

TECHNICAL REPORT



Report No: FCC 1606212  
File reference No: 2016-07-08

Applicant: Shenzhen Star Sources Electronic Technology Co., Ltd.

Product: Bluetooth keyboard

Model No: ST-ICBK20

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 Subpart C, Paragraph 15.247 regulations for the evaluation of electromagnetic compatibility

Approved By

*Jack Chung*

Jack Chung

Manager

Dated: July 08, 2016

**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 17025:1999 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.

#### **IC- Registration No.: IC5205A-02**

The EMC Laboratory has been registered and fully described in a report filed with the (IC) Industry Canada. The acceptance letter from the IC is maintained in our files. Registration No.: IC 5205A-02.

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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 States  
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: Shenzhen Star Sources Electronic Technology Co., Ltd.  
Address: RM2001 MeiLan Business Center,intersection between the road of XiXiang and Qianjin, BaoAn District, Shenzhen, China  
Telephone: +86-755-86397262 (811)  
Fax: 86-755-26609516

### 1.3 Description of EUT

Product: Bluetooth keyboard  
Manufacturer: Shenzhen Star Sources Electronic Technology Co., Ltd.  
Address: RM2001 MeiLan Business Center,intersection between the road of XiXiang and Qianjin, BaoAn District, Shenzhen, China  
Brand Name: N/A  
Model Number: ST-ICBK20  
Additional Model Number: N/A  
Type of Modulation GFSK,  $\pi/4$ DQPSK, 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: PCB Antenna and the maximum Gain of this antenna is 0dBi

### 1.4 Submitted Sample: 2 Samples

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1.5 Test Duration

2016-06-29 to 2016-07-06

1.6 Test Uncertainty

Conducted Emissions Uncertainty =3.6dB

Radiated Emissions Uncertainty =4.7dB

1.7 Test Engineer

*Terry Tang*

The sample tested by \_\_\_\_\_

Print Name: Terry Tang

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<b>2.0 Test Equipments</b>					
Instrument Type	Manufacturer	Model	Serial No.	Date of Cal.	Due Date
ESPI Test Receiver	R&S	ESPI 3	100379	2015-08-22	2016-08-21
TWO Line-V-NETW	R&S	EZH3-Z5	100294	2015-08-22	2016-08-21
TWO Line-V-NETW	R&S	EZH3-Z5	100253	2015-08-22	2016-08-21
Ultra Broadband ANT	R&S	HL562	100157	2015-08-23	2016-08-22
ESDV Test Receiver	R&S	ESDV	100008	2015-08-22	2016-08-21
Impuls-Begrenzer	R&S	ESH3-Z2	100281	2015-08-22	2016-08-21
System Controller	CT	SC100	-	--	--
Printer	EPSON	PHOTO EX3	CFNH234850	--	--
Computer	IBM	8434	1S8434KCE99BLXLO*	-	-
Loop Antenna	EMCO	6502	00042960	2015-08-23	2016-08-22
ESPI Test Receiver	R&S	ESI26	838786/013	2015-08-22	2016-08-23
3m OATS	--	--	N/A	2015-08-24	2016-08-23
Horn Antenna	R&S	BBHA 9170	BBHA9170265	2015-08-24	2016-08-23
Horn Antenna	R&S	BBHA 9120D	9120D-631	2015-08-24	2016-08-23
Power meter	Anritsu	ML2487A	6K00003613	2015-08-22	2016-08-21
Power sensor	Anritsu	MA2491A	32263	2015-08-22	2016-08-21
Bilog Antenna	Schwarebeck	VULB9163	9163/340	2015-08-23	2016-08-21
LISN	AFJ	LS16C	10010947251	2015-08-22	2016-08-21
LISN (Three Phase)	Schwarebeck	NSLK 8126	8126453	2015-08-23	2016-08-22
9*6*6 Anechoic	--	--	N/A	2015-08-24	2016-08-23
EMI Test Receiver	RS	ESCS30	100139	2015-08-22	2016-08-21

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**3.0 Technical Details**

**3.1 Summary of test results**

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

**3.2 Test Standards**

**FCC Part 15 Subpart & Subpart C, Paragraph 15.247, ANSI C63.4:2014 and ANSI C63.10:2013**

**4.0 EUT Modification**

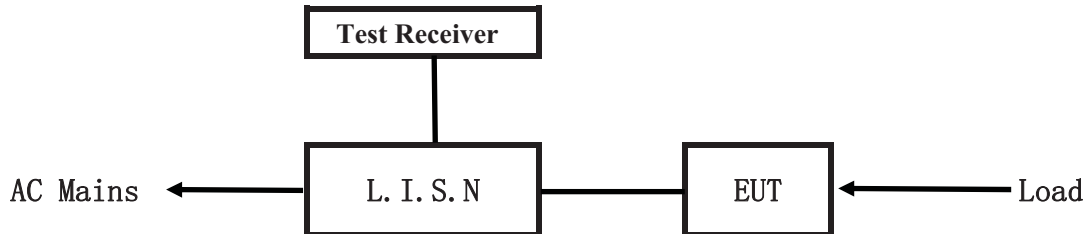
**No modification by SHENZHEN TIMEWAY TESTING LABORATORIES**

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## 5. Power Line Conducted Emission Test

### 5.1 Schematics of the test



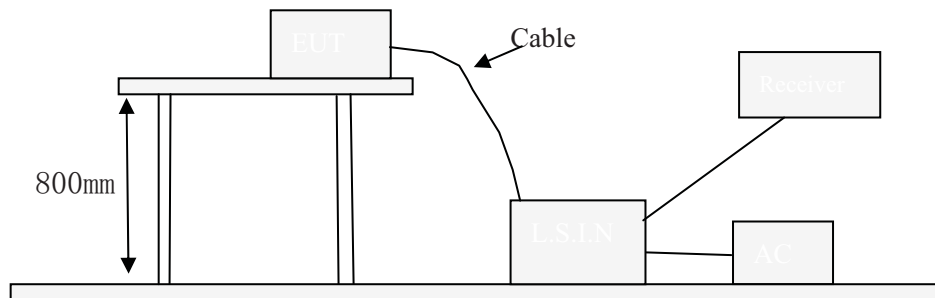
EUT: Equipment Under Test

### 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
Bluetooth keyboard	Shenzhen Star Sources Electronic Technology Co., Ltd.	ST-ICBK20	ZJEST-ICBK20

B. Internal Device

Device	Manufacturer	Model	Rating

C. Peripherals

Device	Manufacturer	Model	Cable
Power Supply	Ruiheng	RH-050100US	Input: 100-240V~, 0.2A, 50/60Hz, Output: DC5V, 1A

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 $\mu$ V)		Class B Limits (dB $\mu$ 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)**

**EUT Operating Environment**

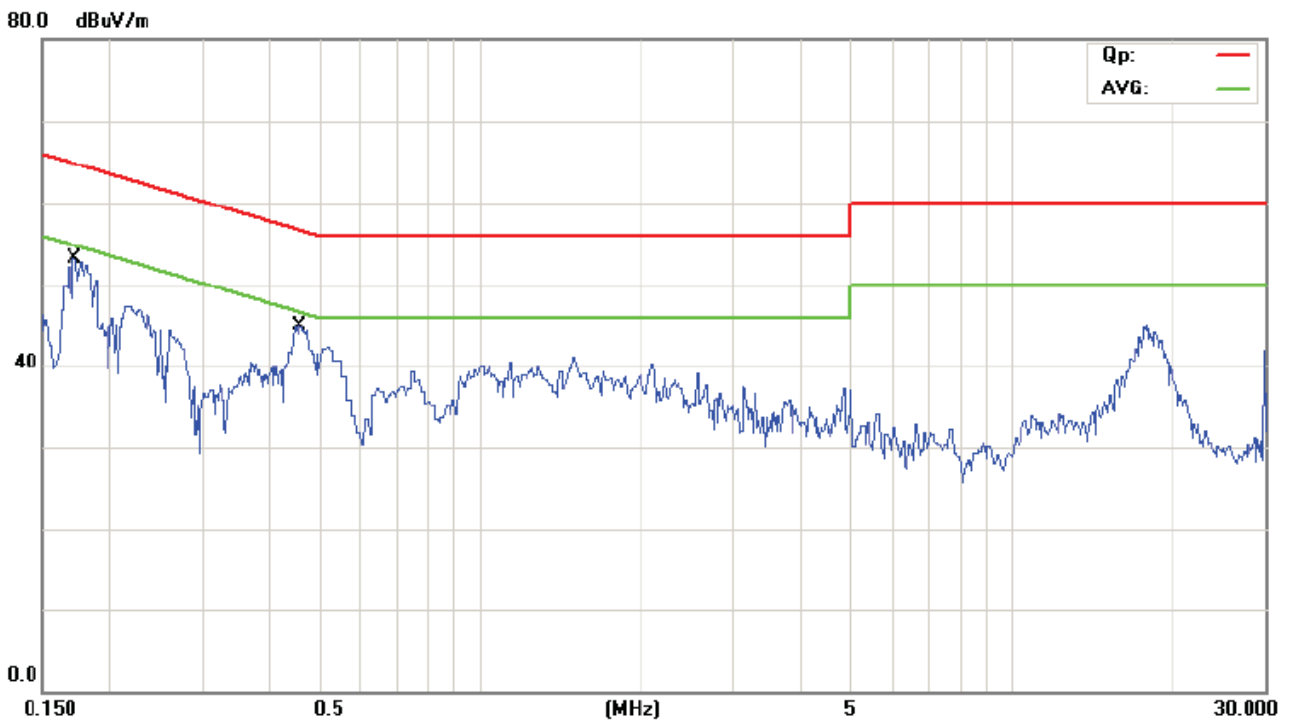
Temperature: 26°C Humidity: 65%RH Atmospheric Pressure: 101 KPa

**EUT set Condition: Keep Bluetooth Transmitting**

**Equipment Level: Class B**

**Results: PASS**

Please refer to following diagram for individual



No.	Mk.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		0.1720	36.10	11.02	47.12	64.86	-17.74	QP	
2		0.1720	14.70	11.02	25.72	54.86	-29.14	AVG	
3	*	0.4637	30.80	11.33	42.13	56.63	-14.50	QP	
4		0.4637	12.10	11.33	23.43	46.63	-23.20	AVG	

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

**EUT Operating Environment**

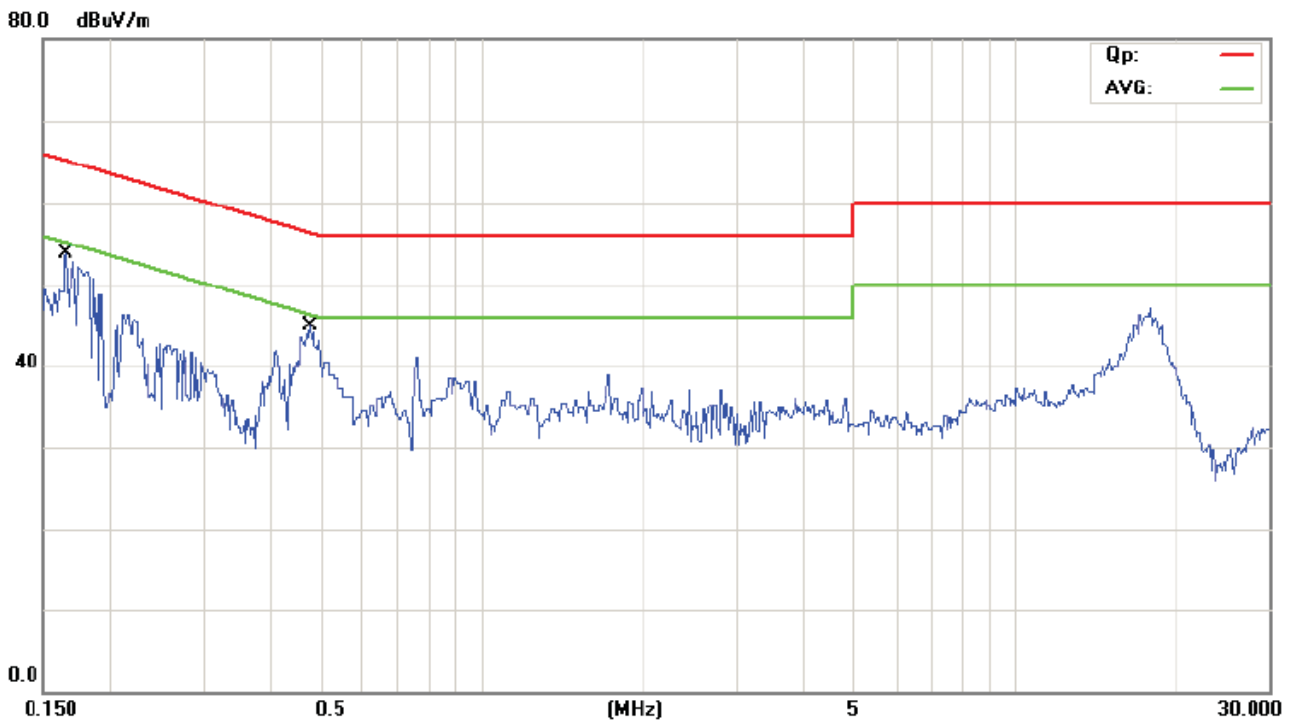
Temperature: 26°C Humidity: 65%RH Atmospheric Pressure: 101 KPa

**EUT set Condition: Keep Bluetooth Transmitting**

**Equipment Level: Class B**

**Results: Pass**

Please refer to following diagram for individual



No.	Mk.	Freq. MHz	Reading Level dBuV/m	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		0.1644	36.30	11.02	47.32	65.24	-17.92	QP	
2		0.1644	15.50	11.02	26.52	55.24	-28.72	AVG	
3	*	0.4750	30.70	11.34	42.04	56.43	-14.39	QP	
4		0.4750	13.30	11.34	24.64	46.43	-21.79	AVG	

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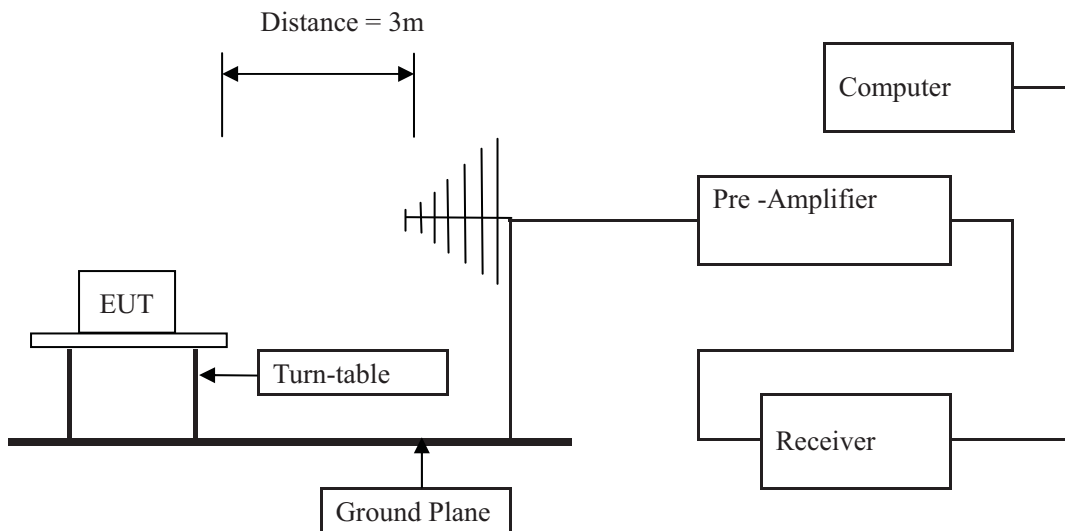


## 6 Radiated Emission Test

### 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 Laboratory. This site is on file with the FCC laboratory division, Registration No.899988
- (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 $\mu$ 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 ( $\mu$ V)
  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. This is a handheld 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.
  5. All modulation have been tested ,GFSK was found as the worst case and only reported

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**Test result**

**General Radiated Emission Data and Harmonics Radiated Emission Data**

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

EUT set Condition: Keep Bluetooth Transmitting

**Results: Pass**

Frequency (MHz)	Level@3m (dB $\mu$ V/m)	Antenna Polarity	Limit@3m (dB $\mu$ V/m)
292.280	24.81	H	46.00
141.880	22.33	H	43.50
947.480	39.68	H	46.00
887.640	38.74	V	46.00
33.400	29.57	V	40.00
281.880	25.21	V	46.00

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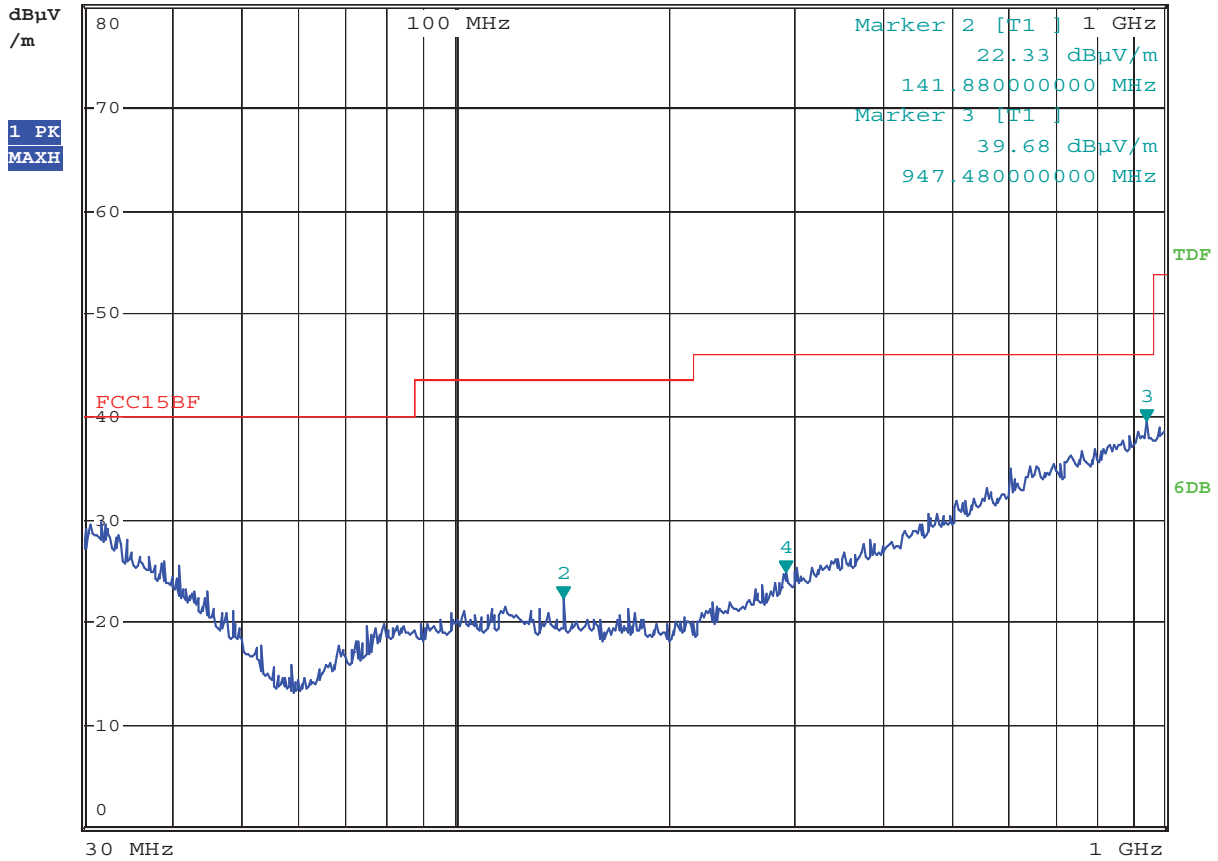
Test Figure:

H



**MARKER 4**  
 292.28 MHz  
 Att 10 dB

RBW 120 kHz Marker 4 [T1 ]  
 MT 50 μs 24.81 dBμV/m  
 PREAMP ON 292.280000000 MHz



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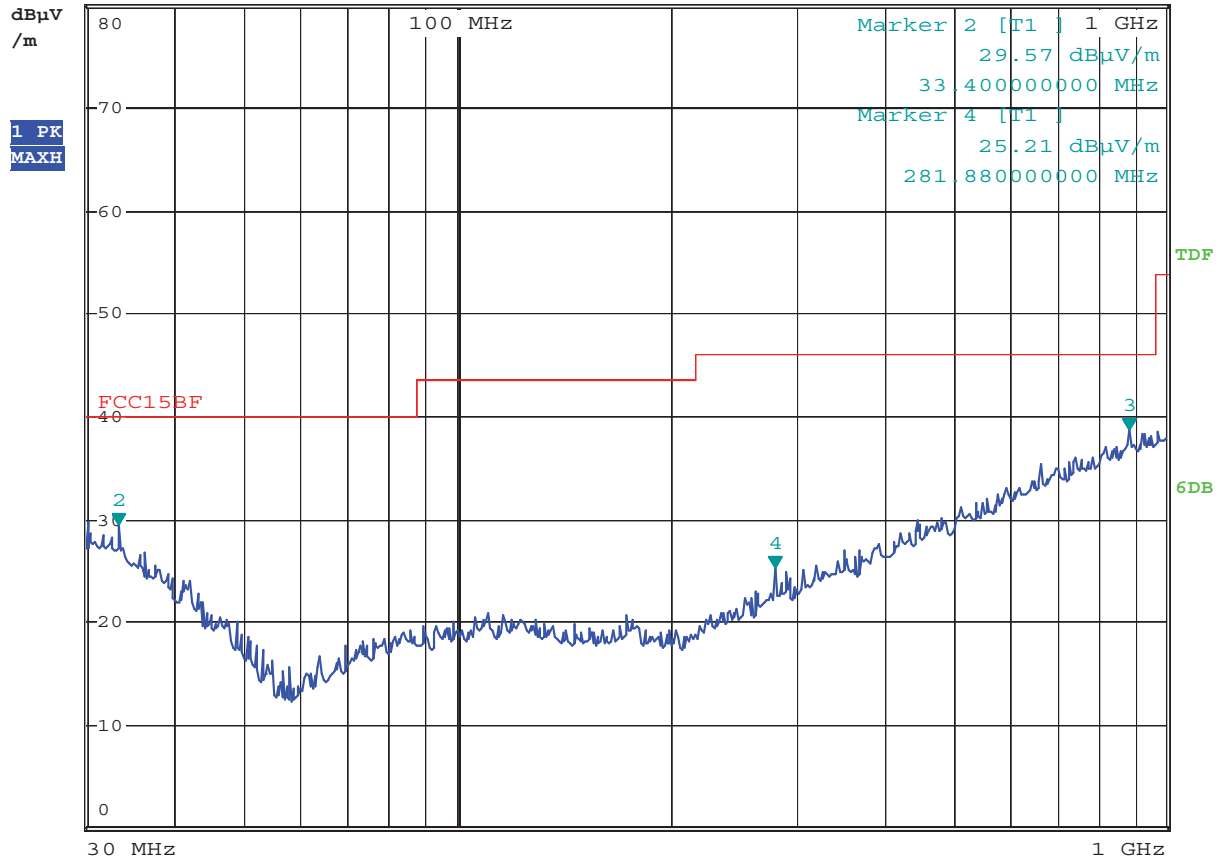
Test Figure:

V



**MARKER 3**  
 887.64 MHz  
 Att 10 dB

RBW 120 kHz Marker 3 [T1 ]  
 MT 50 μs 38.74 dBμV/m  
 PREAMP ON 887.640000000 MHz



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**Operation Mode: Transmitting under Low Channel (2402MHz)**

Frequency (MHz)	Level@3m (dB $\mu$ V/m)	Antenna Polarity	Limit@3m (dB $\mu$ 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 $\mu$ V/m)	Antenna Polarity	Limit@3m (dB $\mu$ 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 $\mu$ V/m)	Antenna Polarity	Limit@3m (dB $\mu$ 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)

