

InterLab[®]

RF Exposure and Maximum ERP/EIRP Assessment

For

LISA-U200 GSM/UMTS Module
FCC ID: XPYLISAU200
IC: 8595A-LISAU200

Assessment Reference: MDE_UBLOX_1918_MPE01

Test Laboratory:

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Note:

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

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0 Summary

0.1 Technical Report Summary

Type of 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 and ISSED 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 – March 2015

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 3 / SRSP-513, July 2015

Report version control			
Rev Version	Release date	Changes	Version validity
-	2019-08-08	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
DAkKS ISO/IEC 17025 accreditation	D-PL-12140-01-00, D-PL-12140-01-01
FCC accreditation	Designation Number: DE0015
ISED accreditation	CAB identifier: DE0007 Test Firm Registration #: 3699A
Responsible for Accreditation Scope:	Dipl.-Ing. Bernhard Retka Dipl.-Ing. Robert Machulec Dipl.-Ing. Andreas Petz Dipl.-Ing. Marco Kullik
Report Template Version:	2017-08-02

1.2 Project Data

Responsible for assessment and report:	Mr. Roseelan Sathiyaseelan
Date of Report:	2019-08-08

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	LISA-U200 Module
Type Designation:	LISA-U200
Kind of Device:	GSM/UMTS Module
GSM MSC/UMTS/LTE CAT	8
FCC ID:	XPYLISAU200
IC Number:	8595A-LISAU200

General product description:

The EUT is Cellular radio module supporting GSM/GPRS/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 A Code: DE1015114 AE01	LISA-U200	U200	358875100011231	146DB0	23.41
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
NA						—

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						–

3 Evaluation Results

3.1 Maximum ERP / EIRP

Standard	Frequency Band
FCC 47 CFR §22.913 IC RSS-132, Issue 3	GSM 850/FDD5 WCDMA/HSUPA/HSDPA
FCC 47 CFR §24.232 IC RSS-133 Issue 6	GSM 1900/FDD2 WCDMA/HSUPA/HSDPA
FCC 47 CFR §27.50(d) RSS-139, Issue 3 / SRSP-513	(FDD4,7 UMTS/LTE)

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 EIRP value of 11.5 Watts.

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

3.1.2 Test Protocol

Maximum antenna gain to comply with EIRP limits for FCC and Industry Canada

Band	Mode	Duty Cycle (%)	Frequency (MHz)	Maximum Conducted output power (dBm)	Maximum Conducted output power (mW)	Freq of highest power (MHz)	FCC EIRP limit (mW)	Maximum antenna gain to meet EIRP Limit (dBi)
850	GSM	50.0%	824.2 - 848.8	34	2511.8864	848.80	11484	6.6
1900	GSM	50.0%	1850.2 - 1909.8	31	1258.9254	1909.80	2000	2.0
FDD 2	UMTS	100.0%	1850 - 1907.6	25	316.22777	1907.60	2000	8.0
FDD 4	UMTS	100.0%	1710 - 1752.6	25	316.22777	1752.60	1000	5.0
FDD 5	UMTS	100.0%	824 - 846.6	25	316.22777	846.60	11484	15.6

3.1.3 Conclusion

Band	Max gain to be used to comply with EIRP Limits	Max gain to be used to comply with FCC MPE	Max gain to be used to comply with IC MPE Limits	Maximum gain to be compliant with all limits
850	6.6	4.4	1.1	1.1
1900	2.0	9.3	5.9	2.0
FDD 2	8.0	12.9	9.5	8.0
FDD 4	5.0	12.3	8.7	5.0
FDD 5	15.6	10.0	6.7	6.7

Gain expressed in dBi

3.2 RF Exposure Evaluation for Module

Standards
OET Bulletin 65 Edition 97-01 August 1997
RSS-102 Issue 5 – March 2015

3.2.1 Test limits

Limits specified per RSS-102, Issue 5.

