InterLab®

RF Exposure and Maximum ERP/EIRP Assessment

For

LISA-U201 Wireless Module

FCC ID: XPYLISAU201

IC 8595A-LISA201

Assessment Reference: MDE_UBLOX_1519_MPEa

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0 Summary

0.1 Technical Report Summary

Type of Report
RF Exposure and Maximum ERP/EIRP Assessment for a GSM/UMTS radio module. Including RF Exposure for use with co-located radios on generic host device.

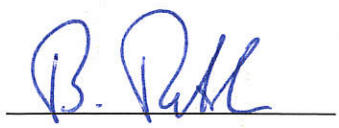
Applicable FCC Rules

For RF Exposure:
OET Bulletin 65 Edition 97-01 August 1997
FCC 47 CFR §1.1307
FCC 47 CFR §1.1310
RSS-102 Issue 5

For Maximum ERP/EIRP:

FCC 47 CFR §22.913
IC SRSP-503 Issue 7, September 2008
FCC 47 CFR §24.232
IC SRSP-510 Issue 5, February 2009
FCC 47 CFR §27.50(d)
RSS-139, Issue 2 / SRSP-513

Report version control			
Version	**Release date**	**Changes**	**Version validity**
000	2015-09-08	Initial version	Valid

Responsible for Accreditation Scope: 

Responsible for Report: 

1 Administrative Data

1.1 Testing Laboratory

Company Name:	7layers GmbH
Address	Borsigstr. 11 40880 Ratingen Germany

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

The test facility is also accredited by the following accreditation organisation:

Laboratory accreditation no.:	DAkkS D-PL-12140-01-01
Responsible for Accreditation Scope:	Dipl.-Ing. Bernhard Retka Dipl.-Ing. Robert Machulec Dipl.-Ing. Andreas Petz Dipl.-Ing. Marco Kullik
Report Template Version:	2014-05-15

1.2 Project Data

Responsible for assessment and report:	Mr. Andreas Tübel
Date of Report:	2015-09-08

1.3 Applicant Data

Company Name:	u-blox AG
Address:	Zürcherstrasse 68, CH-8800 Thalwil Switzerland
Contact Person:	Giulio Comar

1.4 Manufacturer Data

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

2 Test object Data

2.1 General EUT Description

Equipment under Test	GSM/UMTS/HSPA Data Module
Type Designation:	LISA-U201
Kind of Device: GPRS/EDGE MSC	Cellular Module
GPRS Multi-slot class	12
FCC ID:	XPYLISAU201
IC Number:	8595A-LISAU201

General product description:

The EUT is Cellular radio module supporting GSM/WCDMA/HSDPA/HSUPA

2.2 EUT Main components

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

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status
EUT ad01	GSM/UMTS/ HSPA Module	LISA-U201	359486060010277	214001	23.35
EUT ag01	GSM/UMTS/ HSPA Module	LISA-U201	359486060010434	214001	23.35
Remark: EUT A is equipped with a temporary antenna connector. The Module is not sold with a predefined antenna.					

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

2.3 Ancillary Equipment

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

Short Description	Equipment under Test	Type Designation	HW Status	SW Status	Serial no.	FCC ID
AE 1	AC/DC converter	UUX324-1215	-	-	E06-0272182	–
AE 2	Evaluation test board	EVB-WL3	EVB-WL3	-	-	-

2.4 Auxiliary Equipment

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

Short Description	Equipment under Test	Type Designation	Serial no.	HW Status	SW Status	FCC ID
N/A						–

