TECHNICAL REPORT

Report No: FCC 1709045-02
File reference No: 2017-09-15

Applicant: GLORY STAR TECHNICS (SHENZHEN) CO., LTD.

Product: Advertising Displayer

Model No: NEB215, GAD101-A, NEB156

Trademark: N/A

Test Standards: FCC Part 15.247

Test result: It is herewith confirmed and found to comply with the requirements set up by ANSI C63.10, FCC Part 15.247 for the evaluation of electromagnetic compatibility

Approved By

Jack Chung

Jack Chung

Manager

Dated: September 15, 2017

Results appearing herein relate only to the sample tested
The technical reports is issued errors and omissions exempt and is subject to withdrawal at

SHENZHEN TIMEWAY TESTING LABORATORIES

Room 512-519, 5/F., East Tower, Building 4, Anhua Industrial Zone, Futian District, Shenzhen, Guangdong, China
Tel (755) 83448688, Fax (755) 83442996, E-Mail:info@timeway-lab.com

Special Statement：

The testing quality ability of our laboratory meet with "Quality Law of People's Republic of China" Clause 19.

The testing quality system of our laboratory meets with ISO/IEC-17025 requirements, which is approved by CNAS. This approval result is accepted by MRA of APLAC.

Our test facility is recognized, certified, or accredited by the following organizations:

CNAS-LAB Code: L2292

The EMC Laboratory has been assessed and in compliance with CNAS-CL01 accreditation criteria for testing Laboratories (identical to ISO/IEC 17025:2005 General Requirements) for the Competence of testing Laboratories.

FCC-Registration No.: 899988

The EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications commission. The acceptance letter from the FCC is maintained in our files. Registration No.:899988.

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Test Report Conclusion

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1.0 **General Details**

1.1 Test Lab Details

Name : SHENZHEN TIMEWAY TESTING LABORATORIES.

Address: Room 512-519,5/F., East Tower,Building 4, Anhua Industrial Zone, Futian District,Shenzhen, Guangdong China

Telephone: (755) 83448688

Fax: (755) 83442996

Site on File with the Federal Communications Commission – United Sates

Registration Number: 899988

For 3m & 10 m OATS

Site Listed with Industry Canada of Ottawa, Canada

Registration Number: IC: 5205A-02

For 3m & 10 m OATS

1.2 Applicant Details

Applicant: GLORY STAR TECHNICS (SHENZHEN) CO., LTD.

Address: 4/Floor,west block,Longzhu Road,Xin WuCun Industry Building,NanShan District, ShenZhen

Telephone: (755)-26001808-305

Fax: (755)-26002933

1.3 Description of EUT

Product: Advertising Displayer

Manufacturer: GLORY STAR TECHNICS (SHENZHEN) CO., LTD.

Address: 4/Floor,west block,Longzhu Road,Xin WuCun Industry Building,NanShan District,ShenZhen

Brand Name: N/A

Model Number: NEB215

Additional Model Number: GAD101-A, NEB156

Power Adapter Model: SUN-1200500; Input: 100-240V, 50/60Hz, Max 1.7A; Output: 12V, 5A (Note: for NEB215 and NEB156)
Model: SUN-1200200; Input: 100-240V, 50/60Hz, Max 0.6A; Output: 12V, 2A (Note: for GAD101-A)

Type of Modulation GFSK, Л/4DQPSK, 8DPSK for Bluetooth

Frequency range 2402-2480MHz for Bluetooth

Channel Spacing 1MHz for Bluetooth

Frequency Selection By software

Channel Number 79 channel for Bluetooth

Antenna: Integral Antenna and the maximum Gain of this antenna is 2.0dBi;

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1.4 Submitted Sample: 3 Samples

1.5 Test Duration

2017-07-08 to 2017-07-11

1.6 Test Uncertainty

Conducted Emissions Uncertainty =3.6dB

Radiated Emissions Uncertainty =4.7dB

1.7 Test Engineer

The sample tested by Terry Tang

Print Name: Terry Tang

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2.0 Test Equipment					
Instrument Type	Manufacturer	Model	Serial No.	Date of Cal.	Due Date
ESPI Test Receiver	R&S	ESPI 3	100379	2016-08-22	2017-08-21
TWO Line-V-NETW	R&S	EZH3-Z5	100294	2016-08-22	2017-08-21
TWO Line-V-NETW	R&S	EZH3-Z5	100253	2016-08-22	2017-08-21
Ultra Broadband ANT	R&S	HL562	100157	2016-08-23	2017-08-22
ESDV Test Receiver	R&S	ESDV	100008	2016-08-22	2017-08-21
Impuls-Begrenzer	R&S	ESH3-Z2	100281	2016-08-22	2017-08-21
System Controller	CT	SC100	-	--	--
Printer	EPSON	PHOTO EX3	CFNH234850	--	--
Computer	IBM	8434	1S8434KCE99BLXLO*	-	-
Loop Antenna	EMCO	6502	00042960	2016-08-23	2017-08-22
ESPI Test Receiver	R&S	ESI26	838786/013	2016-08-22	2017-08-21
3m OATS	--	--	N/A	2016-08-24	2017-08-23
Horn Antenna	R&S	BBHA 9170	BBHA9170265	2016-08-24	2017-08-23
Horn Antenna	R&S	BBHA 9120D	9120D-631	2016-08-24	2017-08-23
Power meter	Anritsu	ML2487A	6K00003613	2016-08-22	2017-08-21
Power sensor	Anritsu	MA2491A	32263	2016-08-22	2017-08-21
Bilog Antenna	Schwarebeck	VULB9163	9163/340	2016-08-23	2017-08-21
LISN	AFJ	LS16C	10010947251	2016-08-22	2017-08-21
LISN (Three Phase)	Schwarebeck	NSLK 8126	8126453	2016-08-23	2017-08-22
9*6*6 Anechoic	--	--	N/A	2016-08-24	2017-08-23
EMI Test Receiver	RS	ESCS30	100139	2016-08-22	2017-08-21
RF Cable	SCHWARZBECK	--	--	2016-08-23	2017-08-22
Pre-Amplifier	HP	8447D	2727A05017	2016-08-05	2017-08-04
Pre-Amplifier	EM	EM30265	--	2016-08-05	2017-08-04

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3.0 Technical Details

3.1 Summary of test results

The EUT has been tested according to the following specifications:

Requirement	CFR 47 Section	Result	Notes
Antenna Requirement	15.203, 15.247(b)(4)	PASS	Complies
Maximum Peak Out Power	15.247 (b)(1), (4)	PASS	Complies
Carrier Frequency Separation	15.247(a)(1)	PASS	Complies
20dB Channel Bandwidth	15.247 (a)(1)	PASS	Complies
Number of Hopping Channels	15.247(a)(iii), 15.247(b)(1)	PASS	Complies
Time of Occupancy (Dwell Time)	15.247(a)(iii)	PASS	Complies
Spurious Emission, Band Edge, and Restricted bands	15.247(d),15.205(a), 15.209 (a),15.109	PASS	Complies
Conducted Emissions	15.207(a)，15.107	PASS	Complies
RF Exposure	15.247(i), 1.1307(b)(1)	PASS	Complies

3.2 Test Standards

FCC Part 15 Subpart & Subpart C, Paragraph 15.247 ; ANSI C63.10-2013

4.0 EUT Modification

No modification by SHENZHEN TIMEWAY TESTING LABORATORIES.

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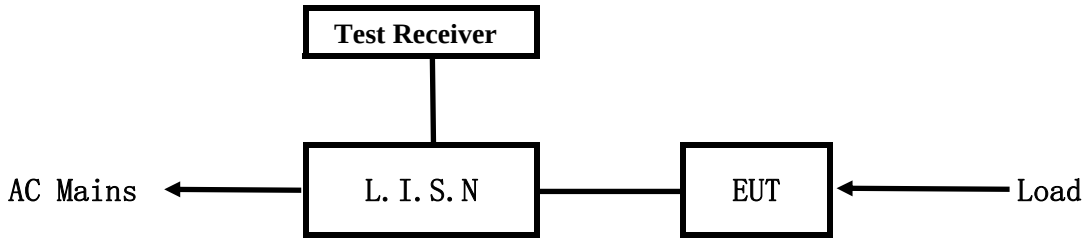
5. Power Line Conducted Emission Test

5.1 Schematics of the test



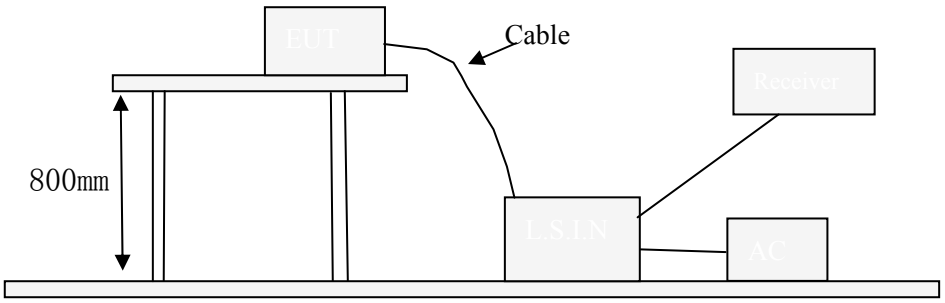
EUT: Equipment Under Test

5.2 Test Method and test Procedure

The EUT was tested according to ANSI C63.10-2013.The Frequency spectrum From 0.15MHz to 30MHz was investigated. The LISN used was 50ohm/50uH as specified by section 5.1 of ANSI C63.10–2013.

Test Voltage: 120V~60Hz

Block diagram of Test setup



5.3 Configuration of The EUT

The EUT was configured according to ANSI C63.10-2013. All interface ports were connected to the appropriate peripherals. All peripherals and cables are listed below.

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A. EUT

Device	Manufacturer	Model	FCC ID
Advertising Displayer	GLORY STAR TECHNICS (SHENZHEN) CO., LTD.	NEB215, GAD101-A, NEB156	2AACS-NEB156-215

B. Internal Device

Device	Manufacturer	Model	Rating

C. Peripherals

Device	Manufacturer	Model	FCC ID/DOC	Cable
--	--	--	--	--

5.4 EUT Operating Condition

Operating condition is according to ANSI C63.10-2013.

A Setup the EUT and simulators as shown on follow

B Enable AF signal and confirm EUT active to normal condition

5.5 Power line conducted Emission Limit according to Paragraph 15.107 ,15.207

Frequency (MHz)	Class A Limits (dB μ V)		Class B Limits (dB μ V)	
	Quasi-peak Level	Average Level	Quasi-peak Level	Average Level
0.15 ～ 0.50	79.0	66.0	66.0～56.0*	56.0～46.0*
0.50 ～ 5.00	73.0	60.0	56.0	46.0
5.00 ～ 30.00	73.0	60.0	60.0	50.0

Notes: 1. *Decreasing linearly with logarithm of frequency.

2. The tighter limit shall apply at the transition frequencies

5.6 Test Results

The frequency spectrum from 0.15MHz to 30MHz was investigated. All reading are quasi-peak values with a resolution bandwidth of 9kHz.

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A: Conducted Emission on Live Terminal (150kHz to 30MHz)

Model: NEB215

EUT Operating Environment

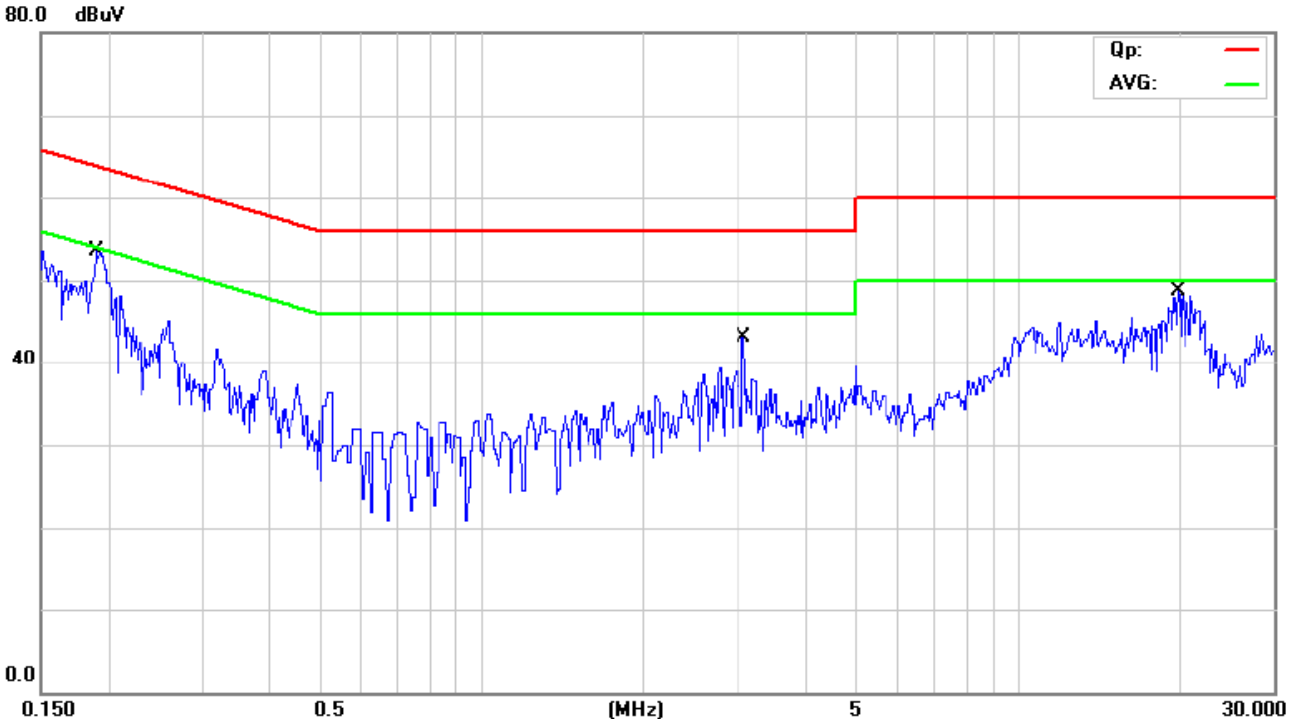
Temperature: 26℃ Humidity: 65%RH Atmospheric Pressure: 101 KPa

EUT set Condition: Keep Bluetooth Transmitting

Equipment Level: Class B

Results: PASS

Please refer to following diagram for individual



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1911	40.70	9.89	50.59	63.99	-13.40	QP	
2		0.1911	24.80	9.89	34.69	53.99	-19.30	AVG	
3		3.0746	16.70	10.86	27.56	56.00	-28.44	QP	
4		3.0746	-7.60	10.86	3.26	46.00	-42.74	AVG	
5		19.8290	35.60	11.11	46.71	60.00	-13.29	QP	
6	*	19.8290	35.20	11.11	46.31	50.00	-3.69	AVG	

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B: Conducted Emission on Neutral Terminal (150kHz to 30MHz)

Model: NEB215

EUT Operating Environment

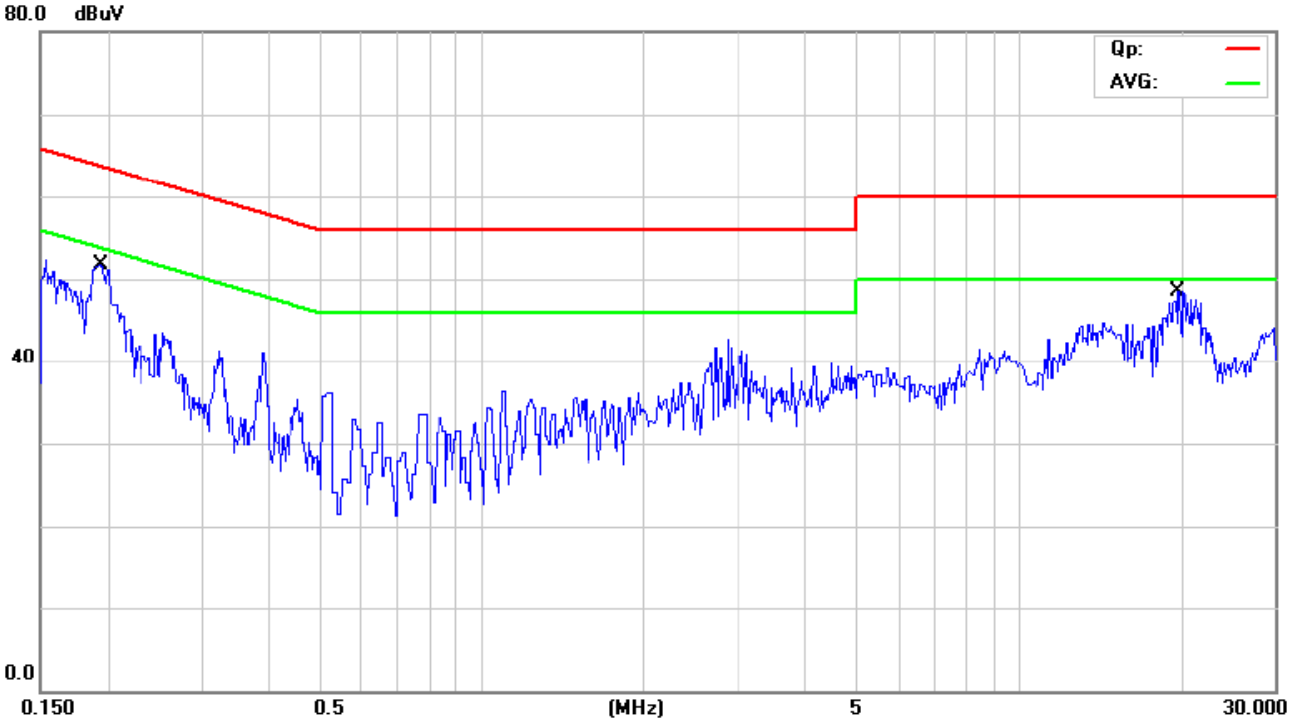
Temperature: 26℃ Humidity: 65%RH Atmospheric Pressure: 101 KPa

EUT set Condition: Keep Bluetooth Transmitting

Equipment Level: Class B

Results: Pass

Please refer to following diagram for individual



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1932	40.50	9.89	50.39	63.90	-13.51	QP	
2		0.1932	25.10	9.89	34.99	53.90	-18.91	AVG	
3		19.7103	35.80	11.11	46.91	60.00	-13.09	QP	
4	*	19.7103	34.20	11.11	45.31	50.00	-4.69	AVG	

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C: Conducted Emission on Live Terminal (150kHz to 30MHz)

Model: GAD101-A

EUT Operating Environment

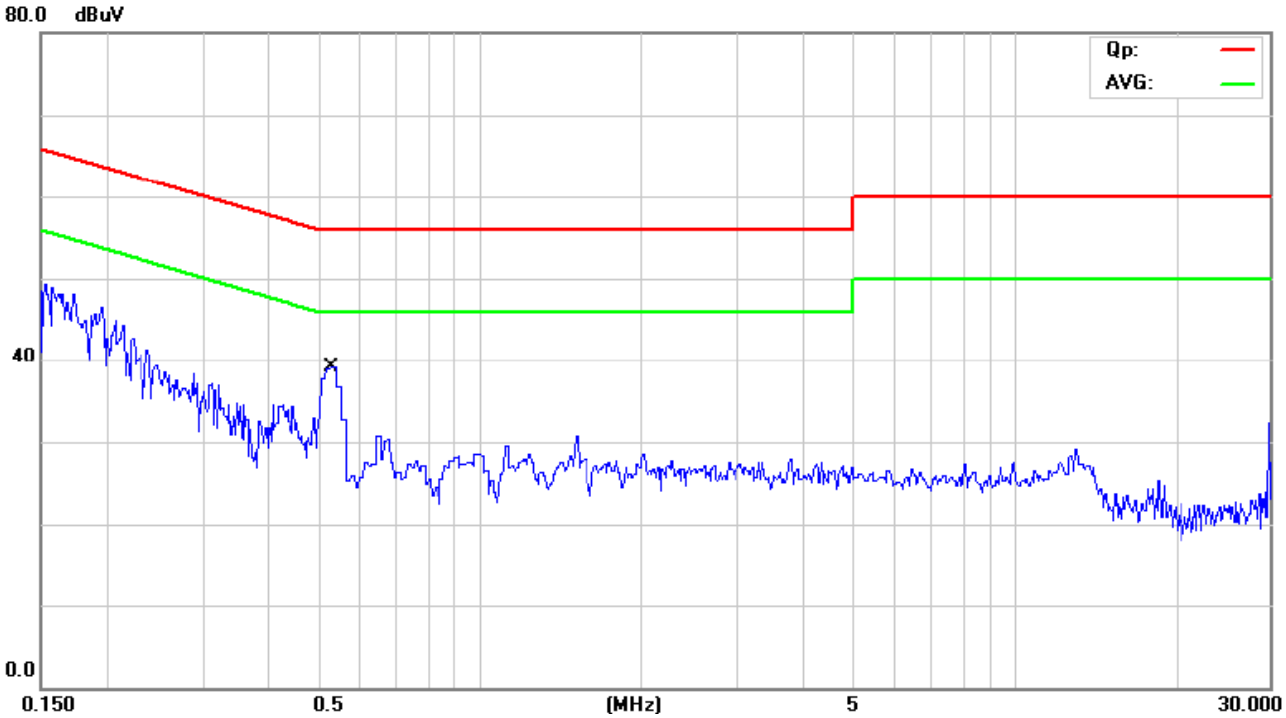
Temperature: 26℃ Humidity: 65%RH Atmospheric Pressure: 101 KPa

EUT set Condition: Keep Bluetooth Transmitting

Equipment Level: Class B

Results: PASS

Please refer to following diagram for individual



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.5307	27.40	10.31	37.71	56.00	-18.29	QP	
2		0.5307	13.90	10.31	24.21	46.00	-21.79	AVG	

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D: Conducted Emission on Neutral Terminal (150kHz to 30MHz)

Model: GAD101-A

EUT Operating Environment

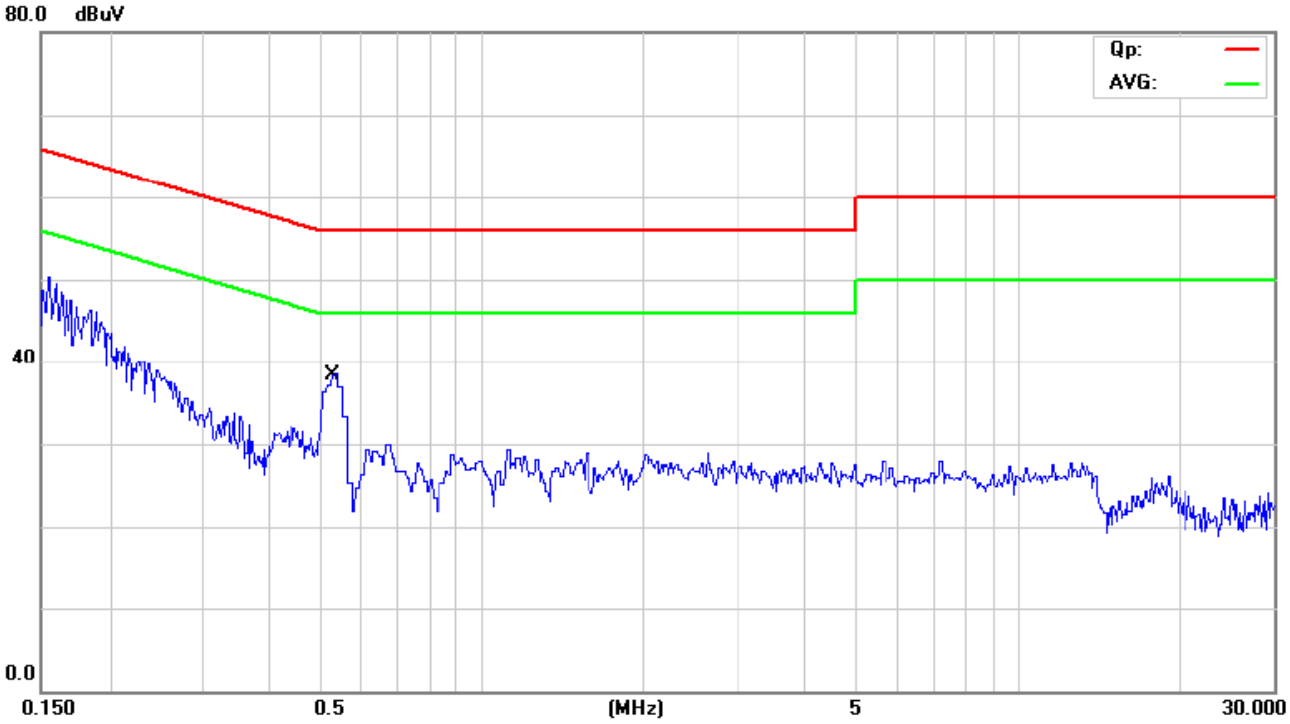
Temperature: 26℃ Humidity: 65%RH Atmospheric Pressure: 101 KPa

EUT set Condition: Keep Bluetooth Transmitting

Equipment Level: Class B

Results: Pass

Please refer to following diagram for individual



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.5320	26.30	10.32	36.62	56.00	-19.38	QP	
2		0.5320	12.30	10.32	22.62	46.00	-23.38	AVG	

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E: Conducted Emission on Live Terminal (150kHz to 30MHz)

Model: NEB156

EUT Operating Environment

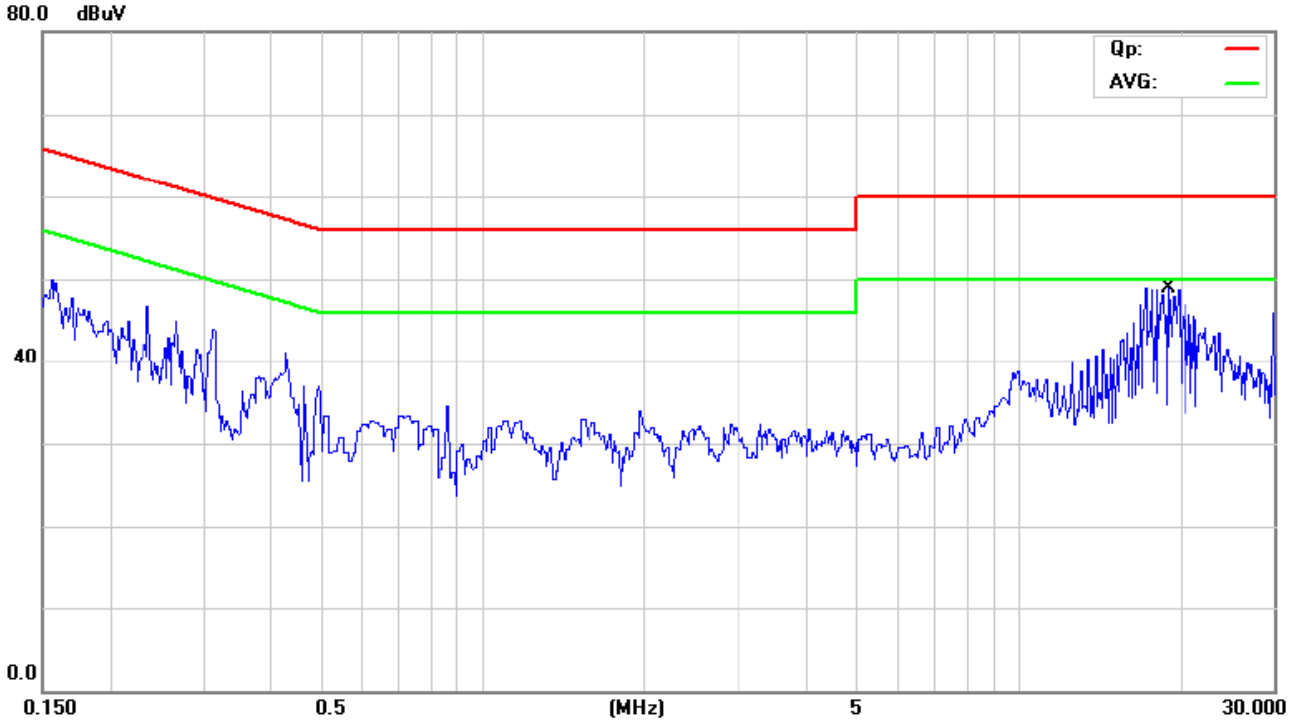
Temperature: 26℃ Humidity: 65%RH Atmospheric Pressure: 101 KPa

EUT set Condition: Keep Bluetooth Transmitting

Equipment Level: Class B

Results: PASS

Please refer to following diagram for individual



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		19.0120	29.10	11.14	40.24	60.00	-19.76	QP	
2	*	19.0120	22.60	11.14	33.74	50.00	-16.26	AVG	

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F: Conducted Emission on Neutral Terminal (150kHz to 30MHz)

Model: NEB156

EUT Operating Environment

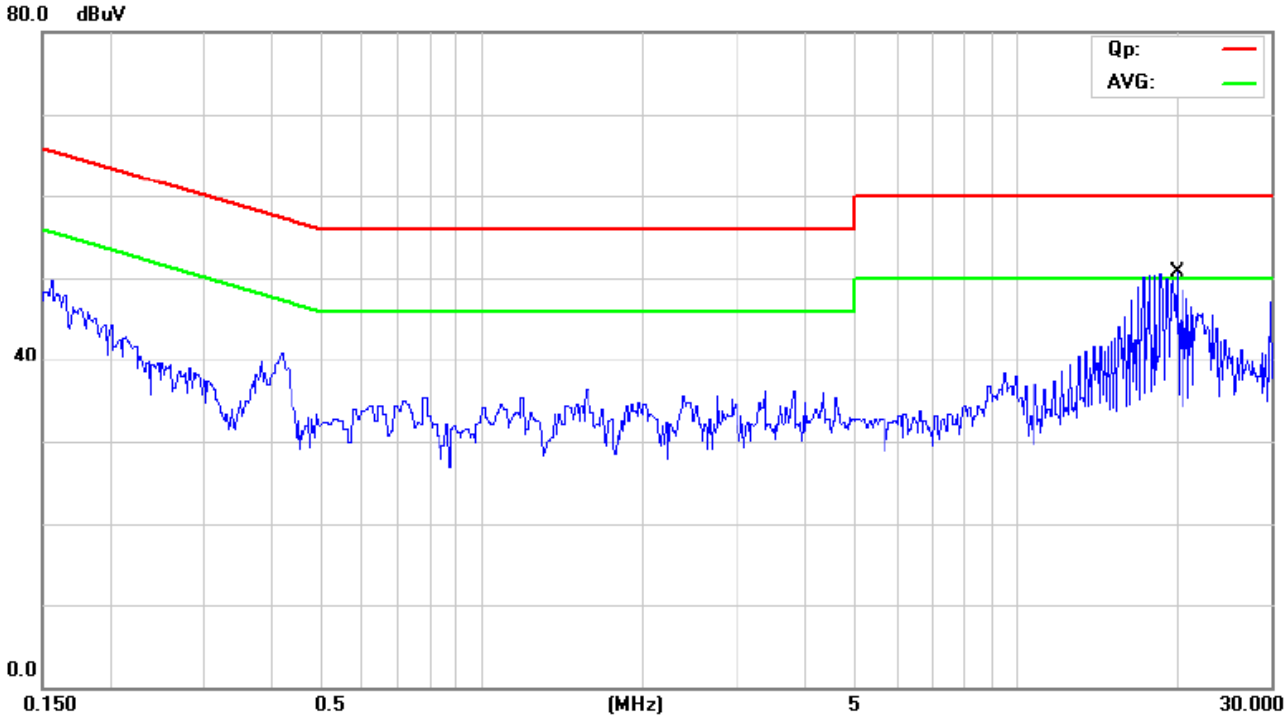
Temperature: 26℃ Humidity: 65%RH Atmospheric Pressure: 101 KPa

EUT set Condition: Keep Bluetooth Transmitting

Equipment Level: Class B

Results: Pass

Please refer to following diagram for individual



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		19.9685	22.20	11.10	33.30	60.00	-26.70	QP	
2	*	19.9685	16.50	11.10	27.60	50.00	-22.40	AVG	

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6 Radiated Emission Test

6.1 Test Method and test Procedure:

(1) The EUT was tested according to ANSI C63.10-2013. The radiated test was performed at Timeway EMC Laboratory. This site is on file with the FCC laboratory division, Registration No. 8999988

(2) The EUT, peripherals were put on the turntable which table size is 1m x 1.5 m, table high 0.8 m. All set up is according to ANSI C63.10-2013.

