                                     |                         |                                    |                            |                     |                                     |     |                          |    |
| <b>External antenna connection</b>                                      |                                                                                                          |                                     |                         |                                    |                            |                     |                                     |     |                          |    |
|                                                                         |                                                                                                          |                                     |                         |                                    |                            |                     |                                     |     |                          |    |



## 4 Tests results

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

METHOD OF MEASUREMENTS: ANSI 63.4 §13.1.4  
DATE: February 26, 2002  
RELATIVE HUMIDITY: 43 %  
AMBIENT TEMPERATURE: 22 °C  
TEST PERFORMED IN: ANECHOIC CHAMBER  
DISTANCE BETWEEN ANTENNA AND EUT: 3 m  
ANTENNA TYPE: BICONILOG

#### Peak detector

| Carrier frequency, MHz      | Field strength, dB(μV/m) | Specification limit, dB(μV/m) | Margin, dB | Reference to Plots in Appendix A |
|-----------------------------|--------------------------|-------------------------------|------------|----------------------------------|
| 916.5                       | 87.70                    | 94                            | 6.30       | A1                               |
| Measurement uncertainty, dB |                          | +5.73 / -5.57                 |            |                                  |

#### TEST EQUIPMENT USED:

|         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|
| HL 0465 | HL 0521 | HL 0589 | HL 0593 | HL 0594 | HL 0604 | HL 1004 | HL 2009 |
|---------|---------|---------|---------|---------|---------|---------|---------|

#### 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                                  |

For frequencies above 1000 MHz, the above field strength limits are based on average limits.

#### TEST PROCEDURE

The EUT was tested, being placed on a wooden 80 cm height table in each of three orthogonal planes in turn.

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.



METHOD OF MEASUREMENTS: ANSI 63.4 §13.1.4  
DATE: February 26, 2002  
RELATIVE HUMIDITY: 43 %  
AMBIENT TEMPERATURE: 22 °C  
TEST PERFORMED IN: ANECHOIC CHAMBER  
DISTANCE BETWEEN ANTENNA AND EUT: 3 m  
ANTENNA TYPE: LOOP

**Peak detector**

| Carrier frequency, kHz      | Field strength, dB(μV/m) | Limit*, dB(μV/m) | Margin, dB | Reference to Plots in Appendix A |
|-----------------------------|--------------------------|------------------|------------|----------------------------------|
| 126.0                       | 69.36                    | 105.6            | 36.24      | A2                               |
| Measurement uncertainty, dB |                          | ±4               |            |                                  |

\* The limit is based on measurements employing an average detector according to §15.209(d).

**TEST EQUIPMENT USED:**

|         |         |         |         |         |         |  |
|---------|---------|---------|---------|---------|---------|--|
| HL 0446 | HL 0465 | HL 0521 | HL 0589 | HL 1004 | HL 2009 |  |
|---------|---------|---------|---------|---------|---------|--|

**LIMIT**

| Frequency, MHz | Limit dB(μV/m) | Measurement distance, m |
|----------------|----------------|-------------------------|
| 0.009 – 0.490  | 67.60-20logF*  | 300**                   |
| 0.490 – 1.705  | 87.60-20logF*  | 30**                    |
| 1.705 - 30     | 29.5           | 30**                    |
| 30 - 88        | 40.0           | 3                       |
| 88 - 216       | 43.5           | 3                       |
| 216 - 960      | 46.0           | 3                       |
| Above 960*     | 54.0           | 3                       |

\* F is frequency in kHz.

\*\*The limit for 3 m distance was calculated using the inverse square distance extrapolation factor as follows:

$\text{Lim}S_2 = \text{Lim} S_1 + 40 \log (S_1/S_2)$ , where  $S_1 = 300 \text{ m}$  or  $30 \text{ m}$ ,  $S_2 = 3 \text{ m}$ .

**TEST PROCEDURE**

The EUT was tested, being placed on a wooden 80 cm height table in each of three orthogonal planes in turn.

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.



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

METHOD OF MEASUREMENTS: ANSI 63.4 §13.1.4  
DATE: February 26, 2002  
RELATIVE HUMIDITY: 43 %  
AMBIENT TEMPERATURE: 22 °C  
CARRIER FREQUENCY: 916.5 MHz  
TEST PERFORMED IN: ANECHOIC CHAMBER  
DISTANCE BETWEEN ANTENNA AND EUT: 3 m  
ANTENNA TYPE: DOUBLE RIDGED GUIDE

### Peak detector

| Harmonic, MHz               | Field strength, dB(μV/m) | Average limit, dB(μV/m) | Margin, dB | Reference to Plots in Appendix A |
|-----------------------------|--------------------------|-------------------------|------------|----------------------------------|
| 1833                        | 52.0                     | 54                      | 2.0        | A3, A4                           |
| 2750                        | 53.0                     | 54                      | 1.0        | A5                               |
| Measurement uncertainty, dB |                          | ± 2.36                  |            |                                  |

### TEST EQUIPMENT USED:

|         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|
| HL 0041 | HL 0465 | HL 0521 | HL 0589 | HL 0593 | HL 0594 | HL 1947 |
|---------|---------|---------|---------|---------|---------|---------|

### 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 tested, being placed on a wooden 80 cm height table in each of three orthogonal planes in turn.

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.



### 4.3 Out of band spurious emissions according to § 15.249 (d), §15.209

METHOD OF MEASUREMENTS: ANSI 63.4 §13.1.4/ §13.1.5  
EQUIPMENT UNDER TEST: DataSeal  
MODE OF OPERATION: Tx + Rx  
DATE: February 26, 2002  
RELATIVE HUMIDITY: 43 %  
AMBIENT TEMPERATURE: 22 °C  
TEST DISTANCE: 3 m  
CARRIER FREQUENCY: 916.5 MHz  
FIELD STRENGTH LEVEL AT WHICH THE MEASUREMENT HAS BEEN PERFORMED: 87.7 dB(μV/m)  
FREQUENCY RANGE: 9 kHz – 9.5 GHz

TEST PERFORMED IN: ANECHOIC CHAMBER  
FREQUENCY RANGE: 9 kHz – 30 MHz  
ANTENNA TYPE: LOOP

#### Peak detector

| Frequency,<br>MHz           | Radiated<br>emission,<br>dB (μV/m) | Limit<br>(50 dB below carrier),<br>dB(μV/m) | Margin,<br>dB | Reference<br>to Plots<br>in Appendix A |
|-----------------------------|------------------------------------|---------------------------------------------|---------------|----------------------------------------|
| 0.009 – 0.15                | No spurious emissions were found   |                                             |               | A6                                     |
| 0.15 - 30                   | No spurious emissions were found   |                                             |               | A7                                     |
| Measurement uncertainty, dB | ±4                                 |                                             |               |                                        |

TEST PERFORMED IN: ANECHOIC CHAMBER  
FREQUENCY RANGE: 30 MHz – 2 GHz

#### Quasi-peak detector

| Frequency,<br>MHz           | Antenna<br>polarization | Turntable<br>position,<br>(°) | Radiated<br>emission,<br>dB (μV/m) | Limit,<br>dB(μV/m) | Margin,<br>dB | Reference<br>to Plots<br>in Appendix A |
|-----------------------------|-------------------------|-------------------------------|------------------------------------|--------------------|---------------|----------------------------------------|
| 285.4                       | V                       | 0                             | 29.35                              | 46.00              | 16.65         | A8                                     |
| 630.1                       | V                       | 0                             | 38.73                              | 46.00              | 7.27          | A8, A9                                 |
| 902.5                       | H                       | 0.8                           | 41.90                              | 46.00              | 4.10          | A8, A10                                |
| 928.1                       | H                       | 0.8                           | 40.10                              | 46.00              | 5.90          | A11, A12                               |
| Measurement uncertainty, dB | +5.73 / -5.57           |                               |                                    |                    |               |                                        |

#### Average detector

| Frequency,<br>MHz           | Antenna<br>polarization | Turntable<br>position,<br>(°) | Radiated<br>emission,<br>dB (μV/m) | Limit,<br>dB(μV/m) | Margin,<br>dB | Reference<br>to Plots<br>in Appendix A |
|-----------------------------|-------------------------|-------------------------------|------------------------------------|--------------------|---------------|----------------------------------------|
| 1200.9                      | H                       | 0                             | 40.80                              | 54.00              | 13.20         | A12                                    |
| 1833                        | V                       | 0                             | 52.00                              | 54.00              | 2.00          | A12                                    |
| Measurement uncertainty, dB | +5.73 / -5.57           |                               |                                    |                    |               |                                        |

The test results recorded in the tables were obtained throughout the testing with biconilog antenna at 2.06 m height.

#### Table abbreviations:

Antenna polarization: V = vertical, H = horizontal

Turntable position: 0° = EUT front panel faces the receiving antenna

Margin = dB below (negative if above) specification limit.



TEST PERFORMED IN: ANECHOIC CHAMBER  
FREQUENCY RANGE: 2 – 9.5 GHz  
ANTENNA TYPE: DOUBLE RIDGED GUIDE

**Peak detector**

| Frequency,<br>MHz           | Antenna<br>polarization | Radiated<br>emission,<br>dB (μV/m)                | Limit,<br>dB(μV/m) | Margin,<br>dB | Reference to Plots<br>in Appendix A |
|-----------------------------|-------------------------|---------------------------------------------------|--------------------|---------------|-------------------------------------|
| 2000 – 4000                 | V+H                     | No spurious emissions were found except harmonics |                    |               | A13                                 |
| 4000 – 6500                 | V+H                     | No spurious emissions were found except harmonics |                    |               | A14                                 |
| 6000 – 9500                 | V+H                     | No spurious emissions were found except harmonics |                    |               | A15                                 |
| Measurement uncertainty, dB |                         | ± 2.36                                            |                    |               |                                     |

**Table abbreviations:**

Antenna polarization: V = vertical, H = horizontal

**LIMIT**

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.

