CETECOM ICT Services
consulting - testing - certification

TEST REPORT

Test Report No.: 1-5708/12-01-02

DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-01

Testing Laboratory

CETECOM ICT Services GmbH
Untertürkheimer Straße 6 – 10
66117 Saarbrücken/Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: http://www.cetecom.com
e-mail: ict@cetecom.com

Accredited Test Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-01

Applicant

HACH LANGE GmbH
Willstätterstraße 11
40549 Düsseldorf/GERMANY

Phone: ---

Contact: Florian Eckelmann
e-mail: florian.eckelmann@hach-lange.de
Phone: +49 30 80986-231
Fax: +49 30 80986-283

Manufacturer

HACH LANGE GmbH
Willstätterstraße 11
40549 Düsseldorf/GERMANY

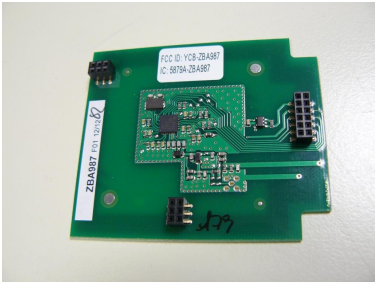
Test Standard/s

ICNIRP Guidelines	Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)
IEEE Std C95.1-2005	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
EN 50364	Limitation of human exposure to electromagnetic fields from devices operating in the frequency range 0 Hz to 10 GHz, used in Electronic Article Surveillance (EAS), Radio Frequency Identification (RFID) and similar applications

For further applied test standards please refer to section 3 of this test report.

Test Item

Kind of test item:	RFID Radio Module
Model name:	**ZBA987**
S/N serial number:	N/A
FCC-ID:	YCB-ZBA987
IC:	5879A-ZBA987
Hardware status:	XMF812-D
Software status:	---
Frequency:	RFID 13.56 MHz
Antenna:	Integrated antenna
Supply Voltage:	5V DC
Accessories:	Host unit RFID handheld device LOC100 (Part No.: LQG156.xx.xxx1x powered by 2x1.5V AA Batteries)
Test sample status:	identical prototype
Exposure category:	general population / uncontrolled environment



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Test Report authorised:

Thomas Vogler
Senior Testing Manager

Test performed:

Oleksandr Hnatovskiy
Testing Manager

1 Table of contents

2 General information

2.1 Notes and disclaimer

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2.2 Application details

Date of receipt of order:	2012-12-06
Date of receipt of test item:	2012-12-10
Start of test:	2013-01-15
End of test:	2013-01-15
Person(s) present during the test:	

2.3 Statement of compliance

The EMF values found for the ZBA987 RFID Radio Module are below the maximum allowed levels according to the standards listed in section 3.

3 Test standard/s:

Test Standard	Version	Test Standard Description
ICNIRP Guidelines	1998-04	Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)
IEEE Std C95.1-2005	2005-10	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
EN 50364	2010-11	Limitation of human exposure to electromagnetic fields from devices operating in the frequency range 0 Hz to 10 GHz, used in Electronic Article Surveillance (EAS), Radio Frequency Identification (RFID) and similar applications
EN 50357	2002-05	Evaluation of human exposure to electromagnetic fields from devices used in Electronic Article Surveillance (EAS), Radio Frequency Identification (RFID) and similar applications
1999/519/EC	1999-07	Council Recommendation 1999/519/EC of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (Official Journal L 197 of 30 July 1999)

3.1 RF exposure limits

Reference levels for general public (uncontrolled environment) exposure to time-varying electric and magnetic fields

According to:	INCNIRP Guidelines		IEEE Std C95.1	
	E-field	B-field	E-field	B-field
Frequency	V / m	µT	V / m	µT
< 1 Hz	**--**	40000	--	--
1 – 8 Hz	**10000**	**40000/f²**	--	--
8 – 25 Hz	**10000**	**5000/f**	--	--
0.025 – 0.8 kHz	**250/f**	**5/f**	--	--
0.8 – 3 kHz	**250/f**	**6.25**	--	--
3 – 100 kHz	**87**	**6.25**	--	--
0.1 – 0.15 kHz	**87**	6.25	--	--
0.15 – 1 MHz	**87**	0.92/f	--	--
1 – 1.34 MHz	**$87/f^{1/2}$**	0.92/f	614	$16.3/f_M$
1.34 – 3 MHz	**$87/f^{1/2}$**	0.92/f	823.8/f	$16.3/f_M$
3 – 10 MHz	**$87/f^{1/2}$**	0.92/f	823.8/f	$16.3/f_M$
10 – 30 MHz	**28**	**0.092**	823.8/f	$16.3/f_M$
30 – 100 MHz	28	0.092	**27.5**	$158.3/ f_M^{1.668}$
100 – 300 MHz	28	0.092	**27.5**	0.0729
300 – 400 MHz	28	0.092	**27.5**	0.0729
400 – 2000 MHz	**$1.375f^{1/2}$**	$0.0046f^{1/2}$	--	--
2 – 300 GHz	**61**	0.20	--	--
50 Hz (power line)	**5000**	**100**		

