



Inter**Lab**[®]

FCC Measurement/Technical Report on Bluetooth – WLAN and Bluetooth transceiver

Report Reference: MDE_Siem_0617_FCCaa

Test Laboratory:

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Note:

The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the testing laboratory.

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0 Summary

0.1 Technical Report Summary

Type of Authorization

Certification for an Intentional Radiator (Frequency Hopping Spread Spectrum and Digital Device / Spread Spectrum).

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 (10-1-06 Edition).

The following parts and subparts are applicable to the results in this test report.

- Part 2, Subpart J - Equipment Authorization Procedures, Certification
- Part 15, Subpart C – Intentional Radiators

Note:

-

Summary Test Results:

The EUT complied with all performed tests as listed in chapter 0.2 Measurement Summary.

0.2 Measurement Summary

FCC Part 15, Subpart C

§15.35, §15.205, §15.209

Spurious radiated emissions

The measurement was performed according to ANSI C63.4

2003

| OP-Mode | Setup | Port | Final Result |
|------------|----------|-----------|--------------|
| op-mode 5 | Setup_01 | Enclosure | passed |
| op-mode 8 | Setup_01 | Enclosure | passed |
| op-mode 10 | Setup_01 | Enclosure | passed |
| op-mode 11 | Setup_01 | Enclosure | passed |

FCC Part 15, Subpart C

§15.35, §15.205, §15.209

Band edge compliance

The measurement was performed according to ANSI C63.4

2003

| OP-Mode | Setup | Port | Final Result |
|-----------|----------|-----------|--------------|
| op-mode 1 | Setup_01 | Enclosure | passed |
| op-mode 2 | Setup_01 | Enclosure | passed |
| op-mode 3 | Setup_01 | Enclosure | passed |
| op-mode 4 | Setup_01 | Enclosure | passed |
| op-mode 5 | Setup_01 | Enclosure | passed |
| op-mode 6 | Setup_01 | Enclosure | passed |
| op-mode 7 | Setup_01 | Enclosure | passed |
| op-mode 8 | Setup_01 | Enclosure | passed |
| op-mode 9 | Setup_01 | Enclosure | passed |

The purpose of the test case and operating mode selection is evaluating of co-location effects.



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Responsible for
Accreditation Scope:

B. Rethke

Responsible
for Test Report:

Maier



1 Administrative Data

1.1 Testing Laboratory

Company Name: 7 Layers AG
Address Borsigstr. 11
40880 Ratingen
Germany

This facility has been fully described in a report submitted to the FCC and accepted under the registration number 96716 .

The test facility is also accredited by the following accreditation organisation:
- Deutscher Akkreditierungs Rat DAR-Registration no. DAT-P-192/99-01

Responsible for Accreditation Scope: Dipl.-Ing. Bernhard Retka
Dipl.-Ing. Robert Machulec
Dipl.-Ing. Thomas Hoell
Dipl.-Ing. Andreas Petz

Report Template Version: 2008-07-15

1.2 Project Data

Responsible for testing and report: Dipl.-Ing. Robert Machulec
Date of Test(s): 2008-07-17 to 2008-08-05
Date of Report: 2008-08-07

1.3 Applicant Data

Company Name: Siemens AG
Address: Siemensallee 84
76187 Karlsruhe
Germany
Contact Person: Markus Rödle

1.4 Manufacturer Data

Company Name: Siemens AG, IA AS Industrial Automation
Systems, Electronic Works Karlsruhe
Address: Gleiwitzer Straße 555
90475 Nürnberg
Germany



2 Product labelling

2.1 FCC ID label

At the time of the report there was no FCC label available.

2.2 Location of the label on the EUT

see above



3 Test object Data

3.1 General EUT Description

| | |
|-----------------------------|--------------------------------------|
| Equipment under Test | Bluetooth and WLAN Transceiver |
| Type Designation: | IMIB |
| Kind of Device: | Integrated Measurement Interface Box |
| (optional) | for car diagnostic |
| Voltage Type: | AC |
| Voltage level: | 120 V |

General product description:

Bluetooth is a short-range radio link intended to be a cable replacement between portable and/or fixed electronic devices.

Bluetooth operates in the unlicensed ISM Band at 2.4 GHz. In the US a band of 83.5 MHz width is available. In this band, the Bluetooth technology defines 79 RF channels spaced 1 MHz (2402 - 2480 MHz). The actual RF channel is chosen from a pseudo-random hopping sequence through the 79 channels. A channel is occupied for a defined amount of time slots, with a nominal slot length of 625 μ s. The maximum dwell time on one channel is defined by the packet type and is 0.625 ms for DH1 packets, 1.875 ms for DH3 and 3.125 ms for DH5. The nominal hop rate is 1600 hops/s for DH1, 1600/3 for DH3 and 1600/5 for DH5. All frequencies are equally used. The maximum nominal average time of occupancy is 0.4 s within a period of 79*0.4 seconds.

WLAN Transceiver operating in the 2.4 GHz ISM band using Direct Sequence Spread Spectrum (DSSS) Modulation. The EUT supports the modes 802.11b (maximum data rate 11Mbps), 802.11g (maximum data rate 54Mbps) and 802.11n (maximum data rate = two times 54Mbps = 108Mbps distributed on two transmit antennas)

WLAN 5 GHz high performance WLAN equipment that is intended to operate in the frequency ranges 5 150 MHz to 5 350 MHz and 5 725 MHz to 5 825 MHz. The EUT supports the modes 802.11a (maximum data rate 54Mbps) and 802.11n (maximum data rate = two times 54Mbps = 108Mbps distributed on two transmit antennas)

The EUT provides the following ports:

Ports

Enclosure
AC Port (power line)
Sensor ports

The main components of the EUT are listed and described in Chapter 3.2



3.2 EUT Main components

Type, S/N, Short Descriptions etc. used in this Test Report

| Short Description | Equipment under Test | Type Designation | Serial No. | HW Status | SW Status | Date of Receipt |
|--|----------------------|------------------|------------|-----------|-----------|-----------------|
| EUT A (Code: 01123b01) Remark: none | IMIB | IMIB | PT0504 | V1.0a | V1.0 | 2008-07-17 |

NOTE: The short description is used to simplify the identification of the EUT in this test report.

3.3 Ancillary Equipment

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

| Short Description | Equipment under Test | Type Designation | HW Status | SW Status | Serial no. | FCC ID |
|-------------------|----------------------|--|-----------|-----------|----------------------|--------|
| AE1 | AC/DC adapter | VAN90A-195A-0A / A5E01212097 | ES 02 | - | - | - |
| AE2 | Pressure sensor | 310CR0100V4 SZ000 / A5E01034079 | ES 03 | - | STUM2012-0017-15A-08 | - |
| AE3 | Trigger pliers | Triggerzange BMW GT1 MT-VF / A5E00205403 | AS 01 | - | - | - |
| AE4 | Temperature sensor | Temperature sensor as probes / A5E01034091 | ES 02 | - | - | - |

3.4 EUT Setups

This chapter describes the combination of EUTs and ancillary equipment used for testing.

| Setup No. | Combination of EUTs | Description |
|-----------|-------------------------------|--|
| Setup_01 | EUT A + AE1 + AE2 + AE3 + AE4 | EUT with connected power supply and sensors for car diagnostic |

3.5 Operating Modes

This chapter describes the operating modes of the EUTs used for testing.

| Op. Mode | Description of Operating Modes | Remarks |
|------------|---|---|
| op-mode 1 | EUT transmits on 2402 MHz (Bluetooth) and on 2412 MHz (WLAN, 802.11b) | Bluetooth: Loopback mode, max output power WLAN: local TX mode, max output power |
| op-mode 2 | EUT transmits on 2480 MHz (Bluetooth) and on 2462 MHz (WLAN, 802.11b) | Bluetooth: Loopback mode, max output power WLAN: local TX mode, max output power |
| op-mode 3 | EUT transmits on 2402 MHz (Bluetooth) and on 2412 MHz (WLAN, 802.11n) | Bluetooth: Loopback mode, max output power WLAN: local TX mode, max output power |
| op-mode 4 | EUT transmits on 2480 MHz (Bluetooth) and on 2462 MHz (WLAN, 802.11n) | Bluetooth: Loopback mode, max output power WLAN: local TX mode, max output power |
| op-mode 5 | EUT transmits on 2480 MHz (Bluetooth) and on 5190 MHz (WLAN, 802.11n) | Bluetooth: Loopback mode, max output power WLAN: local TX mode, max output power |
| op-mode 6 | EUT transmits on 2480 MHz (Bluetooth) and on 5310 MHz (WLAN, 802.11n) | Bluetooth: Loopback mode, max output power WLAN: local TX mode, max output power |
| op-mode 7 | EUT transmits on 2480 MHz (Bluetooth) and on 5755 MHz (WLAN, 802.11n) | Bluetooth: Loopback mode, max output power WLAN: local TX mode, max output power |
| op-mode 8 | EUT transmits on 2480 MHz (Bluetooth) and on 5795 MHz (WLAN, 802.11n) | Bluetooth: Loopback mode, max output power WLAN: local TX mode, max output power |
| op-mode 9 | EUT transmits on 2402 MHz (Bluetooth) and on 5190 MHz (WLAN, 802.11n) | Bluetooth: Loopback mode, max output power WLAN: local TX mode, max output power |
| op-mode 10 | EUT transmits on 2402 MHz (Bluetooth) and on 2462 MHz (WLAN, 802.11n) | Bluetooth: Loopback mode, max output power WLAN: local TX mode, max output power |
| op-mode 11 | EUT transmits on 2480 MHz (Bluetooth) and on 2412 MHz (WLAN, 802.11n) | Bluetooth: Loopback mode, max output power WLAN: local TX mode, max output power |

4 Test Results

4.1 Spurious radiated emissions

Standard FCC Part 15, 10-1-06
Subpart C

The test was performed according to: ANSI C 63.4, 2003

4.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4-2003. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m in the semi-anechoic chamber. The test was performed at the distance of 3 m between the EUT and the receiving antenna.

The radiated emissions measurements were made in a typical installation configuration. The measurement procedure is implemented into the EMI test software ES-K1 from R&S.

1. Measurement up to 30 MHz

The test set-up was made in accordance to the general provisions of ANSI C 63.4-2003. The Equipment Under Test (EUT) was set up on a non-conductive table in the anechoic chamber.

The radiated emissions measurements were made in a typical installation configuration. The measurement procedure is implemented into the EMI test software ES-K1 from R&S. The Loop antenna HFH2-Z2 is used.

Step 1: pre measurement

- Anechoic chamber
- Antenna distance: 10m
- Detector: Peak-Maxhold
- Frequency range: 0.009 - 0.15 and 0.15 – 30 MHz
- Frequency steps: 0.1 kHz and 5 kHz
- IF-Bandwidth: 0.2 kHz and 10 kHz
- Measuring time / Frequency step: 100 ms

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: final measurement

For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is to find the maximum emission level.