**TEST EQUIPMENT USED:**

|         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|
| HL 0041 | HL 0465 | HL 0521 | HL 0589 | HL 0593 | HL 0594 | HL 0604 |
| HL 1004 | HL 1424 | HL 1566 | HL 1863 | HL 1864 | HL 1947 | HL 2009 |

**TEST PROCEDURE**

The EUT was tested, being placed on a wooden 80 cm height table in each of three orthogonal planes in turn.

**9 kHz – 30 MHz frequency range.** 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.** 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.



METHOD OF MEASUREMENTS: ANSI 63.4 §13.1.4/ §13.1.5  
EQUIPMENT UNDER TEST: DataSeal  
MODE OF OPERATION: Tx + Rx  
DATE: February 26, 2002  
RELATIVE HUMIDITY: 43 %  
AMBIENT TEMPERATURE: 22 °C  
TEST DISTANCE: 3 m  
CARRIER FREQUENCY: 125 kHz  
FIELD STRENGTH LEVEL AT WHICH THE  
MEASUREMENT HAS BEEN PERFORMED: 69.36 dB(μV/m)  
FREQUENCY RANGE: 9 kHz – 30 MHz  
  
TEST PERFORMED IN: ANECHOIC CHAMBER  
FREQUENCY RANGE: 9 kHz – 30 MHz  
ANTENNA TYPE: LOOP

**Peak detector**

| Frequency,<br>MHz           | Radiated<br>emission,<br>dB (μV/m) | Limit,<br>dB(μV/m) | Margin,<br>dB | Reference<br>to Plots<br>in Appendix A |
|-----------------------------|------------------------------------|--------------------|---------------|----------------------------------------|
| 0.009 – 0.15                | No spurious emissions were found   |                    |               | A16                                    |
| 0.15 - 30                   | No spurious emissions were found   |                    |               | A17                                    |
| Measurement uncertainty, dB | ±4                                 |                    |               |                                        |

**LIMIT**

Radiated emissions must comply with §15.209(a) limits.

**TEST EQUIPMENT USED:**

|         |         |         |         |         |         |  |
|---------|---------|---------|---------|---------|---------|--|
| HL 0446 | HL 0465 | HL 0521 | HL 0589 | HL 1004 | HL 2009 |  |
|---------|---------|---------|---------|---------|---------|--|

**TEST PROCEDURE**

The EUT was tested, being placed on a wooden 80 cm height table in each of three orthogonal planes in turn.

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.



#### 4.4 Receiver spurious emissions, according to §15.109

METHOD OF MEASUREMENT: ANSI 63.4 §11.6 / ANSI 63.4 §12.1.4  
TEST PERFORMED IN: ANECHOIC CHAMBER  
MODE OF OPERATION: Rx  
DATE: February 26, 2002  
RELATIVE HUMIDITY: 43 %  
AMBIENT TEMPERATURE: 22 °C  
DISTANCE BETWEEN ANTENNA AND EUT: 3 m  
THE EUT WAS TESTED AS: TABLE-TOP  
  
RECEIVER OPERATING FREQUENCY: 916.5 MHz  
FREQUENCY RANGE: 30 MHz – 5 GHz

| 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                                                              | 5 <sup>th</sup> harmonic of the highest frequency or 40 GHz, whichever is lower |

##### 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                               |

The EUT was tested in Tx + Rx mode. The limits of § 15.209 were used. For test results refer to Paragraph 4.3 of the test report and Plots A8 to A12.

RECEIVER OPERATING FREQUENCY: 125 kHz  
FREQUENCY RANGE: 9 kHz – 30 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                                                              | 5 <sup>th</sup> harmonic of the highest frequency or 40 GHz, whichever is lower |

The EUT was tested in Tx + Rx mode. The limits of § 15.209 were used. For test results refer to Paragraph 4.3 of the test report and Plots A16, A17.

##### TEST PROCEDURE

The EUT was tested, being placed on a wooden 80 cm height table.

**9 kHz – 30 MHz frequency range.** 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.** 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.



## 4.5 Unintentional radiated emissions test according to §15.109

METHOD OF MEASUREMENT: ANSI 63.4 §11.6 / ANSI 63.4 §12.1.4  
TEST PERFORMED IN: ANECHOIC CHAMBER  
DATE: February 26, 2002  
RELATIVE HUMIDITY: 43 %  
AMBIENT TEMPERATURE: 22 °C  
DISTANCE BETWEEN ANTENNA AND EUT: 3 m  
THE EUT WAS TESTED AS: TABLE-TOP  
FREQUENCY RANGE: 30 MHz – 5 GHz

|  | 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                                                              | 5 <sup>th</sup> harmonic of the highest frequency or 40 GHz, whichever is lower |

### 30 – 1000 MHz frequency range

DETECTOR TYPE: PEAK  
RESOLUTION BANDWIDTH: 120 kHz

All the measured emissions were found more than 20 dB below specification limit, refer to Plot A18.

### TEST EQUIPMENT USED:

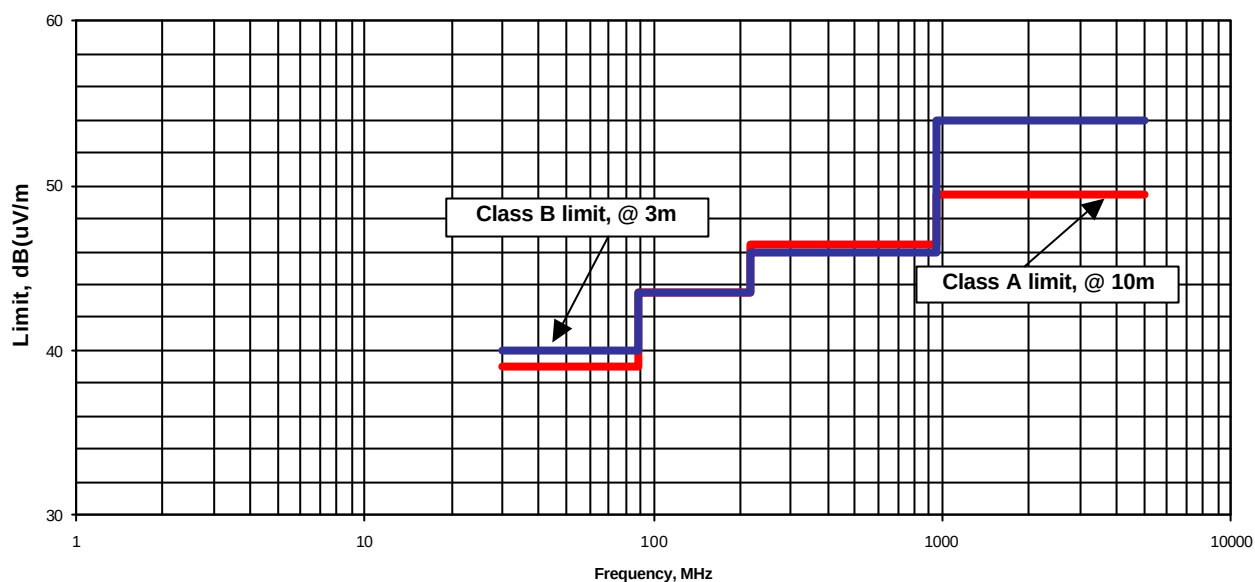
|         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|
| HL 0041 | HL 0465 | HL 0521 | HL 0589 | HL 0593 | HL 0594 | HL 0604 |
| HL 1004 | HL 1947 | HL 2009 |         |         |         |         |

### LIMIT (§ 15.109)

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



Unintentional radiated emissions test according to § 15.109.



TEST PROCEDURE

The EUT was tested, being placed on a wooden 80 cm height table.

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.



## Appendix A Plots

**Plot A1**  
**916.5 MHz carrier field strength**

11:57:46 FEB 26, 2002

ACTV DET: PEAK  
MEAS DET: PEAK OP AVG  
MKR 916.56 MHz  
87.70 dB $\mu$ V/m

MEASURE  
AT MKR

ADD TO  
LIST

MARKER  
↓ CF

MARKER  
△

NEXT  
PEAK

NEXT PK  
RIGHT

NEXT PK  
LEFT

LOG REF 90.0 dB $\mu$ V/m

10  
dB/  
ATN  
10 dB

UA SB  
SC FC  
ACORR

START 902.00 MHz

RL #1F BW 120 kHz

#AVG BW 300 kHz

STOP 928.00 MHz

SWP 24.4 msec

More

1 of 2



Plot A2  
125 kHz carrier field strength

14:26:25 FEB 26, 2002

ACTV DET: PEAK  
MEAS DET: PEAK OP AVG  
MKR 125.0 kHz  
69.36 dB $\mu$ V/m

MEASURE  
AT MKR

ADD TO  
LIST

LOG REF 110.0 dB $\mu$ V/m

10  
dB/  
ATN  
30 dB

MA SB  
SC FC  
ACORR

CENTER 125.0 kHz  
RL #1F BW 9.0 kHz

AVC BW 30 kHz

SPAN 100.0 kHz  
SWP 50.0 msec

MARKER  
↓ CF

MARKER  
△

NEXT  
PEAK

NEXT PK  
RIGHT

NEXT PK  
LEFT

More  
1 of 2



**Plot A3**  
**The 2<sup>nd</sup> harmonic of 916.5 MHz carrier field strength,**  
**1 MHz resolution bandwidth**

10:03:51 FEB 26, 2002

FREQ 1.833 GHz  
PEAK 57.1 dB $\mu$ V/m  
QP 53.4 dB $\mu$ V/m  
AVG 52.0 dB $\mu$ V/m