Frequency range (MHz)	Power density (W/m^2)	Power density (mW/cm^2)
300 – 6000	$0.02619 f^{0.6834}$	$mW/cm^2 = W/m^2 * 0.1$

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 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/cm^2)	Maximum antenna gain to meet MPE Limit (dBi)	Separation distance (cm)
850	GSM	50%	848.8	33.1	2051.16	1025.65	0.2628	1.1	20
1900	GSM	50%	1909.8	30.7	1174.90	587.49	0.4575	5.9	20
FDD 2	UMTS	100%	1907.6	24.1	255.27	255.27	0.4571	9.5	20
FDD 4	UMTS	100%	1752.6	24.7	295.12	295.12	0.4314	8.7	20
FDD 5	UMTS	100%	846.6	24.6	285.10	285.10	0.2624	6.7	20

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/cm^2)	Maximum antenna gain to meet MPE Limit (dBi)	Separation distance (cm)
850	GSM	50%	848.8	33.12	2051.16	1025.65	0.5659	4.4	20
1900	GSM	50%	1909.8	30.7	1174.90	587.49	1.0000	9.3	20
FDD 2	UMTS	100.0%	1907.6	24.07	255.27	255.27	1.0000	12.9	20
FDD 4	UMTS	100.0%	1752.6	24.7	295.12	295.12	1.0000	12.3	20
FDD 5	UMTS	100.0%	846.6	24.55	285.10	285.10	0.5644	10.0	20

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 limits
850	4.4	1.1	1.1
1900	9.3	5.9	5.9
FDD 2	12.9	9.5	9.5
FDD 4	12.3	8.7	8.7
FDD 5	10.0	6.7	6.7

Gain expressed in dBi

3.3 RF Exposure Evaluation for multiple transmitters in co-location

Standards
OET Bulletin 65 Edition 97-01 August 1997
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.

$$\sum_{i=1}^N \frac{S_{eqi}}{S_{Lim i}} = \frac{S_{eq1}}{S_{Lim1}} + \frac{S_{eq2}}{S_{Lim2}} + \dots + \frac{S_{eqN}}{S_{LimN}} \leq 1$$

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 ≥ 20 cm.
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 below. These values are informational only.

Band	Mode	Duty Cycle (%)	Frequency (MHZ)	Maximum Conducted output power (dBm)	Max Conducted output power (mW)	FCC MPE Limit (mW/cm ²)	Power Density (mW/cm ²)	Separation distance (cm)	Verdict
850	GSM	50%	848.8	33.12	1025.65	0.5659	0.5245	20	Pass
1900	GSM	50%	1909.8	30.7	587.49	1.0000	0.1857	20	Pass
FDD 2	UMTS	100%	1907.6	24.07	255.27	1.0000	0.3212	20	Pass
FDD 4	UMTS	100%	1752.6	24.7	295.12	1.0000	0.1857	20	Pass
FDD 5	UMTS	100%	846.6	24.55	285.10	0.5644	0.5293	20	Pass

Band	Mode	Duty Cycle (%)	Frequency (MHZ)	Maximum Conducted output power (dBm)	Max Conducted output power (mW)	FCC MPE Limit (mW/cm ²)	Power Density (mW/cm ²)	Separation distance (cm)	Verdict
850	GSM	50%	848.8	33.12	1025.65	0.2628	0.2343	20	Pass
1900	GSM	50%	1909.8	30.7	587.49	0.4575	0.1857	20	Pass

FDD 2	UMTS	100%	1907.6	24.07	255.27	0.4571	0.3212	20	Pass
FDD 4	UMTS	100%	1752.6	24.7	295.12	0.4314	0.1857	20	Pass
FDD 5	UMTS	100%	846.6	24.55	285.10	0.2624	0.2364	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	Freq (MHz)	Duty Cycle	ERP (mW)	ERP Equivalent (mW)	MPE Limit (mW/cm ²)	Maximum antenna gain (dBi)	Power density (mW/cm ²)	Separation distance (cm)	Verdict
Bluetooth	2441	64%	8.91	3.72	1.0000	4.0	0.0019	20	Pass
WLAN	2412	100%	79.43	79.43	1.0000	5.0	0.0500	20	Pass

MPE Calculation for Single Transmitter installed in Generic host for ISED

Radio type	Duty Cycle	ERP (mW)	ERP Equivalent (mW)	MPE Limit (mW/cm ²)	Maximum antenna gain (dBi)	Power density (mW/cm ²)	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.

