

InterLab[®]

Final Report on

EHS5T-US FCC ID: QIPEHS5T

HW: Rev. 4

SW: 02.000, SVN: 08

Report Reference: MDE_GEMALTO_1501_FCCa
acc. Title 47 CFR chapter I part 15 subpart B, Class B

Date: February 27, 2015

Test Laboratory:

7Layers AG
Borsigstr. 11
40880 Ratingen
Germany



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

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Dr. H. Ansorge

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USt-IdNr • VAT No.:
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TAX No. 147/5869/0385

1 Administrative Data

1.1 Project Data

Project Responsible: Andreas Tübel
Date Of Test Report: 2015/02/27
Date of first test: 2015/02/06
Date of last test: 2015/02/20

1.2 Applicant Data

Company Name: Gemalto M2M GmbH
Street: Siemensdamm 50
City: 13629 Berlin
Country: Germany

Contact Person: Mr. Thorsten Liebig
Function: Manager Approval
Department: Research and Innovation
Phone: +49 3031102 8241
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1.3 Test Laboratory Data

The following list shows all places and laboratories involved for test result generation:

7 layers DE

Company Name : 7 layers AG
Street : Borsigstrasse 11
City : 40880 Ratingen
Country : Germany
Contact Person : Mr. Michael Albert
Phone : +49 2102 749 201
Fax : +49 2102 749 444
E Mail : Michael.Albert@7Layers.com

Laboratory Details

Lab ID	Identification	Responsible	Accreditation Info
Lab 1	Conducted Emissions	Mr. Andreas Petz Mr. Wolfgang Richter	DAkKS-Registration no. D-PL-12140-01-01
Lab 2	Radiated Emissions	Mr. Marco Kullik Mr. Robert Machulec	DAkKS-Registration no. D-PL-12140-01-01

1.4 Signature of the Testing Responsible


 Imad.Hjiye
 responsible for tests performed in Lab 1, Lab 2

1.5 Signature of the Accreditation Responsible


 Accreditation scope responsible person
 responsible for Lab 1, Lab 2

2 Test Object Data

2.1 General OUT Description

The following section lists all OUTs (Object's Under Test) involved during testing.

OUT: EHS5T-US

Type / Model / Family: EHS5T-US
 HW: Rev. 4
 SW: 02.000, SVN: 08

Product Category: Fixed Wireless Access Terminal

Manufacturer:
Company Name: See applicant Data

Contact Person: -

Parameter List:

Parameter name	Value
Parameter for Scope FCC_v2:	
AC Power Supply	120 (V)
DC Power Supply	12 (V)
highest internal frequency	below 108 Mhz

2.2 Detailed Description of OUT Samples

Sample : aa01

<i>OUT Identifier</i>	EHS5T-US
<i>Sample Description</i>	
<i>Serial No.</i>	357330050466275
<i>HW Status</i>	Rev. 4
<i>SW Status</i>	02.000

2.3 OUT Features

Features for OUT: EHS5T-US

<i>Designation</i>	<i>Description</i>	<i>Allowed Values</i>	<i>Supported Value(s)</i>
Features for scope: FCC_v2			
AC	The OUT is powered by or connected to AC Mains		
Dant	removable antenna supplied and type tested with the radio equipment, designed as an example part of the equipment		
DC	The OUT is powered by or connected to DC		
EDGE850	EUT supports EDGE in the band 824 MHz - 849 MHz		
EDGE1900	EUT supports EDGE in the band 1850 MHz - 1910 MHz		
FDD2	EUT supports UMTS FDD2 in the band 1850 MHz - 1910 MHz		
FDD5	EUT supports UMTS FDD5 in the band 824 MHz - 849 MHz		
GSM850	EUT supports GSM850 band 824MHz - 849MHz		
HSUPA-FDD2	EUT supports UMTS FDD2 HSUPA in the band 1850 MHz - 1910 MHz		
HSUPA-FDD5	EUT supports UMTS FDD5 HSUPA in the band 824 MHz - 849 MHz		
PantC	permanent fixed antenna connector, which may be built-in, designed as an indispensable part of the equipment		
PCS1900	EUT supports PCS1900 band 1850MHz - 1910MHz		

2.4 Operating Mode(s)

<i>Ref.-No.</i>	<i>Description</i>
1	GSM 1900 traffic , data transfer between EUT and Laptop. The connection was over RS485 and USB 2.0.

2.5 Setups used for Testing

For each setup a relation is given to determine if and which samples and auxiliary equipment is used. The left side list all OUT samples and the right side lists all auxiliary equipment for the given setup.

