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Rev.2: 2017-02-03

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Equipment Authorization measurements on Reflector of RECCO system

(6 appendices)

Rev.1, 2016-12-05: Appendix 1 and 6 have been revised due to proposal from FCC. Antenna type deleted in Appendix 1 and FCC Inquiry Tracking number deleted at photo 7, 12 and 13 in Appendix 6.
Rev.2, 2017-02-03: On the FCC request measurements according Appendix 4 and 5 were performed, which was performed after the tests in Appendix 2 and 3. Appendix 1 and 6 has also been revised.

Test object

Product name: RECCO Detector
Product number: 713
Batch: 160209
Identity: #1

Summary

Measurements according to guidelines based on FCC Inquiry.
See Appendix 1 for general information and Appendix 6 for photos.
Emission measurements as specified below have been performed.

Standard	Compliant	Appendix	Remarks
FCC 47 CFR Part 15 C 15.209 Radiated emission limits; general requirements	**Yes**		
Justification measurements, EUT antenna efficiency	N/A	2	
15.209 (a) Radiated emission limits; general requirements	Yes	3	
Sound level versus reflector signal strength	N/A	4	
Determine the worst illumination angle in the horizontal plane	N/A	5	

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Purpose of test

The tests were performed to verify that Reflector meets the electromagnetic compatibility requirements of FCC 47 CFR part 15 C.

Test facility

The used semi-anechoic chamber is compliant with the requirements of section 2.948 of the FCC rules and listed, registration number 96866, as a facility accepted for certification under parts 15 and 18. The site complies with RSS Gen, Issue 4 and is accepted by Industry Canada for the performance of radiated measurements, IC-file number 3482A-1.

Test object

Reflector, passive:	713. Batch: 160209
Frequency:	Twice the exciter transmitter frequency, 1805.7 MHz
Supply voltage:	N/A. passive device

The lowest generated frequency in the EUT is the fundamental at 1805.7 MHz.

Operational test mode

The test object Reflector was placed in position 2“lying on edge” position, worst case position, which was found during the justification measurements.
The test object was “excited” with an RECCO Detector at a distance of 2.9 m from the test object with the same height as the EUT and with an azimuth at 45 degree in the horizontal plane (45 degree according to FCC Inquiry).
The “exciter” RECCO Detector was rotating with the turntable and attached at an arm at a distance of 2.9 m from the EUT (just rotating in front of the measuring antenna, approximately 10 cm between the RECCO Detector and the measuring antenna). See the photos in Appendix 4.
The “exciter” RECCO Detector was transmitting at 902.85 MHz and the output power was set to two steps above the lowest power setting. With this power setting the sound level from the speaker was measured to 69 dBA at a distance of 0.5 m behind the Detector (operator position).
The RECCO Detector was powered by AC mains during the tests.

Justification measurements (Appendix 2):
Before the §15.209 measurements some justification measurements were performed, to identify the EUT Reflector antenna efficiency and to decide max/min response regarding the turntable angle.
The EUT Reflector was orientated in two relevant different positions (due to the known antenna design/pattern), position 1, “standing on the edge” and position 2 “lying on the edge”. See the photos in Appendix 6.

Measurement equipment

Measurement used during 2016-10-27—28 (Appendix 2 and 3):

Measurement equipment	Calibration Due	SP number
Test site Tesla	2017-03	503 881
EMI Test Receiver R&S ESU 40	2017-07	901 385
Signal generator R&S SMB100A	2017-07	900 120
Schwarzbeck dipol antenna UHAP-10dB	2017-02	500 592
Horn antenna EMCO 3115	2016-11	502 175
Standard gain horn Flann 16240-25	-	503 939
Standard gain horn Flann 18240-25	-	503 900
Low Noise Amplifier Miteq	2016-12	901 545
1 GHz low pass filter	-	Client filter Note 1
1 GHz high pass filter Wainwright	2017-06	504 199
1 GHz high pass filter Wainwright	2017-06	901 501
Precision Sound Analyzer Norsonic Nor140	2018-08	901 193
Temperature and humidity meter Testo 625	2017-06	504 188

Note 1: This filter was only used during the relative justification measurements and was not used during the §15.209 measurements.

Measurement used during 2017-01-17 (Appendix 4 and 5):

Measurement equipment	Calibration Due	SP number
Test site Tesla	2017-03	503 881
EMI Test Receiver R&S ESU 40	2017-07	901 385
Horn antenna EMCO 3115	2019-12	502 175
Low Noise Amplifier Miteq	2017-12	901 545
1 GHz high pass filter Wainwright	2017-06	504 199
Precision Sound Analyzer Norsonic Nor140	2018-08	901 193
Temperature and humidity meter Testo 625	2017-06	504 188

Auxiliary and/or support equipment

Product name: RECCO Detector Product number: R99 Serial number: 99A-1437	Client equipment

Uncertainties

Measurement and test instrument uncertainties are described in the quality assurance documentation ”SP QD 10885”. The measurement uncertainties can be found in the table below. The uncertainties are calculated with a coverage factor k=2 (95% level of confidence). The measurement uncertainties can be found in the table below:

Method	**Uncertainty**
Radiated emission, 1 – 40 GHz	2.6 dB

Compliancy evaluation is based on a shared risk principle with respect to the measurement uncertainty.

Reservation

The test results in this report apply only to the particular test object as declared in the report.

Delivery of test object

The test object was delivered: 2016-10-27 and 2017-01-17

Test participant

Tomas Forssen, RECCO

Test engineer

Fredrik Isaksson, SP

Radiated justification measurements, EUT Reflector antenna efficiency

Date	Temperature	Humidity
2016-10-27	23 °C ± 3 °C	40 % ± 5 %

Test set-up and procedure

The measurements were performed according to the guidelines based on the FCC Inquiry.

Before the §15.209 measurements some relative justification measurements were performed, to identify the EUT Reflector antenna efficiency and to decide max/min response regarding the turntable angle.
The EUT Reflector was orientated in two relevant different positions (due to the known antenna design/pattern), position 1, "standing on the edge" and position 2 "lying on the edge" on the turntable. See the photos in Appendix 6.

The test was performed in a semi anechoic chamber. The measurements were performed with two antennas, just below/above each other.
The transmitting antenna was a tuned dipole antenna (Tx), tuned to 902.85 MHz (the frequency of the transmitter RECCO Detector) connected to a signal generator (CW signal) via a 1 GHz low pass filter (client filter).
The receiving antenna was a horn antenna (Rx) connected to EMI Test Receiver, tuned to 1805.7 MHz (fundamental of EUT reflector), via a 1 GHz high pass filter and an external pre amplifier.
The height of the EUT Reflector was 0.8 m above the reference ground plane, the height of the Tx dipole antenna was 0.7 m and the height of the Rx horn antenna was 0.9 m.
The distance between the EUT Reflector and the two antennas during the measurements was 3.0 m. Absorbers were placed on the ground reference plane between the EUT Reflector and the two antennas.

The measurements were performed with both horizontal and vertical polarizations of the antennas. Due to the know EUT antenna orientation the EUT Reflector was orientated in two relevant different positions, position 1, "standing on the edge" and position 2 "lying on the edge".
For the EUT Reflector in position 1, "standing on the edge" the Tx and Rx antennas was in vertical polarization.
For the EUT Reflector in position 2, "lying on the edge" the Tx and Rx antennas was in horizontal polarization.
It was deemed to not be relevant to test cross polarization between the EUT Reflector antenna and the Tx/Rx antennas due to the known EUT antenna orientation.

The signal generator to the Tx antenna was set to 25 dBm (maximum level of the signal generator) at 902.85 MHz. The level of the signal generator was adjusted to a level to reach approximately -30 dBm at the EUT Reflector at 3 m distance. Theoretical level at the EUT Reflector was calculated to -27.9 dBm *) (with 25 dBm at the signal generator). The signal generator was set to maximum level for maximum dynamic range of the measured levels at the EMI Test Receiver.

For each 5 degree step (0-90 degree) of the turntable the peak level of the EMI Test Receiver was noted. 0 degree was according to photos 5 and 6.
Peak detector and a RBW of 20 kHz were used. An offset (-6.3 dB) **) was used in the EMI Test Receiver to get the measured results in absolute levels at 1805.7 MHz (levels at the EUT Reflector).

*): Theoretical level at the EUT Reflector at 902.85 MHz = Level out from signal generator – loss at low pass filter at 902 MHZ – cable loss – dipole antenna atten.- theoretical path loss at 902 MHz at 3m = 25-3.3-0.4-8.1-41.1 = -27.9 dBm.

**): Offset (total loss) at EMI Test Receiver at 1805.7 MHz = Theoretical path loss at 1805 MHz at 3m-horn antenna gain+loss at high pass filter at 1805 MHz-external pre amplifier+cable loss = 47.1-7.7+0.6-50.7+4.4 = -6.3 dB.

Measurements were also performed to secure that the external pre amplifier and the EMI Test Receiver not was saturated and that the external filtering components was enough.

Test set-up photos during the tests can be found in Appendix 6.

Measurement equipment	SP number
Test site Tesla	503 881
EMI Test Receiver R&S ESU 40	901 385
Signal generator R&S SMB100A	900 120
Schwarzbeck dipol antenna UHAP-10dB	500 592
Horn antenna EMCO 3115	502 175
Low Noise Amplifier Miteq	901 545
1 GHz low pass filter	Client filter
1 GHz high pass filter Wainwright	504 199
Temperature and humidity meter Testo 625	504 188

Results

The measurement levels at some different turn table positions can be found in the diagrams below:

Diagram 1:	EUT in pos 2 “lying on the edge”, horizontal polarization, turntable at 0 degree
Diagram 2:	EUT in pos 2 “lying on the edge”, horizontal polarization, turntable at 45 degree
Diagram 3:	EUT in pos 2 “lying on the edge”, horizontal polarization, turntable at 65 degree
Diagram 4:	EUT in pos 2 “lying on the edge”, horizontal polarization, turntable at 75 degree

Appendix 2

The detected absolute levels out from the EUT Reflector at the Reflector at 1805.7 MHz are listed in the table below.

Turntable (degree)	EUT in pos 1"standing" Ver pol Levels at EUT (dBm)	EUT in pos 2"lying" Hor pol Levels at EUT (dBm)
0	-51.0	-51.3
5	-51.0	-51.3
10	-51.0	-51.3
15	-51.0	-52.0
20	-51.0	-52.7
25	-51.0	-53.5
30	-51.0	-54.4
35	-51.0	-55.6
40	-51.0	-57.0
45	-51.0	-58.6
50	-51.0	-60.5
55	-50.7	-62.5
60	-50.4	-64.8
65	-50.4	-68.1
70	-49.9	-71.3
75	-50.2	-75.9 ~Noise floor
80	-50.9	Noise floor
85	-51.0	Noise floor
90	-51.2	Noise floor
-5 (355)	Not measured	-51.5
-10 (350)	Not measured	-51.8
-15 (345)	Not measured	-52.3
-20 (340)	Not measured	-53.1
-25 (335)	Not measured	-53.9
-30 (330)	Not measured	-55.2
-35 (325)	Not measured	-56.5
-40 (320	Not measured	-57.9
-45 (315)	Not measured	-59.8

Note: The measurements were performed with both horizontal and vertical polarizations of the antennas. Due to the know EUT antenna orientation the EUT Reflector was orientated in two relevant different positions, position 1, "standing on the edge" and position 2 "lying on the edge".
For the EUT Reflector in position 1, "standing on the edge" the Tx and Rx antennas was in vertical polarization.
For the EUT Reflector in position 2, "lying on the edge" the Tx and Rx antennas was in horizontal polarization.
It was deemed to not be relevant to test cross polarization between the EUT Reflector antenna and the Tx/Rx antennas due to the known EUT antenna orientation.

