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Test Report

Report Number: F133431E3

Applicant:

ATTINGIMUS Nachrichtentechnik GmbH & Co. KG

Manufacturer:

ATTINGIMUS Nachrichtentechnik GmbH & Co. KG

Equipment under Test (EUT):

CRA61

DAkkS
Deutsche
Akkreditierungsstelle
D-PL-17186-01-01
D-PL-17186-01-02
D-PL-17186-01-03

Laboratory (CAB) accredited by
Deutsche Akkreditierungsstelle GmbH (DAkkS)
in compliance with DIN EN ISO/IEC 17025
under the Reg. No. D-PL-17186-01-02,
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 (May 2013)** 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 Radio Apparatus

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		17 February 2014
	Name	Signature	Date
Authorized reviewer:	Bernd STEINER		17 February 2014
	Name	Signature	Date

RESERVATION

This test report is only valid in its original form.

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1 IDENTIFICATION

1.1 Applicant

Name:	ATTINGIMUS Nachrichtentechnik GmbH & Co. KG
Address:	Rebenring 31 38106 Braunschweig
Country:	Germany
Name for contact purposes:	Dr.-Ing. Wilfried PLAGGE
Phone:	+49 531 34 46 - 51
Fax:	+49 531 34 46 - 13
eMail Address:	wplagge@attingimus.de
Applicant represented during the test by the following person:	Dr.-Ing. Wilfried PLAGGE

1.2 Manufacturer

Name:	ATTINGIMUS Nachrichtentechnik GmbH & Co. KG
Address:	Rebenring 31 38106 Braunschweig
Country:	Germany
Name for contact purposes:	Dr.-Ing. Wilfried PLAGGE
Phone:	+49 531 34 46 - 51
Fax:	+49 531 34 46 - 13
eMail Address:	wplagge@attingimus.de
Manufacturer represented during the test by the following person:	Dr.-Ing. Wilfried PLAGGE

1.3 Test laboratory

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

accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-02, FCC Test site registration number 90877 and Industry Canada Test site registration IC3469A-1.

1.4 EUT (Equipment Under Test)

Test object: *	24 GHz-Lane Change Decision Aid System LCDAS Generation 1.5
Model name: *	CRA61
FCC ID: *	2ABU7-CRA61
IC: *	11765A-CRA61
PCB identifier: *	titcan11
Serial number: *	None
Hardware version: *	titcan11
Software version: *	cra61
Lowest internal frequency: *	12 MHz

1.5 Technical data of equipment

Channel 1	RX:	24.075 GHz to 24.175 GHz	TX:	24.075 GHz to 24.175 GHz
Channel 2	RX:	-	TX:	-
Channel 3	RX:	-	TX:	-

Duty cycle:*	100 %					
Rated RF output power: *	< +20 dBm (e.i.r.p.)					
Antenna type:	Integral patch antenna					
Alignment range: *	24.075 GHz to 24.175 GHz					
Switching range: *	24.075 GHz to 24.175 GHz					
Modulation: *	FMCW					
Bit rate of transmitter: *	-					
Supply Voltage: *	U_{Nom} =	24.0 V DC	U_{Min}=	10.0 V DC	U_{Max}=	30.0 V DC
Power Supply: *	External by vehicular battery					
Temperature range: *	-40 °C to +85 °C					
Ancillaries to be tested with:	-					

*: Declared by the applicant.

The following external I/O cables were used:

Identification	Connector		Length
	EUT	Ancillary	
Input cable (DC and CAN)	4 pole M12 plug	4 pole M12 plug	Up to 12 m
Output cable (to next radar unit)	5 pole M12 plug socket	5 pole M12 plug	Up to 3 m
-	-	-	-
-	-	-	-
-	-	-	-

1.6 Dates

Date of receipt of test sample:	12 August 2013
Start of test:	12 August 2013
End of test:	13 August 2013

2 OPERATIONAL STATES

All tests were carried out with an unmodified sample with integral antenna.

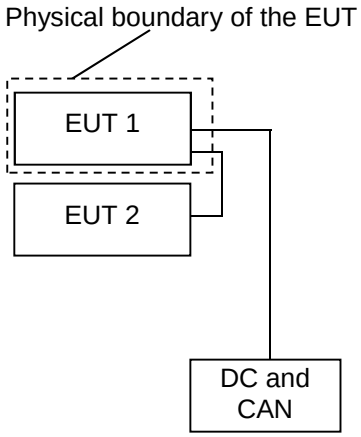
All measurements were carried out with the EUT supplied with 24.0 V DC, because pre-tests have shown that there is no noticeable difference of the output signal with respect to the supply voltage.

The EUT is a Lane Change Decision Aid System (LCDAS), which is intended for vehicular use.

No tests in stand-by mode of the transmitter / receive mode were carried out, because the transmitter is operating continuously and has no stand-by mode.

For the whole frequency range a preliminary measurement in a fully anechoic chamber was carried out to determine the frequencies, which were radiated by the EUT. The final measurements on the detected frequencies were carried out on an outdoor test site without ground plane (for the frequency range 9 kHz to 30 MHz), on an open area test site with ground plane (for the frequency range 30 MHz to 1 GHz) or the fully anechoic chamber (for the frequency range 1 GHz to 110 GHz).

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



3 Additional Information

The EUT used for the tests was not labeled.

4 OVERVIEW

Application	Frequency range	FCC 47 CFR Part 15 section [2]	RSS-210, issue 8 [4]; RSS-Gen, issue 3 [5]	Status	Refer page
20 dB bandwidth	24.075 GHz to 24.175 GHz	15.215 (c)	-	Passed	8 et seq.
99 % bandwidth	24.075 GHz to 24.175 GHz	-	4.6.1 [4]	Passed	8 et seq.
Band edge compliance	24.075 GHz to 24.175 GHz	15.215 (c)	2.5 [4]	Passed	11 et seq.
Field strength of fundamental	24.075 GHz to 24.175 GHz	15.245 (b)	Annex 7 [4]	Passed	14 et seq.
Field strength of harmonics	Restricted bands	15.245 (b) (1) (ii), 15.245 (b) (1) (iii)	Annex 7 [4]	Passed	14 et seq.
Emissions outside the specified bands	9 kHz to 110 GHz	15.205 (a), 15.209 (a), 15.245 (3)	Annex 7 (1) [4], 7.2.2 [5], 7.2.5 [5]	Passed	14 et seq.
Conducted emissions	150 kHz to 30 MHz	15.207	7.2.4 [5]	Not applicable*	-

* EUT is DC powered and designed for vehicular use only.

