

Test Report

Report Number: F112416E2, 2nd version

Applicant:

EMTEC GmbH

Manufacturer:

EMTEC GmbH

Equipment under Test (EUT):

Zonescan 820 Commlink



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 (October 2010)** 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 <small>Name</small>	 <small>Signature</small>	18 January 2012 <small>Date</small>
Authorized reviewer:	Bernd STEINER <small>Name</small>	 <small>Signature</small>	18 January 2012 <small>Date</small>

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1 IDENTIFICATION

1.1 Applicant

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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)7541 9537-15
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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**
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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 Commlink
FCC ID: *	ZSSZS820915CL
IC: *	9789A-ZS820915CL
Serial number: *	CL820-3310-154/2
PCB identifier: *	ZS820-20a 0608-01
Hardware version: *	1.3/2
Software version: *	2.27

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: *	External monopole type CTA868/5/DT/SM/H1				
Antenna gain: *	5 dBi (cable loss excluded)				
Antenna connector: *	RP-BNC				
Power supply: (external) *	U _{Nom} =	12.0 V DC	U _{Min} =	11.0 V DC	U _{Max} = 17.0 V DC
Type of modulation: *	FHSS (GFSK)				
Operating frequency range:*	904.0 MHz to 918.7 MHz				
Number of channels: *	50				
Temperature range: *	-20 °C to 55 °C				
Lowest / highest Internal clock frequency: *	32.768 kHz / 918.7 MHz				
Ancillary Equipment used for testing:	An AC / DC adaptor Monacor type PSS-3800SV was used during emission measurement on power supply line.				

* declared by the applicant.

The following external I/O cables were used:

Identification	Connector		Length
	EUT	Ancillary	
Antenna	RP-BNC	RP-BNC	3.0 m
DC in	Customised connector	-	2.0 m

*: Length during the test if no other specified.

1.6 Dates

Date of receipt of test sample:	05 July 2011
Start of test:	05 July 2011
End of test:	08 July 2011

2 OPERATIONAL STATES

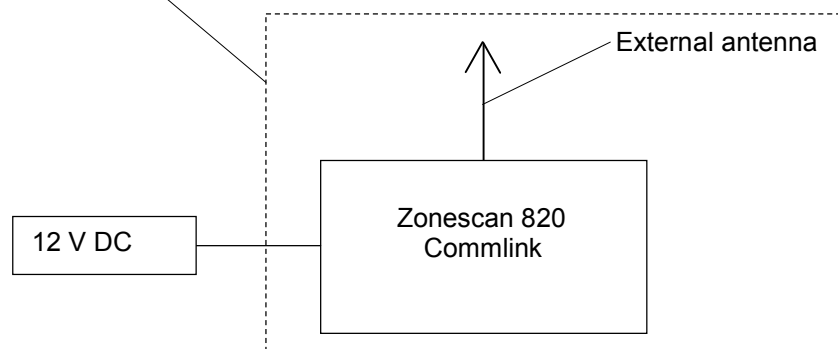
The used sample was unmodified and could be configured to operate as requested for any test item by the use of a Bluetooth remote station.

The EUT could be regarded as handheld device. Therefore the radiated emissions were measured with the EUT in three orthogonal directions. The worst-case results were documented and the appropriate position is stated. The 3 orthogonal axes were defined as pos. 1 EUT standing vertical on the longer side, pos. 2 EUT lying flat and pos. 3 EUT standing vertical on the shorter side.

During the tests the test sample was powered by the internal battery, which was buffered by an external 12.0 V DC power supply.

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	

Physical boundary of the EUT's



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

Because the external antenna is equipped with an magnetic base and is intended to be installed on a metal surface, during the measurements the antenna was positioned on a metal plate with the dimensions 22 x 32 cm.

The EUT contains also an already certified Bluetooth module (FCC ID QQQWT12). As declared by the applicant the Bluetooth link will be not active during the 915 MHz - operation. After adjusting the operation mode via Bluetooth the EUT has to be reset for further operation mode changes. Object of this test report is the 915 MHz transceiver and its digital part only.

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.
Conducted emissions on supply line	0.15 - 30	15.207 (a)	7.2.4 [5]	Passed	40 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.

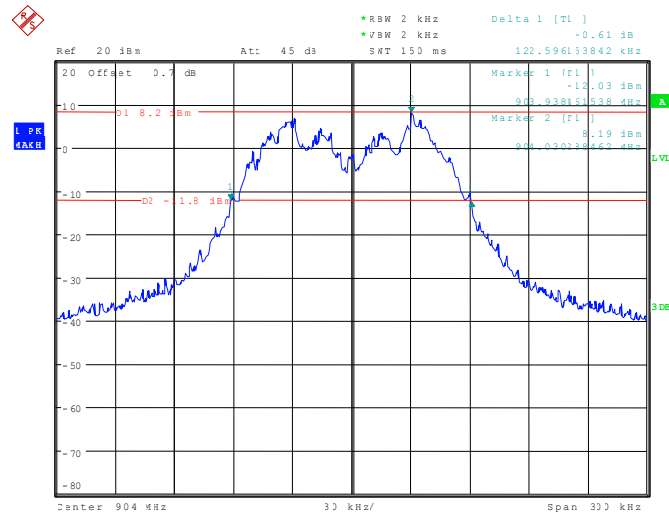
Test set-up:



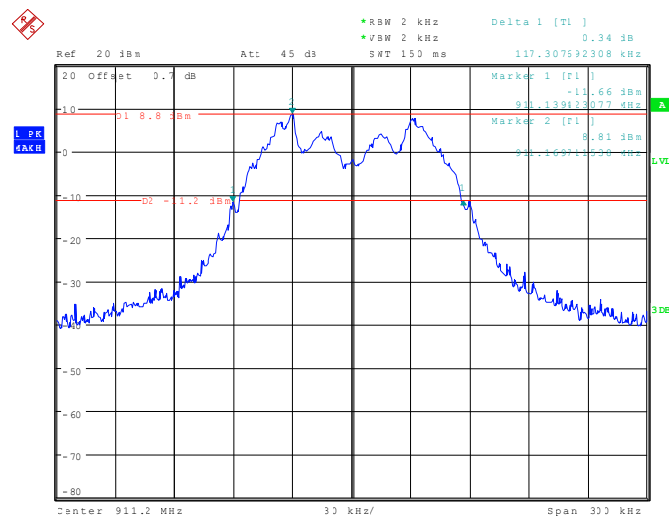
5.1.2 Test results (20 dB bandwidth)

Ambient temperature	21 °C	Relative humidity	56 %
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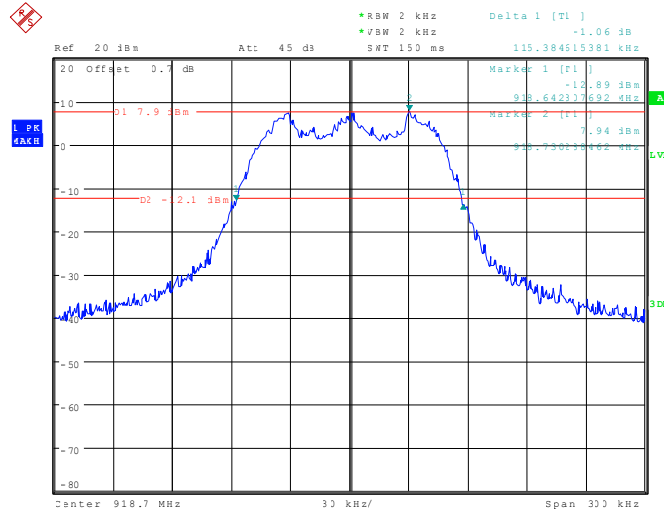
112416_19.wmf: 20 dB bandwidth at the lower end of the assigned frequency band:



112416_20.wmf: 20 dB bandwidth at the middle of the assigned frequency band:



112416_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	122.596
24	911.200 MHz	117.308
49	918.700 MHz	115.385
Measurement uncertainty		+0.66 dB / -0.72 dB

TEST EQUIPMENT USED FOR THE TEST:

30

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.