- Open area test side
- Antenna distance: according to the Standard
- Detector: Quasi-Peak
- Frequency range: 0.009 – 30 MHz
- Frequency steps: measurement at frequencies detected in step 1
- IF-Bandwidth: 200 Hz - 10 kHz
- Measuring time / Frequency step: 100 ms

2. Measurement above 30 MHz and up to 1 GHz

Step 1: Preliminary scan

Preliminary test to identify the highest amplitudes relative to the limit.

Settings for step 1:

- Detector: Peak-Maxhold
- Frequency range: 30 – 1000 MHz
- Frequency steps: 60 kHz

- IF-Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 μ s
- Turntable angle range: -180 to 180 $^{\circ}$
- Turntable step size: 90°
- Height variation range: 1 – 3m
- Height variation step size: 2m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: second measurement

For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is, to find out the approximate turntable angle and antenna height for each frequency.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100ms
- Turntable angle range: -180 to 180 $^{\circ}$
- Turntable step size: 45°
- Height variation range: 1 – 4m
- Height variation step size: 0.5m
- Polarisation: horizontal + vertical

After this step the EMI test system has determined the following values for each frequency (of step 1):

- Frequency
- Azimuth value (of turntable)
- Antenna height

The last two values have now the following accuracy:

- Azimuth value (of turntable): 45°
- Antenna height: 0.5m

Step 3: final measurement

In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.

For each frequency the turntable azimuth and antenna height, which was determined in step 3, will be adjusted. The turntable azimuth will be slowly varied by $\pm 22.5^{\circ}$ around this value. During this action the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position the antenna height is also slowly varied by ± 25 cm around the antenna height determined in step 3. During this action the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100ms
- Turntable angle range: -22.5° to $+ 22.5^{\circ}$ around the value determined in step 2
- Height variation range: -0.25m to $+ 0.25$ m around the value determined in step 2

Step 4: final measurement with QP detector

With the settings determined in step 3, the final measurement will be performed:

EMI receiver settings for step 4:

- Detector: Quasi-Peak(< 1GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1s

3. Measurement above 1GHz

The following modifications apply to the measurement procedure for the frequency range above 1 GHz:

The measurement distance was reduced to 1m. The results were extrapolated by the extrapolation factor of 20 dB/decade (inverse linear distance for field strength measurements, inverse linear-distance squared for the power reference level measurements). Due to the fact that in this frequency range a double ridged wave guided horn antenna (up to 18 GHz) and a horn antenna (18-25 GHz) are used, the steps 2-4 are omitted. Step 1 was performed with one height of the receiving antenna only.

EMI receiver settings:

- Detector: Peak, Average
- RBW = VBW = 100 kHz

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

4.1.2 Test Requirements / Limits

FCC §15.205 (b)

“Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in § 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in § 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in § 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in § 15.35 apply to these measurements.”

FCC §15.209 (a)

“Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:”

FCC §15.209, Radiated Emission Limits

| Frequency in MHz | Limit (µV/m) | Measurement distance (m) | Limit(dBµV/m @10m) |
|------------------|--------------|--------------------------|---------------------|
| 0.009 – 0.49 | 2400/F(kHz) | 300 | Limit (dBµV/m)+30dB |
| 0.49 – 1.705 | 24000/F(kHz) | 30 | Limit (dBµV/m)+10dB |
| 1.705 - 30 | 30 | 30 | Limit (dBµV/m)+10dB |

| Frequency in MHz | Limit (µV/m) | Measurement distance (m) | Limit (dBµV/m) |
|------------------|--------------|--------------------------|----------------|
| 30 - 88 | 100 | 3 | 40.0 |
| 88 - 216 | 150 | 3 | 43.5 |
| 216 - 960 | 200 | 3 | 46.0 |
| above 960 | 500 | 3 | 54.0 |

FCC §15.35(b)

“..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....

Used conversion factor: $\text{Limit (dBµV/m)} = 20 \log (\text{Limit (µV/m)}/1\mu\text{V/m})$ ”

4.1.3 Test Protocol

Temperature: 25 °C
 Air Pressure: 1010 hPa
 Humidity: 37 %

Op. Mode **Setup** **Port**
 op-mode 5 Setup_01 Enclosure

| Polarisation | Frequency MHz | Corrected value dBµV/m | | | Limit dBµV/m | Limit dBµV/m | Limit dBµV/m | Delta to limit dB | Delta to limit dB |
|-----------------------|---------------|------------------------|-------|-------|--------------|--------------|--------------|-------------------|-------------------|
| | | QP | Peak | AV | QP | Peak | AV | QP/Peak | AV |
| Vertical + horizontal | 73 | 31.50 | | | 40.00 | | | 8.50 | |
| | 752 | 30.70 | | | 40.00 | | | 9.30 | |
| | 120 | 33.80 | | | 43.50 | | | 9.70 | |
| | 249 | 38.20 | | | 46.00 | | | 7.80 | |
| | 1600 | | 47.39 | 38.51 | | 74 | 54 | 26.61 | 15.49 |
| | 2483.5 | | 55.04 | 38.25 | | 74 | 54 | 18.96 | 15.75 |
| | 5150 | | 44.98 | 29.21 | | 74 | 54 | 29.02 | 24.79 |
| | 5350 | | 43.59 | 30.53 | | 74 | 54 | 30.41 | 23.47 |
| 15542 | | 60.68 | 41.76 | | 74 | 54 | 13.32 | 12.24 | |

Remark: No (further) spurious emissions in the range 20 dB below the limit found.
 Tested in the range 30MHz to 26 GHz

Op. Mode **Setup** **Port**
 op-mode 8 Setup_01 Enclosure

| Polarisation | Frequency MHz | Corrected value dBµV/m | | | Limit dBµV/m | Limit dBµV/m | Limit dBµV/m | Delta to limit dB | Delta to limit dB |
|-----------------------|---------------|------------------------|-------|-------|--------------|--------------|--------------|-------------------|-------------------|
| | | QP | Peak | AV | QP | Peak | AV | QP/Peak | AV |
| Vertical + horizontal | 1600 | | 47.54 | 38.56 | | 74 | 54 | 26.46 | 15.44 |
| | 2484 | | 55.65 | 38.39 | | 74 | 54 | 18.35 | 15.61 |

Remark: No (further) spurious emissions in the range 20 dB below the limit found.
 Tested in the range 1GHz to 26 GHz.

Op. Mode **Setup** **Port**
 op-mode 10 Setup_01 Enclosure

| Polarisation | Frequency MHz | Corrected value dBµV/m | | | Limit dBµV/m | Limit dBµV/m | Limit dBµV/m | Delta to limit dB | Delta to limit dB |
|-----------------------|---------------|------------------------|-------|-------|--------------|--------------|--------------|-------------------|-------------------|
| | | QP | Peak | AV | QP | Peak | AV | QP/Peak | AV |
| Vertical + horizontal | 73 | 28.50 | | | 40.00 | | | 11.50 | |
| | 120 | 33.90 | | | 43.50 | | | 9.60 | |
| | 249 | 38.40 | | | 46.00 | | | 7.60 | |
| | 1600 | | 48.07 | 38.47 | | 74 | 54 | 25.93 | 15.53 |
| | 2483.5 | | 57.11 | 40.50 | | 74 | 54 | 16.89 | 13.50 |

Remark: No (further) spurious emissions in the range 20 dB below the limit found.
 Tested in the range 30MHz to 26 GHz



Op. Mode **Setup** **Port**
 op-mode 11 Setup_01 Enclosure

| Polarisation | Frequency MHz | Corrected value dBµV/m | | | Limit dBµV/m | Limit dBµV/m | Limit dBµV/m | Delta to limit dB | Delta to limit dB |
|-----------------------|---------------|------------------------|-------|-------|--------------|--------------|--------------|-------------------|-------------------|
| | | QP | Peak | AV | QP | Peak | AV | QP/Peak | AV |
| Vertical + horizontal | 1600 | | 47.26 | 38.35 | | 74 | 54 | 26.74 | 15.65 |
| | 2400 | | 55.29 | 39.91 | | 74 | 54 | 18.71 | 14.09 |
| | 2483.5 | | 56.38 | 38.98 | | 74 | 54 | 17.62 | 15.02 |

Remark: No (further) spurious emissions in the range 20 dB below the limit found.
 Tested in the range 1GHz to 26 GHz.

4.1.4 Test result: Spurious radiated emissions

| FCC Part 15, Subpart C | Op. Mode | Result |
|------------------------|------------|--------|
| | op-mode 5 | passed |
| | op-mode 8 | passed |
| | op-mode 10 | passed |
| | op-mode 11 | passed |



4.2 Band edge compliance

Standard FCC Part 15, 10-1-06
Subpart C

The test was performed according to: ANSI C 63.4, 2003

4.2.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4-2003. The Equipment Under Test (EUT) was placed inside FAC (fully anechoic chamber) to perform the measurements. The radiated emissions measurements were made in a typical installation configuration.

The measurement was carry out with a spectrum analyse, cable and horn antenna in a distance of 1 m using peak detector.

The measurement was performed at the lowest and highest band edges of the used ISM bands:

- 2400MHz
- 2483.5MHz

- 5150MHz
- 5350MHz
- 5725MHz
- 5825MHz

4.2.2 Test Requirements / Limits

For the measurement at the band edges the limit is specified in §15.209.

| Frequency in MHz | Limit (µV/m) | Measurement distance (m) | Limit (dBµV/m @10m) |
|------------------|--------------|--------------------------|-----------------------|
| 0.009 – 0.49 | 2400/F(kHz) | 300 | Limit (dBµV/m) + 30dB |
| 0.49 – 1.705 | 24000/F(kHz) | 30 | Limit (dBµV/m) + 10dB |
| 1.705 - 30 | 30 | 30 | Limit (dBµV/m) + 10dB |

| Frequency in MHz | Limit (µV/m) | Measurement distance (m) | Limit (dBµV/m) |
|------------------|--------------|--------------------------|----------------|
| 30 - 88 | 100 | 3 | 40.0 |
| 88 - 216 | 150 | 3 | 43.5 |
| 216 - 960 | 200 | 3 | 46.0 |
| above 960 | 500 | 3 | 54.0 |

"In the emission table above, the tighter limit applies at the band edges."

FCC §15.35(b)

"..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....

