Königswinkel 10
32825 Blomberg
Germany
Phone +49 5235 9500-0
Fax +49 5235 9500-10

# TEST REPORT

**Test Report Reference: R40694a Edition 2**

**Equipment under Test: MobiScan-75**

**Serial Number: 50000900**

**Applicant: aitronic GmbH**

**Manufacturer: aitronic GmbH**

**FCC ID: Not available**

**Test Laboratory**
**(CAB)**
**accredited by**
**DATech e.V.**
**in compliance with DIN EN ISO/IEC 17025**
**under the**
**Reg. No. TTI-P-G071/94-11**
**and listed by**
**FCC 31040/SIT1300F2**

**Contents:** **Page**

# 1 IDENTIFICATION

## 1.1 APPLICANT

| | |
|---|---|
| Name: | aitronic GmbH |
| Address: | Max-Planck-Str. 19<br>33104 Paderborn |
| Country: | Germany |
| Name for contact purposes: | Mr. Bönninghoff |
| Phone: | +49-(0)-5254-9969-24 |
| Fax: | +49-(0)-5254-9969-40 |
| Mail address: | m.boenninghoff@aitronic.de |
| Applicant represented during the test by the following person: | Mr. Bönninghoff |

## 1.2 MANUFACTURER

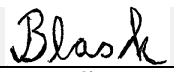
| | |
|---|---|
| Name: | aitronic GmbH |
| Address: | Max-Planck-Str. 19<br>33104 Paderborn |
| Country: | Germany |
| Name for contact purposes: | Mr. Bönninghoff |
| Phone: | +49-(0)-5254-9969-24 |
| Fax: | +49-(0)-5254-9969-40 |
| Mail address: | m.boenninghoff@aitronic.de |
| Applicant represented during the test by the following person: | Mr. Bönninghoff |

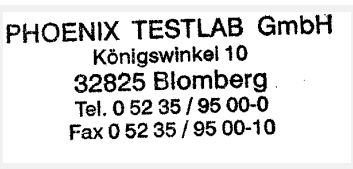
## 1.3 DATES

| | |
|---|---|
| Date of receipt of test sample: | 21 July 2004 |
| Start of test: | 21 July 2004 |
| Finish of test: | 21 July 2004 |

## 1.4 TEST LABORATORY

The tests were carried out at: **PHOENIX TEST-LAB GmbH**
**Königswinkel 10**
**D-32825 Blomberg** **Phone:** **+49 (0) 52 35 / 95 00-0**
**Germany** **Fax:** **+49 (0) 52 35 / 95 00-10**

| | | | |
|---|---|---|---|
| Test engineer: | Raimund BLASK |  | 24 August 2004 |
| | Name | Signature | Date |
| Test report checked: | Wilfried MEIER |  | 24 August 2004 |
| | Name | Signature | Date |




Stamp

## 1.5 RESERVATION

This test report is only valid in its original form.



The test results herein refer only to the tested sample. PHOENIX TEST-LAB GmbH is not responsible for any generalisations or conclusions drawn from these test results concerning further samples. Any modification of the tested samples is prohibited and leads to the invalidity of this test report. Each page necessarily contains the PHOENIX TEST-LAB Logo and the TEST REPORT REFERENCE.

## 1.6 NORMATIVE REFERENCES

[1] **ANSI C63.4-2001** American National Standard for Methods of Measuring of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

[2] **FCC 47 CFR Part 15 (23 April 2004)** Radio Frequency Devices

## 1.7 TEST RESULTS

The requirements of this test document are fulfilled by the equipment under test. The complete test results are presented in the following.

# 2 TECHNICAL DATA OF EQUIPMENT

## 2.1 DEVICE UNDER TEST

| | |
|---|---|
| Type of equipment: | 125 kHz reader |
| Type designation : | MobiScan-75 |
| Serial No.: | 50000900 |
| Highest internal frequency: | 7.372 MHz |
| FCC ID: | Not available |

**The following external I/O cables were used:**

| Cable | Length | Shielding | Connector |
|---|---|---|---|
| - | - | - | - |
| - | - | - | - |
| - | - | - | - |

## 2.2 PERIPHERY DEVICES

**The following equipment was used as control unit and ancillary equipment:**

The EUT was stimulated with a TAG (type 0F01AFA50D).

## 2.3 MODIFICATIONS

No modifications necessary to fulfil the requirements.

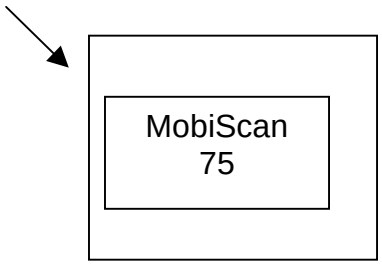
# 3 OPERATIONAL STATES AND PHYSICAL BOUNDARIES

The EUT was tested in normal operation mode:

| Channel: | Transmit frequency: |
|---|---|
| 1 | 125.000 kHz |

The physical boundaries of the Equipment Under Test are shown below.

