RF EXPOSURE EVALUATION REPORT

Application No.:	GZCR2306000633AT
Applicant:	Guangzhou Robustel Co., Ltd.
Address of Applicant:	501, Building #2, 63 Yongan Road, Huangpu District, Guangzhou, Guangdong Province, China
Manufacturer:	Guangzhou Robustel Co., Ltd.
Address of Manufacturer:	501, Building #2, 63 Yongan Road, Huangpu District, Guangzhou, Guangdong Province, China
Factory:	Guangzhou Robustel Co., Ltd.
Address of Factory:	501, Building #2, 63 Yongan Road, Huangpu District, Guangzhou, Guangdong Province, China
Equipment Under Test (EUT):	
EUT Name:	Industrial Cellular Gateway
Model No.:	R2010-B-4L-A27NA, R2010-A-4L-A27NA, R2010-A-4L-A03AU ♣
♣	Please refer to section 2 of this report which indicates which item was actually tested and which were electrically identical.
Trade Mark:	robustel
Standard(s) :	47 CFR Part 1.1310 KDB447498D01 General RF Exposure Guidance v06
Date of Receipt:	2023-06-27
Date of Evaluation:	2023-07-12
Date of Issue:	2023-07-14
Evaluation Result:	**Pass***

* In the configuration evaluated, the EUT complied with the standards specified above.

Ricky Liu
Manager

Revision Record			
Version	**Report No.**	**Date**	**Remark**
01	GZCR220900127103	2023-03-06	Original
02	GZCR220900127106	2023-07-14	Copy Report: added LTE and WIFI antennas

Authorized for issue by:				
		Jim Li **Jim Li/Project Engineer**		
		Vico Cui **Vico Cui/Reviewer**		

2 Evaluation Summary

Item	Standard	Method	Requirement	Result
RF Exposure	KDB447498D01 General RF Exposure Guidance v06	KDB447498D01 General RF Exposure Guidance v06	47 CFR Part 1.1310	Pass

Note:

E.U.T./EUT means Equipment Under Test.

Pass means the test result passed the test standard requirement, please find the detailed decision rule in the report relative section.

Remark for original report GZCR220900127103:

♣ Declaration of EUT Family Grouping:

Model No.: R2010-B-4L-A27NA, R2010-A-4L-A27NA, R2010-A-4L-A03AU

According to the declaration from the applicant, the electrical circuit design, layout, components used and internal wiring were identical for all models, with only difference as below:

Model No.:	Difference on:
R2010-A-4L-A27NA, R2010-B-4L-A27NA	Remove the POE function for model R2010-A-4L-A27NA
R2010-A-4L-A03AU, R2010-B-4L-A27NA	Remove the POE function and change the WWAN module for model R2010-A-4L-A03AU

Therefore, only one model R2010-B-4L-A27NA was tested in this report.

Remark for report GZCR220900127106

This report GZCR220900127106 was based on original report GZCR220900127102, added LTE and WIFI antenas.

Reviewed the new WIFI antena, RF Exposure evaluation were performed on model **R2010-B-4L-A27NA with the new antennas** and recorded the new test results in this report GZCR220900127106.

All other test results please refer to original report GZCR220900127103 for details.

3 Contents

4 General Information

4.1 Details of E.U.T.

Power supply:	DC 12V 1.5A supply by adaptor
	Adaptor information
	Model: GQ24-120150-AX
	Input: AC100-240V 50/60Hz 1A MAX
	Output: DC12V 1.5A 18W
Operation Frequency:	802.11b/g/n(HT20): 2412MHz to 2462MHz;802.11n(HT40): 2422MHz to 2452MHz
Modulation Type:	802.11b: DSSS (CCK, DQPSK, DBPSK);802.11g/n: OFDM (64QAM, 16QAM, QPSK, BPSK)
Number of Channels:	802.11b/g/n(HT20):11;802.11n(HT40):7
Channel Spacing:	5MHz
Antenna Type:	RP-SMA Connector with dedicated antenna
Antenna Number:	2
Antenna Gain:	Wi-Fi ANT
	Option 1: ANT1:5 dBi; ANT2:5 dBi
	Option 2: ANT1:3 dBi; ANT2:3 dBi
Remark:	The switching adaptor is an optional part of EUT, all test in this report is performed with this adaptor.
	Two antennas can simultaneous transmission
Communication part:	Option 1：Module ID XMR202008EC25AFXD
	Option 2：Module ID XMR201805EC25AU
	Only 1 of both options is used in the host
LTE Antenna：	Option 1：E003168 with Gain 2.2dBi@824-960MHz; 2.6dBi@1710-2400MHz
	Option 2：E003204 with Gain 2.4dBi@700-960MHz; 2.3dBi@1710-2700MHz
	Option 3：WH-GLW-EP-M(SMA) with Gain 0.2dBi@699-1511MHz; 2.9dBi@1710-2170MHz

4.2 Evaluating Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou Branch EMC Laboratory,

198 Kezhu Road, Scientech Park, Guangzhou Economic & Technology Development District, Guangzhou, China 510663

Tel: +86 20 82155555 Fax: +86 20 82075059

No tests were sub-contracted.