Setup No.	List of OUT samples	List of auxiliary equipment	
Sample No.	Sample Description	AE No.	AE Description
S01_AA01			
Sample: aa01		AE AE04	Keyboard
		AE AE08	AC/DC adapter
		AE AE03	TFT Display
		AE AE01	Laptop
		AE AE05	Mouse
		AE AE06	Adaptercable RS485 to RS232
		AE AE02	AC Adapter 2 Laptop RE
		AE AE07	External cellular antenna

3 Results

3.1 General

Documentation of tested devices:

Available at the test laboratory.

Interpretation of the test results:

The results of the inspection are described on the following pages, where 'Conformity' or 'Passed' means that the certification criteria were verified and that the tested device is conform to the applied standard.

In cases where 'Declaration' is printed, the required documents are available in the manufacturers product documentation.

In cases where 'not applicable' is printed, the test case requirements are not relevant to the specific equipment implementation.

Note:

1. EHS5T-US Terminal contains a Cinterion® EHS5-US module and implements a USB 2.0 interface with a USB-B connector and also RS-485 interface socket as well as a 6-pole Western jack as plug-in power supply connector.

2. All tests are performed under environmental conditions within the requirements of the specifications. Environmental conditions are available at the laboratory.

3.2 List of the Applicable Body

(Body for Scope: FCC_v2)

Designation	Description
FCC47CFRChIPART15bRADIO FREQUENCY DEVICES	Part 15, Subpart B - Unintentional Radiators

3.3 List of Test Specification

<i>Test Specification:</i>	FCC part 2 and 15
<i>Version</i>	10-1-13 Edition
<i>Title:</i>	PART 2 - GENERAL RULES AND REGULATIONS PART 15 - RADIO FREQUENCY DEVICES

3.4 Summary

<i>Test Case Identifier / Name</i>	<i>Result</i>	<i>Date of Test</i>	<i>Lab Ref.</i>	<i>Setup</i>
15b.1 Conducted Emissions (AC Power Line) §15.107				
15b.1; Mode = Generating a high power consumption	Passed	2015/02/20	Lab 1	S01_AA01
	operating mode: 1			
15b.2 Spurious Radiated Emissions §15.109				
15b.2; Mode = Generating a high power consumption	Passed	2015/02/06	Lab 2	S01_AA01
	operating mode: 1			

3.5 Detailed Results

3.5.1 15b.1 Conducted Emissions (AC Power Line) §15.107

Test: 15b.1; Mode = Generating a high power consumption

<i>Result:</i>	Passed
<i>Setup No.:</i>	S01_AA01
<i>Date of Test:</i>	2015/02/20 10:31
<i>Body:</i>	FCC47CFRChIPART15bRADIO FREQUENCY DEVICES
<i>Test Specification:</i>	FCC part 2 and 15

