Test Report No. 9812320845

***Applicant*: Check-Cap Ltd.**

Equipment Under Test:

C-Scan track transceiver

Model: *100076-00*

From The Standards Institution
Of Israel
Industry Division
Electronics & Telematics Laboratory
EMC Branch

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

Certificate Number: AT-1359

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Applicant:	Check-Cap Ltd.
Address:	Aba Hushi 29 Ave., POB 1271, Isfiya, Israel
Sample for test selected by:	The customer
The date of tests:	22 July, 13 August 2018

Description of Equipment Under Test (EUT):	C-Scan track transceiver.
Model:	100076-00
Software version of radio unit:	3.3.0
Hardware version of radio unit:	05
Manufactured by:	Check-Cap Ltd.

Reference Documents:

❖	CFR 47 FCC:	Rules and Regulations; Part 15. “Radio frequency devices”; Subpart C: “Intentional radiators” Section 15.205. “Restricted bands of operations”, Section 15.209. “Radiated emission limits, general requirements”. “Radiated Emission Limits, Additional Provisions”; Section 15.231. “Periodic operation in the bands 40.66 – 40.70 MHz, and above 70 MHz”.

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1. EUT Description and operation

1.1. General description:

* Note: the applicant supplied all information in clause below.

The C-Scan Track transceiver is a standalone application used for to collect acquired data from C-Scan Cap. The acquired data from the human colon is used to analyze and identify polyps. The EUT comprises the 433.5 MHz transceiver module.
C-Scan Track has two RF transceivers. The purpose of the two transceivers is to cover the clinical volume of the C-Scan System (human abdomen). Both of the transceivers are used for reception simultaneously and if transmission back to the capsule is required, only the best reception transceiver is used. There are no simultaneous transmissions from both transceivers.
Power source: 2x1.5 volt AA Lithium batteries.

Declare maximum EIRP power:	4 dBm@ 433.5 MHz
Type of modulation:	GFSK
Antenna type:	Internal integrated on PCB. Comply with part 15.203 requirements.

The EUT external view presented in photo # 1.

Photo 1. Transceiver external view.

2. Test summary

Parameter	FCC Part 15 Reference paragraph	Verdict
Radiated emission from intentional radiators in restricted bands	Subpart C Section 15.205	Comply
Test of field strength emission from intentional radiators	"Radiated Emission Limits, Additional Provisions"; Section 15.231.	Comply
Occupied bandwidth	Subpart C section 15.231(c)	Comply

Electronics & Telematics Laboratory

August 2018

Name: Eng. Yuri Rozenberg
Position: Head of EMC Branch

Name: Michael Feldman
Position: Test Technician

Measurement uncertainty.

The test equipment has been calibrated according to its recommended procedures and is within the manufacturer's published limit of error.
The laboratory calibrates its standards by a third party (traceable to NIST, USA) on a regular basis according to equipment manufacturer requirements.
In the following table the uncertainty calculation is given.

Type of disturbance Test description	Calculated uncertainty U_{LAB}
Radiated disturbance electric field strength in a SAR at 3 m distance 30 MHz – 1.0 GHz	±4.32 dB
electric field strength in a FAR at 3 m distance 1.0 – 18 GHz.	±4.47 dB
18 – 40 GHz.	±2.78 dB

Normative References.

FCC 47 CFR Part 15, Subpart C	Radio Frequency Devices Subpart C – Intentional Radiators
ANSI C63.4: 2009	American National Standard for Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10: 2013	American National Standard for Testing of Unlicensed Wireless Devices.

2.1. Potential emission sources:

The potential emission sources are detailed in Table 1.

Table 1. Potential emission sources

Frequency	Location
8.12 kHz	Positioning system magnetic field frequency
32.768 KHz	Microcontroller oscillator
12.0 MHz	Microcontroller Lo crystal
26.0 MHz	RF transceiver Lo oscillator
50.0 MHz	Microcontroller clock crystal
433.5 MHz	RF signal

2.2. EUT setup and operation:

Test was performed in continuous transmission mode.

3. Measurements and derived results

3.1. Location of the Test Site:

Radiated test measurements were conducted in the Anechoic chamber at the EMC laboratory of the Standards Institution of Israel in Tel-Aviv.

