

# Report on the RadioTesting of: SmartTAG

Model(s): STG-875W(P1)

In accordance with  
47 CFR FCC Part 15C

Cadi Scientific Pte Ltd  
31 Ubi Road 1 #07-01A  
Aztech Building  
Singapore 408694



## COMMERCIAL-IN-CONFIDENCE

Document Number: 7191227398-EEC20/07 | Issue: 01  
FCC ID: VPE-STG-875W

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Foo Kai Maun	08 Apr 2020	
Authorised Signatory	Quek Keng Huat	07 Apr 2020	

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).



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

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.  
No.1 Science Park Drive  
Singapore 118221

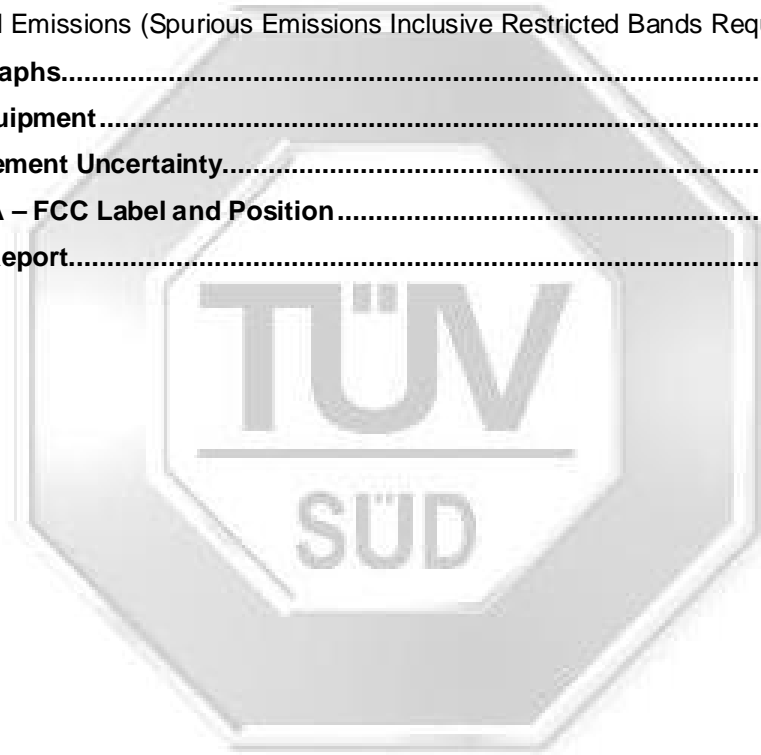
Phone : +65-6885 1333  
Fax : +65-6776 8670  
E-mail: enquiries@tuv-sud-psb.sg  
www.tuv-sud-psb.sg  
Co. Reg : 199002667R

Regional Head Office:  
TÜV SÜD Asia Pacific Pte. Ltd.  
1 Science Park Drive, #02-01  
Singapore 118221  
TUV®



## Contents

<b>1</b>	<b>Report Summary</b> .....	<b>3</b>
1.1	Report Modification Record.....	3
1.2	Introduction.....	4
1.3	Brief Summary of Results.....	5
1.4	Product Information.....	6
1.5	Deviations from the Standard.....	7
1.6	EUT Modification Record.....	7
1.7	Test Location(s).....	8
1.8	Test Facilities Registrations.....	8
1.9	Supporting Equipment.....	9
<b>2</b>	<b>Test Details</b> .....	<b>10</b>
2.1	Radiated Emissions (Spurious Emissions Inclusive Restricted Bands Requirement).....	10
<b>3</b>	<b>Photographs</b> .....	<b>15</b>
<b>4</b>	<b>Test Equipment</b> .....	<b>24</b>
<b>5</b>	<b>Measurement Uncertainty</b> .....	<b>25</b>
<b>6</b>	<b>Annex A – FCC Label and Position</b> .....	<b>26</b>
	<b>End of the Test Report</b> .....	<b>28</b>





