

Radio Test Report (BT-LE)

Report No.: RJBSE-WTW-P20120306B-3

Test Model: ZAP5220

Received Date: 2022/4/27

Test Date: 2022/6/17

Issued Date: 2022/8/25

Applicant: ZPE Systems, Inc.

Address: 3793 Spinnaker Ct., Fremont, CA 94538

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

Test Location: E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan



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Release Control Record

Issue No.	Description	Date Issued
RJBBSE-WTW-P20120306B-3	Original release.	2022/8/25

1 Certificate of Conformity

Product: 802.11ac wireless Access Point

Brand: ZPE Systems, Inc.

Test Model: ZAP5220

Sample Status: Engineering sample

Applicant: ZPE Systems, Inc.

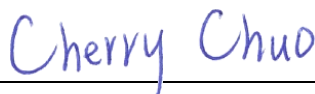
Test Date: 2022/6/17

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

Certification Ordinance Article 2-1-19

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 EMC characteristics under the conditions specified in this report.


Prepared by :


Cherry Chuo / Specialist

Date:

2022/8/25

Approved by :


May Chen / Manager

Date:

2022/8/25

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: 1. C = Conform NC = Not Conform NT = Not Tested NA = Not Applicable

2. 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	Calibration Method
Spectrum Analyzer R&S	FSV40	101516	2022/3/7	2023/3/6	ETC	(c)
ESG Vector signal generator Agilent	E4438C	MY45094468	2021/11/21	2022/11/20	ETC	(c)
Power Meter Anritsu	ML2495A	1529002	2021/6/21	2022/6/20	ETC	(c)
Pulse Power Sensor Anritsu	MA2411B	1339443	2022/5/29	2023/5/28	ETC	(c)
DC POWER SUPPLY Topward	6603D	795558	Note 3	Note 3	BV CPS E&E	(d)
AC Power Source GOOD WILL	6905S	1991551	Note 3	Note 3	BV CPS E&E	(d)
True RMS Clamp Meter Fluke	325	31130711WS	2022/6/9	2023/6/8	ETC	(c)
Combiner Mini-Circuits	ZFRSC-123-S+	F698501347_02	2021/12/22	2022/12/21	BV CPS E&E	(d)
40GHz 2.92mm 1W 4Way Resistive Power Divide Warison	WDIV-4R4029	0001	2022/1/10	2023/1/9	BV CPS E&E	(d)

- 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. 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).
 - b) : Calibration conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Law (Law No. 51 of 1992) Japan Calibration Service System.
 - c) : Calibration conducted in foreign countries, which shall be equivalent to the calibration conducted by the NICT or a designated calibration agency under Article 102-18 paragraph (1).
 - d) : Calibration conducted by using other equipment that listed above from a) to c).
 3. The power supply no evaluation calibrated, which used the digital multimeter to verify before each testing.
 4. Tested Date: 2022/6/17

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	± 960 Hz
Spurious emissions	± 2.5 dB
Output power density	± 1.2 dB
Out of band radiated power	± 2.5 dB
Frequency Tolerance	± 960 Hz

2.3 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT (BT-LE)

Product	802.11ac wireless Access Point
Brand	ZPE Systems, Inc.
Test Model	ZAP5220
Status of EUT	Engineering sample
Nominal Voltage	12Vdc from power adapter or 48Vdc from POE
Modulation Type	GFSK
Modulation Technology	DTS
Transfer Rate	Up to 1Mbps
Operating Frequency	2.402 ~ 2.480GHz
Number of Channel	40
Rated RF Output Power	2 mW
Conducted RF Output Power	1.205 mW
Radiated RF Output Power	3.090 mW
Antenna Type	Refer to section 3.5
Antenna Connector	Refer to section 3.5
Accessory Device	Adapter x1
Data Cable Supplied	NA

Note:

1. Simultaneously transmission condition.

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

2. The EUT must be supplied with a power adapter or POE as below table :

Adapter		
Brand	Model	Specification
APD	WB-12G12FU	AC Input: 100-240V, 0.5A, 50/60Hz DC Output: 12V, 1.0A DC output cable: Unshielded 1.8m
APD	WA-12M12FU	AC Input: 100-240V, 0.5A, 50/60Hz DC Output: 12V, 1.0A DC output cable: Unshielded 1.8m
POE (only for test not for sale)		
Brand	Model No.	Spec.
NA	GRT-480125A	AC Input: 100-240Vac, 50/60Hz DC Output: 48Vdc, 1250mA

3. For input voltage of EUT, the worse case was found at the voltage 12Vdc condition. Therefore only the test data of the mode was recorded in this report individually.

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 (Run telnet paste BLE command) provided by manufacturer, the power levels during the tests were set according to the following codes:

Channel	Power Setting
0	Default
19	Default
39	Default

3.3 Test Conditions

Test Conditions		Voltage (Vdc)
V_{normal}		12
$V_{max.}$	+10%	13.2
$V_{min.}$	-10%	10.8

Test mode is presented in the report as below:

Test Item	Environmental Conditions
Frequency Tolerance	24 deg.C, 64 % RH
Occupied Bandwidth	24 deg.C, 64 % RH
Spurious Emissions for Transmitter	24 deg.C, 64 % RH
Antenna Power	24 deg.C, 64 % RH
Spurious Emissions for Receiver	24 deg.C, 64 % RH

3.4 Assembly

The EUT is constructed as a 802.11ac Wireless Access Point. 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 antenna Spec.							
Antenna No.	Brand	Model	Antenna Net Gain(dBi)	Frequency range (GHz)	Antenna Type	Connector Type	Cable Length (mm)
Antenna 1	Accton	120G00000153A	4.17	2.4~2.4835	Monopole	i-pex	180
			5.83	5.15~5.85			
Antenna 2	Accton	120G00000153A	4.27	2.4~2.4835	Monopole	i-pex	160
			8.18	5.15~5.85			
Bluetooth antenna Spec.							
Brand	Model	Antenna Net Gain(dBi)	Frequency range (GHz)	Antenna Type	Connector Type	Cable Length (mm)	
Accton	120G00000153A	4.09	2.4~2.4835	PIFA	i-pex	80	

Note: The above Antenna information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications, the laboratory shall not be held responsible.

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

Channel	Frequency (MHz)	V_{normal}		V_{max.}		V_{min.}	
		Carrier frequency (MHz)	Frequency tolerance (ppm)	Carrier frequency (MHz)	Frequency tolerance (ppm)	Carrier frequency (MHz)	Frequency tolerance (ppm)
0	2402	2401.998319	-0.699	2401.998359	-0.683	2401.998360	-0.682
19	2440	2439.998360	-0.672	2439.998360	-0.672	2439.998360	-0.672
39	2480	2479.998319	-0.677	2479.998319	-0.677	2479.998319	-0.677

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

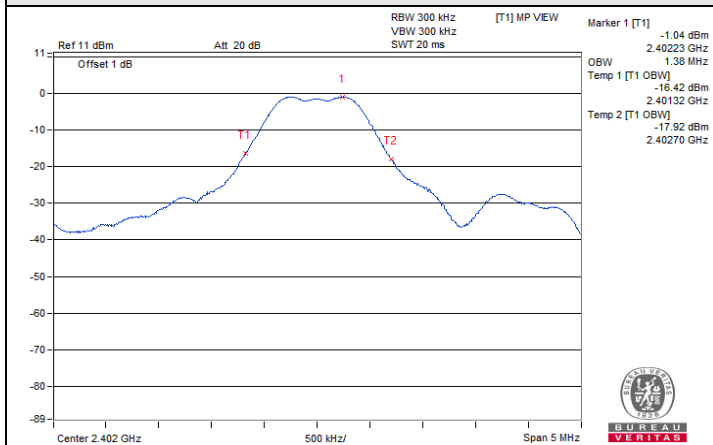


4.2.3 Test Results

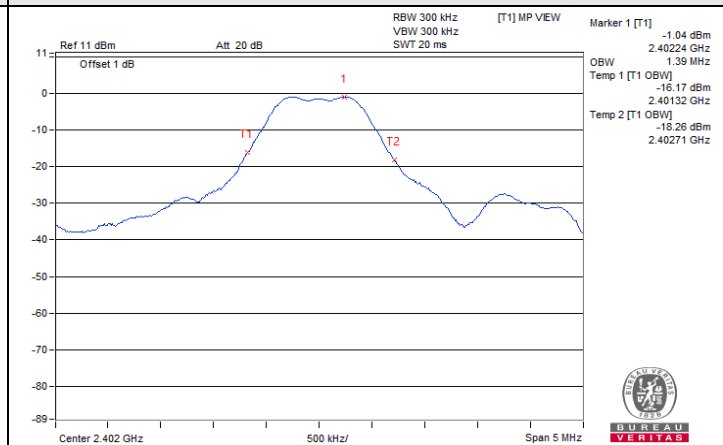
Channel	Frequency (MHz)	V_{normal}	$V_{\text{max.}}$	$V_{\text{min.}}$
		Occupied bandwidth (MHz)	Occupied bandwidth (MHz)	Occupied bandwidth (MHz)
0	2402	1.38	1.39	1.39
19	2440	1.35	1.35	1.35
39	2480	1.33	1.33	1.33

