Test Report No. 7191174282-EEC17/01
dated 07 Dec 2017

PSB Singapore

Choose certainty.
Add value.

Note: This report is issued subject to the Testing and Certification Regulations of the TÜV SÜD Group and the General Terms and Conditions of Business of TÜV SÜD PSB Pte Ltd. In addition, this report is governed by the terms set out within this report.

FORMAL REPORT ON TESTING IN ACCORDANCE WITH
47 CFR FCC Parts 15B & C
OF AN
ALARM PANEL
[Model : Zerowire]
[FCC ID : 2ADG2ZW-6400H]

TEST FACILITY	TÜV SÜD PSB Pte Ltd Electrical & Electronics Centre (EEC), Product Services, No. 1 Science Park Drive, Singapore 118221
FCC REG. NO.	994109 (Test Firm Registration Number) SG0002 (Designation Number)
IND. CANADA REG. NO.	2932I-1 (3m and 10m Semi-Anechoic Chamber, Science Park)
PREPARED FOR	UHS Pty. Ltd 5-9 Ricketty Street Level 1, Unit 2 Mascot NSW 2020 Australia Tel : (61) 2 9663 2299 Fax : (61) 2 9663 2288
QUOTATION NUMBER	2191072220
JOB NUMBER	71911742825
TEST PERIOD	15 Nov 2017 – 06 Dec 2017

PREPARED BY	**APPROVED BY**
Quek Keng Huat	Foo Kai Maun
Higher Associate Engineer	Executive Engineer

TÜV SÜD PSB

ilac-MRA

ACCREDITED LABORATORY SAC-SINGLAS

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

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

TABLE OF CONTENTS

TEST SUMMARY

The product was tested in accordance with the customer's specifications.

Test Results Summary

Test Standard	Description	Pass / Fail
47 CFR FCC Part 15		
15.107(a), 15.207	Conducted Emissions	Pass
15.109(a), 15.205, 15.209	Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)	Pass
15.249(a)	Radiated Emissions (Fundamental and Harmonics)	Pass
15.35(c)	Duty Cycle Factor Computation	Refer to page 18 for details

Notes

1. The bands listed below are the available operating frequency bands of the Equipment Under Test (EUT). For each band, the EUT was configured to operate in test mode at lower, middle and upper channels.

Frequency Band	Up Link Frequencies (MHz)	Down Link Frequencies (MHz)
UMTS B2 (1900)	1850 – 1910	1930 – 1990
UMTS B5 (850)	824 – 849	869 – 894
LTE B2 (1900)	1850 – 1910	1930 – 1990
LTE B4 (1700)	1710 – 1755	2110 – 2155
LTE B5 (850)	824 – 849	869 – 894
LTE B13 (700)	777 – 787	746 – 756
LTE B17 (700)	704 – 716	734 – 746

2. The Equipment Under Test (EUT) was configured to operate in Z-Wave test mode at 908.4MHz.

3. Three channels as listed below, which respectively represent the lower, middle and upper channels of the Equipment Under Test (EUT) under Wi-Fi mode were chosen and tested. For each channel, the EUT was configured to operate in the test mode.

Transmit Channel	Frequency (GHz)
Channel 1	2.412
Channel 6	2.437
Channel 11	2.462

4. The EUT is a Class B device when in non-transmitting state and meets the 47 CFR FCC Part15B Class B requirements.

5. All test measurement procedures are according to ANSI C63.4: 2014 and ANSI C63.10: 2013.

Modifications

No modifications were made.

