



Inter**Lab**[®]

FCC Measurement/Technical Report on

RFID module

Model: MIRARE TGS READER

FCC ID: ZQWGIT000001

Report Reference: MDE_TGYM_1101_FCCa

Test Laboratory:

Borsigstr. 11
Germany
7Layers AG
40880 Ratingen



Note:

The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the test laboratory.

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0 Summary

0.1 Technical Report Summary

Type of Authorization

Certification for an intentional radiator operating at 13.56 MHz

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 (10-1-11 Edition) and 15 (10-1-11 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 15, Subpart C – Intentional Radiators

§ 15.205 Restricted bands of operation

§ 15.207 Conducted limits

§ 15.209 Radiated emission limits; general requirements

§ 15.215 Additional provisions to the general radiated emission limitations

§ 15.225 Operation within the band 13.110-14.010 MHz

Summary Test Results:

The EUT complied with all performed tests as listed in chapter 0.2 Measurement Summary.

0.2 Measurement Summary

FCC Part 15, Subpart C § 15.207

Conducted Emissions AC Power line

The measurement was performed according to ANSI C63.4

OP-Mode	Setup	Port	2009 Final Result
op-mode 1	Setup_01	AC port (power line)	N/A

FCC Part 15, Subpart C §15.209

Radiated Emissions

The measurement was performed according to ANSI C63.4

OP-Mode	Setup	Port	2009 Final Result
op-mode 1	Setup_01	Enclosure	passed

FCC Part 15, Subpart C § 15.215

Occupied Bandwidth

The measurement was performed according to FCC § 2.1049

OP-Mode	Setup	Port	10-1-11 Edition Final Result
op-mode 1	Setup_02	Enclosure	passed

FCC Part 15, Subpart C § 15.225

Spectrum Mask

The measurement was performed according to ANSI C63.4

OP-Mode	Setup	Port	2009 Final Result
op-mode 1	Setup_01	Enclosure	passed

FCC Part 15, Subpart C § 15.225

Frequency Tolerance

The measurement was performed according to FCC § 2.1055


OP-Mode	Setup	Port	10-1-11 Edition Final Result
op-mode 2	Setup_01	Enclosure	passed

N/A not applicable (the EUT is powered by DC)

Responsible for
Accreditation Scope:



Responsible
for Test Report:




7 layers AG, Borsigstr. 11
40860 Ratingen, Germany
Phone +49 (0)2102 749 0



1 Administrative Data

1.1 Testing Laboratory

Company Name: 7Layers AG
Address Borsigstr. 11
40880 Ratingen
Germany

This facility has been fully described in a report submitted to the FCC and accepted under the registration number 96716.

The test facility is also accredited by the following accreditation organisation:
Laboratory accreditation no.: DAkKS D-PL-12140-01-01

Responsible for Accreditation Scope: Dipl.-Ing. Bernhard Retka
Dipl.-Ing. Robert Machulec
Dipl.-Ing. Andreas Petz

Report Template Version: 2012-03-14

1.2 Project Data

Responsible for testing and report: Dipl.-Ing. Marco Kullik
Date of Test(s): 2012-06-06 to 2012-07-26
Date of Report: 2013-02-19

1.3 Applicant Data

Company Name: TECHNOGYM SPA
Address: Via G. Peticari, 20
Gambettola (FC)
Italy
Contact Person: Mr. Pietro Lotti

1.4 Manufacturer Data

Company Name: please see applicant data
Address:
Contact Person:



2 Test object Data

2.1 General EUT Description

Equipment under Test	RFID transceiver
Type Designation:	MIFARE TGS KEY READER
Kind of Device: (optional)	RFID transceiver operating at 13.56 MHz
Voltage Type:	DC
Voltage level:	12 V /

General product description:

The MIFARE TGS KEY READER is a 13.56 MHz contactless smartcard reader and encoder for PC for reading RFID tags.

Specific product description for the EUT:

The EUT is a module, which can be built-in to TECHNOGYM equipment to enable the use of RFID tags.

The EUT provides the following ports:

Ports

Power and control connector
Enclosure

The main components of the EUT are listed and described in Chapter 2.2.



2.2 EUT Main components

Type, S/N, Short Descriptions etc. used in this Test Report

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status	Date of Receipt
EUT A (Code: VJ010A01)	Technogym RFID reader	MIFARE TGS KEY READER	001	0WQ00340	1.29.00	2011-10-02

NOTE: The short description is used to simplify the identification of the EUT in this test report.

2.3 Ancillary Equipment

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status	FCC ID
–	–	–	–	–	–	–

2.4 Auxiliary Equipment

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Auxiliary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	Serial no.	HW Status	SW Status	FCC ID
AUX 1	AC/DC supply	Mean Well GS18A12	–	–	–	–
AUX 2	Serial Cable	RS232 Serial cable	–	–	–	–



2.5 EUT Setups

This chapter describes the combination of EUTs and equipment used for testing. The rationale for selecting the EUTs, ancillary and auxiliary equipment and interconnecting cables, is to test a representative configuration meeting the requirements of the referenced standards.

Setup No.	Combination of EUTs	Description
Setup_01	EUT A + AUX 1 + AUX 2	setup for EUT active TRX

2.6 Operating Modes

This chapter describes the operating modes of the EUTs used for testing.