MEASURE  
AT MKR

ADD TO  
LIST

LOG REF 68.0 dB $\mu$ V/m

PREAMP ON

CLEAR  
WRITE A

10  
dB/  
#ATN  
0 dB

MAX  
HOLD A

VA SB  
SC FC  
ACORR

VIEW A

BLANK A

Trace  
A B C

CENTER 1.833030 GHz

SPAN 2.000 MHz

RL #JF BW 1.0 MHz

#AVG BW 1 MHz

SWP 20.0 msec

More  
1 of 3



**Plot A4**  
**The 2<sup>nd</sup> harmonic of 916.5 MHz carrier field strength,**  
**120 kHz resolution bandwidth**

10:06:03 FEB 26, 2002

FREQ 1.833 GHz  
PEAK 54.8 dB $\mu$ V/m  
QP 52.8 dB $\mu$ V/m  
AVG 51.9 dB $\mu$ V/m

MEASURE  
AT MKR

ADD TO  
LIST

LOG REF 68.0 dB $\mu$ V/m

PREAMP ON

CLEAR  
WRITE A

10  
dB/  
#ATN  
0 dB

MAX  
HOLD A

VA SB  
SC FC  
ACORR

VIEW A

BLANK A

Trace  
A B C

CENTER 1.833030 GHz

SPAN 2.000 MHz

RL #JF BW 120 kHz

#AVG BW 300 kHz

SWP 20.0 msec

More  
1 of 3



**Plot A5**  
**The 3<sup>rd</sup> harmonic of 916.5 MHz carrier field strength**

12:24:47 FEB 26, 2002

FREQ 2.750 GHz  
PEAK 56.6 dB $\mu$ V/m  
QP 53.6 dB $\mu$ V/m  
AVG 53.0 dB $\mu$ V/m

MEASURE  
AT MKR

ADD TO  
LIST

CLEAR  
WRITE A

MAX  
HOLD A

VIEW A

BLANK A

Trace  
A B C

More  
1 of 3

LOG REF 60.0 dB $\mu$ V/m

PREAMP ON

10  
dB/  
#ATTN  
0 dB

VA SB  
SC FC  
ACORR

CENTER 2.74957 GHz

RL #JF BW 1.0 MHz

#AVG BW 1 MHz

SPAN 20.10 MHz

SWP 20.0 msec



**Plot A6**  
**Out of band spurious emissions test results**

EUT OPERATING FREQUENCY: 916.5 MHz  
FREQUENCY RANGE: 9 – 150 kHz

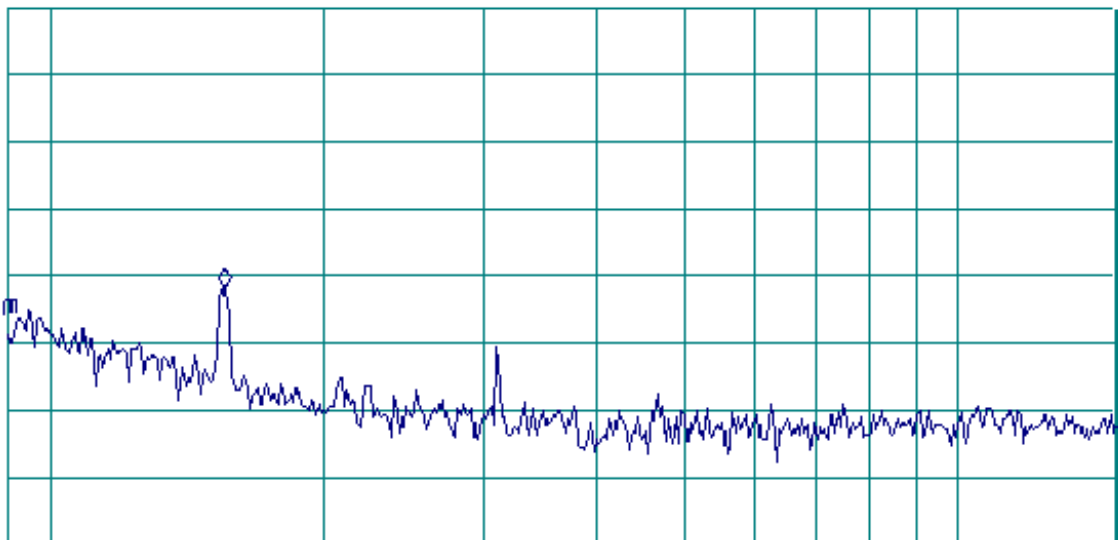


ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 15.7 kHz  
8.11 dB $\mu$ V/m

LOG REF 50.0 dB $\mu$ V/m

10  
dB/  
#ATN  
0 dB

DL  
44.0  
dB $\mu$ V/m  
UA SB  
SC FC  
ACORR



START 9.0 kHz

RL IF BW 200 Hz

AVG BW 300 Hz

STOP 150.0 kHz

SWP 10.3 sec



**Plot A7**  
**Out of band spurious emissions test results**

EUT OPERATING FREQUENCY: 916.5 MHz  
FREQUENCY RANGE: 0.15 – 30 MHz

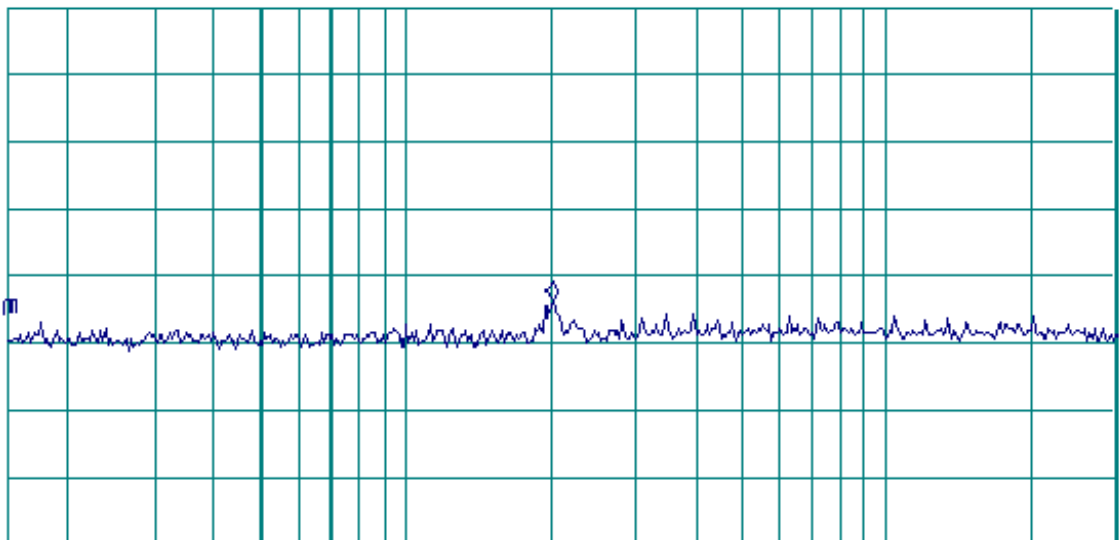


ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 2.00 MHz  
6.33 dB $\mu$ V/m

LOG REF 50.0 dB $\mu$ V/m

10  
dB/  
#ATTN  
0 dB

DL  
44.0  
dB $\mu$ V/m  
UA SB  
SC FC  
ACORR



START 150 kHz

STOP 30.00 MHz

RL IF BW 9.0 kHz

AVG BW 30 kHz

SWP 2.49 sec



**Plot A8**  
**Out of band spurious emissions test results**

EUT OPERATING FREQUENCY: 916.5 MHz  
FREQUENCY RANGE: 30 – 902 MHz

11:21:45 FEB 26, 2002

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 631.7 MHz  
43.95 dB $\mu$ V/m

MEASURE  
AT MKR

ADD TO  
LIST

MARKER  
↓ CF

MARKER  
△

NEXT  
PEAK

NEXT PK  
RIGHT

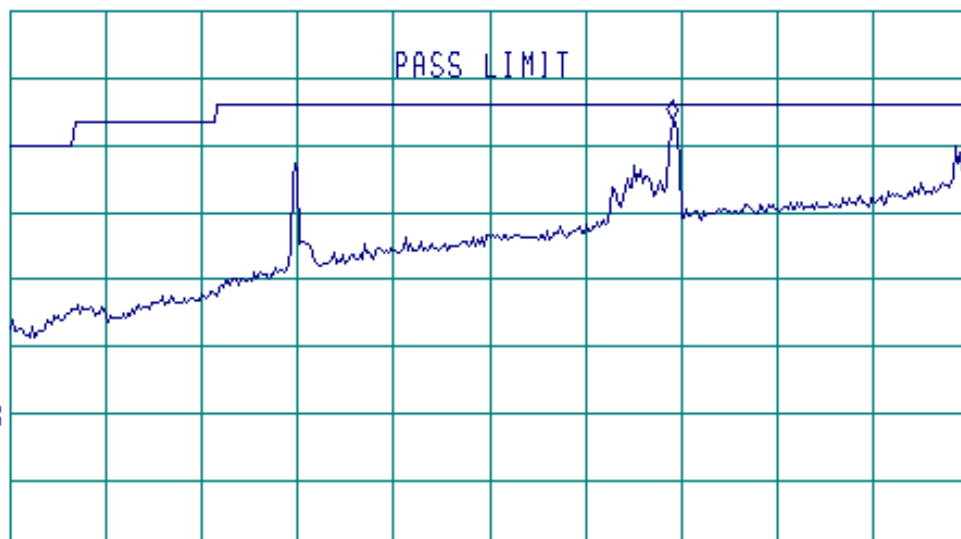
NEXT PK  
LEFT

More  
1 of 2

LOG REF 60.0 dB $\mu$ V/m

10  
dB/  
#ATN  
0 dB

VA SB  
SC FC  
ACORR



START 30.0 MHz

RL #1F BW 120 kHz

#AVG BW 300 kHz

STOP 902.0 MHz

SWP 818 msec



**Plot A9**  
**Out of band spurious emissions test results**

EUT OPERATING FREQUENCY: 916.5 MHz  
CENTER FREQUENCY: 629.5 MHz

11:16:13 FEB 26, 2002

SPAN  
100.0 MHz

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 629.5 MHz  
42.10 dB $\mu$ V/m