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

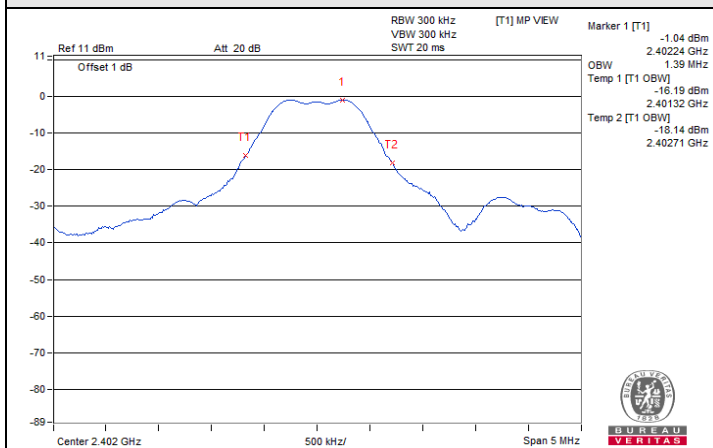
V_{normal}



V_{max.}

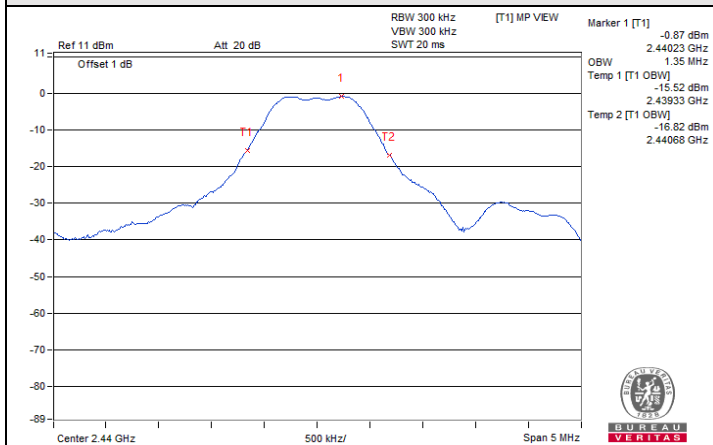


V_{min.}

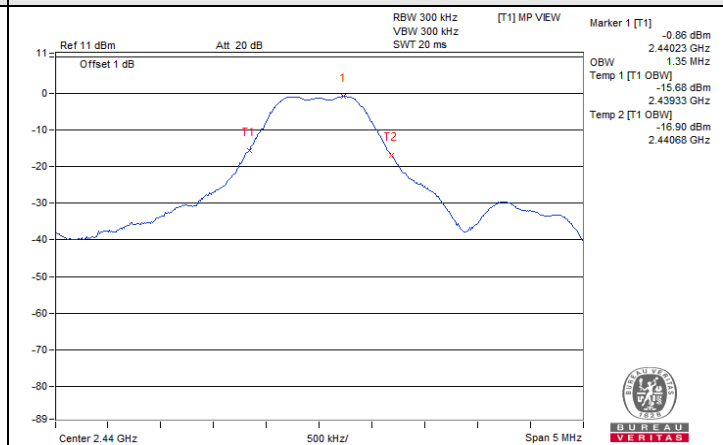


CH 0 (2402MHz)

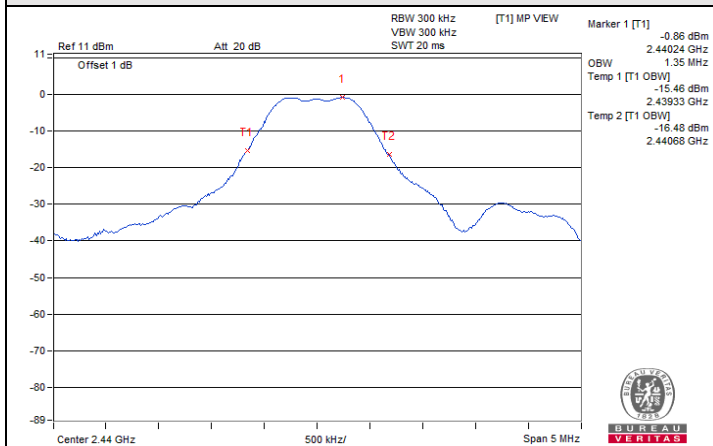
V_{normal}



V_{max}

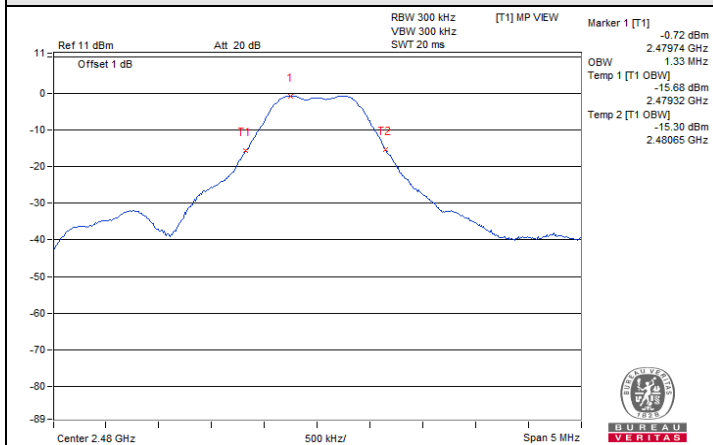


V_{min}

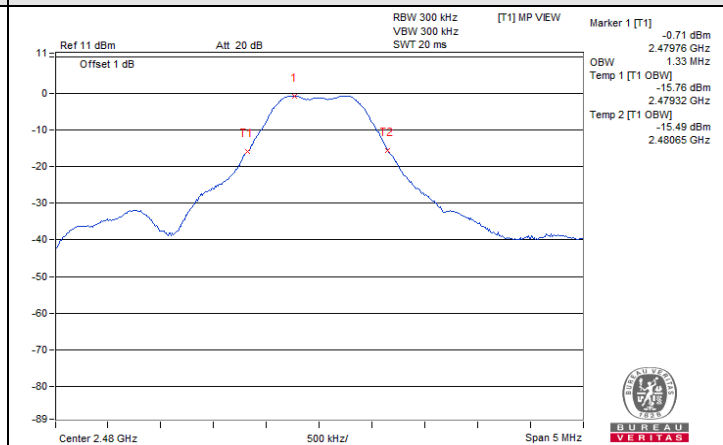


CH 19 (2440MHz)

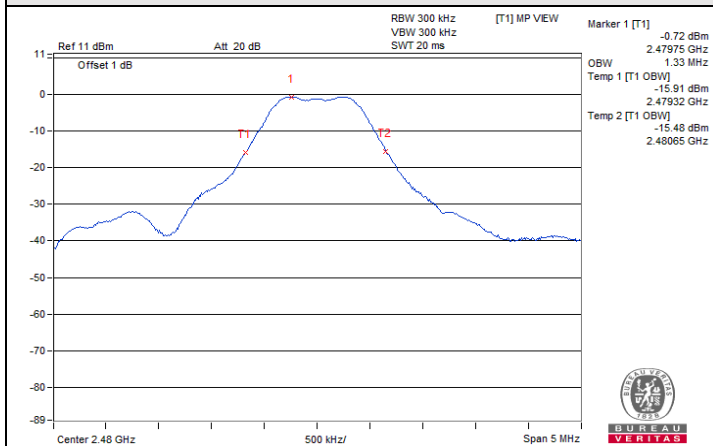
V_{normal}



V_{max.}



V_{min.}



CH 39 (2480MHz)