Op. Mode	Description of Operating Modes	Remarks
op-mode 1	CW carrier signal	EUT is transmitting a periodic CW signal and RX is continuously active.

2.7 Special software used for testing

Device uses a special "test mode" state in the firmware activated via RS232.

2.8 Product labelling

2.8.1 FCC ID label

2.8.2 Location of the label on the EUT

Please refer to the documentation of the applicant.

3 Test Results

3.1 Spurious radiated emissions

Standard FCC Part 15, 10-1-11 Edition Subpart C

The test was performed according to: ANSI C63.4–2009

3.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4–2009 in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m² in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.

The measurement procedure is implemented into the EMI test software ES-K1 from R&S. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is performed at 2 axes.

1. Measurement up to 30 MHz

The Loop antenna HFH2-Z2 is used.

Step 1: pre measurement

- Anechoic chamber
- Antenna distance: 10 m
- Detector: Peak-Maxhold
- Frequency range: 0.009 – 0.15 and 0.15 – 30 MHz
- Frequency steps: 0.1 kHz and 5 kHz
- IF-Bandwidth: 0.2 kHz and 10 kHz
- Measuring time / Frequency step: 100 ms

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: final measurement

For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is to find the maximum emission level.

- Open area test side
- Antenna distance: according to the Standard
- Detector: Quasi-Peak
- Frequency range: 0.009 – 30 MHz
- Frequency steps: measurement at frequencies detected in step 1
- IF-Bandwidth: 200 Hz – 10 kHz
- Measuring time / Frequency step: 100 ms

2. Measurement above 30 MHz and up to 1 GHz

Step 1: Preliminary scan

Preliminary test to identify the highest amplitudes relative to the limit.

Settings for step 1:

- Antenna distance: 3 m
- Detector: Peak-Maxhold
- Frequency range: 30 – 1000 MHz
- Frequency steps: 60 kHz
- IF-Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 μ s
- Turntable angle range: -180° to 180°
- Turntable step size: 90°
- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: second measurement

For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is, to find out the approximate turntable angle and antenna height for each frequency.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: -180° to 180°
- Turntable step size: 45°
- Height variation range: 1 – 4 m
- Height variation step size: 0.5 m
- Polarisation: horizontal + vertical

After this step the EMI test system has determined the following values for each frequency (of step 1):

- Frequency
- Azimuth value (of turntable)
- Antenna height

The last two values have now the following accuracy:

- Azimuth value (of turntable): 45°
- Antenna height: 0.5 m

Step 3: final measurement

In this step the accuracy of the turntable azimuth and antenna height will be improved.

This is necessary to find out the maximum value of every frequency.

For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will be slowly varied by $\pm 22.5^{\circ}$ around this value. During this action the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position the antenna height is also slowly varied by ± 25 cm around the antenna height determined. During this action the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: -22.5° to $+22.5^{\circ}$ around the determined value
- Height variation range: -0.25 m to $+0.25$ m around the determined value

**Step 4:** final measurement with QP detector

With the settings determined in step 3, the final measurement will be performed:

EMI receiver settings for step 4:

- Detector: Quasi-Peak(< 1 GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

3. Measurement above 1 GHz

The following modifications apply to the measurement procedure for the frequency range above 1 GHz:

The Equipment Under Test (EUT) was set up on a non-conductive support at 1.4 m height in the fully-anechoic chamber. The measurement distance was reduced to 1 m. The results were extrapolated by the extrapolation factor of 20 dB/decade (inverse linear distance for field strength measurements, inverse linear-distance squared for the power reference level measurements). Due to the fact that in this frequency range a double ridged wave guided horn antenna (up to 18 GHz) and a horn antenna (18-25 GHz) are used, the steps 2-4 are omitted. Step 1 was performed with one height of the receiving antenna only.

EMI receiver settings:

- Detector: Peak, Average
- IF Bandwidth = 1 MHz

3.1.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (d)

... In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

FCC Part 15, Subpart C, §15.209, Radiated Emission Limits

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limit(dBµV/m @10m)
0.009 – 0.49	2400/F(kHz)	300	Limit (dBµV/m)+30dB
0.49 – 1.705	24000/F(kHz)	30	Limit (dBµV/m)+10dB
1.705 – 30	30	30	Limit (dBµV/m)+10dB

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limit (dBµV/m)
30 – 88	100	3	40.0
88 – 216	150	3	43.5
216 – 960	200	3	46.0
above 960	500	3	54.0

§15.35(b)

..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit...

Used conversion factor: $\text{Limit (dBµV/m)} = 20 \log (\text{Limit (µV/m)}/1\mu\text{V/m})$

3.1.3 Test Protocol

Temperature: 23 – 27 °C
 Air Pressure: 1000 – 1006 hPa
 Humidity: 40 – 41 %

3.1.3.1 Measurement up to 30 MHz

Op. Mode	Setup	Port
op-mode 1	Setup_01	Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
0°	–	–	–	–	–	–	–	–	–
90°	–	–	–	–	–	–	–	–	–

Remark: No (further) spurious emissions in the range 20 dB below the limit found therefore step 2 was not performed. Please refer to the plot in the annex.
 The found peak at 99.5 kHz is an emission from loop antenna power supply, and the peak found at 13.56 MHz is the wanted signal of the EUT.

