TEST REPORT
No.: 6-0143-12-2-3b

According to:
FCC Regulations
Part 15B
IC-Regulations
RSS-132, RSS-133, RSS-139 &
RSS-Gen

for

u-blox AG

RF-Module LISA-U230
FCC-ID: XPYLISAU230
IC-ID: 8595A-LISAU230

Laboratory Accreditation and Listings			
DAkkS Deutsche Akkreditierungsstelle D-PL-12047-01-01	Reg. No.: 736496 MRA US-EU 0003	Industry Canada Reg. No.: 3462D-1 Reg. No.: 3462D-2 Reg. No.: 3462D-3	Voluntary Controls for Electromagnetic Emissions Reg. No.: R-2665, R-2666 C-2914, T-1967, G-301
Wi Fi ALLIANCE AUTHORIZED RF LABORATORY	CTIA Authorized Test Lab LAB CODE 20011130-00		
accredited according to DIN EN ISO/IEC 17025			

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1. Summary of test results

The test results apply exclusively to the test samples as presented in chapter 3.1. The CETECOM GmbH does not assume responsibility for any conclusions and generalizations taken in conjunction with other specimens or samples of the type of the item presented to tests.

The presented RF-Module includes GSM/(E)GPRS (Bands 850/1900) and W-CDMA Band 2, 4 and 5 Band technologies. This test report shows tests results performed in IDLE Mode only. Pls. refer the other test report for TX-Mode.

Following tests have been performed to show compliance with applicable FCC Part 15.107 class B, 15.109 class B and FCC CFR 47 rules (11-1-10 Edition) and RSS-Gen standards.

1.1. RX Mode TESTS OVERVIEW FCC (USA) and RSS (CANADA) Standards

TEST CASES	PORT	REFERENCES & LIMITS			EUT set-up	EUT op-mode	Result
		FCC Standard	RSS Section	TEST LIMIT			
Diagram section 1: EMI-AC Power lines tests							
Emissions AC-Power Lines 0,15-30 MHz conducted	AC-Power lines	§15.107	RSS-Gen, Issue 3: Chapter 7.2.4	FCC §15.107 class B limits IC: Table 4, Chapter 7.2.4	1	1+ 2+ 3+ 4 + 5	Passed
Diagram section 2: Electric field strength tests							
RECEIVER emissions radiated	Cabinet + Inter-connec-ting cables	§15.109 §15.33 §15.35	RSS-Gen, Issue 3: 6.1 RSS-132, Issue 2: 4.6 RSS 133, Issue 5: 6.6 RSS-139, Issue 2 6.6	FCC 15.109 class B limits IC-limits: Table 1, Chapter 6	1	1+ 2+ 3+ 4 + 5	Passed
Diagram section 4: Conducted tests							
RECEIVER Emissions 30-1000MHz conducted	Ant. termi-nal	§2.1051 §15.111	RSS-Gen: 6.2 RSS132: 4.6 RSS133: 6.7(b) RSS-139: 6.6	FCC: 43+10log(P) dBc IC: < 2 nW/4kHz < 5nW/4kHz (f> 1GHz)	2	1+ 2+ 3+ 4 + 5	Passed

Remark: --

Dipl.-Ing. W. Richter
Responsible for test section

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Dipl.-Ing. B. Taslica
Responsible for test report

2. Administrative Data

2.1. Identification of the testing laboratory

Company name: Address:	CETECOM GmbH Im Teelbruch 116 45219 Essen - Kettwig Germany
Responsible for testing laboratory:	Dipl.-Ing. W. Richter
Deputy:	Dipl.-Ing. J. Schmitt
Laboratory accreditations/Listings:	DAkkS-Registration No. D-PL-12047-01-01 FCC-Registration No.: 736496, MRA US-EU 0003 IC-Registration No. 3462D-1, 3462D-2, 3462D-3 VCCI Reg. No. R-2665, R-2666, C-2914, T-1967, G-301

2.2. Test location

2.2.1. Test laboratory "CTC"

Company name:	see chapter 2.1. Identification of the testing laboratory

2.3. Organizational items

Order No.:	E600143002
Responsible for test report and project leader:	Dipl.-Ing. B. Taslica
Receipt of EUT:	2012-03-19
Date(s) of test:	2012-03-20- 2011-03-30
Date of report:	2012-04-10
Version of template: 11.05 _All.Dotm	

2.4. Applicant's details

Applicant's name:	u-blox AG
Address:	Zürcherstrasse 68 8800 Thalwil Switzerland
Contact person:	Mr. Giulio Comar

2.5. Manufacturer's details

Manufacturer's name:	please see Applicant's details
Address:	please see Applicant's details

3. Equipment under test (EUT)

3.1. Additional declaration and description of main EUT

Main function	GSM/(E)GPRS/WCDMA RF Module		
Type	RF module		
TX/RX-frequency ranges	GSM 850: 824 – 849MHz (Uplink), 869-894MHz (Downlink) GSM1900: 1850-1910MHz (Uplink), 1930-1990MHz (Downlink) FDD Band 2: 1852.4–1907.6 MHz (Uplink), 1930-1990MHz (Downlink) FDD Band 4: 1712.4–1752.6 MHz (Uplink), 2110-2155MHZ (Downlink) FDD Band 5: 826.4-846.6 MHz (Uplink), 869-894MHz (Downlink)		
Type of modulation	GSM-mode: GMSK GPRS-Mode: 8-PSK FDD-Mode Release99: QPSK FDD Mode Release 5+6: 16QAM additionally		
Number of channels	GSM 850: 128 – 251, 125 channels GSM1900: 512 – 810, 300 channels FDD Band 2: UARFCN range 9262 – 9400 – 9538 FDD Band 4: UARFCN range 1312 – 1450 – 1513 FDD Band 5: UARFCN range 4132 – 4183 – 4233		
EMISSION DESIGNATOR(S) [GSM]	244KGXW (GPRS850) 242KGXW (EDGE850) 247KG7W (GPRS1900) 244KG7W (EDGE 1900)		
EMISSION DESIGNATOR(S) [FDD]	4M06F9D (FDD 2) 4M05F9D (FDD 4) 4M08F9D (FDD 5)		
Antenna Type	☐ Integrated ☐ External, no RF- connector ☒ External, separate RF-connector	Frequency range of antenna: 800MHz to 2200MHz	
FCC-ID	XPYLISAU230		
IC	8959-LISAU230		
Installed options	☒ GSM900 and GSM1800 Bands (not usable in USA/Canada) ☒ W-CDMA Band I, VI and VIII (not usable in USA/Canada)		
Power supply	☒ over AC/DC adaptor: 110V/60Hz		
Voltage settings	3.8 V DC (nominal), 3.4 V DC (minimum) and 4.2 V DC (maximum)		
Temperature range	Lowest -20 °C to highest +65°C (manufacturer declared)		
Special EMI components	--		
EUT sample type	☐ Production	☒ Pre-Production	☐ Engineering

3.2. EUT: Type, S/N etc. and short descriptions used in this test report

Short description*)	EUT	Type	S/N serial number	HW hardware status	SW software status
EUT A	RF-Module	LISA-U230	IMEI: 35223705001 1958	146AA0	22.00
EUT B	RF-Module	LISA-U230	IMEI: 35223705001 1990	146AA0	22.00
EUT C	Adapter Board	LISA-U200 FAE	SN096	IP02_HW_CS_ 150000	--
EUT D	Adapter Board	LISA-U200 FAE	SN073	IP02_HW_CS_ 150000	--
EUT E	Magnetic Mount Antenna	Taoglas GA.107	#1	--	--

*) EUT short description is used to simplify the identification of the EUT in this test report.

3.3. Auxiliary Equipment (AE): Type, S/N etc. and short descriptions

AE short description *)	Auxiliary Equipment	Type	S/N serial number	HW hardware status	SW software status
AE 1	AC/DC adaptor (AC 110V/60Hz, DC 12 V)	0055 (Power supply connected on EUT B)	# 1	--	--
AE 2	USB cable	Mini USB to USB	#1	1,8m	--
AE 3	USB cable	Mini USB to USB	#2	1,8m	--
AE 4	Head-Set (HS) portable earphone	V109	--	--	--
AE 5	Laptop	CTC #7	--	--	--

*) AE short description is used to simplify the identification of the auxiliary equipment in this test report.

3.4. EUT set-ups

EUT set-up no.*)	Combination of EUT and AE	Remarks
Set. 1	EUT A +EUT C +EUT E +AE 1 +AE 2 +AE 3 +AE 4 +AE 5	Used for radiated tests (Laptop on, used as interface and the display switch-off after 3 minutes)
Set. 2	EUT B + EUT D + AE 5	Used for conducted tests (power supply cables at EUT B for nominal voltage)

*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.

3.5. EUT operating modes

EUT operating mode no.*)	Description of operating modes	Additional information
op. 1	GSM 850 Idle mode BCCH 182	The mobile station is synchronized to the Broadcast Control Channel (BCCH) and listening to the Common Control Channel (CCCH). Periodic location update is disabled.
op. 2	GSM 1900 Idle mode BCCH 651	The mobile station is synchronized to the Broadcast Control Channel (BCCH) and listening to the Common Control Channel (CCCH).
op. 3	UMTS / FDD 2 IDLE-MODE	The mobile is synchronized to the UMTS base station.
op. 4	UMTS / FDD 4 IDLE-MODE	The mobile is synchronized to the UMTS base station.
op. 5	UMTS / FDD 5 IDLE-MODE	The mobile is synchronized to the UMTS base station.

*) EUT operating mode no. is used to simplify the test report.

3.6. Parameter Settings on mobile phone and base station CMU200

Following settings apply to the MS during the measurements in **GSM/(E)GPRS**-Mode only:

Parameter	Traffic Mode	Idle Mode
Traffic Channels mobile station (EUT)	GSM 850 TCH_{MS}= 128/ 192 /251 GSM 1900 TCH_{MS} = 512 / 681 / 810	--
maximum power level (PCL)	GSM 850: PCL = 5 (2 Watt) GSM 1900: PCL = 0 (1 Watt)	--
Modulation	GSM: GMSK-Modulation Scheme EDGE: 8-PSK Modulation Scheme	--
DTX	off	--
Bitstream	PRBS 2E9-1 (pseudo-random-sequence) – CCITT 0.153	
Timeslot	3	
Hopping	off	
Timeslot (slot mode)	GSM-Mode: single E/GPRS-Mode: maximum allowed uplink slots no. according MS class	
Maximum data transmission rate, single time slot	GPRS: 20.0 kbps/ Slot EDGE: 59.2 kbps/ Slot FDD: 12.2 kbps	
Speech transcoding (Traffic Mode)	Full rate Version 1	
Mode	BCCH and TCH	
BCCH – base station (CMU,CMD)	GSM 850: 182 GSM 1900: 651	
TCH – base station (CMD, CMU)	auto	
Power level TCH – base station (used timeslot level)	- 70 dBm	
Power level BCCH – base station (control channel level)	- 80 dBm	
External attenuation RF/AF-Input/Output	Accord. calibration prior to measurements	
Mobile Country Code	310	310
BS_AG_BLKS_RES	Not applicable	0
Paging reorganisation		Off (0)
Signalling channel		SDCCH
Location Update		Auto
Cell access		Disabled (barred)

Following settings apply to the UE (EUT) during the measurements in **FDD-Mode** only:

Parameter	Traffic Mode	Idle Mode
UARFCN UE Uplink (EUT) (according TS34.108)	FDD 2 = 9262/ 9400/ 9538 FDD 4 = 1312/1413/1513 FDD 5 = 4132/ 4182/ 4233	--
UARFCN Node B (downlink) (according TS34.108)	FDD 2 = 9663/ 9800/ 9937 FDD 4 = 1537/1675/1738 FDD 5 = 4358/ 4400/ 4457	
UE power class	Class 3 (+24dBm)	
HSDPA UE category/ HSUPA category	14/6	
Maximum power	FDD 2/4/5 12.2kbps RMC -> all TPC bits up ("1") HSDPA-mode = accord. Subtests 1,2,3,4 defined in 3GPP TS34.121 HSUPA mode = accord. Subtests 1,2,3,4,5 defined in 3GPP TS34.121	--
Modulation	12.2kbps RMC99-mode: QPSK-Modulation Scheme HSDPA/HSUPA = QPSK, BPSK and 16 QAM Modulation Scheme is applicable	--
Compression mode	Off	--
Bitstream	PRBS 2E9-1 (pseudo-random-sequence) – CCITT 0.153	
Maximum data transmission rate:	GPRS: 20 kbit/s Slot EDGE: 59,2 kbit/s Slot FDD: according defined UE category	
Node B Downlink physical channels settings	According Table E.5.1/E.5.1A in 3GPP TS34.121	
External attenuation RF/AF-Input/Output	Accord. Set-up calibration prior to measurements	

Settings for CMU (general)

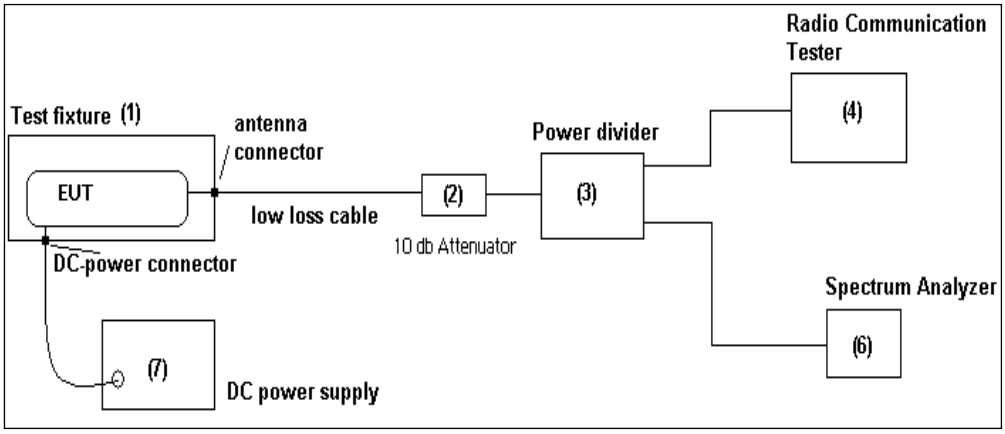
Repetition	Continuous	
Stop condition	None	
Display mode	Max./Min	
Statistic Count	1000 Bursts	
Decoder	Standard	

Additional settings on the base stations CMU200 for frequency stability measurements

4. DESCRIPTION OF TEST SET-UP's

4.1. Mode test set-up for conducted measurements

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first 10 dB attenuated (2) before it is 0° divided by a power divider (3). One of the signal path is connected to the communication base station (4), other branch is connected to the spectrum – analyzer (5). The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.



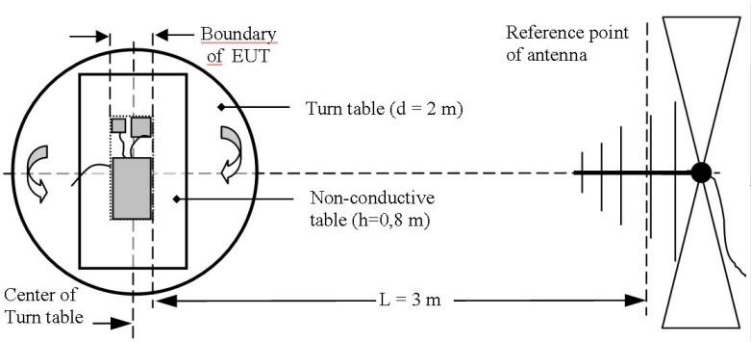
Schematic: Test set-up conducted

4.2. Test set-up for radiated measurements

Please see below description and schematic for radiated measurements used set-up.

MEASUREMENT METHOD (30 MHz<f <1 GHz):

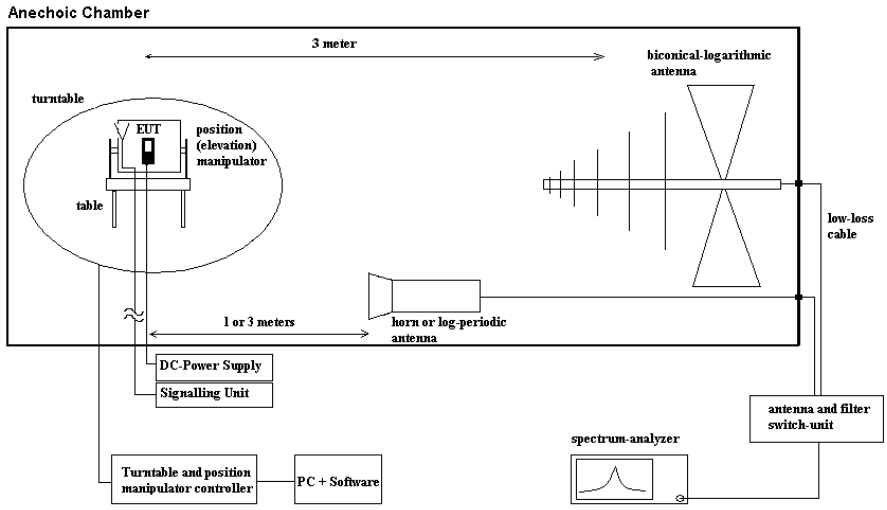
A EMI analyzer together with a broadband antenna was used in order to identify the emissions from the EUT by positioning the antenna close to the EUT surfaces. The interconnecting cables and equipment position were varied in order to maximize the emissions. Then most critical frequencies are recorded for further investigations. Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's operating mode, cable position, etc. The EUT was placed on a non-conductive support of 0.8 m height. By rotating the turntable angle in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position) and the measurement antenna height from 1 meter to 4 meters, the maximized emissions are recorded. The measurements are performed for both polarizations of the measuring antenna: horizontal and vertical.



MEASUREMENT METHOD (1 GHz<f <26.5 GHz):

The EUT and accessories are placed on a non-conducting tipping table of 0.8 meter height (semi-anechoic chamber) or 1.55m height (fully-anechoic chamber) which is situated in the middle of the turntable. The turntable can rotate the device under test 360 degree, the tipping table can rotate the device from laid to standing position. This way the device under test can be rotated in all three orthogonal planes in order to maximize the detected emissions. The turn- and tipping table are controlled by a controller unit. All positions manipulations are software controlled from a operator PC.
The measurements are performed for both receiving antenna polarisations: vertical and horizontal.

Up to 18 GHz a measurement distance of 3 meters is used, below 18 GHz the distance is 1 meter. A biconical-logarithmic antenna up to 1 GHz and a log.-periodic antenna for frequencies below 1 GHz up to 26.5 GHz is used. For frequencies below 26.5 GHz a horn antenna is used, pls. compare the equipment list for more details.



The EUT is powered either by a external DC-supply with nominal voltage or a AC/DC power supply as accessory. The communication signalling (if necessary for operation) is performed from outside the chamber with a communication test simulator (CMU200 from Rohde&Schwarz) and a signalling antenna place near the EUT.

Schematic: radiated measurements test set-up

5. Measurements and Diagrams

5.1. Conducted emissions on AC-Power lines

5.1.1.TEST LOCATION AND EQUIPMENT (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter 2.2.1)		☐ Please see Chapter 2.2.2		☐ Please see Chapter 2.2.3	
test site	☐ 333 EMI field	☒ 348 EMI cond.				
receiver	☐ 001 ESS	☒ 377 ESCS 30				
LISN	☒ 005 ESH2-Z5	☐ 007 ESH3-Z6	☐ 300 ESH3-Z5 & 50Ω used for AE		☐ no LISN for AE	
signaling	☐ 392 MT8820A	☒ 436 CMU	☐ 547 CMU			
line voltage	☐ 230 V 50 Hz via public mains		☒060 110 V 60 Hz via PAS 5000			

5.1.2.STANDARDS AND LIMITS: PART 15, SUBPART B, §15.107, CANADA: RSS-Gen, ANSI C63.4:2009

Frequency [MHz]	Conducted limit Class B [dBµV]	
	QUASI-Peak	AVERAGE
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50
Remark: * decreases with the logarithm of the frequency		

5.1.3.TEST CONDITION AND MEASUREMENT PROCEDURES TEST SET-UP

link to test system (if used):	☒ air link	☐ cable connection	☐
EUT-grounding	☒ none	☐ with power supply	☐ additional connection
Equipment set up	☒ table top (40 cm distance to reference ground plane (wall)		☐ floor standing EUT stands isolated on reference ground plane (floor)
Climatic conditions	Temperature: (22±3°C)		Rel. humidity: (40±20)%
EMI-Receiver (Analyzer) Settings	Span/Range: 150 kHz to 30 MHz RBW: 9 kHz Detector/Mode: Max PEAK-hold, repetitive scan for preliminary testing Quasi-Peak Detector and Average-Detector for final measurement according ANSI 63.4, CISPR 16		

Devices which can be connected to the public AC-power network, should be tested against the radio frequency voltage conducted back into the AC-power line in the frequency range 150kHz to 30 MHz. Compliance should be tested by measuring the radio frequency voltage between each power line and ground at the power terminals in the stated frequency range.
A 50Ohm/50µH line impedance stabilization network (LISN) is used therefore. The EUT power input leads are connected through the LISN to the AC-power source. The LISN enclosure is electrically connected to the GND-plane. The measuring instrument is connected to the coaxial output of the LISN.
Tabletop devices were set-up on a 80 cm height over reference ground plane, floor standing equipment 10 cm raised below ground plane.
Measurements have been performed on each phase line and neutral line of the devices AC-power lines. The EUT was power supplied with 110 V/60Hz.
The EUT was tested in the defined operating mode and installed (connected) to accessory equipment according the general description of use given by the applicant.
Preliminary testing as a first step, determines the worst-case phase line (neutral or phase) as well as the most critical amplitude by changing the operating mode. A complete frequency-sweep is performed with PK-Detector.
Final testing for power phases and critical frequencies (Margin to AV- or QP limit lower than 3dB) as a second step includes measurements either on discrete frequency components with receivers detector set to Quasi-Peak and Average per frequency component or a complete frequency sweep with corresponding detector.

