

Radio Test Report (BT-LE)

Report No.: RJBCKS-WTW-P20120454A-3

Test Model: AL11

Received Date: 2021/8/19

Test Date: 2021/9/16

Issued Date: 2021/12/8

Applicant: LatticeWork, Inc.

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



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Release Control Record

Issue No.	Description	Date Issued
RJBCKS-WTW-P20120454A-3	Original release.	2021/12/8

1 Certificate of Conformity

Product: Amber X

Brand: Latticework

Test Model: AL11

Sample Status: Engineering sample

Applicant: LatticeWork, Inc.

Test Date: 2021/9/16

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 : Vivian Huang , **Date:** 2021/12/8
Vivian Huang / Specialist

Approved by : Clark Lin , **Date:** 2021/12/8
Clark Lin / 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	3.4	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	2021/3/8	2022/3/7	ETC	(c)
ESG Vector signal generator Agilent	E4438C	MY45094468/005 506 602 UK6 UNJ	2020/11/18	2021/11/17	ETC	(c)
Power Meter Anritsu	ML2495A	1529002	2021/6/21	2022/6/20	ETC	(c)
Pulse Power Sensor Anritsu	MA2411B	1339443	2021/5/31	2022/5/30	ETC	(c)
DC POWER SUPPLY Topward	6603D	795558	Note 3	Note 3	BV	(d)
AC Power Source GOOD WILL	6905S	1991551	Note 3	Note 3	BV	(d)
True RMS Clamp Meter Fluke	325	31130711WS	2021/6/2	2022/6/1	ETC	(c)

- 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: 2021/9/16

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	Amber X
Brand	Latticework
Test Model	AL11
Status of EUT	Engineering sample
Nominal Voltage	12Vdc from power adapter
Modulation Type	GFSK
Modulation Technology	DTS
Transfer Rate	Up to 2Mbps
Operating Frequency	2.402 ~ 2.480GHz
Number of Channel	40
Rated RF Output Power	Refer to Note
Conducted RF Output Power	Refer to Note
Radiated RF Output Power	Refer to Note
Antenna Type	Refer to section 3.5
Antenna Connector	Refer to section 3.5
Accessory Device	Adapter x1
Data Cable Supplied	NA

Note:

1. There are WLAN & Bluetooth technology used for the EUT.
2. 2.4GHz & 5GHz technology can not transmit at same time.
3. The EUT must be supplied with a power adapter and following below table:

No.	Brand	Model No.	Spec.
1	Jiangsu Chenyang Electron Co., Ltd	CYCQ24-120200U	Input: 100-240 Vac, 0.6 A, 50/60Hz Output: 12 Vdc, 2 A DC output cable (unshielded, 1.5 m)
2	TUE	A3P-1200200VU	Input: 100-240 Vac, 1.0 A Max, 50/60Hz Output: 12 Vdc, 2 A DC output cable (unshielded, 1.15 m,)
3	APD	WB-24J12FU	Input: 100-240 Vac, 0.7 A Max, 50-60Hz Output: 12 Vdc, 2 A DC output cable (unshielded, 1.2 m)

4. The power table as below table:

Technology Mode	Rated output power (mW)	Conducted RF output power (mW)	Radiated RF output power (mW)
BT-LE 1M	7.7	7.691	16.032
BT-LE 2M	7.7	7.709	16.069

5. 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 (HyperTerminal paste Amber Lite BT SOP.doc command) provided by manufacturer, the power levels during the tests were set according to the following codes:

BT-LE 1M		BT-LE 2M	
Channel	Power Setting	Channel	Power Setting
0	0x09	1	0x09
19	0x08	19	0x08
39	0x08	38	0x08

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	25 deg.C, 60 % RH
Occupied Bandwidth	25 deg.C, 60 % RH
Spurious Emissions for Transmitter	25 deg.C, 60 % RH
Antenna Power	25 deg.C, 60 % RH
Spurious Emissions for Receiver	25 deg.C, 60 % RH

3.4 Assembly

The RF circuits was located inside of the EUT. The plastic enclosure was assembled by one screw and covered by mylar rubbers patch with glue, the screw can not be observed directly. Also it won't be easy to be opened.

3.5 Antenna Specifications

3.5.1 Antenna Gain

Antenna No.	RF Chain NO.	Antenna Net Gain(dBi)	Frequency range (GHz)	Antenna Type	Connector Type
1	0	3.19	2.4~2.4835	PIFA	i-pex(MHF)
		3.57	5.15~5.25		
		3.29	5.25~5.35		
		4.28	5.47~5.725		
		4.37	5.725~5.85		
2	1	3.14	2.4~2.4835	PIFA	i-pex(MHF)
		4.69	5.15~5.25		
		4.21	5.25~5.35		
		3.81	5.47~5.725		
		4.55	5.725~5.85		

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

BT-LE 1M

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	2401.983720	-6.777	2401.983360	-6.927	2401.983159	-7.011
19	2440	2439.983441	-6.786	2439.982080	-7.344	2439.982601	-7.130
39	2480	2479.982479	-7.064	2479.982399	-7.097	2479.982359	-7.113

BT-LE 2M

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	2401.983920	-6.694	2401.983560	-6.844	2401.983359	-6.927
19	2440	2439.982999	-6.967	2439.982599	-7.131	2439.982239	-7.279
39	2480	2479.982839	-6.919	2479.982479	-7.064	2479.982480	-7.064

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



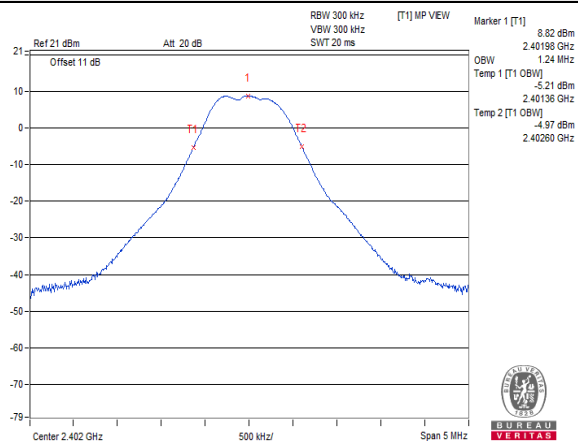
4.2.3 Test Results

BT-LE 1M

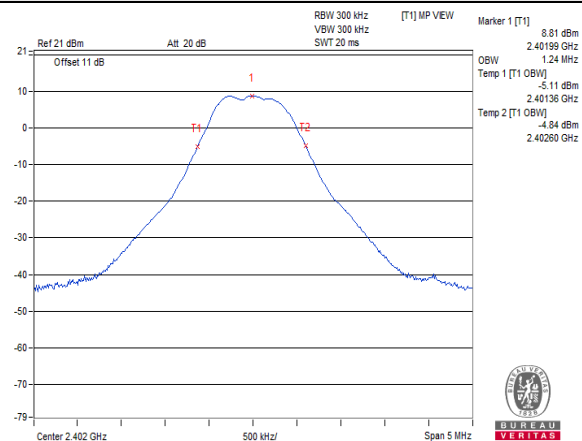
Channel	Frequency (MHz)	V_{normal}	$V_{max.}$	$V_{min.}$
		Occupied bandwidth (MHz)	Occupied bandwidth (MHz)	Occupied bandwidth (MHz)
0	2402	1.24	1.24	1.24
19	2440	1.25	1.24	1.24
39	2480	1.24	1.24	1.24

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

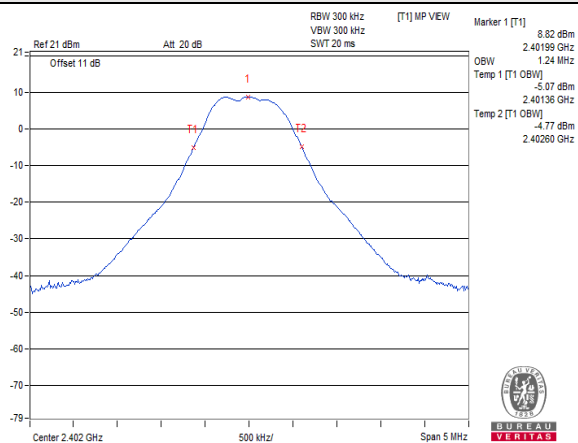
V_{normal}



V_{max.}

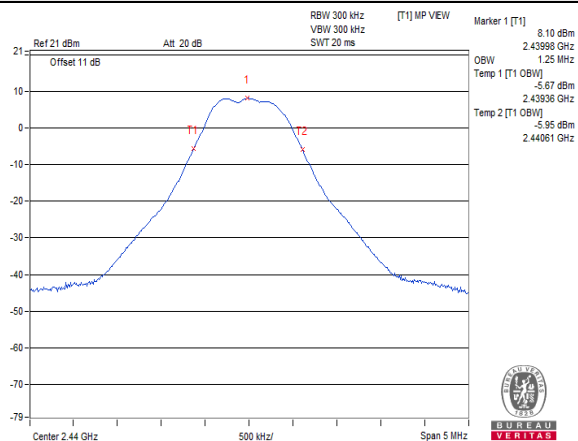


V_{min.}

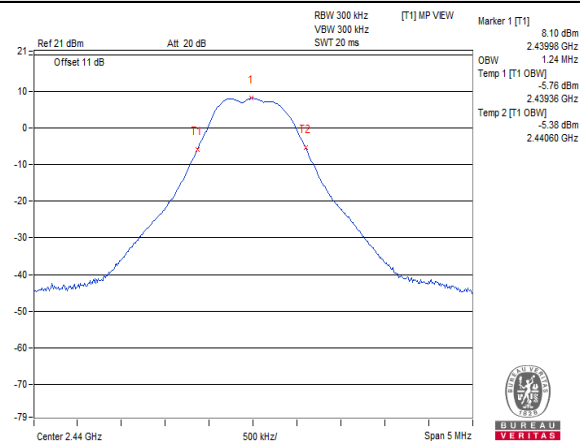


CH 0 (2402MHz)

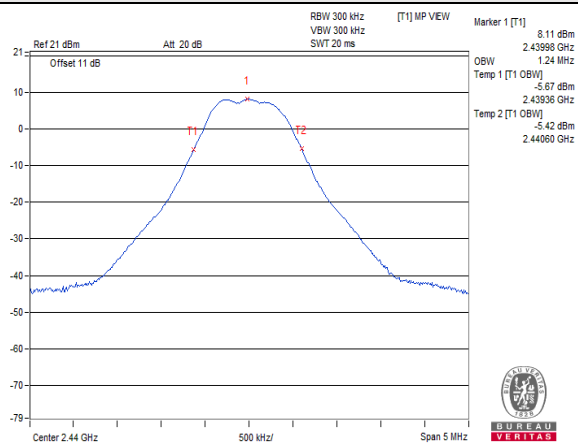
V_{normal}



V_{max.}

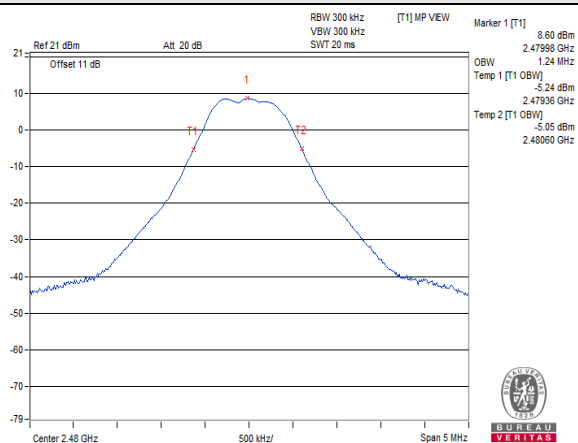


V_{min.}

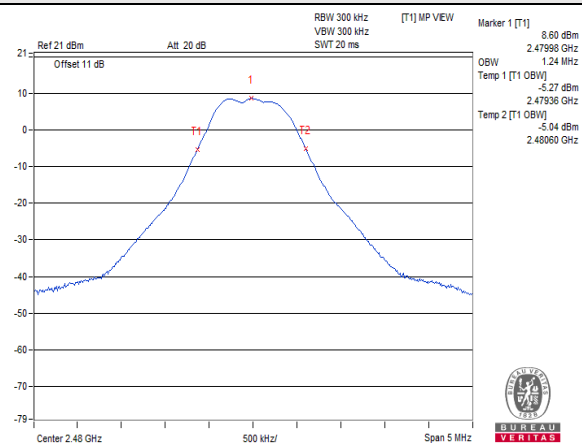


CH 19 (2440MHz)

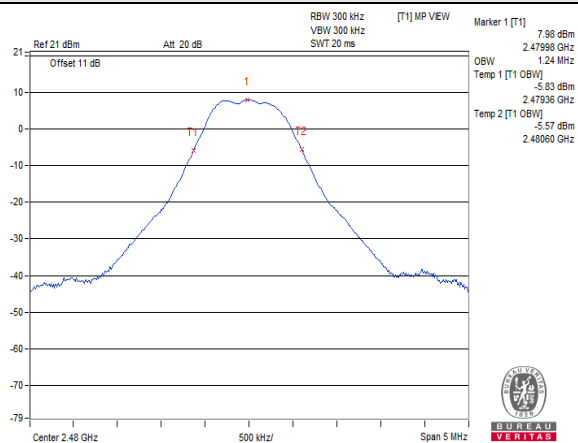
V_{normal}



V_{max.}



V_{min.}



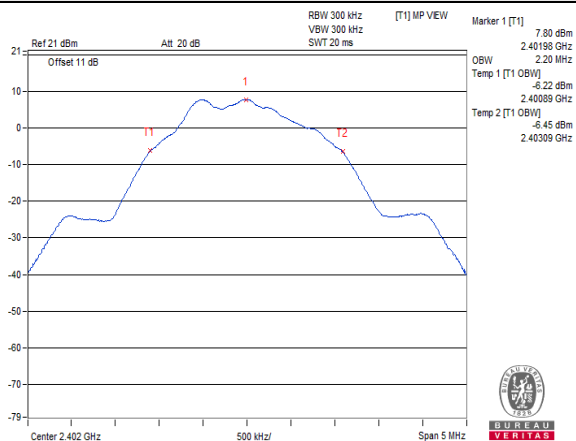
CH 39 (2480MHz)

BT-LE 2M

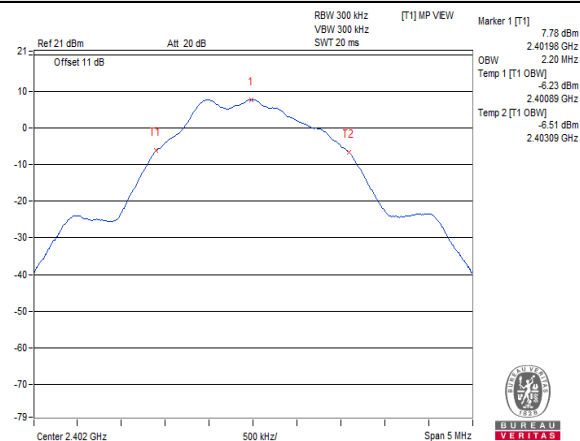
Channel	Frequency (MHz)	V_{normal}	$V_{\text{max.}}$	$V_{\text{min.}}$
		Occupied bandwidth (MHz)	Occupied bandwidth (MHz)	Occupied bandwidth (MHz)
0	2402	2.20	2.20	2.20
19	2440	2.20	2.20	2.20
39	2480	2.20	2.20	2.19

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

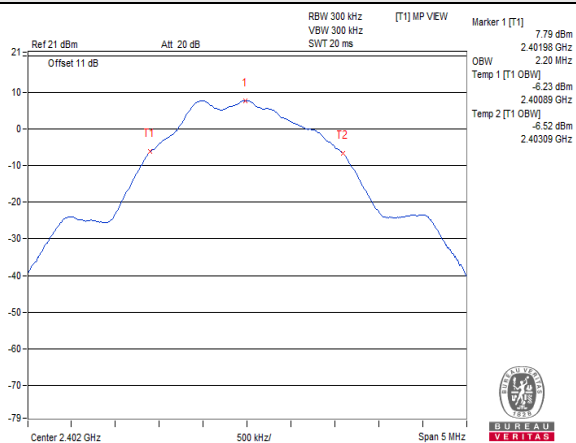
V_{normal}



V_{max.}

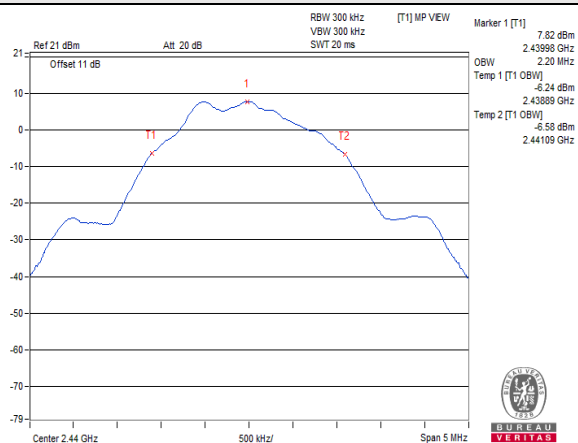


V_{min.}

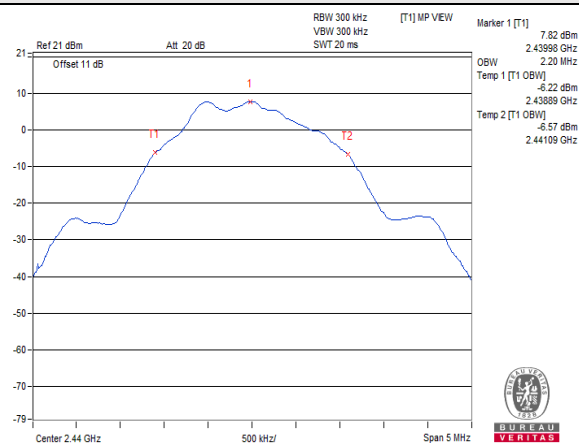
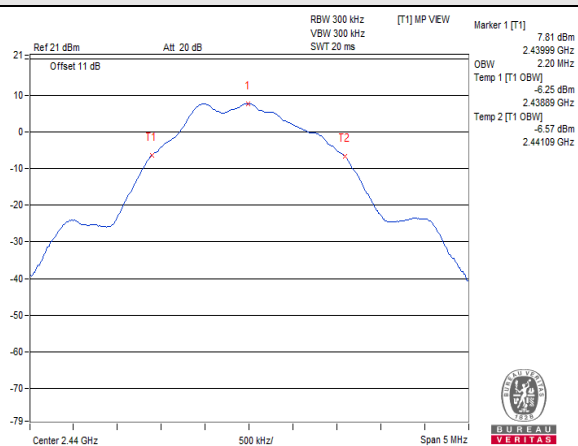


