

## Radio Test Report (BT-EDR)

**Report No.:** RJBCKS-WTW-P20120454A-2

**Test Model:** AL11

**Received Date:** 2021/8/19

**Test Date:** 2021/9/16

**Issued Date:** 2021/12/8

**Applicant:** LatticeWork, Inc.

**Address:** 2210 O'Toole Ave, Suite 250, San Jose. CA 95131

**Issued By:** Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch  
Hsin Chu Laboratory

**Lab Address:** E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300,  
Taiwan

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



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**Release Control Record**

Issue No.	Description	Date Issued
RJBCKS-WTW-P20120454A-2	Original release.	2021/12/8

## 1 Certificate of Conformity

**Product:** Amber X

**Brand:** Latticework

**Test Model:** AL11

**Sample Status:** Engineering sample

**Applicant:** LatticeWork, Inc.

**Test Date:** 2021/9/16

**Standards:** ARIB STD-T66 (V3.7), MIC notice 88 Appendix 43  
Certification Ordinance Article 2-1-19

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

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

**Approved by :** Clark Lin , **Date:** 2021/12/8  
Clark Lin / Technical Manager

## 2 Summary of Test Results

The EUT has been tested according to the following specifications:

Notice 88 Appendix 43 Reference	ARIB STD-T66 Ref.	Report Reference	Parameter	Test Results (Note)
<b>General Provisions</b>				
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
<b>Transmitting Equipment</b>				
F	--	4.5	Antenna power	C
--	--	--	SAR	NA
<b>Transmitting Antenna</b>				
--	--	3.5	Type, configuration, etc. of transmitting antenna	C
--	--	3.5	Direction pattern of transmitting antenna	C
<b>Receiving Equipment</b>				
G	3.3 (1)	4.6	Spurious emissions of receiver	C
--	--	3.5	Refer to all articles for transmitting antenna	C
<b>Operating Frequency 2400 to 2483.5MHz</b>				
--	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)	--	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)	4.7	Frequency retention time (FH employed)	C
--	3.4.1 (1)	4.8	Interference Prevention Function	C
--	3.4.1 (3)	--	Carrier Sense Capability	NA
Note: 1. C = Conform NC = Not Conform NT = Not Tested NA = Not Applicable 2. Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.				

## 2.1 Test Instruments

Description & Manufacturer	Model no.	Serial No.	Calibrated Date	Calibrated Until	Calibration Authority	Calibration Method
Spectrum Analyzer R&S	FSV40	101516	2021/3/8	2022/3/7	ETC	(c)
ESG Vector signal generator Agilent	E4438C	MY45094468/005 506 602 UK6 UNJ	2020/11/18	2021/11/17	ETC	(c)
Power Meter Anritsu	ML2495A	1529002	2021/6/21	2022/6/20	ETC	(c)
Pulse Power Sensor Anritsu	MA2411B	1339443	2021/5/31	2022/5/30	ETC	(c)
DC POWER SUPPLY Topward	6603D	795558	Note 3	Note 3	BV	(d)
AC Power Source GOOD WILL	6905S	1991551	Note 3	Note 3	BV	(d)
True RMS Clamp Meter Fluke	325	31130711WS	2021/6/2	2022/6/1	ETC	(c)

- Note:**
1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
  2. Calibration method :
    - a) : Calibration conducted by the National Institute of Information and Communications Technology (NICT) or a designated calibration agency under Article 102-18 paragraph (1).
    - b) : Calibration conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Law (Law No. 51 of 1992) Japan Calibration Service System.
    - c) : Calibration conducted in foreign countries, which shall be equivalent to the calibration conducted by the NICT or a designated calibration agency under Article 102-18 paragraph (1).
    - d) : Calibration conducted by using other equipment that listed above from a) to c).
  3. The power supply no evaluation calibrated, which used the digital multimeter to verify before each testing.
  4. Tested Date: 2021/9/16

## 2.2 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in TR 100 028-1.

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ .

Parameter	Uncertainty
Occupied Bandwidth	$\pm 960$ Hz
Spurious emissions	$\pm 2.5$ dB
Output power density	$\pm 1.2$ dB
Out of band radiated power	$\pm 2.5$ dB
Frequency Tolerance	$\pm 960$ Hz

## 2.3 Modification Record

There were no modifications required for compliance.

### 3 General Information

#### 3.1 General Description of EUT (BT-EDR)

Product	Amber X
Brand	Latticework
Test Model	AL11
Status of EUT	Engineering sample
Nominal Voltage	12Vdc from power adapter
Modulation Type	GFSK, $\pi/4$ -DQPSK, 8DPSK
Modulation Technology	FHSS
Transfer Rate	Up to 3 Mbps
Operating Frequency	2.402 ~ 2.480 GHz
Number of Channel	79
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	Adapter x1
Data Cable Supplied	NA

Note:

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

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

4. The power table as below table:

	Rated output power density (mW/MHz)	Conducted RF output power density (mW/MHz)	Radiated RF output power density (mW/MHz)
<b>Normal mode</b>			
<b>GFSK</b>	0.2	0.188591	0.393116
<b><math>\pi/4</math>-DQPSK</b>	0.2	0.192	0.400222
<b>8DPSK</b>	0.2	0.189898	0.395841
<b>Enable AFH function</b>			
<b>GFSK</b>	1	0.741042	1.544695
<b><math>\pi/4</math>-DQPSK</b>	1	0.750756	1.564944
<b>8DPSK</b>	1	0.74659	1.55626

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

79 channels are provided for BT-EDR mode:

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
<b>0</b>	<b>2402</b>	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	<b>78</b>	<b>2480</b>
19	2421	<b>39</b>	<b>2441</b>	59	2461		

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.

**NOTE 1:** By means of test software (HyperTerminal paste Amber Lite BT SOP.doc command) provided by manufacturer, the power levels during the tests were set according to the following codes:

Modulation type: GFSK		Modulation type: $\pi/4$ -DQPSK		Modulation type: 8DPSK	
Channel	Power setting	Channel	Power setting	Channel	Power setting
0	0x0C	0	0x0C	0	0x0C
39	0x0C	39	0x0C	39	0x0C
78	0x0C	78	0x0C	78	0x0C

**NOTE 2:** The EUT was tested under following test modes, and the test data was recorded in this report:

Normal mode	Enable AFH function
GFSK	GFSK
$\pi/4$ -DQPSK	$\pi/4$ -DQPSK
8DPSK	8DPSK

\* For AFH function only tested occupied bandwidth, spreading bandwidth, Antenna power and dwell time.

### 3.3 Test Conditions

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

Test mode is presented in the report as below:

Test Item	Environmental Conditions
Frequency Tolerance	25 deg.C, 60 % RH
Occupied Bandwidth / Spreading Bandwidth	25 deg.C, 60 % RH
Spurious Emissions for Transmitter	25 deg.C, 60 % RH
Antenna Power	25 deg.C, 60 % RH
Spurious Emissions for Receiver	25 deg.C, 60 % RH
Dwell Time	25 deg.C, 60 % RH

### 3.4 Assembly

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

### 3.5 Antenna Specifications

#### 3.5.1 Antenna Gain

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

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

#### 3.5.2 Antenna Pattern

Please refer to the attached file (Antenna pattern).

## 4 Test Results

### 4.1 Frequency Tolerance Measurement

#### 4.1.1 Limits of Frequency Tolerance Measurement

Tolerance of frequency shall be +/- 50ppm

#### 4.1.2 Test Setup



#### 4.1.3 Test Results

Modulation: GFSK

Channel	Frequency (MHz)	V <sub>normal</sub>		V <sub>max.</sub>		V <sub>min.</sub>	
		Carrier frequency (MHz)	Frequency tolerance (ppm)	Carrier frequency (MHz)	Frequency tolerance (ppm)	Carrier frequency (MHz)	Frequency tolerance (ppm)
0	2402	2401.989091	-4.541	2401.988996	-4.581	2401.988827	-4.651
39	2441	2440.988793	-4.591	2440.988450	-4.731	2440.988652	-4.648
78	2480	2479.988362	-4.692	2479.988421	-4.668	2479.988247	-4.739

## 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

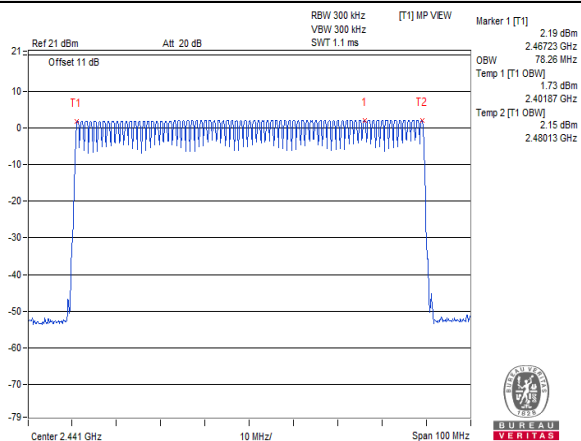
Modulation: GFSK

Normal Mode:

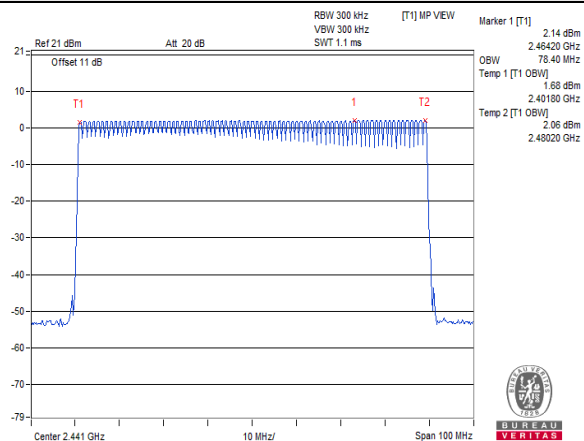
$V_{\text{normal}}$	$V_{\text{max.}}$	$V_{\text{min.}}$
Occupied bandwidth (MHz)	Occupied bandwidth (MHz)	Occupied bandwidth (MHz)
78.26	78.40	78.26

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

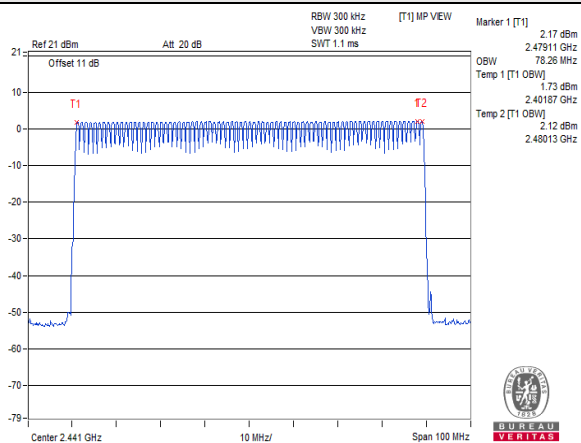
## V<sub>normal</sub>



## V<sub>max.</sub>



## V<sub>min.</sub>

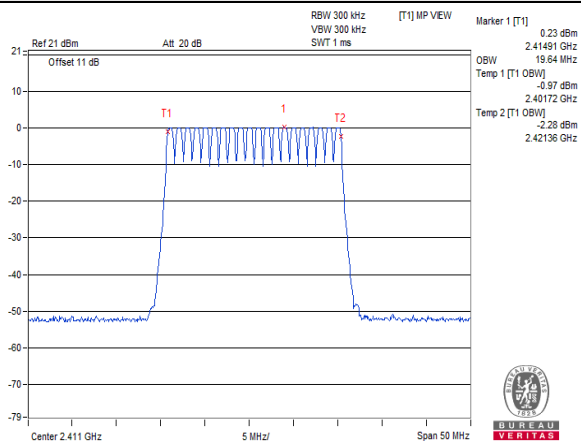


**AFH Mode:**

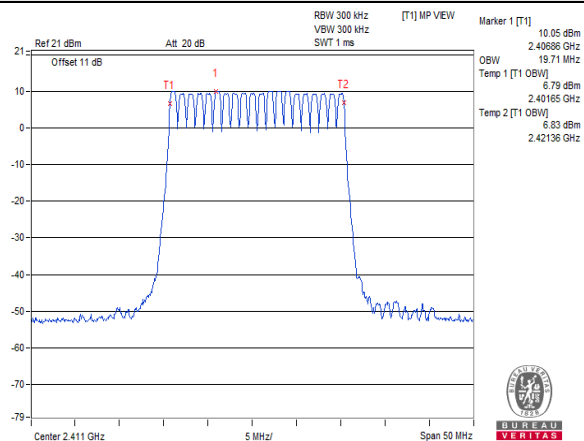
$V_{\text{normal}}$	$V_{\text{max.}}$	$V_{\text{min.}}$
Occupied bandwidth (MHz)	Occupied bandwidth (MHz)	Occupied bandwidth (MHz)
19.64	19.71	19.64

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

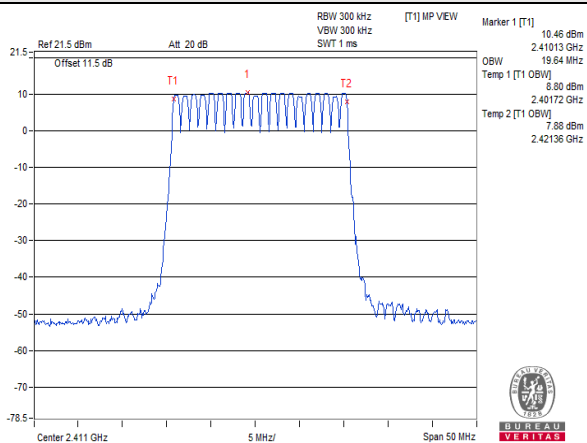
## V<sub>normal</sub>



## V<sub>max.</sub>



## V<sub>min.</sub>

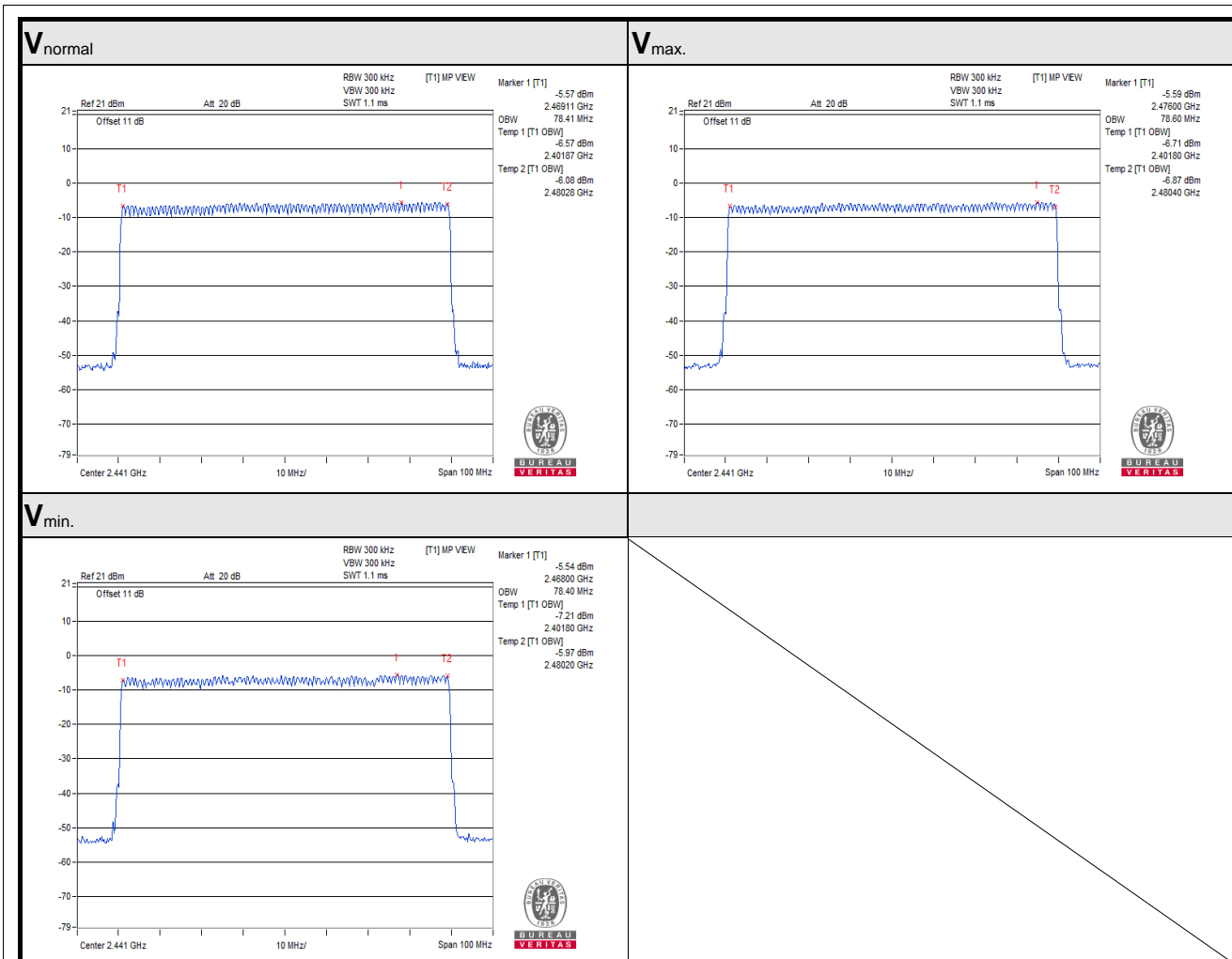


**Modulation:**  $\pi/4$ -DQPSK

**Normal Mode:**

$V_{\text{normal}}$	$V_{\text{max.}}$	$V_{\text{min.}}$
Occupied bandwidth (MHz)	Occupied bandwidth (MHz)	Occupied bandwidth (MHz)
78.41	78.60	78.40

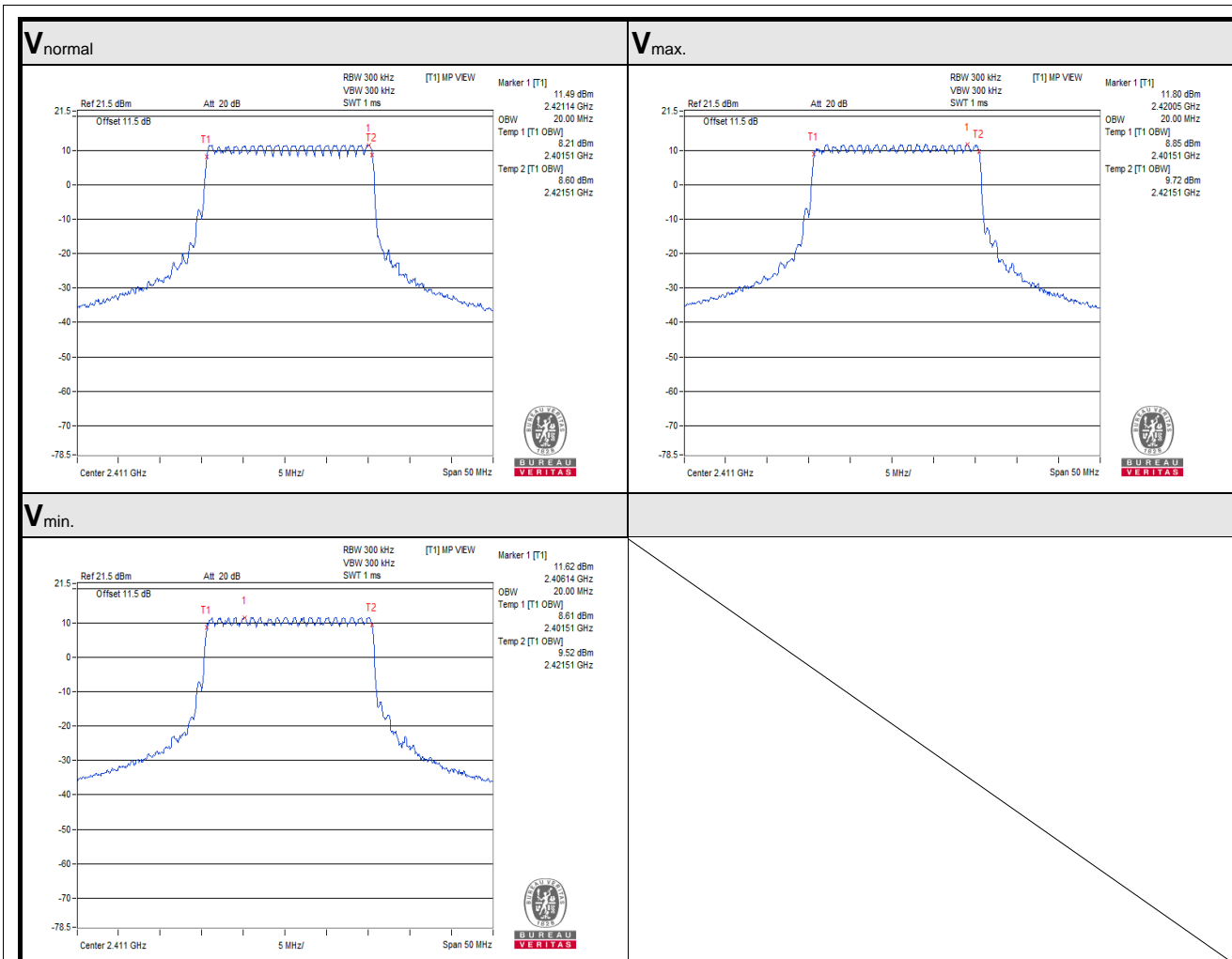
**NOTE:** For the test plots please refer to the below pages.



**AFH Mode:**

$V_{\text{normal}}$	$V_{\text{max.}}$	$V_{\text{min.}}$
Occupied bandwidth (MHz)	Occupied bandwidth (MHz)	Occupied bandwidth (MHz)
20.00	20.00	20.00

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



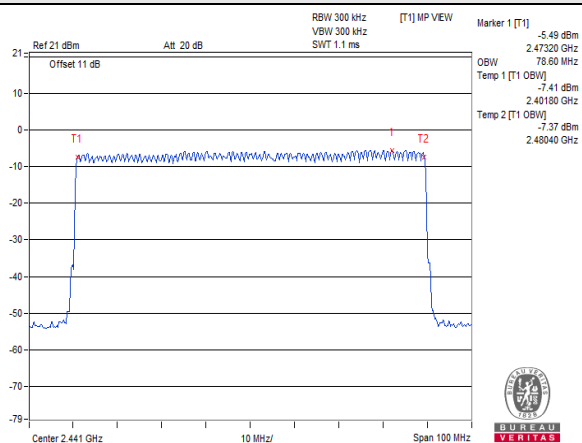
**Modulation: 8DPSK**

**Normal Mode:**

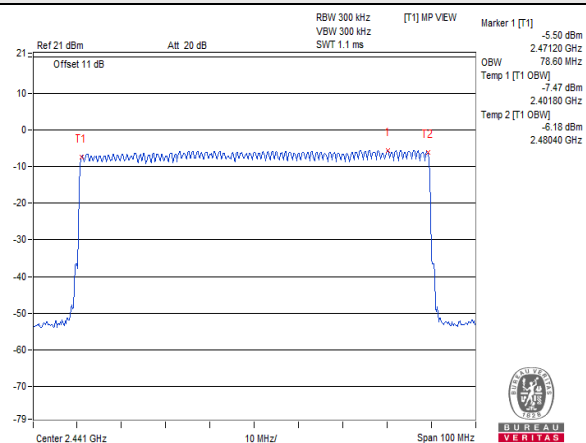
$V_{\text{normal}}$	$V_{\text{max.}}$	$V_{\text{min.}}$
Occupied bandwidth (MHz)	Occupied bandwidth (MHz)	Occupied bandwidth (MHz)
78.60	78.60	78.60

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

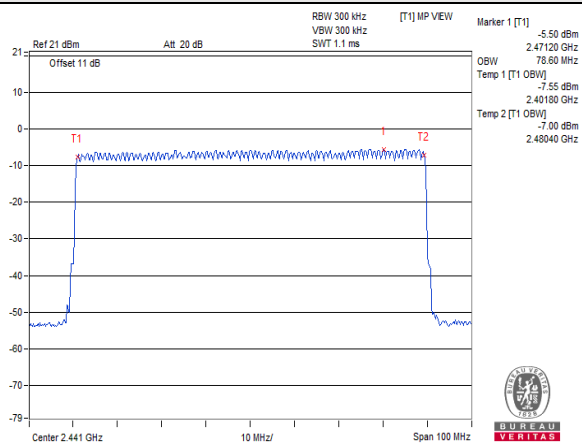
## V<sub>normal</sub>



## V<sub>max.</sub>



## V<sub>min.</sub>

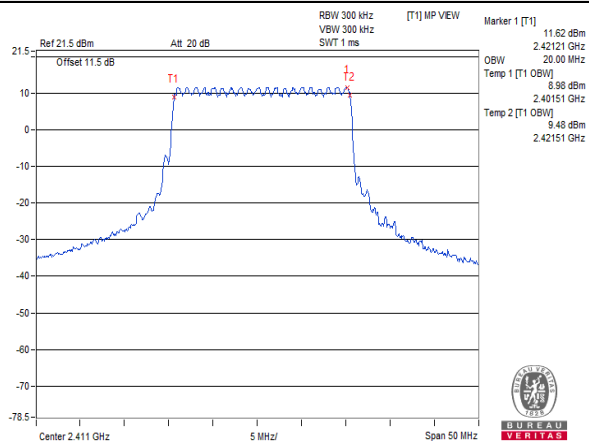


**AFH Mode:**

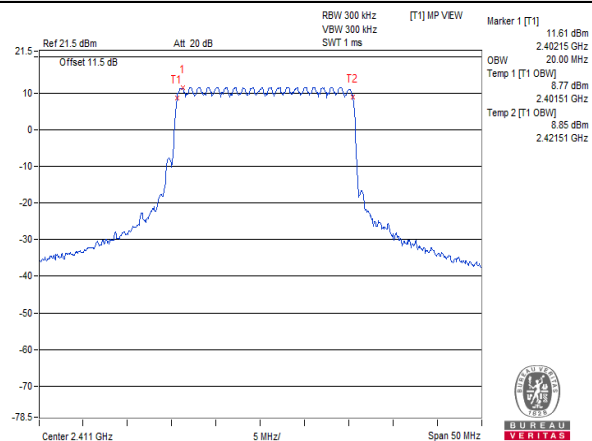
$V_{\text{normal}}$	$V_{\text{max.}}$	$V_{\text{min.}}$
Occupied bandwidth (MHz)	Occupied bandwidth (MHz)	Occupied bandwidth (MHz)
20.00	20.00	20.00

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

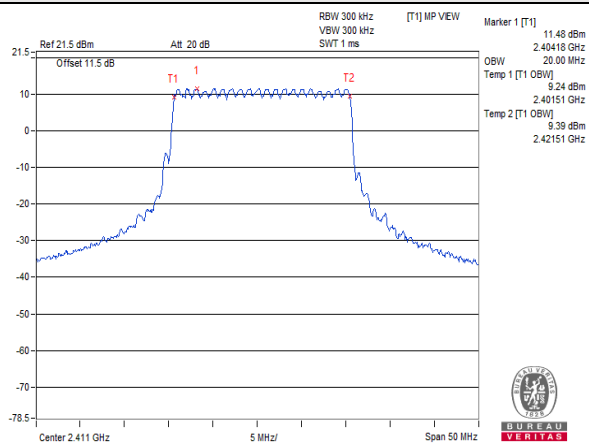
## V<sub>normal</sub>



## V<sub>max.</sub>



## V<sub>min.</sub>



### 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	$\geq 5$	Operating frequency 2400 to 2483.5MHz

#### 4.3.2 Test Setup



#### 4.3.3 Test Results

Modulation: GFSK

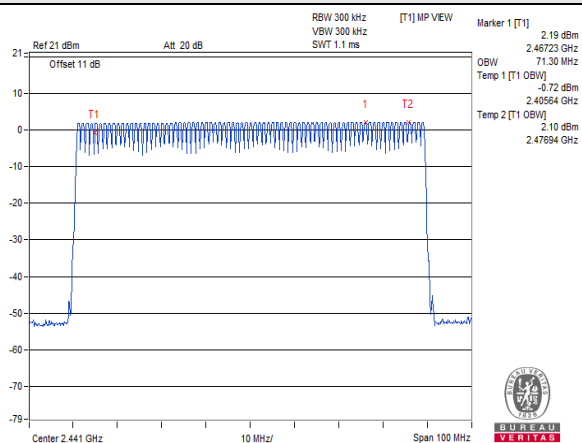
Normal Mode:

$V_{\text{normal}}$		$V_{\text{max.}}$		$V_{\text{min.}}$	
Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor
71.30	71.30	71.20	71.20	71.30	71.30

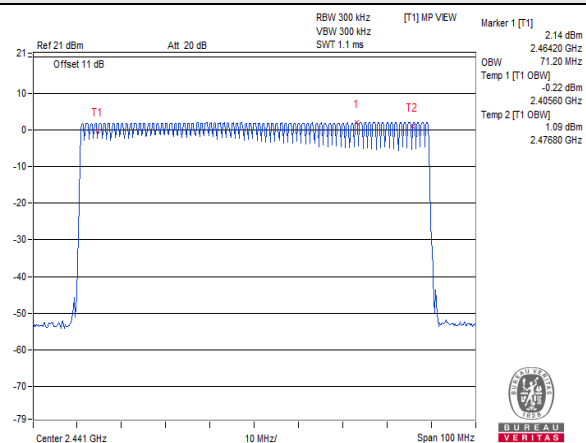
**NOTE:** For the test plots please refer to the below pages.

Spreading Factor: 90% channel power bandwidth / 1

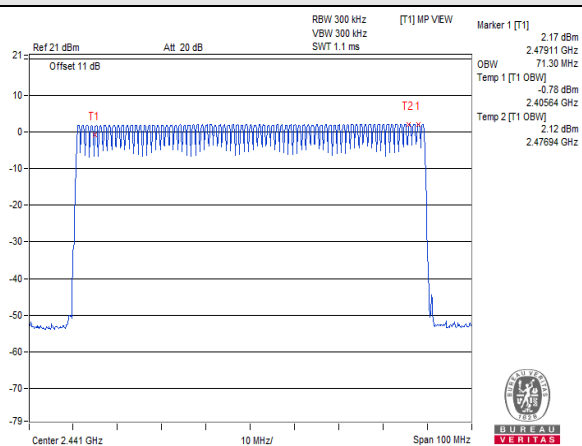
## V<sub>normal</sub>



## V<sub>max.</sub>



## V<sub>min.</sub>



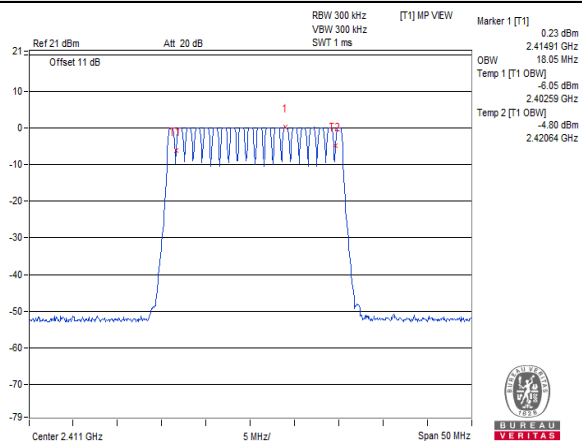
**AFH Mode:**

<b>V<sub>normal</sub></b>		<b>V<sub>max.</sub></b>		<b>V<sub>min.</sub></b>	
Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor
18.05	18.05	18.12	18.12	18.04	18.04

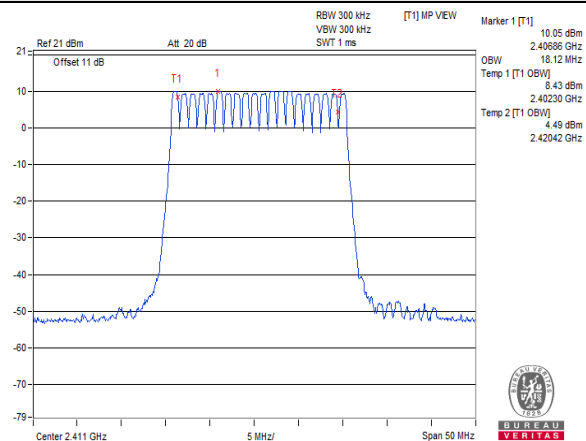
**NOTE:** For the test plots please refer to the below pages.

