

Königswinkel 10

32825 Blomberg

Germany

Phone: +49 (0) 52 35 95 00-0

Fax: +49 (0) 52 35 95 00-10

Test Report

Report Number: F113573E1

Applicant:

EMTEC GmbH

Manufacturer:

EMTEC GmbH

Equipment under Test (EUT):

ZONESCAN 820 ALPHA



Laboratory (CAB) accredited by
Deutsche Gesellschaft für Akkreditierung mbH
in compliance with DIN EN ISO/IEC 17025
under the Reg. No. DGA-PL-105/99-22,
FCC Test site registration number 90877 and
Industry Canada Test site registration IC3469A-1

REFERENCES

- [1] **ANSI C63.4-2009** 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 CFR 47 Part 15 (August 2011)** Radio Frequency Devices
- [3] **FCC Public Notice DA 00-705 (March 2000)**
- [4] **RSS-210 Issue 8 (December 2010)** Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
- [5] **RSS-Gen Issue 3 (December 2010)** General Requirements and Information for the Certification of Radiocommunication Equipment

TEST RESULT

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test.
The complete test results are presented in the following.

Test engineer:	Thomas KÜHN		16 November 2011
	Name	Signature	Date
Authorized reviewer:	Bernd STEINER		16 November 2011
	Name	Signature	Date

RESERVATION

This test report is only valid in its original form.

Any reproduction of its contents in extracts 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 NUMBER.

Contents:	Page
1 IDENTIFICATION.....	4
1.1 Applicant.....	4
1.2 Manufacturer	4
1.3 Test laboratory	4
1.4 EUT (Equipment Under Test).....	5
1.5 Technical data of equipment	5
1.6 Dates	6
2 OPERATIONAL STATES.....	6
3 ADDITIONAL INFORMATION.....	7
4 OVERVIEW	7
5 TEST RESULTS.....	8
5.1 20 dB bandwidth	8
5.1.1 Method of measurement (20 dB bandwidth).....	8
5.1.2 Test results (20 dB bandwidth)	9
5.2 Carrier frequency separation.....	11
5.2.1 Method of measurement (carrier frequency separation)	11
5.2.2 Test results (carrier frequency separation)	12
5.3 Number of hopping frequencies	14
5.3.1 Method of measurement (number of hopping frequencies).....	14
5.3.2 Test results (number of hopping frequencies)	15
5.4 Dwell time.....	16
5.4.1 Method of measurement (dwell time)	16
5.4.2 Test results (dwell time)	17
5.5 Maximum peak output power	18
5.5.1 Method of measurement (maximum peak output power)	18
5.5.2 Test results (maximum peak output power).....	19
5.6 Radiated emissions.....	21
5.6.1 Method of measurement (radiated emissions)	21
5.6.2 Test results (radiated emissions).....	26
5.6.2.1 Preliminary radiated emission measurement	26
5.6.2.2 Final radiated emission measurement (30 MHz to 1 GHz)	35
5.6.2.3 Final radiated emission measurement (1 GHz to 10 GHz).....	38
6 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS	40
7 REPORT HISTORY	40
8 LIST OF ANNEXES.....	41

1 IDENTIFICATION

1.1 Applicant

Name:	EMTEC GmbH
Address:	Olgastraße 72 88045 Friedrichshafen
Country:	Germany
Name for contact purposes:	Mr. Hermann WAIBEL
Phone:	+49 (0)7541 9537-15
Fax:	+49 (0)7541 9537-10
eMail Address:	Hermann.Waibel@emtec-gmbh.de
Applicant represented during the test by the following person:	Mr. Hermann WAIBEL; Mr. Stefan LANG

1.2 Manufacturer

Name:	EMTEC GmbH
Address:	Olgastraße 72 88045 Friedrichshafen
Country:	Germany
Name for contact purposes:	Mr. Hermann WAIBEL
Phone:	+49 (0) 75 41 95 37-15
Fax:	+49 (0) 75 41 95 37-10
eMail Address:	Hermann.Waibel@emtec-gmbh.de
Manufacturer represented during the test by the following person:	Mr. Hermann WAIBEL; Mr. Stefan LANG

1.3 Test laboratory

The tests were carried out at: **PHOENIX TESTLAB GmbH**
Königswinkel 10
32825 Blomberg
Germany

accredited by DGA Deutsche Gesellschaft für Akkreditierung mbH in compliance with DIN EN ISO/IEC 17025 under Reg. No. DGA-PL-105/99-22, FCC Test site registration number 90877 and Industry Canada Test site registration IC3469A-1.

1.4 EUT (Equipment Under Test)

Test object: *	915 MHz FHSS transceiver
Model name: *	ZONESCAN 820 ALPHA
FCC ID: *	ZSSZS820915AL
IC: *	9789A-ZS820915AL
Serial number: *	Alpha-0611-5002
PCB identifier: *	ZS820-30c 1.209-02
Hardware version: *	1.3
Software version: *	2.41

1.5 Technical data of equipment

Channel 0	RX:	904.0 MHz	TX:	904.0 MHz
Channel 24	RX:	911.2 MHz	TX:	911.2 MHz
Channel 49	RX:	918.7 MHz	TX:	918.7 MHz

Antenna type: *	Internal				
Antenna gain: *	0 dBi (internal antenna)				
Antenna connector: *	None external				
Power supply: *	U _{Nom} =	7.2 V DC	U _{Min} =	5.0 V DC	U _{Max} = 8.0 V DC
Type of modulation: *	FHSS (GFSK)				
Operating frequency range: *	904.0 MHz to 918.7 MHz				
Number of channels: *	50				
Temperature range: *	-30 °C to 70 °C				
Lowest / highest Internal clock frequency: *	32.768 kHz / 918.7 MHz				

* declared by the applicant.

The following external I/O cables were used:

Identification	Connector		Length
	EUT	Ancillary	
-	No cables were connectable to the EUT		-
-	-		-

*: Length during the test if no other specified.

1.6 Dates

Date of receipt of test sample:	28 September 2011
Start of test:	28 September 2011
End of test:	28 September 2011

2 OPERATIONAL STATES

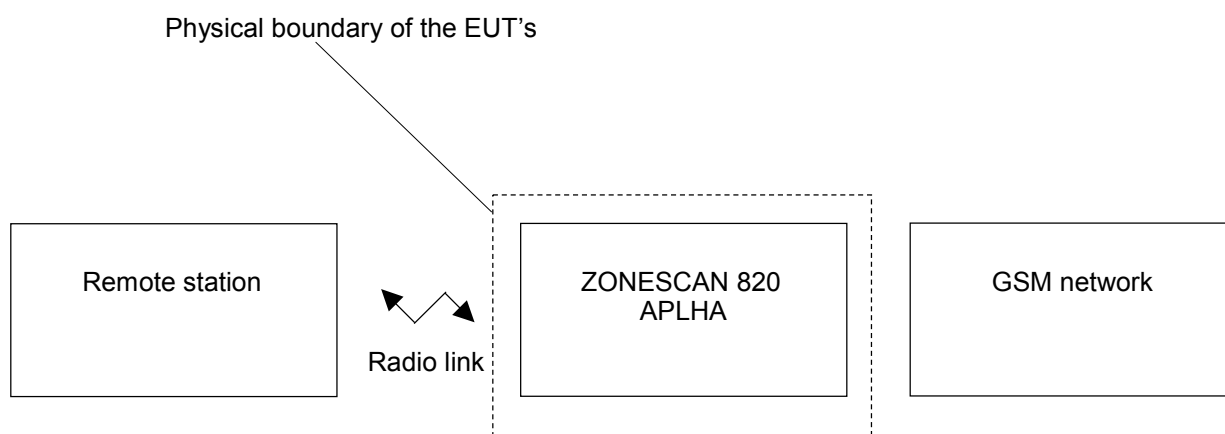
The used sample was unmodified and could be configured to operate as requested for any test item by the use of the remote station.

All conducted measurements were carried out at the internal antenna port, which is not reachable after the EUT is mounted inside the housing.

During the radiated tests the EUT was mounted in its normal usable position.

During the tests the test sample was powered with 7.2 V DC via two internal batteries.

Operation mode	Description of the operation mode	Modulation
1	Continuous transmitting on channel 0 (904.0 MHz)	GFSK
2	Continuous transmitting on channel 24 (911.2 MHz)	GFSK
3	Continuous transmitting on channel 49 (918.7) MHz	GFSK
4	Transmitter hopping on all channels	GFSK
5	Continuous receiving on 911.2 MHz	



The following test modes were adjusted during the tests:

Test items	Operation mode
20 dB bandwidth	1, 2, 3
Carrier frequency separation	1, 2, 3
Number of hopping channels	4
Dwell time	2
Maximum peak output power	1, 2, 3
Radiated emissions (transmitter)	1, 2, 3
Radiated emissions (receiver)	5

3 ADDITIONAL INFORMATION

The EUT is equipped with an already certified GSM / GPRS module. As declared by the applicant the EUT transmits only either on 900 MHz or at GSM. The simultaneously transmission is blocked by the firmware of the EUT.

During the tests the EUT was not labelled as required by FCC / IC.

4 OVERVIEW

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS 210, Issue 8 [4] or RSS-Gen, Issue 3 [5]	Status	Refer page
20 dB bandwidth	General	15.247 (a) (1) (i)	A8.1 (c) [4]	Passed	8 et seq.
Carrier frequency separation	General	15.247 (a) (1) (i)	-	Passed	11 et seq.
Number of hopping channels	902 - 928	15.247 (a) (1) (i)	A8.1 (c) [4]	Passed	14 et seq.
Dwell time	902 - 928	15.247 (a) (1) (i)	A8.1 (c) [4]	Passed	16 et seq.
Maximum peak output power	902 - 928	15.247 (b) (2)	A8.4 (1) [4]	Passed	18 et seq.
Radiated emissions (transmitter)	0.009 - 10,000	15.247 (d) 15.205 (a) 15.209 (a)	A8.5 [4] 2.5 [4] 7.2.2 [5]	Passed	21 et seq.
Radiated emissions (receiver)	30 – 5,000	15.109 (a)	6.1 [5]	Passed	Annex D

5 TEST RESULTS

5.1 20 dB bandwidth

5.1.1 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. The EUT has to be switched on and the hopping function has to be disabled, 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 hopping channel.
- Resolution bandwidth: $\geq 1\%$ of the 20 dB bandwidth.
- Video bandwidth: \geq the resolution bandwidth.
- 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.

The measurement will be performed at the upper, the lower end and the middle of the assigned frequency band.

