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Test Report

Report Number:

F162386E4

Equipment under Test (EUT):

IVTM WM2

Applicant:

WABCO GmbH

Manufacturer:

WABCO Polska

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 9 (August 2016) Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
[4] RSS-Gen Issue 4 (November 2014) 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:	Manuel BASTERT		05/19/2017
	Name	Signature	Date
Authorized reviewer:	Bernd STEINER		05/19/2017
	Name	Signature	Date

RESERVATION

This test report is only valid in its original form.

Contents: Page

1 Identification

1.1 Applicant

Name:	WABCO GmbH
Address:	Am Lindener Hafen 21 30453 Hannover
Country:	Germany
Name for contact purposes:	Mr. CORNELIUS
Phone:	+49-511-922-1072
Fax:	+49-511-922-41072
eMail Address:	christian.cornelius@wabco-auto.com
Applicant represented during the test by the following person:	None

1.2 Manufacturer

Name:	WABCO Polska
Address:	ul-Ostrowskiego 34, 53-238 Wroclaw
Country:	Poland
Name for contact purposes:	Justyna Kasperska
Phone:	+48 717821448
Fax:	None
eMail Address:	
Applicant represented during the test by the following person:	Justyna.Kasperska@wabco-auto.com

1.3 Test laboratory

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

accredited by *Deutsche Akkreditierungsstelle GmbH* 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: *	**IVTM WM2**
Type / PMN: *	Not present during test
Modelname / HVIN:*	Not present during test
Order number: *	960 731 031 0
Serial number: *	10753737 and engineering sample (not grouted for photos only)
PCB identifier: *	446 222 200 4
Hardware version: *	446 220 200 2
Software version: *	246 731 0x0 2
FCC ID:*	SA4-WM2V4
IC: *	6970A-WM2V4

*: Declared by the applicant.

1.5 Technical data of equipment

Operating frequency: *	433.92 MHz					
Operating Channel Bandwidth: *	1.74 MHz					
Receiver category: *	None (Transmitter only)					
Receiver bandwidth: *	None (Transmitter only)					
Frequency hopping:	Not used					
Antenna: *	Customized					
Rated RF output power: *	0 dBm ERP					
Channel spacing: *	No channel spacing, whole band used					
Modulation: *	ASK					
Bit rate of transmitter: *	4096 bit/s					
Supply Voltage: *	U_{Nom} =	3.0 V_{DC}	U_{Min}=	2.4 V_{DC}	U_{Max}=	3.6 V_{DC}
Power Supply: *	Battery					
Temperature range: *	-40 °C to +120 °C					

* declared by the applicant.

1.6 Dates

Date of receipt of test sample:	04/24/2017
Start of test:	05/10/2017
End of test:	05/12/2017

2 Operational states

The EUT is a tire pressure sensor for use at truck wheels. It is a transmitter only and sends supervision transmissions including sensor identification together with pressure & temperature data and battery status at 433.92 MHz every 9 minutes. It can be triggered to send messages by using a 125 kHz LF signal.
During all radiated tests the EUT was powered by battery with 3.0 V_{DC}.

The TX tests were performed with samples with test software or standard software depending on the test.

All tests were carried out radiated.

3 Additional information

The tested sample was not labelled with a FCC-label.

As declared by the applicant the T-shape metallic holder is the configuration which causes the highest emission

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS 210, Issue 9 [3] or RSS-Gen, Issue 4 [4]	Status	Refer page
Occupied bandwidth	433.92	15.231 (c)	A1.3 [3]	Passed	9 et seq.
Transmission time control	433.92	15.231 (a) (3)	A1.1 (c) [3]	Passed	14 et seq.
Radiated emissions Field strength	0.009 – 4,500	15.231 (b) 15.205 (a) 15.209 (a)	4.1 [3] A1.2 [3] 8.9 [4]	Passed	17 et seq.
Conducted emissions on supply line	0.15 - 30	15.207 (a)	8.8 [4]	Not applicable*	-

* EUT is battery powered, no line connectable.