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



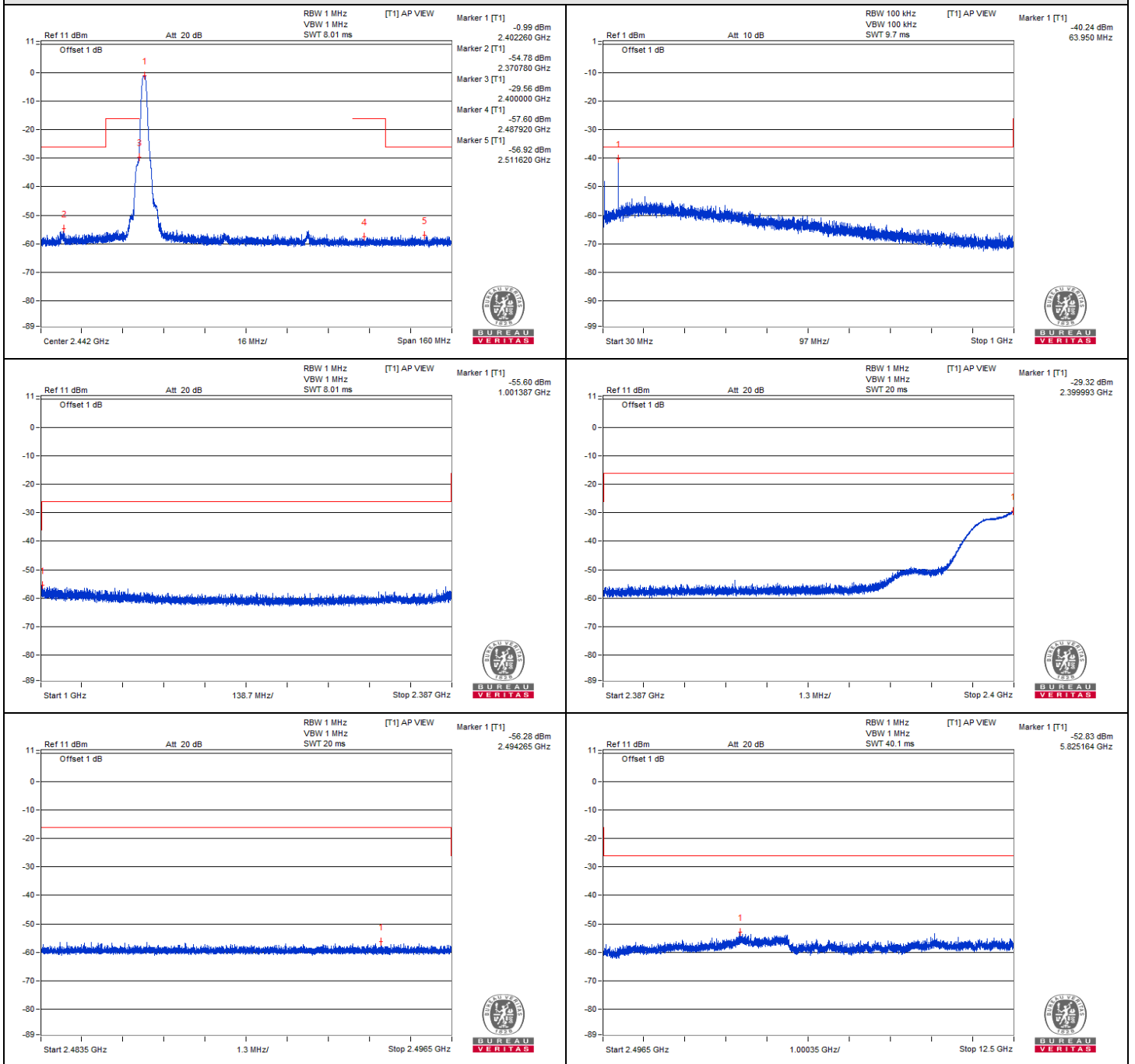
4.3.3 Test Results

TEST CHANNEL		CH 0 (2402MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE(μ W)	LIMIT (μ W)	RESULT
V_{normal}	30MHz to 1000MHz	63.950	0.094624	0.25	PASS
	1000MHz to 2387MHz	1001.387	0.002754	2.5	PASS
	2387MHz to 2400MHz	2399.993	1.169499	25	PASS
	2483.5MHz to 2496.5MHz	2494.265	0.002355	25	PASS
	2496.5MHz to 12500MHz	5825.164	0.005212	2.5	PASS
V_{max.}	30MHz to 1000MHz	63.950	0.091622	0.25	PASS
	1000MHz to 2387MHz	1088.247	0.002825	2.5	PASS
	2387MHz to 2400MHz	2399.980	1.279381	25	PASS
	2483.5MHz to 2496.5MHz	2487.928	0.002495	25	PASS
	2496.5MHz to 12500MHz	5748.887	0.004603	2.5	PASS
V_{min.}	30MHz to 1000MHz	63.950	0.070307	0.25	PASS
	1000MHz to 2387MHz	1018.204	0.002786	2.5	PASS
	2387MHz to 2400MHz	2399.998	1.250259	25	PASS
	2483.5MHz to 2496.5MHz	2490.765	0.002323	25	PASS
	2496.5MHz to 12500MHz	5841.420	0.004571	2.5	PASS
TEST CHANNEL		CH 19 (2440MHz)			
V_{normal}	30MHz to 1000MHz	63.950	0.083368	0.25	PASS
	1000MHz to 2387MHz	1026.006	0.003289	2.5	PASS
	2387MHz to 2400MHz	2395.612	0.002564	25	PASS
	2483.5MHz to 2496.5MHz	2484.889	0.002483	25	PASS
	2496.5MHz to 12500MHz	6380.358	0.004932	2.5	PASS
V_{max.}	30MHz to 1000MHz	63.950	0.099541	0.25	PASS
	1000MHz to 2387MHz	1047.504	0.003396	2.5	PASS
	2387MHz to 2400MHz	2399.067	0.002559	25	PASS
	2483.5MHz to 2496.5MHz	2492.884	0.002812	25	PASS
	2496.5MHz to 12500MHz	5838.919	0.005675	2.5	PASS
V_{min.}	30MHz to 1000MHz	63.950	0.047315	0.25	PASS
	1000MHz to 2387MHz	2376.077	0.003214	2.5	PASS
	2387MHz to 2400MHz	2396.030	0.002742	25	PASS
	2483.5MHz to 2496.5MHz	2491.733	0.002655	25	PASS
	2496.5MHz to 12500MHz	6755.490	0.004831	2.5	PASS

TEST CHANNEL		CH 39 (2480MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE(μ W)	LIMIT (μ W)	RESULT
V_{normal}	30MHz to 1000MHz	63.950	0.092683	0.25	PASS
	1000MHz to 2387MHz	1032.074	0.002773	2.5	PASS
	2387MHz to 2400MHz	2397.612	0.002213	25	PASS
	2483.5MHz to 2496.5MHz	2483.500	0.071285	25	PASS
	2496.5MHz to 12500MHz	6682.964	0.005047	2.5	PASS
V_{max.}	30MHz to 1000MHz	63.950	0.047863	0.25	PASS
	1000MHz to 2387MHz	1002.774	0.003373	2.5	PASS
	2387MHz to 2400MHz	2395.420	0.002113	25	PASS
	2483.5MHz to 2496.5MHz	2483.504	0.069502	25	PASS
	2496.5MHz to 12500MHz	6990.572	0.004677	2.5	PASS
V_{min.}	30MHz to 1000MHz	64.071	0.091622	0.25	PASS
	1000MHz to 2387MHz	1001.733	0.002944	2.5	PASS
	2387MHz to 2400MHz	2390.172	0.002606	25	PASS
	2483.5MHz to 2496.5MHz	2483.516	0.063096	25	PASS
	2496.5MHz to 12500MHz	5785.150	0.005297	2.5	PASS

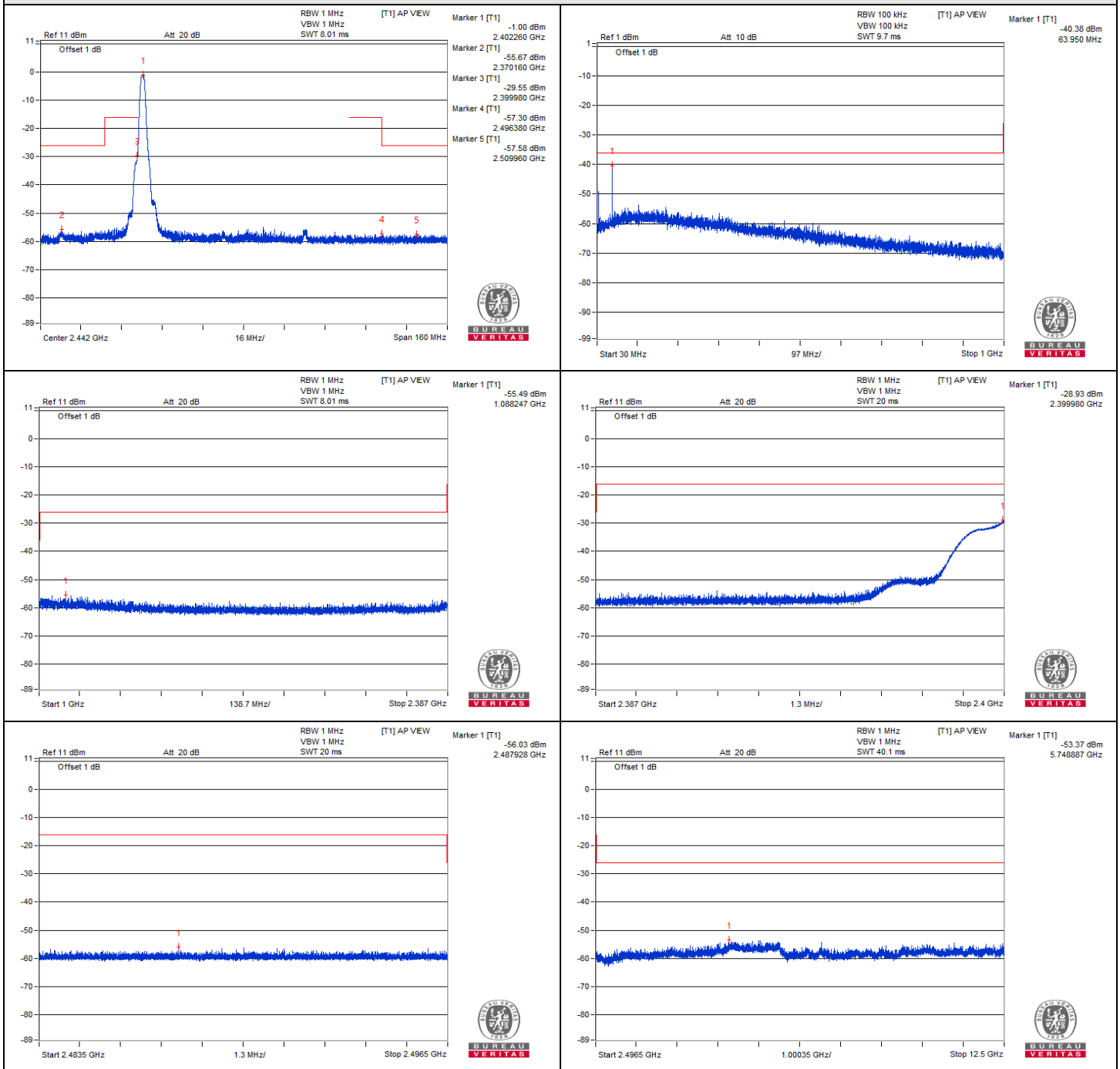
NOTE: 1. The spectrum plots are attached on the following pages.

Vnormal



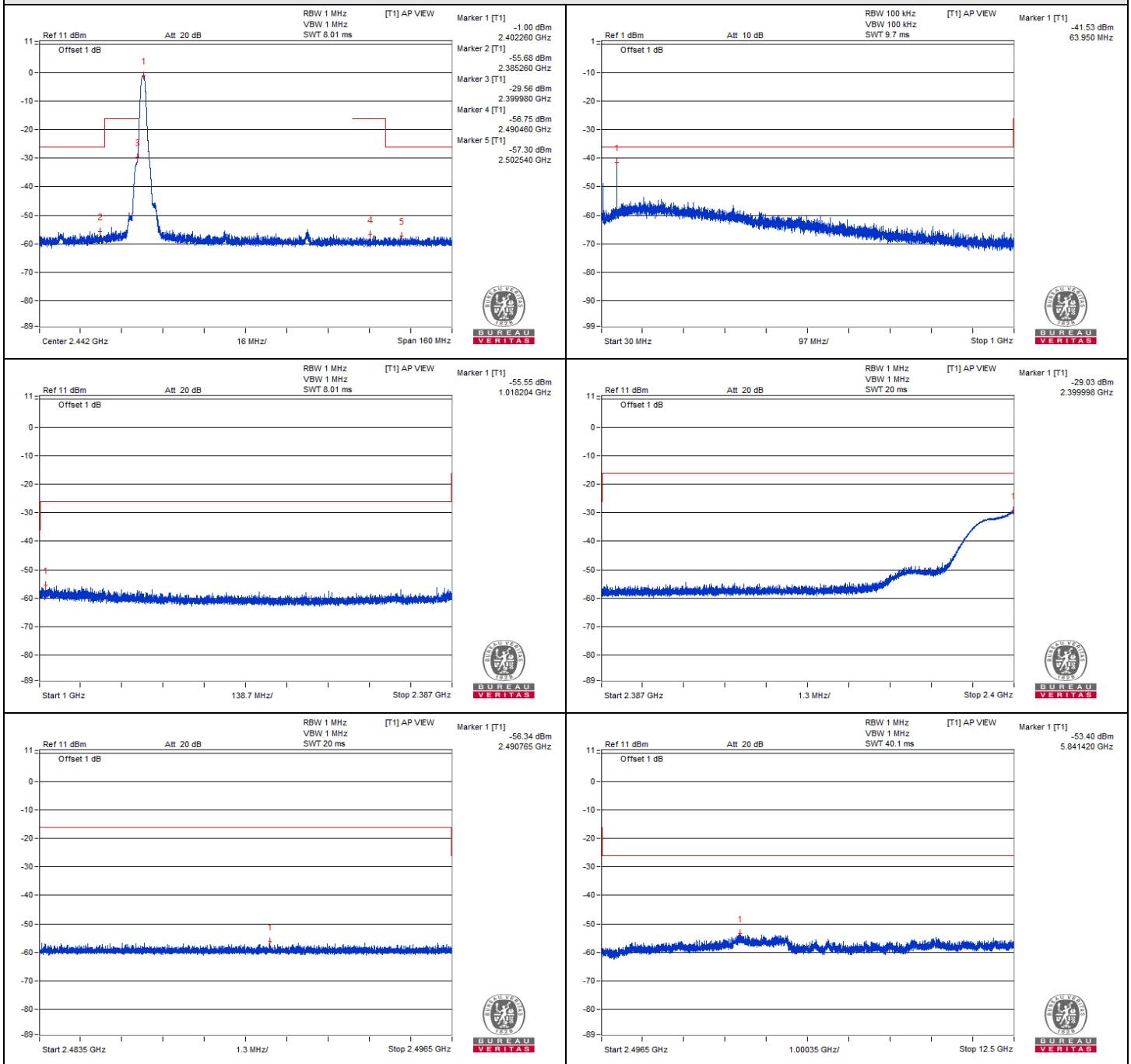
CH 0 (2402MHz)

V_{max}.



