

Radio Test Report (Bluetooth LE)

Report No.: RJ181217C39-1

Test Model: H2A

Received Date: Dec. 17, 2018

Test Date: Jan. 14 ~ Feb. 20, 2019

Issued Date: Mar. 07, 2019

Applicant: Google LLC

Address: 1600 Amphitheatre Parkway, Mountain View, CA 94043, USA

Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch

Lab Address: No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan (R.O.C)

Test Location: No.19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, TAIWAN (R.O.C.)



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Release Control Record

Issue No.	Description	Date Issued
RJ181217C39-1	Original release	Mar. 07, 2019

1 Certificate of Conformity

Product: Interactive Video Streaming Device
Test Model: H2A
Sample Status: Engineering sample
Applicant: Google LLC
Test Date: Jan. 14 ~ Feb. 20, 2019
Standards: ARIB STD-T66 (V3.7), MIC notice 88 Appendix 43
Article 2 Paragraph 1 of Item 19

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

Prepared by : Pettie Chen, **Date:** Mar. 07, 2019
Pettie Chen / Senior Specialist

Approved by : Bruce Chen, **Date:** Mar. 07, 2019
Bruce Chen / Project Engineer

2 Summary of Test Results

The EUT has been tested according to the following specifications:

Notice 88 Appendix 43 Reference	ARIB STD-T66 Ref.	Report Reference	Parameter	Test Results (Note)
General Provisions				
C	3.2 (4)	4.1	Frequency tolerance	C
D	3.2 (7)	4.2	Occupied bandwidth	C
E	3.2 (6)	4.4	Spurious emissions	C
Transmitting Equipment				
F	--	4.5	Antenna power	C
--	--	--	SAR	NA
Transmitting Antenna				
--	--	3.5	Type, configuration, etc. of transmitting antenna	C
--	--	3.5	Direction pattern of transmitting antenna	C
Receiving Equipment				
G	3.3 (1)	4.6	Spurious emissions of receiver	C
--	--	3.6	Refer to all articles for transmitting antenna	C
Operating Frequency 2400 to 2483.5MHz				
--	3.7 (1)	3.2	High Frequency	C
--	3.7 (1)	3.4	Modulation section cannot be opened easily	C
--	3.1 (1)	3.1	Communication method	C
--	3.2 (1)a	3.1	Modulation method	C
--	3.2 (1)a	3.1	Spread spectrum method	C
--	3.2 (2)	4.5	Antenna power	C
--	3.6 (2)	3.5.2	Absolute gain of transmitting antenna	C
--	3.6 (2)	--	Angular width of principal radiation (AWPR)	NA
--	3.2 (10)	--	Number of carriers within 1 MHz bandwidth in OFDM	NA
--	3.2 (8)	4.3	Spreading bandwidth	C
--	3.2 (9)	4.3	Spreading factor	C
--	3.2 (11)	--	Frequency retention time (FH employed)	NA
--	3.4.1(1)	4.7	Interference Prevention Function	C
Note: C = Conform NC = Not Conform NT = Not Tested NA = Not Applicable				

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in TR 100 028-1.

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

Parameter	Uncertainty
Occupied Bandwidth	491.896Hz
Spurious emissions	3.508dB
Output power density	2.889dB
Adjacent Channel Leakage Power	1.35dB
Out of band radiated power	3.93dB
Frequency Tolerance	6805.18Hz
Burst length	0.01%

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Interactive Video Streaming Device
Test Model	H2A
Status of EUT	Engineering sample
Nominal Voltage	24Vdc (adapter)
Modulation Type	GFSK
Transfer Rate	1Mbps
Operating Frequency	2402 ~ 2480MHz
Number of Channel	40
Rated RF Output Power Density	4.00mW
Conducted RF Output Power Density	3.741mW
Radiated RF Output Power Density	5.533mW
Antenna Type	PIFA antenna with 1.7dBi gain
Antenna Connector	i-pex(MHF)
Accessory Device	Adapter
Data Cable Supplied	NA
SN	8C192AB2263W

Note:

1. The EUT accessories list refers to EUT Photo.pdf.
2. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

3.2 Description of Test Modes

40 channels are provided to this EUT:

CHANNEL	FREQ. (MHz)	CHANNEL	FREQ. (MHz)	CHANNEL	FREQ. (MHz)	CHANNEL	FREQ. (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

By means of test software (CMD) provided by manufacture, the power levels during the tests were set according to the following codes:

Modulation type: GFSK	
Channel	Power Setting
0	Default
19	Default
39	Default

3.3 Test Conditions

Test Conditions	Voltage (Vac)
V_{normal}	100
$V_{\text{max.}}$	110 (Note)
$V_{\text{min.}}$	90 (Note)

Note: After checking the fluctuation of input voltage to the circuit of the radio part (excluding the power supply) of the equipment to be tested, the fluctuation less than +/- 1 % when input voltage from an external supply into the equipment fluctuates +/- 10%, therefore, the test is carried out only at the normal voltage.

3.4 Assembly

The modulation section, preamplifier, RF component etc, are shielded on the metal housing, and is not capable of being open easily.

3.5 Antenna Specifications

3.5.1 Antenna Gain

PIFA antenna with 1.7dBi gain

3.5.2 Antenna Pattern

Provided by client.

