

# TEST REPORT

**Test Report Reference: R70711\_A Edition 1**

**Equipment under Test:**

**TN-M30-H1147 / TN-M30-H1147/S1126  
TN-EM30WD-H1147 / TN-EM30WD-H1147/S1126**

**Article No: 7030004 / 7030215 / 7030222 / 7030226**

**Applicant: Turck, Werner GmbH & Co. KG**

**Manufacturer: Turck, Werner GmbH & Co. KG**

**Test Laboratory  
(CAB)  
accredited by  
DATech in der TGA GmbH  
in compliance with DIN EN ISO/IEC 17025  
under the  
Reg. No. DAT-P-105/99-21,  
FCC Test site registration number 90877  
and  
Industry Canada Test site registration IC3469**

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## 1 IDENTIFICATION

### 1.1 APPLICANT

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Name for contact purposes:	Markus Teubner
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e-mail address:	m.teubner@turck-halver.de

### 1.3 DATES

Date of receipt of test sample:	03 August 2007
Start of test:	03 August 2007
End of test:	14 October 2007

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## 1.4 TEST LABORATORY

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

accredited by DATech in der TGA GmbH in compliance with DIN EN ISO/IEC 17025 under  
Reg. No. DAT-P-105/99-21,  
FCC Test site registration number 90877 and Industry Canada Test site registration IC3469

Test engineer: Dieter SÜTTHOFF

Name



Signature

29 February 2008

Date

Test report checked: Bernd STEINER

Name



Signature

29 February 2008

Date

**PHOENIX TESTLAB GmbH**  
**Königswinkel 10**  
**32825 Blomberg**  
Tel. 0 52 35 / 95 00-0  
Fax 0 52 35 / 95 00-10

Stamp

## 1.5 RESERVATION

This test report is only valid in its original form.

Any reproduction of its contents without written permission of the accredited test laboratory  
PHOENIX TESTLAB GmbH is prohibited.

The test results herein refer only to the tested sample. PHOENIX TESTLAB 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 TESTLAB Logo and the TEST REPORT REFERENCE.

## 1.6 NORMATIVE REFERENCES

- [1] **ANSI C63.4:2003** 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 2 (2007-10)** General Rules and Regulations
- [3] **FCC 47 CFR Part 15 (2007-10)** Radio Frequency Devices (Subpart B)

## 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.

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## 2 TECHNICAL DATA OF EQUIPMENT

### 2.1 DEVICE UNDER TEST

Type of equipment:	13.56 MHz Reader
Type designation:	TN-M30-H1147, TN-M30-H1147/S1126, TN-EM30WD-H1147, TN-EM30WD-H1147/S1126
Art. No.:	7030003, 7030214, 7030221, 7030225
Highest internal frequency:	13.56 MHz
Antenna type:	Integral

The following external I/O cables were used:

Cable	Length	Shielding	Connector
Connection cable (including DC supply lines and Data in/ out lines)	10 m *	Yes	H1147
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

\*: Length during the test

### 2.2 PERIPHERY DEVICES

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

During all measurements the EUT was reading a 13.56 MHz transponder card TW-R30-B128  
The EUT submits the receiving data to the RFID module 2RFID-A / gateway PG-EN

### 2.3 SPECIAL EMC MEASURES

The following EMC measures were necessary to reach the documented results:

- IC33 = Toshiba TC7SU04F
- C34 = 47 pF

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### 3 OPERATIONAL STATES AND PHYSICAL BOUNDARIES

All measurements reported in this document were done with the model TN-M30-H1147.

The TN-M30-H1147/S1126, TN-EM30WD-H1147, TN-EM30WD-H1147/S1126 are variants of the TN-M30-H1147 which have only differences in the material of the enclosure and in the supported TAG protocols. These differences have no impact on the RF parameters and the electrical circuit, as declared by the applicant.

- Enclosure material of TN-EM30WD-H1147 and TN-EM30WD-H1147/S1126 is stainless steel.
- Enclosure material of TN-M30-H1147 and TN-M30-H1147/S1126 is brazen.

The extension /S1126 mean that an additional SL1- software protocol is supported.

A radiated emission pre test (30 MHz up to 1 GHz) between the variants has shown that the equipment variant with the brazen material is the worst case. Furthermore a pre-measurement has shown that the software protocols don't affected the emission behaviour.

Due to this reasons all measurements was done with the TN-M30-H1147 variant.

During all tests the EUT was supplied with a DC supply voltage, which was provided by an external power supply or an AC / DC adaptor type Phoenix Contact MINI-PS-100-240AC/24V (used only for the conducted emissions on AC-mains). For the conducted emission measurement on AC-mains the AC / DC adaptor was supplied with 120 V AC / 60 Hz.

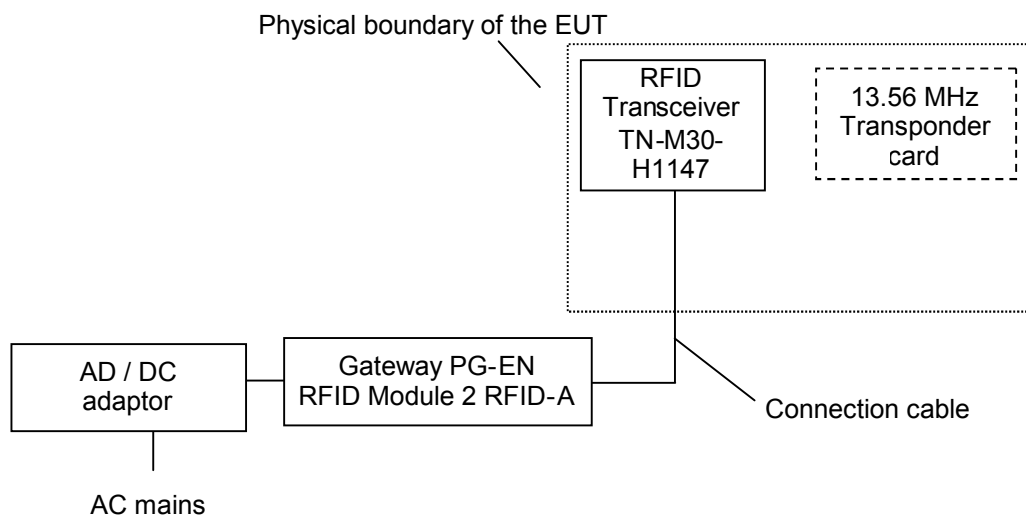
If a variation of the supply voltage was necessary, it was done in the range 10.0 V DC to 30 V DC. This range was declared by the applicant as extreme supply voltage range.

For the whole frequency range a preliminary measurement in a fully anechoic chamber with a measuring distance of 3 m was carried out to determine the frequencies, which were radiated by the EUT.

The final measurements on the detected frequencies were carried out on an outdoor test site without ground plane (for the frequency range 9 kHz to 30 MHz) and on an open area test site with ground plane (for the frequency range 30 MHz to 1 GHz).

During the tests, the EUT was not sealed and not labelled with a FCC-label.