# 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	08 Apr 2020





## 1.2 Introduction

Applicant	:	Cadi Scientific Pte Ltd 31 Ubi Road 1 #07-01A Aztech Building Singapore 408694
Manufacturer	:	Same as applicant
Factory	:	Same as applicant
Model Number(s)	:	STG-875W(P1)
Serial Number(s)	:	Please refer to manufacturer
Number of Samples Tested	:	1
Test Sample(s) Condition	:	Good
Quotation Reference	:	5278517
Test Specification/Issue/Date	:	FCC 47 CFR 15C
Test Sample(s) Received Date	:	19 Feb 2020
Start of Test	:	19 Feb 2020
Finish of Test	:	17 Mar 2020



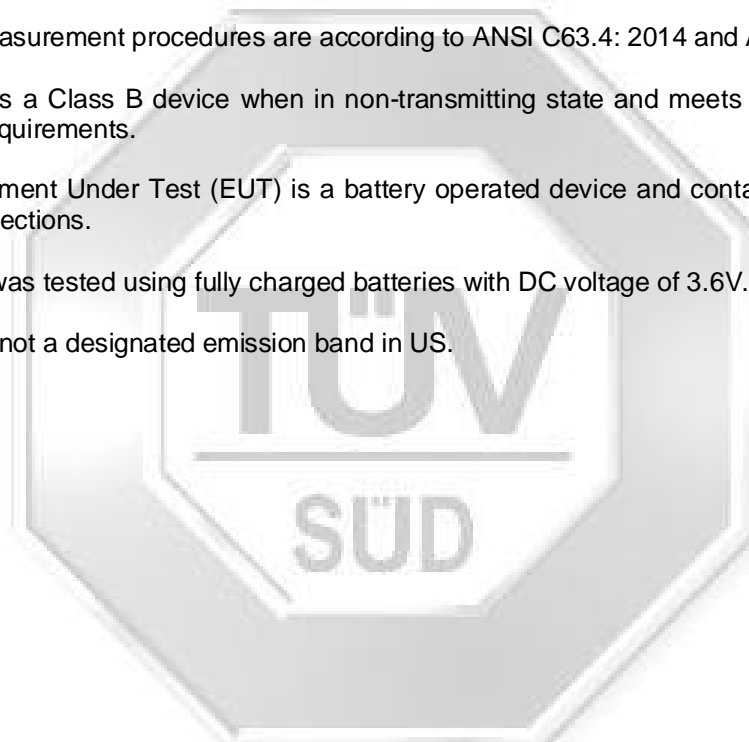
### 1.3 Brief Summary of Results

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

Specification Clause	Test Description	Result	Comments/Base Standard
<i>47 CFR FCC Part 15</i>			
15.107(a), 15.207	Conducted Emissions	Not Applicable *See Note 3	ANSI C63.4: 2014 ANSI C63.10: 2013
15.109(a), 15.205, 15.209, 15.225(d)	Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)	Pass	ANSI C63.4: 2014 ANSI C63.10: 2013
15.215(c)	Spectrum Bandwidth	Not Applicable *See Note 5	ANSI C63.10: 2013

#### Notes

1. All test measurement procedures are according to ANSI C63.4: 2014 and ANSI C63.10: 2013.
2. The EUT is a Class B device when in non-transmitting state and meets the 47 CFR FCC Part15B Class B requirements.
3. The Equipment Under Test (EUT) is a battery operated device and contains no provision for public utility connections.
4. The EUT was tested using fully charged batteries with DC voltage of 3.6V.
5. 125kHz is not a designated emission band in US.





