

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

TEST REPORT

Test Report Reference: R70545_A Edition 1

Equipment under Test: WM2

Serial Number: None

Article Number: 011 1 002 0001 01

FCC ID: QNF-WM731

IC: 6869A-WM731

Applicant: Digades GmbH

Manufacturer: Digades GmbH

**Test Laboratory
(CAB)
accredited by
DATech 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

Name:	Digades GmbH
Address:	Äußere Weberstraße 20 02763 Zittau
Country:	Germany
Name for contact purposes:	Mr. Harald ANDERS
Phone:	+ 49 35 83 57 75-126
Fax:	+ 49 35 83 57 75-145
Mail address:	anders@digades.com
Applicant represented during the test by the following person:	-

1.2 MANUFACTURER

Name:	Digades GmbH
Address:	Äußere Weberstraße 20 02763 Zittau
Country:	Germany
Name for contact purposes:	Mr. Harald ANDERS
Phone:	+ 49 35 83 57 75-126
Fax:	+ 49 35 83 57 75-145
Mail address:	anders@digades.com
Manufacturer represented during the test by the following person:	-

1.3 DATES

Date of receipt of test sample:	07 May 2007
Start of test:	14 May 2007
End of test:	30 May 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 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: Thomas KÜHN
Name

J. Lin

10 July 2007

Date

Test report checked: Bernd STEINER
Name

B. Stein

10 July 2007

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.

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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 15 (May 2007)** Radio Frequency Devices
- [3] **RSS-210 Issue 7 (June 2007)** Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment
- [4] **RSS-Gen Issue 2 (June 2007)** General Requirements and Information for the Certification of Radiocommunication Equipment

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:	Tire pressure transmitter for truck use
Type designation:*	WM2
Article No.:*	011 1 002 0001 01
FCC ID:*	QNF-WM731
IC:*	6869A-WM731
Highest/Lowest internal frequency*	433.92 MHz / 32.768 kHz
Antenna type:	Integral
Software	none

* as declared by the applicant

The following external I/O cables were used:

No cables were connectable to the EUT.

2.2 PERIPHERY DEVICES

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

EUT initiator

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3 ADDITIONAL INFORMATION

The tested sample was sealed and not labelled with a FCC-label. The internal photographs were taken with an unsealed sample provided by the applicant.

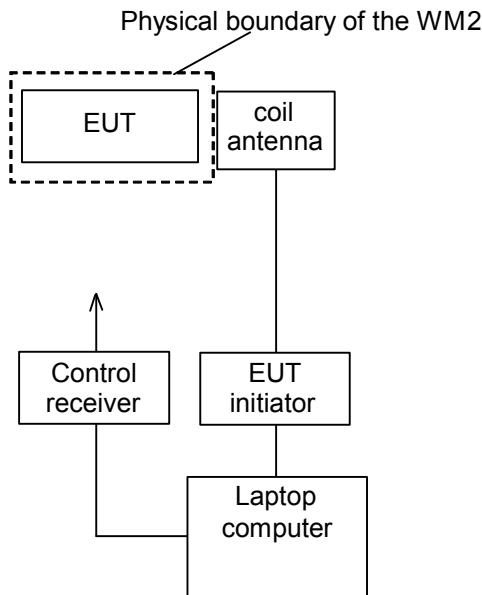
During the tests the EUT was supplied by the internal battery.

For the whole frequency range a preliminary (9 kHz to 1 GHz) and a final (1 GHz to 4.5 GHz) measurement in a fully anechoic chamber 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).

4 OPERATIONAL STATES AND PHYSICAL BOUNDARIES

For all measurements except the measurement of duty cycle the external wheel module WM2 was tested in diagnosis mode, because in this mode the module transmits more often than in its normal operation mode. Presenting an If-antenna in front of the EUT activates this test mode. During this mode the temperature and pressure data were transmitted every second. This operation mode was entered by presenting an coil antenna at the front of the EUT and activated by using a test software (WM2_drucktemp, provided by the applicant) on a laptop computer and a EUT initiator (also provided by the applicant).

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



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5 LIST OF TEST MODULES

5.1 EMISSION

Radiated Emissions fundamental frequency FCC 47 CFR Part 15 section 15.231 (e) [2]					
Application	Fundamental Frequency	Limits	Reference standard	Remark	Status
Intentional radiator (fundamental frequency)	433.92 MHz	72.9 dB μ V/m at 3m	ANSI C63.4 (2001);	-	Passed
Spurious Emissions FCC 47 CFR Part 15 section 15.231 (e) [2]					
Application	Spurious emissions	Limits	Reference standard	Remark	Status
Intentional radiator (spurious emissions)	433.92 MHz	52.9 dB μ V/m or 54.0 dB μ V/m * at 3m	ANSI C63.4 (2001);	-	Passed
* limit out of 15.209, whichever permits a higher limit					
Radiated emissions in restricted bands FCC 47 CFR Part 15 section 15.209					
Application	Frequency of Emission	Limits	Reference standard	Remark	Status
Radiated emissions	30 to 88 MHz 88 to 216 MHz 216 to 960 MHz Above 960 MHz	40 dB μ V/m at 3 m** 43 dB μ V/m at 3 m** 46 dB μ V/m 3 m** 54 dB μ V/m 3m	ANSI C63.4 (2001);	-	Passed
** Except as provided in paragraph (g) of Part 15.209, fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54 – 72 MHz, 76 – 88 MHz, 174 – 216 MHz or 470 – 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.					
Emission bandwidth FCC 47 CFR Part 15 section 15.231 (c)					
Application	Fundamental Frequency	Limits	Reference standard	Remark	Status
20 dB Bandwidth	433.92 MHz	0.25 % of the center frequency	ANSI C63.4 (2003);	-	Passed
Antenna requirement FCC 47 CFR Part 15 section 15.203 [2]					
The EUT has an integrated antenna only					Status
					Passed

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6 RADIATED EMISSIONS

6.1 METHOD OF MEASUREMENT (RADIATED EMISSIONS)

The radiated emission measurement is subdivided into four stages.

- A preliminary measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 9 kHz to 4.5 GHz.
- A final measurement carried out on an outdoor test side without reflecting ground plane and a fixed antenna height in the frequency range 9 kHz to 30 MHz.
- A final measurement carried out on an open area test side with reflecting ground plane and various antenna height in the frequency range 30 MHz to 1 GHz.
- A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 1 GHz to 4.5 GHz.