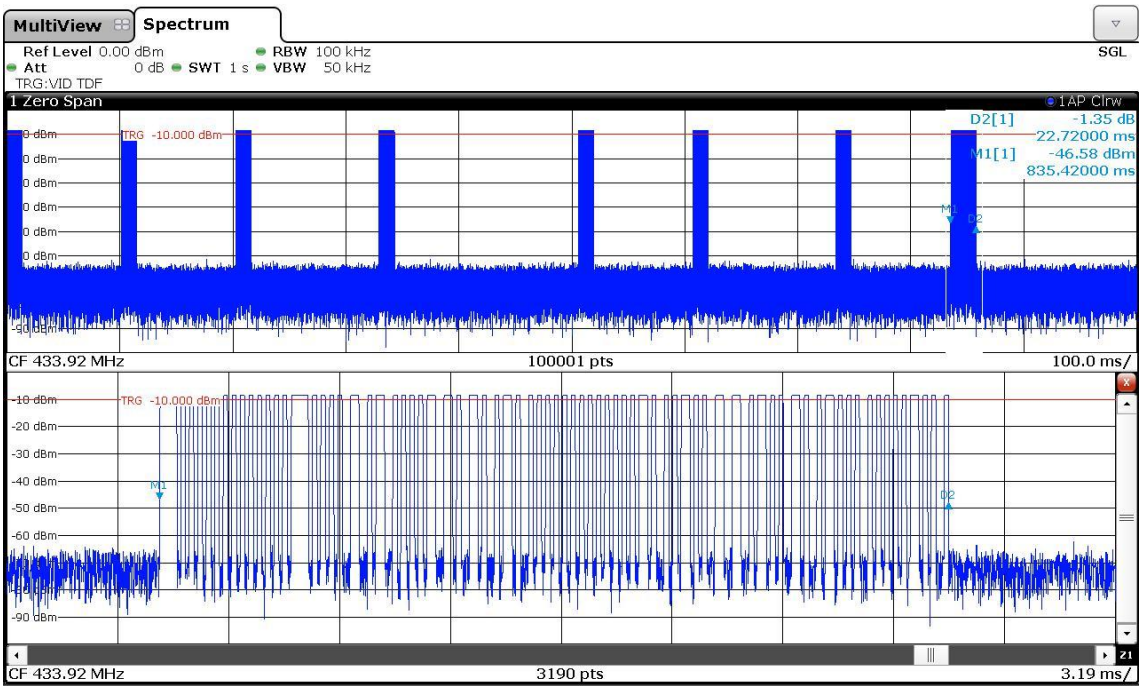
5 Test results

5.1 Average correction factor

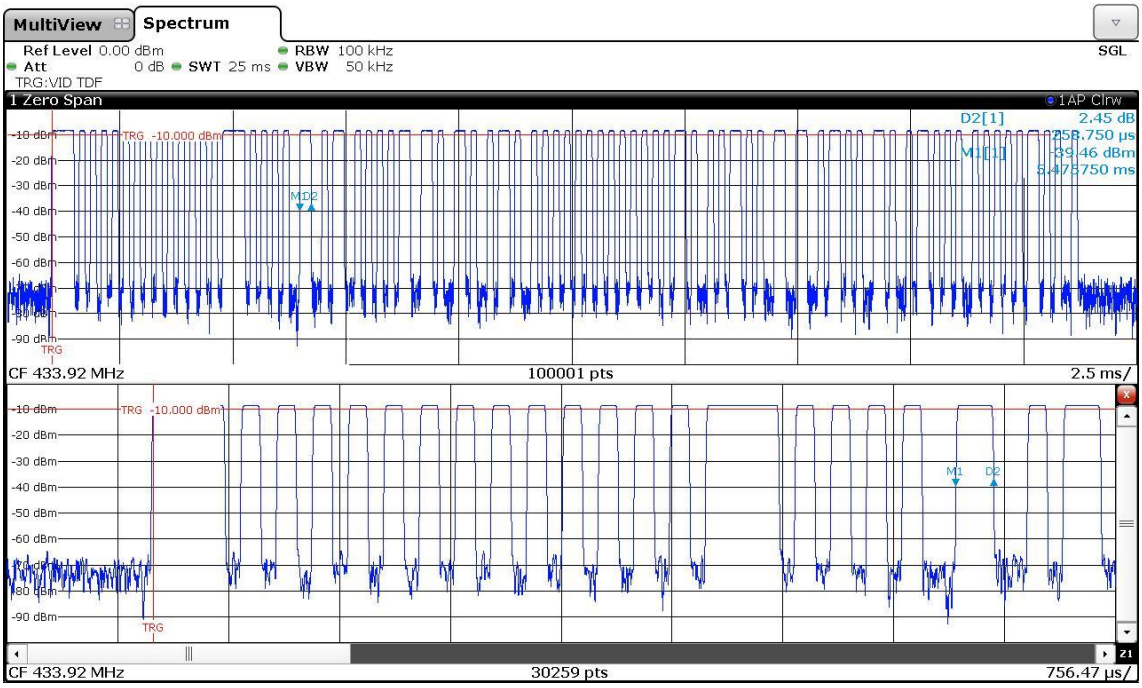
Because of a single transmission all measurements were carried out with a peak detector and the average value is calculated over the real pulse train as required in Part 15.35.

To calculate the average value a timing of the emission was measured. A detail view to the transmission pulse was recorded and the total transmitter on time was calculated.

162386_burst.png: Timing of the bursts in the longest paket:



162386_detail_burst.png: Summing of each emission:



Summary of the complete pulse train:

The pulse train consists of

2 pulses type 1: 2 * 488 µs = 976 µs
62 pulses type 2: 62 *136 µs = 8,432 µs
14 pulses type 3: 14 * 260 µs = 3,640 µs

total on time of sub pulse = 13,048 µs
total length of one sub pulse = 22.7 ms

Duty cycle correction factor according to 15.35c

Because the pulse is longer than 100 ms the duty cycle correction factor has to be calculated with 100 ms.

F [dB] = 20 * log (13,048 µs / 100 ms) = -17.7 dB

So the measured peak values were calculated with 17.7 dB down into average values.

Test equipment used (refer clause 6):

24, 26, 145

5.2 Bandwidth

5.2.1 Method of measurement (20 dB bandwidth)

The calibration of the spectrum analyzer has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyzer 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 has to be used. The EUT has to be switched on. The transmitter shall work with its maximum data rate.

The following spectrum analyzer settings shall be used:

- Span: App. 2 to 3 times the 20 dB bandwidth, centred on the actual channel.
- Resolution bandwidth: If no requirements were made, the following minimum values shall be used:
  From 9 kHz to 30 MHz: RBW_{min} = 1 kHz;
  from 30 MHz to 1000 MHz RBW_{min} = 10 kHz,
  and from 1000 MHz to 40 GHz RBW_{min} = 100 kHz
- Video bandwidth: ³ the resolution bandwidth.
- Sweep: Auto.
- Detector function: peak.
- Trace mode: Max hold.

After trace stabilisation the marker shall be set on the signal peak. If possible the 20 dB down function of the analyzer shall be used, if not, the display lines of the analyzer shall be used as follows: 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.

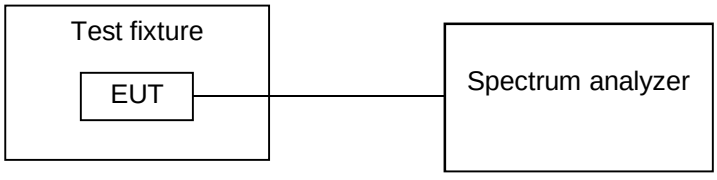
5.2.2 Method of measurement (99 % bandwidth)

The following spectrum analyzer settings shall be used (99 % bandwidth):

- Span: The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- Resolution bandwidth: App. 1% to 5% of the occupied bandwidth (OBW).
- Video bandwidth: 3 x RBW.
- Sweep: Auto.
- Detector function: peak.
- Trace mode: Max hold.

After trace stabilisation the marker shall be set on the signal peak. The 99 % bandwidth function of the analyzer shall be used to determine 99 % bandwidth of the EUTs transmission.

Test set-up: (20 dB and 99 % bandwidth)



5.2.3 Test results (20 dB bandwidth)

Ambient temperature	22 °C	Relative humidity	28 %

162386_20dB.png: 20 dB Bandwidth:

Lower frequency	Upper frequency	20 dB bandwidth	LIMIT (0.25 % of the center frequency)
433.88703 MHz	433.93489 MHz	47.85 kHz	1084.135 kHz
Measurement uncertainty		< $1*10^{-7}$	

Test: Passed

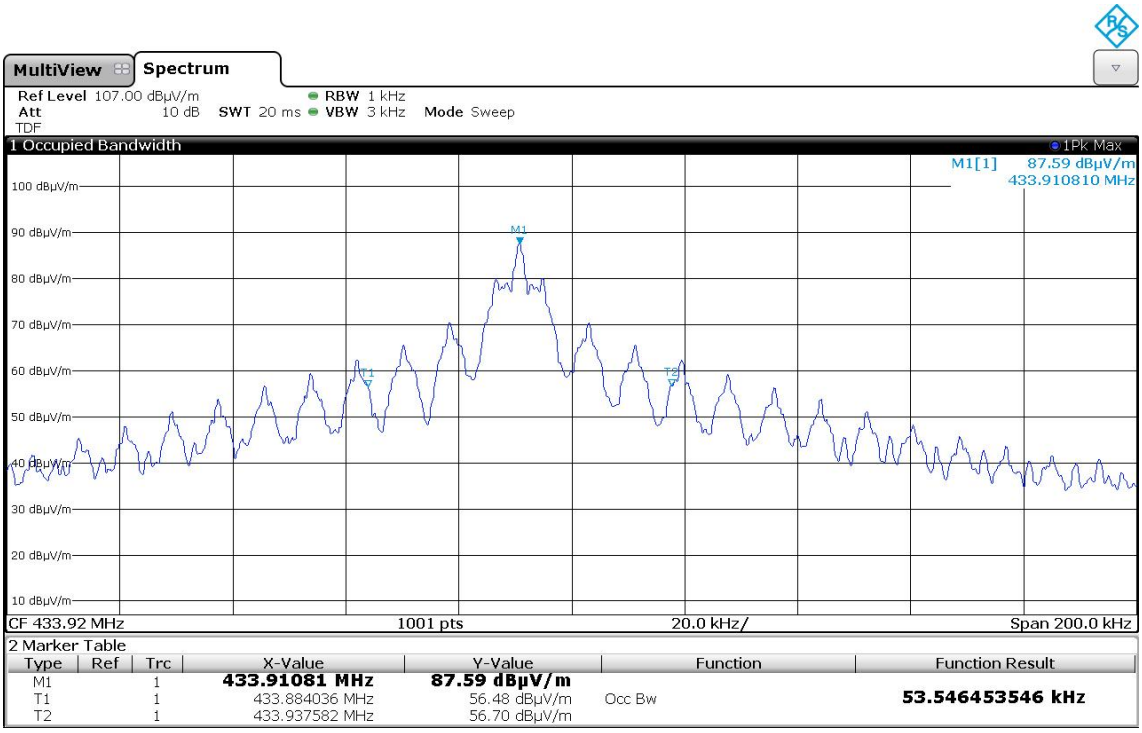
Test equipment used (refer clause 6):