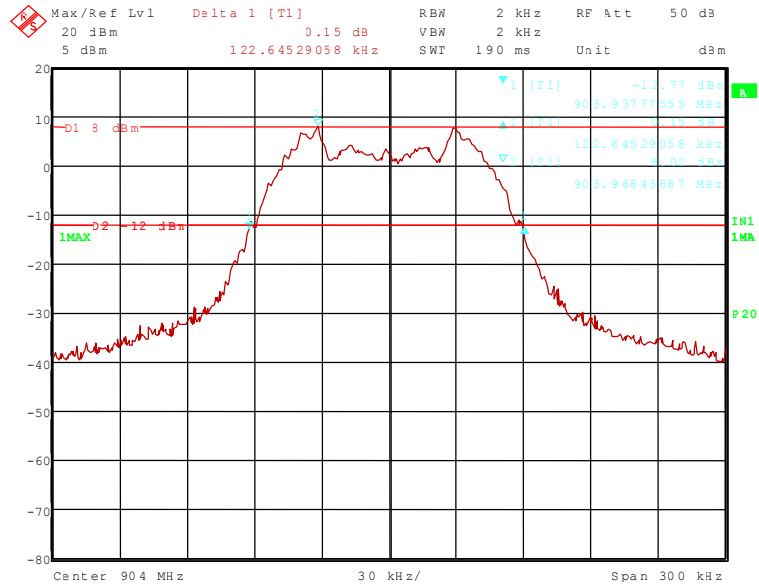
Test set-up:



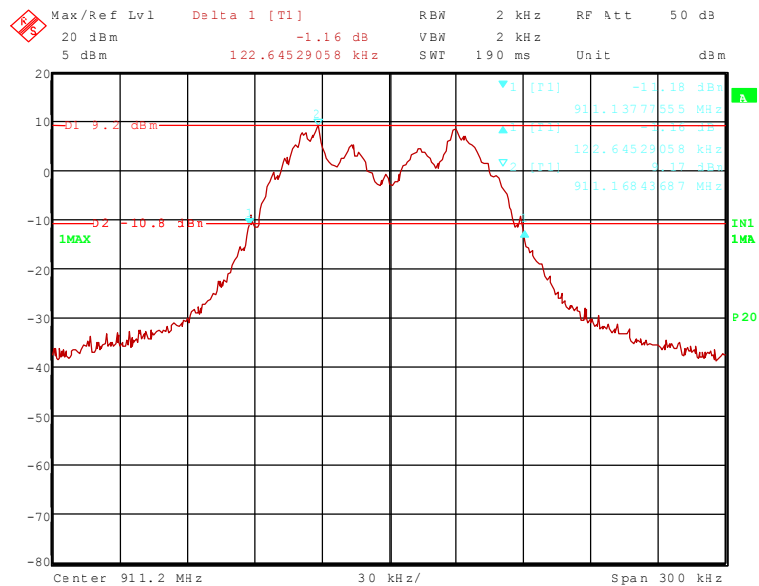
5.1.2 Test results (20 dB bandwidth)

Ambient temperature	21 °C	Relative humidity	52 %
---------------------	-------	-------------------	------

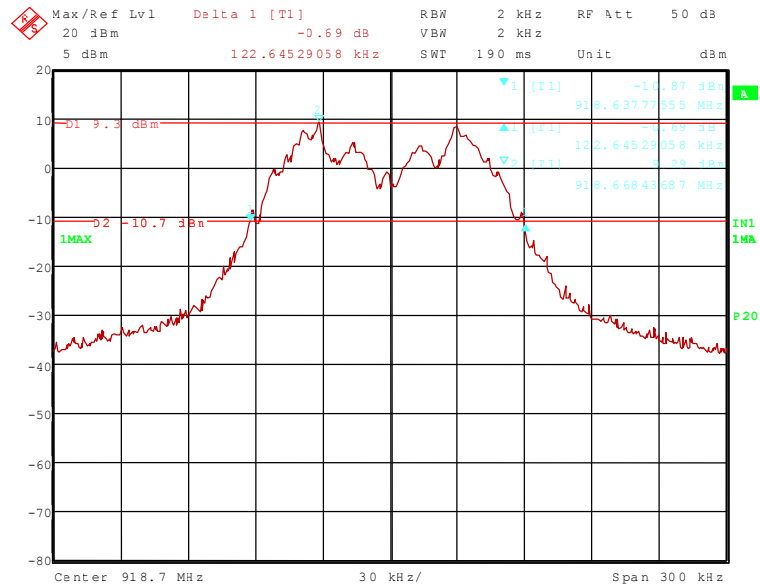
113573_19.wmf: 20 dB bandwidth at the lower end of the assigned frequency band:



113573_20.wmf: 20 dB bandwidth at the middle of the assigned frequency band:



113573_21.wmf: 20 dB bandwidth at the upper end of the assigned frequency band:



Channel number	Channel frequency [MHz]	20 dB bandwidth [kHz]
0	904.000 MHz	122.645
24	911.200 MHz	122.645
49	918.700 MHz	122.645
Measurement uncertainty		+0.66 dB / -0.72 dB

TEST EQUIPMENT USED FOR THE TEST:

31

5.2 Carrier frequency separation

5.2.1 Method of measurement (carrier frequency separation)

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. The EUT has to be switched on and the hopping function has to be enabled.

The following spectrum analyser settings shall be used:

- Span: Wide enough to capture the peaks of two adjacent channels.
- Resolution bandwidth: $\geq 1\%$ of the span.
- Video bandwidth: \geq the resolution bandwidth.
- Sweep: Auto.
- Detector function: peak.
- Trace mode: Max hold.

After trace stabilisation the marker and the delta marker function will be used to determine the separation between the peaks of two adjacent channel signals.

The measurement will be performed at the upper, the lower end and the middle of the assigned frequency band.

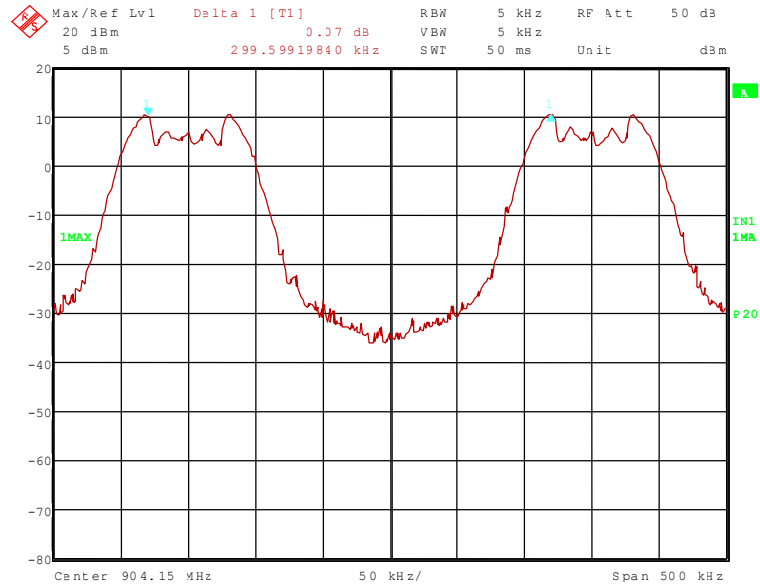
Test set-up:



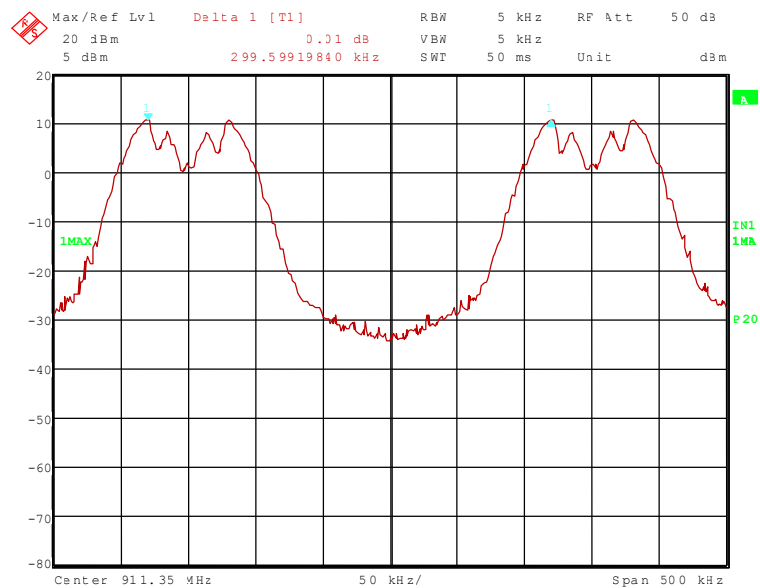
5.2.2 Test results (carrier frequency separation)

Ambient temperature	21 °C	Relative humidity	52 %
---------------------	-------	-------------------	------

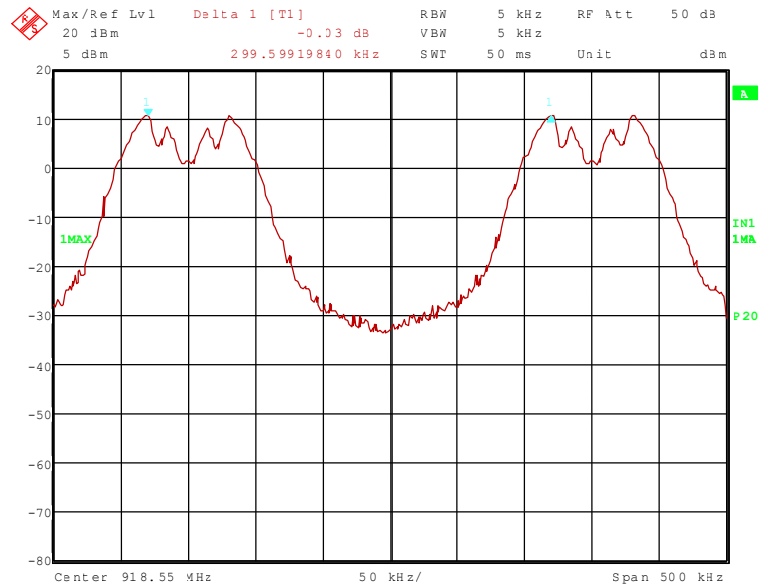
113573_22.wmf: Channel separation at the lower end of the assigned frequency band:



113573_23.wmf: Channel separation at the middle of the assigned frequency band:



113573_24.wmf: Channel separation at the upper end of the assigned frequency band:



Channel number	Channel frequency [MHz]	Channel separation [kHz]	Minimum limit [kHz]
0	904.000	299.599	122.645 (the 20 dB bandwidth)
24	911.200	299.599	122.645 (the 20 dB bandwidth)
49	918.700	299.599	122.645 (the 20 dB bandwidth)
Measurement uncertainty			$<10^{-7}$

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

31

5.3 Number of hopping frequencies

5.3.1 Method of measurement (number of hopping frequencies)

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. The EUT has to be switched on and the hopping function has to be enabled.

The following spectrum analyser settings shall be used:

- Span: Equal to the assigned frequency band.
- Resolution bandwidth: $\geq 1\%$ of the span.
- Video bandwidth: \geq the resolution bandwidth.
- Sweep: Auto.
- Detector function: Peak.
- Trace mode: Max hold.

