



TEST REPORT

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1. Client

- Name : Sena Technologies Co., Ltd.
- Address..... : 19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, Korea

2. Use of Report..... : FCC & IC Approval

3. Sample Description

- Product Name : Bluetooth Module
- Model Name : IW05

4. Date of Receipt..... : 2024-10-08

5. Date of Test : 2024-10-29

6. Test Method : FCC Part 15 Subpart C 15.247 RSS-247 Issue 3(2023-08), RSS-GEN Issue 5(2019-03)

7. Test Results : Refer to the test results

- ※ The results shown in this test report are the results of testing the samples provided.
- ※ This test report is prepared according to the requirements of ISO / IEC 17025.

Affirmation	Tested by	Technical Manager
	Jong-Myoung, Shin (Sign)	Kyung-Taek, Lee (Sign)

Oct 30, 2024

EMC Labs Co., Ltd.



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Version

TEST REPORT NO.	DATE	DESCRIPTION
KR0140-RF2410-002	Oct 30, 2024	Initial Issue



1. Applicant & Manufacturer & Test Laboratory Information

1.1 Applicant Information

Applicant	Sena Technologies Co., Ltd.
Applicant Address	19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, Korea
Contact Person	Seunghyun Kim
Telephone No.	+82-2-573-7772
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1.2. Manufacturer Information

Manufacturer	Sena Technologies Co., Ltd.
Manufacturer Address	19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, Korea

1.3 Test Laboratory Information

Laboratory	EMC Labs Co., Ltd.
Laboratory Address	100, Jangjateo-ro, Hobeop-myeon, Icheon-si, Gyeonggi-do, Republic of Korea
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FCC Designation No.	KR0140
FCC Registration No.	580000
IC Site Registration No.	28751



2. Equipment under Test(EUT) Information

2.1 General Information

Product Name	Bluetooth Module
Model Name	IW05
Variant Model Name	IW05-DC, IW05-DS, IW05-DU, IW05-SC, IW05-SU
FCC ID	S7A-IW05
IC	8154A-IW05
Rated Voltage	DC 3.3 V

2.2 Additional Information

Operating Frequency	2 402 MHz ~ 2 480 MHz
Number of channel	79
Modulation Type	BDR Mode(GFSK), EDR Mode(Pi/4 DQPSK, 8DPSK)
Antenna Type & Gain	Dipole Antenna with Max. Gain: 5.37 dBi(M/N: R-AN2400-1901RS) / Dipole Antenna with Max. Gain: 3.09 dBi(M/N: R-AN2400-5801RS) / Dipole Antenna with Max. Gain: 1.40 dBi(M/N: AN2400-3306RS) / Chip Antenna with Max. Gain: 0.20 dBi(M/N: SENA_F0165) / Dipole Antenna with Max. Gain: 3.00 dBi(M/N: WE11-BO-21) / PCB Antenna with Max. Gain: 2.248 dBi(M/N: HWI-2450DP-IPEX-150) / Dome Antenna with Max. Gain: 0.00 dBi(M/N: WBZ28)
Firmware Version	1.1
Hardware Version	1.1
Test software	BlueTest3 V2.6.2

2.3 Test Frequency

Test mode	Test Frequency (MHz)		
	Low Frequency	Middle Frequency	High Frequency
GFSK	2 402	2 441	2 480
Pi/4 DQPSK	2 402	2 441	2 480
8DPSK	2 402	2 441	2 480

2.4 Test Mode

Test Mode	Module Type	Antenna Type & Gain		
		Model Name	Type	Gain
TM1	UFL Type	HWI-2450DP-IPEX-150	PCB Antenna	2.248 dBi
TM2	UFL Type	WBZ28	Dome Antenna	0.00 dBi



2.5 Worst-Case

BDR	GFSK (DH5)
EDR	8DPSK (3-DH5)

2.6 Mode of operation during the test

- The EUT continuous transmission mode during the test with set at Low Channel, Middle Channel, and High Channel. To get a maximum radiated emission levels from the EUT, the EUT was moved throughout the XY, YZ, XZ planes.

2.7 Modifications of EUT

- None



3. Test Summary

Applied	FCC Rule	IC Rule	Test Items	Test Condition	Result
☒	15.203	–	Antenna Requirement	Conducted	C
☒	15.247(a)	–	20 dB Bandwidth		NT ^{Note2}
☒	–	RSS-GEN (6.7)	Occupied Bandwidth (99%)		NT ^{Note2}
☒	15.247(a)	RSS-247 (5.1)	Number of Hopping Frequencies		NT ^{Note2}
☒	15.247(a)	RSS-247 (5.1)	Time of Occupancy (Dwell Time)		NT ^{Note2}
☒	15.247(a)	RSS-247 (5.1)	Carrier Frequencies Separation		NT ^{Note2}
☒	15.247(b)	RSS-247 (5.4)	Peak Output Power		NT ^{Note2}
☒	15.247(d)	RSS-247 (5.5)	Conducted Spurious Emission		NT ^{Note2}
☒	15.247(d) 15.205 & 15.209	RSS-247 (5.5) RSS-GEN (8.9 & 8.10)	Radiated Spurious Emission	Radiated	C
☒	15.207	RSS-GEN (8.8)	Conducted Emissions	AC Line Conducted	NT ^{Note2}

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

Note 2: This test item was tested on the certified RF Module(Test Report No.: DRTFCC1612-0159(1))

The sample was tested according to the following specification: ANSI C63.10:2013.

Compliance was determined by specification limits of the applicable standard according to customer requirements.



4. Used equipment on test

	Description	Manufacturer	Model Name	Serial Name	Next Cal.
■	TEMP & HUMID CHAMBER	JFM	JFMA-001	20200929-01	2024.12.07
■	CONTROLLER	AMWON TECHNOLOGY	TEMI2500	S7800VK191 0707	2024.12.07
■	PSA SERIES SPECTRUM ANALYZER	AGILENT	E4440A	MY45304057	2024.12.08
■	MXG ANALOG SIGNAL GENERATOR	AGILENT	N5183A	MY50141890	2024.12.08
■	SYSTEM DC POWER SUPPLY	AGILENT	6674A	MY53000118	2024.12.11
□	VECTOR SIGNAL GENERATOR	ROHDE & SCHWARZ	SMBV100A	257524	2024.12.08
□	DIRECTIONAL COUPLER	AGILENT	773D	2839A01855	2024.12.08
□	ATTENUATOR	AGILENT	8493C	73193	2024.12.08
□	TERMINATION	HEWLETT PACKARD	909D	07492	2024.12.08
□	POWER DIVIDER	HEWLETT PACKARD	11636A	06916	2024.12.08
□	SLIDE-AC	DAEKWANG TECH	SV-1023	NONE	2024.11.10
■	DIGITAL MULTIMETER	HUMANTECHSTORE	15B+	50561541WS	2024.12.08
■	ATTENUATOR	ACE RF COMM	ATT SMA 20W 20dB 8GHz	A-0820.SM20.2	2025.04.04
■	DC POWER SUPPLY	AGILENT	E3634A	MY40012120	2025.02.22
□	USB Peak Power Sensor	Anritsu	MA24408A	12321	2024.11.09
□	High Pass Filter	WT Microwave INC.	WT-A3314-HS	WT22111804-1	2024.12.08
■	High Pass Filter	WT Microwave INC.	WT-A1935-HS	WT22111804-2	2024.12.08
□	SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSU26	200444	2025.02.22
■	ATTENUATOR	Mini-Circuits	BW-K3-2W44+	2318-1	2025.06.28
□	ATTENUATOR	Mini-Circuits	BW-K3-2W44+	2318-2	2025.06.28
□	Balanced Temperature and Humidity Control System	ESPEC CORP.	SH-241	92004650	2025.06.13
■	ACTIVE LOOP ANTENNA	TESEQ	HLA 6121	55685	2024.12.22
■	Biconilog ANT	Schwarzbeck	VULB 9160	3260	2026.04.01
□	Biconilog ANT	Schwarzbeck	VULB9168	902	2024.11.30
■	Horn ANT	Schwarzbeck	BBHA9120D	974	2024.11.30
□	Horn ANT	Schwarzbeck	BBHA9120D	1497	2025.01.04
■	Amplifier	TESTEK	TK-PA18H	200104-L	2025.03.14
■	Horn ANT	Schwarzbeck	BBHA9170	01188	2025.03.19
□	Horn ANT	Schwarzbeck	BBHA9170	01189	2025.03.19
■	AMPLIFIER	TESTEK	TK-PA1840H	220105-L	2025.03.14
■	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW44	101952	2025.03.14
■	Test Receiver	ROHDE & SCHWARZ	ESR7	101616	2025.06.27
■	LISN	ROHDE & SCHWARZ	ENV216	100409	2025.01.04
■	PULSE LIMITER	lignex1	EPL-30	NONE	2025.01.04



5. Antenna Requirement

According to §15.203 An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

According to §15.247(b)(4) e conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.1 Result

Complies

(The transmitter has a Dipole Antenna with directional peak gain of the antenna is 5.37 dBi, and Chip Antenna with directional peak gain of the antenna is 0.20 dBi, and PCB Antenna with directional peak gain of the antenna is 2.248 dBi, and Dome Antenna with directional peak gain of the antenna is 0.00 dBi.)



6. TX Radiated Spurious Emission

6.1 Test Setup

Refer to the APPENDIX I.

6.2 Limit

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph(b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

According to § 15.209(a), except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Limit (uV/m)	Measurement Distance (meter)
0.009 ~ 0.490	2400/F (kHz)	300
0.490 ~ 1705	24000/F (kHz)	30
1705 ~ 30.0	30	30
30 ~ 88	100 **	3
88 ~ 216	150 **	3
216 ~ 960	200 **	3
Above 960	500	3

** Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 – 72 MHz, 76 – 88 MHz, 174 – 216 MHz or 470 – 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.



According to § 15.205(a) and (b), only spurious emissions are permitted in any of
The frequency bands listed below:

MHz	MHz	MHz	GHz
0.009 ~ 0.110	16.42 ~ 16.423	399.90 ~ 410	4.5 ~ 5.15
0.495 ~ 0.505	16.69475 ~ 16.69525	608 ~ 614	5.35 ~ 5.46
2.1735 ~ 2.1905	16.80425 ~ 16.80475	960 ~ 1240	7.25 ~ 7.75
4.125 ~ 4.128	25.5 ~ 25.67	1300 ~ 1427	8.025 ~ 8.5
4.17725 ~ 4.17775	37.5 ~ 38.	1435 ~ 1626.5	9.0 ~ 9.2
4.20725 ~ 4.20775	25.73 ~ 74.6	1645.5 ~ 1646.5	9.3 ~ 9.5
4.17725 ~ 4.17775	74.8 ~ 75.2	1660 ~ 1710	10.6 ~ 12.7
6.215 ~ 6.218	108 ~ 121.94	1718.8 ~ 1722.2	13.25 ~ 13.4
6.26775 ~ 6.26825	149.9 ~ 150.05	2200 ~ 2300	14.47 ~ 14.5
6.31175 ~ 6.31225	156.52475 ~ 156.52525	2310 ~ 2390	15.35 ~ 16.2
8.291 ~ 8.294	156.7 ~ 156.9	2483.5 ~ 2500	17.7 ~ 21.4
8.362 ~ 8.366	162.0125 ~ 167.17	2690 ~ 2900	22.01 ~ 23.12
8.37625 ~ 8.38675	3345.8 ~ 3358	3260 ~ 3267	23.6 ~ 24.0
8.41425 ~ 8.41475	3600 ~ 4400	3332 ~ 3339	31.2 ~ 31.8
12.51975 ~ 12.52025	3345.8 ~ 3358	240 ~ 285	36.43 ~ 36.5
12.57675 ~ 12.57725	3600 ~ 4400	322 ~ 335.4	Above 38.6
13.36 ~ 13.41			

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

6.3 Test Procedure for Radiated Spurious Emission

1. The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 3.75 meter away from the interference-receiving antenna.
3. For measurements above 1 GHz absorbers are placed on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1 GHz, the absorbers are removed.
4. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
5. For each suspected emission, the EUT was arranged to its worst case and then The antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
(The EUT was pre-tested with three axes (X, Y, Z) and the final test was performed at the worst case.)
6. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
7. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.