Appendix 2

Diagram 1

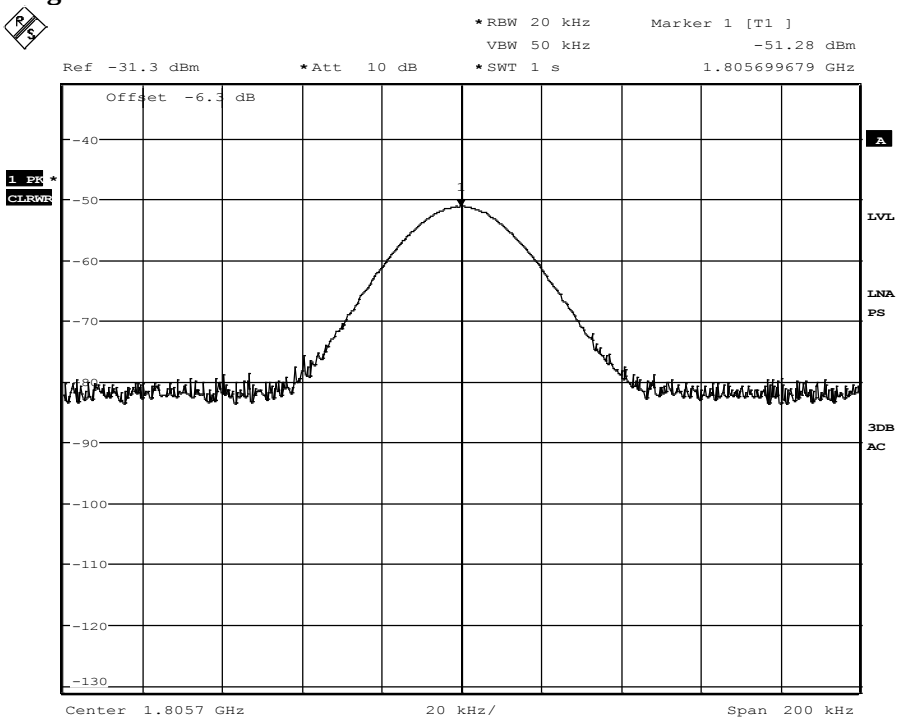

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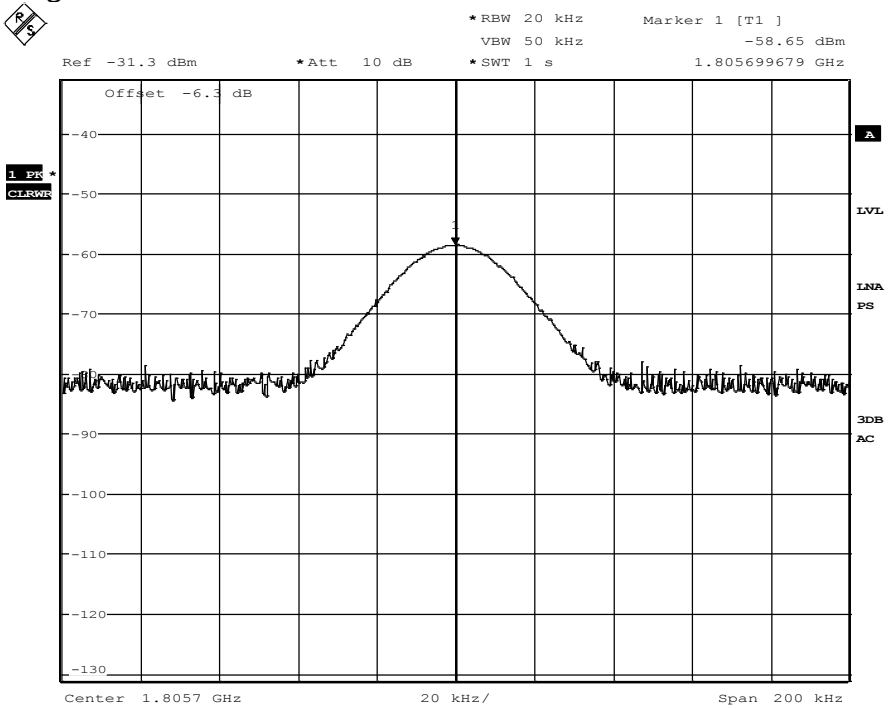
Diagram 2



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Appendix 2

Diagram 3

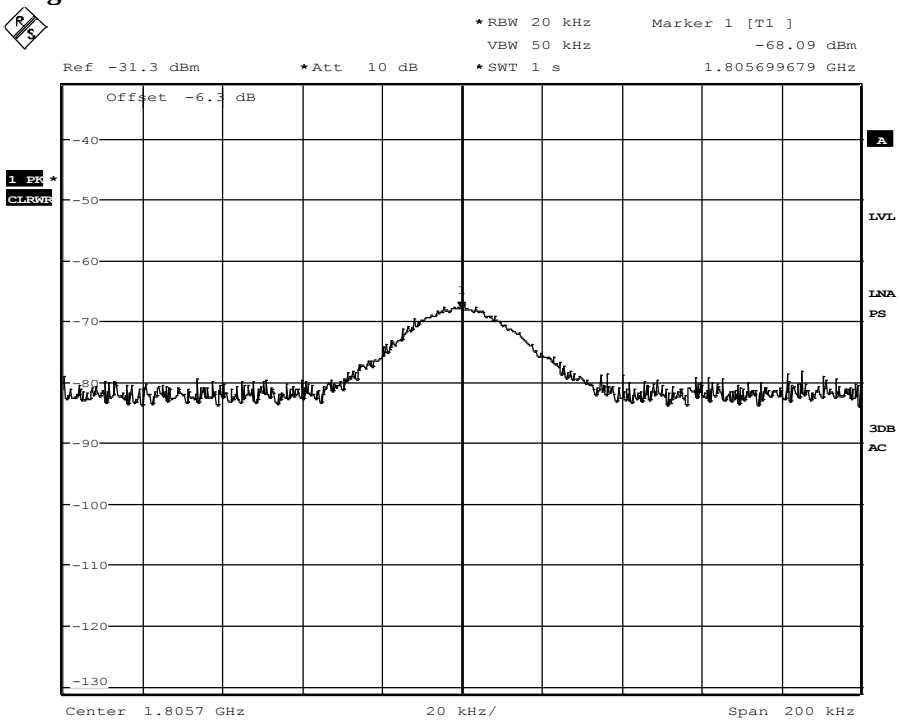

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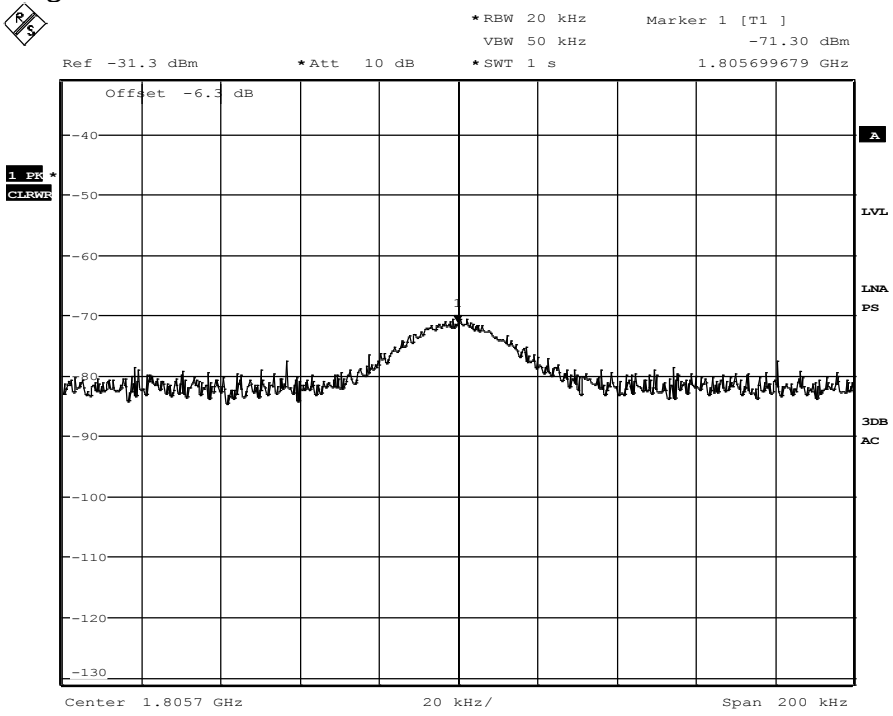
Diagram 4



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Radiated emission limits; general requirements measurements according to FCC 47 CFR part 15.209

Date	Temperature	Humidity
2016-10-27	23 °C ± 3 °C	40 % ± 5 %
2016-10-28	22 °C ± 3 °C	42 % ± 5 %

Test set-up and procedure

The measurements were performed according to ANSI C63.10-2013 and according to the guidelines based on the FCC Inquiry.

The test of radiated emission was performed in a semi anechoic chamber. The measurements were performed with both horizontal and vertical polarizations of the antenna. The antenna distance during the measurements was 3.0 m.
The EUT height above the reference ground plane was 1.5 m in the frequency range 1-18.06 GHz.

The measurement procedure is as follows:

1. A pre-measurement is performed with peak detector. The test object is measured in sixteen directions at frequencies above 1 GHz, with the antenna at three heights, 1.0 m, 1.5 m and 2.0 m.
2. If the emission is close or above the limit during the pre-measurement, the test object is scanned 360 degrees and the antenna height scanned from 1 to 4 m for maximum response. Then the emission is measured with the average and peak detector above 1 GHz.

The following RBW were used:
1-18.06 GHz: RBW=1 MHz

Test set-up photos during the tests can be found in Appendix 6.

Measurement equipment	SP number
Test site Tesla	503 881
EMI Test Receiver R&S ESU 40	901 385
Software: R&S EMC32, ver. 9.15.0	BX62351
Horn antenna EMCO 3115	502 175
Standard gain horn Flann 16240-25	503 939
Standard gain horn Flann 18240-25	503 900
Low Noise Amplifier Miteq	901 545
1 GHz high pass filter Wainwright	504 199
1 GHz high pass filter Wainwright	901 501
Precision Sound Analyzer Norsonic Nor140	901 193
Temperature and humidity meter Testo 625	504 188

Results

The pre-measurement emission spectra for the worst case configuration can be found in the diagrams below:

Diagram 1:	1-8.2 GHz, EUT in pos 2 “lying on the edge”, vertical and horizontal polarization
Diagram 2:	8.2-12.5 GHz, EUT in pos 2 “lying on the edge”, vertical and horizontal polarization
Diagram 3:	12.5-18 GHz, EUT in pos 2 “lying on the edge”, vertical and horizontal polarization

The highest detected levels during the final measurement in the frequency range 1-18.06 GHz are listed in the table below.

EUT in pos 2 “lying on the edge”:

Frequency (MHz)	QP level (dBµV/m)	CAV level (dBµV/m)	Peak level (dBµV/m)	Corr (dB)	Limit (dBµV/m)	Height (m)	Azimuth (deg)	Polarization
1003.627	N/A	24.2 *)	48.7 *)	-21.5	54 (Av)	1.10	311	Horizontal
1018.627	N/A	24.9 *)	50.2 *)	-21.5	54 (Av)	1.29	319	Vertical
1805.991	N/A	22.1 **)	43.4 **)	-17.6	54 (Av)	2.80	160	Horizontal
17850.291	N/A	26.0	39.1	-0.6	54 (Av)	2.33	238	Vertical
18057.000	N/A	25.8	39.1	-0.6	54 (Av)	1.58	173	Horizontal

Above 1 GHz the peak limit is 20 dB above the Average limit.

*) = This emission was related to the “exciter” RECCO Detector. Without the EUT Reflector the level was the same as with the EUT Reflector, thus the emission shall be disregarded.
The highest detected level was also with the “exciter” RECCO Detector just in front of the measuring antenna, approximately 10 cm distance between the Detector an the measuring antenna, see photos 9 and 10.

**)= This emission (fundamental of the EUT) was also measured without the EUT Reflector. Without the EUT the level was decreased down to the noise floor, thus the measured emission was related to the EUT.

Appendix 3

Limits

According to 47CFR 15.209(a), Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurements distance (meters)
0.009-0.490	2400/F(kHz) (128.5-93.8 dBuV/m@3m)	300
0.490-1.705	24000/F(kHz) (73.8-62.9 dBuV/m@3m)	30
1.705-30.0	30 (69.5 dBuV/m@3m)	30
30-88	100 (40 dBuV/m@3m)	3
88-216	150 (43.5 dBuV/m@3m)	3
216-960	200 (46 dBuV/m@3m)	3
Above 960	500 (54 dBuV/m@3m)	3