Used conversion factor: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)"

4.2.3 Test Protocol

4.2.3.1 Lower band edge

Temperature: 27 °C
 Air Pressure: 1012 hPa
 Humidity: 44 %

| Op. Mode | Setup | Port |
|-----------|----------|-----------|
| op-mode 1 | Setup_01 | Enclosure |

| Frequency MHz | Polarisation | Corrected value dBµV/m | | Limit Peak dBµV/m | Limit AV dBµV/m | Delta to Peak limit/dB | Delta to AV limit dB |
|---------------|-----------------------|------------------------|-------|-------------------|-----------------|------------------------|----------------------|
| | | Peak | AV | | | | |
| 2400 | Vertical + horizontal | 59.68 | 47.74 | 74.00 | 54.00 | 14.32 | 6.26 |

Remark: Ref level: 97.21 => Delta > 20dB. Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|-----------|----------|-----------|
| op-mode 3 | Setup_01 | Enclosure |

| Frequency MHz | Polarisation | Corrected value dBµV/m | | Limit Peak dBµV/m | Limit AV dBµV/m | Delta to Peak limit/dB | Delta to AV limit dB |
|---------------|-----------------------|------------------------|-------|-------------------|-----------------|------------------------|----------------------|
| | | Peak | AV | | | | |
| 2400 | Vertical + horizontal | 58.80 | 40.73 | 74.00 | 54.00 | 15.20 | 13.27 |

Remark: Ref level: 95.49 => Delta > 20dB. Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|-----------|----------|-----------|
| op-mode 5 | Setup_01 | Enclosure |

| Frequency MHz | Polarisation | Corrected value dBµV/m | | Limit Peak dBµV/m | Limit AV dBµV/m | Delta to Peak limit/dB | Delta to AV limit dB |
|---------------|-----------------------|------------------------|-------|-------------------|-----------------|------------------------|----------------------|
| | | Peak | AV | | | | |
| 5150 | Vertical + horizontal | 35.44 | 22.16 | 74.00 | 54.00 | 38.56 | 31.84 |

Remark: Ref level: 88.85 => Delta > 20dB. Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|-----------|----------|-----------|
| op-mode 7 | Setup_01 | Enclosure |

| Frequency MHz | Polarisation | Corrected value dBµV/m | | Limit Peak dBµV/m | Limit AV dBµV/m | Delta to Peak limit/dB | Delta to AV limit dB |
|---------------|-----------------------|------------------------|-------|-------------------|-----------------|------------------------|----------------------|
| | | Peak | AV | | | | |
| 5725 | Vertical + horizontal | 41.44 | 25.67 | 74.00 | 54.00 | 32.56 | 28.33 |

Remark: Ref level: 88.07 => Delta > 20dB. Please see annex for the measurement plot.

| Op. Mode | Setup | Port |
|-----------|----------|-----------|
| op-mode 9 | Setup_01 | Enclosure |

| Frequency MHz | Polarisation | Corrected value dBµV/m | | Limit Peak dBµV/m | Limit AV dBµV/m | Delta to Peak limit/dB | Delta to AV limit dB |
|---------------|-----------------------|------------------------|-------|-------------------|-----------------|------------------------|----------------------|
| | | Peak | AV | | | | |
| 2400 | Vertical + horizontal | 45.14 | 34.09 | 74.00 | 54.00 | 28.86 | 19.91 |

Remark: Ref level: 89.10 => Delta > 20dB. Please see annex for the measurement plot.

4.2.3.2 Higher band edge

Temperature: 27 °C
 Air Pressure: 1012 hPa
 Humidity: 44 %

Op. Mode **Setup** **Port**
 op-mode 2 Setup_01 Enclosure

| Frequency MHz | Polarisation | Corrected value dB μ V/m | | Limit Peak dB μ V/m | Limit AV dB μ V/m | Delta to Peak limit/dB | Delta to AV limit dB |
|---------------|-----------------------|------------------------------|-------|-------------------------|-----------------------|------------------------|----------------------|
| | | Peak | AV | | | | |
| 2483.5 | Vertical + horizontal | 45.52 | 34.79 | 74.00 | 54.00 | 28.48 | 19.21 |

Remark: Ref level: 97.04 => Delta > 20dB. Please see annex for the measurement plot.

Op. Mode **Setup** **Port**
 op-mode 4 Setup_01 Enclosure

| Frequency MHz | Polarisation | Corrected value dB μ V/m | | Limit Peak dB μ V/m | Limit AV dB μ V/m | Delta to Peak limit/dB | Delta to AV limit dB |
|---------------|-----------------------|------------------------------|-------|-------------------------|-----------------------|------------------------|----------------------|
| | | Peak | AV | | | | |
| 2483.5 | Vertical + horizontal | 45.37 | 33.20 | 74.00 | 54.00 | 28.63 | 20.80 |

Remark: Ref level: 95.49 => Delta > 20dB. Please see annex for the measurement plot.

Op. Mode **Setup** **Port**
 op-mode 6 Setup_01 Enclosure

| Frequency MHz | Polarisation | Corrected value dB μ V/m | | Limit Peak dB μ V/m | Limit AV dB μ V/m | Delta to Peak limit/dB | Delta to AV limit dB |
|---------------|-----------------------|------------------------------|-------|-------------------------|-----------------------|------------------------|----------------------|
| | | Peak | AV | | | | |
| 5350 | Vertical + horizontal | 36.30 | 24.02 | 74.00 | 54.00 | 37.70 | 29.98 |

Remark: Ref level: 90.24 => Delta > 20dB. Please see annex for the measurement plot.

Op. Mode **Setup** **Port**
 op-mode 8 Setup_01 Enclosure

| Frequency MHz | Polarisation | Corrected value dB μ V/m | | Limit Peak dB μ V/m | Limit AV dB μ V/m | Delta to Peak limit/dB | Delta to AV limit dB |
|---------------|-----------------------|------------------------------|-------|-------------------------|-----------------------|------------------------|----------------------|
| | | Peak | AV | | | | |
| 5825 | Vertical + horizontal | 36.68 | 24.53 | 74.00 | 54.00 | 37.32 | 29.47 |

Remark: Ref level: 86.67 => Delta > 20dB. Please see annex for the measurement plot.

Op. Mode **Setup** **Port**
 op-mode 5 Setup_01 Enclosure

| Frequency MHz | Polarisation | Corrected value dB μ V/m | | Limit Peak dB μ V/m | Limit AV dB μ V/m | Delta to Peak limit/dB | Delta to AV limit dB |
|---------------|-----------------------|------------------------------|-------|-------------------------|-----------------------|------------------------|----------------------|
| | | Peak | AV | | | | |
| 2483.5 | Vertical + horizontal | 43.68 | 32.42 | 74.00 | 54.00 | 30.32 | 21.58 |

Remark: Ref level: 92.74 => Delta > 20dB. Please see annex for the measurement plot.



4.2.4 Test result: Band edge compliance

| FCC Part 15, Subpart C | Op. Mode | Result |
|------------------------|-----------|--------|
| | op-mode 1 | passed |
| | op-mode 2 | passed |
| | op-mode 3 | passed |
| | op-mode 4 | passed |
| | op-mode 5 | passed |
| | op-mode 6 | passed |
| | op-mode 7 | passed |
| | op-mode 8 | passed |
| | op-mode 9 | passed |

5 Test Equipment

EUT Digital Signalling System

| Equipment | Type | Serial No. | Manufacturer | Cal data | Next cal |
|--------------------------------------|-------------|-------------------|---------------------|-----------------|--------------------------------|
| Digital Radio Communication Tester | CMD 55 | 831050/020 | Rohde & Schwarz | 01.12.05 | 01.12.08 |
| Signalling Unit for Bluetooth | PTW60 | 100004 | Rohde & Schwarz | - | - |
| Universal Radio Communication Tester | CMU200 | 102366 | Rohde & Schwarz | 22.09.07 | 22.09.09 |
| Universal Radio Communication Tester | CMU200 | 837983/052 | Rohde & Schwarz | 22.09.07 | 22.09.09 |
| Signalling Unit for Bluetooth | CBT | 100302 | Rohde & Schwarz | 22.09.06 | N/A – only used for signalling |

EMI Test System

| Equipment | Type | Serial No. | Manufacturer | Cal data | Next cal |
|--------------------------|-------------|-------------------|---------------------|-----------------|-----------------|
| Comparison Noise Emitter | CNE III | 99/016 | York | - | - |
| EMI Analyzer | ESI 26 | 830482/004 | Rohde & Schwarz | 06.12.07 | 06.12.09 |
| Signal Generator | SMR 20 | 846834/008 | Rohde & Schwarz | 05.12.07 | 05.12.09 |

EMI Radiated Auxiliary Equipment

| Equipment | Type | Serial No. | Manufacturer | Cal data | Next cal |
|---------------------------------|----------------------|----------------------|-----------------------|-----------------|---------------------------------|
| Antenna mast 4m | MA 240 | 240/492 | HD GmbH H. Deisel | - | - |
| Biconical dipole | VUBA 9117 | 9117108 | Schwarzbeck | 02.07.03 | 02.07.08 |
| Broadband Amplifier 18MHz-26GHz | JS4-18002600-32 | 849785 | Miteq | 06.02.08 | 06.08.08 |
| Broadband Amplifier 30MHz-18GHz | JS4-00101800-35 | 896037 | Miteq | 06.02.08 | 06.08.08 |
| Broadband Amplifier 45MHz-27GHz | JS4-00102600-42 | 619368 | Miteq | 06.02.08 | 06.08.08 |
| Cable "ESI to EMI Antenna" | EcoFlex10 | W18.01-2 W38.01-2 | Kabel Kusch | 06.02.08 | 06.08.08 |
| Cable "ESI to Horn Antenna" | UFB311A UFB293C | W18.02-2 W38.02-2 | Rosenberger-Microcoax | 06.02.08 | 06.08.08 |
| Double-ridged horn | HF 906 | 357357/002 | Rohde & Schwarz | 12.05.06 | 12.05.08 |
| Double-ridged horn | HF 906 | 357357/001 | Rohde & Schwarz | 20.01.04 | N/A – spare antenna |
| High Pass Filter | 5HC3500/12750-1.2-KK | 200035008 | Trilithic | 06.02.08 | 06.08.08 |
| High Pass Filter | 5HC2700/12750-1.5-KK | 9942012 | Trilithic | 06.02.08 | 06.08.08 |
| High Pass Filter | 4HC1600/12750-1.5-KK | 9942011 | Trilithic | 06.02.08 | 06.08.08 |
| Log.-per. Antenna | HL 562 UltraLog | 830547/003 | Rohde & Schwarz | 17.05.06 | 17.05.09 |
| Loop Antenna | HFH2-Z2 | 829324/006 | Rohde & Schwarz | 19.08.02 | N/A – only used for pre-testing |
| Pyramidal Horn Antenna 26.5 GHz | Model 3160-09 | 9910-1184 | EMCO | 06.02.08 | 06.08.08 |