Measurement Instrument Setting

1. Frequency Range: Below 1 GHz
RBW = 100 or 120 kHz, VBW = 3 x RBW, Detector = Peak or Quasi Peak
2. Frequency Range: Above 1 GHz
Peak Measurement
RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Sweep time = Auto,
Trace mode = Max Hold until the trace stabilizes

Average Measurement
RBW = 1MHz, VBW $\geq 1/T$, Detector = Peak, Sweep Time = Auto,
Trace Mode = Max Hold until the trace stabilizes

6.5 Test Result

9 kHz ~ 25 GHz Data for TM1(Modulation: GFSK)

● Low frequency

Frequency	Reading		Pol.	T.F (dB)	DCCF (dB)	Limits		Result		Margin	
	(dBuV/m)					(dBuV/m)		(dBuV/m)		(dB)	
	AV / Peak					AV / Peak		AV / Peak		AV / Peak	
(MHz)											
2 389.96	N/A	52.33	V	9.00	−24.72	54.0	74.0	36.6	61.3	17.4	12.7
4 803.77	N/A	50.48	H	−0.92	−24.72	54.0	74.0	24.8	49.6	29.2	24.4
7 206.48	N/A	49.81	V	8.43	−24.72	54.0	74.0	33.5	58.2	20.5	15.8
9 607.29	N/A	48.09	H	10.78	−24.72	54.0	74.0	34.2	58.9	19.8	15.1
12 009.05	N/A	46.34	V	15.90	−24.72	54.0	74.0	37.5	62.2	16.5	11.8

● Middle frequency

Frequency (MHz)	Reading		Pol.	T.F (dB)	DCCF (dB)	Limits		Result		Margin	
	(dBuV/m)					(dBuV/m)		(dBuV/m)		(dB)	
	AV / Peak					AV / Peak		AV / Peak		AV / Peak	
4 882.10	N/A	51.23	H	−0.95	−24.72	54.0	74.0	25.6	50.3	28.4	23.7
7 322.41	N/A	46.93	V	8.59	−24.72	54.0	74.0	30.8	55.5	23.2	18.5
9 763.40	N/A	44.07	H	11.27	−24.72	54.0	74.0	30.6	55.3	23.4	18.7
12 204.01	N/A	44.97	V	16.03	−24.72	54.0	74.0	36.3	61.0	17.7	13.0

● High frequency

Frequency	Reading		Pol.	T.F (dB)	DCCF (dB)	Limits		Result		Margin	
	(dBuV/m)					(dBuV/m)		(dBuV/m)		(dB)	
	AV / Peak					AV / Peak		AV / Peak		AV / Peak	
(MHz)											
2 483.52	N/A	58.12	V	9.84	−24.72	54.0	74.0	43.2	68.0	10.8	6.0
4 960.32	N/A	52.55	H	−0.82	−24.72	54.0	74.0	27.0	51.7	27.0	22.3
7 440.54	N/A	45.40	V	8.72	−24.72	54.0	74.0	29.4	54.1	24.6	19.9
9 920.54	N/A	45.28	H	11.35	−24.72	54.0	74.0	31.9	56.6	22.1	17.4
12 400.62	N/A	42.21	V	15.50	−24.72	54.0	74.0	33.0	57.7	21.0	16.3

Note 1: The radiated emissions were investigated 9 kHz to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.

Note 2: DCCF(Duty Cycle Correction Factor)

- Time to cycle through all channels = $\Delta t = T \text{ [ms]} \times 20$ minimum hopping channels, where $T = \text{pulse width} = 2.905 \text{ ms}$
 - $100 \text{ ms} / \Delta t \text{ [ms]} = H \rightarrow$ Round up to next highest integer, to account for worst case, $H' = 100 / (2.905 \times 20) = 1.72 \approx 2$

- The Worst Case Dwell Time = $T \text{ [ms]} \times H' = 2.905 \text{ ms} \times 2 = 5.81 \text{ ms}$

- $\text{DCCF} = 20 \times \log(\text{The Worst Case Dwell Time} / 100 \text{ ms}) \text{ dB} = 20 \times \log(5.81 / 100) = -24.72 \text{ dB}$

Note 3: Sample Calculation.

Margin = Limit - Result / Peak Result = Peak Reading + TF / Average Result = Peak Reading + TF + DCCF

TF = Ant factor + Cable Loss + Filter Loss - Amp Gain + Distance Factor

Distance Factor = $20\log(\text{applied distance}/\text{required distance}) = 20\log(3.75\text{m}/3\text{m}) = 1.94$

9 kHz ~ 25 GHz Data for TM1(Modulation: 8DPSK)

● Low frequency

Frequency	Reading		Pol.	T.F (dB)	DCCF (dB)	Limits		Result		Margin	
	(dBuV/m)					(dBuV/m)		(dBuV/m)		(dB)	
	AV / Peak					AV / Peak		AV / Peak		AV / Peak	
2 386.04	N/A	44.12	V	9.00	-24.70	54.0	74.0	28.4	53.1	25.6	20.9

● Middle frequency

Frequency (MHz)	Reading		Pol.	T.F (dB)	DCCF (dB)	Limits		Result		Margin	
	(dBuV/m)					(dBuV/m)		(dBuV/m)		(dB)	
	AV / Peak					AV / Peak		AV / Peak		AV / Peak	

● High frequency

Frequency (MHz)	Reading		Pol.	T.F (dB)	DCCF (dB)	Limits		Result		Margin	
	(dBuV/m)					(dBuV/m)		(dBuV/m)		(dB)	
	AV / Peak					AV / Peak		AV / Peak		AV / Peak	
2 483.54	N/A	51.20	V	9.84	-24.70	54.0	74.0	36.3	61.0	17.7	13.0

Note 1: The radiated emissions were investigated 9 kHz to 25 GHz.

Note 2: DCCF(Duty Cycle Correction Factor)

- Time to cycle through all channels = $\Delta t = T \text{ [ms]} \times 20$ minimum hopping channels, where $T = \text{pulse width} = 2.910 \text{ ms}$
- $100 \text{ ms} / \Delta t \text{ [ms]} = H \rightarrow$ Round up to next highest integer, to account for worst case, $H' = 100 / (2.910 \times 20) = 1.72$

≈ 2

- The Worst Case Dwell Time = $T \text{ [ms]} \times H' = 2.910 \text{ ms} \times 2 = 5.82 \text{ ms}$

- $DCCF = 20 \times \log(\text{The Worst Case Dwell Time} / 100 \text{ ms}) \text{ dB} = 20 \times \log(5.82 / 100) = -24.70 \text{ dB}$

Note 3: Sample Calculation.

Margin = Limit - Result / Peak Result = Peak Reading + TF / Average Result = Peak Reading + TF + DCCF

TF = Ant factor + Cable Loss + Filter Loss - Amp Gain + Distance Factor

Distance Factor = $20\log(\text{applied distance}/\text{required distance}) = 20\log(3.75\text{m}/3\text{m}) = 1.94$

9 kHz ~ 25 GHz Data for TM2(Modulation: GFSK)

● Low frequency

Frequency (MHz)	Reading		Pol.	T.F (dB)	DCCF (dB)	Limits		Result		Margin	
	(dBuV/m)					(dBuV/m)		(dBuV/m)		(dB)	
	AV / Peak					AV / Peak		AV / Peak		AV / Peak	
2 389.96	N/A	43.98	H	9.00	−24.72	54.0	74.0	28.3	53.0	25.7	21.0
4 803.46	N/A	51.07	H	−0.92	−24.72	54.0	74.0	25.4	50.2	28.6	23.9
7 206.46	N/A	49.53	H	8.43	−24.72	54.0	74.0	33.2	58.0	20.8	16.0
9 607.26	N/A	49.24	H	10.78	−24.72	54.0	74.0	35.3	60.0	18.7	14.0
12 010.75	N/A	43.40	V	15.90	−24.72	54.0	74.0	34.6	59.3	19.4	14.7

● Middle frequency

Frequency (MHz)	Reading		Pol.	T.F (dB)	DCCF (dB)	Limits		Result		Margin	
	(dBuV/m)					(dBuV/m)		(dBuV/m)		(dB)	
	AV / Peak					AV / Peak		AV / Peak		AV / Peak	
4 882.31	N/A	54.53	V	-0.95	-24.72	54.0	74.0	28.9	53.6	25.1	20.4
7 322.45	N/A	49.37	H	8.59	-24.72	54.0	74.0	33.2	58.0	20.8	16.0
9 764.44	N/A	42.42	H	11.27	-24.72	54.0	74.0	29.0	53.7	25.0	20.3
12 205.86	N/A	40.14	V	16.03	-24.72	54.0	74.0	31.5	56.2	22.5	17.8

● High frequency

Frequency	Reading		Pol.	T.F (dB)	DCCF (dB)	Limits		Result		Margin	
	(dBuV/m)					(dBuV/m)		(dBuV/m)		(dB)	
	AV / Peak					AV / Peak		AV / Peak		AV / Peak	
(MHz)											
2 483.54	N/A	47.75	H	9.84	-24.72	54.0	74.0	32.9	57.6	21.1	16.4
4 959.72	N/A	54.10	V	-0.82	-24.72	54.0	74.0	28.6	53.3	25.4	20.7
7 440.31	N/A	48.47	H	8.72	-24.72	54.0	74.0	32.5	57.2	21.5	16.8
9 920.54	N/A	45.70	H	11.35	-24.72	54.0	74.0	32.3	57.1	21.7	17.0
12 398.99	N/A	37.83	H	15.60	-24.72	54.0	74.0	28.7	53.4	25.3	20.6

Note 1: The radiated emissions were investigated 9 kHz to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.

Note 2: DCCF(Duty Cycle Correction Factor)

- Time to cycle through all channels = $\Delta t = T \text{ [ms]} \times 20$ minimum hopping channels, where $T = \text{pulse width} = 2.905 \text{ ms}$
 - $100 \text{ ms} / \Delta t \text{ [ms]} = H \rightarrow$ Round up to next highest integer, to account for worst case, $H' = 100 / (2.905 \times 20) = 1.72 \approx 2$

- The Worst Case Dwell Time = $T \text{ [ms]} \times H' = 2.905 \text{ ms} \times 2 = 5.81 \text{ ms}$

- $\text{DCCF} = 20 \times \log(\text{The Worst Case Dwell Time} / 100 \text{ ms}) \text{ dB} = 20 \times \log(5.81 / 100) = -24.72 \text{ dB}$

Note 3: Sample Calculation.

Margin = Limit - Result / Peak Result = Peak Reading + TF / Average Result = Peak Reading + TF + DCCF

TF = Ant factor + Cable Loss + Filter Loss - Amp Gain + Distance Factor

Distance Factor = $20 \log(\text{applied distance} / \text{required distance}) = 20 \log(3.75 \text{ m} / 3 \text{ m}) = 1.94$

9 kHz ~ 25 GHz Data for TM2(Modulation: 8DPSK)

● Low frequency

Frequency (MHz)	Reading		Pol.	T.F (dB)	DCCF (dB)	Limits		Result		Margin	
	(dBuV/m)					(dBuV/m)		(dBuV/m)		(dB)	
	AV / Peak					AV / Peak		AV / Peak		AV / Peak	
2 385.80	N/A	36.08	H	9.00	−24.70	54.0	74.0	20.4	45.1	33.6	28.9

● Middle frequency

Frequency (MHz)	Reading		Pol.	T.F (dB)	DCCF (dB)	Limits		Result		Margin	
	(dBuV/m)					(dBuV/m)		(dBuV/m)		(dB)	
	AV / Peak					AV / Peak		AV / Peak		AV / Peak	

● High frequency

Frequency (MHz)	Reading		Pol.	T.F (dB)	DCCF (dB)	Limits		Result		Margin	
	(dBuV/m)					(dBuV/m)		(dB)			
	AV / Peak					AV / Peak		AV / Peak			
2 483.59	N/A	41.12	H	9.84	−24.70	54.0	74.0	26.3	51.0	27.7	23.0

Note 1: The radiated emissions were investigated 9 kHz to 25 GHz.

