Radio Test Report (BT-LE)

Report No.: RJ171018E05-3 R1

Test Model: SP-W2M-AC1200

Received Date: Sep. 27, 2017

Test Date: Sep. 27, 2017

Issued Date: June 22, 2018

Applicant: Accton Technology Corporation

Address: No.1, Creation Rd. III, Science-based Industrial Park, Hsinchu, Taiwan, R.O.C.

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

Lab Address: E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan R.O.C.

Table of Contents

Release Control Record

Issue No.	Description	Date Issued
RJ171018E05-3	Original release.	Nov. 07, 2017
RJ171018E05-3 R1	Added test plots.	June 22, 2018

1 Certificate of Conformity

Product: Spark™ AC Wave2 Mini

Brand: IgniteNet

Model No.: SP-W2M-AC1200

Sample Status: PROTOTYPE

Applicant: Accton Technology Corporation

Test Date: Sep. 27, 2017

Standards: ARIB STD-T66 (V3.7), MIC notice 88 Appendix 43

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 EMC characteristics under the conditions specified in this report.

Prepared by : _____ , **Date:** June 22, 2018

Wendy Wu / Specialist

Approved by : _____ , **Date:** June 22, 2018

May Chen / Manager

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)	4.3	Spurious emissions	C
Transmitting Equipment				
F	--	4.4	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)	4.5	Spurious emissions of receiver	C
--	--	3.5	Refer to all articles for transmitting antenna	C
Operating Frequency 2400 to 2483.5MHz				
--	3.7 (1)	3.4	High frequency / 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)	4.4	Antenna power	C
--	3.6 (2)	4.4	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)	--	Spreading bandwidth	NA
--	3.2 (9)	--	Spreading factor	NA
--	3.2 (11)	--	Frequency retention time (FH employed)	NA
--	3.4.1(1)	4.6	Interference Prevention Function	C
--	3.4.1(3)	--	Carrier Sense Capability	NA
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	703.56 Hz
Spurious emissions	2.52 dB
Output power density	1.37 dB
Out of band radiated power	2.52 dB
Frequency Tolerance	703.56 Hz

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT (BT-LE)

Product	Spark™ AC Wave2 Mini
Brand	IgniteNet
Model No.	SP-W2M-AC1200
Status of EUT	PROTOTYPE
Nominal Voltage	5Vdc from power adapter
Modulation Type	GFSK
Modulation Technology	DTS
Transfer Rate	up to 1Mbps
Operating Frequency	2402MHz ~ 2480MHz
Number of Channel	40
Rated RF Output Power	8.5 mW
Conducted RF Output Power	8.453 mW
Radiated RF Output Power	14.69 mW
Antenna Type	Refer to section 3.5
Antenna Connector	Refer to section 3.5
Accessory Device	Adapter x1
Cable Supplied	USB cable x 1 (Unshielded, 1m)

Note:

1. There are WLAN, Bluetooth technology used for the EUT.
2. Simultaneously transmission condition.

Condition	Technology	
1	WLAN (2.4GHz)	Bluetooth
2	WLAN (5GHz)	Bluetooth

3. The EUT must be supplied with a power adapter as following table:

Brand	Model No.	Spec.
MASS POWER	NBS10B050200VUU	AC Input: 100-240V 50/60Hz 0.3A DC Output: 5.0V 2.0A

4. 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 for BT-LE mode:

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**

Note:

1. The channels which were indicated in bold type of the above channel list were selected as representative test channel. Therefore only the data of the test channels were recorded in this report.

By means of test software (RTL819 x 3.4) provided by manufacture, the power levels during the tests were set according to the following codes:

Channel	Power Setting
0	33
19	32
39	31

3.3 Test Conditions

Test Conditions	Voltage (Vdc)
V_{normal}	5
V_{max}	5.5
V_{min}	4.5

3.4 Assembly

The EUT is constructed as an Spark™ AC Wave2 Mini. The housing consists of two parts, the parts was fixed together by special type screws. Separating the two parts was only possible by special tools.

3.5 Antenna Specifications

3.5.1 Antenna Gain

WLAN				
Ant No.	Antenna Gain (dBi)	Frequency rang (GHz)	Antenna type	Connector type
1	3.9	2.4~2.4835	PCB	i-pex(MHF)
	3.9	5.15~5.85		
2	4.1	2.4~2.4835	PCB	i-pex(MHF)
	3.8	5.15~5.85		
Bluetooth				
Ant No.	Antenna Gain (dBi)	Frequency rang (GHz)	Antenna type	Connector type
1	2.4	2.4~2.4835	PCB	i-pex(MHF)

3.5.2 Antenna Pattern

Please refer to the attached file (Antenna pattern).

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

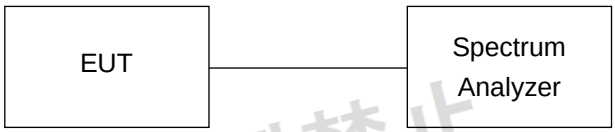
Environmental Conditions		24 deg.C, 66% RH					
Channel	Frequency (MHz)	Voltage normal		Voltage max		Voltage min	
		Carrier frequency (MHz)	Frequency tolerance (ppm)	Carrier frequency (MHz)	Frequency tolerance (ppm)	Carrier frequency (MHz)	Frequency tolerance (ppm)
0	2402	2402.017320	7.210	2402.017120	7.127	2402.017040	7.094
19	2440	2440.017320	7.098	2440.017360	7.114	2440.017160	7.032
39	2480	2480.017440	7.032	2480.017440	7.032	2480.017240	6.951

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

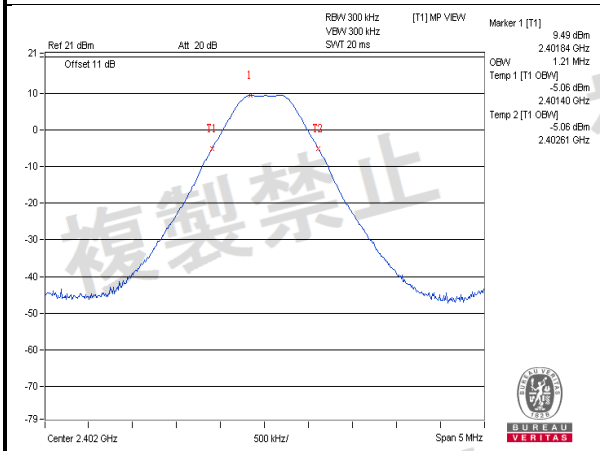


4.2.3 Test Results

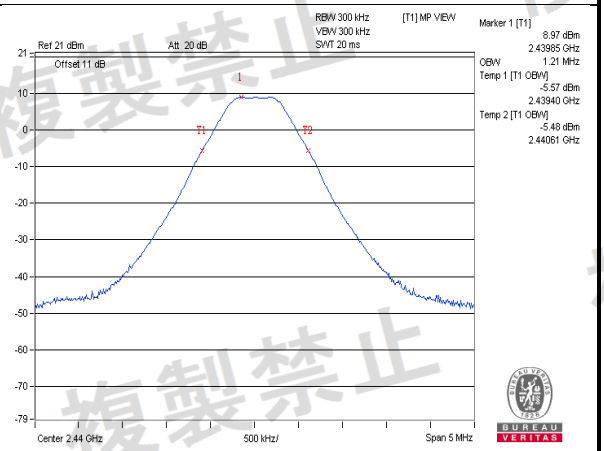
Environmental Conditions		24 deg.C, 66% RH		
Channel	Frequency (MHz)	V_{normal}	V_{max}	V_{min}
		Occupied Bandwidth (MHz)	Occupied Bandwidth (MHz)	Occupied Bandwidth (MHz)
0	2402	1.21	1.21	1.21
19	2440	1.21	1.21	1.21
39	2480	1.21	1.21	1.21

