TEST REPORT

Report No.:	TW2207043E
File reference No.:	2022-07-09
Applicant:	Shenzhen Glory Star Technology Industrial Co., Ltd.
Product:	TWS Earphone
Model No.:	TWS105, MI-E101T
Trademark:	Merkury, Glory Star
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

Terry Tang

Manager

Dated: July 09, 2022

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

Zone C, 1st Floor, Block B, Jun Xiang Da Building, Zhongshan Park Road West, Tong Le Village, Nanshan District, Shenzhen, 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 17025:2017 General Requirements) for the Competence of testing Laboratories.

FCC-Registration No.: 744189

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.: 744189.

Industry Canada (IC) —Registration No.:5205A

The EMC Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 5205A.

A2LA (Certification Number:5013.01)

The EMC Laboratory has been accredited by the American Association for Laboratory Accreditation (A2LA). Certification Number:5013.01

Test Report Conclusion

Content

1.0 General Details

1.1 Test Lab Details

Name : SHENZHEN TIMEWAY TESTING LABORATORIES.
Address: Zone C, 1st Floor, Block B, Jun Xiang Da Building, Zhongshan Park Road West, Tong Le Village, Nanshan District, Shenzhen, China
Telephone: (755) 83448688
Fax: (755) 83442996

1.2 Applicant Details

Applicant: Shenzhen Glory Star Technology Industrial Co., Ltd.
Address: Room2102, Block 1st, Yi Luan Building, Xixiang Road 230, BaoAn District, Shenzhen, China
Telephone: +86-755-86397260
Fax: +86-755-26609516

1.3 Description of EUT

Product: TWS Earphone
Manufacturer: Shenzhen Glory Star Technology Industrial Co., Ltd.
Address: Room 2102, Block 1st, Yi Luan Building, Xixiang Road 230, BaoAn District, Shenzhen, China
Brand Name: Merkury, Glory Star
Model Number: TWS105
Additional Model Number: MI-E101T

Type of Modulation	GFSK, Π/4DQPSK for Bluetooth
Frequency range	2402-2480MHz for Bluetooth
Channel Spacing	1MHz for Bluetooth
Frequency Selection	By software
Channel Number	79 channels for Bluetooth
Antenna:	Chip Antenna. The gain of the antennas is 1.06dBi (Get from the antenna specification)
Input Voltage:	DC5.0V
Battery:	DC5V input or Built-in DC3.7V, 35mAh Li-ion battery for earphones and DC5V input or Built-in DC3.7V, 400mAh Li-ion battery for charger base
Hardware Version:	V1.0
Software Version:	V1.0
Serial No.:	TWS105202207

1.4 Submitted Sample: 2 Samples

1.5 Test Duration

2022-07-05 to 2022-07-09

1.6 Test Uncertainty

Conducted Emissions Uncertainty =3.6dB

Radiated Emissions below 1GHz Uncertainty =4.7dB

Radiated Emissions above 1GHz Uncertainty =6.0dB

Conducted Power Uncertainty =6.0dB

Occupied Channel Bandwidth Uncertainty =5%

1.7 Test Engineer

The sample tested by Andy

Print Name: Andy Xing

2.0 Test Equipment					
Instrument Type	Manufacturer	Model	Serial No.	Date of Cal.	Due Date
ESPI Test Receiver	R&S	ESPI 3	100379	2022-06-17	2023-06-16
LISN	R&S	EZH3-Z5	100294	2022-06-17	2023-06-16
LISN	R&S	EZH3-Z5	100253	2022-06-17	2023-06-16
Impuls-Begrenzer	R&S	ESH3-Z2	100281	2022-06-17	2023-06-16
Loop Antenna	EMCO	6507	00078608	2022-06-17	2023-06-16
Spectrum	R&S	FSIQ26	100292	2022-06-17	2023-06-16
Horn Antenna	A-INFO	LB-180400-KF	J211060660	2022-06-17	2023-06-16
Horn Antenna	R&S	BBHA 9120D	9120D-631	2021-07-02	2024-07-01
Power meter	Anritsu	ML2487A	6K00003613	2022-06-17	2023-06-16
Power sensor	Anritsu	MA2491A	32263	2022-06-17	2023-06-16
Bilog Antenna	Schwarebeck	VULB9163	9163/340	2021-07-02	2024-07-01
9*6*6 Anechoic	--	--	N/A	2022-06-17	2023-06-16
EMI Test Receiver	RS	ESVB	826156/011	2022-06-17	2023-06-16
EMI Test Receiver	RS	ESH3	860904/006	2022-06-17	2023-06-16
Spectrum	HP/Agilent	ESA-L1500A	US37451154	2022-06-17	2023-06-16
Spectrum	HP/Agilent	E4407B	MY50441392	2022-06-17	2023-06-16
Spectrum	RS	FSP	1164.4391.38	2022-06-17	2023-06-16
RF Cable	Zhengdi	ZT26-NJ-NJ-8M/FA	--	2022-06-17	2023-06-16
RF Cable	Zhengdi	7m	--	2022-06-17	2023-06-16
RF Switch	EM	EMSW18	060391	2022-06-17	2023-06-16
Pre-Amplifier	Schwarebeck	BBV9743	#218	2022-06-17	2023-06-16
Pre-Amplifier	HP/Agilent	8449B	3008A00160	2022-06-17	2023-06-16
LISN	SCHAFFNER	NNB42	00012	2022-01-14	2023-01-13

