

Radio Test Report

Report No.: RJBHSE-WTW-P20110975

Test Model: HSA-N001E

Received Date: Nov. 11, 2020

Test Date: Jan. 18, 2021

Issued Date: Feb. 24, 2021

Applicant: Nuheara Limited.

Address: 190 Aberdeen St, Northbridge, Western Australia 6003

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

Lab Address: No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan

Test Location: No. 19, Hwa Ya 2nd Rd, Wen Hwa Vil, Kwei Shan Dist., Taoyuan City
33383, Taiwan



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Release Control Record

Issue No.	Description	Date Issued
RJBHSE-WTW-P20110975	Original Release	Feb. 24, 2021

1 Certificate of Conformity

Product: HP Elite Wireless Earbuds

Brand: HP

Test Model: HSA-N001E

Sample Status: Engineering Sample

Applicant: Nuheara Limited.

Test Date: Jan. 18, 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 RF characteristics under the conditions specified in this report.

Prepared by : Shelly Hsueh, **Date:** Feb. 24, 2021
Shelly Hsueh / Specialist

Approved by : Dylan Chiou, **Date:** Feb. 24, 2021
Dylan Chiou / Senior 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
--	--	3.5	Refer to All Articles for Transmitting Antenna	C
Operating Frequency 2400 to 2483.5 MHz				
--	3.7 (1)a	3.4	Radio Frequency / Modulation Section cannot be opened easily	C
--	3.1 (1)	3.1	Communication Method	C
--	3.2 (1)	3.1	Modulation Method	C
--	3.2 (1)	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	C
--	3.2 (9)	4.3	Spreading Factor	C
--	3.2 (11)	--	Frequency Retention Time (FH Employed)	NA
--	3.4.1(1)	4.8	Interference Prevention Function	C
--	3.4.1(3)	--	Carrier Sense Capability	NA
Note: 1. Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty. 2. C = Conform NC = Not Conform NT = Not Tested NA = Not Applicable				

2.1 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	491.896 Hz
Spurious Emissions	2.208 dB
Output Power Density	2.889 dB
Out of Band Radiated Power	3.93 dB
Frequency Tolerance	6805.18 Hz

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	HP Elite Wireless Earbuds
Brand	HP
Test Model	HSA-N001E
Status of EUT	Engineering Sample
Nominal Voltage	3.7 Vdc (Li-ion battery) <For Buds> 5 Vdc (Adapter or Host equipment) <For Charger>
Modulation Type	GFSK, $\pi/4$ -DQPSK, 8DPSK
Transfer Rate	1/2/3 Mbps
Operating Frequency	2402 ~ 2480 MHz
Number of Channel	79
Rated RF Output Power / Power Density	Refer to Note
Conducted RF Output Power / Power Density	Refer to Note
Radiated RF Output Power / Power Density	Refer to Note
Antenna Type	Refer to Note
Data Cable Supplied	Refer to Note

Note:

1. The power table as below:

	Rated Power (mW/MHz)	Total Conducted RF Output Power Density (mW/MHz)	Radiated RF Output Power Density (mW/MHz)
Bluetooth EDR			
Normal mode	0.1	0.09339	0.097791
AFH mode	0.4	0.366376	0.383643

2. The antenna used in this EUT is listed as below table:

Item	Type	Gain(dBi)
Frequency		2400 ~ 2480 MHz
2.4 GHz	PIFA	0.2

3. The EUT contains following accessory devices.

Product	Brand	Model	Description
Battery 1	VDL	ZJ1654A Rev A/3	3.7Vdc, 120mAh, 0.444Wh
Battery 2	Shenzhen Mastang Technology	CFX802050 Rev A0	3.7Vdc, 800mAh, 2.96Wh
USB Cable	CMI/Wisdom Plus	USB Type-C	0.8 m P/N: CAB0000008-01

4. 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

5. The above EUT information is declared by manufacturer and for more detailed features description, please refers to the manufacturer's specifications or user's manual.

3.2 Description of Test Modes

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461		

NOTE 1: By means of test software provided by manufacture, the power levels during the tests were set according to the following codes:

NOTE 2: Pre-Scan has been conducted to determine the worst-case mode from packet type; we found the DH5 was the worst case, and chosen for final test. Following test items were selected for the final test as listed below.

Test Items
Spurious emissions
Power density (Antenna power)
Occupied / spreading bandwidth

Modulation type: GFSK		Modulation type: $\pi/4$ -DQPSK		Modulation type: 8DPSK	
Channel	Power Setting	Channel	Power Setting	Channel	Power Setting
0	Default	0	Default	0	Default
39	Default	39	Default	39	Default
78	Default	78	Default	78	Default

3.3 Test Conditions

Test Conditions	Voltage (Vdc)
V_{normal}	3.70
$V_{\text{max.}}$	4.2
$V_{\text{min.}}$	3

3.4 Assembly

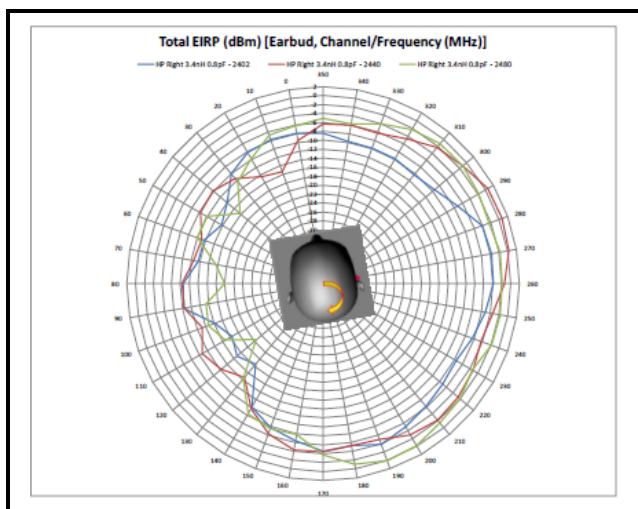
The RF areas for HSA-N001E are covered by shielding frames.

3.5 Antenna Specifications

3.5.1 Antenna Gain

	Antenna type	Gain (dBi)
Bluetooth	PIFA	0.2

3.5.2 Antenna Pattern



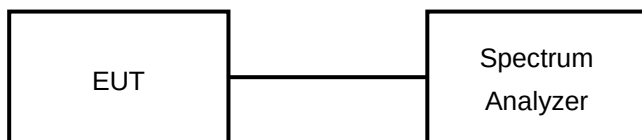
4 Test Results

4.1 Frequency Tolerance Measurement

4.1.1 Limits of Frequency Tolerance Measurement

Tolerance of frequency shall be +/- 50 ppm.

4.1.2 Test Setup



4.1.3 Test Results

Modulation: GFSK

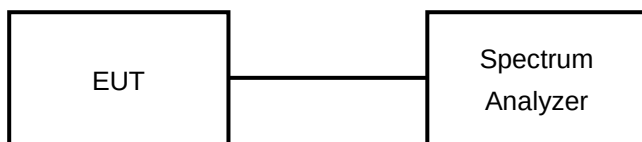
Environmental Conditions		25 deg.C, 60 % RH					
Channel	Frequency (MHz)	Voltage _{normal}		Voltage _{max.}		Voltage _{min.}	
		Carrier Frequency (MHz)	Frequency Tolerance (ppm)	Carrier Frequency (MHz)	Frequency Tolerance (ppm)	Carrier Frequency (MHz)	Frequency Tolerance (ppm)
0	2402	2401.998400	-0.666	2401.998400	-0.666	2401.998400	-0.666
39	2441	2440.998400	-0.655	2440.998400	-0.655	2440.998400	-0.655
78	2480	2479.997600	-0.967	2479.997600	-0.967	2479.997600	-0.967

4.2 Occupied Bandwidth Measurement (99 % Power Bandwidth)

4.2.1 Limits of Occupied Bandwidth Measurement

Item	Limit
Occupied Bandwidth	< 83.5 MHz

4.2.2 Test Setup



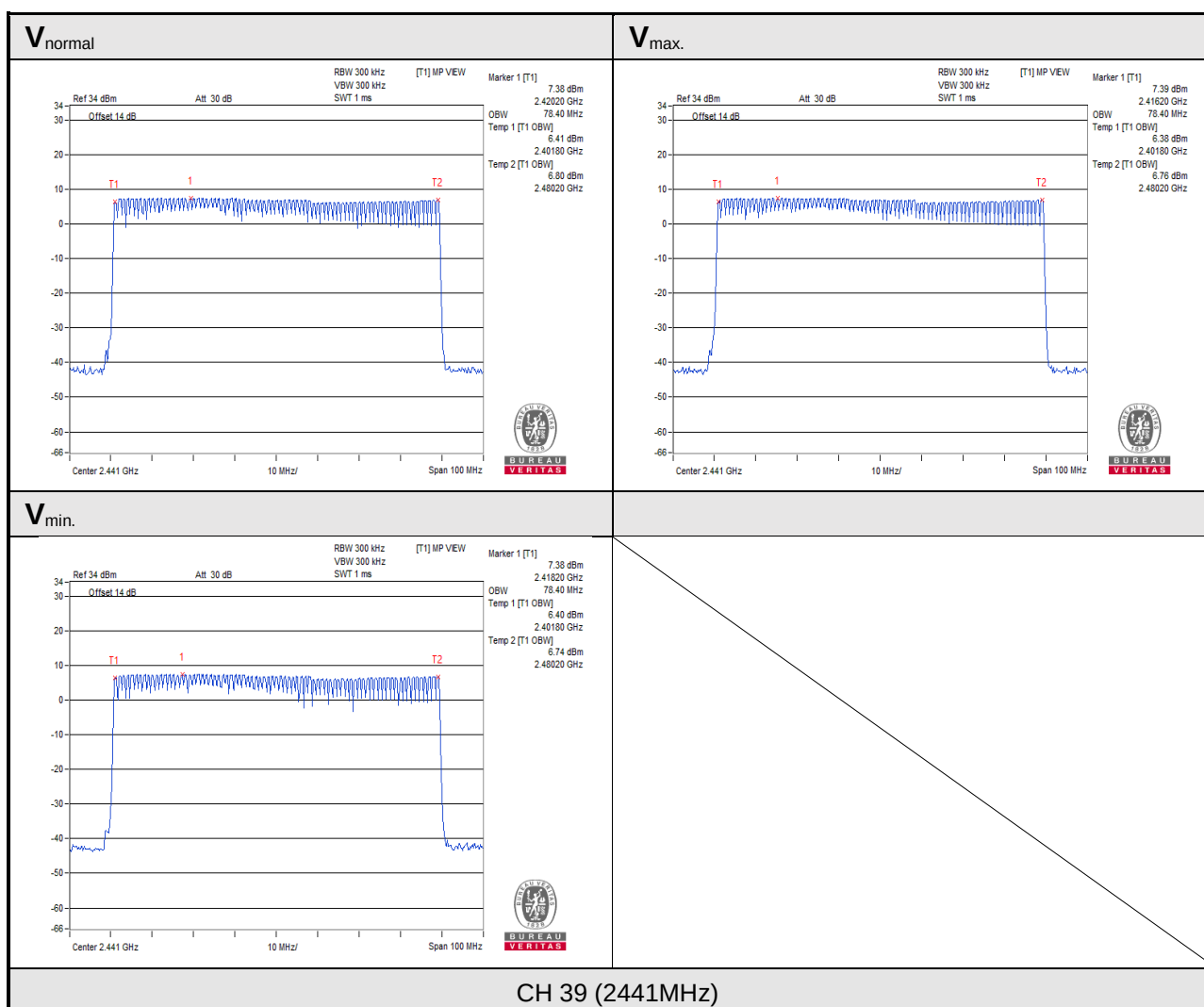
4.2.3 Test Results

Modulation: GFSK

Normal Mode:

Channel	Frequency (MHz)	V_{normal}	$V_{max.}$	$V_{min.}$
		Occupied bandwidth (MHz)	Occupied bandwidth (MHz)	Occupied bandwidth (MHz)
39	2441	78.40	78.40	78.40

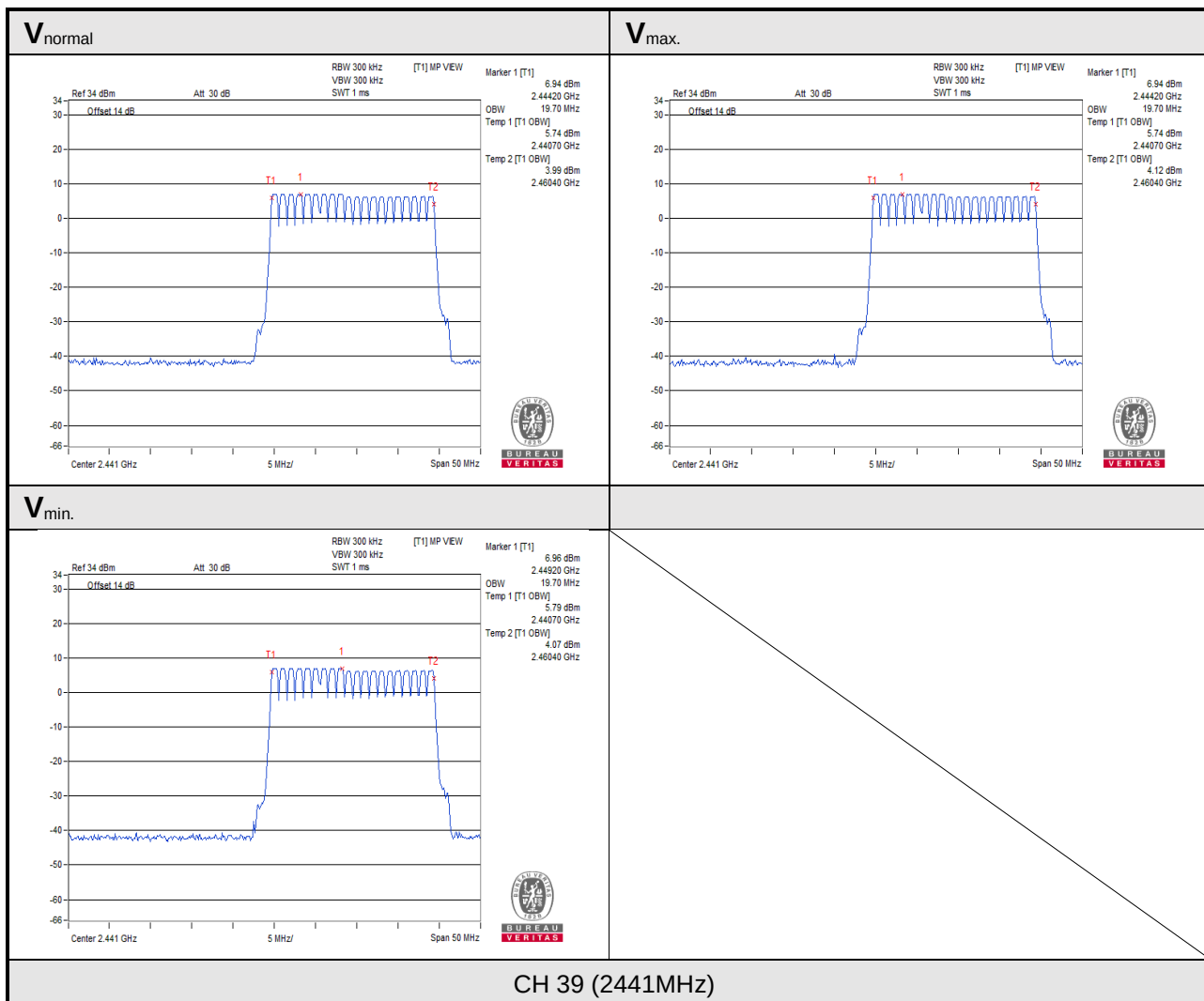
NOTE: For the test plots please refer to the below pages.



AFH Mode:

Channel	Frequency (MHz)	V_{normal}	$V_{max.}$	$V_{min.}$
		Occupied bandwidth (MHz)	Occupied bandwidth (MHz)	Occupied bandwidth (MHz)
39	2441	19.70	19.70	19.70

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

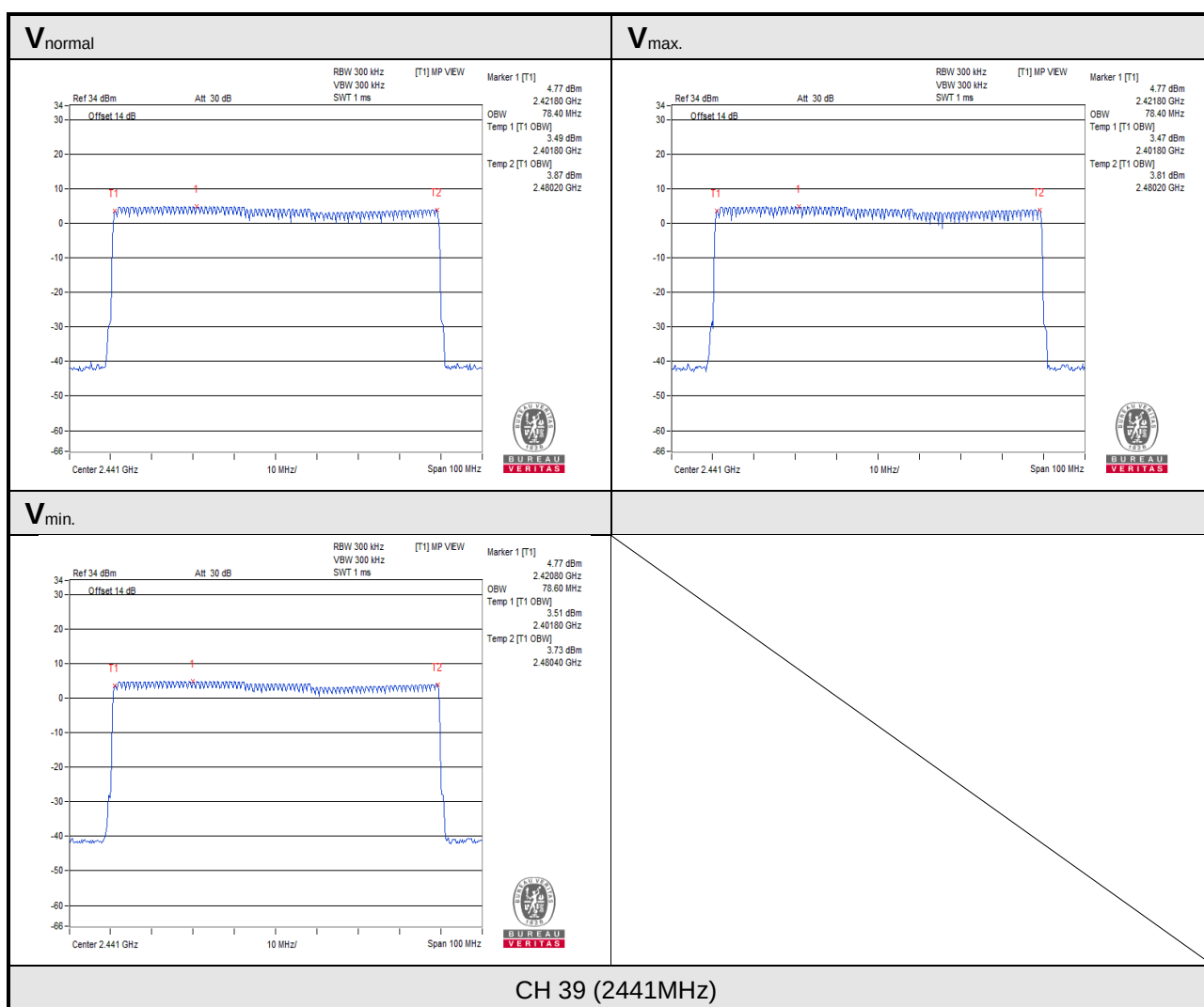


Modulation: $\pi/4$ -DQPSK

Normal Mode:

Channel	Frequency (MHz)	V_{normal}	$V_{max.}$	$V_{min.}$
		Occupied bandwidth (MHz)	Occupied bandwidth (MHz)	Occupied bandwidth (MHz)
39	2441	78.40	78.40	78.60

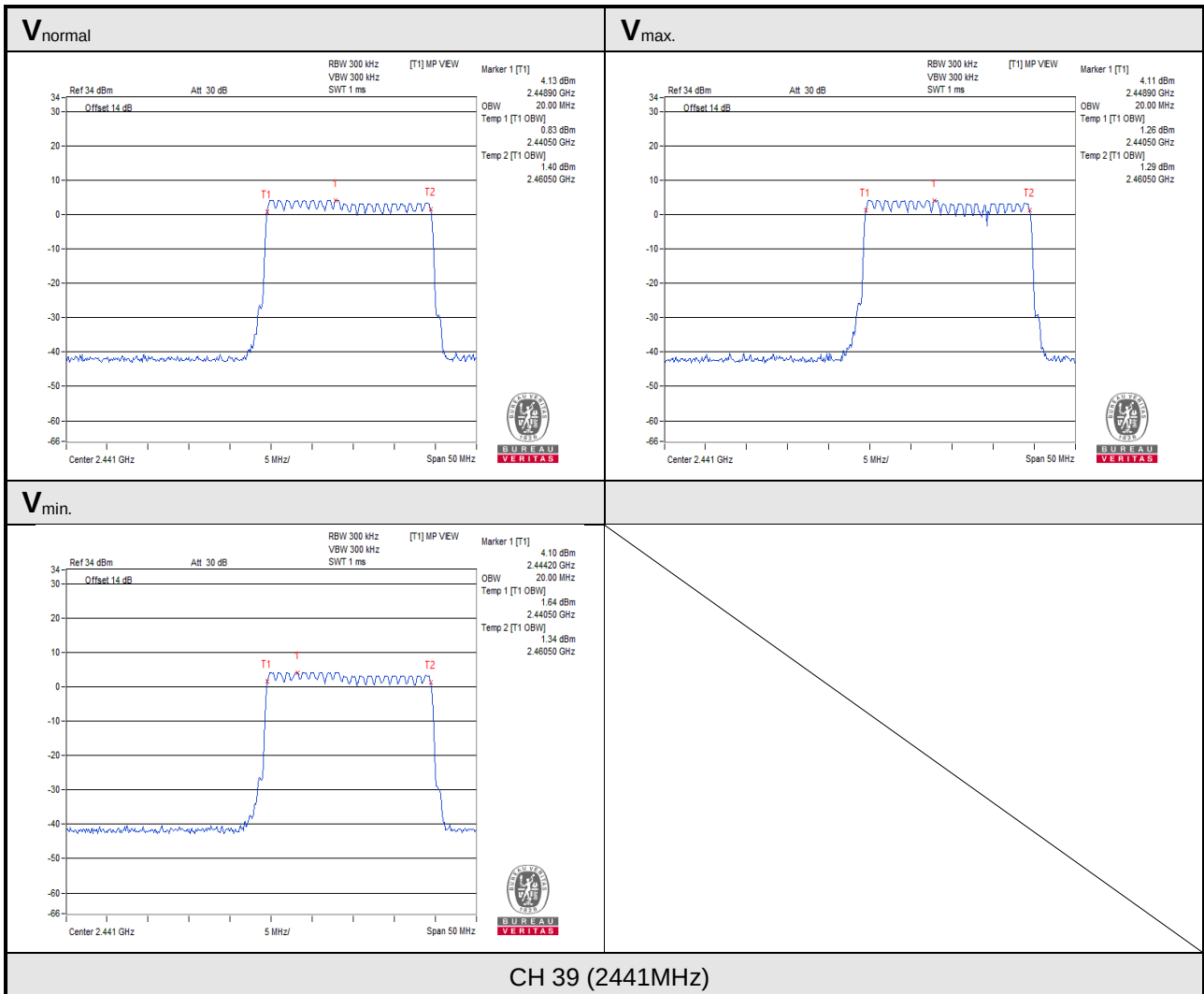
NOTE: For the test plots please refer to the below pages.



