



TEST REPORT

100, Jangjateo-ro, Hobeop-myeon,
Icheon-si, Gyeonggi-do, 17396, Korea
Tel: 031-637-8898 / Fax: 0505-116-8895

1. Client

- Name : CELLULARLINE S.P.A
- Address : VIA GRIGORIS LAMBRAKIS 1/A Reggio Emilia RE Italy

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

3. Sample Description

- Product Name : Wireless Communication Systems
- Model Name : ERA 1 X

4. Date of Receipt..... : 2025-12-01

5. Date of Test..... : 2025-12-19 ~ 2025-12-23

6. Test Method..... : FCC Part 15 Subpart C 15.247

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)

Jan 02, 2026

EMC Labs Co., Ltd.



Contents

1. Applicant & Manufacturer & Test Laboratory Information.....	4
2. Equipment under Test(EUT) Information.....	4
3. Test Summary.....	6
4. Used equipment on test.....	8
5. Antenna Requirement.....	9
6. 20 dB Bandwidth & Occupied Bandwidth (99%).....	10
7. Number of Hopping Frequencies	11
8. Time of Occupancy (Dwell Time).....	24
9. Carrier Frequencies Separation.....	29
10. Peak Output Power	32
11. TX Radiated Spurious Emission and Conducted Spurious Emission.....	50
12. Conducted Emission	93

APPENDIX

APPENDIX I TEST SETUP.....	96
APPENDIX II UNCERTAINTY.....	98

Version

TEST REPORT NO.	DATE	DESCRIPTION
KR0140-RF2601-004	Jan 02, 2026	Initial Issue



1. Applicant & Manufacturer & Test Laboratory Information

1.1 Applicant Information

Applicant	CELLULARLINE S.P.A
Applicant Address	VIA GRIGORIS LAMBRAKIS 1/A Reggio Emilia RE Italy
Contact Person	Giovanni Bo
Telephone No.	+39-0522-334002
Fax No.	+39-0522-334001
E-mail	giovanni.bo@cellularline.com

1.2. Manufacturer Information

Manufacturer	CELLULARLINE S.P.A
Manufacturer Address	VIA GRIGORIS LAMBRAKIS 1/A Reggio Emilia RE Italy

1.3 Test Laboratory Information

Laboratory	EMC Labs Co., Ltd.
Laboratory Address	100, Jangjateo-ro, Hobeop-myeon, Icheon-si, Gyeonggi-do, Republic of Korea
Contact Person	Jong-Myoung, Shin
Telephone No.	+82-31-637-8895
Fax No.	+82-505-116-8895
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	Wireless Communication Systems
Model Name	ERA 1 X
FCC ID	2A5D3-SP190
Rated Voltage	DC 3.7 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	Chip Antenna for BT1(with Max gain: 0.27 dBi) / PCB Pattern Antenna for BT2(with Max gain: 1.55 dBi)
Firmware Version	1.0
Hardware Version	1.0
Test software	BlueTest3 V3.3.5 for BT1 Lab Test Tool V3.5.4.2 for BT2

2.3 Test Frequency

Test mode	Test Frequency (MHz)		
	Low Frequency	Middle Frequency	High Frequency
GFSK (BT1)	2 402	2 441	2 480
Pi/4 DQPSK (BT1)	2 402	2 441	2 480
8DPSK (BT1)	2 402	2 441	2 480
GFSK (BT2)	2 402	2 441	2 480
Pi/4 DQPSK (BT2)	2 402	2 441	2 480
8DPSK (BT2)	2 402	2 441	2 480



2.4 Worst-Case

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

Note: The power measurement has been conducted to determine the worst-case mode from all possible Combinations between available modulations, data rates.

2.5 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.

2.6 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		C
☒	–	RSS-GEN (6.7)	Occupied Bandwidth (99%)		C
☒	15.247(a)	RSS-247 (5.1)	Number of Hopping Frequencies		C
☒	15.247(a)	RSS-247 (5.1)	Time of Occupancy (Dwell Time)		C
☒	15.247(a)	RSS-247 (5.1)	Carrier Frequencies Separation		C
☒	15.247(b)	RSS-247 (5.4)	Peak Output Power		C
☒	15.247(d)	RSS-247 (5.5)	Conducted Spurious Emission		C
☒	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	C

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

The sample was tested according to the following specification: ANSI C63.10:2020.

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	2026.11.05
■	CONTROLLER	AMWON TECHNOLOGY	TEMI2500	S7800VK191 0707	2026.11.05
□	PSA SERIES SPECTRUM ANALYZER	AGILENT	E4440A	MY45304057	2026.11.05
■	MXG ANALOG SIGNAL GENERATOR	AGILENT	N5183A	MY50141890	2026.11.05
□	SYSTEM DC POWER SUPPLY	AGILENT	6674A	MY53000118	2026.11.05
□	VECTOR SIGNAL GENERATOR	ROHDE & SCHWARZ	SMBV100A	257524	2026.11.05
□	DIRECTIONAL COUPLER	AGILENT	773D	2839A01855	2026.11.05
□	ATTENUATOR	AGILENT	8493C	73193	2026.11.06
□	TERMINATION	HEWLETT PACKARD	909D	07492	2026.11.06
□	POWER DIVIDER	HEWLETT PACKARD	11636A	06916	2026.11.05
□	SLIDE-AC	DAEKWANG TECH	SV-1023	NONE	2026.11.05
■	DIGITAL MULTIMETER	HUMANTECHSTORE	15B+	50561541WS	2026.11.05
■	ATTENUATOR	ACE RF COMM	ATT SMA 20W 20dB 8GHz	A-0820.SM20.2	2026.04.04
■	DC POWER SUPPLY	AGILENT	E3634A	MY40012120	2026.02.13
□	USB Peak Power Sensor	Anritsu	MA24408A	12321	2026.11.05
□	High Pass Filter	WT Microwave INC.	WT-A3314-HS	WT22111804-1	2026.11.05
■	High Pass Filter	WT Microwave INC.	WT-A1935-HS	WT22111804-2	2026.11.05
■	SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSU26	200444	2026.02.13
■	ATTENUATOR	Mini-Circuits	BW-K3-2W44+	2318-1	2026.02.13
□	ATTENUATOR	Mini-Circuits	BW-K3-2W44+	2318-2	2026.05.08
□	Balanced Temperature and Humidity Control System	ESPEC CORP.	SH-241	92004650	2026.05.07
■	ACTIVE LOOP ANTENNA	TESEQ	HLA 6121	55685	2026.12.20
■	Biconilog ANT	Schwarzbeck	VULB 9160	3260	2026.04.01
□	Biconilog ANT	Schwarzbeck	VULB9168	902	2026.08.28
■	Horn ANT	Schwarzbeck	BBHA9120D	974	2026.12.01
□	Horn ANT	Schwarzbeck	BBHA9120D	1497	2026.01.03
■	Amplifier	TESTEK	TK-PA18H	200104-L	2026.05.23
■	Horn ANT	Schwarzbeck	BBHA9170	01188	2026.03.20
□	Horn ANT	Schwarzbeck	BBHA9170	01189	2026.03.20
■	AMPLIFIER	TESTEK	TK-PA1840H	220105-L	2026.03.17
■	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW44	101952	2026.03.17
■	Test Receiver	ROHDE & SCHWARZ	ESR7	101616	2026.06.25
■	TWO LINE V-NETWORK	ROHDE & SCHWARZ	ENV216	102596	2026.04.14
■	PULSE LIMITER	lignex1	EPL-30	NONE	2026.01.04

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 Chip Antenna with directional peak gain of the antenna is 0.27 dBi, and PCB Pattern Antenna with directional peak gain of the antenna is 1.55 dBi.)



6. 20 dB Bandwidth & Occupied Bandwidth (99%)

6.1 Test Setup

Refer to the APPENDIX I.

6.2 Limit

Limit : Not Applicable

6.3 Test Procedure

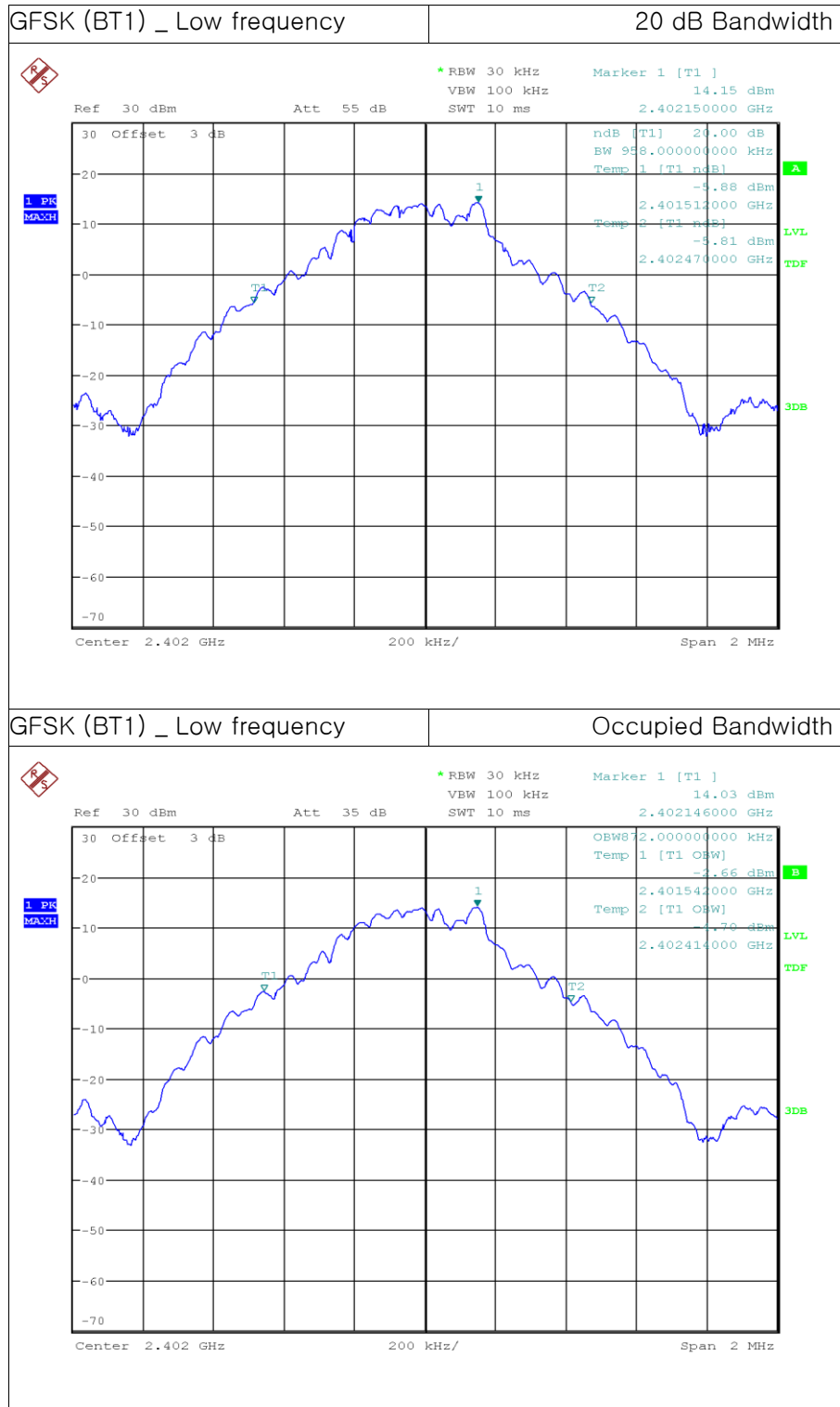
1. The 20 dB bandwidth & Occupied bandwidth were measured with a spectrum analyzer connected to RF antenna Connector (conducted measurement) while EUT was operating in transmit mode. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using below setting:
RBW = 1% to 5% of the 20 dB Bandwidth & Occupied Bandwidth
VBW $\geq 3 \times$ RBW
Span = between two times and five times the 20 dB Bandwidth & Occupied Bandwidth
Sweep = Auto
Detector function = Peak
Trace = Max Hold

