

RF EXPOSURE EVALUATION REPORT

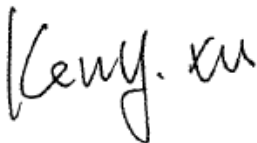
Application No.: SZCR2303000901AT
Applicant: GL Technologies (Hong Kong) Limited
Address of Applicant: Unit 601, Building 5W, Hong Kong Science Park, Shatin, N.T., Hong Kong
Manufacturer: Shenzhen Guanglian Zhitong Technology Co., LTD
Address of Manufacturer: Room 305-306, Skyworth Digital Building, Shiyan Street, Baoan District, Shenzhen, China
Factory: Shenzhen Guanglian Zhitong Technology Co., LTD
Address of Factory: Room 305-306, Skyworth Digital Building, Shiyan Street, Baoan District, Shenzhen, China

Equipment Under Test (EUT):
EUT Name: 4G LTE Wi-Fi 6 Router
Model No.: GL-X3000C16
Trade Mark: GL.iNET
FCC ID: 2AFIW-X3000C16
Contain FCC ID: XMR2020EM160RGL
Standard(s) : FCC Rules 47 CFR §2.1091
KDB 447498 D04 interim General RF Exposure Guidance v01

Date of Receipt: 2023-03-31
Date of Evaluation: 2023-05-18
Date of Issue: 2023-05-29

Evaluation Result:	Pass*
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* In the configuration evaluated, the EUT complied with the standards specified above.



Keny Xu
EMC Laboratory Manager



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Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2023-05-29		Original

Authorized for issue by:			
		Frank Chen	
		Frank Chen/Project Engineer	
		Eric Fu	
		Eric Fu/Reviewer	



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3 General Information

3.1 General Description of E.U.T.

Product Type:	<input type="checkbox"/> Portable device
	<input checked="" type="checkbox"/> Mobile device
	<input type="checkbox"/> Fixed device

3.2 Details of E.U.T.

Power supply:	Adapter Model: ICP30A-120-2500 Input: AC 100-240V 50/60Hz 0.8A Output: DC 12V 2.5A.
Cable(s):	DC cable:100cm unshielded Network cable:70cm unshielded
For 2.4G WIFI:	
Operation Frequency:	802.11b/g/n(HT20)/ax(HEW20): 2412MHz to 2462MHz, 802.11n(HT40)/ax(HEW40): 2422MHz to 2452MHz
Modulation Type:	802.11b: DSSS (CCK, DQPSK, DBPSK), 802.11g/n: OFDM (64QAM, 16QAM, QPSK, BPSK) 802.11ax: OFDMA(16QAM, 64QAM, 256QAM, 1024QAM, QPSK, BPSK)
Number of Channels:	802.11b/g/n(HT20)/ax(HEW20): 11, 802.11n(HT40)/ax(HEW40):7
Channel Spacing:	5MHz
Antenna Type:	Dipole Antenna
Antenna Gain:	ANT1 & ANT2: 1.63dBi; Directional Gain:4.64dBi.
For 5G WIFI:	
Operation Frequency (20MHz):	U-NII-1: 5180-5240MHz; U-NII-2A: 5260-5320MHz; U-NII-2C: 5500-5700MHz; U-NII-3: 5745-5825MHz
Operation Frequency (40MHz):	U-NII-1: 5190-5230MHz; U-NII-2A: 5270-5310MHz; U-NII-2C: 5510-5670MHz; U-NII-3: 5755-5795MHz
Operation Frequency (80MHz):	U-NII-1: 5210MHz; U-NII-2A: 5290MHz; U-NII-2C: 5530-5610MHz; U-NII-3: 5775MHz
Operation Frequency (160MHz):	5250MHz/5570MHz
Modulation Type:	802.11a: OFDM (64QAM, 16QAM, QPSK, BPSK); 802.11n: OFDM (BPSK, QPSK, 16QAM, 64QAM); 802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM) 802.11ax: OFDMA(16QAM, 64QAM, 256QAM, 1024QAM, QPSK, BPSK)
DFS Function:	Master
TPC Function:	Support