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

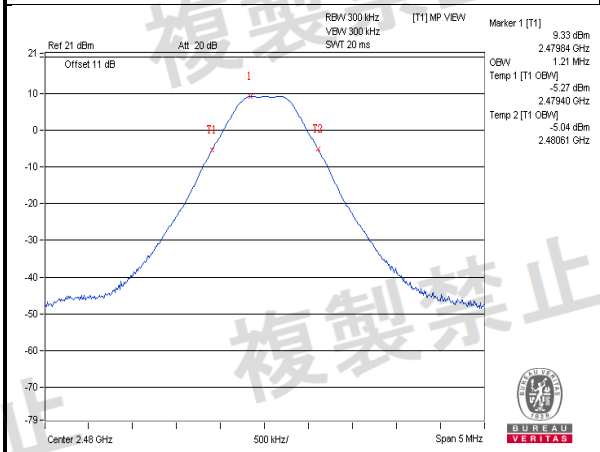
Vnormal



Channel 0

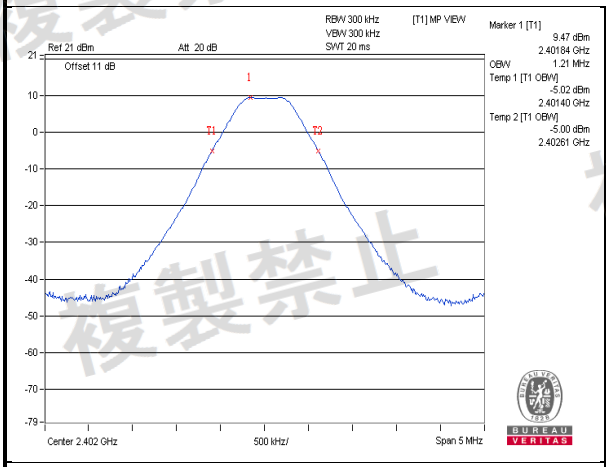


Channel 19

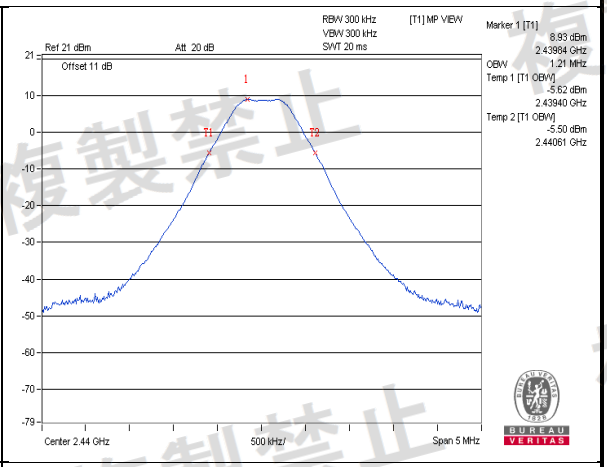


Channel 39

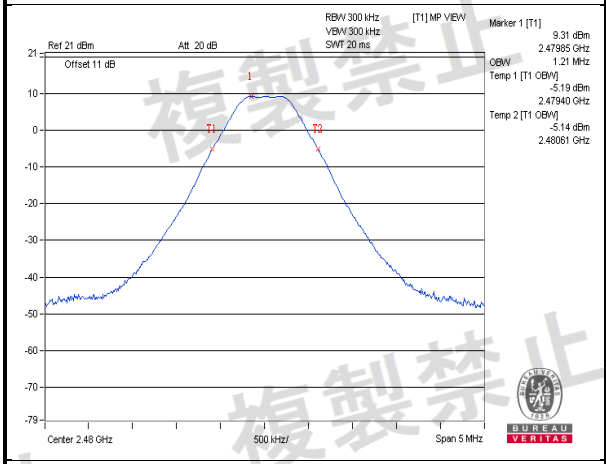
$V_{+10\%}$



Channel 0

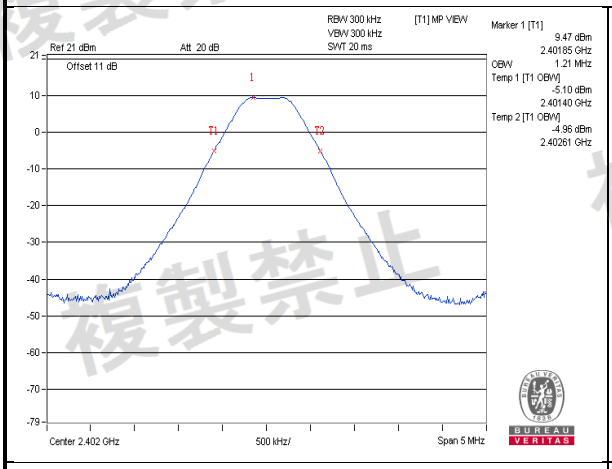


Channel 19

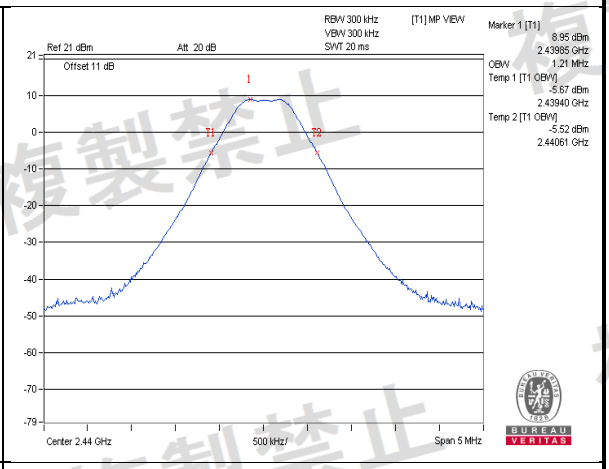


Channel 39

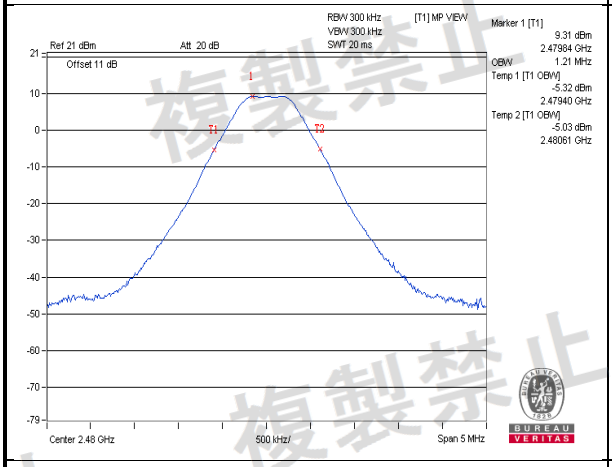
V-10%



Channel 0



Channel 19



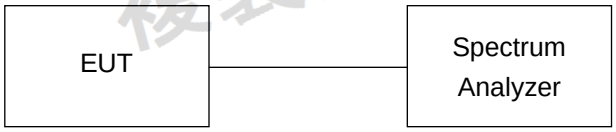
Channel 39

4.3 Spurious Emissions for Transmitter Measurement

4.3.1 Limits of Spurious Emissions

Frequencies (MHz)	Limit
Operating frequency 2400 to 2483.5MHz	
30.0MHz to 1000.0MHz	≦ 0.25 uW/100kHz
1000.0MHz to 2387MHz	≦ 2.5 uW/MHz
2387.0MHz to 2400.0MHz	≦ 25 uW/MHz
2483.5MHz to 2496.5MHz	≦ 25 uW/MHz
2496.5MHz to 12500.0MHz	≦ 2.5 uW/MHz

4.3.2 Test Setup



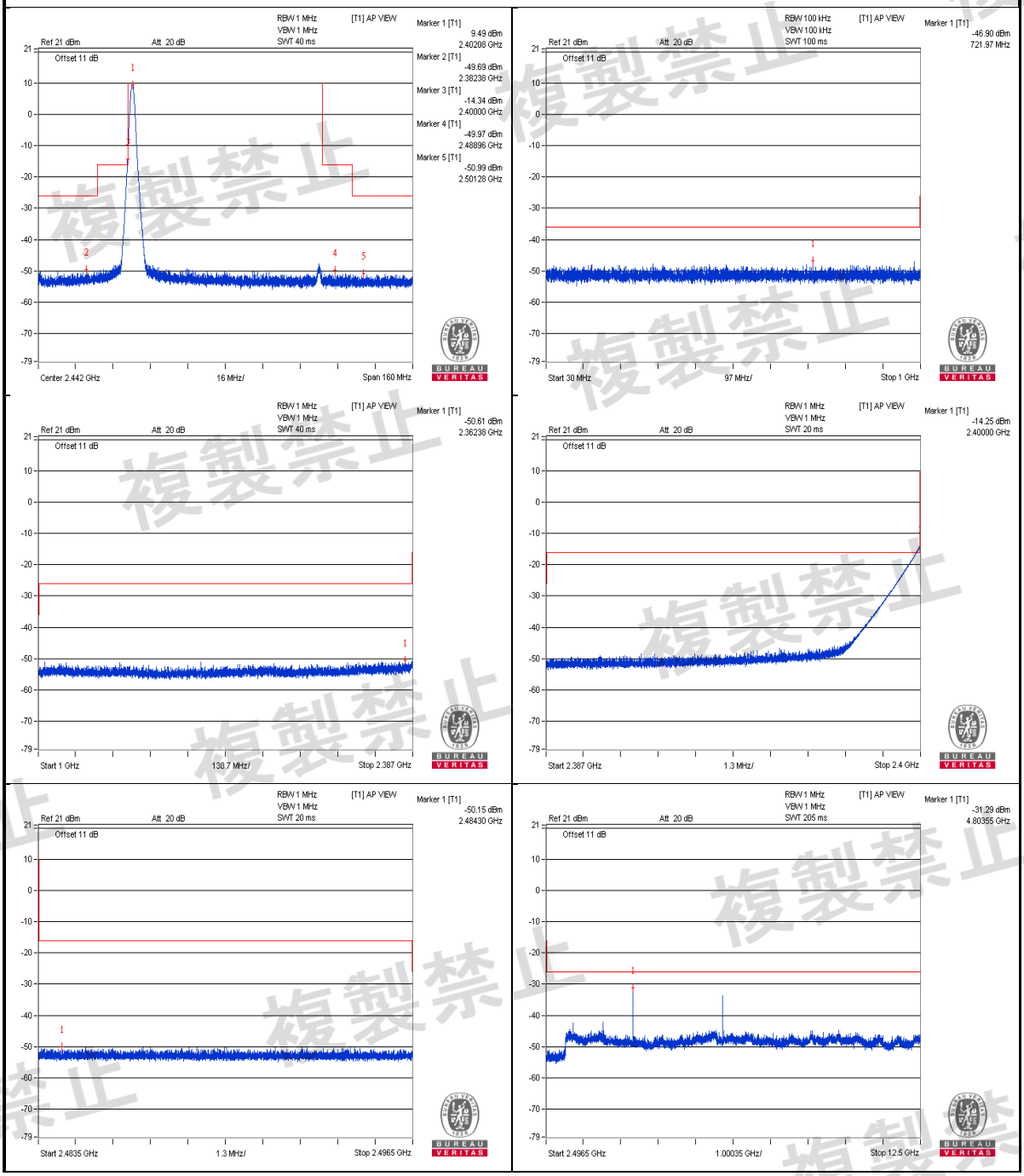
4.3.3 Test Results

Environmental Conditions		24 deg.C, 66% RH					
Test Channel		CH 0 (2402MHz)		CH 19 (2440MHz)		Limit	Result
Test Condition	Frequency Range	Frequency (MHz)	Measured Value	Frequency (MHz)	Measured Value		
V_{normal}	30.0MHz to 1000.0MHz	721.97	**0.020417uW**	710.33	**0.018578uW**	0.25 uW/100kHz	PASS
	1000.0MHz to 2387MHz	2362.38	0.00869uW	2363.07	0.009183uW	2.5uW/MHz	PASS
	2387.0MHz to 2400.0MHz	2400	21.798uW	2399.92	0.010864uW	25uW/MHz	PASS
	2483.5MHz to 2496.5MHz	2484.3	0.009661uW	2493.83	0.011117uW	25uW/MHz	PASS
	2496.5MHz to 12500.0MHz	4803.55	0.743019uW	4879.83	0.539511uW	2.5uW/MHz	PASS
V_{max}	30.0MHz to 1000.0MHz	668.01	0.018664uW	564.47	0.01845uW	0.25 uW/100kHz	PASS
	1000.0MHz to 2387MHz	2378.85	**0.010069uW**	1177.18	0.00881uW	2.5uW/MHz	PASS
	2387.0MHz to 2400.0MHz	2400	**22.13uW**	2399.72	**0.011066uW**	25uW/MHz	PASS
	2483.5MHz to 2496.5MHz	2486.51	0.010471uW	2495.72	**0.012823uW**	25uW/MHz	PASS
	2496.5MHz to 12500.0MHz	4803.55	0.756833uW	4879.83	**0.570164uW**	2.5uW/MHz	PASS
V_{min}	30.0MHz to 1000.0MHz	708.15	0.019543uW	401.63	0.017298uW	0.25 uW/100kHz	PASS
	1000.0MHz to 2387MHz	2372.95	0.009226uW	2360.3	**0.009727uW**	2.5uW/MHz	PASS
	2387.0MHz to 2400.0MHz	2399.99	20.093uW	2391.22	0.010814uW	25uW/MHz	PASS
	2483.5MHz to 2496.5MHz	2484.91	**0.01183uW**	2487.94	0.01219uW	25uW/MHz	PASS
	2496.5MHz to 12500.0MHz	4803.55	**0.794328uW**	4879.83	0.532108uW	2.5uW/MHz	PASS