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



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## 4 LIST OF TEST MODULES

### 4.1 EMISSION

Conducted emissions FCC 47 CFR Part 15 section 15.207 (a)[3]					
Application	Frequency range	Limits	Reference standard	Remark	Status
On AC supply line	0.15 to 0.5 MHz	66 to 56 dBμV (QP) * 56 to 46 dBμV (AV) *	ANSI C63.4 (2003)	-	Passed
	0.5 to 5 MHz	56 dBμV (QP) 46 dBμV (AV)			
	5 to 30 MHz	60 dBμV (QP) 50 dBμV (AV)			
*: Decreases with the logarithm of the frequency					
Radiated emissions FCC 47 CFR Part 15 section 15.209 [3]					
Application	Frequency range	Limits (microvolts/meter)	Reference standard	Remark	Status
Intentional radiator	0.009 to 0.49 MHz 0.490 to 1.705 MHz 1.705 to 30.0 MHz 30 to 88 MHz 88 to 216 MHz 216 to 960 MHz 960 to 1000 MHz	2400/f(kHz) at 300 m 24000/f(kHz) at 30 m 30.0 dBμV/m at 30 m 40.0 dBμV/m at 3 m 43.5 dBμV/m at 3 m 46.0 dBμV/m at 3 m 54.0 dBμV/m at 3 m	ANSI C63.4 (2003);	-	Passed
Radiated emissions FCC 47 CFR Part 15 section 15.225 (a)[3]					
	Frequency range	Limits (microvolts/meter)	Reference standard	Remark	Status
Operation with in the band 13.553 – 13.567 MHz	13.553 to 13.567 MHz	15,848 at 30 m	ANSI C63.4 (2003);	-	Passed
Frequency tolerance over temperature and supply voltage FCC 47 CFR Part 15 section 15.225 (e)[2]					
Application		Limits	Reference standard	Remark	Status
Temperature range -20°C to +50°C and supply voltage 85 % to 115 % or new battery		0.01 %	ANSI C63.4 (2003);	-	Passed

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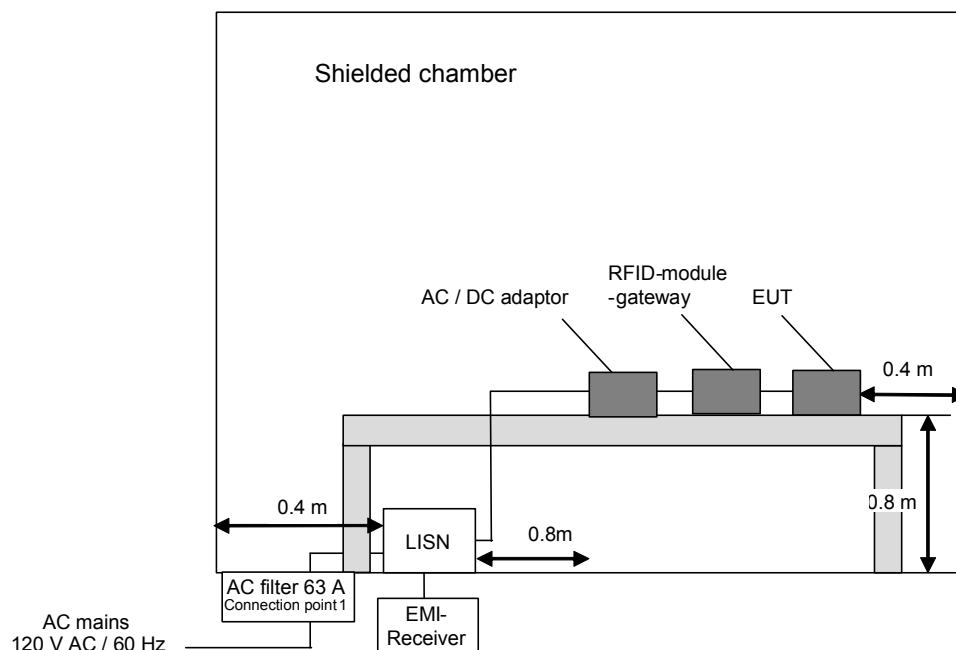
## 5 METHOD OF MEASUREMENT

### 5.1 CONDUCTED EMISSIONS ON POWER SUPPLY LINES (150 kHz to 30 MHz)

This test will be carried out in a shielded chamber. 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 above the ground plane. Floor-standing devices will be placed directly on the ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003 [1].

The frequency range 150 kHz to 30 MHz will be measured with an EMI Receiver set to MAX Hold mode with peak and average detector and a resolution bandwidth of 9 kHz. A scan will be carried out on the phase (or plus pole in case of DC powered devices) of the AC mains network. If levels detected 10 dB below the appropriable limit, this emission will be measured with the average and quasi-peak detector on all lines.

Frequency range	Resolution bandwidth
150 kHz to 30 MHz	9 kHz





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## 5.2 RADIATED EMISSIONS 9 kHz to 30 MHz

The radiated emission measurement is divided into two stages.

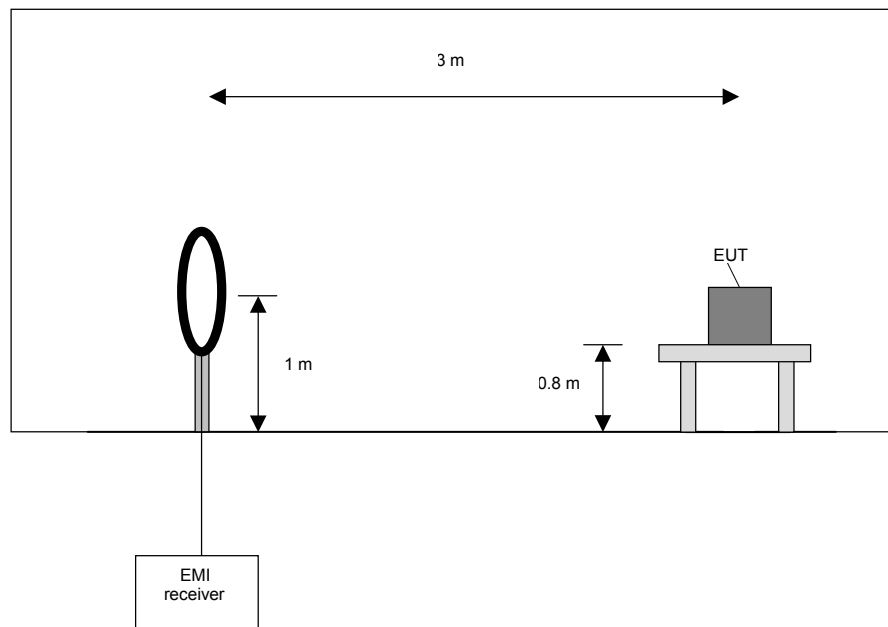
### Preliminary measurement:

In the first stage a preliminary measurement will be performed in a shielded room with a measuring distance of 3 meters. Tabletop devices will be 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 C63.4-2003 [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 find 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



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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.
- 7) Rotate the measuring antenna and repeat steps 1) to 5).

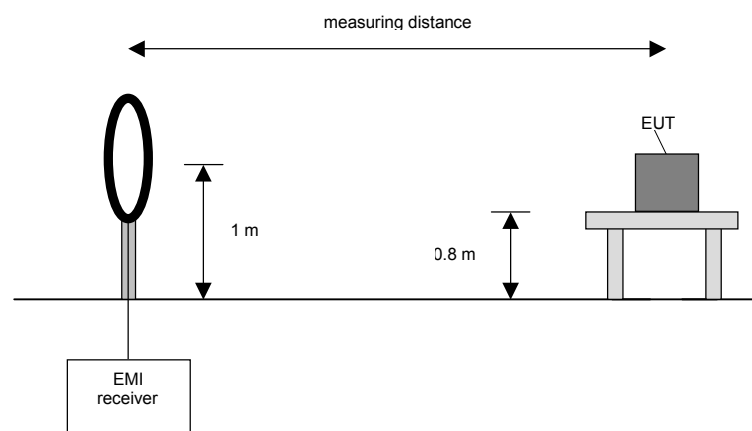
Final measurement:

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



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#### 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).

### 5.3 RADIATED EMISSIONS 30 MHz to 1 GHz

The radiated emission measurement is divided into two stages.