4.3 Facility

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

- **ACMA**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory can also perform testing for the Australian/New Zealand Regulatory Compliance Mark (RCM).

- **SGS UK(Certificate No.: 32), SGS-TUV SAARLAND and SGS-FIMKO**

Have approved SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory as a supplier of EMC TESTING SERVICES and SAFETY TESTING SERVICES.

- **FCC Recognized Accredited Test Firm(Registration No.: 486818)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been accredited and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Designation Number: CN5016, Test Firm Registration Number: 486818.

- **ISED (Registration No.: 4620B, CAB identifier: CN0052)**

SGS-CSTC Standards Technical Services Co., Ltd., has been registered by Innovation Science and Economic Development Canada for Wireless Device Testing laboratories to test to Canadian radio equipment requirements. Registration No. 4620B, CAB identifier: CN0052.

- **VCCI (Registration No.: R-12460, C-12584, G-20107 and T-11179)**

The 10m Semi-anechoic chamber, 966 Anechoic Chamber and Shielded Room of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-12460, C-12584, G-20107 and T-11179 respectively.

- **CBTL (Lab Code: TL129)**

SGS-CSTC Standards Technical Services Co., Ltd., E&E Laboratory has been assessed and fully comply with the requirements of ISO/IEC 17025:2017, the Basic Rules, IECEE 01 and Rules of procedure IECEE 02, and the relevant IECEE CB-Scheme Operational documents.

4.4 Deviation from Standards

None

4.5 Abnormalities from Standard Conditions

None

5 Technical Requirements Specification

5.1 General Description of Applied Standards

KDB447498D01 General RF Exposure Guidance v06

4.3.1. Standalone SAR test exclusion considerations

Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions,

by measurement or numerical simulation, is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied.

5.2 RF Exposure Evaluation

5.2.1 Limit & Test Method

According to FCC Part1.1310: The criteria listed in the following table shall be used to evaluate the environmen impact of human exposure to radio frequency (RF) radiation as specified in part1.1307(b)

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f^2)	6
30–300	61.4	0.163	1.0	6
300–1500	.....	.....	f/300	6
1500–100,000	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f^2)	30
30–300	27.5	0.073	0.2	30
300–1500	.....	.....	f/1500	30
1500–100,000	.....	.....	1.0	30

F= Frequency in MHz

Friis Formula

Friis transmission formula: $P_d = (P_{out}*G)/(4* P_i * R^2)$

Where

P_d = power density in mW/cm^2

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

P_i = 3.1416

R = distance between observation point and center of the radiator in cm

P_d id the limit of MPE, 1 mW/cm^2. If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

5.2.2 Conclusion

Normal use condition for Distance between antenna and body: 20cm declared by applicant
Antenna Gain: 3 dBi
Directional gain 6.01 dBi

For 2.4 GHz Wi-Fi

Frequency (MHz)	Antenna Gain (Numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
11B						
2412	1.995	15.29	33.806	0.01342	1	Complies
2437	1.995	15.94	39.264	0.01559	1	Complies
2462	1.995	17.00	50.119	0.01989	1	Complies
11G						
2412	1.995	16.06	40.365	0.01602	1	Complies
2437	1.995	16.49	44.566	0.01769	1	Complies
2462	1.995	17.72	59.156	0.02348	1	Complies
11N20						
2412	3.990	18.9	77.625	0.06162	1	Complies
2437	3.990	19.01	79.616	0.06320	1	Complies
2462	3.990	20.03	100.693	0.07993	1	Complies
11N40						
2422	3.990	18.77	75.336	0.05980	1	Complies
2437	3.990	19.32	85.507	0.06788	1	Complies
2452	3.990	19.79	95.280	0.07563	1	Complies

Module ID XMR202008EC25AXD for R2010-B-4L-A27NA, R2010-A-4L-A27NA:

Band	Maximum Conducted Output Power (dBm)	MAX. antenna gain (dBi)	PG		Test Result (mW/cm^2)	Limit Value (mW/cm^2)	Conclusion
			(dBm)	(mW)			
WCDMA II	25.00	8.000	33.000	1995.262	0.397	1.000	Pass
WCDMA IV	25.00	5.000	30.000	1000.000	0.199	1.000	Pass
WCDMA V	25.00	9.416	34.416	2764.394	0.550	0.550	Pass
LTE Band 2	25.00	8.000	33.000	1995.262	0.397	1.000	Pass
LTE Band 4	25.00	5.000	30.000	1000.000	0.199	1.000	Pass
LTE Band 5	25.00	9.416	34.416	2764.394	0.550	0.550	Pass
LTE Band 12	25.00	8.734	33.734	2362.653	0.470	0.470	Pass
LTE Band 13	25.00	9.173	34.173	2613.966	0.520	0.520	Pass
LTE Band 14	25.00	9.255	34.255	2663.790	0.530	0.530	Pass
LTE Band 66	25.00	5.000	30.000	1000.000	0.199	1.000	Pass
LTE Band 71	25.00	8.545	33.545	2262.039	0.450	0.450	Pass
Note: **R** = 20cm ∏= 3.1416							

The LTE Antenna is changed to as below whose antenna gain is less than the original module ID, so only RF exposure should be re-evaluated.

