

Radio Test Report (For Bluetooth Low Energy)

Report No.: RJCDBM-WTW-P22030865

Test Model: MGM240P22A

Received Date: Mar. 22, 2022

Test Date: Apr. 19 ~ May 09, 2022

Issued Date: Jun. 23, 2022

Applicant: Silicon Laboratories Finland Oy

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Table of Contents

Release Control Record	3
1 Certificate of Conformity	4
2 Summary of Test Results	5
2.1 Test Instruments	6
2.2 Measurement Uncertainty	6
2.3 Modification Record	6
3 General Information	7
3.1 General Description of EUT	7
3.2 Description of Test Modes	8
3.3 Test Conditions	9
3.4 Assembly	9
3.5 Antenna Specifications	9
3.5.1 Antenna Gain	9
3.5.2 Antenna Pattern	10
4 Test Results	11
4.1 Frequency Tolerance Measurement	11
4.1.1 Limits of Frequency Tolerance Measurement	11
4.1.2 Test Setup	11
4.1.3 Test Results	11
4.2 Occupied Bandwidth Measurement (99% power bandwidth)	12
4.2.1 Limits of Occupied Bandwidth Measurement	12
4.2.2 Test Setup	12
4.2.3 Test Results	13
4.3 Spurious Emissions for Transmitter Measurement	23
4.3.1 Limits of Spurious Emissions	23
4.3.2 Test Setup	23
4.3.3 Test Results	24
4.4 Antenna Power Measurement	57
4.4.1 Limits of Antenna Power	57
4.4.2 Test Setup	57
4.4.3 Test Results	58
4.5 Spurious Emissions for Receiver	60
4.5.1 Limits of Spurious Emissions For Receiver	60
4.5.2 Test Setup	60
4.5.3 Test Result	61
4.6 Interference Prevention Function	72
4.6.1 Limits of Interference Prevention Function	72
4.6.2 Test Setup	72
4.6.3 Test Results	72
5 Photographs of the Test Configuration	73
Appendix - Information of the Testing Laboratories	74

Release Control Record

Issue No.	Description	Date Issued
RJCDBM-WTW-P22030865	Original release	Jun. 23, 2022

1 Certificate of Conformity

Product: Bluetooth Low Energy and 802.15.4 wireless radio module

Brand: Silicon Labs

Test Model: MGM240P22A

Sample Status: Engineering samples fully representing the production modules

Applicant: Silicon Laboratories Finland Oy

Test Date: Apr. 19 ~ May 09, 2022

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 RF characteristics under the conditions specified in this report.

Prepared by : Celine Chou , **Date:** Jun. 23, 2022
Celine Chou / Senior Specialist

Approved by : Jeremy Lin , **Date:** Jun. 23, 2022
Jeremy Lin / Project Engineer

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	3.2 (2)	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
--	--	--	Refer to all articles for transmitting antenna	C
Operating Frequency 2400 to 2483.5MHz				
--	3.7 (1)	3.4	Radio 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)	--	Angular width of principal radiation (AWPR)	NA
--	3.2 (10)	--	Number of carriers within 1 MHz bandwidth in OFDM	NA
--	3.2 (8)	4.3	Spreading bandwidth	NA
--	3.2 (9)	4.3	Spreading factor	NA
--	3.2 (11)	--	Frequency retention time (FH employed)	NA
--	3.4.1(1)	4.7	Interference Prevention Function	C

Note:

- Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.
- C = Conform NC = Not Conform NT = Not Tested NA = Not Applicable

2.1 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration	Calibration Authority	Cal. Method
Spectrum Analyzer / KEYSIGHT	N9020B	MY60110462	Dec. 21, 2021	Dec. 20, 2022	ETC	c)
Signal Generator / Anritsu	E4438C	MY49071692	Nov. 09, 2021	Nov. 08, 2022	ETC	c)
Power Meter / Anritsu	ML2495A	1232003	Jan. 09, 2022	Jan. 08, 2023	ETC	c)
Power Sensor / Anritsu	MA2411B	1207333	Jan. 09, 2022	Jan. 08, 2023	ETC	c)
Power Splitter / Marvelous Microwave Inc.	MVE8546	20161123081	Jan. 12, 2022	Jan. 11, 2023	BV CPS E&E	d)
DC Power Supply / Keysight	U8002A	MY56330015	Note 3	Note 3	BV CPS E&E	d)
True RMS Clamp Meter / Fluke	325	31130711WS	Jun. 02, 2021	Jun. 01, 2022	ETC	c)

Note:

1. Calibration Method

- Calibration conducted by the National Institute of Information and Communications Technology (NICT) or a designated calibration agency under Article 102-18 paragraph (1) of the Radio Law.
- 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.
- 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).
- Calibration conducted by using other equipment that listed above from a) to c).

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

3. The power supply no evaluation calibrated, which used the digital multimeter to verify before each testing.

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	$\pm 491.896\text{Hz}$
Spurious emissions	$\pm 2.208\text{dB}$
Output power density	$\pm 2.889\text{dB}$
Out of band radiated power	$\pm 3.93\text{dB}$
Frequency Tolerance	$\pm 6805.18\text{Hz}$

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

2.3 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Bluetooth Low Energy and 802.15.4 wireless radio module
Brand	Silicon Labs
Test Model	MGM240P22A
Status of EUT	Engineering samples fully representing the production modules
Nominal Voltage	1.8Vdc, 3.0Vdc, 3.8Vdc
Modulation Type	GFSK
Modulation Technology	DTS
Transfer Rate	1MBaud with 1Mbps transfer rate 1MBaud with Coded 125kbps transfer rate 1MBaud with Coded 500kbps transfer rate 2MBaud with 2Mbps transfer rate
Operating Frequency	2402 ~ 2480MHz
Number of Channel	1MBaud: 40 2MBaud: 37
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 note
Antenna Connector	Refer to note
Accessory Device	NA
Data Cable Supplied	NA

Note:

1. For 1MBaud, after pre-test three transfer rates (125kbps, 500kbps and 1Mbps), 1MBaud with 1Mbps transfer rate was the worse and chosen for final test.
2. The antenna information is listed as below.

Type	Connector	Gain (dBi)
Integral antenna	NA	1.82

* 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. The power table as below:

Transfer Rate	Rated power (mW)	Conducted RF output power (mW)	Radiated RF output power (mW)
1MBaud with 1Mbps transfer rate	9.00	9.036	13.740
2MBaud with 2Mbps transfer rate	9.00	8.414	12.794

3.2 Description of Test Modes

1MBaud

40 channels are provided to this EUT:

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

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

2MBaud

37 channels are provided to this EUT:

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
1	2404	11	2424	21	2444	31	2464
2	2406	-	-	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		
10	2422	20	2442	30	2462		

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

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

Channel	Power Setting	
	1MBaud with 1Mbps transfer rate	2MBaud with 2Mbps transfer rate
0	91	-
1	91	91
19	91	91
38	91	91
39	91	-

3.3 Test Conditions

Test Conditions	Voltage (Vdc)
Vnormal	3.00
Vmax.	3.80
Vmin.	1.80

Note: After checking the fluctuation of input voltage to the circuit of the radio part (excluding the power supply) of the equipment to be tested, the fluctuation less than +/- 1 % when input voltage from an external supply into the equipment fluctuates +/- 10%, therefore, the test is carried out only at the normal voltage.

Test Item	Test Conditions	Environmental Conditions	Test Engineer
Frequency Tolerance	1MBaud with 1Mbps transfer rate 2MBaud with 2Mbps transfer rate	25 deg.C, 60 % RH	Alan Wu
Occupied Bandwidth (99% power bandwidth)	1MBaud with 1Mbps transfer rate 2MBaud with 2Mbps transfer rate	25 deg.C, 60 % RH	Alan Wu
Spurious Emissions for Transmitter	1MBaud with 1Mbps transfer rate 2MBaud with 2Mbps transfer rate	25 deg.C, 60 % RH	Alan Wu
Antenna Power	1MBaud with 1Mbps transfer rate 2MBaud with 2Mbps transfer rate	25 deg.C, 60 % RH	Alan Wu
Spurious Emissions for Receiver	1MBaud with 1Mbps transfer rate 2MBaud with 2Mbps transfer rate	25 deg.C, 60 % RH	Alan Wu

3.4 Assembly

The EUT is constructed as a standalone unit. The modulation section, preamplifier, RF component etc, are shielded under a metal housing, which is soldered to the PCB and cannot be detached easily.

3.5 Antenna Specifications

3.5.1 Antenna Gain

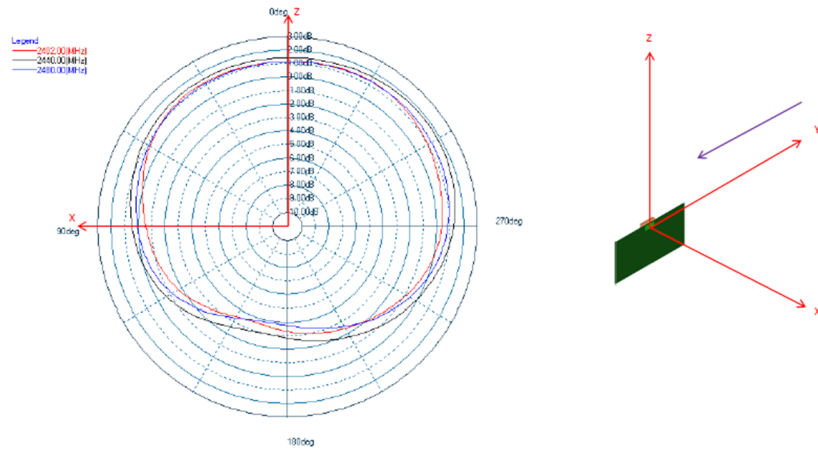
Type	Connector	Gain (dBi)
Integral antenna	NA	1.82

* 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.

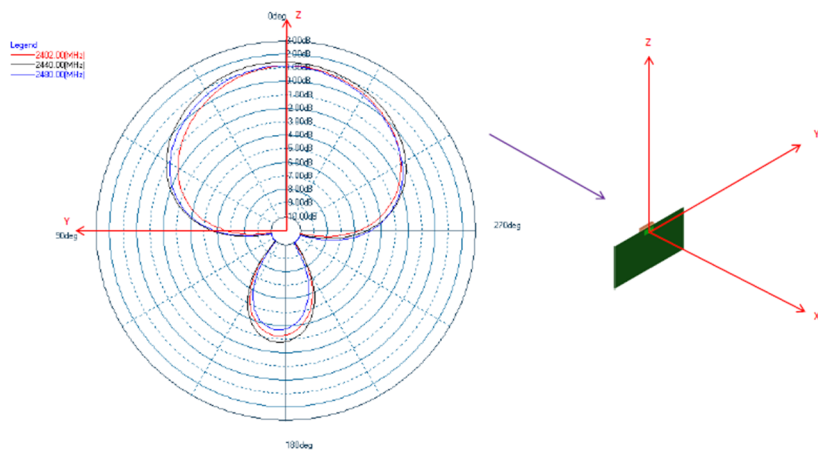
3.5.2 Antenna Pattern

Antenna Pattern

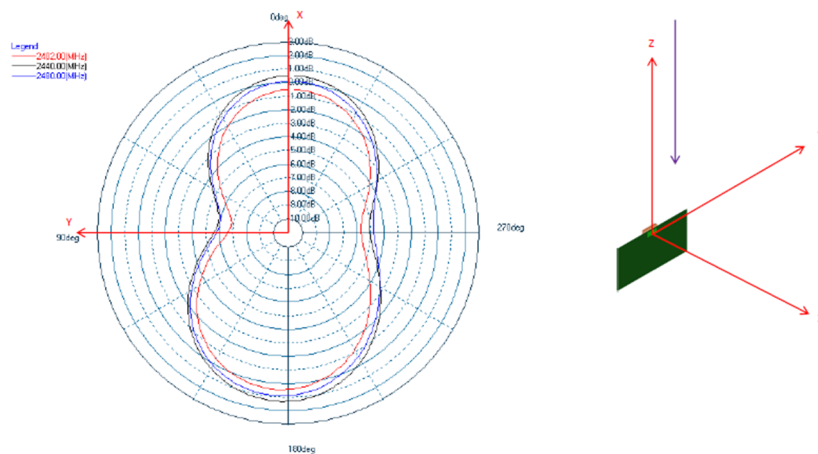
Phi0 Gain cut (dBi)



Phi90 Gain cut



Theta90 Gain cut



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

1MBaud with 1Mbps transfer rate

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	2402.000641	0.266	2402.000801	0.333	2402.000481	0.200
1	2404	2404.000160	0.066	2404.000160	0.066	2404.000160	0.066
19	2440	2440.000000	0.000	2440.000000	0.000	2440.000000	0.000
38	2478	2478.000321	0.129	2478.000160	0.064	2478.000160	0.064
39	2480	2480.000481	0.193	2480.000481	0.193	2480.000321	0.129

2MBaud with 2Mbps transfer rate

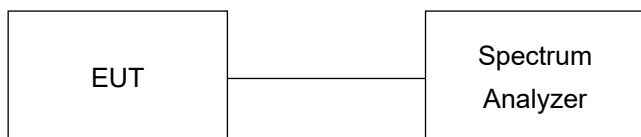
Channel	Frequency (MHz)	V _{normal}		V _{max.}		V _{min.}	
		Carrier Frequency (MHz)	Frequency Tolerance (ppm)	Carrier Frequency (MHz)	Frequency Tolerance (ppm)	Carrier Frequency (MHz)	Frequency Tolerance (ppm)
1	2404	2404.000321	0.133	2404.000481	0.200	2404.000321	0.133
19	2440	2440.000160	0.065	2440.000160	0.065	2440.000160	0.065
38	2478	2478.000160	0.064	2478.000160	0.064	2478.000321	0.129

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



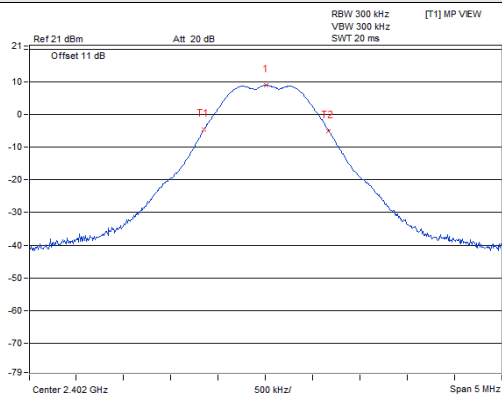
4.2.3 Test Results

1MBaud with 1Mbps transfer rate

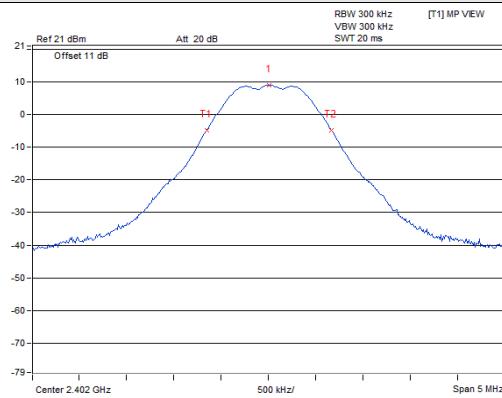
Channel	Frequency (MHz)	V_{normal}	$V_{\text{max.}}$	$V_{\text{min.}}$
		Occupied Bandwidth (MHz)	Occupied Bandwidth (MHz)	Occupied Bandwidth (MHz)
0	2402	1.33	1.33	1.33
1	2404	1.33	1.33	1.33
19	2440	1.33	1.33	1.33
38	2478	1.33	1.33	1.33
39	2480	1.33	1.33	1.33

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

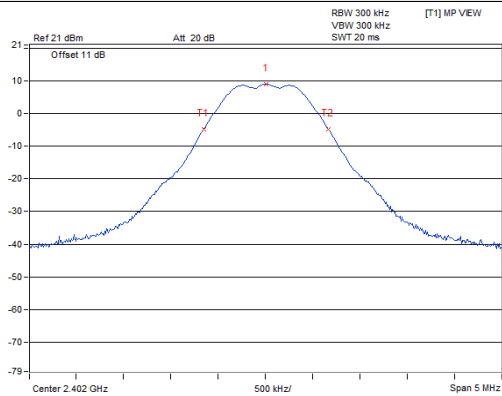
V_{normal}



V_{max.}

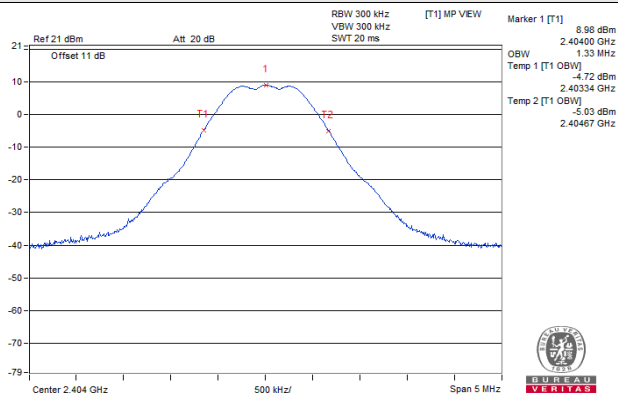


V_{min.}

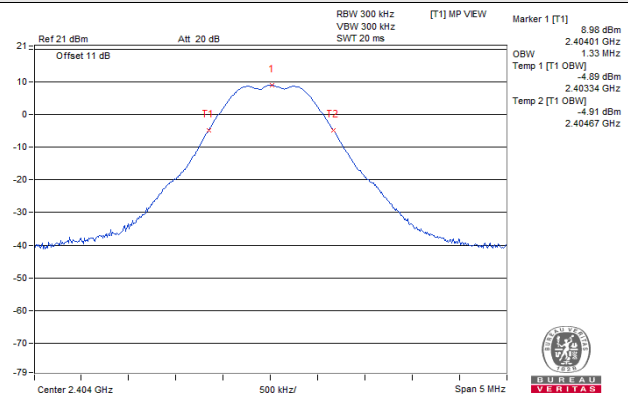


CH 0 (2402MHz)

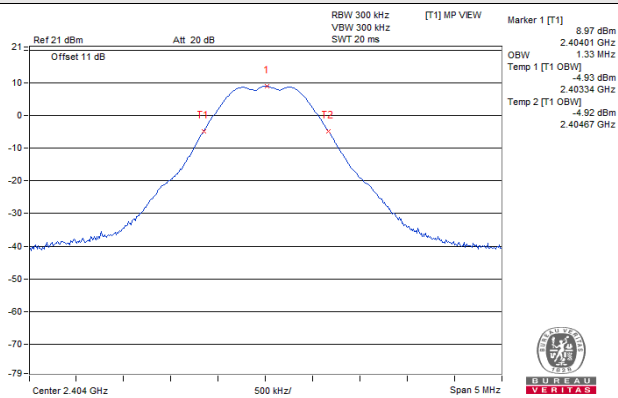
V_{normal}



V_{max.}

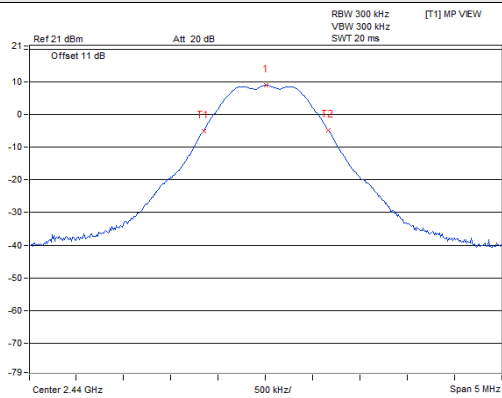


V_{min.}

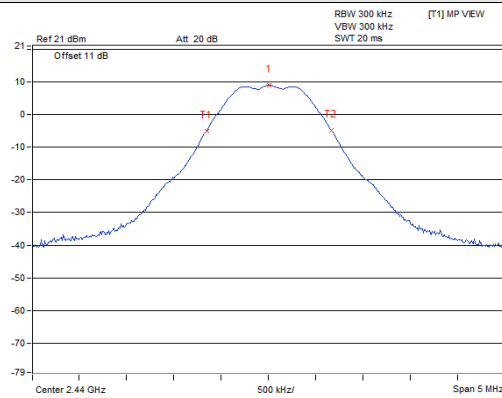


CH 1 (2404MHz)

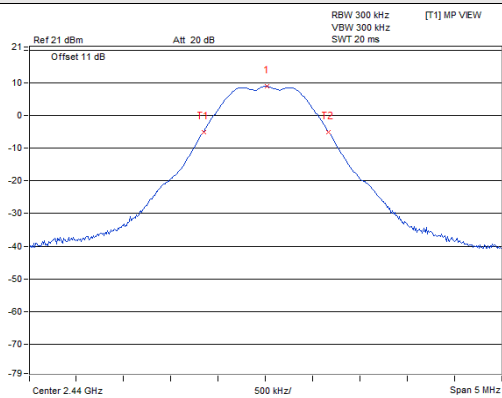
V_{normal}



V_{max.}

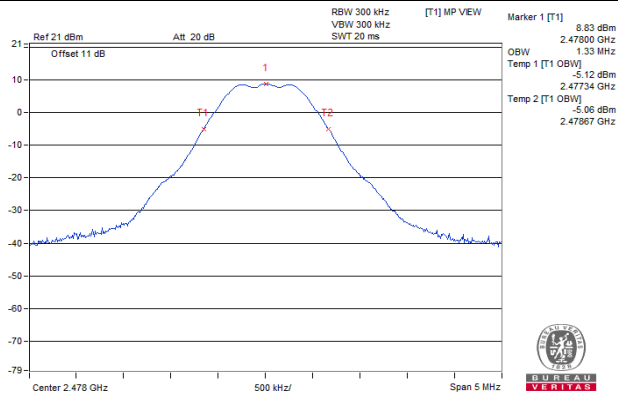


V_{min.}

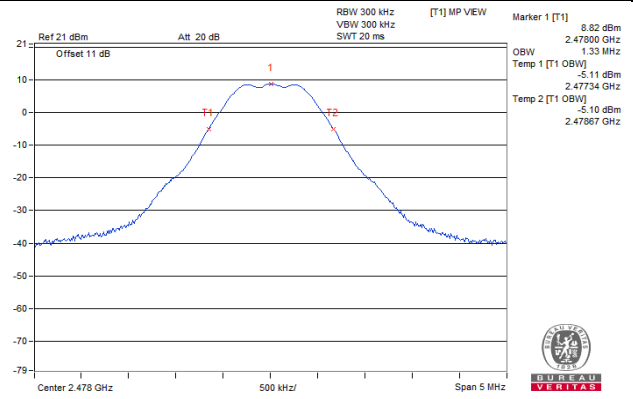


CH 19 (2440MHz)

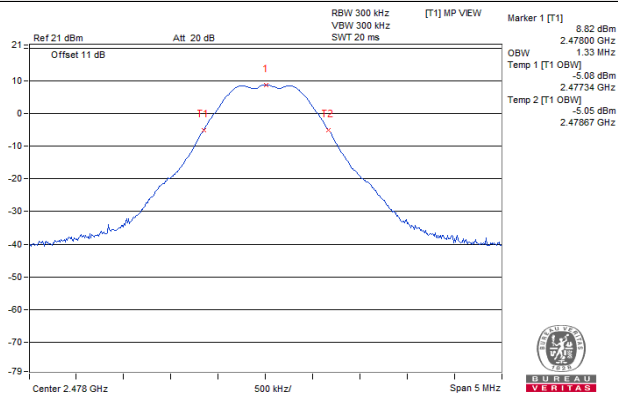
V_{normal}



V_{max.}

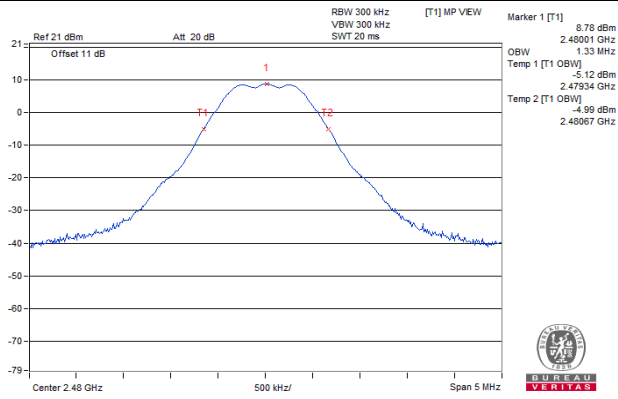


V_{min.}

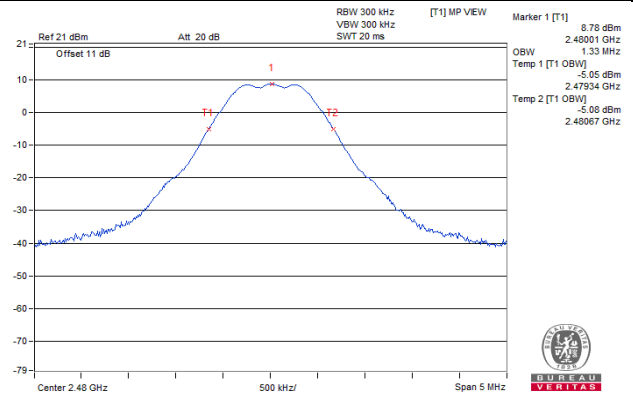


CH 38 (2478MHz)

