



Radio Test Report (BT LE)

Report No.: RJ190724D02-1

Test Model: MS5320Wc

Received Date: Jul. 24, 2019

Test Date: Aug. 6, 2019

Issued Date: Aug. 14, 2019

Applicant: Chicony Electronics Co., Ltd.

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

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Release Control Record

Issue No.	Description	Date Issued
RJ190724D02-1	Original release.	Aug. 14, 2019



1 Certificate of Conformity

Product: Wireless mouse

Brand: DELL

Test Model: MS5320Wc

Sample Status: Engineering sample

Applicant: Chicony Electronics Co., Ltd.

Test Date: Aug. 6, 2019

Standards: ARIB STD-T66 (V3.7),
MIC No.88(2004) Test method of specified radio equipments
Annex no. 43 Article 2 paragraph 1 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 :

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Date: Aug. 14, 2019

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Approved by :

Rex Lai

Date: Aug. 14, 2019

Rex Lai / Associate Technical 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)	3.2	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)	4.4	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				

Note: Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.



2.1 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until	Calibration Authority
ROHDE & SCHWARZ Spectrum Analyzer	FSV40	101042	Sep. 27, 2018	Sep. 26, 2019	ETC
ROHDE & SCHWARZ Signal Generator	SMR 40	100231	Jul. 1, 2019	Jun. 30, 2020	ETC
Anritsu Power Sensor	MA2411B	0738404	Apr. 16, 2019	Apr. 15, 2020	ETC
Anritsu Power Meter	ML2495A	0842014	Apr. 16, 2019	Apr. 15, 2020	ETC
KEYSIGHT MIMO Powermeasurement Test set	U2021XA	U2021XA-001	Jun. 11, 2019	Jun. 10, 2020	ETC
KEYSIGHT Spectrum Analyzer	N9030A	MY54490260	Jul. 30, 2019	Jul. 29, 2020	ETC
KEYSIGHT MXG Vector Signal Generator	N5182B	MY53052658	May 20, 2019	May 19, 2020	ETC

NOTE: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

2.2 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	206.50 Hz
Spurious emissions	3.93 dB
Output power density	1.11 dB
Out of band radiated power	3.93 dB
Frequency Tolerance	603.76 Hz

2.3 Modification Record

There were no modifications required for compliance.



3 General Information

3.1 General Description of EUT

Product	Wireless mouse
Brand	DELL
Test Model	MS5320Wc
Status of EUT	Engineering sample
Nominal Voltage	1.5Vdc from battery
Modulation Type	GFSK
Transfer Rate	1Mbps
Operating Frequency	2402 ~ 2480MHz
Number of Channel	40
Rated RF Output Power Density	1 mW
Conducted RF Output Power Density	0.902mW
Radiated RF Output Power Density	1.755 mW
Antenna Type	PCB antenna with 2.89dBi gain
Antenna Connector	N/A
Accessory Device	N/A
Data Cable Supplied	N/A

Note: The above EUT information is declared by manufacturer and for more detailed features description, please refers 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

Note: 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 provided by manufacture, the power levels during the tests were set according to the following codes:

Channel	Power setting
0	0
19	0
39	0



3.3 Test Conditions

Test Conditions		Voltage (Vdc)
V_{normal}	-	1.5
$V_{max.}$	+10%	1.65 (Note)
$V_{min.}$	-10%	1.35 (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 EUT used a kind of particular screw, which could not operated by a tool bought in the market. Only means of brute force will be able to open.

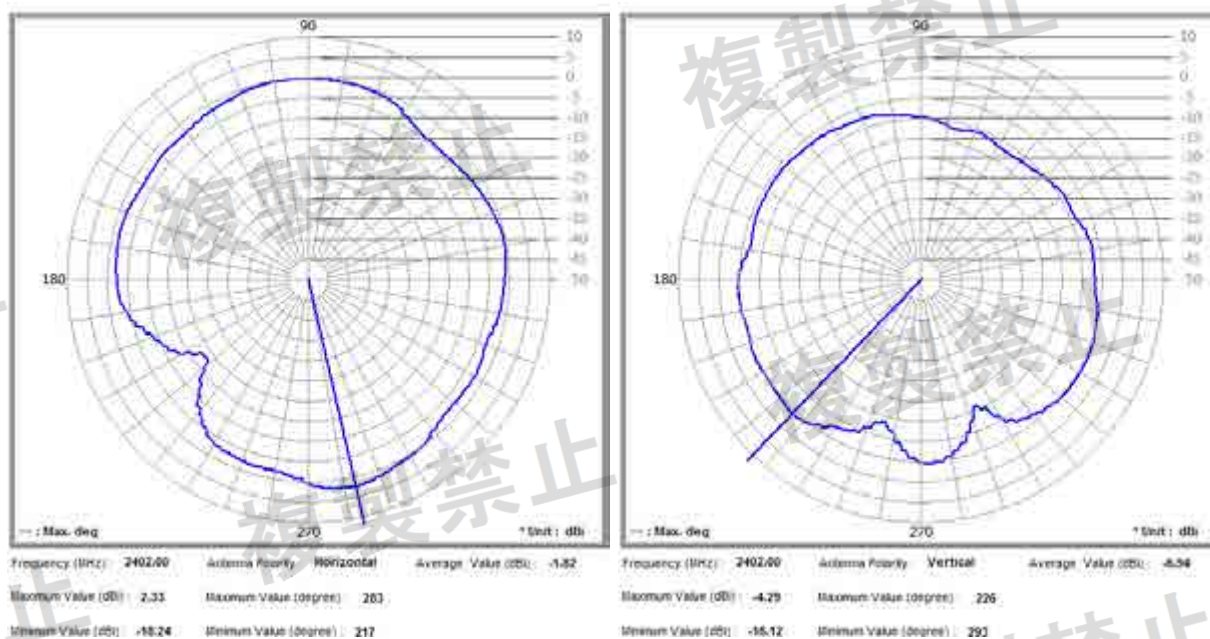


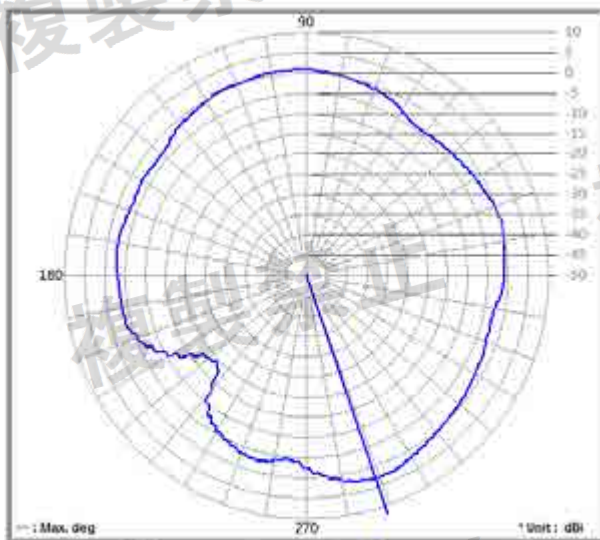
3.5 Antenna Specifications

3.5.1 Antenna Gain

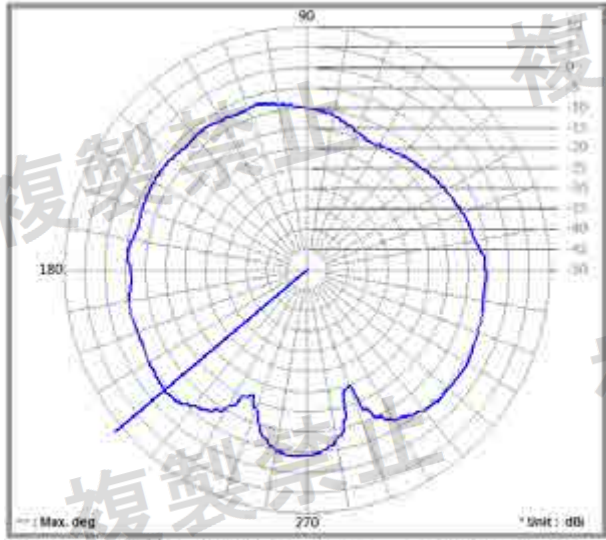
Antenna Type	Max. Gain (dBi)
PCB antenna	2.89

3.5.2 Antenna Pattern

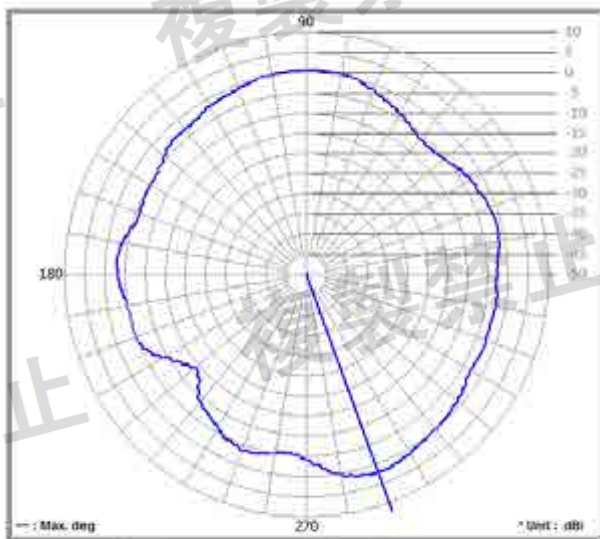




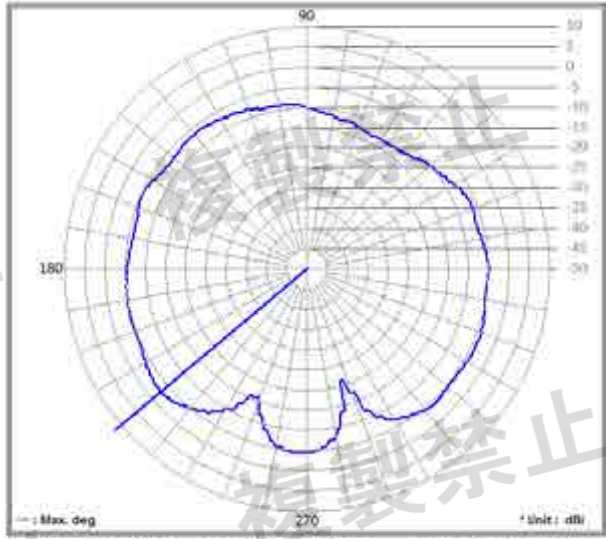
Frequency (MHz): 2440.00 Antenna Polarity: Horizontal Average Value (dBi): -1.55
Maximum Value (dBi): 2.89 Maximum Value (degree): 289
Minimum Value (dBi): -15.33 Minimum Value (degree): 331