Note 2: DCCF(Duty Cycle Correction Factor)

- Time to cycle through all channels = $\Delta t = T \text{ [ms]} \times 20$ minimum hopping channels, where $T = \text{pulse width} = 2.910 \text{ ms}$
- $100 \text{ ms} / \Delta t \text{ [ms]} = H \rightarrow$ Round up to next highest integer, to account for worst case, $H' = 100 / (2.910 \times 20) = 1.72$

≈ 2

- The Worst Case Dwell Time = $T \text{ [ms]} \times H' = 2.910 \text{ ms} \times 2 = 5.82 \text{ ms}$

- $\text{DCCF} = 20 \times \log(\text{The Worst Case Dwell Time} / 100 \text{ ms}) \text{ dB} = 20 \times \log(5.82 / 100) = -24.70 \text{ dB}$

Note 3: Sample Calculation.

Margin = Limit - Result / Peak Result = Peak Reading + TF / Average Result = Peak Reading + TF + DCCF

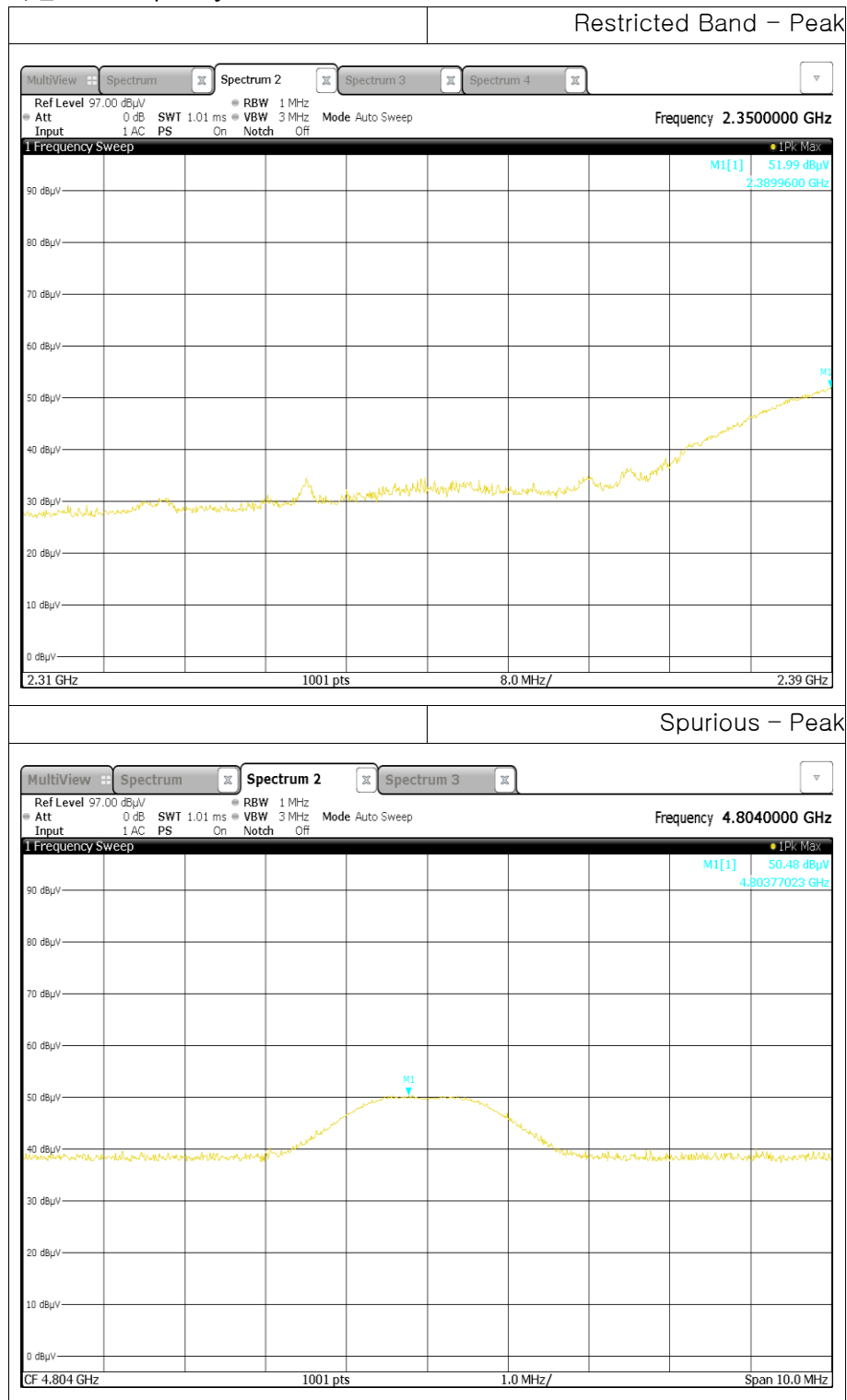
TF = Ant factor + Cable Loss + Filter Loss - Amp Gain + Distance Factor

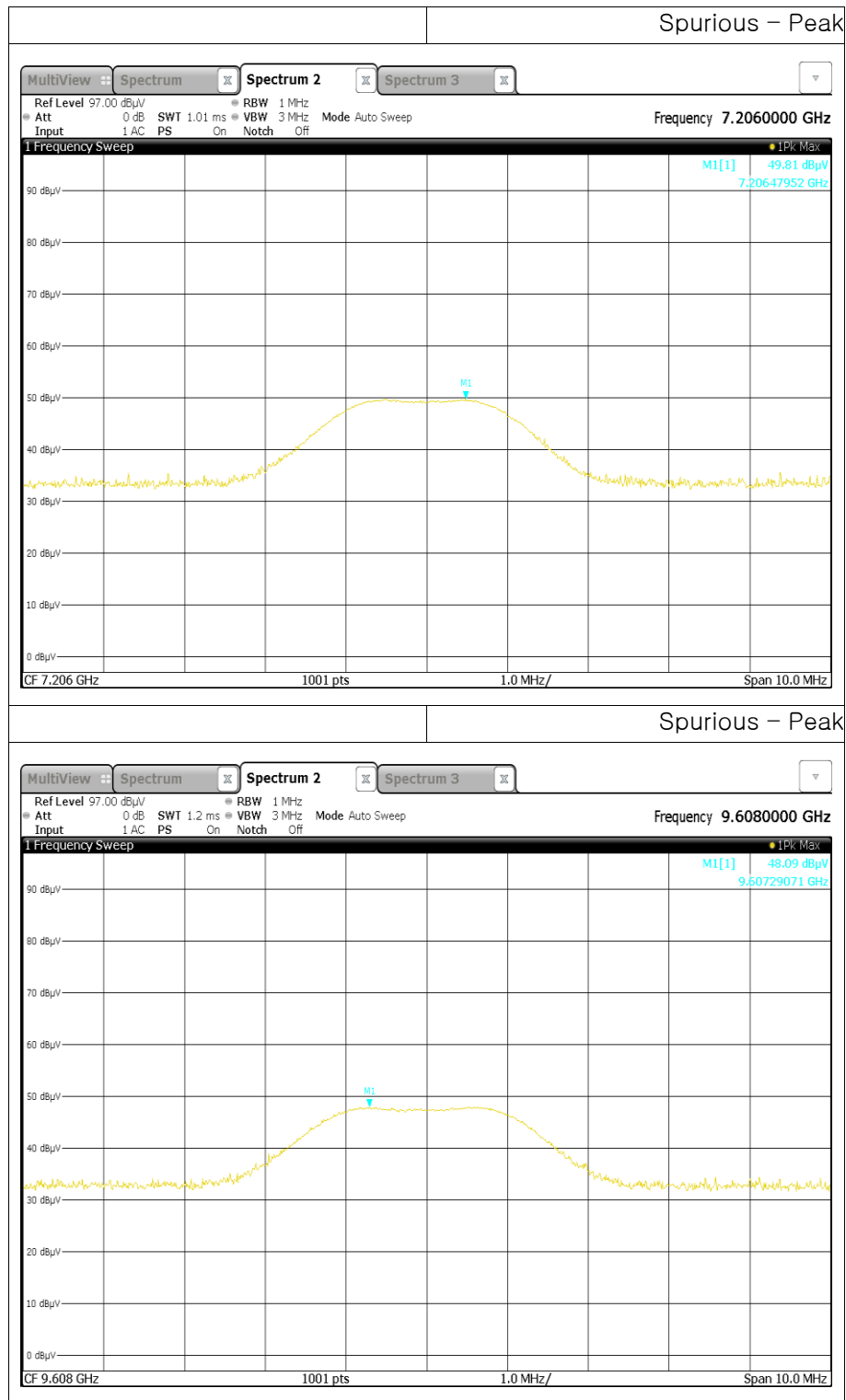
Distance Factor = $20\log(\text{applied distance}/\text{required distance}) = 20\log(3.75\text{m}/3\text{m}) = 1.94$