3.2. Test condition:

Temperature: 24 °C. Humidity: 56 %. Atmospheric pressure: 1010 mbar.

3.3. Radiated emission test.

3.3.1. General:

Per FCC Part 15 Subpart C Sections 15.209, 15.231.

- Initial scans were made using a peak detector but still using the appropriate ANSI IF bandwidth.
- A tolerance limit was set 10 dB below the specification limit. Levels above the tolerance limit were retested using the Peak, QP or Average detectors.

3.3.2. Radiated emission measurements:

Preliminary investigation was performed from the lowest radio frequency signal generated in the equipment up to ten harmonic of a carrier frequency.
The final radiated emission measurements were performed in the semi Anechoic chamber at the 3 m test distances. Test was started with new fresh batteries. The EUT was operated in continue transmition mode. The transmitter was installed on a turn - table. Biconilog and Double Ridged Guide antennas were used. The measurements were performed at frequencies at which the signal level was 10 dB below the limit or less. The levels were maximized by rotating turntable through 360° and changing antenna-to-EUT polarization from vertical to horizontal. The worse case result was noted in tables.

3.3.3. Radiated emission test results:

Final measurements result are presented in tables and plots ## 1 - 8 in section 3.5.

3.4. Common conditions for operation in the band above 70 MHz.

3.4.1. General:

Per FCC Part 15 Subpart C clause 15.231 (a).

3.4.2. Requirements:

15.231(a) – Transmitter is not a part of security system.

15.231(a)(1) – Not applicable. Transmitter is not activated manually.

15.231(a)(2) - Transmission duration is limited by program and after activation is less than 5 second.

15.231(a)(3) – *Duration of transmissions data in application is 1.14 second per hour that is less than 2 seconds limit per hour.

15.231(a)(4) – Transmitter is not designed to use during the emergencies.

15.231(a)(5) - Transmitter doesn't exceed the limits of this section.

*Based on applicant declaration:

"The calculation below shows how the limitation of 730 pages per hour effects the total transmission time of C-Scan Track in one hour. For the purpose of worst case scenario calculation, we assume that 730 pages are requested by one scan request from the capsule.

$Start\ Data\ Session\ Acknowledge\ Packet\ TX\ time = 0.64\ mSec$
$End\ Data\ Session\ Acknowledge\ Packe\ TX\ time = 0.92\ mSec$
$Total\ Track\ TX\ time\ (one\ data\ session) = 0.64 + 0.92 = 1.56\ mSec$
$Total\ Track\ TX\ time\ (730\ data\ sessions) = 1.56 \times 730 = 1138.8\ mSec = 1.14\ Sec$"

3.4.3. Summary:

The EUT is complies with the requirements of clause 15.231(a).

3.5. Test of field strength emission from intentional radiator.

3.5.1. General:

Per FCC Part 15 Subpart C clause 15.231(b).

3.5.2. Requirements:

The field strength emissions from intentional radiators operated on this frequency shall comply with the limit based on the average value.

Fundamental Frequency MHz	Calculated Field Strength limit of Fundamental dBμV/m	Calculated Field Strength limit of Harmonics dBμV/m
433.5	80.8	60.8

Note: Peak field strength shall not exceed the maximum permitted specified limit by more than 20 dB.
Field strength limits are specified at a distance of 3 meters.

3.5.3. Test procedure:

The test was conducted according to clause 15.231.

3.5.4. Test summary:

The tested unit meets the standard requirement.

3.5.5. Test results:

Radiated emission result at carrier frequencies.

Carrier frequency MHz	Peak Ampl. dBμV/m	Peak Limit dBμV/m	Margin dB	Avg Ampl.* dBμV/m	Specified Avg. @3m limit, dBμV/m	Margin dB
433.5	100.3	100.8	0.5	60.3	80.8	>20

The test was provided for both left and right side transmitters. The worst case result present in a table above.
*Average amplitude result was calculated from measured Peak value – Average factor.
Average factor = 20Log Tx on/100msec = 20Log [0.92ms/100] = - 40 dB
For transmitter average factor calculation see plot # 11.

For recorded Fundamental frequency result, see plots #1 and #2.
All received spurious emissions were found below the specified limit.
Founded spurious emissions results presented in table below.