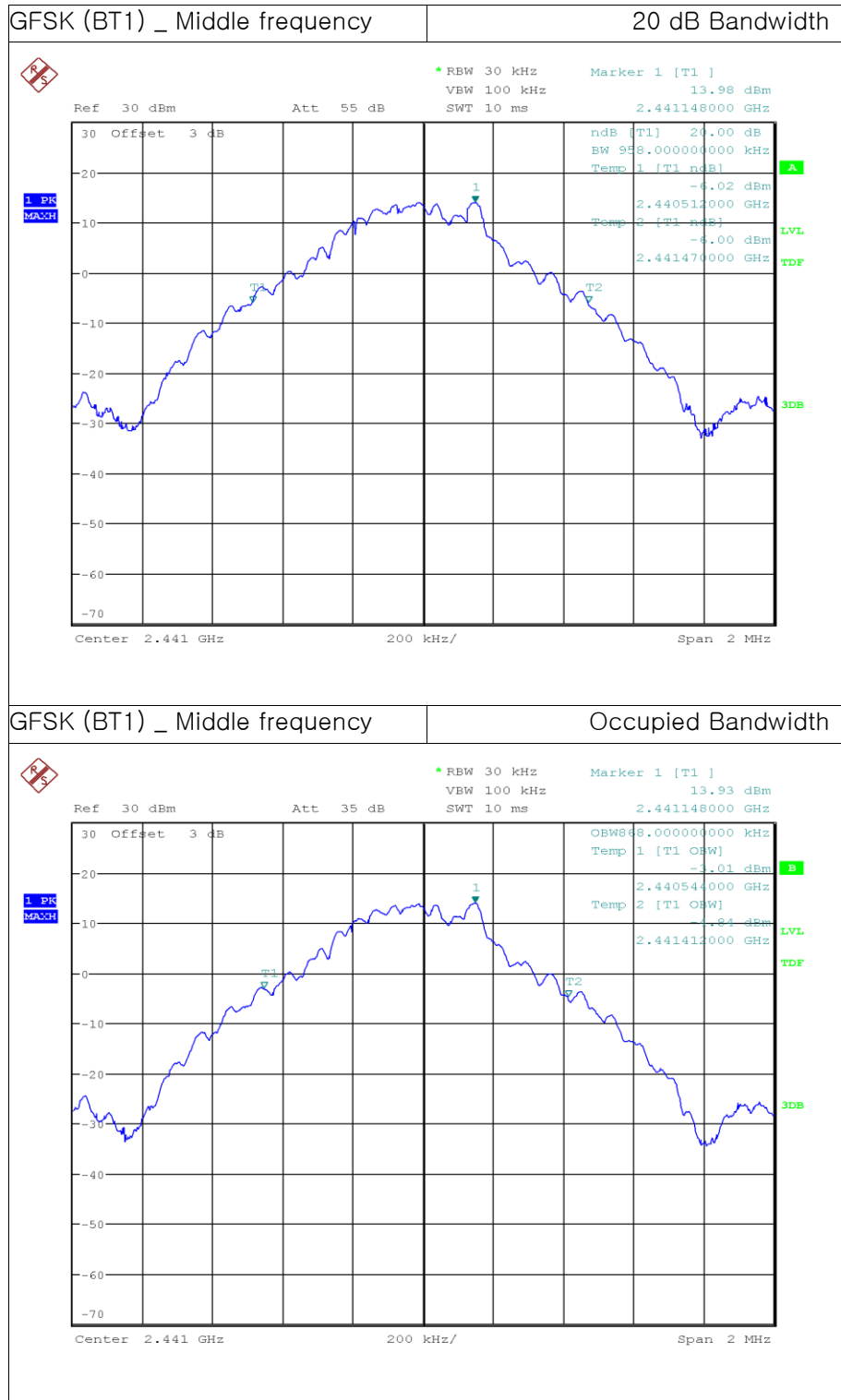
6.4 Test Result

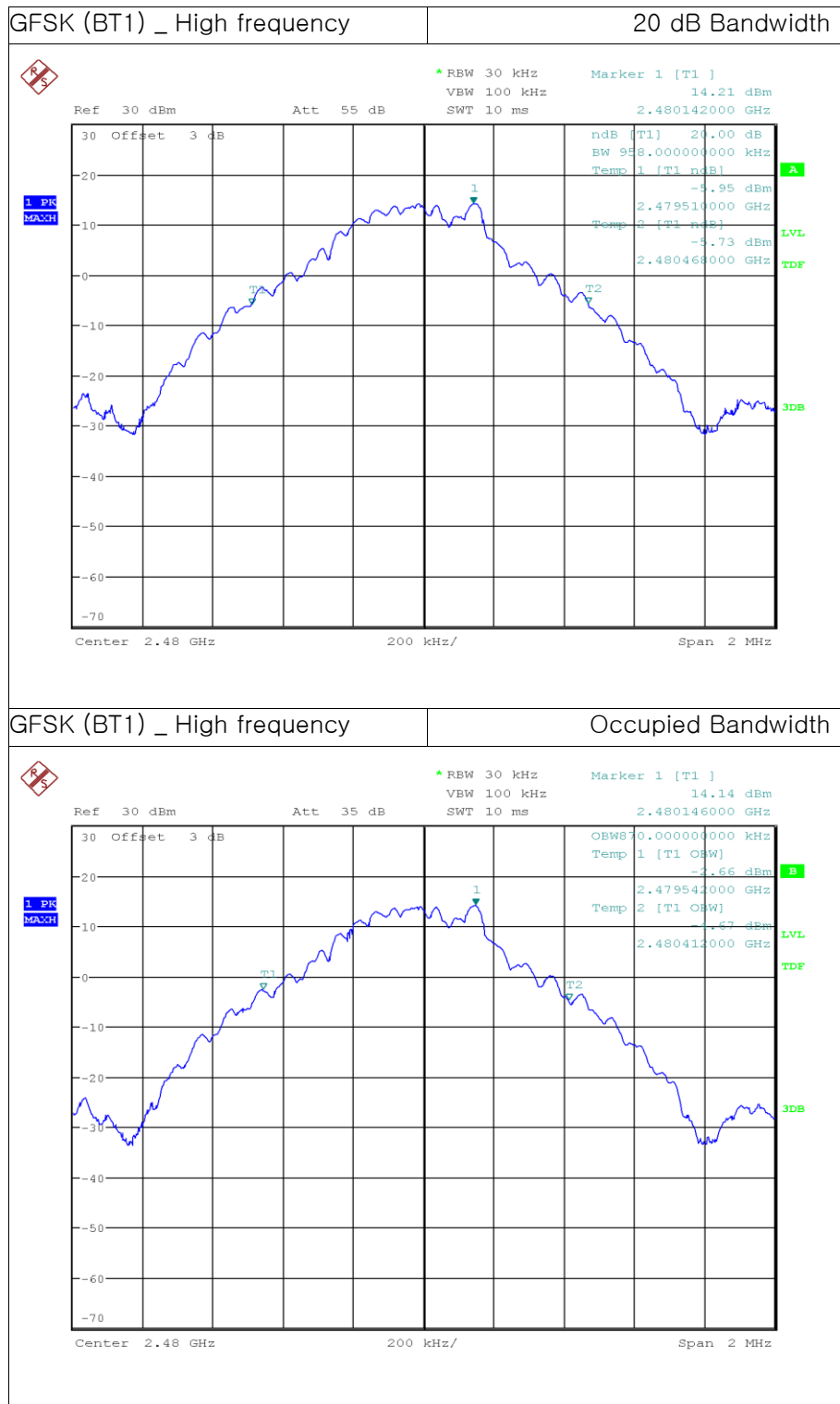
Test Mode	Test Frequency	20 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)
GFSK (BT1)	Low	0.958	0.872
	Middle	0.958	0.868
	High	0.958	0.870
8DPSK (BT1)	Low	1.308	1.190
	Middle	1.306	1.190
	High	1.308	1.190
GFSK (BT2)	Low	0.964	0.888
	Middle	0.964	0.886
	High	0.964	0.886
8DPSK (BT2)	Low	1.284	1.156
	Middle	1.284	1.156
	High	1.286	1.156