5.1.4.MEASUREMENT RESULTS

EUT Type and S/N or EUT set-up no.		EUT set-up: see below			
EUT operating mode		EUT operating mode: see below			
Diagram No.	Command or EUT operating mode or operating mode no.	Detector (Peak, CISPR AV, CISPR QP)	Power line (L1, L2, L3, N)	Additional (scan-) information (e.g. Pre-test Fast scan, Maxhold, Final measurement)	Result (passed / failed /final measurem. necessary)
1.06	EUT operating mode 1 (ARFCN 182)	☒ Peak ☐ CAV ☐ QP	L1/ N	The Diagram shows PK detector at pre-measurements on L1 and N with maxhold mode.	Passed
1.07	EUT operating mode 2 (ARFCN 651)	☒ Peak ☐ CAV ☐ QP	L1/ N	The Diagram shows QP/CAV detector at pre-measurements on L1 and N with maxhold mode.	Passed
1.08	EUT operating mode 3 (U-ARFCN 9800)	☐ Peak ☒ CAV ☒ QP	L1/ N	The Diagram shows PK detector at final-measurements on L1 and N with maxhold mode.	Passed
1.09	EUT operating mode 4 (U-ARFCN 1675)	☒ Peak ☐ CAV ☐ QP	L1/ N	The Diagram shows PK detector at pre-measurements on L1 and N with maxhold mode.	Passed
1.10	EUT operating mode 5 (U-ARFCN 4400)	☐ Peak ☒ CAV ☒ QP	L1/ N	The Diagram shows QP/CAV detector at final-measurements on L1 and N with maxhold mode.	Passed

Remarks: The diagram contains the maximum values from L 1 + N

Margin to Limit for verdict: $M = L_T - R_R + C_{Loss}$

Abbreviations used:
- R_R : Receiver readings in dBµV
- C_{Loss}: cable loss
- L_T : Limit in dBµV

5.1.5.VERDICT

Summary of measurement results for conducted emissions on AC-Power lines: Passed

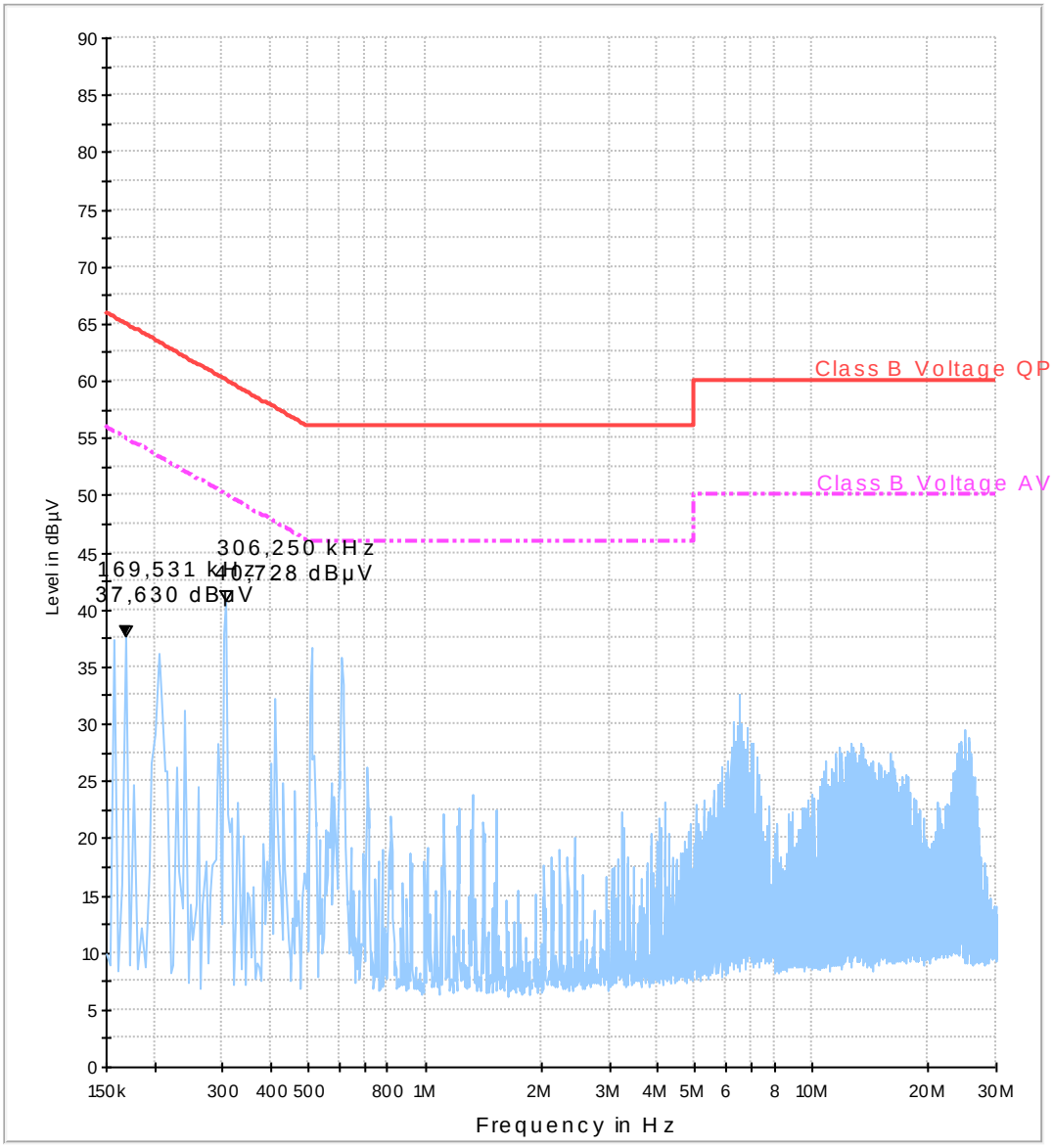
Diagrams

Diagram No. 1.06

Date: 22.03.2012 Page 1 of 2

Test Description:	Conducted Voltage Measurement Class B
Testspezification:	FCC 15.107 Class B, RSS-Gen. issue 3
Technical Data:	Please see next page for detailed information
Diagram:	Shows the peak values as a sum of measured ports (N+L1) in maxhold mode
Operator name:	Hla
Report.- Nr.	6-0143-12-2-3b
EUT:	LISA-U230
Manufacturer:	U-blox AG
Operating mode:	GSM 850 RX (channel:182)
Measured on line:	Mains AC L1 and N
Power during test:	110 V AC 60 Hz
Comment 1:	AC/DC adapter + Magn. Ant. Taoglas GA.107+ USB Adapter+ CTC Laptop#7

01_Class B_Voltage_PK_QPAV_N_L1



Date: 22.03.2012 Page 2 of 2

Technical Data of Measurements with R&S EMC32 V8.51.1

EMI Auto Test Template: 01_Class B_Voltage_PK_QPAV_N_L1

Hardware Setup:	ESH2-Z5
Measurement Type:	4 Line LISN
Frequency Range:	150 kHz - 30 MHz
Graphics Level Range:	0 dBµV - 90 dBµV

Preview Measurements:

Scan Test Template: 02_Class B pre_PK_fast

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
150 kHz - 30 MHz	3.906 kHz	PK+	9 kHz	0,00005 s	0 dB

Receiver: [ESCS 30]

Diagram No. 1.07

Date: 22.03.2012 Page 1

Test Description:	Conducted Voltage Measurement Class B
Testspezification:	FCC 15.107 Class B, RSS-Gen. issue 3
Technical Data:	Please see next page for detailed information
Diagram:	Shows the peak values as a sum of measured ports (N+L1) in maxhold mode
Operator name:	Hla
Report.- Nr.	6-0143-12-2-3b
EUT:	LISA-U230
Manufacturer:	U-blox AG
Operating mode:	PCS 1900 - RX (channel:651)
Measured on line:	Mains AC L1 and N
Power during test:	110 V AC 60 Hz
Comment 1:	AC/DC adapter + Magn. Ant. Taoglas GA.107+ USB Adapter+ CTC Laptop#7

01_Class B_Voltage_PK_QPAV_N_L1

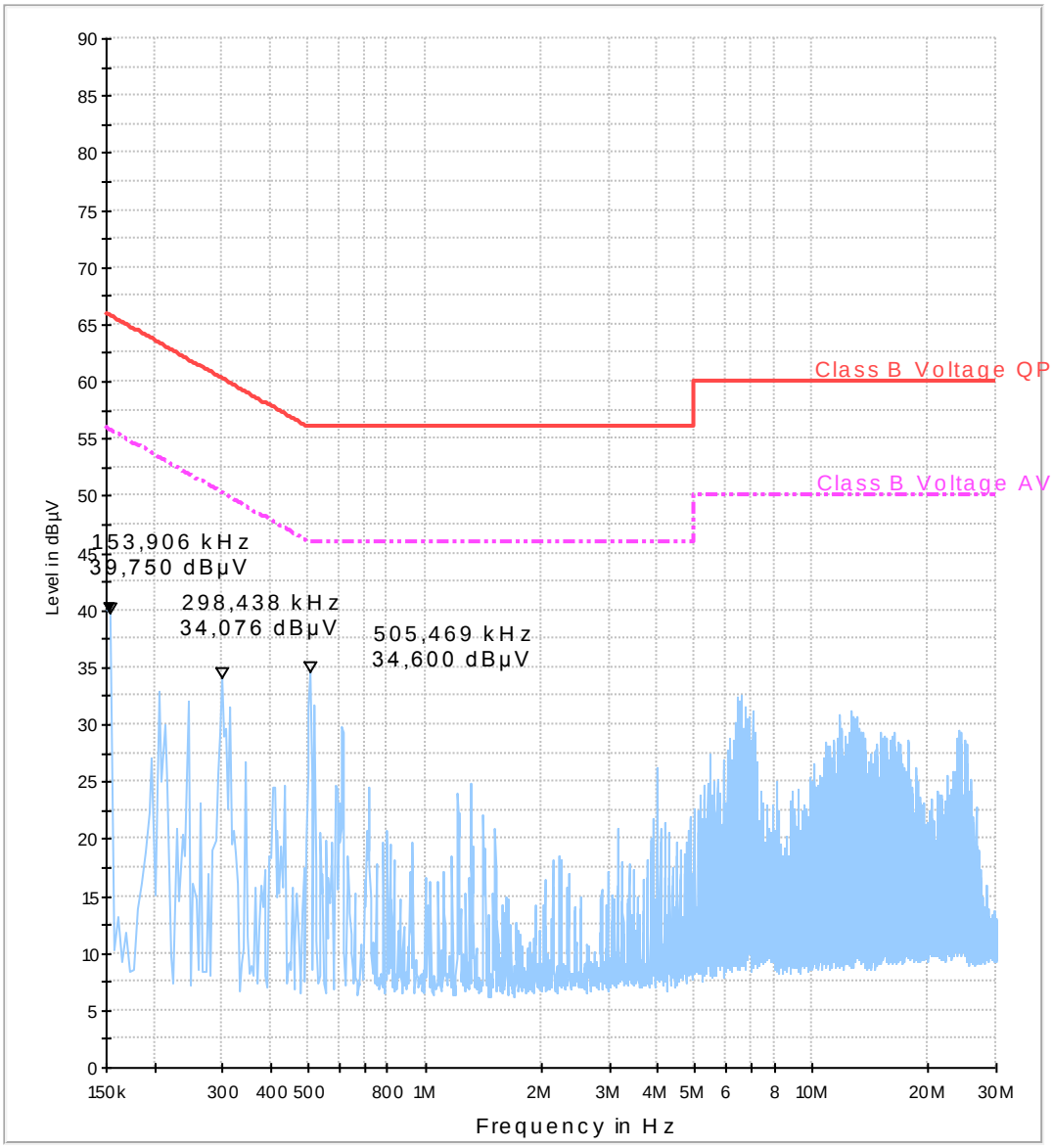


Diagram No. 1.08

Date: 28.03.2012 Page 1 of 2

Test Description:	Conducted Voltage Measurement Class B
Testspezification:	FCC 15.107 Class B/ RSS-Gen Issue 3
Technical Data:	Please see next page for detailed information
Diagram:	Shows the peak values as a sum of measured ports (N+L1) in maxhold mode
Operator name:	Tas
Report.- Nr.	6-0143-12-2-3b
EUT:	LISA-U230
Manufacturer:	U-blox AG
Operating mode:	FDD II - RX (channel:9800)
Measured on line:	Mains AC L1 and N
Power during test:	110 V AC 60 Hz
Comment 1:	AC/DC adapter + Magn. Ant. Taoglas GA.107+ USB Adapter+ CTC Laptop#7

Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.303750	35.3	15000.0	9.000	GND	N	0.0	24.8	60.1
0.511875	31.2	15000.0	9.000	GND	L1	0.0	24.8	56.0

Final Result 2

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.303750	13.6	15000.0	9.000	GND	N	0.0	36.6	50.1
0.511875	10.9	15000.0	9.000	GND	L1	0.0	35.1	46.0

01_Class B_Voltage_PK_QPAV_N_L1

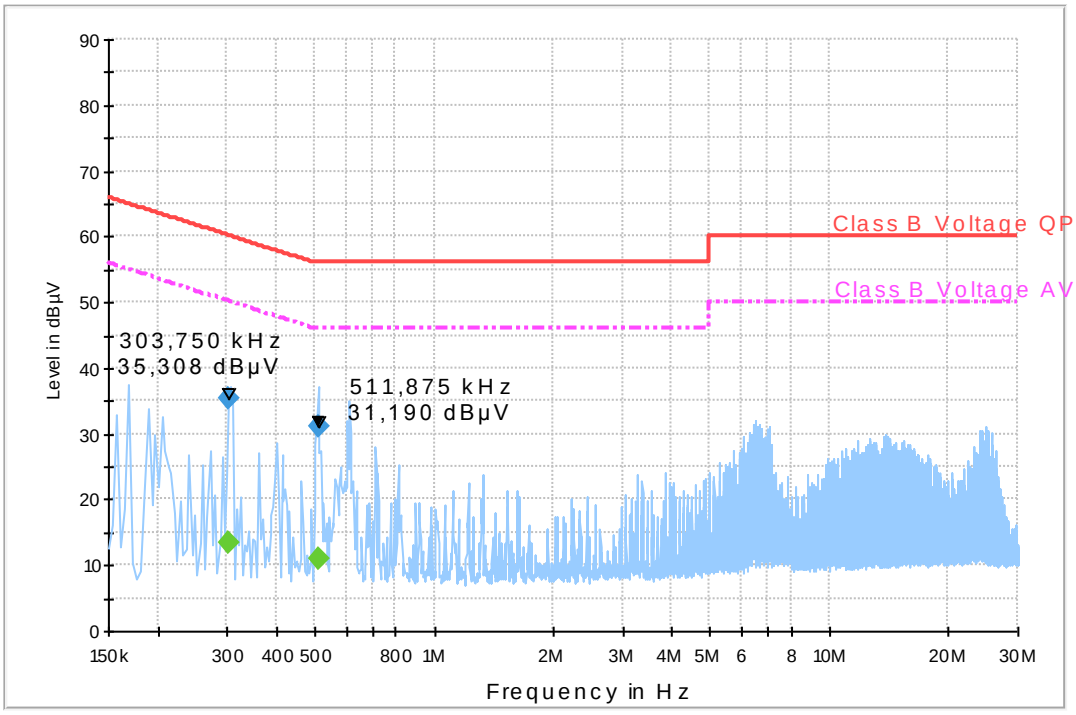


Diagram No. 1.09

Date: 28.03.2012 Page 1

Test Description:	Conducted Voltage Measurement Class B
Testspezification:	FCC 15.107 Class B/ RSS-Gen Issue 3
Technical Data:	Please see next page for detailed information
Diagram:	Shows the peak values as a sum of measured ports (N+L1) in maxhold mode
Operator name:	Tas
Report.- Nr.	6-0143-12-2-3b
EUT:	LISA-U230
Manufacturer:	U-blox AG
Operating mode:	FDD IV - RX (channel:1638)
Measured on line:	Mains AC L1 and N
Power during test:	110 V AC 60 Hz
Comment 1:	AC/DC adapter + Magn. Ant. Taoglas GA.107+ USB Adapter+ CTC Laptop#7

01_Class B_Voltage_PK_QPAV_N_L1

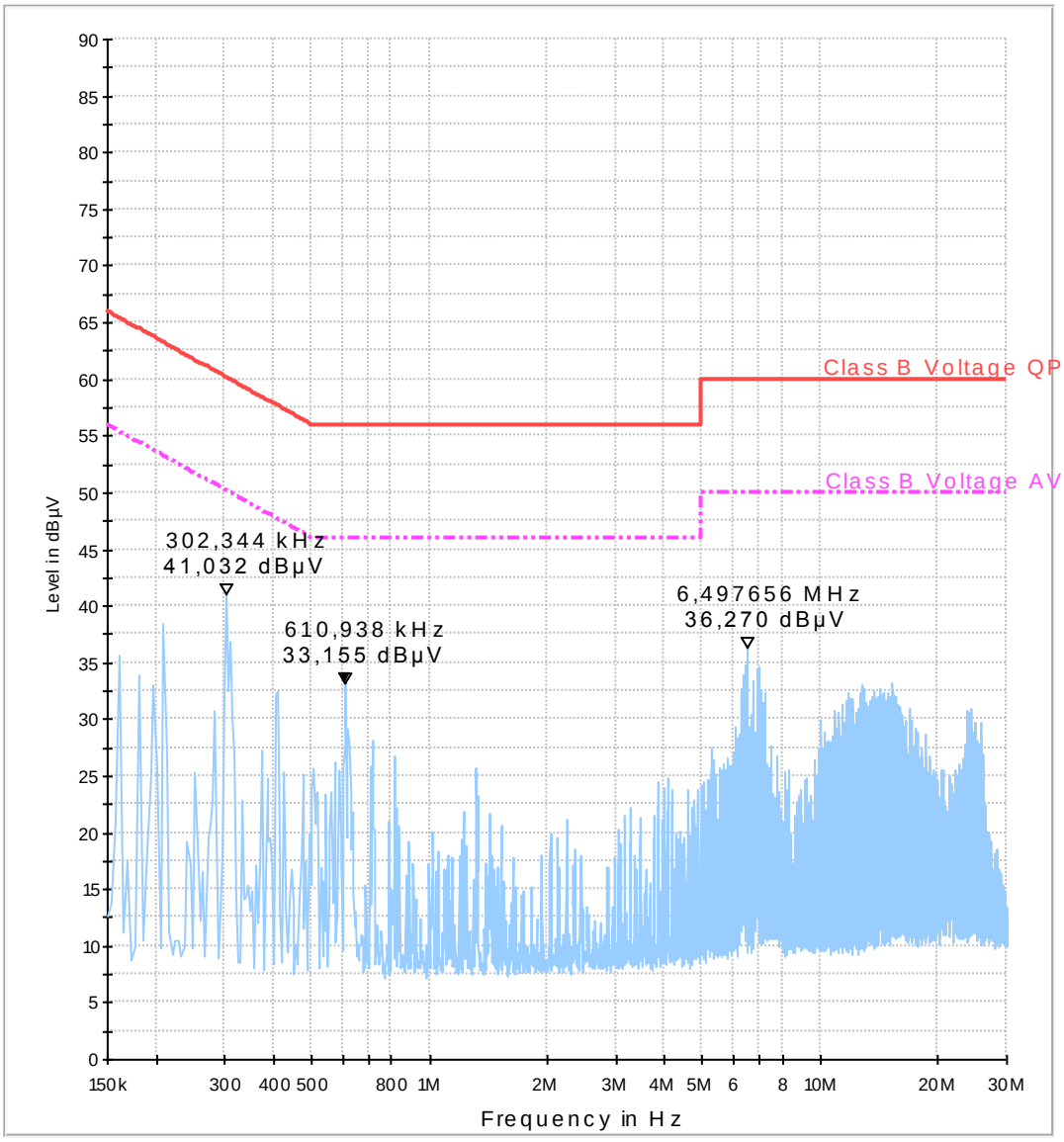


Diagram No. 1.10

Date: 28.03.2012 Page 1

Test Description:	Conducted Voltage Measurement Class B
Testspezification:	FCC 15.107 Class B/ RSS-Gen Issue 3
Technical Data:	Please see next page for detailed information
Diagram:	Shows the peak values as a sum of measured ports (N+L1) in maxhold mode
Operator name:	Tas
Report.- Nr.	6-0143-12-2-3b
EUT:	LISA-U230
Manufacturer:	U-blox AG
Operating mode:	FDD V - RX (channel:4400)
Measured on line:	Mains AC L1 and N
Power during test:	110 V AC 60 Hz
Comment 1:	AC/DC adapter + Magn. Ant. Taoglas GA.107+ USB Adapter+ CTC Laptop#7