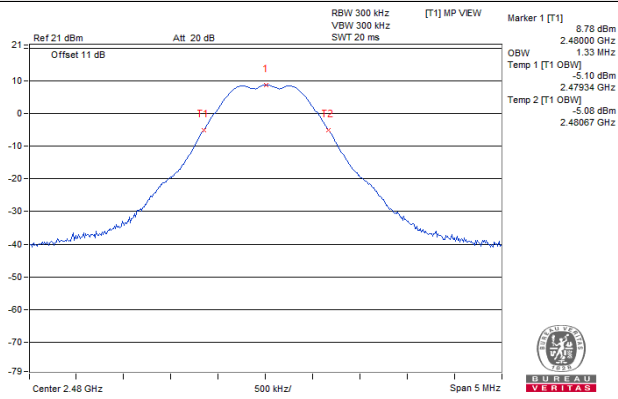
V_{normal}



V_{max.}



V_{min.}



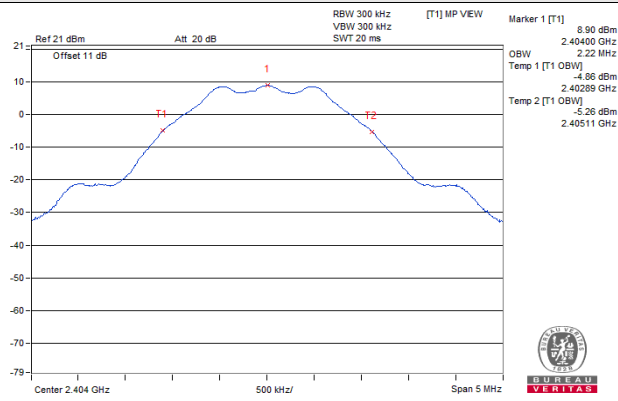
CH 39 (2480MHz)

2MBaud with 2Mbps transfer rate

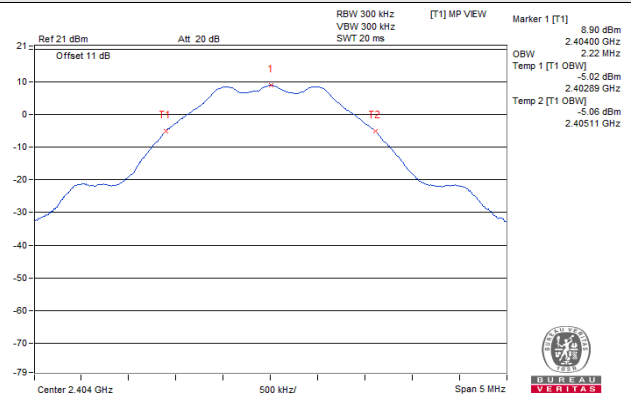
Channel	Frequency (MHz)	V_{normal}	$V_{max.}$	$V_{min.}$
		Occupied Bandwidth (MHz)	Occupied Bandwidth (MHz)	Occupied Bandwidth (MHz)
1	2404	2.22	2.22	2.22
19	2440	2.23	2.23	2.23
38	2478	2.23	2.23	2.23

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

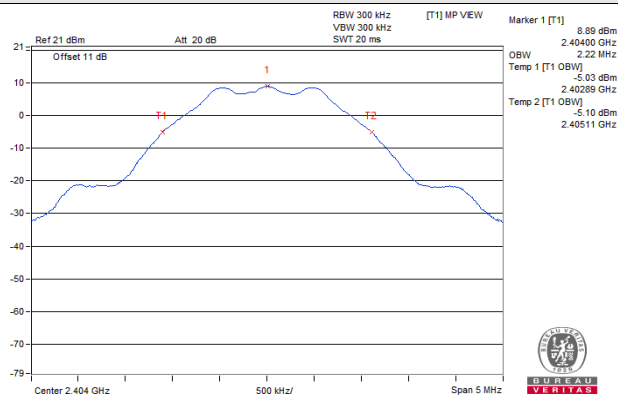
V_{normal}



V_{max.}

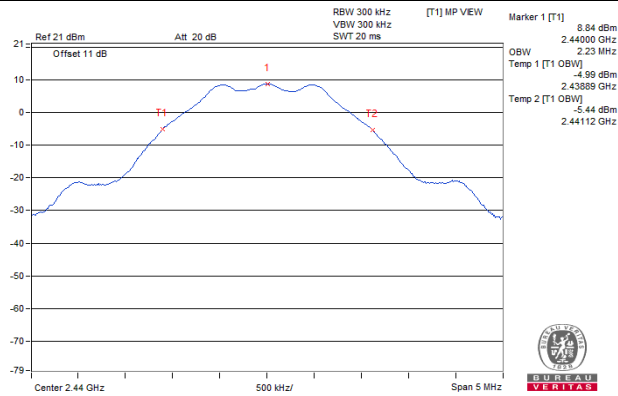


V_{min.}

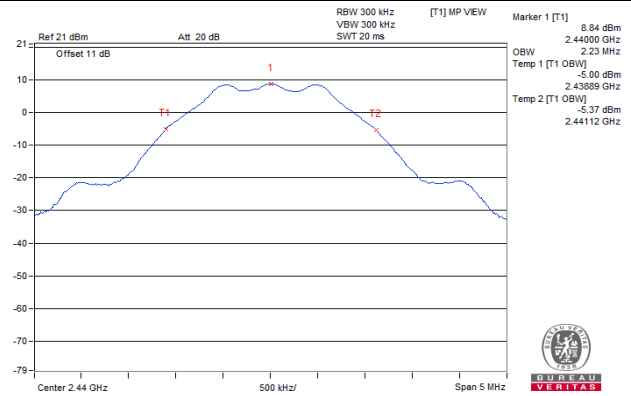


CH 1 (2404MHz)

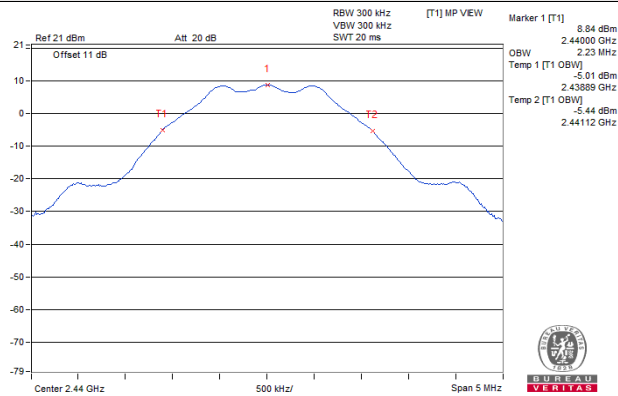
V_{normal}



V_{max.}

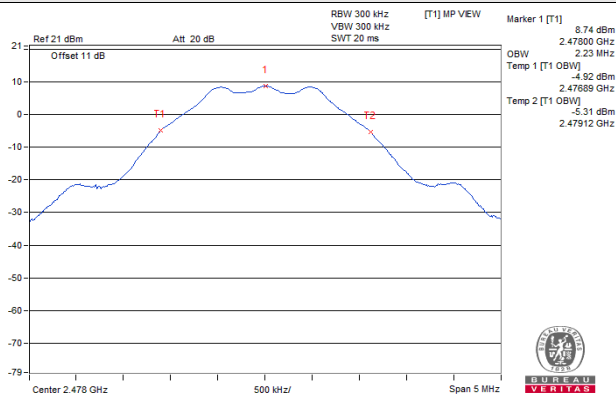


V_{min.}

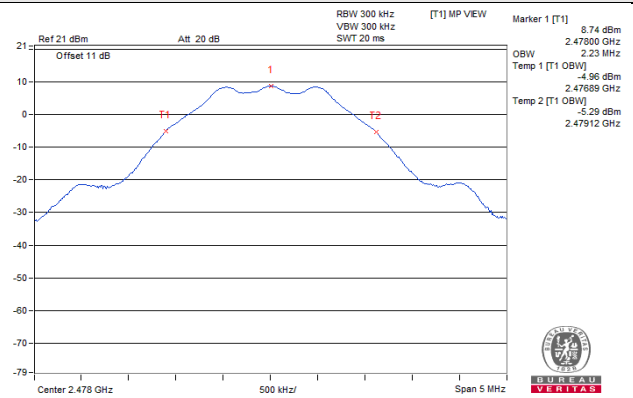


CH 19 (2440MHz)

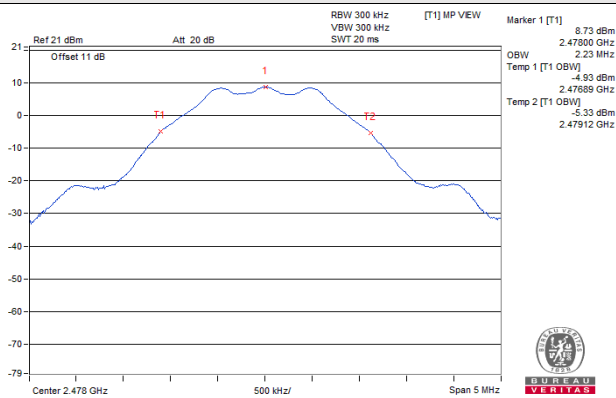
V_{normal}



V_{max.}



V_{min.}



CH 38 (2478MHz)

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

1MBaud with 1Mbps transfer rate

Test Channel		CH 0 (2402MHz)			
Test Condition	Frequency Range (MHz)	Frequency (MHz)	Measured Value (uW)	Limit (uW)	Result
V_{normal}	30 to 1000	702.695	0.003342	0.25	Pass
	1000 to 2387	2383.359	0.040365	2.5	Pass
	2387 to 2400	2399.991	16.299078	25	Pass(1)
	2483.5 to 2496.5	2489.881	0.015922	25	Pass
	2496.5 to 12500	4803.557	0.144212	2.5	Pass
V_{max.}	30 to 1000	927.492	0.003443	0.25	Pass
	1000 to 2387	2372.783	0.038019	2.5	Pass
	2387 to 2400	2399.990	16.148356	25	Pass(2)
	2483.5 to 2496.5	2489.515	0.014825	25	Pass
	2496.5 to 12500	4803.557	0.126474	2.5	Pass
V_{min.}	30 to 1000	436.308	0.003639	0.25	Pass
	1000 to 2387	2372.609	0.026002	2.5	Pass
	2387 to 2400	2400.000	17.234325	25	Pass(3)
	2483.5 to 2496.5	2490.258	0.015704	25	Pass
	2496.5 to 12500	4803.557	0.138995	2.5	Pass

Test Channel		CH 1 (2404MHz)			
Test Condition	Frequency Range (MHz)	Frequency (MHz)	Measured Value (uW)	Limit (uW)	Result
V_{normal}	30 to 1000	89.897	0.004797	0.25	Pass
	1000 to 2387	2384.052	0.058884	2.5	Pass
	2387 to 2400	2394.115	0.384592	25	Pass
	2483.5 to 2496.5	2491.573	0.015596	25	Pass
	2496.5 to 12500	4808.558	0.135519	2.5	Pass
V_{max.}	30 to 1000	550.162	0.003597	0.25	Pass
	1000 to 2387	2375.383	0.026853	2.5	Pass
	2387 to 2400	2394.236	0.387258	25	Pass
	2483.5 to 2496.5	2491.508	0.018750	25	Pass
	2496.5 to 12500	4808.558	0.139316	2.5	Pass
V_{min.}	30 to 1000	632.491	0.003443	0.25	Pass
	1000 to 2387	2384.399	0.088308	2.5	Pass
	2387 to 2400	2394.366	0.343558	25	Pass
	2483.5 to 2496.5	2491.792	0.015776	25	Pass
	2496.5 to 12500	4807.308	0.159588	2.5	Pass

Test Channel		CH 19 (2440MHz)			
Test Condition	Frequency Range (MHz)	Frequency (MHz)	Measured Value (uW)	Limit (uW)	Result
V_{normal}	30 to 1000	520.456	0.003890	0.25	Pass
	1000 to 2387	2034.875	0.010520	2.5	Pass
	2387 to 2400	2391.106	0.026915	25	Pass
	2483.5 to 2496.5	2488.813	0.031477	25	Pass
	2496.5 to 12500	4879.833	0.090365	2.5	Pass
V_{max.}	30 to 1000	913.306	0.004581	0.25	Pass
	1000 to 2387	2184.324	0.011695	2.5	Pass
	2387 to 2400	2391.356	0.029785	25	Pass
	2483.5 to 2496.5	2488.683	0.036392	25	Pass
	2496.5 to 12500	4881.084	0.096161	2.5	Pass
V_{min.}	30 to 1000	643.161	0.003342	0.25	Pass
	1000 to 2387	2173.228	0.011324	2.5	Pass
	2387 to 2400	2391.358	0.023605	25	Pass
	2483.5 to 2496.5	2488.667	0.034914	25	Pass
	2496.5 to 12500	4879.833	0.108143	2.5	Pass

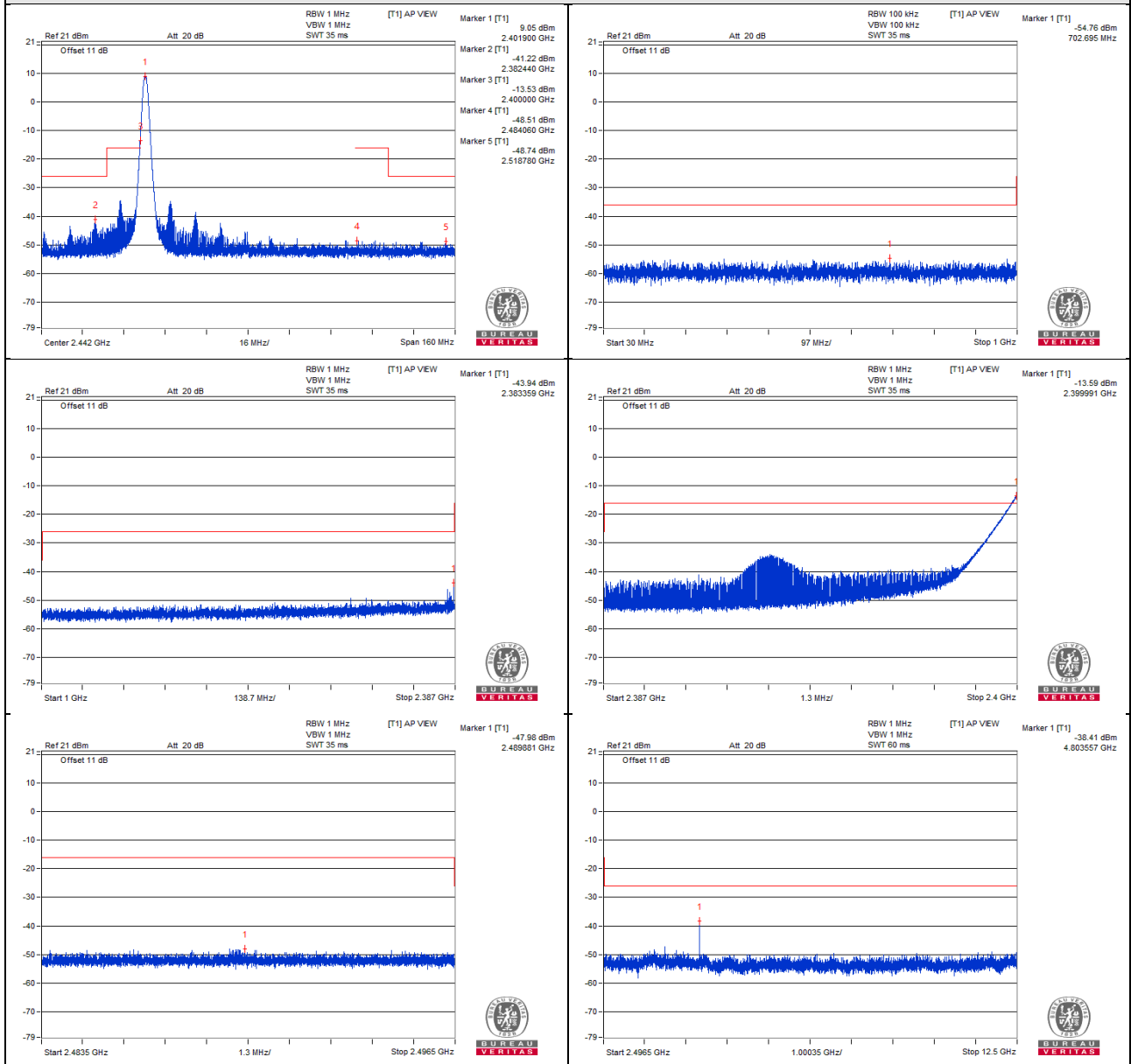
Test Channel		CH 38 (2478MHz)			
Test Condition	Frequency Range (MHz)	Frequency (MHz)	Measured Value (uW)	Limit (uW)	Result
V_{normal}	30 to 1000	163.496	0.005521	0.25	Pass
	1000 to 2387	2144.621	0.011402	2.5	Pass
	2387 to 2400	2399.974	0.015066	25	Pass
	2483.5 to 2496.5	2487.851	0.418794	25	Pass
	2496.5 to 12500	4954.860	0.081096	2.5	Pass
V_{max.}	30 to 1000	936.101	0.003776	0.25	Pass
	1000 to 2387	2277.427	0.011169	2.5	Pass
	2387 to 2400	2399.769	0.016293	25	Pass
	2483.5 to 2496.5	2487.617	0.415911	25	Pass
	2496.5 to 12500	4956.110	0.044771	2.5	Pass
V_{min.}	30 to 1000	163.738	0.004677	0.25	Pass
	1000 to 2387	2293.204	0.013274	2.5	Pass
	2387 to 2400	2399.878	0.015959	25	Pass
	2483.5 to 2496.5	2487.806	0.421697	25	Pass
	2496.5 to 12500	4956.110	0.058479	2.5	Pass

Test Channel		CH 39 (2480MHz)			
Test Condition	Frequency Range (MHz)	Frequency (MHz)	Measured Value (uW)	Limit (uW)	Result
V_{normal}	30 to 1000	143.853	0.003214	0.25	Pass
	1000 to 2387	2314.876	0.010093	2.5	Pass
	2387 to 2400	2389.803	0.016444	25	Pass
	2483.5 to 2496.5	2483.511	0.486407	25	Pass
	2496.5 to 12500	4959.861	0.058345	2.5	Pass
V_{max.}	30 to 1000	151.250	0.003155	0.25	Pass
	1000 to 2387	2387.000	0.010520	2.5	Pass
	2387 to 2400	2392.018	0.013552	25	Pass
	2483.5 to 2496.5	2483.513	0.469894	25	Pass
	2496.5 to 12500	4959.861	0.048195	2.5	Pass
V_{min.}	30 to 1000	558.892	0.003698	0.25	Pass
	1000 to 2387	2232.176	0.010765	2.5	Pass
	2387 to 2400	2393.446	0.014689	25	Pass
	2483.5 to 2496.5	2483.500	0.488652	25	Pass
	2496.5 to 12500	4959.861	0.065013	2.5	Pass

Note:

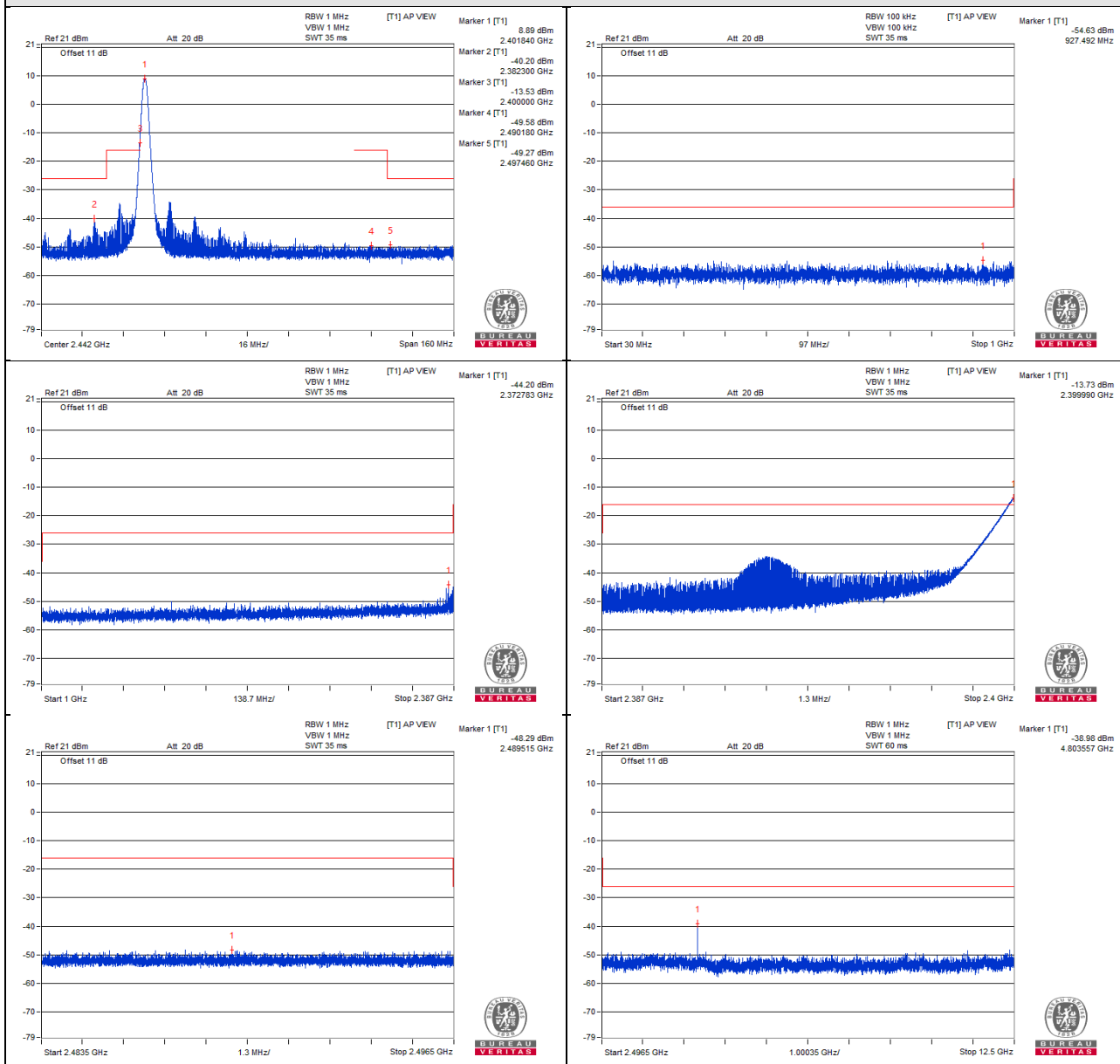
1. The spectrum plots are attached on the following pages.
2. (No.): The value was tested under Measuring Mode *Zero Span.