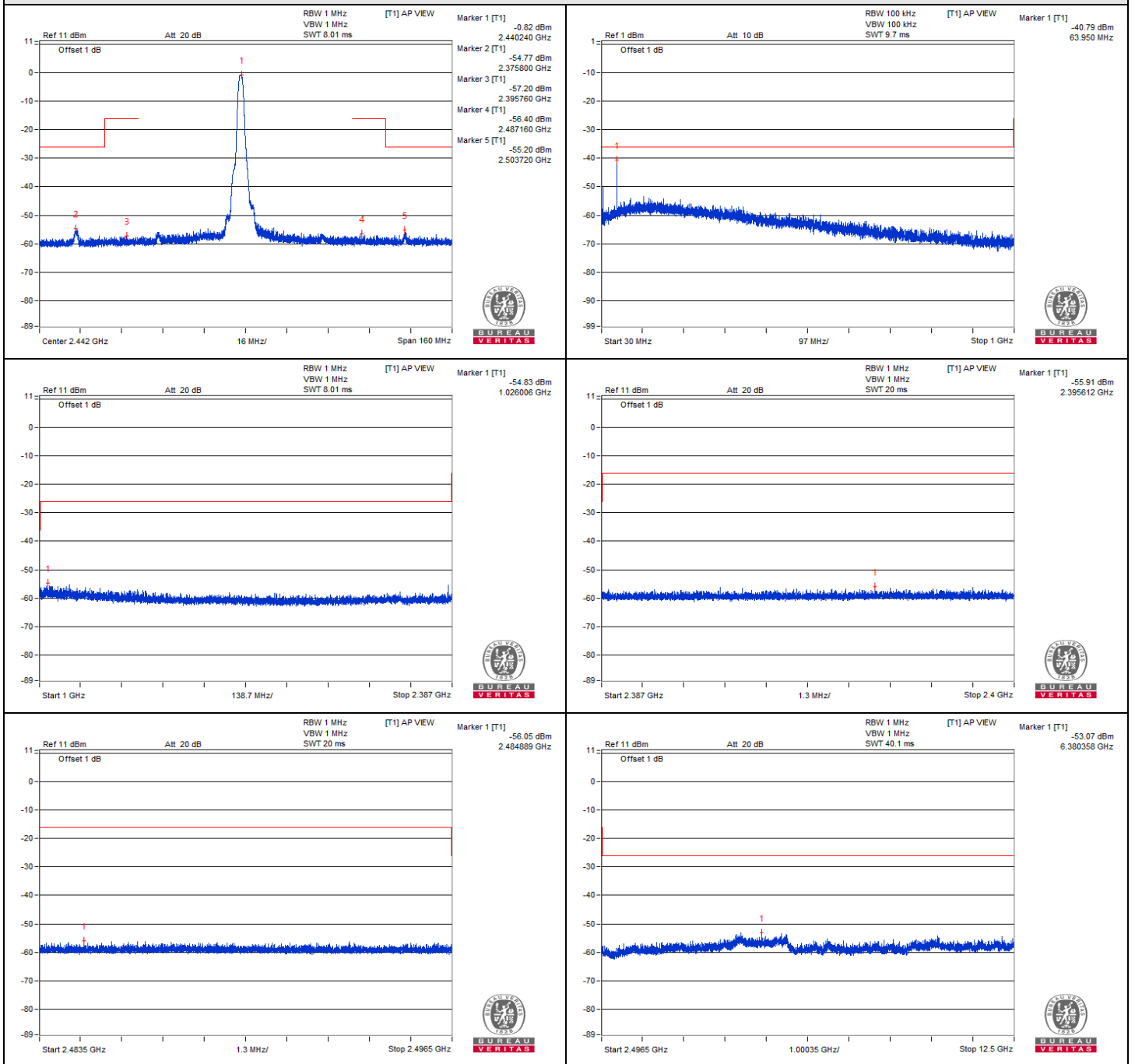
CH 0 (2402MHz)

V_{min}.



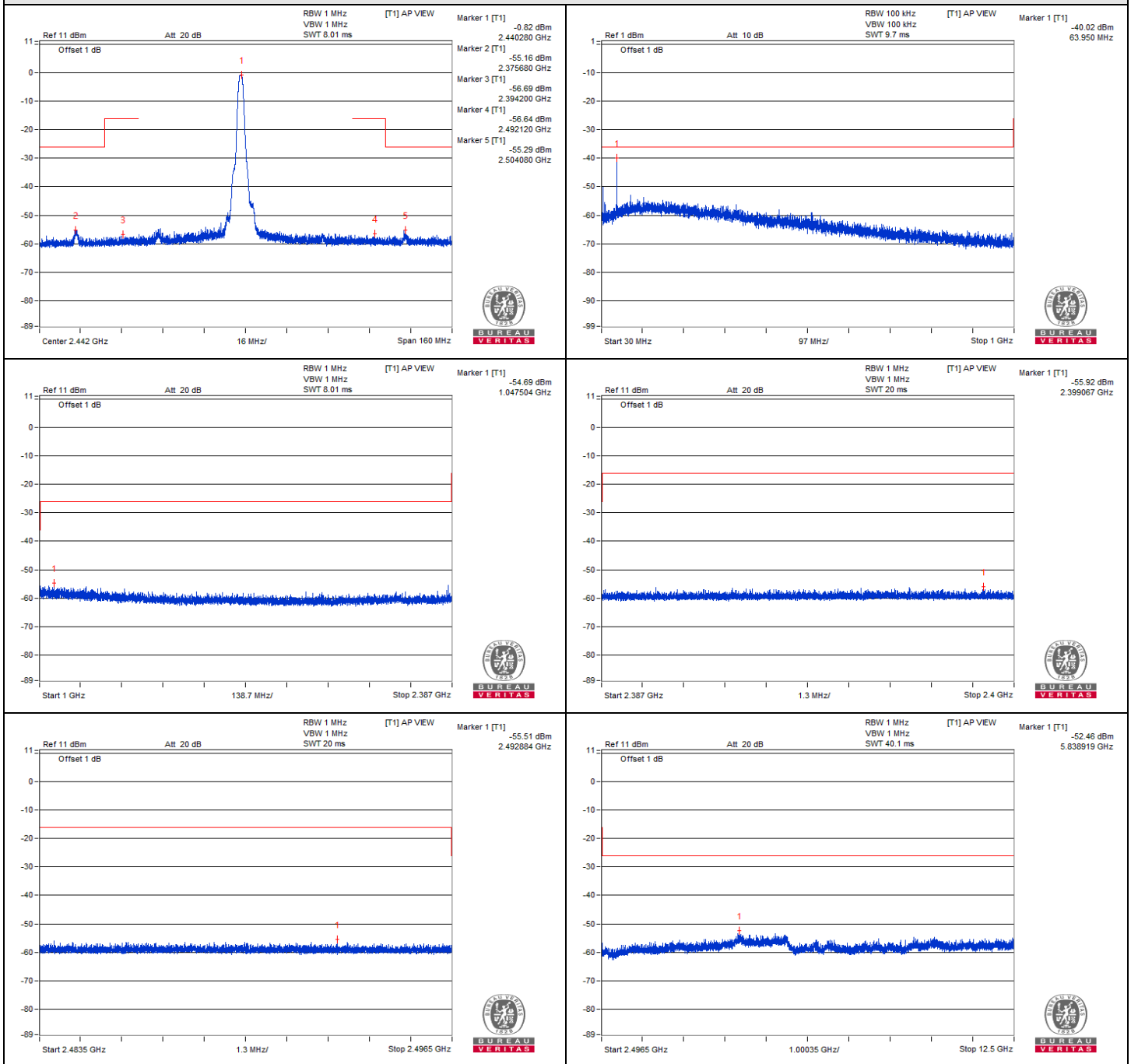
CH 0 (2402MHz)

V_{normal}



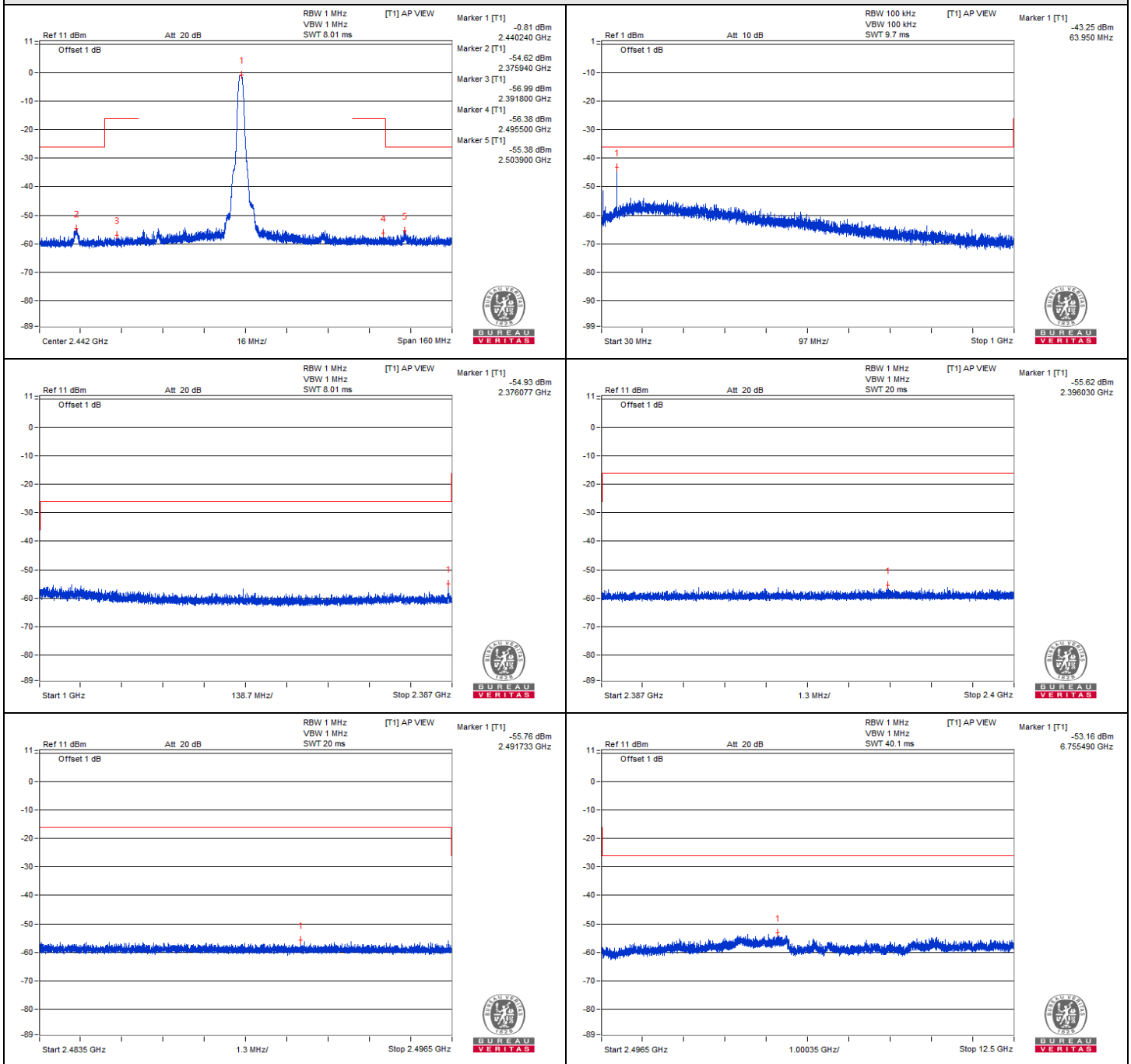
CH 19 (2440MHz)

V_{max}.