Spreading Factor: 90% channel power bandwidth / 1

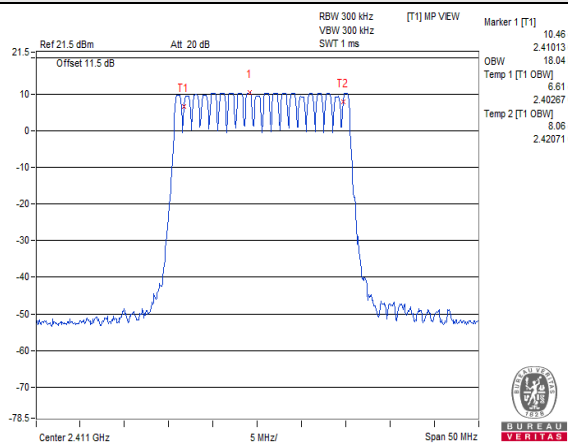
## V<sub>normal</sub>



## V<sub>max.</sub>



## V<sub>min.</sub>



**Modulation:**  $\pi/4$ -DQPSK

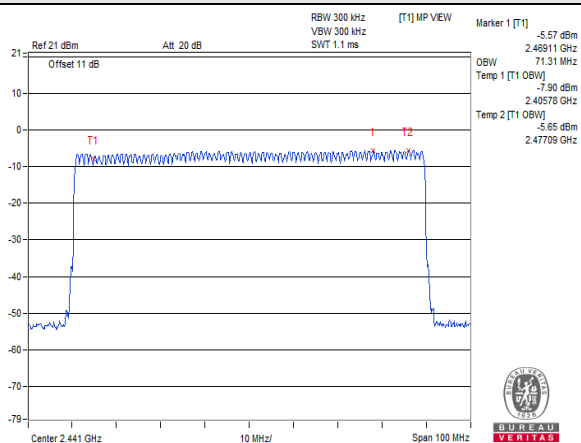
**Normal Mode:**

$V_{\text{normal}}$		$V_{\text{max.}}$		$V_{\text{min.}}$	
Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor
71.31	71.31	71.40	71.40	71.40	71.40

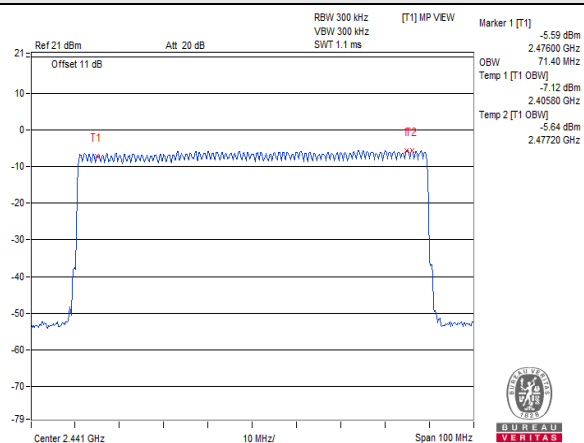
**NOTE:** For the test plots please refer to the below pages.

Spreading Factor: 90% channel power bandwidth / 1

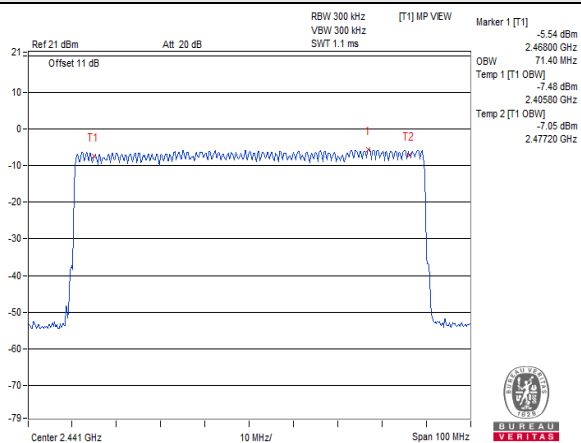
## V<sub>normal</sub>



## V<sub>max.</sub>



## V<sub>min.</sub>



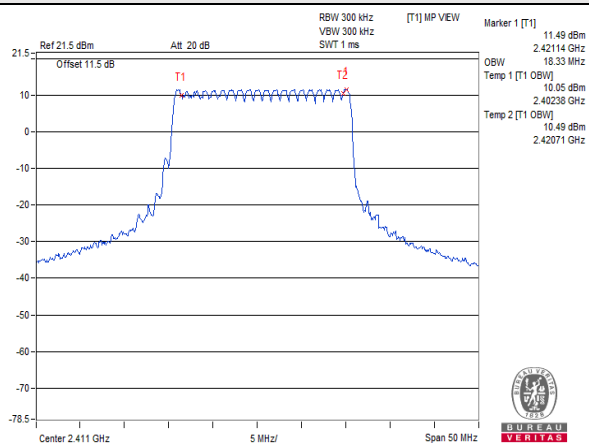
#### AFH Mode:

$V_{\text{normal}}$		$V_{\text{max.}}$		$V_{\text{min.}}$	
Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor
18.33	18.33	18.05	18.05	18.26	18.26

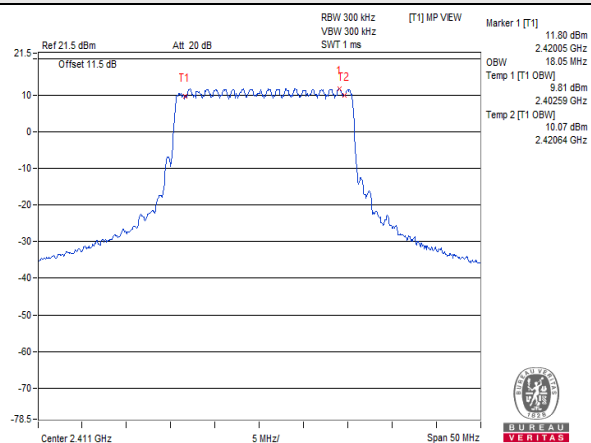
**NOTE:** For the test plots please refer to the below pages.

Spreading Factor: 90% channel power bandwidth / 1

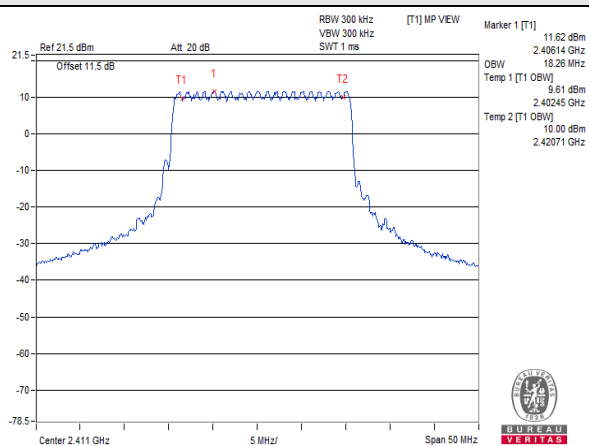
## V<sub>normal</sub>



## V<sub>max.</sub>



## V<sub>min.</sub>



**Modulation: 8DPSK**

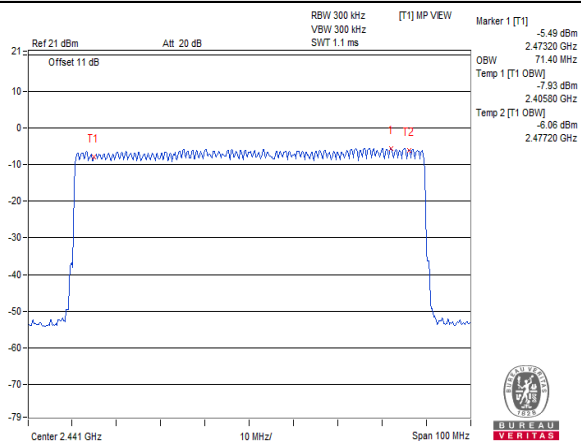
**Normal Mode:**

<b>V<sub>normal</sub></b>		<b>V<sub>max.</sub></b>		<b>V<sub>min.</sub></b>	
Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor
71.40	71.40	71.20	71.20	71.00	71.00

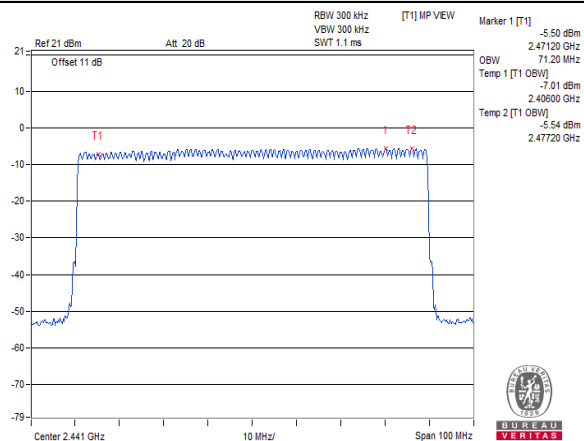
**NOTE:** For the test plots please refer to the below pages.

Spreading Factor: 90% channel power bandwidth / 1

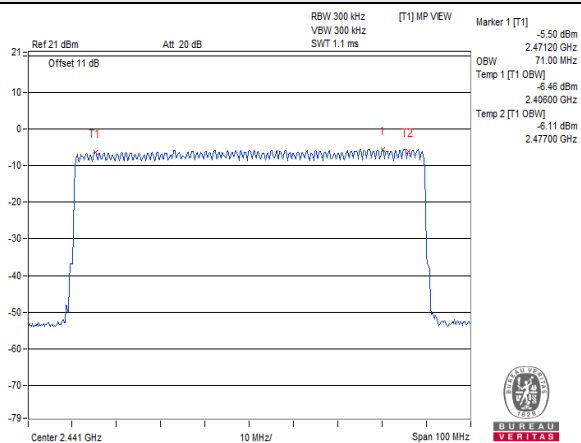
## V<sub>normal</sub>



## V<sub>max.</sub>



## V<sub>min.</sub>

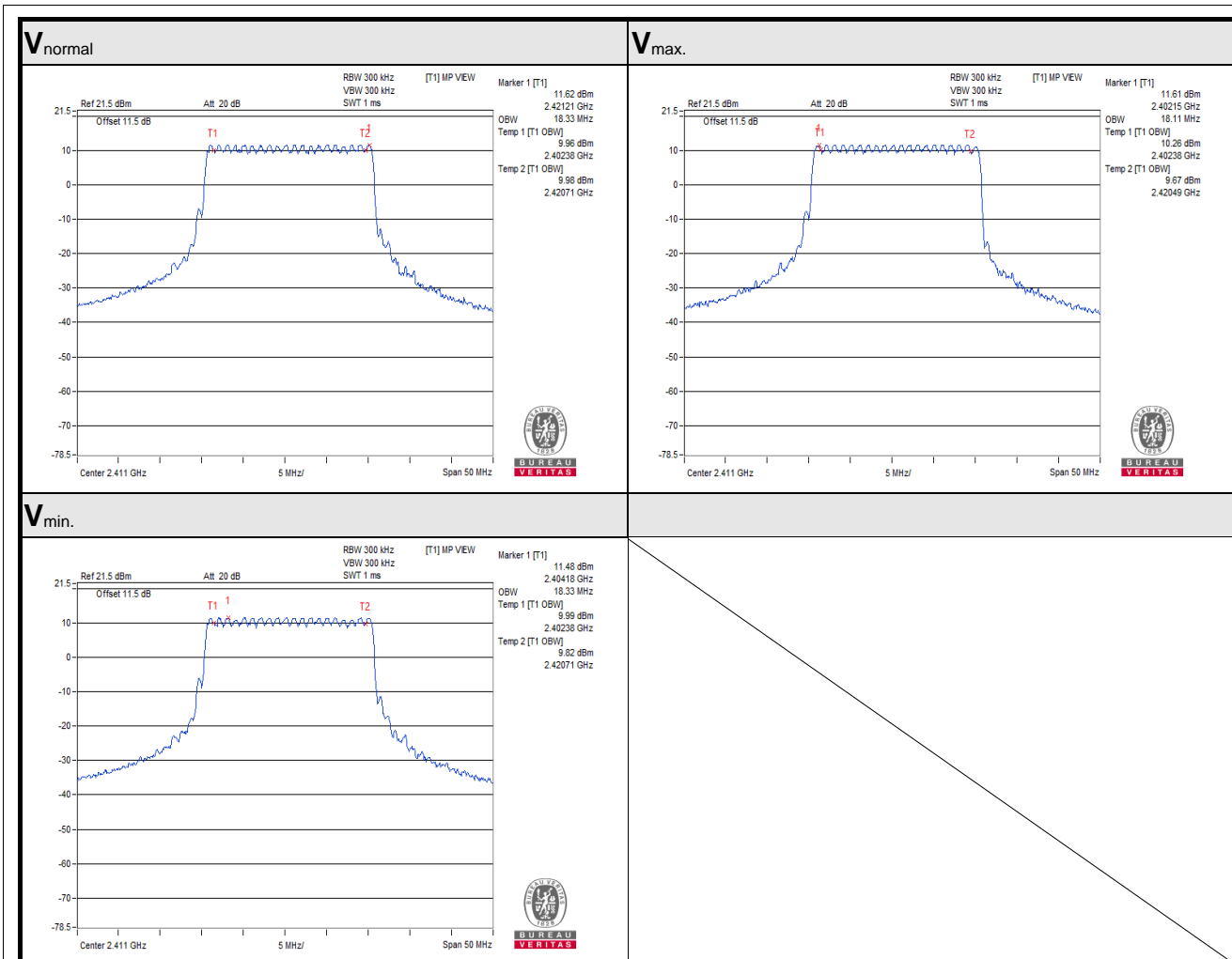


#### AFH Mode:

$V_{\text{normal}}$		$V_{\text{max.}}$		$V_{\text{min.}}$	
Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor	Occupied bandwidth (MHz)	Spreading factor
18.33	18.33	18.11	18.11	18.33	18.33

**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 2483.5MHz	
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	$\leq 2.5 \text{ uW/MHz}$

##### 4.4.2 Test Setup



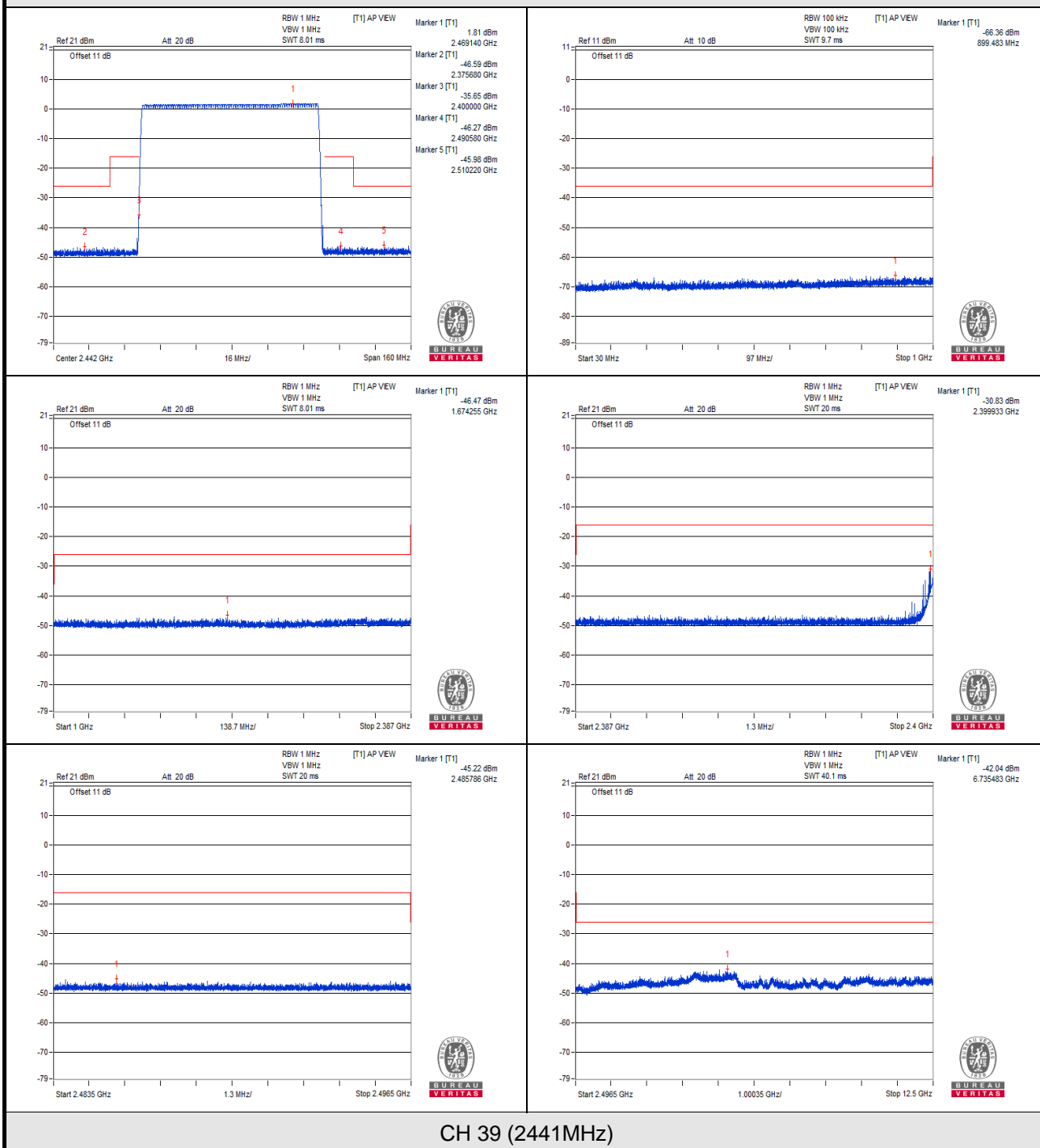
#### 4.4.3 Test Results

Modulation: GFSK

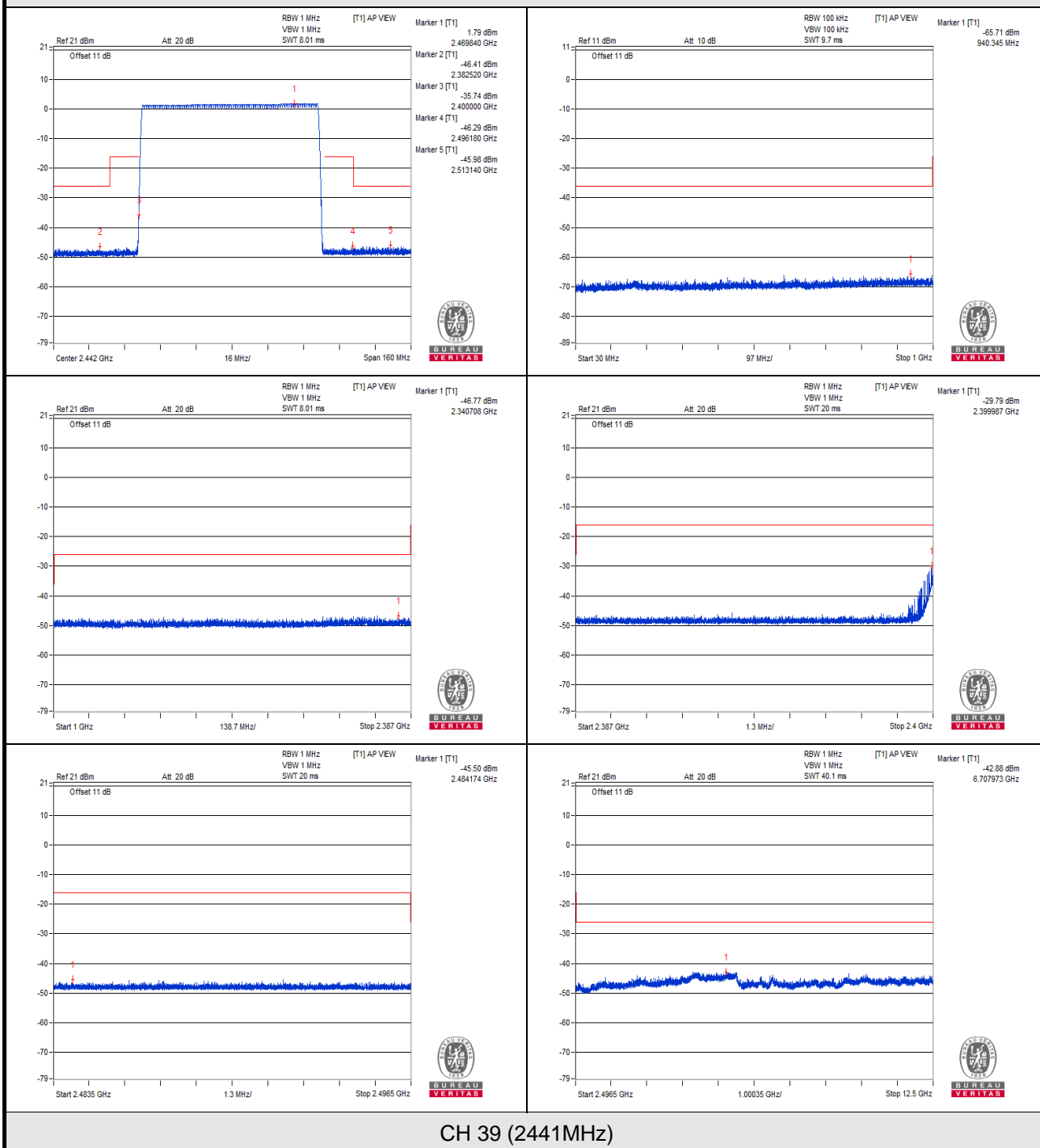
TEST CHANNEL		CH 39 (2441MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE(uW)	LIMIT (uW)	RESULT
<b>V<sub>normal</sub></b>	30MHz to 1000MHz	899.483	0.000231	0.25	PASS
	1000MHz to 2387MHz	1674.255	0.022542	2.5	PASS
	2387MHz to 2400MHz	2399.933	0.826038	25	PASS
	2483.5MHz to 2496.5MHz	2485.786	0.030061	25	PASS
	2496.5MHz to 12500MHz	6735.483	0.062517	2.5	PASS
<b>V<sub>max.</sub></b>	30MHz to 1000MHz	940.345	0.000269	0.25	PASS
	1000MHz to 2387MHz	2340.708	0.021038	2.5	PASS
	2387MHz to 2400MHz	2399.987	1.049542	25	PASS
	2483.5MHz to 2496.5MHz	2484.174	0.028184	25	PASS
	2496.5MHz to 12500MHz	6707.973	0.051523	2.5	PASS
<b>V<sub>min.</sub></b>	30MHz to 1000MHz	903.606	0.000267	0.25	PASS
	1000MHz to 2387MHz	1533.128	0.019187	2.5	PASS
	2387MHz to 2400MHz	2399.969	1.013911	25	PASS
	2483.5MHz to 2496.5MHz	2487.416	0.027290	25	PASS
	2496.5MHz to 12500MHz	5845.171	0.056234	2.5	PASS

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

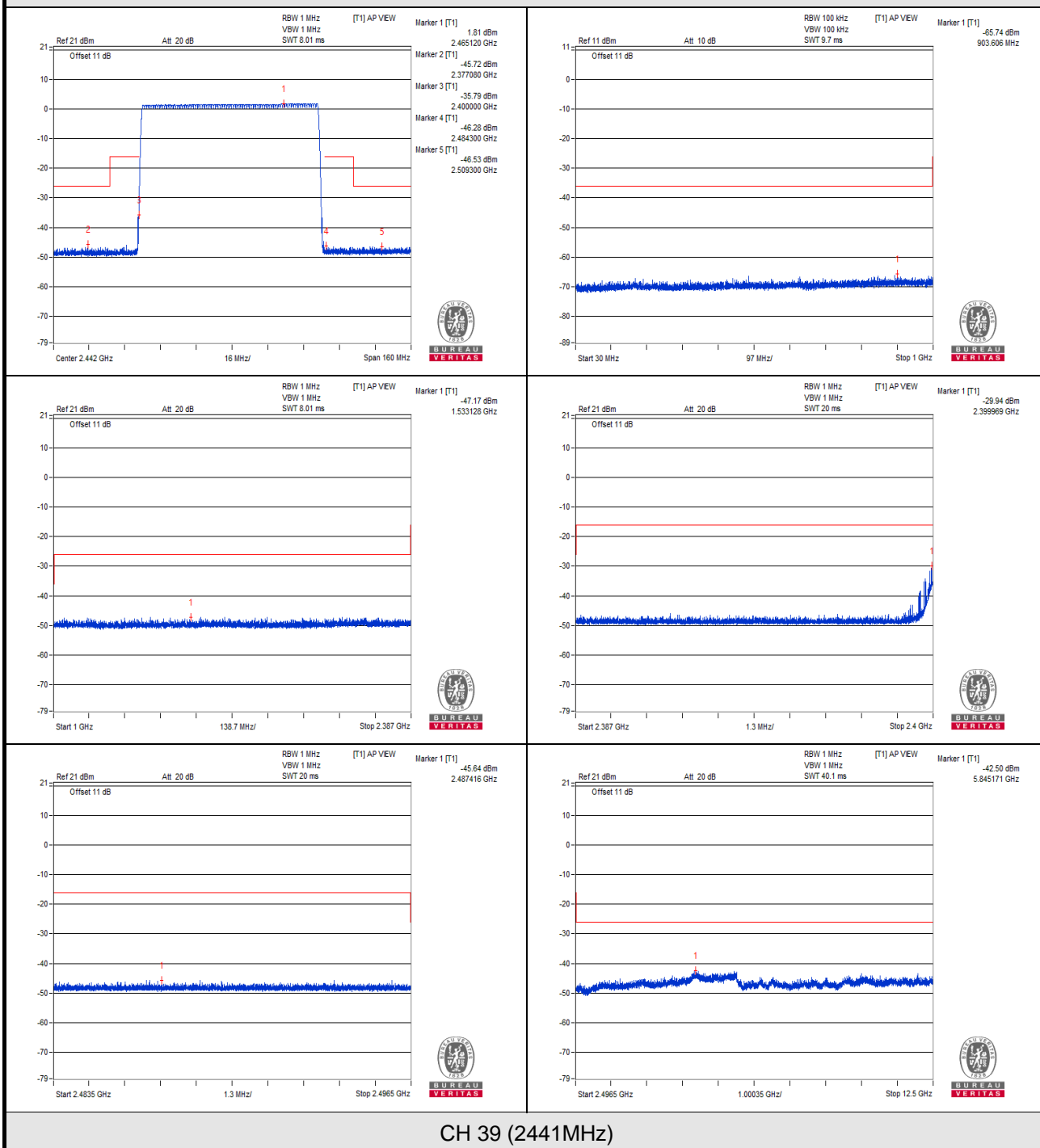
# Vnormal



V<sub>max</sub>.



V<sub>min</sub>.

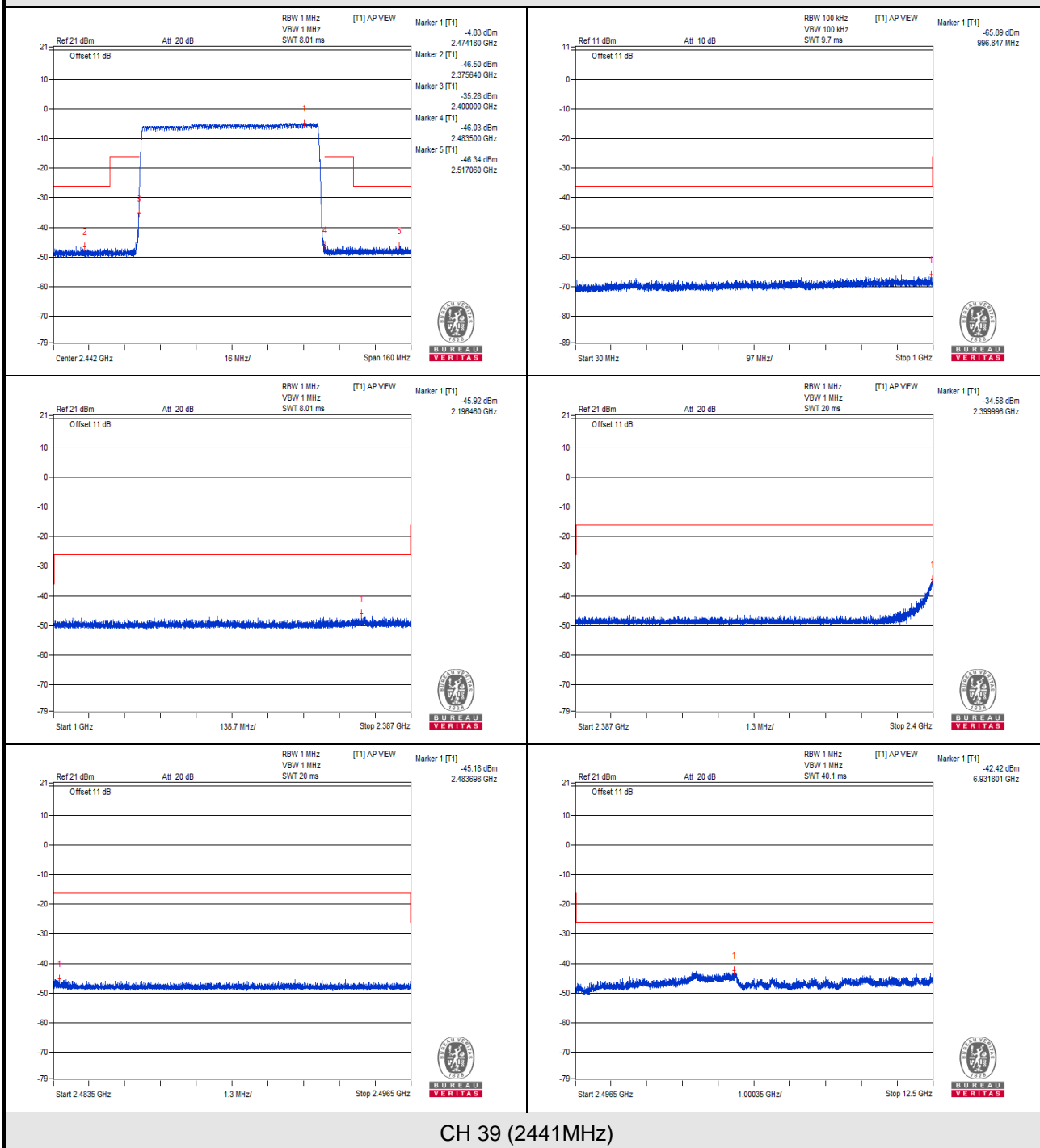


Modulation:  $\pi/4$ -DQPSK

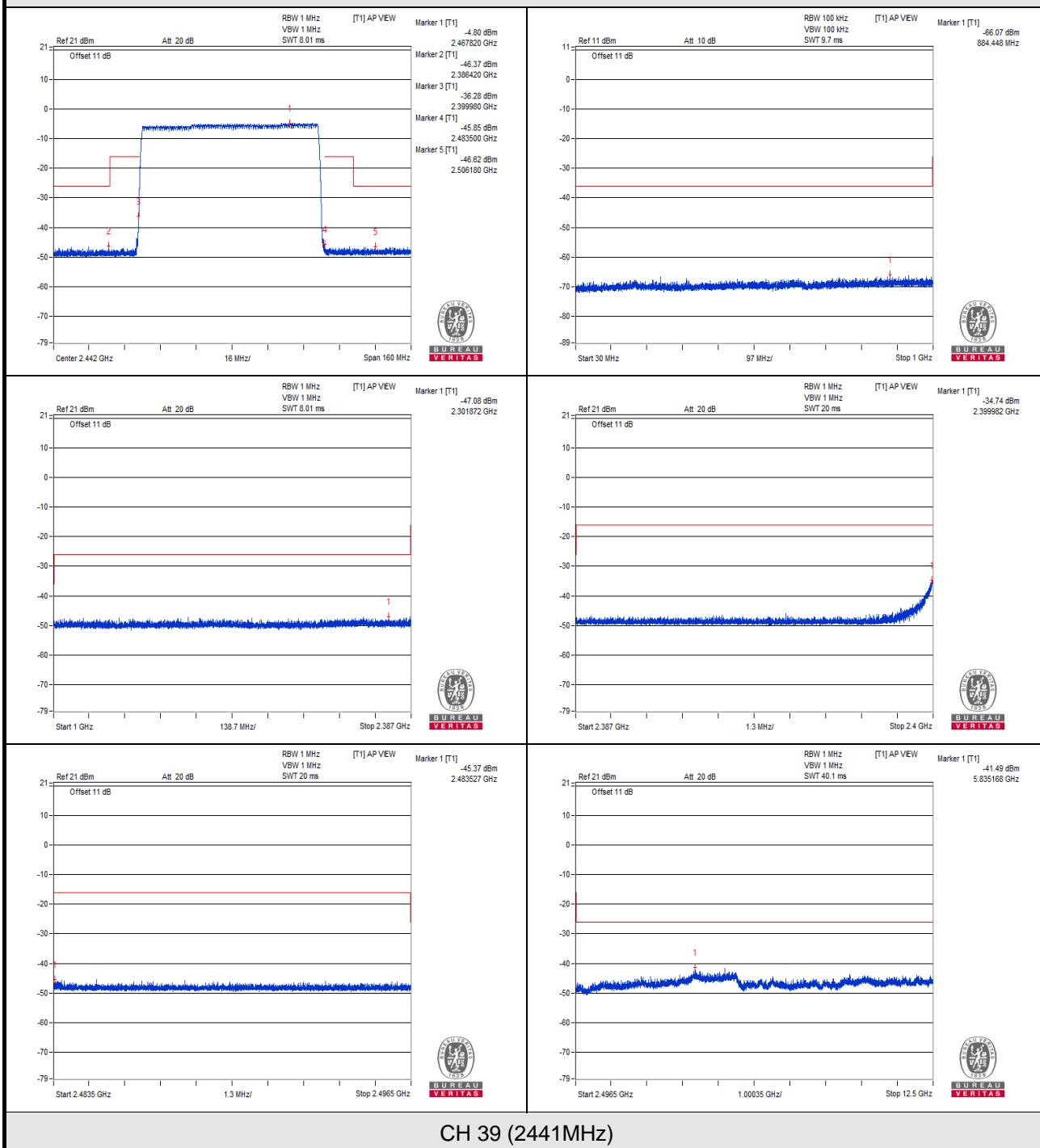
TEST CHANNEL		CH 39 (2441MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE( $\mu$ W)	LIMIT ( $\mu$ W)	RESULT
<b>V<sub>normal</sub></b>	30MHz to 1000MHz	996.847	0.000258	0.25	PASS
	1000MHz to 2387MHz	2196.460	0.025586	2.5	PASS
	2387MHz to 2400MHz	2399.996	0.348337	25	PASS
	2483.5MHz to 2496.5MHz	2483.698	0.030339	25	PASS
	2496.5MHz to 12500MHz	6931.801	0.057280	2.5	PASS
<b>V<sub>max.</sub></b>	30MHz to 1000MHz	884.448	0.000247	0.25	PASS
	1000MHz to 2387MHz	2301.872	0.019588	2.5	PASS
	2387MHz to 2400MHz	2399.982	0.335738	25	PASS
	2483.5MHz to 2496.5MHz	2483.527	0.029040	25	PASS
	2496.5MHz to 12500MHz	5835.168	0.070958	2.5	PASS
<b>V<sub>min.</sub></b>	30MHz to 1000MHz	924.946	0.000271	0.25	PASS
	1000MHz to 2387MHz	2259.049	0.021878	2.5	PASS
	2387MHz to 2400MHz	2400.000	0.328095	25	PASS
	2483.5MHz to 2496.5MHz	2483.503	0.028379	25	PASS
	2496.5MHz to 12500MHz	5906.443	0.057544	2.5	PASS