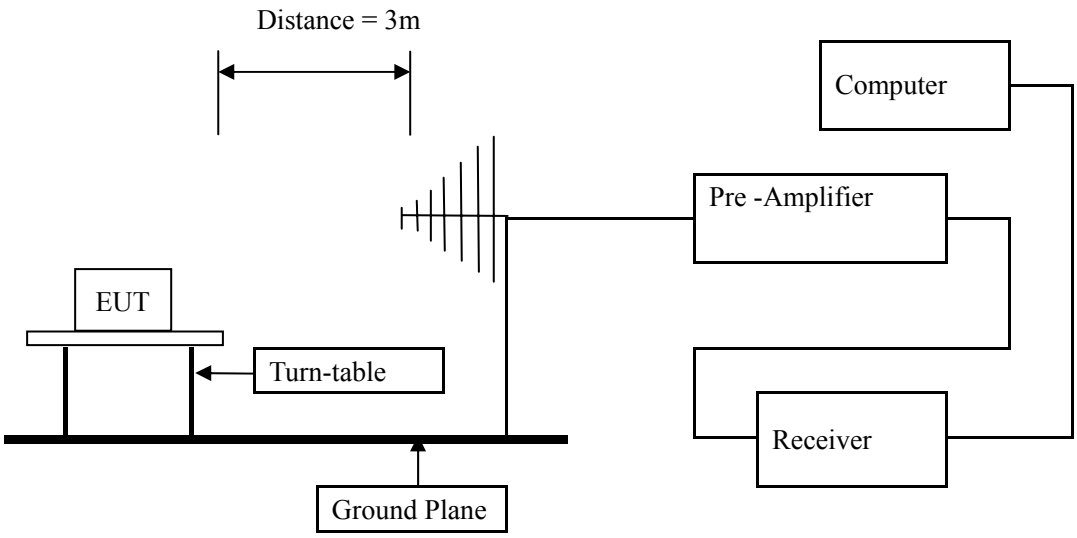
(3) The frequency spectrum from 30 MHz to 25GHz was investigated. All readings from 30 MHz to 1 GHz are quasi-peak values with a resolution bandwidth of 120 kHz. For measurement above 1GHz, peak values with RBW=VBW=1MHz and PK detector. AV value with RBW=1MHz, VBW=10Hz and PK detector. Measurements were made at 3 meters.

(4) The antenna high is varied from 1 m to 4 m high to find the maximum emission for each frequency.

(5) Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations. All data was recorded in the peak detection mode. Quasi-peak readings was performed only when an emission was found to be marginal (within -4 dB of specification limit), and are distinguished with a "**QP**" in the data table.

(6) The antenna polarization : Vertical polarization and Horizontal polarization.

Block diagram of Test setup



6.2 Configuration of The EUT

Same as section 5.3 of this report

6.3 EUT Operating Condition

Same as section 5.4 of this report.

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6.4 Radiated Emission Limit

All emission from a digital device, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strength specified below:

Frequencies in restricted band are complied to limit on Paragraph 15.209 and 15.109 and RSS-210

Frequency Range (MHz)	Distance (m)	Field strength (dB μ V/m)
30-88	3	40.0
88-216	3	43.5
216-960	3	46.0
Above 960	3	54.0

Note: 1. RF Voltage (dBuV) = 20 log RF Voltage (uV)

2. In the Above Table, the higher limit applies at the band edges.

3. Distance refers to the distance in meters between the measuring instrument antenna and the EUT

4. For radiation emissions test below 1GHz, all models were tested. For radiation emissions test above 1GHz, only NEB215 was the worst case and reported.

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Test result

General Radiated Emission Data and Harmonics Radiated Emission Data

Model: NEB215

Radiated Emission In Horizontal/Vertical (30MHz----1000MHz)

EUT set Condition: Keep Bluetooth Transmitting

Results: **Pass**

Frequency (MHz)	Level@3m (dB μ V/m)	Antenna Polarity	Limit@3m (dB μ V/m)
54.760	23.88	H	40.00
349.760	40.98	H	46.00
792.120	42.44	H	46.00
108.320	32.31	H	43.50
648.080	39.34	V	46.00
142.000	36.73	V	43.50
94.520	32.99	V	43.50
51.480	35.42	V	40.00

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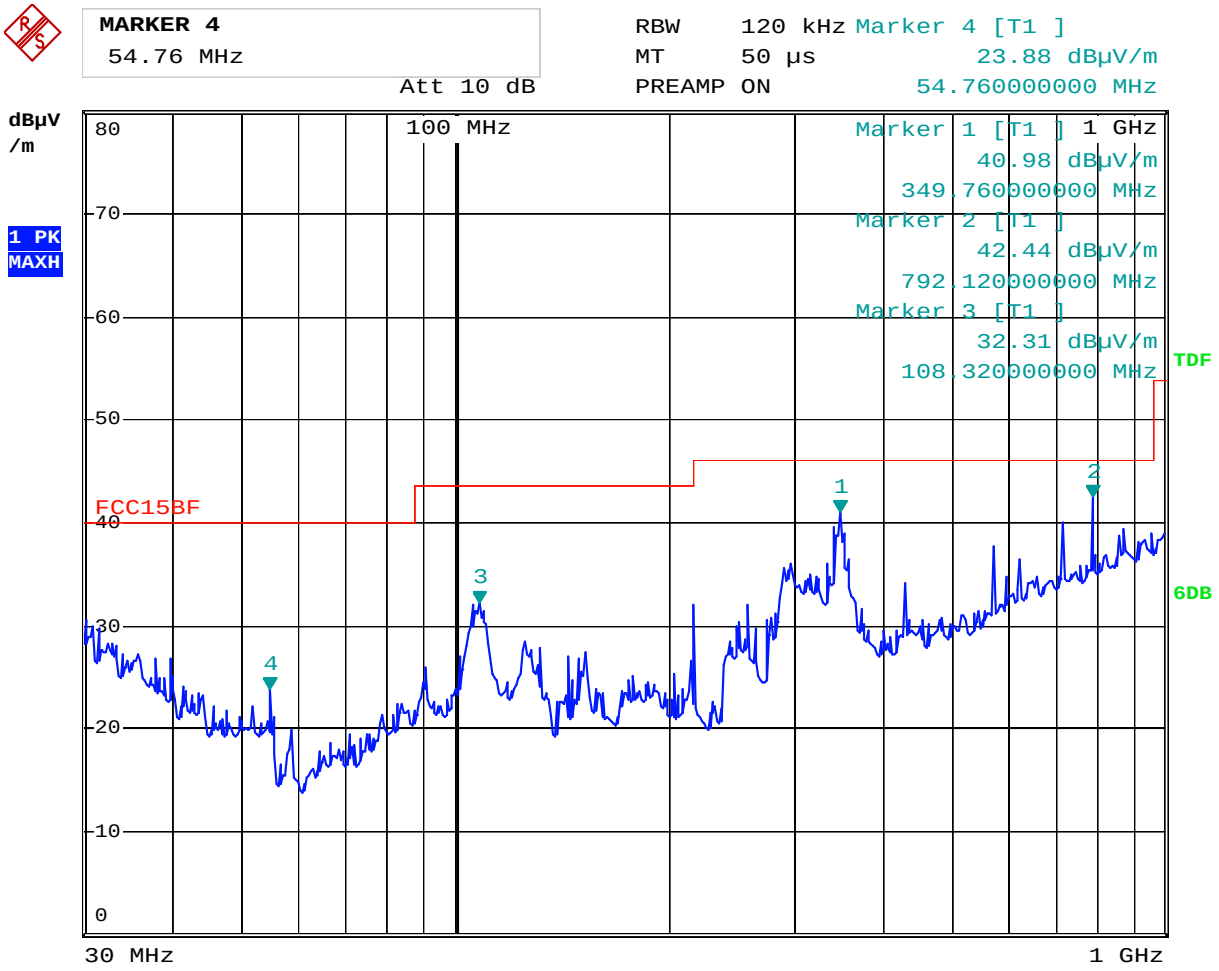
Test Figure:

H



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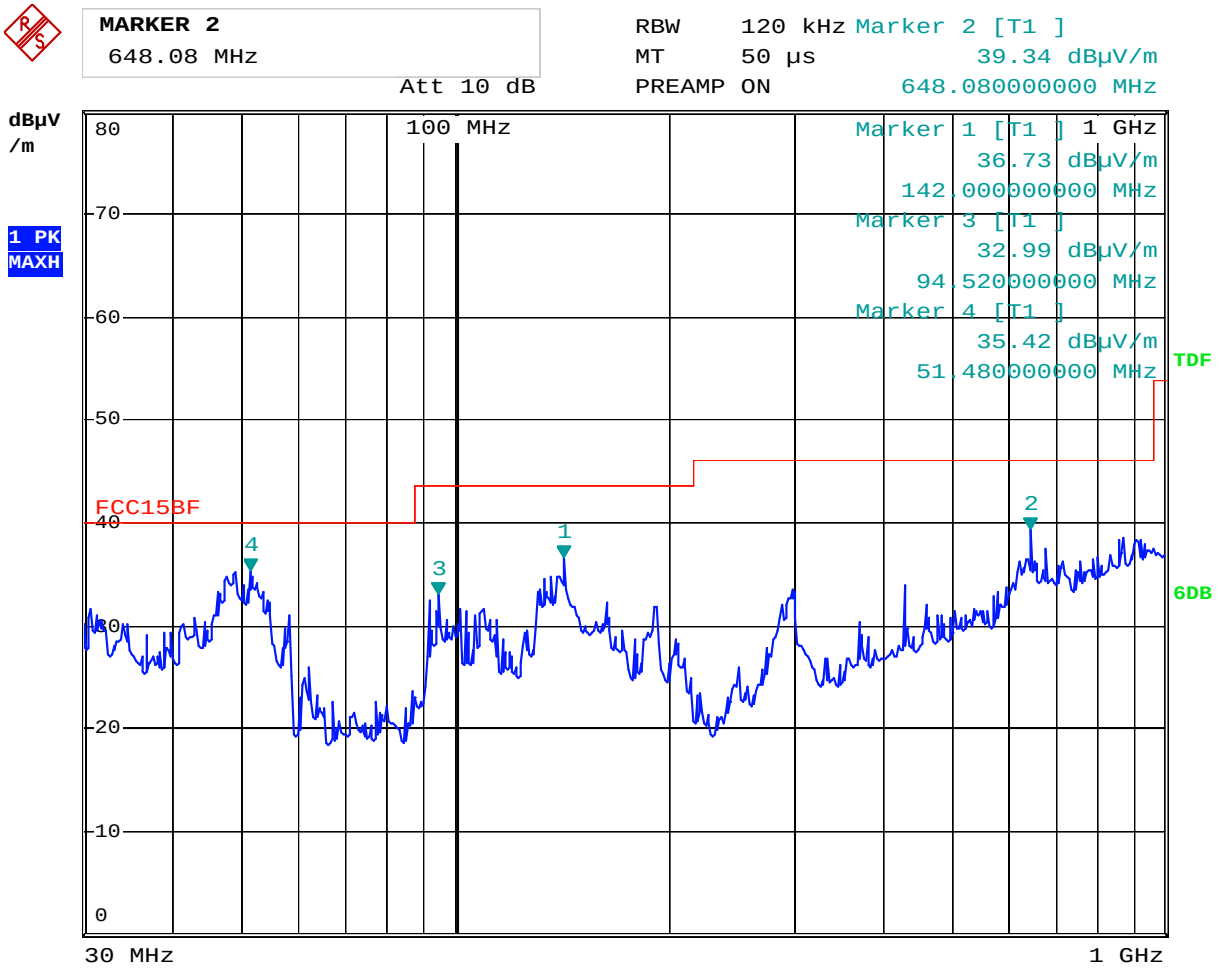
Test Figure:

V



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Test result

General Radiated Emission Data and Harmonics Radiated Emission Data

Model: GAD101-A

Radiated Emission In Horizontal/Vertical (30MHz----1000MHz)

EUT set Condition: Keep Bluetooth Transmitting

Results: **Pass**

Frequency (MHz)	Level@3m (dB μ V/m)	Antenna Polarity	Limit@3m (dB μ V/m)
136.440	35.75	H	43.50
125.040	38.63	H	43.50
162.160	34.45	H	43.50
375.040	40.39	H	46.00
875.080	40.16	V	46.00
125.000	30.58	V	43.50
160.200	28.32	V	43.50
375.040	40.20	V	46.00

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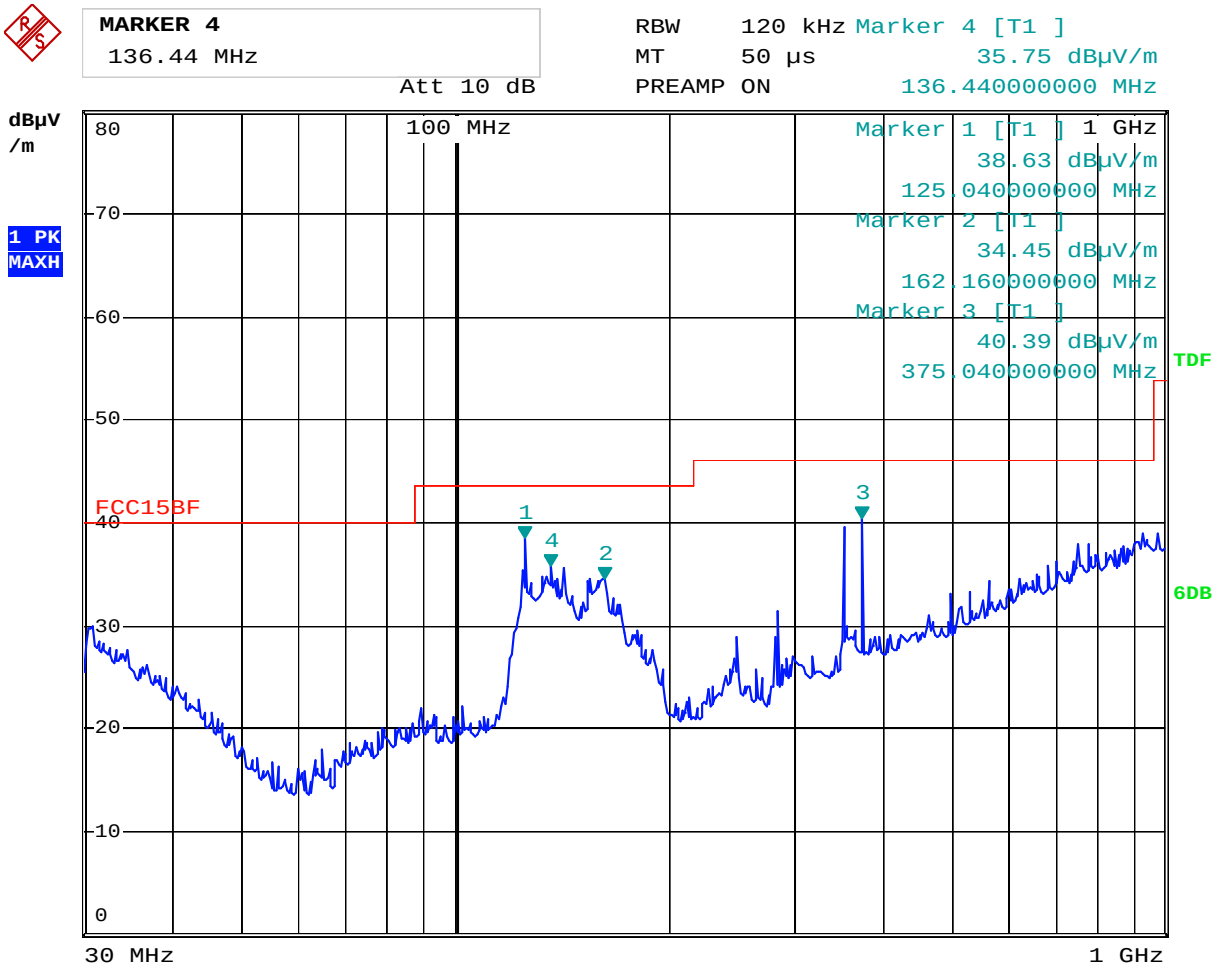
Test Figure:

H



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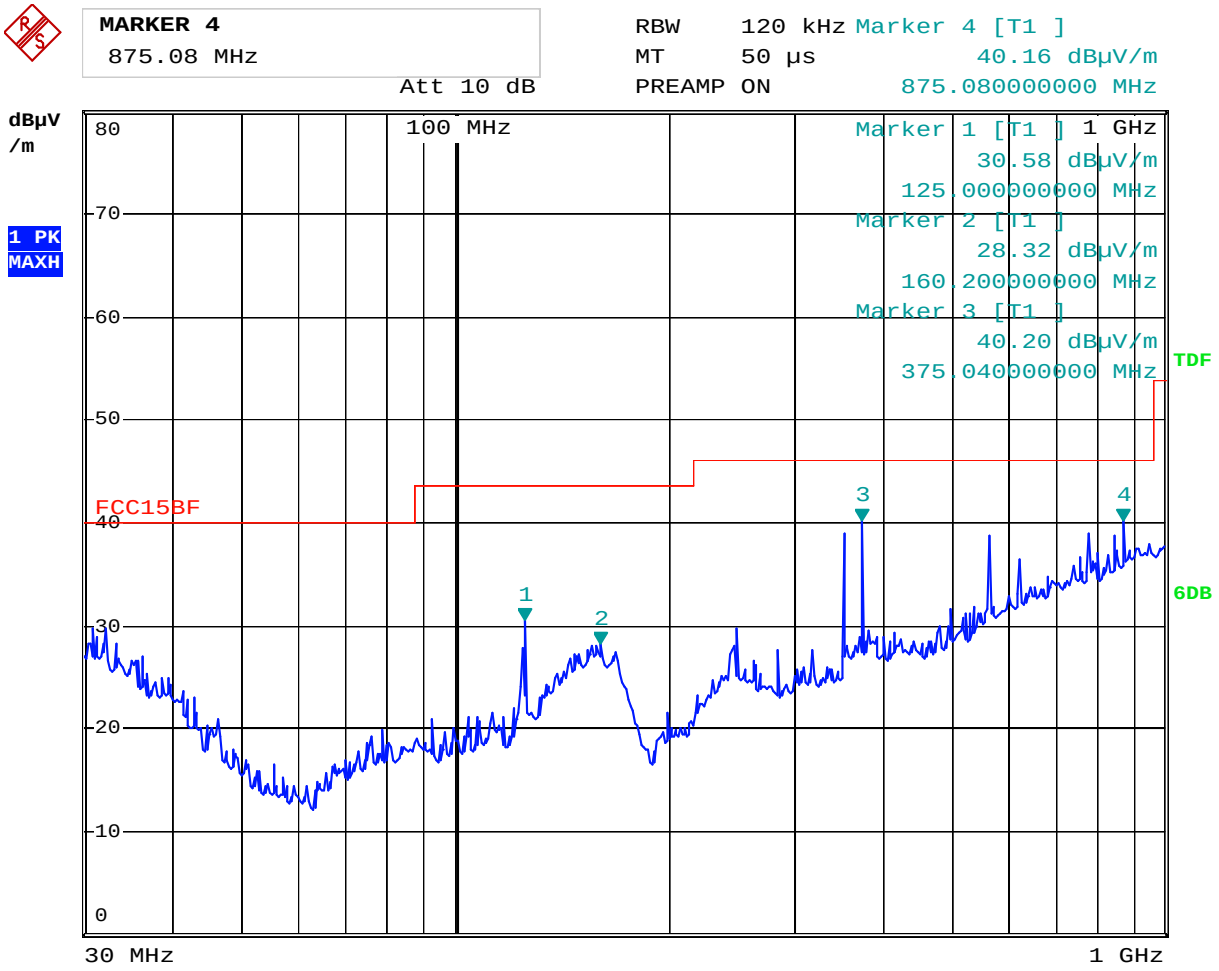
Test Figure:

V



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Test result

General Radiated Emission Data and Harmonics Radiated Emission Data

Model: NEB156

Radiated Emission In Horizontal/Vertical (30MHz----1000MHz)

EUT set Condition: Keep Bluetooth Transmitting

Results: **Pass**

Frequency (MHz)	Level@3m (dB μ V/m)	Antenna Polarity	Limit@3m (dB μ V/m)
31.320	28.77	H	40.00
736.120	41.19	H	46.00
355.160	39.85	H	46.00
131.960	35.48	H	43.50
127.760	30.19	V	43.50
875.040	43.87	V	46.00
31.880	33.62	V	40.00
96.680	32.89	V	43.50

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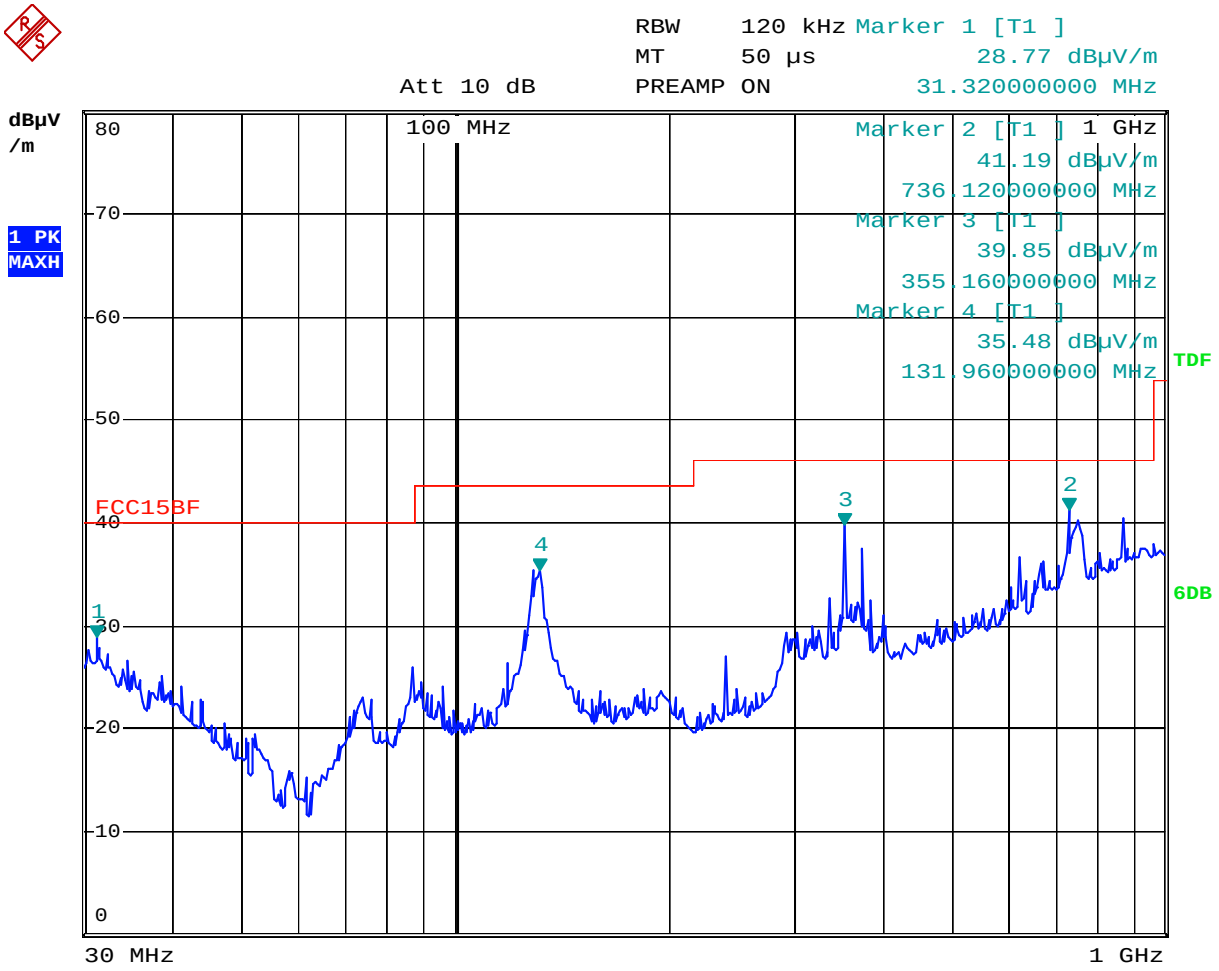
Test Figure:

H



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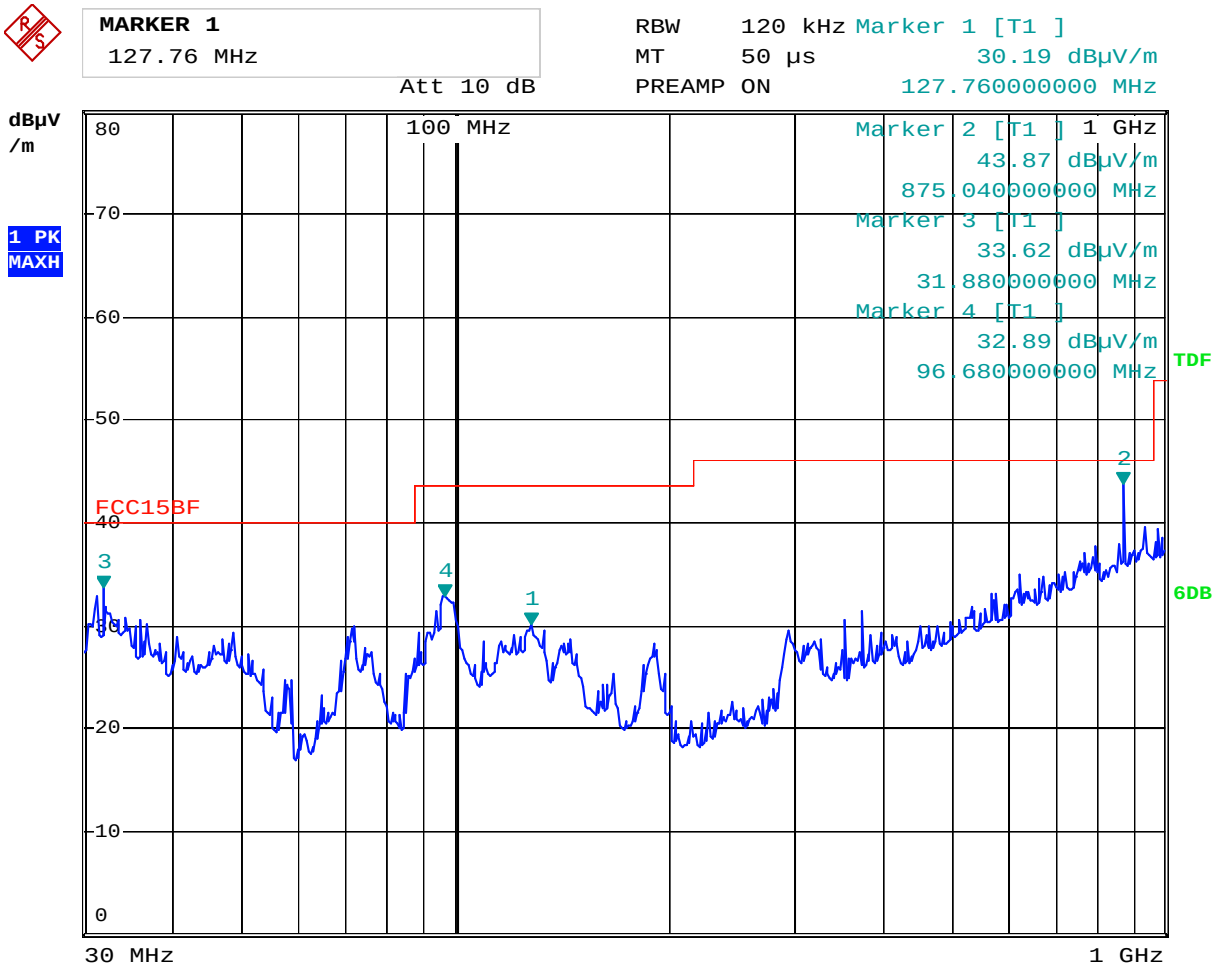
Test Figure:

V



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Operation Mode: Transmitting under Low Channel (2402MHz)

Frequency (MHz)	Level@3m (dB μ V/m)	Antenna Polarity	Limit@3m (dB μ V/m)
4804	--	H	74(Peak)/ 54(AV)
4804	--	V	74(Peak)/ 54(AV)
7206	--	H/V	74(Peak)/ 54(AV)
9608	--	H/V	74(Peak)/ 54(AV)
12010	--	H/V	74(Peak)/ 54(AV)
14412	--	H/V	74(Peak)/ 54(AV)
16814	--	H/V	74(Peak)/ 54(AV)
19216	--	H/V	74(Peak)/ 54(AV)
21618	--	H/V	74(Peak)/ 54(AV)
24020	--	H/V	74(Peak)/ 54(AV)

Note: 1. Level = Reading + AF + Cable - Preamp + Filter - Dist, Margin = Level - Limit
2. Remark "---" means that the emissions level is too low to be measured

Operation Mode: Transmitting g under Middle Channel (2441MHz)

Frequency (MHz)	Level@3m (dB μ V/m)	Antenna Polarity	Limit@3m (dB μ V/m)
4882	--	H	74(Peak)/ 54(AV)
4882	--	V	74(Peak)/ 54(AV)
7323	--	H/V	74(Peak)/ 54(AV)
9764	--	H/V	74(Peak)/ 54(AV)
12205	--	H/V	74(Peak)/ 54(AV)
14646	--	H/V	74(Peak)/ 54(AV)
17087	--	H/V	74(Peak)/ 54(AV)
19528	--	H/V	74(Peak)/ 54(AV)
21969	--	H/V	74(Peak)/ 54(AV)
24410	--	H/V	74(Peak)/ 54(AV)

Note: 1. Level = Reading + AF + Cable - Preamp + Filter - Dist, Margin = Level - Limit
2. Remark "---" means that the emissions level is too low to be measured

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Operation Mode: Transmitting under High Channel (2480MHz)

Frequency (MHz)	Level@3m (dB μ V/m)	Antenna Polarity	Limit@3m (dB μ V/m)
4960	--	H	74(Peak)/ 54(AV)
4960	--	V	74(Peak)/ 54(AV)
7440	--	H/V	74(Peak)/ 54(AV)
9920	--	H/V	74(Peak)/ 54(AV)
12400	--	H/V	74(Peak)/ 54(AV)
14880	--	H/V	74(Peak)/ 54(AV)
17360	--	H/V	74(Peak)/ 54(AV)
19840	--	H/V	74(Peak)/ 54(AV)
22320	--	H/V	74(Peak)/ 54(AV)
24800	--	H/V	74(Peak)/ 54(AV)

Note: 1. Level = Reading + AF + Cable - Preamp + Filter - Dist, Margin = Level - Limit
2. Remark "---" means that the emissions level is too low to be measured

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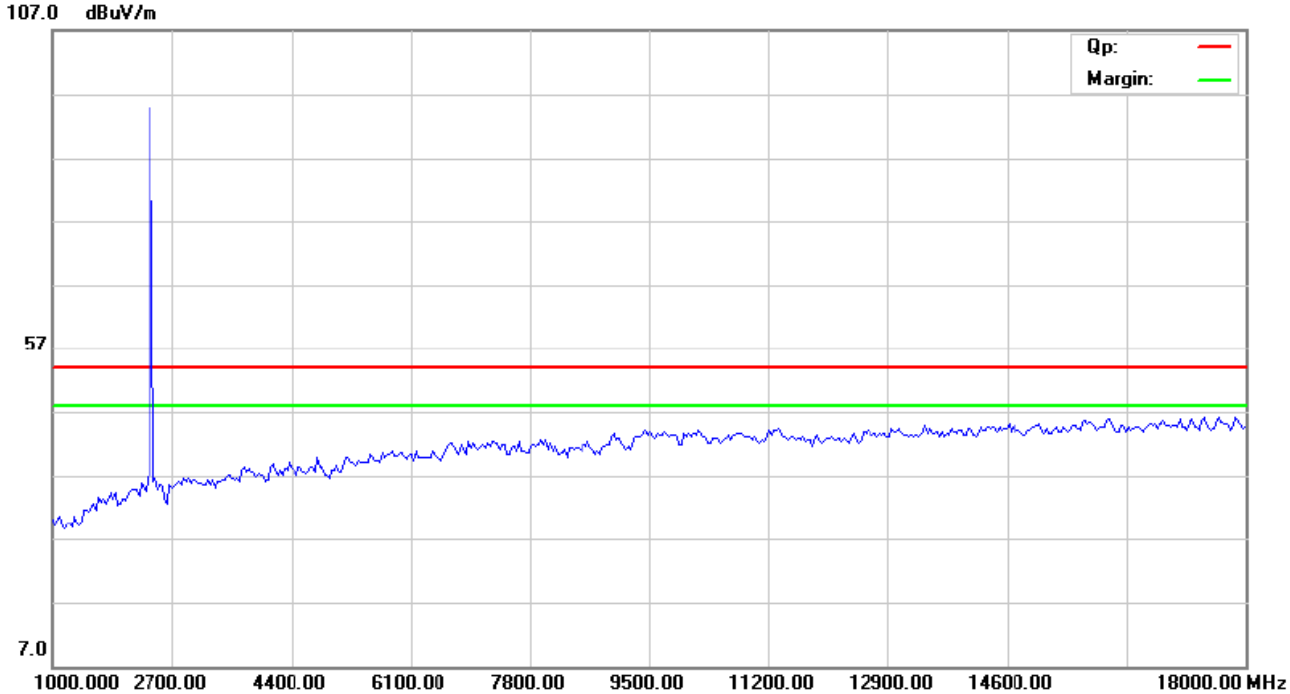
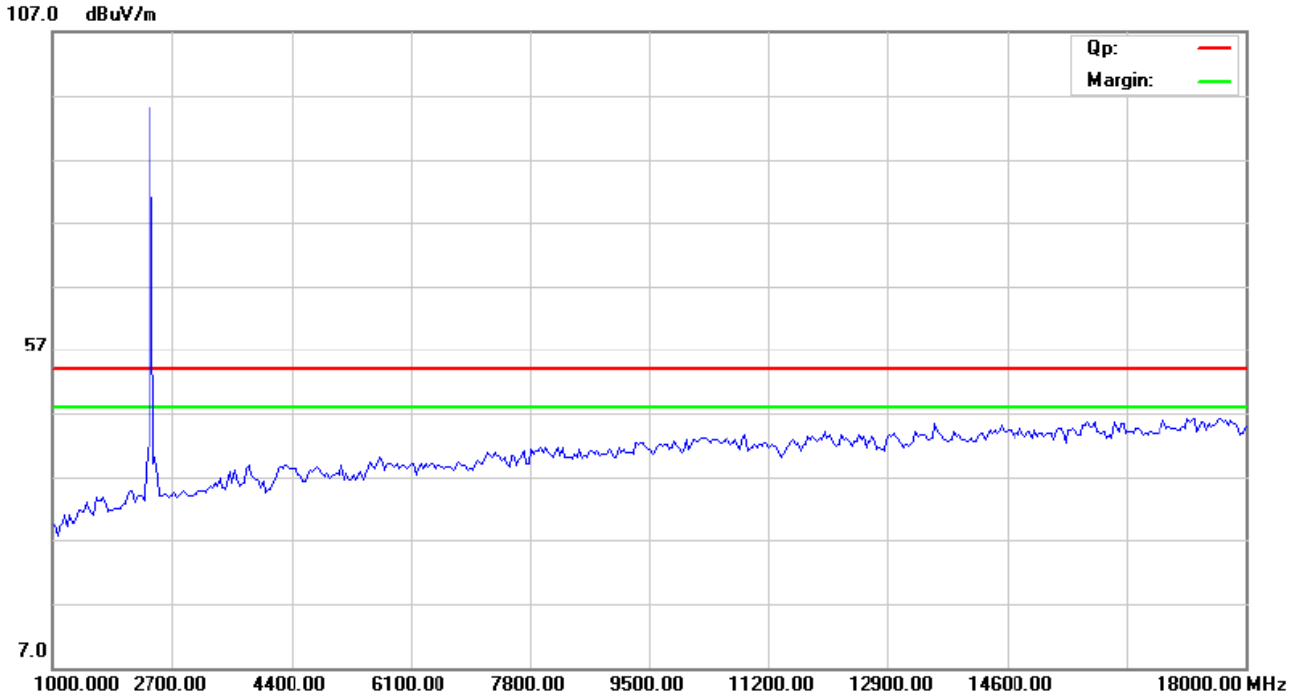
Please refer to the following test plots for details:

Low Channel: Horizontal



Low Channel : Vertical



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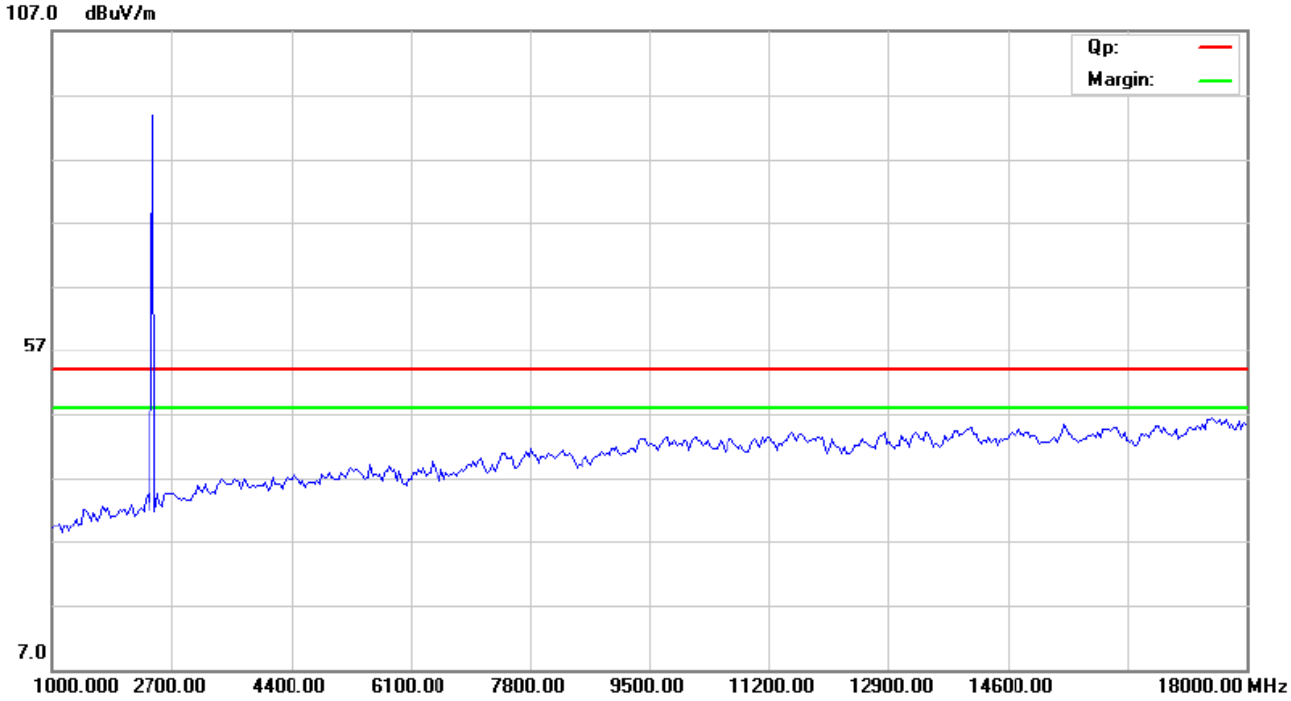
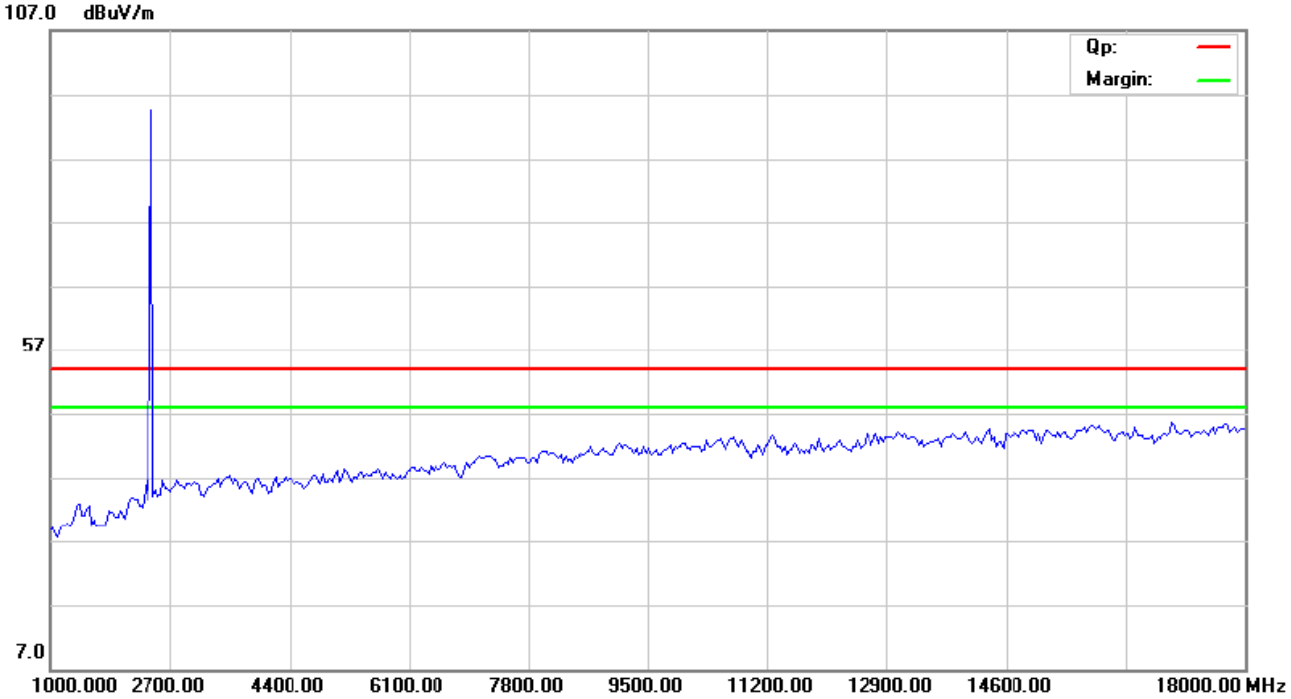
Middle Channel : Horizontal



Middle Channel : Vertical



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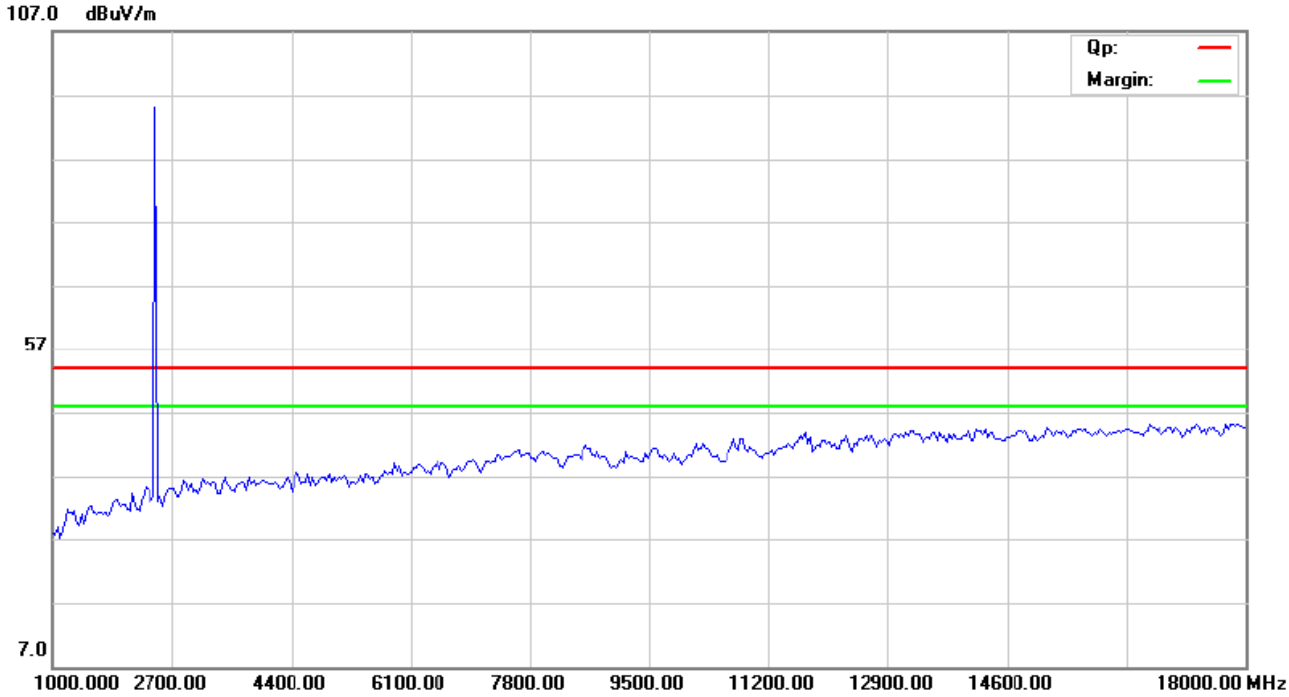
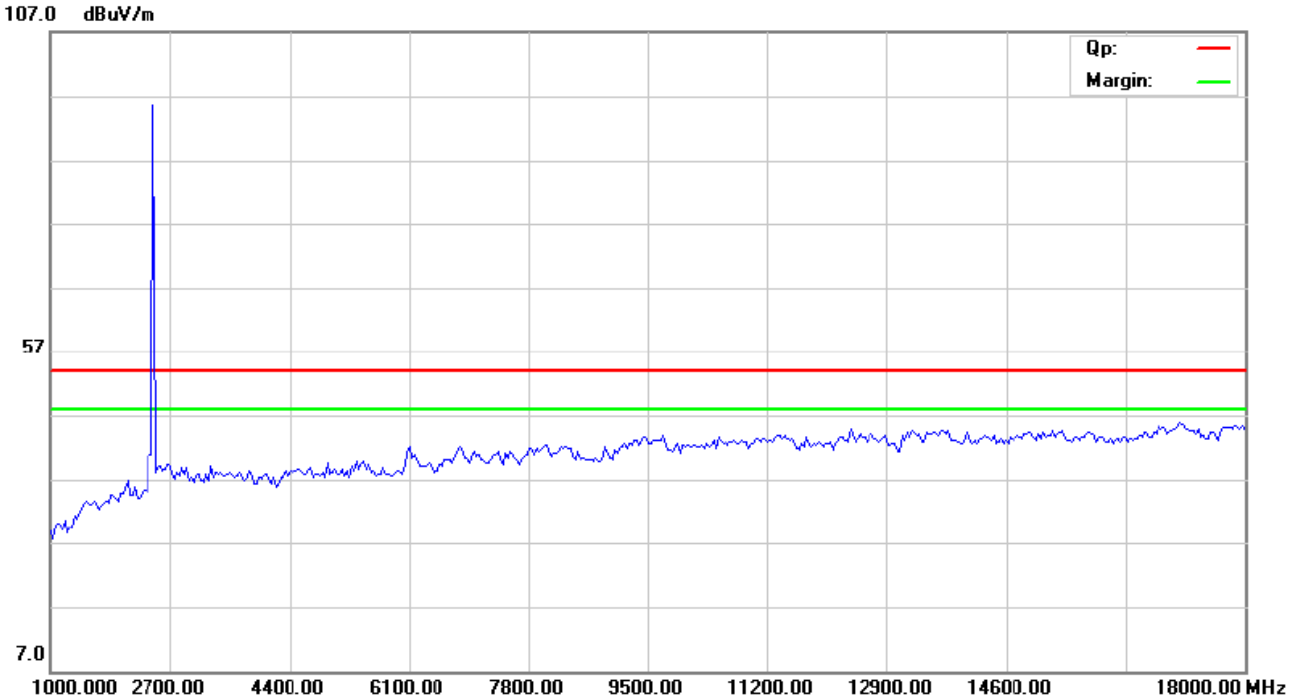
High Channel : Horizontal



High Channel : Vertical



Note: for the radiated emissions above 18G, it is the floor noise.

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7.0 20dB Bandwidth Measurement

7.1 Regulation

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

7.2 Limits of 20dB Bandwidth Measurement

N/A

7.3 Test Procedure.

1. Check the calibration of the measuring instrument (spectrum analyzer) using either an internal calibrator or a known signal from an external generator.
2. Set the spectrum analyzer as follows: Span =3MHz, RBW =30 kHz, VBW=100 kHz, Sweep = auto Detector function = peak, Trace = max hold
3. Measure the highest amplitude appearing on spectral display and record the level to calculate results. 6. Repeat above procedures until all frequencies measured were complete.

7.4 Test Result

Type of Modulation: GFSK

EUT	Advertising Displayer		Model	NEB215
Mode	Keep Transmitting		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Channel	Channel Frequency (MHz)	20 dB Bandwidth (kHz)	Minimum Limit (kHz)	Pass/ Fail
Low	2402	1016	--	Pass
Middle	2441	1023	--	Pass
High	2480	1022	--	Pass

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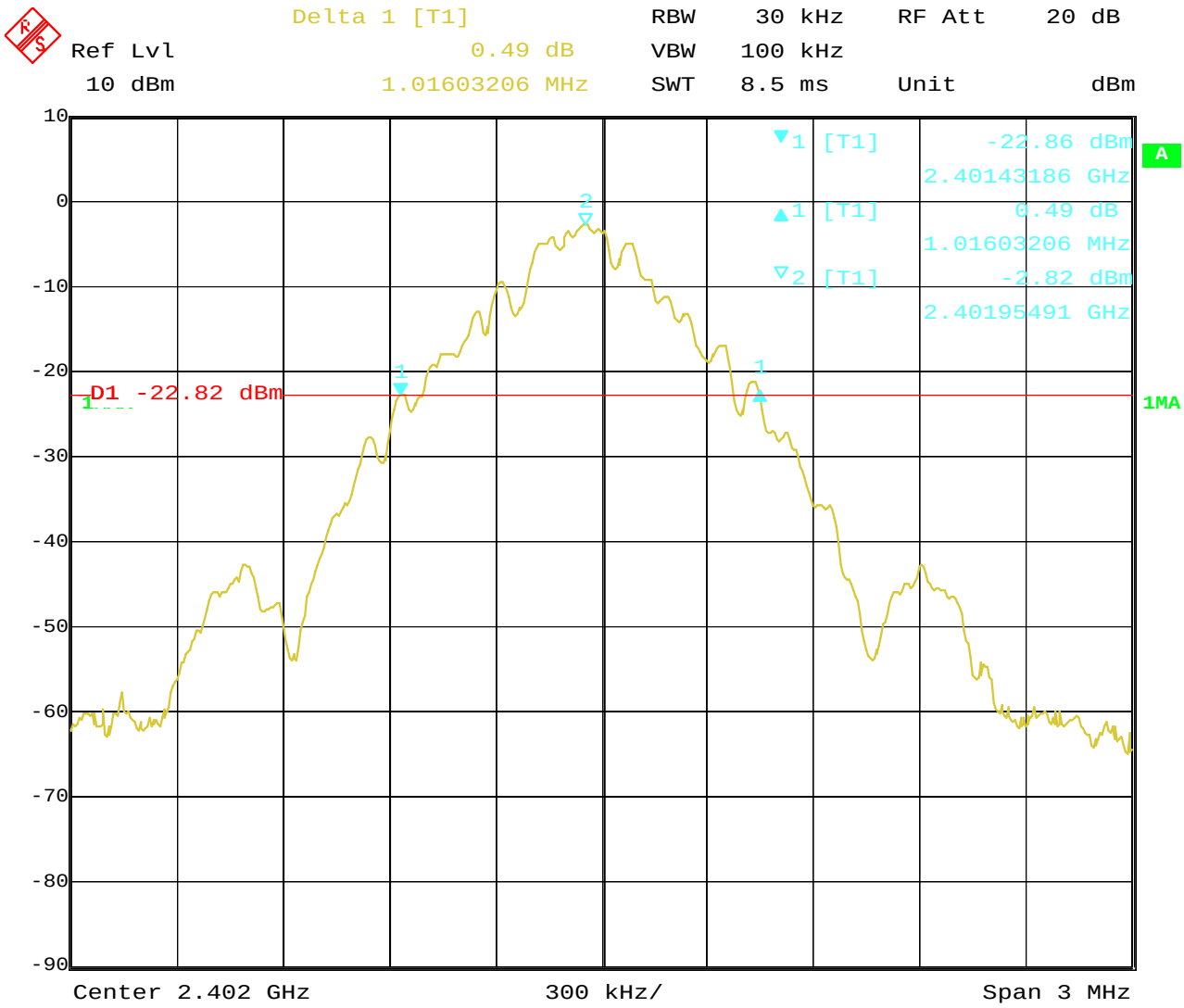
Test Figure:

1. Condition: Low Channel



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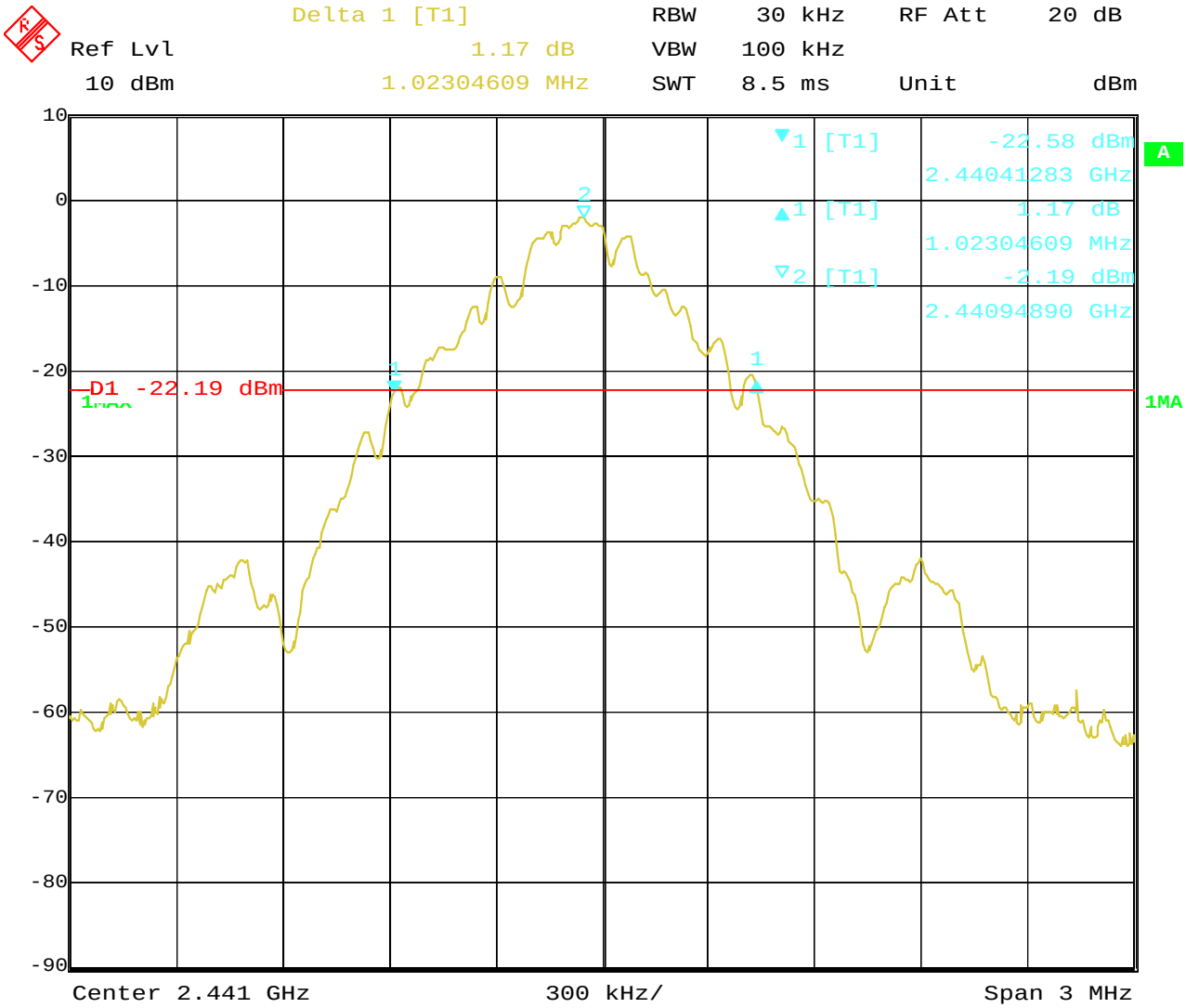
2. Condition: Middle Channel