All measurements will be carried out with the EUT working on the middle and upper and lower edge of the assigned frequency band. For this reason the hopping function of the EUT has to be disabled.

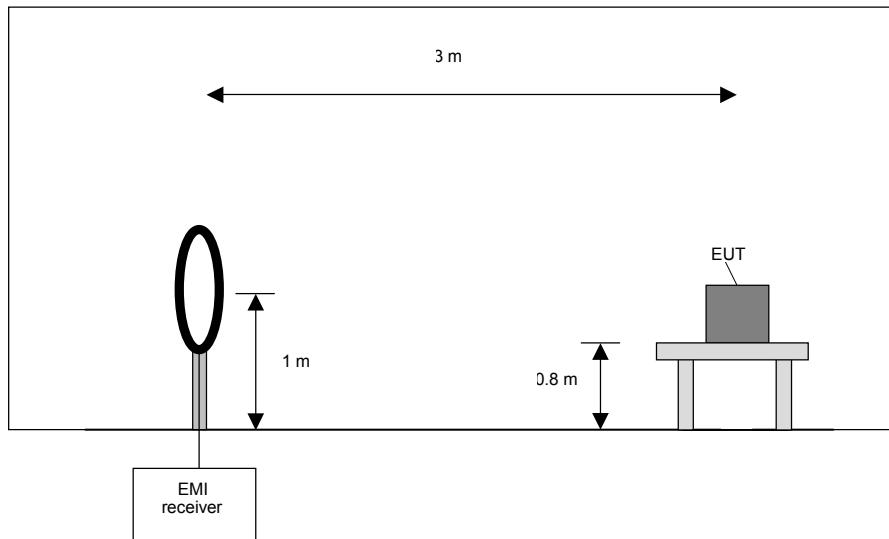
Preliminary measurement (9 kHz to 30 MHz):

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 C63.4-2003 [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 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



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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 5) with the other orthogonal axes of the EUT (because of EUT is a module and might be used in a handheld equipment application).
- 7) Rotate the measuring antenna and repeat steps 1) to 5).

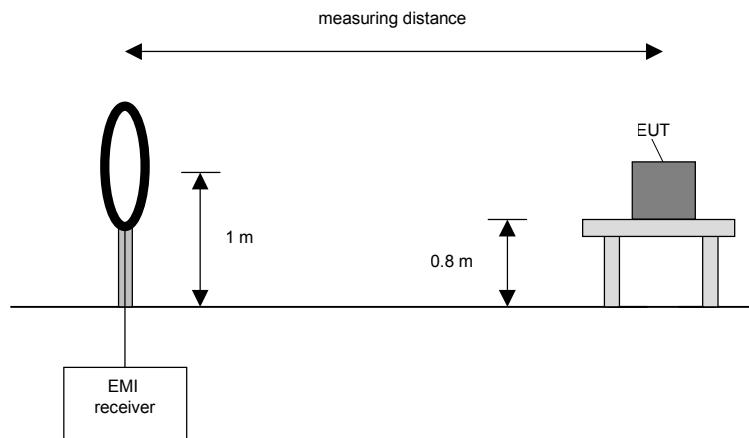
Final measurement (9 kHz to 30 MHz):

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 if possible. 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 30 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 (because of EUT is a module and might be used in a handheld equipment application).

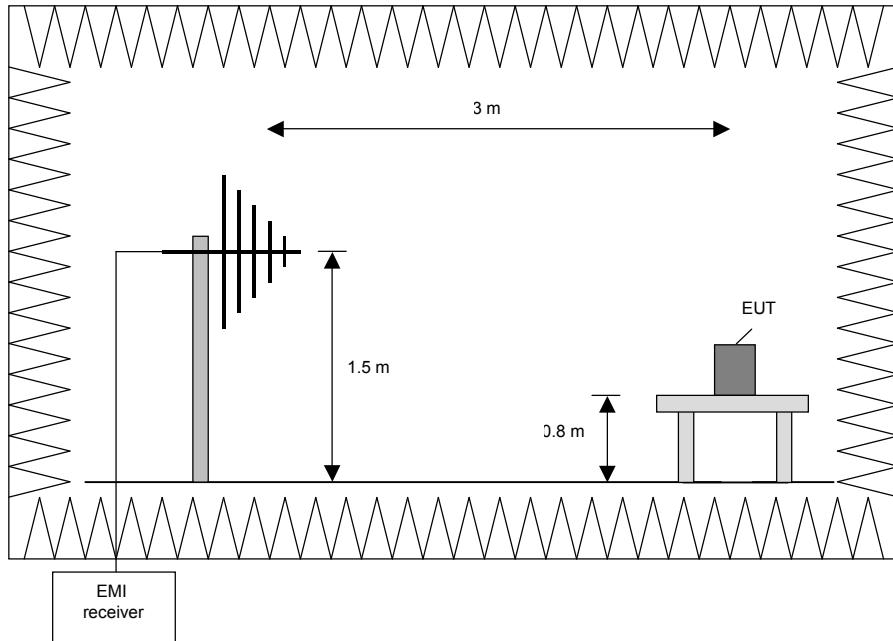
Preliminary measurement (30 MHz to 1 GHz)

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 230 MHz	100 kHz
230 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:

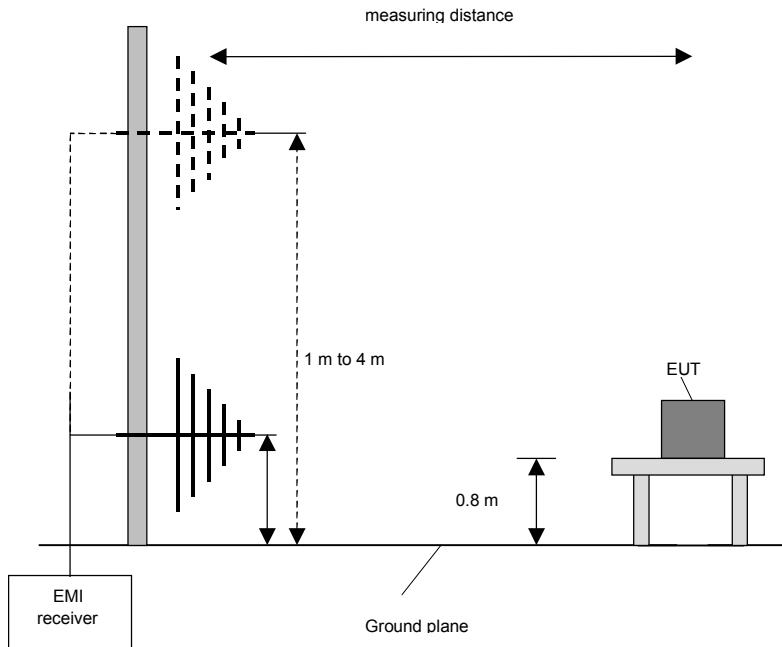
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the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

Final measurement (30 MHz to 1 GHz)

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 and 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.