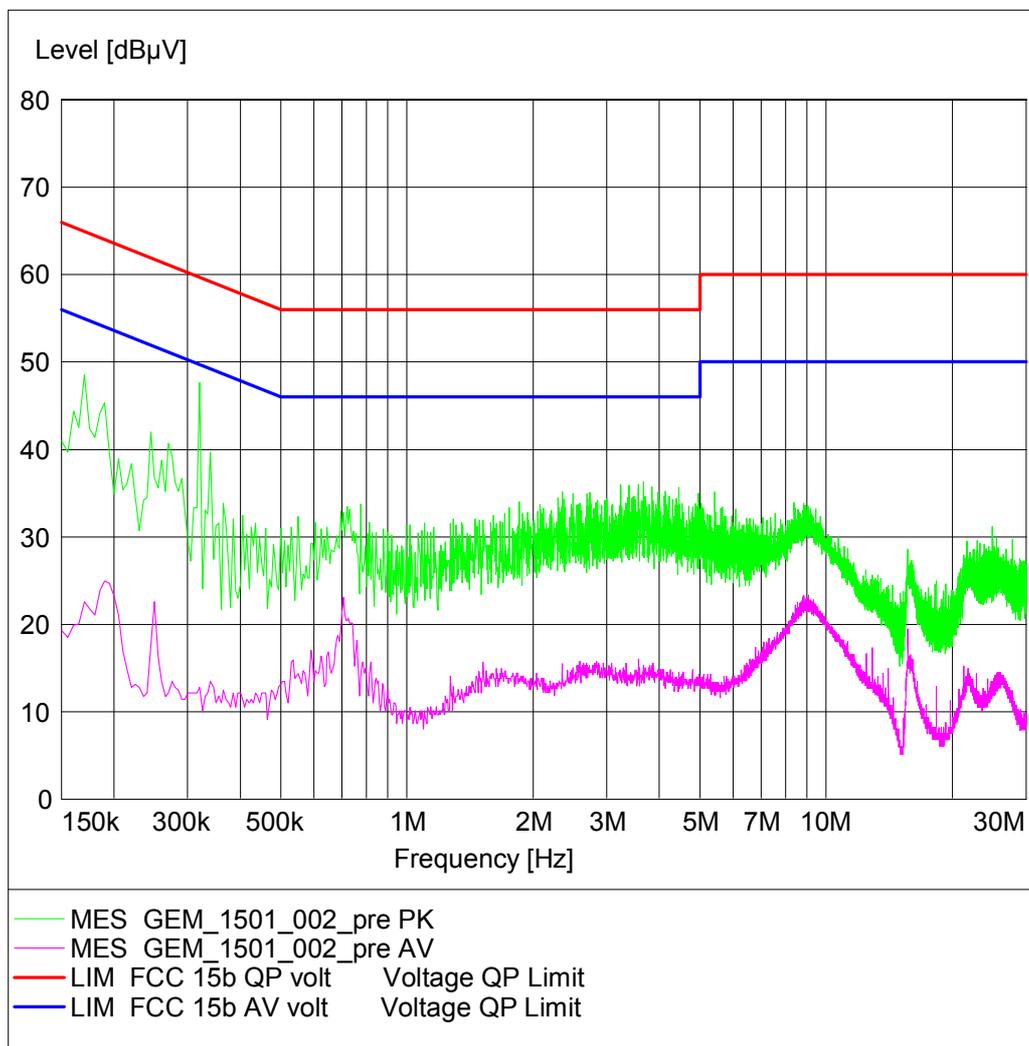
Detailed Results:

AC MAINS CONDUCTED

EUT: (DE1034007aa01)
 Manufacturer: Gemalto
 Operating Condition: GSM 1900 traffic, Data-Transfer, 120 V/60 Hz, comp. peri.
 Test Site: 7 layers Ratingen
 Operator: Mit
 Test Specification: ANSI C63.4; FCC 15.107 / 15.207
 Comment:
 Start of Test: 20.02.2015 / 11:05:43

SCAN TABLE: "FCC Voltage"

Short Description:			FCC Voltage			
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
150.0 kHz	30.0 MHz	5.0 kHz	MaxPeak Average	20.0 ms	9 kHz	ESH3-Z5



3.5.2 15b.2 Spurious Radiated Emissions §15.109

Test: 15b.2; Mode = Generating a high power consumption

<i>Result:</i>	Passed
<i>Setup No.:</i>	S01_AA01
<i>Date of Test:</i>	2015/02/06 15:55
<i>Body:</i>	FCC47CFRChIPART15bRADIO FREQUENCY DEVICES
<i>Test Specification:</i>	FCC part 2 and 15