24, 26, 145

5.2.4 Test results (99 % bandwidth)

Ambient temperature	22 °C	Relative humidity	28 %

162386_99%.png: 99 % Bandwidth:



Lower frequency	Upper frequency	99 % bandwidth	LIMIT (0.25 % of the center frequency)
433.884036 MHz	433.937582 MHz	53.54 kHz	1084.135 kHz
Measurement uncertainty		< $1*10^{-7}$	

Test: Passed

Test equipment used (refer clause 6):

24, 26, 145

5.3 Band-edge compliance

5.3.1 Method of measurement (radiated measurement)

The same test set-up as used for the final radiated emission measurement shall be used (refer also subclause 5.5.1 of this test report).

The following spectrum analyzer 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: ³ the resolution bandwidth.
- Sweep: Auto.
- Detector function: Peak.
- Trace mode: Max hold.

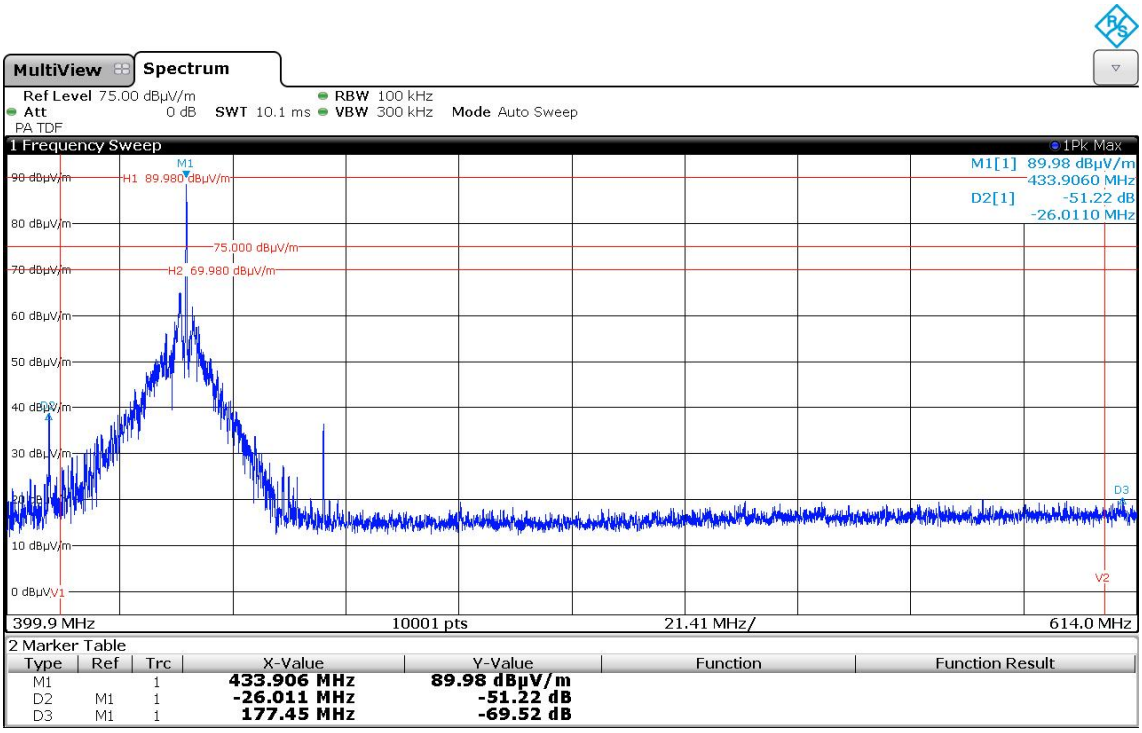
After trace stabilization the marker shall be set on the signal peak. The first display line has to be set on this value. The second display line has to be set 20 dB below the first line (or the peak marker). The frequency line shall be set on the edge of the assigned frequency band. Set the second marker 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 sub clause 5.5.1of this test report, but 100 kHz resolution bandwidth shall be used.

The measurement will be performed at the upper end of the assigned frequency band if applicable.

5.3.2 Test results (radiated measurement)

Ambient temperature	22 °C	Relative humidity	28 %

162386_band-edge-compliance.png: Band edge compliance (radiated):



Test: Passed

Test equipment used (refer clause 6):

24, 29, 31 – 35, 145

5.4 Total duration of transmissions

5.4.1 Method of measurement

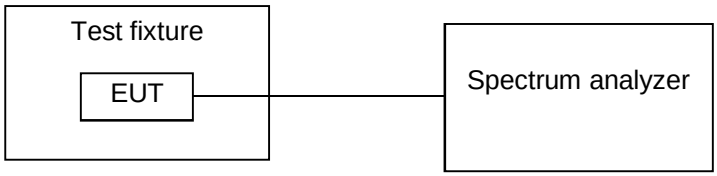
The calibration of the spectrum analyzer has to be checked with the help of a known signal from a signal generator. The EUT has to be connected to the spectrum analyzer via a low loss cable. If the EUT is not equipped with an antenna connector, a temporary antenna connector has to be installed or a test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

The following spectrum analyzer settings shall be used:

- Span: = 0 Hz.
- Resolution bandwidth: 1 MHz.
- Video bandwidth: ³ the resolution bandwidth.
- Sweep: Sufficient to detect single transmission pulses and the gap between them.
- Detector function: peak.
- Trace mode: Max hold.

The time between two transmissions shall be measured with the delta marker function of the spectrum analyzer and the total transmitter on time per hour shall be calculated.