Max Antenna gain for cellular part: 0.2dBi@699-1511MHz and 2.9dBi@1710-2170MHz for WH-GLW-EP-M(SMA) antenna

Band	Conducted power (dBm)	Antenna gain(dBi) Rubber antenna	Power Density (S) (mW/cm2)	Limit (mW/cm2)
WCDMA II	25	2.9	0.123	1.000
WCDMA IV	25	2.9	0.123	1.000
WCDMA V	25	0.2	0.066	0.550
LTE Band 2	25	2.9	0.123	1.000
LTE Band 4	25	2.9	0.123	1.000
LTE Band 5	25	0.2	0.066	0.550
LTE Band 12	25	0.2	0.066	0.470
LTE Band 13	25	0.2	0.066	0.520
LTE Band 14	25	0.2	0.066	0.530
LTE Band 66	25	2.9	0.123	1.000
LTE Band 71	25	0.2	0.066	0.450

Note:

Refer to report No. GZCR220900127102 & FCC ID: XMR202008EC25AFXD for EUT Max Conducted Peak Output Power value.

The 2.4G Wi-Fi and 2/3/4G can be transmitted simultaneously, the Max. sum of the MPE ratios for all wireless function is

0.07993/1 + 0.066/0.450 =0.07993 + 0.14667 =0.22660 < 1.0 for WH-GLW-EP-M(SMA) antenna

Module ID XMR201805EC25AU for R2010-A-4L-A03AU

Band	Maximum Conducted Output Power (dBm)		Antenna Gain (dBi)	Numeric gain
	(dBm)	(mW)		
GSM850	25.97	395.367	4.0	2.512
GSM1900	22.97	198.153	4.0	2.512
WCDMA II	25.00	316.228	4.0	2.512
WCDMA V	25.00	316.228	4.0	2.512
LTE Band 2	25.00	316.228	4.0	2.512
LTE Band 4	25.00	316.228	4.0	2.512
LTE Band 5	25.70	371.535	4.0	2.512
LTE Band 7	25.00	316.228	4.0	2.512

Band	PG (mW)	Test Result (mW/cm^2)	Limit Value (mW/cm^2)
GSM850	993.116	0.198	0.57
GSM1900	497.737	0.099	1.0
WCDMA II	794.328	0.158	1.0
WCDMA V	794.328	0.158	0.57
LTE Band 2	794.328	0.158	1.0
LTE Band 4	794.328	0.158	1.0
LTE Band 5	933.254	0.186	0.55
LTE Band 7	794.328	0.158	1.0
Note: **R** = 20cm ∏= 3.1416			

The LTE Antenna is changed to as below whose antenna gain is less than the original module ID, so only RF exposure should be re-evaluated.

Max Antenna gain for cellular part: 0.2dBi@699-1511MHz and 2.9dBi@1710-2170MHz for WH-GLW-EP-M(SMA) antenna

Band	Conducted power (dBm)	Antenna gain(dBi) Rubber antenna	Power Density (S) (mW/cm2)	Limit (mW/cm2)
GSM850	25.97	0.2	0.082	0.570
GSM1900	22.97	2.9	0.077	1.000
WCDMA II	25	2.9	0.123	1.000
WCDMA V	25	0.2	0.066	0.570
LTE Band 2	25	2.9	0.123	1.000
LTE Band 4	25	2.9	0.123	1.000
LTE Band 5	25.7	0.2	0.077	0.550
LTE Band 7	25	2.9	0.123	1.000

Note:

Refer to report No. GZCR220900127102 & FCC ID: XMR201805EC25AU for EUT Max Conducted Peak Output Power value.

The 2.4G Wi-Fi and 2/3/4G can be transmitted simultaneously, the Max. sum of the MPE ratios for all wireless function is

0.07993/1 + 0.077/0.550 =0.07993 + 0.14000 =0.21993 < 1.0 for WH-GLW-EP-M(SMA) antenna

So SAR report is not required.

Note: Refer to report No. GZCR220900127102 for EUT test Max Conducted Peak Output Power value.

6 EUT Constructional Details (EUT Photos)

Refer to Appendix - External and Internal Photos for GZCR2306000633AT

- End of the Report -