Vnormal



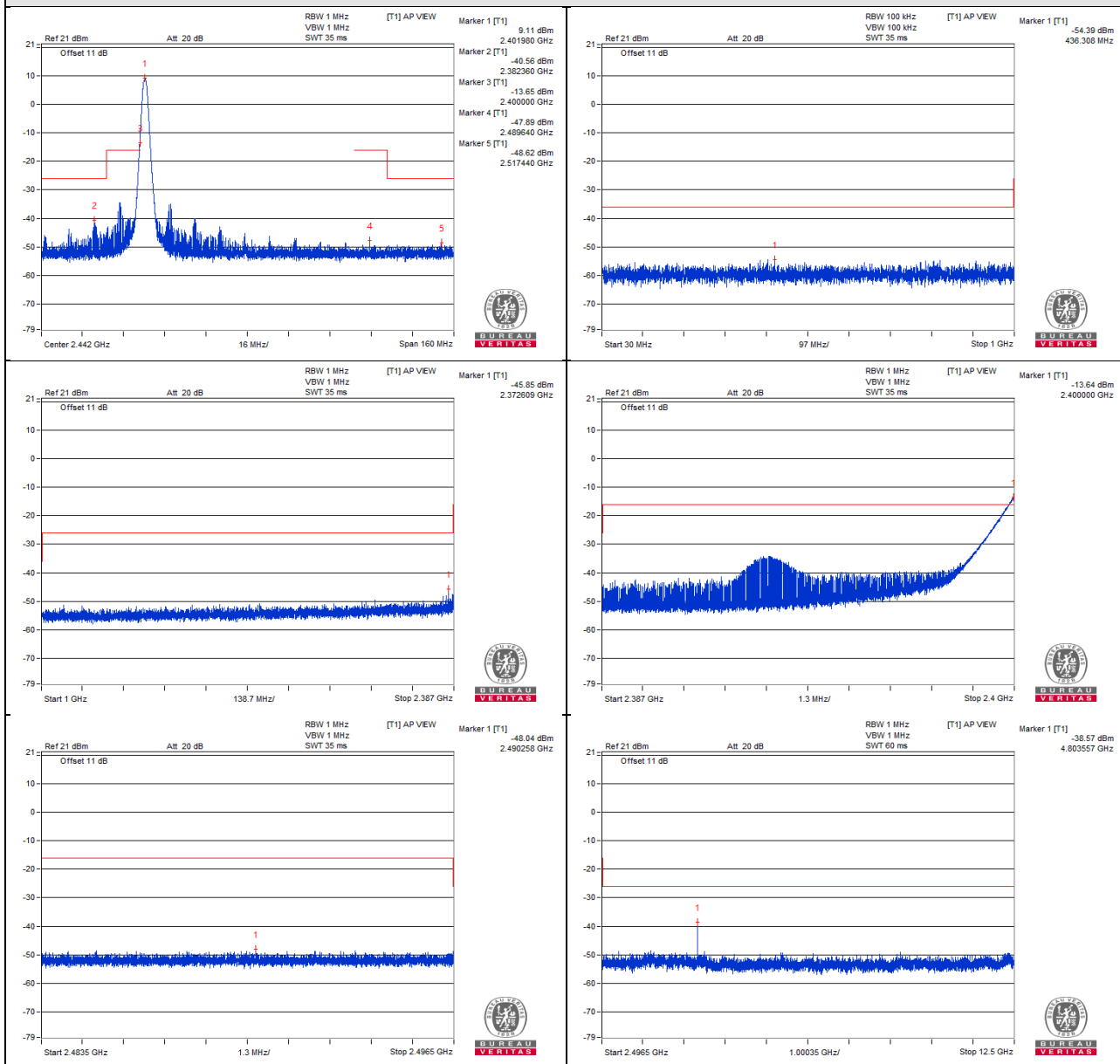
CH 0 (2402MHz)

V_{max}.



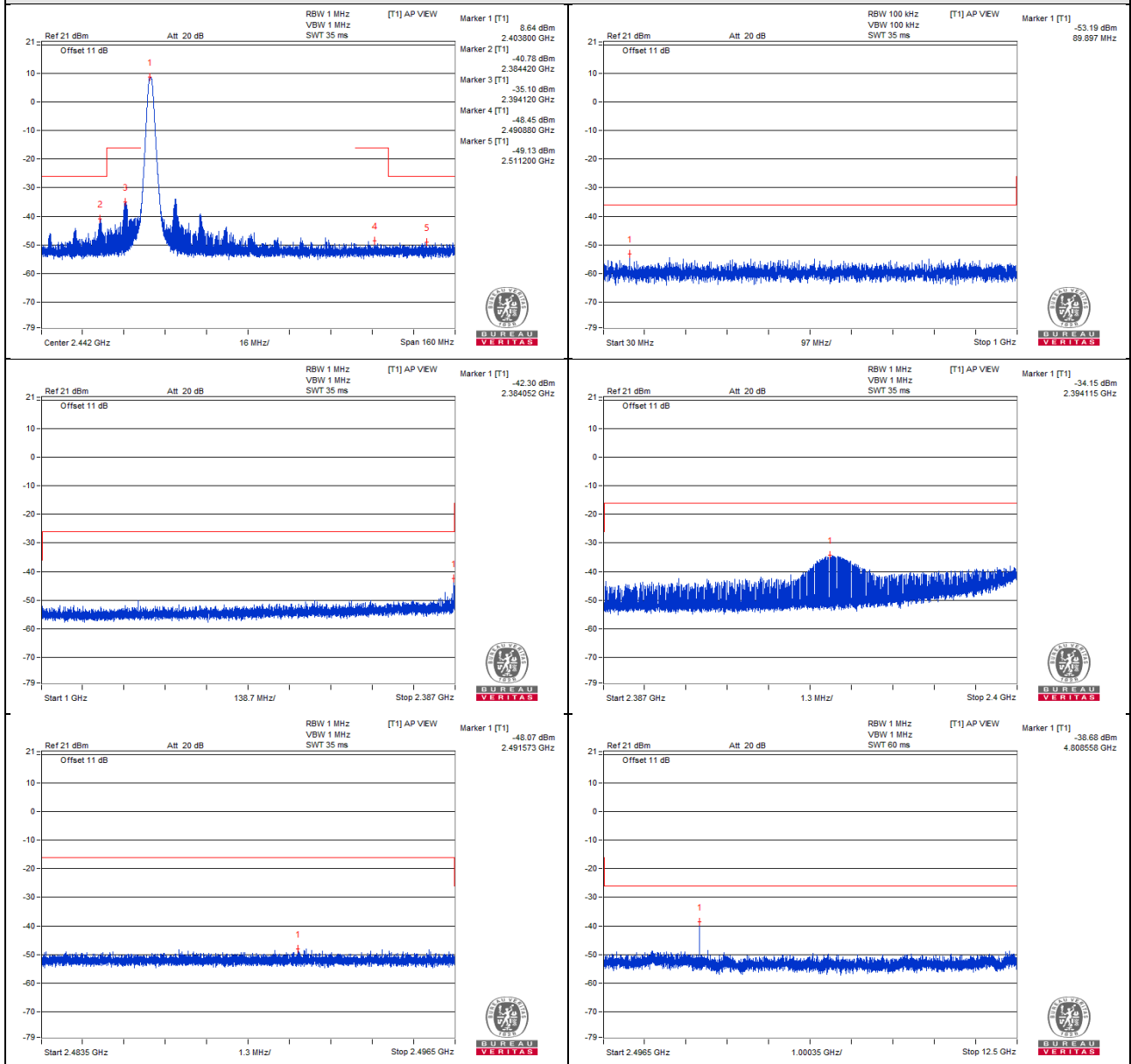
CH 0 (2402MHz)

V_{min}.



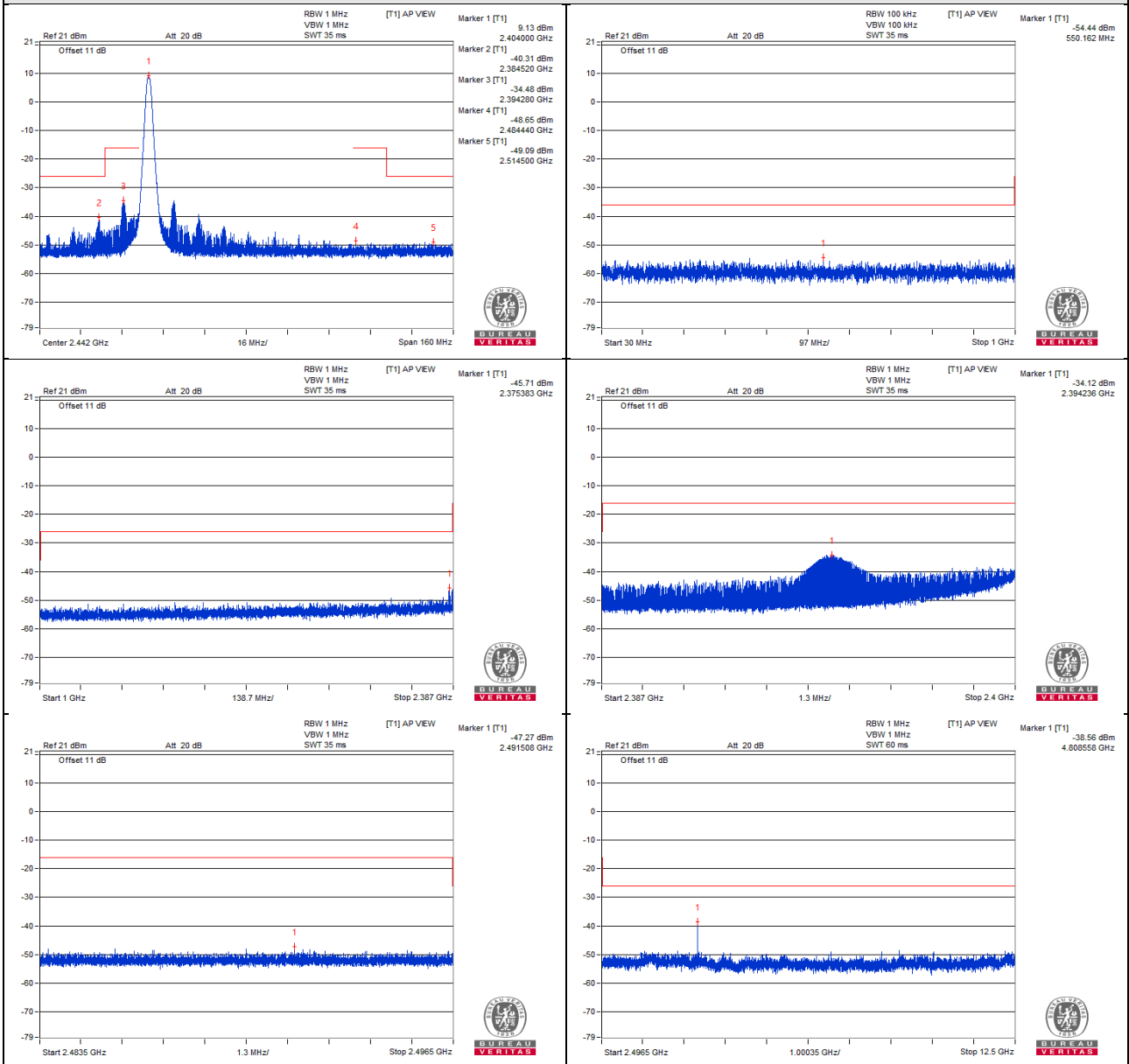
CH 0 (2402MHz)

Vnormal



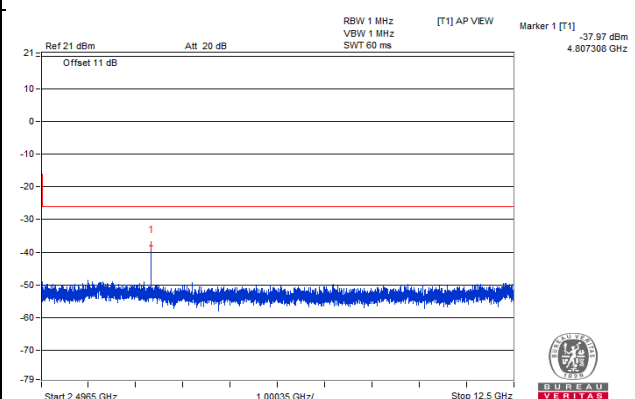
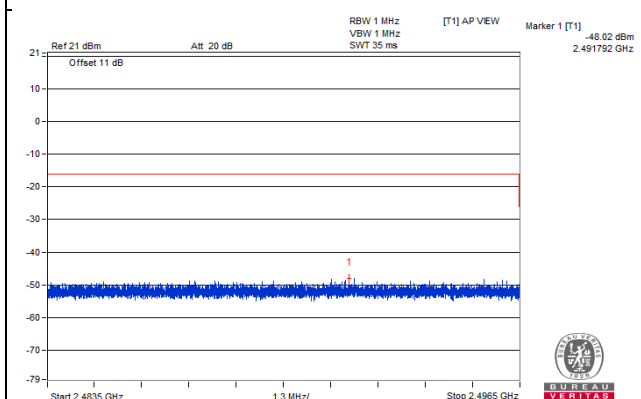
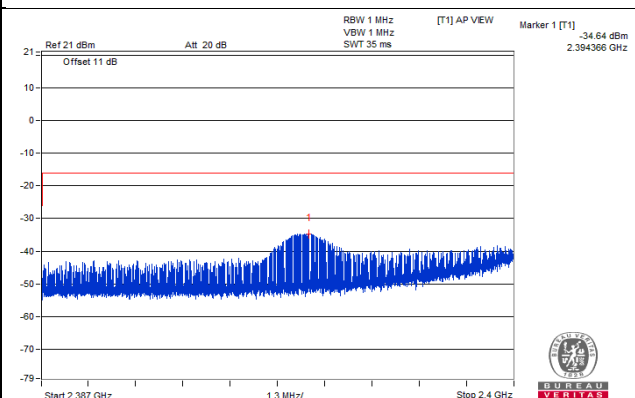
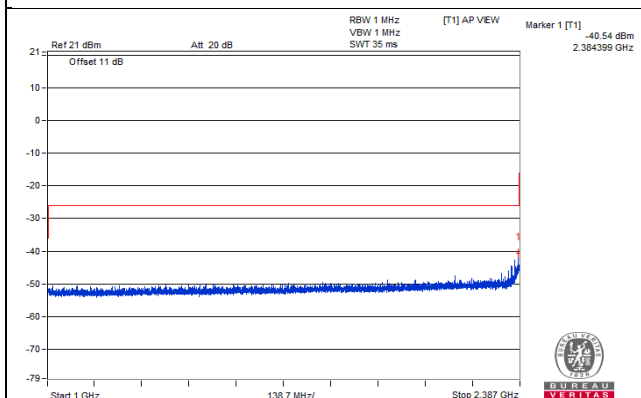
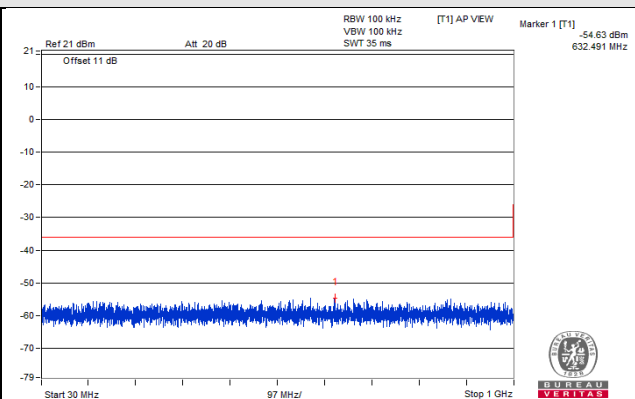
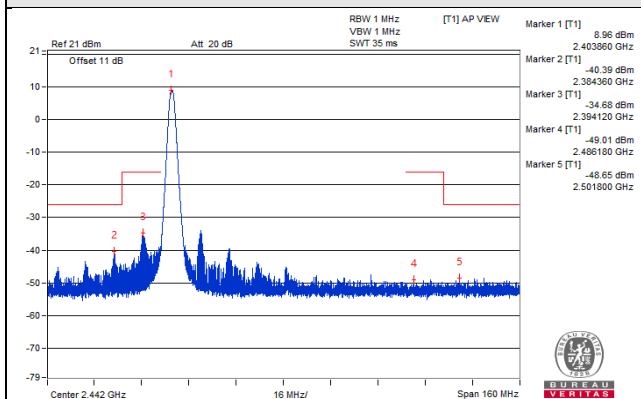
CH 1 (2404MHz)

V_{max}.



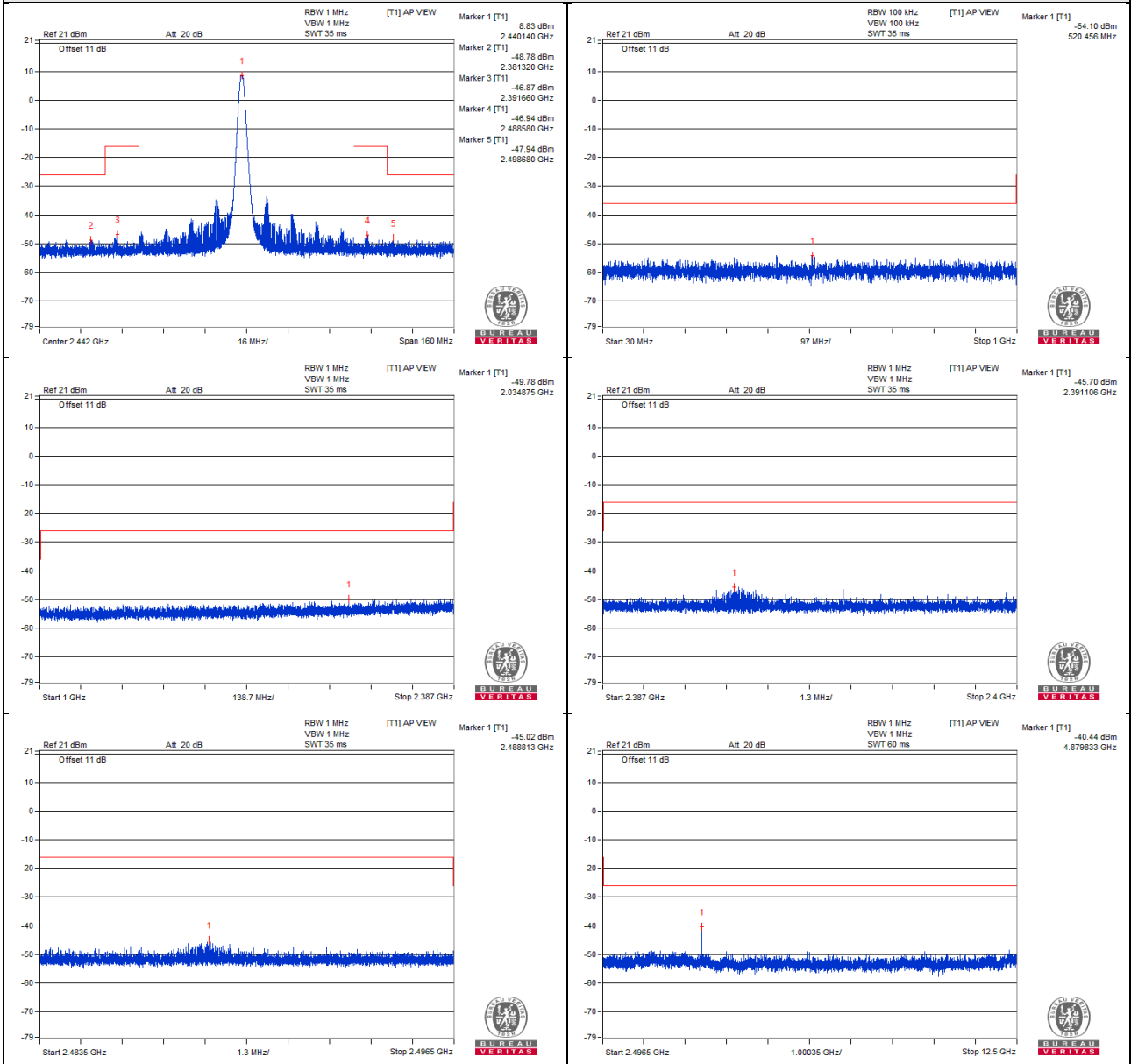
CH 1 (2404MHz)

V_{min}.



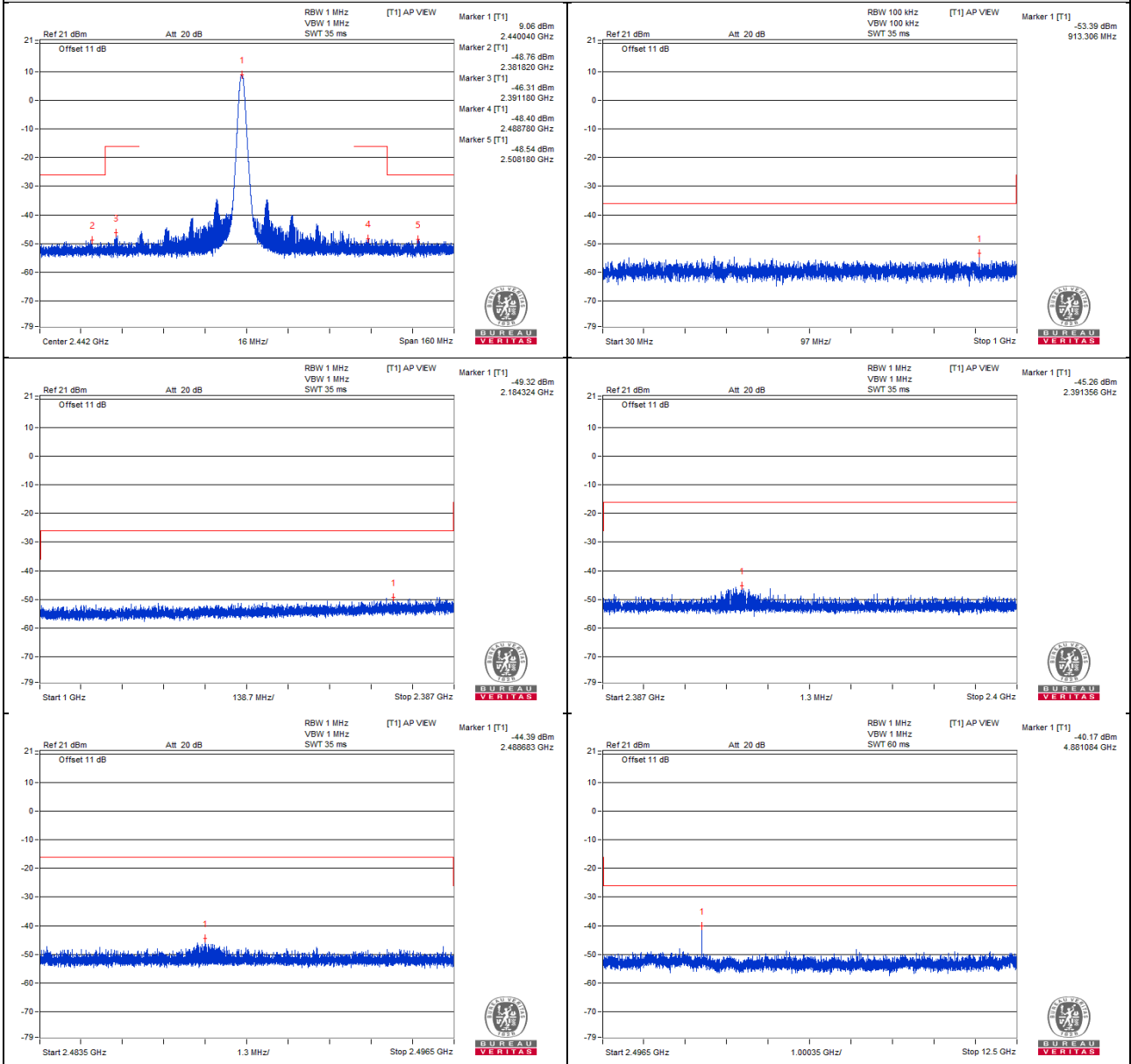
CH 1 (2404MHz)