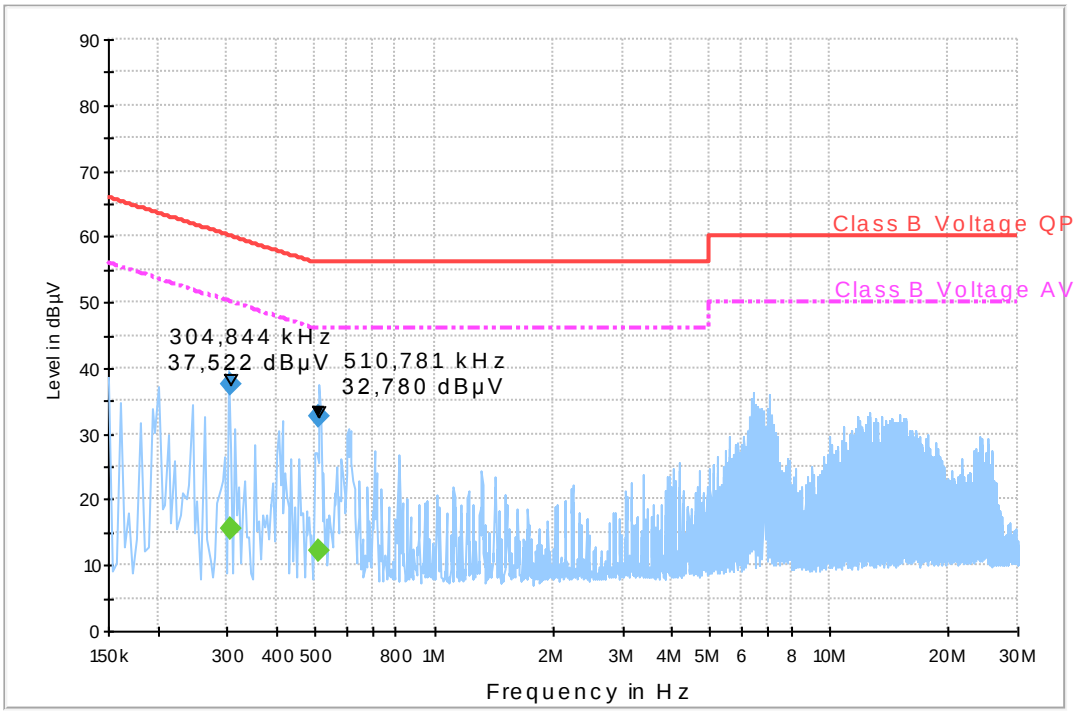
Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.304844	37.5	15000.0	9.000	GND	L1	0.0	22.6	60.1
0.510781	32.8	15000.0	9.000	GND	L1	0.0	23.2	56.0

Final Result 2

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.304844	15.4	15000.0	9.000	GND	L1	0.0	34.7	50.1
0.510781	12.1	15000.0	9.000	GND	L1	0.0	33.9	46.0

01_Class B_Voltage_PK_QPAV_N_L1



5.2. Radiated field strength emissions, 30 MHz - 1 GHz

5.2.1.TEST LOCATION AND EQUIPMENT (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☒ 441 EMI SAR	☐ 487 SAR NSA				
receiver	☐ 377 ESCS30	☒ 001 ESS	☐			
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☐ 264 FSEK			
antenna	☐ 574 BTA-L	☐ 133 EMCO3115	☐ 302 BBHA9170	☐ 289 CBL 6141	☐ 030 HFH-Z2	☐ 477 GPS
signaling	☐ 392 MT8820A	☐ 436 CMU	☐ 547 CMU			
otherwise	☐ 400 FTC40x15E	☐ 401 FTC40x15E	☐ 110 USB LWL	☒ 482 Filter Matrix		
DC power	☐ 456 EA 3013A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE
line voltage	☐ 230 V 50 Hz via public mains		☒ 060 110 V 60 Hz via PAS 5000			

5.2.2.STANDARDS AND LIMITS: CFR 47, PART 15B, §15.109, RSS-Gen, ANSI 63.4:2009

Frequency [MHz]	Radiated emission limits, Class B, 3 meters	
	QUASI-Peak [microvolts/meter]	QUASI-Peak [dBµV/m]
30-88	100	40
88-216	150	43,5
216-960	200	46,0
below 960	500	54,0

5.2.3.TEST CONDITION AND MEASUREMENT TEST SET-UP

link to test system (if used):	☒ air link	☐ cable connection	☐
EUT-grounding	☒ none	☐ with power supply	☐ additional connection
Equipment set up	☒ table top 0.8m height		☐ floor standing
Climatic conditions	Temperature: (22±3°C)		Rel. humidity: (40±20)%
EMI-Receiver (Analyzer) Settings	Span/Range: 30 MHz to 1 GHz RBW/VBW: 120 kHz / (auto) Detector/ Mode: PEAK, TRACE max-hold mode, repetitive scan Quasi-Peak, for final measurement for critical measurements		

GENERAL MEASUREMENT PROCEDURES:

The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.4: 2009

The ***Equipment under Test*** (EUT) set-up to defined operating mode and installed (connected) to accessory equipment according the general description of use given by the applicant.

5.2.4.MEASUREMENT RESULTS

EUT Type and S/N EUT set-up no.	EUT set-up 1			
Diagram No.	Test parameter: Frequency range 30 MHz – 1000 MHz IF Bandwidth at 6 dB: 120 kHz,		Op. mode	Result
2.16	**Pre-measurement, variation of turntable positions** Searching critical frequencies for determined critical operating mode with peak detector, repetitive scan and max-hold mode. The antenna heights are 1.0 m + 1.82 m (both heights for all measured turntable positions).		Op. mode 1	Final measure-ment carried out
	Polarisation of antenna:	☐ horizontal ☐ vertical ☒ horizontal and vertical		
	Receiving antenna directed to EUT side: (Turntable position during pre-measurement)	☒ front (0°) ☒ right (90°) ☒ rear (180°) ☒ left (270°)	☒ EUT device in vertical position (= 0°) used	
		☐ under (0°) ☐ top (180°)	☐ EUT tipping device in horiz. position (= 90°) used	
	Critical frequencies found:	☐ no, margin to limit > 6 dB with PK detector ☒ yes, final measurement with QP detector carried out		
	Step 3: Final measurement at critical frequencies (to find the worst case with Peak and CISPR QP detector)			passed
	Antenna height:	☒ moved from 1.0 m to 4.0 m continuously		
	Turntable:	☒ turned from 0° to 360° continuously		
	EUT Tipping device:	no		

Remarks: Please see chapter of 'diagrams' of this test section.

☐ Mounting position / usual operating position is defined => under and top side of EUT are not measured

EUT Type and S/N EUT set-up no.	EUT set-up 1			
Diagram No.	Test parameter: Frequency range 30 MHz – 1000 MHz IF Bandwidth at 6 dB: 120 kHz,		Op. mode	Result
2.17	**Pre-measurement, variation of turntable positions** Searching critical frequencies for determined critical operating mode with peak detector, repetitive scan and max-hold mode. The antenna heights are 1.0 m + 1.82 m (both heights for all measured turntable positions).		Op. mode 2	Final measure-ment carried out
	Polarisation of antenna:	☐ horizontal ☐ vertical ☒ horizontal and vertical		
	Receiving antenna directed to EUT side: (Turntable position during pre-measurement)	☒ front (0°) ☒ right (90°) ☒ rear (180°) ☒ left (270°)	☒ EUT device in vertical position (= 0°) used	
		☐ under (0°) ☐ top (180°)	☐ EUT tipping device in horiz. position (= 90°) used	
	Critical frequencies found:	☐ no, margin to limit > 6 dB with PK detector ☒ yes, final measurement with QP detector carried out		
	Step 3: Final measurement at critical frequencies (to find the worst case with Peak and CISPR QP detector)			passed
	Antenna height:	☒ moved from 1.0 m to 4.0 m continuously		
	Turntable:	☒ turned from 0° to 360° continuously		
	EUT Tipping device:	no		

Remarks: Please see chapter of 'diagrams' of this test section.

☐ Mounting position / usual operating position is defined => under and top side of EUT are not measured

EUT Type and S/N EUT set-up no.		EUT set-up 3		
Diagram No.	Test parameter: Frequency range 30 MHz – 1000 MHz IF Bandwidth at 6 dB: 120 kHz,		Op. mode	Result
2.18	**Pre-measurement, variation of turntable positions** Searching critical frequencies for determined critical operating mode with peak detector, repetitive scan and max-hold mode. The antenna heights are 1.0 m + 1.82 m (both heights for all measured turntable positions).		Op. mode 3	Final measure-ment carried out
	Polarisation of antenna:	☐ horizontal ☐ vertical ☒ horizontal and vertical		
	Receiving antenna directed to EUT side: (Turntable position during pre-measurement)	☒ front (0°) ☒ right (90°) ☒ rear (180°) ☒ left (270°)	☒ EUT device in vertical position (= 0°) used	
		☐ under (0°) ☐ top (180°)	☐ EUT tipping device in horiz. position (= 90°) used	
	Critical frequencies found:	☐ no, margin to limit > 6 dB with PK detector ☒ yes, final measurement with QP detector carried out		
	Step 3: Final measurement at critical frequencies (to find the worst case with Peak and CISPR QP detector)			passed
	Antenna height:	☒ moved from 1.0 m to 4.0 m continuously		
	Turntable:	☒ turned from 0° to 360° continuously		
	EUT Tipping device:	no		

Remarks: Please see chapter of 'diagrams' of this test section.

☐ Mounting position / usual operating position is defined => under and top side of EUT are not measured

EUT Type and S/N EUT set-up no.		EUT set-up 1		
Diagram No.	Test parameter: Frequency range 30 MHz – 1000 MHz IF Bandwidth at 6 dB: 120 kHz,		Op. mode	Result
2.19	**Pre-measurement, variation of turntable positions** Searching critical frequencies for determined critical operating mode with peak detector, repetitive scan and max-hold mode. The antenna heights are 1.0 m + 1.82 m (both heights for all measured turntable positions).		Op. mode 4	Final measure-ment carried out
	Polarisation of antenna:	☐ horizontal ☐ vertical ☒ horizontal and vertical		
	Receiving antenna directed to EUT side: (Turntable position during pre-measurement)	☒ front (0°) ☒ right (90°) ☒ rear (180°) ☒ left (270°)	☒ EUT device in vertical position (= 0°) used	
		☐ under (0°) ☐ top (180°)	☐ EUT tipping device in horiz. position (= 90°) used	
	Critical frequencies found:	☐ no, margin to limit > 6 dB with PK detector ☒ yes, final measurement with QP detector carried out		
	Step 3: Final measurement at critical frequencies (to find the worst case with Peak and CISPR QP detector)			passed
	Antenna height:	☒ moved from 1.0 m to 4.0 m continuously		
	Turntable:	☒ turned from 0° to 360° continuously		
	EUT Tipping device:	no		

Remarks: Please see chapter of 'diagrams' of this test section.

☐ Mounting position / usual operating position is defined => under and top side of EUT are not measured

EUT	Type and S/N EUT set-up no.	EUT set-up 1		
Diagram No.	Test parameter: Frequency range 30 MHz – 1000 MHz IF Bandwidth at 6 dB: 120 kHz,		Op. mode	Result
2.20	Pre-measurement, variation of turntable positions Searching critical frequencies for determined critical operating mode with peak detector, repetitive scan and max-hold mode. The antenna heights are 1.0 m + 1.82 m (both heights for all measured turntable positions).		Op. mode 5	Final measure-ment carried out
	Polarisation of antenna:	☐ horizontal ☐ vertical ☒ horizontal and vertical		
	Receiving antenna directed to EUT side: (Turntable position during pre-measurement)	☒ front (0°) ☒ right (90°) ☒ rear (180°) ☒ left (270°)	☒ EUT device in vertical position (= 0°) used	
		☐ under (0°) ☐ top (180°)	☐ EUT tipping device in horiz. position (= 90°) used	
	Critical frequencies found:	☐ no, margin to limit > 6 dB with PK detector ☒ yes, final measurement with QP detector carried out		
	Step 3: Final measurement at critical frequencies (to find the worst case with Peak and CISPR QP detector)			passed
	Antenna height:	☒ moved from 1.0 m to 4.0 m continuously		
	Turntable:	☒ turned from 0° to 360° continuously		
	EUT Tipping device:	no		

Remarks: Please see chapter of 'diagrams' of this test section.

☐ Mounting position / usual operating position is defined => under and top side of EUT are not measured

Margin to Limit:

$$M = L_T - R_R + C_F + D_F$$
$$= L_T - R_R + (AF_{ANTENNA} + Cable_{LOSS}) + D_F$$

Remark: positive margin means passed result

Abbreviations used:

- R_R : Receiver readings in dBµV/m
- CF: Transducer in dB = AF (antenna factor) + CL (cable loss)
- D_F : distance correction factor (if different measurement distance used than specified in the standard
- L_T : Limit in dBµV/m

5.2.5.VERDICT

Summary of measurement results for radiated emissions below 30 MHz and below 1 GHz : Passed

Diagrams

Diagram No. 2.16

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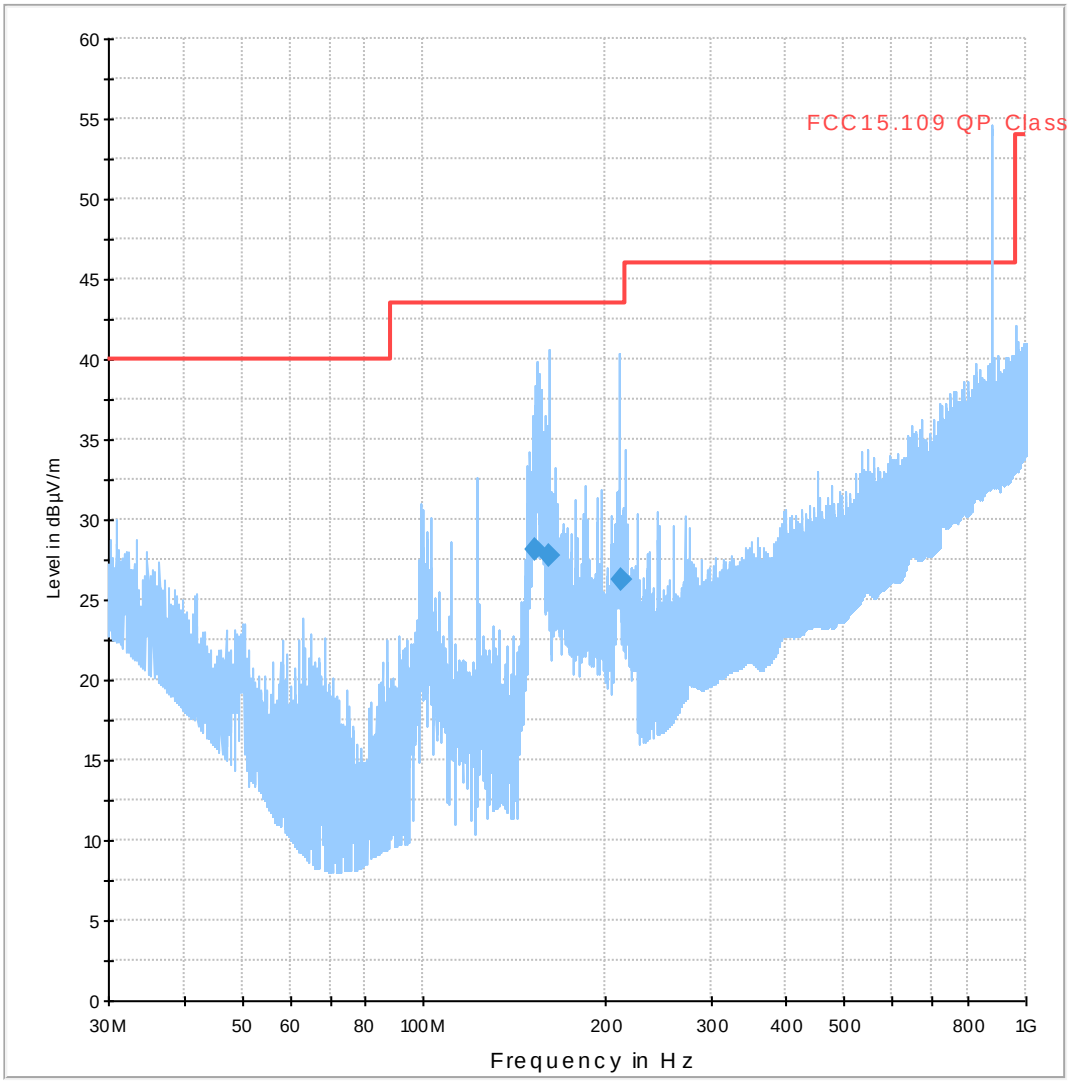
Test description:	Electric Fieldstrength Measurement below 1 GHz
Test site and distance:	Semi Anechoic Room (SAR) with 3 m measurement distance
Distance correction:	not used
Used filter:	not used
Technical Data:	please see page 2 for detailed data of measurement setup
Test specification.:	FCC 15.109 Class B; RSS-Gen: Issue 3
Operator:	kru
Operating conditions:	IDLE 850
Power during tests:	110V 60Hz
Comment 1:	Channel 182

EUT Information

EUT Name:	LISA-U230
Manufacturer:	u-blox AG
IMEI:	352237-05-001195-8
FW:	22.00
Accessories:	AC/DC adapter Model 0055 + Portable earphones V109 + Magnetic Ant. GA.107 Taoglas +2 USB cable (1,8m) +Test laptop #6

FCC15.109_hor+vert



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Final Result 1

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
153.500000	28.2	1000.0	120.000	166.0	H	125.0	8.9	15.3	43.5
161.620000	27.7	1000.0	120.000	163.0	V	283.0	9.5	15.8	43.5
212.400000	26.2	1000.0	120.000	119.0	V	83.0	11.8	17.3	43.5

Diagram No. 2.17

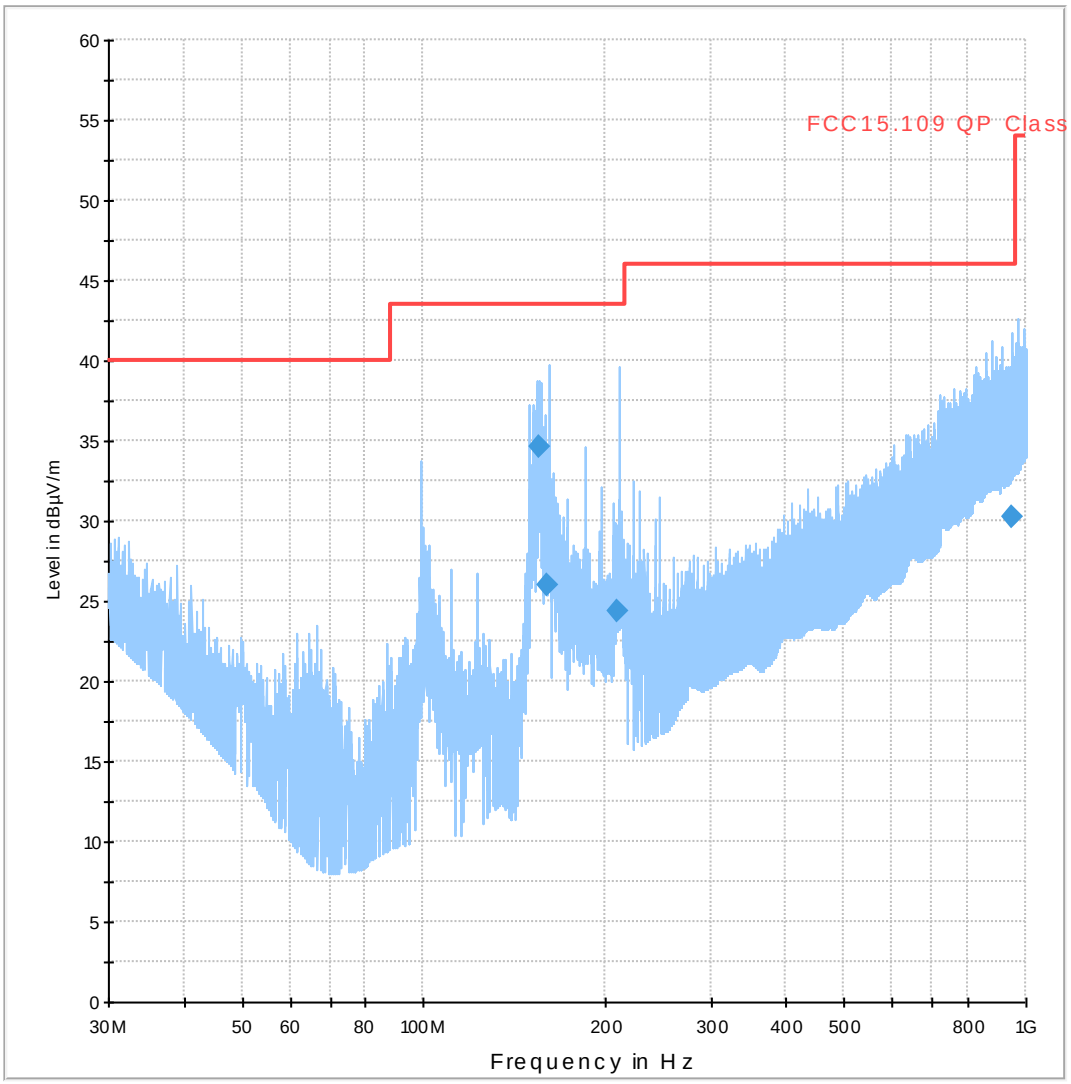
20.03.2012 Page 1 of 2

Test description:	Electric Fieldstrength Measurement below 1 GHz
Test site and distance:	Semi Anechoic Room (SAR) with 3 m measurement distance
Distance correction:	not used
Used filter:	not used
Technical Data:	please see page 2 for detailed data of measurement setup
Test specification.:	FCC 15.109 Class B; RSS-Gen: Issue 3
Operator:	npe/kru
Operating conditions:	IDLE 1900
Power during tests:	110V 60Hz
Comment 1:	Channel 651

EUT Information

EUT Name:	LISA-U230
Manufacturer:	u-blox AG
IMEI:	352237-05-001195-8
FW:	22.00
Accessories:	AC/DC adapter Model 0055 + Portable earphones V109 + Magnetic Ant. GA.107 Taoglas +2 USB cable (1,8m) +Test laptop #7

FCC15.109_hor+vert



Date: 20.03.2012 Page 2 of 2

Final Result 1

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
156.010000	34.7	1000.0	120.000	100.0	V	266.0	9.1	8.8	43.5
160.110000	26.0	1000.0	120.000	100.0	V	68.0	9.3	17.5	43.5
210.190000	24.3	1000.0	120.000	308.0	H	257.0	11.8	19.2	43.5
948.650000	30.3	1000.0	120.000	100.0	H	45.0	26.9	15.7	46.0