PRODUCT DESCRIPTION

Description	:	The Equipment Under Test (EUT) is an **Alarm Panel.**
Applicant	:	UHS Pty. Ltd 5-9 Ricketty Street Level 1, Unit 2 Mascot NSW 2020 Australia
Manufacturer	:	UHS Pty. Ltd 5-9 Ricketty Street Level 1, Unit 2 Mascot NSW 2020 Australia
Factory (ies)	:	UHS Pty. Ltd 5-9 Ricketty Street Level 1, Unit 2 Mascot NSW 2020 Australia
Model Number	:	Zerowire
FCC ID	:	2ADG2ZW-6400H
Serial Number	:	955894088560
Microprocessor	:	Microchip dsPIC33EP512MU810
Operating / Transmitting Frequency	:	a. Wi-Fi Transceiver: 2.412GHz (lower channel) to 2.462GMz (upper channel) (802.11b/g) b. Z-Wave Transceiver: 908.4MHz c. LTE Transceiver: 806MHz to 1910MHz
Clock / Oscillator Frequency	:	a. 12MHz / 120MHz (Microprocessor) b. 32MHz (Z-Wave Transceiver)
Modulation	:	a. Frequency Shift Keying (FSK) b. Orthogonal Frequency Division Multiplexing (OFDM)

(Continued)

Antenna Gain	:	a. 2.3dBi (Z-Wave Transceiver) b. 0dBi (802.11b/g Wi-Fi Transceiver) c. LTE Transceiver - Antenna alternative 1, max antenna gain 700MHz, 1.43dBi 800/850MHz, 1.26dBi 1700MHz, 4.01dBi 1900MHz, 4.42dBi - Antenna alternative 2, max antenna gain 700MHz, 4.3dBi 800/850MHz, 4.3dBi 1700MHz, 4.1dBi 1900MHz, 4.1dBi - Worst Antenna gains 700MHz, 4.3dBi 800/850MHz, 4.3dBi 1700MHz, 4.1dBi 1900MHz, 4.42dBi
Port / Connectors	:	Refer to manufacturer's user manual / operating manual
Rated Input Power	:	120V 60Hz
Accessories	:	M.C.E. AC Switching Power Supply Adaptor Model: YMC18-2UW Input: 100-240 ~ 50/60H, 0.5A Output: 9V ⎓ 2.0A

SUPPORTING EQUIPMENT DESCRIPTION

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

EUT OPERATING CONDITIONS

47 CFR FCC Part 15
1. Conducted Emissions **2. Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)** **3. Radiated Emissions (Fundamental and Harmonics)** **4. Maximum Permissible Exposure**
The EUT was exercised by operating in maximum continuous transmission in test mode, i.e transmitting at lower, middle and upper channels respectively at one time together with multiple transmitters operating at the same time.

47 CFR FCC Parts 15.107(a) and 15.207 Conducted Emission Limits

Frequency Range (MHz)	Limit Values (dBµV)	
	Quasi-peak (Q-P)	Average (AV)
0.15 - 0.5	66 – 56 *	56 – 46 *
0.5 - 5.0	56	46
5.0 - 30.0	60	50
* Decreasing linearly with the logarithm of the frequency		

47 CFR FCC Parts 15.107(a) and 15.207 Conducted Emission Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Schaffner EMI Receiver	SMR4503	040	22 Mar 2018
Agilent EMC Analyzer-SA7	E7403A	US41160167	03 Aug 2018
Schaffner LISN –LISN7 (Ref)	NNB42	00008	11 Jan 2018

47 CFR FCC Parts 15.107(a) and 15.207 Conducted Emission Test Setup

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.
2. The power supply for the EUT was fed through a 50Ω/50μH EUT LISN, connected to filtered mains.
3. The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.
4. All other supporting equipment were powered separately from another LISN.

47 CFR FCC Parts 15.107(a) and 15.207 Conducted Emission Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. A scan was made on the NEUTRAL line over the required frequency range using an EMI test receiver.
3. High peaks, relative to the limit line, were then selected.
4. The EMI test receiver was then tuned to the selected frequencies and the necessary measurements made with a receiver bandwidth setting of 9kHz. Both Quasi-peak and Average measurements were made.
5. Steps 2 to 4 were then repeated for the LIVE line.