Preliminary and final measurement (1 GHz to 4.5 GHz)

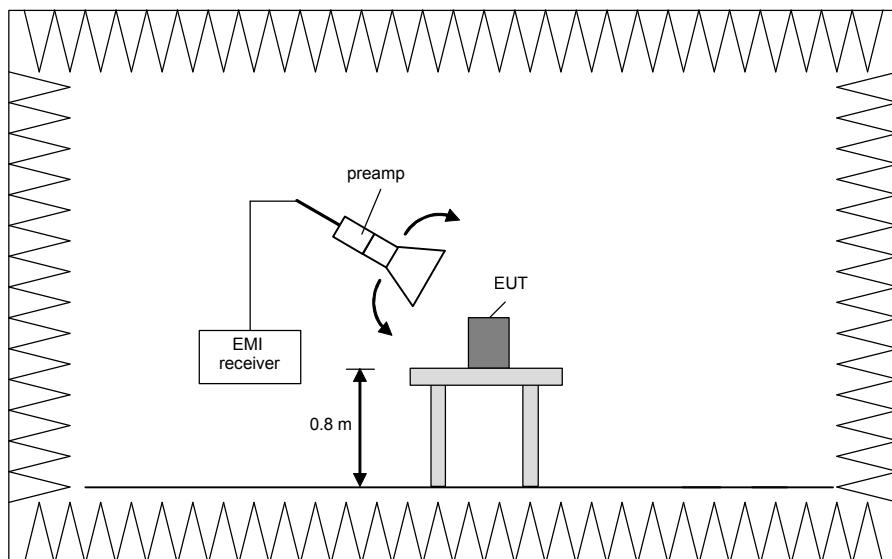
This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2003 [1].

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

Frequency range	Resolution bandwidth (preliminary)	Resolution bandwidth (final)
1 GHz to 4.5 GHz	100 kHz	1 MHz

Preliminary measurement (1 GHz to 4.5 GHz)

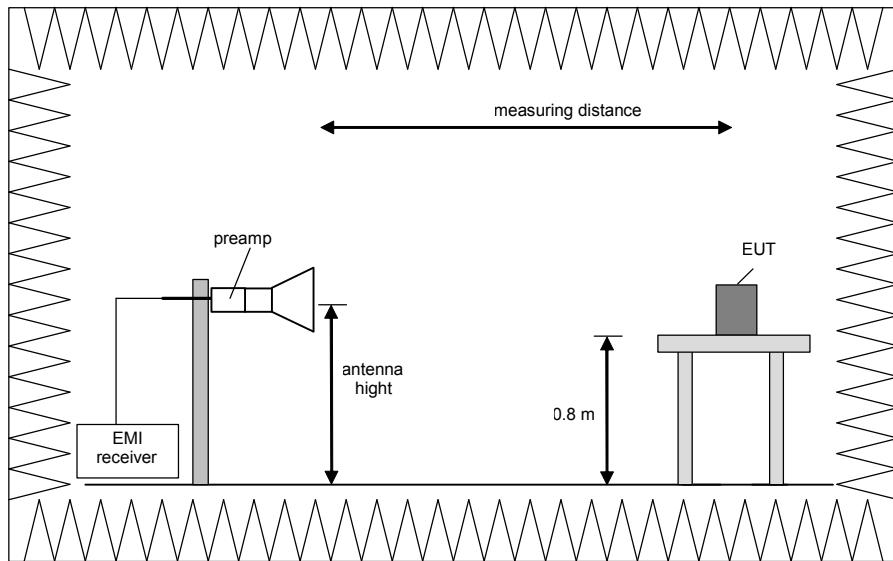
The spectrum analyser set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna, the antenna close to the EUT and while moving the antenna over all sides of the EUT. With the spectrum analyser in CLEAR / WRITE mode the cone of the emission should be found and than the measuring distance will be set to 3 m with the receiving antenna moving in this cone of emission. At this position the final measurement will be carried out.



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Final measurement (1 GHz to 4.5 GHz)

The EMI Receiver set to peak and average mode and a resolution bandwidth of 1 MHz. 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 ° in order to have the antenna inside the cone of radiation.



Procedure of measurement:

The measurements were performed in the frequency range 1 GHz to 4.5 GHz.

The following procedure will be used:

- 1) Monitor the frequency range at horizontal polarisation and move the antenna over all sides of the EUT (if necessary move the EUT to another orthogonal axis).
- 2) Change the antenna polarisation and repeat 1) with vertical polarisation.
- 3) Make a hardcopy of the spectrum.
- 4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
- 5) Change the analyser mode to Clear / Write and found the cone of emission.
- 6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3 m and the antenna will be still inside the cone of emission.
- 7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarisation and azimuth and the peak and average detector, which causes the maximum emission.
- 8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beam width.

Step 1) to 6) are defined as preliminary measurement.

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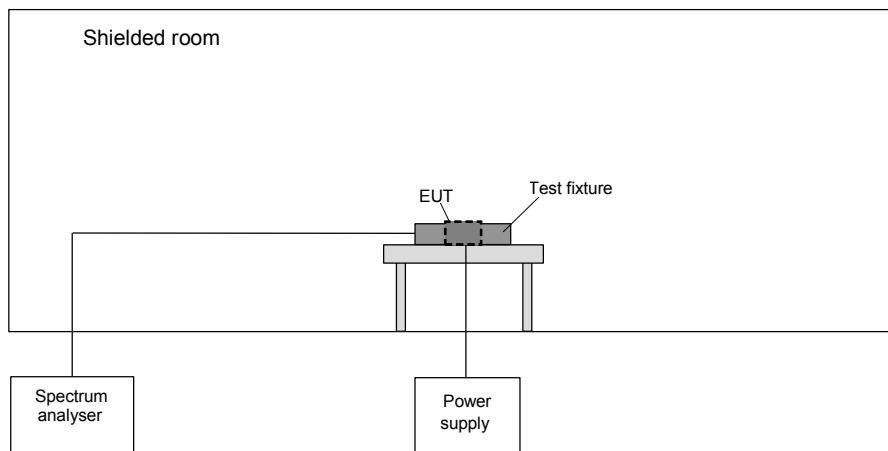
6.2 METHOD OF MEASUREMENT (20 dB BANDWIDTH)

The calibration of the spectrum analyser has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyser via a low loss cable. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed or a test fixture shall be used. The EUT has to be switched on, the transmitter shall work with its maximum data rate.