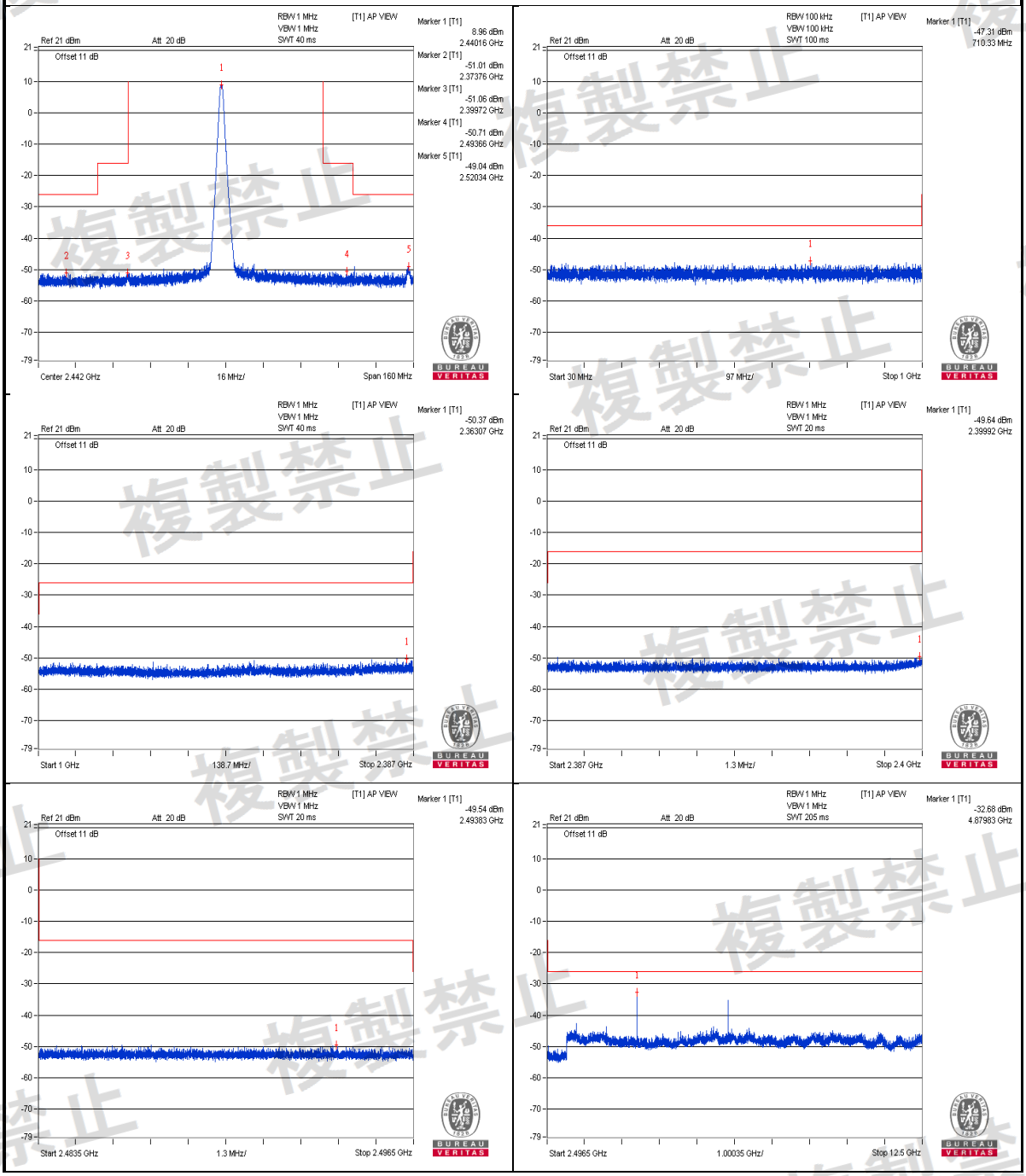
Test Channel		CH 39 (2480MHz)		Limit	Result
Test Condition	Frequency Range	Frequency (MHz)	Measured Value		
V_{normal}	30.0MHz to 1000.0MHz	108.69	**0.020091uW**	0.25 uW/100kHz	PASS
	1000.0MHz to 2387MHz	2382.31	0.008318uW	2.5uW/MHz	PASS
	2387.0MHz to 2400.0MHz	2399.81	**0.016904uW**	25uW/MHz	PASS
	2483.5MHz to 2496.5MHz	2483.5	0.977237uW	25uW/MHz	PASS
	2496.5MHz to 12500.0MHz	4959.86	0.474242uW	2.5uW/MHz	PASS
V_{max}	30.0MHz to 1000.0MHz	715.42	0.018197uW	0.25 uW/100kHz	PASS
	1000.0MHz to 2387MHz	2242.75	0.008531uW	2.5uW/MHz	PASS
	2387.0MHz to 2400.0MHz	2399.98	0.013521uW	25uW/MHz	PASS
	2483.5MHz to 2496.5MHz	2483.5	0.981748uW	25uW/MHz	PASS
	2496.5MHz to 12500.0MHz	4959.86	**0.484172uW**	2.5uW/MHz	PASS
V_{min}	30.0MHz to 1000.0MHz	903.36	0.019187uW	0.25 uW/100kHz	PASS
	1000.0MHz to 2387MHz	1653.62	**0.009162uW**	2.5uW/MHz	PASS
	2387.0MHz to 2400.0MHz	2399.49	0.011455uW	25uW/MHz	PASS
	2483.5MHz to 2496.5MHz	2483.5	**1uW**	25uW/MHz	PASS
	2496.5MHz to 12500.0MHz	4959.86	0.467735uW	2.5uW/MHz	PASS

