Report on the Radio Testing of:

BEOREMOTE HALO TABLE

Model: 3054

In accordance with
47 CFR FCC Part 15E

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Add value.
Inspire trust.

Prepared for:
Bang & Olufsen a/s
Bang og Olufsen Allé 1, Struer, 7600 Denmark

COMMERCIAL-IN-CONFIDENCE

Document Number: 7191217919-EEC19/17 | Issue: 01
FCC ID: TTU-HALOTABLE

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Foo Kai Maun	03 Oct 2019	
Authorised Signatory	Quek Keng Huat	02 Oct 2019	

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).

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
LA-2018-0702-B
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.

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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	03 Oct 2019

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1.2 Introduction

Applicant	:	Bang & Olufsen a/s Bang og Olufsen Allé 1, Struer, 7600 Denmark
Manufacturer	:	Same as applicant
Factory	:	PCI Kunshan Electronics Company Limited
Model Number(s)	:	3054
Serial Number(s)	:	32587238
Number of Samples Tested	:	1
Test Sample(s) Condition	:	Good
Quotation Reference	:	5231291
Test Specification/Issue/Date	:	FCC 47 CFR Part 15E
Test Sample(s) Received Date	:	20 Aug 2019
Start of Test	:	20 Aug 2019
Finish of Test	:	02 Oct 2019

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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	Pass	ANSI C63.4: 2014 ANSI C63.10: 2013 KDB 789033 D02 General U-NII Test Procedures V02R01: 2017
15.109(a), 15.205, 15.209, 15.407(b)(4), (5), (6), (7)	Radiated Emissions (Spurious Emissions Inclusive Restricted Bands Requirement)	Pass	ANSI C63.4: 2014 ANSI C63.10: 2013 KDB 789033 D02 General U-NII Test Procedures V02R01: 2017
15.407(a)	Spectrum Bandwidth (26dB Bandwidth Measurement)	Not Tested *See Note 2	ANSI C63.4: 2014 ANSI C63.10: 2013 KDB 789033 D02 General U-NII Test Procedures V02R01: 2017
15.407(e)	Spectrum Bandwidth (6dB Bandwidth Measurement)	Not Tested *See Note 2	ANSI C63.4: 2014 ANSI C63.10: 2013 KDB 789033 D02 General U-NII Test Procedures V02R01: 2017
15.407(a)(1)(iv) (2),(3)	Maximum Conducted Output Power	Pass	ANSI C63.4: 2014 ANSI C63.10: 2013 KDB 789033 D02 General U-NII Test Procedures V02R01: 2017
15.407(h)(1)	Transmit Power Control	Not Tested *See Note 2	ANSI C63.4: 2014 ANSI C63.10: 2013 KDB 789033 D02 General U-NII Test Procedures V02R01: 2017
15.407(a)(1)(iv) , (2), (3)	Peak Power Spectral Density	Not Tested *See Note 2	ANSI C63.4: 2014 ANSI C63.10: 2013 KDB 789033 D02 General U-NII Test Procedures V02R01: 2017
15.407(g)	Frequency Stability	Not Tested *See Note 2	ANSI C63.4: 2014 ANSI C63.10: 2013 KDB 789033 D02 General U-NII Test Procedures V02R01: 2017
15.407(b)(1), (2), (3), (4)(i)	Undesirable Emissions	Not Tested *See Note 2	ANSI C63.4: 2014 ANSI C63.10: 2013 KDB 789033 D02 General U-NII Test Procedures V02R01: 2017
15.407(h), (i)	Dynamic Frequency Selection	Not Tested *See Note 3	ANSI C63.4: 2014 ANSI C63.10: 2013 KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02 2016
2.1091	Maximum Permissible Exposure	Pass	

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Notes

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

2. The WLAN module of the Equipment Under Test (EUT) is a FCC certified module. The module was integrated into the main board without modifications in hardware nor firmware. Refer to FCC Grant bearing FCC ID: VPYLBEE59B1LV for details.

3. The WLAN module of the Equipment Under Test (EUT) is a FCC certified module. The module was integrated into the main board without modifications in hardware nor firmware. As such, the Dynamic Frequency Selection (DFS) of the EUT is deemed to meet the requirement of FCC 15.407(h), (i) without testing.

4. The EUT was operated in continuous transmission, ie 100% duty cycle.

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1.4 Product Information

1.4.1 Technical Description

Description	:	The Equipment Under Test(s) (EUT(s)) is a **BEOREMOTE HALO TABLE.**
Microprocessor	:	STMicroelectronics STM32l4S9AII
Operating Frequency	:	Microcontroller: 120MHz Bluetooth Low Energy: 2402MHz – 2480MHz 802.11b/g/n: 2412MHz – 2462MHz 802.11a/n: 5180MHz – 5240MHz, 5260MHz – 5320MHz, 5500MHz – 5720MHz, 5745MHz – 5825MHz
Clock / Oscillator Frequency	:	16MHz
Modulation	:	Bluetooth Low Energy: Gaussian Frequency Shift Keying (GFSK) 802.11b: Direct Sequence Spread Spectrum (DSSS) 802.11g: Orthogonal Frequency Division Multiplexing (OFDM) 802.11a: Orthogonal Frequency Division Multiplexing (OFDM) 802.11n: Orthogonal Frequency Division Multiplexing (OFDM)
Antenna Gain	:	0.99dBi (BLE) 0.99dBi (2.4GHz WLAN) 2.23dBi (5GHz WLAN)
Port / Connectors	:	1 x USB-C Port (USB SHIELDED I/O RECP TYPE C)
Rated Power	:	DC 5V 1.5A
Accessories	:	USB to USB Type C Cable

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1.4.2 Test Configuration and Modes of Operation

<table>
<tr><th>Mode(s)</th><th>Description</th></tr>
<tr><td>Maximum RF power transmission</td><td>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.