CH 0 (2402MHz)

V normal

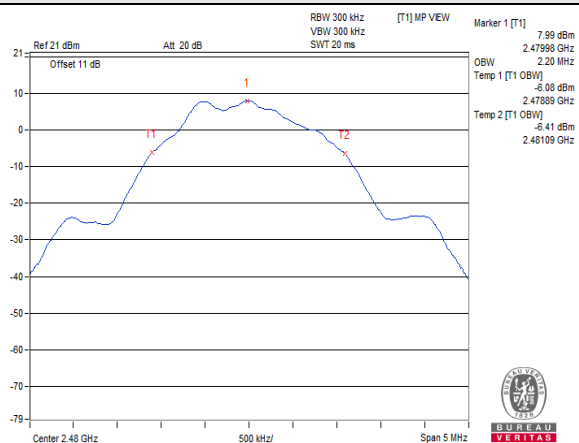


V	V _{max.}
----------	--------------------------

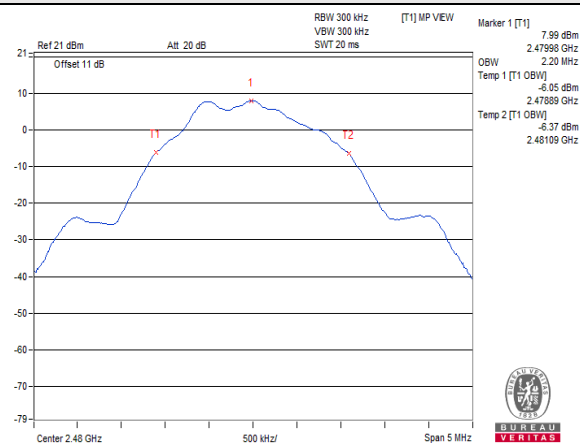
 $V_{\min.}$ 

CH 19 (2440MHz)

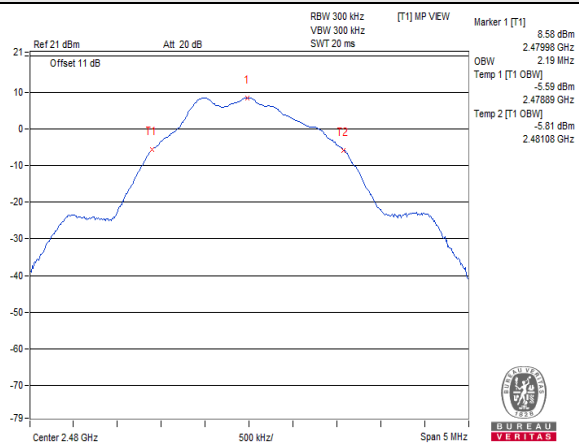
V_{normal}



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	$\leq 0.25 \text{ uW/100kHz}$
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	$\leq 2.5 \text{ uW/MHz}$

4.3.2 Test Setup



4.3.3 Test Results

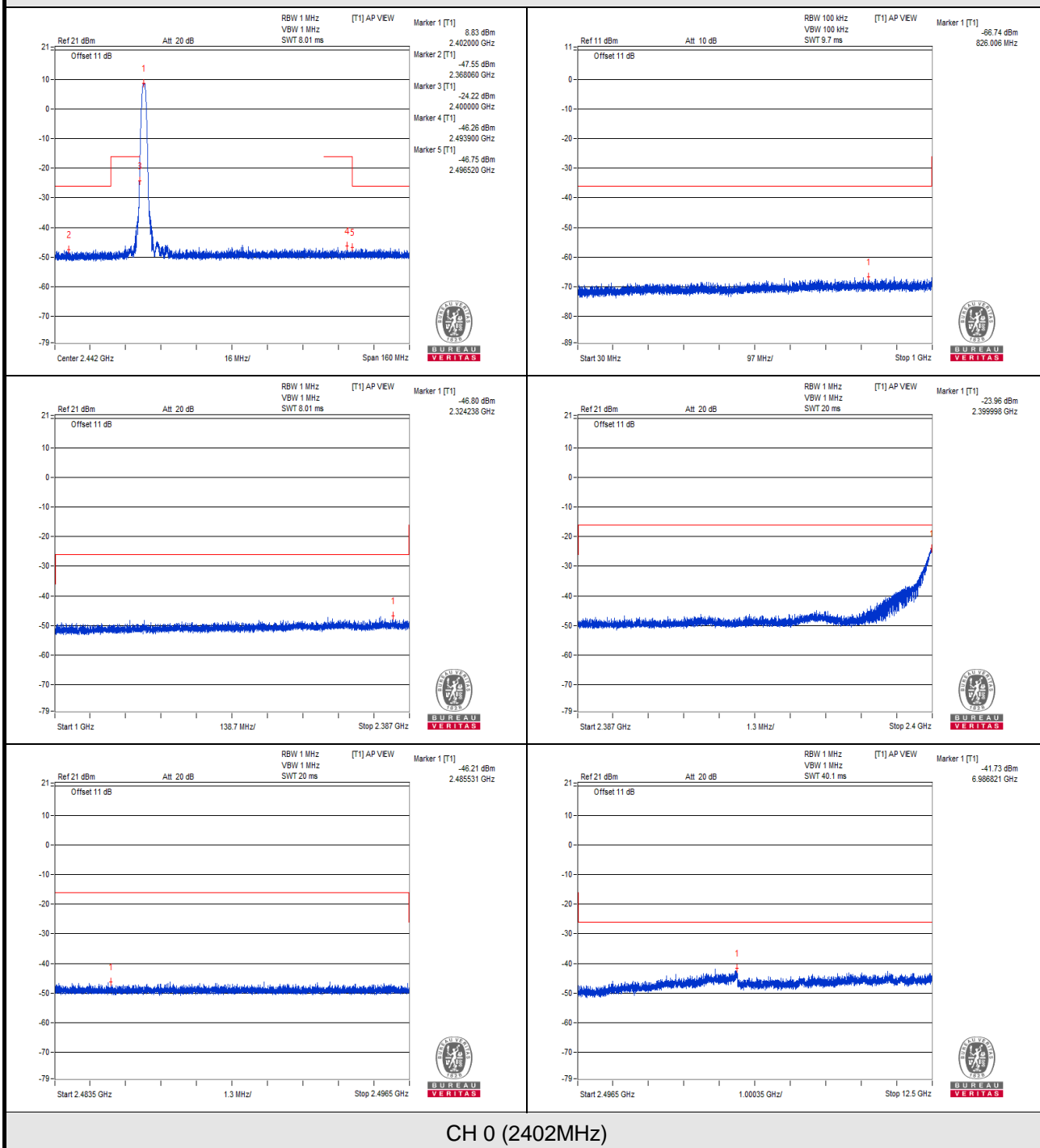
BT-LE 1M

TEST CHANNEL		CH 0 (2402MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE(uW)	LIMIT (uW)	RESULT
V_{normal}	30MHz to 1000MHz	826.006	0.000212	0.25	PASS
	1000MHz to 2387MHz	2324.238	0.020893	2.5	PASS
	2387MHz to 2400MHz	2399.998	4.017908	25	PASS
	2483.5MHz to 2496.5MHz	2485.531	0.023933	25	PASS
	2496.5MHz to 12500MHz	6986.821	0.067143	2.5	PASS
V_{max.}	30MHz to 1000MHz	628.975	0.000198	0.25	PASS
	1000MHz to 2387MHz	2319.730	0.018113	2.5	PASS
	2387MHz to 2400MHz	2400.000	4.149540	25	PASS
	2483.5MHz to 2496.5MHz	2487.663	0.024099	25	PASS
	2496.5MHz to 12500MHz	6998.075	0.066374	2.5	PASS
V_{min.}	30MHz to 1000MHz	746.951	0.000252	0.25	PASS
	1000MHz to 2387MHz	2067.469	0.018072	2.5	PASS
	2387MHz to 2400MHz	2400.000	4.092607	25	PASS
	2483.5MHz to 2496.5MHz	2491.261	0.024322	25	PASS
	2496.5MHz to 12500MHz	6191.542	0.059841	2.5	PASS
TEST CHANNEL		CH 19 (2440MHz)			
V_{normal}	30MHz to 1000MHz	779.567	0.000212	0.25	PASS
	1000MHz to 2387MHz	2296.671	0.018281	2.5	PASS
	2387MHz to 2400MHz	2390.591	0.020045	25	PASS
	2483.5MHz to 2496.5MHz	2493.498	0.022284	25	PASS
	2496.5MHz to 12500MHz	6999.325	0.057677	2.5	PASS
V_{max.}	30MHz to 1000MHz	698.815	0.000212	0.25	PASS
	1000MHz to 2387MHz	1854.218	0.018113	2.5	PASS
	2387MHz to 2400MHz	2397.733	0.023014	25	PASS
	2483.5MHz to 2496.5MHz	2484.842	0.023335	25	PASS
	2496.5MHz to 12500MHz	6989.321	0.056754	2.5	PASS
V_{min.}	30MHz to 1000MHz	827.461	0.000229	0.25	PASS
	1000MHz to 2387MHz	2154.677	0.021038	2.5	PASS
	2387MHz to 2400MHz	2392.991	0.020845	25	PASS
	2483.5MHz to 2496.5MHz	2488.513	0.022029	25	PASS
	2496.5MHz to 12500MHz	6984.320	0.058884	2.5	PASS

TEST CHANNEL		CH 39 (2480MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE(uW)	LIMIT (uW)	RESULT
V_{normal}	30MHz to 1000MHz	939.375	0.000211	0.25	PASS
	1000MHz to 2387MHz	2303.606	0.020464	2.5	PASS
	2387MHz to 2400MHz	2399.780	0.020559	25	PASS
	2483.5MHz to 2496.5MHz	2483.503	0.075858	25	PASS
	2496.5MHz to 12500MHz	6976.817	0.064565	2.5	PASS
V_{max.}	30MHz to 1000MHz	646.313	0.000228	0.25	PASS
	1000MHz to 2387MHz	2386.133	0.019187	2.5	PASS
	2387MHz to 2400MHz	2392.529	0.020137	25	PASS
	2483.5MHz to 2496.5MHz	2483.504	0.084333	25	PASS
	2496.5MHz to 12500MHz	6995.574	0.067143	2.5	PASS
V_{min.}	30MHz to 1000MHz	891.723	0.000198	0.25	PASS
	1000MHz to 2387MHz	2134.045	0.018880	2.5	PASS
	2387MHz to 2400MHz	2397.227	0.020749	25	PASS
	2483.5MHz to 2496.5MHz	2483.558	0.092683	25	PASS
	2496.5MHz to 12500MHz	6529.160	0.068707	2.5	PASS

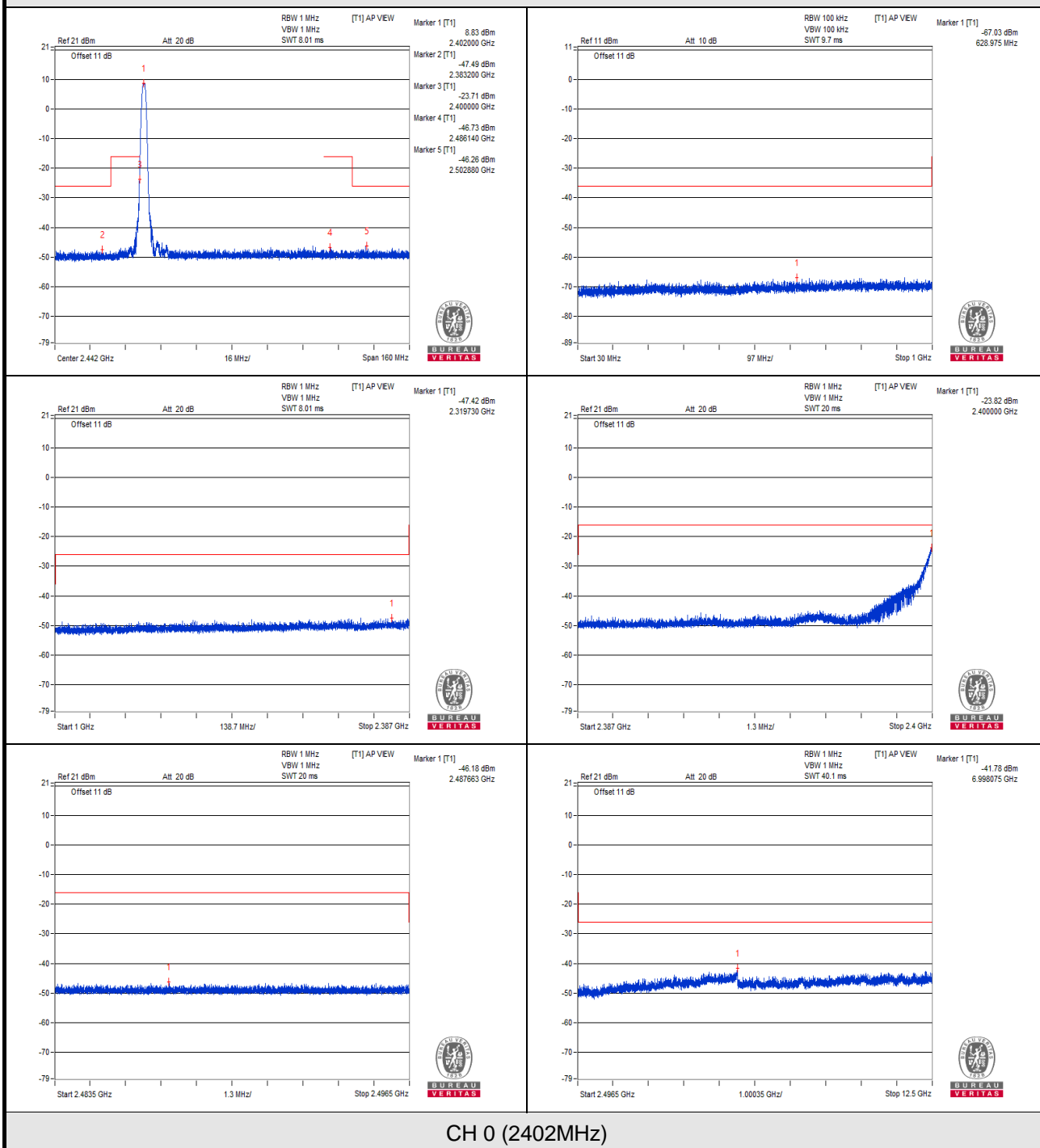
NOTE: 1. The spectrum plots are attached on the following pages.

Vnormal

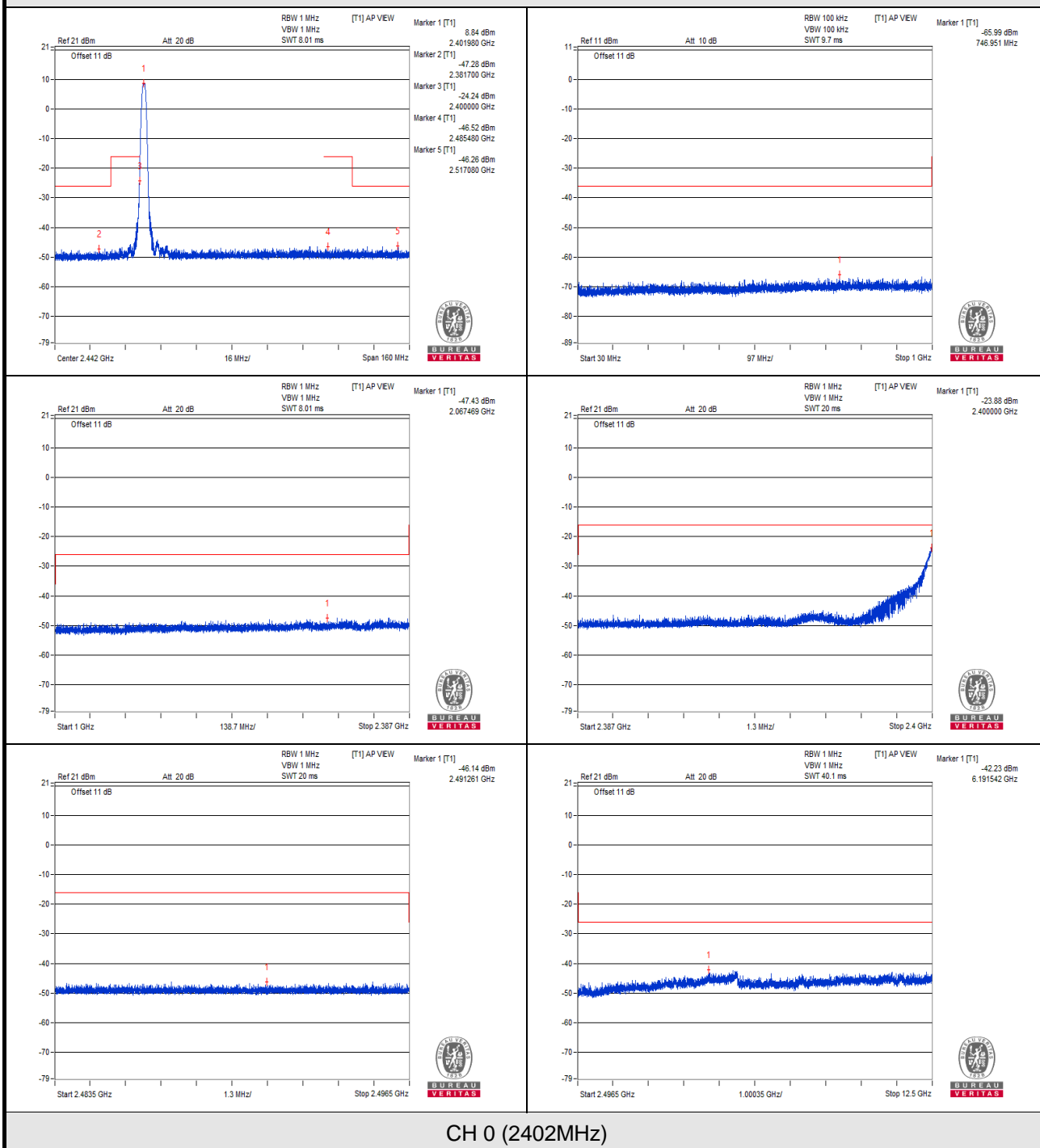


CH 0 (2402MHz)