After trace stabilisation the number of hopping channels could be counted. It might be possible to divide the span into some sub ranges in order to clearly show all hopping frequencies.

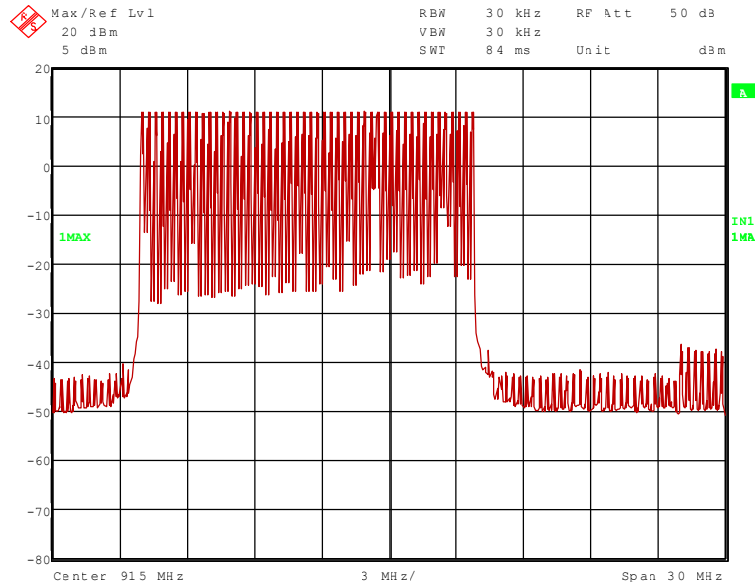
Test set-up:



5.3.2 Test results (number of hopping frequencies)

Ambient temperature	21 °C	Relative humidity	52 %
---------------------	-------	-------------------	------

113573_25.wmf: Number of hopping channels:



Number of hopping channels	Limit
Operation mode 4	
50	At least 50

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

31

5.4 Dwell time

5.4.1 Method of measurement (dwell time)

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. The EUT has to be switched on and the hopping function has to be enabled.

The following spectrum analyser settings shall be used:

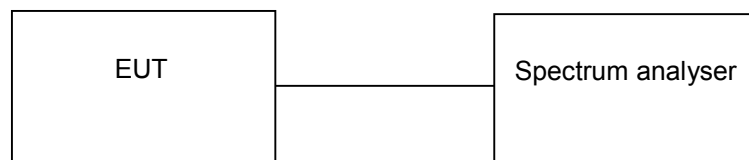
- Span: Zero, centred on a hopping channel.
- Resolution bandwidth: 1 MHz.
- Video bandwidth: \geq the resolution bandwidth.
- Sweep: As necessary to capture the entire dwell time per hopping channel.
- Detector function: peak.
- Trace mode: Max hold.

The marker and delta marker function of the spectrum analyser will be used to determine the dwell time.

The measurement will be performed at the middle of the assigned frequency band.

If the EUT is possible to operate with different mode of operation (data rates, modulation formats etc.) the test will be repeated with every different operation mode of the EUT.

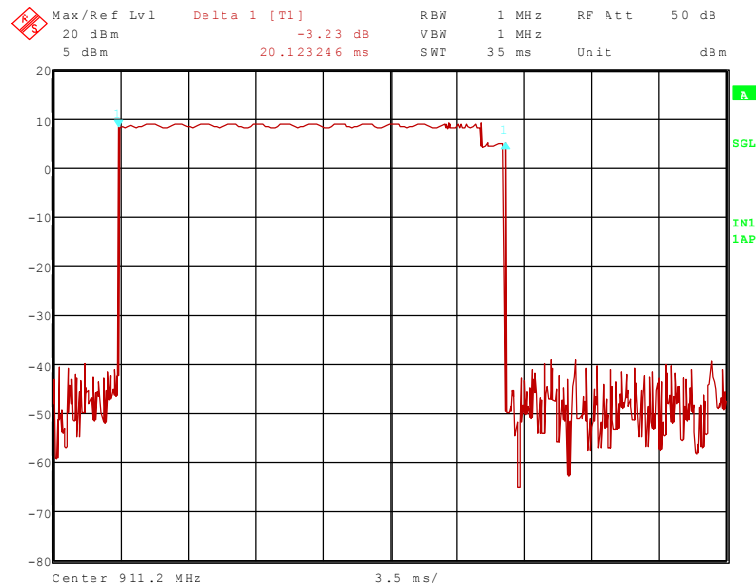
Test set-up:



5.4.2 Test results (dwell time)

Ambient temperature	21 °C	Relative humidity	52 %
---------------------	-------	-------------------	------

113573_26.wmf: Dwell time at the middle of the assigned frequency band:



The dwell time is calculated with the following formula:

$$\text{Dwell time} = t_{\text{pulse}} \times n_{\text{hops}} / \text{number of hopping channels} \times 20 \text{ s}$$

Where:

t_{pulse} is the measured pulse time (pls. refer the plots of the spectrum analyser above) [s],
 n_{hops} is the number of hops per second in the actual operating mode of the transmitter [1/s].

The hopping rate of the system is 25 hops per second and the system uses 50 channels.

Channel number	Channel frequency [MHz]	t_{pulse} [ms]	Dwell time [ms]	Limit [ms]
24	911.200	20.123	201.23	400
Measurement uncertainty			<10 ⁻⁷	

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

31

5.5 Maximum peak output power

5.5.1 Method of measurement (maximum peak output power)

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. The EUT has to be switched on and the hopping function has to be disabled.

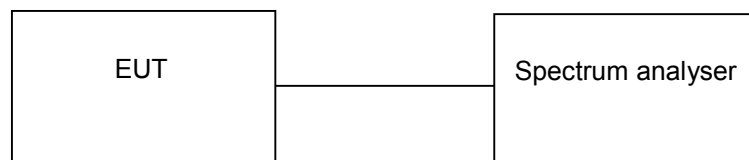
The following spectrum analyser settings shall be used:

- Span: Approx. 5 times the 20 dB bandwidth, centred on a hopping channel.
- Resolution bandwidth: > the 20 dB bandwidth of the emission being measured.
- Video bandwidth: \geq the resolution bandwidth.
- Sweep: Auto.
- Detector function: peak.
- Trace mode: Max hold.

After trace stabilisation the marker shall be set on the signal peak. The indicated level is the peak output power, which has to be corrected with the value of the cable loss and an external attenuation (if necessary).

The measurement will be performed at the upper and lower end and the middle of the assigned frequency band.

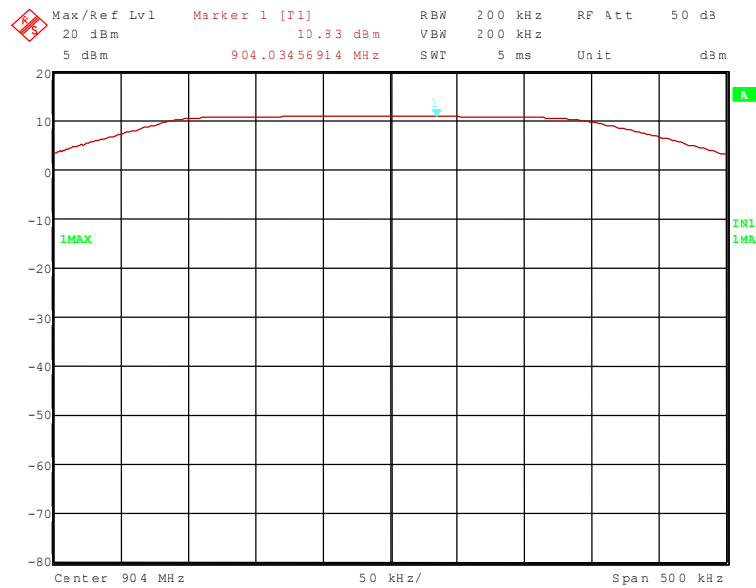
Test set-up:



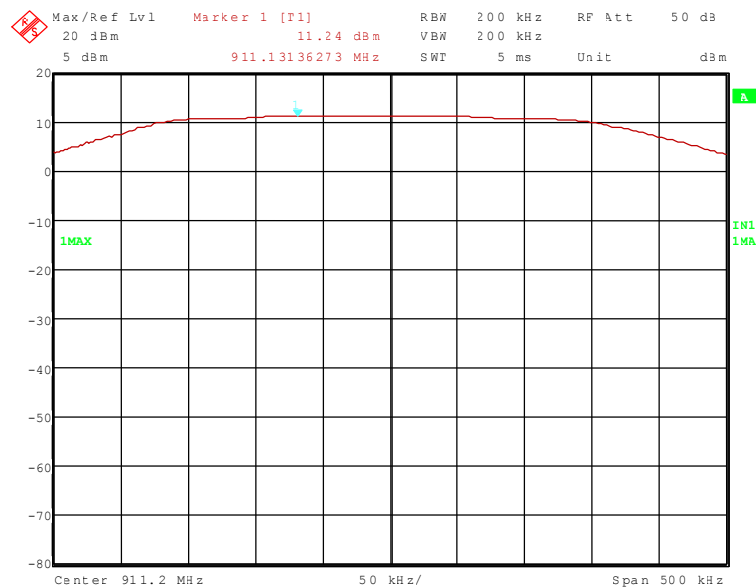
5.5.2 Test results (maximum peak output power)

Ambient temperature	21 °C	Relative humidity	52 %
---------------------	-------	-------------------	------

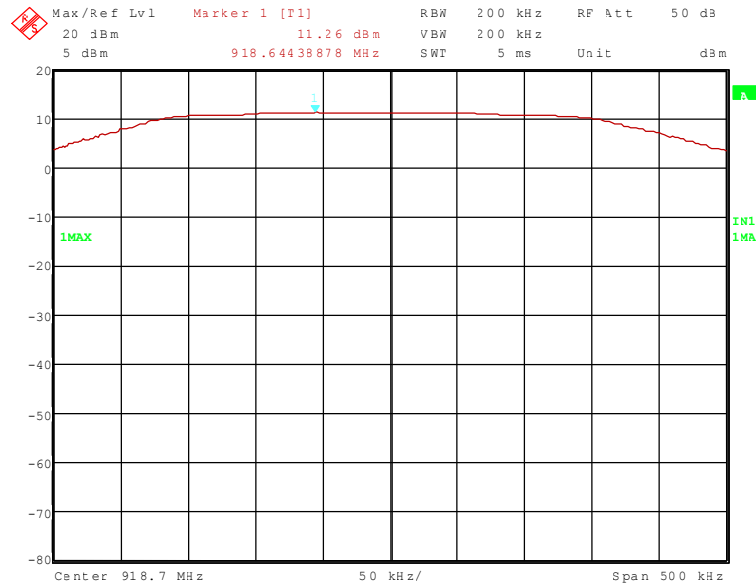
113753_27.wmf: Maximum peak output power at the lower end of the assigned frequency band (operation mode 1):



113753_28.wmf: Maximum peak output power at the middle of the assigned frequency band (operation mode 2):



113753_29.wmf: Maximum peak output power at the upper end of the assigned frequency band (operation mode 3):



Operation mode	Channel number	Channel frequency [MHz]	Maximum peak output power [dBm]	Antenna gain [dBi]	Peak power limit [dBm]
1	0	904.000	10.8	0.0	30.0
2	24	911.200	11.2	0.0	30.0
3	49	918.700	11.3	0.0	30.0
Measurement uncertainty				+0.66 dB / -0.72 dB	

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

31

5.6 Radiated emissions

5.6.1 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 30 MHz to 1 GHz.
- A final measurement carried out on an open area test site with reflecting ground plane and various antenna height in the frequency range 30 MHz to 1 GHz.
- A preliminary measurement carried out in a fully anechoic chamber with a variable antenna distance and height in the frequency range 1 GHz to 110 GHz.
- A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range 1 GHz to 110 GHz.