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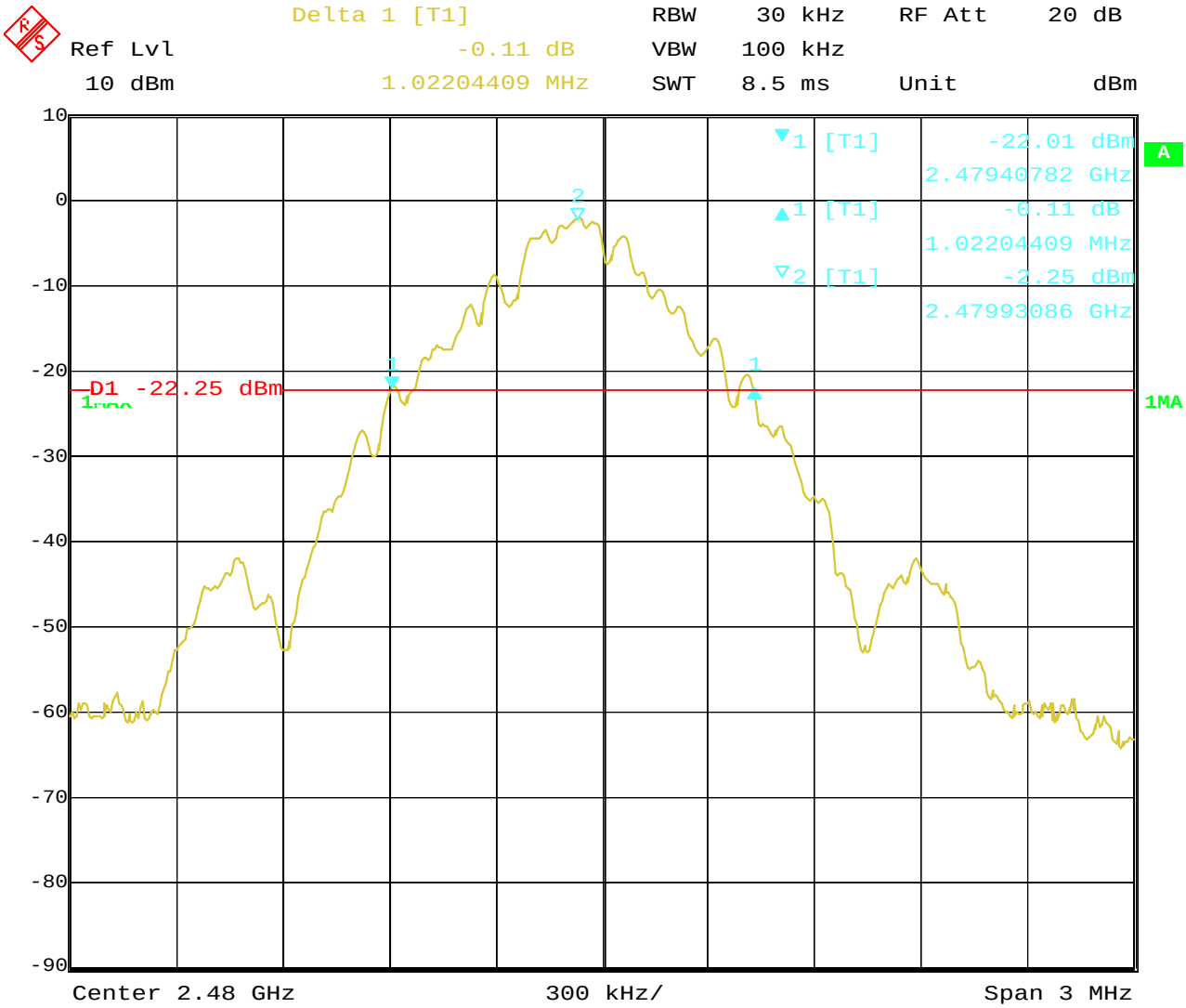
3. High Channel



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Test Result

Type of Modulation: Л/4DQPSK

EUT	Advertising Displayer	Model	NEB215
Mode	Keep Transmitting	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH

Channel	Channel Frequency (MHz)	20 dB Bandwidth (kHz)	Maximum Limit (kHz)	Pass/ Fail
Low	2402	1317	--	Pass
Middle	2441	1317	--	Pass
High	2480	1317	--	Pass

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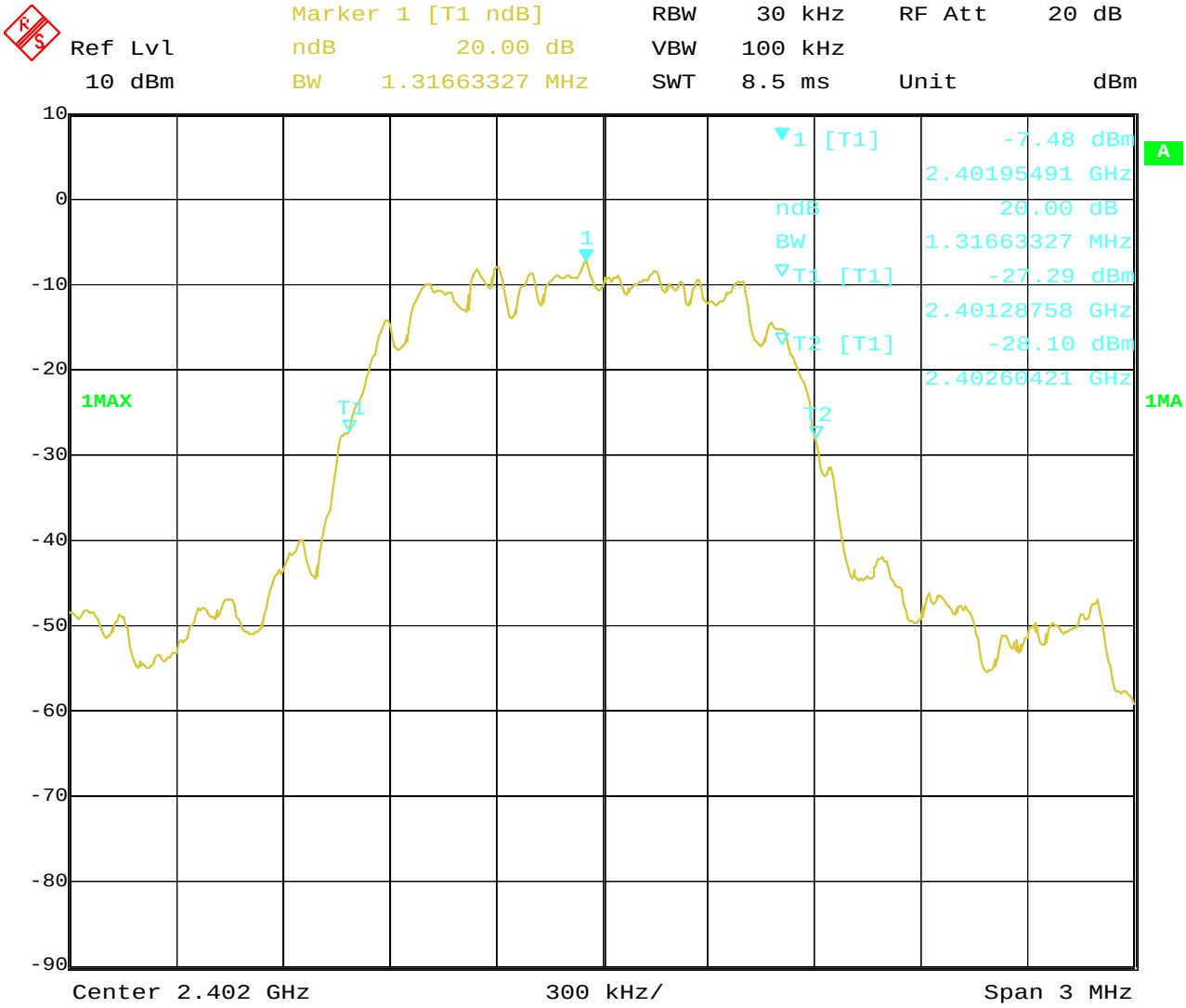
Test Figure:

1. Condition: Low Channel



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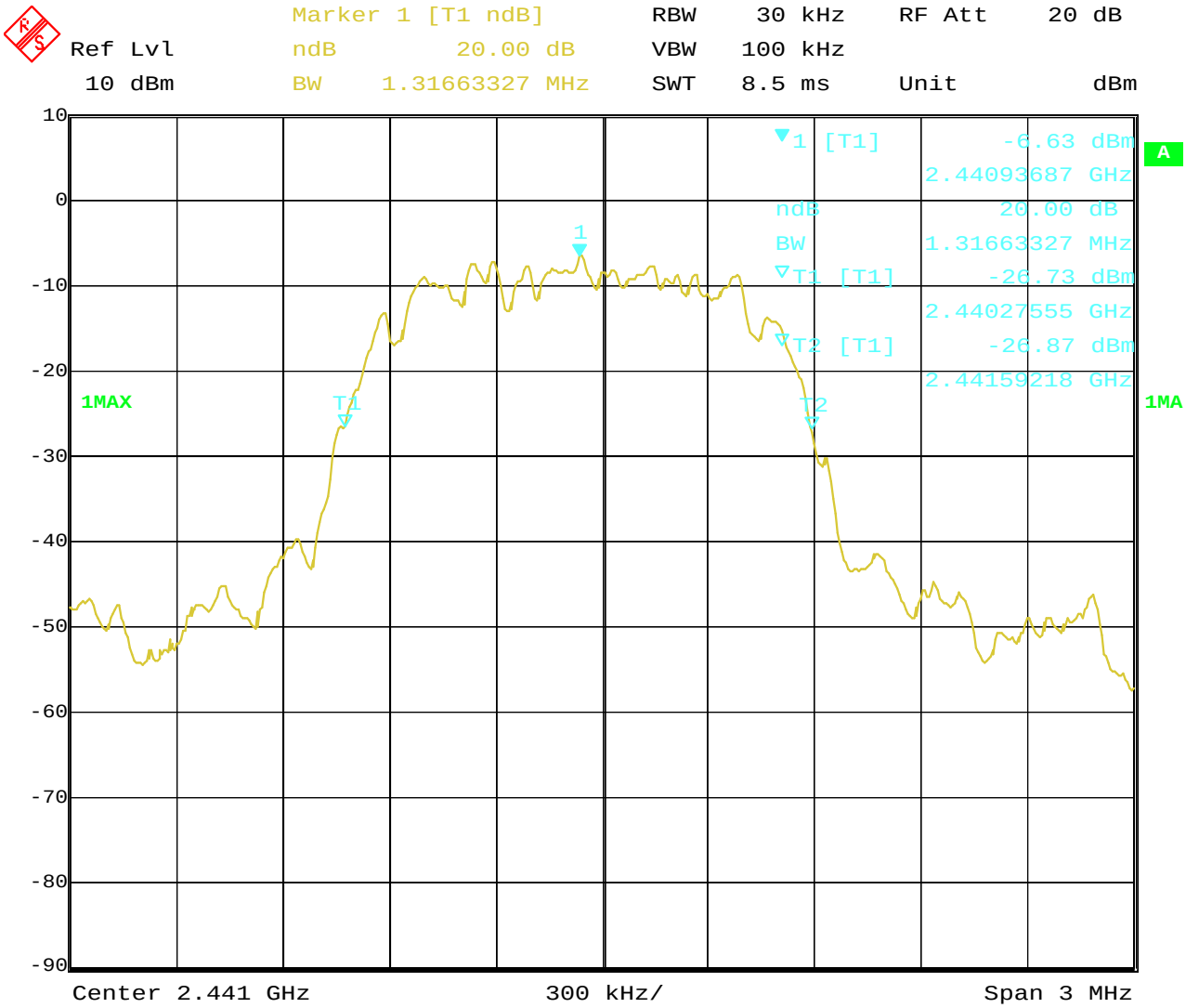
2. Condition: Middle Channel



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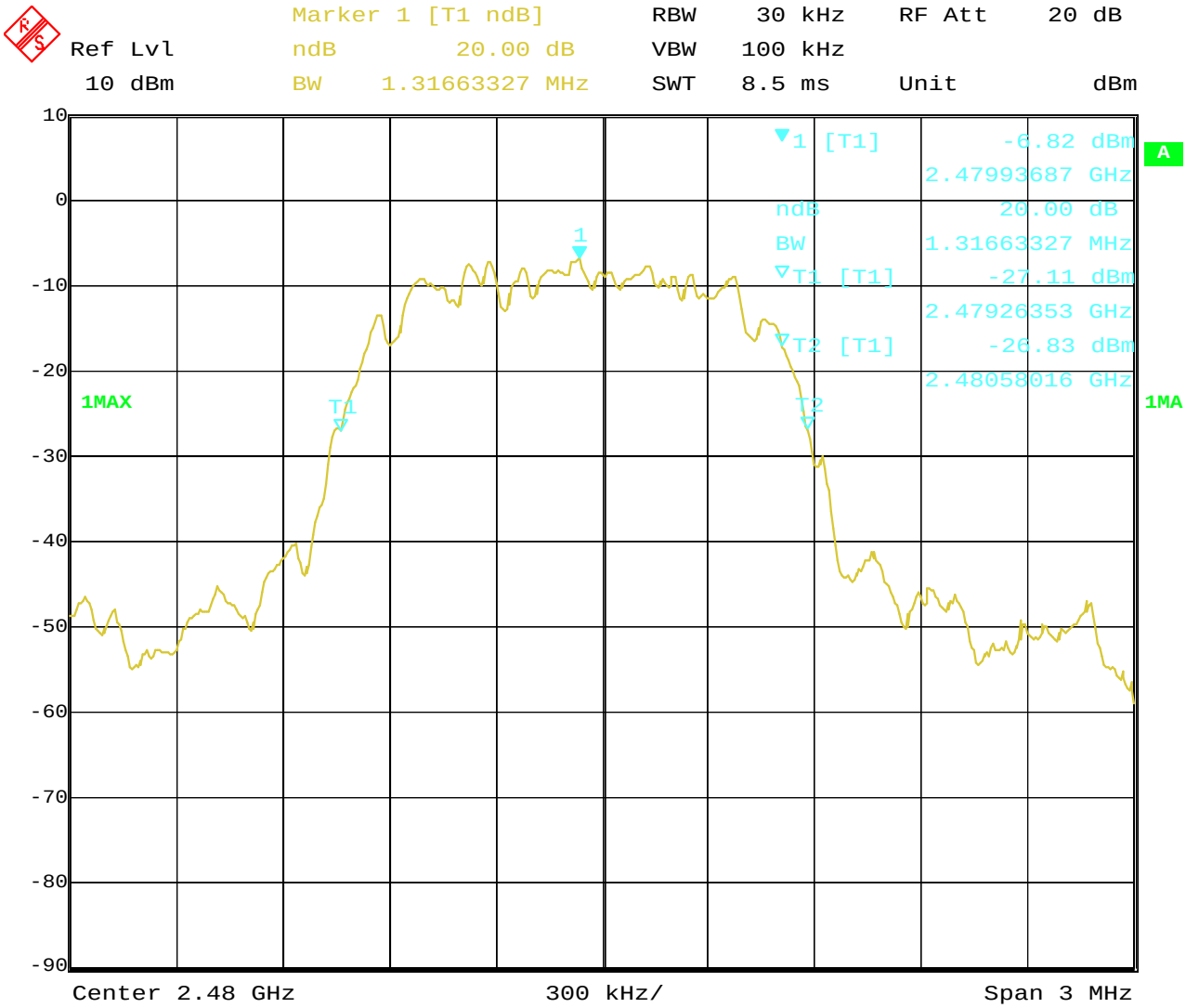
3. High Channel



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Test Result

Type of Modulation: 8DPSK

EUT	Advertising Displayer	Model	NEB215
Mode	Keep Transmitting	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH

Channel	Channel Frequency (MHz)	20 dB Bandwidth (kHz)	Maximum Limit (kHz)	Pass/ Fail
Low	2402	1371	--	Pass
Middle	2441	1371	--	Pass
High	2480	1371	--	Pass

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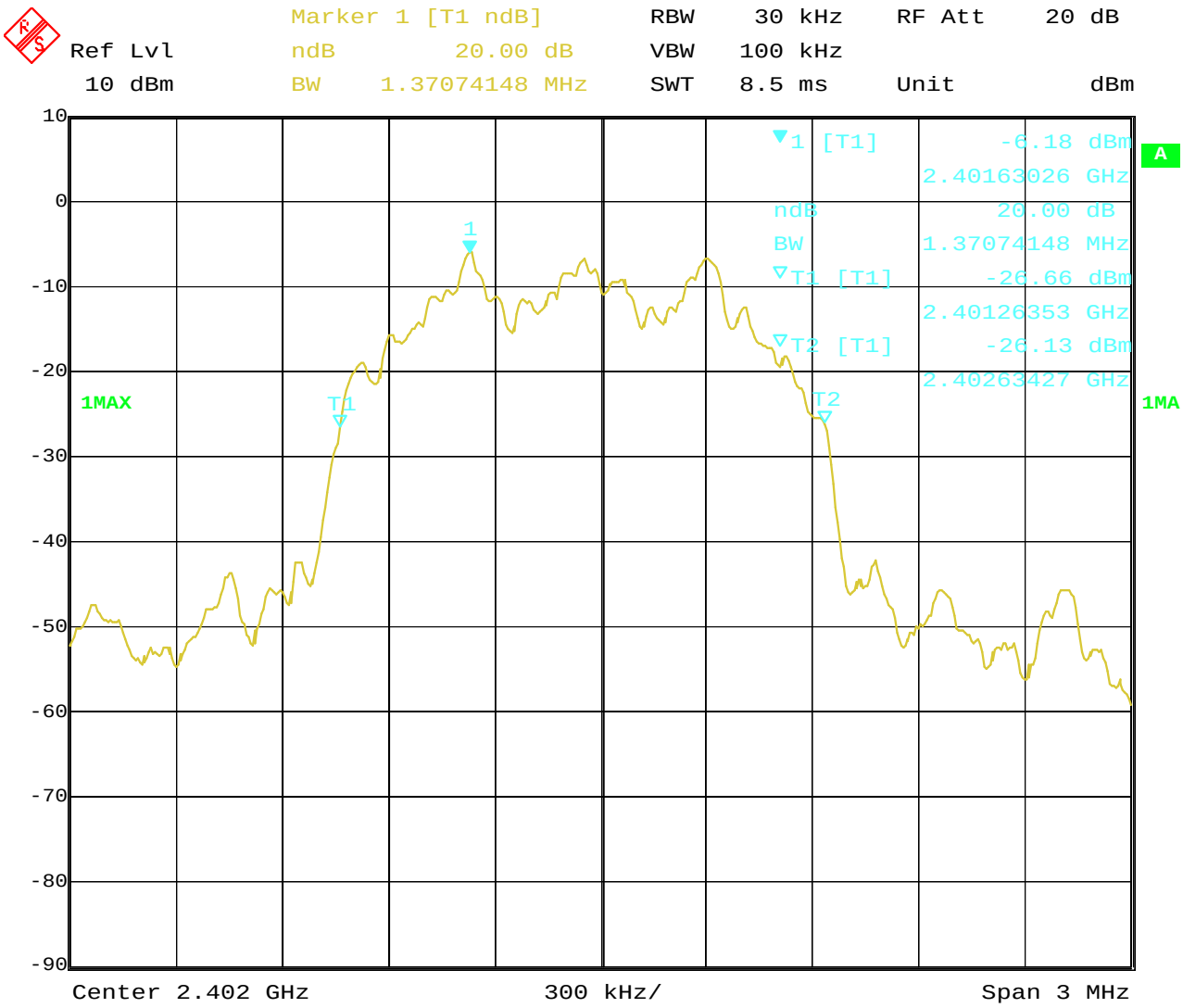
Test Figure:

1. Condition: Low Channel



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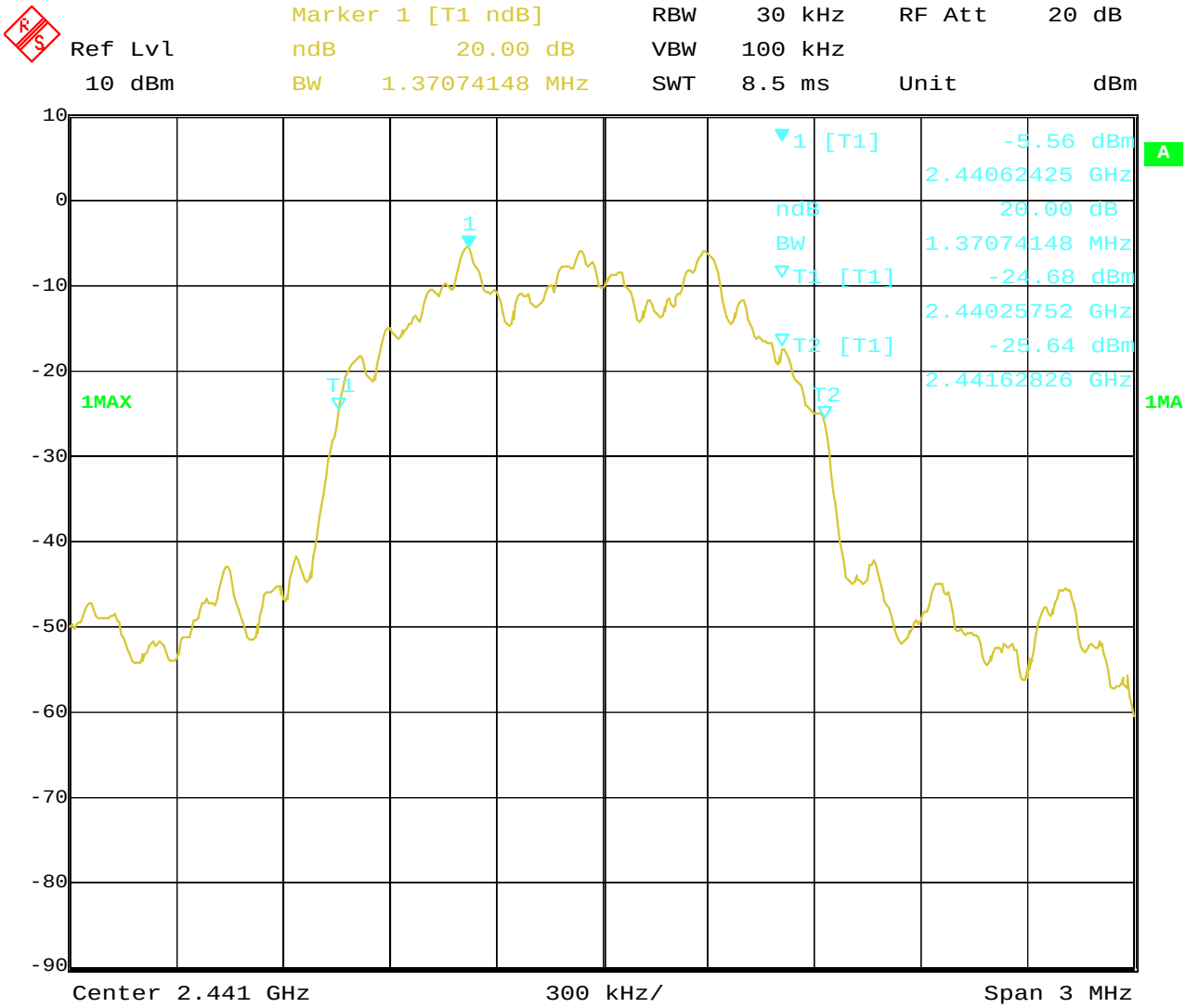
2. Condition: Middle Channel



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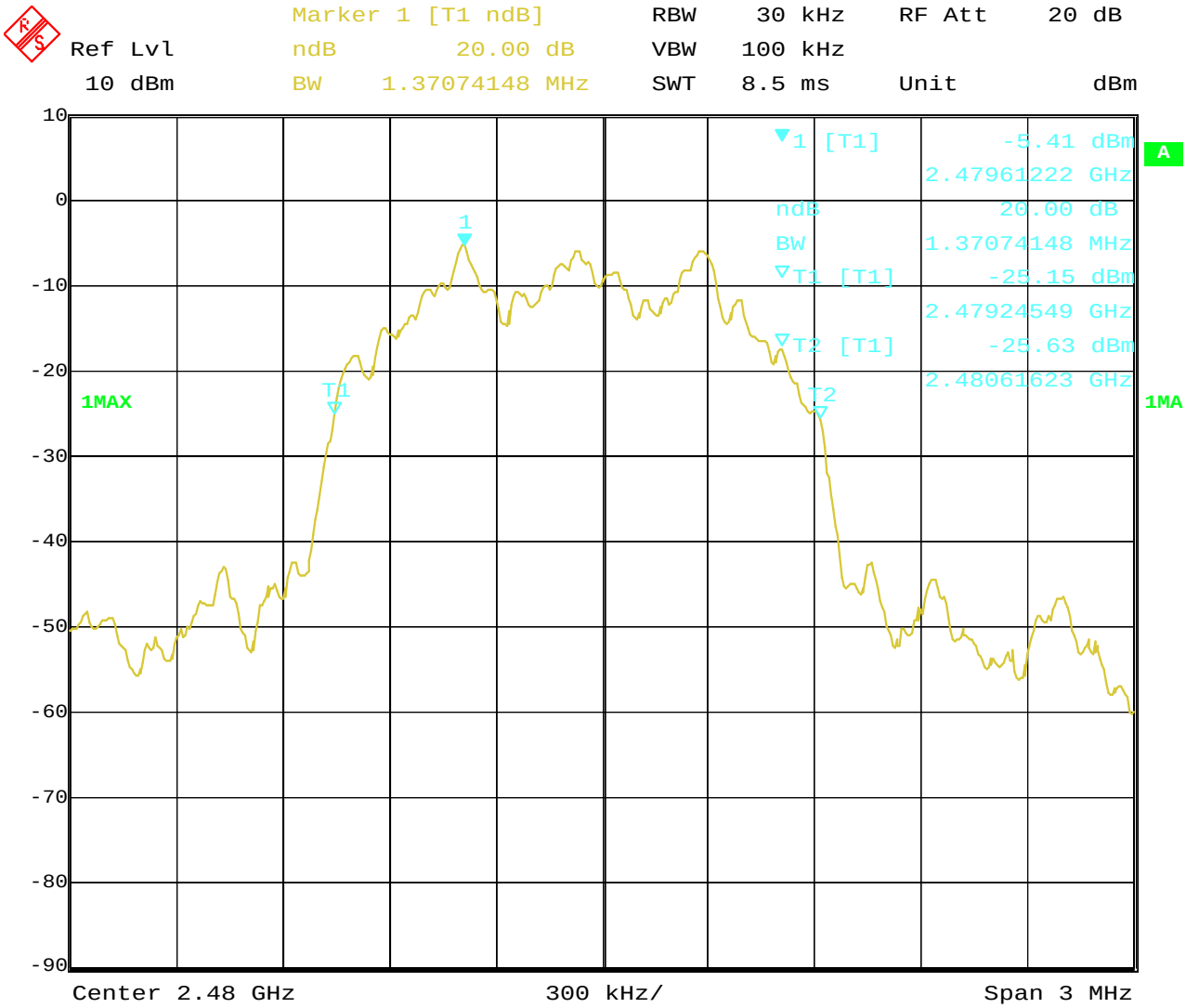
3. High Channel



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8. Maximum Output Power

8.1 Regulation

According to §15.247(b)(1), for frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5MHz band:0.125 watts. According to §15.247(b)(4), the 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.

8.2 Limits of Maximum Output Power

The Maximum Output Power Measurement is 30dBm.

8.3 Test Procedure

1. Check the calibration of the measuring instrument (spectrum analyzer) using either an internal calibrator or a known signal from an external generator.
2. Set the spectrum analyzer as follows: Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel; RBW > the 20 dB bandwidth of the emission being measured; VBW =3MHz
RBW=3MHz; Sweep = 60s; Detector function = PK; Trace = max hold
3. Measure the highest amplitude appearing on spectral display and record the level to calculate results.
4. Repeat above procedures until all frequencies measured were complete.

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8.4Test Results

Type of Modulation: GFSK

EUT	Advertising Displayer	Model	NEB215
Mode	Keep Transmitting	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH

Channel	Channel Frequency (MHz)	Max. Power Output (dBm)	Peak Power Limit (dBm)	Pass/ Fail
		Peak		
Low	2402	3.80	30	Pass
Middle	2441	3.89	30	Pass
High	2480	4.09	30	Pass

Note: 1. the result basic equation calculation as follow:

Max. Power Output = Power Reading + Cable loss + Attenuator

2. The worse case was recorded

3. The Peak power was measured

Type of Modulation: Л/4DQPSK

EUT	Advertising Displayer	Model	NEB215
Mode	Keep Transmitting	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH

Channel	Channel Frequency (MHz)	Max. Power Output (dBm)	Peak Power Limit (dBm)	Pass/ Fail
		Peak		
Low	2402	3.78	30	Pass
Middle	2441	3.72	30	Pass
High	2480	3.91	30	Pass

Note: 1. the result basic equation calculation as follow:

Max. Power Output = Power Reading + Cable loss + Attenuator

2. The worse case was recorded

3. The Peak power was measured

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Type of Modulation: 8DPSK

EUT	Advertising Displayer	Model	NEB215
Mode	Keep Transmitting	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH

Channel	Channel Frequency (MHz)	Max. Power Output (dBm)	Peak Power Limit (dBm)	Pass/ Fail
		Peak		
Low	2402	3.67	30	Pass
Middle	2441	3.70	30	Pass
High	2480	3.86	30	Pass

Note: 1. the result basic equation calculation as follow:

Max. Power Output = Power Reading + Cable loss + Attenuator

2. The worse case was recorded

3. The Peak power was measured

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9. Carrier Frequency Separation

9.1 Regulation

According to §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.