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

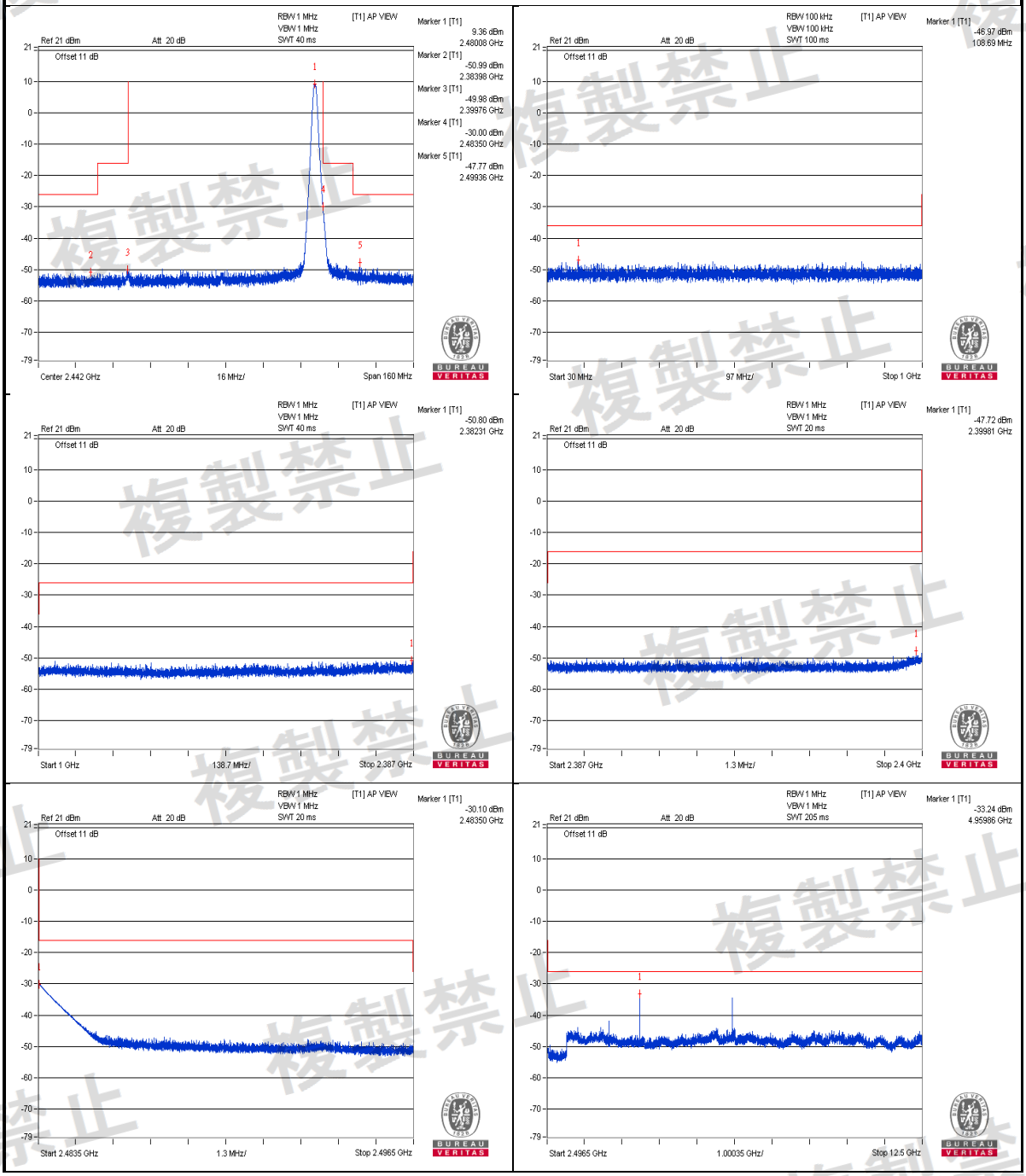
Vnormal
Channel 0



Vnormal
Channel 19



Vnormal
Channel 39

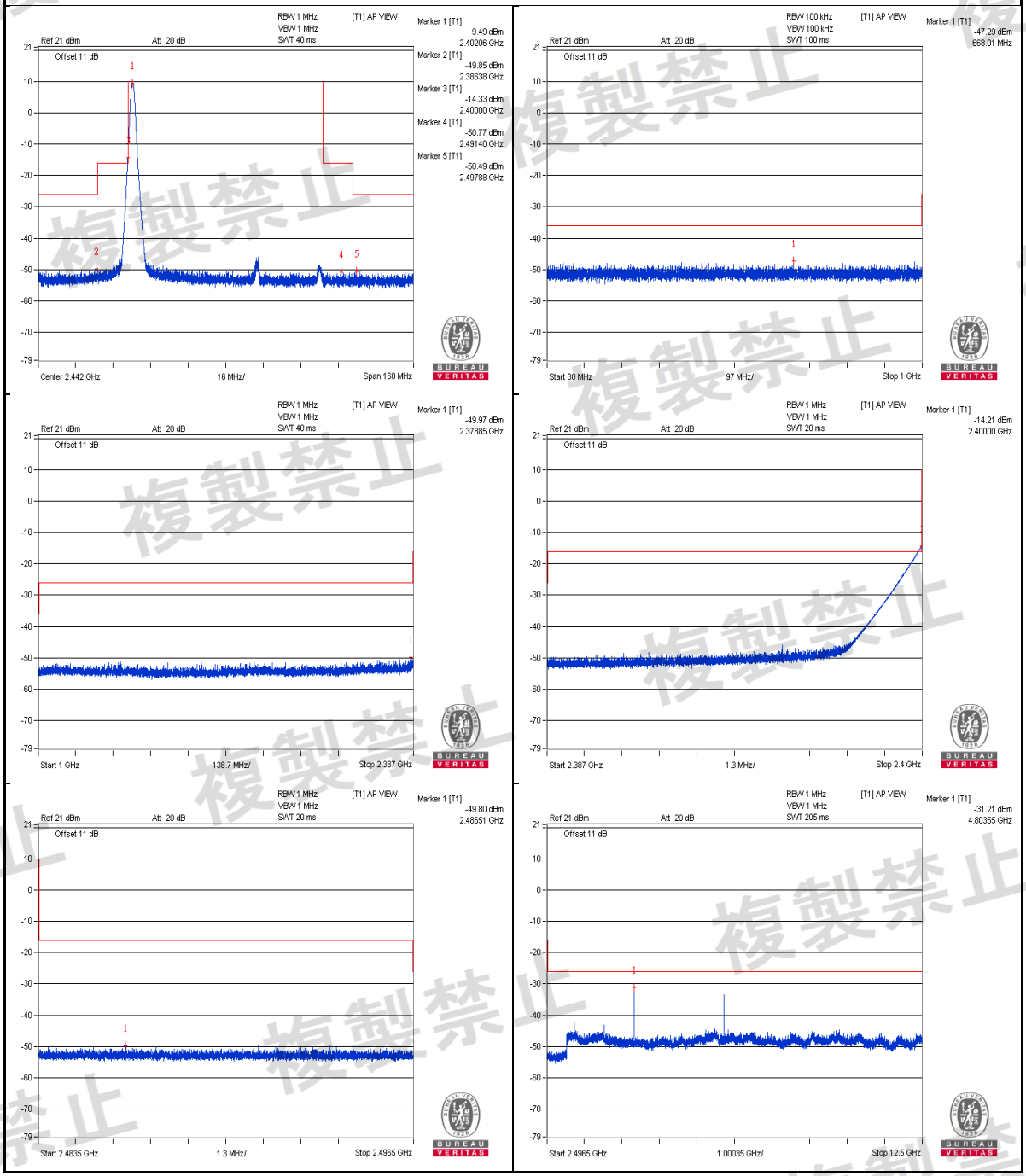


Measuring Mode *Zero Span

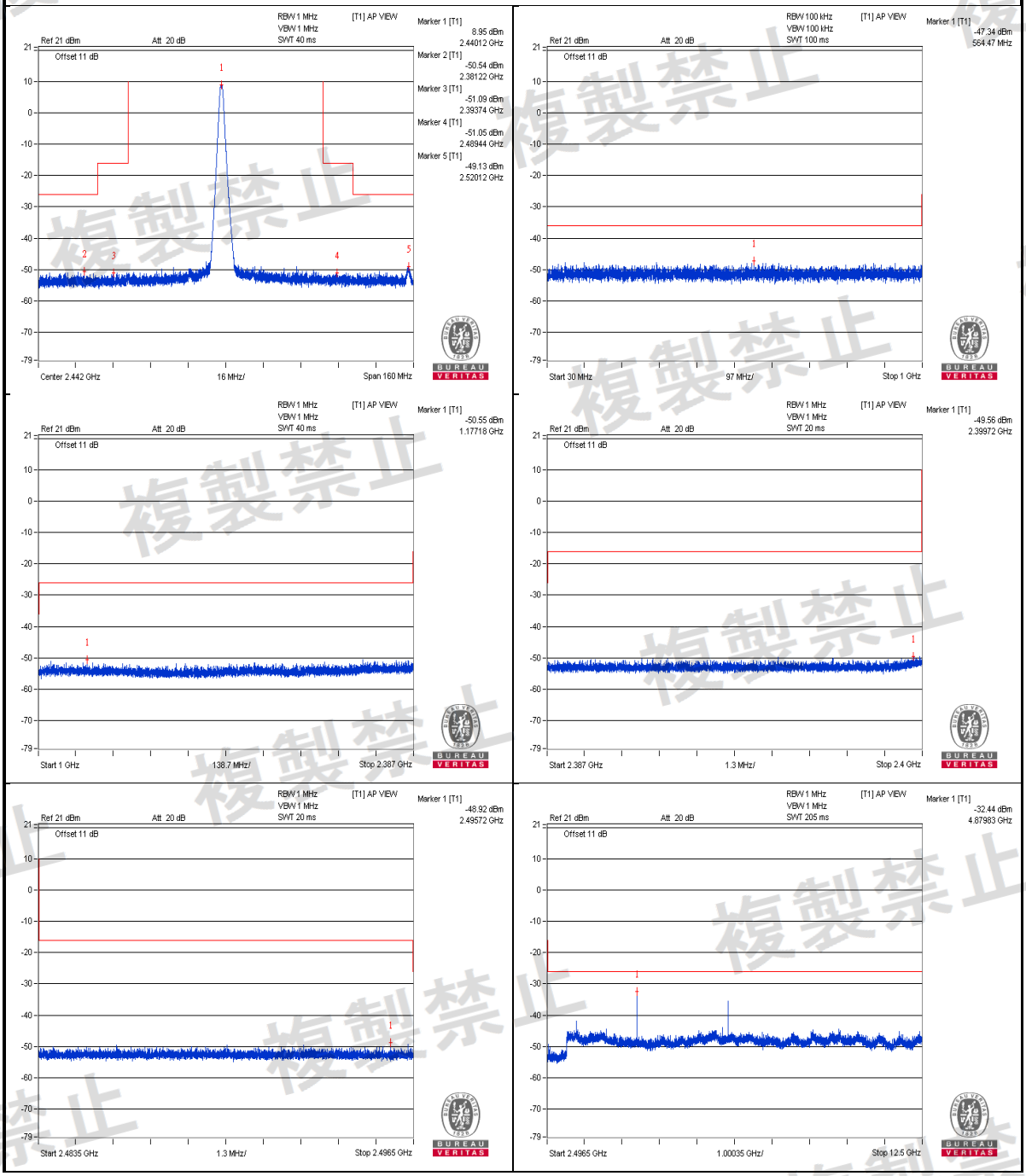
1. Set the spectrum analyzer as below and it takes in a value of all data point.
2. Regarding the all data value, it transforms the “dBm” value into “mW” value.
3. It adds the all values and calculates a grand total. Define a grand total as “P”.
4. It divides “P” by sample data point (ex.501) and calculates the mean value.
5. It reports the mean value.

P= 0.021798 (mW)