Diagram No. 2.18

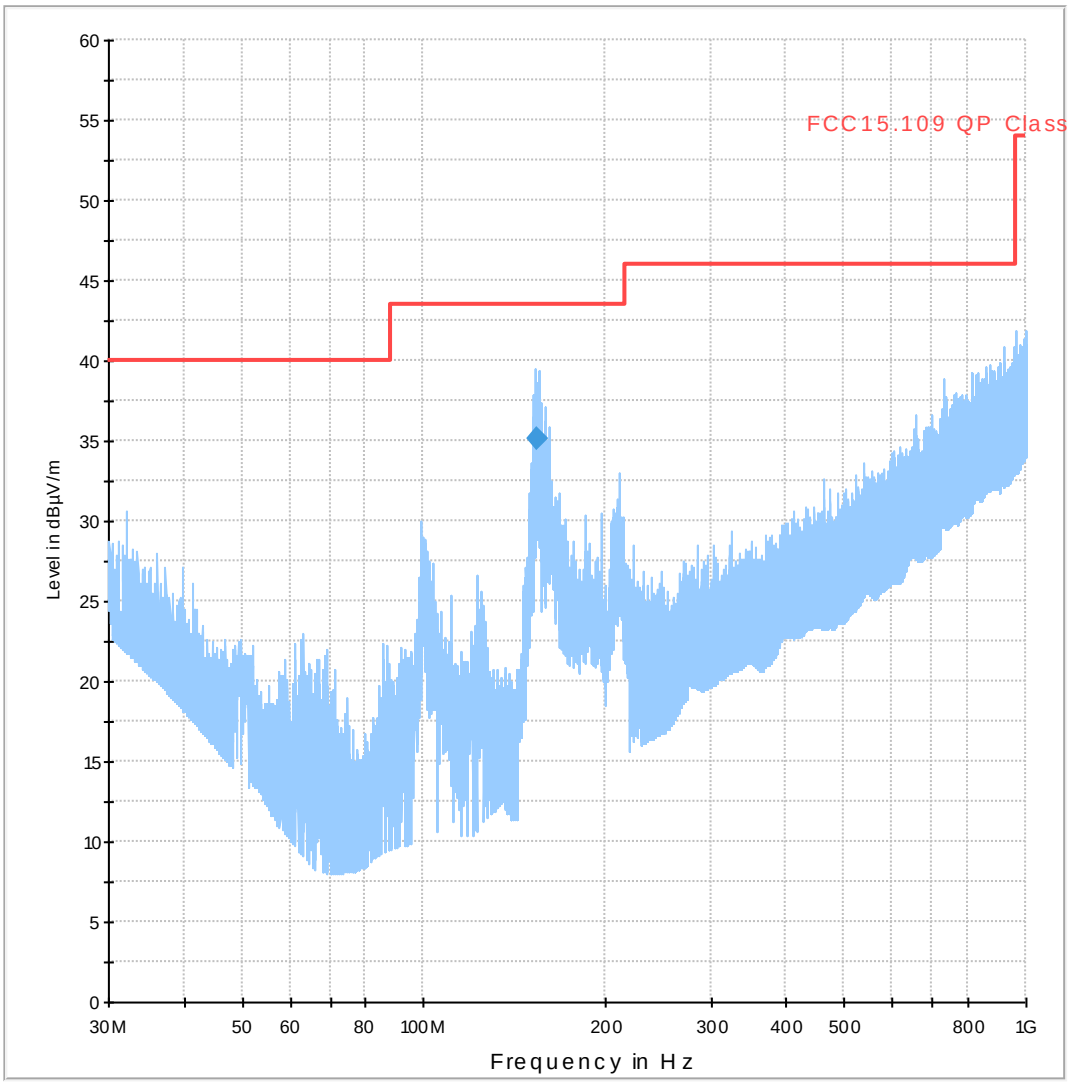
20.03.2012 Page 1 of 2

Test description:	Electric Fieldstrength Measurement below 1 GHz
Test site and distance:	Semi Anechoic Room (SAR) with 3 m measurement distance
Distance correction:	not used
Used filter:	not used
Technical Data:	please see page 2 for detailed data of measurement setup
Test specification.:	FCC 15.109 Class B; RSS-Gen: Issue 3
Operator:	kru
Operating conditions:	IDLE FDD II
Power during tests:	110V 60Hz
Comment 1:	Channel 9800

EUT Information

EUT Name:	LISA-U230
Manufacturer:	u-blox AG
IMEI:	352237-05-001195-8
FW:	22.00
Accessories:	AC/DC adapter Model 0055 + Portable earphones V109 + Magnetic Ant. GA.107 Taoglas +2 USB cable (1,8m) +Test laptop #7

FCC15.109_hor+vert



Date: 20.03.2012 Page 2 of 2

Final Result 1

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
153.900000	35.1	1000.0	120.000	115.0	V	180.0	8.9	8.4	43.5

Diagram No. 2.19

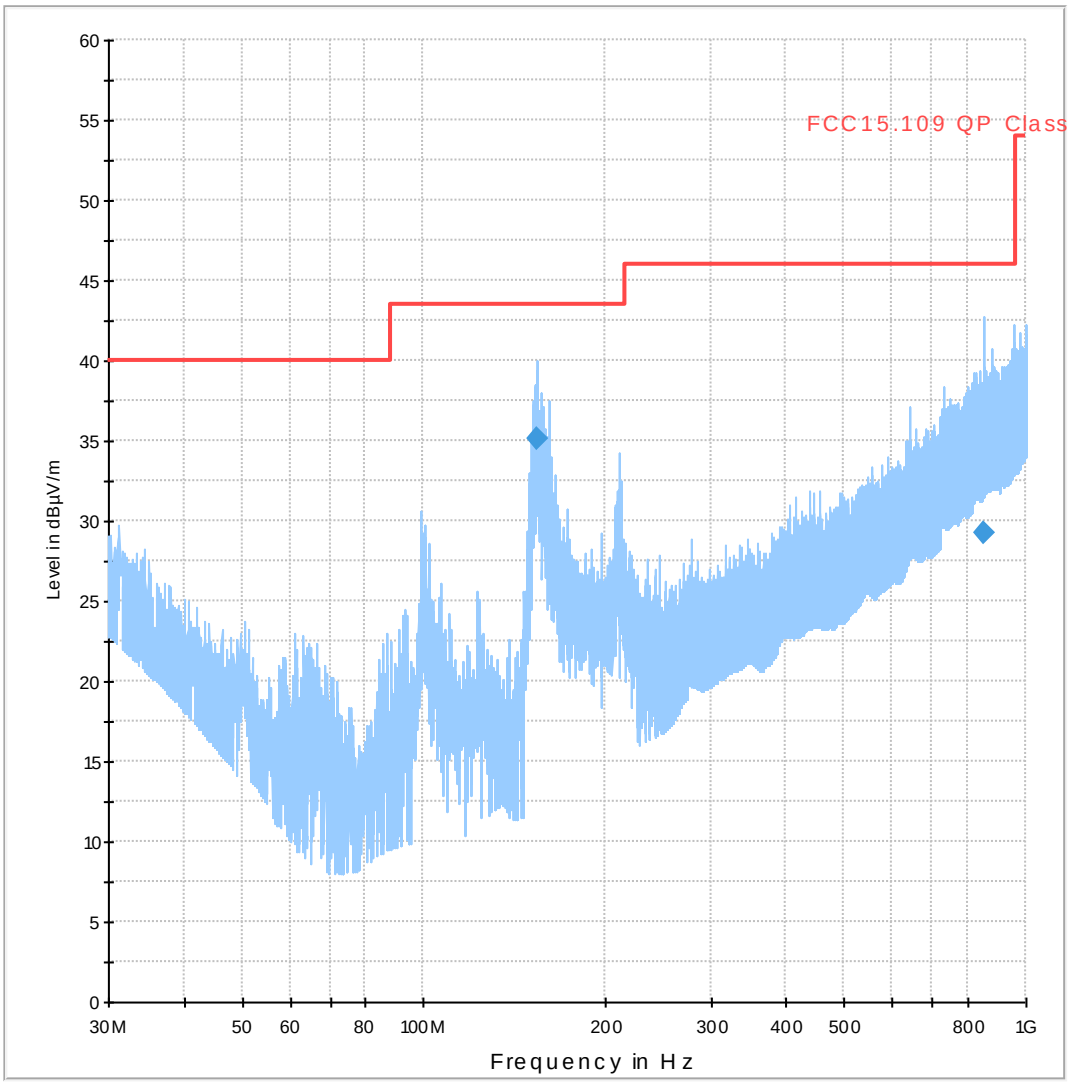
20.03.2012 Page 1 of 2

Test description:	Electric Fieldstrength Measurement below 1 GHz
Test site and distance:	Semi Anechoic Room (SAR) with 3 m measurement distance
Distance correction:	not used
Used filter:	not used
Technical Data:	please see page 2 for detailed data of measurement setup
Test specification.:	FCC 15.109 Class B; RSS-Gen: Issue 3
Operator:	kru
Operating conditions:	IDLE FDD IV
Power during tests:	110V 60Hz
Comment 1:	Channel 1638

EUT Information

EUT Name:	LISA-U230
Manufacturer:	u-blox AG
IMEI:	352237-05-001195-8
FW:	22.00
Accessories:	AC/DC adapter Model 0055 + Portable earphones V109 + Magnetic Ant. GA.107 Taoglas +2 USB cable (1,8m) +Test laptop #7

FCC15.109_hor+vert



Date: 20.03.2012 Page 2 of 2

Final Result 1

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
154.090000	35.1	1000.0	120.000	100.0	V	264.0	9.0	8.4	43.5
853.720000	29.3	1000.0	120.000	213.0	H	0.0	25.7	16.7	46.0

Diagram No. 2.20

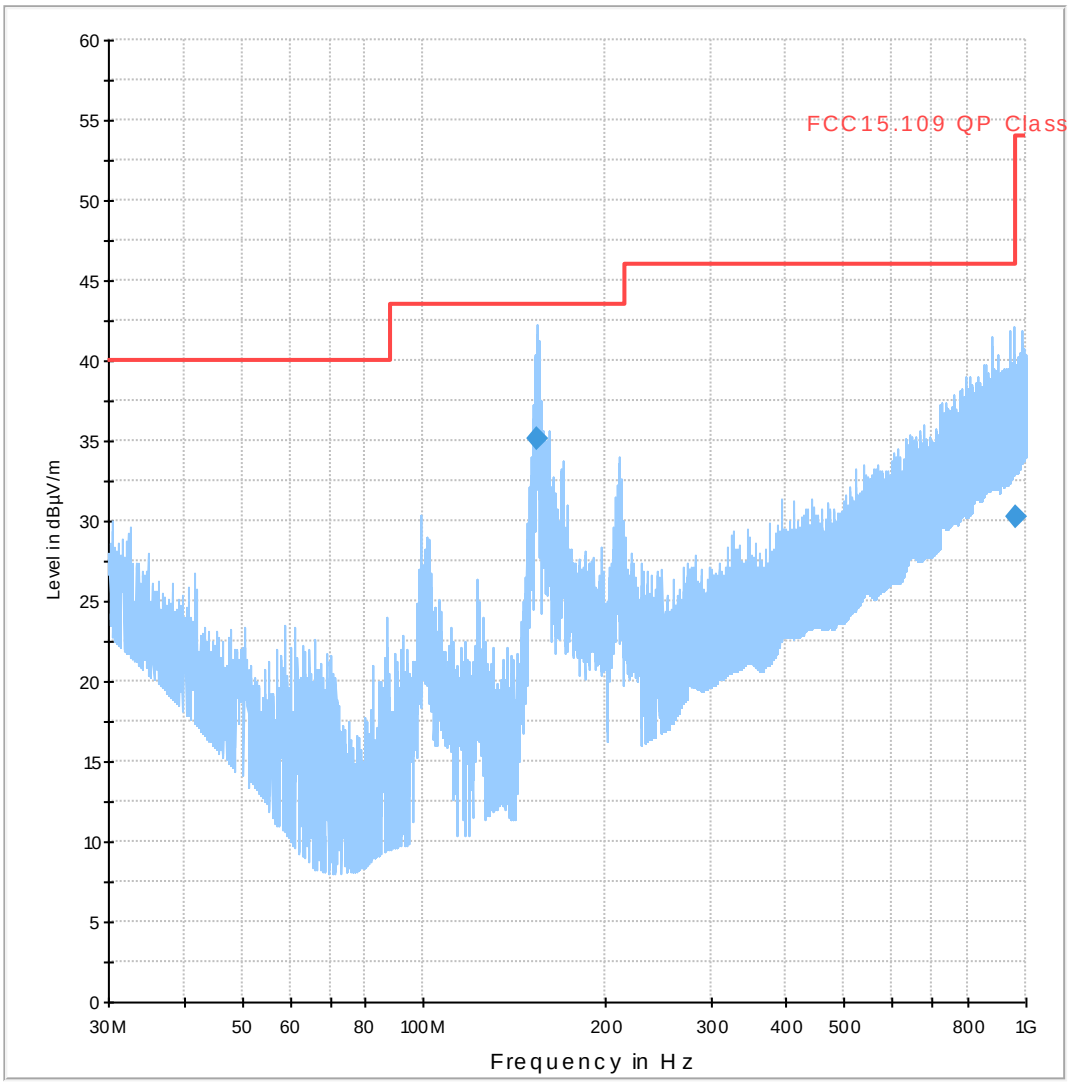
20.03.2012 Page 1 of 2

Test description:	Electric Fieldstrength Measurement below 1 GHz
Test site and distance:	Semi Anechoic Room (SAR) with 3 m measurement distance
Distance correction:	not used
Used filter:	not used
Technical Data:	please see page 2 for detailed data of measurement setup
Test specification.:	FCC 15.109 Class B; RSS-Gen: Issue 3
Operator:	kru
Operating conditions:	IDLE FDD V
Power during tests:	110V 60Hz
Comment 1:	Channel 4400

EUT Information

EUT Name:	LISA-U230
Manufacturer:	u-blox AG
IMEI:	352237-05-001195-8
FW:	22.00
Accessories:	AC/DC adapter Model 0055 + Portable earphones V109 + Magnetic Ant. GA.107 Taoglas +2 USB cable (1,8m) +Test laptop #7

FCC15.109_hor+vert



Date: 20.03.2012 Page 2 of 2

Final Result 1

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
154.780000	35.2	1000.0	120.000	100.0	V	281.0	9.0	8.3	43.5
959.380000	30.3	1000.0	120.000	182.0	V	5.0	27.0	15.7	46.0

5.3. Radiated emissions, below 1GHz

5.3.1. TEST LOCATION AND EQUIPMENT (for reference numbers please see chapter 'List of test equipment')

test site	☐ 441 EMI SAR	☐ 348 EMI cond.	☒ 443 EMI FAR	☐ 347 Radio.lab.	☐ 337 OATS	☐
equipment	☐ 331 HC 4055	☐	☐	☐	☐	☐
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☐ 264 FSEK	☒ 489 ESU	☐	☐
antenna meas	☐ 574 BTA-L	☐ 289 CBL 6141	☒ 608 HL 562	☒ 549 HL025	☐ 302 BBHA9170	☐ 477 GPS
antenna meas	☐ 123 HUF-Z2	☐ 132 HUF-Z3	☐ 030 HFH-Z2	☐	☐	☐
antenna subst	☐ 071 HUF-Z2	☐ 020 EMCO3115	☐ 063 LP 3146	☐ 303 BBHA9170	☐	☐
power meter	☐ 009 NRV	☐ 010 URV5-Z2	☐ 011 URV5-Z2	☐	☐	☐
signalgener.	☐ 008 SMG	☐ 140 SMHU	☐ 263 SMP04	☐	☐	☐
power meter	☐ 262 NRV-S	☐ 266 NRV-Z31	☐ 265 NRV-Z33	☐ 261 NRV-Z55	☐ 356 NRV-Z1	☐
multimeter	☐ 341 Fluke 112	☐	☐	☐	☐	☐
signaling	☐ 392 MT8820A	☒ 436 CMU	☐ 547 CMU			
DCpower	☐ 086 LNG50-10	☐ 087 EA3013	☐ 354 NGPE 40	☐ 349 car battery	☐ 350 Car battery	☐
line voltage	☐ 230 V 50 Hz via public mains		☒060 110 V 60 Hz via PAS 5000			

5.3.2. STANDARDS AND LIMITS: CFR 47, §15.109 (CLASS B), RSS-Gen, ANSI C63.4:2009

Frequency [MHz]	Radiated emission limits, 3 meters measurement distance			
	AV [microvolts/meter]	AV [dBµV/m]	Peak [microvolts/meter]	Peak [dBµV/m]
below 1GHz	500	54.0	5000	74.0

5.3.3. TEST CONDITION AND MEASUREMENT TEST SET-UP

link to test system (if used):	☒ air link	☐ cable connection	☐
EUT-grounding	☒ none	☐ with power supply	☐ additional connection
Equipment set up	☒ table top 1.5m height		☐ floor standing
Climatic conditions	Temperature: (22±3°C)		Rel. humidity: (40±20)%
Spectrum-Analyzer settings	Span/Frequency range : GSM850: 1..12.75 GHz +single frequencies determined in step 1GSM1900: 1..18GHz+single frequencies determined in step 1 RBW/VBW: 1 MHz / 3 MHz Detector/ Mode: Peak, MAX-hold, repetitive scan for exploratory measurement PEAK/ AVERAGE, for final measurement for critical frequencies Antenna Polarisation Horizontal / Vertical		

5.3.4. GENERAL MEASUREMENT PROCEDURES:

The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.4: 2009 (RX)

The ***Equipment under Test*** (EUT) was placed on a non-conductive positioning table of 0.8 or 1.5 meter height depending from the frequency range. The measuring distance was set to 3 meter for frequencies up to 18 GHz and 1 meter below 18 GHz.
The EUT was set-up to defined operating mode and installed (connected) to accessory equipment according the general description of use given by the applicant.

For the upper frequency measurement range, it was assumed that the highest frequency generated in the device is same as the highest operable TX-frequency in GSM850 or GSM1900 Mode (848.8 MHz or 1909.8 MHz). For practical reasons the upper frequency limit was set to 5 GHz or respective 9/10 GHz.

1. **Step exploratory measurement**: see below description as in the frequency range lower 1GHz.
2. **Step Final Measurement(1 GHz<f <18 GHz)**: On the Worst-Case EUT configuration, frequency components with a margin lower than 6 dB to the limits, will be re-measured by maintaining the EUT's operating mode, cable position, etc.. For find the worst-case emission, the turntable was changed in the range 0 to 360 degree and the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position). The measurements are performed for both polarizations of the measuring antenna: horizontal and vertical.

5.3.5. Results

Set-up No.:			EUT set-up 1								
Operating Mode:			Op. mode 1								
Dia-gram no.	Start-Frequency (MHz)	Stop-Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
2.21	1000	5000	Please see diagram								Passed

Set-up No.:			EUT set-up 1								
Operating Mode:			Op. mode 2								
Dia-gram no.	Start-Frequency (MHz)	Stop-Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
2.22	1000	10000	Please see diagram								Passed

Set-up No.:			EUT set-up 1								
Operating Mode:			Op. mode 3								
Dia-gram no.	Start-Frequency (MHz)	Stop-Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
2.23	1000	10000	Please see diagram								Passed

Set-up No.:			EUT set-up 1								
Operating Mode:			Op. mode 4								
Dia-gram no.	Start-Frequency (MHz)	Stop-Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
2.24	1000	9000	Please see diagram								Passed

Set-up No.:			EUT set-up 1								
Operating Mode:			Op. mode 5								
Dia-gram no.	Start-Frequency (MHz)	Stop-Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB) (CF)	Margin (dB) (M)	Limit (dBµV/m) (LT)
2.25	1000	5000	Please see diagram								Passed

General remarks: At all diagrams only noise-floor visible (except down link channel of FDD II and FDD IV)

Margin to Limit:

$$M = L_T - R_R + C_F + D_F$$
$$= L_T - R_R + \left(AF_{ANTENNA} + Cable_{LOSS}\right) + D_F$$

Abbreviations used:

- R_R : Receiver readings in dBµV/m
- CF: Transducer in dB = AF (antenna factor) + CL (cable loss)
- D_F : distance correction factor (if different measurement distance used than specified in the standard
- L_T : Limit in dBµV/m

Diagrams

Diagram no. 2.21

Common Information

Test Description:	Radiated Filed Strength Emission
Test Site Location:	CETECOM GmbH Essen
Test Site:	Fully Anechoic Room (FAR)
Test Standard:	FCC Part 15.109
Operating Mode:	UE RX_mode, U-ARFCN 182
Equipment Class:	Class B
Environmental Conditions:	Humidity: 37%rH; Temperature: 19°C
Operator:	hla
	6-0143-12-2-3b

EUT Information

Manufacturer:	u-blox AG
EUT:	LISA-U230
Serial Number:	352237-05-001195-8
Hardware Rev:	146AA0
SW:	22.00
Accessories:	HS portable earphone V109 + Magn. Ant. Taoglas GA.107+ USB adapter cable 1m + AC/DC adpater(110 V/60 Hz)+ CTC Laptop #7

Final Result 1

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Band-width (kHz)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
4214.478958	41.5	100.0	1000.000	V	-45.0	90.0	1.8	32.5	74.0

Final Result 2

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Band-width (kHz)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
3500.010020	31.0	100.0	1000.000	V	314.0	90.0	1.7	23.0	54.0