4 Test Results

4.1 Frequency Tolerance Measurement

4.1.1 Limits of Frequency Tolerance Measurement

Tolerance of frequency shall be +/- 50ppm

4.1.2 Test Setup



4.1.3 Test Results

Environmental Conditions		25 deg.C, 68% RH	
Channel	Frequency (MHz)	V _{normal}	
		Carrier frequency (MHz)	Frequency tolerance (ppm)
0	2402	2402.002400	0.999
19	2440	2440.006400	2.622
39	2480	2480.011200	4.516

4.2 Occupied Bandwidth Measurement (99% power bandwidth)

4.2.1 Limits of Occupied Bandwidth Measurement

Item	Limit
Occupied bandwidth	<26MHz

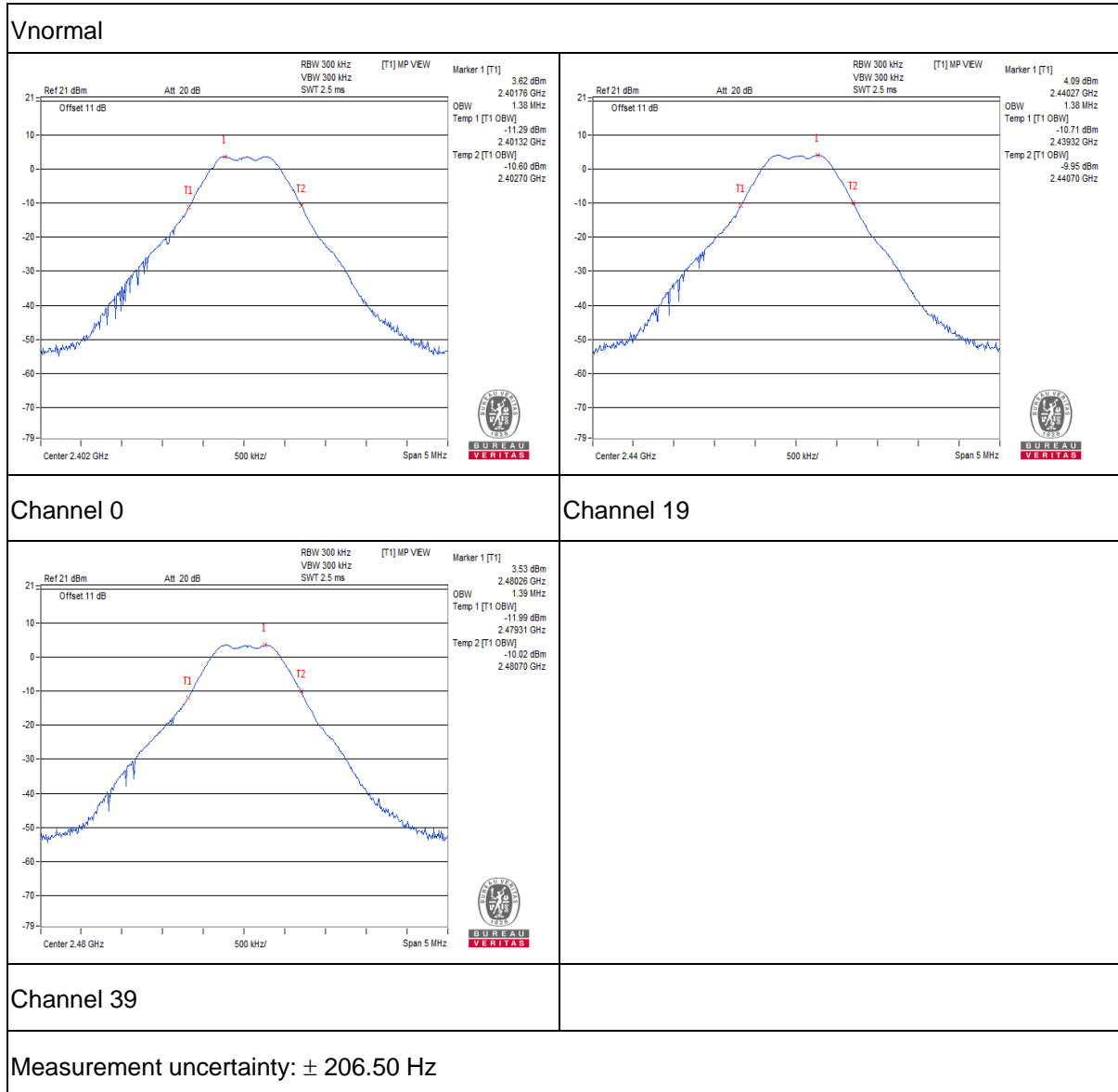
4.2.2 Test Setup



4.2.3 Test Results

Environmental Conditions		25 deg.C, 68% RH
Channel	Frequency (MHz)	V _{normal}
		Occupied Bandwidth (MHz)
0	2402	1.38
19	2440	1.38
39	2480	1.39

Note: 1. For the test plots please refer to the below pages.



4.3 Spreading Bandwidth Measurement (90% power bandwidth)

4.3.1 Limits of Spreading Bandwidth and Spreading Factor Measurement

Item	Limit	Remark
Spreading Bandwidth	$\geq 500\text{kHz}$	
Spreading Factor	≥ 5	Operating frequency 2400 to 2483.5MHz