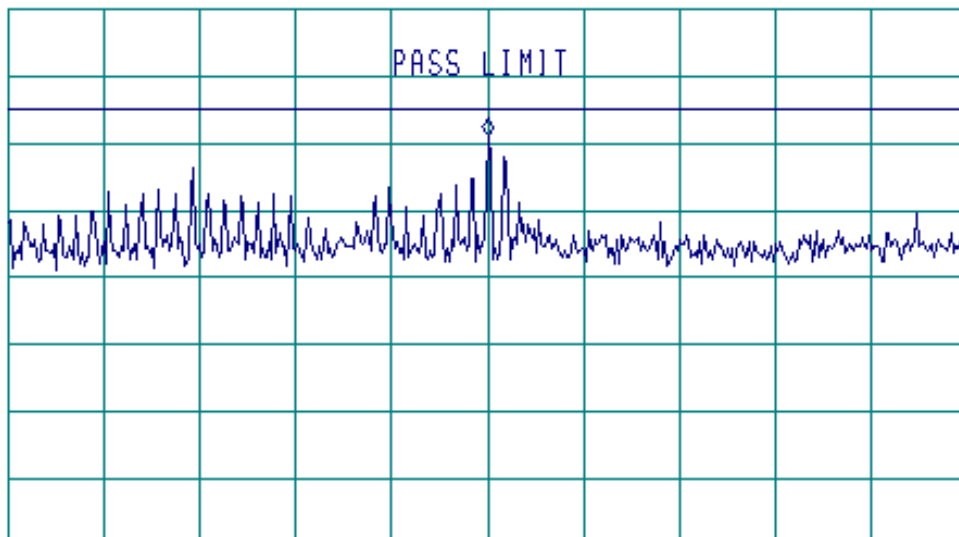
MEASURE  
AT MKR

ADD TO  
LIST

LOG REF 61.0 dB $\mu$ V/m

10  
dB/  
#ATN  
0 dB

VA SB  
SC FC  
ACORR



CENTER 629.5 MHz

RL #1F BW 120 kHz

#AVG BW 300 kHz

SPAN 100.0 MHz

SWP 93.8 msec

MARKER  
↓ CF

MARKER  
△

NEXT  
PEAK

NEXT PK  
RIGHT

NEXT PK  
LEFT

More  
1 of 2



**Plot A10**  
**Out of band spurious emissions test results**  
**902.5 MHz center frequency**

EUT OPERATING FREQUENCY: 916.5 MHz  
FREQUENCY RANGE: 880 – 950 MHz

11:04:43 FEB 26, 2002

FREQ 902.5 MHz  
PEAK 47.7 dB $\mu$ V/m  
QP 41.9 dB $\mu$ V/m  
AVG 34.3 dB $\mu$ V/m

MEASURE  
AT MKR

ADD TO  
LIST

MARKER  
NORMAL

MARKER  
 $\Delta$

MARKER  
AMPTD

SELECT  
1 2 3 4

MARKER 1  
ON OFF

LOG REF 89.0 dB $\mu$ V/m

10  
dB/  
ATN  
10 dB

UA SB  
SC FC  
ACORR

START 880.00 MHz

RL #1F BW 120 kHz

#AVG BW 300 kHz

STOP 950.00 MHz

SWP 65.6 msec

More

1 of 2



**Plot A11**  
**Out of band spurious emissions test results**  
**928.1 MHz center frequency**

EUT OPERATING FREQUENCY: 916.5 MHz  
FREQUENCY RANGE: 880 – 950 MHz

11:06:35 FEB 26, 2002

FREQ 928.1 MHz  
PEAK 46.1 dB $\mu$ V/m  
QP 40.1 dB $\mu$ V/m  
AVG 33.1 dB $\mu$ V/m

MEASURE  
AT MKR

ADD TO  
LIST

MARKER  
NORMAL

MARKER  
 $\Delta$

MARKER  
AMPTD

SELECT  
1 2 3 4

MARKER 1  
ON OFF

LOG REF 89.0 dB $\mu$ V/m

10  
dB/  
ATN  
10 dB

UA SB  
SC FC  
ACORR

START 880.00 MHz

RL #1F BW 120 kHz

#AVG BW 300 kHz

STOP 950.00 MHz

SWP 65.6 msec

More

1 of 2



**Plot A12**  
**Out of band spurious emissions test results**

EUT OPERATING FREQUENCY: 916.5 MHz  
FREQUENCY RANGE: 928 – 2000 MHz

11:41:36 FEB 26, 2002

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 1.834 GHz  
49.51 dB $\mu$ V/m

MEASURE  
AT MKR

ADD TO  
LIST

MARKER  
↓ CF

MARKER  
△

NEXT  
PEAK

NEXT PK  
RIGHT

NEXT PK  
LEFT

LOG REF 70.0 dB $\mu$ V/m

10  
dB/  
#ATN  
0 dB

VA SB  
SC FC  
ACORR

START 928 MHz

RL #1F BW 120 kHz

#AVG BW 300 kHz

STOP 2.000 GHz

SWP 1.01 sec

More

1 of 2



**Plot A13**  
**Out of band spurious emissions test results**

EUT OPERATING FREQUENCY: 916.5 MHz  
FREQUENCY RANGE: 2000 – 4000 MHz

12:29:26 FEB 26, 2002

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 2.751 GHz  
53.53 dB $\mu$ V/m

