Report on the Radio Testing of:

WEARABLE RESPIRATORY MONITORING DEVICE

Model(s): RS001.2.C/S/D

In accordance with 47 CFR FCC Part 15C

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Add value.
Inspire trust.

Prepared for:
Respiree Pte Ltd
115 East Coast Road
Singapore 428804

COMMERCIAL-IN-CONFIDENCE

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RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Song Zhi Qun	18 Nov 2021	
Authorised Signatory	Quek Keng Huat	17 Nov 2021	

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD PSB document control rules.

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with the mentioned standard(s).

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ilac-MRA

Accredited Laboratory SAC-SINGLAS

LA-2007-0380-A LA-2007-0386-C
LA-2007-0381-F LA-2010-0464-D
LA-2007-0382-B LA-2018-0702-B
LA-2007-0383-G LA-2018-0703-G
LA-2007-0384-G LA-2020-0747-L
LA-2007-0385-E

The results reported herein have been performed in accordance with the terms of accreditation under the Singapore Accreditation Council. Inspections/Calibrations/Tests marked "Not SAC-SINGLAS Accredited" in this Report are not included in the SAC-SINGLAS Accreditation Schedule for our inspection body/laboratory.

Laboratory:
TÜV SÜD PSB Pte. Ltd.
15 International Business Park
TÜV SÜD @ IBP
Singapore 609937

Phone : +65-6778 7777
E-mail: info.sg@tuvsud.com
https://www.tuvsud.com/sg
Co. Reg : 199002667R

Regional Head Office:
TÜV SÜD Asia Pacific Pte. Ltd.
15 International Business Park
TÜV SÜD @ IBP
Singapore 609937

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Contents

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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	18 Nov 2021

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1.2 Introduction

Applicant	:	Respiree Pte Ltd 115 East Coast Road Singapore 428804
Manufacturer	:	Same as applicant
Factory	:	Same as applicant
Model Number(s)	:	RS001.2.C/S/D
Serial Number(s)	:	Refer to manufacturer
Number of Samples Tested	:	3
Test Sample(s) Condition	:	Good
Quotation Reference	:	5557977
Test Specification/Issue/Date	:	FCC 47 CFR Part 15C
Test Sample(s) Received Date	:	25 Oct 2021
Start of Test	:	25 Oct 2021
Finish of Test	:	26 Oct 2021

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1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with specifications as shown below.

Specification Clause	Test Description	Result	Comments/Base Standard
47 CFR FCC Part 15			
15.107(a), 15.207	Conducted Emissions	Not Applicable *See Note 1	ANSI C63.4: 2014 ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V05R02: 2018
15.109(a), 15.205, 15.209	Radiated Emissions (Spurious Emissions Inclusive Restricted Bands Requirement)	Pass	ANSI C63.4: 2014 ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V05R02: 2019
15.247(a)(2)	Spectrum Bandwidth (6dB Bandwidth Measurement)	Not Tested *See Note 2	ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V05R02: 2019
15.247(b)(3)	Maximum Peak Power	Not Tested *See Note 2	ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V05R02: 2019
15.247(d)	RF Conducted Spurious Emissions (Non-Restricted Bands)	Not Tested *See Note 2	ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V05R02: 2019
15.247(d)	RF Conducted Spurious Emissions (Restricted Bands)	Not Tested *See Note 2	ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V05R02: 2019
15.247(d)	Band Edge Compliance (Conducted)	Not Tested *See Note 2	ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V05R02: 2019
15.247(d)	Band Edge Compliance (Radiated)	Not Tested *See Note 2	ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V05R02: 2019
15.247(e)	Peak Power Spectral Density	Not Tested *See Note 2	ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V05R02: 2019
15.35(c)	Duty Cycle Factor Computation	Not Tested *See Note 2	ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V05R02: 2019
2.1091	Maximum Permissible Exposure	Pass	

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Notes

1. The Equipment Under Test (EUT) is a battery-operated device.

2. The EUT is using a certified Bluetooth module with FCC ID: YCP-STM32WB5M001 and the module is implemented inside the circuitry without any modification.