Spurious emission test result.

Freq. MHz	Antenna pol. V/H	Peak Ampl dBμV/m	Peak Ampl limit, dBμV/m	Margin dB	Avg Ampl. dBμV/m	Specified @3m limit, dBμV/m	Margin dB	Ref. to plot #
867.2	H	47.7	-	-	-	60.8	13.1	8

Unwanted emissions test result.

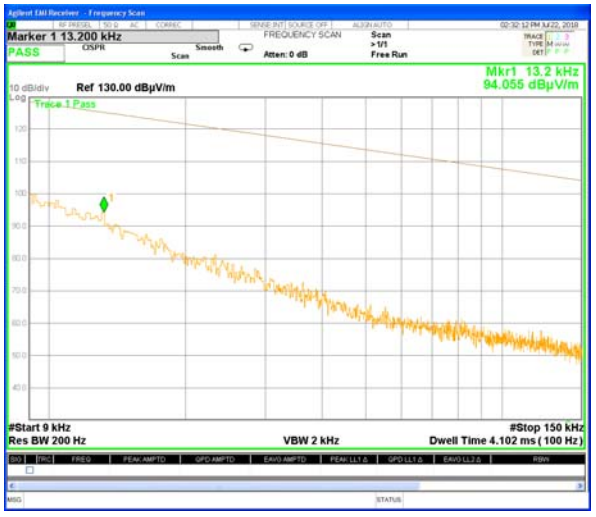
Freq. MHz	Antenna Polariz. V/H	Antenna Height (m)	Turn table Angle (°)	QP. Emission Level (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)	Reference to plot #
150.0	V	2.3	257	38.2	43.5	5.3	5
250.0	V	1.0	66	33.5	46.0	12.5	5
450.0	V	1.0	71	40.7	46.0	5.3	6
550.0	V	1.0	102	39.4	46.0	6.6	6
750.0	V	1.2	69	42.1	46.0	3.9	6
866.7	V	1.0	247	43.8	46.0	2.2	6
950.0	V	1.2	299	44.3	46.0	1.7	6

Emission level = E Reading (dBμV) + Cable loss (dB) + Antenna Factor (dB/m). For Cable Loss and Antenna Factor refer to Appendix 2.
Margin (dB) = Limit (dBμV/m) – Emission level (dBμV/m)

Fundamental frequency test.

Plot # 1. Left side transmitter.

Plot # 2. Right side transmitter



Plot # 3.

Plot # 4.

Spurious emissions scan 0.009 MHz – 30 MHz.

Plot # 5. Spurious emissions scan 30 MHz – 433.0 MHz.

Plot # 6. Spurious emissions scan 434.2 MHz – 1000 MHz.

Plot # 7. Spurious emissions scan 1.0 – 5.0 GHz.

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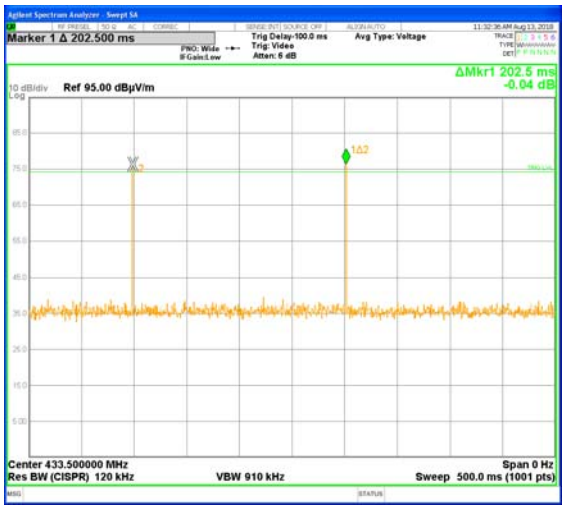
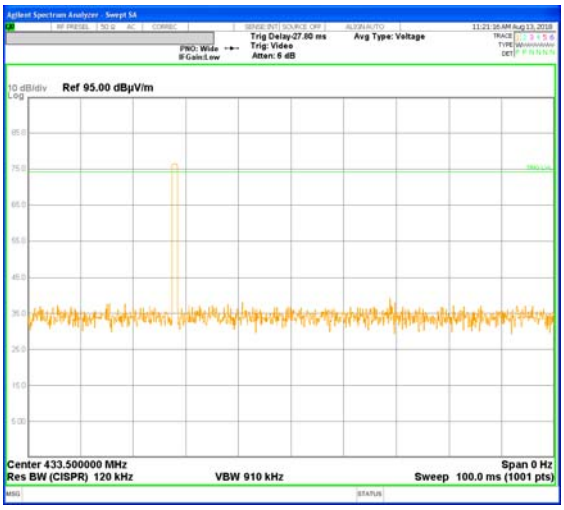
Harmonic emissions result.

