

Inter**Lab**[®]

RF Exposure and Maximum
ERP/EIRP Assessment

For

LARA-R202

UMTS/HSPA/LTE data and voice module

FCC ID: XPY1EIQ24NN

IC: 8595A-1EIQ24NN

Assessment Reference: MDE_UBLOX_1712_MPEb

Test Laboratory:

7layers GmbH
Borsigstrasse 11
40880 Ratingen
Germany



Note:

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

7layers GmbH

Borsigstraße 11
40880 Ratingen, Germany
T +49 (0) 2102 749 0
F +49 (0) 2102 749 350

Geschäftsführer/

Managing Directors:
Frank Spiller
Bernhard Retka
Alexandre Norré-Oudard

Registergericht/registered:

Düsseldorf HRB 75554
USt-Id.-Nr./VAT-No. DE203159652
Steuer-Nr./TAX-No. 147/5869/0385

*a Bureau Veritas
Group Company*

www.7layers.com

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0 Summary

0.1 Technical Report Summary

Type of Report

RF Exposure and Maximum ERP/EIRP Assessment for a UMTS and LTE 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

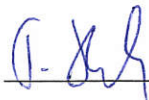
IC SRSP-510 Issue 5, February 2009

FCC 47 CFR §27.50(d)

RSS-139, Issue 2 / SRSP-513

Report version control			
Version	Release date	Changes	Version validity
001	02.10.2017	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: 2016-08-30

1.2 Project Data

Responsible for assessment and report: Mr. Andreas Tübel
Date of Report: 2017-08-30

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	UMTS/LTE Module
Type Designation:	LARA-R202
Kind of Device:	UMTS/LTE Module
UMTS/LTE CAT	8 / 1
FCC ID:	XPY1EIQ24NN
IC Number:	8595A-1EIQ24NN

General product description:

The EUT is Cellular radio module supporting UMTS and LTE

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: DE1015054aek04)	UMTS/LTE Module	LARA-R202	357649070014041	273A02	30.42
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	-	-	G05-0122293	-
AE 2	Evaluation test board	EVB-WL3	NO_EVK_CS_191A00	-	-	-

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	(FDD5 WCDMA/HSUPA/HSDPA/LTE)
FCC 47 CFR §24.232 IC RSS-133 Issue 6	(FDD2 WCDMA/HSUPA/HSDPA/LTE)
FCC 47 CFR §27.50(d) RSS-139, Issue 2 / SRSP-513	(FDD4,12 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 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 (MHz)	FCC / IC EIRP limit (mW)	Maximum antenna gain to meet EIRP Limit (dBi)
FDD 2	UMTS	100.0%	1850 - 1907.6	24.27	267.30064	1907.60	2000	8.7
FDD 5	UMTS	100.0%	824 - 846.6	23.57	227.50974	836.00	11484	17.0
eFDD 2	LTE	100.0%	1850-1910	23.43	220.29265	1902.50	2000	9.6
eFDD 4	LTE	100.0%	1710-1755	23.55	226.46443	1732.50	1000	6.5
eFDD 5	LTE	100.0%	824 - 849	23	199.52623	825.50	11484	17.6
eFDD12	LTE	100.0%	698-716	23.12	205.11622	711.00	4921	13.8

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	
FDD 2	8.7	12.5	9.1	8.7	
FDD 5	17.0	10.0	6.7	6.7	
eFDD 2	9.6	13.0	9.6	9.6	
eFDD 4	6.5	13.0	9.3	6.5	
eFDD 5	17.6	10.4	7.1	7.1	
eFDD12	13.8	9.8	6.7	6.7	

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/cm ²)
300 – 1,500	f/1500
1,500 – 100,000	1.0