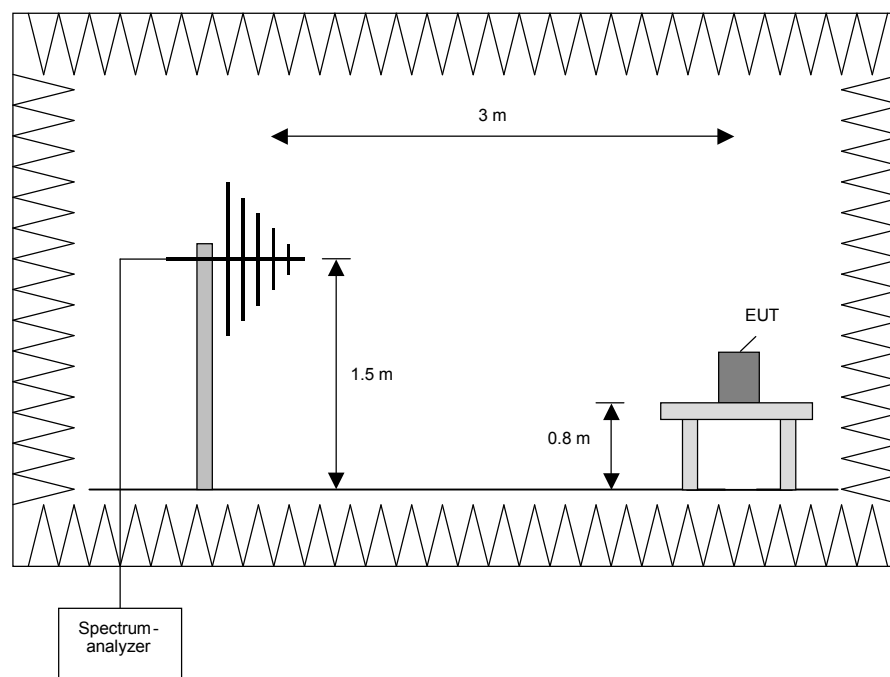
#### Preliminary measurement:

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 C63.4-2003 [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



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#### 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:

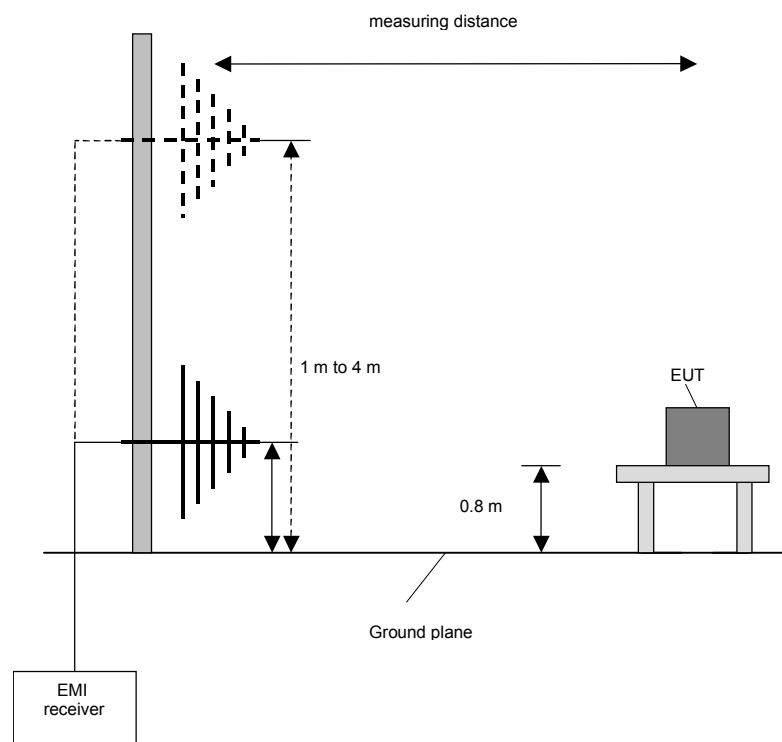
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of 3 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.
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



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Procedure final measurement:

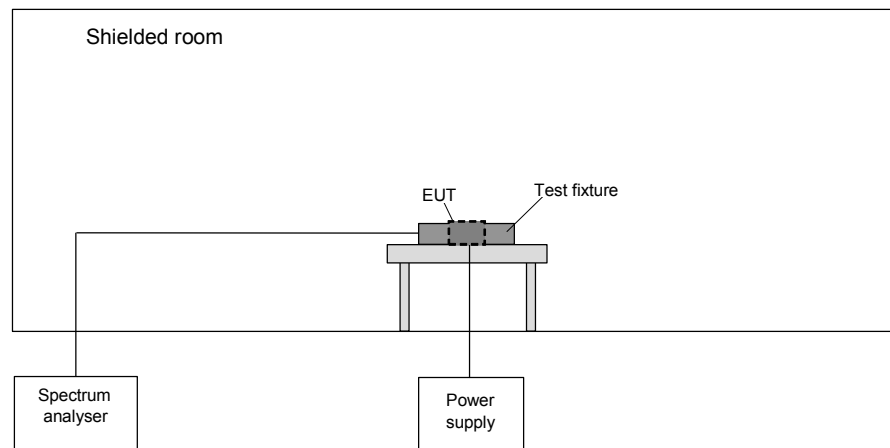
The following procedure will be used:

- 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.

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## 5.4 SPECTRUM MASK AND OCCUPIED BANDWIDTH



The following procedure will be used for the spectrum mask measurement:

- 1) Place the EUT in the test fixture and switch it on.
- 2) Use the following spectrum analyser settings: RWB = VBW = 1 kHz, Span = wide enough to capture the whole 13 MHz band including the frequency ranges where the 15.209 limit applies, Trace mode = MaxHold, select the limit line 15225spc
- 3) After trace stabilisation, set the marker to the signal peak.
- 4) The Reference level will be calculated by the amount of the margin of the wanted signal to its 30 m emission limit plus the marker value.
- 5) The whole signal trace has to be below the limit line.

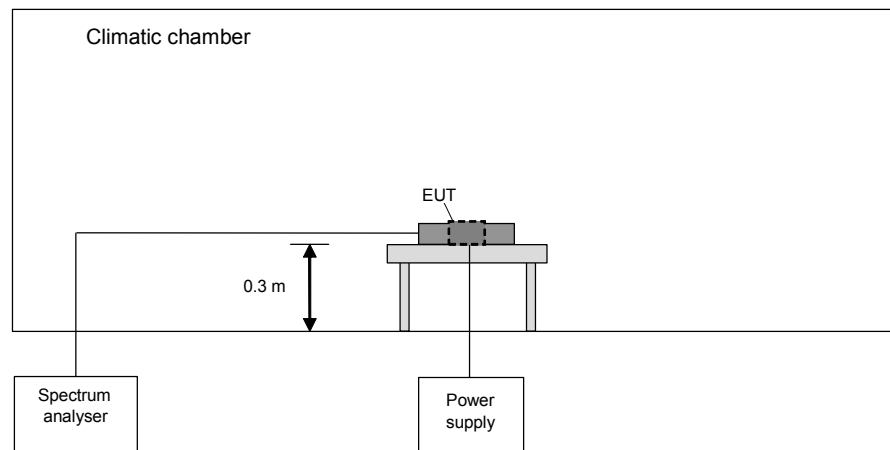
The following procedure will be used for the occupied bandwidth measurement:

- 1) Place the EUT in the test fixture and switch it on.
- 2) Use the following spectrum analyser settings: RWB = VBW = 1 kHz, Span = wide enough to capture app. 1.5 times the 20 dB bandwidth, Trace mode = MaxHold.
- 3) After trace stabilisation, set the first marker and the first display line to the signal peak. Set the second display line 20 dB below the first display line. The second marker and its delta marker shall be set to cross points of the spectrum line and the second display line and note these frequencies.
- 4) Alternatively the 20 dB down function of the analyser could be used, if this function will be applicable to the displayed spectrum.

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## 5.5 FREQUENCY TOLERANCE



The following procedure will be used:

- 1) Place the EUT in the climatic chamber.
- 2) Switch on the EUT and check the correct function and the settings of the spectrum analyser.
- 3) Switch off the EUT and tune the climatic chamber to a temperature of 70 °C. Wait until the thermal balance is obtained.
- 4) Switch the EUT on and record the frequencies at start-up and 2, 5 and 10 minutes after powering on.
- 5) Repeat 4) with the minimum and the maximum of the supply voltage.
- 6) Switch off the EUT and tune the climatic chamber to a temperature range of 70 °C to –25 °C in ten-degree steps. Wait until the thermal balance is obtained for every step.
- 7) Switch the EUT on and record the frequencies at start-up and 2, 5 and 10 minutes after powering on.
- 8) Repeat 7) with the minimum and the maximum of the supply voltage at 20 °C.
- 9) Repeat 6) with the next temperature step until –25 °C were reached.

