

Radio Test Report

Report No.: RJBDQX-WTW-P21031185

Test Model: BM-DWCB

Received Date: Mar. 31, 2021

Test Date: Apr. 09, 2021

Issued Date: Apr. 28, 2021

Applicant: Tribute Co.,Ltd.

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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
RJBDQX-WTW-P21031185	Original release	Apr. 28, 2021

1 Certificate of Conformity

Product: 2.4GHz Digital RF Module

Brand: mamasuma

Test Model: BM-DWCB

Sample Status: MP

Applicant: Tribute Co.,Ltd.

Test Date: Apr. 09, 2021

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 :



Claire Kuan / Specialist

Apr. 28, 2021

Approved by :



Clark Lin / Technical Manager

, **Date:** Apr. 28, 2021

2 Summary of Test Results

The EUT has been tested according to the following specifications:

Notice 88 Appendix 43 Reference	ARIB STD-T66 Ref.	Report Reference	Parameter	Test Results (Note)
General Provisions				
C	3.2 (4)	4.1	Frequency tolerance	C
D	3.2 (7)	4.2	Occupied bandwidth	C
E	3.2 (6)	4.4	Spurious emissions	C
Transmitting Equipment				
F	--	4.5	Antenna power	C
--	--	--	SAR	NA
Transmitting Antenna				
--	--	3.5	Type, configuration, etc. of transmitting antenna	C
--	--	3.5	Direction pattern of transmitting antenna	C
Receiving Equipment				
G	3.3 (1)	4.6	Spurious emissions of receiver	C
--	--	3.5	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)	4.5	Antenna power	C
--	3.6 (2)	4.5	Absolute gain of transmitting antenna	C
--	3.6 (2)	4.5	Angular width of principal radiation (AWPR)	C
--	3.2 (10)	4.8	Number of carriers within 1 MHz bandwidth in OFDM	C
--	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)	4.7	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	100964	May 29, 2020	May 28, 2021	ETC	(c)
ESG Vector signal generator Agilent	E4438C	MY45094468	Nov. 18, 2020	Nov. 17, 2021	ETC	(c)
Power Meter Anritsu	ML2495A	1529002	July 22, 2020	July 21, 2021	ETC	(c)
Power Sensor Anritsu	MA2411B	1339443	July 22, 2020	July 21, 2021	ETC	(c)
DC Power Supply Topward	6603D	795558	NA	NA	NA	NA
AC Power Source Extech Electronics	6905S	1991551	NA	NA	NA	NA
True RMS Clamp Meter FLUKE	325	31130711WS	June 06, 2020	June 05, 2021	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.
 4. Tested Date: Apr. 09, 2021

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	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

2.3 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	2.4GHz Digital RF Module
Brand	mamasuma
Test Model	BM-DWCB
Status of EUT	MP
Nominal Voltage	5Vdc from host equipment
Modulation Type	CCK, DQPSK, DBPSK for DSSS, 64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Technology	DSSS, OFDM
Transfer Rate	802.11b: up to 11Mbps 802.11a/g: up to 54Mbps 802.11n: up to 72.2Mbps
Operating Frequency	2412MHz ~ 2472MHz
Number of Channel	13
Rated RF Output Power Density	Refer to note
Conducted RF Output Power Density	Refer to note
Radiated RF Output Power Density	Refer to note
Antenna Type	Refer to section 3.5
Antenna Connector	Refer to section 3.5
Accessory Device	NA
Data Cable Supplied	NA

Note:

1. The EUT incorporates a SISO function:

MODULATION MODE	TX & RX CONFIGURATION	
802.11b	1TX	1RX
802.11g	1TX	1RX
802.11n (HT20)	1TX	1RX

2. The power table as below table:

Modulation Mode	Rated output power density (mW/MHz)	Conducted RF output power density (mW/MHz)	Radiated RF output power density (mW/MHz)
802.11b	7.1	7.081	16.222
802.11g	7	7	16.036
802.11n (HT20)	7	6.747	15.456

3. 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

Thirteen channels are provided for 802.11b, 802.11g, 802.11n (HT20):

Channel	Freq. (MHz)	Channel	Freq. (MHz)
1	2412	8	2447
2	2417	9	2452
3	2422	10	2457
4	2427	11	2462
5	2432	12	2467
6	2437	13	2472
7	2442		

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 (QA V1.0.1.5) provided by manufacturer, the power levels during the tests were set according to the following codes:

802.11b		802.11g	
Channel	Power Setting	Channel	Power Setting
1	0A	1	0E
7	0A	7	0E
13	0A	13	0E
802.11n (HT20)			
Channel	Power Setting		
1	11		
7	11		
13	11		

3.3 Test Conditions

Test Conditions		Voltage (Vdc)
V_{normal}		5
$V_{\text{max.}}$	+10%	5.5
$V_{\text{min.}}$	-10%	4.5

3.4 Assembly

The EUT is constructed as a 2.4GHz Digital RF Module. The RF circuit was covered by metal shielding case, and the metal shielding case was soldered on PCB.

3.5 Antenna Specifications

3.5.1 Antenna Gain

Antenna NO.	Brand	Model	Antenna Net Gain(dBi)	Frequency range	Antenna Type	Connector Type
1	TRANWO	ANTENNA 2.4GHz	3.6	2.4~2.4835GHz	Dipole	i-pex(MHF)
2	TRANWO	ANTENNA 2.4GHz	1.9	2.4~2.4835GHz	Dipole	i-pex(MHF)
3	TRANWO	ANTENNA 2.4GHz	1.9	2.4~2.4835GHz	Dipole	i-pex(MHF)
4	TRANWO	ANTENNA 2.4GHz	1.8	2.4~2.4835GHz	Dipole	i-pex(MHF)

Note: 1. Max. gain was selected for the final test.

2. 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

[802.11b](#) / [802.11g](#) / [802.11n](#) (HT20)

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)
1	2412	2411.994519	-2.272	2411.994479	-2.288	2411.994519	-2.272
7	2442	2441.994400	-2.293	2441.994400	-2.293	2441.994400	-2.293
13	2472	2471.994279	-2.314	2471.994319	-2.298	2471.994319	-2.298

4.2 Occupied Bandwidth Measurement (99% power bandwidth)

4.2.1 Limits of Occupied Bandwidth Measurement

Item	Limit	Remark
Occupied bandwidth	<26MHz	For 802.11b, g & 802.11n (HT20)

4.2.2 Test Setup



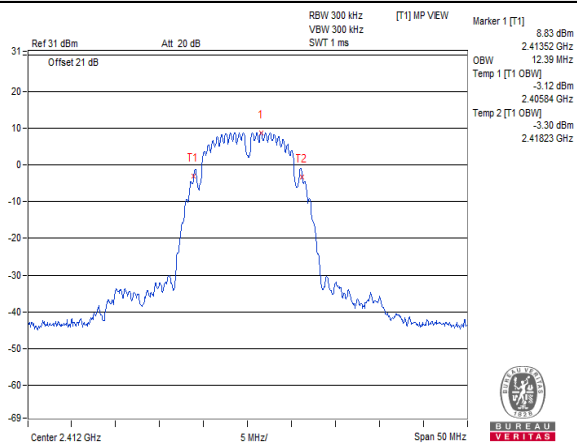
4.2.3 Test Results

802.11b

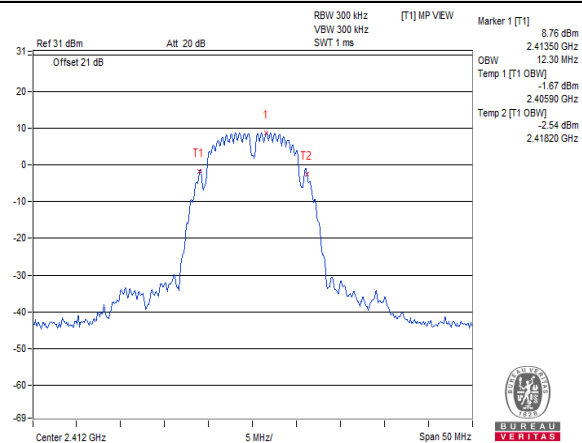
Channel	Frequency (MHz)	V_{normal}	$V_{max.}$	$V_{min.}$
		Occupied bandwidth (MHz)	Occupied bandwidth (MHz)	Occupied bandwidth (MHz)
1	2412	12.39	12.30	12.30
7	2442	12.30	12.30	12.30
13	2472	12.39	12.40	12.40

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

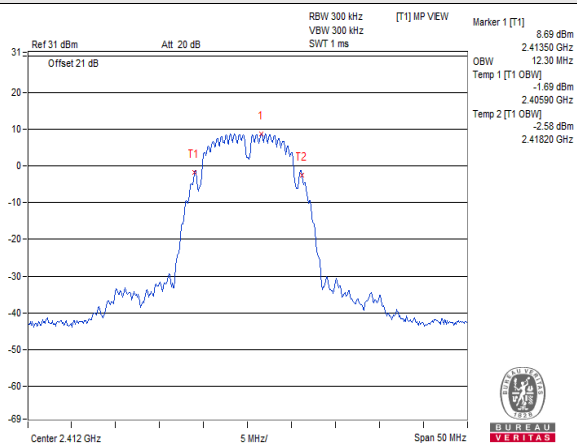
V_{normal}



V_{max.}

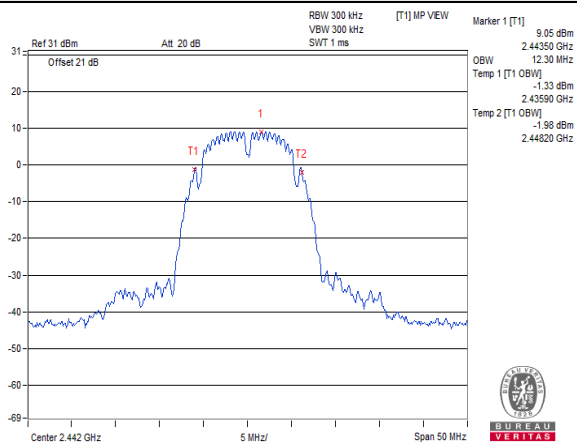


V_{min.}

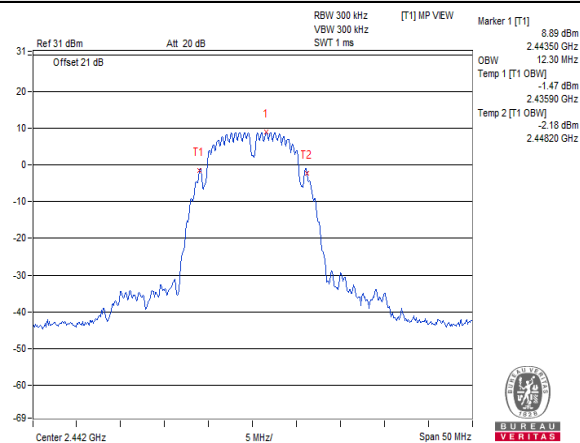


CH 1 (2412MHz)

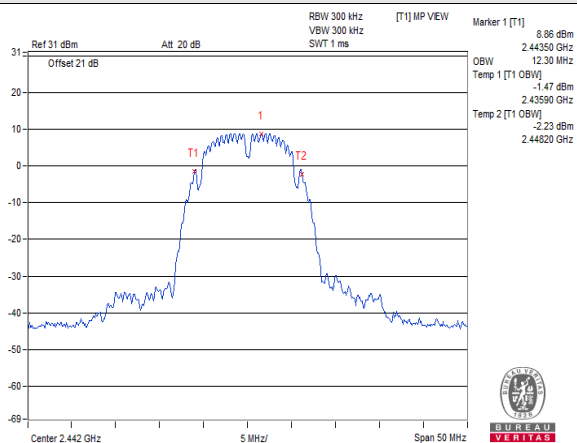
V_{normal}



V_{max.}

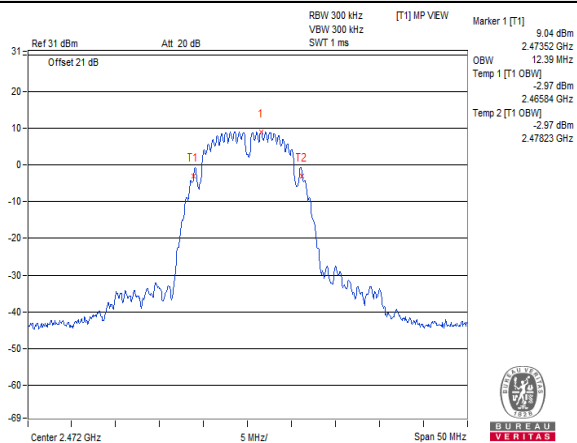


V_{min.}

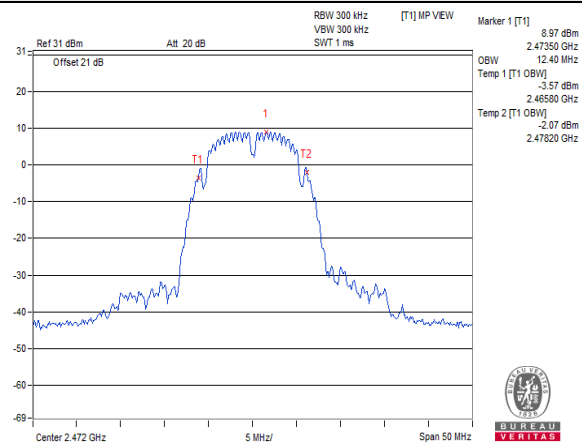


CH 7 (2442MHz)

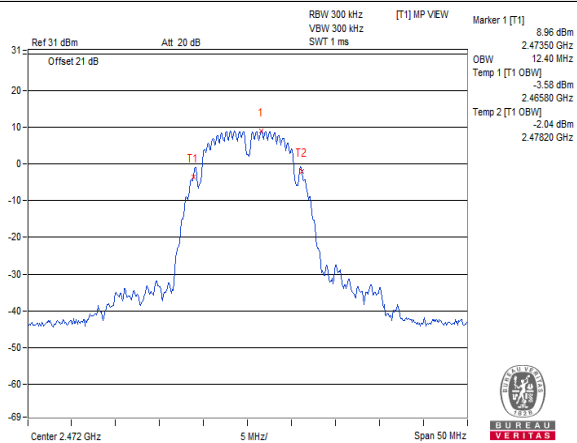
V_{normal}



V_{max.}



V_{min.}



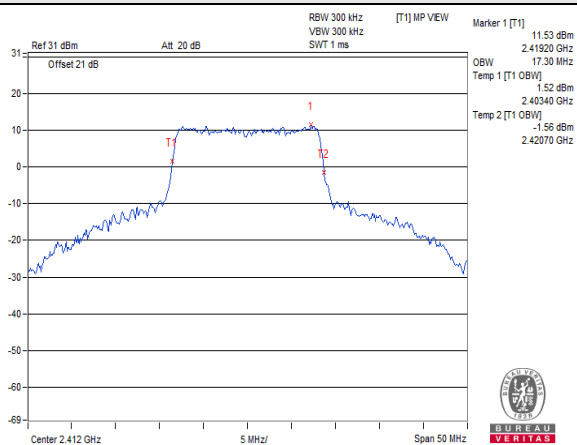
CH 13 (2472MHz)

802.11g

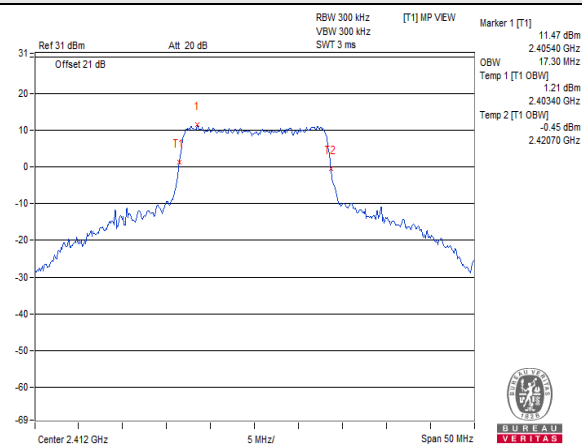
Channel	Frequency (MHz)	V_{normal}	$V_{\text{max.}}$	$V_{\text{min.}}$
		Occupied bandwidth (MHz)	Occupied bandwidth (MHz)	Occupied bandwidth (MHz)
1	2412	17.30	17.30	17.20
7	2442	17.30	17.30	17.30
13	2472	17.40	17.30	17.32

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

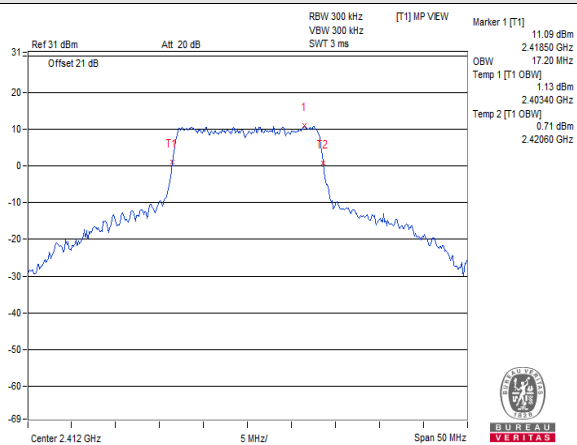
V_{normal}



V_{max.}

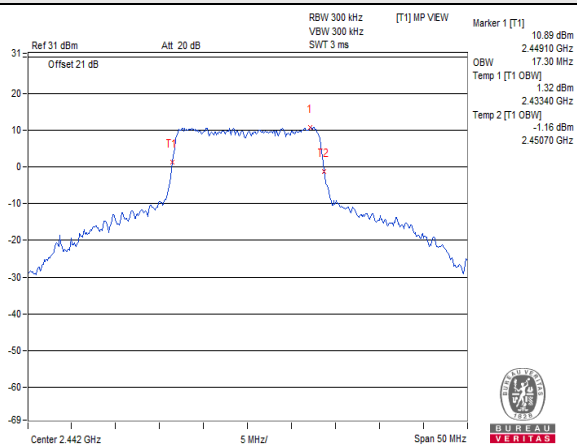


V_{min.}

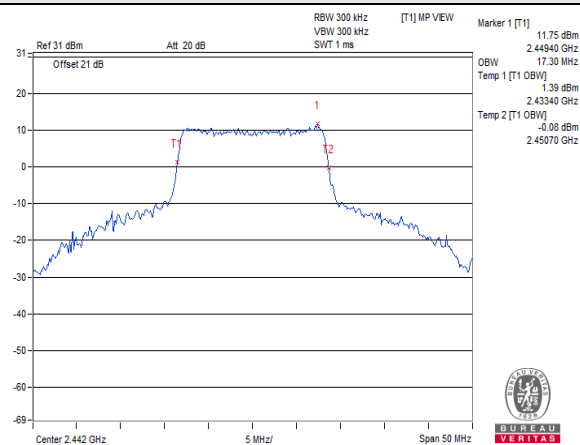


CH 1 (2412MHz)

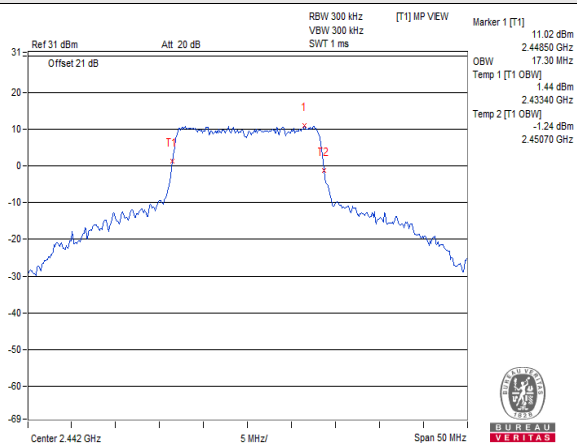
V_{normal}



V_{max.}

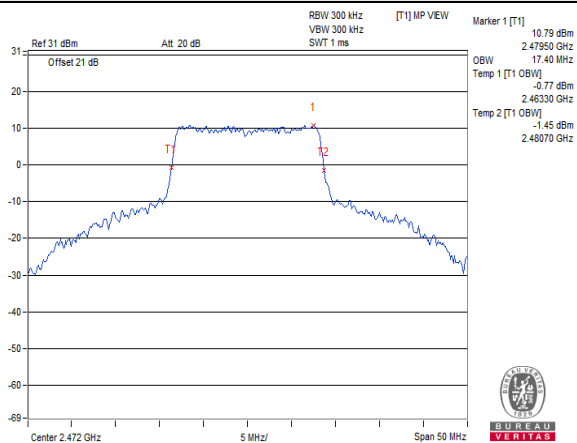


V_{min.}

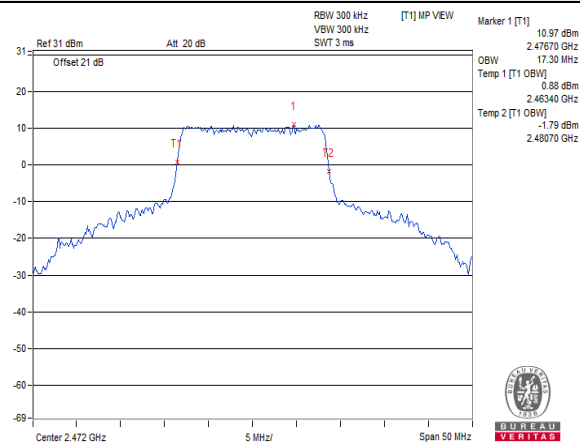


CH 7 (2442MHz)

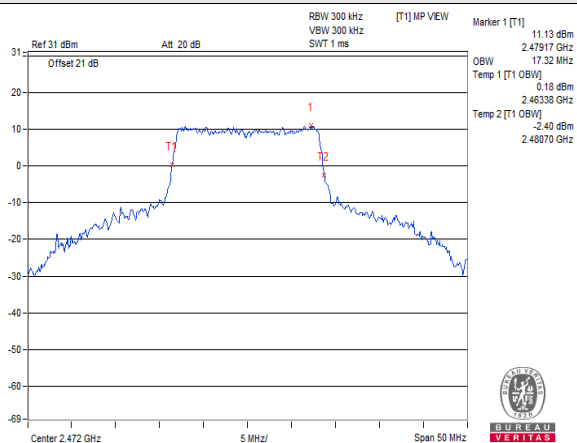
V_{normal}



V_{max.}



V_{min.}



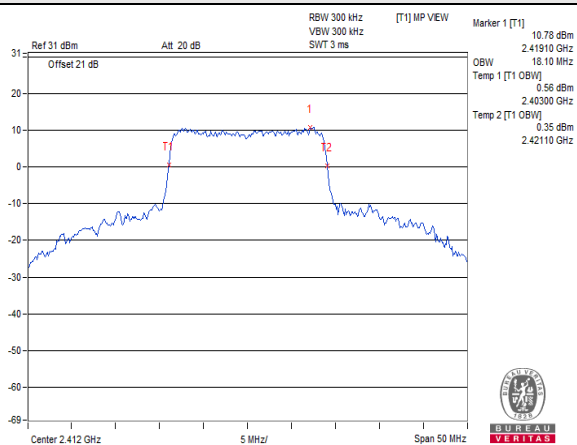
CH 13 (2472MHz)

802.11n (HT20)

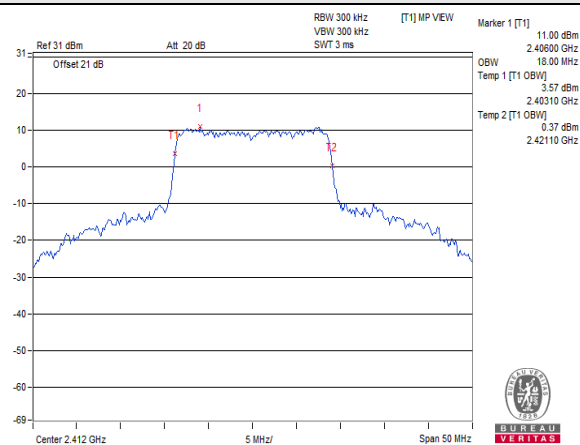
Channel	Frequency (MHz)	V_{normal}	$V_{\text{max.}}$	$V_{\text{min.}}$
		Occupied bandwidth (MHz)	Occupied bandwidth (MHz)	Occupied bandwidth (MHz)
1	2412	18.10	18.00	18.00
7	2442	18.20	18.20	18.20
13	2472	18.40	18.40	18.20

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

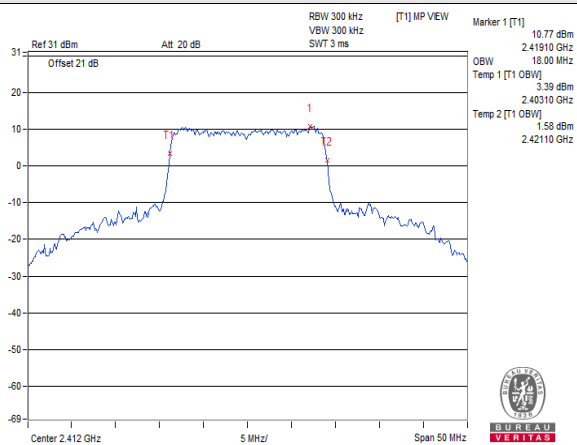
V_{normal}



V_{max.}

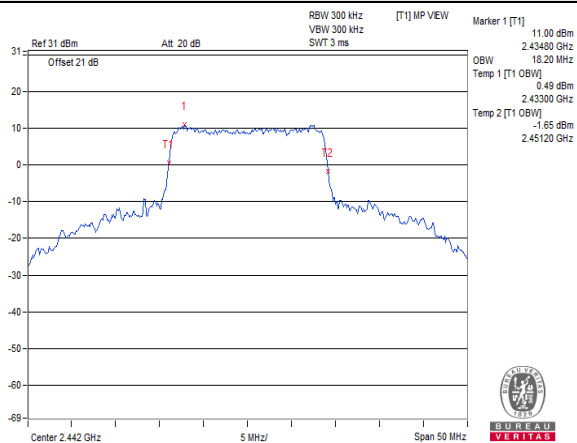


V_{min.}

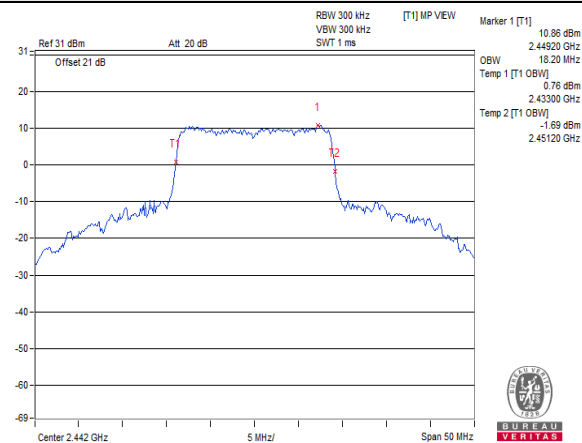


CH 1 (2412MHz)

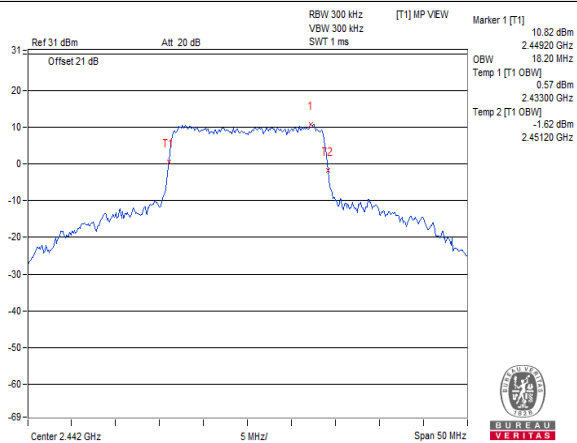
V_{normal}



V_{max.}

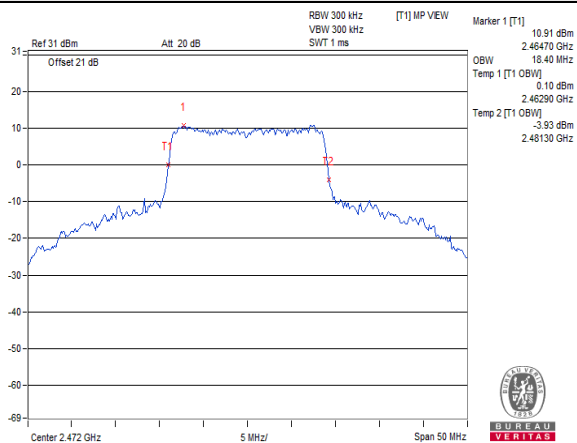


V_{min.}

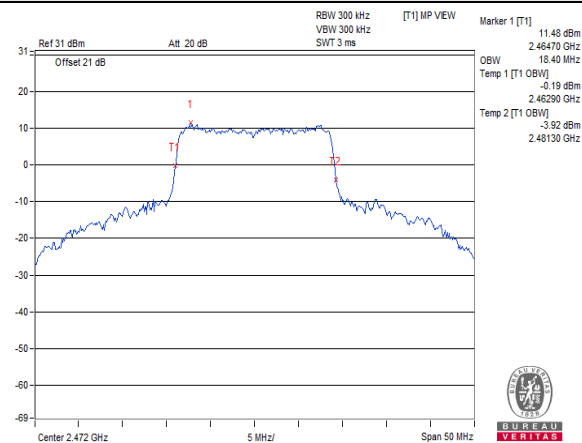


CH 7 (2442MHz)

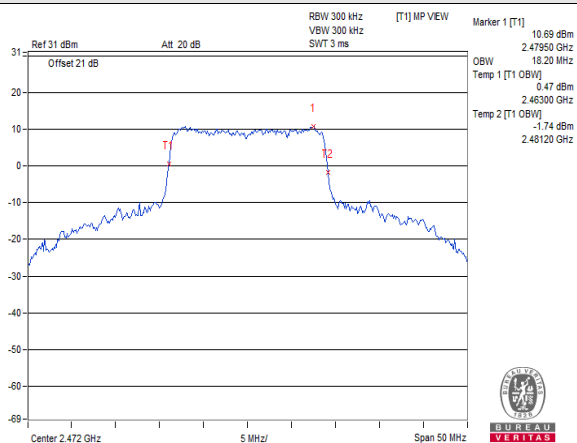
V_{normal}



V_{max.}



V_{min.}



CH 13 (2472MHz)

4.3 Spreading Bandwidth Measurement (90% power bandwidth)

4.3.1 Limits of Spreading Bandwidth and Spreading Factor Measurement

Item	Limit	Remark
Spreading Bandwidth	$\geq 500\text{kHz}$	(For DSSS, FHSS)
Spreading Factor	≥ 5	Operating frequency 2400 to 2483.5MHz

4.3.2 Test Setup



4.3.3 Test Results

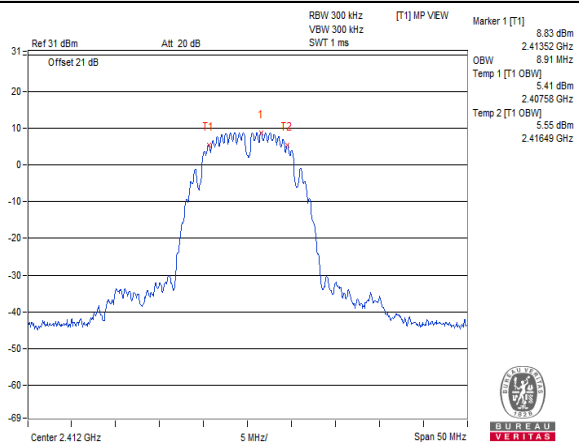
802.11b_Data Rate: 1Mbps

Channel	Frequency (MHz)	V_{normal}		$V_{\text{max.}}$		$V_{\text{min.}}$	
		Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor
1	2412	8.91	8.91	8.90	8.90	8.90	8.90
7	2442	8.90	8.90	8.90	8.90	8.90	8.90
13	2472	8.91	8.91	8.90	8.90	8.90	8.90

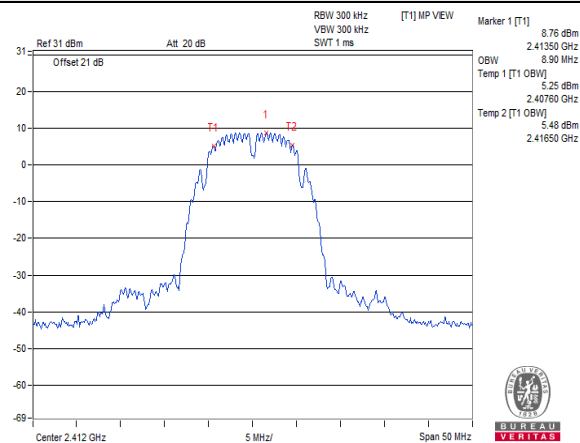
NOTE: For the test plots please refer to the below pages.