EMI Conducted Auxiliary Equipment

| Equipment | Type | Serial No. | Manufacturer | Cal data | Next cal |
|---------------------|----------|---------------|-----------------|----------|----------|
| Cable "LISN to ESI" | RG214 | W18.03+W48.03 | Huber+Suhner | 06.02.08 | 06.08.08 |
| Two-Line V-Network | ESH 3-Z5 | 828304/029 | Rohde & Schwarz | 01.11.05 | 01.11.08 |
| Two-Line V-Network | ESH 3-Z5 | 829996/002 | Rohde & Schwarz | - | - |

Auxiliary Test Equipment – calibration not applicable; spare equipment

| Equipment | Type | Serial No. | Manufacturer | Cal data | Next cal |
|-------------------------------------|----------------------|----------------|-----------------------------------|----------|----------|
| Broadband Resist. Power Divider N | 1506A / 93459 | LM390 | Weinschel | - | - |
| Broadband Resist. Power Divider SMA | 1515 / 93459 | LN673 | Weinschel | - | - |
| Digital Multimeter 01 | Voltcraft M-3860M | IJ096055 | Conrad | - | - |
| Digital Multimeter 02 | Voltcraft M-3860M | IJ095955 | Conrad | - | - |
| Digital Oscilloscope | TDS 784C | B021311 | Tektronix | - | - |
| Fibre optic link Satellite | FO RS232 Link | 181-018 | Pontis | - | - |
| Fibre optic link Transceiver | FO RS232 Link | 182-018 | Pontis | - | - |
| I/Q Modulation Generator | AMIQ-B1 | 832085/018 | Rohde & Schwarz | - | - |
| Notch Filter ultra stable | WRCA800 /960-6E | 24 | Wainwright | - | - |
| Spectrum Analyzer 9 kHz to 3 GHz | FSP3 | 838164/004 | Rohde & Schwarz | - | - |
| Temperature Chamber | VT 4002 | 58566002150010 | Vötsch | - | - |
| Temperature Chamber | KWP 120/70 | 59226012190010 | Weiss | - | - |
| ThermoHygro Datalogger 03 | Opus10 THI (8152.00) | 7482 | Lufft Mess- und Regeltechnik GmbH | - | - |

Anechoic Chamber – calibration not applicable

| Equipment | Type | Serial No. | Manufacturer | Cal data | Next cal |
|-----------------------------------|----------------|-----------------------|-------------------------------------|----------|----------|
| Air Compressor (pneumatic) | | | Atlas Copco | - | - |
| Controller | CO 2000 | CO2000/328/12470406/L | Innco innovative constructions GmbH | - | - |
| EMC Camera | CE-CAM/1 | | CE-SYS | - | - |
| EMC Camera for observation of EUT | CCD-400E | 0005033 | Mitsubishi | - | - |
| Filter ISDN | B84312-C110-E1 | | Siemens & Matsushita | - | - |
| Filter telephone systems / modem | B84312-C40-B1 | | Siemens & Matsushita | - | - |
| Filter Universal 1A | B84312-C30-H3 | | Siemens & Matsushita | - | - |
| Fully/Semi AE Chamber | 10.58x6.3 8x6 | | Frankonia | - | - |
| Turntable | DS 420S | 420/573/99 | HD GmbH, H.Deisel | - | - |
| Valve Control Unit (pneum.) | VE 615P | 615/348/99 | HD GmbH, H.Deisel | - | - |

6 Photo Report

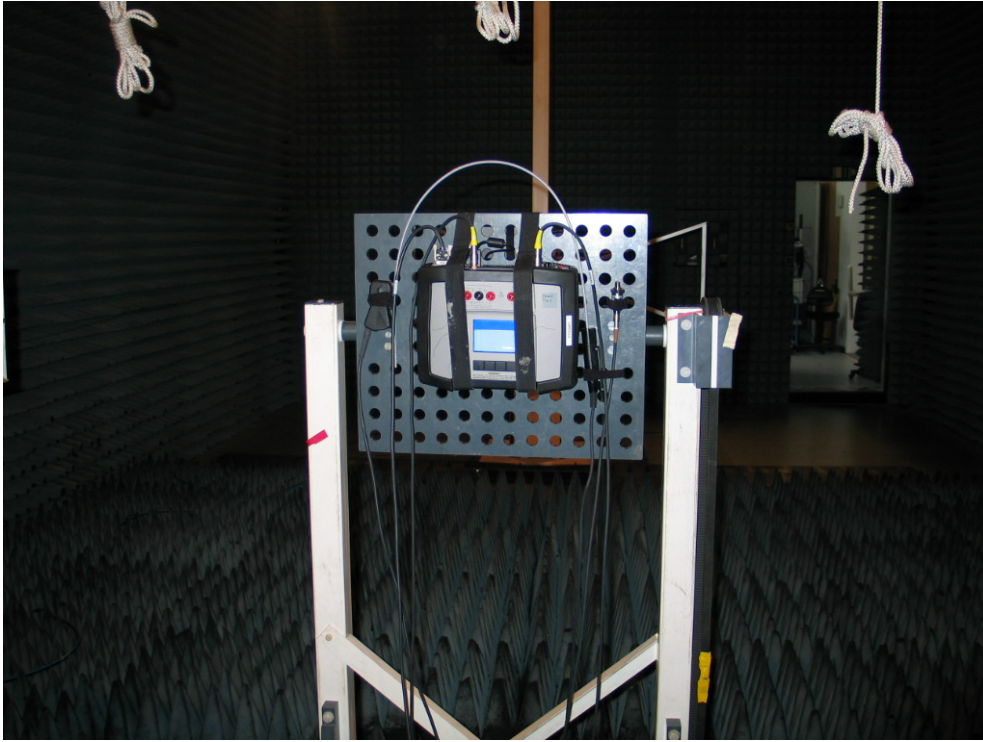


Photo 1: Test setup for radiated measurements



Photo 2: EUT front side

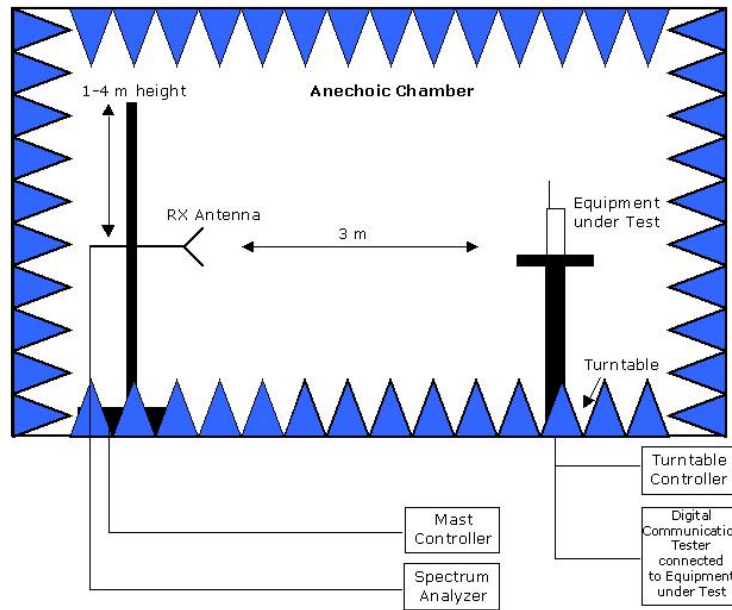


Photo 3: EUT rear side



Photo 4: EUT connectors

7 Setup Drawings



Remark: Depending on the frequency range suitable antenna types, attenuators or preamplifiers are used.

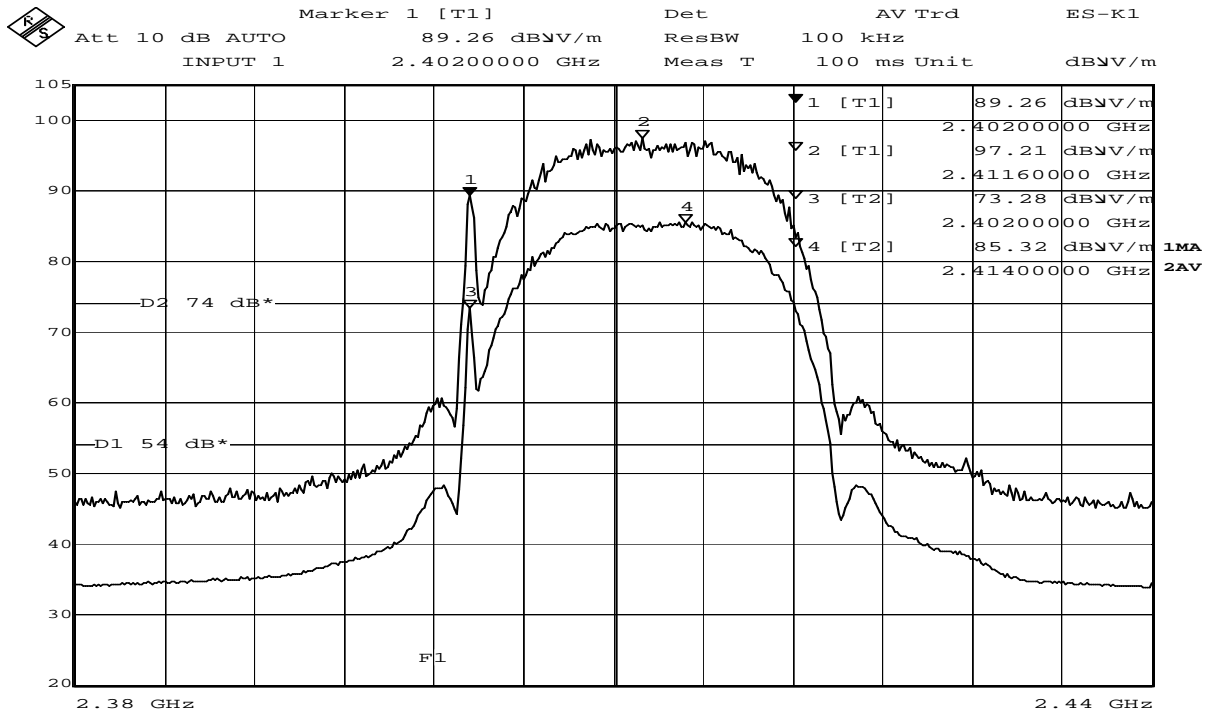
Drawing 1: Setup in the Anechoic chamber. For measurements below 1 GHz the ground was replaced by a conducting ground plane.