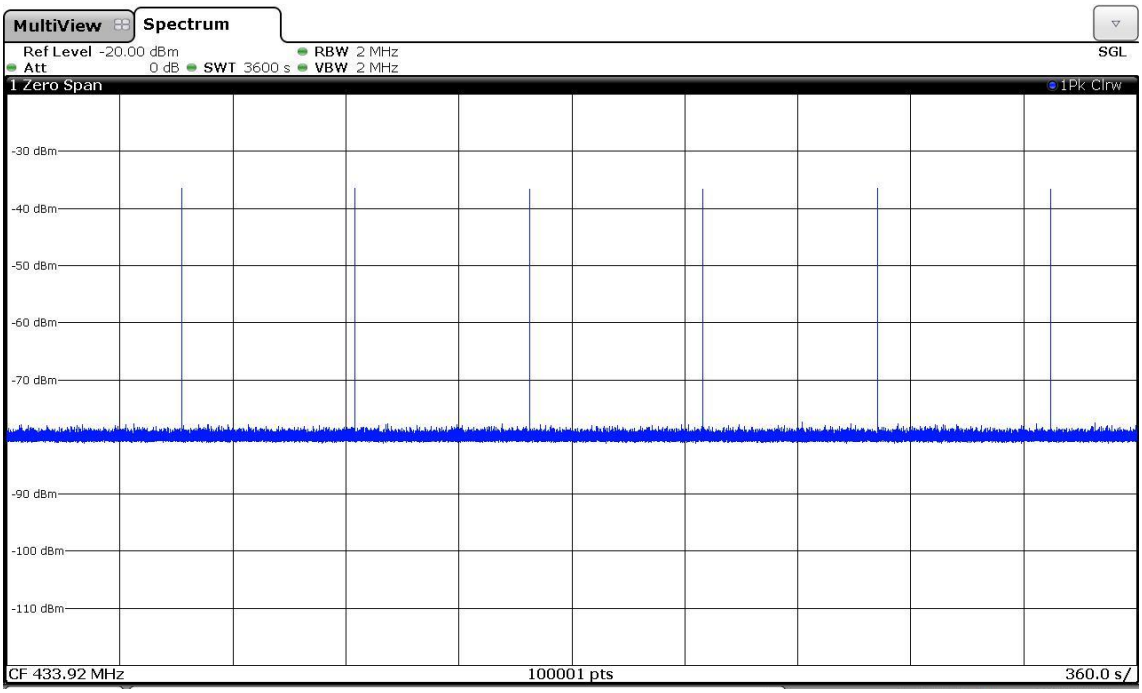
Test set-up:



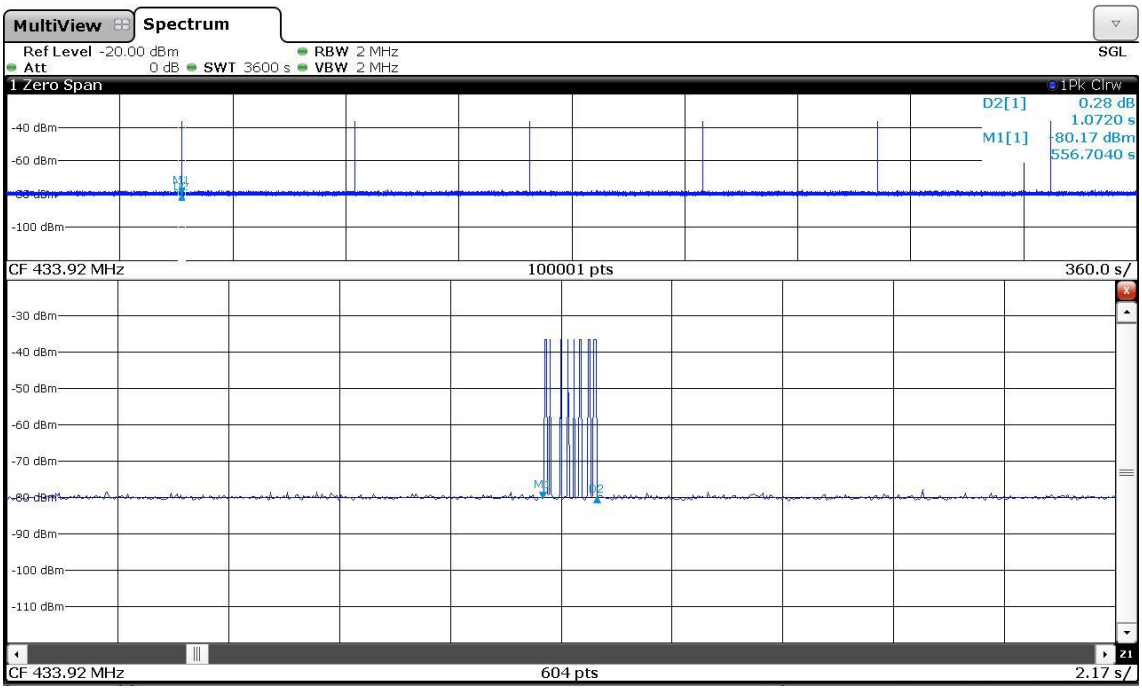
5.4.2 Test results

Ambient temperature	21 °C		Relative humidity	37 %	

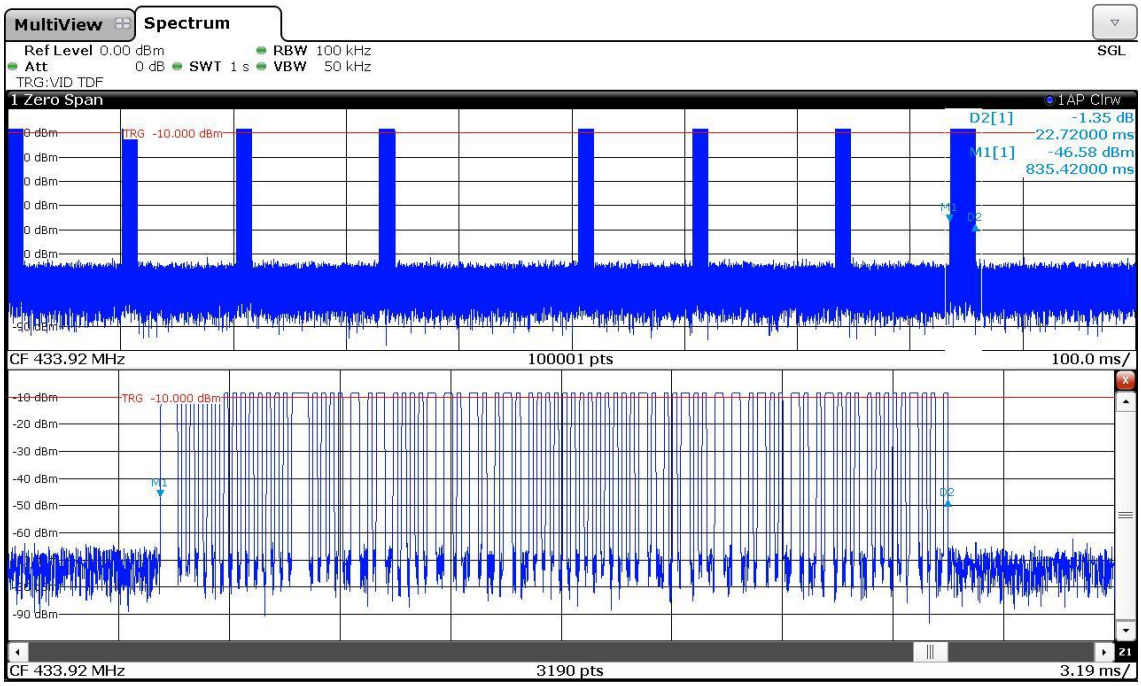
162386_1h.png: Total transmissions in one hour:



162386_1h_zoom1burst.png: Total transmissions in one hour with zoom to one burst packet:



162386_burst.png: Timing of one packet:



Measurement of the total transmission time per hour:

The normal transmission time is one burst packet every 9 minutes. One packet consists of 7 bursts with a length of 13.4 ms and one burst with a length of 22.7 ms.