5 TEST RESULTS

5.1 Bandwidth

5.1.1 Method of measurement (bandwidth)

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

The following spectrum analyser settings shall be used:

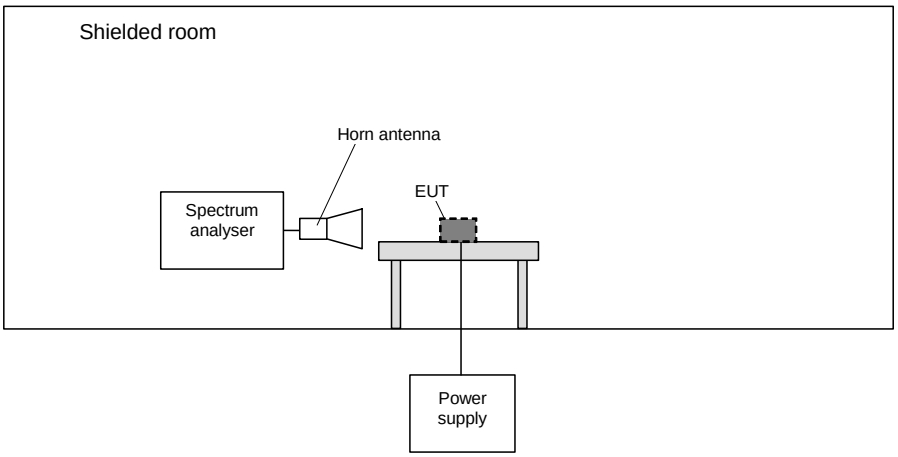
- Span: App. 2 to 3 times the 20 dB bandwidth, centred on the actual channel.
- Resolution bandwidth: 100 kHz.
- Video bandwidth: 300 kHz.
- Sweep: Auto.
- Detector function: peak.
- Trace mode: Max hold.

<u>20 dB bandwidth:</u>

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.

<u>99 % bandwidth:</u>

After trace stabilisation the marker shall be set on the signal peak. The power measurement function of the spectrum analyser has to be used to determine the 99 % bandwidth.



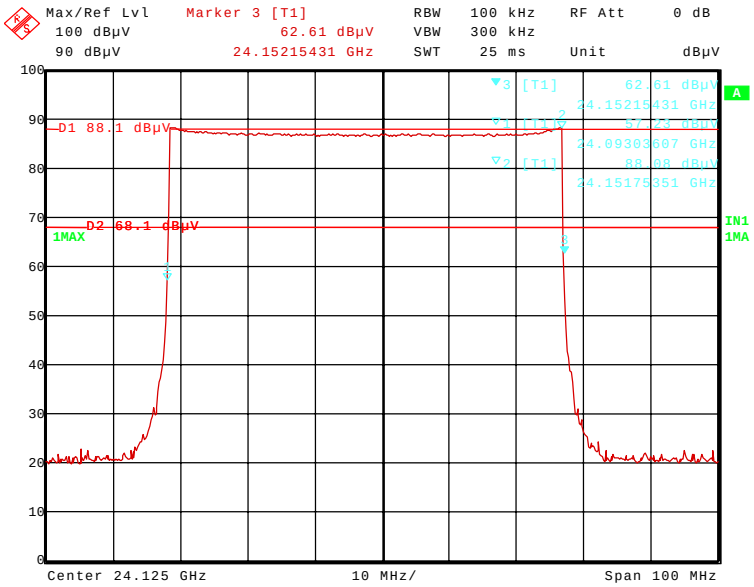
5.1.2 Test results (20 dB bandwidth)

Ambient temperature	21 °C	Relative humidity	55 %

Position of EUT: The EUT was set-up 5 cm in front of the measuring antenna

Supply voltage: During all measurements the EUT was supplied by an external 24 V DC-Power-Supply.

132431_50.wmf: 20 dB bandwidth:



F_L	F_U	BW (F_U - F_L)
24.093036 GHz	24.151754 GHz	58.718 MHz
Measurement uncertainty		$< \pm 1*10^{-7}$

Test: Passed

TEST EQUIPMENT USED THE TEST:

29, 31, 52, 149, 165, 176

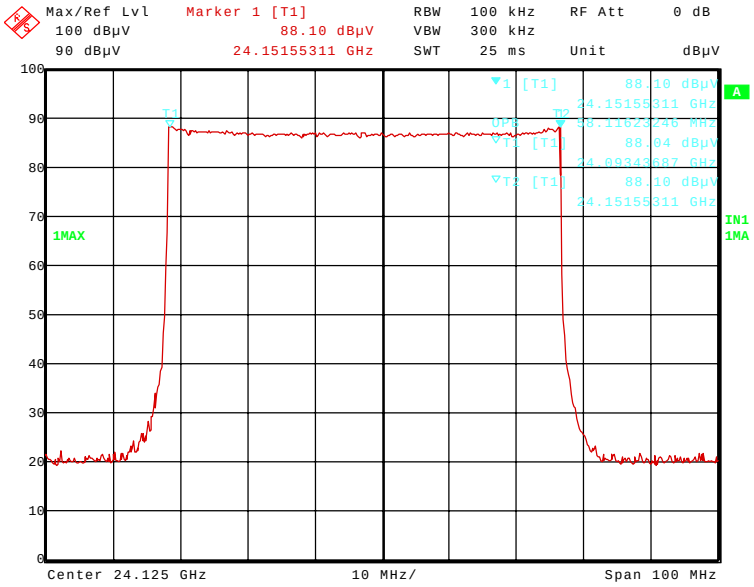
5.1.3 Test results (99 % bandwidth)

Ambient temperature	21 °C	Relative humidity	55 %

Position of EUT: The EUT was set-up 5 cm in front of the measuring antenna

Supply voltage: During all measurements the EUT was supplied by an external 24 V DC-Power-Supply.

132431_51.wmf: 99 % bandwidth:



F_L	F_U	BW (F_U - F_L)
24.093437 GHz	24.151553 GHz	58.116 MHz
Measurement uncertainty		$< \pm 1*10^{-7}$

Test: Passed

TEST EQUIPMENT USED THE TEST:

29, 31, 52, 149, 165, 176

5.2 Band-edge compliance

5.2.1 Method of measurement (band-edge compliance)

The same test set-up as used for the final radiated emission measurement shall be used.
The measurements shall be carried out with using a resolution bandwidth of 100 kHz.

The following spectrum analyser settings shall be used:

- Span: Wide enough to capture the peak level of the emission on the channel closest to the band-edge, as well as any modulation products, which fall outside the assigned frequency band.
- Resolution bandwidth: 100 kHz.
- Video bandwidth: ≥ the resolution bandwidth.
- Sweep: Auto.
- Detector function: Peak.
- Trace mode: Max hold.

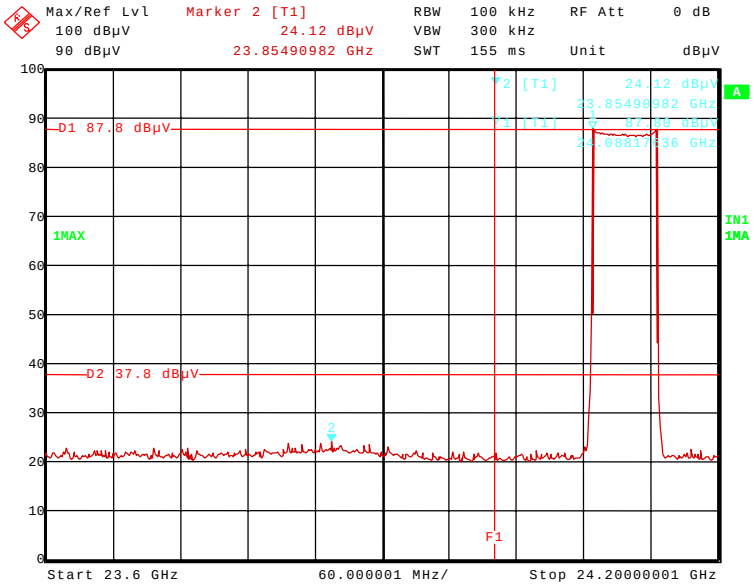
After trace stabilisation the marker shall be set on the signal peak. The first display line has to be set on this value. The second display line has to be set 50 dB below the first line (or the peak marker). The frequency line shall be set on the edge of the assigned frequency band. Set the second marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is higher than that at the band-edge. This frequency shall be measured with the EMI receiver as described in subclause 5.3.1 of this test report, but 100 kHz resolution bandwidth shall be used.