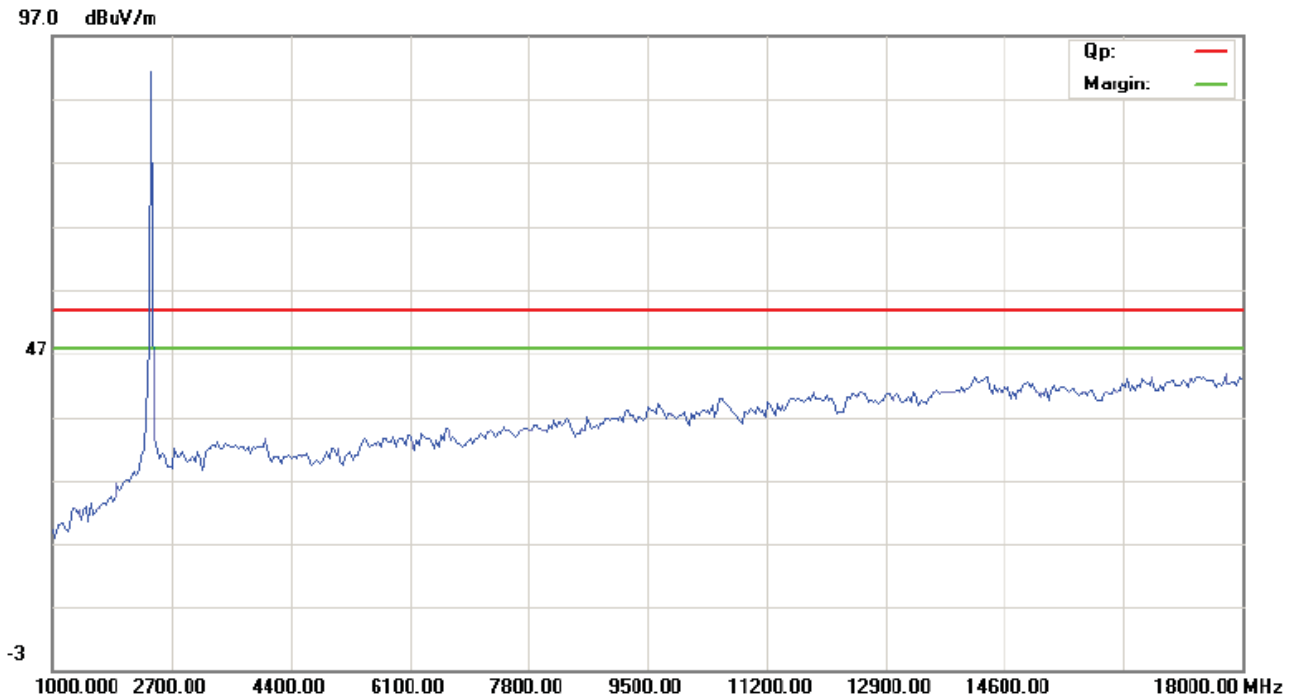
- Note: 1. Level = Reading + AF + Cable - Preamp + Filter - Dist, Margin = Level - Limit  
2. Remark “---” means that the emissions level is too low to be measured

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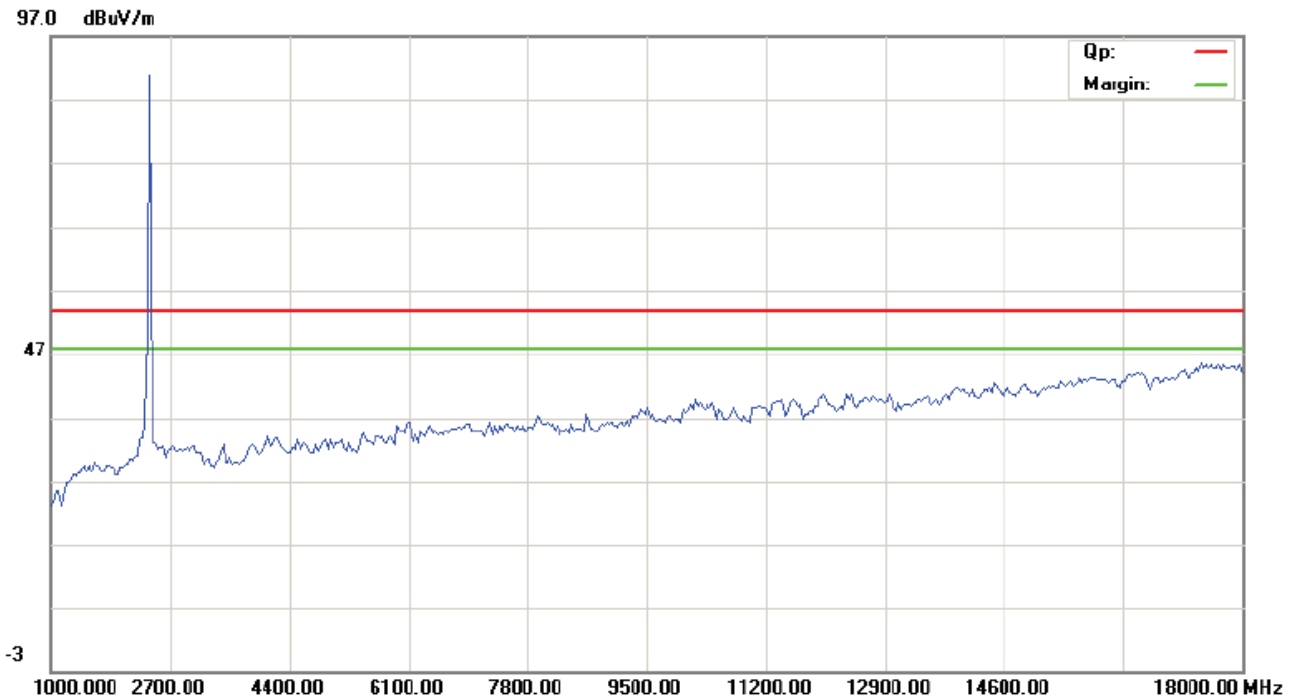


Please refer to the following test plots for details:

**Low Channel: Horizontal**



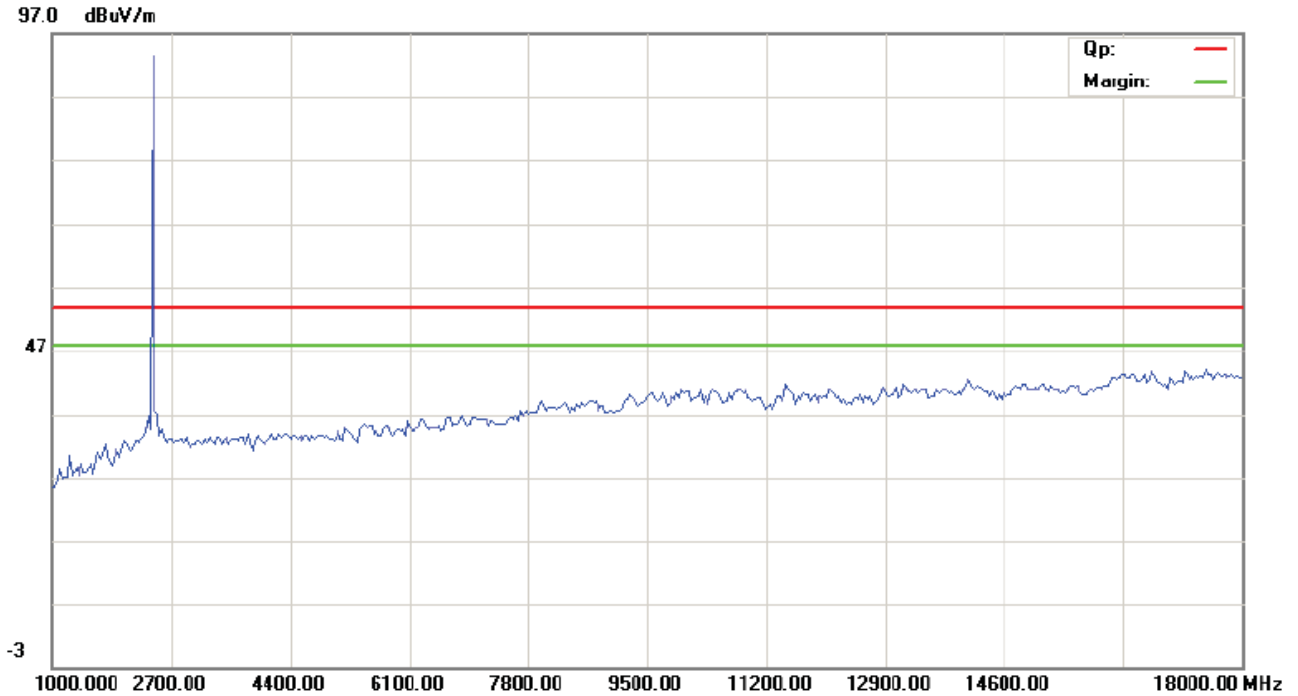
**Low Channel : Vertical**



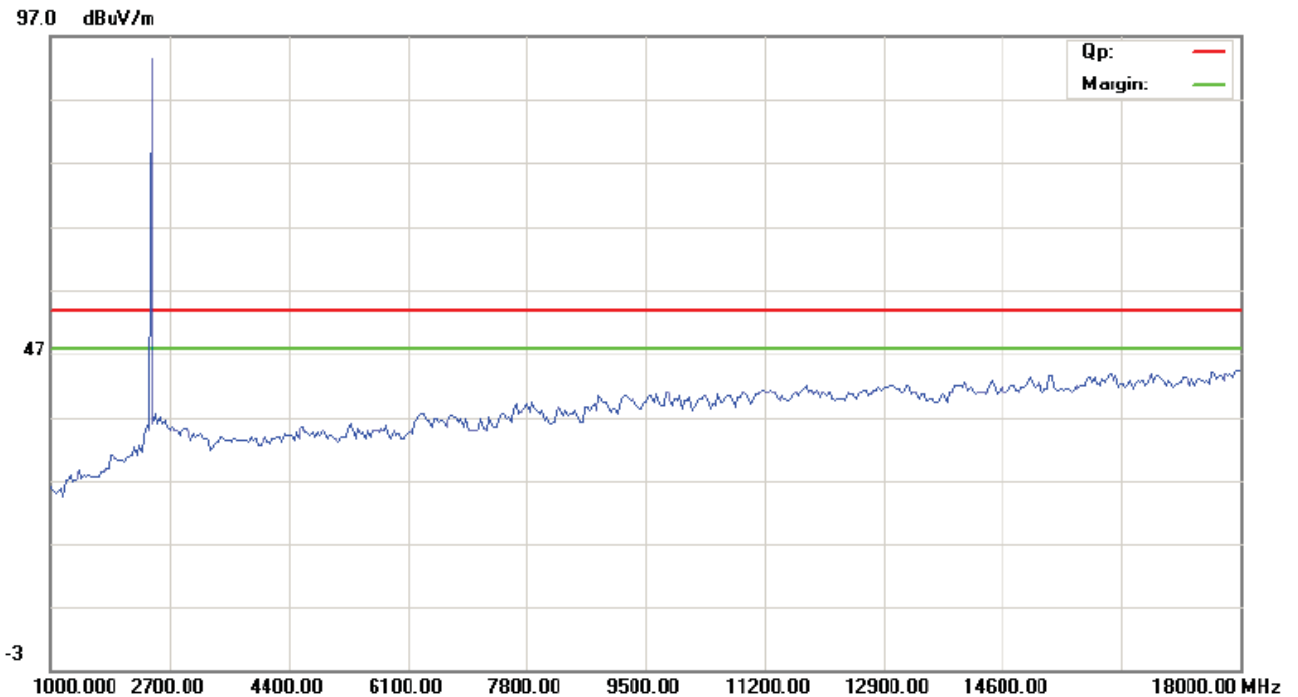
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**Middle Channel : Horizontal**



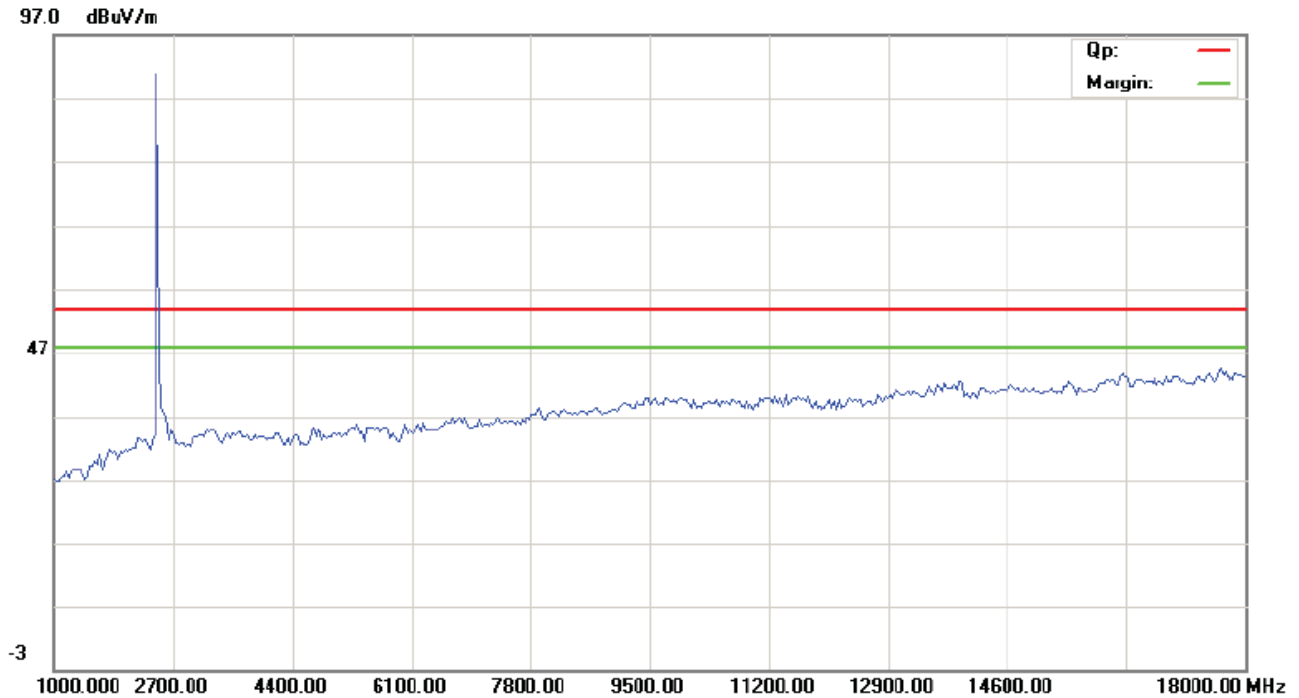
**Middle Channel : Vertical**



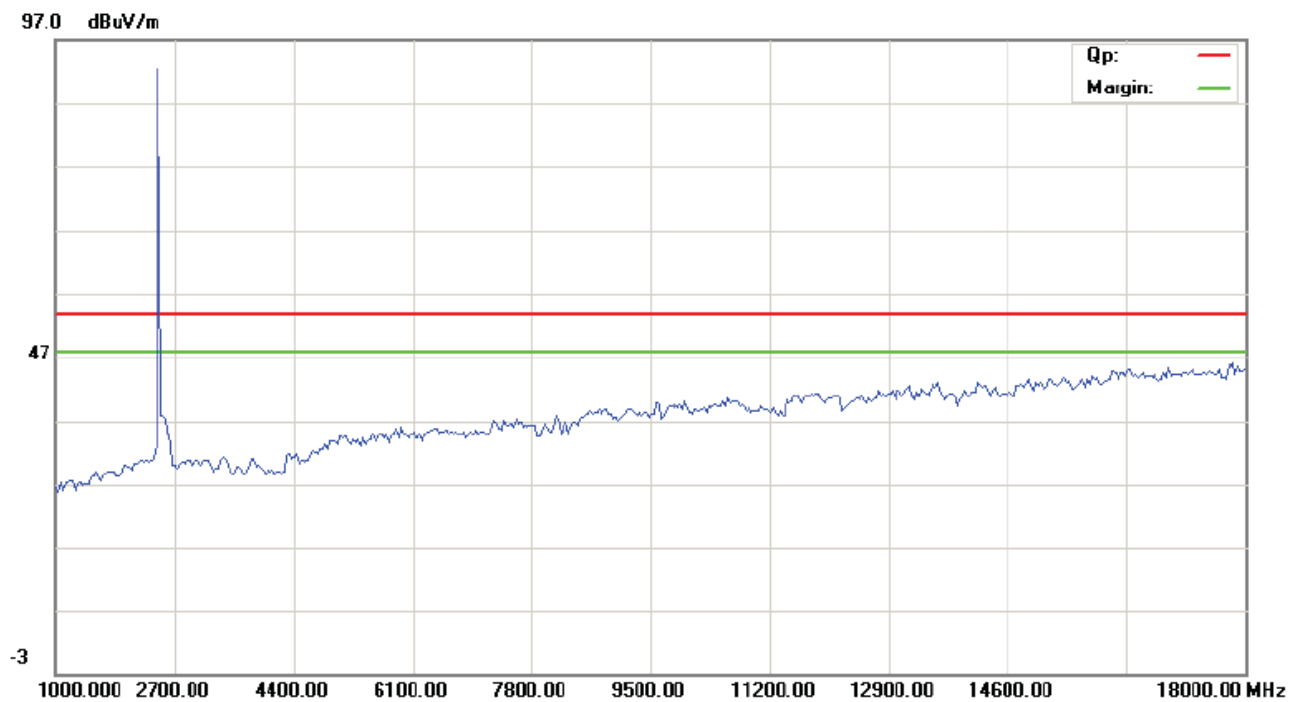
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### High Channel : Horizontal



### 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:  
GFSK Modulation: Span =3MHz, RBW =100 kHz, VBW=300 kHz, Sweep = auto Detector function = peak, Trace = max hold  
π/4DQPSK and 8DPSK Modulation: 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	Bluetooth keyboard		Model	ST-ICBK20
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	878	--	Pass
Middle	2441	878	--	Pass
High	2480	854	--	Pass

The report refers only to the sample tested and does not apply to the bulk.

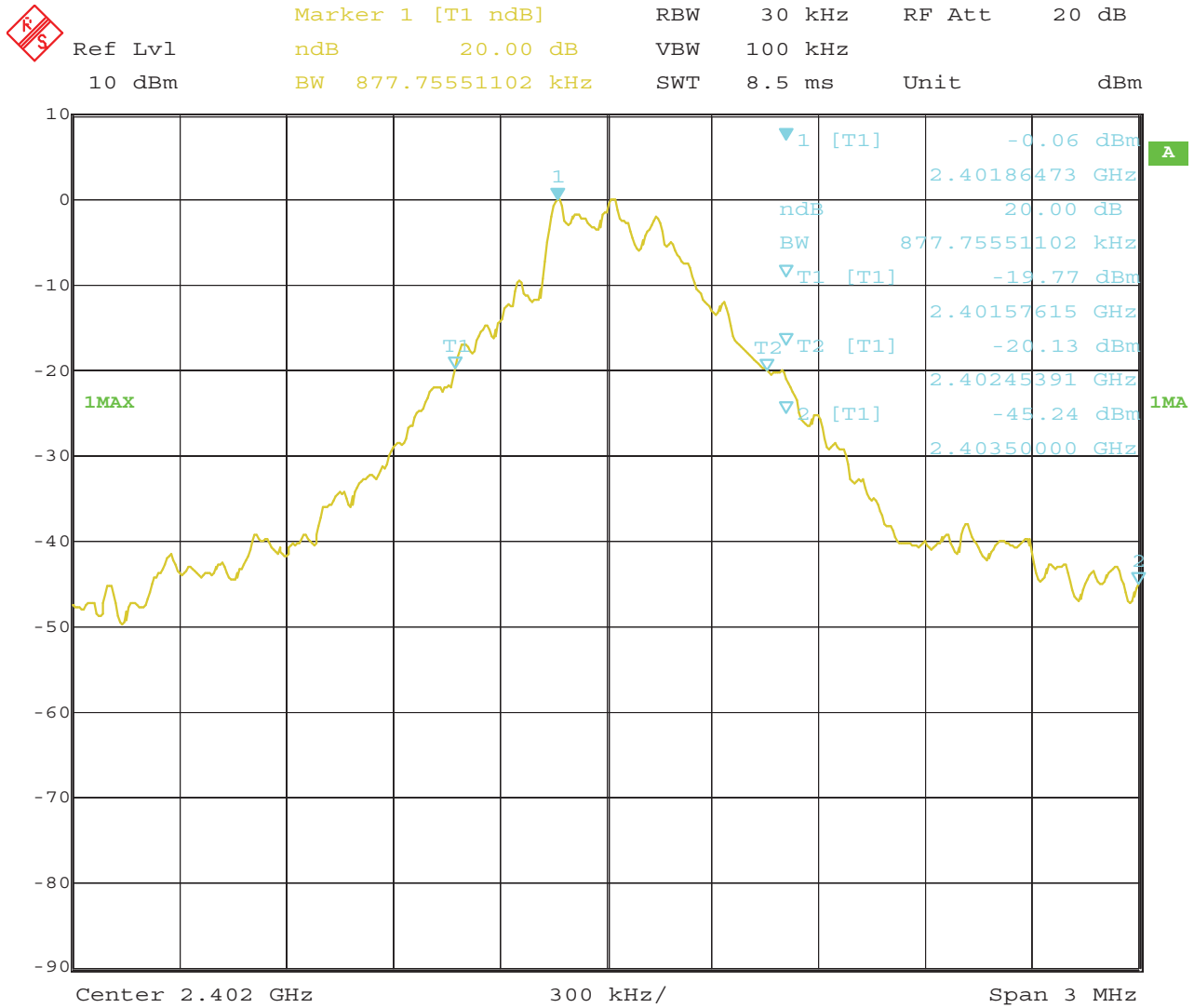
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Test Figure:

**1. Condition: Low Channel**

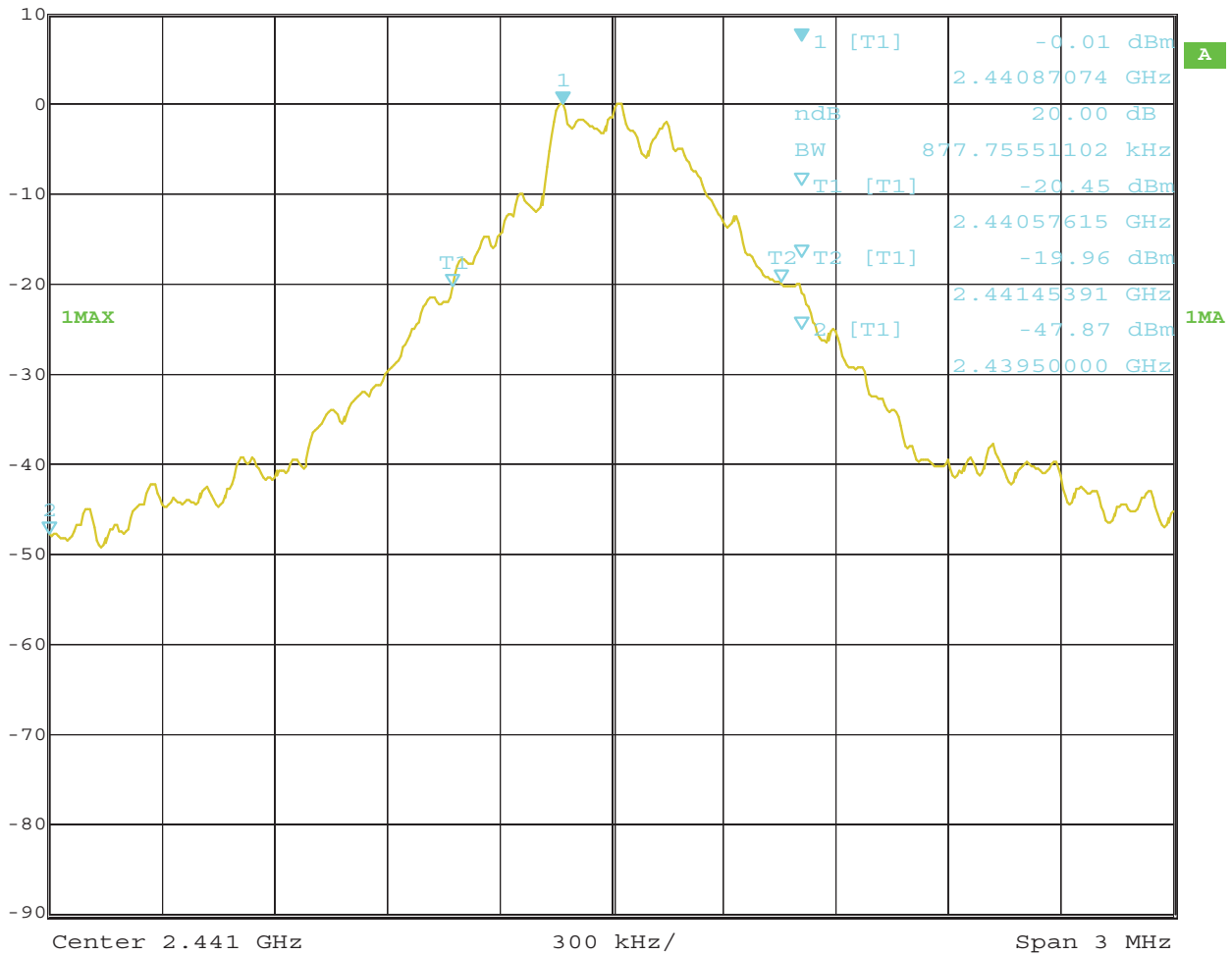


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**2. Condition: Middle Channel**