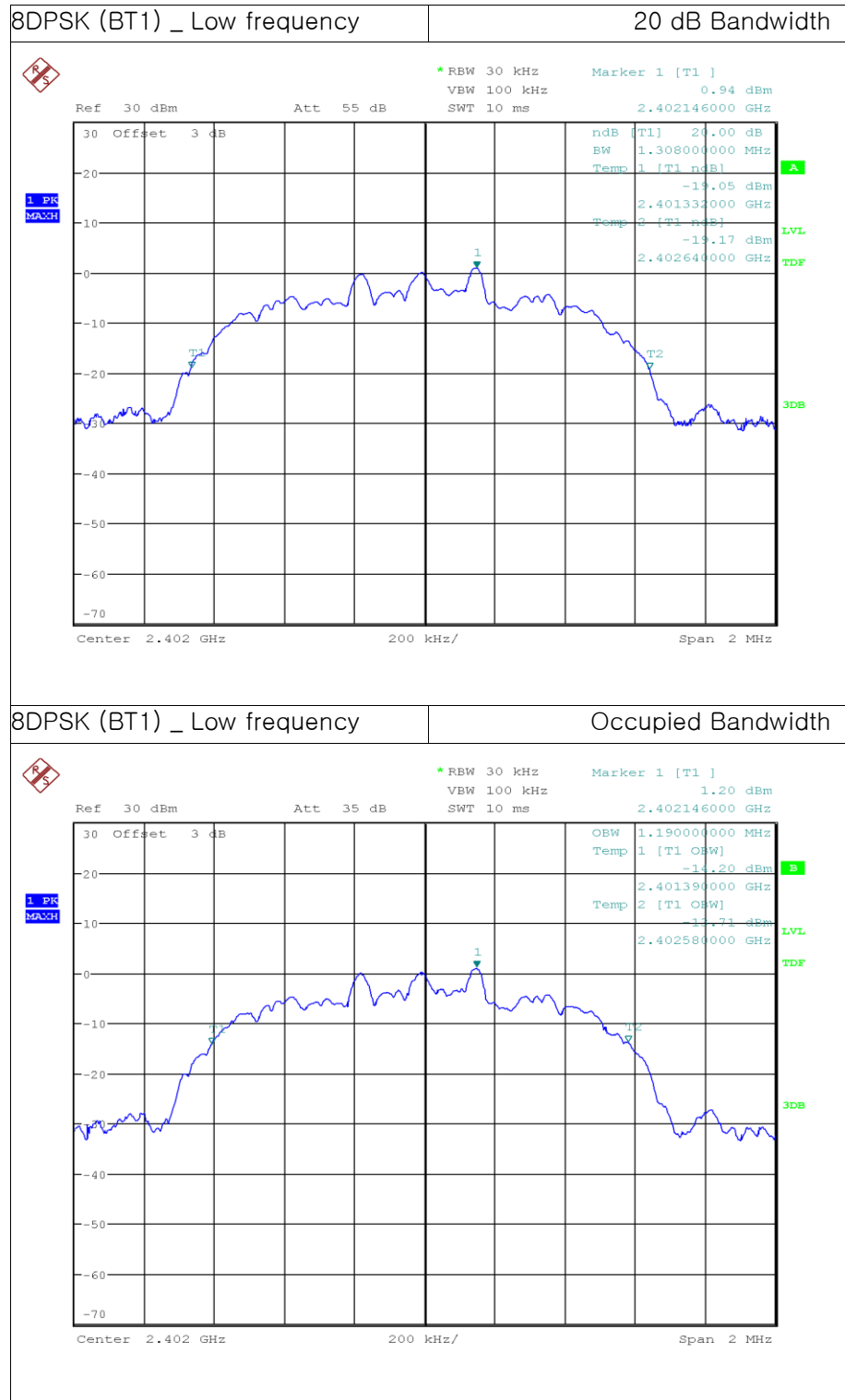


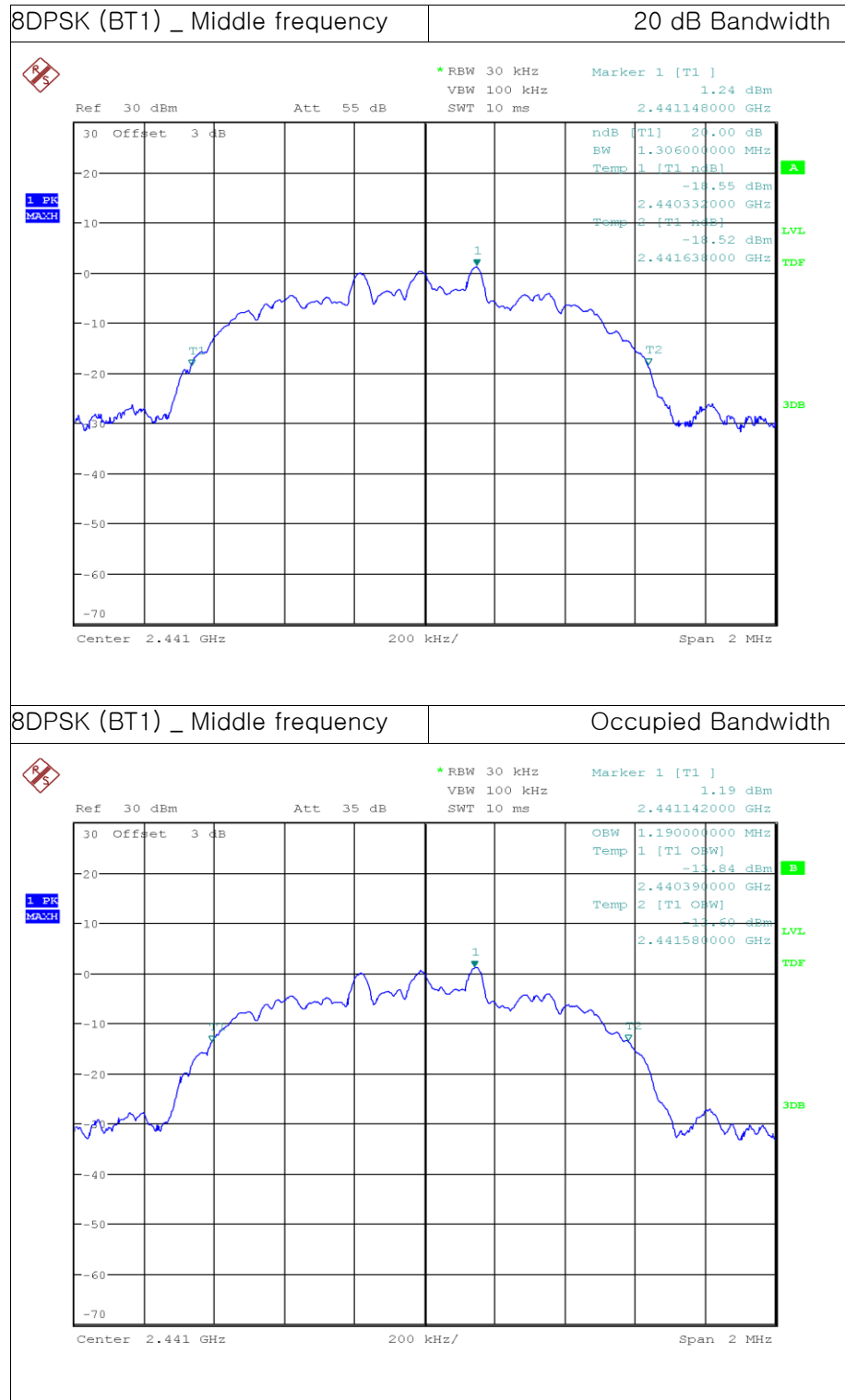
6.5 Test Plot

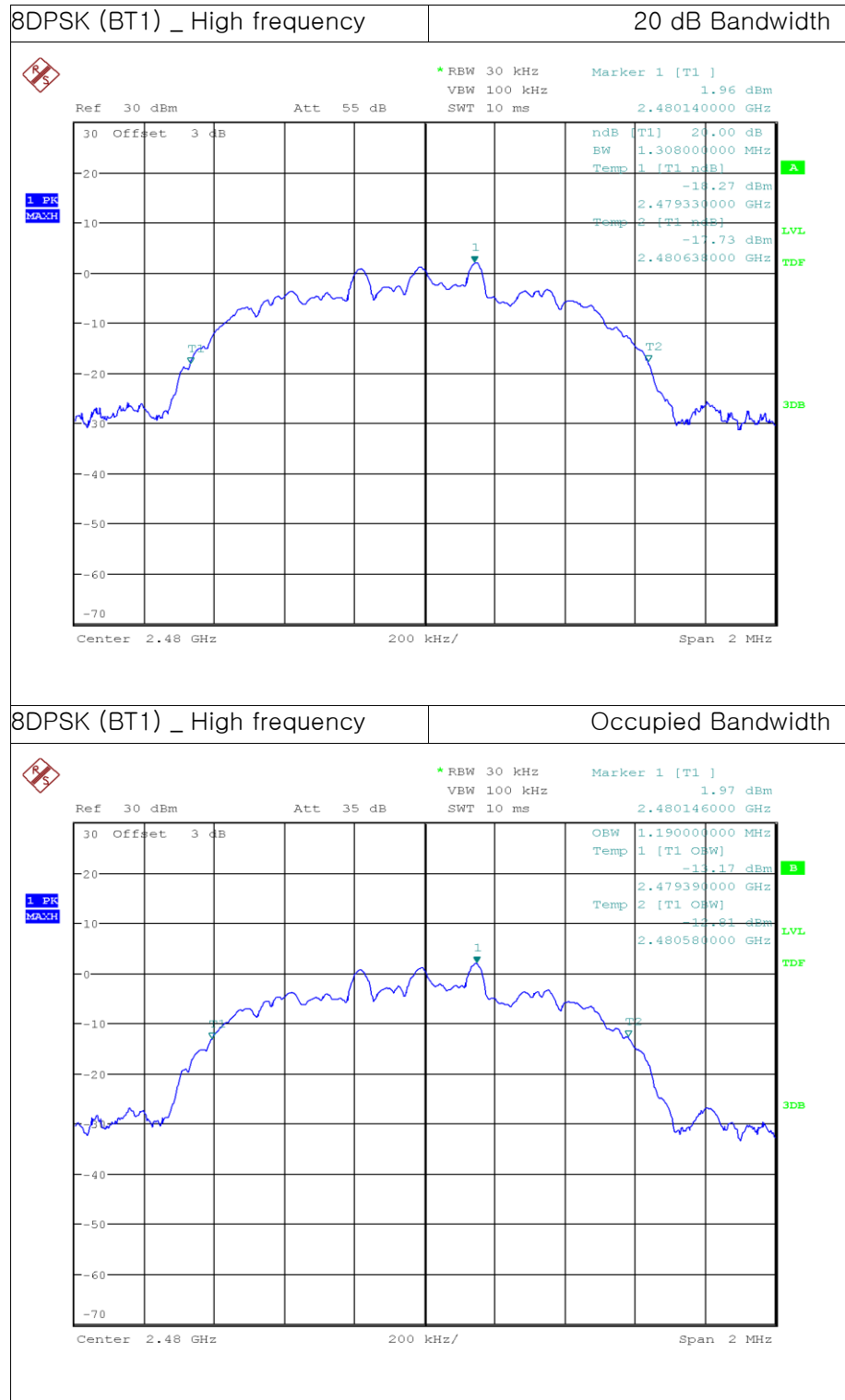


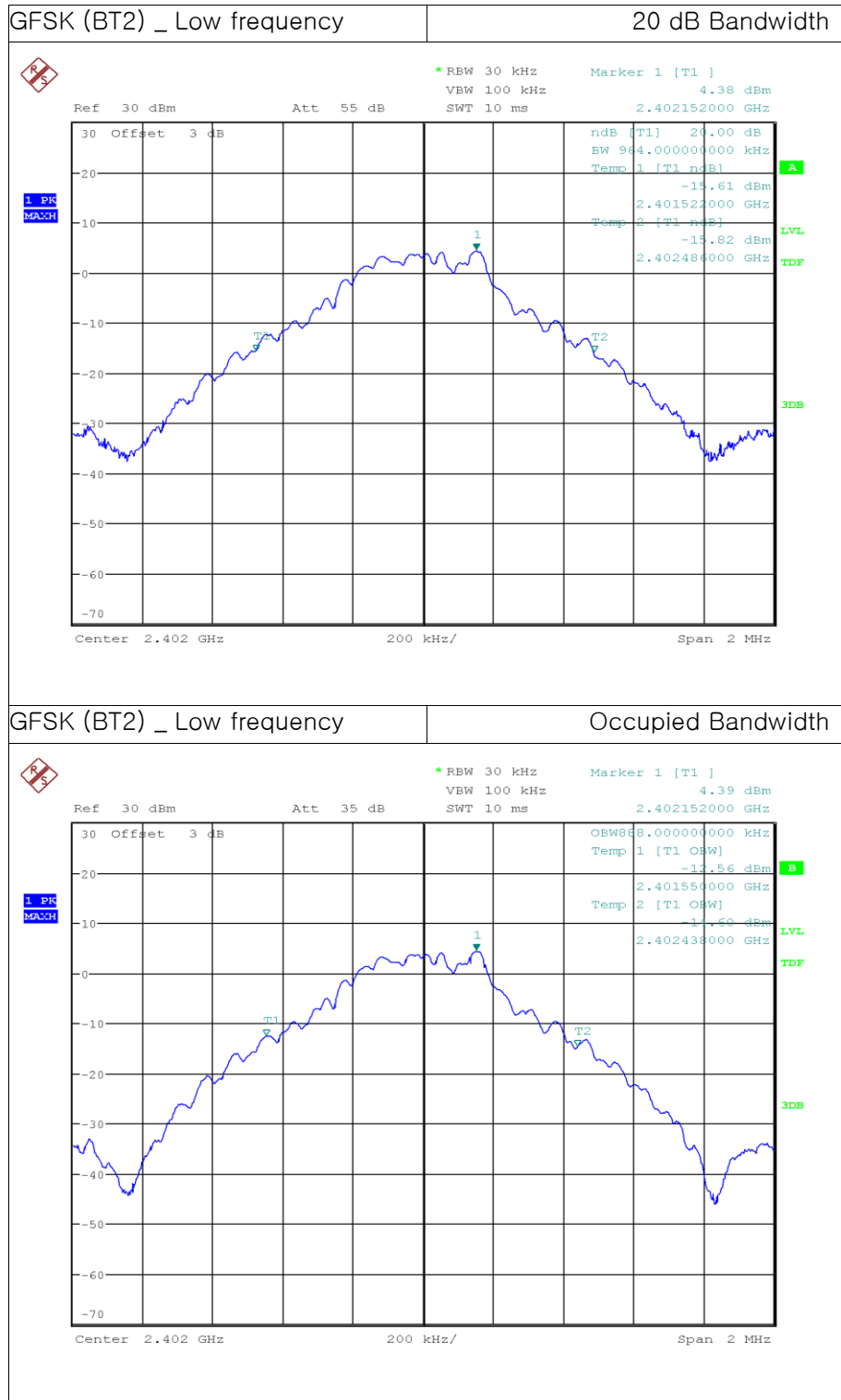


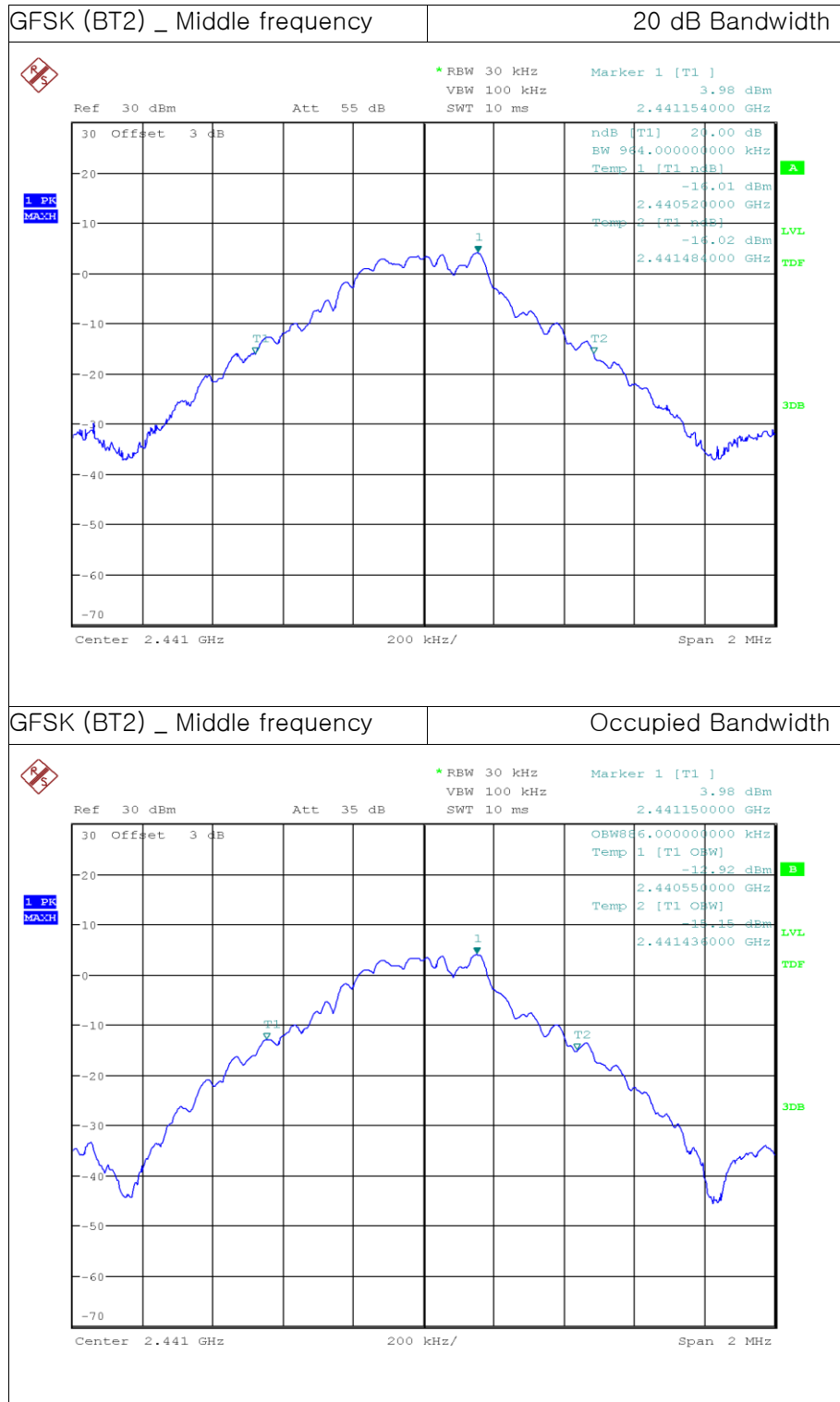


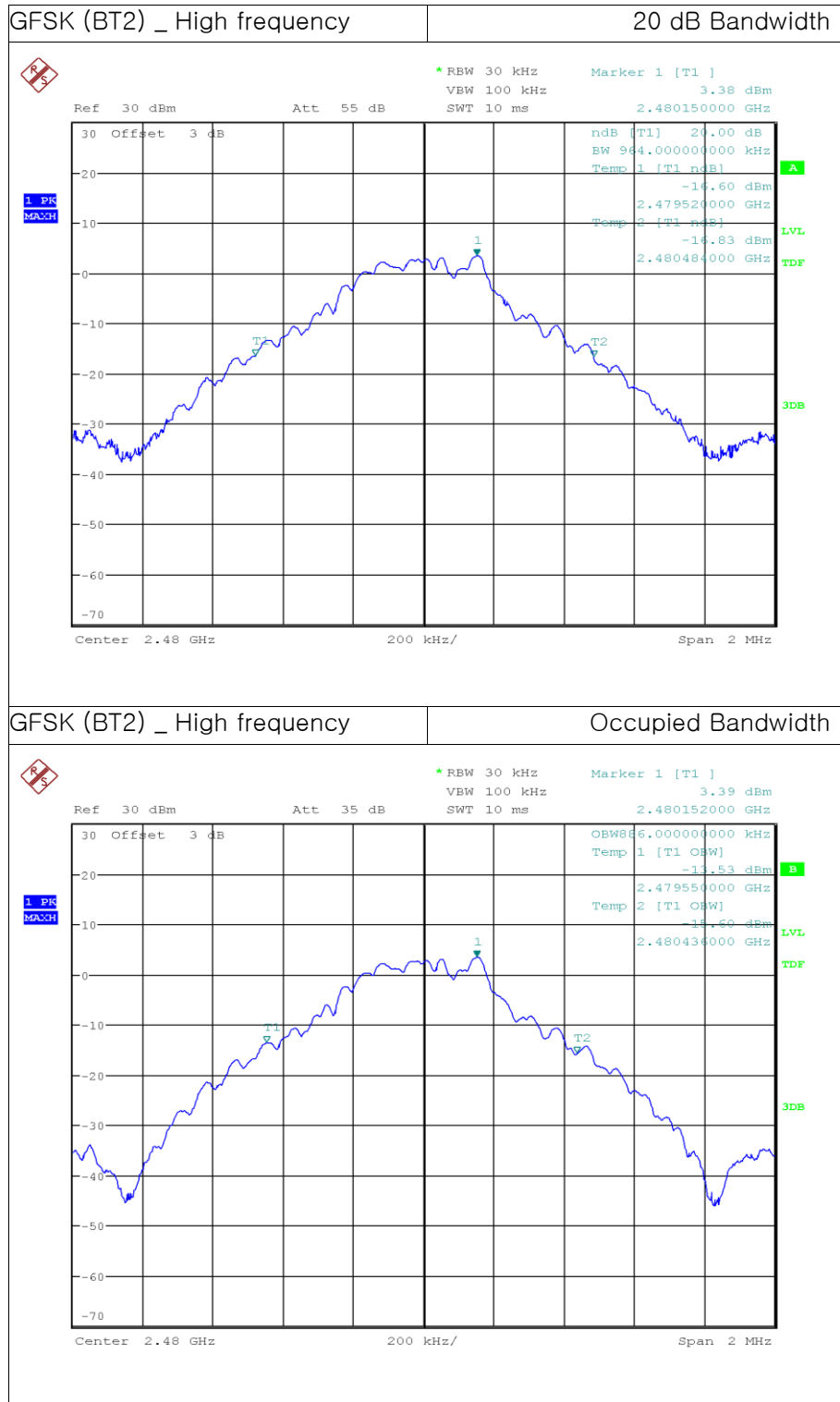


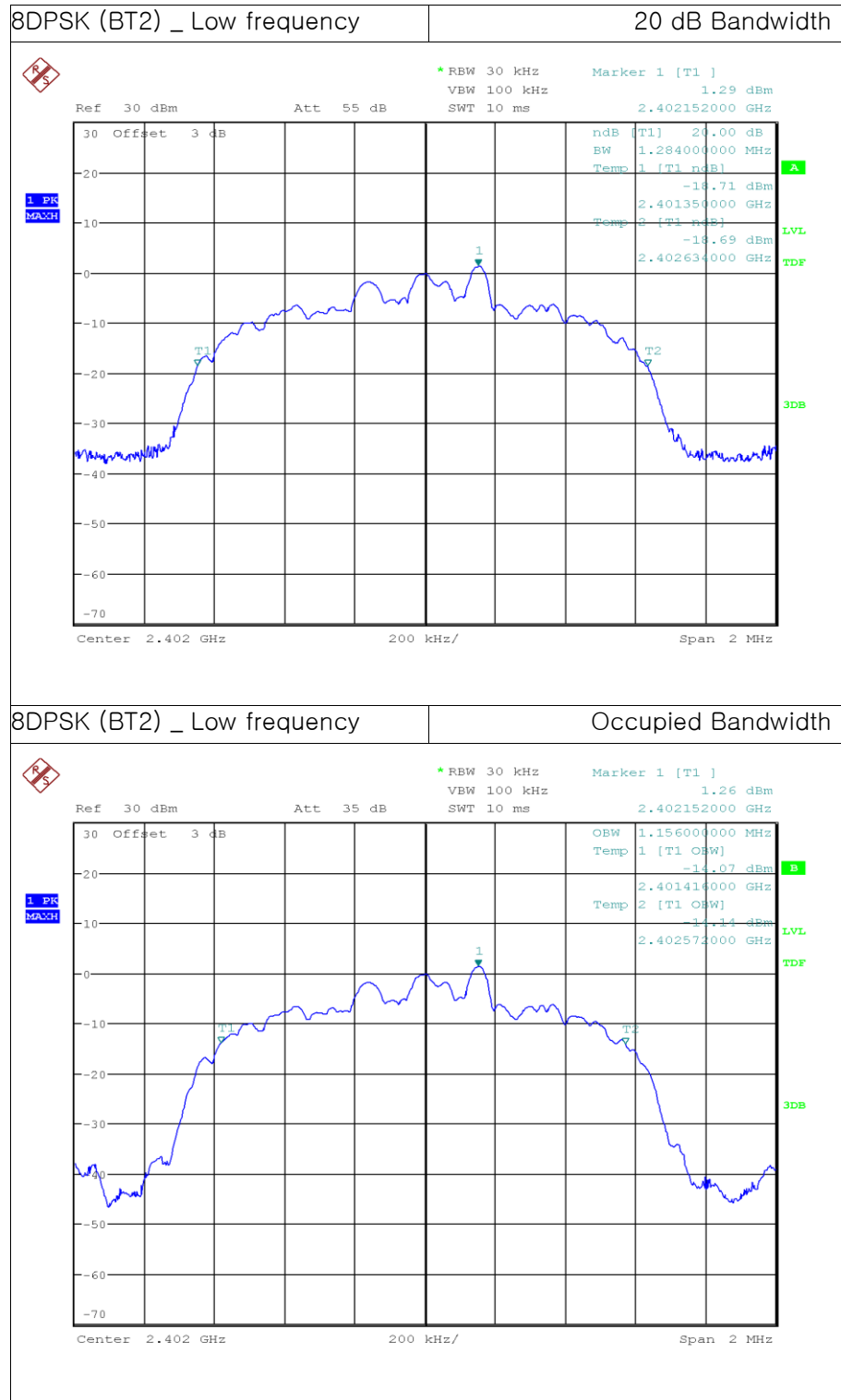


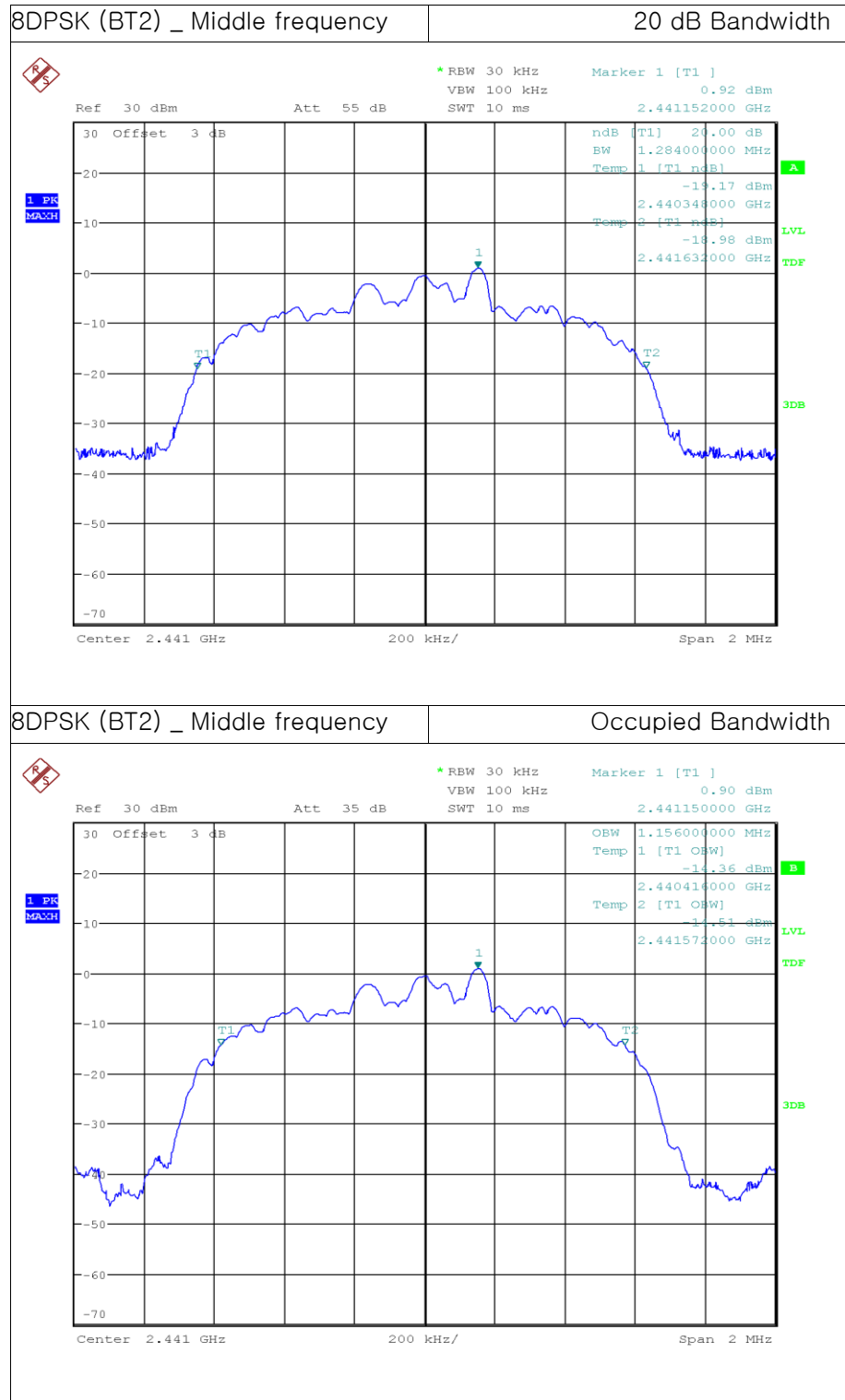


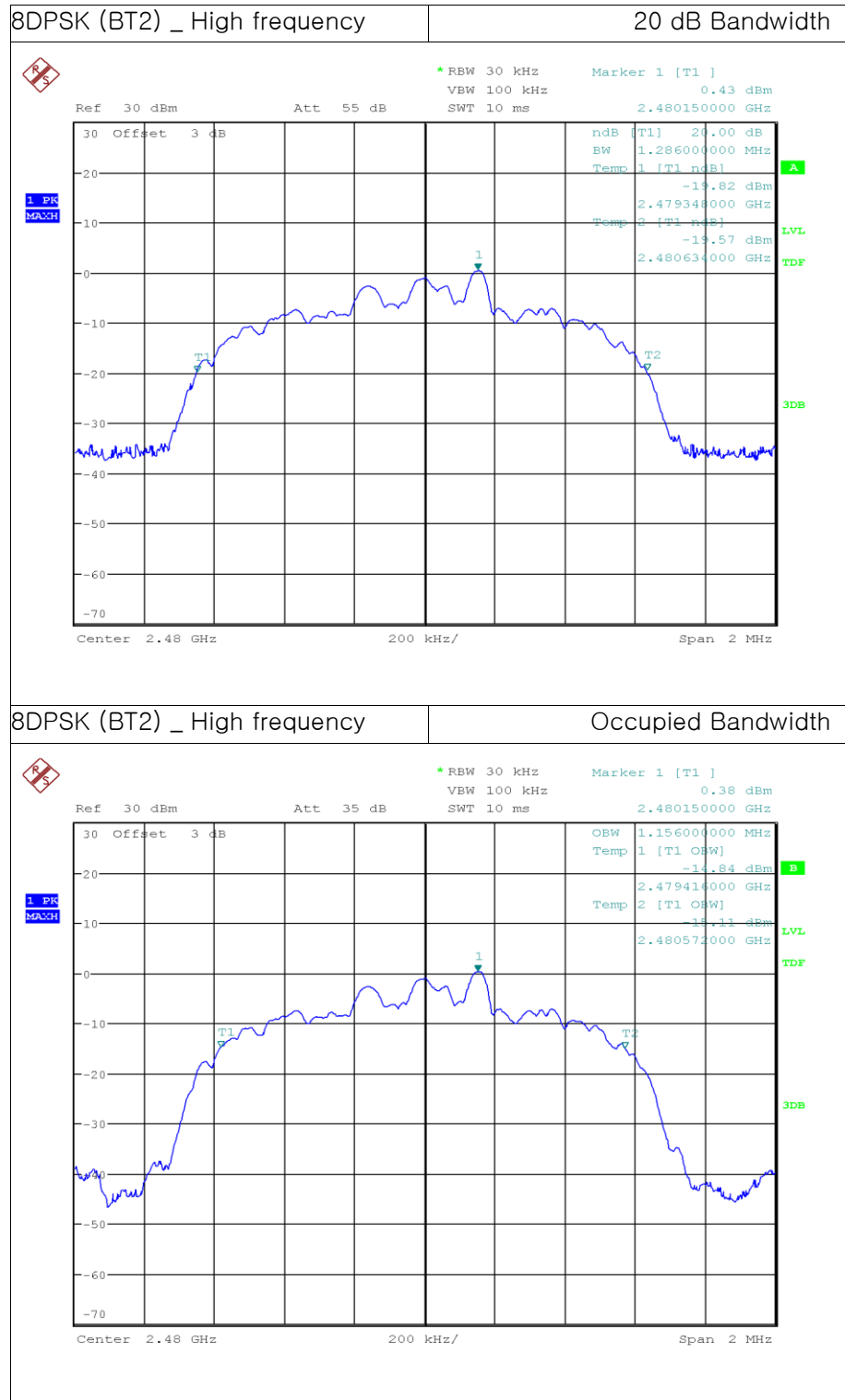














7. Number of Hopping Frequencies

7.1 Test Setup

Refer to the APPENDIX I.

7.2 Limit

Limit : ≥ 15 hops

7.3 Test Procedure

The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