Complies?	Yes

Diagram 1

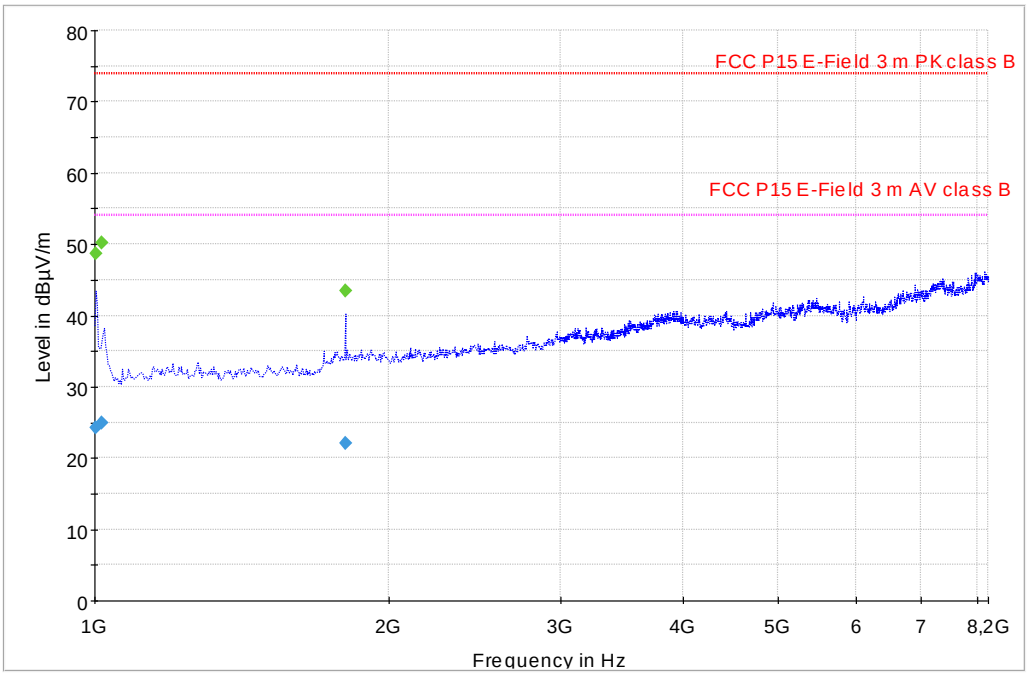
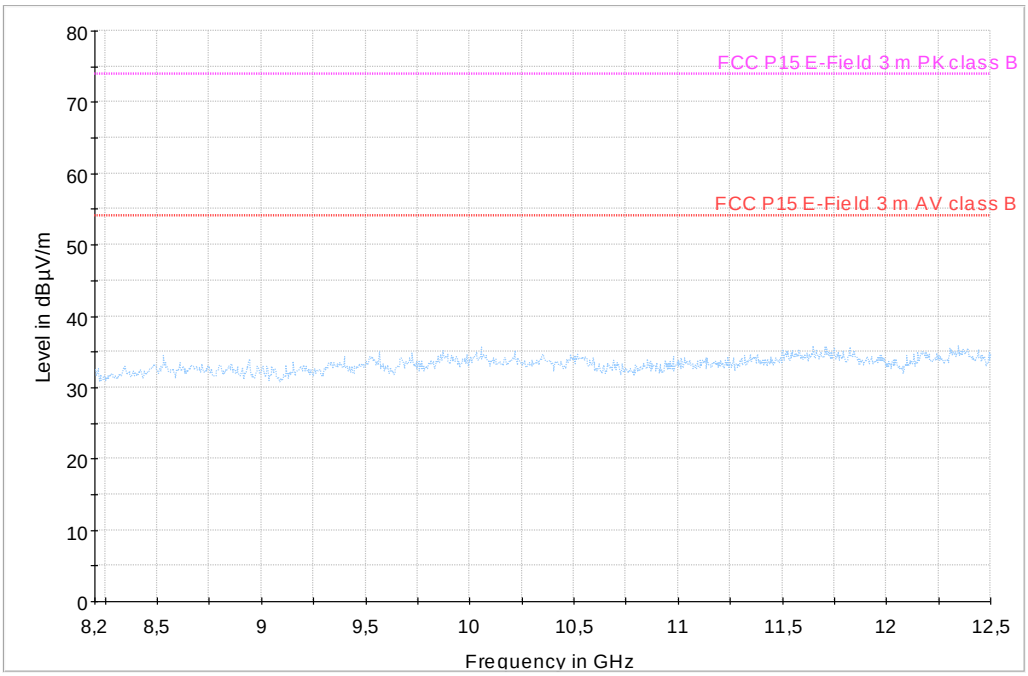
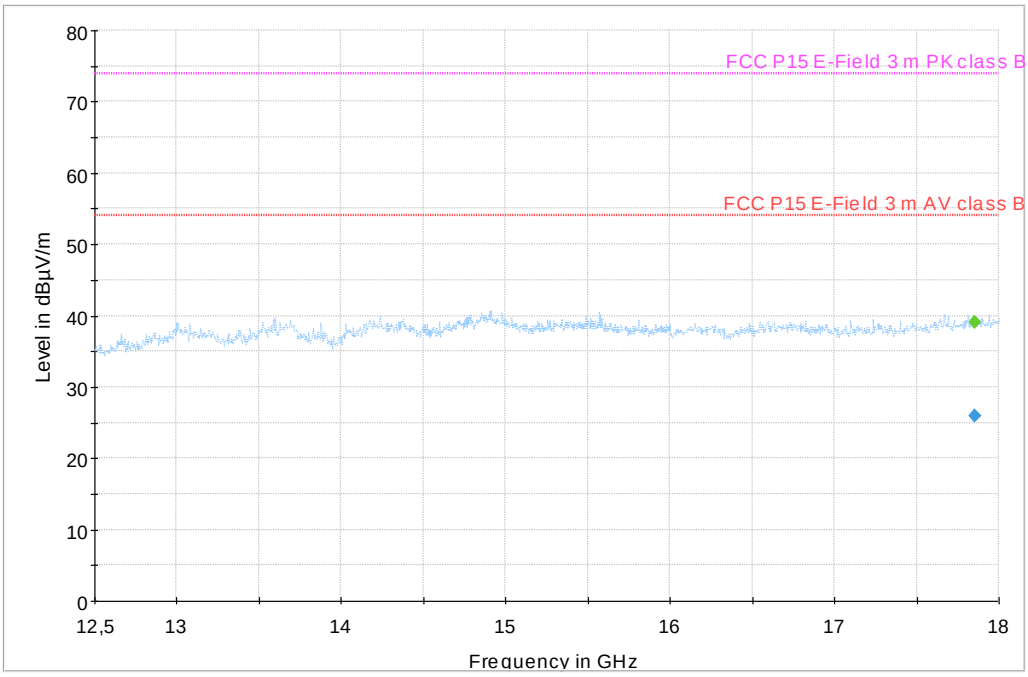


Diagram 2



Appendix 3

Diagram 3



Sound level versus reflector signal strength

Date	Temperature	Humidity
2017-01-17	21 °C ± 3 °C	19 % ± 5 %

Test set-up and procedure

The measurements were performed according to the guidelines based on the FCC Inquiry.

Measure the dependency between the sound level from the detector and the received reflector signal. This relation could later be used to normalize the emission strength from the reflector to a sound level of 67dBA from the Recco detector.

The test was performed in a semi anechoic chamber.
The antenna distance between the reflector and the detector during the measurements was 2.9 m (same distance as in appendix 1 and 2.
The EUT Reflector height above the reference ground plane was 1.5 m.
Absorbers were placed on the ground reference plane between the EUT Reflector and the Rx antenna

The height, centre of the RECCO Detector was 1.15 m above the reference ground plane and the height, centre of the Rx horn antenna was 1.5 m.
The distance between then EUT and the RECCO Detector during the measurements was 2.9 m.

The measurements were performed with horizontal polarization of the Rx antenna. The EUT Reflector was orientated in one position, position 2, “lying on the edge”.
For the EUT Reflector in position 2, “lying on the edge” the Tx and Rx antennas was in horizontal polarization.
It was deemed to not be relevant to test cross polarization between the EUT Reflector antenna and the Rx antennas due to the known EUT antenna orientation.

The Rx antenna was positioned such that it measured the signal strength of the signal received by the detector. The Rx antenna and spectrum analyzer were configured such that peak signal levels in the range -135 to -120 dBm were measured for a center frequency at 1805.7 MHz. RBW = 1kHz and span 50kHz.

The level to and from the EUT Reflector was adjusted with ferrite plates, by adjusting the distance between the EUT and the ferrite, see photos in Appendix 6.
For each signal strength level of the signal received by the detector also the sound level from the speaker from the detector was measured 0.5 m behind the detector with the Precision Sound Analyzer.
Offset (total loss) at EMI Test Receiver at 1805.7 MHz = horn antenna gain+loss at high pass filter at 1805 MHz-external pre amplifier+cable loss = -9.0+0.6-50.5+4.4 = -54.4 dB.

Test set-up photos during the tests can be found in Appendix 6.

Measurement equipment	SP number
Test site Tesla	503 881
EMI Test Receiver R&S ESU 40	901 385
Horn antenna EMCO 3115	502 175
Low Noise Amplifier Miteq	901 545
1 GHz high pass filter Wainwright	504 199
Precision Sound Analyzer Norsonic Nor140	901 193
Temperature and humidity meter Testo 625	504 188

Results

Measurement levels two different ferrite plate positions can be found in the diagrams below:

Diagram 1:	45 mm distance between the EUT and the ferrite plate
Diagram 2:	30 mm distance between the EUT and the ferrite plate

The detected absolute levels at the Detector at 1805.7 MHz are listed in the table below.

Distance between the EUT and the ferrite plats (mm)	Sound pressure (dBA)	Signal strength level of the signal received by the detector (dBm)	Power setting of Detector
45	48.6	-138.1	-1
55	50.9	-136.9	-1
25	56.5	-133.5	-2
40	63.7	-128.8	-2
50	65.1	-127.2	-2
70	66.7	-125.9	-2
1 ferrite removed	67.8	-124.3	-2
5	69.0	-121.8	-2
2 ferrites removed	70.7	-118.4	-2
10	70.8	-117.6	-3
30	72.7	-108.6	-3
1 ferrite removed	72.8	-102.3	-3
Calculation Note 1	67.0	-125.5	

Note 1: The received signal at the detector when in normal operation can be obtained by linear interpolating using the two measurements nearest 67dBA, from the table above we have:
(x1;y1) = (66,7; -125,9)
(x2;y2) = (67,8; -124,3)
then for all sound levels (x) between x1 and x2 the corresponding signal level (y) can be interpolated according to:

$$y = (y2 - y1) * (x - x2) / (x2 - x1) + y2$$

Diagram 3

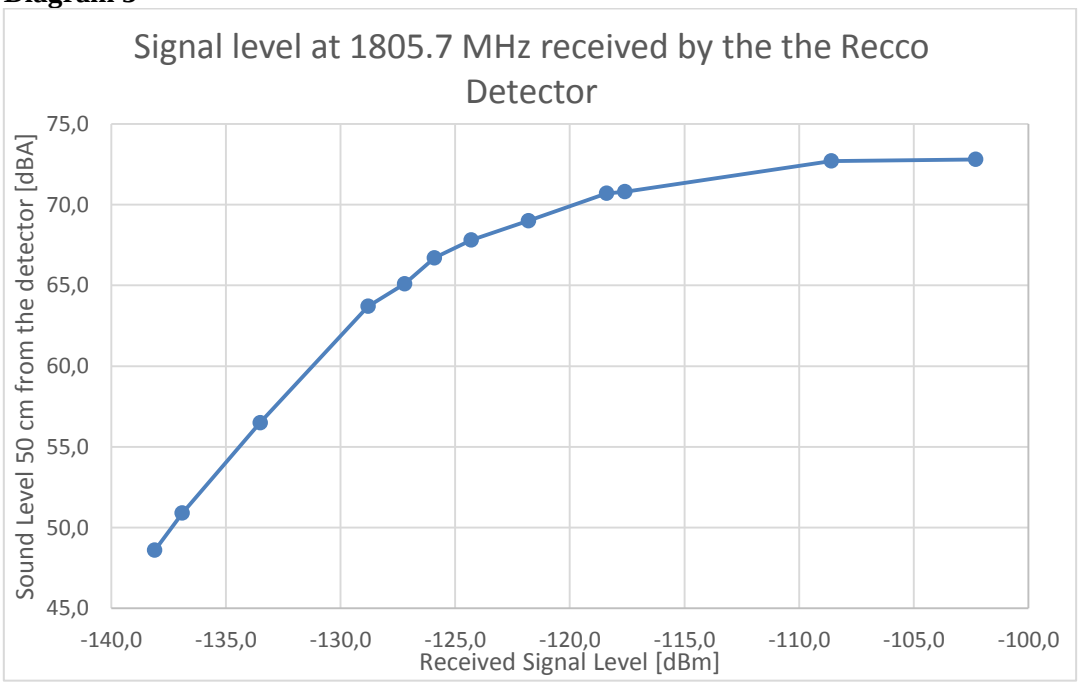


Diagram 1

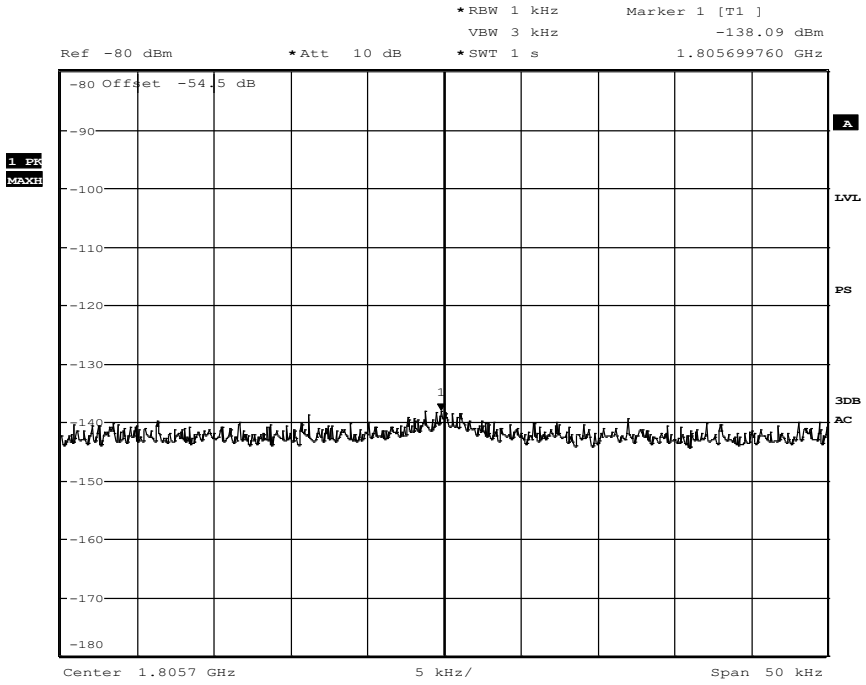


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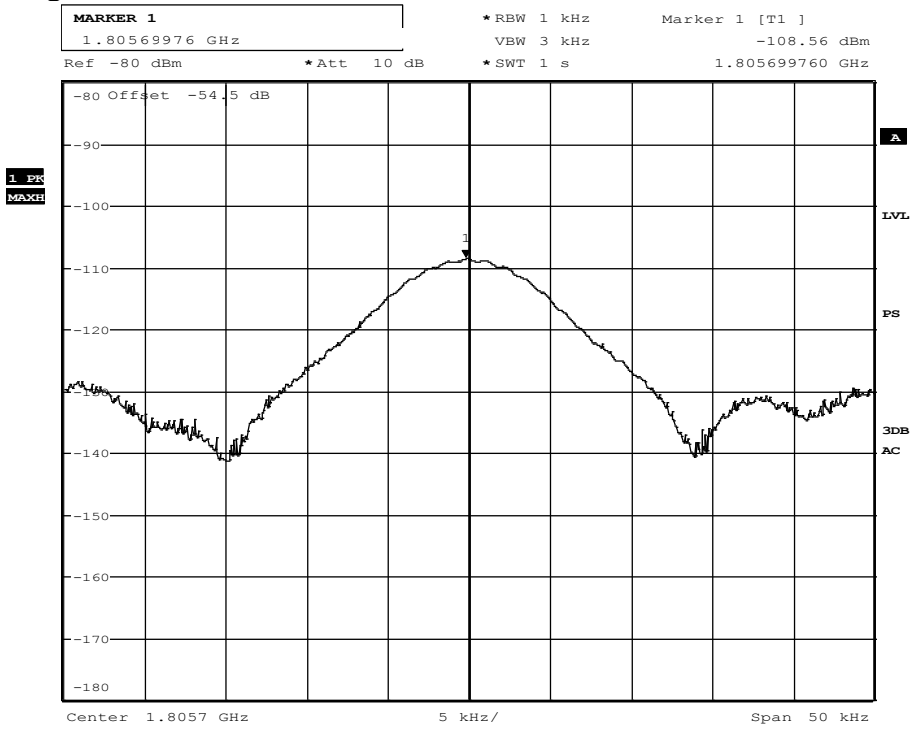
Diagram 2



Date: 17.JAN.2017 13:30:29

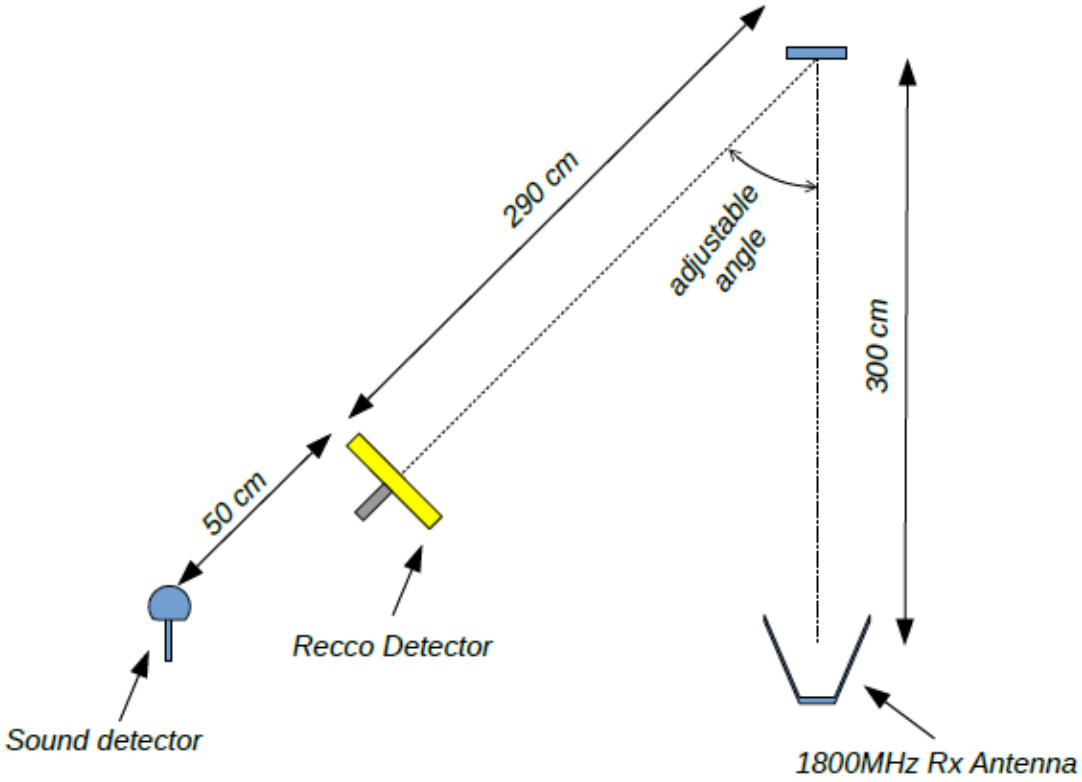
Determine the worst illumination angle in the horizontal plane

Date	Temperature	Humidity
2017-01-17	21 °C ± 3 °C	19 % ± 5 %

Test set-up and procedure

The measurements were performed according to the guidelines based on the FCC Inquiry.

During a normal search and rescue operation the illumination angle between the reflector and the detector could be anything in the range from 0-90deg. Due to the fact that the reflector emission is strongest in the broadside direction (0 deg) the detector receives only a portion of the response when illumination occur from other angles. The purpose with this measurement is to determine for which illumination angle the broadside emission is maximized, for each angle the detector should operate normally.



The test was performed in a semi anechoic chamber.
The antenna distance during the measurements was 2.9 m.
The EUT Reflector height above the reference ground plane was 1.5 m.
Absorbers were placed on the ground reference plane between the EUT Reflector and the Rx antenna

The height, centre of the RECCO Detector was 1.15 m above the reference ground plane and the height, centre of the Rx horn antenna was 1.5 m.
The distance between then EUT and the RECCO Detector during the measurements was 2.9 m.

The measurements were performed with horizontal polarization of the Rx antenna. The EUT Reflector was orientated in one position, position 2, “lying on the edge”.

For the EUT Reflector in position 2, “lying on the edge” the Tx and Rx antennas was in horizontal polarization.
It was deemed to not be relevant to test cross polarization between the EUT Reflector antenna and the Rx antenna. During a search operation the detector is constantly shifting the polarization and when the reflector is detected only the strongest polarization is used. Here, the horizontal polarization will give the strongest response.

Measurement for the illumination angles was performed in the span 0 to 90 deg. For each angle, the detector output power should be adjusted such that the detected sound level is as close as possible to 67dBA. By using the findings from the measurement in Appendix4, the emission could be normalized to the corresponding 67dBA level. To enable normalization the same resolution settings as in Appendix 4 was used.
RBW = 1kHz and span 50kHz.

For each signal strength level of the signal received by the detector also the sound level from the speaker from the detector was measured 0.5 m behind the detector with the Precision Sound Analyzer.
Offset (total loss) at EMI Test Receiver at 1805.7 MHz = horn antenna gain+loss at high pass filter at 1805 MHz-external pre amplifier+cable loss = -9.0+0.6-50.5+4.4 = -54.4 dB.

Test set-up photos during the tests can be found in Appendix 6.

Measurement equipment	SP number
Test site Tesla	503 881
EMI Test Receiver R&S ESU 40	901 385
Horn antenna EMCO 3115	502 175
Low Noise Amplifier Miteq	901 545
1 GHz high pass filter Wainwright	504 199
Precision Sound Analyzer Norsonic Nor140	901 193
Temperature and humidity meter Testo 625	504 188

Results

The measurement levels at some different ferrite plate positions can be found in the diagrams below:

Diagram 1:	15 degree illumination angle
Diagram 2:	60 degree illumination angle
Diagram 3:	75 degree illumination angle

The measured levels at 1805.7 MHz and displayed in the diagram 3 are listed in the table below.

Illumination angle (degrees)	Power setting of Detector	Sound pressure (dBA)	Measured emission (dBm)	Emission rel. 67 dBA Note 1	Normalized emission at 67 dBA Note 2	Measured levels relative 45 degree Note 3
15	-2	69.9	-116.3	5.5	-121.8	-2.0
30	-2	69.1	-117.7	3.9	-121.6	-1.8
45	-2	65.5	-121.2	-1.4	-119.8	0
60	-2	44.9	-128.6	-14.6	-114.0	+5.8
65	-3	70.8	-104.9	7.9	-112.8	+7.0
70	**-3**	**60.2**	**-107.5**	**-5.6**	**-101.9**	**+17.9**
75	-3	61.0	-111.9	-5.1	-106.8	+13.0
75	-4	70.8	-100.5	7.9	--108.4	+11.4
80	-3	55.9	-114.9	-8.4	-106.5	+13.3
90	-6	53.9	-116.2	-9.6	-106.6	+13.2
90	-7	67.0	-109.7	0.0	-109.7	+10.1

Note 1: Emission level relative to emission at 67 dBA was obtained from measurements in Appendix 4. Linear interpolation according to Appendix 4, Diagram 3 was used.

Note 2: Measured emission is normalized with difference in emission between the measured sound pressure and the emission at 67 dBA.

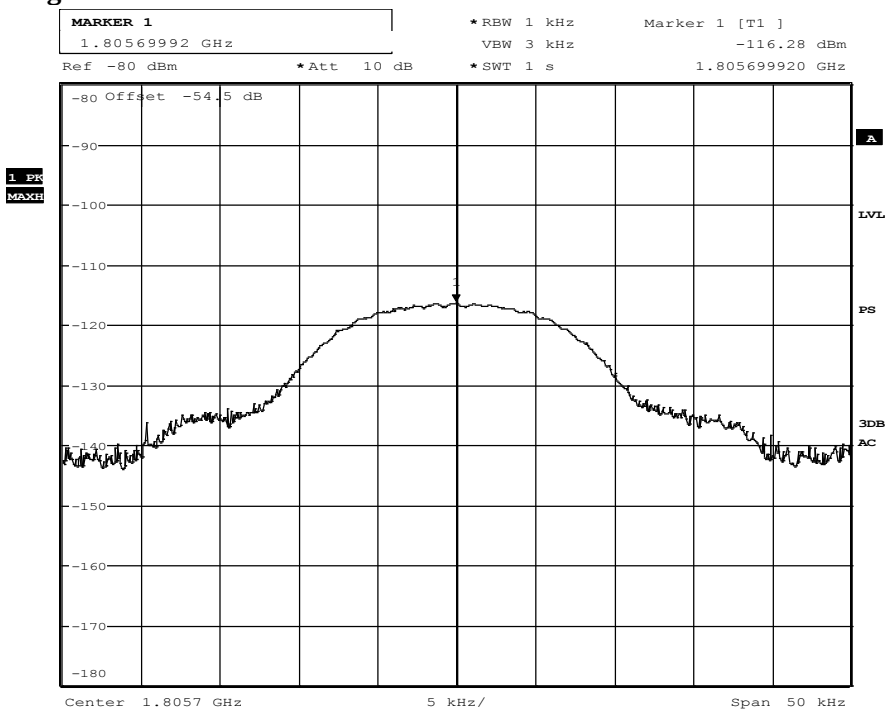
Note 3: The 45 degree illumination angle was used during the part 15 measurements in Appendix 3. Here, the worst illumination angle was found to be 70degrees with 17.9dB stronger emission than the 45degree angle.

The worst illumination angle was found to be 70deg, with 17.9dB stronger emission than the previous measured angle at 45deg. In Appendix 3 the measured sound pressure was measured to 69dBA. For a sound pressure of 67dBA the emission is 3.7dB lower. The 70deg illumination angle would generate an emission that is 17.9-3.7 = 14.2 dB stronger than the measured emission from Appendix 3.