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

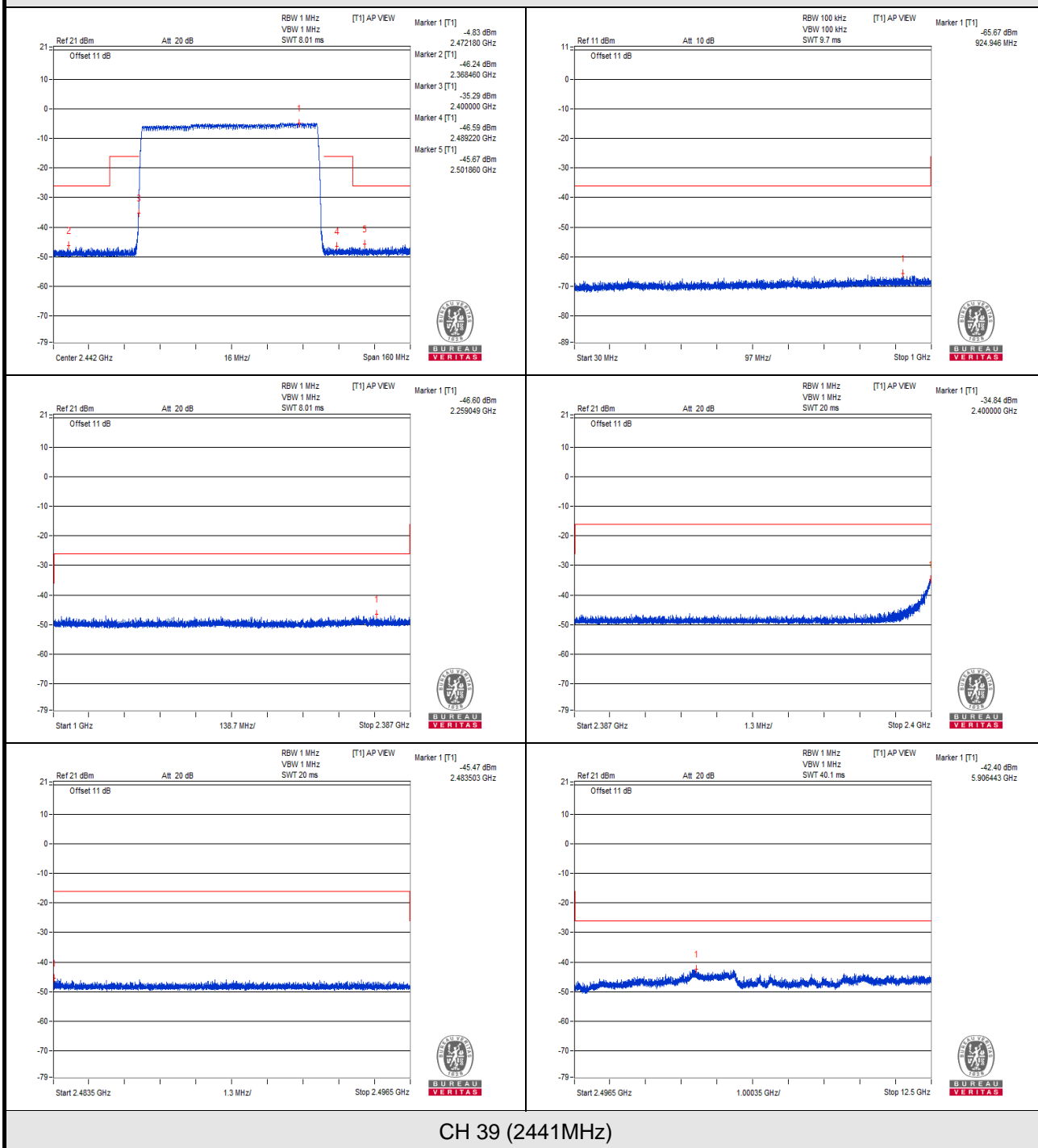
Vnormal



V<sub>max</sub>.



V<sub>min</sub>.

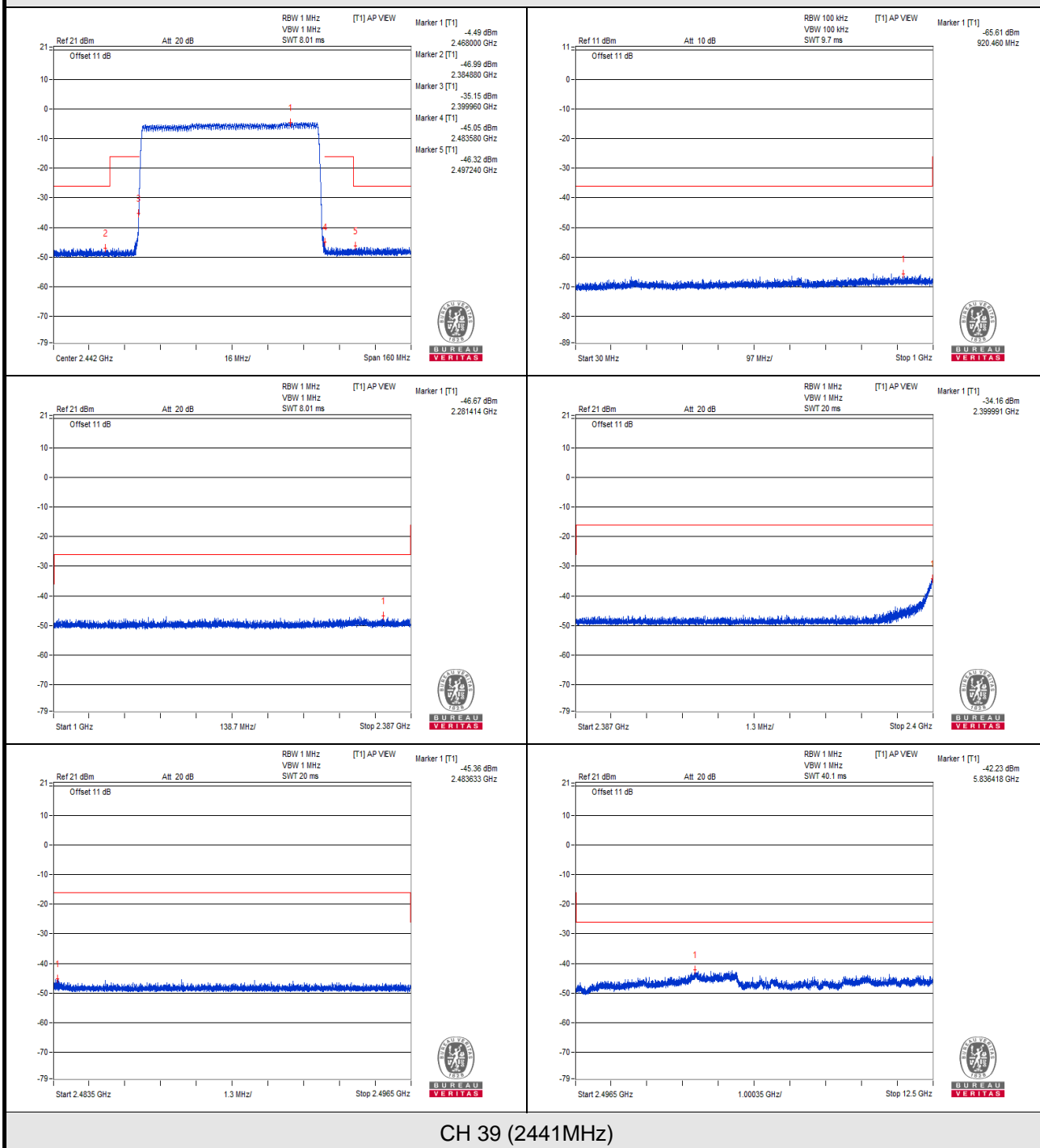


# Modulation: 8DPSK

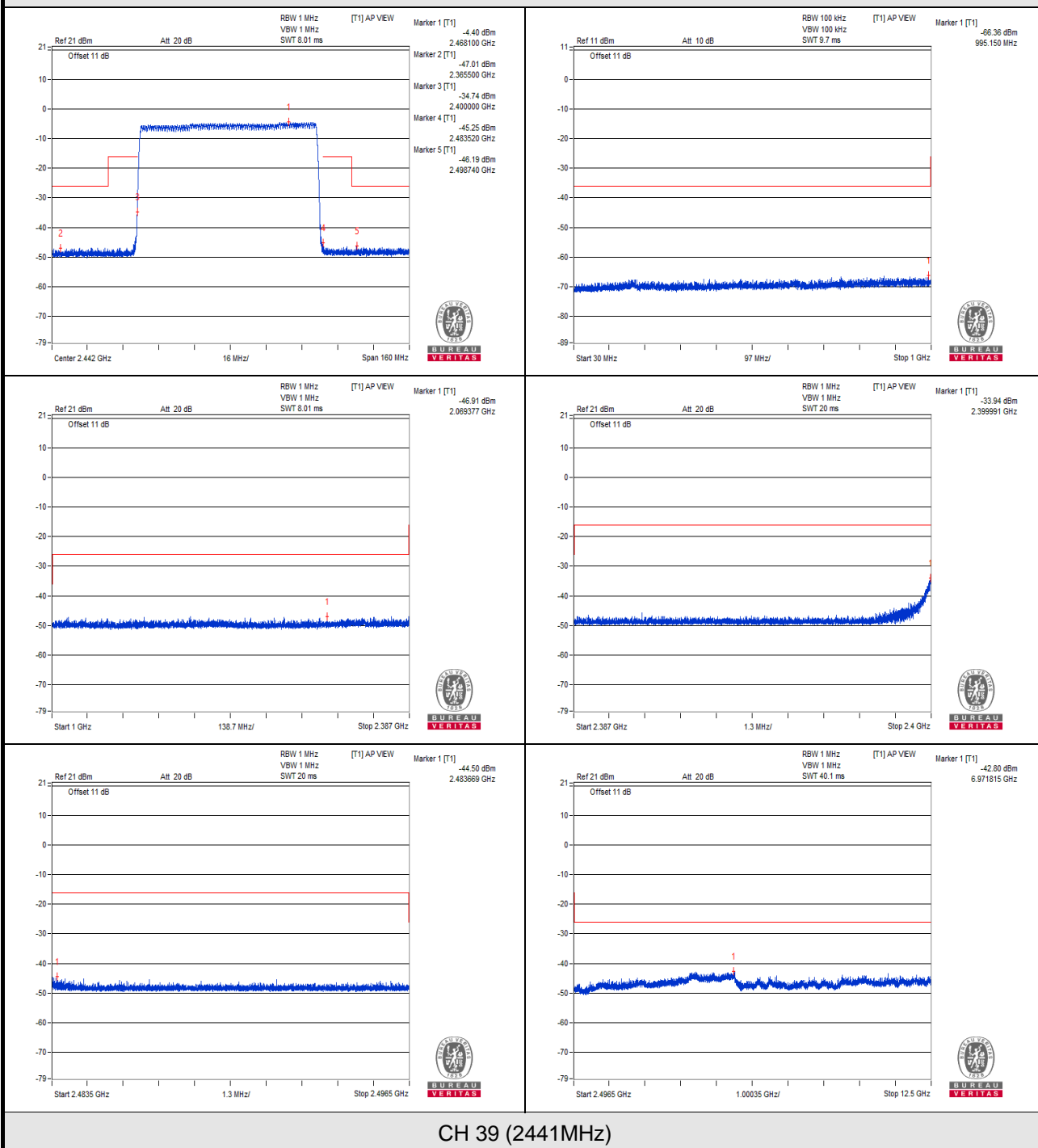
TEST CHANNEL		CH 39 (2441MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE( $\mu$ W)	LIMIT ( $\mu$ W)	RESULT
<b>V<sub>normal</sub></b>	30MHz to 1000MHz	920.460	0.000275	0.25	PASS
	1000MHz to 2387MHz	2281.414	0.021528	2.5	PASS
	2387MHz to 2400MHz	2399.991	0.383707	25	PASS
	2483.5MHz to 2496.5MHz	2483.633	0.029107	25	PASS
	2496.5MHz to 12500MHz	5836.418	0.059841	2.5	PASS
<b>V<sub>max.</sub></b>	30MHz to 1000MHz	995.150	0.000231	0.25	PASS
	1000MHz to 2387MHz	2069.377	0.020370	2.5	PASS
	2387MHz to 2400MHz	2399.991	0.403645	25	PASS
	2483.5MHz to 2496.5MHz	2483.669	0.035481	25	PASS
	2496.5MHz to 12500MHz	6971.815	0.052481	2.5	PASS
<b>V<sub>min.</sub></b>	30MHz to 1000MHz	886.752	0.000251	0.25	PASS
	1000MHz to 2387MHz	2197.327	0.021727	2.5	PASS
	2387MHz to 2400MHz	2400.000	0.373250	25	PASS
	2483.5MHz to 2496.5MHz	2483.511	0.042267	25	PASS
	2496.5MHz to 12500MHz	6995.574	0.053951	2.5	PASS

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

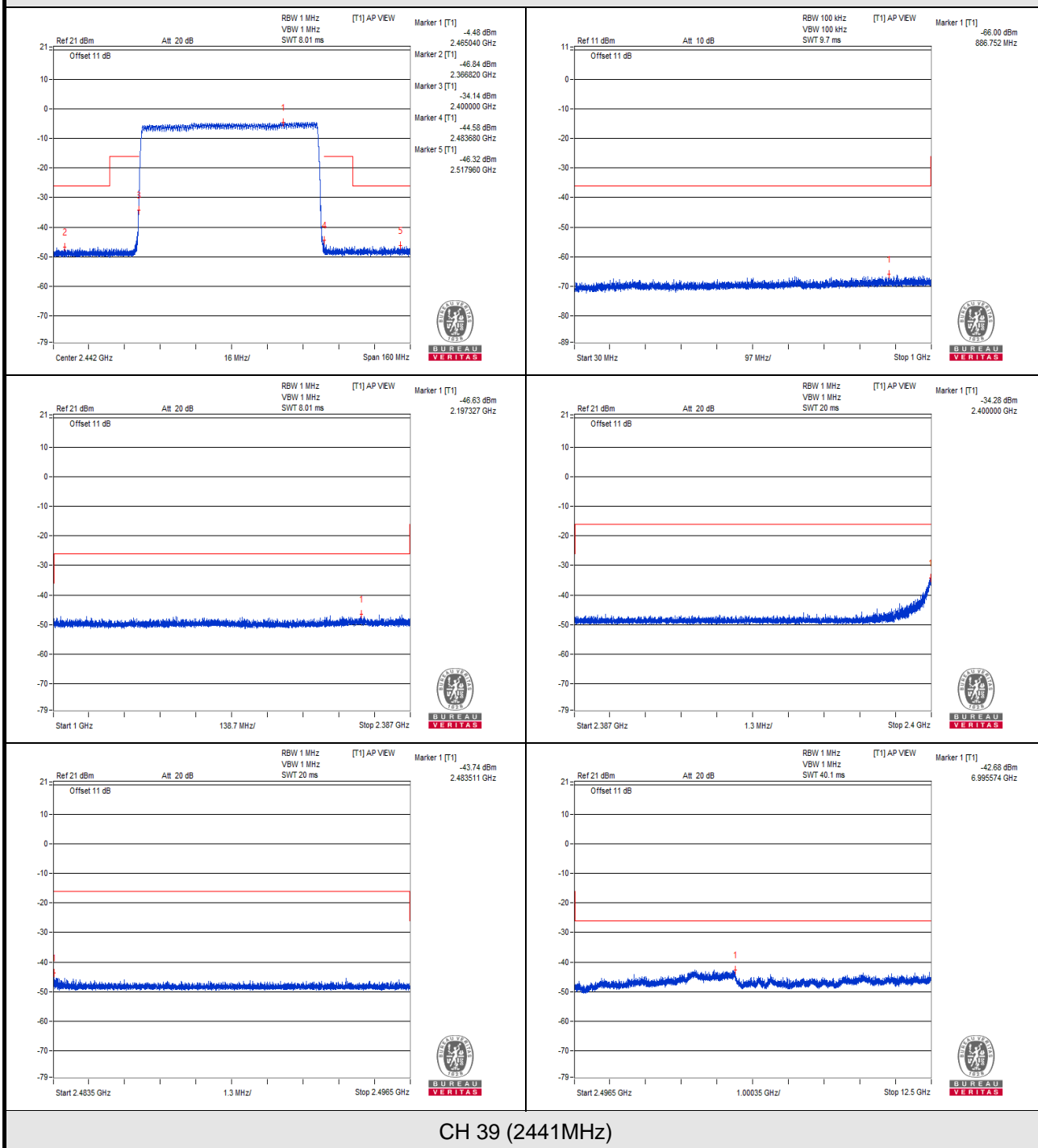
Vnormal



V<sub>max</sub>.



V<sub>min</sub>.



## 4.5 Antenna Power Measurement

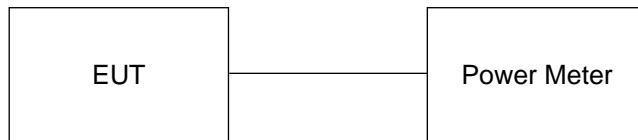
### 4.5.1 Limits of Antenna Power

Modulation System	Frequency Band Used	Antenna Power (Max.)	EIRP Limit (Note 3)
<b>DS</b>	2400 – 2483.5 MHz	10 mW/MHz	12.14 dBm/MHz ~ 22.14 dBm/MHz (16.368 mW/MHz ~ 163.68 mW/MHz)
<b>OFDM (Note 1)</b>	2400 – 2483.5 MHz	10 mW/MHz	12.14 dBm/MHz ~ 22.14 dBm/MHz (16.368 mW/MHz ~ 163.68 mW/MHz)
<b>OFDM (Note 2)</b>	2400 – 2483.5 MHz	5 mW/MHz	9.13 dBm/MHz ~ 19.13 dBm/MHz (8.184 mW/MHz ~ 81.84 mW/MHz)
<b>FH</b>	2400 – 2483.5 MHz	3 mW/MHz	6.91 dBm/MHz ~ 16.91 dBm/MHz (4.91 mW/MHz ~ 49.10 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 = 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:

Voltage (Vdc)	Modulation	Data Rate	Conducted RF Output Power Density (mW/MHz)	Radiated RF Output Power Density (mW/MHz)
12	GFSK	DH5	0.183616	0.382746
	$\pi/4$ -DQPSK	2DH5	0.185289	0.386233
	8DPSK	3DH5	0.182516	0.380453
13.2	GFSK	DH5	0.188591	0.393116
	$\pi/4$ -DQPSK	2DH5	0.188062	0.392014
	8DPSK	3DH5	0.189898	0.395841
10.8	GFSK	DH5	0.186599	0.388964
	$\pi/4$ -DQPSK	2DH5	0.192	0.400222
	8DPSK	3DH5	0.178543	0.372171
Max. Limit (mW/MHz):			3	-
Rated Power (mW/MHz):			0.2	-
Tolerance of Antenna Power (mW/MHz):			0.04 ~ 0.24	-
Max. EIRP Limit (mW/MHz):			-	4.91

Note: 1. Antenna gain is 3.19 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

**AFH Mode:**

Voltage (Vdc)	Modulation	Data Rate	Conducted RF Output Power Density (mW/MHz)	Radiated RF Output Power Density (mW/MHz)
12	GFSK	DH5	0.725309	1.5119
	$\pi/4$ -DQPSK	2DH5	0.720838	1.50258
	8DPSK	3DH5	0.710946	1.48196
13.2	GFSK	DH5	0.741042	1.544695
	$\pi/4$ -DQPSK	2DH5	0.743913	1.55068
	8DPSK	3DH5	0.74659	1.55626
10.8	GFSK	DH5	0.7375	1.537312
	$\pi/4$ -DQPSK	2DH5	0.750756	1.564944
	8DPSK	3DH5	0.691574	1.44158
Max. Limit (mW/MHz):			3	-
Rated Power (mW/MHz):			1	-
Tolerance of Antenna Power (mW/MHz):			0.2 ~ 1.2	-
Max. EIRP Limit (mW/MHz):			-	4.91

Note: 1. Antenna gain is 3.19 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	$\leq 4\text{nW}/100\text{kHz}$ (-54dBm)
Above 1GHz	$\leq 20\text{nW}/\text{MHz}$ (-47dBm)

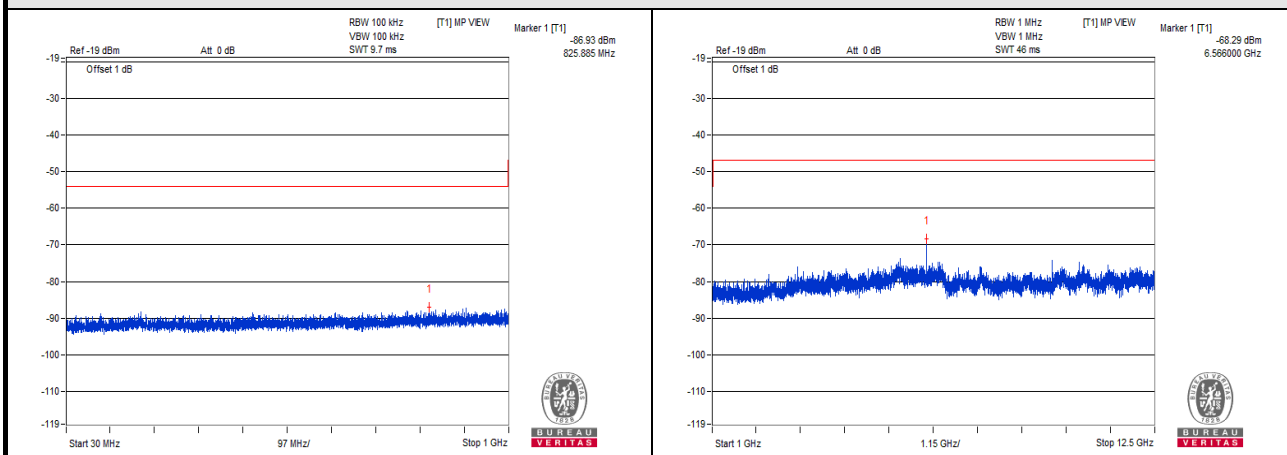
### 4.6.2 Test Setup



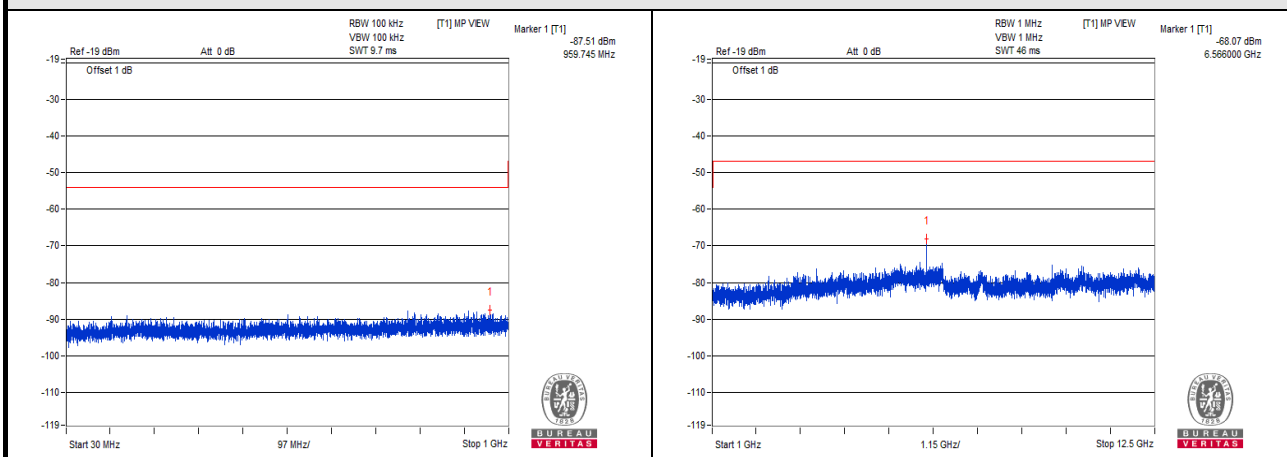
#### 4.6.3 Test Result

TEST CHANNEL		CH 0 (2402MHz)			
TEST CONDITION	FREQUENCY RANGE(MHz)	FREQUENCY (MHz)	MEASURE. VALUE(nW)	LIMIT (nW)	RESULT
<b>V<sub>normal</sub></b>	30MHz to 1000MHz	825.885	0.002028	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.148252	20.0	PASS
<b>V<sub>max.</sub></b>	30MHz to 1000MHz	959.745	0.001774	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.155955	20.0	PASS
<b>V<sub>min.</sub></b>	30MHz to 1000MHz	922.642	0.001607	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.148252	20.0	PASS
TEST CHANNEL		CH 39 (2441MHz)			
<b>V<sub>normal</sub></b>	30MHz to 1000MHz	902.515	0.001589	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.174181	20.0	PASS
<b>V<sub>max.</sub></b>	30MHz to 1000MHz	903.727	0.001589	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.165577	20.0	PASS
<b>V<sub>min.</sub></b>	30MHz to 1000MHz	997.938	0.001545	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.157036	20.0	PASS
TEST CHANNEL		CH 78 (2480MHz)			
<b>V<sub>normal</sub></b>	30MHz to 1000MHz	966.413	0.001746	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.130017	20.0	PASS
<b>V<sub>max.</sub></b>	30MHz to 1000MHz	974.658	0.001517	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.143880	20.0	PASS
<b>V<sub>min.</sub></b>	30MHz to 1000MHz	936.101	0.001400	4.0	PASS
	1000MHz to 12500MHz	6566.000	0.206538	20.0	PASS