AFH Mode:

Channel	Frequency (MHz)	V_{normal}	$V_{max.}$	$V_{min.}$
		Occupied bandwidth (MHz)	Occupied bandwidth (MHz)	Occupied bandwidth (MHz)
39	2441	20.00	20.00	20.00

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

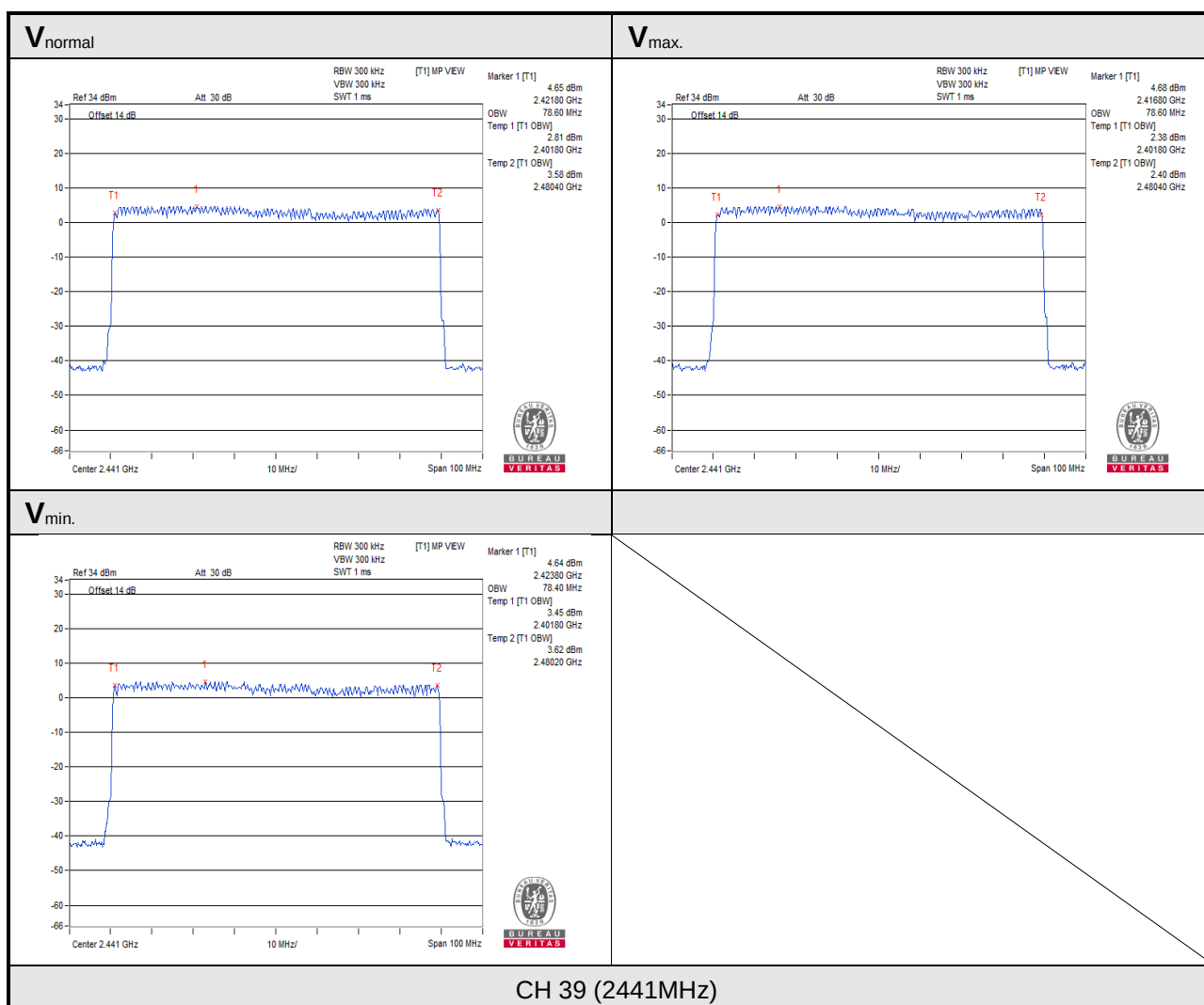


Modulation: 8DPSK

Normal Mode:

Channel	Frequency (MHz)	V _{normal}	V _{max.}	V _{min.}
		Occupied bandwidth (MHz)	Occupied bandwidth (MHz)	Occupied bandwidth (MHz)
39	2441	78.60	78.60	78.40

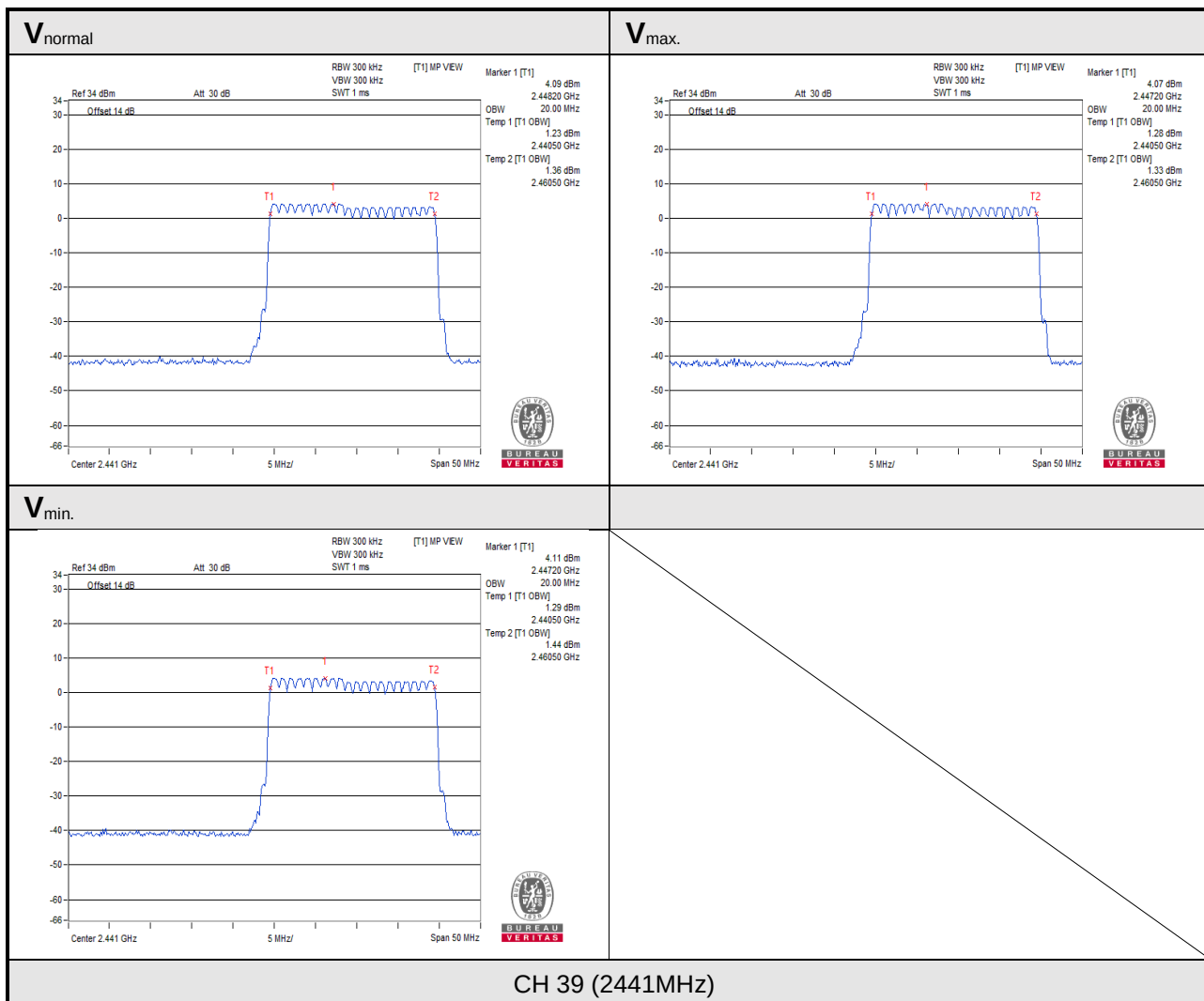
NOTE: For the test plots please refer to the below pages.



AFH Mode:

Channel	Frequency (MHz)	V_{normal}	$V_{max.}$	$V_{min.}$
		Occupied bandwidth (MHz)	Occupied bandwidth (MHz)	Occupied bandwidth (MHz)
39	2441	20.00	20.00	20.00

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

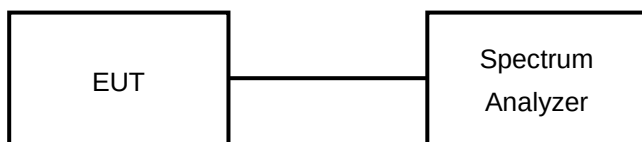


4.3 Spreading Bandwidth Measurement (90 % Power Bandwidth)

4.3.1 Limits of Spreading Bandwidth and Spreading Factor Measurement

Item	Limit	Remark
Spreading Bandwidth	≥ 500 kHz	(For DSSS, FHSS)
Spreading Factor	≥ 5	Operating frequency 2400 to 2483.5 MHz

4.3.2 Test Setup



4.3.3 Test Results

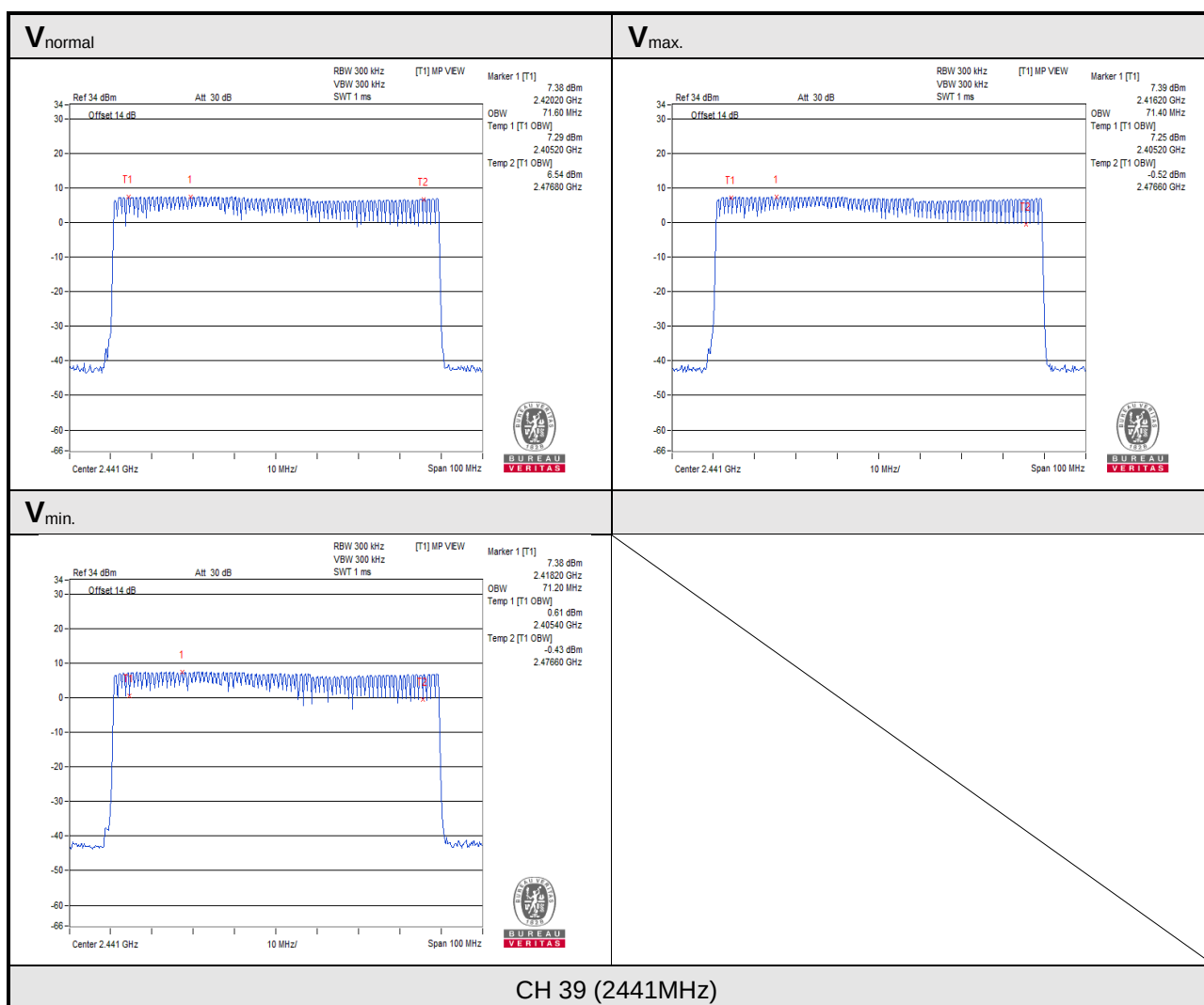
Modulation: GFSK

Normal Mode:

Channel	Frequency (MHz)	V_{normal}		V_{max.}		V_{min.}	
		Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor
39	2441	71.60	71.60	71.40	71.40	71.20	71.20

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

Spreading Factor: 90% channel power bandwidth / 1

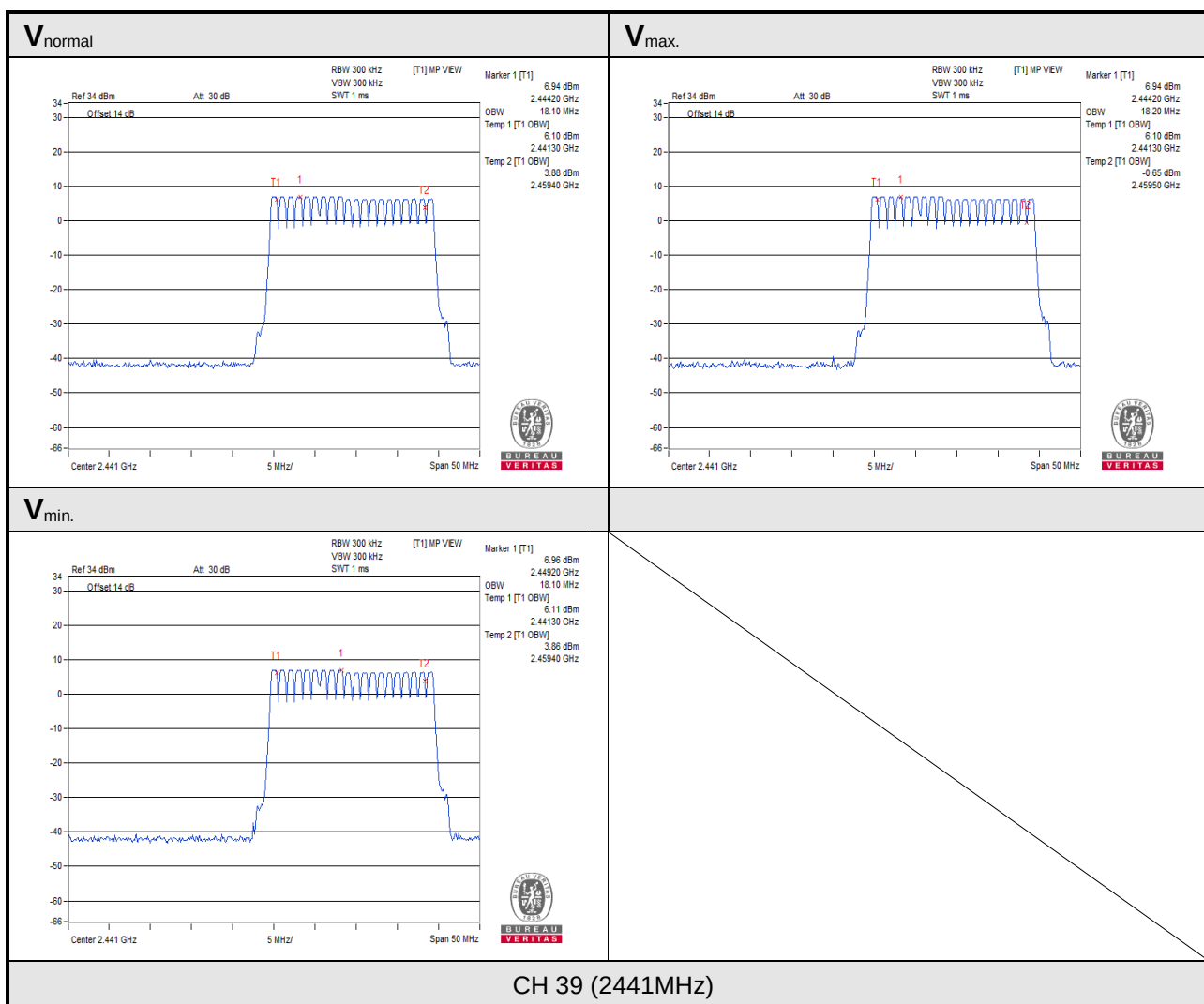


AFH Mode:

Channel	Frequency (MHz)	V _{normal}		V _{max.}		V _{min.}	
		Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor
39	2441	18.10	18.10	18.20	18.20	18.10	18.10

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

Spreading Factor: 90% channel power bandwidth / 1



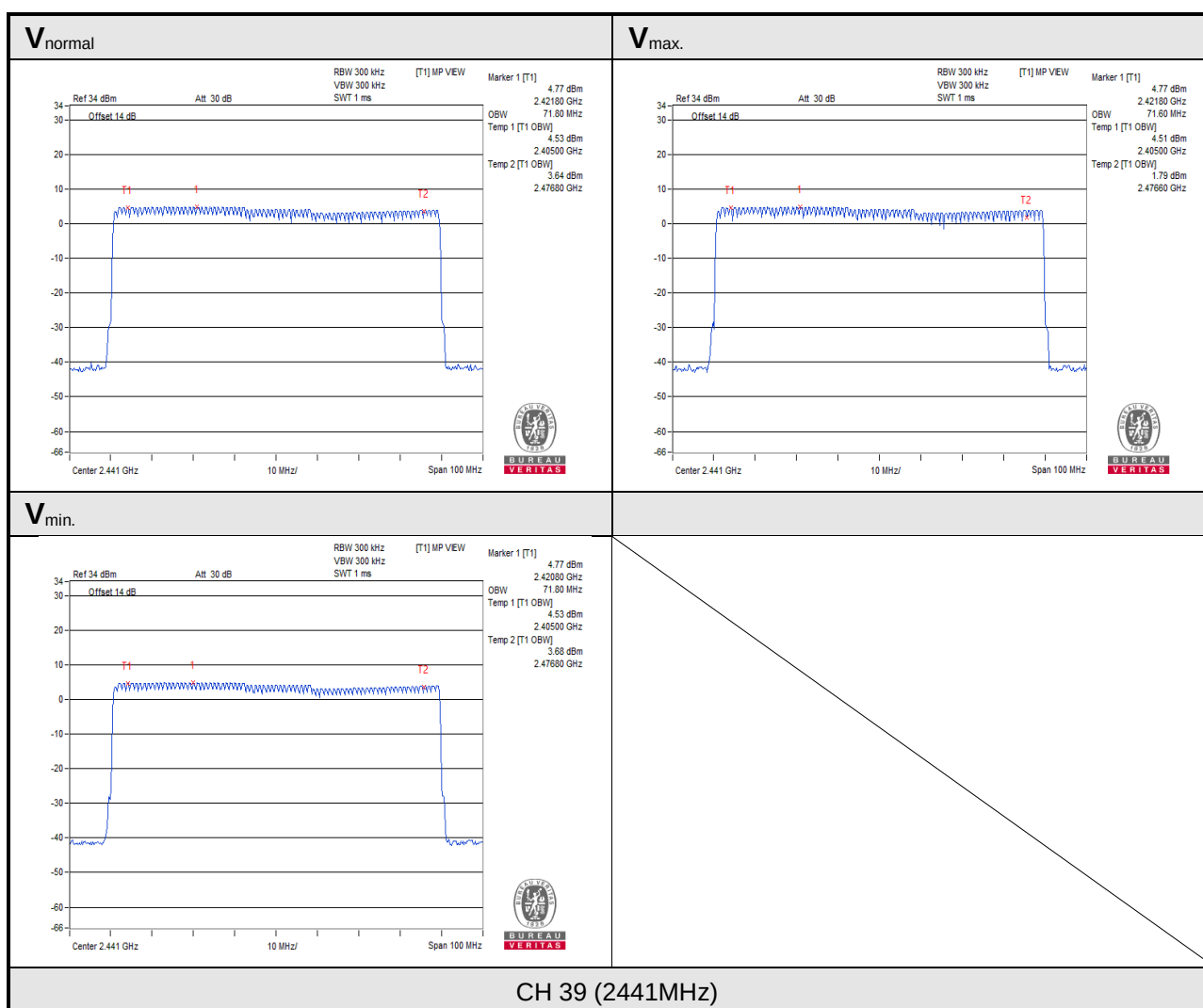
Modulation: $\pi/4$ -DQPSK

Normal Mode:

Channel	Frequency (MHz)	V_{normal}		$V_{max.}$		$V_{min.}$	
		Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor
39	2441	71.80	71.80	71.60	71.60	71.80	71.80

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

Spreading Factor: 90% channel power bandwidth / 1

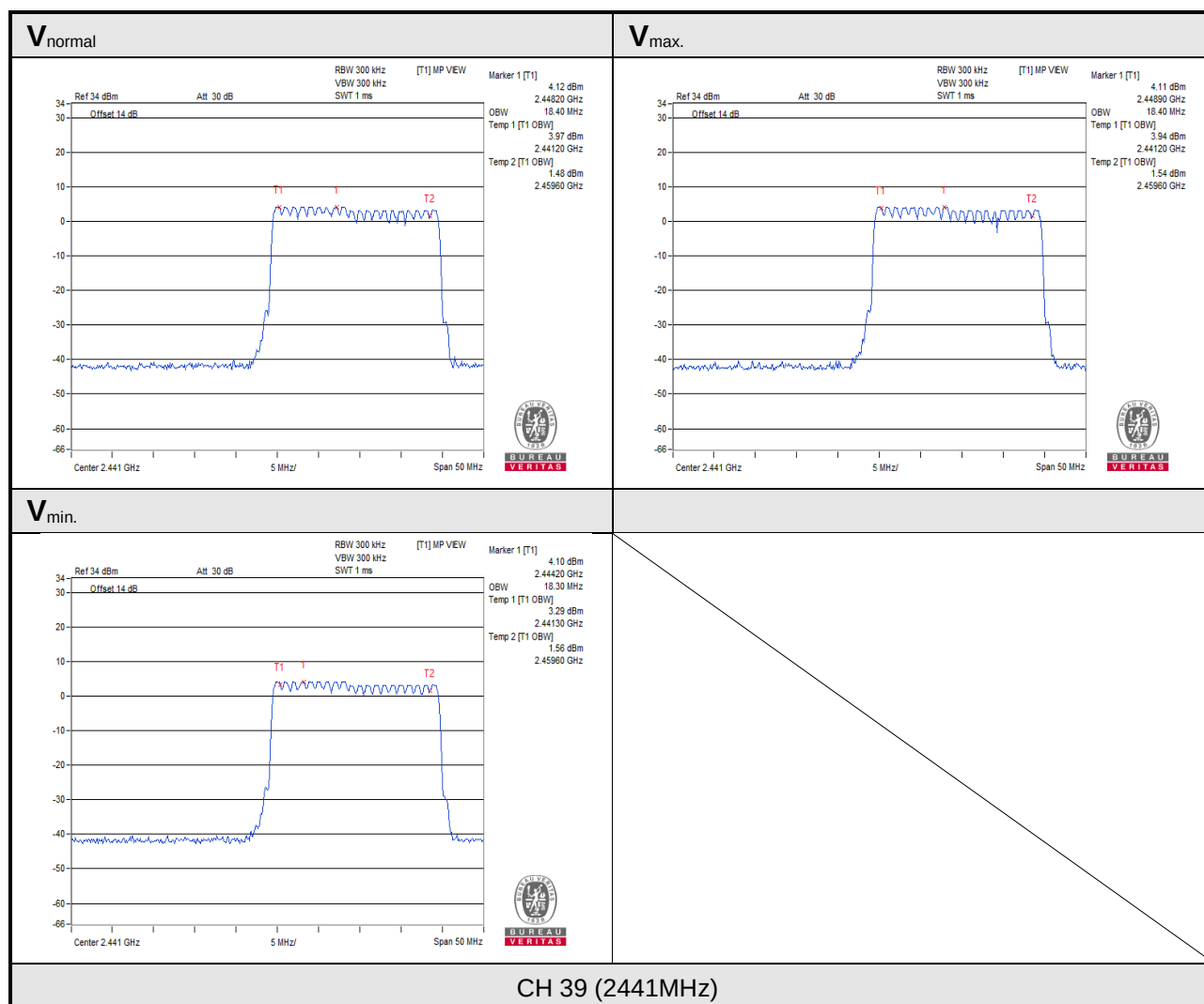


AFH Mode:

Channel	Frequency (MHz)	V _{normal}		V _{max.}		V _{min.}	
		Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor
39	2441	18.40	18.40	18.40	18.40	18.30	18.30

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

Spreading Factor: 90% channel power bandwidth / 1



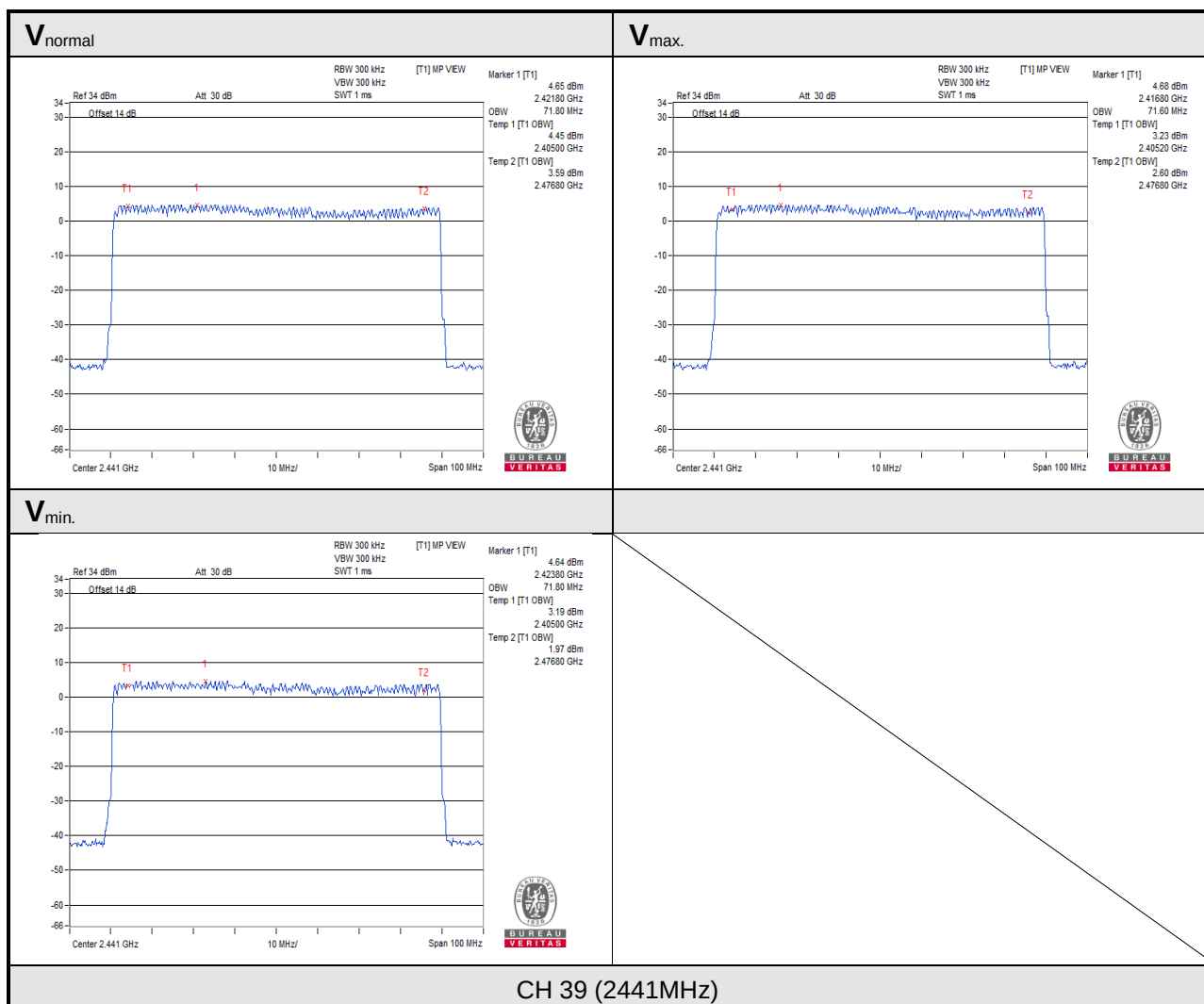
Modulation: 8DPSK

Normal Mode:

Channel	Frequency (MHz)	V _{normal}		V _{max.}		V _{min.}	
		Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor
39	2441	71.80	71.80	71.60	71.60	71.80	71.80

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

Spreading Factor: 90% channel power bandwidth / 1

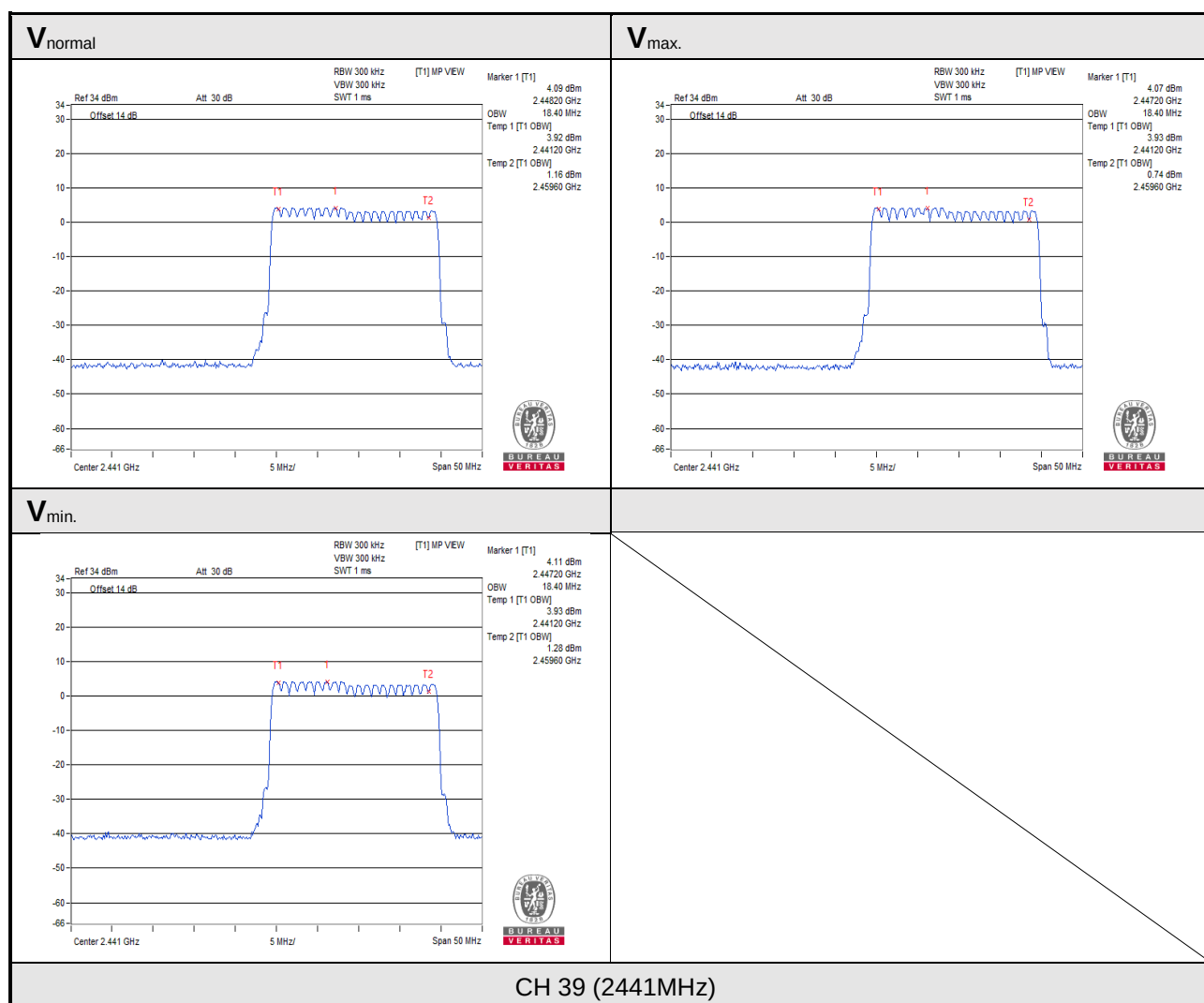


AFH Mode:

Channel	Frequency (MHz)	V _{normal}		V _{max.}		V _{min.}	
		Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor
39	2441	18.40	18.40	18.40	18.40	18.40	18.40

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

Spreading Factor: 90% channel power bandwidth / 1

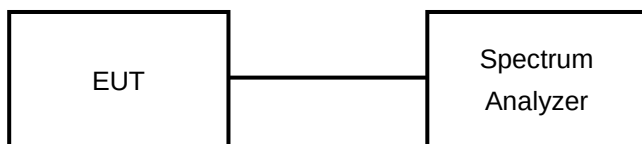


4.4 Spurious Emissions for Transmitter Measurement

4.4.1 Limits of Spurious Emissions

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

4.4.2 Test Setup



4.4.3 Test Results

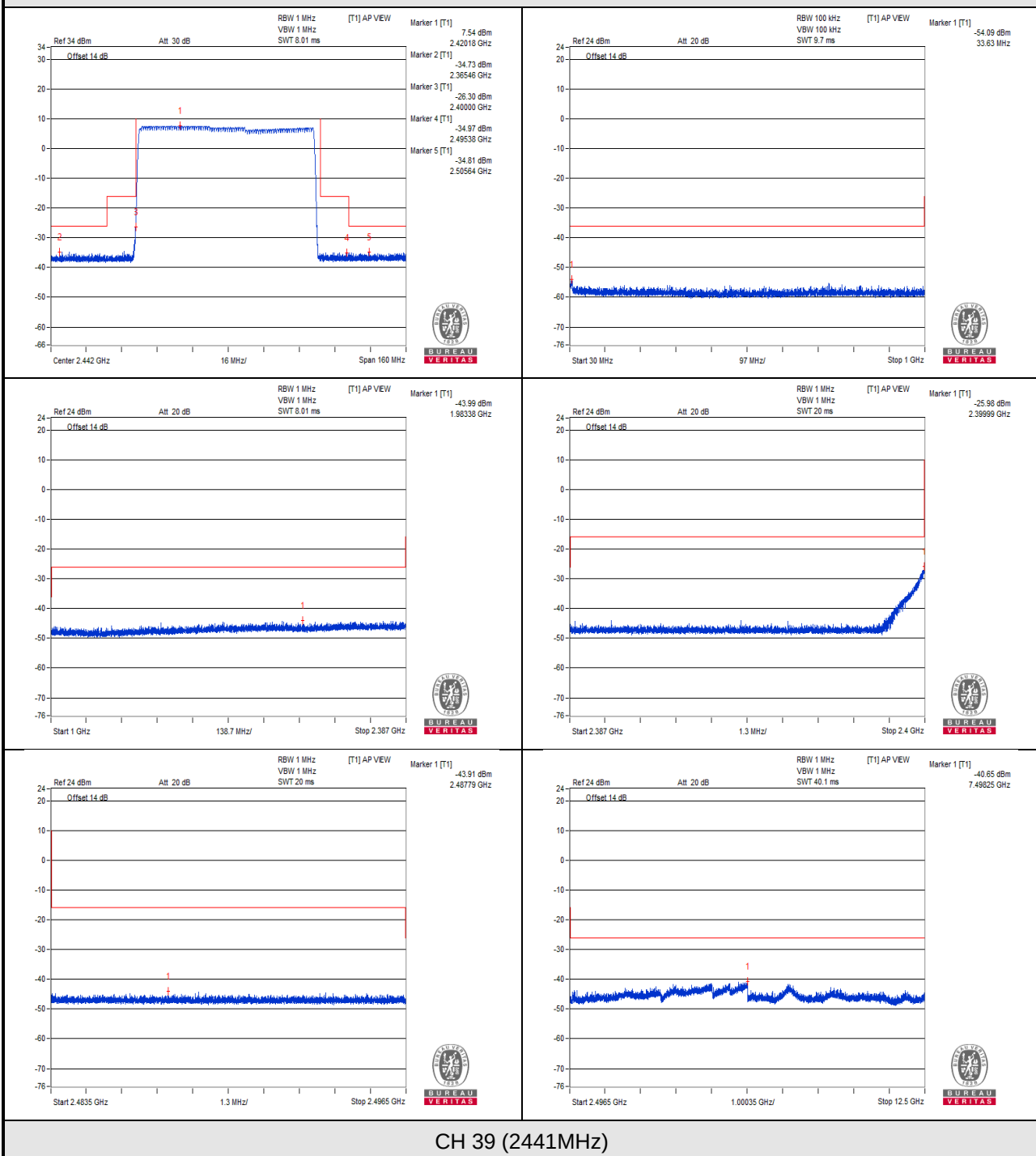
Modulation: GFSK

Environmental Conditions		25 deg.C, 60 % RH			
Test Channel		Hopping Mode		Limit	Result
Test Condition	Frequency Range	Frequency (MHz)	Measured Value (uW)		
V_{normal}	30.0 MHz to 1000.0 MHz	33.630	0.003000	0.25uW / 100kHz	Pass
	1000.0 MHz to 2387.0 MHz	1983.380	0.039000	2.5uW / MHz	Pass
	2387.0 MHz to 2400.0 MHz	2399.990	2.523000	25uW / MHz	Pass
	2483.5 MHz to 2496.5 MHz	2487.790	0.040000	25uW / MHz	Pass
	2496.5 MHz to 12500.0 MHz	7498.250	0.086000	2.5uW / MHz	Pass
V_{max.}	30.0 MHz to 1000.0 MHz	34.000	0.004000	0.25uW / 100kHz	Pass
	1000.0 MHz to 2387.0 MHz	2264.770	0.044000	2.5uW / MHz	Pass
	2387.0 MHz to 2400.0 MHz	2399.990	2.296000	25uW / MHz	Pass
	2483.5 MHz to 2496.5 MHz	2484.820	0.038000	25uW / MHz	Pass
	2496.5 MHz to 12500.0 MHz	7450.730	0.086000	2.5uW / MHz	Pass
V_{min.}	30.0 MHz to 1000.0 MHz	34.600	0.004000	0.25uW / 100kHz	Pass
	1000.0 MHz to 2387.0 MHz	1550.290	0.045000	2.5uW / MHz	Pass
	2387.0 MHz to 2400.0 MHz	2399.990	2.409000	25uW / MHz	Pass
	2483.5 MHz to 2496.5 MHz	2493.200	0.035000	25uW / MHz	Pass
	2496.5 MHz to 12500.0 MHz	7301.930	0.085000	2.5uW / MHz	Pass

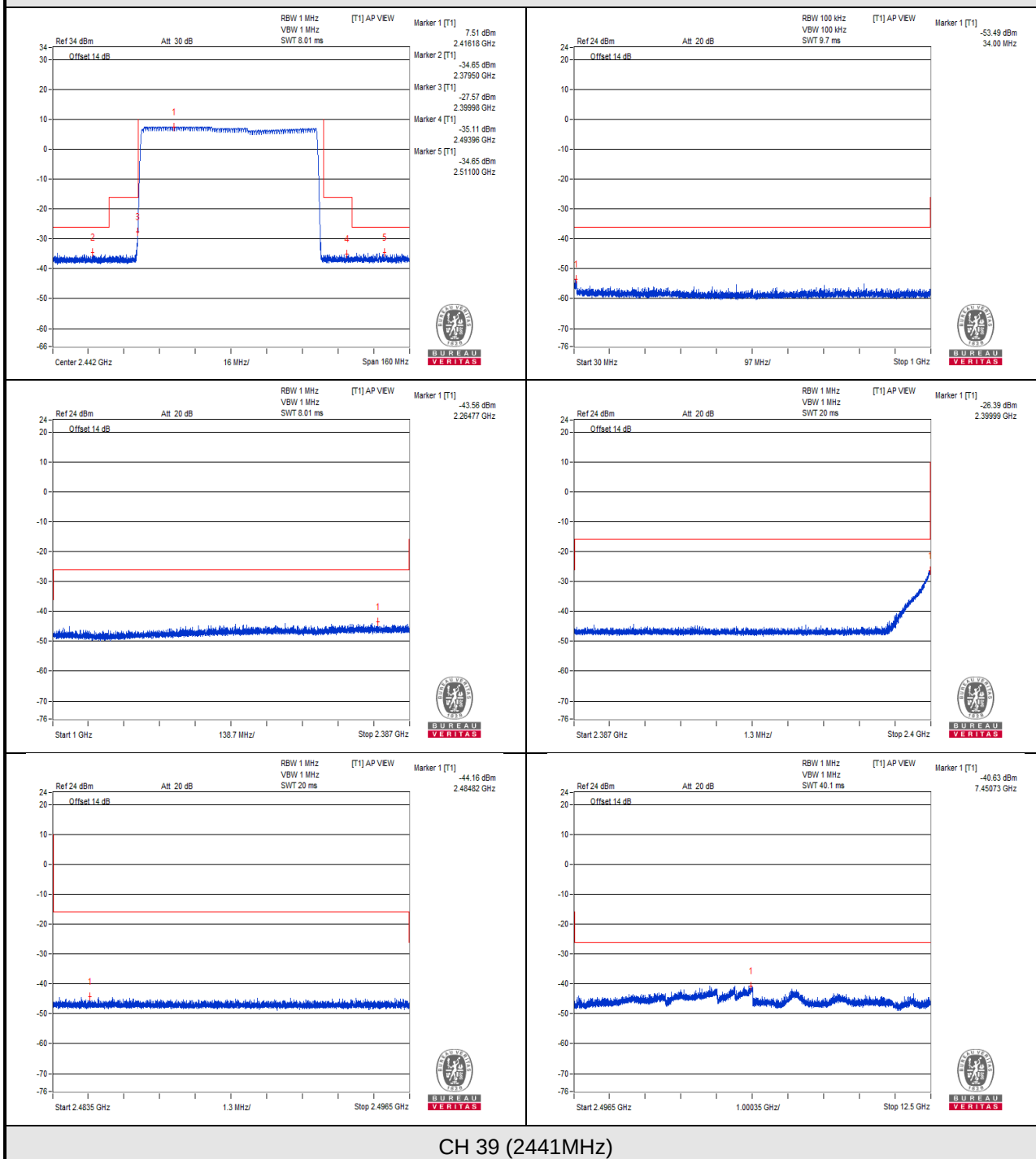
Note:

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

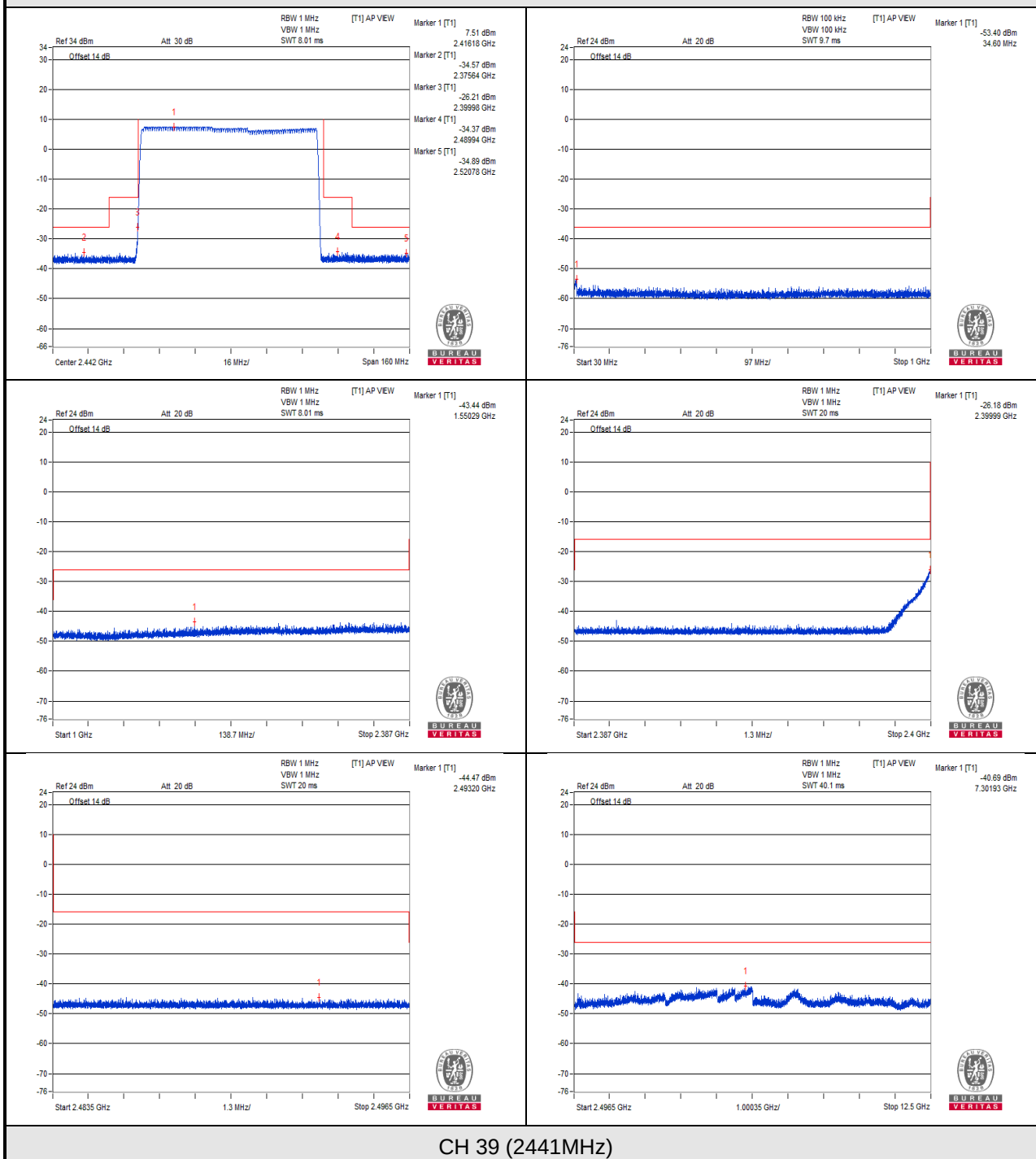
Vnormal



V_{max}.



V_{min}.



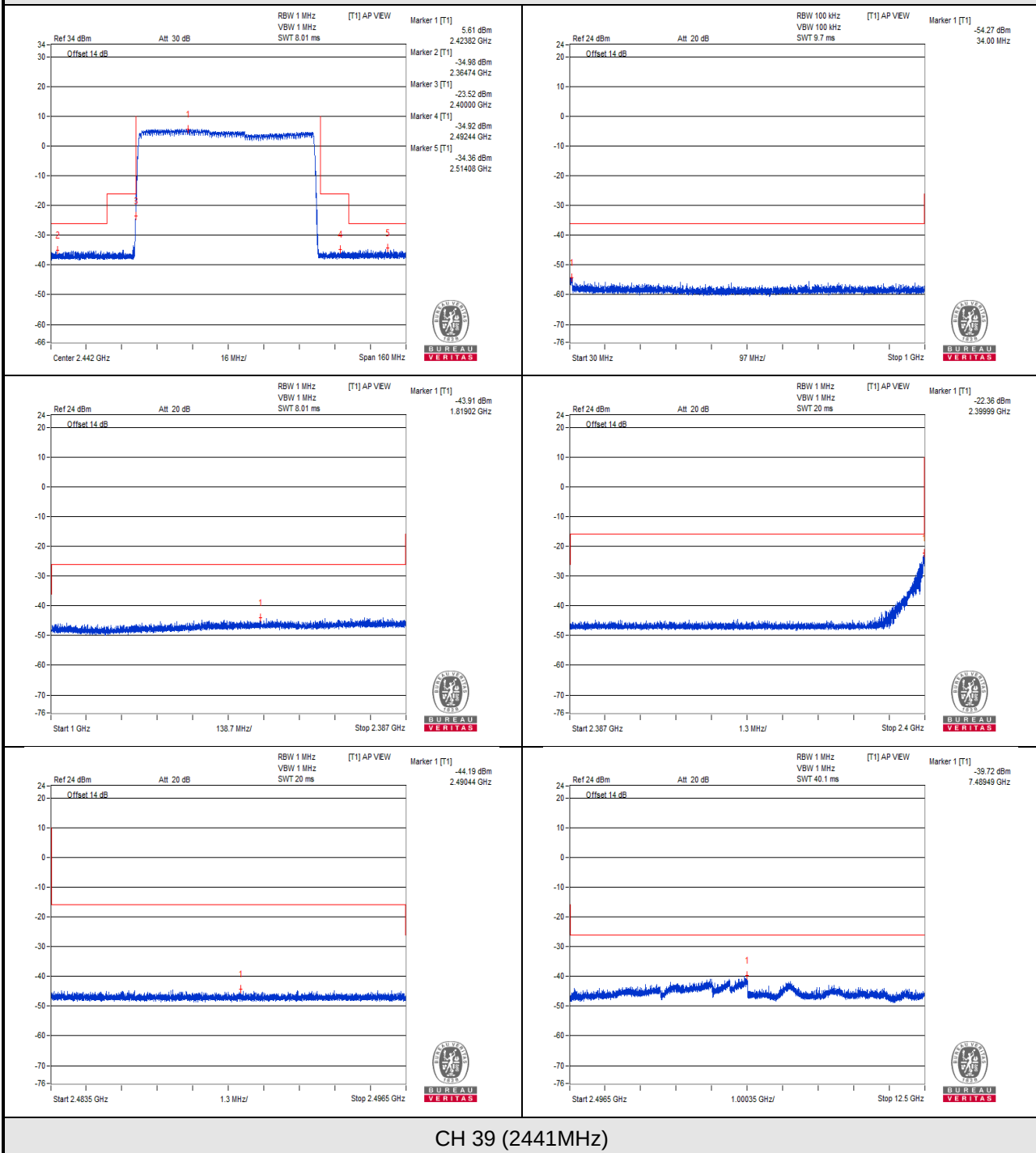
Modulation: $\pi/4$ -DQPSK

Environmental Conditions		25 deg.C, 60 % RH			
Test Channel		Hopping Mode		Limit	Result
Test Condition	Frequency Range	Frequency (MHz)	Measured Value (uW)		
V_{normal}	30.0 MHz to 1000.0 MHz	34.000	0.003000	0.25uW / 100kHz	Pass
	1000.0 MHz to 2387.0 MHz	1819.020	0.040000	2.5uW / MHz	Pass
	2387.0 MHz to 2400.0 MHz	2399.990	5.807000	25uW / MHz	Pass
	2483.5 MHz to 2496.5 MHz	2490.440	0.038000	25uW / MHz	Pass
	2496.5 MHz to 12500.0 MHz	7489.490	0.106000	2.5uW / MHz	Pass
$V_{max.}$	30.0 MHz to 1000.0 MHz	35.210	0.003000	0.25uW / 100kHz	Pass
	1000.0 MHz to 2387.0 MHz	2288.520	0.042000	2.5uW / MHz	Pass
	2387.0 MHz to 2400.0 MHz	2399.990	6.095000	25uW / MHz	Pass
	2483.5 MHz to 2496.5 MHz	2491.140	0.034000	25uW / MHz	Pass
	2496.5 MHz to 12500.0 MHz	7479.490	0.103000	2.5uW / MHz	Pass
$V_{min.}$	30.0 MHz to 1000.0 MHz	34.240	0.003000	0.25uW / 100kHz	Pass
	1000.0 MHz to 2387.0 MHz	2331.520	0.041000	2.5uW / MHz	Pass
	2387.0 MHz to 2400.0 MHz	2400.000	3.531000	25uW / MHz	Pass
	2483.5 MHz to 2496.5 MHz	2495.940	0.032000	25uW / MHz	Pass
	2496.5 MHz to 12500.0 MHz	7485.740	0.096000	2.5uW / MHz	Pass