3. Respiree Pte Ltd declares the following:

Letter of Declaration on Family Models

1. Product: Cardio-respiratory Monitor
   Trade name: Respiree
   Model number: RS001.2.C

2. Product: Cardio-respiratory Monitor
   Trade name: Respiree
   Model number: RS001.2.S

3. Product: Cardio-respiratory Monitor
   Trade name: Respiree
   Model number: RS001.2.D

Respiree Pte Ltd, hereby declare that the above models are in the family models. The main difference in between models are as follows:

1) RS001.2.C turns on BLE and communicates processed data

2) RS001.2.S does not turn on BLE

3) RS001.2.D turns on BLE and communicates raw data

Both RS001.2.C and RS001.2.D are using same BLE protocol and BLE software.
All RS001.2.S and RS001.2.C and RS001.2.D are using same hardware architecture.

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1.4 Product Information

1.4.1 Technical Description

Description	:	The Equipment Under Test(s) (EUT(s)) is a **WEARABLE RESPIRATORY MONITORING DEVICE.**
Microprocessor	:	STM32 (Cortex-M4)
Operating Frequency	:	Up to 64 MHz
Clock / Oscillator Frequency	:	32 MHz (radio and CPU clock)
Modulation	:	Gaussian frequency shift
Antenna Gain	:	2.0dBi
Port / Connectors	:	1 x USB Inlet
Rated Power	:	Input 5V
Accessories	:	Nil

1.4.2 Test Configuration and Modes of Operation

Mode(s)	**Description**
Maximum RF power transmission	The EUT was exercised in the mode, transmitting at lower, middle and upper channels as shown below one at a time with all supported modulation schemes were evaluated. For Band Edge Compliance, only lower and upper channels were evaluated.

Transmit Channel	Frequency (GHz)
Channel 0 (Lower Channel)	2.402
Channel 19 (Middle Channel)	2.440
Channel 39 (Upper Channel)	2.480

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1.5 Deviations from the Standard

Nil.

1.6 EUT Modification Record

No modifications were made.

1.7 Test Location(s)

TÜV SÜD PSB Pte Ltd
Electrical & Electronics Centre (EEC), Product Services,
15 International Business Park
TÜV SÜD @ IBP
Singapore 609937

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1.8 Test Facilities Registrations

Requirements	Registration Numbers
FCC	994109 (Test Firm Registration Number) SG0002 (Designation Number)
ISED	SGAP01 (CAB Identifier) 2932N-1 (10m Semi-Anechoic Chamber)
VCCI	R-13324 (10m ANC), G-10203 (10mANC) C-14933 (C.E @ CEIBP) T-12403 (Telecom Ports @ CEIBP)
BSMI	SL2-IS-E-6001R *[CNS-13803 (ISM Equipment)]* SL2-IN-E-6001R *[CNS-13438 (IT Equipment)]* SL2-R1/R2-E-6001R *[CNS-13439 (Broadcast Receivers)]* SL2-A1-E-6001R *[CNS-13783-1 (Household Appliances)]* SL2-L1-E-6001R *[CNS-14115 (Lighting Equipment)]*
SABS	SABS/A-LAB/0030/2018
ASCA	TL-86

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1.9 Supporting Equipment

The EUT was tested as a stand-alone unit without any supporting equipment.

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2 Test Details

2.1 Radiated Emissions (Spurious Emissions Inclusive Restricted Bands Requirement)

2.1.1 Test Limits

Frequency Range (MHz)	Quasi-Peak Limit Values (dBµV/m)
0.009 - 0.490 *	20 log [2400 / F (kHz)] @ 300m
0.490 - 1.705	20 log [24000 / F (kHz)] @ 30m
1.705 - 30.0	30.0 @ 30m
30 – 88	40.0 @ 3m
88 – 216	43.5 @ 3m
216 – 960	46.0 @ 3m
Above 960 *	54.0 @ 3m
* For frequency bands 9kHz – 90kHz, 110kHz – 490kHz and above 1GHz, average detector was used. A peak limit of 20dB above the average limit does apply.	