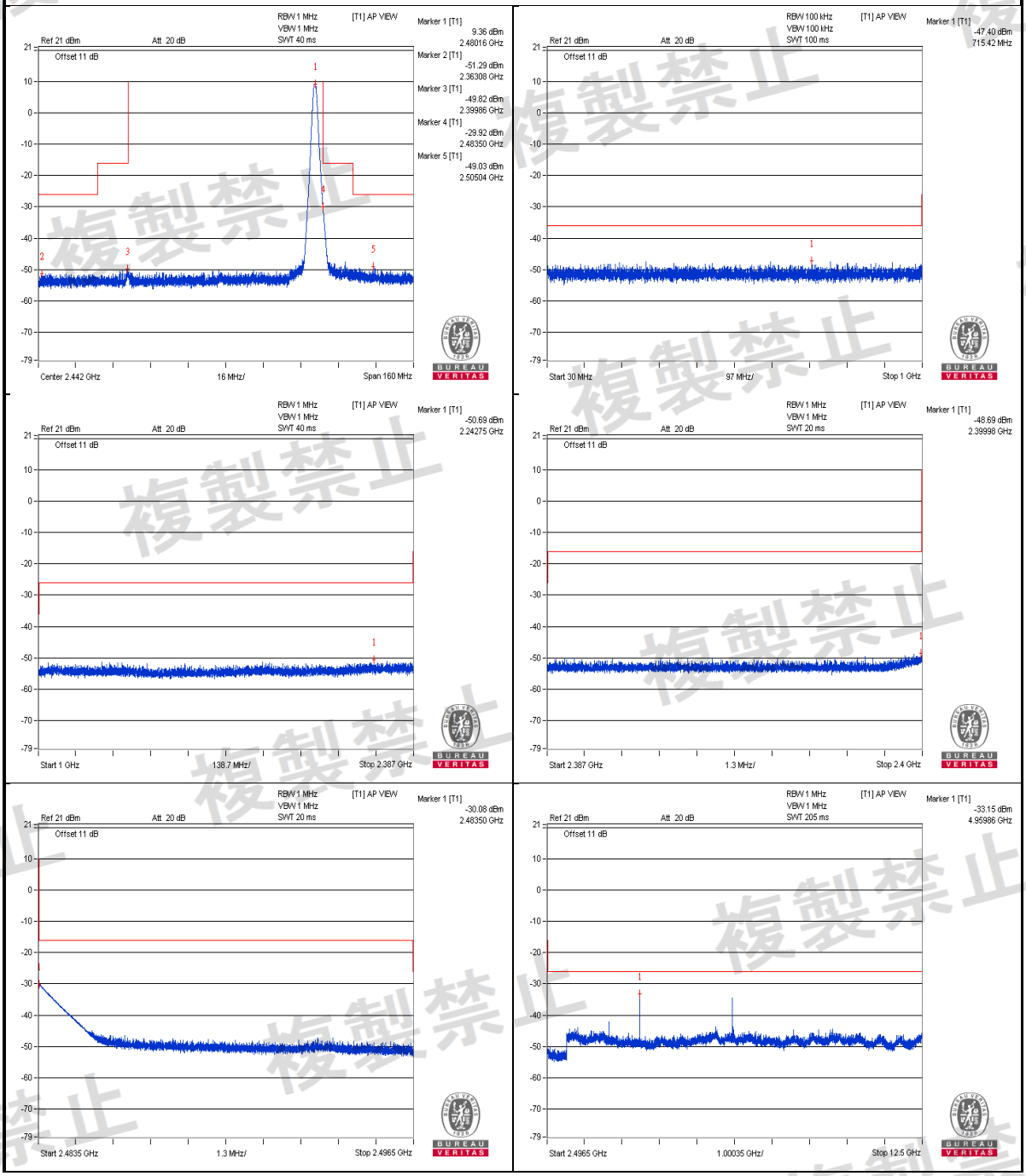
V+10%
Channel 0



V+10%
Channel 19

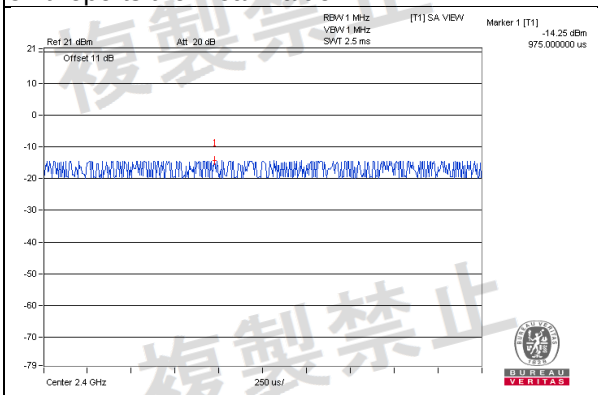


V+10%
Channel 39



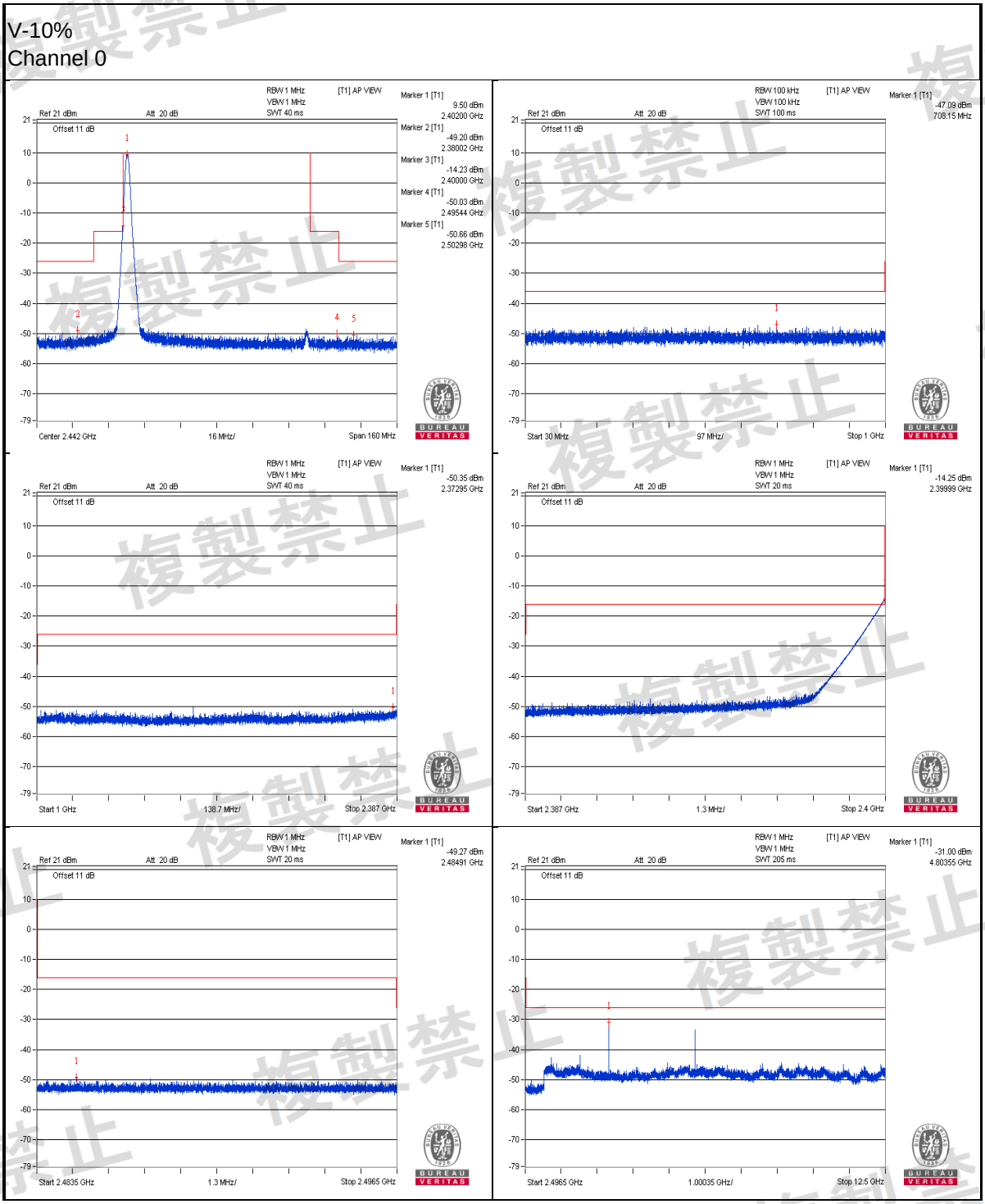
Measuring Mode *Zero Span

1. Set the spectrum analyzer as below and it takes in a value of all data point.
2. Regarding the all data value, it transforms the “dBm” value into “mW” value.
3. It adds the all values and calculates a grand total. Define a grand total as “P”.
4. It divides “P” by sample data point (ex.501) and calculates the mean value.
5. It reports the mean value.

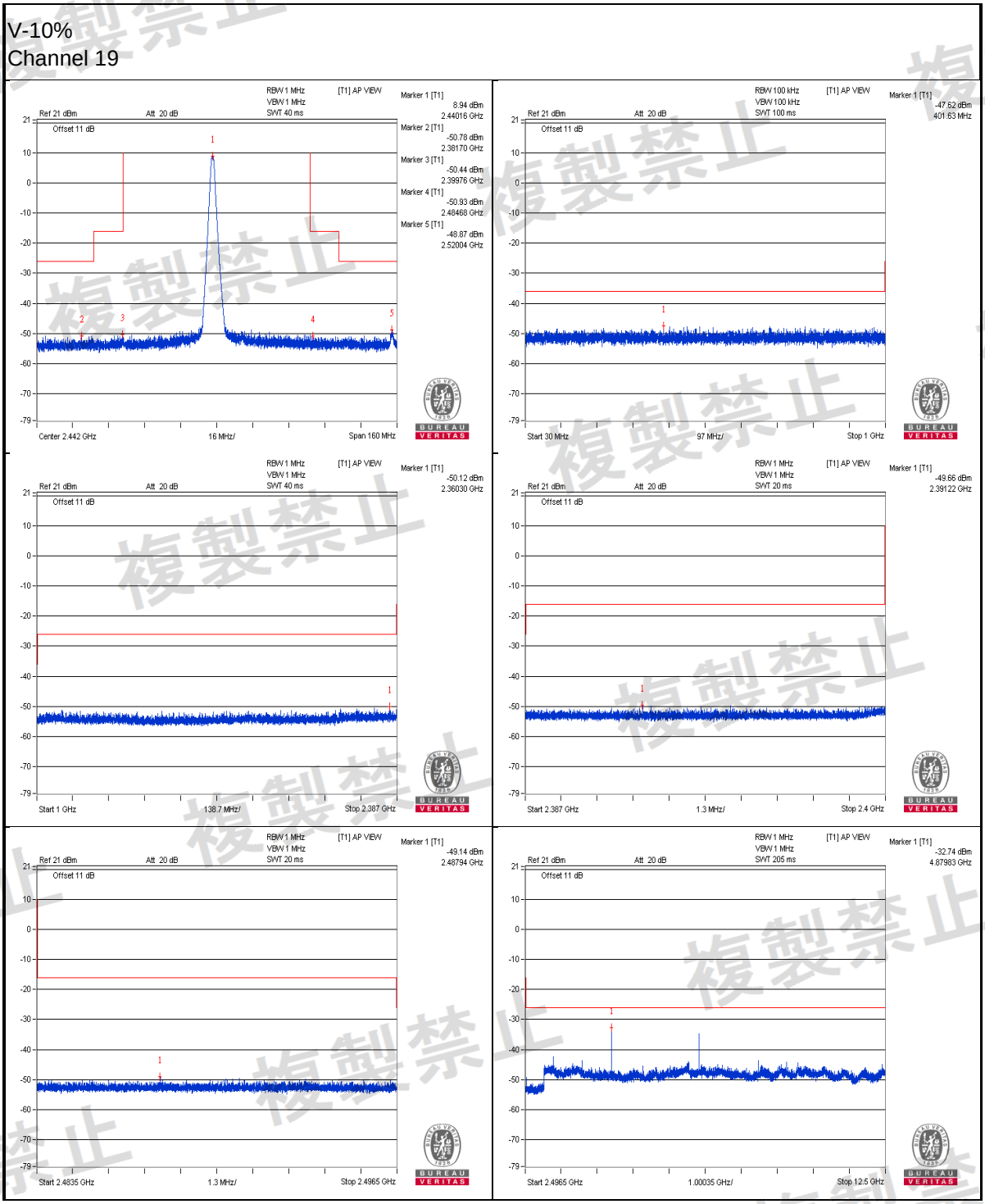


P= 0.02213 (mW)