2.2 Automation Test Software

For Conducted Emission Test

Name	Version
EZ-EMC	Ver.EMC-CON 3A1.1

For Radiated Emissions

Name	Version
EMI Test Software BL410-EV18.91	V18.905
EMI Test Software BL410-EV18.806 High Frequency	V18.06

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

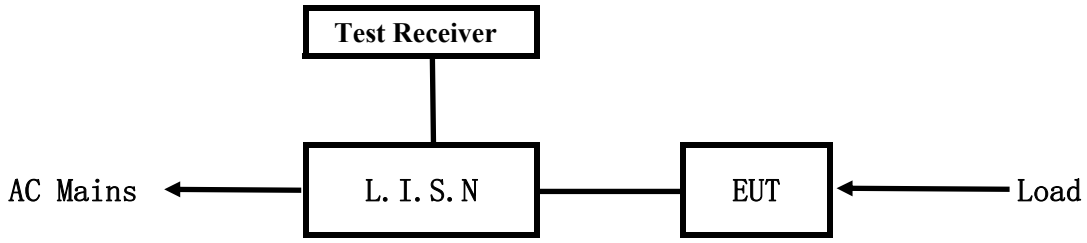
FCC Part 15 Subpart & Subpart C, Paragraph 15.247

4.0 EUT Modification

No modification by SHENZHEN TIMEWAY TESTING LABORATORIES.

5. Power Line Conducted Emission Test

5.1 Schematics of the test



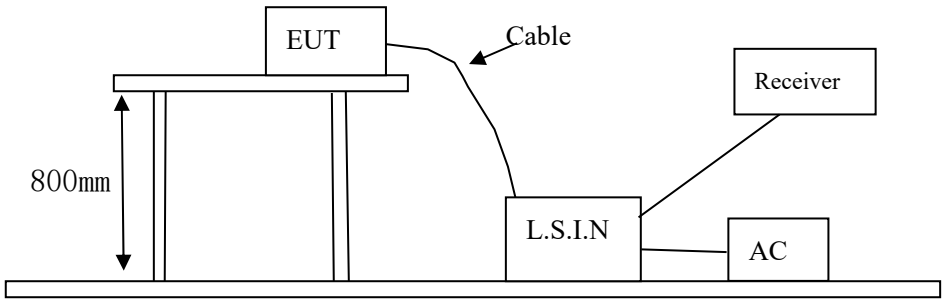
EUT: Equipment Under Test

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.

A. EUT

Device	Manufacturer	Model	FCC ID
TWS Earphone	Glory Star Technology Industrial Co., Ltd.	TWS105, MI-E101T	2AS7V-TWS105

B. Internal Device

Device	Manufacturer	Model	Rating
N/A			

C. Peripherals

Device	Manufacturer	Model	Rating
N/A			

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 15.207

Frequency (MHz)	Limits (dB μ V)	
	Quasi-peak Level	Average Level
0.15 ～ 0.50	66.0～56.0*	56.0～46.0*
0.50 ～ 5.00	56.0	46.0
5.00 ～ 30.00	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 Pass

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

A: Disturbance Voltage Limits at mains on Live terminals (150kHz to 30MHz)