Restricted Bands

MHz			MHz			MHz			GHz		
0.090	-	0.110	16.42	-	16.423	399.9	-	410	4.5	-	5.15
0.495	-	0.505	16.69475	-	16.69525	608	-	614	5.35	-	5.46
2.1735	-	2.1905	16.80425	-	16.80475	960	-	1240	7.25	-	7.75
4.125	-	4.128	25.5	-	25.67	1300	-	1427	8.025	-	8.5
4.17725	-	4.17775	37.5	-	38.25	1435	-	1626.5	9.0	-	9.2
4.20725	-	4.20775	73	-	74.6	1645.5	-	1646.5	9.3	-	9.5
6.215	-	6.218	74.8	-	75.2	1660	-	1710	10.6	-	12.7
6.26775	-	6.26825	108	-	121.94	1718.8	-	1722.2	13.25	-	13.4
6.31175	-	6.31225	123	-	138	2200	-	2300	14.47	-	14.5
8.291	-	8.294	149.9	-	150.05	2310	-	2390	15.35	-	16.2
8.362	-	8.366	156.52475	-	156.52525	2483.5	-	2500	17.7	-	21.4
8.37625	-	8.38675	156.7	-	156.9	2690	-	2900	22.01	-	23.12
8.41425	-	8.41475	162.0125	-	167.17	3260	-	3267	23.6	-	24.0
12.29	-	12.293	167.72	-	173.2	3332	-	3339	31.2	-	31.8
12.51975	-	12.52025	240	-	285	3345.8	-	3358	36.43	-	36.5
12.57675	-	12.57725	322	-	335.4	3600	-	4400	Above 38.6		
13.36	-	13.41									

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2.1.2 Test Setup

2.1.2.1 The EUT and supporting equipment were set up in accordance with the requirements of the standard as shown in the setup photos.

2.1.2.2 The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.

2.1.2.3 The relevant broadband antenna was set at the required test distance away from the EUT and supporting equipment boundary.

2.1.3 Test Method

2.1.3.1 The EUT was switched on and allowed to warm up to its normal operating condition.

2.1.3.2 A prescan was carried out to pick the worst emission frequencies from the EUT. For EUT which is a portable device, the prescan was carried out by rotating the EUT through three orthogonal axes to determine which altitude and equipment arrangement produces such emissions.

2.1.3.3 The test was carried out at the selected frequency points obtained from the pre-scan. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:

a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
b. The EUT was then rotated to the direction that gave the maximum emission.
c. Finally, the antenna height was adjusted to the height that gave the maximum emission

2.1.3.4 A Quasi-peak measurement was made for that frequency point if it was less than or equal to 1GHz.For frequency point in range of 9kHz – 90kHz, 110kHz – 49k0kHz and above 1GHz, both Peak and Average measurements were carried out.

2.1.3.5 The measurements were repeated for the next frequency point, until all selected frequency points were measured.

2.1.3.6 The frequency range covered was from the lowest radio frequency signal generated from the EUT, without going below 9kHz to 10th harmonics of the EUT fundamental frequency, using the loop antenna for frequency below 30MHz, Bi-log antenna for frequencies from 30MHz up to 1GHz, and the Horn antenna above 1GHz.