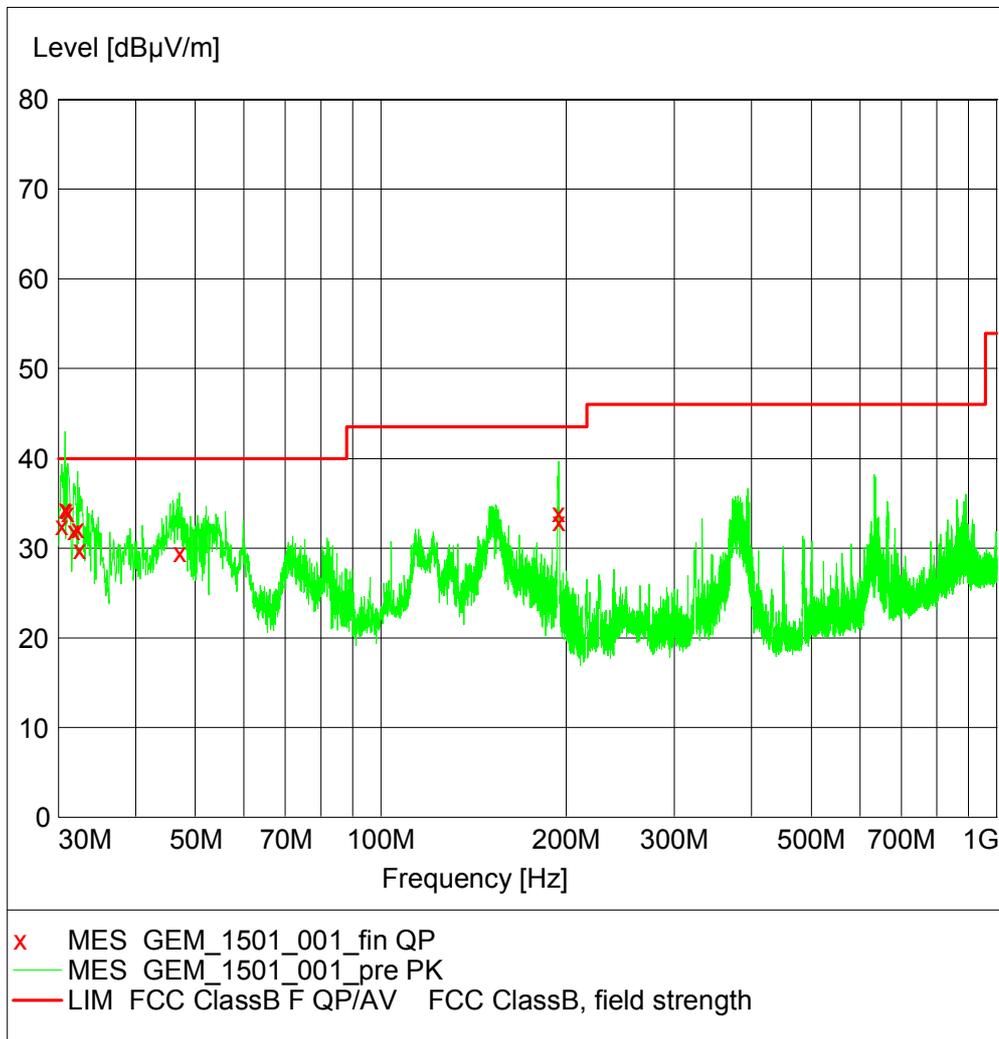
Detailed Results:

EMI RADIATED TEST

EUT: (DE1034007aa01)
 Manufacturer: Gemalto
 Operating Condition: GSM 1900 traffic , data transfer, computer peripheral; 120V/60Hz
 Test Site: 7 layers, Ratingen
 Operator: URO/ZAM
 Test Specification: FCC Part 15 B Class B
 Comment: Horizontal EUT position, Horizontal+Vertical antenna polaris
 Start of Test: 06.02.2015 / 13:26:49

SCAN TABLE: "FCC part 15 b"

Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	60.0 kHz	MaxPeak	1.0 ms	120 kHz	HL562



MEASUREMENT RESULT: "GEM_1501_001_fin QP"

06.02.2015 14:16

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Polarisation
30.360000	32.50	20.9	40.0	7.5	100.0	247.00	VERTICAL
30.720000	34.40	20.7	40.0	5.6	100.0	241.00	VERTICAL
30.840000	34.30	20.6	40.0	5.7	105.0	202.00	VERTICAL
31.020000	34.00	20.5	40.0	6.0	100.0	202.00	VERTICAL
31.740000	32.00	20.1	40.0	8.0	100.0	224.00	VERTICAL
32.220000	32.20	19.8	40.0	7.8	100.0	252.00	VERTICAL
32.400000	29.90	19.7	40.0	10.1	100.0	203.00	VERTICAL
47.100000	29.60	11.6	40.0	10.4	101.0	4.00	VERTICAL
193.980000	33.90	9.7	43.5	9.6	102.0	184.00	VERTICAL
194.580000	32.90	9.7	43.5	10.6	100.0	157.00	VERTICAL

4 Test Equipment Details

4.1 List of Used Test Equipment

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

Test Equipment Anechoic Chamber

Lab ID:	Lab 2		
<i>Manufacturer:</i>	Frankonia		
<i>Description:</i>	Anechoic Chamber for radiated testing		
<i>Type:</i>	10.58x6.38x6.00 m ³		
	<i>Calibration Details</i>	<i>Last Execution</i>	<i>Next Execution</i>
	NSA (FCC)	2014/01/09	2017/01/09