Vnormal



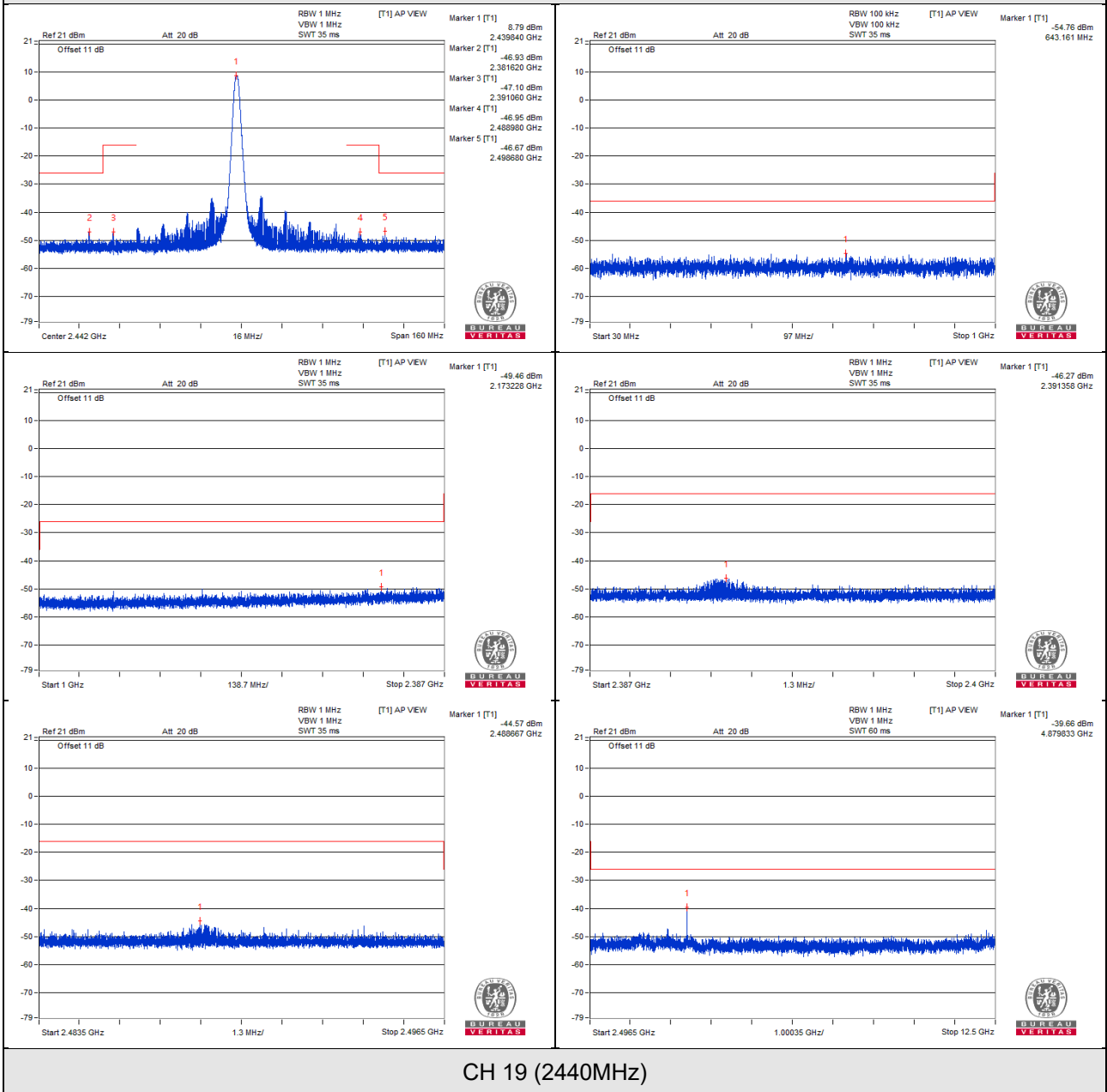
CH 19 (2440MHz)

V_{max}.

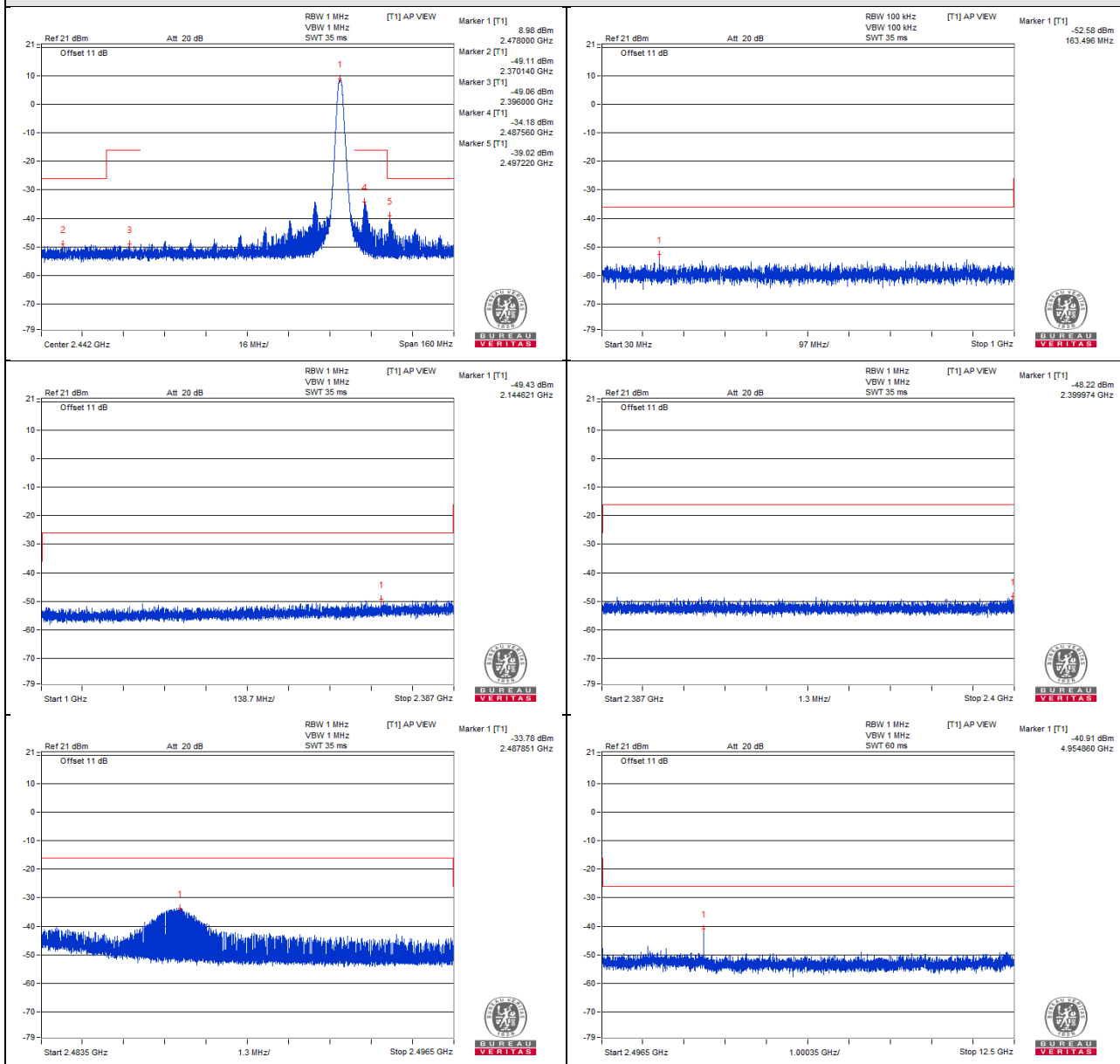


CH 19 (2440MHz)

V_{min}.

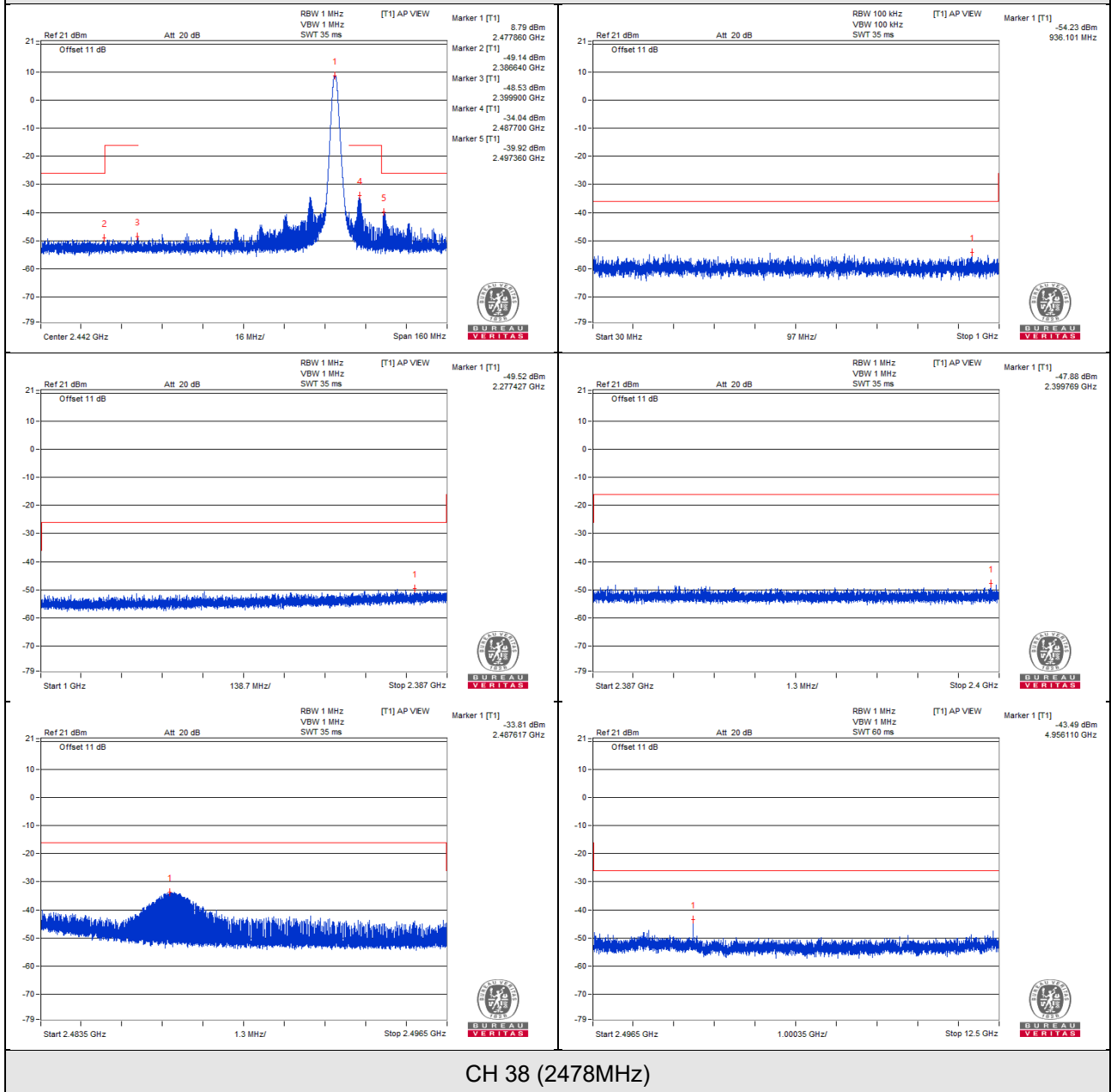


Vnormal

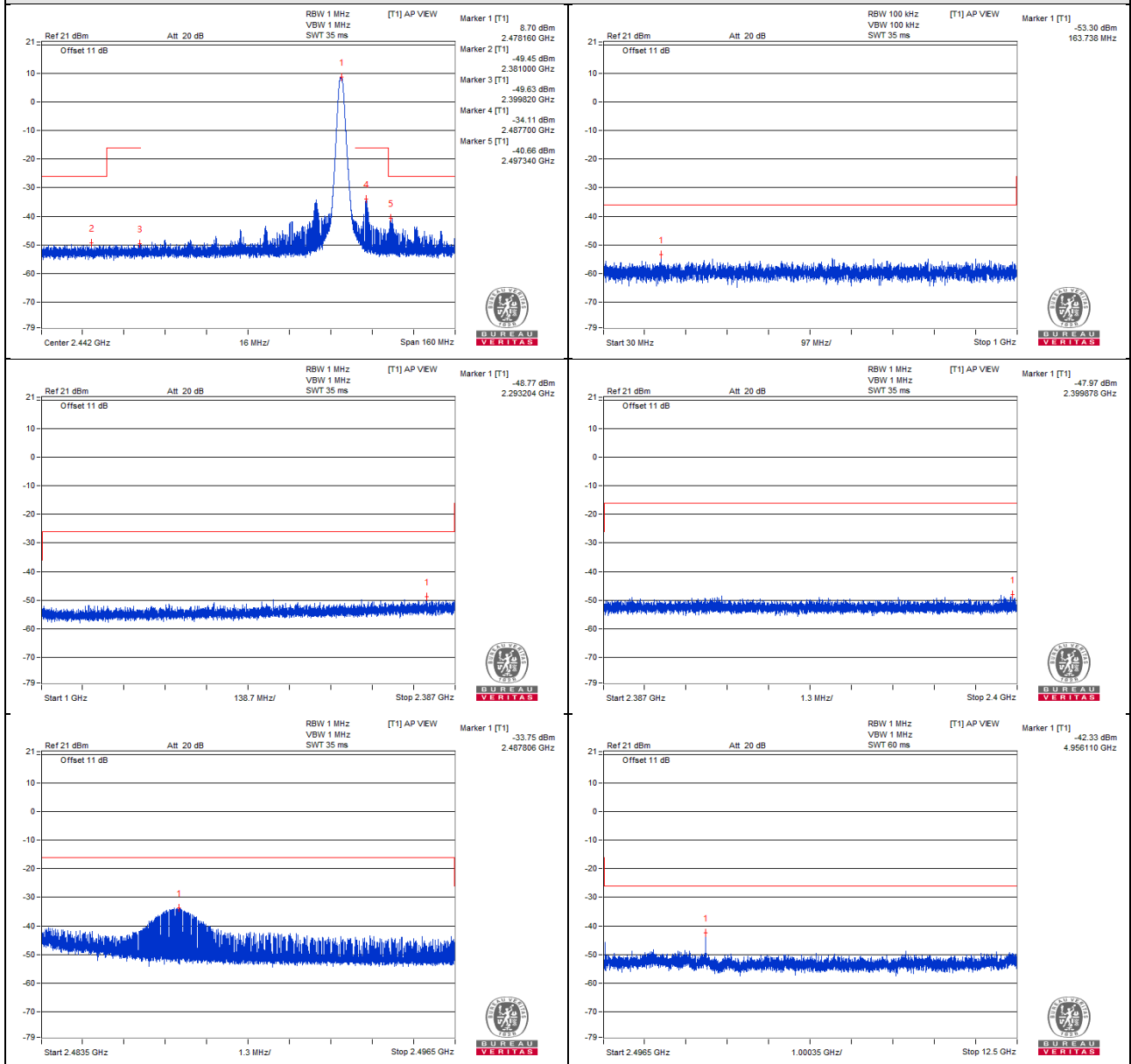


CH 38 (2478MHz)

V_{max}.

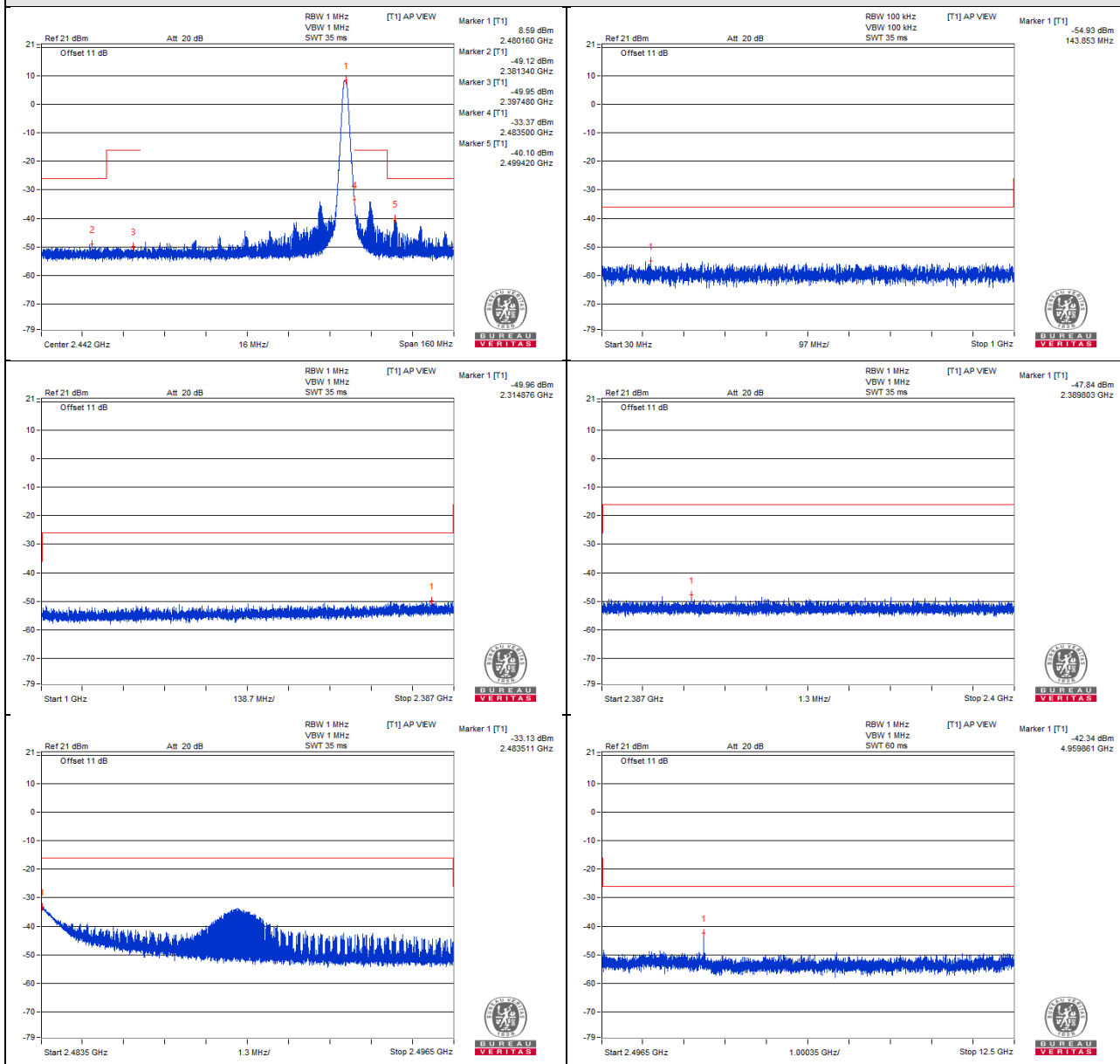


V_{min}.



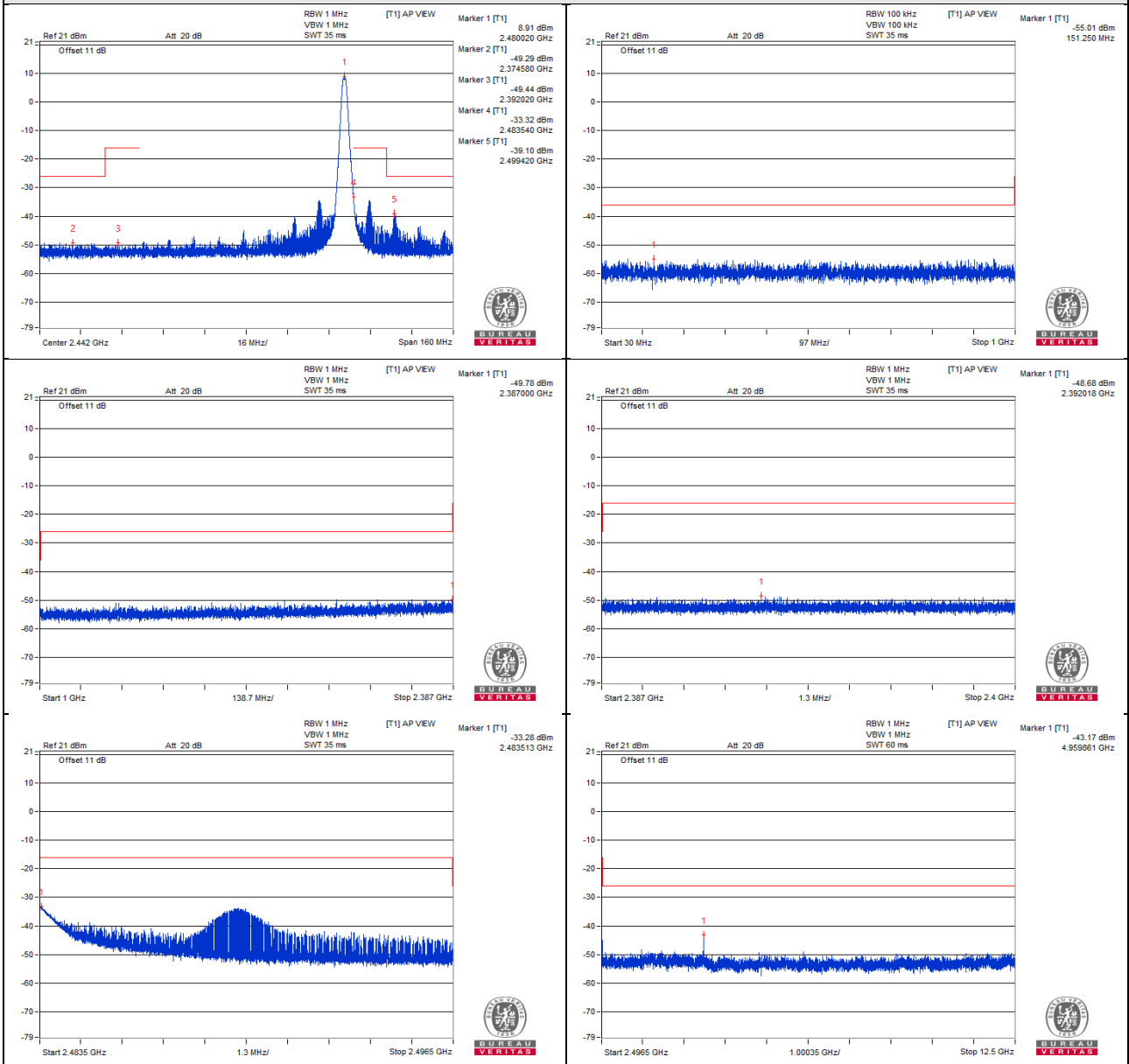
CH 38 (2478MHz)

Vnormal



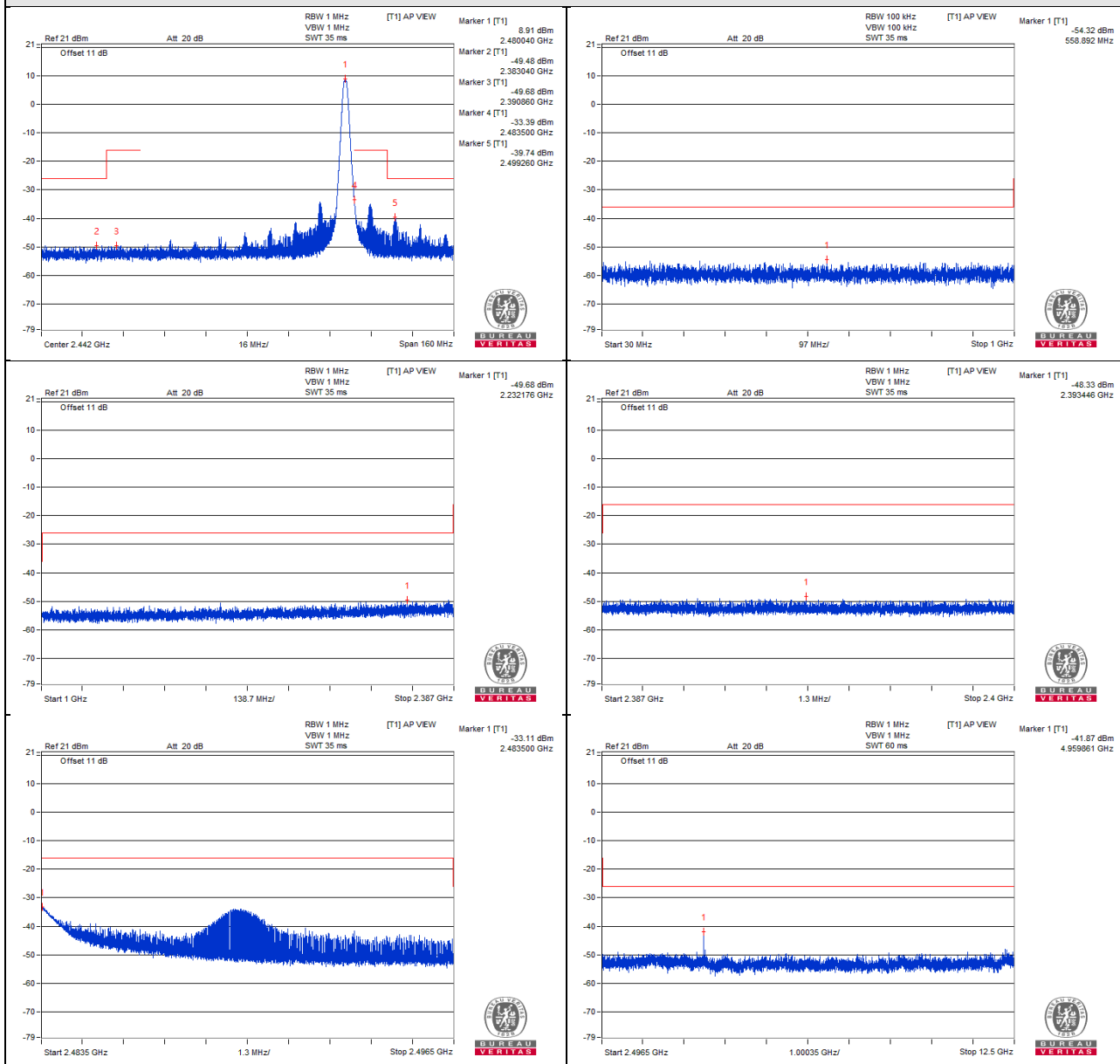
CH 39 (2480MHz)

V_{max}.