Frequency (MHz): 2440.00 Antenna Polarity: Vertical Average Value (dBi): -6.99
Maximum Value (dBi): -3.32 Maximum Value (degree): 270
Minimum Value (dBi): -19.20 Minimum Value (degree): 250



Frequency (MHz): 2400.00 Antenna Polarity: Horizontal Average Value (dBi): -2.41
Maximum Value (dBi): 2.52 Maximum Value (degree): 290
Minimum Value (dBi): -14.29 Minimum Value (degree): 220



Frequency (MHz): 2400.00 Antenna Polarity: Vertical Average Value (dBi): -4.51
Maximum Value (dBi): -2.82 Maximum Value (degree): 229
Minimum Value (dBi): -21.18 Minimum Value (degree): 387



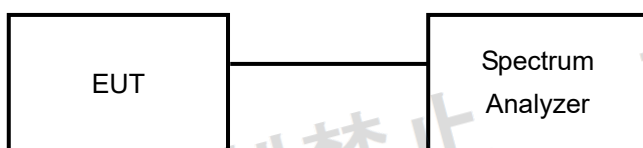
4 Test Results

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		25deg.C, 76% 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	2402.012250	5.099	2402.012250	5.099	2402.012250	5.099
19	2440	2440.012650	5.184	2440.012400	5.081	2440.012400	5.081
39	2480	2480.012400	5.000	2480.012600	5.080	2480.012600	5.080



4.2 Occupied Bandwidth Measurement (99% power bandwidth)

4.2.1 Limits of Occupied Bandwidth Measurement

Item	Limit	Remark
Occupied bandwidth	<26MHz	-

4.2.2 Test Setup



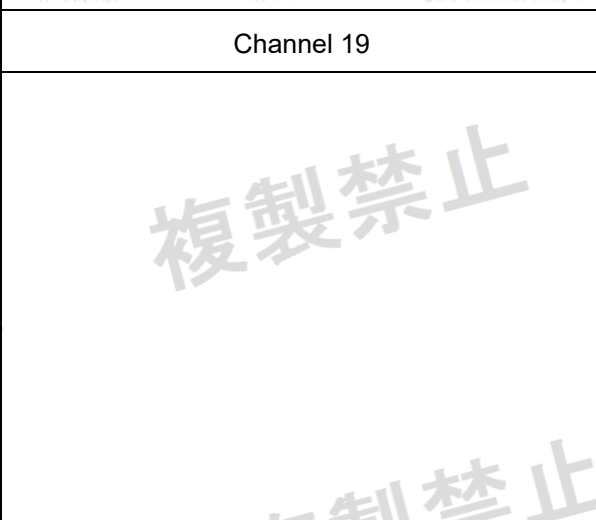
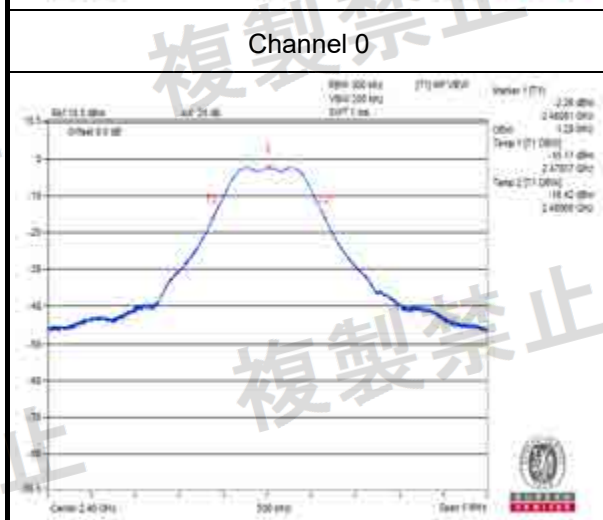
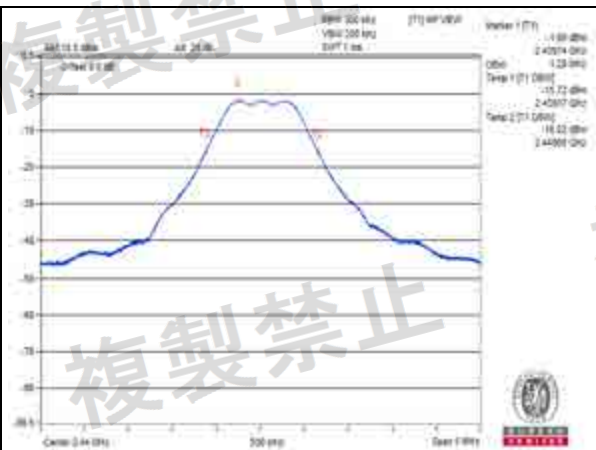
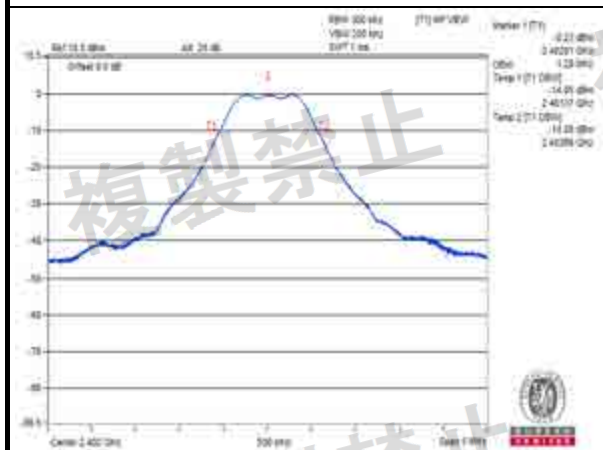
4.2.3 Test Results

Environmental Conditions		25deg.C, 76% RH		
Channel	Frequency (MHz)	V _{normal}	V _{max.}	V _{min.}
		Occupied Bandwidth (MHz)	Occupied Bandwidth (MHz)	Occupied Bandwidth (MHz)
0	2402	1.29	1.29	1.29
19	2440	1.29	1.29	1.29
39	2480	1.29	1.29	1.29