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Antenna Type:	For ANT1 & ANT2:Dipole Antenna; For ANT3:FPC Antenna	
Antenna Gain:	ANT1 &ANT2: 2.5dBi ANT3:3.65dBi; Directional Gain: 7.67dBi.	
For 4G LTE:		
Operation Frequency:	WCDMA Band 2	1850~1910 MHz
	WCDMA Band 4	1710~1755 MHz
	WCDMA Band 5	824~849 MHz
	LTE Band 2	1850~1910 MHz
	LTE Band 4	1710~1755 MHz
	LTE Band 5	824~849 MHz
	LTE Band 7	2500~2570 MHz
	LTE Band 12	699~716 MHz
	LTE Band 13	777~787 MHz
	LTE Band 14	788~798 MHz
	LTE Band 25	1850~1915 MHz
	LTE Band 26	814~849 MHz
	LTE Band 30	2305~2315 MHz
	LTE Band 38	2570~2620 MHz
	LTE Band 41	2496~2690 MHz
LTE Band 48	3550~3700 MHz	
LTE Band 66	1710~1780 MHz	
Antenna Type:	Dipole Antenna	
Antenna Gain:	660-960MHz:0.11dBi;1710-2170MHz:2.01 dBi; 2170-2690MHz:1.42 dBi;3300-4000MHz:2.33 dBi (Note: This device changed the antenna gain as above.)	
Note:Based on Module certification(FCC ID: XMR2020EM160RGL)		

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3.3 Separation Distance

Minimum test separation distance:	20cm
Remark: This minimum test separation distance is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander.	



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3.4 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen Branch

No. 1 Workshop, M-10, Middle Section, Science & Technology Park, Nanshan District, Shenzhen, Guangdong, China. 518057.

Tel: +86 755 2601 2053 Fax: +86 755 2671 0594

No tests were sub-contracted.

3.5 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

- **VCCI (Member No. 1937)**

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen EMC laboratory have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

- **FCC –Designation Number: CN1336**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1336. Test Firm Registration Number: 787754.

- **Innovation, Science and Economic Development Canada**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0006.

IC#: 4620C.

3.6 Deviation from Standards

None

3.7 Abnormalities from Standard Conditions

None



4 FCC Radiofrequency radiation exposure limits

Test exemptions apply for devices used in general population/uncontrolled exposure environments, according to the SAR-based, or MPE-based exemption thresholds.

4.1 Blanket 1 mW Blanket Exemption

The 1 mW Blanket Exemption of §1.1307(b)(3)(i)(A) applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power of no more than 1 mW, regardless of separation distance.

The 1-mW blanket exemption applies at separation distances less than 0.5 cm, including where there is no separation. This exemption shall not be used in conjunction with other exemption criteria other than those for multiple RF sources in paragraph §1.1307(b)(3)(ii)(A).

The 1-mW exemption is independent of service type and covers the full range of 100 kHz to 100 GHz, but it shall not be used in conjunction with other exemption criteria or in devices with higher-power transmitters operating in the same time-averaging period. Exposure from such higher-power transmitters would invalidate the underlying assumption that exposure from the lower-power transmitter is the only contributor to SAR in the relevant volume of tissue.

4.2 MPE-based Exemption

General frequency and separation-distance dependent MPE-based effective radiated power (ERP) thresholds are in Table B.1 [Table 1 of §1.1307(b)(1)(i)(C)] to support an exemption from further evaluation from 300 kHz through 100 GHz.

Table B.1—Thresholds For Single RF Sources Subject to Routine Environmental Evaluation

RF Source Frequency			Minimum Distance			Threshold ERP
f_L MHz		f_H MHz	$\lambda_L / 2\pi$		$\lambda_H / 2\pi$	W
0.3	–	1.34	159 m	–	35.6 m	1,920 R ²
1.34	–	30	35.6 m	–	1.6 m	3,450 R ² /f ²
30	–	300	1.6 m	–	159 mm	3.83 R ²
300	–	1,500	159 mm	–	31.8 mm	0.0128 R ² f
1,500	–	100,000	31.8 mm	–	0.5 mm	19.2R ²

Subscripts L and H are low and high; λ is wavelength.
From §1.1307(b)(3)(i)(C), modified by adding Minimum Distance columns.