UNII-1
<table>
<tr><th>Transmit Channel</th><th>Frequency (GHz)</th></tr>
<tr><td>Channel 36 (Lower Channel)</td><td>5.180</td></tr>
<tr><td>Channel 42 (Middle Channel)</td><td>5.210</td></tr>
<tr><td>Channel 48 (upper Channel)</td><td>5.240</td></tr>
</table>
UNII-2A
<table>
<tr><th>Transmit Channel</th><th>Frequency (GHz)</th></tr>
<tr><td>Channel 52 (Lower Channel)</td><td>5.260</td></tr>
<tr><td>Channel 60 (Middle Channel)</td><td>5.300</td></tr>
<tr><td>Channel 64 (upper Channel)</td><td>5.320</td></tr>
</table>
UNII-2C
<table>
<tr><th>Transmit Channel</th><th>Frequency (GHz)</th></tr>
<tr><td>Channel 100 (Lower Channel)</td><td>5.500</td></tr>
<tr><td>Channel 120 (Middle Channel)</td><td>5.600</td></tr>
<tr><td>Channel 144 (upper Channel)</td><td>5.720</td></tr>
</table>
UNII-3
<table>
<tr><th>Transmit Channel</th><th>Frequency (GHz)</th></tr>
<tr><td>Channel 149 (Lower Channel)</td><td>5.745</td></tr>
<tr><td>Channel 157 (Middle Channel)</td><td>5.785</td></tr>
<tr><td>Channel 165 (upper Channel)</td><td>5.825</td></tr>
</table>
</td></tr>
</table>

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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,
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

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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) Science Park 2932I-1 (3m and 10m Semi-Anechoic Chamber) International Business Park 2932N-1 (10m Semi-Anechoic Chamber)
VCCI	Science Park R-1335 (10m ANC) C-2306 (C.E @ Lab 3) T-1471 (Telecom Ports @ Lab 3) International Business Park R-3324 (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

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1.9 Supporting Equipment

Equipment Description (Including Brand Name)	Model, Serial & FCC ID Number	Cable Description (List Length, Type & Purpose)
Fujitsu Lifebook	M/N: SH560 S/N: R0400172 FCC ID: EJE-WB0001	Nil
Fujitsu AC Adaptor	M/N: CP311808-01 S/N: 08903690B FCC ID: DoC	1.80m unshielded power cable

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2 Test Details

2.1 Conducted Emissions

2.1.1 Test 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		

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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 power supply for the EUT was fed through a 50Ω/50μH EUT LISN, connected to filtered mains.

2.1.2.3 The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.

2.1.2.4 All other supporting equipment were powered separately from another LISN.

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 scan was made on the NEUTRAL line over the required frequency range using an EMI test receiver.

2.1.3.3 High peaks, relative to the limit line, were then selected.

2.1.3.4 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.

2.1.3.5 The measurements 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

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2.1.4 Test Results

Test Input Power	120V 60Hz	Temperature	24°C
Line Under Test	AC Mains	Relative Humidity	60%
Worst Mode	IEEE 802.11n (6.5Mbps)	Atmospheric Pressure	1030mbar
		Tested By	Chang Wai Kit
		Test Date	04 Sep 2019

Frequency (MHz)	Q-P Value (dBµV)	Q-P Limit (dBµV)	Q-P Margin (dB)	AV Value (dBµV)	AV Limit (dBµV)	AV Margin (dB)	Line	Channel (Worst)
0.1745	43.7	64.7	21.0	33.8	54.7	20.9	Neutral	149
0.1953	41.7	63.8	22.1	31.8	53.8	22.0	Neutral	149
0.2247	39.6	62.6	23.0	29.7	52.6	22.9	Neutral	149
0.2639	35.4	61.3	25.9	25.5	51.3	25.8	Neutral	149
0.5002	34.5	56.0	21.5	24.6	46.0	21.4	Neutral	149
0.9276	32.8	56.0	23.2	22.9	46.0	23.1	Live	149

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

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2.2 Radiated Emissions (Spurious Emissions Inclusive Restricted Bands Requirement)

2.2.1 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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2.2.2 Test Setup

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

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

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

2.2.3 Test Method

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

2.2.3.2 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.

2.2.3.3 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 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

2.2.3.4 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.

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

2.2.3.6 The frequency range covered was from the lowest radio frequency signal generated from the EUT, without going below 9kHz to 10^{th} 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	120V 60Hz	Temperature	22ºC
Test Distance	3m (<30MHz) 3m (≥30MHz – 40GHz)	Relative Humidity	56%
Worst Mode	802.11n (6.5Mbps)	Atmospheric Pressure	1029mbar
		Tested By	Nazrulhizat
		Test Date	24 Sep 2019

Spurious Emissions ranging from 9kHz – 30MHz (for 9kHz – 90kHz, 110kHz – 490kHz) *See Note 2 & 3

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
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Spurious Emissions ranging from 9kHz – 30MHz *See Note 2 & 3

Frequency (MHz)	Q-P Value (dBµV/m)	Q-P Limit (dBµV/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Channel
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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 (Worst)
40.7280	22.8	40.0	17.2	100	221	V	149
97.2070	22.3	43.5	21.2	401	55	H	149
514.7070	33.1	46.0	12.9	100	330	V	149
521.8090	33.5	46.0	12.5	100	323	V	149
526.6100	32.4	46.0	13.6	100	339	V	149
531.2150	32.3	46.0	13.7	100	330	V	149

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Spurious Emissions above 1GHz – 40GHz

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
1.2484	49.0	74.0	25.0	38.2	54.0	15.8	100	217	H	36
1.5964	49.0	74.0	25.0	31.6	54.0	22.4	300	36	H	36
2.4936	49.3	74.0	24.7	33.4	54.0	20.6	300	353	V	36
2.6604	47.4	74.0	26.6	33.9	54.0	20.1	102	4	V	36
4.9793	50.0	74.0	24.0	34.7	54.0	19.3	300	35	V	36
14.1874	54.9	74.0	19.1	42.4	54.0	11.6	398	103	V	36