Plot # 8.

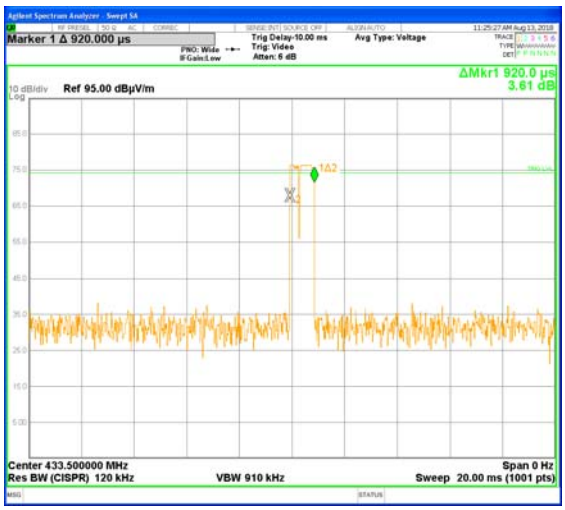
Duty Cycle result.



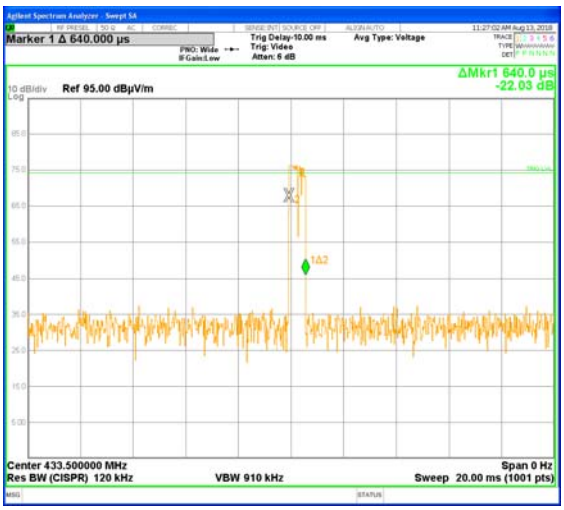
Plot # 9. Transmissions in 500 msec.



Plot # 10. Transmissions in 100 msec.



Plot # 11. Long transmission duration.



Plot # 12. Short transmission duration.

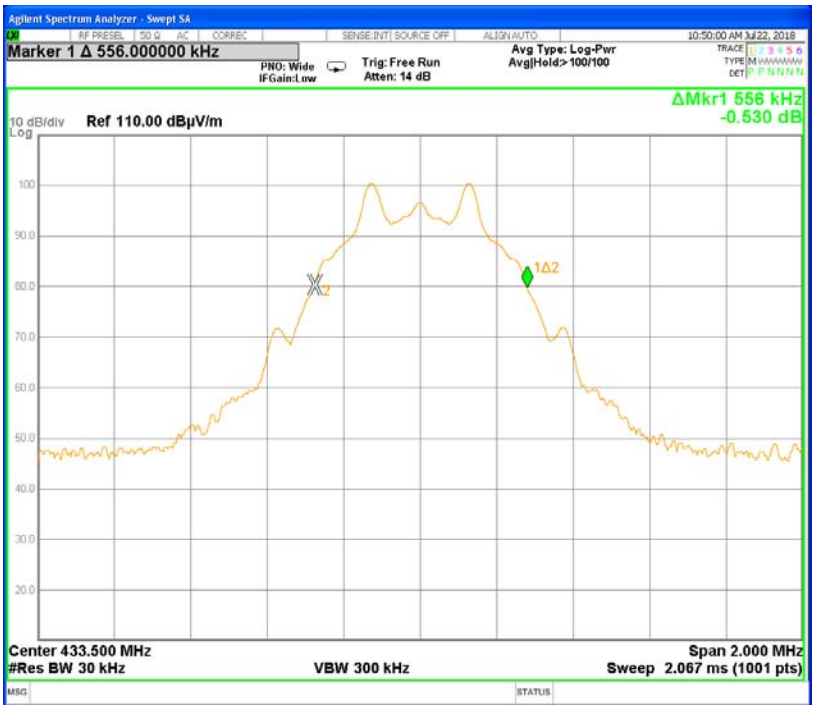
3.6. Test of occupied bandwidth per 15.231(c)