CH 39 (2480MHz)

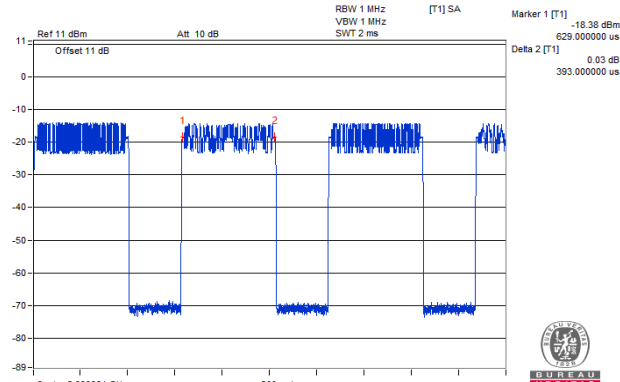
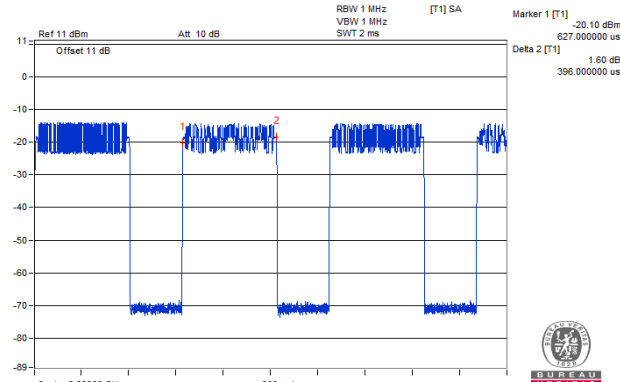
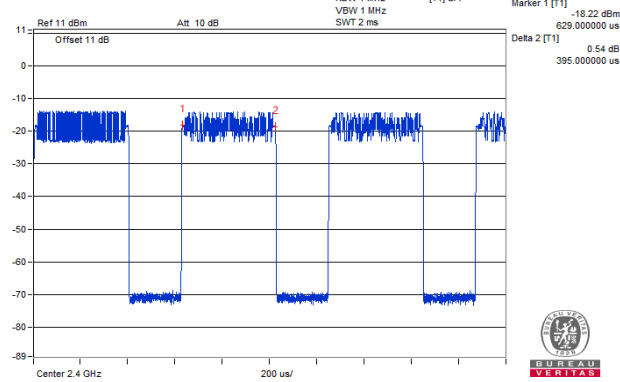
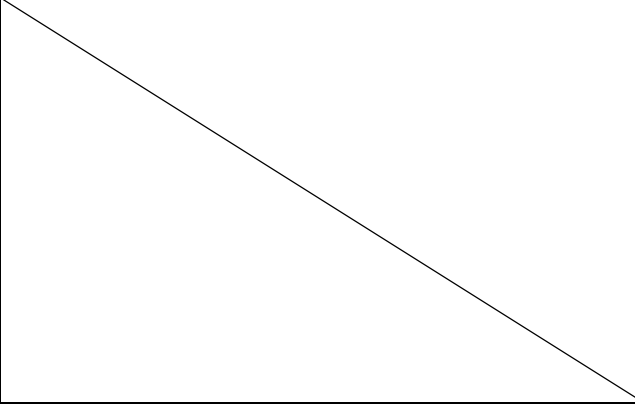
V_{min}.



CH 39 (2480MHz)

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 2399.991MHz P = 16.299078uW	2 2399.990MHz P = 16.148356uW
	
3 2400.000MHz P = 17.234325uW	

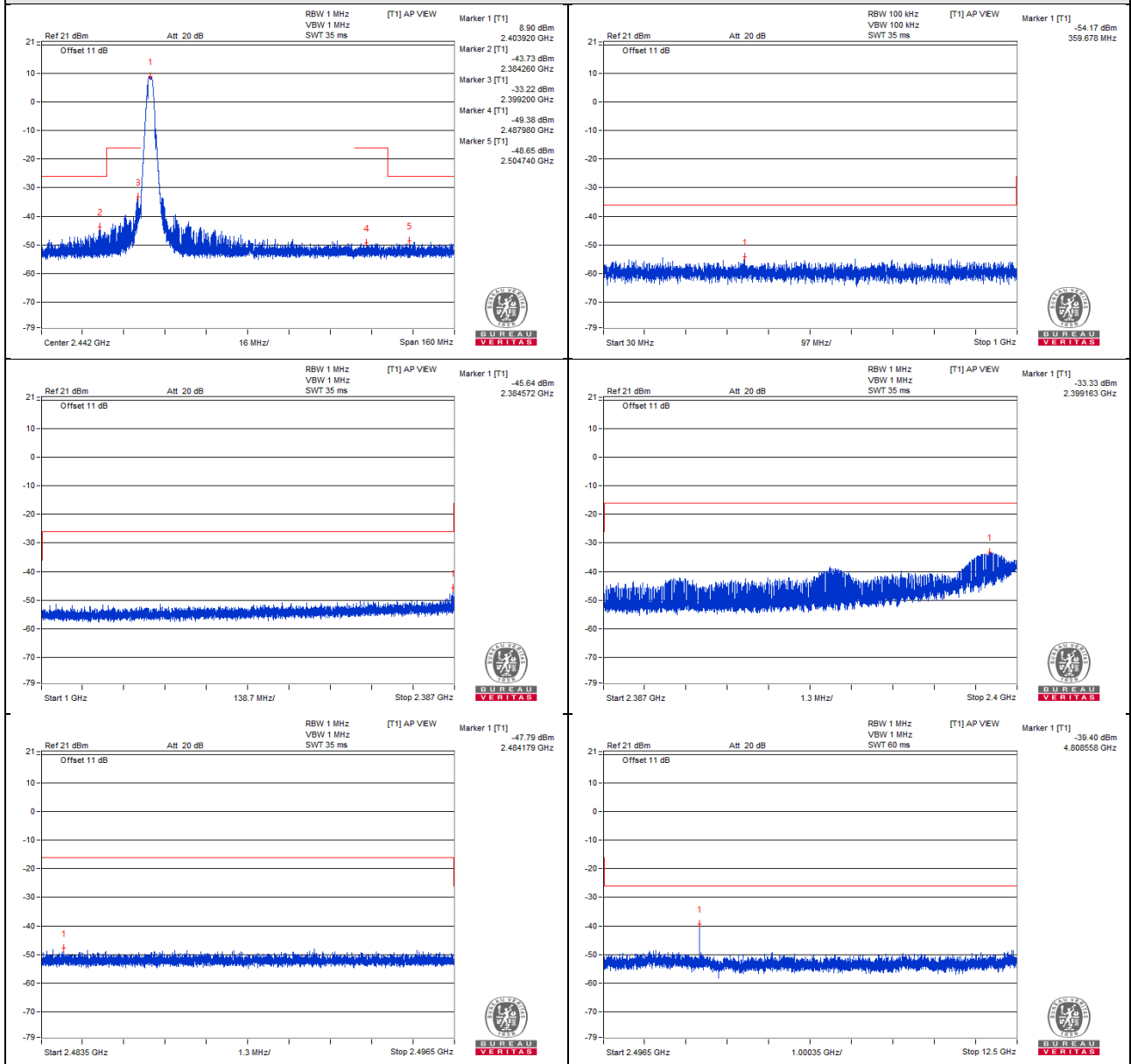
2MBaud with 2Mbps transfer rate

Test Channel		CH 1 (2404MHz)			
Test Condition	Frequency Range (MHz)	Frequency (MHz)	Measured Value (uW)	Limit (uW)	Result
V_{normal}	30 to 1000	359.678	0.003828	0.25	Pass
	1000 to 2387	2384.572	0.027290	2.5	Pass
	2387 to 2400	2399.163	0.464515	25	Pass
	2483.5 to 2496.5	2484.179	0.016634	25	Pass
	2496.5 to 12500	4808.558	0.114815	2.5	Pass
V_{max.}	30 to 1000	190.292	0.003917	0.25	Pass
	1000 to 2387	2383.532	0.021135	2.5	Pass
	2387 to 2400	2399.015	0.475335	25	Pass
	2483.5 to 2496.5	2495.911	0.014928	25	Pass
	2496.5 to 12500	4808.558	0.099083	2.5	Pass
V_{min.}	30 to 1000	376.896	0.003199	0.25	Pass
	1000 to 2387	2380.238	0.025468	2.5	Pass
	2387 to 2400	2399.046	0.464515	25	Pass
	2483.5 to 2496.5	2490.281	0.013772	25	Pass
	2496.5 to 12500	4807.308	0.134276	2.5	Pass

Test Channel		CH 19 (2440MHz)			
Test Condition	Frequency Range (MHz)	Frequency (MHz)	Measured Value (uW)	Limit (uW)	Result
V_{normal}	30 to 1000	880.447	0.003681	0.25	Pass
	1000 to 2387	2360.820	0.012823	2.5	Pass
	2387 to 2400	2391.489	0.018197	25	Pass
	2483.5 to 2496.5	2483.878	0.020230	25	Pass
	2496.5 to 12500	4878.583	0.067920	2.5	Pass
V_{max.}	30 to 1000	491.598	0.003565	0.25	Pass
	1000 to 2387	2292.163	0.010715	2.5	Pass
	2387 to 2400	2396.165	0.019861	25	Pass
	2483.5 to 2496.5	2488.701	0.021038	25	Pass
	2496.5 to 12500	10279.223	0.015136	2.5	Pass
V_{min.}	30 to 1000	523.730	0.003882	0.25	Pass
	1000 to 2387	2381.278	0.012560	2.5	Pass
	2387 to 2400	2395.927	0.017458	25	Pass
	2483.5 to 2496.5	2485.271	0.030200	25	Pass
	2496.5 to 12500	4879.833	0.069343	2.5	Pass

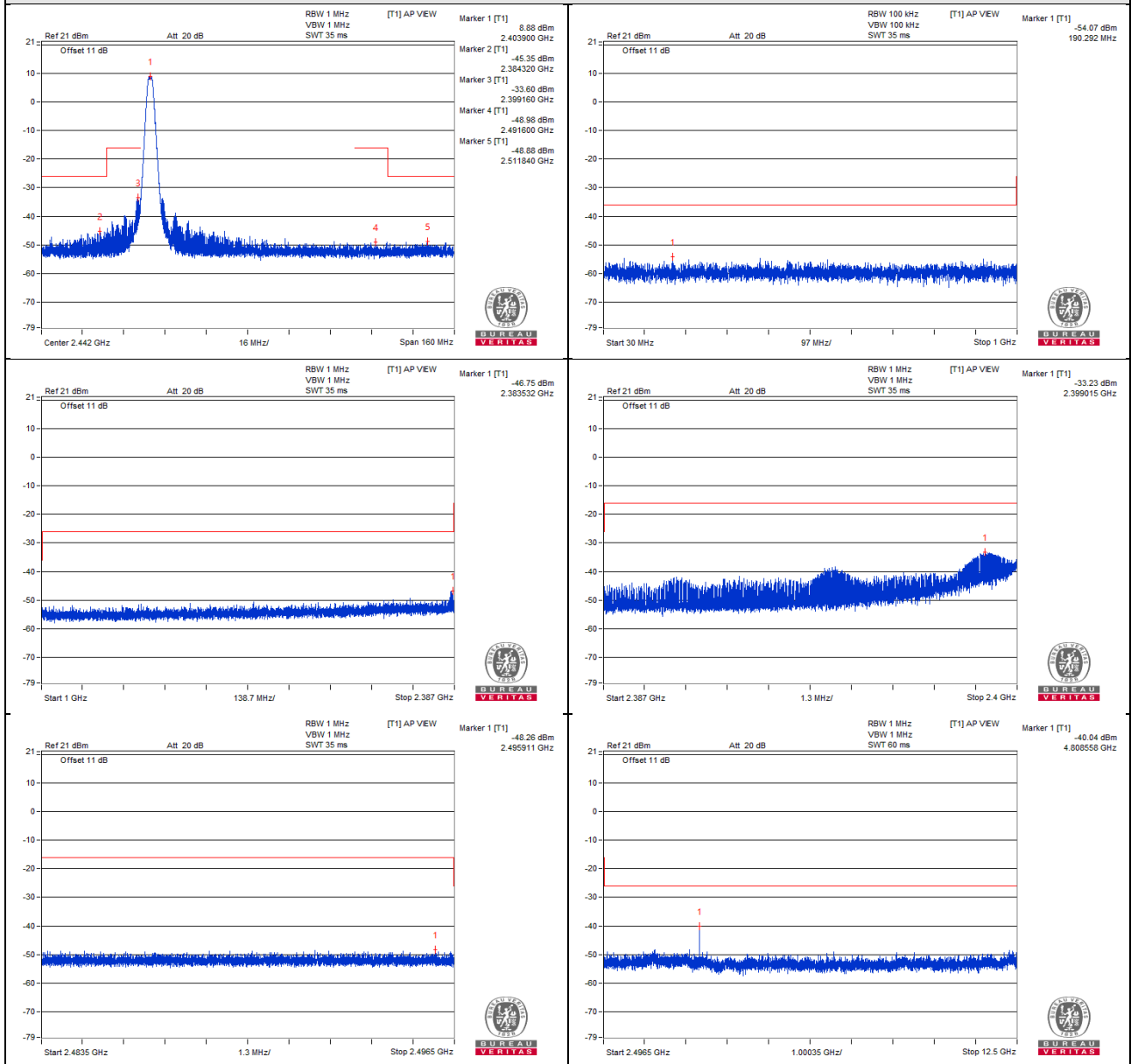
Test Channel		CH 38 (2478MHz)			
Test Condition	Frequency Range (MHz)	Frequency (MHz)	Measured Value (uW)	Limit (uW)	Result
V_{normal}	30 to 1000	102.992	0.003606	0.25	Pass
	1000 to 2387	2337.241	0.011995	2.5	Pass
	2387 to 2400	2390.352	0.015453	25	Pass
	2483.5 to 2496.5	2483.506	0.236048	25	Pass
	2496.5 to 12500	4956.110	0.044259	2.5	Pass
V_{max.}	30 to 1000	485.293	0.003499	0.25	Pass
	1000 to 2387	2106.999	0.011508	2.5	Pass
	2387 to 2400	2389.996	0.016106	25	Pass
	2483.5 to 2496.5	2483.543	0.237684	25	Pass
	2496.5 to 12500	2509.004	0.020559	2.5	Pass
V_{min.}	30 to 1000	634.673	0.004178	0.25	Pass
	1000 to 2387	2384.746	0.010666	2.5	Pass
	2387 to 2400	2399.322	0.013836	25	Pass
	2483.5 to 2496.5	2483.524	0.228034	25	Pass
	2496.5 to 12500	4956.110	0.037239	2.5	Pass
Note: The spectrum plots are attached on the following pages.					

Vnormal



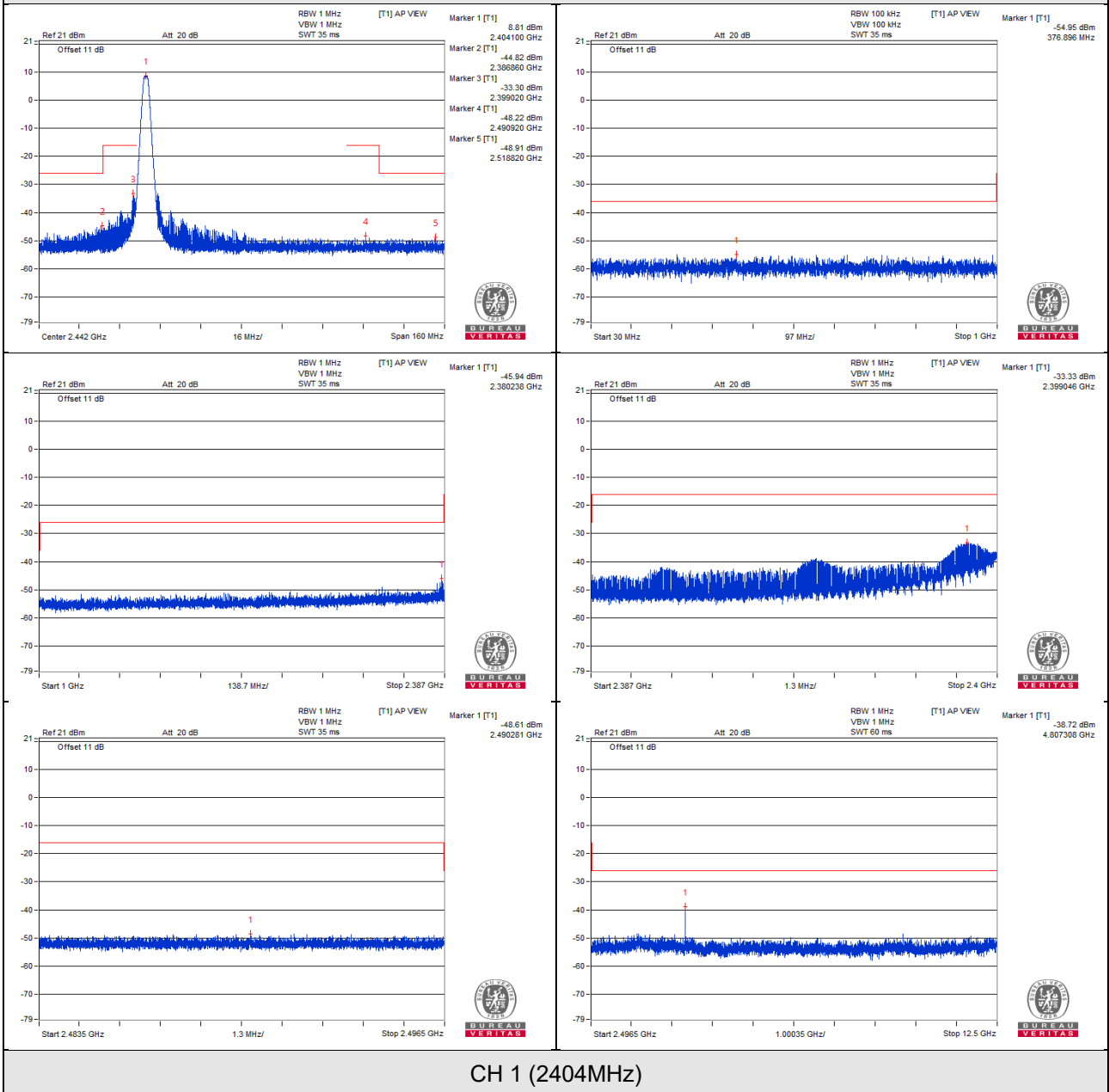
CH 1 (2404MHz)

V_{max}.

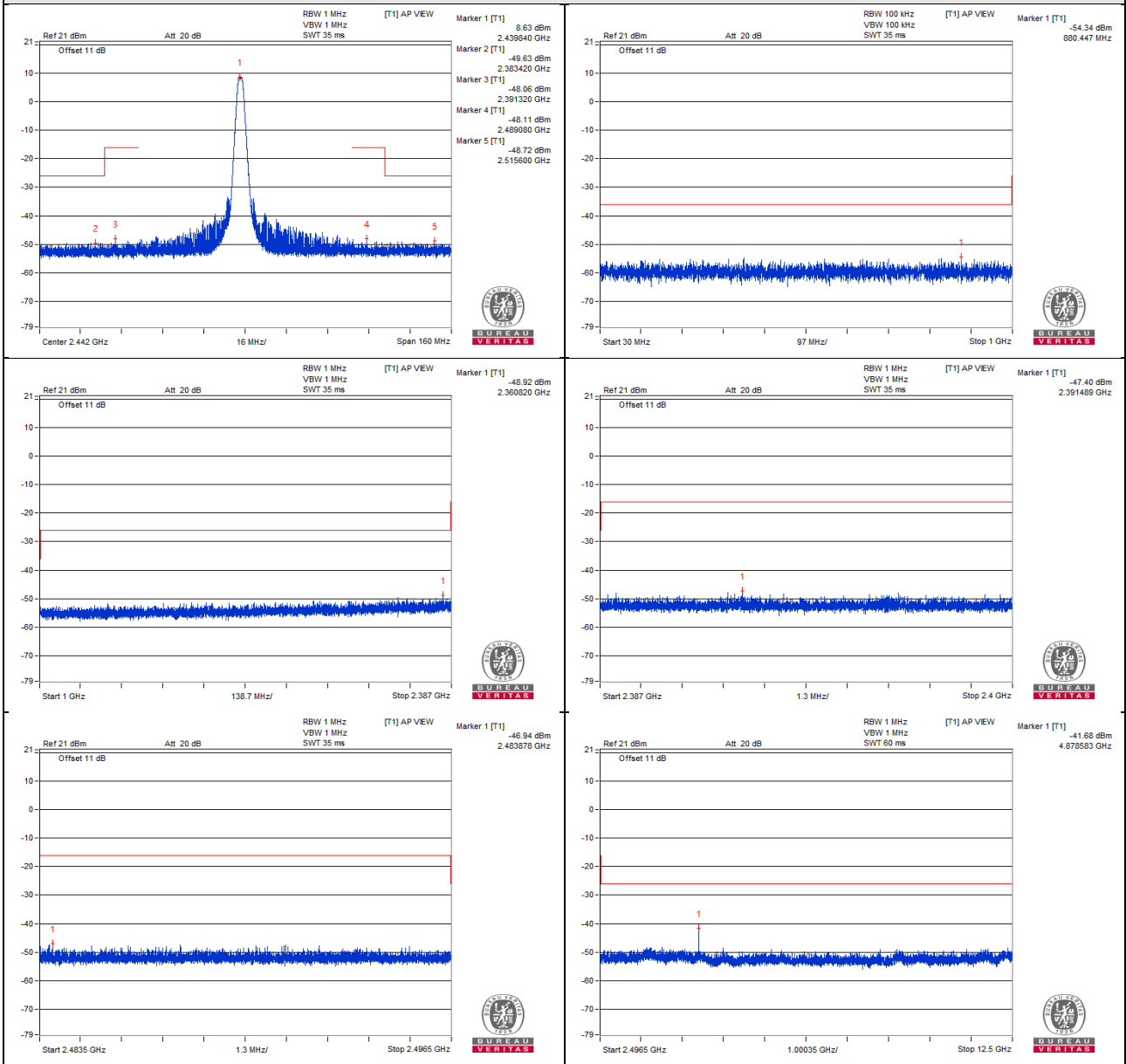


CH 1 (2404MHz)

V_{min}.