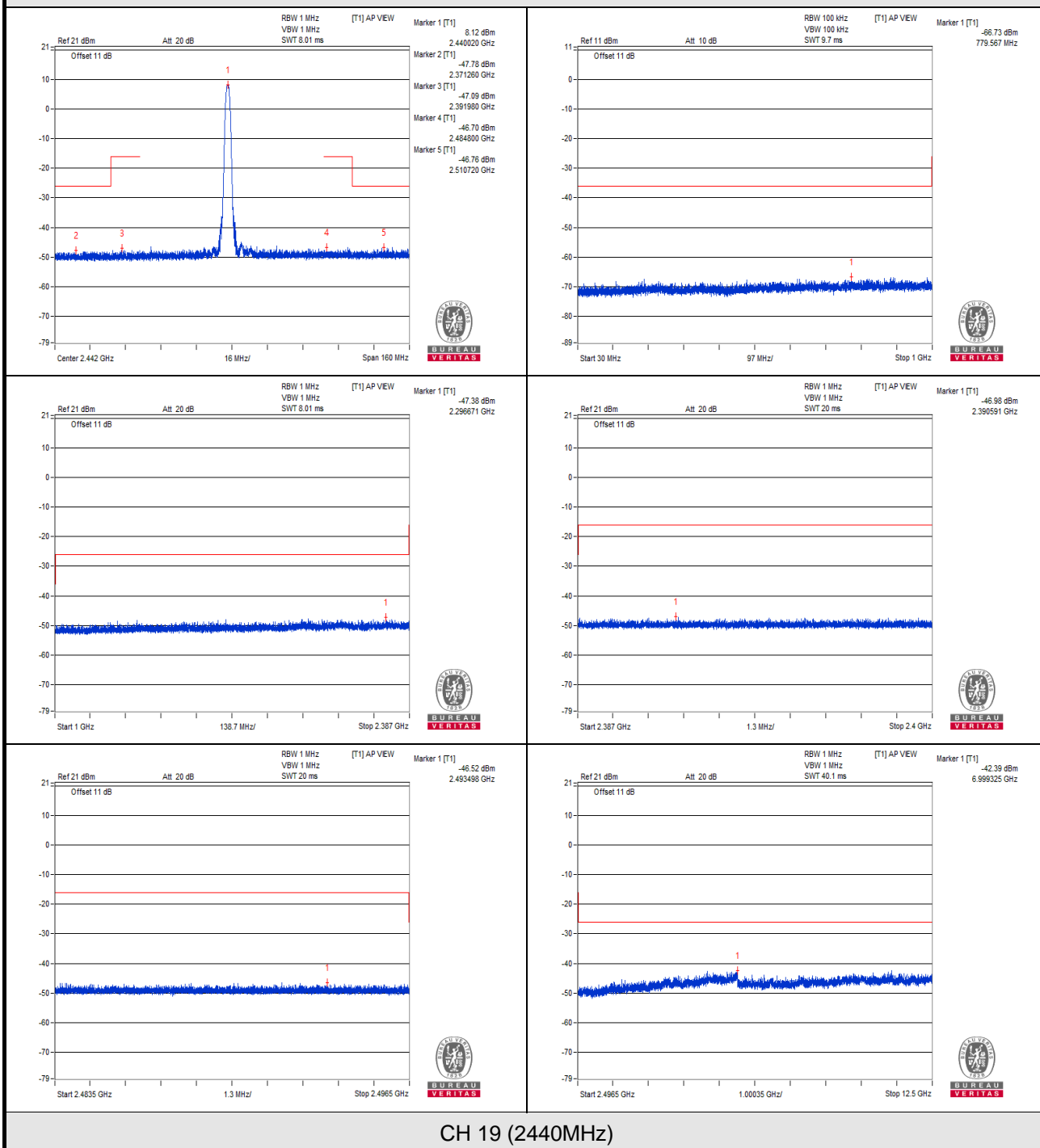
V_{max}.



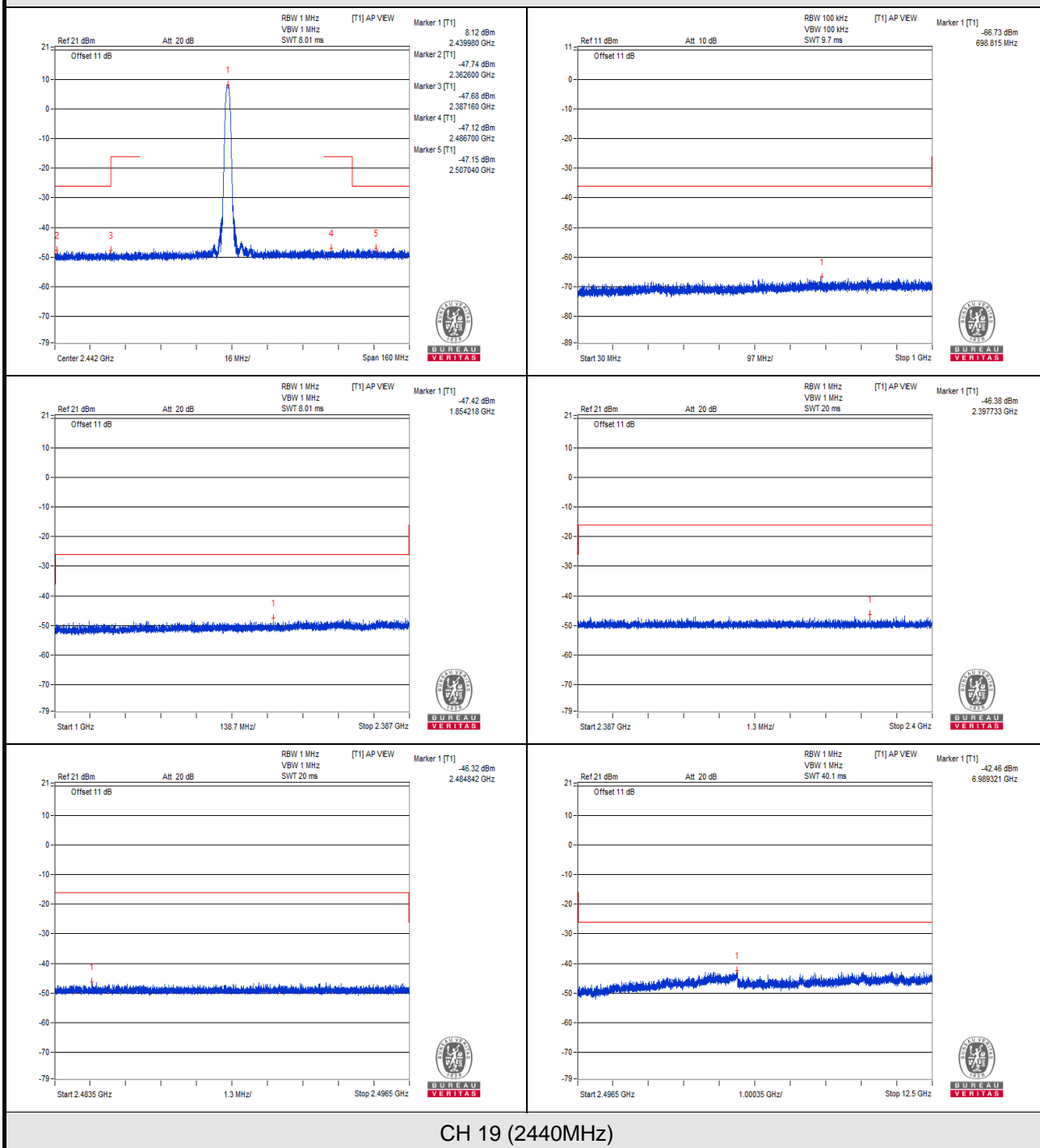
V_{min}.



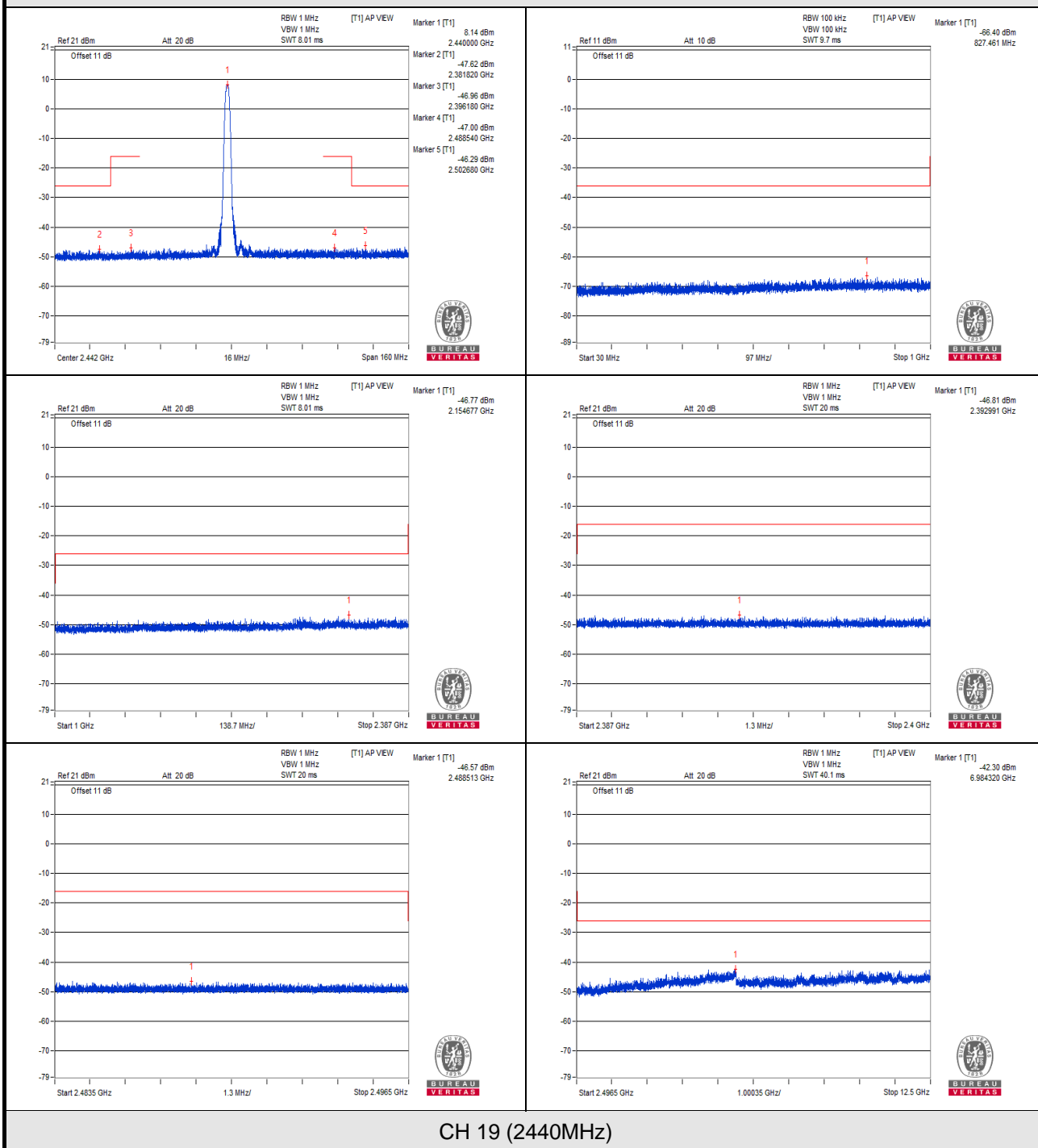
Vnormal



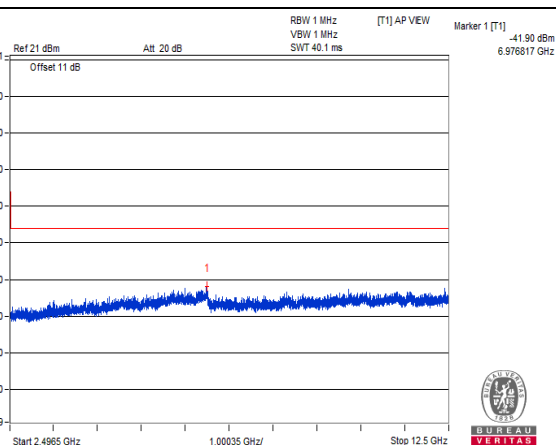
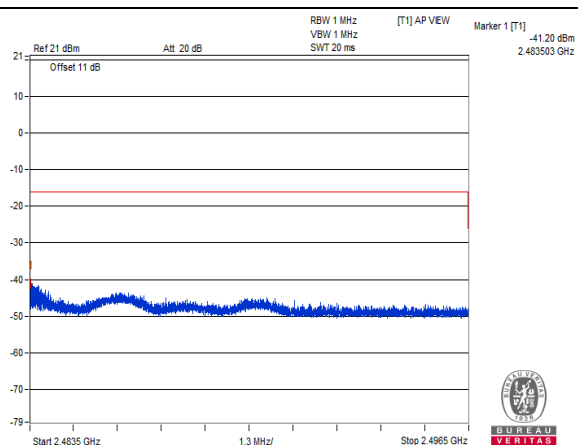
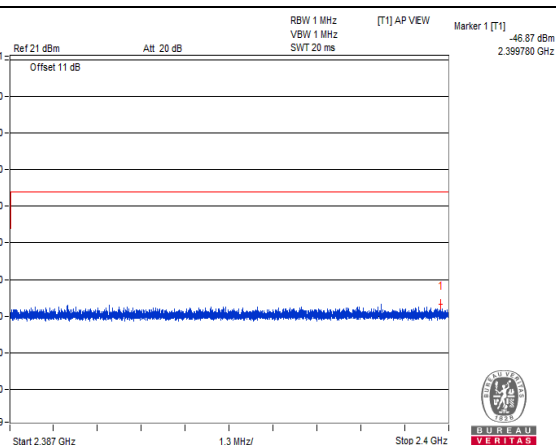
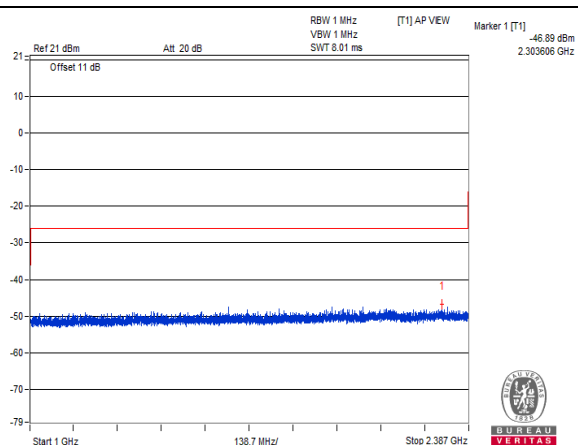
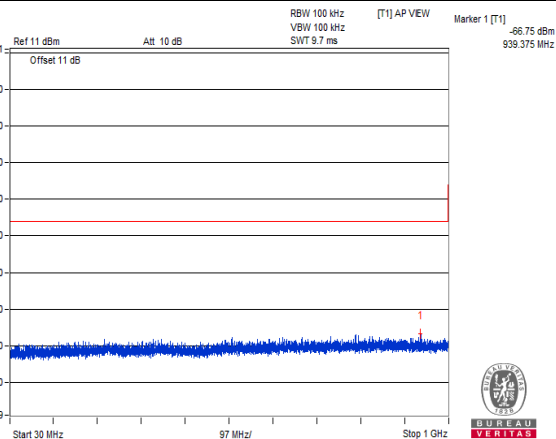
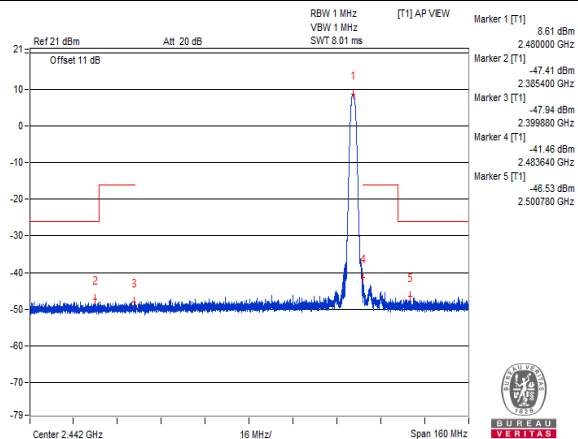
V_{max}.



V_{min}.