8 Annex measurement plots

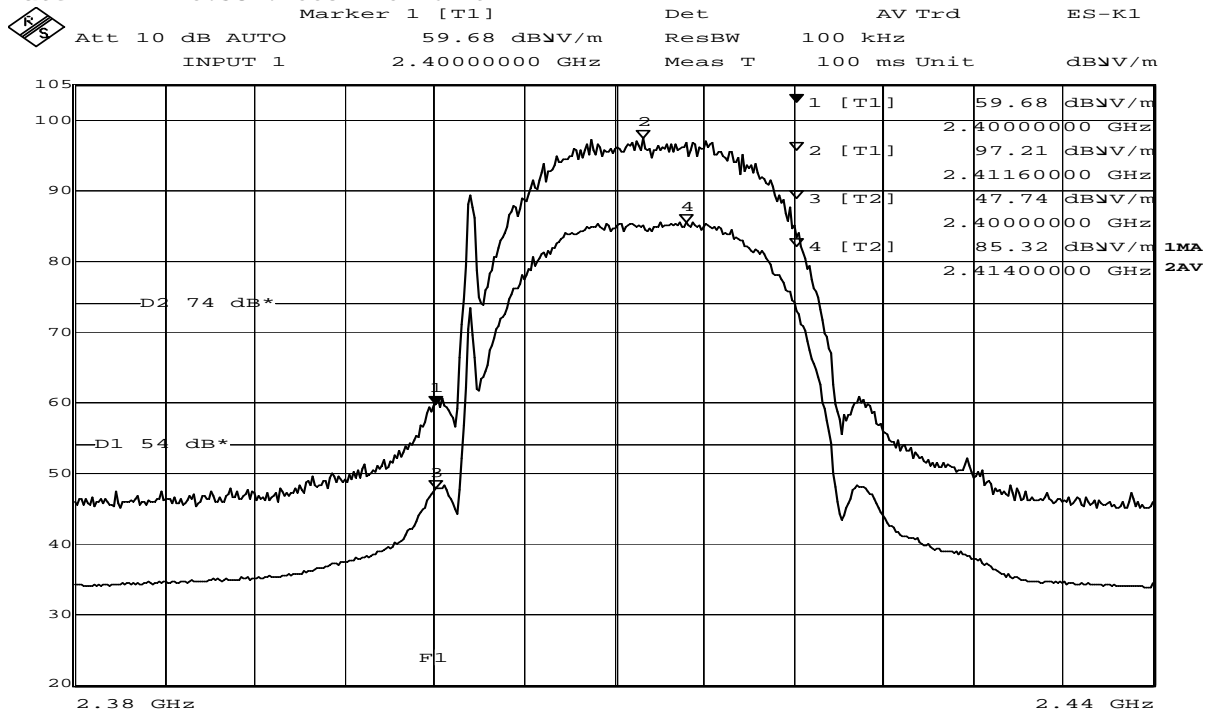
8.1 Band edge compliance

Op. Mode

op-mode 1



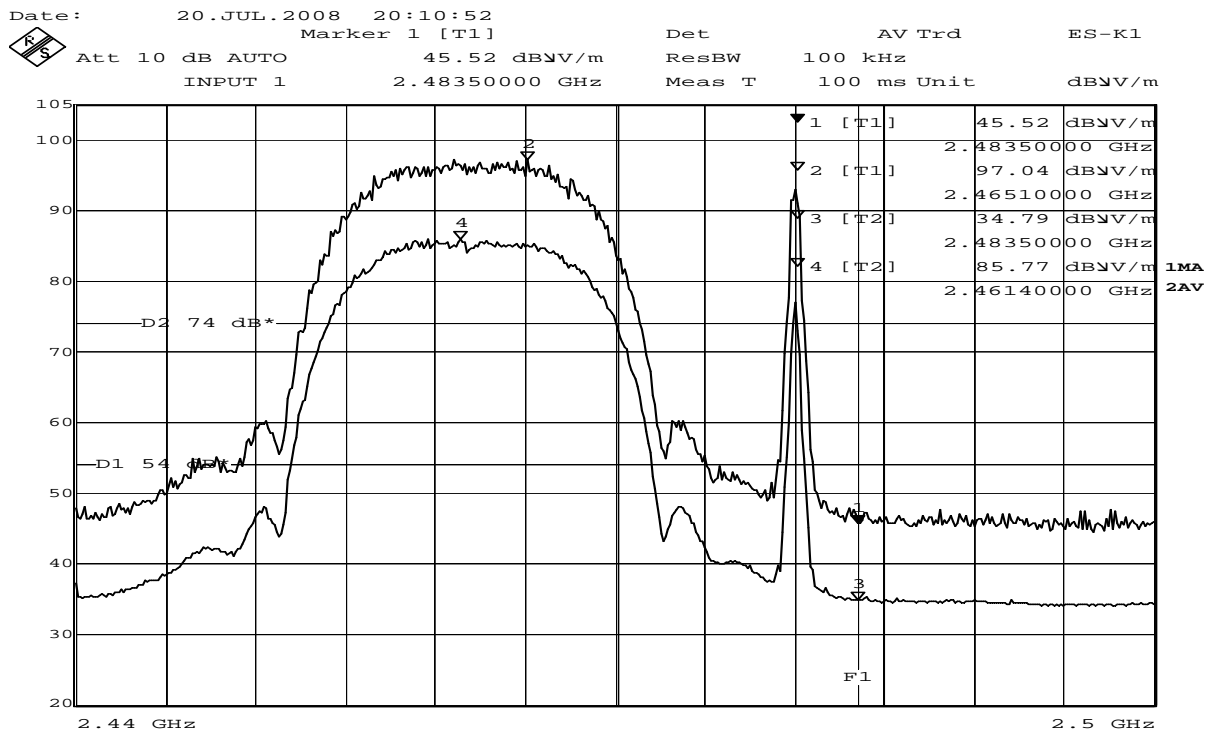
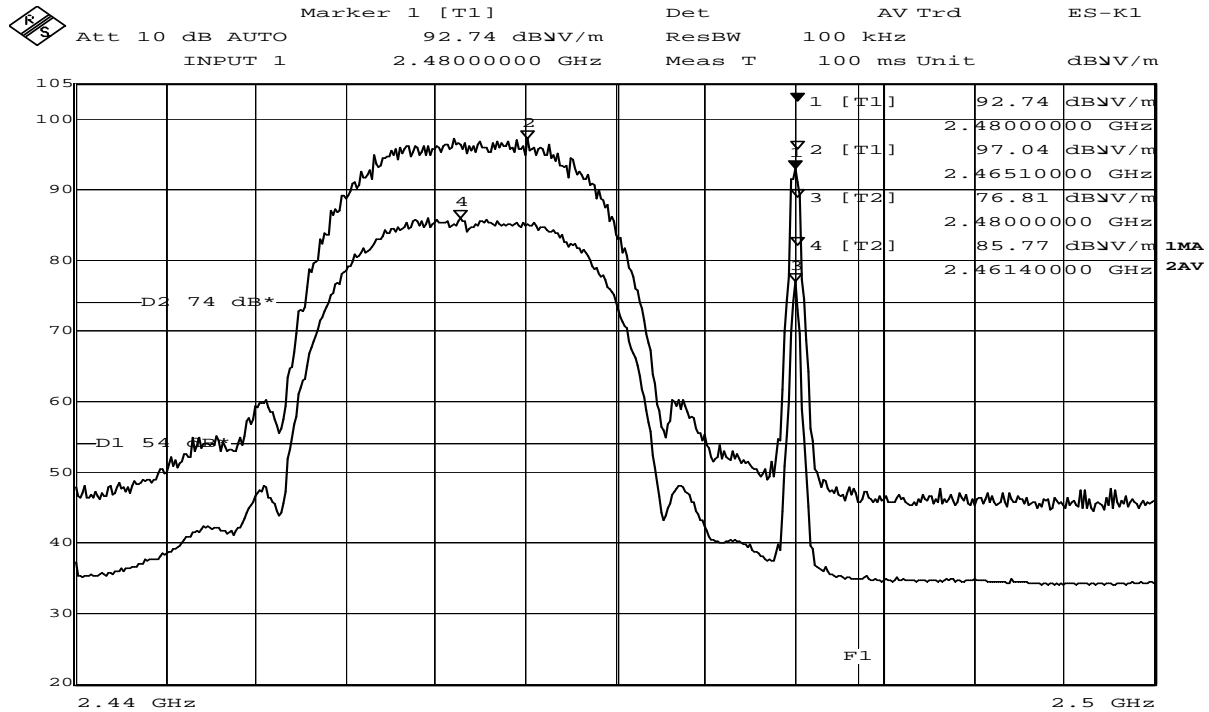
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Date: 20.JUL.2008 20:16:59