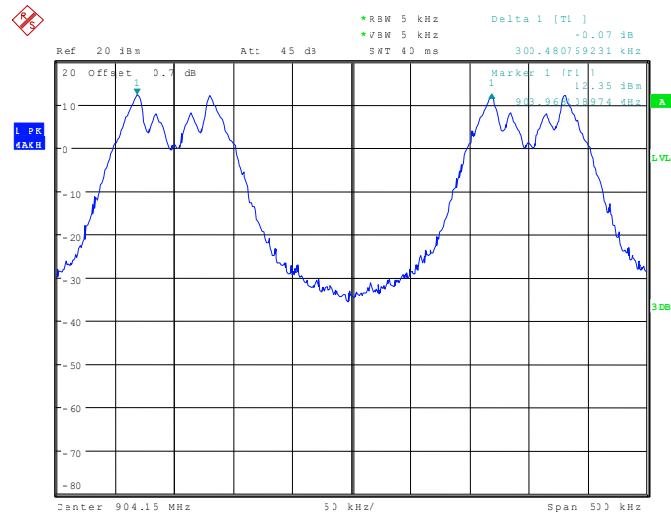
Test set-up:



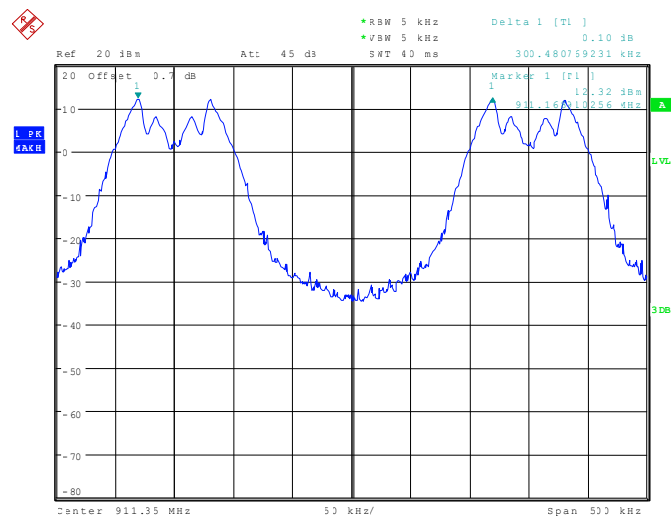
5.2.2 Test results (carrier frequency separation)

Ambient temperature	21 °C	Relative humidity	56 %
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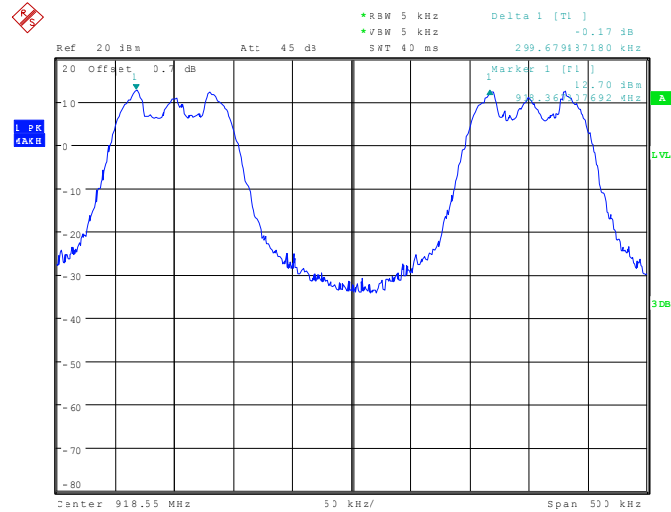
112416_24.wmf: Channel separation at the lower end of the assigned frequency band:



112416_23.wmf: Channel separation at the middle of the assigned frequency band:



112416_22.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	300.481	122.596 (the 20 dB bandwidth)
24	911.200	300.481	117.308 (the 20 dB bandwidth)
49	918.700	299.679	115.385 (the 20 dB bandwidth)
Measurement uncertainty			<10 ⁻⁷

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

30

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.

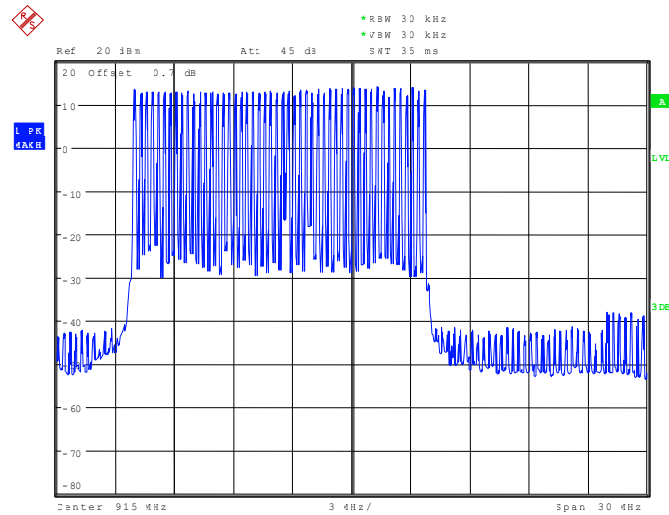
Test set-up:



5.3.2 Test results (number of hopping frequencies)

Ambient temperature	21 °C	Relative humidity	56 %
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112416_25.wmf: Number of hopping channels:



Number of hopping channels	Limit
Operation mode 4	
50	At least 15

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

30

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 upper and lower end and 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.

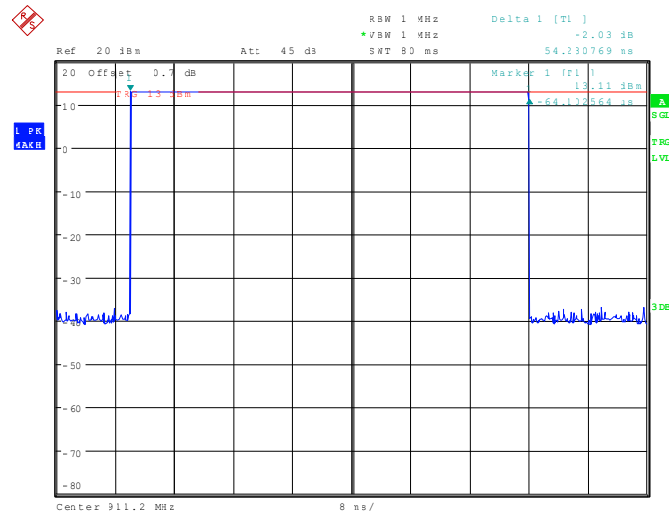
Test set-up:



5.4.2 Test results (dwell time)

Ambient temperature	21 °C	Relative humidity	56 %
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112416_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	54.231	292.847	400
Measurement uncertainty			<10 ⁻⁷	

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

30

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.

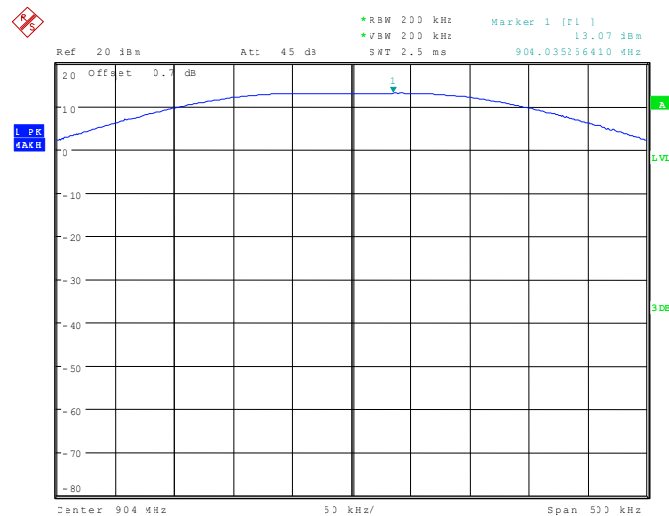
Test set-up:



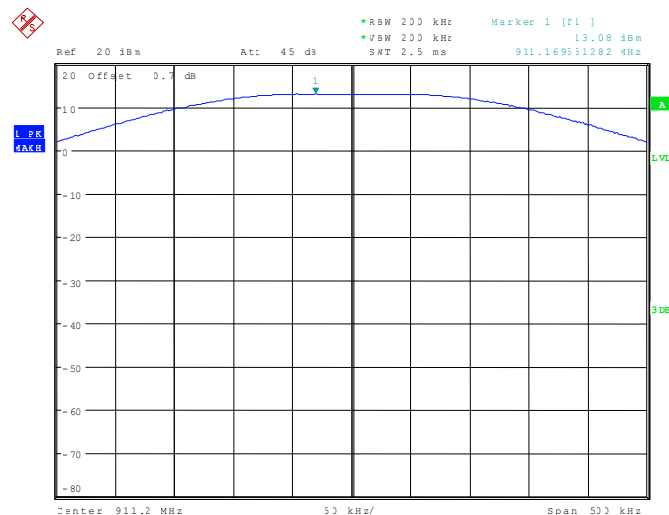
5.5.2 Test results (maximum peak output power)