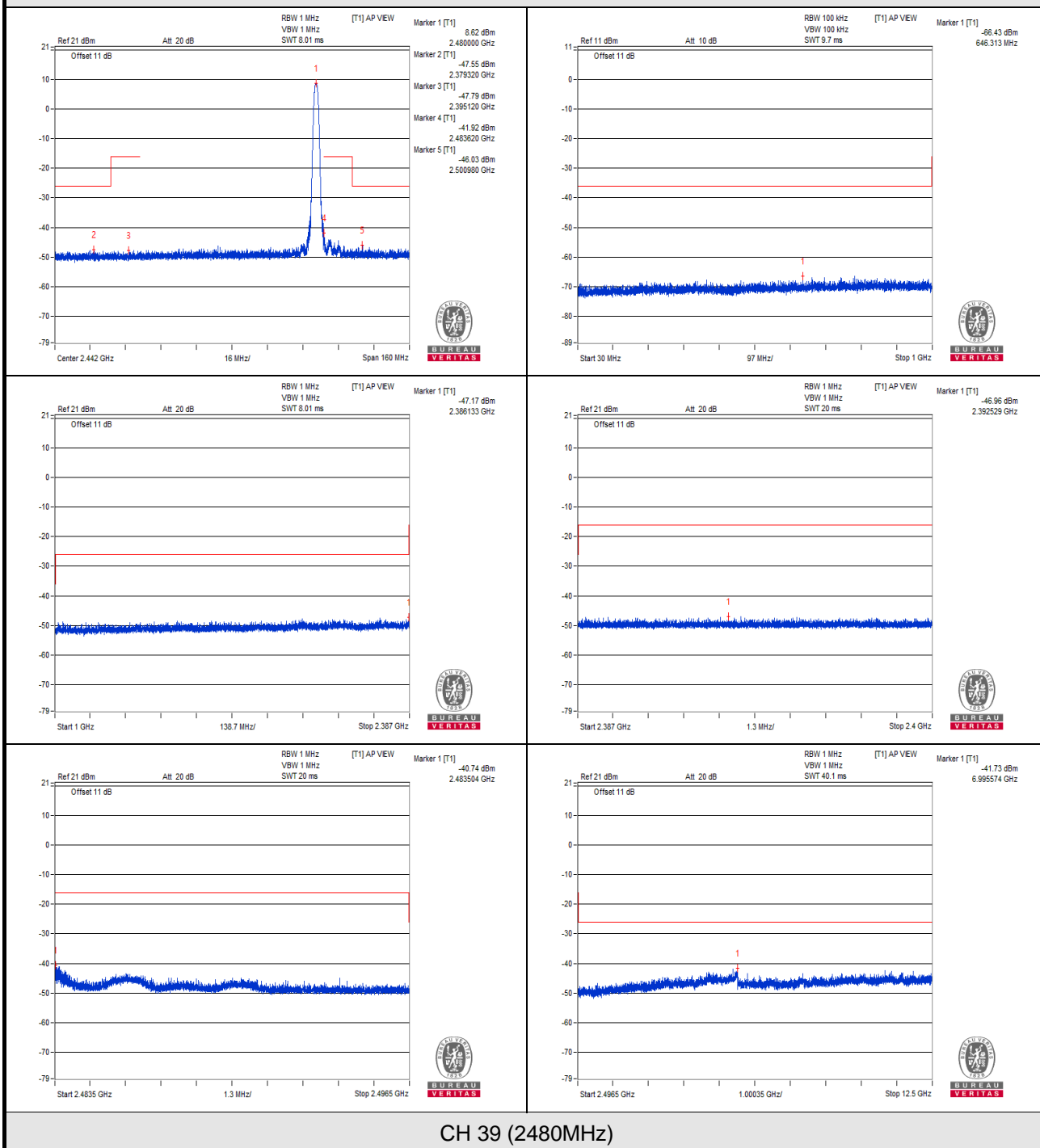


Vnormal

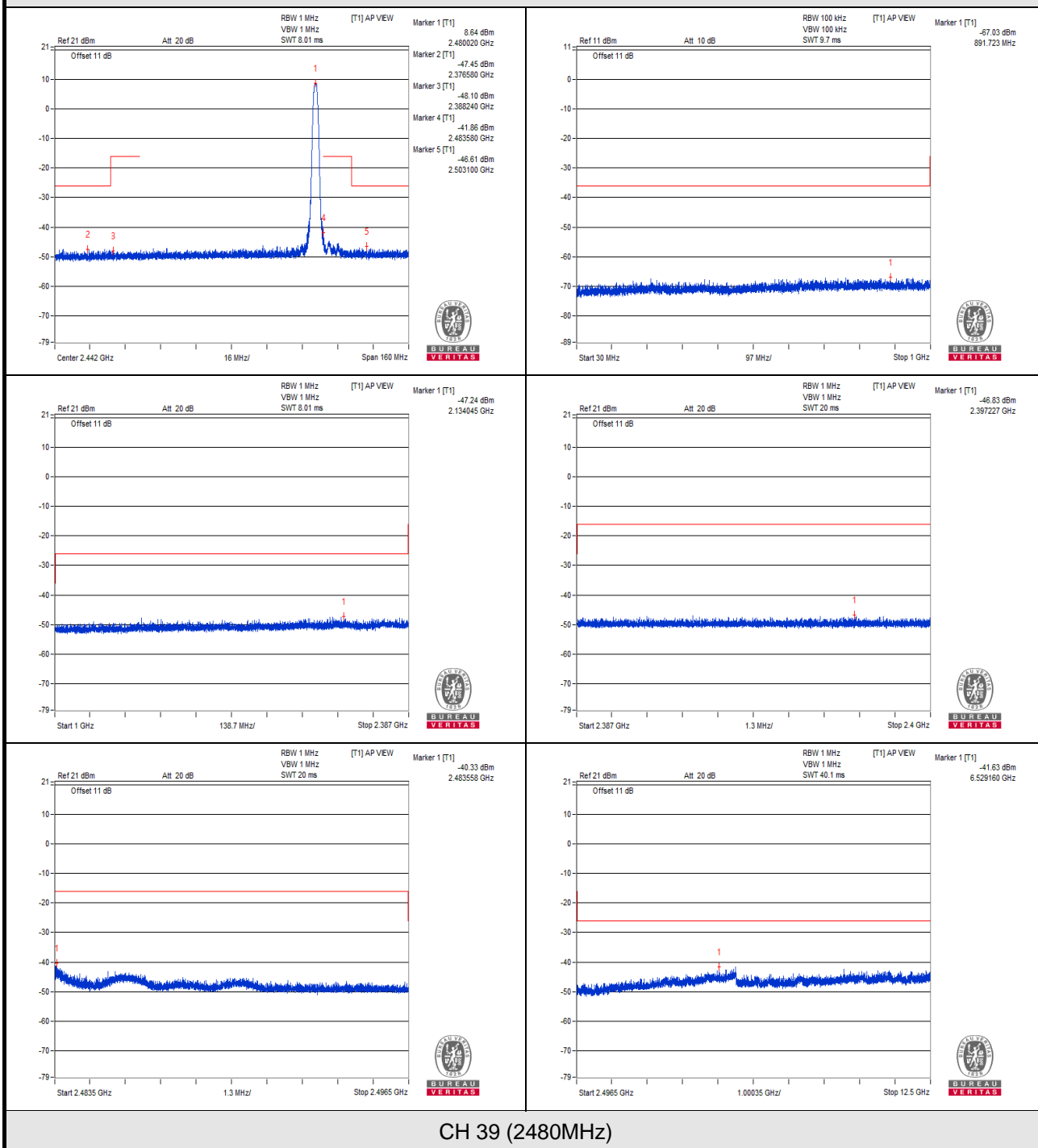


CH 39 (2480MHz)

V_{max}.



V_{min}.



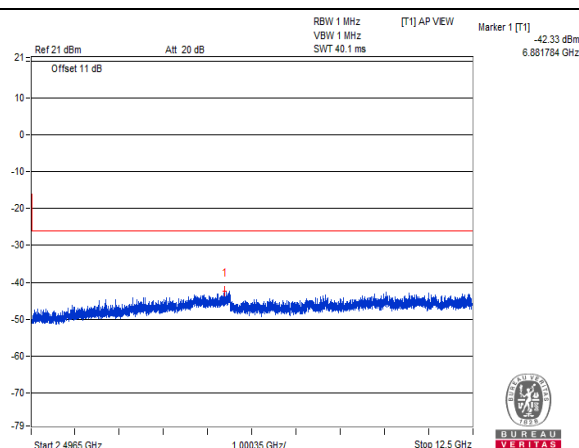
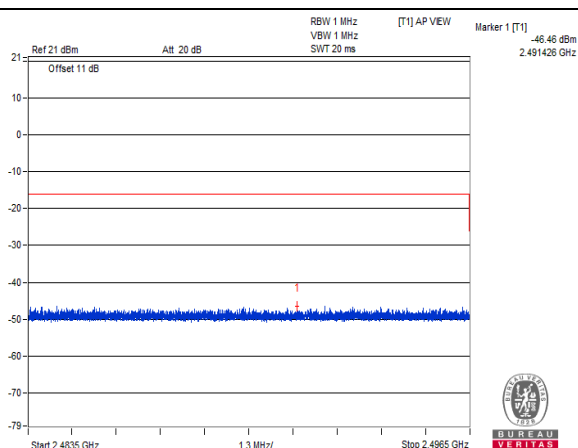
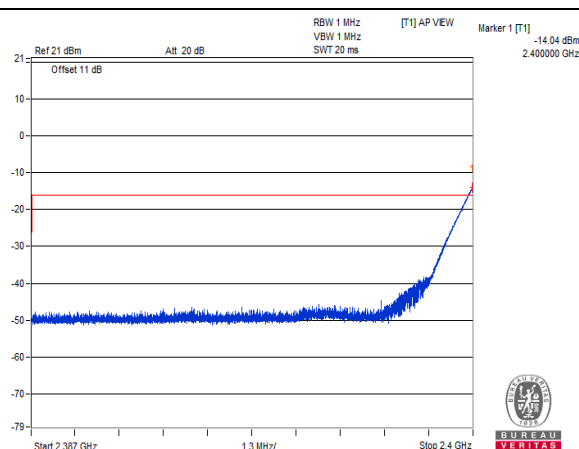
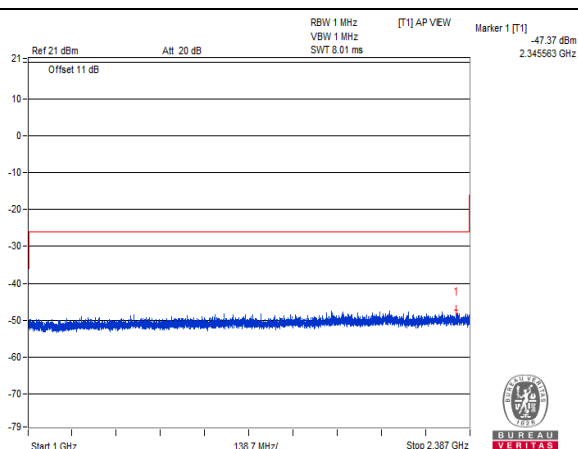
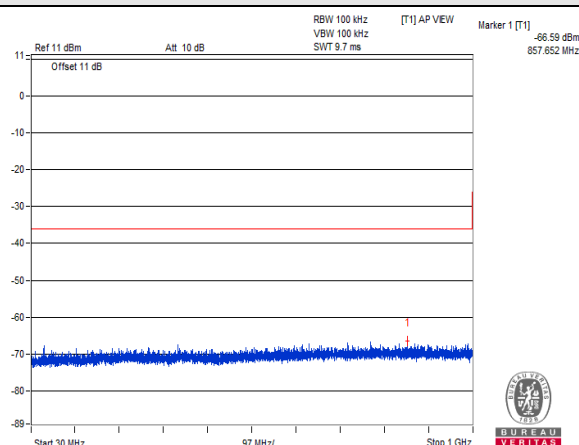
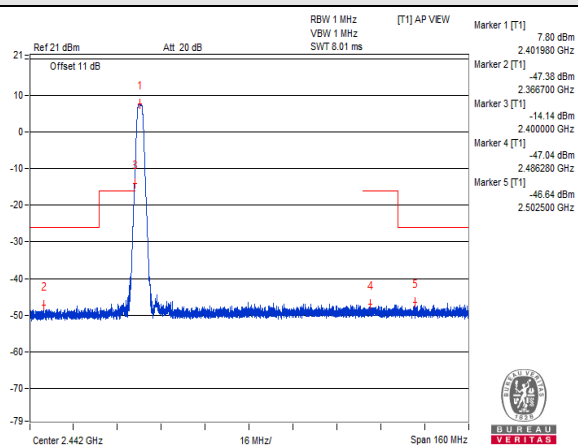
BT-LE 2M

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	857.652	0.000219	0.25	PASS
	1000MHz to 2387MHz	2345.563	0.018323	2.5	PASS
	2387MHz to 2400MHz	2400.000	11.144347	25	PASS(1)
	2483.5MHz to 2496.5MHz	2491.426	0.022594	25	PASS
	2496.5MHz to 12500MHz	6881.784	0.058479	2.5	PASS
V_{max.}	30MHz to 1000MHz	792.783	0.000195	0.25	PASS
	1000MHz to 2387MHz	2377.984	0.020941	2.5	PASS
	2387MHz to 2400MHz	2400.000	12.129833	25	PASS(2)
	2483.5MHz to 2496.5MHz	2495.845	0.024155	25	PASS
	2496.5MHz to 12500MHz	6985.570	0.068549	2.5	PASS
V_{min.}	30MHz to 1000MHz	799.816	0.000222	0.25	PASS
	1000MHz to 2387MHz	1975.754	0.020137	2.5	PASS
	2387MHz to 2400MHz	2400.000	11.159314	25	PASS(3)
	2483.5MHz to 2496.5MHz	2492.424	0.024660	25	PASS
	2496.5MHz to 12500MHz	11615.940	0.079799	2.5	PASS
TEST CHANNEL		CH 19 (2440MHz)			
V_{normal}	30MHz to 1000MHz	765.017	0.000219	0.25	PASS
	1000MHz to 2387MHz	1982.862	0.016520	2.5	PASS
	2387MHz to 2400MHz	2398.846	0.021330	25	PASS
	2483.5MHz to 2496.5MHz	2494.634	0.021135	25	PASS
	2496.5MHz to 12500MHz	10267.968	0.064714	2.5	PASS
V_{max.}	30MHz to 1000MHz	633.946	0.000209	0.25	PASS
	1000MHz to 2387MHz	2310.715	0.018323	2.5	PASS
	2387MHz to 2400MHz	2389.552	0.021038	25	PASS
	2483.5MHz to 2496.5MHz	2495.676	0.025119	25	PASS
	2496.5MHz to 12500MHz	6993.073	0.053456	2.5	PASS
V_{min.}	30MHz to 1000MHz	689.842	0.000217	0.25	PASS
	1000MHz to 2387MHz	2252.461	0.018621	2.5	PASS
	2387MHz to 2400MHz	2397.388	0.021038	25	PASS
	2483.5MHz to 2496.5MHz	2496.413	0.030339	25	PASS
	2496.5MHz to 12500MHz	6979.318	0.064714	2.5	PASS

TEST CHANNEL		CH 39 (2480MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE(uW)	LIMIT (uW)	RESULT
V_{normal}	30MHz to 1000MHz	844.193	0.000222	0.25	PASS
	1000MHz to 2387MHz	2086.887	0.018880	2.5	PASS
	2387MHz to 2400MHz	2399.714	0.021677	25	PASS
	2483.5MHz to 2496.5MHz	2483.548	0.110917	25	PASS
	2496.5MHz to 12500MHz	6984.320	0.061376	2.5	PASS
V_{max.}	30MHz to 1000MHz	900.938	0.000216	0.25	PASS
	1000MHz to 2387MHz	2350.071	0.018535	2.5	PASS
	2387MHz to 2400MHz	2396.631	0.019364	25	PASS
	2483.5MHz to 2496.5MHz	2483.526	0.110917	25	PASS
	2496.5MHz to 12500MHz	9976.617	0.065163	2.5	PASS
V_{min.}	30MHz to 1000MHz	545.070	0.000237	0.25	PASS
	1000MHz to 2387MHz	1607.159	0.020324	2.5	PASS
	2387MHz to 2400MHz	2390.344	0.019770	25	PASS
	2483.5MHz to 2496.5MHz	2483.501	0.106905	25	PASS
	2496.5MHz to 12500MHz	6974.316	0.070795	2.5	PASS

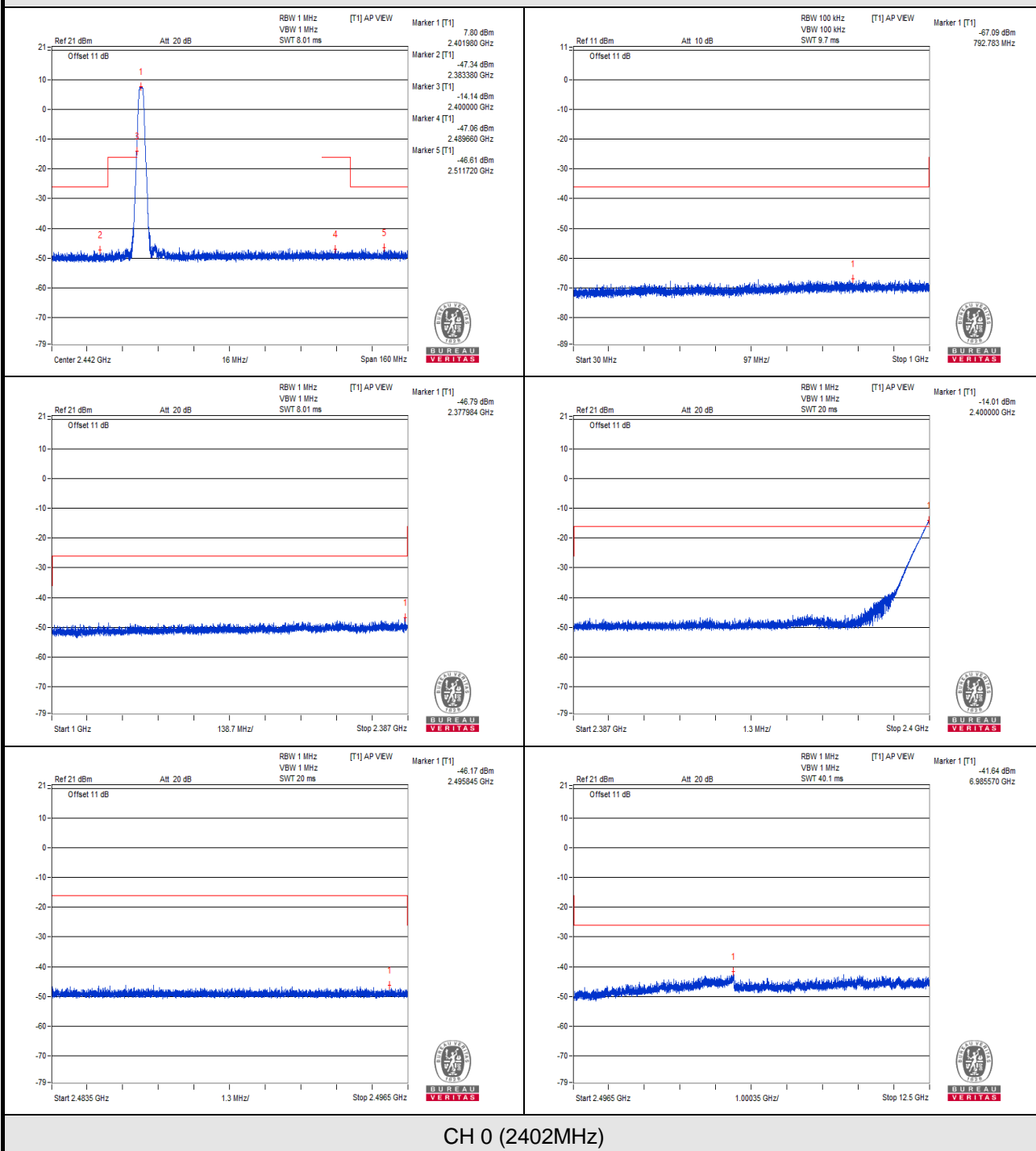
NOTE: 1. The spectrum plots are attached on the following pages.
2. (No.): The value was tested under Measuring Mode *Zero Span.

