

Radio Test Report (For Bluetooth Low Energy)

Report No.: RJCDBM-WTW-P22030865-3

Test Model: MGM240P32A, MGM240P32N (refer to item 3.1 for more details)

Received Date: Mar. 22, 2022

Test Date: Apr. 19 ~ May 09, 2022

Issued Date: Jun. 23, 2022

Applicant: Silicon Laboratories Finland Oy

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

Release Control Record	3
1 Certificate of Conformity	4
2 Summary of Test Results	5
2.1 Test Instruments	6
2.2 Measurement Uncertainty	6
2.3 Modification Record	6
3 General Information	7
3.1 General Description of EUT	7
3.2 Description of Test Modes	9
3.3 Test Conditions	11
3.4 Assembly	12
3.5 Antenna Specifications	12
3.5.1 Antenna Gain	12
3.5.2 Antenna Pattern	13
4 Test Results	15
4.1 Frequency Tolerance Measurement	15
4.1.1 Limits of Frequency Tolerance Measurement	15
4.1.2 Test Setup	15
4.1.3 Test Results	15
4.2 Occupied Bandwidth Measurement (99% power bandwidth)	16
4.2.1 Limits of Occupied Bandwidth Measurement	16
4.2.2 Test Setup	16
4.2.3 Test Results	17
4.3 Spreading Bandwidth Measurement (90% power bandwidth)	21
4.3.1 Test Setup	21
4.3.2 Test Results	22
4.4 Spurious Emissions for Transmitter Measurement	26
4.4.1 Limits of Spurious Emissions	26
4.4.2 Test Setup	26
4.4.3 Test Results	27
4.5 Antenna Power Measurement	35
4.5.1 Limits of Antenna Power	35
4.5.2 Test Setup	35
4.5.3 Test Results	36
4.6 Spurious Emissions for Receiver	38
4.6.1 Limits of Spurious Emissions For Receiver	38
4.6.2 Test Setup	38
4.6.3 Test Result	39
4.7 Dwell Time	50
4.7.1 Limits of Dwell Time	50
4.7.2 Test Setup	50
4.7.3 Test Result	51
4.8 Interference Prevention Function	55
4.8.1 Limits of Interference Prevention Function	55
4.8.2 Test Setup	55
4.8.3 Test Results	55
5 Photographs of the Test Configuration	56
Appendix - Information of the Testing Laboratories	57

Release Control Record

Issue No.	Description	Date Issued
RJCDBM-WTW-P22030865-3	Original release	Jun. 23, 2022

1 Certificate of Conformity

Product: Bluetooth Low Energy and 802.15.4 wireless radio module

Brand: Silicon Labs

Test Model: MGM240P32A, MGM240P32N (refer to item 3.1 for more details)

Sample Status: Engineering samples fully representing the production modules

Applicant: Silicon Laboratories Finland Oy

Test Date: Apr. 19 ~ May 09, 2022

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

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

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

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

2 Summary of Test Results

The EUT has been tested according to the following specifications:

Notice 88 Appendix 43 Reference	ARIB STD-T66 Ref.	Report Reference	Parameter	Test Results (Note)
General Provisions				
C	3.2 (4)	4.1	Frequency tolerance	C
D	3.2 (7)	4.2	Occupied bandwidth	C
E	3.2 (6)	4.4	Spurious emissions	C
Transmitting Equipment				
F	3.2 (2)	4.5	Antenna power	C
--	--	--	SAR	NA
Transmitting Antenna				
--	--	3.4	Type, configuration, etc. of transmitting antenna	C
--	--	3.5	Direction pattern of transmitting antenna	C
Receiving Equipment				
G	3.3 (1)	4.6	Spurious emissions of receiver	C
--	--	3.5	Refer to all articles for transmitting antenna	C
Operating Frequency 2400 to 2483.5MHz				
--	3.7 (1)	3.4	Radio Frequency/modulation section cannot be opened easily	C
--	3.1 (1)	3.1	Communication method	C
--	3.2 (1)a	3.1	Modulation method	C
--	3.2 (1)a	3.1	Spread spectrum method	C
--	3.2 (2)	4.5	Antenna power	C
--	3.6 (2)	4.5	Absolute gain of transmitting antenna	C
--	3.6 (2)	--	Angular width of principal radiation (AWPR)	NA
--	3.2 (10)	--	Number of carriers within 1 MHz bandwidth in OFDM	NA
--	3.2 (8)	4.3	Spreading bandwidth	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. 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 Test Instruments

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

Note:

1. Calibration Method

- Calibration conducted by the National Institute of Information and Communications Technology (NICT) or a designated calibration agency under Article 102-18 paragraph (1) of the Radio Law.
- Calibration conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Law (Law No. 51 of 1992) Japan Calibration Service System.
- Calibration conducted in foreign countries, which shall be equivalent to the calibration conducted by the NICT or a designated calibration agency under Article 102-18 paragraph (1).
- Calibration conducted by using other equipment that listed above from a) to c).

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

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

2.2 Measurement Uncertainty

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

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

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

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

2.3 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Bluetooth Low Energy and 802.15.4 wireless radio module
Brand	Silicon Labs
Test Model	MGM240P32A, MGM240P32N
Model Difference	Refer to note
Status of EUT	Engineering samples fully representing the production modules
Nominal Voltage	1.8Vdc, 3.3Vdc, 3.8Vdc
Modulation Type	GFSK
Modulation Technology	FHSS
Transfer Rate	1MBaud with 1Mbps transfer rate 1MBaud with Coded 125kbps transfer rate 1MBaud with Coded 500kbps transfer rate 2MBaud with 2Mbps transfer rate
Operating Frequency	2402 ~ 2480MHz
Number of Channel	1MBaud: 40 2MBaud: 37
Rated RF Output Power	Refer to note
Conducted RF Output Power	Refer to note
Radiated RF Output Power	Refer to note
Antenna Type	Refer to note
Antenna Connector	Refer to note
Accessory Device	NA
Data Cable Supplied	NA

Note:

1. All models are listed as below.

Product Spec.	Model	
	MGM240P32A	MGM240P32N
	High-Power/ Bluetooth Low Energy and 802.15.4	High-Power/ Bluetooth Low Energy and 802.15.4
Max nominal RF TX power, as declared by manufacturer	20dBm	20dBm
Antenna type	integral antenna	RF pin
Hardware	MGM240P32A --> hardware variants with integral antenna and 20dBm max power, to be tested as DTS for 802.15.4 and FHSS for Bluetooth Low Energy MGM240P32N --> hardware variants with RF pin and 20dBm max power, to be tested as DTS for 802.15.4 and FHSS for Bluetooth Low Energy These hardware variants should be RF tested separately, because PAs are configured differently and also antenna matching components are different between them, meaning for example that conducted RF measurements cannot be assumed to deliver the exact same results across the these samples. MGM modules are the ones under testing as they support both 802.15.4 and Bluetooth Low Energy.	

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

3. The antenna information is listed as below.

No.	Type	Connector	Gain (dBi)	Remark
1	Integral antenna	NA	1.82	For model: MGM240P32A
2	External reference dipole antenna**	SMA Male	2.80	For model: MGM240P32N

* 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.

** The dipole antenna is not sold with the EUT, but is used during testing as a reference antenna for radiated measurements of the parts with the RF pin.

4. The power table as below:

Model: MGM240P32A

Transfer Rate	Mode	Rated power (mW/MHz)	Conducted RF output power density (mW/MHz)	Radiated RF output power density (mW/MHz)
1MBaud with 1Mbps transfer rate	Normal mode	1.00	0.711427	1.081759
2MBaud with 2Mbps transfer rate	AFH mode	2.40	2.449892	3.725177

Model: MGM240P32N

Transfer Rate	Mode	Rated power (mW/MHz)	Conducted RF output power density (mW/MHz)	Radiated RF output power density (mW/MHz)
1MBaud with 1Mbps transfer rate	Normal mode	1.00	0.711427	1.355596
2MBaud with 2Mbps transfer rate	AFH mode	2.40	2.449892	4.668173

3.2 Description of Test Modes

1MBaud

40 channels are provided to this EUT:

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

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

2MBaud

37 channels are provided to this EUT:

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

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

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

Model: MGM240P32A

1MBaud with 1Mbps transfer rate	2MBaud with 2Mbps transfer rate
Power setting	Power setting
167	167

Model: MGM240P32N

1MBaud with 1Mbps transfer rate	2MBaud with 2Mbps transfer rate
Power setting	Power setting
167	167

3.3 Test Conditions

Test Conditions	Voltage (Vdc)
Vnormal	3.30
Vmax.	3.80
Vmin.	1.80

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

Test Item	Test Conditions	Environmental Conditions	Test Engineer
Frequency Tolerance	1MBaud with 1Mbps transfer rate Normal Mode 2MBaud with 2Mbps transfer rate Normal Mode	25 deg.C, 60 % RH	Alan Wu
Occupied Bandwidth (99% power bandwidth)	1MBaud with 1Mbps transfer rate Normal Mode AFH Mode 2MBaud with 2Mbps transfer rate Normal Mode AFH Mode	25 deg.C, 60 % RH	Alan Wu
Spreading Bandwidth (90% power bandwidth)	1MBaud with 1Mbps transfer rate Normal Mode AFH Mode 2MBaud with 2Mbps transfer rate Normal Mode AFH Mode	25 deg.C, 60 % RH	Alan Wu
Spurious Emissions for Transmitter	1MBaud with 1Mbps transfer rate AFH Mode 2MBaud with 2Mbps transfer rate AFH Mode	25 deg.C, 60 % RH	Alan Wu
Antenna Power	1MBaud with 1Mbps transfer rate Normal Mode AFH Mode 2MBaud with 2Mbps transfer rate Normal Mode AFH Mode	25 deg.C, 60 % RH	Alan Wu
Spurious Emissions for Receiver	1MBaud with 1Mbps transfer rate Normal Mode 2MBaud with 2Mbps transfer rate Normal Mode	25 deg.C, 60 % RH	Alan Wu
Dwell Time	1MBaud with 1Mbps transfer rate Normal Mode AFH Mode 2MBaud with 2Mbps transfer rate Normal Mode AFH Mode	25 deg.C, 60 % RH	Alan Wu

3.4 Assembly

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

3.5 Antenna Specifications

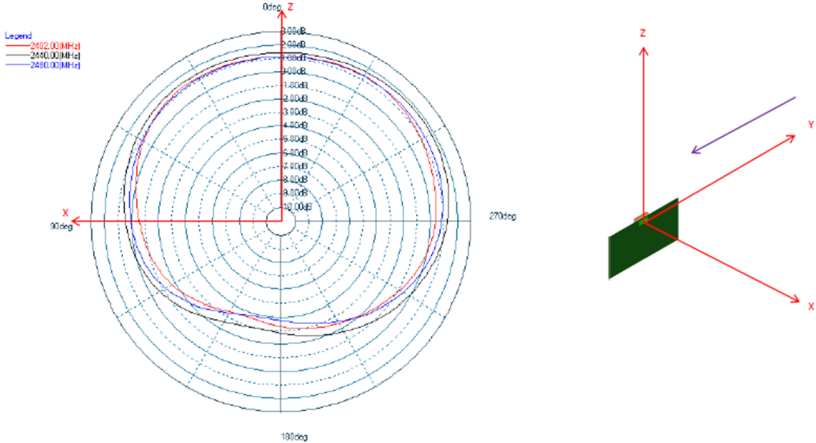
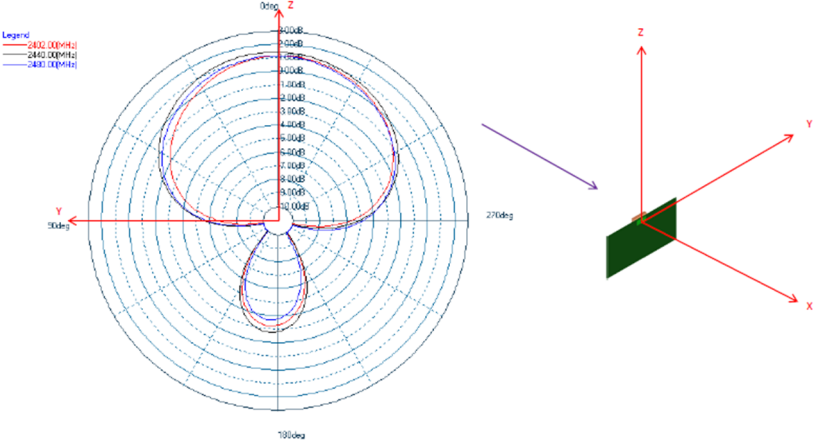
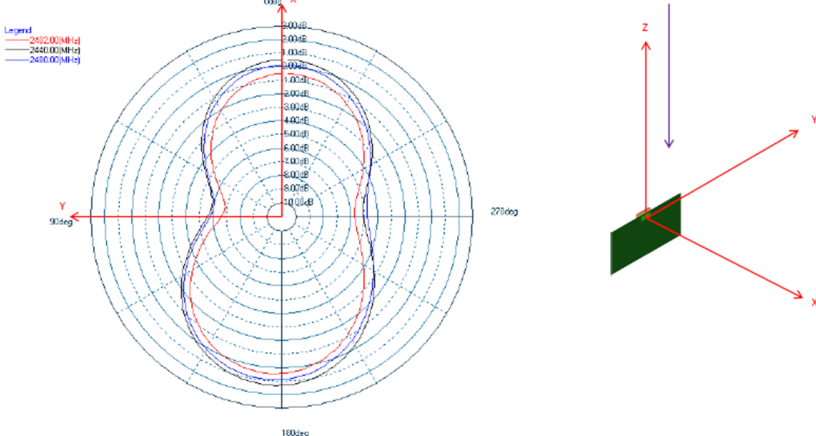
3.5.1 Antenna Gain

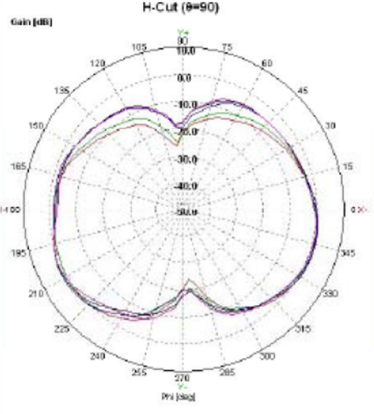
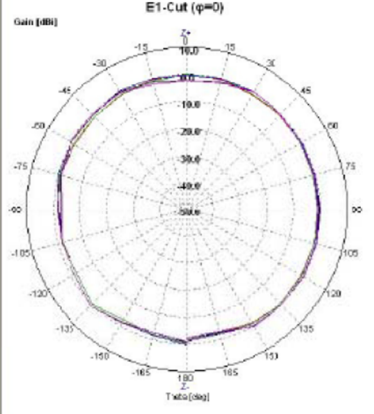
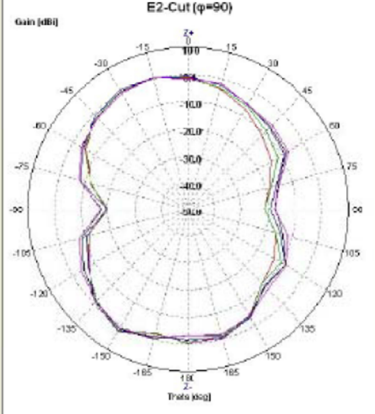
No.	Type	Connector	Gain (dBi)	Remark
1	Integral antenna	NA	1.82	For model: MGM240P32A
2	External reference dipole antenna**	SMA Male	2.80	For model: MGM240P32N

* 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.

** The dipole antenna is not sold with the EUT, but is used during testing as a reference antenna for radiated measurements of the parts with the RF pin.