All measurements will be carried out with the EUT working on the middle of the assigned frequency band.

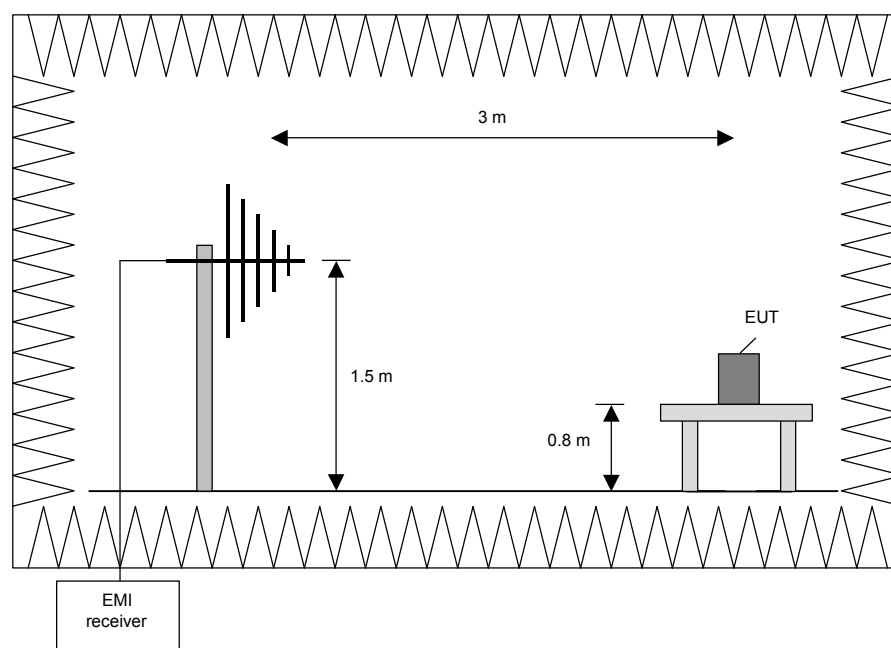
Preliminary measurement (30 MHz to 1 GHz)

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 C63.4-2009 [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 2300 MHz	100 kHz
200 MHz to 1 GHz	100 kHz



Procedure preliminary measurement:

Prescans were performed in the frequency range 30 MHz to 200 MHz and 200 MHz to 1 GHz.

The following procedure will be used:

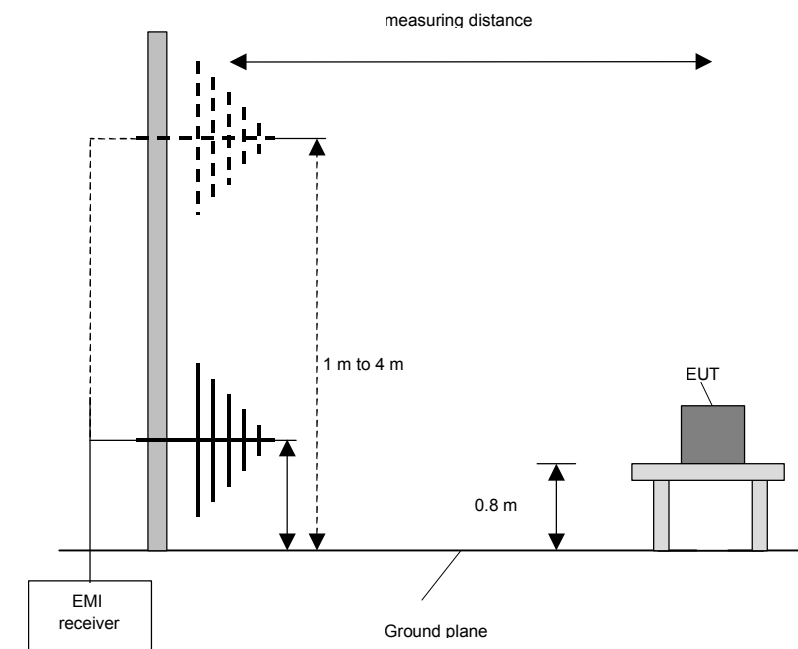
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the 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 (because of EUT is a module and might be used in a handheld equipment application).
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



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

Preliminary and final measurement (1 GHz to 110 GHz)

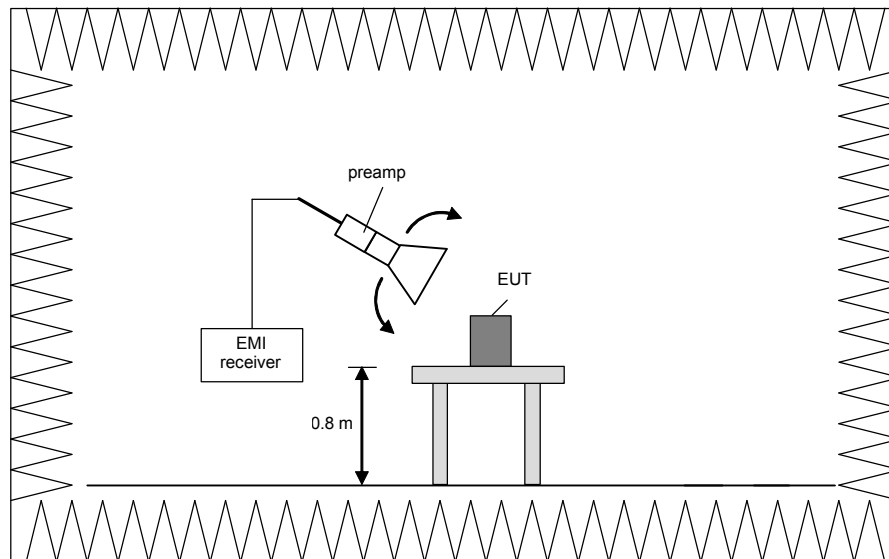
This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance to ANSI C63.4-2009 [1].

Preliminary measurement (1 GHz to 110 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. 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.

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

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	100 kHz
4 GHz to 12 GHz	100 kHz
12 GHz to 18 GHz	100 kHz
18 GHz to 26.5 GHz	100 kHz
26.5 GHz to 40 GHz	100 kHz
40 GHz to 60 GHz	100 kHz
50 GHz to 75 GHz	100 kHz
75 GHz to 110 GHz	100 kHz

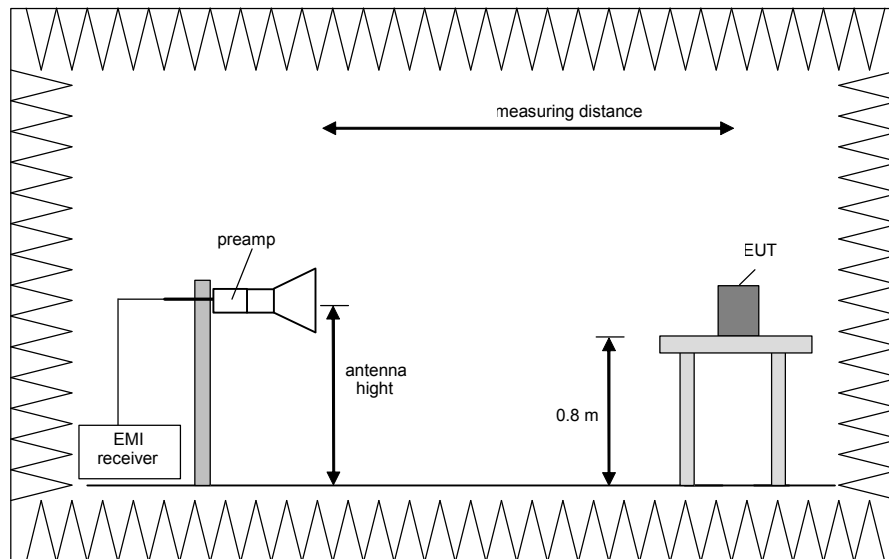


Final measurement (1 GHz to 110 GHz)

The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. 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.

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

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz
40 GHz to 60 GHz	1 MHz
50 GHz to 75 GHz	1 MHz
75 GHz to 110 GHz	1 MHz



Procedure of measurement:

The measurements were performed in the frequency range 1 GHz to 4 GHz, 4 GHz to 12 GHz, 12 GHz to 18 GHz, 18 GHz to 26.5 GHz, 26.5 GHz to 40 GHz, 40 GHz to 60 GHz, 60 GHz to 75 GHz and 75 GHz to 110 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 beamwidth.

