

1 Cover Page

RF Exposure Evaluation Report

Application No.: SHCR2212002662PT
FCC ID: 2ASC3WR220
IC: 24992-WR220
Applicant: Positec Technology (China) Co.,Ltd
Address of Applicant: No.18 Dongwang Road Suzhou industrial Park, Jiangsu 215123, P.R.China
Manufacturer: Positec Technology (China) Co.,Ltd
Address of Manufacturer: No.18 Dongwang Road Suzhou industrial Park, Jiangsu 215123, P.R.China
Factory: Positec Technology (China) Co.,Ltd
Address of Factory: No.18 Dongwang Road Suzhou industrial Park, Jiangsu 215123, P.R.China

Equipment Under Test (EUT):
EUT Name: Lawn Mowing Robot
Model No.: WR235
Add Model No.: WR220, WR210, WR235.*, WR208, WR208.*, WR230, WR230.*, WR220.*, WR210.*(*=1-99, A-Z or M1-M9)
For IC Model No: WR235, WR220, WR210, WR208, WR230
Trade Mark: WORX
Standard(s) : FCC Rules 47 CFR §2.1091
 KDB447498 D01 General RF Exposure Guidance v06
 RSS-102 Issue 5 Amendment 1 (February 2, 2021)

Date of Receipt: 2022-12-06
Date of Test: 2022-12-21 to 2023-01-16
Date of Issue: 2023-08-30

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

Parlam Zhan


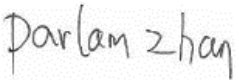
Parlam Zhan
Laboratory Manager



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Revision Record			
Version	Description	Date	Remark
00	Original	2023-08-30	/

Authorized for issue by:			
		 <hr/> Wade Zhang/Project Engineer	
		 <hr/> Parlam Zhan/Reviewer	



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3 General Information

3.1 General Description of E.U.T.

Power supply:	DC18V 5.0Ah Li-ion Battery Pack for WR220, WR230, WR235 DC18V 4.0Ah Li-ion Battery Pack for WR208, WR210 Charging adapter for W210, WR220: Input: AC 120V~ 60Hz 90W; Output: DC 20V 3.0A Charging adapter for WR235: Input: AC 120V~ 60Hz 230W; Output: DC 28V 7.0A Charging adapter for WR230: Input: AC 120V~ 60Hz 190W; Output: DC 28V 5.0A Charging adapter for WR208: Input: AC 120V~ 60Hz 38W; Output: DC 20V 1.5A
Firmware Version:	16.92.21.p11.1
S/N:	2023 3029720100022996

3.2 Technical Specifications

BT

Bluetooth Version:	V5.2 Dual mode
Operation Frequency:	2402MHz to 2480MHz
Modulation Type:	GFSK, Pi/4DQPSK, 8DPSK
Channel Spacing:	1MHz
Number of Channels:	79
Antenna Type:	FPC Antenna
Adaptive Type:	Adaptive Frequency Hopping using LBT based DAA
Antenna Gain:	4.50 dBi (Provided by manufacturer)
Power Class:	<10mW
Receiver Category:	2

BLE

Bluetooth Version:	V5.2 Dual mode
Operation Frequency:	2402MHz to 2480MHz
Modulation Type:	GFSK
Channel Spacing:	2MHz
Number of Channels:	40
Antenna Type:	FPC Antenna



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Adaptive Type:	LBE under LBT based DAA
Antenna Gain:	4.50 dBi (Provided by manufacturer)
Power Class:	<10mW
Receiver Category:	2

2.4G WiFi

Operation Frequency:	802.11b/g/n(HT20): 2412MHz to 2472MHz, 802.11n(HT40): 2422MHz to 2462MHz
Modulation Type:	802.11b: DSSS (CCK, DQPSK, DBPSK), 802.11g/n: OFDM (64QAM, 16QAM, QPSK, BPSK)
Channel Spacing:	5MHz
Number of Channels:	802.11b/g/n(HT20): 13, 802.11n(HT40):9
Antenna Type:	FPC Antenna
Adaptive Type:	LBE under LBT based DAA
Antenna Gain:	4.50 dBi (Provided by manufacturer)
Power Class:	>=10mW
Receiver Category:	1
Date Rate:	802.11b:1/2/5.5./11Mbps 802.11g:6/9/12/18/24/36/48/54Mbps 802.11n:MCS0-MCS7

