PHOENIX TESTLAB
Königswinkel 10
32825 Blomberg, Germany
Phone: +49 (0) 52 35 / 95 00-0
Fax: +49 (0) 52 35 / 95 00-10
office@phoenix-testlab.de
www.phoenix-testlab.de

Test Report

Report Number:

F191984E1 2nd version

Equipment under Test (EUT):

IRS31Pro-UMB

Applicant:

G. Lufft Mess- und Regeltechnik GmbH

Manufacturer:

G. Lufft Mess- und Regeltechnik GmbH

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

References

[1] ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

[2] FCC CFR 47 Part 15, Radio Frequency Devices

[3] RSS-210 Issue 10 (December 2019), Licence-Exempt Radio Apparatus: Category I Equipment

[4] RSS-Gen Issue 5 (March 2019) Amendment 1, General Requirements for Compliance 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		08.10.2020
	Name	Signature	Date
Authorized reviewer:	Bernd STEINER		08.10.2020
	Name	Signature	Date

This test report is only valid in its original form.

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.

This test report is valid in hardcopy form as well as in electronic form.

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 6
4 Overview 6
5 Results 7
5.1 Calculation of the average correction factor 7
5.2 Bandwidth 9
5.2.1 Method of measurement (bandwidth) 9
5.2.2 Test result (bandwidth) 10
5.3 Maximum unwanted emissions 12
5.3.1 Method of measurement (radiated emissions) 12
5.3.2 Test results (radiated emissions) 1 MHz – 25 GHz 19
5.3.2.1 Preliminary radiated emission measurement 1 MHz – 25 GHz 19
5.3.2.2 Final radiated measurements 23
5.4 Conducted emissions on power supply lines 25
5.4.1 Method of measurement (conducted emissions on power supply lines) 25
5.4.2 Test result (conducted emissions on power supply lines) 26
6 Test equipment and ancillaries used for tests 27
7 Test site validation 28
8 Report history 28
9 List of annexes 28

1 Identification

1.1 Applicant

Name:	G. Lufft Mess- und Regeltechnik GmbH
Address:	Gutenbergstr. 20 70736 Fellbach
Country:	Germany
Name for contact purposes:	Mr. Tobias WEIL
Phone:	+49 711 51 82 217
Fax:	+49 711 51 82 241
eMail Address:	hardware@lufft.com
Applicant represented during the test by the following person:	Mr. Martin KENNERKNECHT, Mr. Manfred KÖNIG

1.2 Manufacturer

Name:	G. Lufft Mess- und Regeltechnik GmbH
Address:	Gutenbergstr. 20 70736 Fellbach
Country:	Germany
Name for contact purposes:	Mr. Tobias WEIL
Phone:	+49 711 51 82 217
Fax:	+49 711 51 82 241
eMail Address:	hardware@lufft.com
Manufacturer represented during the test by the following person:	Mr. Martin KENNERKNECHT, Mr. Manfred KÖNIG

1.3 Test laboratory

The tests were carried out by: 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 and D-PL-17186-01-05, FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

1.4 EUT (Equipment Under Test)

Test object: *	Passive road sensor
Type / PMN: *	IRS31Pro-UMB
FCC ID: *	UF9IRS31PRO
IC: *	6650A-IRS31PRO
Serial number: *	014.0919.1203.021
PCB identifier: *	48.4552-60
HVIN (Hardware Version Identification Number): *	SPLAN.1203.6
FVIN (Firmware Version Identification Number): *	SW.1203.24

Note: PHOENIX TESTLAB GmbH does not take samples. The samples used for tests are provided exclusively by the applicant.

1.5 Technical data of equipment

Antenna type: *	Integrated PCB patch antenna					
Antenna connector: *	None					
Power supply – EUT: *	U_{nom}=	12.0 V_{DC}	U_{min}=	9.0 V_{DC}	U_{max}=	14.0 V_{DC}
Type of modulation: *	Pulsed CW					
Data rate: *	None					
Operating frequency range: *	2.459 GHz					
Number of channels: *	1					
Temperature range: *	-40 °C to +80 °C					
Lowest internal clock frequency: *	1.0 MHz					
Ancillaries used for testing:	Laptop PC type Dell Precision M4800, USB to RS485 converter type Delck 62501 (both provided by the applicant), external power supply type enercell CAT: NO. 273-316 for emission measurement on power supply lines (provided by the laboratory).					

* Declared by the applicant

The following external I/O cables were used:

Identification	Connector		Length
	EUT	Ancillary	
Connection cable (DC and RS 485)	Fixed	-	3 m
-	-	-	-
-	-	-	-

*: Length during the test if no other specified.

1.6 Dates

Date of receipt of test sample:	12.11.2019
Start of test:	12.11.2019
End of test:	15.11.2019

2 Operational states

The EUT is a passive road sensor, intended to measure the inter alia the road temperature and the water film height. It is intended to be fixed mounted in the road.

During all tests the EUT was supplied with 12.0 V_{DC} and was connected to a tablet PC via RS485. It is operational after powering up and reports the measurement results on its interface (RS485).

In order to measure the maximum radiated emission values, the EUT was mounted on a 3-D positioner during the radiated tests inside the fully anechoic chamber.

For details of the mounting refer also the photographs in annex A of this test report.

With the help of a software (ConfigTool.net, supplied by the applicant) installed on a laptop PC and a USB to RS485 converter it was possible to display the measurement results.

For the AC power line conducted measurement the following operation mode was measured:
The EUT was connected via RS485 and a USB to RS485 converter type to the laptop PC, which was powered by its internal battery. The EUT was powered by an external power supply type enercell CAT: NO. 273-316, solely powered by an AC mains network with 120 V AC / 60 Hz.

3 Additional information

The EUT was not labelled as required.

In order to keep the tested sample operational, some internal photographs were supplied by the applicant.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-210 [3] or RSS-Gen [4]	Status	Refer page
Bandwidth	2.435 GHz to 2.465 GHz	15.215 (c)	6.7 [4]	Passed	9 et seq.
Radiated emissions (transmitter)	1.0 MHz to 25,000 MHz	15.249 (a), (c), (d) and (e), 15.205 (a), 15.209 (a).	B.10 [3], 8.9 [4]	Passed	12 et seq.
Conducted emissions	150 kHz to 30 MHz	15.207	8.8 [4]	Passed	25 et seq.
Antenna requirement	-	15.203	6.8 [4]	Passed *	-

*: The EUT has an internal antenna only and no antenna connector, so this requirement is regarded as fulfilled.