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

5.6.2 Test results (radiated emissions)

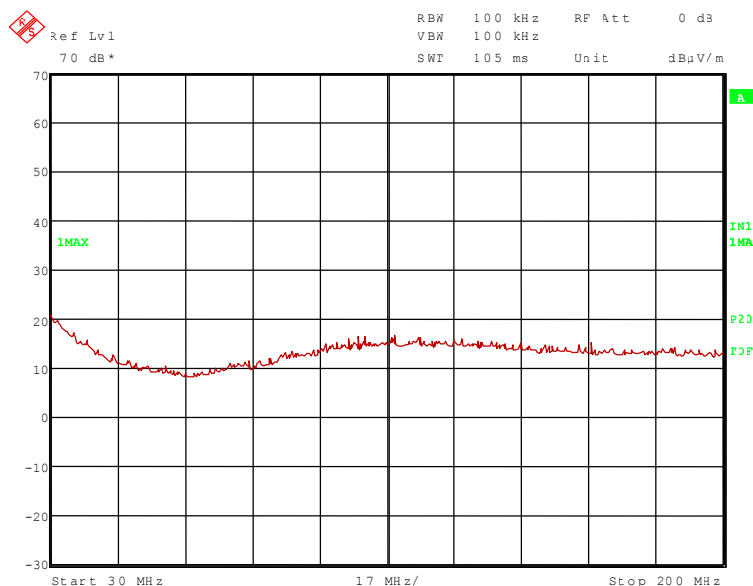
5.6.2.1 Preliminary radiated emission measurement

Ambient temperature	21 °C	Relative humidity	52 %
---------------------	-------	-------------------	------

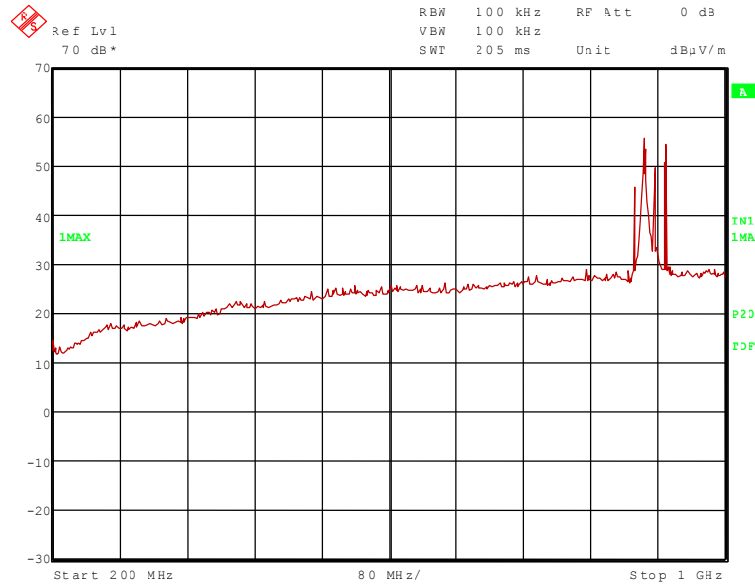
Position of EUT:	The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.
Cable guide:	No cables were connectable to the EUT. For detail information of test set-up refer to the pictures in annex A of this test report.
Test record:	All results are shown in the following.
Supply voltage:	During all measurements the EUT was supplied by a new internal battery.
Remark:	As pre-tests have shown, the emissions in the frequency range 9 kHz to 30 MHz are not depending on the transmitter operation mode. Therefore the emissions in this frequency range were measured only with the transmitter operates in operation mode 2.

Transmitter operates at the lower end of the assigned frequency band (operation mode 1)

113573_2.wmf: Spurious emissions from 30 MHz to 200 MHz (operation mode 1):



113573_1.wmf: Spurious emissions from 200 MHz to 1 GHz (operation mode 1, carrier notched):



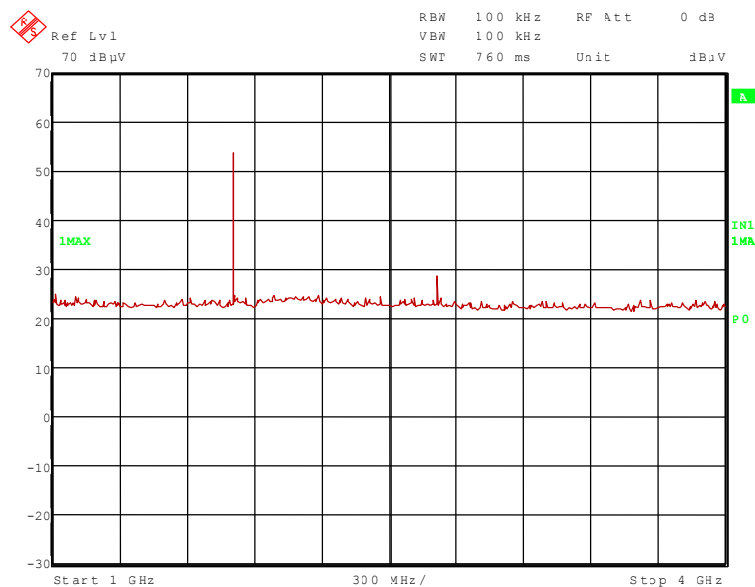
No frequencies were found inside the restricted bands during the preliminary radiated emission test.

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

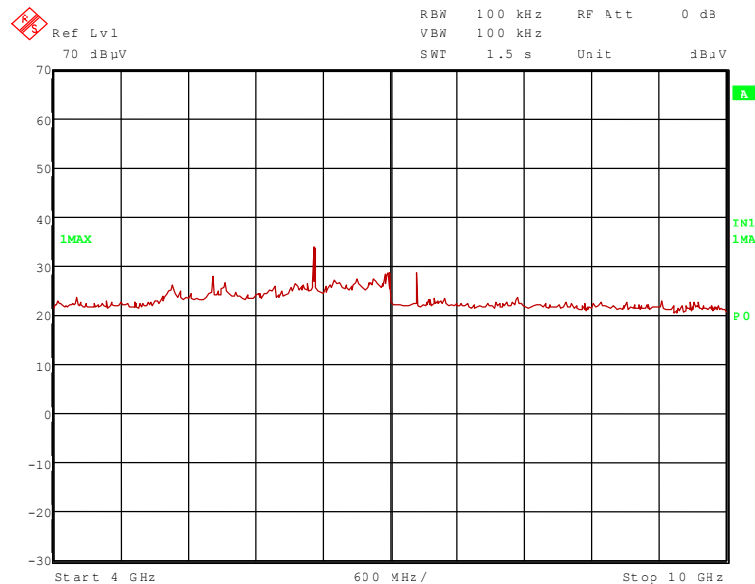
- 892.000 MHz, 904.000 MHz, 916.000 MHz and 928.000 MHz.

These frequencies have to be measured on the open area test site. The result is presented in the following.

113753_12.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 1):



113573_13.wmf: Spurious emissions from 4 GHz to 10 GHz (operation mode 1):



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

- 2.712 GHz.

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

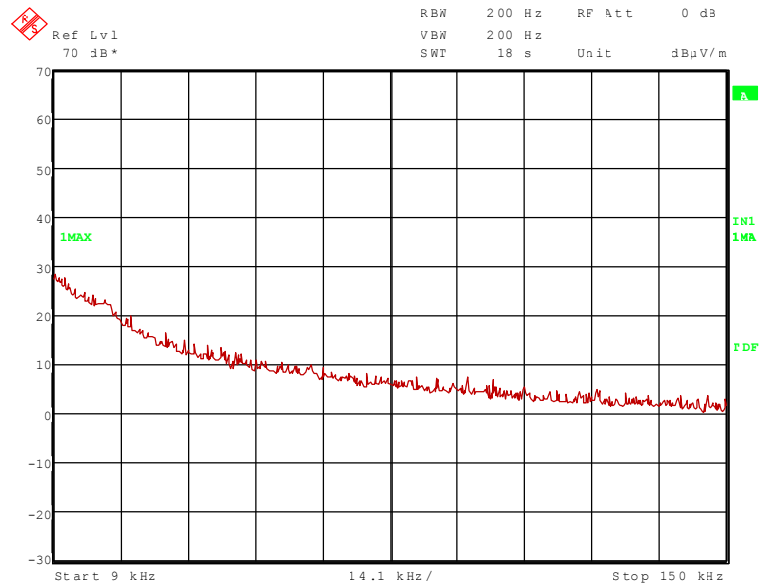
- 1.808 GHz, 6.328 GHz and 7.232 GHz.

These frequencies have to be measured in a final measurement. The results were presented in the following.

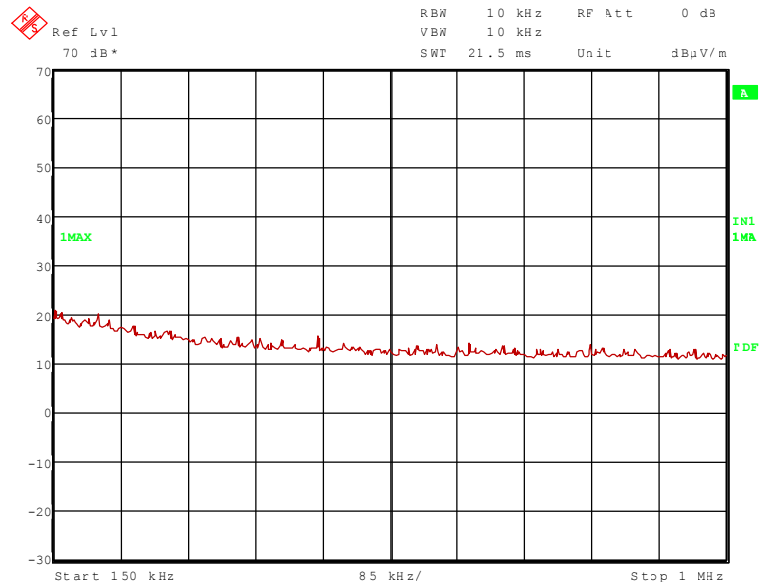
TEST EQUIPMENT USED FOR THE TEST:
29, 31 - 36, 43, 44, 46, 49, 55, 73

Transmitter operates on the middle of the assigned frequency band (operation mode 2)

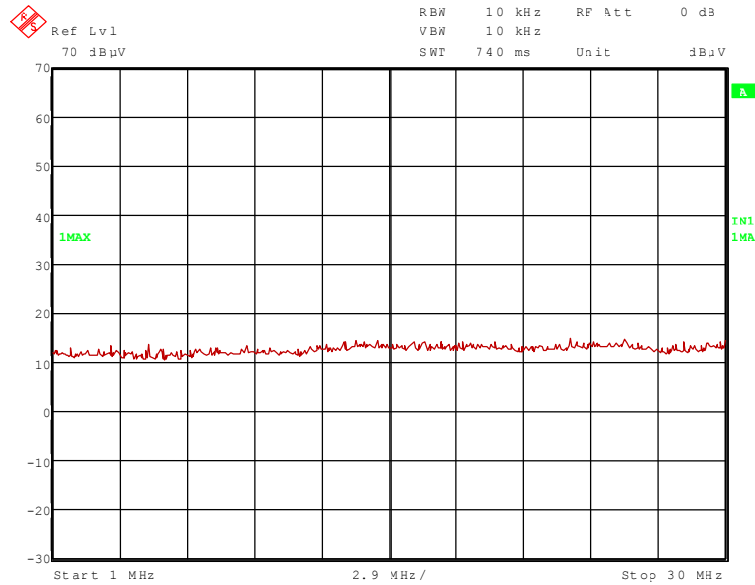
113753_7.wmf: Spurious emissions from 9 kHz to 150 MHz (operation mode 2):



113573_8.wmf: Spurious emissions from 150 kHz to 1 MHz (operation mode 2):