Sample Calculation Example

At 20 MHz Q-P limit = 60.0 dBμV
Transducer factor of LISN, pulse limiter & cable loss at 20 MHz = 11.2 dB
Q-P reading obtained directly from EMI Receiver = 40.0 dBμV (Calibrated for system losses)
Therefore, Q-P margin = 60.0 - 40.0 = 20.0 i.e. 20.0 dB below Q-P limit

47 CFR FCC Parts 15.107(a) and 15.207 Conducted Emission Results

Test Input Power	120V 60Hz	Temperature	22ºC
Line Under Test	AC Mains	Relative Humidity	54%
Antenna Type	Pulse Antenna	Atmospheric Pressure	1030mbar
		Tested By	Dylan Lin

Frequency (MHz)	Q-P Value (dBµV)	Q-P Limit (dBµV)	Q-P Margin (dB)	AV Value (dBµV)	AV Limit (dBµV)	AV Margin (dB)	Line
0.1670	48.6	65.1	16.5	35.4	55.1	19.7	Neutral
0.2287	42.2	62.5	20.3	31.4	52.5	21.1	Neutral
0.3401	37.0	59.2	22.2	30.1	49.2	19.1	Live
0.4604	39.6	56.7	17.1	32.8	46.7	13.9	Live
0.5493	34.5	56.0	21.5	26.4	46.0	19.6	Live
0.7046	34.1	56.0	21.9	26.2	46.0	19.8	Live

Test Input Power	120V 60Hz	Temperature	22ºC
Line Under Test	AC Mains	Relative Humidity	54%
Antenna Type	Toaglas Antenna	Atmospheric Pressure	1030mbar
		Tested By	Dylan Lin

Frequency (MHz)	Q-P Value (dBµV)	Q-P Limit (dBµV)	Q-P Margin (dB)	AV Value (dBµV)	AV Limit (dBµV)	AV Margin (dB)	Line
0.1733	42.9	64.8	21.9	28.8	54.8	26.0	Live
0.1755	42.7	64.7	22.0	31.7	54.7	23.0	Neutral
0.2128	37.9	63.1	25.2	23.1	53.1	30.0	Live
0.2443	35.5	61.9	26.4	25.2	51.9	26.7	Neutral
0.3781	31.2	58.3	27.1	23.4	48.3	24.9	Live
0.5014	38.2	56.0	17.8	31.3	46.0	14.7	Live

Notes

1. All possible modes of operation were investigated from 150kHz to 30MHz. 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 - 30MHz
   RBW: 9kHz VBW: 30kHz
4. Conducted Emissions 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, in the range 9kHz – 30MHz is ±2.2dB.

47 CFR FCC Part 15.205 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									

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission 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.	

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Agilent EMC Analyzer (9kHz-26.5GHz)	E7405A	US40240195	20 Mar 2018
Schaffner Bilog Antenna	CBL6112B	2593	18 Jan 2018
TDK-RF Horn Antenna	HRN-0118	130256	18 Oct 2018
Com-Power Preamplifier (1MHz-1GHz)	PAM-103	441058	22 Sep 2018
R&S Preamplifier (1GHz -18GHz)	SCU18	102191	10 Mar 2018
ETS Horn Antenna(18GHz-40GHz) (Ref)	3116	0004-2474	18 Oct 2018
Agilent Preamplifier(1GHz-26.5GHz)	8449B	3008A01078	08 Jun 2018
EMCO Loop Ant (ext)_red_00134413	6502	134413	28 Oct 2018
Micro-tronics Bandstop Filter (2.4GHz)	BRM50701-02	007	13 Jan 2018
K&L Microwave Tunable Band Reject Filter	3TNF-500/1000-N/N	396	15 Jan 2018

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Test Setup

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m X 1.0m X 0.8m high, non-metallic table for measurement up to 1GHz. For measurement above 1GHz, 1.5m height table was used.
2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
3. The relevant broadband antenna was set at the required test distance away from the EUT and supporting equipment boundary.