To get higher resolution, two frequency ranges for FH mode within the 2400 ~ 2483.5 MHz were examined.

The spectrum analyzer is set to:

Span = 50 MHz

RBW = To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.

VBW $\geq$ RBW

Sweep = Auto

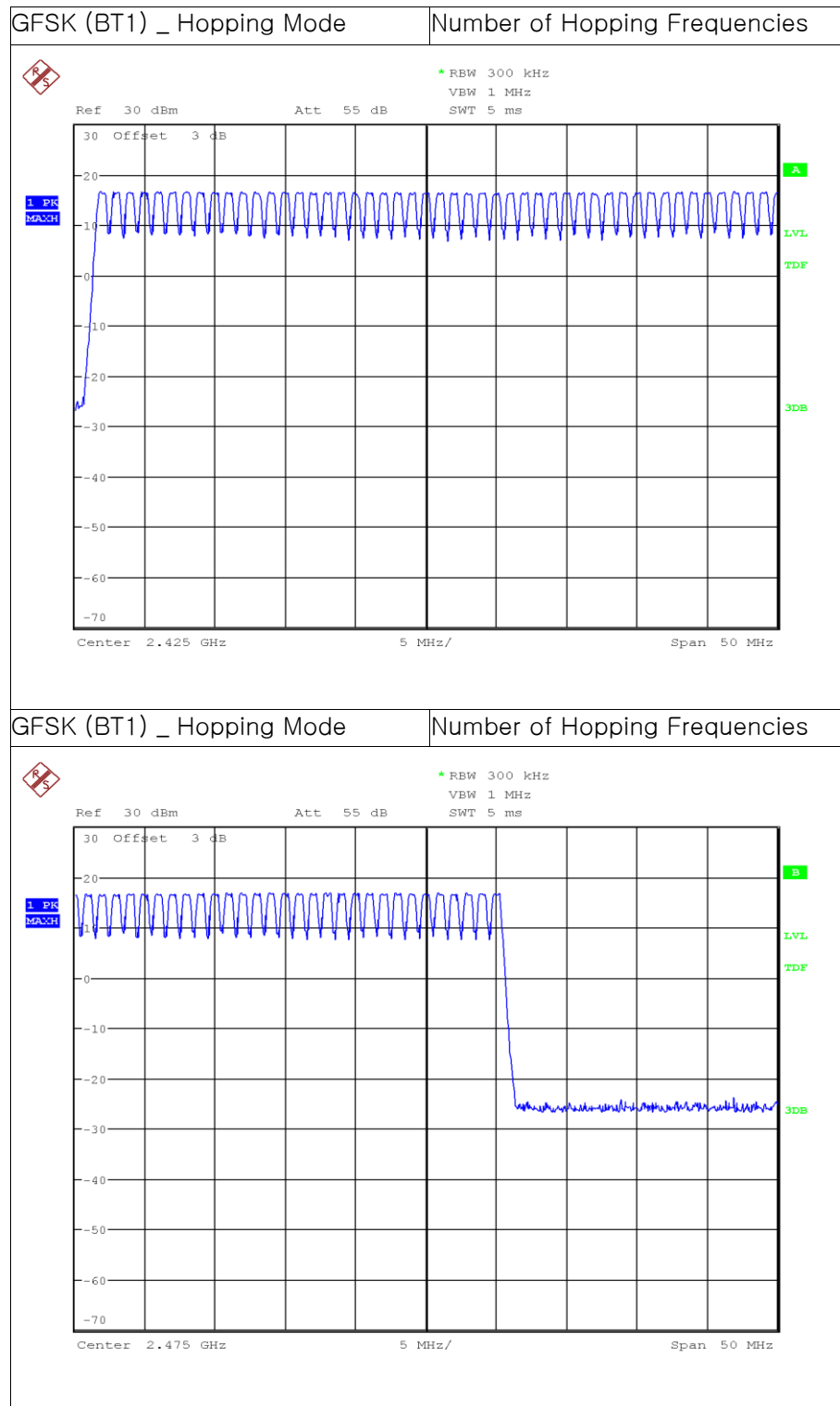
Detector = Peak

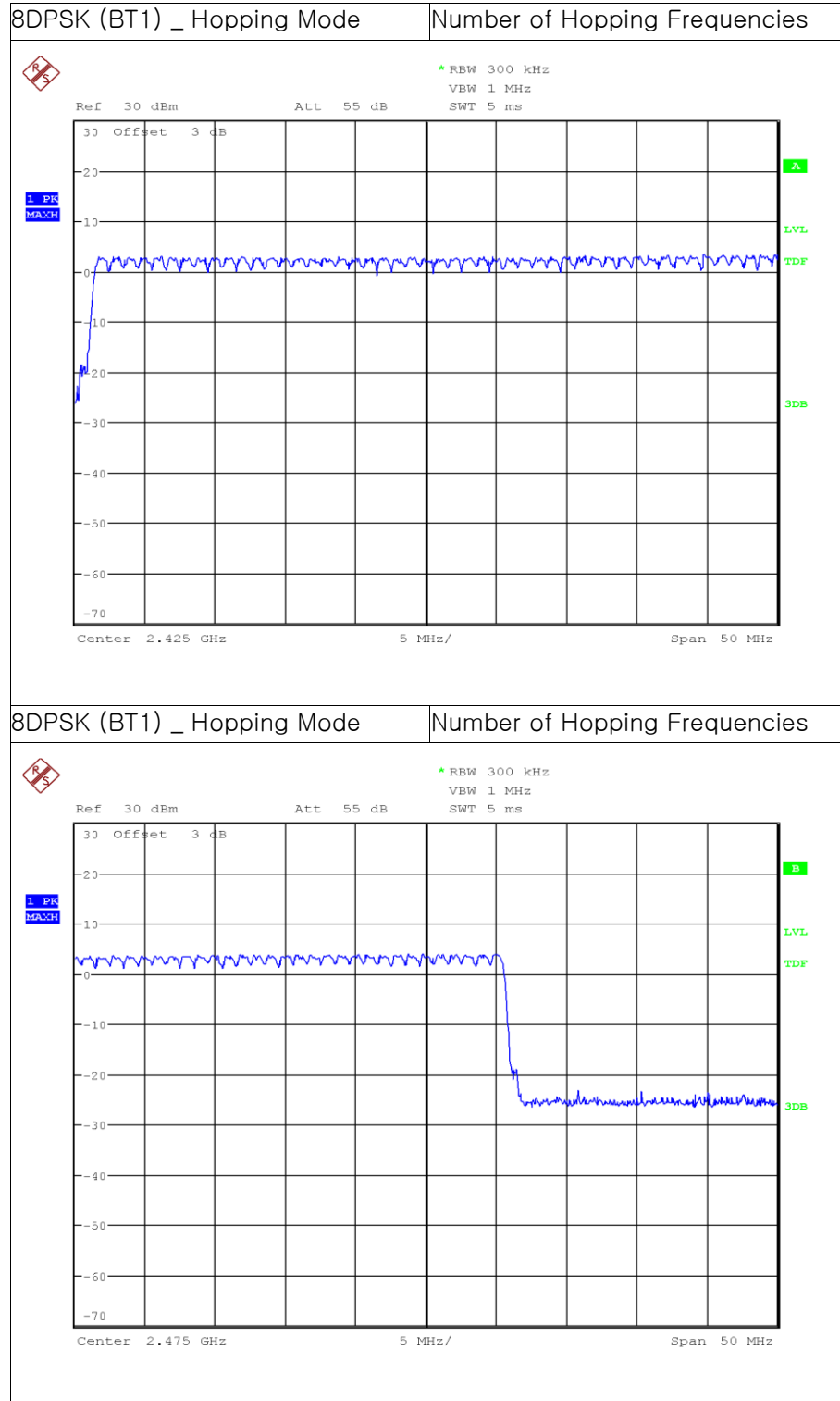
Trace = Max hold

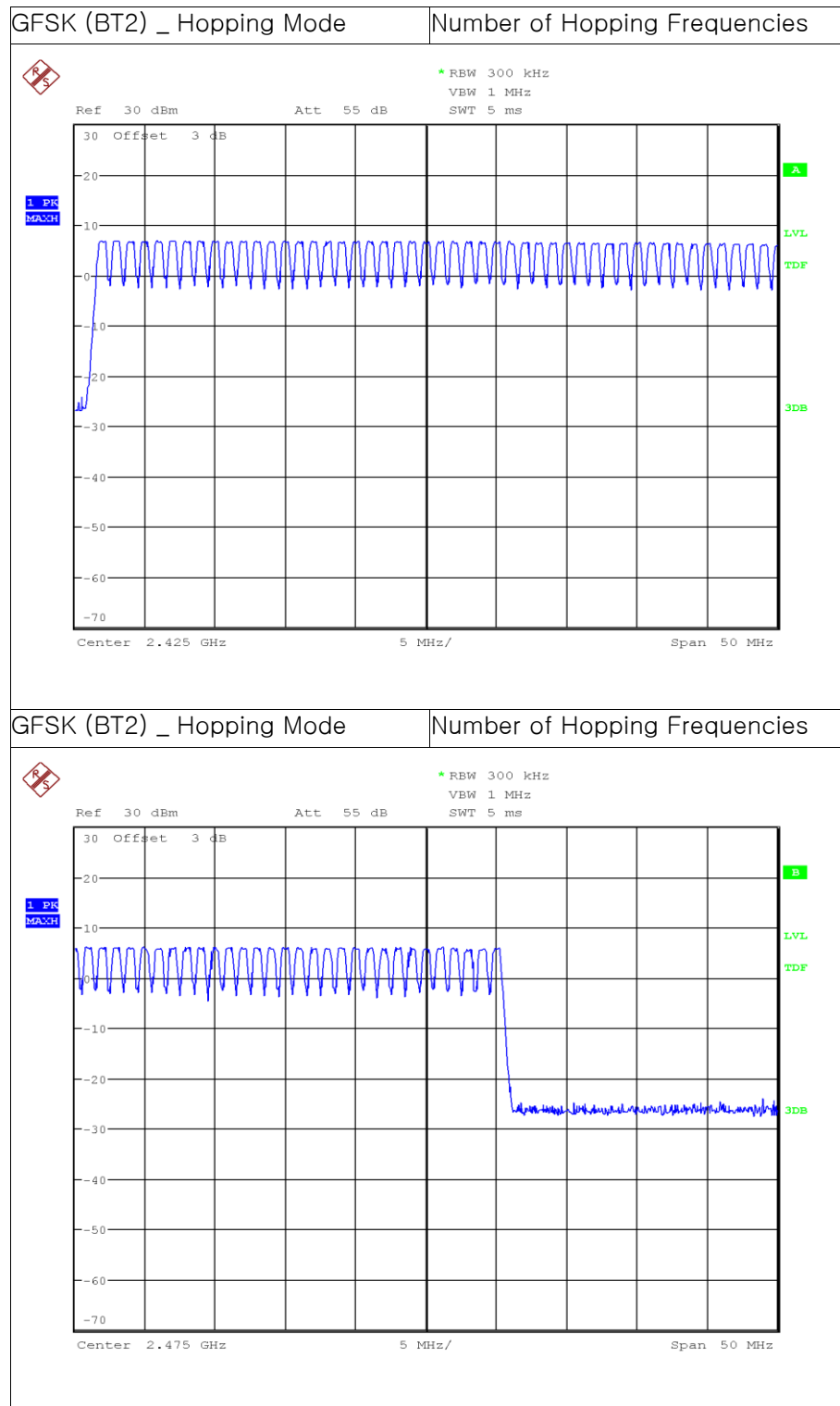
7.4 Test Result

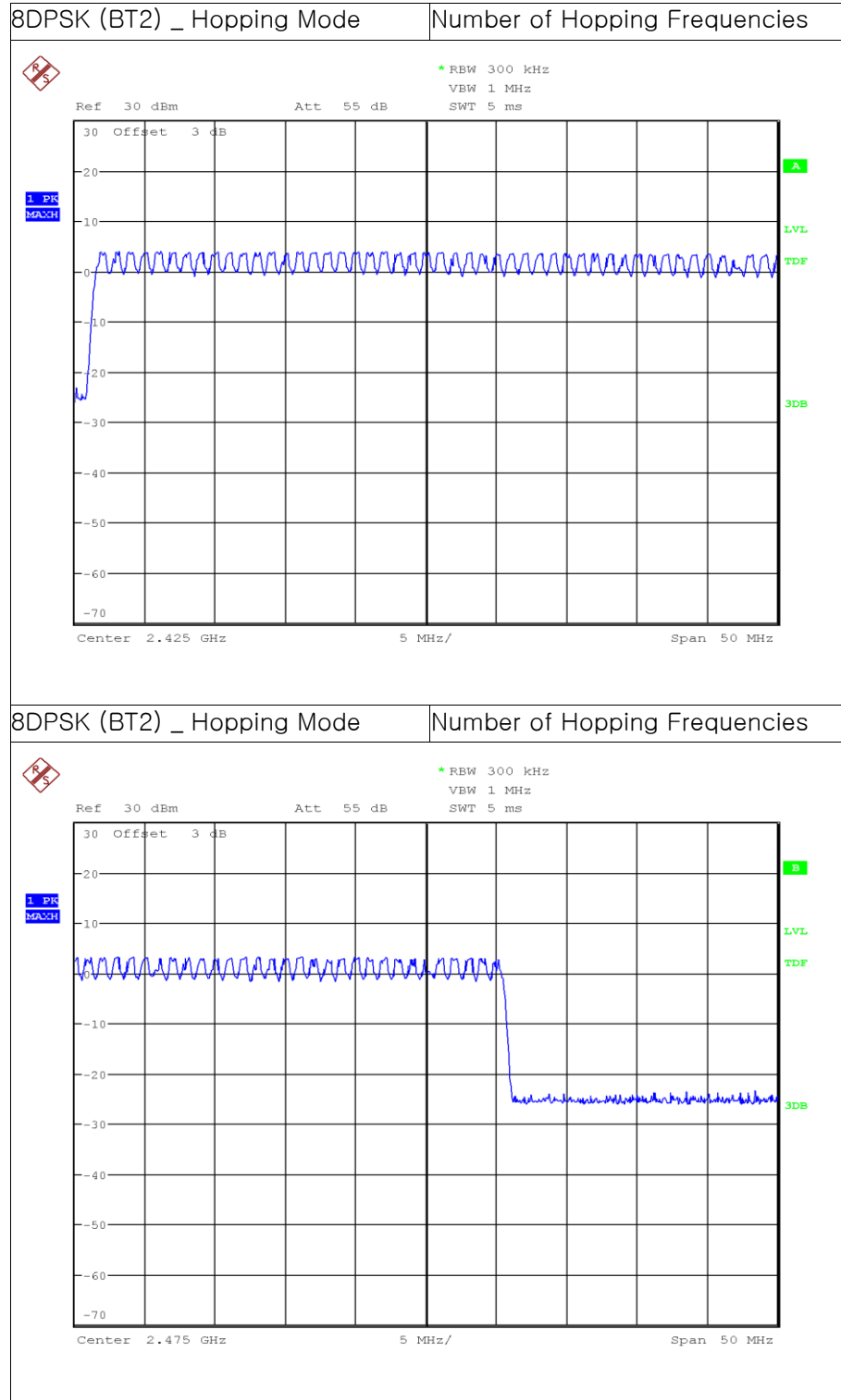
Test Mode	Number of Hopping Channels
GFSK (BT1)	79
8DPSK (BT1)	79
GFSK (BT2)	79
8DPSK (BT2)	79

7.5 Test Plot











8. Time of Occupancy (Dwell Time)

8.1 Test Setup

Refer to the APPENDIX I.