Number of packets per hour	Packet length	Total transmission time per hour	Limit	Result
7	116.5 ms	815.5 ms	2000 ms	Passed
Measurement uncertainty		$<10^{-7}$		

Test equipment used (refer clause 6):

24, 26, 145

5.5 Radiated emissions

5.5.1 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 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 40 GHz.

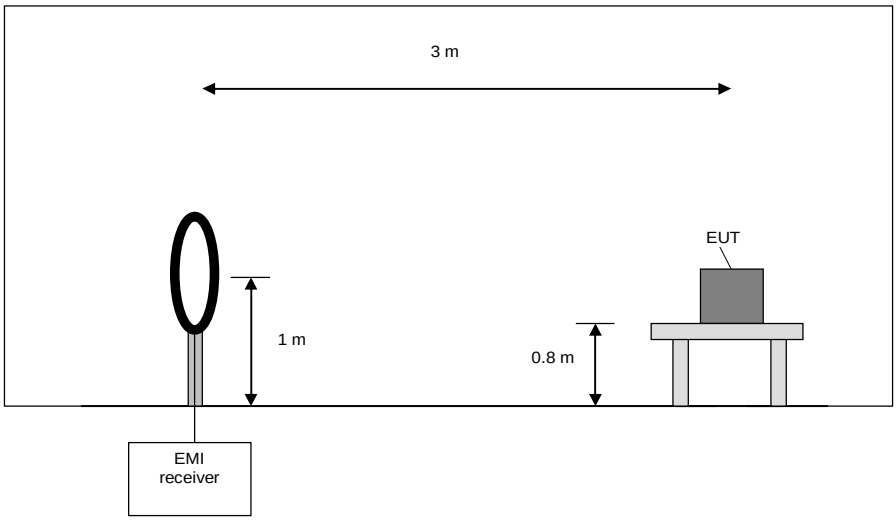
Preliminary measurement (9 kHz to 30 MHz):

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 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 setup 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 analyzer 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 analyzer 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 polarization 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).

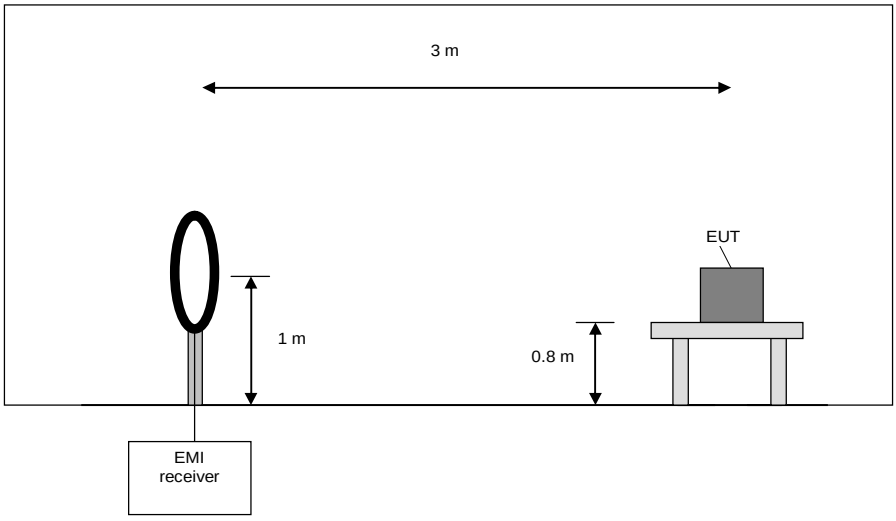
Final measurement (9 kHz to 30 MHz):

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. 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).

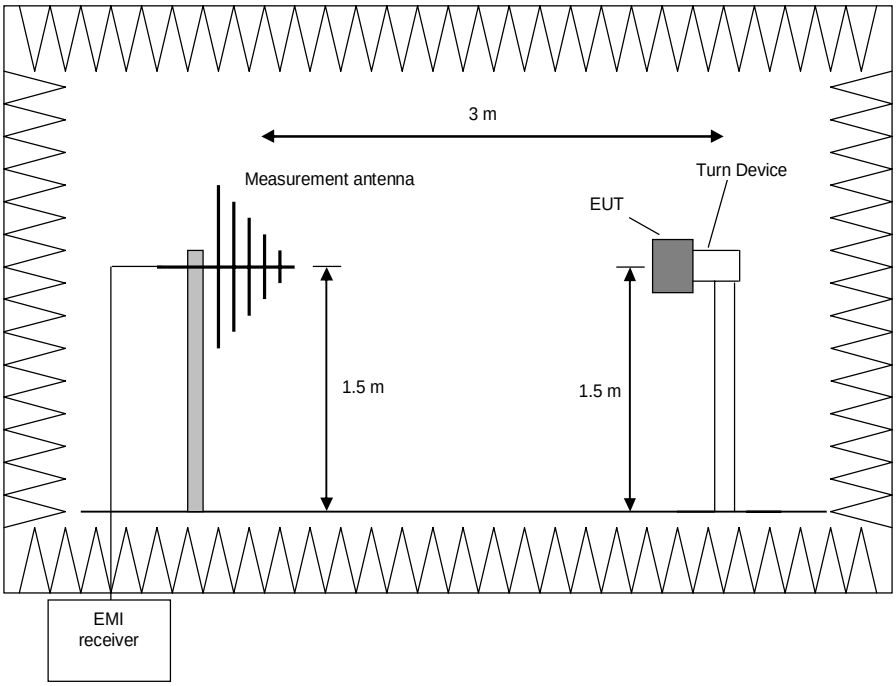
Preliminary measurement (30 MHz to 1 GHz)

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 1.5 m. 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 polarization 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:

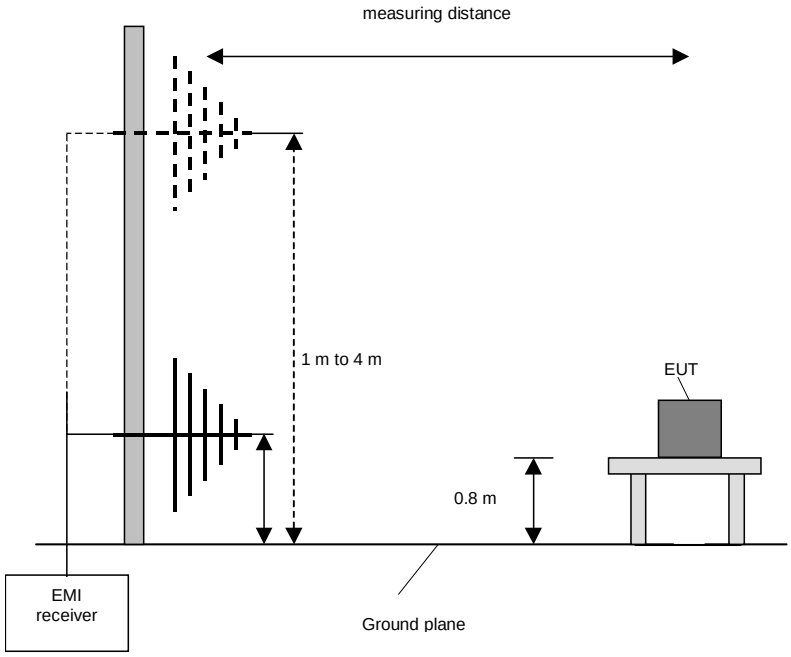
1. Monitor the frequency range at horizontal polarization and a EUT azimuth of 0 °.
2. Manipulate the system cables within the range to produce the maximum level of emission.
3. Rotate the EUT by 360 ° to maximize the detected signals.
4. Repeat 1) to 3) with the vertical polarization of the measuring antenna.
5. Make a hardcopy of the spectrum.
6. Repeat 1) to 5) with the EUT raised by an angle of 30 ° (60 °, 90 °, 120 ° and 150 °) 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 polarization 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)