Spreading Factor: 90% channel power bandwidth / 1

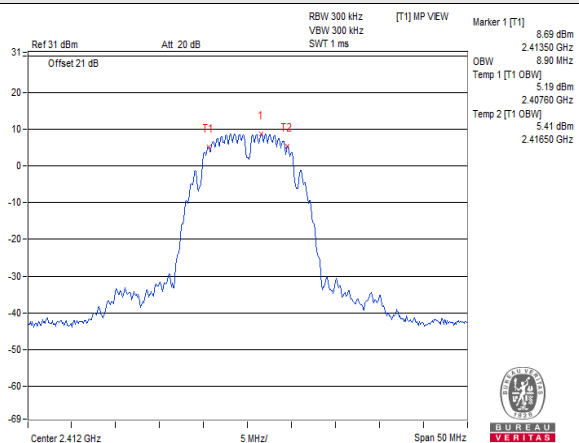
V_{normal}



V_{max.}

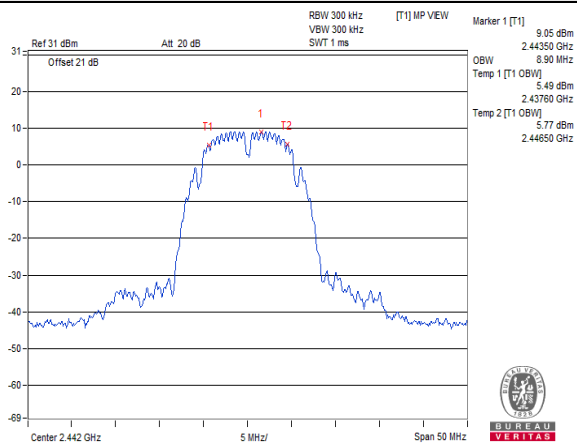


V_{min.}

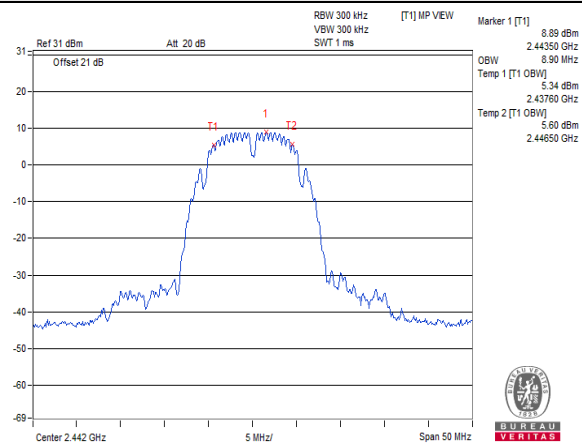


CH 1 (2412MHz)

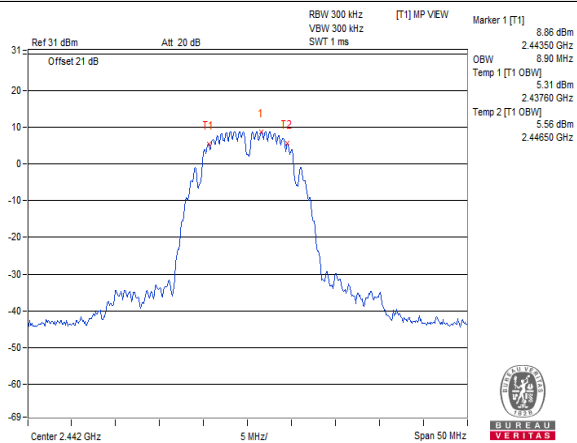
V_{normal}



V_{max.}

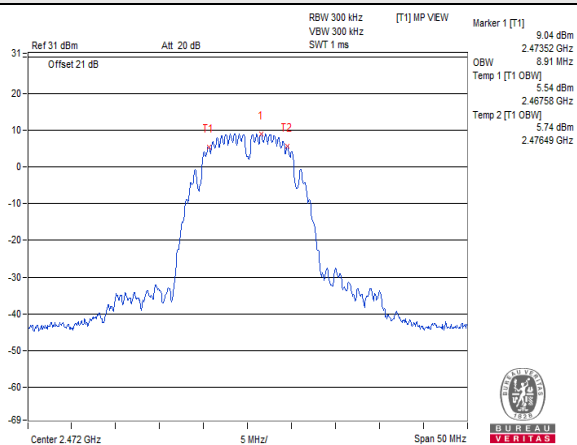


V_{min.}

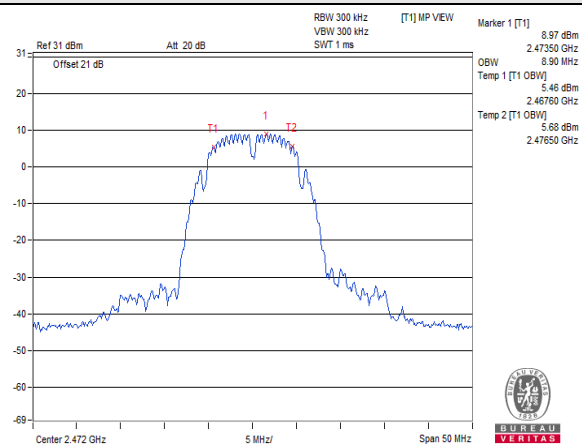


CH 7 (2442MHz)

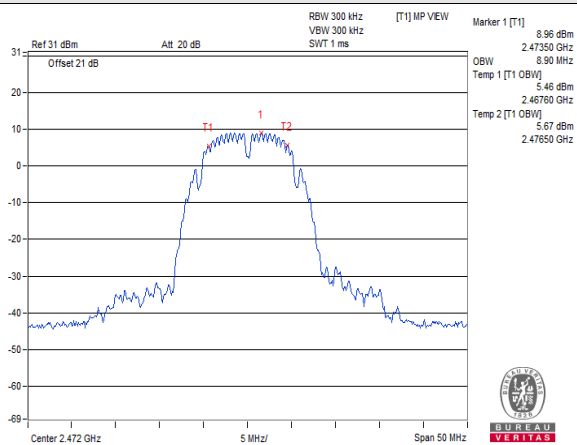
V_{normal}



V_{max.}



V_{min.}



CH 13 (2472MHz)

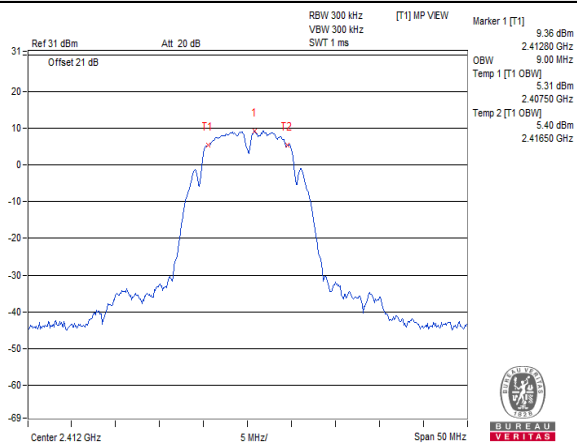
802.11b_Data Rate: 2Mbps

Channel	Frequency (MHz)	V_{normal}		$V_{max.}$		$V_{min.}$	
		Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor
1	2412	9.00	9.00	9.00	9.00	8.90	8.90
7	2442	8.90	8.90	8.90	8.90	8.90	8.90
13	2472	9.00	9.00	9.00	9.00	9.00	9.00

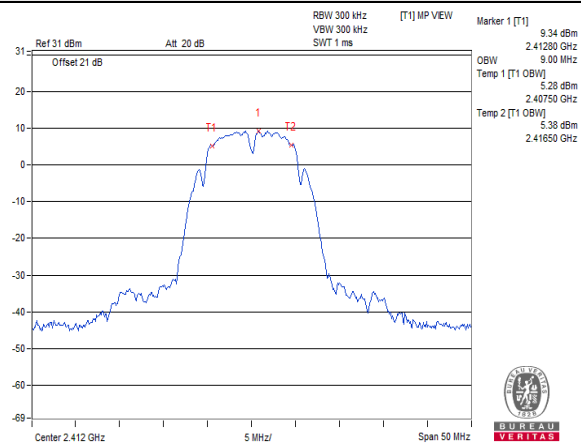
NOTE: For the test plots please refer to the below pages.

Spreading Factor: 90% channel power bandwidth / 1

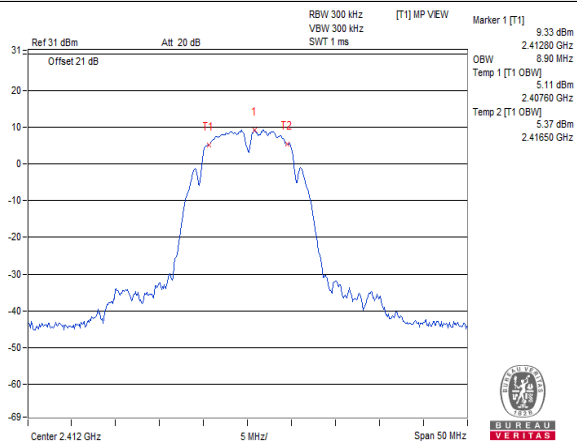
V_{normal}



V_{max.}

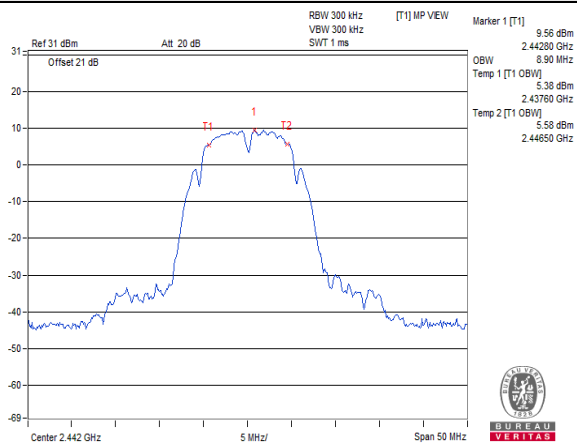


V_{min.}

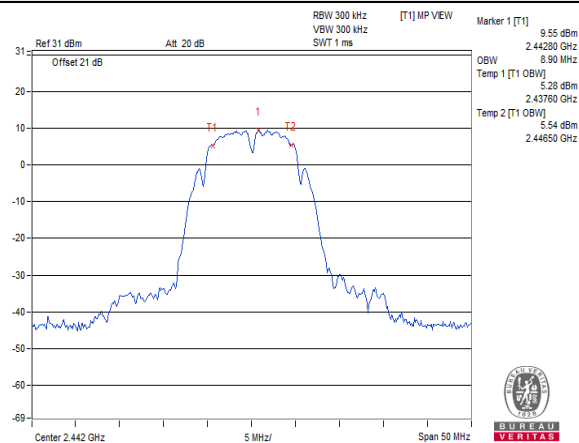


CH 1 (2412MHz)

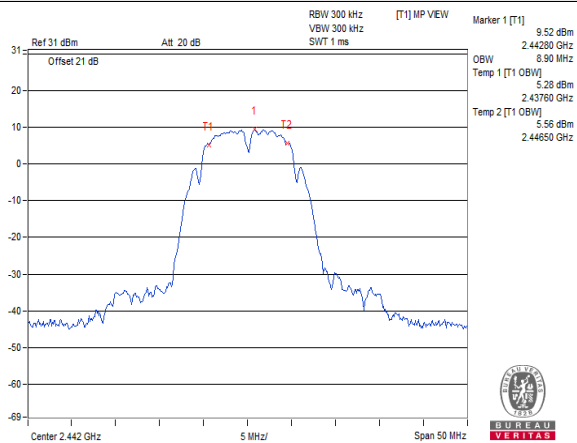
V_{normal}



V_{max.}

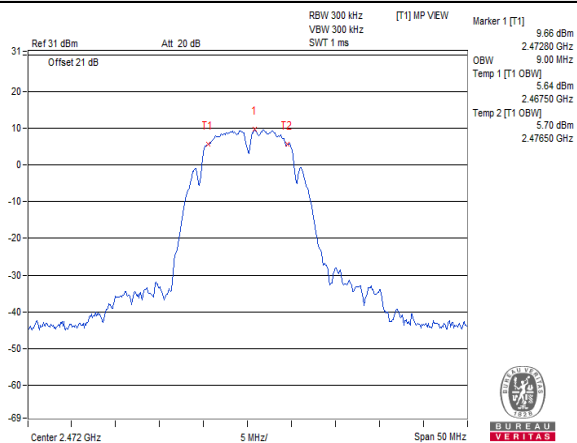


V_{min.}

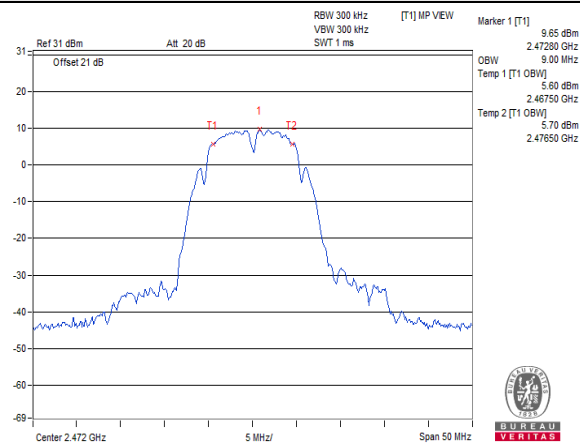


CH 7 (2442MHz)

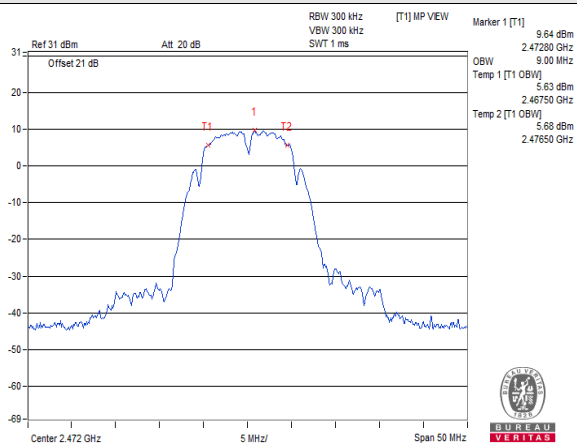
V_{normal}



V_{max.}



V_{min.}



CH 13 (2472MHz)

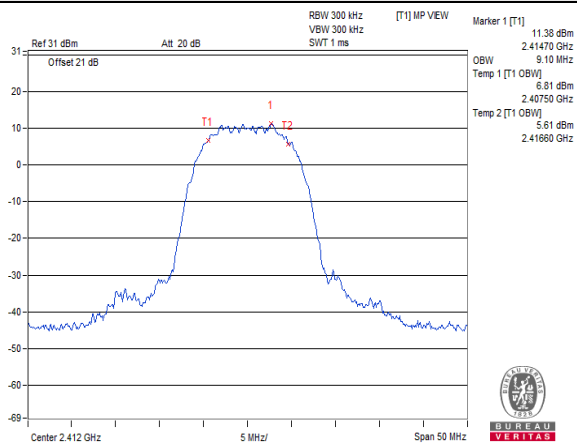
802.11b_Data Rate: 5.5Mbps

Channel	Frequency (MHz)	V_{normal}		$V_{max.}$		$V_{min.}$	
		Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor
1	2412	9.10	6.61	9.10	6.61	9.10	6.61
7	2442	9.10	6.61	9.10	6.61	9.10	6.61
13	2472	9.10	6.61	9.10	6.61	9.10	6.61

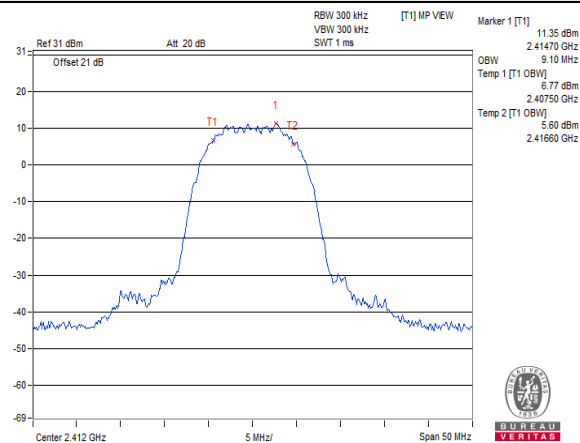
NOTE: For the test plots please refer to the below pages.

Spreading Factor: $90\% \text{ channel power bandwidth} / 1.375$

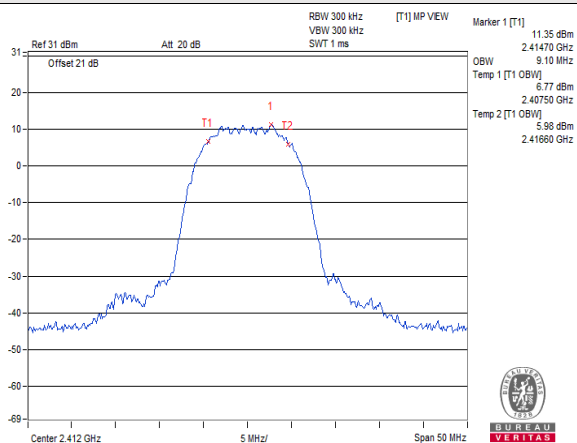
V_{normal}



V_{max.}

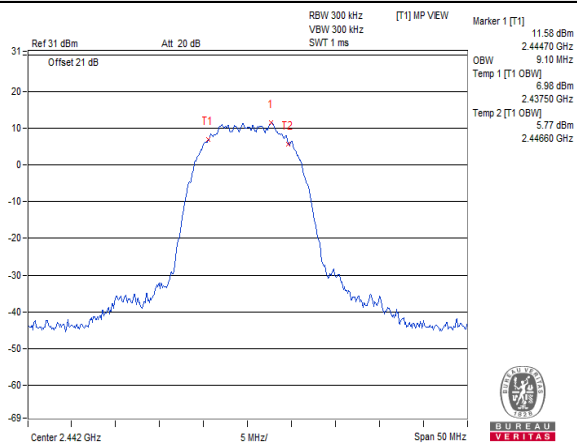


V_{min.}

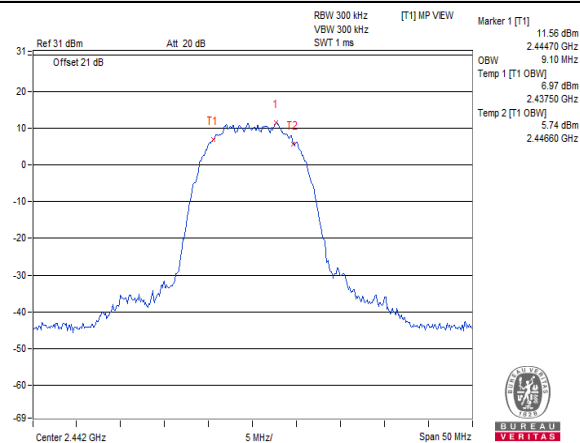


CH 1 (2412MHz)

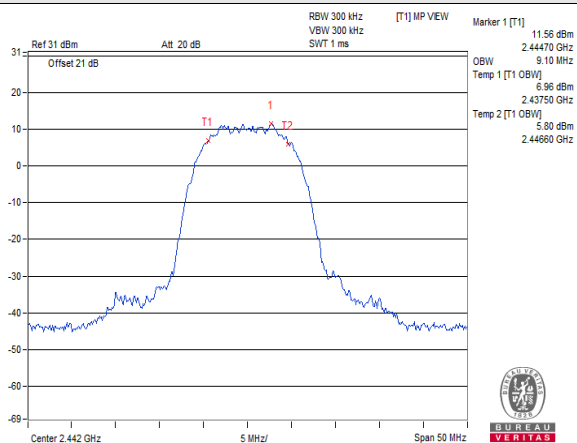
V_{normal}



V_{max.}

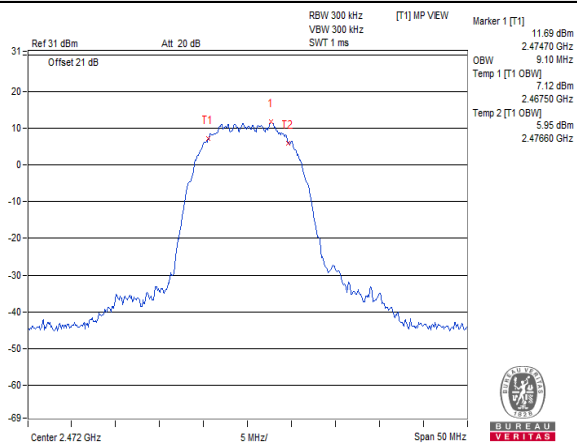


V_{min.}

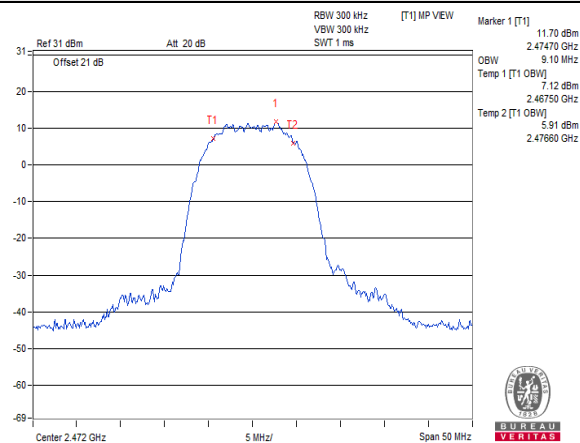


CH 7 (2442MHz)

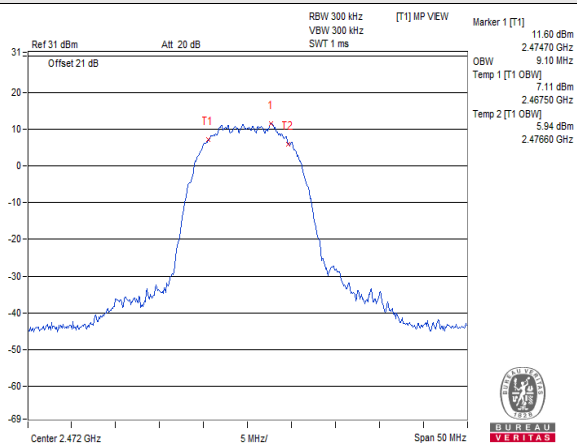
V_{normal}



V_{max.}



V_{min.}



CH 13 (2472MHz)

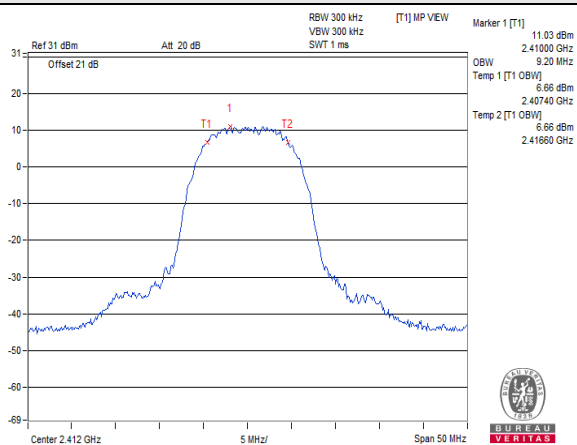
802.11b_Data Rate: 11Mbps

Channel	Frequency (MHz)	V_{normal}		$V_{\text{max.}}$		$V_{\text{min.}}$	
		Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor
1	2412	9.20	6.69	9.20	6.69	9.20	6.69
7	2442	9.20	6.69	9.20	6.69	9.20	6.69
13	2472	9.20	6.69	9.20	6.69	9.20	6.69

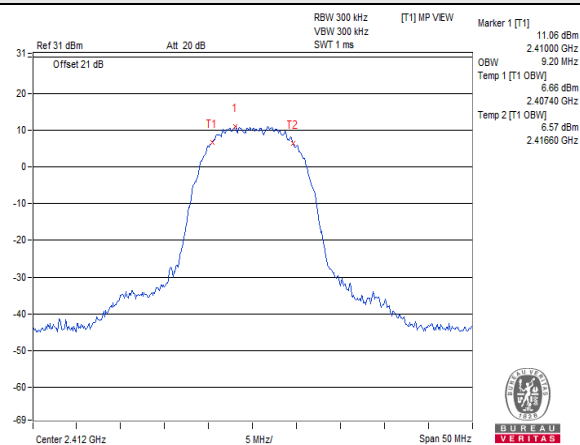
NOTE: For the test plots please refer to the below pages.