	Marker 1 [T1 ndB]	RBW	30 kHz	RF Att	20 dB	
	Ref Lvl	ndB	20.00 dB	VBW	100 kHz	
	10 dBm	BW	877.75551102 kHz	SWT	8.5 ms	Unit



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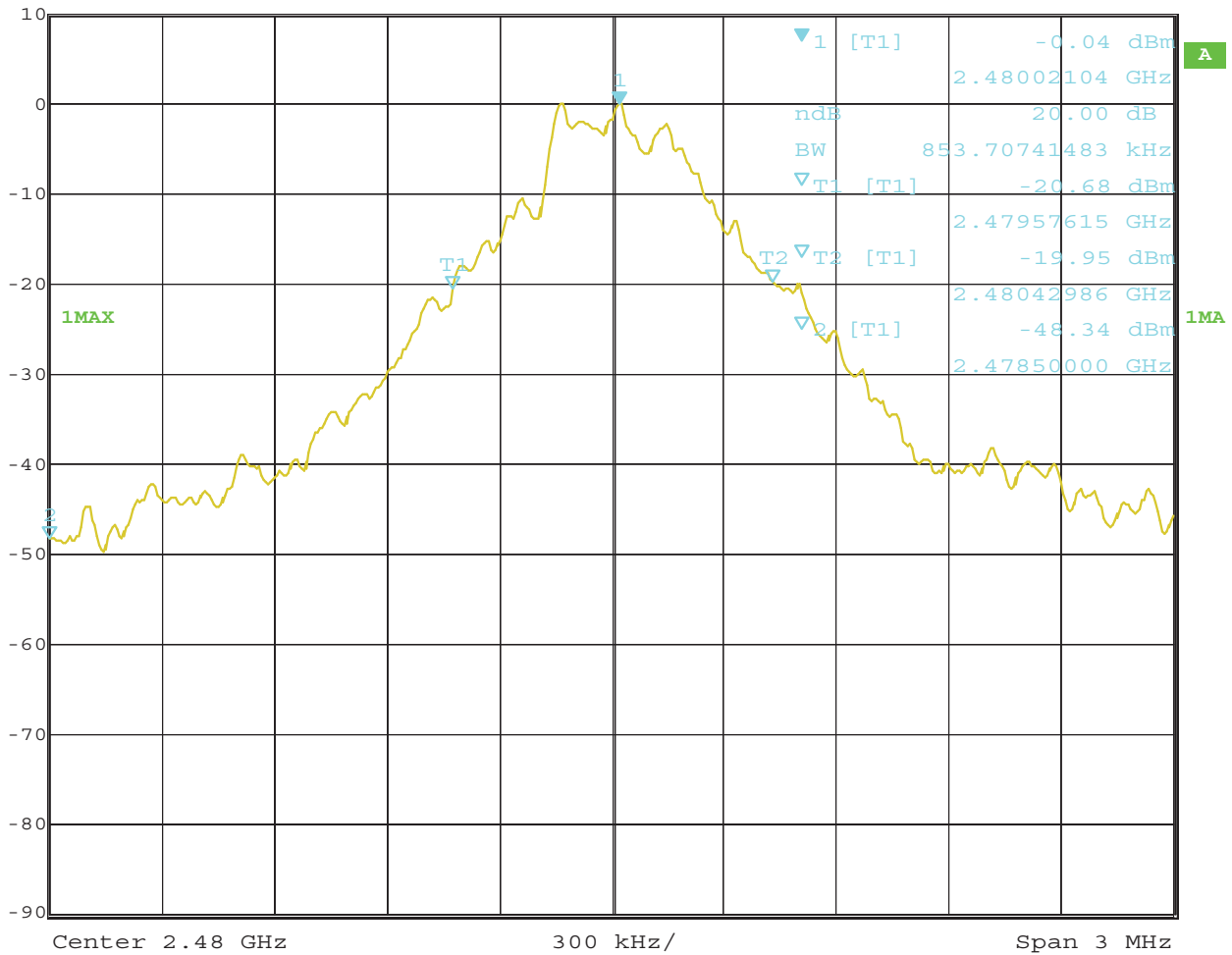




### 3. High Channel



Ref Lvl	Marker 1 [T1 ndB]	RBW	30 kHz	RF Att	20 dB
10 dBm	ndB 20.00 dB	VBW	100 kHz		
	BW 853.70741483 kHz	SWT	8.5 ms	Unit	dBm



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**Test Result**

**Type of Modulation:**  $\pi/4$ DQPSK

EUT	Bluetooth keyboard		Model	ST-ICBK20
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	1220	--	Pass
Middle	2441	1220	--	Pass
High	2480	1214	--	Pass

The report refers only to the sample tested and does not apply to the bulk.

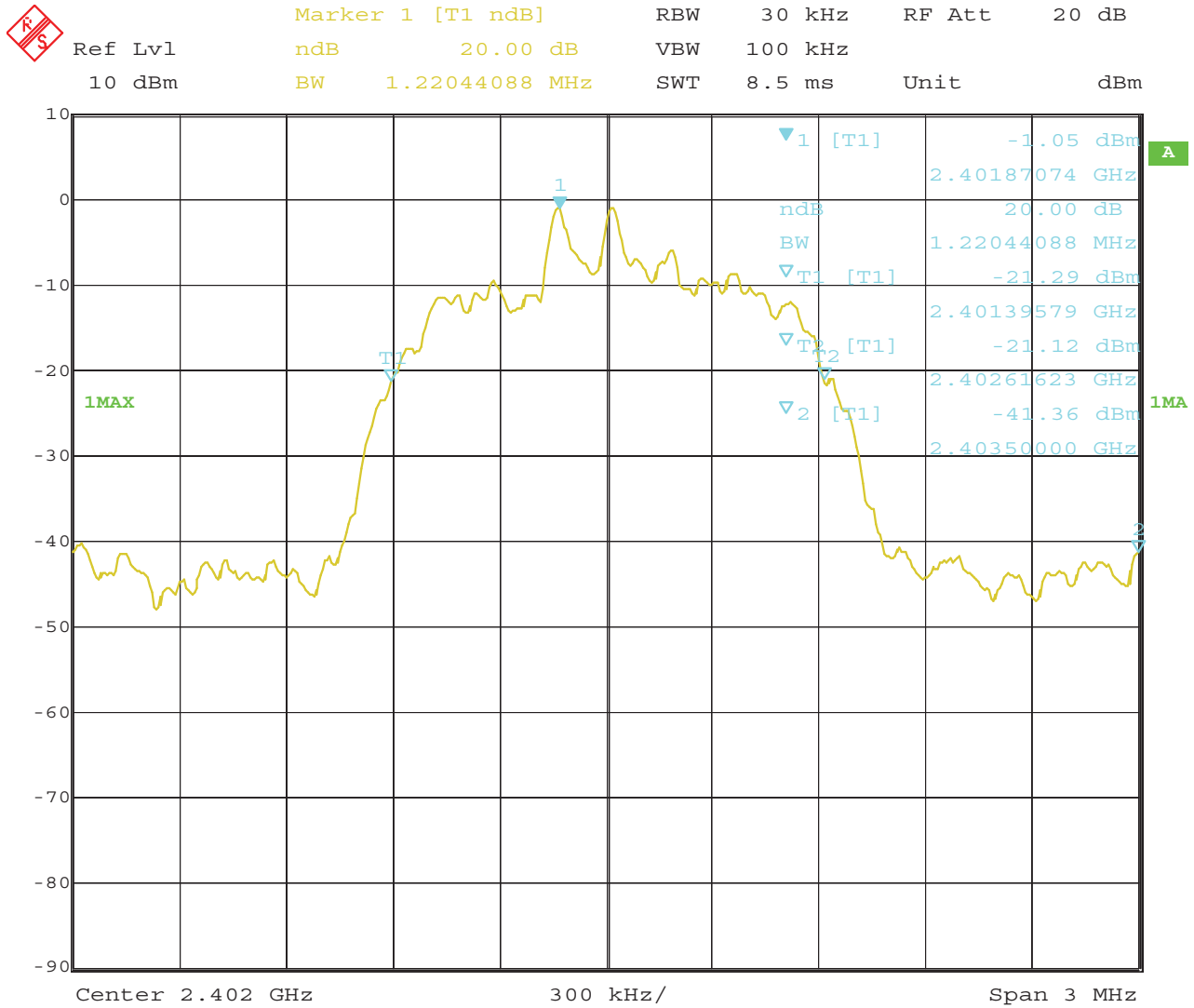
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Test Figure:

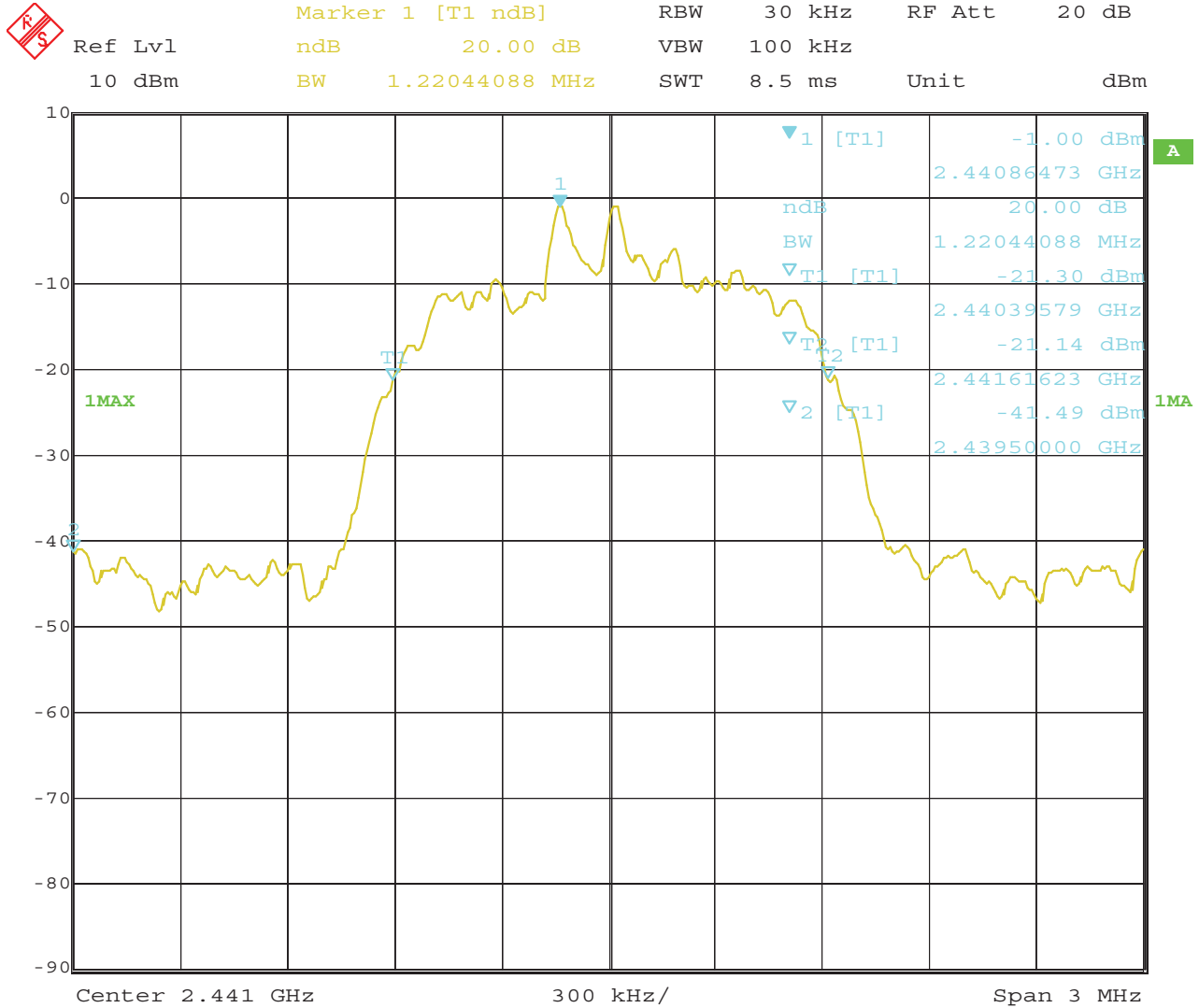
**1. Condition: Low Channel**



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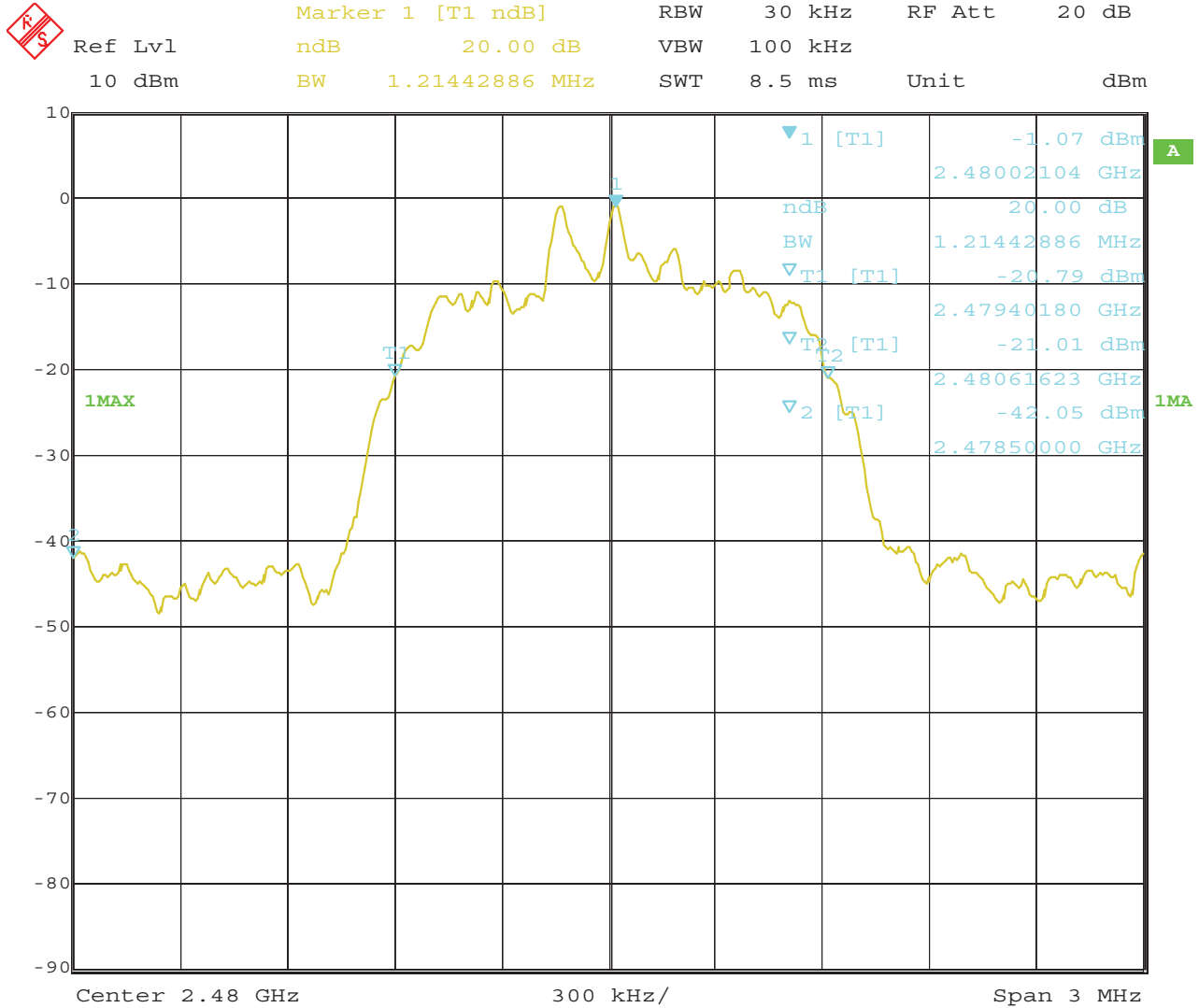
**2. Condition: Middle Channel**



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### 3. High Channel



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**Test Result**

**Type of Modulation: 8DPSK**

EUT	Bluetooth keyboard		Model	ST-ICBK20
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	1220	--	Pass
Middle	2441	1220	--	Pass
High	2480	1214	--	Pass

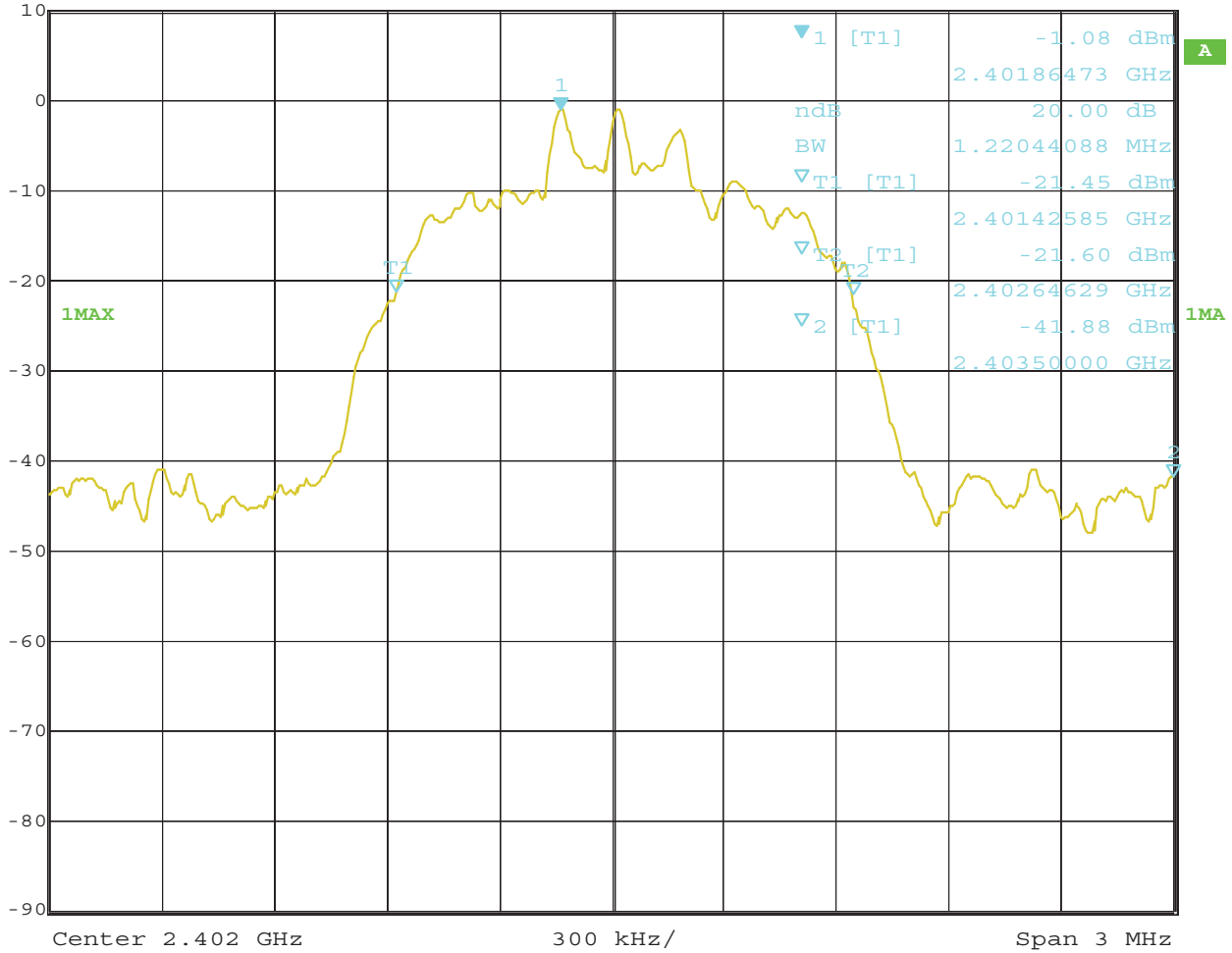
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Test Figure:

**1. Condition: Low Channel**

	Marker 1 [T1 ndB]	RBW	30 kHz	RF Att	20 dB	
	Ref Lvl	ndB	20.00 dB	VBW	100 kHz	
	10 dBm	BW	1.22044088 MHz	SWT	8.5 ms	Unit



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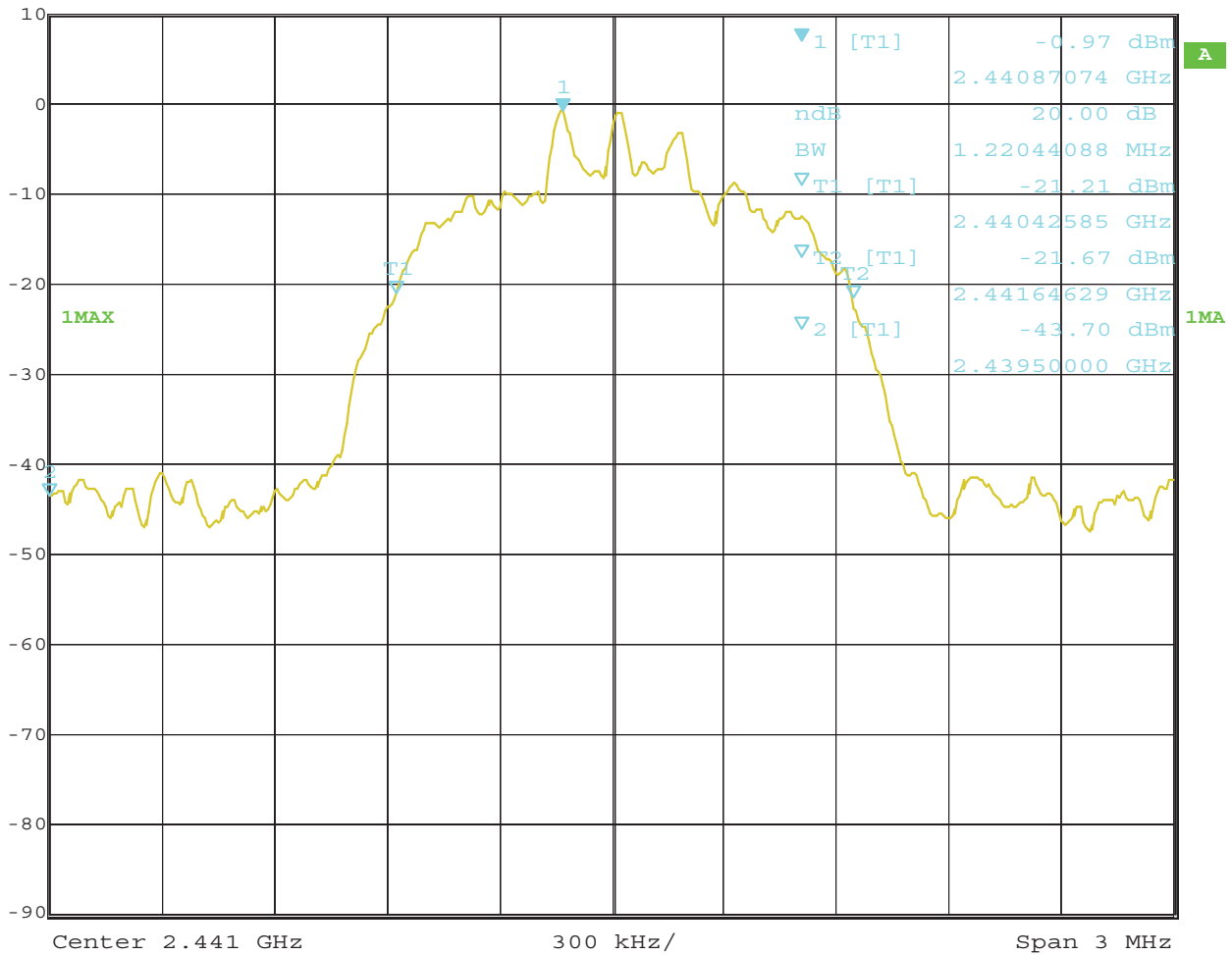
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2. Condition: Middle Channel



Ref Lvl	Marker 1 [T1 ndB]	RBW	30 kHz	RF Att	20 dB
10 dBm	ndB 20.00 dB	VBW	100 kHz		
	BW 1.22044088 MHz	SWT	8.5 ms	Unit	dBm