8.2 Limit

The maximum permissible time of occupancy is 400 ms within a period of 400 ms multiplied by the number of hopping channels employed.

8.3 Test Procedure

The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

The spectrum analyzer is set to:

Center frequency = 2441 MHz Span = Zero

RBW = 1 MHz (RBW shall be $\leq$ channel spacing and where possible RBW should be set $\gg 1 / T$, where T is the expected dwell time per channel)

VBW $\geq$ RBW

Detector = Peak

Trace = Max hold

8.4 Test Result

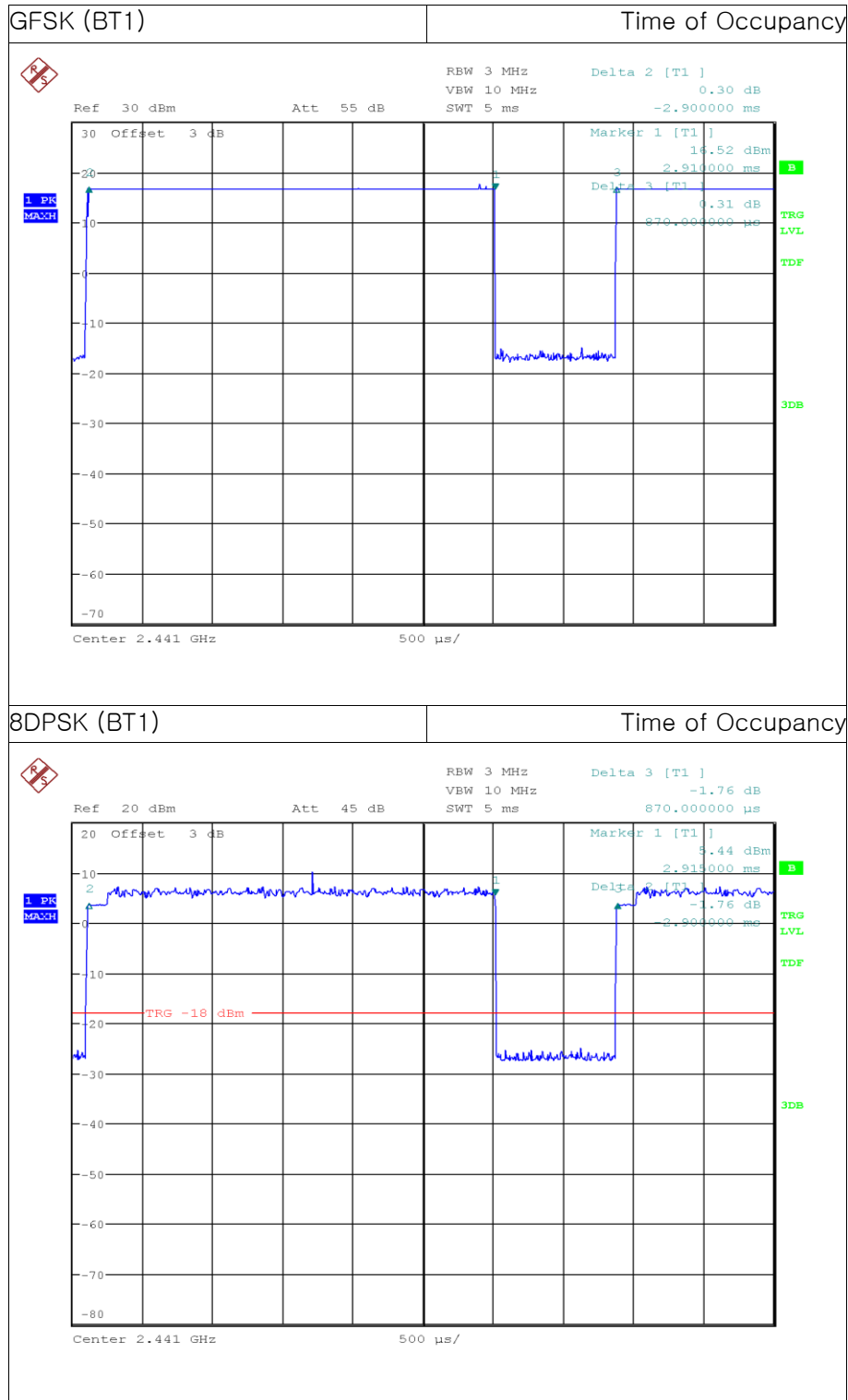
Test Mode	Number of Hopping Channels	Burst On Time (ms)	Result (sec)	Limit (sec)
GFSK (BT1) (non-AFH)	79	2.900	0.31	0.40
GFSK (BT1) (AFH)	20	2.900	0.15	0.40
8DPSK (BT1) (non-AFH)	79	2.900	0.31	0.40
8DPSK (BT1) (AFH)	20	2.900	0.15	0.40
GFSK (BT2) (non-AFH)	79	2.900	0.31	0.40
GFSK (BT2) (AFH)	20	2.900	0.15	0.40
8DPSK (BT2) (non-AFH)	79	2.890	0.31	0.40
8DPSK (BT2) (AFH)	20	2.890	0.15	0.40

Note: Dwell Time = $0.4 \times \text{Hopping channel} \times \text{Burst On Time} \times ((\text{Hopping rate} / \text{Time slots}) / \text{Hopping channel})$

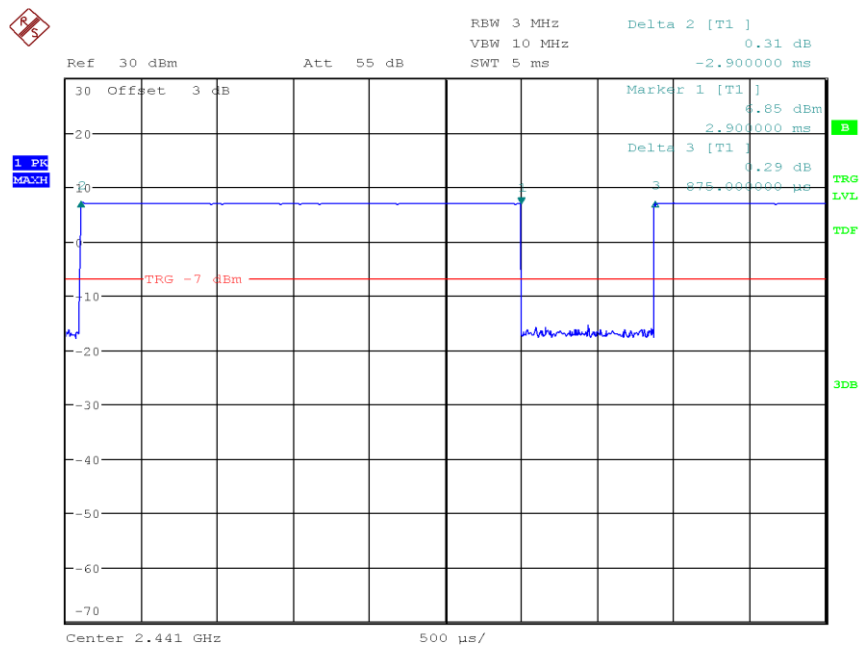
- Time slots for FH5 = 6 slots (TX = 5 slot / RX = 1 slot)

- Hopping Rate = 1600 for FH mode & 800 for AFH mode

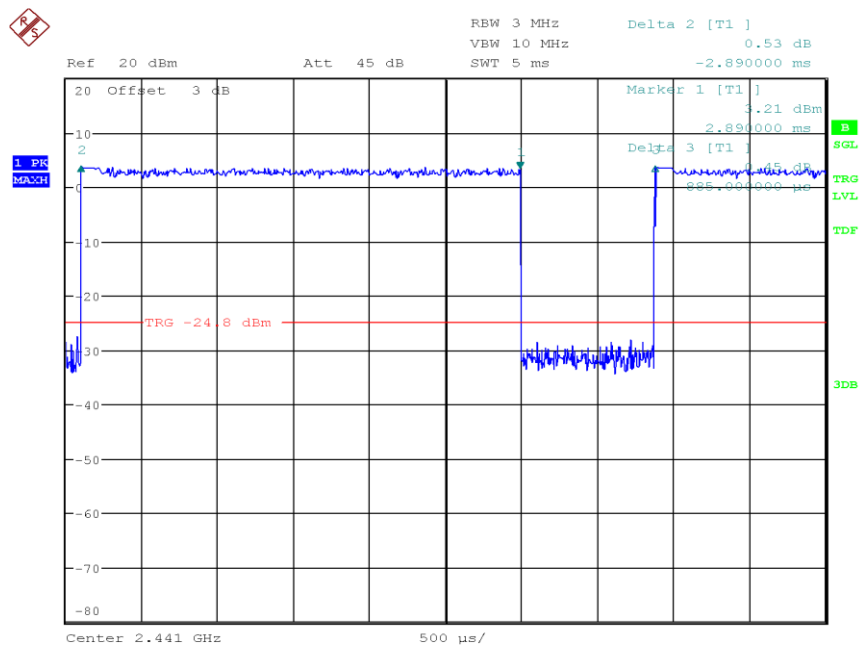
8.5 Test Plot



GFSK (BT2) Time of Occupancy



8DPSK (BT2) Time of Occupancy





9. Carrier Frequencies Separation

9.1 Test Setup

Refer to the APPENDIX I.

9.2 Limit

Limit : ≥ 25 kHz or $\geq$ Two-Thirds of the 20 dB Bandwidth whichever is greater.

9.3 Test Procedure

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

After the trace being stable, the reading value between the peaks of the adjacent channels using the marker delta function was recorded as the measurement results.

The spectrum analyzer is set to:

Span = wide enough to capture the peaks of two adjacent channels

RBW = Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.

VBW $\geq$ RBW

Sweep = Auto

Detector = Peak

Trace = Max hold

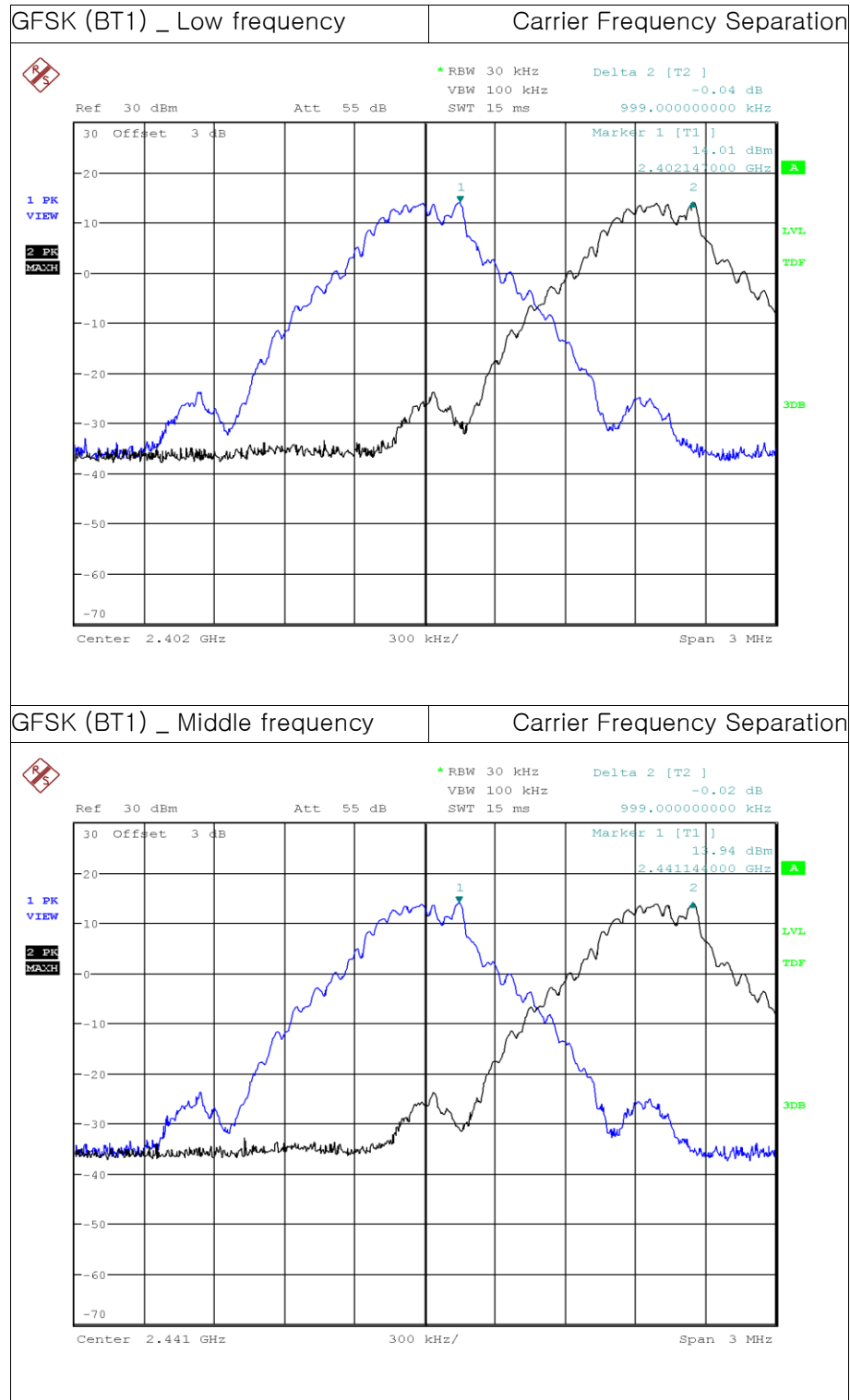
9.4 Test Result

Test Mode	Test Frequency	Carrier Frequencies Separation (MHz)	Min. Limit (MHz)
GFSK (BT1)	Low	0.999	0.639
	Middle	0.999	0.639
	High	0.999	0.639
8DPSK (BT1)	Low	0.996	0.872
	Middle	1.002	0.871
	High	0.999	0.872
GFSK (BT2)	Low	1.002	0.643
	Middle	0.999	0.643
	High	1.002	0.643
8DPSK (BT2)	Low	1.002	0.856
	Middle	0.999	0.856
	High	1.002	0.857