Ambient temperature	21 °C	Relative humidity	56 %
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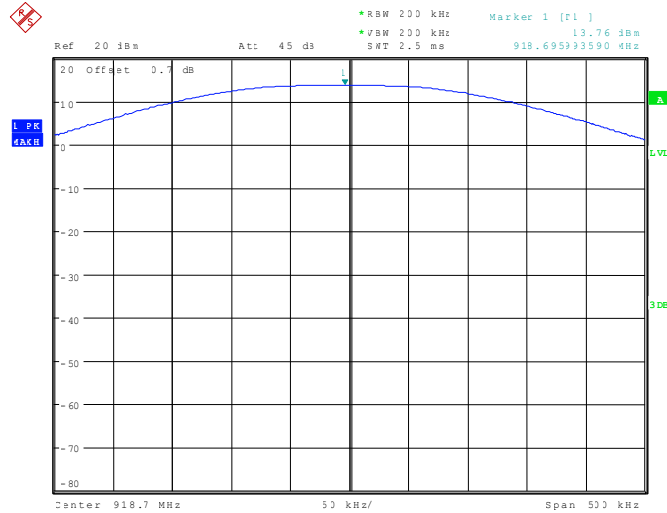
112416_27.wmf: Maximum peak output power at the lower end of the assigned frequency band (operation mode 1):



112416_28.wmf: Maximum peak output power at the middle of the assigned frequency band (operation mode 2):



112416_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	13.1	5.0	30.0
2	24	911.200	13.1	5.0	30.0
3	49	918.700	13.8	5.0	30.0
Measurement uncertainty				+0.66 dB / -0.72 dB	

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

30

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.

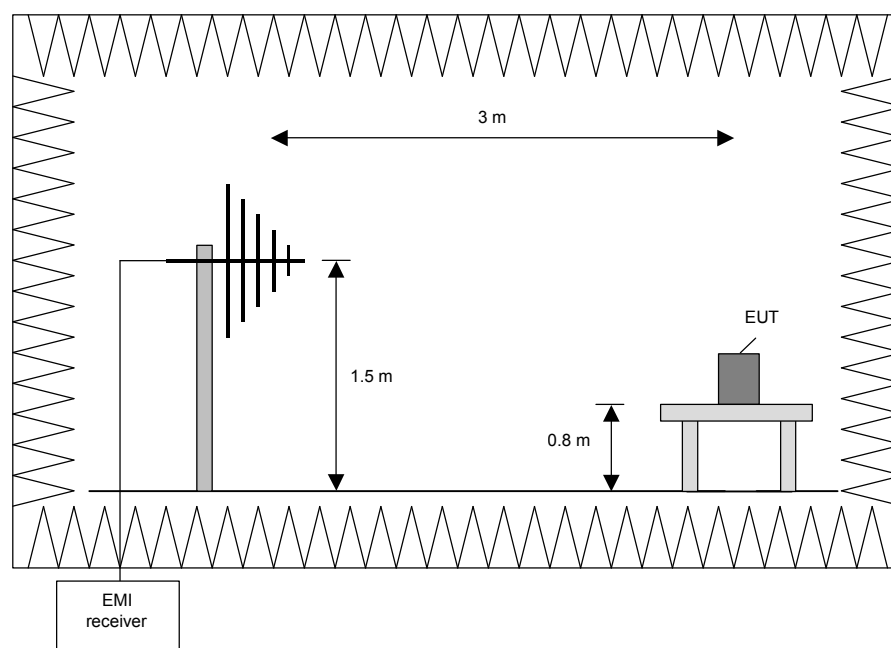
Preliminary measurement (30 MHz to 1 GHz)

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 230 MHz	100 kHz
230 MHz to 1 GHz	100 kHz



Procedure preliminary measurement:

Prescans were performed in the frequency range 30 MHz to 230 MHz and 230 MHz to 1 GHz.

The following procedure will be used:

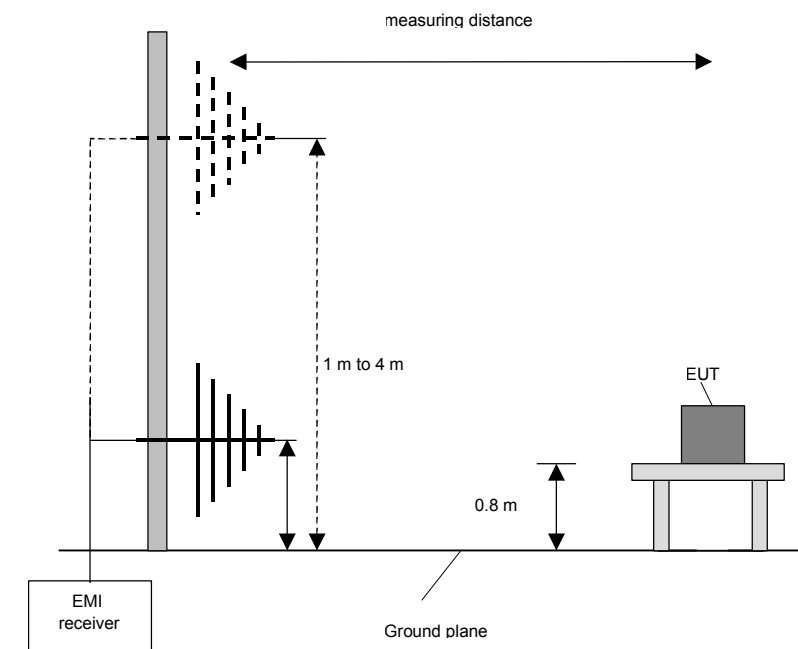
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the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

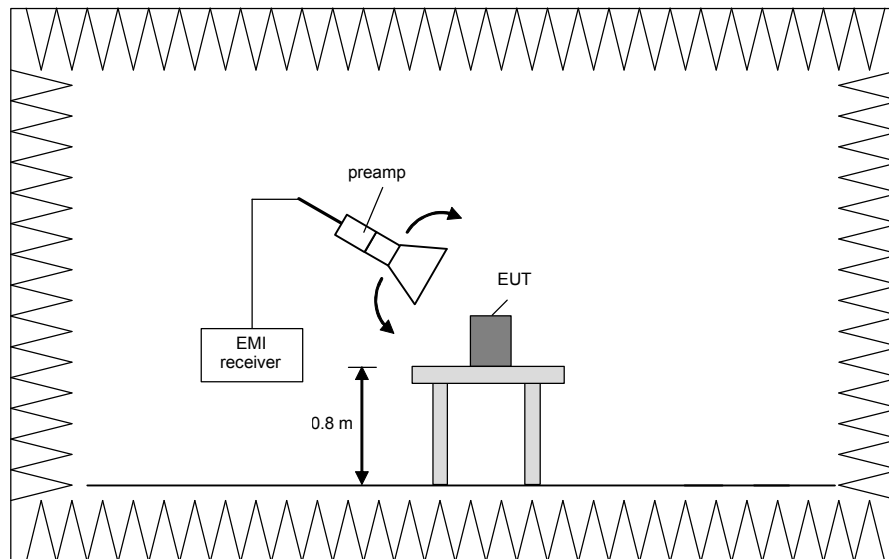
This measurement will be performed in a fully anechoic chamber. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set up of the Equipment under test will be in accordance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

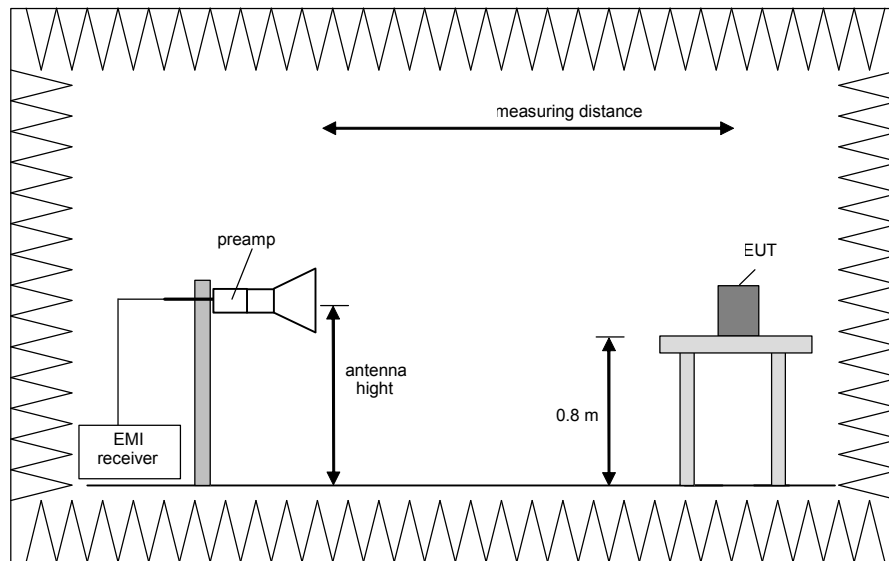


Final measurement (1 GHz to 110 GHz)

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)