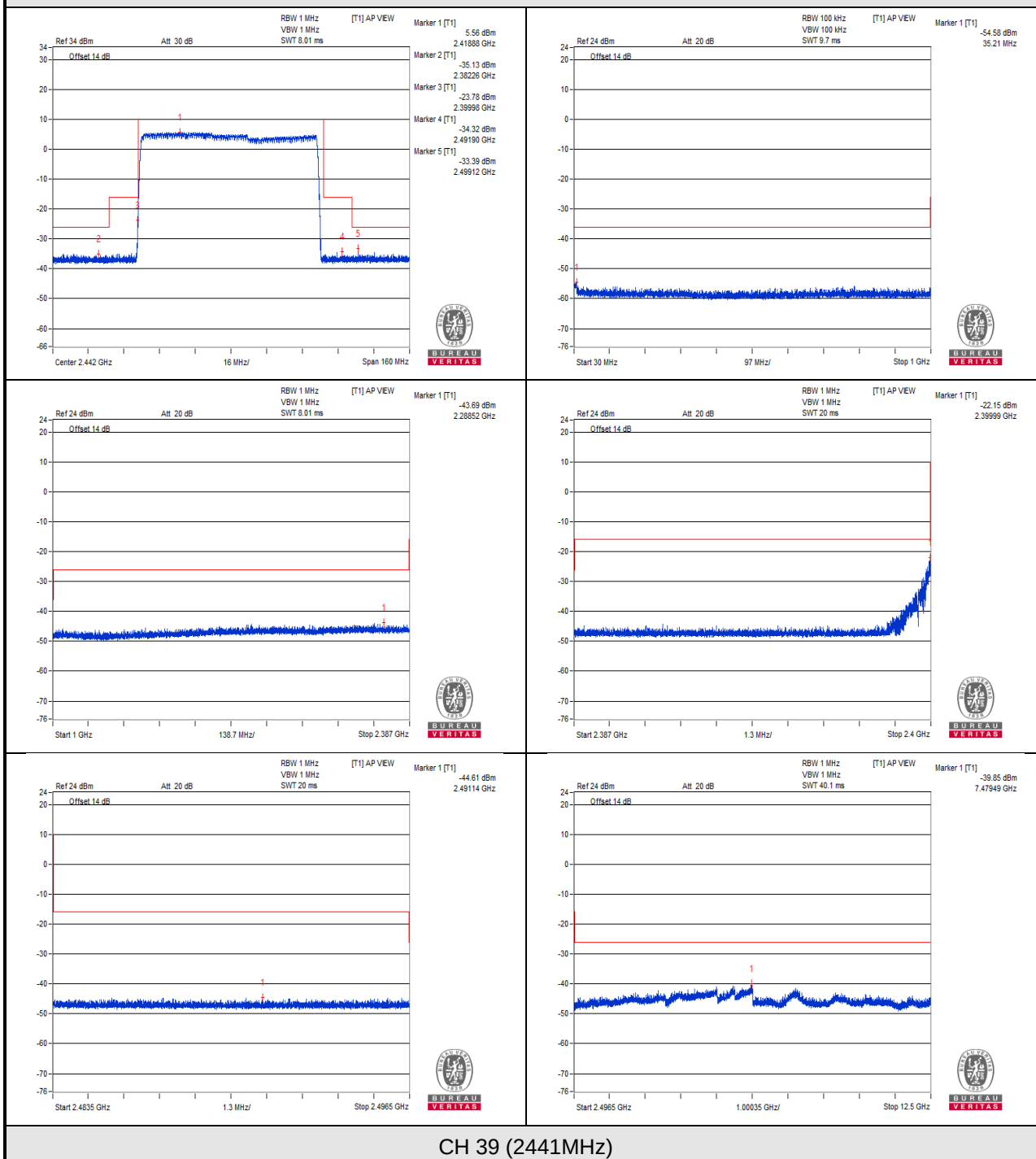
Note:

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

Vnormal

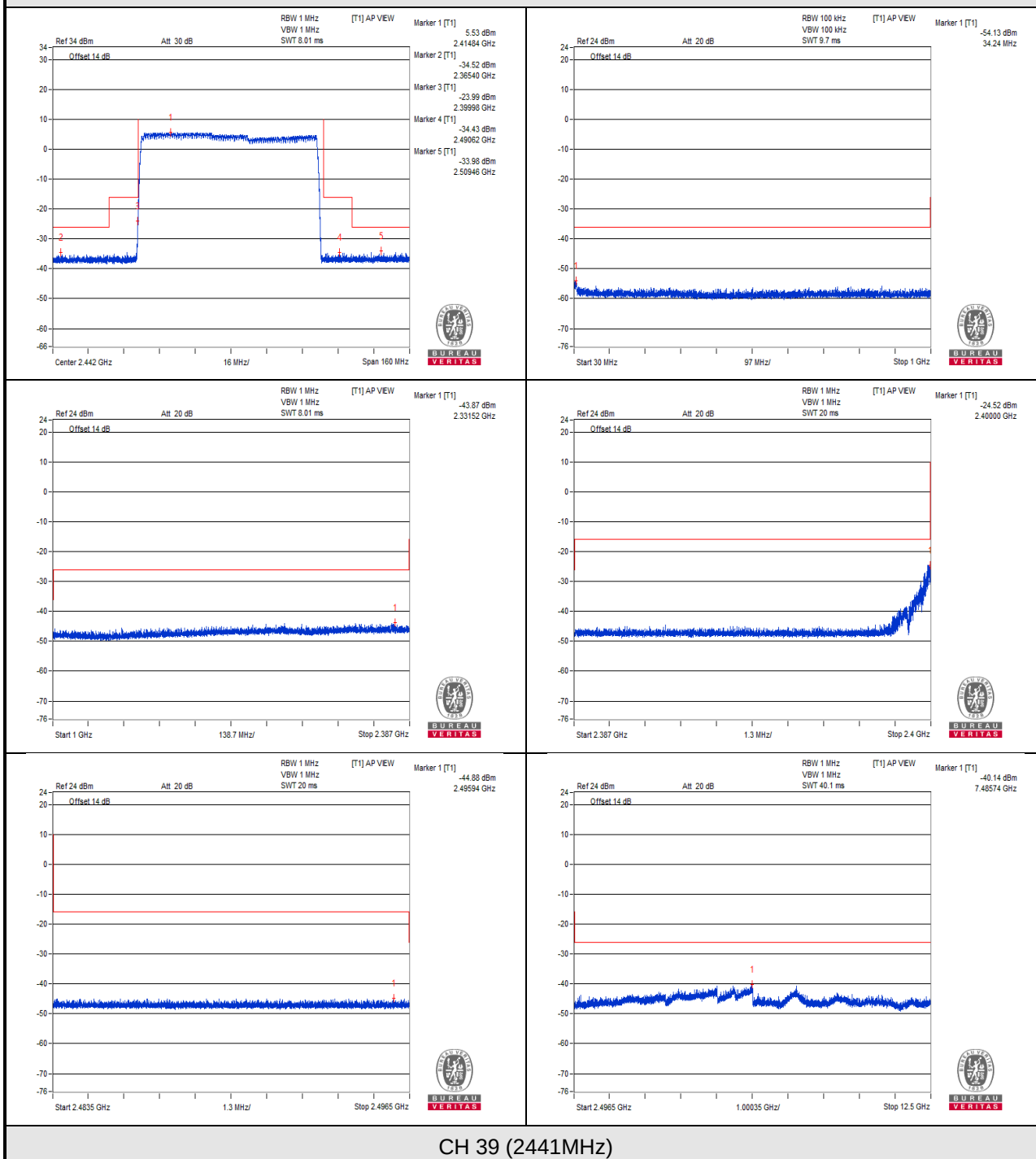


V_{max}.



CH 39 (2441MHz)

V_{min}.



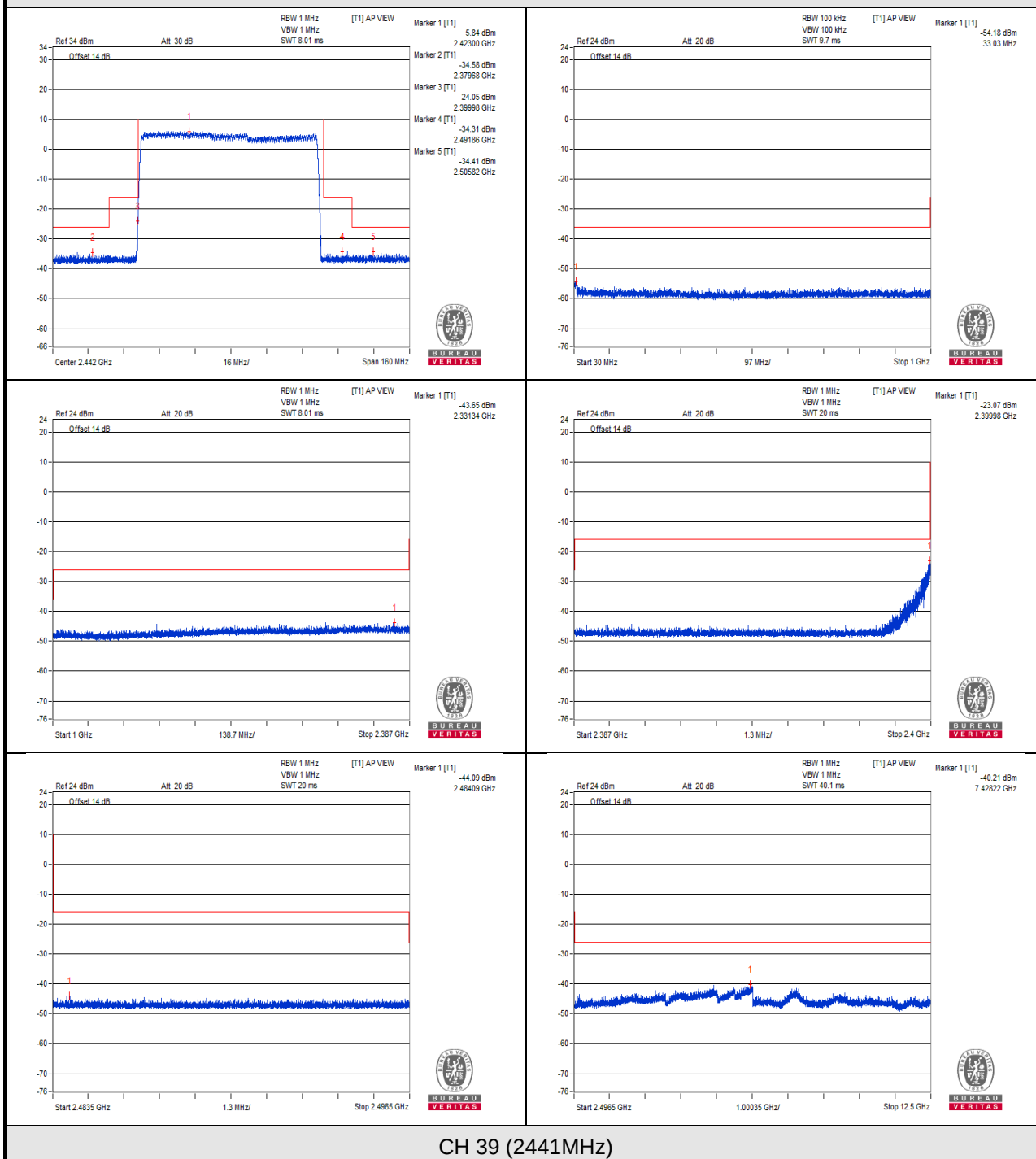
Modulation: 8DPSK

Environmental Conditions		25 deg.C, 60 % RH			
Test Channel		Hopping Mode		Limit	Result
Test Condition	Frequency Range	Frequency (MHz)	Measured Value (uW)		
V _{normal}	30.0 MHz to 1000.0 MHz	33.030	0.003000	0.25uW / 100kHz	Pass
	1000.0 MHz to 2387.0 MHz	2331.340	0.043000	2.5uW / MHz	Pass
	2387.0 MHz to 2400.0 MHz	2399.980	4.931000	25uW / MHz	Pass
	2483.5 MHz to 2496.5 MHz	2484.090	0.038000	25uW / MHz	Pass
	2496.5 MHz to 12500.0 MHz	7428.220	0.095000	2.5uW / MHz	Pass
V _{max.}	30.0 MHz to 1000.0 MHz	34.850	0.003000	0.25uW / 100kHz	Pass
	1000.0 MHz to 2387.0 MHz	2267.190	0.049000	2.5uW / MHz	Pass
	2387.0 MHz to 2400.0 MHz	2400.000	5.610000	25uW / MHz	Pass
	2483.5 MHz to 2496.5 MHz	2495.080	0.040000	25uW / MHz	Pass
	2496.5 MHz to 12500.0 MHz	6377.850	0.084000	2.5uW / MHz	Pass
V _{min.}	30.0 MHz to 1000.0 MHz	35.690	0.004000	0.25uW / 100kHz	Pass
	1000.0 MHz to 2387.0 MHz	2112.020	0.046000	2.5uW / MHz	Pass
	2387.0 MHz to 2400.0 MHz	2399.980	3.935000	25uW / MHz	Pass
	2483.5 MHz to 2496.5 MHz	2485.040	0.049000	25uW / MHz	Pass
	2496.5 MHz to 12500.0 MHz	6974.310	0.100000	2.5uW / MHz	Pass

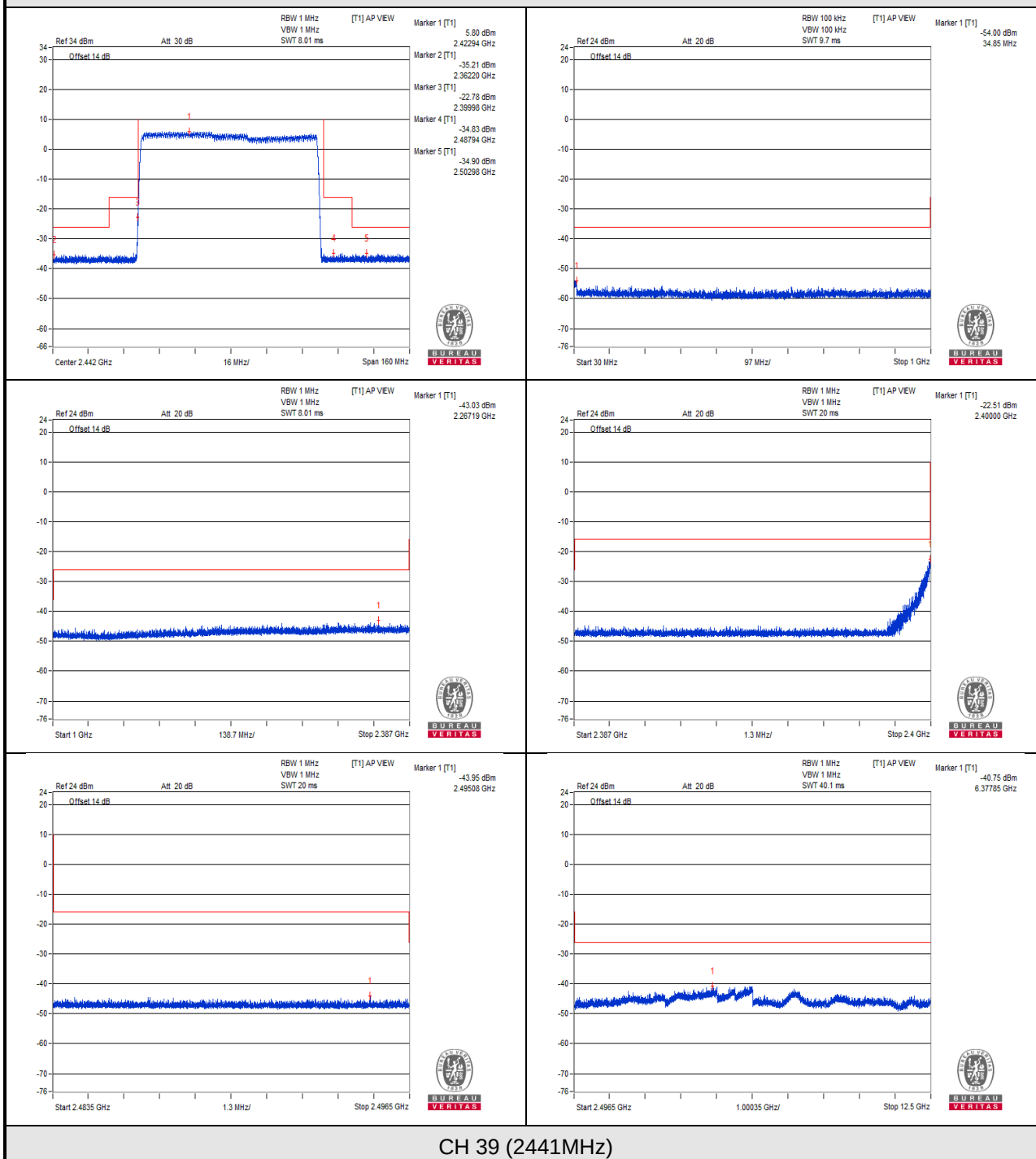
Note:

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

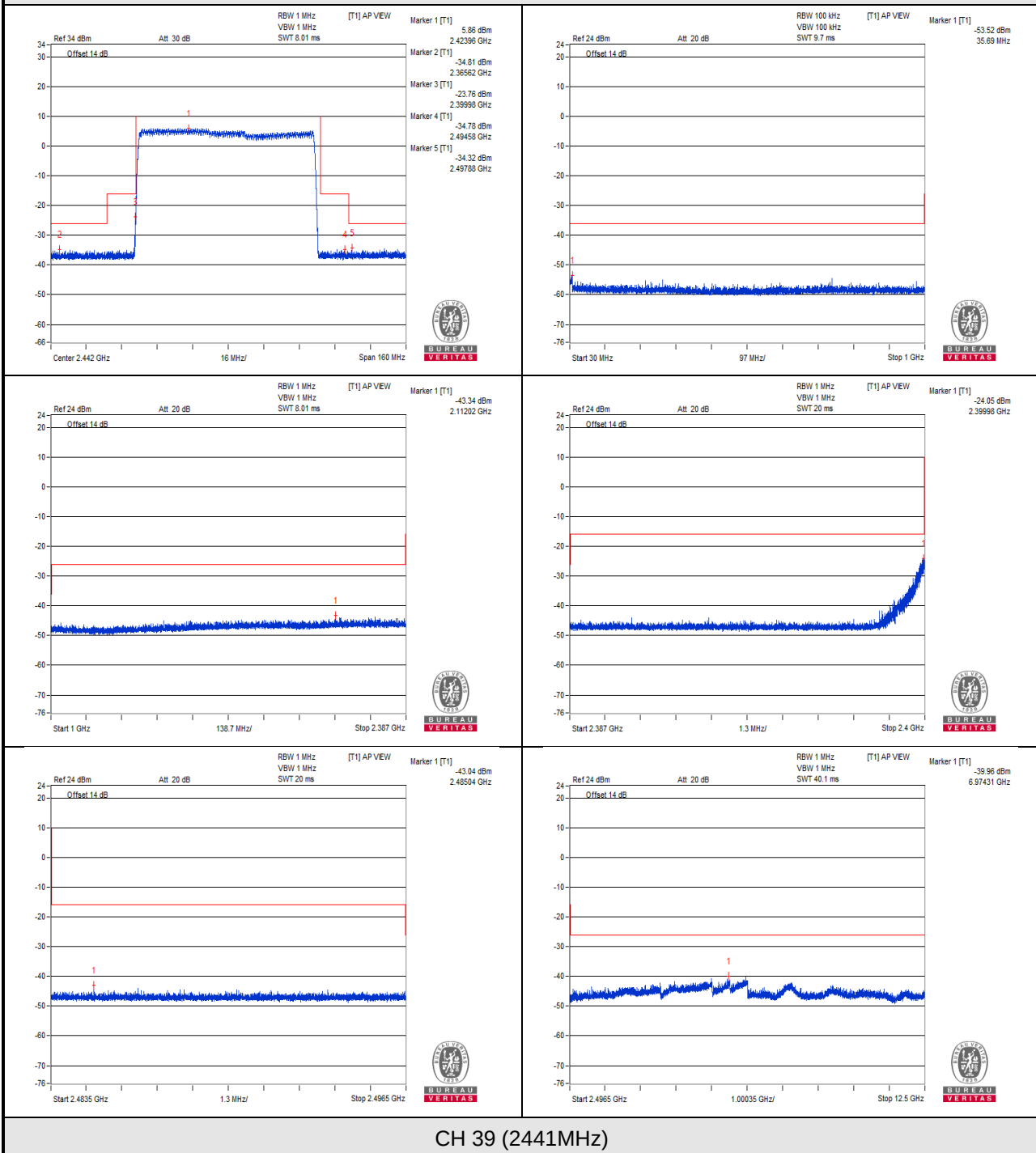
Vnormal



V_{max}.



V_{min}.



4.5 Antenna Power Measurement

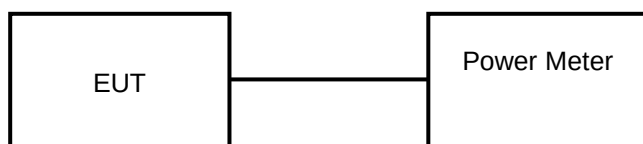
4.5.1 Limits of Antenna Power

Modulation System	Frequency Band Used	Antenna Power (Max.)	EIRP Limit (Note 3)
DS	2400 – 2483.5 MHz	10 mW/MHz	12.14 dBm/MHz ~ 22.14 dBm/MHz (16.368 mW/MHz ~ 163.68 mW/MHz)
OFDM (Note 1)	2400 – 2483.5 MHz	10 mW/MHz	12.14 dBm/MHz ~ 22.14 dBm/MHz (16.368 mW/MHz ~ 163.68 mW/MHz)
OFDM (Note 2)	2400 – 2483.5 MHz	5 mW/MHz	9.13 dBm/MHz ~ 19.13 dBm/MHz (8.203 mW/MHz ~ 82.03 mW/MHz)
FH	2400 – 2483.5 MHz	3 mW/MHz	6.91 dBm/MHz ~ 16.91 dBm/MHz (4.9 mW/MHz ~ 49.09 mW/MHz)

Note:

1. Occupied bandwidth is less than 26 MHz
2. Occupied bandwidth is more than 26 MHz and less than 38 MHz
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).

4.5.2 Test Setup



Output Power Density (mW/MHz) = Total Output Power (mW) / Spread Bandwidth (MHz)

Average power sensor was used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

4.5.3 Test Results

Normal Mode:

Environmental Conditions		26 deg.C, 60 % RH			
Modulation Type	Data Rate Type	Conducted RF Output Power Density (mW/MHz)			
		V _{normal}	V _{max.}	V _{min.}	Max. Limit (mW/MHz)
GFSK	DH5	0.0908	0.09339	0.092794	3
$\pi/4$ -DQPSK	2DH5	0.045907	0.046783	0.047629	3
8DPSK	3DH5	0.046012	0.047873	0.044759	3
Rated Power		0.1 mW			
Tolerance of Antenna Power		0.02 ~ 0.12 mW			

PIFA Antenna with 0.2 dBi gain

Environmental Conditions		26 deg.C, 60 % RH			
Modulation Type	Data Rate Type	Radiated RF Output Power Density (mW/MHz)			
		V _{normal}	V _{max.}	V _{min.}	Max. Limit (mW/MHz)
GFSK	DH5	0.095079	0.097791	0.097167	4.909
$\pi/4$ -DQPSK	2DH5	0.048071	0.048988	0.049874	4.909
8DPSK	3DH5	0.04818	0.050129	0.046868	4.909

- Note: 1. The radiated RF output power density is a “calculated” value derived from the conducted value.
2. Formula: Radiated RF output power density = Conducted RF output power density + Antenna Gain.

AFH Mode:

Environmental Conditions		26 deg.C, 60 % RH			
Modulation Tpe	Data Rate Type	Conducted RF Output Power Density (mW)			
		V _{normal}	V _{max.}	V _{min.}	Max. Limit (mW/MHz)
GFSK	DH5	0.359187	0.366376	0.365024	3
$\pi/4$ -DQPSK	2DH5	0.179137	0.182047	0.186872	3
8DPSK	3DH5	0.179547	0.186288	0.174657	3
Rated Power		0.4 mW			
Tolerance of Antenna Power		0.08 ~ 0.48 mW			

PIFA Antenna with 0.2 dBi gain

Environmental Conditions		26 deg.C, 60 % RH			
Modulation Tpe	Data Rate Type	Radiated RF Output Power Density (mW)			
		V _{normal}	V _{max.}	V _{min.}	Max. Limit (mW/MHz)
GFSK	DH5	0.376115	0.383643	0.382227	4.909
$\pi/4$ -DQPSK	2DH5	0.187579	0.190627	0.195679	4.909
8DPSK	3DH5	0.188009	0.195067	0.182888	4.909

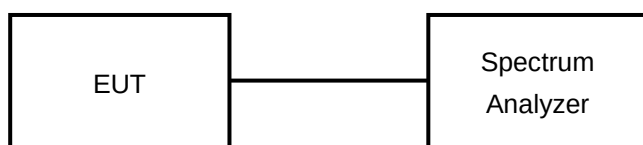
- Note: 1. The radiated RF output power density is a "calculated" value derived from the conducted value.
2. Formula: Radiated RF output power density = Conducted RF output power density + Antenna Gain.