4.3.2 Test Setup

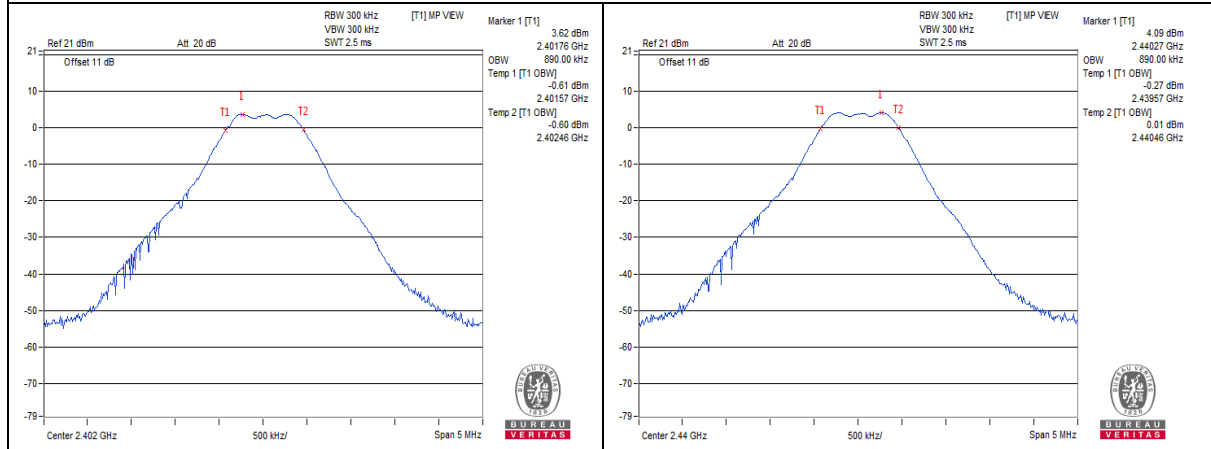


4.3.3 Test Results

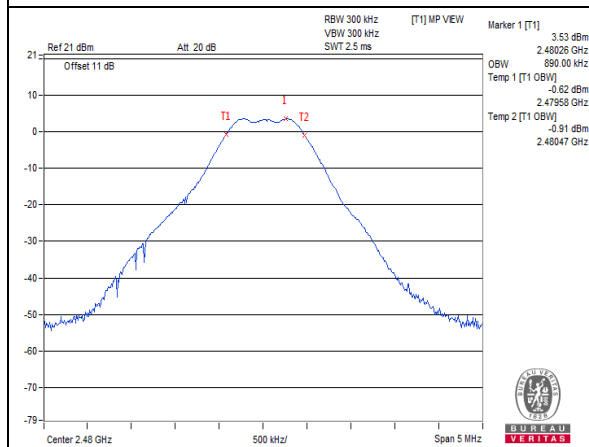
Environmental Conditions		25 deg.C, 68% RH	
Channel	Frequency (MHz)	V _{normal}	
		Occupied Bandwidth (MHz)	Spreading Factor
0	2402	0.89	14.24
19	2440	0.89	14.24
39	2480	0.89	14.24

- Note: 1. For the test plots please refer to the below pages.
 2. Spreading Factor: 90% channel power bandwidth / 0.0625

Vnormal



Channel 0



Channel 19



Channel 39

Measurement uncertainty: ± 206.50 Hz

4.4 Spurious Emissions for Transmitter Measurement

4.4.1 Limits of Spurious Emissions

Frequencies (MHz)	Limit
Operating frequency 2400 to 2483.5MHz	
30.0MHz to 1000.0MHz	$\leq 0.25 \text{ uW/100kHz}$
1000.0MHz to 2387MHz	$\leq 2.5 \text{ uW/MHz}$
2387.0MHz to 2400.0MHz	$\leq 25 \text{ uW/MHz}$
2483.5MHz to 2496.5MHz	$\leq 25 \text{ uW/MHz}$
2496.5MHz to 12500.0MHz	$\leq 2.5 \text{ uW/MHz}$