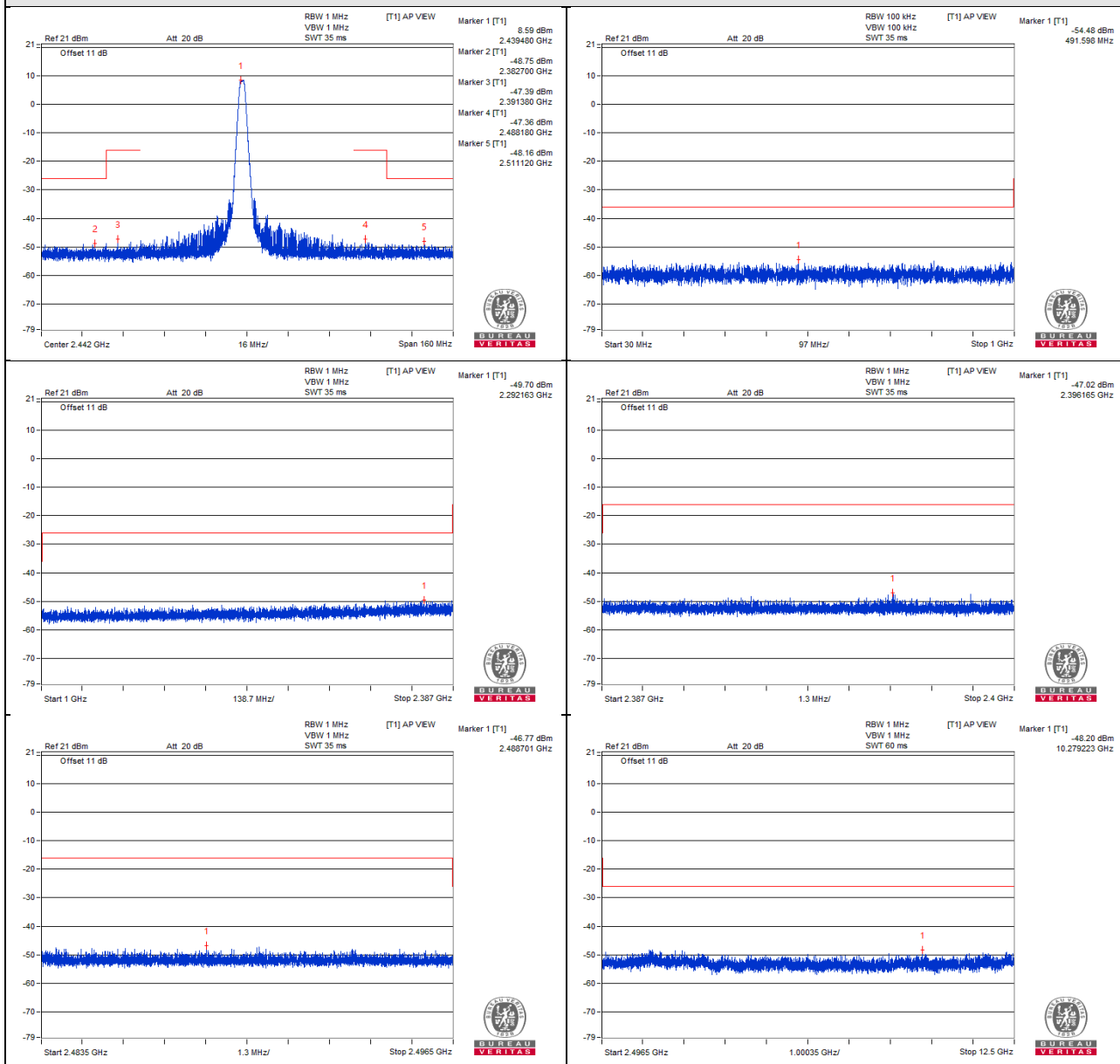


Vnormal



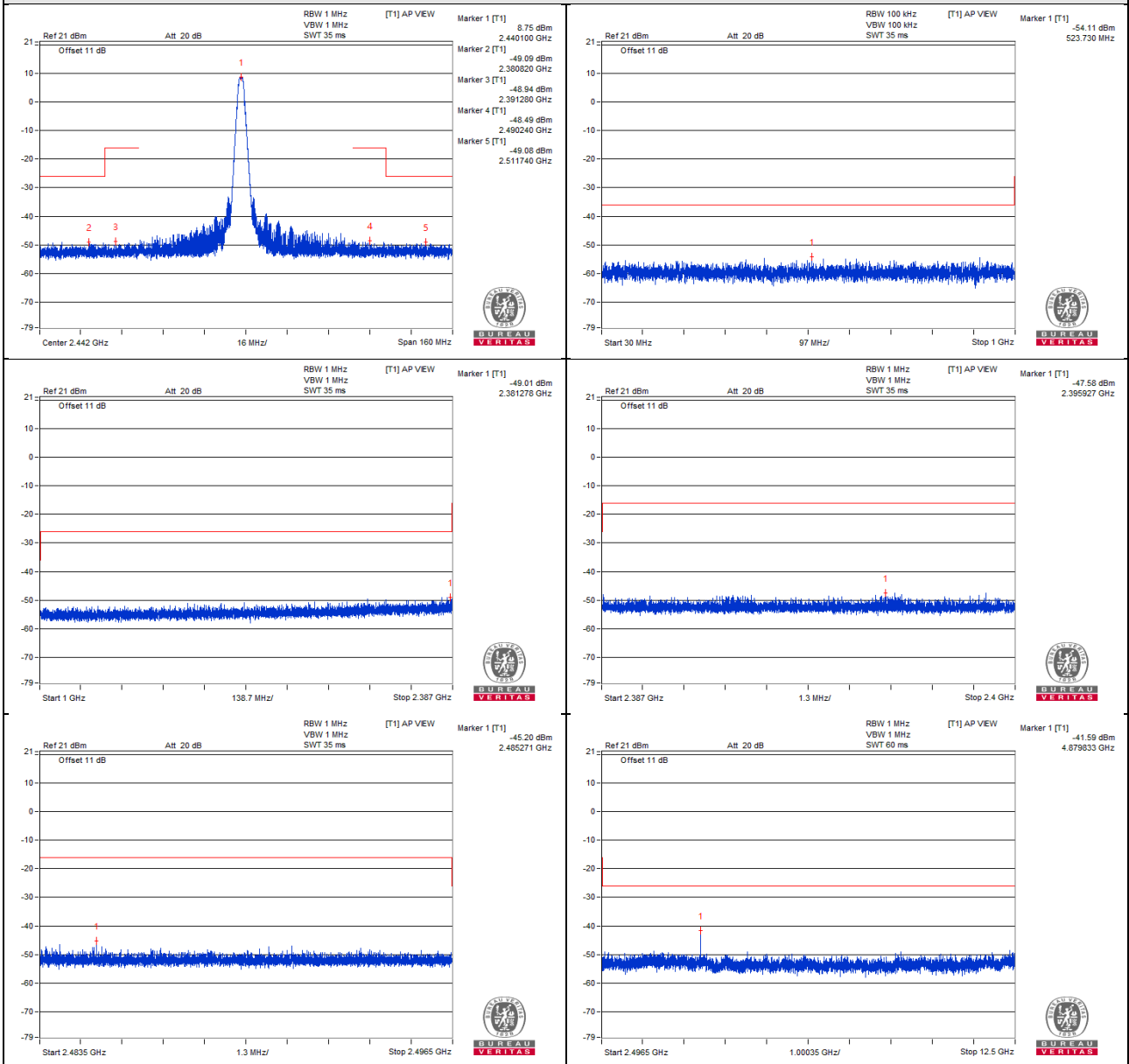
CH 19 (2440MHz)

V_{max}.



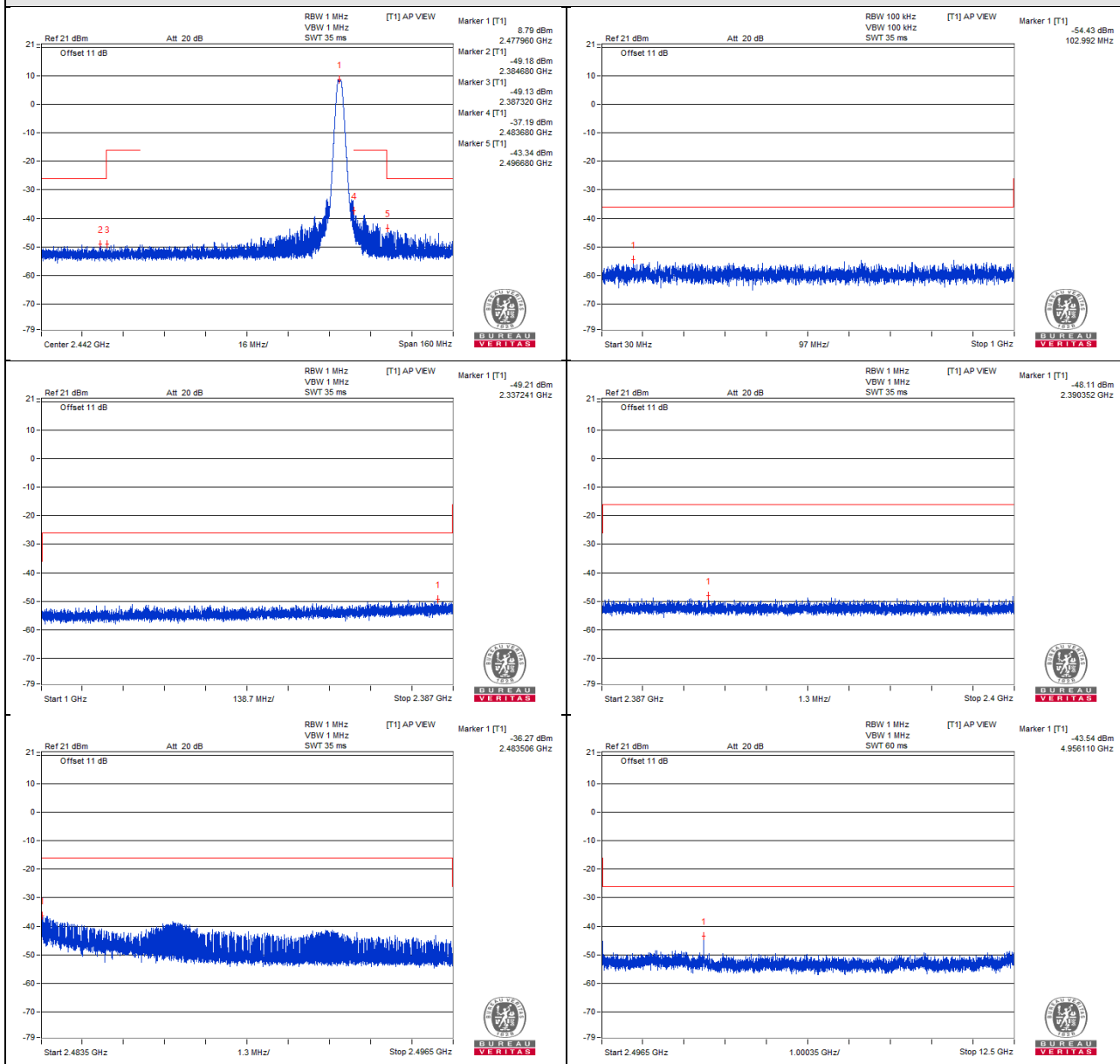
CH 19 (2440MHz)

V_{min}.



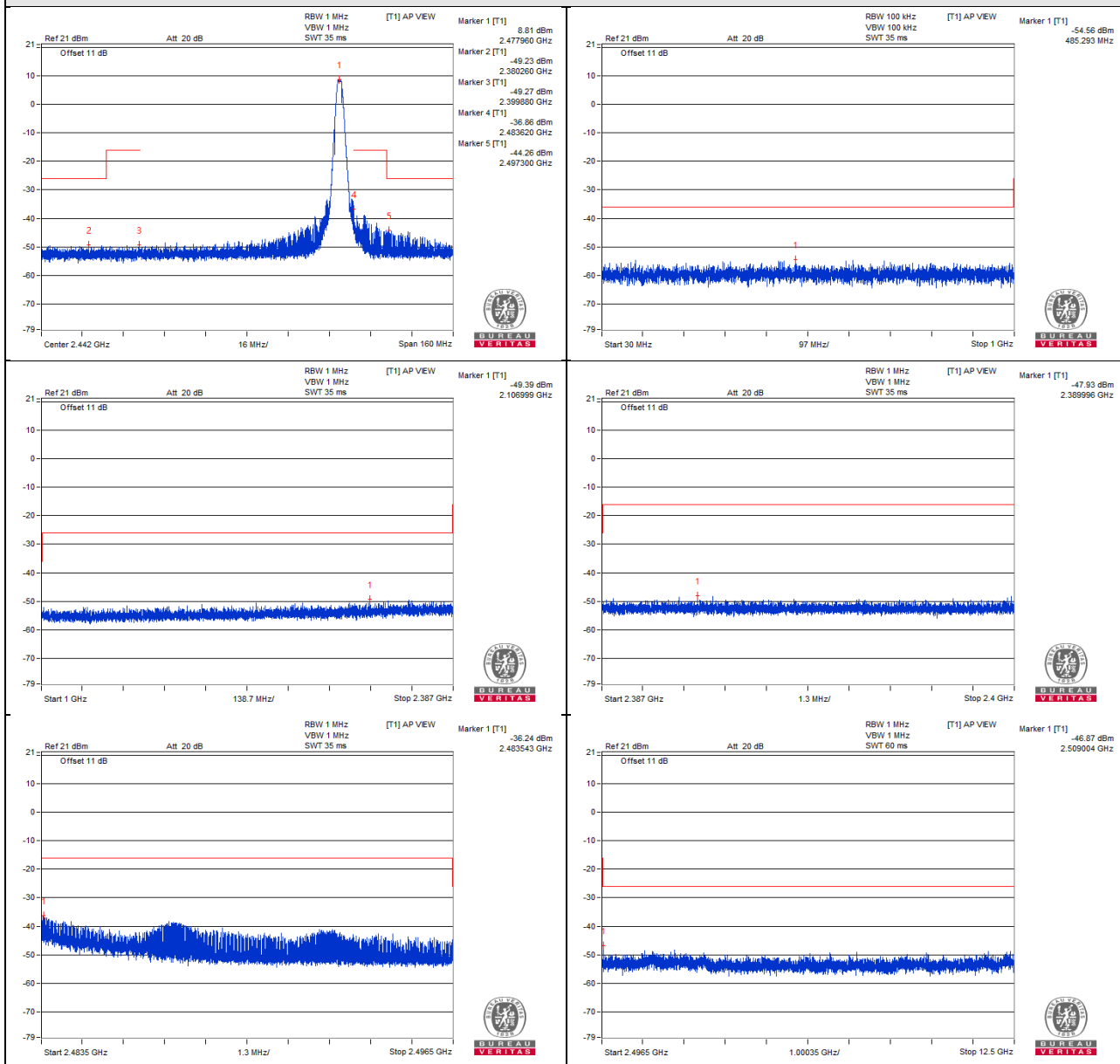
CH 19 (2440MHz)

Vnormal



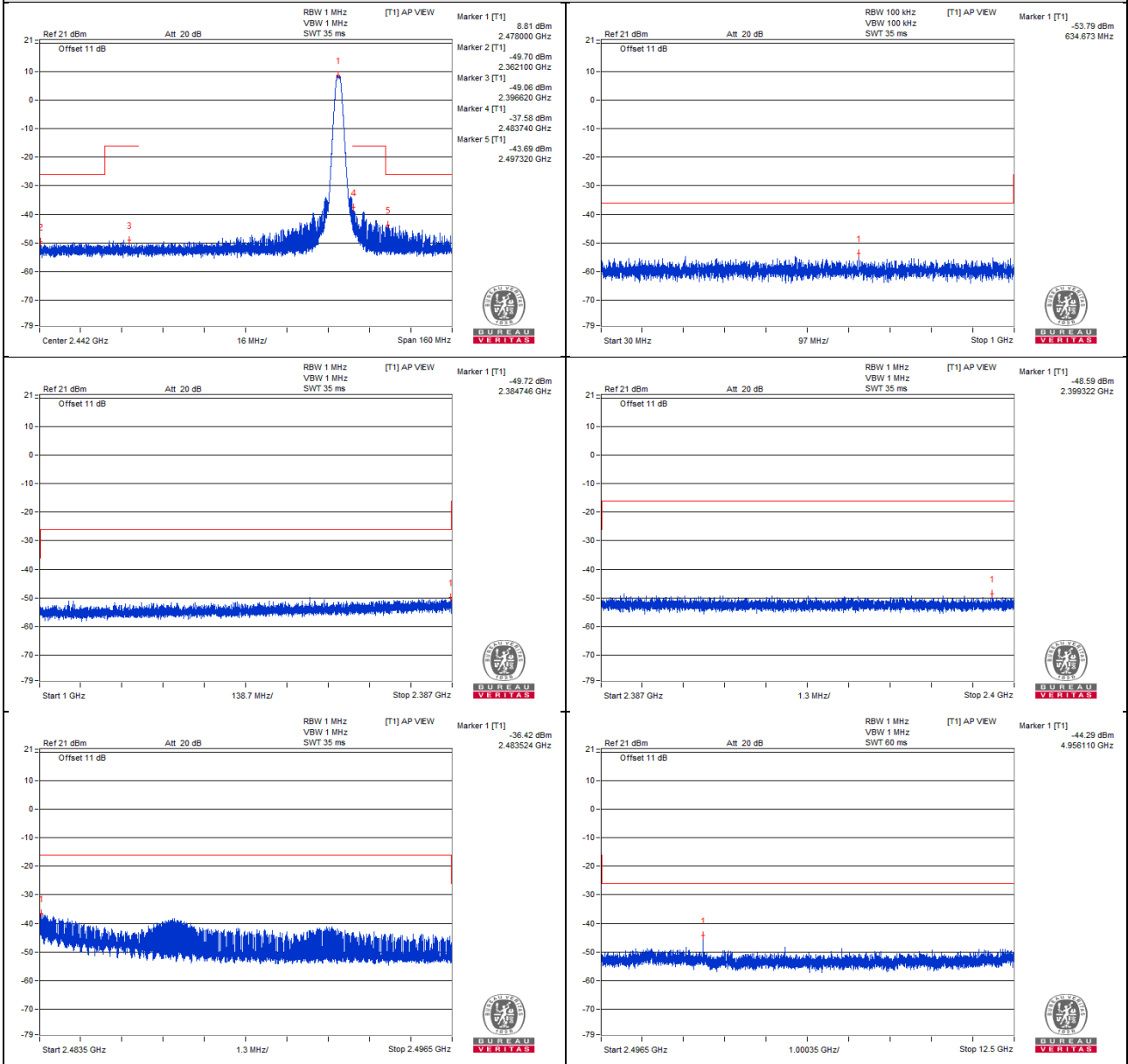
CH 38 (2478MHz)

V_{max}.



CH 38 (2478MHz)

V_{min}.



CH 38 (2478MHz)

4.4 Antenna Power Measurement

4.4.1 Limits of Antenna Power

Modulation Method	Frequency Band Used	Antenna Power (Max.)	EIRP Limit (Note 3)
DSSS	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 ~ 81.846 mW/MHz)
FH	2400 – 2483.5 MHz	3 mW/MHz	6.91 dBm/MHz ~ 16.91 dBm/MHz (4.91 mW/MHz ~ 49.1 mW/MHz)
Other than the above	2400 – 2483.5 MHz	10 mW	12.14 dBm ~ 22.14 dBm (16.368 mW ~ 163.68 mW)
Modulation System	Frequency Band Used	Antenna Power (Max.)	EIRP Limit
DS	2471 – 2497 MHz	10 mW/MHz	12.14 dBm/MHz (16.368 mW/MHz)

Note:

1. Occupied bandwidth is less than 26MHz
2. Occupied bandwidth is more than 26MHz and less than 40MHz
3. EIRP limit is variable by the HPBA, the HPBA (half-power beam width) of the antenna shall be 360/A degrees or less, where A = EIRP/(2.14 dBi + "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

1MBaud with 1Mbps transfer rate

Test Voltage	Channel Number	Frequency (MHz)	Conducted RF Output Power (mW)	Radiated RF Output Power (mW)
V_{normal}	0	2402	8.222	12.502
	1	2404	8.770	13.335
	19	2440	8.395	12.765
	38	2478	8.414	12.794
	39	2480	8.035	12.218
V_{max.}	0	2402	8.110	12.332
	1	2404	8.650	13.153
	19	2440	8.204	12.475
	38	2478	8.035	12.218
	39	2480	7.674	11.669
V_{min.}	0	2402	8.472	12.882
	1	2404	9.036	13.740
	19	2440	8.185	12.446
	38	2478	8.128	12.359
	39	2480	7.762	11.802
Max. Limit (mW):			10	-
Rated Power (mW):			9	-
Tolerance of Antenna Power (mW):			1.8 ~ 10.8	-
Max. EIRP Limit (mW):			-	16.368

Note: 1. Antenna gain: 1.82dBi.

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.

2MBaud with 2Mbps transfer rate

Test Voltage	Channel Number	Frequency (MHz)	Conducted RF Output Power (mW)	Radiated RF Output Power (mW)
V_{normal}	1	2404	8.204	12.475
	19	2440	8.356	12.706
	38	2478	8.166	12.417
V_{max.}	1	2404	8.035	12.218
	19	2440	7.980	12.134
	38	2478	8.072	12.274
V_{min.}	1	2404	8.204	12.475
	19	2440	8.414	12.794
	38	2478	8.414	12.794
Max. Limit (mW):			10	-
Rated Power (mW):			9	-
Tolerance of Antenna Power (mW):			1.8 ~ 10.8	-
Max. EIRP Limit (mW):			-	16.368

Note: 1. Antenna gain: 1.82dBi.