9.2 Limits of Carrier Frequency Separation

The Maximum Power Spectral Density Measurement is 25kHz or two-thirds of the 20dB bandwidth of the hopping Channel which is great.

9.3 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Set the spectrum analyzer as follows: Span = wide enough to capture the peaks of two adjacent channels: Resolution (or IF) Bandwidth (RBW) ⩾ 1% of the span; Video (or Average) Bandwidth (VBW) ⩾ RBW; Sweep = auto; Detector function = peak; Trace = max hold
3. Measure the separation between the peaks of the adjacent channels using the marker-delta function.
4. Repeat above procedures until all frequencies measured were complete.

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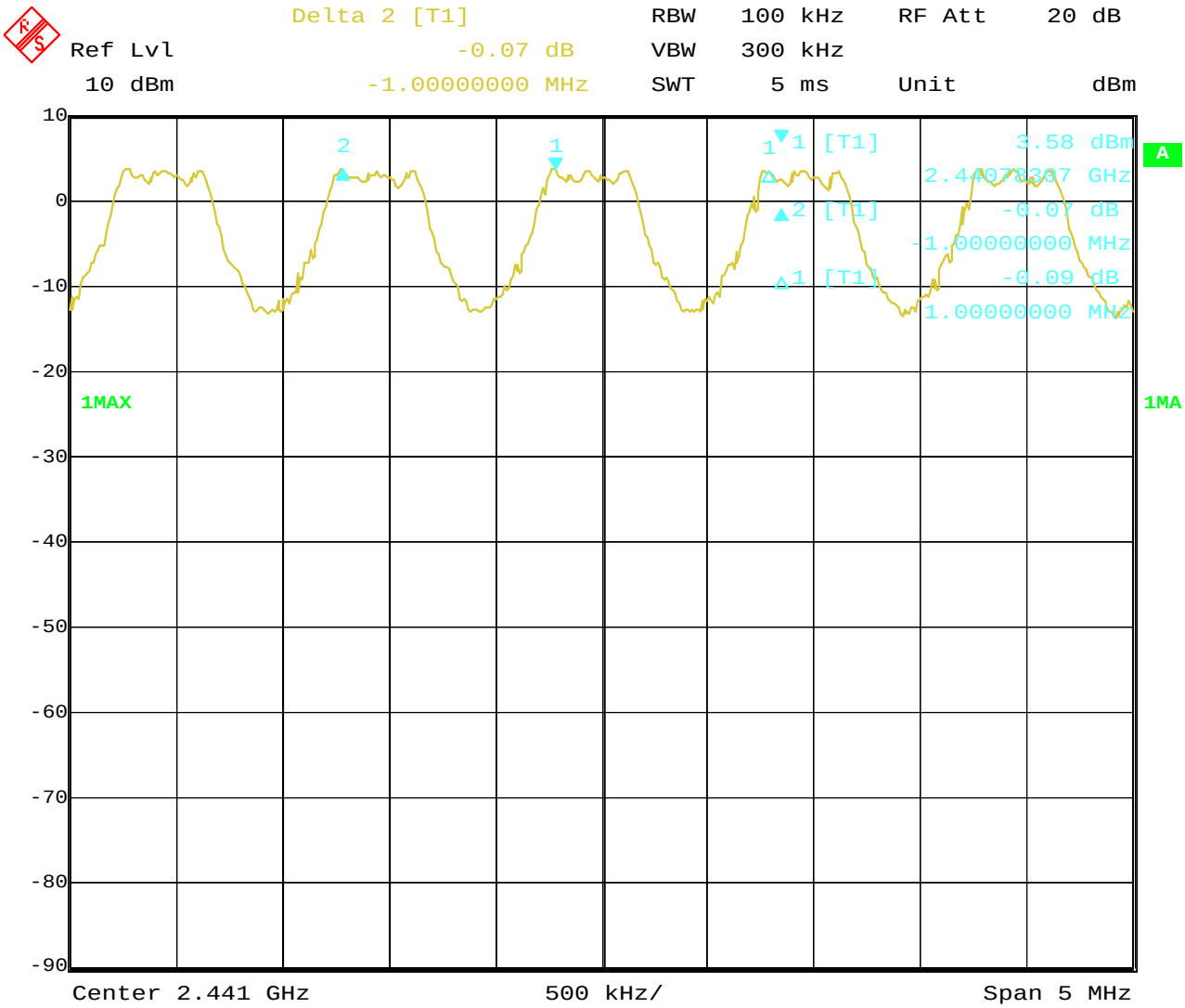
9.4Test Result

Type of Modulation: GFSK

EUT	Advertising Displayer	Model	NEB215
Mode	Hopping On	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH

Carrier Frequency Separation	Limit	Pass/ Fail
1.000MHz	⩾ 25 kHz or 2/3 of the 20 dB bandwidth	Pass

Test Plots



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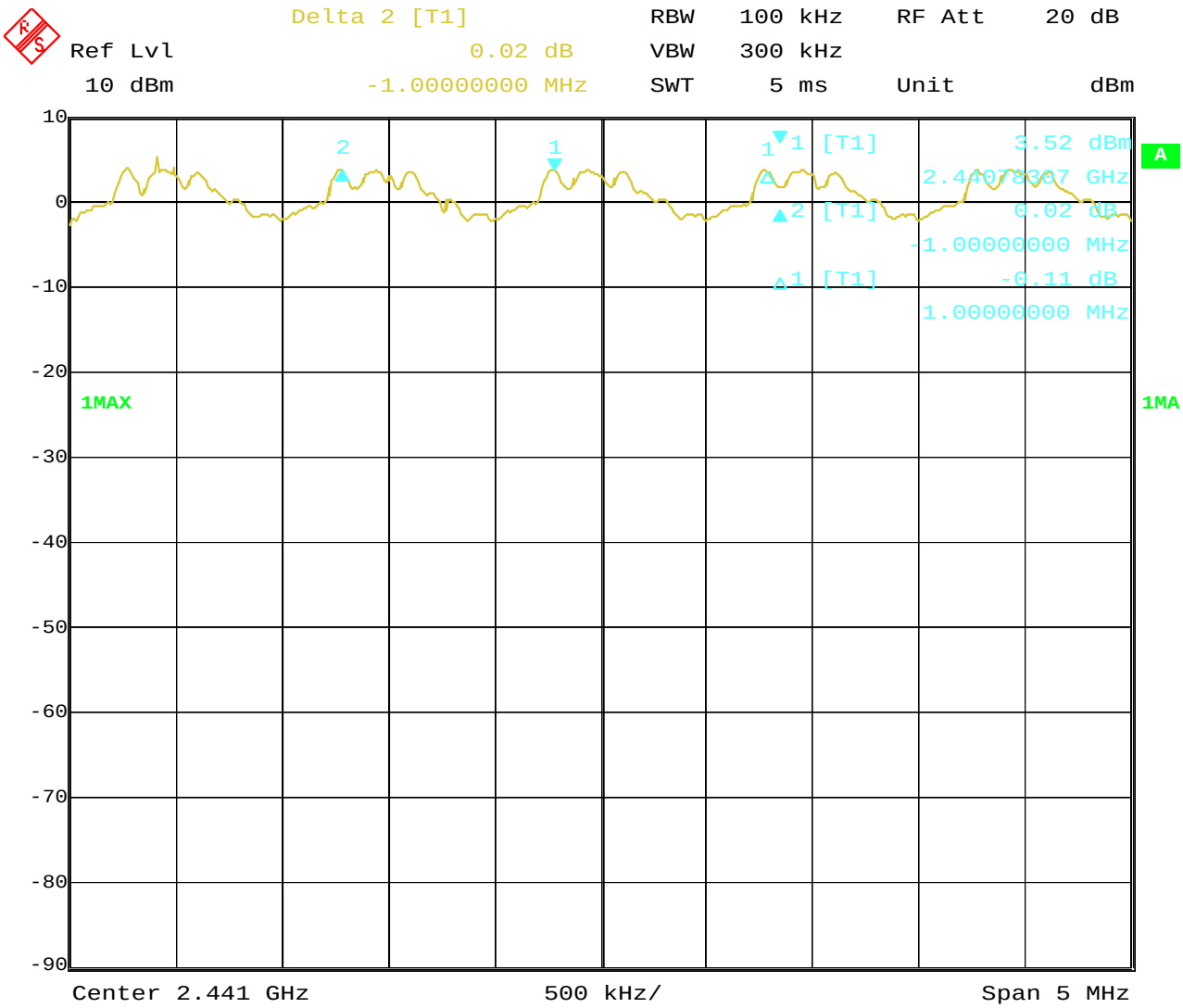
Type of Modulation: Л/4DQPSK

EUT	Advertising Displayer	Model	NEB215
Mode	Hopping On	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH

Carrier Frequency Separation	Limit	Pass/ Fail
1.000MHz	⩾ 25 kHz or 2/3 of 20 dB bandwidth	Pass

Test Plots



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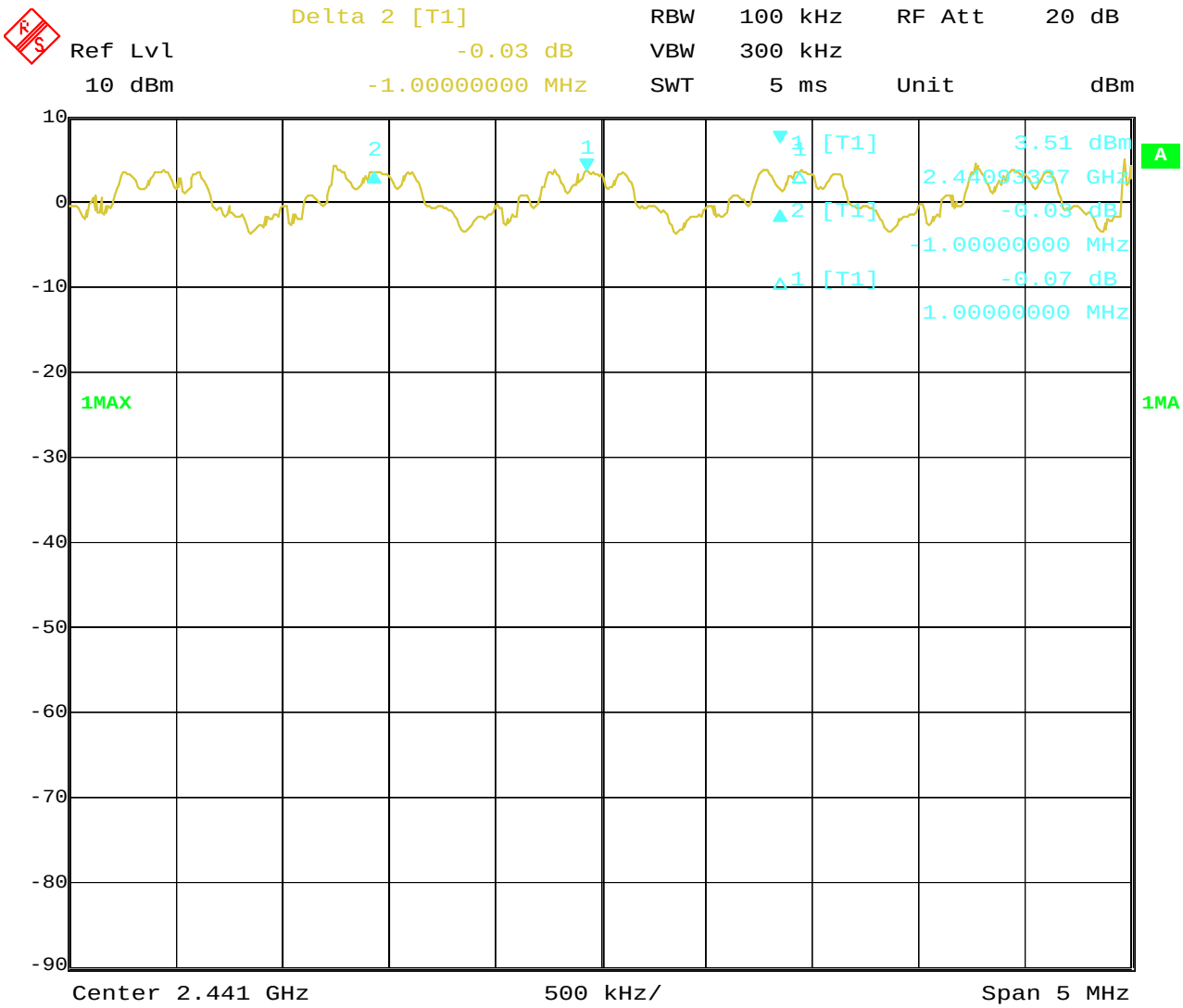
Type of Modulation: 8DPSK

EUT	Advertising Displayer	Model	NEB215
Mode	Hopping On	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH

Carrier Frequency Separation	Limit	Pass/ Fail
1.000MHz	⩾ 25 kHz or 2/3 of 20 dB bandwidth	Pass

Test Plots



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10. Number of Hopping Channels

10.1 Regulation

According to §15.247(a)(1)(iii), frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used. According to §15.247(b)(1), for frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

10.2 Limits of Number of Hopping Channels

The frequency hopping systems in the 2400-2483.5MHz band shall use at least 15 channels.

10.3 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Set the spectrum analyzer as follows: Span = the frequency band of operation; RBW=100 kHz, VBW=300 kHz; Sweep = auto; Detector function = peak; Trace = max hold
3. Record the number of hopping channels.

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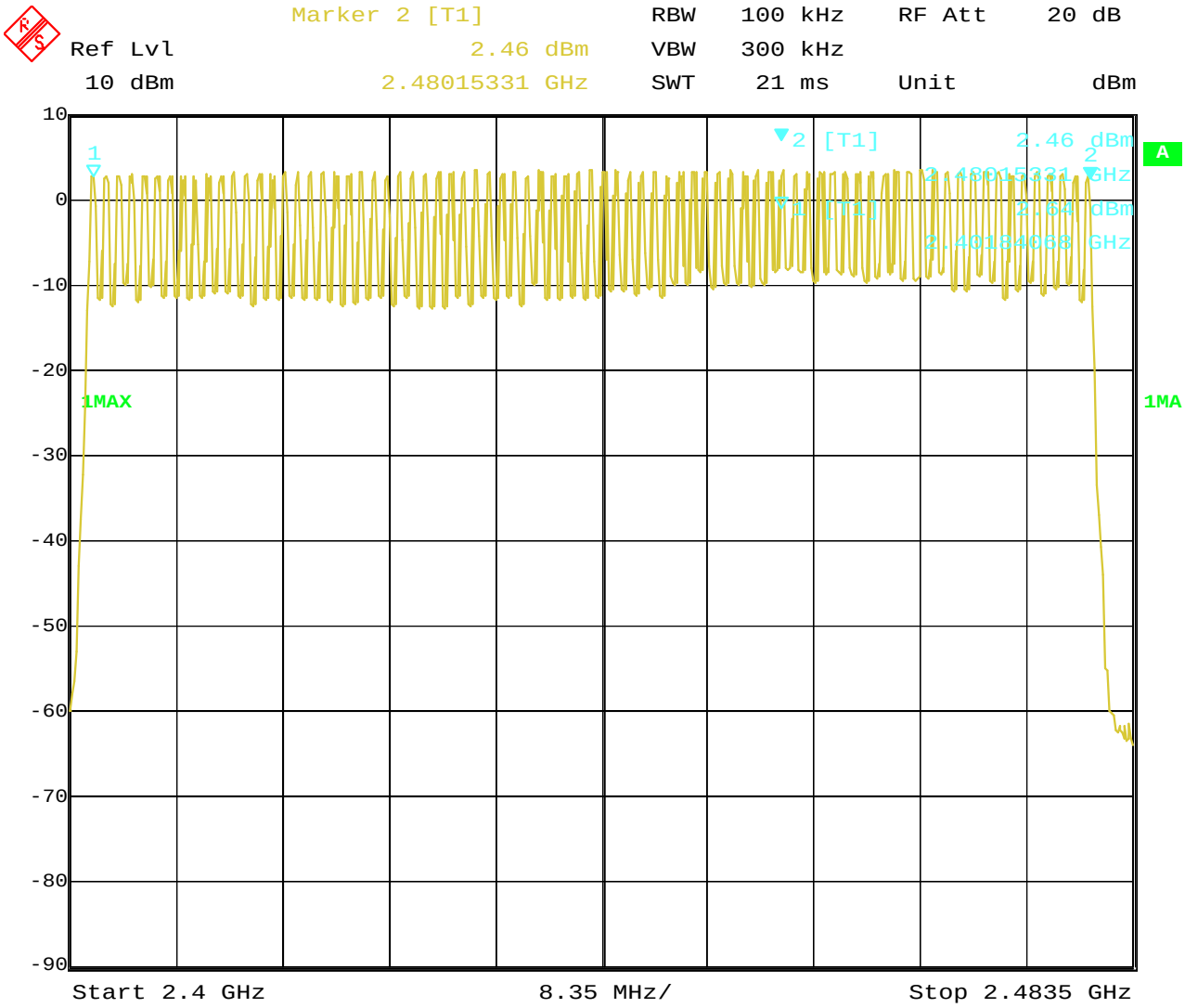
10.4Test Result

Type of Modulation: GFSK

EUT	Advertising Displayer	Model	NEB215
Mode	Hopping On	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH

Operating Frequency	Number of hopping channels	Limit	Pass/ Fail
2402-2480MHz	79	≥ 15	Pass

Test Plot



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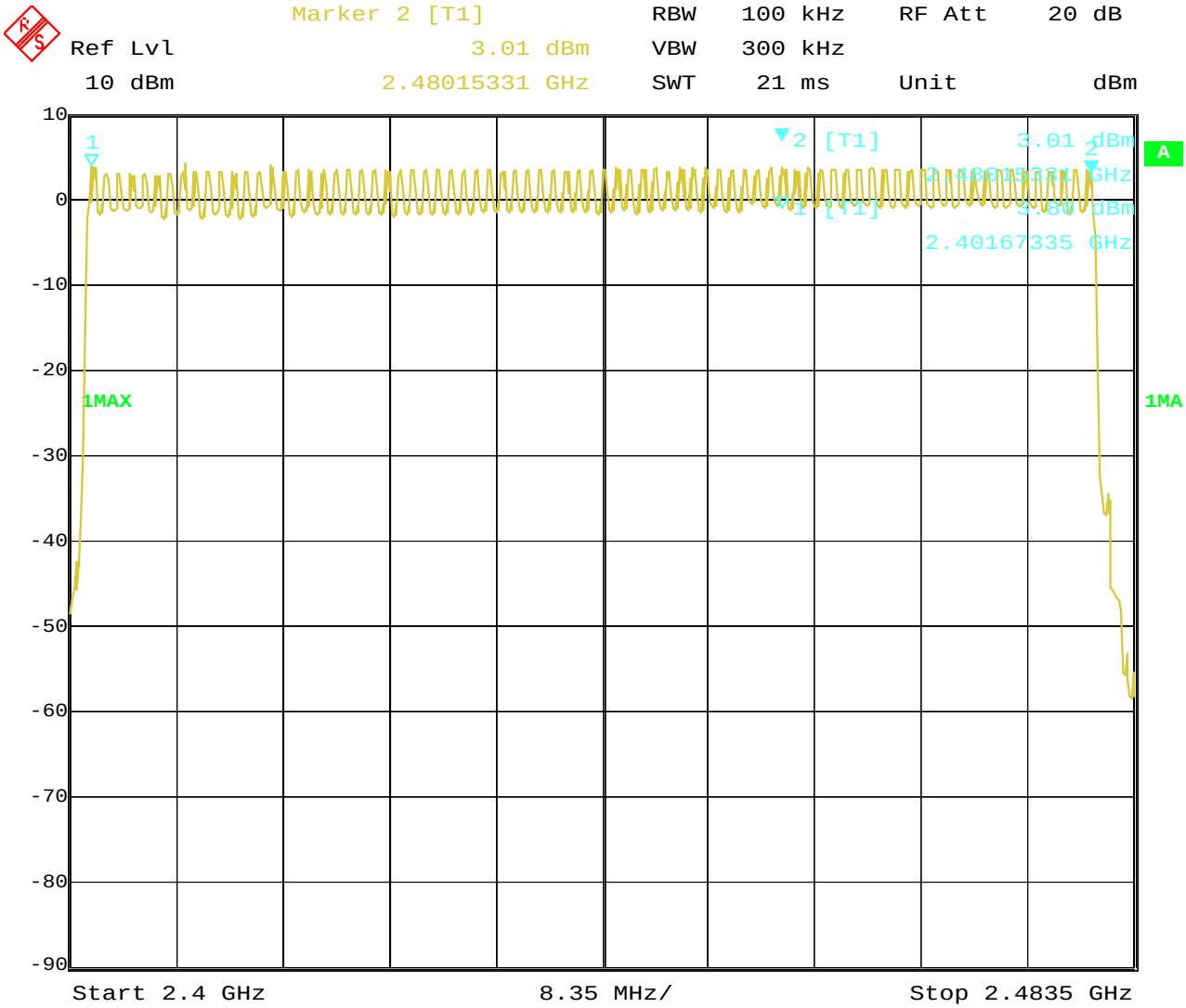
Type of Modulation: Л/4DQPSK

EUT	Advertising Displayer	Model	NEB215
Mode	Hopping On	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH

Operating Frequency	Number of hopping channels	Limit	Pass/ Fail
2402-2480MHz	79	≥ 15	Pass

Test Plot



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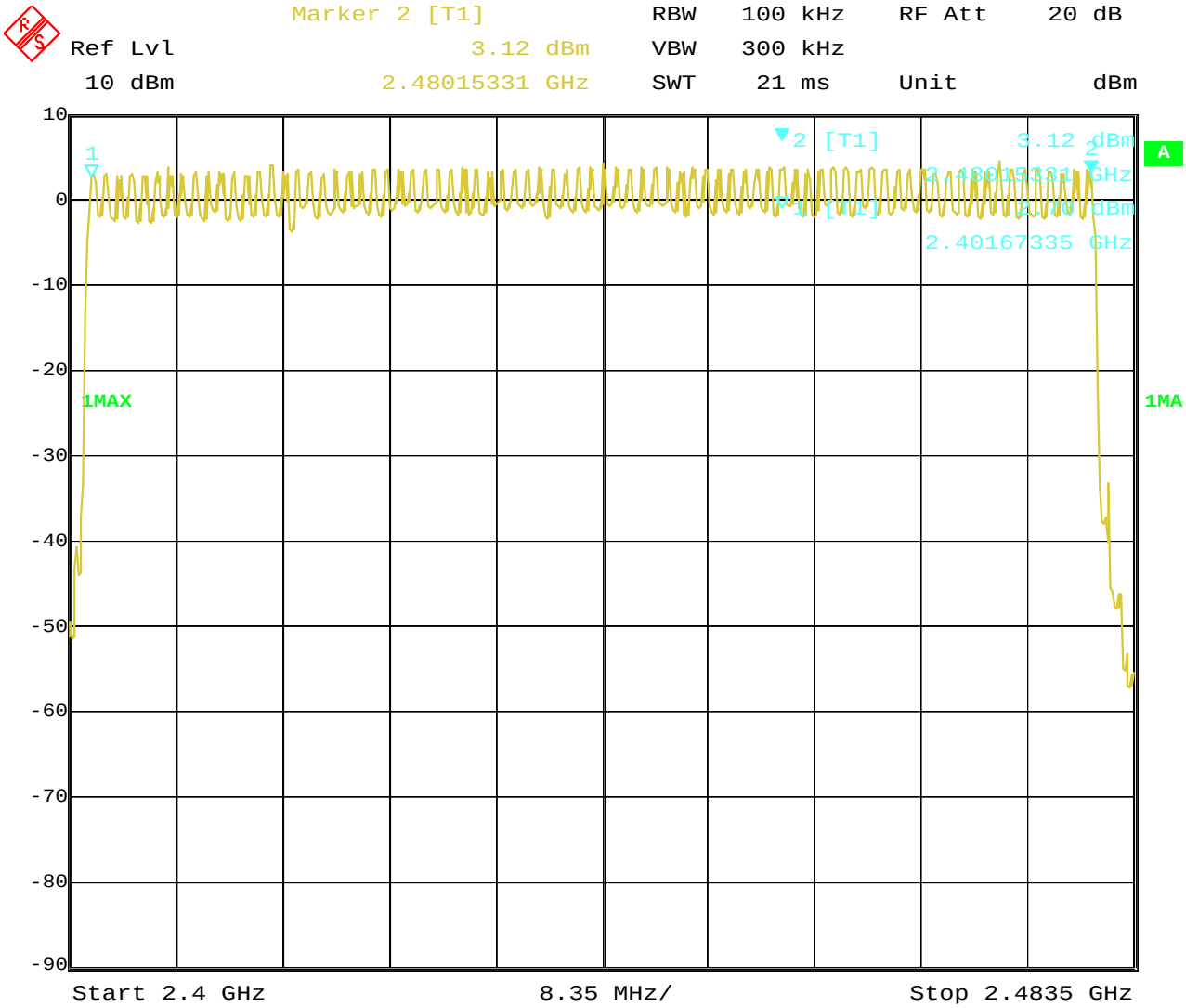
Type of Modulation: 8DPSK

EUT	Advertising Displayer	Model	NEB215
Mode	Hopping On	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH

Operating Frequency	Number of hopping channels	Limit	Pass/ Fail
2402-2480MHz	79	≥ 15	Pass

Test Plot



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11. Time of Occupancy (Dwell Time)

11.1 Regulation

According to §15.247(a)(1)(iii), frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

11.2 Limits of Carrier Frequency Separation

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed

11.3 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Set the spectrum analyzer as follows: Span = zero span, centered on a hopping channel; RBW = 1 MHz; VBW ⩾ RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold
3. Measure the dwell time using the marker-delta function.
4. Repeat above procedures until all frequencies measured were complete.
5. Repeat this test for different modes of operation (e.g., data rate, modulation format, etc.), if applicable.

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11.4 Test Result

Type of Modulation: GFSK

EUT	Advertising Displayer	Model	NEB215
Mode	Keep Transmitting	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH

Channel	Reading	Hoping Rate	Actual	Limit
DH5				
High	2.94ms	266.667 hop/s	0.314s	0.4s
DH5				
Middle	2.96ms	266.667 hop/s	0.316s	0.4s
DH5				
Low	3.00ms	266.667 hop/s	0.320s	0.4s

Actual = Reading × (Hopping rate / Number of channels) × Test period, Test period = 0.4 [seconds / channel] × 79 [channel] = 31.6 [seconds] NOTE: The EUT makes worst case 1600 hops per second or 1 time slot has a length of 625μs with 79 channels.

A DH5 Packet needs 5 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 266.667 hops per second with 79 channels.

A DH3 Packet needs 3 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 400 hops per second with 79 channels.

A DH1 Packet needs 1 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 800 hops per second with 79 channels.

Note: DH5 was the worst case.