Vnormal

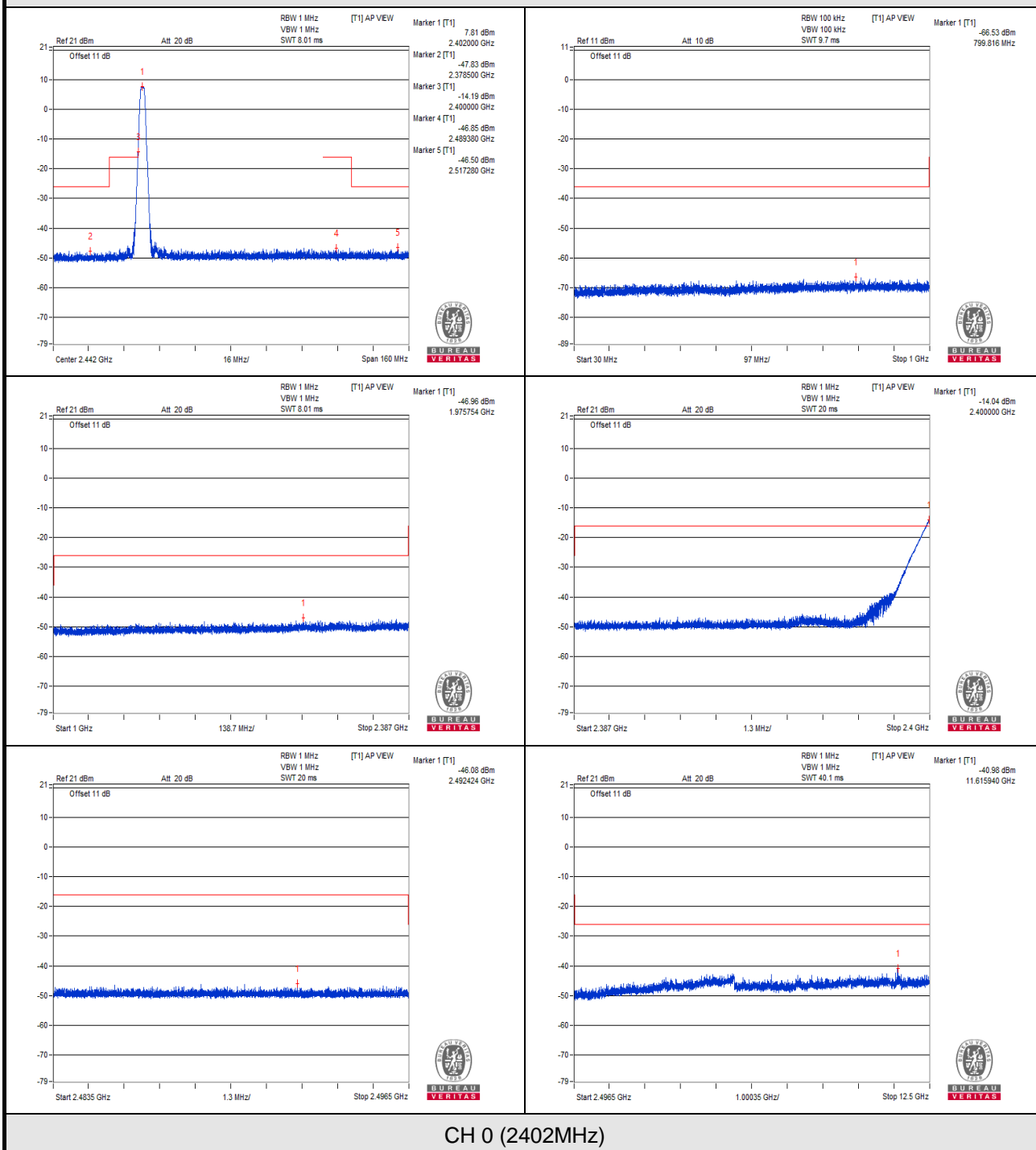


CH 0 (2402MHz)

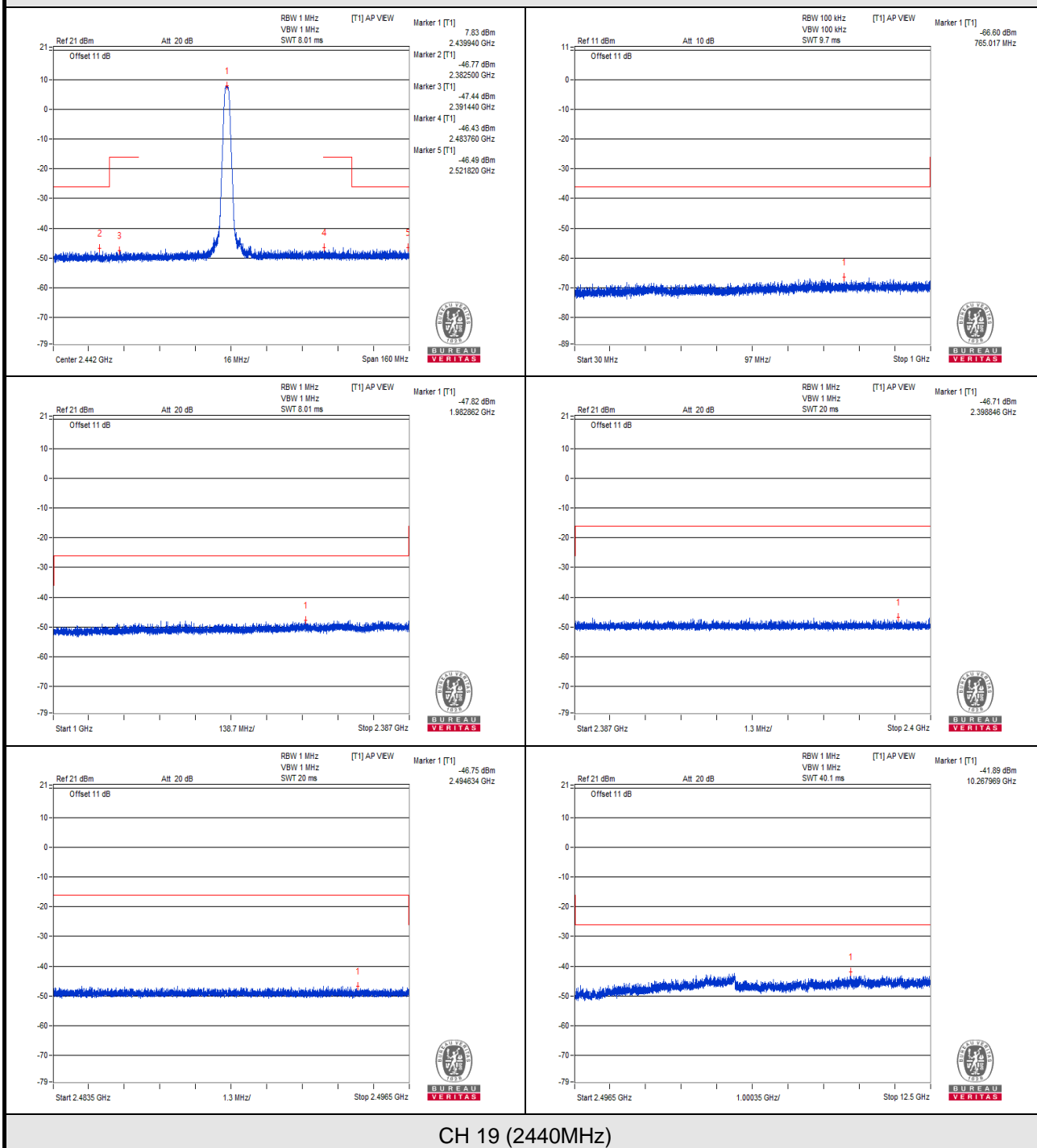
V_{max}.



V_{min}.

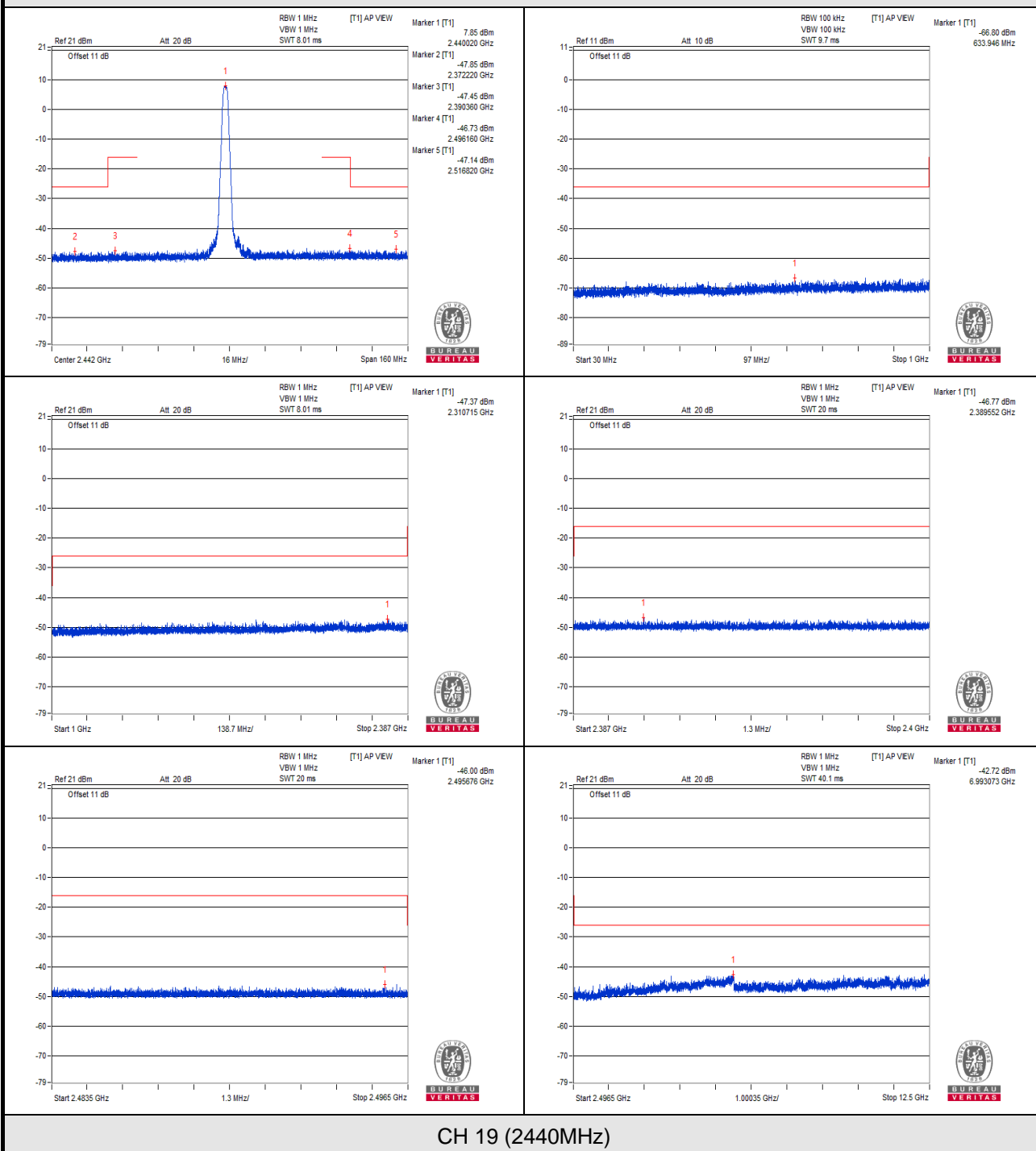


Vnormal

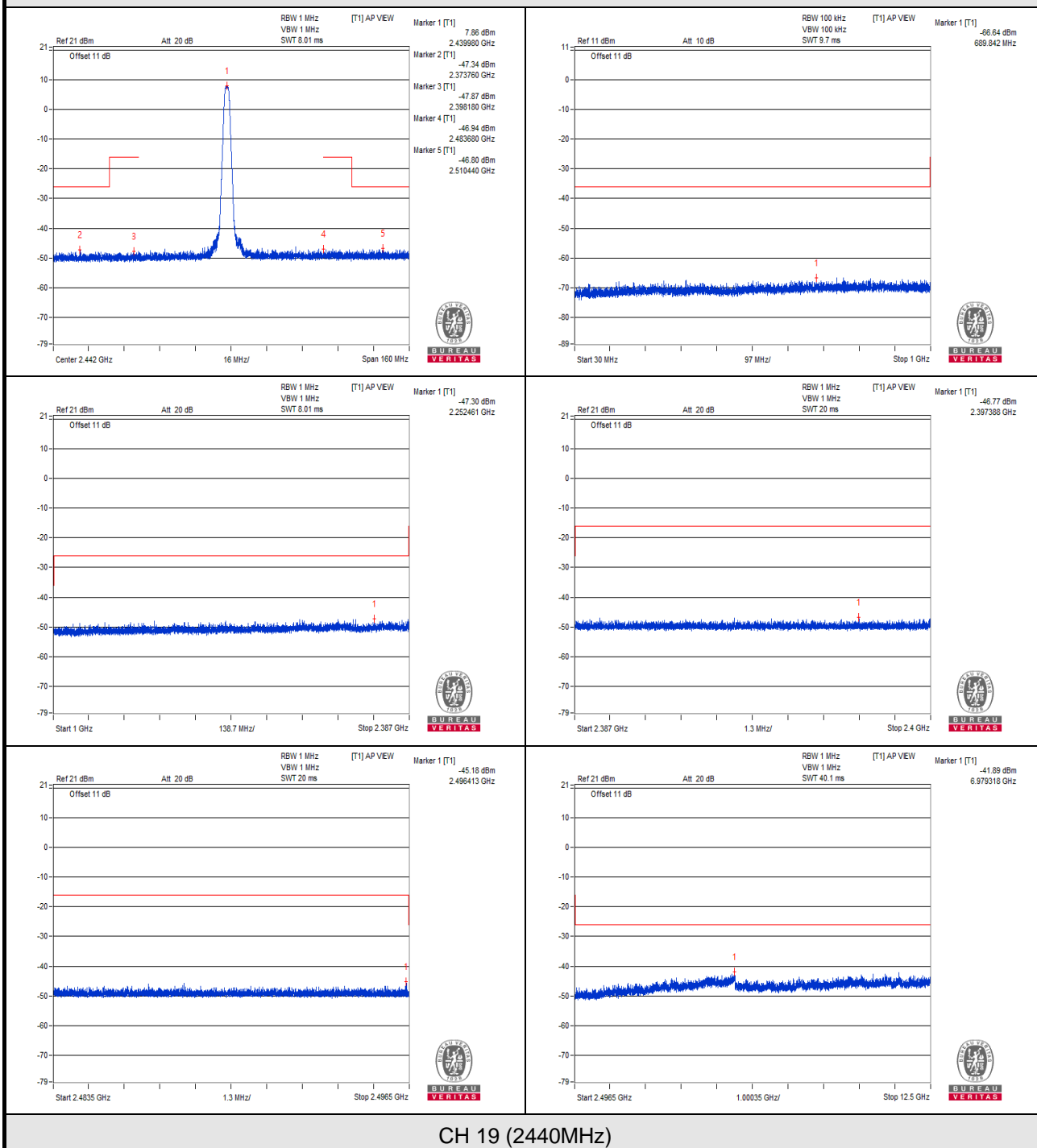


CH 19 (2440MHz)

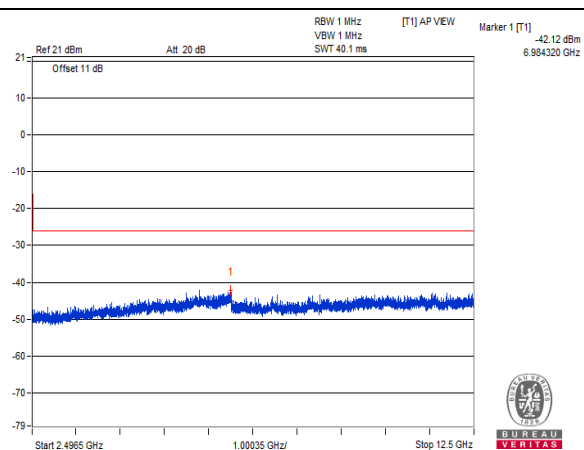
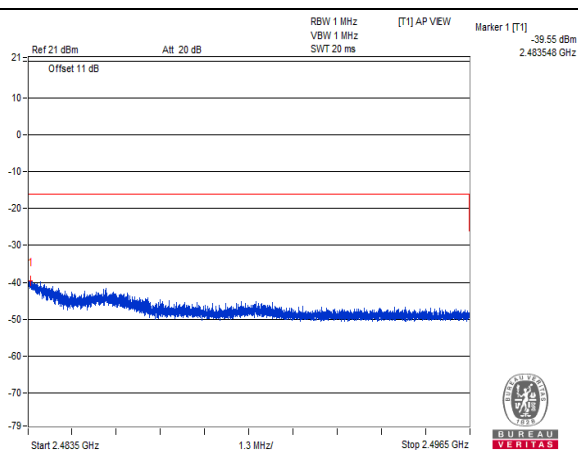
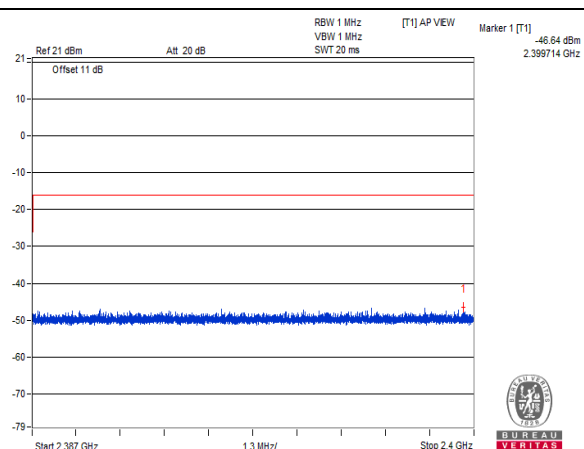
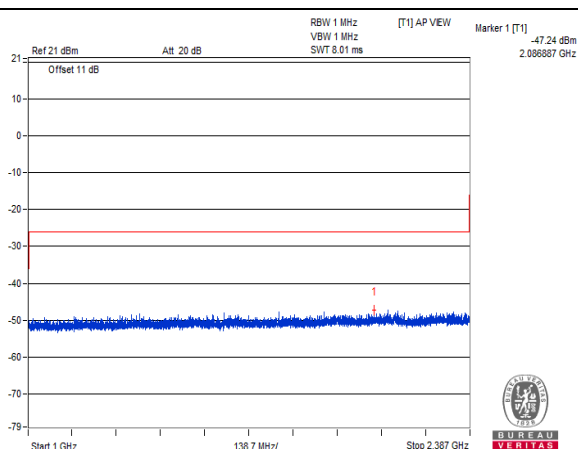
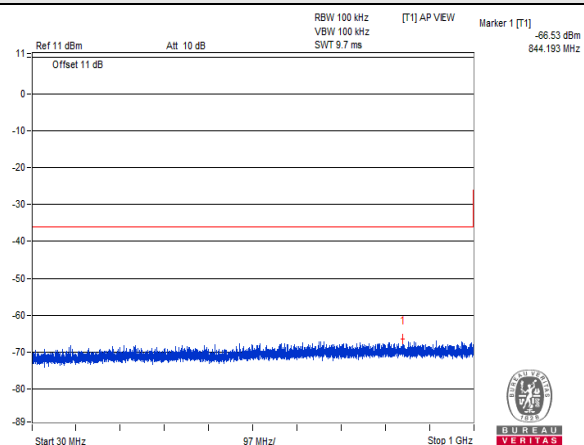
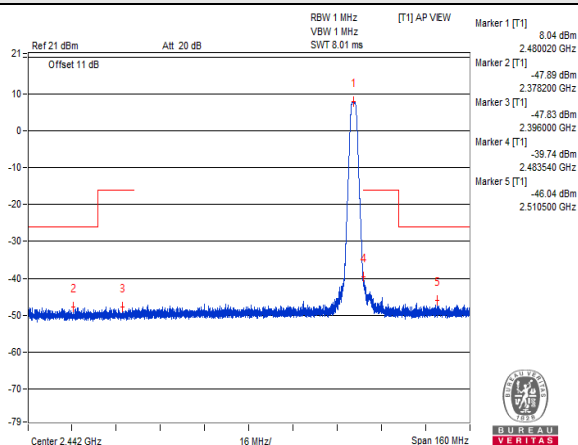
V_{max}.