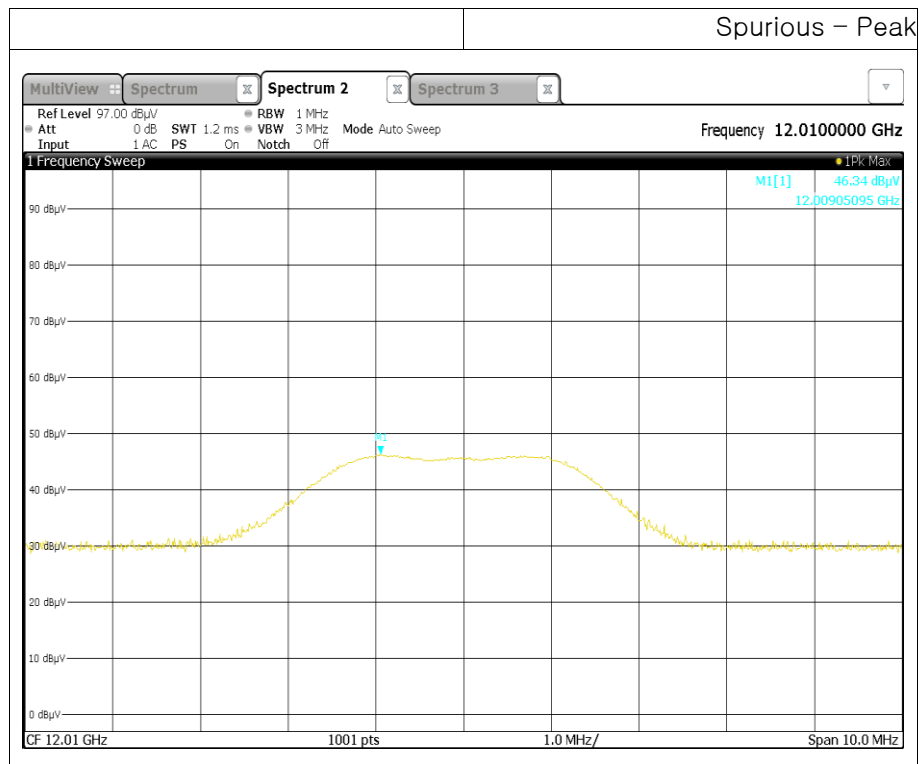


6.6 Test Plot for Radiated Spurious Emission

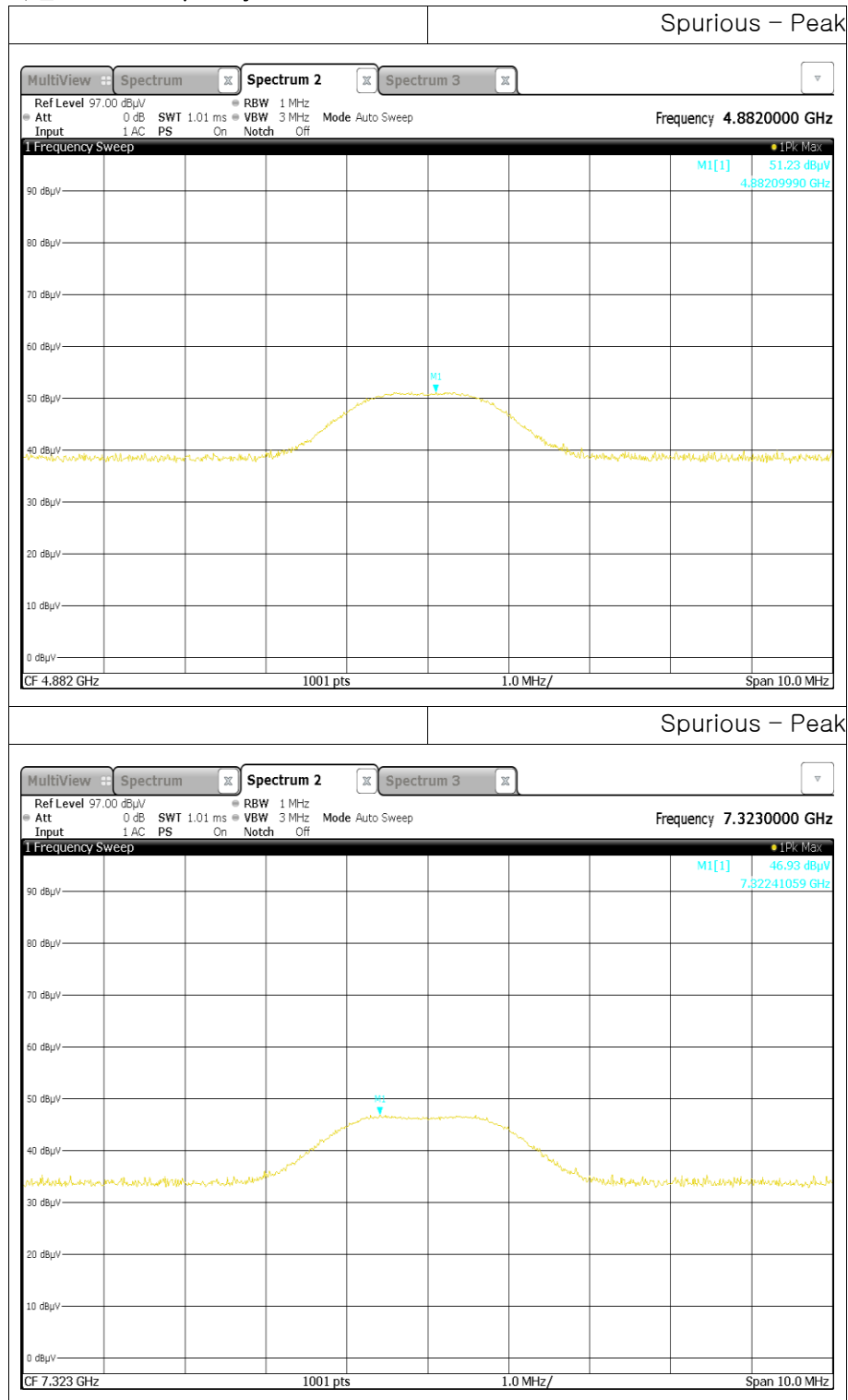
● TM1(GFSK) _ Low frequency

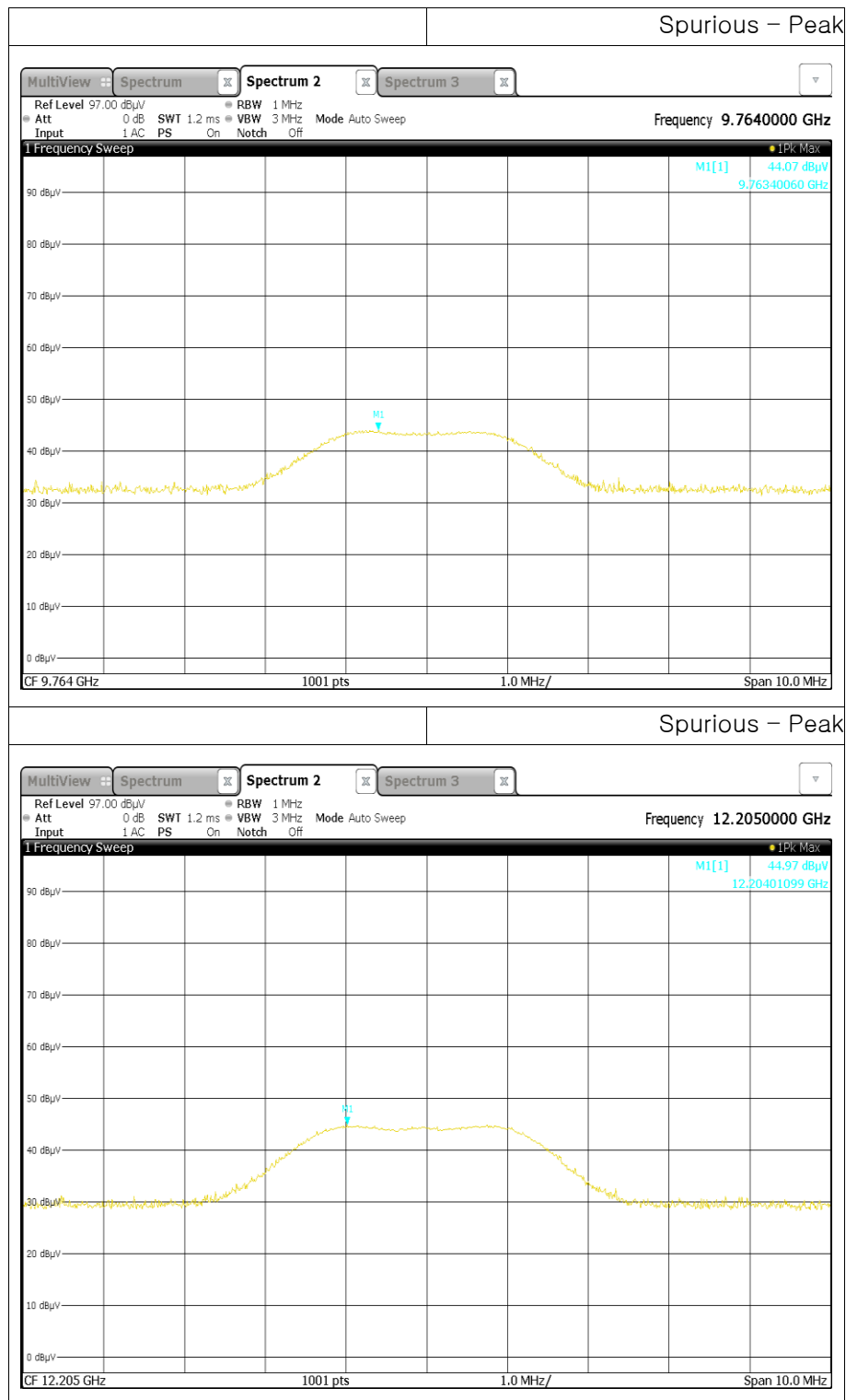




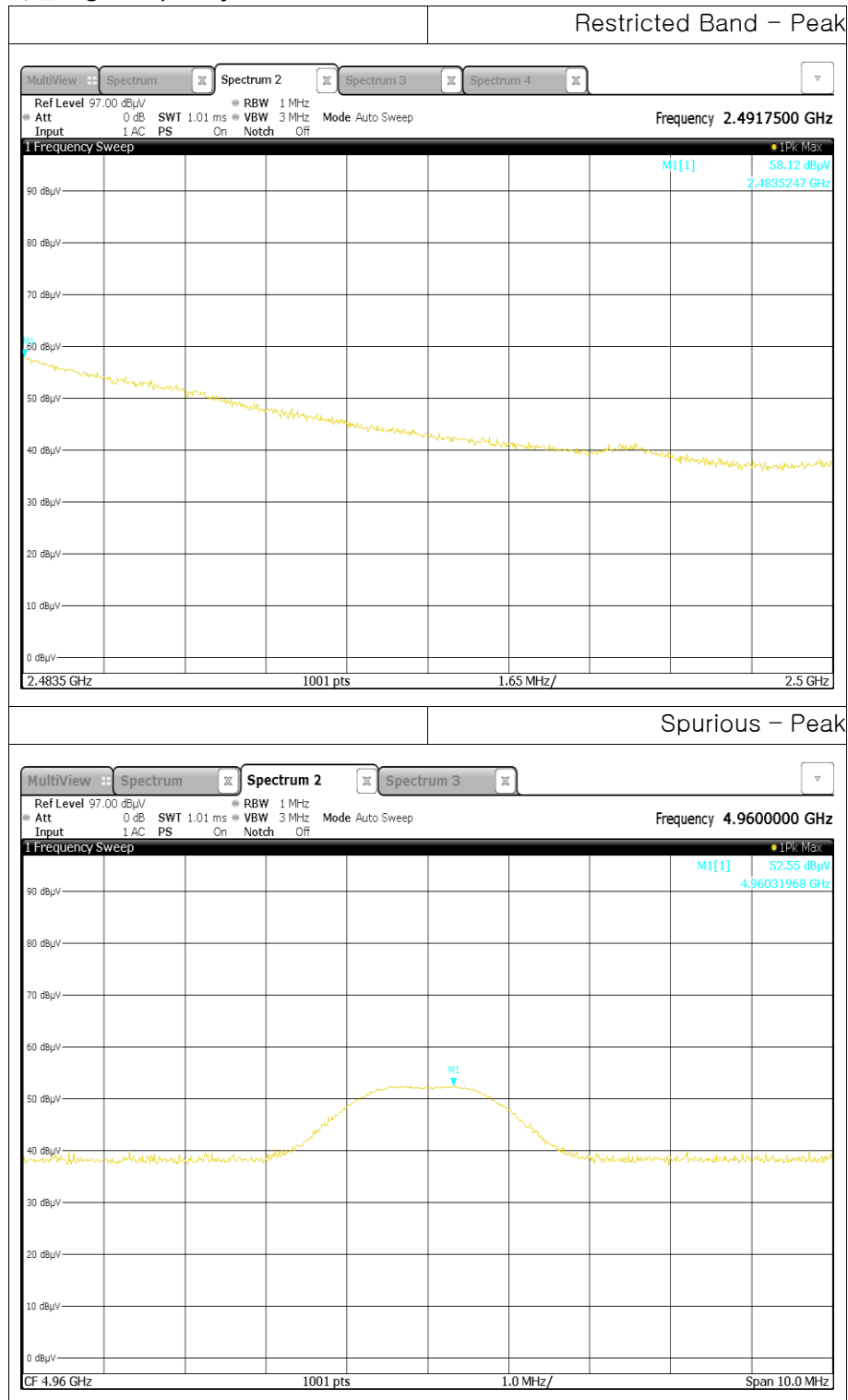


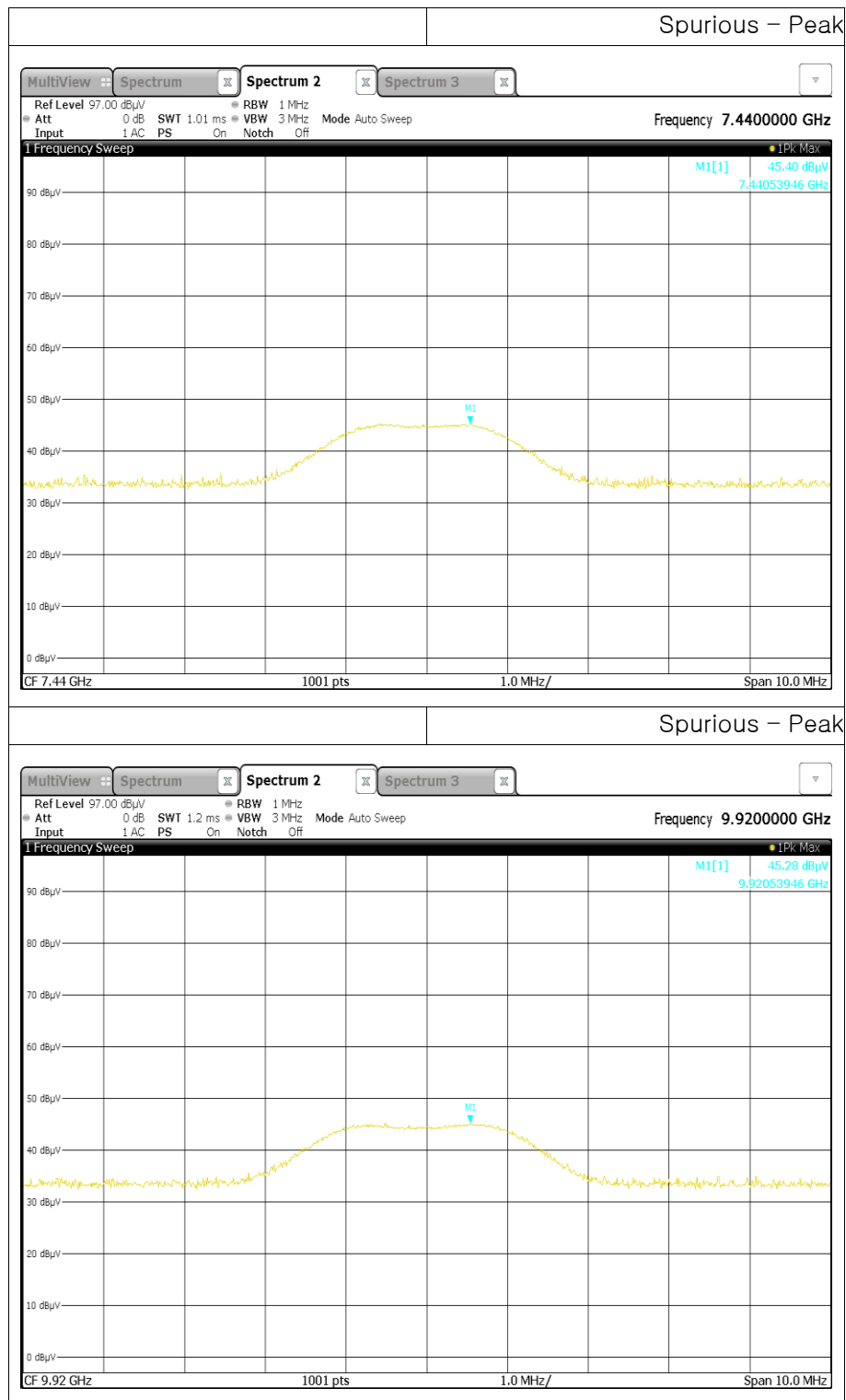
● TM1(GFSK) _ Middle frequency

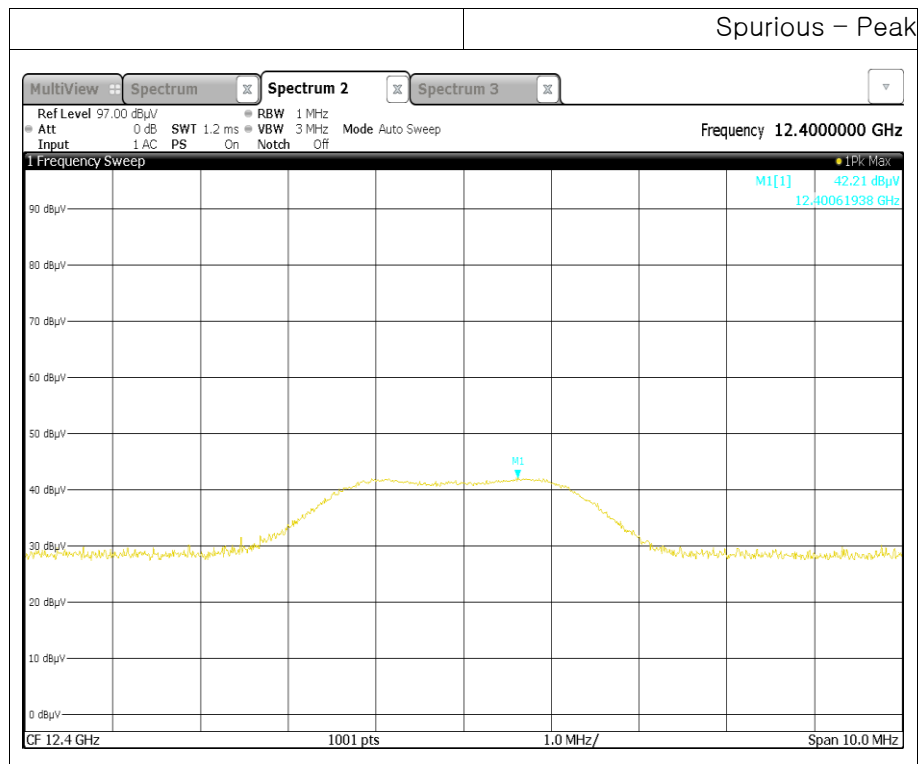