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

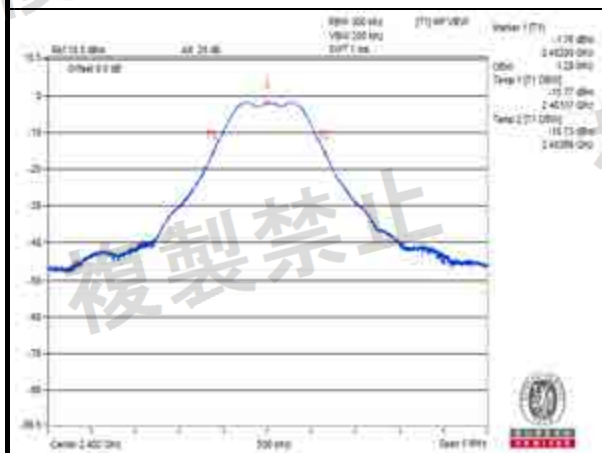


V_{normal}

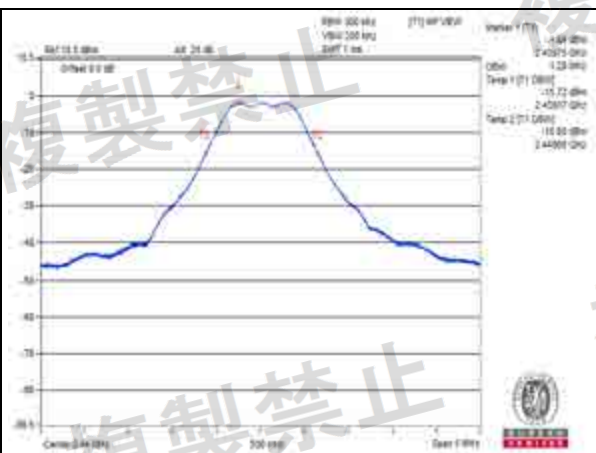




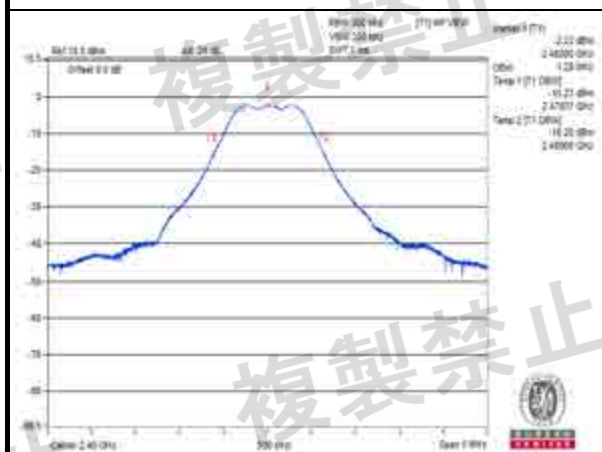
V_{max}



Channel 0



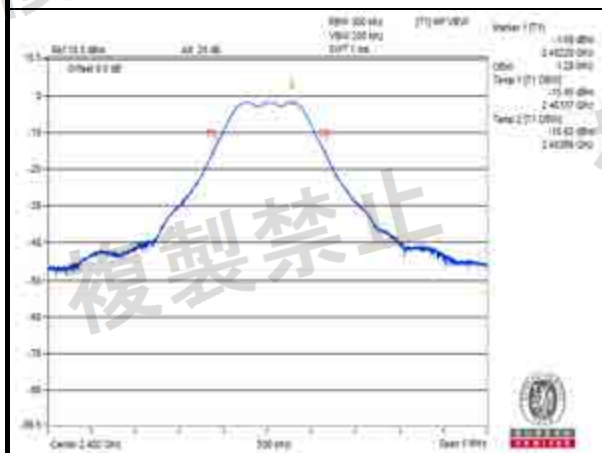
Channel 19



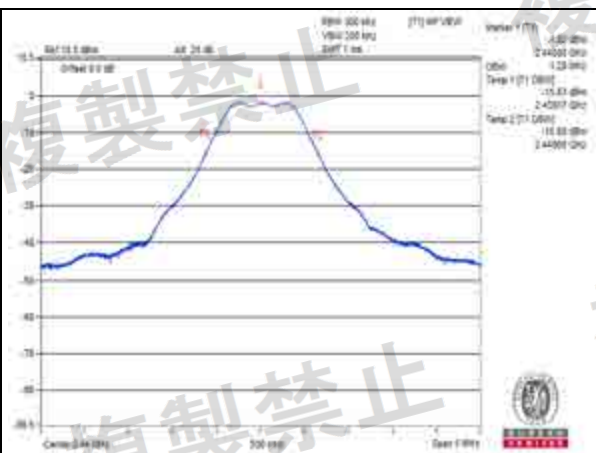
Channel 39



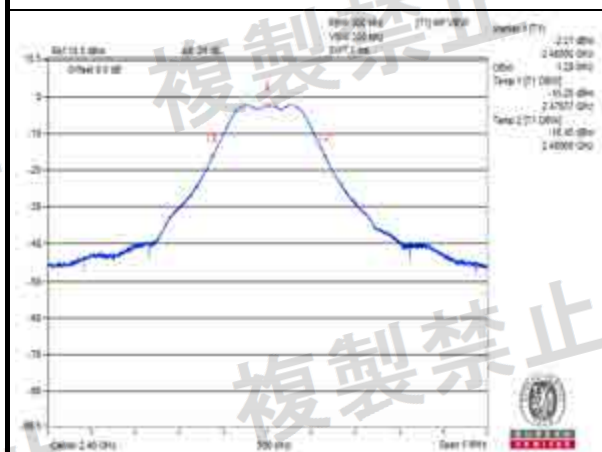
V_{min}



Channel 0



Channel 19



Channel 39

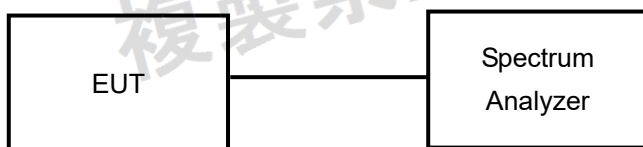


4.3 Spurious Emissions for Transmitter Measurement

4.3.1 Limits of Spurious Emissions

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

4.3.2 Test Setup





4.3.3 Test Results

Environmental Conditions		25deg.C, 76% 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	423.330	0.000242uW	938.400	0.000274uW	0.25uW/100kHz	Pass
	1000.0MHz to 2387MHz	2273.950	0.002594uW	2312.790	0.002377uW	2.5uW/MHz	Pass
	2387.0MHz to 2400.0MHz	2400.000	0.457088uW	2392.400	0.002259uW	25uW/MHz	Pass
	2483.5MHz to 2496.5MHz	2490.980	0.002244uW	2489.090	0.002443uW	25uW/MHz	Pass
	2496.5MHz to 12500.0MHz	9608.980	0.006668uW	10724.370	0.007745uW	2.5uW/MHz	Pass
V _{max.}	30.0MHz to 1000.0MHz	746.830	0.000577uW	911.730	0.000263uW	0.25uW/100kHz	Pass
	1000.0MHz to 2387MHz	2274.650	0.002138uW	2312.790	0.00241uW	2.5uW/MHz	Pass
	2387.0MHz to 2400.0MHz	2399.980	0.453942uW	2394.640	0.001811uW	25uW/MHz	Pass
	2483.5MHz to 2496.5MHz	2494.640	0.002128uW	2488.250	0.002143uW	25uW/MHz	Pass
	2496.5MHz to 12500.0MHz	9608.980	0.00955uW	9759.040	0.00881uW	2.5uW/MHz	Pass
V _{min.}	30.0MHz to 1000.0MHz	729.370	0.000809uW	918.030	0.000263uW	0.25uW/100kHz	Pass
	1000.0MHz to 2387MHz	2274.650	0.002793uW	2312.100	0.002415uW	2.5uW/MHz	Pass
	2387.0MHz to 2400.0MHz	2399.970	0.452898uW	2397.490	0.001945uW	25uW/MHz	Pass
	2483.5MHz to 2496.5MHz	2488.300	0.002254uW	2487.830	0.00228uW	25uW/MHz	Pass
	2496.5MHz to 12500.0MHz	9608.980	0.00743uW	9759.040	0.00778uW	2.5uW/MHz	Pass

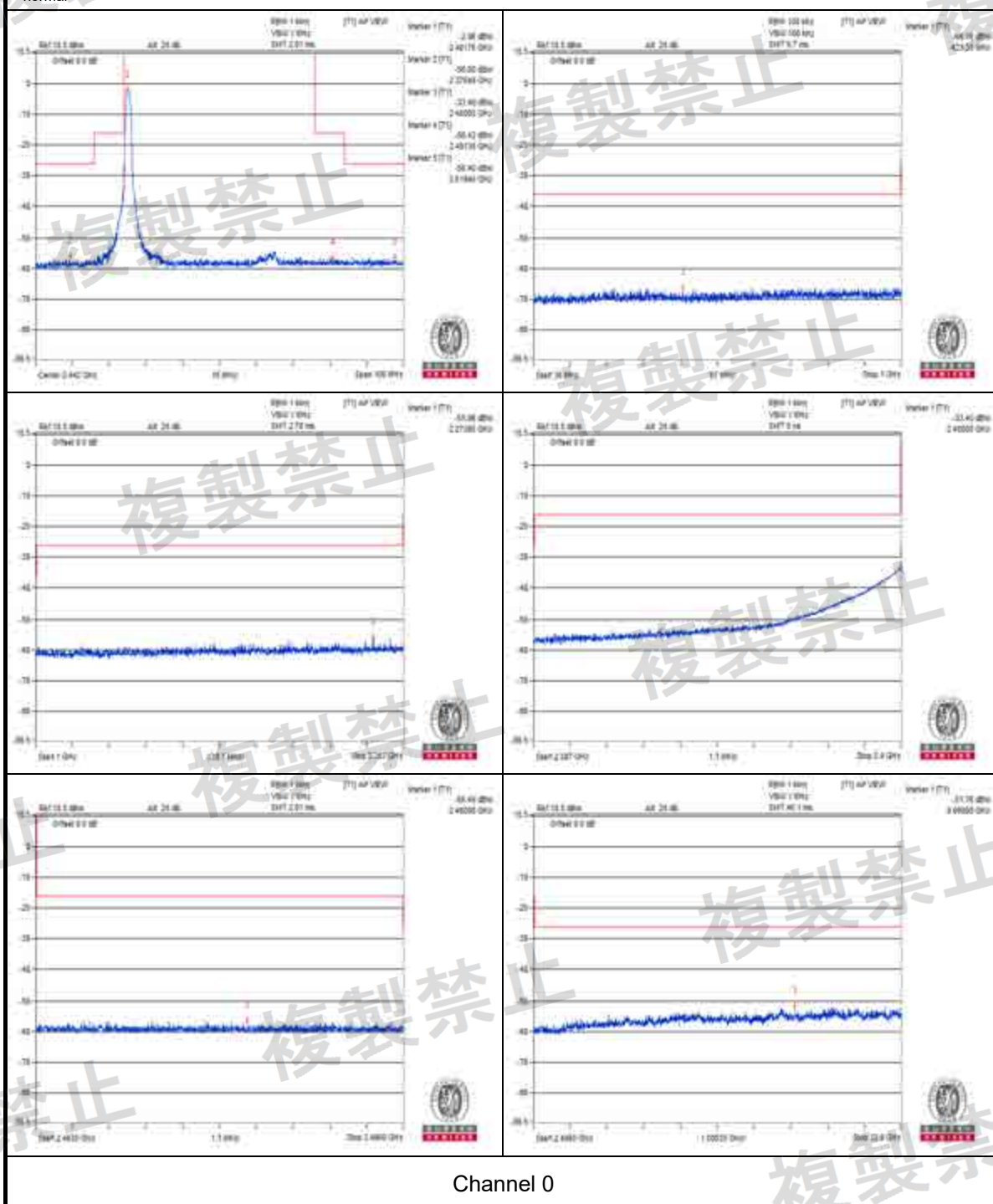


Environmental Conditions		25deg.C, 76% RH			
Test Channel		CH 39 (2480MHz)		Limit	Result
Test Condition	Frequency Range	Frequency (MHz)	Measured Value		
V _{normal}	30.0MHz to 1000.0MHz	778.840	0.000302uW	0.25uW/100kHz	Pass
	1000.0MHz to 2387MHz	2353.010	0.002871uW	2.5uW/MHz	Pass
	2387.0MHz to 2400.0MHz	2394.000	0.002037uW	25uW/MHz	Pass
	2483.5MHz to 2496.5MHz	2483.500	0.081283uW	25uW/MHz	Pass
	2496.5MHz to 12500.0MHz	9924.090	0.007244uW	2.5uW/MHz	Pass
V _{max.}	30.0MHz to 1000.0MHz	858.860	0.000357uW	0.25uW/100kHz	Pass
	1000.0MHz to 2387MHz	2353.010	0.002133uW	2.5uW/MHz	Pass
	2387.0MHz to 2400.0MHz	2392.200	0.002028uW	25uW/MHz	Pass
	2483.5MHz to 2496.5MHz	2483.510	0.076913uW	25uW/MHz	Pass
	2496.5MHz to 12500.0MHz	12314.930	0.006368uW	2.5uW/MHz	Pass
V _{min.}	30.0MHz to 1000.0MHz	701.720	0.000279uW	0.25uW/100kHz	Pass
	1000.0MHz to 2387MHz	2352.320	0.002291uW	2.5uW/MHz	Pass
	2387.0MHz to 2400.0MHz	2389.260	0.001841uW	25uW/MHz	Pass
	2483.5MHz to 2496.5MHz	2483.500	0.087096uW	25uW/MHz	Pass
	2496.5MHz to 12500.0MHz	10619.340	0.006637uW	2.5uW/MHz	Pass

NOTE: The spectrum plots are attached on the following pages.