Note: f as indicated in the frequency range column
f_M is the frequency in MHz

Limits for Maximum permissible exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3/1.34	614	1.63	*(100)	6
3.0-30	1842/f	4.98/f	*(900/f^2)	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	f/300	6
1500-100,000	-	-	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3/1.34	614	1.63	*(100)	30
3.0-30	842/f	2.19/f	*(180/f^2)	30
30-300	27.5	0.073	0.2	30
300-1500	-	-	f/1500	30
1500-100,000	-	-	1.0	30

f - Frequency in MHz
* - Plane wave equivalent power density
Note 1: Occupational/controlled limits apply in situations in which persons are exposed as consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
Note 2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

4 Summary of Measurement Results

☒	**No deviations from the technical specifications ascertained**
☐	Deviations from the technical specifications ascertained

5 Test Environment

Ambient temperature:	20 – 24 °C
Relative humidity content:	40 – 50 %
Air pressure:	not relevant for this kind of testing
Power supply:	Powered by host unit handheld RFID Device LOC100 (Part No.: LQC156.xx.xxx1x) 2x1.5V AA Batteries

6 Test Set-up

6.1 Measurement system

6.1.1 Broadband Electromagnetic Field Test system

A state of the art Broadband Electromagnetic Field Test system was used. The probes of the system are fitted with three sensors which measure the field strength of the X, Y and Z plane directions separately. The field strength is calculated by the instrument's processor by summing the squares of the three measured values.

The frequency range 5 Hz to 40 GHz is covered.
Depending on the used probe type E- and H-field or E-field only is detectable.

- EHP50B 5 Hz to 100 kHz E and H-Field
- EP 330 100 kHz to 3 GHz E-Field
- EP 408 1 MHz to 40 GHz E-Field

6.1.2 Test equipment list

Manufacturer	Device	Type	Serial number
PMM	Electric and Magnetic Field Meter	PMM 8053	0220J10945
PMM	Electric Field Probe 100 kHz - 3 GHz	EP330	1010J10627
PMM	Electric Field Probe 1 MHz - 40 GHz	EP408	0000J10902
PMM	Optical Repeater	OR 02	0100J10812
PMM	Electric and Magnetic Field Analyser 5 Hz – 100 kHz	EHP-50B	241WM30404
Rohde & Schwarz	Test Receiver	ESPI	1164640703
Rohde & Schwarz	Inductive Probe Antenna 100 kHz - 30 MHz	HFH 2-Z4	338301652

Last calibration date of PMM equipment : September 1, 2011

6.1.3 Averaging

For time efficient testing the average function “last 32 samples” was used. With some spot checks was verified, that caused by the time structure of the measured responses, the results did not change with a 6-minute-averaging.

6.1.4 Uncertainties

The probe uncertainties stated by the manufacturer are considered to be the main relevant and dominant issues.

	Expanded Uncertainties k=2 in %		
Probe type	Magn. Flux Density (B) in μT	Electrical Field Strength in V/m	Frequency Range
EHP 50B	4	3	5 Hz – 100 kHz
	10	10	50 Hz
EP 330	-	15	100 kHz – 3 GHz
	-	10	300 MHz
EP 408	-	10	1 MHz – 300 MHz
	-	15	300 MHz – 18 GHz
	-	20	18 GHz – 40 GHz

6.1.5 Validation procedure

Before performing the tests the empty test chamber was checked for system immanent frequency responses. The following background signal level was detected. All levels are small enough to allow accurate proof of the limits to be considered.

Test Pos.	Frequency Range	Magn. Flux Density (B) in μT	Electrical Field Strength in V/m	Remark
DUT position	5 – 1000 Hz	0.016	0.82	
	1 – 100 kHz	0.042	0.230	
	100 kHz – 3 GHz	-	<0.3	
	1 MHz – 40 GHz	-	<0.3	

6.1.6 Definition of test position and distances

In absence of an equipment specific regulation with given test distances, all not further noted test positions were measured in “touched” mode, the probe radome touching the DUT at the defined test position.
Due to the mechanical concept of the used probe a distance between DUT surface and electrical centre of the probe antennas remains.

Probe type	Magn. Field Distance in mm	Electrical Field distance in mm
EHP 50B	max. 4 cm	max. 4cm
EP 330	-	max. 2 cm
	-	
EP 408)*	-	max. 1.5 cm
	-	

)* The smaller distance to the DUT compared to the EP 330 may lead to slightly higher measurement values when frequency components between 1 MHz and 3 GHz are measured even if no additional contribution of signals higher than 3 GHz can be expected.