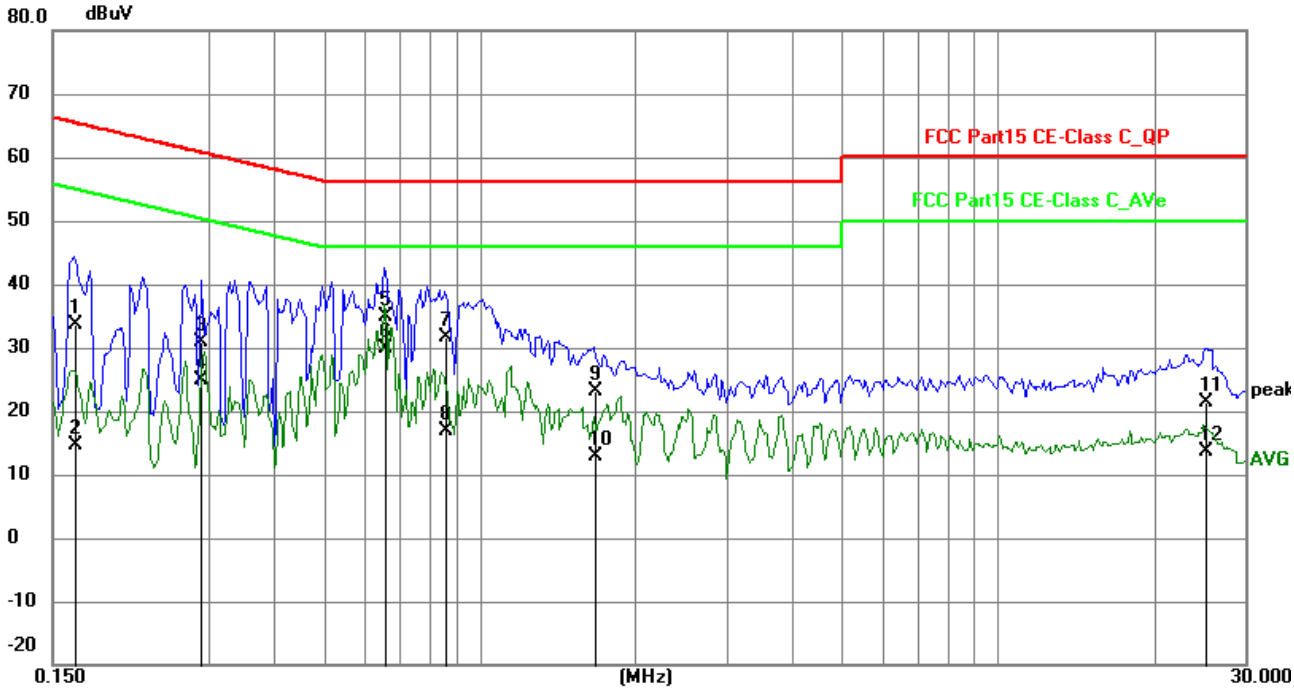
EUT Operating Environment

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

EUT set Condition: Keep Bluetooth Transmitting

Results: Pass

Please refer to following diagram for individual



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.1655	23.74	9.77	33.51	65.18	-31.67	QP	P
2	0.1655	4.96	9.77	14.73	55.18	-40.45	AVG	P
3	0.2904	21.09	9.76	30.85	60.51	-29.66	QP	P
4	0.2904	15.18	9.76	24.94	50.51	-25.57	AVG	P
5	0.6570	25.06	9.78	34.84	56.00	-21.16	QP	P
6	0.6570	20.06	9.78	29.84	46.00	-16.16	AVG	P
7	0.8598	21.78	9.79	31.57	56.00	-24.43	QP	P
8	0.8598	6.97	9.79	16.76	46.00	-29.24	AVG	P
9	1.6710	13.31	9.80	23.11	56.00	-32.89	QP	P
10	1.6710	3.04	9.80	12.84	46.00	-33.16	AVG	P
11	25.0779	10.43	10.99	21.42	60.00	-38.58	QP	P
12	25.0779	2.69	10.99	13.68	50.00	-36.32	AVG	P

B: Disturbance Voltage Limits at mains on Neutral terminals (150kHz to 30MHz)