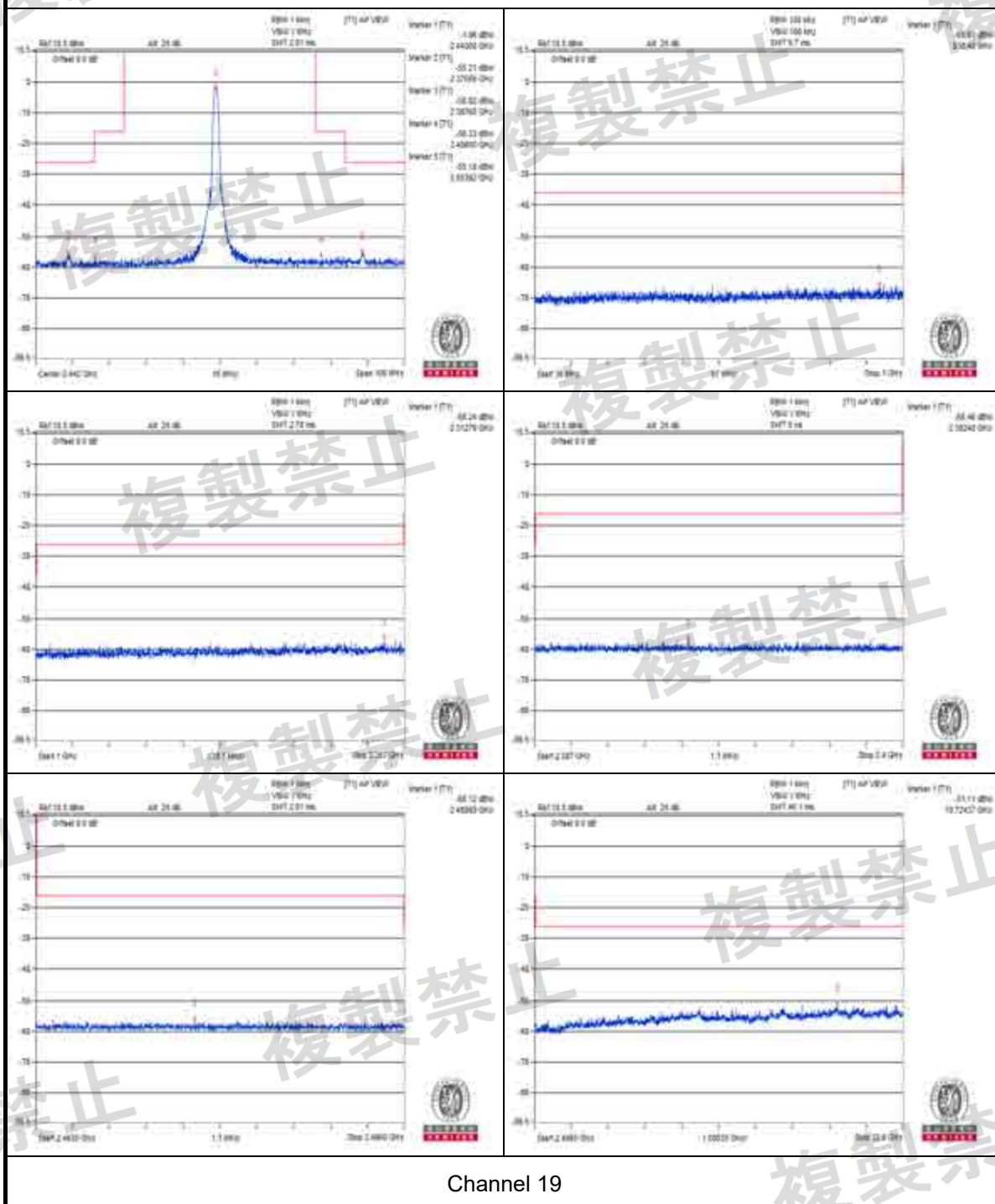


V_{normal}



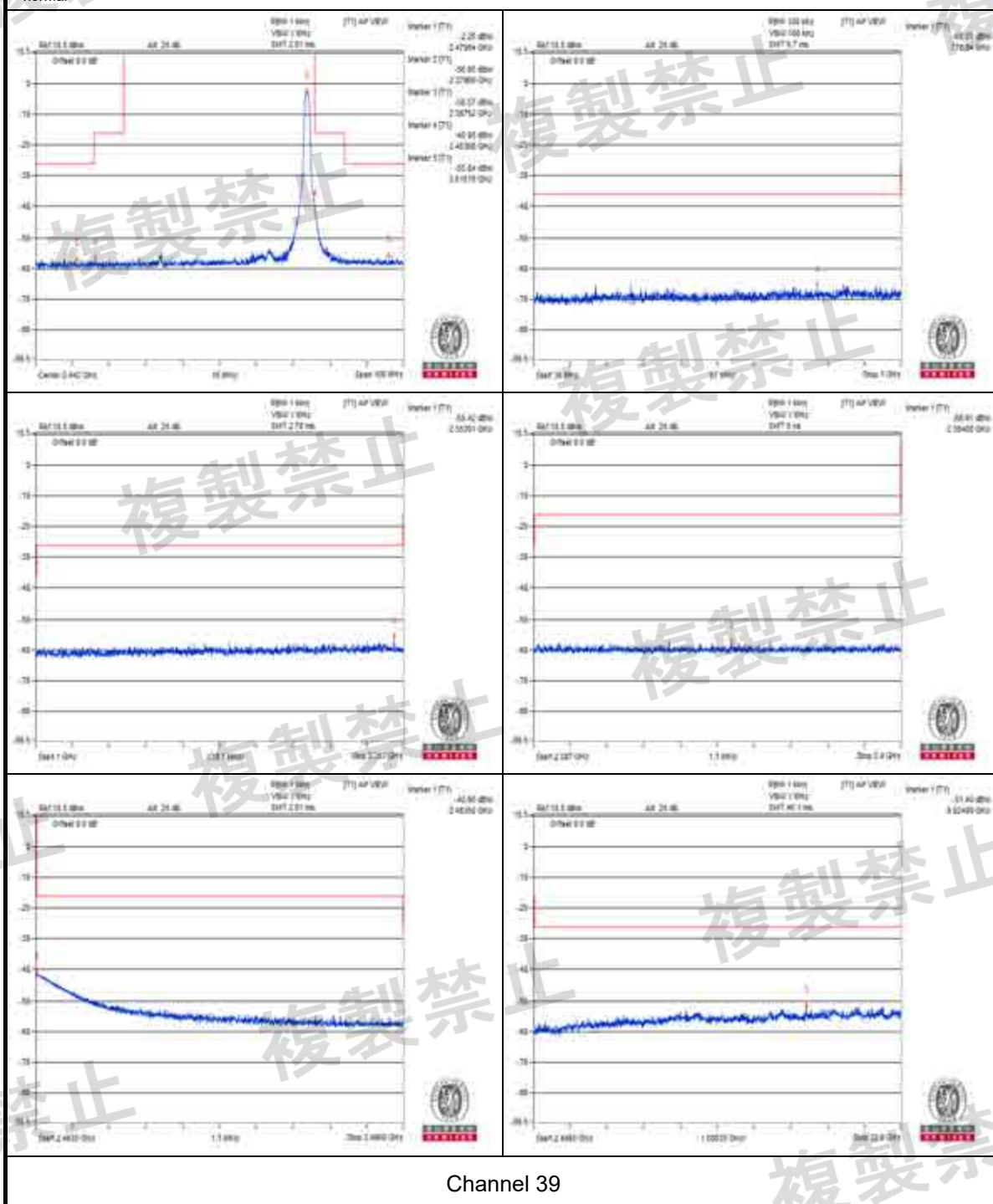


V_{normal}



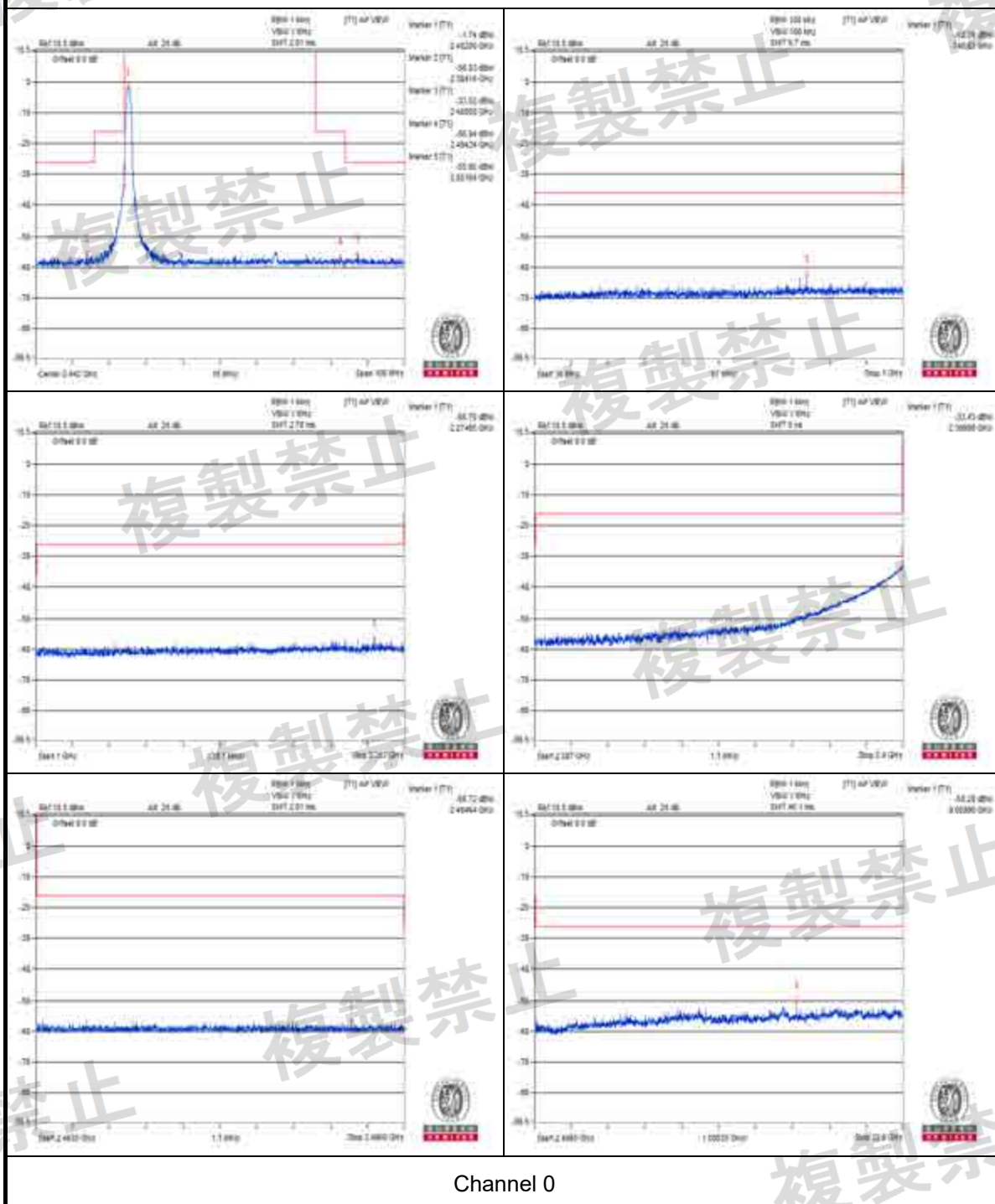


V_{normal}