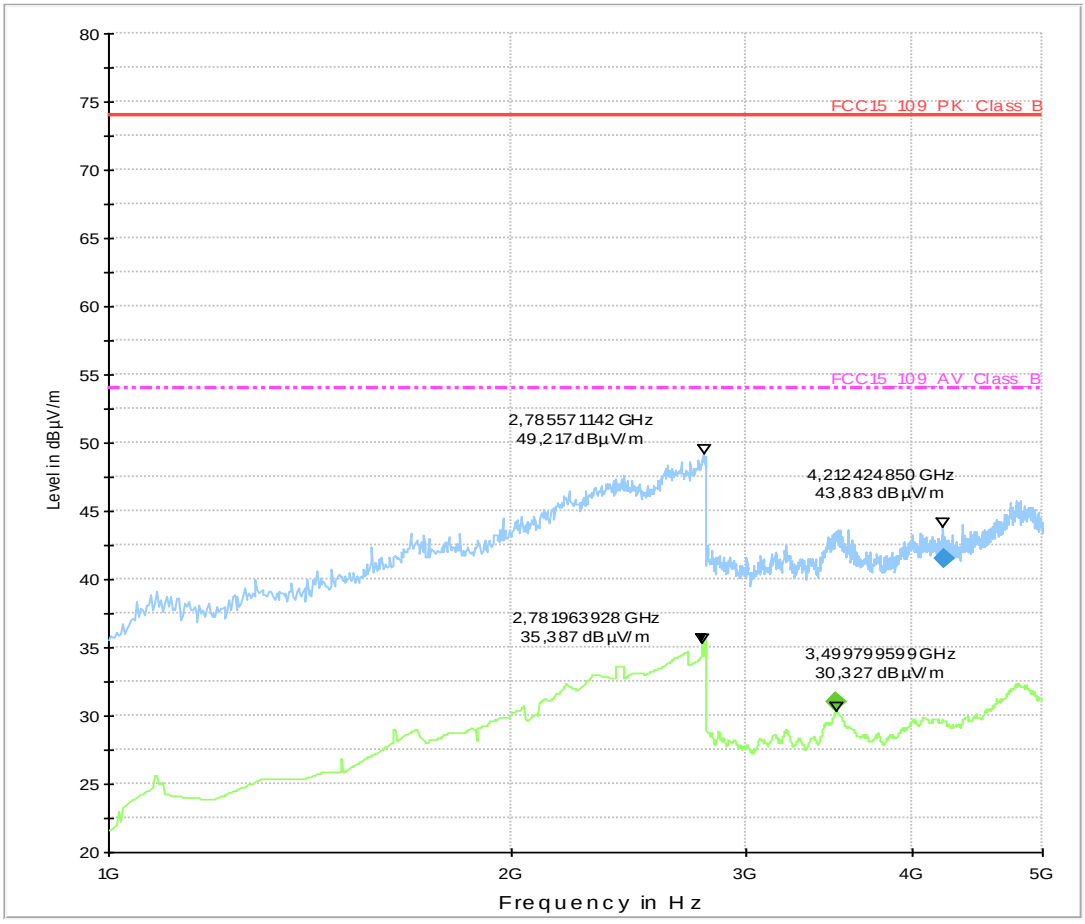


Diagram no. 2.22

Common Information

Test Description:	Radiated Filed Strength Emission
Test Site Location:	CETECOM GmbH Essen
Test Site:	Fully Anechoic Room (FAR)
Test Standard:	FCC Part 15.109
Section	15.109
Operating Mode:	PCS1900, RX_mode, U-ARFCN 651
Equipment Class:	Class B
Environmental Conditions:	Humidity: 37%rH; Temperature: 19°C
Operator:	hla
	6-0143-12-2-3b

EUT Information

Manufacturer:	u-blox AG
EUT:	LISA-U230
Serial Number:	352237-05-001195-8
Hardware Rev:	146AA0
SW:	22.00
Accessories:	HS portable earphone V109 + Magn. Ant. Taoglas GA.107+ USB adapter cable 1m + AC/DC adpater(110 V/60 Hz)

030445_FCC_Part15.109_Unintentional_Radiator_Class_B_1G-20G_FSEK

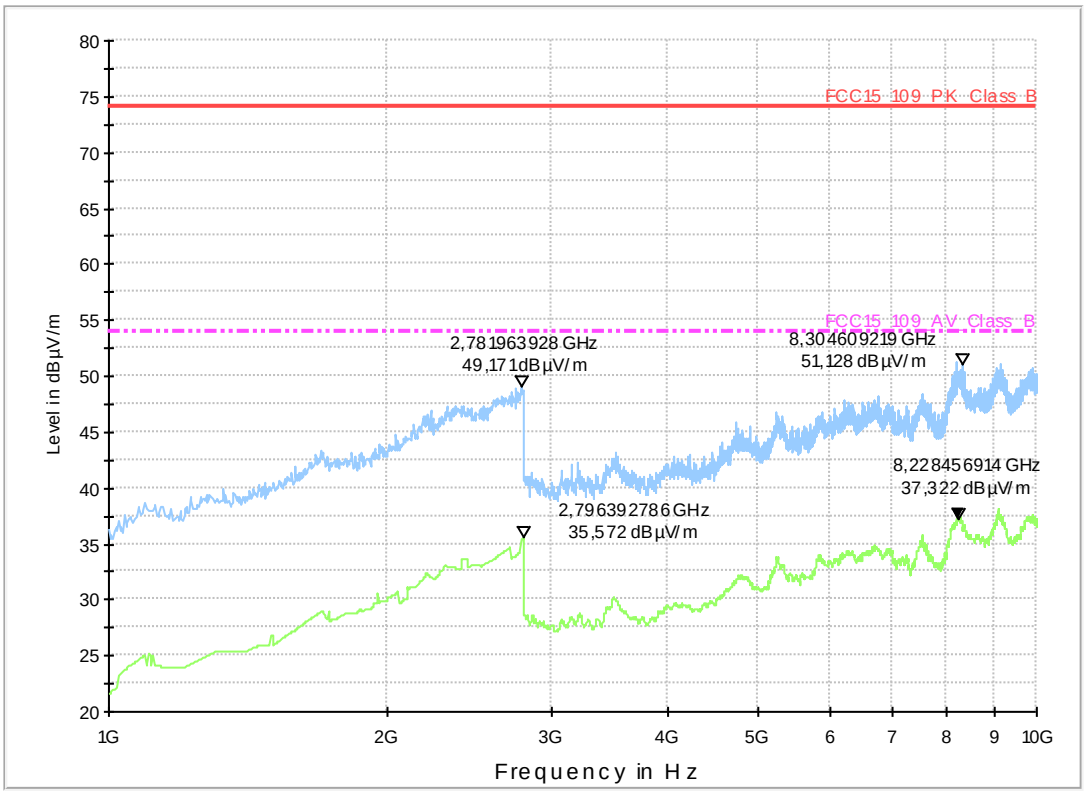


Diagram no. 2.23

Common Information

Test Description:	Radiated Field Strength Emission in 3m distance
Test Site Location:	CETECOM GmbH Essen
Test Site:	Fully Anechoic Room (FAR)
Test Standard:	FCC Part 15.109
Section	15.109
Operating Mode:	Operator, please fill in the operating mode
Equipment Class:	Class B
Environmental Conditions:	Humidity: 37%rH; Temperature: 19°C
Operator:	Tas
	6-0143-12-2-3b
Operating mode:	FDDII, RX-Mode U-ARFCN 9800 (DL)
Comment	DL channel at 1960 MHz visible

EUT Information

Manufacturer:	u-blox AG
EUT:	LISA-U230
Serial Number:	352237-05-001195-8
Hardware Rev:	146AA0
SW:	22.00
Accessories:	HS portable earphone V109 + Magn. Ant. Taoglas GA.107+ USB adapter cable 1m + AC/DC adpater(110 V/60 Hz)+ CTC Laptop#7

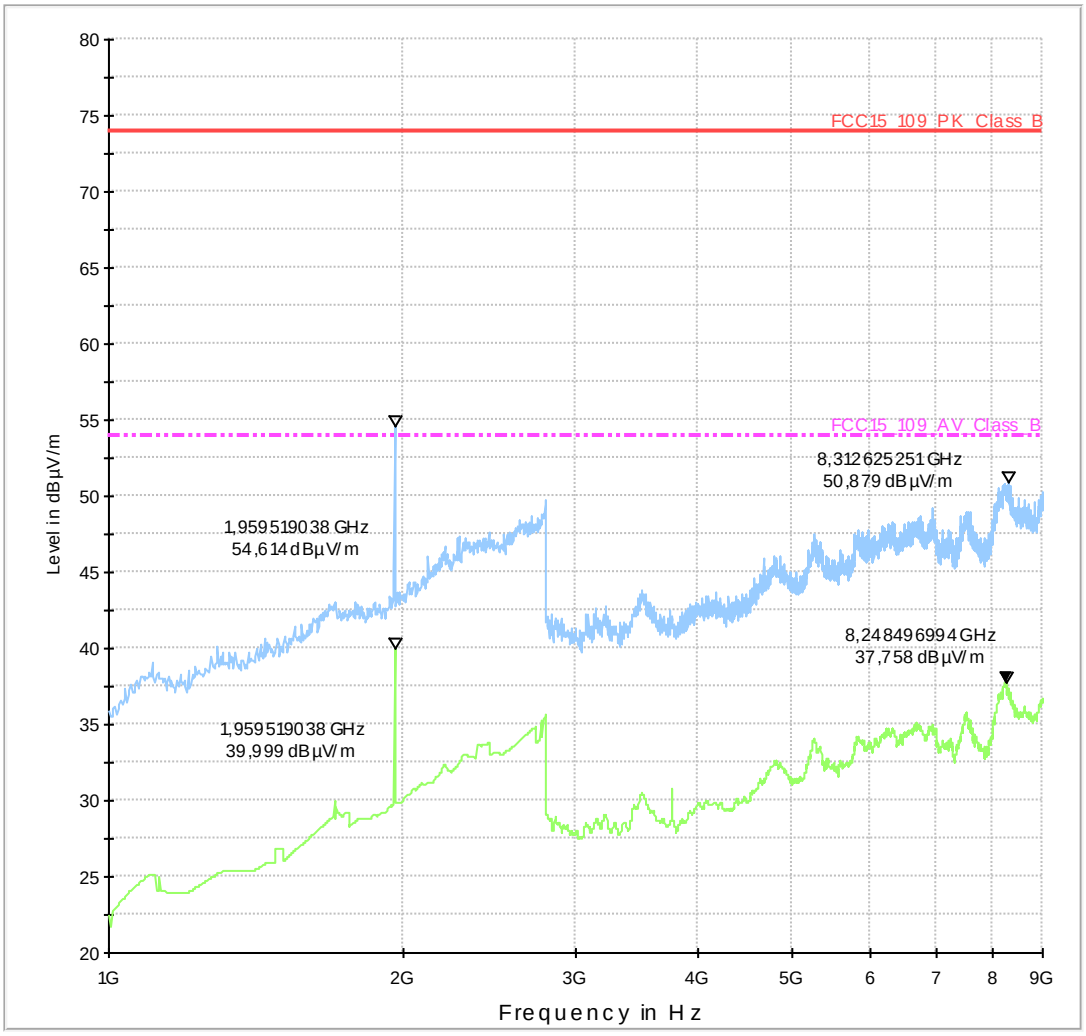


Diagram no. 2.24

Common Information

Test Description:	Radiated Field Strength Emission in 3m distance
Test Site Location:	CETECOM GmbH Essen
Test Site:	Fully Anechoic Room (FAR)
Test Standard:	FCC Part 15.109
Section	15.109
Operating Mode:	Operator, please fill in the operating mode
Equipment Class:	Class B
Environmental Conditions:	Humidity: 37%rH; Temperature: 19°C
Operator:	Tas
	6-0143-12-2-3b
Operating mode:	FDDIV, RX-Mode U-ARFCN 1675 (DL)
	Downlink channel at 2139 MHz visible

EUT Information

Manufacturer:	u-blox AG
EUT:	LISA-U230
Serial Number:	352237-05-001195-8
Hardware Rev:	146AA0
SW:	22.00
Accessories:	HS portable earphone V109 + Magn. Ant. Taoglas GA.107+ USB adapter cable 1m + AC/DC adpater(110 V/60 Hz)+ CTC Laptop#7

Final Result 1

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Polarization	Azimuth (deg)	Elevation (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV /m)
3294.919839	40.9	100.0	1000.000	V	346.0	0.0	-0.5	33.1	74.0

Final Result 2

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Pol.	Azimuth (deg)	Elevation (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/ m)
8239.248497	38.0	100.0	1000.000	V	270.0	90.0	14.0	16.0	54.0

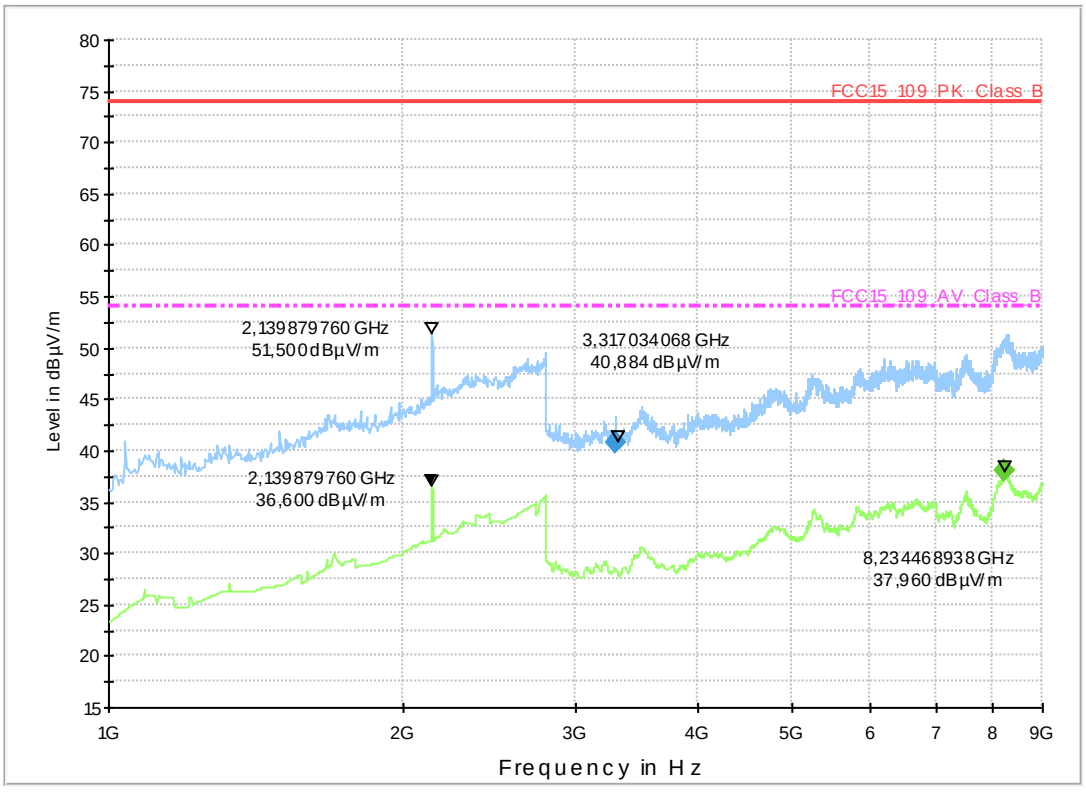


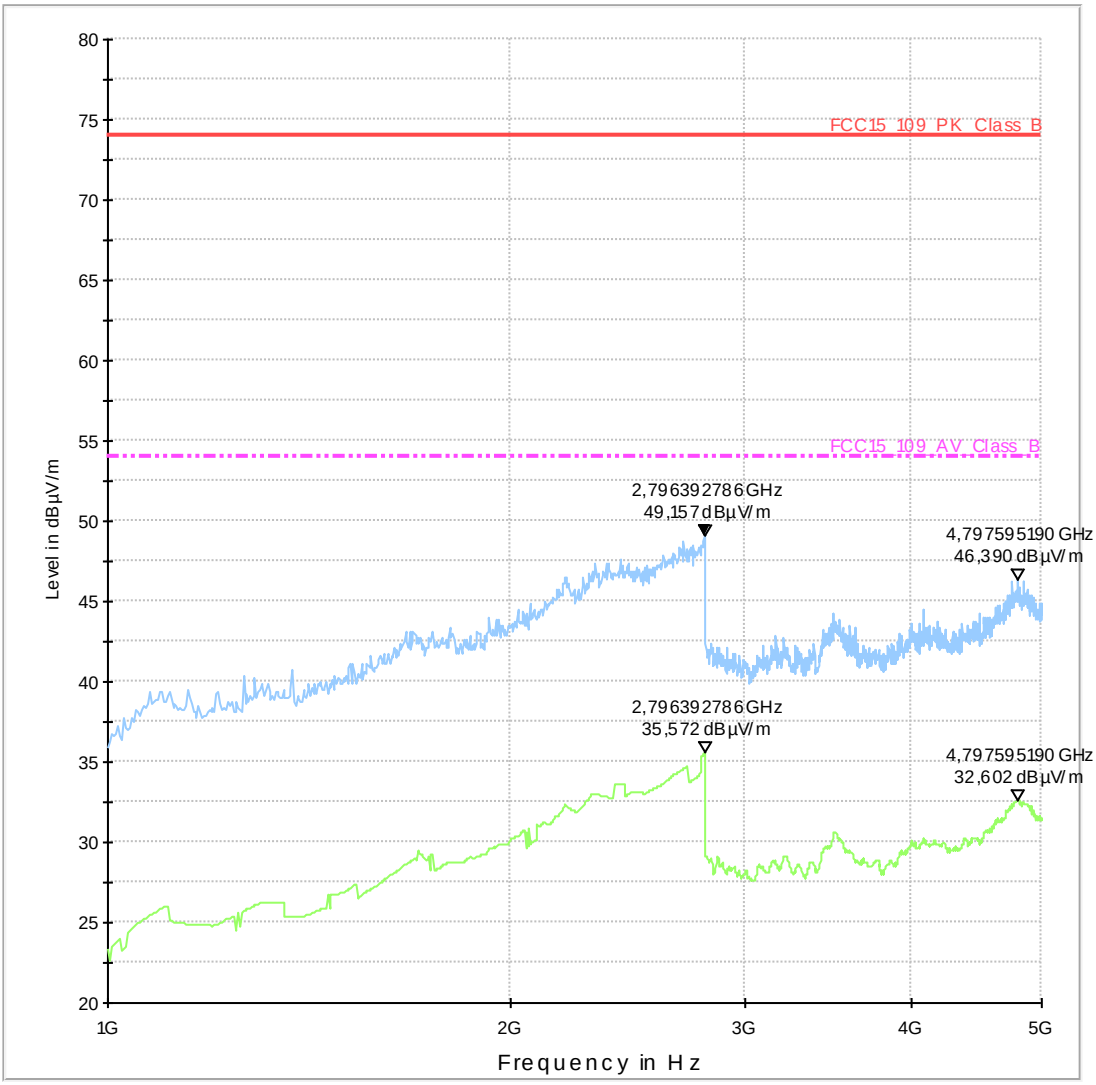
Diagram no. 2.25

Common Information

Test Description:	Radiated Field Strength Emission in 3m distance
Test Site Location:	CETECOM GmbH Essen
Test Site:	Fully Anechoic Room (FAR)
Test Standard:	FCC Part 15.109
Section	15.109
Operating Mode:	UE in Idle mode (FDD V, DL ARFCN 4400)
Equipment Class:	Class B
Environmental Conditions:	Humidity: 30%rH; Temperature: 23°C
Operator:	Tas
	6-0143-12-2-3b

EUT Information

Manufacturer:	u-blox AG
EUT:	LISA-U230
Serial Number:	352237-05-001195-8
Hardware Rev:	146AA0
SW:	22.00
Accessories:	HS portable earphone V109 + Magn. Ant. Taoglas GA.107+ USB adapter cable 1m + AC/DC adpater(110 V/60 Hz)+ CTC Laptop#7



5.4. Conducted emissions on antenna port (RX-Mode)

Test location and equipment (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☐ 441 EMI SAR	☐ 487 SAR NSA	☐ 337 OATS	☒ 347 Radio.lab.	☐	☐
receiver	☐ 377 ESCS30	☐ 001 ESS	☒ ESU	☐	☐	☐
spectr. analys.	☐ 574 FSU	☐ 120 FSEM	☐ 264 FSEK	☐	☐	☐
signaling	☐ 392 MT8820A	☐ 436 CMU	☐ 547 CMU			
power supply	☐ 456 EA 3013A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☒ 498 NGPE 40
otherwise	☐ 400 FTC40x15E	☐ 401 FTC40x15E	☐ 110 USB LWL	☐ 482 Filter Matrix		
line voltage	☐ 230 V 50 Hz via public mains		☒060 110 V 60 Hz via PAS 5000			

Standards and Limits: CFR 47, §15.111(a), RSS-132, RSS-133, RSS-Gen

Standard	conducted emission limits on antenna port	
	Value / [nW]	Value / [dBm]
FCC: §15.111(a)	2 nW for all frequencies	-57 dBm
RSS-Gen RSS-132 RSS-133	2 nW below 1GHz 5 nW about 1GHz	-57 dBm -53 dBm

Test condition and measurement test set-up

link to test system (if used):	☐ Air-link	☒ cable connection
Climatic conditions	Temperature: (22±3°C)	Rel. humidity: (40±20)%
EMI-Receiver (Analyzer) Settings	Please see diagram	

GENERAL MEASUREMENT PROCEDURES:
The measurement test set-up and test procedure are in accordance with the provisions described in ANSI C63.4: 2009

The ***Equipment under Test*** (EUT) set-up to defined operating mode and installed (connected) to accessory equipment according the general description of use given by the applicant.

The test set-up for conducted measurements was used (s. chapter 4.1)

5.4.1. Conducted emissions on antenna port, §15.111(a) and Canada requirements, RSS-132, Issue 2, §4.6

5.4.1.1. IDLE GSM850

BCCH channel = 182 (Downlink)								
Diagram numbers	Frequency of emission [MHz]	Level [dBm]	Margin IC [dB]	Correction factor for Canada only (RBW:3kHz-> 4kHz)	Result FCC [dBm]	Result IC [dBm]	Limit [dBm]	Verdict
4.51	--	--	--	+ 1.25 dB	<-80.0	<-81.25	-57	Passed [1.)]
4.52	3940	-70.78	19.03		-70.78	-72.03	-53	Passed

Remark: Please see chapter ‚diagrams' for more details

1.) Peak from measurement set-up, BCCH carrier of base station

5.4.1.2. IDLE W-CDMA Band V

BCCH channel = 4400								
Diagram number	Frequency of emission [MHz]	Level [dBm]	Margin IC [dB]	Correction factor for Canada only (RBW:3kHz-> 4kHz)	Result FCC [dBm]	Result IC [dBm]	Limit [dBm]	Verdict
4.53	--	--	--	+ 1.25 dB	<-80.0	<-81.25	-57	Passed 1.)
4.54	4658.4	-70.77	19.02		-70.77	-72.02	-53	Passed

Remark: Please see chapter ‚diagrams' for more details

1.) Peak from measurement set-up, BCCH carrier of base station

5.4.2. Conducted emissions on antenna port, §15.111(a) and Canada requirements, RSS-133, Issue 2, §4.6 RSS-139, Issue 2, §6.6

5.4.2.1. IDLE PCS1900

BCCH channel = 651								
Diagram number	Frequency of emission [MHz]	Level [dBm]	Margin IC [dB]	Correction factor for Canada only (RBW:3kHz-> 4kHz)	Result FCC [dBm]	Result IC [dBm]	Limit [dBm]	Verdict
4.55	980.69	-78.6	22.85	+ 1.25 dB	-78.6	-79.85	-57	Passed
4.56	--	--	18.25		<-70.0	<-71.25	-53	Passed 1.)