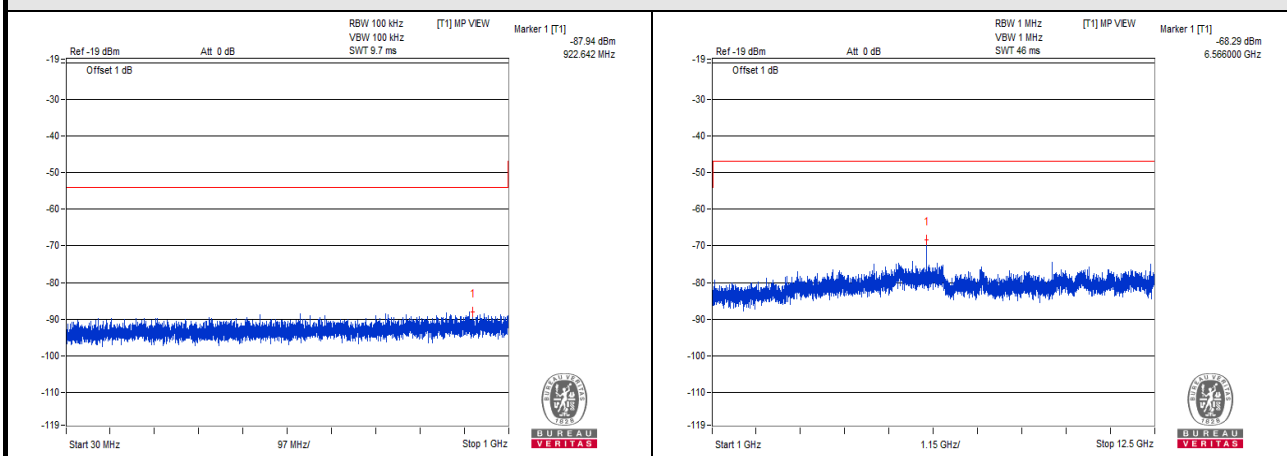
## V<sub>normal</sub>



## V<sub>max</sub>

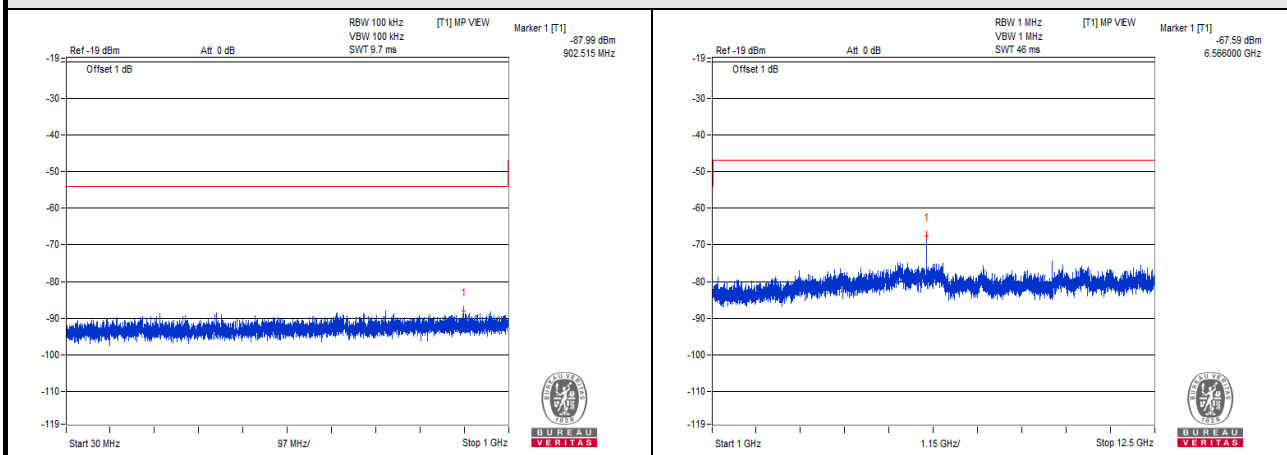


## V<sub>min</sub>

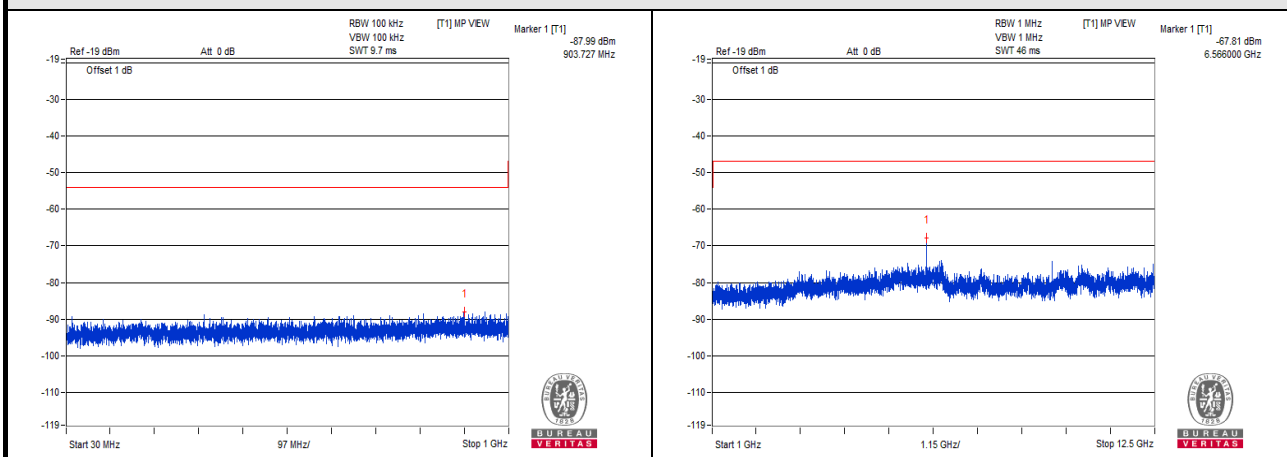


CH 0 (2402MHz)

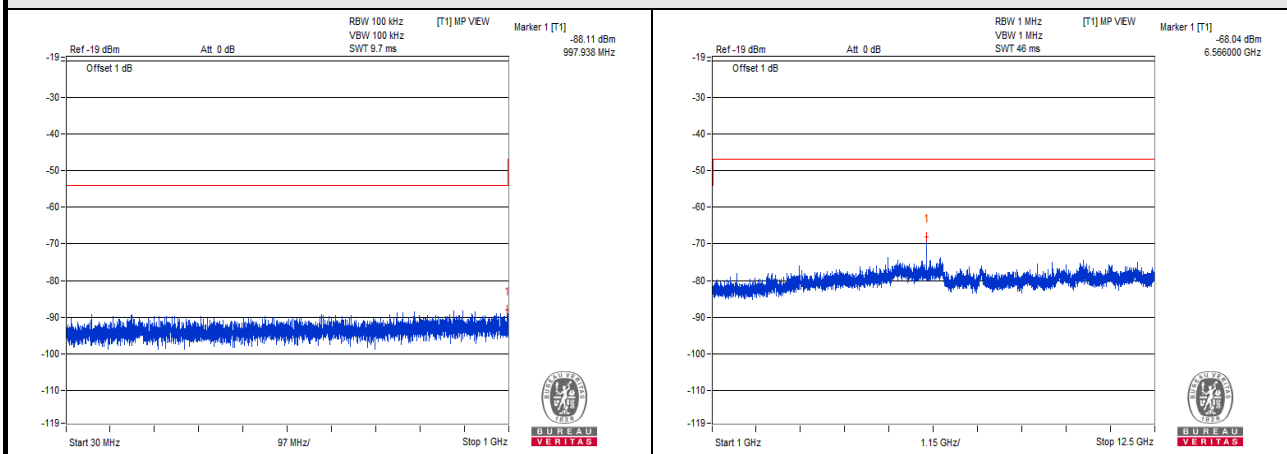
## V<sub>normal</sub>



## V<sub>max.</sub>

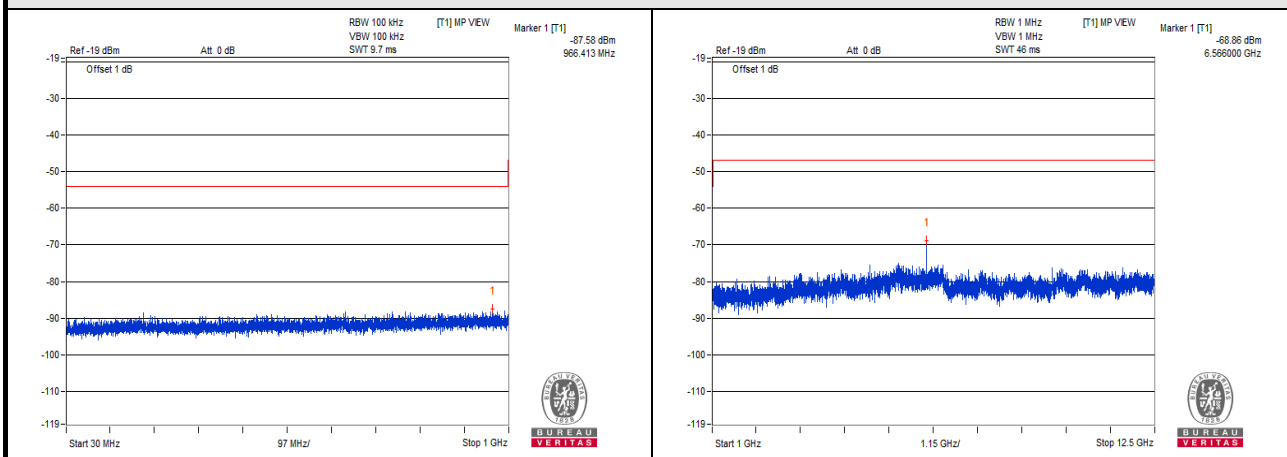


## V<sub>min.</sub>

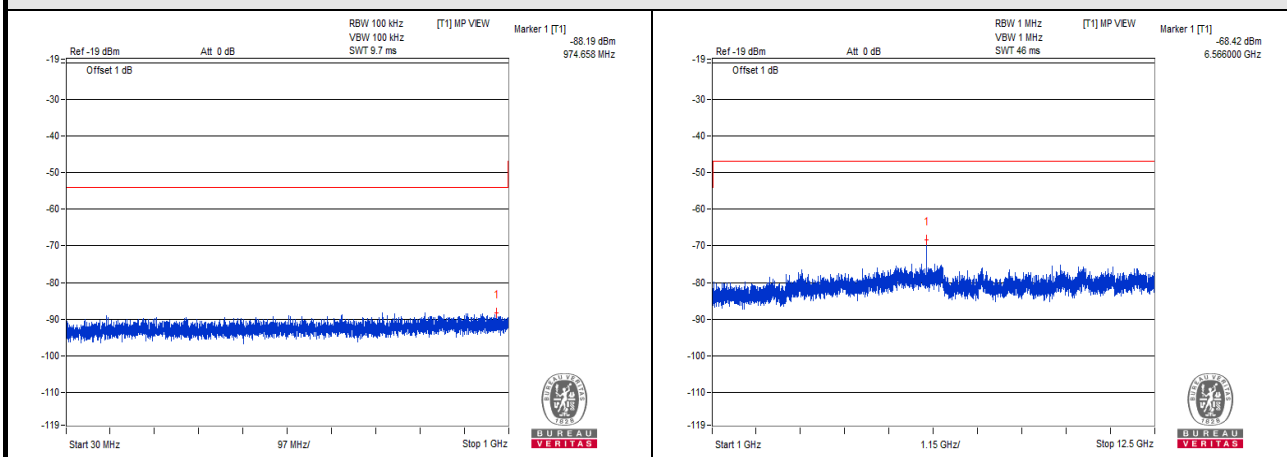


CH 39 (2441MHz)

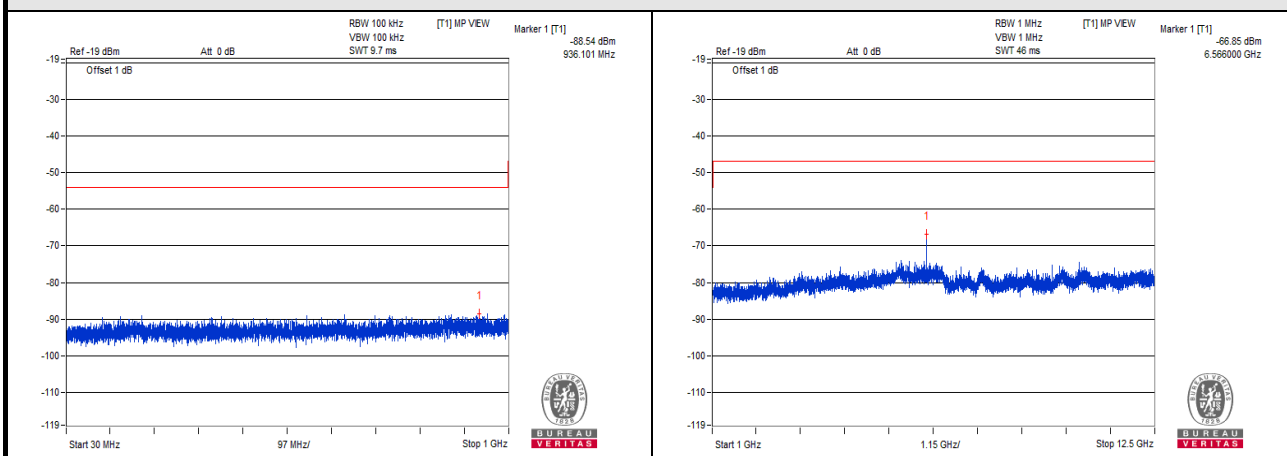
## V<sub>normal</sub>



## V<sub>max</sub>



## V<sub>min</sub>



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 second 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 = [diffusion rate/ 79] x duty-cycle x 0.4 second

**(AFH mode)** dwell time = [diffusion rate/20] x duty-cycle x 0.4 second

### 4.7.2 Test Setup



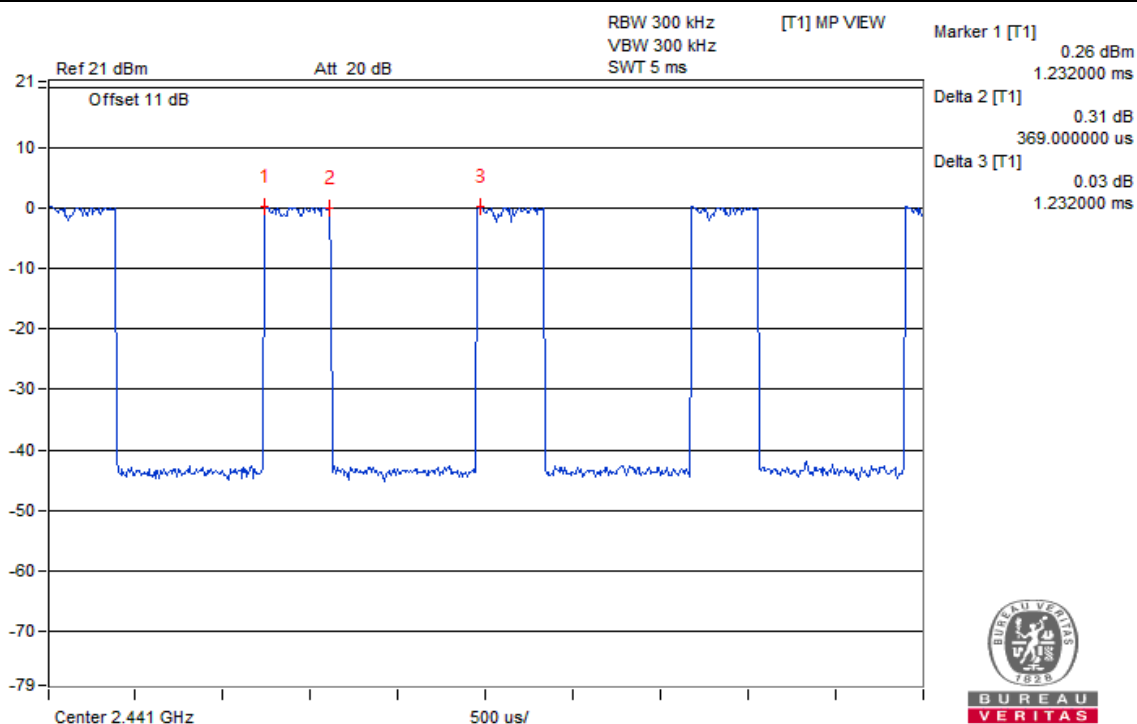
#### 4.7.3 Test Result

Modulation: GFSK

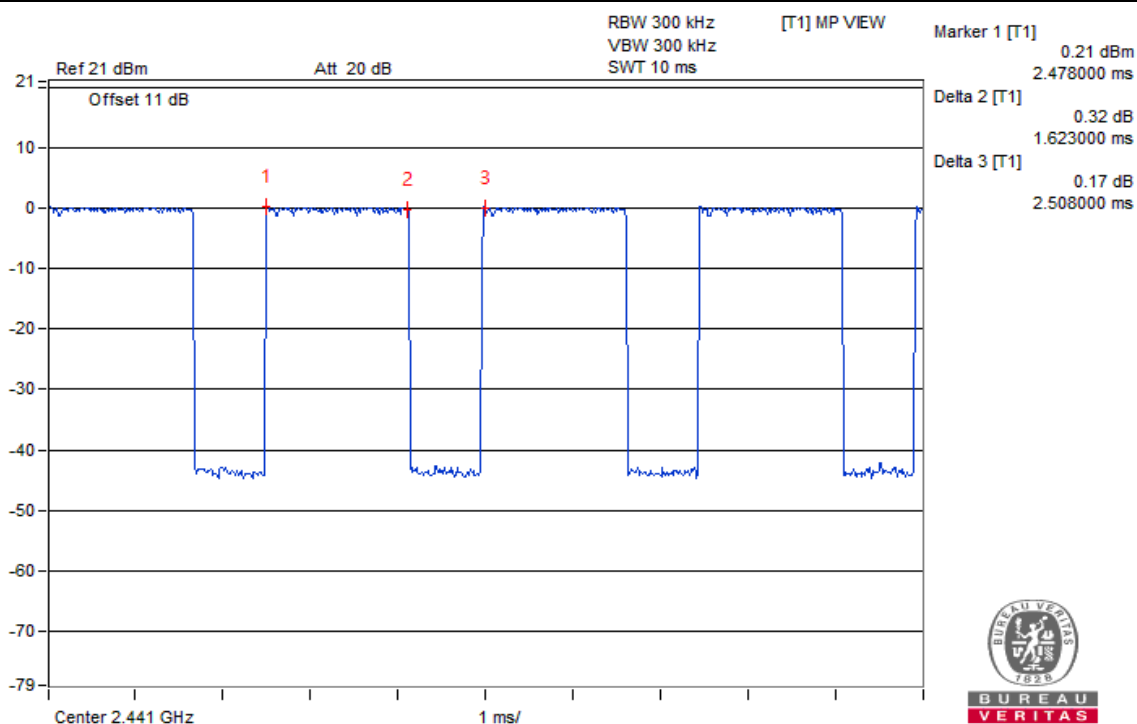
Normal Mode:

Test Condition	Mode	Diffusion Rate	[Diffusion Rate/79]*0.4 sec	Duty Cycle	Result (msec)	Limit (msec)
<b>V<sub>normal</sub></b>	DH1	71.30	0.361	0.299	107.939	400
	DH3	71.30	0.361	0.647	233.567	400
	DH5	71.30	0.361	0.767	276.887	400
<b>V<sub>max.</sub></b>	DH1	71.20	0.360	0.299	107.640	400
	DH3	71.20	0.360	0.647	232.920	400
	DH5	71.20	0.360	0.767	276.120	400
<b>V<sub>min.</sub></b>	DH1	71.30	0.361	0.299	107.939	400
	DH3	71.30	0.361	0.647	233.567	400
	DH5	71.30	0.361	0.767	276.887	400

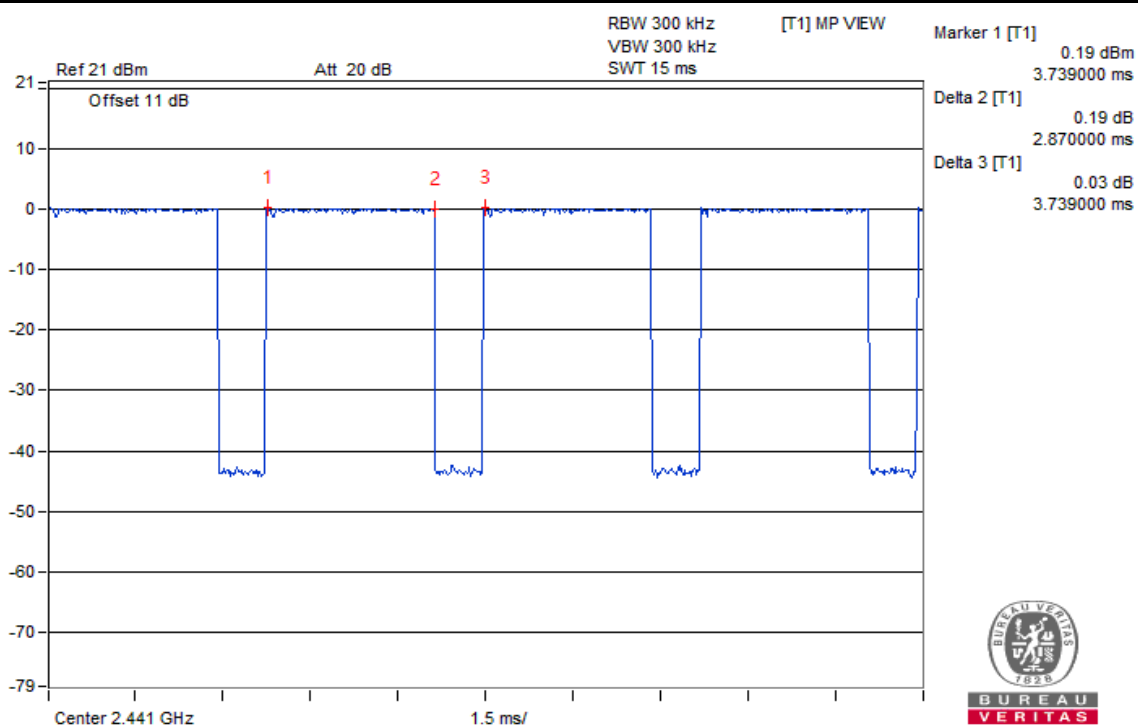
V<sub>normal</sub>



DH1

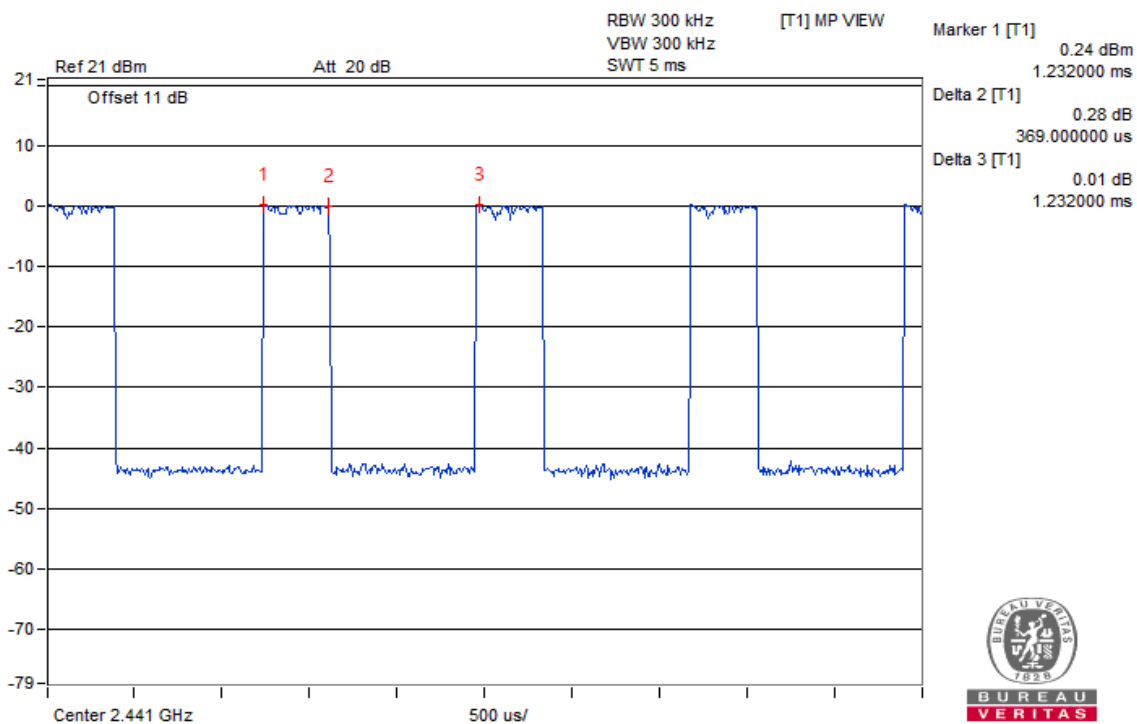


DH3

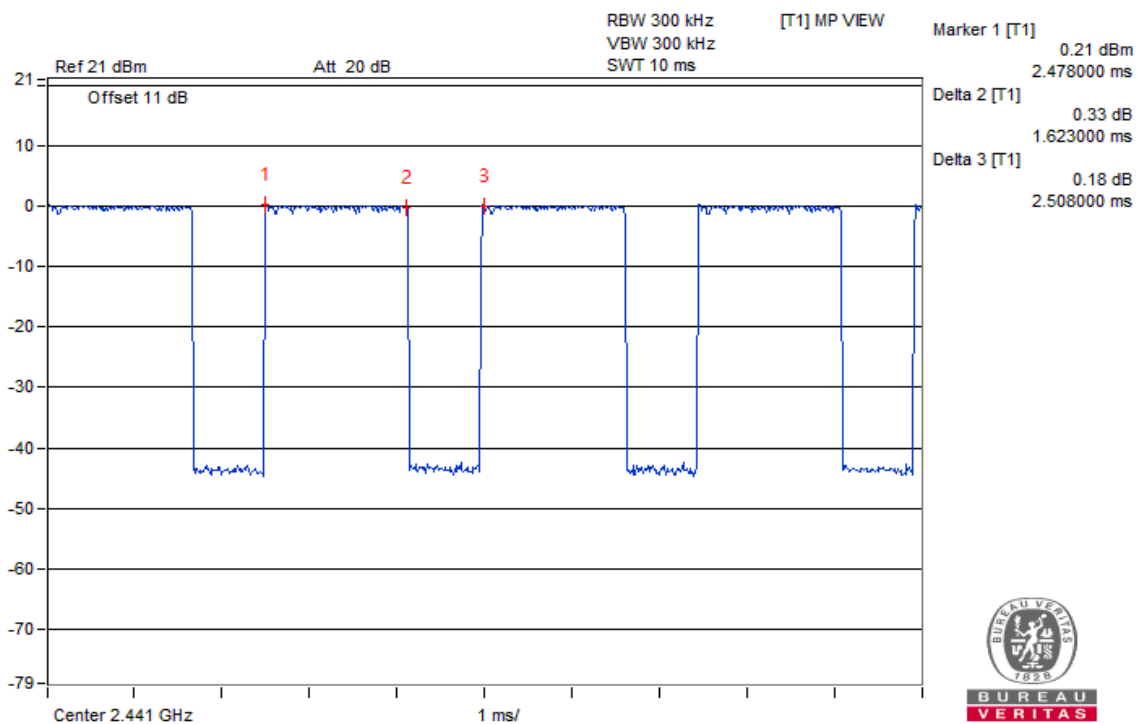


DH5

V<sub>max</sub>.



DH1

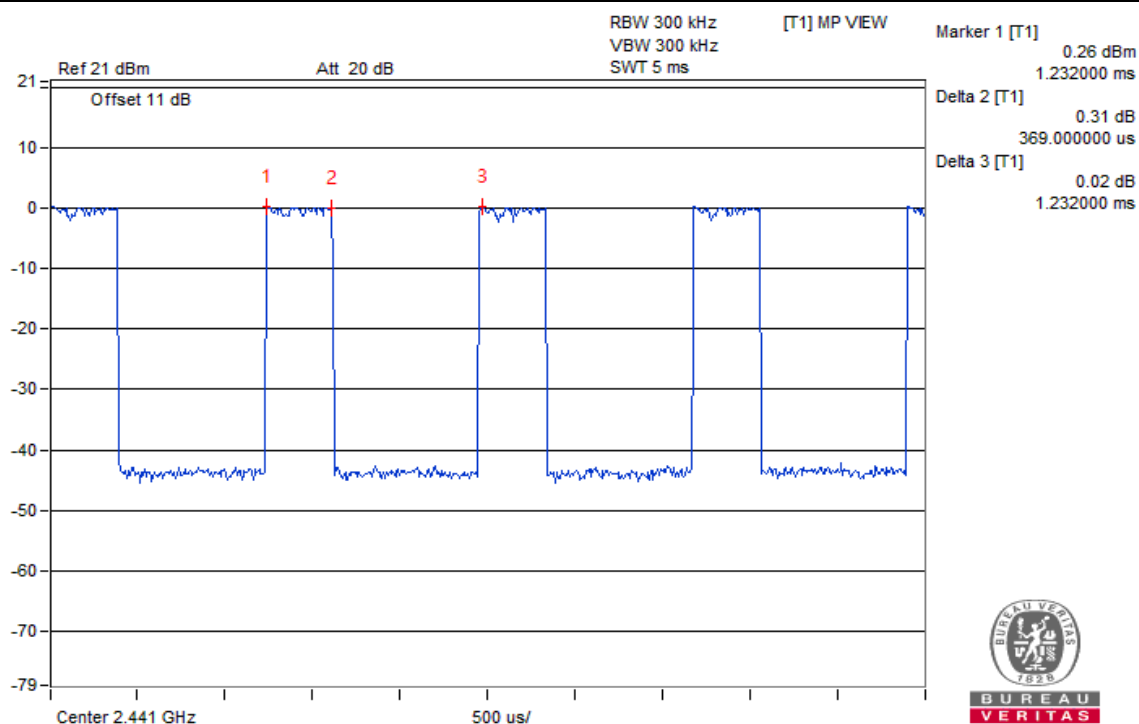


DH3

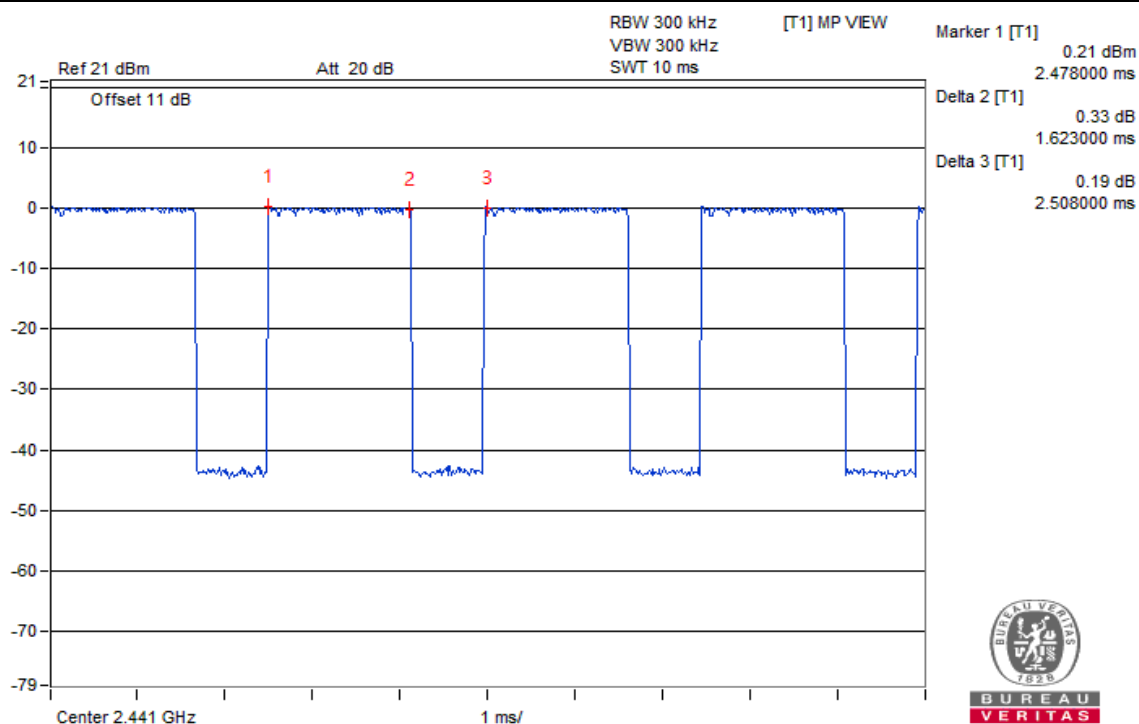


BUREAU  
VERITAS

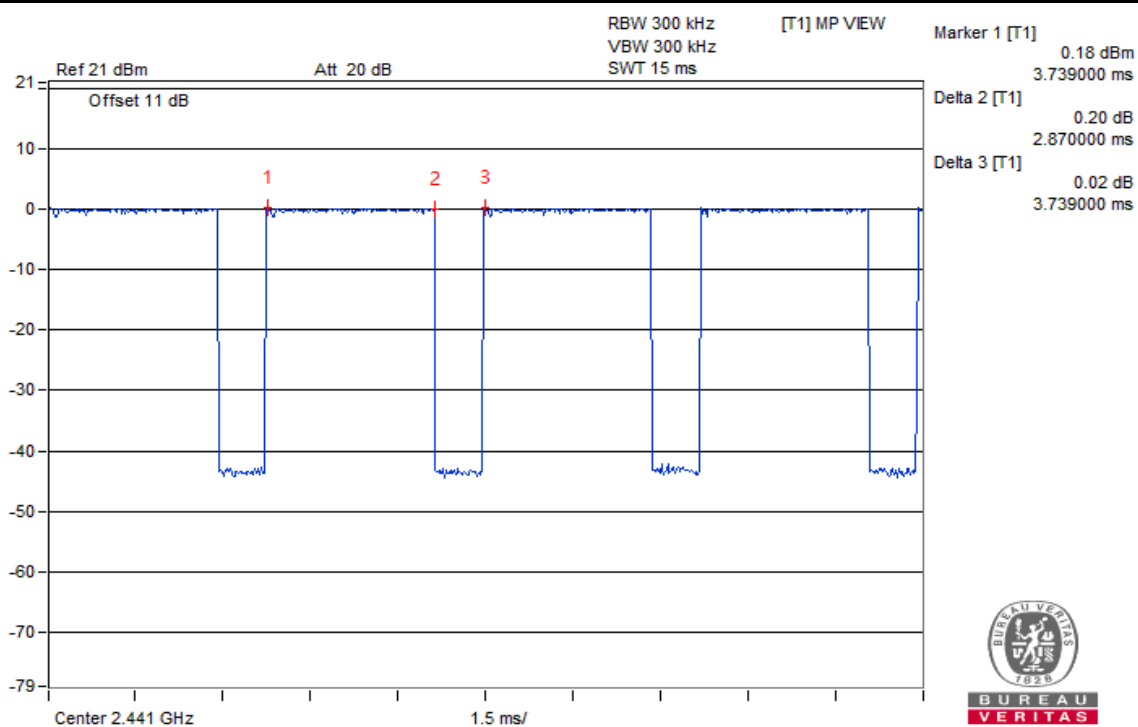
V<sub>min</sub>.