3.5.2 Antenna Pattern

Ant. No.	Antenna Pattern
1	<p data-bbox="395 367 671 405">Phi0 Gain cut (dBi)</p>  <p data-bbox="395 898 608 936">Phi90 Gain cut</p>  <p data-bbox="395 1429 651 1467">Theta90 Gain cut</p> 

Ant. No.	Antenna Pattern		
2	<p>H-Cut ($\phi=90^\circ$)</p> 	<p>E1-Cut ($\phi=0^\circ$)</p> 	<p>E2-Cut ($\phi=90^\circ$)</p> 

4 Test Results

4.1 Frequency Tolerance Measurement

4.1.1 Limits of Frequency Tolerance Measurement

Tolerance of frequency shall be +/- 50ppm

4.1.2 Test Setup



4.1.3 Test Results

1MBaud with 1Mbps transfer rate

Channel	Frequency (MHz)	V _{normal}		V _{max.}		V _{min.}	
		Carrier Frequency (MHz)	Frequency Tolerance (ppm)	Carrier Frequency (MHz)	Frequency Tolerance (ppm)	Carrier Frequency (MHz)	Frequency Tolerance (ppm)
0	2402	2401.994800	-2.164	2401.994800	-2.164	2401.995000	-2.081
1	2404	2403.996600	-1.414	2403.996400	-1.497	2403.996200	-1.580
19	2440	2439.994800	-2.131	2439.994600	-2.213	2439.994600	-2.213
38	2478	2477.995600	-1.775	2477.995400	-1.856	2477.995400	-1.856
39	2480	2479.994600	-2.177	2479.994600	-2.177	2479.994400	-2.258

2MBaud with 2Mbps transfer rate

Channel	Frequency (MHz)	V _{normal}		V _{max.}		V _{min.}	
		Carrier Frequency (MHz)	Frequency Tolerance (ppm)	Carrier Frequency (MHz)	Frequency Tolerance (ppm)	Carrier Frequency (MHz)	Frequency Tolerance (ppm)
1	2404	2403.995200	-1.996	2403.994000	-2.495	2403.993600	-2.662
19	2440	2439.992000	-3.278	2439.991600	-3.442	2439.991400	-3.524
38	2478	2477.992600	-2.986	2477.993000	-2.824	2477.993400	-2.663

4.2 Occupied Bandwidth Measurement (99% power bandwidth)

4.2.1 Limits of Occupied Bandwidth Measurement

Item	Limit
Occupied bandwidth	< 83.5MHz

4.2.2 Test Setup

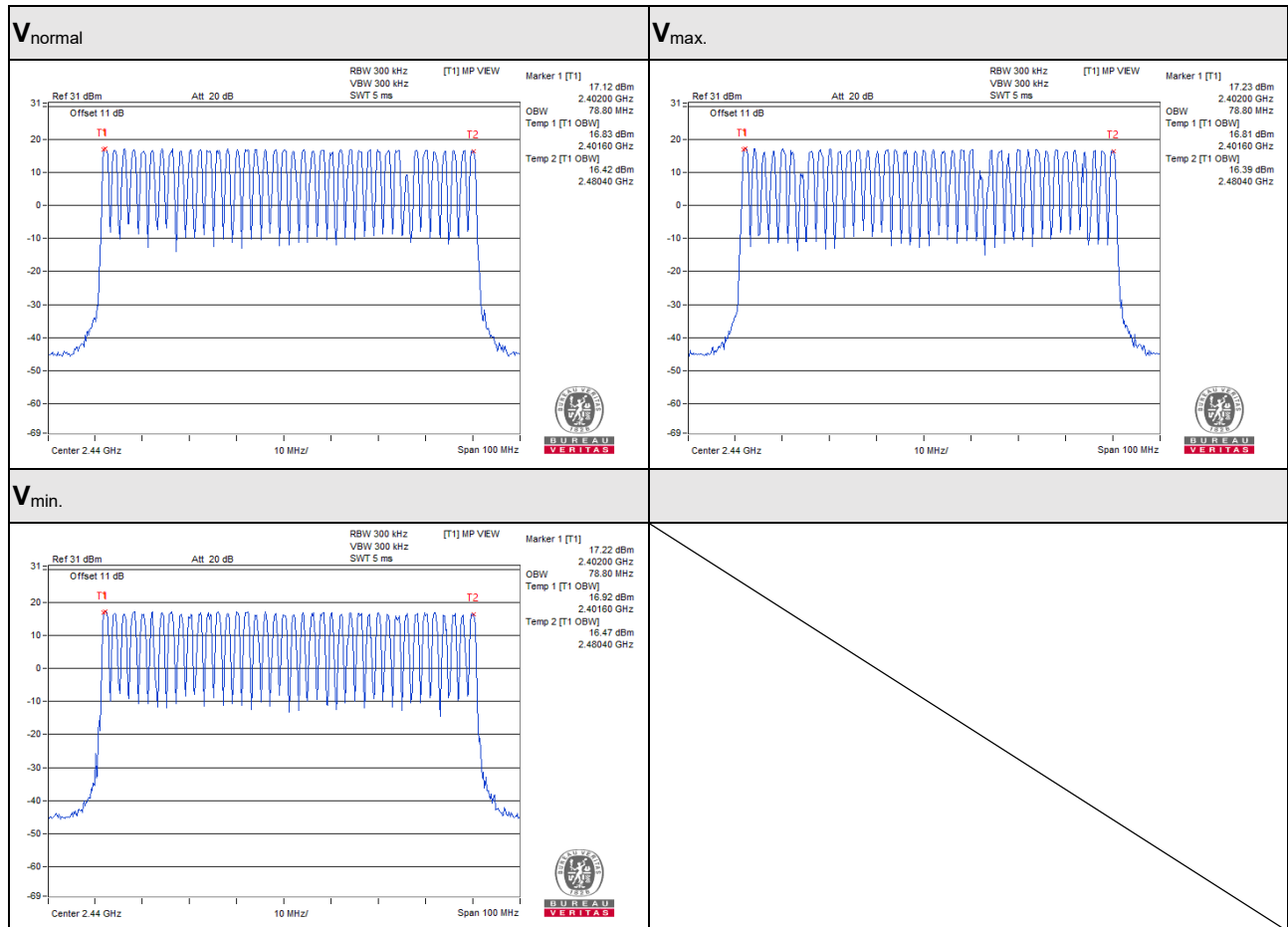


4.2.3 Test Results

1MBaud with 1Mbps transfer rate

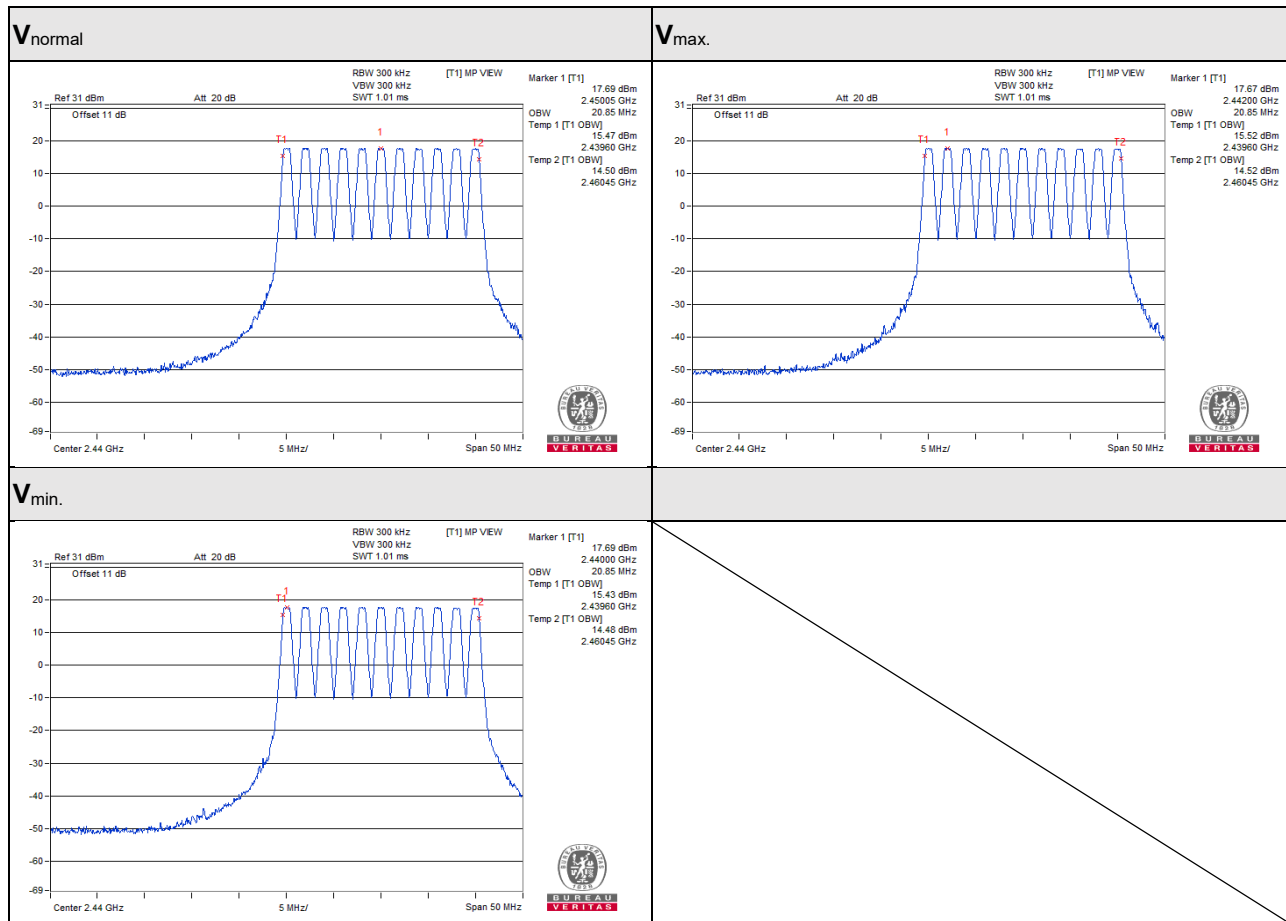
Normal Mode:

V_{normal}	$V_{\text{max.}}$	$V_{\text{min.}}$
Occupied Bandwidth (MHz)	Occupied Bandwidth (MHz)	Occupied Bandwidth (MHz)
78.80	78.80	78.80



AFH Mode:

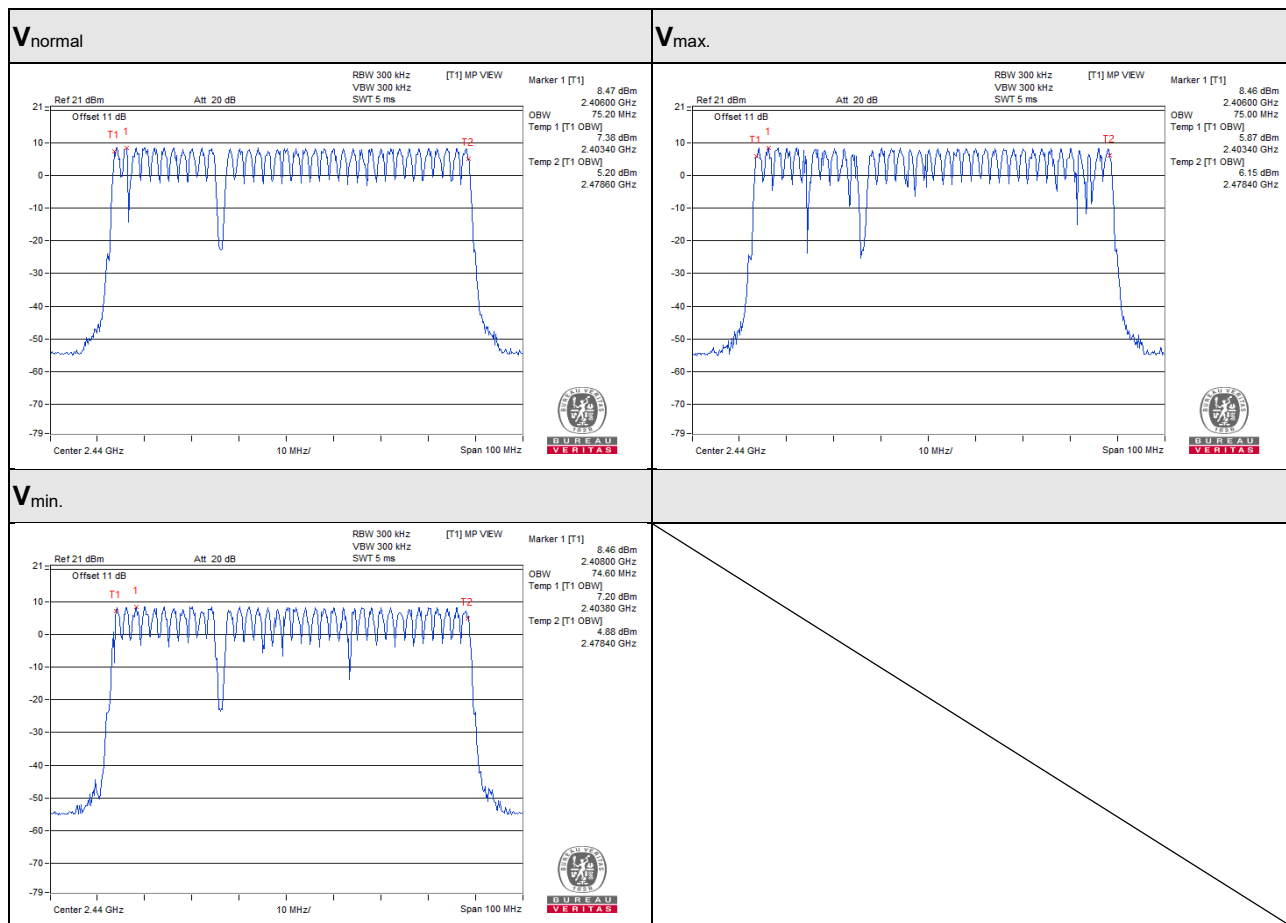
V_{normal}	$V_{max.}$	$V_{min.}$
Occupied Bandwidth (MHz)	Occupied Bandwidth (MHz)	Occupied Bandwidth (MHz)
20.85	20.85	20.85



2MBaud with 2Mbps transfer rate

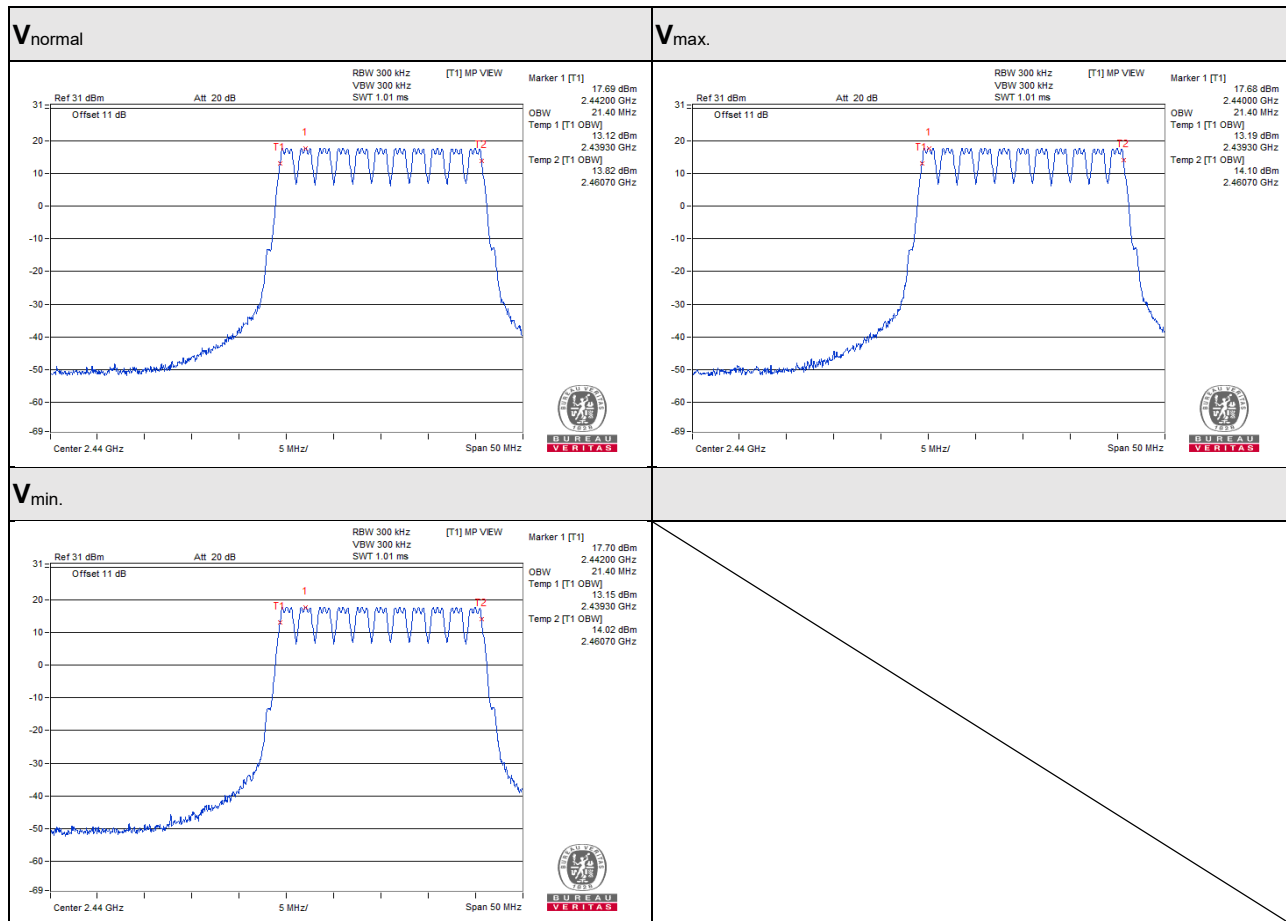
Normal Mode:

V_{normal}	$V_{\text{max.}}$	$V_{\text{min.}}$
Occupied Bandwidth (MHz)	Occupied Bandwidth (MHz)	Occupied Bandwidth (MHz)
75.20	75.00	74.60



AFH Mode:

V_{normal}	$V_{max.}$	$V_{min.}$
Occupied Bandwidth (MHz)	Occupied Bandwidth (MHz)	Occupied Bandwidth (MHz)
21.40	21.40	21.40