4.6 Spurious Emissions for Receiver

4.6.1 Limits of Spurious Emissions for Receiver

Frequencies (MHz)	Limit
Below 1 GHz	≤ 4 nW (-54 dBm)
Above 1 GHz	≤ 20 nW (-47 dBm)

4.6.2 Test Setup

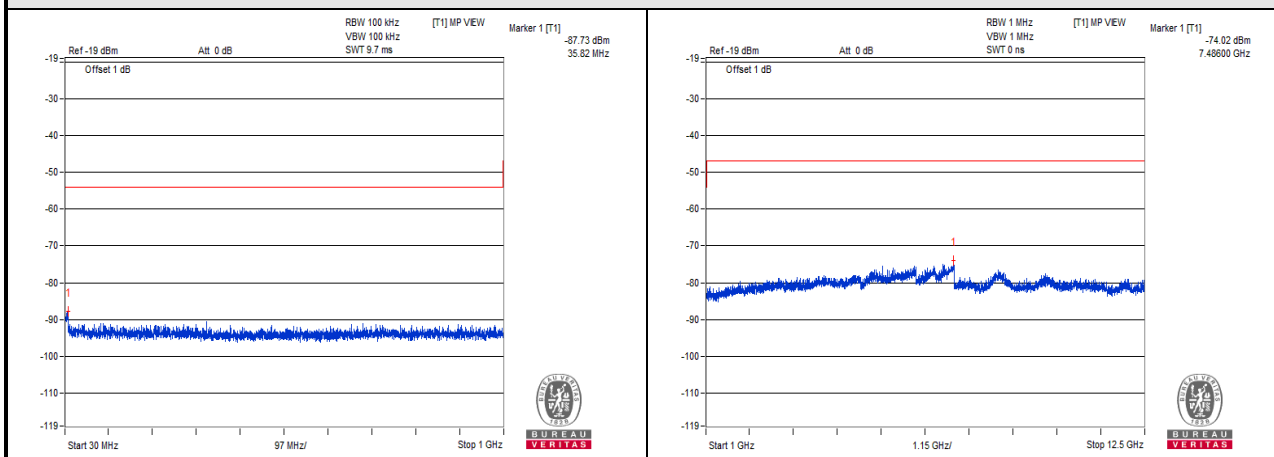


4.6.3 Test Result

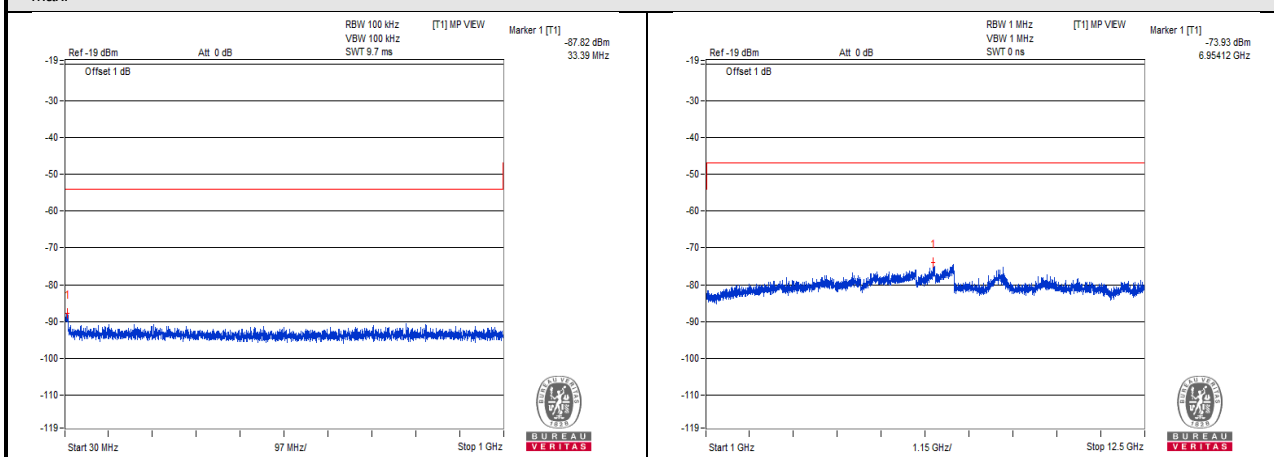
Environmental Conditions		25 deg.C, 60 % RH					
Test Channel		Channel 0 (2402 MHz)		Channel 39 (2441 MHz)		Limit	Result
Test Condition	Frequency Range	Frequency (MHz)	Measured Value (nW)	Frequency (MHz)	Measured Value (nW)		
V _{normal}	Below 1 GHz	35.820	0.001687	35.330	0.001866	4 nW	Pass
	Above 1 GHz	7486.000	0.039628	7440.000	0.038905	20 nW	Pass
V _{max.}	Below 1 GHz	33.390	0.001652	31.940	0.001694	4 nW	Pass
	Above 1 GHz	6954.120	0.040458	7339.370	0.036644	20 nW	Pass
V _{min.}	Below 1 GHz	31.940	0.002168	33.390	0.001560	4 nW	Pass
	Above 1 GHz	7468.750	0.030130	7471.620	0.035481	20 nW	Pass
Test Channel		Channel 78 (2480 MHz)				Limit	Result
Test Condition	Frequency Range	Frequency (MHz)		Measured Value (nW)			
V _{normal}	Below 1 GHz	34.600		0.001866		4 nW	Pass
	Above 1 GHz	6994.370		0.033343		20 nW	Pass
V _{max.}	Below 1 GHz	31.450		0.001600		4 nW	Pass
	Above 1 GHz	7417.000		0.040738		20 nW	Pass
V _{min.}	Below 1 GHz	35.330		0.001766		4 nW	Pass
	Above 1 GHz	7440.000		0.035645		20 nW	Pass

Note: 1. The worst value in each frequency range v.s. each channel has been marked by boldface.
2. The spectrum plots are attached on the following pages.

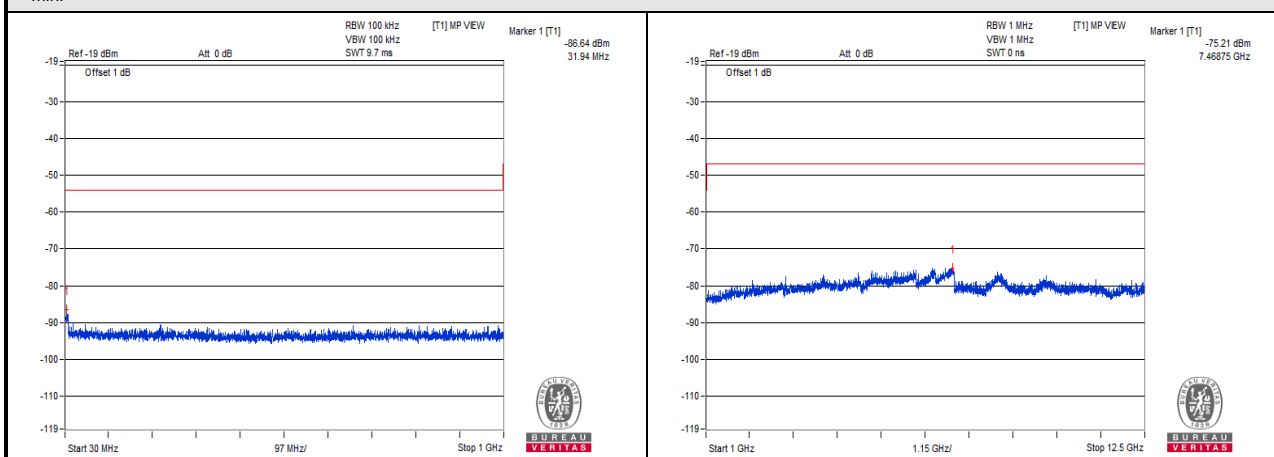
V_{normal}



V_{max}

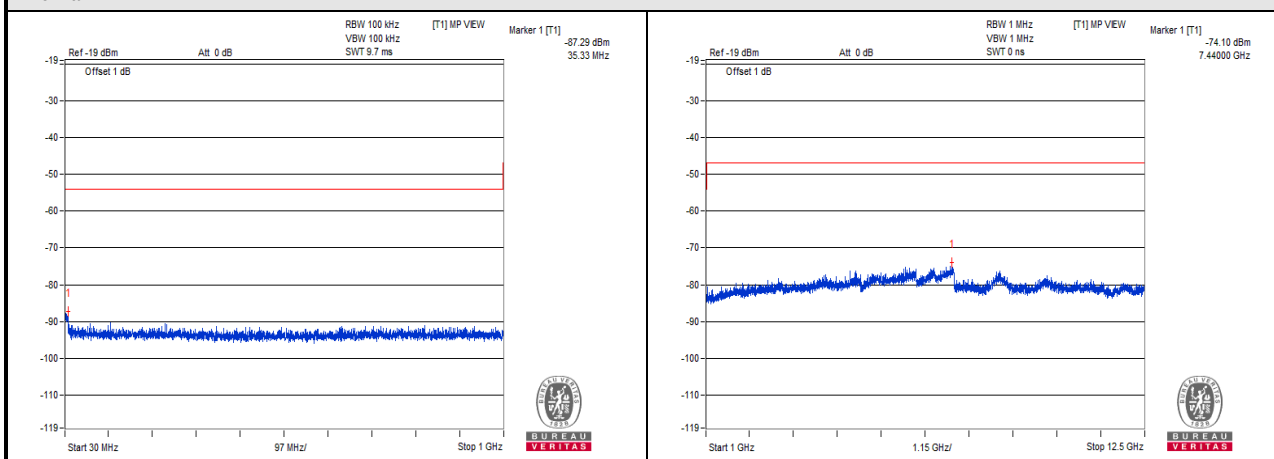


V_{min}

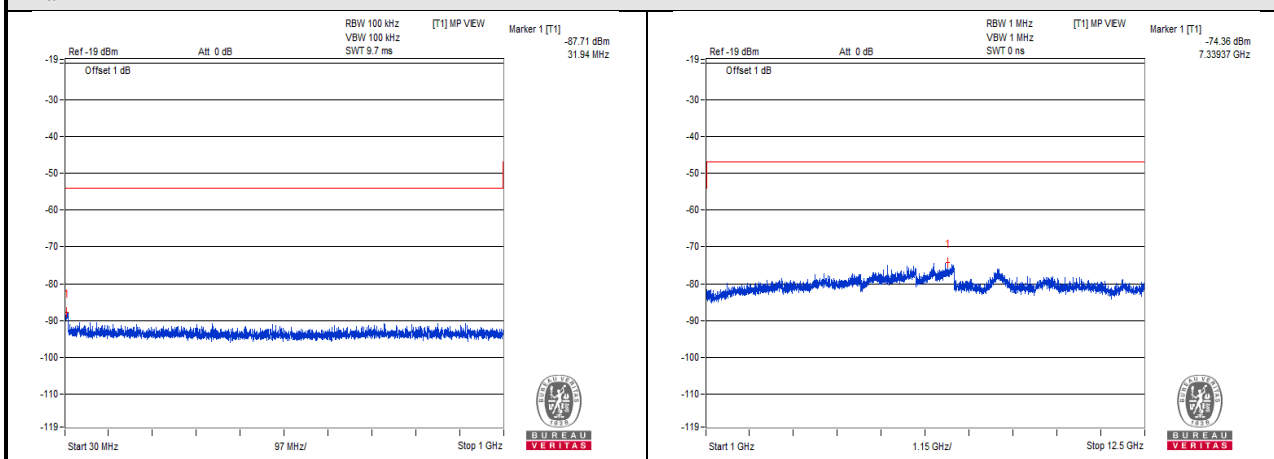


CH 0 (2402MHz)

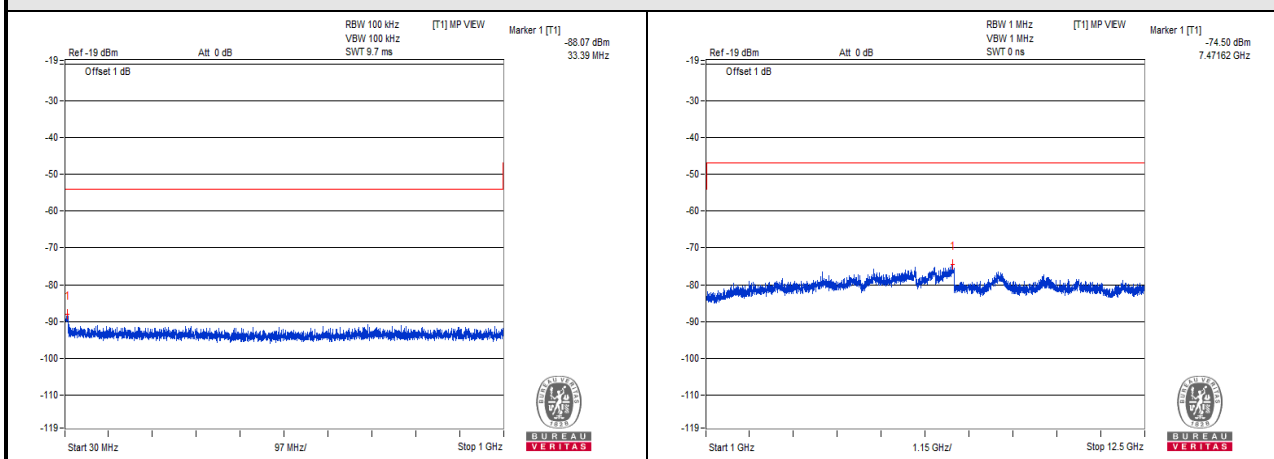
V normal



V max.

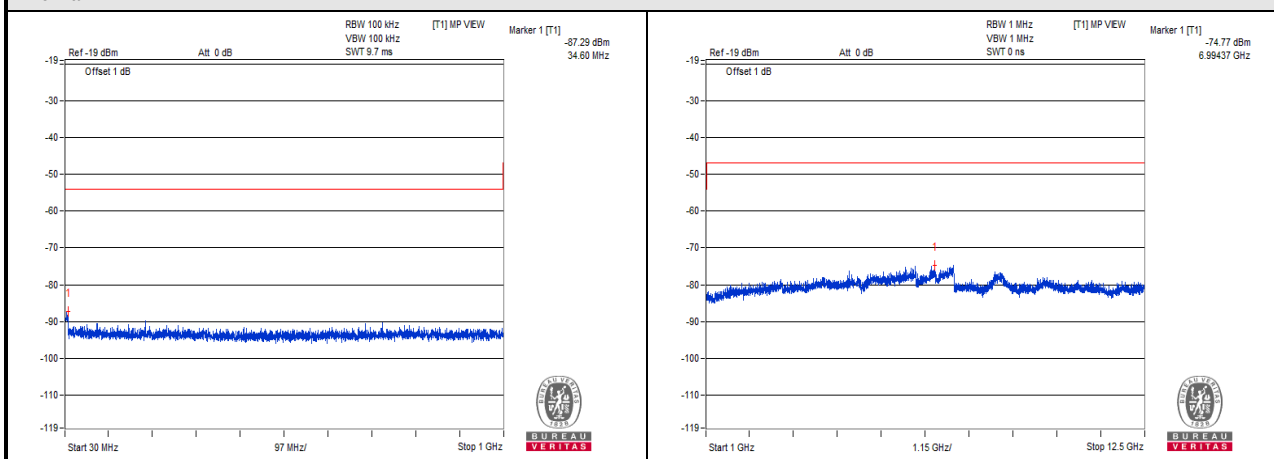


V min.

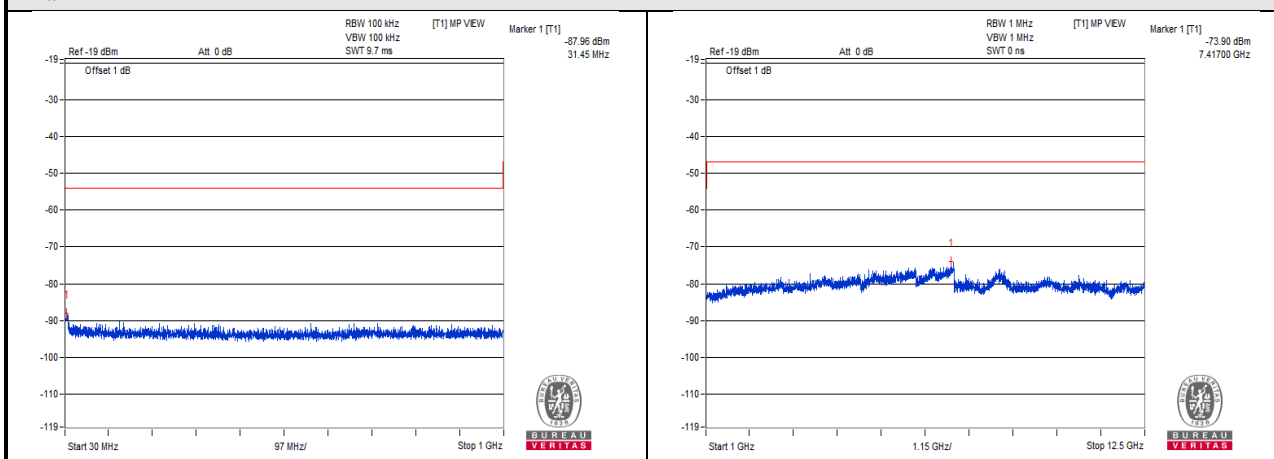


CH 39 (2441MHz)

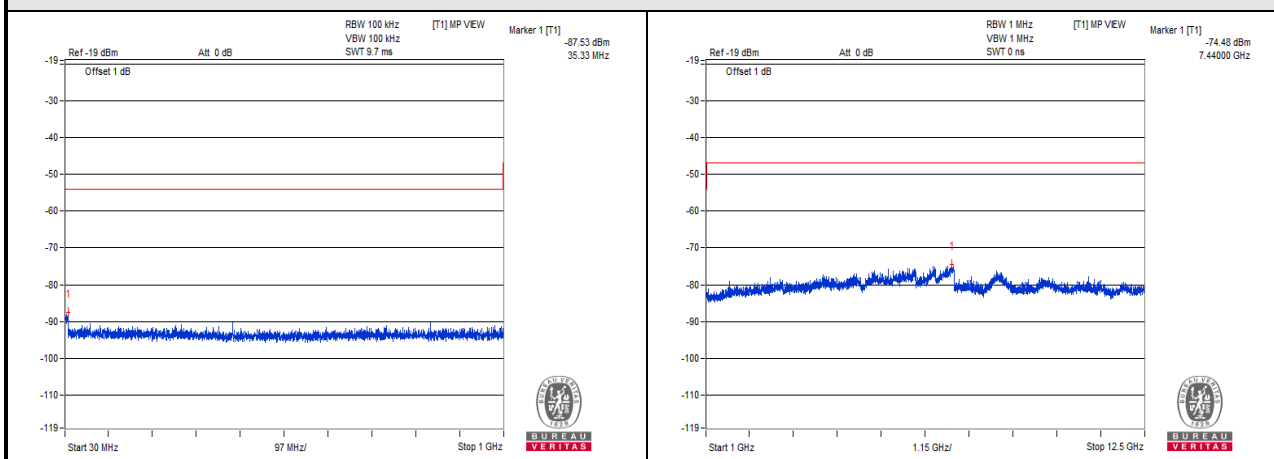
V normal



V max.



V min.



CH 78 (2480MHz)

4.7 Dwell Time

4.7.1 Limits of Dwell Time

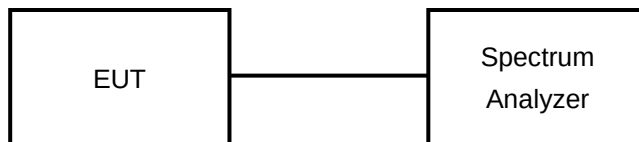
The frequency retention time in the frequency hopping method shall be 0.4 seconds or less. The total sum of the frequency retention time in any frequency within the time obtained by multiplying the diffusion rate by 0.4 second shall be 0.4 second or shorter.

Formula:

(Normal mode) dwell time = $[\text{diffusion rate} / 79] \times \text{duty-cycle} \times 0.4 \text{ seconds}$

(AFH mode) dwell time = $[\text{diffusion rate} / 20] \times \text{duty-cycle} \times 0.4 \text{ sec}$

4.7.2 Test Setup



4.7.3 Test Result

Modulation: GFSK

Normal Mode:

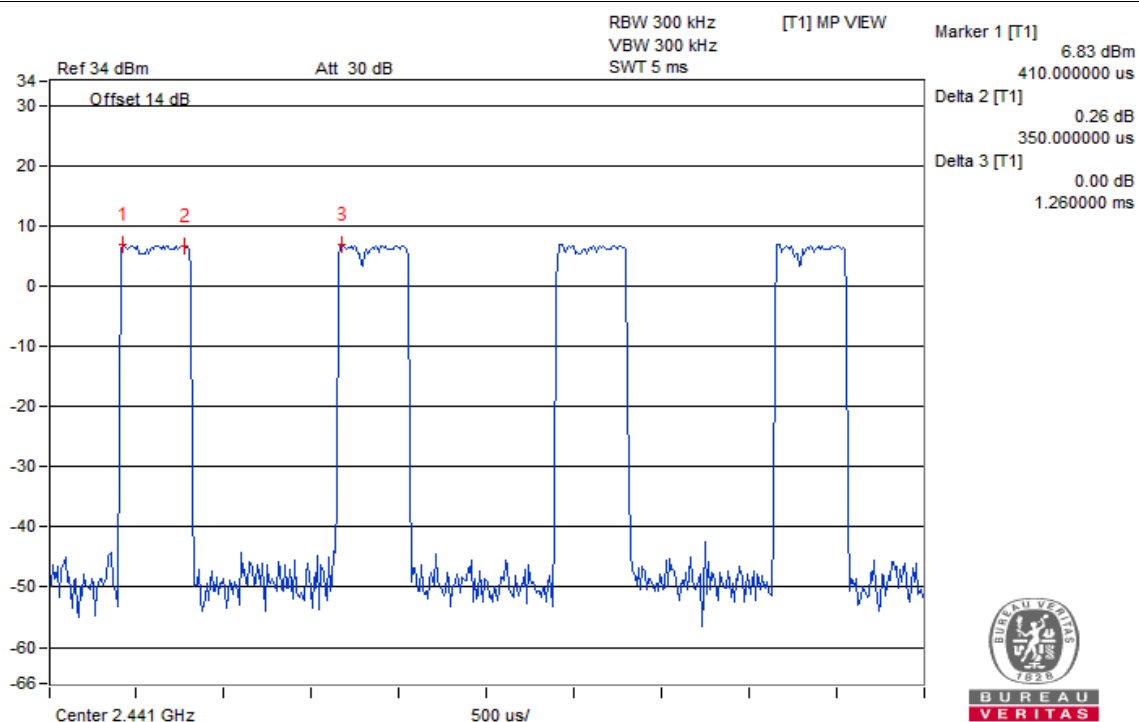
Test Condition	Mode	Spreading Rate	[Spreading Rate/79]*0.4	Duty Cycle	Result (msec)	Limit (msec)
V _{normal}	DH1	71.60	0.362	0.277	100.274	400
	DH3	71.60	0.362	0.414	149.868	400
	DH5	71.60	0.362	0.459	166.158	400
V _{max.}	DH1	71.40	0.361	0.296	106.856	400
	DH3	71.40	0.361	0.425	153.425	400
	DH5	71.40	0.361	0.459	165.699	400
V _{min.}	DH1	71.20	0.360	0.272	97.920	400
	DH3	71.20	0.360	0.414	149.040	400
	DH5	71.20	0.360	0.454	163.440	400

AFH Mode:

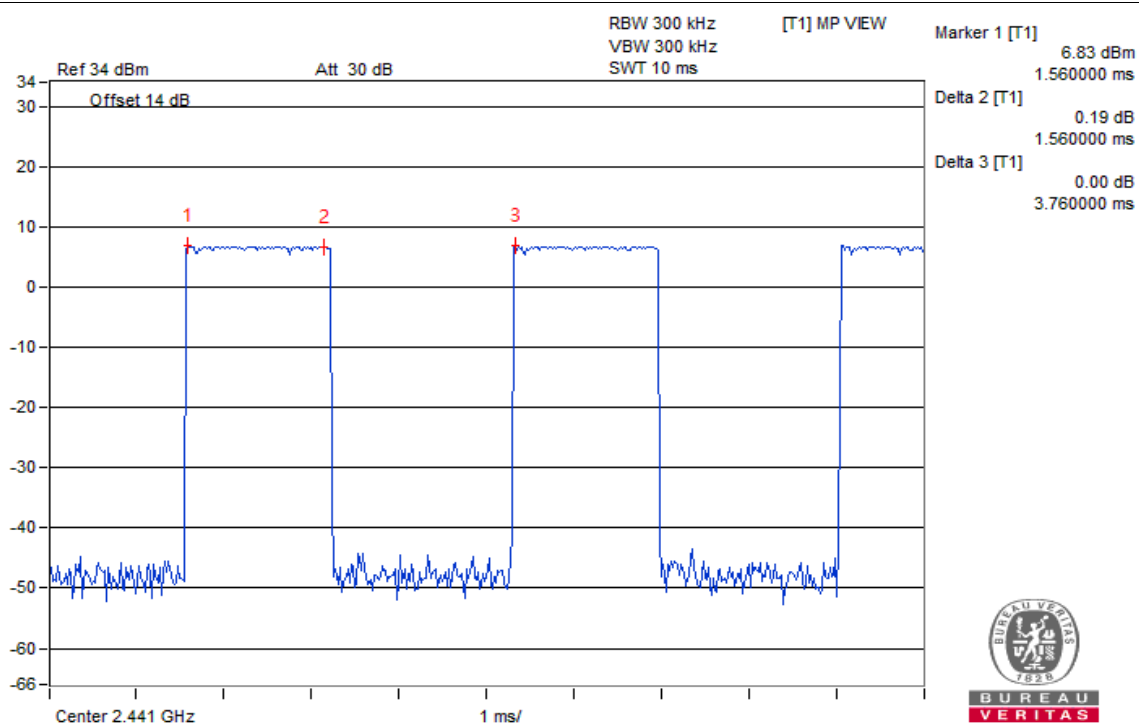
Test Condition	Mode	Spreading Rate	[Spreading Rate/20]*0.4	Duty Cycle	Result (msec)	Limit (msec)
V _{normal}	DH1	18.10	0.362	0.277	100.274	400
	DH3	18.10	0.362	0.414	149.868	400
	DH5	18.10	0.362	0.459	166.158	400
V _{max.}	DH1	18.20	0.364	0.296	107.744	400
	DH3	18.20	0.364	0.425	154.700	400
	DH5	18.20	0.364	0.459	167.076	400
V _{min.}	DH1	18.10	0.362	0.272	98.464	400
	DH3	18.10	0.362	0.414	149.868	400
	DH5	18.10	0.362	0.454	164.348	400

NOTE: Test plots of the transmitting time slot are shown on following pages.