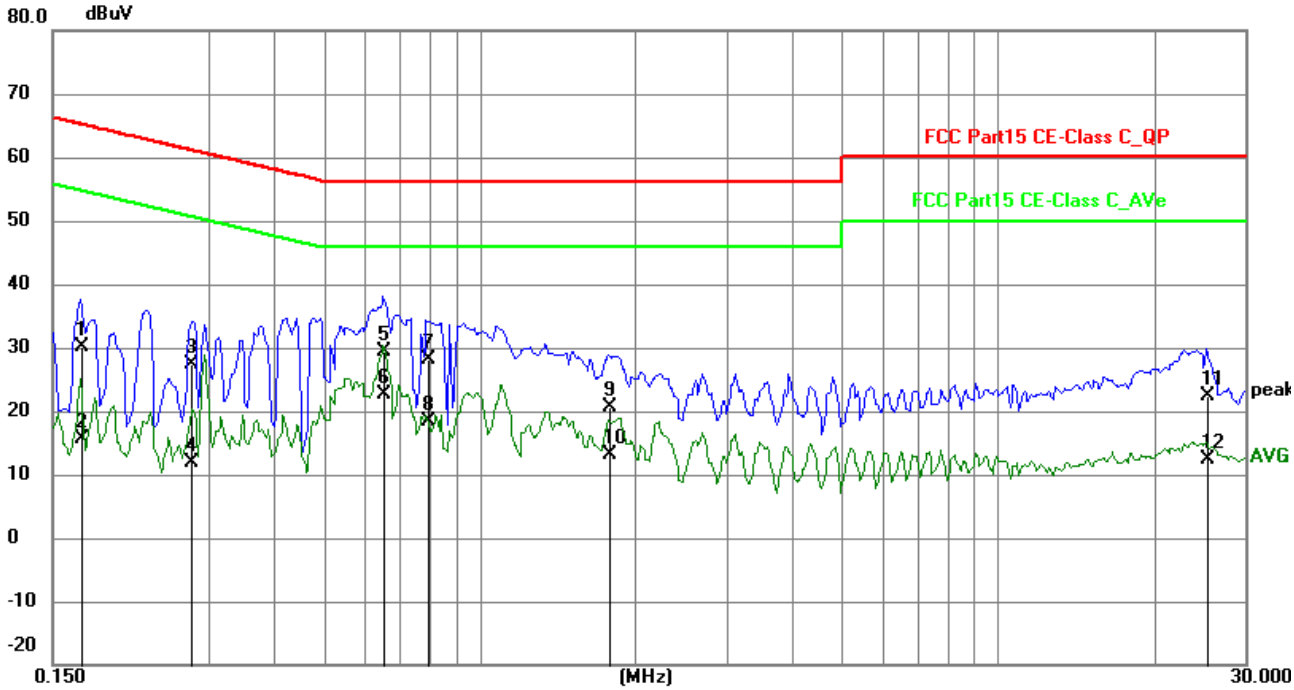
EUT Operating Environment

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

EUT set Condition: Keep Bluetooth Transmitting

Results: Pass

Please refer to following diagram for individual



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F
1	0.1695	20.45	9.77	30.22	64.98	-34.76	QP	P
2	0.1695	5.93	9.77	15.70	54.98	-39.28	AVG	P
3	0.2787	17.62	9.76	27.38	60.85	-33.47	QP	P
4	0.2787	2.22	9.76	11.98	50.85	-38.87	AVG	P
5	0.6531	19.67	9.78	29.45	56.00	-26.55	QP	P
6	0.6531	12.81	9.78	22.59	46.00	-23.41	AVG	P
7	0.7960	18.46	9.78	28.24	56.00	-27.76	QP	P
8	0.7960	8.67	9.78	18.45	46.00	-27.55	AVG	P
9	1.7724	10.93	9.80	20.73	56.00	-35.27	QP	P
10	1.7724	3.33	9.80	13.13	46.00	-32.87	AVG	P
11	25.1949	11.35	11.00	22.35	60.00	-37.65	QP	P
12	25.1949	1.44	11.00	12.44	50.00	-37.56	AVG	P

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. 744189

(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.

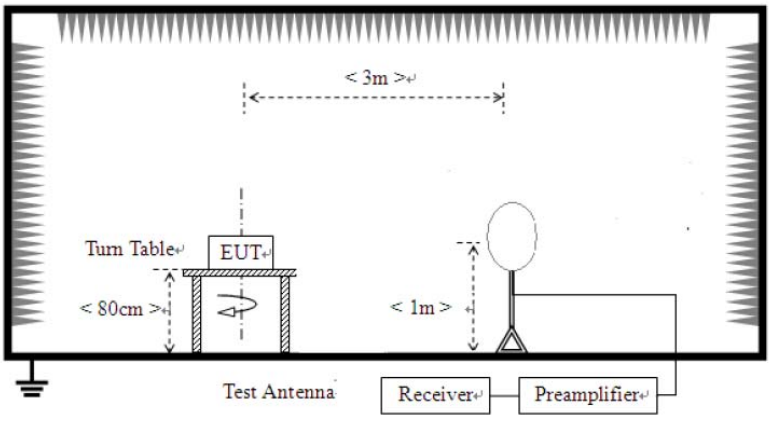
(4) The antenna high is varied from 1 m to 4 m high to find the maximum emission for each frequency.

(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.