4.3 Spreading Bandwidth Measurement (90% power bandwidth)

4.3.1 Limits of Spreading Bandwidth and Spreading Factor Measurement

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

4.3.2 Test Setup



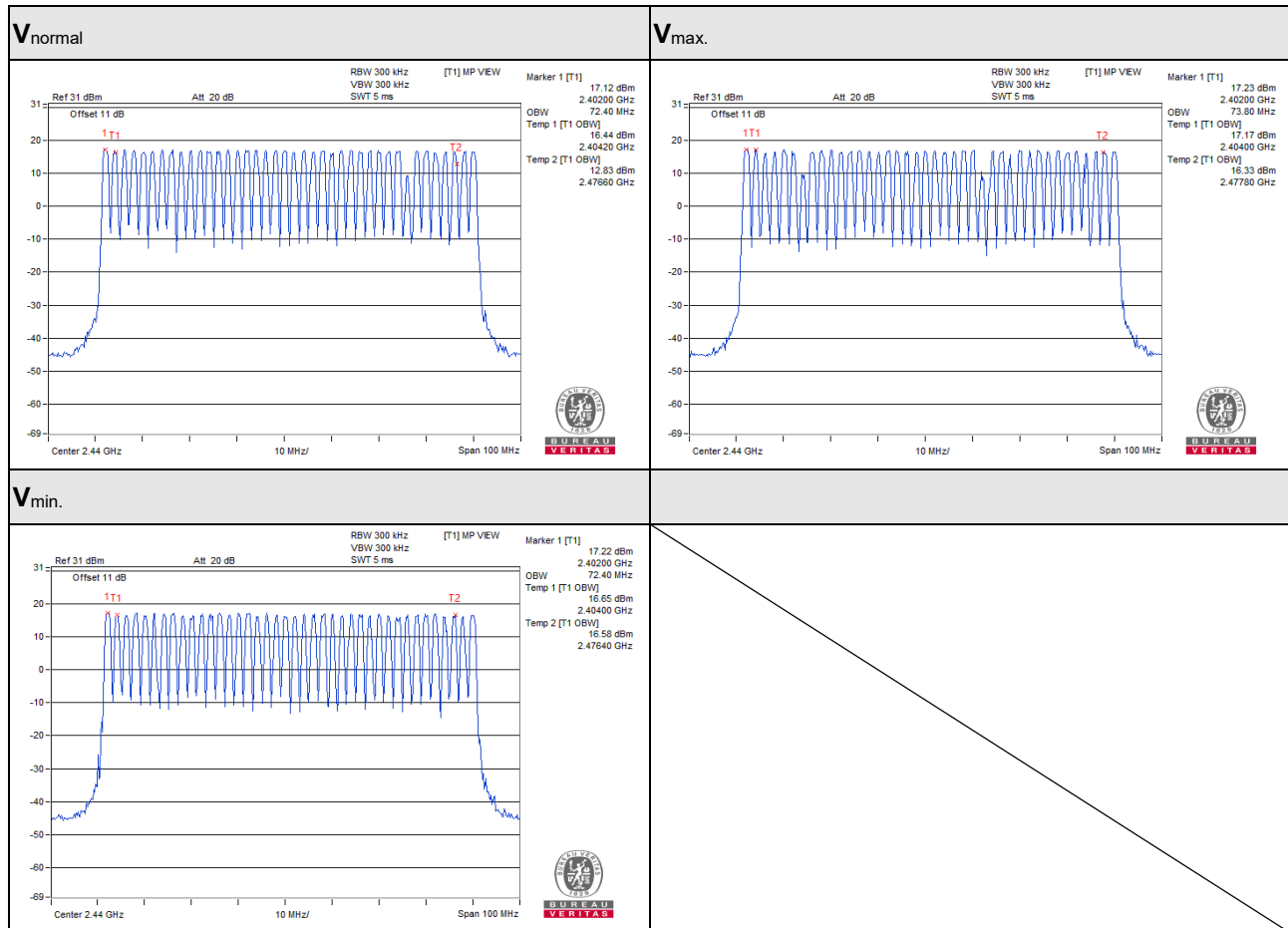
4.3.3 Test Results

1MBaud with 1Mbps transfer rate

Normal Mode:

V _{normal}		V _{max.}		V _{min.}	
Occupied Bandwidth (MHz)	Spreading Factor	Occupied Bandwidth (MHz)	Spreading Factor	Occupied Bandwidth (MHz)	Spreading Factor
72.40	72.40	73.80	73.80	72.40	72.40

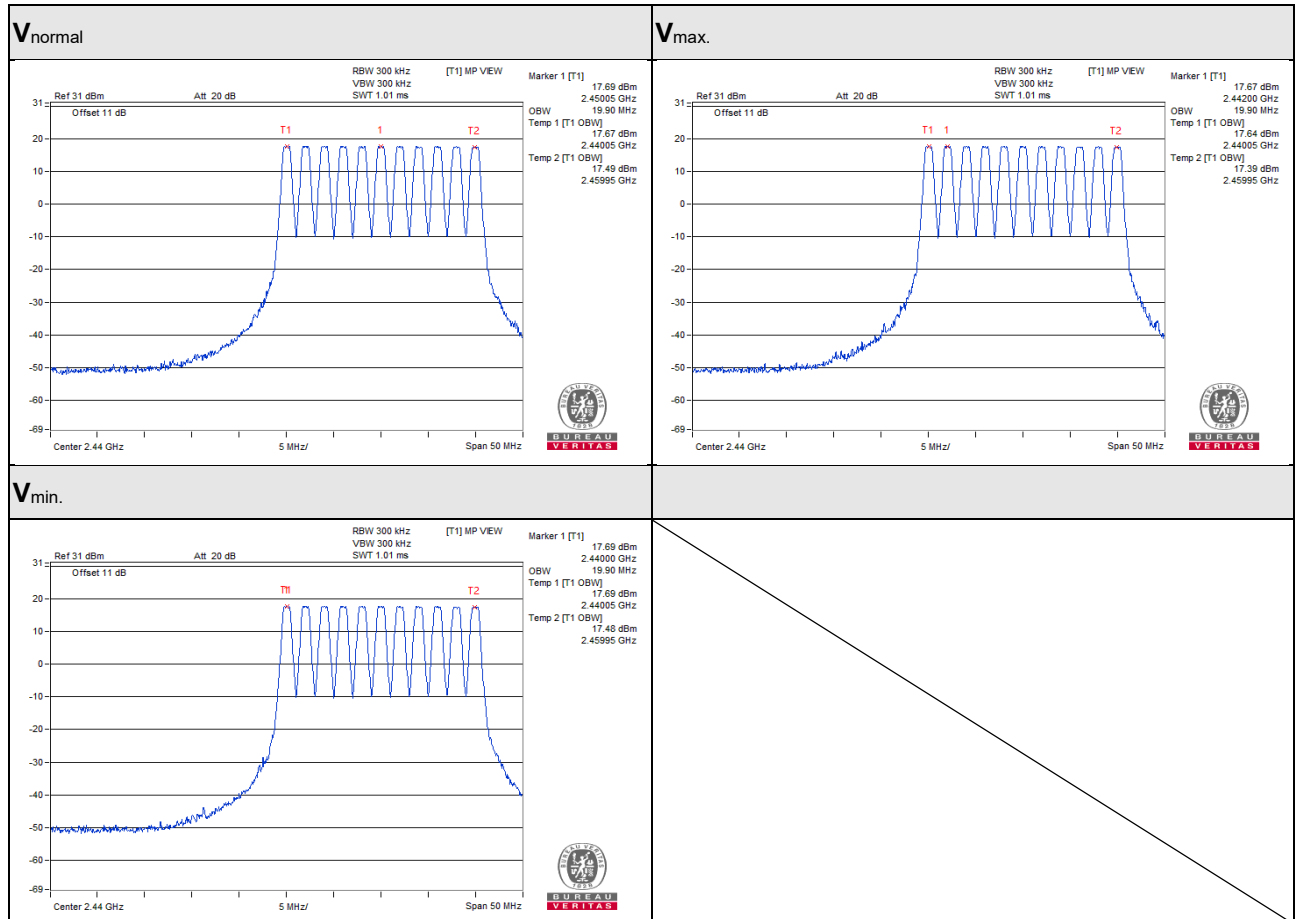
Note: Spreading Factor: 90% channel power bandwidth / 1.



AFH Mode:

V_{normal}		$V_{max.}$		$V_{min.}$	
Occupied Bandwidth (MHz)	Spreading Factor	Occupied Bandwidth (MHz)	Spreading Factor	Occupied Bandwidth (MHz)	Spreading Factor
19.90	19.90	19.90	19.90	19.90	19.90

Note: Spreading Factor: 90% channel power bandwidth / 1.

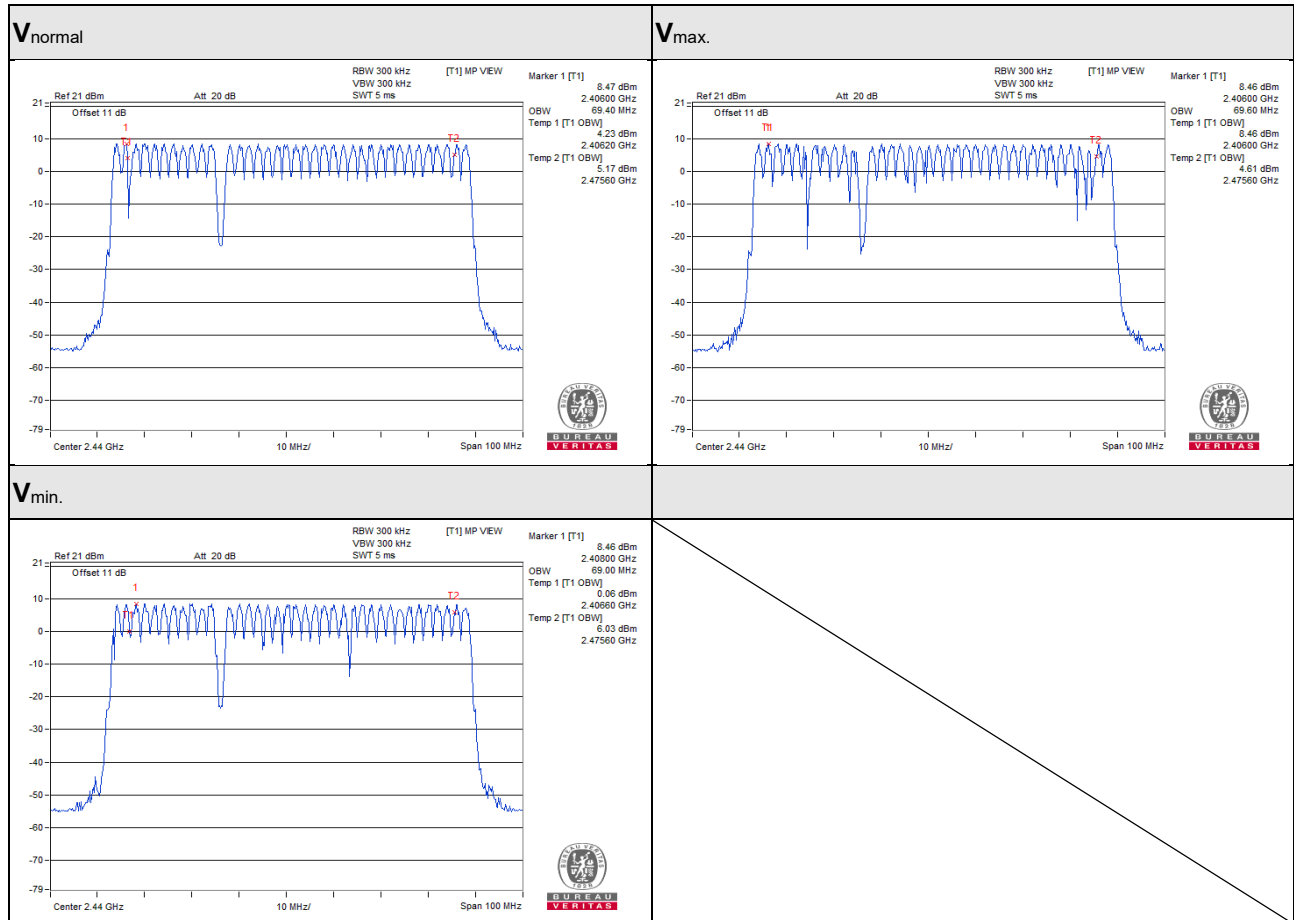


2MBaud with 2Mbps transfer rate

Normal Mode:

V _{normal}		V _{max.}		V _{min.}	
Occupied Bandwidth (MHz)	Spreading Factor	Occupied Bandwidth (MHz)	Spreading Factor	Occupied Bandwidth (MHz)	Spreading Factor
69.40	34.70	69.60	34.80	69.00	34.50

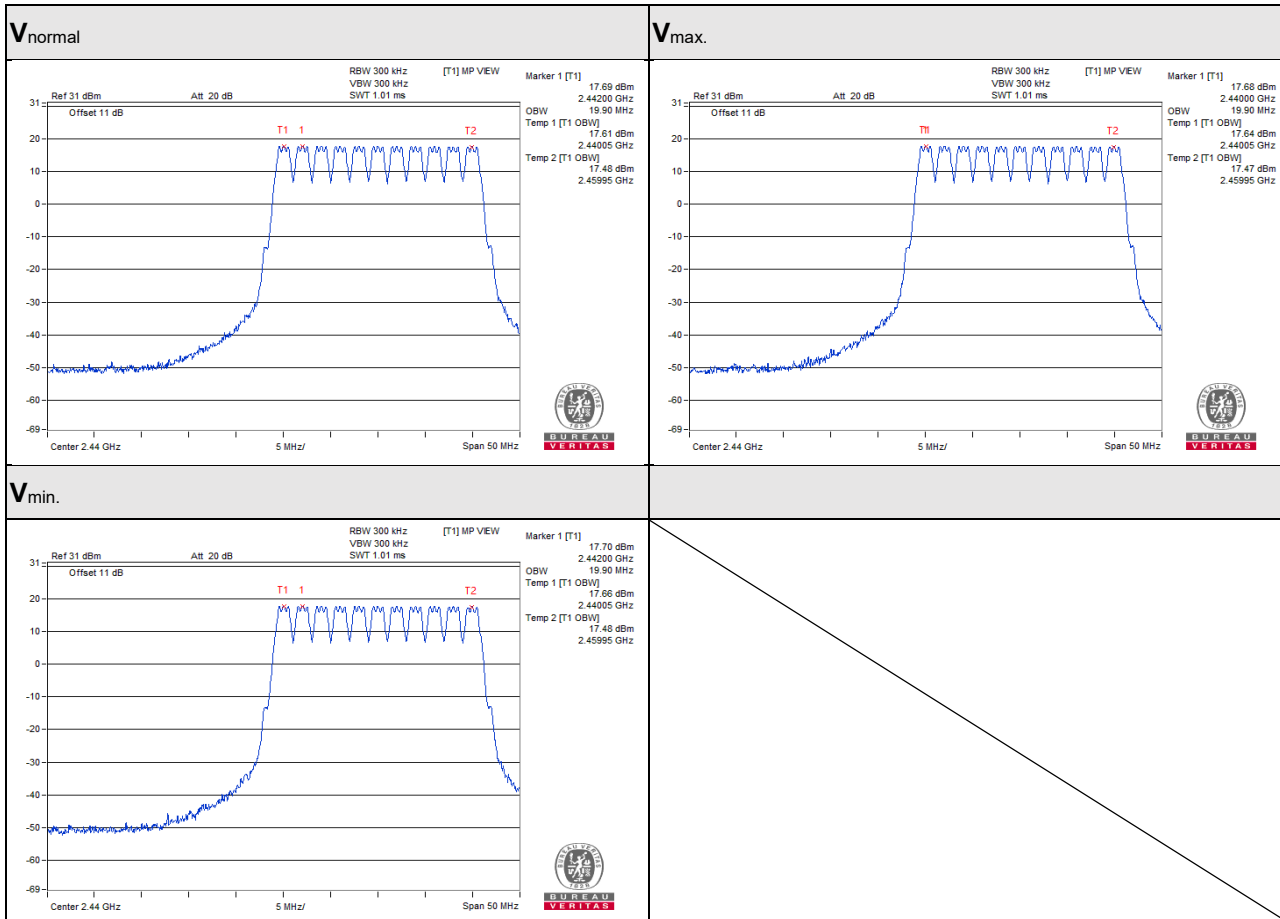
Note: Spreading Factor: 90% channel power bandwidth / 2.



AFH Mode:

V _{normal}		V _{max.}		V _{min.}	
Occupied Bandwidth (MHz)	Spreading Factor	Occupied Bandwidth (MHz)	Spreading Factor	Occupied Bandwidth (MHz)	Spreading Factor
19.90	9.95	19.90	9.95	19.90	9.95

Note: Spreading Factor: 90% channel power bandwidth / 2.