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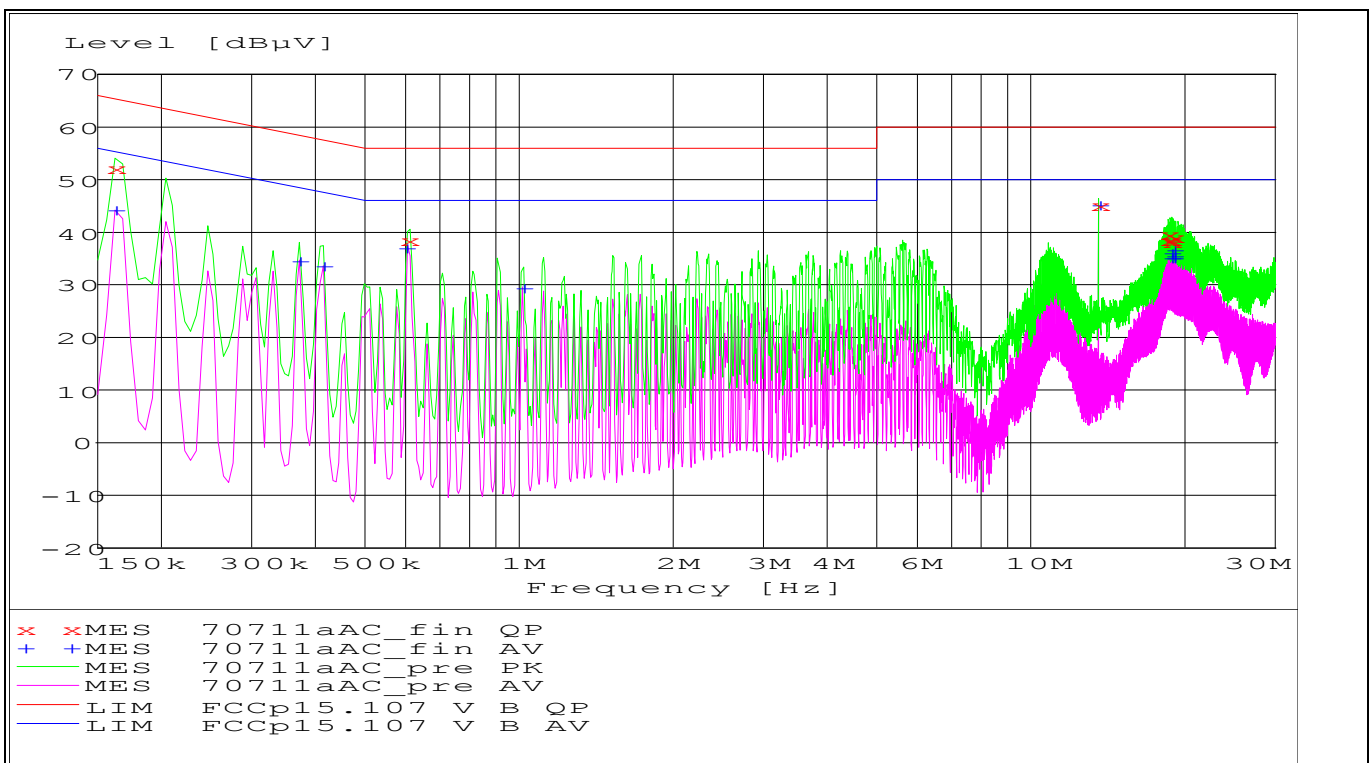
## 6 TEST RESULTS EMISSION TEST

### 6.1 CONDUCTED EMISSION MEASUREMENT ON AC MAINS (150 kHz to 30 MHz)

Ambient temperature:	21 °C	Relative humidity:	42 %
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Position of EUT: The EUT was set-up on a wooden table of a height of 0.8 m.  
Cable guide: All cables of the EUT were fixed on the wooden table. For further information of the cable guide refer to the pictures in annex A of this test report.  
Test record: The test was carried out in normal operation mode of the EUT (reading a 13.56 MHz TAG). All results are shown in the following.  
Power supply: During this test the EUT was powered by an AC / DC adaptor type Phoenix Contact MINI-PS-100-240AC/24V.  
Title: AC Powerline Conducted Emission Test with protective ground conductor simulating network  
EUT: TN-M30-H1147  
Manufacturer: Turck GmbH & Co. KG  
Operating Condition: 120 V / 60 Hz; AC  
Test site: PHOENIX TESTLAB Blomberg M4  
Operator: D. Sütthoff

The curves in the diagram only represent for each frequency point the maximum measured value of all preliminary measurements which were made for each power supply line. The top measured curve represents the peak measurement and the bottom measured curve the average measurement. The quasi-peak measured points are marked by x and the average measured points by +.





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### Result measured with the quasipeak detector:

(These values are marked in the above diagram by x)

Frequency MHz	Level dBµV	Transducer dB	Limit dBµV	Margin dB	Line	PE
0.162000	52.60	0.9	65.4	12.7	L1	FLO
0.612000	38.70	0.2	56.0	17.3	L1	FLO
13.560000	45.30	2.3	60.0	14.7	L1	FLO
18.564000	38.80	3.4	60.0	21.2	L1	FLO
18.726000	39.50	3.4	60.0	20.5	L1	FLO
18.852000	38.90	3.5	60.0	21.1	L1	FLO
18.888000	38.90	3.5	60.0	21.1	L1	FLO
18.894000	38.40	3.5	60.0	21.6	L1	FLO
19.014000	39.40	3.5	60.0	20.6	L1	FLO

### Result measured with the average detector:

(These values are marked in the above diagram by +)

Frequency MHz	Level dBµV	Transducer dB	Limit dBµV	Margin dB	Line	PE
0.162000	44.20	0.9	55.4	11.2	L1	FLO
0.372000	34.60	0.2	48.5	13.8	L1	FLO
0.414000	33.60	0.2	47.6	14.0	N	FLO
0.606000	37.00	0.2	46.0	9.0	L1	FLO
1.014000	29.50	0.1	46.0	16.5	L1	FLO
13.560000	45.10	2.3	50.0	4.9	L1	FLO
18.810000	36.20	3.4	50.0	13.8	L1	FLO
18.852000	35.00	3.5	50.0	15.0	L1	FLO
19.056000	36.90	3.5	50.0	13.1	L1	FLO
19.140000	35.90	3.5	50.0	14.1	L1	FLO
19.182000	35.00	3.5	50.0	15.0	L1	FLO

Test: Passed

TEST EQUIPMENT USED:

1 - 6

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## 6.2 PRELIMINARY RADIATED EMISSION TEST (9 kHz to 30 MHz)

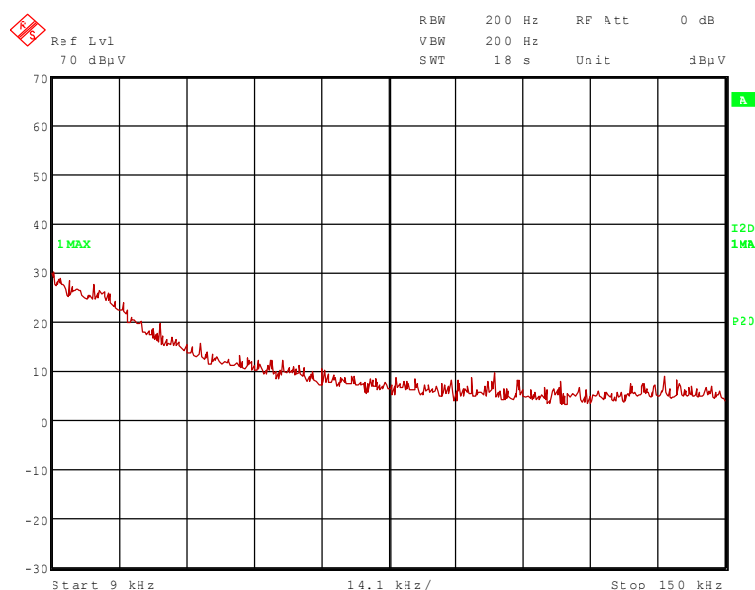
Ambient temperature:	21 °C	Relative humidity:	43 %
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Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: The cable of the EUT was fixed on the non-conducting table. For further information of the cable guide refer to the pictures in annex A of this test report.

