

G7 Bridge Model 103989 Radio Frequency (RF) Exposure Compliance

1 Document Revision History

Revision	Date	Author	Summary
1	June 7, 2021	Scott Jacobsen	Initial release
2	Feb 3, 2024	Scott Jacobsen	Update cellular radio module to LARA-R6001D Remove older version of 915 MHz radio module

2 Purpose of this Report

The purpose of this report is to show the radio frequency (RF) exposure compliance of certain simultaneous transmission configurations of the modules inside the product named G7 Bridge Model 103989.

3 Identifiers

3.1 Host Product

Internal Product Name: G7 Bridge

Model: 103989

3.2 Radio Identifiers

Radio Description	Model	FCC ID	IC ID	Grantee
Cellular	LARA-R6001D	XPYUBX21BE01	8595A-UBX21BE01	u-blox AG
Satellite	9602N	Q639603N	4629A-9603N	Iridium Satellite LLC
Frequency Hopping Transceiver	AMU900	2AZEh-AMU900	27118-AMU900	Aurora Wireless Networks Inc.

3.3 Antennas

Frequency Band	Vendor	Model	Peak Gain(dBi)	Data Sheet Reference
Cellular	Blackline Safety	102214r1	0.8	G7 Bridge Antennas.pdf
Satellite	Taoglas	IP.1621.25.4.A.02	3.0	G7 Bridge Antennas.pdf
915 MHz ISM	Murandi Communications	MLink Antenna	2.4	G7 Bridge Antennas.pdf

4 Test Standards

Test Standard	Version	Test Standard Description
FCC 47 CFR 2.1091	e-CFR May 3, 2021	Radiofrequency radiation exposure evaluation: mobile devices.
FCC 47 CFR 1.1310	e-CFR June 1, 2020	Radiofrequency radiation exposure limits
RSS-102	Issue 6, Dec 15, 2023	5 Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

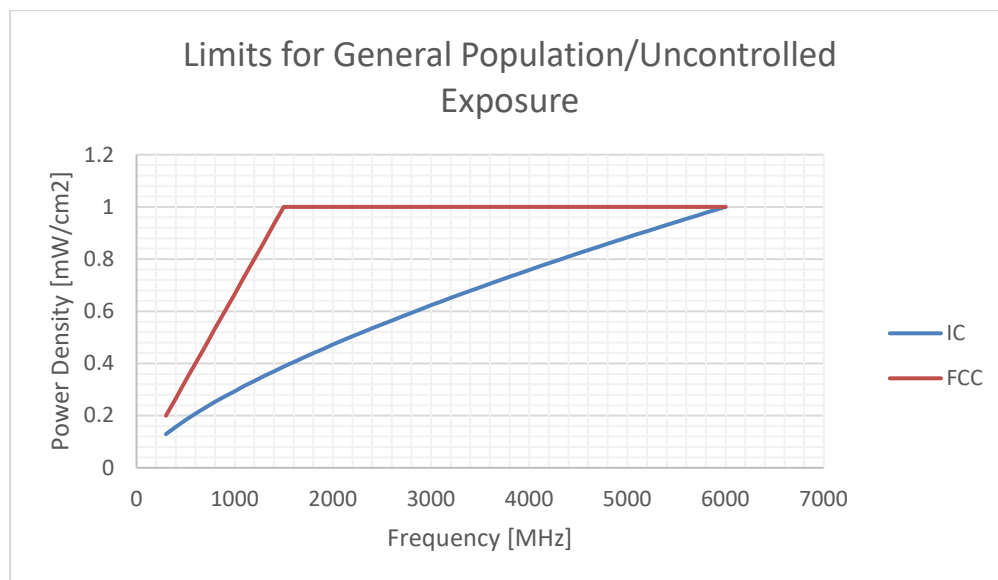
6 Limits

6.1 FCC Limits for General Population/Uncontrolled Exposure

Frequency Range	E-field strength (V/m)	H-field strength (A/m)	B-field strength (μT)	Power density (mW/cm ²)
300 – 1500 MHz	--	--	--	$f(\text{MHz}) / 1500$
1.5 – 100 GHz	--	--	--	1.0