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

4.5.2 Test Setup



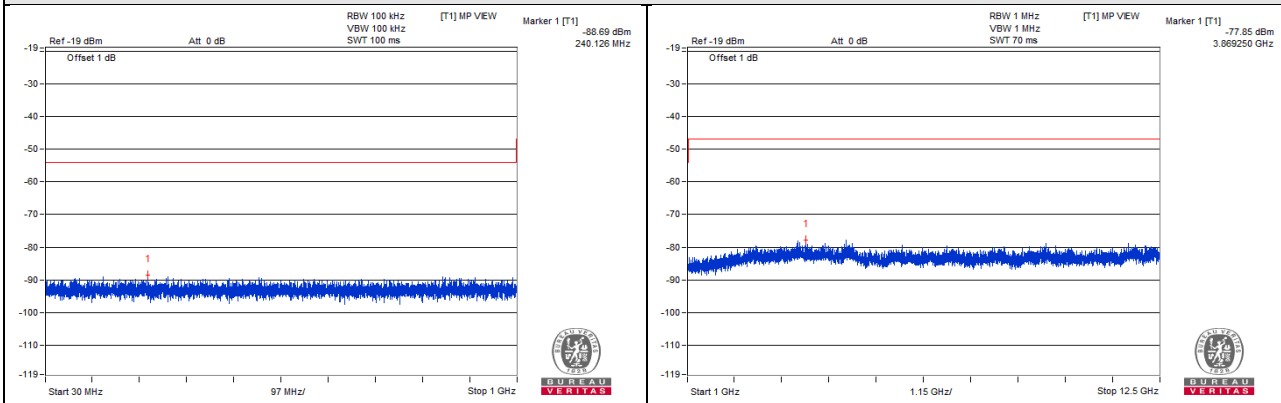
4.5.3 Test Result

1MBaud with 1Mbps transfer rate

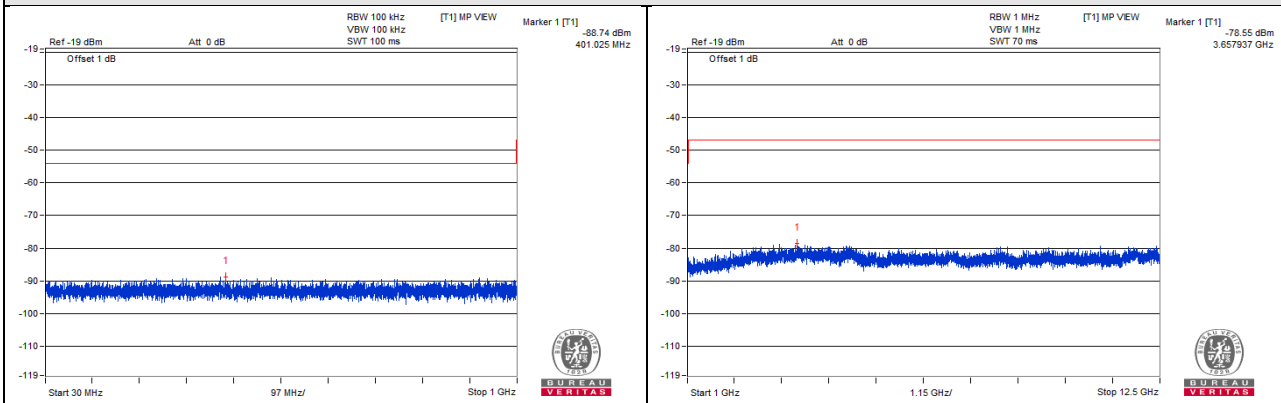
Test Channel		CH 0 (2402MHz)			
Test Condition	Frequency Range (MHz)	Frequency (MHz)	Measured Value (nW)	Limit (nW)	Result
V_{normal}	30 to 1000	240.126	0.001352	4.0	Pass
	1000 to 125000	3869.250	0.016406	20.0	Pass
$V_{max.}$	30 to 1000	401.025	0.001337	4.0	Pass
	1000 to 125000	3657.937	0.013964	20.0	Pass
$V_{min.}$	30 to 1000	188.958	0.001419	4.0	Pass
	1000 to 125000	3757.125	0.014962	20.0	Pass
Test Channel		CH 1 (2404MHz)			
V_{normal}	30 to 1000	501.298	0.001403	4.0	Pass
	1000 to 125000	4254.500	0.013459	20.0	Pass
$V_{max.}$	30 to 1000	468.925	0.001403	4.0	Pass
	1000 to 125000	3708.250	0.015136	20.0	Pass
$V_{min.}$	30 to 1000	469.531	0.001514	4.0	Pass
	1000 to 125000	4984.750	0.015922	20.0	Pass
Test Channel		CH 19 (2440MHz)			
V_{normal}	30 to 1000	461.165	0.001683	4.0	Pass
	1000 to 125000	2679.000	0.015417	20.0	Pass
$V_{max.}$	30 to 1000	867.473	0.001445	4.0	Pass
	1000 to 125000	3728.375	0.019679	20.0	Pass
$V_{min.}$	30 to 1000	268.013	0.001581	4.0	Pass
	1000 to 125000	3588.937	0.018923	20.0	Pass
Test Channel		CH 38 (2478MHz)			
V_{normal}	30 to 1000	566.652	0.001486	4.0	Pass
	1000 to 125000	4856.812	0.015704	20.0	Pass
$V_{max.}$	30 to 1000	478.140	0.001213	4.0	Pass
	1000 to 125000	3728.375	0.013032	20.0	Pass
$V_{min.}$	30 to 1000	448.797	0.001472	4.0	Pass
	1000 to 125000	7540.625	0.014622	20.0	Pass

Test Channel		CH 39 (2480MHz)			
Test Condition	Frequency Range (MHz)	Frequency (MHz)	Measured Value (nW)	Limit (nW)	Result
V_{normal}	30 to 1000	82.865	0.001570	4.0	Pass
	1000 to 125000	3829.000	0.014060	20.0	Pass
$V_{\text{max.}}$	30 to 1000	990.906	0.001374	4.0	Pass
	1000 to 125000	3741.312	0.015488	20.0	Pass
$V_{\text{min.}}$	30 to 1000	111.116	0.001607	4.0	Pass
	1000 to 125000	3547.250	0.016788	20.0	Pass

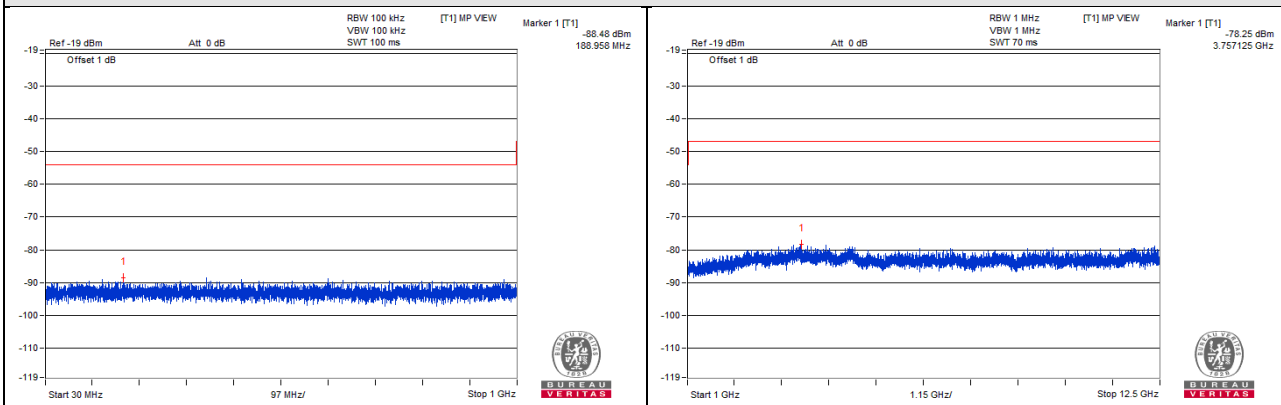
V_{normal}



V_{max}

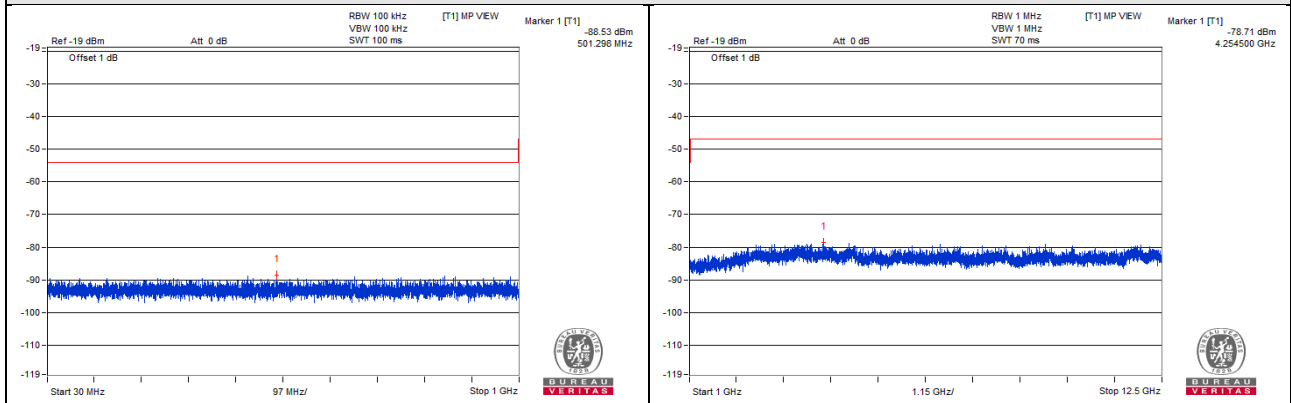


V_{min}

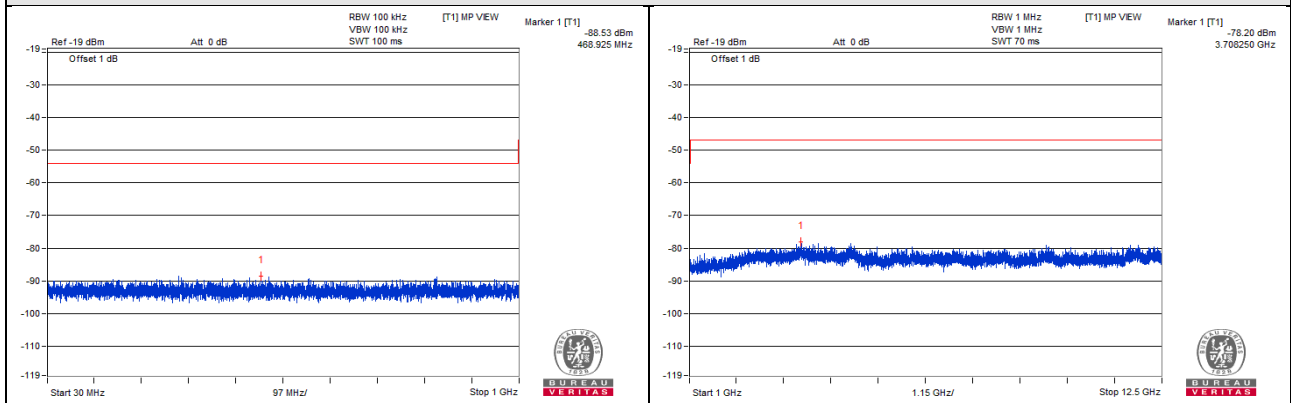


CH 0 (2402MHz)

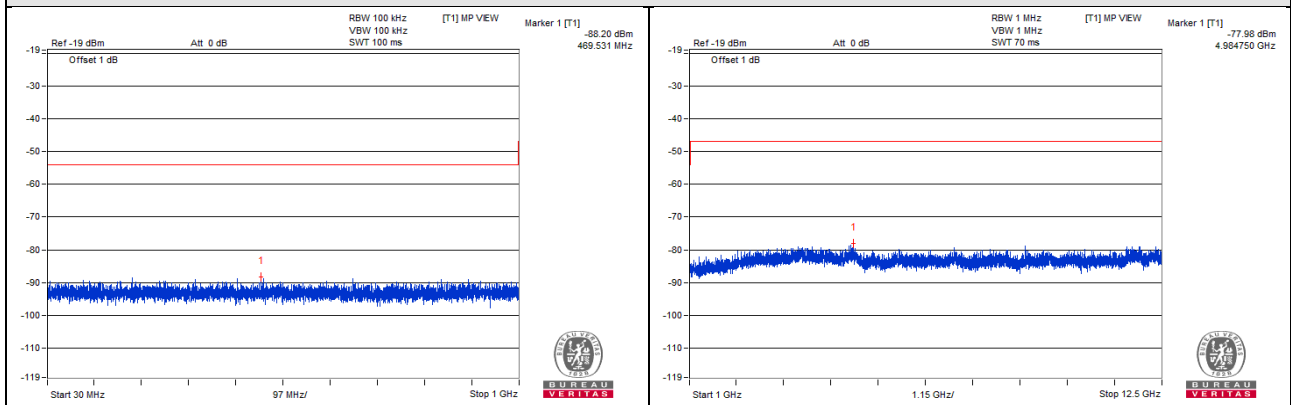
V_{normal}



V_{max}

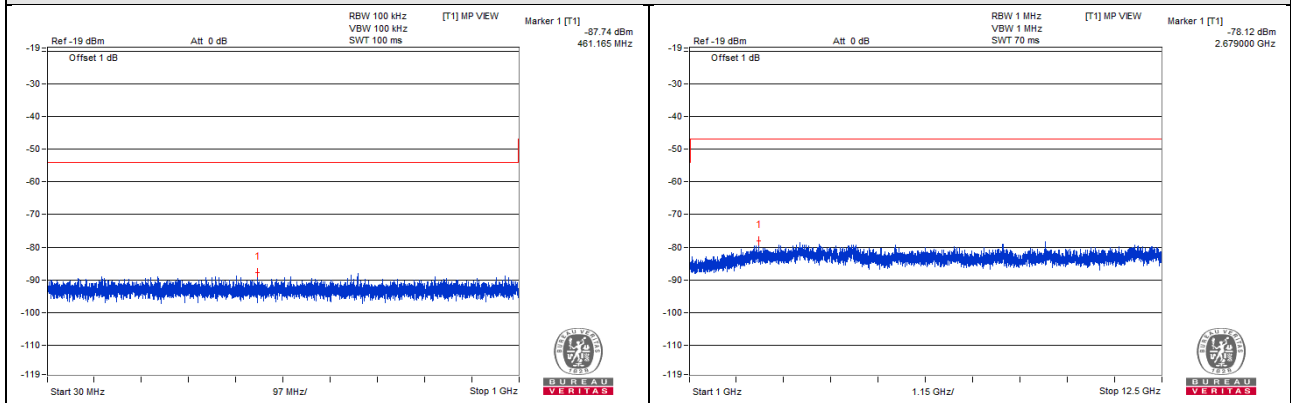


V_{min}

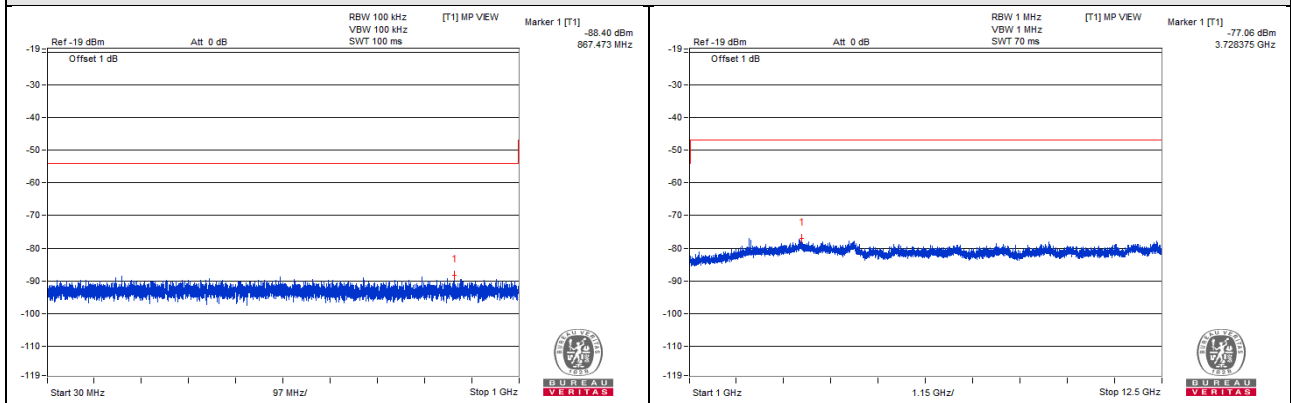


CH 1 (2404MHz)

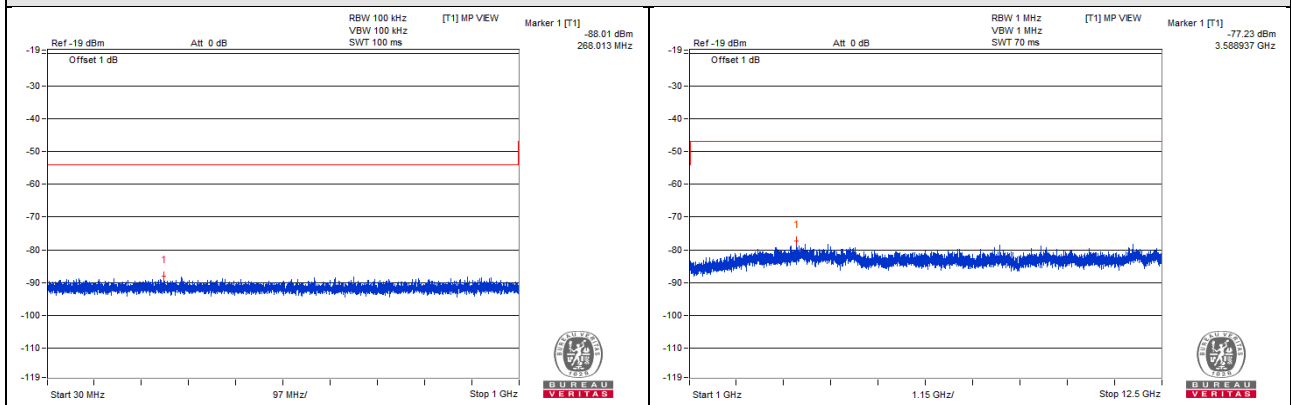
V_{normal}



V_{max}

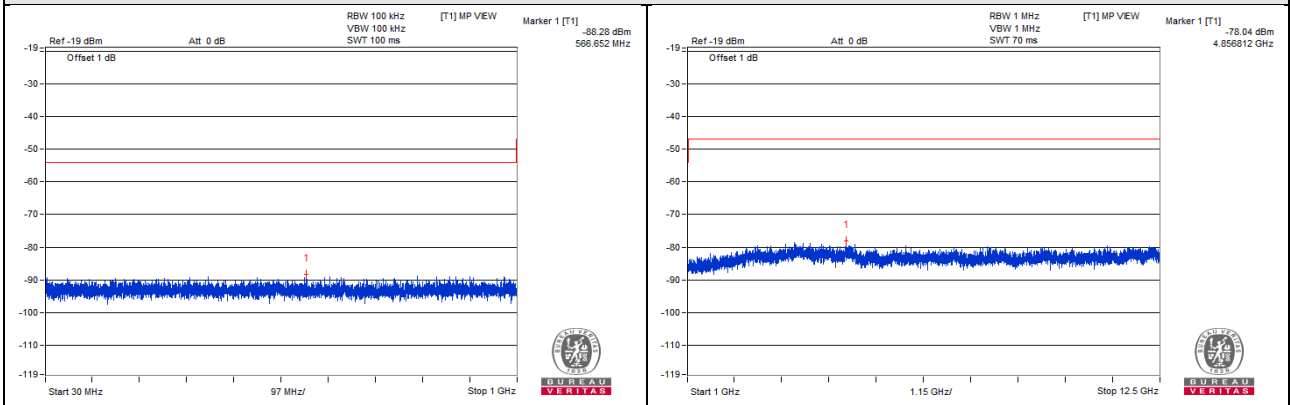


V_{min}

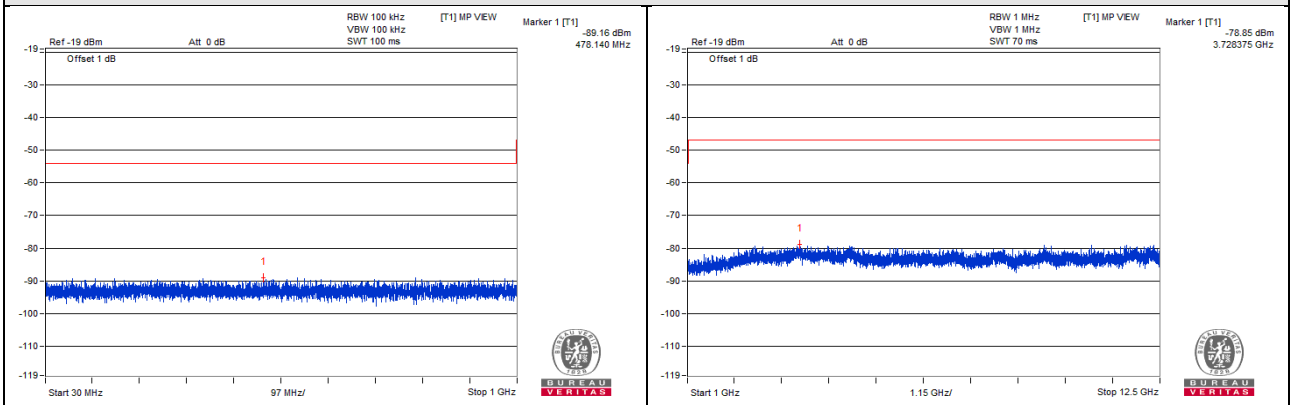


CH 19 (2440MHz)

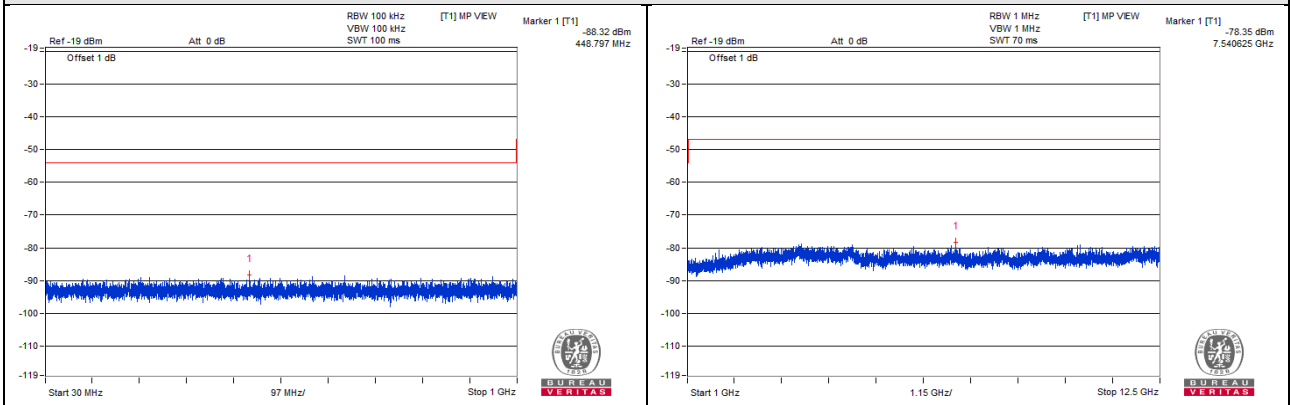
V_{normal}



V_{max}

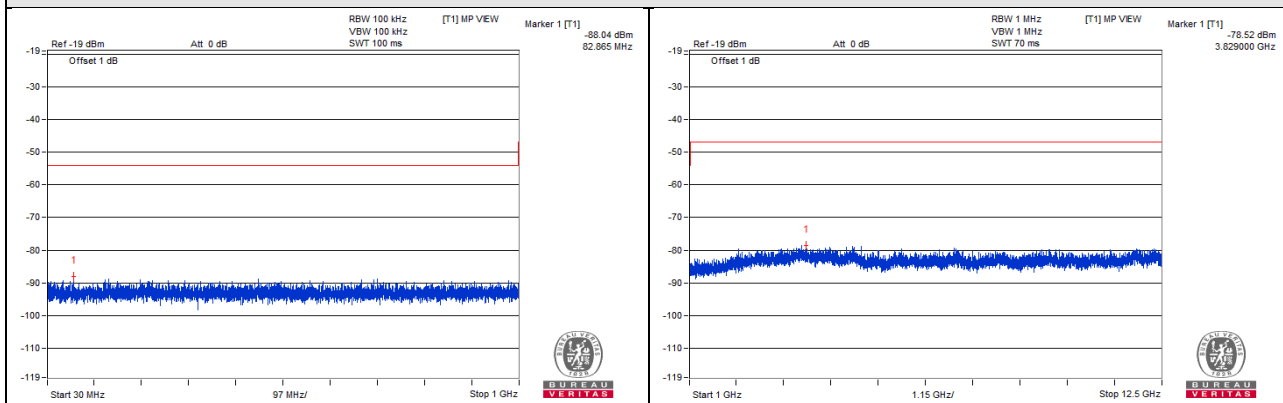


V_{min}

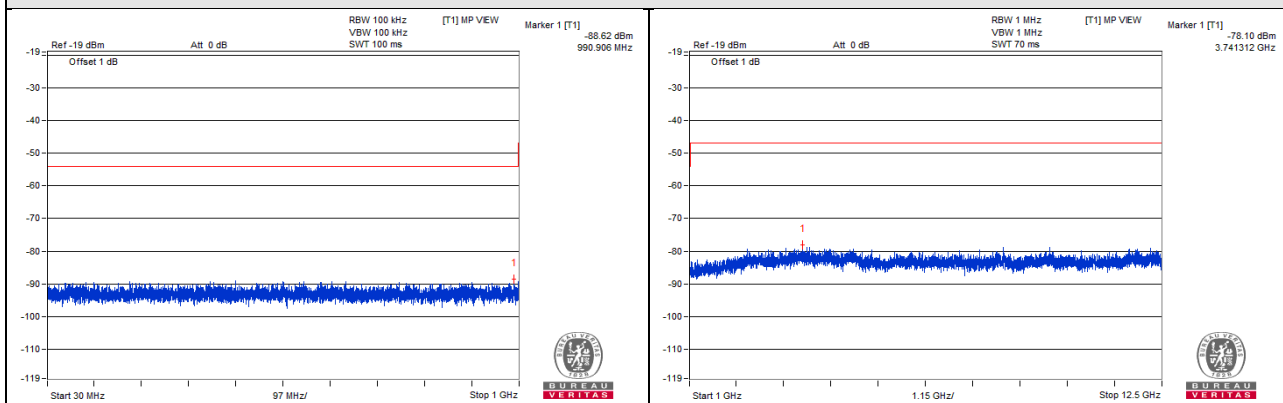


CH 38 (2478MHz)