V_{normal}

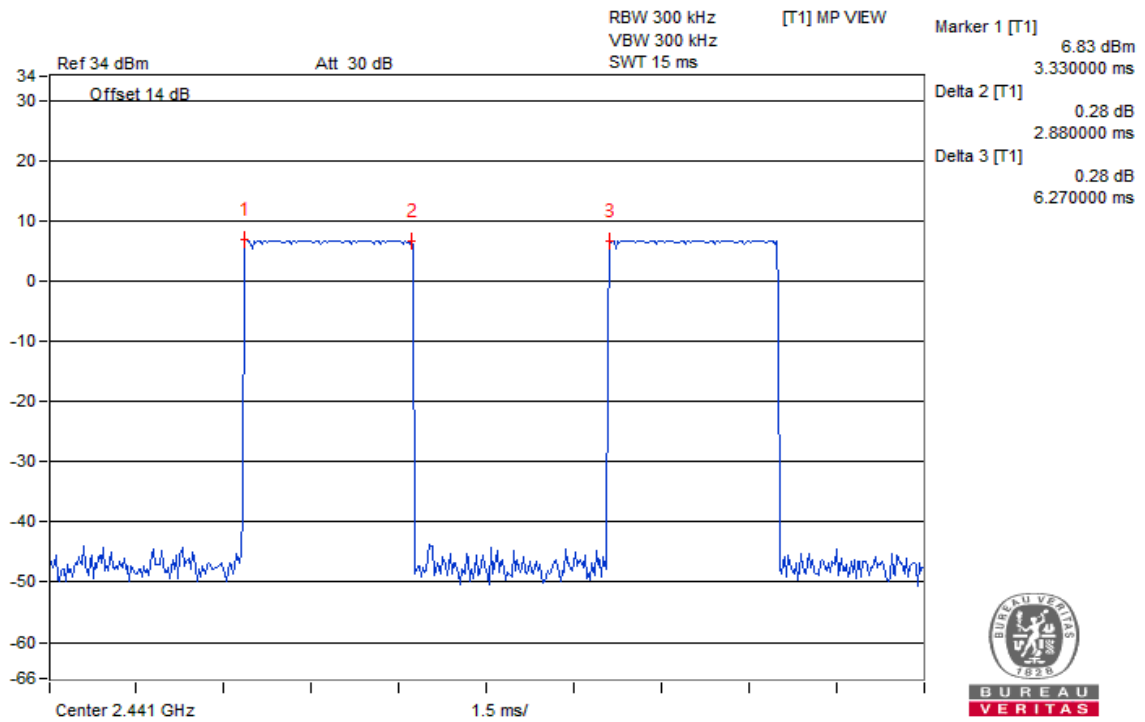


DH1



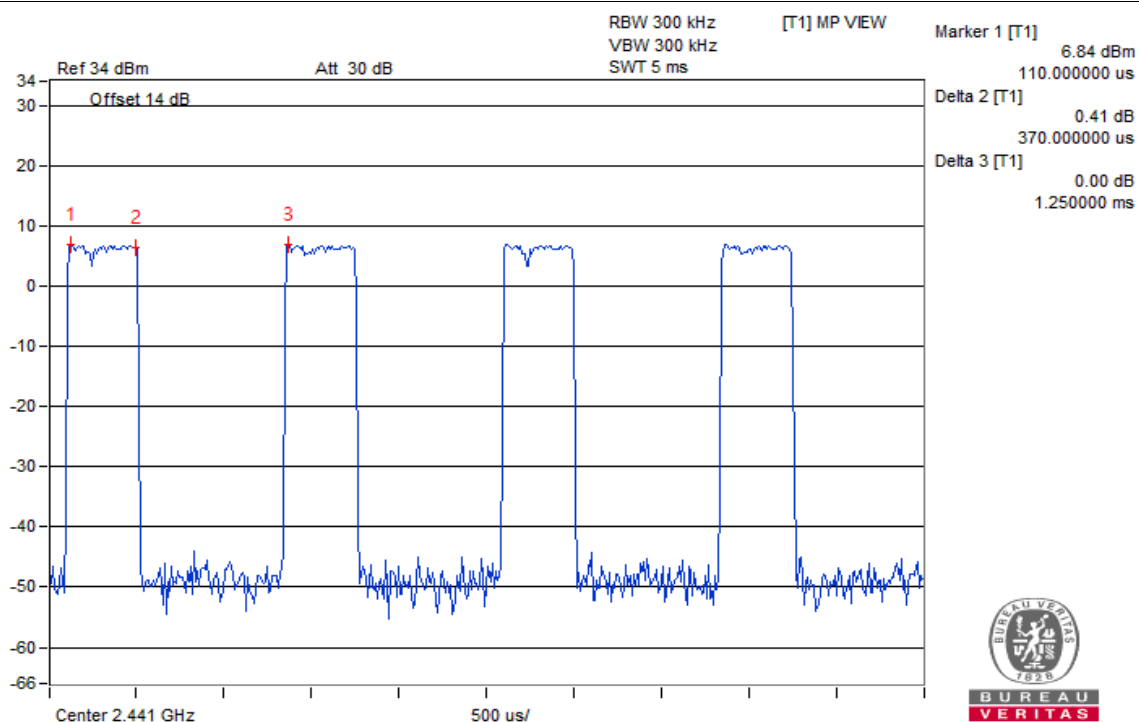
DH3

V_{normal}

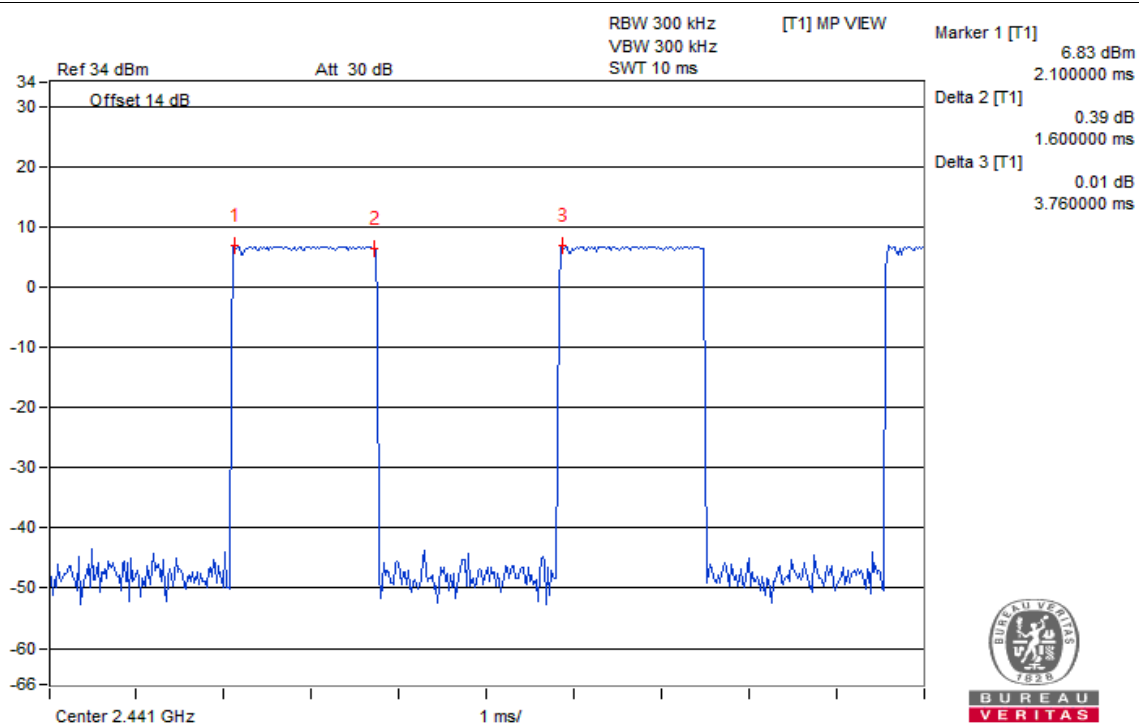


DH5

V_{max}.

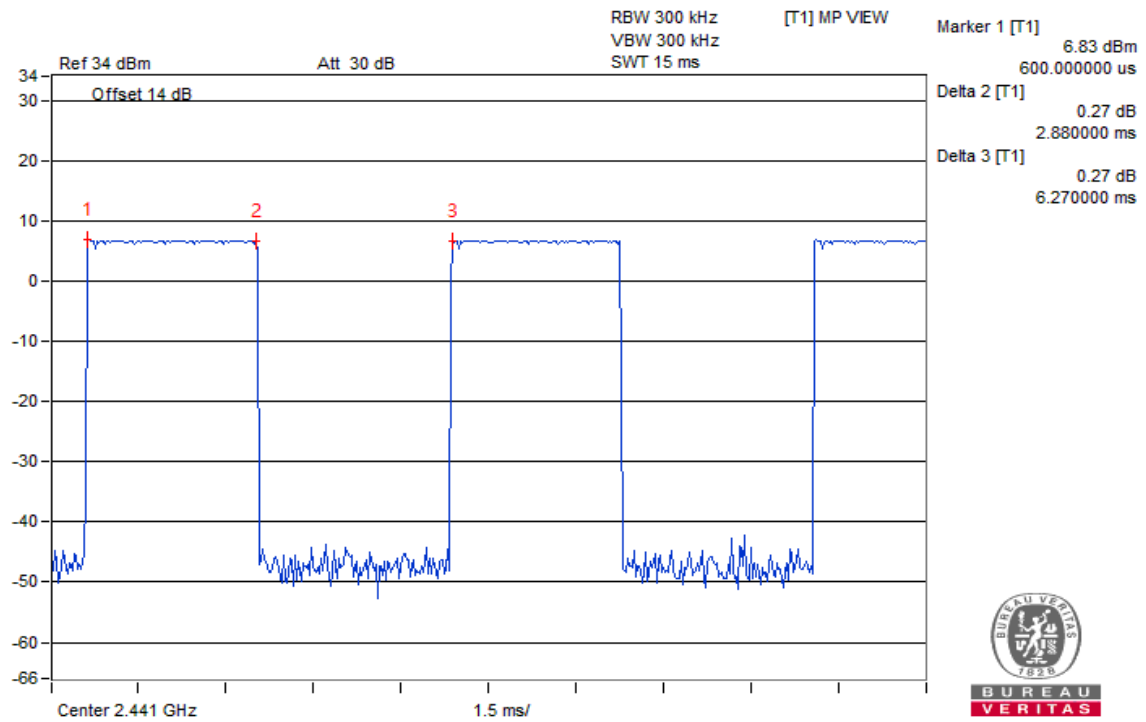


DH1



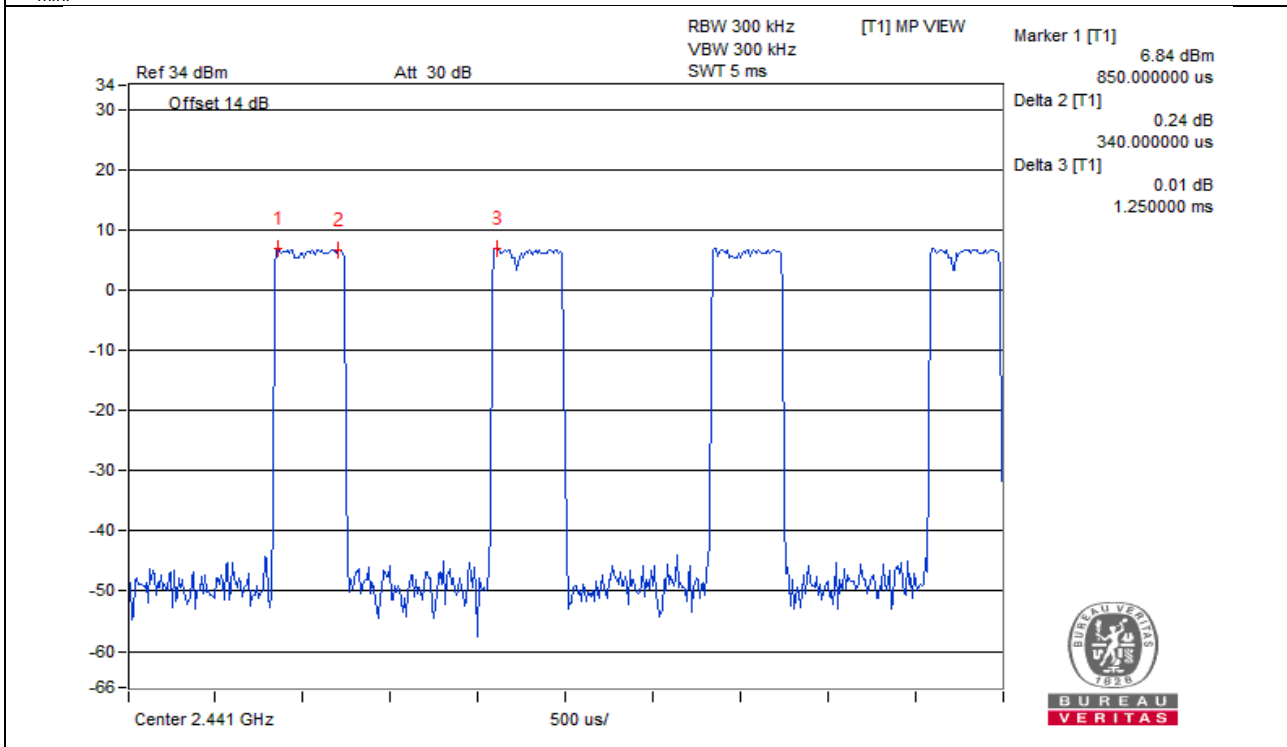
DH3

V_{max}.

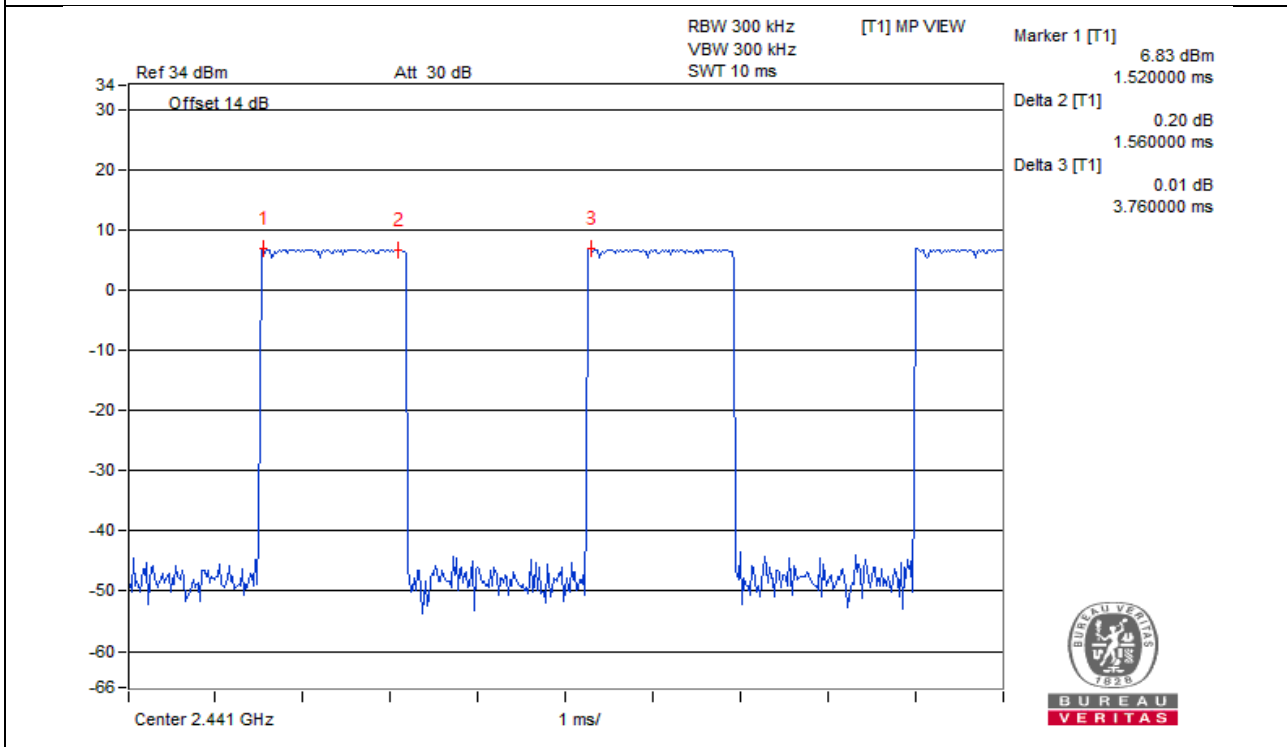


DH5

V_{min}.

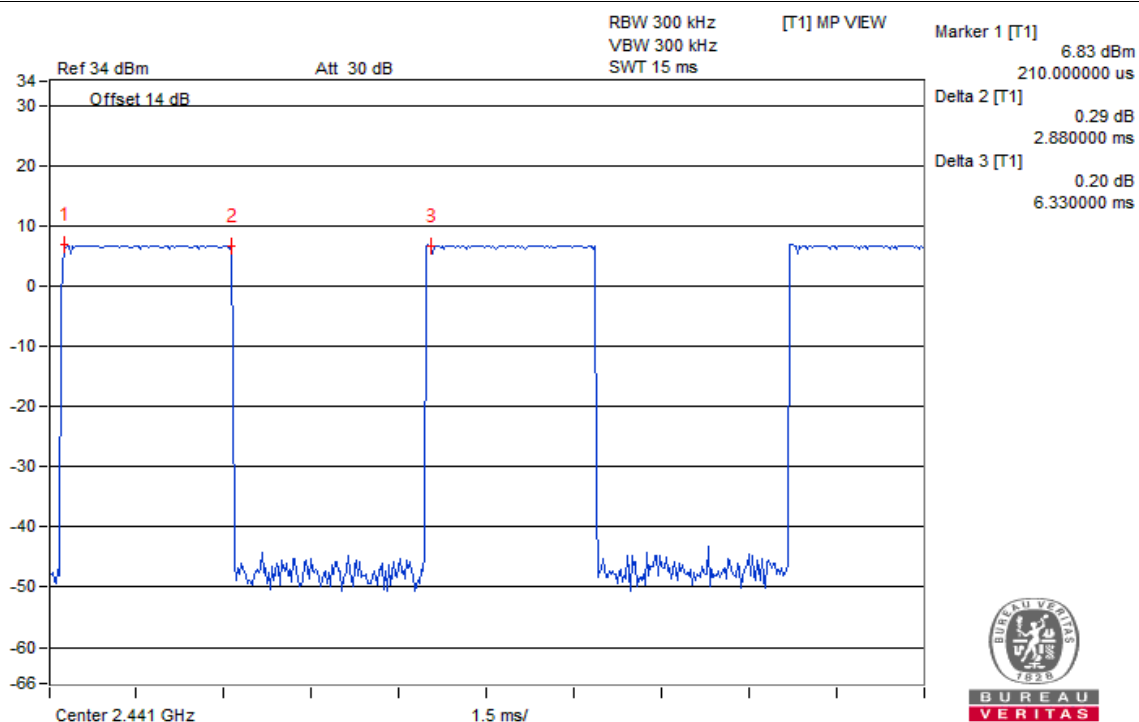


DH1



DH3

V_{min}.



DH5

Modulation: $\pi/4$ -DQPSK

Normal Mode:

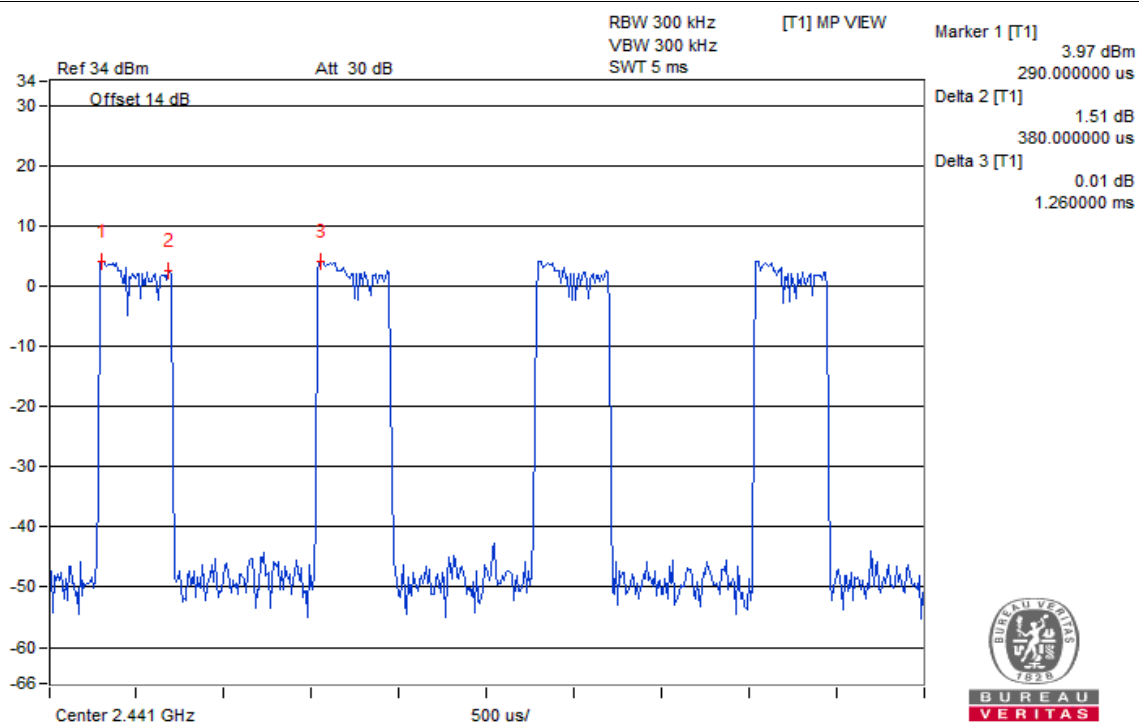
Test Condition	Mode	Spreading Rate	[Spreading Rate/79]*0.4	Duty Cycle	Result (msec)	Limit (msec)
V_{normal}	2DH1	71.80	0.363	0.301	109.263	400
	2DH3	71.80	0.363	0.438	158.994	400
	2DH5	71.80	0.363	0.464	168.432	400
$V_{max.}$	2DH1	71.60	0.362	0.304	110.048	400
	2DH3	71.60	0.362	0.437	158.194	400
	2DH5	71.60	0.362	0.461	166.882	400
$V_{min.}$	2DH1	71.80	0.363	0.304	110.352	400
	2DH3	71.80	0.363	0.437	158.631	400
	2DH5	71.80	0.363	0.462	167.706	400

AFH Mode:

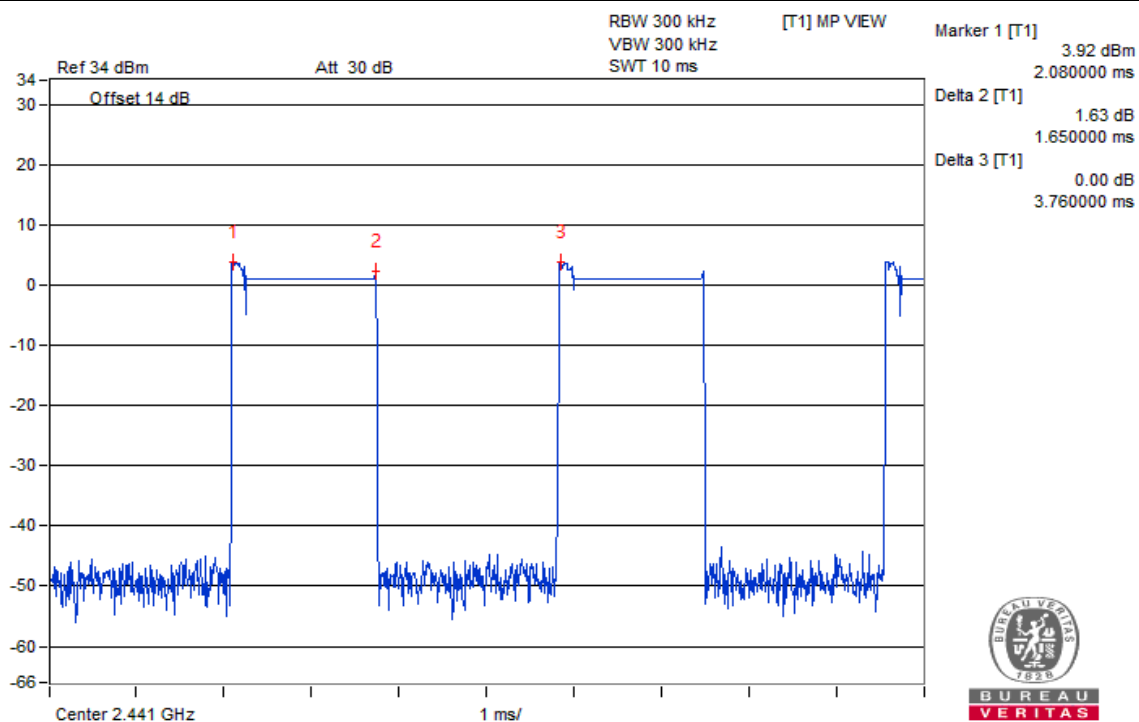
Test Condition	Mode	Spreading Rate	[Spreading Rate/20]*0.4	Duty Cycle	Result (msec)	Limit (msec)
V_{normal}	2DH1	18.40	0.368	0.301	110.768	400
	2DH3	18.40	0.368	0.438	161.184	400
	2DH5	18.40	0.368	0.464	170.752	400
$V_{max.}$	2DH1	18.40	0.368	0.304	111.872	400
	2DH3	18.40	0.368	0.437	160.816	400
	2DH5	18.40	0.368	0.461	169.648	400
$V_{min.}$	2DH1	18.30	0.366	0.304	111.264	400
	2DH3	18.30	0.366	0.437	159.942	400
	2DH5	18.30	0.366	0.462	169.092	400

NOTE: Test plots of the transmitting time slot are shown on following pages.

