



Compliance Certification Services (Kunshan) Inc.


CCSEM-TRF-001 Rev. 02 Sep 01, 2023

Report No.: KSCR240400073805

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1 Cover Page

RF Exposure Evaluation Report

Application No.: KSCR2404000738AU
FCC ID: 2BBDIVBK30C21
Applicant: Wuxi Auto-link world Information Technology Co., Ltd.
Address of Applicant: No. 2, Gaokai Road, Economic Development Zone, Wuxi City, Jiangsu Province, China
Manufacturer: Wuxi Auto-link world Information Technology Co., Ltd.
Address of Manufacturer: No. 2, Gaokai Road, Economic Development Zone, Wuxi City, Jiangsu Province, China
Factory: Wuxi Auto-link world Information Technology Co., Ltd.
Address of Factory: No. 2, Gaokai Road, Economic Development Zone, Wuxi City, Jiangsu Province, China
Equipment Under Test (EUT):
EUT Name: Telematics Headunit
Model No.: 30C21
Trade Mark: 
Standard(s) : FCC Rules 47 CFR §2.1091
KDB 447498 D04 interim General RF Exposure Guidance v01
Date of Receipt: 2024-04-28
Date of Test: 2024-04-29 to 2024-05-29
Date of Issue: 2024-05-30

Test Result:	Pass*
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* In the configuration tested, the EUT complied with the standards specified above.

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Revision Record			
Version	Description	Date	Remark
00	Original	2024-05-30	/

Authorized for issue by:				
Tested By		Maker Qi		
		Maker Qi /Project Engineer		
Approved By		Terry Hou		
		Terry Hou /Reviewer		



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3 General Information

3.1 General Description of E.U.T.

Power supply:	DC 12V
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3.2 Details of E.U.T.

BT

Operation Frequency:	2402MHz to 2480MHz
Modulation Type:	GFSK, pi/4DQPSK, 8DPSK
Number of Channels:	79
Channel Spacing:	1MHz
Spectrum Spread Technology:	Frequency Hopping Spread Spectrum(FHSS)
Antenna Type:	Internal antenna
Antenna Gain:	1.71dBi (Provided by the manufacturer)

BLE

Operation Frequency:	2402MHz to 2480MHz
Modulation Type:	GFSK
Number of Channels:	40
Channel Spacing:	2MHz
Antenna Type:	Internal antenna
Antenna Gain:	1.71dBi (Provided by the manufacturer)

2.4G

Operation Frequency:	802.11b/g/n(HT20): 2412MHz to 2462MHz
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
Channel Spacing:	5MHz
Antenna Type:	Internal antenna
Antenna Gain:	2.79dBi (Provided by the manufacturer)

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5G

Operation Frequency/Number of channels (20MHz):	5180-5240MHz (4 Channels); U-NII-3: 5745-5825MHz (5 Channels)
Operation Frequency/Number of channels/(40MHz):	5190-5230MHz (2 Channels); U-NII-3: 5755-5795MHz (2 Channels)
Operation Frequency/Number of channels (80MHz):	5210MHz (1 Channel); U-NII-3: 5775MHz (1 Channel)
Modulation Type:	OFDM (64QAM, 16QAM, QPSK, BPSK); 802.11n: OFDM (BPSK, QPSK, 16QAM, 64QAM); 802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM)
Channel Spacing:	802.11a/n/ac 20: 20MHz; 802.11n/ac 40: 40MHz; 802.11ac 80: 80MHz
Antenna Type:	Internal antenna
Antenna Gain:	5100MHz-5250MHz: ANT1: 3.49dBi (Provided by the manufacturer) ANT2: 0.93dBi (Provided by the manufacturer) 5825MHz-5850MHz: ANT1: 1.47dBi (Provided by the manufacturer) ANT2: -0.32dBi (Provided by the manufacturer) Directional Gain: 5100MHz-5250MHz ANT1&2: 3.49dBi (Provided by the manufacturer) 5825MHz-5850MHz ANT1&2: 1.47dBi (Provided by the manufacturer)
Remark:	Two antennas can simultaneous transmission



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3.3 Test Location

All tests were performed at:

Compliance Certification Services (Kunshan) Inc.