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 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)
FDD 2	UMTS	100.0%	1907.6	24.5	281.84	281.84	1.0000	12.5	20
FDD 5	UMTS	100.0%	836.0	24.5	281.84	281.84	0.5573	10.0	20
eFDD 2	LTE	100.0%	1902.5	24	251.19	251.19	1.0000	13.0	20
eFDD 4	LTE	100.0%	1732.5	24	251.19	251.19	1.0000	13.0	20
eFDD 5	LTE	100.0%	825.5	24	251.19	251.19	0.5503	10.4	20
eFDD12	LTE	100.0%	711.0	24	251.19	251.19	0.4740	9.8	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/cm ²)	Maximum antenna gain to meet MPE Limit (dBi)	Separation distance (cm)
FDD 2	UMTS	100%	1907.6	24.5	281.84	281.84	0.4571	9.1	20
FDD 5	UMTS	100%	836.0	24.5	281.84	281.84	0.2601	6.7	20
eFDD 2	LTE	100%	1902.5	24.0	251.19	251.19	0.4563	9.6	20
eFDD 4	LTE	100%	1732.5	24.0	251.19	251.19	0.4280	9.3	20
eFDD 5	LTE	100%	825.5	24.0	251.19	251.19	0.2579	7.1	20
eFDD12	LTE	100%	711.0	24.0	251.19	251.19	0.2329	6.7	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 limits
FDD 2	12.5	9.1	9.1
FDD 5	10.0	6.7	6.7
eFDD 2	13.0	9.6	9.6
eFDD 4	13.0	9.3	9.3
eFDD 5	10.4	7.1	7.1
eFDD12	9.8	6.7	6.7

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

3.4 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.

3.5 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.

3.5.1 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

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
FDD 2	UMTS	100%	1907.6	24.5	281.84	1.0000	0.4353	20	Pass
FDD 5	UMTS	100%	836.0	24.5	281.84	0.5573	0.5234	20	Pass
eFDD 2	LTE	100%	1902.5	24	251.19	1.0000	0.4537	20	Pass
eFDD 4	LTE	100%	1732.5	24	251.19	1.0000	0.2207	20	Pass
eFDD 5	LTE	100%	825.5	24	251.19	0.5503	0.5115	20	Pass
eFDD12	LTE	100%	711.0	24	251.19	0.4740	0.4475	20	Pass

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

OP mode-1 – FOR Industry Canada ONLY

Band	Mode	Duty Cycle (%)	Frequency (MHZ)	Maximum Conducted output power (dBm)	Max Conducted output power (mW)	IC MPE Limit (mW/cm ²)	Power Density (mW/cm ²)	Separation distance (cm)	Verdict
FDD 2	UMTS	100%	1907.6	24.5	281.84	0.4571	0.4062	20	Pass
FDD 5	UMTS	100%	836.0	24.5	281.84	0.2601	0.2337	20	Pass
eFDD 2	LTE	100%	1902.5	24	251.19	0.4563	0.4072	20	Pass
eFDD 4	LTE	100%	1732.5	24	251.19	0.4280	0.2207	20	Pass
eFDD 5	LTE	100%	825.5	24	251.19	0.2579	0.2285	20	Pass
eFDD12	LTE	100%	711.0	24	251.19	0.2329	0.2093	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/cm ²)	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/cm ²)	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} (mW/cm ²)	S_{lin} (mW/cm ²)	S_{eq} ----- S_{Lin}	Verdict
FDD 2	UMTS	281.8383	1907.6	0.4353	1.0000	0.4352718	Pass
FDD 5	UMTS	281.8383	836.0	0.5234	0.5573	0.9390932	Pass
eFDD 2	LTE	251.1886	1902.5	0.4537	1.0000	0.4536914	Pass
eFDD 4	LTE	251.1886	1732.5	0.2207	1.0000	0.2206635	Pass
eFDD 5	LTE	251.1886	825.5	0.5115	0.5503	0.9293897	Pass
eFDD12	LTE	251.1886	711.0	0.4475	0.4740	0.9440729	Pass