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

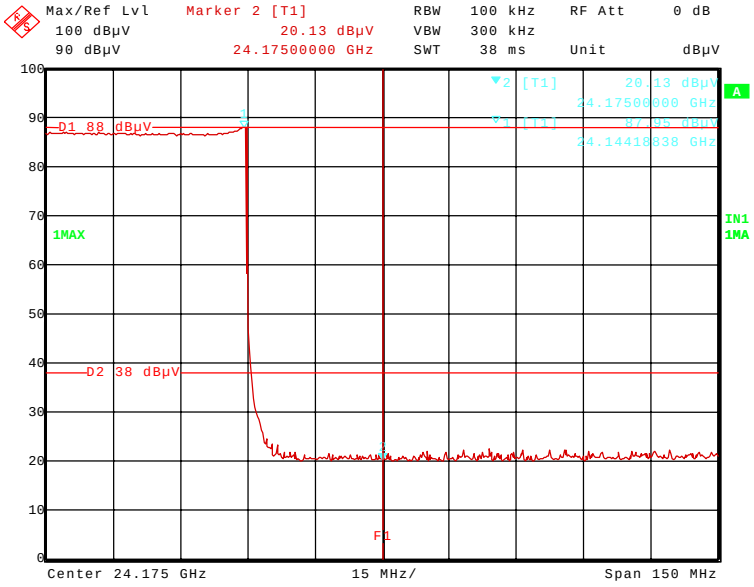
5.2.2 Test results (band-edge compliance)

Ambient temperature	21 °C		Relative humidity	55 %

132431_52.wmf: Band-edge compliance, lower band edge:



132431_53.wmf: Band-edge compliance, upper band edge:



The plots on the page before are showing the band-edge compliance for the lower and upper band-edge. The display line 1 (D1) in these plots represents the highest level within the assigned frequency band. The display line 2 (D2) represents the -50 dB offset to this highest level and shows the compliance with FCC 47 CFR Part 15.245 (d). The frequency line 1 (F1) shows the edge of the assigned frequency.

Band-edge compliance (lower band edge)									
Result measured with the peak detector:									
Frequency GHz	Result dBµV/m	Limit (3 m) dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Corr. factor from 3 m to 30 cm	Restr. Band
24.103000	107.7	148.0	40.3	88.0	37.2	0.0	2.5	20 dB	No
23.854166	44.0	74.0	30.0	24.3	37.2	0.0	2.5	20 dB	Yes
Result measured with the average detector:									
Frequency GHz	Result dBµV/m	Limit (3 m) dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Corr. factor from 3 m to 30 cm	Restr. Band
24.103000	72.3	128.0	55.7	52.6	37.2	0.0	2.5	20 dB	No
23.854166	8.6	54-0	45.4	-11.1	37.2	0.0	2.5	20 dB	Yes
Measurement uncertainty							-3.6 dB / +2.2 dB		

Band-edge compliance (upper band edge)									
Result measured with the peak detector:									
Frequency GHz	Result dBµV/m	Limit (3 m) dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Corr. factor from 3 m to 30 cm	Restr. Band
24.103000	107.7	148.0	40.3	88.0	37.2	0.0	2.5	20 dB	No
24.175000	39.8	108.0	68.2	20.1	37.2	0.0	2.5	20 dB	No
Result measured with the average detector:									
Frequency GHz	Result dBµV/m	Limit (3 m) dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Corr. factor from 3 m to 30 cm	Restr. Band
24.103000	72.3	128.0	55.7	52.6	37.2	0.0	2.5	20 dB	No
24.175000	4.4	88.0	83.6	-15.6	37.2	0.0	2.5	20 dB	No
Measurement uncertainty							-3.6 dB / +2.2 dB		

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:

29, 31, 52, 49, 165, 176

5.3 Radiated emissions

5.3.1 Method of measurement (radiated emissions)

The radiated emission measurement is subdivided into 5 stages.

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

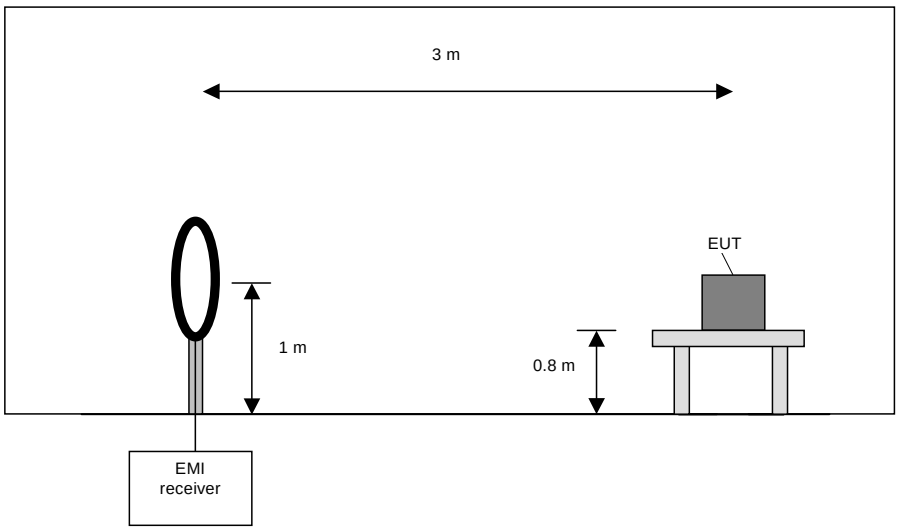
Preliminary measurement (9 kHz to 30 MHz):

In the first stage a preliminary measurement will be performed in a shielded room with a measuring distance of
3 meters. Tabletop devices will set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices will be placed directly on the turntable/ground plane. The set-up of the Equipment under test will be in accordance to ANSI C63.4-2009 [1].