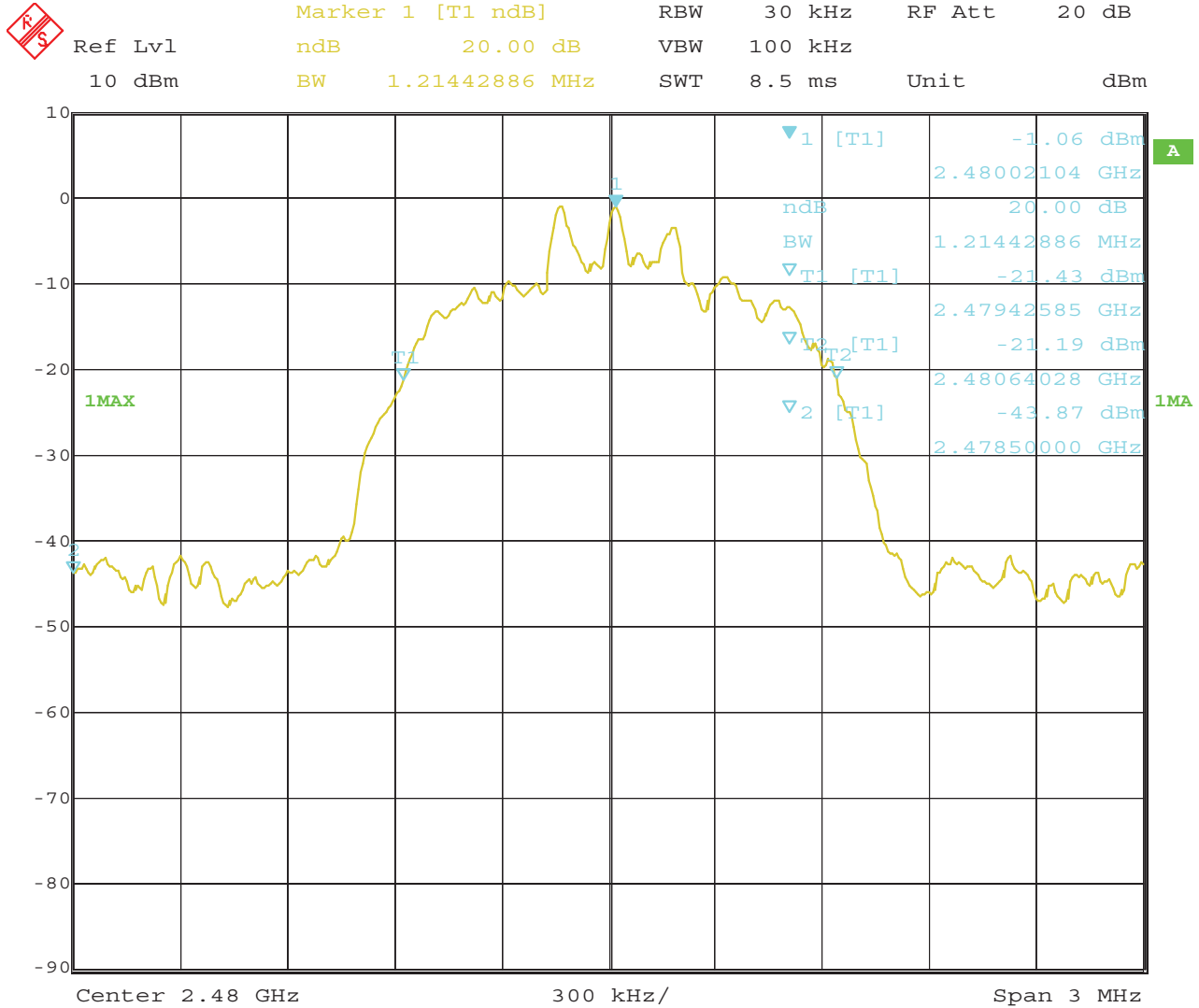


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### 3. High Channel



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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 = 10MHz, RBW=3MHz; Sweep = auto; Detector function = peak; 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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#### 8.4 Test Results

##### Type of Modulation: GFSK

EUT	Bluetooth keyboard		Model	ST-ICBK20
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
Low	2402	1.94	30	Pass
Middle	2441	2.06	30	Pass
High	2480	1.94	30	Pass

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

$$\text{Max. Power Output} = \text{Power Reading} + \text{Cable loss} + \text{Attenuator}$$

2. The worse case was recorded

##### Type of Modulation: $\pi/4$ DQPSK

EUT	Bluetooth keyboard		Model	ST-ICBK20
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
Low	2402	1.01	30	Pass
Middle	2441	1.01	30	Pass
High	2480	0.88	30	Pass

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

$$\text{Max. Power Output} = \text{Power Reading} + \text{Cable loss} + \text{Attenuator}$$

2. The worse case was recorded

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**Type of Modulation: 8DPSK**

EUT	Bluetooth keyboard		Model	ST-ICBK20
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
Low	2402	1.18	30	Pass
Middle	2441	1.30	30	Pass
High	2480	1.18	30	Pass

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

$$\text{Max. Power Output} = \text{Power Reading} + \text{Cable loss} + \text{Attenuator}$$

2. The worse case was recorded

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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)  $\geq$  1% of the span; Video (or Average) Bandwidth (VBW)  $\geq$  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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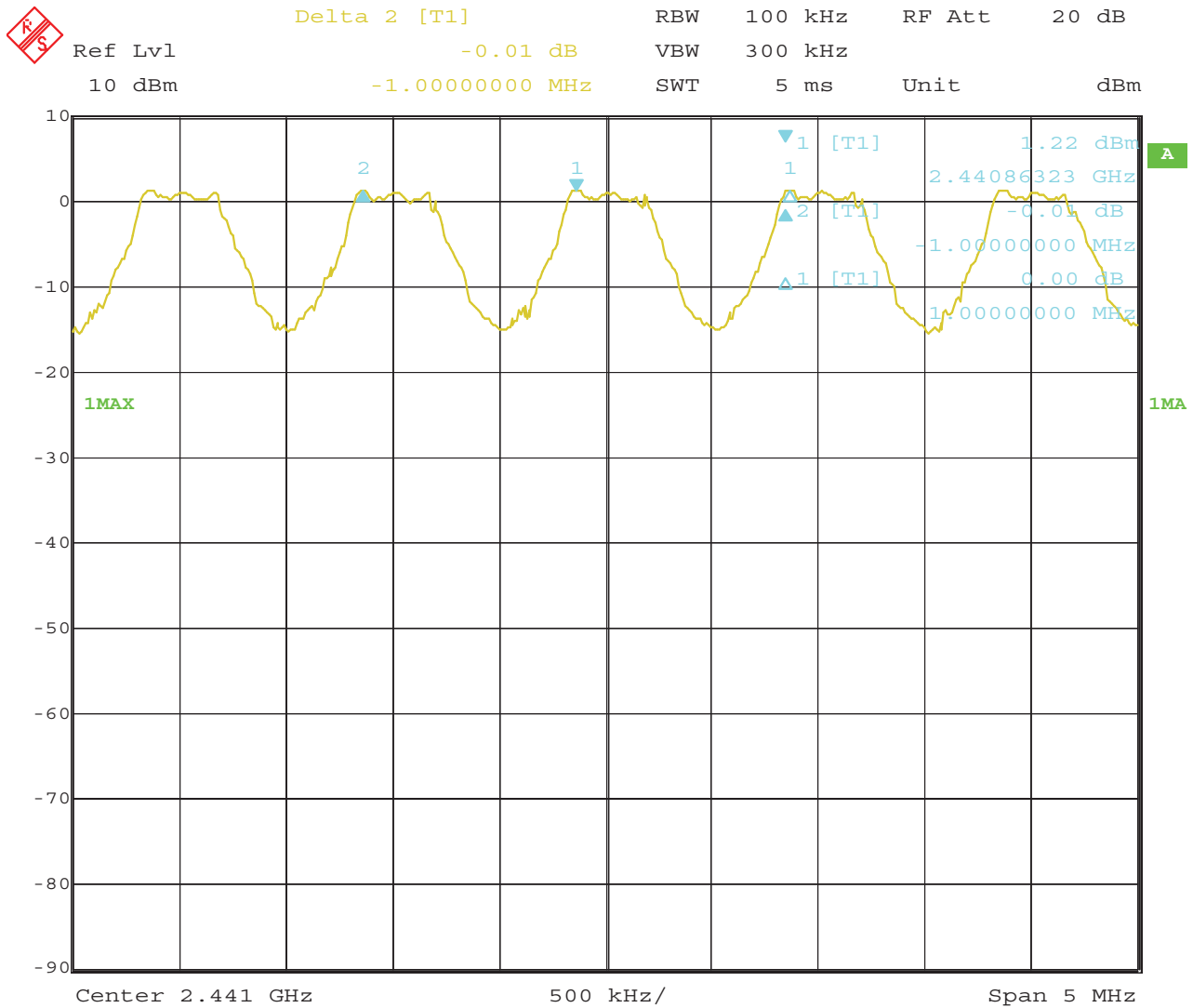


**9.4 Test Result**

**Type of Modulation: GFSK**

EUT	Bluetooth keyboard	Model	ST-ICBK20
Mode	Hopping On	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH
Carrier Frequency Separation		Limit	Pass/ Fail
1.000MHz		$\geq 25$ kHz or 2/3 of the 20 dB bandwidth	Pass

**Test Plots**



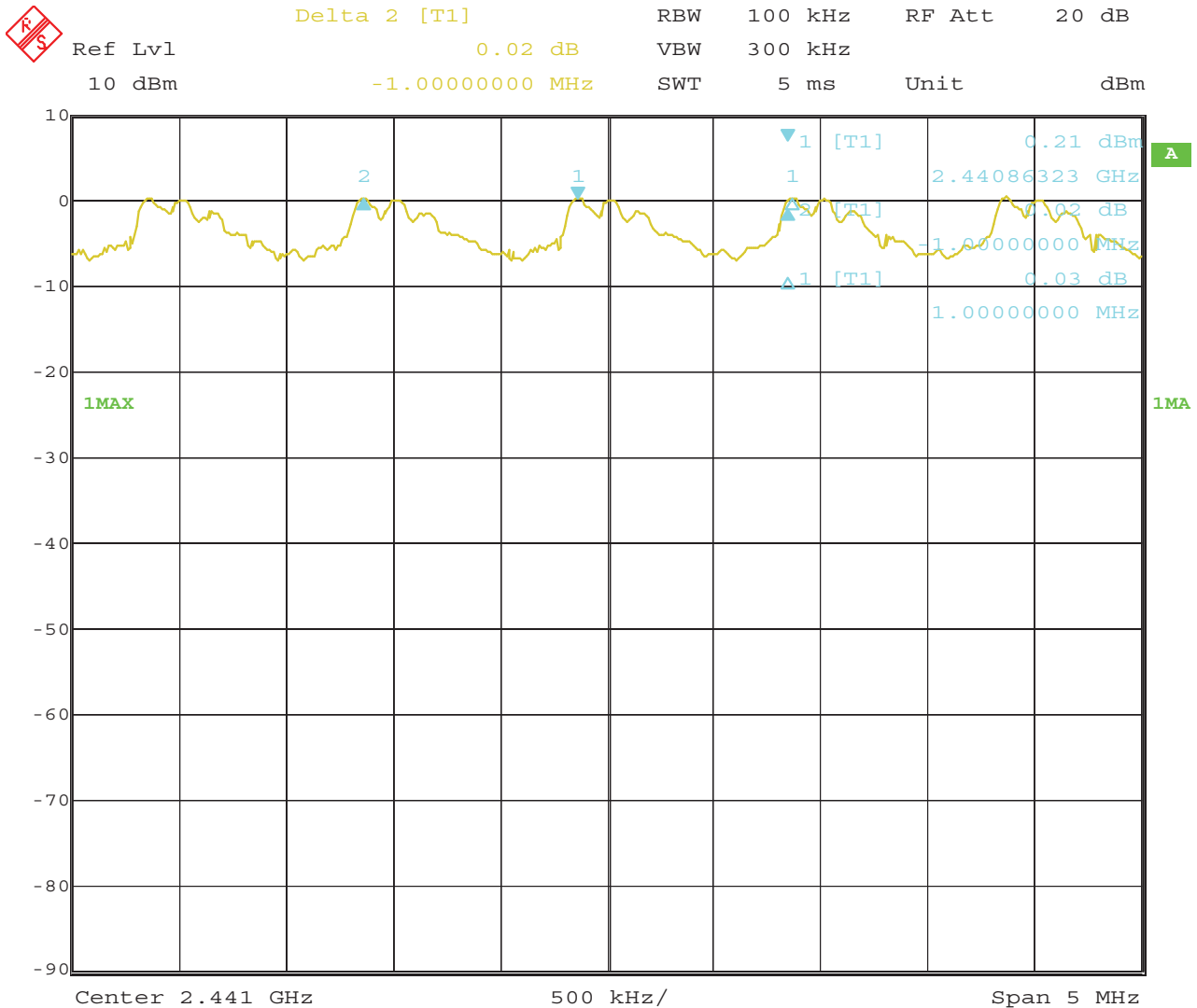
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**Type of Modulation:**  $\pi/4$ DQPSK

EUT	Bluetooth keyboard	Model	ST-ICBK20
Mode	Hopping On	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH
Carrier Frequency Separation		Limit	Pass/ Fail
1.000MHz		$\geq 25$ kHz or 2/3 of 20 dB bandwidth	Pass

**Test Plots**



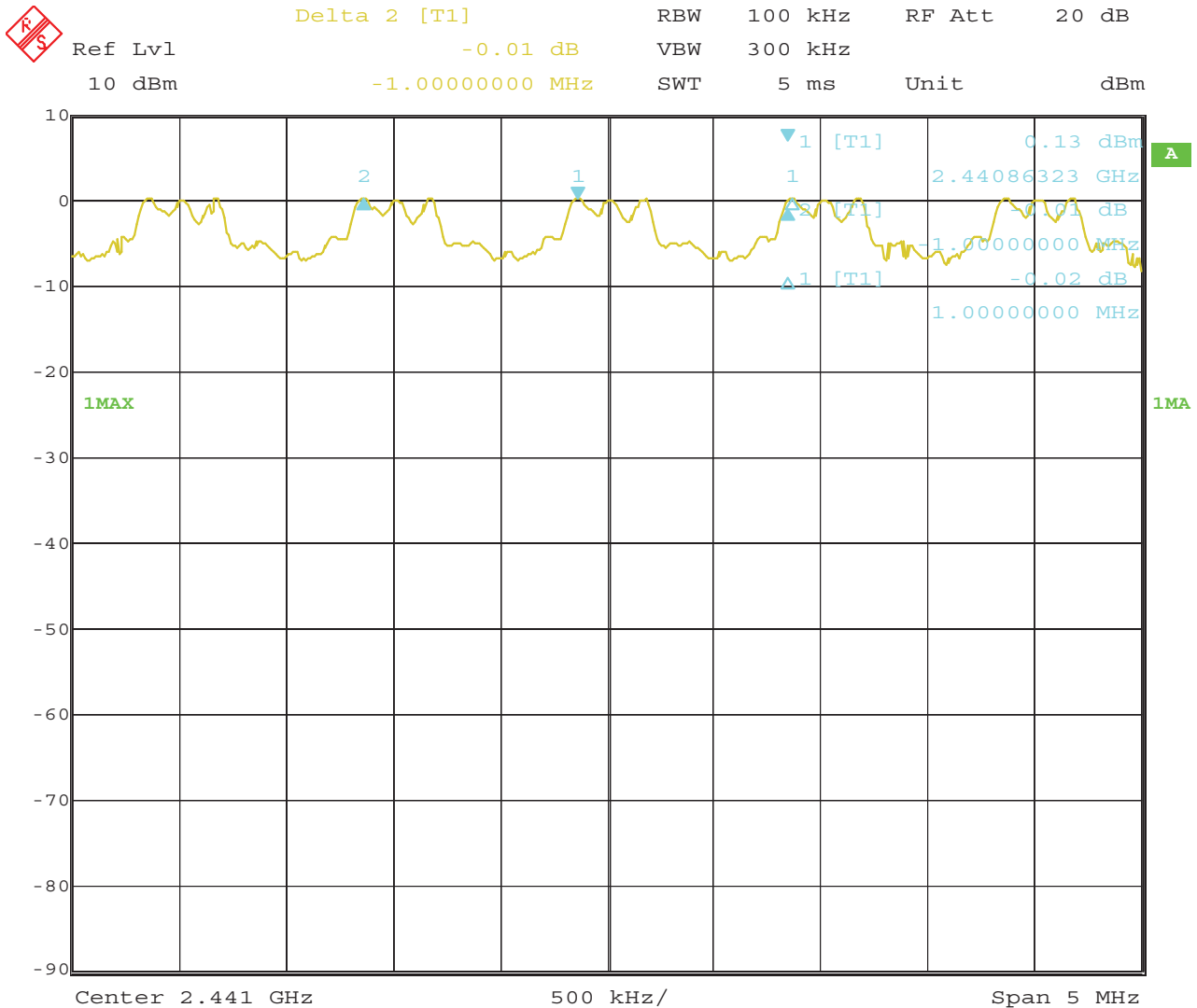
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**Type of Modulation: 8DPSK**

EUT	Bluetooth keyboard	Model	ST-ICBK20
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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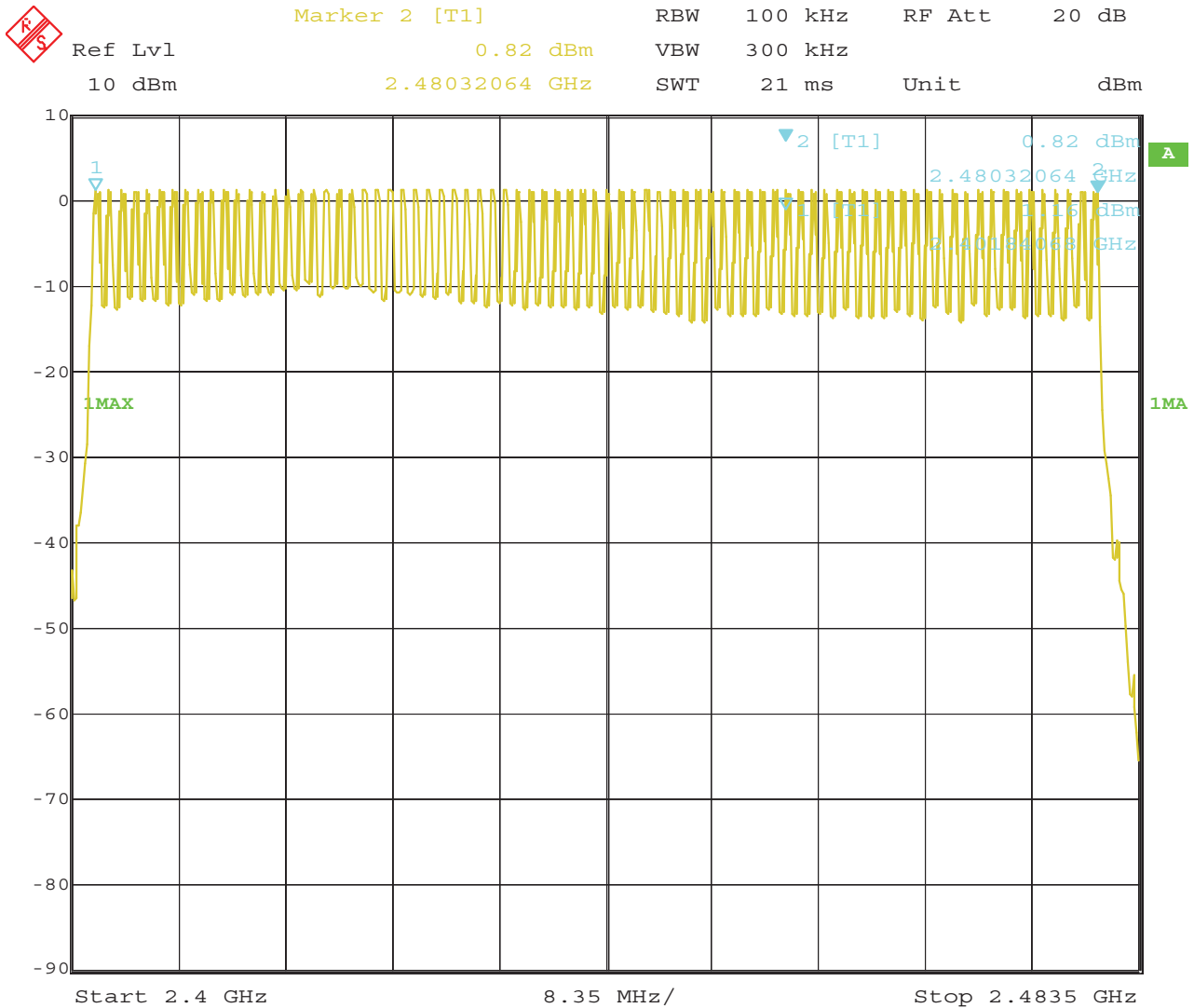


**10.4 Test Result**

**Type of Modulation: GFSK**

EUT	Bluetooth keyboard	Model	ST-ICBK20	
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**



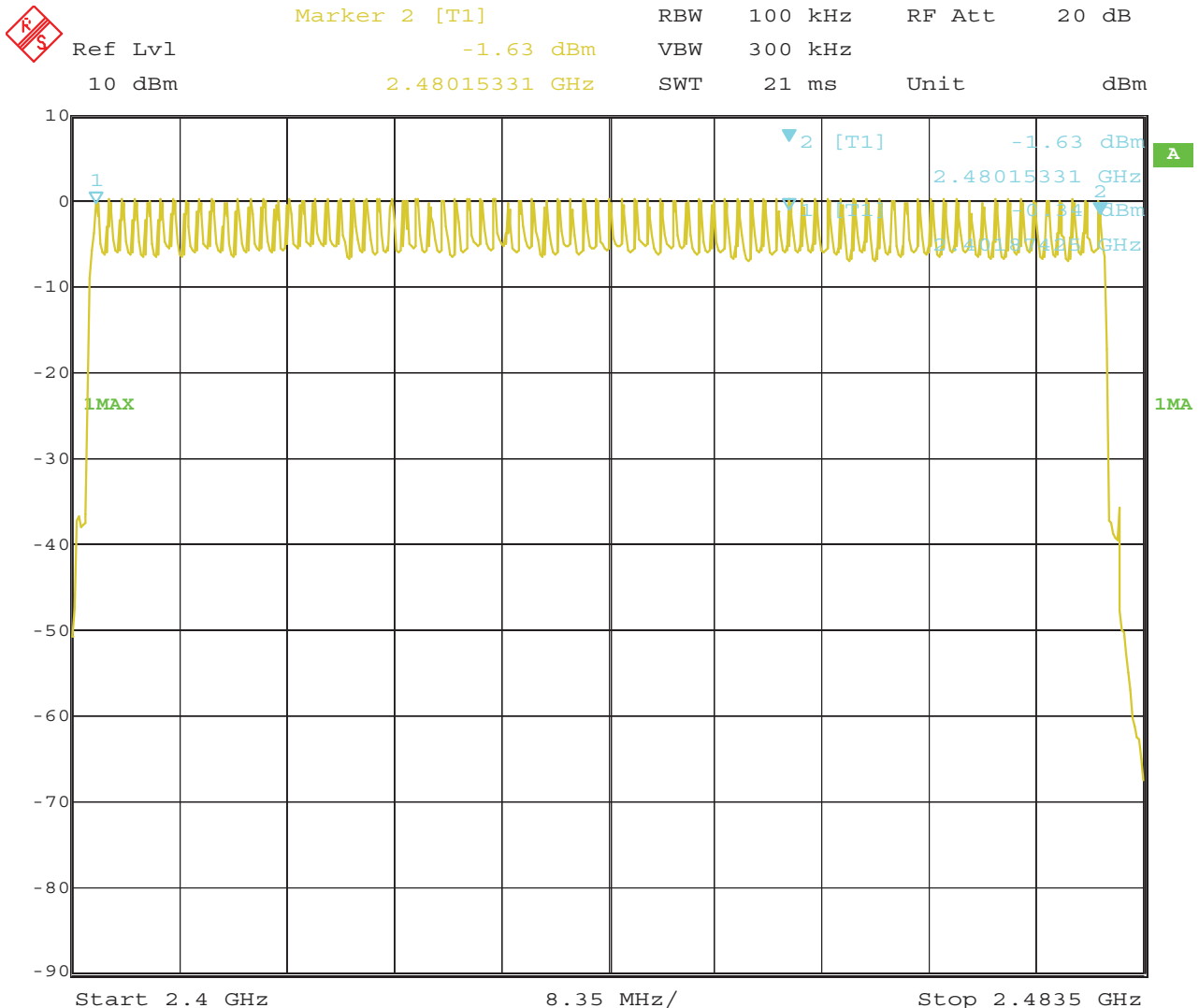
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**Type of Modulation:**  $\pi/4$ DQPSK

EUT	Bluetooth keyboard	Model	ST-ICBK20
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	$\geq 15$	Pass