6.2 IC Limits for General Population/Uncontrolled Exposure

Frequency Range	E-field strength (V/m)	H-field strength (A/m)	B-field strength (μT)	Power density (W/m ²)	Power density (mW/cm ²)
300 – 6000 MHz	--	--	--	$0.02619f^{0.6834}$	$0.002619f^{0.6834}$

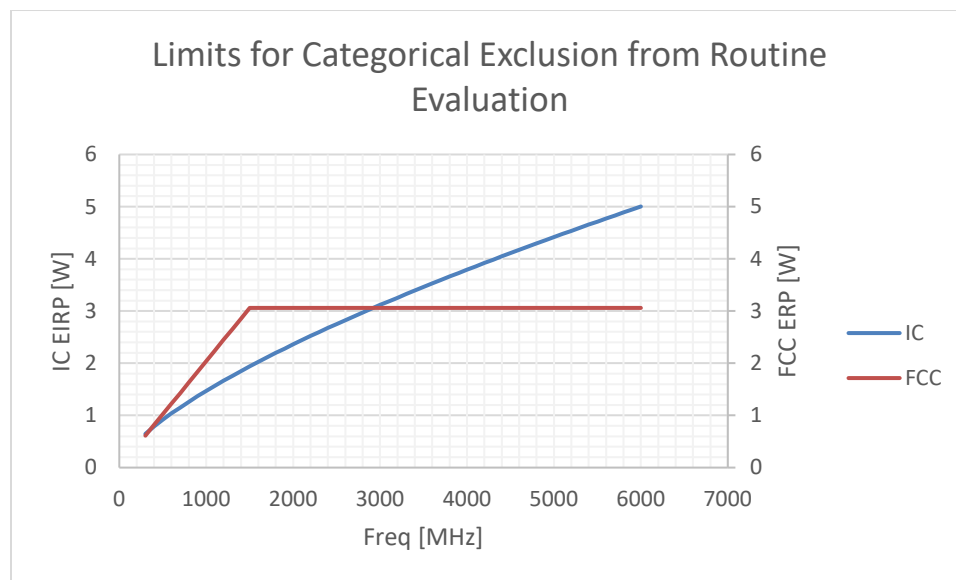


6.3 FCC Limits for Categorical Exclusion from Routine Evaluation

Frequency Range	Specification
$0.3 \text{ GHz} \leq f < 1.5 \text{ GHz}$	ERP < 2040f mW
$1.5 \text{ GHz} \leq f < 6 \text{ GHz}$	ERP < 3060 mW

6.4 ISED Limits for Categorical Exclusion from Routine Evaluation

Frequency Range	Specification
300 MHz – below 6 GHz	Source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834} \text{ W}$ (adjusted for tune-up tolerance), where f is in MHz



7 RF Exposure Assessment

7.1 Maximum permissible exposure (MPE)

Fixed/mobile exposure conditions of multiple transmitters installed in different hosts represent the most difficult situation in terms of the determination of minimum safety distances. While EMF measurements most often only refer to a single configuration with only one transmitter or with multiple co-located transmitters a general approach is needed to determine a worst case condition under which several transmitters and their antennas can be installed to prevent additional RF exposure evaluation for each host.

This test report illustrates how three specific radio modules can be integrated in a host without the need of further testing.

The background of the calculation is a minimum distance of 20 cm between antenna(s) and user (mobile exposure condition), and the compliance with the requirements of section 5.