3.6.1. Requirements:

The bandwidth of the emissions shall be no wide than 0.25% of the center frequency for devises operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.
For 433.5 MHz center frequency allowed emission bandwidth shell be less than (433.5/100) 0.25% = 1.083 MHz.

3.6.2. Test results:

Test result present in plot below.



Plot # 13. Occupied bandwidth test result

3.6.3. Test summary:

20 dB occupied bandwidth is 0.556 MHz.
The tested unit meets the standard requirement.

4. Appendix 1. Test equipment used

All measurements equipment is on SII calibration schedule with a recalibration interval not exceeding one year.

Test equipment used

No	Description	Manufacturer information			Due Calibration date
		Name	Model	Serial No	
1	MXE EMI Receiver 20 Hz -26.5 GHz	Agilent	N9038A	SII 650114	April 2019
2	Double Ridged Guide Antenna 0.75 – 18 GHz	ETS-Lindgren	3115	00143138	December 2018
3	Broadband Horn antenna 15 – 40 GHz	Schwarzbeck Mess-Electronik	BBHA 9170	9170-341	December 2018
4	Double Ridged Waveguide Horn Antenna 1 – 18 GHz	ETS-Lindgren	3117	00139055	December 2018
5	Antenna Biconilog 30 – 6000 MHz	ETS-Lindgren	31142D	0146490	December 2018
6	Spectrum analyzer 20 Hz-40 GHz	Rohde&Schwarz	ESU 40	100168	November 2018
7	EMI Analyser 9 kHz - 26.5 GHz	HP	E7405A	SII 4944	May 2019
8	Attenuator 3 dB DC – 12.4 GHz	HP	8491A	50469	October 2018
9	LISN 9 kHz – 30 MHz	FCC	LISN 250-32-4-16	SII5023	October 2018
10	Transient limiter 0.009-200 MHz	HP	11947A	3107105	August 2018
11	Cable RF 1m	Huber-Suhner	Sucoflex 104PE	21325/4PE	October 2018
12	Cable RF 4m	Huber-Suhner	Sucoflex 104PE	21329/4PE	October 2018
13	Cable RF 0.5m	Huber-Suhner	Multiflex 141	520201	October 2018
14	Active Loop antenna 1.0 kHz – 30 MHz	ETS-Lindgren	6507	00144641	December 2018

5. Appendix 2: Antenna Factor and Cable Loss

Cable Loss. Mast 6 m set cable.

Point	Frequency, MHz	Cable Loss, dB	Point	Frequency, MHz	Cable Loss, dB
1	30	0.3	21	1000	2.5
2	50	0.4	22	1100	2.6
3	100	0.6	23	1200	2.8
4	150	0.8	24	1300	2.9
5	200	1.0	25	1400	3.1
6	250	1.1	26	1500	3.2
7	300	1.2	27	1600	3.3
8	350	1.3	28	1700	3.5
9	400	1.5	29	1800	3.6
10	450	1.6	30	1900	3.7
11	500	1.7	31	2000	3.9
12	550	1.8	32	2100	4.0
13	600	1.9	33	2200	4.1
14	650	1.9	34	2300	4.2
15	700	2.0	35	2400	4.4
16	750	2.1	36	2500	4.6
17	800	2.1	37	2600	4.7
18	850	2.2	38	2700	4.8
19	900	2.3	39	2800	4.9
20	950	2.4	40	2900	5.0

Antenna factor
Biconilog Antenna, ETS-Lindgren mod. 31142D, S/N: 0146490 3m calibration.