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

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

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



Preliminary measurement procedure:

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

The following procedure will be used:

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

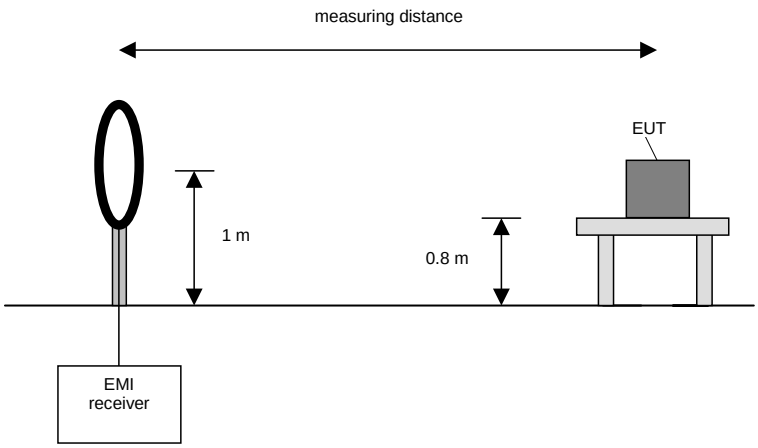
Final measurement (9 kHz to 30 MHz):

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

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

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

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



Final measurement procedure:

The following procedure will be used:

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

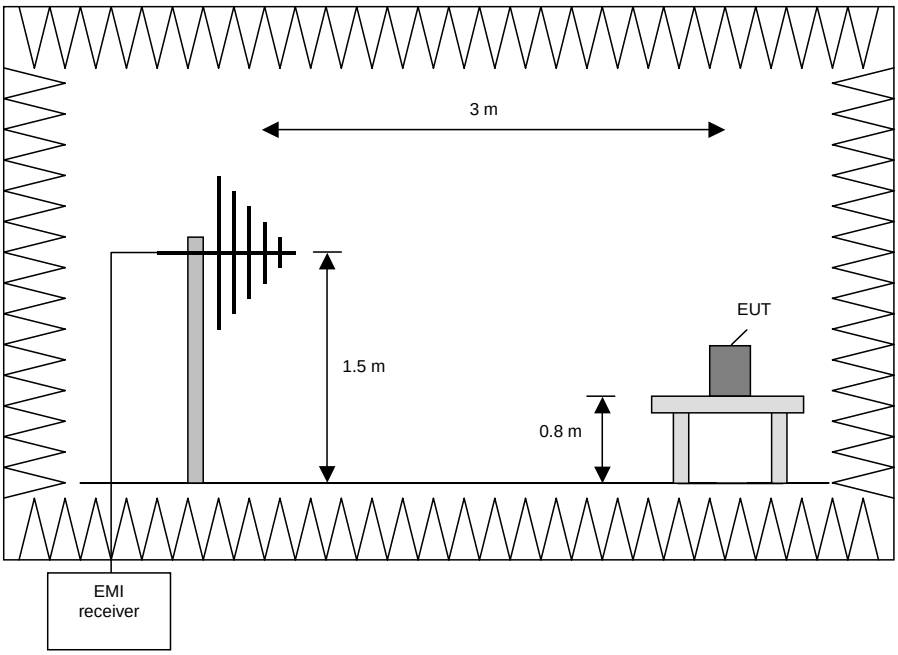
Preliminary measurement (30 MHz to 1 GHz)

In the first stage a preliminary measurement will be performed in a fully anechoic chamber with a measuring distance of 3 meter. Table top 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:

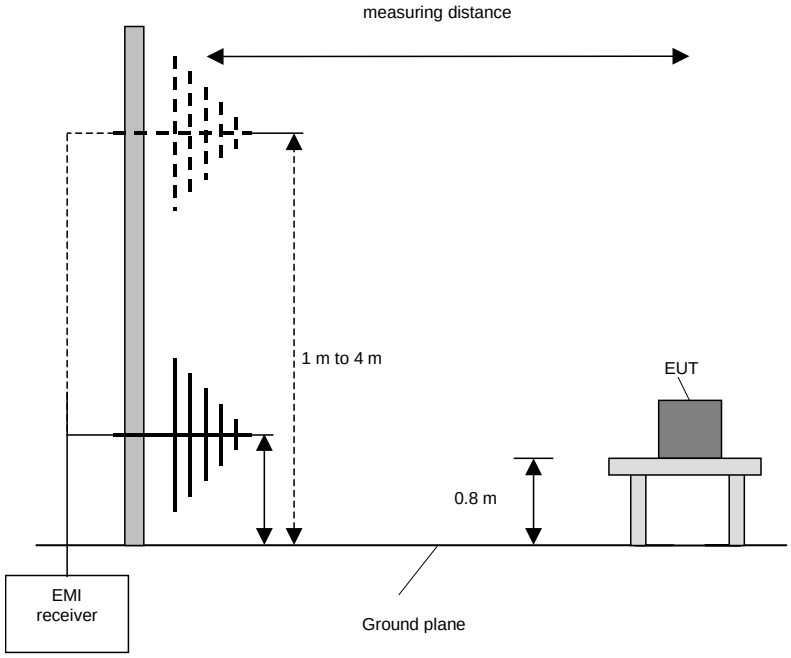
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Make a hardcopy of the spectrum.
5. Measure the frequency of the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

Final measurement (30 MHz to 1 GHz)

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

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

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	120 kHz



Procedure final measurement:

The following procedure will be used:

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

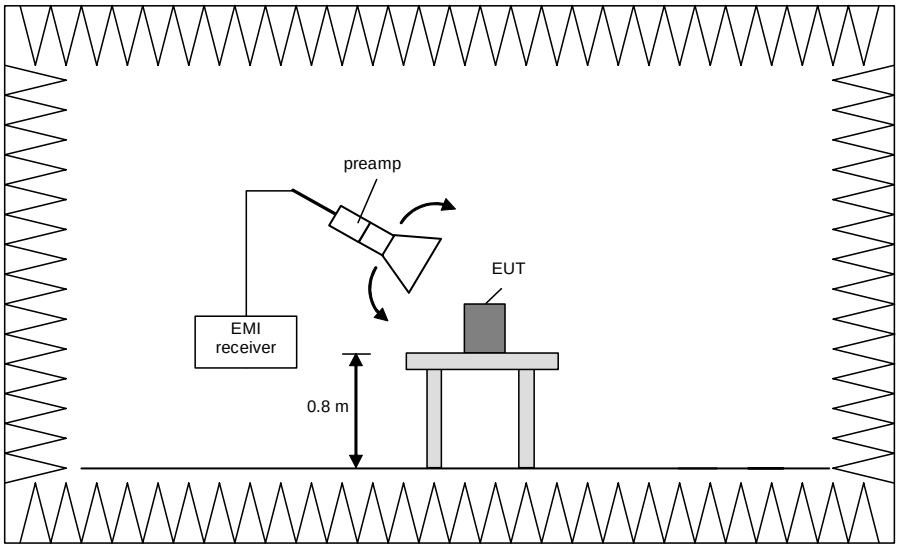
Preliminary and final measurement (1 GHz to 110 GHz)

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

Frequency range	Resolution bandwidth (preliminary)	Resolution bandwidth (final)
1 GHz to 110 GHz	1 MHz	1 MHz