3.1.3.2 Measurement above 30 MHz

Op. Mode	Setup	Port
op-mode 1	Setup_01	Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
–	–	–	–	–	–	–	–	–	–

Remark: No (further) spurious emissions in the range 20 dB below the limit found.

3.1.4 Test result: Spurious radiated emissions

FCC Part 15, Subpart C		Op. Mode	Result
		op-mode 1	passed



3.2 Occupied bandwidth

Standard FCC Part 15, 10-1-11 Edition Subpart C

The test was performed according to: FCC §15.31

3.2.1 Test Description

The Equipment Under Test (EUT) was setup in a shielded room to perform the occupied bandwidth measurements.

The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.

The results recorded were measured with the modulation which produces the worst-case (widest) occupied bandwidth.

3.2.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.215 (c)

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. ...

3.2.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1000 hPa
Humidity: 40 %

Op. Mode	Setup	Port
op-mode 1	Setup_02	Enclosure

20 dB bandwidth kHz	99% bandwidth kHz	Remarks
83.66	396.79	The 20 dB bandwidth from 13.3185 MHz to 13.7153 MHz is contained within the designated frequency band 13.110 MHz to 14.010 MHz.

Remark: Please see annex for the measurement plot.

3.2.4 Test result: Occupied bandwidth

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed

3.3 Spectrum mask

Standard FCC Part 15, 10-1-11 Edition Subpart C

The test was performed according to: FCC §15.225

3.3.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4–2009. The Equipment Under Test (EUT) was set up on a non-conductive table in the anechoic chamber.

The radiated emissions measurements were made in a typical installation configuration. The measurement procedure is implemented into the EMI test software ES-K1 from R&S. The Loop antenna HFH2-Z2 is used.

- Anechoic chamber
- Antenna distance: 10 m
- Detector: Peak-Maxhold
- Frequency range 13.06 – 14.06 MHz
- Frequency steps: 5 kHz
- IF-Bandwidth: 10 kHz
- Measuring time / Frequency step: 100 ms

3.3.2 Test Limits

FCC Part 15, Subpart C, §15.225 (a-d), and §15.209, corrected by the means of the extrapolation of §15.31 due to the reduced measuring distance from 30m to 10m

3.3.3 Test Protocol

Temperature: 27 °C
Air Pressure: 1006 hPa
Humidity: 40 %

Op. Mode	Setup	Port
op-mode 1	Setup_01	Enclosure

Maximum value dBµV/m	Limit dBµV/m	Remarks
42.04	93.5	measuring distance 10 m

Remark: Please see annex for the measurement plot.

3.3.4 Test result: Spectrum mask

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed



3.4 Frequency tolerance

Standard FCC Part 15, 10-1-11 Edition Subpart C

The test was performed according to: FCC §15.225

3.4.1 Test Description

The Equipment Under Test (EUT) is placed in a climatic temperature chamber. The frequency drift during temperature and voltage variation is measured by the means of a spectrum analyzer with frequency counter function. The temperature was varied from -20°C to $+50^{\circ}\text{C}$. At $+20^{\circ}\text{C}$ the extreme power supply voltages of 85% and 115% are applied. After reaching each target temperature and waiting sufficient time allowing the temperature to stabilize, one measurement is performed immediately after powering on the EUT, and two further measurements are performed after 5 and 10 minutes continuous operation of EUT.

3.4.2 Test Limits

FCC Part 15, Subpart C, §15.225 (e): The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20°C to $+50^{\circ}\text{C}$ at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20°C .



3.4.3 Test Protocol

Temperature: 26 °C
Air Pressure: 1010 hPa
Humidity: 40 %

Op. Mode	Setup	Port
op-mode 1	Setup_01	Enclosure

Temperature	Voltage	Time	Frequency	Delta	Verdict
/ °C	/ V	/ min.	/ MHz	/ Hz	
50	12	0	13.560211	211	Passed
50	12	5	13.560209	209	Passed
50	12	10	13.560214	214	Passed
40	12	0	13.560300	300	Passed
40	12	5	13.560240	240	Passed
40	12	10	13.560239	239	Passed
30	12	0	13.560360	360	Passed
30	12	5	13.560263	263	Passed
30	12	10	13.560254	254	Passed
20	11	0	13.560414	414	Passed
20	11	5	13.560302	302	Passed
20	11	10	13.560289	289	Passed
20	12	0	13.560418	418	Passed
20	12	5	13.560302	302	Passed
20	12	10	13.560291	291	Passed
20	13	0	13.560421	421	Passed
20	13	5	13.560294	294	Passed
20	13	10	13.560285	285	Passed
10	12	0	13.560464	464	Passed
10	12	5	13.560349	349	Passed
10	12	10	13.560333	333	Passed
0	12	0	13.560492	492	Passed
0	12	5	13.560399	399	Passed
0	12	10	13.560381	381	Passed
-10	12	0	13.560493	493	Passed
-10	12	5	13.560446	446	Passed
-10	12	10	13.560434	434	Passed
-20	12	0	13.560462	462	Passed
-20	12	5	13.560485	485	Passed
-20	12	10	13.560478	478	Passed

Remark: The limit is a delta of max. ± 1356 Hz (0.01 %).

3.4.4 Test result: Frequency tolerance

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed

4 Test Equipment

The calibration, hardware and software states are shown for the testing period.