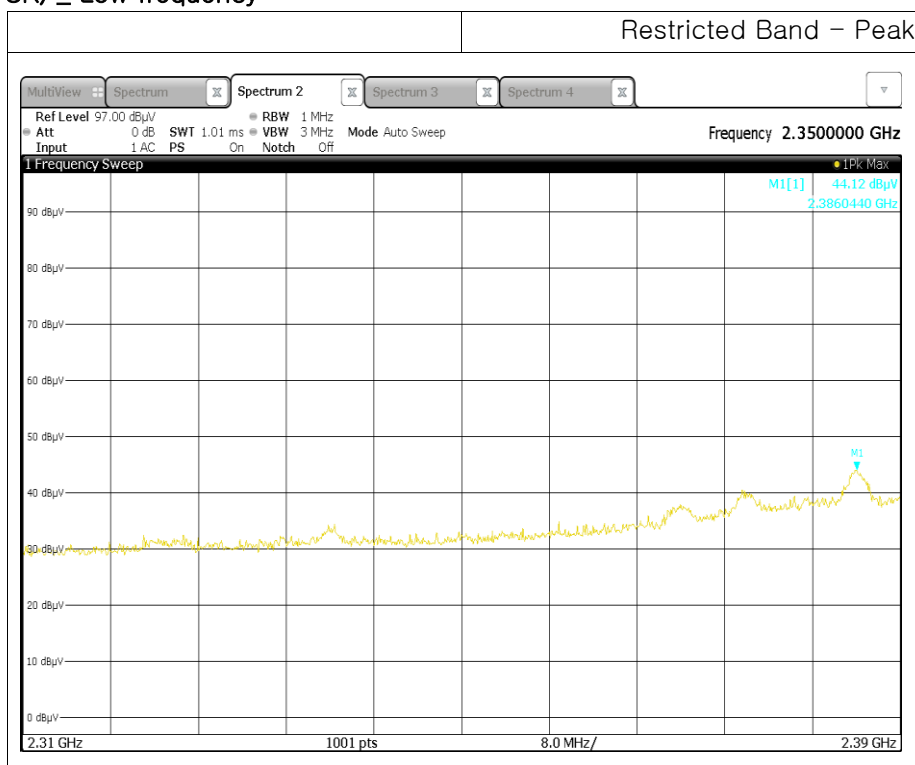
- TM1(GFSK) _ High frequency



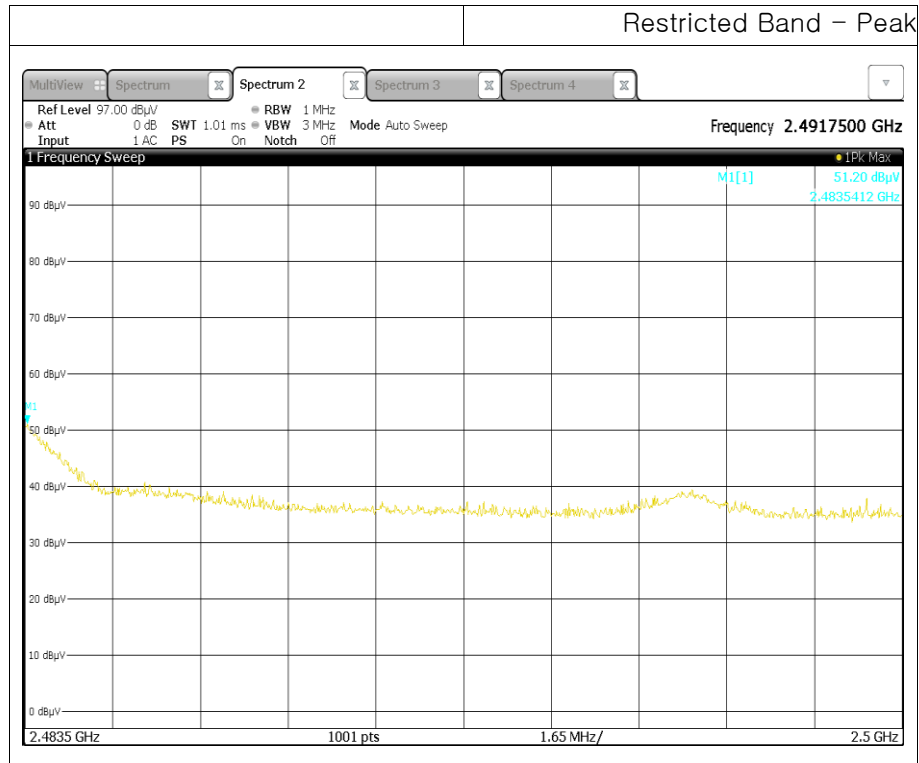




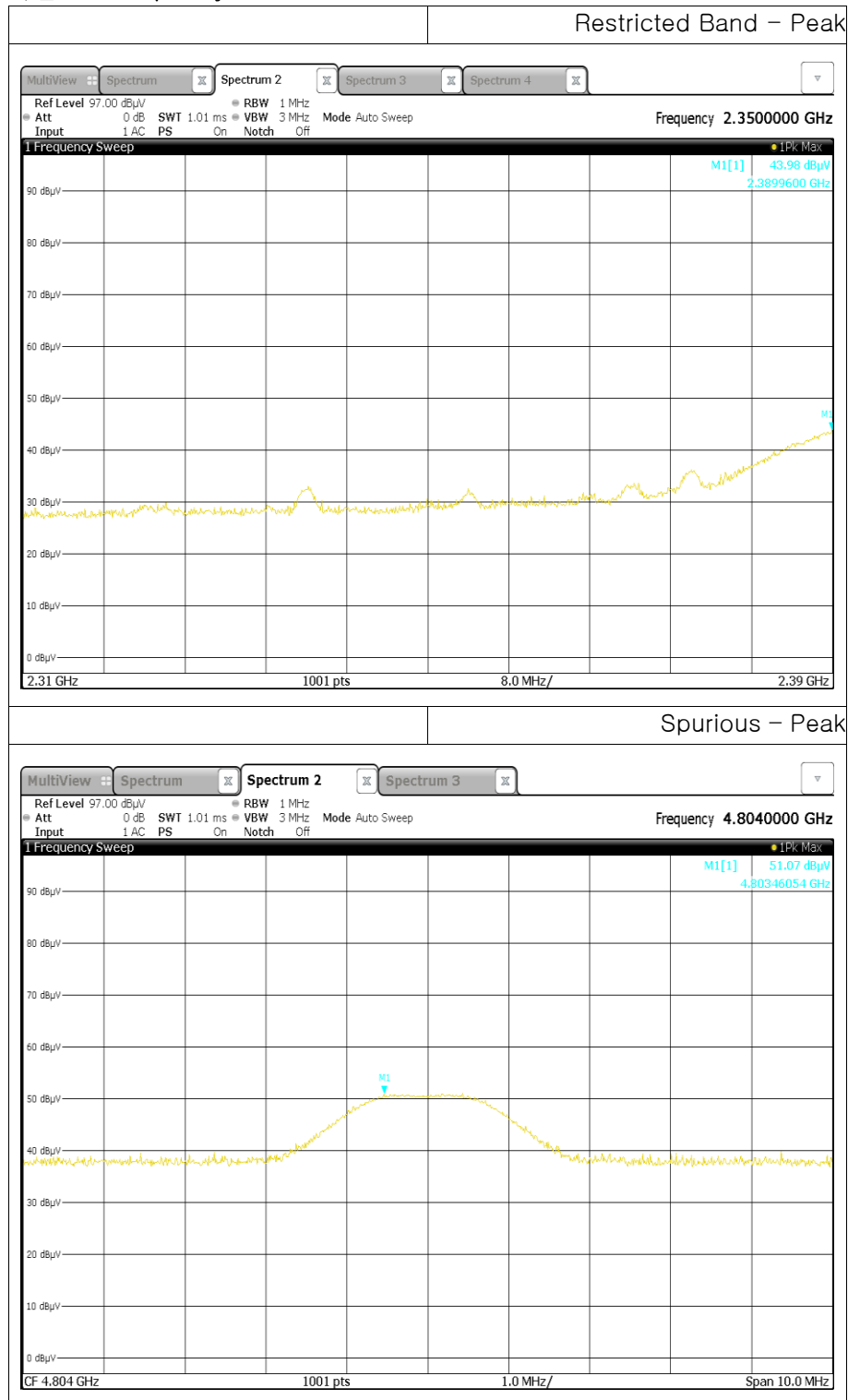
- TM1(8DPSK) _ Low frequency

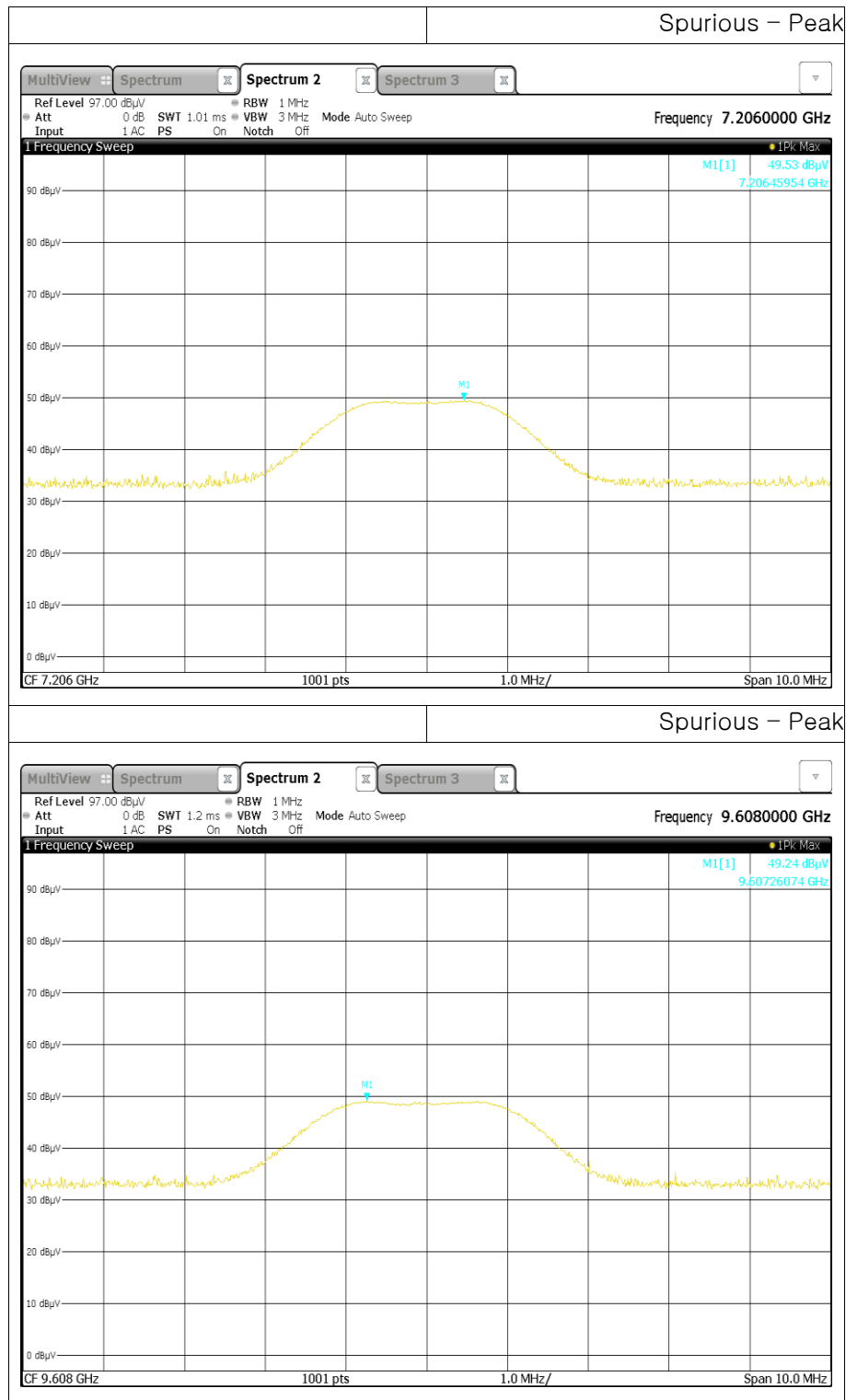


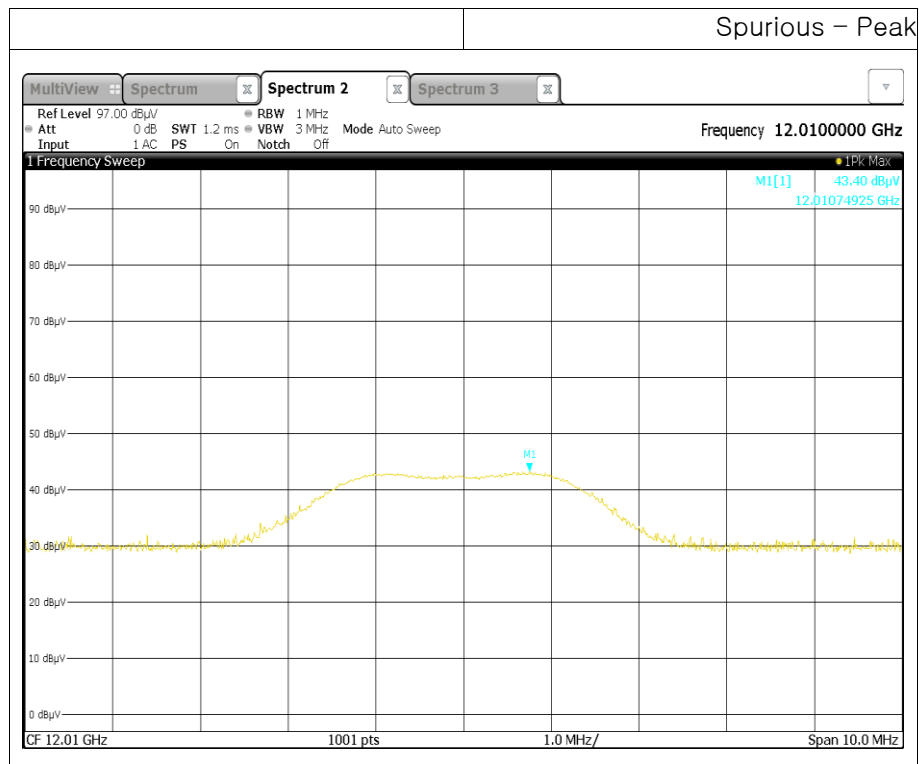
- TM1(8DPSK) _ High frequency



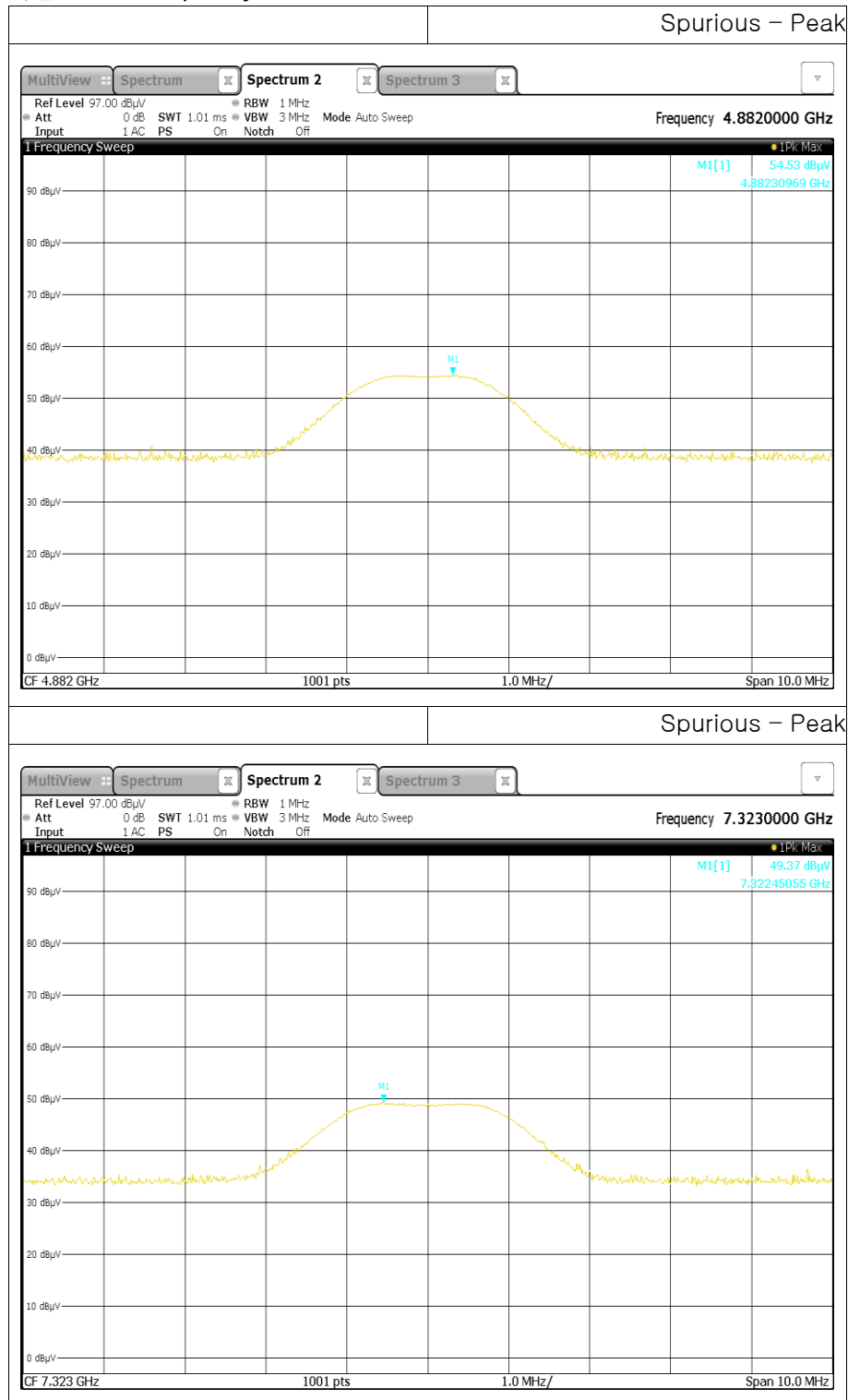