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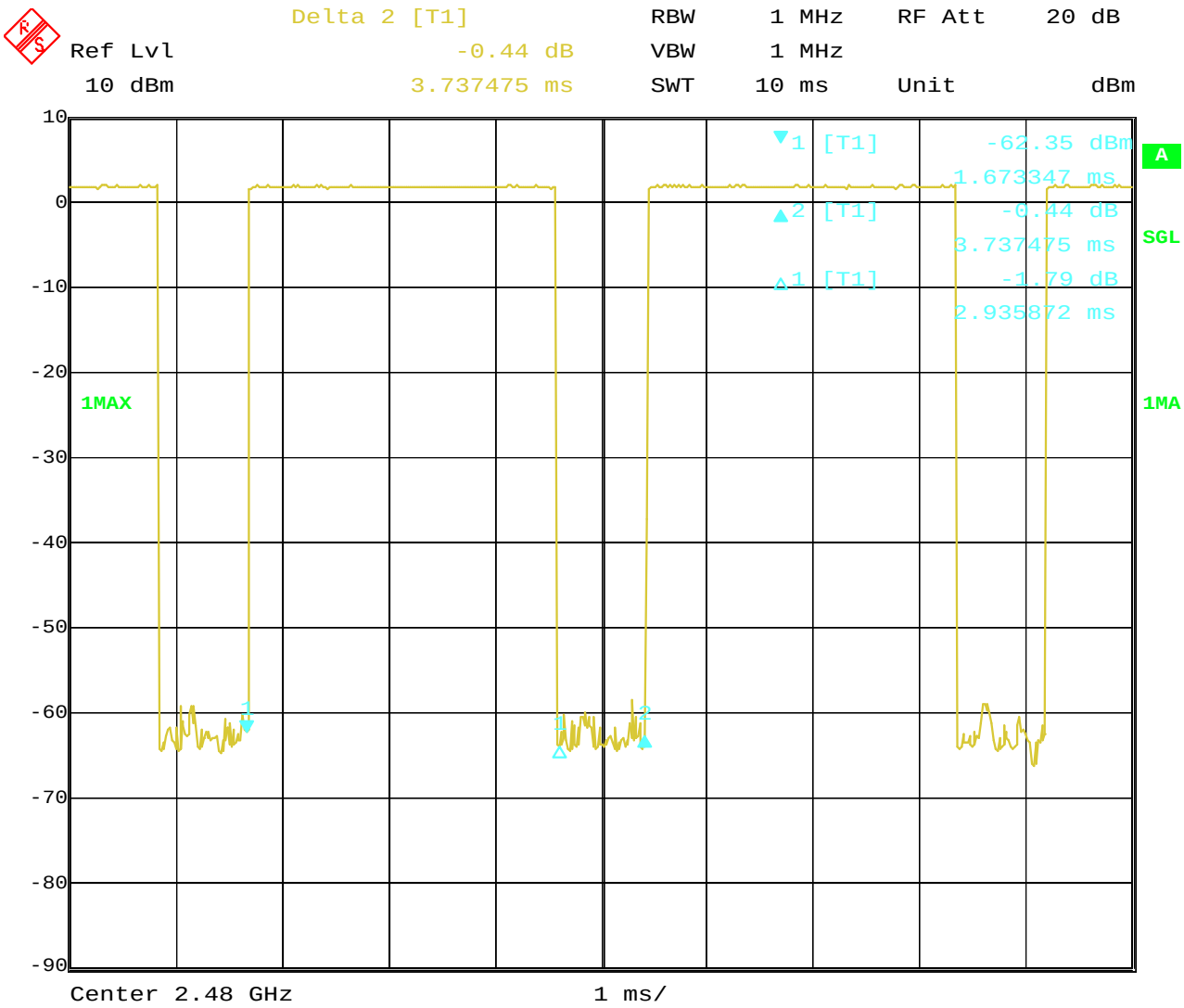
Test Plots:

High Channel:



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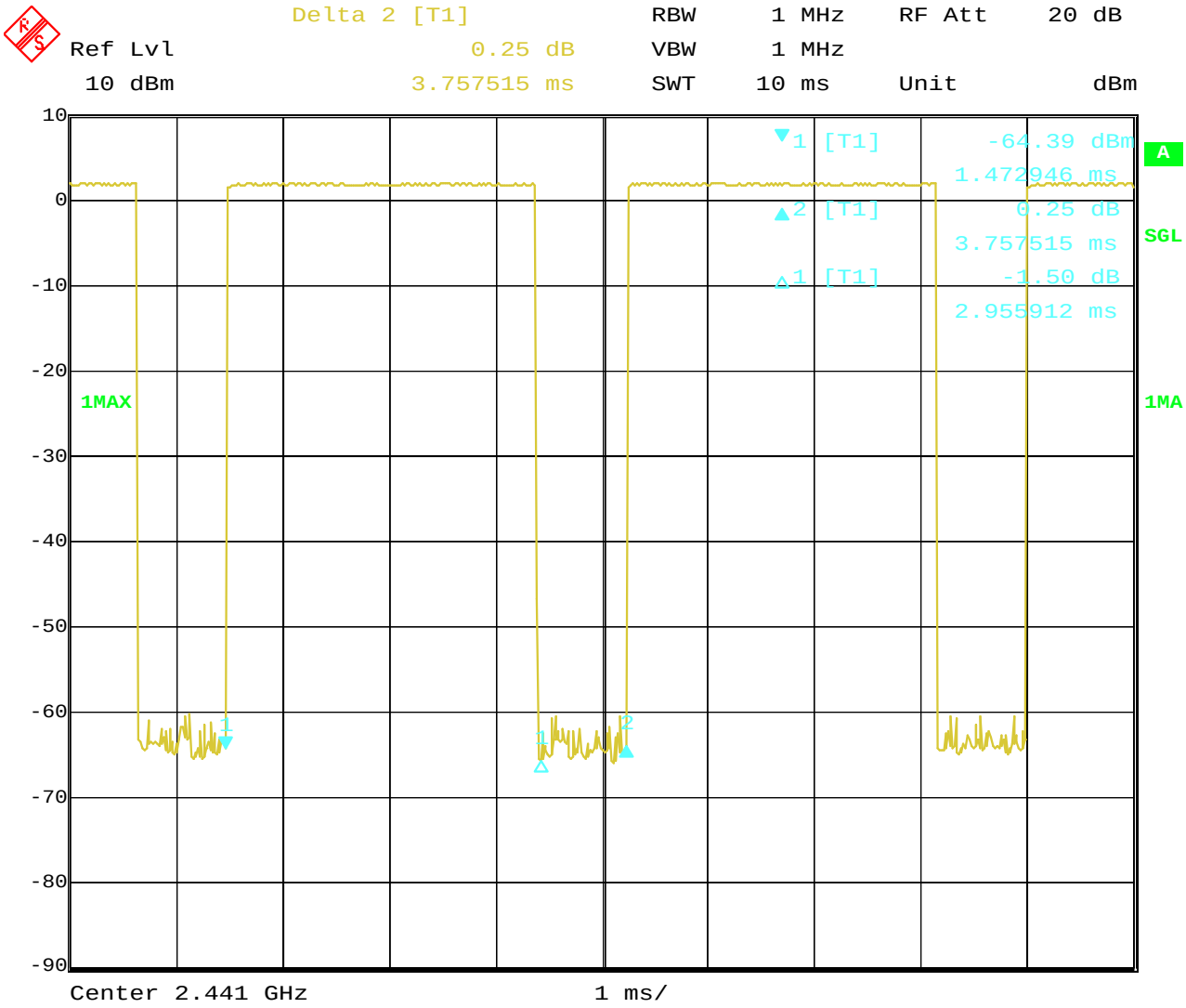
Middle Channel



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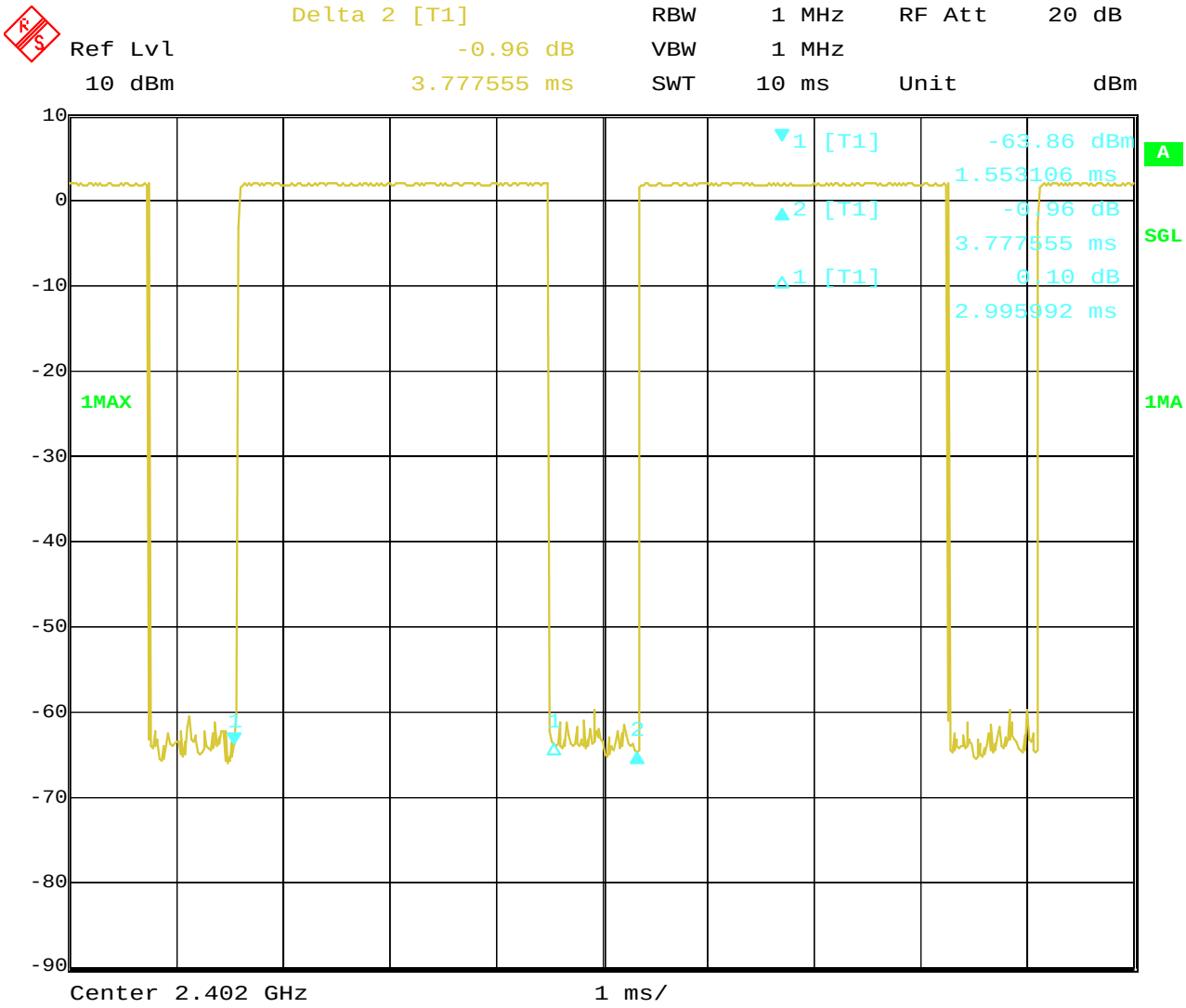
Low Channel



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Test Result

Type of Modulation: Л/4DQPSK

EUT	Advertising Displayer	Model	NEB215
Mode	Keep Transmitting	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH

Channel	Reading	Hoping Rate	Actual	Limit
2DH5				
High	2.98ms	266.667 hop/s	0.318s	0.4s
2DH5				
Middle	2.96ms	266.667 hop/s	0.316s	0.4s
2DH5				
Low	2.96ms	266.667 hop/s	0.316s	0.4s

Actual = Reading × (Hopping rate / Number of channels) × Test period, Test period = 0.4 [seconds / channel] × 79 [channel] = 31.6 [seconds] NOTE: The EUT makes worst case 1600 hops per second or 1 time slot has a length of 625μs with 79 channels.

A DH5 Packet needs 5 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 266.667 hops per second with 79 channels.

A DH3 Packet needs 3 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 400 hops per second with 79 channels.

A DH1 Packet needs 1 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 800 hops per second with 79 channels.

Note: 2DH5 was the worst case.

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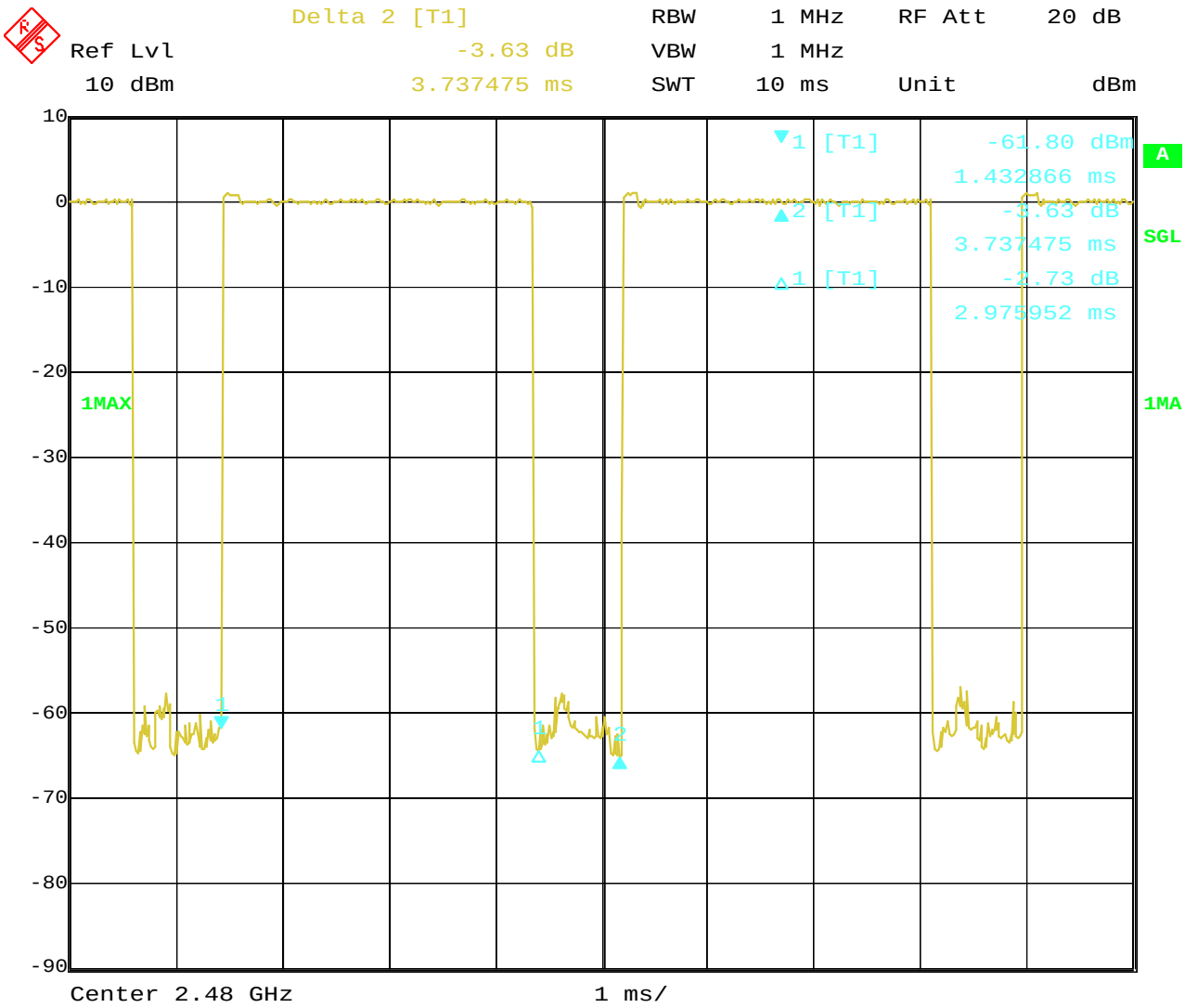
Test Plots:

High Channel



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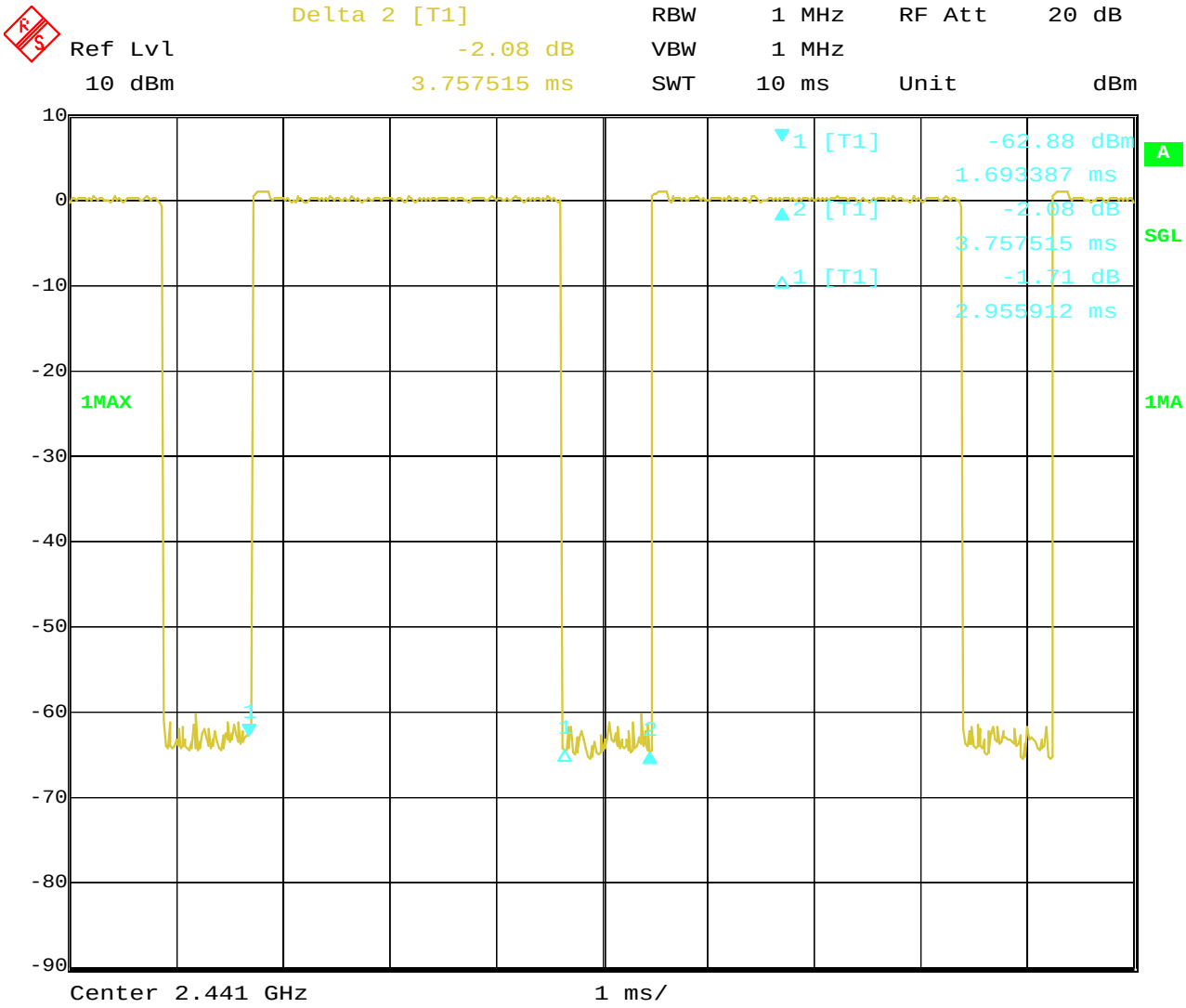
Middle Channel



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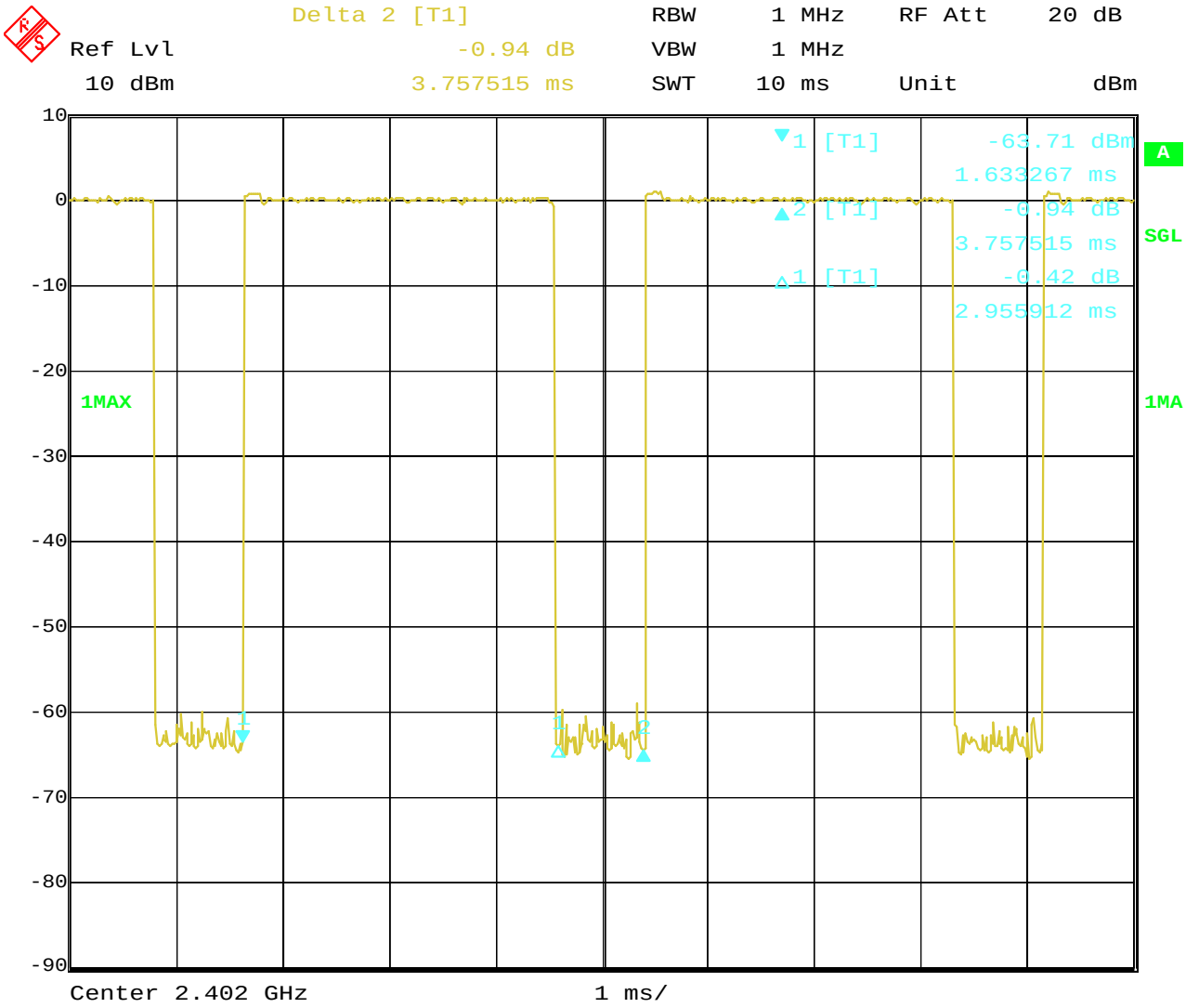
Low Channel



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Type of Modulation: 8DPSK

EUT	Advertising Displayer	Model	NEB215
Mode	Keep Transmitting	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH

Channel	Reading	Hoping Rate	Actual	Limit
3DH5				
High	2.96ms	266.667 hop/s	0.316s	0.4s
3DH5				
Middle	2.96ms	266.667 hop/s	0.316s	0.4s
3DH5				
Low	2.96ms	266.667 hop/s	0.316s	0.4s

Actual = Reading × (Hopping rate / Number of channels) × Test period, Test period = 0.4 [seconds / channel] × 79 [channel] = 31.6 [seconds] NOTE: The EUT makes worst case 1600 hops per second or 1 time slot has a length of 625μs with 79 channels.

A DH5 Packet needs 5 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 266.667 hops per second with 79 channels.

A DH3 Packet needs 3 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 400 hops per second with 79 channels.

A DH1 Packet needs 1 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 800 hops per second with 79 channels.

Note: 3DH5 was the worst case.

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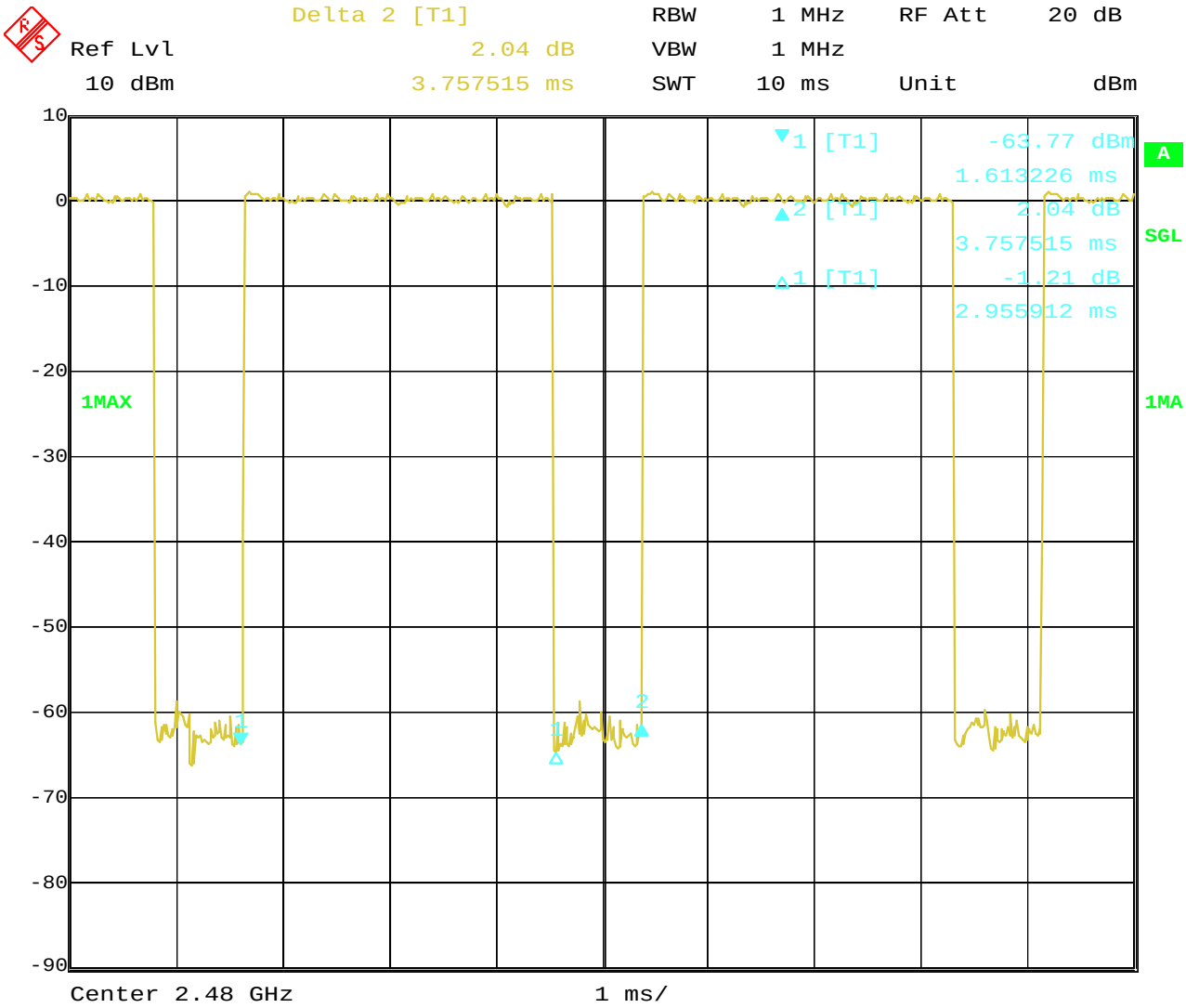
Test Plots:

High Channel



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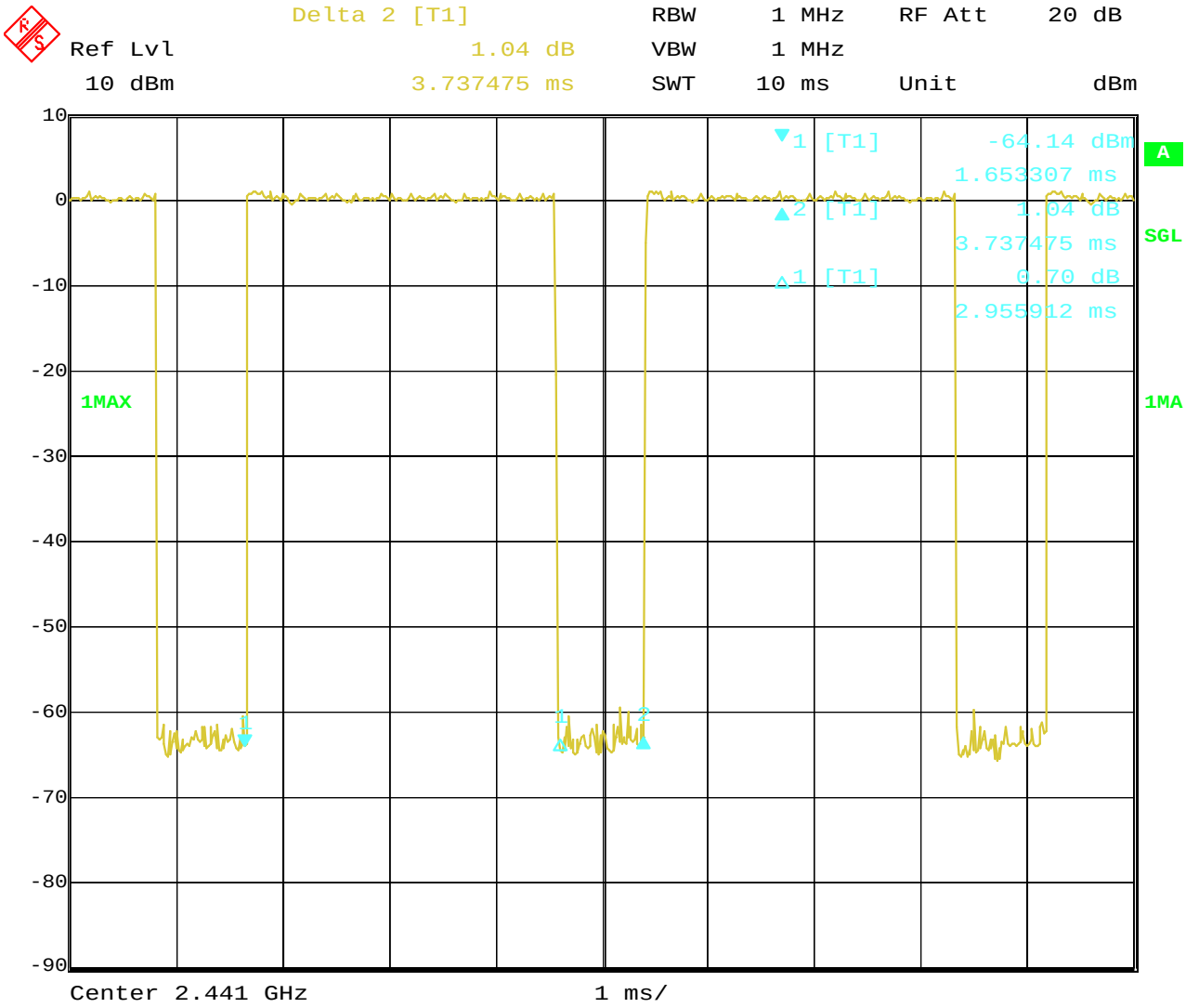
Middle Channel