DH1



DH3

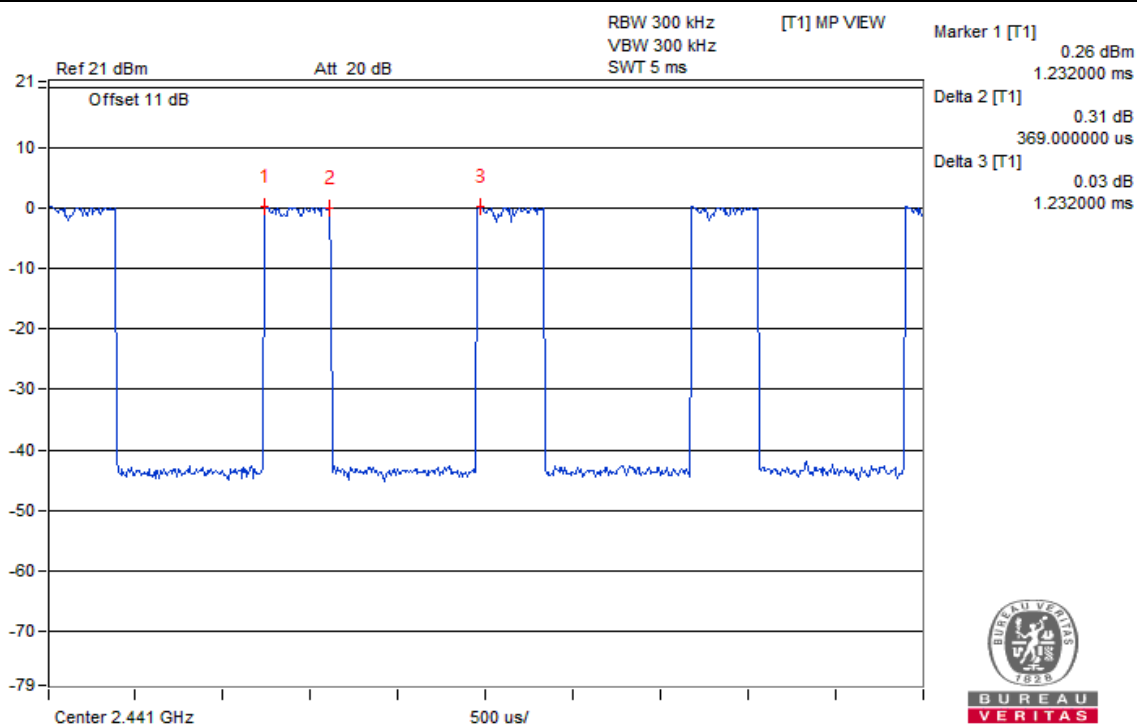


DH5

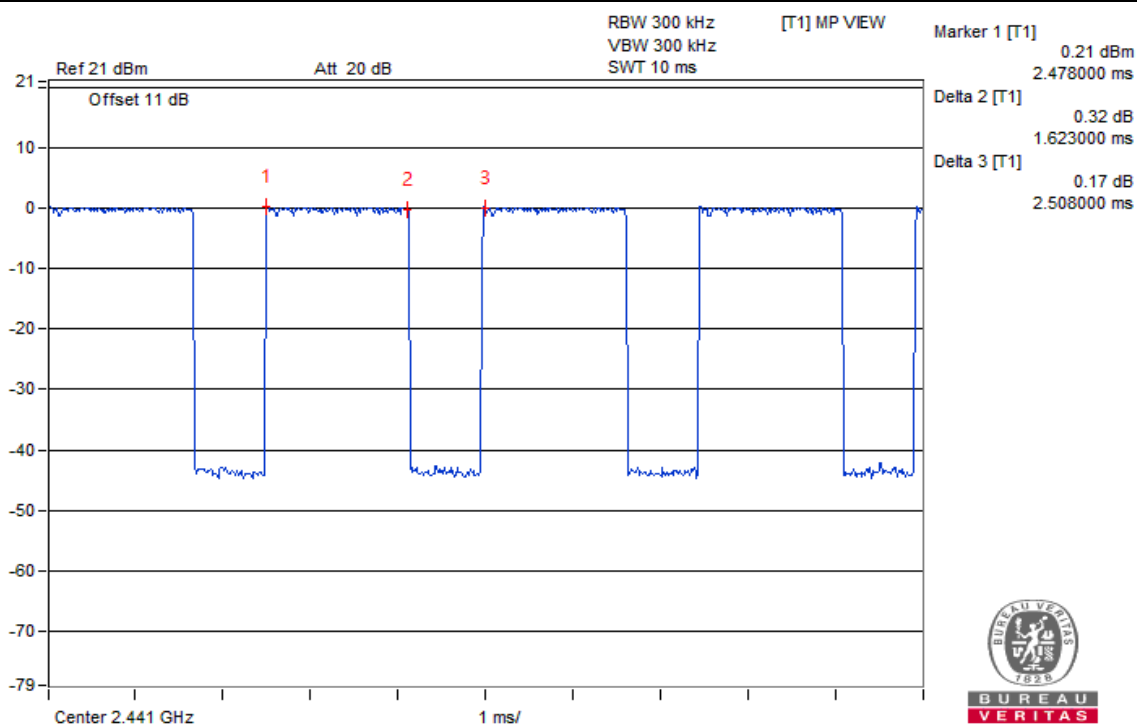
**AFH Mode:**

Test Condition	Mode	Diffusion Rate	[Diffusion Rate/79]*0.4 sec	Duty Cycle	Result (msec)	Limit (msec)
<b>V<sub>normal</sub></b>	DH1	18.05	0.361	0.299	107.939	400
	DH3	18.05	0.361	0.647	233.567	400
	DH5	18.05	0.361	0.767	276.887	400
<b>V<sub>max.</sub></b>	DH1	18.12	0.362	0.299	108.238	400
	DH3	18.12	0.362	0.647	234.214	400
	DH5	18.12	0.362	0.767	277.654	400
<b>V<sub>min.</sub></b>	DH1	18.04	0.360	0.299	107.640	400
	DH3	18.04	0.360	0.647	232.920	400
	DH5	18.04	0.360	0.767	276.120	400

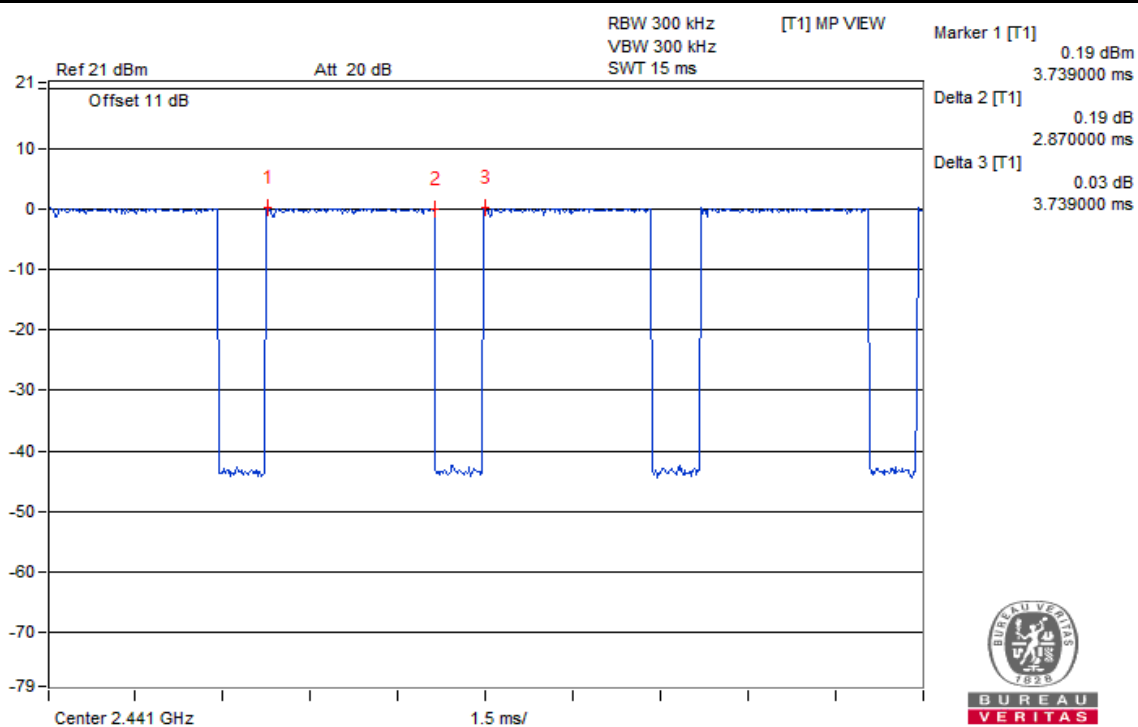
V<sub>normal</sub>



DH1

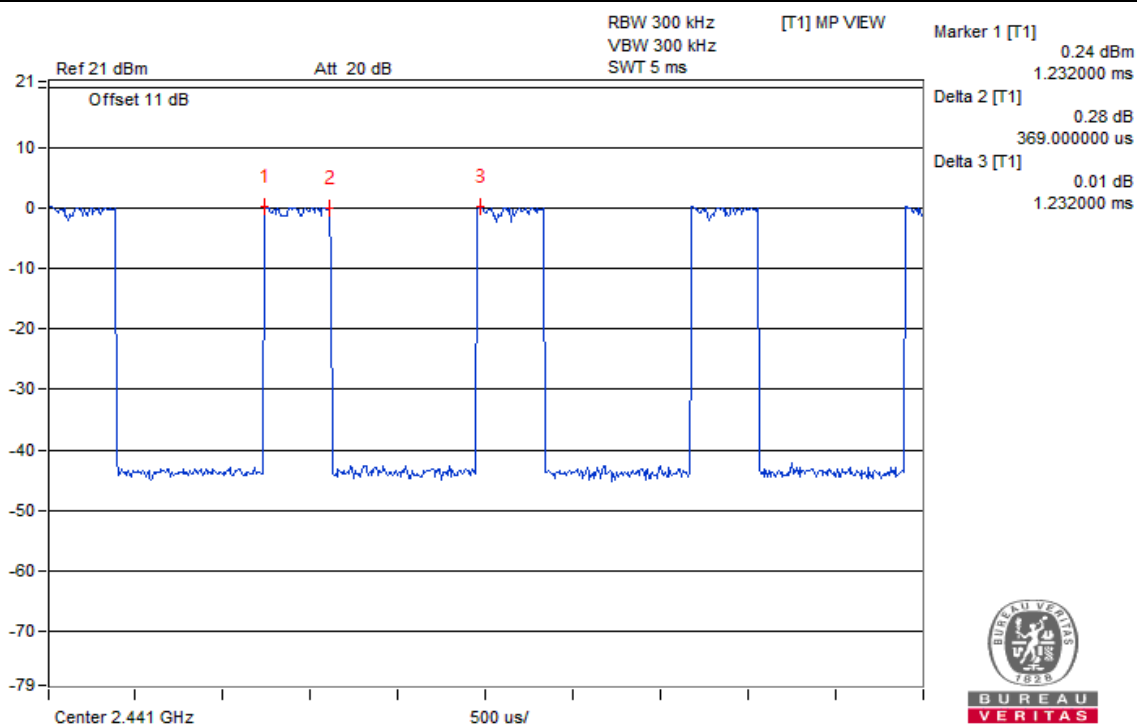


DH3

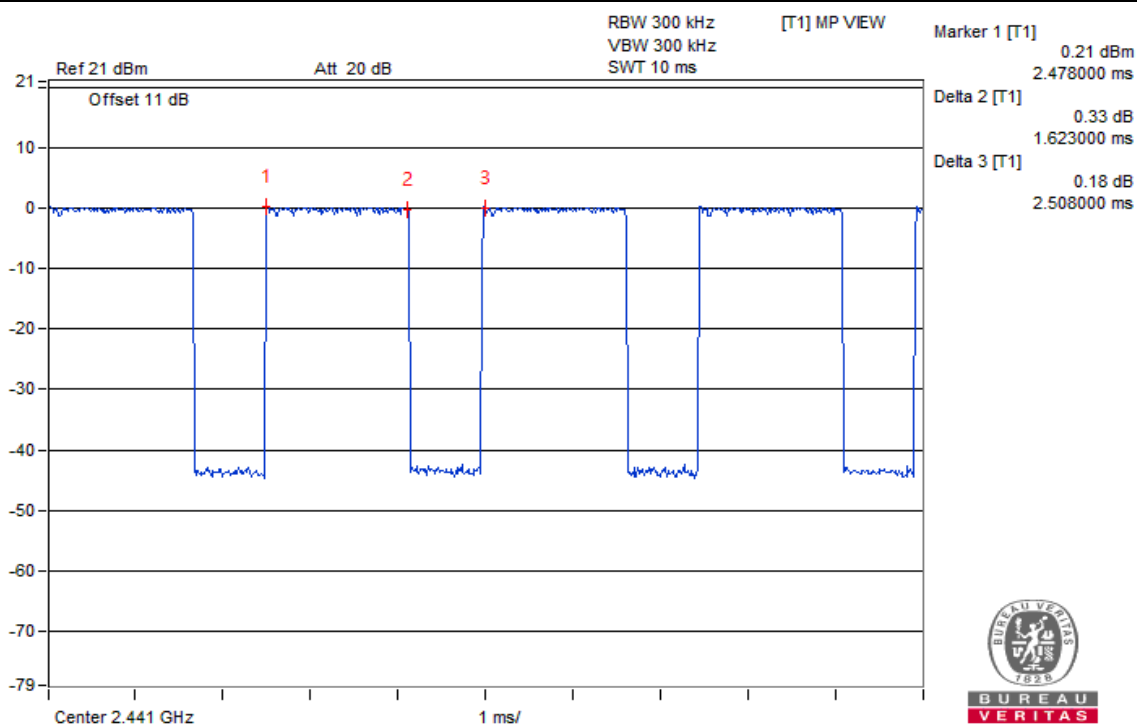


DH5

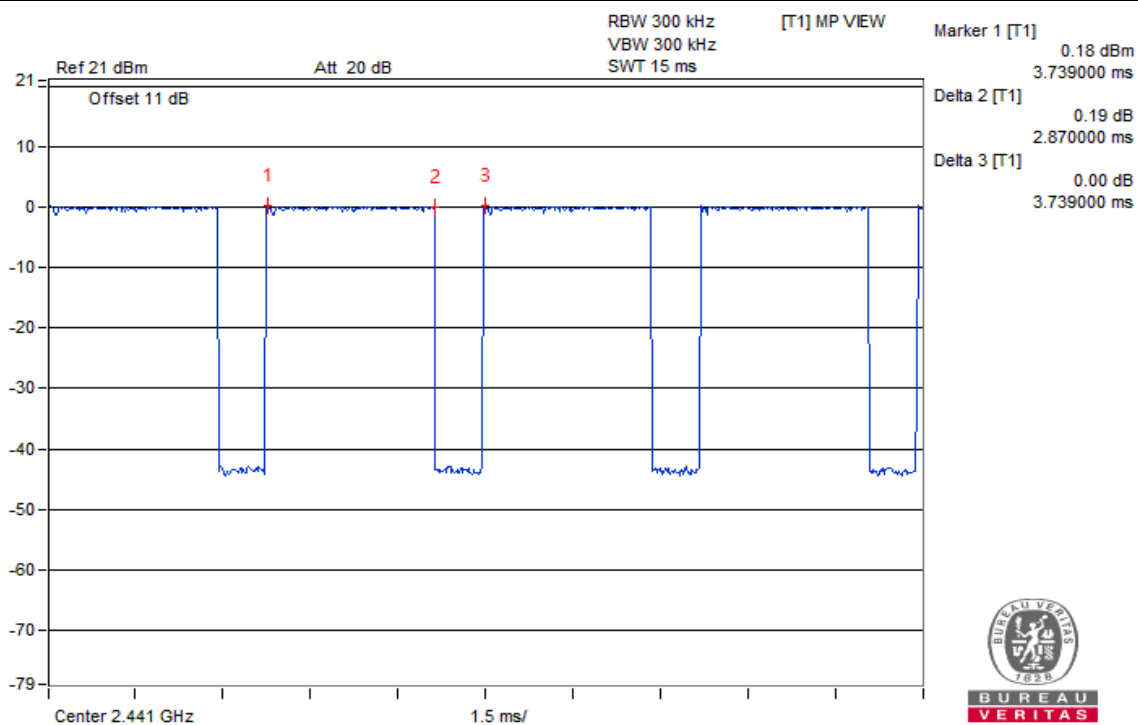
V<sub>max</sub>.



DH1

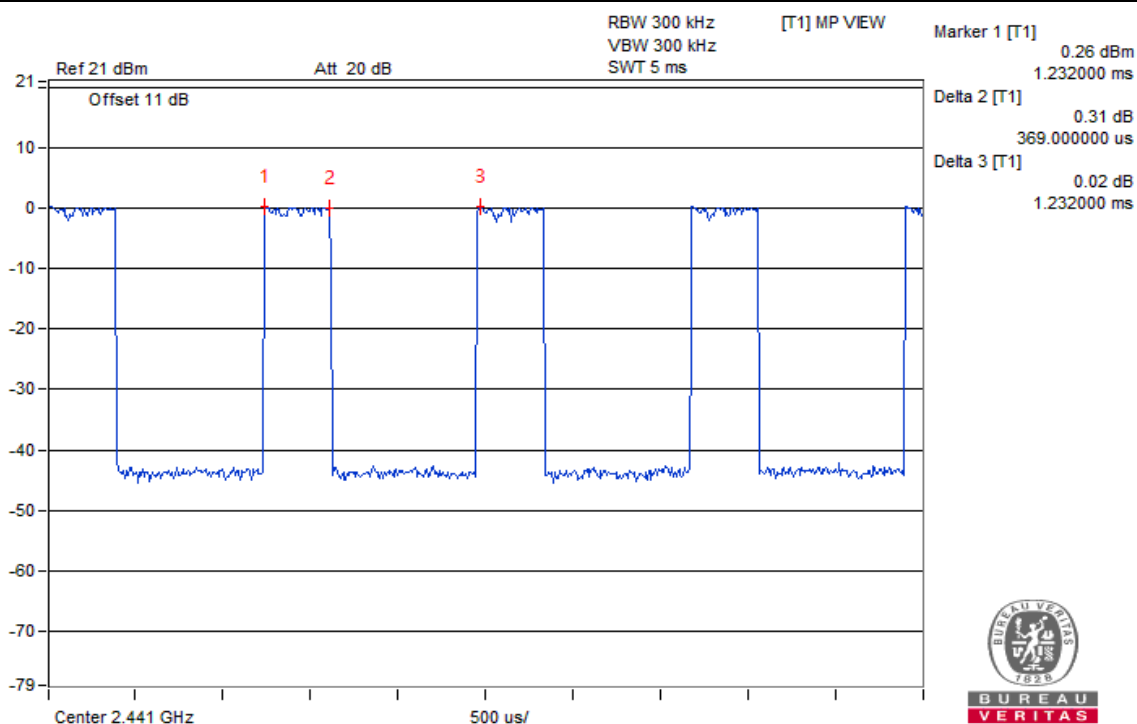


DH3

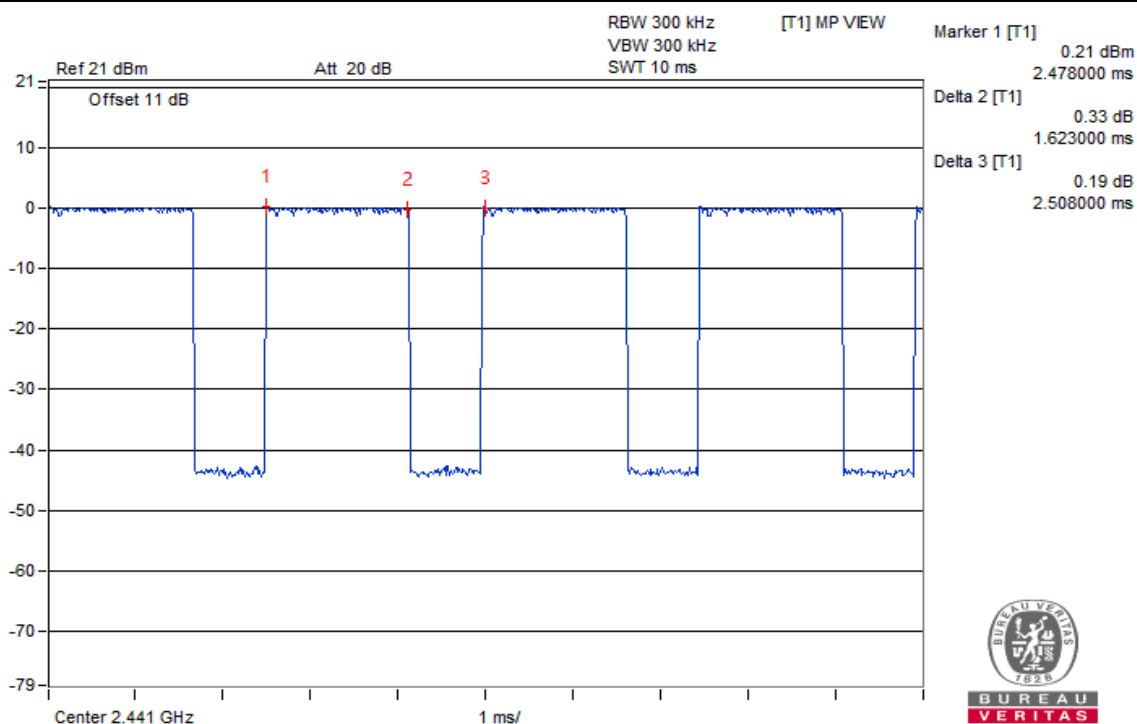


DH5

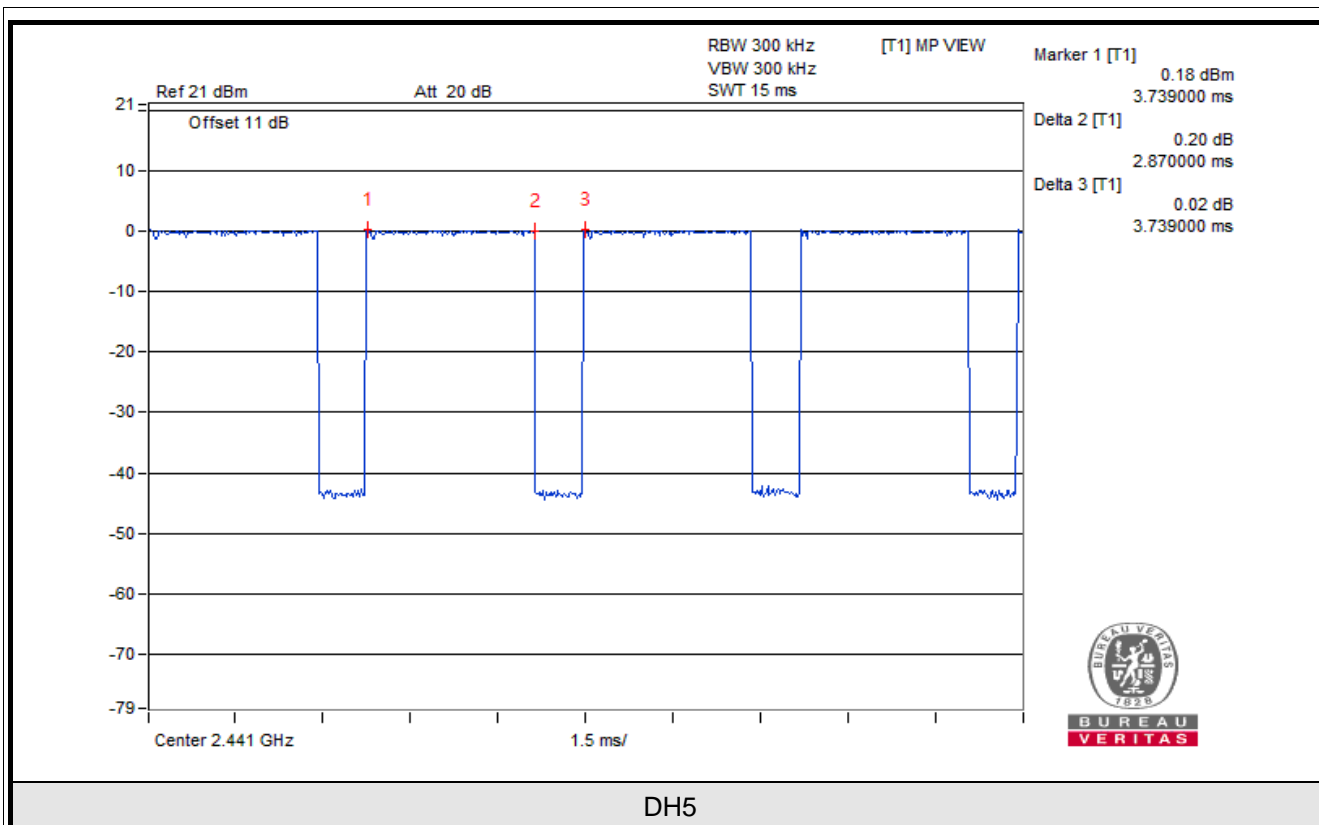
V<sub>min</sub>.



DH1



DH3

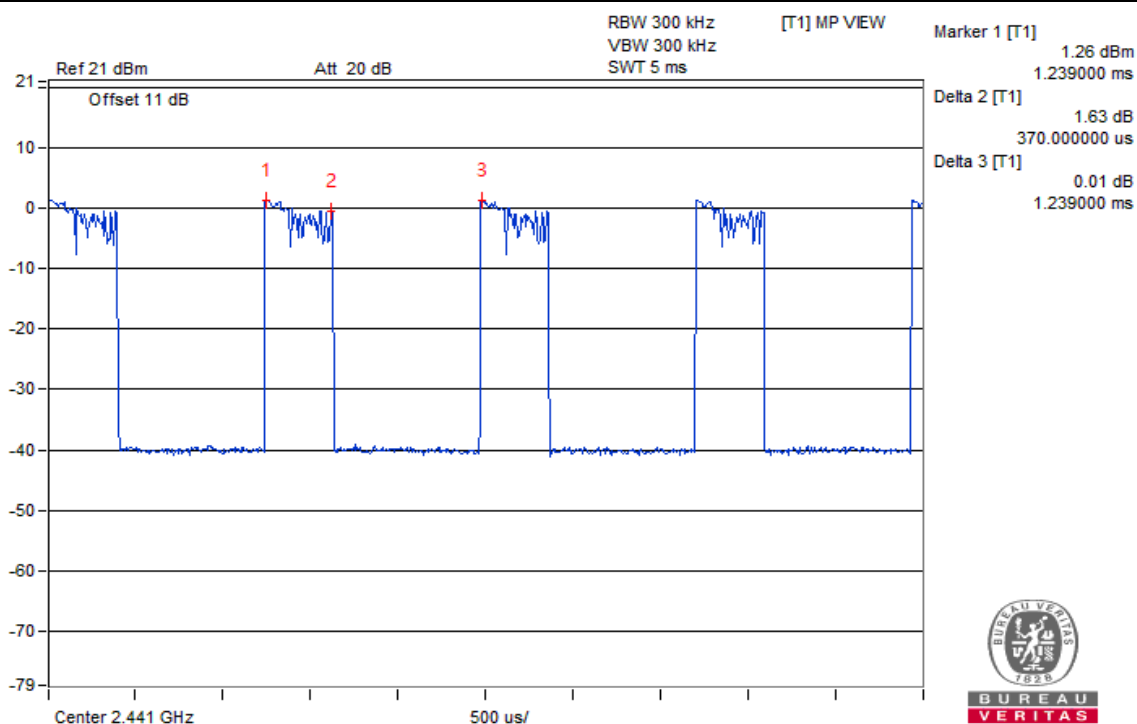


Modulation:  $\pi/4$ -DQPSK

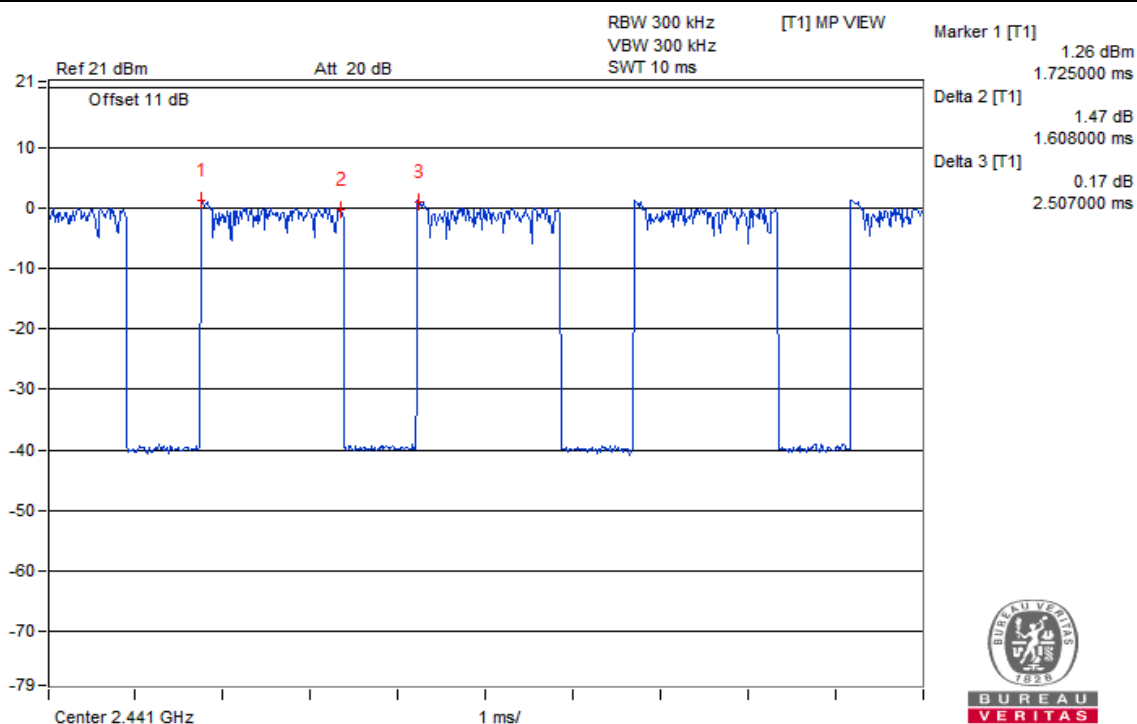
Normal Mode:

Test Condition	Mode	Diffusion Rate	[Diffusion Rate/79]*0.4 sec	Duty Cycle	Result (msec)	Limit (msec)
<b>V<sub>normal</sub></b>	2DH1	71.31	0.361	0.298	107.578	400
	2DH3	71.31	0.361	0.641	231.401	400
	2DH5	71.31	0.361	0.751	271.111	400
<b>V<sub>max.</sub></b>	2DH1	71.40	0.361	0.298	107.578	400
	2DH3	71.40	0.361	0.645	232.845	400
	2DH5	71.40	0.361	0.757	273.277	400
<b>V<sub>min.</sub></b>	2DH1	71.40	0.361	0.298	107.578	400
	2DH3	71.40	0.361	0.645	232.845	400
	2DH5	71.40	0.361	0.751	271.111	400