Spurious Emissions above 1GHz – 40GHz

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
1.1984	43.4	74.0	30.6	35.8	54.0	18.2	300	3	V	42
1.2449	48.0	74.0	26.0	40.0	54.0	14.0	200	267	V	42
1.3477	48.1	74.0	25.9	32.2	54.0	21.8	300	68	V	42
1.5973	49.4	74.0	24.6	34.6	54.0	19.4	200	29	H	42
2.4926	46.6	74.0	27.4	40.1	54.0	13.9	398	9	V	42
14.6100	54.9	74.0	19.1	42.4	54.0	11.6	398	103	V	42

Spurious Emissions above 1GHz – 40GHz

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
1.2728	46.7	74.0	27.3	35.3	54.0	18.7	230	200	V	48
1.3226	48.6	74.0	25.4	37.9	54.0	16.1	270	300	V	48
1.3476	48.6	74.0	25.4	39.4	54.0	14.6	200	398	V	48
1.4972	48.3	74.0	25.7	34.8	54.0	19.2	250	398	V	48
2.9948	46.8	74.0	27.2	37.4	54.0	16.6	102	200	V	48
14.2478	53.1	74.0	20.9	44.1	54.0	9.9	398	102	V	48

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Spurious Emissions above 1GHz – 40GHz

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
1.3475	48.3	74.0	25.7	37.9	54.0	16.1	300	353	V	52
1.5974	49.7	74.0	24.3	38.8	54.0	15.2	398	327	V	52
2.4892	48.0	74.0	26.0	32.7	54.0	21.3	300	353	V	52
2.6640	47.8	74.0	26.2	33.6	54.0	20.4	102	3	V	52
9.2669	48.8	74.0	25.2	36.7	54.0	17.3	102	353	V	52
9.8851	53.3	74.0	20.7	39.5	54.0	14.5	398	346	V	52

Spurious Emissions above 1GHz – 40GHz

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
1.1745	37.0	74.0	37.0	34.3	54.0	19.7	398	308	V	60
1.3087	39.8	74.0	34.2	35.9	54.0	18.1	102	29	V	60
1.3478	42.5	74.0	31.5	37.4	54.0	16.6	398	352	V	60
1.5939	42.0	74.0	32.0	32.6	54.0	21.4	398	104	V	60
2.1235	39.1	74.0	34.9	31.0	54.0	23.0	102	353	V	60
2.6536	43.4	74.0	30.6	31.6	54.0	22.4	102	104	V	60

Spurious Emissions above 1GHz – 40GHz

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
1.2727	39.9	74.0	34.1	34.9	54.0	19.1	102	40	V	64
1.3224	40.3	74.0	33.7	36.1	54.0	17.9	398	343	V	64
1.3470	38.4	74.0	35.6	37.8	54.0	16.2	398	13	V	64
1.3725	40.7	74.0	33.3	32.4	54.0	21.6	102	14	V	64
1.5931	44.3	74.0	29.7	30.7	54.0	23.3	398	251	V	64
2.3041	42.6	74.0	31.4	30.8	54.0	23.2	102	104	V	64

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Spurious Emissions above 1GHz – 40GHz

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
1.2000	40.4	74.0	33.6	33.6	54.0	20.4	398	88	H	100
1.3482	42.3	74.0	31.7	30.0	54.0	24.0	398	256	V	100
1.5971	45.5	74.0	28.5	29.5	54.0	24.5	398	256	V	100
1.6658	40.6	74.0	33.4	29.3	54.0	24.7	102	139	V	100
2.6560	47.5	74.0	26.5	31.9	54.0	22.1	102	5	V	100
6.8944	49.6	74.0	24.4	33.9	54.0	20.1	398	82	V	100

Spurious Emissions above 1GHz – 40GHz

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
1.3474	43.8	74.0	30.2	34.9	54.0	19.1	398	32	V	120
1.6000	45.5	74.0	28.5	29.7	54.0	24.3	398	38	H	120
1.6650	40.7	74.0	33.3	29.0	54.0	25.0	102	183	V	120
2.1247	44.4	74.0	29.6	30.4	54.0	23.6	398	135	V	120
2.4964	42.5	74.0	31.5	29.8	54.0	24.2	102	349	V	120
2.6621	44.1	74.0	29.9	33.1	54.0	20.9	102	11	V	120

Spurious Emissions above 1GHz – 40GHz

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
1.2727	42.0	74.0	32.0	33.5	54.0	20.5	102	19	V	144
1.3224	41.1	74.0	32.9	36.2	54.0	17.8	102	26	V	144
1.3470	38.7	74.0	35.3	35.3	54.0	18.7	102	44	V	144
1.3721	46.1	74.0	27.9	31.4	54.0	22.6	102	351	V	144
1.4973	38.2	74.0	35.8	34.2	54.0	19.8	398	77	H	144
2.9998	41.5	74.0	32.5	33.4	54.0	20.6	398	358	V	144

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Spurious Emissions above 1GHz – 40GHz

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
1.2727	42.0	74.0	32.0	33.5	54.0	20.5	102	19	V	149
1.3224	41.1	74.0	32.9	36.2	54.0	17.8	102	26	V	149
1.3470	38.7	74.0	35.3	35.3	54.0	18.7	102	44	V	149
1.3721	46.1	74.0	27.9	31.4	54.0	22.6	102	351	V	149
1.4973	38.2	74.0	35.8	34.2	54.0	19.8	398	77	H	149
2.9998	41.5	74.0	32.5	33.4	54.0	20.6	398	358	V	149

Spurious Emissions above 1GHz – 40GHz

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
1.1959	40.5	74.0	33.5	29.5	54.0	24.5	398	73	H	157
1.3478	43.3	74.0	30.7	32.7	54.0	21.3	398	46	H	157
1.5987	45.3	74.0	28.7	33.2	54.0	20.8	398	40	H	157
2.2835	40.2	74.0	33.8	29.8	54.0	24.2	398	359	V	157
2.6568	43.5	74.0	30.5	36.1	54.0	17.9	102	353	V	157
6.1066	48.1	74.0	25.9	27.5	54.0	26.5	398	309	H	157