7.2 Formulas

1. Average power density for each transmitter at a distance of 20 cm, S_{eq} , is calculated using the following formula:

$$S_{eq} = \frac{P \cdot G}{4\pi \cdot r^2} \times \eta$$

where

P is the peak power conducted into the antenna

G is the peak antenna gain

η is the duty cycle of transmissions

R = 20 cm

2. Then the ratio S_{eq}/S_{lim} is calculated for all applied limits, where S_{lim} is the limit at the frequency of interest, as specified in section 6. This essentially converts the power densities into unit-less values representing the portion of the power density limit generated by individual transmitters.
3. Finally, it must be ensured that the sum of all worst case power densities of all active transmitters do not exceed the limits, even if they are far below the limits for the single transmitter. The ratios for all the transmitters calculated in step 2 are summed together in all possible combinations of transmitters such that

$$\sum_{1}^n \frac{S_{eq\ n}}{S_{lim\ n}} = \frac{S_{eq\ 1}}{S_{lim\ 1}} + \frac{S_{eq\ 2}}{S_{lim\ 2}} + \dots + \frac{S_{eq\ n}}{S_{lim\ n}} \leq 1$$

7.3 Individual Radiated Power Densities

Module	Frequency (MHz)	Conducted Output Power (mW)	Conducted Output Power (dBm)	Antenna Gain (dBi)	Antenna Gain (linear)	EIRP (dBm)	EIRP (mW)	Duty Cycle (%)	S_{eq} - Average Power Density (mW/cm ²)	FCC S_{lim} - Power Density Limit (mW/cm ²)	IC S_{lim} - Power Density Limit (mW/cm ²)	Portion of FCC Limit	Portion of IC Limit
FDD Band 2	1852.4	203.2	23.1	-0.8	0.83	22.3	169.0	100.00	0.004	1.00	0.45	0.0038	0.0085
FDD Band 5	836.6	212.3	23.3	-2.8	0.52	20.5	111.4	100.00	0.002	0.56	0.26	0.0044	0.0093
FDD LTE Band 12	699.7	275.0	24.4	-3.3	0.47	21.1	128.6	100.00	0.026	0.47	0.23	0.0549	0.1111
FDD LTE Band 13	779.5	255.0	24.1	-3.3	0.47	20.8	119.3	100.00	0.024	0.52	0.25	0.0457	0.0957
FDD LTE Band 2	1880.0	222.3	23.5	-0.8	0.83	22.7	184.9	100.00	0.004	1.00	0.45	0.0039	0.0086
FDD LTE Band 26	819.0	258.8	24.1	-2.8	0.52	21.3	135.8	100.00	0.003	0.55	0.26	0.0046	0.0098
FDD LTE Band 4	1710.7	249.0	24.0	-0.9	0.81	23.1	202.4	100.00	0.040	1.00	0.42	0.0403	0.0949
FDD LTE Band 5	836.5	253.5	24.0	-2.8	0.52	21.2	133.0	100.00	0.003	0.56	0.26	0.0045	0.0096
FDD LTE Band 7	2502.5	186.0	22.7	0.8	1.20	23.5	223.6	100.00	0.044	1.00	0.55	0.0445	0.0808
FDD LTE Band 8	899.0	191.0	22.8	-2.1	0.62	20.7	117.8	100.00	0.023	0.60	0.27	0.0391	0.0857
GSM1900	1850.2	716.1	28.6	-0.8	0.83	27.8	595.7	0.25	0.000	1.00	0.45	0.0000	0.0000
GSM850	824.2	1428.9	31.6	-2.8	0.52	28.8	749.9	0.25	0.000	0.55	0.26	0.0007	0.0014
TDD LTE Band 38	2572.5	248.0	23.9	0.3	1.07	24.2	265.7	100.00	0.053	1.00	0.56	0.0529	0.0943
TDD LTE Band 41	2593.0	187.5	22.7	0.8	1.20	23.5	225.4	100.00	0.005	1.00	0.56	0.0054	0.0096
Mlink	915.0	973.0	29.9	2.4	1.74	32.3	1690.9	50.00	0.168	0.61	0.28	0.2757	0.6079
Satellite	1616.0	1410.0	31.5	3.0	2.00	34.5	2813.3	10.36	0.058	1.00	0.41	0.0580	0.1421