Note: Limit(kHz) = Test Result of 20 dB BW * 2/3



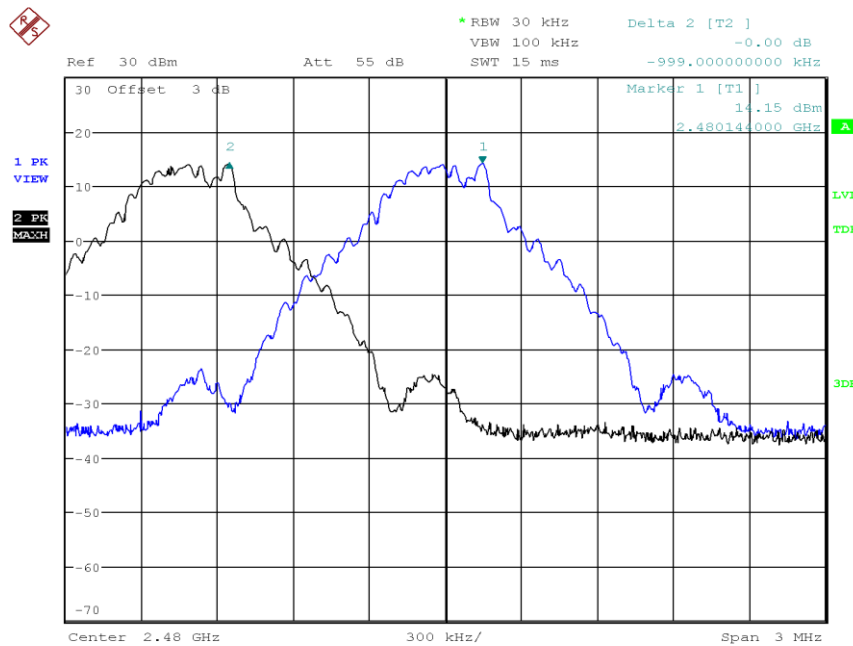
9.5 Test Plot





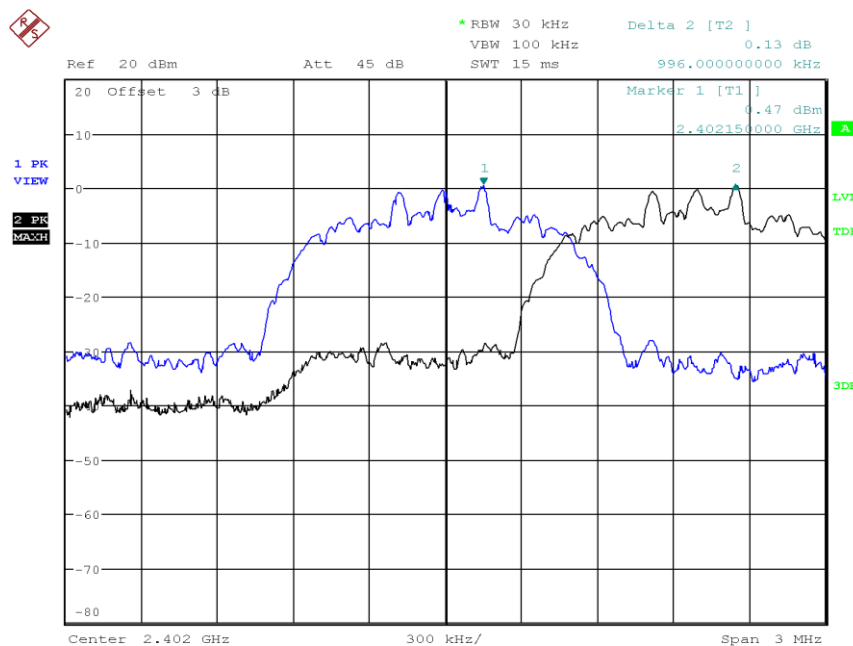
GFSK (BT1) _ High frequency

Carrier Frequency Separation



8DPSK (BT1) _ Low frequency

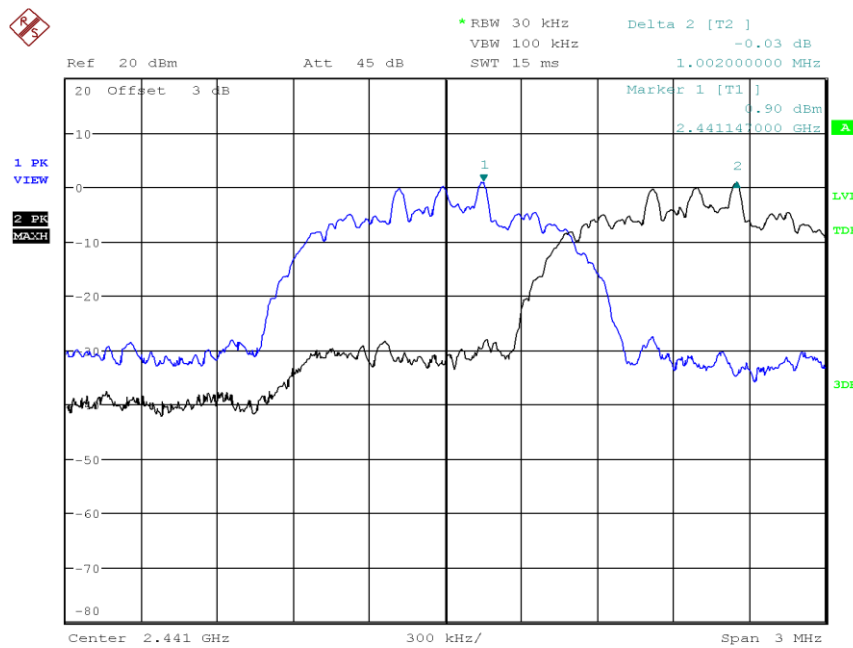
Carrier Frequency Separation





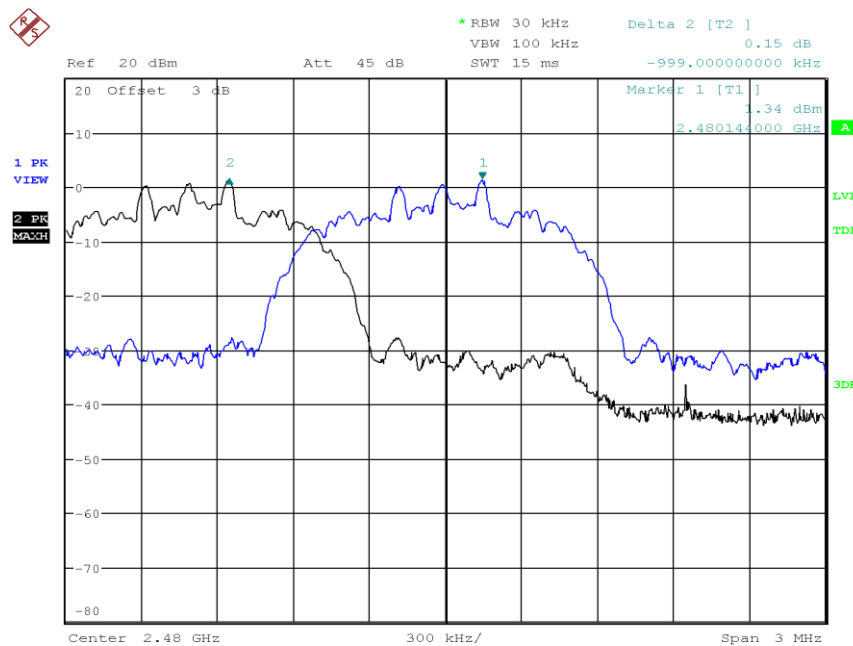
8DPSK (BT1) _ Middle frequency

Carrier Frequency Separation



8DPSK (BT1) _ High frequency

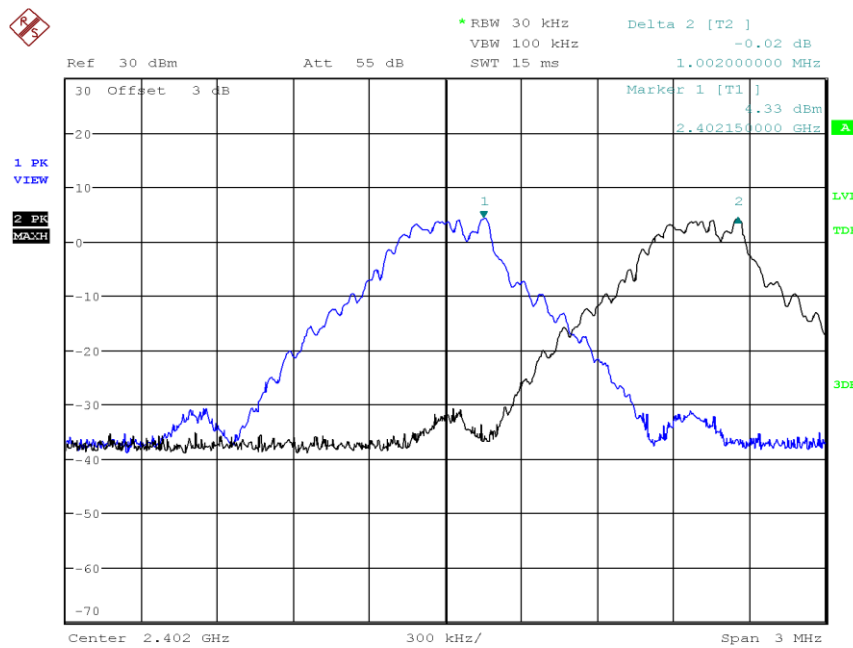
Carrier Frequency Separation





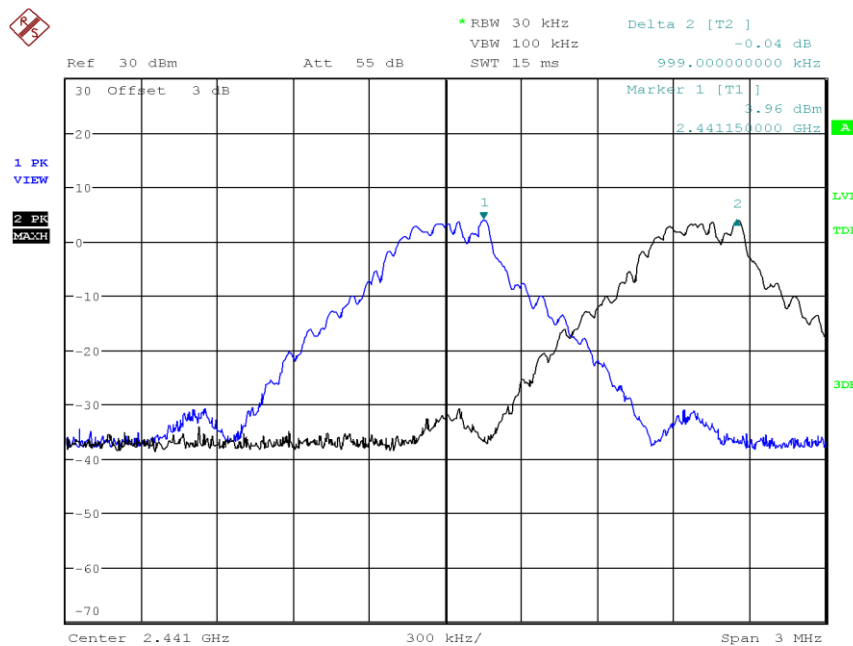
GFSK (BT2) _ Low frequency

Carrier Frequency Separation

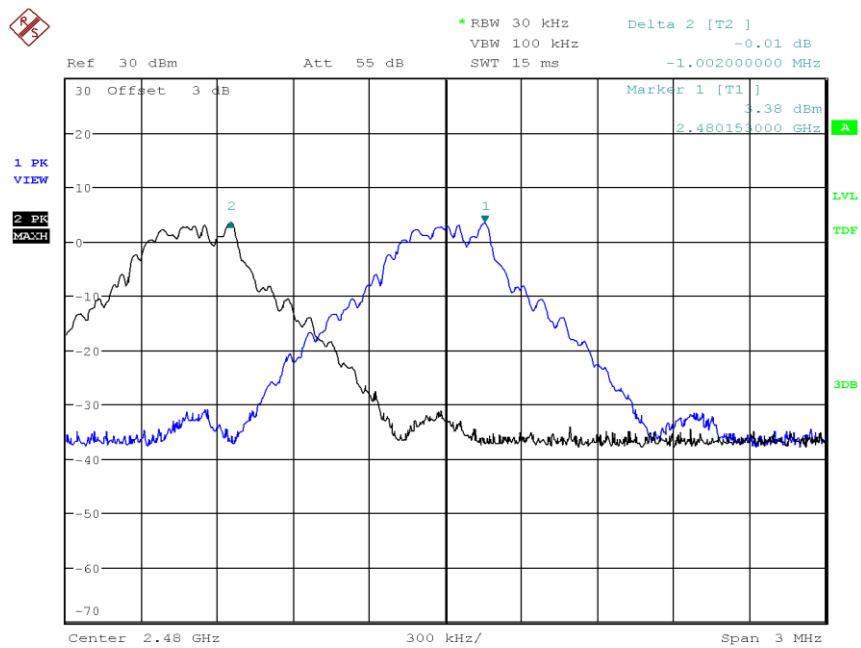


GFSK (BT2) _ Middle frequency

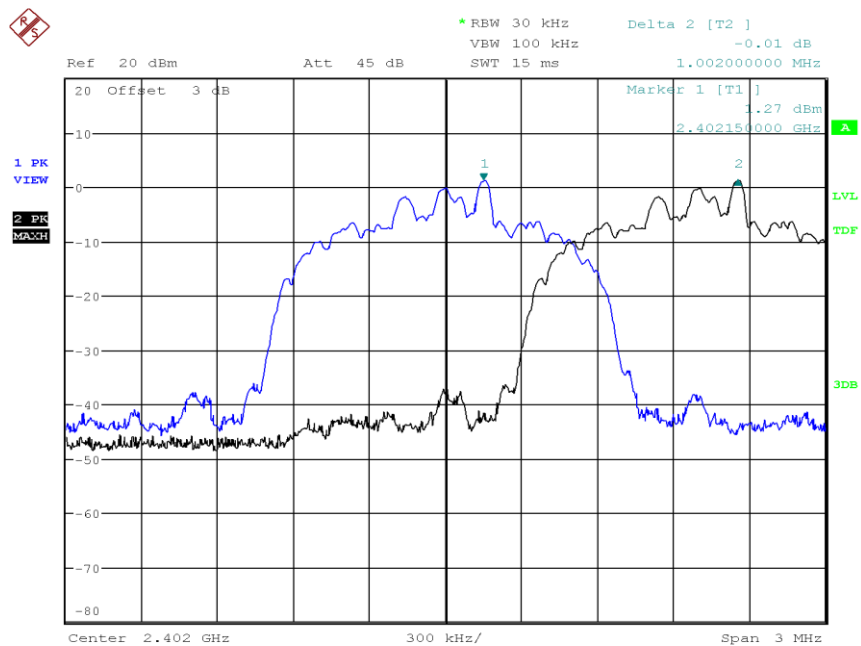
Carrier Frequency Separation



GFSK (BT2) _ High frequency Carrier Frequency Separation



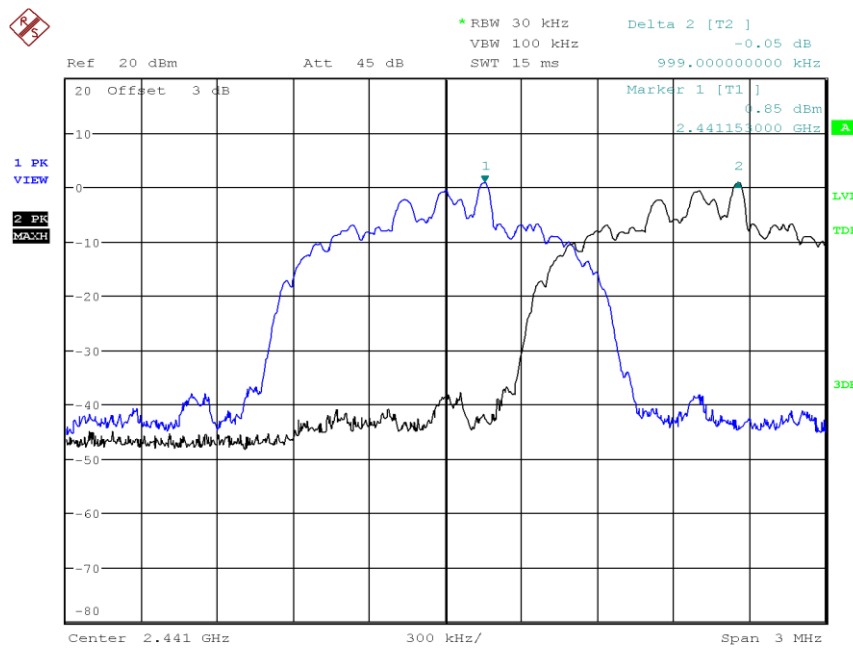
8DPSK (BT2) _ Low frequency Carrier Frequency Separation





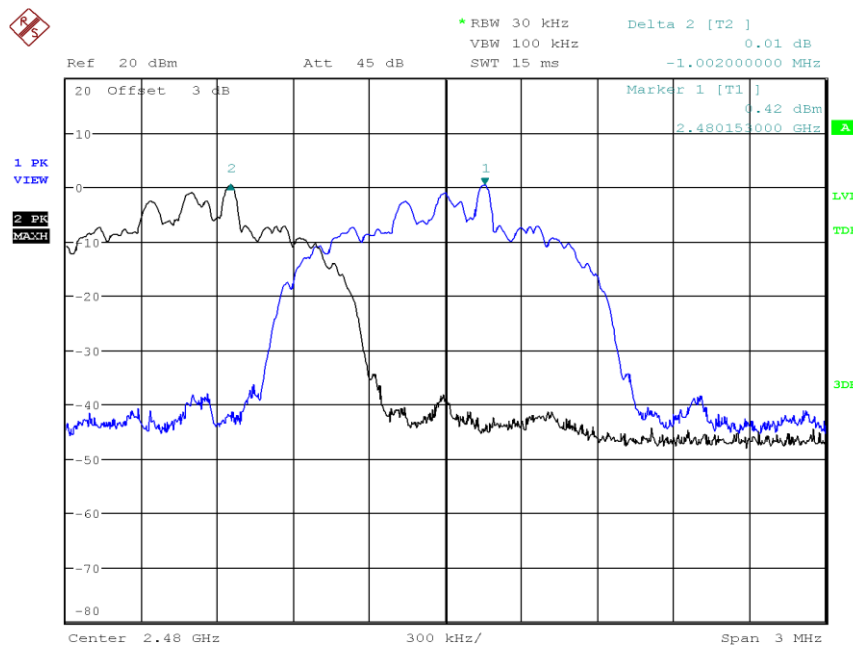
8DPSK (BT2) _ Middle frequency

Carrier Frequency Separation



8DPSK (BT2) _ High frequency

Carrier Frequency Separation





10. Peak Output Power

10.1 Test Setup

Refer to the APPENDIX I.