5 Results

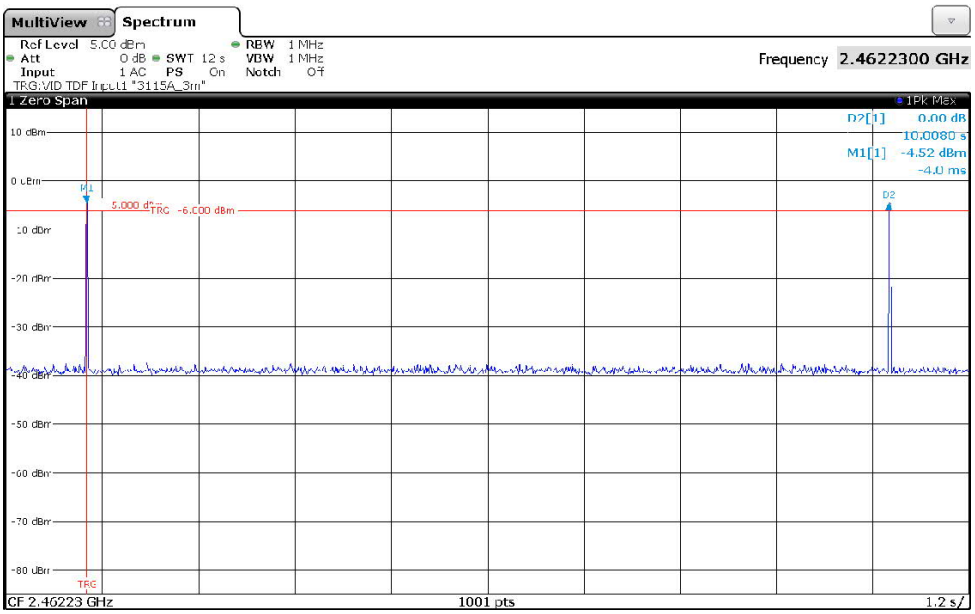
5.1 Calculation of the average correction factor

Ambient temperature	22 °C	Relative humidity	31 %

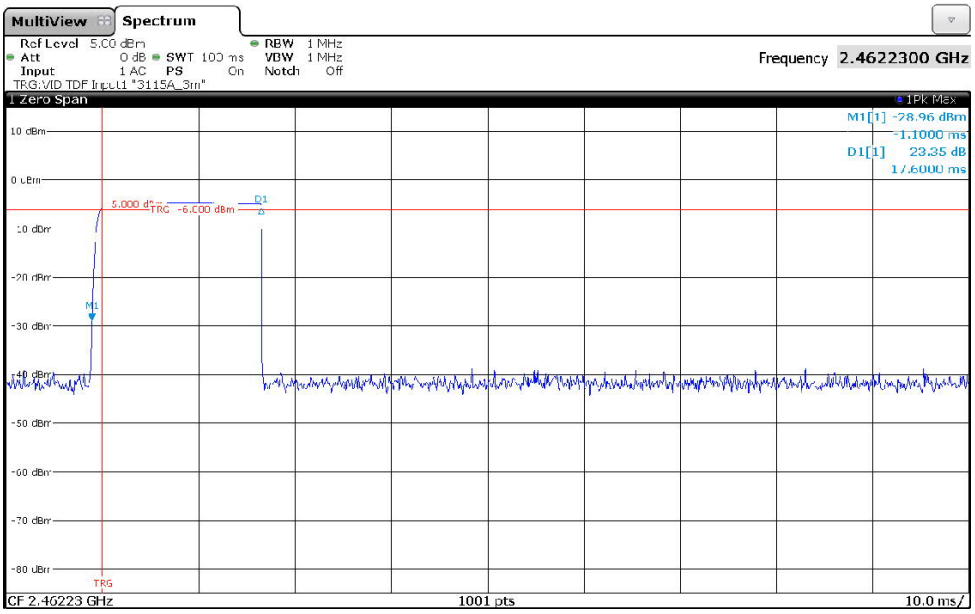
Because of pulsed transmission with a fixed duty cycle, measurements were carried out with a peak detector and the average value is calculated as required in clause 7.5 [1 and 8.2 [4]].

To calculate the average value a timing of the emission was measured. The EUT transmits an unmodulated signal. A detail view to the pulse period and a single pulse was recorded. These times were used to calculate to average correction factor.

191984_1.png: Duty cycle (pulse repetition time):



191984_2.png: Duty cycle (on time):



Calculation of the average correction factor:

Pulse repetition time: 10.008 s
Duration of one pulse: 17.6 ms
Observation interval: 100 ms

Average correction factor according to 7.5 [1] and 8.2 [4]:

F [dB] = 20 * log (17.6 ms / 100 ms) = -15.1 dB

So the measured peak values were calculated with –15.1 dB down into average values.

Test equipment used (refer clause 6):

1, 2, 4 – 7, 14, 24, 25

5.2 Bandwidth

5.2.1 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.

20 dB bandwidth:

The following spectrum analyser settings according to [1] shall be used:

- Span: App. 2 to 5 times the 20 dB bandwidth, centred on the actual hopping channel.
- Resolution bandwidth: 1 % to 5 % of the 20 dB bandwidth.
- Video bandwidth: three times the resolution bandwidth.
- Set the reference level of the instrument either above the measured peak conducted output power level or as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level.
- 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.

99 % bandwidth:

The following spectrum analyser settings shall be used:

- Span: wide enough to capture all emission scirts.
- Resolution bandwidth: 1 to 5 % of the OBW.
- Video bandwidth: App. three times the RBW.
- Sweep: Auto.
- Detector function: Peak.
- Trace mode: Max hold.

After trace stabilisation the marker shall be set on the signal peak. Use the 99 % bandwidth functionality of the spectrum analyser to integrate the requested bandwidth.

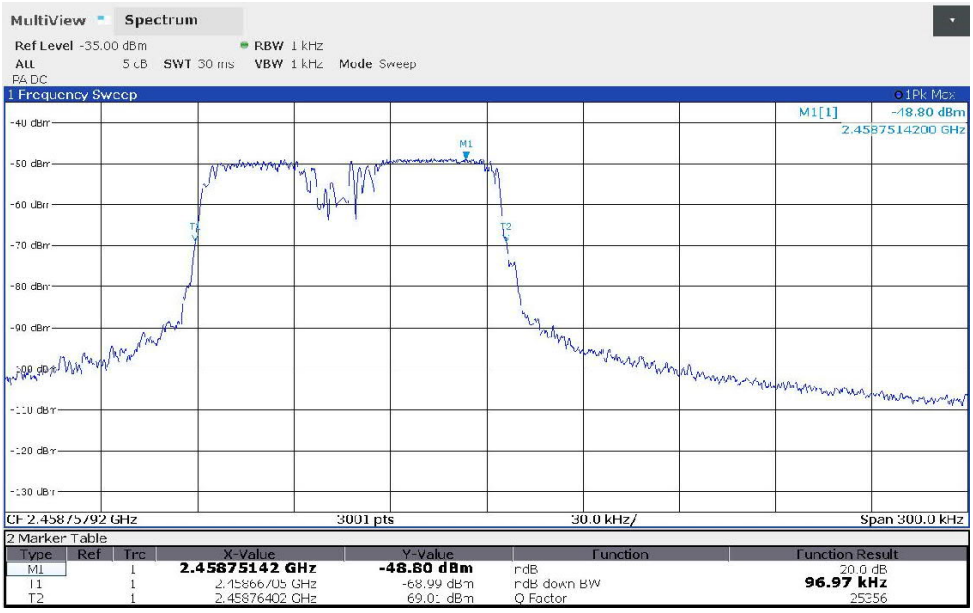
5.2.2 Test result (bandwidth)