2.5 Operating Modes

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

Op. Mode	Description of Operating Modes	Remarks
Op-mode 1	EUT transmitting in standalone configuration	Antenna-to-person distance > 20cm
Op-mode 2	EUT transmitting in the GSM 850 MHz Band simultaneously with a generic Bluetooth radio.	Antenna-to-person distance > 20cm
Op-mode 3	EUT transmitting in the GSM 1900 MHz Band simultaneously with a generic Bluetooth radio.	Antenna-to-person distance > 20cm
Op-mode 4	EUT transmitting in the GSM 850 MHz Band simultaneously with a generic WLAN radio.	Antenna-to-person distance > 20cm
Op-mode 5	EUT transmitting in the GSM 1900 MHz Band simultaneously with a generic WLAN radio.	Antenna-to-person distance > 20cm
Op-mode 6	EUT transmitting in the GSM 850 MHz Band simultaneously with a generic Bluetooth radio and WLAN radio.	Antenna-to-person distance > 20cm
Op-mode 7	EUT transmitting in the GSM 1900 MHz Band simultaneously with a generic Bluetooth radio and WLAN radio.	Antenna-to-person distance > 20cm
Op-mode 21	EUT transmitting in the FDD 5 Band simultaneously with a generic Bluetooth radio.	Antenna-to-person distance > 20cm
Op-mode 22	EUT transmitting in the FDD 2 Band simultaneously with a generic WLAN radio.	Antenna-to-person distance > 20cm
Op-mode 23	EUT transmitting in the FDD 5 Band simultaneously with a generic Bluetooth radio and WLAN radio.	Antenna-to-person distance > 20cm
Op-mode 24	EUT transmitting in the FDD 5 Band simultaneously with a generic Bluetooth radio.	Antenna-to-person distance > 20cm
Op-mode 25	EUT transmitting in the FDD 5 Band simultaneously with a generic WLAN radio.	Antenna-to-person distance > 20cm
Op-mode 26	EUT transmitting in the FDD 2 Band simultaneously with a generic Bluetooth radio and WLAN radio.	Antenna-to-person distance > 20cm

3 Evaluation Results

3.1 Maximum ERP / EIRP

Standard	Frequency Band
FCC 47 CFR §22.913 IC RSS-132, Issue 3	(850MHZ GSM/GPRS) (FDD5 WCDMA/HSUPA/HSDPA)
FCC 47 CFR §24.232 IC RSS-133 Issue 6	(1900MHZ GSM/GPRS) (FDD2 WCDMA/HSUPA/HSDPA)

3.1.1 Test Limits

For the 850MHz band, FCC §22.913 states that the maximum ERP of this device shall not exceed 7 Watts. IC SRSP-503 Issue 7, states that this device shall not exceed a maximum EIRP of 11.5 Watts
For the purposes of this test report, the 7 Watt ERP limit stipulated in FCC §22.913 has been converted to an equivalent ERIP value of 11.5 Watts.

For all other limits, refer to the values stipulated in the corresponding tables.

3.1.2 Test Protocol

Band	Mode	Duty Cycle (%)	Frequency (MHZ)	Maximum Conducted output power (dBm)	Maximum Conducted output power (mW)	Freq of highest power	FCC / IC EIRP limit (mW)	Maximum antenna gain to meet EIRP Limit (dBi)*
850	GSM	50.0%	836.2 - 848.8	32.83	1918.668741	836.60	11484	7.8
1900	GSM	50.0%	1850.2 - 1909.8	29.55	901.5711376	1907.60	2000	3.5
FDD 2	UMTS	100.0%	1850 - 1907.6	22.19	165.5769963	1852.40	2000	10.8
FDD 5	UMTS	100.0%	824 - 846.6	23.06	202.3019179	826.40	11484	17.5

*Calculated using maximum output power as stated in the tune-up procedure.

3.1.3 Conclusion

All gains in (dBi) Band	Max gain to be used to comply with EIRP Limits	Max gain to be used to comply with FCC MPE Limits	Max gain to be used to comply with IC MPE Limits	Maximum gain to be compliant with all limits
850	7.8	4.0	0.7	0.7
1900	3.5	8.0	4.6	3.5
FDD 2	10.8	12.0	8.5	8.5
FDD 5	17.5	9.4	6.1	6.1

3.2 RF Exposure Evaluation for Module

Standards
OET Bulletin 65 Edition 97-01 August 1997
FCC 47 CFR §1.1307
FCC 47 CFR §1.1310
RSS-102 Issue 5 – March 2015

3.2.1 Test limits

As specified in Table 1B of 47 CFR 1.1310 – Limits for Maximum Permissible Exposure (MPE), Limits for General Population/Uncontrolled Exposure.

Frequency range (MHz)	*Power density (mW/cm²)*
300 – 1,500	f/1500
1,500 – 100,000	1.0

Limits specified per RSS-102, Issue 5.