4.4.2 Test Setup

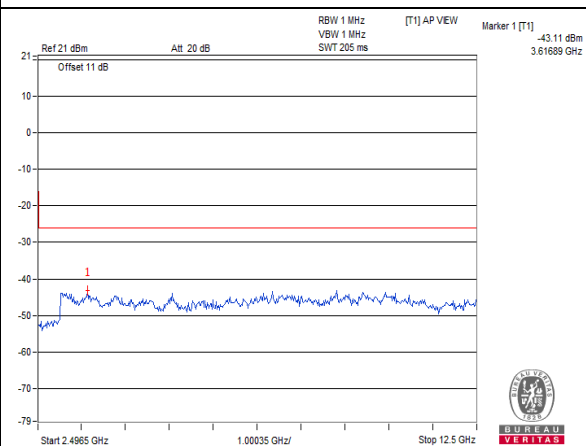
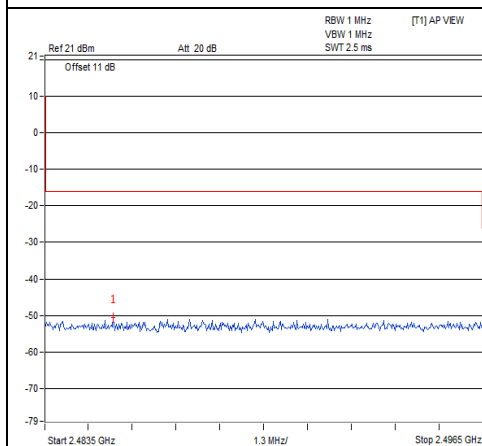
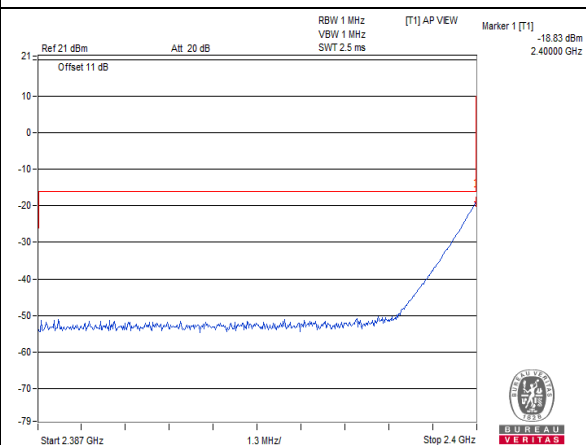
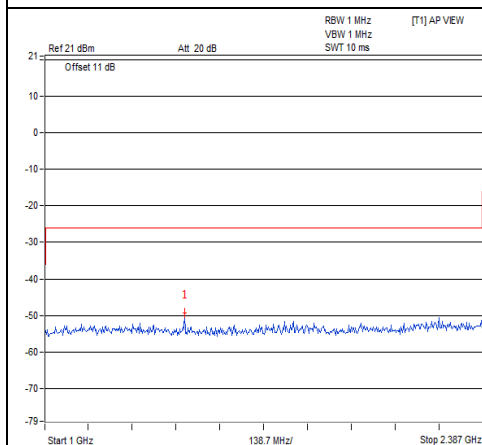
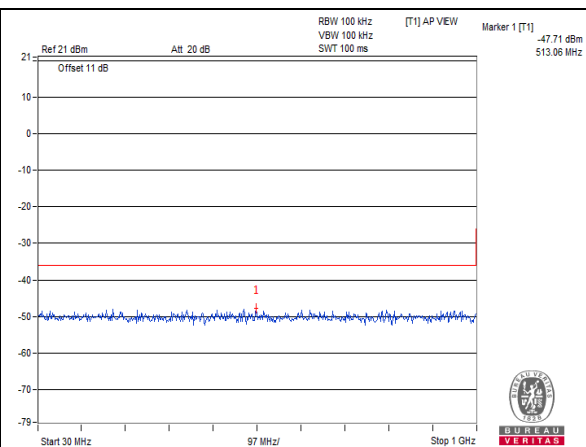
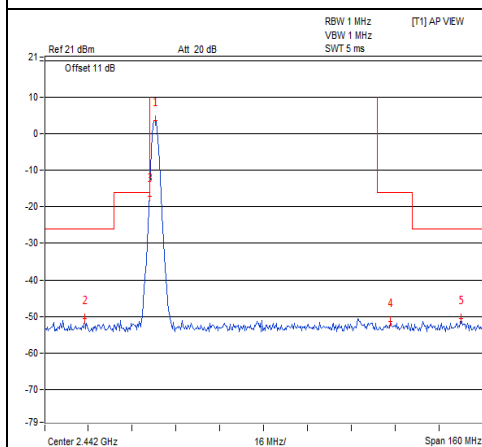


4.4.3 Test Results

Environmental Conditions		25 deg.C, 68% RH					
Test Channel		CH 0 (2402MHz)		CH 19 (2440MHz)		Limit	Result
Test Condition	Frequency Range	Frequency (MHz)	Measured Value (dBm)	Frequency (MHz)	Measured Value (dBm)		
V _{normal}	30.0MHz to 1000.0MHz	513.060	0.016943uW	796.300	0.017458uW	0.25uW	PASS
	1000.0MHz to 2387MHz	1441.060	0.011508uW	1463.250	0.011967uW	2.5uW	PASS
	2387.0MHz to 2400.0MHz	2400.000	13.091819uW	2387.520	0.007656uW	25uW	PASS
	2483.5MHz to 2496.5MHz	2485.500	0.008551uW	2492.960	0.00826uW	25uW	PASS
	2496.5MHz to 12500.0MHz	3616.890	0.048865uW	3156.730	0.055081uW	2.5uW	PASS
Test Channel		CH 39 (2480MHz)				Limit	Result
Test Condition	Frequency Range	Frequency (MHz)		Measured Value (dBm)			
V _{normal}	30.0MHz to 1000.0MHz	497.540		0.016788uW		0.25uW	PASS
	1000.0MHz to 2387MHz	1488.220		0.015171uW		2.5uW	PASS
	2387.0MHz to 2400.0MHz	2397.140		0.007129uW		25uW	PASS
	2483.5MHz to 2496.5MHz	2483.500		0.391742uW		25uW	PASS
	2496.5MHz to 12500.0MHz	9618.990		0.050003uW		2.5uW	PASS