7.4 Total Radiated Power Densities from Transmitter Combinations – Against FCC Limits

Radio	Portion of FCC Limit
Mlink	0.2757
GSM850	0.0007
Satellite	0.0580
	0.3344
Mlink	0.2757
GSM1900	0.0000
Satellite	0.0580
	0.3337
Mlink	0.2757
FDD Band 2	0.0038
Satellite	0.0580
	0.3375
Mlink	0.2757
FDD LTE Band 2	0.0039
Satellite	0.0580
	0.3376
Mlink	0.2757
FDD LTE Band 4	0.0403
Satellite	0.0580
	0.3740
Mlink	0.2757
FDD Band 5	0.0044
Satellite	0.0580
	0.3381

Mlink	0.2757
FDD LTE Band 5	0.0045
Satellite	0.0580
	0.3382

Mlink	0.2757
FDD LTE Band 26	0.0046
Satellite	0.0580
	0.3383

Mlink	0.2757
FDD LTE Band 7	0.0445
Satellite	0.0580
	0.3782

Mlink	0.2757
FDD LTE Band 13	0.0457
Satellite	0.0580
	0.3794

Mlink	0.2757
FDD LTE Band 12	0.0549
Satellite	0.0580
	0.3886

Mlink	0.2757
FDD LTE Band 8	0.0391
Satellite	0.0580
	0.3728

Mlink	0.2757
TDD LTE Band 38	0.0529
Satellite	0.0580
	0.3866

Mlink	0.2757
TDD LTE Band 41	0.0054
Satellite	0.0580
	0.3392



Alert. Locate. Respond.

The summations of the individual radiated power density portions for the transmitter combinations are both less than the limits, and hence the total radiated power density from the G7 Bridge Model 103989 is deemed to be compliant with the FCC regulatory requirements.

7.5 Total Radiated Power Densities from Transmitter Combinations – Against ISED Limits

Radio	Portion of IC Limit
Mlink	0.6079
GSM850	0.0014
Satellite	0.1421
	0.7514
Mlink	0.6079
GSM1900	0.0000
Satellite	0.1421
	0.7500
Mlink	0.6079
FDD Band 2	0.0085
Satellite	0.1421
	0.7585
Mlink	0.6079
FDD LTE Band 2	0.0086
Satellite	0.1421
	0.7586
Mlink	0.6079
FDD LTE Band 4	0.0949
Satellite	0.1421
	0.8449
Mlink	0.6079
FDD Band 5	0.0093
Satellite	0.1421
	0.7593

Mlink	0.6079
FDD LTE Band 5	0.0096
Satellite	0.1421
	0.7596

Mlink	0.6079
FDD LTE Band 26	0.0098
Satellite	0.1421
	0.7598

Mlink	0.6079
FDD LTE Band 7	0.0808
Satellite	0.1421
	0.8308

Mlink	0.6079
FDD LTE Band 13	0.0957
Satellite	0.1421
	0.8457

Mlink	0.6079
FDD LTE Band 12	0.1111
Satellite	0.1421
	0.8611

Mlink	0.6079
FDD LTE Band 8	0.0857
Satellite	0.1421
	0.8357

Mlink	0.6079
TDD LTE Band 38	0.0943
Satellite	0.1421
	0.8443

Mlink	0.6079
TDD LTE Band 41	0.0096
Satellite	0.1421
	0.7596

The summations of the individual radiated power density portions for the transmitter combinations are both less than the limits, and hence the total radiated power density from the G7 Bridge Model 103989 is deemed to be compliant with the ISED regulatory requirements.

8 Statement of Compliance

The electromagnetic field (EMF) values found for the co-located modules of G7 Bridge Model 103989 are below the maximum allowed levels according to the standards listed in section 5 when used with the antennas specified in section 3.3.