Frequency range (MHz)	*Power density (W/m²)*	*Power density (mW/cm²)*
300 – 6000	$0.02619\ f^{0.6834}$	*mW/cm² = W/m² * 0.1*

Equation OET bulletin 65, page 18, edition 97-01: $S = \frac{PG}{4\pi R^2} = \frac{EIRP}{4\pi R^2}$

Where:

S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the centre of radiation of the antenna

3.2.2 Test Protocol

Maximum antenna gain to comply with MPE limits for FCC									
Band	Mode	Duty Cycle	Frequency (MHZ)	Maximum Conducted output power (dBm)	Maximum Conducted output power (mW)	Equivalent conducted output power (mW)	MPE Limit (mW/cm²)	Maximum antenna gain to meet MPE Limit (dBi)	Separation distance (cm)
850	GSM / GPRS	50%	836.6	33.5	2238.72	1119.44	0.5577	**4.0**	20
1900	GSM / GPRS	50%	1907.6	32	1584.89	792.50	1.0000	**8.0**	20
FDD 2	UMTS	100.0%	1852.4	25	316.23	316.23	1.0000	**12.0**	20
FDD 5	UMTS	100.0%	826.4	25	316.23	316.23	0.5509	**9.4**	20

* Conducted output power values bases on "Tune-up" information provided by manufacturer.

Maximum antenna gain to comply with MPE limits for Industry Canada									
Band	Mode	Duty Cycle	Frequency (MHZ)	Maximum Conducted output power (dBm)	Maximum Conducted output power (mW)	Equivalent conducted output power (mW)	MPE Limit (mW/cm²)	Maximum antenna gain to meet MPE Limit (dBi)	Separation distance (cm)
850	GSM / GPRS	50%	836.6	33.5	2238.72	1119.44	0.2602	**0.7**	20
1900	GSM / GPRS	50%	1907.6	32.0	1584.89	792.50	0.4571	**4.6**	20
FDD 2	UMTS	100.0%	1852.4	25.0	316.23	316.23	0.4480	**8.5**	20
FDD 5	UMTS	100.0%	826.4	25.0	316.23	316.23	0.2581	**6.1**	20

* Conducted output power values bases on "Tune-up" information provided by manufacturer.

3.2.3 Conclusion

Band	Max gain for FCC MPE Limits	Max gain for Industry Canada MPE Limits	Maximum gain to be compliant with all MPE limits
850	4.0	0.7	0.7
1900	8.0	4.6	4.6
FDD 2	12.0	8.5	8.5
FDD 5	9.4	6.1	6.1

3.3 RF Exposure Evaluation for multiple transmitters in co-location

Standards
OET Bulletin 65 Edition 97-01 August 1997
FCC 47 CFR §1.1307
FCC 47 CFR §1.1310
RSS-102 Issue 5 – March 2015

3.3.1 Co-Location Considerations

The calculation below is used to consider situations in which simultaneous exposure to fields of different frequencies occur. The calculation is performed by the sum of each relative exposure for each equipment according to the following criteria.

$$\sum_{1}^{N} \frac{S_{eqn}}{S_{Limn}} = \frac{S_{eq1}}{S_{Lim1}} + \frac{S_{eq2}}{S_{Lim2}} + \ldots + \frac{S_{eqN}}{S_{LimN}} \leq 1$$

Where:

S_{eq} is the power density of the electromagnetic field at a given distance by a specific transmitter and a defined frequency.

S_{lin} is the MPE limit for the frequency being evaluated.

3.3.2 Assumptions

1. Primary transmitter does not support power reduction for multiple time slots on the uplink.
2. Antenna separation from module to human body is ≥ 20cm.
3. Separation distance between co-located transmitting antennas is 0cm.
4. Hypothetical Bluetooth radio is assumed to have an output power of 9.5dBm and an antenna gain of 4dBi.
5. Hypothetical WLAN radio is assumed to have an output power of 19dBm and an antenna gain of 5dBi.

3.3.3 Test Protocol

The below table is to determine the MPE values using the maximum gain values obtained in section 3.3.4 of this document.

OP mode-1 – FOR FCC ONLY Informational only

Band	Mode	Duty Cycle	Frequency (MHZ)	Maximum Conducted output power (dBm)	Equivalent conducted output power (mW)	MPE Limit (mW/cm²)	MPE Value using Max gain	Separation distance (cm)	Verdict
850	GSM / GPRS	50%	836.6	33.5	1119.44	0.5577	**0.4986**	20	Pass
1900	GSM / GPRS	50%	1907.6	32	792.50	1.0000	**0.3530**	20	Pass
FDD 2	UMTS	100.0%	1852.4	25	316.23	1.0000	**0.7564**	20	Pass
FDD 5	UMTS	100.0%	826.4	25	316.23	0.5509	**0.4883**	20	Pass

* Conducted output power values bases on "Tune-up" information provided by manufacturer.

