RF Exposure and Maximum ERP/EIRP Assessment

for

LARA-R6401 / LARA-R6401D

FCC ID: XPYUBX21BE02

IC ID: 8595A-UBX21BE02

Assessment Reference: MDE_UBLOX_2029_MPE_04_rev01

Test Laboratory:
7layers GmbH
Borsigstraße 11
40880 Ratingen
Germany

Deutsche Akkreditierungsstelle
D-PL-12140-01-01
D-PL-12140-01-02
D-PL-12140-01-03

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0 Summary

0.1 Technical Report Summary

Type of Report
RF Exposure and Maximum ERP/EIRP Assessment for LTE radio module.

Applicable FCC and ISED 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
ISED RSS-132, Issue 4
FCC 47 CFR §24.232
ISED RSS-133 Issue 6, Amendment 1
FCC 47 CFR §27.50(b), (c), (d)
ISED RSS-139, Issue 4 / SRSP-513, RSS-130, Issue 3
FCC 47 CFR §90.635
ISED RSS-140, Issue 1
FCC 47 CFR §90.531(g)

Report version control			
Rev Version	**Release date**	**Changes**	**Version validity**
-	2022-04-29	Initial version	valid
rev01	2023-11-07	Update ISED RSS-132 and ISED RSS-139, editorial changes	valid

Responsible for Accreditation Scope:

Responsible for Report:

7 layers GmbH, Borsigstr. 11
40880 Ratingen, Germany
Phone +49 (0)2102 749 0

1 Administrative Data

1.1 Testing Laboratory

Company Name:	7layers GmbH
Address	Borsigstr. 11 40880 Ratingen Germany
FCC accreditation	Designation Number: DE0015 Test Firm Registration #: 929146
Industry Canada Test Site Acceptance	CAB identifier: DE0007 Test Firm Registration #: 3699A

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

Laboratory accreditation no.:	DAkkS D-PL-12140-01-01 DAkkS D-PL-12140-01-02 DAkkS D-PL-12140-01-03
Responsible for Accreditation Scope:	Dipl.-Ing. Bernhard Retka Dipl.-Ing. Robert Machulec Dipl.-Ing. Andreas Petz Dipl.-Ing. Marco Kullik
Report Template Version:	2021-12-23

1.2 Project Data

Responsible for assessment and report:	Michael Albert
Date of Report:	2023-11-07

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	LARA-R6401 / LARA-R6401D
Kind of Device:	LTE module
GSM MSC/UMTS/LTE CAT	Cat 1
FCC ID:	XPYUBX21BE02
IC ID:	8595A-UBX21BE02

General product description:

The EUT is Cellular radio module supporting LTE.
LARA-R6401D is a data only product, LARA-R6401 is supporting voice and data.

2.2 EUT Main components

Short Descriptions etc. used in this Test Report

Short Description	Equipment under Test	HW Status	SW Status
EUT Code: DE1015146	LARA-R6401	UBX-393B01	00.13,A00.01
EUT Code: DE1015156	LARA-R6401D	UBX-393B01	00.13,A00.01

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 ISED RSS-132, Issue 4	eFDD5
FCC 47 CFR §24.232 ISED RSS-133 Issue 6, Amendment 1	eFDD2
FCC 47 CFR §27.50(d) ISED RSS-139, Issue 4 / SRSP-513	eFDD4/eFDD66
FCC 47 CFR §27.50(c) ISED RSS-130, Issue 3	eFDD12
FCC 47 CFR §27.50(b) ISED RSS-130, Issue 3	eFDD13
FCC 47 CFR §90.635	-
FCC 47 CFR §27.1507(a)	-
FCC 47 CFR §90.531(g)	eFDD14
ISED RSS-199, Issue	eFDD71

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

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

Band	Mode	Duty Cycle	Frequency Range (MHZ)	Maximum Conducted output power (dBm)	Maximum Conducted output power (mW)	FCC EIRP limit (mW)	Maximum antenna gain to meet EIRP Limit (dBi)
eFDD 2	LTE	100.0%	1850-1910	23.55	226.464431	2000	9.5
eFDD 4	LTE	100.0%	1710-1755	23.99	250.610925	1000	6.0
eFDD 5	LTE	100.0%	824 - 849	23.17	207.491352	11484	17.4
eFDD 12	LTE	100.0%	699-716	24.42	276.694165	4920	12.5
eFDD 13	LTE	100.0%	777-787	24.11	257.632116	4920	12.8
eFDD 14	LTE	100.0%	788-798	23.08	203.235701	4920	13.8
eFDD 66	LTE	100.0%	1710-1780	21.31	135.207256	1000	8.7
eFDD 71	LTE	100.0%	663-698	24.44	277.971327	4920	12.5

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 Limits	Max gain to be used to comply with IC MPE Limits	Maximum gain to be compliant with all limits
eFDD 2	9.5	13.0	9.5	9.5
eFDD 4	6.0	13.0	9.3	6.0
eFDD 5	17.4	10.4	7.1	7.1
eFDD 12	12.5	9.7	6.6	6.6
eFDD 13	12.8	10.2	7.0	7.0
eFDD 14	13.8	10.2	7.0	7.0
eFDD 66	8.7	13.0	9.3	8.7
eFDD 71	12.5	9.5	6.5	6.5

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

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 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)
eFDD 2	LTE	100%	1850.7	24.0	251.19	251.19	0.4477	**9.5**	20
eFDD 4	LTE	100%	1710.7	24.0	251.19	251.19	0.4243	**9.3**	20
eFDD 5	LTE	100%	824.7	24.0	251.19	251.19	0.2577	**7.1**	20
eFDD 12	LTE	100%	699.7	24.0	251.19	251.19	0.2303	**6.6**	20
eFDD 13	LTE	100%	779.5	24.0	251.19	251.19	0.2480	**7.0**	20
eFDD 14	LTE	100%	788.0	24.0	251.19	251.19	0.2498	**7.0**	20
eFDD 66	LTE	100%	1710.7	24.0	251.19	251.19	0.4243	**9.3**	20
eFDD 71	LTE	100%	665.5	24.0	251.19	251.19	0.2226	**6.5**	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/cm²)	Maximum antenna gain to meet MPE Limit (dBi)	Separation distance (cm)
eFDD 2	LTE	100.0%	1850.7	24	251.19	251.19	1.0000	**13.0**	20
eFDD 4	LTE	100.0%	1710.7	24	251.19	251.19	1.0000	**13.0**	20
eFDD 5	LTE	100.0%	824.7	24	251.19	251.19	0.5498	**10.4**	20
eFDD 12	LTE	100.0%	699.7	24	251.19	251.19	0.4665	**9.7**	20
eFDD 13	LTE	100.0%	779.5	24	251.19	251.19	0.5197	**10.2**	20
eFDD 14	LTE	100.0%	788.0	24	251.19	251.19	0.5253	**10.2**	20
eFDD 66	LTE	100.0%	1710.7	24	251.19	251.19	1.0000	**13.0**	20
eFDD 71	LTE	100.0%	665.5	24	251.19	251.19	0.4437	**9.5**	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 MPE limits
eFDD 2	13.0	9.5	9.5
eFDD 4	13.0	9.3	9.3
eFDD 5	10.4	7.1	7.1
eFDD 12	9.7	6.6	6.6
eFDD 13	10.2	7.0	7.0
eFDD 14	10.2	7.0	7.0
eFDD 66	13.0	9.3	9.3
eFDD 71	9.5	6.5	6.5

Gain expressed in dBi