Spurious Emissions above 1GHz – 40GHz

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
1.2727	39.5	74.0	34.5	33.2	54.0	20.8	102	14	V	165
1.2977	38.1	74.0	35.9	30.7	54.0	23.3	102	34	V	165
1.3224	39.4	74.0	34.6	36.5	54.0	17.5	102	34	V	165
1.3474	44.2	74.0	29.8	36.1	54.0	17.9	102	26	V	165
1.3725	39.5	74.0	34.5	31.8	54.0	22.2	102	14	V	165
2.9998	43.4	74.0	30.6	32.8	54.0	21.2	398	250	V	165

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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.	"--" indicates no emissions were found and shows compliance to the limits
3.	The measurement was done at 3m. The measured results were extrapolated to the specified test limits as specified in RSS-GEN 6.4 based on 40dB/decade.
4.	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.
5.	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.
6.	EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings: 30MHz - 1GHz RBW: 120kHz VBW: 1MHz >1GHz RBW: 1MHz VBW: 3MHz
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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2.3 Band Edge Compliance (Radiated)

2.3.1 Test Limits

The EUT shows compliance to the requirements of this section, which states in any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator (EUT) is operating, the radio frequency power that is produced by the EUT shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands shall comply to the radiated emission limits specified in 15.209.

2.3.2 Test Setup

2.3.2.1 The EUT and supporting equipment were set up as shown in the setup photo.

2.3.2.2 The power supply for the EUT was connected to a filtered mains.

2.3.2.3 The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 300kHz to show compliance of spurious at band edges are at least 20dB below the carriers. For restricted band spurious at band edges, peak and average measurement plots were taken using the following setting:

a. Peak Plot:
RBW = 1MHz, VBW = 3RBW

b. Average Plot
RBW = 1MHz, VBW = 10Hz

2.3.2.4 All other supporting equipment were powered separately from another filtered mains.

2.3.3 Test Method

2.3.3.1 The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode.

2.3.3.2 The frequency span of the spectrum analyser was set to wide enough to capture the upper band edge of the transmission band, 5.1500GHz and any spurious emissions at the band edge.

2.3.3.3 The spectrum analyser was set to max hold to capture any spurious emissions within the span. The signal capturing was continuous until no further spurious emissions were detected.

2.3.3.4 The measurements were repeated if the EUT supports more than one modulation and data rate.

2.3.3.5 The measurements were repeated with the frequency span of the spectrum analyser was set to wide enough to capture the lower band edge frequency of the transmission band, 5.3500GHz and the any spurious emissions at the band-edge.

2.3.3.6 The measurements were repeated with the frequency span of the spectrum analyser was set to wide enough to capture the upper band edge frequency of the transmission band, 5.4600GHz and the any spurious emissions at the band-edge.

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2.3.4 Test Results

Test Input Power	120V 60Hz	Temperature	22ºC
Attached Plots	1 - 6	Relative Humidity	56%
		Atmospheric Pressure	1029mbar
		Tested By	Nazrulhizat
		Test Date	24 Sep 2019

No significant signal was found and they were below the specified limit.

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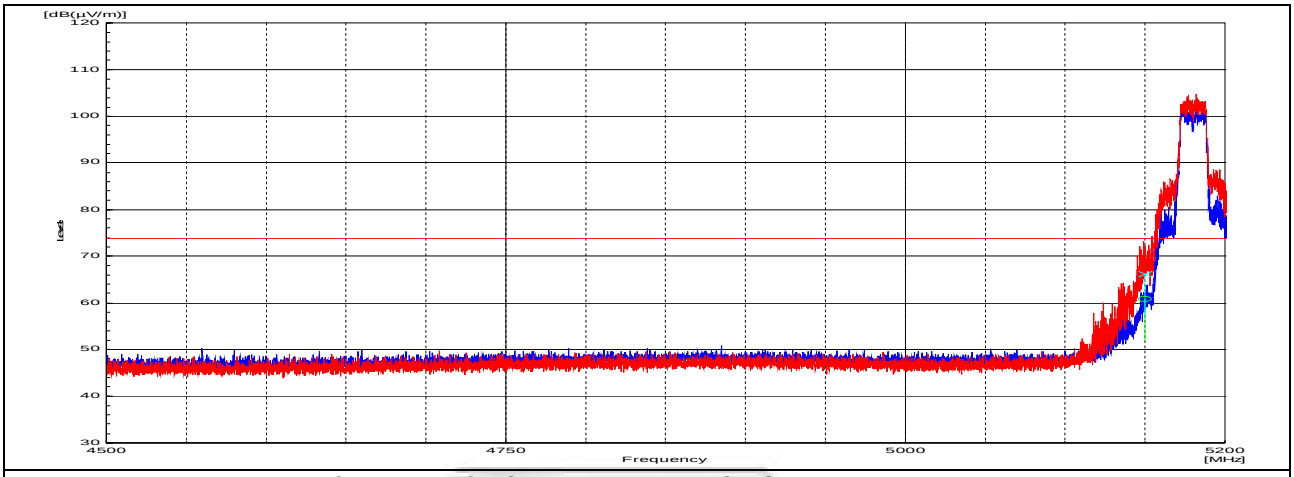
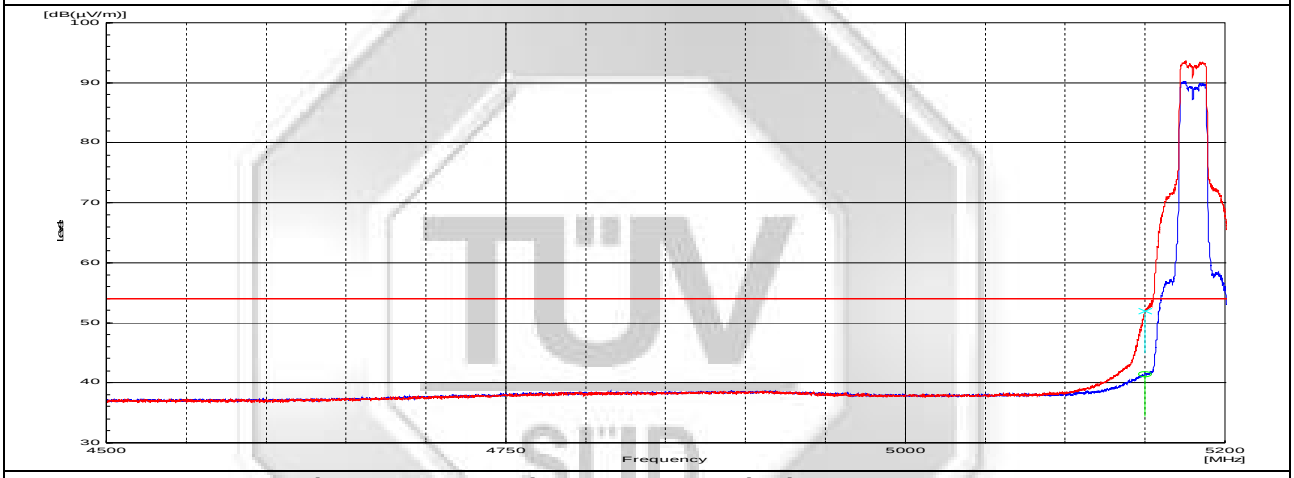
Band Edge Compliance (Radiated) Plots (Restricted Band)