5G WiFi

Operation Frequency / Number of channels (20MHz):	U-NII-1: 5180-5240MHz (4 Channels); U-NII-2A: 5260-5320MHz (4 Channels); U-NII-2C: 5500-5700MHz (11 Channels); U-NII-3: 5745-5825MHz (5 Channels)
Operation Frequency / Number of channels (40MHz):	U-NII-1: 5190-5230MHz (2 Channels); U-NII-2A: 5270-5310MHz (2 Channels); U-NII-2C: 5510-5670MHz (5 Channels); U-NII-3: 5755-5795MHz (2 Channels)
Operation Frequency / Number of channels (80MHz):	U-NII-1: 5210MHz (1 Channel); U-NII-2A: 5290MHz (1 Channel); U-NII-2C: 5530-5610MHz (2 Channels); U-NII-3: 5775MHz (1 Channel)
Modulation Type:	802.11a: 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(HT20)/ac(HT20): 20MHz; 802.11n(HT40)/ac(HT40): 40MHz; 802.11ac(HT80): 80MHz
DFS Function:	Slave without Radar detection
TPC Function:	Without TPC function
Antenna Type:	FPC Antenna
Antenna Gain:	5.69 dBi (Provided by manufacturer)
Date Rate:	802.11a:6/9/12/18/24/36/48/54Mbps 802.11n:MCS0-MCS7 802.11ac:VHT MCS0-MCS7

13.56MHz

Antenna Type	Loop Antenna
Modulation Type	ASK



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SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.
EEC EMC Lab

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Number of Channels	1
Operation Frequency	13.56MHz

For GSM

Operation Frequency Band:	GSM850/GSM1900
Modulation Type:	GMSK for GSM/GPRS 8PSK for EGPRS
Antenna Type:	FPC Antenna
Antenna Gain:	GSM850: -1.09dBi (Provided by the manufacturer) GSM1900: 3.41dBi (Provided by the manufacturer)

Test mode:	TX / RX	RF Channel		
		Low (L)	Middle (M)	High (H)
GSM850	TX	Channel 128	Channel 190	Channel 251
		824.2MHz	836.6 MHz	848.8 MHz
	RX	Channel 128	Channel 190	Channel 251
		869.2 MHz	881.6 MHz	893.8 MHz
Test mode:	TX / RX	RF Channel		
		Low (L)	Middle (M)	High (H)
GSM1900	TX	Channel 512	Channel 661	Channel 810
		1850.2MHz	1880.0 MHz	1909.8 MHz
	RX	Channel 512	Channel 661	Channel 810
		1930.2 MHz	1960.0 MHz	1989.8 MHz

For LTE

LTE Operation Frequency Band:	LTE Band 2,4,12,13
Modulation Type:	QPSK, 16QAM, 64QAM
Antenna Type:	PIFA Antenna
Antenna Gain:	Band 2: 3.41dBi (Provided by the manufacturer) Band 4: 3.27dBi (Provided by the manufacturer) Band 12: -0.99dBi (Provided by the manufacturer) Band 13: 0.29dBi (Provided by the manufacturer)



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3.3 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. E&E Lab

588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China

Tel: +86 21 6191 5666 Fax: +86 21 6191 5678

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).

3.4 Test Facility

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

- **A2LA (Certificate No. 6332.01)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. is accredited by the American Association for Laboratory Accreditation(A2LA).

- **FCC (Designation Number: CN1301)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been recognized as an accredited testing laboratory.

- **ISED (CAB Identifier: CN0020)**

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. EMC Laboratory has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory
Company Number: 8617A

- **VCCI (Member No.: 3061)**

The 3m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-13868, C-14336, T-12221, G-10830 respectively.



4 Test Standards and Limits

4.1 FCC Radiofrequency radiation exposure limits:

According to §1.1310, the limit for general population/uncontrolled exposures

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
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

Note: Limit for 2.4GHz is 1.0 mW/cm², 5GHz is 1.0 mW/cm², Limit for 13.56MHz is 60.77 V/m
GSM 850 is 0.55mW/cm², GSM 1900 is 1mW/cm²,
LTE B2 is 1mW/cm², LTE B4 is 1mW/cm², LTE B12 is 0.47mW/cm², LTE B13 is 0.52mW/cm².

4.2 IC Radiofrequency radiation exposure limits:

According to RSS-102 section 2.5.2, RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);

- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).



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For 2.4G device, the limit of worse case is 2.68 W

For 5G device, the limit of worse case is 4.53W

For 13.56MHz device, the limit of worse case is 1W

For GSM 850, the limit of worse case is 1.29W,

For GSM 1900, the limit of worse case is 2.24W,

For LTE B2, the limit of worse case is 2.24W,

For LTE B4, the limit of worse case is 2.12W,

For LTE B12, the limit of worse case is 1.15W,

For LTE B13, the limit of worse case is 1.24W.