Ambient temperature	22 °C

Relative humidity	30 %

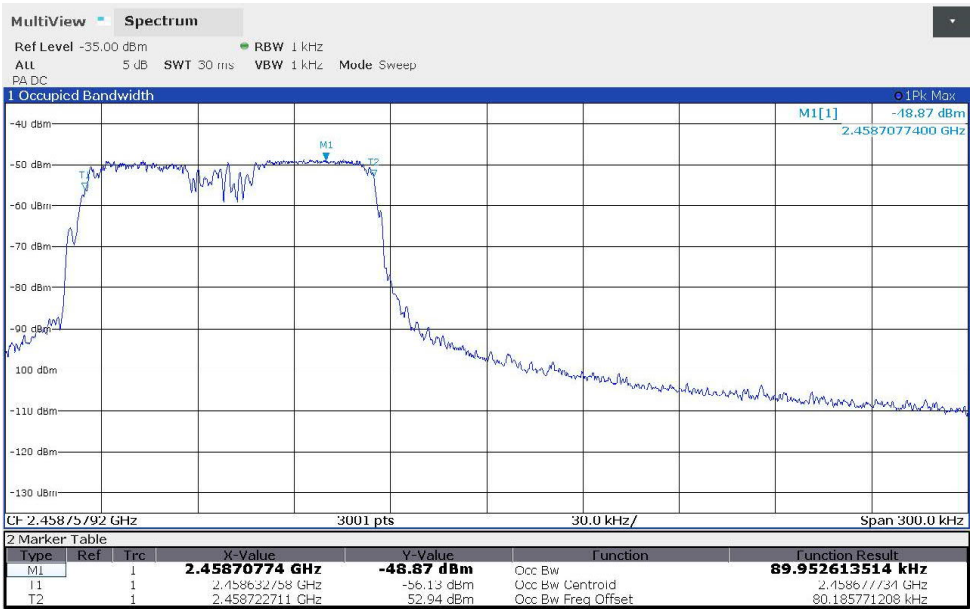
Operation mode: Pulsed transmission on dedicated channel

191984_17.jpeg: 20 dB bandwidth



F_L	F_U	20 dB Bandwidth	Result
2.458667 GHz	2.458764 GHz	97.000 kHz	Passed
Measurement uncertainty		$<1*10^{-7}$	

191984_18.jpeg: 99 % bandwidth



F_L	F_U	99 % Bandwidth	Result
2.458633 GHz	2.458723 GHz	90.000 kHz	Passed
Measurement uncertainty		$<1*10^{-7}$	

Test equipment used (refer clause 6):

1, 3, 14, 24, 25

5.3 Maximum unwanted emissions

5.3.1 Method of measurement (radiated emissions)

The radiated emission measurement is subdivided into five 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 heights in the frequency range 30 MHz to 1 GHz.
- A preliminary measurement carried out in a fully anechoic chamber with fixed antenna distance and height in the frequency range above 1 GHz.
- A final measurement carried out in a fully anechoic chamber with a fixed antenna height in the frequency range above 1 GHz.

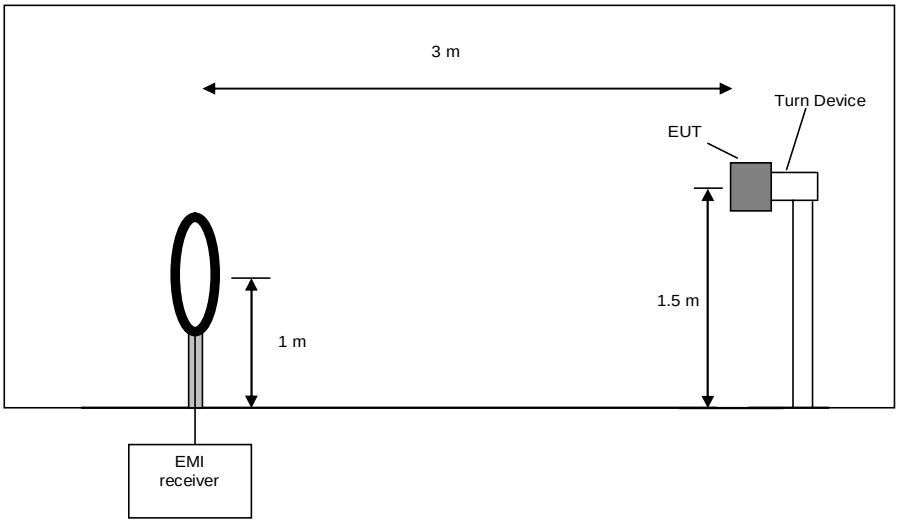
Preliminary measurement (9 kHz to 30 MHz):

In the first stage a preliminary measurement will be performed in a shielded room with a measuring distance of 3 meters. Table top devices will set up on a non-conducting turn device on the height of 1.5m. 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 [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.

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. Repeat 1) to 3) with the vertical polarisation of the measuring antenna.
5. Make a hardcopy of the spectrum.
6. Repeat 1) to 5) with the EUT raised by an angle of 0° (45°, 90°) according to 6.6.5.4 in [1].
7. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.

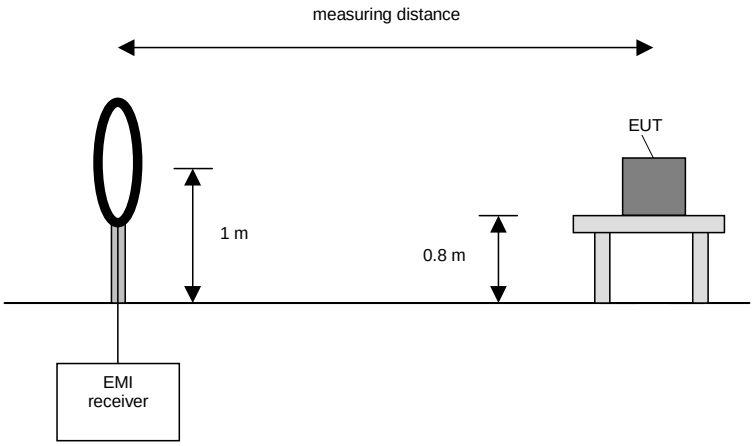
Final measurement (9 kHz to 30 MHz):

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. In the case where larger measuring distances are required the results will be extrapolated based on the values measured on the closer distances according to Section 15.31 (f) (2) [2]. The final measurement will be performed with a EMI Receiver set to Quasi Peak detector except for the frequency bands 9 kHz to 90 kHz and 110 kHz to 490 kHz where an average detector will be used according Section 15.209 (d) [2].

On the frequencies, which were detected during the preliminary measurements, 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 (if the EUT is a module and might be used in a handheld equipment application).