No.10 Weiye Rd, Innovation park, Eco&Tec, Development Zone, Kunshan City, Jiangsu, China.

Tel: +86 512 5735 5888 Fax: +86 512 5737 0818

No tests were sub-contracted.

Note:

- 1.SGS is not responsible for wrong test results due to incorrect information (e.g. max. clock frequency, highest internal frequency, antenna gain, cable loss, etc) is provided by the applicant. (if applicable).
- 2.SGS is not responsible for the authenticity, integrity and the validity of the conclusion based on results of the data provided by applicant. (if applicable).
3. Sample source: sent by customer.

3.4 Test Facility

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

- **A2LA**

Compliance Certification Services (Kunshan) Inc. is accredited by the American Association for Laboratory Accreditation (A2LA). Certificate No. 2541.01.

- **FCC**

Compliance Certification Services (Kunshan) Inc. has been recognized as an accredited testing laboratory. Designation Number: CN1172.

- **ISED**

Compliance Certification Services (Kunshan) Inc. has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory. Company Number: 2324E

- **VCCI**

The 3m and 10m Semi-anechoic chamber and Shielded Room of Compliance Certification Services (Kunshan) Inc. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-20134, R-11600, C-11707, T-11499, G-10216 respectively.

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)].

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

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	2462	0.0194	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.

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

For 2.4G WiFi

Limit calculation				
Frequency range(GHz)	Frequency(GHz)	X	Distance(cm)	Pth (mW)
1.5~6	2.462	1.903	20	3060.000

For 5G WiFi

Limit calculation				
Frequency range(GHz)	Frequency(GHz)	X	Distance(cm)	Pth (mW)
1.5~6	5.825	2.090	20	3060.000

For BT

Limit calculation				
Frequency range(GHz)	Frequency(GHz)	X	Distance(cm)	Pth (mW)
1.5~6	2.48	1.905	20	3060.000

For BLE

Limit calculation				
Frequency range(GHz)	Frequency(GHz)	X	Distance(cm)	Pth (mW)
1.5~6	2.48	1.905	20	3060.000

5 Measurement and Calculation

5.1 Maximum transmit power

The Power Data is based on the RF Test Report KSCR240400073801, KSCR240400073802, KSCR240400073803, KSCR240400073804

BT

Test Mode	Test Frequency (MHz)	Output Power (dBm)	Reading Power (mW)
GFSK	2402	0.37	1.09
	2441	0.01	1.00
	2480	0.67	1.17
$\pi/4$ DQPSK	2402	-1.25	0.75
	2441	-1.87	0.65
	2480	-1.24	0.75
8DPSK	2402	-0.95	0.80
	2441	-1.42	0.72
	2480	-0.76	0.84

BLE

Test Mode	Test Frequency (MHz)	Output Power (dBm)	Reading Power (mW)
1M	2402	10.32	10.76
	2440	10.10	10.23
	2480	10.53	11.30

2.4G WiFi

Test Mode	Test Channel	Ant	Power [dBm]	Power [mW]
11B SISO	2412	Ant1	14.86	30.62
11B SISO	2437	Ant1	15.22	33.27
11B SISO	2462	Ant1	15.03	31.84
11G SISO	2412	Ant1	12.01	15.89
11G SISO	2437	Ant1	15.24	33.42
11G SISO	2462	Ant1	12.25	16.79
11N20 SISO	2412	Ant1	12.44	17.54
11N20 SISO	2437	Ant1	12.49	17.74
11N20 SISO	2462	Ant1	12.55	17.99