Test Equipment Anechoic Chamber

Lab ID: Lab 3
Manufacturer: Frankonia
Description: Anechoic Chamber for radiated testing
Type: 10.58x6.38x6.00 m³

Single Devices for Anechoic Chamber

Single Device Name	Type	Serial Number	Manufacturer
Air compressor	none	-	Atlas Copco
Anechoic Chamber	10.58 x 6.38 x 6.00 m ³ FCC listing 96716 3m Part15/18 IC listing 3699A-1 3m	none	Frankonia 2011/01/11 2014/01/10 2011/02/07 2014/02/06
Controller Innco 2000	CO 2000	CO2000/328/12470 406/L	Innco innovative constructions GmbH
Controller Maturo	MCU	961208	Maturo GmbH
EMC camera	CE-CAM/1	-	CE-SYS
EMC camera Nr.2	CCD-400E	0005033	Mitsubishi
Filter ISDN	B84312-C110-E1		Siemens&Matsushita
Filter Universal 1A	BB4312-C30-H3	-	Siemens&Matsushita

Test Equipment Auxiliary Equipment for Conducted emissions

Lab ID: Lab 1
Manufacturer: Rohde & Schwarz GmbH & Co.KG
Description: EMI Conducted Auxiliary Equipment

Single Devices for Auxiliary Equipment for Conducted emissions

Single Device Name	Type	Serial Number	Manufacturer
AC Power Source	Chroma 6404	64040001304	Chroma ATE INC.
Cable "LISN to ESI"	RG214 Path Calibration	W18.03+W48.03	Huber&Suhner 2011/11/11 2012/11/10
Coupling-Decoupling- Network	CDN ENY41 Standard calibration	100002	Rohde & Schwarz GmbH & Co. KG 2011/01/20 2013/01/19
One-Line V-Network	ESH 3-Z6 Standard calibration	100489	Rohde & Schwarz GmbH & Co. KG 2011/02/08 2014/02/07
Two-Line V-Network	ESH 3-Z5	828304/029	Rohde & Schwarz GmbH & Co. KG
Two-Line V-Network	ESH 3-Z5 DKD calibration	829996/002	Rohde & Schwarz GmbH & Co. KG 2011/01/20 2013/01/19

Test Equipment Auxiliary Equipment for Radiated emissions

Lab ID: Lab 3
Description: Equipment for emission measurements
Serial Number: see single devices

Single Devices for Auxiliary Equipment for Radiated emissions

Single Device Name	Type	Serial Number	Manufacturer
Antenna mast	AS 620 P	620/37	HD GmbH
Biconical dipole	VUBA 9117	9117-108	Schwarzbeck
	Standard Calibration		2008/10/27 2013/10/26
	Standard Calibration		2012/01/18 2015/01/17
Broadband Amplifier 18MHz-26GHz	JS4-18002600-32-5P	849785	Miteq
Broadband Amplifier 1GHz-4GHz	AFS4-01000400-1Q-10P-4	-	Miteq
Broadband Amplifier 30MHz-18GHz	JS4-00101800-35-5P	896037	Miteq
Cable "ESI to EMI Antenna"	EcoFlex10	W18.01-2+W38.01- Kabel Kusch 2	
Cable "ESI to Horn Antenna"	UFB311A+UFB293C	W18.02-2+W38.02- Rosenberger Micro-Coax 2	
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz GmbH & Co. KG
	Standard Calibration		2012/05/18 2015/05/17
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz GmbH & Co. KG
Dreheinheit	DE 325		HD GmbH
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic
High Pass Filter	5HC3500/12750-1.2-KK	200035008	Trilithic
High Pass Filter	WHKX 7.0/18G-8SS	09	Wainwright
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz GmbH & Co. KG
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz GmbH & Co. KG
	Standard calibration		2011/10/27 2014/10/26
Pyramidal Horn Antenna 26,5 GHz	3160-09	00083069	EMCO Elektronik GmbH
Pyramidal Horn Antenna 40 GHz	3160-10	00086675	EMCO Elektronik GmbH
Tilt device Maturo (Rohacell)	Antrieb TD1.5-10kg	TD1.5- 10kg/024/3790709	Maturo GmbH



Test Equipment Auxiliary Test Equipment

Lab ID: Lab 3, Lab 4
Manufacturer: see single devices
Description: Single Devices for various Test Equipment
Type: various
Serial Number: none

Single Devices for Auxiliary Test Equipment

Single Device Name	Type	Serial Number	Manufacturer
AC Power Source	Chroma 6404	64040001304	Chroma ATE INC.
Broadband Power Divider1506A / 93459 N (Aux)		LM390	Weinschel Associates
Broadband Power DividerWA1515 SMA		A855	Weinschel Associates
Broadband Power Divider1515 / 93459 SMA (Aux)		LN673	Weinschel Associates
Digital Multimeter 01 (Multimeter)	Voltcraft M-3860M	IJ096055	Conrad Electronics
Digital Multimeter 03 (Multimeter)	Fluke 177	86670383	Fluke Europe B.V.
	Customized calibration		2011/10/19 2013/10/18
Digital Oscilloscope [SA2] (Aux)	TDS 784C	B021311	Tektronix GmbH
Fibre optic link Satellite (Aux)	FO RS232 Link	181-018	Pontis
Fibre optic link Transceiver (Aux)	FO RS232 Link	182-018	Pontis
Isolating Transformer	LTS 604	1888	Thalheimer Transformatorenwerke GmbH
Notch Filter Ultra Stable (Aux)	WRCA800/960-6EEK	24	Wainwright
Spectrum Analyser	FSP3	836722/011	Rohde & Schwarz GmbH & Co. KG
ThermoHygro_01 (Aux)	430202	none	Fischer Feingerätebau K. Fischer GmbH
Vector Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz GmbH & Co.KG



Test Equipment Digital Signalling Devices

Lab ID: Lab 1, Lab 3, Lab 4
Description: Signalling equipment for various wireless technologies.