Physical boundaries of the EUT:



# 4 LIST OF TEST MODULES

## 4.1 EMISSION

| Radiated emissions FCC 47 CFR Part 15 section 15.209 [2] | | | | | | |
|---|---|---|---|---|---|---|
| No. | Application | Frequency range | Limits (microvolts/meter) | Reference standard | Remark | Status |
| 1 | Intentional radiator | 0.009 to 0.49 MHz<br>0.490 to 1.705 MHz<br>1.705 to 30.0 MHz<br>30 to 88 MHz<br>88 to 216 MHz<br>216 to 960 MHz<br>960 to 1000 MHz | 2400/f(kHz) at 300 m<br>24000/f(kHz) at 30 m<br>30 dBµV/m at 30 m<br>40.0 dBµV/m at 3 m<br>43.5 dBµV/m at 3 m<br>46.0 dBµV/m at 3 m<br>54.0 dBµV/m at 3 m | ANSI C63.4 (2001); | - | Passed |
| Radiated emissions FCC 47 CFR Part 15 section 15.109 [2] | | | | | | |
| No. | Application | Frequency range | Limits (at 3 m distance) | Reference standard | Remark | Status |
| 2 | Unintentional radiator | 30 to 88 MHz<br>88 to 216 MHz<br>216 to 960 MHz<br>above 960 MHz | 100 µV / m<br>150 µV / m<br>200 µV / m<br>500 µV / m | ANSI C63.4 (2001); | - | Passed |

# METHOD OF MEASUREMENT

## 4.2 RADIATED EMISSIONS 9 kHz to 30 MHz

The radiated emission measurement is divided into two stages.

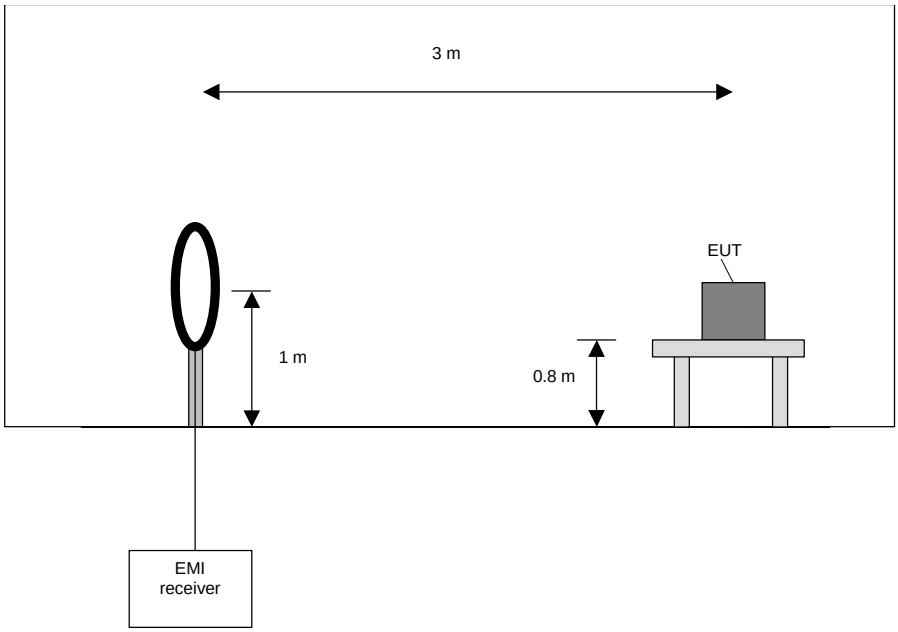
**Preliminary measurement:**

In the first stage a preliminary measurement will be performed in a shielded room with a measuring distance of 3 meters. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2001 [1].

The frequency range 9 kHz to 30 MHz will be monitored with a spectrum analyser while the system and its cables will be manipulated to find out the configuration with the maximum emission levels if applicable. The EMI Receiver will be set to MAX Hold mode. The EUT and the measuring antenna will be rotated around their vertical axis to found the maximum emissions.

The resolution bandwidth of the spectrum analyser will be set to the following values:

| Frequency range | Resolution bandwidth |
|---|---|
| 9 kHz to 150 kHz | 200 Hz |
| 150 kHz to 30 MHz | 10 kHz |



Preliminary measurement procedure:

Prescans were performed in the frequency range 9 kHz to 150 kHz and 150 kHz to 30 MHz.

The following procedure will be used:

1) Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2) Manipulate the system cables within the range to produce the maximum level of emission.
3) Rotate the EUT by 360 ° to maximize the detected signals.
4) Make a hardcopy of the spectrum.
5) Measure the frequencies of highest detected emission with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
6) Repeat steps 1) to 4) with the other orthogonal axes of the EUT if applicable (handheld equipment).
7) Rotate the measuring antenna and repeat steps 1) to 5).