Spreading Factor: 90% channel power bandwidth / 1.375

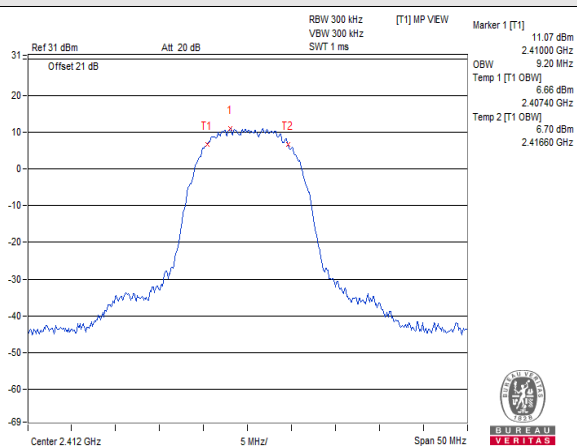
V_{normal}



V_{max.}

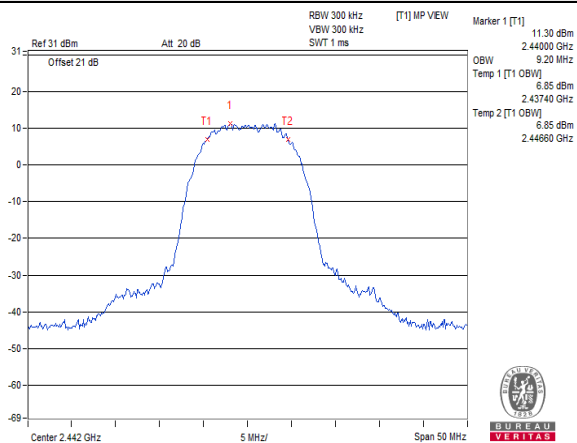


V_{min.}

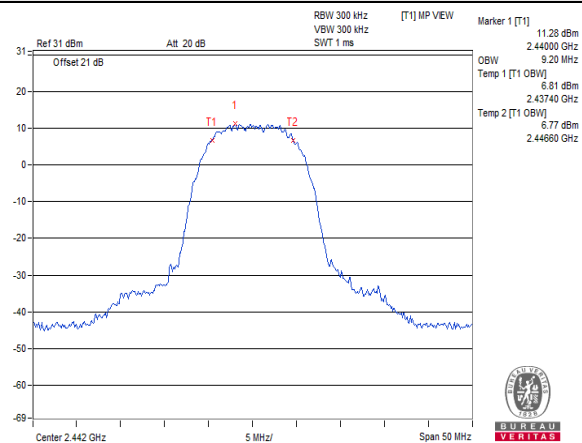


CH 1 (2412MHz)

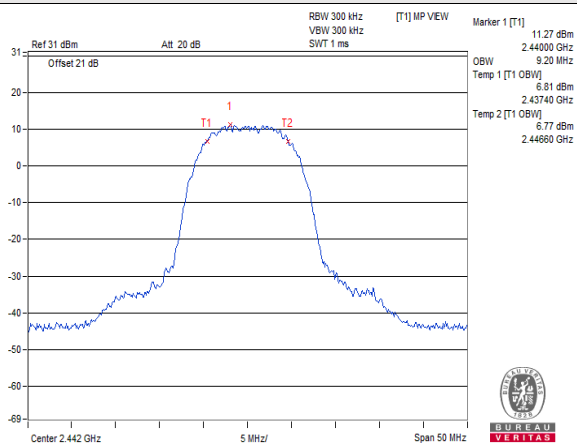
V_{normal}



V_{max.}

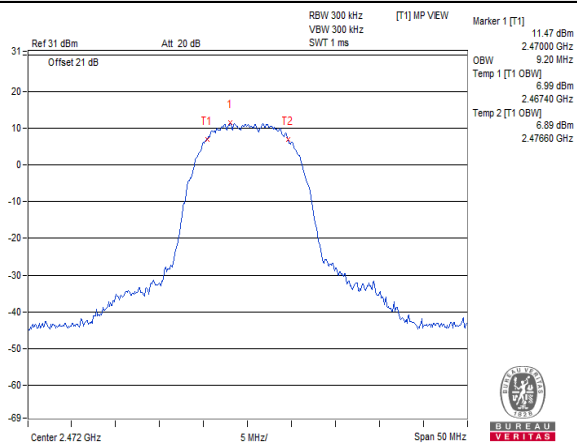


V_{min.}

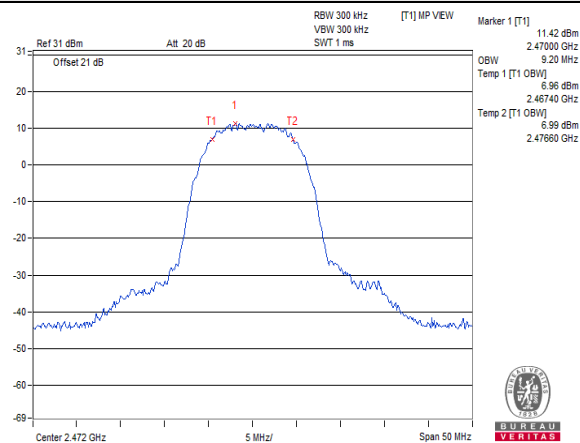


CH 7 (2442MHz)

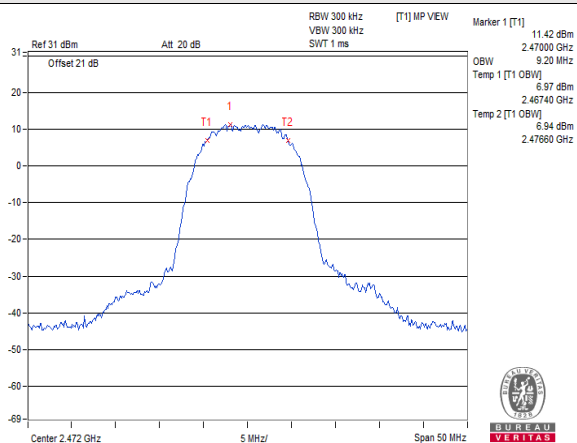
V_{normal}



V_{max}



V_{min}



CH 13 (2472MHz)

4.4 Spurious Emissions for Transmitter Measurement

4.4.1 Limits of Spurious Emissions

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

4.4.2 Test Setup



4.4.3 Test Results

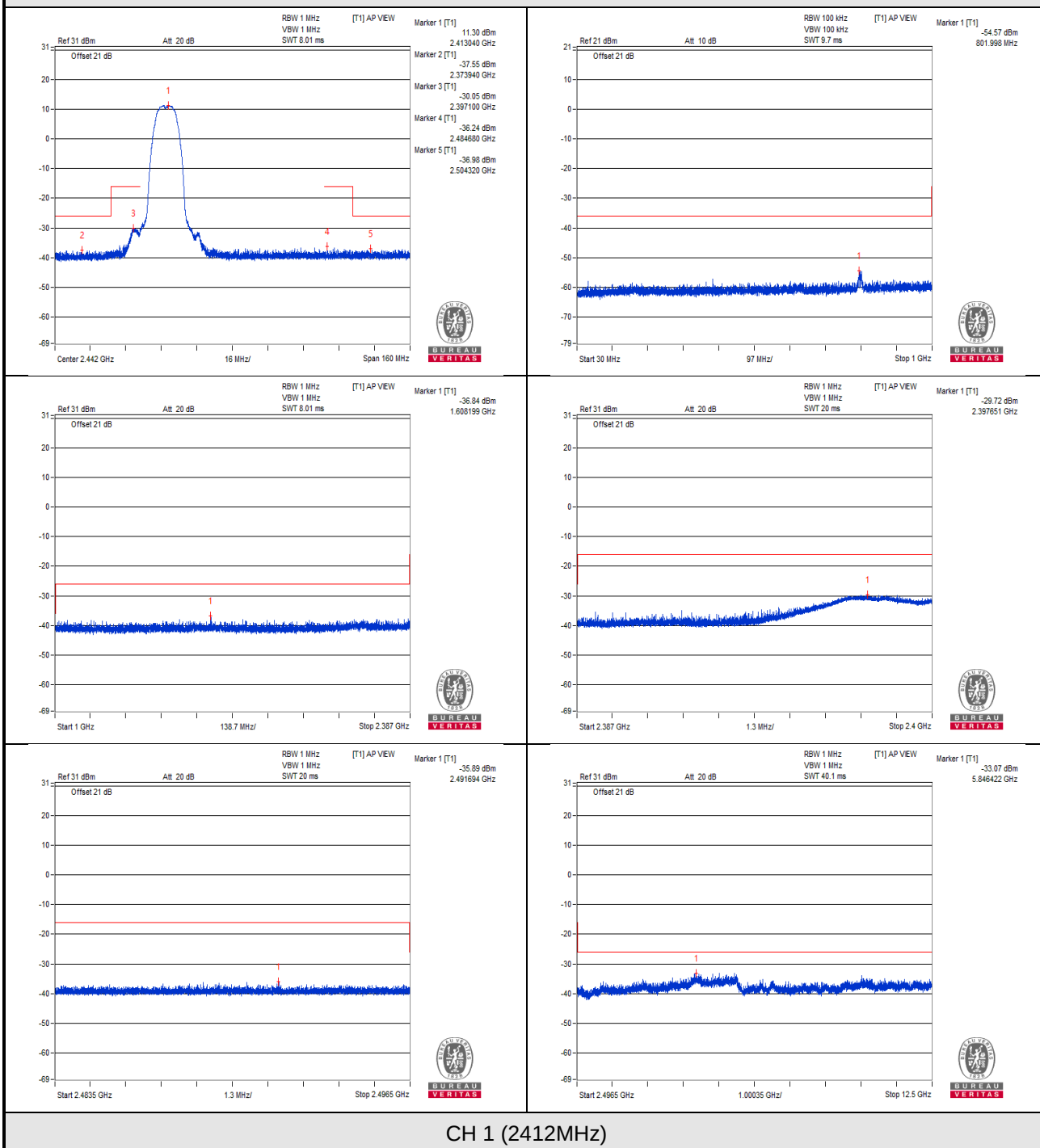
802.11b

TEST CHANNEL		CH 1 (2412MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE(uW)	LIMIT (uW)	RESULT
V_{normal}	30.0 to 1000.0	801.998	0.003491	0.25	PASS
	1000.0 to 2387.0	1608.199	0.207014	2.5	PASS
	2387.0 to 2400.0	2397.651	1.066596	25	PASS
	2483.5 to 2496.5	2491.694	0.257632	25	PASS
	2496.5 to 12500.0	5846.422	0.493174	2.5	PASS
V_{max.}	30.0 to 1000.0	801.998	0.003540	0.25	PASS
	1000.0 to 2387.0	2373.476	0.231739	2.5	PASS
	2387.0 to 2400.0	2397.812	1.018591	25	PASS
	2483.5 to 2496.5	2496.303	0.269774	25	PASS
	2496.5 to 12500.0	6989.321	0.599791	2.5	PASS
V_{min.}	30.0 to 1000.0	806.121	0.002661	0.25	PASS
	1000.0 to 2387.0	1608.199	0.221820	2.5	PASS
	2387.0 to 2400.0	2397.310	1.069055	25	PASS
	2483.5 to 2496.5	2492.500	0.264241	25	PASS
	2496.5 to 12500.0	5841.420	0.478630	2.5	PASS
TEST CHANNEL		CH 7 (2442MHz)			
V_{normal}	30.0 to 1000.0	812.062	0.002350	0.25	PASS
	1000.0 to 2387.0	1628.137	0.182390	2.5	PASS
	2387.0 to 2400.0	2388.517	0.207970	25	PASS
	2483.5 to 2496.5	2491.109	0.234423	25	PASS
	2496.5 to 12500.0	6272.821	0.469894	2.5	PASS
V_{max.}	30.0 to 1000.0	812.305	0.002600	0.25	PASS
	1000.0 to 2387.0	1628.311	0.185780	2.5	PASS
	2387.0 to 2400.0	2399.959	0.206538	25	PASS
	2483.5 to 2496.5	2495.339	0.253513	25	PASS
	2496.5 to 12500.0	5850.173	0.474242	2.5	PASS
V_{min.}	30.0 to 1000.0	815.578	0.003076	0.25	PASS
	1000.0 to 2387.0	1628.311	0.231739	2.5	PASS
	2387.0 to 2400.0	2396.408	0.198153	25	PASS
	2483.5 to 2496.5	2490.118	0.253513	25	PASS
	2496.5 to 12500.0	5877.683	0.493174	2.5	PASS

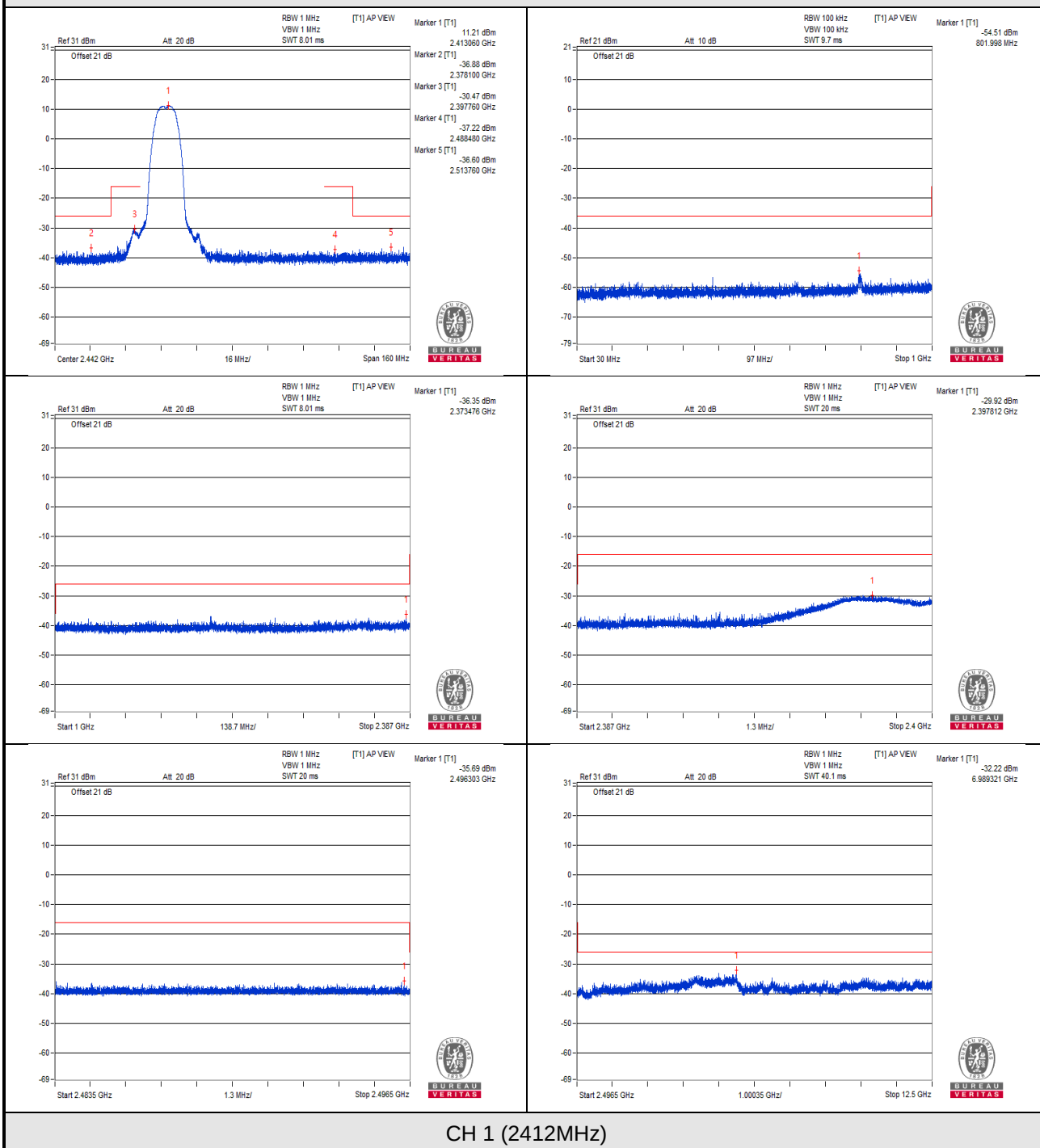
TEST CHANNEL		CH 13 (2472MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE(uW)	LIMIT (uW)	RESULT
V_{normal}	30.0 to 1000.0	400.055	0.002421	0.25	PASS
	1000.0 to 2387.0	2210.330	0.172982	2.5	PASS
	2387.0 to 2400.0	2390.748	0.219280	25	PASS
	2483.5 to 2496.5	2483.608	1.883649	25	PASS
	2496.5 to 12500.0	6979.318	0.500035	2.5	PASS
V_{max.}	30.0 to 1000.0	826.006	0.002761	0.25	PASS
	1000.0 to 2387.0	2279.160	0.213304	2.5	PASS
	2387.0 to 2400.0	2398.423	0.200909	25	PASS
	2483.5 to 2496.5	2483.620	1.995262	25	PASS
	2496.5 to 12500.0	6983.069	0.514044	2.5	PASS
V_{min.}	30.0 to 1000.0	822.368	0.002208	0.25	PASS
	1000.0 to 2387.0	1082.353	0.180717	2.5	PASS
	2387.0 to 2400.0	2396.988	0.200909	25	PASS
	2483.5 to 2496.5	2483.680	1.896706	25	PASS
	2496.5 to 12500.0	5767.644	0.478630	2.5	PASS

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

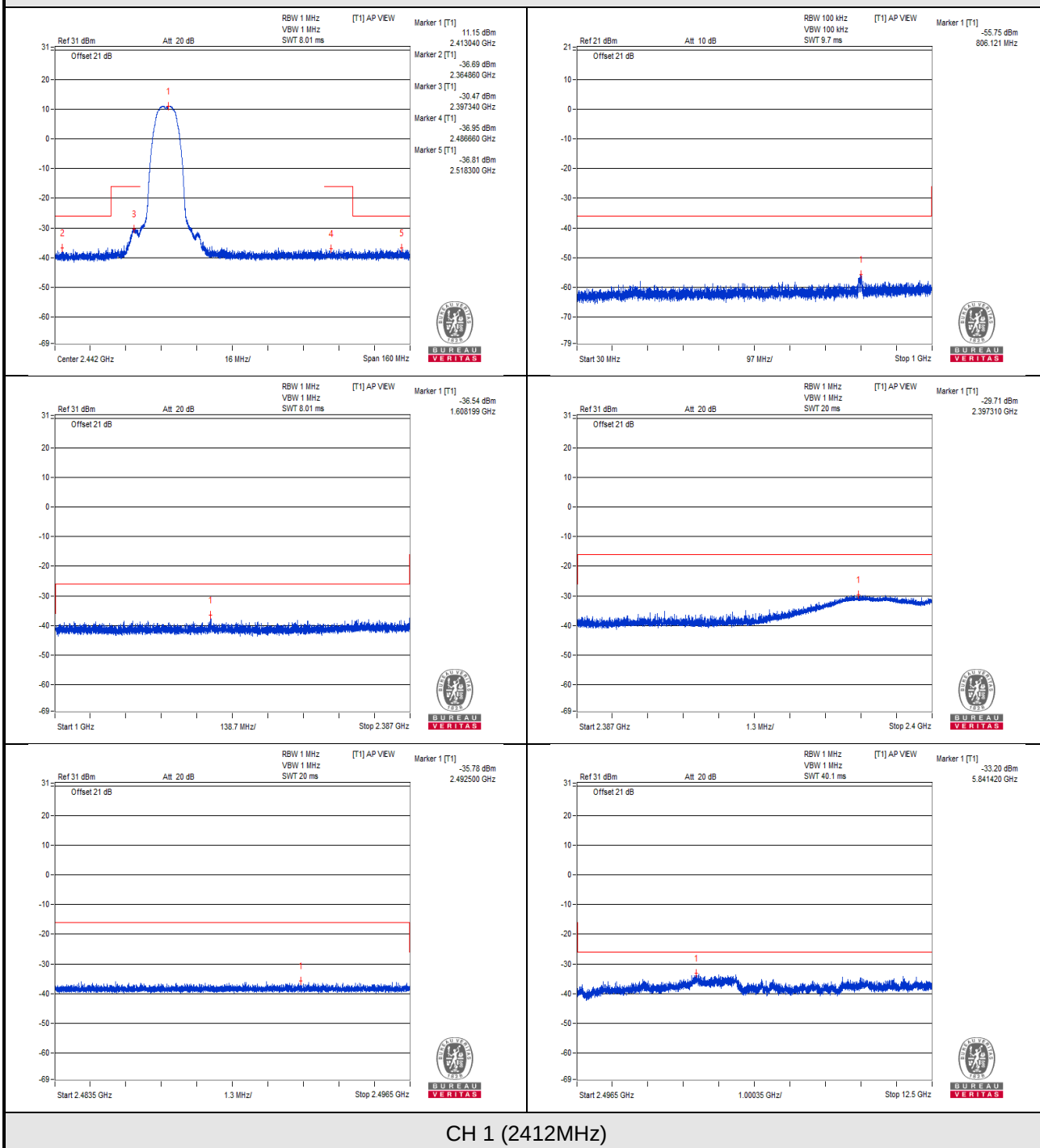
Vnormal



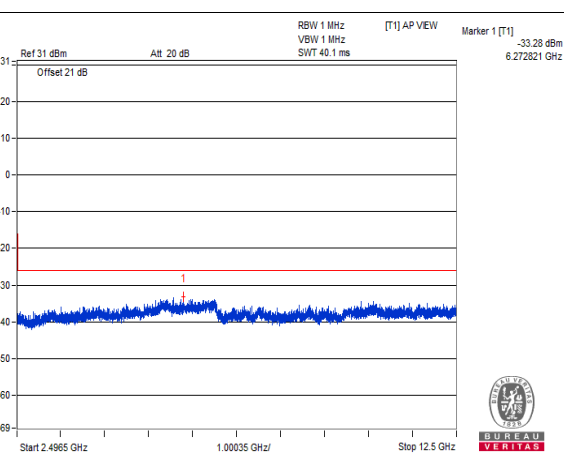
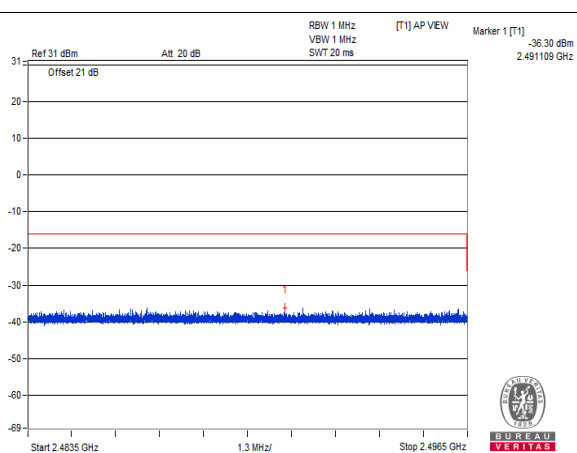
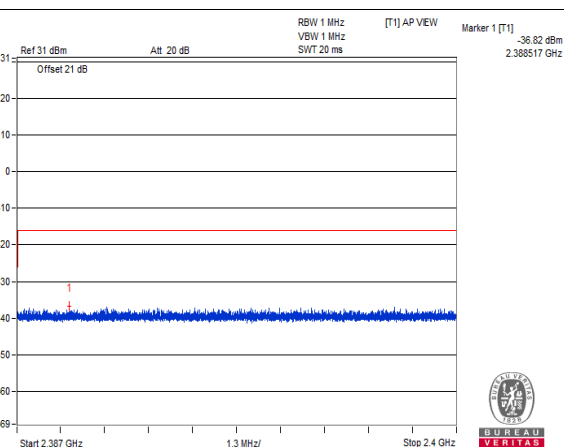
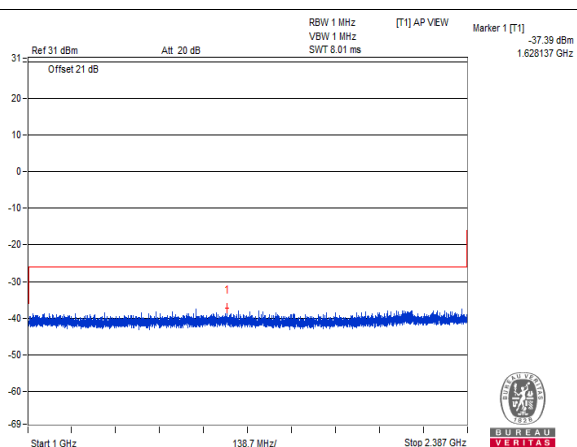
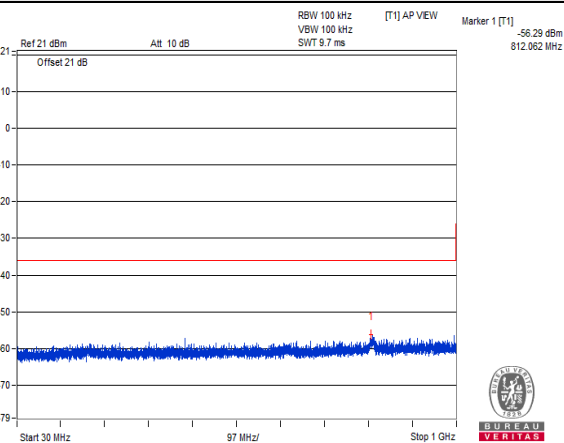
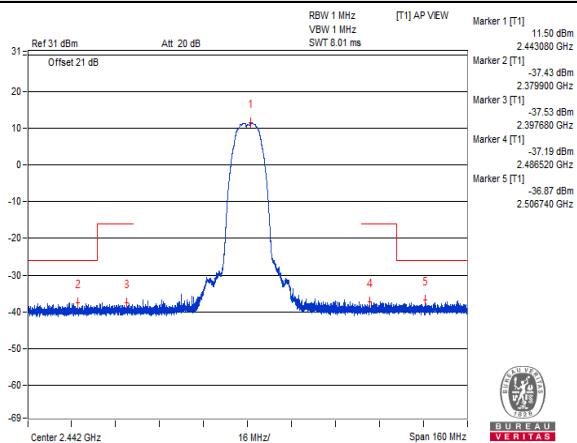
V_{max}.



V_{min}.