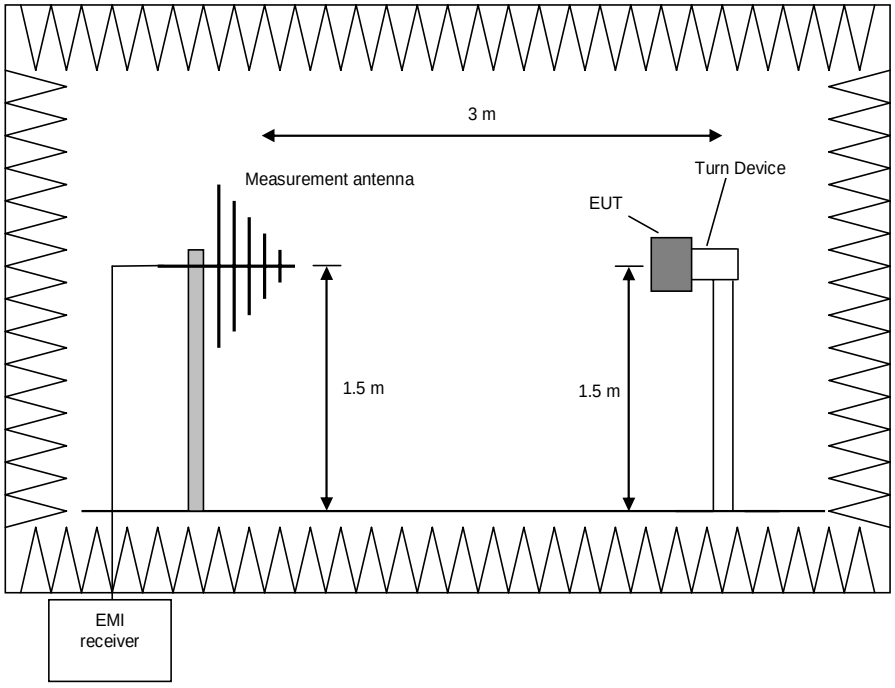
Preliminary measurement (30 MHz to 1 GHz)

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 turn device on the height of 1.5m. 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 [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 °. This measurement is repeated after raising the EUT in 30° steps according 6.6.5.4 in [1].

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:

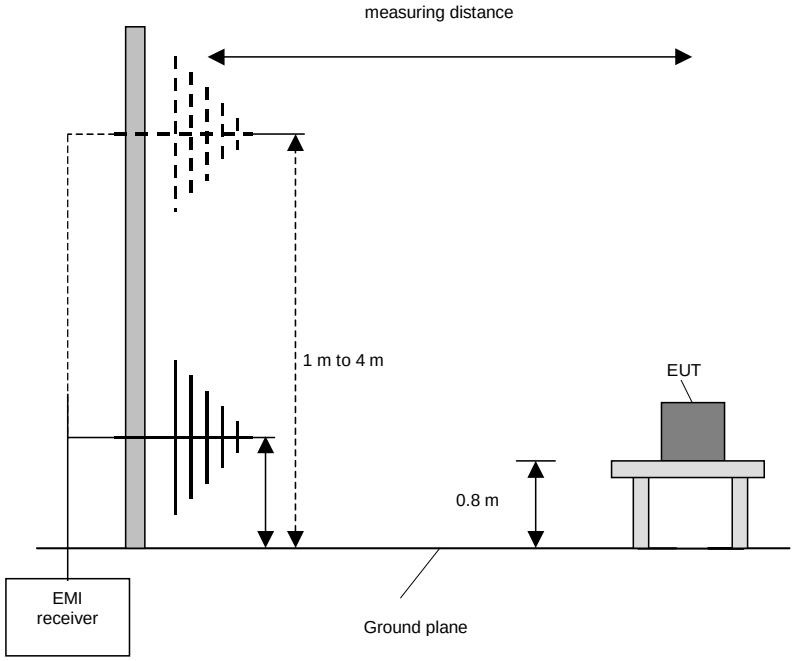
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Repeat 1) to 3) with the vertical polarisation of the measuring antenna.
5. Make a hardcopy of the spectrum.
6. Repeat 1) to 5) with the EUT raised by an angle of 0° (45°, 90°) according to 6.6.5.4 in [1].
7. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.

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 40 GHz)

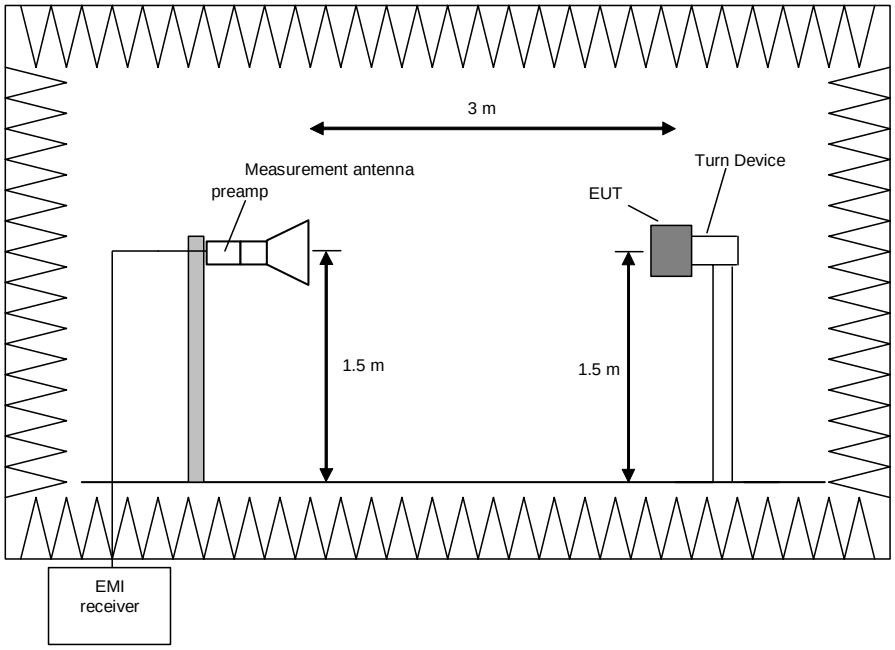
This measurement will be performed in a fully anechoic chamber. Table top devices will set up on a non-conducting turn device on the height of 1.5m. The set-up of the Equipment under test will be in accordance to [1].

Preliminary measurement (1 GHz to 40 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 and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °. This measurement is repeated after raising the EUT in 30° steps according 6.6.5.4 in [1].

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 25 / 26.5 GHz	100 kHz
26.5 GHz to 40 GHz	100 kHz



Procedure preliminary measurement:

Prescans were performed in the frequency range 1 to 40 GHz.
The following procedure will be used:

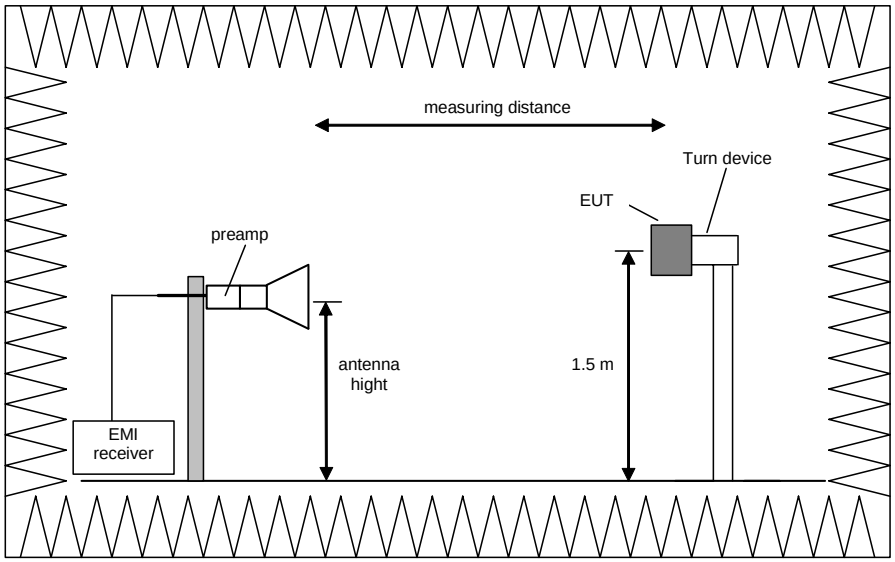
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an angle of 30° (60°, 90°, 120° and 150°) according to 6.6.5.4 in [1].
6. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
7. The measurement antenna polarisation, with the according EUT position (Turntable and Turn device) which produces the highest emission for each frequency will be used for the final measurement. The six closest values to the applicable limit will be used for the final measurement.