MEASURE  
AT MKR

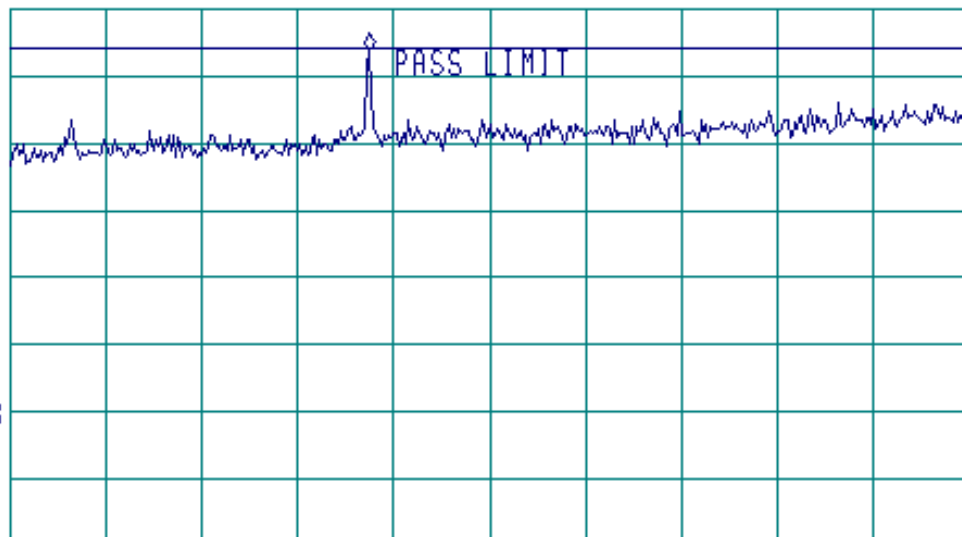
ADD TO  
LIST

LOG REF 60.0 dB $\mu$ V/m

PREAMP ON

MARKER  
↓ CF

10  
dB/  
#ATN  
0 dB



MARKER  
△

NEXT  
PEAK

NEXT PK  
RIGHT

NEXT PK  
LEFT

START 2.000 GHz

STOP 4.000 GHz

More

RL #1F BW 1.0 MHz

#AVG BW 1 MHz

SWP 41.6 msec

1 of 2



**Plot A14**  
**Out of band spurious emissions test results**

EUT OPERATING FREQUENCY: 916.5 MHz  
FREQUENCY RANGE: 4000 – 6500 MHz

13:34:51 FEB 26, 2002

ACTV DET: SMPL  
MEAS DET: PEAK OP AVG  
MKR 6.313 GHz  
43.05 dB $\mu$ V/m

MEASURE  
AT MKR

ADD TO  
LIST

LOG REF 70.0 dB $\mu$ V/m

PREAMP ON

10  
dB/  
#ATN  
0 dB  
AVG  
100

VA SB  
SC FC  
ACORR

START 4.000 GHz

RL #1F BW 1.0 MHz

#AVG BW 1 MHz

STOP 6.500 GHz

SWP 50.0 msec

MARKER  
↓ CF

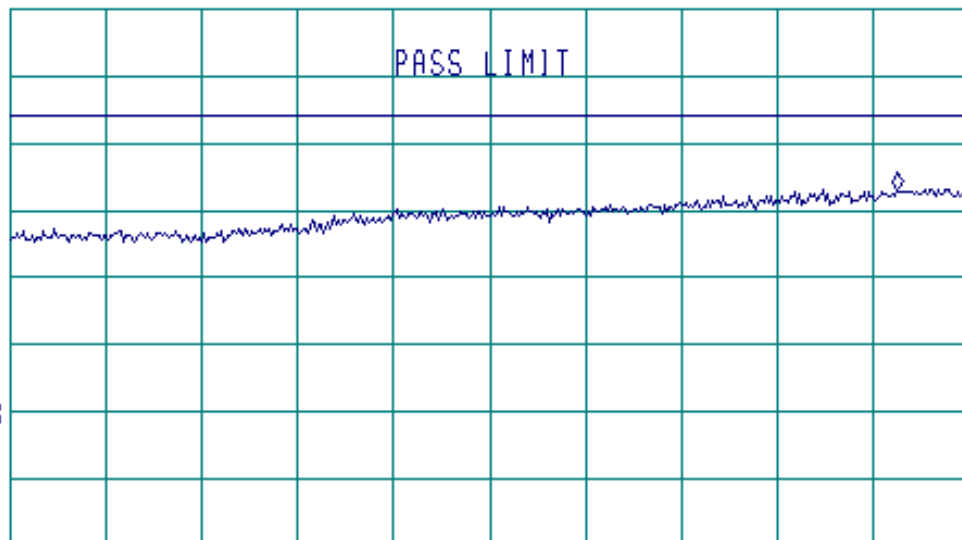
MARKER  
△

NEXT  
PEAK

NEXT PK  
RIGHT

NEXT PK  
LEFT

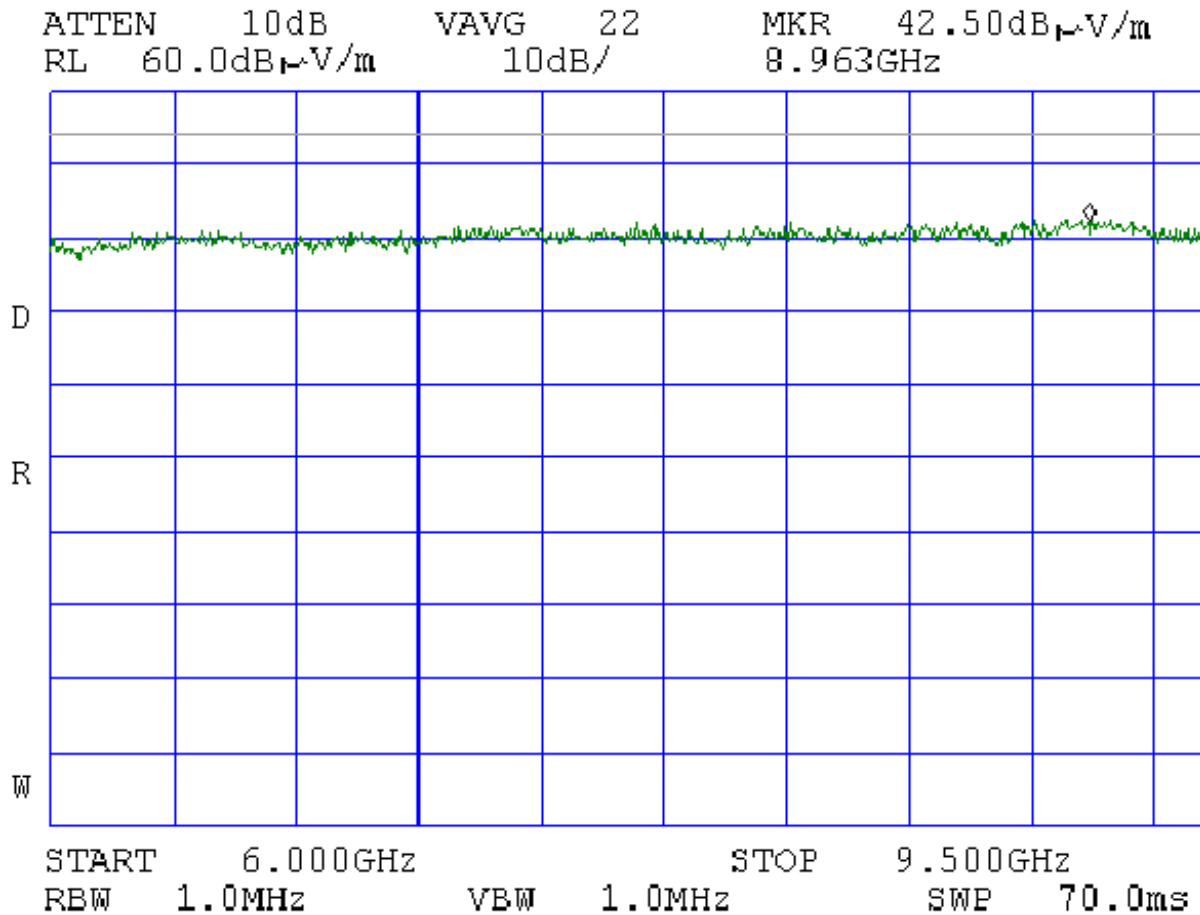
More  
1 of 2





**Plot A15**  
**Out of band spurious emissions test results**

EUT OPERATING FREQUENCY: 916.5 MHz  
FREQUENCY RANGE: 6000 – 9500 MHz





**Plot A16**  
**Out of band spurious emissions test results**

EUT OPERATING FREQUENCY: 125 kHz  
FREQUENCY RANGE: 9 – 150 kHz

14:32:38 FEB 26, 2002

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 124.8 kHz  
64.00 dB $\mu$ V/m

MEASURE  
AT MKR

ADD TO  
LIST

MARKER  
↓ CF

MARKER  
△

NEXT  
PEAK

NEXT PK  
RIGHT

NEXT PK  
LEFT

LOG REF 129.0 dB $\mu$ V/m

15  
dB/  
ATN  
50 dB

VA SB  
SC FC  
ACORR

START 9.0 kHz

RL #1F BW 200 Hz

AVG BW 300 Hz

STOP 150.0 kHz

SWP 10.3 sec

More

1 of 2



**Plot A17**  
**Out of band spurious emissions test results**

EUT OPERATING FREQUENCY: 125 kHz  
FREQUENCY RANGE: 150 kHz – 30 MHz

14:29:42 FEB 26, 2002

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 160 kHz  
55.24 dB $\mu$ V/m