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



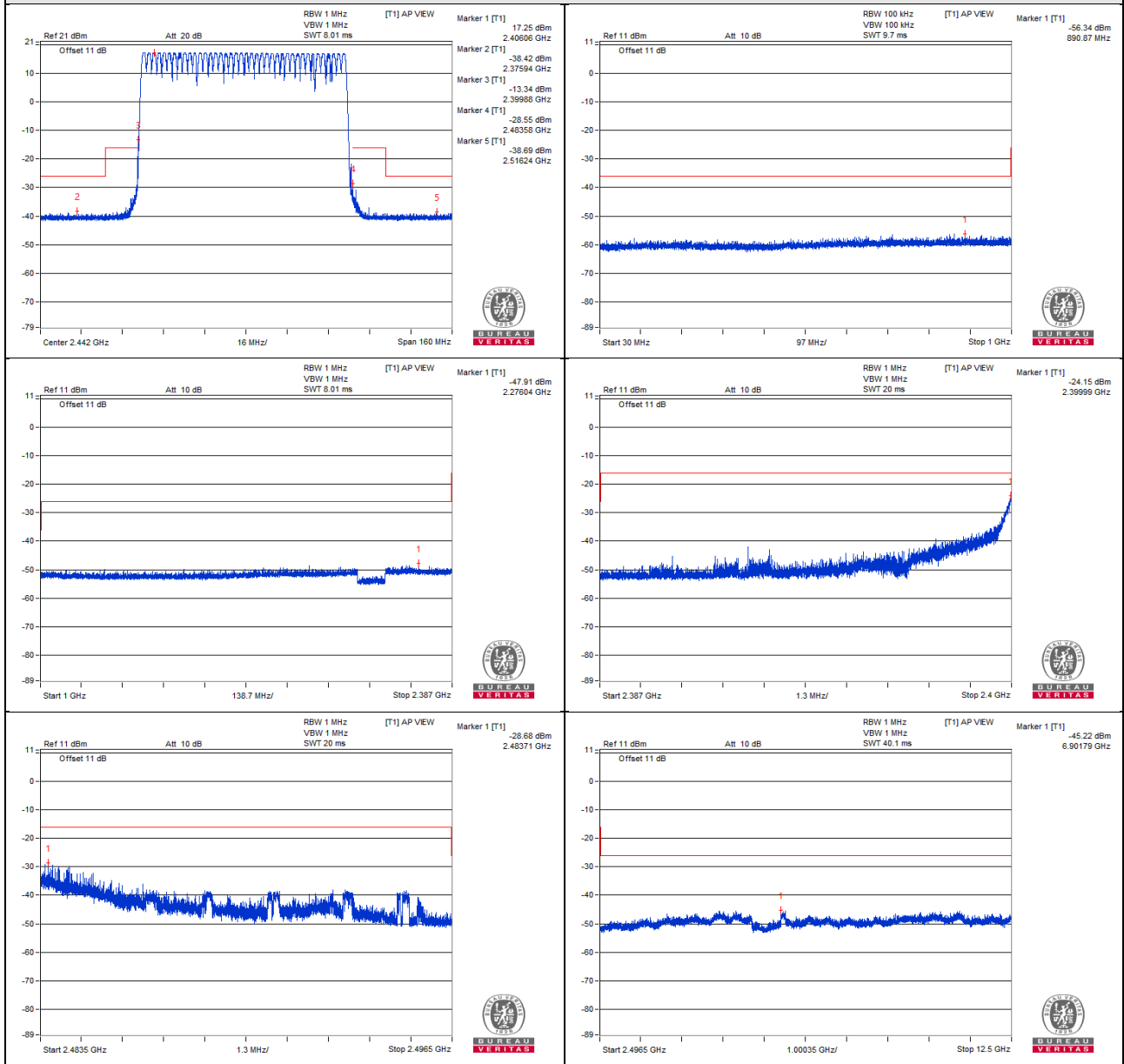
4.4.3 Test Results

1MBaud with 1Mbps transfer rate

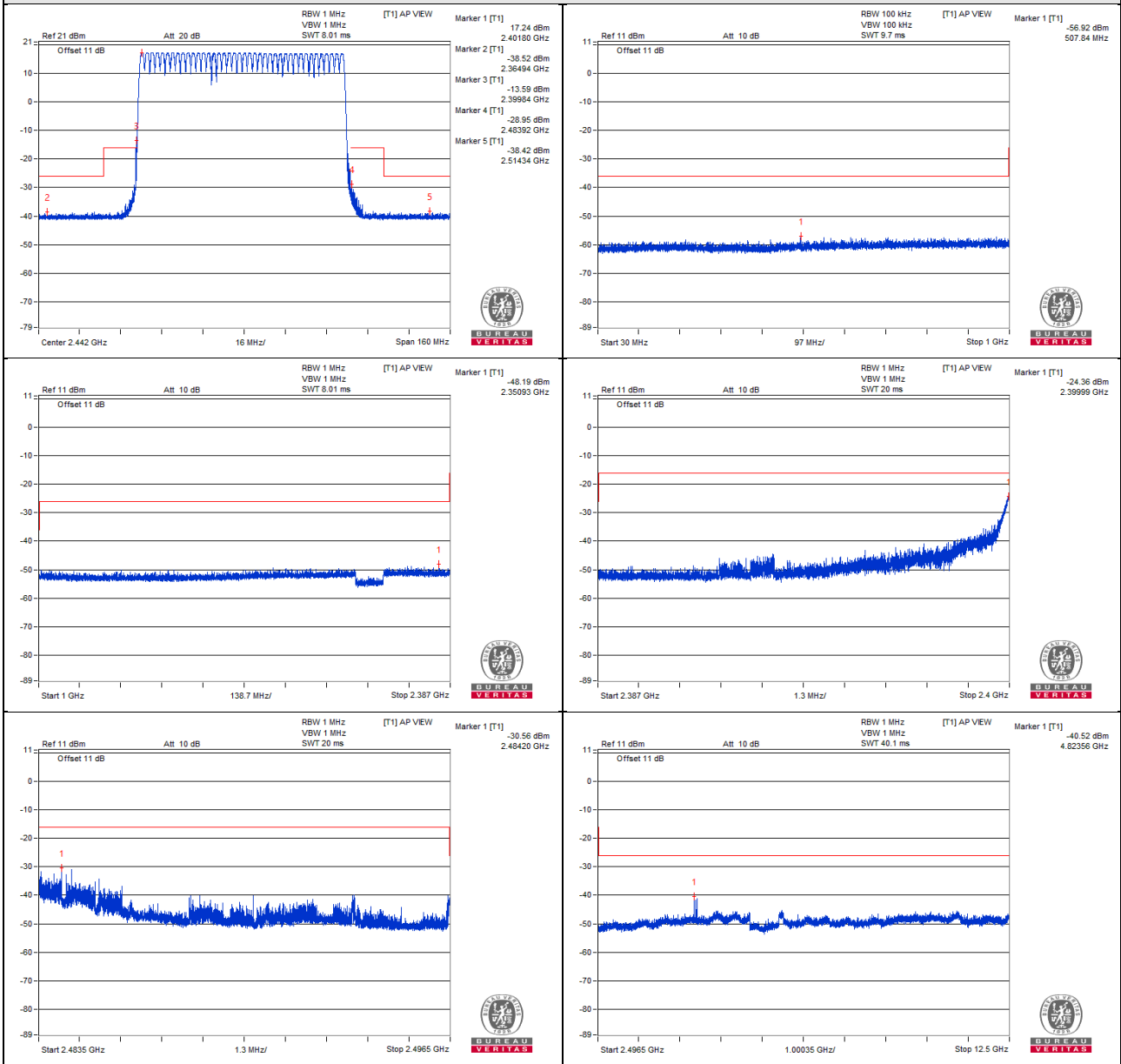
Test Channel		Hopping Mode			
Test Condition	Frequency Range (MHz)	Frequency (MHz)	Measured Value (uW)	Limit (uW)	Result
V_{normal}	30 to 1000	890.870	0.002000	0.25	Pass
	1000 to 2387	2276.040	0.016000	2.5	Pass
	2387 to 2400	2399.990	3.845000	25	Pass
	2483.5 to 2496.5	2483.710	1.355000	25	Pass
	2496.5 to 12500	6901.790	0.030000	2.5	Pass
V_{max.}	30 to 1000	507.840	0.002000	0.25	Pass
	1000 to 2387	2350.930	0.015000	2.5	Pass
	2387 to 2400	2399.990	3.664000	25	Pass
	2483.5 to 2496.5	2484.200	0.879000	25	Pass
	2496.5 to 12500	4823.560	0.088000	2.5	Pass
V_{min.}	30 to 1000	926.520	0.001000	0.25	Pass
	1000 to 2387	2224.020	0.013000	2.5	Pass
	2387 to 2400	2399.990	3.372000	25	Pass
	2483.5 to 2496.5	2484.260	1.076000	25	Pass
	2496.5 to 12500	4803.550	0.091000	2.5	Pass

Note: The spectrum plots are attached on the following pages.

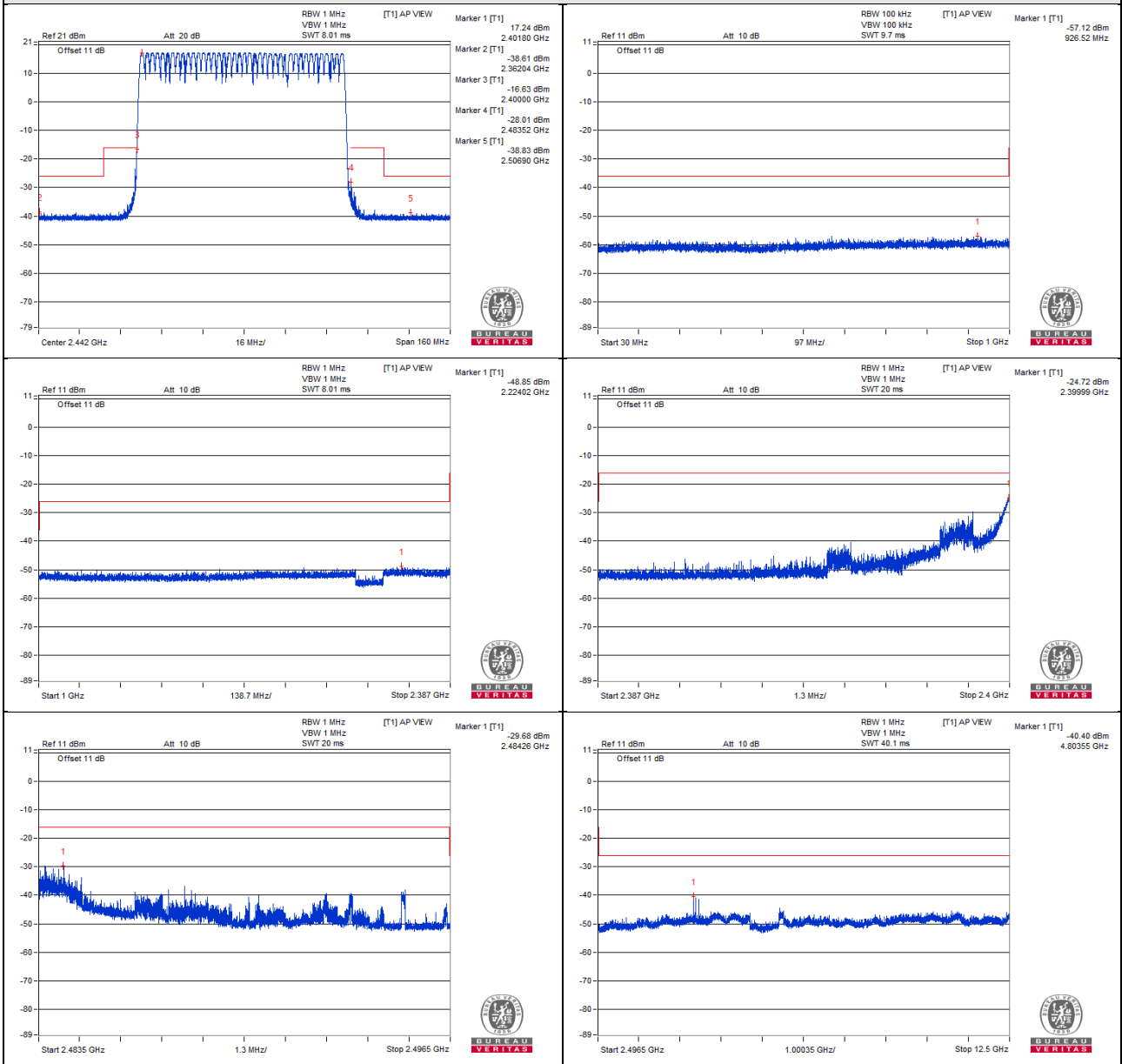
Vnormal



V_{max}.



V_{min}.