Single Devices for Anechoic Chamber

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>
Air compressor	none	-	Atlas Copco
Anechoic Chamber	10.58 x 6.38 x 6.00 m ³	none	Frankonia
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Execution</i>
	FCC listing 96716 3m Part15/18		2014/01/09 2017/01/08
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		
Cable "LISN to ESI"	RG214	W18.03+W48.03	Huber&Suhner		
Impedance Stabilization Network	ISN T800	36159	Teseq GmbH	<i>Calibration Details</i>	
				Standard Calibration	Last Execution: 2014/02/06 Next Execution: 2016/02/28
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN ENY41	100002	Rohde & Schwarz GmbH & Co. KG	<i>Calibration Details</i>	
				Standard calibration	Last Execution: 2013/03/01 Next Execution: 2015/03/31
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN ST08	36292	Teseq GmbH	<i>Calibration Details</i>	
				Standard calibration	Last Execution: 2014/01/10 Next Execution: 2016/01/31
Impedance Stabilization Network, Coupling Decoupling Network	ISN/CDN T8-Cat6	32187	Teseq GmbH	<i>Calibration Details</i>	
				Standard Calibration	Last Execution: 2014/01/08 Next Execution: 2016/01/31
One-Line V-Network	ESH 3-Z6	100489	Rohde & Schwarz GmbH & Co. KG	<i>Calibration Details</i>	
				standard calibration	Last Execution: 2014/06/18 Next Execution: 2017/11/30
One-Line V-Network	ESH 3-Z6	100570	Rohde & Schwarz GmbH & Co. KG	<i>Calibration Details</i>	
				Standard Calibration	Last Execution: 2013/11/25 Next Execution: 2016/11/24
Two-Line V-Network	ESH 3-Z5	828304/029	Rohde & Schwarz GmbH & Co. KG	<i>Calibration Details</i>	
				Standart Calibration	Last Execution: 2013/03/01 Next Execution: 2015/02/28
Two-Line V-Network	ESH 3-Z5	829996/002	Rohde & Schwarz GmbH & Co. KG	<i>Calibration Details</i>	
				Standard Calibration	Last Execution: 2013/03/01 Next Execution: 2015/02/28

Test Equipment Auxiliary Equipment for Radiated emissions

Lab ID:	Lab 2
<i>Description:</i>	Equipment for emission measurements
<i>Serial Number:</i>	see single devices

Single Devices for Auxiliary Equipment for Radiated emissions

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>		
Antenna mast	AM 4.0	AM4.0/180/11920 513	Maturo GmbH		
Biconical Broadband Antenna	SBA 9119	9119-005	Schwarzbeck		
Biconical dipole	VUBA 9117	9117-108	Schwarzbeck		
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+W38.01-2	Kabel Kusch		
Cable "ESI to Horn Antenna"	UFB311A+UFB293C	W18.02- 2+W38.02-2	Rosenberger Micro-Coax		
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz GmbH & Co. KG	<i>Last Execution</i>	<i>Next Execution</i>
	<i>Calibration Details</i>			2012/05/18	2015/05/17
	Standard Calibration				
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz GmbH & Co. KG	<i>Last Execution</i>	<i>Next Execution</i>
	<i>Calibration Details</i>			2012/06/26	2015/06/25
	Standard Calibration				
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		
Horn Antenna Schwarzbeck 15-26 GHz BBHA 9170	BBHA 9170	BBHA9170262			
Log.-per. Antenna	HL 562 Ultralog	100609	Rohde & Schwarz GmbH & Co. KG	<i>Last Execution</i>	<i>Next Execution</i>
	<i>Calibration Details</i>			2012/12/18	2015/12/17
	Standard Calibration				
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz GmbH & Co. KG		
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz GmbH & Co. KG	<i>Last Execution</i>	<i>Next Execution</i>
	<i>Calibration Details</i>			2014/11/27	2017/11/27
	DKD Calibration				
Standard Gain / Pyramidal Horn Antenna 26,5 GHz	3160-09	00083069	EMCO Elektronik GmbH		

Single Devices for Auxiliary Equipment for Radiated emissions (continued)

Single Device Name	Type	Serial Number	Manufacturer
Standard Gain / Pyramidal Horn Antenna 40 GHz	3160-10	00086675	EMCO Elektronik GmbH
Tilt device Maturo (Rohacell)	Antrieb TD1.5-10kg	TD1.5- 10kg/024/379070 9	Maturo GmbH