The following spectrum analyser settings shall be used:

- Span: App. 2 to 3 times the 20 dB bandwidth, centred on the actual channel.
- Resolution bandwidth: 10 kHz.
- Video bandwidth: 10 kHz.
- Sweep: Auto.
- Detector function: peak.
- Trace mode: Max hold.

After trace stabilisation the marker shall be set on the signal peak. The first display line has to be set on this value. The second display line has to be set 20 dB below the first line (or the peak marker). The frequency lines shall be set on the intersection points between the second display line and the measured curve.



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7 TEST RESULTS

7.1 CALCULATION OF THE MEASUREMENT RESULTS

Because of pulsed transmission all measurements were carried out with a peak detector and the average value is calculated over a pulse train of 100 ms as required in Part 15.35.

To calculate the average value a complete pulse train was measured. A detail view to a pulse period was taken and the transmitter-on-time was recorded. This time was used to calculate the average correction factor.

A pulse train consists of eight sub pulse trains. During a pulse train the transmitter on time for a sub pulse will be the same for the first seven sub pulses. The last sub pulse will be the longest one; it will be used for calculating the average correction factor.

Because the complete pulse train exceeds 100 ms, the average correction factor was calculated with the length of the longest sub pulse train divided by 100 ms.

Silent period between two transmissions (pulses) in normal operation mode: At least 7 minutes.

Summary of the complete sub pulse train:

one sub pulse train consists of

2 pulses type 1: $2 * 471 \mu s = 942 \mu s$

16 pulses type 2: $16 * 220 \mu s = 3520 \mu s$

57 pulses type 3: $57 * 110 \mu s = 6270 \mu s$

total on time of sub pulse = $10,732 \mu s$

total length of one sub pulse = 22.846 ms

Duty cycle correction factor according to 15.35c

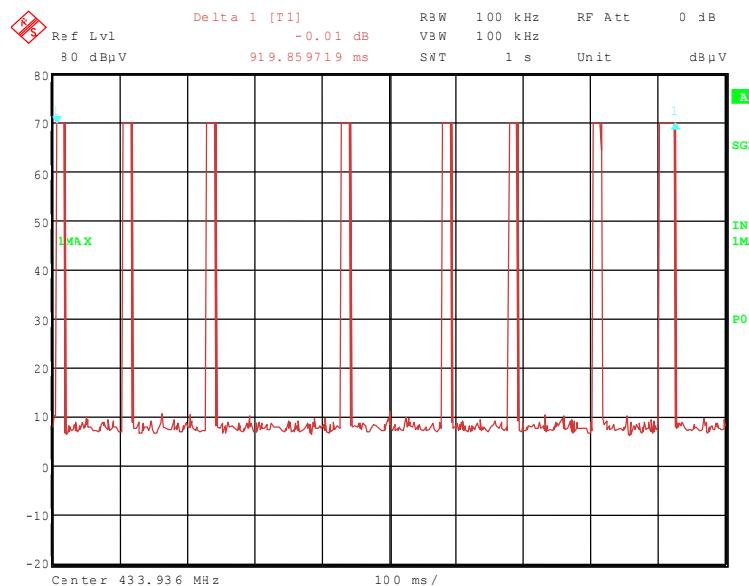
$F [\text{dB}] = 20 * \log (10,732 \mu s / 100\text{ms}) = -19.4 \text{ dB}$

So the measured peak values were calculated with 19.4 dB down into average values.

Please refer also to the plots in the following.

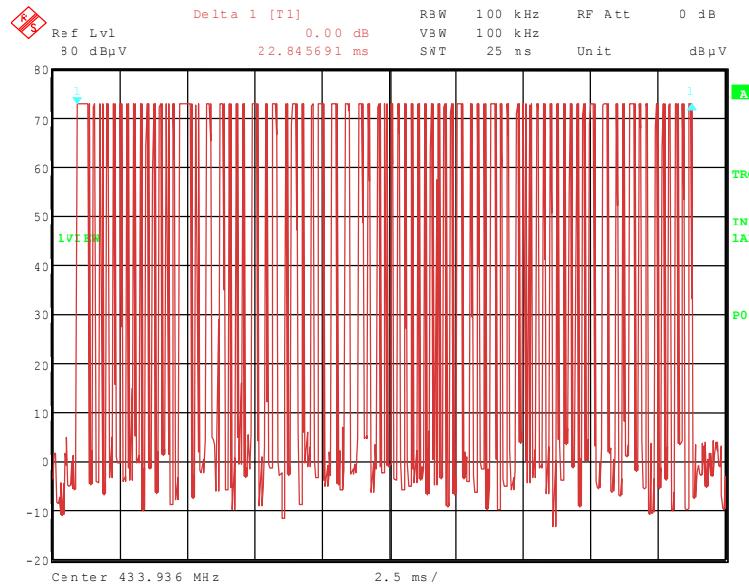
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70545_12.wmf: total pulse train:



Complete pulse trains consists of 8 sub pulse trains with a total length of 919.860 ms

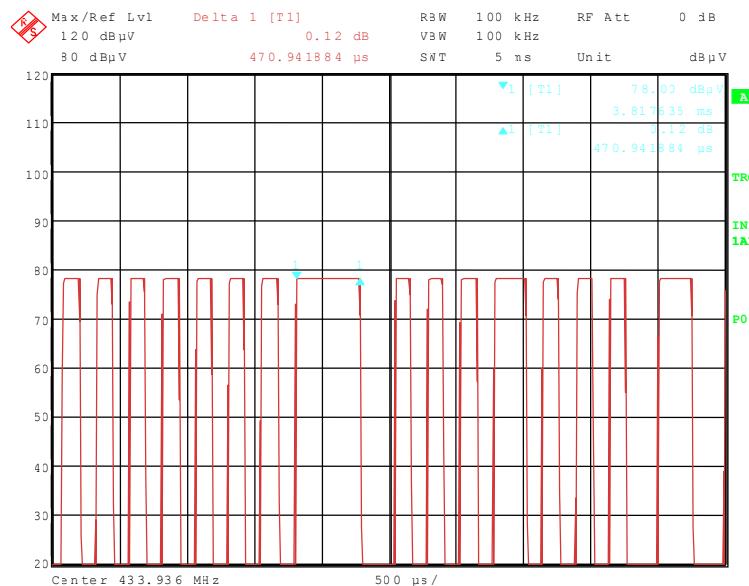
70545_14.wmf: total view to longest pulse:



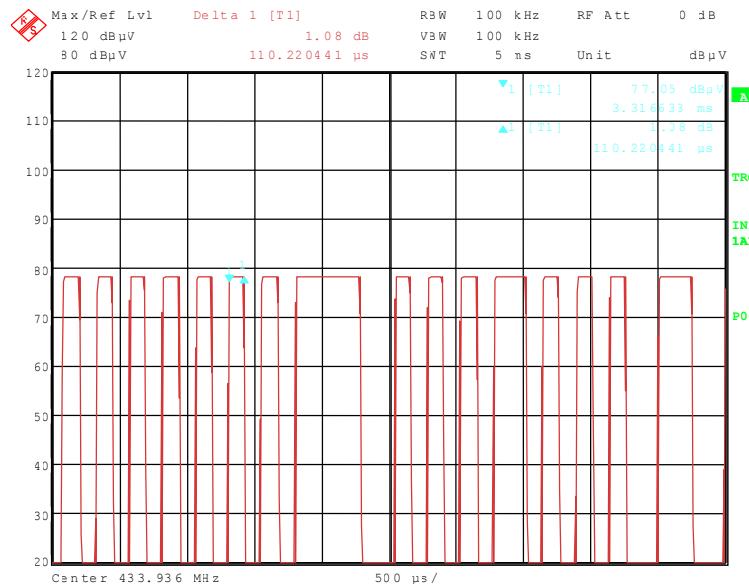
Total length of sub pulse train 8 (worst case) = 22.846 ms

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70545_16.wmf: detail view to pulse train:

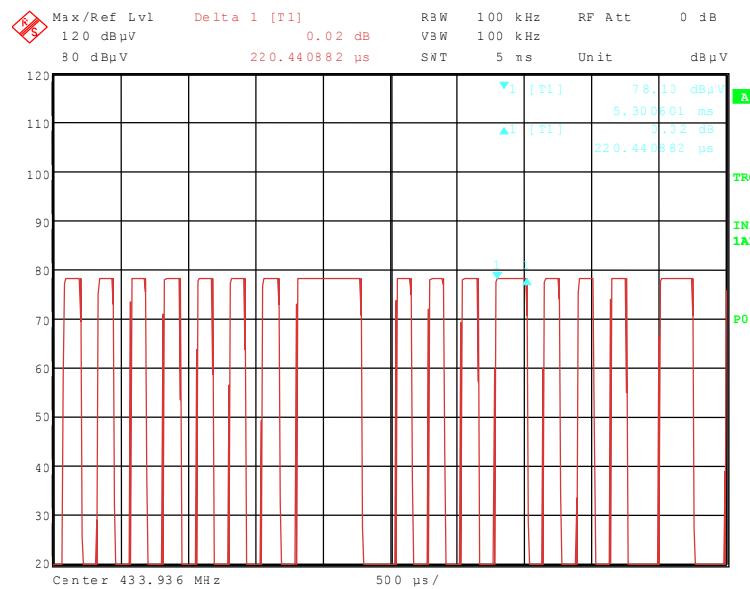


70545_17.wmf: detail view to pulse train:



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70545_18.wmf: detail view to pulse train:



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7.2 PRELIMINARY RADIATED EMISSION TEST (9 kHz to 4.5 GHz)

Ambient temperature	21 °C	Relative humidity	48 %
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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.

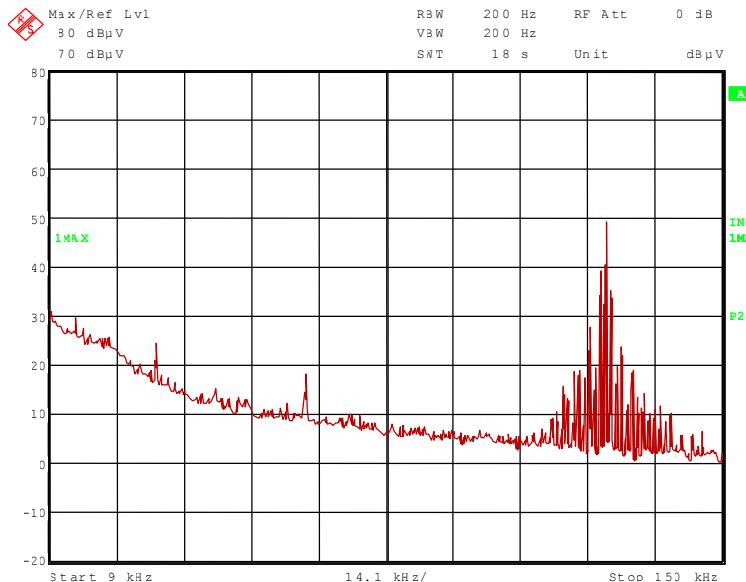
Cable guide: The cable of the coil antenna was fixed on the non-conducting table. For further information of the cable guide refer to the pictures in annex A of this test report.

Test record: The test was carried out in transmit mode of the EUT.

Supply voltage: The EUT was supplied by the internal battery.

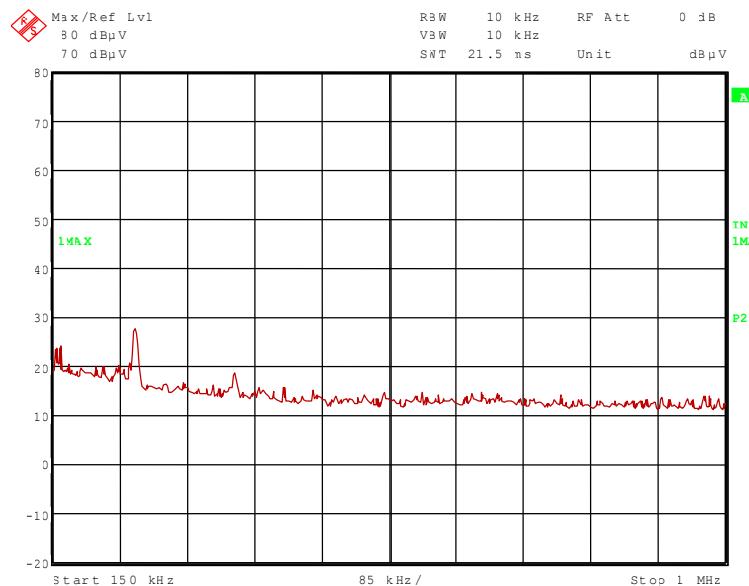
Remark: The emissions found at 31 kHz and 62 kHz caused by the measuring system and not by the EUT.