Remark: Please see chapter ‚diagrams' for more details

1.) Peak at 1.9472 GHz from measurement set-up, BCCH carrier of base station

5.4.2.2. IDLE W-CDMA Band II

BCCH channel = 9800								
Diagram number	Frequency of emission [MHz]	Level [dBm]	Margin IC [dB]	Correction factor for Canada only (RBW:3kHz-> 4kHz)	Result FCC [dBm]	Result IC [dBm]	Limit [dBm]	Verdict
4.57	494.34	-80.6	24.85	+ 1.25 dB	-80.6	-81.85	-57	Passed
4.58	1329.6	-69.2	17.45		-69.2	-70.45	-53	Passed 1.)

Remark: Please see chapter ‚diagrams' for more details

1.) Peak at 1.9608 GHz from measurement set-up, BCCH carrier of base station

5.4.2.3. IDLE W-CDMA Band IV

BCCH channel = 1638								
Diagram number	Frequency of emission [MHz]	Level [dBm]	Margin IC [dB]	Correction factor for Canada only (RBW:3kHz-> 4kHz)	Result FCC [dBm]	Result IC [dBm]	Limit [dBm]	Verdict
4.59	801.64	-79.9	24.15	+ 1.25 dB	-79.9	<-81.15	-57	Passed
4.60	1329.6	-67.5	15.75		-67.5	-68.75	-53	Passed 1.)

Remark: Please see chapter ‚diagrams' for more details

1.) Peak at 2.1336 GHz from measurement set-up, BCCH carrier of base station

Verdict

Summary of conducted measurement on antenna port: Passed

Diagrams

Diagram No.: 4.51

Common Information

Test Description:	Transmitter unwanted emissions (Conducted)/ FCC requirements
Test Site:	Radio laboratory 1
Test Standard:	FCC 2.1051 , RSS 132
Operation mode:	G850-RX, CHANNEL 182
Operator Name:	HLa
SAP No::	6-0143-12-2-3b

EUT Information

EUT Name:	LISA-U230
IMEI:	352237-05-001199-0
HW, FW:	146AA0, 22.00
Manufacturer:	u-blox AG
Voltage:	3,8 VDC

Sweep Setup: Sweep1 [EMI radiated]

Hardware Setup:	31_ESU_Conducted_FCC_Part_15_22_24
Receiver:	[ESU 40]
Level Unit:	dBm

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	97 kHz	PK+	3 kHz	20 s	0 dB

Sweep1

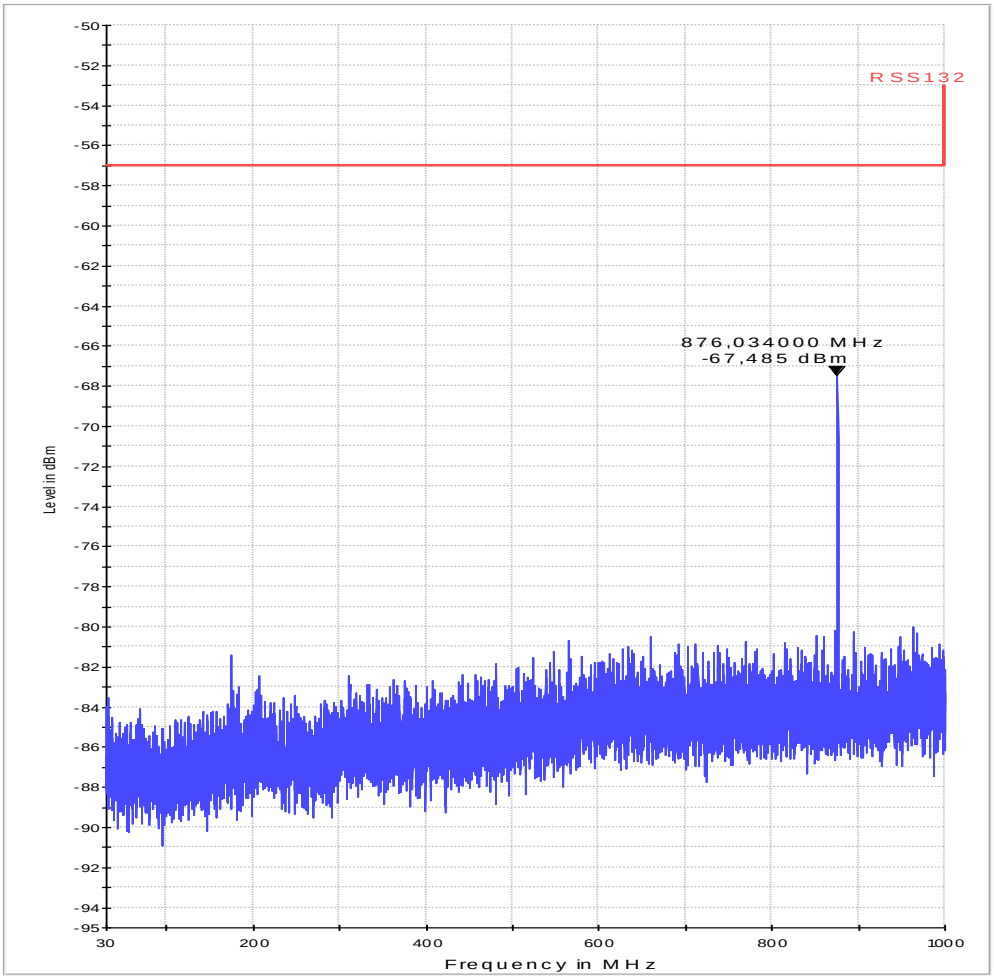


Diagram No.: 4.52

Common Information

Test Description:	Transmitter unwanted emissions (Conducted)/ FCC requirements
Test Site:	Radio laboratory 1
Test Standard:	FCC 2.1051 , RSS 132
Operation mode:	G850-RX, CHANNEL 182
Operator Name:	HLa
SAP No:	6-0143-12-2-3b

EUT Information

EUT Name:	LISA-U230
IMEI:	352237-05-001199-0
HW, FW:	146AA0, 22.00
Manufacturer:	u-blox AG
Voltage:	3,8 VDC

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
1 GHz - 5 GHz	400 kHz	PK+	3 kHz	30 s	0 dB

Sweep2

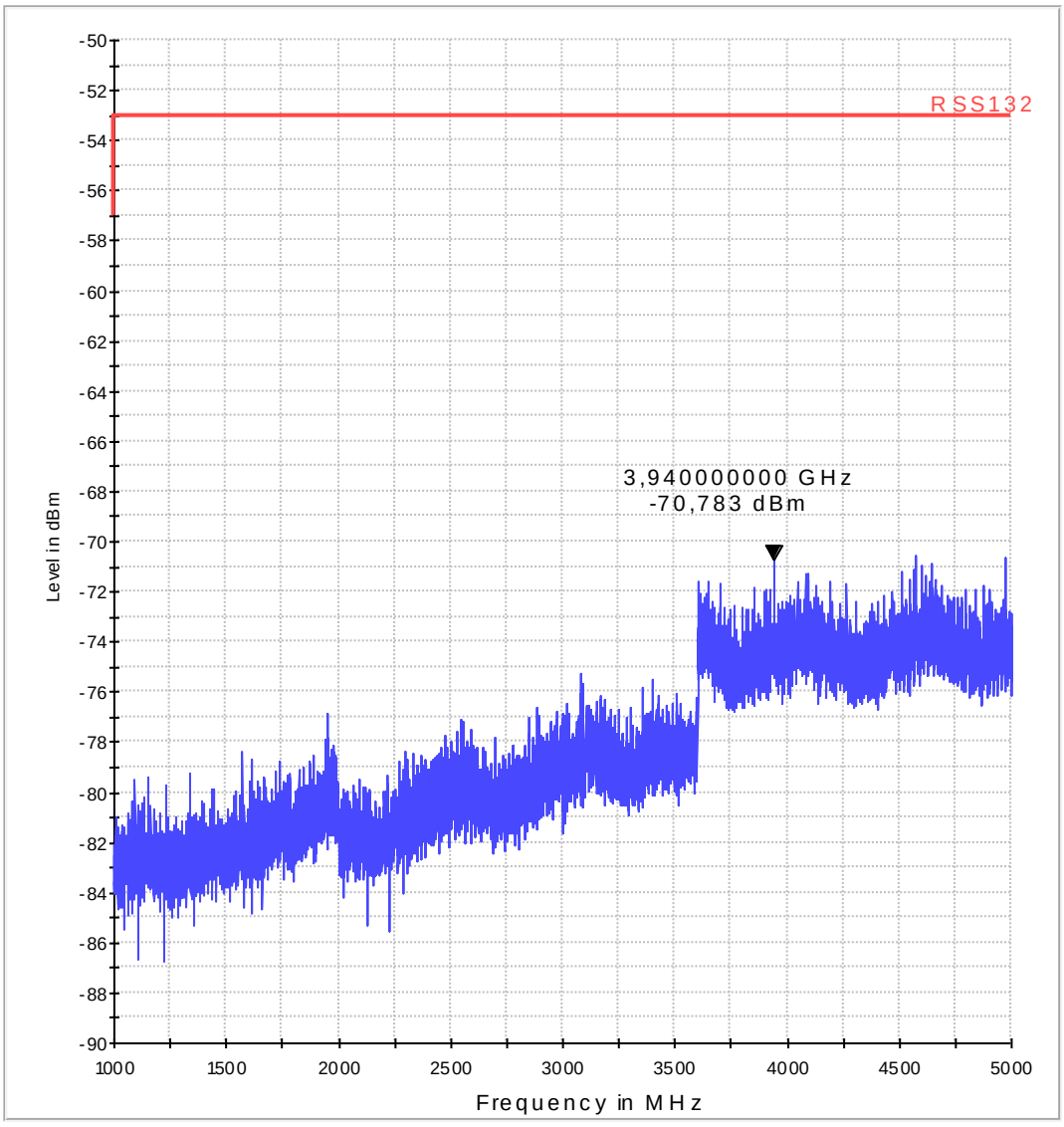


Diagram No.: 4.53

Common Information

Test Description:	Transmitter unwanted emissions (Conducted)/ FCC requirements
Test Site:	Radio laboratory 1
Test Standard:	FCC Part 22, RSS-132
Operation mode:	FDD V -RX (channel :4400)
Operator Name:	HLa
SAP No:	6-0143-12-2-3b

EUT Information

EUT Name:	LISA-U230
IMEI:	352237-05-001199-0
HW, FW:	146AA0, 22.00
Manufacturer:	u-blox AG
Voltage:	3,8 VDC

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	97 kHz	PK+	3 kHz	20 s	0 dB

Sweep1

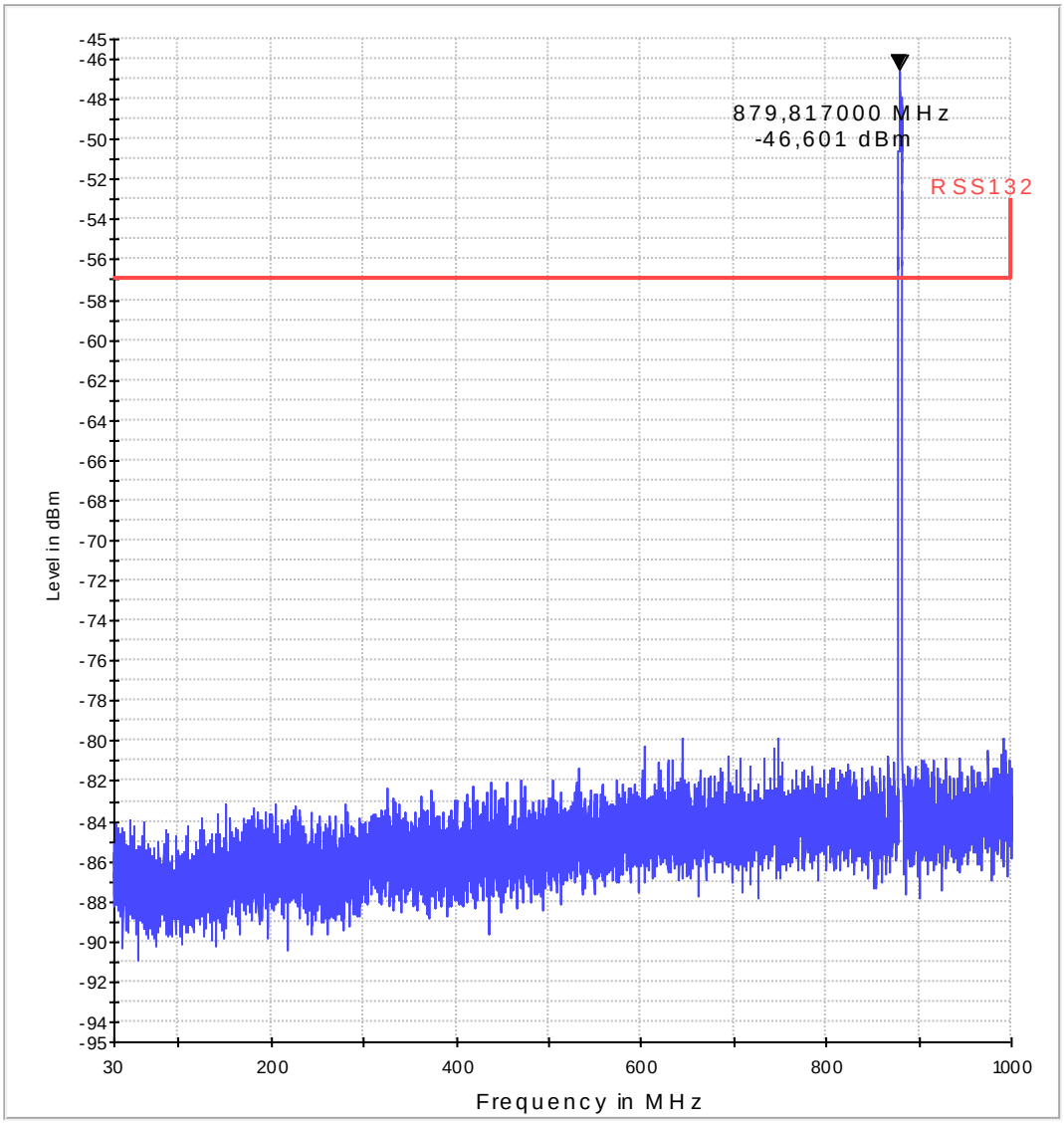


Diagram No.: 4.54

Common Information

Test Description:	Transmitter unwanted emissions (Conducted)/ FCC requirements
Test Site:	Radio laboratory 1
Test Standard:	FCC Part 22, RSS-132
Antenna polarisation:	vertical / horizontal
Operation mode:	FDDV-RX (Downlink 4400)
Operator Name:	Hla
Comment:	6-0143-12-2-3b

EUT Information

EUT Name:	LISA-U230
IMEI:	352237-05-001199-0
HW, FW:	146AA0, 22.00
Manufacturer:	u-blox AG
Voltage:	3,8 VDC

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
1 GHz - 5 GHz	400 kHz	PK+	3 kHz	30 s	0 dB

Sweep2

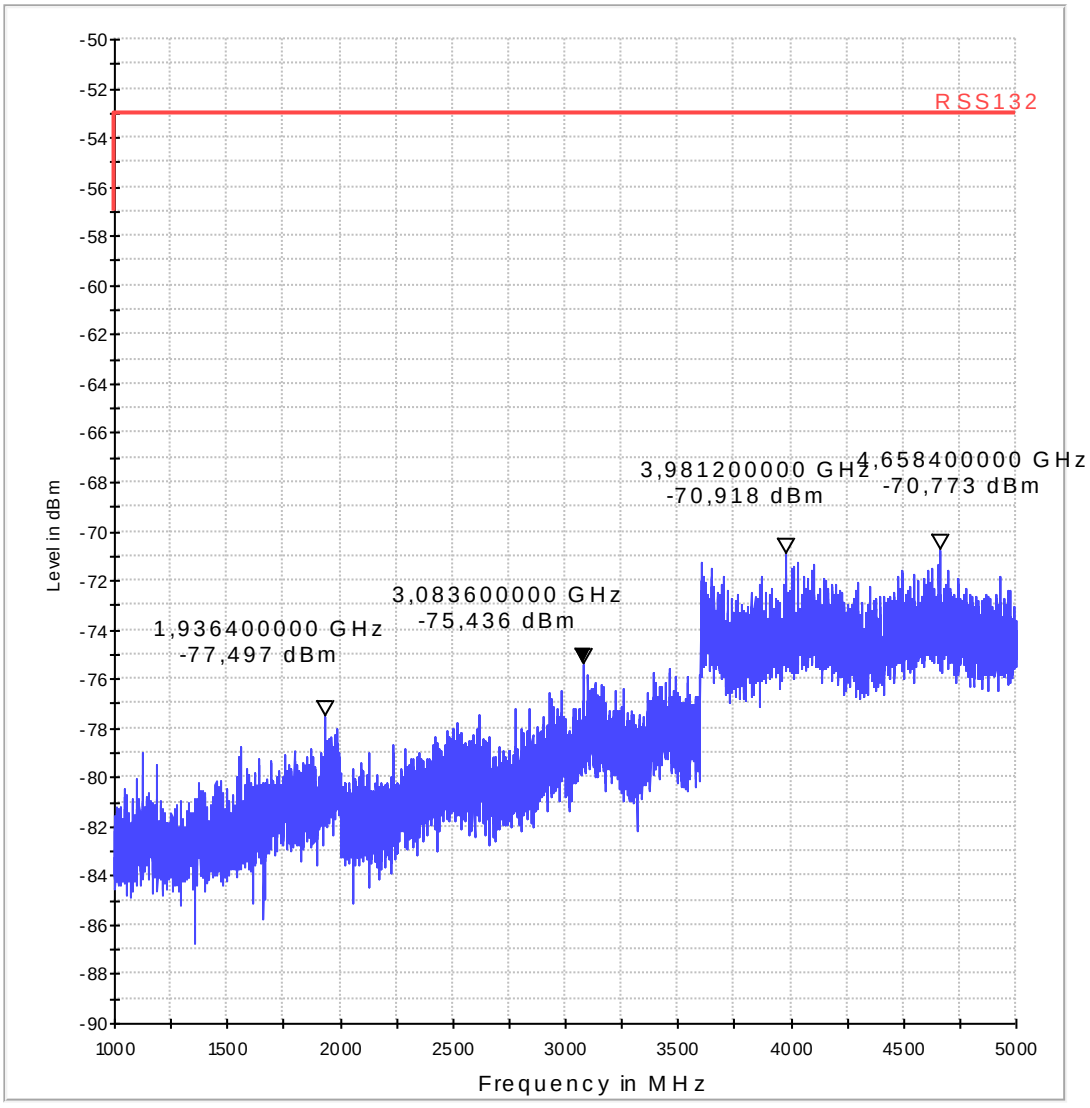


Diagram No.: 4.55

Common Information

Test Description:	Spurious Emission conducted
Test Site:	Radio laboratory 1
Test Standard:	FCC Part 24.238 RSS-133
Operation mode:	PCS1900-RX, CHANNEL 651
Operator Name:	HLa
Comment:	

EUT Information

EUT Name:	LISA-U230
IMEI:	352237-05-001199-0
HW, FW:	146AA0, 22.00
Manufacturer:	u-blox AG
Voltage:	3,8 VDC

Sweep Setup: Sweep1 [EMI radiated]

Hardware Setup:	31_ESU_Conducted_FCC_Part_15_22_24
Receiver:	[ESU 40]
Level Unit:	dBm

