InterLab®

RF Exposure and Maximum ERP/EIRP Assessment

For

SARA-R410 Cat M1

FCC ID: XPY2AGQN4NNN

IC: 8595A-2AGQN4NNN

Assessment Reference: MDE_UBLOX_1901_MPE_CatM1

Test Laboratory:
7layers GmbH
Borsigstraße 11
40880 Ratingen
Germany

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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 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:

IC SRSP-503 Issue 7, September 2008
IC SRSP-510 Issue 5, February 2009
IC RSS-132, Issue 3, FCC 47 CFR §22.913
IC RSS-133 Issue 6, FCC 47 CFR §24.232
IC RSS-139, Issue 3 / SRSP-513, FCC 47 CFR §27.50(d)
IC RSS-140, Issue 1, FCC 47 CFR §90.635

Report version control			
Rev Version	**Release date**	**Changes**	**Version validity**
-	2019-06-03	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 Test Firm Registration #: 929146
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:	2019-06-03

1.3 Applicant Data

Company Name:	u-blox, Inc
Address:	12626 High Bluff Dr, Ste 200 San Diego, CA92130 US
Contact Person:	Jake Bascon

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	SARA-R410 Module
Type Designation:	SARA-R410
Kind of Device:	Cat M1/ NB-IOT Module
GSM MSC/UMTS/LTE	LTE (CAT-M1), NB-IoT
FCC ID:	XPY2AGQN4NNN
IC Number:	8595A-2AGQN4NNN

General product description:

The EUT is Cellular radio module supporting LTE Category M1 and NB-IoT.

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: DE1015105 AB01	SARA-R410	SARA-R410	352753095787196	306B01	L0.08.01
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	eFDD5, eFDD26
FCC 47 CFR §24.232 IC RSS-133 Issue 6	eFDD2, eFDD25
FCC 47 CFR §27.50(d) IC RSS-139, Issue 3 / SRSP-513	eFDD4, eFDD12, eFDD13
FCC 47 CFR §90.635 IC RSS-140, Issue 1	eFDD26

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 (MHZ)	Maximum Conducted output power (dBm)	Maximum Conducted output power (mW)	Freq of highest power	FCC EIRP limit (mW)	Maximum antenna gain to meet EIRP Limit (dBi)
eFDD2	LTE	100.0%	1850-1910	22.74	187.93168	1850.00	2000	10.3
eFDD4	LTE	100.0%	1710-1755	22.41	174.18069	1755.00	1000	7.6
eFDD5	LTE	100.0%	824 - 849	23.24	210.86281	836.50	11484	17.4
eFDD13	LTE	100.0%	777-787	23.75	237.13737	787.00	4920	13.2
eFDD12	LTE	100.0%	698-716	22.74	187.93168	707.50	4921	14.2
eFDD25	LTE	100.0%	1850-1915	22.49	177.41895	1882.50	4923	14.4
eFDD26	LTE	100.0%	814-849	22.97	198.1527	849.00	4924	14.0

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
eFDD2	10.3	12.0	8.5	8.5
eFDD4	7.6	12.0	8.4	7.6
eFDD5	17.4	9.5	6.2	6.2
eFDD13	13.2	9.2	6.0	6.0
eFDD12	14.2	9.2	6.1	6.1
eFDD25	14.4	14.2	9.8	9.8
eFDD26	14.0	11.1	7.8	7.8

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/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)
eFDD2	LTE	100%	1850.0	25.0	316.23	316.23	0.4476	**8.5**	20
eFDD4	LTE	100%	1755.0	25.0	316.23	316.23	0.4318	**8.4**	20
eFDD5	LTE	100%	836.5	25.0	316.23	316.23	0.2602	**6.2**	20
eFDD13	LTE	100%	787.0	25.0	316.23	316.23	0.2496	**6.0**	20
eFDD12	LTE	100%	707.5	25.0	316.23	316.23	0.2321	**6.1**	20
eFDD25	LTE	100%	1882.5	25.0	316.23	316.23	0.4530	**9.8**	20
eFDD26	LTE	100%	849.0	25.0	316.23	316.23	0.2629	**7.8**	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)
eFDD2	LTE	100.0%	1850.0	25	316.23	316.23	1.0000	**12.0**	20
eFDD4	LTE	100.0%	1755.0	25	316.23	316.23	1.0000	**12.0**	20
eFDD5	LTE	100.0%	836.5	25	316.23	316.23	0.5577	**9.5**	20
eFDD13	LTE	100.0%	777.0	25	316.23	316.23	0.5247	**9.2**	20
eFDD12	LTE	100.0%	707.5	25	316.23	316.23	0.4717	**9.2**	20
eFDD25	LTE	100.0%	1882.5	25	316.23	316.23	1.2550	**14.2**	20
eFDD26	LTE	100.0%	849.0	25	316.23	316.23	0.5660	**11.1**	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
eFDD2	12.0	8.5	8.5
eFDD4	12.0	8.4	8.4
eFDD5	9.5	6.2	6.2
eFDD13	9.2	6.0	6.0
eFDD12	9.2	6.1	6.1
eFDD25	14.2	9.8	9.8
eFDD26	11.1	7.8	7.8

Gain expressed in dBi