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5G WiFi

Test Mode	Test Frequency (MHz)	Ant 1 Antenna Power (dBm)	Ant 2 Antenna Power (dBm)	MIMO Power(dBm)	Ant 1 Antenna Power (mW)	Ant 2 Antenna Power (mW)	MIMO Power (mW)
802.11a	5180	16.40	16.00	/	43.65	39.81	/
	5200	16.38	16.00	/	43.45	39.81	/
	5240	16.35	15.97	/	43.15	39.54	/
	5745	17.06	15.53	/	50.82	35.73	/
	5785	16.74	15.32	/	47.21	34.04	/
	5825	17.45	16.03	/	55.59	40.09	/
802.11n (HT20)	5180	13.09	12.79	15.95	20.37	19.01	39.36
	5200	12.82	12.81	15.83	19.14	19.10	38.28
	5240	12.93	13.02	15.99	19.63	20.04	39.72
	5745	13.08	12.53	15.82	20.32	17.91	38.19
	5785	12.79	12.25	15.54	19.01	16.79	35.81
	5825	13.57	12.99	16.30	22.75	19.91	42.66
802.11n (HT40)	5190	10.44	10.43	13.45	11.07	11.04	22.13
	5230	10.37	10.47	13.43	10.89	11.14	22.03
	5755	13.70	12.69	16.23	23.44	18.58	41.98
	5795	13.12	12.40	15.79	20.51	17.38	37.93
802.11ac (VHT80)	5210	4.00	10.53	11.40	2.51	11.30	13.80
	5775	11.73	11.91	14.83	14.89	15.52	30.41

5.2 RF Exposure Calculation

For FCC:

BT:

The Max Conducted Peak Output Power is 1.17mW. The best case gain of the antenna is 1.71dBi.

1.71dBi logarithmic terms convert to numeric result is nearly 1.48.

According to the formula. calculate the EIRP test result:

$$\text{EIRP} = P \times G = 1.17\text{mW} \times 1.48 = 1.73\text{mW} < 3060\text{mW}$$

BLE:

The Max Conducted Peak Output Power is 10.76mW. The best case gain of the antenna is 1.71dBi.

1.71dBi logarithmic terms convert to numeric result is nearly 1.48.

According to the formula. calculate the EIRP test result:

$$\text{EIRP} = P \times G = 10.76 \text{ mW} \times 1.48 = 15.92\text{mW} < 3060\text{mW}$$

2.4G WiFi

The Max Conducted Peak Output Power is 33.43mW. The best case gain of the antenna is 2.79dBi.

2.79dBi logarithmic terms convert to numeric result is nearly 1.90.

According to the formula. calculate the EIRP test result:

$$\text{EIRP} = P \times G = 33.43 \text{ mW} \times 1.90 = 63.52\text{mW} < 3060\text{mW}$$

5G WiFi

The Max Conducted Peak Output Power is 55.59mW. The best case gain of the antenna is 3.49dBi.

3.49dBi logarithmic terms convert to numeric result is nearly 2.23.

According to the formula. calculate the EIRP test result:

$$\text{EIRP} = P \times G = 55.59\text{mW} \times 2.23 = 123.97\text{mW} < 3060\text{mW}$$

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

	Evaluation method	Exempt Limit(mW)	Verdict
<input type="checkbox"/>	Blanket 1 mW Blanket Exemption	1mW	N/A
<input type="checkbox"/>	MPE-based Exemption(ERP)	7mW(ERP) (2.4GHz Band)	N/A
<input checked="" type="checkbox"/>	SAR-based Exemption(P_{th})	3060mW(ERP) (1.5GHz~6GHz)	Yes

The BLE, 2.4G and 5G WiFi can simultaneously transmit, and the maximum rate of MPE is $15.92/3060+63.52/3060+123.97/3060=0.0665 \leq 1$. So, the device is to qualify for SAR test exemption, the exemption report is in lieu of the SAR report

--End of the Report--