1 Test results

For considering worst-case conditions all measurements were performed at smallest possible distance from the device under test. Limits shown in the tables below are the lowest ones within the 4 wideband frequency ranges of the field probes applied.
Due to limitations of test equipment the frequency ranges of < 5 Hz and > 40 GHz for E-field and < 5Hz and > 30 MHz for H-field have been omitted.
Test positions see also photo documentation (Annex A).

description	distance (cm)	dBµA/m	B (µT)
limit			**0.092**
front	0	60.6	0.00135
front	5	38.4	0.00010
front	10	25.0	0.00002
front	15	17.0	0.00001
front	20	5.9	0.00000

Table 1: Test results 13.56 MHz with probe HFH 2-Z4

description	E (V/m) 0.01 - 1 kHz	E (V/m) 1 - 100 kHz	B (µT) 0.01 - 1 kHz	B (µT) 1 - 100 kHz	E(V/m) > 100 kHz	E(V/m) > 1 MHz
worst case limit of the considered frequency range	**250**	**87**	**6.25**	**6.25**	**28**	**28**
module	14.6	1.4	0.06	0.05	5.2	9.1

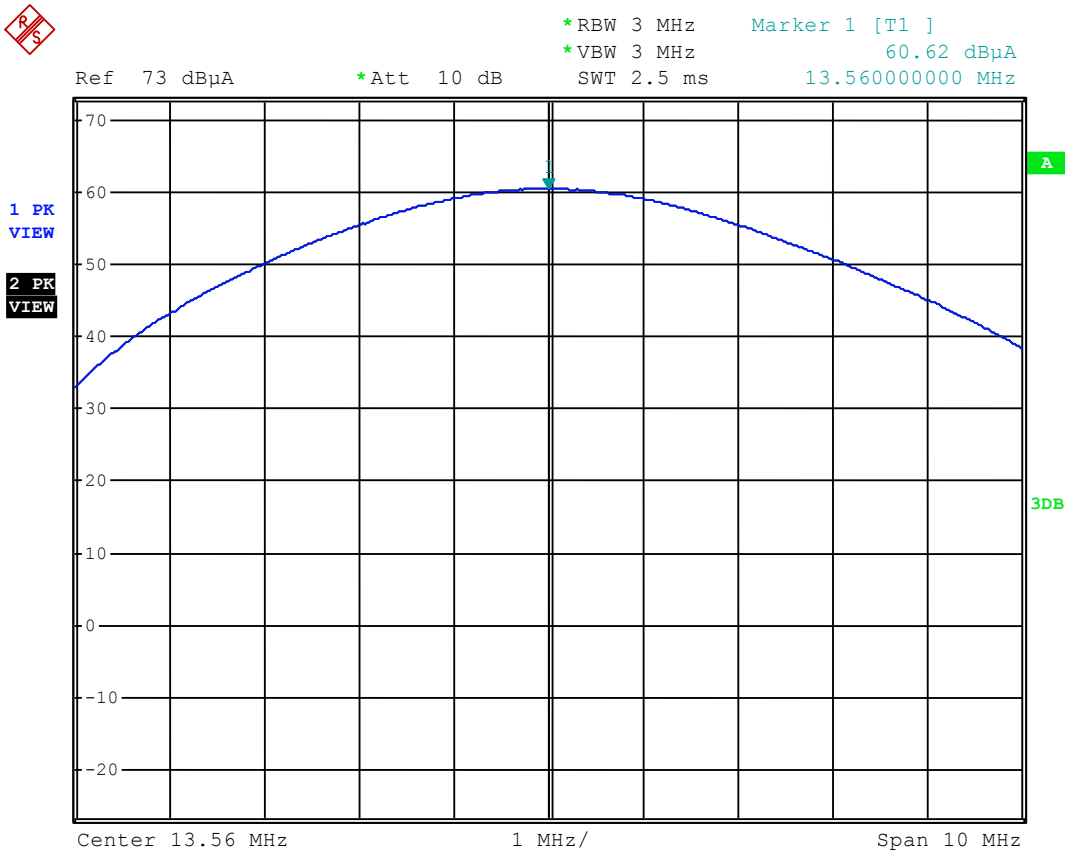
Table 2: Test results in active mode

Remark: the frequency range higher than 40 GHz was not tested because emissions mainly appear on power mains frequency and harmonics of it as well. Those frequency components concentrate on the frequency range below 1 GHz. Above that frequency no electromagnetic emission exceeds noise level.

Final verdict:

No relevant emissions out of the cabinet of the DUT could be detected.