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
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.
3. The test was carried out at the selected frequency points obtained from the prescan in step 2. 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 polarisation (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.
4. A Quasi-peak measurement was made for that frequency point if it was less than or equal to 1GHz. For frequency point in the range of 9kHz – 90kHz, 110kHz – 490kHz and above 1GHz, both Peak and Average measurements were carried out.
5. Steps 3 and 4 were repeated for the next frequency point, until all selected frequency points were measured.
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

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Results

Test Input Power	120V 60Hz	Temperature	22°C
Test Distance	3m (≥30MHz – 25GHz)	Relative Humidity	56%
Antenna type	Toaglas	Atmospheric Pressure	1030mbar
		Tested By	Dylan Lin

Spurious Emissions ranging from 9kHz – 30MHz (for 9kHz – 90kHz, 110kHz – 490kHz) *See Note 2

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)
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--

Spurious Emissions ranging from 9kHz – 30MHz *See Note 2

Frequency (MHz)	Q-P Value (dBµV/m)	Q-P Limit (dBµV/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--

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)
563.8110	29.5	46.0	16.5	100	359	H
599.9220	29.8	46.0	16.2	100	19	H
648.5930	28.0	46.0	18.0	100	343	H
661.1530	27.2	46.0	18.8	100	343	H
769.4850	27.4	46.0	18.6	100	144	H
876.2470	28.4	46.0	17.6	100	182	V

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)
9.3936	47.0	74.0	27.0	34.5	54.0	19.5	399	30	V
10.5298	47.6	74.0	26.4	36.8	54.0	17.2	200	207	V
11.1358	48.6	74.0	25.4	39.6	54.0	14.4	101	225	V
11.2873	48.9	74.0	25.1	39.8	54.0	14.2	399	30	V
13.9240	55.1	74.0	18.9	41.2	54.0	12.8	399	295	V
17.6812	54.5	74.0	19.5	44.8	54.0	9.2	200	350	V

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Results

Test Input Power	120V 60Hz	Temperature	22°C
Test Distance	3m (≥30MHz – 25GHz)	Relative Humidity	56%
Antenna type	Pulse	Atmospheric Pressure	1030mbar
		Tested By	Dylan Lin

Spurious Emissions ranging from 9kHz – 30MHz (for 9kHz – 90kHz, 110kHz – 490kHz) *See Note 2

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)
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--

Spurious Emissions ranging from 9kHz – 30MHz *See Note 2

Frequency (MHz)	Q-P Value (dBµV/m)	Q-P Limit (dBµV/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--
--	--	--	--	--	--	--

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)
191.7130	26.5	43.5	17.0	100	359	H
576.3710	27.7	46.0	18.3	100	283	V
599.9220	27.5	46.0	18.5	201	348	H
612.4820	27.8	46.0	18.2	100	318	H
623.4720	27.3	46.0	18.7	300	12	H
636.0320	27.9	46.0	18.1	100	336	H

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)
2.1766	36.0	74.0	38.0	31.0	54.0	23.0	300	324	V
2.1918	36.5	74.0	37.5	31.1	54.0	22.9	101	319	V
2.7140	36.2	74.0	37.8	31.2	54.0	22.8	399	218	H
2.9139	37.9	74.0	36.1	32.0	54.0	22.0	300	42	H
13.9695	54.6	74.0	19.4	39.5	54.0	14.5	300	182	H
17.0601	53.5	74.0	20.5	45.0	54.0	9.0	200	108	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. A closer test distance of 10m was used for the measurement instead of 30m as the fundamental (carrier) electric field strength of the EUT at the 10m distance shows compliance to the limit of 30m test distance.
3. 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.
4. 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.
5. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
   9kHz - 150kHz
   RBW: 100Hz VBW: 300Hz
   150kHz - 30MHz
   RBW: 10kHz VBW: 30kHz
   30MHz - 1GHz
   RBW: 120kHz VBW: 1MHz
   >1GHz
   RBW: 1MHz VBW: 3MHz
6. 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.
7. The channel in the table refers to the transmit channel of the EUT.
8. Radiated Emissions 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, in the range 9kHz – 1GHz is ±3.8dB and >1GHz – 40GHz is ±4.5dB.