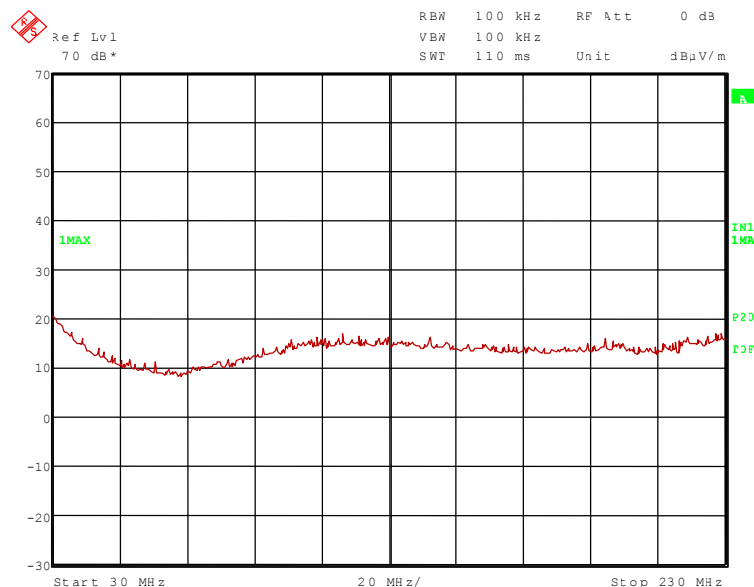
5.6.2.1 Preliminary radiated emission measurement

Ambient temperature	20 °C	Relative humidity	54 %
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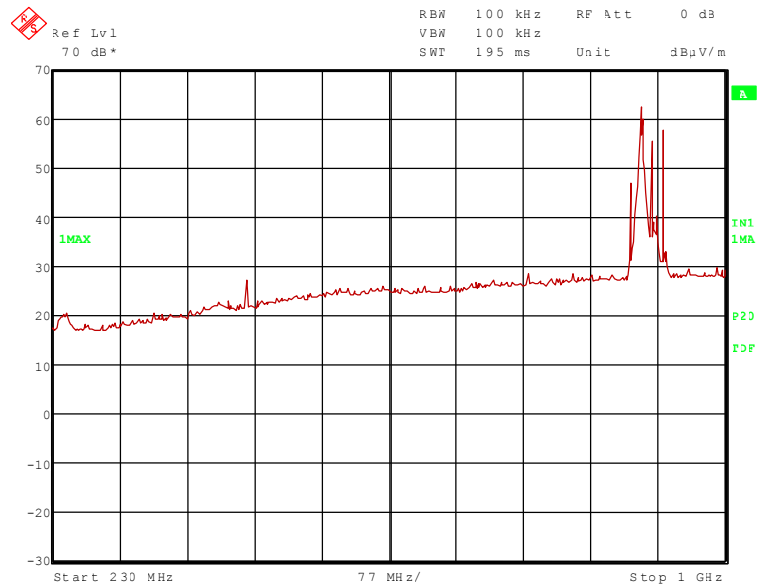
Position of EUT:	The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.
Cable guide:	For detail information of test set-up and the cable guide refer to the pictures in annex A of this test report.
Test record:	All results are shown in the following.
Supply voltage:	During all measurements the EUT was supplied with 12 D DC by an external power supply.
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)

112416_2.wmf: Spurious emissions from 30 MHz to 230 MHz (operation mode 1):



112416_1.wmf: Spurious emissions from 230 MHz to 1 GHz (operation mode 1, carrier notched):



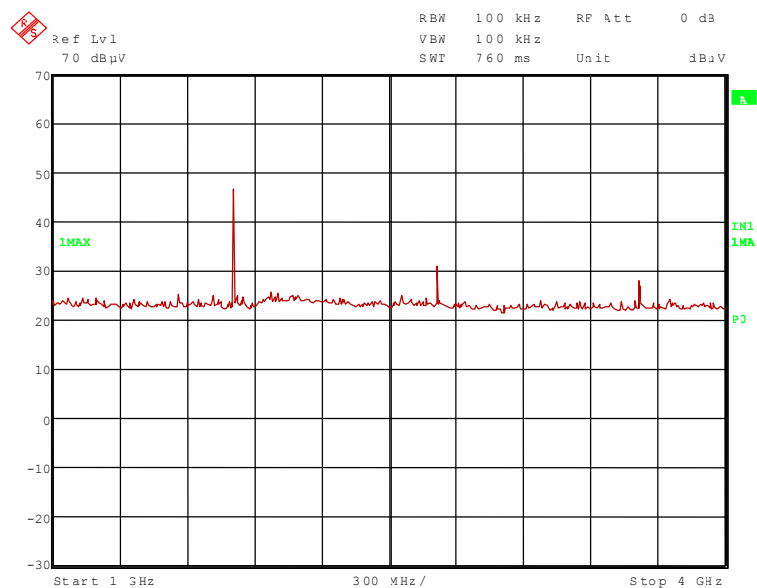
No frequencies were found inside the restricted bands during the preliminary radiated emission test.

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

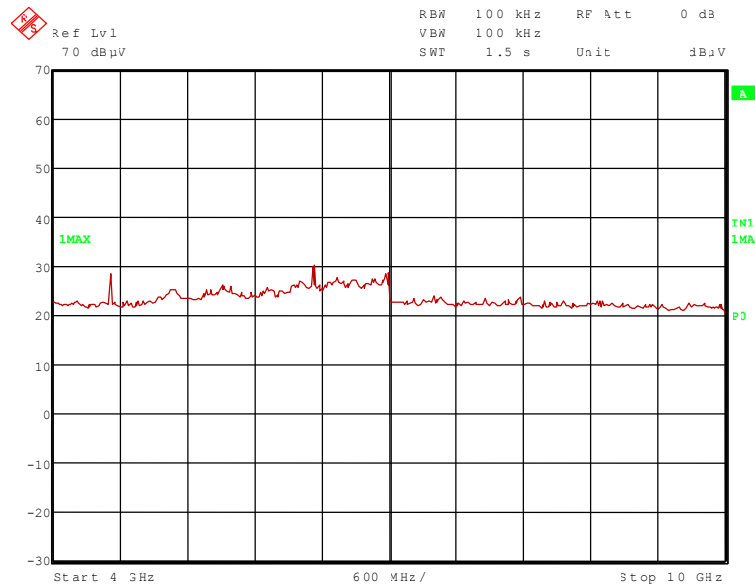
- 452.000 MHz, 892.000 MHz, 904.000 MHz, 916.000 MHz and 928.000 MHz.

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

112416_11.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 1):



112416_12.wmf: Spurious emissions from 4 GHz to 10 GHz (operation mode 1):



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

- 2.7120 GHz, 3.6160 GHz and 4.5200 GHz.

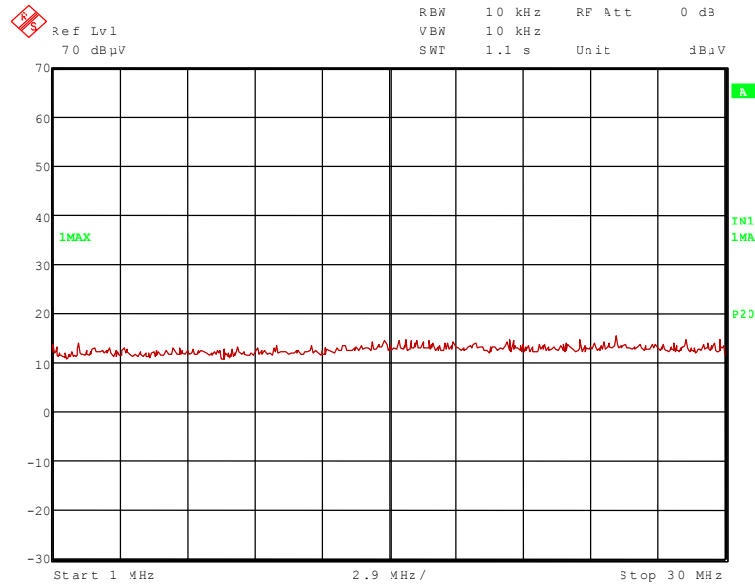
The following frequencies were found outside the restricted bands during the preliminary radiated emission test:

- 1.8080 GHz and 6.3280 GHz.