Op. Mode

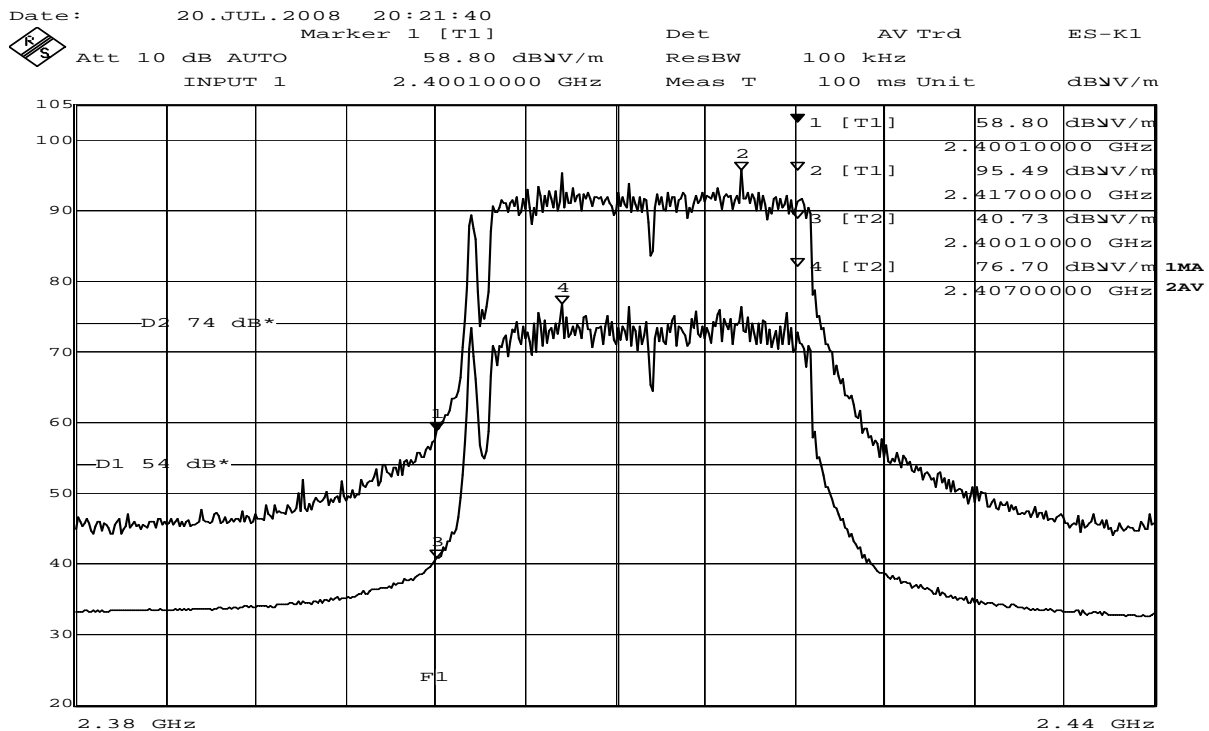
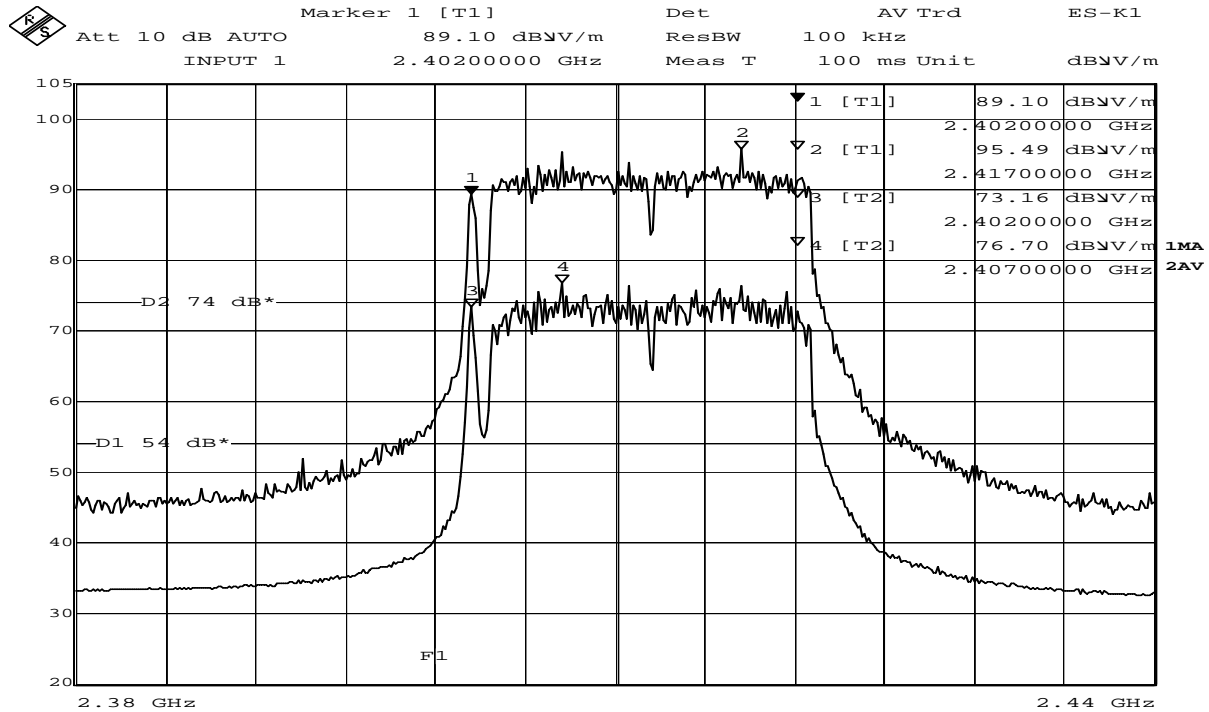
op-mode 2



Date: 20.JUL.2008 20:11:22

Op. Mode

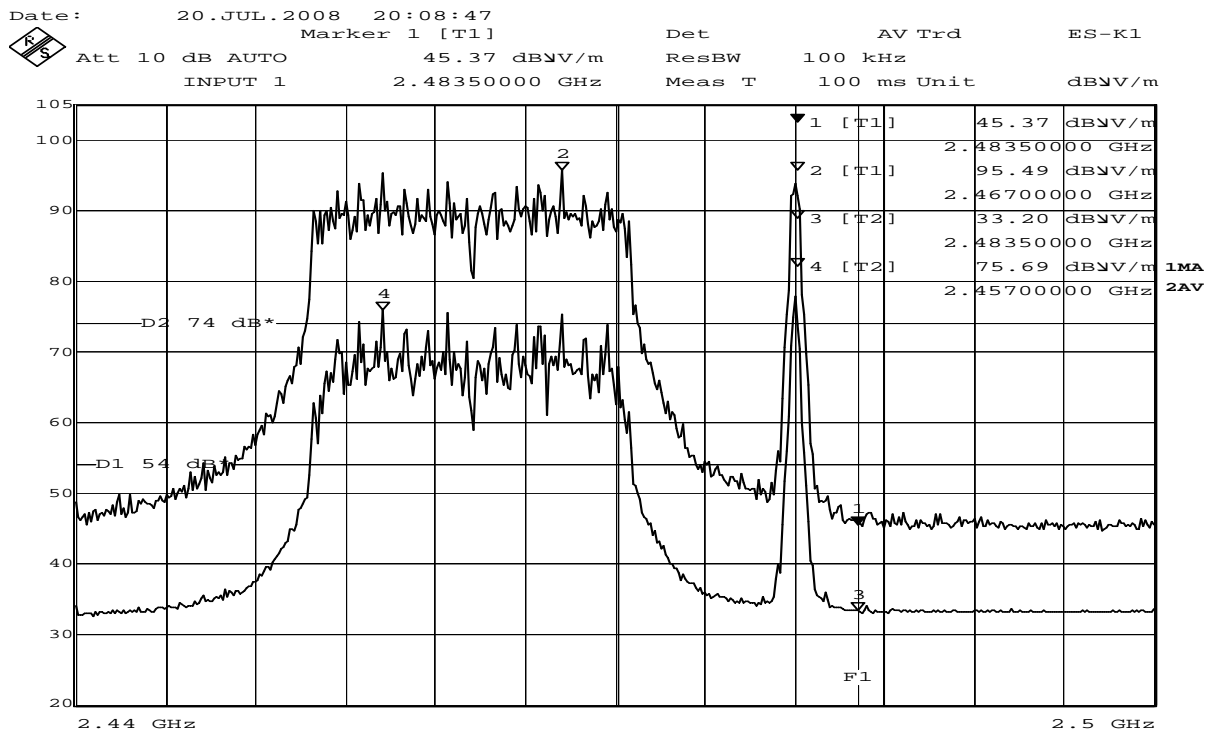
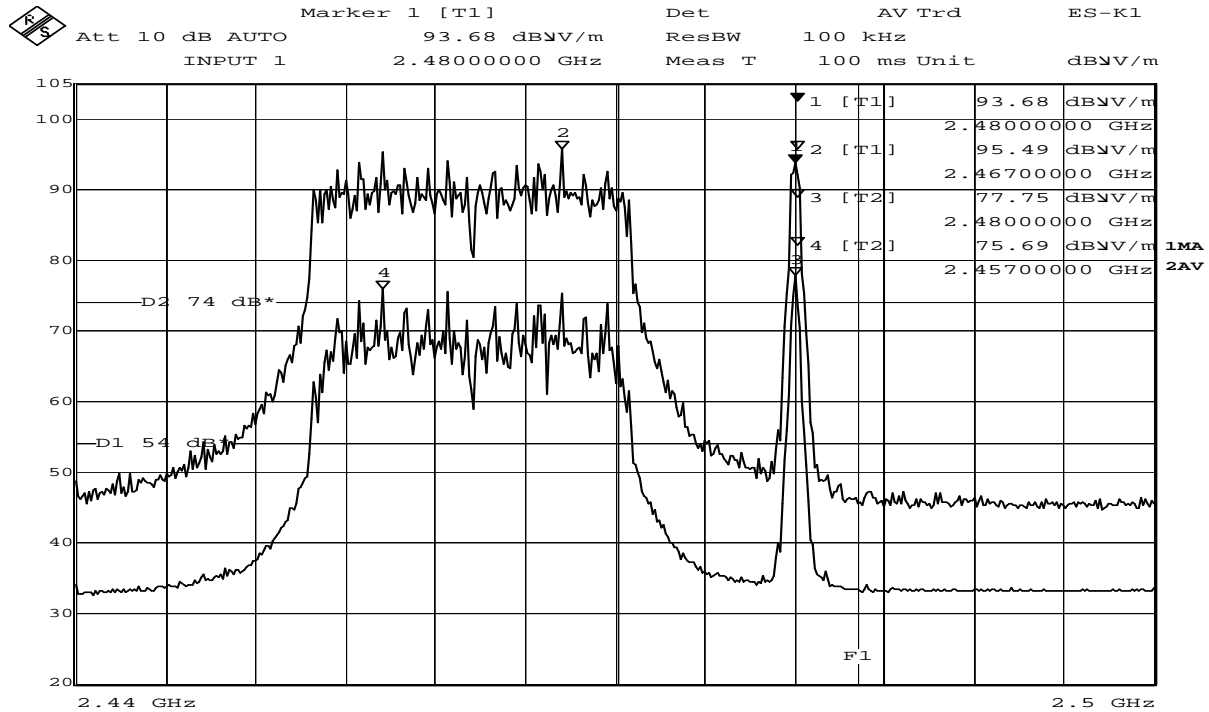
op-mode 3