V<sub>normal</sub>



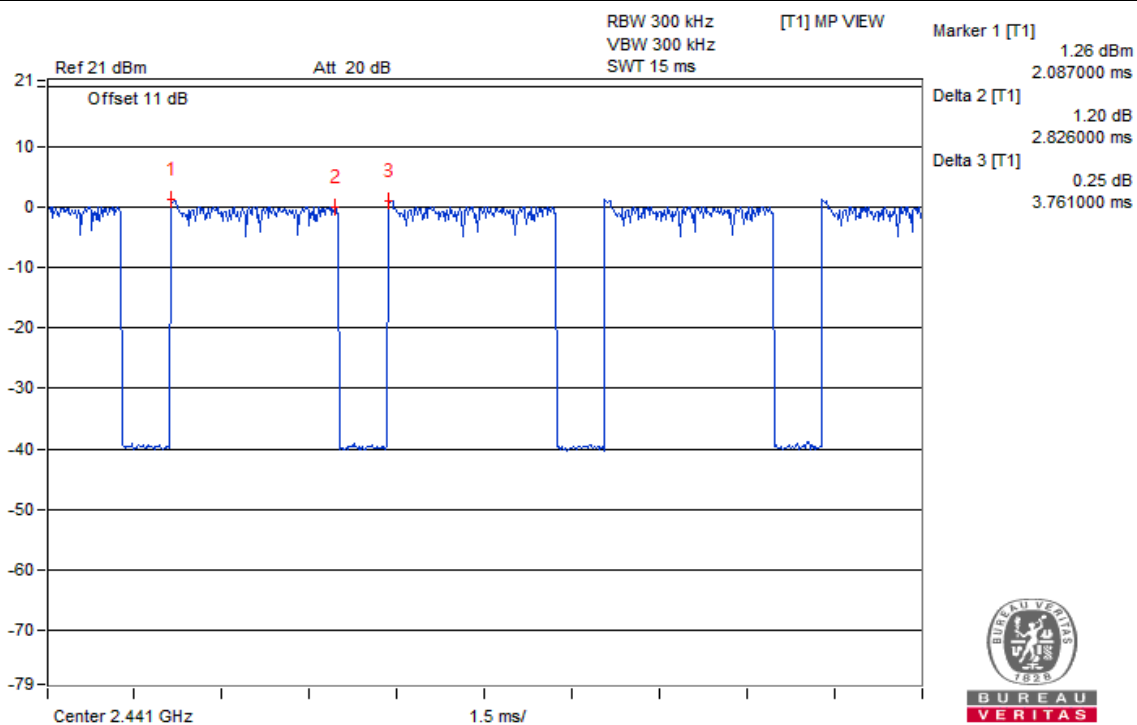
2DH1



2DH3



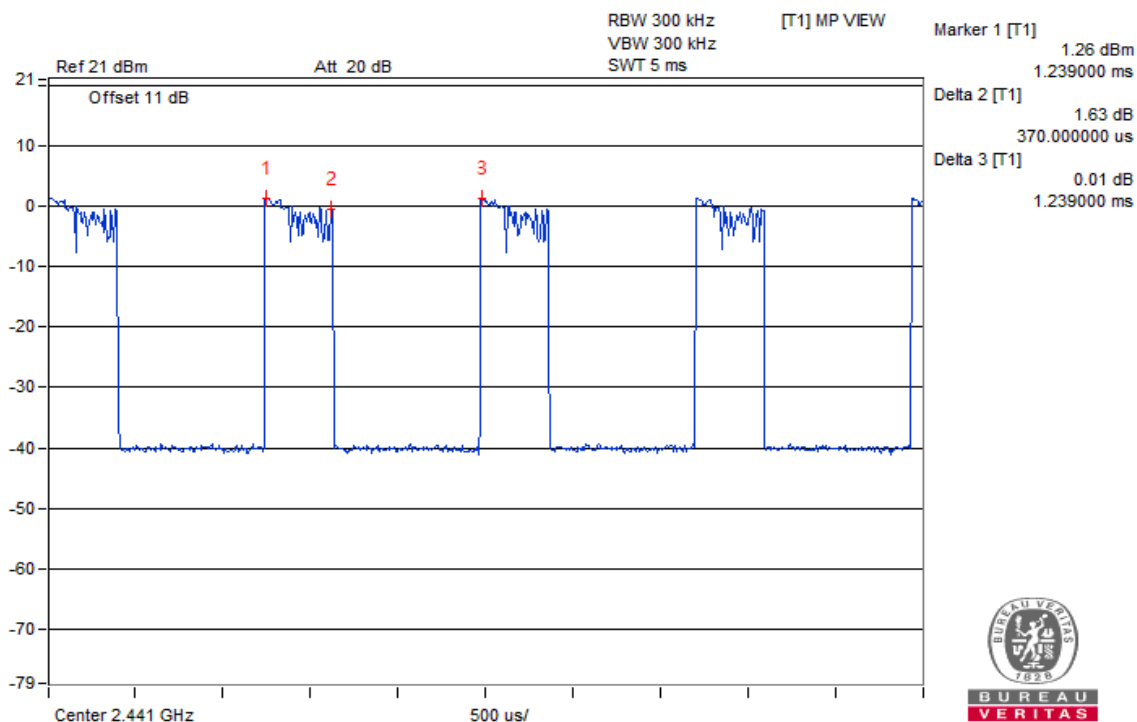
BUREAU  
VERITAS



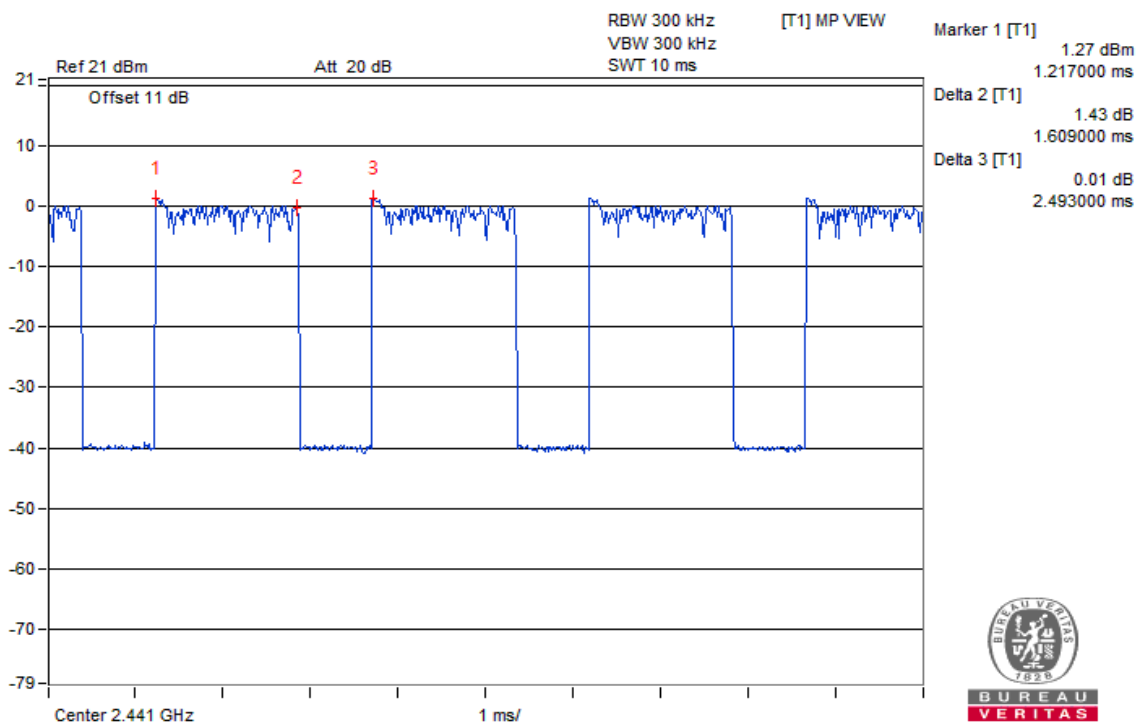
BUREAU  
VERITAS

2DH5

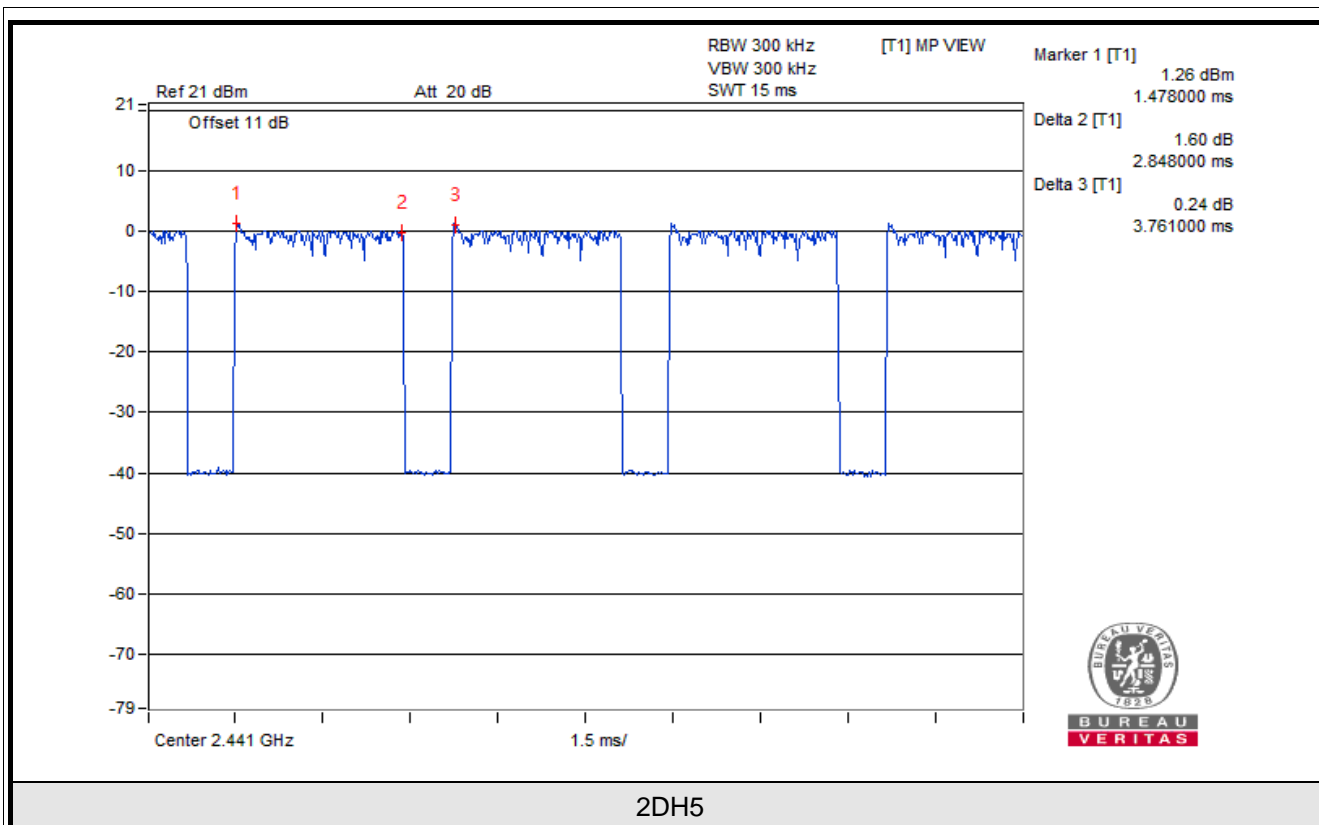
V<sub>max</sub>.



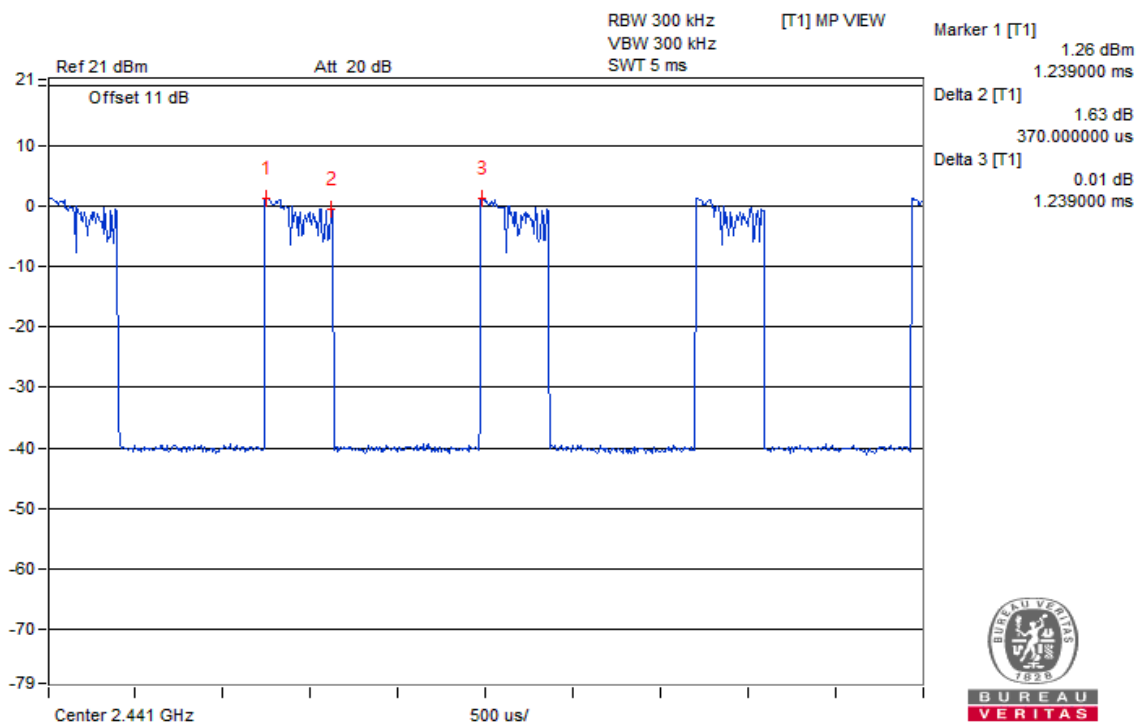
2DH1



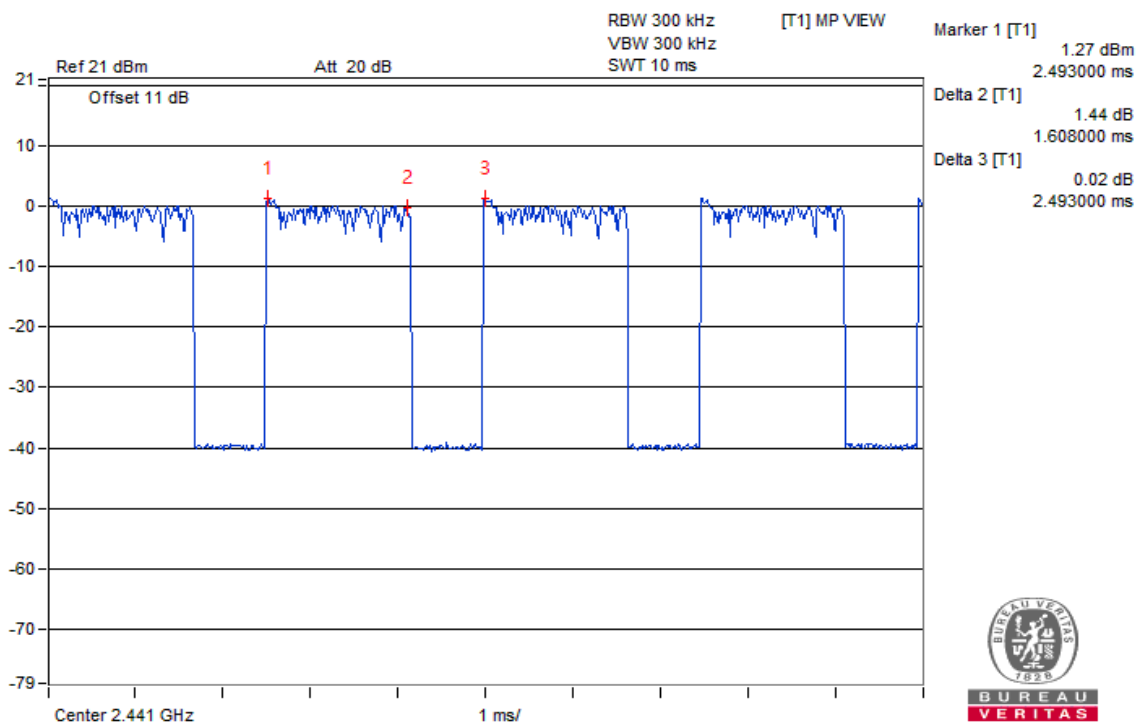
2DH3



V<sub>min</sub>.



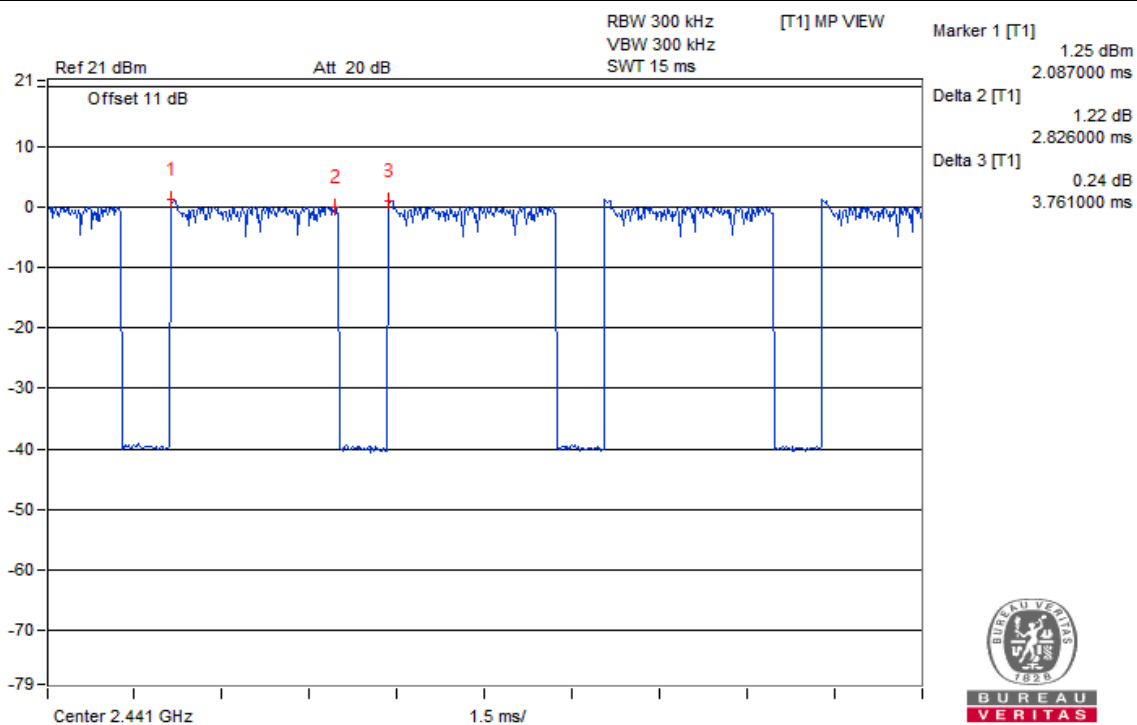
2DH1



2DH3



BUREAU  
VERITAS

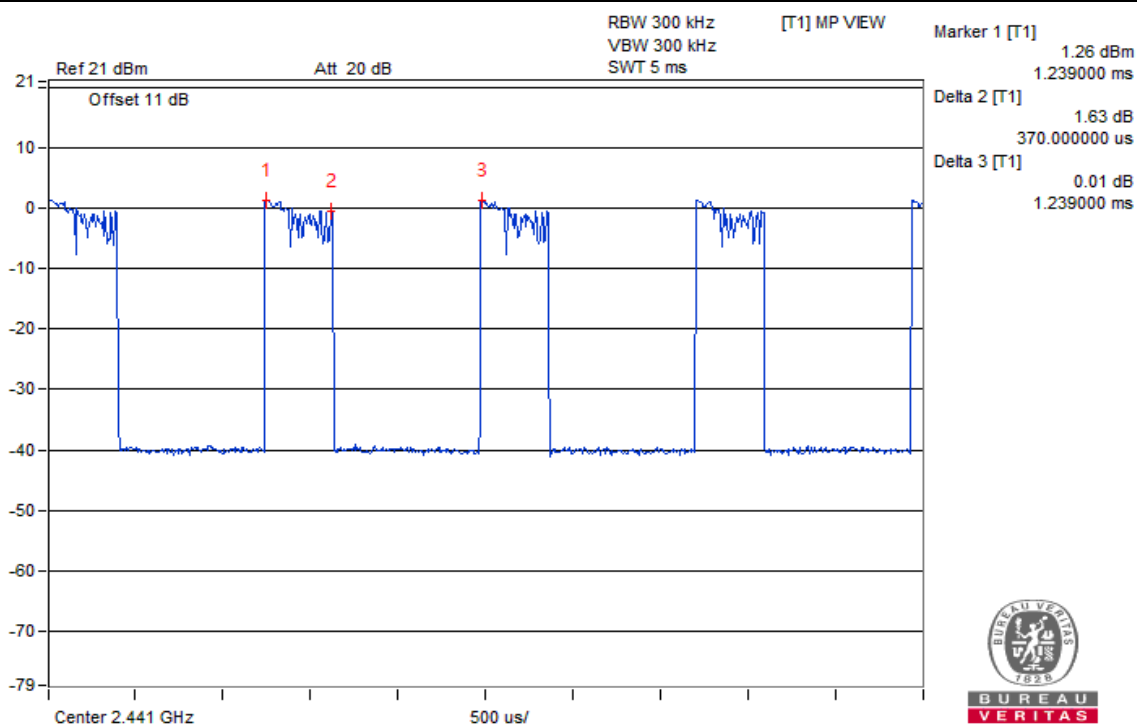


BUREAU  
VERITAS

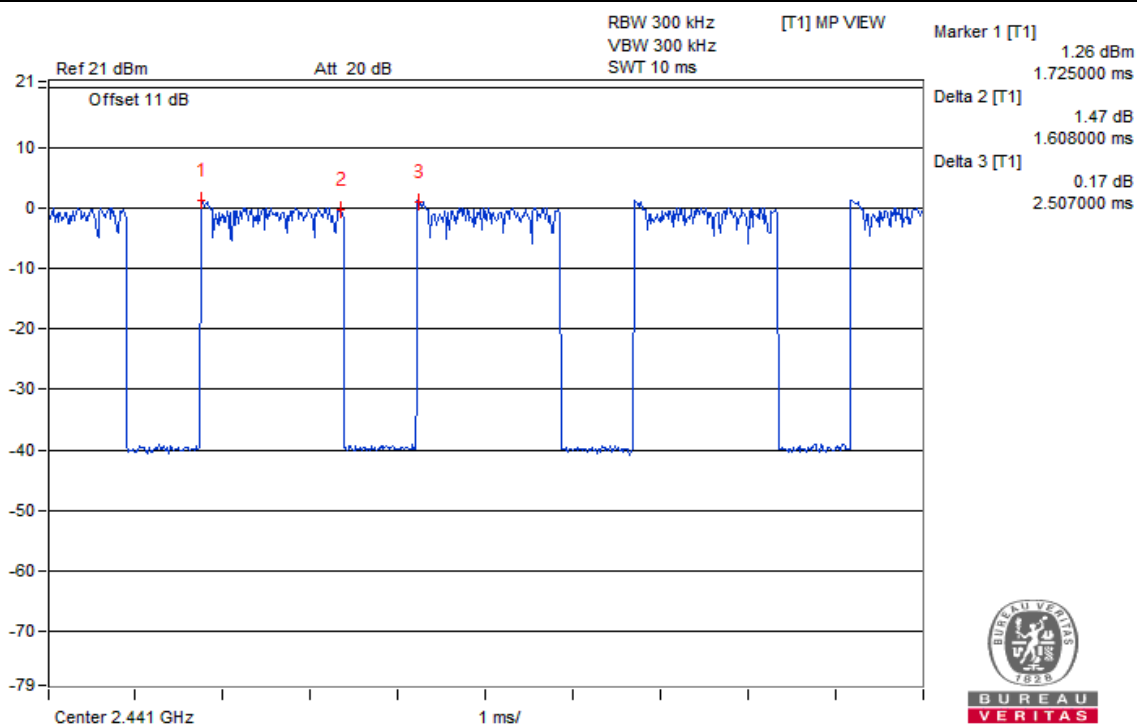
**AFH Mode:**

Test Condition	Mode	Diffusion Rate	[Diffusion Rate/79]*0.4 sec	Duty Cycle	Result (msec)	Limit (msec)
<b>V<sub>normal</sub></b>	2DH1	18.33	0.366	0.298	109.068	400
	2DH3	18.33	0.366	0.641	234.606	400
	2DH5	18.33	0.366	0.751	274.866	400
<b>V<sub>max.</sub></b>	2DH1	18.05	0.361	0.298	107.578	400
	2DH3	18.05	0.361	0.645	232.845	400
	2DH5	18.05	0.361	0.757	273.277	400
<b>V<sub>min.</sub></b>	2DH1	18.26	0.365	0.298	108.770	400
	2DH3	18.26	0.365	0.645	235.425	400
	2DH5	18.26	0.365	0.751	274.115	400

V<sub>normal</sub>



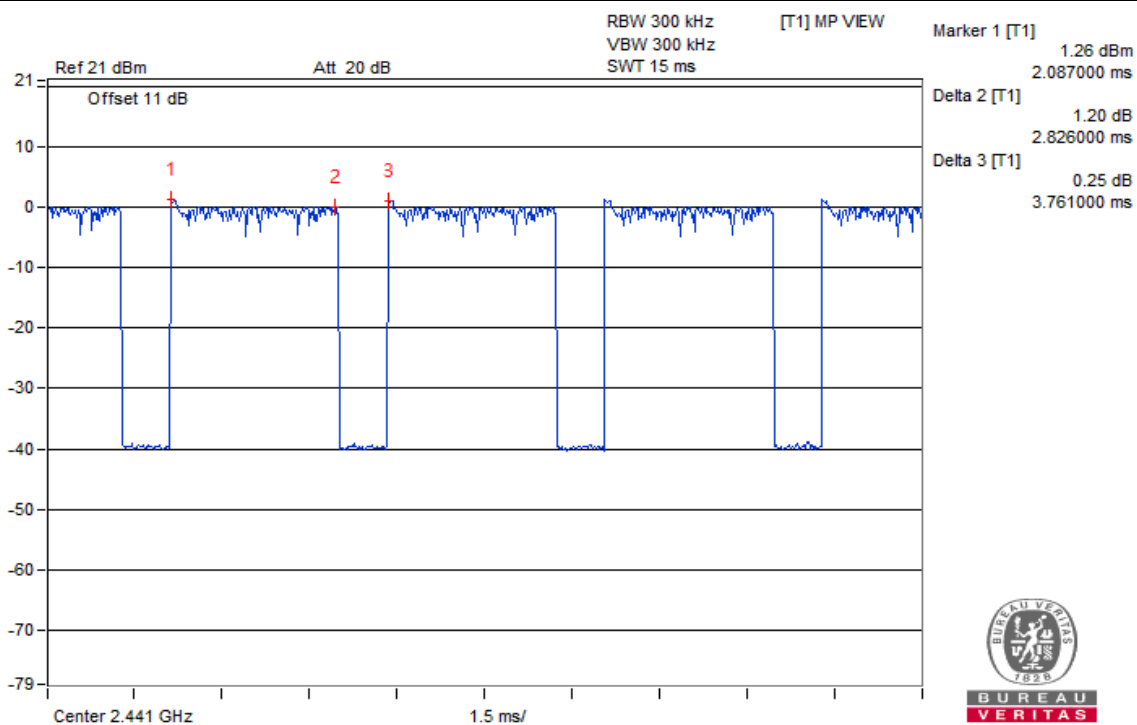
2DH1



2DH3



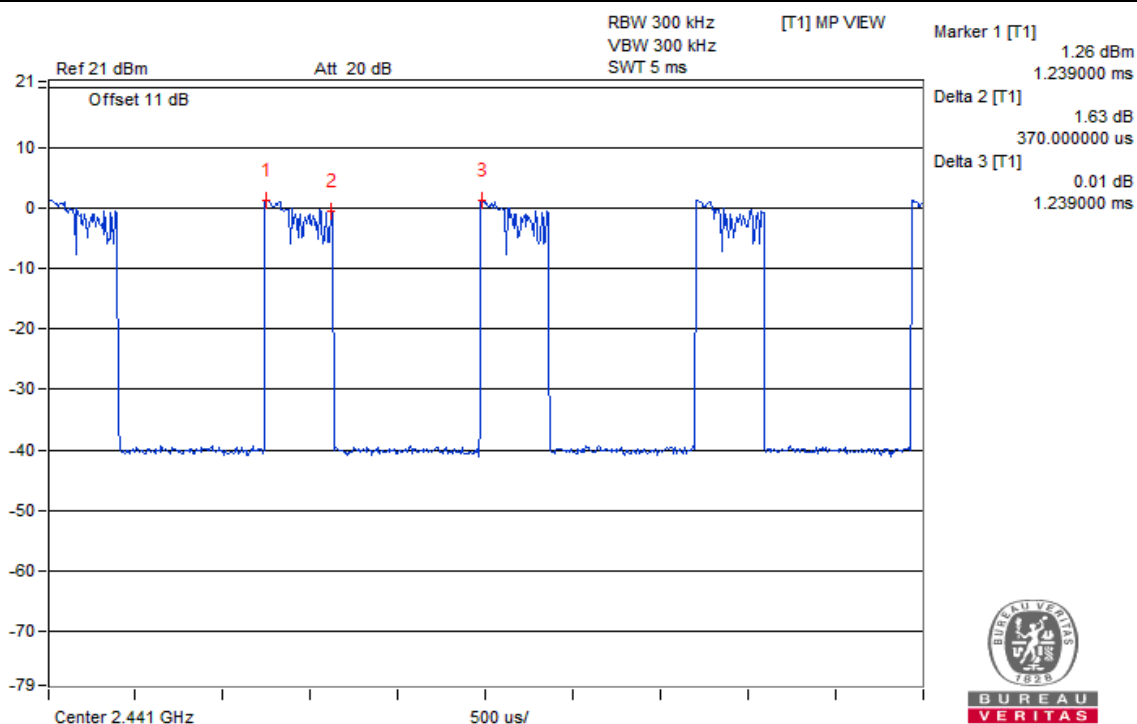
BUREAU  
VERITAS



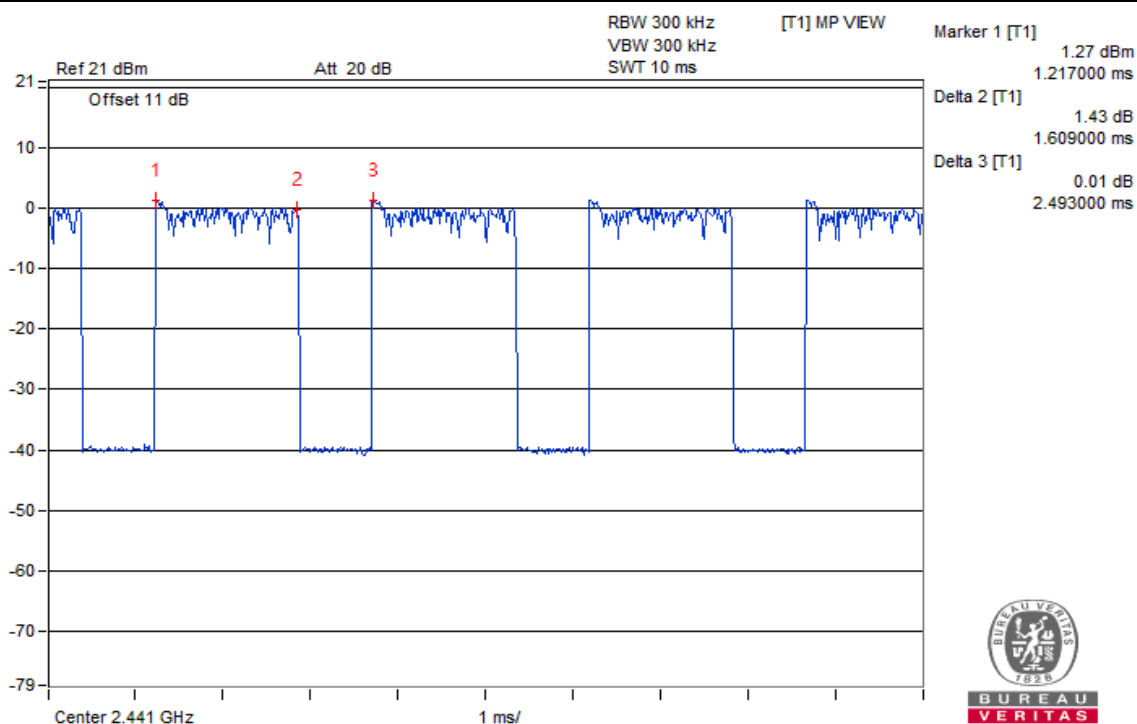
BUREAU  
VERITAS

2DH5

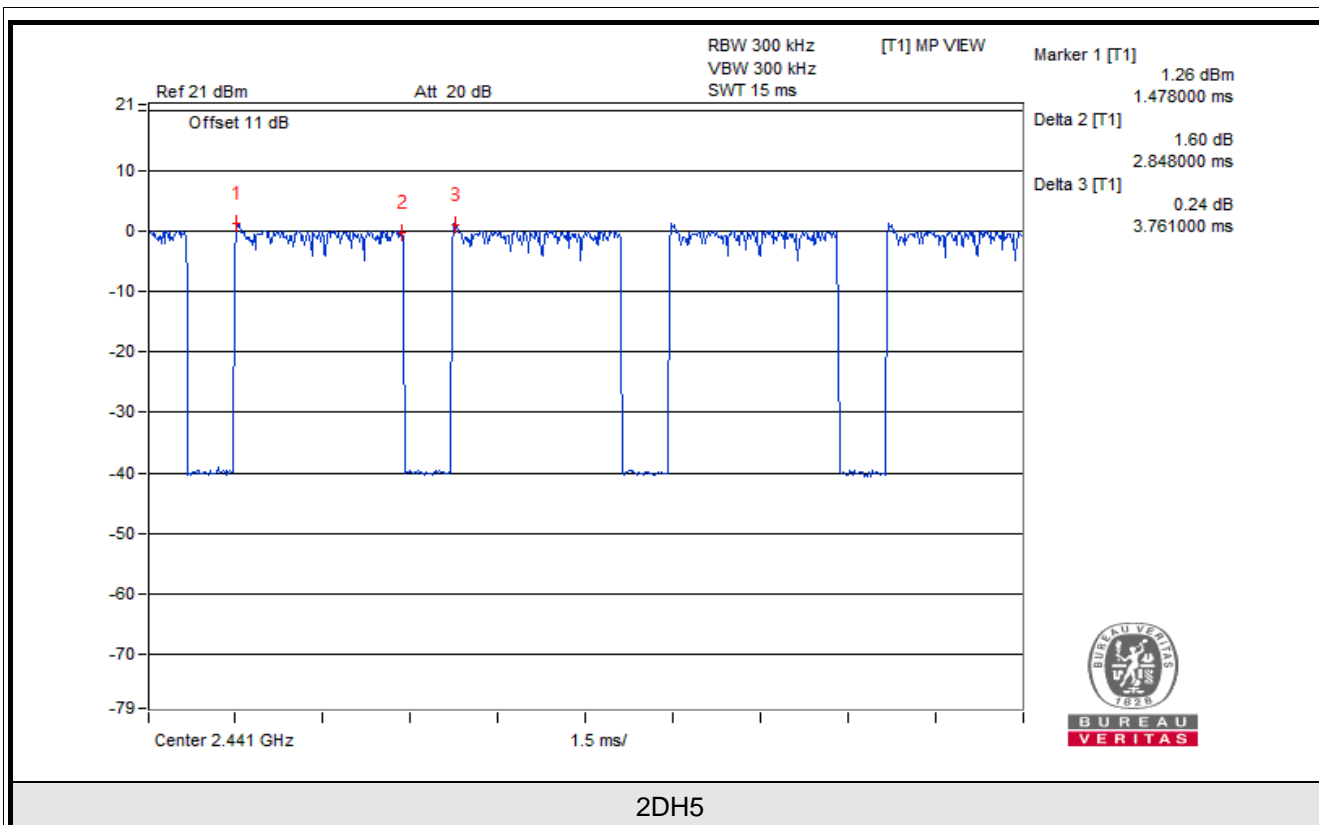
V<sub>max</sub>.