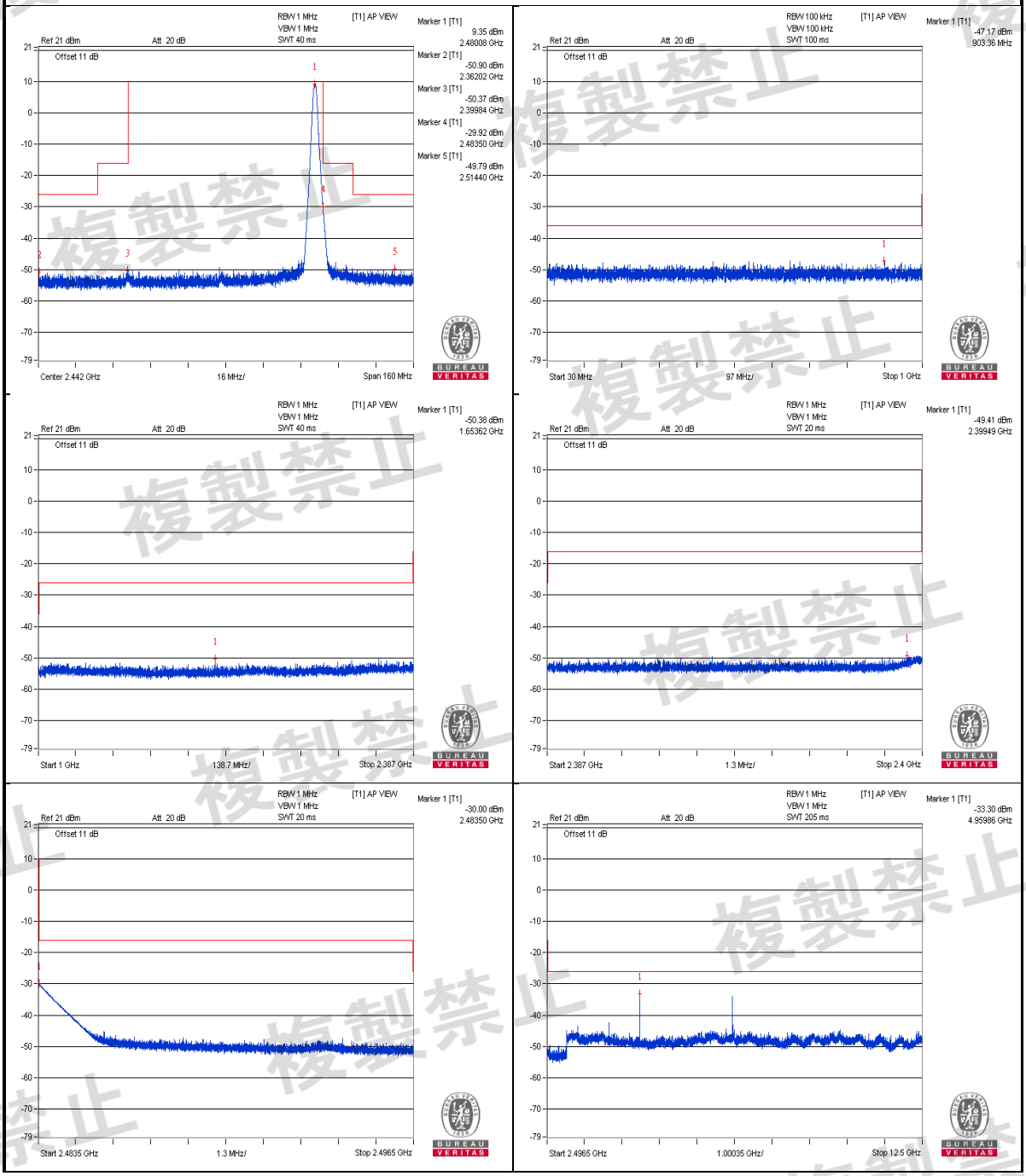
V-10%
Channel 0



V-10%
Channel 19



V-10%
Channel 39



Measuring Mode *Zero Span

1. Set the spectrum analyzer as below and it takes in a value of all data point.
2. Regarding the all data value, it transforms the “dBm” value into “mW” value.
3. It adds the all values and calculates a grand total. Define a grand total as “P”.
4. It divides “P” by sample data point (ex.501) and calculates the mean value.
5. It reports the mean value.

P= 0.020093 (mW)

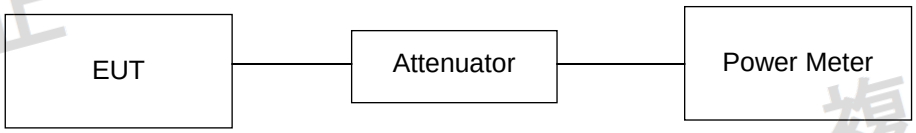
4.4 Antenna Power Measurement

4.4.1 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	9.14d Bm/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 (16.368 mW)	22.14 dBm (163.68 mW)

Note:
1. Occupied bandwidth is less than 26MHz
2. Occupied bandwidth is more that 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).

4.4.2 Test Setup



4.4.3 Test Results

Environmental Conditions		24 deg.C, 66% RH		
Channel Number	Frequency (MHz)	Conducted RF Output Power (mW)		
		V_{normal}	V_{max}	V_{min}
0	2402	8.337	8.299	8.147
19	2440	8.453	8.279	8.147
39	2480	7.798	8.072	7.464
Max. Limit (mW)		10		
Rated Power		8.5		
Tolerance of Antenna Power		1.7 ~ 10.2		

PCB antenna with antenna gain: 2.4 dBi

Environmental Conditions		24 deg.C, 66% RH		
Channel Number	Frequency (MHz)	Radiated RF Output Power (mW)		
		V_{normal}	V_{max}	V_{min}
0	2402	14.488	14.422	14.158
19	2440	14.69	14.387	14.158
39	2480	13.551	14.028	12.971
EIRP Max. Limit (mW)		16.368		

Note: 1. The radiated RF output power is a “calculated” value derived from the conducted value.

2. Formula: Radiated RF output power = Conducted RF output power + Maximum Antenna Gain

4.5 Spurious Emissions for Receiver

4.5.1 Limits of Spurious Emissions for Receiver

Frequencies (MHz)	Limit
Below 1GHz	≦4nW (-54dBm)
Above 1GHz	≦20nW (-47dBm)

4.5.2 Test Setup

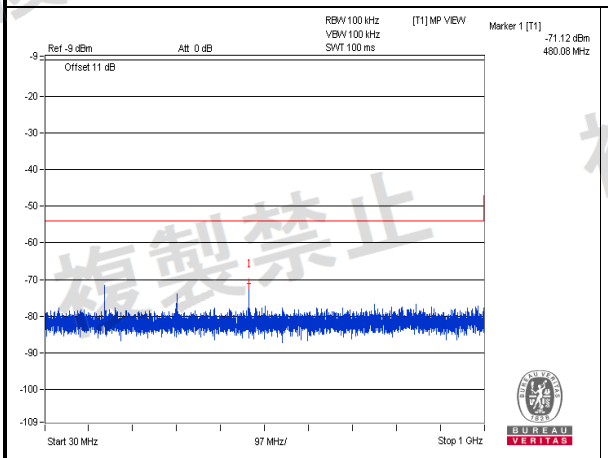
4.5.3 Test Result

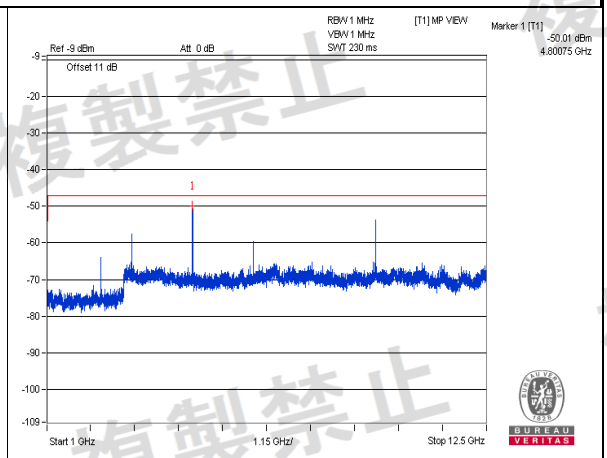
Environmental Conditions		24 deg.C, 66% RH					
Test Channel		CH 0 (2402MHz)		CH 19 (2440MHz)		Limit	Result
Test Condition	Frequency Range	Frequency (MHz)	Measured Value	Frequency (MHz)	Measured Value		
V_{normal}	Below 1GHz	480.08	0.077268nW	159.98	**0.082985nW**	4nW/ 100kHz	PASS
	Above 1GHz	4800.75	**9.977001nW**	4876.93	4.977371nW	20nW/MHz	PASS
V_{max}	Below 1GHz	159.98	**0.094842nW**	480.08	0.072946nW	4nW/ 100kHz	PASS
	Above 1GHz	4800.75	9.332543nW	4876.93	4.819478nW	20nW/MHz	PASS
V_{min}	Below 1GHz	159.98	0.08356nW	159.98	0.066222nW	4nW/ 100kHz	PASS
	Above 1GHz	4800.75	8.994976nW	4876.93	**4.988845nW**	20nW/MHz	PASS