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5 Measurement and Calculation

5.1 Maximum transmit power

BT

The Power Data is based on the RF Test Report SHCR221100257201

TestMode	Antenna	Channel	Result[dBm]	Result[mW]
DH5	Ant1	2402	2.55	1.80
		2441	2.43	1.75
		2480	1.69	1.48
2DH5	Ant1	2402	4.83	3.04
		2441	4.83	3.04
		2480	4.16	2.61
3DH5	Ant1	2402	5.16	3.28
		2441	5.05	3.20
		2480	4.37	2.74

BLE

The Power Data is based on the RF Test Report SHCR221100257202

TestMode	Antenna	Channel	Result[dBm]	Result[mW]
BLE_1M	Ant1	2402	0.71	1.18
		2440	0.58	1.14
		2480	-0.12	0.97
BLE_2M	Ant1	2402	0.68	1.17
		2440	0.54	1.13
		2480	-0.14	0.97

2.4GHz

The Power Data is based on the RF Test Report SHCR221100257203

TestMode	Antenna	Channel	Result[dBm]	Result[mW]
11B	Ant1	2412	15.02	31.77
		2437	15.61	36.39
		2462	15.80	38.02
11G	Ant1	2412	12.76	18.88
		2437	13.44	22.08
		2462	13.40	21.88
11N20SISO	Ant1	2412	12.01	15.89
		2437	12.35	17.18
		2462	12.69	18.58
11N40SISO	Ant1	2422	11.55	14.29
		2437	11.91	15.52
		2452	12.13	16.33



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5GHz

The Power Data is based on the RF Test Report SHCR221100257204

TestMode	Antenna	Channel	Result[dBm]	Result[mW]
11A	Ant1	5180	13.90	24.55
		5220	13.60	22.91
		5240	13.67	23.28
		5260	13.59	22.86
		5300	12.87	19.36
		5320	12.31	17.02
		5500	12.74	18.79
		5580	12.58	18.11
		5700	12.91	19.54
		5745	13.37	21.73
		5785	12.88	19.41
		5825	13.88	24.43
11N20SISO	Ant1	5180	13.20	20.89
		5220	12.86	19.32
		5240	12.91	19.54
		5260	12.57	18.07
		5300	12.10	16.22
		5320	12.54	17.95
		5500	11.69	14.76
		5580	12.03	15.96
		5700	12.06	16.07
		5745	12.52	17.86
11N40SISO	Ant1	5190	15.50	35.48
		5230	15.35	34.28
		5270	14.40	27.54
		5310	14.39	27.48
		5510	13.90	24.55
		5550	14.80	30.20
		5670	15.14	32.66
		5755	15.03	31.84
		5795	14.92	31.05
11AC20SISO	Ant1	5180	13.20	20.89
		5220	12.61	18.24
		5240	12.67	18.49
		5260	12.87	19.36
		5300	12.11	16.26
		5320	12.39	17.34
		5500	11.45	13.96
		5580	11.19	13.15
		5700	12.64	18.37
		5745	12.92	19.59
5785	12.12	16.29		



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		5825	12.37	17.26
11AC40SISO	Ant1	5190	15.45	35.08
		5230	15.13	32.58
		5270	14.31	26.98
		5310	14.31	26.98
		5510	13.83	24.15
		5550	14.82	30.34
		5670	15.21	33.19
		5755	14.72	29.65
11AC80SISO	Ant1	5795	14.77	29.99
		5210	11.59	14.42
		5290	11.40	13.80
		5530	10.73	11.83
		5610	10.61	11.51
		5775	11.57	14.35

5GHz for IC:

The Power Data is based on the RF Test Report SHCR221100257204

TestMode	Antenna	Channel	Result[dBm]	Result[mW]
11A	Ant1	5260	13.59	22.86
		5300	12.87	19.36
		5320	12.31	17.02
		5500	12.74	18.79
		5580	12.58	18.11
		5700	12.91	19.54
		5745	13.37	21.73
		5785	12.88	19.41
		5825	13.88	24.43
11N20SISO	Ant1	5260	12.57	22.86
		5300	12.10	19.36
		5320	12.54	17.02
		5500	11.69	18.79
		5580	12.03	18.11
		5700	12.06	19.54
		5745	12.52	21.73
		5785	12.03	19.41
11N40SISO	Ant1	5825	12.56	24.43
		5270	14.40	27.54
		5310	14.39	27.48
		5510	13.90	24.55
		5550	14.80	30.20
		5670	15.14	32.66
		5755	15.03	31.84
11AC20SISO	Ant1	5795	14.92	31.05
		5260	12.87	19.36
		5300	12.11	16.26



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		5320	12.39	17.34
		5500	11.45	13.96
		5580	11.19	13.15
		5700	12.64	18.37
		5745	12.92	19.59
		5785	12.12	16.29
		5825	12.37	17.26
11AC40SISO	Ant1	5270	14.31	26.98
		5310	14.31	26.98
		5510	13.83	24.15
		5550	14.82	30.34
		5670	15.21	33.19
		5755	14.72	29.65
11AC80SISO	Ant1	5795	14.77	29.99
		5290	11.40	13.80
		5530	10.73	11.83
		5610	10.61	11.51
		5775	11.57	14.35

