

Inter**Lab**[®]

RF Exposure and Maximum ERP/EIRP Assessment

For

SARA-R510M8S

CAT-M1 /NB-IoT Data Module embedding

u-blox Chipset Model UBX-R5 HW: UBX-R5231

FCC ID: XPYUBX19KM01

IC: 8595A-UBX19KM01

CAT-M1 Part

Assessment Reference: MDE_UBLOX_2105_MPE02#CAT-M1

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/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

IC RSS-132, Issue 3

FCC 47 CFR §24.232

IC RSS-133 Issue 6

FCC 47 CFR §27.50(d)

RSS-139, Issue 2 / SRSP-513

FCC 47 CFR §90.635

RSS-140, Issue 1

Report version control			
Rev Version	Release date	Changes	Version validity
-	2021-08-02	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

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: 2020-03-26

1.2 Project Data

Responsible for assessment and report: Mr. Sören Berentzen

Date of Report: 2021-08-02

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	SARA-R510M8S
Type Designation:	SARA-R510M8S
Kind of Device:	CAT-M1 / NB-IoT Data Module
GSM MSC/UMTS/LTE CAT	CAT-M1 / NB2
FCC ID:	XPYUBX19KM01
IC Number:	8595A-UBX19KM01

General product description:

The EUT is Cellular radio module supporting LTE CAT-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: DE1015140 AA01	SARA-R510M8S	SARA-R510M8S	352709570010223	UBX-352L00	03.11

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	LTE eFDD5, eFDD26
FCC 47 CFR §24.232 IC RSS-133 Issue 6	LTE eFDD2, eFDD25
FCC 47 CFR §27.50(d) RSS-139, Issue 3 / SRSP-513	LTE eFDD4, eFDD8, eFDD12, eFDD13, eFDD66, eFDD71
FCC 47 CFR §90.635	LTE 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 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	22.67	184.9268619	2000	10.3
eFDD 4	LTE	100.0%	1710-1755	23.17	207.4913517	1000	6.8
eFDD 5	LTE	100.0%	824 - 849	23	199.5262315	11484	17.6
eFDD 13	LTE	100.0%	777-787	22.62	182.8100216	4920	14.3
eFDD 12	LTE	100.0%	699-716	22.21	166.341265	4920	14.7
eFDD 66	LTE	100.0%	1710-1780	23.79	239.3315756	1000	6.2
eFDD 25	LTE	100.0%	1850-1915	22.62	182.8100216	2000	10.4
eFDD 26	LTE	100.0%	814-849	22.64	183.6538343	11484	18.0
eFDD 71	LTE	100.0%	663-698	22.89	194.5360082	4920	14.0
eFDD 8	LTE	100.0%	898-890	22.51	178.2378767	4920	14.4

3.1.3 Conclusion

Use this table if you are also considering MPE max gain in the same report

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	10.3	12.0	8.5	8.5
eFDD 4	6.8	12.0	8.3	6.8
eFDD 5	17.6	9.4	6.1	6.1
eFDD 13	14.3	9.2	6.0	6.0
eFDD 12	14.7	8.7	5.6	5.6
eFDD 66	6.2	12.0	8.3	6.2
eFDD 25	10.4	12.9	8.5	8.5
eFDD 26	18.0	9.4	6.1	6.1
eFDD 71	14.0	8.5	5.5	5.5
eFDD 8	14.4	9.7	6.3	6.3

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/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 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)
eFDD 2	LTE	100%	1850.7	25.0	316.23	316.23	0.4477	8.5	20
eFDD 4	LTE	100%	1710.7	25.0	316.23	316.23	0.4243	8.3	20
eFDD 5	LTE	100%	824.7	25.0	316.23	316.23	0.2577	6.1	20
eFDD 13	LTE	100%	779.5	25.0	316.23	316.23	0.2480	6.0	20
eFDD 12	LTE	100%	699.7	25.0	316.23	316.23	0.2303	5.6	20
eFDD 66	LTE	100%	1710.7	25.0	316.23	316.23	0.4243	8.3	20
eFDD 25	LTE	100%	1850.7	25.0	316.23	316.23	0.4477	8.5	20
eFDD 26	LTE	100%	814.7	25.0	316.23	316.23	0.2556	6.1	20
eFDD 71	LTE	100%	665.5	25.0	316.23	316.23	0.2226	5.5	20
eFDD 8	LTE	100%	880.7	25.0	316.23	316.23	0.2695	6.3	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)
eFDD 2	LTE	100.0%	1850.7	25	316.23	316.23	1.0000	12.0	20
eFDD 4	LTE	100.0%	1710.7	25	316.23	316.23	1.0000	12.0	20
eFDD 5	LTE	100.0%	824.7	25	316.23	316.23	0.5498	9.4	20
eFDD 13	LTE	100.0%	777.0	25	316.23	316.23	0.5197	9.2	20
eFDD 12	LTE	100.0%	699.7	25	316.23	316.23	0.4665	8.7	20
eFDD 66	LTE	100.0%	1710.7	25	316.23	316.23	1.0000	12.0	20
eFDD 25	LTE	100.0%	1850.7	25	316.23	316.23	1.2338	12.9	20
eFDD 26	LTE	100.0%	814.7	25	316.23	316.23	0.5431	9.4	20
eFDD 71	LTE	100.0%	665.5	25	316.23	316.23	0.4437	8.5	20
eFDD 8	LTE	100.0%	880.7	25	316.23	316.23	0.5871	9.7	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	12.0	8.5	8.5
eFDD 4	12.0	8.3	8.3
eFDD 5	9.4	6.1	6.1
eFDD 13	9.2	6.0	6.0
eFDD 12	8.7	5.6	5.6
eFDD 66	12.0	8.3	8.3
eFDD 25	12.9	8.5	8.5
eFDD 26	9.4	6.1	6.1
eFDD 71	8.5	5.5	5.5
eFDD 8	9.7	6.3	6.3

Gain expressed in dBi