Single Devices for Digital Signalling Devices

Single Device Name	Type	Serial Number	Manufacturer	
Bluetooth Signalling Unit CBT CBT		100589	Rohde & Schwarz GmbH & Co. KG	
	Standard calibration		2011/11/24	2014/11/23
CMW500	CMW500	107500	Rohde & Schwarz GmbH & Co.KG	
	Calibration Details		Last Execution	Next Exec.
	Initial factory calibration		2012/01/26	2014/01/25
	Firmware: V.2.01.25		2012/05/07	2012/07/03
	3G : KC42x 11.48.02			
	LTE: KC501 1.6.5 up to 1.9.8			
	KC503 1.6.5 up to 1.9.8			
	KC506 1.9.8			
	KC507 1.7.0			
	KC508 1.8.5 up to 1.9.8			
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz GmbH & Co. KG	
	Standard calibration		2011/11/28	2014/11/27
	Digital Radio Test Set	6103E	Racal Instruments, Ltd.	
	Universal Radio Communication Tester	CMU 200	Rohde & Schwarz GmbH & Co. KG	
	Standard calibration		2011/05/26	2013/05/25
	HW/SW Status		Date of Start	Date of End
	Hardware:		2007/07/16	
	B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B56V14, B68 3v04, PCMCIA, U65V04			
	Software:			
	K21 4v21, K22 4v21, K23 4v21, K24 4v21, K42 4v21, K43 4v21, K53 4v21, K56 4v22, K57 4v22, K58 4v22, K59 4v22, K61 4v22, K62 4v22, K63 4v22, K64 4v22, K65 4v22, K66 4v22, K67 4v22, K68 4v22, K69 4v22			
Universal Radio Communication Tester	Firmware:			
	µP1 8v50 02.05.06			

	CMU 200	837983/052	Rohde & Schwarz GmbH & Co. KG	
	Standard calibration		2011/12/07	2014/12/06
	HW/SW Status		Date of Start	Date of End
	HW options:		2007/01/02	
	B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B54V14, B56V14, B68 3v04, B95, PCMCIA, U65V02			
	SW options:			
	K21 4v11, K22 4v11, K23 4v11, K24 4v11, K27 4v10, K28 4v10, K42 4v11, K43 4v11, K53 4v10, K65 4v10, K66 4v10, K68 4v10,			
Vector Signal Generator	Firmware:			
	µP1 8v40 01.12.05			

SMU200A	SW:		2008/11/03	
	K62, K69			
SMU200A		100912	Rohde & Schwarz GmbH & Co. KG	



Test Equipment Emission measurement devices

Lab ID: Lab 1, Lab 3
Description: Equipment for emission measurements
Serial Number: see single devices

Single Devices for Emission measurement devices

Single Device Name	Type	Serial Number	Manufacturer
Personal Computer	Dell	30304832059	Dell
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG
	Standard calibration		2012/05/22 2013/05/21
Power Sensor	NRV-Z1	836219/005	Rohde & Schwarz GmbH & Co. KG
Powermeter	NRVS	836333/064	Rohde & Schwarz GmbH & Co. KG
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG
	Standard calibration		2012/05/21 2013/05/20
Signal Generator	SMR 20	846834/008	Rohde & Schwarz GmbH & Co. KG
	standard calibration		2011/05/12 2014/05/11
Spectrum Analyzer	ESIB 26	830482/004	Rohde & Schwarz GmbH & Co. KG
	Standard Calibration		2011/12/05 2013/12/04
	HW/SW Status		Date of Start Date of End
	Firmware-Update 4.34.4 from 3.45 during calibration		2009/12/03

Test Equipment Multimeter 12

Lab ID: Lab 5, Lab 6
Description: Ex-Tech 520
Serial Number: 05157876

Single Devices for Multimeter 12

Single Device Name	Type	Serial Number	Manufacturer
Digital Multimeter 12 (Multimeter)	EX520	05157876	Extech Instruments Corp.
	Customized calibration		2011/10/18 2013/10/17