Test Channel		CH 39 (2480MHz)		Limit	Result
Test Condition	Frequency Range	Frequency (MHz) Measured Value	Measured Value		
V_{normal}	Below 1GHz	159.98	0.074131nW	4nW/ 100kHz	PASS
	Above 1GHz	9915.37	3.981072nW	20nW/MHz	PASS
V_{max}	Below 1GHz	159.98	**0.08147nW**	4nW/ 100kHz	PASS
	Above 1GHz	9915.37	3.890451nW	20nW/MHz	PASS
V_{min}	Below 1GHz	159.98	0.080353nW	4nW/ 100kHz	PASS
	Above 1GHz	9915.37	**4.008667nW**	20nW/MHz	PASS

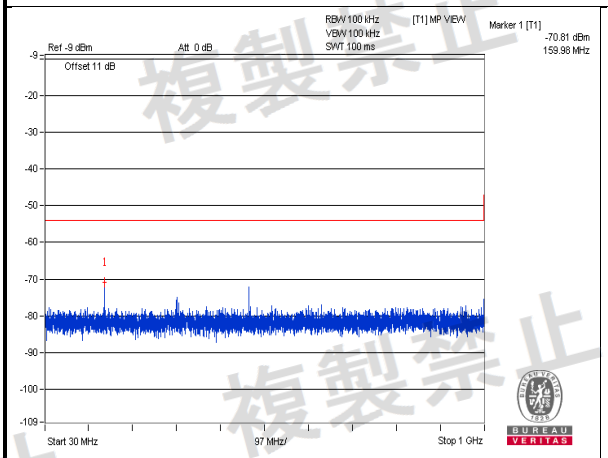
Note: 1. The worst value in each frequency range v.s. each channel has been marked by boldface.
2. The spectrum plots are attached on the following pages.