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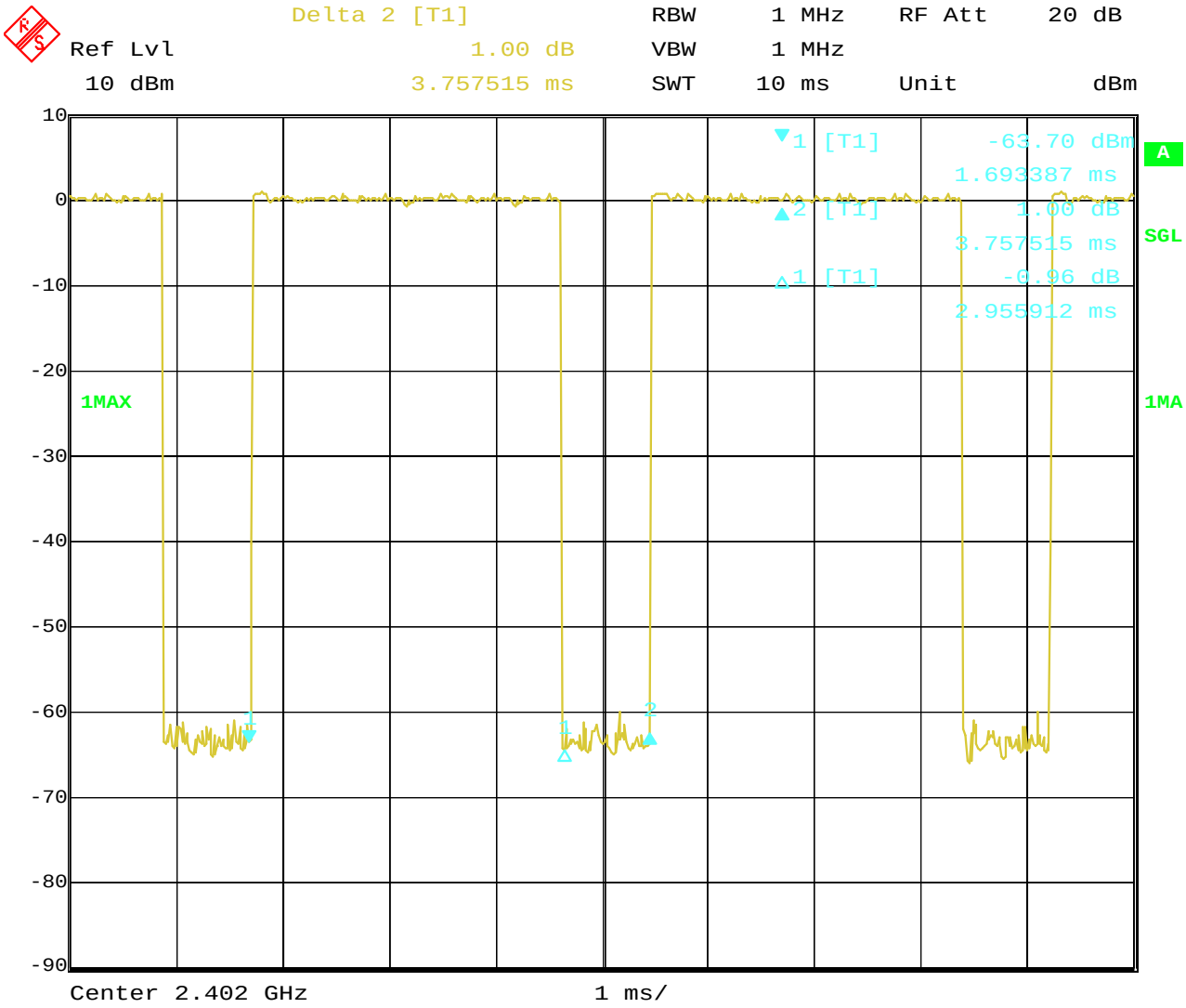
Low Channel



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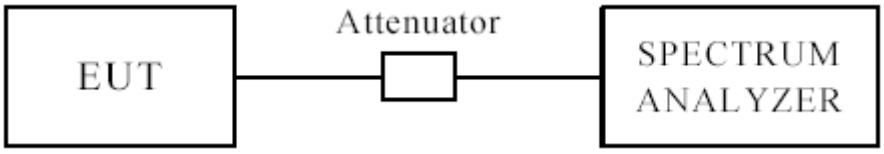
12 Out of Band Measurement

12.1 Test Setup



The restricted band requirement based on radiated emission test; please see the clause 6 for the test setup

12.2 Limits of Out of Band Emissions Measurement

1. Below –20dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).
2. Fall in the restricted bands listed in section 15.205. The maximum permitted average field strength is listed in section 15.209.

12.3 Test Procedure

For signals in the restricted bands above and below the 2.4-2.483GHz allocated band a measurement was made of radiated emission test. Peak values with RBW=VBW=1MHz and PK detector.
For bandage test, the spectrum set as follows: RBW=100kHz, VBW=300 kHz. A conducted measurement used

Note: 1. For band-edge measurement, the frequency from 30MHz-25GHz was tested. And It met the FCC rule.
2. This is a handhold device. The radiated emissions should be tested under 3-axes position (Lying, Side, and Stand), After pre-test. It was found that the worse radiated emission was get at the lying position.

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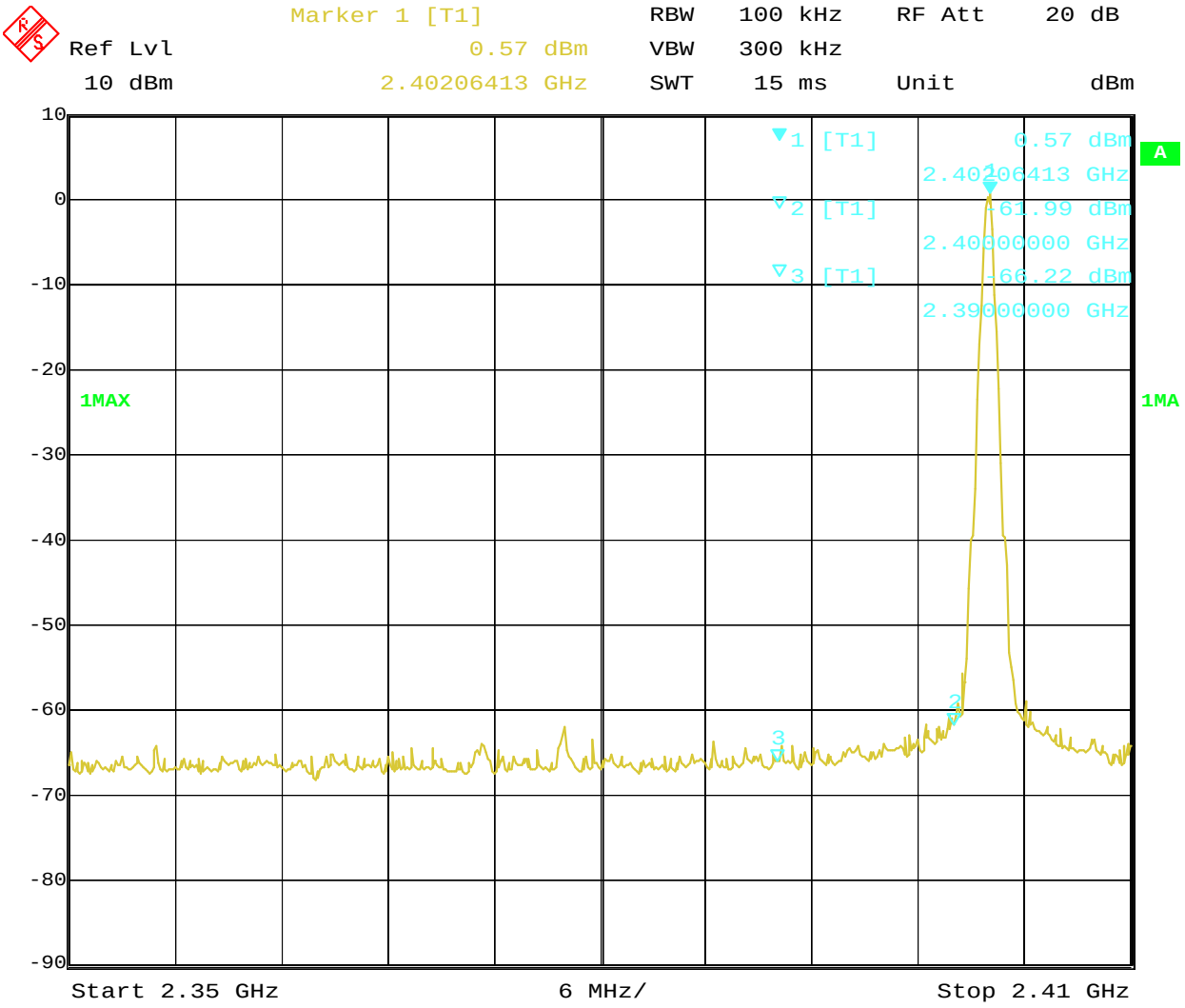
Type of Modulation: GFSK

12.4 Out of Band Test Result

Product:	Advertising Displayer		Test Mode:	Low Channel
Mode	Keeping Transmitting		Input Voltage	DC3.7V
Temperature	24 deg. C		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2390MHz	PK (dBμV/m)	43.6	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



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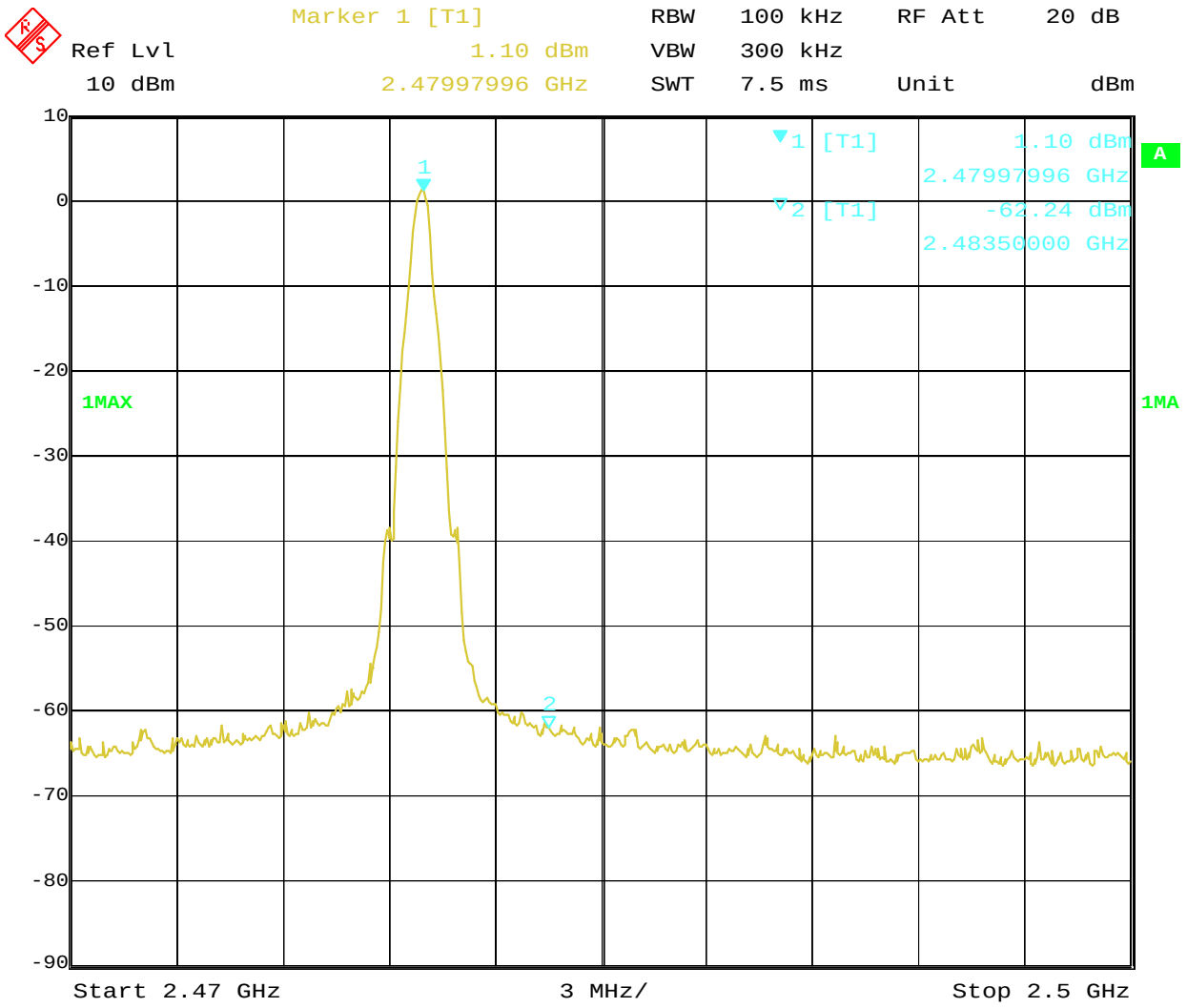
Type of Modulation: GFSK

12.4 Out of Band Test Result

Product:	Advertising Displayer		Test Mode:	High Channel
Mode	Keeping Transmitting		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2483.5MHz	PK (dBμV/m)	43.4	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



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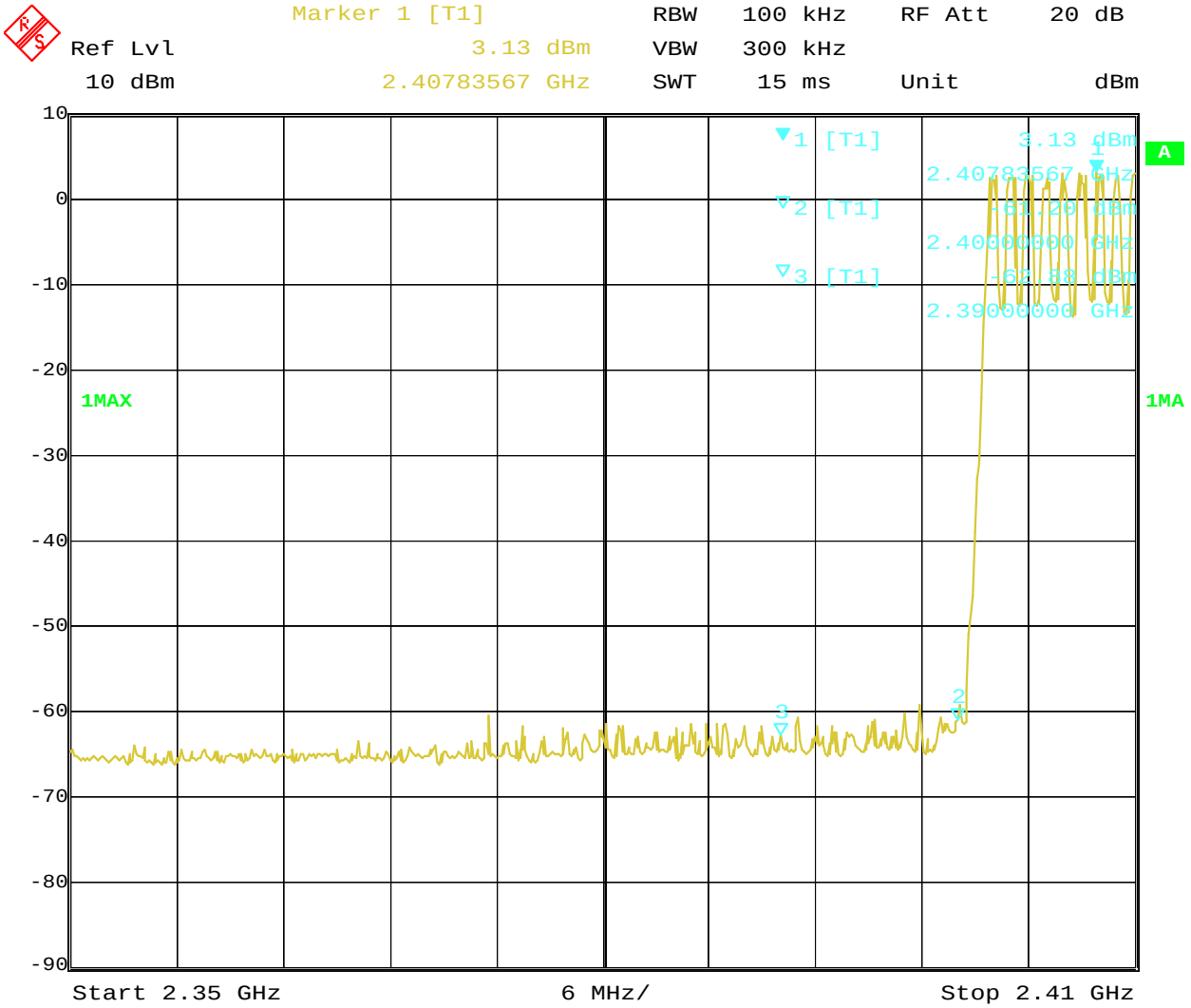
Type of Modulation: GFSK

12.4 Out of Band Test Result

Product:	Advertising Displayer		Test Mode:	Hopping mode
Mode	Hopping On		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2390MHz	PK (dBμV/m)	42.3	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



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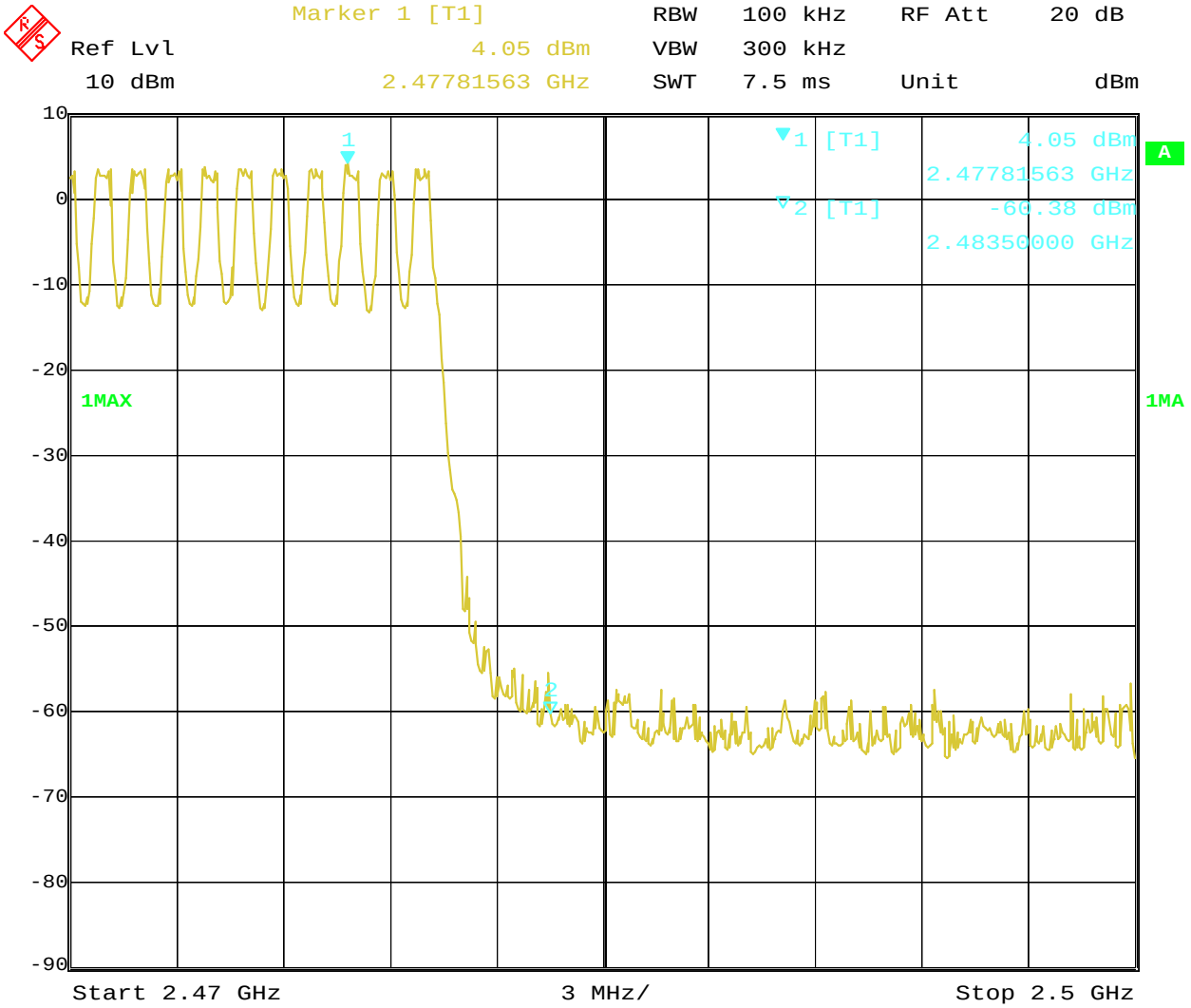
Type of Modulation: GFSK

12.4 Out of Band Test Result

Product:	Advertising Displayer		Test Mode:	Hopping mode
Mode	Hopping On		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2483.5MHz	PK (dBμV/m)	44.3	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



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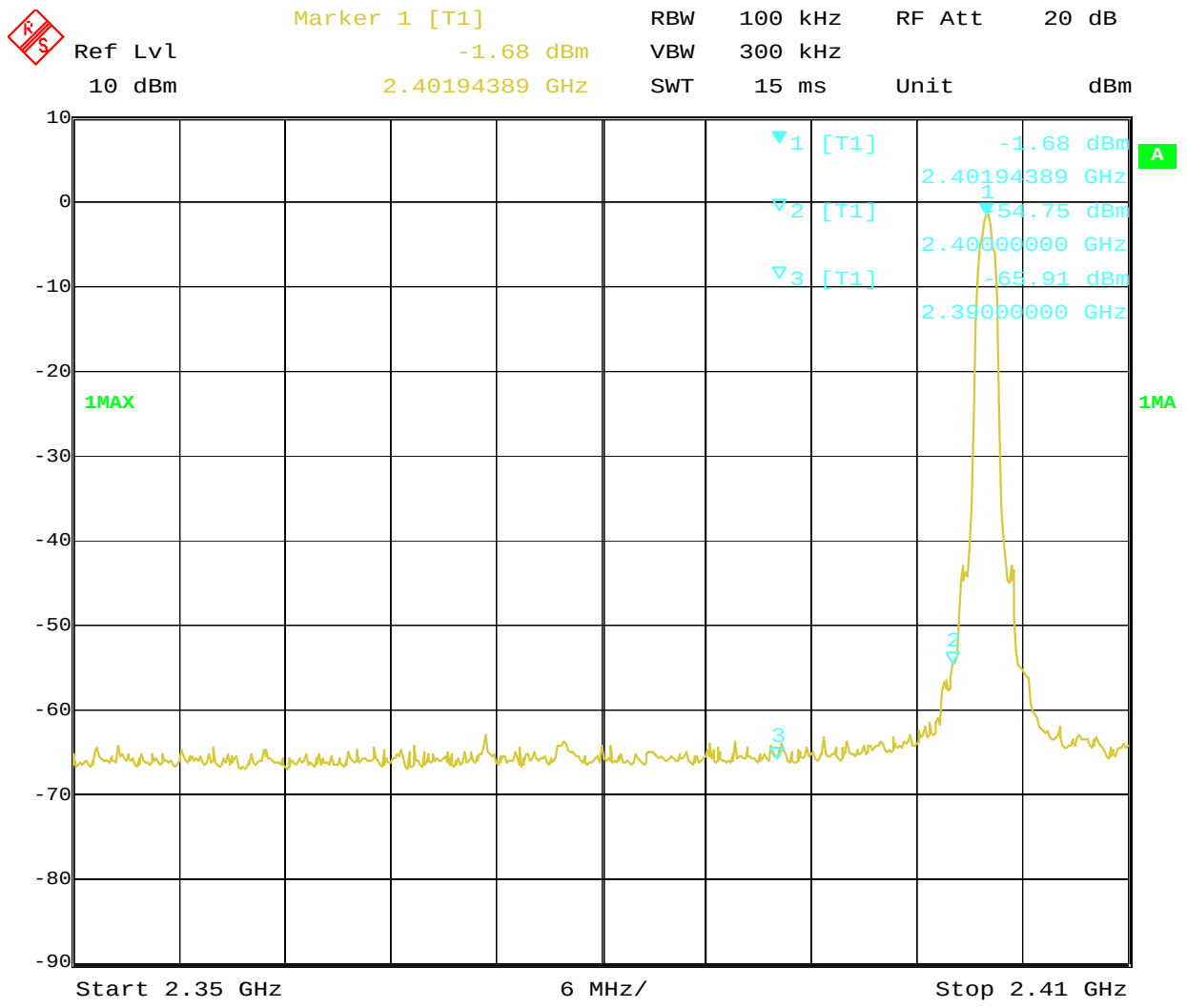
Type of Modulation: Л/4DQPSK

12.4 Out of Band Test Result

Product:	Advertising Displayer		Test Mode:	Low Channel
Mode	Keeping Transmitting		Input Voltage	DC3.7V
Temperature	24 deg. C		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2390MHz	PK (dBμV/m)	46.5	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



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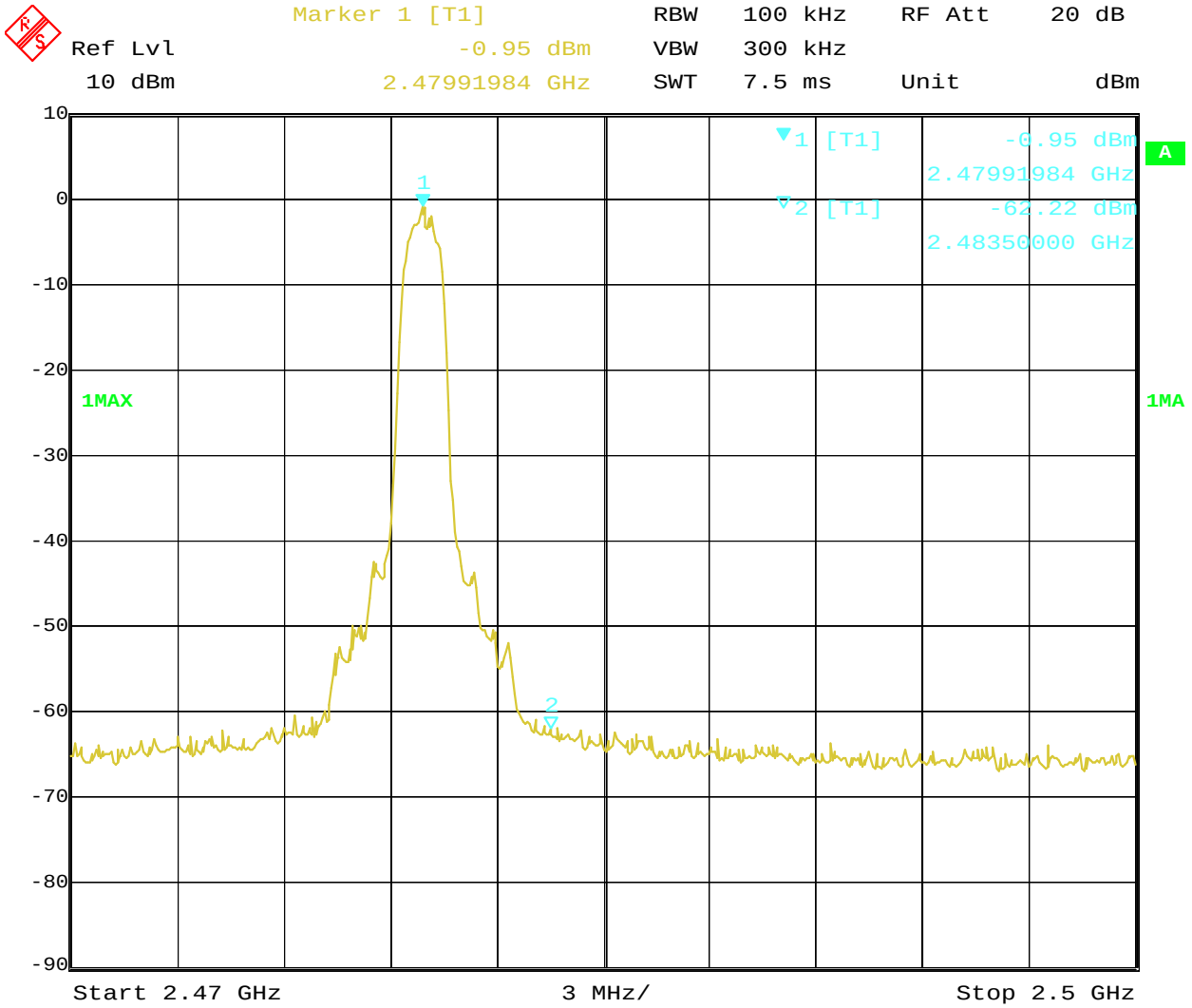
Type of Modulation: Л/4DQPSK