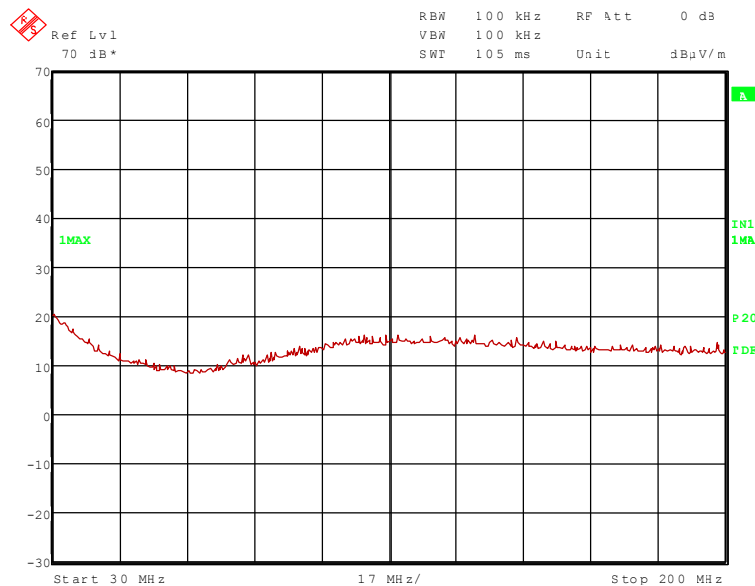


113753_9.wmf: Spurious emissions from 1 MHz to 30 MHz (operation mode 2):

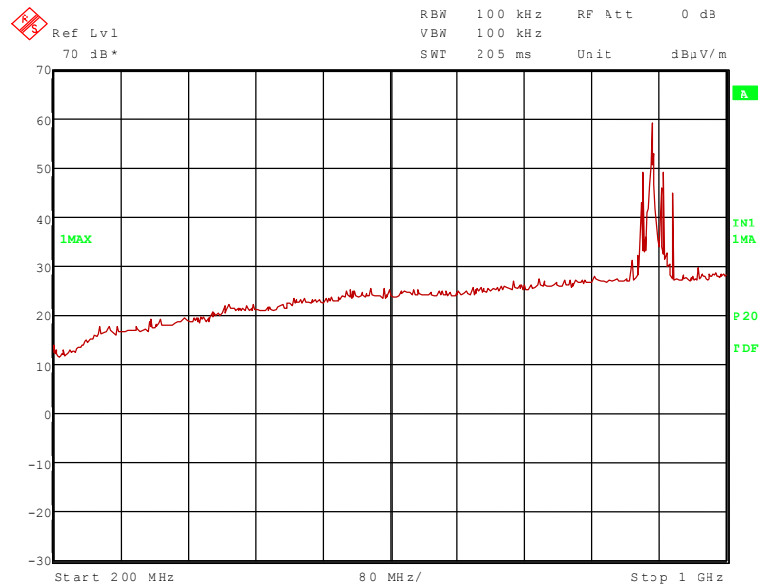


No significant frequencies above the noise floor of the system were found during the preliminary radiated emission test, so no measurements were carried out on the outdoor test site.

113573_5.wmf: Spurious emissions from 30 MHz to 200 MHz (operation mode 2):



113753_6.wmf: Spurious emissions from 200 MHz to 1 GHz (operation mode 2, carrier notched):



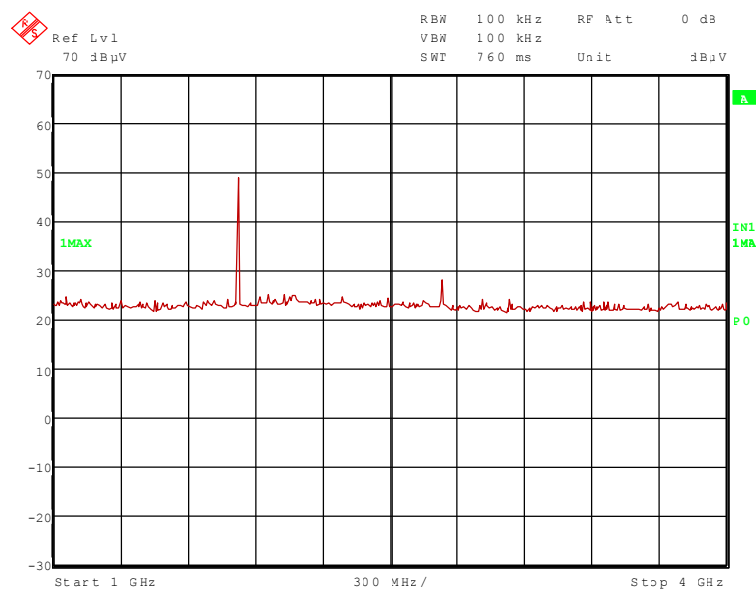
No frequencies were found inside the restricted bands during the preliminary radiated emission test.

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

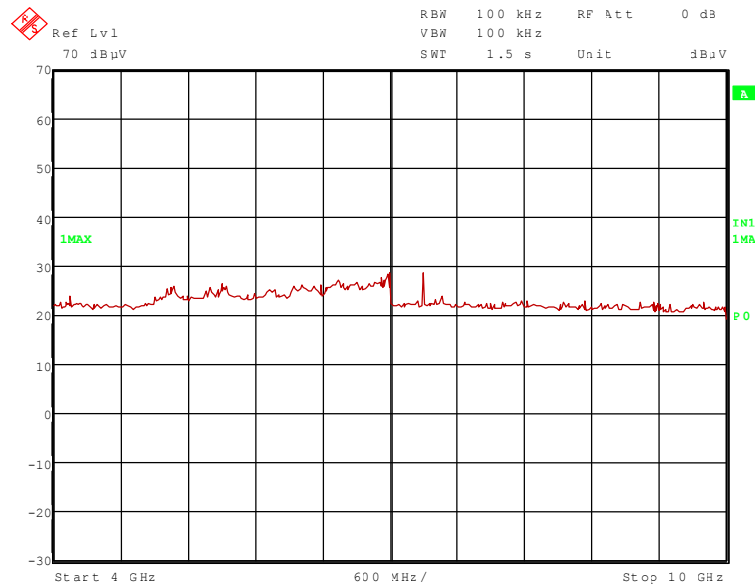
- 899.200 MHz, 911.200 MHz, 923.200 MHz and 935.200 MHz.

These frequencies have to be measured on the open area test site. The result is presented in the following.

113753_10.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 2):



113753_11.wmf: Spurious emissions from 4 GHz to 10 GHz (operation mode 2):



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

- 2.7336 GHz and 7.2896 GHz.

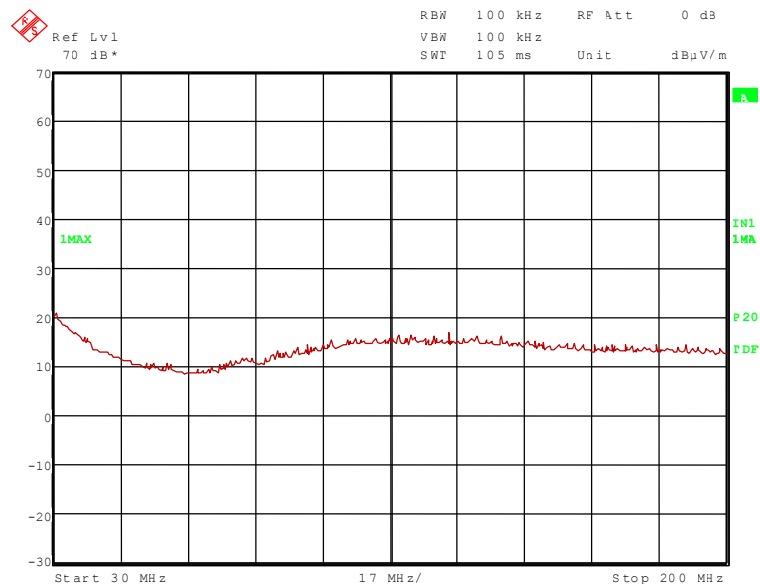
The following frequency was found outside the restricted bands during the preliminary radiated emission test:

- 1.8224 GHz.

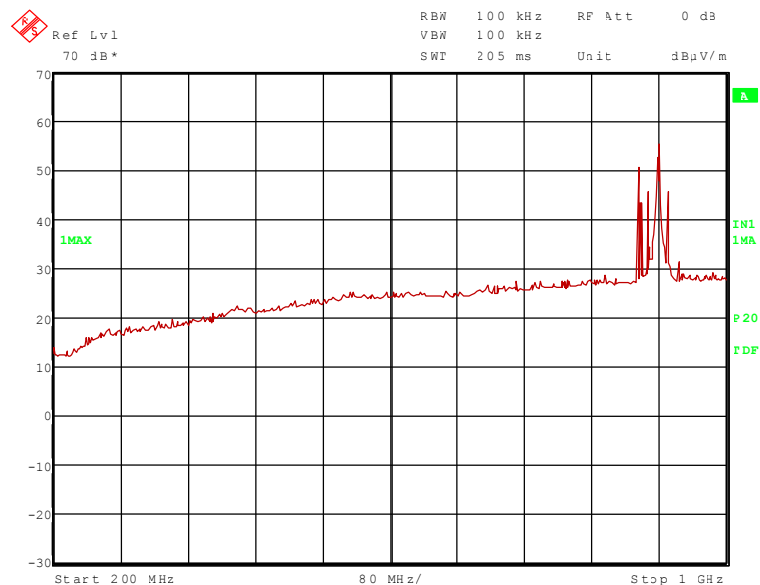
These frequencies have to be measured in a final measurement. The results were presented in the following.

Transmitter operates on the upper end of the assigned frequency (operation mode 3)

113573_4.wmf: Spurious emissions from 30 MHz to 200 MHz (operation mode 3):



113753_3.wmf: Spurious emissions from 200 MHz to 1 GHz (operation mode 3, carrier notched):



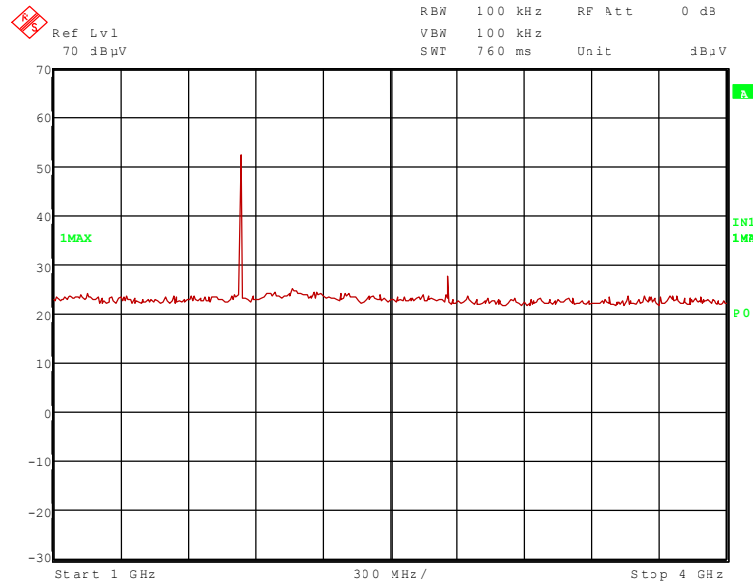
No frequencies were found inside the restricted bands during the preliminary radiated emission test.