Final measurement (1 GHz to 40 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 by rotating the turntable through 0 to 360° in the worst-case EUT orientation which was obtained during the preliminary measurements.

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 25 / 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz



Procedure of measurement:

The measurements were performed in the frequency ranges 1 GHz to 4 GHz, 4 GHz to 12 GHz, 12 GHz to 18 GHz, 18 GHz to 25 /26.5 GHz and 26.5 GHz to 40 GHz.
The following procedure will be used:

1. Set the turntable and the turn device to obtain the worst-case emission for the first frequency identified in the preliminary measurements.
2. Set the measurement antenna polarisation to the orientation with the highest emission for the first frequency identified in the preliminary measurements.
3. Set the spectrum analyser to EMI mode with peak and average detector activated.
4. Rotate the turntable from 0° to 360° to find the TT Pos. that produces the highest emissions.
5. Note the highest displayed peak and average values
6. Repeat the steps 1) to 5) for each frequency detected during the preliminary measurements.

5.3.2 Test results (radiated emissions) 1 MHz – 25 GHz

5.3.2.1 Preliminary radiated emission measurement 1 MHz – 25 GHz

Ambient temperature	22 °C	Relative humidity	31 %

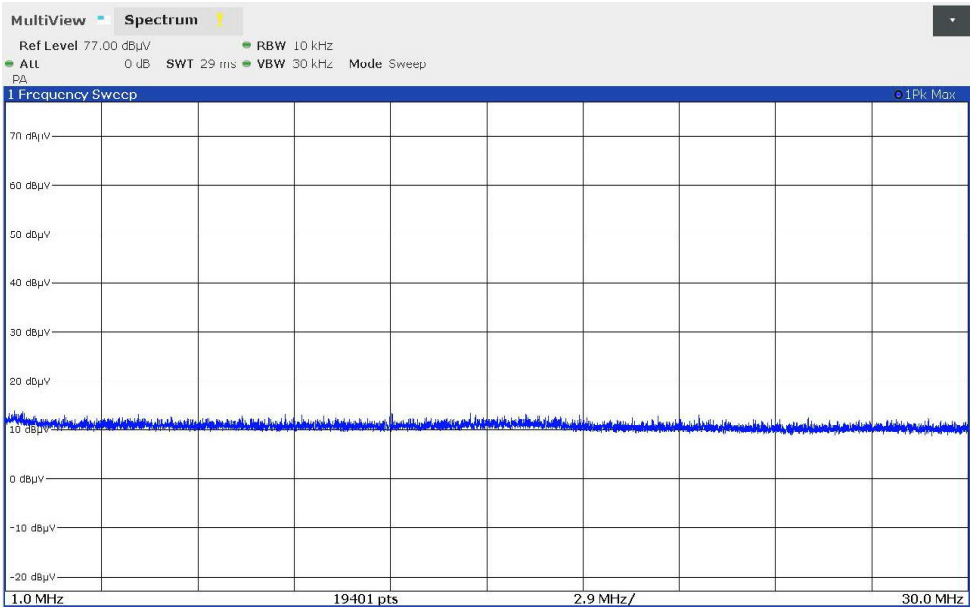
Position of EUT: The EUT was set-up on a turn device of a height of 1.5 m. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in the annex A in the test report.

Test record: Only the plot of the worst case emission is submitted below.

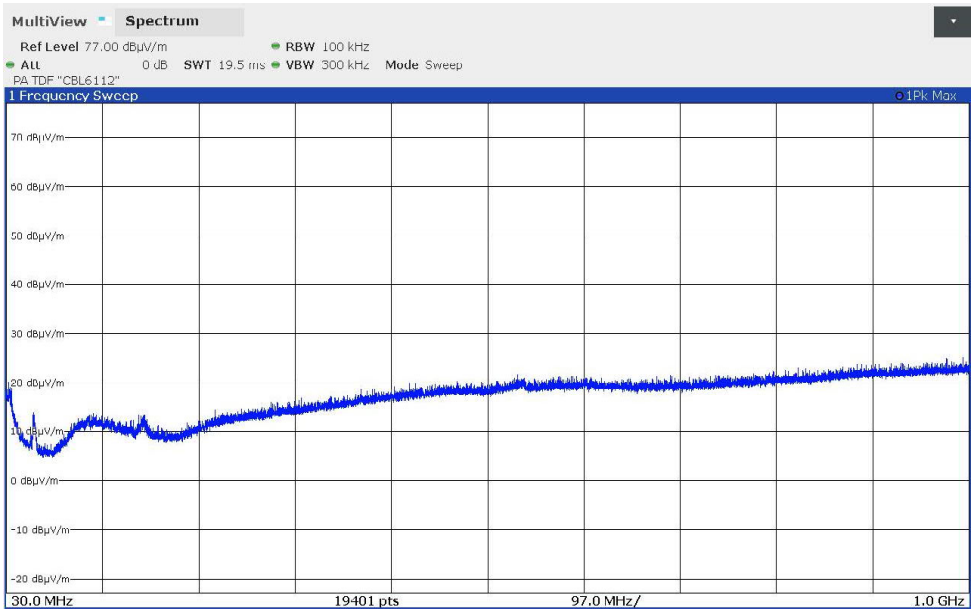
Supply voltage: During this test the EUT was powered by a laboratory power supply with 12.0 V_{DC}.