In Appendix 3 the strongest emission levels, related to the fundamental (=1805.7 MHz) was found to be:
CAV=22.1 dBuV/m and Peak=43.4 dBuV/m
Adding 14.2 dB will result in:
CAV=36.8 dBuV/m and Peak=57.6 dBuV/m

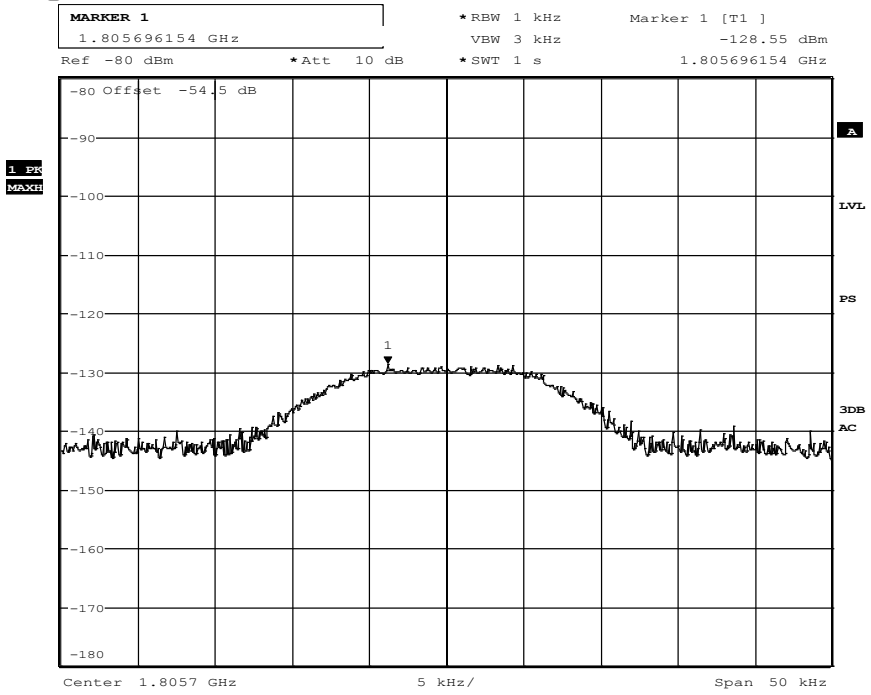
Summary:
Even with the worst case illumination angle, the part 15 measurement was still compliant.

Diagram 1



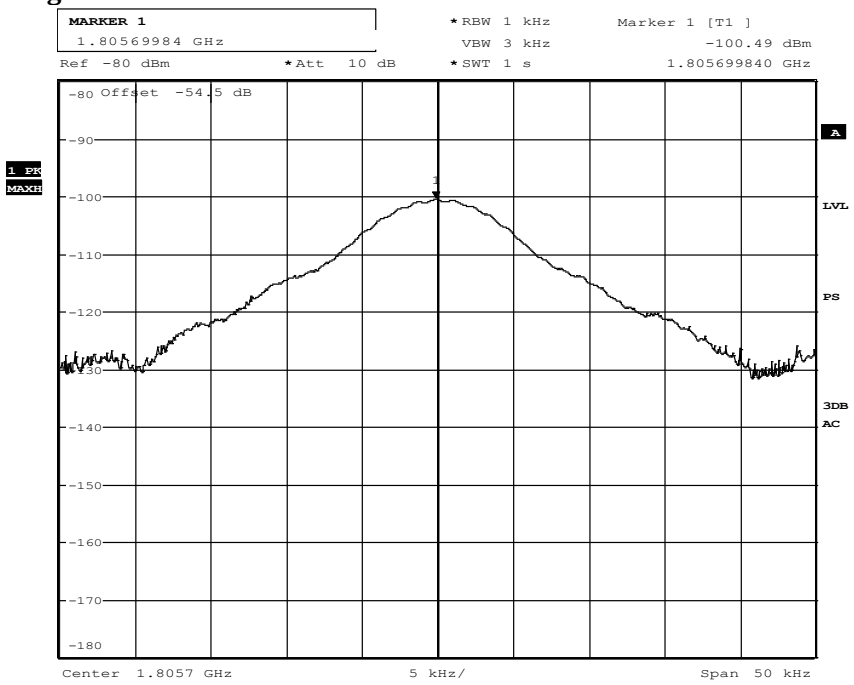
Date: 17.JAN.2017 14:36:53

Diagram 2



Date: 17.JAN.2017 14:10:07

Diagram 3



Date: 17.JAN.2017 14:17:54

Photos

The test set-up during all the radiated tests can be seen in the pictures below.

EUT set-up:

Photo 1:
EUT Reflector in pos 1 “standing on the edge”.

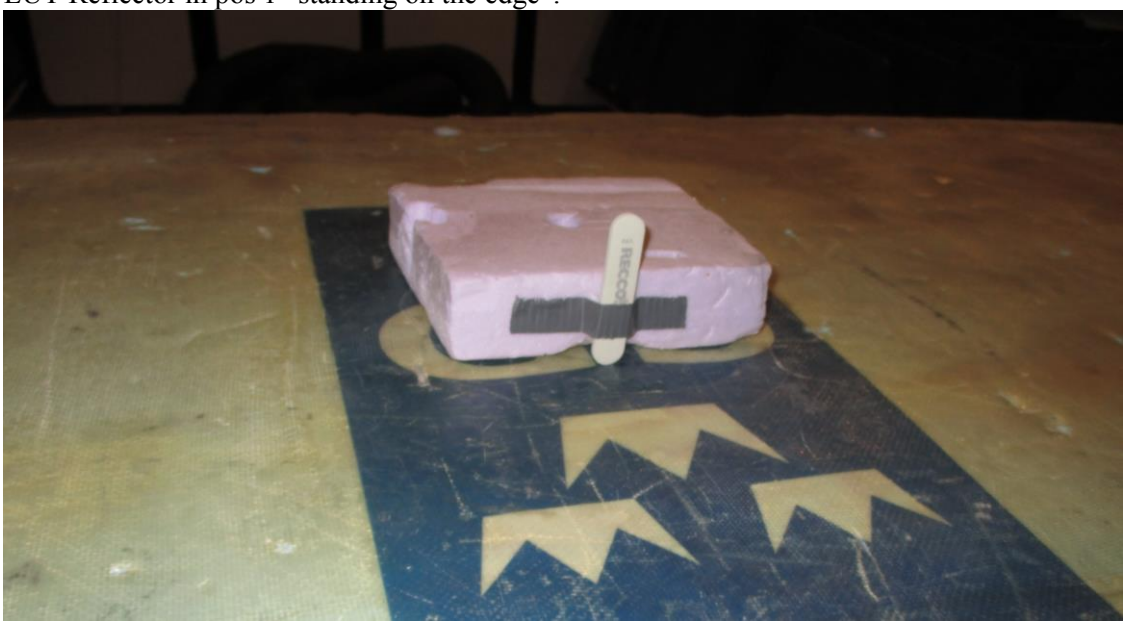
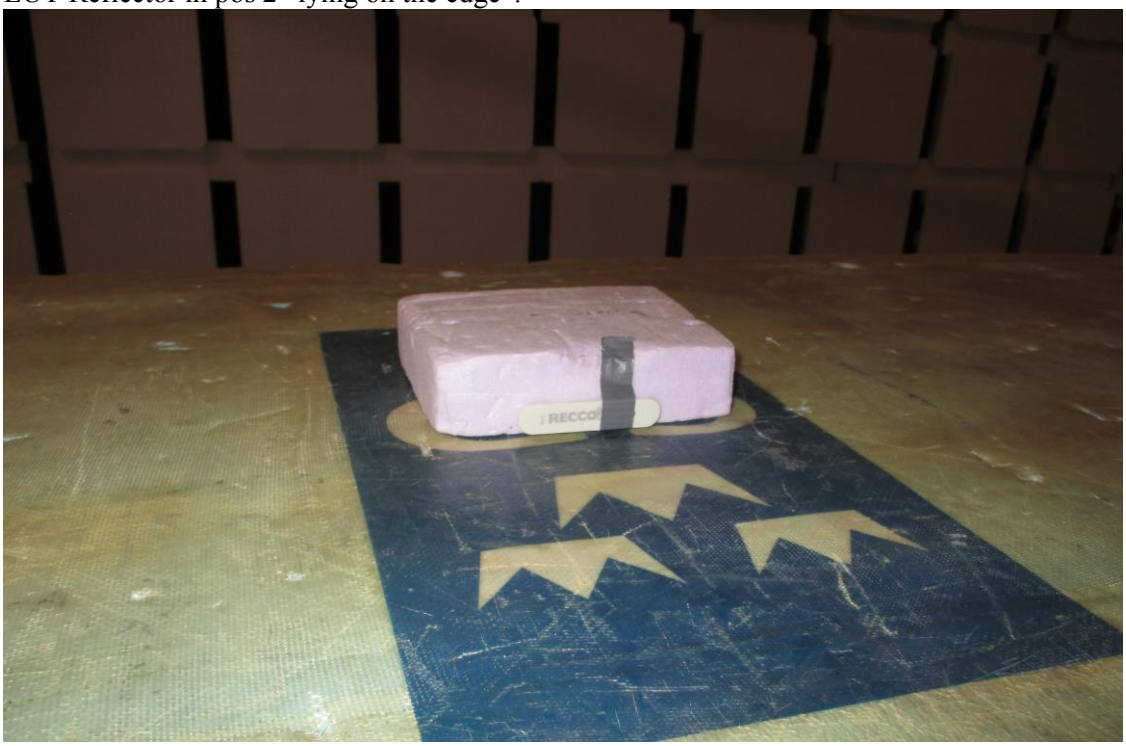


Photo 2:
EUT Reflector in pos 2 “lying on the edge”.



Justification measurements, for the efficiency of the EUT Reflector antenna.

Photo 3:
Tx with signal generator, 1 GHz low pass filter (clients) and dipole antenna ver pol tuned to 902.85 MHz.
Rx with horn antenna ver pol, 1 GHz high pass filter SP504199, connected to signal analyser and tuned to 1805.7 MHz (fundamental of EUT reflector).
3 m measurements distance between EUT Reflector and antennas.

Photo 4:
Tx with signal generator, 1 GHz low pass filter (clients) and dipole antenna ver pol tuned to 902.85 MHz.
Rx with horn antenna ver pol, 1 GHz high pass filter SP504199, connected to signal analyser and tuned to 1805.7 MHz (fundamental of EUT reflector).
3 m measurements distance between EUT Reflector and antennas.

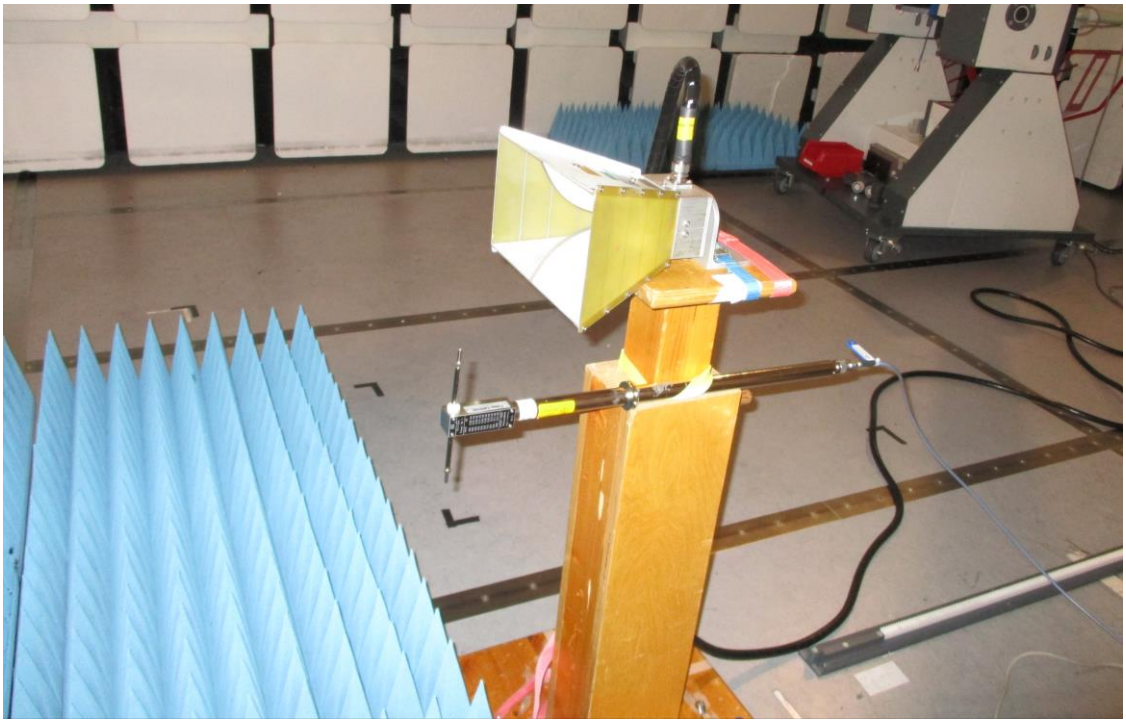


Photo 5:
Tx with signal generator, 1 GHz low pass filter (clients) and dipole antenna ver pol tuned to 902.85 MHz.
Rx with horn antenna ver pol, 1 GHz high pass filter SP504199, connected to signal analyser and tuned to 1805.7 MHz (fundamental of EUT reflector).
EUT Reflector in pos 1 “standing on the edge”.