Plot 1 – Peak Plot at Lower Band Edge at 5.1500GHz



Plot 2 – Average Plot at Lower Band Edge at 5.1500GHz

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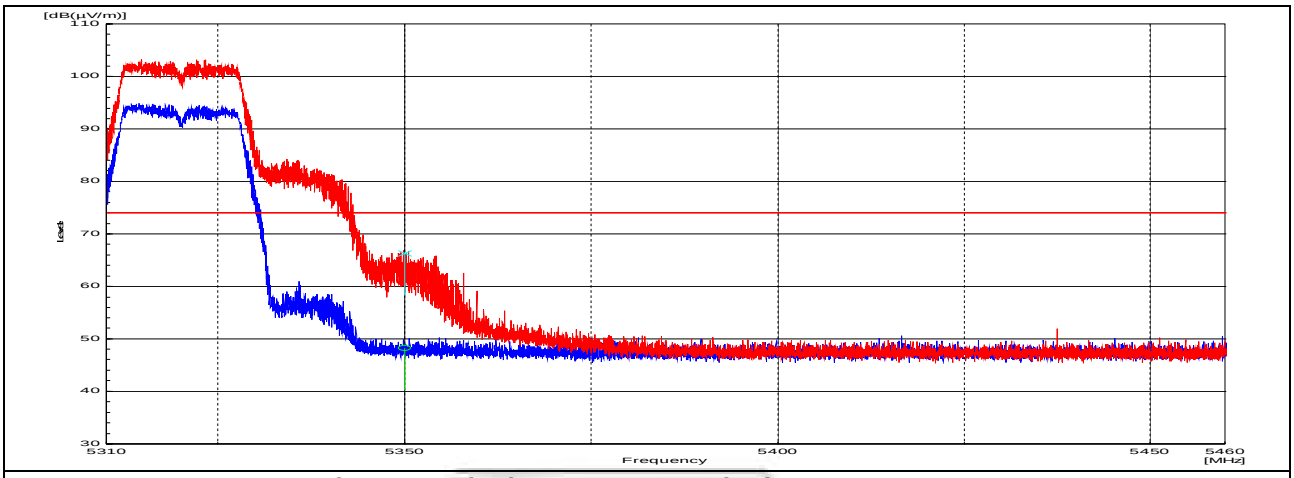
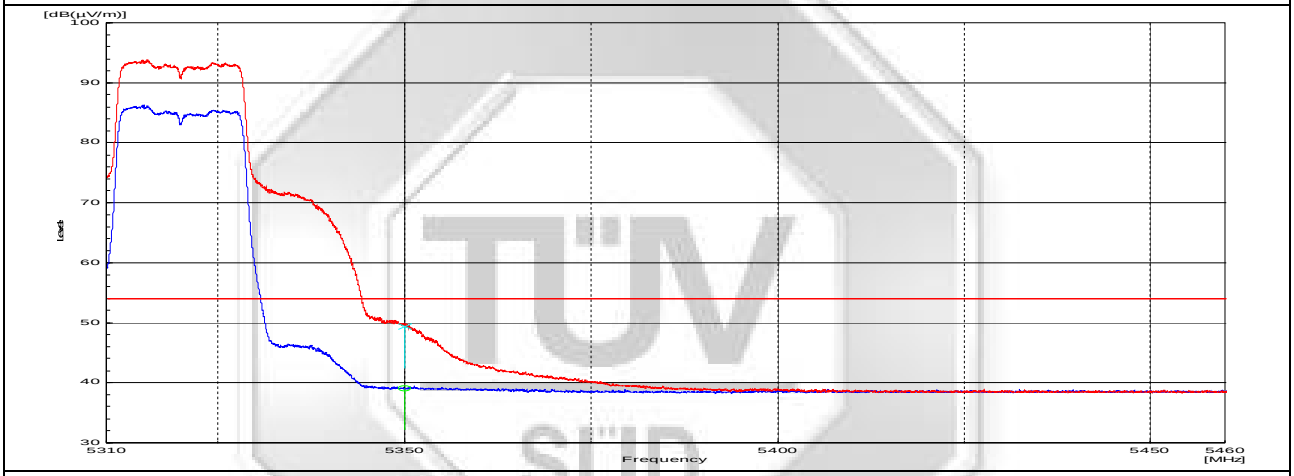
Band Edge Compliance (Radiated) Plots (Restricted Band)