Date: 20.JUL.2008 20:22:27

Op. Mode

op-mode 4



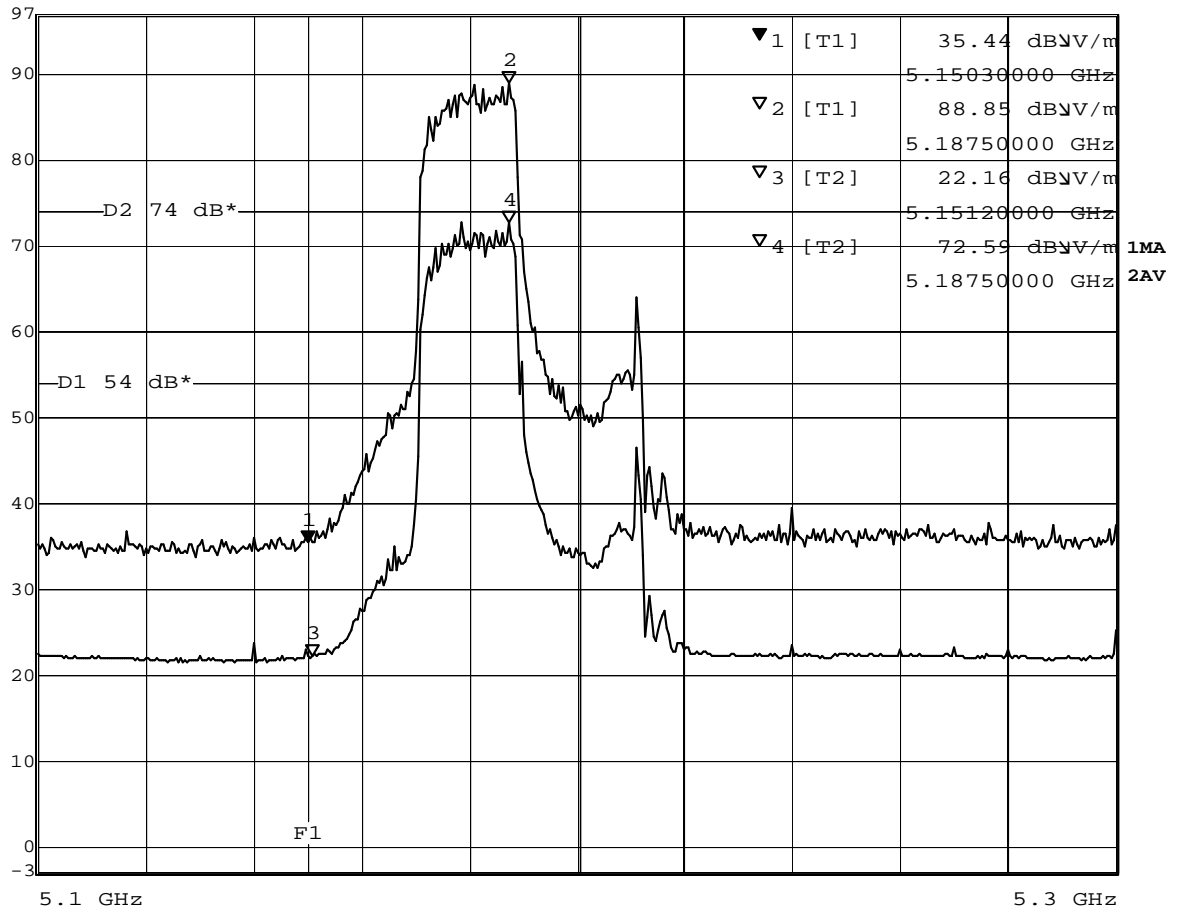
Date: 20.JUL.2008 20:08:21

Op. Mode

op-mode 5



Att 10 dB AUTO Marker 1 [T1] Det AV Trd ES-K1
 INPUT 1 5.15030000 GHz ResBW 100 kHz
 Meas T 100 ms Unit dBV/m

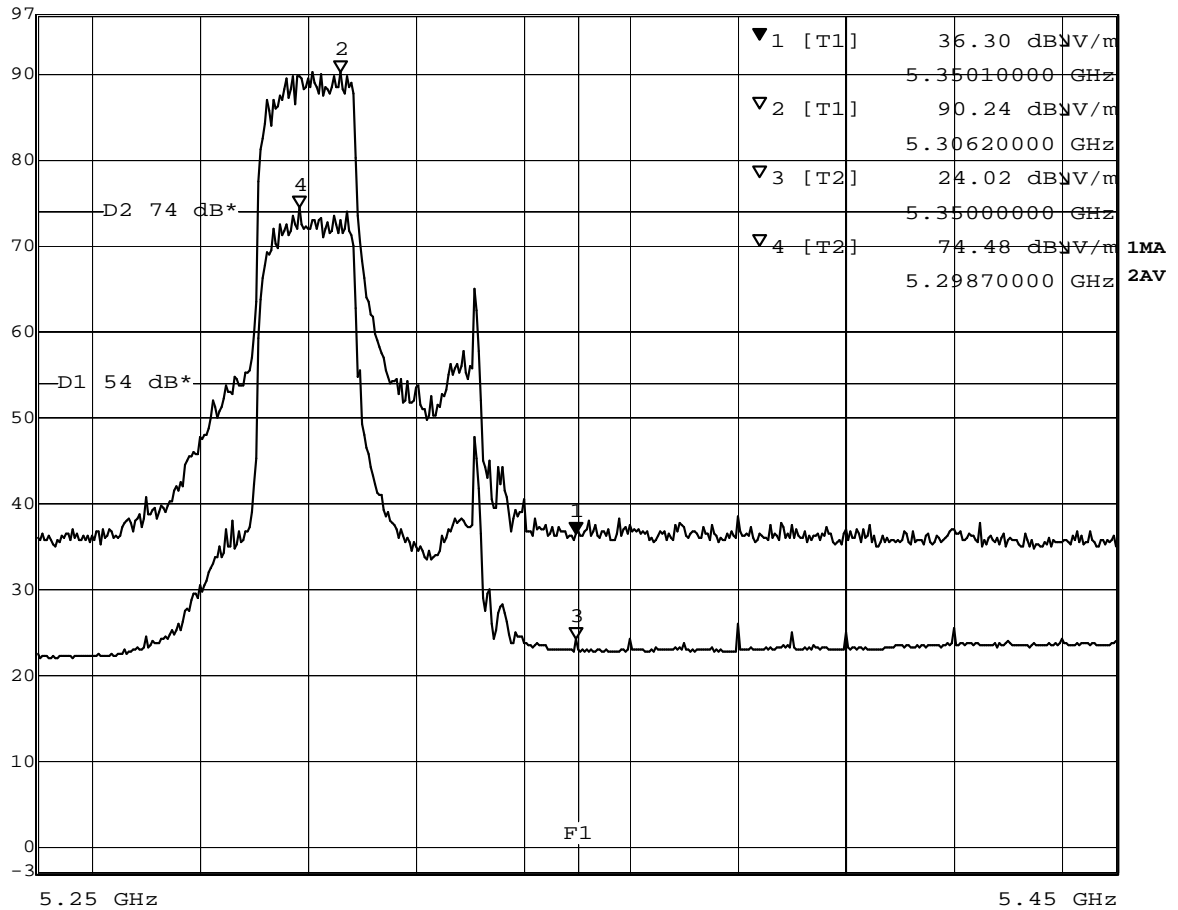


Date: 20.JUL.2008 20:48:04

Op. Mode

op-mode 6

| | | | | | |
|--|----------------|--------------------|--------|-------------|--------------|
| | Att 10 dB AUTO | Marker 1 [T1] | Det | AV Trd | ES-K1 |
| | | 36.30 dB μ V/m | ResBW | 100 kHz | |
| | INPUT 1 | 5.35010000 GHz | Meas T | 100 ms Unit | dB μ V/m |

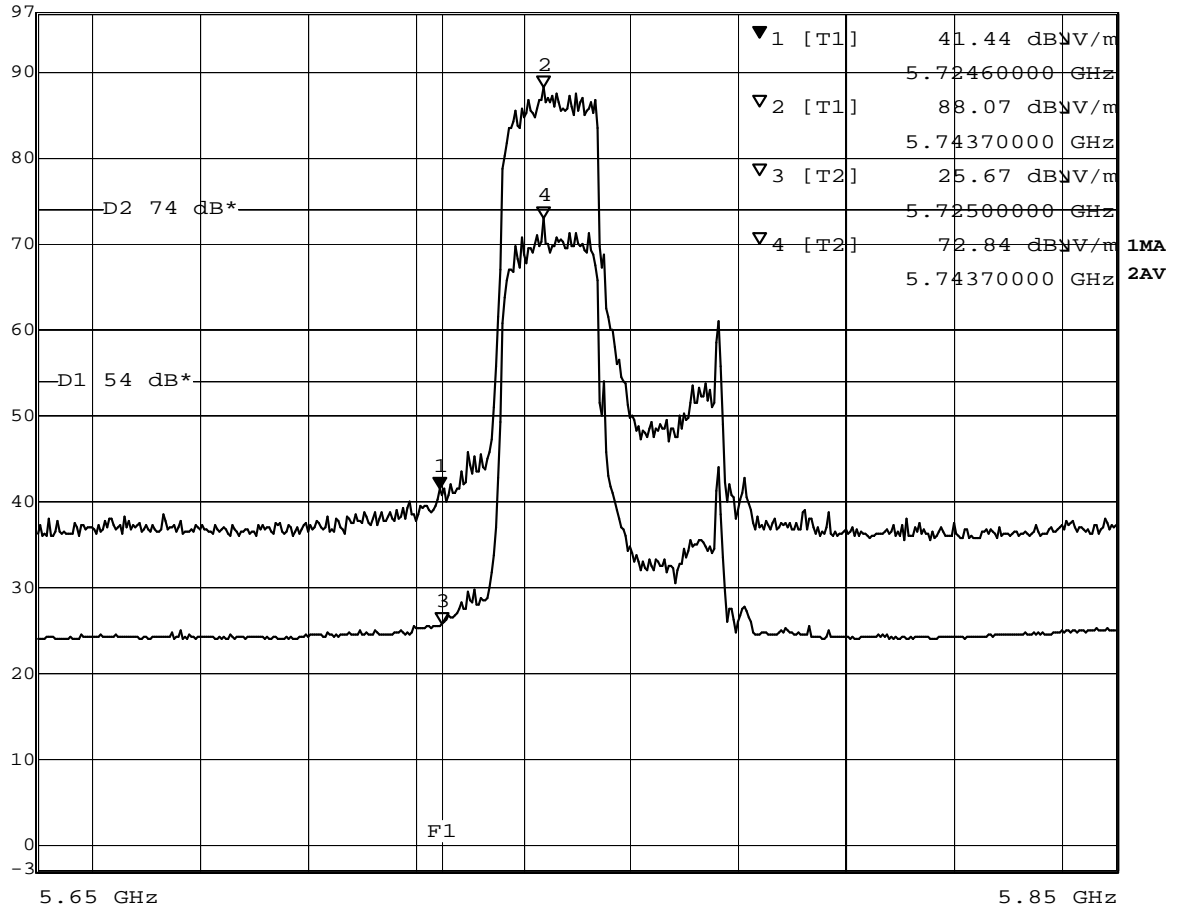


Date: 20.JUL.2008 20:53:57

Op. Mode

op-mode 7

| | | | | | | |
|--|----------------|----------------|-------------|--------|-------------|-------|
| | Att 10 dB AUTO | Marker 1 [T1] | 41.44 dBV/m | Det | AV Trd | ES-K1 |
| | INPUT 1 | 5.72460000 GHz | | ResBW | 100 kHz | |
| | | | | Meas T | 100 ms Unit | dBV/m |