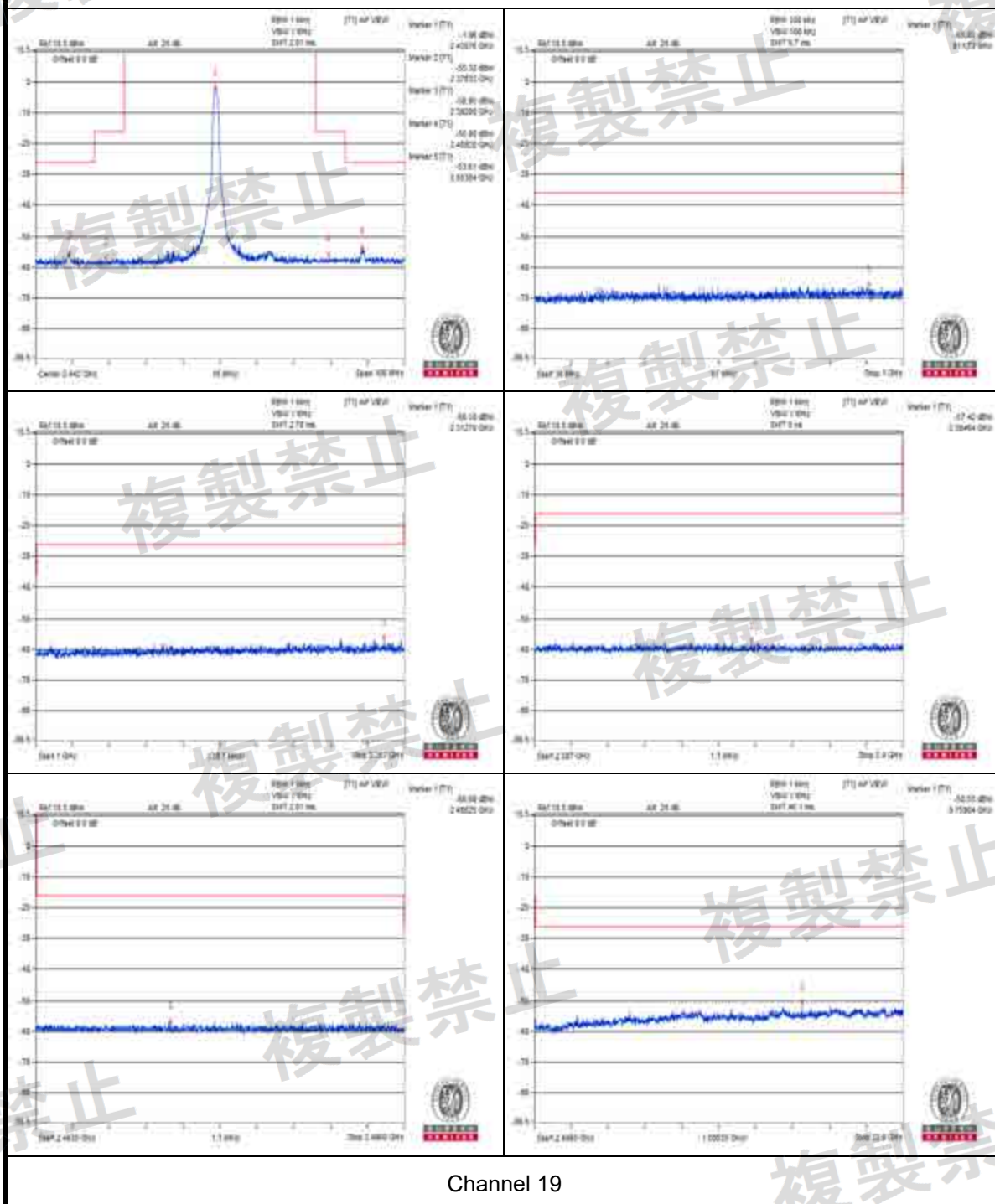


V_{max}.



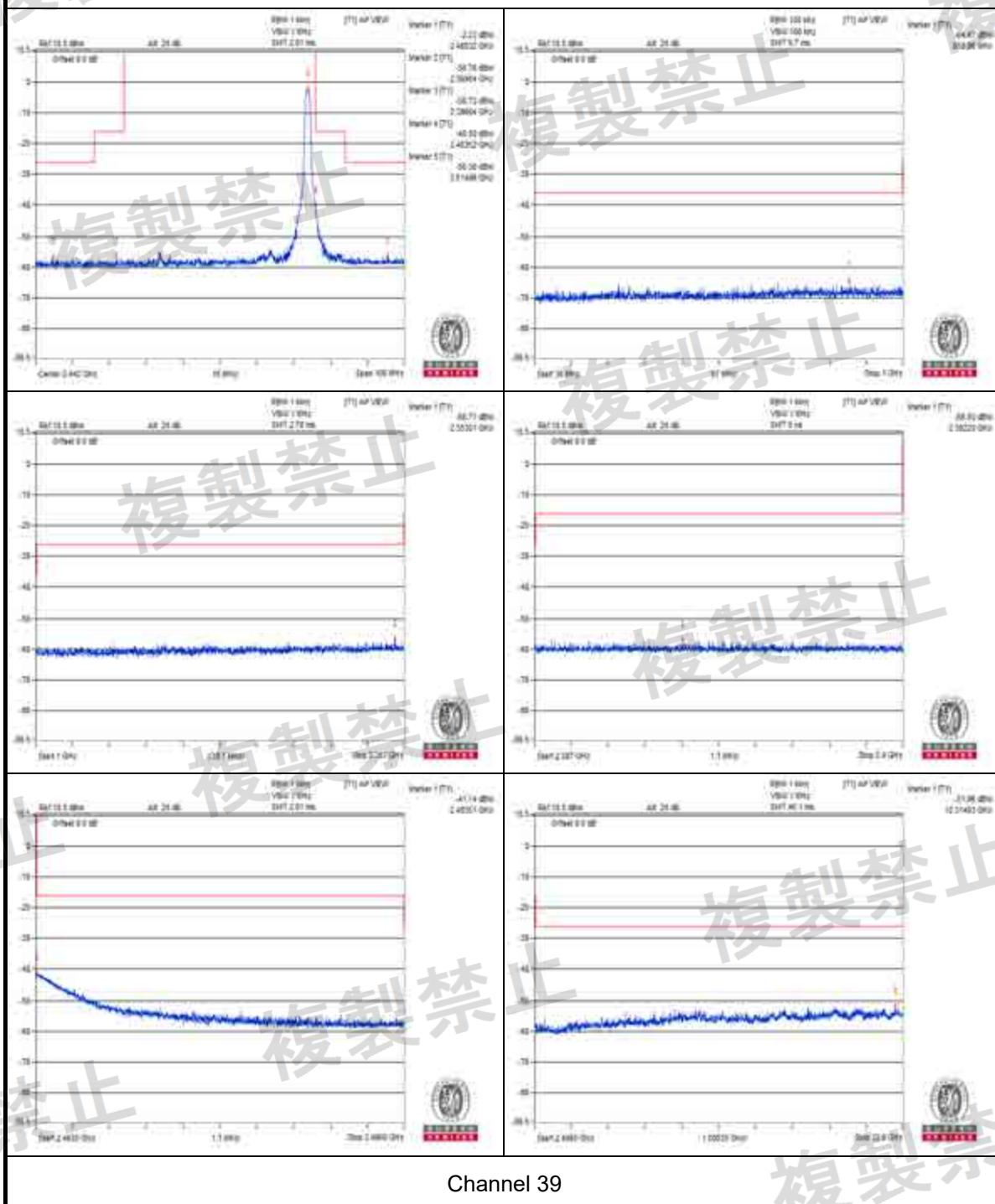


V_{max}.



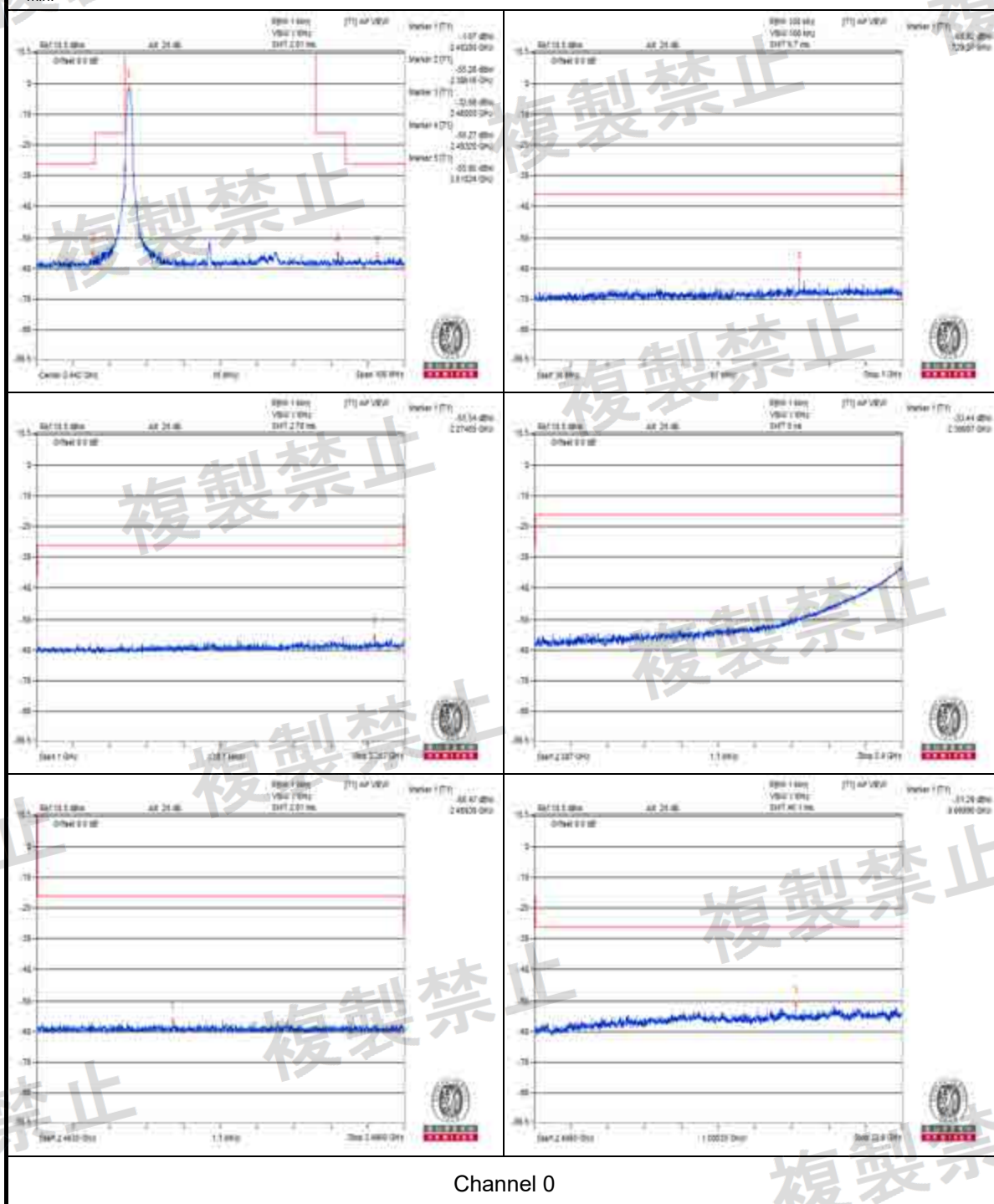


V_{max}.