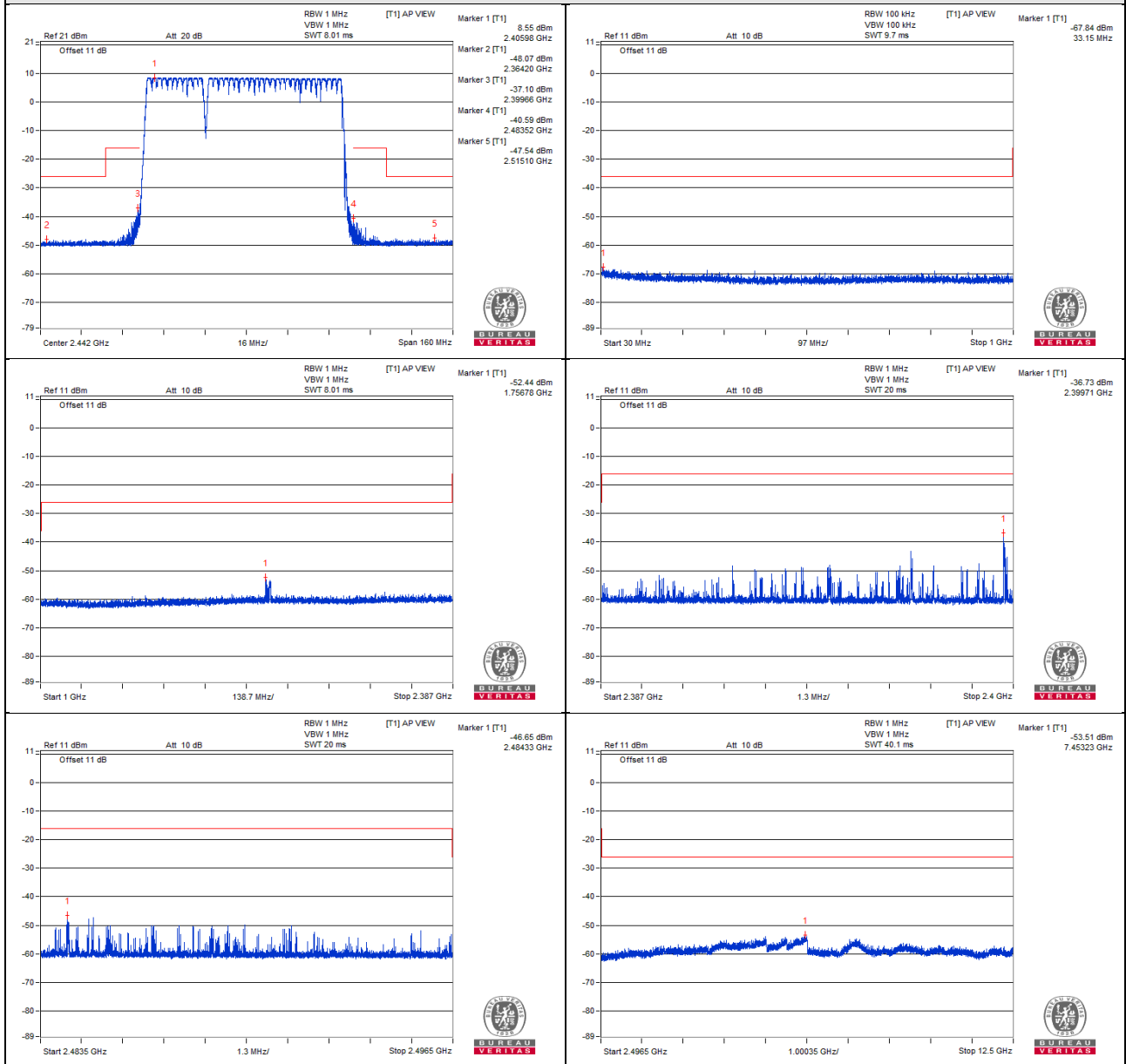


2MBaud with 2Mbps transfer rate

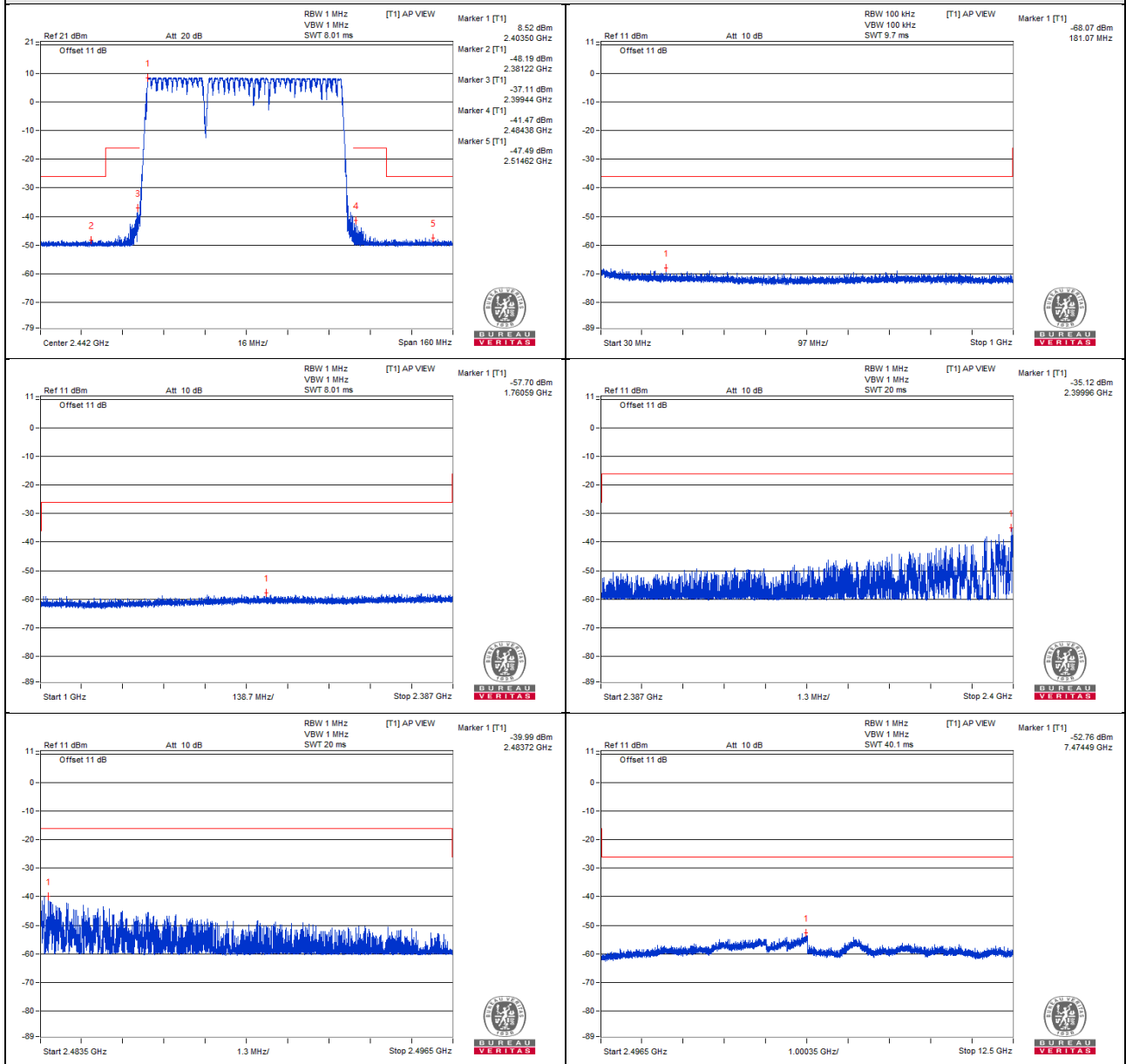
Test Channel		Hopping Mode			
Test Condition	Frequency Range (MHz)	Frequency (MHz)	Measured Value (uW)	Limit (uW)	Result
V_{normal}	30 to 1000	33.150	0.000164	0.25	Pass
	1000 to 2387	1756.780	0.005702	2.5	Pass
	2387 to 2400	2399.710	0.212324	25	Pass
	2483.5 to 2496.5	2484.330	0.021627	25	Pass
	2496.5 to 12500	7453.230	0.004457	2.5	Pass
V_{max.}	30 to 1000	181.070	0.000156	0.25	Pass
	1000 to 2387	1760.590	0.001698	2.5	Pass
	2387 to 2400	2399.960	0.307610	25	Pass
	2483.5 to 2496.5	2483.720	0.100231	25	Pass
	2496.5 to 12500	7474.490	0.005297	2.5	Pass
V_{min.}	30 to 1000	31.330	0.000176	0.25	Pass
	1000 to 2387	1757.640	0.002767	2.5	Pass
	2387 to 2400	2399.180	0.173380	25	Pass
	2483.5 to 2496.5	2484.800	0.069183	25	Pass
	2496.5 to 12500	7495.740	0.004932	2.5	Pass

Note: The spectrum plots are attached on the following pages.

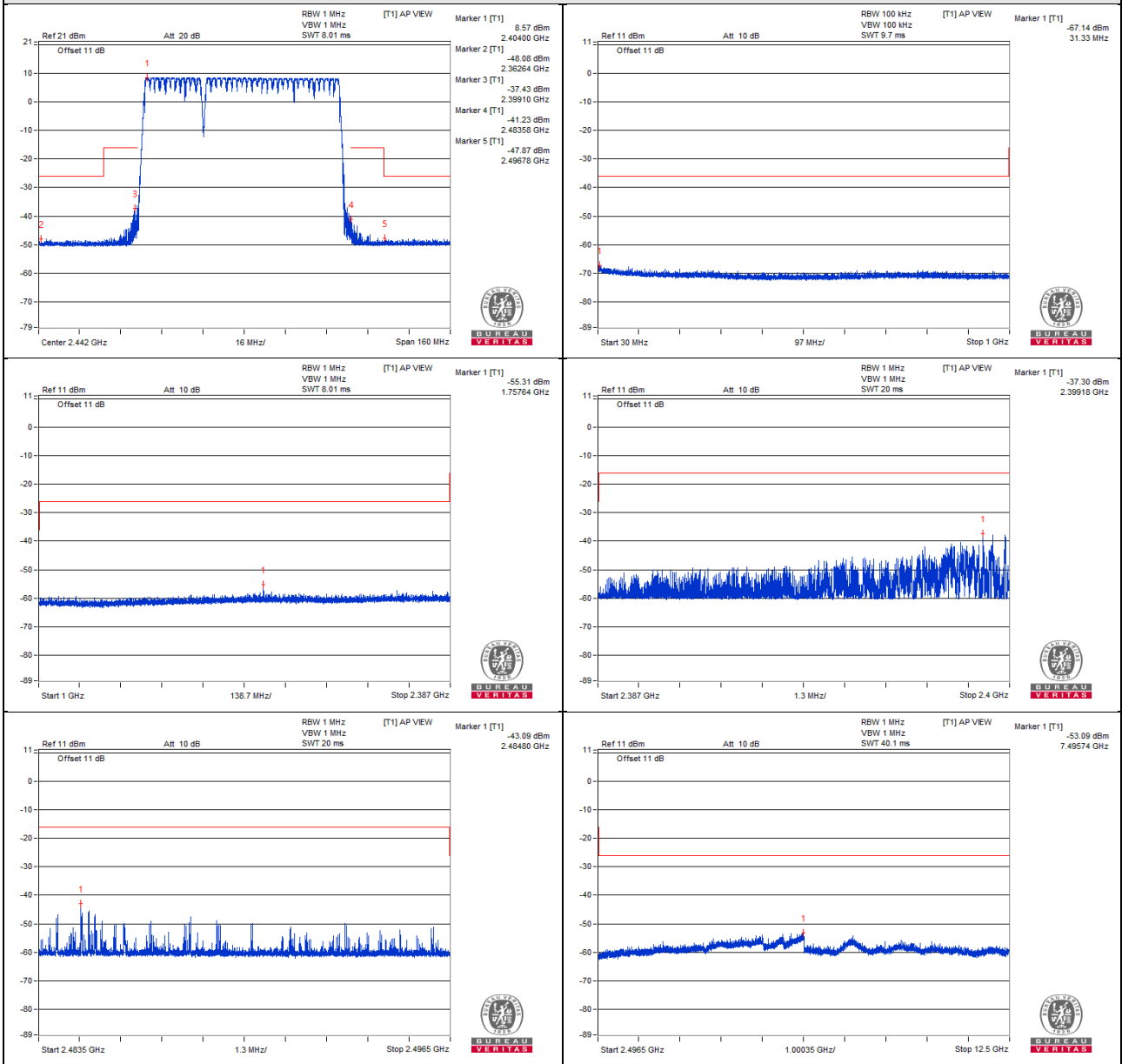
Vnormal



V_{max}.



V_{min}.



4.5 Antenna Power Measurement

4.5.1 Limits of Antenna Power

Modulation Method	Frequency Band Used	Antenna Power (Max.)	EIRP Limit (Note 3)
DSSS	2400 – 2483.5 MHz	10 mW/MHz	12.14 dBm/MHz ~ 22.14 dBm/MHz (16.368 mW/MHz ~ 163.68 mW/MHz)
OFDM (Note 1)	2400 – 2483.5 MHz	10 mW/MHz	12.14 dBm/MHz ~ 22.14 dBm/MHz (16.368 mW/MHz ~ 163.68 mW/MHz)
OFDM (Note 2)	2400 – 2483.5 MHz	5 mW/MHz	9.13 dBm/MHz ~ 19.13 dBm/MHz (8.184 mW/MHz ~ 81.846 mW/MHz)
FH	2400 – 2483.5 MHz	3 mW/MHz	6.91 dBm/MHz ~ 16.91 dBm/MHz (4.91 mW/MHz ~ 49.1 mW/MHz)
Other than the above	2400 – 2483.5 MHz	10 mW	12.14 dBm ~ 22.14 dBm (16.368 mW ~ 163.68 mW)
Modulation System	Frequency Band Used	Antenna Power (Max.)	EIRP Limit
DS	2471 – 2497 MHz	10 mW/MHz	12.14 dBm/MHz (16.368 mW/MHz)

Note:

1. Occupied bandwidth is less than 26MHz
2. Occupied bandwidth is more than 26MHz and less than 40MHz
3. EIRP limit is variable by the HPBA, the HPBA (half-power beam width) of the antenna shall be 360/A degrees or less, where A = EIRP/(2.14 dBi + "Antenna Power (limit)).
4. Tolerance of antenna power shall be +20% (upper value) and –80% (lower value).

4.5.2 Test Setup



4.5.3 Test Results

Model: MGM240P32A

Normal Mode:

Test Voltage	Transfer Rate	Conducted RF Output Power Density (mW/MHz)	Radiated RF Output Power Density (mW/MHz)
V_{normal}	1MBaud with 1Mbps transfer rate	0.696972	1.059779
	2MBaud with 2Mbps transfer rate	0.677081	1.029534
$V_{max.}$	1MBaud with 1Mbps transfer rate	0.666830	1.013947
	2MBaud with 2Mbps transfer rate	0.661288	1.005520
$V_{min.}$	1MBaud with 1Mbps transfer rate	0.711427	1.081759
	2MBaud with 2Mbps transfer rate	0.706563	1.074363
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: 1.82dBi.

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:

Test Voltage	Transfer Rate	Conducted RF Output Power Density (mW/MHz)	Radiated RF Output Power Density (mW/MHz)
V_{normal}	1MBaud with 1Mbps transfer rate	2.388618	3.632007
	2MBaud with 2Mbps transfer rate	2.361277	3.590434
$V_{max.}$	1MBaud with 1Mbps transfer rate	2.328879	3.541171
	2MBaud with 2Mbps transfer rate	2.312846	3.516792
$V_{min.}$	1MBaud with 1Mbps transfer rate	2.427432	3.691026
	2MBaud with 2Mbps transfer rate	2.449892	3.725177
Max. Limit (mW/MHz):		3	-
Rated Power (mW/MHz):		2.4	-
Tolerance of Antenna Power (mW/MHz):		0.48 ~ 2.88	-
Max. EIRP Limit (mW/MHz):		-	4.91

Note: 1. Antenna gain: 1.82dBi.

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.

Model: MGM240P32N

Normal Mode:

Test Voltage	Transfer Rate	Conducted RF Output Power Density (mW/MHz)	Radiated RF Output Power Density (mW/MHz)
V_{normal}	1MBaud with 1Mbps transfer rate	0.696972	1.328053
	2MBaud with 2Mbps transfer rate	0.677081	1.290151
V_{max.}	1MBaud with 1Mbps transfer rate	0.666830	1.270618
	2MBaud with 2Mbps transfer rate	0.661288	1.260058
V_{min.}	1MBaud with 1Mbps transfer rate	0.711427	1.355596
	2MBaud with 2Mbps transfer rate	0.706563	1.346328
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: 2.80dBi.
 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:

Test Voltage	Transfer Rate	Conducted RF Output Power Density (mW/MHz)	Radiated RF Output Power Density (mW/MHz)
V_{normal}	1MBaud with 1Mbps transfer rate	2.388618	4.551418
	2MBaud with 2Mbps transfer rate	2.361277	4.499321
V_{max.}	1MBaud with 1Mbps transfer rate	2.328879	4.437587
	2MBaud with 2Mbps transfer rate	2.312846	4.407037
V_{min.}	1MBaud with 1Mbps transfer rate	2.427432	4.625376
	2MBaud with 2Mbps transfer rate	2.449892	4.668173
Max. Limit (mW/MHz):		3	-
Rated Power (mW/MHz):		2.4	-
Tolerance of Antenna Power (mW/MHz):		0.48 ~ 2.88	-
Max. EIRP Limit (mW/MHz):		-	4.91

Note: 1. Antenna gain: 2.80dBi.
 2. The radiated RF output power density is a “calculated” value derived from the conducted value.
 3. Formula: Radiated RF output power density = Conducted RF output power density + Antenna gain.

4.6 Spurious Emissions for Receiver

4.6.1 Limits of Spurious Emissions For Receiver

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

4.6.2 Test Setup



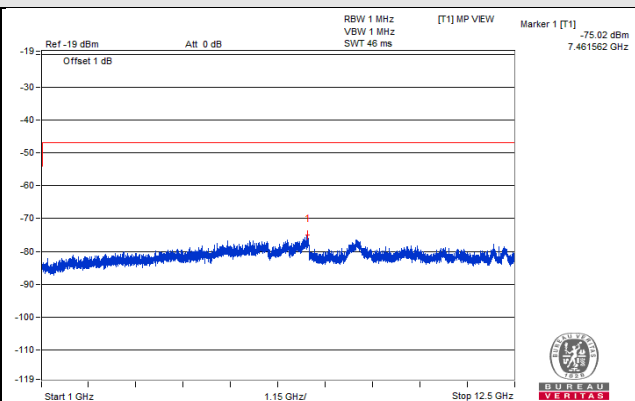
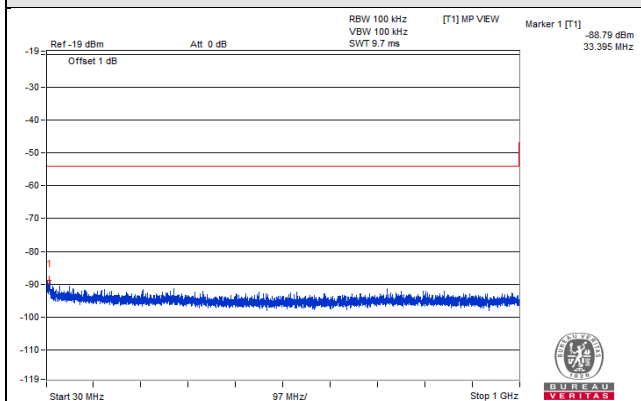
4.6.3 Test Result

1MBaud with 1Mbps transfer rate

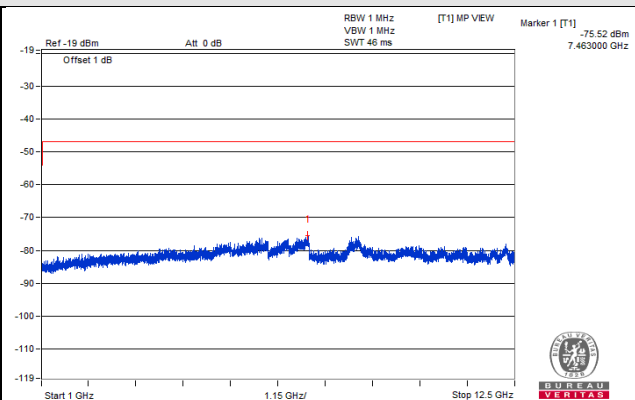
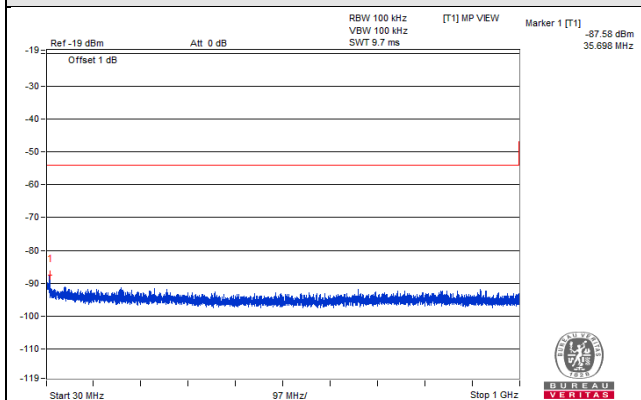
Test Channel		CH 0 (2402MHz)			
Test Condition	Frequency Range (MHz)	Frequency (MHz)	Measured Value (nW)	Limit (nW)	Result
V_{normal}	30 to 1000	33.395	0.001321	4.0	Pass
	1000 to 12500	7461.562	0.031477	20.0	Pass
$V_{max.}$	30 to 1000	35.698	0.001746	4.0	Pass
	1000 to 12500	7463.000	0.028054	20.0	Pass
$V_{min.}$	30 to 1000	32.667	0.001445	4.0	Pass
	1000 to 12500	7452.937	0.036559	20.0	Pass
Test Channel		CH 1 (2404MHz)			
V_{normal}	30 to 1000	35.698	0.001239	4.0	Pass
	1000 to 12500	7441.437	0.029040	20.0	Pass
$V_{max.}$	30 to 1000	34.365	0.001054	4.0	Pass
	1000 to 12500	7445.750	0.029309	20.0	Pass
$V_{min.}$	30 to 1000	33.880	0.001589	4.0	Pass
	1000 to 12500	7483.125	0.028379	20.0	Pass
Test Channel		CH 19 (2440MHz)			
V_{normal}	30 to 1000	32.061	0.001337	4.0	Pass
	1000 to 12500	7461.562	0.031915	20.0	Pass
$V_{max.}$	30 to 1000	34.243	0.001151	4.0	Pass
	1000 to 12500	7372.437	0.032137	20.0	Pass
$V_{min.}$	30 to 1000	34.486	0.001387	4.0	Pass
	1000 to 12500	7483.125	0.029242	20.0	Pass
Test Channel		CH 38 (2478MHz)			
V_{normal}	30 to 1000	34.243	0.001225	4.0	Pass
	1000 to 12500	7454.375	0.027227	20.0	Pass
$V_{max.}$	30 to 1000	35.213	0.001259	4.0	Pass
	1000 to 12500	8693.500	0.029648	20.0	Pass
$V_{min.}$	30 to 1000	34.607	0.001406	4.0	Pass
	1000 to 12500	7494.625	0.034834	20.0	Pass