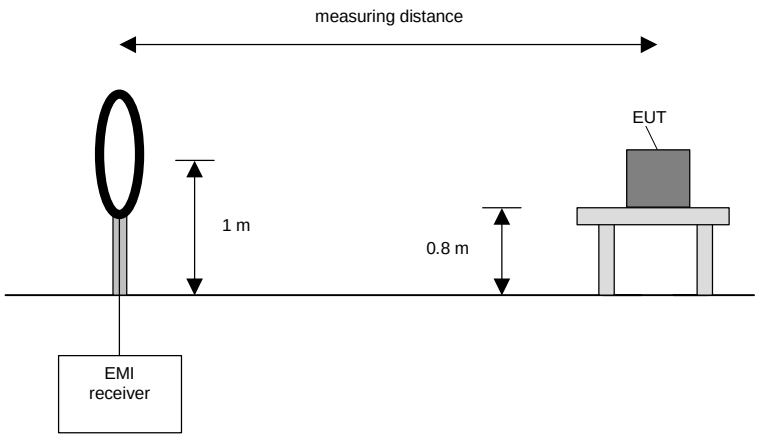
**Final measurement:**

In the second stage a final measurement will be performed on an open area test site with no conducting ground plane in a measuring distances of 3 m, 10 m and 30 m. In the case where larger measuring distances are required the results will be extrapolated based on the values measured on the closer distances according to Section 15.31 (f) (2) [2]. The final measurement will be performed with a EMI Receiver set to Quasi Peak detector except for the frequency bands 9 kHz to 90 kHz and 110 kHz to 490 kHz where an average detector will be used according Section 15.209 (d) [2].

On the during the preliminary measurement detected frequencies the final measurement will be performed while rotating the EUT and the measuring antenna in the range of 0 ° to 360 ° around their vertical axis until the maximum value is found.

The resolution bandwidth of the EMI Receiver will be set to the following values:

| Frequency range | Resolution bandwidth |
|---|---|
| 9 kHz to 150 kHz | 200 Hz |
| 150 kHz to 30 MHz | 9 kHz |



Final measurement procedure:

The following procedure will be used:

1) Monitor the frequency range with the measuring antenna at vertical orientation parallel to the EUT at an azimuth of 0 °.
2) Rotate the EUT by 360 ° to maximize the detected signals and note the azimuth and orientation.
3) Rotate the measuring antenna to find the maximum and note the value.
4) Rotate the measuring antenna and repeat steps 1) to 3) until the maximum value is found.
5) Repeat steps 1) to 4) with the other orthogonal axes of the EUT if applicable (handheld equipment).

## 4.3 RADIATED EMISSIONS 30 MHz TO 1 GHz

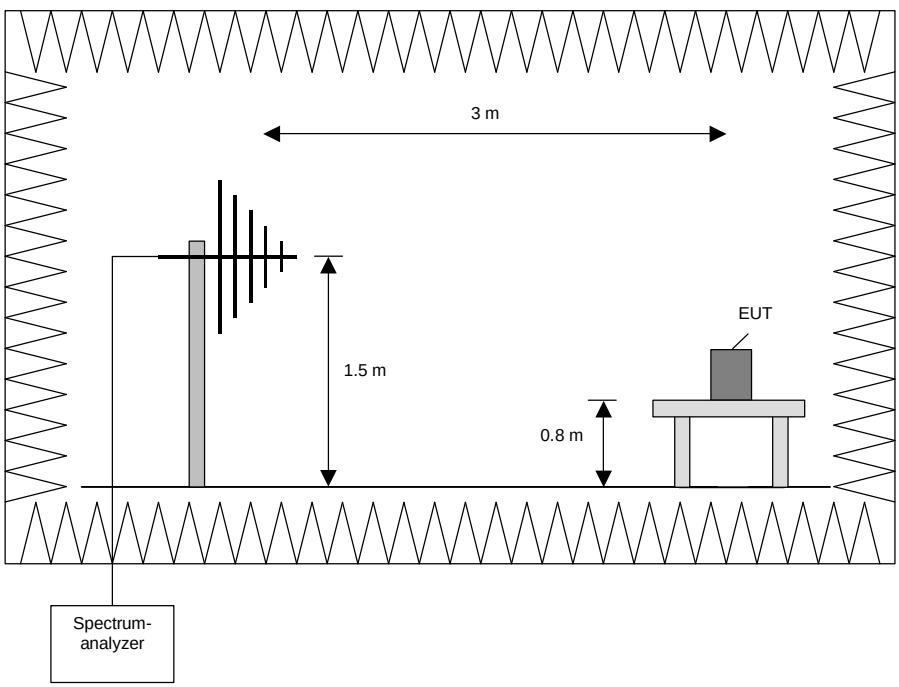
The radiated emission measurement is divided into two stages.

**Preliminary measurement:**

In the first stage a preliminary measurement will be performed in a fully anechoic chamber with a measuring distance of 3 meter. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2001 [1].