1.1 Test results with probe HFH 2-Z4



Test results without any distance
Corresponding plots with intended radiator at 13.56MHz
(60.62dBµA/m = 0.0011A/m = 0.00135µT)

Annex A: Photo documentation

Photo 1: Test equipment overview

Photo 2: Test equipment

Photo 3: DUT - front view

Photo 4: DUT - side view

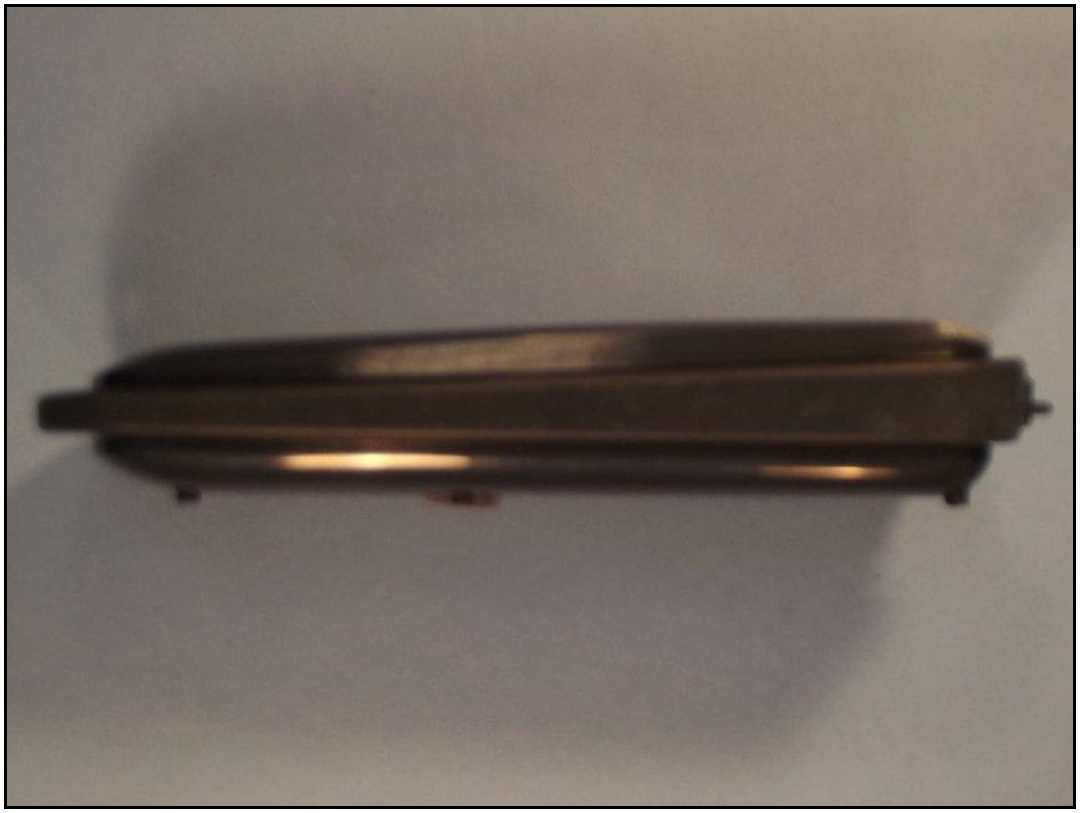


Photo 5: DUT - rear view

Photo 6: DUT - inside view

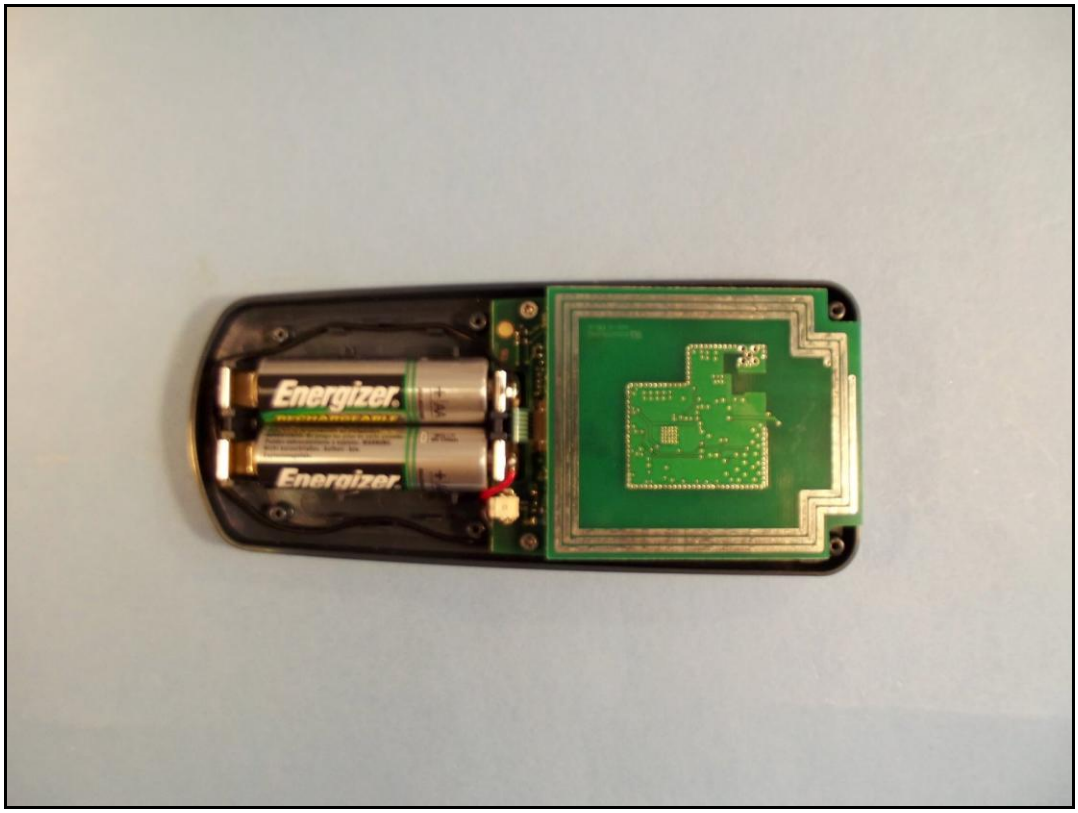


Photo 7: Module Antenna Side

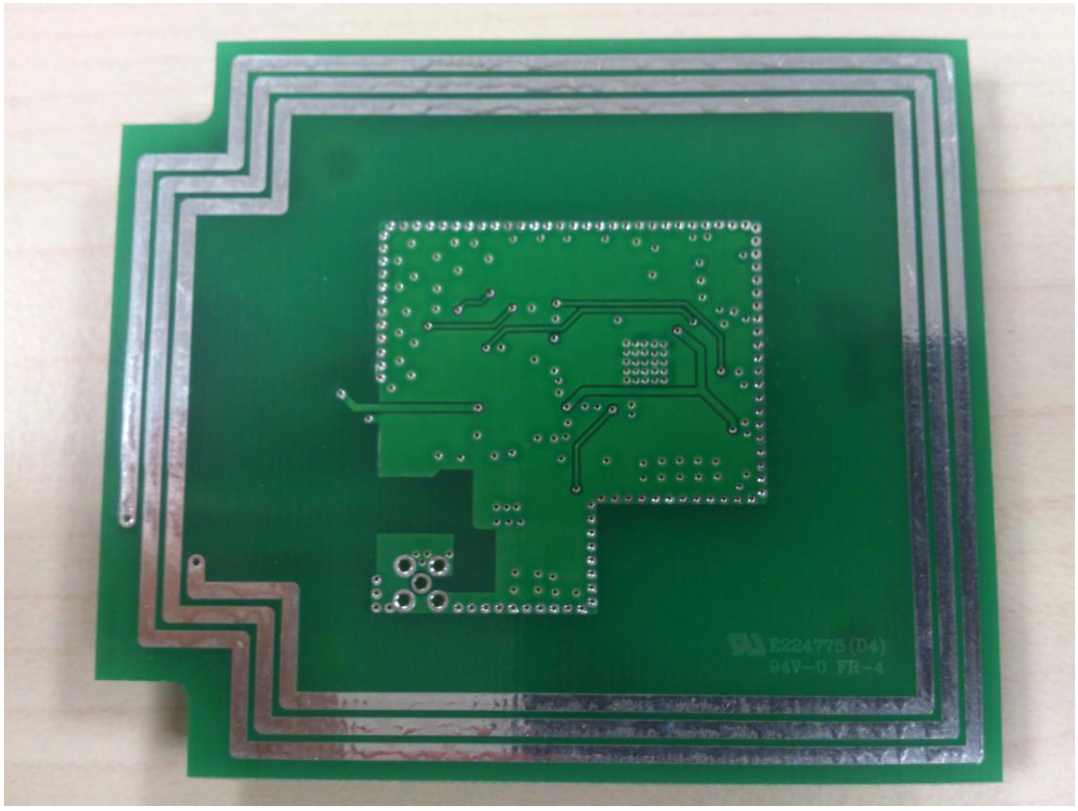


Photo 8: Module components side

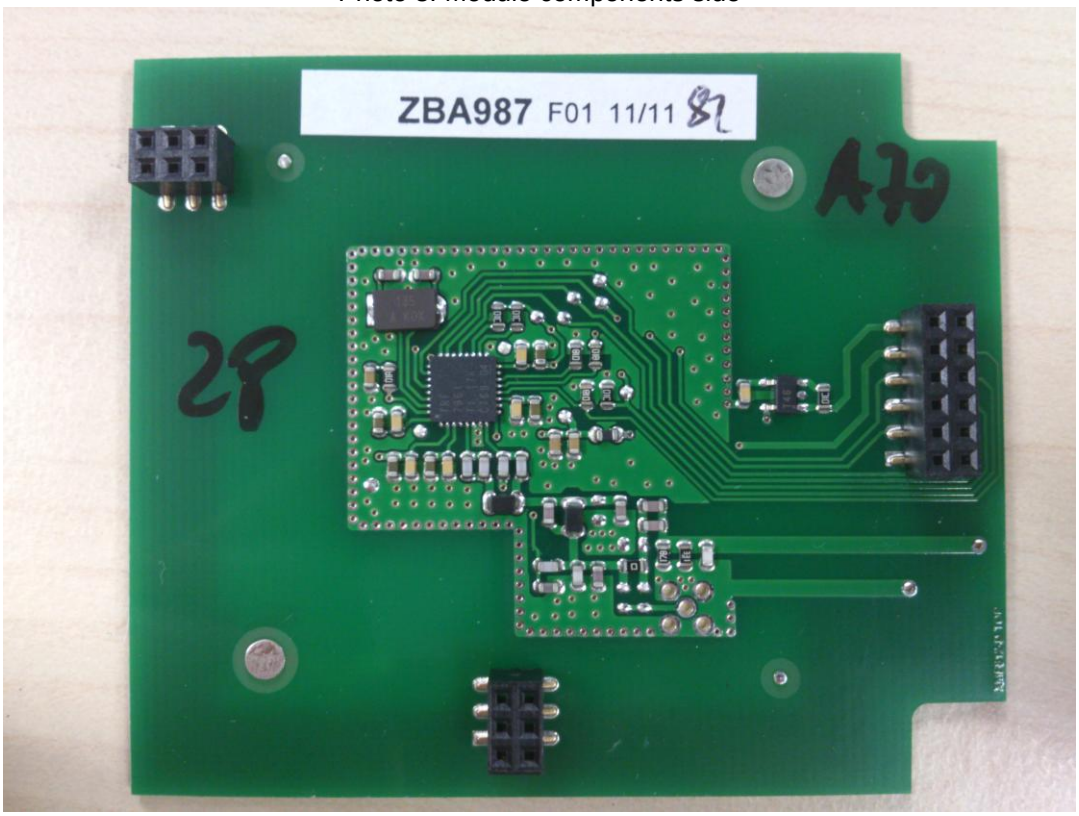