V_{min}.

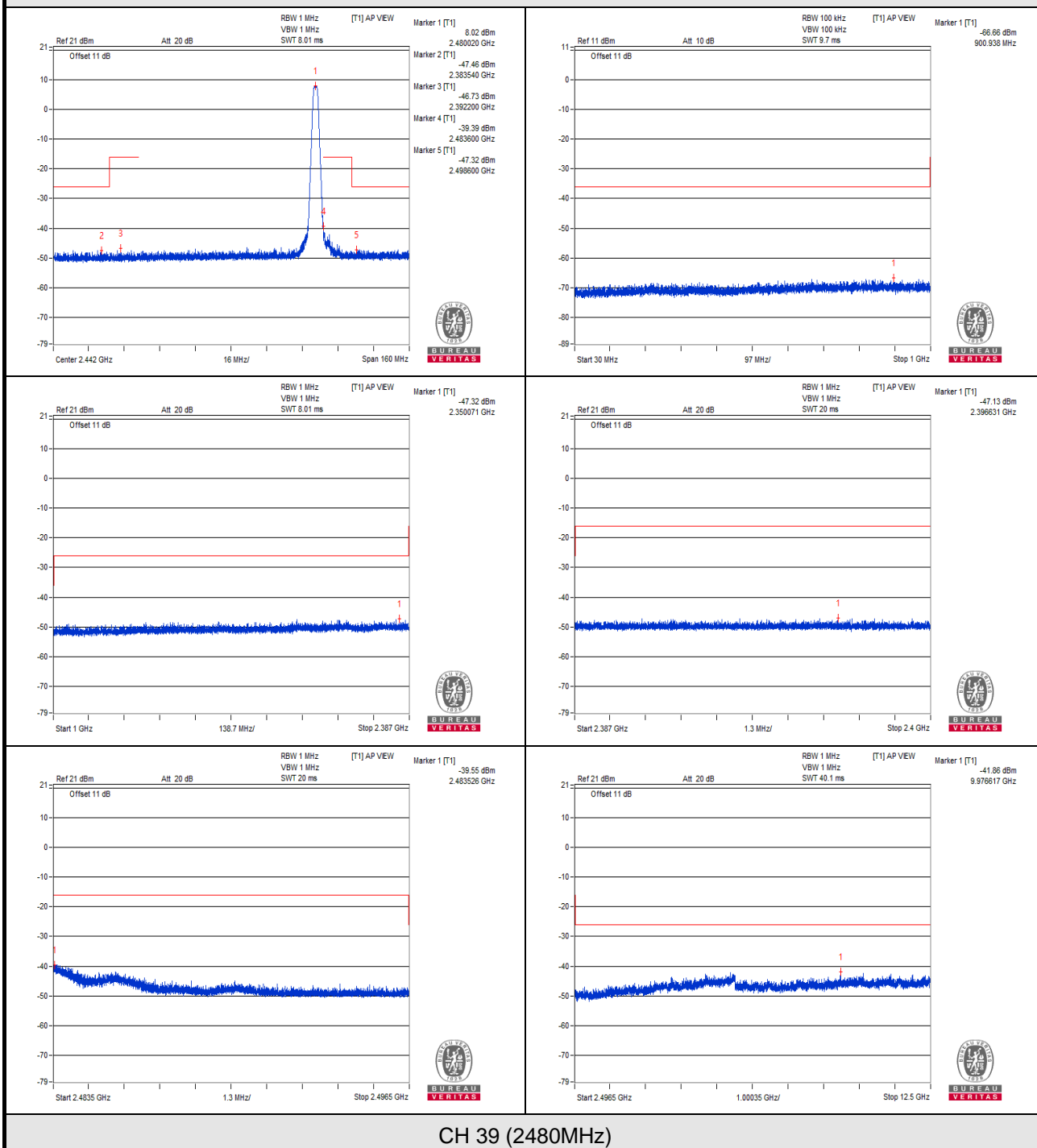


Vnormal

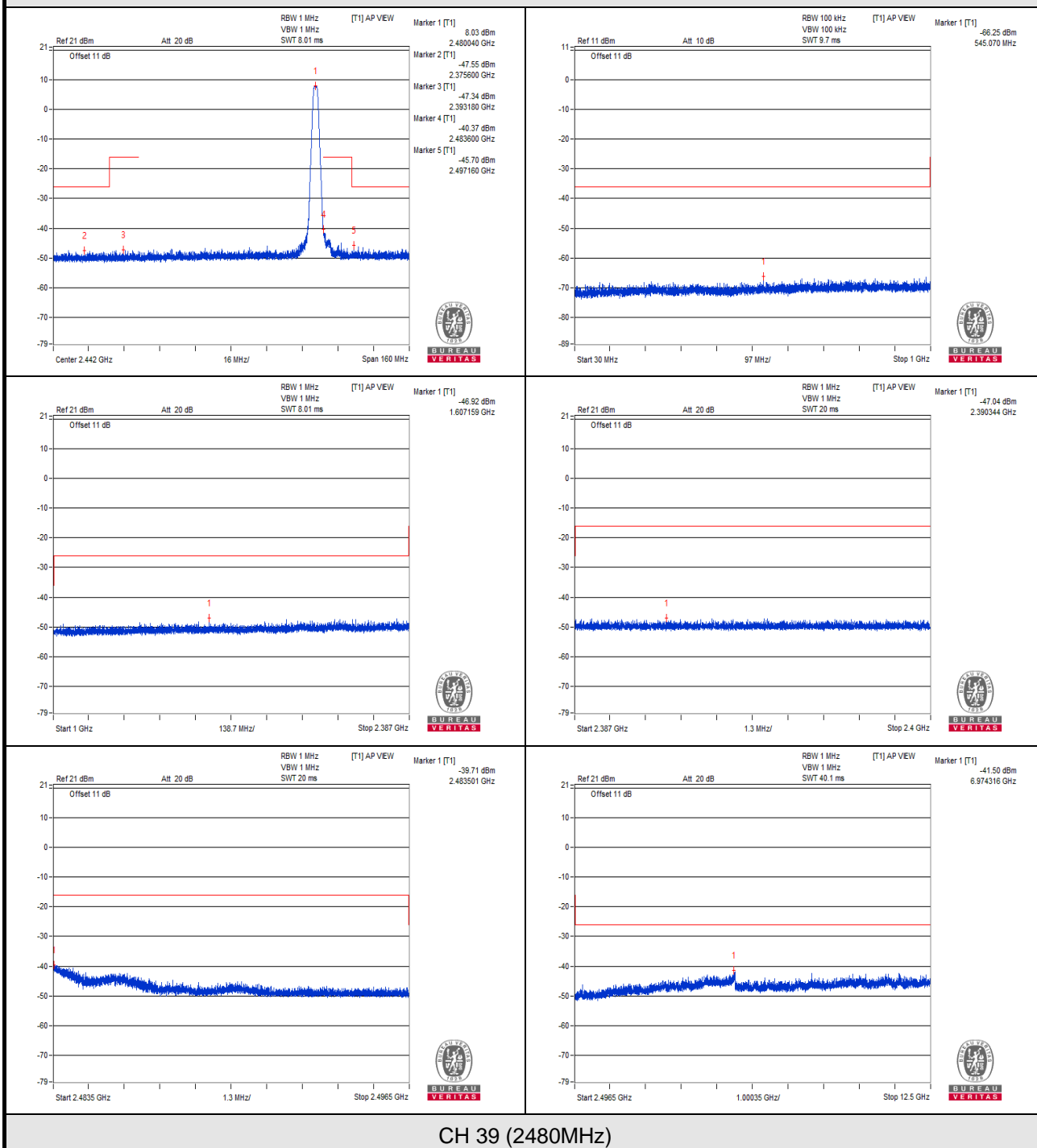


CH 39 (2480MHz)

V_{max}.

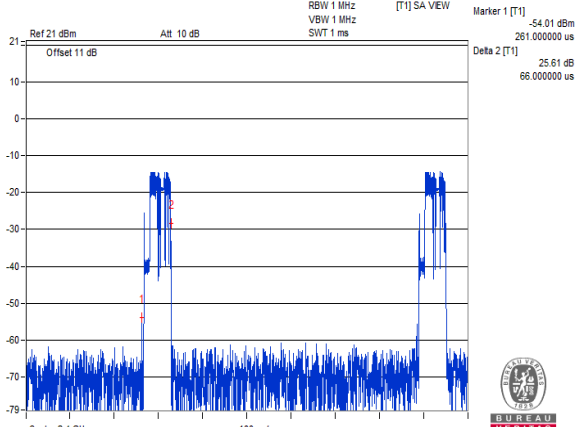
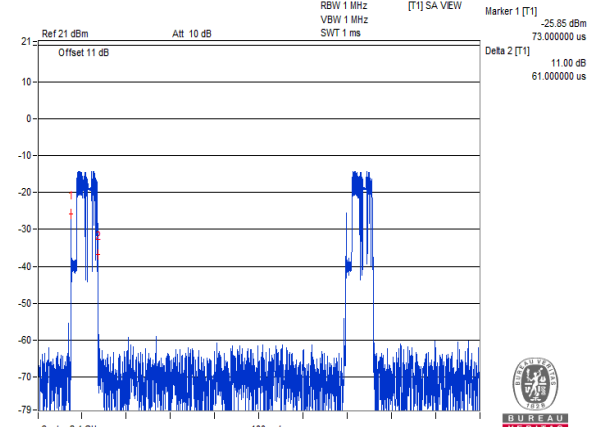
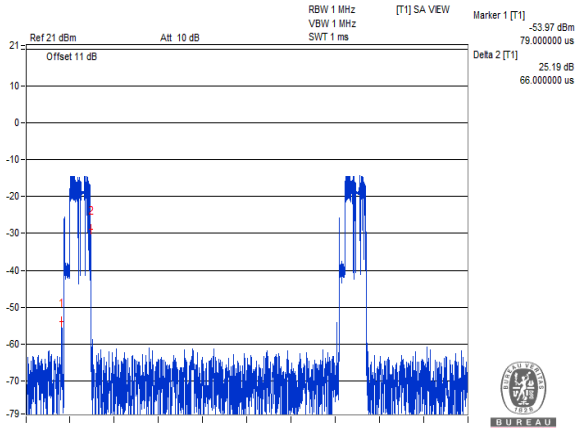
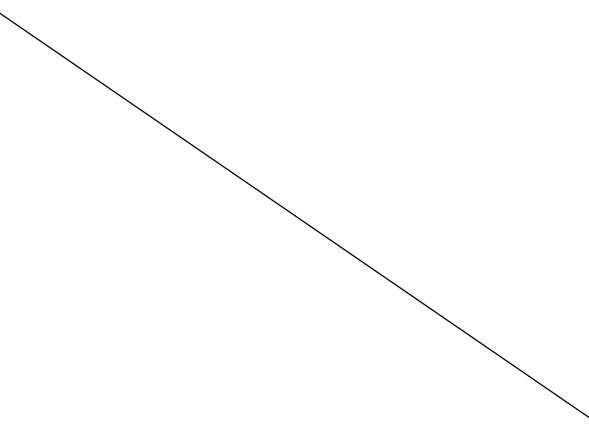


V_{min}.



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 “uW” 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>Ref 21 dBm Alt 10 dB RBW 1 MHz VBW 1 MHz SWT 1 ms [T1] SA VIEW Marker 1 [T1] -54.01 dBm 261.000000 us Delta 2 [T1] 25.61 dB 66.000000 us</p> <p>Center 2.4 GHz 100 us/</p>			 <p>Ref 21 dBm Alt 10 dB RBW 1 MHz VBW 1 MHz SWT 1 ms [T1] SA VIEW Marker 1 [T1] -25.85 dBm 73.000000 us Delta 2 [T1] 11.00 dB 61.000000 us</p> <p>Center 2.4 GHz 100 us/</p>		
1	2400.000MHz	P = 11.144347uW	2	2400.000MHz	P = 12.129833uW
 <p>Ref 21 dBm Alt 10 dB RBW 1 MHz VBW 1 MHz SWT 1 ms [T1] SA VIEW Marker 1 [T1] -53.97 dBm 79.000000 us Delta 2 [T1] 25.19 dB 66.000000 us</p> <p>Center 2.4 GHz 100 us/</p>					
3	2400.000MHz	P = 11.159314uW			

4.4 Antenna Power Measurement

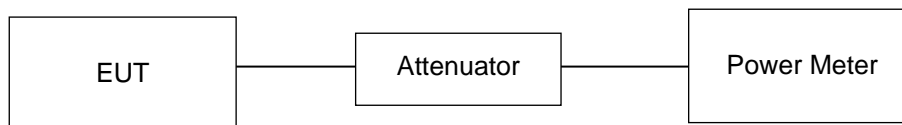
4.4.1 Limits of Antenna Power

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 38MHz
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

BT-LE 1M

Voltage (Vdc)	Channel Number	Frequency (MHz)	Conducted RF Output Power (mW)	Radiated RF Output Power (mW)
12	0	2402	7.396	15.417
	19	2440	7.396	15.417
	39	2480	7.691	16.032
13.2	0	2402	7.295	15.206
	19	2440	7.228	15.067
	39	2480	7.345	15.311
10.8	0	2402	7.621	15.886
	19	2440	7.211	15.031
	39	2480	7.43	15.488
Max. Limit (mW):			10	-
Rated Power (mW):			7.7	-
Tolerance of Antenna Power (mW):			1.54 ~ 9.24	-
Max. EIRP Limit (mW):			-	16.368

Note: 1. Antenna gain is 3.19 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

BT-LE 2M

Voltage (Vdc)	Channel Number	Frequency (MHz)	Conducted RF Output Power (mW)	Radiated RF Output Power (mW)
12	0	2402	7.345	15.311
	19	2440	7.278	15.171
	39	2480	7.482	15.596
13.2	0	2402	7.194	14.996
	19	2440	6.95	14.487
	39	2480	7.396	15.417
10.8	0	2402	7.345	15.311
	19	2440	7.328	15.275
	39	2480	7.709	16.069
Max. Limit (mW):			10	-
Rated Power (mW):			7.7	-
Tolerance of Antenna Power (mW):			1.54 ~ 9.24	-
Max. EIRP Limit (mW):			-	16.368

Note: 1. Antenna gain is 3.19 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

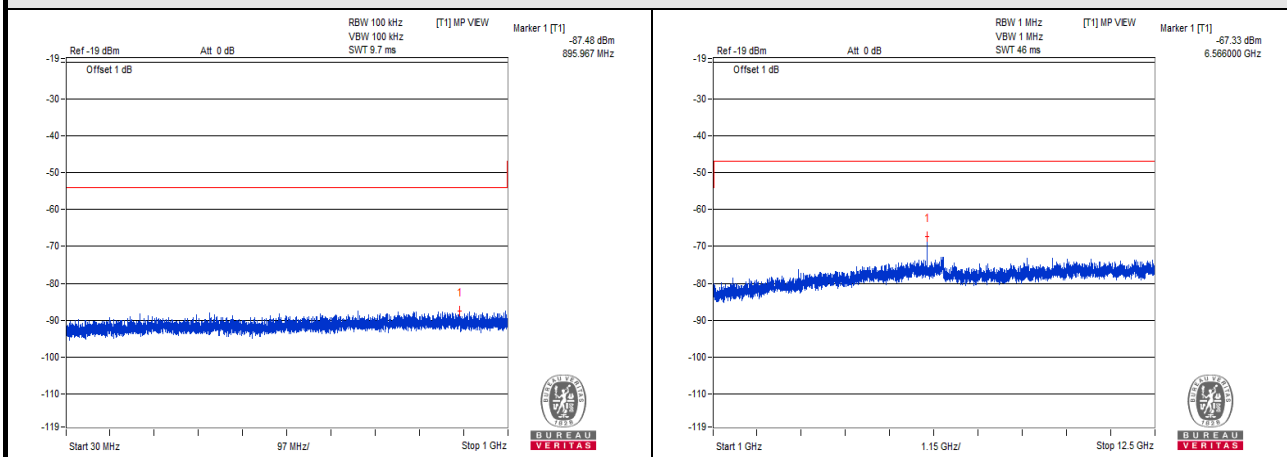


4.5.3 Test Result

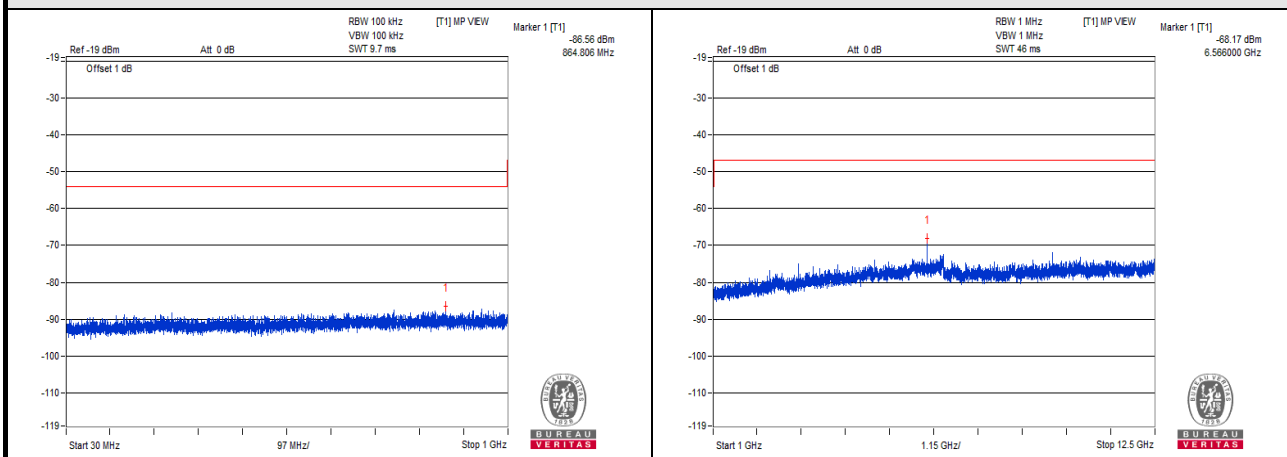
BT-LE 1M

TEST CHANNEL		CH 0 (2402MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE(nW)	LIMIT (nW)	RESULT
V_{normal}	30MHz to 1000MHz	895.967	0.001786	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.184927	20.0	PASS
V_{max.}	30MHz to 1000MHz	864.806	0.002208	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.152405	20.0	PASS
V_{min.}	30MHz to 1000MHz	786.600	0.002163	4.0	PASS
	1000MHz to 12500MHz	6564.562	0.135207	20.0	PASS
TEST CHANNEL		CH 19 (2440MHz)			
V_{normal}	30MHz to 1000MHz	892.693	0.001849	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.174985	20.0	PASS
V_{max.}	30MHz to 1000MHz	917.671	0.002118	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.152757	20.0	PASS
V_{min.}	30MHz to 1000MHz	823.096	0.002328	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.177011	20.0	PASS
TEST CHANNEL		CH 39 (2480MHz)			
V_{normal}	30MHz to 1000MHz	882.023	0.002084	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.151356	20.0	PASS
V_{max.}	30MHz to 1000MHz	842.738	0.002109	4.0	PASS
	1000MHz to 12500MHz	6564.562	0.150661	20.0	PASS
V_{min.}	30MHz to 1000MHz	640.736	0.001892	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.149968	20.0	PASS