47 CFR FCC Part 15.249(a) Radiated Emission (Fundamental and Harmonics) Limits

Fundamental Frequency (MHz)	Field Strength of Fundamental Limit Values @ 3m (dBµV/m) *	Field Strength of Harmonics Limit Values @ 3m (dBµV/m) *
902 - 928	94.0	54.0
2400 - 2483.5	94.0	54.0
5725 - 5875	94.0	54.0
24000 - 24250	108.0	68.0
* Quasi peak detector was employed for frequency up to 1GHz. For above 1GHz frequency, average detector was used. A peak limit of 20dB above the average limit does apply.		

47 CFR FCC Parts 15.249(a) Radiated Emission (Fundamental and Harmonics) Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Agilent EMC Analyzer (9kHz-26.5GHz)	E7405A	US40240195	20 Mar 2018
Schaffner Bilog Antenna	CBL6112B	2593	18 Jan 2018
TDK-RF Horn Antenna	HRN-0118	130256	18 Oct 2018
Com-Power Preamplifier (1MHz-1GHz)	PAM-103	441058	22 Sep 2018
R&S Preamplifier (1GHz -18GHz)	SCU18	102191	10 Mar 2018
ETS Horn Antenna(18GHz-40GHz) (Ref)	3116	0004-2474	18 Oct 2018
Agilent Preamplifier(1GHz-26.5GHz)	8449B	3008A01078	08 Jun 2018
Micro-tronics Bandstop Filter (2.4GHz)	BRM50701-02	007	13 Jan 2018
K&L Microwave Tunable Band Reject Filter	3TNF-500/1000-N/N	396	15 Jan 2018

47 CFR FCC Part 15.249(a) Radiated Emission (Fundamental and Harmonics) Test Setup

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m X 1.0m X 0.8m high, non-metallic table.
2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
3. The relevant broadband antenna was set at the required test distance away from the EUT and supporting equipment boundary.

47 CFR FCC Part 15.249(a) Radiated Emission (Fundamental and Harmonics) Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. A prescan was carried out to pick the fundamental and harmonics 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.
3. The test was carried out at the selected frequency points obtained from the prescan in step 2. 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 polarisation (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.
4. A Quasi-peak measurement was made for that frequency point if it was less than or equal to 1GHz. For frequency point that above 1GHz, both Peak and Average measurements were carried out.
5. Steps 3 and 4 were repeated for the next frequency point, until all selected frequency points were measured.
6. The frequency range covered was from the EUT fundamental frequency until its 10th harmonics, using the 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 (Class B) = 200 μV/m = 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 = 40.0 - 46.0 = -6.0 i.e. 6 dB below Q-P limit

47 CFR FCC Part 15.249(a) Radiated Emission (Fundamental and Harmonics) Results

Test Input Power	120V 60Hz	Temperature	22°C
Test Distance	3m	Relative Humidity	56%
		Atmospheric Pressure	1030mbar
		Tested By	Dylan Lin

Fundamental and harmonics field strengths up to 1GHz

Frequency (GHz)	Q-P Value (dBµV/m)	Q-P Limit (dBµV/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Note
908.3970	90.9	94.0	3.1	100	55	V	F

Fundamental and harmonics field strength above 1GHz

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)	Note
1.8174	54.5	74.0	19.5	43.2	54.0	10.8	200	352	H	H
2.7238	45.6	74.0	28.4	-- *See Note 2	54.0	8.4	200	352	H	H
3.4683	43.9	74.0	30.1	-- *See Note 2	54.0	10.1	200	22	V	H
4.9251	49.3	74.0	24.7	-- *See Note 2	54.0	4.7	200	7	H	H
6.3576	47.6	74.0	26.4	-- *See Note 2	54.0	6.4	300	83	V	H
7.2681	46.4	74.0	8.6	-- *See Note 2	54.0	7.6	400	332	H	H