Sample Calculation Example

At 300 MHz	Q-P limit = 46.0 dBμV/m
Log-periodic antenna factor & cable loss at 300 MHz = 18.5 dB Q-P reading obtained directly from EMI Receiver = 40.0 dBμV/m (Calibrated level including antenna factors & cable losses)	
Therefore, Q-P margin = 46.0 - 40.0 = 6.0	i.e. 6.0 dB below Q-P limit

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2.2.5 Test Results

Test Input Power	5Vdc	Temperature	23°C
Test Distance	10m (<30MHz) 3m (≥30MHz – 25GHz)	Relative Humidity	56%
Mode	Transmission	Atmospheric Pressure	1018mbar
		Tested By	Lim Kay Tak Chang Wai Kit
		Test Date	26 Oct 2021

Spurious Emissions ranging from 9kHz – 30MHz (for 9kHz – 90kHz, 110kHz – 490kHz)

Freq (GHz)	Peak Value (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	AV Value (dBµV/m)	AV Limit (dBµV/m)	AV Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Ch
-	-	-	-	-	-	-	-	-	-	-

Spurious Emissions ranging from 9kHz – 30MHz *See Note 6

Frequency (MHz)	Q-P Value (dBµV/m)	Q-P Limit (dBµV/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Channel
0.5290	31.7	52.2	20.5	120	340	V	19
0.6610	29.8	50.3	20.5	120	60	V	0
0.8400	27.8	48.2	20.4	120	160	V	19
0.9070	27.1	47.5	20.4	120	270	V	39
1.1320	25.6	45.6	20.0	120	60	V	39
1.2100	25.1	45.0	19.9	120	175	V	19

Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dBµV/m)	Q-P Limit (dBµV/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Channel
30.0650	22.4	40.0	17.6	100	116	H	0
509.0730	21.9	46.0	24.1	200	159	V	0
631.9600	23.7	46.0	22.3	200	203	V	0
791.9780	25.3	46.0	20.7	300	58	V	0
857.3570	26.1	46.0	19.9	400	357	V	0
935.7650	26.6	46.0	19.4	200	114	V	0

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Spurious Emissions above 1GHz - 25GHz

Freq (GHz)	Peak Value (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	AV Value (dBµV/m)	AV Limit (dBµV/m)	AV Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Ch
4.8802	53.0	74.0	21.0	44.0	54.0	10.0	286	216	V	0
7.3204	53.0	74.0	21.0	41.2	54.0	12.8	100	292	V	0
9.7592	60.1	74.0	13.9	49.3	54.0	4.7	127	195	V	0
14.6246	54.2	74.0	19.8	40.4	54.0	13.6	199	122	V	0
15.9153	55.6	74.0	18.4	41.9	54.0	12.1	105	17	V	0
16.9604	55.5	74.0	18.5	42.0	54.0	12.0	286	300	V	0

Freq (GHz)	Peak Value (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	AV Value (dBµV/m)	AV Limit (dBµV/m)	AV Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Ch
4.8039	51.4	74.0	22.6	42.9	54.0	11.1	221	248	V	19
9.6070	60.4	74.0	13.6	48.9	54.0	5.1	183	181	V	19
12.0109	60.2	74.0	13.8	46.4	54.0	7.6	100	166	V	19
14.0922	54.1	74.0	19.9	40.6	54.0	13.4	300	295	V	19
14.4006	54.9	74.0	19.1	41.2	54.0	12.8	205	140	V	19
16.8172	56.8	74.0	17.2	42.4	54.0	11.6	166	337	H	19

Freq (GHz)	Peak Value (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	AV Value (dBµV/m)	AV Limit (dBµV/m)	AV Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Ch
4.9597	51.3	74.0	22.7	42.1	54.0	11.9	300	227	V	39
7.4397	54.2	74.0	19.8	42.6	54.0	11.4	100	103	V	39
9.9203	56.1	74.0	17.9	42.2	54.0	11.8	300	187	V	39
12.4130	53.4	74.0	20.6	39.8	54.0	14.2	133	255	V	39
15.9073	55.3	74.0	18.7	41.8	54.0	12.2	286	94	V	39
17.3559	56.6	74.0	17.4	43.3	54.0	10.7	116	190	V	39