## 1.4 Product Information

### 1.4.1 Technical Description

Description	:	The Equipment Under Test(s) (EUT(s)) is a <b>SmartTAG</b> . It is a location tracking tag.
Microprocessor	:	PIC18LF46K22
Operating Frequency	:	125kHz (LF Receiver) 38kHz (IR Receiver) 2.4GHz (Wi-Fi)
Clock / Oscillator Frequency	:	32.768kHz external crystal oscillator 16MHz internal RC oscillator
Modulation	:	Direct Sequence Spread Spectrum (Wi-Fi 802.11b) Orthogonal Frequency Division Multiplexing (Wi-Fi 802.11g/n) Amplitude Shift Keying (RFID)
Antenna Gain	:	3.35dBi
Port / Connectors	:	Nil
Rated Power	:	3.6Vdc battery operated
Accessories	:	Nil

### 1.4.2 Test Configuration and Modes of Operation

Mode(s)	Description
Maximum Continuous Transmission	The EUT was exercised by operating in maximum continuous transmission in test mode, i.e transmitting at 125kHz continuously.



**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,  
 No. 1 Science Park Drive, Singapore 118221

TÜV SÜD PSB Pte Ltd  
 Electrical & Electronics Centre (EEC), Product Services,  
 15 International Business Park #01-01, Singapore 609937

### 1.8 Test Facilities Registrations

Requirements	Registration Numbers
FCC	994109 (Test Firm Registration Number) SG0002 (Designation Number)
ISED	SGAP01 (CAB Identifier)  <u>Science Park</u> 2932I-1 (3m and 10m Semi-Anechoic Chamber)  <u>International Business Park</u> 2932N-1 (10m Semi-Anechoic Chamber)
VCCI	<u>Science Park</u> R-1335 (10m ANC) C-2306 (C.E @ Lab 3) T-1471 (Telecom Ports @ Lab 3)  <u>International Business Park</u> R-13324 (10m ANC), G-10203 (10mANC) C-4933 (C.E @ CEIBP) T-2403 (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/0029/2018





### 1.9 Supporting Equipment

Equipment Description (Including Brand Name)	Model, Serial & FCC ID Number	Cable Description (List Length, Type & Purpose)
GW Laboratory DC Power Supply	M/N: GPS-3030D S/N: 8120428 FCC ID: Nil	1.80 m unshielded power cable





## 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			



## 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 – 490kHz 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 10<sup>th</sup> 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 dB $\mu$ V/m

Log-periodic antenna factor & cable loss at 300 MHz = 18.5 dB  
Q-P reading obtained directly from EMI Receiver = 40.0 dB $\mu$ V/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



### 2.2.5 Test Results

Test Input Power	3.6Vdc Battery Operated	Temperature	24°C
Test Distance	3m (< 30MHz) 3m (30MHz – 25GHz)	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Nazrulhizat Chelmin Li Dylan Lin
		Test Date	19 Feb 2020

Spurious Emissions ranging from 9kHz – 30MHz (for 9kHz – 90kHz, 110kHz – 490kHz) \* See Note 5

Freq (MHz)	Peak Value (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	AV Value (dBµV/m) *See Note 2	AV Limit (dBµV/m)	AV Margin (dB) *See Note 3	Height (cm)	Azimuth (Degrees)
0.1259	-22.9	45.6	68.5	--	25.6	48.5	120	113
0.2080	-37.5	41.2	78.7	--	21.2	58.7	120	195
0.4600	-43.7	34.3	78.0	--	14.3	58.0	120	277
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--

Spurious Emissions ranging from 9kHz – 30MHz \* See Note 5

Frequency (MHz)	Q-P Value (dBµV/m)	Q-P Limit (dBµV/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)
0.7320	-8.4	30.3	38.7	120	345
3.4840	20.4	30.0	9.6	120	213
8.7120	13.3	30.0	16.7	120	335
15.0070	10.5	30.0	19.5	120	339
24.2580	13.4	30.0	16.6	120	163
--	--	--	--	--	--



Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dB $\mu$ V/m)	Q-P Limit (dB $\mu$ V/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	PoI (H/V)
32.1550	25.1	40.0	14.9	100	4	V
38.6540	22.6	40.0	17.4	400	280	V
41.4620	21.3	40.0	18.7	198	20	V
47.6020	20.8	40.0	19.2	100	227	V
51.1290	17.1	40.0	22.9	100	238	V
94.9210	21.8	43.5	21.7	100	136	H