No.	f / MHz	AF / dB/m	f / MHz	AF / dB/m	f / MHz	AF / dB/m
1	30	18.7	250	12.0	2750	31.0
2	35	15.7	300	13.8	3000	31.2
3	40	12.9	400	16.2	3250	32.7
4	45	10.6	500	18.6	3500	34.5
5	50	9.0	600	20.2	3750	34.3
6	60	7.3	700	21.8	4000	34.5
7	70	7.7	800	22.9	4250	35.3
8	80	8.2	900	24.1	4500	35.5
9	90	9.2	1000	24.8	4750	36.1
10	100	9.4	1250	26.9	5000	37.4
11	120	8.5	1500	30.2	5250	38.4
12	140	8.5	1750	28.5	5000	39.9
13	160	9.1	2000	28.9	5750	38.2
14	180	10.5	2250	29.8	6000	39.1
15	200	10.9	2500	32.5		

Antenna Factor
Double Ridged Guide Antenna mfr ETS-Lindgren model 3115 1m calibration

Point	Frequency (MHz)	Antenna Factor (dB/m)
1	1000	23.7
2	2000	28.5
3	3000	29.6
4	4000	32.5
5	4500	32.6
6	5000	33.5
7	6000	36.1
8	6500	36.5
9	7000	37.3
10	7500	38.0
11	8000	37.3
12	8500	37.9
13	9000	38.1
14	9500	38.5
15	10000	38.7
16	10500	38.8
17	11000	38.6
18	11500	38.8
19	12000	38.9
20	12500	39.3
21	13000	40.2
22	13500	40.8
23	14000	40.6
24	14500	40.4
25	15000	39.6
26	15500	39.5
27	16000	39.8
28	16500	40.4
29	17000	41.3
30	17500	42.8
31	18000	43.2

Cable Loss
Type: Sucoflex 104PE; Ser.No.21329/4PE; 4 m length

Point	Frequency, GHz	Cable Loss, dB
1	0.0-1.0	1.7
2	1.0– 3.5	3.2
3	3.5– 5.5	4.0
4	5.5 – 7.5	4.7
5	7.5 – 9.5	5.3
6	9.5 – 10.5	5.6
7	10.5 – 12.5	6.2
8	12.5 – 14.5	6.8
9	14.5 – 16.5	7.5
10	16.5 – 18.0	8.1

Active Loop antenna mfr.ETS-Lindgren mod. 6507 S/N 144641.

Frequency, MHz	Magnetic Antenna factor dBS/m	Electric Antenna factor dB/m
0.009	-20.0	31.5
0.010	-21.0	30.5
0.020	-26.7	24.9
0.075	-32.4	19.1
0.100	-32.7	18.8
0.150	-32.9	18.6
0.250	-33.0	18.5
0.500	-33.0	18.5
0.750	-33.0	18.5
1.000	-32.8	18.7
2.000	-32.7	18.8
3.000	-32.9	18.7
4.000	-33.2	18.3
5.000	-33.4	18.2
10.000	-34.0	17.6
15.000	--34.2	17.3
20.000	-34.4	17.1
25.000	-34.8	16.7
30.000	-35.0	16.5

6. Appendix 3: Test setups photo.

Photo 2.

Photo 3.

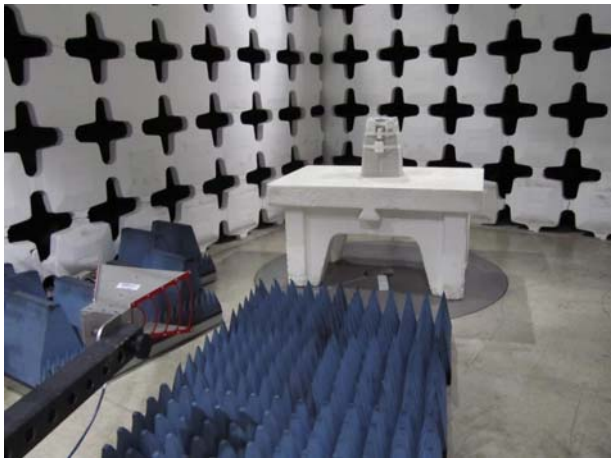


Photo 4.