The frequency range 30 MHz to 1 GHz will be measured with an EMI Receiver set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °.
The resolution bandwidth of the EMI Receiver will be set to the following values:

| Frequency range | Resolution bandwidth |
|---|---|
| 30 MHz to 1 GHz | 100 kHz |



Procedure preliminary measurement:

Prescans were performed in the frequency range 30 MHz to 230 MHz and 230 MHz to 1 GHz.
The following procedure will be used:

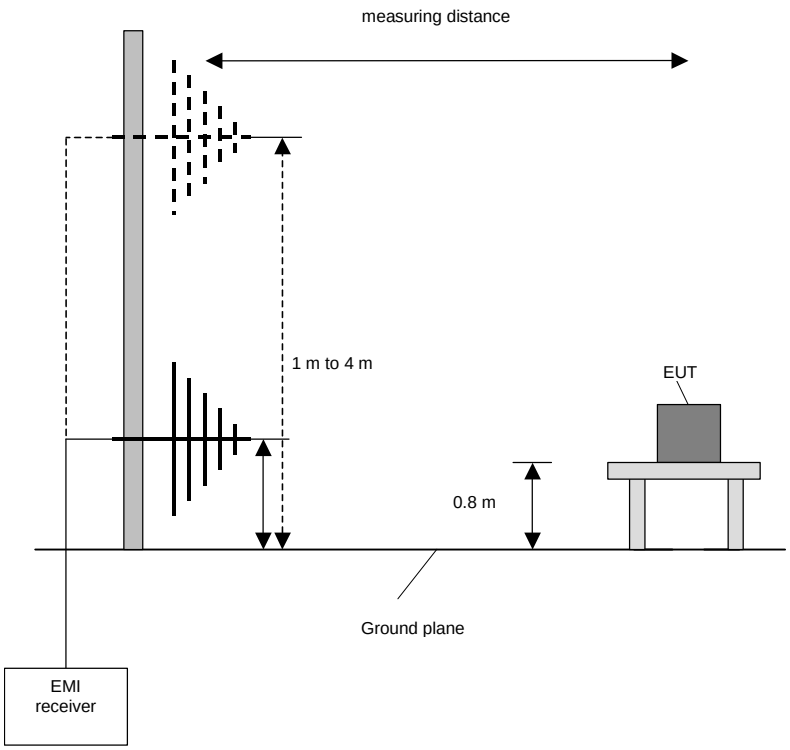
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °
2. Manipulate the system cables within the range to produce the maximum level of emission
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum
5. Measure the frequency of 3 highest detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
6. Repeat steps 1) to 4) with the other orthogonal axes of the EUT if handheld equipment
7. Repeat steps 1) to 5) with the vertical polarisation of the measuring antenna.

**Final Measurement:**

In the second stage a final measurement on an open area test site will be performed on selected frequencies found in the preliminary measurement. During this test the EUT will be rotated in the range of 0 ° to 360 °, the measuring antenna will be set to horizontal and vertical polarisation and raised and lowered in the range from 1 m to 4 m to find the maximum level of emissions.

The resolution bandwidth of the EMI Receiver will be set to the following values:

| Frequency range | Resolution bandwidth |
|---|---|
| 30 MHz to 1 GHz | 120 kHz |



Procedure final measurement:

The following procedure will be used:

1) Measure on the selected frequencies at an antenna height of 1 m and a EUT azimuth of 23 °
2) Move the antenna from 1 m to 4 m and note the maximum value at each frequency.
3) Rotate the EUT by 45 ° and repeat 2) until an azimuth of 337 ° is reached.
4) Repeat 1) to 3) for the other orthogonal antenna polarization.
5) Move the antenna and the turntable to the position where the maximum value is detected.
6) Measure while moving the antenna slowly +/- 1 m
7) Set the antenna to the position where the maximum value is found
8) Measure while moving the turntable +/- 45 °
9) Set the turntable to the azimuth where the maximum value is found
10) Measure with Final detector (QP or AV) and note the value
11) Repeat 5) to 10) for each frequency
12) Repeat 1) to 11) for each orthogonal axes of the EUT if handheld equipment