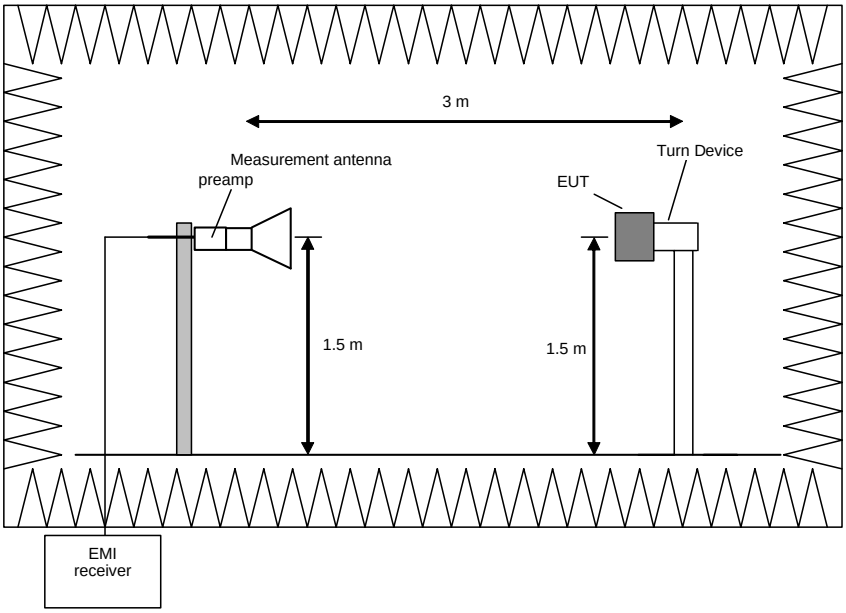
This measurement will be performed in a fully anechoic chamber. Table top devices will set up on a non-conducting turn device on the height of 1.5 m. The set-up of the Equipment under test will be in accordance to [1].

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 analyzer set to MAX Hold mode and a resolution bandwidth of 100 kHz. The measurement will be performed in horizontal and vertical polarization 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	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
40 GHz to 60 GHz	1 MHz
50 GHz to 75 GHz	1 MHz
75 GHz to 110 GHz	1 MHz



Procedure preliminary measurement:

Prescans were performed in the frequency range 1 to 110 GHz.
The following procedure will be used:

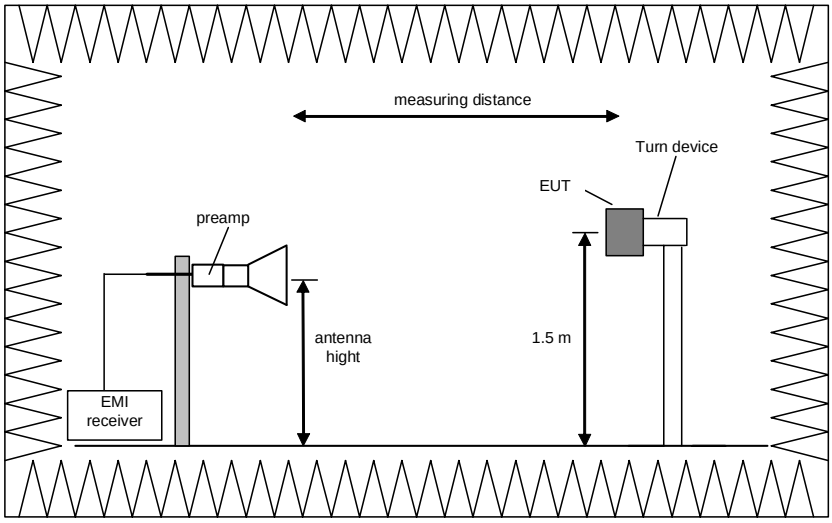
1. Monitor the frequency range at horizontal polarization and a EUT azimuth of 0 °.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarization of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an 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 polarization, 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 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 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
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 ranges 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) 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 polarization to the orientation with the highest emission for the first frequency identified in the preliminary measurements.
3) Set the spectrum analyzer to EMI mode with peak and average detector activated.
4) Rotate the turntable from 0° to 360° to find the EUT angle 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.

5.5.2 Test results (radiated emissions)

5.5.2.1 Preliminary radiated emission measurement (150 kHz to 4.5 GHz)

Ambient temperature	21 °C	Relative humidity	35 %

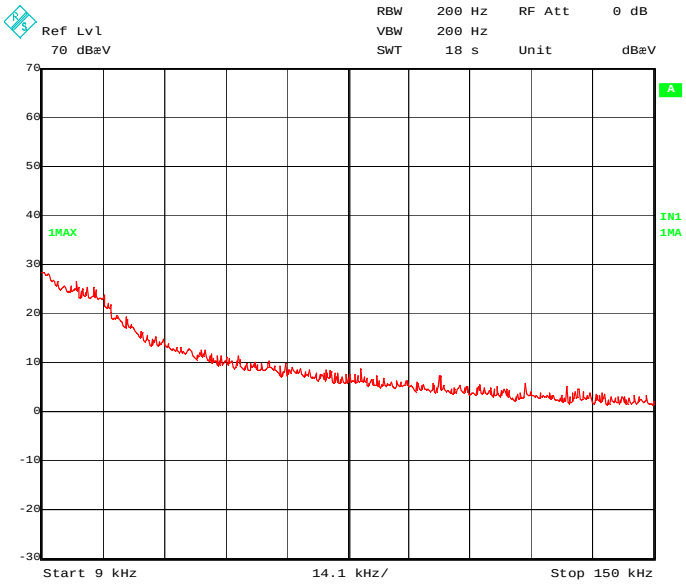
Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: No cables were connected

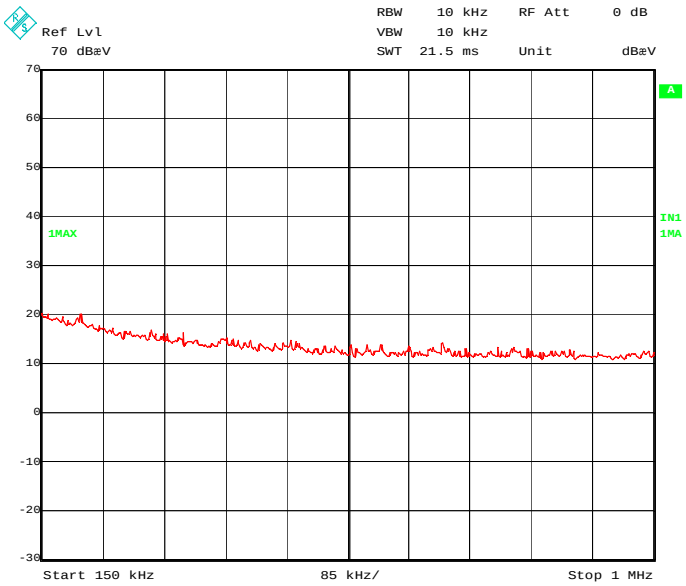
Test record: All results are shown in the following.