191984_16: Spurious emissions from 1 MHz to 30 MHz:



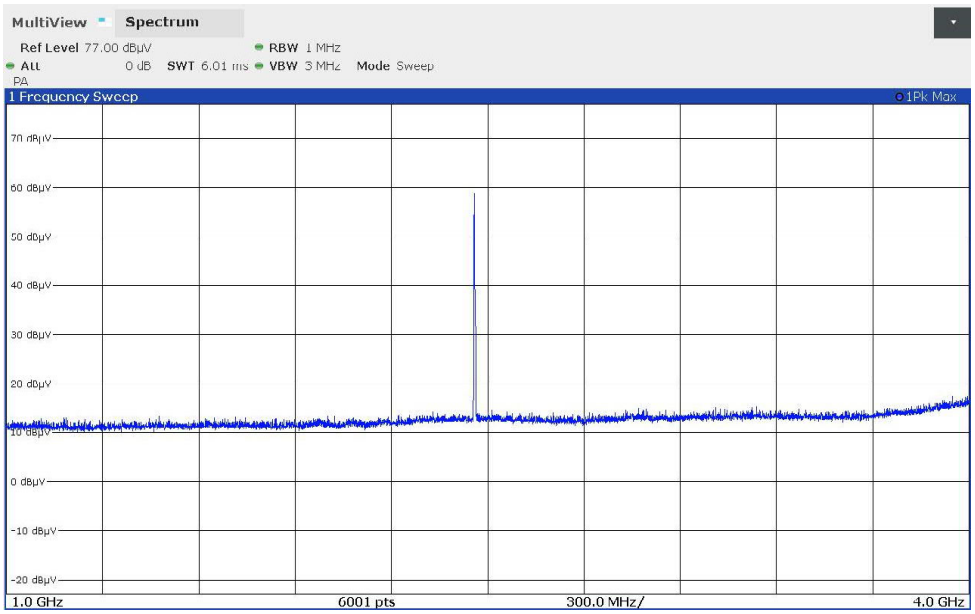
No significant emissions above 33.8 dBµV/m (measured with peak-detector) at 3 m measuring distance were found during the preliminary measurement, so no final measurements on the outdoor test site will be carried out in this frequency range.

191984_15: Spurious emissions from 30 MHz to 1 GHz:

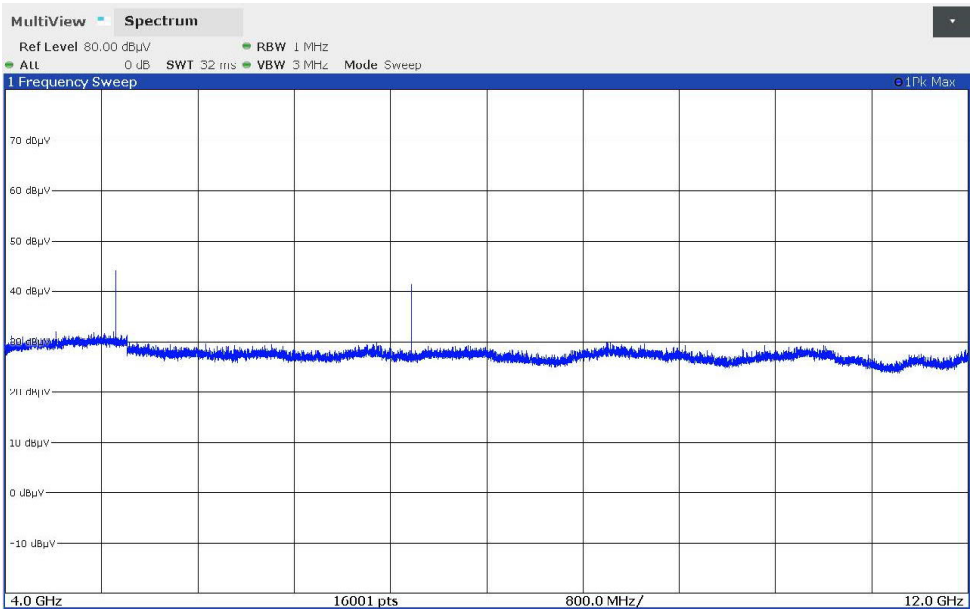


No significant emissions above 25.1 dBµV/m (measured with peak-detector) at 3 m measuring distance were found during the preliminary measurement, so no final measurements on the open area test site will be carried out in this frequency range.

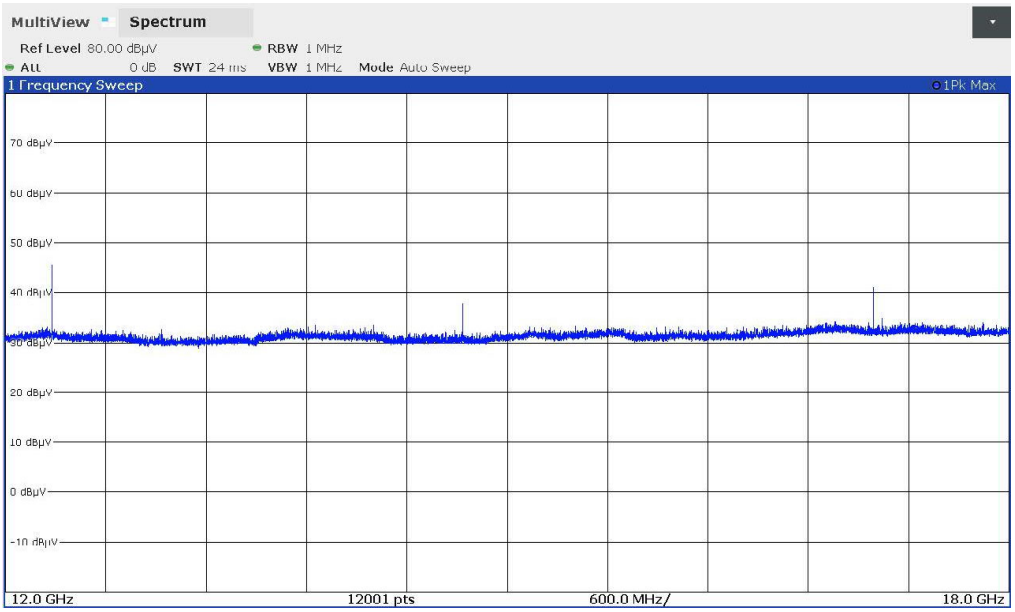
191984_14: Spurious emissions from 1 GHz to 4 GHz:



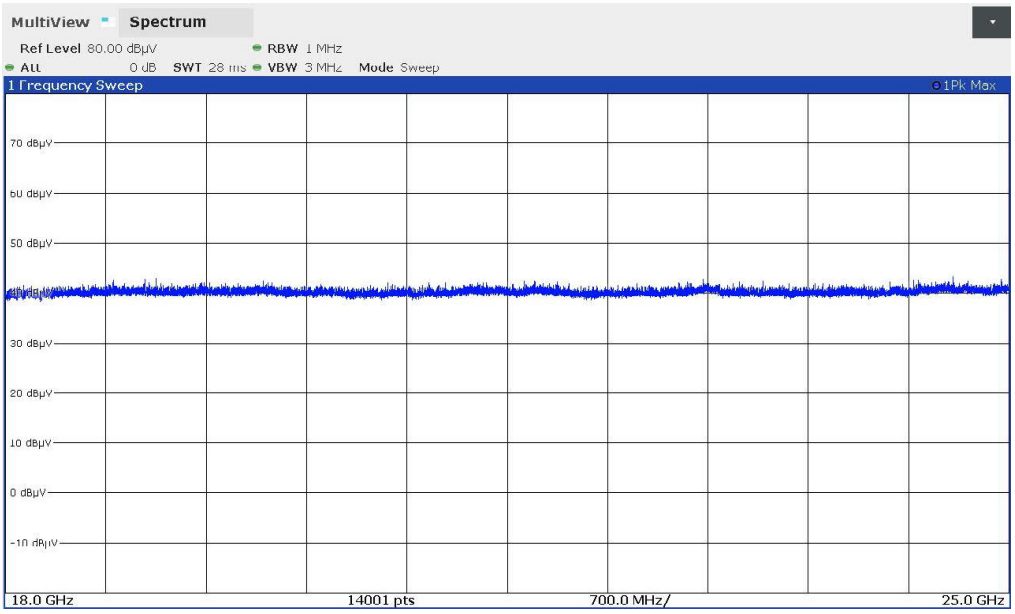
191984_13: Spurious emissions from 4 GHz to12 GHz:



191984_12: Spurious emissions from 12 GHz to 18 GHz:



191984_11: Spurious emissions from 18 GHz to 25 GHz:



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

- 2458.721 MHz, 4917.442 MHz, 7376.163 MHz, 12293.605 MHz,14752.326 MHz and 17211.047 MHz.