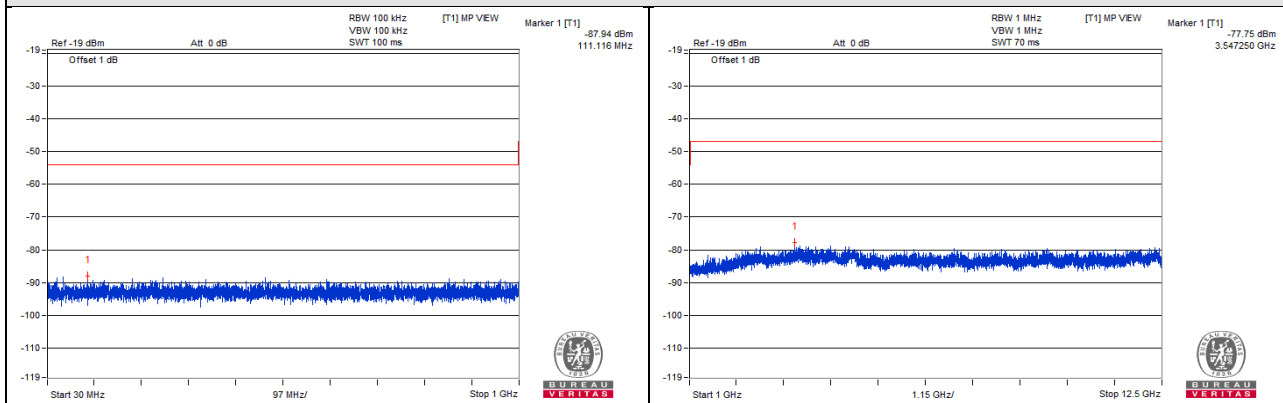
V_{normal}



V_{max}



V_{min}

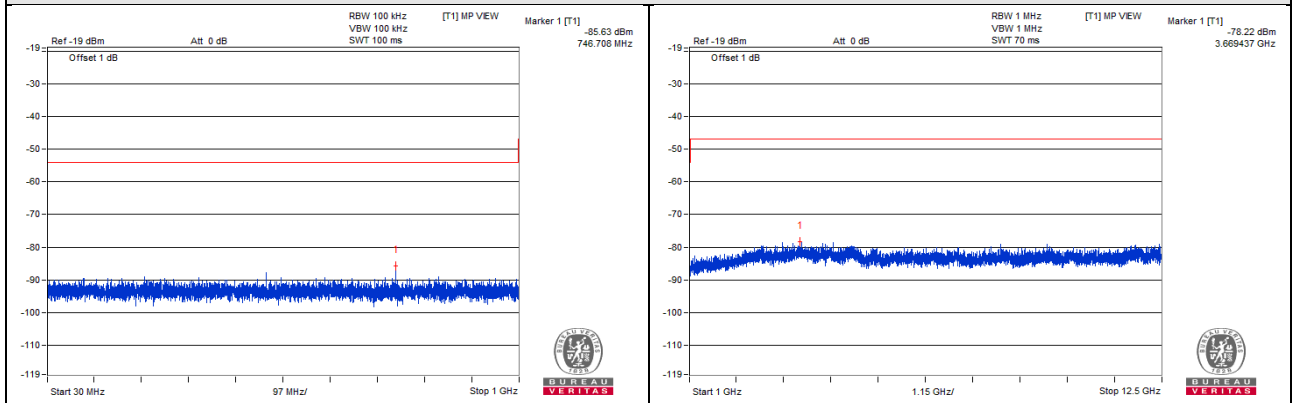


CH 39 (2480MHz)

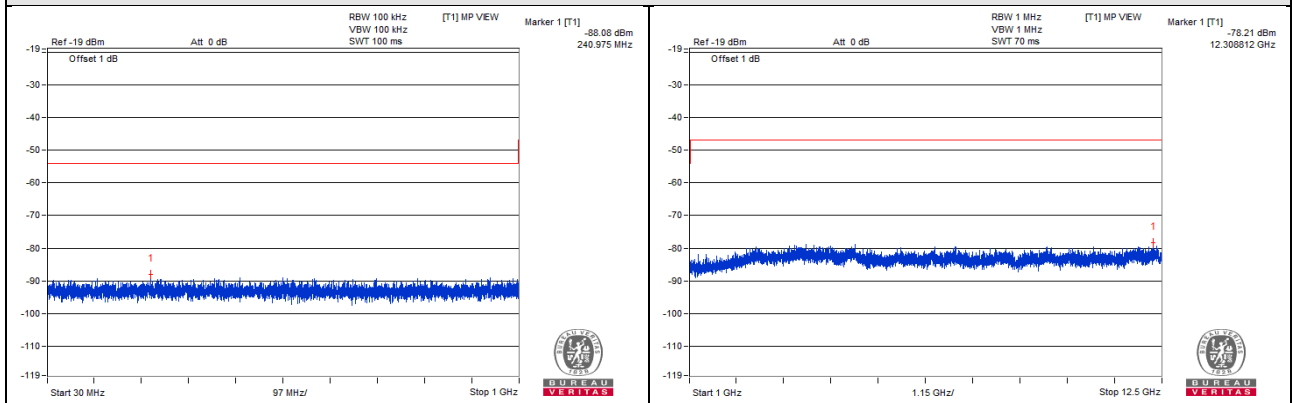
2MBaud with 2Mbps transfer rate

Test Channel		CH 1 (2404MHz)			
Test Condition	Frequency Range (MHz)	Frequency (MHz)	Measured Value (nW)	Limit (nW)	Result
V_{normal}	30 to 1000	746.708	0.002735	4.0	Pass
	1000 to 125000	3669.437	0.015066	20.0	Pass
$V_{max.}$	30 to 1000	240.975	0.001556	4.0	Pass
	1000 to 125000	12308.812	0.015101	20.0	Pass
$V_{min.}$	30 to 1000	611.515	0.001422	4.0	Pass
	1000 to 125000	5007.750	0.014454	20.0	Pass
Test Channel		CH 19 (2440MHz)			
V_{normal}	30 to 1000	406.845	0.001340	4.0	Pass
	1000 to 125000	3846.250	0.017219	20.0	Pass
$V_{max.}$	30 to 1000	620.123	0.001637	4.0	Pass
	1000 to 125000	4858.250	0.015849	20.0	Pass
$V_{min.}$	30 to 1000	847.225	0.001390	4.0	Pass
	1000 to 125000	4172.562	0.013932	20.0	Pass
Test Channel		CH 38 (2478MHz)			
V_{normal}	30 to 1000	746.830	0.001954	4.0	Pass
	1000 to 125000	3771.500	0.015276	20.0	Pass
$V_{max.}$	30 to 1000	525.063	0.001343	4.0	Pass
	1000 to 125000	3580.312	0.015101	20.0	Pass
$V_{min.}$	30 to 1000	171.256	0.001337	4.0	Pass
	1000 to 125000	3242.500	0.015560	20.0	Pass

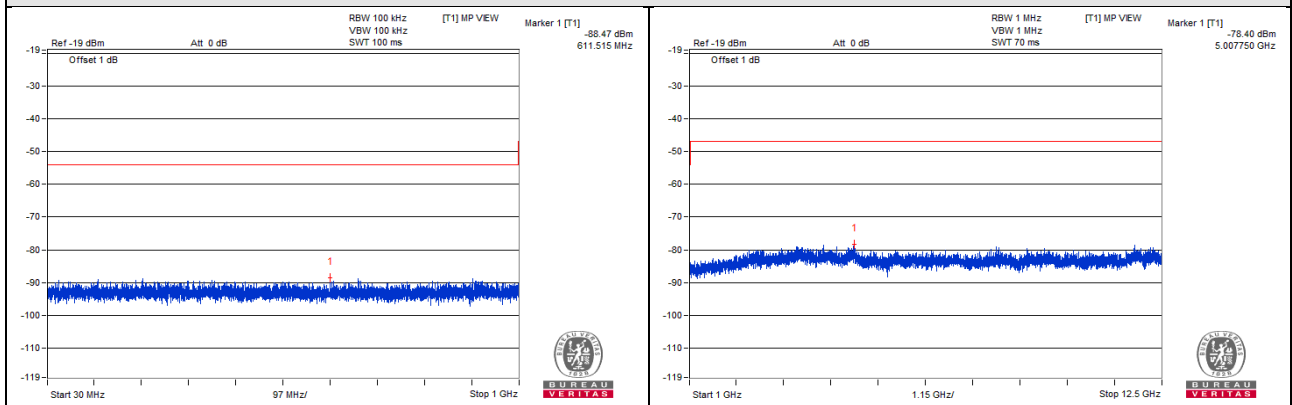
V_{normal}



V_{max}

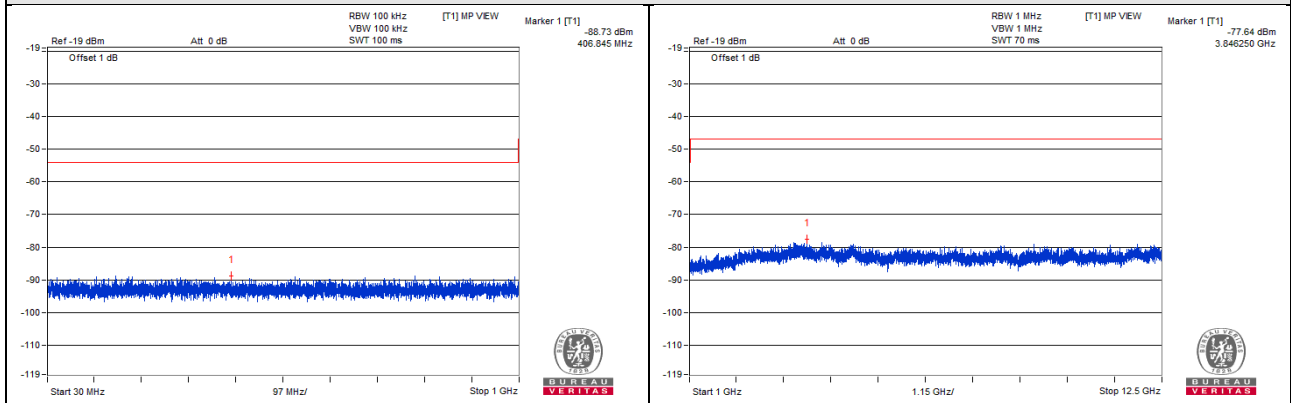


V_{min}

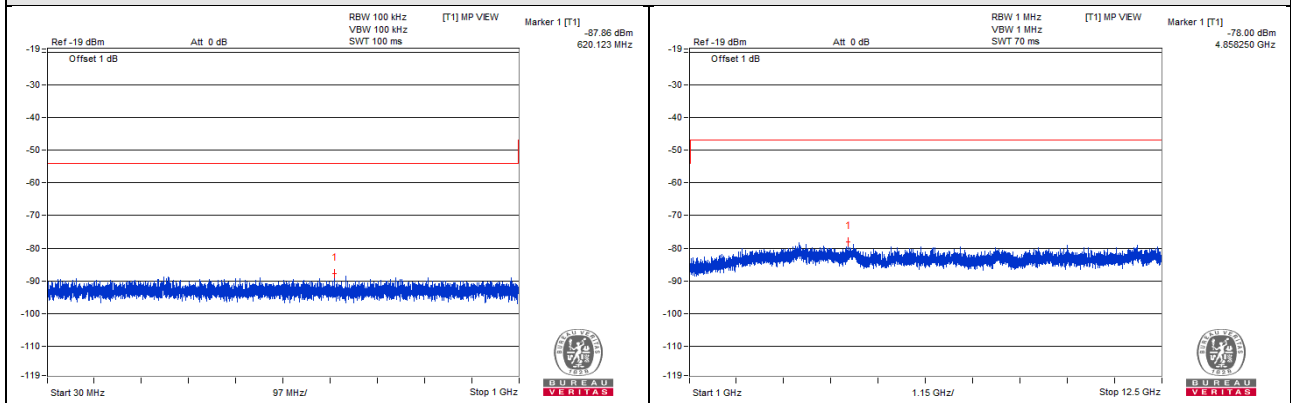


CH 1 (2404MHz)

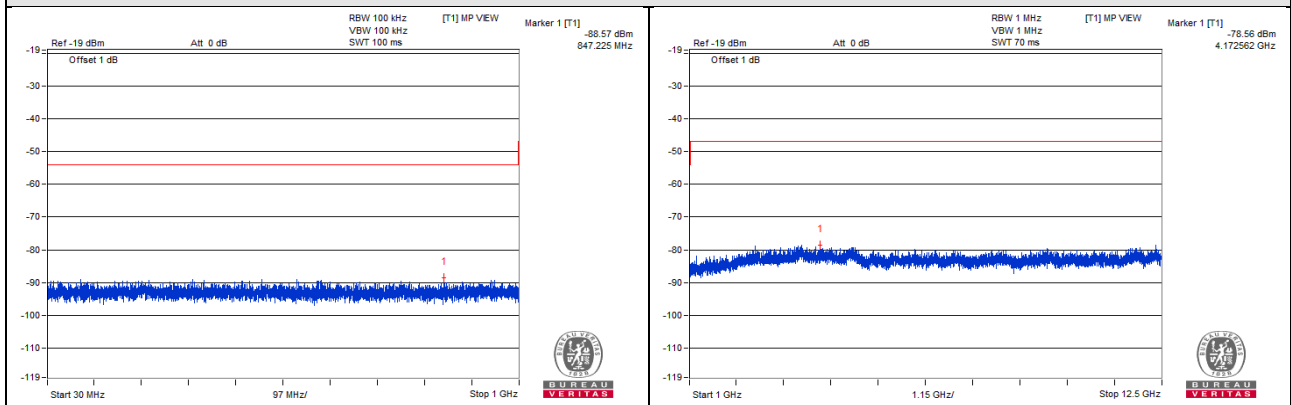
V_{normal}



V_{max}

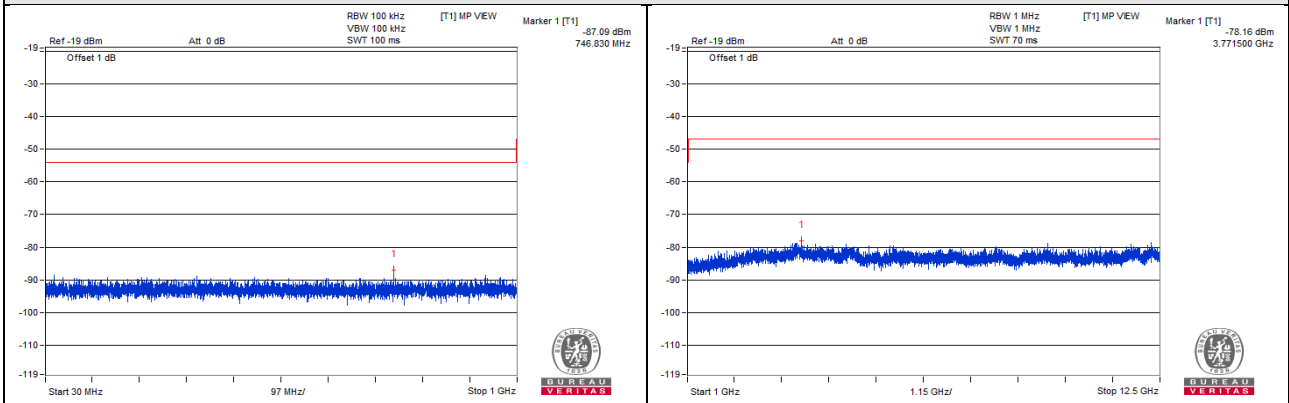


V_{min}

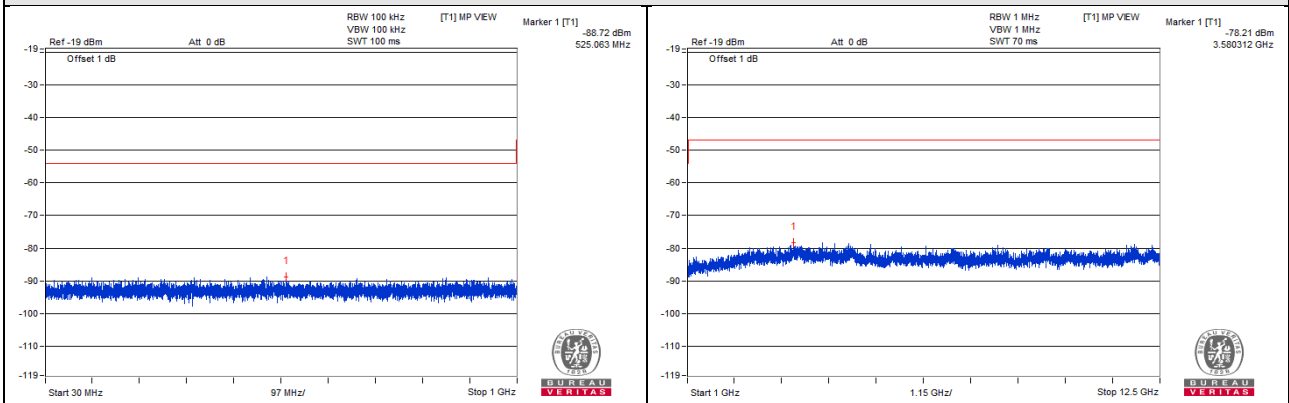


CH 19 (2440MHz)

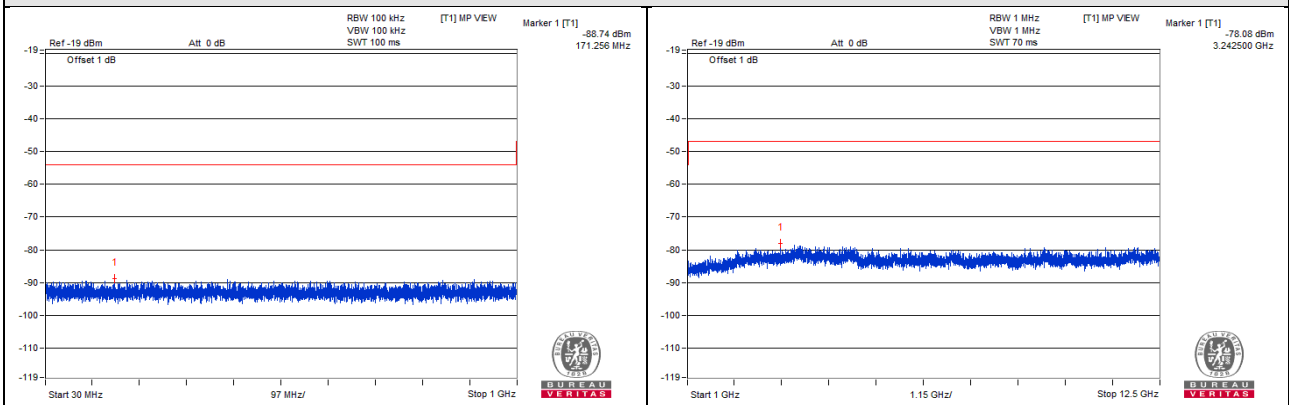
V_{normal}



V_{max}



V_{min}



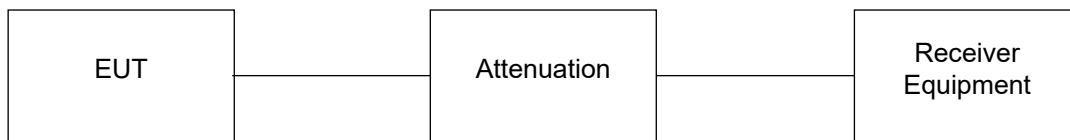
CH 38 (2478MHz)

4.6 Interference Prevention Function

4.6.1 Limits of Interference Prevention Function

NA

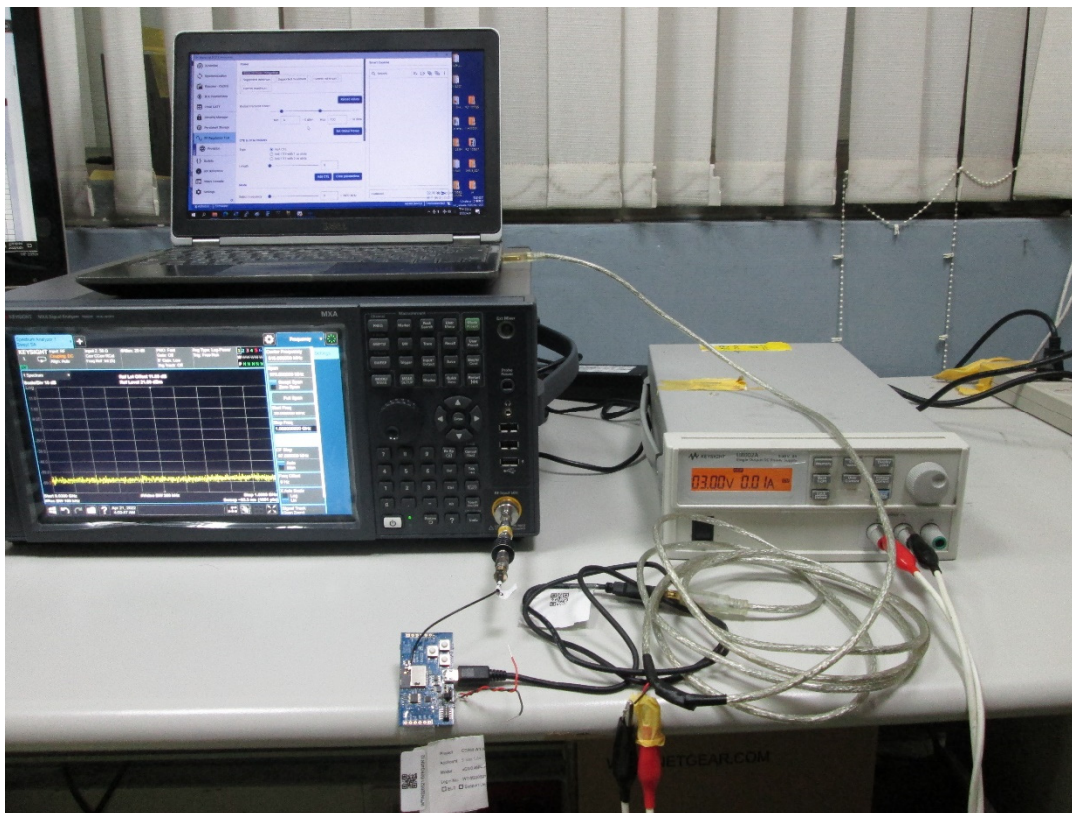
4.6.2 Test Setup



4.6.3 Test Results

Environmental Conditions	25 deg.C, 60% RH
Link Mode	Test Result
1MBaud with 1Mbps transfer rate	Pass
2MBaud with 2Mbps transfer rate	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 FCC recognized accredited test firms and 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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