# 5 TEST RESULTS EMISSION TEST

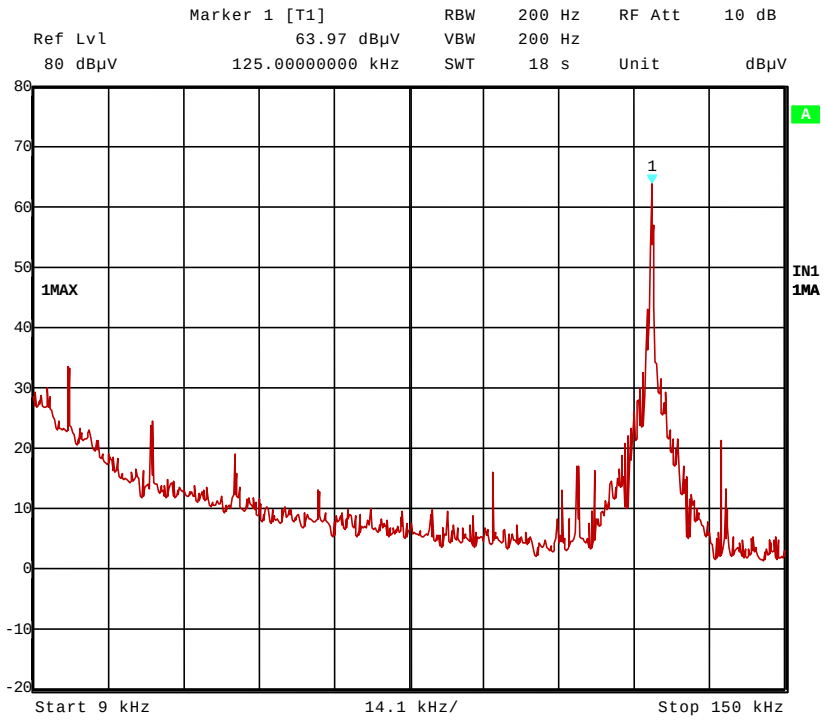
## 5.1 PRELIMINARY RADIATED EMISSION TEST (9 kHz TO 30 MHz)

| | | | |
|---|---|---|---|
| Ambient temperature | 20 °C | Relative humidity | 65 % |

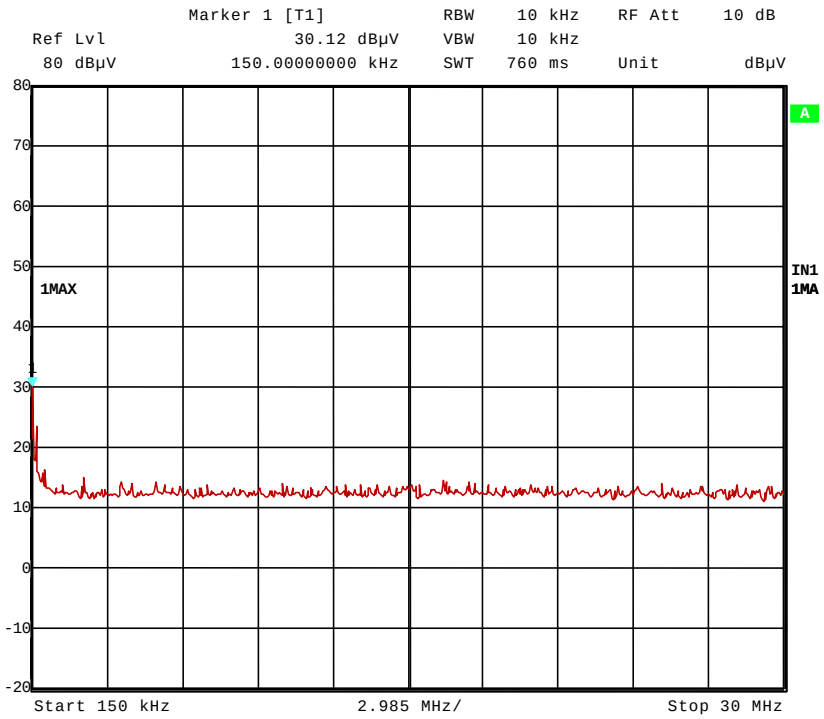
Position of EUT: The EUT was set-up on a wooden table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: No cables necessary.

Test record: The test was carried out in normal operation mode of the EUT (transmit mode). All results are shown in the following.




40694tx1a.wmf: 9 kHz to 150 kHz, transmit mode




40694tx2a.wmf: 150 kHz to 30 MHz, transmit mode

The following significant frequency was found during the preliminary radiated emission test:

15.647 kHz, 31.188 kHz, 46.729 kHz, 62.55 kHz, 125.000 kHz

These frequencies have to be measured on the outdoor test site. The results of this final measurement are shown in this test report.

TEST EQUIPMENT USED THE TEST:

| |
|---|
| 29, 31 - 33, 41, 42 |

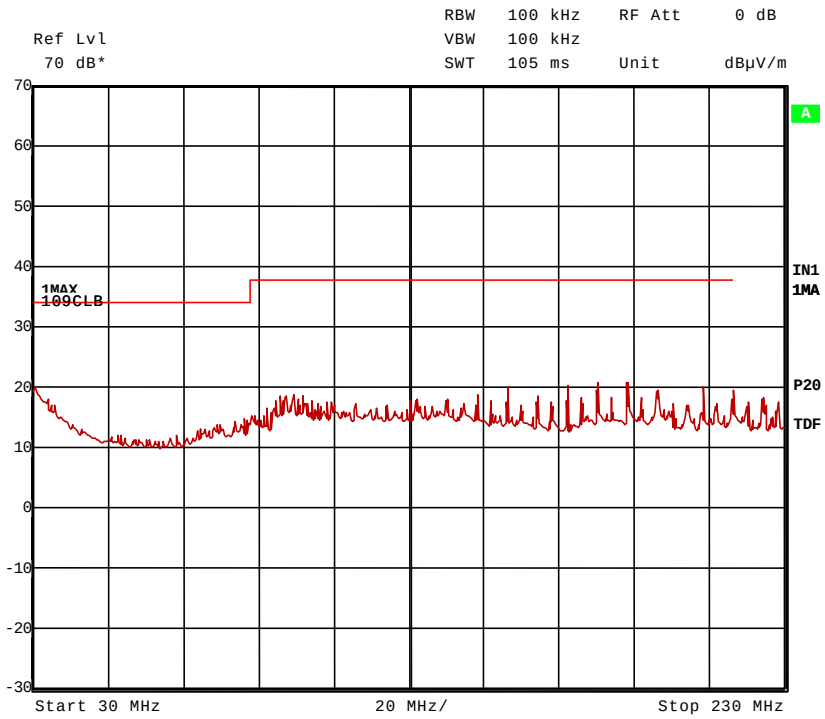
## 5.2 PRELIMINARY RADIATED EMISSION TEST (30 MHz to 1 GHz)

| | | | |
|---|---|---|---|
| Ambient temperature | 20 °C | Relative humidity | 60 % |

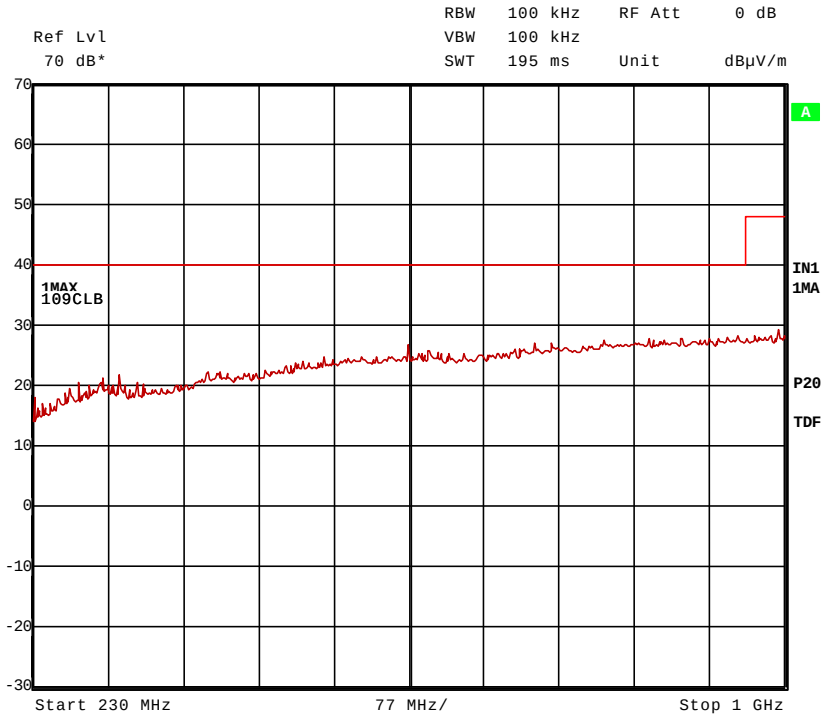
Position of EUT: The EUT was set-up on a wooden table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: No cables necessary.

Test record: The test was carried out in normal operation mode of the EUT (transmit mode). All results are shown in the following.




40694tx3a.wmf: 30 MHz to 200 MHz, transmit mode




40694tx4a.wmf: 200 MHz to 1000 MHz, transmit mode

No significant frequencies were found during the preliminary radiated emission test:

TEST EQUIPMENT USED FOR THE TEST:

| |
|---|
| 29, 31 – 35, 37, 42 |

## 5.3 FINAL RADIATED EMISSION TEST (9 kHz TO 30 MHz)

| | | | |
|---|---|---|---|
| Ambient temperature | 20 °C | Relative humidity | 60 % |

Position of EUT: The EUT was set-up on a wooden table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: No cables necessary.

Test record: The test was carried out in normal operation mode of the EUT (transmit mode). All results are shown in the following.

Limits: To calculate the limits according to the used measuring distance, the 40 dB/decade extrapolation method was used.