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

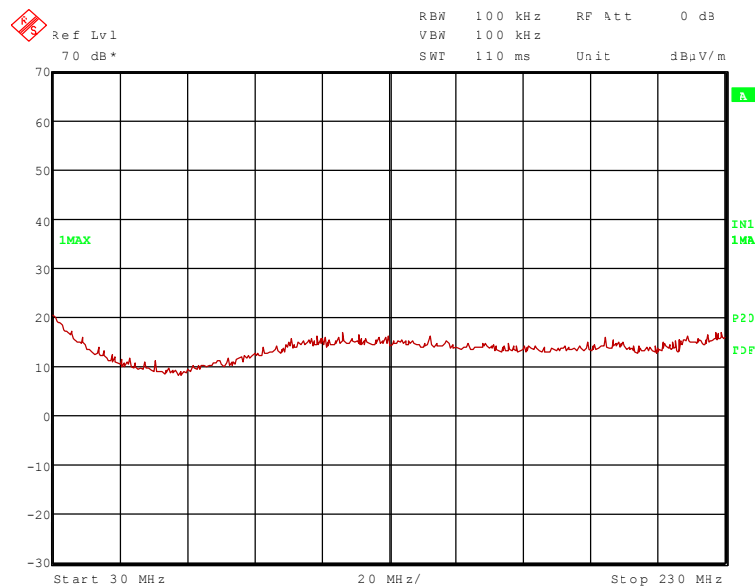
TEST EQUIPMENT USED FOR THE TEST:
29, 31 - 36, 43, 44, 49, 55, 73

112416_18.wmf: Spurious emissions from 1 MHz to 30 MHz (operation mode 2):

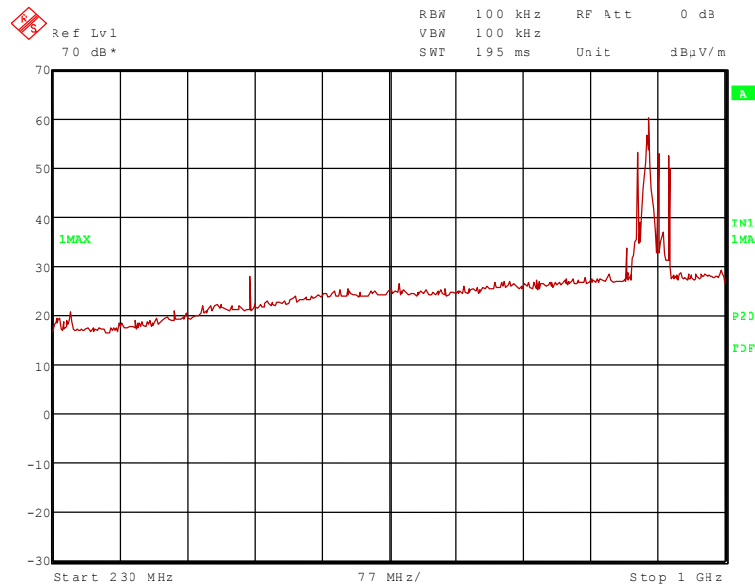


No significant frequencies above the noise floor of the system were found during the preliminary radiated emission test, so no measurements were carried out on the outdoor test site.

112416_3.wmf: Spurious emissions from 30 MHz to 230 MHz (operation mode 2):



112416_4.wmf: Spurious emissions from 230 MHz to 1 GHz (operation mode 2, carrier notched):



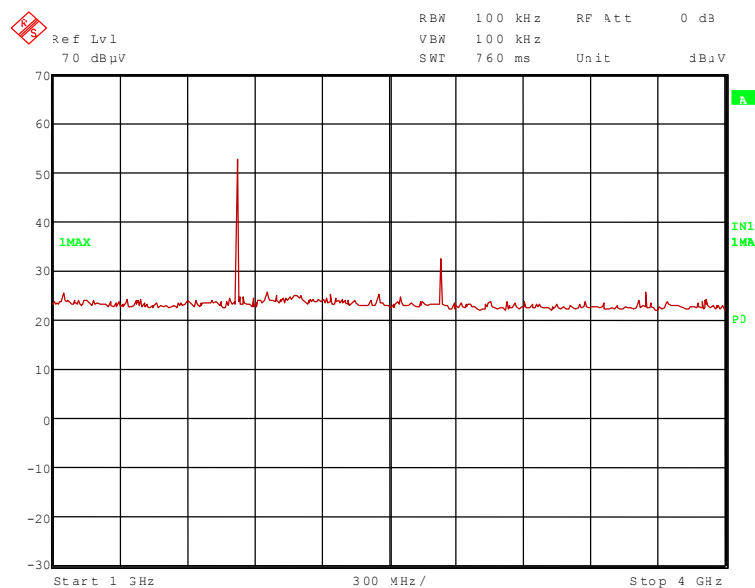
No frequencies were found inside the restricted bands during the preliminary radiated emission test.

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

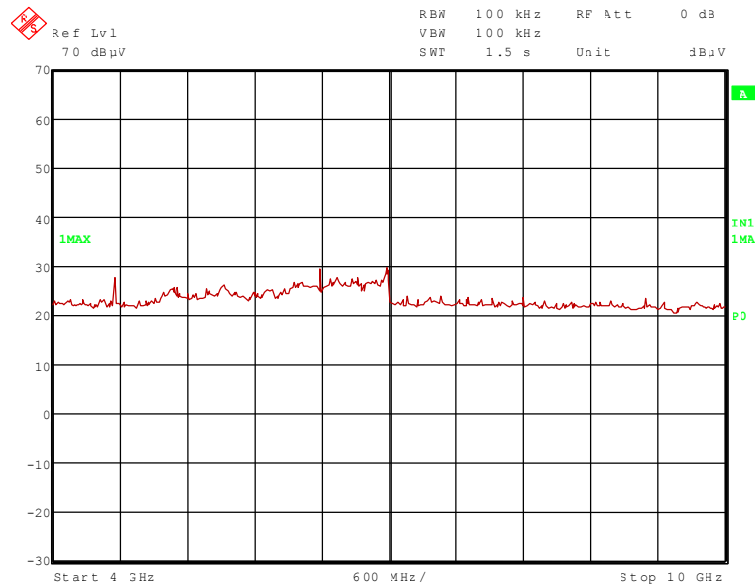
- 455.600 MHz, 887.200 MHz, 911.200 MHz, 923.200 MHz and 935.200 MHz.

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

112416_9.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 2):



112416_10.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, 3.6448 GHz and 4.5560 GHz.

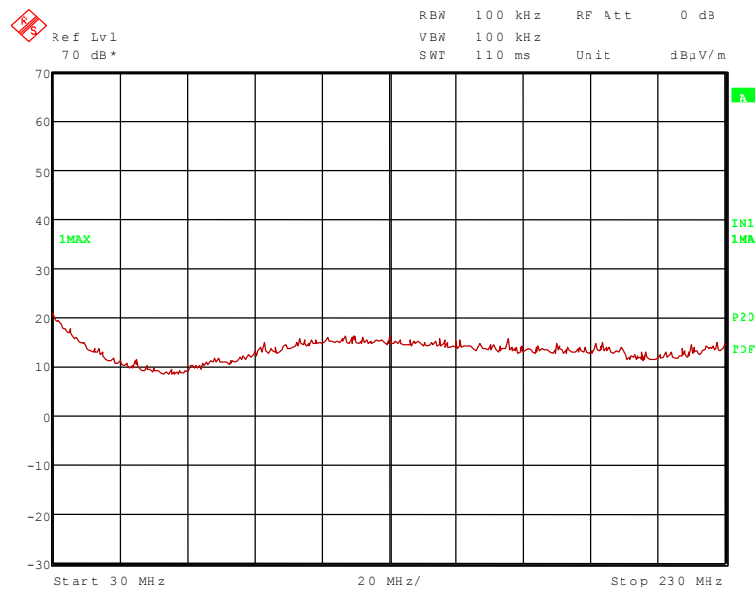
The following frequencies were found outside the restricted bands during the preliminary radiated emission test:

- 1.8224 GHz and 6.3784 GHz.

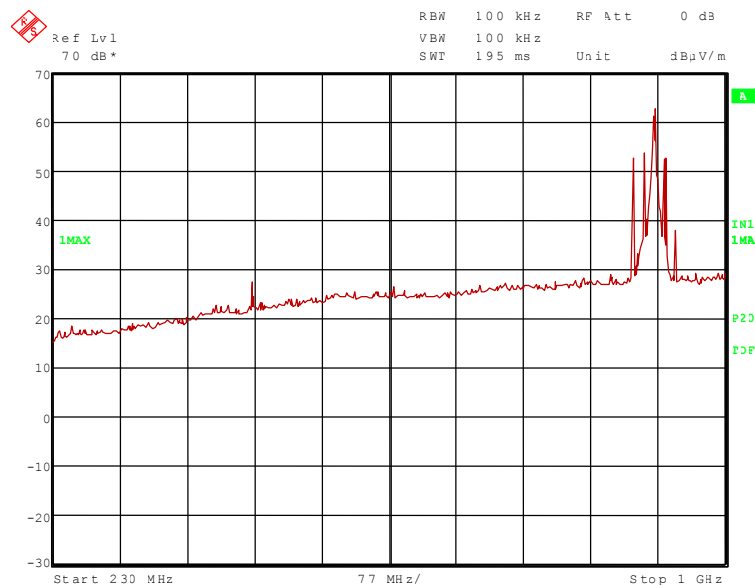
These frequencies have to be measured in a final measurement. The results were presented in the following.