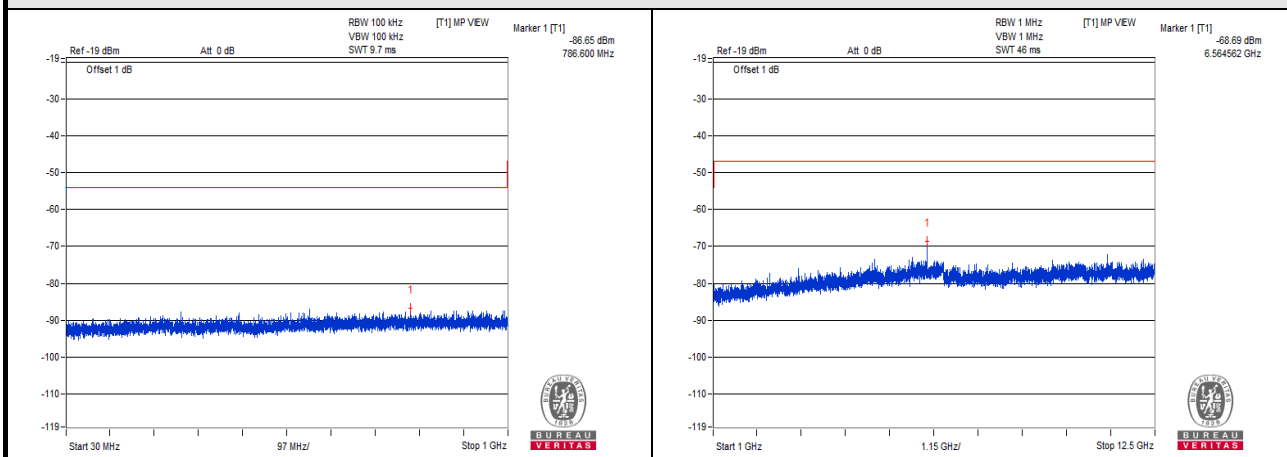
V_{normal}



V_{max.}

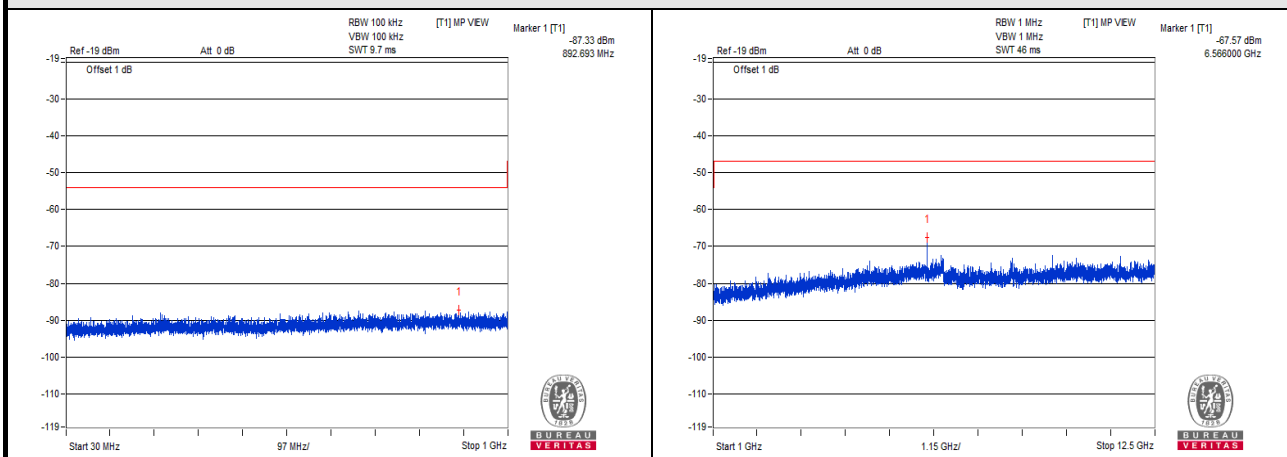


V_{min.}

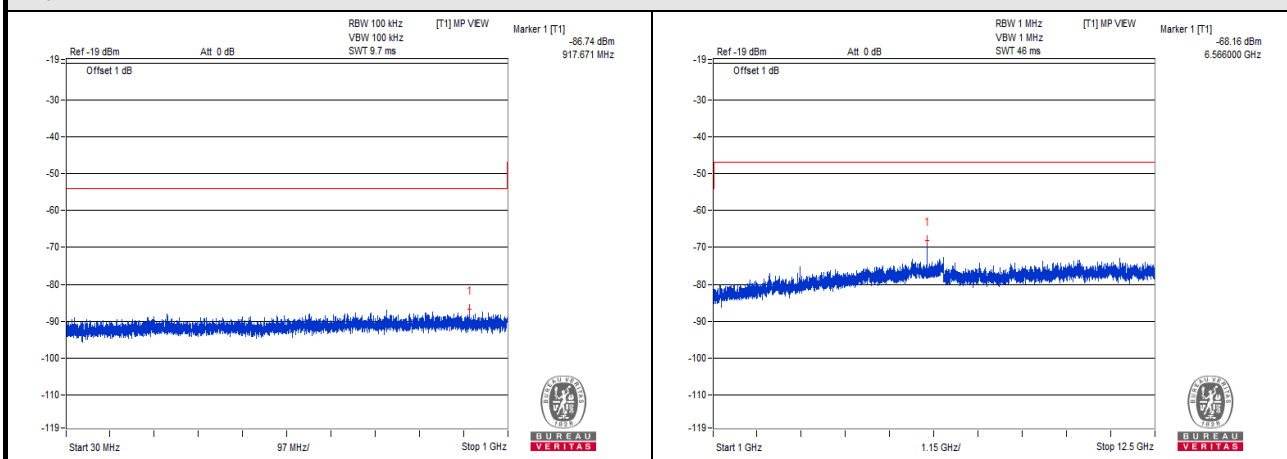


CH 0 (2402MHz)

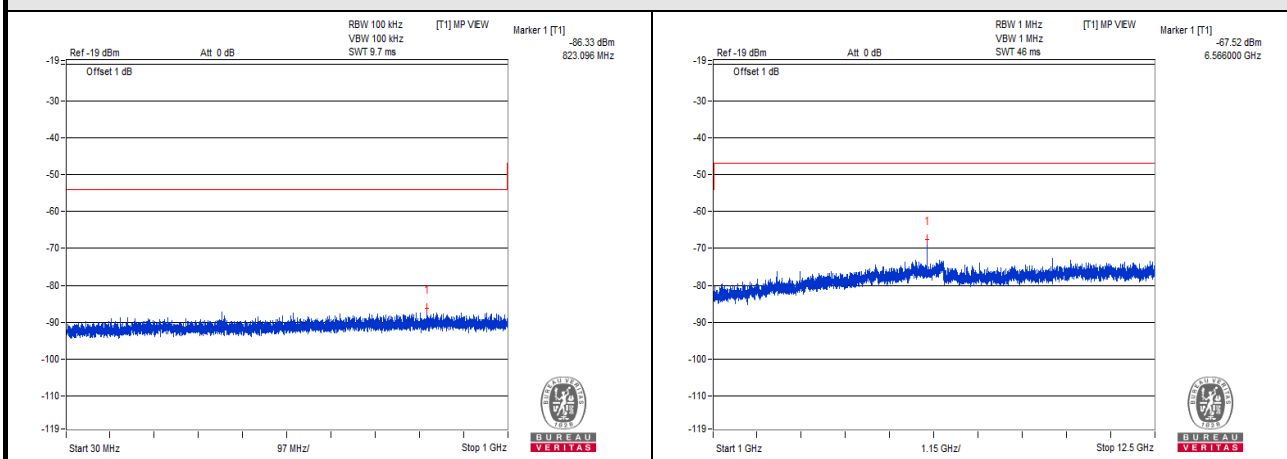
V_{normal}



V_{max.}

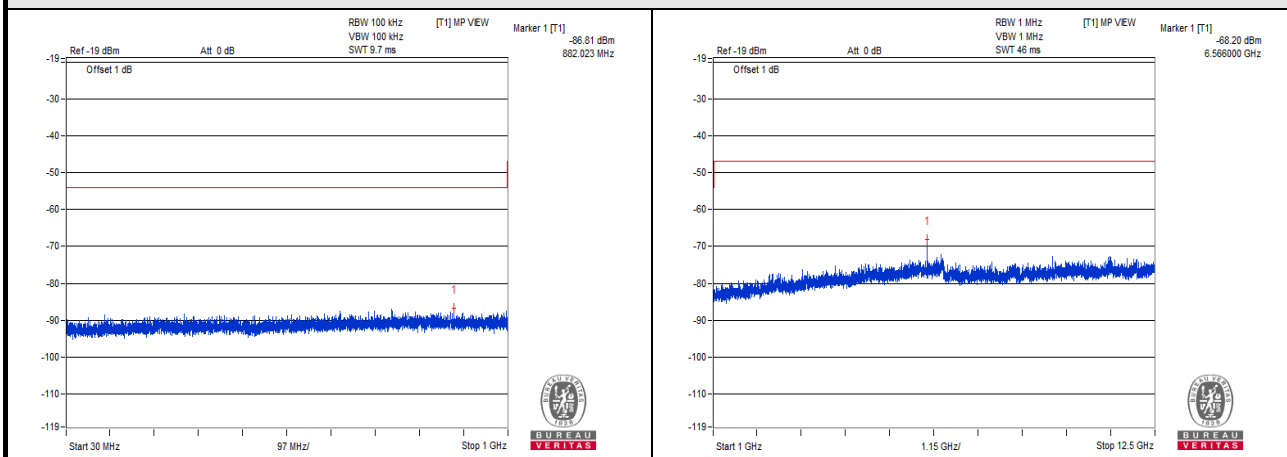


V_{min.}

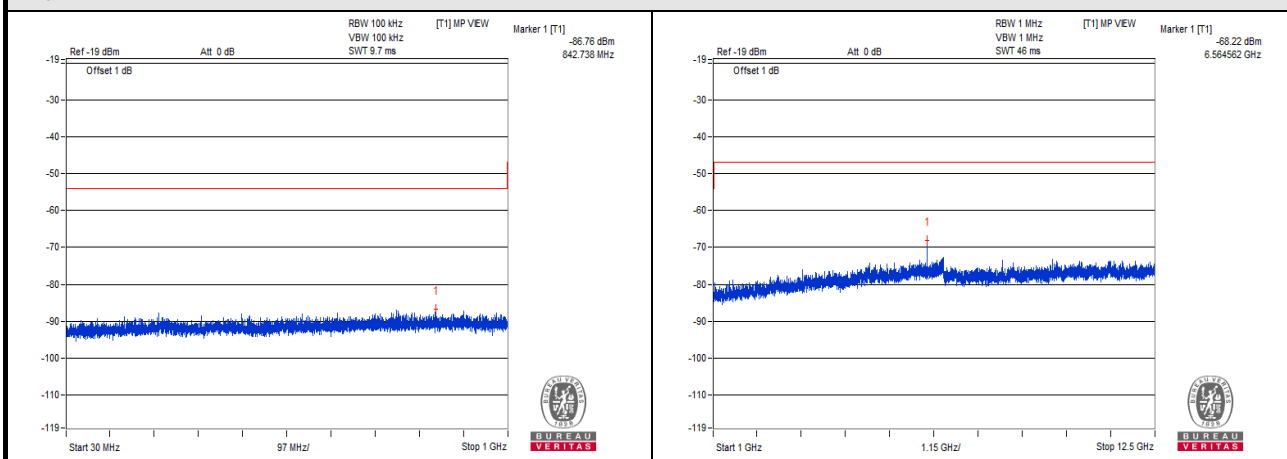


CH 19 (2440MHz)

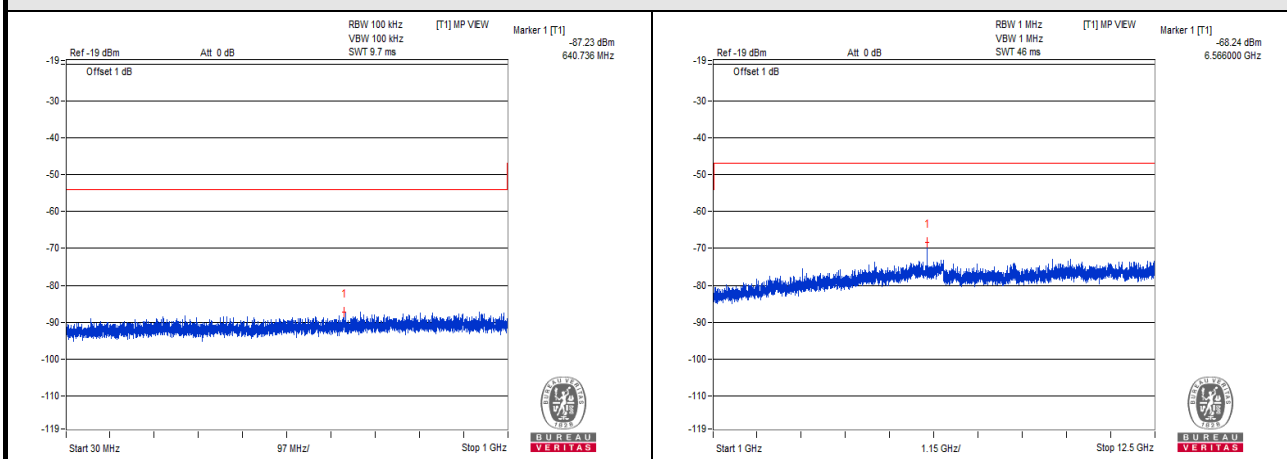
V_{normal}



V_{max.}



V_{min.}

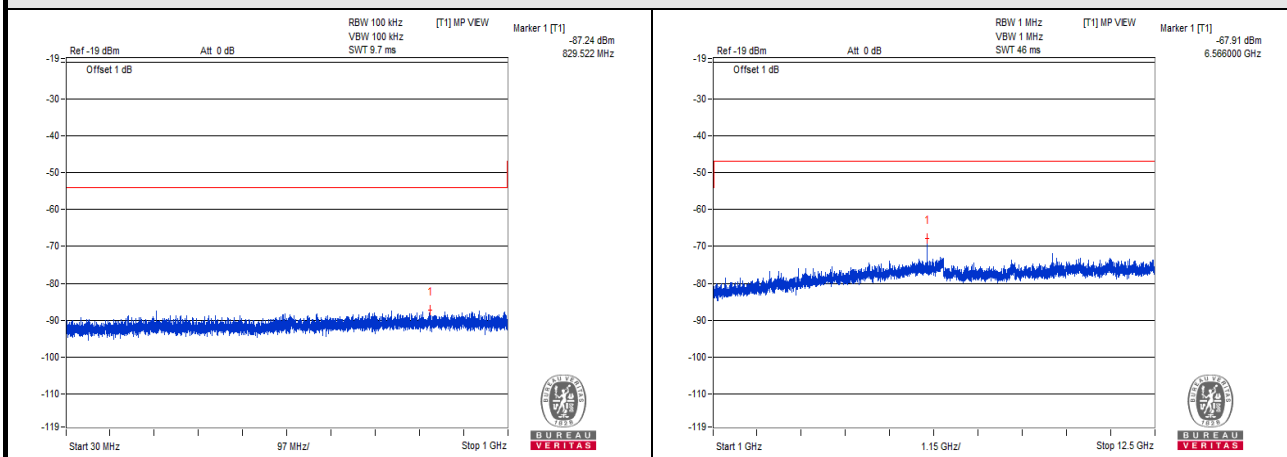


CH 39 (2480MHz)