Relative exposure for Primary Transmitter for FCC

OP-Mode	Mode	Output Power (mW)	Frequency (MHz)	S_{eq} (mW/cm ²)	S_{lin} (mW/cm ²)	S_{eq} ----- S_{lin}	Verdict
850	GSM	1025.6519	848.8	0.5245	0.5659	0.9268648	Pass
1900	GSM	587.4894	1909.8	0.1857	1.0000	0.185678	Pass
FDD 2	UMTS	255.2701	1907.6	0.3212	1.0000	0.3211889	Pass
FDD 4	UMTS	295.1209	1752.6	0.1857	1.0000	0.1856652	Pass
FDD 5	UMTS	285.1018	846.6	0.5293	0.5644	0.9378719	Pass

Relative exposure for Primary Transmitter for ISED

OP-Mode	Mode	Output Power (mW)	Frequency (MHz)	S_{eq} (mW/cm ²)	S_{lin} (mW/cm ²)	S_{eq} ----- S_{lin}	Verdict
850	GSM	1025.6519	848.8	0.2343	0.2628	0.8913524	Pass
1900	GSM	587.4894	1909.8	0.1857	0.4575	0.4058802	Pass
FDD 2	UMTS	255.2701	1907.6	0.3212	0.4571	0.7026515	Pass
FDD 4	UMTS	295.1209	1752.6	0.1857	0.4314	0.43039	Pass
FDD 5	UMTS	285.1018	846.6	0.2364	0.2624	0.9011969	Pass

Relative exposure for Secondary transmitter FCC				
Transmitter	Output power (mW)	S_{eq} (mW/cm ²)	S_{lin} (mW/cm ²)	$\frac{S_{eq}}{S_{Lin}}$
Bluetooth	3.72	0.0019	1.0000	0.0019
WLAN	79.43	0.0500	1.0000	0.0500

Simultaneous exposure of Primary and Secondary transmitter installed in generic host device for ISED and FCC.

Simultaneous exposure of Primary and Secondary transmitter installed in generic host device for ISED						
Primary Band	Primary Mode	Transmitter	Frequency (MHZ)	Maximum S_{eq} / S_{Lin}	Maximum $S_{pri}/S_{lim_pri} + S_{sec} / S_{lin_Sec}$	Compliance Maximum $(S_{pri}/S_{lim_pri}) + (S_{sec} / S_{lin_Sec}) < 1$
850	GSM	Bluetooth	2441	0.0034	0.9872	Compliant
		Wlan	2412	0.0924		
		LISA-U200	848.8	0.8914		
1900	GSM	Bluetooth	2441	0.0034	0.5017	Compliant
		Wlan	2412	0.0924		
		LISA-U200	1909.8	0.4059		
FDD 2	UMTS	Bluetooth	2441	0.0034	0.7985	Compliant
		Wlan	2412	0.0924		
		LISA-U200	1907.6	0.7027		
FDD 4	UMTS	Bluetooth	2441	0.0034	0.5262	Compliant
		Wlan	2412	0.0924		
		LISA-U200	1752.6	0.4304		
FDD 5	UMTS	Bluetooth	2441	0.0034	0.9970	Compliant
		Wlan	2412	0.0924		
		LISA-U200	846.6	0.9012		

Simultaneous exposure of Primary and Secondary transmitter installed in generic host device for FCC						
Primary Band	Primary Mode	All Transmitters	Frequency (MHZ)	Maximum S_{eq} / S_{Lin}	Maximum $S_{pri}/S_{lim_pri} + S_{sec} / S_{lin_Sec}$	Compliance Maximum $(S_{pri}/S_{lim_pri}) + (S_{sec} / S_{lin_Sec}) < 1$
850	GSM	Bluetooth	2441	0.0019	0.9787	Compliant
		Wlan	2412	0.0500		
		LISA-U200	848.8	0.9269		
1900	GSM	Bluetooth	2441	0.0019	0.2375	Compliant
		Wlan	2412	0.0500		
		LISA-U200	1909.8	0.1857		
FDD 2	UMTS	Bluetooth	2441	0.0019	0.3730	Compliant
		Wlan	2412	0.0500		
		LISA-U200	1907.6	0.3212		
FDD 4	UMTS	Bluetooth	2441	0.0019	0.2375	Compliant
		Wlan	2412	0.0500		

		LISA-U200	1752.6	0.1857		
FDD 5	UMTS	Bluetooth	2441	0.0019	0.9897	Compliant
		Wlan	2412	0.0500		
		LISA-U200	846.6	0.9379		

When operating the primary transmitter simultaneously with a generic Bluetooth and WLAN radio, the following antenna gains can be used with the module SARA-U260 while still complying with the exposure limits.

OP-Mode	dBi (For FCC)	dBi (For Industry Canada)
850	4.1	0.6
1900	2.0	2.0
FDD 2	8.0	8.0
FDD 4	5.0	5.0
FDD 5	9.7	6.2