Test record: The test was carried out in normal operation mode of the EUT (reading a 13.56 MHz TAG). All results are shown in the following.

70711ab1.wmf: TN-M30-H1147 spurious emissions from 9 kHz to 150 kHz:

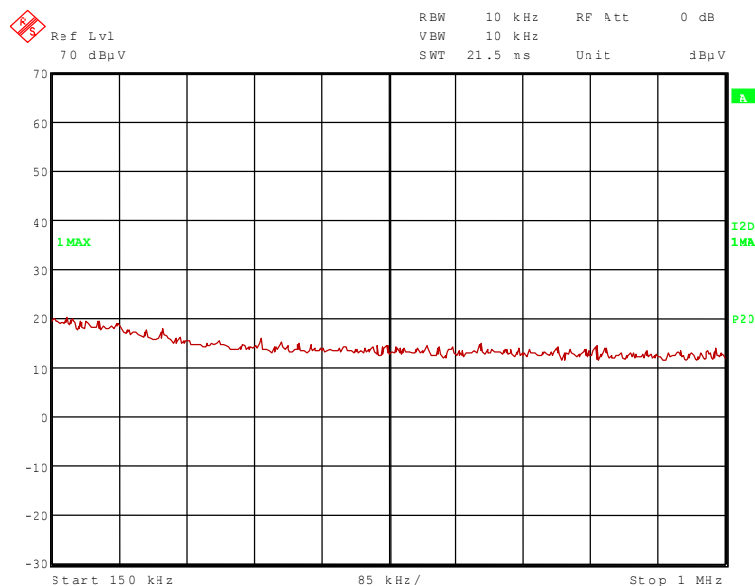


TEST EQUIPMENT USED THE TEST:

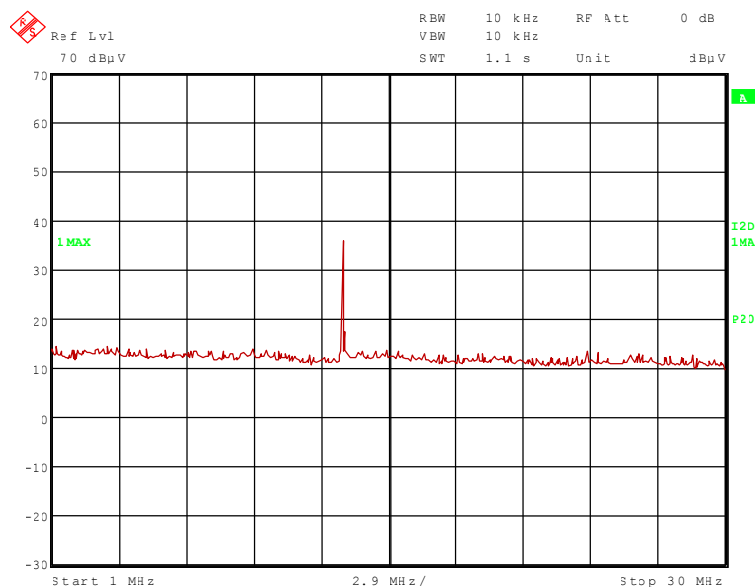
29, 31 – 33, 54, 56

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70711ab2.wmf: TN-M30-H1147 spurious emissions from 150 kHz to 1 MHz:



70711ab3.wmf: TN-M30-H1147 spurious emissions from 1 MHz to 30 MHz:



The following frequency was found inside the 13.533 to 13.567 MHz band according to FCC 47 CFR Part 15 section 15.225 [3]:

13.561 MHz.

This frequency has to be measured on the outdoor test site. The result of this final measurement is shown in subclause 6.4 of this test report.

TEST REPORT REFERENCE: R70711\_A Edition 1

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

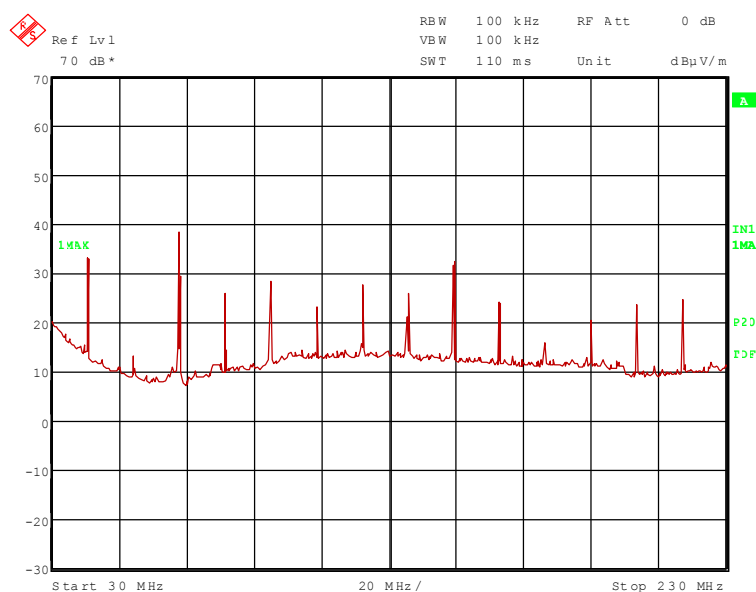
Ambient temperature:	21 °C	Relative humidity:	60 %
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Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: The cable of the EUT was fixed on the non-conducting table. For further information of the cable guide refer to the pictures in annex A of this test report.

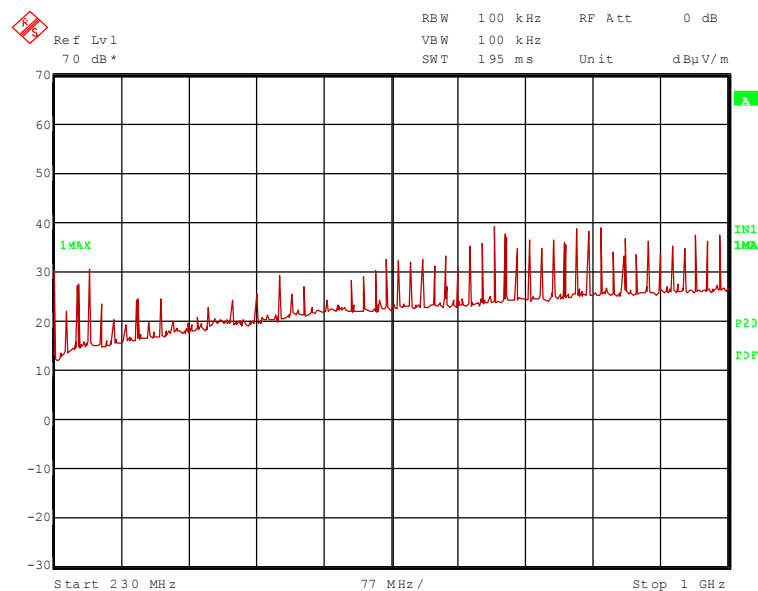
Test record: The test was carried out in normal operation mode of the EUT (reading a 13.56 MHz TAG). All results are shown in the following.