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. “F” denotes fundamental and “H” denotes harmonics.
5. 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.
6. 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.
7. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
   30MHz - 1GHz
   RBW: 120kHz VBW: 1MHz
   >1GHz
   RBW: 1MHz VBW: 3MHz
8. 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.
9. The channel in the table refers to the transmit channel of the EUT.
10. Radiated Emissions 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, in the range 30MHz – 1GHz is ±3.8dB and >1GHz – 40GHz is ±4.5dB.

47 CFR FCC Part 1.1310 Maximum Permissible Exposure (MPE) Limits

The EUT shows compliance to the requirements of this section, which states the MPE limits for general population / uncontrolled exposure are as shown below:

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (min)
0.3 - 1.34	614	1.63	100 Note 2	30
1.34 - 30	824 / f	2.19 / f	$180 / f^2$ Note 2	30
30 - 300	27.5	0.073	0.2	30
300 - 1500	-	-	f / 1500	30
1500 - 100000	-	-	1.0	30
Notes				
1. f = frequency in MHz				
2. Plane wave equivalent power density				

47 CFR FCC Part 1.1310 Maximum Permissible Exposure (MPE) Test Instrumentation

Instrument	Model	S/No	Cal Due Date
PMM 8053 Portable Field Meter	8053	0220J10308	20 Jan 2019
PMM Electric Field Probe	EP183	0000J10206	20 Jan 2019

47 CFR FCC Part 1.1310 Maximum Permissible Exposure (MPE) Test Setup

1. The EUT and supporting equipment were set up as shown on the setup photo.
2. The relevant field probe was positioned at least 20cm away from the EUT and supporting equipment boundary.

47 CFR FCC Part 1.1310 Maximum Permissible Exposure (MPE) Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was first carried out at one of the positions / sides of the EUT.
3. Power density measurement (mW/cm^2) was made using the field meter set to the required averaging time.
4. Steps 2 and 3 were repeated for the next position and its associate EUT operating mode, until all possible positions and modes were measured.

Sample Calculation Example

At 2400 MHz, limit = 1.0 mW/cm^2

Power density reading obtained directly from field meter = 0.3 mW/cm^2 averaged over the required 30 minutes.

Therefore, margin = 0.3 – 1.0 = -0.7 mW/cm^2 i.e. 0.7 mW/cm^2 below limit

47 CFR FCC Part 1.1310 Maximum Permissible Exposure (MPE) Results

Test Input Power	120V 60Hz	Temperature	23°C
Test Distance	20cm	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Li Chelmin

Pulse Antenna

Measuring Point	Power Density Value (mW/cm^2)	Averaging Time (min)	Limit (mW/cm^2)
Front Panel	0.0011	30	0.6056
Left Side	0.0008	30	0.6056
Right Side	0.0009	30	0.6056
Back Outlet	0.0007	30	0.6056
Antenna Left	0.0021	30	0.6056
Antenna Right	0.0086	30	0.6056
Antenna Center	0.0069	30	0.6056

TOAGLAS Antenna

Measuring Point	Power Density Value (mW/cm^2)	Averaging Time (min)	Limit (mW/cm^2)
Front Panel	0.0010	30	0.6056
Left Side	0.0010	30	0.6056
Right Side	0.0008	30	0.6056
Back Outlet	0.0003	30	0.6056
Antenna Left	0.0019	30	0.6056
Antenna Right	0.0052	30	0.6056
Antenna Center	0.0049	30	0.6056

Notes

1. All possible modes of operation were investigated. Only the worst case highest radiation levels were measured. Measurements were taken at the required averaging time. All other radiation levels 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. Maximum Permissible Exposure 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, in the range 0.1MHz – 3GHz is ±15.0%.

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