Test Channel		CH 39 (2480MHz)			
Test Condition	Frequency Range (MHz)	Frequency (MHz)	Measured Value (nW)	Limit (nW)	Result
V_{normal}	30 to 1000	34.607	0.001138	4.0	Pass
	1000 to 12500	7007.312	0.024044	20.0	Pass
$V_{\text{max.}}$	30 to 1000	33.395	0.001130	4.0	Pass
	1000 to 12500	7491.750	0.030339	20.0	Pass
$V_{\text{min.}}$	30 to 1000	35.820	0.001014	4.0	Pass
	1000 to 12500	7496.062	0.028054	20.0	Pass

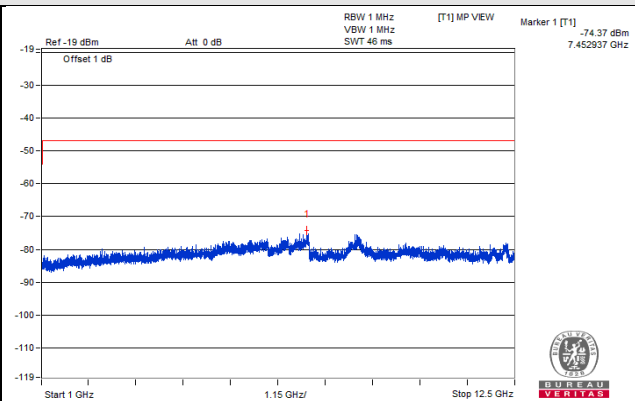
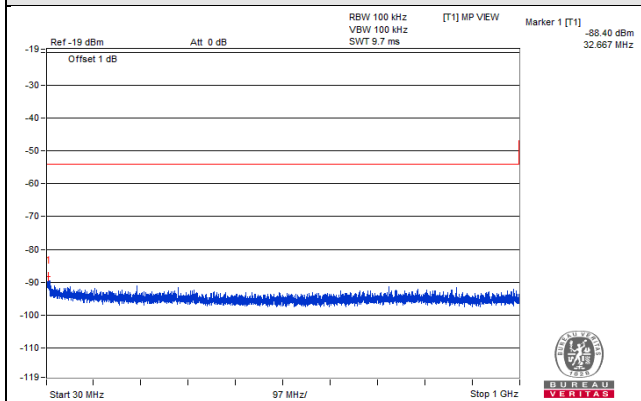
V_{normal}



V_{max}

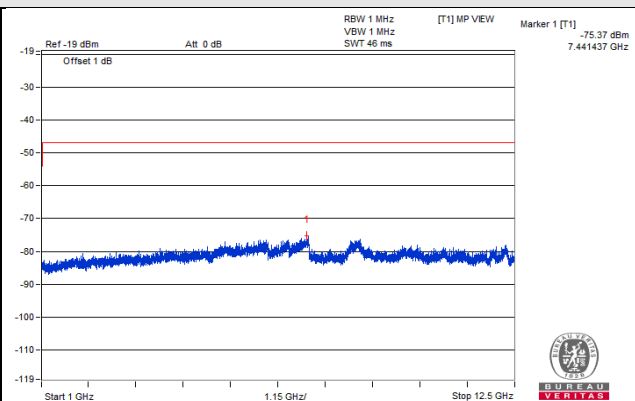
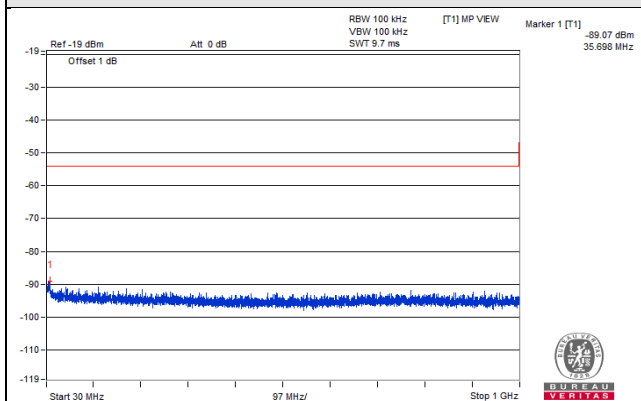


V_{min}

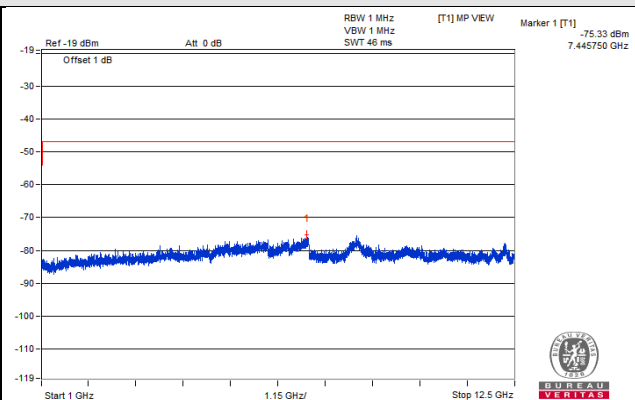
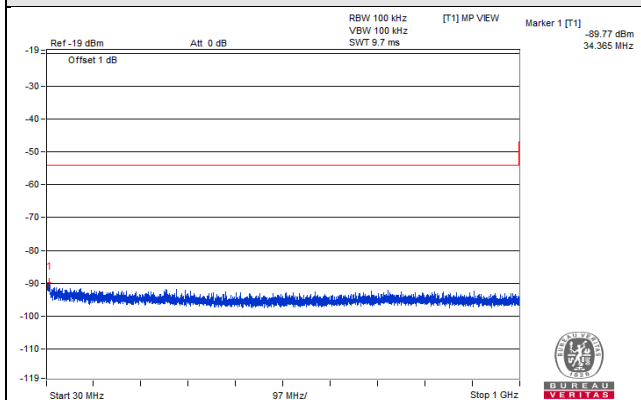


CH 0 (2402MHz)

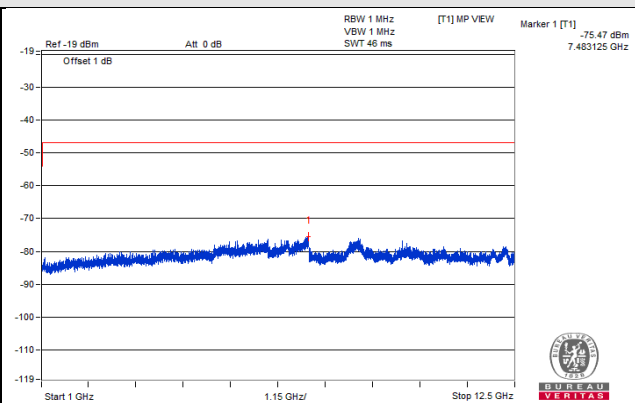
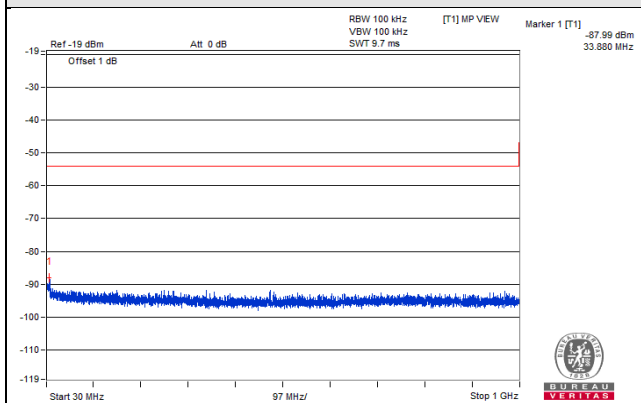
V_{normal}



V_{max}

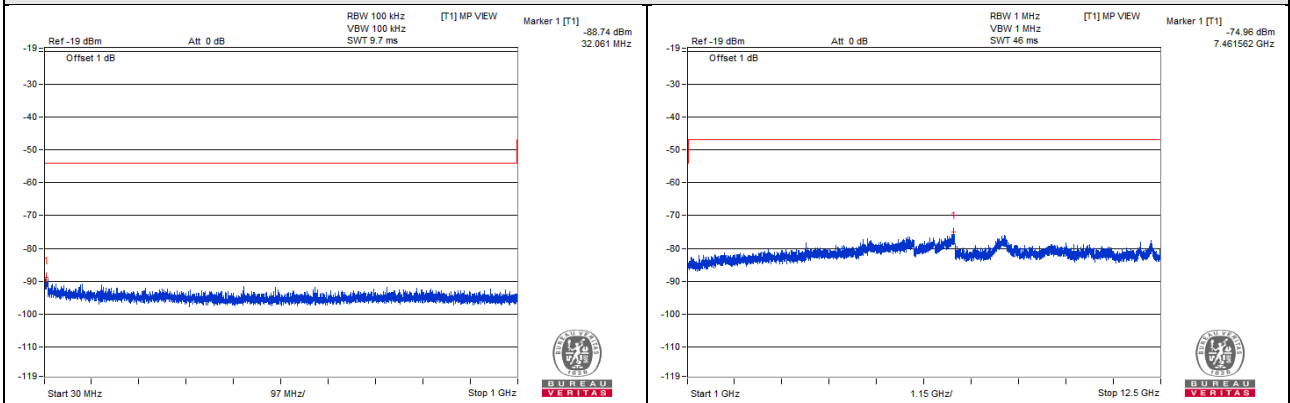


V_{min}

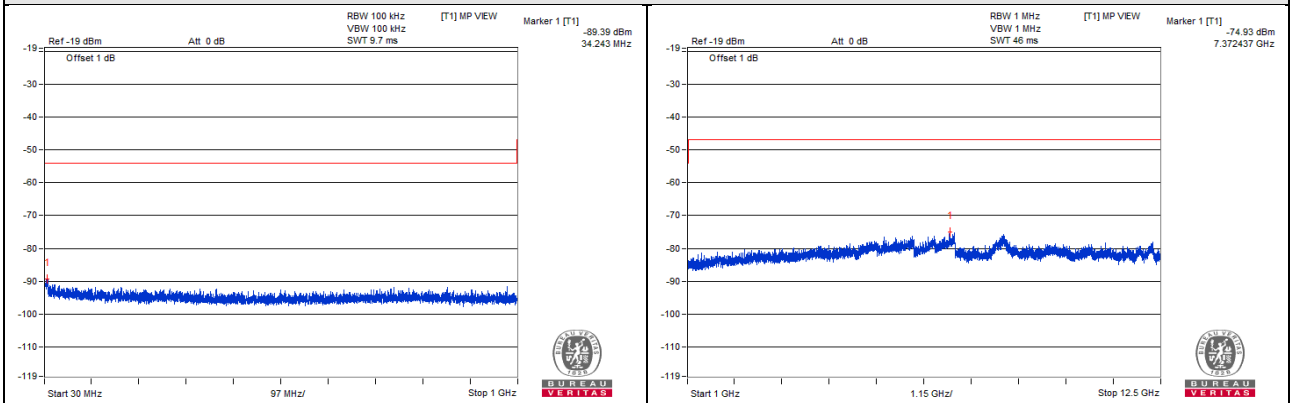


CH 1 (2404MHz)

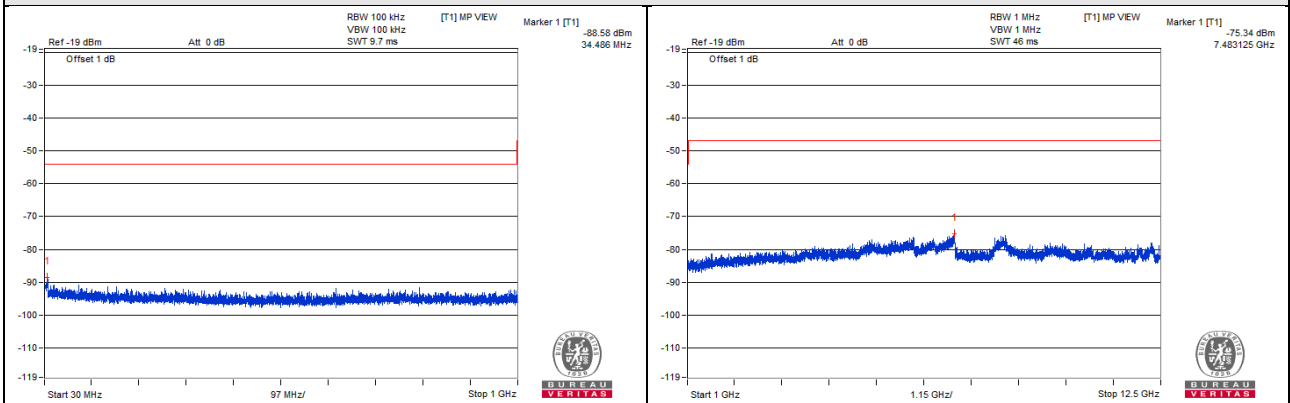
V_{normal}



V_{max}

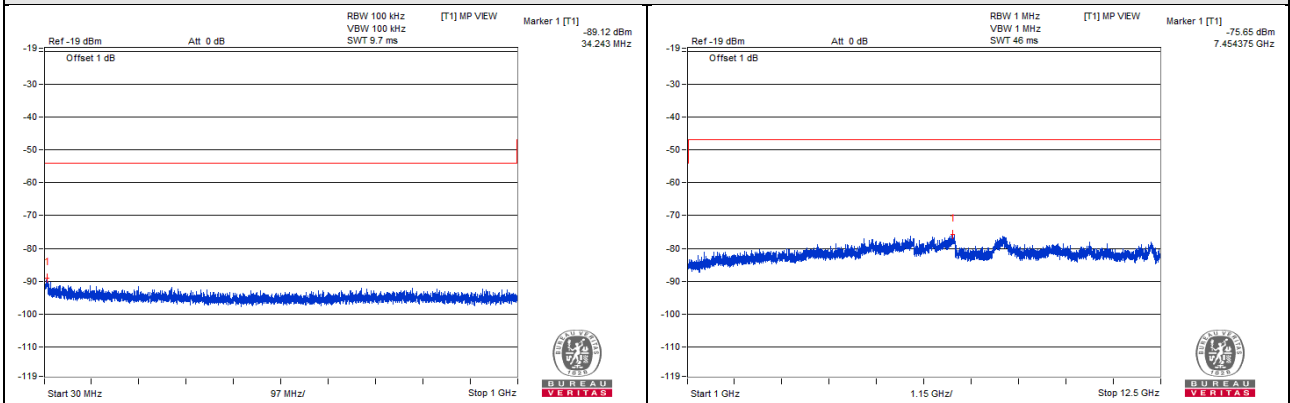


V_{min}

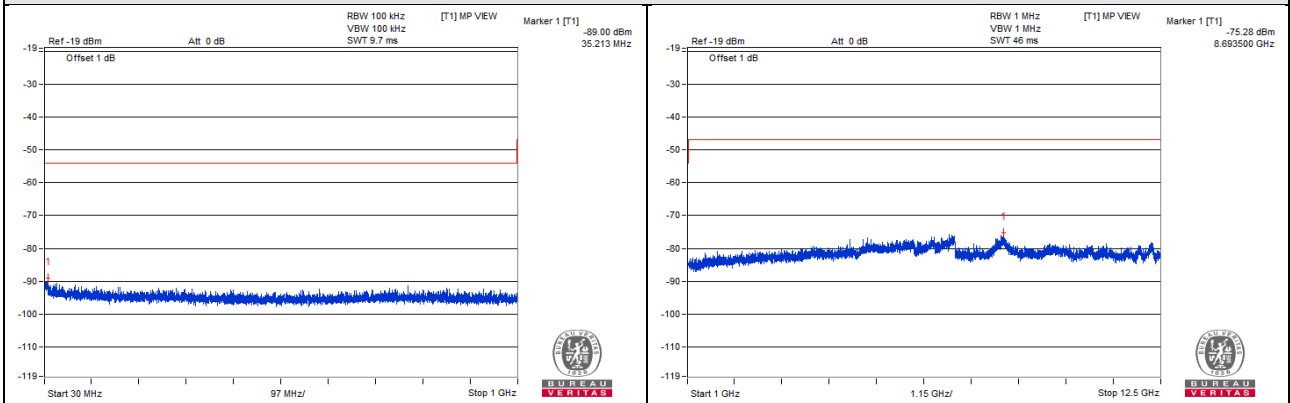


CH 19 (2440MHz)