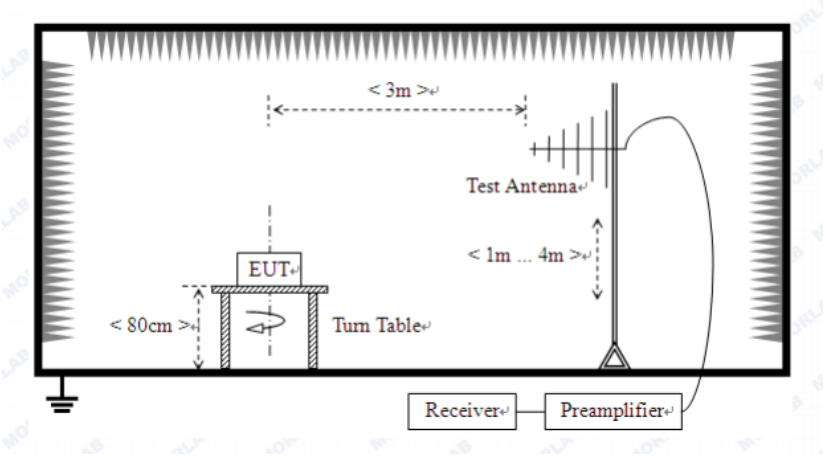
(6) The antenna polarization : Vertical polarization and Horizontal polarization.

Block diagram of Test setup

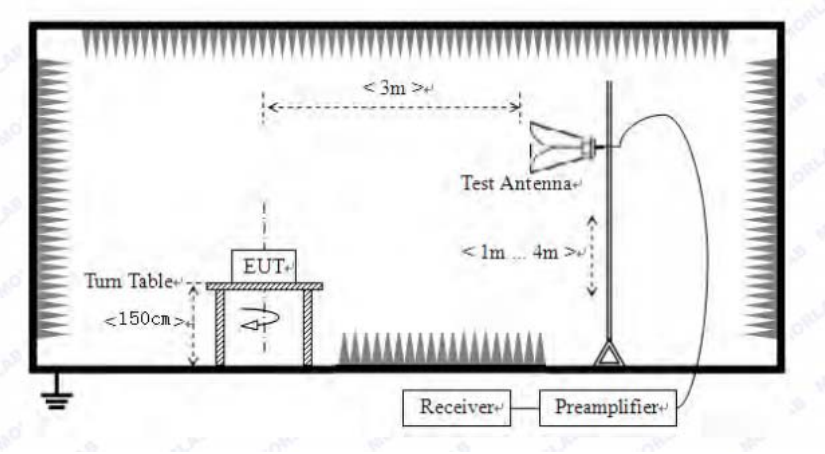
For radiated emissions from 9kHz to 30MHz



For radiated emissions from 30MHz to1GHz



For radiated emissions above 1GHz



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.

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

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. Л/4DQPSK was the worst case because it has highest output power

5. 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.

6. Battery fully charged was used during the test.

Test result

General Radiated Emission Data and Harmonics Radiated Emission Data

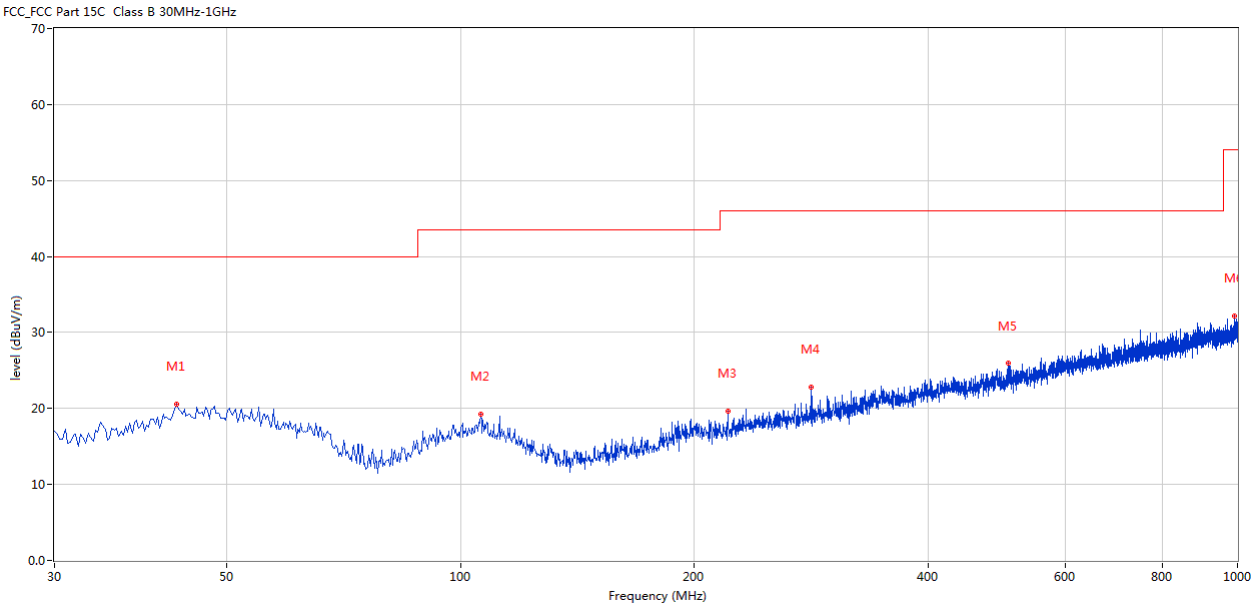
Radiated Emission In Horizontal/Vertical (30MHz----1000MHz)