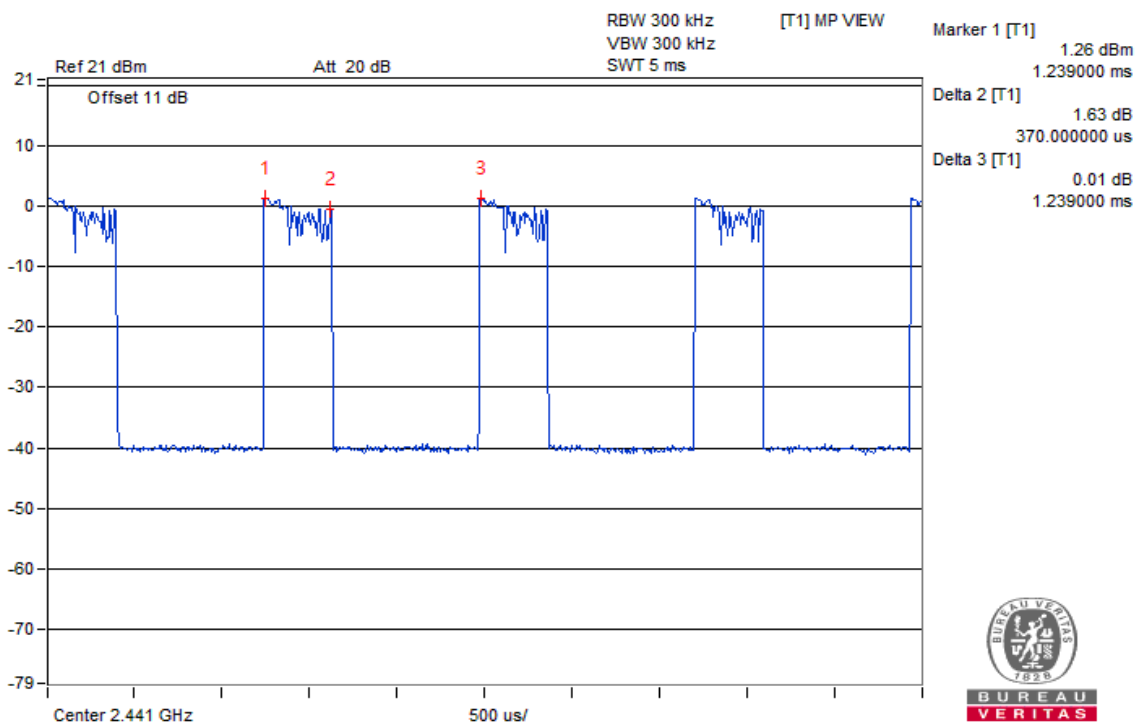
2DH1



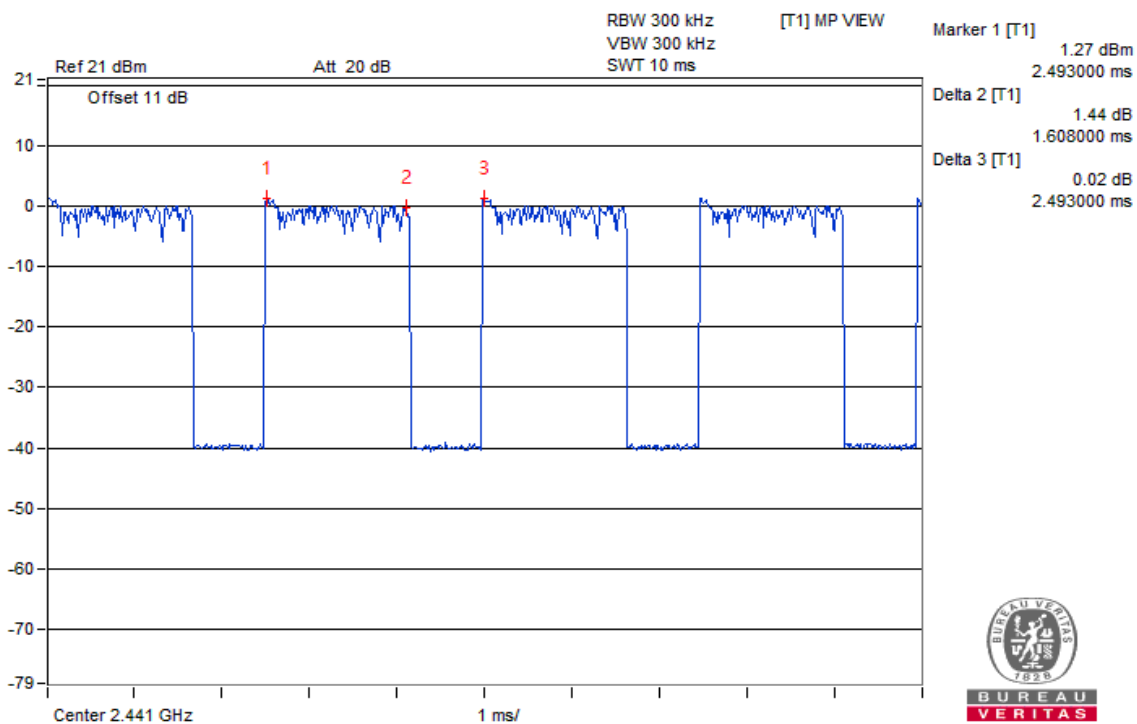
2DH3



V<sub>min</sub>.



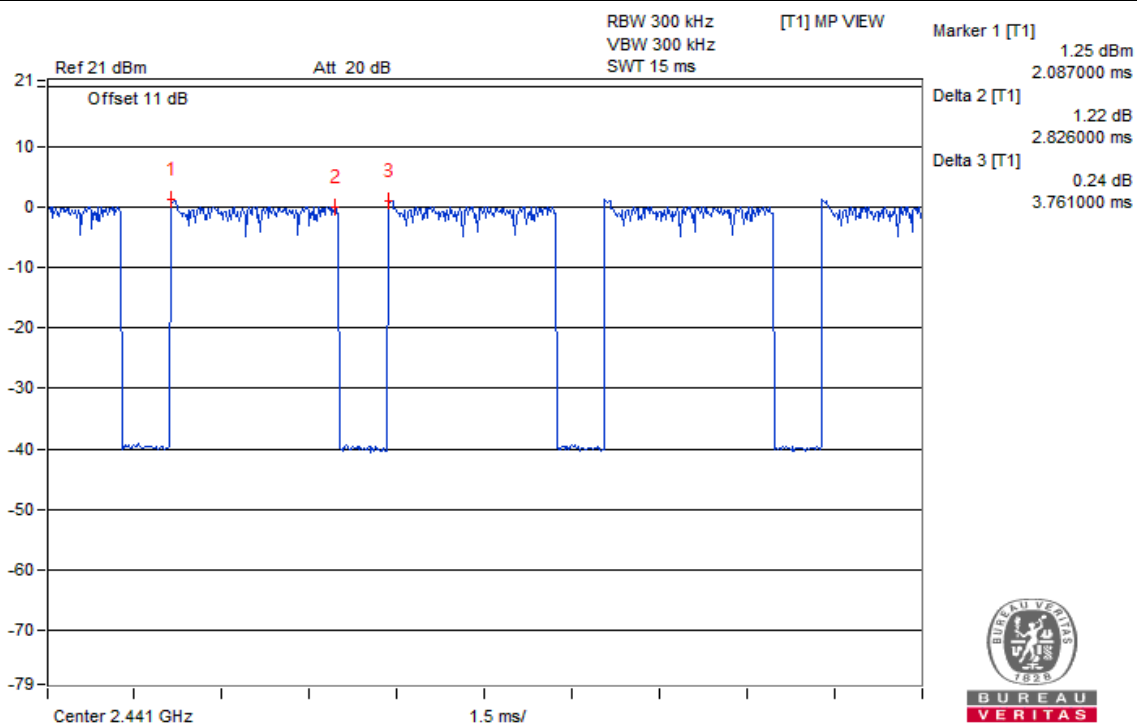
2DH1



2DH3



BUREAU  
VERITAS

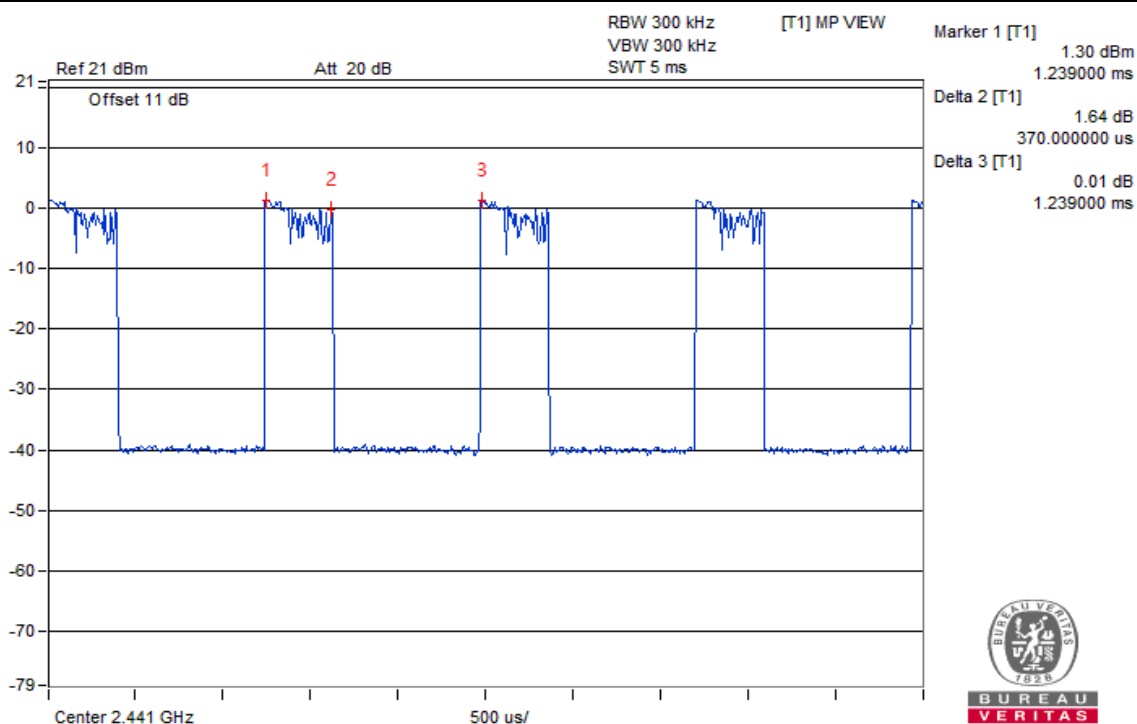


2DH5

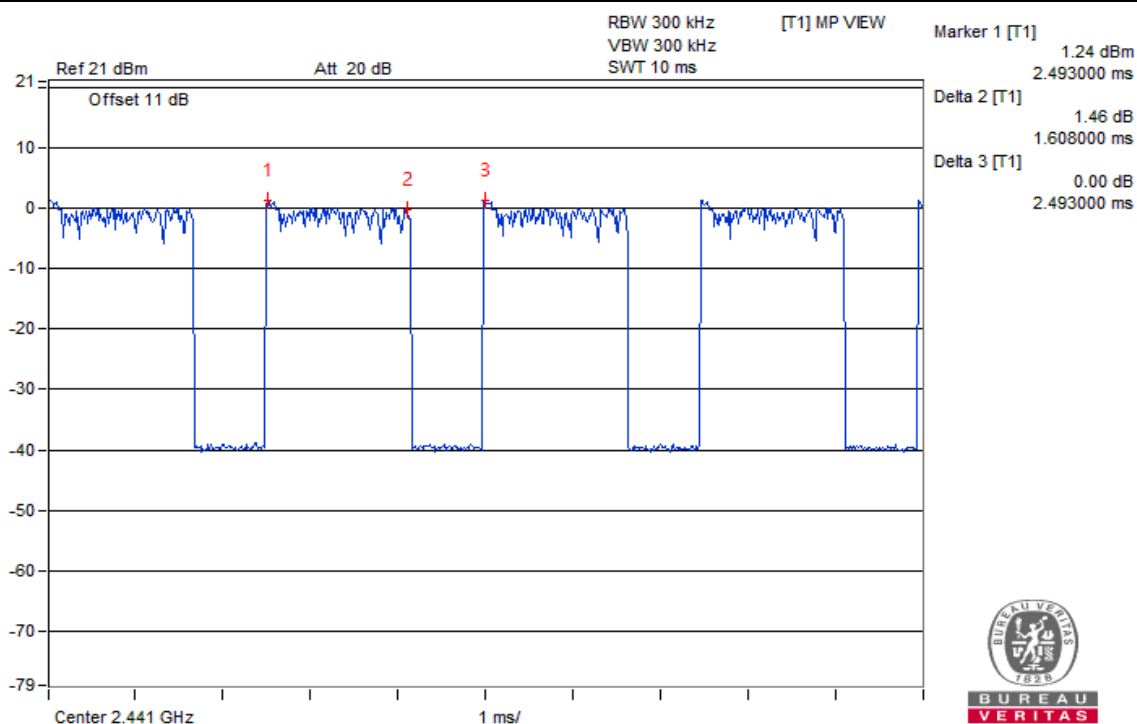
**Modulation: 8DPSK**  
**Normal Mode:**

Test Condition	Mode	Diffusion Rate	[Diffusion Rate/79]*0.4 sec	Duty Cycle	Result (msec)	Limit (msec)
<b>V<sub>normal</sub></b>	3DH1	71.40	0.361	0.298	107.578	400
	3DH3	71.40	0.361	0.645	232.845	400
	3DH5	71.40	0.361	0.751	271.111	400
<b>V<sub>max.</sub></b>	3DH1	71.20	0.360	0.298	107.280	400
	3DH3	71.20	0.360	0.645	232.200	400
	3DH5	71.20	0.360	0.751	270.360	400
<b>V<sub>min.</sub></b>	3DH1	71.00	0.359	0.298	106.982	400
	3DH3	71.00	0.359	0.645	231.555	400
	3DH5	71.00	0.359	0.751	269.609	400

V<sub>normal</sub>



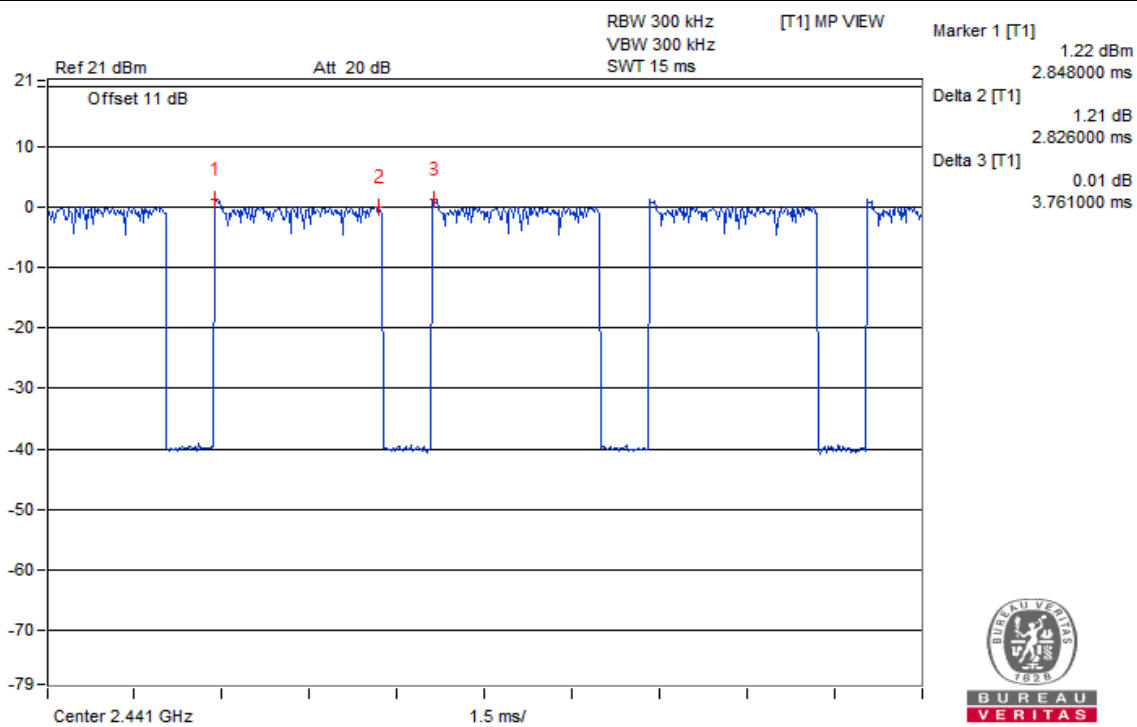
3DH1



3DH3



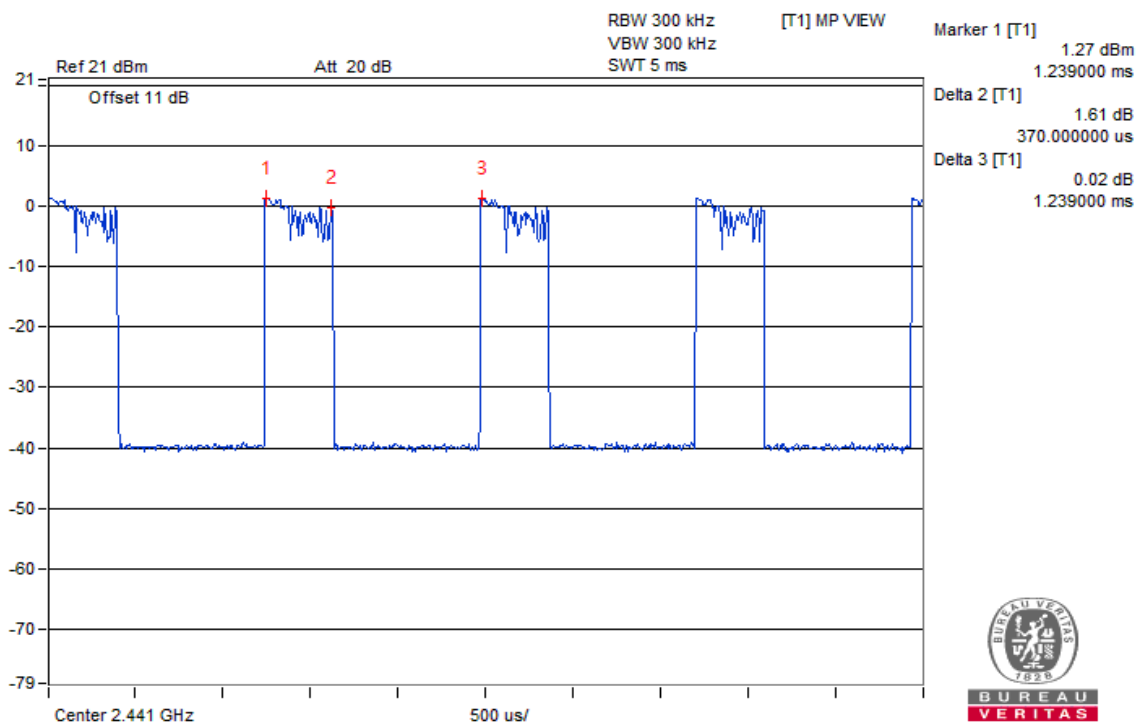
BUREAU  
VERITAS



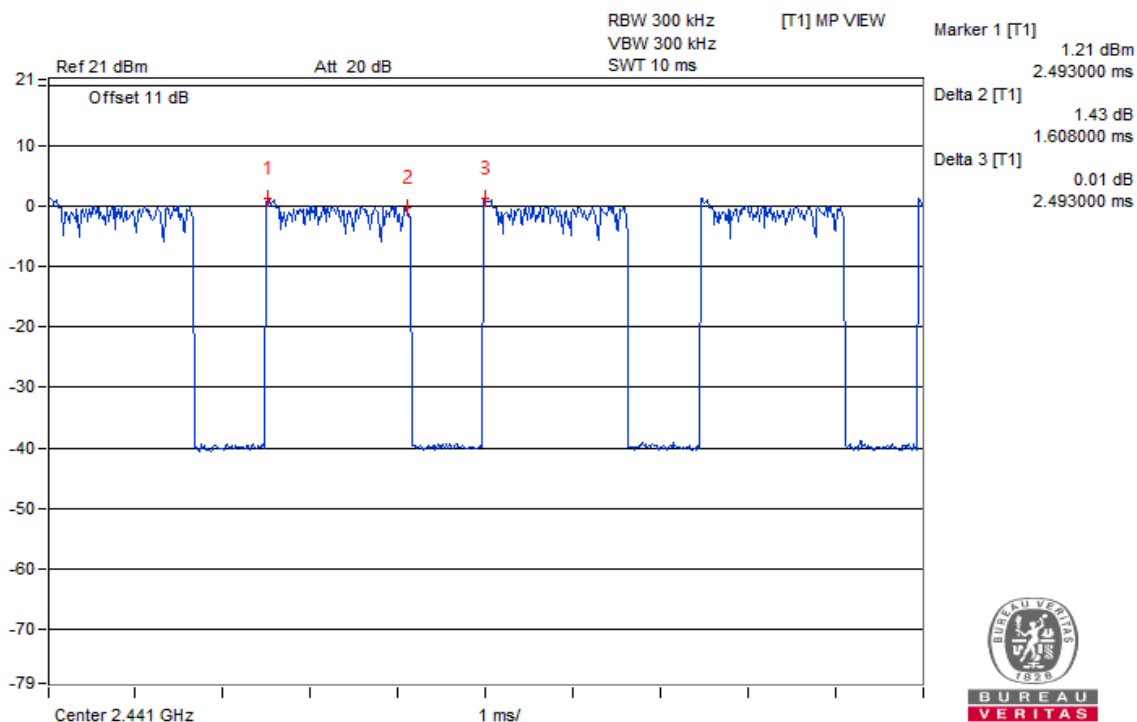
BUREAU  
VERITAS

3DH5

V<sub>max</sub>.



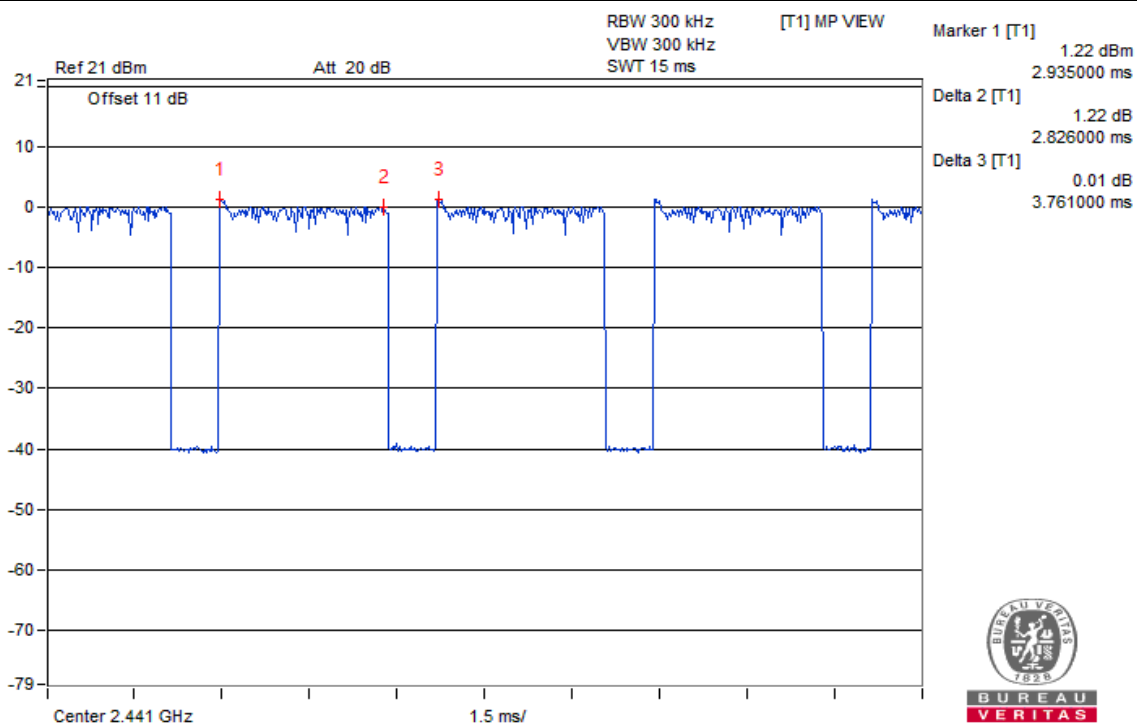
3DH1



3DH3



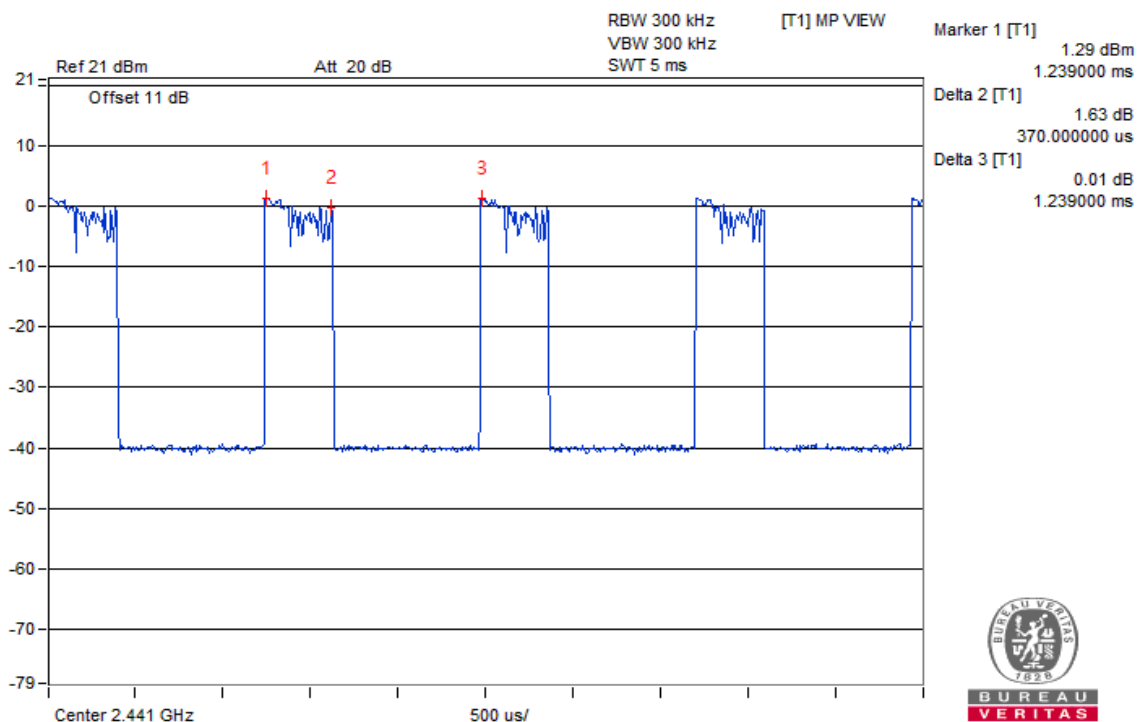
BUREAU  
VERITAS



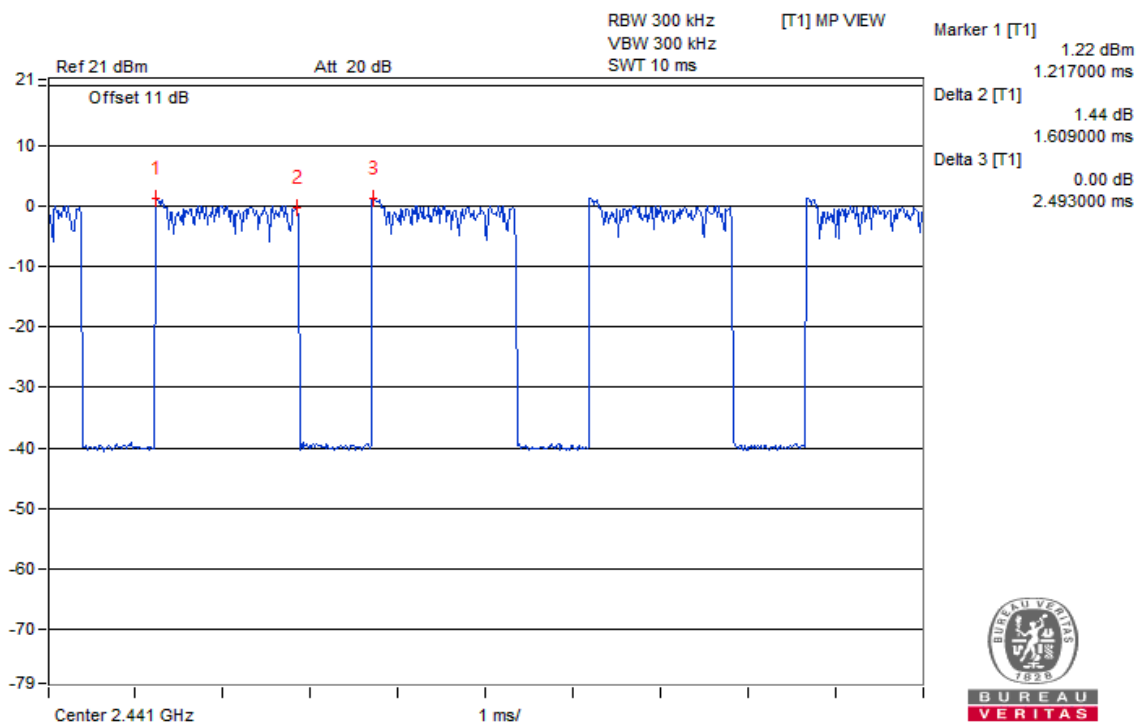
BUREAU  
VERITAS

3DH5

V<sub>min</sub>.