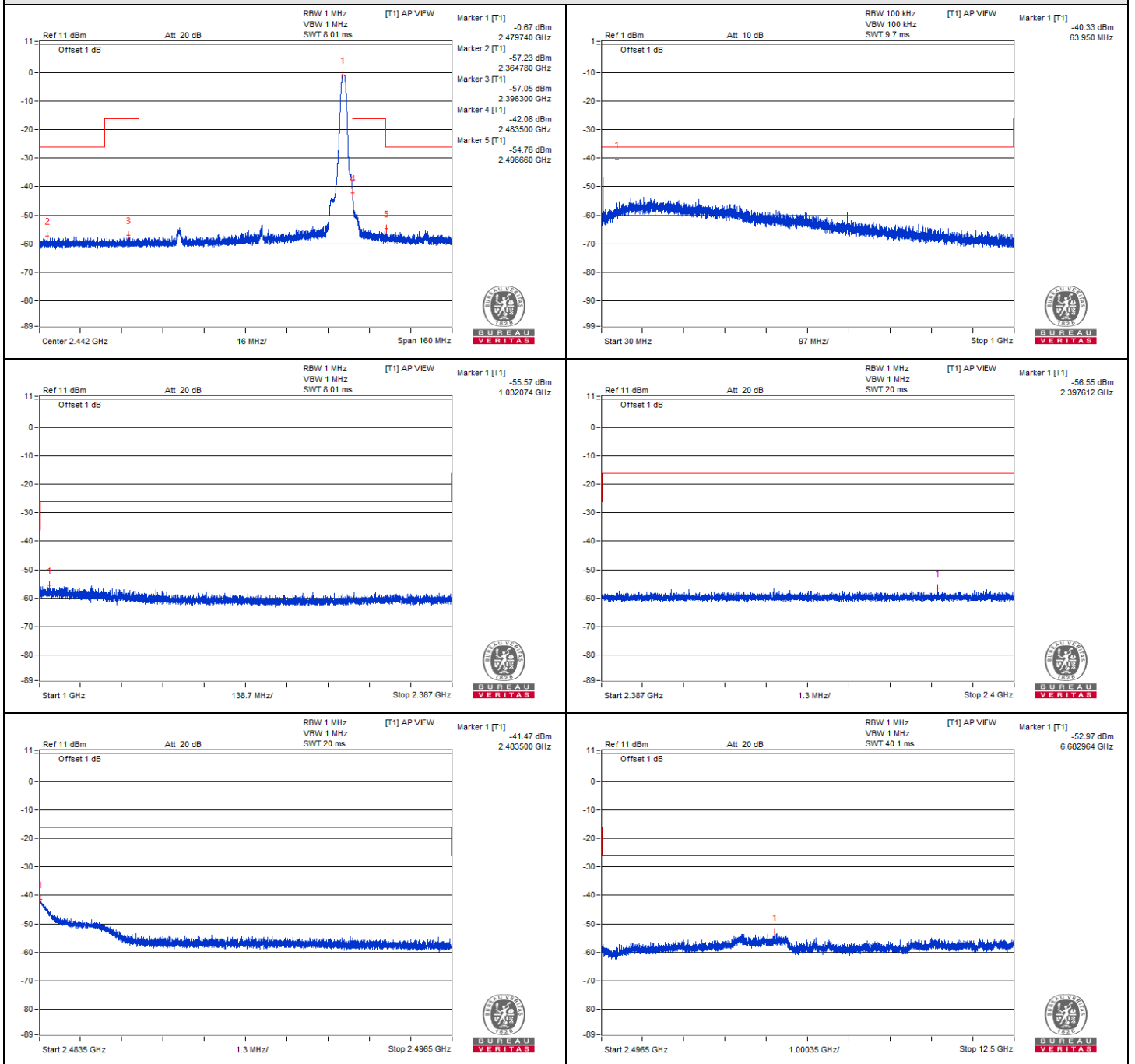
CH 19 (2440MHz)

V_{min}.



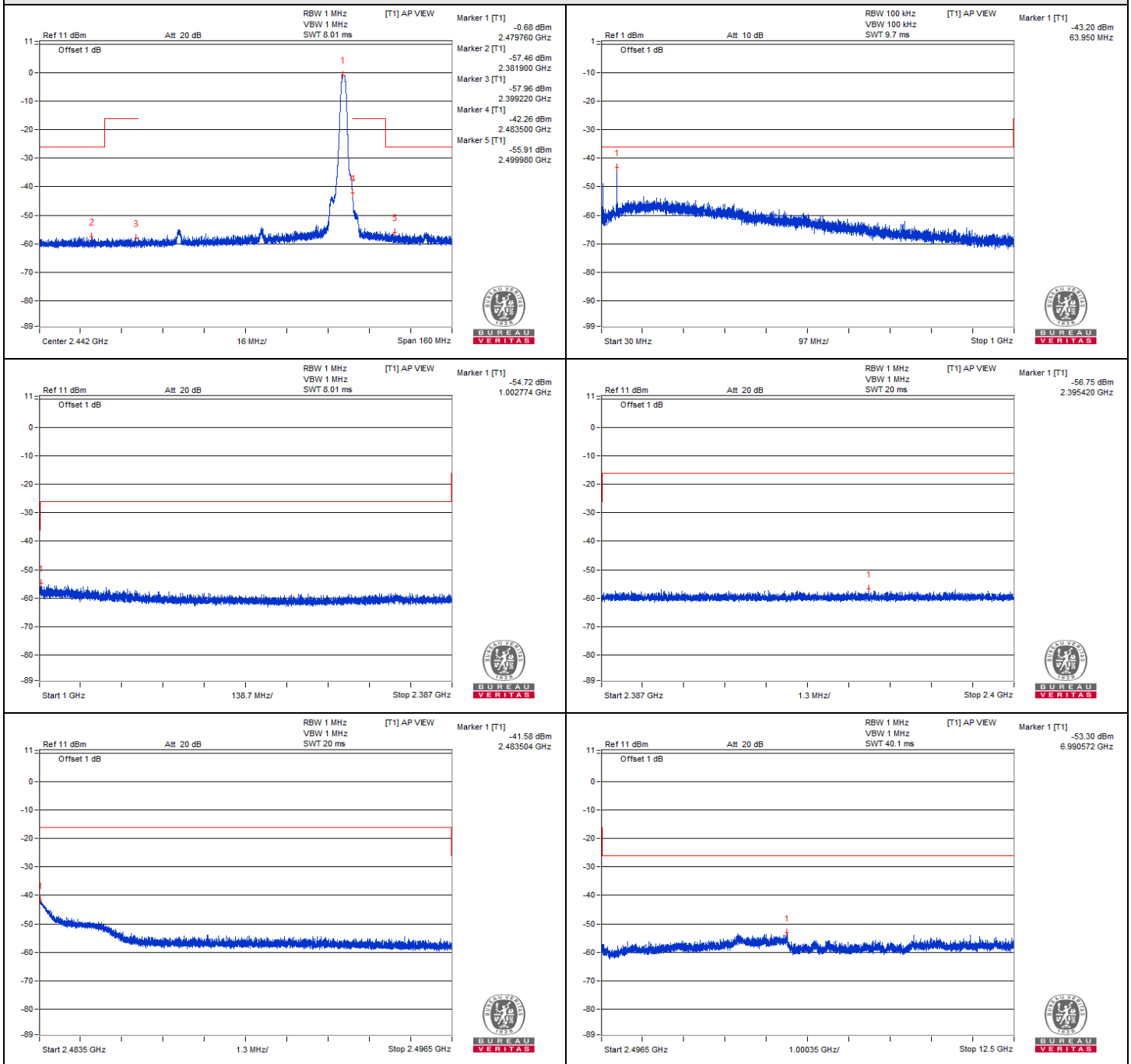
CH 19 (2440MHz)