Test Equipment Radio Lab Test Equipment

Lab ID: Lab 4
Description: Radio Lab Test Equipment

Single Devices for Radio Lab Test Equipment

Single Device Name	Type	Serial Number	Manufacturer
Broadband Power DividerWA1515 SMA		A856	Weinschel Associates
Coax Attenuator 10dB SMA 2W	4T-10	F9401	Weinschel Associates
Coax Attenuator 10dB SMA 2W	56-10	W3702	Weinschel Associates
Coax Attenuator 10dB SMA 2W	56-10	W3711	Weinschel Associates
Coax Cable Huber&Suhner	Sucotest 2,0m		Rosenberger Micro-Coax
Coax Cable Rosenberger Micro Coax FA210A0010003030 SMA/SMA 1,0m	FA210A0010003030	54491-2	Rosenberger Micro-Coax
Power Meter	NRVD Standard calibration	828110/016	Rohde & Schwarz GmbH & Co.KG 2012/05/22 2013/05/21
Power Sensor	NRV-Z1	836219/005	Rohde & Schwarz GmbH & Co. KG
Powermeter	NRVS	836333/064	Rohde & Schwarz GmbH & Co. KG
RF Step Attenuator RSP	RSP	833695/001	Rohde & Schwarz GmbH & Co.KG
Rubidium Frequency Standard	Datum, Model: MFL Standard calibration	2689/001	Datum-Beverly 2011/06/17 2012/06/16
Sensor Head A	NRV-Z1 Standard calibration	827753/005	Rohde & Schwarz GmbH & Co.KG 2012/05/21 2013/05/20
Signal Generator	SMY02 Standard calibration	829309/018	Rohde & Schwarz GmbH & Co. KG 2011/11/04 2014/11/03
Signal Generator SME	SME03 Standard calibration	827460/016	Rohde & Schwarz GmbH & Co.KG 2011/11/25 2014/11/24
Signal Generator SMP	SMP02	836402/008	Rohde & Schwarz GmbH & Co. KG
Spectrum Analyser	FSIQ26 Standard calibration	840061/005	Rohde & Schwarz GmbH & Co. KG 2011/02/10 2013/02/09
Temperature Chamber Vötsch 03	VT 4002 Customized calibration	58566002150010	Vötsch 2012/03/12 2014/03/11
Vector Signal Generator	SMIQ 03B	837747/020	Rohde & Schwarz GmbH & Co. KG



Test Equipment Regulatory Bluetooth RF Test Solution

Lab ID: Lab 5
Description: Regulatory Bluetooth RF Tests
Type: Bluetooth RF
Serial Number: 001

Single Devices for Regulatory Bluetooth RF Test Solution

Single Device Name	Type	Serial Number	Manufacturer
ADU 200 Relay Box 7	Relay Box	A04380	Ontrak Control Systems Inc.
Bluetooth Signalling Unit CBT		100302	Rohde & Schwarz GmbH & Co.KG
	Standard Calibration		2011/08/17 2012/08/16
Power Meter NRVD	NRVD	832025/059	
	Standard Calibration		2011/06/14 2012/06/13
Power Sensor NRV Z1 A	PROBE	832279/013	
	Standard Calibration		2011/06/14 2012/06/13
Power Supply	NGSM 32/10	2725	
	Standard Calibration		2011/06/15 2013/06/14
Rubidium Frequency Normal MFS	Datum MFS	002	Datum GmbH
	Standard Calibration		2011/08/17 2012/08/16
Signal Analyser FSIQ26	1119.6001.26	832695/007	Rohde & Schwarz GmbH & Co.KG
Signal Generator	SMP03	833680/003	Rohde & Schwarz GmbH & Co.KG
	Standard Calibration		2009/06/23 2012/06/22
Vector Signal Generator SMIQ03B	SMIQ03B	832870/017	
	Standard Calibration		2010/06/23 2013/06/20

Test Equipment Shielded Room 02

Lab ID: Lab 1
Manufacturer: Frankonia
Description: Shielded Room for conducted testing
Type: 12 qm
Serial Number: none

Test Equipment Shielded Room 07

Lab ID: Lab 5, Lab 6
Description: Shielded Room 4m x 6m

Test Equipment T/H Logger 04

Lab ID: Lab 5, Lab 6
Description: Lufft Opus10
Serial Number: 7481

Single Devices for T/H Logger 04

Single Device Name	Type	Serial Number	Manufacturer
ThermoHygro DataloggerOpus10 THI (8152.00) 04 (Environ)		7481	Lufft Mess- und Regeltechnik GmbH



Test Equipment Temperature Chamber 01

Lab ID: Lab 5, Lab 6
Manufacturer: see single devices
Description: Temperature Chamber KWP 120/70
Type: Weiss
Serial Number: see single devices

Single Devices for Temperature Chamber 01

Single Device Name	Type	Serial Number	Manufacturer	
Temperature Chamber Weiss 01	KWP 120/70	59226012190010	Weiss Umwelttechnik GmbH	
	Customized calibration		2012/03/12	2014/03/11

Test Equipment WLAN RF Test Solution

Lab ID: Lab 6
Manufacturer: 7 layers AG
Description: Regulatory WLAN RF Tests
Type: WLAN RF
Serial Number: 001

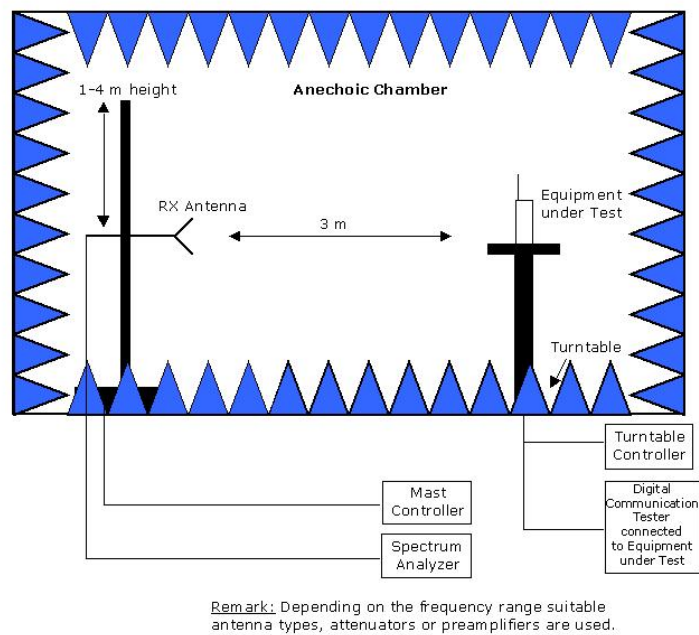
Single Devices for WLAN RF Test Solution