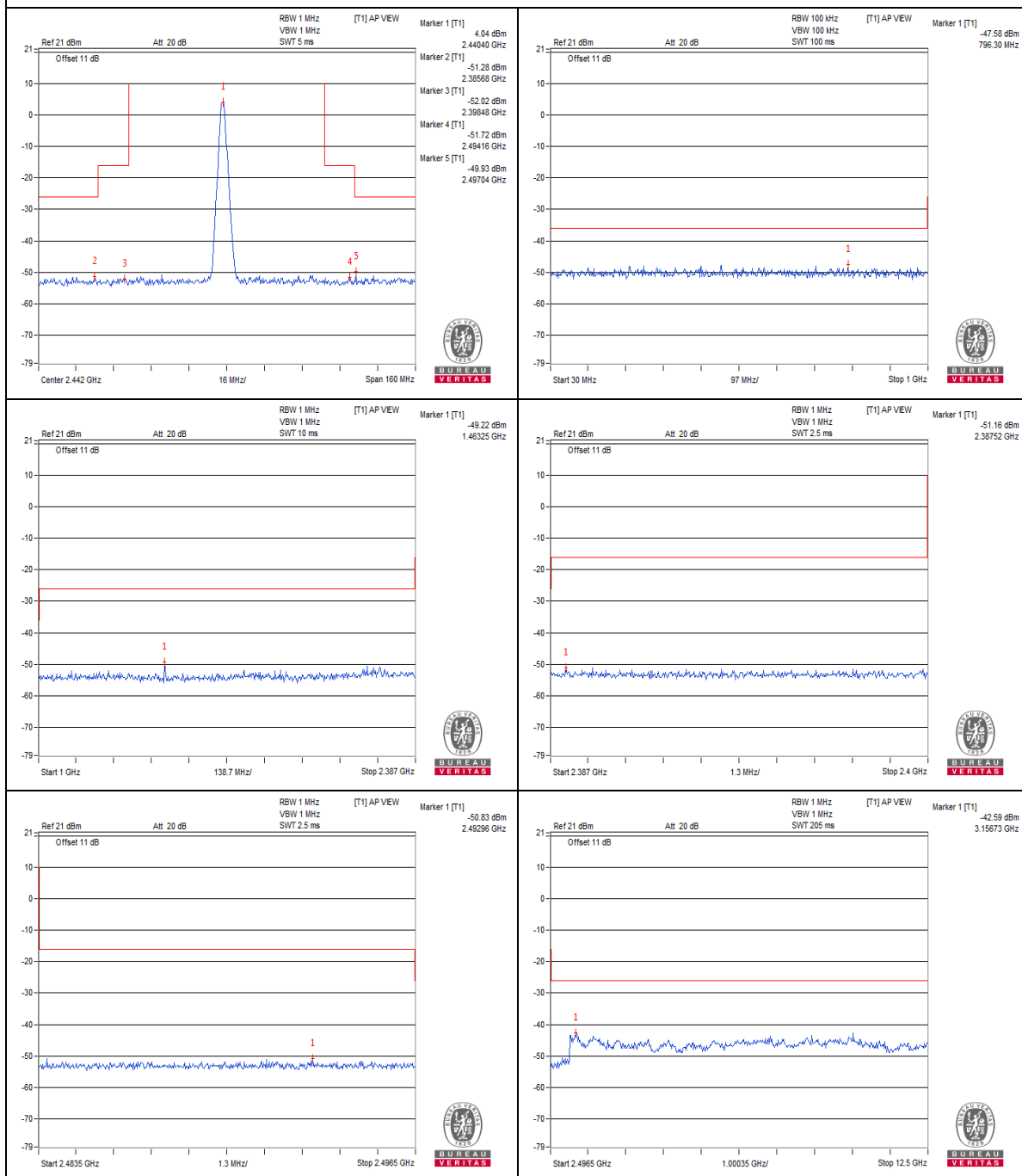
Note: 1. The worst value in each frequency range v.s. each channel has been marked by boldface.

Vnormal Channel 0



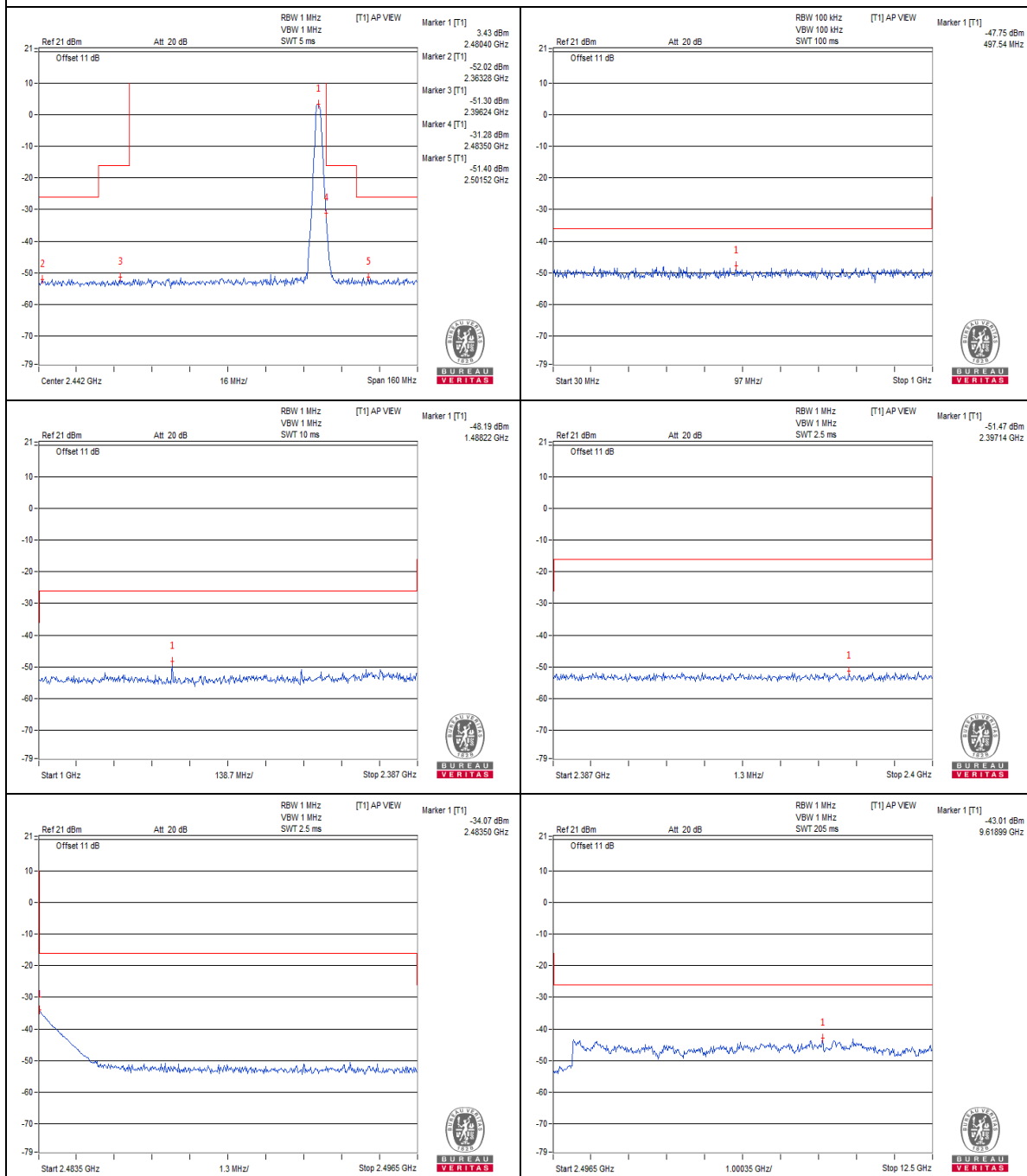
Measurement uncertainty: $\pm 3.93\text{dB}$