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Notes

1.	All possible modes of operation were investigated. Only the worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
2.	A "positive margin" indicates a PASS as it refers to the margin present below the limit line at the particular frequency. Conversely, a "negative margin" indicates a FAIL.
3.	EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings: 9kHz – 150kHz RBW: 200Hz VBW: 1kHz 150kHz – 30MHz RBW: 9kHz VBW: 30kHz 30MHz - 1GHz RBW: 120kHz VBW: 1MHz >1GHz RBW: 1MHz VBW: 3MHz
4.	The transmitting antenna was found to be in the worst case condition when it was orientated in a horizontal position.
5.	"--" indicates no emissions were found and shows compliance to the limits
6.	The measurement was done at 10m. The measured results were extrapolated to the specified test limits as specified in § 15.209 (a) based on 40dB/decade.
7.	The upper frequency of radiated emission investigations was according to requirements stated in Section 15.33 (a) for intentional radiators & Section 15.33 (b) for unintentional radiators.
8.	The channel in the table refers to the transmit channel of the EUT.

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4 Test Equipment

Instrument	Model	S/No	Cal Due Date
Radiated Emissions (Spurious Emissions Inclusive Restricted Bands Requirement)			
R&S EMI Test Receiver (9kHz - 26.5GHz)	ESR26	101714	11 May 2022
Com-Power Preamplifier (1MHz - 1GHz)	PAM-103	441162	01 Feb 2022
Schaffner Bilog Antenna (30MHz - 2GHz)	CBL6112B	2593	18 Mar 2022
HP Preamplifier (1GHz - 26.5GHz)	8449B	3008A1078	01 Jun 2022
TDK-RF Horn Antenna (1GHz - 18GHz)	HRN-0118	130256	18 Apr 2022
ETS Horn Antenna (18GHz - 40GHz)	3116	0004-2474	09 Oct 2022
Toyo Preamplifier (26.5GHz - 40GHz)	HAP26-40W	00000005	09 Oct 2022
Schwarzbeck Active Loop Antenna	FMZB1519B	196	02 Nov 2022

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5 Measurement Uncertainty

All measured results are traceable to the SI units. The uncertainty of the measurement is at a confidence level of approximately 95%, with a coverage factor of 2.

Test Name	Measurement Uncertainty
Conducted Emissions at Mains Terminals	1.0dB (9kHz to 30MHz)
Radiated Emissions	10m Anechoic Chamber (Lab 4) 2.6dB (9kHz to 30MHz @ 10m) 3.5dB (30MHz to 1GHz @ 10m) 4.0dB (30MHz to 1GHz @ 3m) 4.8dB (>1GHz to 40GHz @ 3m) 3m RF Chamber (Lab7) 4.0dB (30MHz to 1GHz @ 3m) 4.5dB (>1GHz to 40GHz @ 3m)
Maximum Permissible Exposure	15% (0.1MHz – 18GHz)

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6 Annex A – FCC Label and Position

Refer to manufacturer

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Please note that this Report is issued under the following terms :

1. This report applies to the sample of the specific product/equipment given at the time of its testing/calibration. The results are not used to indicate or imply that they are applicable to other similar items. In addition, such results must not be used to indicate or imply that TÜV SÜD PSB approves, recommends or endorses the manufacturer, supplier or user of such product/equipment, or that TÜV SÜD PSB in any way "guarantees" the later performance of the product/equipment. Unless otherwise stated in this report, no tests were conducted to determine long term effects of using the specific product/equipment.

2. The sample/s mentioned in this report is/are submitted/supplied/manufactured by the Client. TÜV SÜD PSB therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture, consignment or any information supplied.

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5. Unless otherwise stated, the tests were carried out in TÜV SÜD PSB Pte Ltd, 15 International Business Park TÜV SÜD @ IBP Singapore 609937.

6. The tests carried out by TÜV SÜD PSB and this report are subject to TÜV SÜD PSB's General Terms and Conditions of Business and the Testing and Certification Regulations of the TÜV SÜD Group.

Effective 26 January 2021

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End of the Test Report