EUT set Condition: Keep Bluetooth Transmitting

Results: **Pass**

Test Figure:

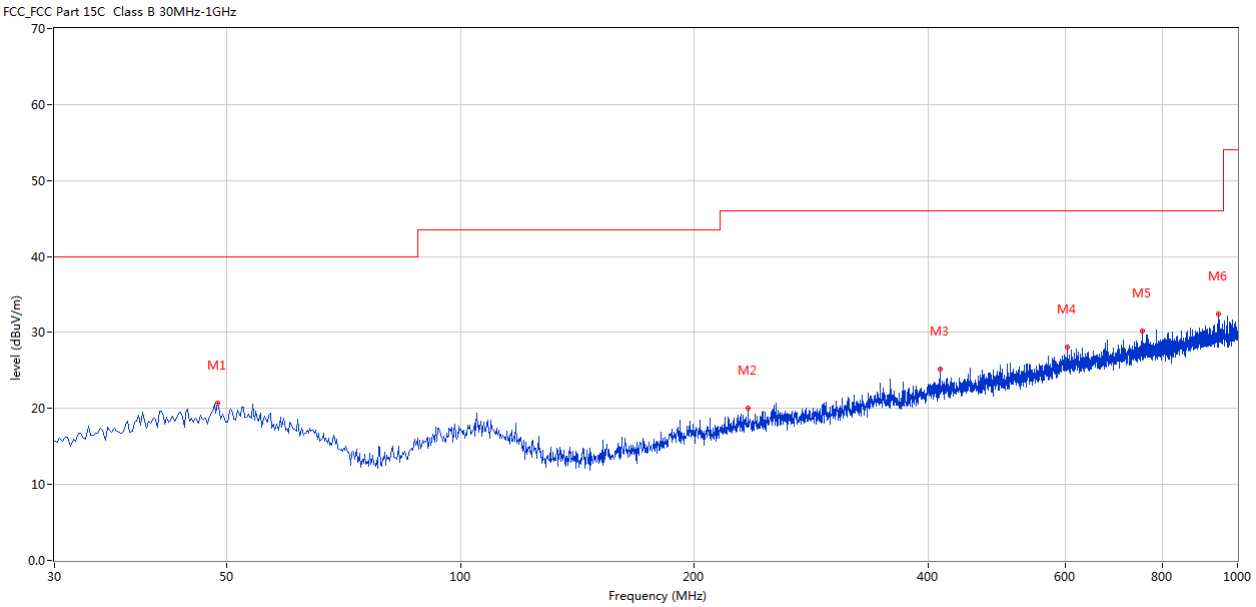
H



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	43.092	20.55	-11.50	40.0	-19.45	Peak	360.00	100	Horizontal	Pass
2	106.126	19.22	-13.32	43.5	-24.28	Peak	333.00	100	Horizontal	Pass
3	220.800	19.60	-13.29	46.0	-26.40	Peak	360.00	100	Horizontal	Pass
4	282.864	22.87	-11.41	46.0	-23.13	Peak	83.00	100	Horizontal	Pass
5	507.606	25.91	-6.89	46.0	-20.09	Peak	212.00	100	Horizontal	Pass
6	991.030	32.16	-1.36	54.0	-21.84	Peak	308.00	100	Horizontal	Pass

Test Figure:

V



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	48.668	20.69	-11.22	40.0	-19.31	Peak	331.00	100	Vertical	Pass
2	234.376	19.97	-12.53	46.0	-26.03	Peak	58.00	100	Vertical	Pass
3	413.782	25.15	-8.27	46.0	-20.85	Peak	229.00	100	Vertical	Pass
4	604.096	28.04	-4.96	46.0	-17.96	Peak	110.00	100	Vertical	Pass
5	753.924	30.21	-3.40	46.0	-15.79	Peak	236.00	100	Vertical	Pass
6	943.997	32.39	-1.62	46.0	-13.61	Peak	326.00	100	Vertical	Pass