OP mode-1 – FOR Industry Canada ONLY Informational only

Band	Mode	Duty Cycle	Frequency (MHZ)	Maximum Conducted output power (dBm)	Equivalent conducted output power (mW)	MPE Limit (mW/cm²)	MPE Value using Max gain	Separation distance (cm)	Verdict
850	GSM / GPRS	50%	836.6	33.5	1119.44	0.2602	**0.2332**	20	PASS
1900	GSM / GPRS	50%	1907.6	32	792.50	0.4571	**0.3530**	20	PASS
FDD 2	UMTS	100.0%	1852.4	25	316.23	0.4480	**0.3969**	20	PASS
FDD 5	UMTS	100.0%	826.4	25	316.23	0.2581	**0.2284**	20	PASS

MPE Values for the generic Bluetooth and WLAN radios operating alone. These values are used to calculate the relative exposure for simultaneous transmission with the primary transmitter.

MPE Calculation for Single Transmitter installed in Generic host for FCC								
Radio type	Duty Cycle	ERP (mW)	ERP Equivalent (mW)	MPE Limit (mW/cm²)	Maximum antenna gain	Power density	Separation distance (cm)	Verdict
Bluetooth	64%	8.91	3.72	1.0000	4.0	**0.0019**	20	Pass
WLAN	100%	79.43	79.43	1.0000	5.0	**0.0500**	20	Pass

MPE Calculation for Single Transmitter installed in Generic host for Industry Canada								
Radio type	Duty Cycle	ERP (mW)	ERP Equivalent (mW)	MPE Limit (mW/cm²)	Maximum antenna gain	Power density	Separation distance (cm)	Verdict
Bluetooth	64%	8.91	3.72	0.54	4.00	**0.0019**	20.00	Pass
WLAN	100%	79.43	79.43	0.54	5.00	**0.0500**	20.00	Pass

Below are the relative exposure values for the primary, secondary and combined primary + secondary transmitters for both FCC and Industry Canada limits.

OP mode-1

Relative exposure for Primary Transmitter for FCC							
OP-Mode	Mode	Output power	Frequency (MHZ)	S_{eq}	S_{lin} (mW/cm²)	$\frac{S_{eq}}{S_{Lin}}$	Verdict
850	GSM / GPRS	**1119.4379**	836.6	**0.4986**	0.5577	0.89393082	Pass
1900	GSM / GPRS	**792.5013**	1907.6	**0.3530**	1.0000	0.35296408	Pass
FDD 2	UMTS	**316.2278**	1852.4	**0.7564**	1.0000	0.756363411	Pass
FDD 5	UMTS	**316.2278**	826.4	**0.4883**	0.5509	0.8864035	Pass

Relative exposure for Primary Transmitter for Industry Canada							
OP-Mode	Mode	Output power	Frequency (MHZ)	S_{eq}	S_{lin} (mW/cm²)	$\frac{S_{eq}}{S_{Lin}}$	Verdict
850	GSM / GPRS	**1119.4379**	836.6	**0.2332**	0.2602	0.896079016	Pass
1900	GSM / GPRS	**792.5013**	1907.6	**0.3530**	0.4571	0.77216477	Pass
FDD 2	UMTS	**316.2278**	1852.4	**0.3969**	0.4480	0.885982349	Pass
FDD 5	UMTS	**316.2278**	826.4	**0.2284**	0.2581	0.885089434	Pass

Relative exposure for Secondary transmitter for FCC					
OP-Mode	Transmitter	Output power	S_{eq} (mW/cm²)	S_{lin} (mW/cm²)	$\frac{S_{eq}}{S_{Lin}}$
2	Bluetooth	3.72	**0.0019**	1.0000	0.001856652
3	WLAN	79.43	**0.0500**	1.0000	0.049972435
4	Bluetooth	3.72	**0.0019**	1.0000	0.001856652
	WLAN	79.43	**0.0500**	1.0000	0.049972435

Relative exposure for Secondary transmitter for Industry Canada					
OP-Mode	Transmitter	Output power	S_{eq} (mW/cm²)	S_{lin} (mW/cm²)	$\frac{S_{eq}}{S_{Lin}}$
2	Bluetooth	3.72	**0.0019**	0.5410	0.003431873
3	WLAN	79.43	**0.0500**	0.5410	0.092370053
4	Bluetooth	3.72	**0.0019**	0.5410	0.003431873
	WLAN	79.43	**0.0500**	0.5410	0.092370053