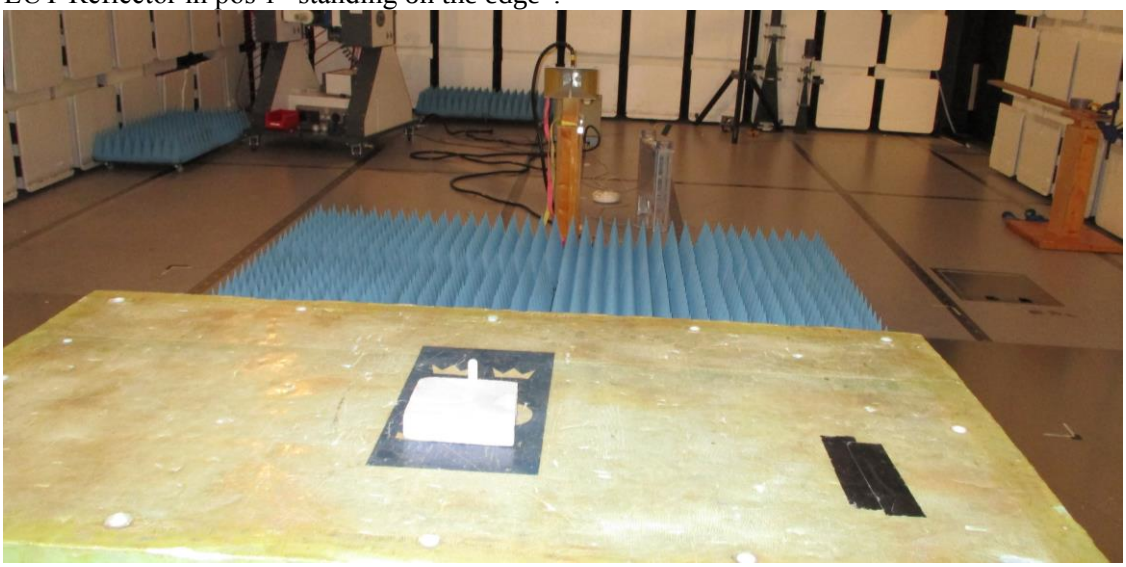
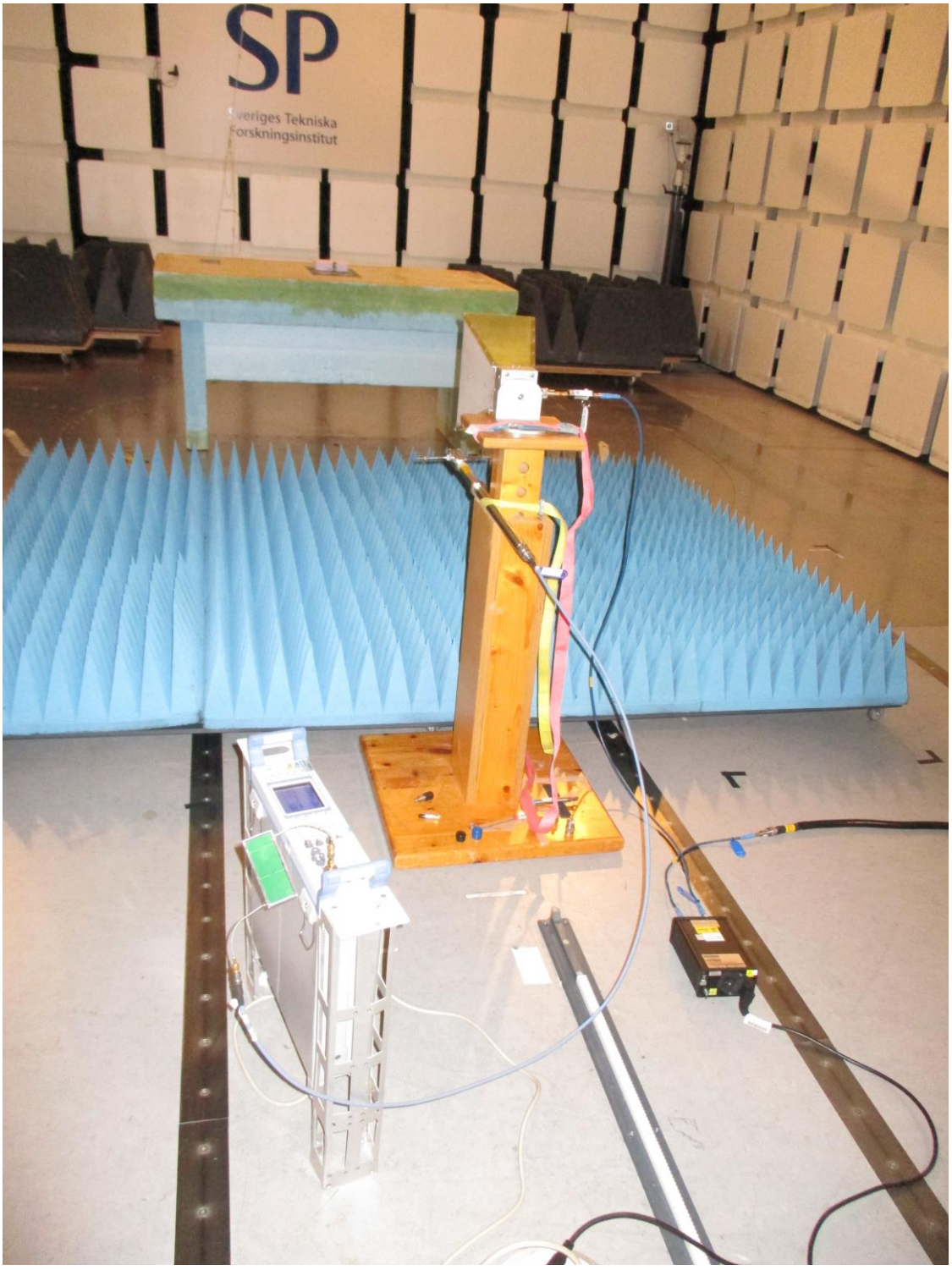


Photo 6:
Tx with signal generator, 1 GHz low pass filter (clients) and dipole antenna hor pol tuned to 902.85 MHz.
Rx with horn antenna hor pol, 1 GHz high pass filter SP504199 and an external pre amplifier SP501545, connected to signal analyser and tuned to 1805.7 MHz (fundamental of EUT reflector).
3 m measurements distance between EUT Reflector and antennas.



§15.209 measurements.

Photo 7:
The test object was “excited” with an RECCO Detector at a distance with 2.9 m from the test object with the same height as the EUT and with an azimuth at 45 degree in the horizontal plane (45 degree according to FCC Inquiry).
Sound level measurements 0.5 behind the “exciter” RECCO Detector. The output power from the RECCO Detector was adjusted to the target sound level 67 dBA or just above at the sound level analyser.

Photo 8:
Measuring horn antenna (1-8.2 GHz), 1 GHz high pass filter SP504199 and external pre amplifier SP901545.
3 m measurements distance between EUT Reflector and antennas.
The test object was “excited” with an RECCO Detector at a distance with 2.9 m from the test object with the same height as the EUT and with an azimuth at 45 degree in the horizontal plane (45 degree according to FCC Inquiry).
The “exciter” RECCO Detector was rotating with the turntable and attached at an arm at a distance of 2.9 m from the EUT (just rotating in front of the measuring antenna, approximately 10 cm between the RECCO Detector and the measuring antenna).

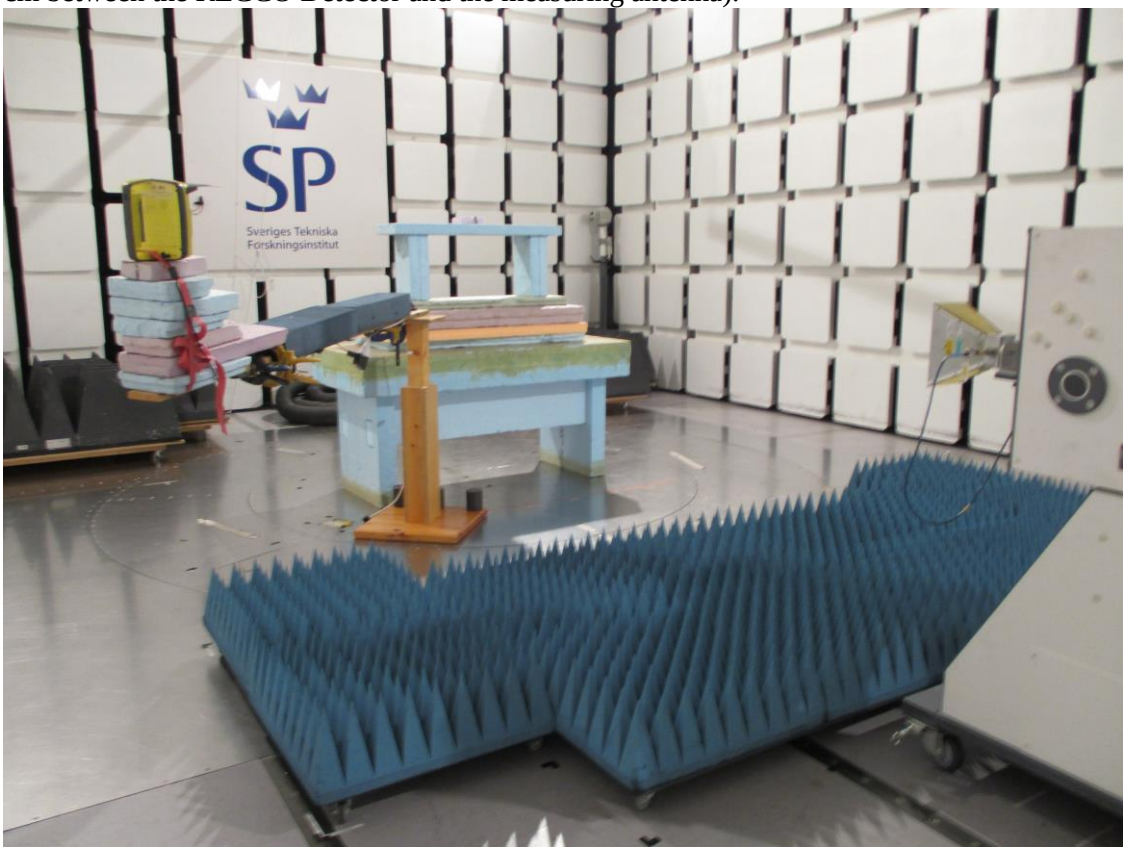


Photo 9:
Measuring horn antenna (1-8.2 GHz), maximum response position for the emission peak at 1003 MHz (related to the “exciter” RECCO Detector).

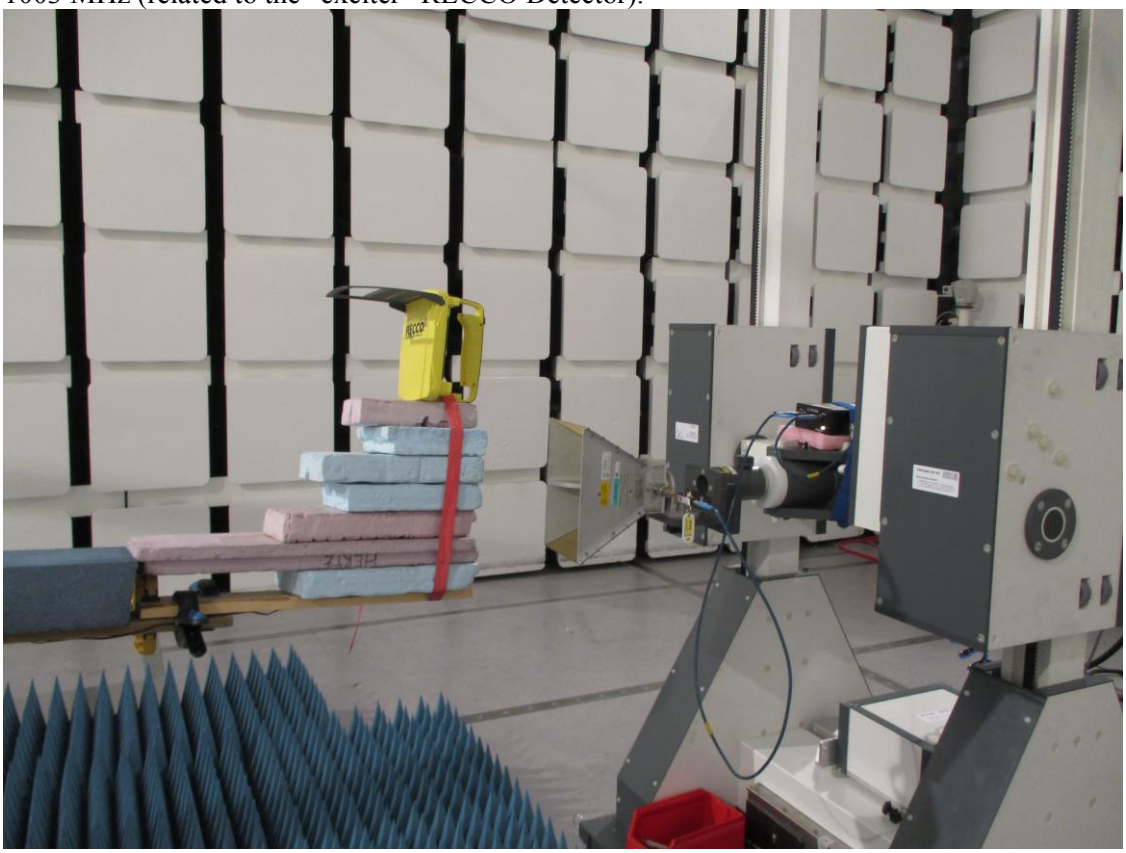


Photo 10:
Measuring horn antenna (1-8.2 GHz), maximum response position for the emission peak at 1018 MHz (related to the “exciter” RECCO Detector).