Test Equipment Auxiliary Test Equipment

Lab ID:	Lab 2
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		
Broadband Power Divider N (Aux)	1506A / 93459	LM390	Weinschel Associates		
Broadband Power Divider SMA	WA1515	A855	Weinschel Associates		
Digital Multimeter 03 (Multimeter)	Fluke 177	86670383	Fluke Europe B.V.		
	<i>Calibration Details</i>			<i>Last Execution</i>	<i>Next Execution</i>
	Customized calibration			2013/12/04	2015/12/03
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		
Signal Analyzer	FSV30	103005	Rohde & Schwarz GmbH & Co. KG		
	<i>Calibration Details</i>			<i>Last Execution</i>	<i>Next Execution</i>
	Standard			2014/02/10	2016/02/09
Spectrum Analyser	FSP3	836722/011	Rohde & Schwarz GmbH & Co. KG		
	<i>Calibration Details</i>			<i>Last Execution</i>	<i>Next Execution</i>
	Standard			2012/06/13	2015/06/12
	DKD calibration			2014/11/24	2017/11/23
Spectrum Analyser	FSU26	200418	Rohde & Schwarz GmbH & Co.KG		
	<i>Calibration Details</i>			<i>Last Execution</i>	<i>Next Execution</i>
	Standard calibration			2014/07/29	2015/07/28
Vector Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz GmbH & Co.KG		

Test Equipment Digital Signalling Devices

Lab ID: Lab 1, Lab 2
Description: Signalling equipment for various wireless technologies.

Single Devices for Digital Signalling Devices

Single Device Name	Type	Serial Number	Manufacturer	
CMW500	CMW500	107500	Rohde & Schwarz GmbH & Co.KG	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Execution</i>
	Standard calibration		2014/01/27	2016/01/26
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz GmbH & Co. KG	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Execution</i>
	DKD calibration		2014/12/02	2017/12/01
Universal Radio Communication Tester	CMU 200	102366	Rohde & Schwarz GmbH & Co. KG	
	<i>HW/SW Status</i>		<i>Date of Start</i>	<i>Date of End</i>
	Hardware: 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 Firmware: µP1 8v50 02.05.06 ---		2007/07/16	
Universal Radio Communication Tester	CMU 200	837983/052	Rohde & Schwarz GmbH & Co. KG	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Execution</i>
	DKD calibration		2014/12/03	2017/12/02
	<i>HW/SW Status</i>		<i>Date of Start</i>	<i>Date of End</i>
	HW options: 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, Firmware: µP1 8v40 01.12.05 --- SW: K62, K69		2008/11/03	
Vector Signal Generator	SMU200A	100912	Rohde & Schwarz GmbH & Co. KG	

Test Equipment Emission measurement devices

Lab ID: Lab 1, Lab 2
Description: Equipment for emission measurements
Serial Number: see single devices

Single Devices for Emission measurement devices

Single Device Name	Type	Serial Number	Manufacturer	Last Execution	Next Execution
Personal Computer	Dell	30304832059	Dell		
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG		
			<i>Calibration Details</i>		
			Standard calibration	2014/05/13	2015/05/12
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG		
			<i>Calibration Details</i>		
			Standard calibration	2014/05/13	2015/05/12
Signal Generator	SMR 20	846834/008	Rohde & Schwarz GmbH & Co. KG		
			<i>Calibration Details</i>		
			Standard Calibration	2014/06/24	2017/06/23
Spectrum Analyzer	ESIB 26	830482/004	Rohde & Schwarz GmbH & Co. KG		
			<i>Calibration Details</i>		
			Standard Calibration	2014/01/07	2016/01/31
			<i>HW/SW Status</i>	<i>Date of Start</i>	<i>Date of End</i>
			Firmware-Update 4.34.4 from 3.45 during calibration	2009/12/03	

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 T/A Logger 13

Lab ID: Lab 1, Lab 2
Description: Lufft Opus10 TPR
Type: Opus10 TPR
Serial Number: 13936

Single Devices for T/A Logger 13

Single Device Name	Type	Serial Number	Manufacturer
ThermoAirpressure Datalogger 13 (Environ)	Opus10 TPR (8253.00)	13936	Lufft Mess- und Regeltechnik GmbH

Test Equipment T/H Logger 02

Lab ID: Lab 1
Description: Lufft Opus10
Serial Number: 7489

Single Devices for T/H Logger 02

Single Device Name	Type	Serial Number	Manufacturer
ThermoHygro Datalogger 02 (Environ)	Opus10 THI (8152.00)	7489	Lufft Mess- und Regeltechnik GmbH

Test Equipment T/H Logger 12

Lab ID: Lab 2
Description: Lufft Opus10
Serial Number: 12482

Single Devices for T/H Logger 12

Single Device Name	Type	Serial Number	Manufacturer	
ThermoHygro Datalogger 12 (Environ)	Opus10 THI (8152.00)	12482	Lufft Mess- und Regeltechnik GmbH	
<i>Calibration Details</i>			<i>Last Execution</i>	<i>Next Execution</i>
Customized calibration			2013/01/07	2015/02/24

5 Annex

5.1 Additional Information for Report

Test Description

Conducted emissions (AC power line)

Standard FCC Part 15 Subpart B

The test was performed according to: ANSI C 63.4, 2009

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 setup in a shielded room to perform the conducted emissions measurements in a typical installation configuration. The EUT was connected to a 50 μ H || 50 Ohm Line Impedance Stabilization Network (LISN), which meets the requirements of ANSI C63.4-2009, Annex B, in the frequency range of the measurements. The LISN's unused connections were terminated with 50 Ohm loads. AC Power supply voltage for EUT: 120 V 60 Hz (if not stated within the measurement plot and/or test result).