MEASURE  
AT MKR

ADD TO  
LIST

MARKER  
↓ CF

MARKER  
△

NEXT  
PEAK

NEXT PK  
RIGHT

NEXT PK  
LEFT

More  
1 of 2

LOG REF 110.0 dB $\mu$ V/m

10  
dB/  
ATN  
30 dB

VA SB  
SC FC  
ACORR

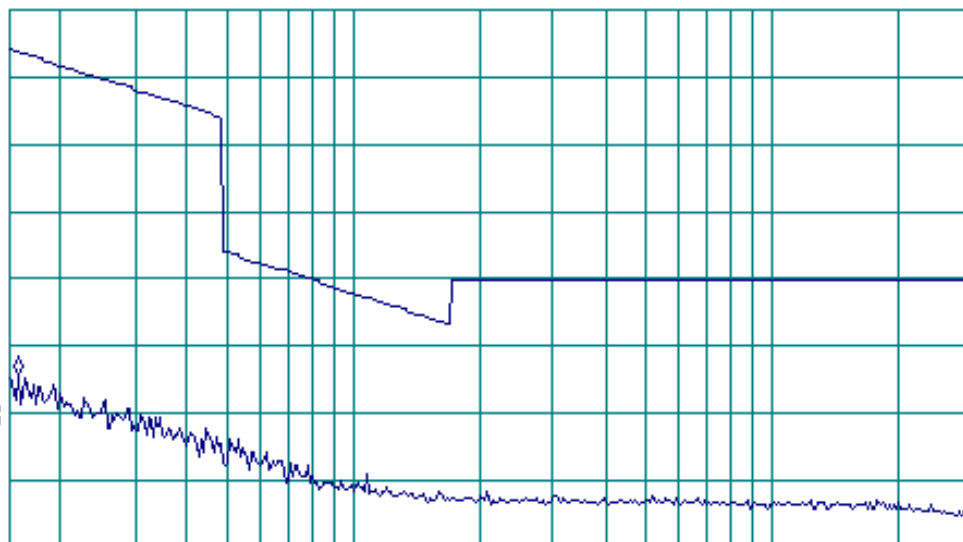
START 150 kHz

RL #1F BW 9.0 kHz

AVG BW 30 kHz

STOP 30.00 MHz

SWP 2.49 sec





**Plot A18**  
**Unintentional radiated emissions test results**

FREQUENCY RANGE: 30 – 1000 MHz

14:45:30 FEB 26, 2002

ACTV DET: PEAK  
MEAS DET: PEAK OP AVG  
MKR 942.8 MHz  
28.87 dB $\mu$ V/m

MEASURE  
AT MKR

ADD TO  
LIST

LOG REF 60.0 dB $\mu$ V/m

PREAMP ON

MARKER  
↓ CF

10  
dB/  
#ATN  
0 dB

MARKER  
△

VA SB  
SC FC  
ACORR

NEXT  
PEAK

NEXT PK  
RIGHT

NEXT PK  
LEFT

START 30.0 MHz

STOP 1.0000 GHz

More

RL IF BW 120 kHz

AVG BW 300 kHz

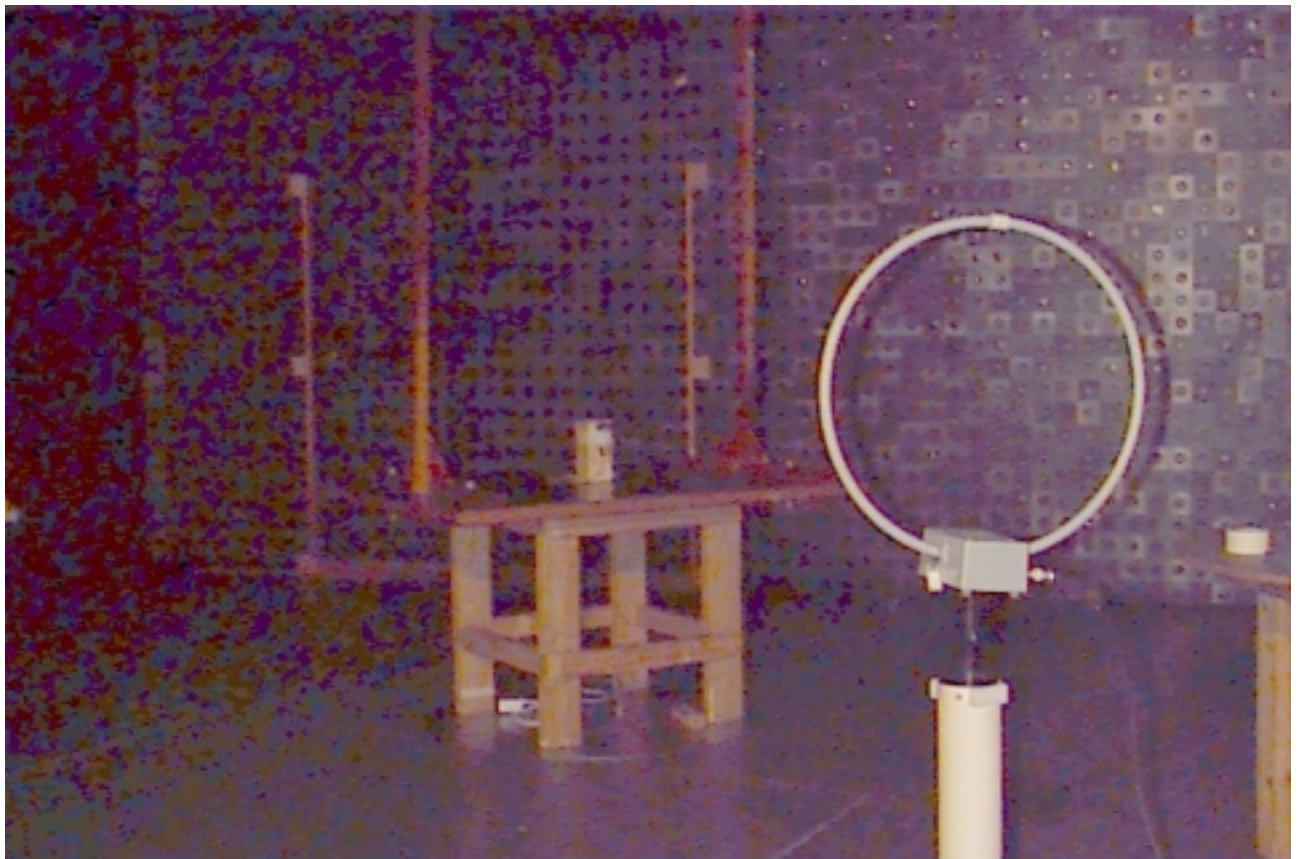
SWP 909 msec

1 of 2



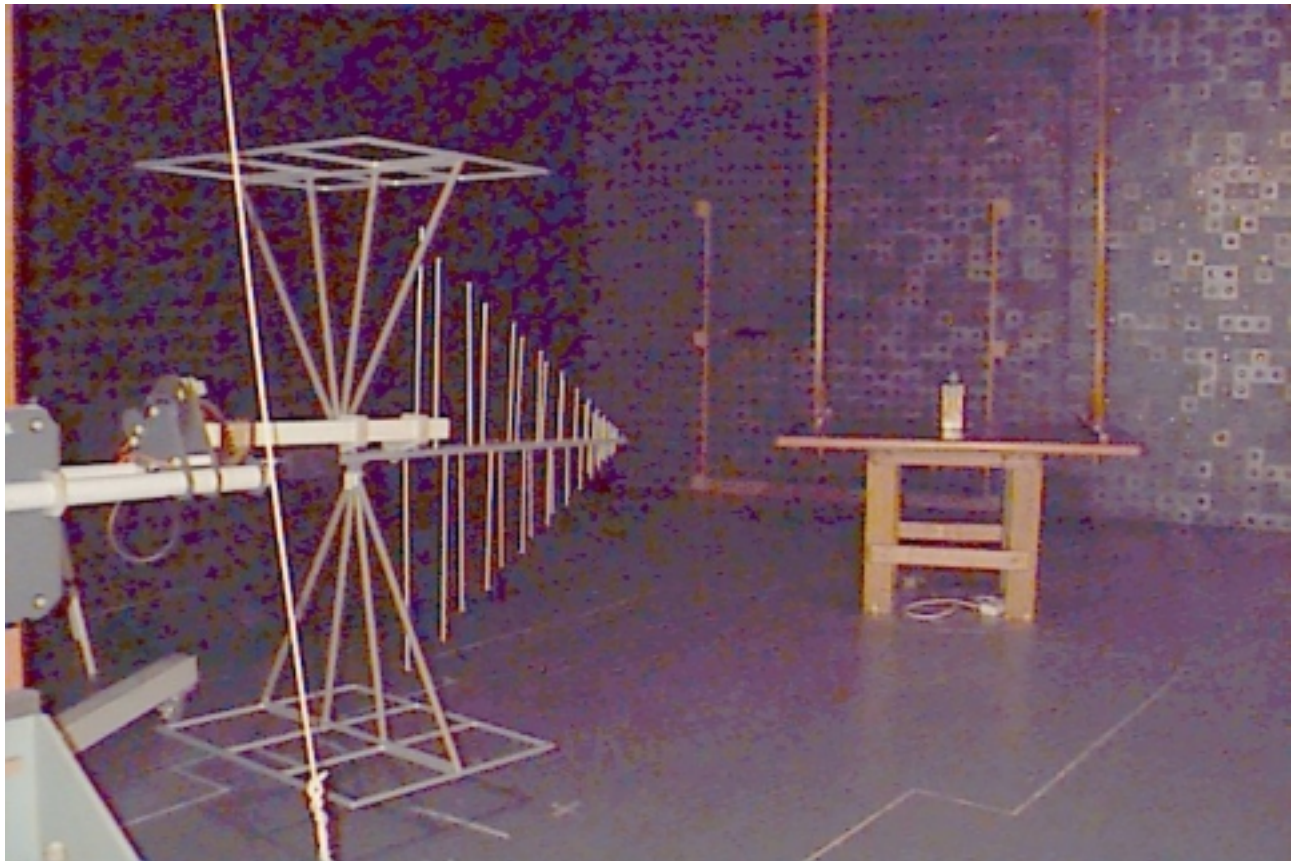
## Appendix B Test setup photographs

**Photograph 1**  
**Radiated emission measurements test setup with loop antenna,**  
**9 kHz – 30 MHz frequency range, anechoic chamber method**



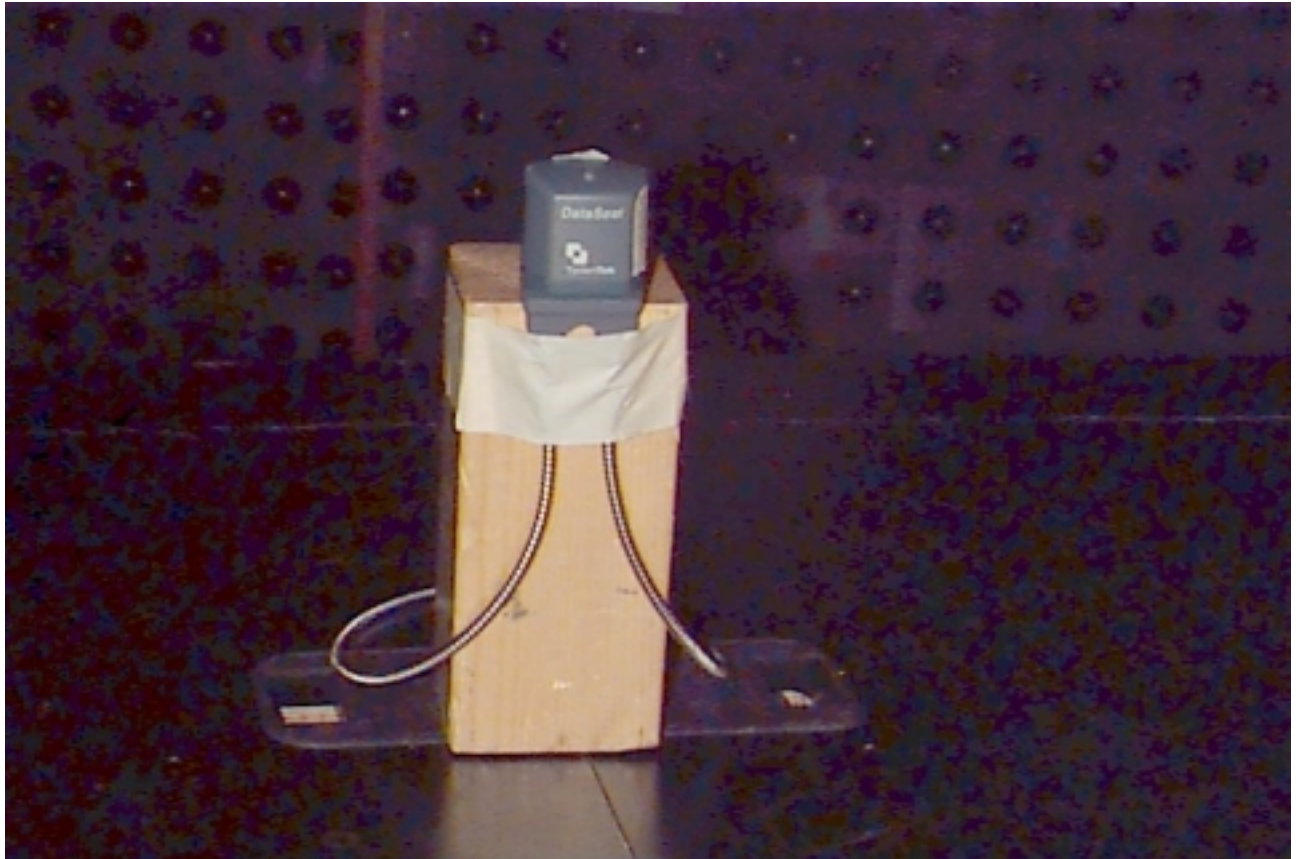


**Photograph 2**  
**Radiated emission measurements test setup with biconilog antenna,**  
**30 MHz – 2000 MHz frequency range, anechoic chamber method**