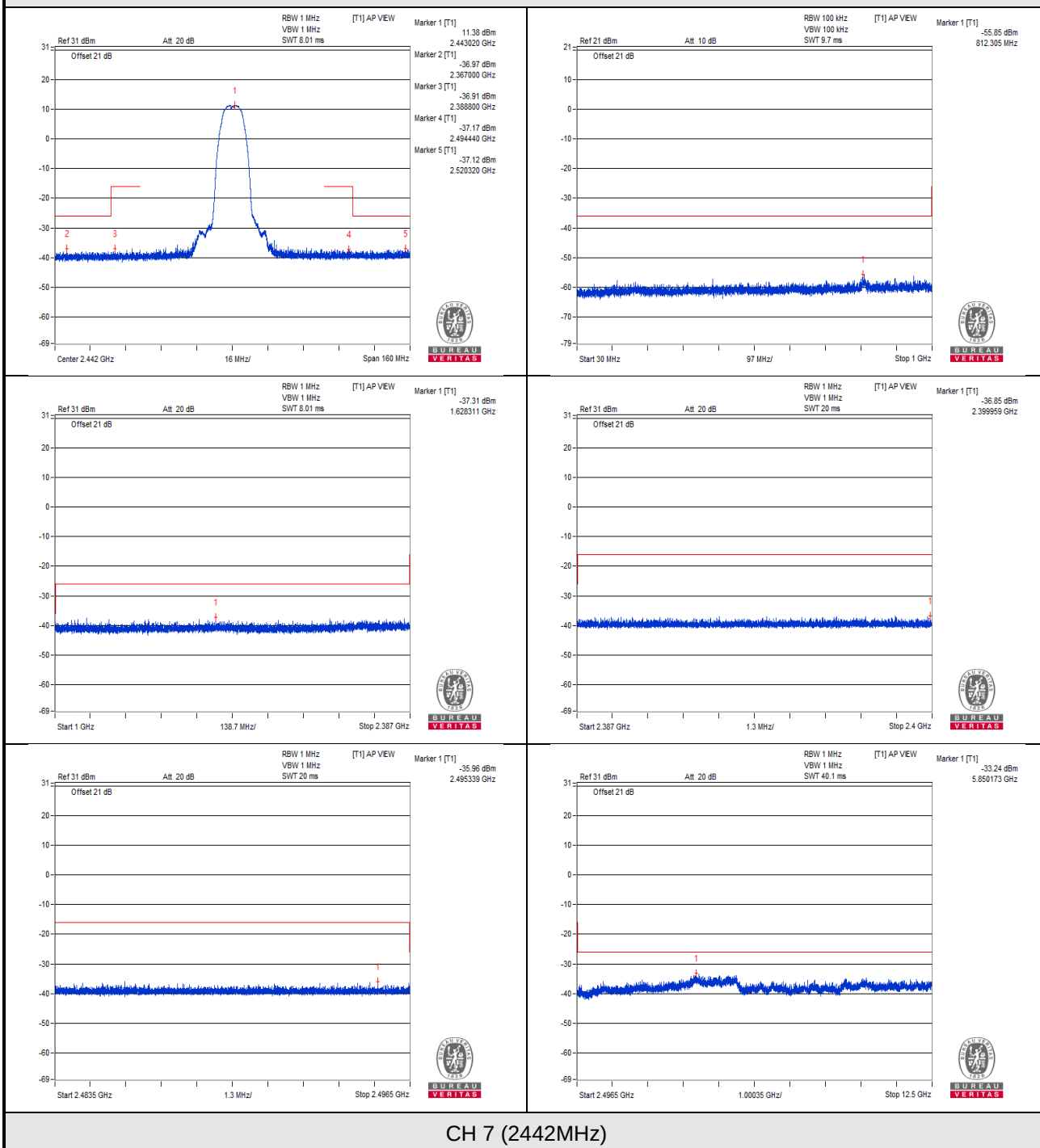


Vnormal

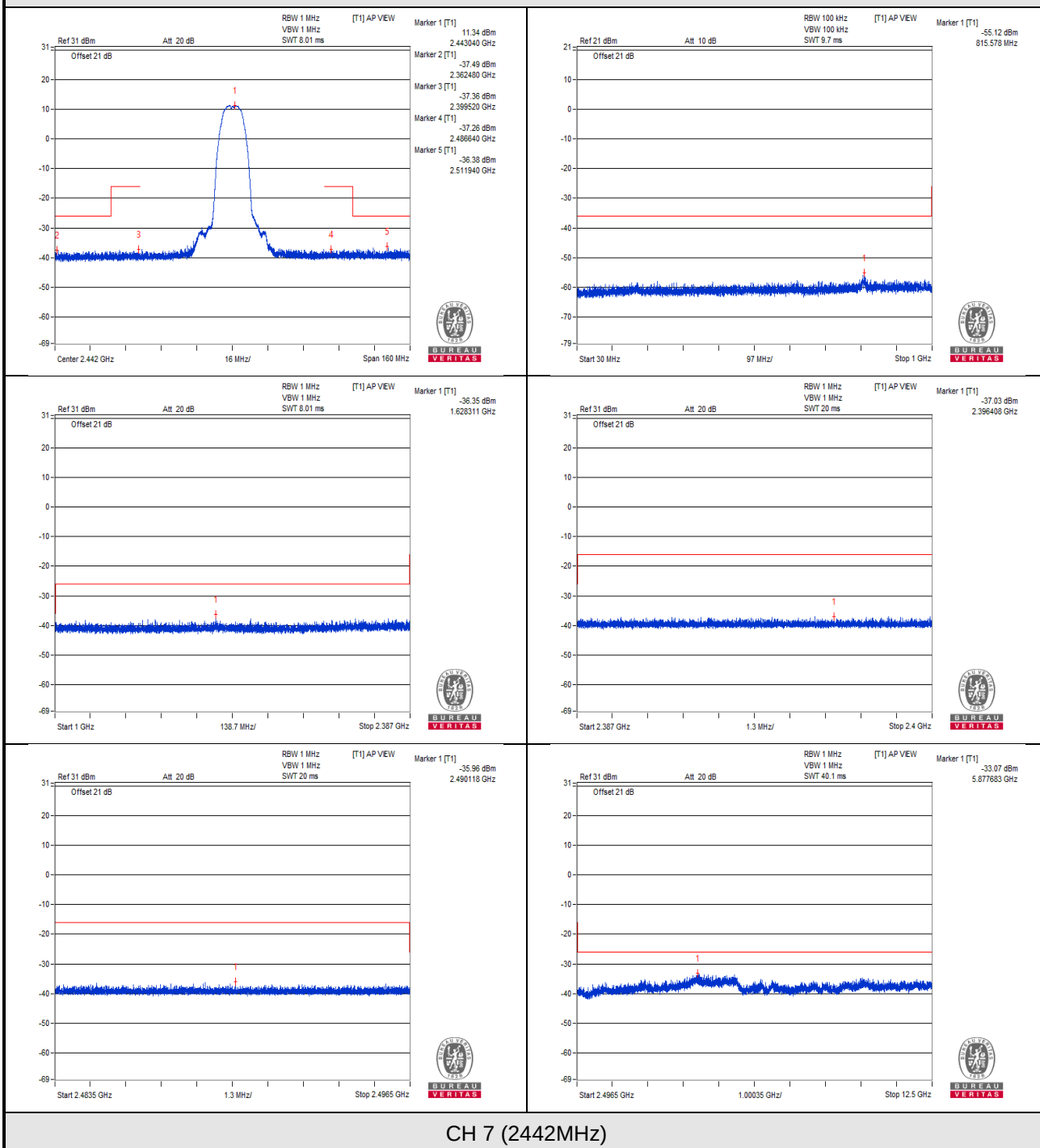


CH 7 (2442MHz)

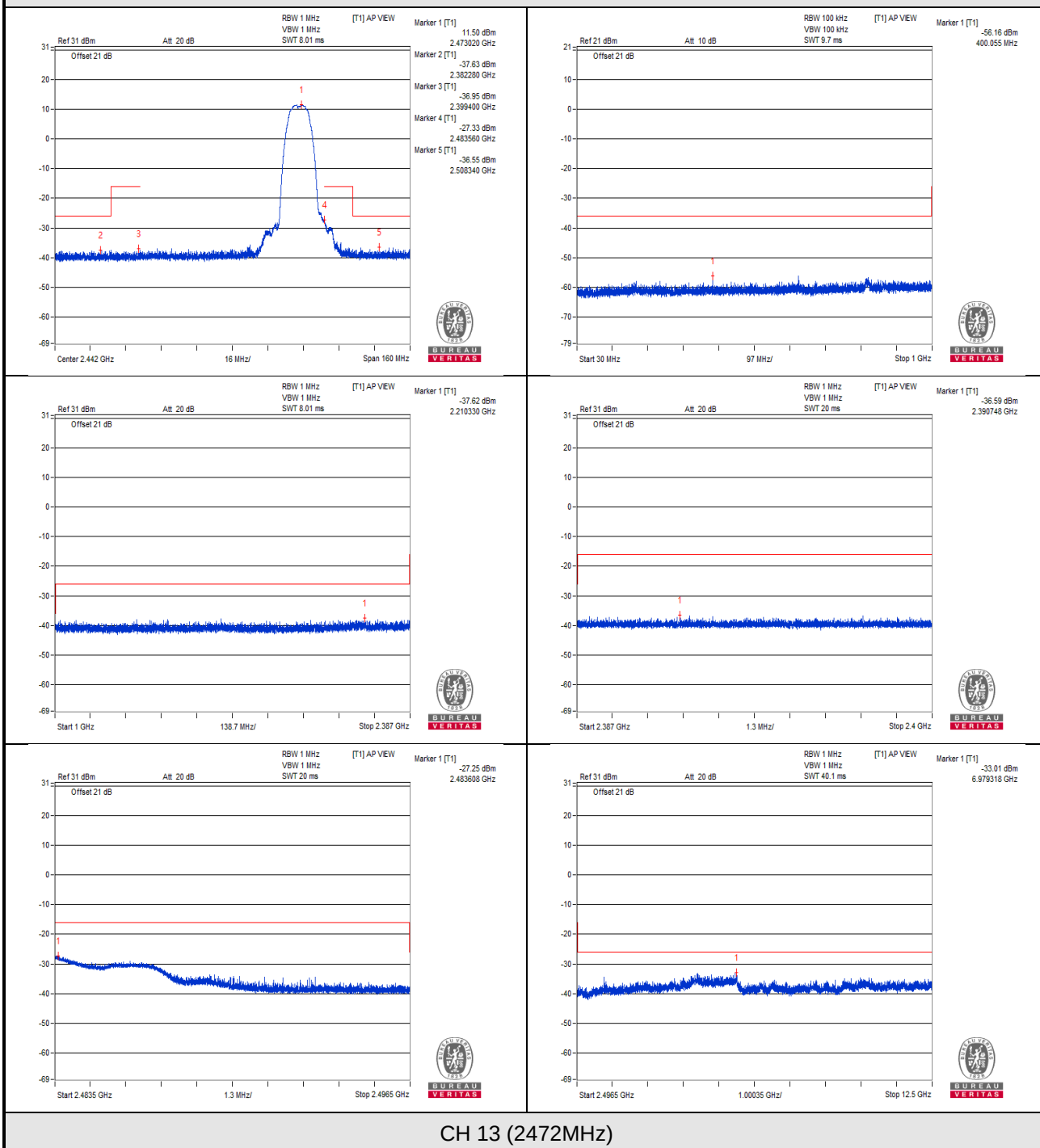
V_{max}.



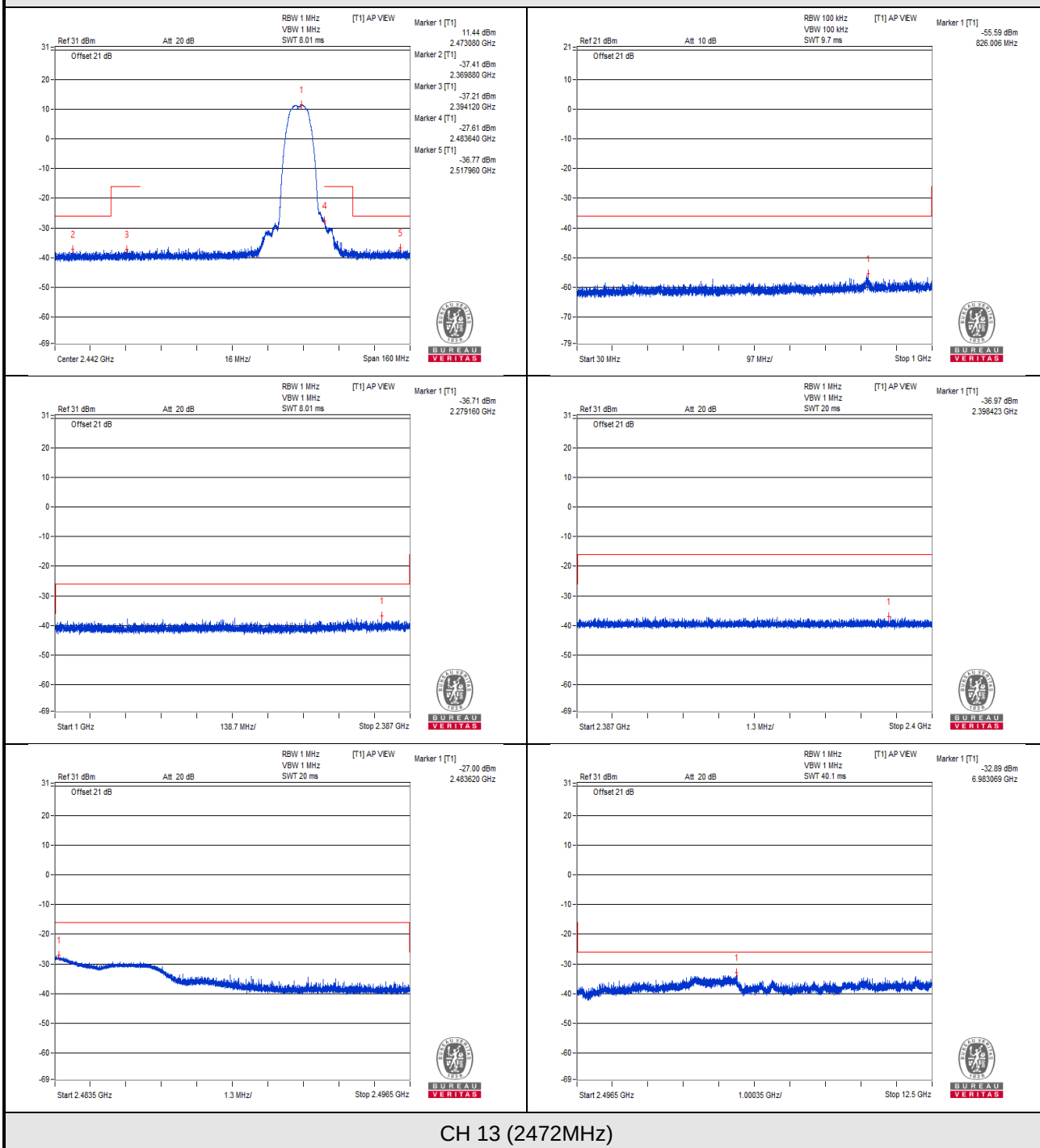
V_{min}.



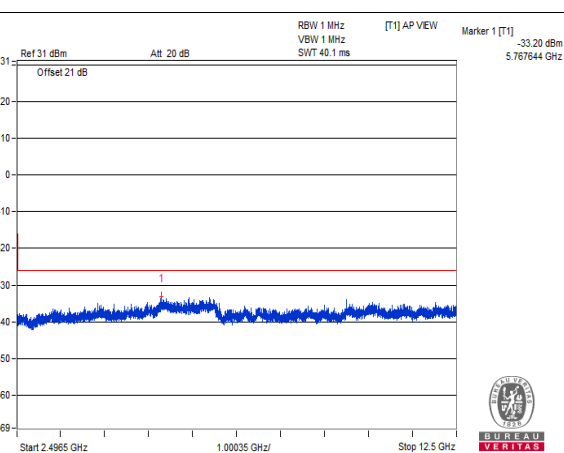
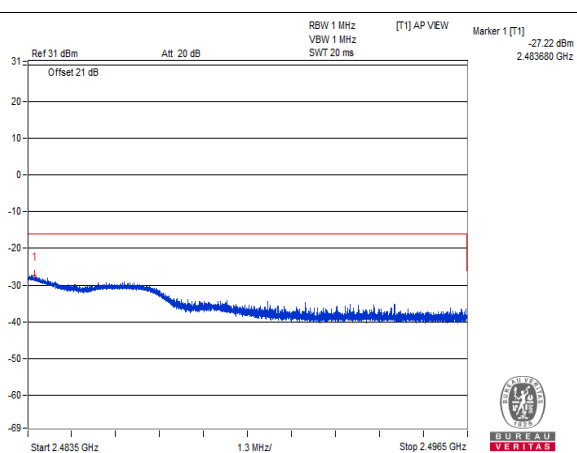
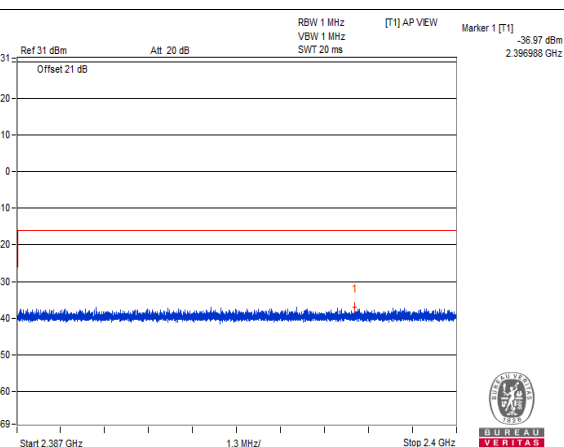
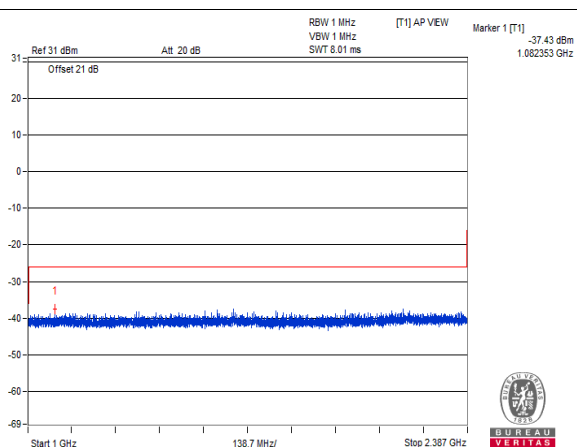
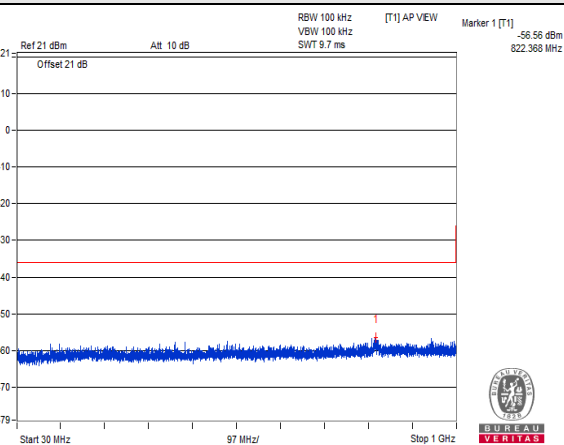
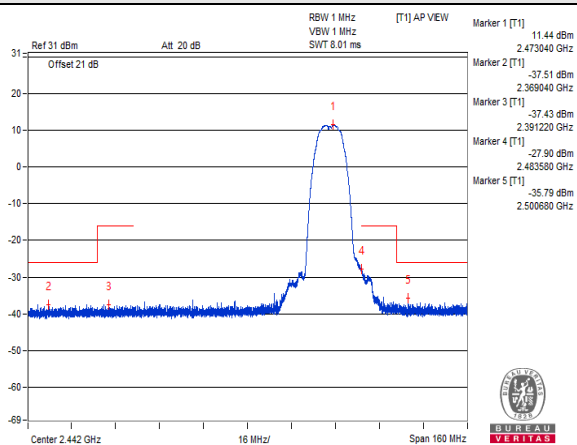
Vnormal



V_{max}.



V_{min}.



CH 13 (2472MHz)

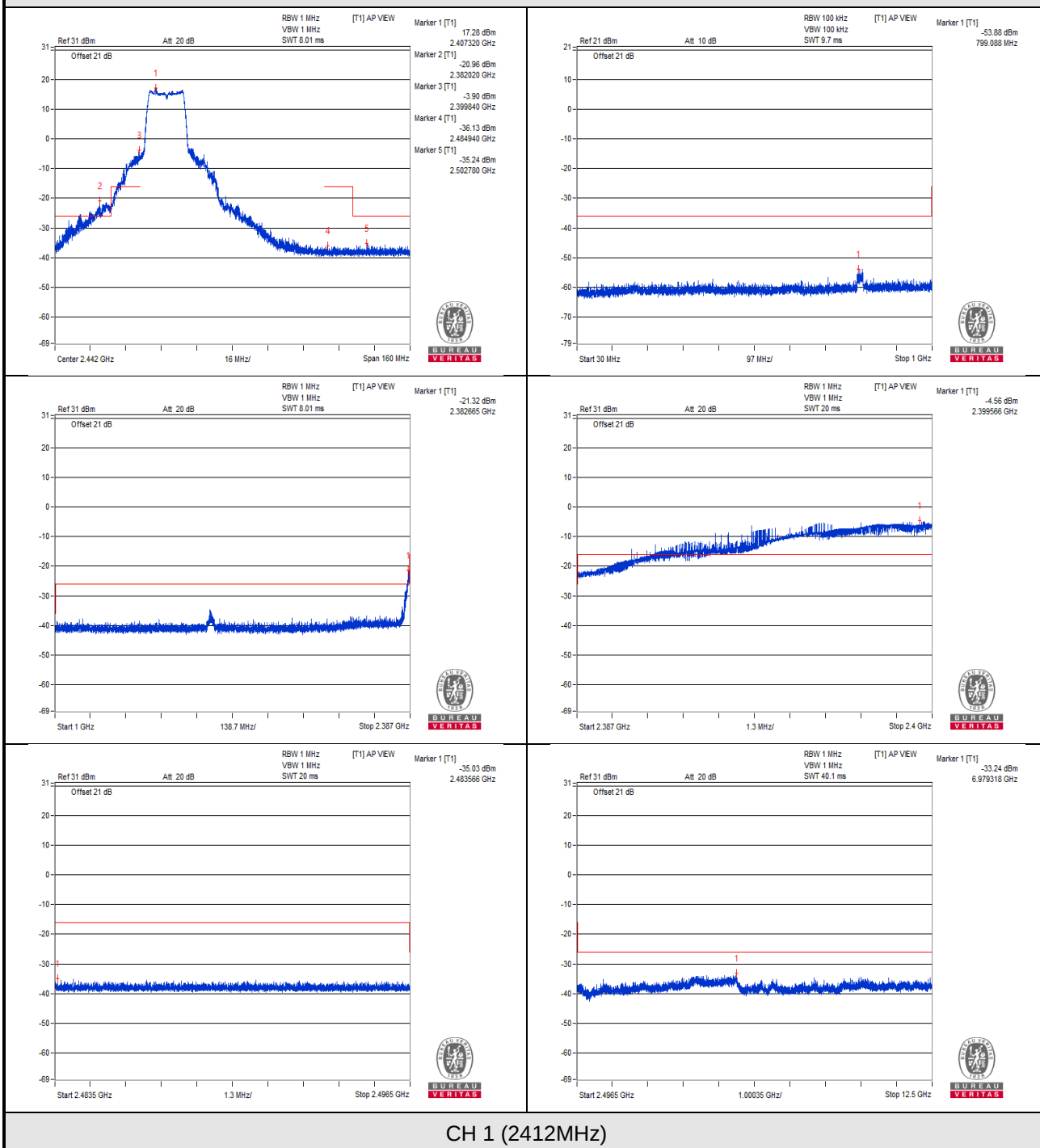
802.11g

TEST CHANNEL		CH 1 (2412MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE(uW)	LIMIT (uW)	RESULT
V_{normal}	30.0 to 1000.0	799.088	0.004093	0.25	PASS
	1000.0 to 2387.0	2382.665	0.169903	2.5	PASS(1)
	2387.0 to 2400.0	2399.566	8.539318	25	PASS(2)
	2483.5 to 2496.5	2483.566	0.314051	25	PASS
	2496.5 to 12500.0	6979.318	0.474242	2.5	PASS
V_{max.}	30.0 to 1000.0	810.728	0.004667	0.25	PASS
	1000.0 to 2387.0	2385.266	0.300276	2.5	PASS(3)
	2387.0 to 2400.0	2399.670	9.296857	25	PASS(4)
	2483.5 to 2496.5	2490.339	0.344350	25	PASS
	2496.5 to 12500.0	6878.033	0.508159	2.5	PASS
V_{min.}	30.0 to 1000.0	809.152	0.005358	0.25	PASS
	1000.0 to 2387.0	2385.266	0.289672	2.5	PASS(5)
	2387.0 to 2400.0	2399.608	9.074607	25	PASS(6)
	2483.5 to 2496.5	2484.726	0.391742	25	PASS
	2496.5 to 12500.0	5850.173	0.460257	2.5	PASS
TEST CHANNEL		CH 7 (2442MHz)			
V_{normal}	30.0 to 1000.0	820.913	0.003006	0.25	PASS
	1000.0 to 2387.0	2385.786	0.252348	2.5	PASS
	2387.0 to 2400.0	2398.210	1.406048	25	PASS
	2483.5 to 2496.5	2485.978	2.133045	25	PASS
	2496.5 to 12500.0	5891.437	0.477529	2.5	PASS
V_{max.}	30.0 to 1000.0	807.212	0.003141	0.25	PASS
	1000.0 to 2387.0	2278.640	0.246037	2.5	PASS
	2387.0 to 2400.0	2399.353	1.836538	25	PASS
	2483.5 to 2496.5	2483.511	2.449063	25	PASS
	2496.5 to 12500.0	6915.546	0.500035	2.5	PASS
V_{min.}	30.0 to 1000.0	819.095	0.004436	0.25	PASS
	1000.0 to 2387.0	2386.306	0.226464	2.5	PASS
	2387.0 to 2400.0	2399.330	1.651962	25	PASS
	2483.5 to 2496.5	2483.784	1.954339	25	PASS
	2496.5 to 12500.0	6672.961	0.465586	2.5	PASS

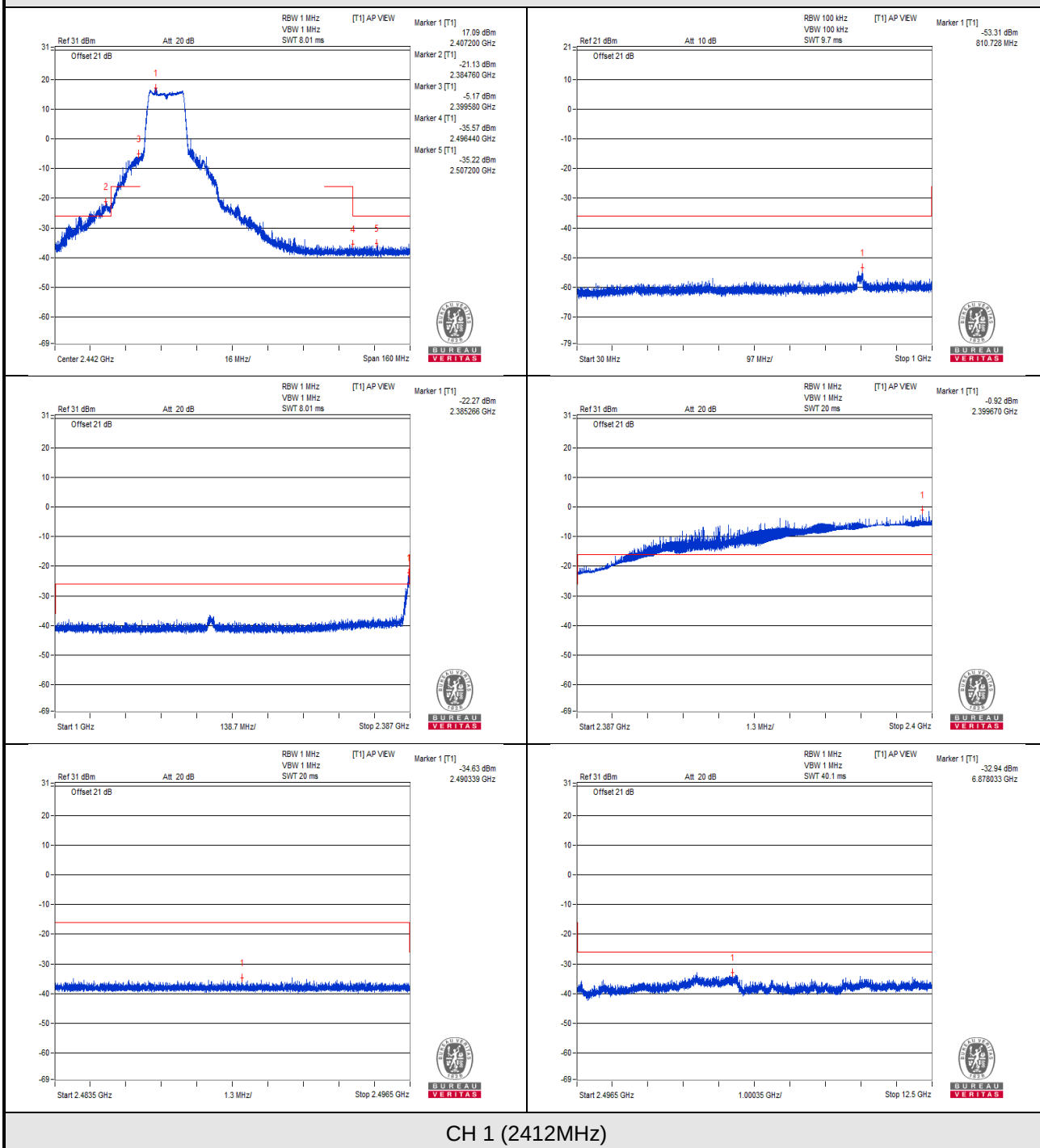
TEST CHANNEL		CH 13 (2472MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE(uW)	LIMIT (uW)	RESULT
V_{normal}	30.0 to 1000.0	816.548	0.003412	0.25	PASS
	1000.0 to 2387.0	2271.879	0.234963	2.5	PASS
	2387.0 to 2400.0	2399.965	0.260016	25	PASS
	2483.5 to 2496.5	2483.729	17.169401	25	PASS(7)
	2496.5 to 12500.0	2497.750	0.389275	2.5	PASS(8)
V_{max.}	30.0 to 1000.0	898.635	0.011298	0.25	PASS
	1000.0 to 2387.0	2334.120	0.256448	2.5	PASS
	2387.0 to 2400.0	2393.183	0.283139	25	PASS
	2483.5 to 2496.5	2483.771	17.286804	25	PASS(9)
	2496.5 to 12500.0	2496.500	0.415585	2.5	PASS(10)
V_{min.}	30.0 to 1000.0	829.037	0.005420	0.25	PASS
	1000.0 to 2387.0	2343.136	0.264241	2.5	PASS
	2387.0 to 2400.0	2397.057	0.271644	25	PASS
	2483.5 to 2496.5	2483.587	18.208468	25	PASS(11)
	2496.5 to 12500.0	2496.500	0.447306	2.5	PASS(12)