**Test Plot**



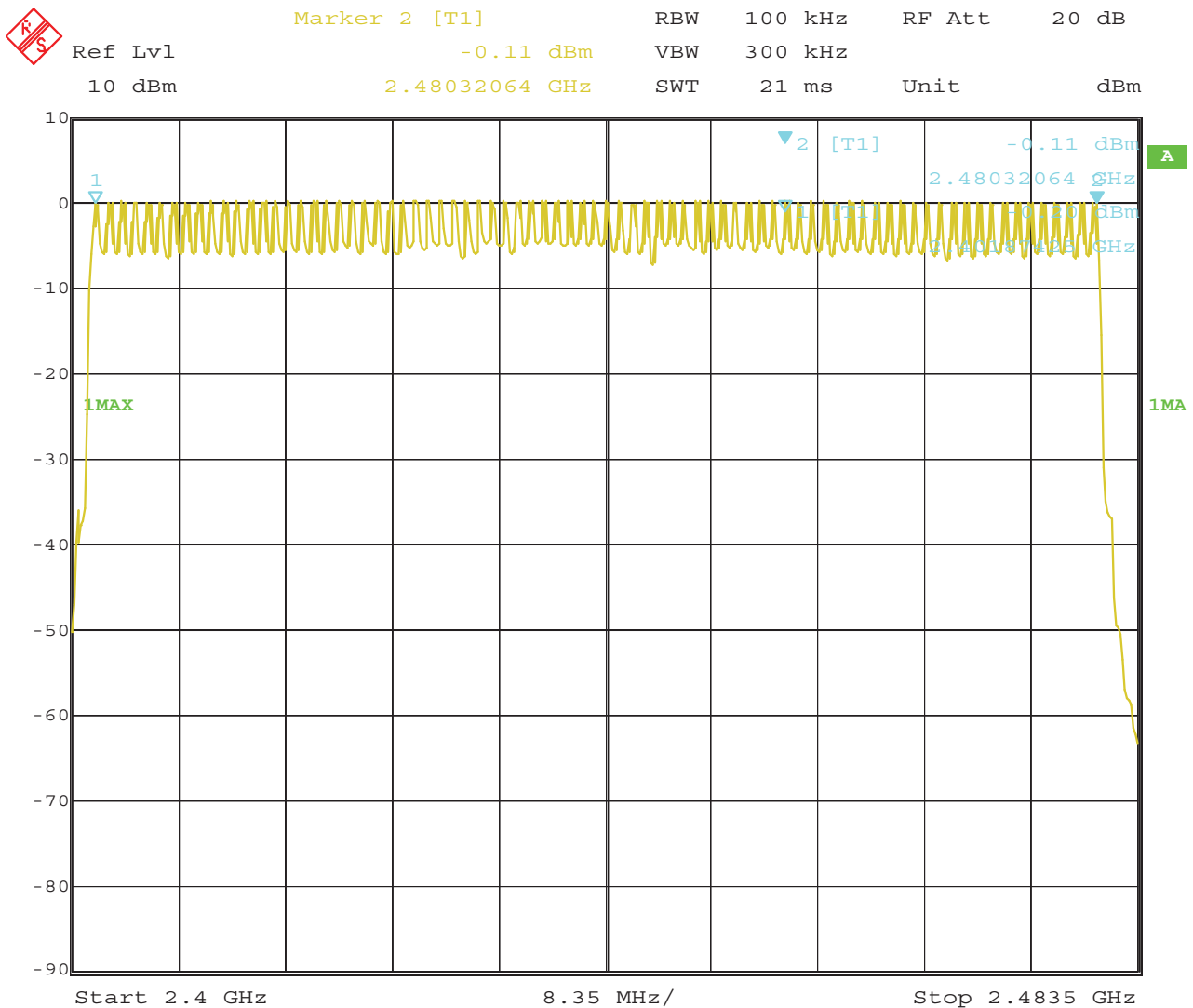
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**Type of Modulation: 8DPSK**

EUT	Bluetooth keyboard	Model	ST-ICBK20
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  $\geq$  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	Bluetooth keyboard		Model	ST-ICBK20	
Mode	Keep Transmitting		Input Voltage	DC3.7V	
Temperature	24 deg. C,		Humidity	56% RH	
Channel	Reading	Hoping Rate		Actual	Limit
High	2.97ms	266.667 hop/s		0.317s	0.4s
Middle	2.97ms	266.667 hop/s		0.317s	0.4s
Low	3.03ms	266.667 hop/s		0.323s	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.

**Note: DH5 was the wore case**

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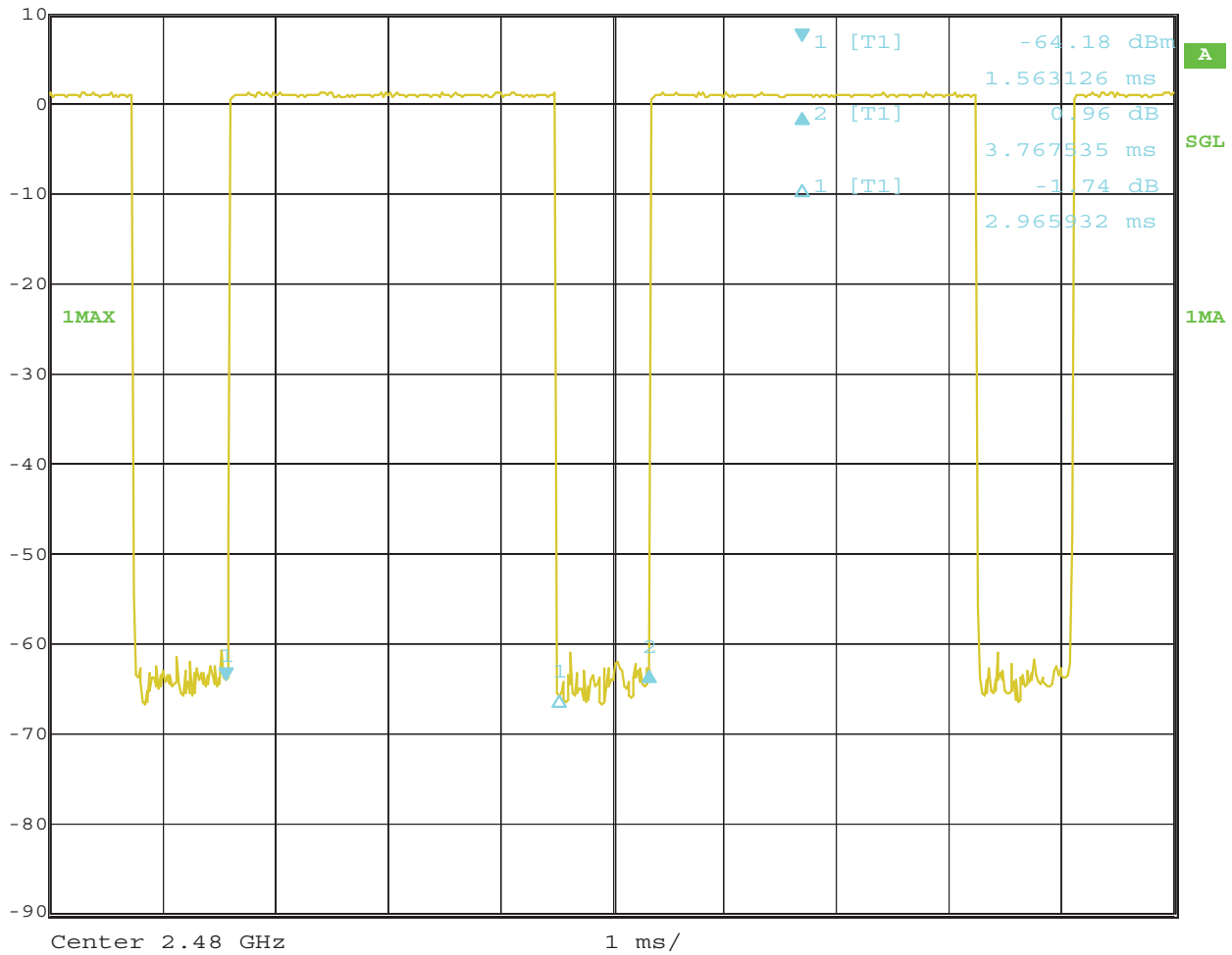


Test Plots:

**DH5**

High Channel

	Delta 2 [T1]	RBW	1 MHz	RF Att	20 dB
	Ref Lvl	0.96 dB	VBW	1 MHz	
	10 dBm	3.767535 ms	SWT	10 ms	Unit

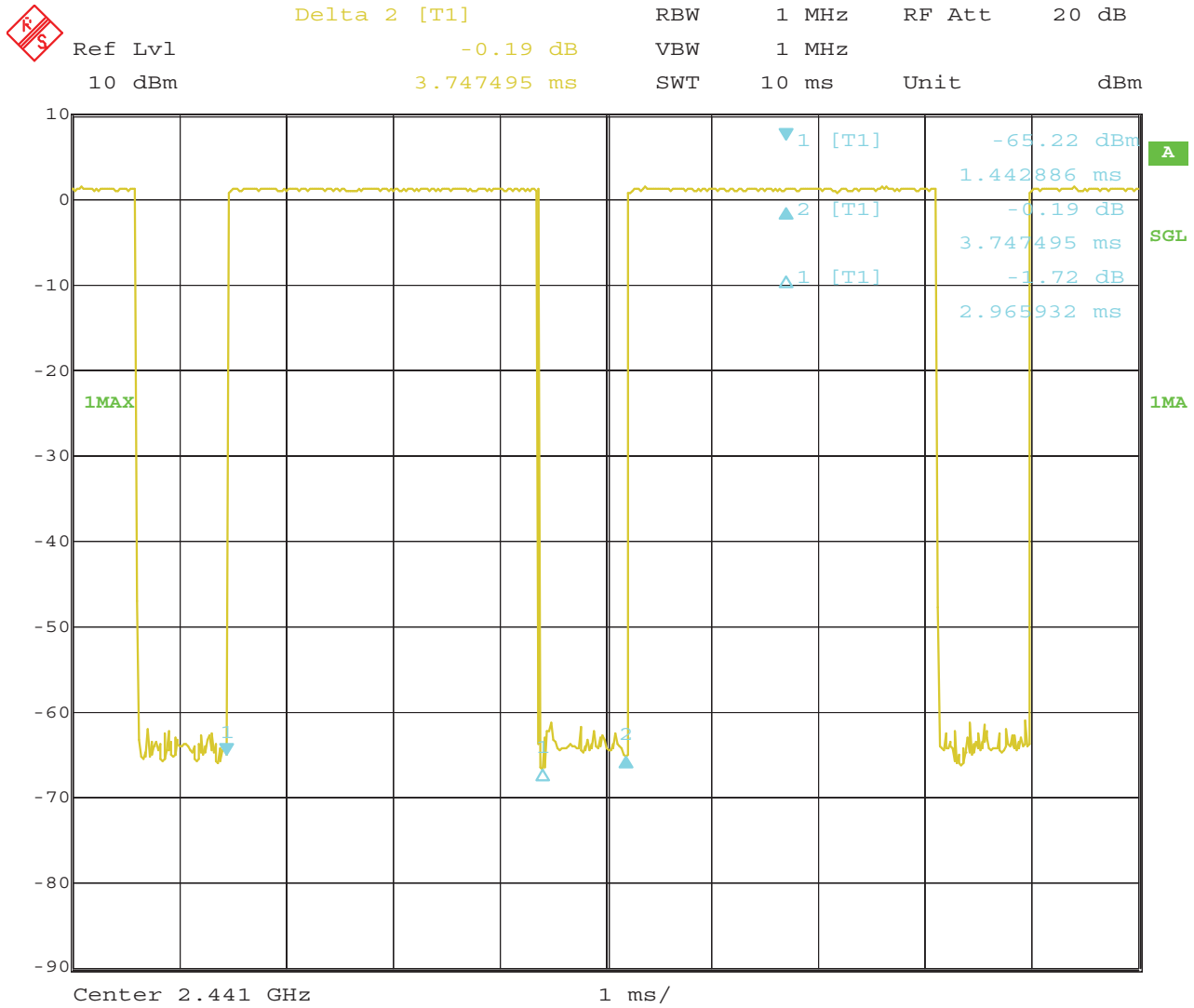


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**DH5**

Middle Channel



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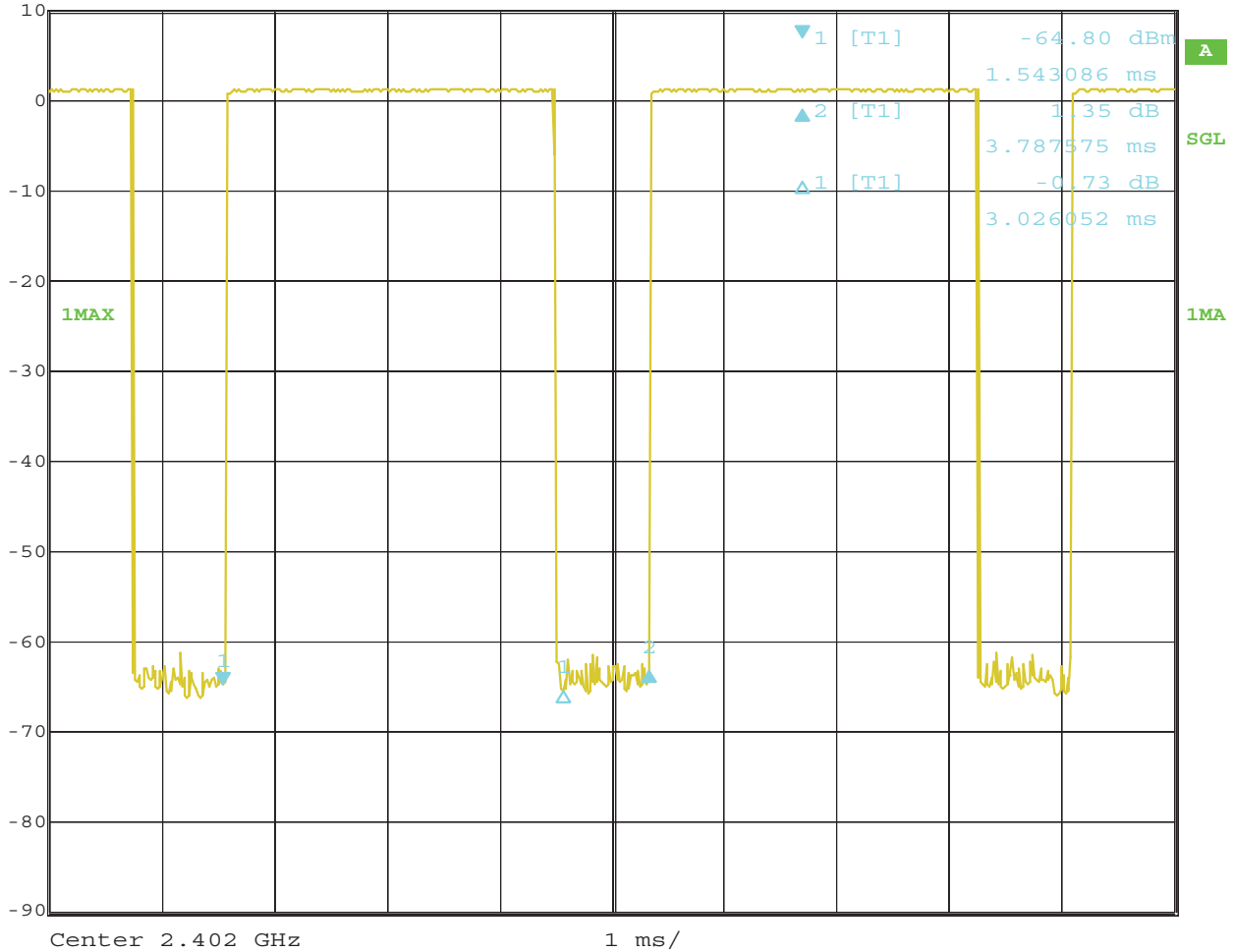


**DH5**

Low Channel



	Delta 2 [T1]	RBW	1 MHz	RF Att	20 dB
Ref Lvl	1.35 dB	VBW	1 MHz		
10 dBm	3.787575 ms	SWT	10 ms	Unit	dBm



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**Test Result**

**Type of Modulation:**  $\pi/4$ DQPSK

EUT	Bluetooth keyboard		Model	ST-ICBK20	
Mode	Keep Transmitting		Input Voltage	DC3.7V	
Temperature	24 deg. C,		Humidity	56% RH	
Channel	Reading	Hoping Rate		Actual	Limit
High	3.01ms	266.667 hop/s		0.321s	0.4s
Middle	3.03ms	266.667 hop/s		0.323s	0.4s
Low	2.97ms	266.667 hop/s		0.317s	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.

**Note: DH5 was the worse case.**

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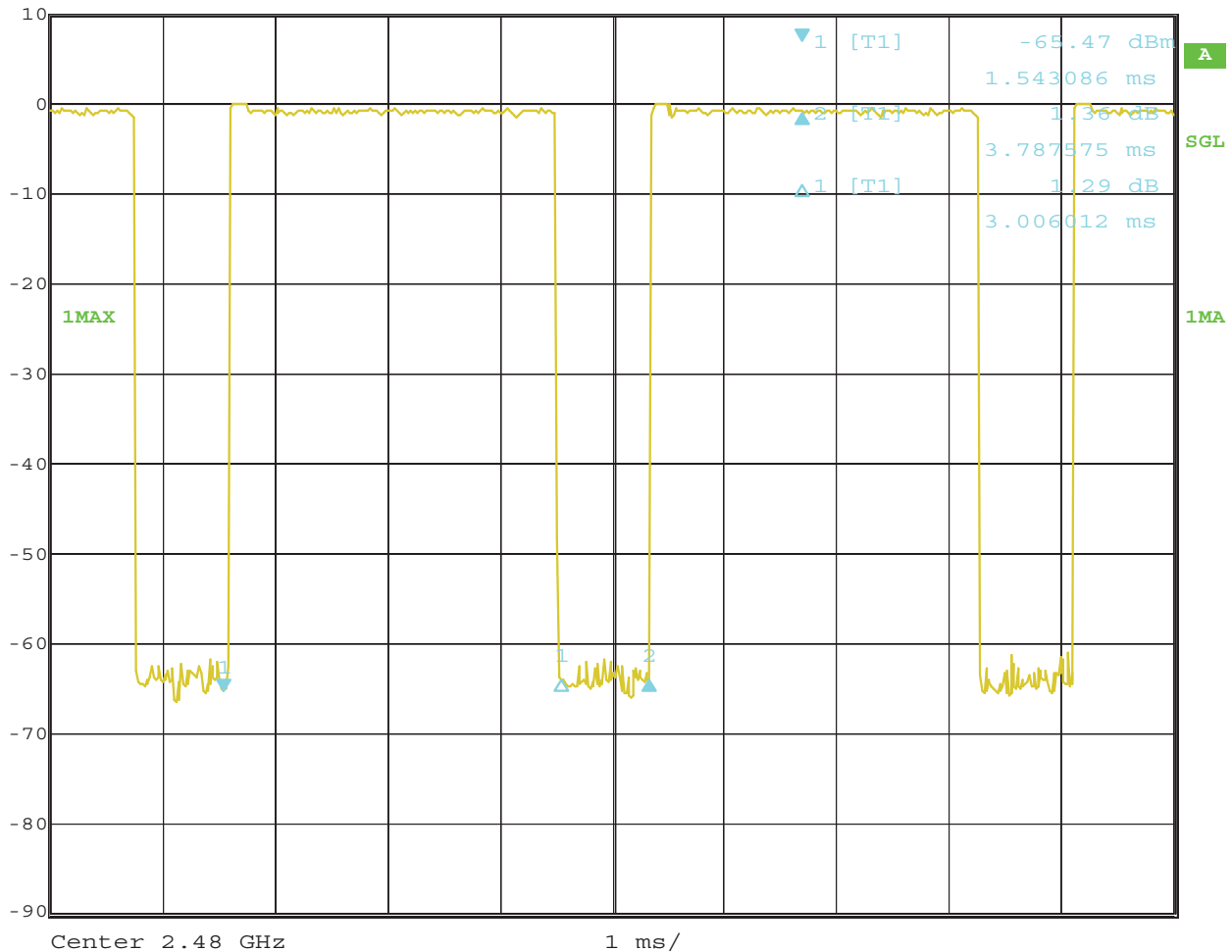


Test Plots:

**2DH5**

**High Channel**

	Delta 2 [T1]	RBW	1 MHz	RF Att	20 dB
	Ref Lvl	1.36 dB	VBW	1 MHz	
	10 dBm	3.787575 ms	SWT	10 ms	Unit



The report refers only to the sample tested and does not apply to the bulk.

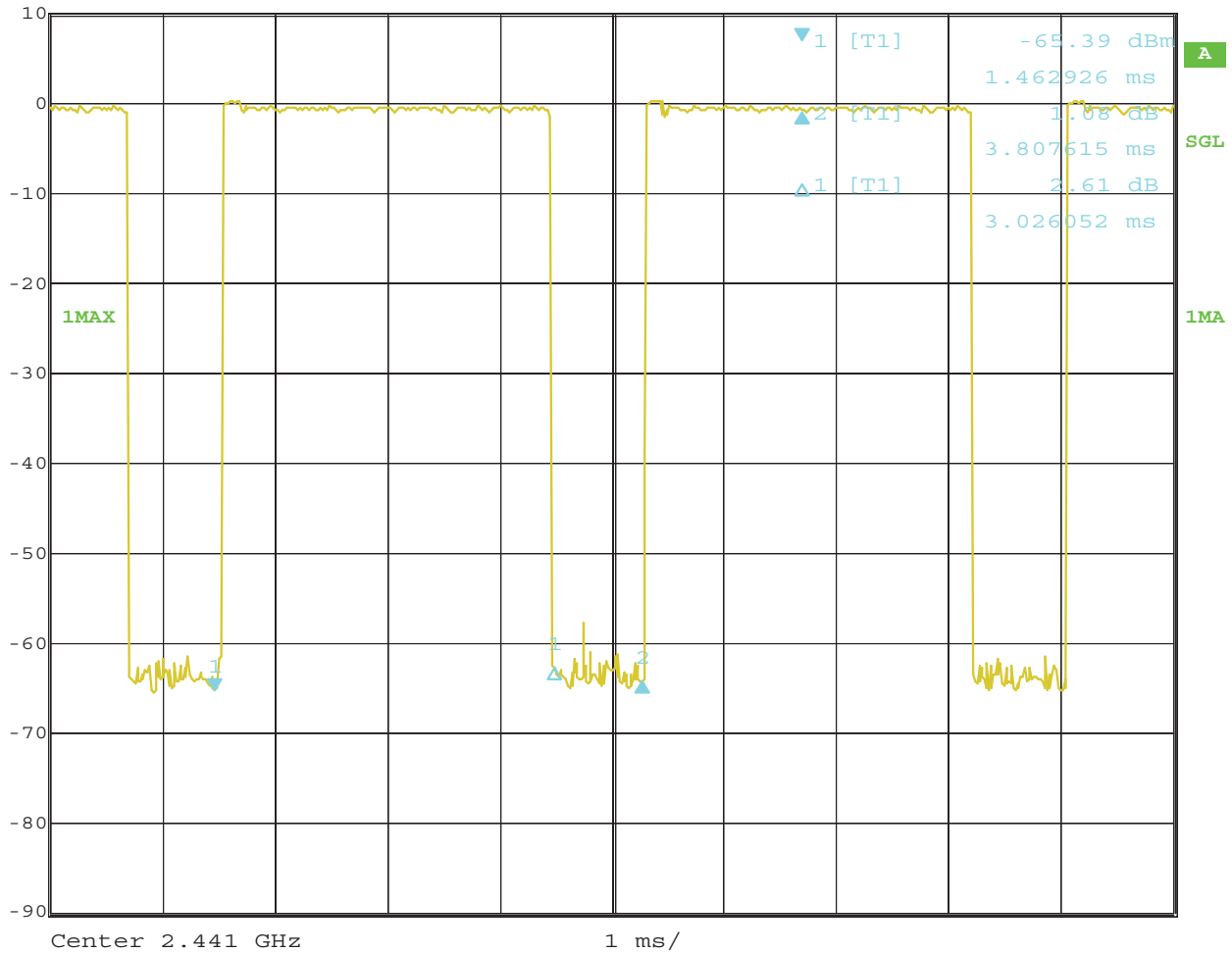
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**2DH5**  
**Middle Channel**

	Delta 2 [T1]	RBW	1 MHz	RF Att	20 dB
	Ref Lvl	1.08 dB	VBW	1 MHz	
	10 dBm	3.807615 ms	SWT	10 ms	Unit dBm