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

112416_6.wmf: Spurious emissions from 30 MHz to 230 MHz (operation mode 3):



112416_5.wmf: Spurious emissions from 230 MHz to 1 GHz (operation mode 3, carrier notched):



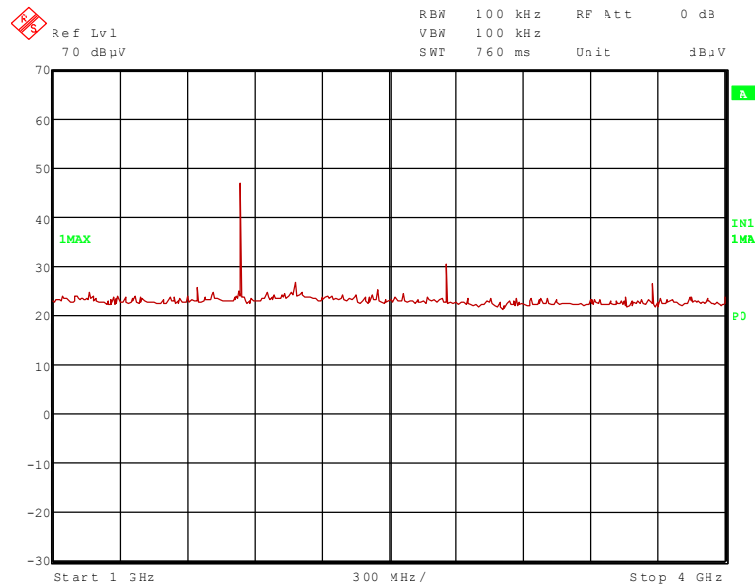
No frequencies were found inside the restricted bands during the preliminary radiated emission test.

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

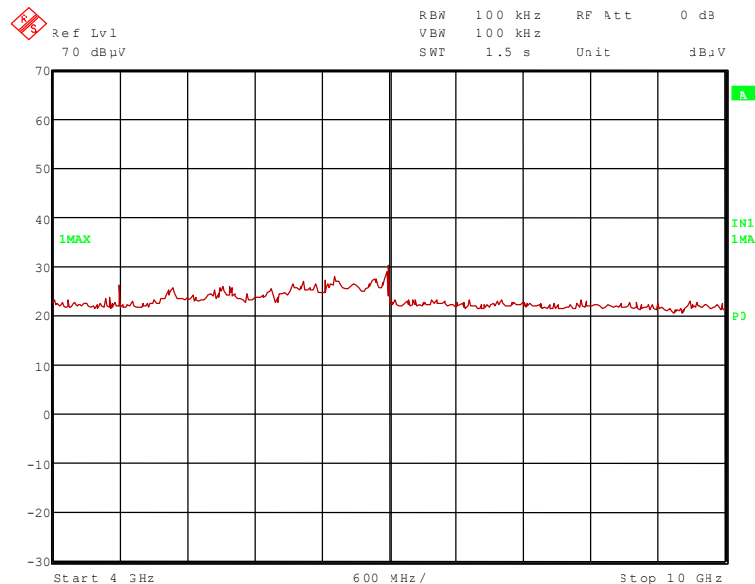
- 459.350 MHz, 894.700 MHz, 906.700 MHz, 918.700 MHz and 930.700 MHz.

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

112416_7.wmf: Spurious emissions from 1 GHz to 4 GHz (operation mode 3):



112416_8.wmf: Spurious emissions from 4 GHz to 10 GHz (operation mode 3):



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

- 2.75610 GHz, 3.6748 GHz and 4.5935 GHz.

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

- 1.8374 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)

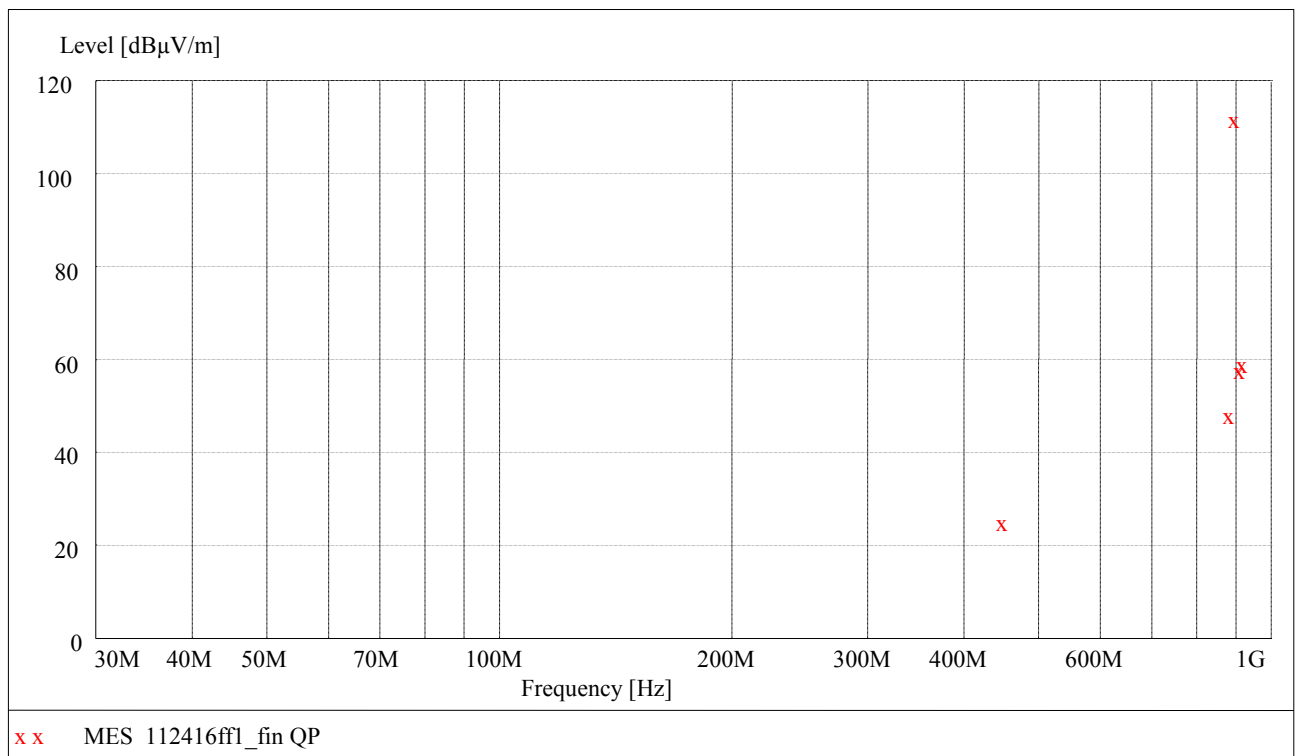
Ambient temperature	21 °C	Relative humidity	56 %
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- Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.
- Cable guide: For detail information of test set-up and the cable guide 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 with 12 D DC by an external power supply.
- Test results: The test results were calculated with the following formula:

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

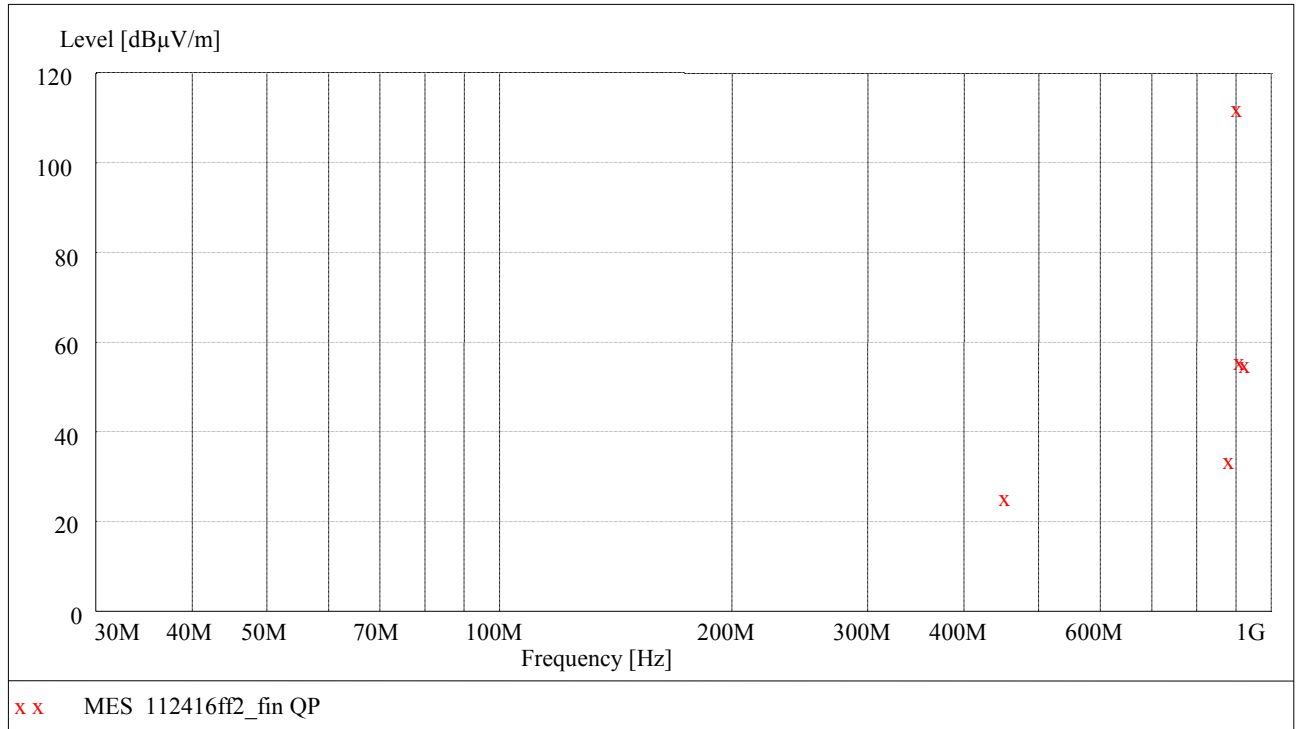
The measured points and the limit line in the following diagrams refer to the standard measurement of the emitted interference in compliance with the above-mentioned standard. The measured points marked with an x are the measured results of the standard final measurement on the open area test site.

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



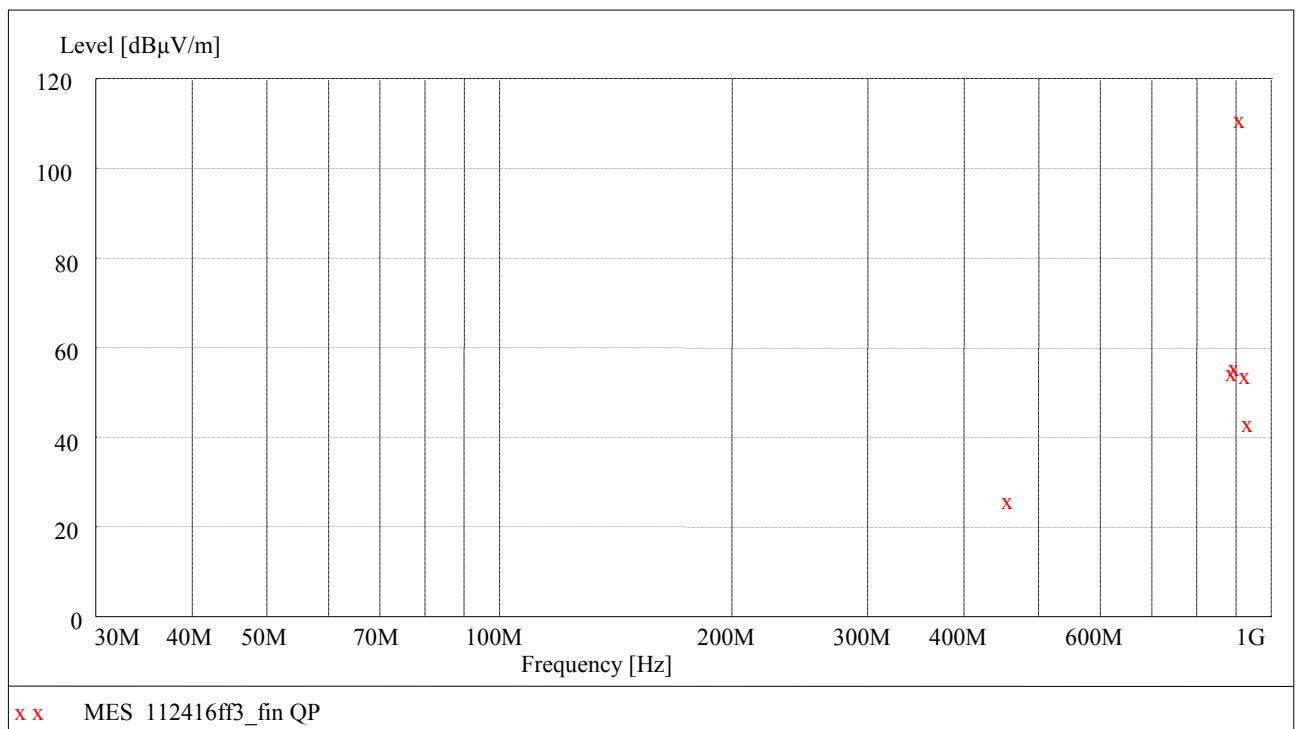
Data record name: 112416ff1

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



Data record name: 112416ff2

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



Data record name: 112416ff6

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	Result	Limit	Margin	Readings	Antenna factor	Cable loss	Height	Azimuth	Pol.	Pos.
MHz	dBµV/m	dBµV/m	dB	dBµV	dB/m	dB	cm	deg		
452.000	25.5	92.6	67.1	6.5	16.6	2.4	100.0	209.0	Hor.	1
892.000	48.9	92.6	43.7	23.2	22.2	3.5	100.0	210.0	Vert.	1
904.000	112.6	carrier	-	86.7	22.5	3.4	100.0	212.0	Vert.	1
916.000	58.5	92.6	34.1	32.2	22.9	3.4	107.0	10.0	Vert.	1
928.000	59.8	92.6	32.8	33.0	23.4	3.4	105.0	167.0	Vert.	1
Transmitter operates on the middle of the assigned frequency band (operation mode 2)										
Spurious emissions outside restricted bands										
Frequency	Result	Limit	Margin	Readings	Antenna factor	Cable loss	Height	Azimuth	Pol.	Pos.
MHz	dBµV/m	dBµV/m	dB	dBµV	dB/m	dB	cm	deg		
455.600	26.2	93.2	67.0	7.1	16.7	2.4	179.0	206.0	Hor.	1
887.200	34.6	93.2	58.6	9.0	22.1	3.5	103.0	314.0	Vert.	1
911.200	113.2	carrier	-	87.1	22.7	3.4	104.0	181.0	Vert.	1
923.200	56.4	93.2	36.8	29.8	23.2	3.4	103.0	193.0	Vert.	1
935.200	55.8	93.2	37.4	28.7	23.7	3.4	103.0	191.0	Vert.	1
Transmitter operates on the upper end of the assigned frequency band (operation mode 3)										
Spurious emissions outside restricted bands										
Frequency	Result	Limit	Margin	Readings	Antenna factor	Cable loss	Height	Azimuth	Pol.	Pos.
MHz	dBµV/m	dBµV/m	dB	dBµV	dB/m	dB	cm	deg		
459.350	27.1	92.2	65.1	8.0	16.7	2.4	181.0	206.0	Hor.	1
894.700	55.5	92.2	36.7	29.8	22.2	3.5	100.0	312.0	Vert.	1
906.700	56.7	92.2	35.5	30.8	22.5	3.4	100.0	199.0	Vert.	1
918.700	112.2	carrier	-	85.8	23.0	3.4	100.0	199.0	Vert.	1
930.700	54.9	92.2	37.3	28.0	23.5	3.4	100.0	194.0	Vert.	1
Measurement uncertainty				+2.2 dB / -3.6 dB						

The test results were calculated with the following formula:

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

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	20 °C	Relative humidity	54 %
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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: For detail information of test set-up and the cable guide 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 with 12 D DC by an external power supply.
- 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	Pos.
1.8080	52.4	92.6	40.2	49.4	26.5	26.5	3.0	150	Vert.	No	1
2.7120	43.0	74.0	31.0	36.7	28.7	26.4	4.0	150	Hor.	Yes	1
3.6160	44.1	74.0	29.9	34.4	31.3	26.2	4.6	150	Hor.	Yes	1
4.5200	46.3	74.0	27.7	34.7	32.3	25.8	5.1	150	Hor.	Yes	1
6.3280	53.6	92.6	39.0	38.1	34.3	25.0	6.2	150	Hor.	No	1
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	Pos.
1.8080	50.9	92.6	41.7	47.9	26.5	26.5	3.0	150	Vert.	No	1
2.7120	35.8	54.0	18.2	29.5	28.7	26.4	4.0	150	Hor.	Yes	1
3.6160	35.8	54.0	18.2	26.1	31.3	26.2	4.6	150	Hor.	Yes	1
4.5200	39.1	54.0	14.9	27.5	32.3	25.8	5.1	150	Hor.	Yes	1
6.3280	43.9	92.6	48.7	28.4	34.3	25.0	6.2	150	Hor.	No	1
Measurement uncertainty							+2.2 dB / -3.6 dB				