V_{normal}

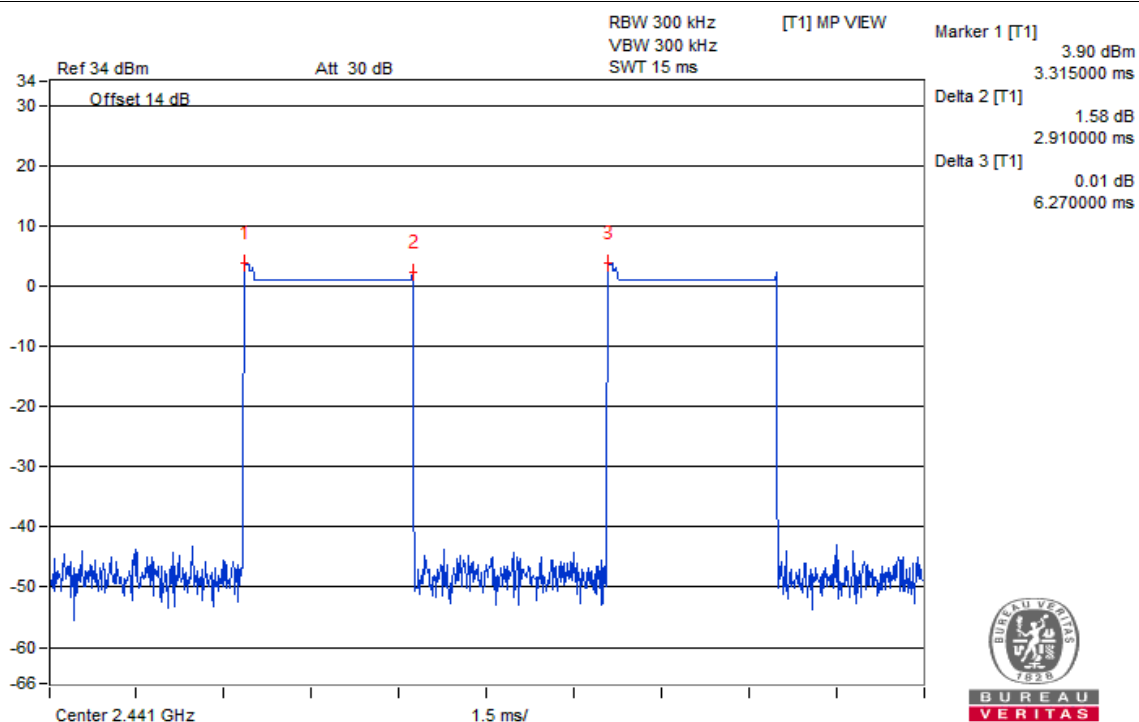


2DH1



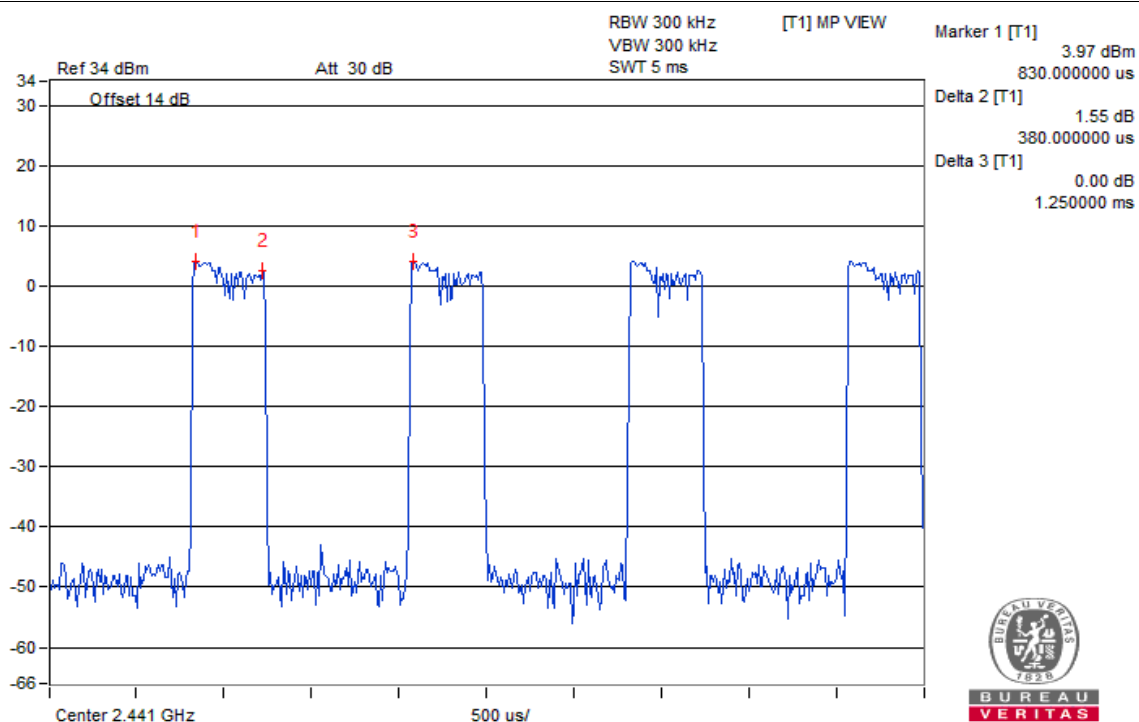
2DH3

V_{normal}

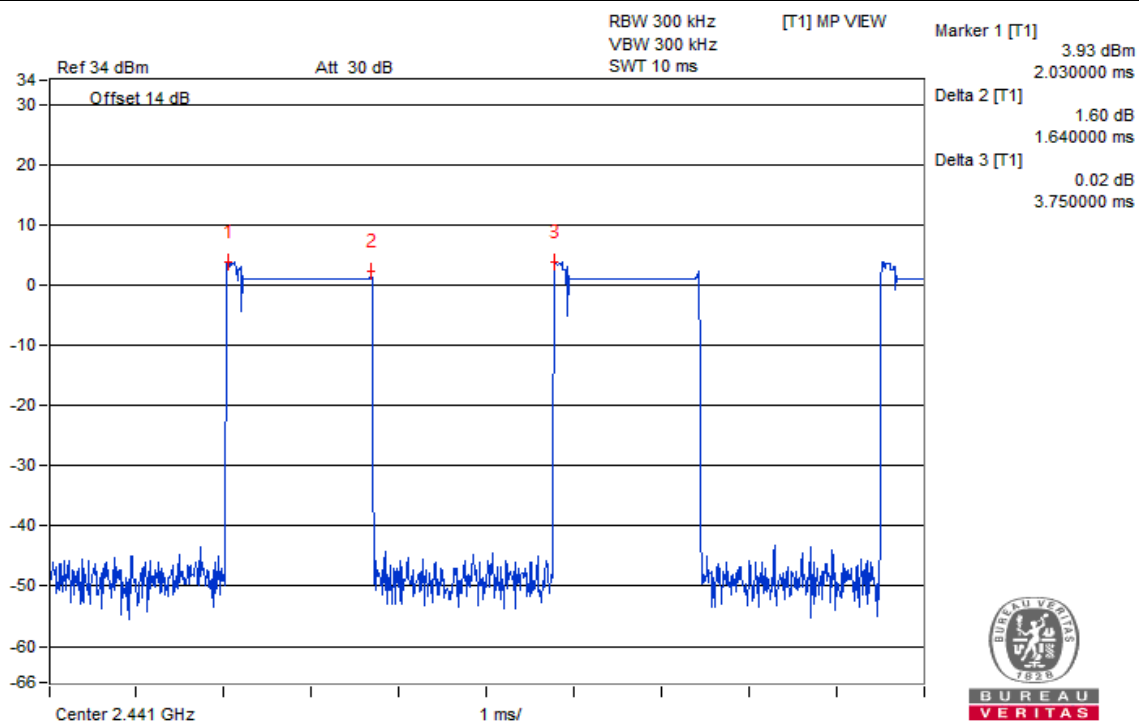


2DH5

V_{max}.

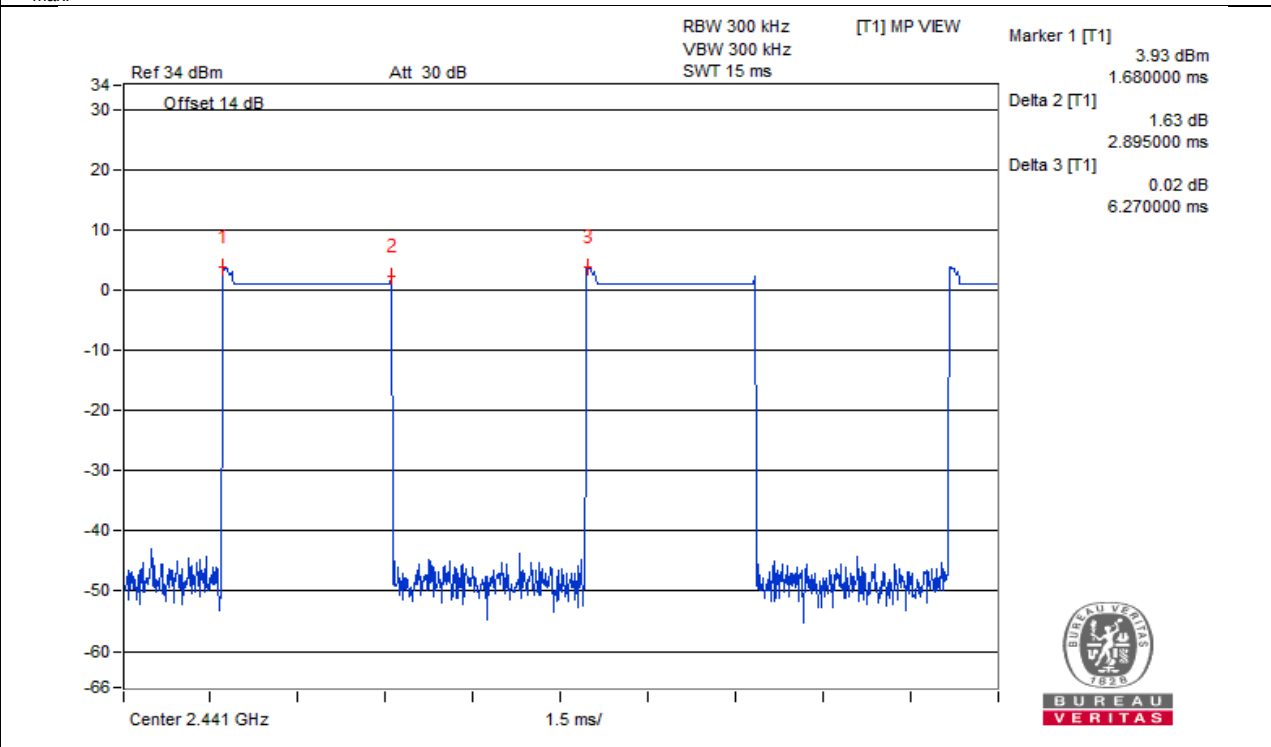


2DH1



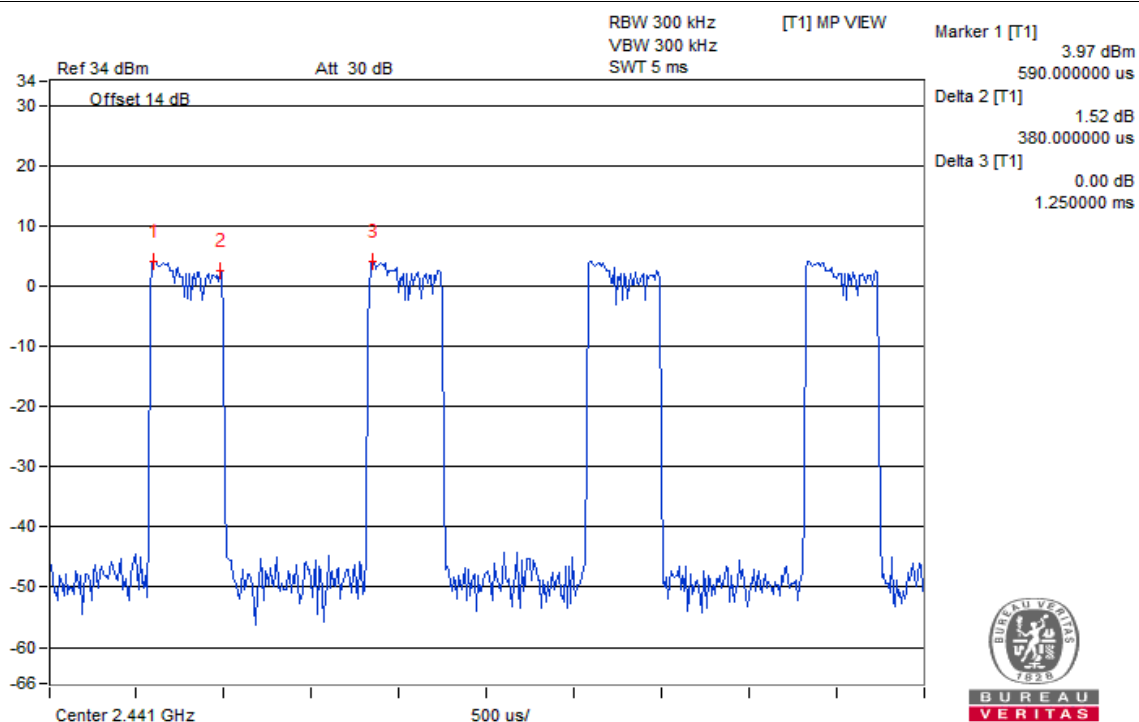
2DH3

V_{max}.

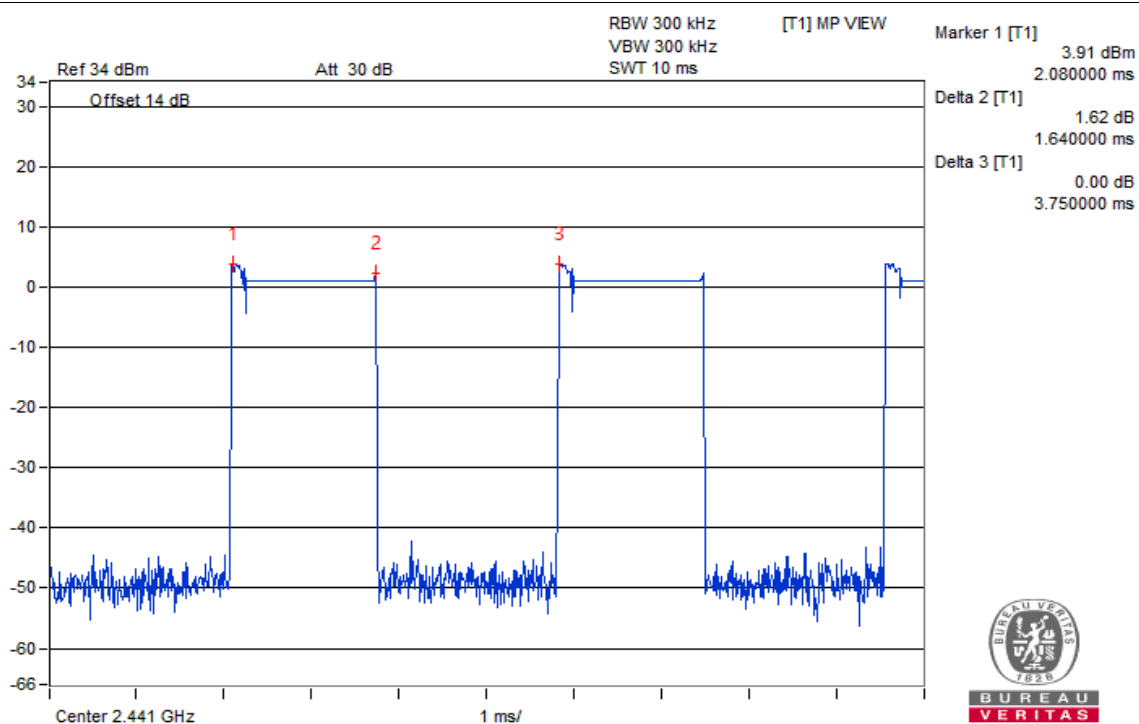


2DH5

V_{min}.

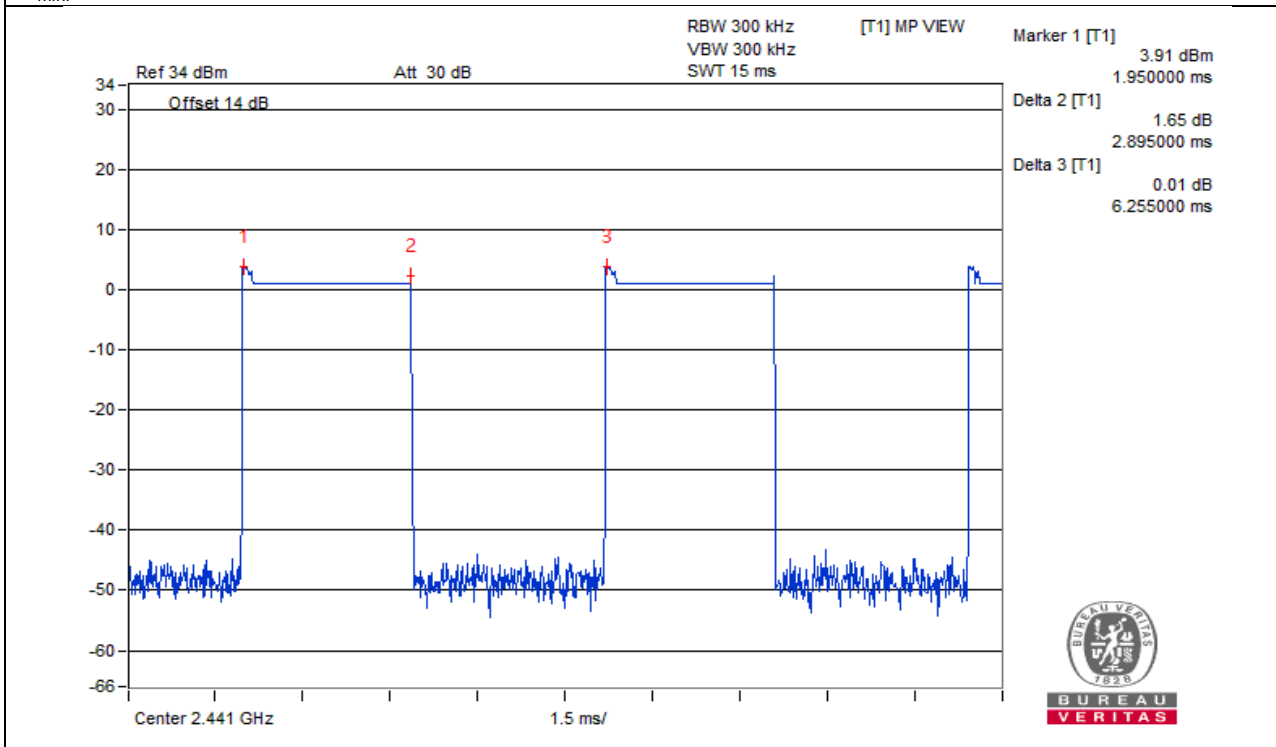


2DH1



2DH3

V_{min}.



2DH5

Modulation: 8DPSK

Normal Mode:

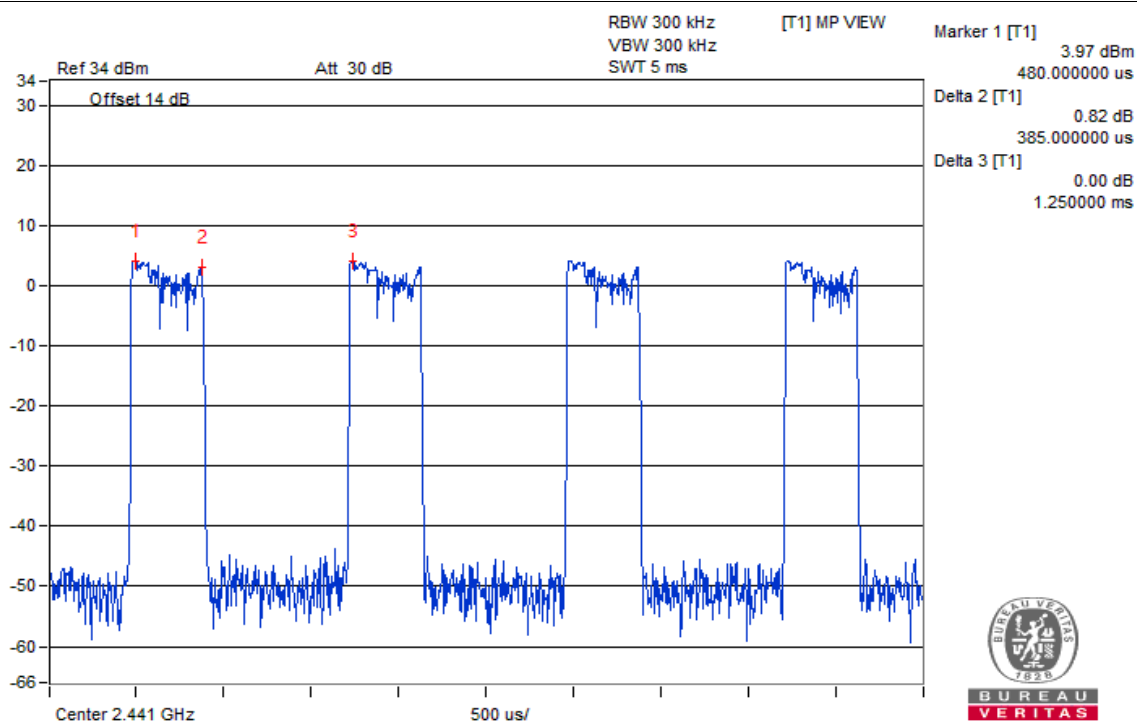
Test Condition	Mode	Spreading Rate	[Spreading Rate/79]*0.4	Duty Cycle	Result (msec)	Limit (msec)
V _{normal}	3DH1	71.80	0.363	0.308	111.804	400
	3DH3	71.80	0.363	0.438	158.994	400
	3DH5	71.80	0.363	0.462	167.706	400
V _{max.}	3DH1	71.60	0.362	0.312	112.944	400
	3DH3	71.60	0.362	0.437	158.194	400
	3DH5	71.60	0.362	0.461	166.882	400
V _{min.}	3DH1	71.80	0.363	0.309	112.167	400
	3DH3	71.80	0.363	0.435	157.905	400
	3DH5	71.80	0.363	0.462	167.706	400

AFH Mode:

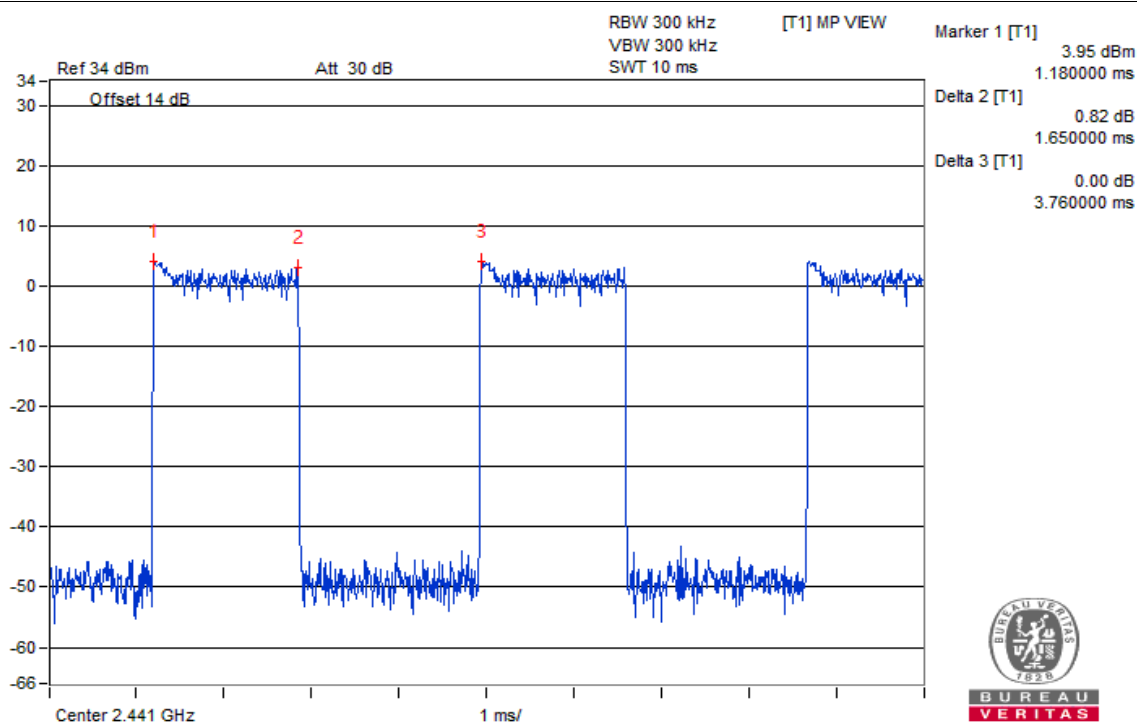
Test Condition	Mode	Spreading Rate	[Spreading Rate/20]*0.4	Duty Cycle	Result (msec)	Limit (msec)
V _{normal}	3DH1	18.40	0.368	0.308	113.344	400
	3DH3	18.40	0.368	0.438	161.184	400
	3DH5	18.40	0.368	0.462	170.016	400
V _{max.}	3DH1	18.40	0.368	0.312	114.816	400
	3DH3	18.40	0.368	0.437	160.816	400
	3DH5	18.40	0.368	0.461	169.648	400
V _{min.}	3DH1	18.40	0.368	0.309	113.712	400
	3DH3	18.40	0.368	0.435	160.080	400
	3DH5	18.40	0.368	0.462	170.016	400

NOTE: Test plots of the transmitting time slot are shown on following pages.