Spurious Emissions above 1GHz – 25GHz

Freq (GHz)	Peak Value (dB $\mu$ V/m)	Peak Limit (dB $\mu$ V/m)	Peak Margin (dB)	AV Value (dB $\mu$ V/m)	AV Limit (dB $\mu$ V/m)	AV Margin (dB)	Height (cm)	Azimuth (Degrees)	PoI (H/V)
2.2302	39.5	74.0	34.5	25.9	54.0	28.1	101	76	V
2.8950	41.3	74.0	32.7	27.5	54.0	26.5	101	261	V
3.5840	41.3	74.0	32.7	27.6	54.0	26.4	101	232	V
4.9128	47.3	74.0	26.7	33.8	54.0	20.2	198	310	V
5.5483	47.0	74.0	27.0	33.6	54.0	20.4	101	67	V
5.8467	49.6	74.0	24.4	35.9	54.0	18.1	171	80	V

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.	As the measured peak shows compliance to the average limit, as such no average measurement was required.
3.	The average margin indicates the margin of the measured peak value below the average limit.
4.	“--” indicates no emissions were found and shows compliance to the limits.
5.	The measurement was done at 3m. The measured results were extrapolated to the specified test limits as specified in § 15.209 (a) based on 40dB/decade.
6.	Quasi-peak measurement was used for frequency measurement up to 1GHz. Average and peak measurements were used for emissions above 1GHz. The average measurement was done by averaging over a complete cycle of the pulse train, including the blanking interval as the pulse train duration does not exceed 0.1 second.
7.	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.



8.	EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings: <u>9kHz - 150kHz</u> RBW: 100Hz            VBW: 300Hz <u>150kHz - 30MHz</u> RBW: 10kHz            VBW: 30kHz <u>30MHz - 1GHz</u> RBW: 120kHz            VBW: 1MHz <u>&gt;1GHz</u> RBW: 1MHz            VBW: 3MHz
9.	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.





## 4 Test Equipment

Instrument	Model	S/No	Cal Due Date
<i>Radiated Emissions (Spurious Emissions Inclusive Restricted Bands Requirement)</i>			
R&S EMI Test Receiver	ESU40	100355	07 Feb 2021
EMCO Loop Antenna	6502	9108-2673	13 May 2020
R&S EMI Test Receiver	ESW44	101661	30 May 2020
Schaffner Bilog Antenna (30MHz-2GHz)	CBL6112B	2597	27 Jun 2020
Com-Power Preampifier (1MHz-1GHz)	PAM-103	441056	07 May 2020
Electro-Metrics Horn Antenna(1GHz-18GHz)	EM-6961	6553	18 Nov 2020
R&S Preampifier (1GHz -18GHz)	SCU18	102191	15 Jan 2021
ETS Horn Antenna (18GHz-40GHz)	3116	0004-2474	07 Jul 2020
Agilent Preampifier (1GHz-26.5GHz)	8449D	3008A02305	26 Sep 2020
Toyo Preampifier (26.5GHz-40GHz)	HAP26-40W	00000005	07 Jul 2020





## 5 Measurement Uncertainty

All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2.

Test Name	Measurement Uncertainty
Conducted Emissions at Mains Terminals	9kHz to 30MHz, $\pm 2.4$ dB
Radiated Emissions	9kHz – 30MHz @10m, $\pm 2.3$ dB 30MHz to 1GHz @ 10m, $\pm 4.0$ dB 30MHz to 1GHz @ 3m, $\pm 5.6$ dB >1GHz to 40GHz @3m, $\pm 5.0$ dB







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.
3. Nothing in this report shall be interpreted to mean that TÜV SÜD PSB has verified or ascertained any endorsement or marks from any other testing authority or bodies that may be found on that sample.
4. This report shall not be reproduced wholly or in parts and no reference shall be made by the Client to TÜV SÜD PSB or to the report or results furnished by TÜV SÜD PSB in any advertisements or sales promotion.
5. Unless otherwise stated, the tests were carried out in TÜV SÜD PSB Pte Ltd, No.1 Science Park Drive Singapore 118221.

July 2011