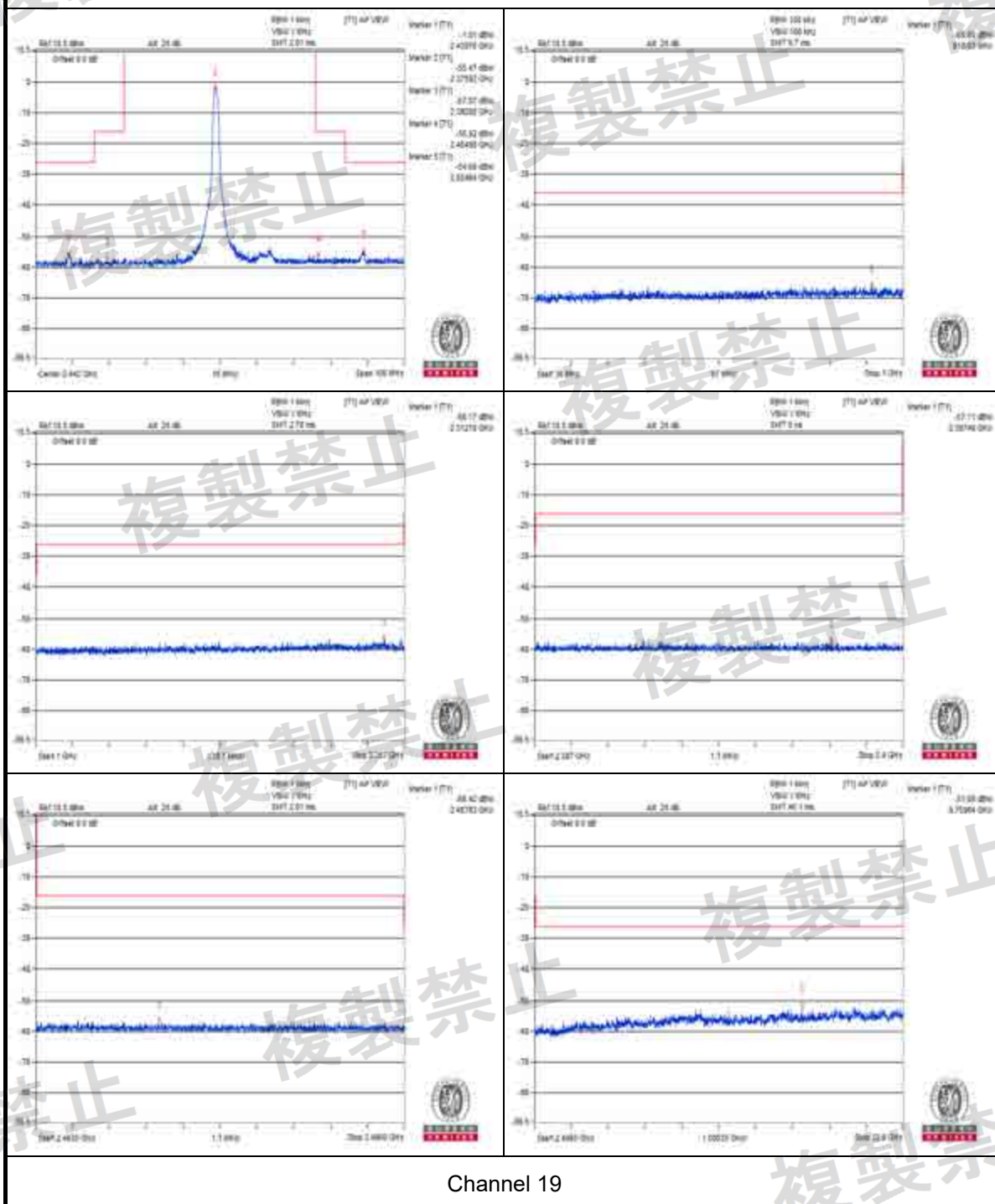


V_{min}.



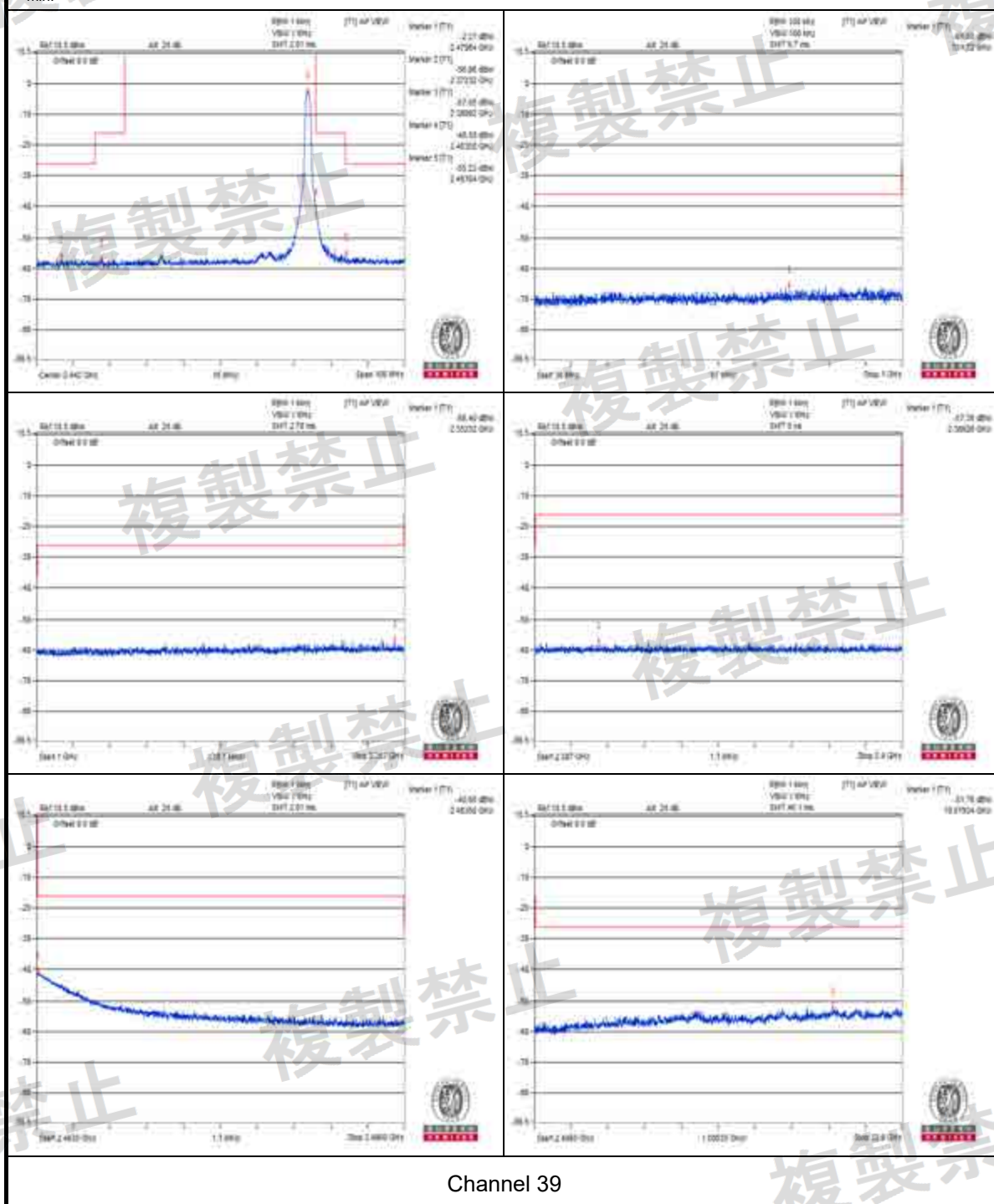


V_{min}.





V_{min}.



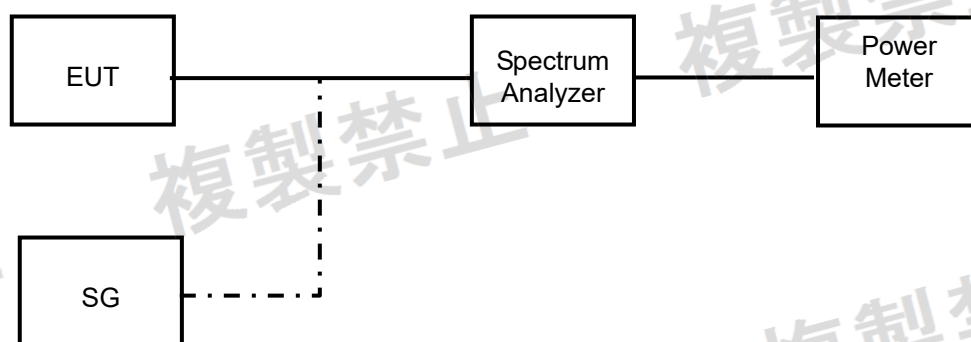
4.4 Antenna Power Measurement

4.4.1 Limits of Antenna Power

Antenna power shall be 10 mW or less.