12.4 Out of Band Test Result

Product:	Advertising Displayer		Test Mode:	High Channel
Mode	Keeping Transmitting		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2483.5MHz	PK (dBμV/m)	42.9	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



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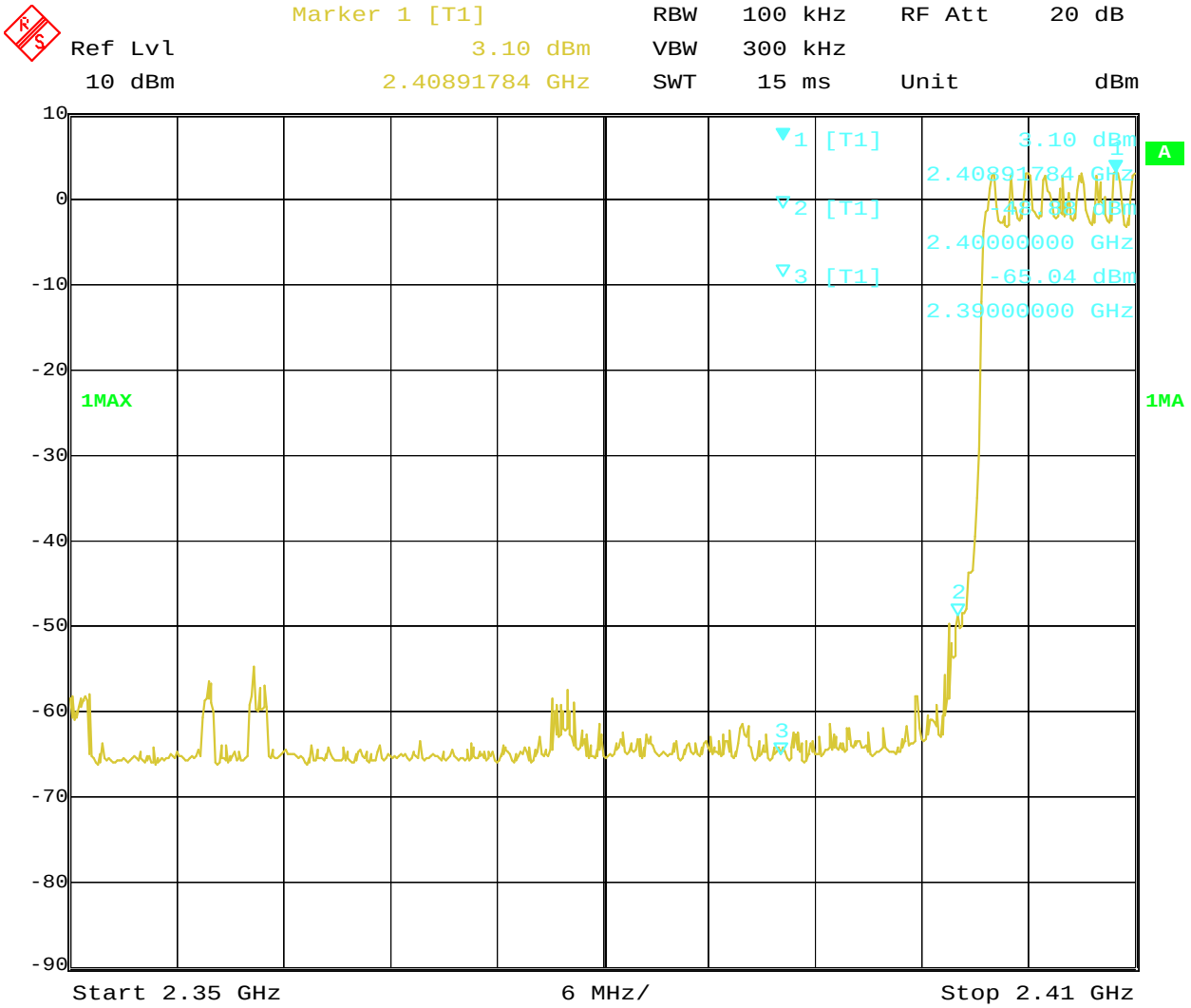
Type of Modulation: Л/4DQPSK

12.4 Out of Band Test Result

Product:	Advertising Displayer		Test Mode:	Hopping mode
Mode	Hopping On		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2390MHz	PK (dBμV/m)	46.8	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



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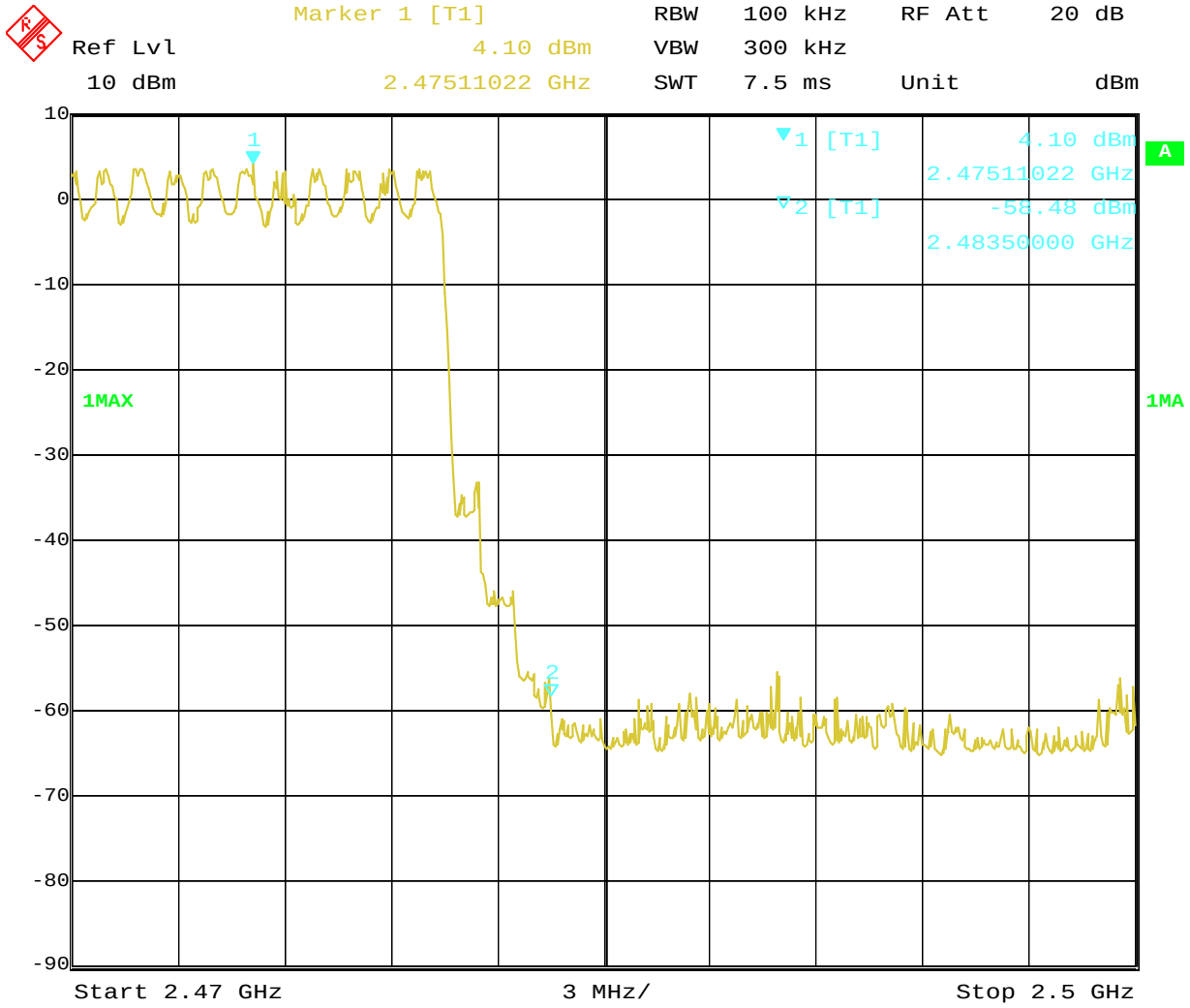
Type of Modulation: Л/4DQPSK

12.4 Out of Band Test Result

Product:	Advertising Displayer		Test Mode:	Hopping mode
Mode	Hopping On		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2483.5MHz	PK (dBμV/m)	45.1	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



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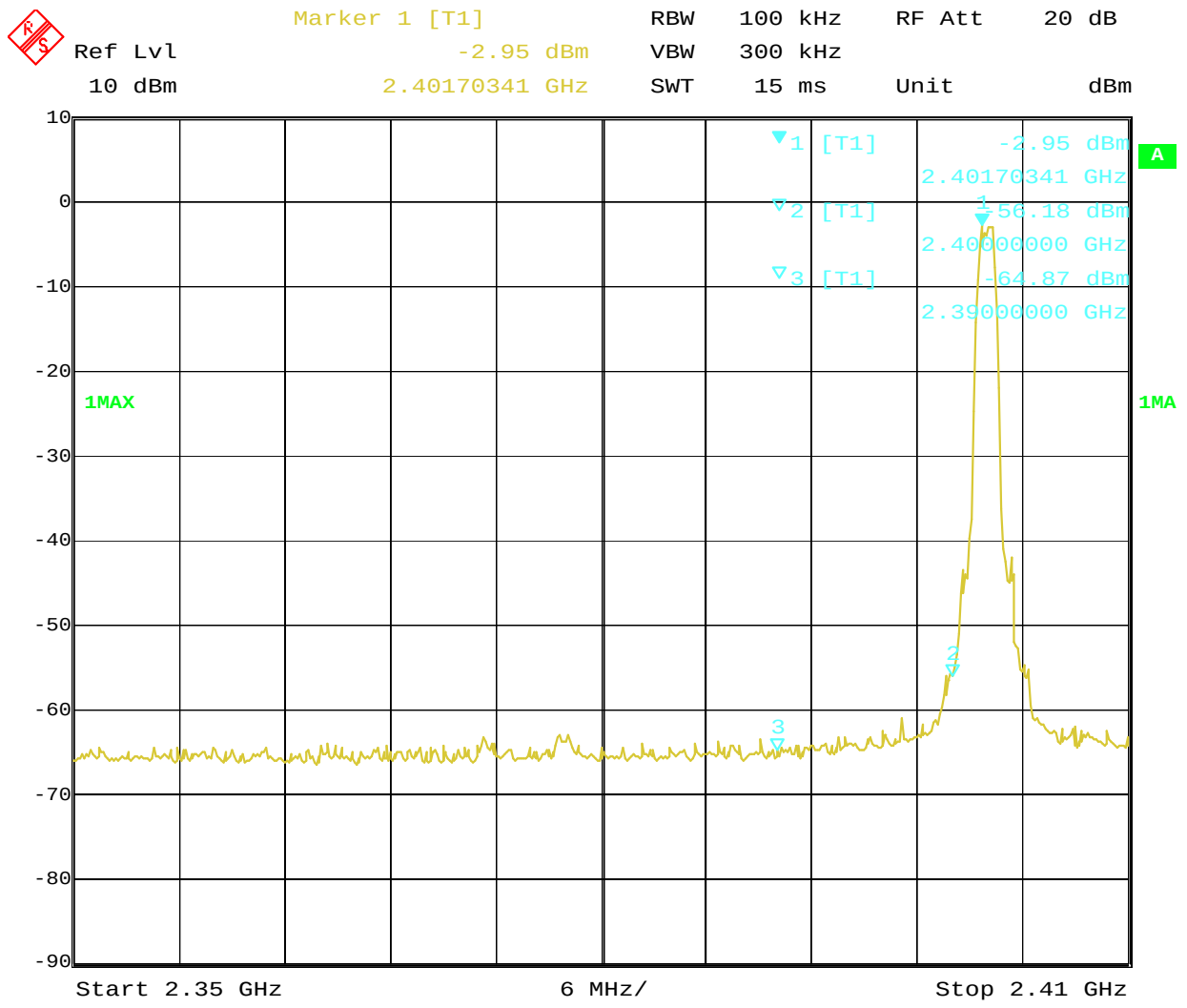
Type of Modulation: 8DPSK

12.4 Out of Band Test Result

Product:	Advertising Displayer		Test Mode:	Low Channel
Mode	Keeping Transmitting		Input Voltage	DC3.7V
Temperature	24 deg. C		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2390MHz	PK (dBμV/m)	45.4	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



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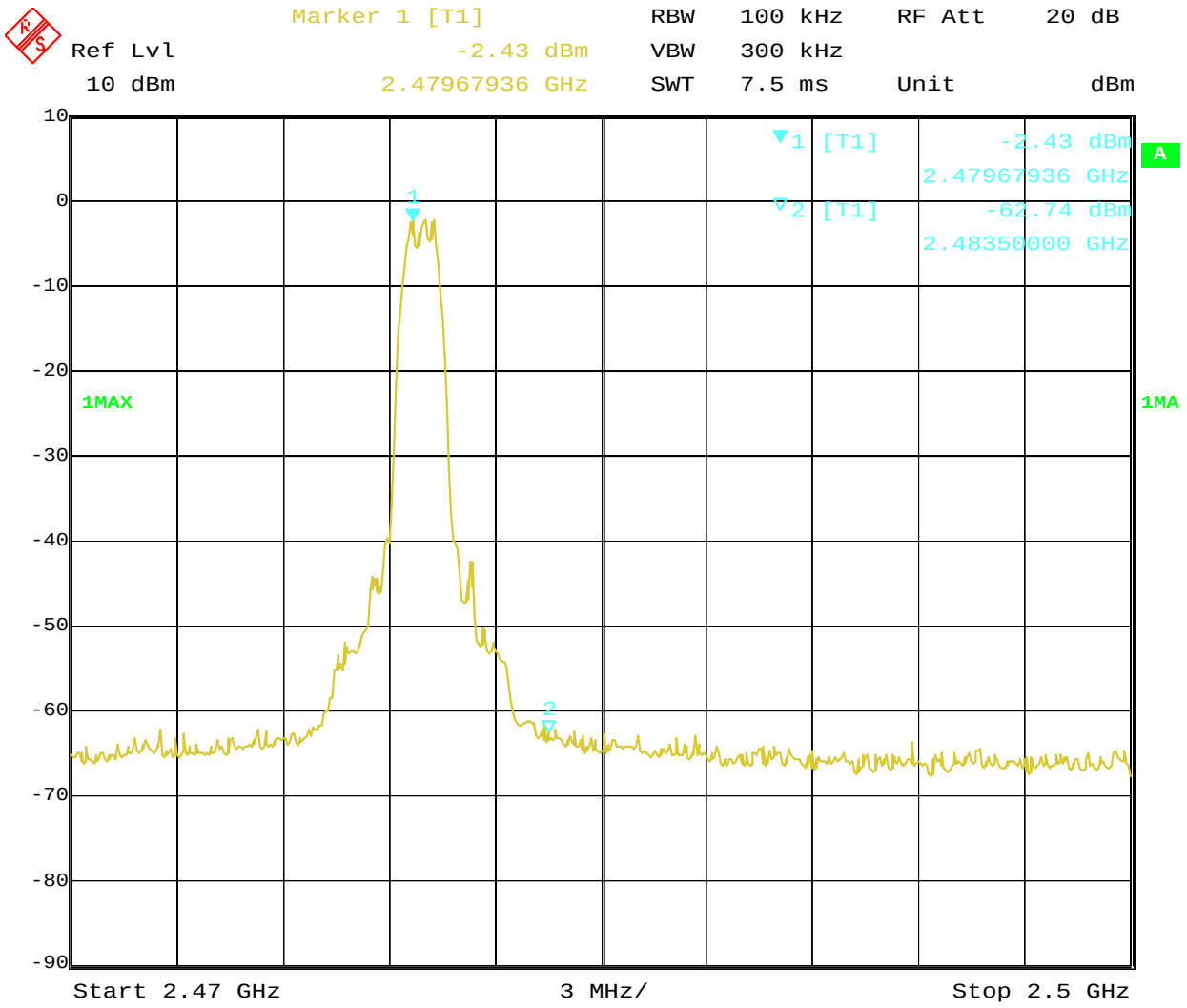
Type of Modulation: 8DPSK

12.4 Out of Band Test Result

Product:	Advertising Displayer		Test Mode:	High Channel
Mode	Keeping Transmitting		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2483.5MHz	PK (dBμV/m)	43.3	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



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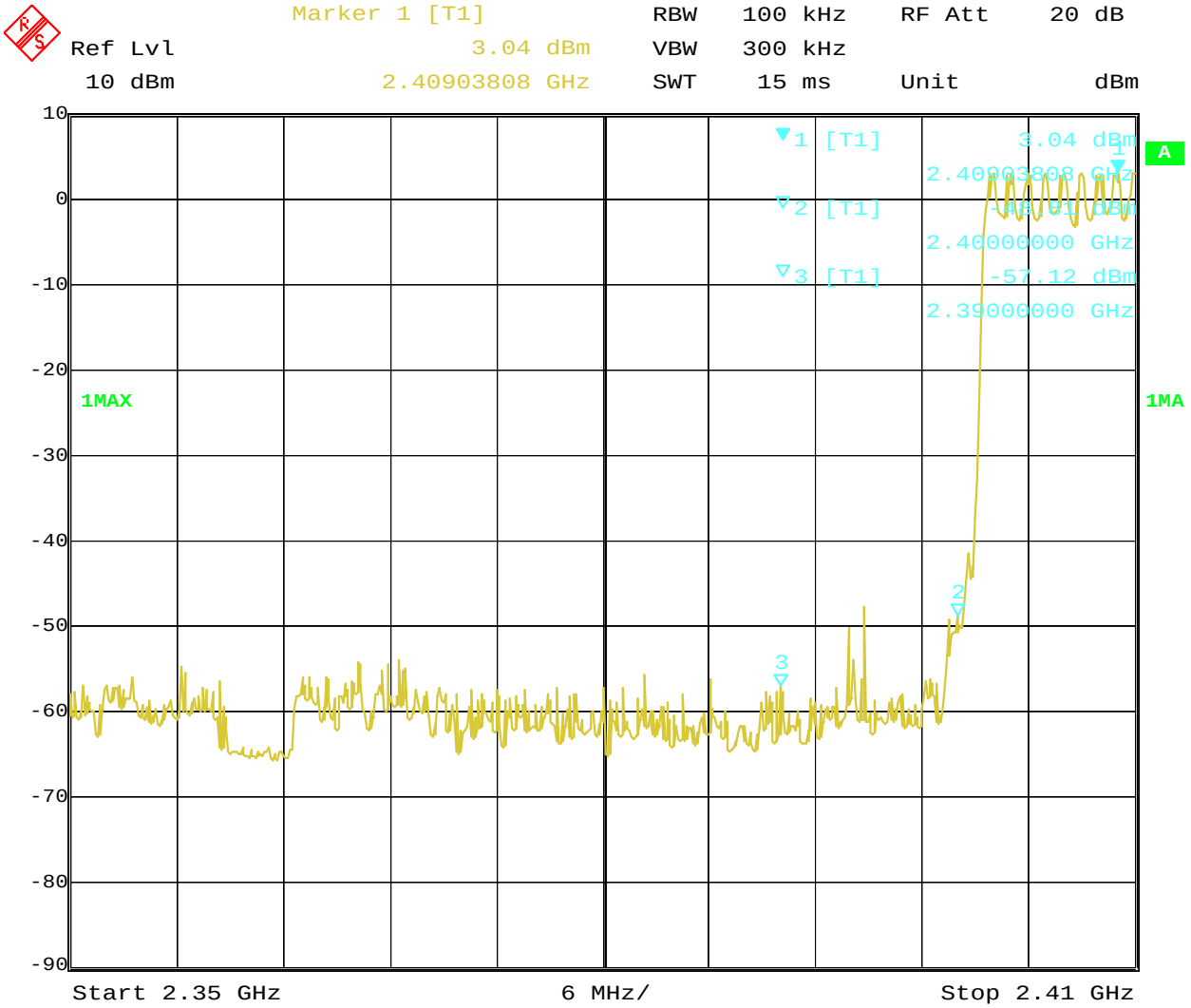
Type of Modulation: 8DPSK

12.4 Out of Band Test Result

Product:	Advertising Displayer		Test Mode:	Hopping mode
Mode	Hopping On		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2390MHz	PK (dBμV/m)	46.6	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



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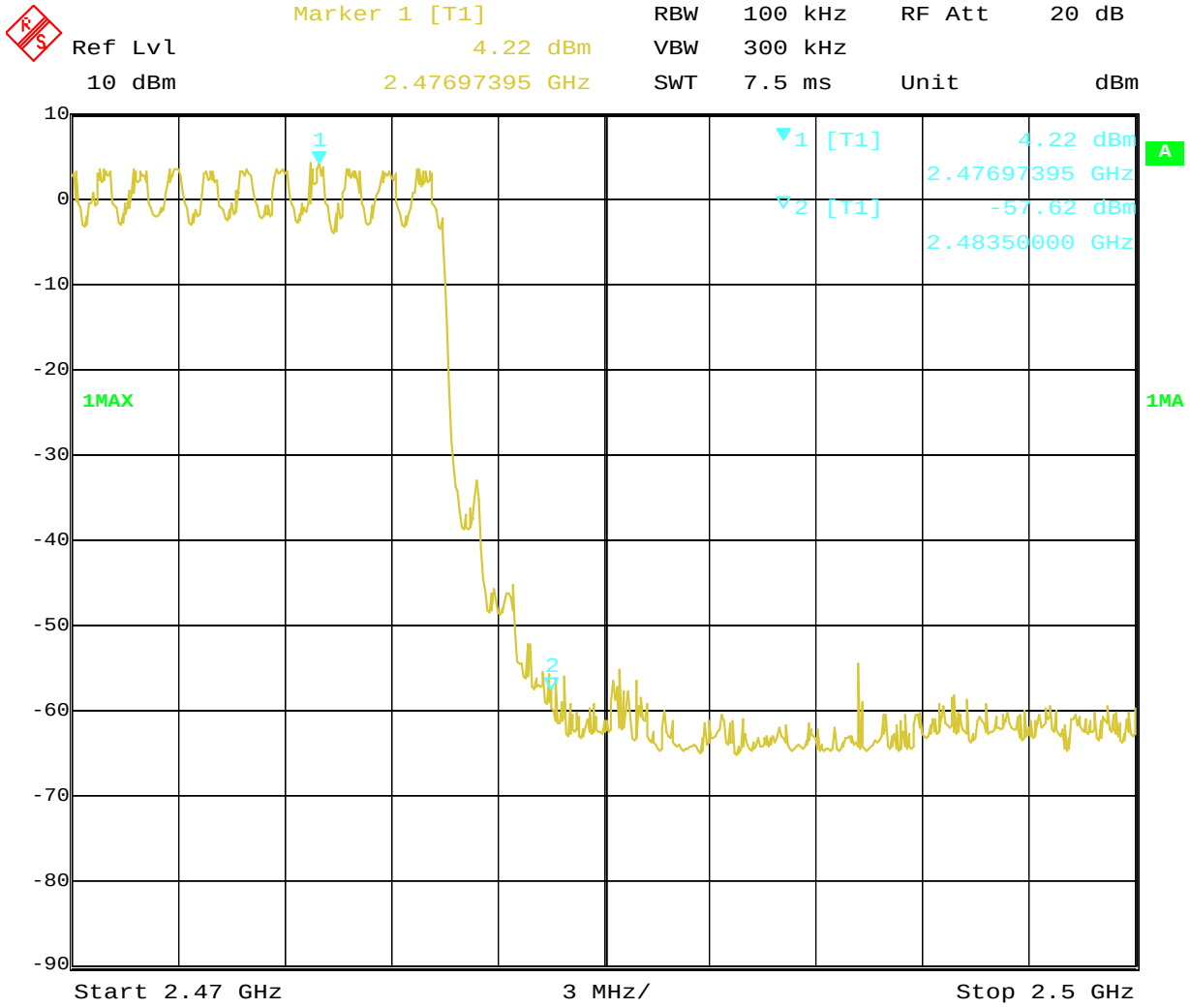
Type of Modulation: 8DPSK

12.4 Out of Band Test Result

Product:	Advertising Displayer		Test Mode:	Hopping mode
Mode	Hopping On		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Test Result:	Pass		Detector	PK
The Max. FS in Restrict Band 2483.5MHz	PK (dBμV/m)	44.7	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

Test Figure:



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13.0 **Antenna Requirement**

13.1 Standard Applicable

For intentional device, according to FCC 47 CFR Section 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.

And according to FCC 47 CFR Section 15.247 (b), if transmitter antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the mount in dB that the directional gain of the antenna exceeds 6 dBi.

13.2 Antenna Connected constructions

Integral antenna used. The maximum Gain of the antennas is 2.0dBi.

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14.0 FCC ID Label

FCC ID: 2AACS-NEB156-215

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The label must not be a stick-on paper label. The label on these products must be permanently affixed to the product and readily visible at the time of purchase and must last the expected lifetime of the equipment not be readily detachable.

Mark Location:

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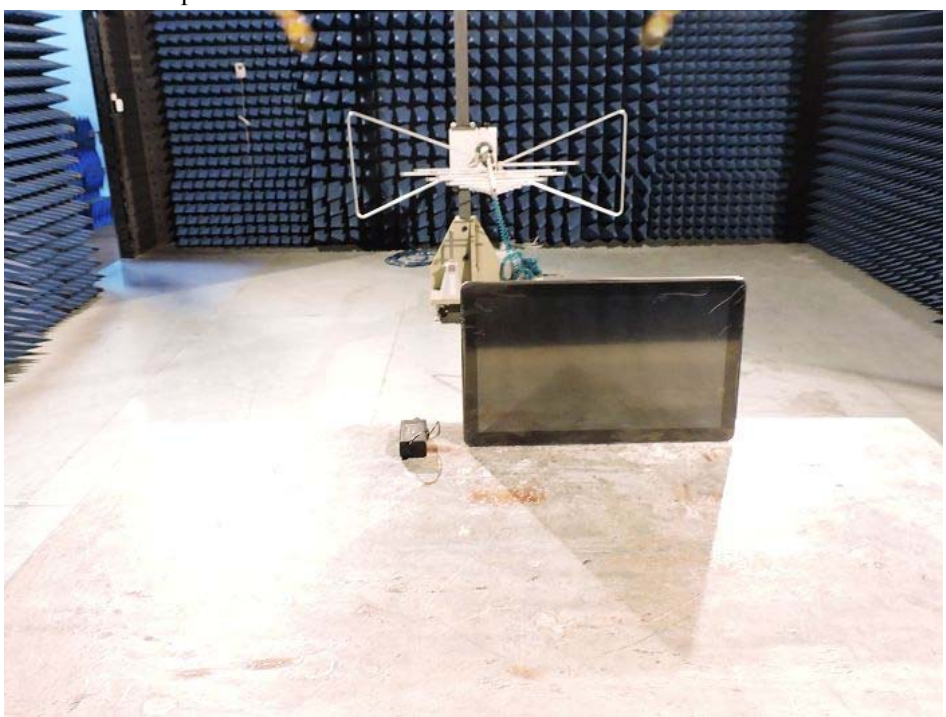
15.0 Photo of testing

Conducted Emission Test Setup:

Radiated Emission Test Setup:



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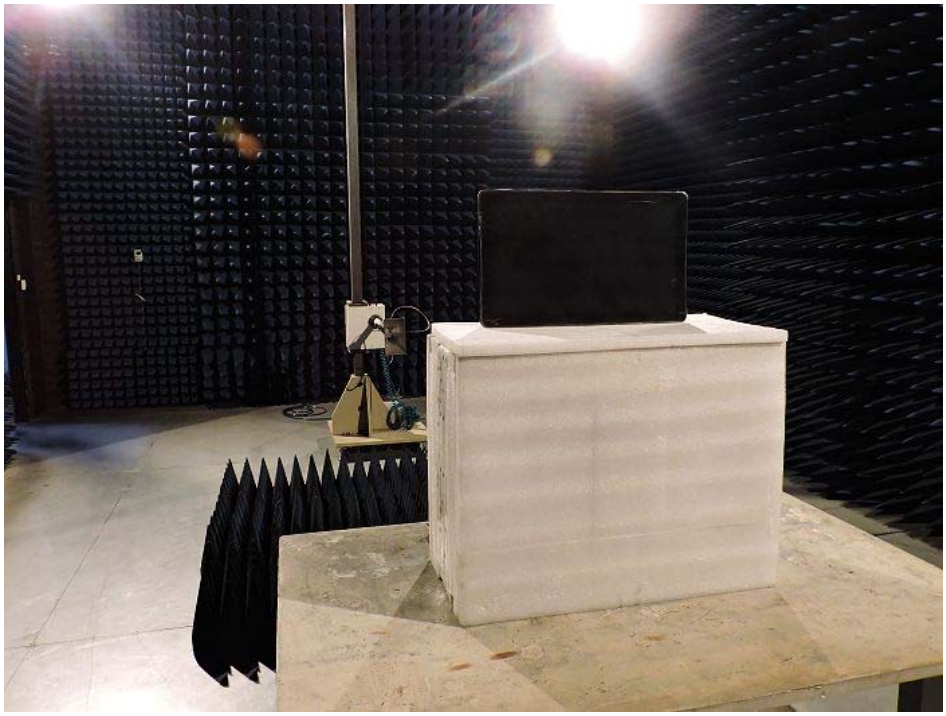

Photos of EUT

Please refer to test report FCC1709045-01

End of the report

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