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

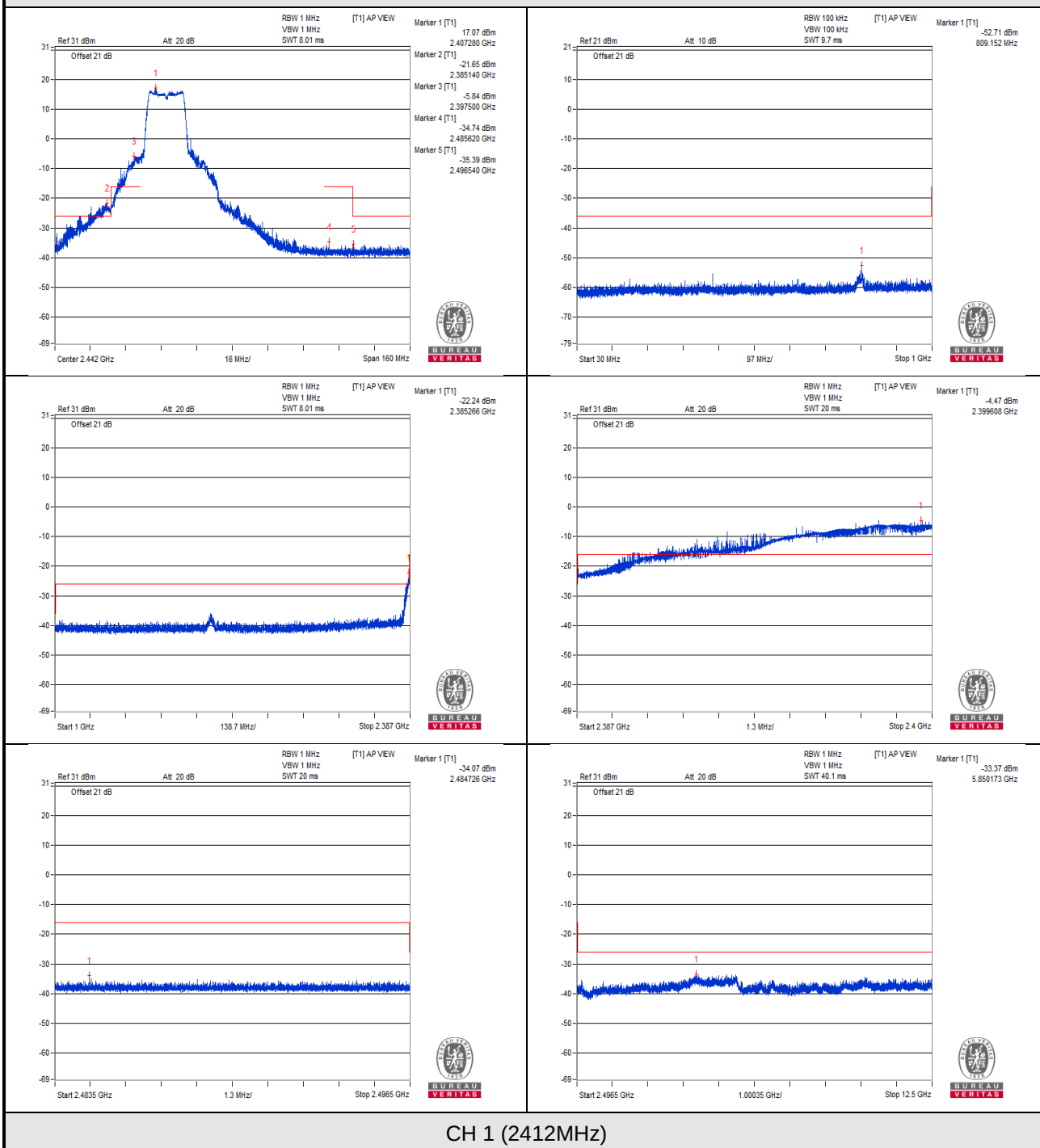
Vnormal



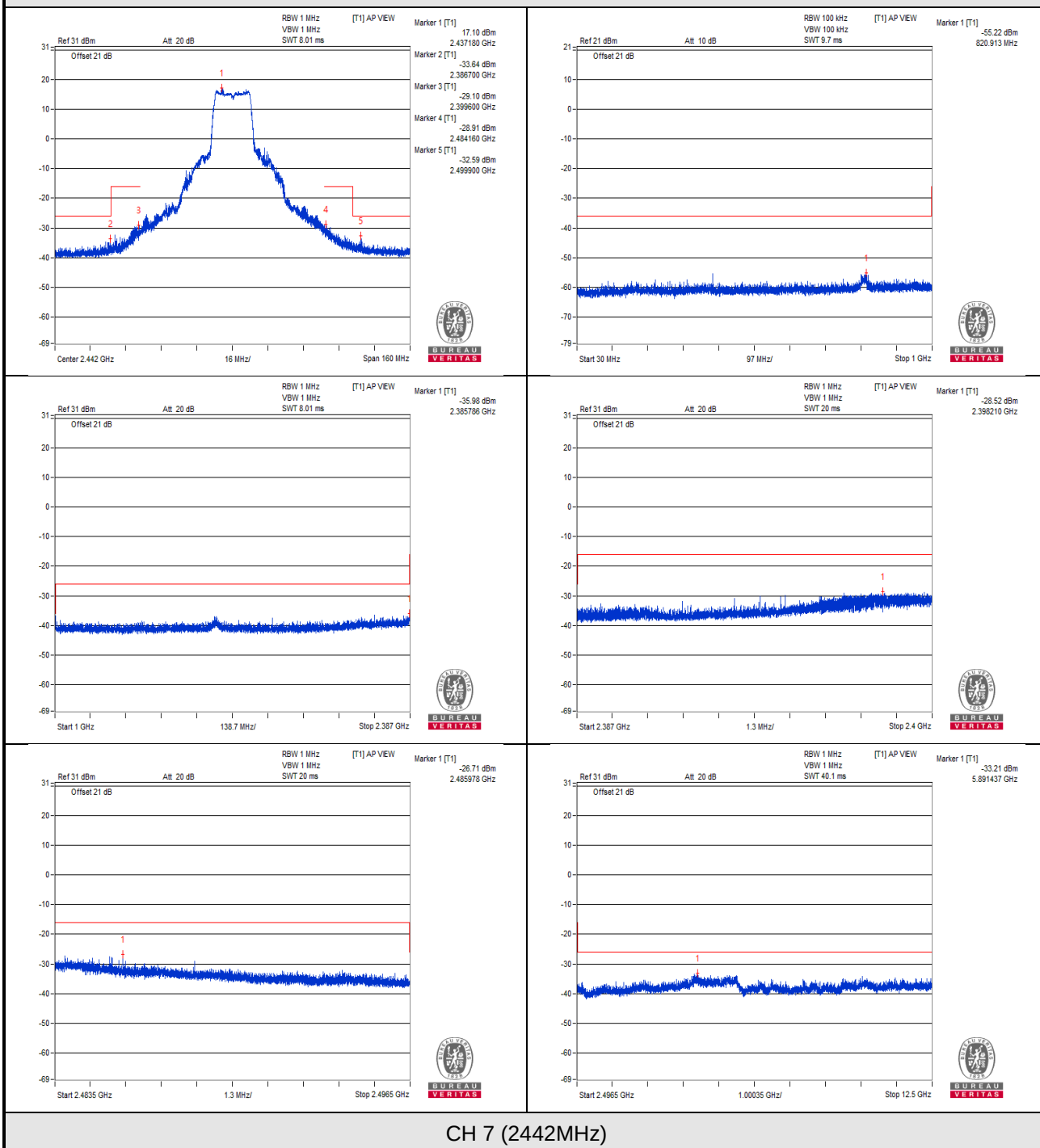
V_{max}.



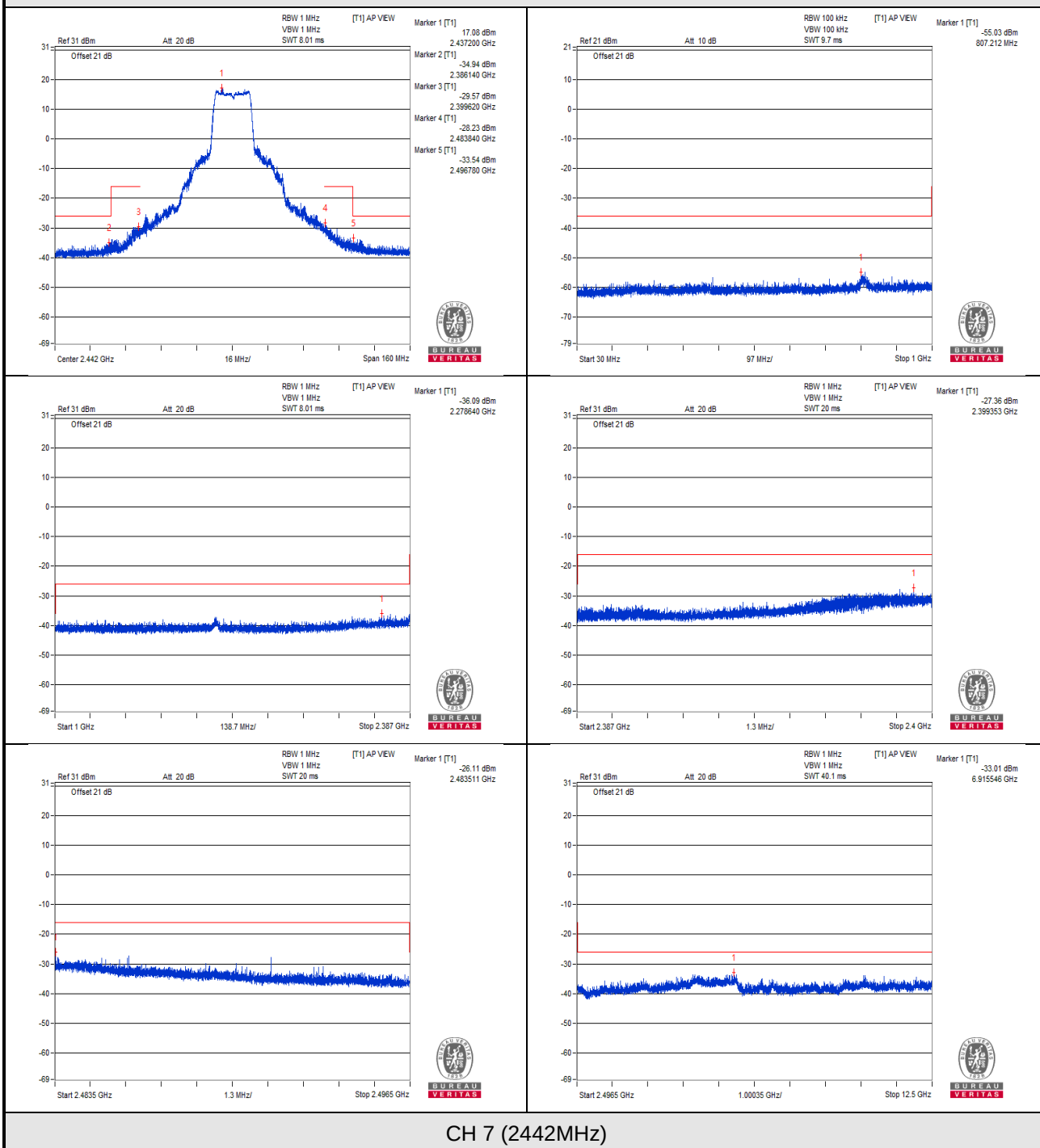
V_{min}.



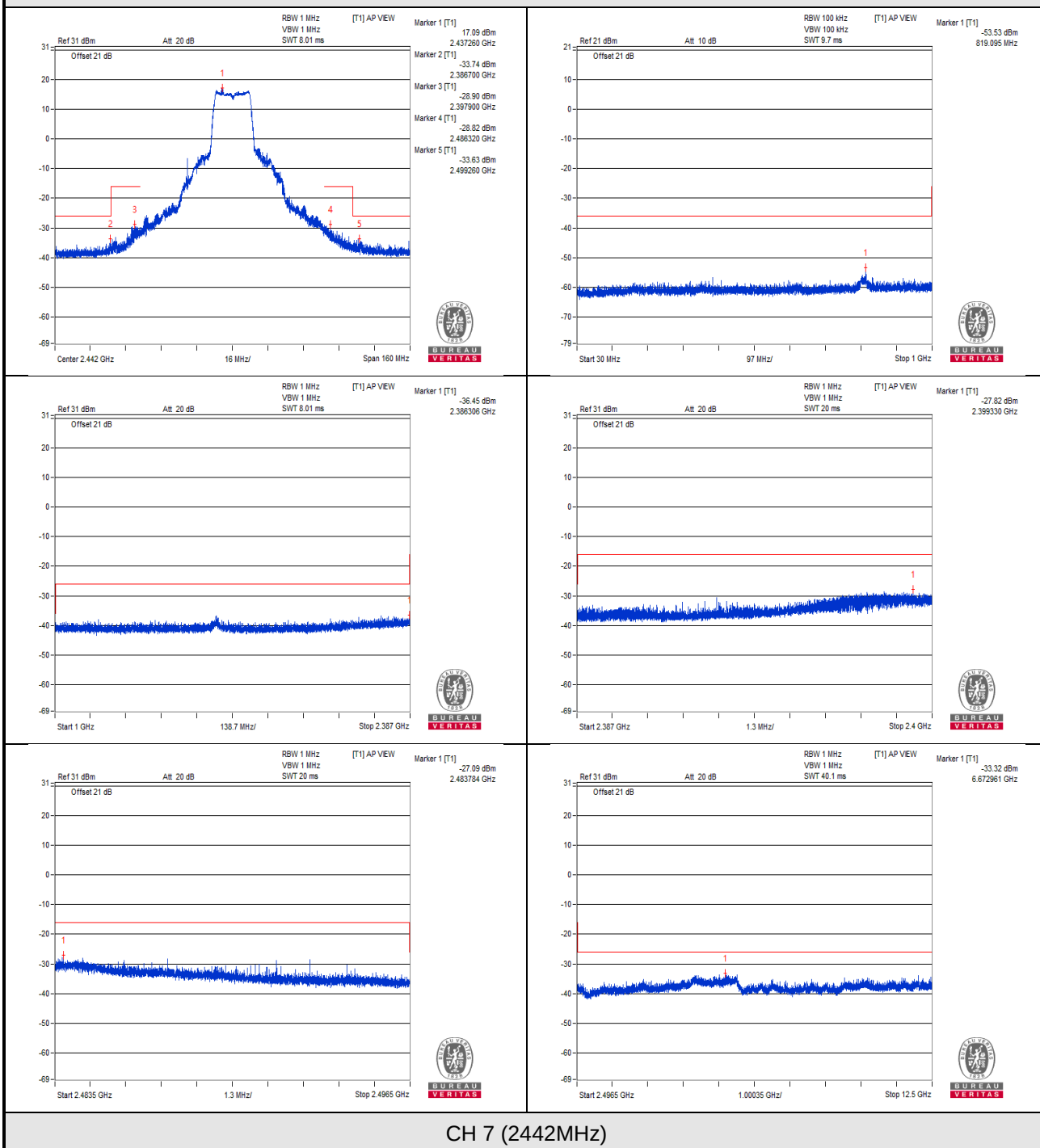
Vnormal



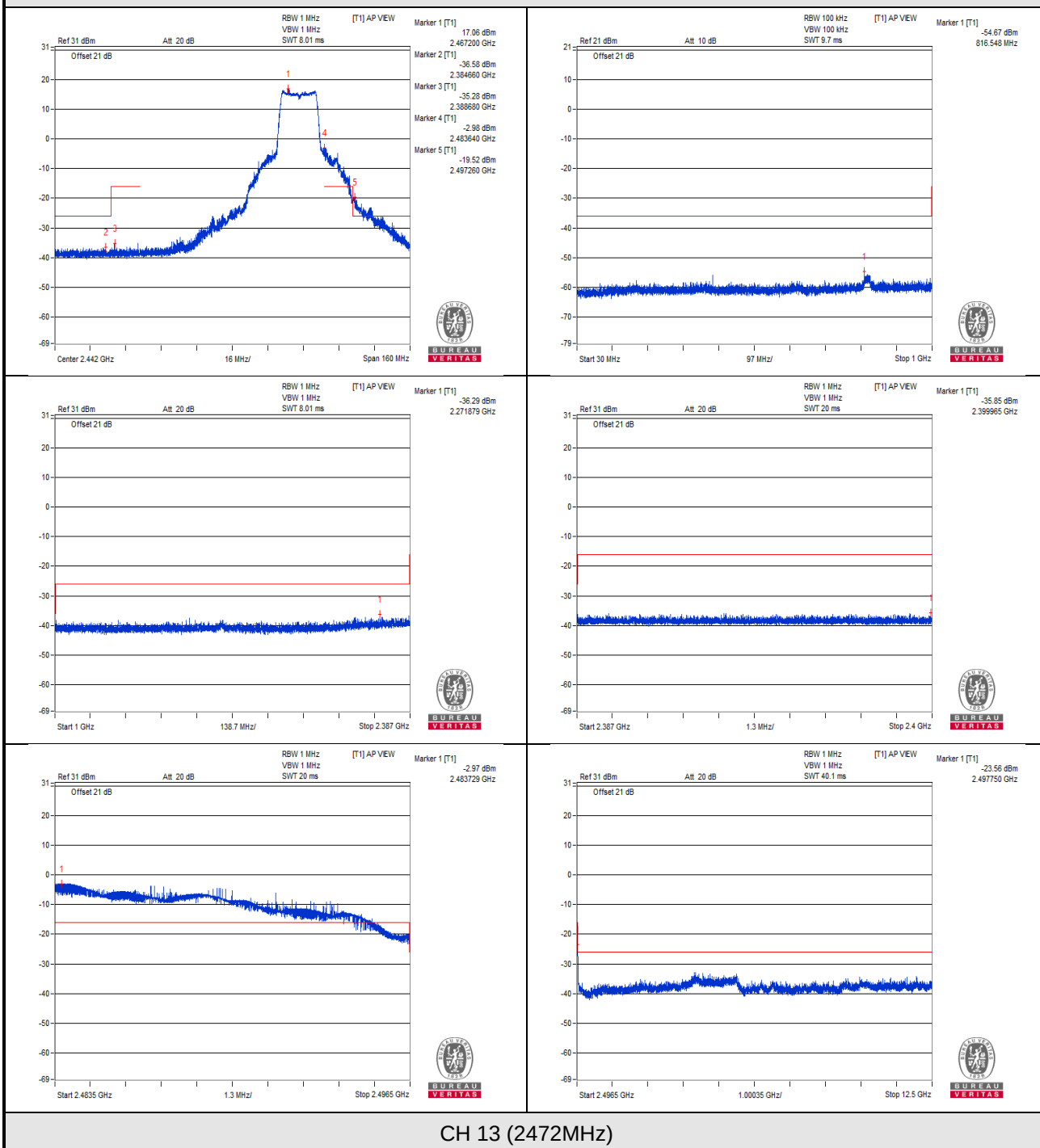
V_{max}.



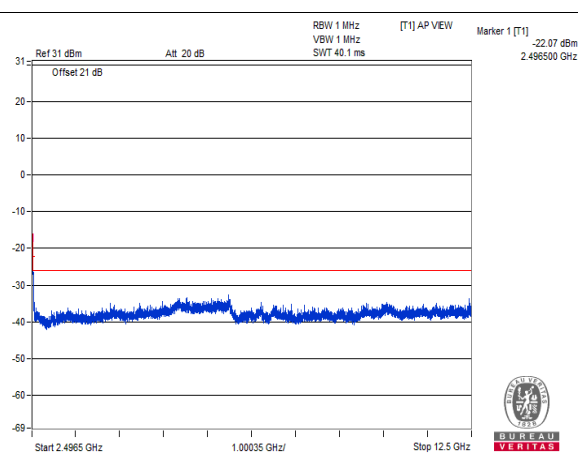
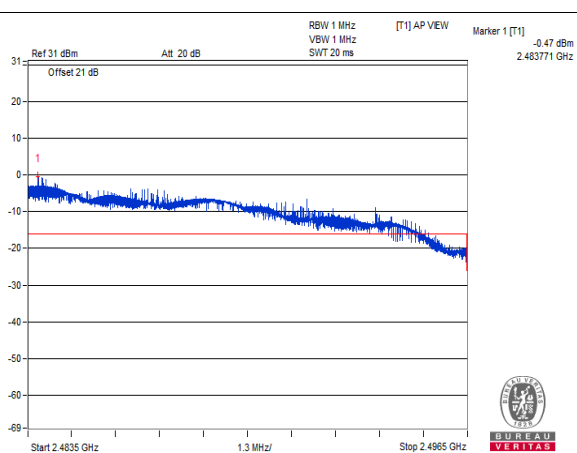
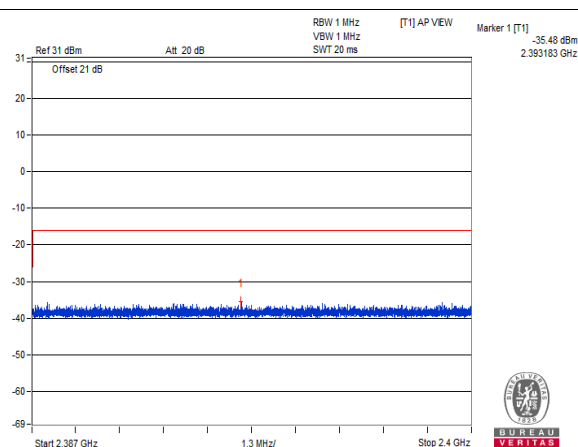
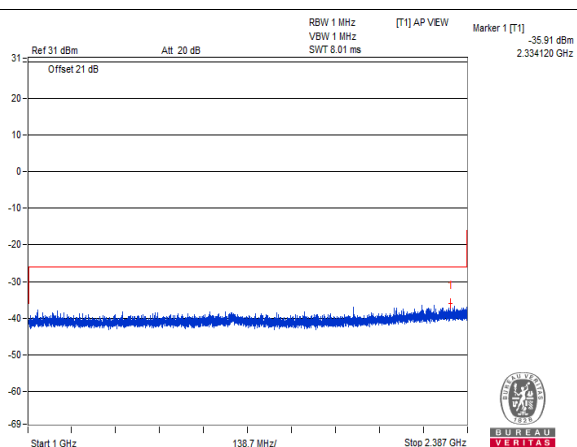
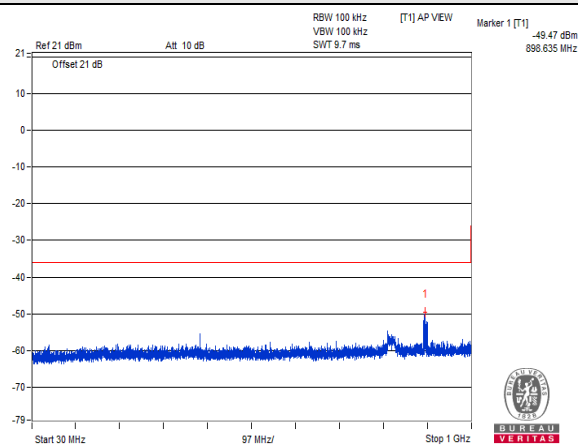
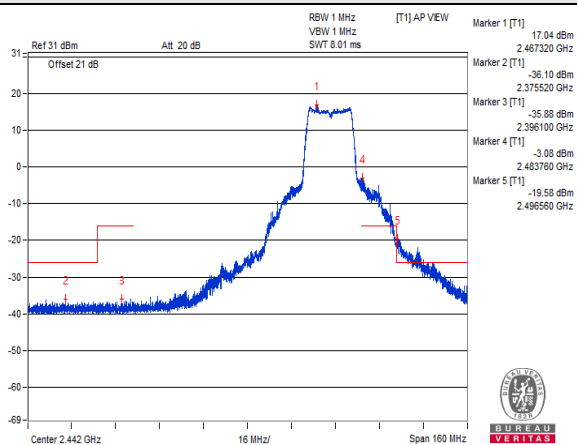
V_{min}.



Vnormal

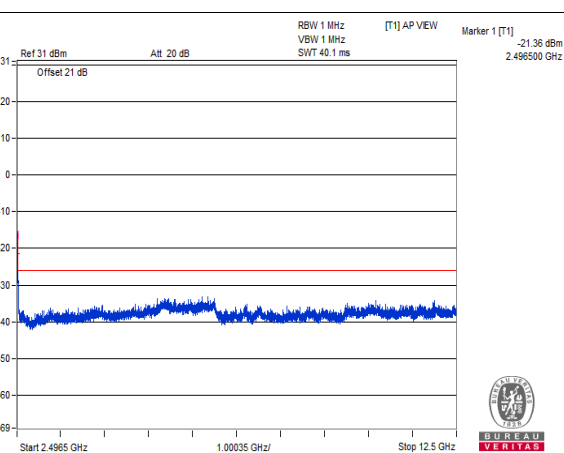
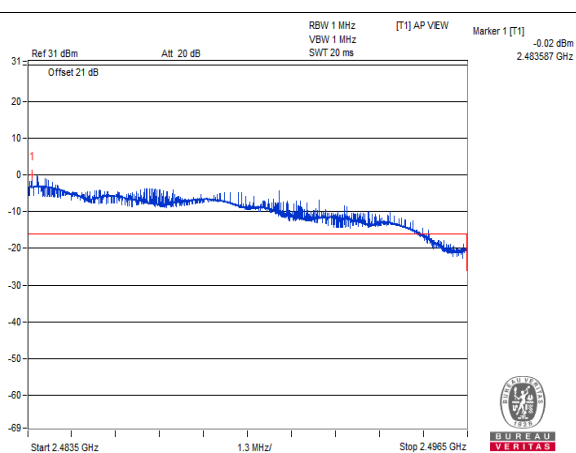
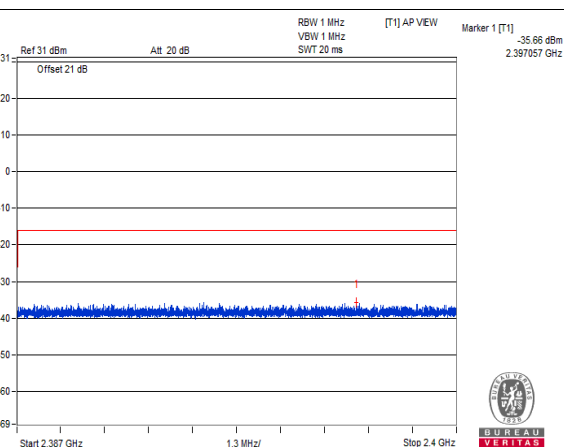
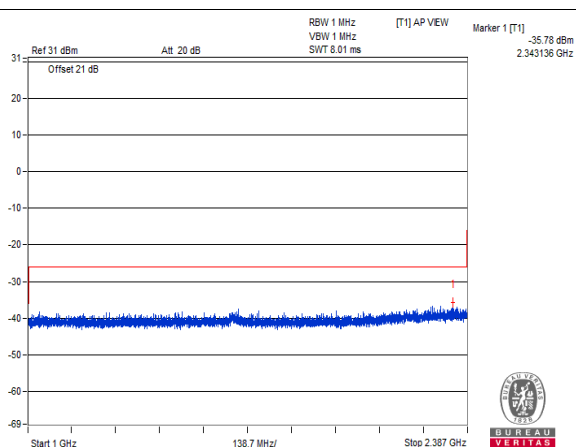
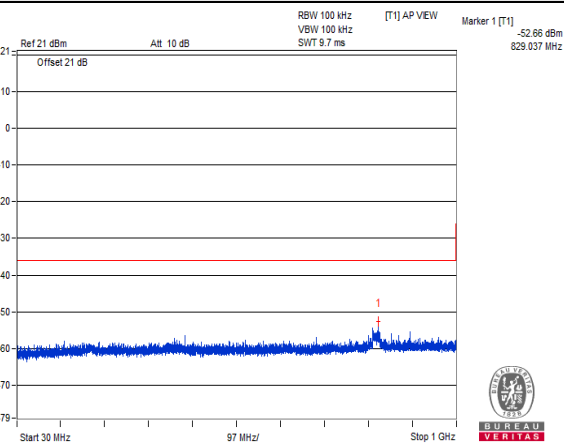
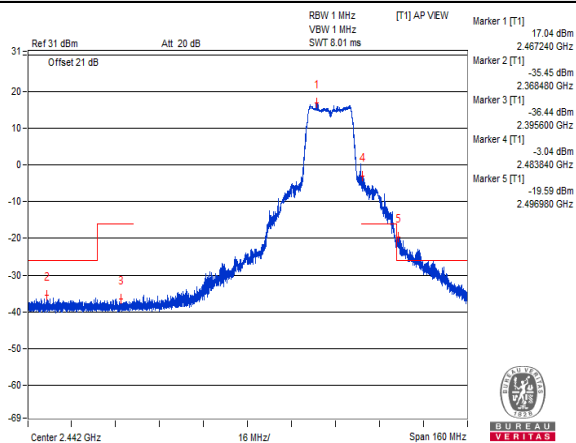


V_{max}.