Photo 9: Module with final label

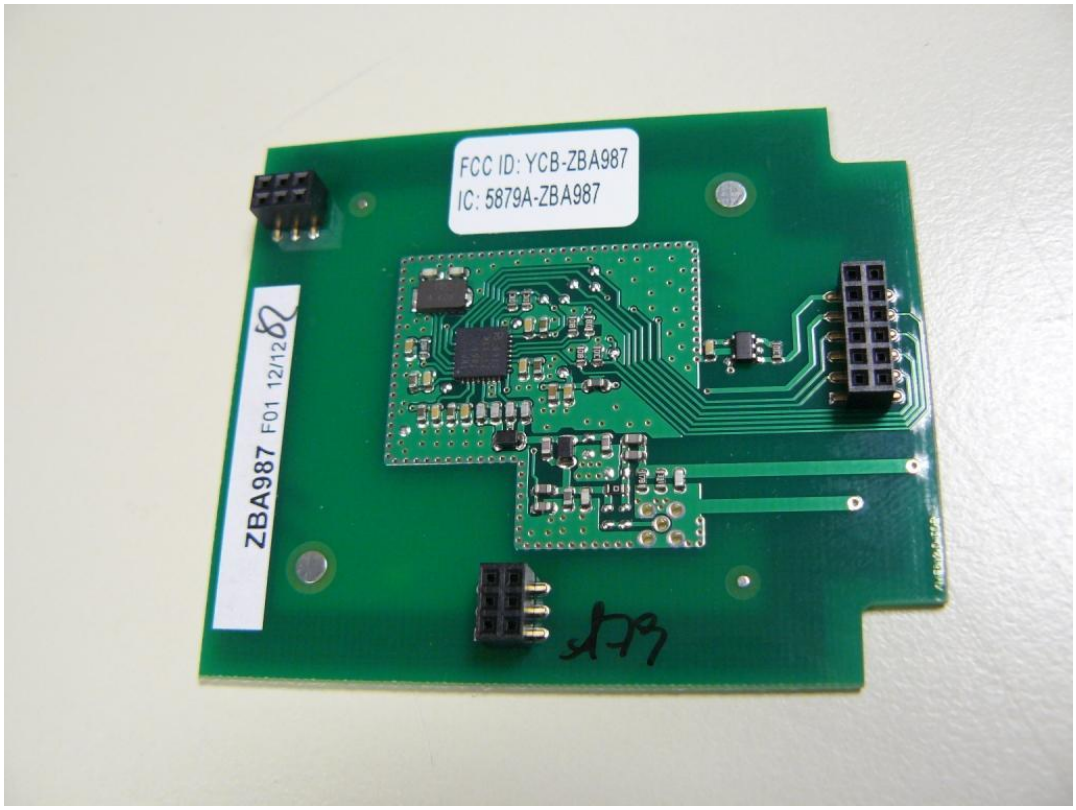


Photo 10: Test position with Probe HFH 2-Z4

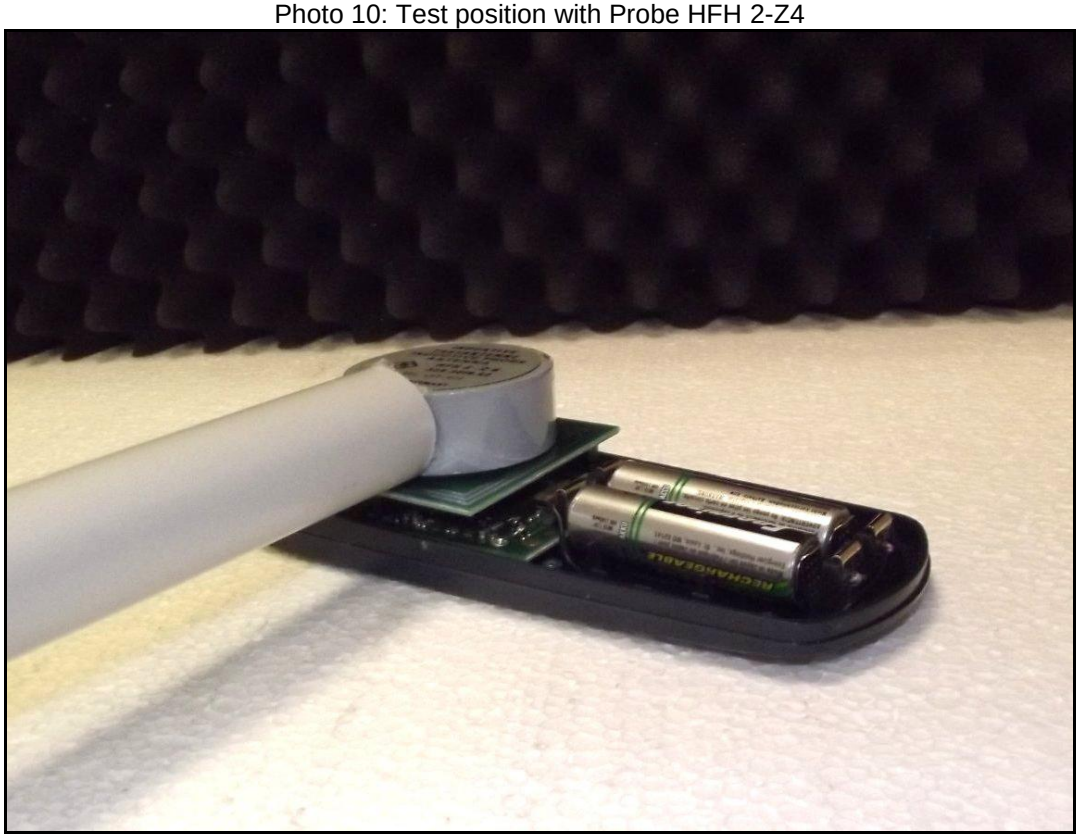


Photo 11: Test position with Probe EP330

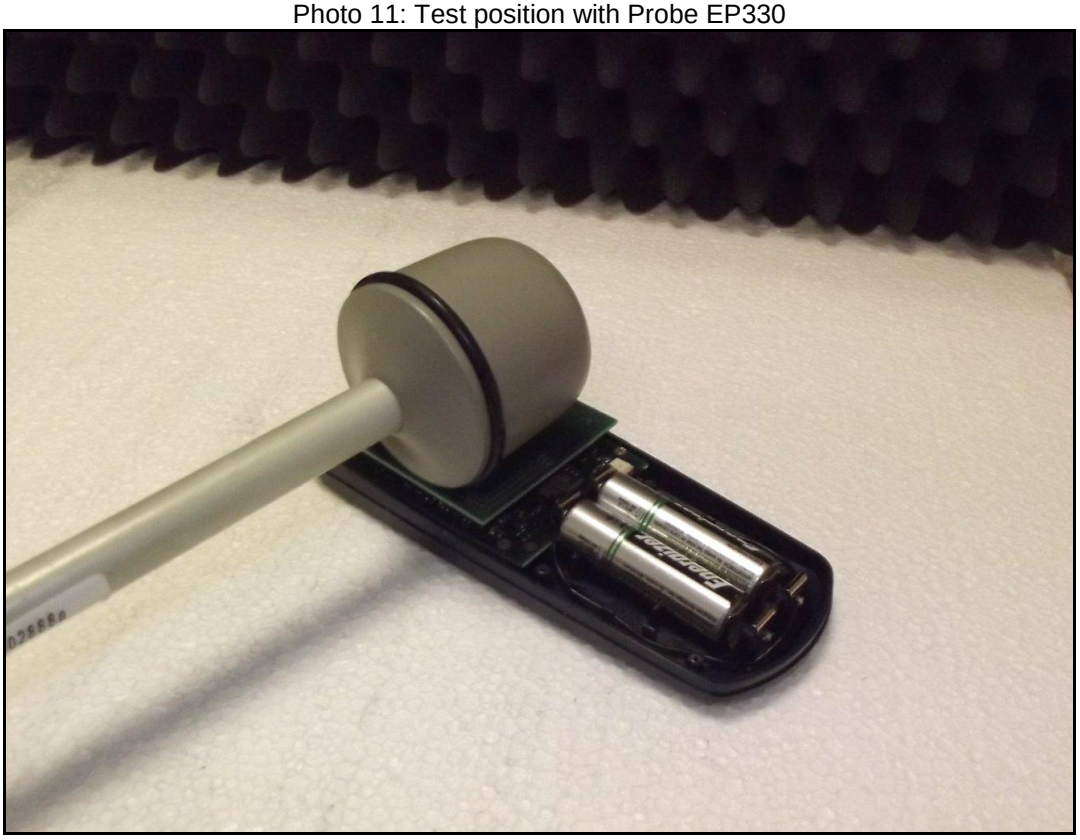


Photo 12: Test position with Probe EP408