Single Device Name	Type	Serial Number	Manufacturer	
Arbitrary Waveform Generator	TGA12101	284482		
Power Meter NRVD	NRVD Standard Calibration	832025/059	2011/06/14	2012/06/13
Power Sensor NRV Z1 A	PROBE Standard Calibration	832279/013	2011/06/14	2012/06/13
Power Supply	NGSM 32/10 Standard Calibration	2725	2011/06/15	2013/06/14
Rubidium Frequency Normal MFS	Datum MFS Standard Calibration	002	Datum GmbH	2011/08/17 2012/08/16
Signal Analyser FSIQ26	1119.6001.26	832695/007	Rohde & Schwarz GmbH & Co.KG	
Signal Generator	SMP03 Standard Calibration	833680/003	Rohde & Schwarz GmbH & Co.KG 2009/06/23 2012/06/22	
Spectrum Analyser	FSU26 FSU FW Update to v4.61 SP3, K5 v4.60 and K73 v4.61	100136	Rohde & Schwarz GmbH & Co.KG 2011/12/05	
Spectrum Analyser	FSU3 Standard calibration Firmware Version 4.51 SP1 Option FS-K72 4.50 SP1 Option FS-K73 4.50 SP1	200046	Rohde & Schwarz GmbH & Co.KG 2012/05/15 2013/05/14 2011/12/07	
TOCT Switching Unit	Switching Unit	030106	7 layers, Inc.	
TOCT Switching Unit (loan unit)	Switching Unit	030101	7 layers, Inc.	
Vector Signal Generator SMIQ03B	SMIQ03B Standard Calibration	832870/017	2010/06/23	2013/06/20

5 Photo Report

Photos are included in an external report.

6 Setup Drawings



Drawing 1: Setup in the Anechoic chamber:
Measurements below 1 GHz: Semi-anechoic, conducting ground plane.



7 FCC and IC Correlation of measurement requirements

The following tables show the correlation of measurement requirements for RFID equipment and Digital Apparatus from FCC and IC standards.

RFID equipment

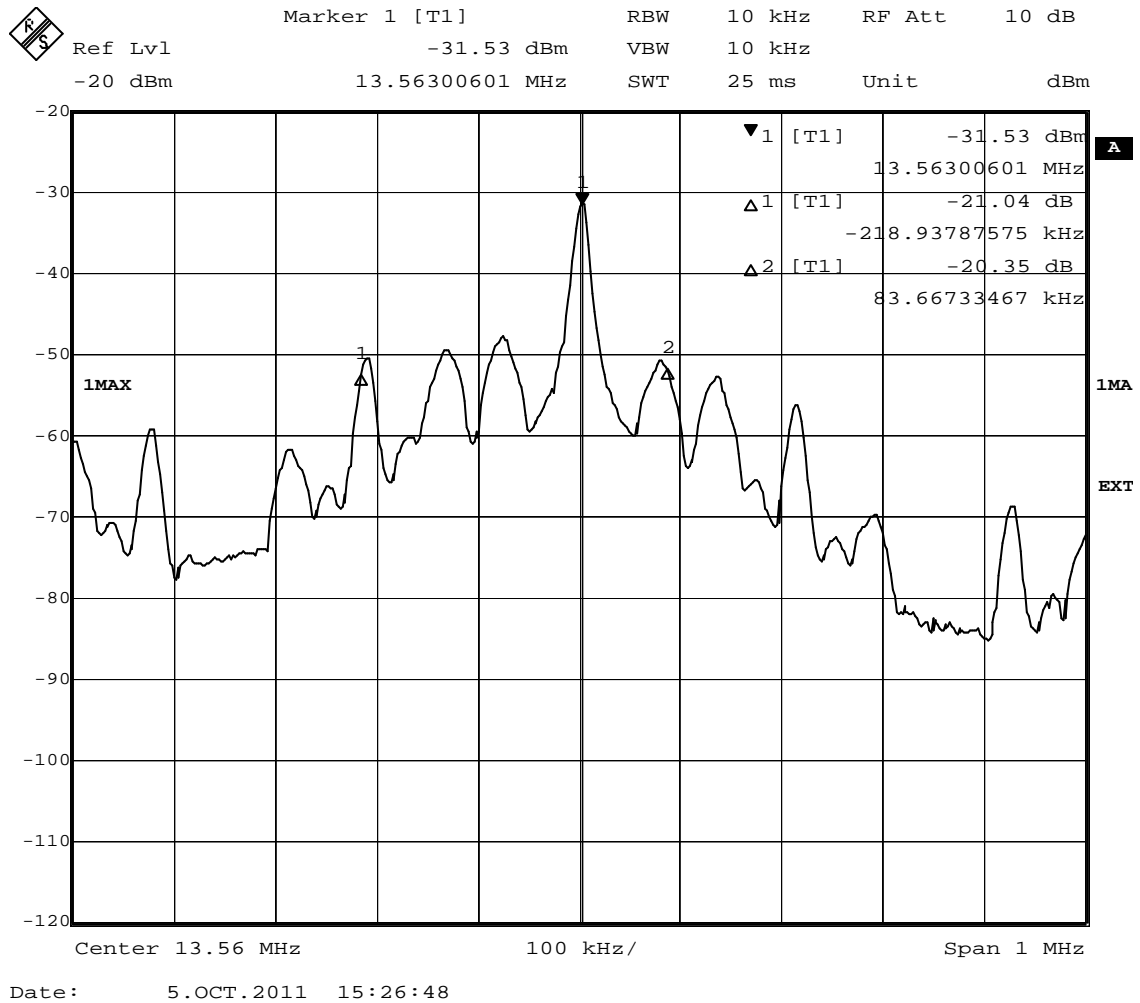
Measurement	FCC reference	IC reference
Conducted emissions on AC mains	§ 15.207	RSS-Gen: 7.2.4
Spurious radiated emissions	§ 15.209	RSS-Gen: 6; RSS-210: A2.6
Occupied bandwidth	§ 15.215	RSS-Gen: 4.6
Spectrum Mask	§ 15.225	RSS-210: A2.6
Frequency Tolerance	§ 15.225	RSS-210: A2.6