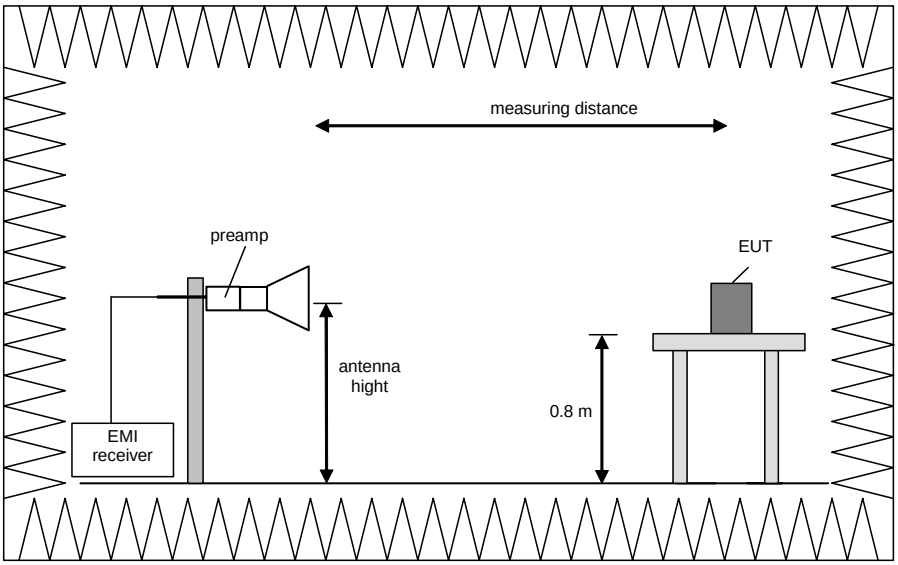
Preliminary measurement (1 GHz to 110 GHz)

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



Final measurement (1 GHz to 110 GHz)

The EMI Receiver set to peak and average mode and a resolution bandwidth of 1 MHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 ° in order to have the antenna inside the cone of radiation.



Procedure of measurement:

The measurements were performed in the frequency range 1 GHz to 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 lager than the antenna beam width.

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

5.3.2 Test results (radiated emissions)

5.3.2.1 Preliminary radiated emission measurement (10 MHz to 110 GHz)

Ambient temperature	21 °C	Relative humidity	55 %

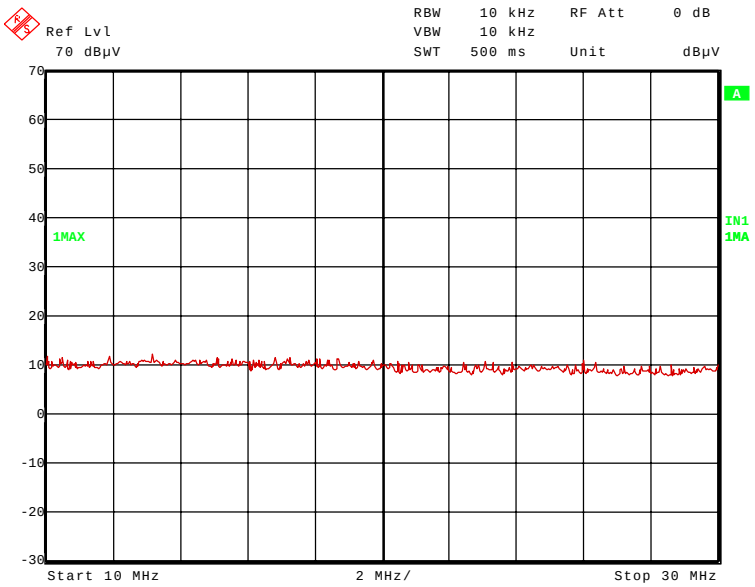
Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and the antenna was 3 m (9 kHz to 1 GHz).

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

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

Supply voltage: The EUT was supplied by an external 24.0 V DC-Power Supply.

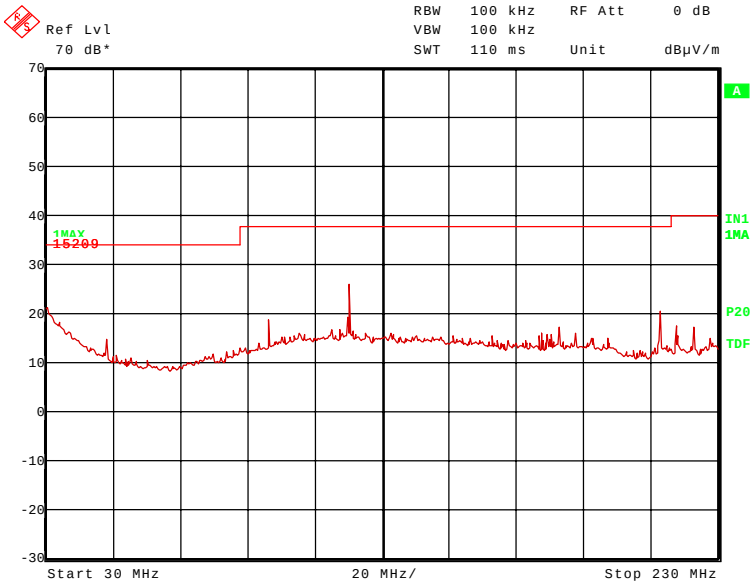
132431_64.wmf: Radiated emissions from 10 MHz to 30 MHz:



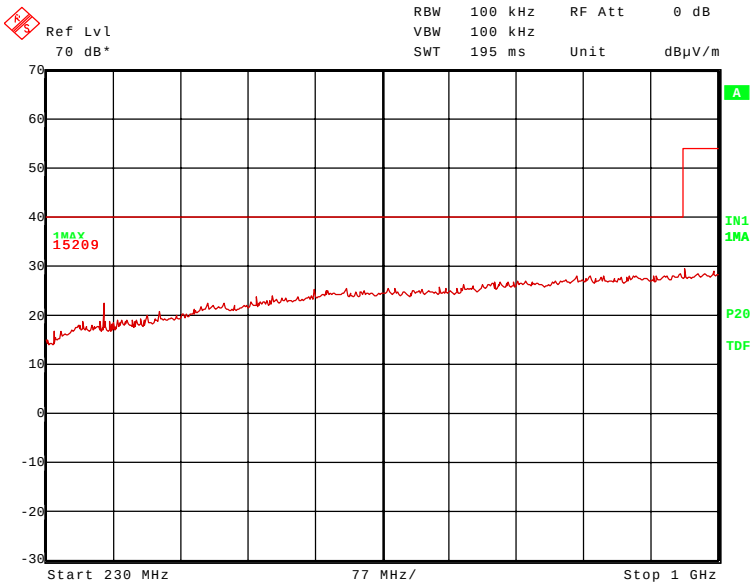
No significant emissions above the noise floor of the measuring system found, so no measurements on the outdoor test site were carried out.