CH 13 (2472MHz)

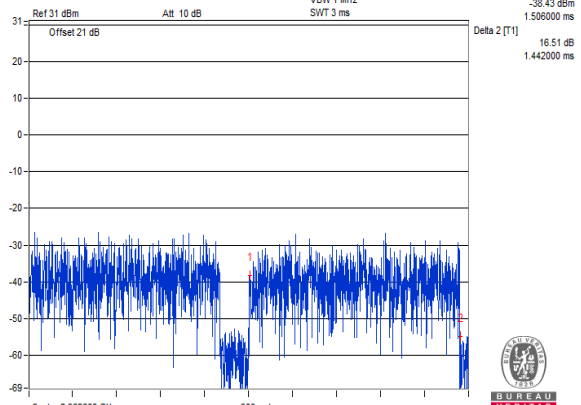
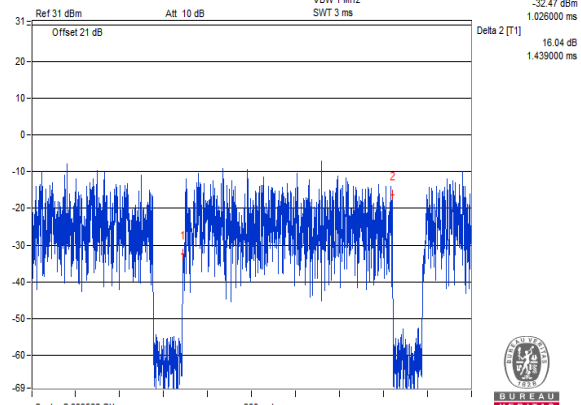
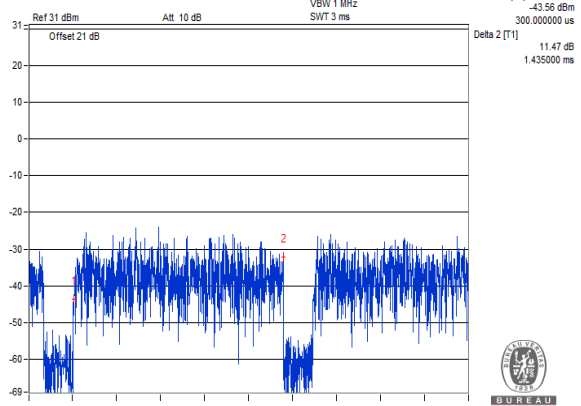
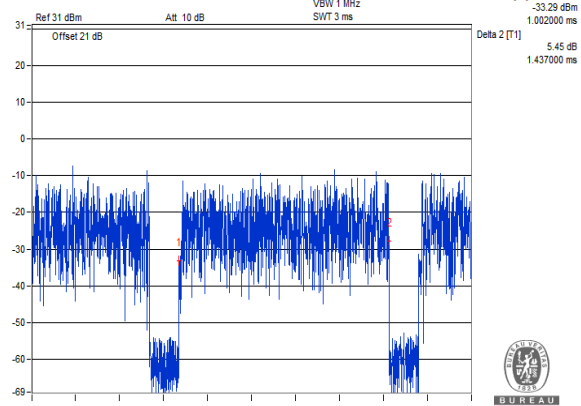
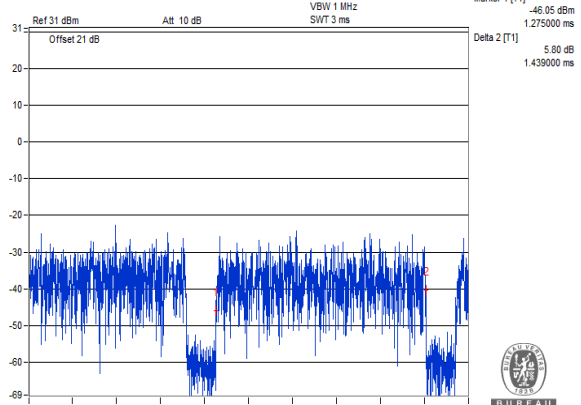
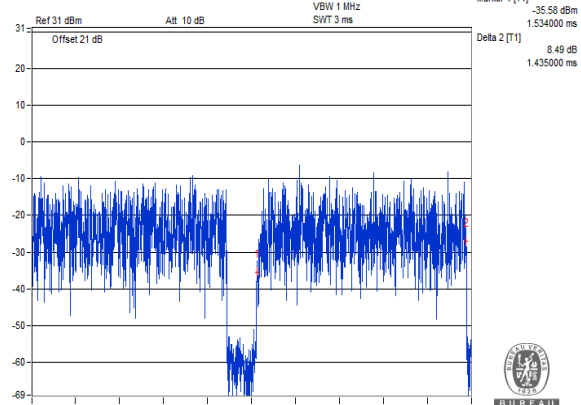
V_{min}.



CH 13 (2472MHz)

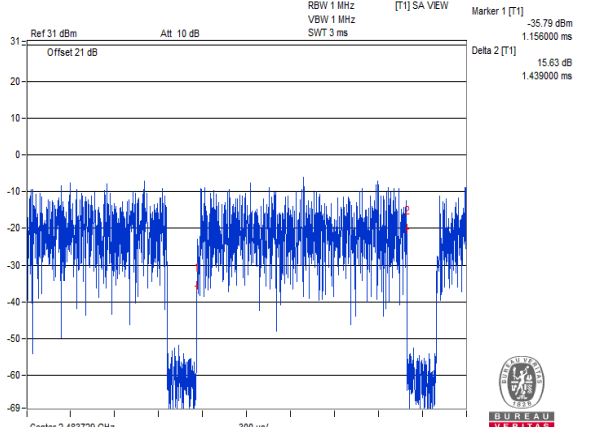
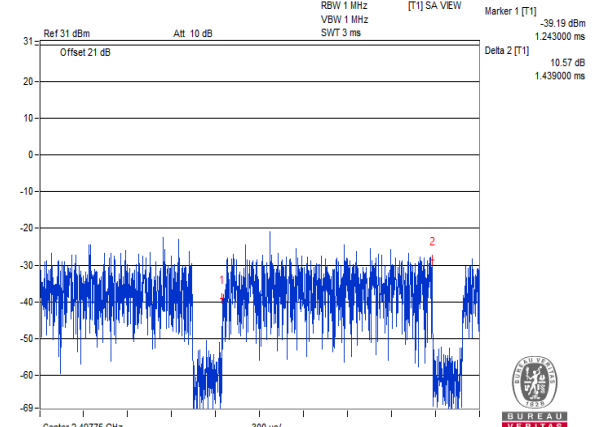
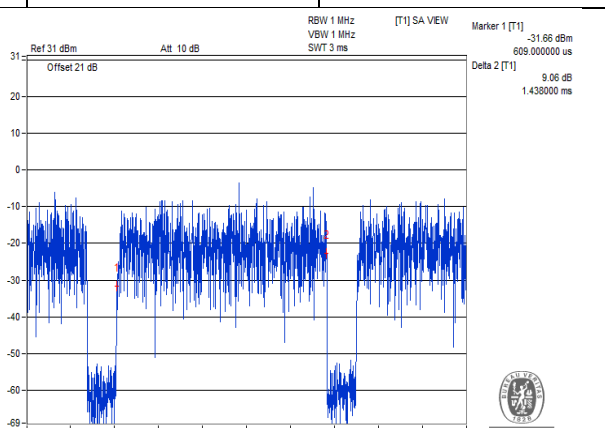
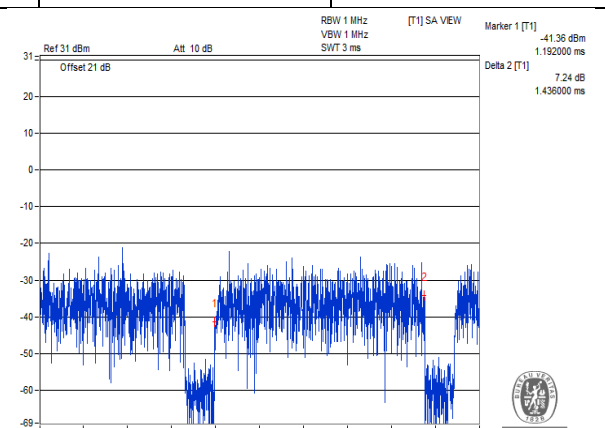
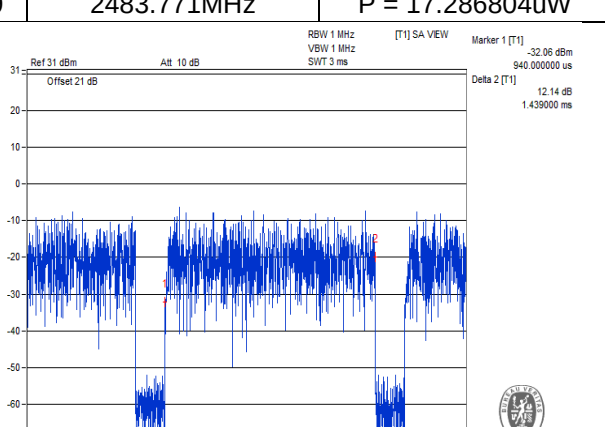
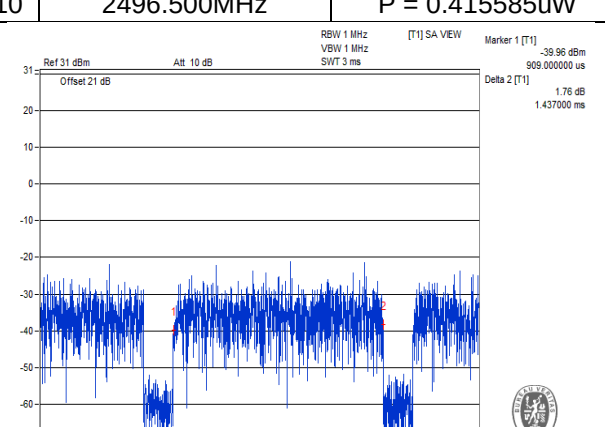
Measuring Mode *Zero Span

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.

	
1 2382.665MHz P = 0.169903uW	2 2399.566MHz P = 8.539318uW
	
3 2385.266MHz P = 0.300276uW	4 2399.670MHz P = 9.296857uW
	
5 2385.266MHz P = 0.289672uW	6 2399.608MHz P = 9.074607uW

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.

					
7	2483.729MHz	P = 17.169401uW	8	2497.750MHz	P = 0.389275uW
					
9	2483.771MHz	P = 17.286804uW	10	2496.500MHz	P = 0.415585uW
					
11	2483.587MHz	P = 18.208468uW	12	2496.500MHz	P = 0.447306uW

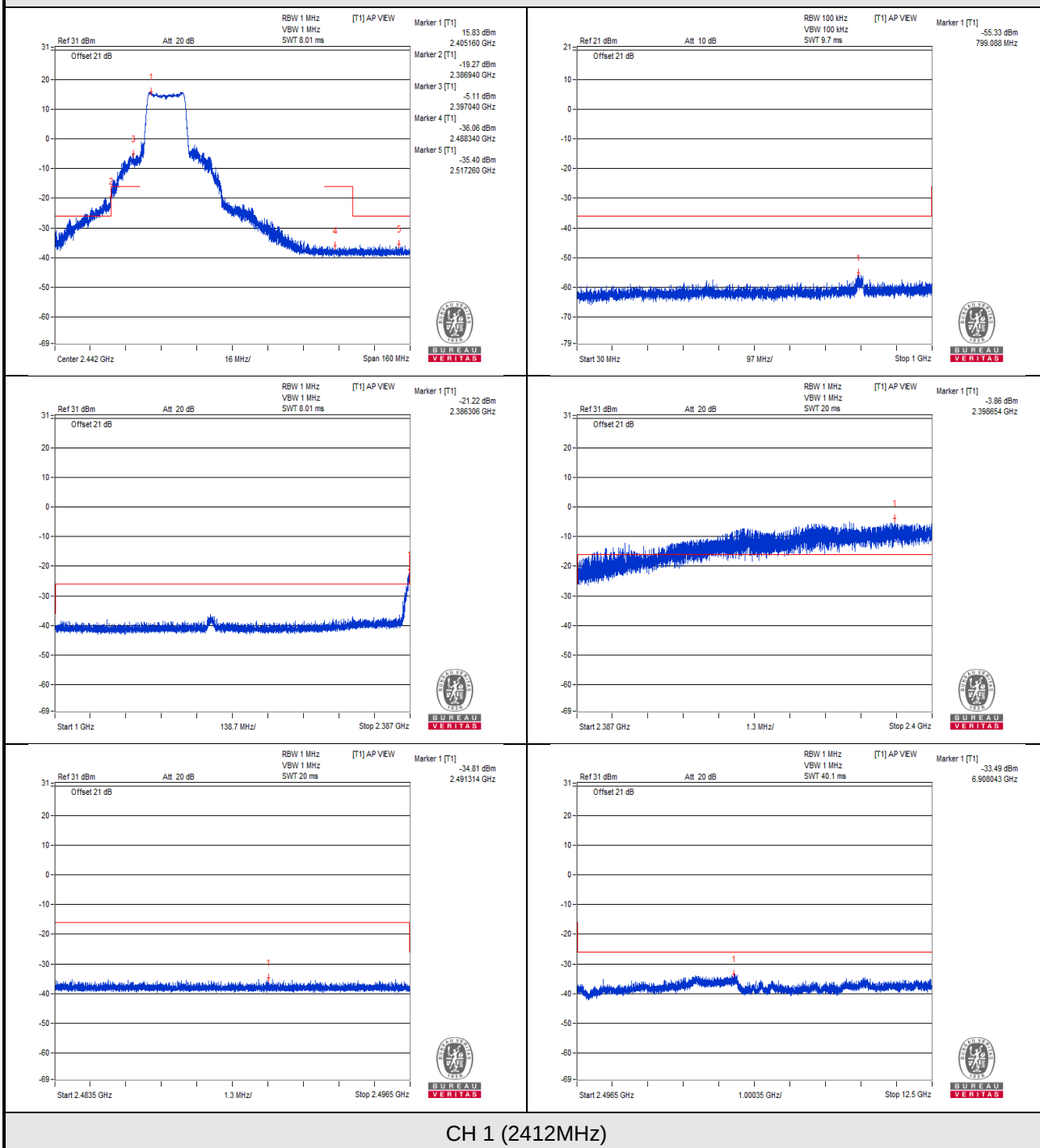
802.11n (HT20)

TEST CHANNEL		CH 1 (2412MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE(μ W)	LIMIT (μ W)	RESULT
V_{normal}	30.0 to 1000.0	799.088	0.002931	0.25	PASS
	1000.0 to 2387.0	2386.306	0.353649	2.5	PASS(1)
	2387.0 to 2400.0	2398.654	7.724418	25	PASS(2)
	2483.5 to 2496.5	2491.314	0.330370	25	PASS
	2496.5 to 12500.0	6908.043	0.447713	2.5	PASS
V_{max.}	30.0 to 1000.0	800.907	0.003532	0.25	PASS
	1000.0 to 2387.0	2383.705	0.241510	2.5	PASS(3)
	2387.0 to 2400.0	2398.719	7.578200	25	PASS(4)
	2483.5 to 2496.5	2488.865	0.303389	25	PASS
	2496.5 to 12500.0	6974.316	0.602560	2.5	PASS
V_{min.}	30.0 to 1000.0	809.152	0.003373	0.25	PASS
	1000.0 to 2387.0	2387.000	0.409324	2.5	PASS(5)
	2387.0 to 2400.0	2399.387	8.542555	25	PASS(6)
	2483.5 to 2496.5	2493.167	0.329610	25	PASS
	2496.5 to 12500.0	6976.817	0.542001	2.5	PASS
TEST CHANNEL		CH 7 (2442MHz)			
V_{normal}	30.0 to 1000.0	821.277	0.003707	0.25	PASS
	1000.0 to 2387.0	2255.755	0.252930	2.5	PASS
	2387.0 to 2400.0	2398.626	2.312065	25	PASS
	2483.5 to 2496.5	2484.263	2.443431	25	PASS
	2496.5 to 12500.0	6695.469	0.519996	2.5	PASS
V_{max.}	30.0 to 1000.0	807.818	0.002780	0.25	PASS
	1000.0 to 2387.0	2383.705	0.286418	2.5	PASS
	2387.0 to 2400.0	2398.732	2.269865	25	PASS
	2483.5 to 2496.5	2485.750	2.254239	25	PASS
	2496.5 to 12500.0	11360.851	0.419759	2.5	PASS
V_{min.}	30.0 to 1000.0	809.152	0.003214	0.25	PASS
	1000.0 to 2387.0	2345.216	0.242661	2.5	PASS
	2387.0 to 2400.0	2398.610	2.355049	25	PASS
	2483.5 to 2496.5	2487.008	2.648500	25	PASS
	2496.5 to 12500.0	5846.422	0.505825	2.5	PASS

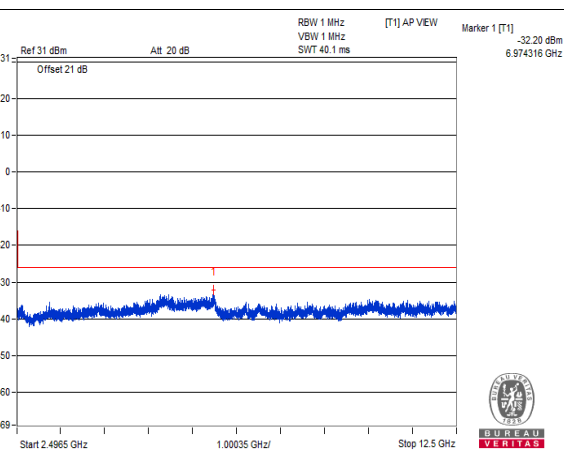
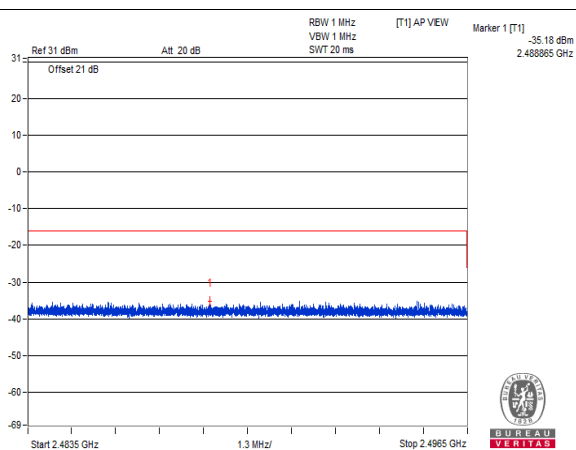
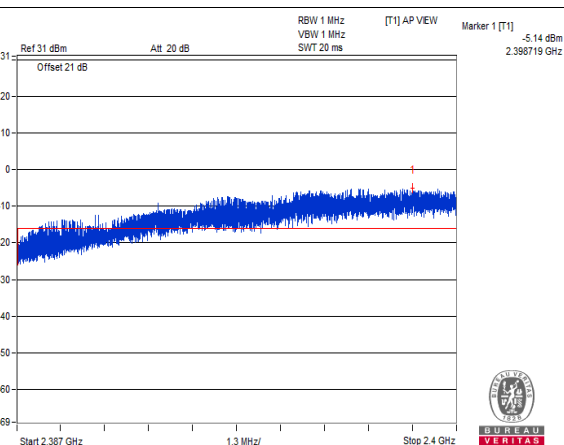
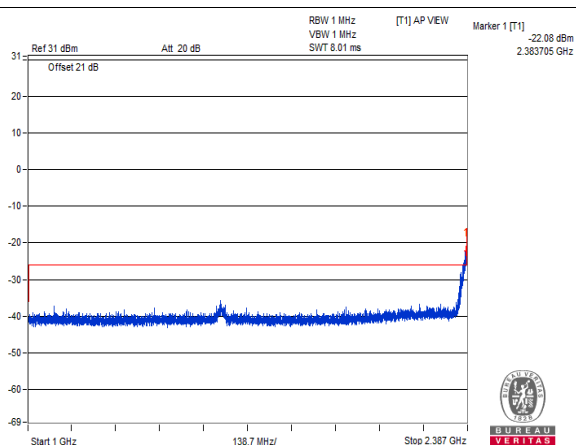
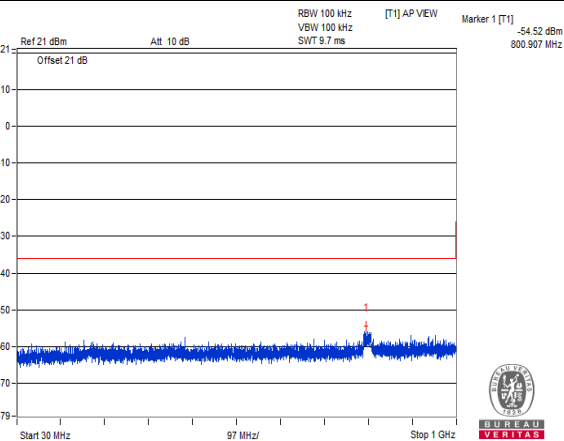
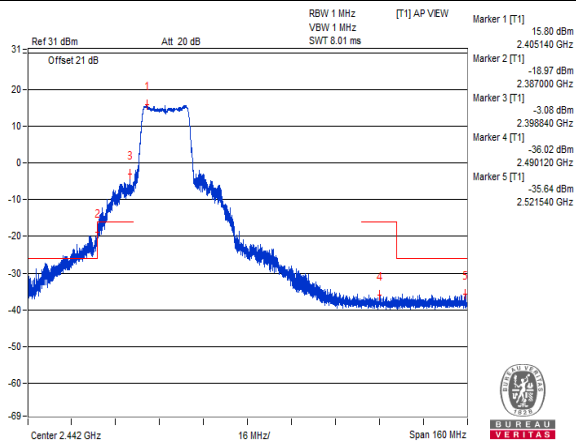
TEST CHANNEL		CH 13 (2472MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE(uW)	LIMIT (uW)	RESULT
V_{normal}	30.0 to 1000.0	829.037	0.003243	0.25	PASS
	1000.0 to 2387.0	2299.098	0.233884	2.5	PASS
	2387.0 to 2400.0	2394.819	0.334965	25	PASS
	2483.5 to 2496.5	2484.426	13.325735	25	PASS(7)
	2496.5 to 12500.0	2496.500	0.707111	2.5	PASS(8)
V_{max.}	30.0 to 1000.0	821.883	0.002679	0.25	PASS
	1000.0 to 2387.0	2365.154	0.197697	2.5	PASS
	2387.0 to 2400.0	2399.081	0.343558	25	PASS
	2483.5 to 2496.5	2486.051	12.464238	25	PASS(9)
	2496.5 to 12500.0	2496.500	0.724651	2.5	PASS(10)
V_{min.}	30.0 to 1000.0	824.793	0.003524	0.25	PASS
	1000.0 to 2387.0	2274.132	0.220293	2.5	PASS
	2387.0 to 2400.0	2393.625	0.301995	25	PASS
	2483.5 to 2496.5	2484.611	12.785346	25	PASS(11)
	2496.5 to 12500.0	2496.500	0.681656	2.5	PASS(12)

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

Vnormal

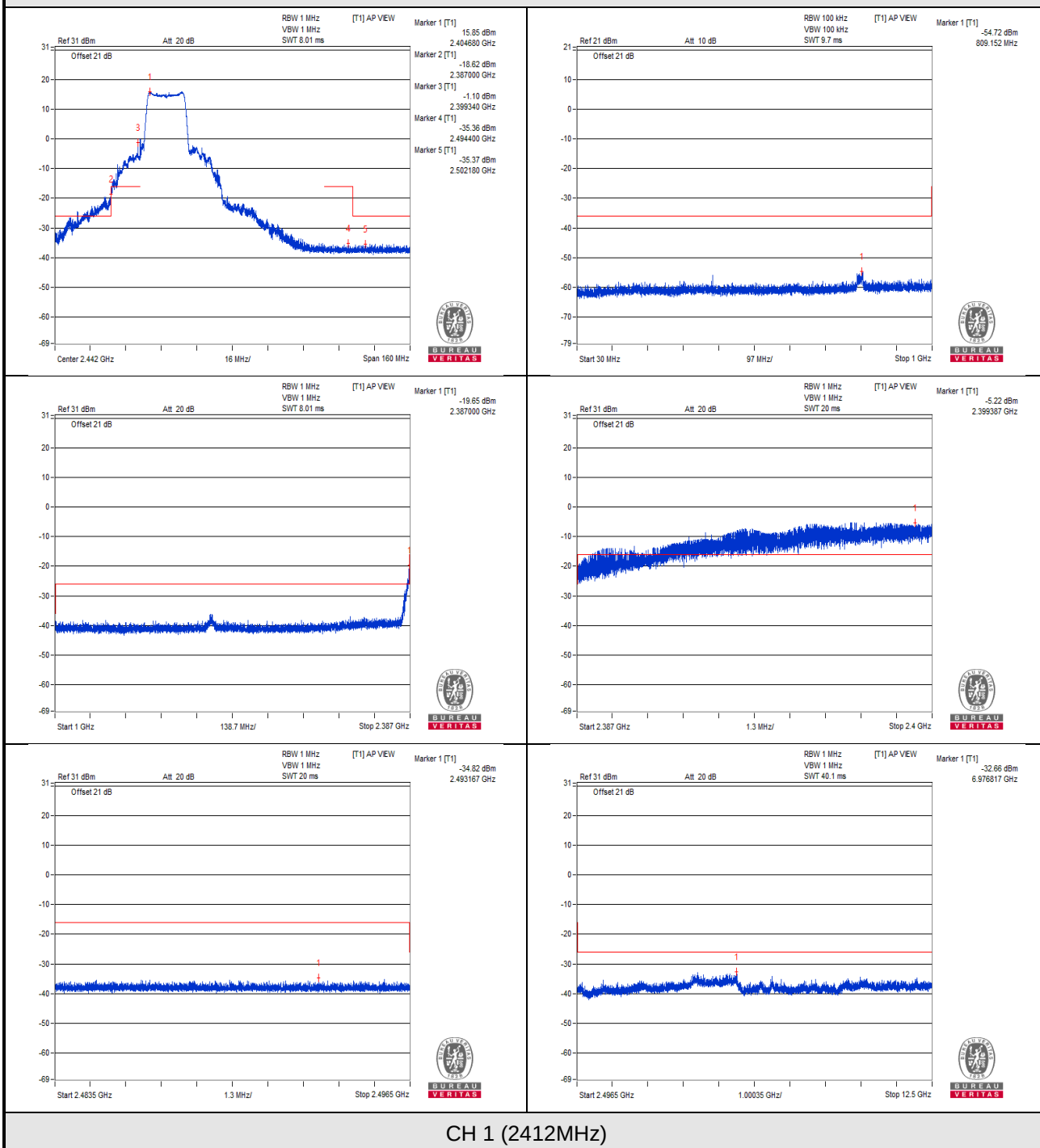


V_{max}.

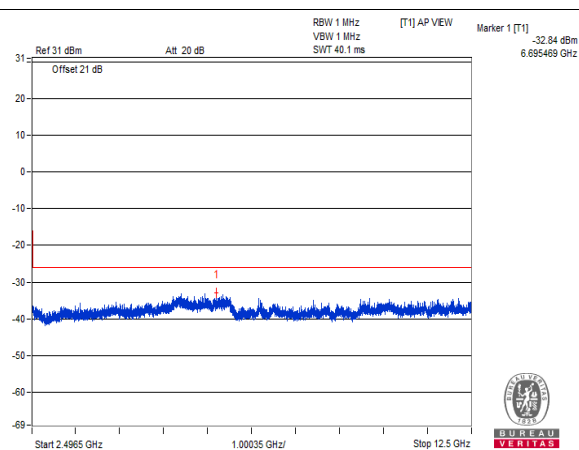
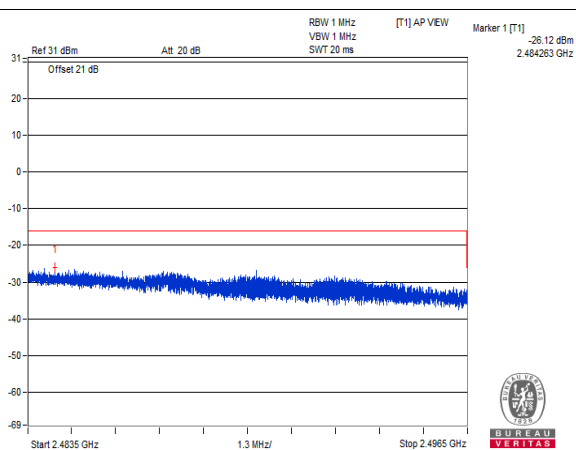
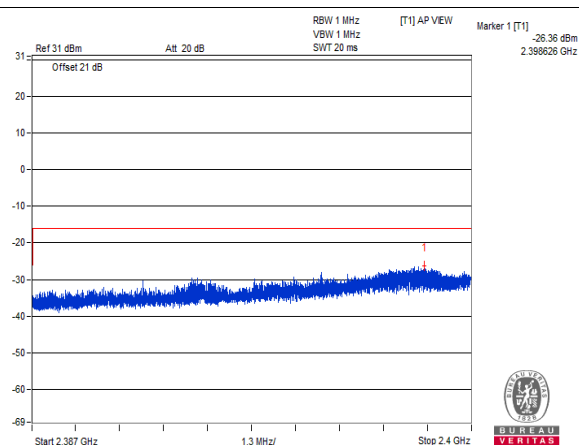
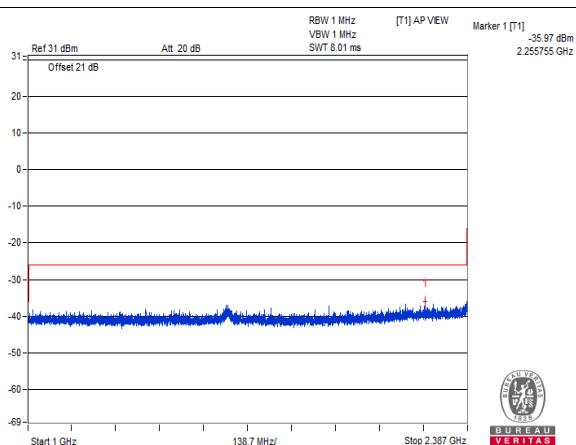
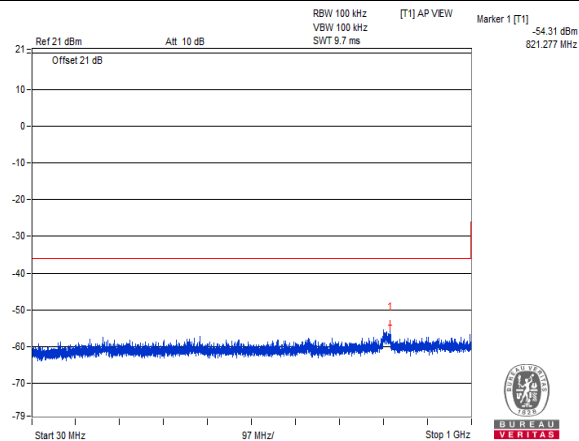
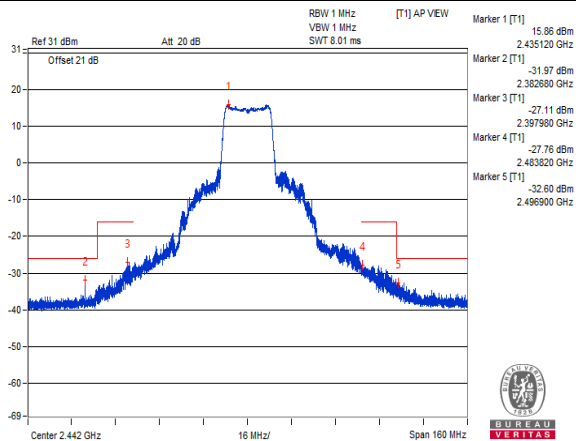


CH 1 (2412MHz)

V_{min}.