Operation Mode: Transmitting under Low Channel (2402MHz)

Frequency (MHz)	Level@3m (dBμV/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

Operation Mode: Transmitting under High Channel (2480MHz)

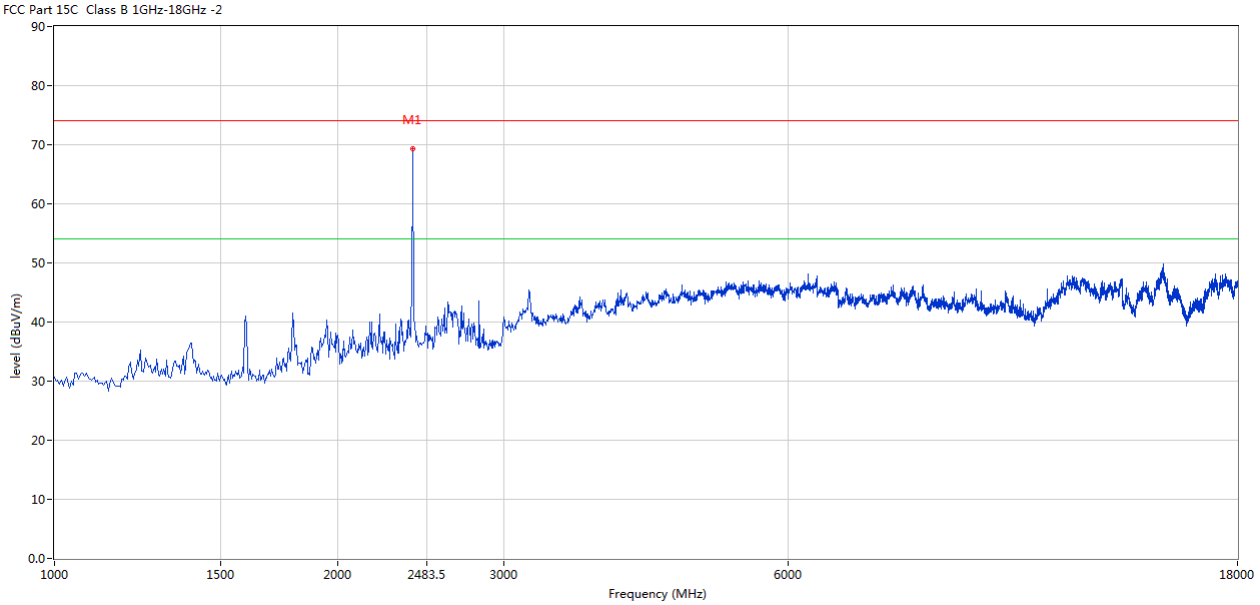
Frequency (MHz)	Level@3m (dB μ V/m)	Antenna Polarity	Limit@3m (dB μ V/m)
4960	--	H	74(Peak)/ 54(AV)
4960	--	V	74(Peak)/ 54(AV)
7440	--	H/V	74(Peak)/ 54(AV)
9920	--	H/V	74(Peak)/ 54(AV)
12400	--	H/V	74(Peak)/ 54(AV)
14880	--	H/V	74(Peak)/ 54(AV)
17360	--	H/V	74(Peak)/ 54(AV)
19840	--	H/V	74(Peak)/ 54(AV)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