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

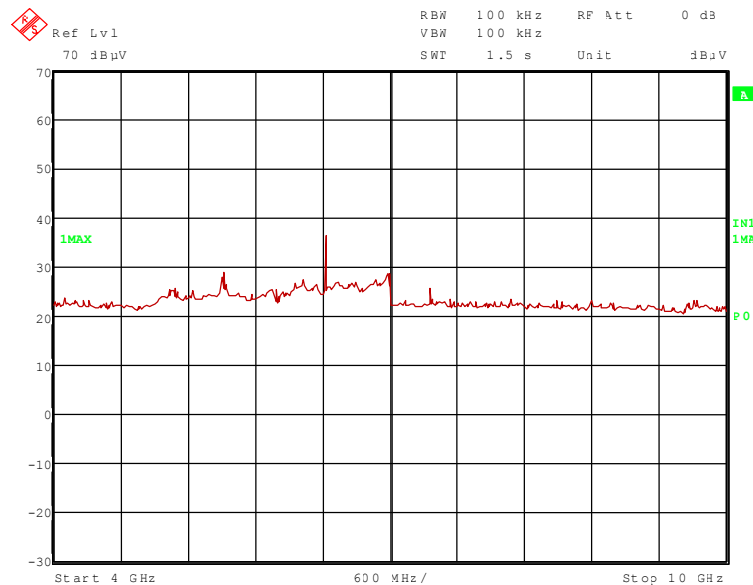
- 894.700 MHz, 906.700 MHz, 918.700 MHz, 930.700 MHz and 942.700 MHz.

These frequencies have to be measured on the open area test site. The result is presented in the following.

113753_14.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 3):



113573_15.wmf: Spurious emissions from 4 GHz to 10 GHz (operation mode 3):



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

- 2.7561 GHz and 7.3496 GHz.

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

- 1.8374 GHz, 5.5122 GHz and 6.4309 GHz.

These frequencies have to be measured in a final measurement. The results were presented in the following.

5.6.2.2 Final radiated emission measurement (30 MHz to 1 GHz)

Ambient temperature	21 °C	Relative humidity	52 %
---------------------	-------	-------------------	------

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: No cables were connectable to the EUT. For detail information of test set-up refer to the pictures in annex A of this test report.

Test record: All results are shown in the following.

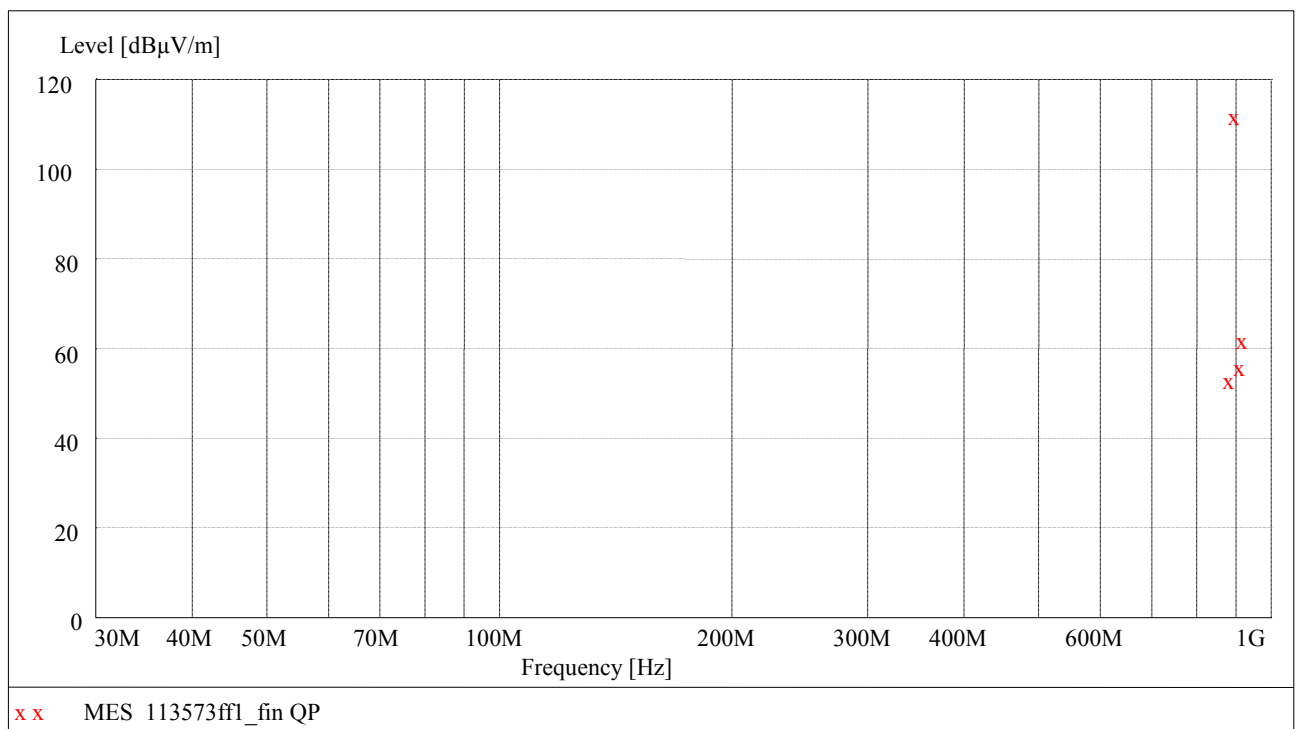
Supply voltage: During all measurements the EUT was supplied by a new internal battery.

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

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

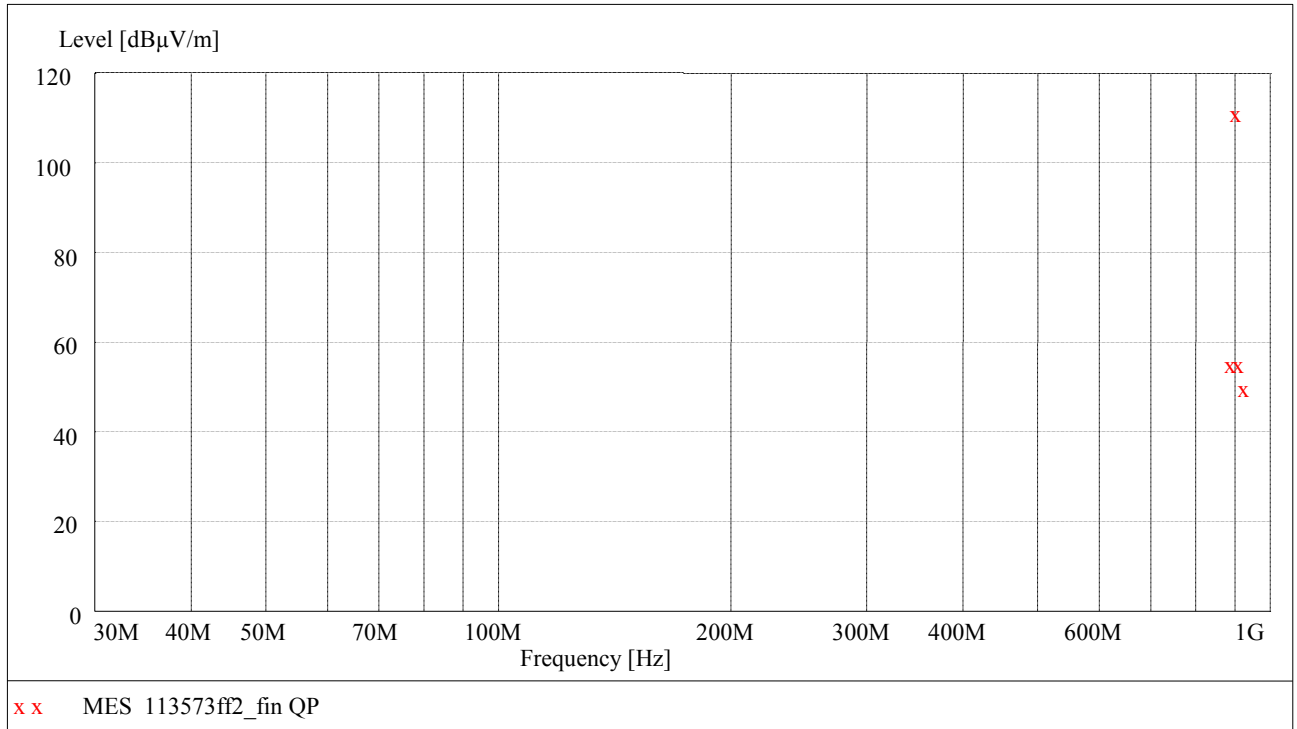
The measured points and the limit line in the following diagrams refer to the standard measurement of the emitted interference in compliance with the above-mentioned standard. The measured points marked with an x are the measured results of the standard final measurement on the open area test site.

Transmitter operates on the lower end of the assigned frequency (operation mode 1)



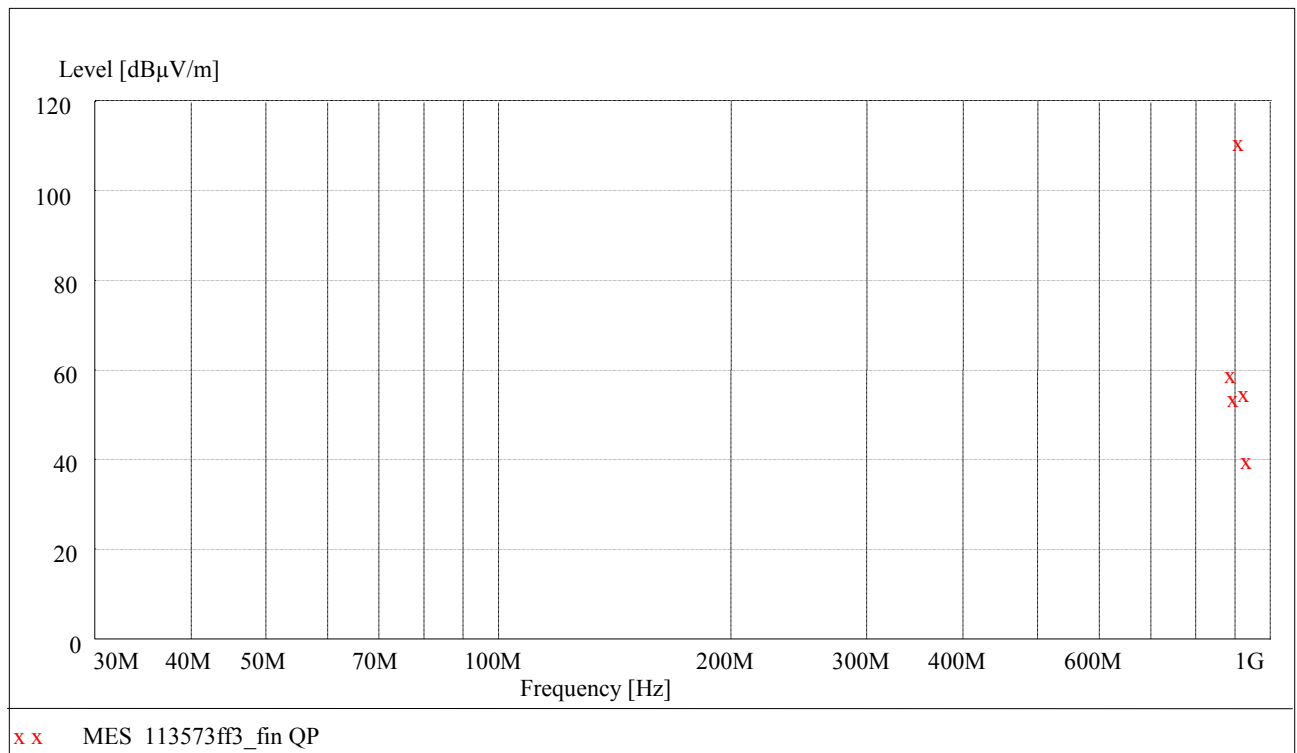
Data record name: 113573ff1

Transmitter operates on the middle of the assigned frequency (operation mode 2)



Data record name: 113573ff2

Transmitter operates on the upper end of the assigned frequency (operation mode 3)



Data record name: 113573ff3

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.