V_{normal}



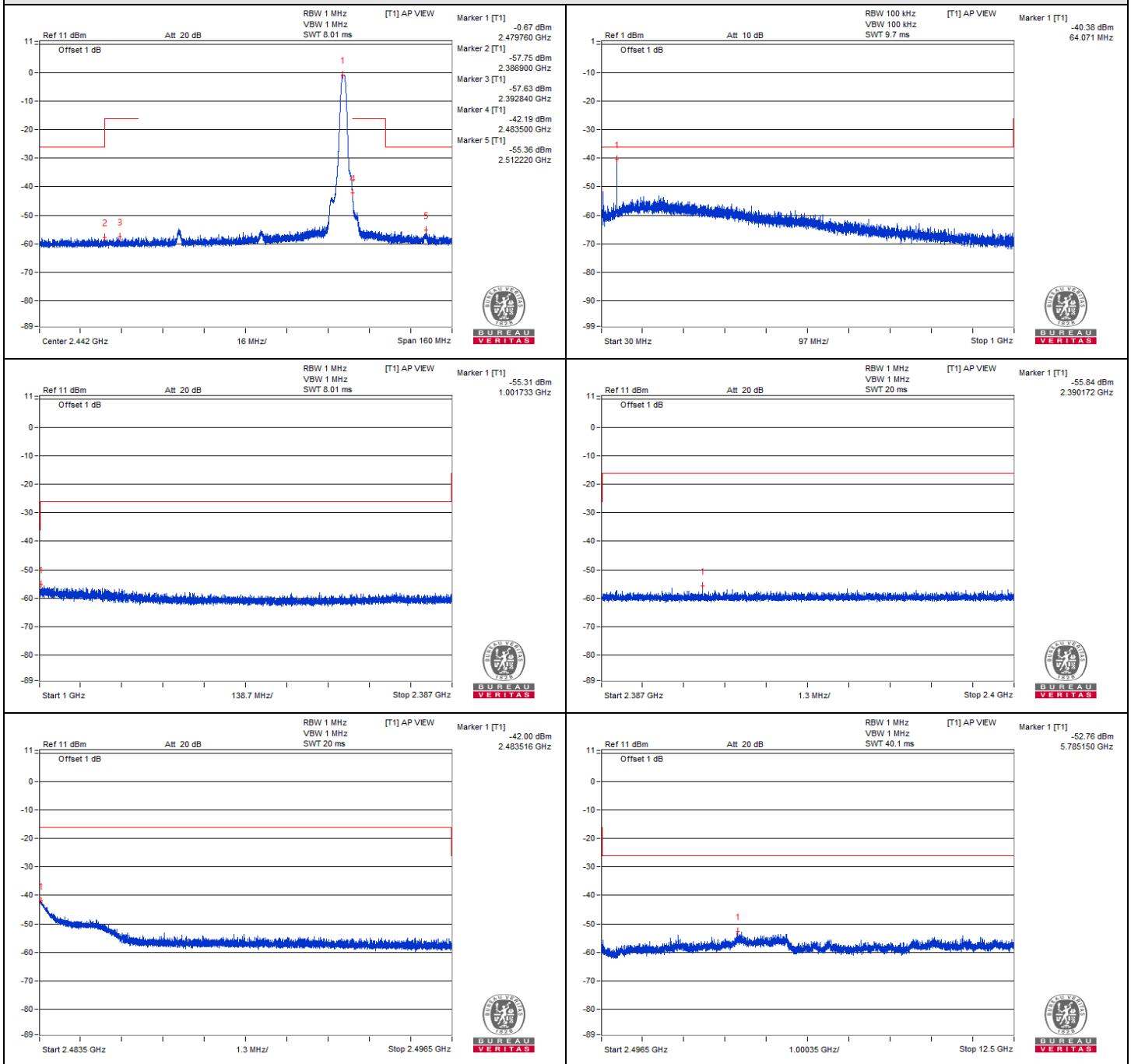
CH 39 (2480MHz)

V_{max}.



CH 39 (2480MHz)

V_{min}.



CH 39 (2480MHz)

4.4 Antenna Power Measurement

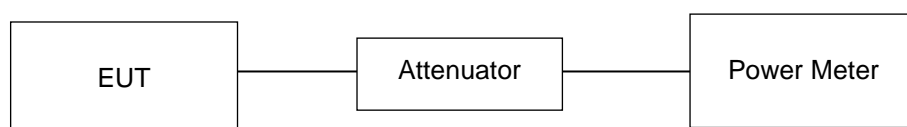
4.4.1 Limits of Antenna Power

Modulation System	Frequency Band Used	Antenna Power (Max.)	EIRP Limit (Note 3)
DS	2400 – 2483.5 MHz	10 mW/MHz	12.14 dBm/MHz ~ 22.14 dBm/MHz (16.368 mW/MHz ~ 163.68 mW/MHz)
OFDM (Note 1)	2400 – 2483.5 MHz	10 mW/MHz	12.14 dBm/MHz ~ 22.14 dBm/MHz (16.368 mW/MHz ~ 163.68 mW/MHz)
OFDM (Note 2)	2400 – 2483.5 MHz	5 mW/MHz	9.13 dBm/MHz ~ 19.13 dBm/MHz (8.184 mW/MHz ~ 81.84 mW/MHz)
Other than the above	2400 – 2483.5 MHz	10 mW	12.14 dBm ~ 22.14 dBm (16.368 mW ~ 163.68 mW)

Note:

1. Occupied bandwidth is less than 26MHz
2. Occupied bandwidth is more than 26MHz and less than 40MHz
3. EIRP limit is variable by the HPBA, the HPBA (half-power beam width) of the antenna shall be $360/A$ degrees or less, where $A = \text{EIRP} / (2.14 \text{ dBi} + \text{Antenna Power (limit)})$.
4. Tolerance of antenna power shall be +20% (upper value) and -80% (lower value).

4.4.2 Test Setup



4.4.3 Test Results

Voltage (Vdc)	Channel Number	Frequency (MHz)	Conducted RF Output Power (mW)	Radiated RF Output Power (mW)
12	0	2402	1.109	2.844
	19	2440	1.138	2.918
	39	2480	1.169	2.998
13.2	0	2402	1.084	2.780
	19	2440	1.096	2.811
	39	2480	1.205	3.090
10.8	0	2402	1.159	2.972
	19	2440	1.167	2.993
	39	2480	1.125	2.885
Maximum Limit (mW):			10	-
Rated Power (mW):			2	-
Tolerance of Antenna Power (mW):			0.4 ~ 2.4	-
Maximum EIRP Limit (mW):			-	16.368

Notes:

1. Antenna gain is 4.09 dBi.
2. The radiated RF output power is a "calculated" value derived from the conducted value.
3. Formula: Radiated RF output power = Conducted RF output power + Antenna gain

4.5 Spurious Emissions for Receiver

4.5.1 Limits of Spurious Emissions for Receiver

Frequencies (MHz)	Limit
Below 1GHz	$\leq 4\text{nW}/100\text{kHz}$ (-54dBm)
Above 1GHz	$\leq 20\text{nW}/\text{MHz}$ (-47dBm)

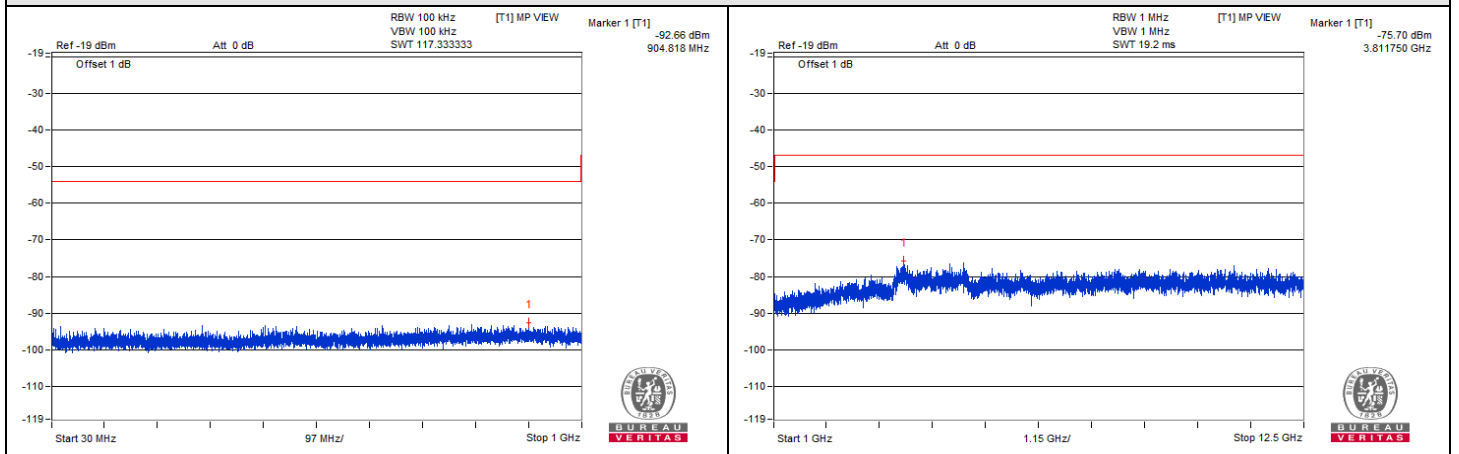
4.5.2 Test Setup



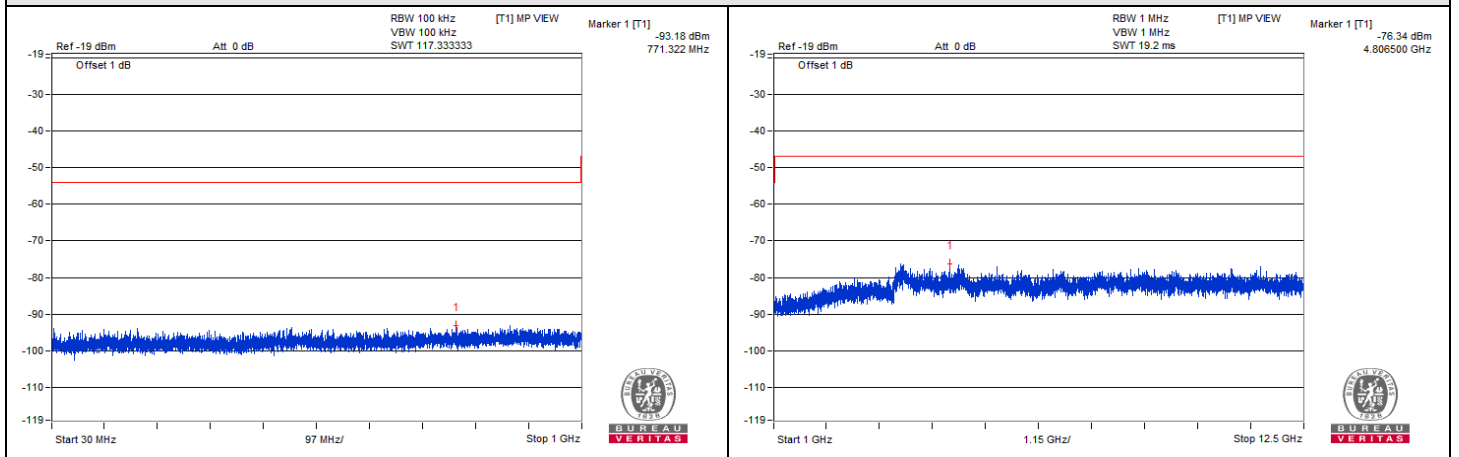
4.5.3 Test Result

TEST CHANNEL		CH 0 (2402MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE(nW)	LIMIT (nW)	RESULT
V_{normal}	30MHz to 1000MHz	904.818	0.000542	4.0	PASS
	1000MHz to 12500MHz	3811.750	0.026915	20.0	PASS
V_{max.}	30MHz to 1000MHz	771.322	0.000481	4.0	PASS
	1000MHz to 12500MHz	4806.500	0.023227	20.0	PASS
V_{min.}	30MHz to 1000MHz	885.782	0.000540	4.0	PASS
	1000MHz to 12500MHz	3793.062	0.025527	20.0	PASS
TEST CHANNEL		CH 19 (2440MHz)			
V_{normal}	30MHz to 1000MHz	750.225	0.000519	4.0	PASS
	1000MHz to 12500MHz	4806.500	0.035892	20.0	PASS
V_{max.}	30MHz to 1000MHz	631.157	0.000525	4.0	PASS
	1000MHz to 12500MHz	4806.500	0.034356	20.0	PASS
V_{min.}	30MHz to 1000MHz	984.843	0.000516	4.0	PASS
	1000MHz to 12500MHz	4806.500	0.025003	20.0	PASS
TEST CHANNEL		CH 39 (2480MHz)			
V_{normal}	30MHz to 1000MHz	766.472	0.000522	4.0	PASS
	1000MHz to 12500MHz	7198.500	0.025468	20.0	PASS
V_{max.}	30MHz to 1000MHz	817.882	0.000596	4.0	PASS
	1000MHz to 12500MHz	4805.062	0.026915	20.0	PASS
V_{min.}	30MHz to 1000MHz	873.778	0.000550	4.0	PASS
	1000MHz to 12500MHz	3709.687	0.023067	20.0	PASS