The table applies to any RF source (i.e. single fixed, mobile, and portable transmitters) and specifies power and distance criteria for each of the five frequency ranges used for the MPE limits. These criteria apply at separation distances from any part of the radiating structure of at least $\lambda/2\pi$. The thresholds are



based on the general population MPE limits with a single perfect reflection, outside of the reactive near-field, and in the main beam of the radiator.

For mobile devices that are not exempt per Table B.1 [Table 1 of §1.1307(b)(1)(i)(C)] at distances from 20 cm to 40 cm and in 0.3 GHz to 6 GHz, evaluation of compliance with the exposure limits in §1.1310 is necessary if the ERP of the device is greater than ERP_{20cm} in Formula (B.1) [repeated from §2.1091(c)(1); also in §1.1307(b)(1)(i)(B)].

$$P_{Th} \text{ (mW)} = ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases} \quad (\text{B.1})$$

If the ERP is not easily obtained, then the available maximum time-averaged power may be used (i.e., without consideration of ERP only if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole.

SAR-based exemptions are constant at separation distances between 20 cm and 40 cm to avoid discontinuities in the threshold when transitioning between SAR-based and MPE-based exemption criteria at 40 cm, considering the importance of reflections.

Limit calculation			
Frequency range	Frequency(MHz)	$R(\lambda/2\pi)$ (m)	Threshold ERP(W)
300~1500MHz	915	0.0522	0.032
1500~100000MHz	2480	0.0193	0.007

4.3 SAR-based Exemption

SAR-based thresholds are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum time-averaged power or maximum time-averaged ERP, whichever is greater.

If the ERP of a device is not easily determined, such as for a portable device with a small form factor, the applicant may use the available maximum time-averaged power exclusively if the device antenna or radiating structure does not exceed an electrical length of $\lambda/4$.

As for devices with antennas of length greater than $\lambda/4$ where the gain is not well defined, but always less than that of a half-wave dipole (length $\lambda/2$), the available maximum time-averaged power generated by the device may be used in place of the maximum time-averaged ERP, where that value is not known.

The separation distance is the smallest distance from any part of the antenna or radiating structure for all persons, during operation at the applicable ERP. In the case of mobile or portable devices, the separation distance is from the outer housing of the device where it is closest to the antenna.



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The SAR-based exemption formula of §1.1307(b)(3)(i)(B), repeated here as Formula (B.2), applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power or effective radiated power (ERP), whichever is greater, of less than or equal to the threshold P_{th} (mW).

This method shall only be used at separation distances from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by Formula (B.2).

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}}(d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases} \quad (\text{B.2})$$

where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right)$$

and f is in GHz, d is the separation distance (cm), and $ERP_{20\text{cm}}$ is per Formula (B.1).



Example values shown in Table B.2 are for illustration only.

Table B.2—Example Power Thresholds (mW)

Frequency (MHz)	Distance(mm)									
	5	10	15	20	25	30	35	40	45	50
300	39	65	88	110	129	148	166	184	201	217
450	22	44	67	89	112	135	158	180	203	226
835	9	25	44	66	90	116	145	175	207	240
1900	3	12	26	44	66	92	122	157	195	236
2450	3	10	22	38	59	83	111	143	179	219
3600	2	8	18	32	49	71	96	125	158	195
5800	1	6	14	25	40	58	80	106	136	169

Limit calculation				
Frequency range(GHz)	Frequency(GHz)	X	Distance(cm)	Pth (mW)
0.3~1.5	0.915	1.474	0.5	8.133
1.5~6	2.48	1.905	0.5	2.717



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5 Measurement and Calculation

5.1 Maximum transmit power

For 2.4G WIFI:

The Power Data is based on the RF Test Report SZCR230300078602.

Antenna Gain: ANT1 &ANT2: 1.63dBi;Directional Gain:4.64dBi.

Output Power Into Antenna & RF Exposure Evaluation Distance:

Frequency	Maximum EIRP [dBm]	Maximum EIRP (mW)	Limit (mW)	Ratio	Result
2462	18.99+4.64=23.63	230.67	3060	0.08	Pass

For 5G WIFI:

The Power Data is based on the RF Test Report SZCR230300078603.

Antenna Gain: ANT1 &ANT2: 2.5dBi ANT3:3.65dBi; Directional Gain: 7.67dBi.