10.2 Limit

■ FCC Requirements

The maximum peak output power of the intentional radiator shall not exceed the following:

1. §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.
2. §15.247(b)(1), For frequency hopping systems operating in the 2400 – 2483.5 MHz employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725 – 5805 MHz band: 1 Watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

■ IC Requirements

1. RSS-247(5.4) (b), For FHSS operating in the band 2400 – 2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels, the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p shall not exceed 4 W, except as provided in section 5.4(e)

10.3 Test Procedure

1. The RF output power was measured with a spectrum analyzer connected to the RF Antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency, a spectrum analyzer was used to record the shape of the transmit signal.
2. The peak output power of the fundamental frequency was measured with the spectrum analyzer using:
 - Span = approximately 5 times of the 20 dB bandwidth, centered on a hopping channel
 - RBW $\geq$ 20 dB Bandwidth
 - VBW $\geq$ RBW
 - Sweep = Auto
 - Detector function = Peak
 - Trace = Max Hold

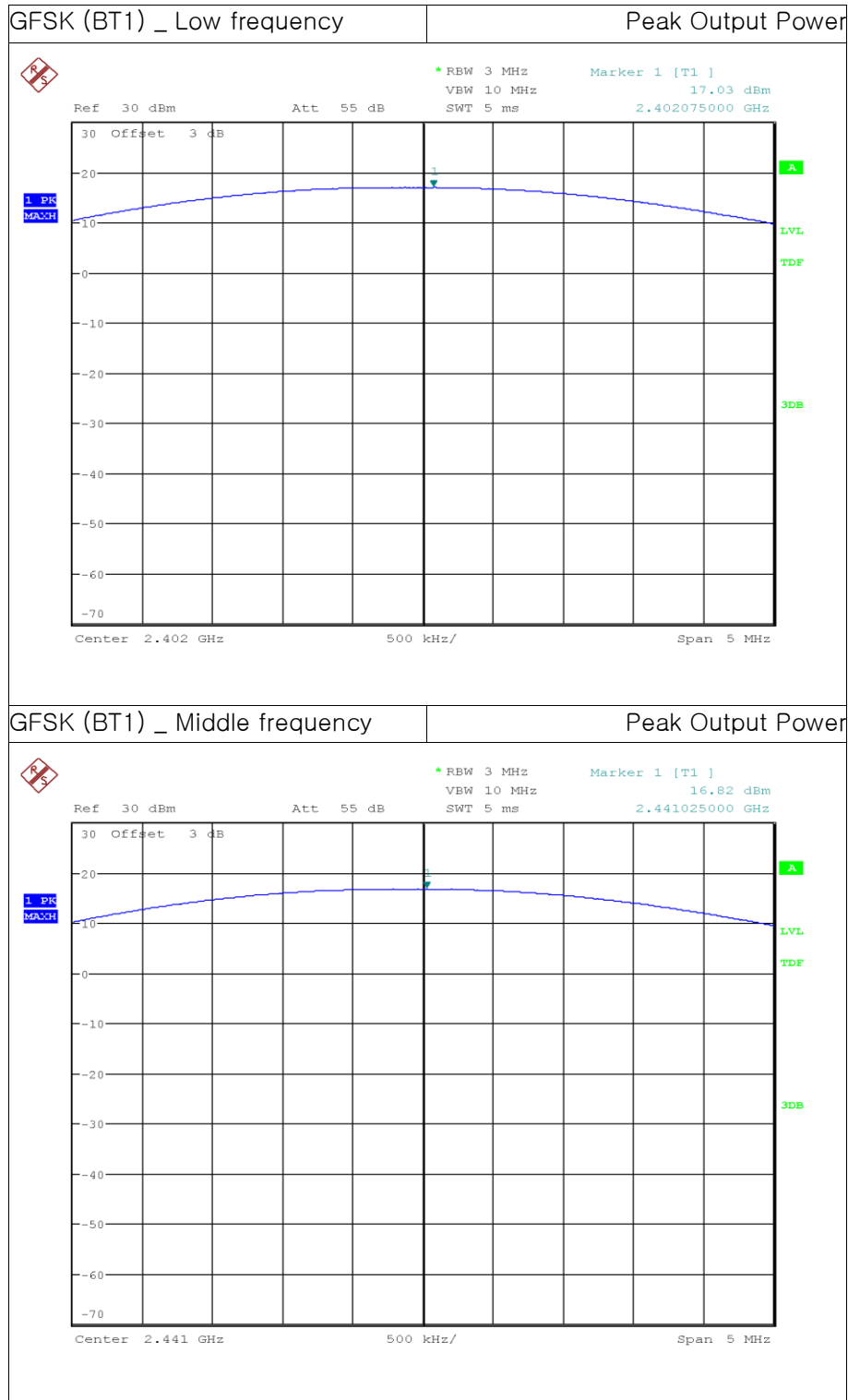


10.4 Test Result

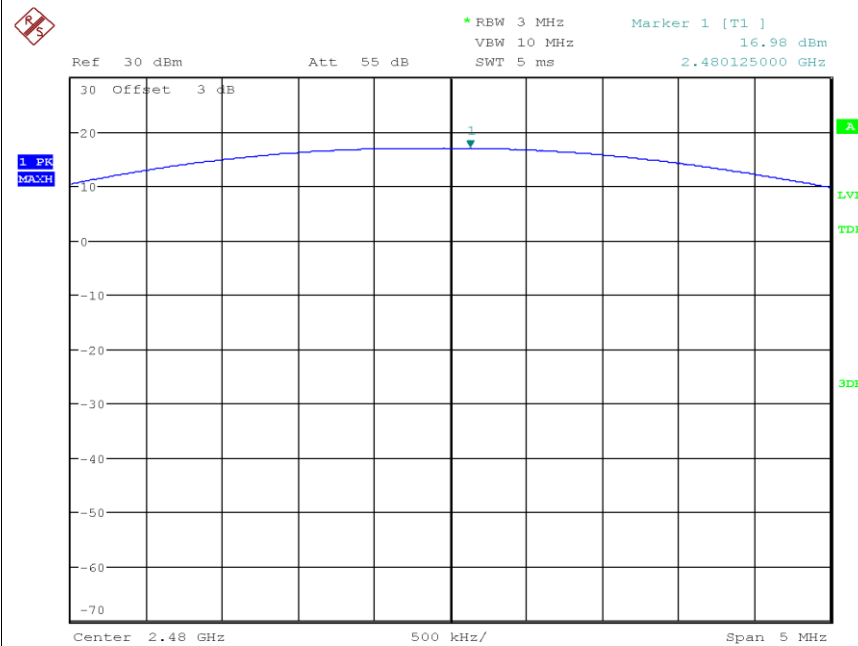
Test Mode	Test Frequency	Peak Output Power		Frame Average Power	
		dBm	mW	dBm	mW
GFSK (BT1)	Low	17.03	50.47	16.19	41.63
	Middle	16.82	48.08	16.32	42.82
	High	16.98	49.89	16.47	44.34
Pi/4 DQPSK (BT1)	Low	5.84	3.84	1.91	1.55
	Middle	6.14	4.11	2.20	1.66
	High	6.74	4.72	3.10	2.04
8DPSK (BT1)	Low	6.65	4.62	2.05	1.60
	Middle	6.67	4.65	2.34	1.71
	High	7.27	5.33	3.24	2.11
GFSK (BT2)	Low	7.47	5.58	6.61	4.58
	Middle	7.05	5.07	6.18	4.15
	High	6.57	4.54	5.56	3.60
Pi/4 DQPSK (BT2)	Low	4.58	2.87	1.01	1.26
	Middle	3.65	2.32	0.58	1.14
	High	3.47	2.22	0.06	1.01
8DPSK (BT2)	Low	4.64	2.91	1.15	1.30
	Middle	4.31	2.70	0.73	1.18
	High	4.00	2.51	0.21	1.05

Note1: Frame Average Power was tested using an average power meter for reference only.

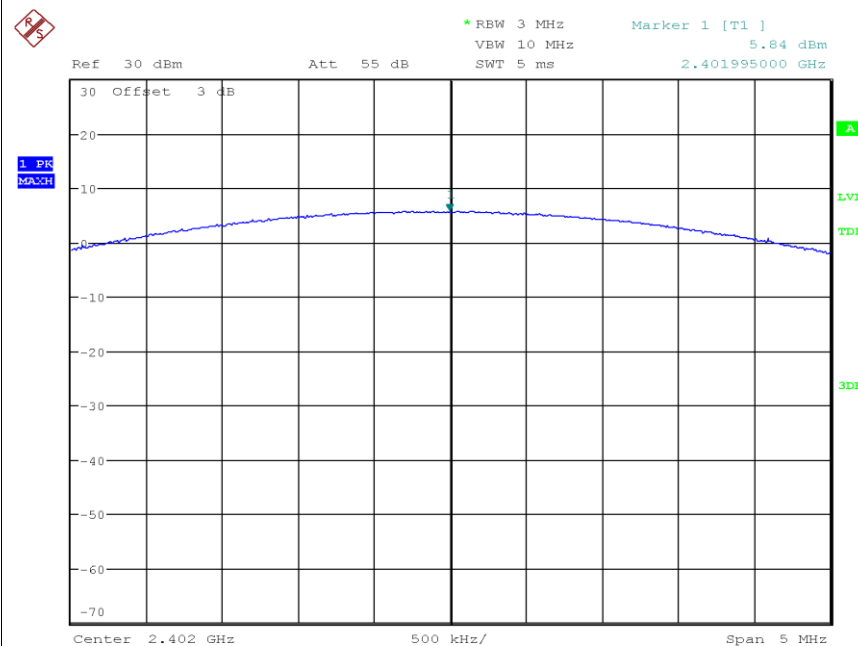
10.5 Test Plot



GFSK (BT1) _ High frequency Peak Output Power



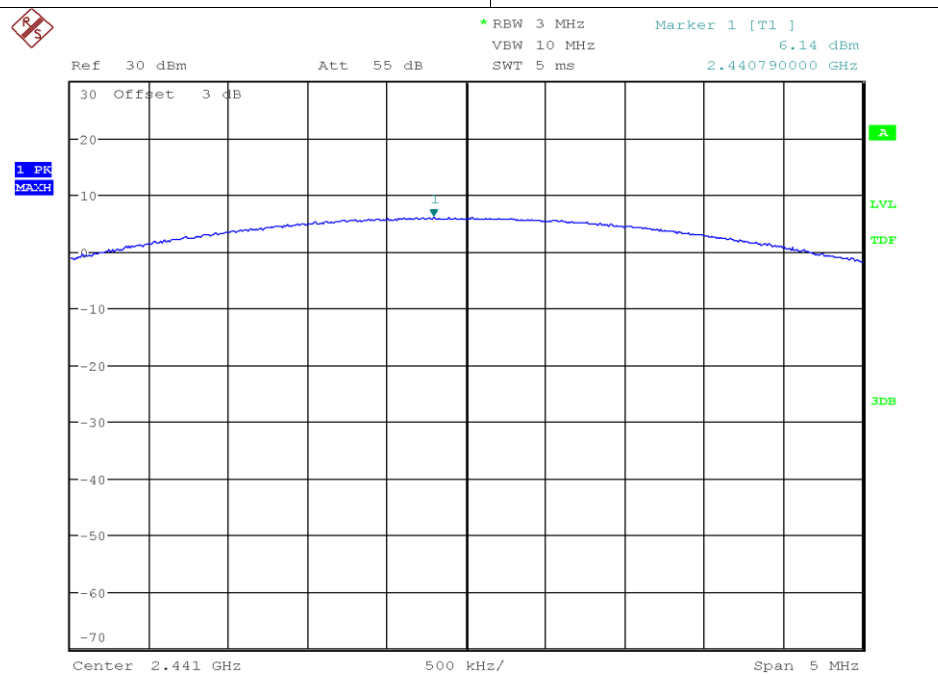
Pi/4 DQPSK (BT1) _ Low frequency Peak Output Power