70711ab4.wmf: TN-M30-H1147spurious emissions from 30 MHz to 230 MHz:



TEST REPORT REFERENCE: R70711\_A Edition 1

70711ab5.wmf: TN-M30-H1147 spurious emissions from 230 MHz to 1 GHz:



At following frequencies the highest radiation levels were found during the preliminary radiated emission test:

Frequency	Level
13.561 MHz	55.03 dBμV/m (PK)
40.682 MHz	31.05 dBμV/m (PK)
67.804 MHz	37.21 dBμV/m (PK)
149.167 MHz	34.53 dBμV/m (PK)
732.274 MHz	38.03 dBμV/m (PK)
854.320 MHz	38.11 dBμV/m (PK)

These frequencies have to be measured on the open area test site. The results of this final measurement are shown in subclause 6.5 of this test report.

TEST EQUIPMENT USED FOR THE TEST:

29, 31 - 35, 43, 54

TEST REPORT REFERENCE: R70711\_A Edition 1

## 6.4 FINAL RADIATED EMISSION TEST (9 kHz to 30 MHz)

Ambient temperature:	14 °C	Relative humidity:	45 %
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**Position of EUT:** The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m and 10 m.

**Cable guide:** The cable of the EUT was fixed on the non-conducting table. For further information of the cable guide refer to the pictures in annex A of this test report.

**Test record:** The test was carried out in normal operation mode of the EUT (reading 13.56 MHz TAG). All results are shown in the following.

**Supply voltage:** The EUT was supplied with 24 V DC via suitable AC/DC adaptors, and no difference was noticeable with supply voltages from 10 V DC to 30 V DC.

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

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

Results with measuring distance of 3 m						
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Detector	Readings dBµV	Antenna factor * dB/m
13.561	54.4	124.0	69.6	QP	34.4	20.0
Results with measuring distance of 10 m						
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Detector	Readings dBµV	Antenna factor * dB/m
13.561	41.4	104.0	62.6	QP	21.4	20.0
Results with measuring distance of 30 m						
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Detector	Readings dBµV	Antenna factor * dB/m
13.561	21.4**	84.0	62.6	Level was extrapolated from 10 m value		
	Signal was below the noise floor of the system					

\*: Cable loss included

\*\*.: Level was extrapolated with an inverse linear distance extrapolation factor of 40 dB / decade as described in 15.31 (2) [3]

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

54 – 57
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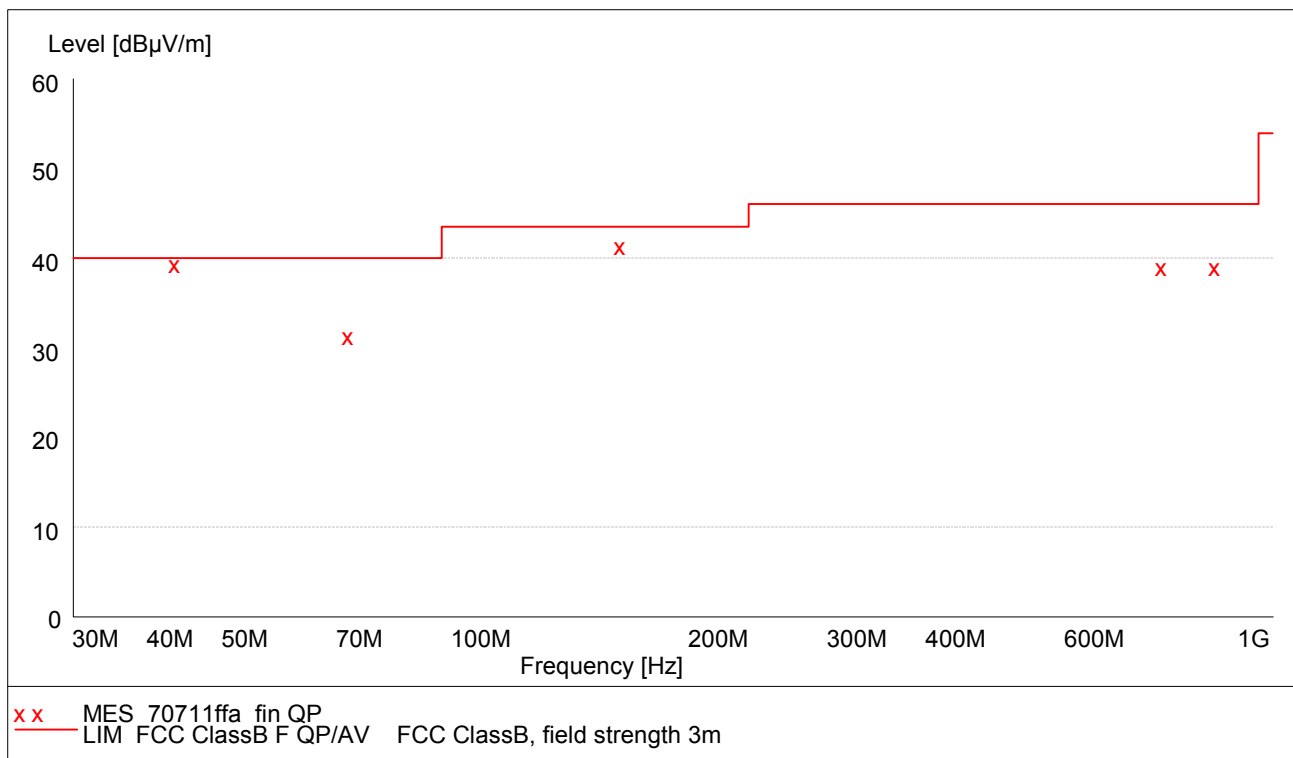
TEST REPORT REFERENCE: R70711\_A Edition 1

## 6.5 FINAL RADIATED EMISSION TEST (30 MHz to 1 GHz)

Ambient temperature:	20 °C	Relative humidity:	34 %
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- Position of EUT:** The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.
- Cable guide:** The cable of the EUT was fixed on the non-conducting table. For further information of the cable guide refer to the pictures in annex A of this test report.
- Test record:** The test was carried out in normal operation mode of the EUT (reading 13.56 MHz TAG). All results are shown in the following.
- Supply voltage:** The EUT was supplied with 24 V DC via suitable AC/DC adaptors, and no difference was noticeable with supply voltages from 10 V DC to 30 V DC.
- Test results:** The test results were calculated with the following formula:
- $$\text{Result [dB}\mu\text{V/m]} = \text{reading [dB}\mu\text{V]} + \text{cable loss [dB]} + \text{antenna factor [dB/m]}$$

The measured points and the limit line in the following diagram refer to the standard measurement of the emitted interference in compliance with the above mentioned standard. The measured points marked with x are the measured results of the standard subsequent measurement on the open area test site.



TEST REPORT REFERENCE: R70711\_A Edition 1

The results of the standard subsequent measurement on the open area test site are indicated in the table below. The limits as well as the measured results (levels) refer to the above mentioned standard while taking account of the specified requirements for a 3 m measuring distance.

**Result measured with the quasipeak detector:**

(These values are marked in the above diagram by x)

Frequency MHz	Level dBμV/m	Transducer dB	Limit dBμV/m	Margin dB	Height cm	Azimuth deg	Polarisation
40.682000	39.30	15.0	40.0	0.7	100.0	270.00	VERTICAL
67.804000	31.80	7.2	40.0	8.2	175.0	336.00	VERTICAL
149.167000	41.90	13.0	43.5	1.6	225.0	270.00	HORIZONTAL
732.274000	39.30	24.6	46.0	6.7	113.0	134.00	HORIZONTAL
854.320000	39.30	25.7	46.0	6.7	100.0	224.00	HORIZONTAL

The test results were calculated with the following formula:

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

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

14 - 20



TEST REPORT REFERENCE: R70711\_A Edition 1

## 6.6 SPECTRUM MASK

Ambient temperature:	22 °C	Relative humidity:	41 %
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Supply voltage: The EUT was supplied with 24 V DC.