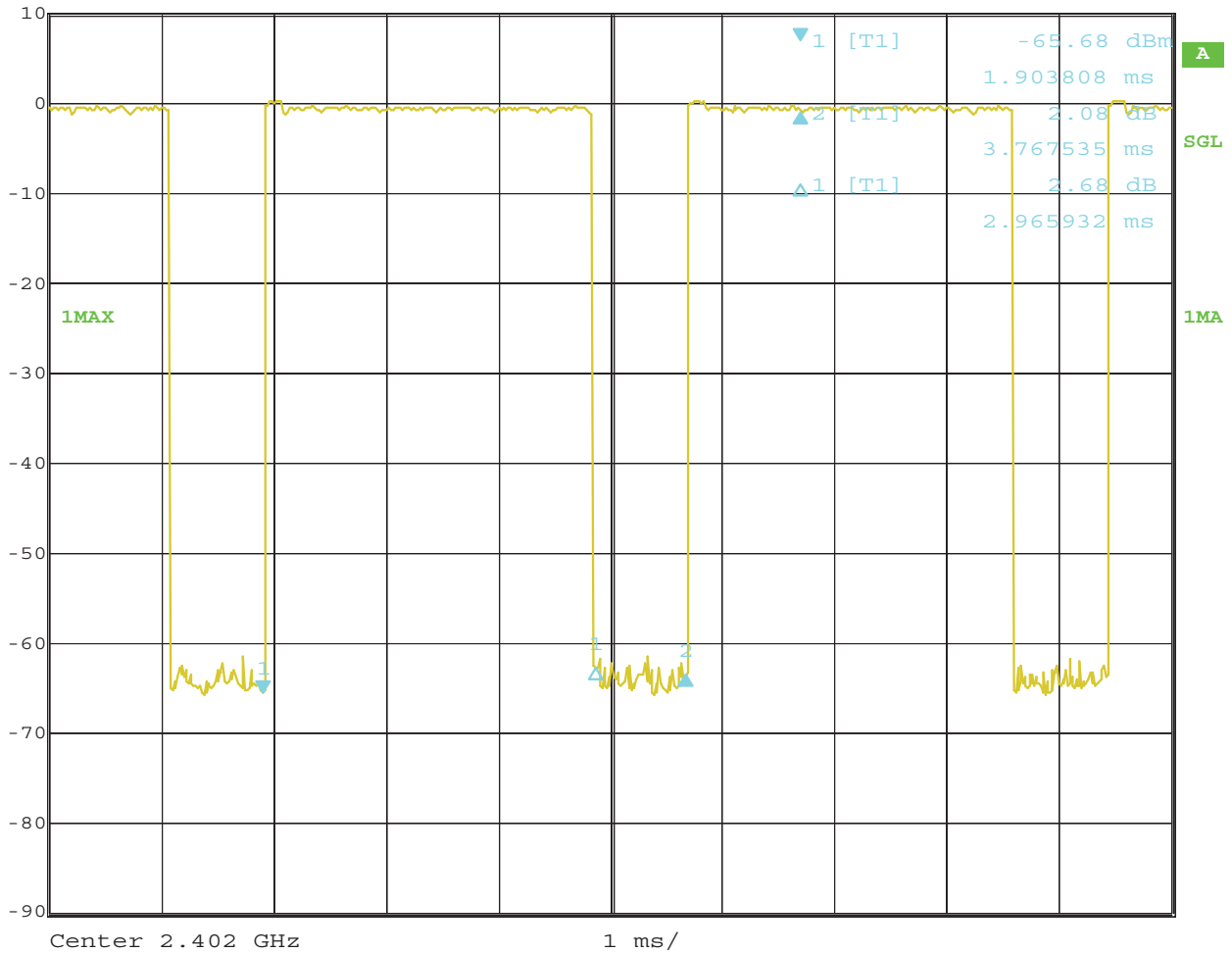
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**2DH5**

**Low Channel**

	Delta 2 [T1]	RBW	1 MHz	RF Att	20 dB
	Ref Lvl	2.08 dB	VBW	1 MHz	
	10 dBm	3.767535 ms	SWT	10 ms	Unit



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**Type of Modulation: 8DPSK**

EUT	Bluetooth keyboard		Model	ST-ICBK20	
Mode	Keep Transmitting		Input Voltage	DC3.7V	
Temperature	24 deg. C,		Humidity	56% RH	
Channel	Reading	Hoping Rate		Actual	Limit
High	2.97ms	266.667 hop/s		0.317s	0.4s
Middle	2.99ms	266.667 hop/s		0.319s	0.4s
Low	2.97ms	266.667 hop/s		0.317s	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.

**Note: DH5 was the worse case.**

The report refers only to the sample tested and does not apply to the bulk.

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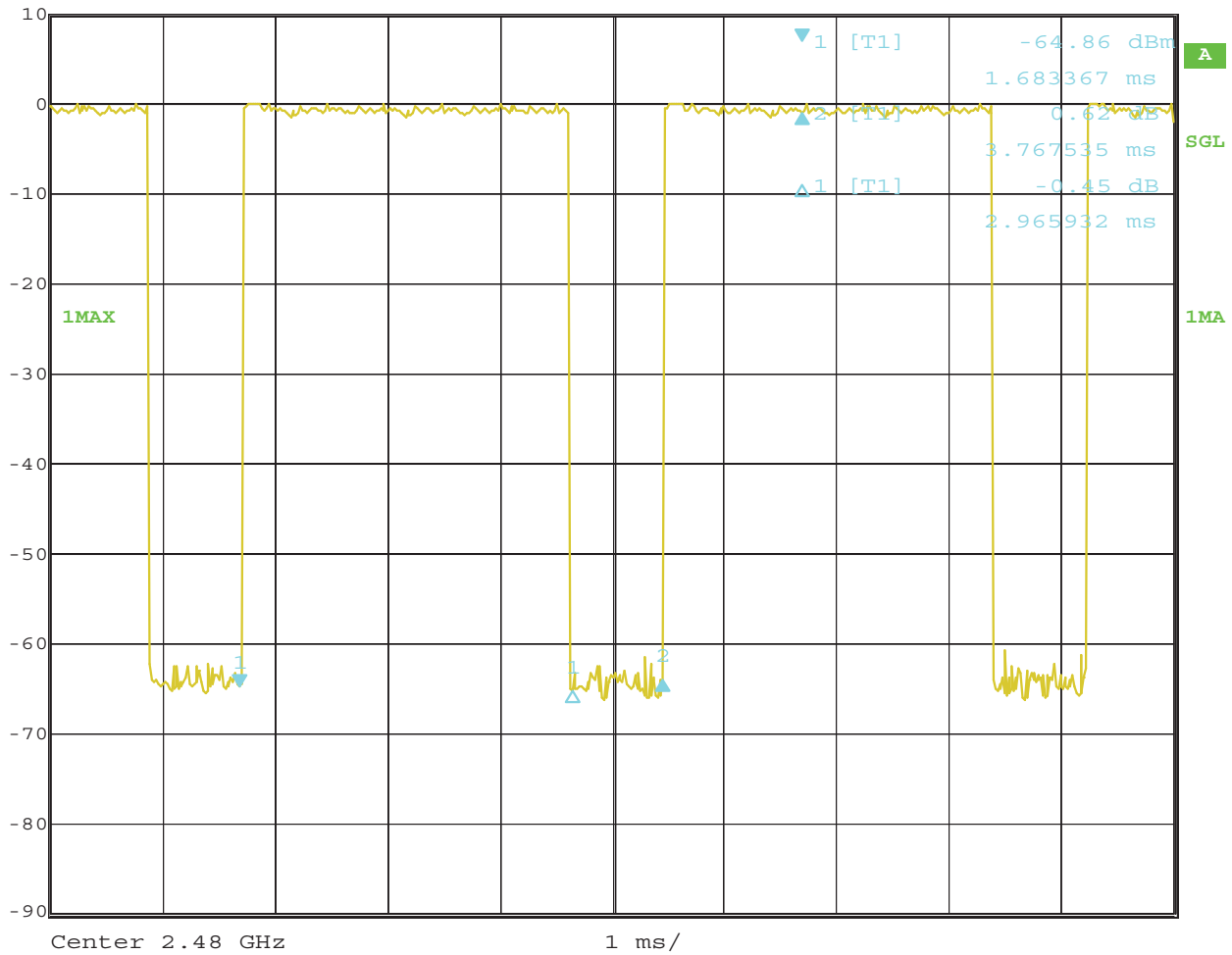


Test Plots:

**3DH5**

**High Channel**

	Delta 2 [T1]	RBW	1 MHz	RF Att	20 dB
	Ref Lvl	0.62 dB	VBW	1 MHz	
	10 dBm	3.767535 ms	SWT	10 ms	Unit

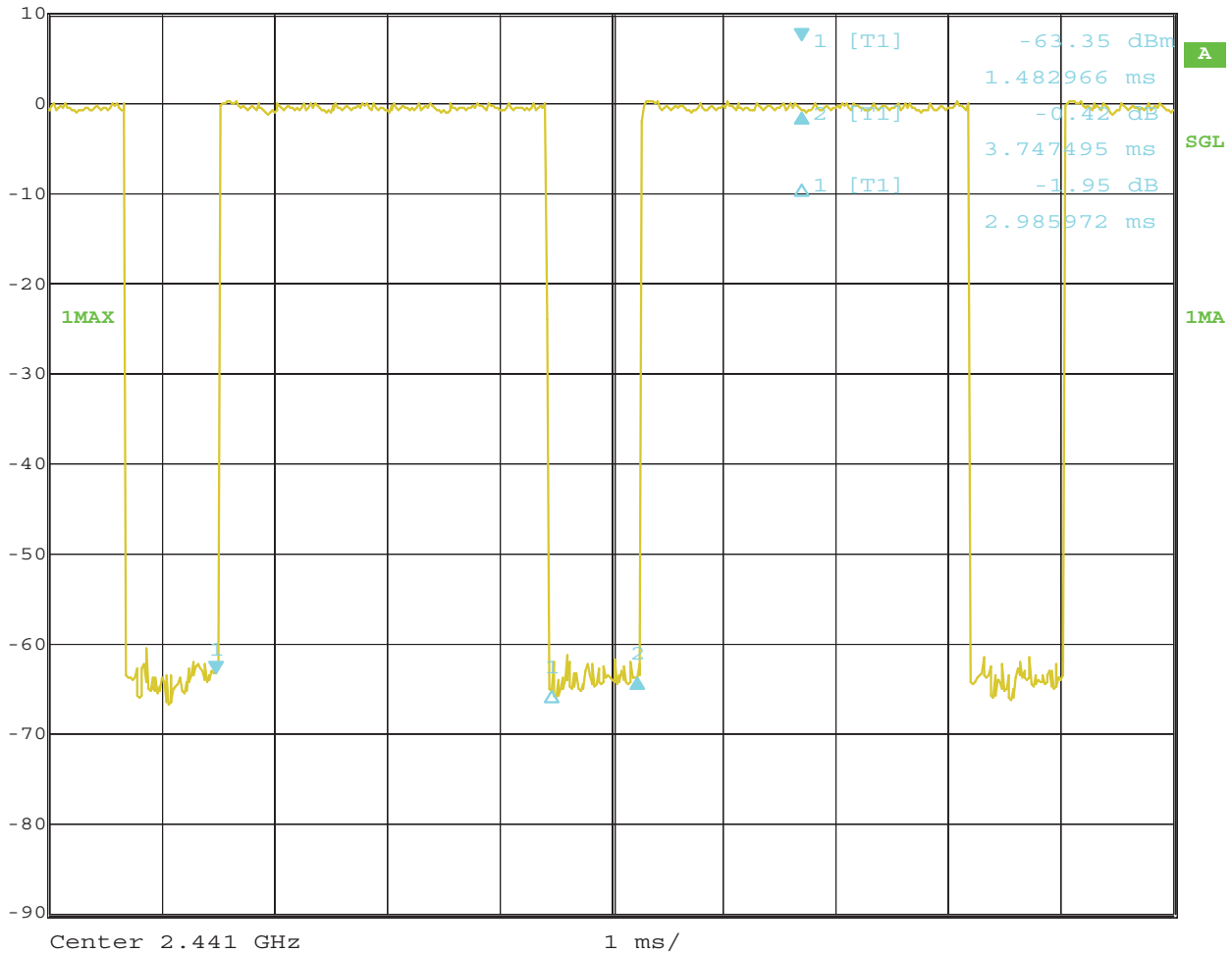


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**3DH5**  
**Middle Channel**

	Delta 2 [T1]	RBW	1 MHz	RF Att	20 dB
	Ref Lvl	VBW	1 MHz	Unit	dBm
	10 dBm	SWT	10 ms		



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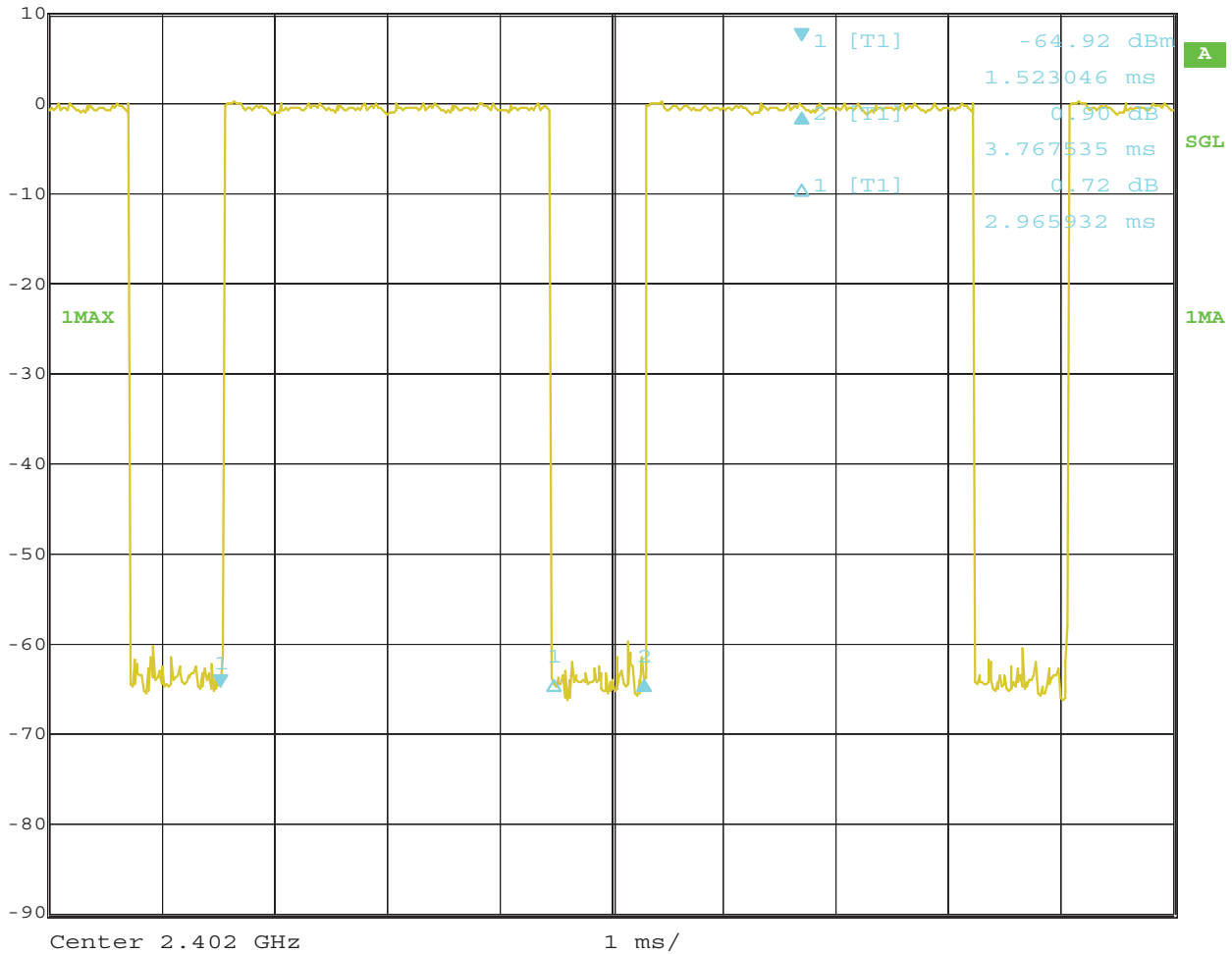


3DH5

Low Channel



Delta 2 [T1]	RBW	1 MHz	RF Att	20 dB
Ref Lvl	0.90 dB	VBW	1 MHz	
10 dBm	3.767535 ms	SWT	10 ms	Unit dBm

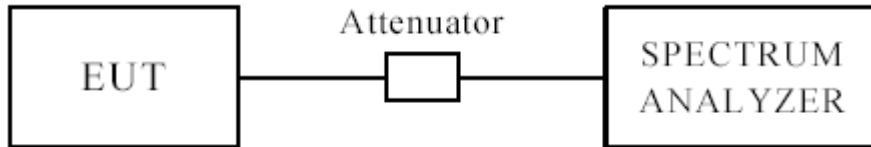


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## 12 Out of Band Measurement

### 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  $-20\text{dB}$  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  $\text{RBW}=\text{VBW}=1\text{MHz}$  and PK detector.

For bandage test, the spectrum set as follows:  $\text{RBW}=100\text{kHz}$ ,  $\text{VBW}=300\text{ kHz}$ . 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 handheld 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.

3. H and V polarity all have been tested, only worse case is reported

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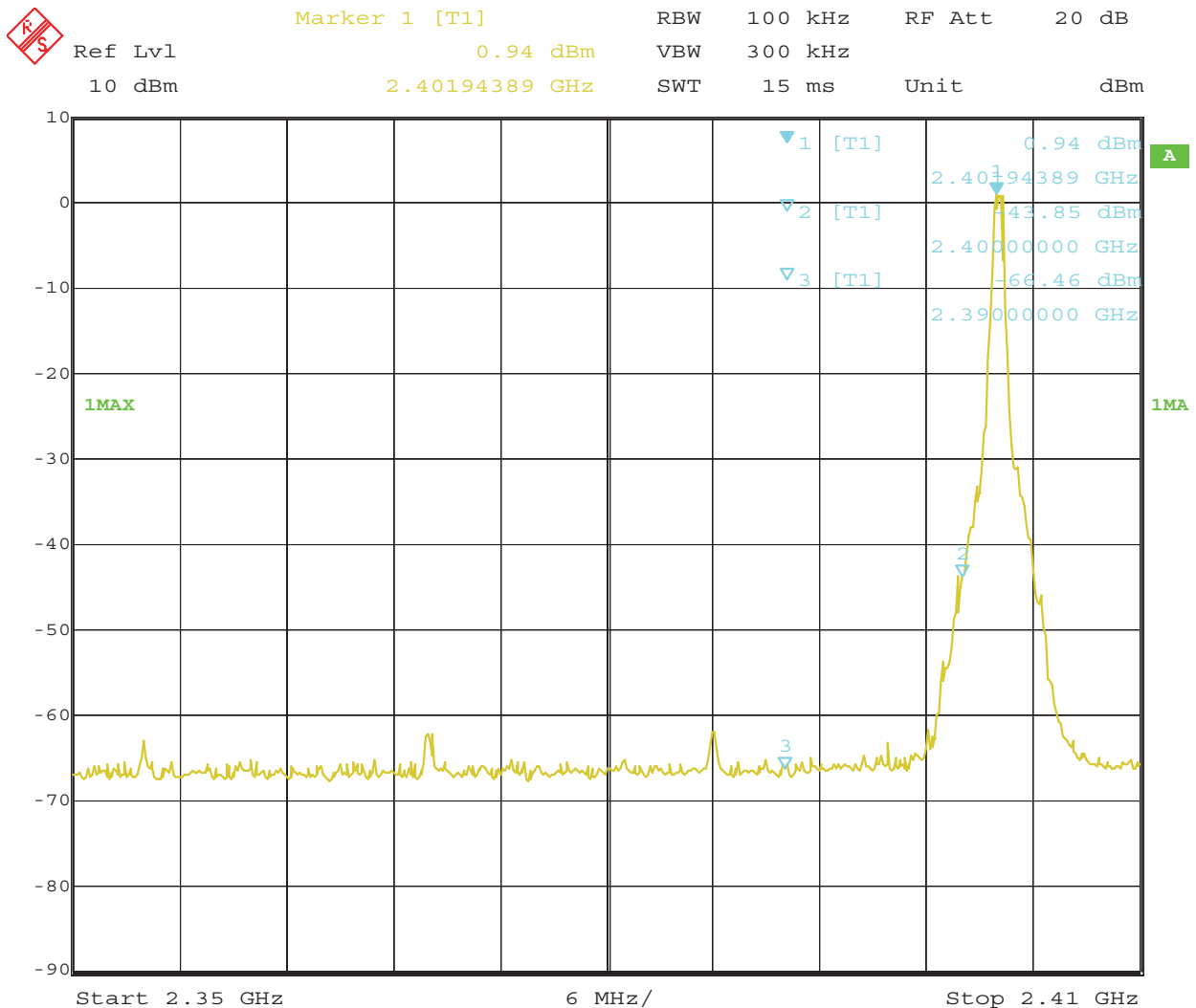


**Type of Modulation: GFSK**

**12.4 Out of Band Test Result**

Product:	Bluetooth keyboard		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)	48.1	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

**Test Figure:**



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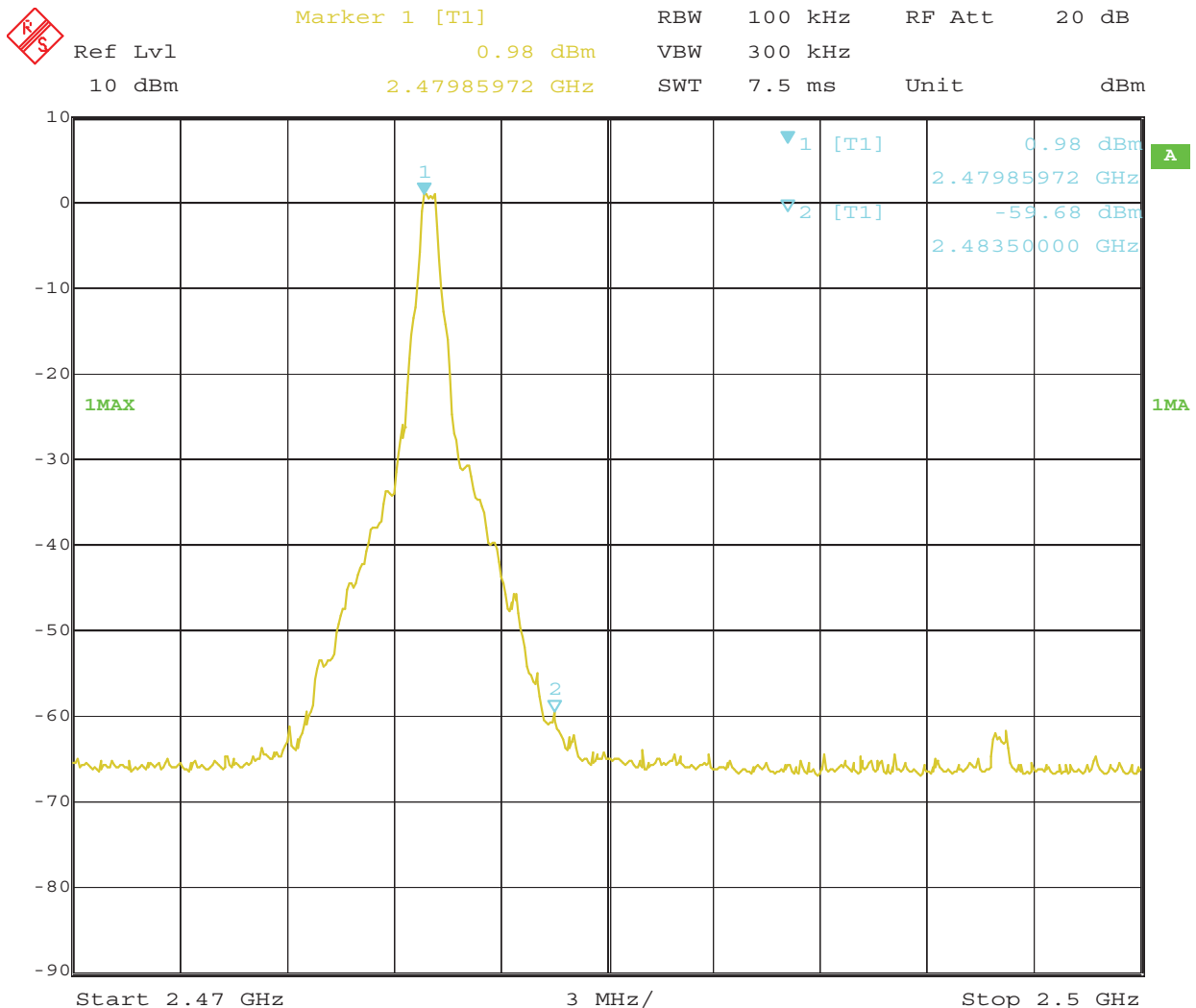