Simultaneous exposure of Primary and Secondary transmitter installed in generic host device for FCC					
OP-Mode	Transmitter	Frequency (MHZ)	Maximum S_{eq} / S_{Lin}	Maximum S_{pri}/S_{lim_pri} + S_{sec} / S_{lin_Sec}	Compliance Maximum (S_{pri}/S_{lim_pri}) + $(S_{sec}$ / $S_{lin\_Sec})$ < 1
	Bluetooth	2441	**0.0034**		
1	LISA-U201	GSM 850	**0.8939**	0.8974	Compliant
	Bluetooth	2441	**0.0034**		
2	LISA-U201	GSM 1900	**0.3530**	0.3564	Compliant
	WLAN	2437	**0.0924**		
3	LISA-U201	GSM 850	**0.8939**	0.9863	Compliant
	WLAN	2437	**0.0924**		
4	LISA-U201	GSM 1900	**0.3530**	0.4453	Compliant
	Bluetooth	2441	**0.0019**		
5	WLAN	2437	**0.0924**		
	LISA-U201	GSM 850	**0.8939**	0.9882	Compliant
6	Bluetooth	2441	**0.0019**		
	WLAN	2437	**0.0924**		
7	LISA-U201	GSM 1900	**0.3530**	0.4472	Compliant
	Bluetooth	2441	**0.0034**		
21	LISA-U201	FDD 5	**0.8864**	0.8898	Compliant
	Bluetooth	2441	**0.0034**		
22	LISA-U201	FDD 2	**0.7564**	0.7598	Compliant
	WLAN	2437	**0.0924**		
23	LISA-U201	FDD 5	**0.8864**	0.9788	Compliant
	WLAN	2437	**0.0924**		
24	LISA-U201	FDD 2	**0.7564**	0.8487	Compliant
	Bluetooth	2441	**0.0034**		
	WLAN	2437	**0.0924**		
25	LISA-U201	FDD 5	**0.8864**	0.9822	Compliant
	Bluetooth	2441	**0.0034**		
	WLAN	2437	**0.0924**		
26	LISA-U201	FDD 2	**0.7564**	0.8522	Compliant

Simultaneous exposure of Primary and Secondary transmitter installed in generic host device for Industry Canada					
OP-Mode	Transmitter	Frequency (MHZ)	Maximum S_{eq} / S_{Lin}	Maximum S_{pri}/S_{lim_pri} + S_{sec} / S_{lin_Sec}	Compliance Maximum (S_{pri}/S_{lim_pri}) + (S_{sec} / S_{lin_Sec}) < 1
	Bluetooth	2441	**0.0034**		
1	LISA-U201	GSM 850	**0.8961**	0.8995	Compliant
	Bluetooth	2441	**0.0034**		
2	LISA-U201	GSM 1900	**0.7722**	0.7756	Compliant
	WLAN	2437	**0.0924**		
3	LISA-U201	GSM 850	**0.8961**	0.9884	Compliant
	WLAN	2437	**0.0924**		
4	LISA-U201	GSM 1900	**0.7722**	0.8645	Compliant
	Bluetooth	2441	**0.0034**		
5	WLAN	2437	**0.0924**		
	LISA-U201	GSM 850	**0.8961**	0.9919	Compliant
6	Bluetooth	2441	**0.0034**		
	WLAN	2437	**0.0924**		
7	LISA-U201	GSM 1900	**0.7722**	0.8680	Compliant
	Bluetooth	2441	**0.0034**		
21	LISA-U201	FDD 5	**0.8851**	0.8885	Compliant
	Bluetooth	2441	**0.0034**		
22	LISA-U201	FDD 2	**0.8860**	0.8894	Compliant
	WLAN	2437	**0.0924**		
23	LISA-U201	FDD 5	**0.8851**	0.9775	Compliant
	WLAN	2437	**0.0924**		
24	LISA-U201	FDD 2	**0.8860**	0.9784	Compliant
	Bluetooth	2441	**0.0034**		
	WLAN	2437	**0.0924**		
25	LISA-U201	FDD 5	**0.8851**	0.9809	Compliant
	Bluetooth	2441	**0.0034**		
	WLAN	2437	**0.0924**		
26	LISA-U201	FDD 2	**0.8860**	0.9818	Compliant

When operating the primary transmitter simultaneously with a generic Bluetooth and WLAN radio, the following antenna gains can be used with the module LISA-U201 while still complying with the exposure limits.

Band	dBi (For FCC)	dBi (For Industry Canada)
850	3.5	0.2
1900	3.5	3.5
FDD 5	8.9	5.6
FDD 2	10.8	8