The measurement time with the quasi-peak measuring detector is 1 second.

Result measured with the quasi-peak detector:
(These values were marked in the diagrams by an x)

Transmitter operates on the lower end of the assigned frequency band (operation mode 1)									
Spurious emissions outside restricted bands									
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.
892.000	53.8	92.6	38.8	28.1	22.2	3.5	112.0	183.0	Vert.
904.000	112.6	-	-	86.7	22.5	3.4	111.0	181.0	Vert.
916.000	56.9	92.6	35.7	30.6	22.9	3.4	109.0	180.0	Vert.
928.000	62.4	92.6	30.2	35.6	23.4	3.4	108.0	179.0	Vert.
Transmitter operates on the middle of the assigned frequency band (operation mode 2)									
Spurious emissions outside restricted bands									
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.
899.200	55.9	92.2	36.3	30.0	22.4	3.5	105.0	165.0	Vert.
911.200	112.2	-	-	86.1	22.7	3.4	109.0	180.0	Vert.
923.200	55.8	92.2	36.4	29.2	23.2	3.4	108.0	180.0	Vert.
935.200	50.8	92.2	41.4	23.7	23.7	3.4	105.0	190.0	Vert.
Transmitter operates on the upper end of the assigned frequency band (operation mode 3)									
Spurious emissions outside restricted bands									
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor dB/m	Cable loss dB	Height cm	Azimuth deg	Pol.
894.700	59.5	91.4	31.9	33.8	22.2	3.5	101.0	123.0	Vert.
906.700	54.5	91.4	36.9	28.6	22.5	3.4	111.0	181.0	Vert.
918.700	111.4	-	-	85.0	23.0	3.4	109.0	187.0	Vert.
930.700	55.4	91.4	36.0	28.5	23.5	3.4	107.0	190.0	Vert.
942.700	40.6	91.4	50.8	13.4	23.8	3.4	104.0	188.0	Vert.
Measurement uncertainty					+2.2 dB / -3.6 dB				

The test results were calculated with the following formula:

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

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
14 - 20

5.6.2.3 Final radiated emission measurement (1 GHz to 10 GHz)

Ambient temperature	21 °C	Relative humidity	52 %
---------------------	-------	-------------------	------

- 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: No cables were connectable to the EUT. For detail information of test set-up refer to the pictures in annex A of this test report.
- Test record: All results are shown in the following.
- Supply voltage: During all measurements the EUT was supplied by a new internal battery.
- Resolution bandwidth: For all measurements a resolution bandwidth of 1 MHz was used.

Transmitter operates at the lower end of the assigned frequency band (operation mode 1)

Result measured with the peak detector:

Frequency GHz	Corr. value dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.808	57.4	92.6	35.2	54.4	26.5	26.5	3.0	150	Vert.	No
2.712	41.2	74.0	32.8	34.9	28.7	26.4	4.0	150	Hor.	Yes
6.328	55.3	92.6	37.3	39.8	34.3	25.0	6.2	150	Hor.	No
7.232	53.4	92.6	39.2	35.4	35.8	24.6	6.8	150	Vert.	No
Measurement uncertainty						+2.2 dB / -3.6 dB				

Result measured with the average detector:

Frequency GHz	Corr. value dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.808	56.2	92.6	36.4	53.2	26.5	26.5	3.0	150	Vert.	No
2.712	32.0	54.0	22.0	25.7	28.7	26.4	4.0	150	Vert.	Yes
6.328	48.6	92.6	44.0	33.1	34.3	25.0	6.2	150	Hor.	No
7.232	44.7	92.6	47.9	26.7	35.8	24.6	6.8	150	Vert.	No
Measurement uncertainty						+2.2 dB / -3.6 dB				

Transmitter operates at the middle of the assigned frequency band (operation mode 2)

Result measured with the peak detector:

Frequency GHz	Corr. value dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8224	53.5	92.2	38.7	50.1	26.7	26.5	3.2	150	Vert.	No
2.7336	41.4	74.0	32.6	34.9	28.8	26.4	4.1	150	Hor.	Yes
7.2896	54.0	74.0	20.0	35.7	36.1	24.6	6.8	150	Hor.	Yes
Measurement uncertainty						+2.2 dB / -3.6 dB				

Result measured with the average detector:

Frequency GHz	Corr. value dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8224	51.9	92.2	40.3	48.5	26.7	26.5	3.2	150	Vert.	No
2.7336	31.8	54.0	22.2	25.3	28.8	26.4	4.1	150	Vert.	Yes
7.2896	45.1	54.0	8.9	26.8	36.1	24.6	6.8	150	Hor.	Yes
Measurement uncertainty						+2.2 dB / -3.6 dB				

Transmitter operates at the upper end of the assigned frequency band (operation mode 3)

Result measured with the peak detector:

Frequency GHz	Corr. value dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8374	56.9	91.4	34.5	53.2	26.8	26.5	3.4	150	Vert.	No
2.7561	41.1	74.0	32.9	34.5	28.9	26.4	4.1	150	Hor.	Yes
5.5122	50.9	91.4	40.5	36.5	34.0	25.4	5.8	150	Hor.	No
6.4309	56.4	91.4	35.0	40.9	34.2	25.0	6.3	150	Hor.	No
7.3496	52.4	74.0	21.6	34.0	36.2	24.6	6.8	150	Hor.	Yes
Measurement uncertainty						+2.2 dB / -3.6 dB				

Result measured with the average detector:

Frequency GHz	Corr. value dB μ V/m	Limit dB μ V/m	Margin dB	Readings dB μ V	Antenna factor 1/m	Preamp dB	Cable loss dB	Height cm	Pol.	Restr. Band
1.8374	56.0	91.4	35.4	52.3	26.8	26.5	3.4	150	Vert.	No
2.7561	32.4	54.0	21.6	25.8	28.9	26.4	4.1	150	Hor.	Yes
5.5122	41.5	91.4	49.9	27.1	34.0	25.4	5.8	150	Hor.	No
6.4309	50.6	91.4	40.8	35.1	34.2	25.0	6.3	150	Hor.	No
7.3496	41.0	54.0	13.0	22.6	36.2	24.6	6.8	150	Hor.	Yes
Measurement uncertainty						+2.2 dB / -3.6 dB				

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

29, 31 - 34, 36, 44, 49, 73

6 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
14	Open area test site	-	Phoenix Test-Lab	-	480085	Weekly verification (system cal.)	
15	Measuring receiver	ESIB7	Rohde & Schwarz	100304	480521	03/15/2010	03/2012
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 D	Chase	25761	480894	09/18/2008	09/2012
20	EMI Software	ES-K1	Rohde & Schwarz	-	480111	-	-
29	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Weekly verification (system cal.)	
31	Measuring receiver	ESI 40	Rohde & Schwarz	100064	480355	03/17/2010	03/2012
32	Controller	MCU	Maturo	MCU/043/971107	480832	-	-
33	Turntable	DS420HE	Deisel	420/620/80	480315	-	-
34	Antenna support	AS615P	Deisel	615/310	480187	-	-
35	Antenna	CBL6112 B	Chase	2688	480328	04/21/2011	04/2014
36	Antenna	3115 A	EMCO	9609-4918	480183	11/04/2008	11/2011
43	RF-cable No. 30	RTK 081	Rosenberger	-	410141	Weekly verification (system cal.)	
44	RF-cable No. 31	RTK 081	Rosenberger	-	410142	Weekly verification (system cal.)	
49	Preamplifier	JS3-00101200-23-5A	Miteq	681851	480337	Six month verification (system cal.)	
55	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	03/10/2010	03/2012
73	High Pass Filter	WHJS1000C 11/60EF	Wainwright Instruments GmbH	1	480413	Weekly verification (system cal.)	

7 REPORT HISTORY

Report Number	Date	Comment
F113573E1	16 November 2011	Document created

8 LIST OF ANNEXES

ANNEX A	TEST SET-UP PHOTOS	5 pages
	113573_6.JPG: ZONESCAN 820 ALPHA, test set-up fully anechoic chamber	
	113573_3.JPG: ZONESCAN 820 ALPHA, test set-up fully anechoic chamber	
	113573_2.JPG: ZONESCAN 820 ALPHA, test set-up fully anechoic chamber	
	113573_4.JPG: ZONESCAN 820 ALPHA, test set-up fully anechoic chamber	
	113573_7.JPG: ZONESCAN 820 ALPHA, test set-up open area test site	
ANNEX B	INTERNAL PHOTOGRAPHS	8 pages
	113573_e.JPG: ZONESCAN 820 ALPHA, internal view	
	113573_d.JPG: ZONESCAN 820 ALPHA, internal view (batteries removed)	
	113573_i.JPG: ZONESCAN 820 ALPHA, PCB, top view (battery holder and GPRS module removed)	
	113573_g.JPG: ZONESCAN 820 ALPHA, PCB, bottom view	
	113573_k.JPG: ZONESCAN 820 ALPHA, PCB, bottom view (shielding removed)	
	113573_n.JPG: ZONESCAN 820 ALPHA, GPRS module, top view	
	113573_o.JPG: ZONESCAN 820 ALPHA, GPRS module, bottom view	
	113573_m.JPG: ZONESCAN 820 ALPHA, GSM / GPS antenna	
ANNEX C	EXTERNAL PHOTOGRAPHS	3 pages
	113573_a.JPG: ZONESCAN 820 ALPHA, 3-D view 1	
	113573_b.JPG: ZONESCAN 820 ALPHA, 3-D view 2	
	113573_J.JPG: ZONESCAN 820 ALPHA, type plate view	
ANNEX D	RESULTS OF THE RECEIVER MEASUREMENTS	2 Pages