13.56MHz:

The Power Data is based on the RF Test Report SHCR221200266201

76.47 dBuV/m@3m, @20cm=@3m+40log(3/0.2)=123.51dBuV/m

GSM<E:

The Power Data is based on the RF Test Report (FCC: R2303A0226-R1&R1812A0591-R1V1, R2303A0226-R1&R1812A0591-R2V1, R1812A0591-R3V1&R2303A0226-R3; IC: R2305A0538-R1V3&R1911A0697-R1V2, R2305A0538-R2V3&R1911A0697-R2V2, R2305A0538-R3V3&R1911A0697-R3V2)

Band	Maximum Conducted Output Power (dBm)		Antenna Gain (dBi)	Numeric gain
	(dBm)	(mW)		
GSM 850	23.97	249.46	-1.09	0.78
GSM 1900	20.97	125.03	3.41	2.19
LTE Band 2	24.00	251.19	3.41	2.19
LTE Band 4	23.00	199.53	3.27	2.12
LTE Band 12	24.00	251.19	-0.99	0.80
LTE Band 13	24.00	251.19	0.29	1.07



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5.2 MPE Calculation

For FCC:

According to the formula $S=P/4\pi R^2$, we can calculate S which is MPE.

Note:

- 1) P (mW)
- 2) R = distance to the center of radiation of antenna (in meter) = 20cm
- 3) MPE limit = 1mW/cm²

Band Information	Frequency (MHz)	Antenna Gain (dBi)	Gain in Linear Scale G	Operation Distance R(cm)	Max Tune-up power (dBm)	Max Tune-up power (mW)	Power Density (mW/cm ²)	Limit (mW/cm ²)	Result
GSM 850	824.2	-1.09	0.78	20	23.97	249.46	0.039	0.55	Pass
GSM 1900	1850.2	3.41	2.19	20	20.97	125.03	0.055	1	Pass
LTE Band 2	1850.7	3.41	2.19	20	24.00	251.19	0.110	1	Pass
LTE Band 4	1710.7	3.27	2.12	20	23.00	199.53	0.084	1	Pass
LTE Band 12	699.7	-0.99	0.80	20	24.00	251.19	0.040	0.47	Pass
LTE Band 13	779.5	0.29	1.07	20	24.00	251.19	0.053	0.52	Pass
BT	2402	4.50	2.82	20	5.16	3.28	0.002	1	Pass
BLE	2402	4.50	2.82	20	0.71	1.18	0.001	1	Pass
2.4G WiFi	2412	4.50	2.82	20	15.80	38.02	0.021	1	Pass
5G WiFi	5180	5.69	3.71	20	15.50	35.48	0.026	1	Pass

For 13.56MHz: 123.51dBuV/m=1.50V/m< 60.77 V/m.

The GSM/LTE, 2.4G WIFI, BT, 5G band and 13.56MHz function can simultaneous transmitting. But the maximum rate of MPE is

$0.110/1+0.021/1.0+0.002/1.0+0.026/1.0+1.50/60.77=0.184\leq 1.0$. according to the KDB447498 section 7.2 determine the device is exclusion from SAR test.



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For IC:

Band Information	Frequency (MHz)	Antenna Gain (dBi)	Max Tune-up power (dBm)	Maximum E.I.R.P. (dBm)	Maximum E.I.R.P. (W)	IC Limit (W)	Result
GSM 850	824.2	-1.09	23.97	22.88	0.194	1.29	Pass
GSM 1900	1850.2	3.41	20.97	24.38	0.274	2.24	Pass
LTE Band 2	1850.7	3.41	24.00	27.41	0.551	2.24	Pass
LTE Band 4	1710.7	3.27	23.00	26.27	0.424	2.12	Pass
LTE Band 12	699.7	-0.99	24.00	23.01	0.200	1.15	Pass
LTE Band 13	779.5	0.29	24.00	24.29	0.269	1.24	Pass
BT	2402	4.50	5.16	9.66	0.009	2.68	Pass
BLE	2402	4.50	0.71	5.21	0.003	2.68	Pass
2.4G WiFi	2412	4.50	15.80	20.3	0.107	2.68	Pass
5G WiFi	5180	5.69	15.21	20.90	0.123	4.53	Pass

For 13.56MHz RFID:

76.47 dBuV/m@3m = 0.000013W < 1W

The GSM/LTE, 2.4G WIFI, BT, 5G band and 13.56MHz can simultaneous transmitting, so the maximum rate of MPE is $0.551/2.24+0.009/2.68+0.107/2.68+0.123/4.53+0.000013/1 = 0.316 < 1$.

So the device is exclusion from SAR test

--End of the Report--



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