**Type of Modulation: GFSK**

**12.4 Out of Band Test Result**

Product:	Bluetooth keyboard		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)	44.6	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

**Test Figure:**



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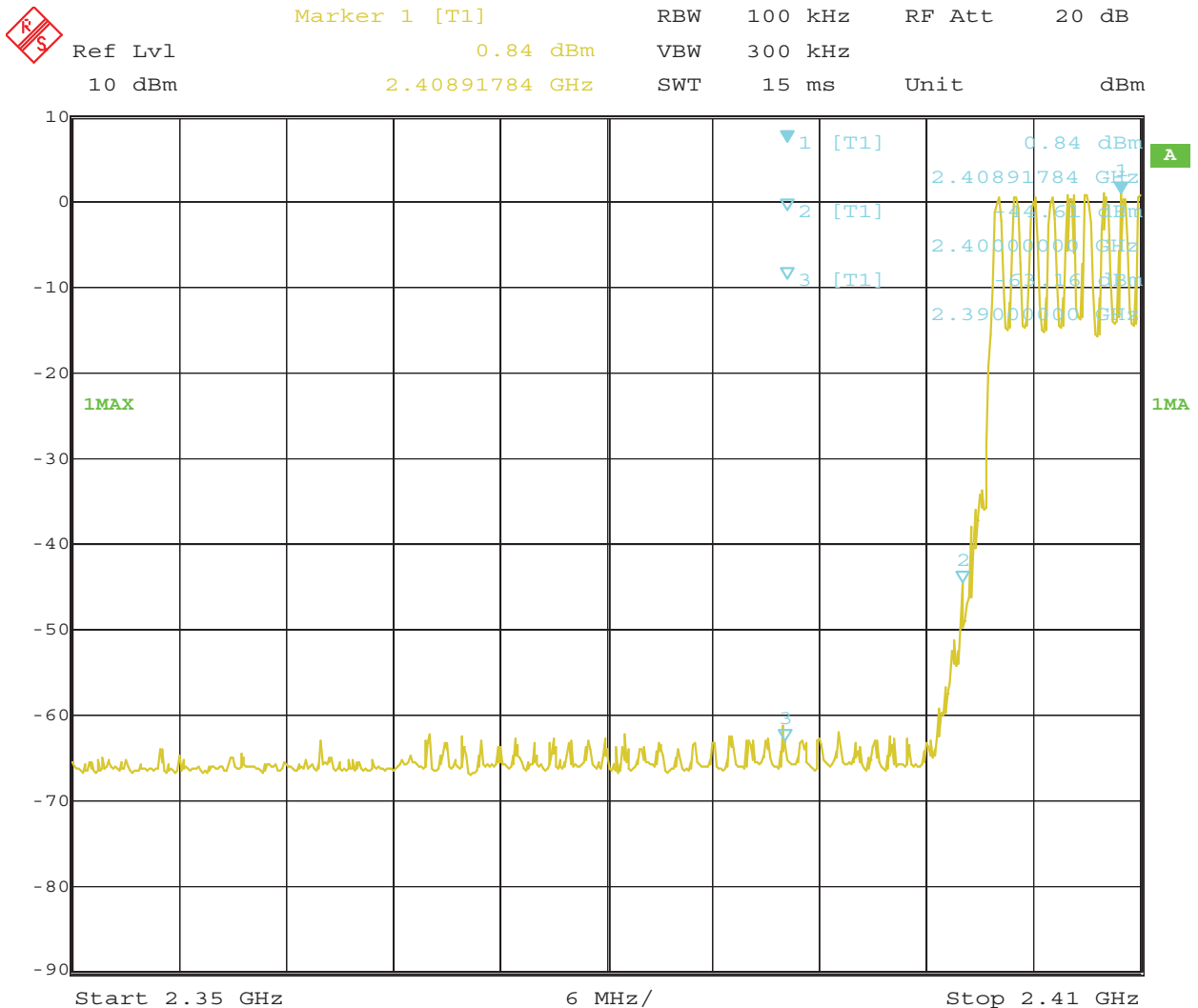


**Type of Modulation: GFSK**

**12.4 Out of Band Test Result**

Product:	Bluetooth keyboard		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)	46.2	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

**Test Figure:**



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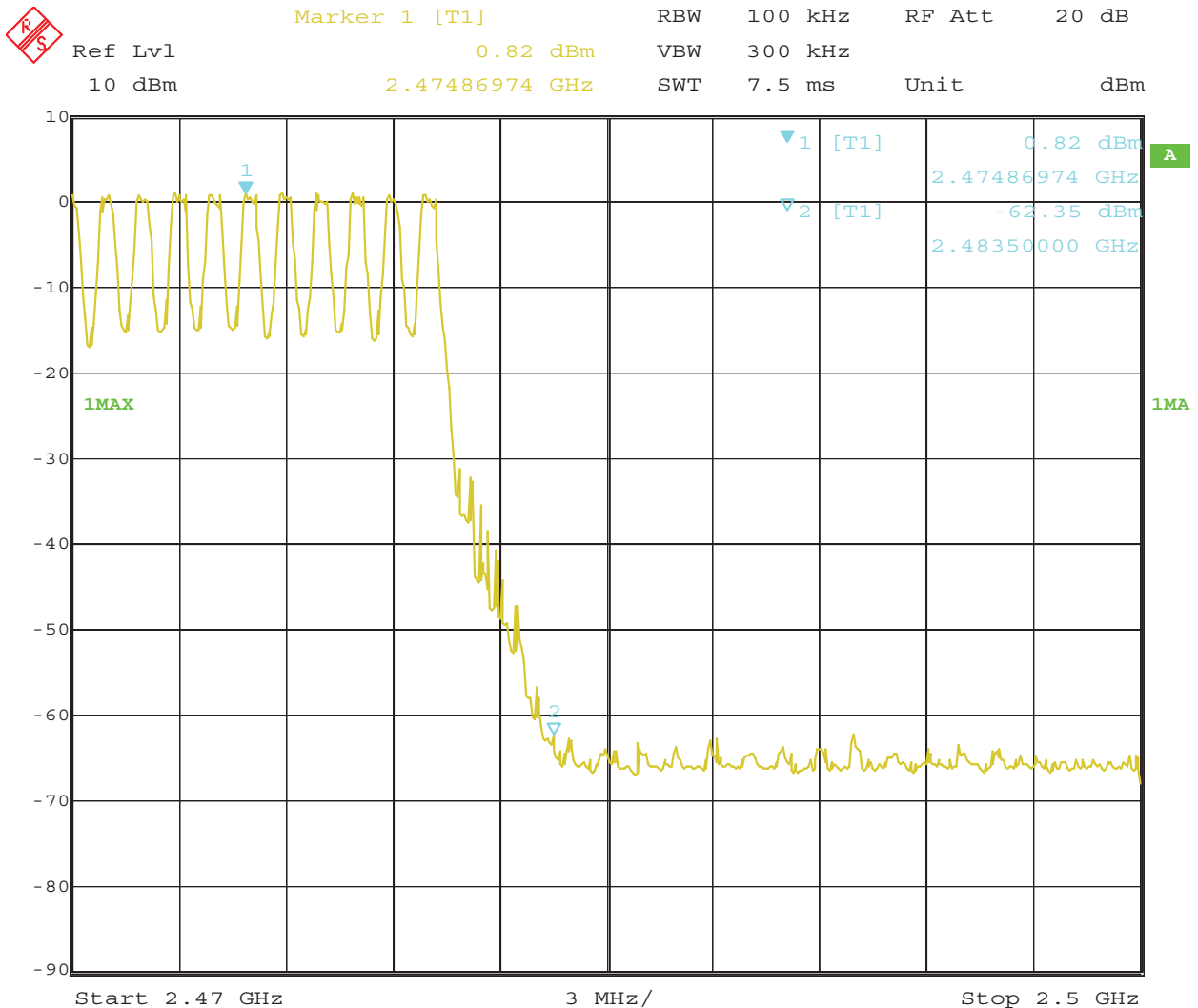


**Type of Modulation: GFSK**

**12.4 Out of Band Test Result**

Product:	Bluetooth keyboard		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)	41.6	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

**Test Figure:**



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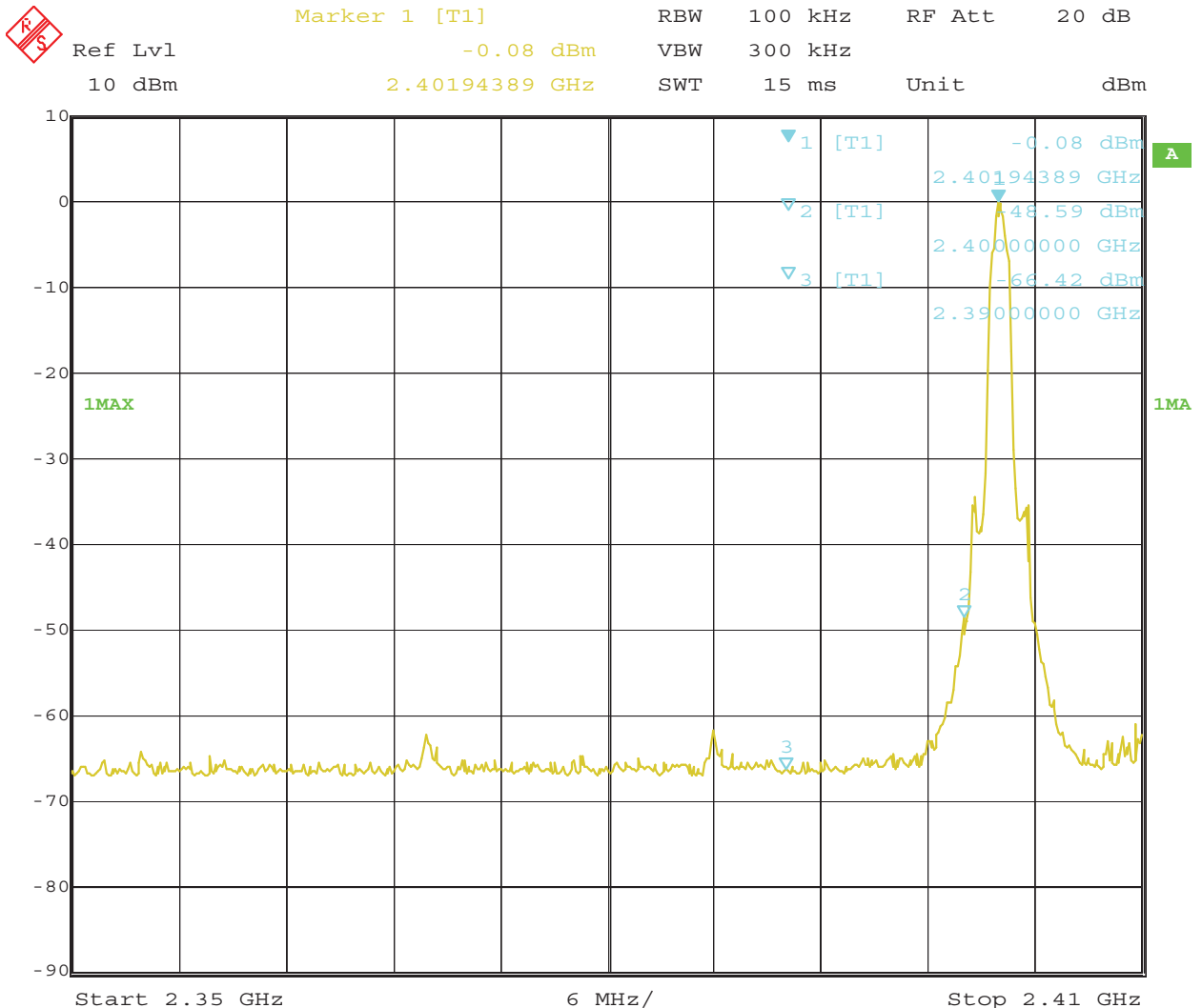


**Type of Modulation:**  $\pi/4$ DQPSK

**12.4 Out of Band Test Result**

Product:	Bluetooth keyboard		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 (dB $\mu$ V/m)	45.9	Limit	74(dB $\mu$ V/m)
	AV(dB $\mu$ V/m)	--		54(dB $\mu$ V/m)

**Test Figure:**



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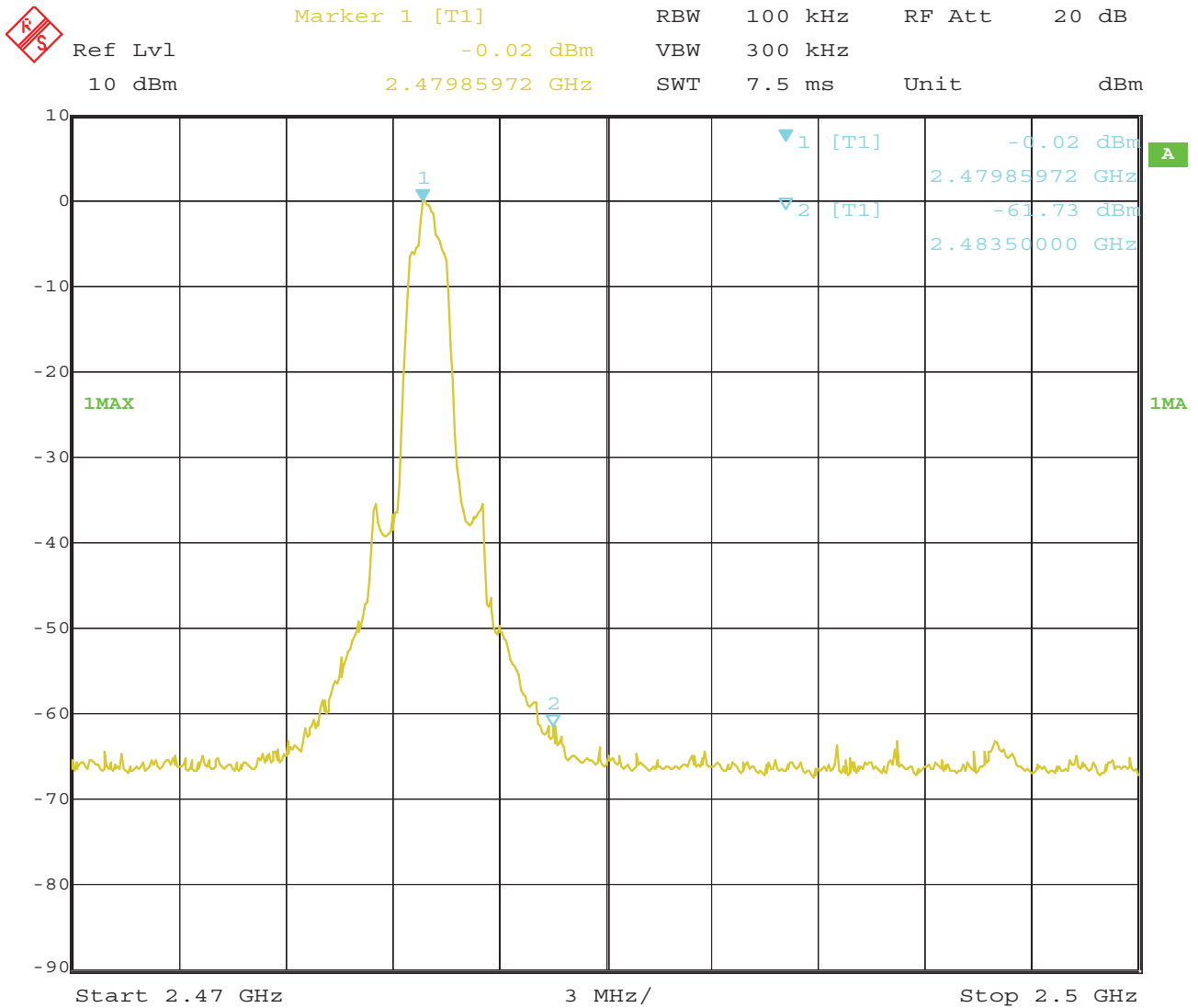


**Type of Modulation:  $\pi/4$ DQPSK**

**12.4 Out of Band Test Result**

Product:	Bluetooth keyboard		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 (dB $\mu$ V/m)	42.3	Limit	74(dB $\mu$ V/m)
	AV(dB $\mu$ V/m)	--		54(dB $\mu$ V/m)

**Test Figure:**



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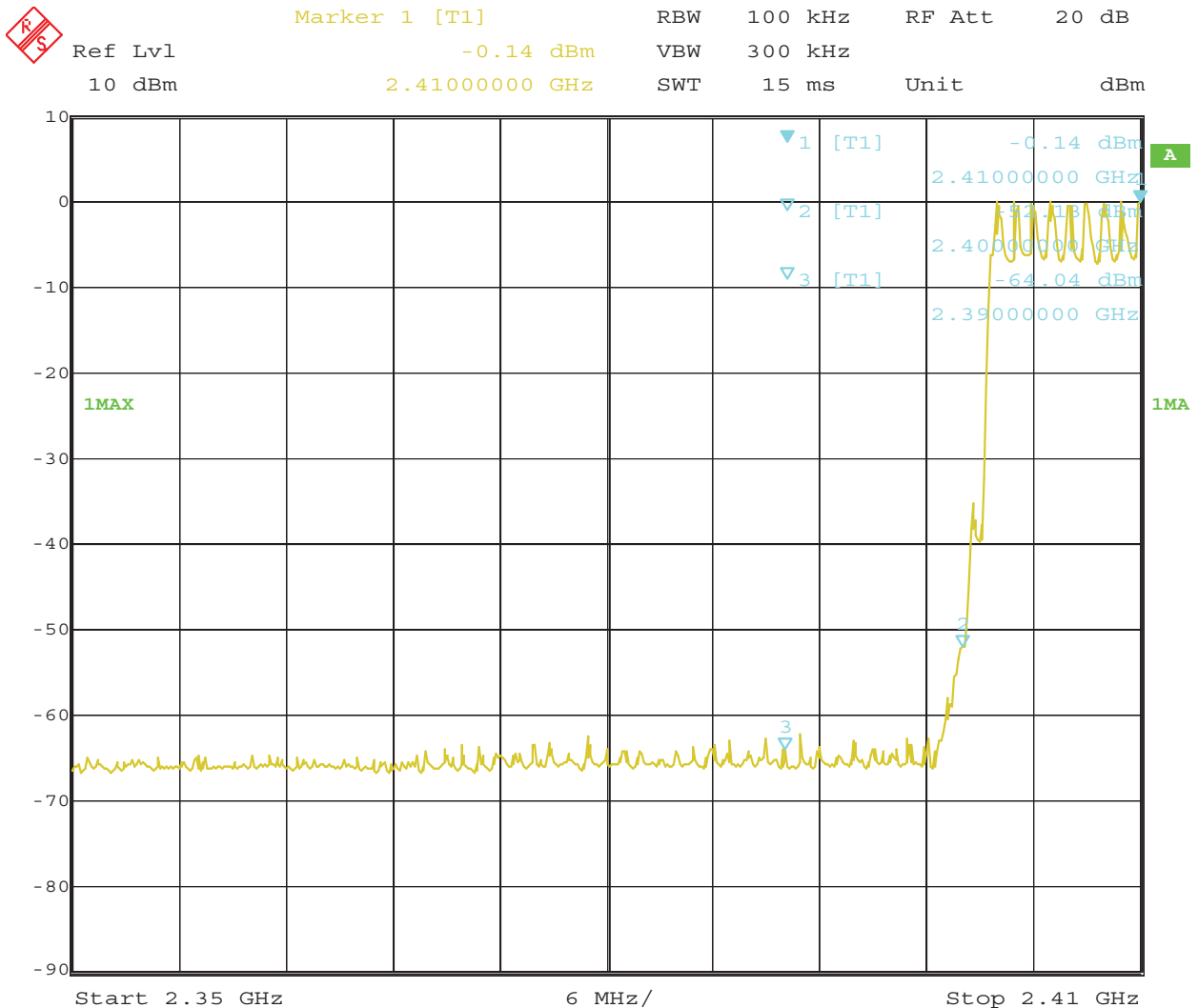


**Type of Modulation:**  $\pi/4$ DQPSK

**12.4 Out of Band Test Result**

Product:	Bluetooth keyboard		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 (dB $\mu$ V/m)	45.7	Limit	74(dB $\mu$ V/m)
	AV(dB $\mu$ V/m)	--		54(dB $\mu$ V/m)

**Test Figure:**



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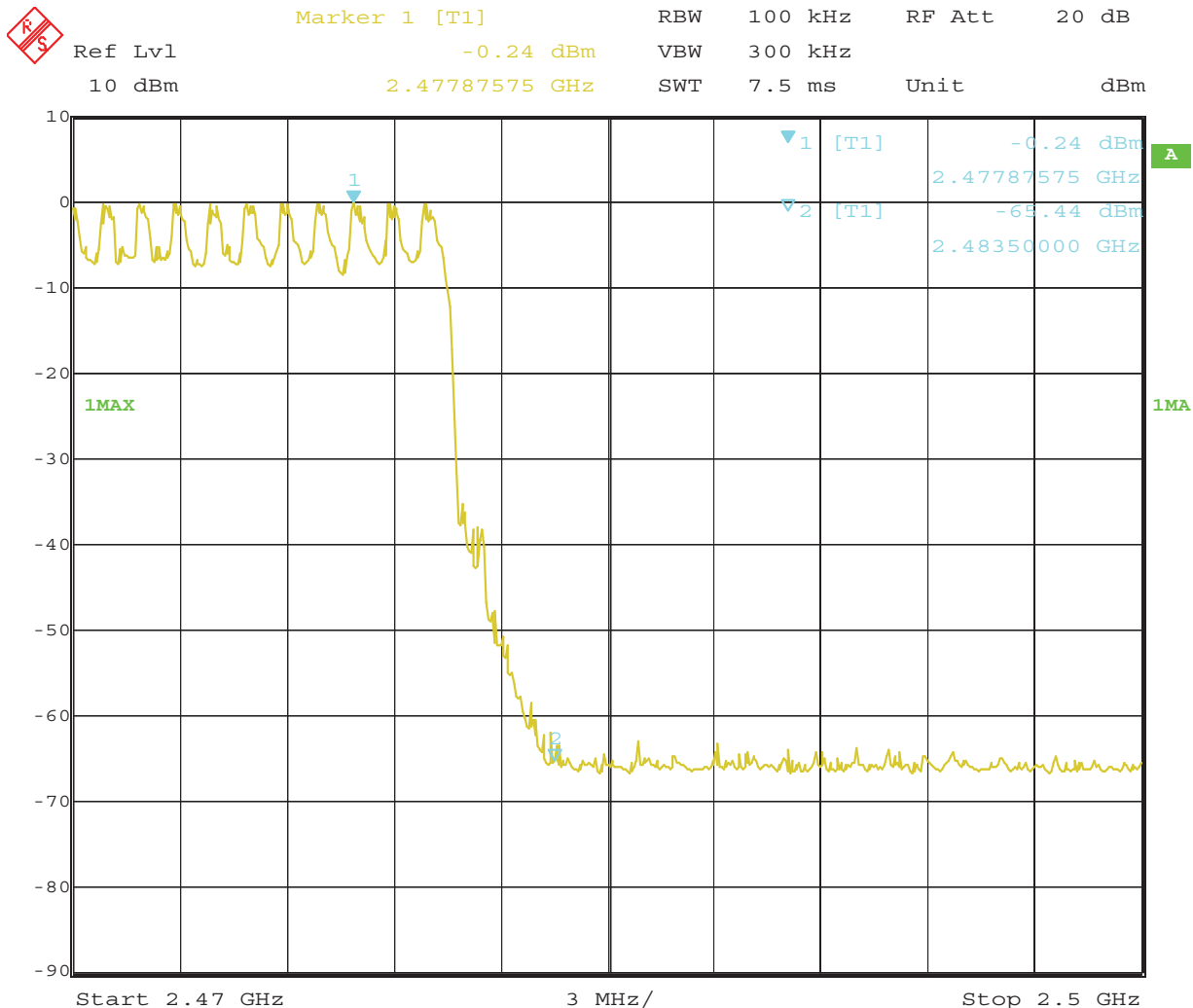


**Type of Modulation:  $\pi/4$ DQPSK**

**12.4 Out of Band Test Result**

Product:	Bluetooth keyboard		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 (dB $\mu$ V/m)	42.6	Limit	74(dB $\mu$ V/m)
	AV(dB $\mu$ V/m)	--		54(dB $\mu$ V/m)