Plot 3 – Peak Plot at Upper Band Edge at 5.3500GHz



Plot 4 – Average Plot at Upper Band Edge at 5.3500GHz

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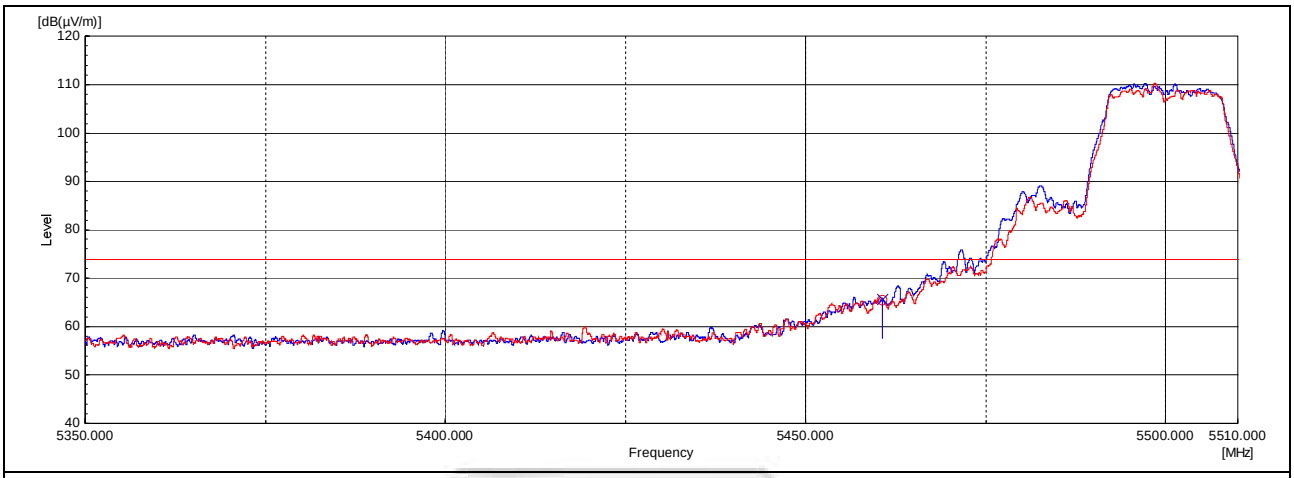
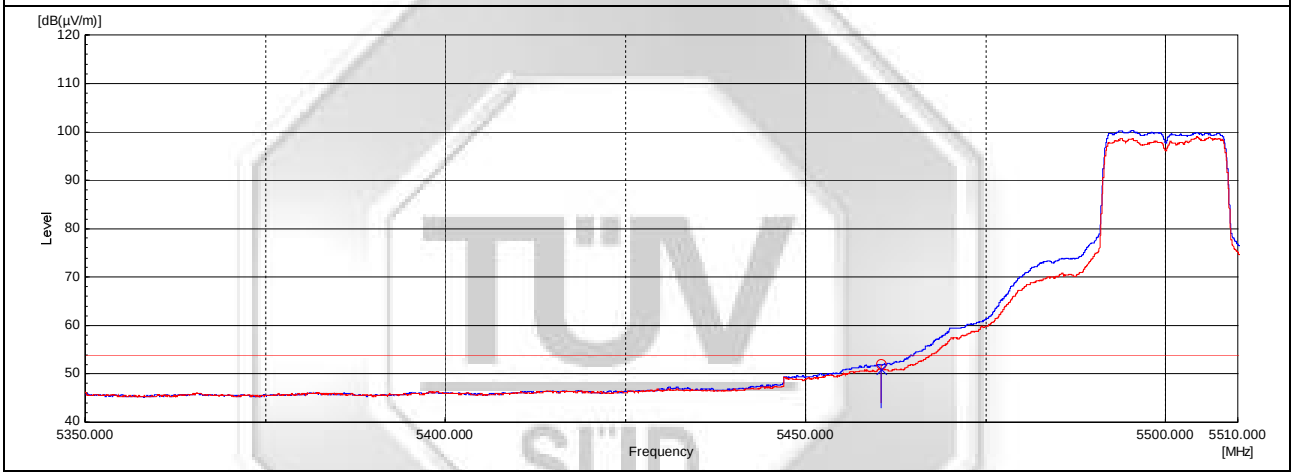
Band Edge Compliance (Radiated) Plots (Restricted Band)



Plot 5 – Peak Plot at Upper Band Edge at 5.4600GHz



Plot 6 – Average Plot at Upper Band Edge at 5.4600GHz

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2.4 Maximum Conducted Output Power

2.4.1 Test Limits

The EUT shows compliance to the requirements of this section, which states the EUT shall not exceed 250mW in bands UNII-1, UNII-2A, UNII-2C. For the EUT operating in UNII-3 band, the maximum conducted output power shall not greater than 1W.

2.4.2 Test Setup

2.4.2.1 The EUT and supporting equipment were set up as shown in the setup photo.

2.4.2.2 The power supply for the EUT was connected to a filtered mains.

2.4.2.3 The RF antenna connector was connected to a power meter via a low-loss coaxial cable.

2.4.2.4 All other supporting equipment were powered separately from another filtered mains.

2.4.3 Test Method

2.4.3.1 The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode, non-hopping with transmitting frequency at lower channel.

2.4.3.2 The maximum peak power of the transmitting frequency was detected and recorded.

2.4.3.3 The measurement were repeated with the transmitting frequency was set to middle channel and upper channel respectively.

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2.4.4 Test Results

Test Input Power	120V 60Hz	Temperature	24°C
Antenna Gain	4.79dBi	Relative Humidity	60%
Mode	IEEE 802.11a	Atmospheric Pressure	1030mbar
		Tested By	Chang Wai Kit
		Test Date	04 Sep 2019

UNII-1

Channel	Channel Frequency (GHz)	Maximum Conducted Output Power (W)				Limit (W)
		9Mbps	18Mbps	36Mbps	54Mbps	
Lower	5.180	0.0409	0.0437	0.0439	0.0422	0.250
Middle	5.220	0.0407	0.0437	0.0428	0.0417	0.250
Upper	5.240	0.0417	0.0443	0.0421	0.0418	0.250

UNII-2A

Channel	Channel Frequency (GHz)	Maximum Conducted Output Power (W)				Limit (W)
		9Mbps	18Mbps	36Mbps	54Mbps	
Lower	5.260	0.0414	0.0446	0.0441	0.0411	0.250
Middle	5.300	0.0417	0.0448	0.0434	0.0416	0.250
Upper	5.320	0.0431	0.0443	0.0438	0.0421	0.250