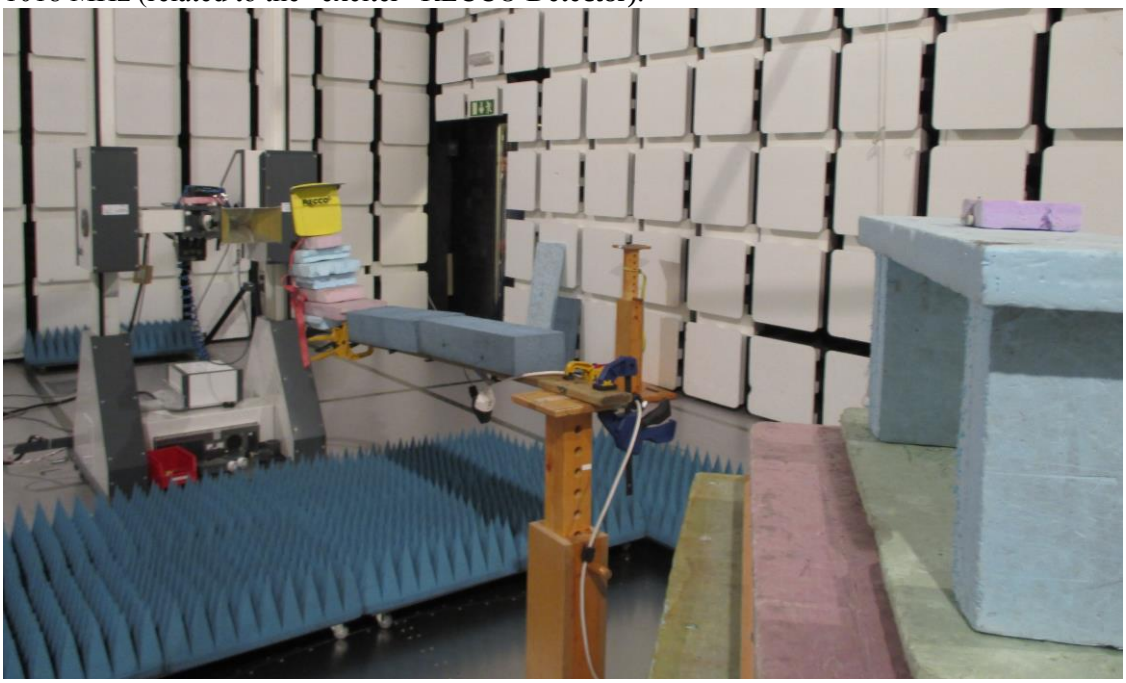


Photo 11:
Measuring horn antenna (1-8.2 GHz), maximum response position at TT for the emission peak at fundamental 1805.7 MHz (rear side of the EUT).

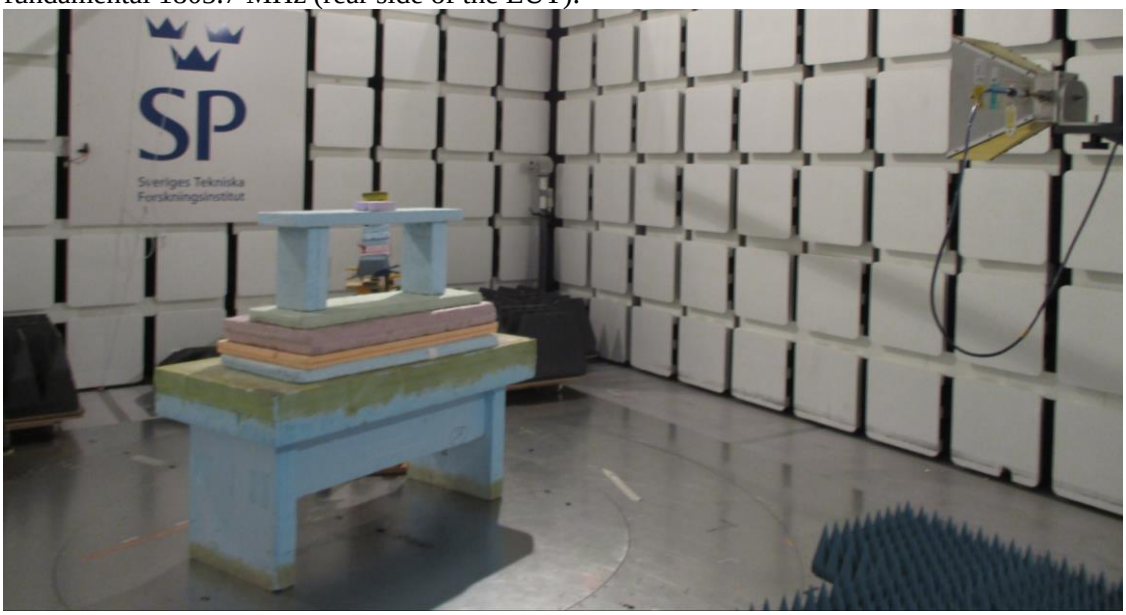


Photo 12:
Measuring horn antenna (8.2-12.5 GHz), 1 GHz high pass filter SP504199 and external pre amplifier SP901545.
3 m measurements distance between EUT Reflector and antennas.
The test object was “excited” with an RECCO Detector at a distance with 2.9 m from the test object with the same height as the EUT and with an azimuth at 45 degree in the horizontal plane (45 degree according to FCC Inquiry).
The “exciter” RECCO Detector was rotating with the turntable and attached at an arm at a distance of 2.9 m from the EUT (just rotating in front of the measuring antenna, approximately 10 cm between the RECCO Detector and the measuring antenna).

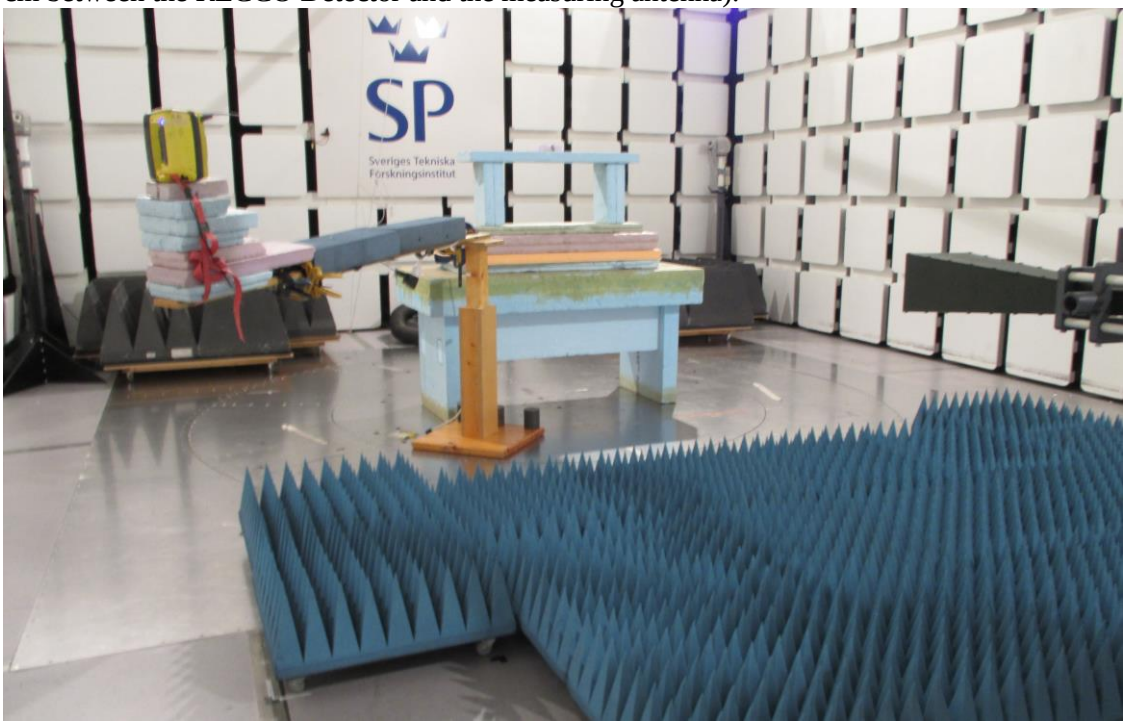


Photo 13:
Measuring horn antenna (12.5-18.056 GHz), 1 GHz high pass filter SP901501 and external pre amplifier SP901545.
3 m measurements distance between EUT Reflector and antennas.
The test object was “excited” with an RECCO Detector at a distance with 2.9 m from the test object with the same height as the EUT and with an azimuth at 45 degree in the horizontal plane (45 degree according to FCC Inquiry).
The “exciter” RECCO Detector was rotating with the turntable and attached at an arm at a distance of 2.9 m from the EUT (just rotating in front of the measuring antenna, approximately 10 cm between the RECCO Detector and the measuring antenna).

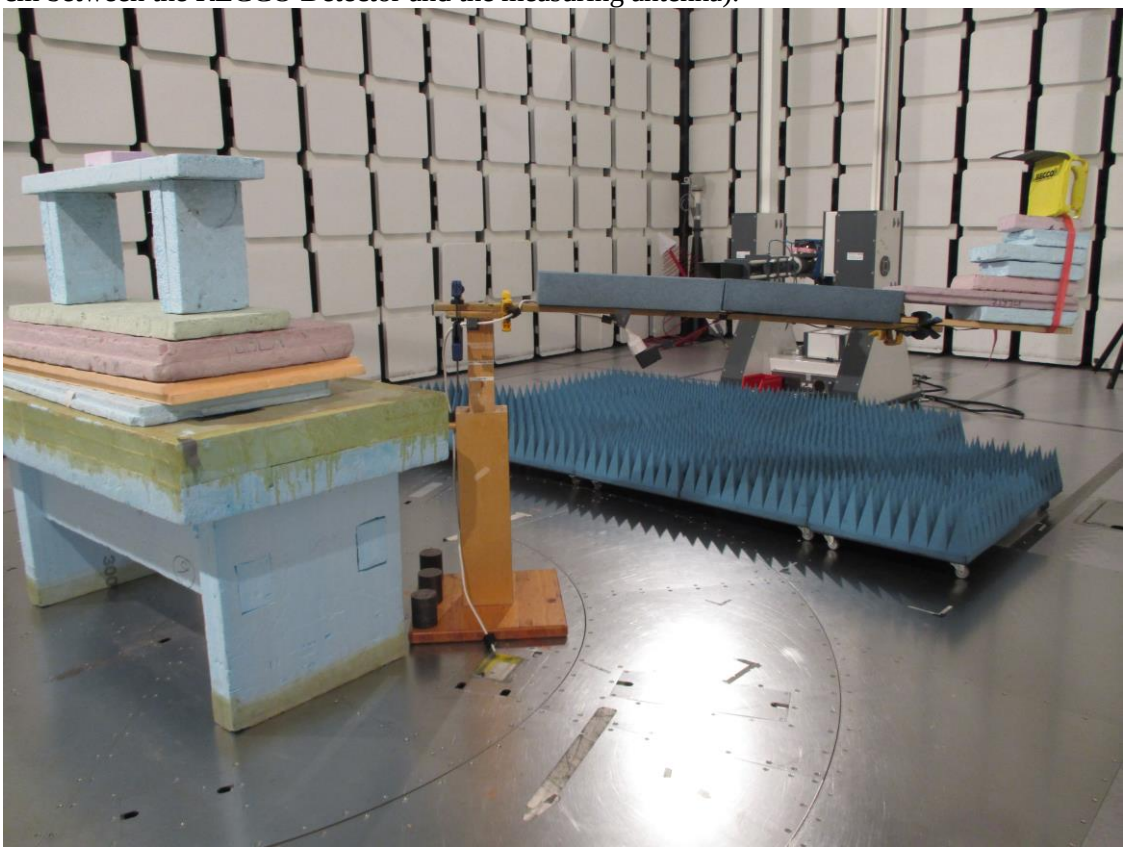


Photo 14:
Measurements according to Appendix 4.