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		25 deg.C, 76% RH			
Channel Number	Frequency (MHz)	Conducted RF Output Power Density (mW)			
		Normal Voltage	Max. Voltage	Min. Voltage	Max. Limit (mW/MHz)
		1.5Vdc	1.65Vdc	1.35Vdc	
0	2402	0.902	0.897	0.881	10
19	2440	0.815	0.798	0.785	10
39	2480	0.755	0.782	0.723	10
Rated power		1mW			
Tolerance of antenna power		0.2mW ~ 1.2mW			

PCB antenna with 2.89dBi gain

Environmental Conditions		25 deg.C, 76% RH			
Channel Number	Frequency (MHz)	Radiated RF Output Power Density (mW)			
		Normal Voltage	Max. Voltage	Min. Voltage	Max. Limit (mW/MHz)
		1.5Vdc	1.65Vdc	1.35Vdc	
0	2402	1.755	1.745	1.714	16.368
19	2440	1.585	1.552	1.527	16.368
39	2480	1.469	1.521	1.406	16.368

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

4.5 Spurious Emissions for Receiver

4.5.1 Limits of Spurious Emissions For Receiver

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

4.5.2 Test Setup





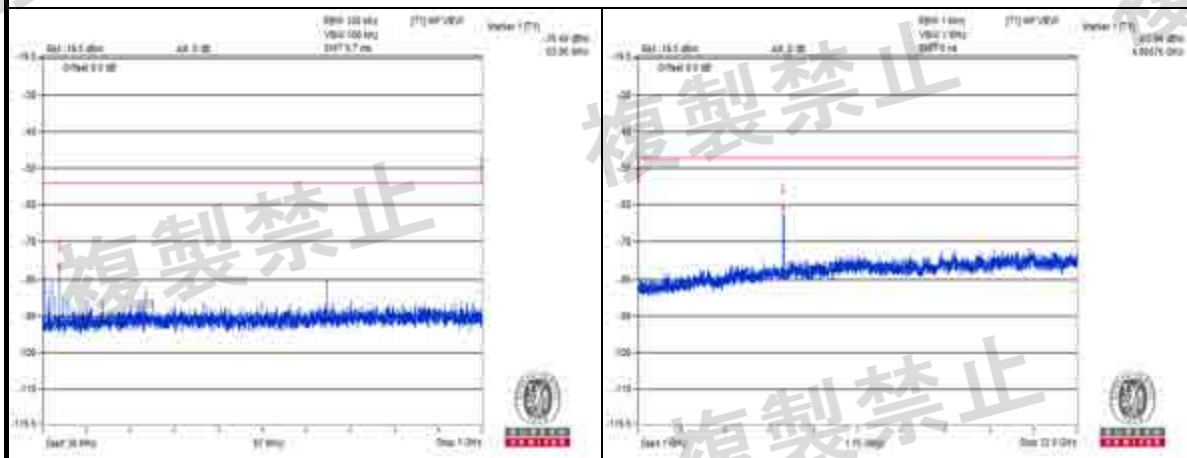
4.5.3 Test Result

Environmental Conditions		25deg.C, 76% 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	63.950	0.022439nW	63.950	0.020464nW	4nW/100kHz	Pass
	Above 1GHz	4800.750	0.805378nW	4878.370	0.592925nW	20nW/MHz	Pass
V _{max.}	Below 1GHz	63.950	0.021677nW	63.950	0.022594nW	4nW/100kHz	Pass
	Above 1GHz	4800.750	0.92683nW	4878.370	0.476431nW	20nW/MHz	Pass
V _{min.}	Below 1GHz	63.950	0.01977nW	63.950	0.022439nW	4nW/100kHz	Pass
	Above 1GHz	4800.750	0.874984nW	4878.370	0.509331nW	20nW/MHz	Pass
Test Channel		CH 39 (2480MHz)				Limit	Result
Test Condition	Frequency Range	Frequency (MHz) Measured Value		Measured Value			
V _{normal}	Below 1GHz	63.950		0.023878nW		4nW/100kHz	Pass
	Above 1GHz	4958.870		0.870964nW		20nW/MHz	Pass
V _{max.}	Below 1GHz	63.950		0.021827nW		4nW/100kHz	Pass
	Above 1GHz	4958.870		0.918333nW		20nW/MHz	Pass
V _{min.}	Below 1GHz	63.950		0.024155nW		4nW/100kHz	Pass
	Above 1GHz	4958.870		0.952796nW		20nW/MHz	Pass

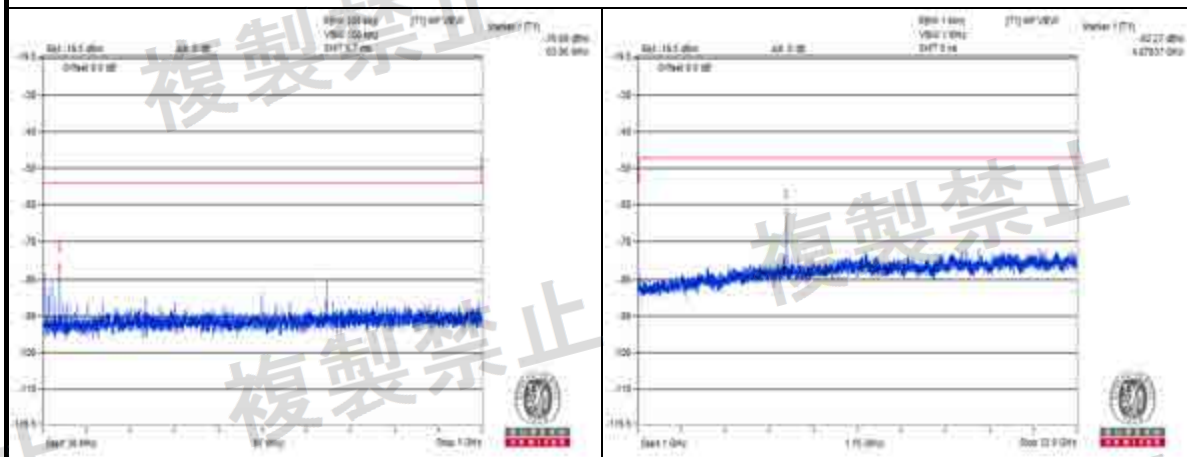
NOTE: The spectrum plots are attached on the following pages.