Test results: The test results were calculated with the following formula:

Result [dBµV/m] = reading [dBµV] + antenna factor [dB/m]

Measuring results (distance 10 m):

| Fundamental frequency | | | | | | |
|---|---|---|---|---|---|---|
| Frequency kHz | Result dBµV/m | Limit dBµV/m | Margin dB | Detector | Readings dBµV | Antenna factor * dB/m |
| 15.647 | 72.0 | 103.7 | 31.7 | QP | 52.0 | 20 |
| 31.188 | 58.0 | 97.7 | 39.7 | QP | 38.0 | 20 |
| 46.729 | 55.0 | 94.2 | 39.2 | QP | 35.0 | 20 |
| 62.550 | 52.0 | 91.7 | 39.7 | QP | 32.0 | 20 |
| 125.000 | 53.1 | 85.6 | 32.5 | QP | 33.1 | 20 |

*: Cable loss included

Test: Passed

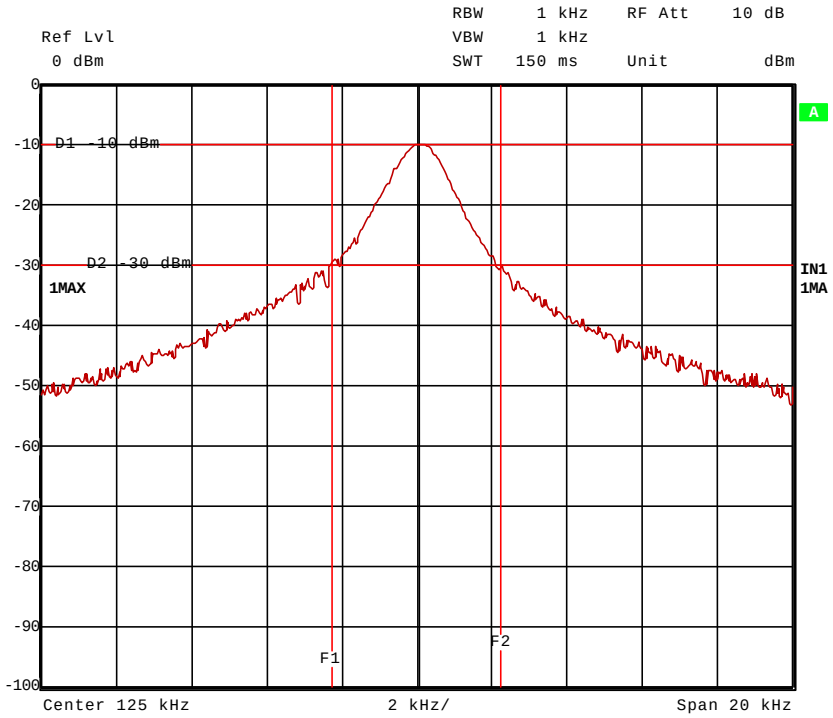
TEST EQUIPMENT USED FOR THE TEST:

| |
|---|
| 40 - 43 |

## 5.4 BAND EDGE COMPLIANCE

| | | | |
|---|---|---|---|
| Ambient temperature: | 20 °C | Relative humidity: | 62 % |

Supply voltage: For measuring the amplitude of the fundamental frequency the supply voltage was varied. There was no changing of the amplitude.




40694obw.wmf: Occupied bandwidth

| $F_L$ | $F_U$ | BW ($F_U$ - $F_L$) |
|---|---|---|
| 122.850 kHz | 127.220 kHz | 4.37 kHz |

TEST EQUIPMENT USED THE TEST:

| |
|---|
| 29, 31, 41, 42, 44, 47 |

# 6 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

| Emission measurement at AC mains and DC in / out ports at M4 | | | | | |
|---|---|---|---|---|---|
| No. | Test equipment | Type | Manufacturer | Serial No. | PM-No |
| 1 | Shielded chamber M4 | - | Siemens | B83117S1-X158 | 480088 |
| 2 | Measuring receiver | ESAI | Rohde & Schwarz | 831953/001<br>833181/018 | 480025<br>480026 |
| 3 | LISN | NSLK8128 | Schwarzbeck | 8128155 | 480058 |
| 4 | DC-filter | B84266-A21-E13 | Siemens | 940164525 | 480099 |
| 5 | AC-filter | B84299-D87-E3 | Siemens | 930262292 | 480097 |
| 6 | EMI-Software | ES-K1 | Rohde & Schwarz | - | 480111 |

| Radiated emission measurement at M5 | | | | | |
|---|---|---|---|---|---|
| No. | Test equipment | Type | Manufacturer | Serial No. | PM-No |
| 7 | Fully anechoic chamber M5 | - | Siemens | B83177-S1-X156 | 480073 |
| 8 | Measuring receiver | ESVS30 | Rohde & Schwarz | 829673/012 | 480024 |
| 9 | Controller | HD100 | Deisel | 100/324 | 480067 |
| 10 | Antenna support | MA240 | Deisel | 228/314 | 480069 |
| 11 | Turntable | DS412 | Deisel | 412/317 | 480070 |
| 12 | Antenna | CBL6112C | Chase | 2689 | 480327 |
| 13 | EMI Software | ES-K1 | Rohde & Schwarz | - | 480111 |