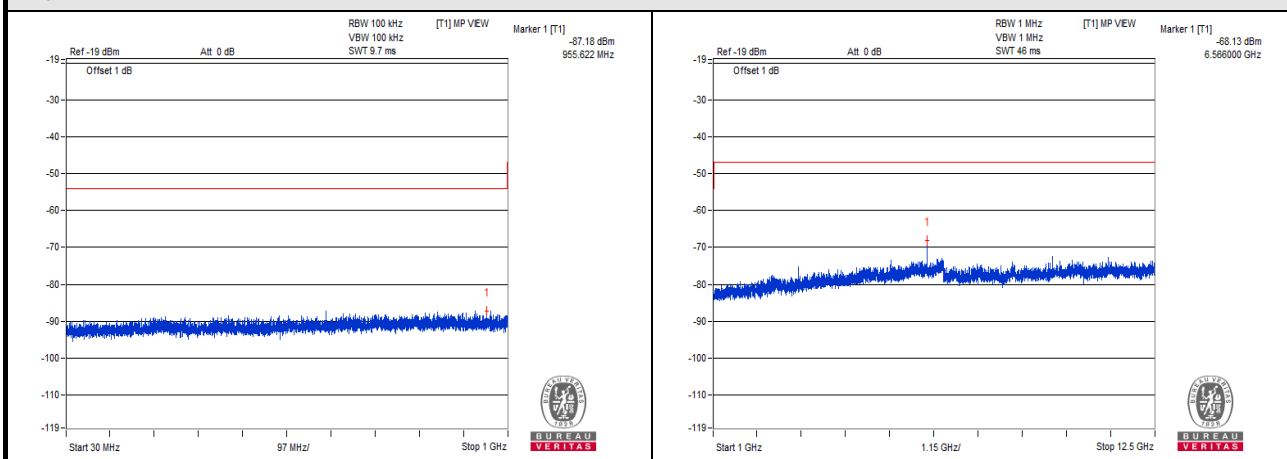
BT-LE 2M

TEST CHANNEL		CH 0 (2402MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE(nW)	LIMIT (nW)	RESULT
V_{normal}	30MHz to 1000MHz	829.522	0.001888	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.161808	20.0	PASS
V_{max.}	30MHz to 1000MHz	955.622	0.001914	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.153815	20.0	PASS
V_{min.}	30MHz to 1000MHz	897.180	0.002023	4.0	PASS
	1000MHz to 12500MHz	6564.562	0.159956	20.0	PASS
TEST CHANNEL		CH 19 (2440MHz)			
V_{normal}	30MHz to 1000MHz	830.492	0.001897	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.152055	20.0	PASS
V_{max.}	30MHz to 1000MHz	254.191	0.001897	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.147911	20.0	PASS
V_{min.}	30MHz to 1000MHz	745.617	0.002084	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.162555	20.0	PASS
TEST CHANNEL		CH 39 (2480MHz)			
V_{normal}	30MHz to 1000MHz	820.913	0.002234	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.157761	20.0	PASS
V_{max.}	30MHz to 1000MHz	791.207	0.001858	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.155239	20.0	PASS
V_{min.}	30MHz to 1000MHz	863.715	0.002249	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.183231	20.0	PASS

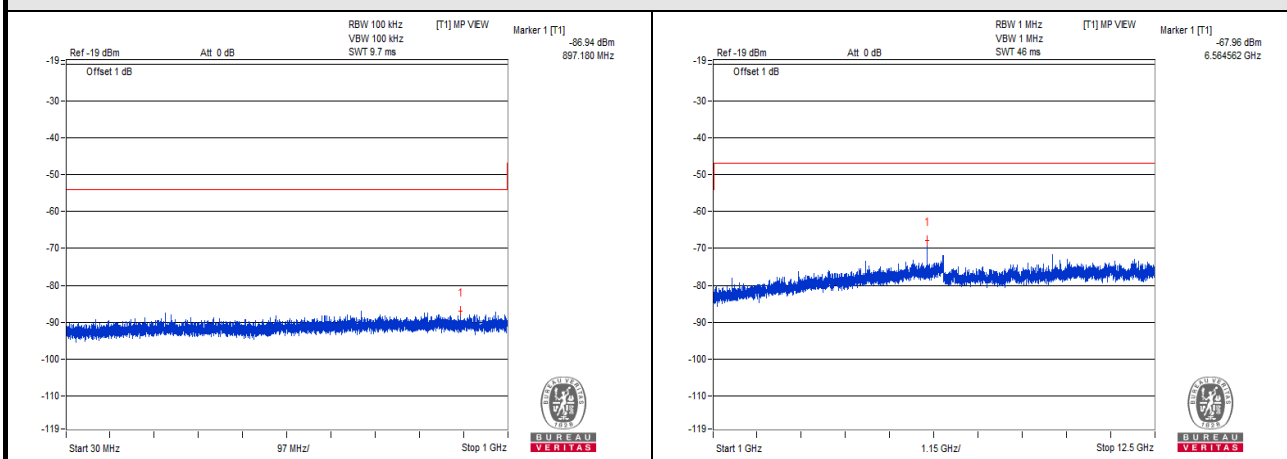
V_{normal}



V_{max.}

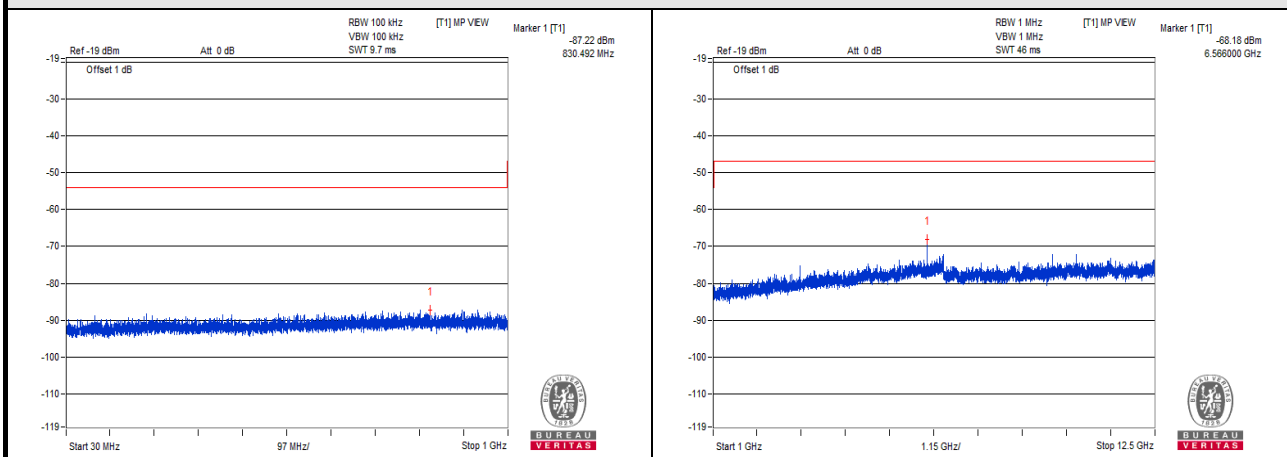


V_{min.}

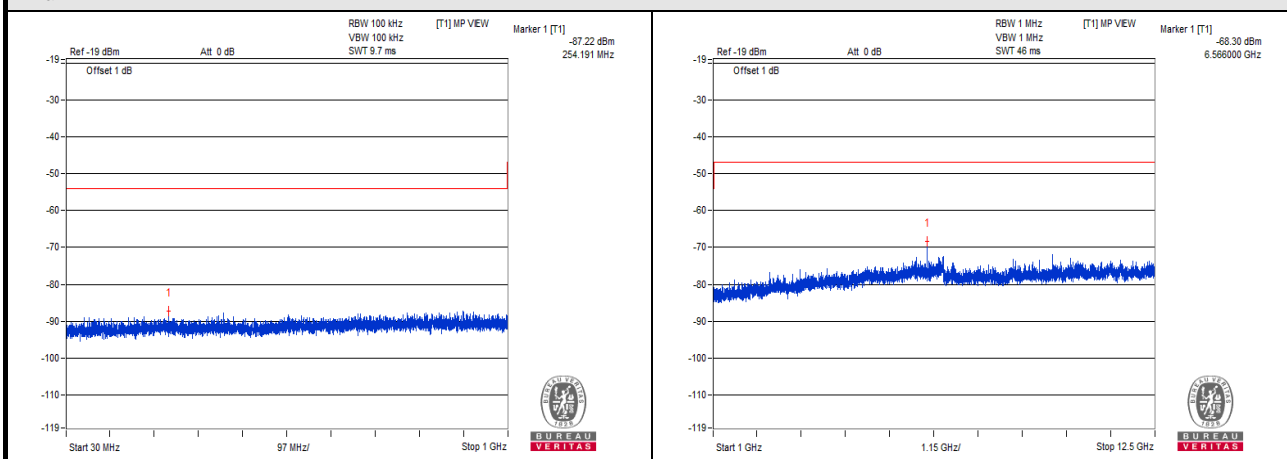


CH 0 (2402MHz)

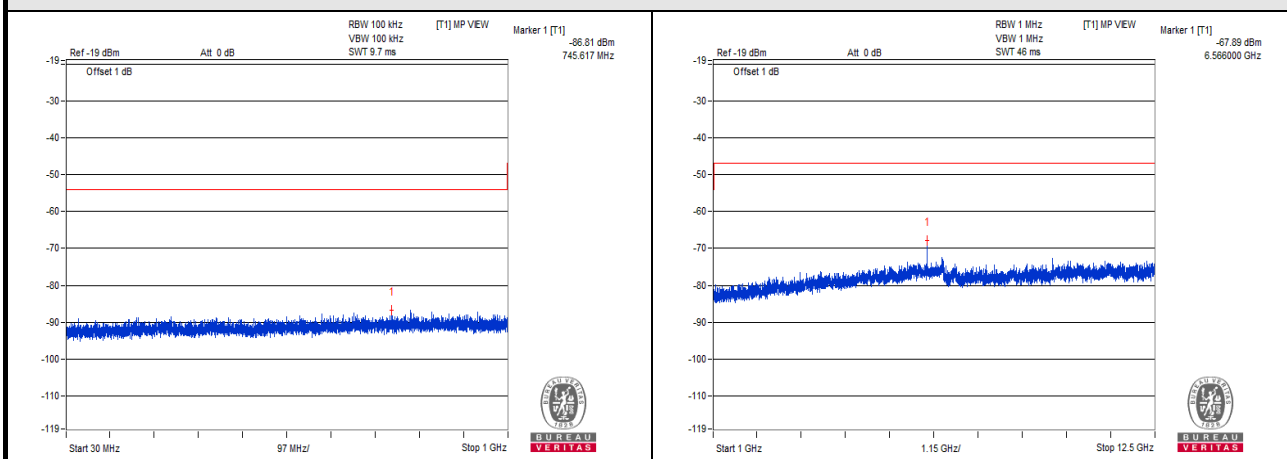
V_{normal}



V_{max.}

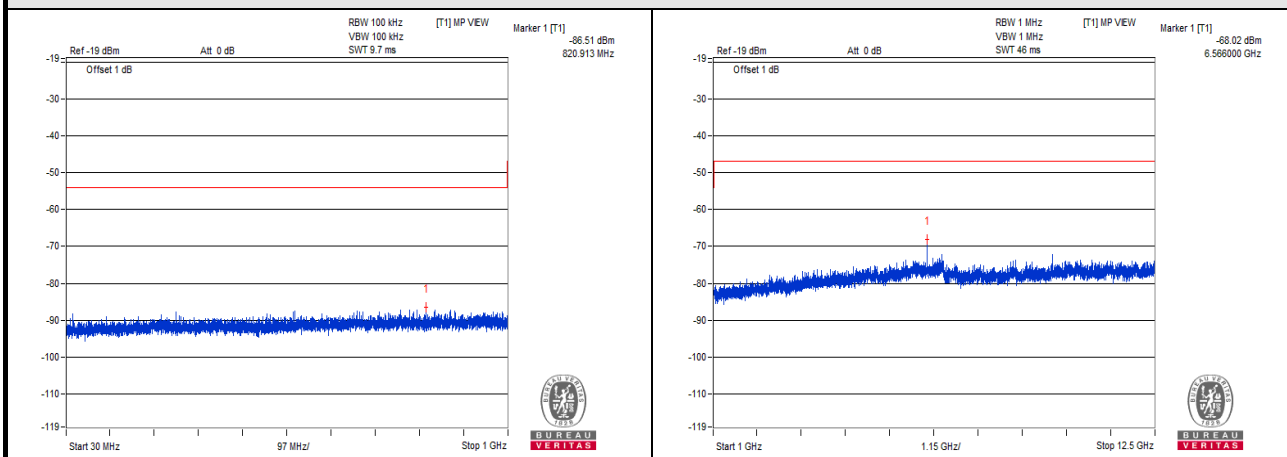


V_{min.}

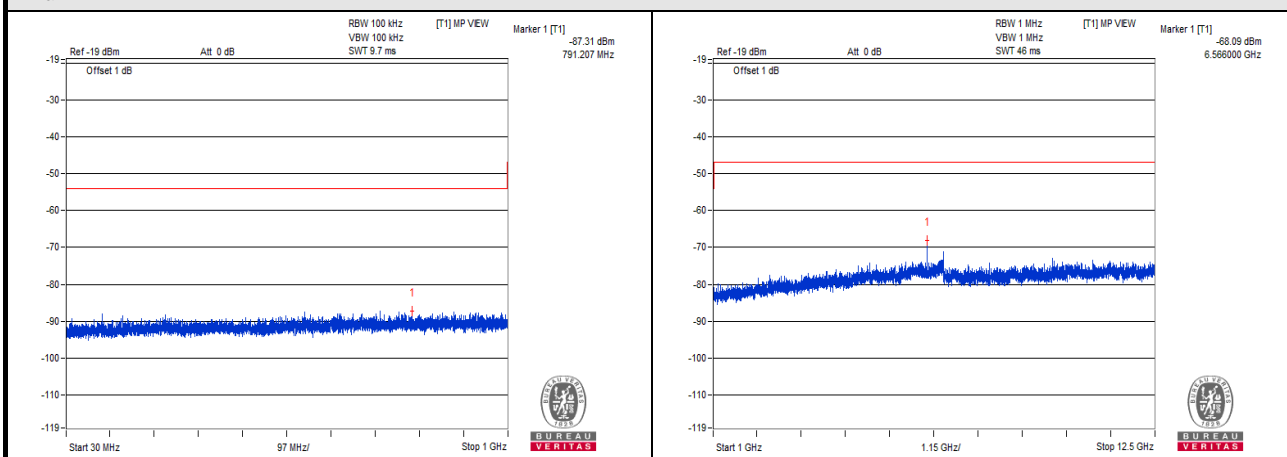


CH 19 (2440MHz)

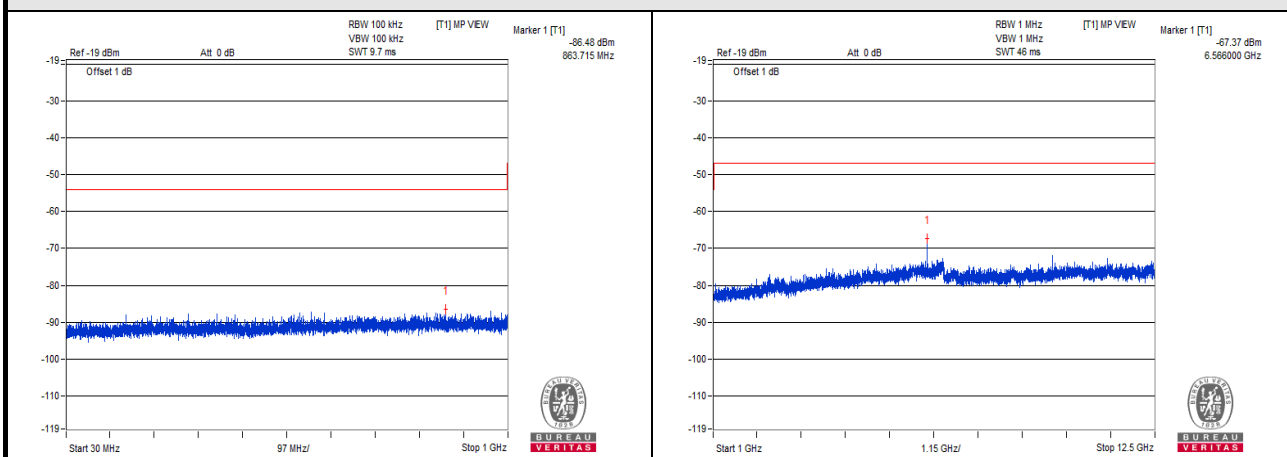
V_{normal}



V_{max.}



V_{min.}



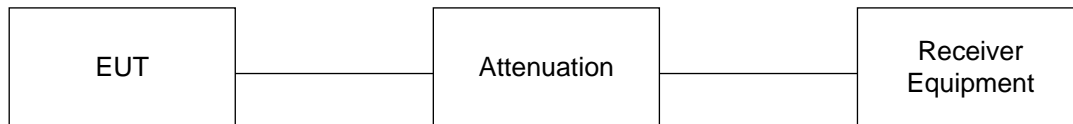
CH 39 (2480MHz)

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.

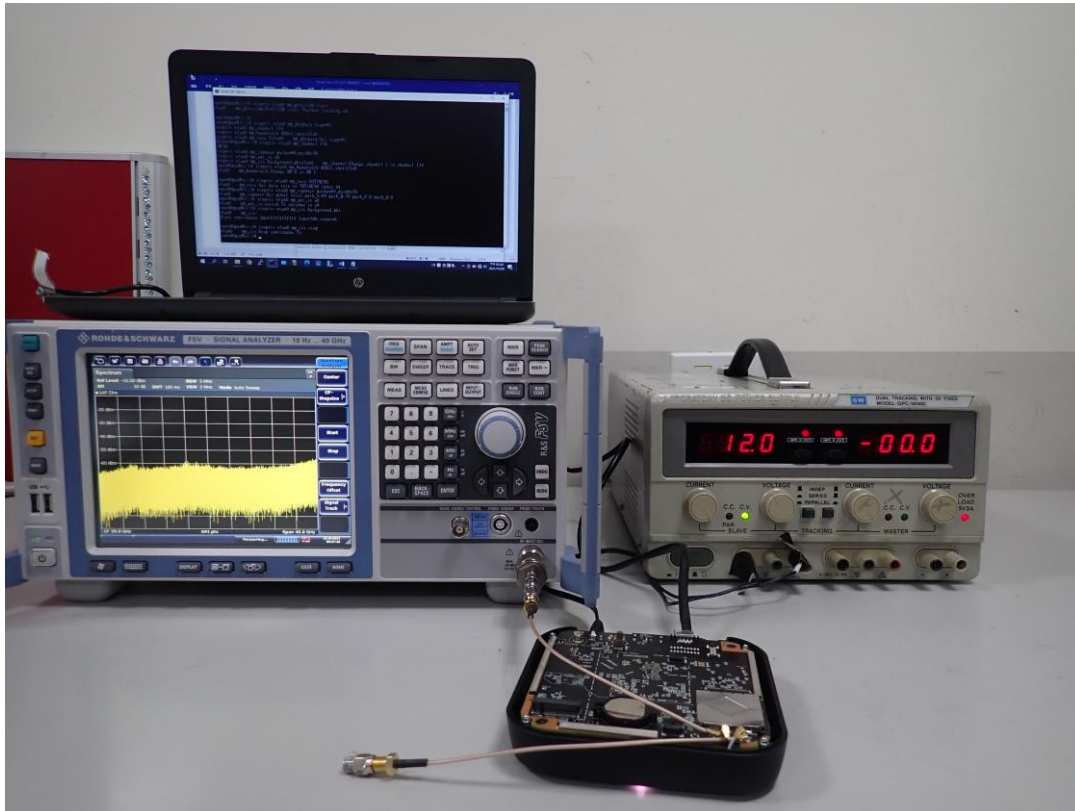
4.6.2 Test Setup



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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