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	97 kHz	PK+	3 kHz	10 s	0 dB

Sweep1

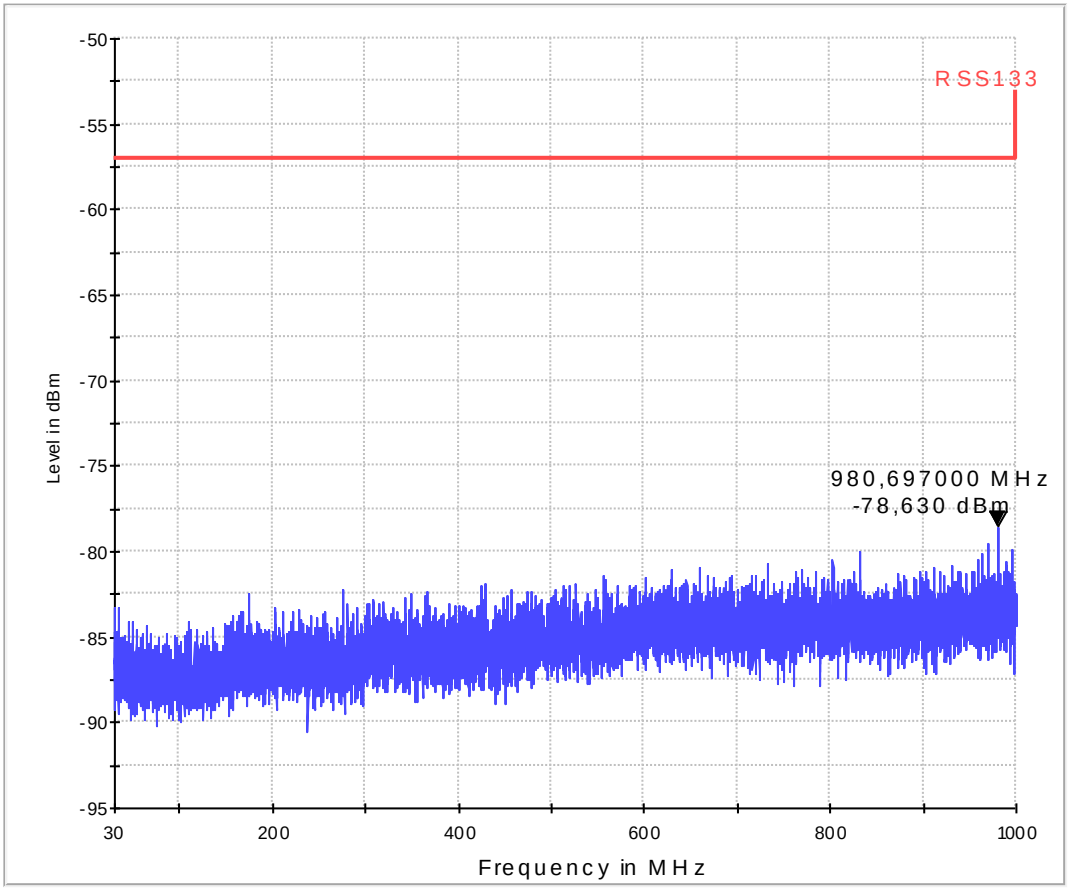


Diagram No.: 4.56

Common Information

Test Description:	Transmitter unwanted emissions (Conducted)/ FCC requirements
Test Site:	Radio laboratory 1
Test Standard:	FCC FCC Part 24.238 Broadband PCS, RSS-133
Operation mode:	TCH 1900, CHANNEL 651
Operator Name:	HLa
SAP No:	6-0143-12-2-3a

EUT Information

EUT Name:	LISA-U230
IMEI:	352237-05-001199-0
HW, FW:	146AA0, 22.00
Manufacturer:	u-blox AG
Voltage:	3,8 VDC

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
1 GHz - 9 GHz	800 kHz	PK+	3 kHz	30 s	0 dB

Sweep2

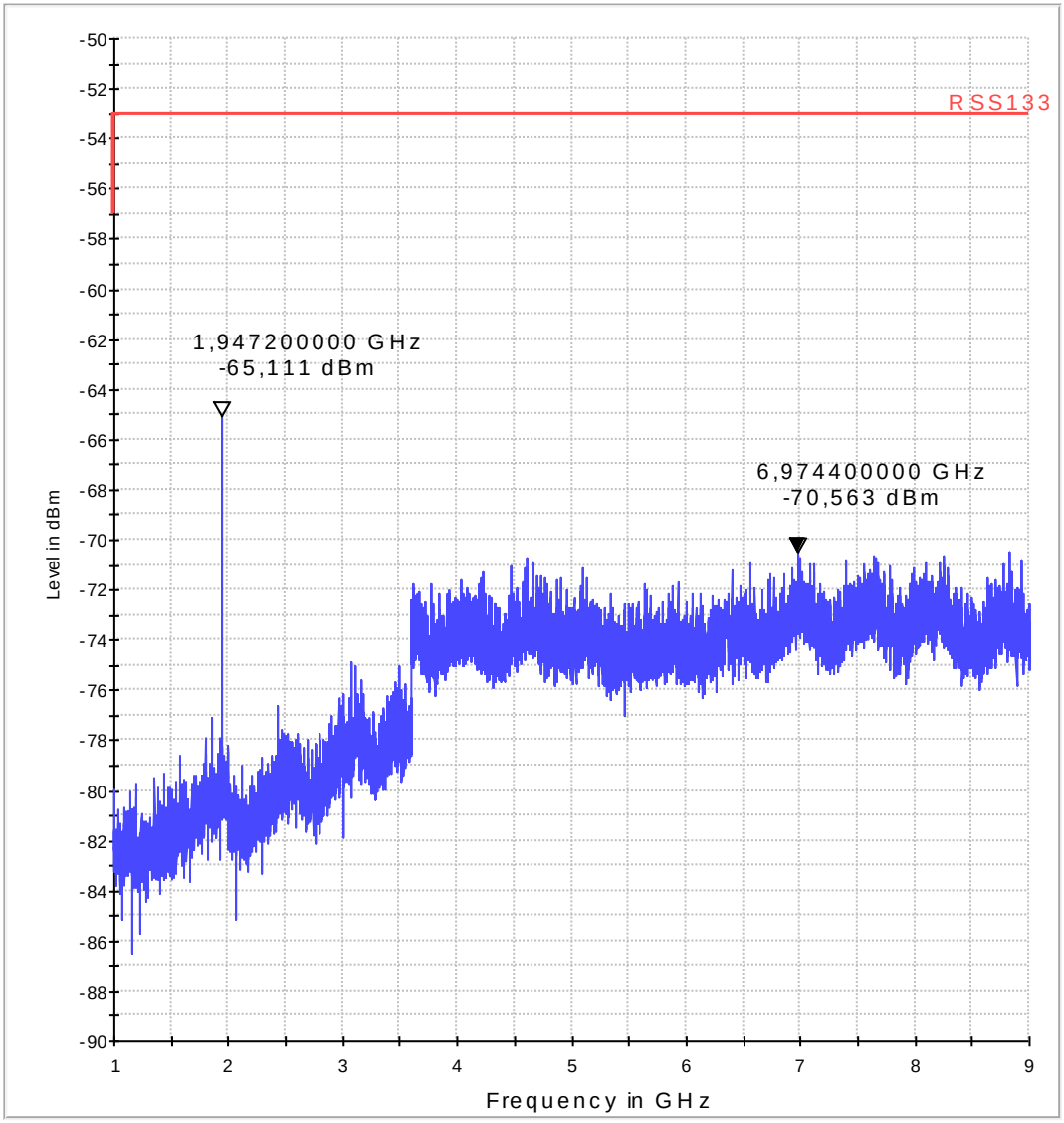


Diagram No.: 4.57

Common Information

Test Description:	Transmitter unwanted emissions (Conducted)/ FCC requirements
Test Site:	Radio laboratory 1
Test Standard:	FCC FCC Part 24.238 Broadband PCS, RSS-133
Operation mode:	FDD II -RX (channel :9800)
Operator Name:	HLa
SAP No:	6-0143-12-2-3b

EUT Information

EUT Name:	LISA-U230
IMEI:	352237-05-001199-0
HW, FW:	146AA0, 22.00
Manufacturer:	u-blox AG
Voltage:	3,8 VDC

Sweep Setup: Sweep1 [EMI radiated]

Hardware Setup:	31_ESU_Conducted_FCC_Part_15_22_24
Receiver:	[ESU 40]
Level Unit:	dBm

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	97 kHz	PK+	3 kHz	10 s	0 dB

Sweep1

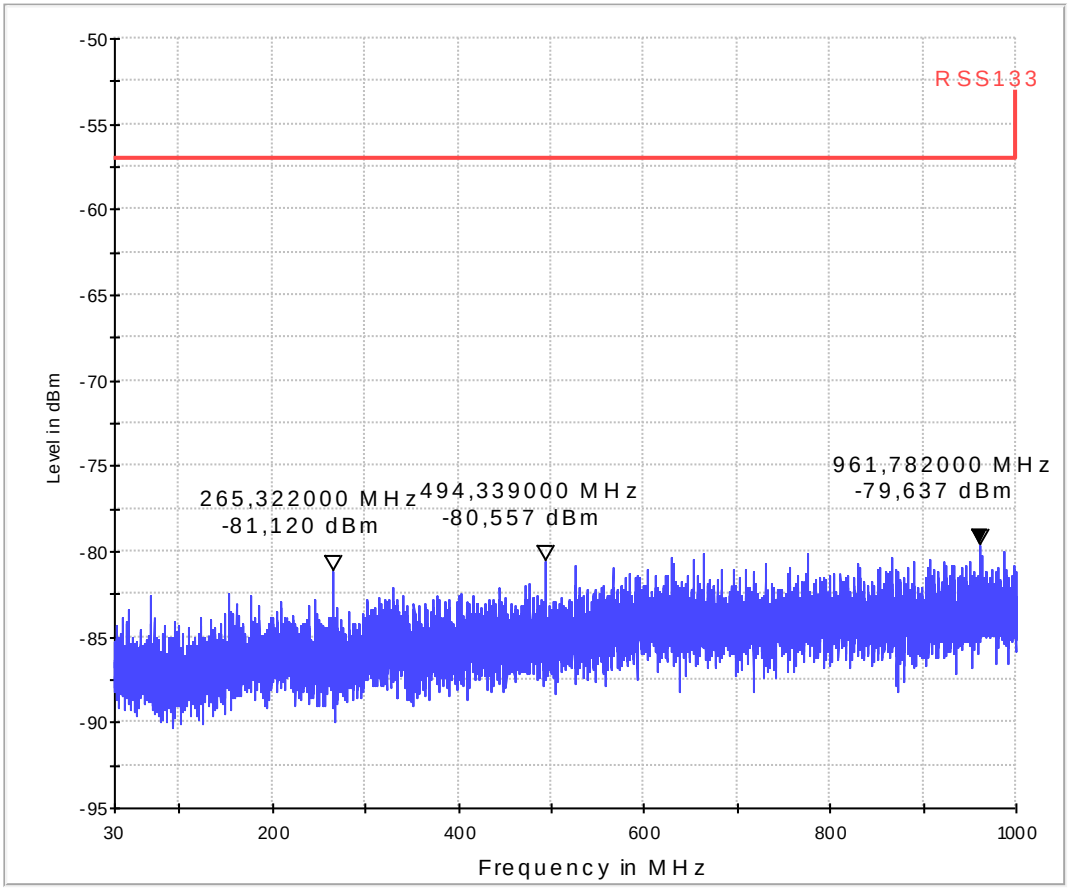


Diagram No.: 4.58

Common Information

Test Description:	Transmitter unwanted emissions (Conducted)/ FCC requirements
Test Site:	Radio laboratory 1
Test Standard:	FCC Part 24.238 RSS-133
Operation mode:	FDD II -RX (channel :9800)
Operator Name:	HLa
SAP No:	6-0143-12-2-3b

EUT Information

EUT Name:	LISA-U230
IMEI:	352237-05-001199-0
HW, FW:	146AA0, 22.00
Manufacturer:	u-blox AG
Voltage:	3,8 VDC

Sweep Setup: Sweep2 [EMI radiated]

Hardware Setup:	31_ESU_Conducted_FCC_Part_15_22_24
Receiver:	[ESU 40]
Level Unit:	dBm

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
1 GHz - 9 GHz	800 kHz	PK+	3 kHz	30 s	0 dB

Sweep2

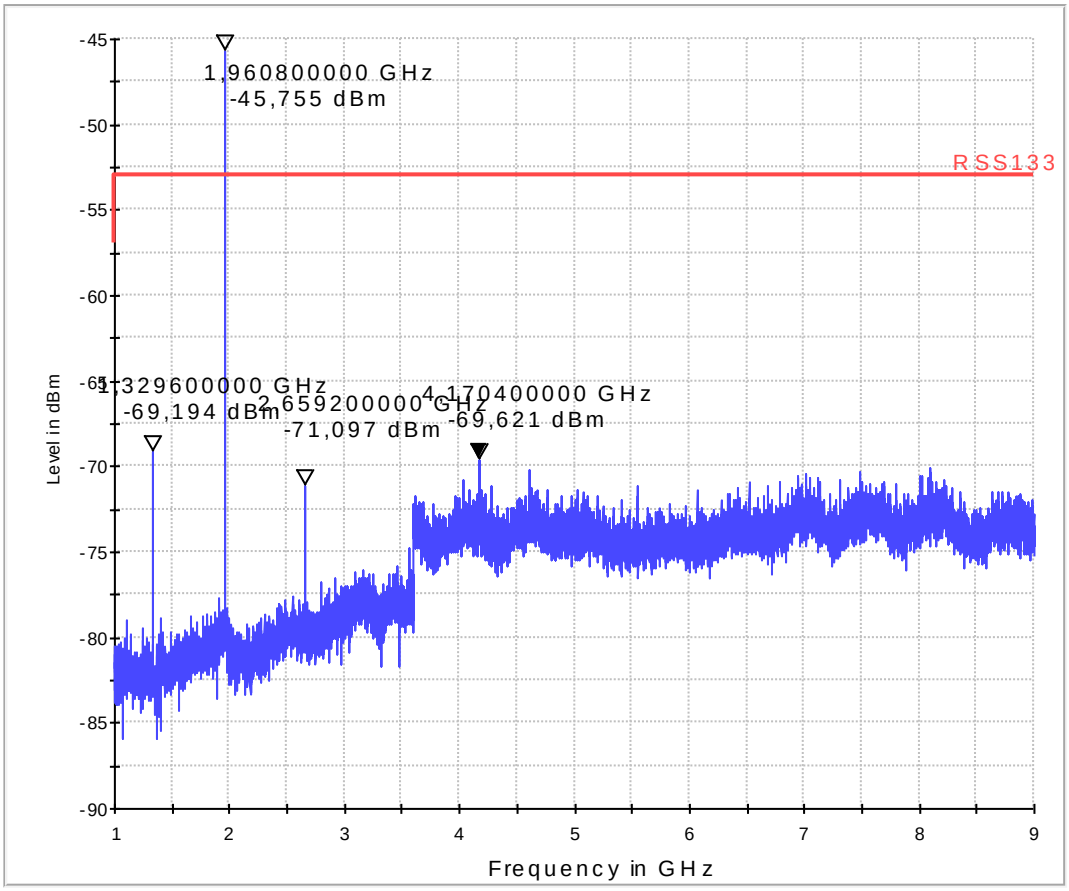


Diagram No.: 4.59

Common Information

Test Description:	Transmitter unwanted emissions (Conducted)/ FCC requirements
Test Site:	Radio laboratory 1
Test Standard:	FCC Part 27 Broadband PCS, RSS-139
Operation mode:	FDD IV -RX (channel :1638)
Operator Name:	HLa
SAP No:	6-0143-12-2-3b

EUT Information

EUT Name:	LISA-U230
IMEI:	352237-05-001199-0
HW, FW:	146AA0, 22.00
Manufacturer:	u-blox AG
Voltage:	3,8 VDC

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	97 kHz	PK+	3 kHz	10 s	0 dB

Sweep1

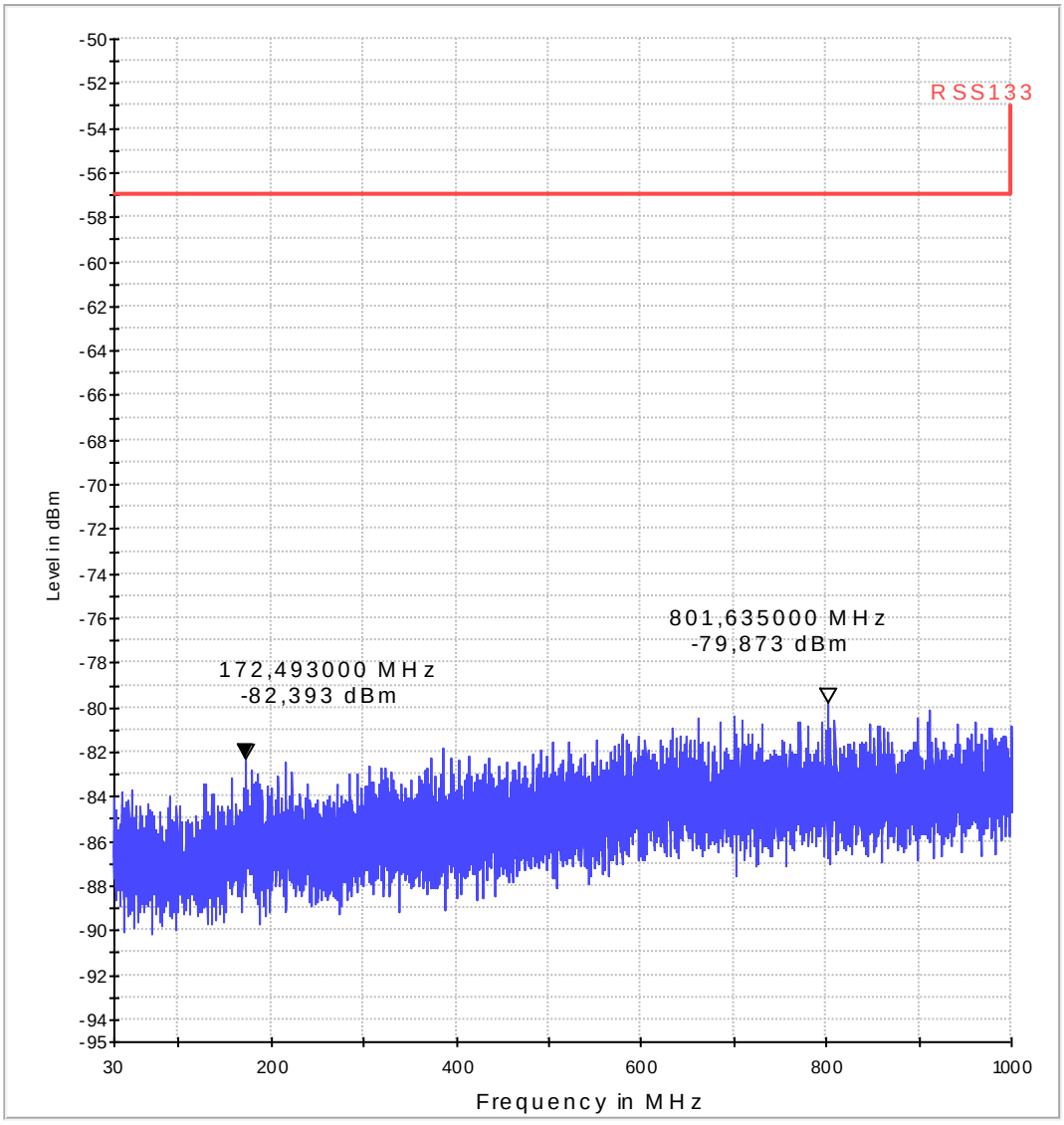


Diagram No.: 4.60

Common Information

Test Description:	Transmitter unwanted emissions (Conducted)/ FCC requirements
Test Site:	Radio laboratory 1
Test Standard:	FCC Part 27 Broadband PCS, RSS-139
Operation mode:	FDD V -RX (channel :1638)
Operator Name:	HLa
SAP No:	6-0143-12-2-3b

EUT Information

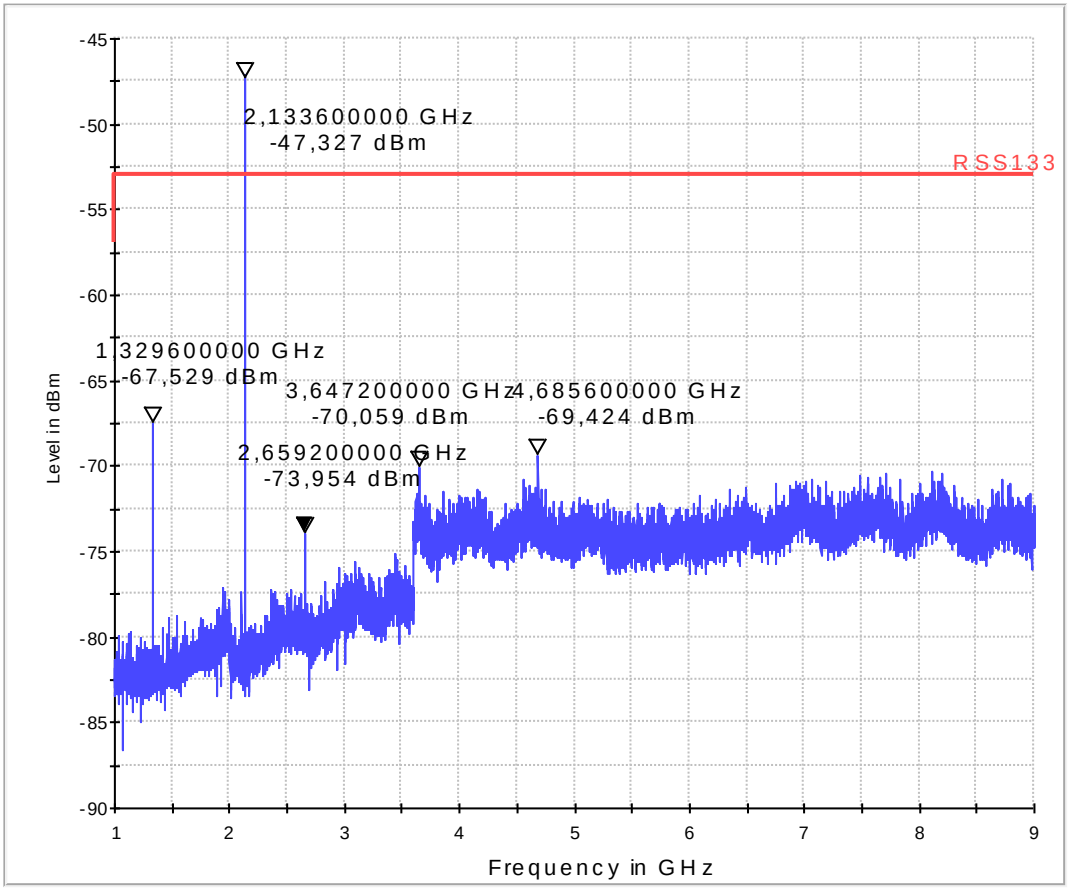
EUT Name:	LISA-U230
IMEI:	352237-05-001199-0
HW, FW:	146AA0, 22.00
Manufacturer:	u-blox AG
Voltage:	3,8 VDC

Sweep Setup: Sweep2 [EMI radiated]

Hardware Setup:	31_ESU_Conducted_FCC_Part_15_22_24
Receiver:	[ESU 40]
Level Unit:	dBm

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
1 GHz - 9 GHz	800 kHz	PK+	3 kHz	30 s	0 dB

Sweep2



5.5. Measurement uncertainties

The reported uncertainties are calculated based on the standard uncertainty multiplied with the appropriate coverage factor **k**, such that a confidence level of approximately 95% is achieved.