UNII-2C

Channel	Channel Frequency (GHz)	Maximum Conducted Output Power (W)				Limit (W)
		9Mbps	18Mbps	36Mbps	54Mbps	
Lower	5.500	0.0459	0.0486	0.0480	0.0454	0.250
Middle	5.600	0.0490	0.0505	0.0491	0.0474	0.250
Upper	5.720	0.0475	0.0497	0.0475	0.0472	0.250

UNII-3

Channel	Channel Frequency (GHz)	Maximum Conducted Output Power (W)				Limit (W)
		9Mbps	18Mbps	36Mbps	54Mbps	
Lower	5.745	0.0590	0.0586	0.0630	0.0564	1.000
Middle	5.785	0.0607	0.0621	0.0612	0.0592	1.000
Upper	5.825	0.0564	0.0592	0.0574	0.0562	1.000

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Test Input Power	120V 60Hz	Temperature	24°C
Antenna Gain	4.79dBi	Relative Humidity	60%
Mode	IEEE 802.11n	Atmospheric Pressure	1030mbar
		Tested By	Anthony Toh
		Test Date	18 Sep 2019

UNII-1

Channel	Channel Frequency (GHz)	Maximum Conducted Output Power (W)				Limit (W)
		6.5Mbps	19.5Mbps	39Mbps	65Mbps	
Lower	5.180	0.0372	0.0364	0.0364	0.0376	0.250
Middle	5.220	0.0363	0.0377	0.0377	0.0374	0.250
Upper	5.240	0.0416	0.0414	0.0421	0.0418	0.250

UNII-2A

Channel	Channel Frequency (GHz)	Maximum Conducted Output Power (W)				Limit (W)
		6.5Mbps	19.5Mbps	39Mbps	65Mbps	
Lower	5.260	0.0410	0.0406	0.0416	0.0415	0.250
Middle	5.300	0.0407	0.0419	0.0425	0.0423	0.250
Upper	5.320	0.0419	0.0417	0.0425	0.0425	0.250

UNII-2C

Channel	Channel Frequency (GHz)	Maximum Conducted Output Power (W)				Limit (W)
		6.5Mbps	19.5Mbps	39Mbps	65Mbps	
Lower	5.500	0.0468	0.0471	0.0470	0.0472	0.250
Middle	5.600	0.0470	0.0476	0.0476	0.0473	0.250
Upper	5.720	0.0463	0.0465	0.0461	0.0457	0.250

UNII-3

Channel	Channel Frequency (GHz)	Maximum Conducted Output Power (W)				Limit (W)
		6.5Mbps	19.5Mbps	39Mbps	65Mbps	
Lower	5.745	0.0632	0.0612	0.0614	0.0603	1.000
Middle	5.785	0.0614	0.0611	0.0589	0.0603	1.000
Upper	5.825	0.0571	0.0575	0.0573	0.0570	1.000

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Notes

1.	Nil.

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2.5 Maximum Permissible Exposure (MPE)

2.5.1 Test 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				

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2.5.2 Test Setup

2.5.2.1 The EUT and supporting equipment were set up as shown on the setup photo.

2.5.2.2 The relevant field probe was positioned at least 20cm away from the EUT and supporting equipment boundary.

2.5.3 Test Method

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

2.5.3.2 The test was first carried out at one of the positions / sides of the EUT.

2.5.3.3 Power density measurement (mW/cm^2) was made using the field meter set to the required averaging time.

2.5.3.4 Measurements 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

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2.5.4 Test Results

Test Input Power	120V 60Hz	Temperature	24°C
Test Distance	20cm	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Anthony Toh
		Test Date	18 Sep 2019

UNII-1

Channel	Channel Frequency (GHz)	Power Density Value (mW/cm^2)	Margin (mW/cm^2)	Averaging Time (min)	Limit (mW/cm^2)
Lower	5.180	0.36	0.66	30	1.0
Middle	5.210	0.35	0.65	30	1.0
Upper	5.240	0.36	0.64	30	1.0

UNII-2A

Channel	Channel Frequency (GHz)	Power Density Value (mW/cm^2)	Margin (mW/cm^2)	Averaging Time (min)	Limit (mW/cm^2)
Lower	5.260	0.38	0.62	30	1.0
Middle	5.300	0.37	0.63	30	1.0
Upper	5.320	0.36	0.64	30	1.0

UNII-2C

Channel	Channel Frequency (GHz)	Power Density Value (mW/cm^2)	Margin (mW/cm^2)	Averaging Time (min)	Limit (mW/cm^2)
Lower	5.500	0.40	0.60	30	1.0
Middle	5.600	0.41	0.59	30	1.0
Upper	5.720	0.40	0.60	30	1.0

UNII-3

Channel	Channel Frequency (GHz)	Power Density Value (mW/cm^2)	Margin (mW/cm^2)	Averaging Time (min)	Limit (mW/cm^2)
Lower	5.745	0.44	0.56	30	1.0
Middle	5.785	0.43	0.57	30	1.0
Upper	5.825	0.42	0.58	30	1.0

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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.