● TM2(GFSK) _ Low frequency

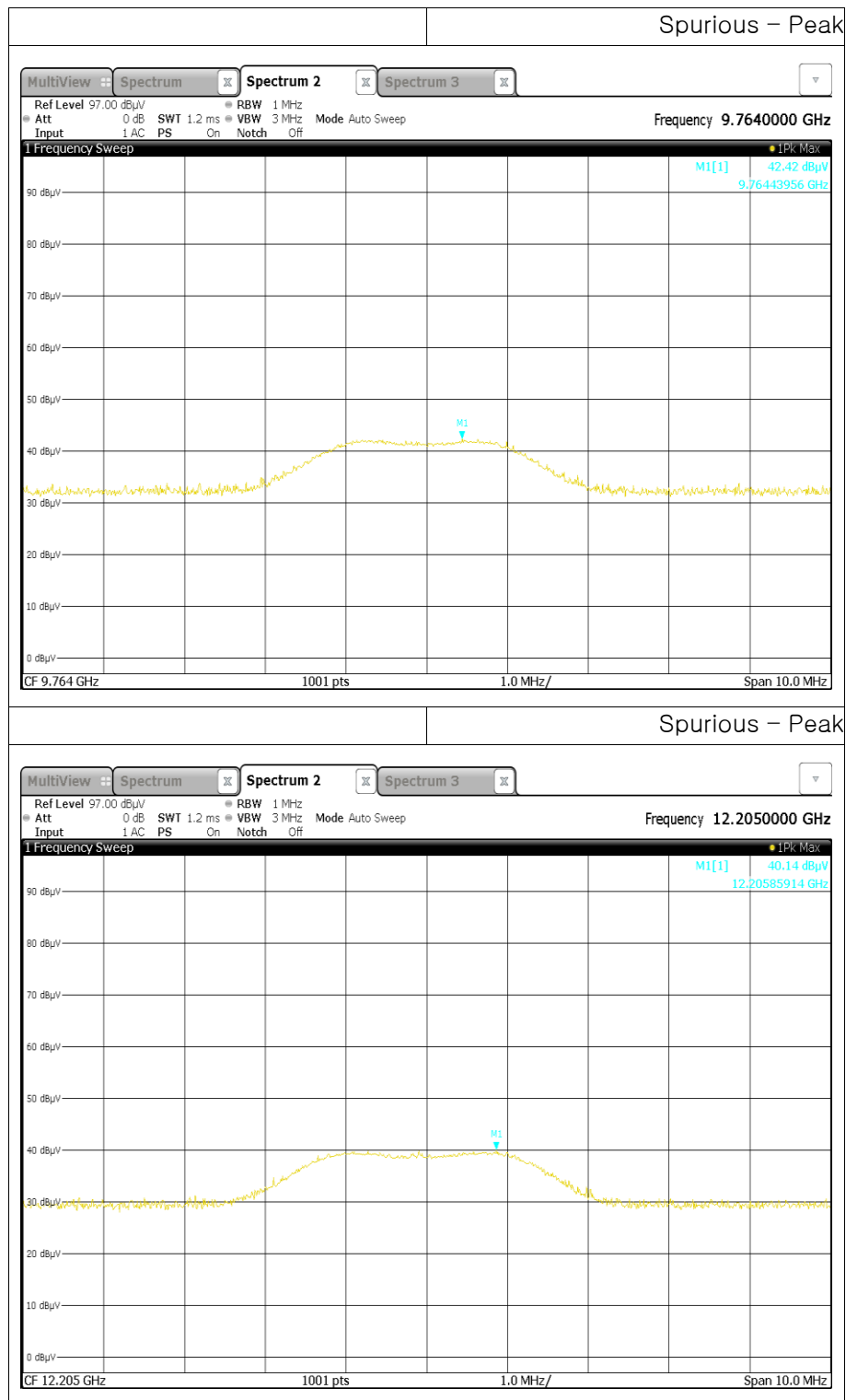




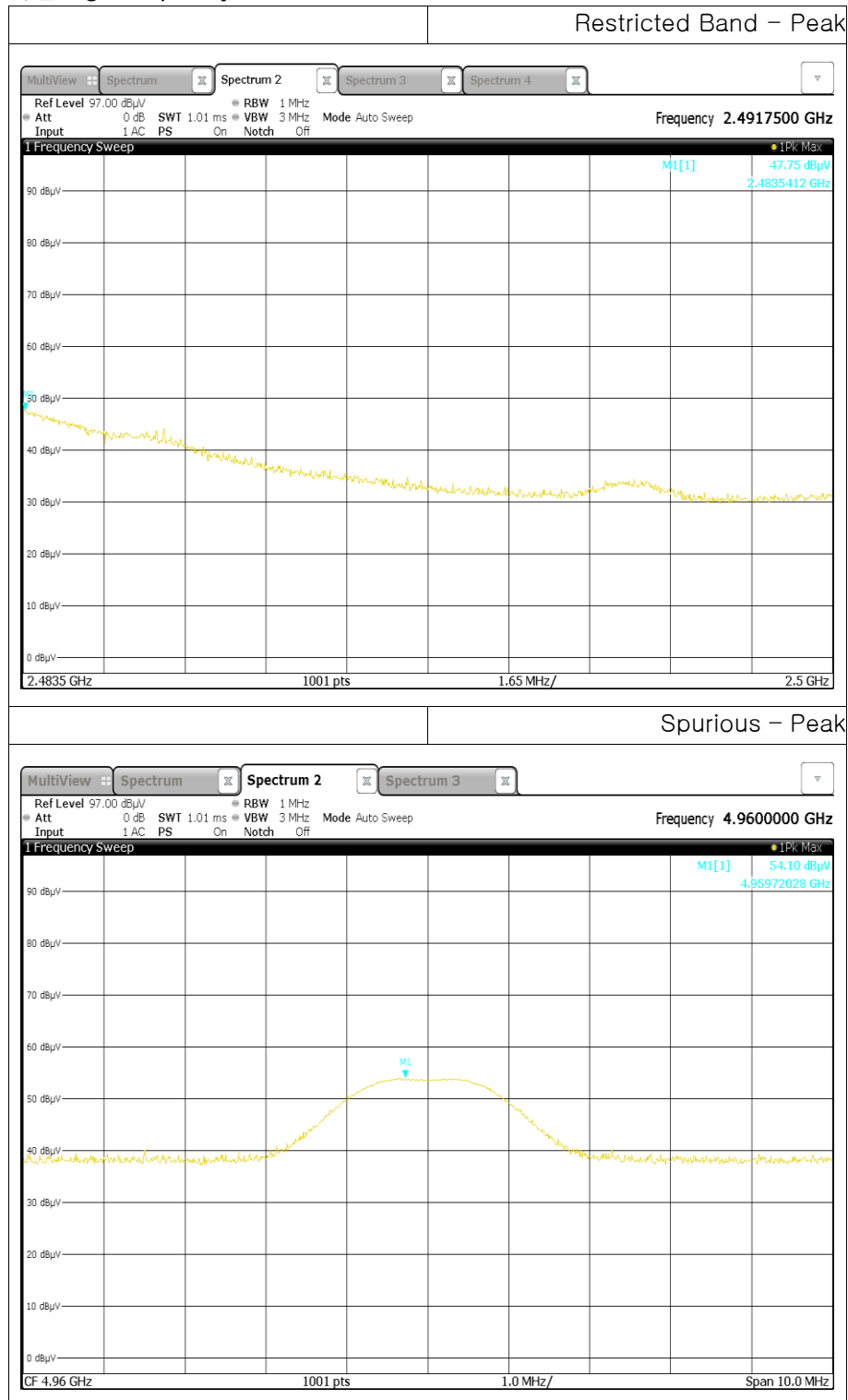


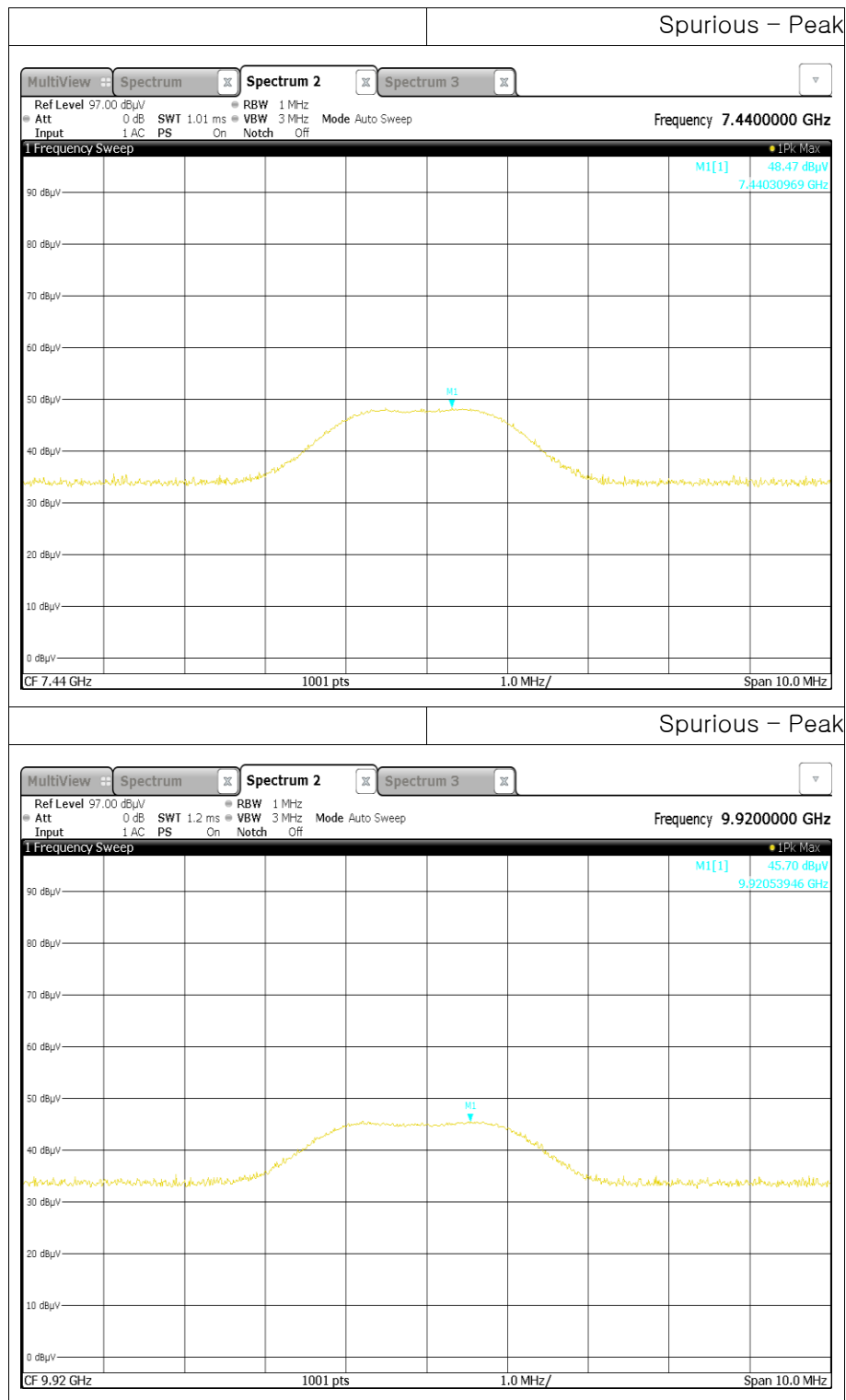
- TM2(GFSK) _ Middle frequency

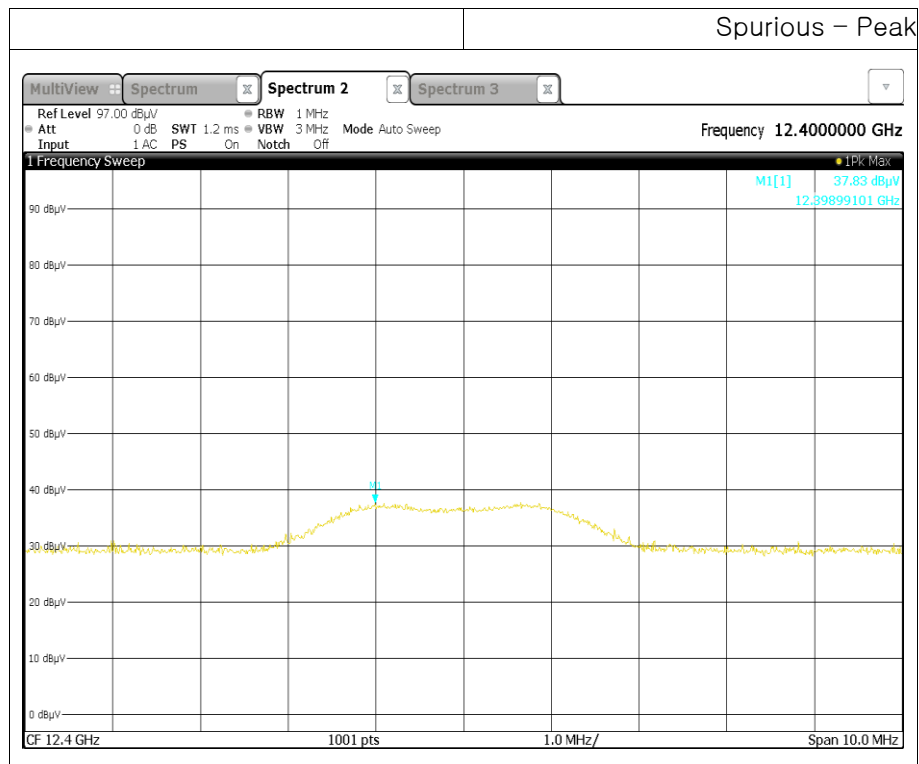




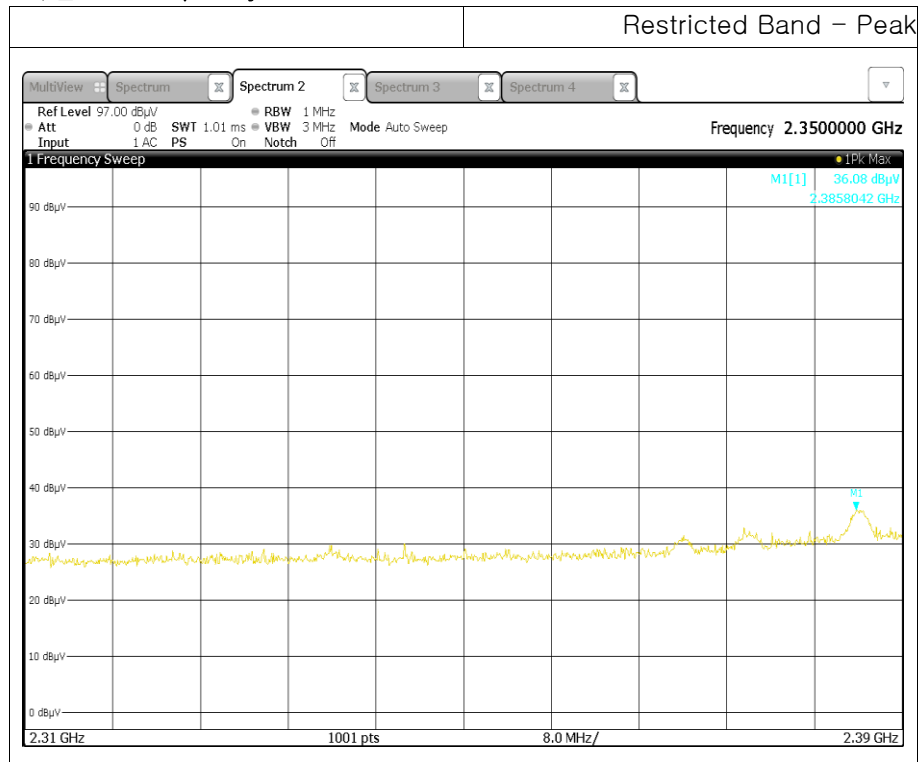
● TM2(GFSK) _ High frequency



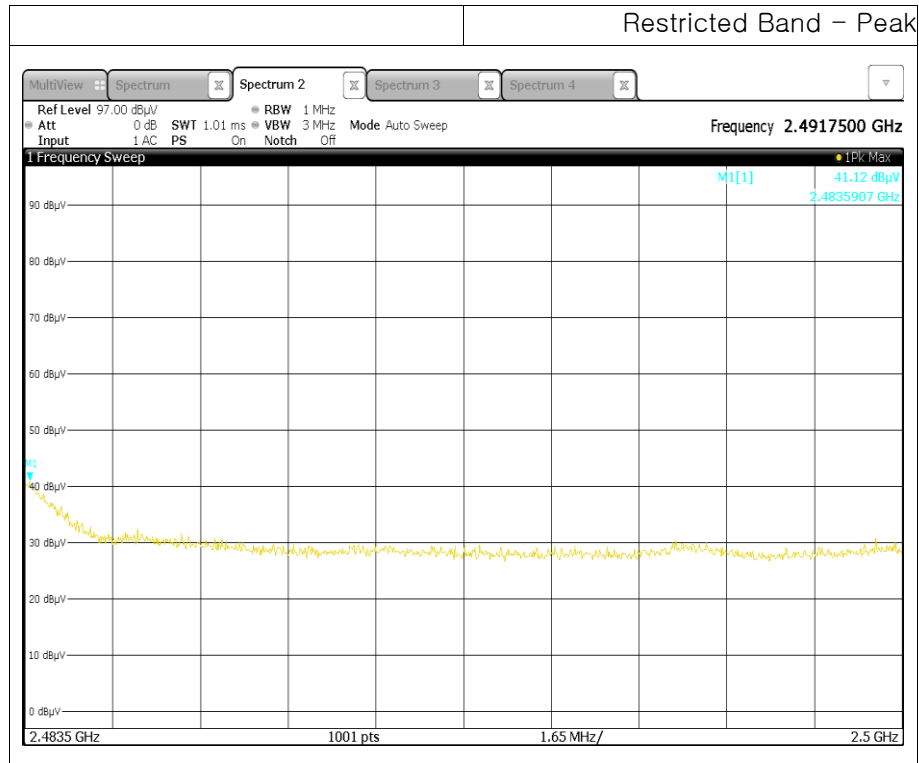