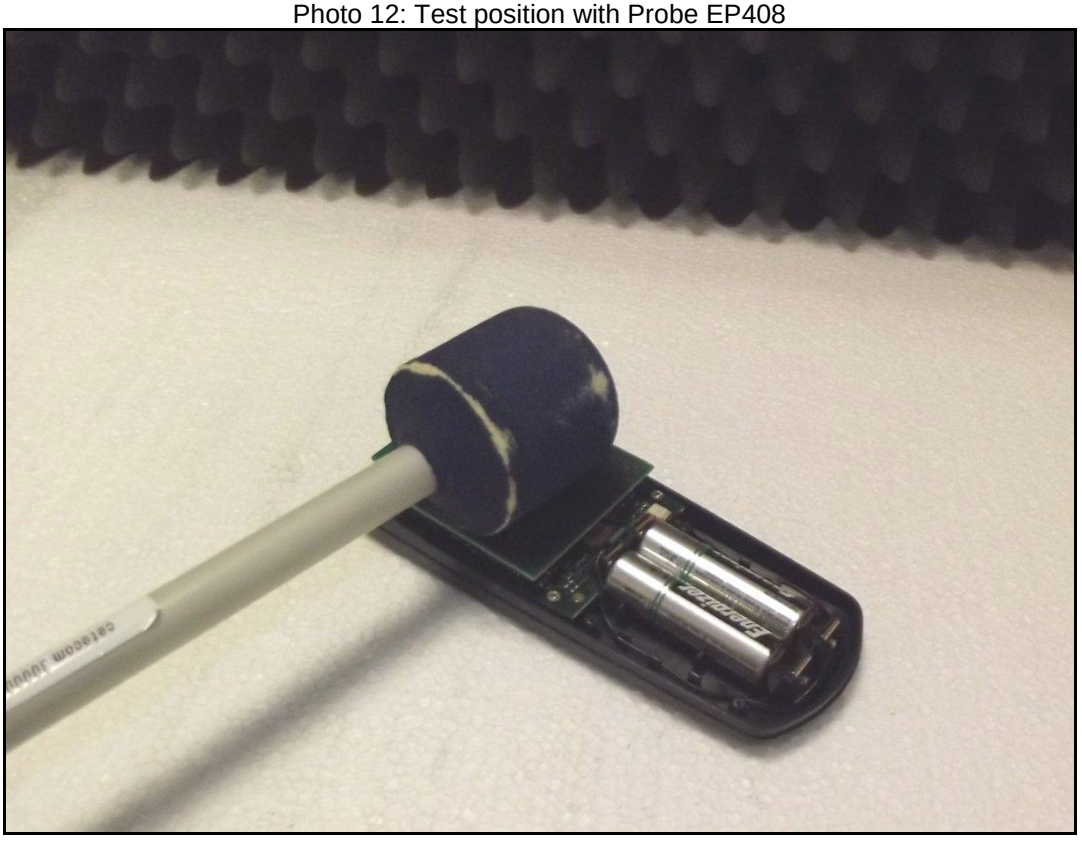


Photo 13: Test position with Probe HP50B

Annex B: Document History

Version	Applied Changes	Date of Release
	Initial Release	2013-01-15

Annex C: Further Information

Glossary

BW	-	Bandwidth
DUT	-	Device under Test
EUT	-	Equipment under Test
FCC	-	Federal Communication Commission
FCC ID	-	Company Identifier at FCC
HW	-	Hardware
IC	-	Industry Canada
Inv. No.	-	Inventory number
LTE	-	Long Term Evolution
N/A	-	not applicable
OET	-	Office of Engineering and Technology
RB	-	resource block(s)
SAR	-	Specific Absorption Rate
S/N	-	Serial Number
SW	-	Software