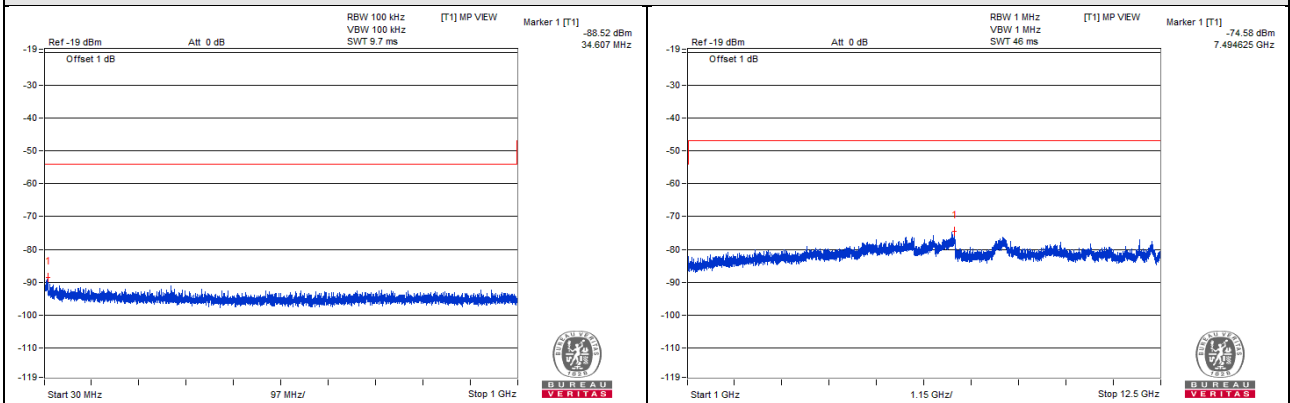
V_{normal}



V_{max}

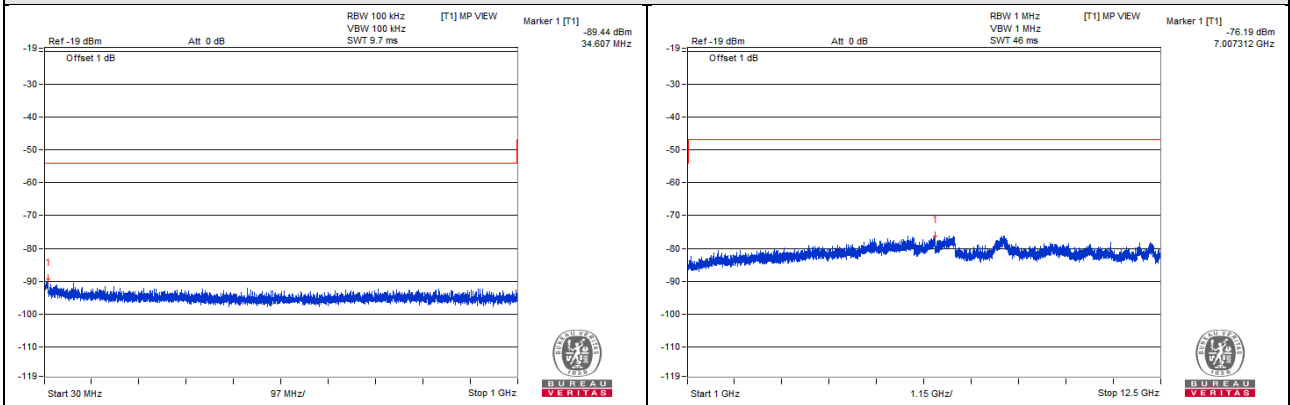


V_{min}

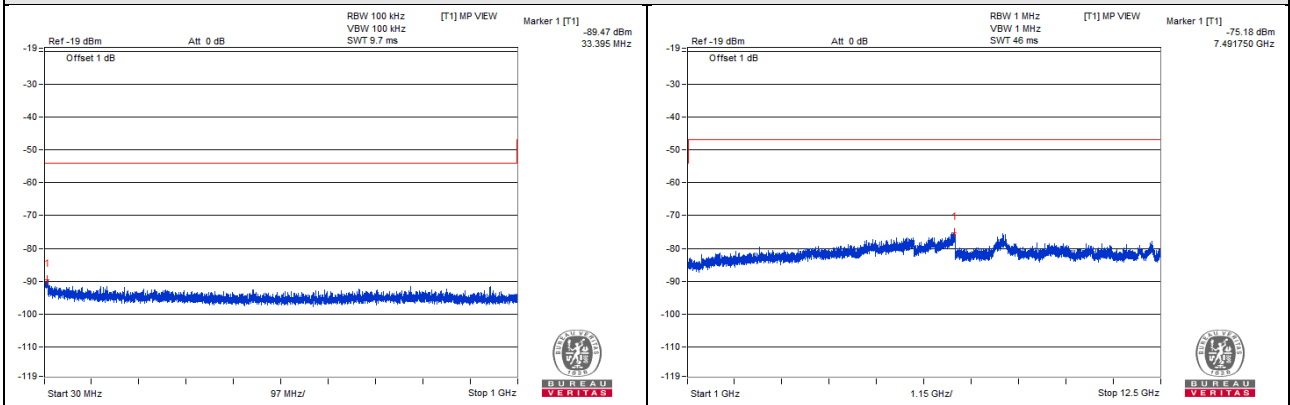


CH 38 (2478MHz)

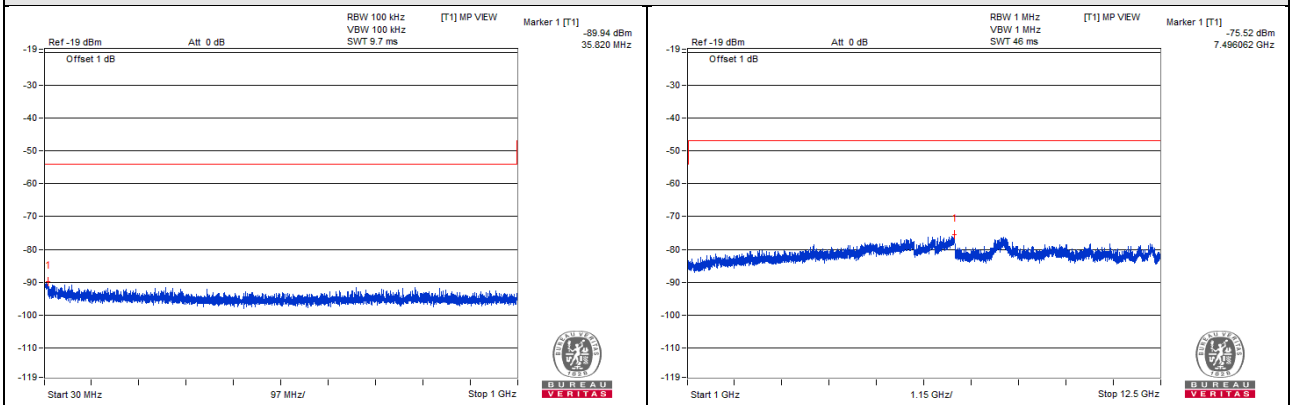
V_{normal}



V_{max}



V_{min}

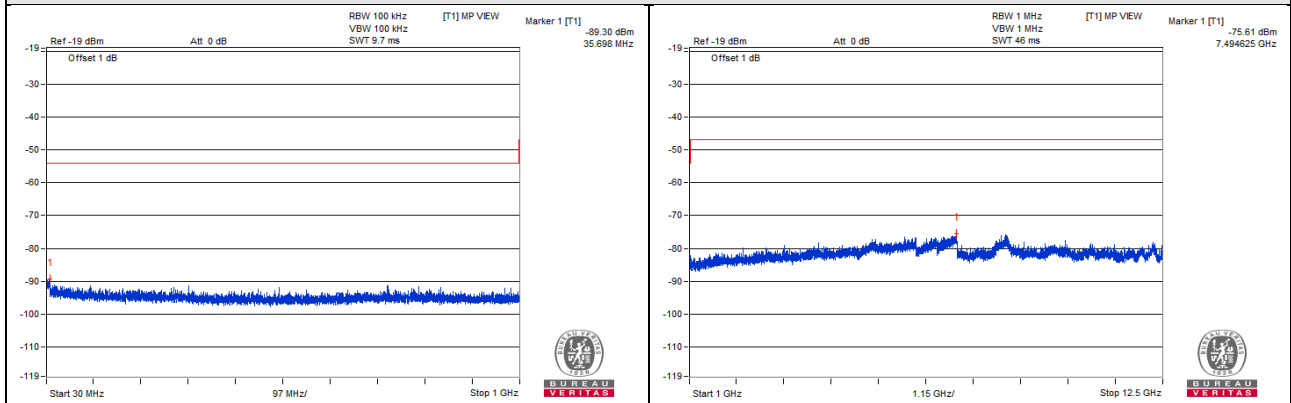


CH 39 (2480MHz)

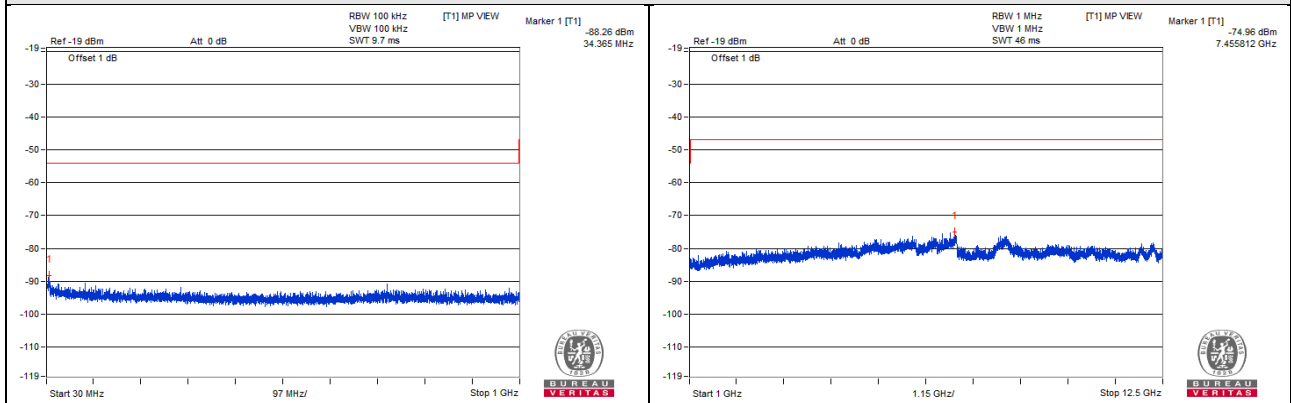
2MBaud with 2Mbps transfer rate

Test Channel		CH 1 (2404MHz)			
Test Condition	Frequency Range (MHz)	Frequency (MHz)	Measured Value (nW)	Limit (nW)	Result
V_{normal}	30 to 1000	35.698	0.001175	4.0	Pass
	1000 to 12500	7494.625	0.027479	20.0	Pass
$V_{max.}$	30 to 1000	34.365	0.001493	4.0	Pass
	1000 to 12500	7455.812	0.031915	20.0	Pass
$V_{min.}$	30 to 1000	32.788	0.001567	4.0	Pass
	1000 to 12500	8730.875	0.028379	20.0	Pass
Test Channel		CH 19 (2440MHz)			
V_{normal}	30 to 1000	33.516	0.001208	4.0	Pass
	1000 to 12500	7496.062	0.030974	20.0	Pass
$V_{max.}$	30 to 1000	34.122	0.001125	4.0	Pass
	1000 to 12500	7465.875	0.029040	20.0	Pass
$V_{min.}$	30 to 1000	32.788	0.001161	4.0	Pass
	1000 to 12500	7474.500	0.029785	20.0	Pass
Test Channel		CH 38 (2478MHz)			
V_{normal}	30 to 1000	33.516	0.001406	4.0	Pass
	1000 to 12500	7470.187	0.031550	20.0	Pass
$V_{max.}$	30 to 1000	30.363	0.001614	4.0	Pass
	1000 to 12500	7434.250	0.029580	20.0	Pass
$V_{min.}$	30 to 1000	30.485	0.001489	4.0	Pass
	1000 to 12500	7481.687	0.030130	20.0	Pass

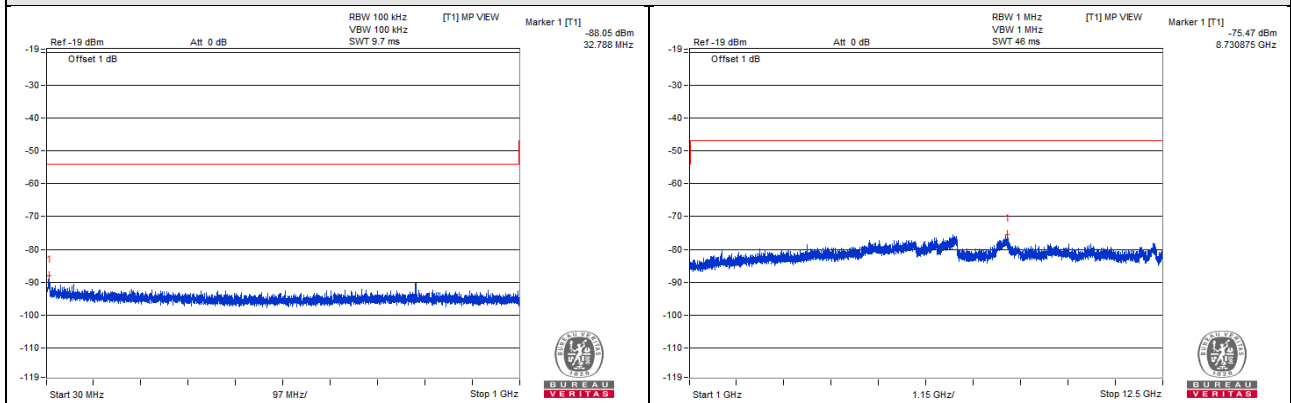
V_{normal}



V_{max}

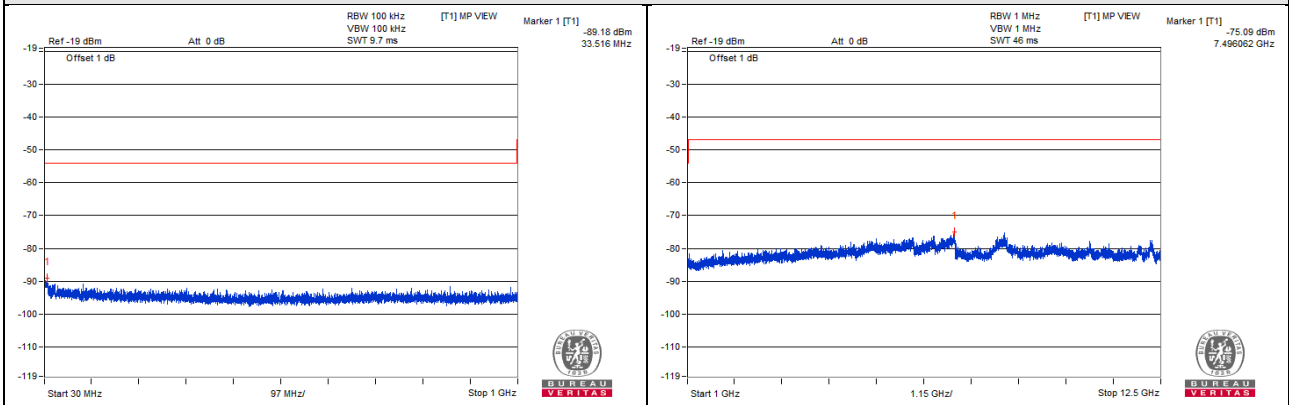


V_{min}

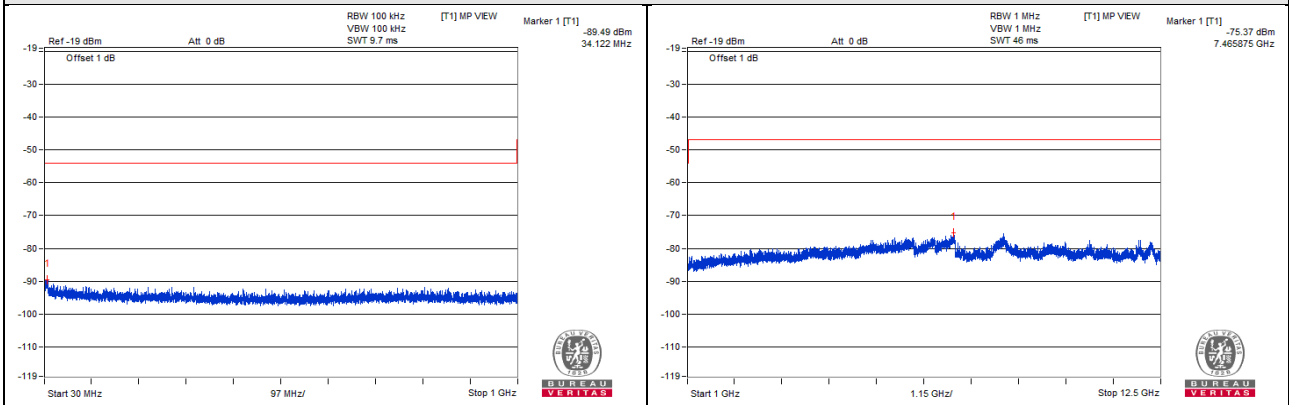


CH 1 (2404MHz)