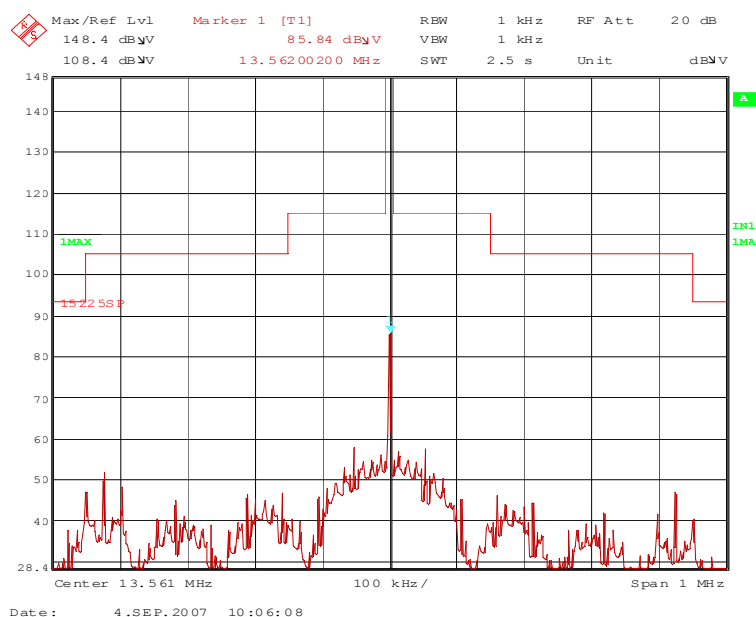
Test record: The test was carried out while the EUT was reading a TAG.

The Reference level in the plot below was calculated with the following formular:

$$\text{Reflevel} = (\text{Limit}_{\text{OATS}} - \text{Level}_{\text{OATS}}) + \text{Marker value}$$

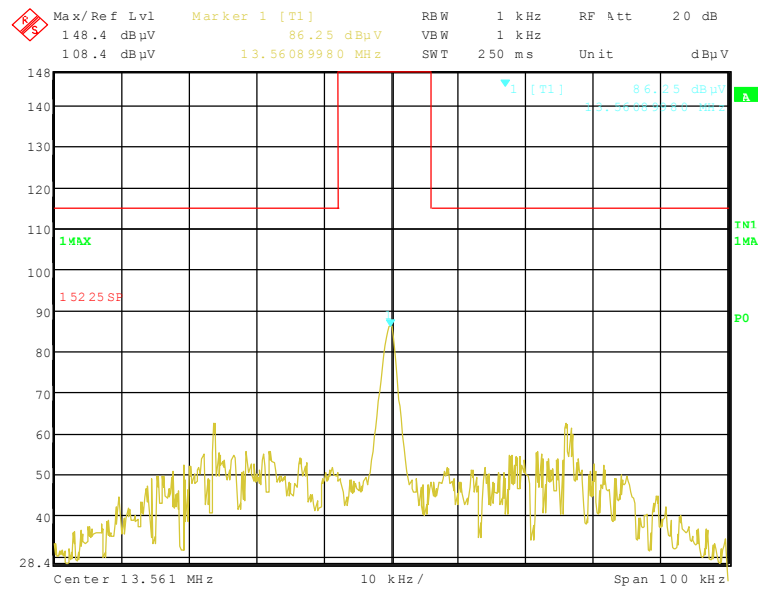
Where  $\text{Limit}_{\text{OATS}} = 84.0 \text{ dB}\mu\text{V/m}$ ,  $\text{Level}_{\text{OATS}} = 21.4 \text{ dB}\mu\text{V/m}$  and Marker value = 85.8 dB $\mu\text{V}$ .

70711\_as.wmf: TN-M30-H1147. Spectrum mask at 13.561 MHz:



TEST REPORT REFERENCE: R70711\_A Edition 1

70711\_as1.wmf: TN-M30-H1147, Spectrum mask at 13.561 MHz:



Test result: Passed

TEST EQUIPMENT USED THE TEST:

31, 54, 58, 59

TEST REPORT REFERENCE: R70711\_A Edition 1

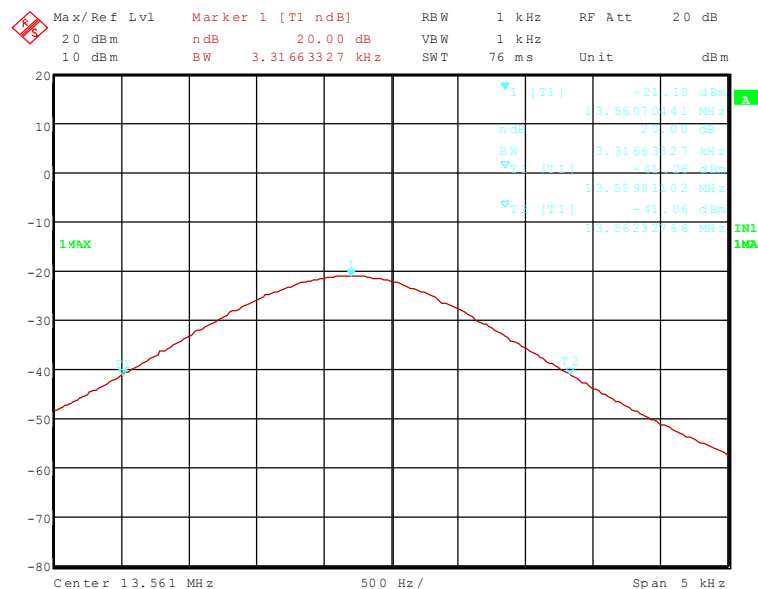
## 6.7 OCCUPIED BANDWIDTH

Ambient temperature:	22 °C	Relative humidity:	41 %
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Supply voltage: The EUT was supplied with 24 V DC.

Test record: The test was carried out while the EUT was reading a TAG.

70711\_a20.wmf: TN-M30-H1147, Occupied bandwidth at 13.561 MHz:



$F_L$	$F_U$	BW ( $F_U - F_L$ )
13.559011 MHz	13.562328 MHz	3.317 kHz
Measurement uncertainty		$< \pm 1 \cdot 10^{-7}$

Test result: Passed

TEST EQUIPMENT USED THE TEST:

31, 54, 58, 59

TEST REPORT REFERENCE: R70711\_A Edition 1

## 6.8 FREQUENCY TOLERANCE

Ambient temperature	22 °C	Relative humidity	41 %
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Test set-up: For this test the EUT was fixed on a wooden table inside the climatic chamber.

Cable guide: For further information of the cable guide refer to the pictures in annex A of this test report.