**Test Figure:**



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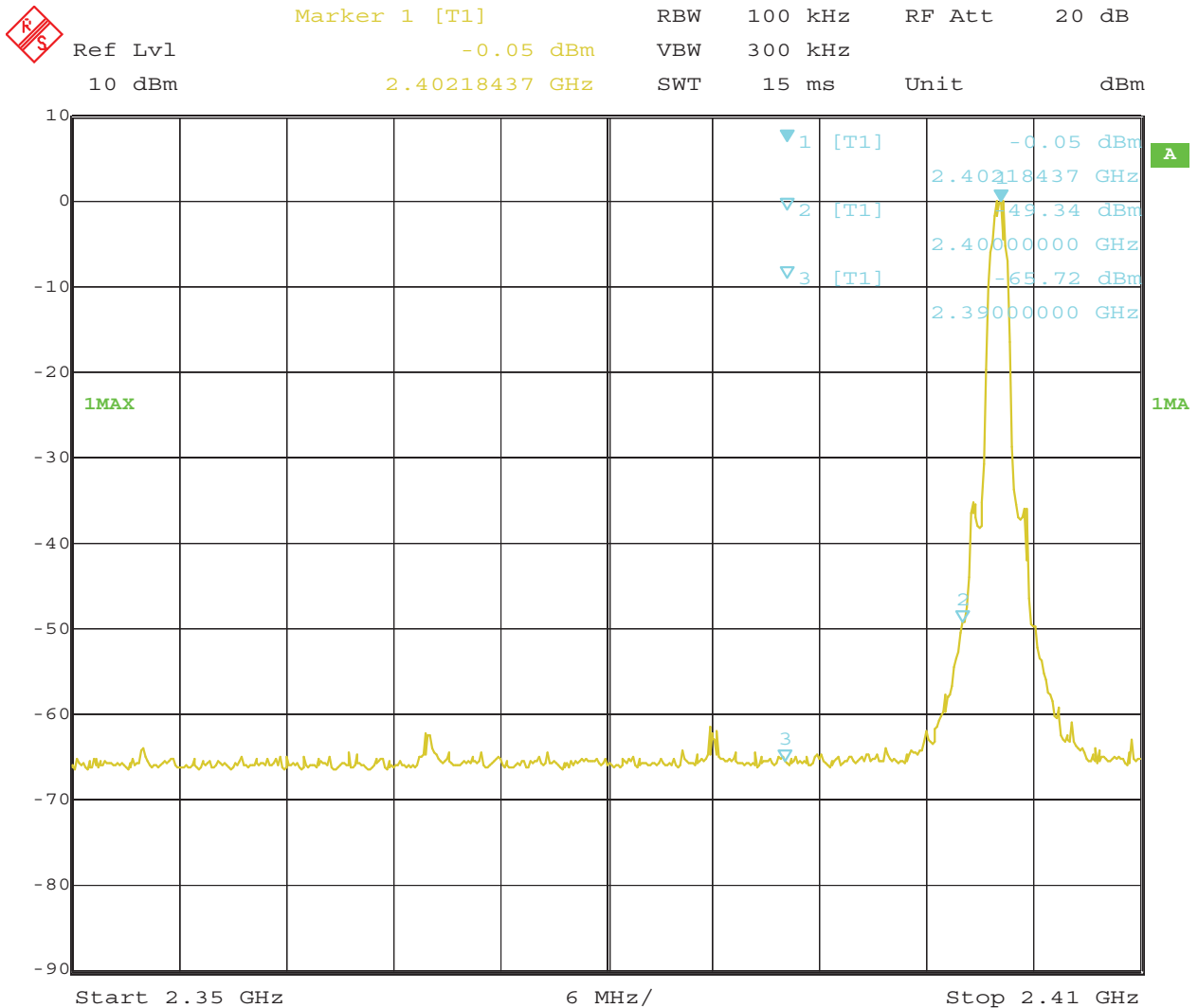


**Type of Modulation: 8DPSK**

**12.4 Out of Band Test Result**

Product:	Bluetooth keyboard		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)	45.5	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

**Test Figure:**



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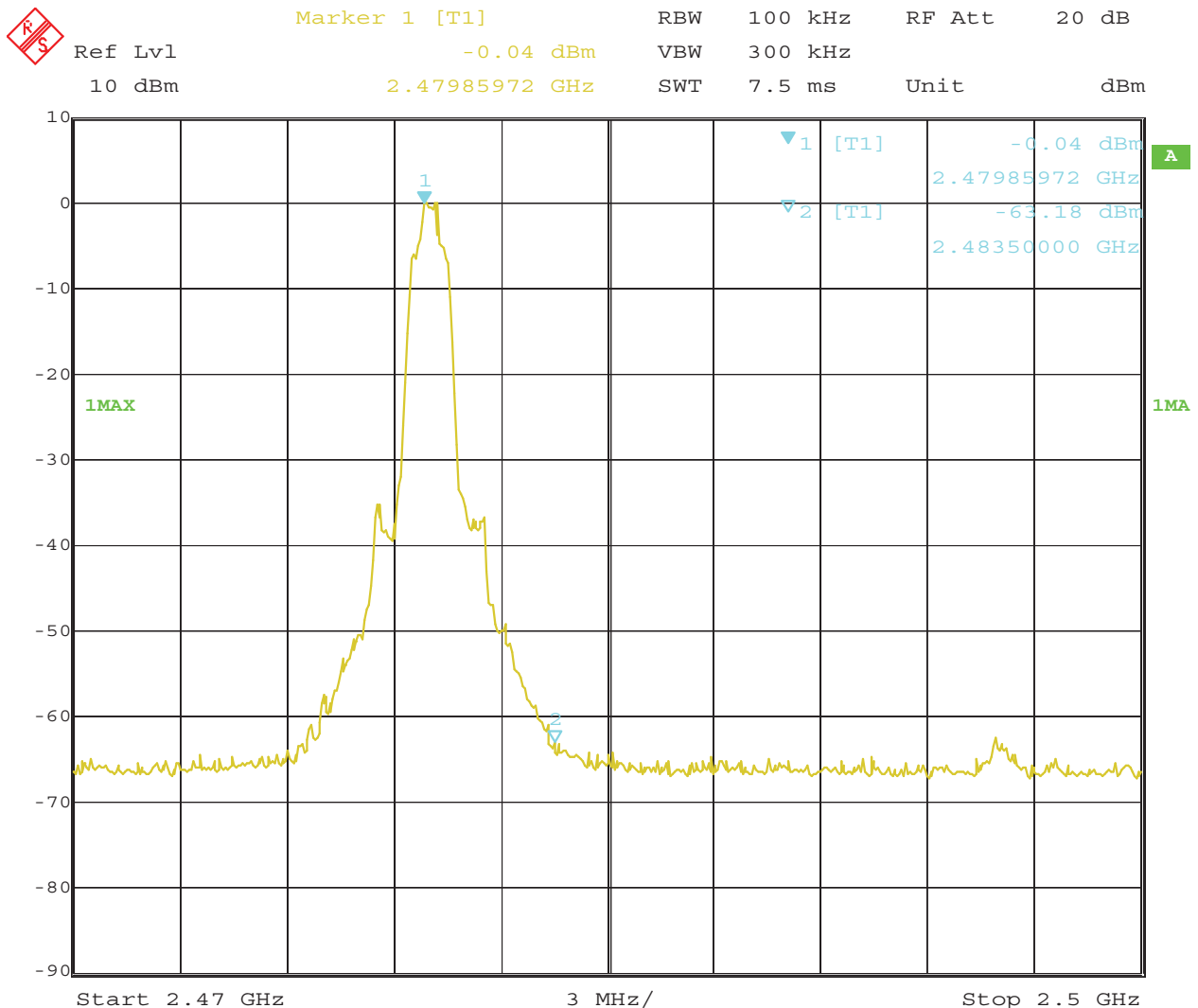


**Type of Modulation: 8DPSK**

**12.4 Out of Band Test Result**

Product:	Bluetooth keyboard		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)	41.4	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

**Test Figure:**



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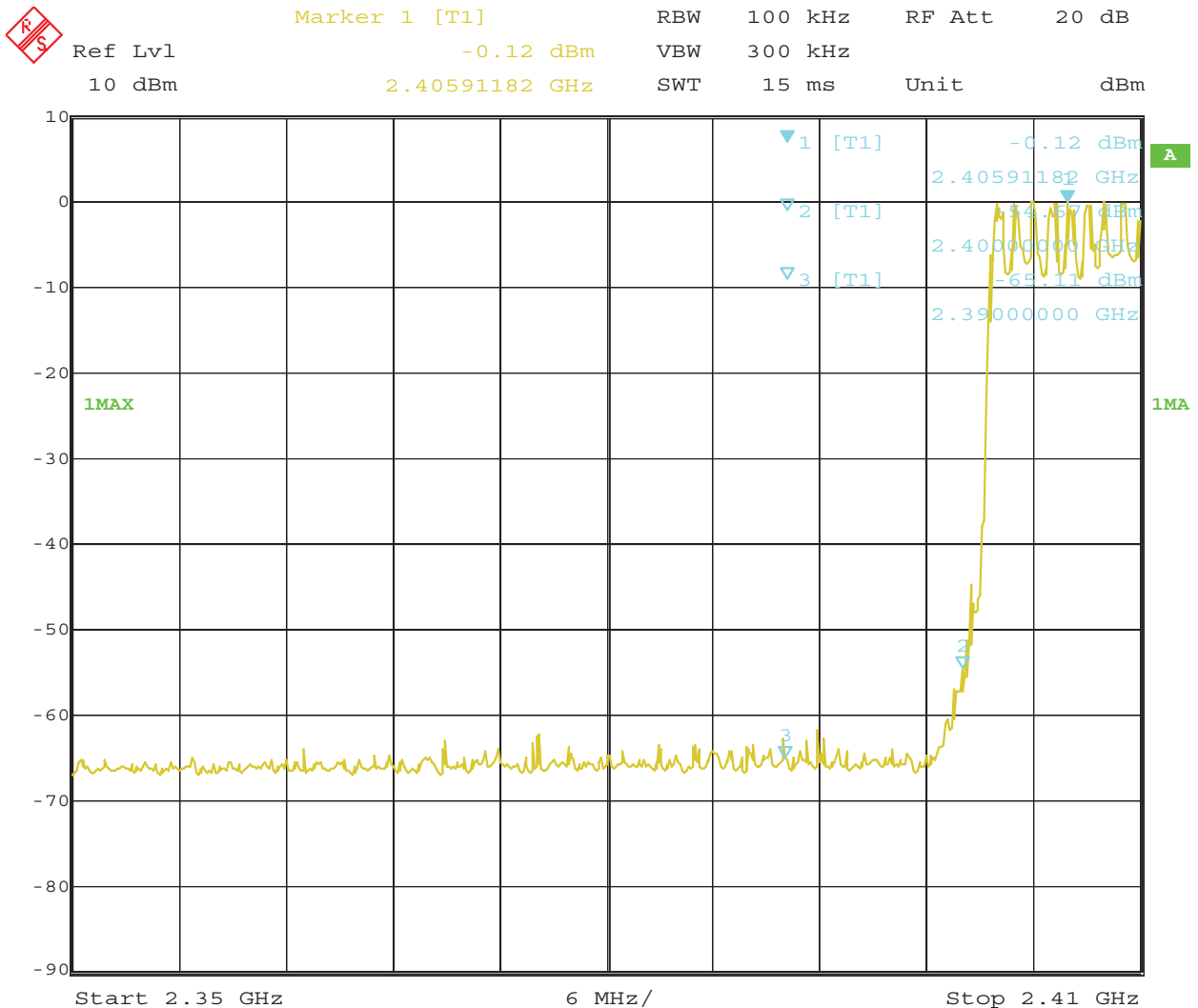


**Type of Modulation: 8DPSK**

**12.4 Out of Band Test Result**

Product:	Bluetooth keyboard		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)	43.9	Limit	74(dBμV/m)
	AV(dBμV/m)	--		54(dBμV/m)

**Test Figure:**



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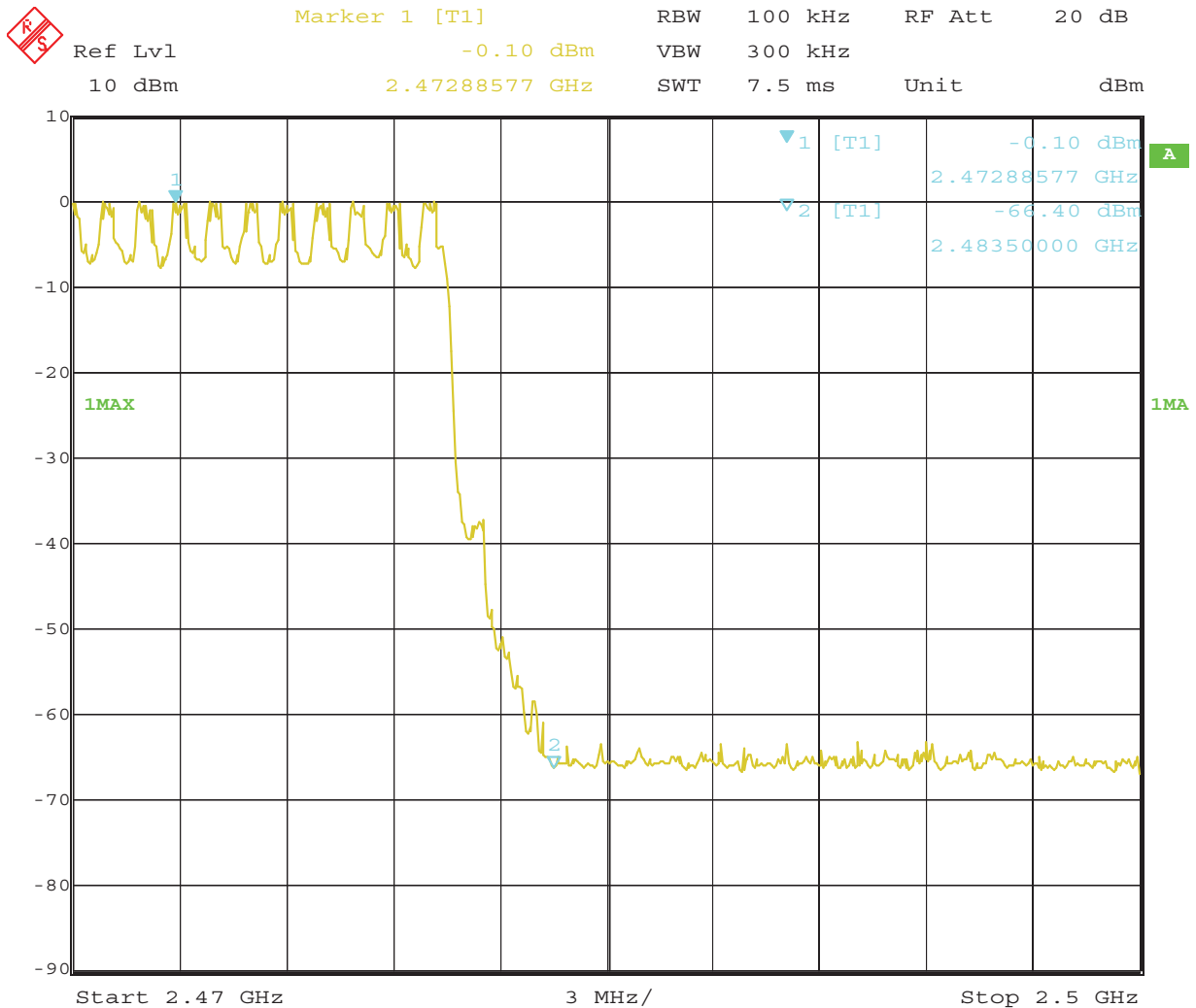


**Type of Modulation: 8DPSK**

**12.4 Out of Band Test Result**

Product:	Bluetooth keyboard		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)	42.0	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 amount in dB that the directional gain of the antenna exceeds 6 dBi.

#### 13.2 Antenna Connected constructions

PCB Antenna and the maximum Gain of this antenna is 0dBi

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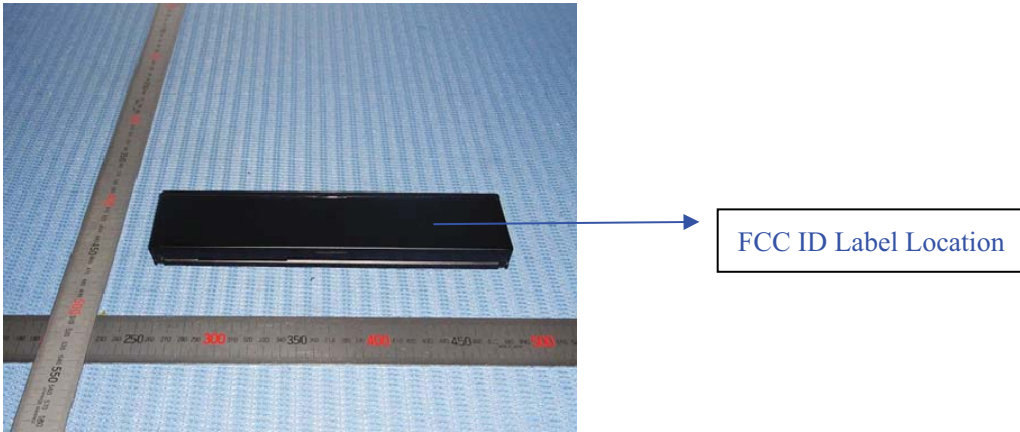
#### 14.0 FCC ID/IC Label

##### FCC ID: ZJEST-ICBK20

**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:



The report refers only to the sample tested and does not apply to the bulk.

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### 15.0 Photo of testing

Conducted Emission Test Setup:



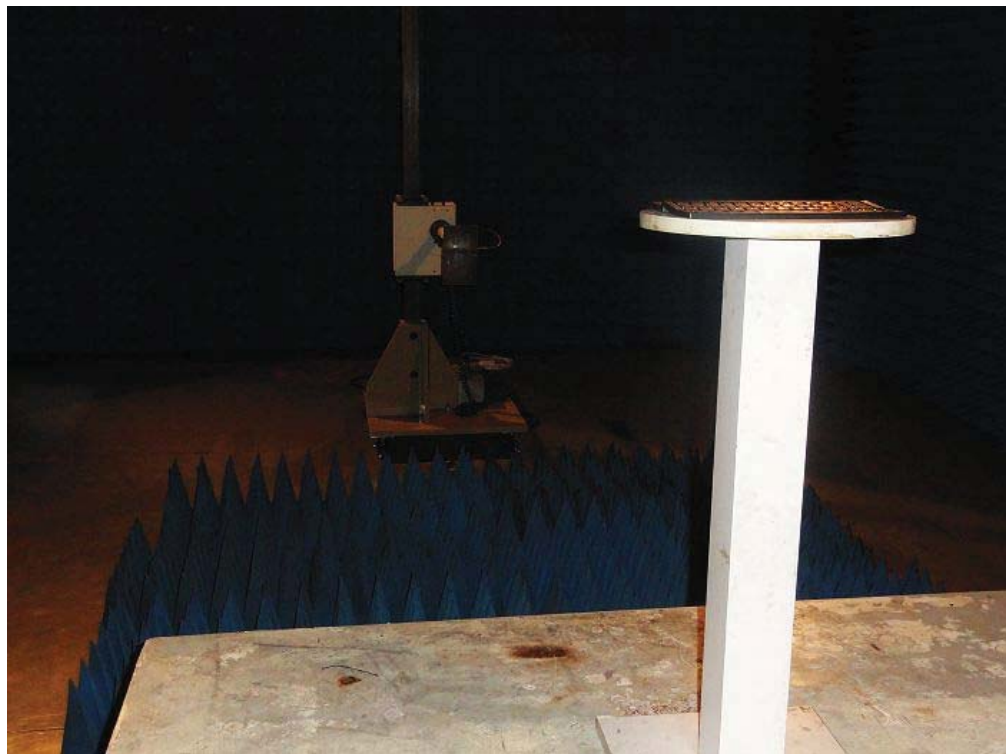
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Radiated Emission Test Setup:



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## Photographs – EUT

Outside view



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Outside view



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Outside view



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Outside view



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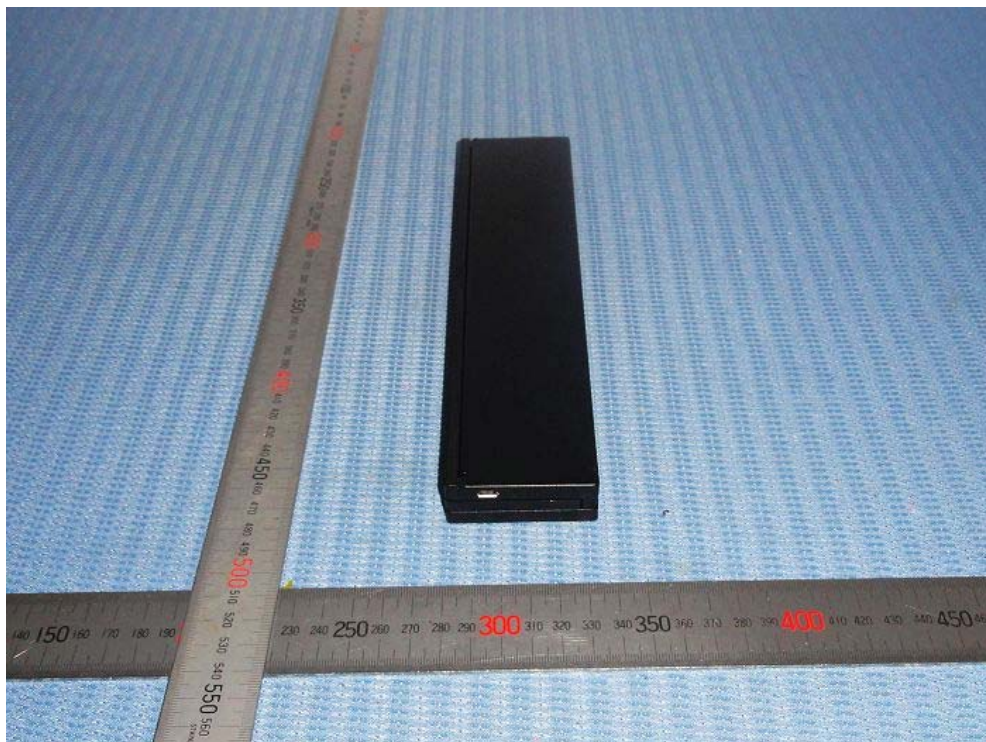
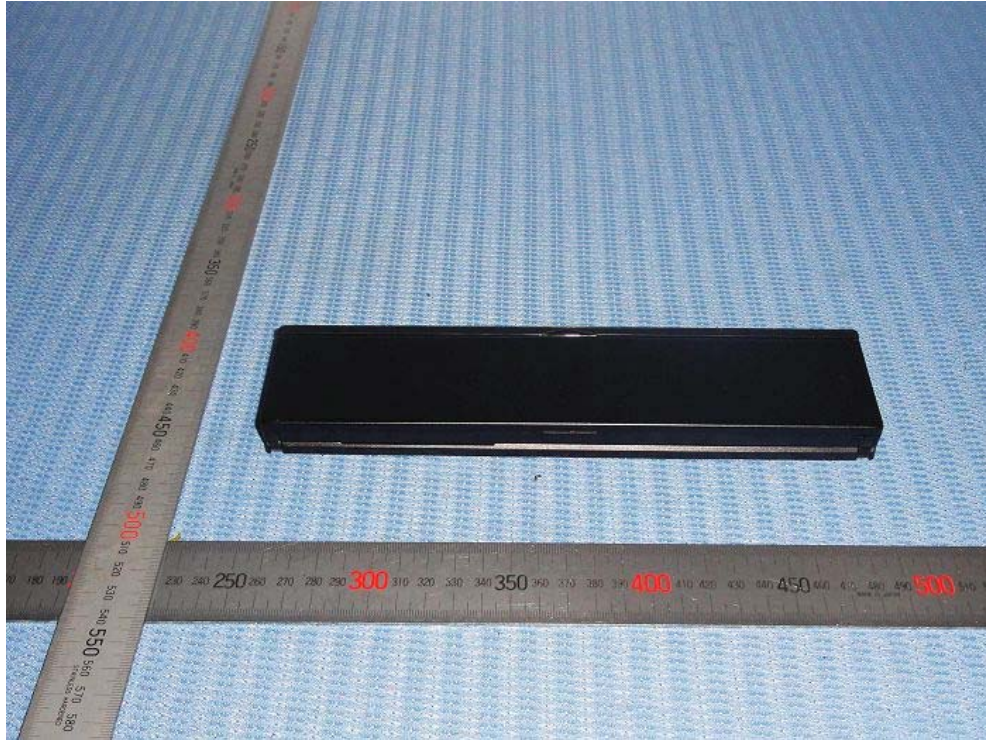
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Outside view



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Outside view



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Inside view



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Inside view



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Inside view



**End of the report**

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