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
29, 31 - 34, 36, 37, 39, 44, 46, 49 - 51, 73

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	Pos.
1.8224	55.1	93.2	38.1	51.7	26.7	26.5	3.2	150	Vert.	No	1
2.7336	43.9	74.0	30.1	37.4	28.8	26.4	4.1	150	Hor.	Yes	1
3.6448	43.6	74.0	30.4	33.9	31.4	26.2	4.5	150	Hor.	Yes	1
4.5560	46.4	74.0	27.6	34.7	32.4	25.8	5.1	150	Hor.	Yes	1
6.3784	53.2	93.2	40.0	37.6	34.3	25.0	6.3	150	Hor.	No	1
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	Pos.
1.8224	54.0	93.2	39.2	50.6	26.7	26.5	3.2	150	Vert.	No	1
2.7336	38.1	54.0	15.9	31.6	28.8	26.4	4.1	150	Hor.	Yes	1
3.6448	33.3	54.0	20.7	23.6	31.4	26.2	4.5	150	Hor.	Yes	1
4.5560	39.1	54.0	14.9	27.4	32.4	25.8	5.1	150	Hor.	Yes	1
6.3784	43.2	93.2	50.0	27.6	34.3	25.0	6.3	150	Hor.	No	1
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	Pos.
1.8374	51.5	92.2	40.7	47.8	26.8	26.5	3.4	150	Vert.	No	1
2.7561	44.4	74.0	29.6	37.8	28.9	26.4	4.1	150	Vert.	Yes	1
3.6748	43.6	74.0	30.4	33.7	31.6	26.2	4.5	150	Hor.	Yes	1
4.5935	46.7	74.0	27.3	35.0	32.3	25.8	5.2	150	Hor.	Yes	1
6.4309	52.3	92.2	39.9	36.8	34.2	25.0	6.3	150	Hor.	No	1
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	Pos.
1.8374	49.8	92.2	42.4	46.1	26.8	26.5	3.4	150	Vert.	No	1
2.7561	38.5	54.0	15.5	31.9	28.9	26.4	4.1	150	Vert.	Yes	1
3.6748	34.0	54.0	20.0	24.1	31.6	26.2	4.5	150	Hor.	Yes	1
4.5935	39.7	54.0	14.3	28.0	32.3	25.8	5.2	150	Hor.	Yes	1
6.4309	42.3	92.2	49.9	26.8	34.2	25.0	6.3	150	Hor.	No	1
Measurement uncertainty							+2.2 dB / -3.6 dB				

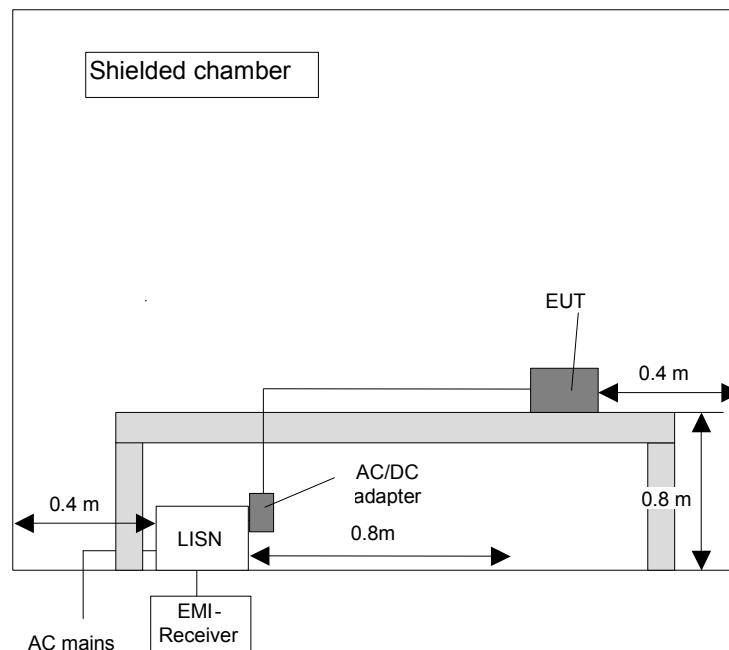
5.7 Conducted emissions on power supply lines (150 kHz to 30 MHz)

5.7.1 Method of measurement

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 C63.4-2009 [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



5.7.2 Test results (conducted emissions on power supply lines)

Ambient temperature	21 °C	Relative humidity	55 %
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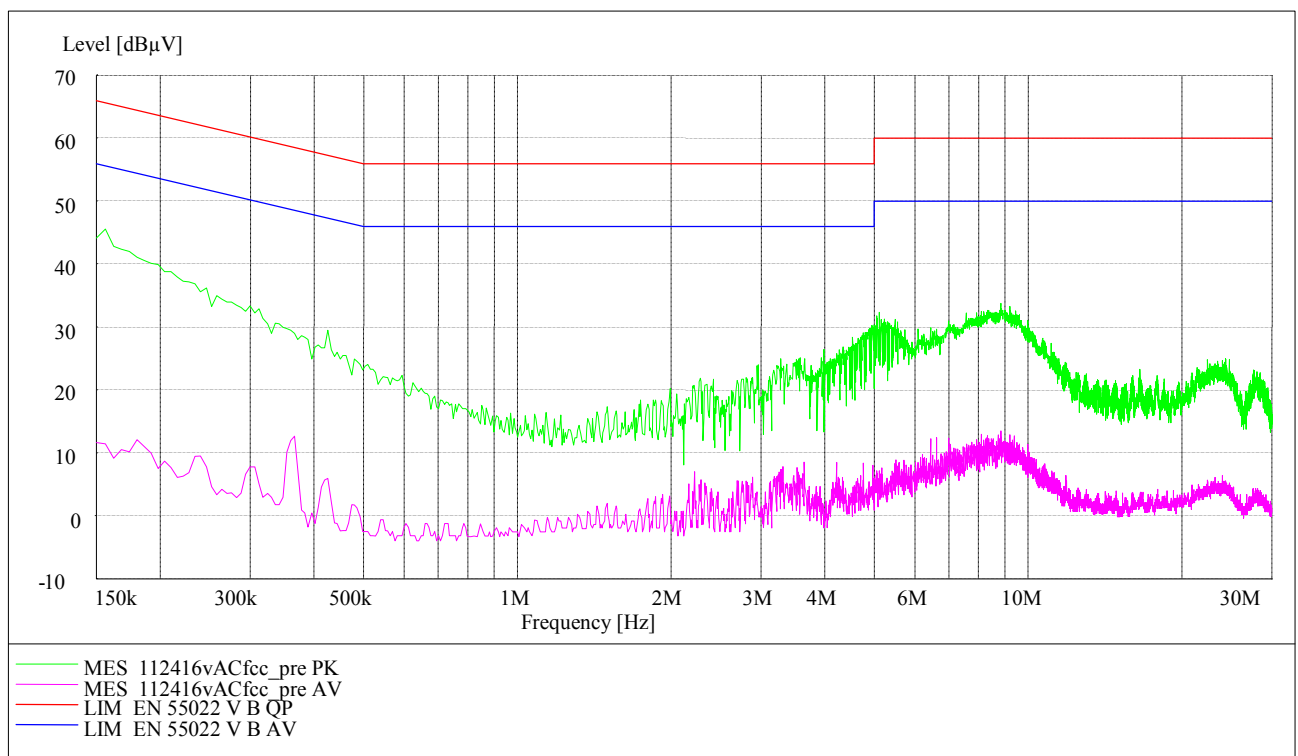
Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m.

Cable guide: The cables of the EUT were 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: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 12.0 V DC by an AC / DC adaptor type PSS-3800SV, which was supplied by 120 V AC / 60 Hz.

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.



Data record name: 112416vACfcc

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

1 - 4, 20

6 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
1	Shielded chamber M47	-	Albatross Projects	B83117-C6439-T262 -	480662	Weekly verification (system cal.)	
2	EMI Receiver	ESIB 26	Rohde & Schwarz	1088.7490	481182	02/08/2010	02/2012
3	LISN	NSLK8128	Schwarzbeck	8128161	480138	05/07/2010	05/2012
4	High pass filter	HR 0.13-5ENN	FSY Microwave Inc.	DC 0109 SN 002	480340	Weekly verification (system cal.)	
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.)	
30	Spectrum analyser	FSU	Rohde & Schwarz	200125	480956	04/15/2010	04/2012
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.)	