● TM2(8DPSK) _ Low frequency

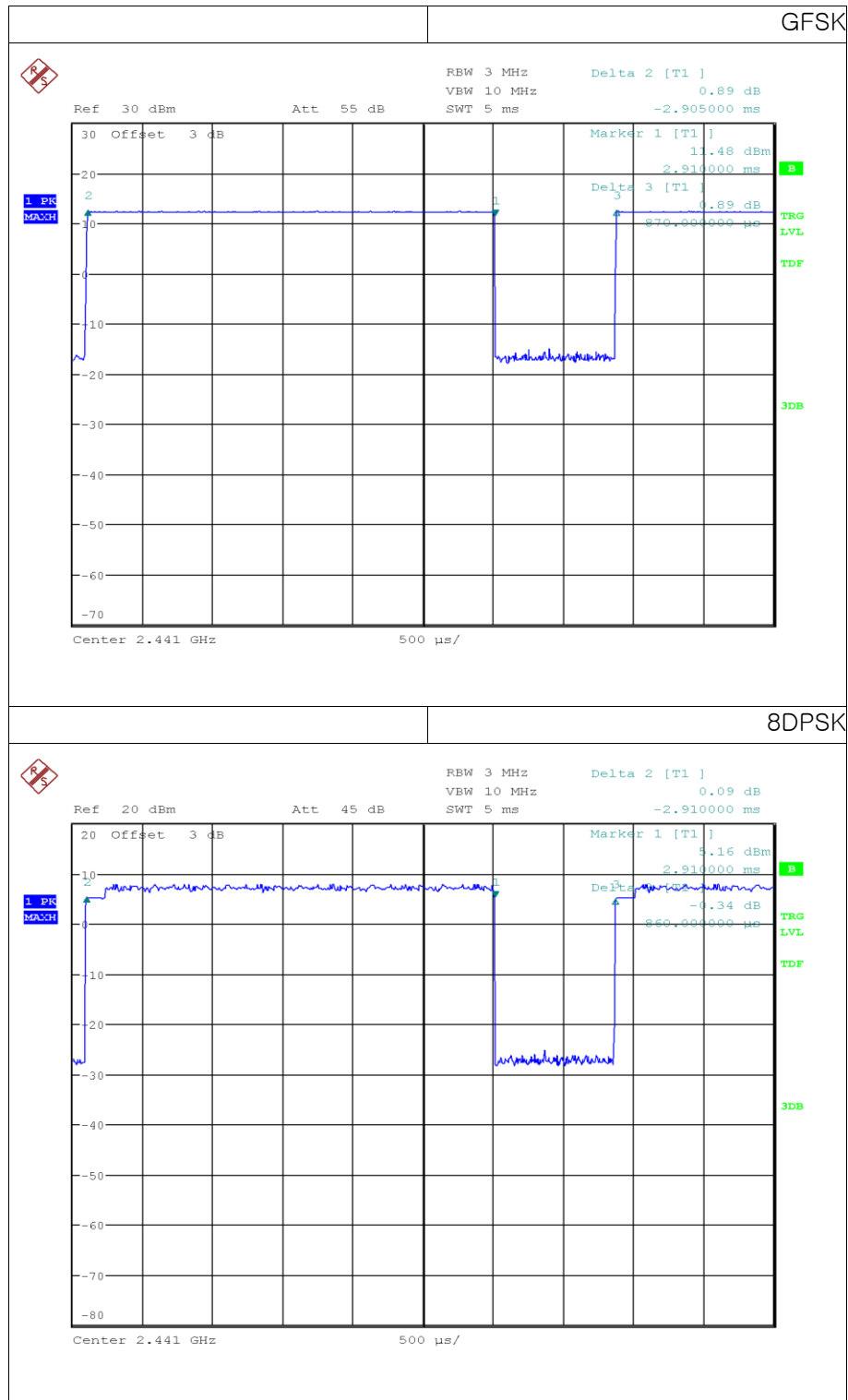


● TM2(8DPSK) _ High frequency





6.7 Test Plot for Duty Cycle

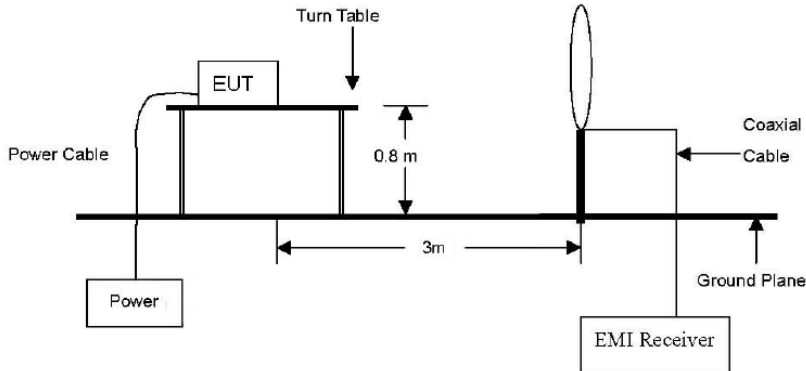
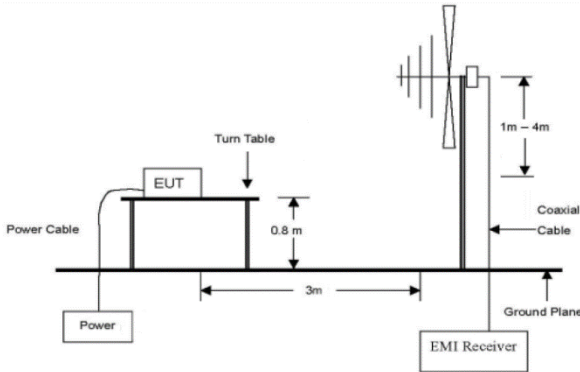
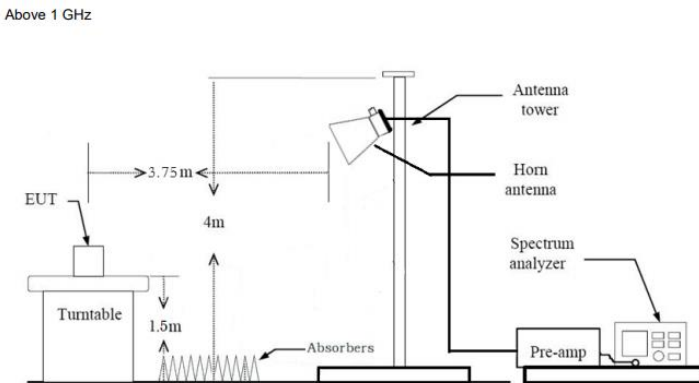


APPENDIX I

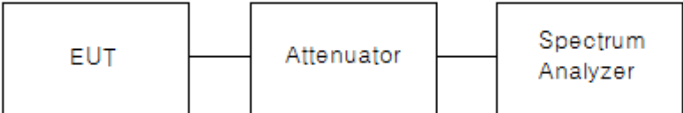
TEST SETUP



● Radiated Measurement

below 30 MHz	
below 1 GHz	
above 1 GHz	

● Conducted Measurement

Conducted	
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APPENDIX II

UNCERTAINTY



Measurement Item	Expanded Uncertainty $U = kU_c (k=2)$
Conducted RF power	0.34 dB
Conducted Spurious Emissions	0.34 dB
Radiated Spurious Emissions	6.34 dB
Conducted Emissions	1.74 dB