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

Test equipment used (refer clause 6):

1, 3 - 25

5.3.2.2 Final radiated measurements

5.3.2.2.1 Final radiated emission measurement (1 MHz to 30 MHz)

No significant emissions above 33.8 dBµV/m (measured with peak-detector) at 3 m measuring distance were found during the preliminary measurement, so no final measurements on the outdoor test site will be carried out in this frequency range.

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

No significant emissions above 25.1 dBµV/m (measured with peak-detector) at 3 m measuring distance were found during the preliminary measurement, so no final measurements on the open area test site will be carried out in this frequency range.

5.3.2.2.3 Final radiated emission measurement (1 GHz to 25 GHz)

Ambient temperature	22 °C	Relative humidity	31 %

Position of EUT: The EUT was set-up on a turn device of a height of 1.5 m. The distance between EUT and antenna was 3 m below 12 GHz and 1 m above 12 GHz.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in the annex A in the test report.

Supply voltage: During this test the EUT was powered by a laboratory power supply with 12.0 V_{DC}.

Result measured with the peak detector:

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]

Frequency [MHz]	Result (Peak) [dBµV/m]	Limit (Peak) [dBµV/m]	Margin [dB]	Reading (Peak) [dBµV]	Antenna factor [1/m]	Preamp [dB]	Cable loss [dB]	Dist. corr. factor * [dB]	Height [cm]	Azimuth [°]	Elevation [°]	Pol.
2458.721	93.0	114.0	21.0	59.9	30.1	0.0	3.0	-	150	0	90	Hor.
4917.442	63.4	74.0	10.6	48.3	36.0	25.3	4.4	-	150	0	90	Hor.
7376.163	65.5	74.0	8.5	44.9	39.3	24.1	5.4	-	150	2	90	Hor.
12293.605	45.6	74.0	28.4	45.5	33.7	26.7	3.1	-10.0	150	0	90	Hor.
14752.326	38.2	74.0	35.8	37.8	33.7	26.7	3.4	-10.0	150	1	90	Hor.
17211.047	40.6	74.0	33.4	41.0	33.8	28.1	3.9	-10.0	150	0	90	Hor.
Measurement uncertainty						±5.08 dB						

*: Measuring distance correction factor from 1 m to 3 m

Result measured with the peak detector and corrected to average:

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] + Average correction factor [dB]

Frequency [MHz]	Result (Average) [dBµV/m]	Limit (Average) [dBµV/m]	Margin [dB]	Reading (Peak) [dBµV]	Ant. factor [1/m]	Pre-amp [dB]	Cable loss [dB]	Dist. corr. factor * [dB]	AV corr factor [dB]	Height [cm]	Azimuth [°]	Elevation [°]	Pol.
2458.721	78.0	94.0	16.0	59.9	30.1	0.0	3.0	-	-15.1	150	0	90	Hor.
4917.442	42.5	54.0	11.5	48.3	36.0	25.3	4.4	-	-15.1	150	0	90	Hor.
7376.163	41.3	54.0	12.7	44.9	39.3	24.1	5.4	-	-15.1	150	2	90	Hor.
12293.605	30.5	54.0	23.5	45.5	33.7	26.7	3.1	-10.0	-15.1	150	0	90	Hor.
14752.326	23.1	54.0	30.9	37.8	33.7	26.7	3.4	-10.0	-15.1	150	1	90	Hor.
17211.047	25.5	54.0	28.5	41.0	33.8	28.1	3.9	-10.0	-15.1	150	0	90	Hor.
Measurement uncertainty							±5.08 dB						

*: Measuring distance correction factor from 1 m to 3 m

Test: Passed

Test equipment used (refer clause 6):

1, 3 – 8, 10, 11, 16 - 25

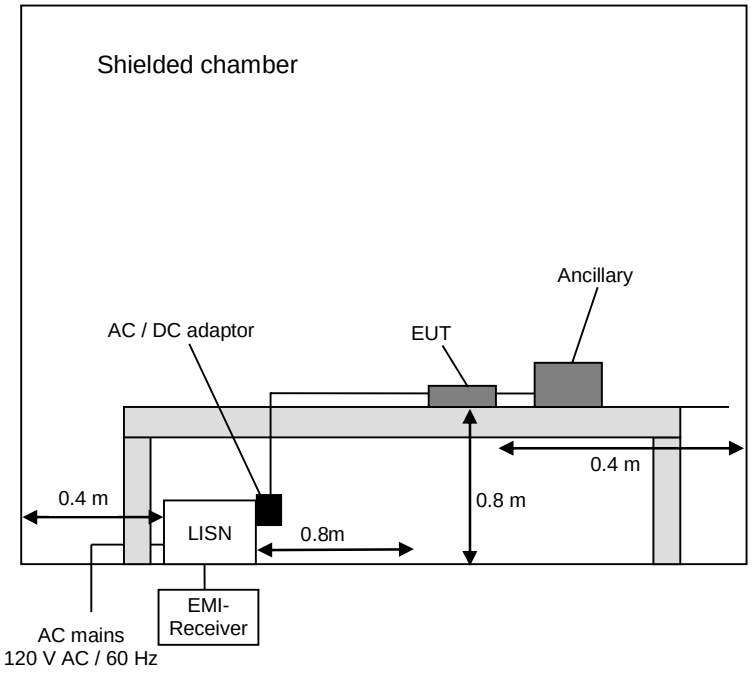
5.4 Conducted emissions on power supply lines

5.4.1 Method of measurement (conducted emissions on power supply lines)

This test will be carried out in a shielded chamber. 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 above the ground plane. Floor-standing devices will be placed directly on the ground plane. The setup of the Equipment under test will be in accordance to [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