For uncertainty determination, each component used in the concrete measurement set-up was taken in account and it's contribution to the overall uncertainty according it's statistical distribution calculated.

Following table shows expectable uncertainties for each measurement type performed.

Measurement	Frequency range	Calculated uncertainty based on a confidence level of 95%	Remarks:
RF-Power Output conducted	9 kHz .. 20 GHz	1.0 dB	--
RF-Power Output radiated	30 MHz .. 4 GHz	3.17 dB	Substitution method
Conducted RF-emissions on antenna ports	9 kHz .. 20 GHz	1.0 dB	--
Radiated RF-emissions enclosure	150 kHz .. 30 MHz	5.0 dB	Magnetic field
	30 MHz .. 1 GHz	4.2 dB	E-Field
	1 GHz .. 18GHz	4.8 dB	E-Field
	1 GHz .. 20 GHz	3.17 dB	Substitution method
Occupied bandwidth	9 kHz .. 4 GHz	0.1272 ppm (Delta Marker method)	Frequency error
		1 dB	Power
Emission bandwidth	9 kHz .. 4 GHz	0.1272 ppm (Delta Marker method)	Frequency error
		1 dB	Power
Frequency stability	9 kHz .. 20 GHz	0.0636 ppm	--
Conducted emissions on AC-mains port (U_{CISPR})	9 kHz .. 150 kHz	4.0 dB	--
	150 kHz .. 30 MHz	3.6 dB	

Table : measurement uncertainties, valid for conducted/radiated measurements

6. Accreditation details of CETECOM's laboratories and test sites

Ref.-No.	Accreditation Certificate	Valid for laboratory area or test site	Accreditation Body
-	D-PL-12047-01-01	All laboratories and test sites of CETECOM GmbH, Essen	DAkkS, Deutsche Akkreditierungsstelle GmbH
337	736496	Radiated Measurements 30 MHz to 1 GHz, 3m+10m OATS	FCC, Federal Communications Commission Laboratory Division, USA (MRA US-EU 0003)
487		Radiated Measurements 30 MHz to 1 GHz, 3m SAR	
558		Radiated Measurements below 1 GHz, 3 m Fully Anechoic Chamber	
348		Mains Ports Conducted Interference Measurements	
348		Telecommunication Ports Conducted Interference Measurements	
337	3462D-1	Radiated Measurements 30 MHz to 1 GHz, 3m + 10m OATS	IC, Industry Canada Certification and Engineering Bureau
487	3462D-2	Radiated Measurements 30 MHz to 1 GHz, 3m SAR	
550	3462D-2	Radiated Measurements 1 GHz to 6 GHz, 3m SAR	
558	3462D-3	Radiated Measurements below 1 GHz ,3 m Fully Anechoic Chamber	
337	R-2665	Radiated Measurements 30 MHz to 1 GHz, 3m+10m OATS	VCCI, Voluntary Control Council for Interference by Information Technology Equipment, Japan
487	R-2666	Radiated Measurements 30 MHz to 1GHz, 3m SAR	
550	G-301	Radiated Measurements 1GHz to 6 GHz, 3m SAR	
348	C-2914	Mains Ports Conducted Interference Measurements	
348	T-1967	Telecommunication Ports Conducted Interference Measurements	

7. Instruments and Ancillary

7.1. Used equipment "CTC"

The "Ref.-No" in the left column of the following tables allows the clear identification of the laboratory equipment.

7.1.1. Test software and firmware of equipment

Ref.-No.	Equipment	Type	Serial-No.	Version of Firmware or Software during the test
001	Emi Test Receiver	ESS	825132/017	Firm.= 1.21 , OTP=2.0, GRA=2.0
012	Signal Generator (EMS-cond.)	SMY 01	839069/027	Firm.= V 2.02
013	Power Meter (EMS cond.)	NRVD	839111/003	Firm.= V 1.51
017	Digital Radiocommunication Tester	CMD 60 M	844365/014	Firmware = V 3.52 .22.01.99, DECT = D2.87 13.01.99
053	Audio Analyzer	UPA3	860612/022	Firm. V 4.3
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	Firm.= V 3.1DHG
140	Signal Generator	SMHU	831314/006	Firm.= 3.21
261	Thermal Power Sensor	NRV-Z55	825083/0008	EPROM-Datum 02.12.04, SE EE 1 B
262	Power Meter	NRV-S	825770/0010	Firm.= 2.6
263	Signal Generator	SMP 04	826190/0007	Firm.=3.21
264	Spectrum Analyzer	FSEK 30	826939/005	Bios=2.1, Analyzer= 3.20
295	Racal Digital Radio Test Set	6103	1572	UNIT Firmware= 4.04, SW-Main=4.04, SW-BBP=1.04, SW-DSP=1.02, Hardboot=1.02, Softboot=2.02
298	Univ. Radio Communication Tester	CMU 200	832221/091	R&S Test Firmware =3.53 /3.54 (current Testsoftw. f. all band used
323	Digital Radiocommunication Tester	CMD 55	825878/0034	Firm.= 3.52 .22.01.99
331	Climatic Test Chamber -40/+80 Grad	HC 4055	43146	TSI 1.53
335	System-CTC-EMS-Conducted	System EMS Conducted	-	EMC 32 V 8.40
340	Digital Radiocommunication Tester	CMD 55	849709/037	Firm.= 3.52 .22.01.99
355	Power Meter	URV 5	891310/027	Firm.= 1.31
365	10V Insertion Unit 50 Ohm	URV5-Z2	100880	Eprom Data = 31.03.08
366	Ultra Compact Simulator	UCS 500 M4	V0531100594	Firm. UCS 500=001925/3.06a02, rc=ISMIEC 4.10
371	Bluetooth Tester	CBT32	100153	CBT V5,30+ SW-Option K55
377	Emi Test Receiver	ESCS 30	100160	Firm.= 2.30, OTP= 02.01, GRA= 02.36
378	Broadband RF Field Monitor	RadiSense III	03D00013SNO-08	Firm.= V.03D13
383	Signal Generator	SME 03	842 828 /034	Firm.= 4.61
389	Digital Multimeter	Keithley 2000	0583926	Firm. = A13 (Mainboard) A02 (Display)
392	Radio Communication Tester	MT8820A	6K00000788	Firm.= 4.50 #005, IPL=4.01#001,OS=4.02#001, GSM=4.41#013, W-CDMA= 4.54#004, scenario= 4.52#002
436	Univ. Radio Communication Tester	CMU 200	103083	R&S Test Firmware Base=5.14, Mess-Software= GSM:5.14 WCDMA:5.14 (current Testsoftw. F. all band to be used ,
441	CTC-SAR-EMI Cable Loss	System EMI field (SAR) Cable	-	EMC 32 Version 8.40
442	CTC-SAR-EMS	System EMS field (SAR)	-	EMC 32 Version 8.40
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	Spuri 7.2.5 or EMC 32 Ver. 8.40
444	CTC-FAR-EMS field	System-EMS-Field (FAR)	-	EMC 32 Version 8.40
460	Univ. Radio Communication Tester	CMU 200	108901	R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used,
489	Emi Test Receiver	ESU40	1000-30	Firmware=4.43 SP3, Bios=V5.1-16-3, Spec. =01.00
491	ESD Simulator dito	ESD dito	dito307022	V 2.30
524	Voltage Drop Simulator	VDS 200	0196-16	Software Nr: 000037 Version V4.20a01
526	Burst Generator	EFT 200 A	0496-06	Software Nr. 000034 Version V2.32
527	Micro Pulse Generator	MPG 200 B	0496-05	Software-Nr. 000030 Version V2.43
528	Load Dump Simulator	LD 200B	0496-06	Software-Nr. 000031 Version V2.35a01
546	Univ. Radio Communication Tester	CMU 200	106436	R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used
547	Univ. Radio Communication Tester	CMU 200	835390/014	R&S Test Firmware Base=V5.1403 (current Testsoftw., f. all band used, GSM = 5.14 WCDMA: = 5.14
584	Spectrum Analyzer	FSU 8	100248	2.82_SP3
594	Univ. Radio Communication Tester	CMW500	101757	Firmware Base=2.0.20.9, LTE=2.0.20.8. CDMA= 2.0.10
597	Univ. Radio Communication Tester	CMU 200	100347	R&S Test Firmware Base=5.01, GSM=5.02 WCDMA= not installed, Mainboard= µP1=V.850
598	Spectrum Analyzer	FSEM 30 (Reserve)	831259/013	Firmware Bios 3.40 , Analyzer 3.40 Sp 2

7.1.2. Single instruments and test systems

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
001	Emi Test Receiver	ESS	825132/017	Rohde & Schwarz	12 M	-	31.03.2013
005	AC - LISN (50 Ohm/50µH, test site 1)	ESH2-Z5	861741/005	Rohde & Schwarz	24/12 M	-	31.03.2013
007	DC - LISN (50 Ohm/5µH)	ESH3-Z6	892563/002	Rohde & Schwarz	24/12 M	-	31.03.2013
009	Power Meter (EMS-radiated)	NRV	863056/017	Rohde & Schwarz	24 M	-	31.03.2013
016	Line Impedance Simulating Network	Op. 24-D	B6366	Spitzenberger+Spies	36 M	-	31.03.2013
020	Horn Antenna 18 GHz (Subst 1)	3115	9107-3699	EMCO	36/12 M	-	31.03.2013
021	Loop Antenna (H-Field)	6502	9206-2770	EMCO	36 M	-	31.03.2013
030	Loop Antenna (H-field)	HFH-Z2	879604/026	Rohde & Schwarz	36 M	-	31.03.2013
033	RF-current probe (100kHz-30MHz)	ESH2-Z1	879581/18	Rohde & Schwarz	24 M	-	31.03.2013
057	relay-switch-unit (EMS system)	RSU	494440/002	Rohde & Schwarz	pre-m	1a	
060	power amplifier (DC-2kHz)	PAS 5000	B6363	Spitzenberger+Spies	-	3	
066	notch filter (WCDMA; FDD1)	WRCT 1900/2200-5/40-10EEK	5	Wainwright GmbH	12 M	1c	30.06.2013
086	DC - power supply, 0 -10 A	LNG 50-10	-	Heinzinger Electronic	pre-m	2	
087	DC - power supply, 0 -5 A	EA-3013 S	-	Elektro Automatik	pre-m	2	
090	Helmholtz coil: 2x10 coils in series	-	-	RWTÜV	-	4	
091	USB-LWL-Converter	OLS-1	007/2006	Ing. Büro Scheiba	-	4	
099	passive voltage probe	ESH2-Z3	299.7810.52	Rohde & Schwarz	36 M	-	31.03.2013
100	passive voltage probe	Probe TK 9416	without	Schwarzbeck	36 M	-	31.03.2013
110	USB-LWL-Converter	OLS-1	-	Ing. Büro Scheiba	-	4	
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	BOCONSULT	36 M	-	31.03.2013
134	horn antenna 18 GHz (Subst 2)	3115	9005-3414	EMCO	12 M	-	31.03.2013
136	adjustable dipole antenna (Dipole 1)	3121C-DB4	9105-0697	EMCO	12 M	-	31.03.2013
140	Signal Generator	SMHU	831314/006	Rohde & Schwarz	24 M	-	31.03.2013
248	attenuator	SMA 6dB 2W	-	Radiall	pre-m	2	
249	attenuator	SMA 10dB 10W	-	Radiall	pre-m	2	
252	attenuator	N 6dB 12W	-	Radiall	pre-m	2	
256	attenuator	SMA 3dB 2W	-	Radiall	pre-m	2	
257	hybrid	4031C	04491	Narda	pre-m	2	
260	hybrid coupler	4032C	11342	Narda	pre-m	2	
261	Thermal Power Sensor	NRV-Z55	825083/0008	Rohde & Schwarz	24/12 M	-	31.03.2013
262	Power Meter	NRV-S	825770/0010	Rohde & Schwarz	24 M	-	31.03.2013
263	Signal Generator	SMP 04	826190/0007	Rohde & Schwarz	36 M	-	31.03.2013
264	Spectrum Analyzer	FSEK 30	826939/005	Rohde & Schwarz	12 M	-	31.03.2014
265	peak power sensor	NRV-Z33, Model 04	840414/009	Rohde & Schwarz	24 M	-	31.03.2013
266	peak power sensor	NRV-Z31, Model 04	843383/016	Rohde & Schwarz	24 M	-	31.03.2013
267	notch filter GSM 850	WRCA 800/960-6EEK	9	Wainwright GmbH	pre-m	2	
268	AC/DC power supply	EA 3050-A	9823636	Elektro Automatik	pre-m	2	
270	termination	1418 N	BB6935	Weinschel	pre-m	2	
271	termination	1418 N	BE6384	Weinschel	pre-m	2	
272	attenuator (20 dB) 50 W	Model 47	BF6239	Weinschel	pre-m	2	
273	attenuator (10 dB) 100 W	Model 48	BF9229	Weinschel	pre-m	2	
274	attenuator (10 dB) 50 W	Model 47 (10 dB) 50 W	BG0321	Weinschel	pre-m	2	
275	DC-Block	Model 7003 (N)	C5129	Weinschel	pre-m	2	
276	DC-Block	Model 7006 (SMA)	C7061	Weinschel	pre-m	2	
279	power divider	1515 (SMA)	LH855	Weinschel	pre-m	2	
287	pre-amplifier 25MHz - 4GHz	AMF-2D-100M4G-35-10P	379418	Miteq	12 M	1c	30.06.2013
291	high pass filter GSM 850/900	WHJ 2200-4EE	14	Wainwright GmbH	12 M	1c	30.06.2013
298	Univ. Radio Communication Tester	CMU 200	832221/091	Rohde & Schwarz	pre-m	3	
300	AC LISN (50 Ohm/50µH, 1-phase)	ESH3-Z5	892 239/020	Rohde & Schwarz	24/12 M	-	31.03.2013
301	attenuator (20 dB) 50W, 18GHz	47-20-33	AW0272	Lucas Weinschel	pre-m	2	
302	horn antenna 40 GHz (Meas 1)	BBHA9170	155	Schwarzbeck	36 M	-	31.03.2014
303	horn antenna 40 GHz (Subst 1)	BBHA9170	156	Schwarzbeck	36 M	-	31.03.2014
331	Climatic Test Chamber -40/+80 Grad	HC 4055	43146	Heraeus Vötsch	24 M	-	30.11.2013
341	Digital Multimeter	Fluke 112	81650455	Fluke	24 M	-	31.03.2013
342	Digital Multimeter	Voltcraft M-4660A	IB 255466	Voltcraft	24 M	-	31.03.2013
347	laboratory site	radio lab.	-	-	-	5	
348	laboratory site	EMI conducted	-	-	-	5	
354	DC - Power Supply 40A	NGPE 40/40	448	Rohde & Schwarz	pre-m	2	
355	Power Meter	URV 5	891310/027	Rohde & Schwarz	24 M	-	31.03.2013
356	power sensor	NRV-Z1	882322/014	Rohde & Schwarz	24 M	-	31.03.2013
357	power sensor	NRV-Z1	861761/002	Rohde & Schwarz	24 M	-	31.03.2013
373	V-Network 5µH/50 Ohm	ESH3-Z6	100535	Rohde & Schwarz	24/12 M	-	31.03.2013
376	Horn Antenna 6 GHz	BBHA9120 E	BBHA 9120 E 179	Schwarzbeck	12 M	-	31.03.2013
377	Emi Test Receiver	ESCS 30	100160	Rohde & Schwarz	12 M	-	31.03.2013
389	Digital Multimeter	Keithley 2000	0583926	Keithley	24 M	-	31.03.2013
392	Radio Communication Tester	MT8820A	6K00000788	Anritsu	12 M	-	31.03.2013
431	Model 7405	Near-Field Probe Set	9305-2457	EMCO	-	4	
436	Univ. Radio Communication Tester	CMU 200	103083	Rohde & Schwarz	12 M	-	31.03.2013
441	CTC-SAR-EMI Cable Loss	System EMI field (SAR) Cable	-	CETECOM	12 M	5	31.10.2013

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	ETS-Lindgren/CETECOM	12 M	5	30.06.2013
448	notch filter WCDMA_FDD II	WRCT 1850.0/2170.0-5/40-10SSK	5	Wainwright Instruments GmbH	12 M	1c	30.06.2013
449	notch filter WCDMA FDD V	WRCT 824.0/894.0-5/40-8SSK	1	Wainwright	12 M	1c	30.06.2013
454	Oscilloscope	HM 205-3	9210 P 29661	Hameg	-	4	
456	DC-Power supply 0-5 A	EA 3013 S	207810	Elektro Automatik	pre-m	2	
459	DC -Power supply 0-5 A , 0-32 V	EA-PS 2032-50	910722	Elektro Automatik	pre-m	2	
460	Univ. Radio Communication Tester	CMU 200	108901	Rohde & Schwarz	12 M	-	31.03.2013
463	Universal source	HP3245A	2831A03472	Agilent	-	4	
466	Digital Multimeter	Fluke 112	89210157	Fluke USA	24 M	-	31.03.2013
467	Digital Multimeter	Fluke 112	89680306	Fluke USA	24 M	-	31.03.2013
468	Digital Multimeter	Fluke 112	90090455	Fluke USA	24 M	-	31.03.2013
477	ReRadiating GPS-System	AS-47	-	Automotive Cons. Fink	-	3	
480	power meter (Fula)	NRVS	838392/031	Rohde & Schwarz	24 M	-	31.03.2013
482	filter matrix	Filter matrix SAR 1	-	CETECOM (Brl)	-	1d	
484	pre-amplifier 2,5 - 18 GHz	AMF-5D-02501800-25-10P	1244554	Miteq	12 M	-	30.07.2013
487	System CTC NSA-Verification SAR-EMI	System EMI field (SAR) NSA	-	ETS Lindgren/CETECOM	12 M	-	30.09.2013
489	Emi Test Receiver	ESU40	1000-30	Rohde & Schwarz	12 M	-	31.03.2013
502	band reject filter	WRCG 1709/1786-1699/1796-	SN 9	Wainwright	pre-m	2	
503	band reject filter	WRCG 824/849-814/859-60/10SS	SN 5	Wainwright	pre-m	2	
512	notch filter GSM 850	WRCA 800/960-02/40-6EEK	SN 24	Wainwrght	12 M	1c	30.06.2012
517	relais switch matrix	HF Relais Box Keithley System	SE 04	Keithley	pre-m	2	
523	Digital Multimeter	L4411A	MY46000154	Agilent	24 M	-	31.03.2013
529	6 dB Broadband resistive power divider	Model 1515	LH 855	Weinschel	pre-m	2	
530	10 dB Broadband resistive power divider	R 416110000	LOT 9828	-	pre-m	2	
546	Univ. Radio Communication Tester	CMU 200	106436	R&S	12 M	-	31.03.2013
547	Univ. Radio Communication Tester	CMU 200	835390/014	Rohde & Schwarz	12 M	-	31.03.2013
548	Digital-Barometer	GBP 2300	without	Greisinger GmbH	36/12 M	-	31.03.2013
549	Log.Per-Antenna	HL025	1000060	Rohde & Schwarz	36/12 M	-	31.03.2013
552	high pass filter 2,8-18GHz	WHKX 2.8/18G-10SS	4	Wainwright	12 M	1c	30.07.2012
558	System CTC FAR S-VSWR	System CTC FAR S-VSWR	-	CTC	24 M	-	31.07.2013
574	Biconilog Hybrid Antenna	BTA-L	980026L	Frankonia	36/12 M	-	30.03.2013
584	Spectrum Analyzer	FSU 8	100248	Rohde & Schwarz	12 M	-	31.03.2013
594	Univ. Radio Communication Tester	CMW500	101757	Rohde & Schwarz	24 M	-	31.03.2013
597	Univ. Radio Communication Tester	CMU 200	100347	Rohde & Schwarz	12 M	-	31.03.2013
598	Spectrum Analyzer	FSEM 30 (Reserve)	831259/013	Rohde & Schwarz	24 M	-	13.01.2013
600	power meter	NRVD (Reserve)	834501/018	Rohde & Schwarz	24 M	-	31.03.2013
601	medium-sensitivity diode sensor	NRV-Z5 (Reserve)	8435323/003	Rohde & Schwarz	24 M	-	12.01.2013
602	peak power sensor	NRV-Z32 (Reserve)	835080	Rohde & Schwarz	24 M	-	12.01.2013
608	UltraLog-Antenna	HL 562	830547/009	Rohde & Schwarz	36/12 M	-	31.03.2014
611	DC power supply	E3632A	KR 75305854	Agilent	pre-m	2	
612	DC power supply	E3632A	MY 40001321	Agilent	pre-m	2	
613	Attenuator	R416120000 20dB 10W	Lot. 9828	Radiall	pre-m	2	

7.1.3. Legend

Note / remarks		Calibrated during system calibration:
	1a	System CTC-SAR-EMS (Ref.-No. 442)
	1b	System-CTC-EMS-Conducted (Ref.-No. 335)
	1c	System CTC-FAR-EMI-RSE (Ref.-No . 443)
	1d	System CTC-SAR-EMI (Ref.-No . 441)
	1e	System CTC-OATS (EMI radiated) (Ref.-No. 337)
	1 f	System CTC-CTIA-OTA (Ref.-No . 420)
	1 g	System CTC-FAR-EMS (Ref.-No . 444)
	2	Calibration or equipment check immediately before measurement
	3	Regulatory maintained equipment for functional check or support purpose
	4	Ancillary equipment without calibration e.g. mechanical equipment or monitoring equipment
	5	Test System

Interval of calibration	12 M	12 month
	24 M	24 month
	36 M	36 month
	24/12 M	Calibration every 24 months, between this every 12 months internal validation
	36/12 M	Calibration every 36 months, between this every 12 months internal validation
	Pre-m	Check before starting the measurement
	-	Without calibration