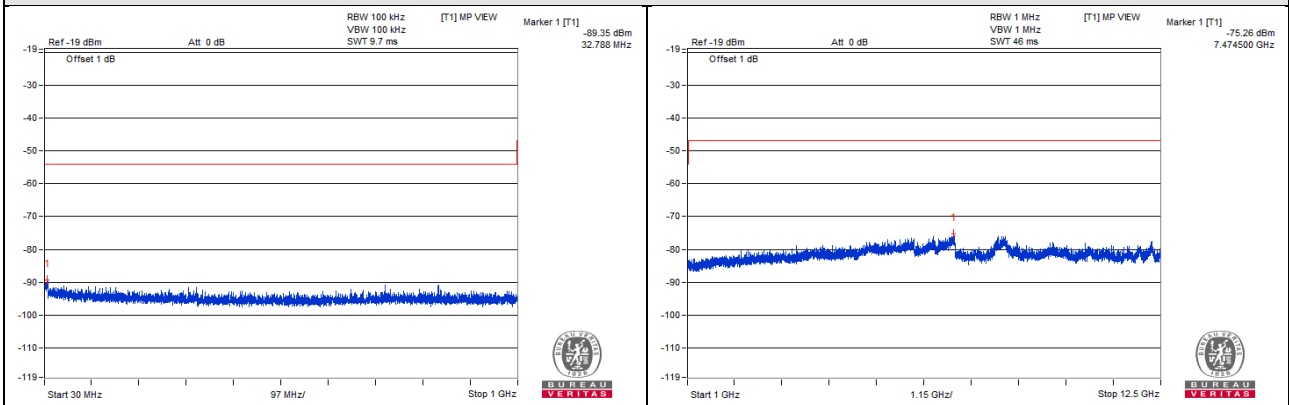
V_{normal}



V_{max}

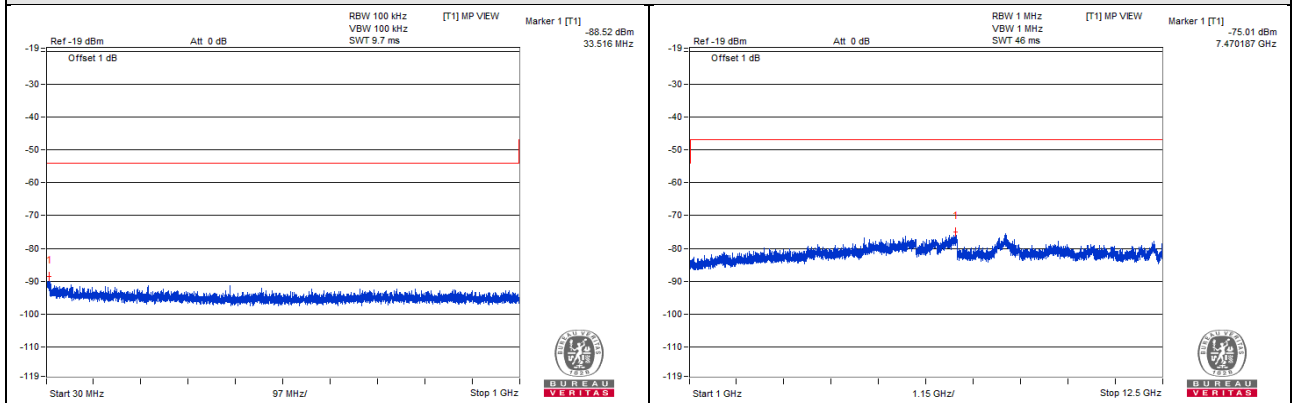


V_{min}

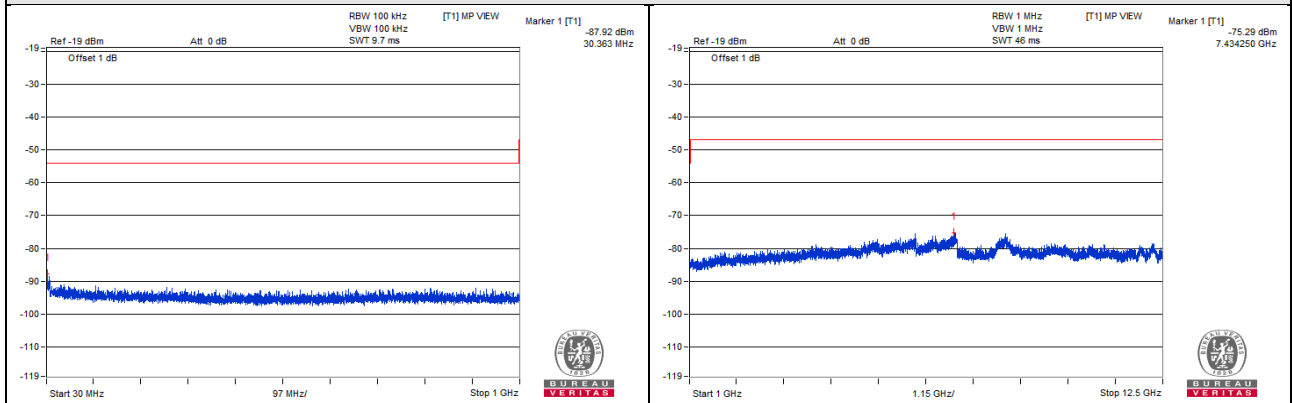


CH 19 (2440MHz)

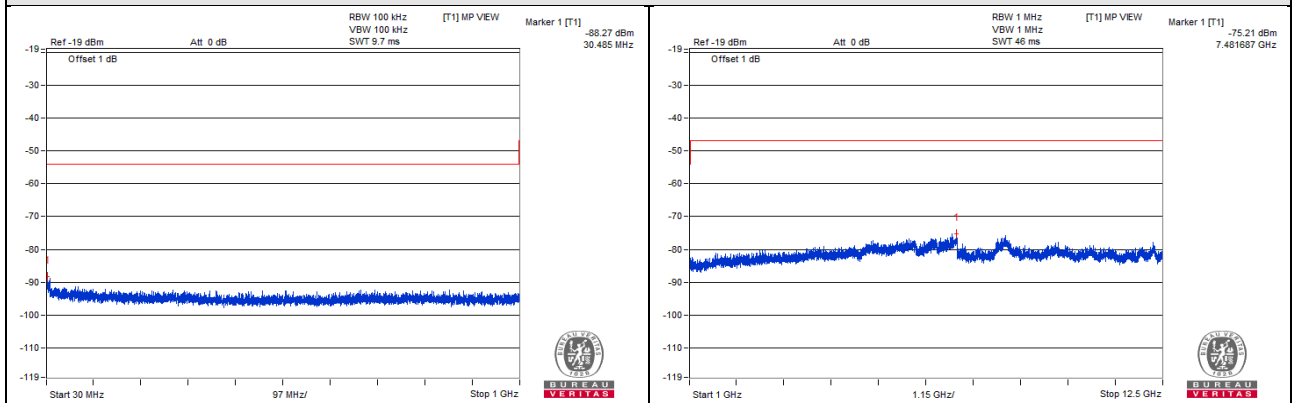
V_{normal}



V_{max}



V_{min}



CH 38 (2478MHz)

4.7 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 seconds

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

4.7.2 Test Setup



4.7.3 Test Result

1MBaud with 1Mbps transfer rate

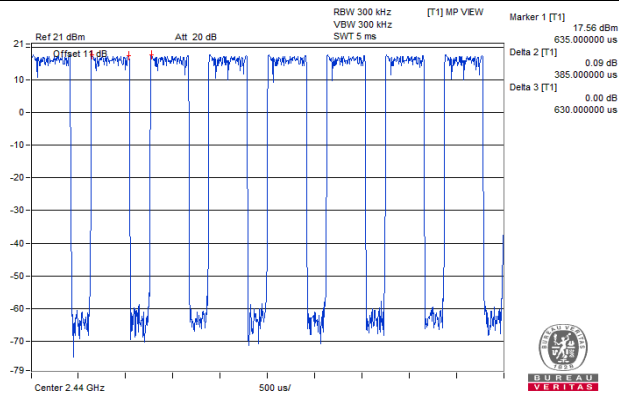
Normal Mode:

Test Condition	Diffusion Rate	$(\text{Diffusion Rate}/79) \times 0.4 \text{ sec}$	Duty Cycle	Result (msec)	Limit (msec)
V_{normal}	68.20	0.345	0.611	210.795	400
$V_{\text{max.}}$	69.50	0.351	0.616	216.216	400
$V_{\text{min.}}$	67.90	0.343	0.616	211.288	400

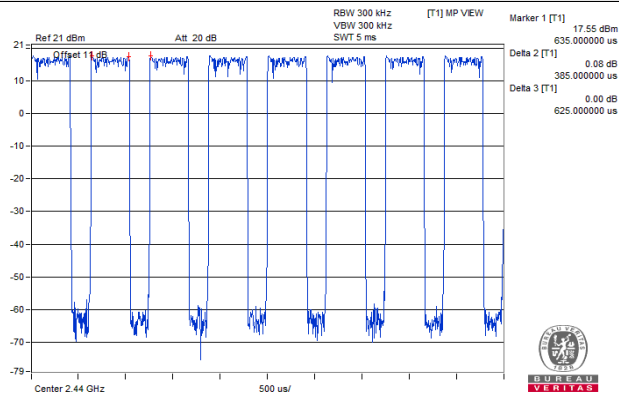
AFH Mode:

Test Condition	Diffusion Rate	$(\text{Diffusion Rate}/20) \times 0.4 \text{ sec}$	Duty Cycle	Result (msec)	Limit (msec)
V_{normal}	19.90	0.398	0.611	243.178	400
$V_{\text{max.}}$	19.90	0.398	0.616	245.168	400
$V_{\text{min.}}$	19.90	0.398	0.616	245.168	400

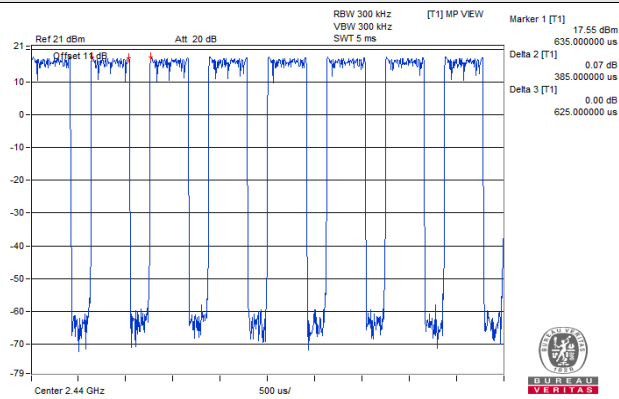
V_{normal}



V_{max.}



V_{min.}



2MBaud with 2Mbps transfer rate

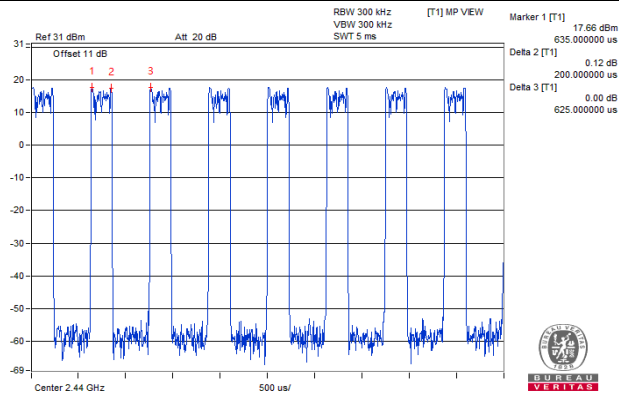
Normal Mode:

Test Condition	Diffusion Rate	(Diffusion Rate/79)*0.4 sec	Duty Cycle	Result (msec)	Limit (msec)
V _{normal}	69.40	0.351	0.320	112.320	400
V _{max.}	69.60	0.352	0.320	112.640	400
V _{min.}	69.00	0.349	0.320	111.680	400

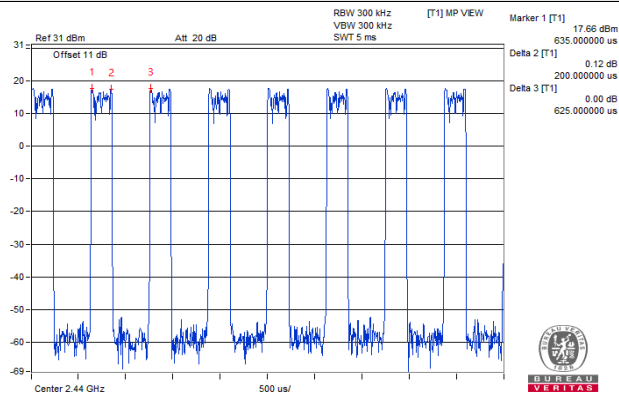
AFH Mode:

Test Condition	Diffusion Rate	(Diffusion Rate/20)*0.4 sec	Duty Cycle	Result (msec)	Limit (msec)
V _{normal}	19.90	0.398	0.320	127.360	400
V _{max.}	19.90	0.398	0.320	127.360	400
V _{min.}	19.90	0.398	0.320	127.360	400

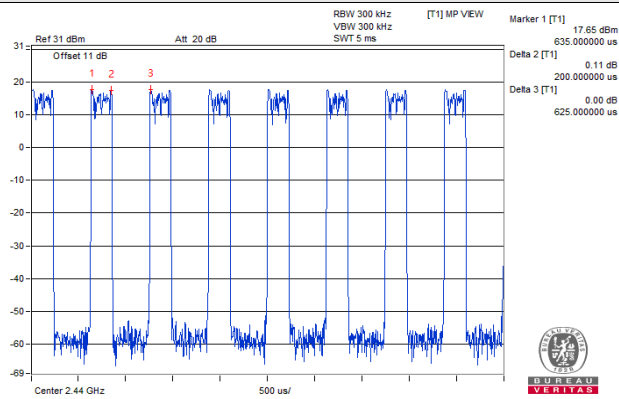
V_{normal}



V_{max.}



V_{min.}

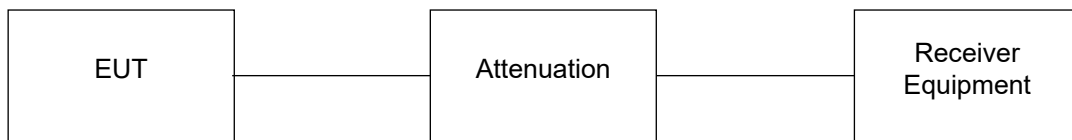


4.8 Interference Prevention Function

4.8.1 Limits of Interference Prevention Function

NA

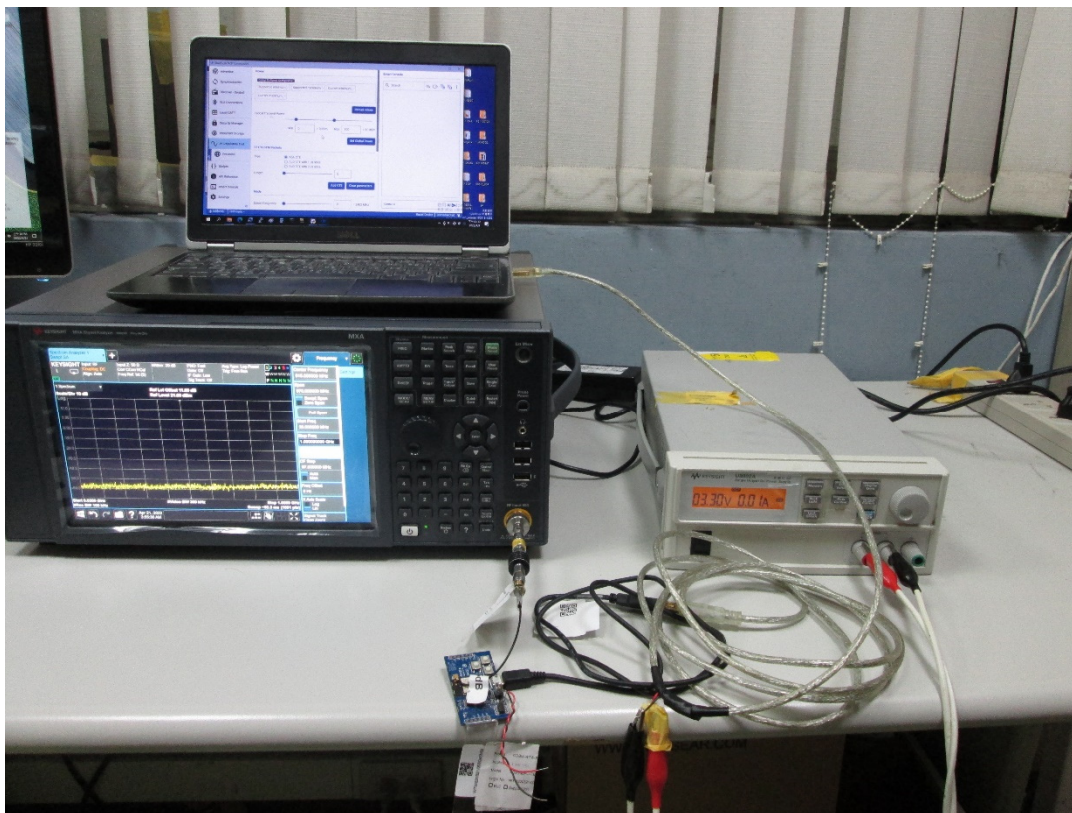
4.8.2 Test Setup



4.8.3 Test Results

Environmental Conditions	25 deg.C, 60% RH
Link Mode	Test Result
1MBaud with 1Mbps transfer rate	Pass
2MBaud with 2Mbps transfer rate	Pass

5 Photographs of the Test Configuration



Appendix - Information of the Testing Laboratories

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

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The address and road map of all our labs can be found in our web site also.

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