Photo 15:
Measurements according to Appendix 4.

Photo 16:
Measurements according to Appendix 4.

Photo 17:
Measurements according to Appendix 4.

Photo 18:
Measurements according to Appendix 4.

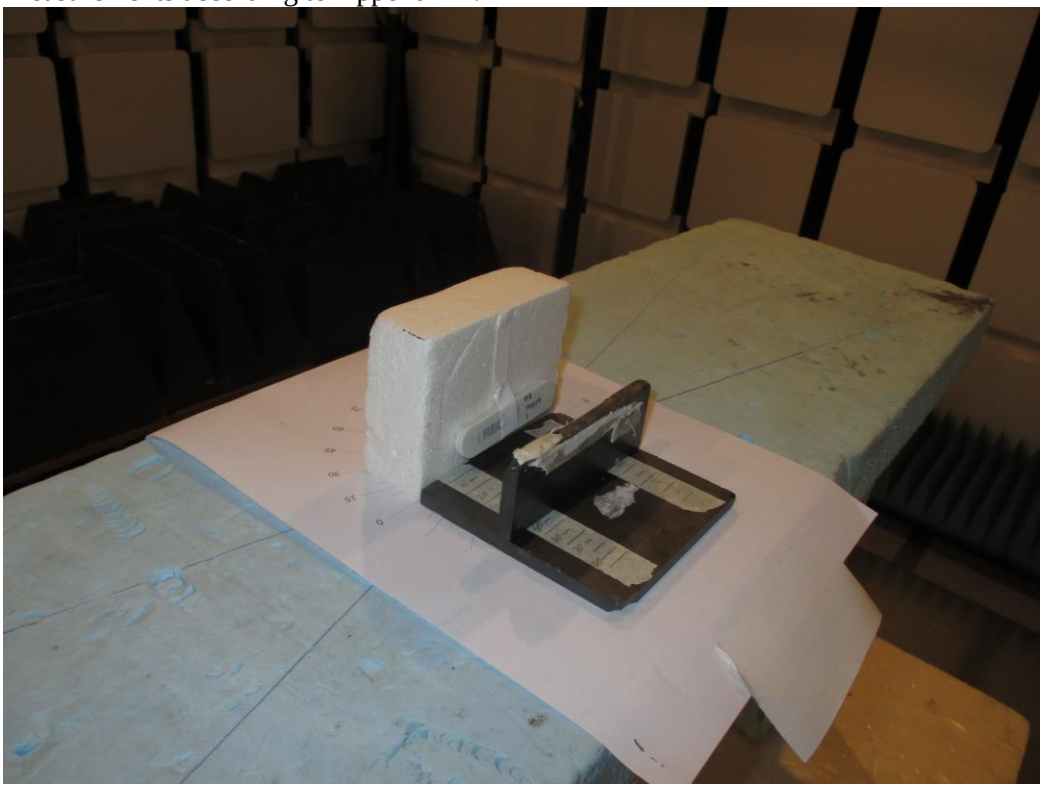


Photo 19:
Measurements according to Appendix 4.

Photo 20:
Measurements according to Appendix 5, 75 degree.

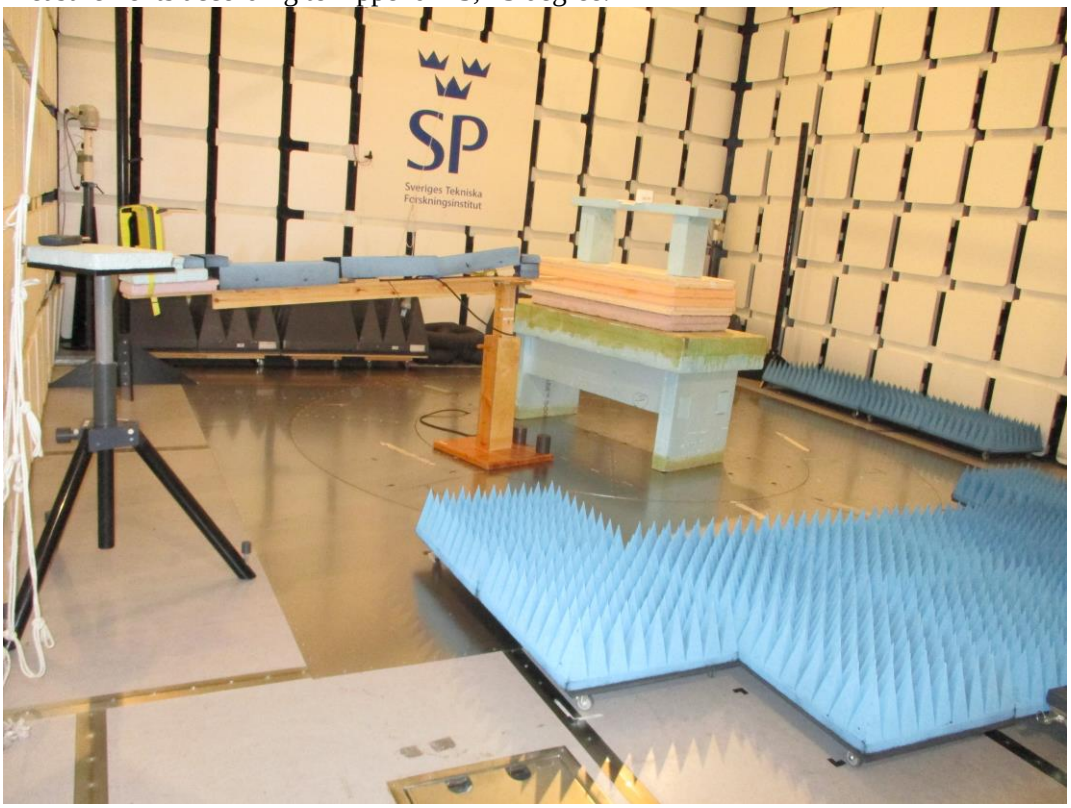
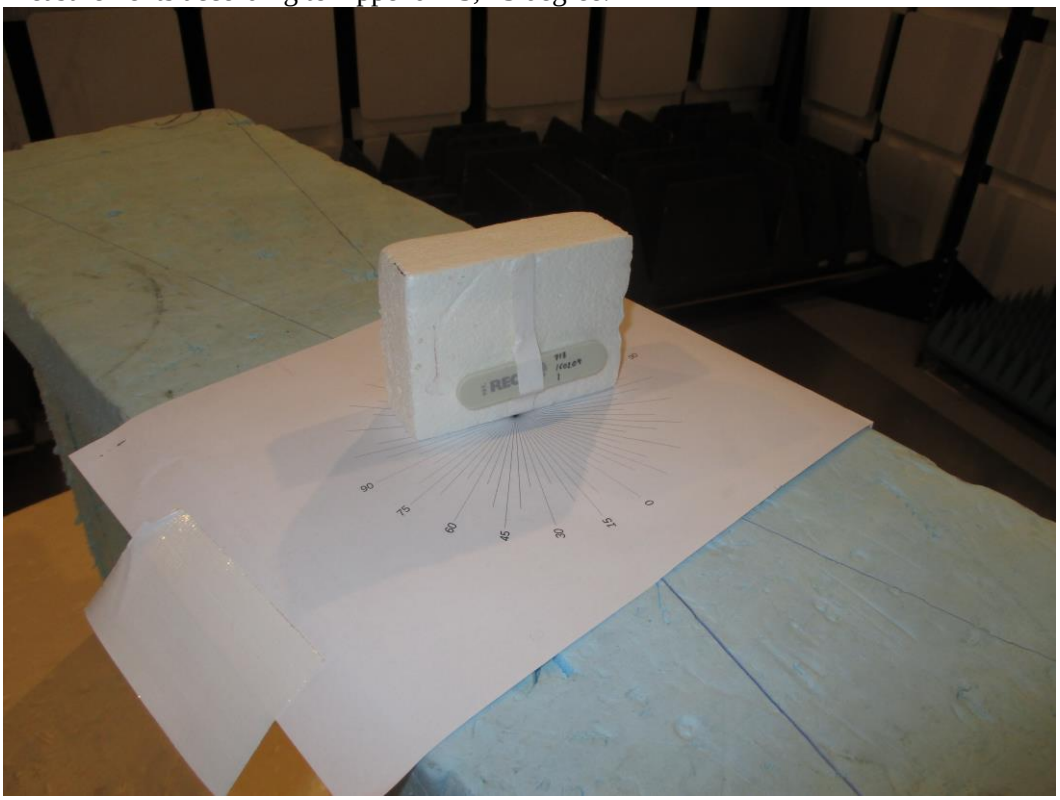


Photo 21:
Measurements according to Appendix 5, 75 degree.

Photo 22:
Measurements according to Appendix 5, 75 degree.



EUT.

Photo 23:
Front with id and batch number.

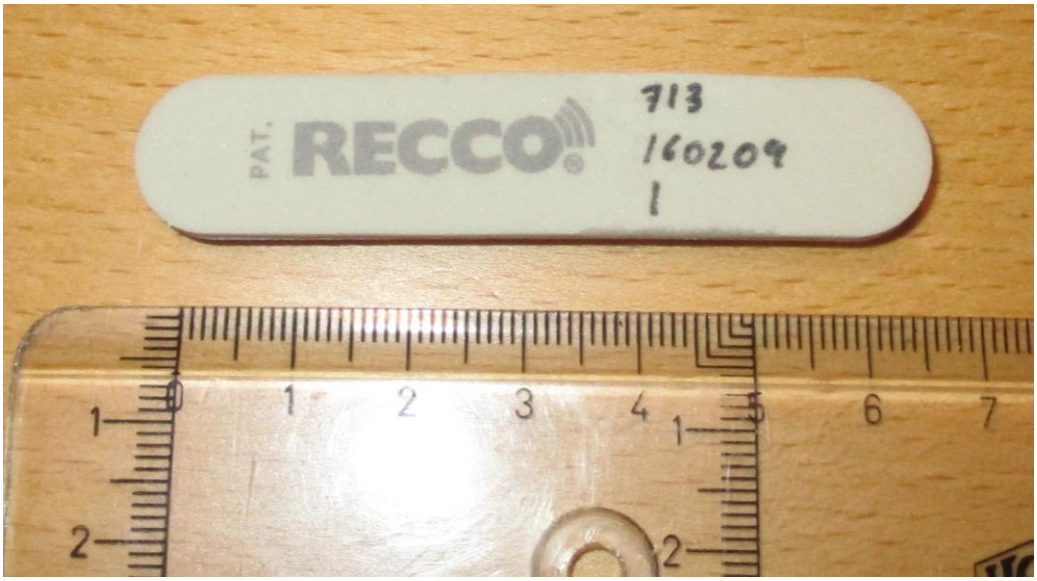


Photo 24:
Rear.

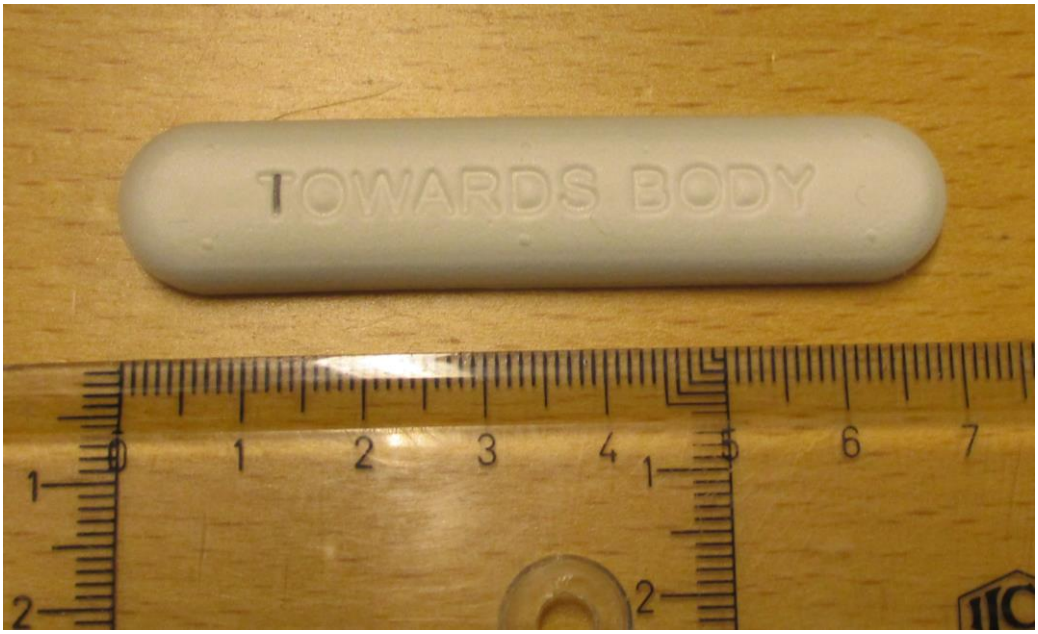


Photo 25:
Top.