70545_8.wmf: Spurious emissions from 9 kHz to 150 kHz:

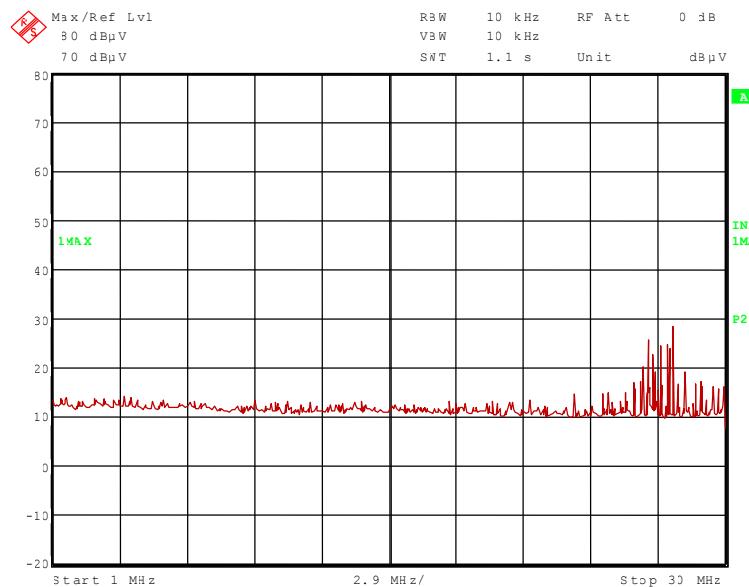


TEST REPORT REFERENCE: R70545_A Edition 1

70545_9.wmf: Spurious emissions from 150 kHz to 1 MHz:



70545_10.wmf: Spurious emissions from 1 MHz to 30 MHz:

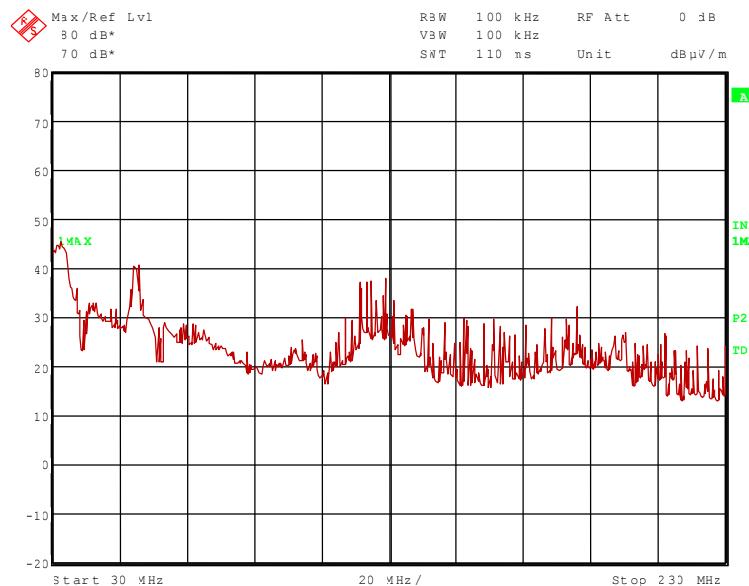


All emissions found, were produced by the EUT-initiator. This was checked by repeating the measurement without the EUT; the measured emissions were identical to the results with EUT.

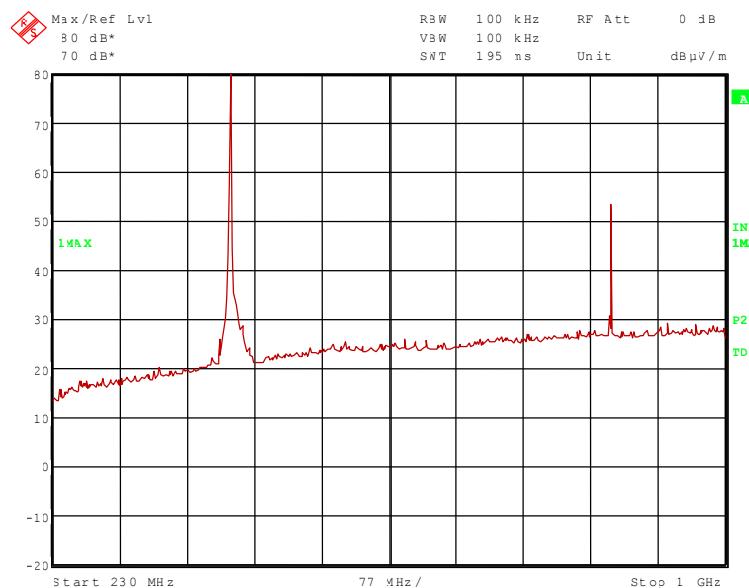
So no final measurements on the outdoor test site were carried out.

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70545_7.wmf: Spurious emissions from 30 MHz to 230 MHz:



70545_4.wmf: Spurious emissions from 230 MHz to 1 GHz:



The following frequencies were found during the preliminary radiated emission test:

32.675 MHz, 55.283 MHz, 433.936 MHz and 867.872 MHz.

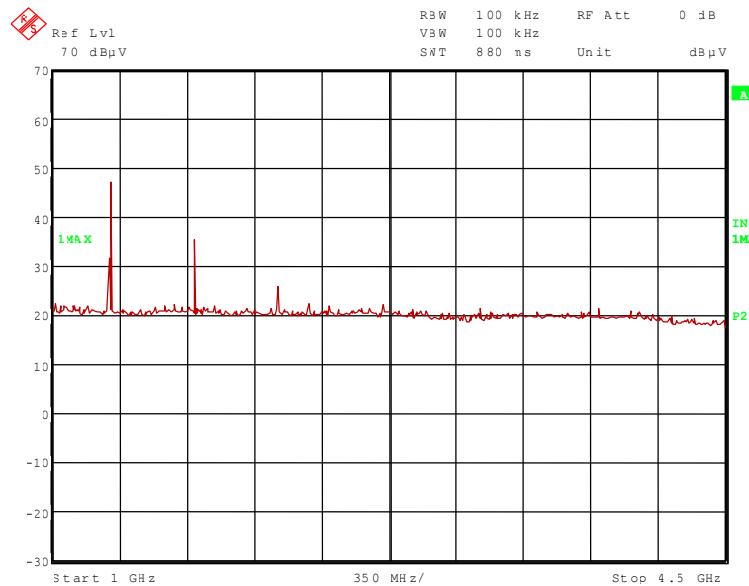
The following frequency was found inside the restricted bands according to FCC 47 CFR Part 15 section 15.205 [2].

