

1 Cover Page

RF Exposure Evaluation Report

Application No.: SHCR2209002071CO
FCC ID: 2ARTN-00009
IC: 24552-00009
Applicant: Honeywell (Beijing) Technology Solutions Labs Co. Ltd.
Address of Applicant: A1 Building, C&W Industry Zone, No. 14 Jiuxianqiao Road, Chaoyang District, Beijing 100015 China
Manufacturer: Honeywell (Beijing) Technology Solutions Labs Co. Ltd.
Address of Manufacturer: A1 Building, C&W Industry Zone, No. 14 Jiuxianqiao Road, Chaoyang District, Beijing 100015 China
Factory: Ademco De Juarez S. De R.L. De C.V. 5201
Address of Factory: Av. Rosa Ma.Y.Fuentes No. 7070 Parque industrial fuentes 32437 Juarez C.P. MEXICO
Equipment Under Test (EUT):
EUT Name: Indoor Air Quality Sensor
Model No.: TR50-5D-BW
Add Model No.: TR50-5N-BW, TR50-3D-BW, TR50-3N-BW
Trade Mark: Honeywell
Standard(s) : FCC Rules 47 CFR §2.1091
 KDB 447498 D04 interim General RF Exposure Guidance v01
 RSS-102 Issue 5 Amendment 1 (February 2, 2021)
Date of Receipt: 2022-09-20
Date of Test: 2022-09-25 to 2022-11-18
Date of Issue: 2022-11-18

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

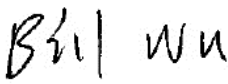
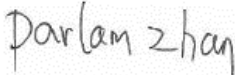
Parlam Zhan

Parlam Zhan
Laboratory Manager



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Revision Record			
Version	Description	Date	Remark
00	Original	2022-11-18	/

Authorized for issue by:			
		 <hr/> Bill Wu/Project Engineer	
		 <hr/> Parlam Zhan/Reviewer	



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3 General Information

3.1 General Description of E.U.T.

Power supply:	DC 24V
S/N:	2233TJS15D0H0055
Firmware Version:	V 0.0.21.0

3.2 Details of E.U.T.

BLE

Operation Frequency:	2402MHz to 2480MHz
Modulation Type:	GFSK
Data Rate:	1Mbps,2Mbps
Number of Channels:	40
Channel Spacing:	2MHz
Antenna Type:	PCB Antenna
Antenna Gain:	3.1dBi (Provided by manufacturer)

Operation Frequency:	902.5-927.5MHz
Modulation Type:	FSK
Number of Channels:	51
Channel Spacing:	500KHz
Antenna Type:	PCB Antenna
Antenna Gain:	1.008 dBi (Provided by manufacturer)

3.3 Separation Distance

Separation distance between the antenna to person (R):	> 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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SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.
EEC EMC Lab

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3.4 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).

3.5 Test Facility

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

- **CNAS (No. CNAS L0599)**

CNAS has accredited SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. to ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

- **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.



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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 $ERP_{20\text{cm}}$ in Formula (B.1) [repeated from §2.1091(c)(1); also in §1.1307(b)(1)(i)(B)].

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

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).



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

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	0.9025	1.465	20	1841.100
1.5~6	2.48	1.905	20	3060.000



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4.4 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).

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

For 902-928MHz device, the limit of worse case is 1.37 W



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5 Measurement and Calculation

5.1 Maximum transmit power

The Power Data is based on the RF Test Report SHCR220900207101 & SHCR220900207102.

BLE

TestMode	Antenna	Channel	Result [dBm]	Result[mW]
BLE_1M	Ant1	2402	5.56	3.60
		2440	6.01	3.99
		2480	5.71	3.72
BLE_2M	Ant1	2402	5.94	3.93
		2440	6.31	4.28
		2480	6.05	4.03

902-928MHz

TestMode	Antenna	Channel	Result [dBm]	Result[mW]
902-928MHz	Ant1	902.5	19.412	87.34
		915.0	19.587	90.93
		927.5	19.535	89.85

5.2 RF Exposure Calculation

For FCC:

For BLE

The Max Conducted Peak Output Power is 4.28mW. The best case gain of the antenna is 3.1dBi.

3.1dBi logarithmic terms convert to numeric result is nearly 2.04

According to the formula. calculate the EIRP test result:

$$EIRP= P \times G = 4.28 \text{ mW} \times 2.04 = 8.73\text{mW}$$

For 902-928MHz

The Max Conducted Peak Output Power is 90.93mW. The best case gain of the antenna is 1.008dBi.

1.008dBi logarithmic terms convert to numeric result is nearly 1.26

According to the formula. calculate the EIRP test result:

$$EIRP= P \times G = 90.93 \text{ mW} \times 1.26 = 114.57 \text{ mW}$$

The BLE and 902-928MHz modules can transmit simultaneously, but the maximum rate of MPE is 8.73mW+114.57mW=123.3mW



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Remark 1: we used the maximum power between the conducted power and ERP/EIRP to perform RF exposure exemption evaluation.

Remark 2: Frequency follow in 0.3GHz~1.5GHz limit was 2040f ($0.3\text{GHz} \leq f < 1.5\text{GHz}$), we used the worst 1841.1mW ($f=0.9025$) limit to 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})	1841.1mW(ERP) (0.3GHz~1.5GHz)	Yes
<input checked="" type="checkbox"/>	SAR-based Exemption(P_{th})	3060mW(ERP) (1.5GHz~6GHz)	Yes

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

For IC:

For BLE

$$\text{EIRP} = P \times G = 0.00428 \text{ W} \times 2.04 = 0.009 \text{ W} < 2.68 \text{ W}$$

For 902-928MHz

$$\text{EIRP} = P \times G = 90.93 \text{ mW} \times 1.26 = 114.57 \text{ mW} < 1.37 \text{ W}$$

The BLE and 902-928MHz modules can transmit simultaneously, but the maximum rate of MPE is $8.73\text{mW} + 114.57\text{mW} = 123.3\text{mW} = 0.123\text{W} < 1.37 \text{ W} < 2.68 \text{ W}$

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

--End of the Report--



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