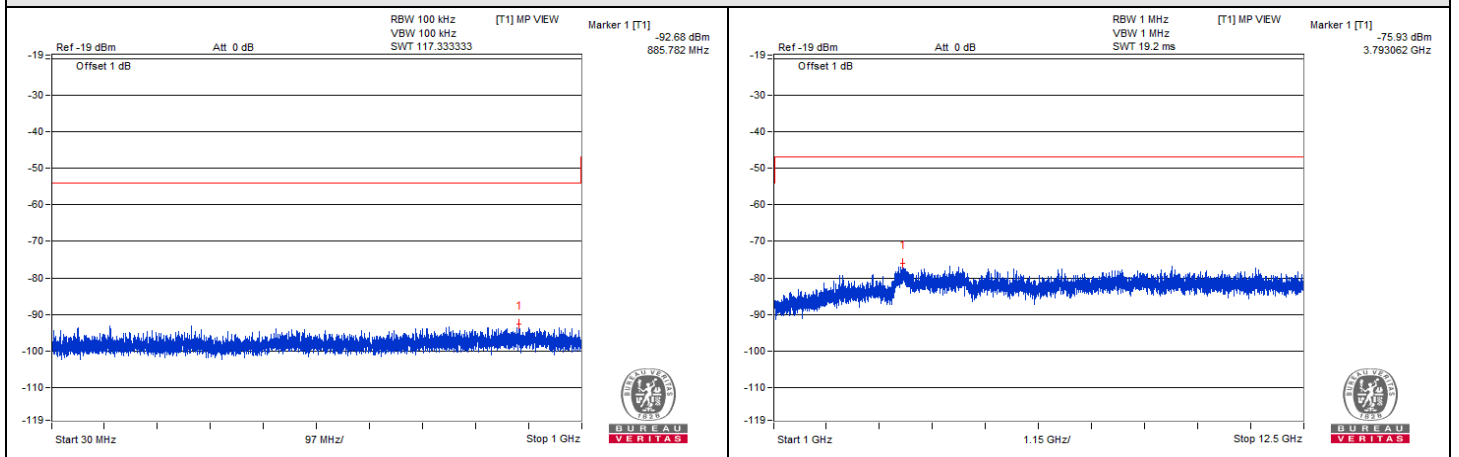
V_{normal}



V_{max}

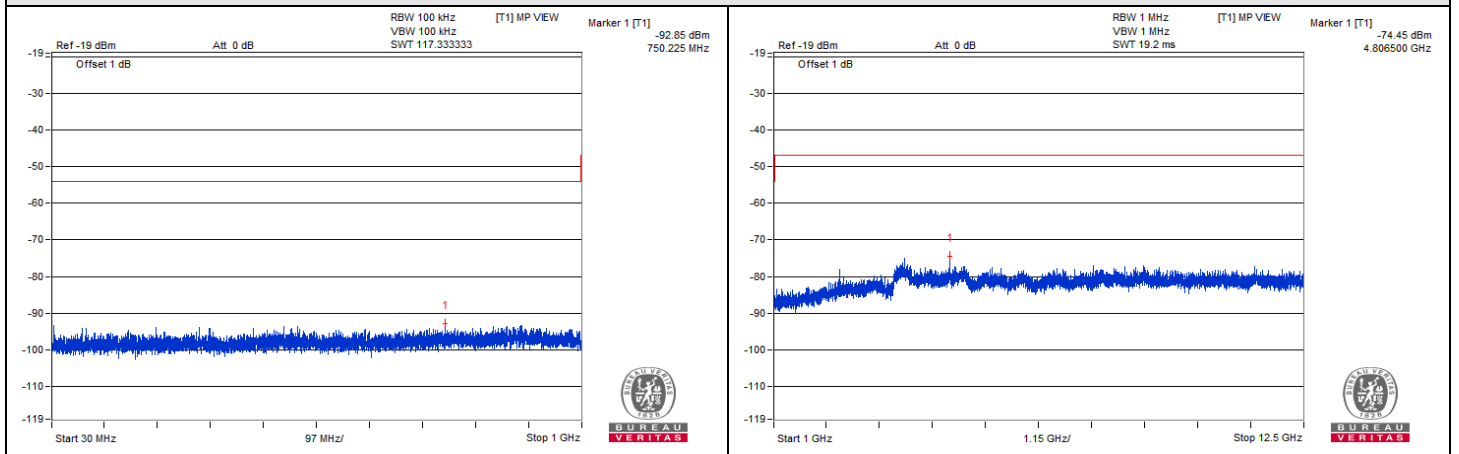


V_{min}

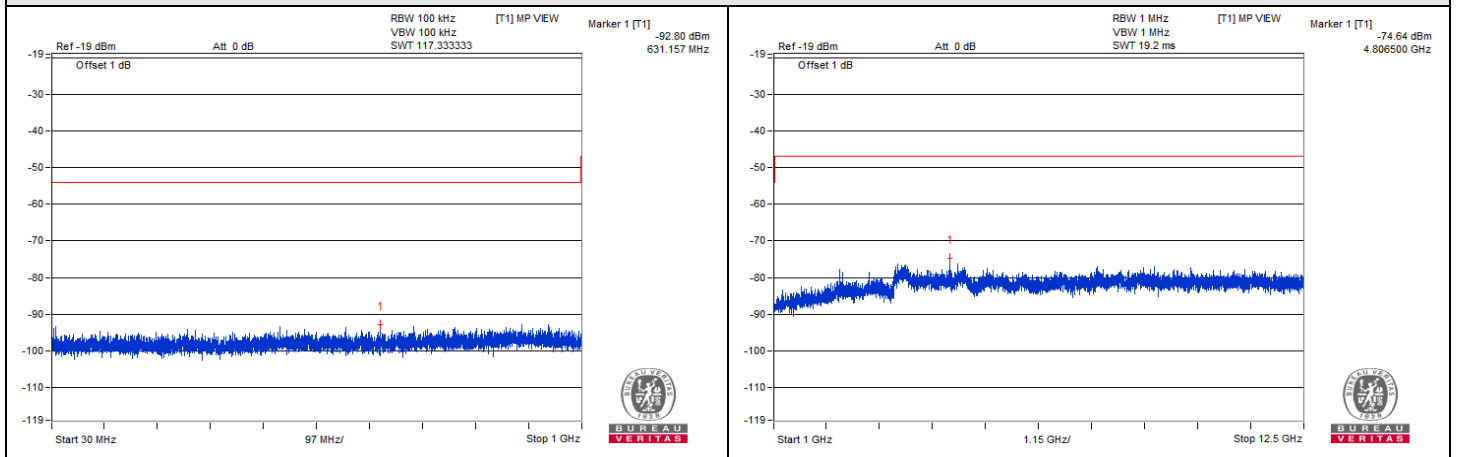


CH 0 (2402MHz)