Vnormal Channel 19



Measurement uncertainty: $\pm 3.93\text{dB}$

Vnormal Channel 39



Measurement uncertainty: $\pm 3.93\text{dB}$

4.5 Antenna Power Measurement

4.5.1 Limits of Antenna Power

Modulation System	Frequency Band Used	Antenna Power (Max.)	EIRP (Max.)	
			Omni-Directional Case	Directional Case
DS	2400 – 2483.5 MHz	10 mW/MHz	12.14 dBm/MHz (16.368 mW/MHz)	22.14 dBm/MHz (163.68 mW/MHz)
OFDM (Note 1)	2400 – 2483.5 MHz	10 mW/MHz	12.14 dBm/MHz (16.368 mW/MHz)	22.14 dBm/MHz (163.68 mW/MHz)
OFDM (Note 2)	2400 – 2483.5 MHz	5 mW/MHz	9.14 dBm/MHz (8.20 mW/MHz)	19.14 dBm/MHz (82.03 mW/MHz)
Other than the above	2400 – 2483.5 MHz	10 mW	12.14 dBm	22.14 dBm

Note:

1. Occupied bandwidth is less than 26MHz
2. Occupied bandwidth is more than 26MHz and less than 38MHz
3. The half-power beam width for directional antenna shall be $360/A$ degrees or less, where A is a ratio which causes the EIRP concerned to exceed the omnidirectional EIRP upper limit.
4. Tolerance of antenna power shall be +20% (upper value) and -80% (lower value).

4.5.2 Test Setup



4.5.3 Test Results

Environmental Conditions		25 deg.C, 68% RH	
Channel Number	Frequency (MHz)	Conducted RF Output Power Density (mW)	
		Normal Voltage	Max. Limit (mW)
		100Vac	
0	2402	3.741	10
19	2440	3.733	10
39	2480	3.467	10
Rated power		4.00mW	
Tolerance of antenna power		0.8mW ~ 4.8mW	
Measurement uncertainty		$\pm 1.11\text{dB}$	

PIFA antenna with 1.7dBi gain

Environmental Conditions		25 deg.C, 68% RH	
Channel Number	Frequency (MHz)	Radiated RF Output Power Density (mW)	
		Normal Voltage	Max. Limit (mW)
		100Vac	
0	2402	5.533	16.368
19	2440	5.522	16.368
39	2480	5.128	16.368
Measurement uncertainty		$\pm 1.11\text{dB}$	

Note: The value of radiated RF output densities are "calculated" values.

4.6 Spurious Emissions for Receiver

4.6.1 Limits of Spurious Emissions for Receiver

Frequencies (MHz)	Limit
Below 1GHz	$\leq 4\text{nW}$ (-54dBm)
Above 1GHz	$\leq 20\text{nW}$ (-47dBm)