Relative exposure for Primary Transmitter for Industry Canada							
OP-Mode	Mode	Output power	Frequency (MHZ)	S_{eq} (mW/cm ²)	S_{lin} (mW/cm ²)	$\frac{S_{eq}}{S_{lin}}$	Verdict
FDD 2	UMTS	281.8383	1907.6	0.4062	0.4571	0.8886689	Pass
FDD 5	UMTS	281.8383	836.0	0.2337	0.2601	0.8985852	Pass
eFDD 2	LTE	251.1886	1902.5	0.4072	0.4563	0.8923486	Pass
eFDD 4	LTE	251.1886	1732.5	0.2207	0.4280	0.5155677	Pass
eFDD 5	LTE	251.1886	825.5	0.2285	0.2579	0.8859388	Pass
eFDD12	LTE	251.1886	711.0	0.2093	0.2329	0.8988365	Pass

Relative exposure for Secondary transmitter for FCC				
Transmitter	Output power	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

Relative exposure for Secondary transmitter for Industry Canada				
Transmitter	Output power	S_{eq} (mW/cm ²)	S_{lin} (mW/cm ²)	$\frac{S_{eq}}{S_{lin}}$
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						
Primary Band	Primary Mode	All Transmitters	Frequency (MHZ)	Maximum Seq / Slin	Maximum Spri/Slim_pri + Ssec / Slin_Sec	Compliance Maximum Maximum (Spri/Slim_pri) + (Ssec / Slin_Sec) < 1
FDD 2	UMTS	Bluetooth	2441	0.0019	0.4871	Compliant
		Wlan	2412	0.0500		
		Toby-L4006	1907.6	0.4353		
FDD 5	UMTS	Bluetooth	2441	0.0019	0.9909	Compliant
		Wlan	2412	0.0500		
		Toby-L4006	836.0	0.9391		
eFDD 2	LTE	Bluetooth	2441	0.0019	0.5055	Compliant
		Wlan	2412	0.0500		
		Toby-L4006	1902.5	0.4537		
eFDD 4	LTE	Bluetooth	2441	0.0019	0.2725	Compliant
		Wlan	2412	0.0500		
		Toby-L4006	1732.5	0.2207		
eFDD 5	LTE	Bluetooth	2441	0.0019	0.9812	Compliant
		Wlan	2412	0.0500		
		Toby-L4006	825.5	0.9294		
eFDD12	LTE	Bluetooth	2441	0.0019	0.9959	Compliant
		Wlan	2412	0.0500		
		Toby-L4006	711.0	0.9441		

Simultaneous exposure of Primary and Secondary transmitter installed in generic host device for ISED						
Primary Band	Primary Mode	Transmitter	Frequency (MHZ)	Maximum Seq / SLin (mW/cm ²)	Maximum Spri/Slim_pri + Ssec / Slin_Sec	Compliance Maximum (Spri/Slim_pri) + (Ssec / Slin_Sec) < 1
FDD 2	UMTS	Bluetooth	2441	0.0034	0.9845	Compliant
		Wlan	2412	0.0924		
		Toby-L4006	1907.6	0.8887		
FDD 5	UMTS	Bluetooth	2441	0.0034	0.9944	Compliant
		Wlan	2412	0.0924		
		Toby-L4006	836	0.8986		
eFDD 2	LTE	Bluetooth	2441	0.0034	0.9882	Compliant
		Wlan	2412	0.0924		
		Toby-L4006	1902.5	0.8923		
eFDD 4	LTE	Bluetooth	2441	0.0034	0.6114	Compliant
		Wlan	2412	0.0924		
		Toby-L4006	1732.5	0.5156		
eFDD 5	LTE	Bluetooth	2441	0.0034	0.9817	Compliant
		Wlan	2412	0.0924		
		Toby-L4006	825.5	0.8859		
eFDD12	LTE	Bluetooth	2441	0.0034	0.9946	Compliant
		Wlan	2412	0.0924		
		Toby-L4006	711	0.8988		

When operating the primary transmitter simultaneously with a generic Bluetooth and WLAN radio, the following antenna gains can be used with the module LARA-R202 while still complying with the exposure limits.

Band	dBi (For FCC)	dBi (For Industry Canada)
FDD 2	8.9	8.6
FDD 5	9.7	6.2
eFDD 2	9.6	9.1
eFDD 4	6.5	6.5
eFDD 5	10.1	6.6
eFDD12	9.5	6.2