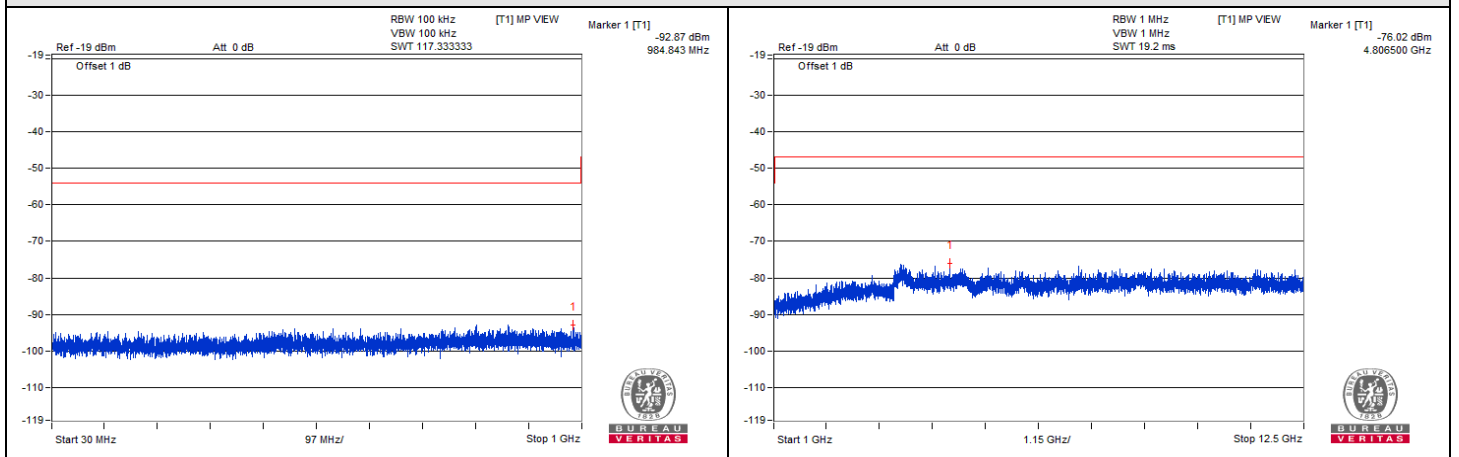
V_{normal}



V_{max}

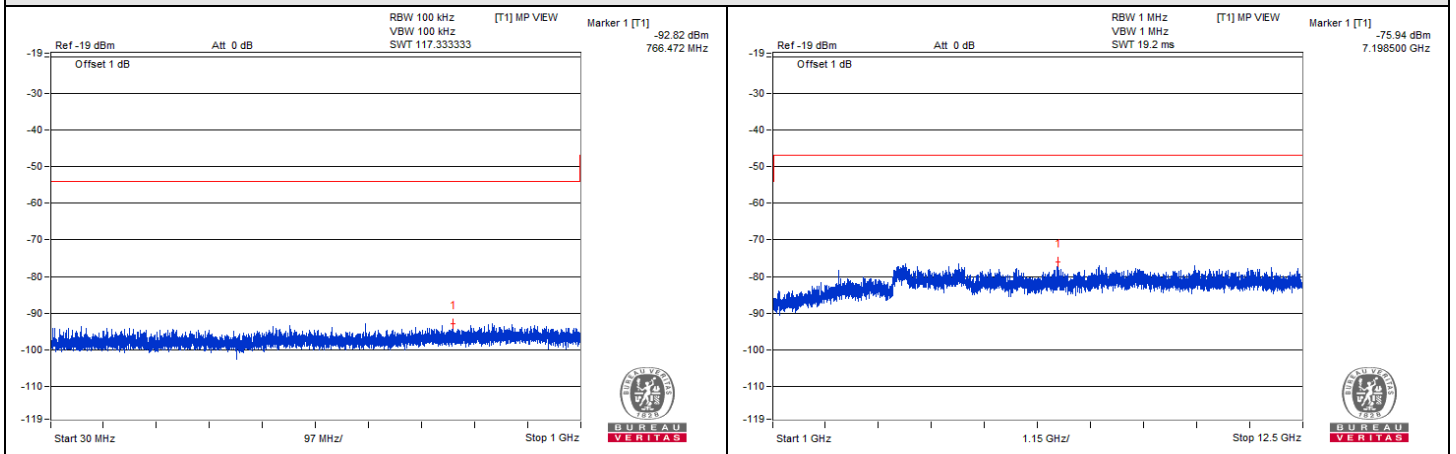


V_{min}

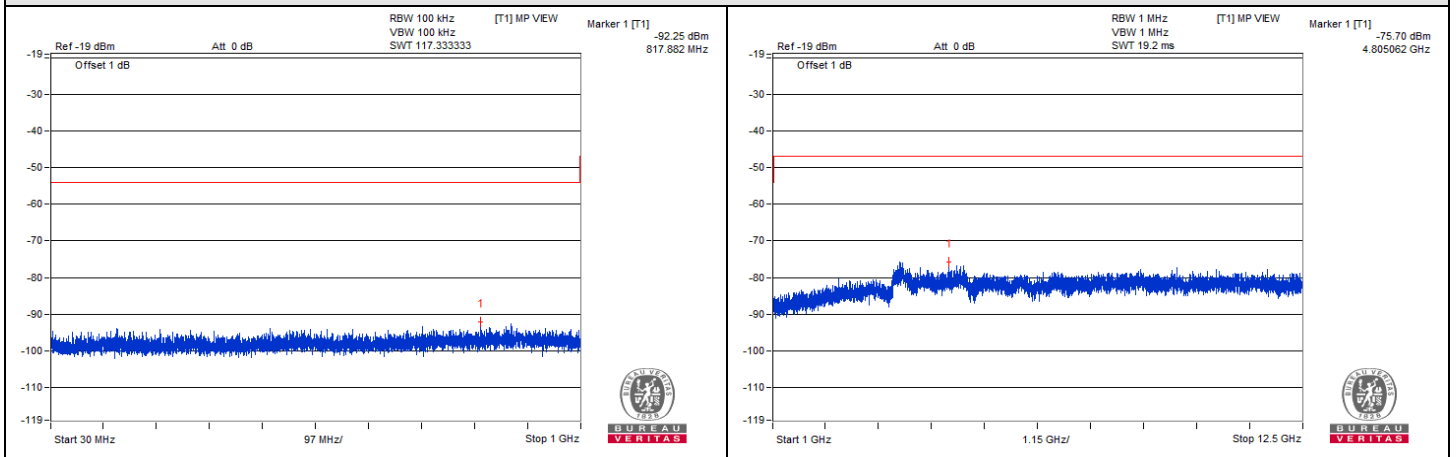


CH 19 (2440MHz)

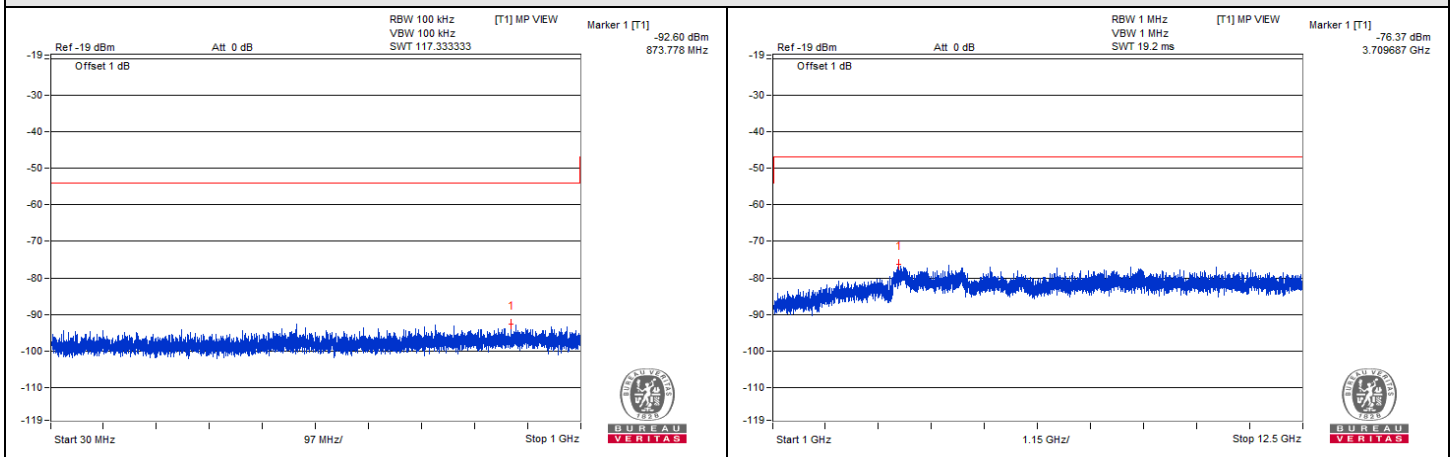
V_{normal}



V_{max}



V_{min}



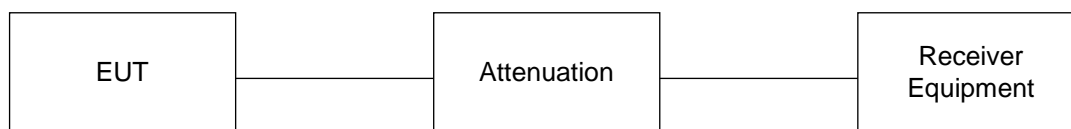
CH 39 (2480MHz)

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.

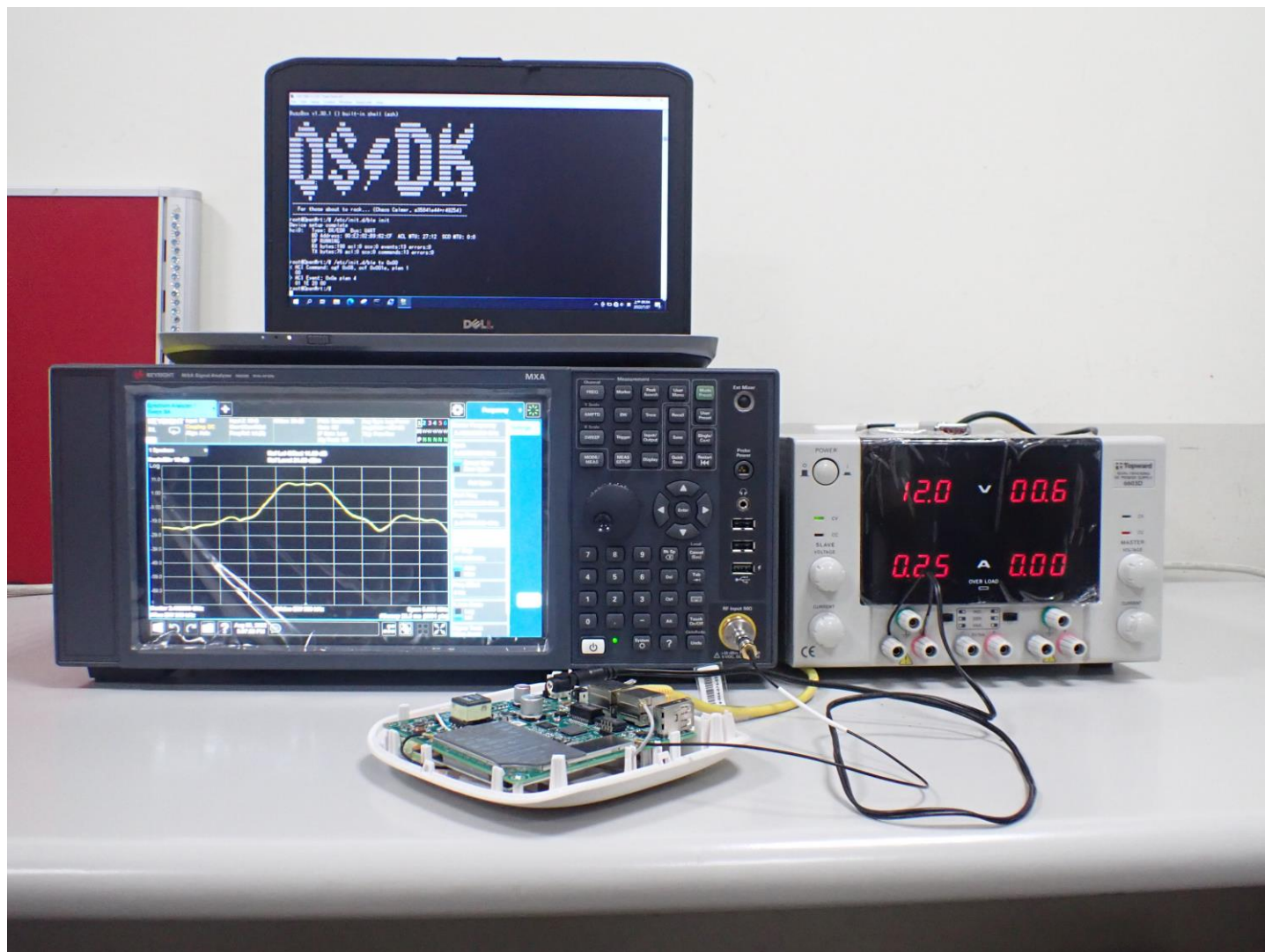
4.6.2 Test Setup



4.6.3 Test Results

Link Mode	Test Result
BT-LE	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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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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