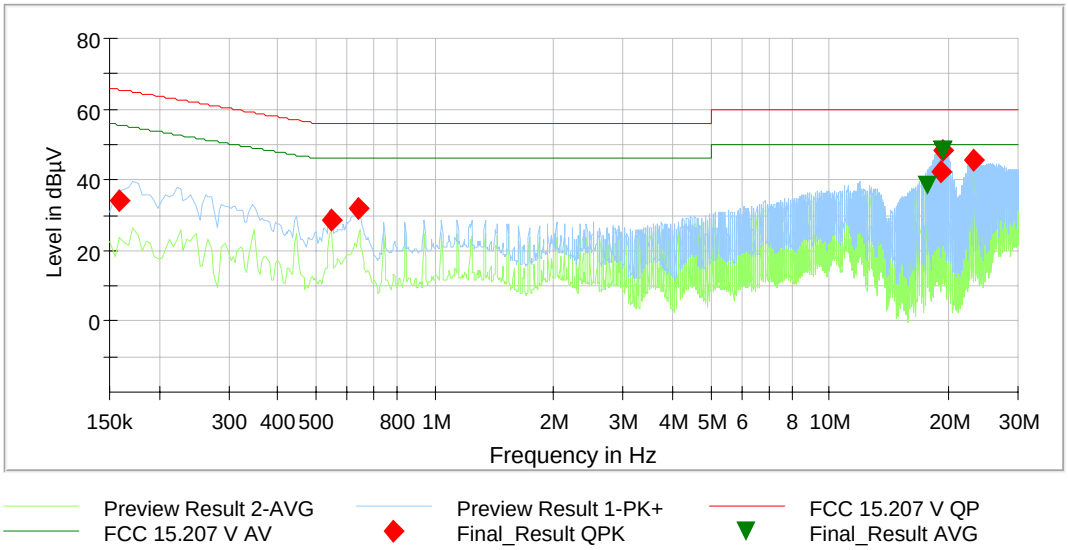


5.4.2 Test result (conducted emissions on power supply lines)

Ambient temperature	22 °C	Relative humidity	28 %

Test description:	Conducted emission measurement
EUT:	Passive road sensor IRS31Pro-UMB
Manufacturer:	G. Lufft Mess- und Regeltechnik GmbH
Operating conditions:	Operate with RS 485 connection
Test site:	Phoenix TESTLAB GmbH, anechoic chamber M20
Operator:	Th. KÜHN
Power supply:	12 V_{DC} via an external power supply type enercell CAT: NO. 273-316, which was powered by an AC mains network with 120 VAC / 60 Hz.

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



Final_Result

Frequency [MHz]	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Meas. Time [ms]	Bandwidth [kHz]	Line	PE	Transducer [dB]
0.158100	34.1	---	65.6	31.5	5000	9.000	L1	GND	9.8
0.546000	28.6	---	56.0	27.4	5000	9.000	N	GND	9.9
0.643200	31.7	---	56.0	24.3	5000	9.000	L1	GND	9.9
17.650500	---	38.2	50.0	11.0	5000	9.000	N	GND	10.9
19.230000	42.3	---	60.0	17.7	5000	9.000	L1	GND	10.9
19.239900	---	48.2	50.0	1.8	5000	9.000	L1	FLO	10.9
19.338900	---	48.3	50.0	1.7	5000	9.000	L1	FLO	10.9
19.435200	48.2	---	60.0	11.8	5000	9.000	N	GND	10.9
19.437900	---	48.4	50.0	1.6	5000	9.000	L1	FLO	10.9
23.107200	45.6	---	60.0	14.4	5000	9.000	L1	GND	10.9
Measurement uncertainty				+2.76 dB / -2.76 dB					

Test result Passed

Test equipment used (refer clause 6):

26 - 30

6 Test equipment and ancillaries used for tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. Due
1	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Calibration not necessary	
2	Signal & Spectrum Analyzer	ESW44	Rohde & Schwarz	101635	482467	22.03.2018	03.2020
3	Spectrum Analyzer	FSW43	Rohde & Schwarz	100586 & 100926	481720	15.03.2018	03.2020
4	Controller	MCU	Maturo	MCU/043/971107	480832	Calibration not necessary	
5	Turn device	TDF 1.5- 10Kg	Maturo	15920215	482034	Calibration not necessary	
6	Turntable	DS420HE	Deisel	420/620/80	480315	Calibration not necessary	
7	Antenna support	AS615P	Deisel	615/310	480187	Calibration not necessary	
8	Antenna (log.-per)	HL050	Rohde & Schwarz	100438	481170	09.10.2017	10.2020
9	HF-Cable	Sucoflex 104	Huber+Suhner	517406	482391	Calibration not necessary	
10	RF-cable No. 3	Sucoflex106B	Huber&Suhner	0563/6B / Kabel 3	480670	Calibration not necessary	
11	RF-cable No. 40	Sucoflex106B	Huber&Suhner	0708/6B / Kabel 40	481330	Calibration not necessary	
12	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	21.02.2018	02.2020
13	Antenna (Bilog)	CBL6112B	Schaffner EMV GmbH (-Chase)	2688	480328	19.06.2017	06.2020
14	Horn Antenna	3115 A	EMCO	9609-4918	480183	05.02.2018	02.2021
15	Kabel 36	Sucoflex 106B	Suhner	500003/6B / Kabel 36	481680	Calibration not necessary	
16	Preamplifier	AFS6-00101600-23-10P-6-R	Narda MITEQ	2011215	482333	10.07.2018	07.2020
17	4 GHz High Pass Filter	WHKX4.0/18G-8SS	Wainwright	1	480587	Calibration not necessary	
18	Standard Gain Horn	18240-20	Flann	483	480294	Calibration not necessary	
19	Standard Gain Horn	20240-20	Flann	411	480297	Calibration not necessary	
20	Standard Gain Horn	18240-20	Flann	483	480294	Calibration not necessary	
21	Preamplifier	AFS6-00101600-23-10P-6-R	MITEQ	2011215	482333	10.07.2018	07.2020
22	Preamplifier	JS3-12001800-16-5A	Miteq	571667	480343	14.03.2018	03.2020
23	Preamplifier	JS3-18002600-20-5A	Miteq	658697	480342	14.03.2018	03.2020
24	Multimeter	971A	Hewlett Packard	JP39009358	480721	19.02.2019	02.2020
25	Power supply	TOE8752-32 (DC)	Toellner	31566	480010	Calibration not necessary	
26	LISN	NSLK8128	Schwarzbeck	8128155	480058	14.03.2018	03.2020
27	Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
28	Shielded chamber M4	B83117-S1-X158	Siemens	190075	480088	Calibration not necessary	
29	EMI Receiver / Spectrum Analyser	ESIB 26	Rohde & Schwarz	100292	481182	28.02.2018	02.2020
30	Transient Filter Limiter	CFL 9206A	Teseq GmbH	38268	481982	14.03.2018	03.2020

7 Test site validation

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
Fully anechoic chamber M20	480303	30 – 1000 MHz	NSA	ANSI C63.4-2014	13.02.2018	12.02.2020
Fully anechoic chamber M20	480303	1 -18 GHz	SVSWR	CISPR 16-1-4 Amd. 1	13.07.2018	12.07.2020
Shielded chamber M4	480088	9 kHz – 30 MHz	GND-Plane	ANSI C63.4-2014	06.11.2018	05.11.2020

8 Report history

Report Number	Date	Comment
F191984E1	26.11.2019	Initial Test Report
F191984E1 2nd version	08.10.2020	Update from RSS-210 issue 9 to RSS-210 issue 10
-	-	-
-	-	-

9 List of annexes

Annex A	Test setup photographs	6 pages
Annex B	External photographs	4 pages
Annex C	Internal photographs	8 pages