Temperature	Supply voltage	Minutes after switch on	Frequency [MHz]	Allowed tolerance	Measured tolerance	Result
70 °C	24 VDC	0	13.560588	±1.356 kHz	-13 Hz	Passed
	24 V DC	2	13.560638	±1.356 kHz	+37 Hz	Passed
	24 V DC	5	13.560648	±1.356 kHz	+47 Hz	Passed
	24 V DC	10	13.560668	±1.356 kHz	+67 Hz	Passed
60 °C	24 VDC	0	13.560579	±1.356 kHz	-22 Hz	Passed
	24 V DC	2	13.560596	±1.356 kHz	-5 Hz	Passed
	24 V DC	5	13.560607	±1.356 kHz	+6 Hz	Passed
	24 V DC	10	13.560609	±1.356 kHz	+8 Hz	Passed
50 °C	24 VDC	0	13.560581	±1.356 kHz	-20 Hz	Passed
	24 V DC	2	13.560581	±1.356 kHz	-20 Hz	Passed
	24 V DC	5	13.560583	±1.356 kHz	-18 Hz	Passed
	24 V DC	10	13.560584	±1.356 kHz	-17 Hz	Passed
40 °C	24 V DC	0	13.560630	±1.356 kHz	+29 Hz	Passed
	24 V DC	2	13.560599	±1.356 kHz	-2 Hz	Passed
	24 V DC	5	13.560589	±1.356 kHz	-12 Hz	Passed
	24 V DC	10	13.560586	±1.356 kHz	-15 Hz	Passed
30 °C	24 V DC	0	13.560677	±1.356 kHz	+76 Hz	Passed
	24 V DC	2	13.560632	±1.356 kHz	+31 Hz	Passed
	24 V DC	5	13.560609	±1.356 kHz	+8 Hz	Passed
	24 V DC	10	13.560601	±1.356 kHz	0 Hz	Passed
20 °C	10 V DC ( $U_{min}$ )	0	13.560659	±1.356 kHz	+58 Hz	Passed
	24 V DC ( $U_{nom}$ )		13.560673	±1.356 kHz	+72 Hz	Passed
	30 V DC ( $U_{max}$ )		13.560647	±1.356 kHz	+46 Hz	Passed
	10 V DC ( $U_{min}$ )	2	13.560641	±1.356 kHz	+40 Hz	Passed
	24 V DC ( $U_{nom}$ )		13.560645	±1.356 kHz	+44 Hz	Passed
	30 V DC ( $U_{max}$ )		13.560632	±1.356 kHz	+31 Hz	Passed
	10 V DC ( $U_{min}$ )	5	13.560623	±1.356 kHz	+22 Hz	Passed
	24 V DC ( $U_{nom}$ )		13.560625	±1.356 kHz	+24 Hz	Passed
	30 V DC ( $U_{max}$ )		13.560622	±1.356 kHz	+21 Hz	Passed
	10 V DC ( $U_{min}$ )	10	13.560603	±1.356 kHz	+2 Hz	Passed
	24 V DC ( $U_{nom}$ )		13.560601	-	-	Reference
	30 V DC ( $U_{max}$ )		13.560603	±1.356 kHz	+2 Hz	Passed

Continued next page

TEST REPORT REFERENCE: R70711\_A Edition 1

10 °C	24 V DC	0	13.560753	±1.356 kHz	+152 Hz	Passed
	24 V DC	2	13.560709	±1.356 kHz	+108 Hz	Passed
	24 V DC	5	13.560681	±1.356 kHz	+80 Hz	Passed
	24 V DC	10	13.560667	±1.356 kHz	+66 Hz	Passed
0 °C	24 V DC	0	13.560771	±1.356 kHz	+170 Hz	Passed
	24 V DC	2	13.560731	±1.356 kHz	+130 Hz	Passed
	24 V DC	5	13.560719	±1.356 kHz	+118 Hz	Passed
	24 V DC	10	13.560707	±1.356 kHz	+106 Hz	Passed
- 10 °C	24 V DC	0	13.560767	±1.356 kHz	+166 Hz	Passed
	24 V DC	2	13.560759	±1.356 kHz	+158 Hz	Passed
	24 V DC	5	13.560745	±1.356 kHz	+144 Hz	Passed
	24 V DC	10	13.560735	±1.356 kHz	+134 Hz	Passed
-20 °C	24 V DC	0	13.560723	±1.356 kHz	+122 Hz	Passed
	24 V DC	2	13.560755	±1.356 kHz	+154 Hz	Passed
	24 V DC	5	13.560755	±1.356 kHz	+154 Hz	Passed
	24 V DC	10	13.560751	±1.356 kHz	+150 Hz	Passed
- 25 °C	24 V DC	0	13.560687	±1.356 kHz	+86 Hz	Passed
	24 V DC	2	13.560733	±1.356 kHz	+132 Hz	Passed
	24 V DC	5	13.560741	±1.356 kHz	+140 Hz	Passed
	24 V DC	10	13.560743	±1.356 kHz	+142 Hz	Passed
Measurement uncertainty				$< \pm 1 \cdot 10^{-7}$		

Test result: Passed

TEST EQUIPMENT USED FOR THE TEST:

31, 54, 58, 59, 61

TEST REPORT REFERENCE: R70711\_A Edition 1

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## **7 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS**

TEST REPORT REFERENCE: R70711\_A Edition 1

Emission measurement at AC mains and DC in / out ports at M47					
No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
1	Shielded chamber M47	-	Albatross Projects	B83117-C6439-T262	480662
2	EMI Receiver	ESCS 30	Rohde & Schwarz	834489/011	580007
3	LISN	ESH2-Z5	Rohde & Schwarz	879675/037	580006
5	AC power source	6813A	Hewlett Packard	US37290155	480017
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

TEST REPORT REFERENCE: R70711\_A Edition 1

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 843530/018	480179 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 843530/018	480179 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	Standard Gain Horn 11.9GHz – 18GHZ	18240-20	Flann Microwave	483	480294
38	Standard Gain Horn 11.9GHz – 18GHZ	18240-20	Flann Microwave	482	480295
39	Standard Gain Horn 17.9GHz – 26.7GHZ	20240-20	Flann Microwave	411	480297
40	Standard Gain Horn 17.9GHz – 26.7GHZ	20240-20	Flann Microwave	410	480296
41	Standard Gain Horn 26.4GHz – 40.1GHZ	22240-20	Flann Microwave	469	480299



TEST REPORT REFERENCE: R70711\_A Edition 1

No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
42	Standard Gain Horn 26.4GHz – 40.1GHz	22240-20	Flann Microwave	468	480298
43	RF-cable No. 30	RTK 081	Rosenberger	-	410141
44	RF-cable No. 31	RTK 081	Rosenberger	-	410142
45	RF-cable 1m	KPS-1533- 400-KPS	Insulated Wire	-	480300
46	RF-cable 1m	KPS-1533- 400-KPS	Insulated Wire	-	480301
47	RF-cable 2m	KPS-1533- 400-KPS	Insulated Wire	-	480302
48	RF-cable No. 5	RTK 081	Rosenberger		410097
49	Preamplifier	JS3- 00101200- 23-5A	Miteq	681851	480337
50	Preamplifier	JS3- 12001800- 16-5A	Miteq	571667	480343
51	Preamplifier	JS3- 18002600- 20-5A	Miteq	658697	480342
52	Preamplifier	JS3- 26004000- 25-5A	Miteq	563593	480344
53	EMI Software	ES-K1	Rohde & Schwarz	-	480111

Ancillary equipment used for testing					
No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
54	Power supply	TOE 8852	Toellner	51712	480233
55	Outdoor test site	-	Phoenix Test-Lab	-	480293
56	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059
57	EMI test receiver	ESPC	Rohde & Schwarz	843756/006	480150
58	Loop Antenna Ø = 225 mm	-	Phoenix Test-Lab	-	410085
59	RF-cable No. 10	RG223	Phoenix-Test-Lab	-	410102
60	AC power source / analyser	6813A	Hewlett Packard	3524A-00484	480155
61	Climatic chamber	MK 240	BINDER	05-79022	480462

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

TEST REPORT REFERENCE: R70711\_A Edition 1

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## 8 LIST OF ANNEXES

<b>ANNEX A</b>	<b>PHOTOGRAPHS OF THE TEST SET-UPS:</b>	<b>6 pages</b>
	TN-M30-H1147, test set-up shielded chamber	70711_a1.jpg
	TN-M30-H1147, test set-up fully anechoic chamber	70711_a2.jpg
	TN-M30-H1147, test set-up fully anechoic chamber	70711_a3.jpg
	TN-M30-H1147, test set-up outdoor test site	70711_a4.jpg
	TN-M30-H1147, test set-up open area test site	70711_a5.jpg
	TN-M30-H1147, test set-up climatic chamber	70711_a6.jpg
<b>ANNEX B</b>	<b>INTERNAL PHOTOGRAPHS OF THE TEST SAMPLE:</b>	<b>2 pages</b>
	TN-M30-H1147, internal view	70711_a7.jpg
	TN-M30-H1147, internal rear view	70711_a8.jpg
<b>ANNEX C</b>	<b>EXTERNAL PHOTOGRAPHS OF THE TEST SAMPLE:</b>	<b>2 pages</b>
	TN-M30-H1147, 3D-view 1	70711_a11.jpg
	TN-M30-H1147, 3D-view 2	70711_a12.jpg