Supply voltage: During all measurements the EUT was supplied by its internal battery (new battery).

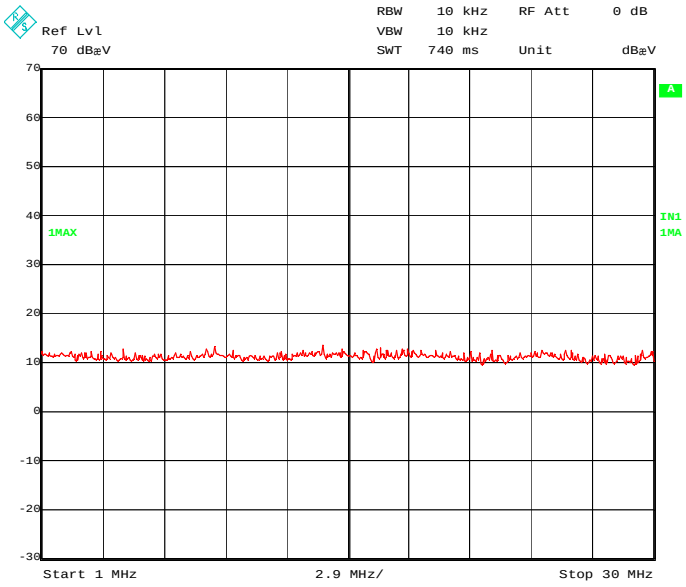
162386_m1.wmf: Spurious emissions from 9 kHz to 150 kHz:



162386_m2.wmf: Spurious emissions from 150 kHz to 1 MHz:



162386_m3.wmf: Spurious emissions from 1 MHz to 30 MHz:

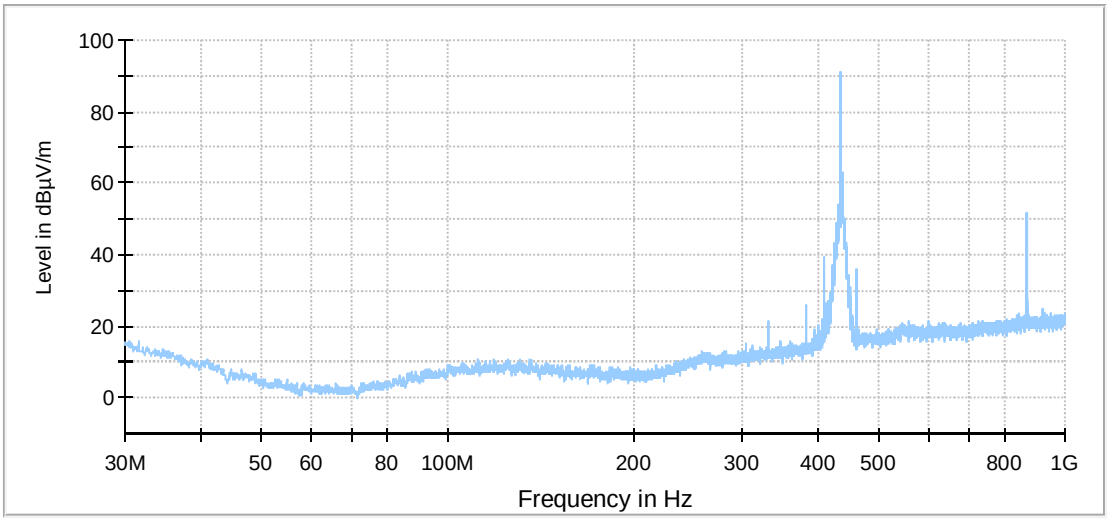


No frequencies were found during the preliminary measurement, so no final measurement on the outdoor test site was carried out.

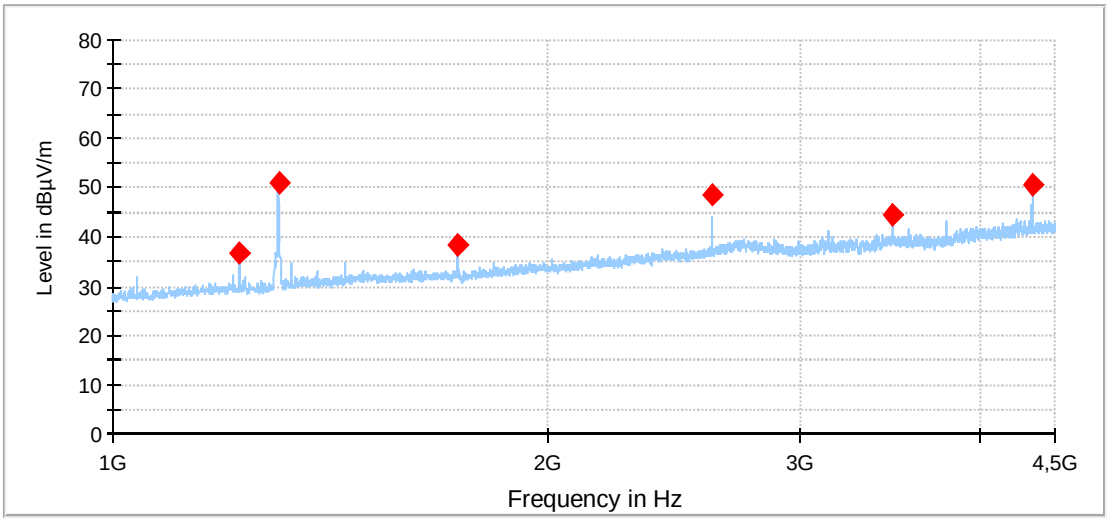
Test equipment used (refer clause 6):

24, 29, 31 – 36, 133, 142 - 144

162386_FCC_AH_30-1000M: Spurious emissions from 30 MHz to 1 GHz:



162386_ FCC_AH_1-4.5G: Spurious emissions from 1 GHz to 4.5 GHz:



The following frequencies were found during the preliminary emission measurement. They have to be measured in a final measurement. Please refer to the following chapter for details.