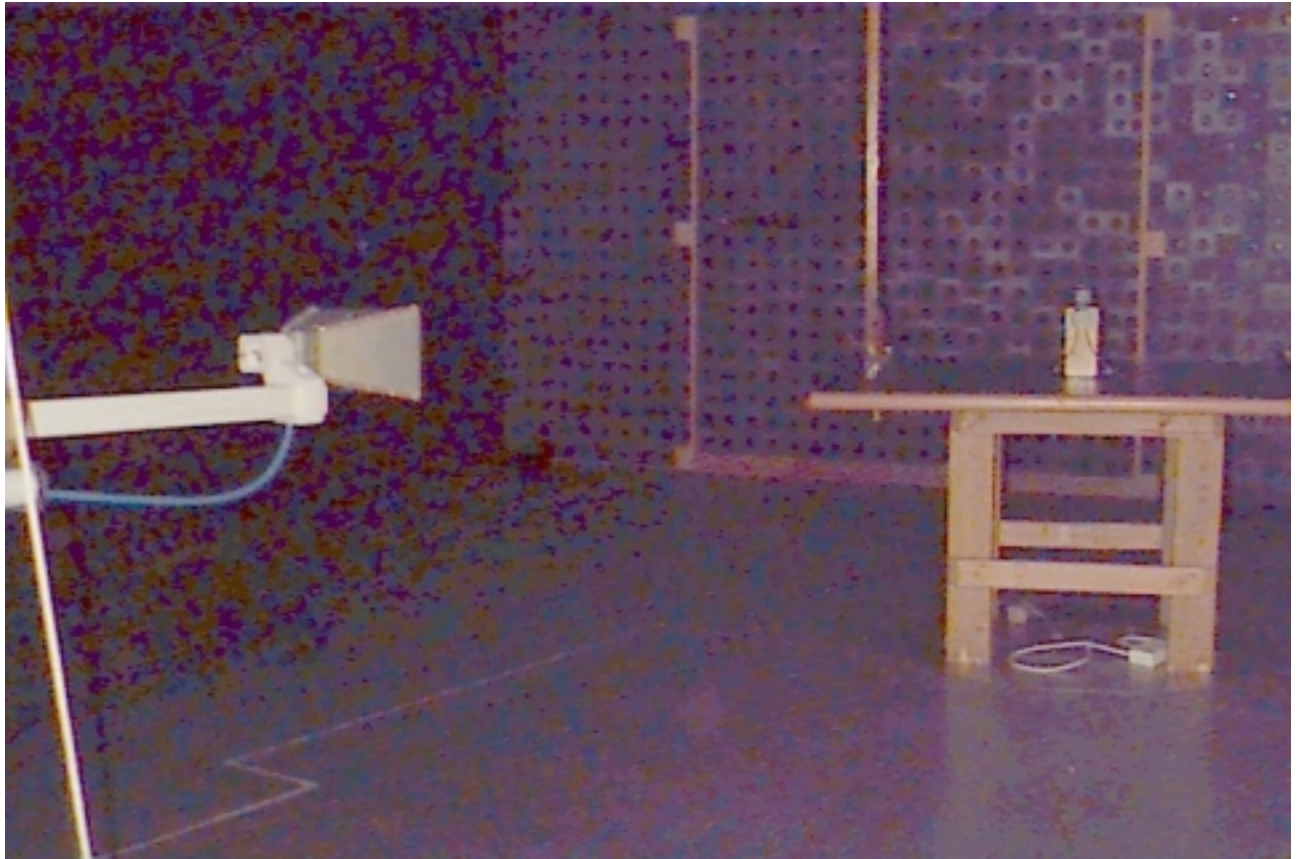


**Photograph 3**  
**Radiated emission measurements test setup with biconilog antenna,**  
**30 MHz – 2000 MHz frequency range, anechoic chamber method**





**Photograph 4**  
**Radiated emission measurements test setup with double ridge guide antenna,**  
**2 GHz – 9.5 GHz frequency range, anechoic chamber method**





## Appendix C Test equipment used for tests

| HL<br>Serial No. | Description                                                                   | Manufacturer information   |                        |            | Due<br>Calibr.<br><br>Month/Year |
|------------------|-------------------------------------------------------------------------------|----------------------------|------------------------|------------|----------------------------------|
|                  |                                                                               | Name                       | Model No.              | Serial No. |                                  |
| 0041             | Double ridged guide antenna,<br>1-18 GHz                                      | Electro-Metrics            | RGA 50/60              | 2811       | 3/03                             |
| 0446             | Active loop antenna<br>10 kHz-30 MHz                                          | Electro-<br>Mechanics      | 6502                   | 2857       | 11/02                            |
| 0465             | Anechoic chamber<br>9 (L) x 6.5 (W) x 5.5 (H) m                               | Hermon Labs                | AC-1                   | 023        | 11/02                            |
| 0521             | Spectrum analyzer with RF<br>filter section (EMI receiver<br>9 kHz - 6.5 GHz) | Hewlett Packard            | 8546A                  | 0319       | 9/02                             |
| 0589             | Cable coaxial, GORE<br>A2POL118.2, 3m                                         | Hermon Labs                | GORE-3                 | 589        | 11/02                            |
| 0593             | Antenna mast, 1-4 m/<br>1-6 m pneumatic                                       | Hermon Labs                | AM-F1                  | 101        | 2/03 Check                       |
| 0594             | Turntable for anechoic<br>chamber, flush mounted,<br>d=1.2 m, pneumatic       | Hermon Labs                | WDC1                   | 102        | 1/03 Check                       |
| 0604             | Antenna biconilog log-<br>periodic/T Bow-Tie,<br>26 - 2000 MHz                | EMCO                       | 3141                   | 9611-1011  | 1/03                             |
| 1004             | Cable, coaxial ANDREW<br>PSWJ4, 6 m                                           | Hermon Labs                | ANDREW-6               | 163        | 12/02                            |
| 1424             | Spectrum analyzer,<br>30 Hz – 40 GHz                                          | Agilent<br>Technologies    | 8564 EC                | 3946A00219 | 8/02                             |
| 1566             | Cable RF, 2 m                                                                 | Huber-Suhner               | Sucoflex 104PE         | 13094/4PE  | 12/02                            |
| 1863             | Amplifier 6 – 18 GHz                                                          | Avantek                    | SA85-1866              | F95468644  | 5/02 Check                       |
| 1864             | Amplifier 6 – 18 GHz                                                          | Avantek                    | SA81-2416              | 96438442   | 5/02 Check                       |
| 1947             | Cable 18 GHz, 6.5 m, blue                                                     | Rhophase<br>Microwave Ltd. | NPS-1803A-<br>6500-NPS | T4974      | 10/02                            |
| 2009             | Cable RF, 8 m                                                                 | Alpha Wire                 | RG-214                 | C-56       | 12/02                            |



## 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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### Abbreviations and acronyms

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

|                |                                             |
|----------------|---------------------------------------------|
| cm             | centimeter                                  |
| dB             | decibel                                     |
| dBm            | decibel referred to one milliwatt           |
| dB( $\mu$ V)   | decibel referred to one microvolt           |
| dB( $\mu$ V/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                                      |
| 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: 1996    | American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.                                            |
| ANSI C63.4: 1992    | 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. |



## 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     |



## Appendix E Test equipment correction factors

**Antenna Factor**  
**Active Loop Antenna**  
**Model 6502**  
**S/N 2857**

| Frequency, MHz | Antenna Factor, dB |
|----------------|--------------------|
| 0.009          | -32.8              |
| 0.010          | -33.8              |
| 0.020          | -38.3              |
| 0.050          | -41.1              |
| 0.075          | -41.3              |
| 0.100          | -41.6              |
| 0.150          | -41.7              |
| 0.250          | -41.6              |
| 0.500          | -41.8              |
| 0.750          | -41.9              |
| 1.000          | -41.4              |
| 2.000          | -41.5              |
| 3.000          | -41.4              |
| 4.000          | -41.4              |
| 5.000          | -41.5              |
| 10.000         | -41.9              |
| 15.000         | -41.9              |
| 20.000         | -42.2              |
| 25.000         | -42.8              |
| 30.000         | -44.0              |

Antenna factor is to be added to receiver meter reading in dB( $\mu$ V) to convert to field intensity in dB( $\mu$ V)/meter



**Antenna Factor**  
**Biconilog Antenna EMCO Model 3141**  
**Ser.No.1011**

| Frequency, MHz | Antenna Factor,<br>dB(1/m) | Frequency, MHz | Antenna Factor,<br>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( $\mu$ V) to convert to field intensity in dB( $\mu$ V/meter).