The measurement procedure consists of two steps. It is implemented into the EMI test software ES-K1 from R&S.

Step 1: Preliminary scan

Intention of this step is, to determine the conducted EMI-profile of the EUT.

EMI receiver settings:

- Detector: Peak - Maxhold
- Frequency range: 150 kHz – 30 MHz
- Frequency steps: 5 kHz
- IF-Bandwidth: 9 kHz
- Measuring time / Frequency step: 20 ms
- Measurement on phase + neutral lines of the power cords

On basis of this preliminary scan the highest amplitudes and the corresponding frequencies relative to the limit are identified. Emissions above the limit and emissions which are in the 10 dB range below the limit are considered.

Step 2: Final measurement

Intention of this step is, to determine the highest emissions with the settings defined in the test specification for the frequencies identified in step 1.

EMI receiver settings:

- Detector: Quasi-Peak
- IF - Bandwidth: 9 kHz
- Measuring time: 1 s / frequency

At each frequency determined in step 1, four measurements are performed in the following combinations:

- 1) Neutral lead - reference ground (PE grounded)
- 2) Phase lead - reference ground (PE grounded)
- 3) Neutral lead - reference ground (PE floating)
- 4) Phase lead - reference ground (PE floating)

The highest value is reported.

Test Requirements / Limits

If not stated within the measurement plot and/or test result, class B limits are applied.

FCC Part 15, Subpart B, §15.107, Class B Limit

Frequency Range (MHz)	QP Limit (dB μ V)	AV Limit (dB μ V)
0.15 – 0.5	66 to 56	56 to 46
0.5 – 5	56	46
5 – 30	60	50

FCC Part 15, Subpart B, §15.107, Class A Limit

Frequency Range (MHz)	QP Limit (dB μ V)	AV Limit (dB μ V)
0.15 - 0.5	79	66
0.5 - 30	73	60

Used conversion factor: Limit (dB μ V) = 20 log (Limit (μ V)/1 μ V).

NOTES:

A missing result table in the corresponding test report section means, that no final measurement was performed because no relevant frequencies (peaks) were found in the preliminary scan.
The chosen operating mode is selected as representative mode to generate "worst-case" conditions, i.e. high power consumption.

Spurious radiated emissions

Standard FCC Part 15, Subpart B

The test was performed according to: ANSI C 63.4, 2009

Test Description

Measurement below 1 GHz:

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 1.0 x 2.0 m in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.

The test was performed at the distance of 3 m between the EUT and the receiving antenna. The measurement procedure is implemented into the EMI test software ES-K1 from R&S. The radiated emissions measurements were made in a typical installation configuration. 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. A pre-check is also performed while the EUT is powered from both AC and DC (battery) power in order to find the worst-case operating condition. AC Power supply voltage for EUT: 120 V 60 Hz (if not stated within the measurement plot and/or test result).

Step 1: Preliminary scan (test to identify the highest amplitudes relative to the limit)

Intention of this step is, to determine the radiated EMI-profile of the EUT.

Settings for step 1:

- 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
- Polarization: Horizontal + Vertical

On basis of this preliminary scan the highest amplitudes and the corresponding frequencies relative to the limit are identified. Emissions above the limit and emissions which are in the 10 dB range below the limit are considered.

Step 2:

A further measurement will be performed on the frequencies determined in step 1. Intention of this step is, to find out the approximate turntable angle and antenna height for each frequency.

Settings for step 2:

- 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
- Polarizations: 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 +/- 22.5° 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: 100ms
- Turntable angle range: -22.5° to +22.5° 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 (< 1GHz)
- Measured frequencies: in step 3 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

Measurement above 1 GHz:

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

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 density 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 as described before, are omitted. Step 1 was performed at one height of the receiving antenna only.

Detector: Peak, Average (simultaneously)

RBW = VBW = 1 MHz; above 7 GHz 100 kHz

Test Requirements / Limits

If not stated within the measurement plot and/or test result, class B limits are applied.