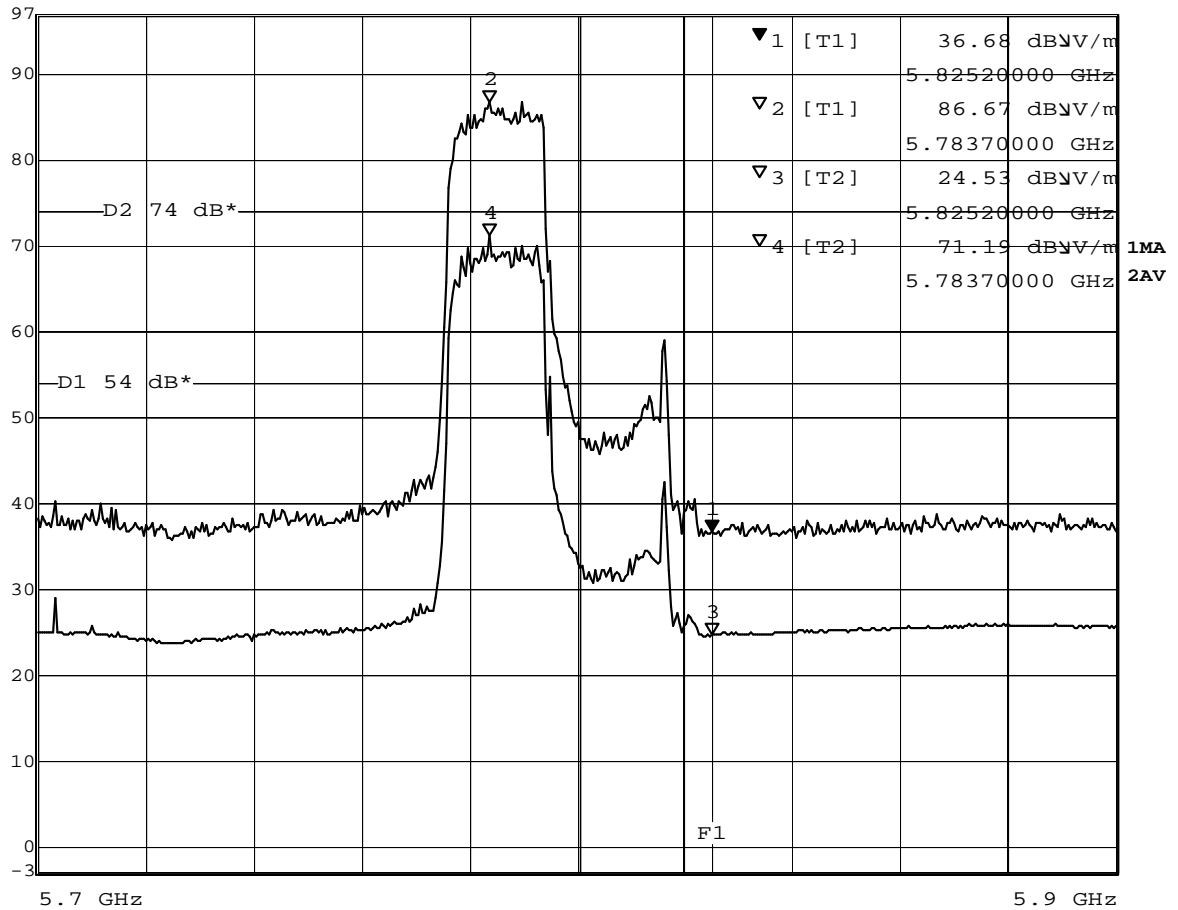
Date: 20.JUL.2008 21:01:16

Op. Mode

op-mode 8



Att 10 dB AUTO Marker 1 [T1] Det AV Trd ES-K1
 INPUT 1 5.82520000 GHz ResBW 100 kHz
 Meas T 100 ms Unit dBV/m

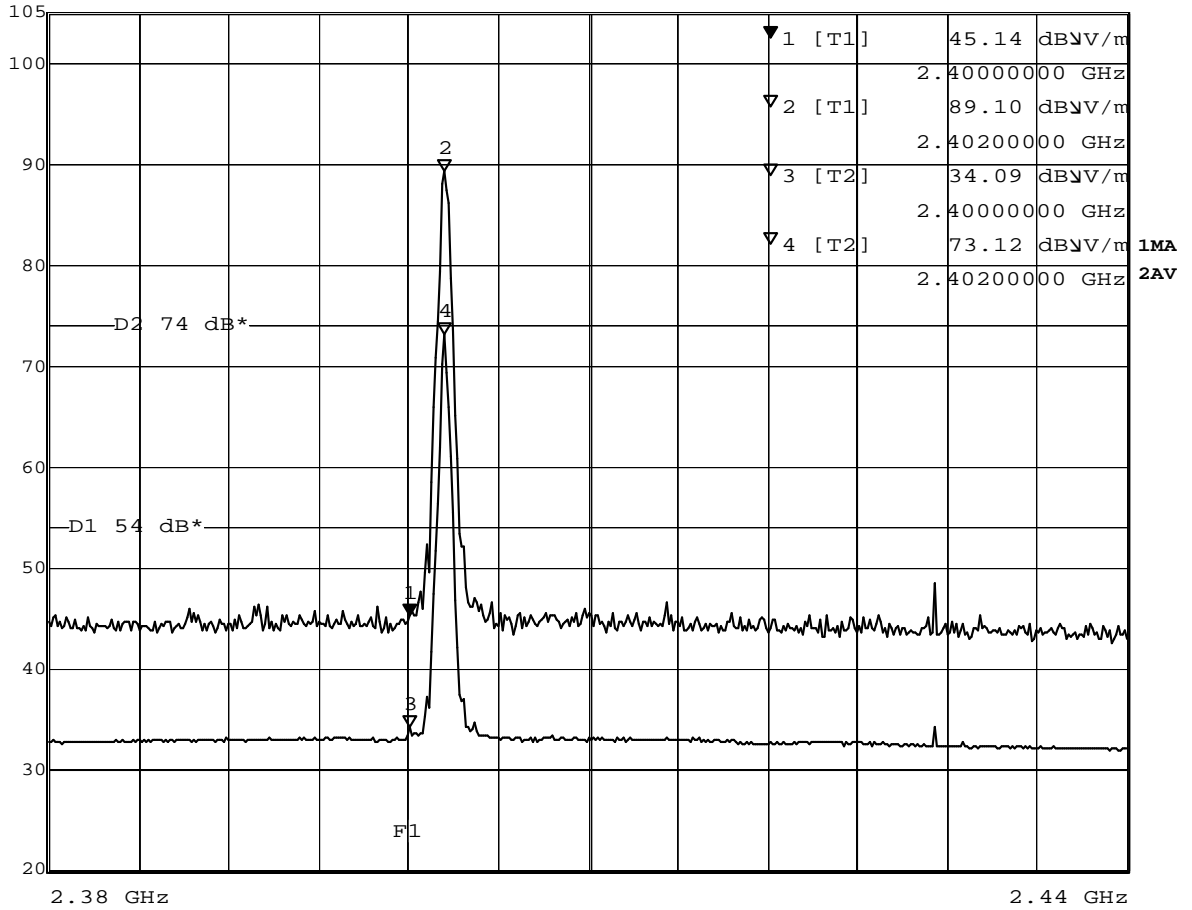


Date: 20.JUL.2008 21:07:36

Op. Mode

op-mode 9

| | | | | | | |
|--|----------------|----------------|-------------|--------|-------------|-------|
| | Att 10 dB AUTO | Marker 1 [T1] | 45.14 dBV/m | Det | AV Trd | ES-K1 |
| | INPUT 1 | 2.40000000 GHz | | ResBW | 100 kHz | |
| | | | | Meas T | 100 ms Unit | dBV/m |

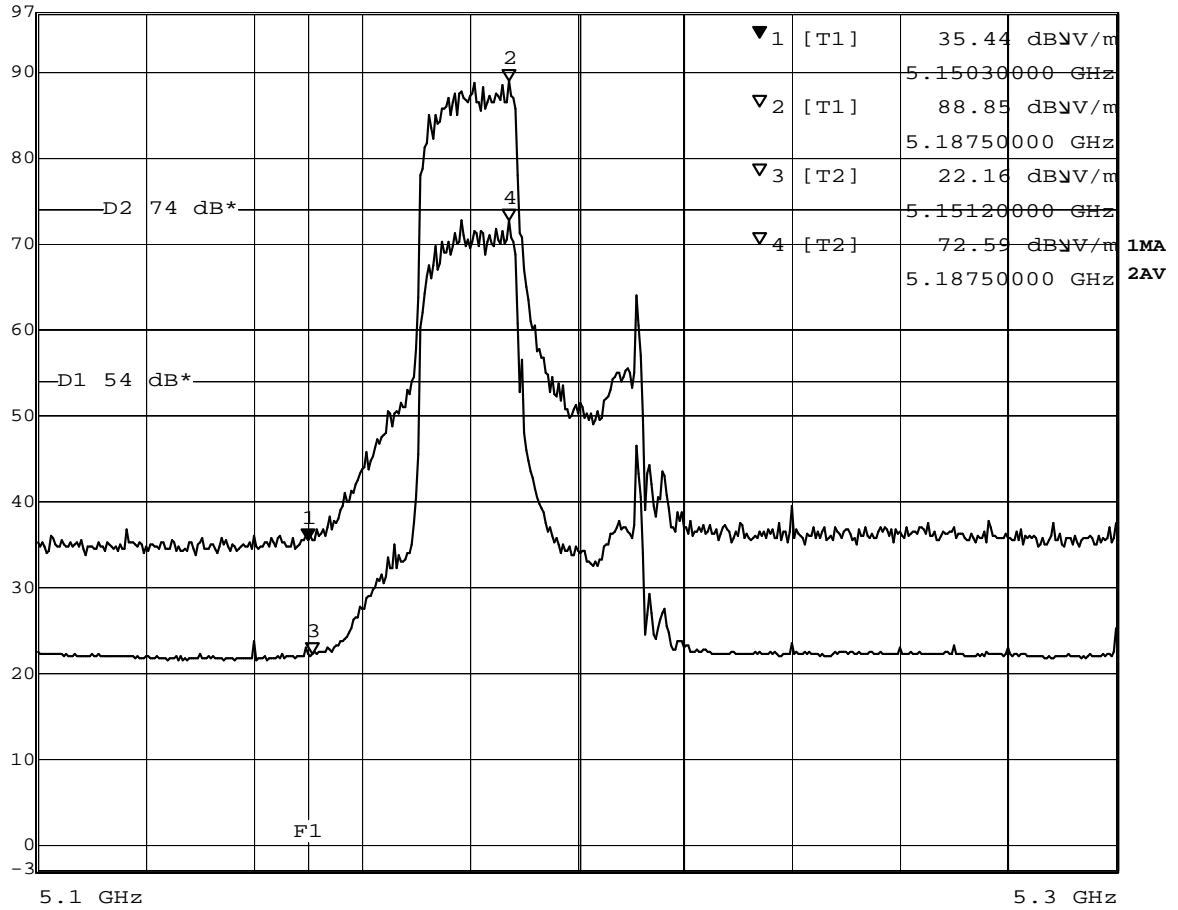


Date: 20.JUL.2008 20:26:41

Op. Mode

op-mode 5

| | | | | | | |
|--|----------------|----------------|--------------------|--------|-------------|--------------|
| | Att 10 dB AUTO | Marker 1 [T1] | 35.44 dB μ V/m | Det | AV Trd | ES-K1 |
| | INPUT 1 | 5.15030000 GHz | | ResBW | 100 kHz | |
| | | | | Meas T | 100 ms Unit | dB μ V/m |



Date: 20.JUL.2008 20:48:04