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4 Test Equipment

Instrument	Model	S/No	Cal Due Date
Conducted Emissions			
Schaffner EMI Receiver	SMR4503	40	24 Jul 2020
Agilent EMC Analyzer	E7403A	US41160166	17 Jun 2020
Schaffner LISN (EUT)	NNB42	04/10055	04 Jan 2020
EMCO LISN (for supporting)	3825/2	9309-2127	06 Jan 2020
Radiated Emissions (Spurious Emissions Inclusive Restricted Bands Requirement)			
R&S EMI Test Receiver	ESW44	101661	30 May 2020
R&S EMI Test Receiver	ESR26	101671	14 Mar 2020
EMCO Loop Antenna	6502	9108-2673	13 Nov 2019
Schaffner Bilog Antenna (30MHz-2GHz)	CBL6112B	2597	27 Mar 2020
Com-Power Preamplifier (1MHz-1GHz)	PAM-103	441096	18 Jul 2020
TDK-RF Horn Antenna	HRN-0118	130256	20 Mar 2020
R&S Preamplifier (1GHz -18GHz)	SCU18	102191	15 Jan 2020
ETS Horn Antenna (18GHz-40GHz)	3116	0004-2474	07 Jan 2020
Agilent Preamplifier (1GHz-26.5GHz)	8449D	3008A02305	28 Dec 2019
Toyo Preamplifier (26.5GHz-40GHz)	HAP26-40W	00000005	07 Jan 2020
Micro-Tronics Bandstop Filter (5.15-5.25GHz)	BRC14719	001	13 Aug 2018
Micro-Tronics Bandstop Filter (5.25-5.35GHz)	BRC14720	001	13 Aug 2018
Micro-Tronics Bandstop Filter (5.47-5.725GHz)	BRC50704	006	13 Aug 2018
Band Edge Compliance (Radiated)			
R&S EMI Test Receiver	ESR26	101671	14 Mar 2020
TDK-RF Horn Antenna	HRN-0118	130256	20 Mar 2020
R&S Preamplifier (1GHz -18GHz)	SCU18	102191	15 Jan 2020
Maximum Conducted Output Power			
Boonton Electronics RF Power Meter	4532	97701	13 Nov 2019
Boonton Electronics Peak Power Sensor	56218-S/1	1417	13 Nov 2019
Maximum Permissible Exposure (MPE)			
PMM Portable Field Meter	PMM8053	0220J10308	07 Mar 2021
PMM Electric Field Probe	EP183	0000J10206	07 Mar 2021

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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	9kHz to 30MHz, ±2.4dB
Radiated Emissions	9kHz to 30MHz @ 10m, ±2.3dB 30MHz to 1GHz @ 10m, ±4.0dB 30MHz to 1GHz @ 3m, ±5.6dB >1GHz to 40GHz @3m, ±5.0dB
Maximum Permissible Exposure	0.1MHz – 3GHz is ±15.0%

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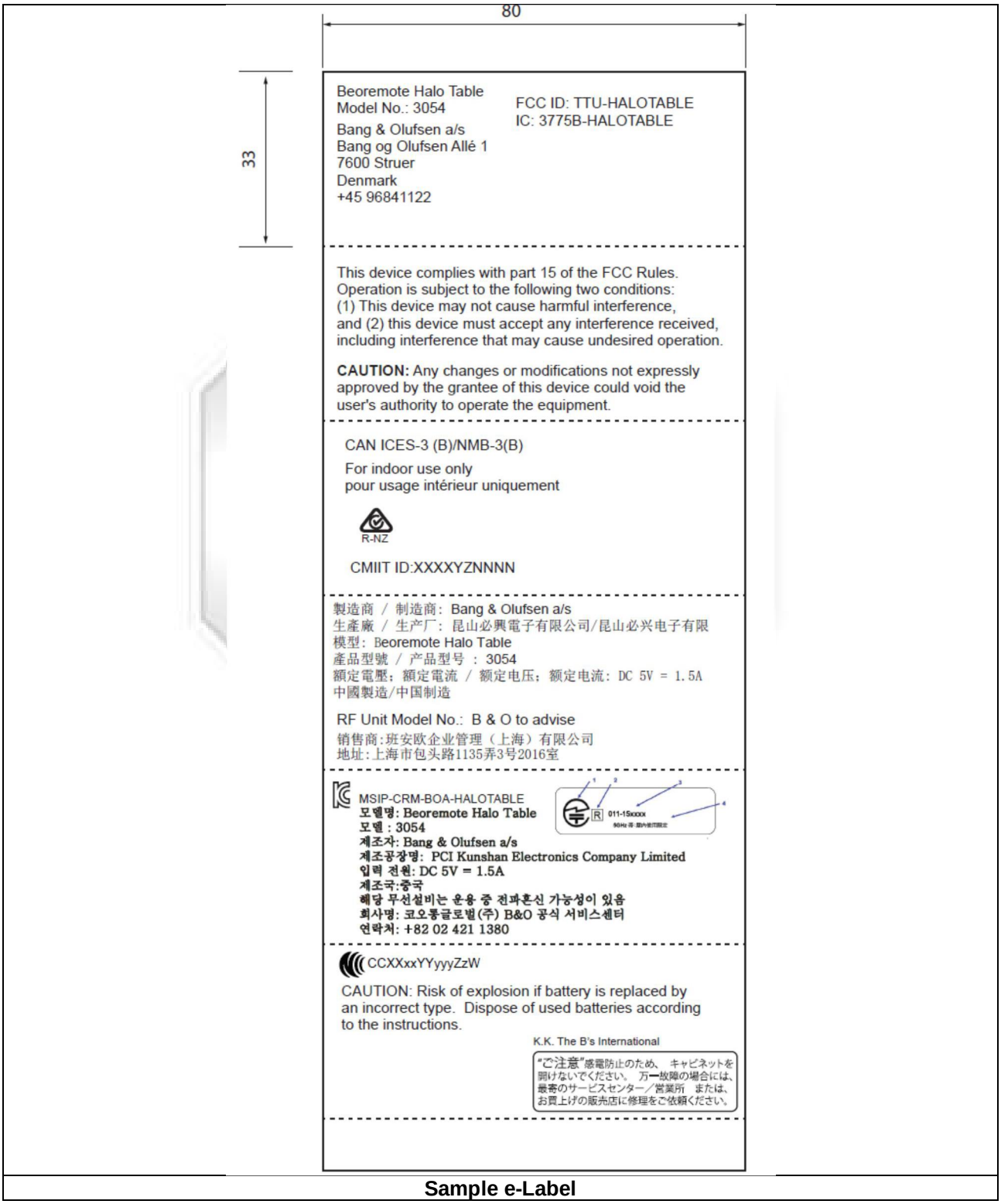
6 Annex A – FCC Label and Position

Labelling requirements per Section 2.925 & 15.19

The label shown will be permanently affixed at a conspicuous location on the device and be readily visible to the user at the time of purchase.



Sample e-Label

PSB Singapore

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July 2011

PSB Singapore

End of the Test Report