FCC Part 15, Subpart B, §15.109, Radiated Emission Limits

Frequency Range (MHz)	Class B Limit (dBµV/m)
30 – 88	40.0
88 – 216	43.5
216 – 960	46.0
above 960	54.0

Frequency Range (MHz)	Class A Limit (dBµV/m) / @ 3 m!
30 – 88	49.5
88 – 216	54.0
216 – 960	56.9
above 960	60.0

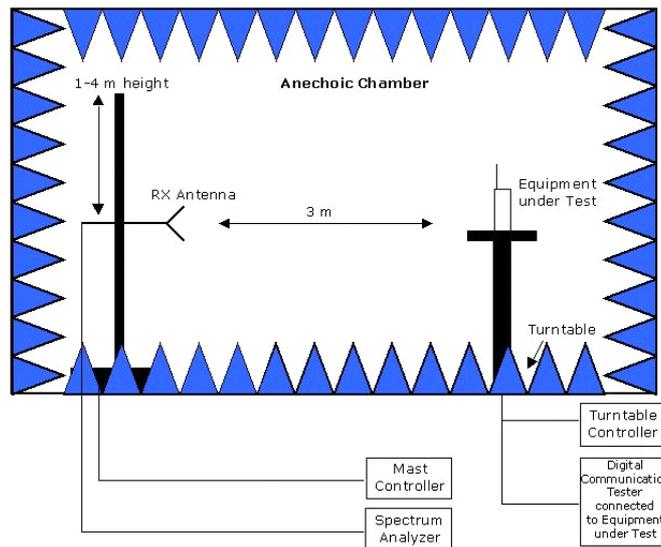
§15.35(b)

..., 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: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)

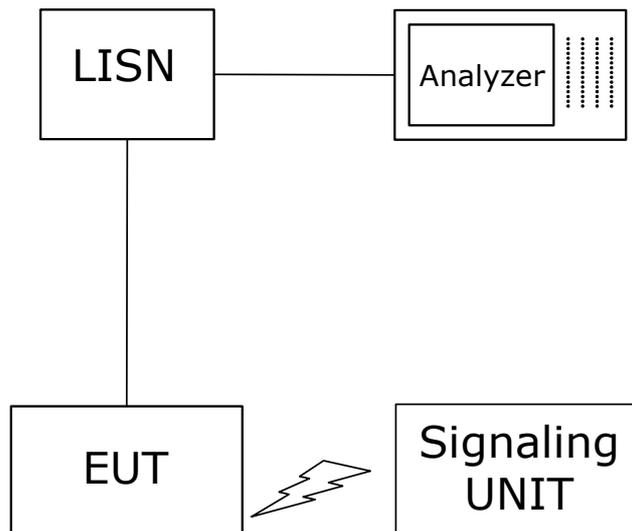
NOTE: A missing result table in the corresponding test report section means, that no final measurement was performed because no relevant frequencies (peaks) were found in the preliminary scan.

Setup Drawings



Remark: Depending on the frequency range suitable antenna types, attenuators or preamplifiers are used.

Setup in the Anechoic chamber. For measurements below 1 GHz the ground was replaced by a conducting ground plane.



Setup in the shielded room for conducted measurements at AC mains port

Correlation of measurement requirements from FCC and IC

Measurement	FCC reference	IC reference
Conducted Emissions (AC Power Line)	§15.107	ICES-001 Issue 4 or ICES-003 Issue 5 or RSS- Gen Issue 3
Radiated Spurious Emissions	§15.109	ICES-001 Issue 4 or ICES-003 Issue 5 or RSS- Gen Issue 3

Remarks:

1. FCC Part 15 subpart B, ICES 003 and CISPR 22 contain different definitions of Class A and Class B limits, i.e. which class is applicable to which kind of EUT. ICES 003 and CISPR 22 distinguish between the location where the EUT is intended to operate whilst FCC refers to the method of commercial distribution (distributive trades).
2. The correct assignment of the appropriate class to the concrete EUT is not scope of this test report!
3. A radio apparatus that is specifically subject to an Industry Canada Radio Standard Specification (RSS) and which contains an ITE is not subject to ICES-003 provided the ITE is used only to enable operation of the radio apparatus and the ITE does not control additional functions or capabilities.
4. ISM (Industrial, Scientific or Medical) radio frequency generators, though they may contain ITE, are excluded from the definition of ITE and are not subject to ICES-003. They are instead subject to the Interference-Causing Equipment Standard ICES-001, which specifically addresses ISM radio frequency generators.
5. The kind of EUT (ITE, ISM, Radio) determines which IC Standard is applicable.

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