4.6.2 Test Setup

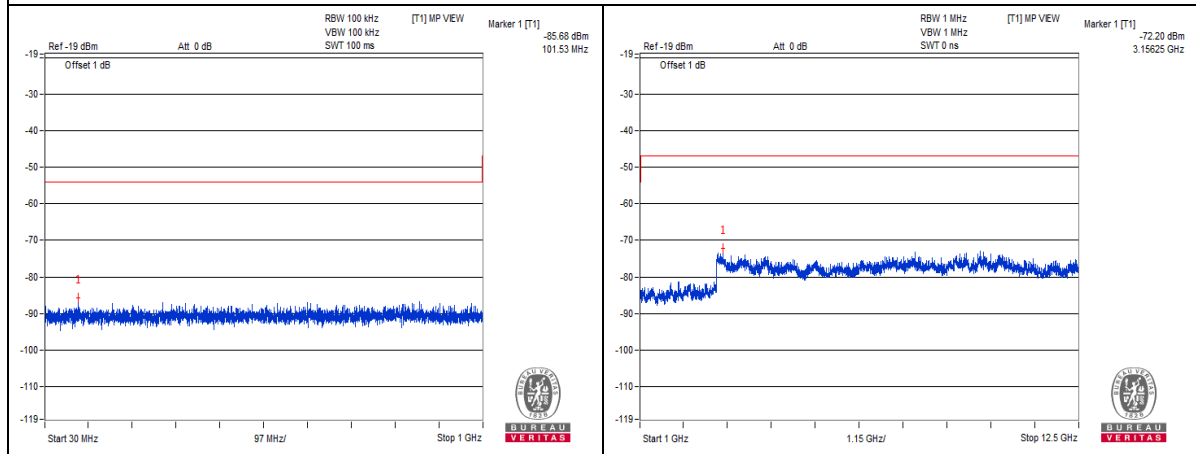


4.6.3 Test Result

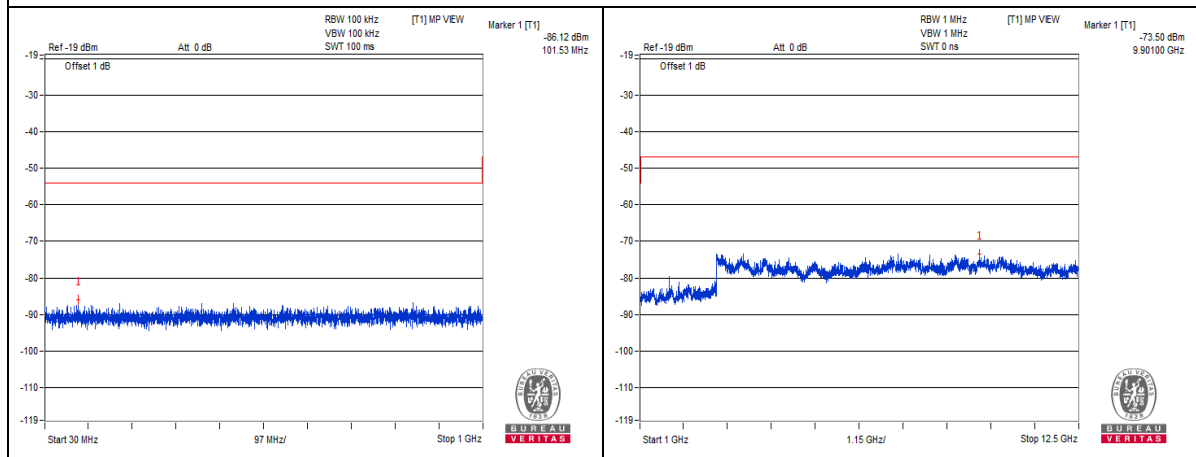
Environmental Conditions		25 deg.C, 68% RH					
Test Channel		CH0 (2402MHz)		CH19 (2440MHz)		Limit	Result
Test Condition	Frequency Range	Frequency (MHz)	Measured Value (dBm)	Frequency (MHz)	Measured Value (dBm)		
V _{normal}	Below 1GHz	101.530	0.002704nW	101.530	0.002443nW	4nW/100kHz	PASS
	Above 1GHz	3156.250	0.060256nW	9901.000	0.044668nW	20nW/MHz	PASS
Test Channel		CH39(2480MHz)				Limit	Result
Test Condition	Frequency Range	Frequency (MHz)		Measured Value (dBm)			
V _{normal}	Below 1GHz	86.980		0.002244nW		4nW/100kHz	PASS
	Above 1GHz	9268.500		0.05224nW		20nW/MHz	PASS

- Note: 1. The worst value in each frequency range v.s. each channel has been marked by boldface.
 2. The spectrum plots are attached on the following pages.

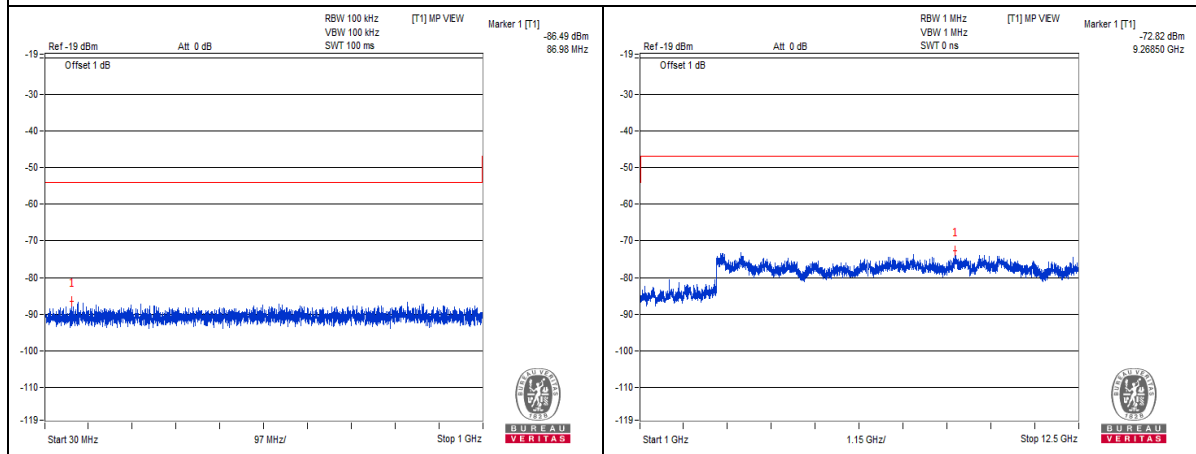
Vnormal



Channel 0



Channel 19



Channel 39

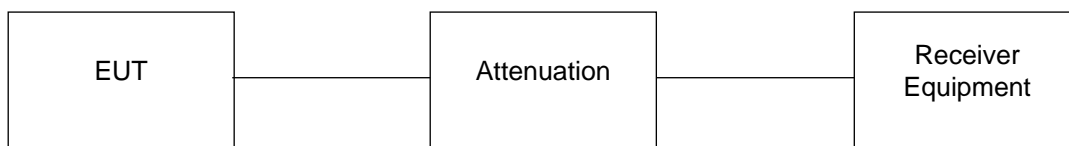
Measurement uncertainty: $\pm 3.93\text{dB}$

4.7 Interference Prevention Function

4.7.1 Limits of Interference Prevention Function

Radio equipment used mainly on the same premises and automatically transmits or receives identification code.