129.360 MHz.

These frequencies have to be measured on the open area test site. The results of this final measurement are shown in subclause 7.3 of this test report.

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70545_11.wmf: Spurious emissions from 1 GHz to 4.5 GHz:



The following frequency was found inside the restricted bands during the preliminary radiated emission test:

1735.744 MHz and 2169.680 MHz.

The following frequencies were found outside the restricted bands during the preliminary radiated emission test:

1301.808 MHz.

On these frequencies a final measurement has to take place. The results of this final measurement are shown in subclause 7.4 of this test report.

TEST EQUIPMENT USED FOR THE TEST:

29, 31 – 36, 43, 44, 49, 56

TEST REPORT REFERENCE: R70545_A Edition 1

7.3 FINAL RADIATED EMISSION TEST (30 MHz to 1 GHz)

Ambient temperature:	20 °C	Relative humidity:	40 %
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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 If antenna 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 transmit mode of the EUT.

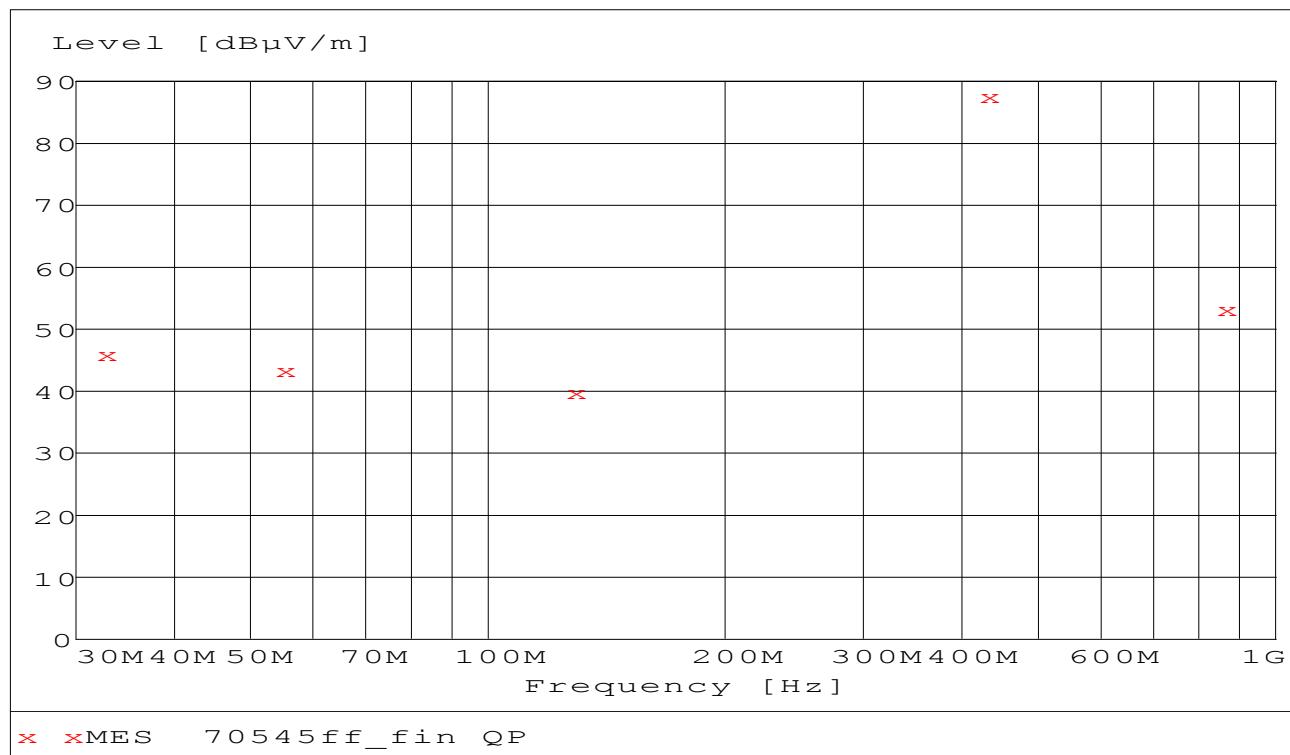
Supply voltage: The EUT was supplied by the internal battery.

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

$$\text{Result [dB}\mu\text{V/m]} = \text{reading [dB}\mu\text{V]} + \text{cable loss [dB]} + \text{antenna factor [dB/m]} + \text{average correction factor [dB]}$$

Remark: As pre tests shows, all found emissions are generated with the same duty cycle, so all emissions were measured with the peak detector and calculated to average values with the same correction factor.

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 (peak detector, without average correction factor) of the standard final measurement on the open area test site.



Data record name: 70545ff

TEST REPORT REFERENCE: R70545_A Edition 1

The results of the standard final 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.

The measurement was carried out with the use of a peak detector.

Result measured with the peak detector:

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

Spurious emissions outside restricted bands										
Frequency MHz	Result dB μ V/m	Limit dB μ V/m	Margin dB	Readings Peak dB μ V	Antenna factor 1/m	Cable loss dB	Average correction factor [dB]	Height cm	Azimuth deg	Pol.
32.675	26.6	54.0	27.4	27.0	18.6	0.4	-19.4	384.0	205.0	Vert.
55.283	24.2	54.0	29.8	36.1	7.0	0.5	-19.4	104.0	0.0	Vert.
433.936	68.3	72.9	4.6	70.1	16.3	1.3	-19.4	206.0	247.0	Hor.
867.872	34.2	54.0	19.8	29.6	22.1	1.9	-19.4	101.0	317.0	Hor.
Spurious emissions inside restricted bands										
Frequency MHz	Result dB μ V/m	Limit dB μ V/m	Margin dB	Readings Peak dB μ V	Antenna factor 1/m	Cable loss dB	Average correction factor [dB]	Height cm	Azimuth deg	Pol.
129.360	20.5	54.0	33.5	27.1	12.2	0.7	-19.4	375.0	227.0	Vert.