V_{normal}

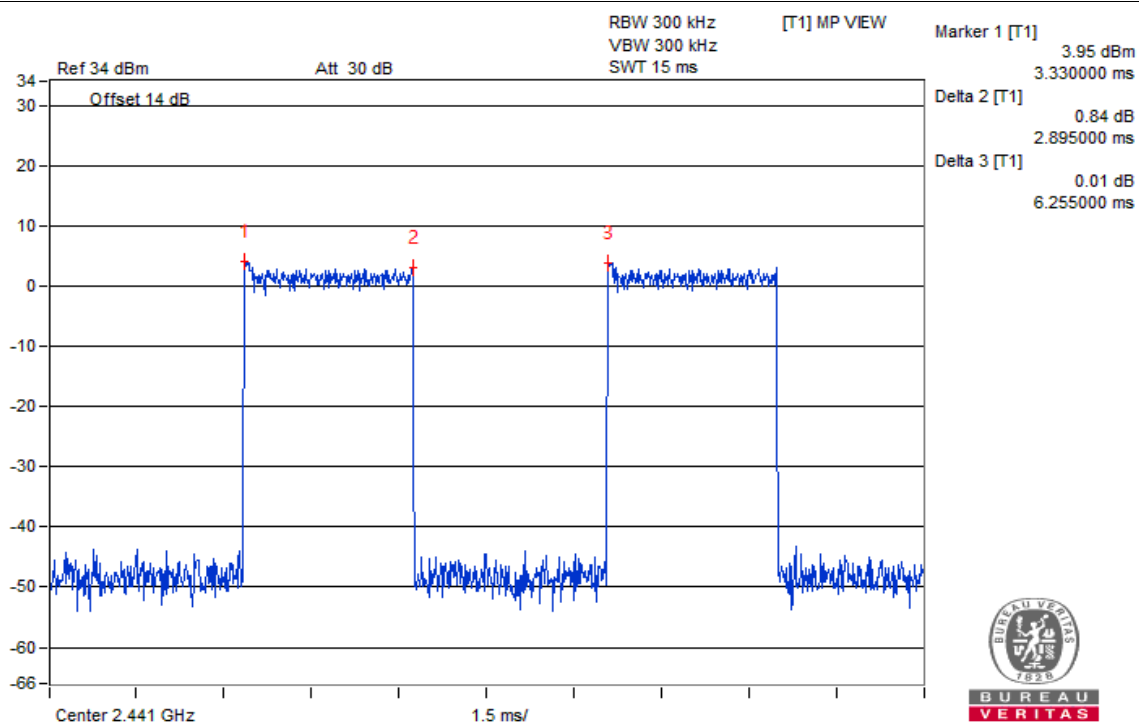


3DH1



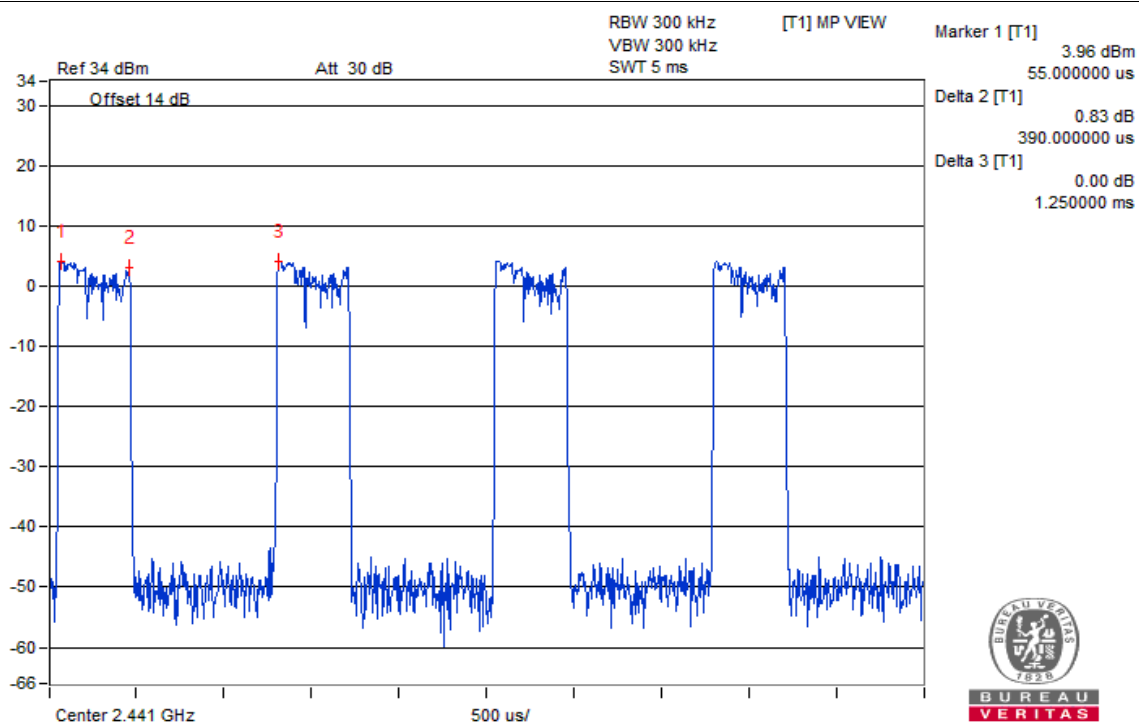
3DH3

V_{normal}

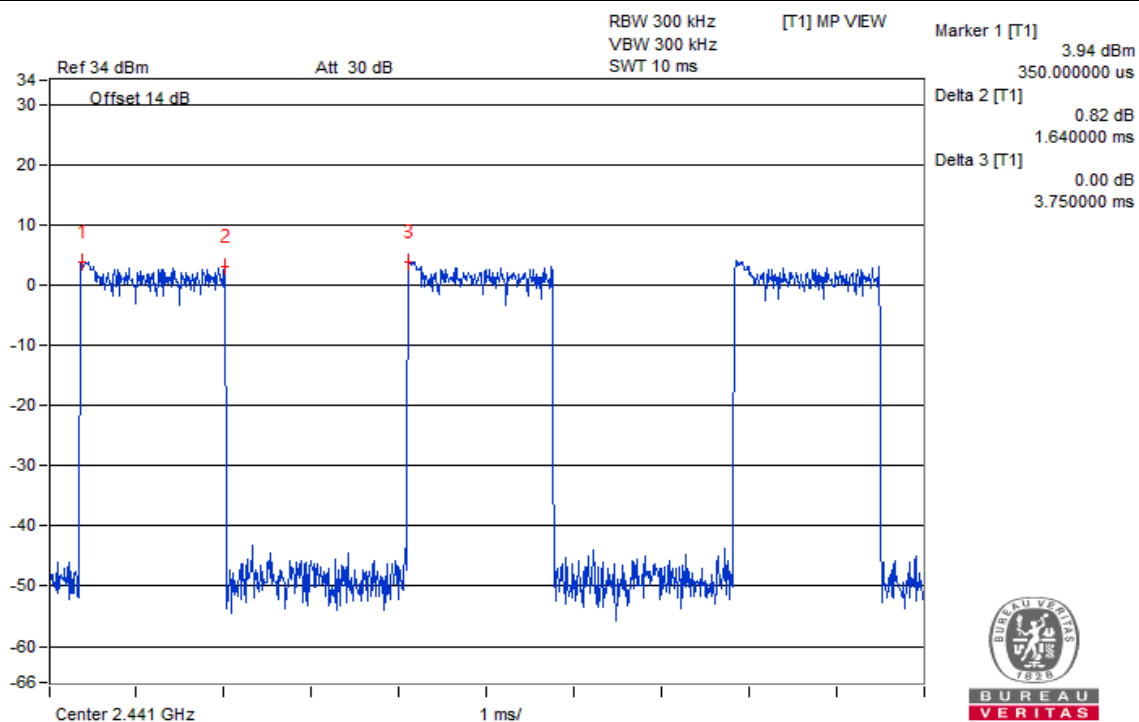


3DH5

V_{max}.

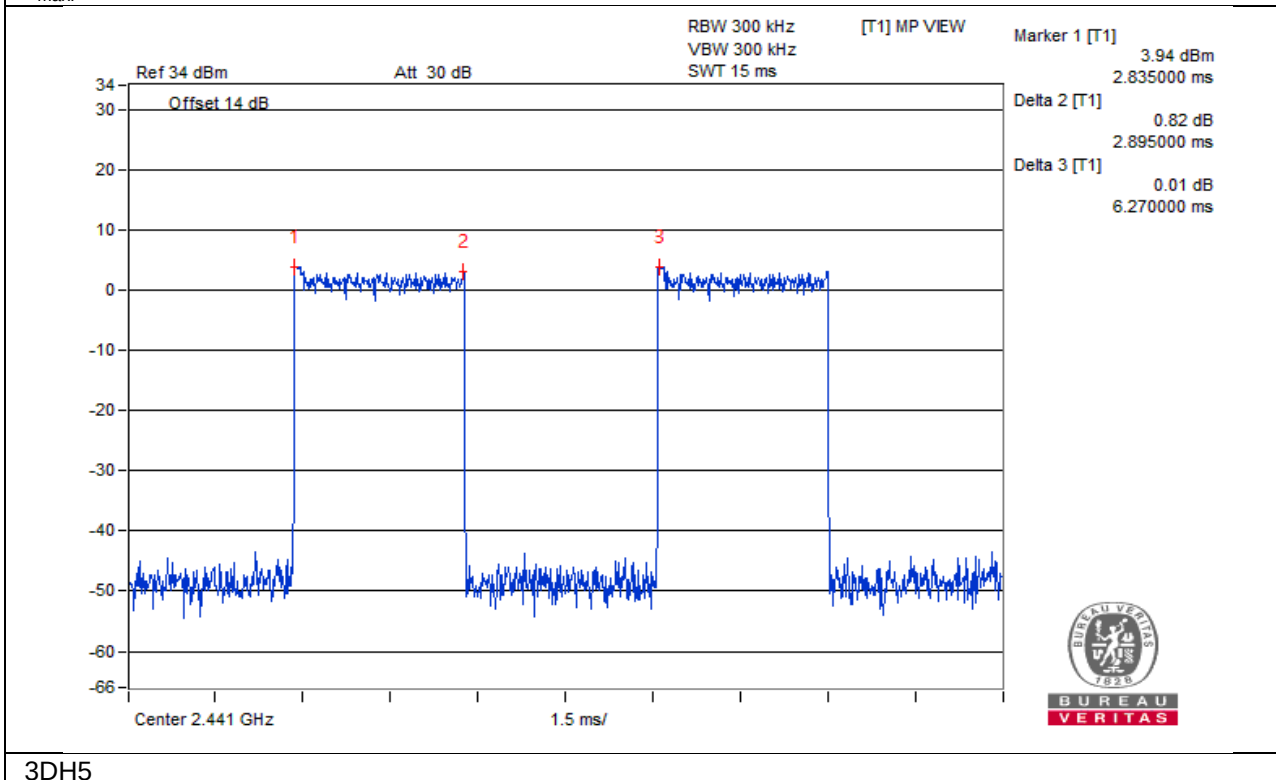


3DH1

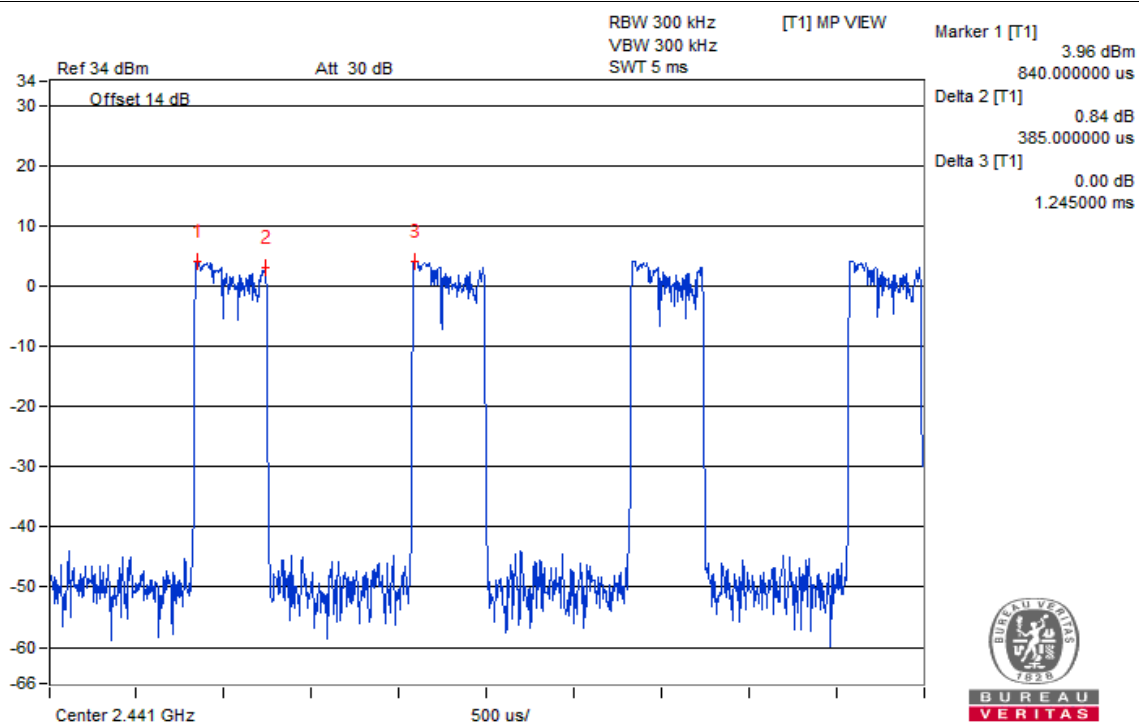


3DH3

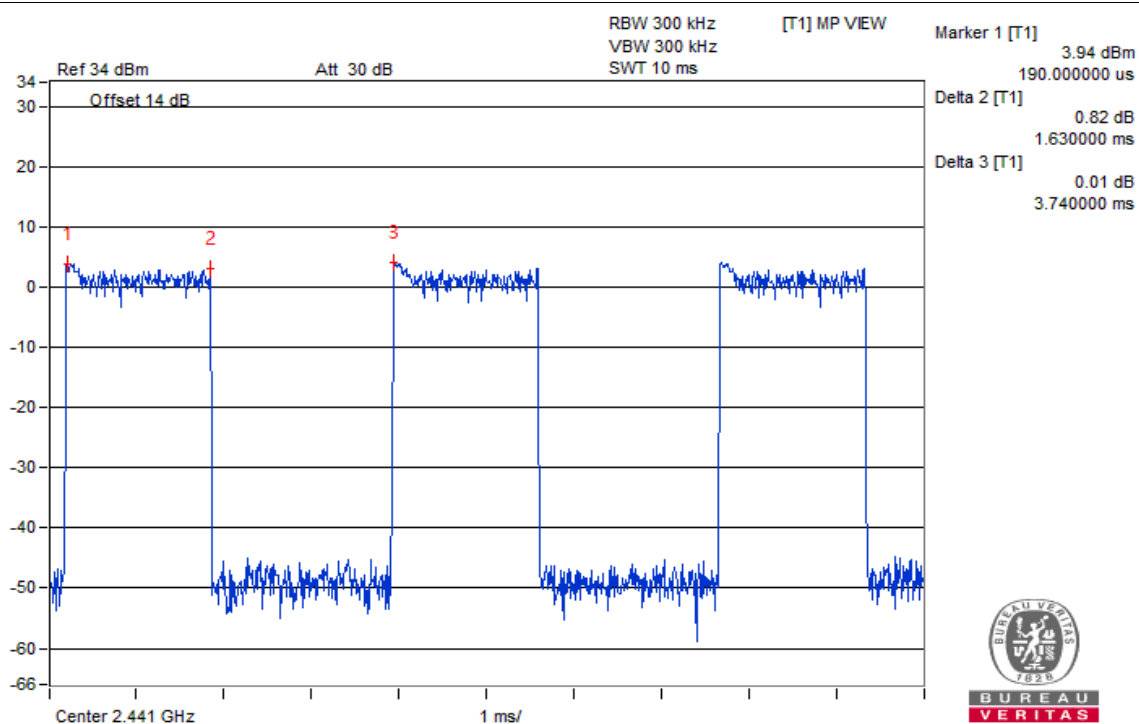
V_{max}.



V_{min}.

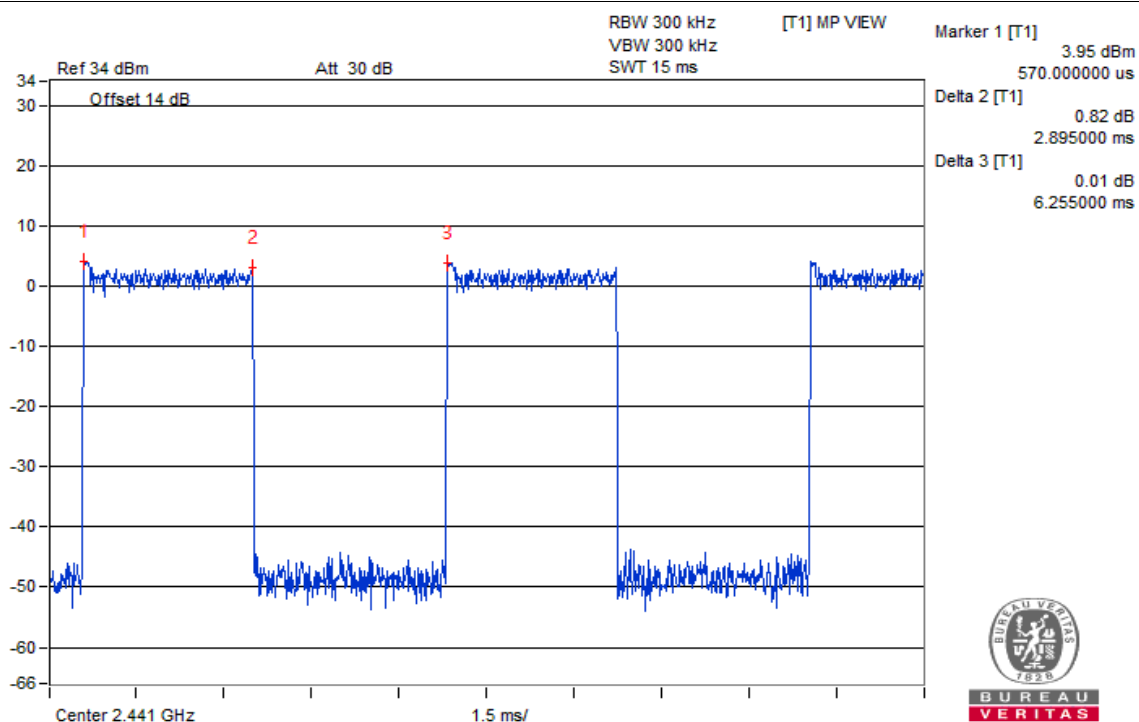


3DH1



3DH3

V_{min}.



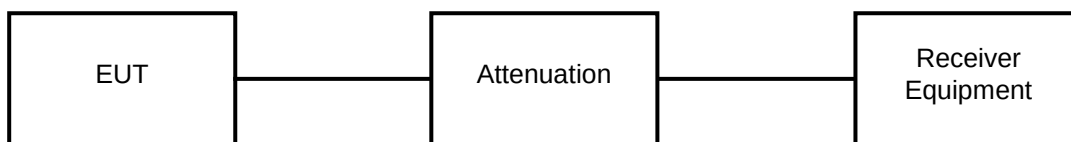
3DH5

4.8 Interference Prevention Function

4.8.1 Limits of Interference Prevention Function

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

4.8.2 Test Setup



4.8.3 Test Results

Environmental Conditions	25 deg.C, 68 % RH
Link Mode	Test Result
Bluetooth EDR	Pass

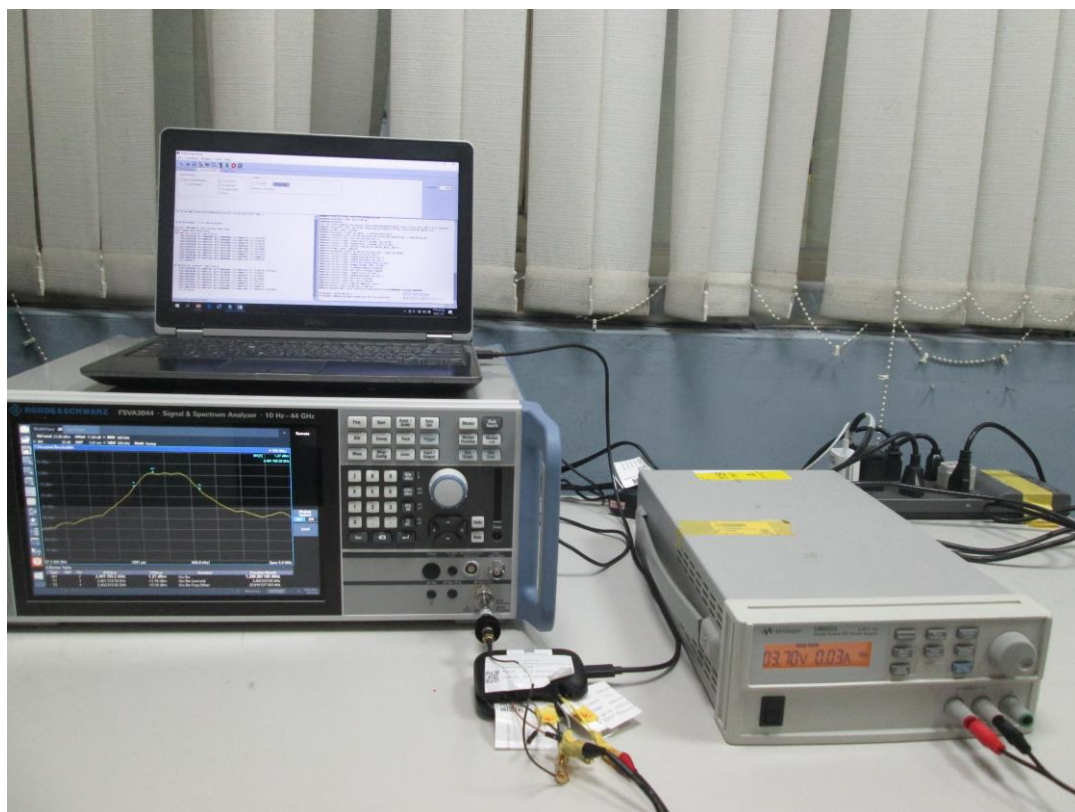
5 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration	Calibration Authority	Cal. Method
SPECTRUM ANALYZER / ROHDE & SCHWARZ	FSU43	101261	Apr. 16, 2020	Apr. 15, 2021	ETC	c)
SIGNAL GENERATOR / AGILENT	N5182B	MY53050430	Nov. 25, 2020	Nov. 24, 2021	ETC	c)
POWER METER / ANRITSU	ML2495A	1145013	Jun. 01, 2020	May 31, 2021	ETC	c)
POWER SENSOR / ANRITSU	MA2411B	1126085	Jun. 01, 2020	May 31, 2021	ETC	c)
2WAY DIV / WOKEN	2Way SMA Fwd.:30W/Rev.:2W Isolated Powe	COM412W5E3	Jan. 13, 2021	Jan. 12, 2022	BV CPS E&E	d)
BLUETOOTH TESTER / ROHDE & SCHWARZ	CBT	100980	Apr. 20, 2020	Apr. 19, 2021	ETC	c)
DC POWER SUPPLY / TWINTEX	TP-3305D	11T35D0801027	NA	NA	BV CPS E&E	d)
TRUE RMS CLAMP METER	325	31130711WS	Jun. 06, 2020	Jun. 05, 2021	ETC	c)

NOTE:

- The calibration interval of the above test instruments is 12/24 months and the calibrations are traceable to NML/ROC and NIST/USA.
- 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) ~ TELEC Engineering Center, Intertek Japan K.K., Keysight Technologies, Inc ~.
 - b) : Correction 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) ~ TELEC Engineering Center, Intertek Japan K.K., Keysight Technologies, Inc ~.
 - d) : Calibration conducted by using other equipment that listed above from a) to c)

6 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:

Lin Kou EMC/RF Lab

Tel: 886-2-26052180

Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab

Tel: 886-3-6668565

Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety Lab

Tel: 886-3-3183232

Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com

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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