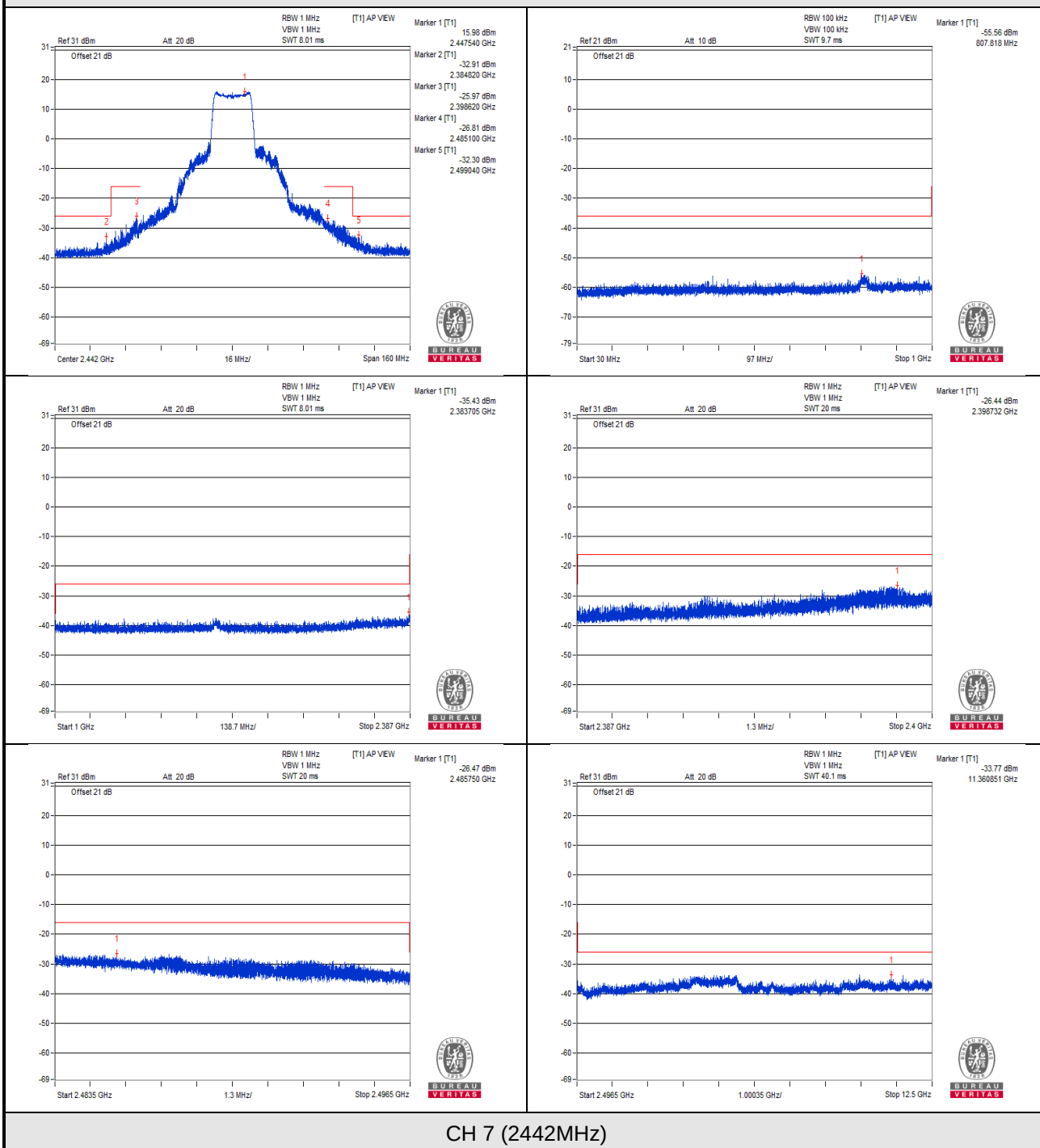


Vnormal

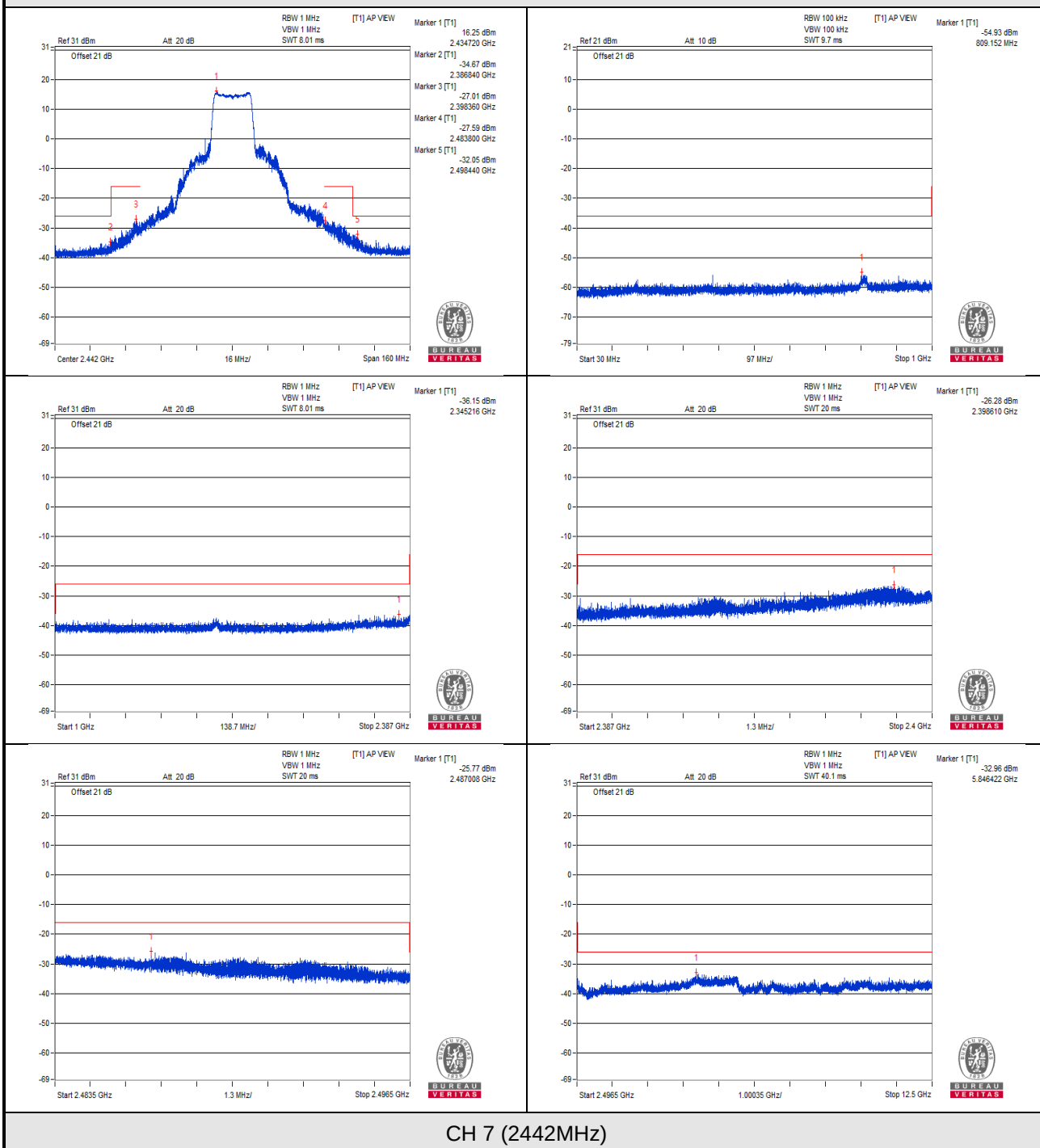


CH 7 (2442MHz)

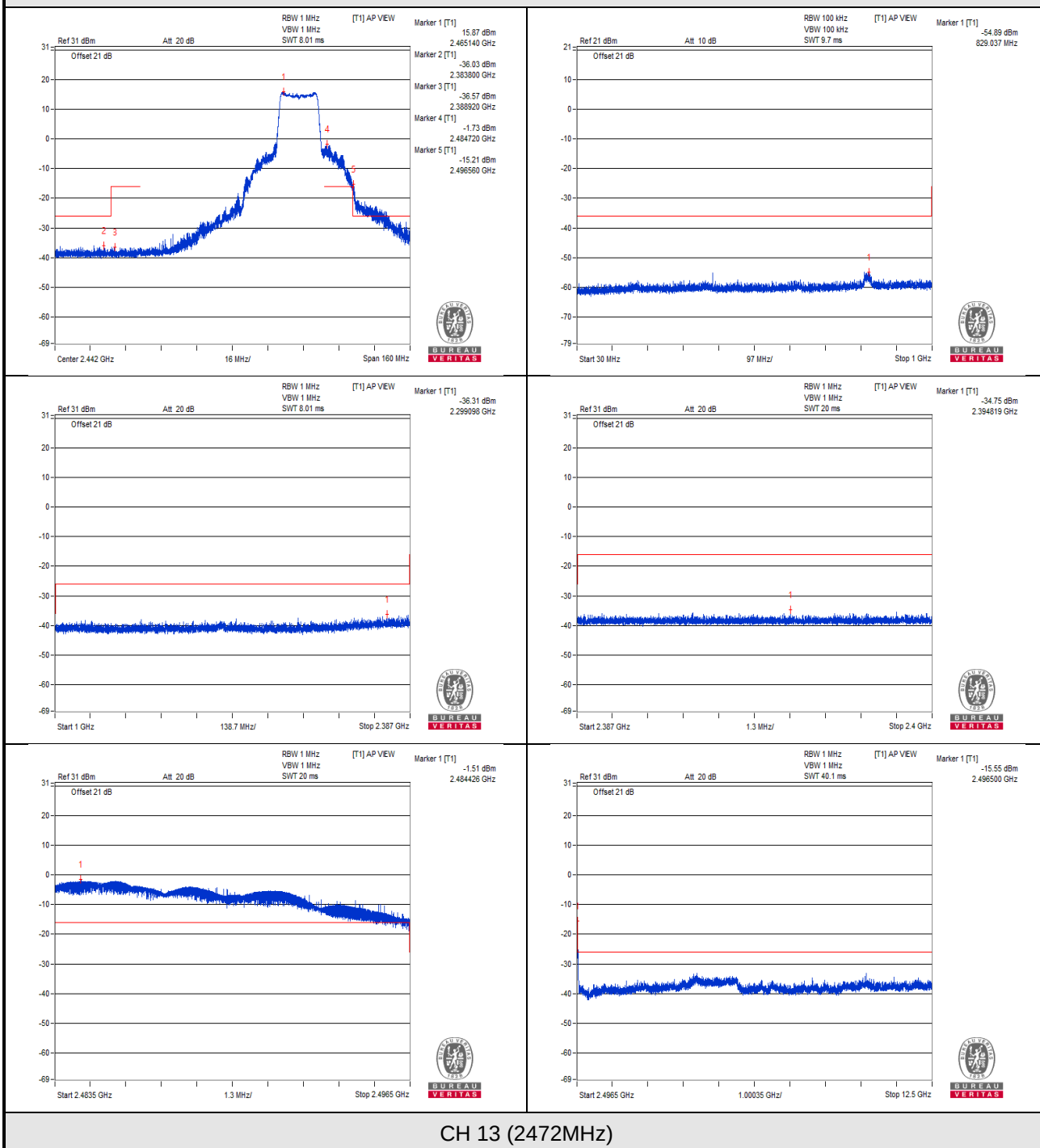
V_{max}.



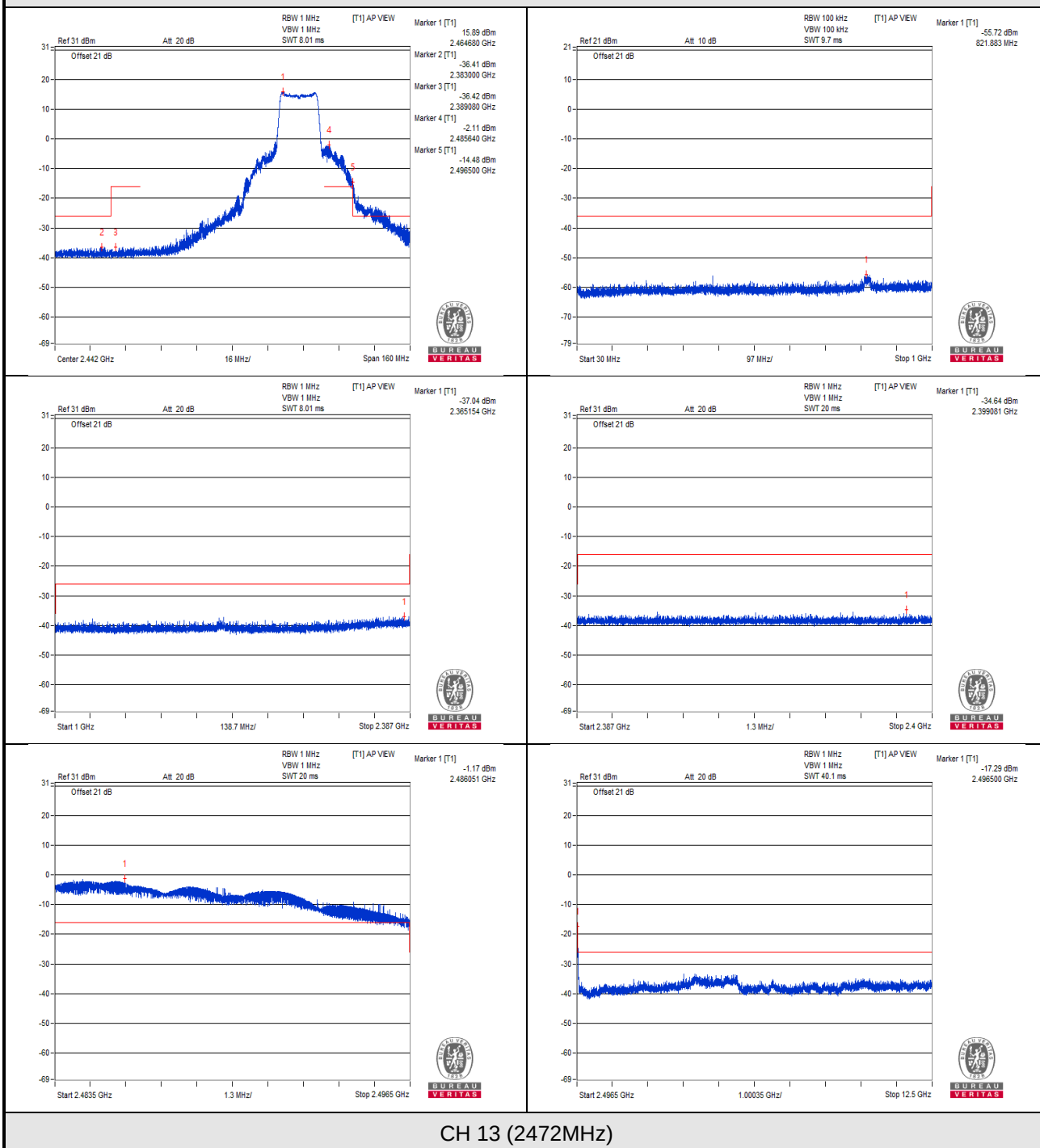
V_{min}.



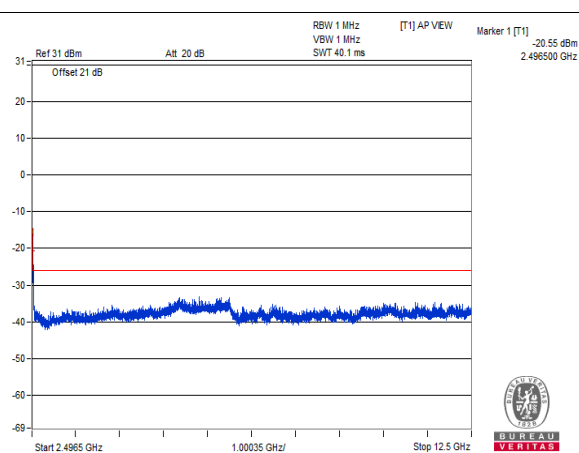
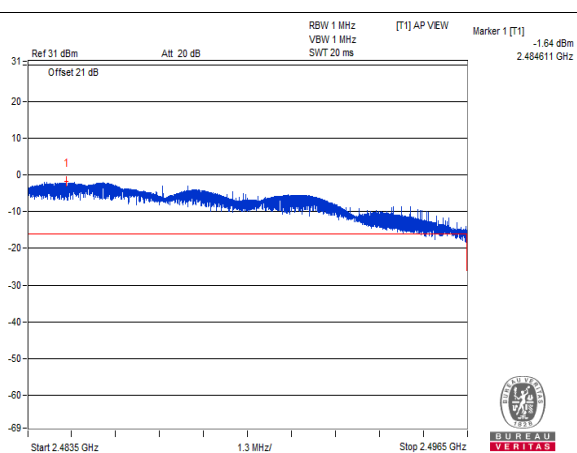
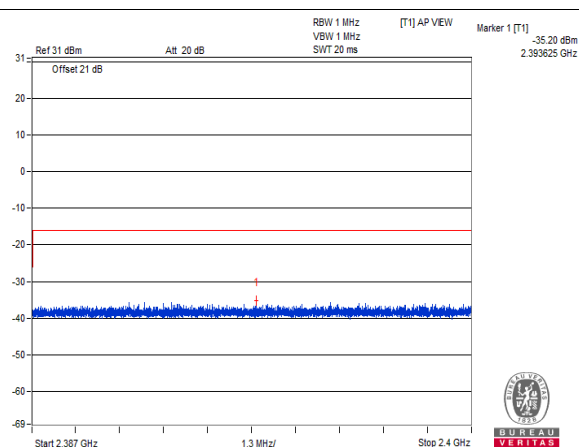
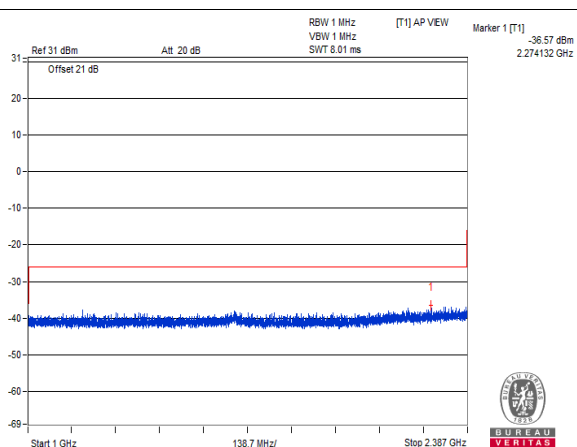
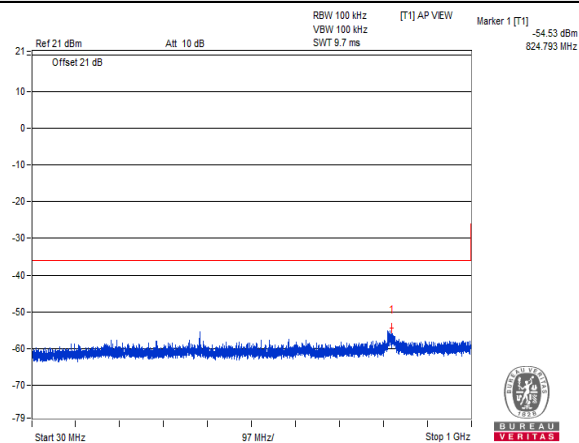
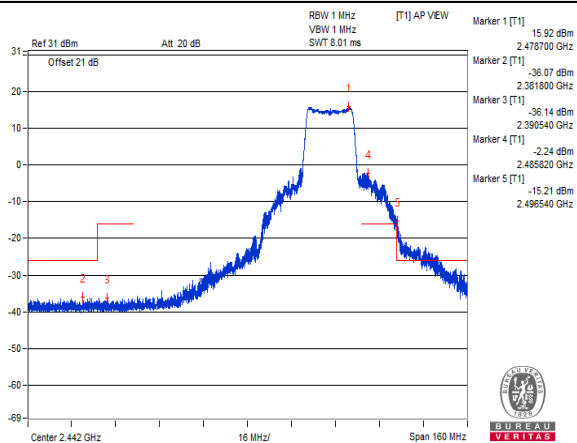
Vnormal



V_{max}.



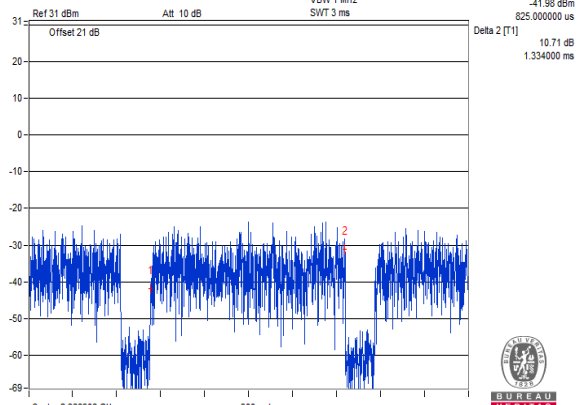
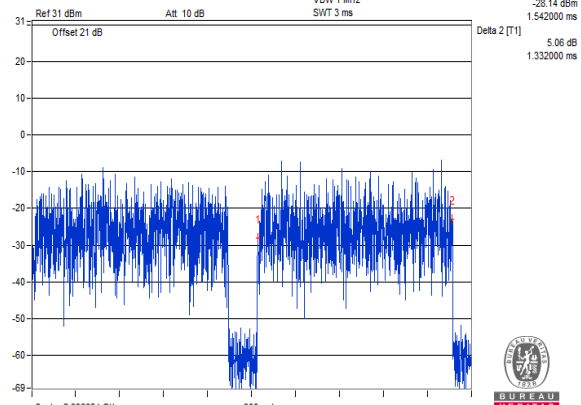
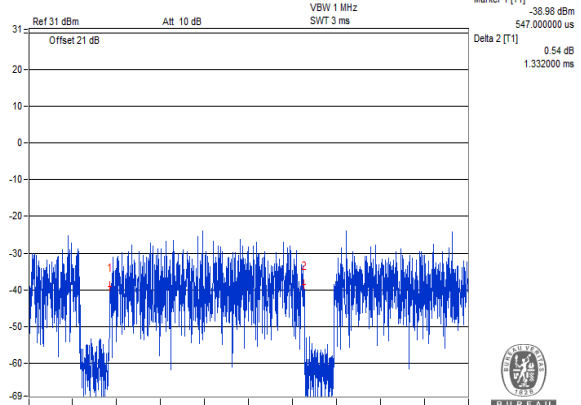
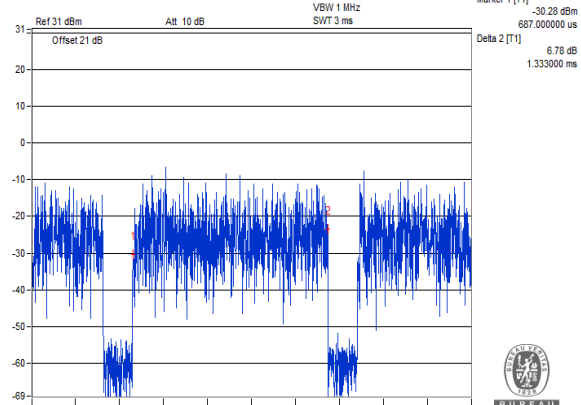
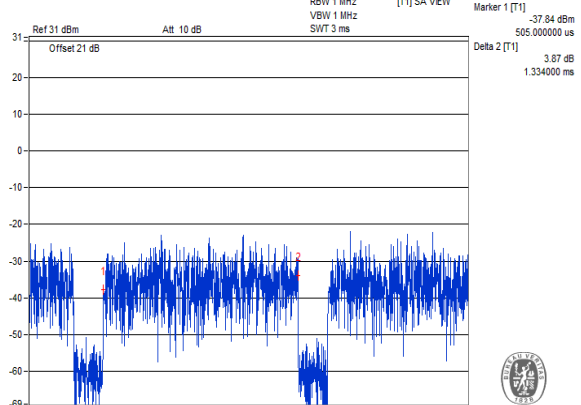
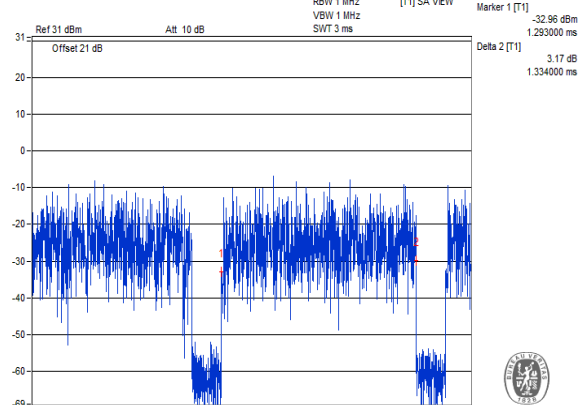
V_{min}.