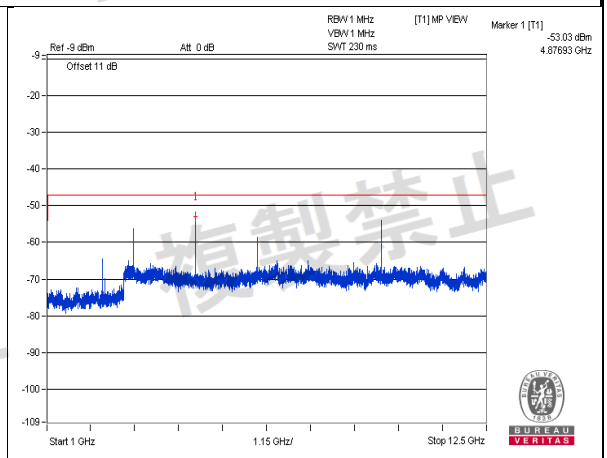
Vnormal



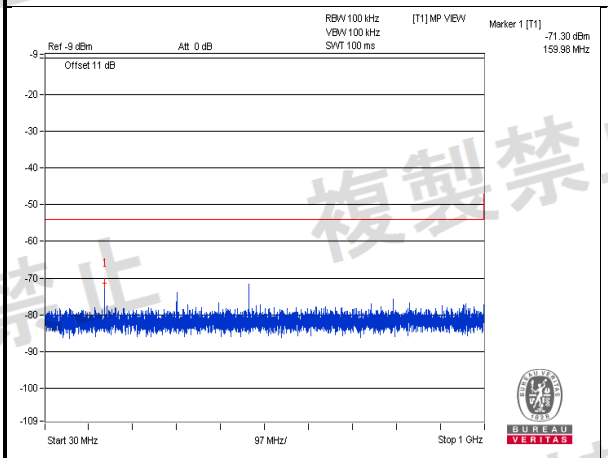


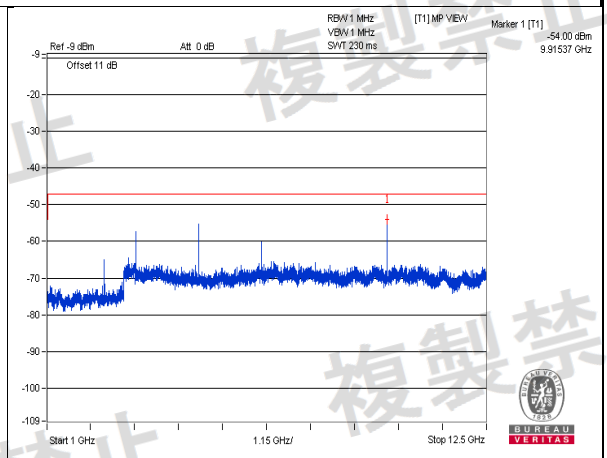
Channel 0





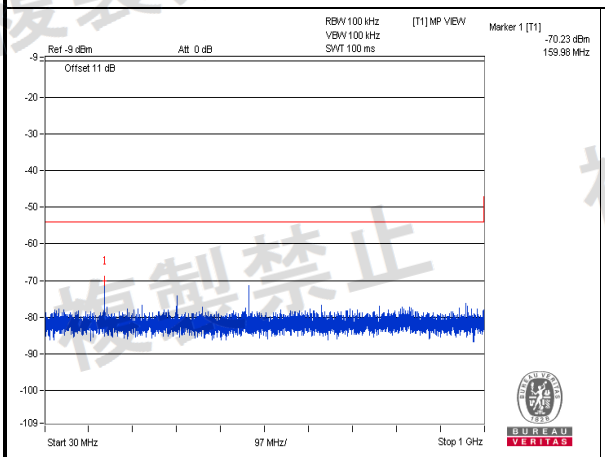
Channel 19

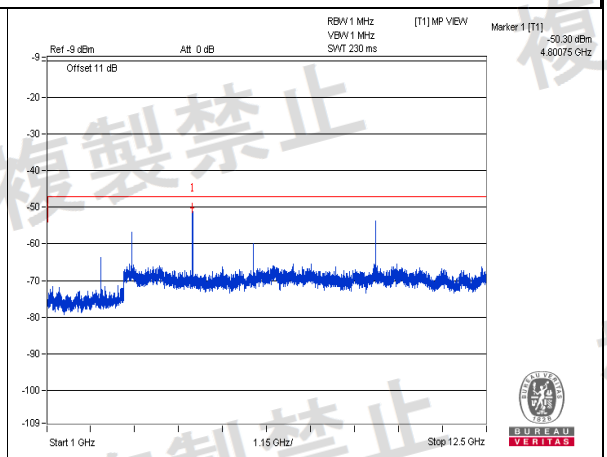




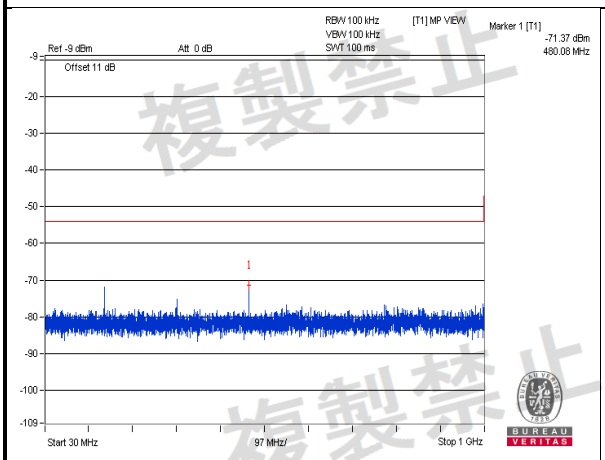
Channel 39

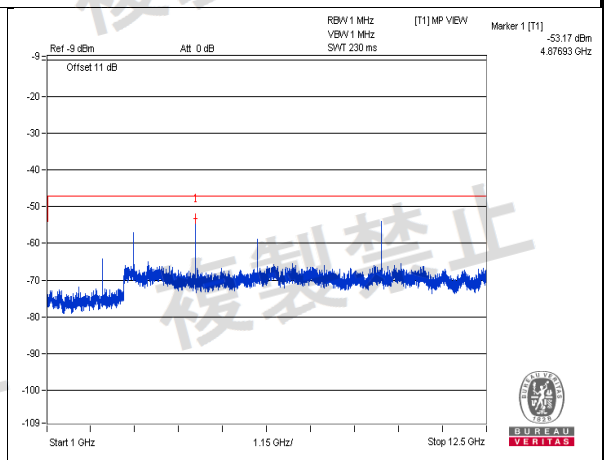
$V_{+10\%}$



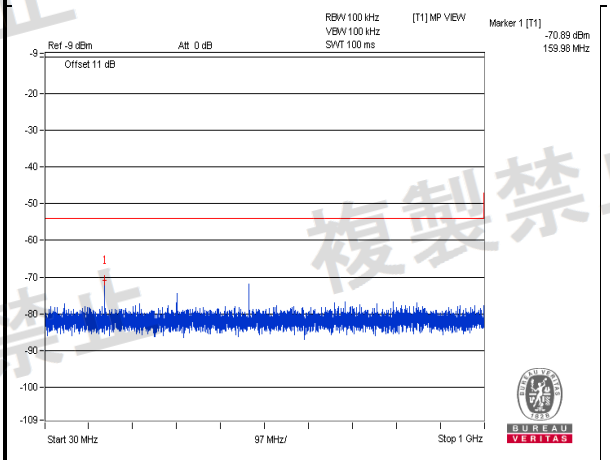


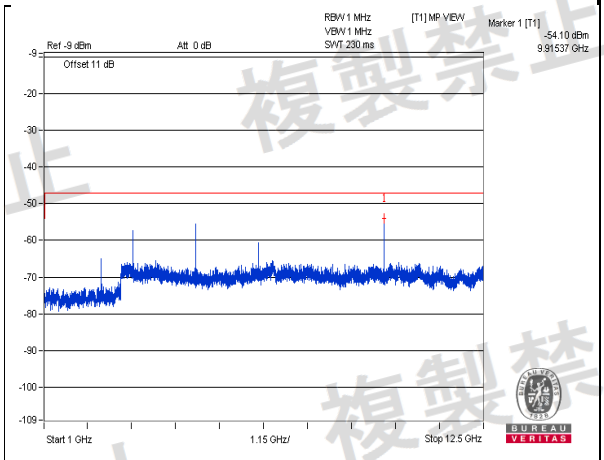
Channel 0





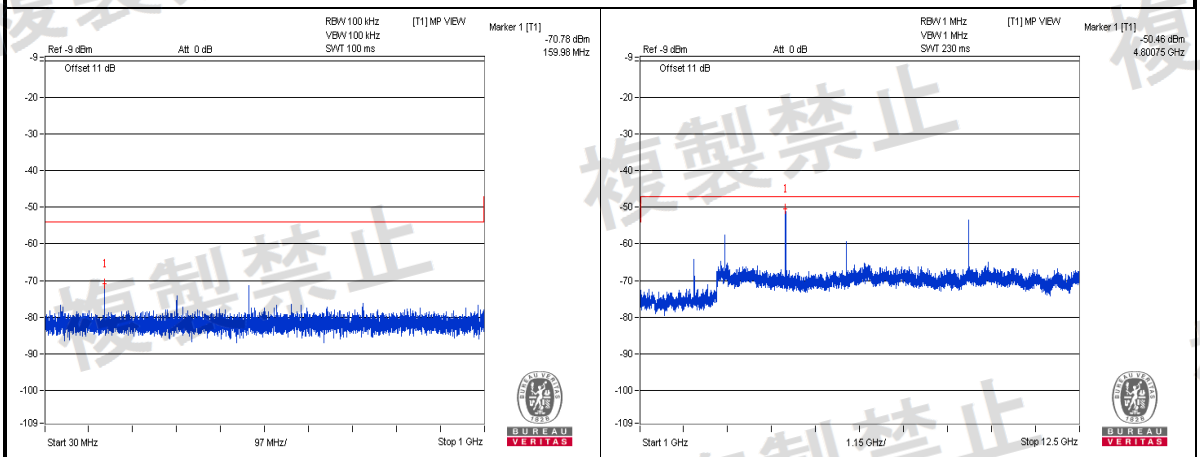
Channel 19



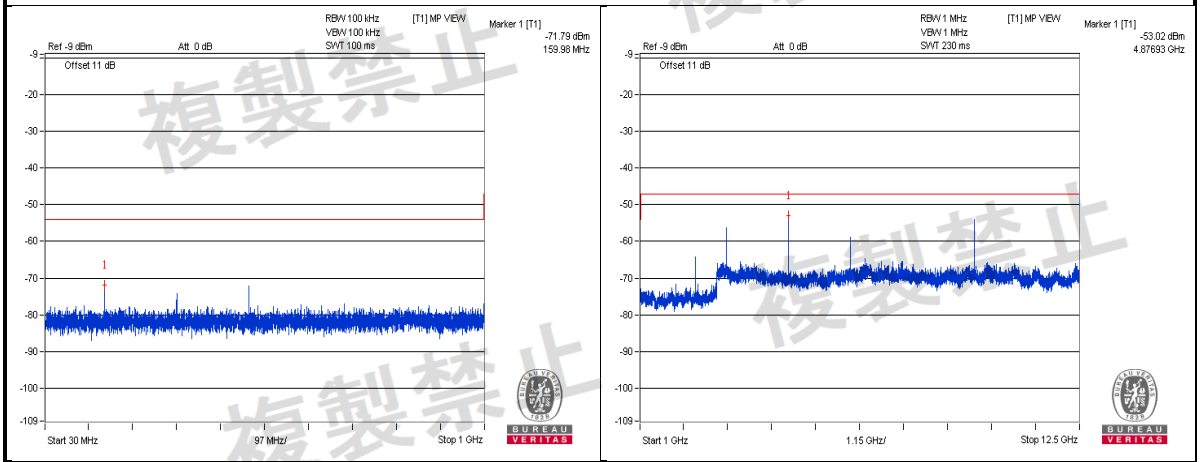


Channel 39

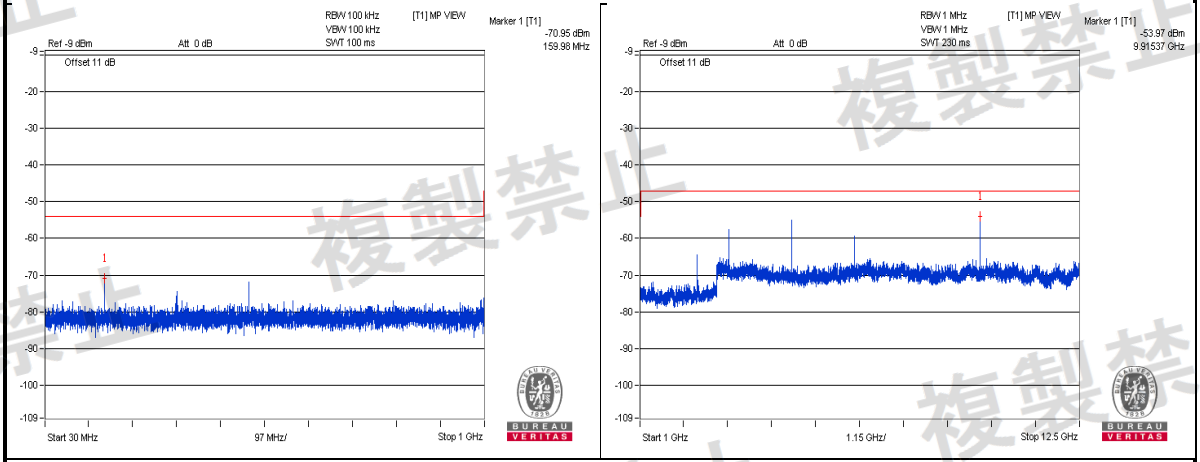
V-10%



Channel 0



Channel 19



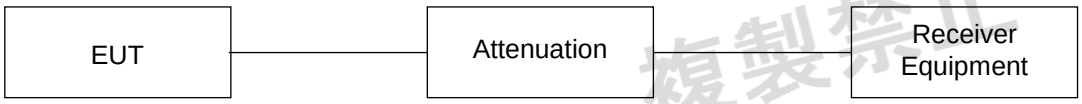
Channel 39

4.6 Interference Prevention Function

4.6.1 Limits of Interference Prevention Function

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

4.6.2 Test Setup



4.6.3 Test Results

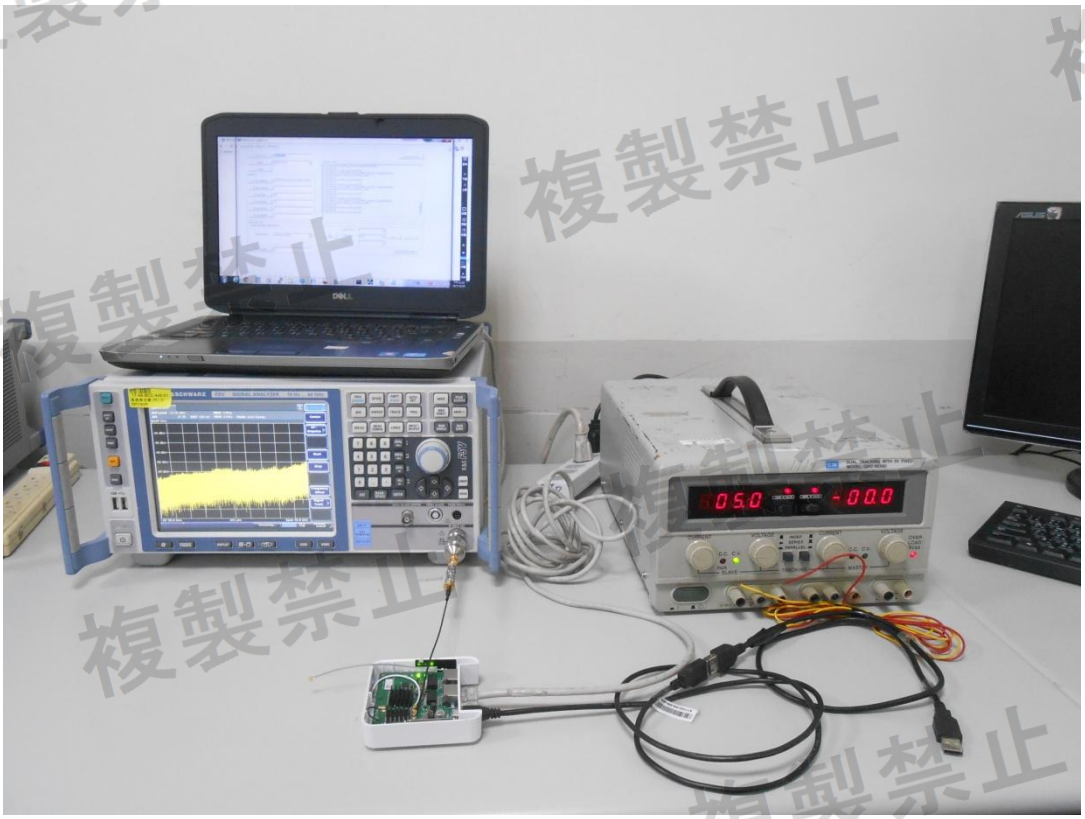
Environmental Conditions	23 deg.C, 66% RH
Link Mode	**Test Result**
BT-LE	PASS

5 Test Instruments

Description & Manufacturer	Model no.	Serial No.	Calibrated Date	Calibrated Until	Calibration Authority
Spectrum Analyzer R&S	FSV40	100964	July 1, 2017	June 30, 2018	ETC
ESG Vector signal generator Agilent	E4438C	MY45094468/005 506 602 UK6 UNJ	Nov. 25, 2016	Nov. 24, 2017	ETC
Detector Narda	4503A	0306	NA	NA	NA
Power Meter Anritsu	ML2495A	1014008	MAY 11, 2017	MAY 10, 2018	ETC
Power Sensor Anritsu	MA2411B	0917122	MAY 11, 2017	MAY 10, 2018	ETC
Digital Oscilloscope R&S	RTO1012	300053	June 28, 2017	June 27, 2018	ETC
DC Power Supply Topward	6603D	795558	NA	NA	NA
Digital Multimeter FLUKE	87III	73680266	Nov. 10, 2016	Nov. 09, 2017	ETC

NOTE: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. Tested Date: Sep. 27, 2017

6 Photographs of the Test Configuration



Appendix - Information on 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:

Linko EMC/RF Lab
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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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