| Radiated emission measurement at M6 | | | | | |
|---|---|---|---|---|---|
| No. | Test equipment | Type | Manufacturer | Serial No. | PM-No |
| 14 | Open area test site | - | Phoenix Test-Lab | - | 480085 |
| 15 | Measuring receiver | ESVS30 | Rohde & Schwarz | 829673/012 | 480024 |
| 16 | Controller | HD100 | Deisel | 100/670 | 480139 |
| 17 | Turntable | DS420HE | Deisel | 420/620/80 | 480087 |
| 18 | Antenna support | AS615P | Deisel | 615/310 | 480086 |
| 19 | Antenna | CBL6111 A | Chase | 1643 | 480147 |
| 20 | EMI Software | ES-K1 | Rohde & Schwarz | - | 480111 |

| Radiated emission measurement at M8 | | | | | |
|---|---|---|---|---|---|
| No. | Test equipment | Type | Manufacturer | Serial No. | PM-No |

| | | | | | |
|---|---|---|---|---|---|
| 21 | Fully anechoic chamber M8 | - | Siemens | B83117-E7019-T231 | 480190 |
| 22 | Measuring receiver | ESMI | Rohde & Schwarz | 843977/001<br>843530/018 | 480179<br>480180 |
| 23 | Measuring receiver | ESCS 30 | Rohde & Schwarz | 828985/014 | 480270 |
| 24 | Controller | HD100 | Deisel | 100/427 | 480181 |
| 25 | Turntable | DS420 | Deisel | 420/435/97 | 480186 |
| 26 | Antenna support | AS615P | Deisel | 615/310 | 480187 |
| 27 | Antenna | CBL6112 A | Chase | 2034 | 480185 |
| 28 | EMI Software | ES-K1 | Rohde & Schwarz | - | 480111 |

| Radiated emission measurement at M20 | | | | | |
|---|---|---|---|---|---|
| No. | Test equipment | Type | Manufacturer | Serial No. | PM-No |
| 29 | Fully anechoic chamber M20 | - | Albatross Projects | B83107-E2439-T232 | 480303 |
| 30 | Measuring receiver | ESMI | Rohde & Schwarz | 843977/001<br>843530/018 | 480179<br>480180 |
| 31 | Measuring receiver | ESI 40 | Rohde & Schwarz | 100064 | 480355 |
| 32 | Controller | HD100 | Deisel | 100/670 | 480326 |
| 33 | Turntable | DS420HE | Deisel | 420/620/80 | 480315 |
| 34 | Antenna support | AS615P | Deisel | 615/310 | 480187 |
| 35 | Antenna | CBL6112 B | Chase | 2688 | 480328 |
| 36 | Antenna | 3115 A | EMCO | 9609-4918 | 480183 |
| 37 | RF-cable No. 30 | RTK 081 | Rosenberger | - | 410141 |
| 38 | EMI Software | ES-K1 | Rohde & Schwarz | - | 480111 |
| 39 | RF-cable No. 5 | RTK 081 | Rosenberger | | 410097 |

| Ancillary equipment used for testing | | | | | |
|---|---|---|---|---|---|
| No. | Test equipment | Type | Manufacturer | Serial No. | PM-No |
| 40 | Outdoor test site | - | Phoenix Test-Lab | - | 480293 |
| 41 | Loop antenna | HFH2-Z2 | Rohde & Schwarz | 832609/014 | 480059 |
| No. | Test equipment | Type | Manufacturer | Serial No. | PM-No |
| 42 | Power supply | TOE 8852 | Toellner | 51712 | 480233 |
| 43 | EMI test receiver | ESPC | Rohde & Schwarz | 843756/006 | 480150 |

| | | | | | |
|---|---|---|---|---|---|
| 44 | Signal generator | SMHU | Rohde & Schwarz | 844170/017 | 480266 |
| 45 | Climatic chamber | GTS500.40 | GTS | 1660 | 490073 |
| 46 | Loop Antenna ∅ = 225 mm | - | Phoenix Test-Lab | - | 410085 |
| 47 | RF-cable No. 11 | RG223 | Phoenix-Test-Lab | - | 410103 |
| - | - | - | - | - | - |
| - | - | - | - | - | - |
| - | - | - | - | - | - |

All used measurement equipment was calibrated (if necessary). The calibration intervals and the calibration history will be given out on request.

# 7 LIST OF ANNEXES

| | | |
|---|---|---|
| **ANNEX A** | **PHOTOGRAPHS OF THE TEST SET-UPS**: | **3 pages** |
| | Test set-up preliminary emission measurement (9 kHz to 30 MHz) | 40694emi5.jpg |
| | Test set-up preliminary emission measurement (30 MHz to 1 GHz) | 40694emi7.jpg |
| | Test set-up final emission measurement (9 kHz to 30 MHz) | 40694emi8.jpg |
| **ANNEX B** | **EXTERNAL PHOTOGRAPHS OF THE TEST SAMPLE**: | **2 pages** |
| | EUT, front view | 40694eut7.jpg |
| | EUT, rear view | 40694eut6.jpg |
| **ANNEX C** | **INTERNAL PHOTOGRAPHS OF THE TEST SAMPLE**: | **1 pages** |
| | EUT, PCB front view | 40694eut14.jpg |