CH 13 (2472MHz)

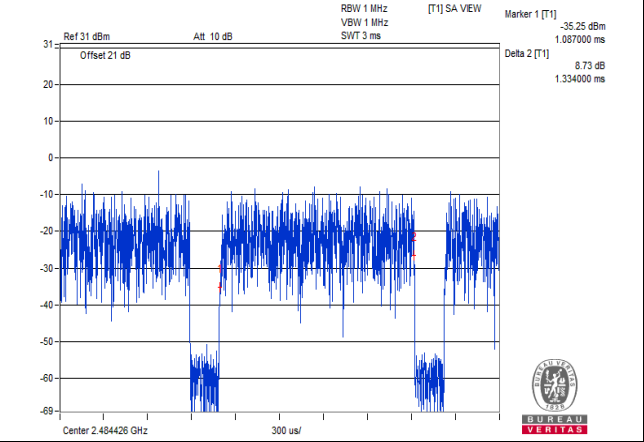
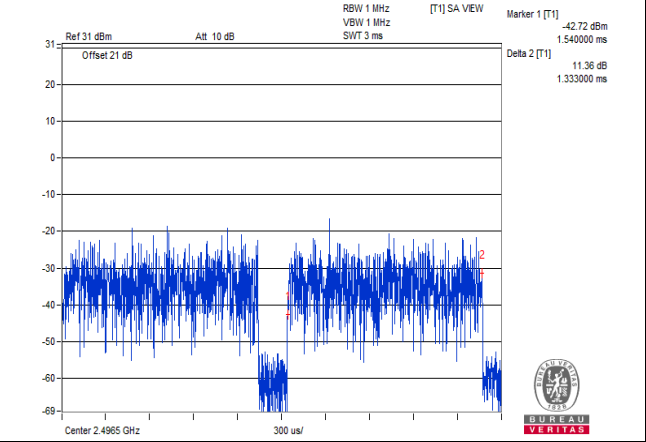
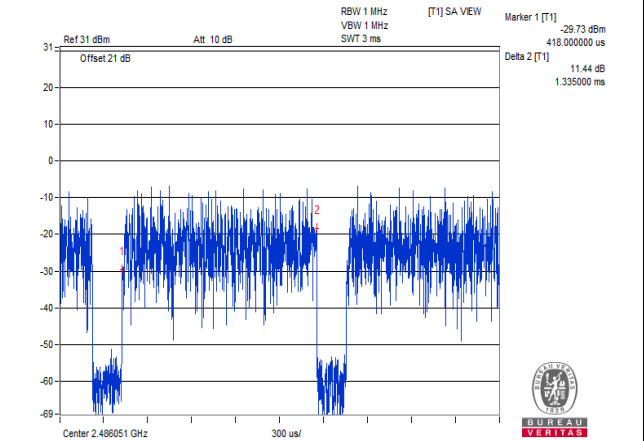
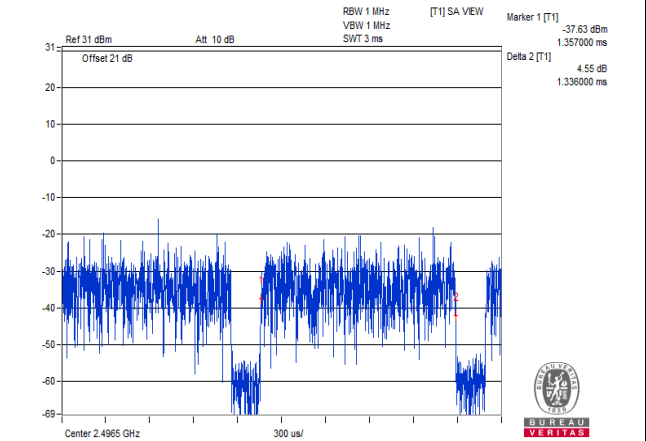
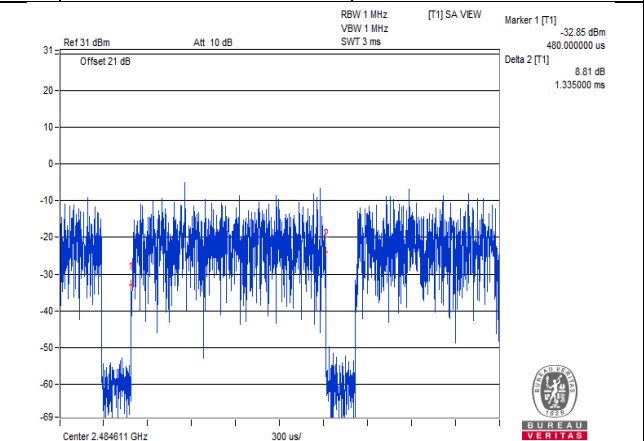
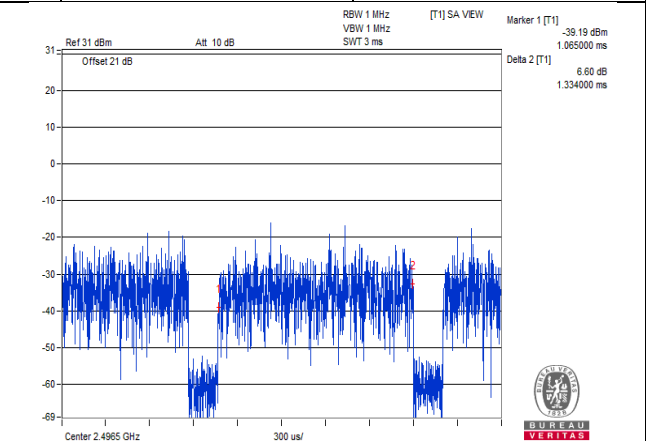
Measuring Mode *Zero Span

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.

	
1 2386.306MHz P = 0.353649uW	2 2398.654MHz P = 7.724418uW
	
3 2383.705MHz P = 0.24151uW	4 2398.719MHz P = 7.5782uW
	
5 2387.000MHz P = 0.409324uW	6 2399.387MHz P = 8.542555uW

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.

	
7 2484.426MHz P = 13.325735uW	8 2496.500MHz P = 0.707111uW
	
9 2486.051MHz P = 12.464238uW	10 2496.500MHz P = 0.724651uW
	
11 2484.611MHz P = 12.785346uW	12 2496.500MHz P = 0.681656uW

4.5 Antenna Power Measurement

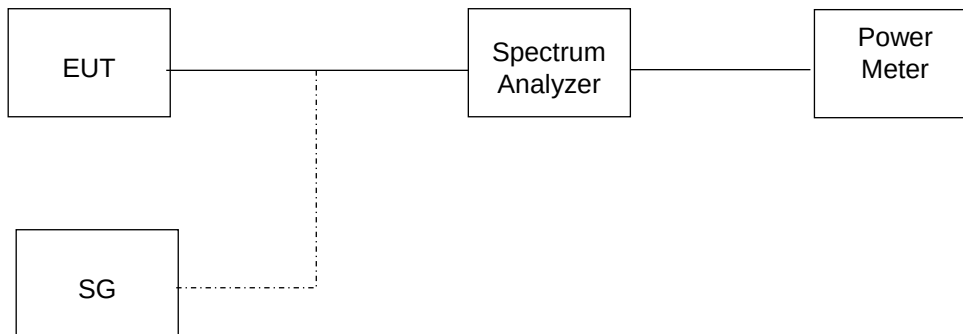
4.5.1 Limits of Antenna Power

Modulation Method	Frequency Band Used	Antenna Power (Max.)	EIRP Limit (Note 3)
DSSS	2400 – 2483.5 MHz	10mW/MHz	12.14 dBm/MHz ~ 22.14 dBm/MHz (16.368 mW/MHz ~ 163.68 mW/MHz)
OFDM (Note 1)	2400 – 2483.5 MHz	10mW/MHz	12.14 dBm/MHz ~ 22.14 dBm/MHz (16.368 mW/MHz ~ 163.68 mW/MHz)
OFDM (Note 2)	2400 – 2483.5 MHz	5mW/MHz	9.13 dBm/MHz ~ 19.13 dBm/MHz (8.203 mW/MHz ~ 82.03 mW/MHz)

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).

4.5.2 Test Setup



4.5.3 Test Results

802.11b

Voltage (Vdc)	Channel Number	Frequency (MHz)	Conducted RF Output Power Density (mW/MHz)	Radiated RF Output Power Density (mW/MHz)
5	1	2412	6.67	15.28
	7	2442	6.716	15.385
	13	2472	6.794	15.564
5.5	1	2412	6.593	15.104
	7	2442	7.081	16.222
	13	2472	7.032	16.109
4.5	1	2412	6.428	14.726
	7	2442	7.016	16.073
	13	2472	6.473	14.829
Max. Limit (mW/MHz):			10	-
Rated Power (mW/MHz):			7.1	-
Tolerance of Antenna Power (mW/MHz):			1.42 ~ 8.52	-
Max. EIRP Limit (mW/MHz):			-	16.368

Note: 1. Antenna gain is 3.6 dBi.

2. The radiated RF output power density is a “calculated” value derived from the conducted value.

3. Formula: Radiated RF output power density = Conducted RF output power density + Antenna gain

802.11g

Voltage (Vdc)	Channel Number	Frequency (MHz)	Conducted RF Output Power Density (mW/MHz)	Radiated RF Output Power Density (mW/MHz)
5	1	2412	6.968	15.963
	7	2442	6.872	15.743
	13	2472	6.608	15.138
5.5	1	2412	6.608	15.138
	7	2442	7	16.036
	13	2472	6.563	15.035
4.5	1	2412	6.624	15.175
	7	2442	6.825	15.635
	13	2472	6.856	15.706
Max. Limit (mW/MHz):			10	-
Rated Power (mW/MHz):			7	-
Tolerance of Antenna Power (mW/MHz):			1.4 ~ 8.4	-
Max. EIRP Limit (mW/MHz):			-	16.368

Note: 1. Antenna gain is 3.6 dBi.

2. The radiated RF output power density is a "calculated" value derived from the conducted value.

3. Formula: Radiated RF output power density = Conducted RF output power density + Antenna gain

802.11n (HT20)

Voltage (Vdc)	Channel Number	Frequency (MHz)	Conducted RF Output Power Density (mW/MHz)	Radiated RF Output Power Density (mW/MHz)
5	1	2412	6.326	14.492
	7	2442	6.654	15.243
	13	2472	6.563	15.035
5.5	1	2412	6.428	14.726
	7	2442	6.414	14.694
	13	2472	6.533	14.966
4.5	1	2412	6.488	14.863
	7	2442	6.747	15.456
	13	2472	6.443	14.76
Max. Limit (mW/MHz):			10	-
Rated Power (mW/MHz):			7	-
Tolerance of Antenna Power (mW/MHz):			1.4 ~ 8.4	-
Max. EIRP Limit (mW/MHz):			-	16.368

Note: 1. Antenna gain is 3.6 dBi.

2. The radiated RF output power density is a “calculated” value derived from the conducted value.

3. Formula: Radiated RF output power density = Conducted RF output power density + Antenna gain

4.6 Spurious Emissions for Receiver

4.6.1 Limits of Spurious Emissions for Receiver

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

4.6.2 Test Setup

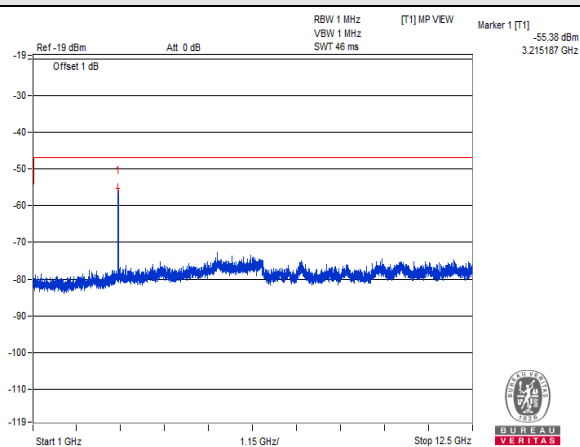
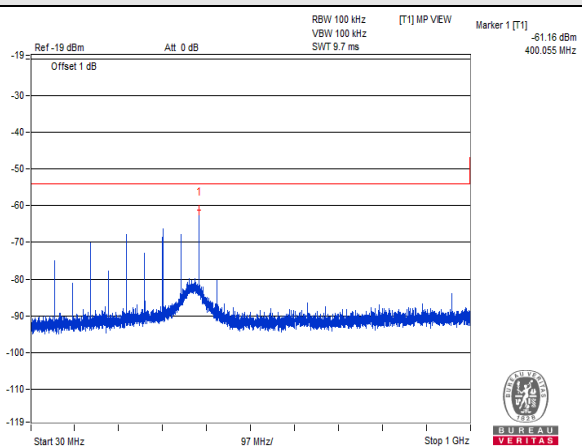


4.6.3 Test Result

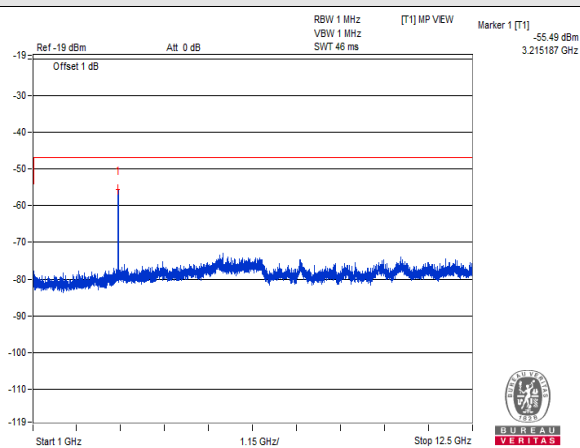
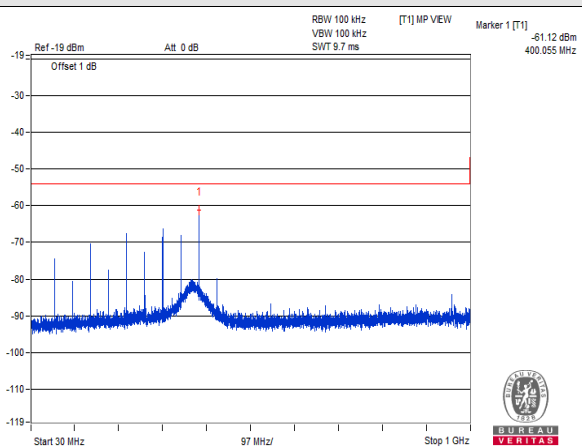
802.11b / 802.11g and 802.11n (HT20)

TEST CHANNEL		CH 1 (2412MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE(nW)	LIMIT (nW)	RESULT
V_{normal}	30.0 to 1000.0	400.055	0.765597	4.0	PASS
	1000.0 to 12500.0	3215.187	2.897344	20.0	PASS
$V_{max.}$	30.0 to 1000.0	400.055	0.772681	4.0	PASS
	1000.0 to 12500.0	3215.187	2.824880	20.0	PASS
$V_{min.}$	30.0 to 1000.0	400.055	0.776247	4.0	PASS
	1000.0 to 12500.0	3215.187	2.824880	20.0	PASS
TEST CHANNEL		CH 7 (2442MHz)			
V_{normal}	30.0 to 1000.0	400.055	0.872971	4.0	PASS
	1000.0 to 12500.0	3255.437	2.208005	20.0	PASS
$V_{max.}$	30.0 to 1000.0	400.055	0.853100	4.0	PASS
	1000.0 to 12500.0	3255.437	2.269865	20.0	PASS
$V_{min.}$	30.0 to 1000.0	400.055	0.833681	4.0	PASS
	1000.0 to 12500.0	3255.437	2.280342	20.0	PASS
TEST CHANNEL		CH 13 (2472MHz)			
V_{normal}	30.0 to 1000.0	400.055	0.897429	4.0	PASS
	1000.0 to 12500.0	3295.687	1.896706	20.0	PASS
$V_{max.}$	30.0 to 1000.0	400.055	0.872971	4.0	PASS
	1000.0 to 12500.0	3295.687	1.949845	20.0	PASS
$V_{min.}$	30.0 to 1000.0	400.055	0.897429	4.0	PASS
	1000.0 to 12500.0	3295.687	1.923092	20.0	PASS

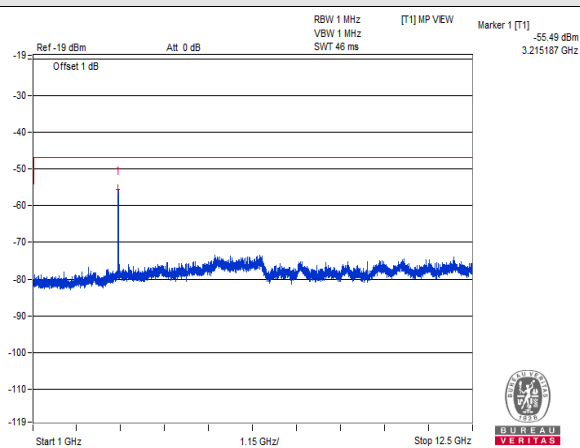
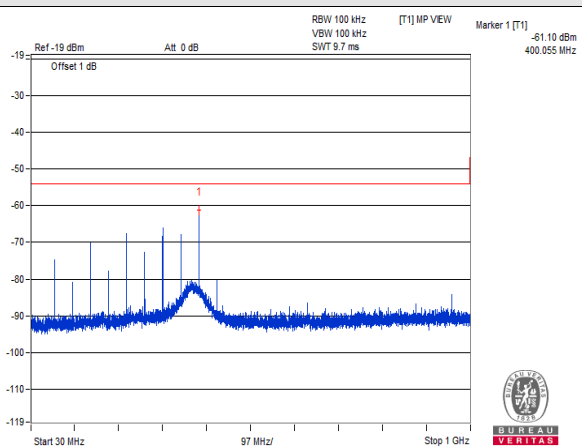
V_{normal}



V_{max.}

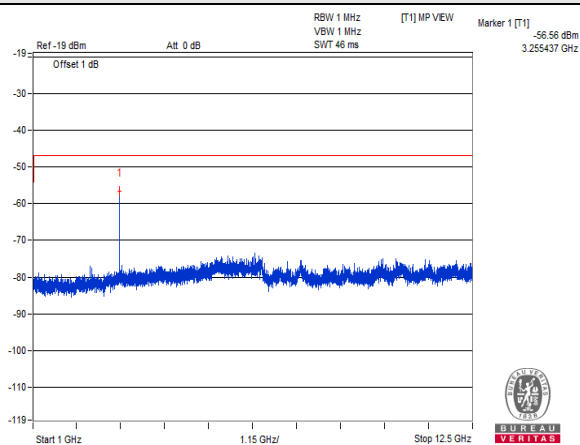
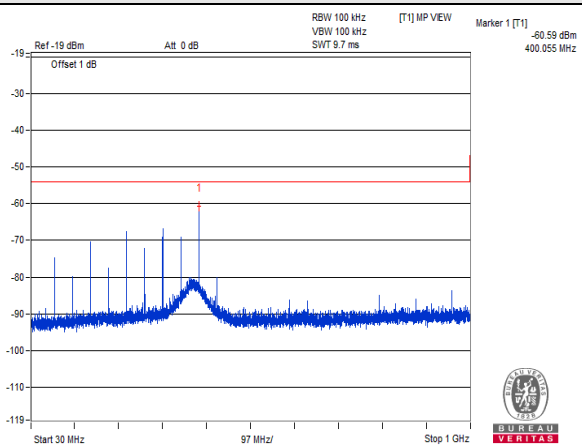


V_{min.}

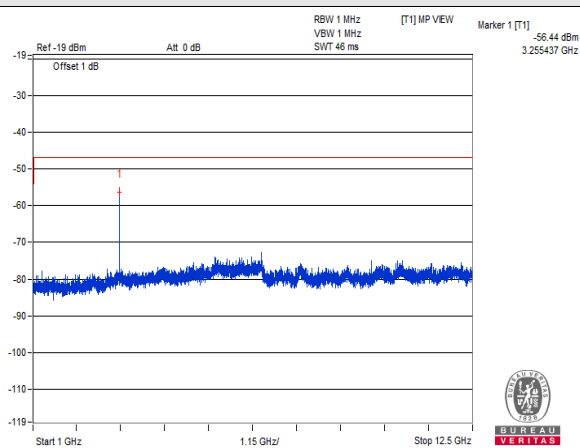
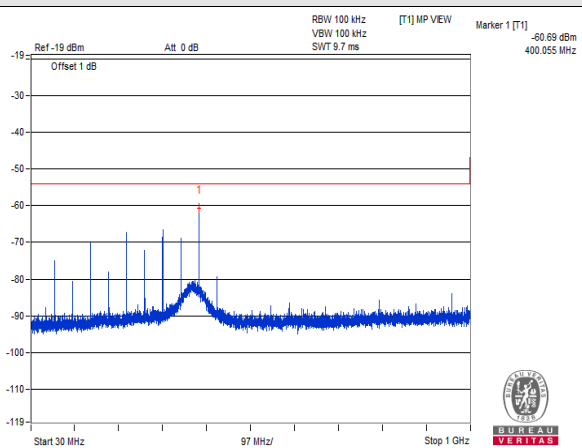


CH 1 (2412MHz)

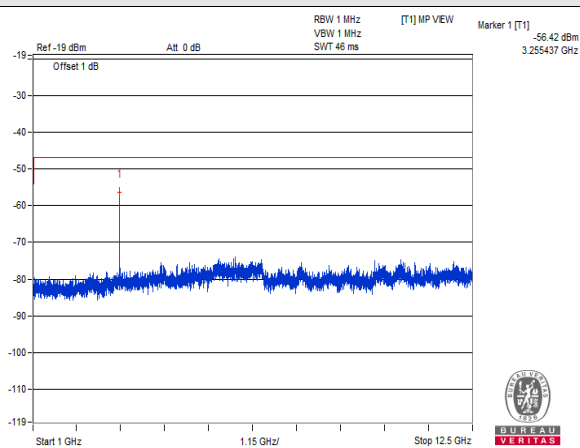
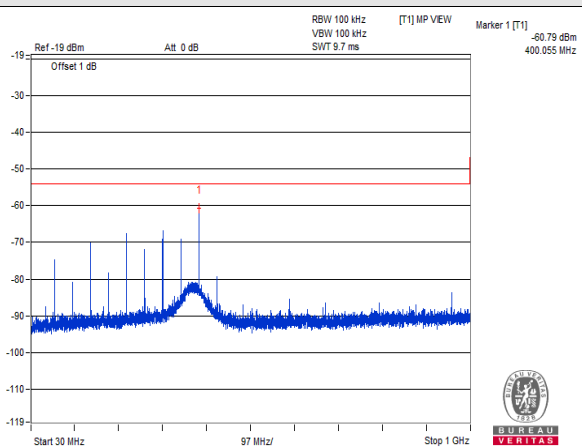
V_{normal}



V_{max}

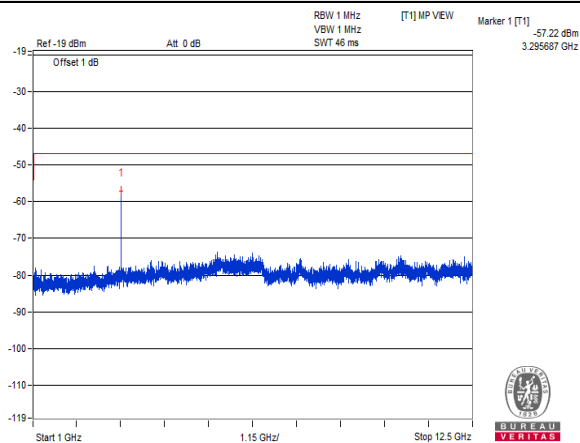
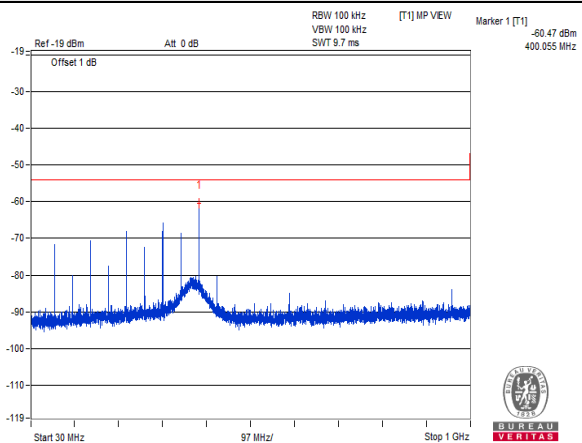


V_{min}

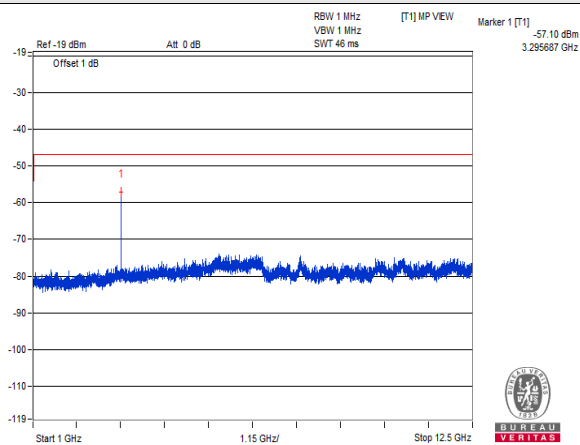
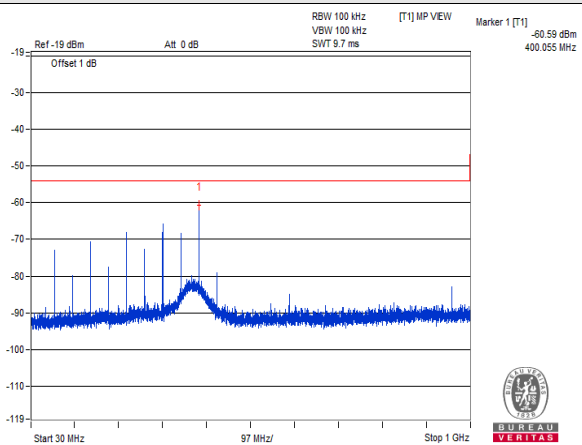


CH 7 (2442MHz)

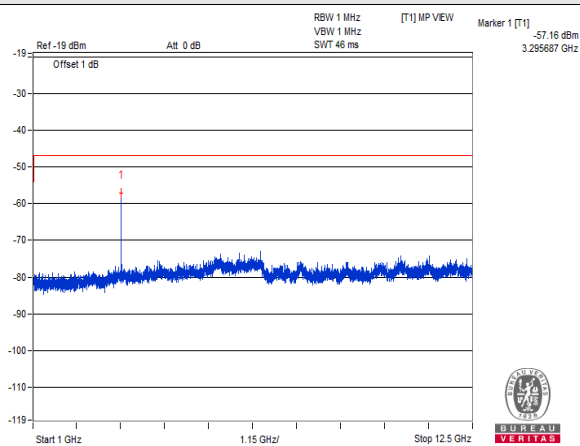
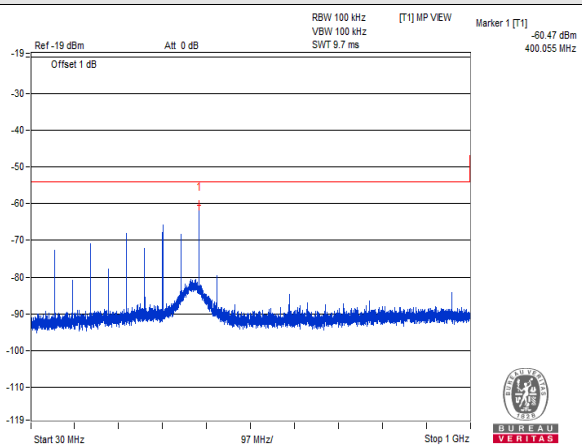
V_{normal}



V_{max}



V_{min}



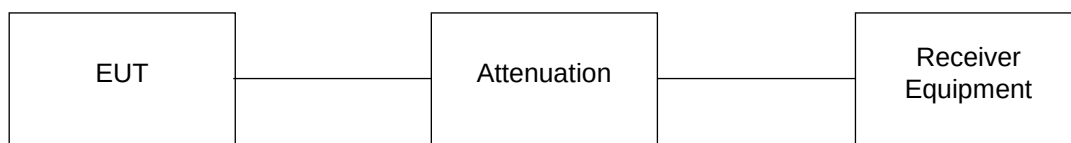
CH 13 (2472MHz)

4.7 Interference Prevention Function

4.7.1 Limits of Interference Prevention Function

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

4.7.2 Test Setup



4.7.3 Test Results

Environmental Conditions	25 deg.C, 68% RH
Link Mode	Test Result
Wi-Fi 2.4GHz	PASS

4.8 Number of Carriers within 1 MHz Bandwidth in OFDM

4.8.1 Limit of Number of Carriers

For each 1MHz bandwidth in OFDM, there should be at least 1 carrier

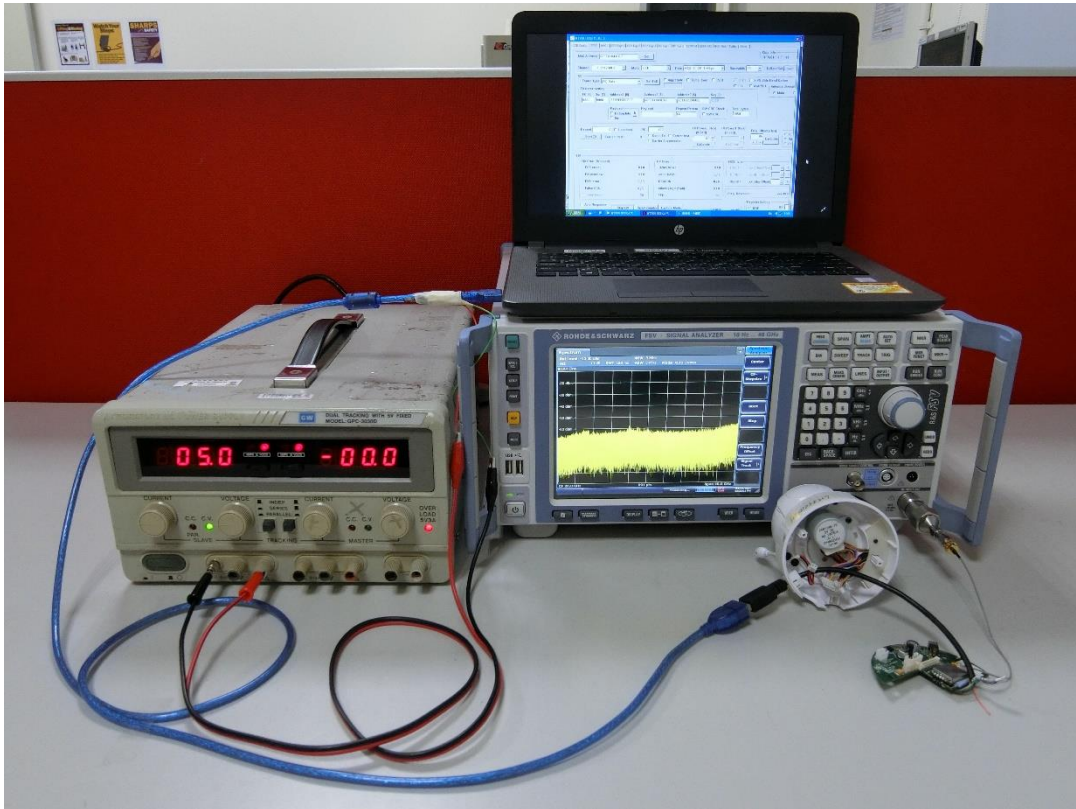
4.8.2 Test Setup



4.8.3 Test Result

About OFDM Technical, one OFDM Channel will have 52 sub-carriers. At present, we observe this product via the spectrum, and we know that there are 3 carriers in 1 MHz bandwidth in OFDM.

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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