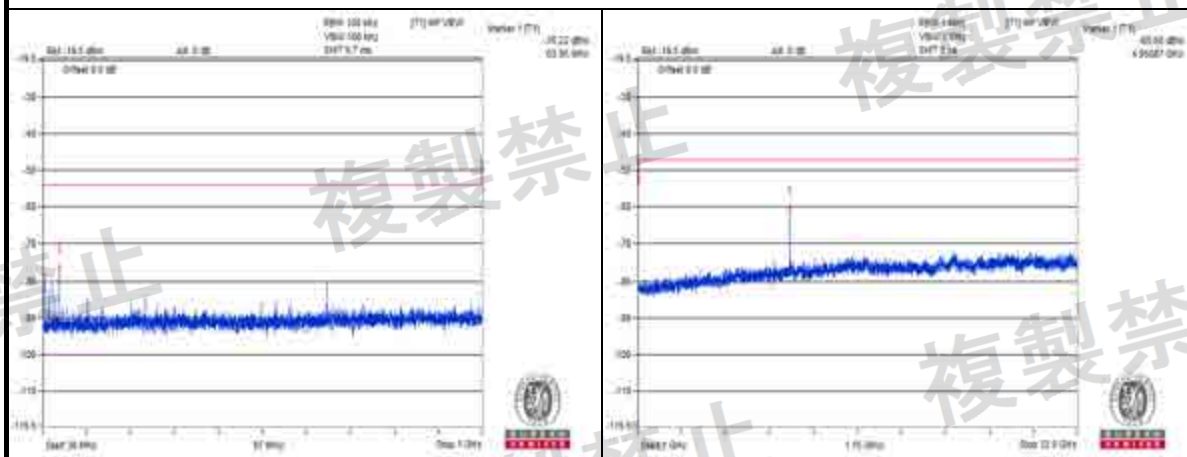
V_{normal}



Channel 0



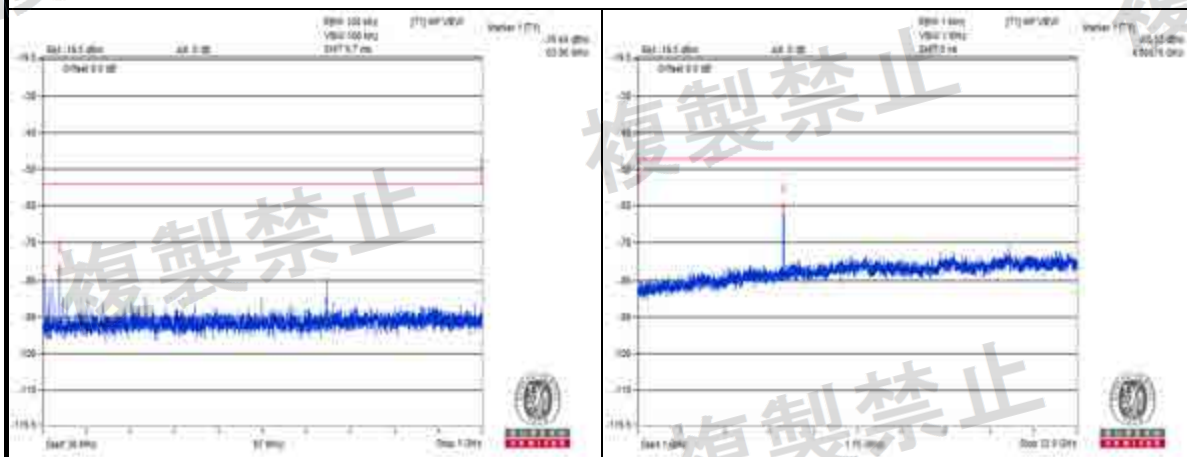
Channel 19



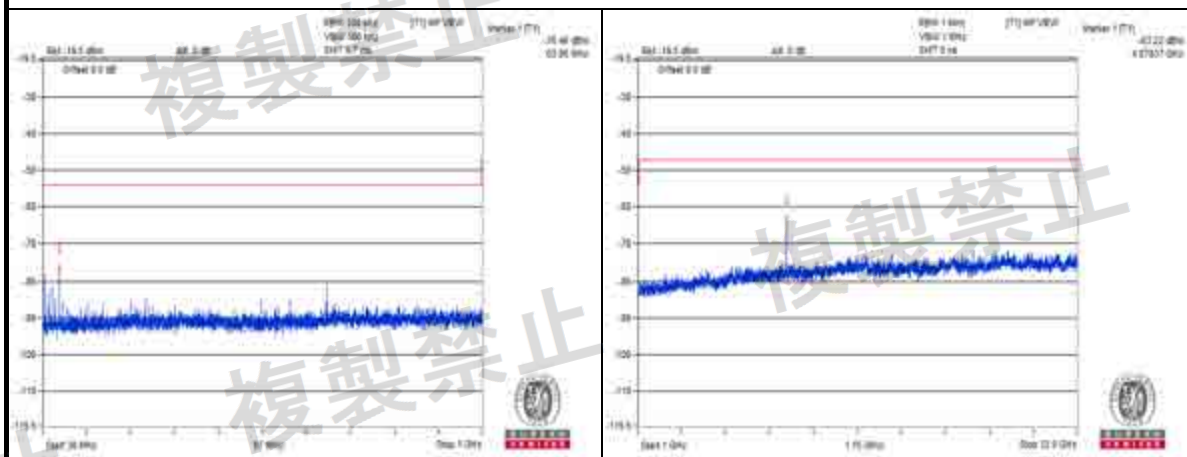
Channel 39



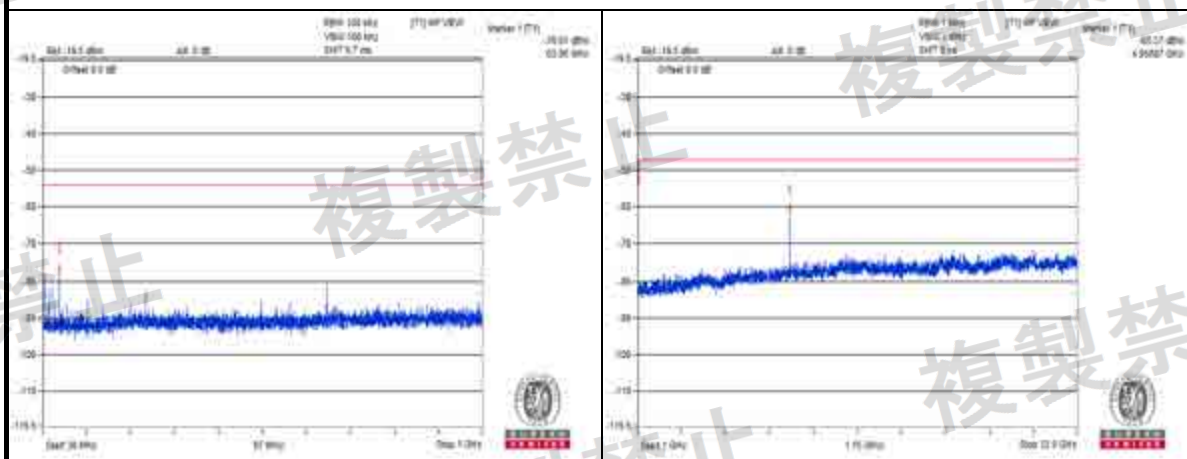
V_{max}



Channel 0

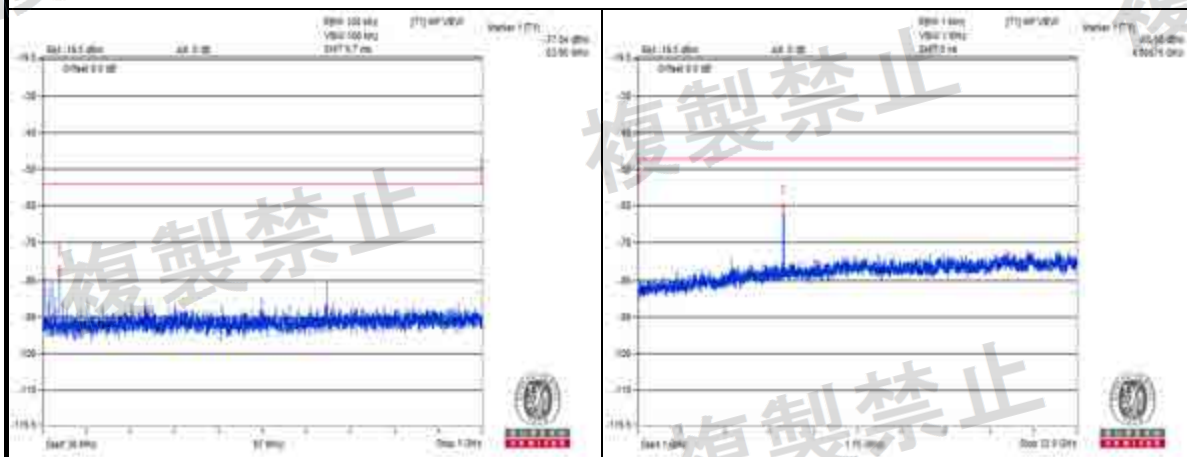


Channel 19

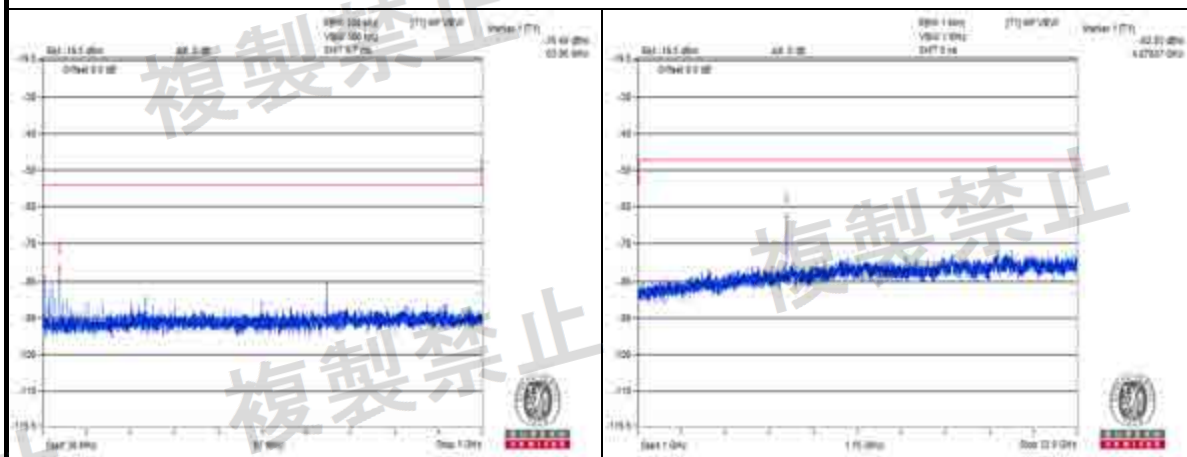


Channel 39

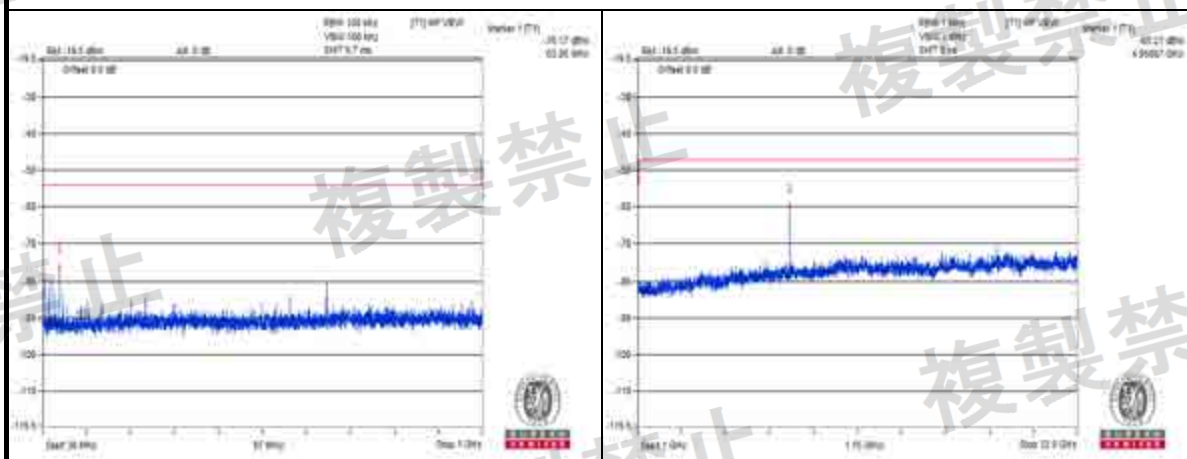
V_{min}.



Channel 0



Channel 19



Channel 39

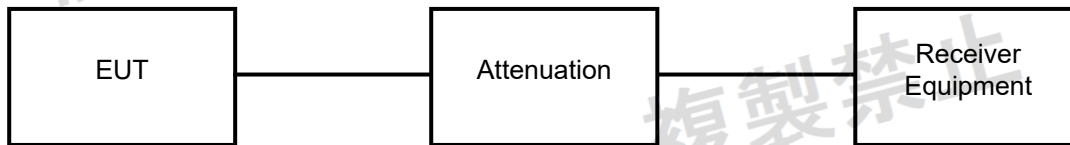


4.6 Interference Prevention Function

4.6.1 Limits of Interference Prevention Function

NA

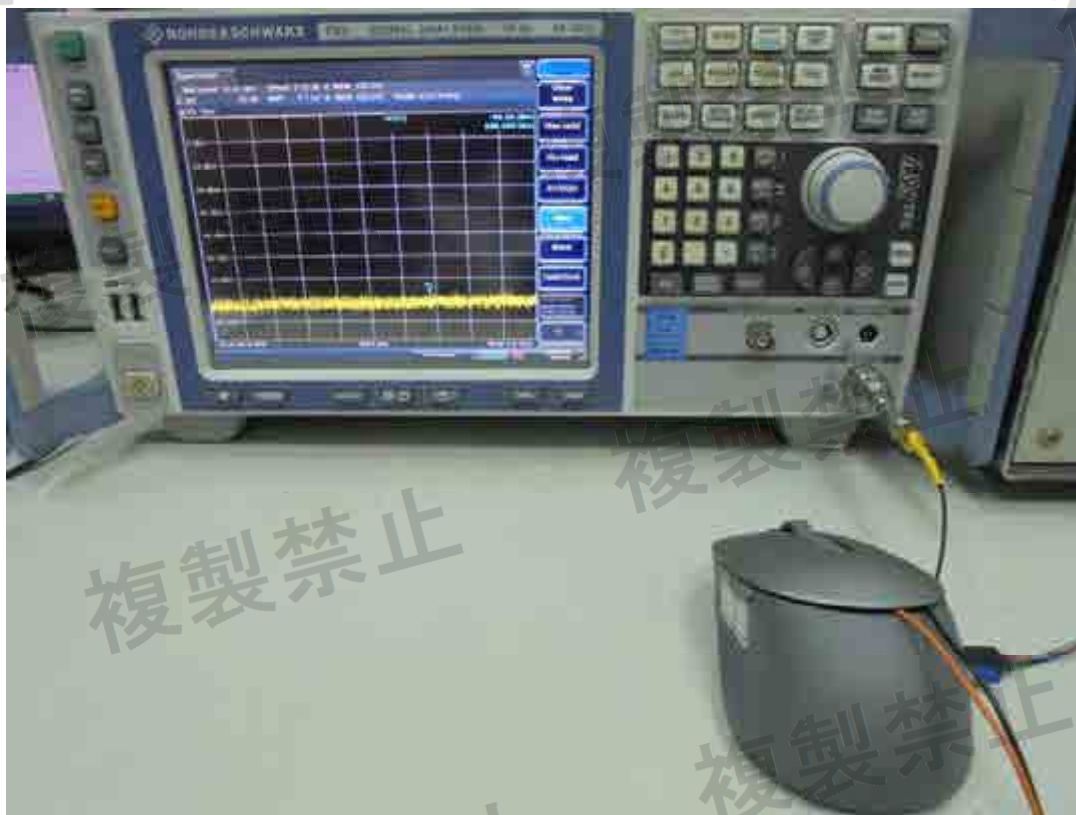
4.6.2 Test Setup



4.6.3 Test Results

Environmental Conditions	25deg.C, 76% RH
Link Mode	Test Result
Bluetooth	PASS

5 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:

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

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