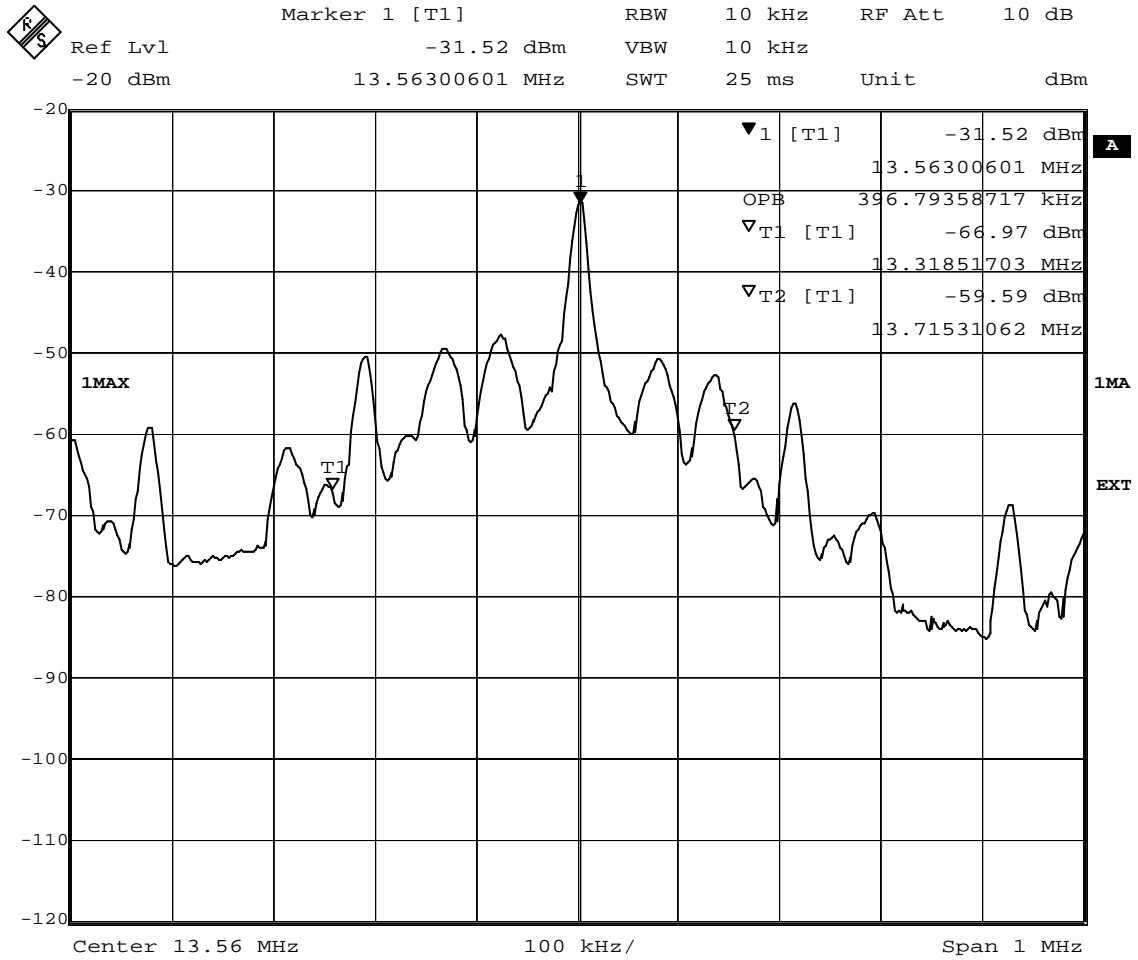
Digital Apparatus

Measurement	FCC reference	IC reference
Conducted Emissions (AC Power Line)	§ 15.107	ICES-003
Spurious Radiated Emissions	§ 15.109	ICES-003

8 Annex measurement plots

8.1 Occupied bandwidth





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8.2 Spectrum mask