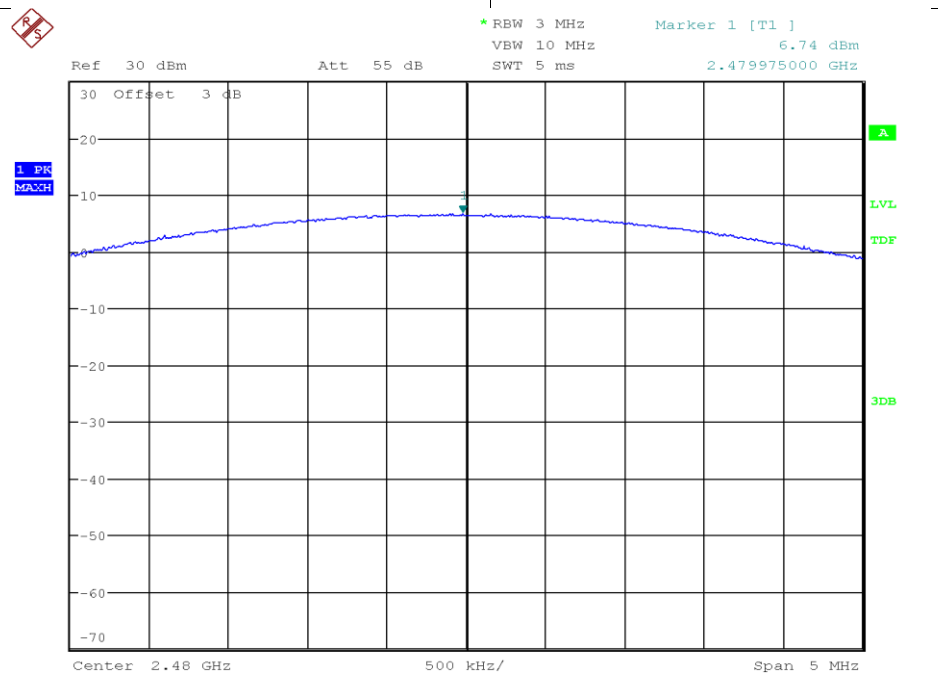
Pi/4 DQPSK (BT1) _ Middle frequency

Peak Output Power

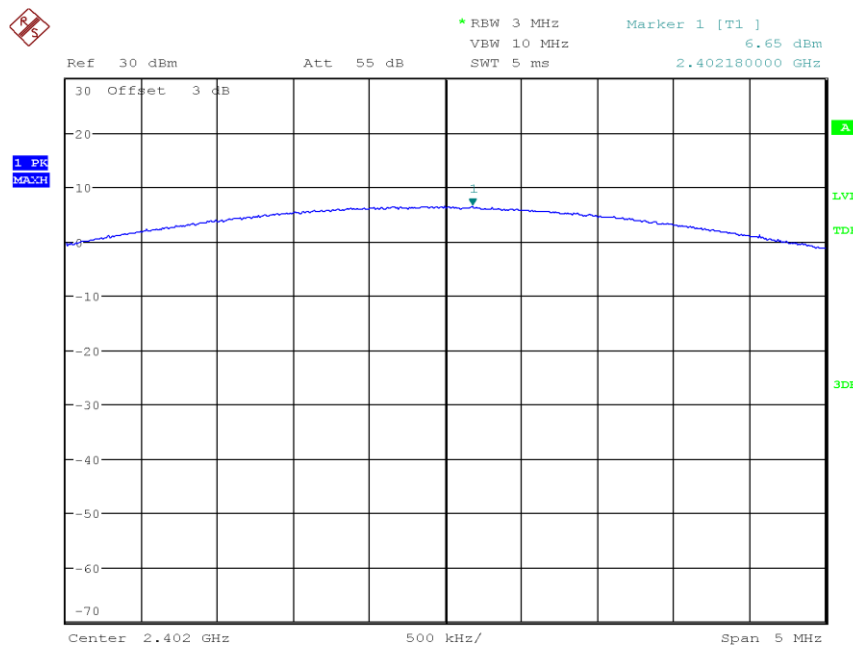


Pi/4 DQPSK (BT1) _ High frequency

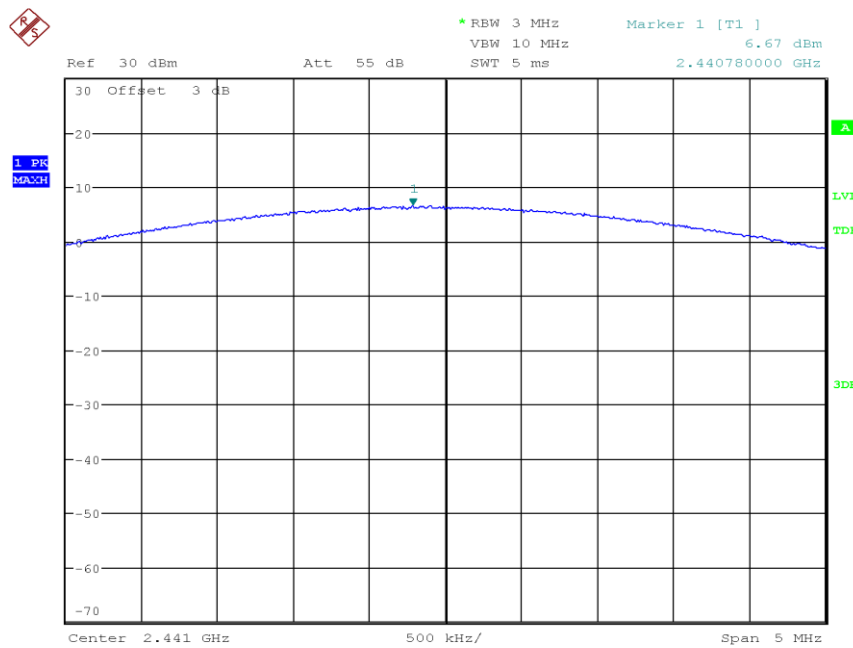
Peak Output Power

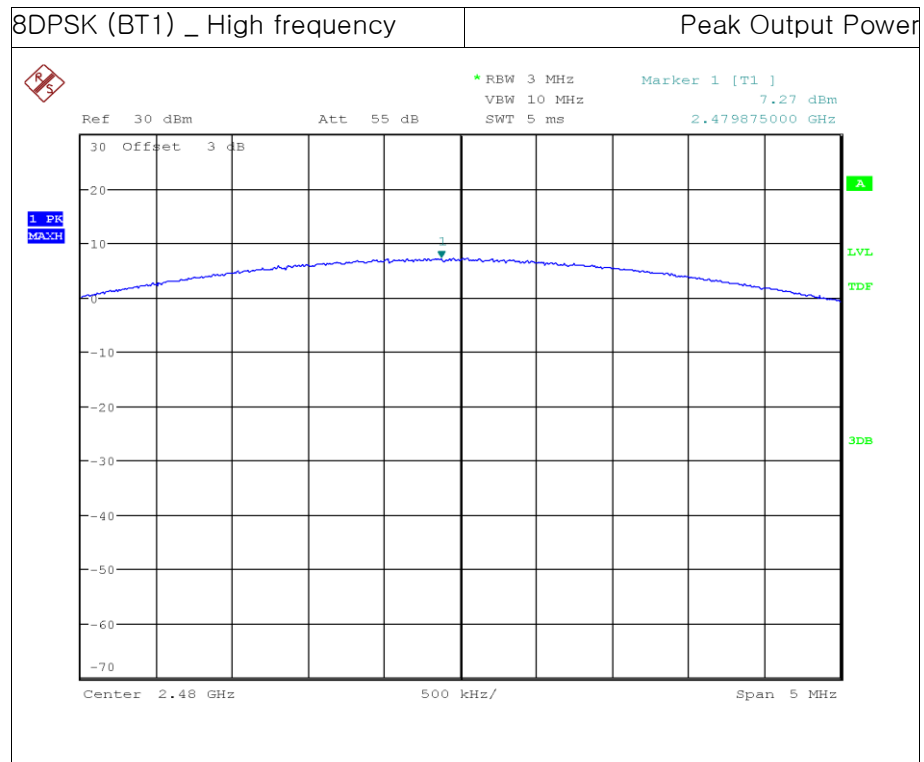


8DPSK (BT1) _ Low frequency Peak Output Power

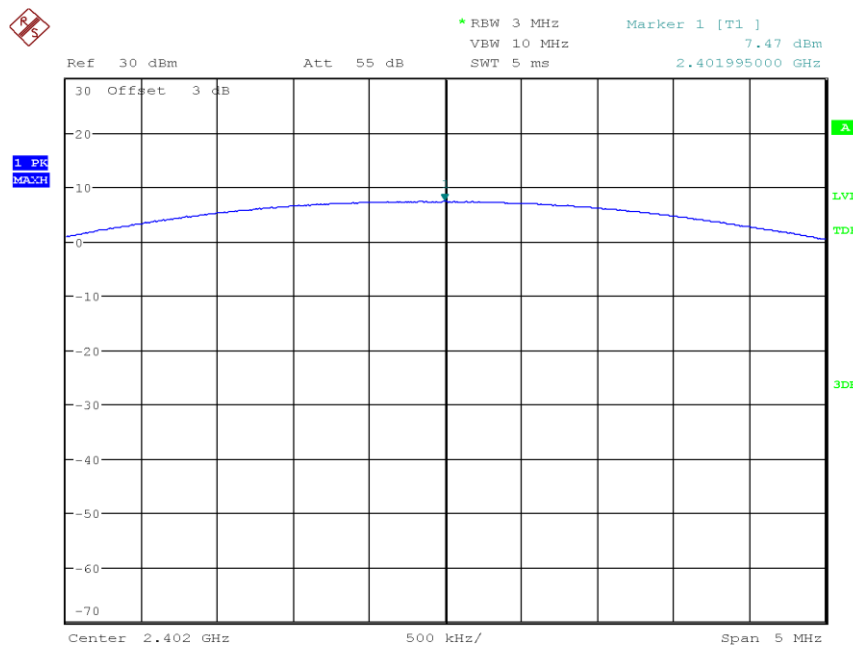


8DPSK (BT1) _ Middle frequency Peak Output Power

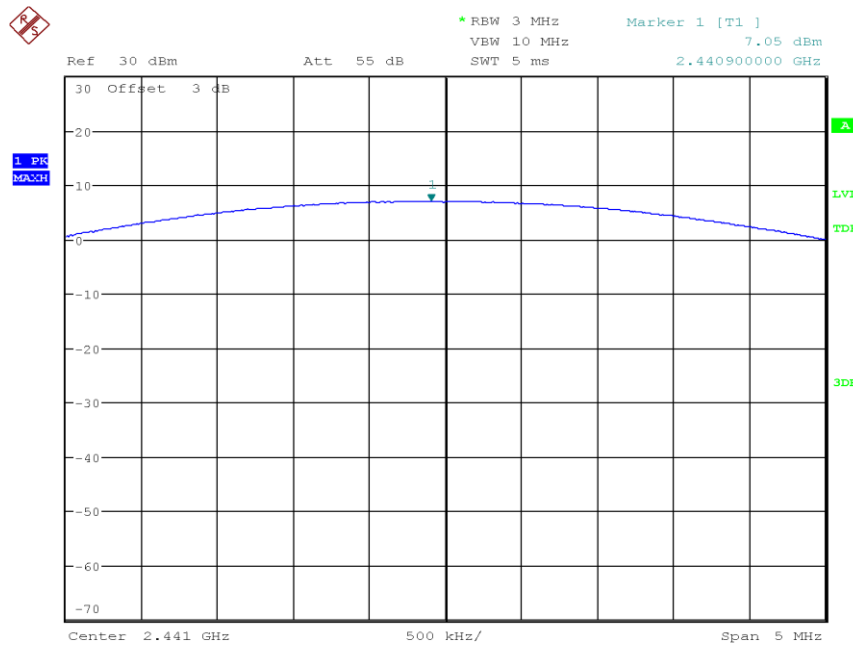




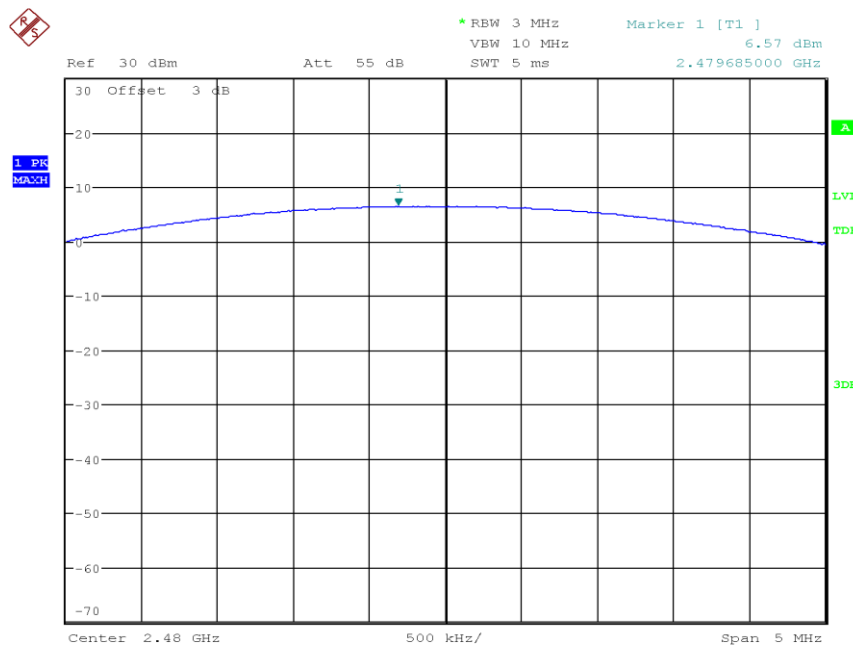
GFSK (BT2) _ Low frequency Peak Output Power



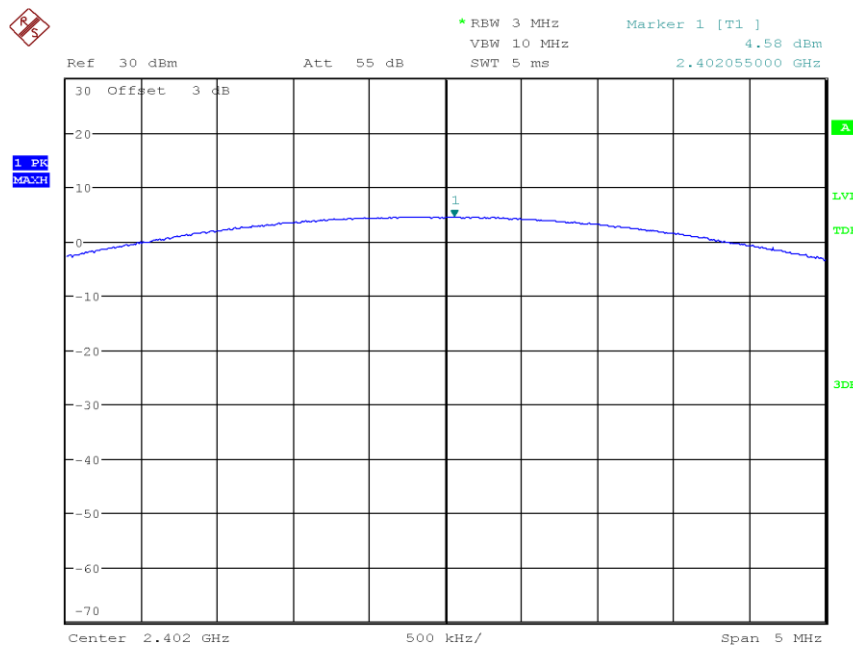
GFSK (BT2) _ Middle frequency Peak Output Power



GFSK (BT2) _ High frequency Peak Output Power

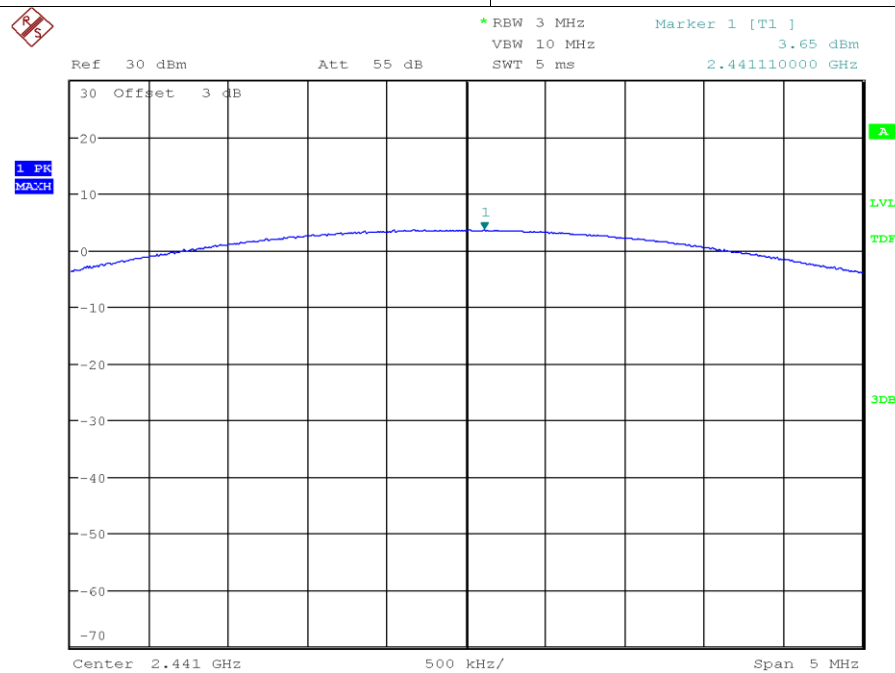


Pi/4 DQPSK (BT2) _ Low frequency Peak Output Power



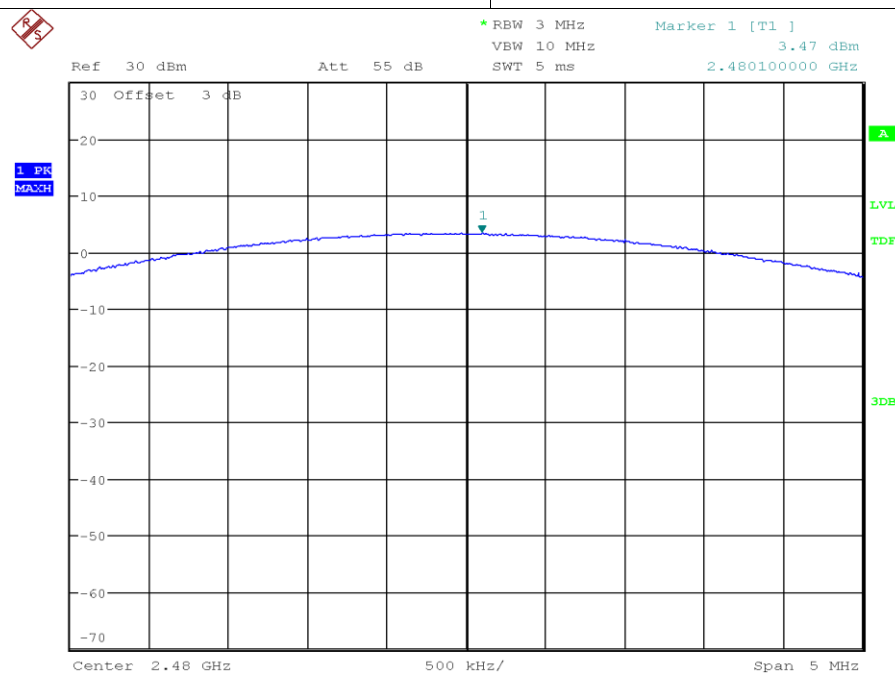
Pi/4 DQPSK (BT2) _ Middle frequency

Peak Output Power

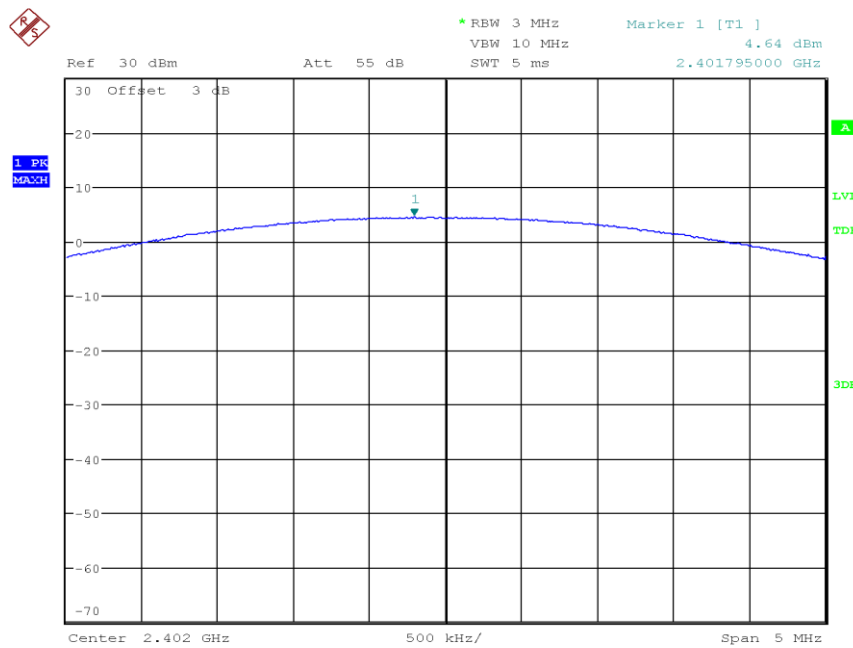


Pi/4 DQPSK (BT2) _ High frequency

Peak Output Power



8DPSK (BT2) _ Low frequency Peak Output Power



8DPSK (BT2) _ Middle frequency Peak Output Power