4.7.2 Test Setup



4.7.3 Test Results

ENVIRONMENTAL CONDITIONS	25 deg.C, 68% RH
Link Mode	Test Result
Bluetooth LE	Pass

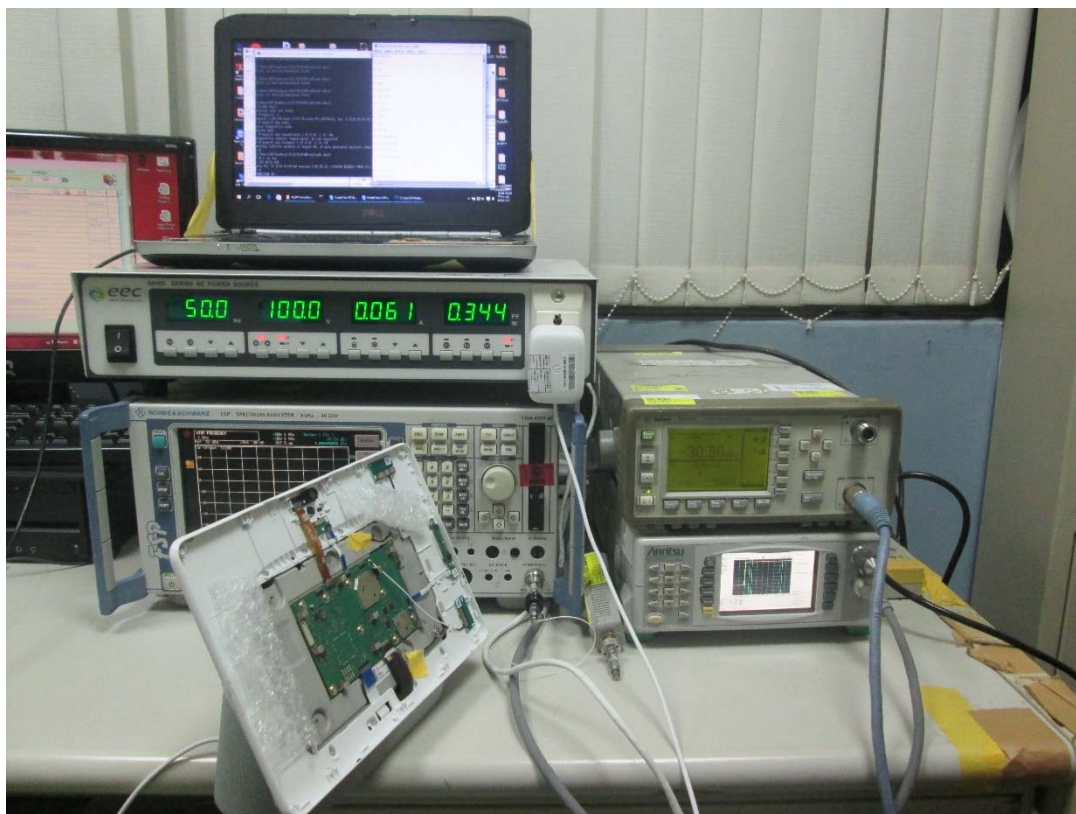
5 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration	Calibration Authority	Cal. Method
Spectrum Analyzer / Rohde & Schwarz	FSV40	100980	Apr. 17, 2018	Apr. 16, 2019	Electronics Testing Center, Taiwan	c)
Signal Generator / Agilent	E4438C	MY45094468	Nov. 19, 2018	Nov. 18, 2019	Electronics Testing Center, Taiwan	c)
Power Meter / Anritsu	ML2495A	1232003	Dec. 25, 2018	Dec. 24, 2019	Electronics Testing Center, Taiwan	c)
Power Sensor / Anritsu	MA2411B	1207333	Dec. 25, 2018	Dec. 24, 2019	Electronics Testing Center, Taiwan	c)
AC Power Supply Extech	6905S	1991553	NA	NA	NA	d)
True RMS Clamp Meter / Fluke	325	31130711WS	May 22, 2018	May 21, 2019	Electronics Testing Center, Taiwan	c)

NOTE: Calibration Method

- a) : Calibration conducted by the National Institute of Information and Communications Technology~NICT~ or a designated calibration agency under Article 102-18 paragraph (1)~ TELEC EngineeringCenter, Intertek Japan K.K., Keysight Technologies, Inc~.
- b) : Correction conducted pursuant to the provisions of Article 135 or Article 144 of the MeasurementLaw (Law No. 51 of 1992)~Japan Calibration Service System~
- c) : Calibration conducted in foreign countries, which shall be equivalent to the calibration conducted bythe NICT or a designated calibration agency under Article 102-18 paragraph (1)~ TELEC EngineeringCenter, Intertek Japan K.K., Keysight Technologies, Inc~.
- d) : Calibration conducted by using other equipment that listed above from a) to c)

6 Photographs of the Test Configuration



Appendix - Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

Lin Kou EMC/RF Lab

Tel: 886-2-26052180

Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab

Tel: 886-3-6668565

Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety Lab

Tel: 886-3-3183232

Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com

Web Site: www.bureauveritas-adt.com

The address and road map of all our labs can be found in our web site also.

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