Measurement uncertainty	+2.2 dB / -3.6 dB
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The test results were calculated with the following formula:

Result [dB μ V/m] = reading [dB μ V] + cable loss [dB] + antenna factor [dB/m] + average correction factor [dB]

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

14 – 20

TEST REPORT REFERENCE: R70545_A Edition 1

7.4 FINAL RADIATED EMISSION TEST (1 GHz to 4.5 GHz)

Ambient temperature	21 °C	Relative humidity	48 %
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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 coil antenna 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 transmit mode of the EUT.

Supply voltage: The EUT was supplied by the internal battery.

Results measured with the peak detector (and calculated to average):

Frequency MHz	Result dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Cable loss dB	Preamp dB	Average correction factor [dB]	Height cm	Pol.	Restricted Band
1301.808	33.0	54.0	21.0	50.5	25.5	2.7	26.3	-19.4	150	Hor.	Yes
1735.744	20.2	54.0	33.8	37.1	25.7	3.1	26.3	-19.4	150	Hor.	No
2169.680	20.5	54.0	33.5	34.2	28.4	3.6	26.3	-19.4	150	Hor.	No
Measurement uncertainty						+2.2 dB / -3.6 dB					

The test results were calculated with the following formula:

Result [dB μ V/m] = reading [dB μ V] + cable loss [dB] + antenna factor [dB/m] – gain of preamplifier [dB]
+ average correction factor [dB]

Test result: Passed

TEST EQUIPMENT USED FOR THE TEST:

29, 31 – 34, 36, 44, 49

TEST REPORT REFERENCE: R70545_A Edition 1

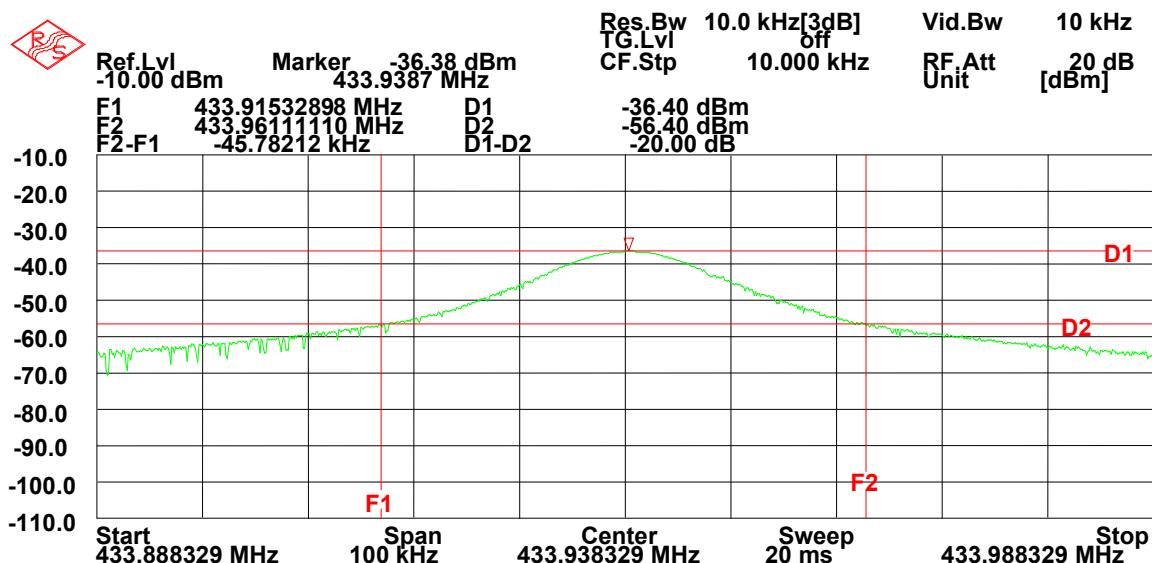
7.5 20 dB BANDWIDTH

Ambient temperature:	21 °C	Relative humidity:	42 %
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Position of EUT: The EUT was set-up on coupling device.

Supply voltage: During all measurements the EUT was supplied by the internal power supply.

70545_f.hgl: 20 dB bandwidth



Measured Bandwidth	Limit
45.782 kHz	1.08 MHz (0.25% of 433.93 MHz)

Test: Passed

TEST EQUIPMENT USED THE TEST:

1, 30, 54, 55

TEST REPORT REFERENCE: R70545_A Edition 1

8 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

TEST REPORT REFERENCE: R70545_A Edition 1

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 833181/018	480025 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

TEST REPORT REFERENCE: R70545_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 11.9 GHz – 18 GHz	18240-20	Flann Microwave	483	480294
38	Standard Gain Horn 11.9 GHz – 18 GHz	18240-20	Flann Microwave	482	480295
39	Standard Gain Horn 17.9 GHz – 26.7 GHz	20240-20	Flann Microwave	411	480297
40	Standard Gain Horn 17.9 GHz – 26.7 GHz	20240-20	Flann Microwave	410	480296
41	Standard Gain Horn 26.4 GHz – 40.1 GHz	22240-20	Flann Microwave	469	480299

TEST REPORT REFERENCE: R70545_A Edition 1

No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
42	Standard Gain Horn 26.4 GHz – 40.1 GHz	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	RF-cable No. 10	RG223	Phoenix-Test-Lab	-	410102
55	Test fixture	-	Phoenix Test-Lab	-	410160
56	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-

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

TEST REPORT REFERENCE: R70545_A Edition 1

9 LIST OF ANNEXES

ANNEX A	PHOTOGRAPHS OF THE TEST SET-UPS:	4 pages
	WM2, test set-up fully anechoic chamber	70545_5.jpg
	WM2, test set-up fully anechoic chamber	70545_4.jpg
	WM2, test set-up fully anechoic chamber	70545_2.jpg
	WM2, test set-up open area test-site	70545_3.jpg
ANNEX B	EXTERNAL PHOTOGRAPHS OF THE TEST SAMPLE:	3 pages
	WM2, 3-D view 1	70545_c.jpg
	WM2, 3-D view 2	70545_a.jpg
	WM2, top view	70545_d.jpg
ANNEX C	INTERNAL PHOTOGRAPHS OF THE TEST SAMPLE:	3 pages
	WM2, PCB, top view	70545_e.jpg
	WM2, PCB, bottom view	70545_f.jpg
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ANNEX D	ADDITIONAL RESULTS FOR INDUSTRY CANADA:	2 pages
ANNEX E	FCC / IC CROSSREFERENCE	1 page