433.92 MHz
329.89 MHz
381.89 MHz
407.87 MHz
459.93 MHz
867.86 MHz
1223.1 MHz
1302.2 MHz
1735.9 MHz
2603.1 MHz
3470.2 MHz
4339.1 MHz

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

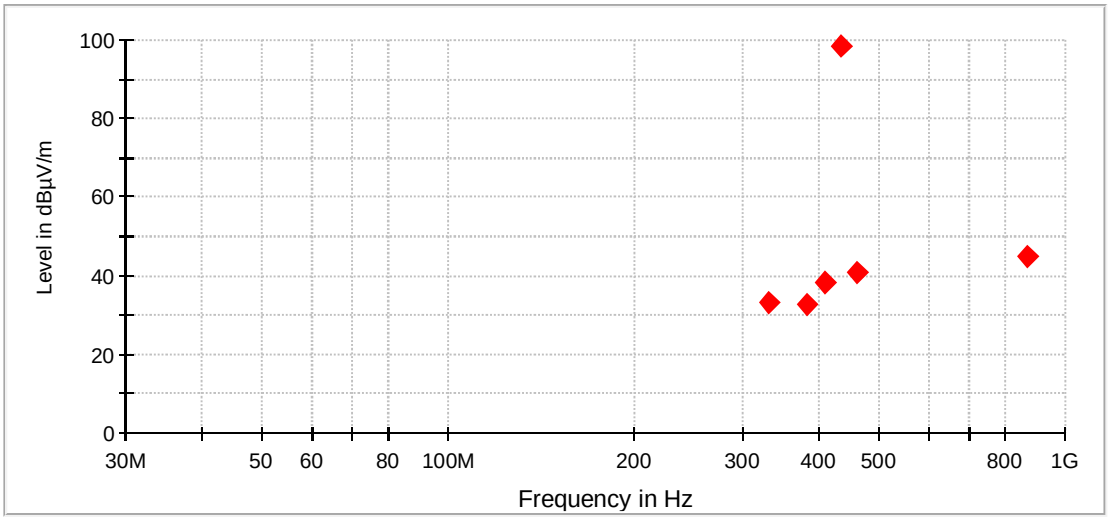
Ambient temperature	20 °C	Relative humidity	32 %

Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: No cables were connected.

Test record: All results are shown in the following.

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



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 peak detector is 1 second.

Result measured with the peak detector and corrected to average:

Spurious emissions											
Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor dB/m	Cable loss dB	Average correction factor [dB]	Height cm	Azimuth deg	Pol.	Restr. Band
433.92	80.75	80.8	0.05	79.3	16.7	2.4	-17.7	194	339	Hor	Yes
329.90	33.33	46.0	12.67	17.6	13.8	1.9	0	103	171	Hor.	No
381.89	32.82	58.9	26.08	15.5	15.1	2.2	0	102	202	Hor.	Yes
407.87	38.31	46.0	7.69	20.2	15.9	2.2	0	112	176	Hor.	No
459.93	40.66	61.9	21.24	15.2	22.1	3.4	0	202	232	Hor.	No
867.86	45.1	61.9	16.8	45.1	0.0	0.0	0	150	238	Hor.	No
Measurement uncertainty: +2.2 dB / -3.6 dB											

The test results were calculated with the following formula:

Result [dBµV/m] = reading [dBµV] + cable loss [dB] + antenna factor [dB/m] + average correction factor [dB].

Test: Passed

Test equipment used (refer clause 6):

14 – 20, 24

5.5.2.3 Final radiated emission measurement (1 GHz to 4.5 GHz)

Ambient temperature	22 °C	Relative humidity	28 %

Position of EUT: The EUT was set-up on a non-conducting table of a height of 0.8 m. The distance between EUT and antenna was 3 m.

Cable guide: No cables were connected

Test record: All results are shown in the following.

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

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

Result measured with the peak detector and converted to average:

Frequency MHz	Result dBµV/m	Limit dBµV/m	Margin dB	Readings dBµV	Antenna factor 1/m	Preamp dB	Cable loss dB	Average correction factor [dB	Height cm	Pol.	Restr. Band
1223.1	36.63	54.0	17.37	36.63	25.0	26.0	2.0	0	150	Vert.	Yes
1302.2	33.31	54.0	20.69	51.01	25.2	25.9	2.1	-17.7	150	Vert.	Yes
1735.9	20.52	61.9	41.38	38.22	26.7	25.9	2.5	-17.7	150	Hor.	No
2603.1	30.78	61.9	31.12	48.48	28.8	25.9	3.2	-17.7	150	Vert.	No
3470.2	26.86	61.9	35.04	44.56	31.2	25.9	3.6	-17.7	150	Hor.	No
4339.1	32.8	54.0	21.20	50.50	32.2	25.4	4.1	-17.7	150	Vert.	Yes
Measurement uncertainty: +2.2 dB / -3.6 dB											

Measurement uncertainty +5.1 dB / -5.1 dB

The correction factor was calculated as follows.

Corr. (dB) = cable attenuation (dB) + amplifier (dB) + antenna factor (dBµV/m)

Therefore the reading can be calculated as follows:

Reading (dBµV/m) = result Peak/Average (dBµV/m) - Corr. (dB)

The test results were calculated with the following formula:

Result [dBµV/m] = reading [dBµV] + cable loss [dB] + antenna factor [dB/m] – preamp. [dB] + average correction factor [dB]

Test: Passed

Test equipment used (refer clause 6):

24, 29, 31 - 34, 36, 73, 143, 144

6 Test equipment and ancillaries used for tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal. due
14	Open area test site	-	Phoenix Test-Lab	-	480085	Weekly verification (system cal.)	
15	Measuring receiver	ESIB7	Rohde & Schwarz	100304	480521	02/18/2016	02/2018
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	-	-
24	Power supply	TOE 8752	Toellner	480009	31569	Not applicable	
26	Test fixture	-	Phoenix Test-Lab	-	410160	Not applicable	
29	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303	Weekly verification (system cal.)	
31	Measuring receiver	ESI 40	Rohde & Schwarz	100064	480355	02/15/2017	02/2018
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	06/14/2014	06/2017
36	Horn Antenna	3115 A	EMCO	9609-4918	480183	11/10/2014	11/2017
73	High Pass Filter	WHJS1000C11/60EF	Wainwright Instruments GmbH	1	480413	Monthly verification (system cal.)	
82	Band Reject Filter	WRCA 432.9/434.9-431/437-50/6EE-1000	Wainwright Instruments GmbH	6	480474	Monthly verification (system cal.)	
133	Loop antenna	HFH2-Z2	Rohde & Schwarz	100417	481912	10/20/2016	10/2017
142	RF-cable No. 36	Sucoflex 106B	Huber + Suhner	-	480865	Weekly verification (system cal.)	
143	RF-cable No. 3	Sucoflex 106B	Suhner	0563/6B	480670	Weekly verification (system cal.)	
144	RF-cable No. 40	Sucoflex 106B	Suhner	0708/6B	481330	Weekly verification (system cal.)	
145	Spectrum analyzer	FSW43	Rohde & Schwarz	100586	481720	02/24/2016	02/2018

7 Report history

Report Number	Date	Comment
F162386E4	05/19/2017	Document created
-	-	-
-	-	-

8 List of annexes

Annex A	Test setup photos	4 pages
	162386_20.JPG: WM2.4, test set-up fully anechoic chamber 162386_21.JPG: WM2.4, test set-up fully anechoic chamber 162386_22.JPG: WM2.4, test set-up fully anechoic chamber 162386_23.JPG: WM2.4, test set-up open area test site, pos. 1	
Annex B	External photos	6 pages
	162386_1.JPG: WM2.4 - 3D view 1 162386_2.JPG: WM2.4 - 3D view 2 162386_3.JPG: WM2.4 - Type plate 1 162386_4.JPG: WM2.4 - Type plate 2 162386_5.JPG: WM2.4 - Shape removed, 3D view 1 162386_6.JPG: WM2.4 - Shape removed, 3D view 2	
Annex C	Internal photos	4 pages
	162386_18.JPG: PCB, top view 162386_19.JPG: PCB, bottom view 162386_10.JPG: PCB, top view, battery removed 162386_11.JPG: PCB, bottom view, without grouting	