Output Power Into Antenna & RF Exposure Evaluation Distance:

Frequency	Maximum EIRP [dBm]	Maximum EIRP (mW)	Limit (mW)	Ratio	Result
5795	20.58+7.67=28.25	668.34	3060	0.22	Pass

For 3G/4G:

Based on Module certification(FCC ID: XMR2020EM160RGL), refer to test Max Conducted Peak Output Power value.

The distance r calculated from the far-field transmission formula is at distances 20 cm or greater from any object.

Test Mode	Max Conducted Power (dBm)	Antenna Gain (dBi)	Max Power (mW)	Limit (mW)	Ratio	Result
WCDMA B2 1850-1910	25	2.01	502.34	3060.00	0.16	Pass
WCDMA B4 1710-1755	25	2.01	502.34	3060.00	0.16	Pass
WCDMA B5 824-849	25	0.11	324.34	1680.96	0.19	Pass
LTE B2	25	2.01	502.34	3060.00	0.16	Pass



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1850-1910						
LTE B4 1710-1755	25	2.01	502.34	3060.00	0.16	Pass
LTE B5 824-849	25	0.11	324.34	1680.96	0.19	Pass
LTE B7 2500-2570	25	1.42	438.53	3060.00	0.14	Pass
LTE B12 699-716	25	0.11	324.34	1425.96	0.23	Pass
LTE B13 777-787	25	0.11	324.34	1585.08	0.20	Pass
LTE B14 788-798	25	0.11	324.34	1607.52	0.20	Pass
LTE B25 1850-1915	25	2.01	502.34	3060.00	0.16	Pass
LTE B26 814-824	25	0.11	324.34	1660.56	0.20	Pass
LTE B30 2305-2315	25	1.42	438.53	3060.00	0.14	Pass
LTE B38 2570-2620	25	1.42	438.53	3060.00	0.14	Pass
LTE B41 2496-2690	26.5	1.42	619.44	3060.00	0.20	Pass
LTE B48 3550-3700	25	2.33	540.75	3060.00	0.18	Pass
LTE B66 1710-1780	25	2.01	502.34	3060.00	0.16	Pass

RF Exposure Calculation

Remark: we used the maximum power between the conducted power and ERP/EIRP to perform RF exposure exemption evaluation.

So, the device is to qualify for SAR test exemption, the exemption report is in lieu of the SAR report.

Exposure condition for simultaneous transmission operations



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Either SAR-based or MPE-based exemption may be considered for test exemption for fixed, mobile, or portable device exposure conditions; therefore, the contributions from each exemption in conjunction with the measured SAR (Evaluated_k term) shall be used to determine exemption for simultaneous transmission according to Formula (C.1) [repeated from § 1.1307(b)(3)(ii)(B)].

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1 \quad (C.1)$$

Remark:

a -number of fixed, mobile, or portable RF sources claiming exemption using the §1.1307(b)(3)(i)(B) formula for P_{th}, including existing exempt transmitters and those being added.

b -number of fixed, mobile, or portable RF sources claiming exemption using the applicable § 1.1307(b)(3)(i)(C) Table 1 formula for Threshold ERP, including existing exempt transmitters and those being added.

c -number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance.

P_i -the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).

P_{th,i} -the exemption threshold power (P_{th}) according to the § 1.1307(b)(3)(i)(B) formula for fixed, mobile, or portable RF source i.

ERP_j -the available maximum time-averaged power or the ERP, whichever is greater, of fixed, mobile, or portable RF source j. ERP_{th,j} -exemption threshold ERP for fixed, mobile, or portable RF source j, at a distance of at least λ/2π, according to the applicable § 1.1307(b)(3)(i)(C) Table 1 formula at the location in question.

Evaluated_k -the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation.

Exposure Limit_k -either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable sources, as applicable

Due to the EUT support WiFi and 3G/4G.

The worst-case(5G WiFi+LTE Band 12)situation is 0.22+0.23=0.45< 1

Therefore, the device is to qualify for simultaneous transmission SAR test exemption, the exemption report is in lieu of the SAR report.



6 EUT Constructional Details (EUT Photos)

Refer to External and Internal Photos for SZCR2303000901AT.

--End of the Report--



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