**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( $\mu$ V) to convert to field intensity in dB( $\mu$ V)/meter



**Cable RF, 2m, model: Sucoflex 104PE, s/n 13094/4PE (HL 1566)**  
**Calibration data**

| No. | Parameter      | SET, MHz | Measured, dB | Deviation, dB | Tolerance (Specification), dB | Meas. Uncert., dB | Notes |
|-----|----------------|----------|--------------|---------------|-------------------------------|-------------------|-------|
| 1   | Insertion Loss | 30       | 0.10         | -             | $\leq 5.0$                    | $\pm 0.12$        |       |
| 2   |                | 50       | 0.13         | -             |                               |                   |       |
| 3   |                | 100      | 0.20         | -             |                               |                   |       |
| 4   |                | 300      | 0.33         | -             |                               |                   |       |
| 5   |                | 500      | 0.45         | -             |                               |                   |       |
| 6   |                | 800      | 0.60         | -             |                               |                   |       |
| 7   |                | 1000     | 0.65         | -             |                               |                   |       |
| 8   |                | 1500     | 0.91         | -             |                               |                   |       |
| 9   |                | 2000     | 1.08         | -             |                               |                   |       |
| 10  |                | 2500     | 1.19         | -             |                               |                   |       |
| 11  |                | 3000     | 1.28         | -             |                               |                   |       |
| 12  |                | 3500     | 1.49         | -             |                               |                   |       |
| 13  |                | 4000     | 1.63         | -             |                               |                   |       |
| 14  | Insertion Loss | 4500     | 1.63         | -             | $\leq 5.0$                    | $\pm 0.17$        |       |
| 15  |                | 5000     | 1.66         | -             |                               |                   |       |
| 16  |                | 5500     | 1.88         | -             |                               |                   |       |
| 17  |                | 6000     | 1.96         | -             |                               |                   |       |
| 18  |                | 6500     | 1.93         | -             |                               |                   |       |
| 19  |                | 7000     | 2.07         | -             |                               |                   |       |
| 20  |                | 7500     | 2.37         | -             |                               |                   |       |
| 21  |                | 8000     | 2.34         | -             |                               |                   |       |
| 22  |                | 8500     | 2.64         | -             |                               |                   |       |
| 23  |                | 9000     | 2.68         | -             |                               |                   |       |
| 24  |                | 9500     | 2.64         | -             |                               |                   |       |
| 25  |                | 10000    | 2.70         | -             |                               |                   |       |
| 26  |                | 10500    | 2.84         | -             |                               |                   |       |
| 27  |                | 11000    | 2.88         | -             |                               |                   |       |
| 28  |                | 11500    | 3.19         | -             |                               |                   |       |
| 29  |                | 12000    | 3.15         | -             |                               |                   |       |
| 30  | Insertion Loss | 12500    | 3.20         | -             | $\leq 5.0$                    | $\pm 0.26$        |       |
| 31  |                | 13000    | 3.22         | -             |                               |                   |       |
| 32  |                | 13500    | 3.47         | -             |                               |                   |       |
| 33  |                | 14000    | 3.41         | -             |                               |                   |       |
| 34  |                | 14500    | 3.59         | -             |                               |                   |       |
| 35  |                | 15000    | 3.79         | -             |                               |                   |       |
| 36  |                | 15500    | 4.24         | -             |                               |                   |       |
| 37  |                | 16000    | 4.12         | -             |                               |                   |       |
| 38  |                | 16500    | 4.46         | -             |                               |                   |       |
| 39  |                | 17000    | 4.50         | -             |                               |                   |       |
| 40  |                | 17500    | 4.49         | -             |                               |                   |       |
| 41  |                | 18000    | 4.45         | -             |                               |                   |       |



**Cable 18GHz, 6.5 m, blue, model: NPS-1803A-6500-NPS, s/n T4974 (HL 1947)**  
**Calibration data**

| Frequency,<br>GHz | Insertion Loss, dB |
|-------------------|--------------------|
|                   | HL1947             |
| 0.03              | 0.30               |
| 0.05              | 0.38               |
| 0.10              | 0.53               |
| 0.20              | 0.74               |
| 0.30              | 0.91               |
| 0.40              | 1.05               |
| 0.50              | 1.18               |
| 0.60              | 1.29               |
| 0.70              | 1.40               |
| 0.80              | 1.50               |
| 0.90              | 1.59               |
| 1.00              | 1.68               |
| 1.10              | 1.77               |
| 1.20              | 1.86               |
| 1.30              | 1.94               |
| 1.40              | 2.01               |
| 1.50              | 2.08               |
| 1.60              | 2.16               |
| 1.70              | 2.22               |
| 1.80              | 2.29               |
| 1.90              | 2.36               |
| 2.00              | 2.42               |
| 2.10              | 2.48               |
| 2.20              | 2.54               |
| 2.30              | 2.60               |
| 2.40              | 2.66               |
| 2.50              | 2.71               |
| 2.60              | 2.77               |
| 2.70              | 2.83               |
| 2.80              | 2.89               |
| 2.90              | 2.95               |
| 3.10              | 3.06               |
| 3.30              | 3.17               |
| 3.50              | 3.28               |
| 3.70              | 3.39               |
| 3.90              | 3.51               |
| 4.10              | 3.62               |
| 4.30              | 3.76               |
| 4.50              | 3.87               |
| 4.70              | 4.01               |
| 4.90              | 4.10               |
| 5.10              | 4.21               |
| 5.30              | 4.31               |
| 5.50              | 4.43               |
| 5.70              | 4.56               |
| 5.90              | 4.71               |

| Frequency,<br>GHz | Insertion Loss, dB |
|-------------------|--------------------|
|                   | HL1947             |
| 6.10              | 4.87               |
| 6.30              | 4.95               |
| 6.50              | 4.94               |
| 6.70              | 4.88               |
| 6.90              | 4.87               |
| 7.10              | 4.83               |
| 7.30              | 4.85               |
| 7.50              | 4.86               |
| 7.70              | 4.91               |
| 7.90              | 4.96               |
| 8.10              | 5.03               |
| 8.30              | 5.08               |
| 8.50              | 5.13               |
| 8.70              | 5.21               |
| 8.90              | 5.22               |
| 9.10              | 5.34               |
| 9.30              | 5.35               |
| 9.50              | 5.52               |
| 9.70              | 5.51               |
| 9.90              | 5.66               |
| 10.10             | 5.70               |
| 10.30             | 5.78               |
| 10.50             | 5.79               |
| 10.70             | 5.82               |
| 10.90             | 5.86               |
| 11.10             | 5.94               |
| 11.30             | 6.06               |
| 11.50             | 6.21               |
| 11.70             | 6.44               |
| 11.90             | 6.61               |
| 12.10             | 6.76               |
| 12.40             | 6.68               |
| 13.00             | 6.66               |
| 13.50             | 6.81               |
| 14.00             | 6.90               |
| 14.50             | 6.90               |
| 15.00             | 6.97               |
| 15.50             | 7.17               |
| 16.00             | 7.28               |
| 16.50             | 7.27               |
| 17.00             | 7.38               |
| 17.50             | 7.68               |
| 18.00             | 7.92               |



**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 Loss | 30       | 0.33         | -             | $\leq 6.5$                    | $\pm 0.12$        |       |
| 2   |                | 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         | -             |                               |                   |       |
| 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 Loss | 2800     | 3.21         | -             | $\leq 6.5$                    | $\pm 0.12$        |       |
| 17  |                | 3000     | 3.32         | -             |                               |                   |       |
| 18  |                | 3300     | 3.47         | -             |                               |                   |       |
| 19  |                | 3600     | 3.62         | -             |                               |                   |       |
| 20  |                | 3900     | 3.84         | -             |                               |                   |       |
| 21  |                | 4200     | 3.92         | -             |                               | $\pm 0.17$        |       |
| 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         | -             |                               |                   |       |



**Cable RF, 8 m, model:RG-214, s/n C-56 (HL 2009)**  
**Calibration data**

| No. | Parameter      | SET,<br>MHz | Measured,<br>dB | Deviation | Tolerance<br>(Specification) | Meas. Uncert.,<br>dB | Notes |
|-----|----------------|-------------|-----------------|-----------|------------------------------|----------------------|-------|
| 1   | Insertion Loss | 1           | 0.10            | NA        | NA                           | ±0.12                |       |
| 2   |                | 10          | 0.14            |           |                              |                      |       |
| 3   |                | 30          | 0.25            |           |                              |                      |       |
| 4   |                | 50          | 0.34            |           |                              |                      |       |
| 5   |                | 100         | 0.53            |           |                              |                      |       |
| 6   |                | 300         | 0.99            |           |                              |                      |       |
| 7   |                | 500         | 1.31            |           |                              |                      |       |
| 8   |                | 800         | 1.73            |           |                              |                      |       |
| 9   |                | 1000        | 1.98            |           |                              |                      |       |
| 10  |                | 1100        | 2.11            |           |                              |                      |       |
| 11  |                | 1200        | 2.21            |           |                              |                      |       |
| 12  |                | 1300        | 2.35            |           |                              |                      |       |
| 13  |                | 1400        | 2.46            |           |                              |                      |       |
| 14  |                | 1500        | 2.55            |           |                              |                      |       |
| 15  |                | 1600        | 2.68            |           |                              |                      |       |
| 16  |                | 1700        | 2.78            |           |                              |                      |       |
| 17  |                | 1800        | 2.88            |           |                              |                      |       |
| 18  |                | 1900        | 2.98            |           |                              |                      |       |
| 19  |                | 2000        | 3.09            |           |                              |                      |       |