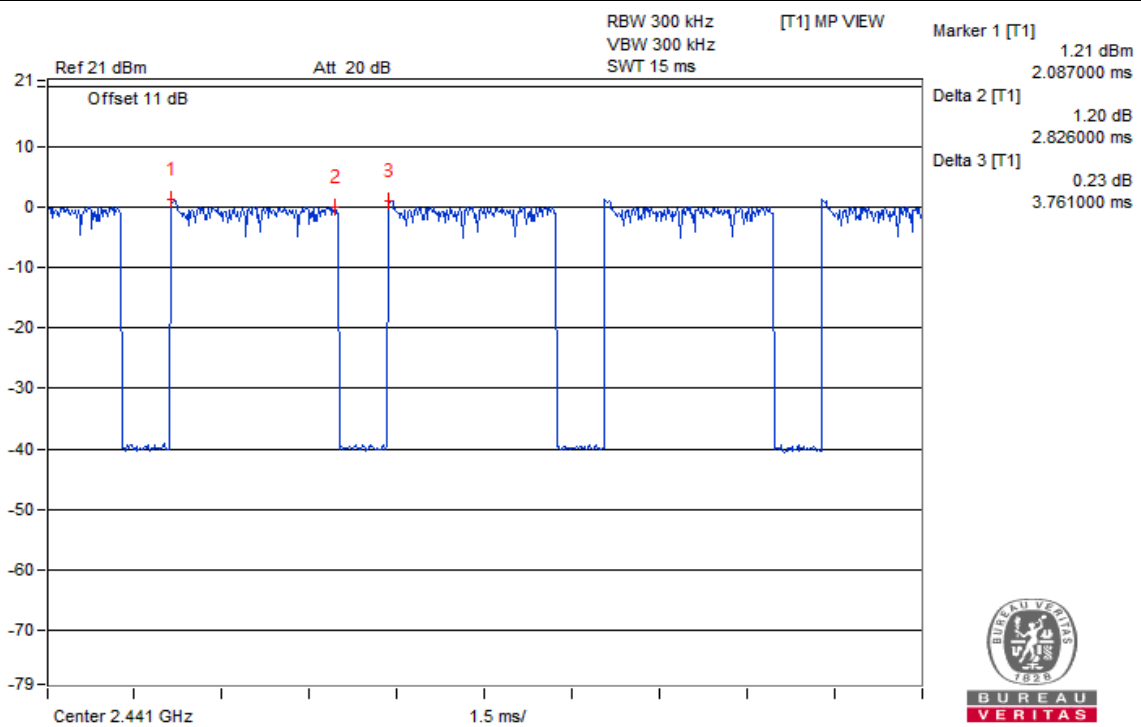
3DH1



3DH3



BUREAU  
VERITAS

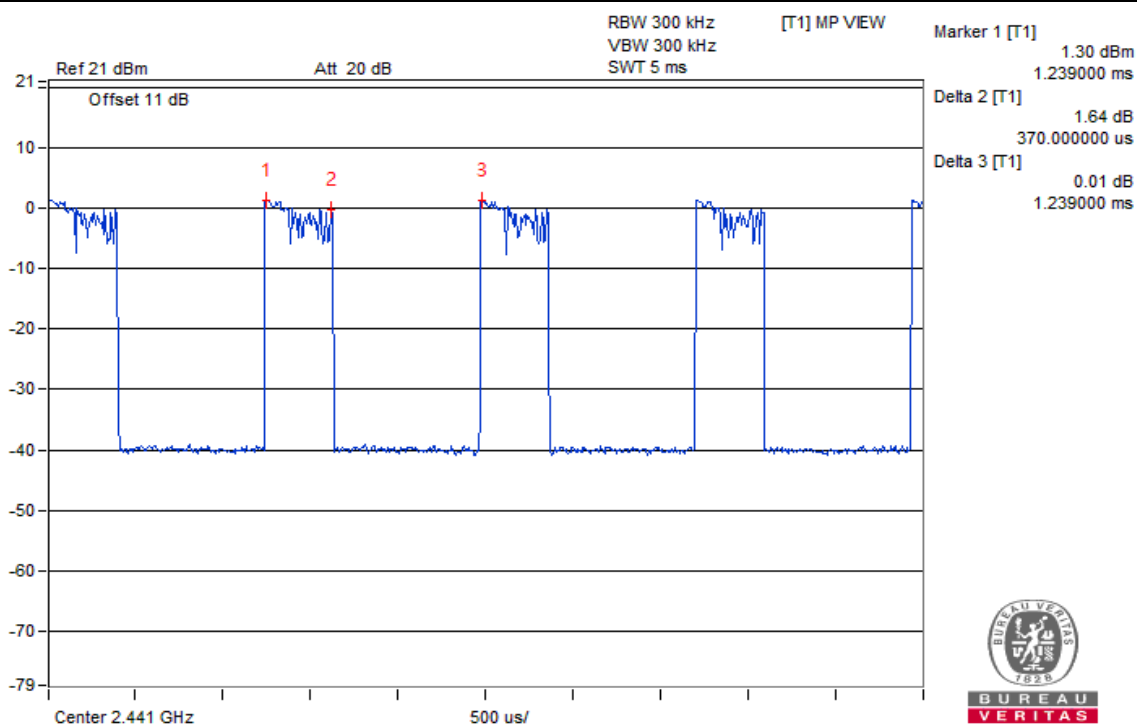


3DH5

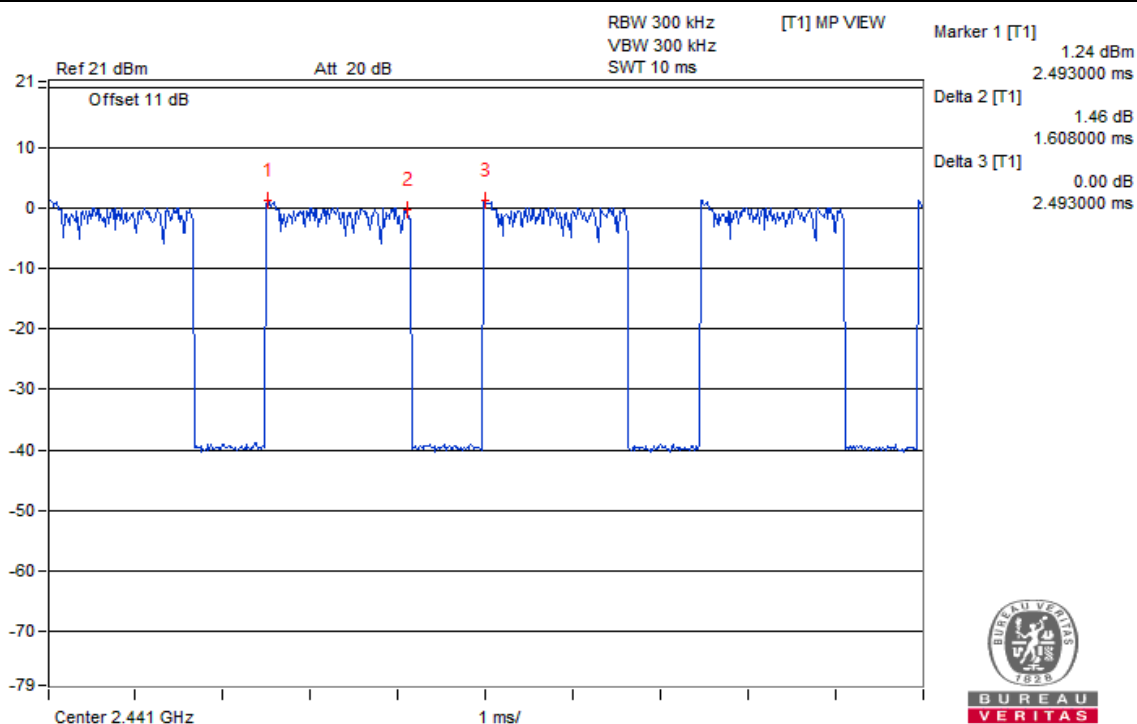
**AFH Mode:**

Test Condition	Mode	Diffusion Rate	[Diffusion Rate/79]*0.4 sec	Duty Cycle	Result (msec)	Limit (msec)
<b>V<sub>normal</sub></b>	3DH1	18.33	0.366	0.298	109.068	400
	3DH3	18.33	0.366	0.645	236.070	400
	3DH5	18.33	0.366	0.751	274.866	400
<b>V<sub>max.</sub></b>	3DH1	18.11	0.362	0.298	107.876	400
	3DH3	18.11	0.362	0.645	233.490	400
	3DH5	18.11	0.362	0.751	271.862	400
<b>V<sub>min.</sub></b>	3DH1	18.33	0.366	0.298	109.068	400
	3DH3	18.33	0.366	0.645	236.070	400
	3DH5	18.33	0.366	0.751	274.866	400

V<sub>normal</sub>



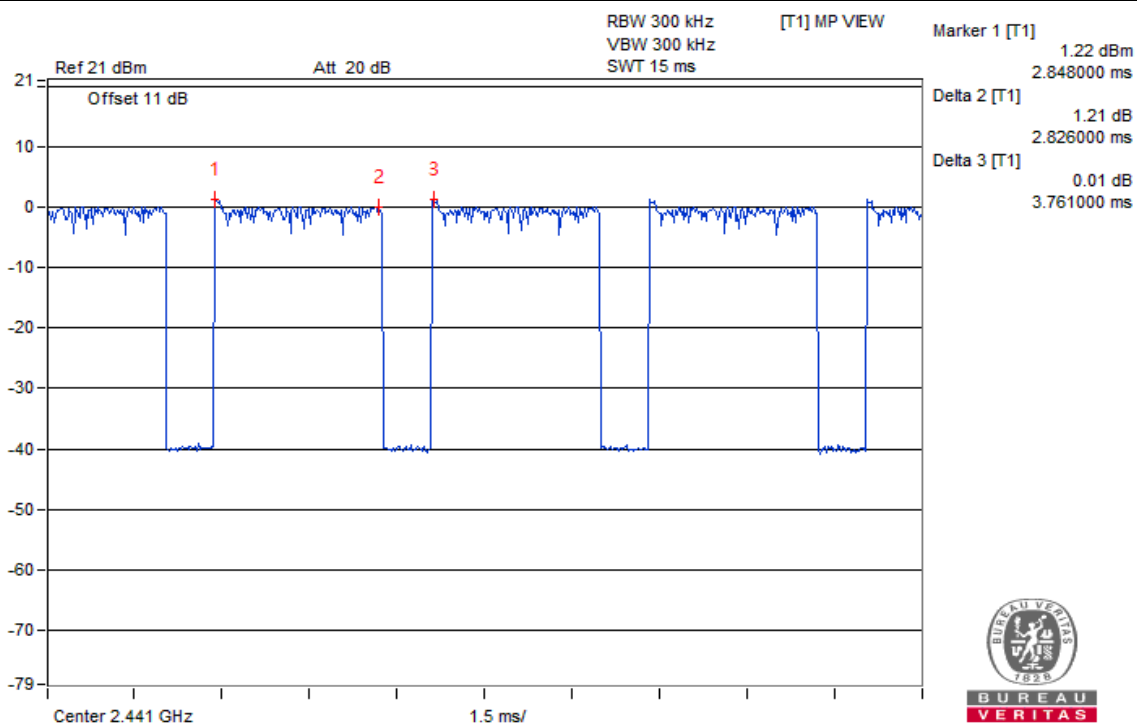
3DH1



3DH3



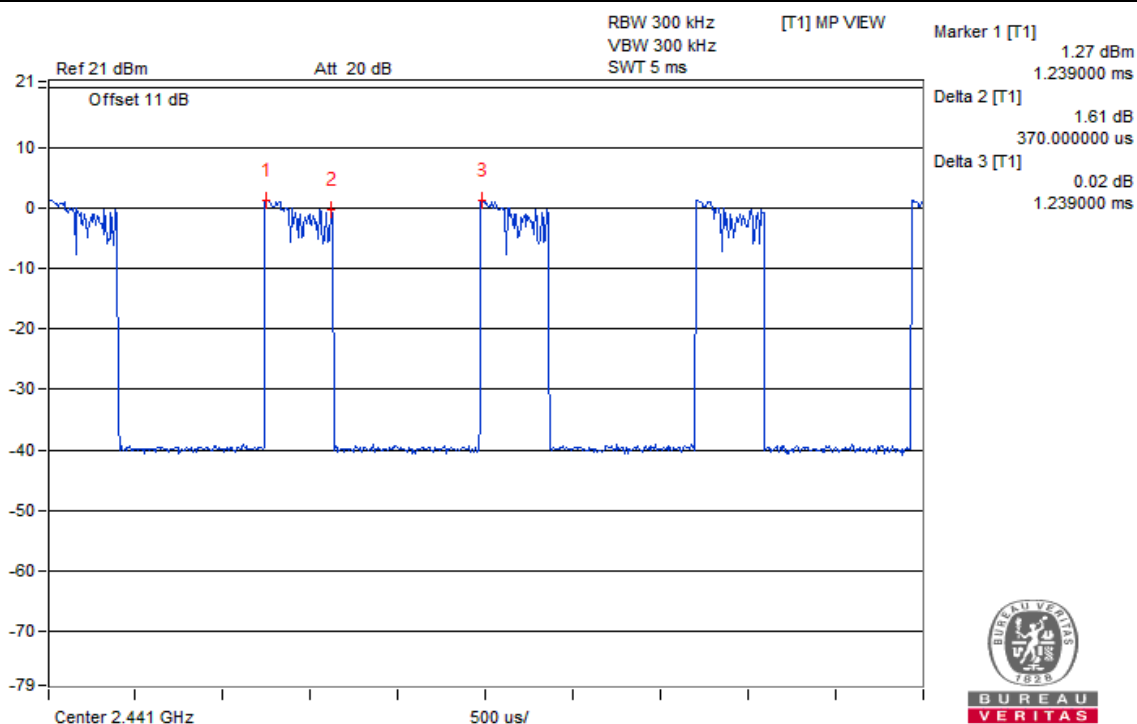
BUREAU  
VERITAS



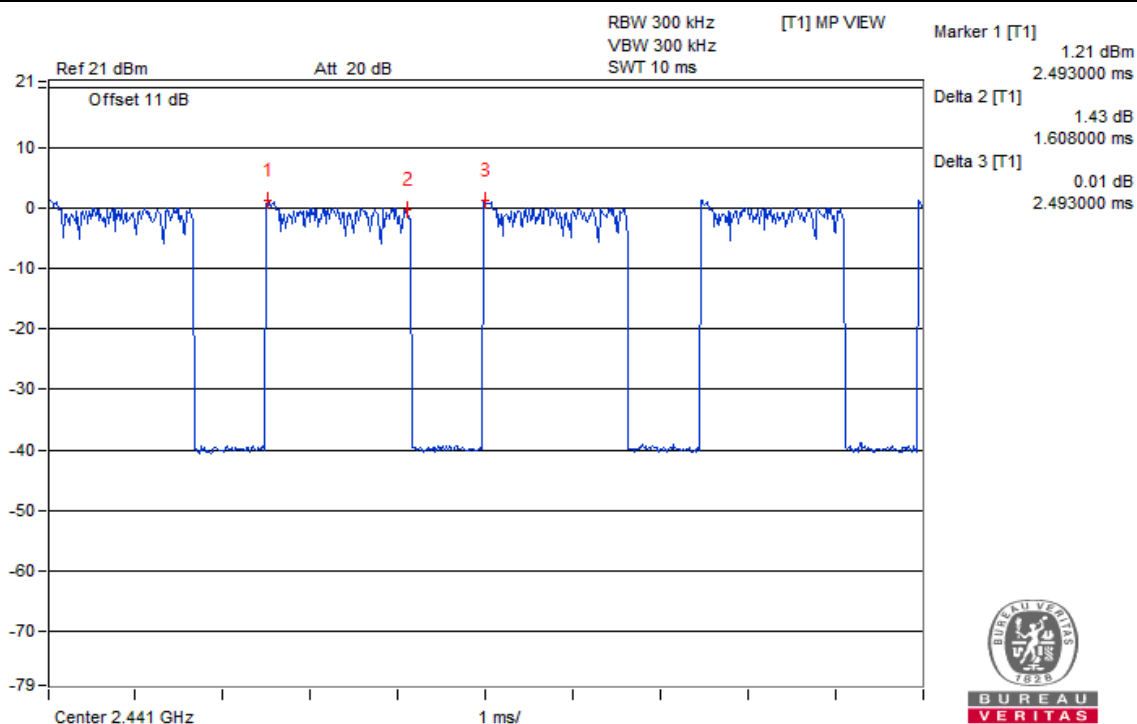
BUREAU  
VERITAS

3DH5

V<sub>max</sub>.



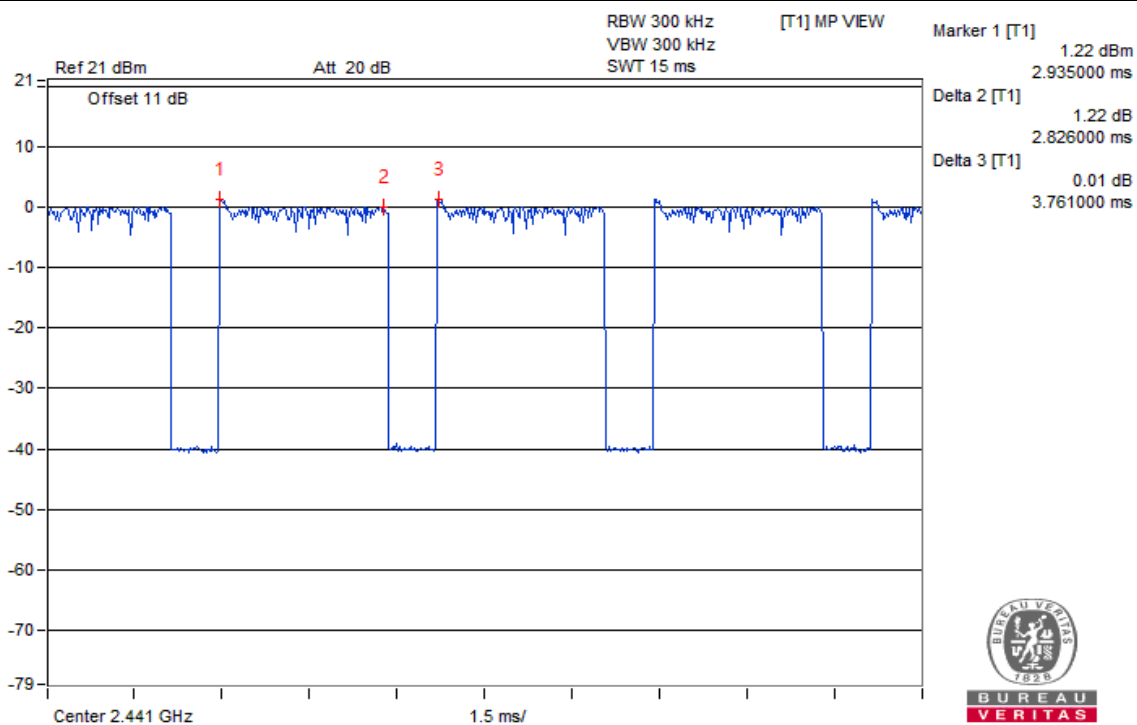
3DH1



3DH3



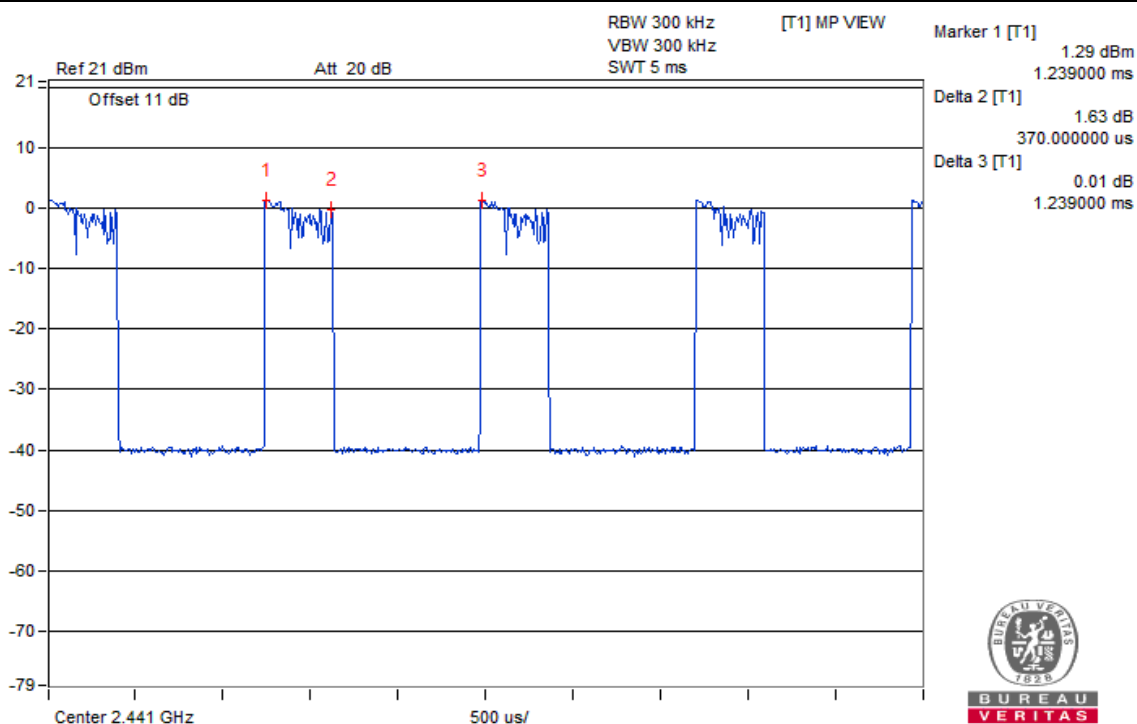
BUREAU  
VERITAS



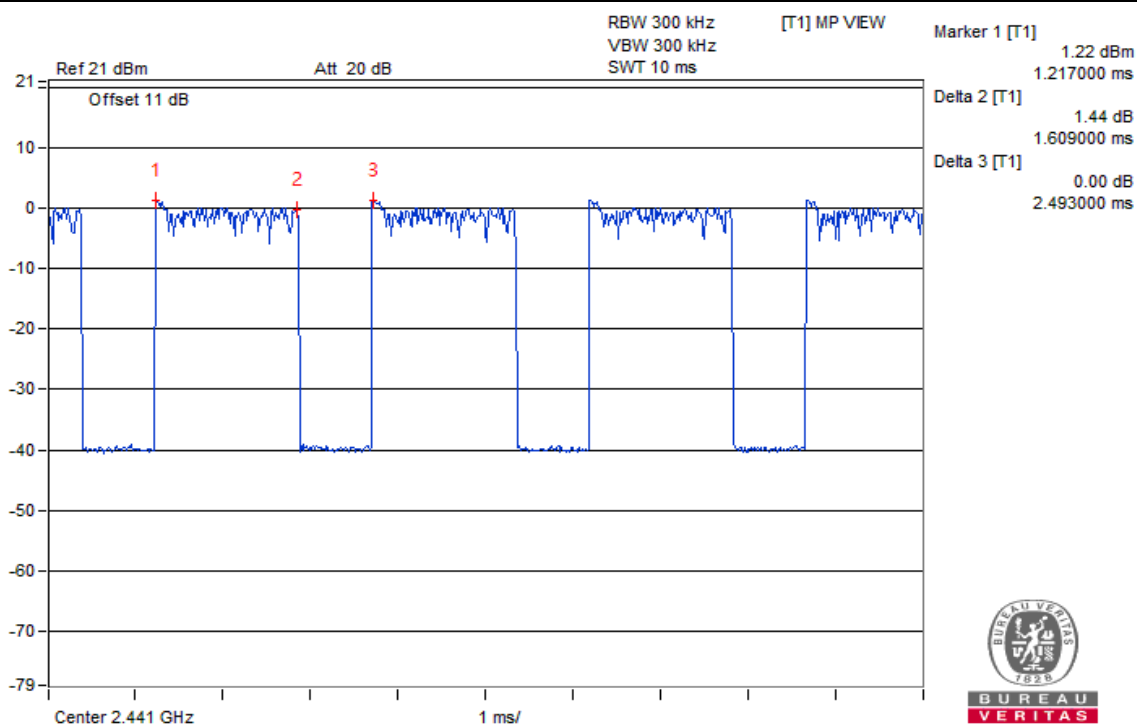
BUREAU  
VERITAS

3DH5

V<sub>min</sub>.



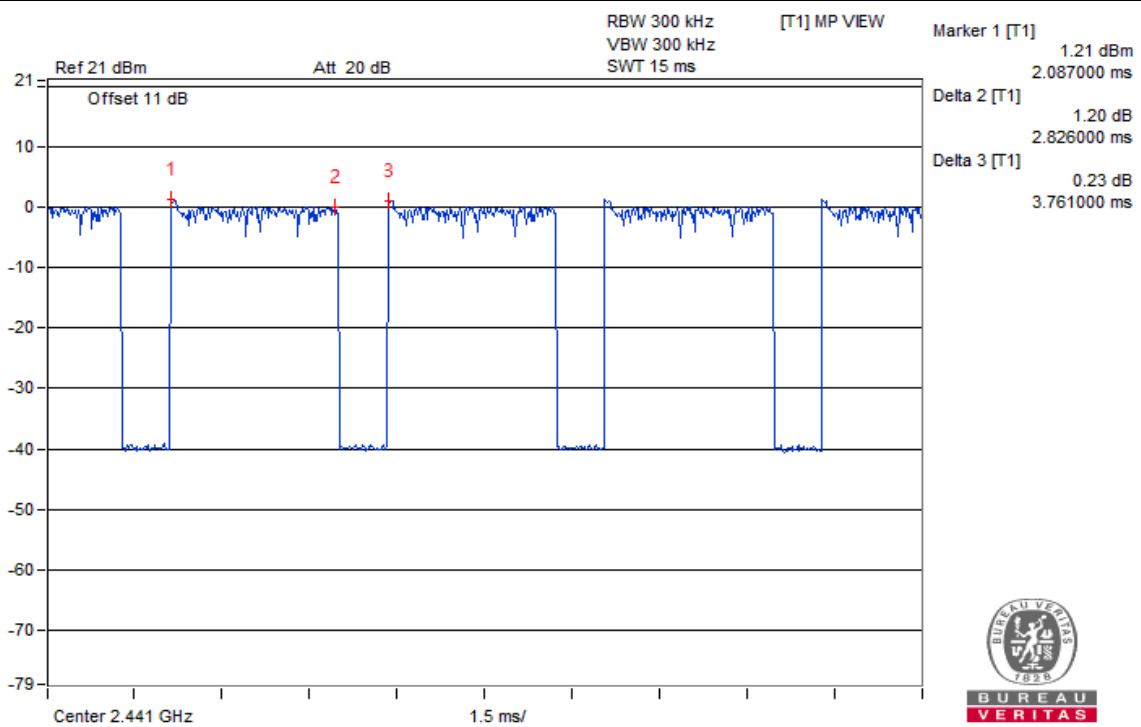
3DH1



3DH3



BUREAU  
VERITAS



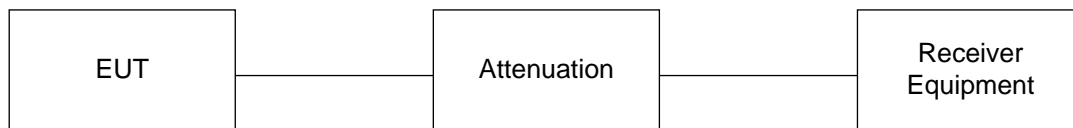
3DH5

## 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.

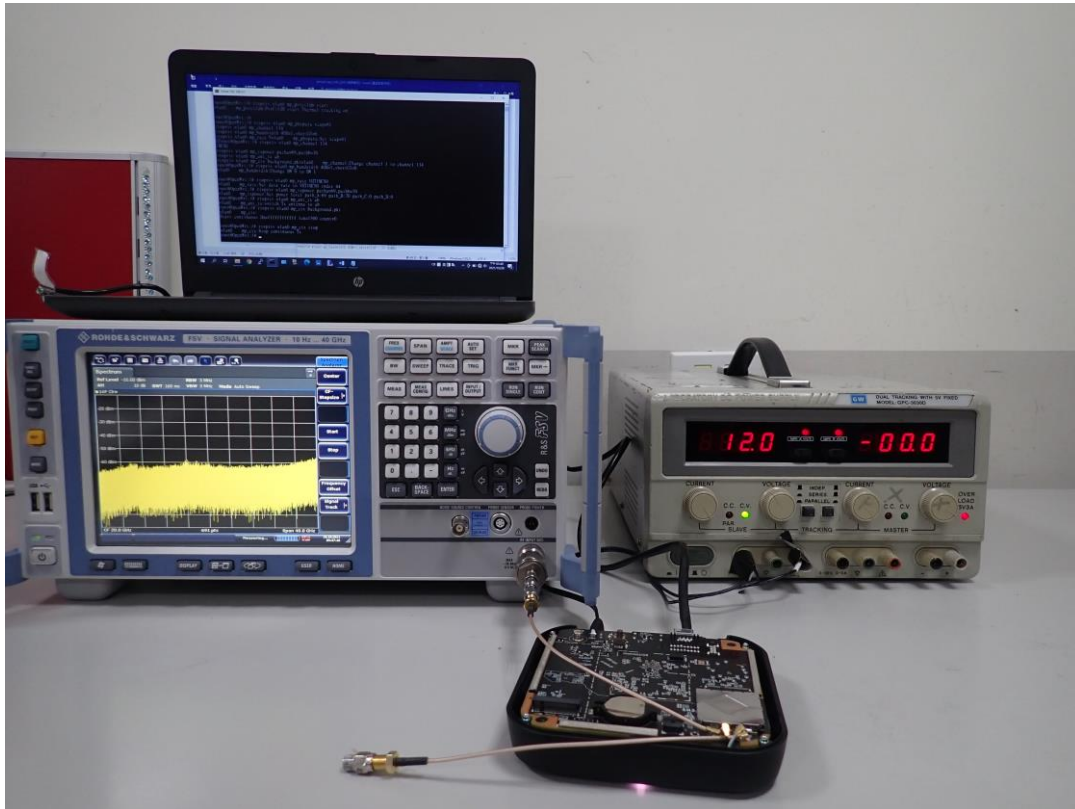
### 4.8.2 Test Setup



### 4.8.3 Test Results

Link Mode	Test Result
BT-EDR	Pass

## 5 Photographs of the Test Configuration



## Appendix - Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

**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](mailto:service.adt@tw.bureauveritas.com)

**Web Site:** [www.bureauveritas-adt.com](http://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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