TEST EQUIPMENT USED FOR THE TEST:
29, 31 - 36, 43, 44, 45, 49, 52, 55, 146, 149, 150, 153 - 155, 159, 161, 165, 176

132431_63.wmf: Radiated emissions from 30 MHz to 230 MHz:



132431_62.wmf: Radiated emissions from 230 MHz to 1000 MHz:



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

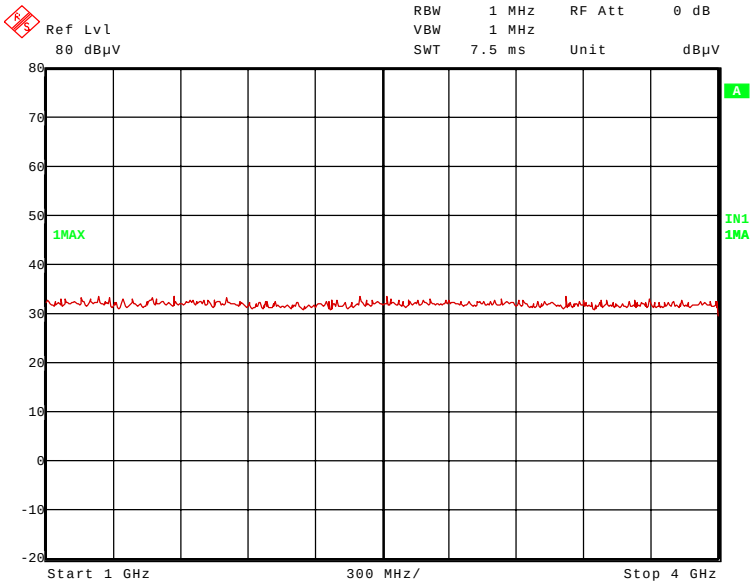
- 212.519 MHz and 297.529 MHz.

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

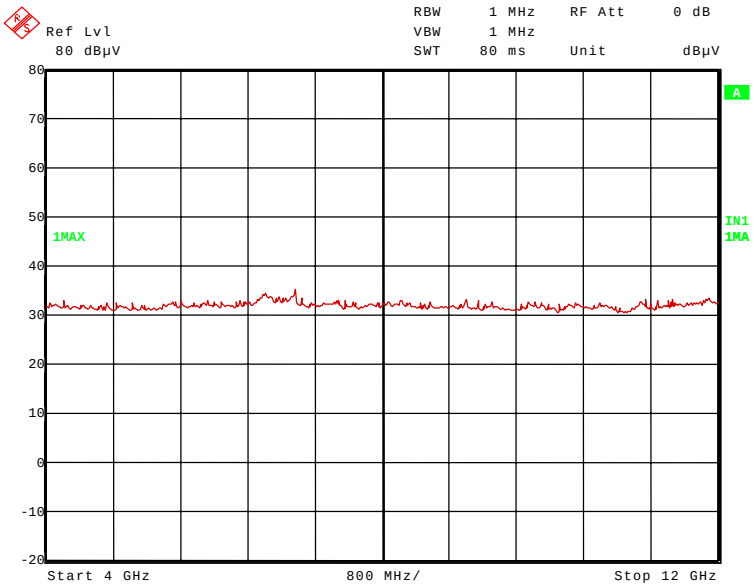
- 120.011 MHz.

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

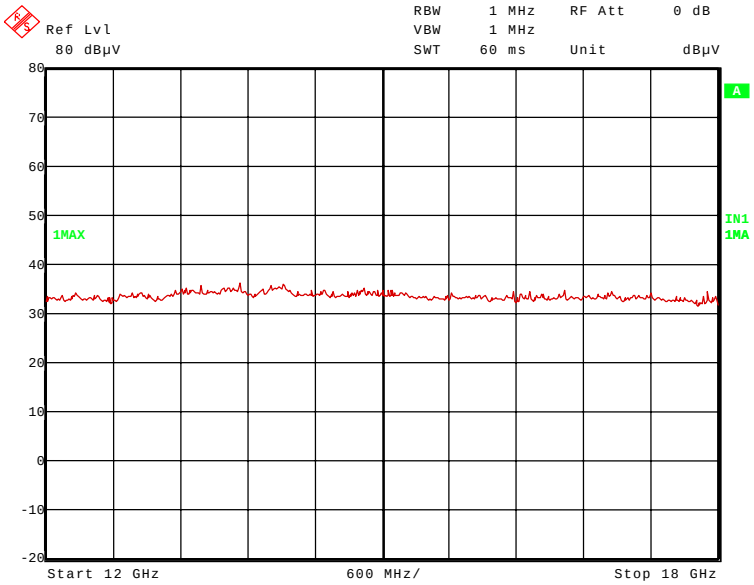
132431_61.wmf: Radiated emissions from 1 GHz to 4 GHz:



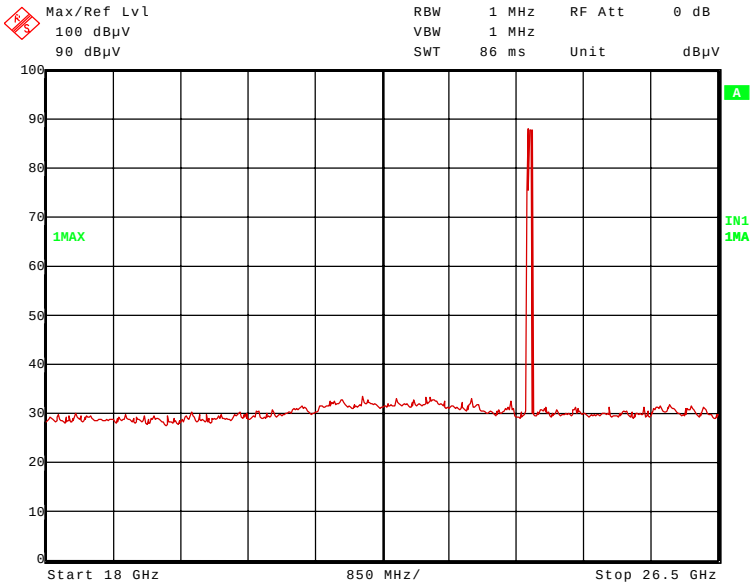
132431_60.wmf: Radiated emissions from 4 GHz to 12 GHz:



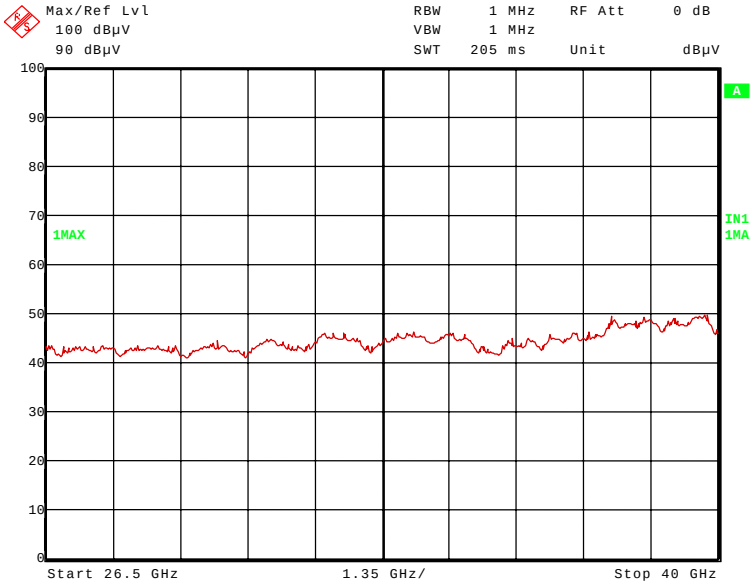
132431_59.wmf: Radiated emissions from 12 GHz to 18 GHz:



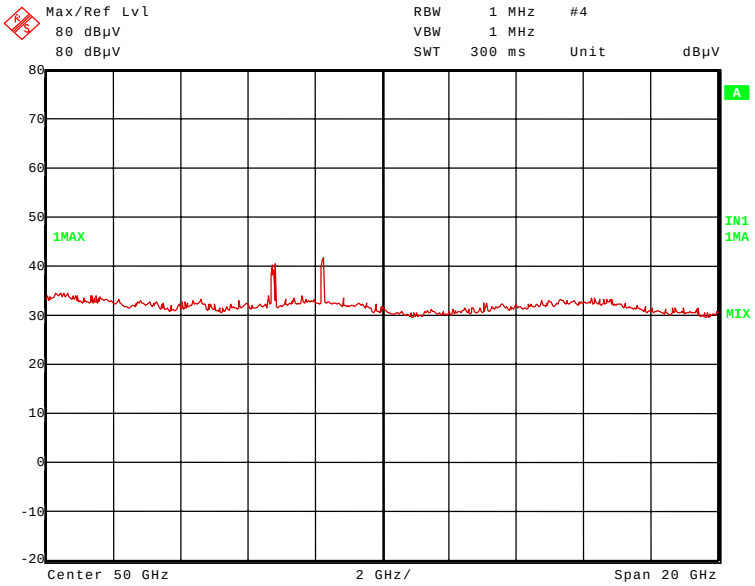
132431_54.wmf: Radiated emissions from 18 GHz to 26.5 GHz:



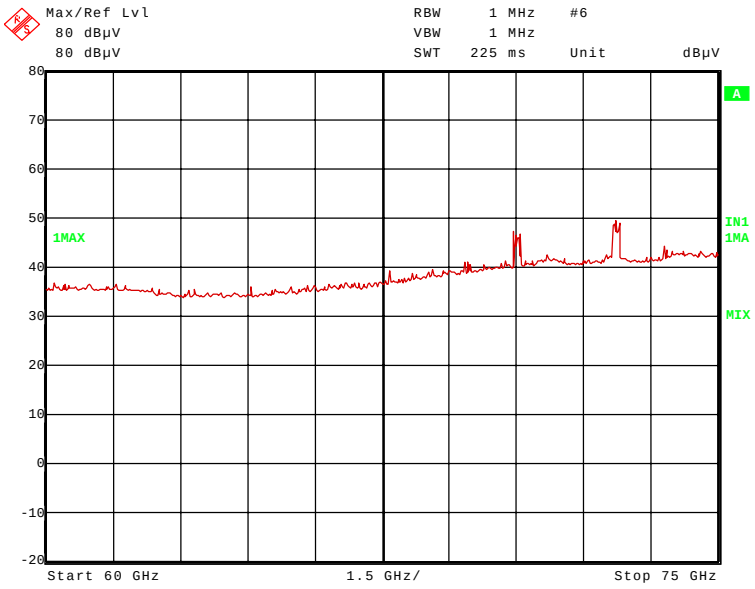
132431_55.wmf: Radiated emissions from 26.5 GHz to 40 GHz:



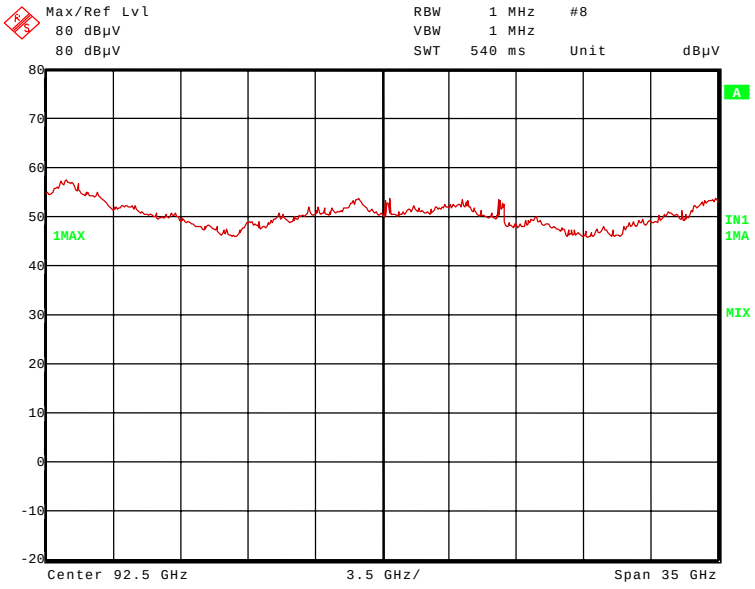
132431_56.wmf: Radiated emissions from 40 GHz to 60 GHz:



132431_.wmf: Radiated emissions from 60 GHz to 75 GHz:



132431_58.wmf: Radiated emissions from 75 GHz to 110 GHz:



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

- 48.290 GHz, 72.806 GHz and 96.500 GHz.

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

- 24.103 GHz.

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

The emissions around 46 GHz, 70.5 GHz, 92.5 GHz and 98.5 GHz are mirror frequencies caused by the harmonic mixer.

5.3.2.2 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.

Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 24.0 V DC by an external power supply.

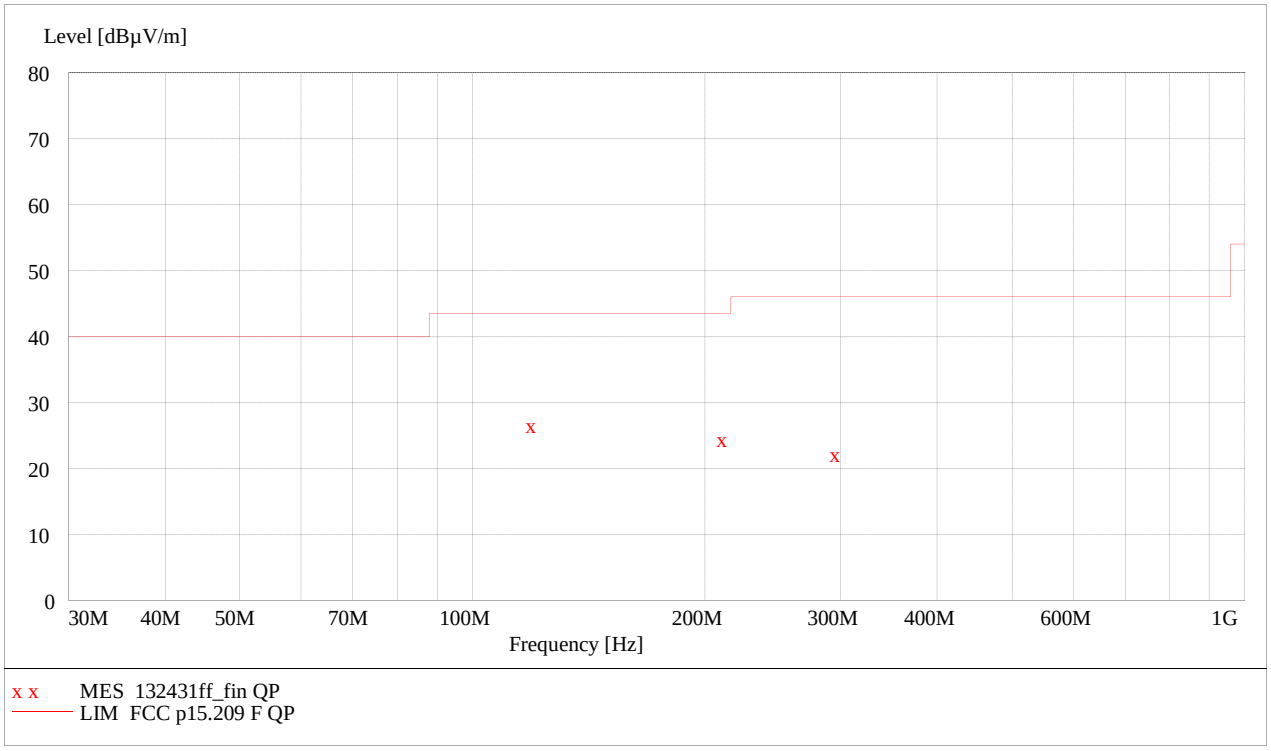
Test results: The test results were calculated with the following formula:

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

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.



Data record name: 132431ff

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

Spurious emissions inside 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.
120.011	26.7	43.5	16.8	13.1	12.4	1.2	101.0	265.0	Hor.
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.
212.519	24.5	43.5	19.0	13.5	9.4	1.6	101.0	239.0	Hor.
297.529	22.3	46.0	23.7	7.4	13.0	1.9	102.0	132.0	Hor.
Measurement uncertainty				+2.2 dB / -3.6 dB					

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
14 - 20

5.3.2.3 Final radiated emission measurement (1 GHz to 110 GHz)

Ambient temperature	21 °C	Relative humidity	55 %

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.

Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied with 24.0 V DC by an external power supply.

Resolution bandwidth: For all measurements a resolution bandwidth of 1 MHz was used.

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

Result [dBµV/m] = reading [dBµV] + cable loss [dB] + antenna factor [dB/m] – Preamp [dB] + measuring distance correction factor [dB]

Result measured with the peak detector:

Frequency GHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Corr. Factor* dB	Height cm	Pol.	Restr. Band
24.103	107.7	148.0	40.3	88.0	37.2	0.0	2.5	-20.0	0.85	Hor.	carrier
48.290	38.6	74.0	35.4	38.9	19.7	0.0	-	-20.0	0.85	Hor.	Yes
72.806	47.4	74.0	26.6	46.3	21.1	0.0	-	-20.0	0.85	Hor.	Yes
96.500	53.2	74.0	20.8	52.9	20.3	0.0	-	-20.0	0.85	Hor.	Yes
Measurement uncertainty								+2.2 dB / -3.6 dB			

*: Measuring distance correction factor from 3 m to 30 cm

Result measured with the average detector:

Frequency GHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Corr. Factor* dB	Height cm	Pol.	Restr. Band
24.103	72.3	128.0	55.7	52.6	37.2	0.0	2.5	-20.0	0.85	Hor.	carrier
48.290	21.8	54.0	32.2	22.1	19.7	0.0	-	-20.0	0.85	Hor.	Yes
72.806	32.1	54.0	21.9	31.0	21.1	0.0	-	-20.0	0.85	Hor.	Yes
96.500	41.0	54.0	11.0	40.7	20.3	0.0	-	-20.0	0.85	Hor.	Yes
Measurement uncertainty								+2.2 dB / -3.6 dB			

*: Measuring distance correction factor from 3 m to 30 cm

Test: Passed

TEST EQUIPMENT USED FOR THE TEST:
29, 31 - 34, 44, 45, 52, 153 – 155, 165, 176

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	EMI Receiver	ESIB 26	Rohde & Schwarz	1088.7490	481182	03/09/2012	03/2014
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		
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	02/13/2012	02/2014
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 B	EMCO	9609-4922	480184	09/28/2011	09/2014
43	RF-cable No. 36	Sucoflex 106B	Suhner	0522/6B	480571	Weekly verification (system cal.)	
44	RF-cable No. 3	Sucoflex 106B	Suhner	0563/6B	480670	Weekly verification (system cal.)	
45	RF-cable No. 40	Sucoflex 106B	Suhner	0708/6B	481330	Weekly verification (system cal.)	
49	Preamplifier	JS3-00101200-23-5A	Miteq	681851	480337	Six month verification (system cal.)	
52	Power supply	TOE 8752	Toellner	31566	480010	-	-
55	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	02/16/2012	02/2014
146	Standard Gain Horn 11.9 GHz – 18 GHz	18240-20	Flann Microwave	483	480294	Six month verification (system cal.)	
149	Standard Gain Horn 17.9 GHz – 26.7 GHz	20240-20	Flann Microwave	410	480296	Six month verification (system cal.)	
150	Standard Gain Horn 26.4 GHz – 40.1 GHz	22240-20	Flann Microwave	469	480299	Six month verification (system cal.)	
153	Harmonic mixer with Standard Gain Horn 40 GHz – 60 GHz	FZ-Z60 / 24240-20	Rohde & Schwarz / Flann Microwave	100071 / 133313	480481	Six month verification (system cal.)	
154	Harmonic mixer with Standard Gain Horn 50 GHz – 75 GHz	FS-Z75 / 25240-20	Rohde & Schwarz / Flann Microwave	100045 / 135181	480480	Six month verification (system cal.)	
155	Harmonic mixer with Standard Gain Horn 75 GHz – 110 GHz	FS-Z110 / 27240-20	Rohde & Schwarz / Flann Microwave	100049 / 138294	480482	Six month verification (system cal.)	
165	RF-cable 1m	KPS-1533-400-KPS	Insulated Wire	-	480300	Six month verification (system cal.)	
159	Preamplifier	JS3-12001800-16-5A	Miteq	571667	480343	04/10/2013	04/2014

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
160	Preamplifier	JS3-18002600-20-5A	Miteq	658697	480342	04/10/2013	04/2014
161	Preamplifier	JS3-26004000-25-5A	Miteq	563593	480344	04/10/2013	04/2014
176	Multimeter	971A	Hewlett Packard	JP39009358	480721	12/06/2011	12/2013

7 REPORT HISTORY

Report Number	Date	Comment
F132431E3	17 February 2014	Document created

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132431_32.JPG: CRA61, test set-up fully anechoic chamber
132431_31.JPG: CRA61, test set-up fully anechoic chamber
132431_30.JPG: CRA61, test set-up fully anechoic chamber
132431_27.JPG: CRA61, test set-up fully anechoic chamber
132431_34.JPG: CRA61, test set-up open area test site

ANNEX B EXTERNAL PHOTOGRAPHS 2 pages

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132431_j.JPG: CRA61, 3-D.view 2

ANNEX C INTERNAL PHOTOGRAPHS 6 pages

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132431_l.JPG: CRA61, internal view 2
132431_q.JPG: CRA61, main PCB, top view
132431_r.JPG: CRA61, main PCB, bottom view
132431_m.JPG: CRA61, Antenna PCB, top view
132431_n.JPG: detail view to RF-module, cover removed