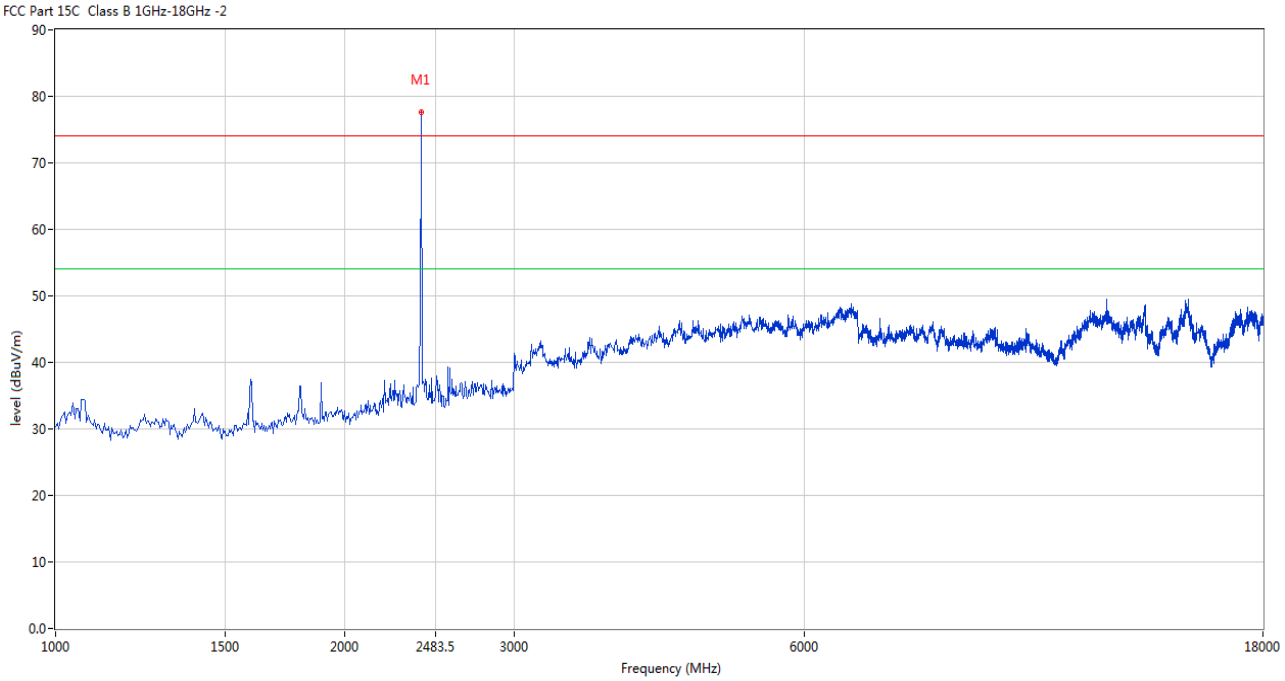
2. Remark “---” means that the emissions level is too low to be measured

Please refer to the following test plots for details:

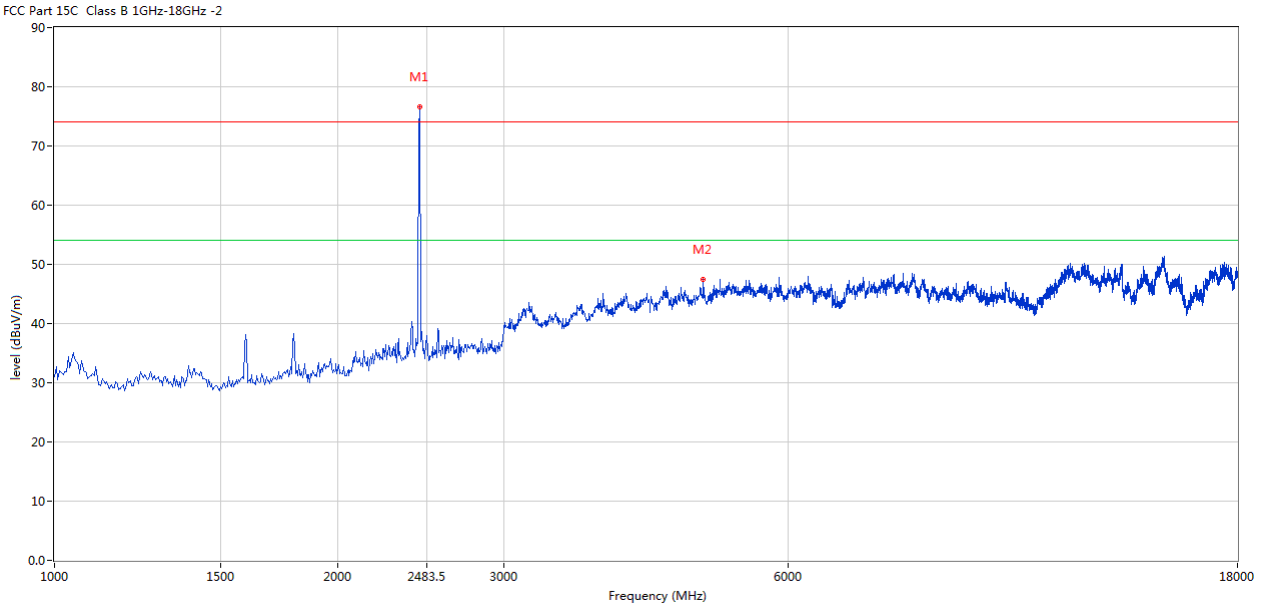
Low Channel: Vertical



Low Channel: Horizontal

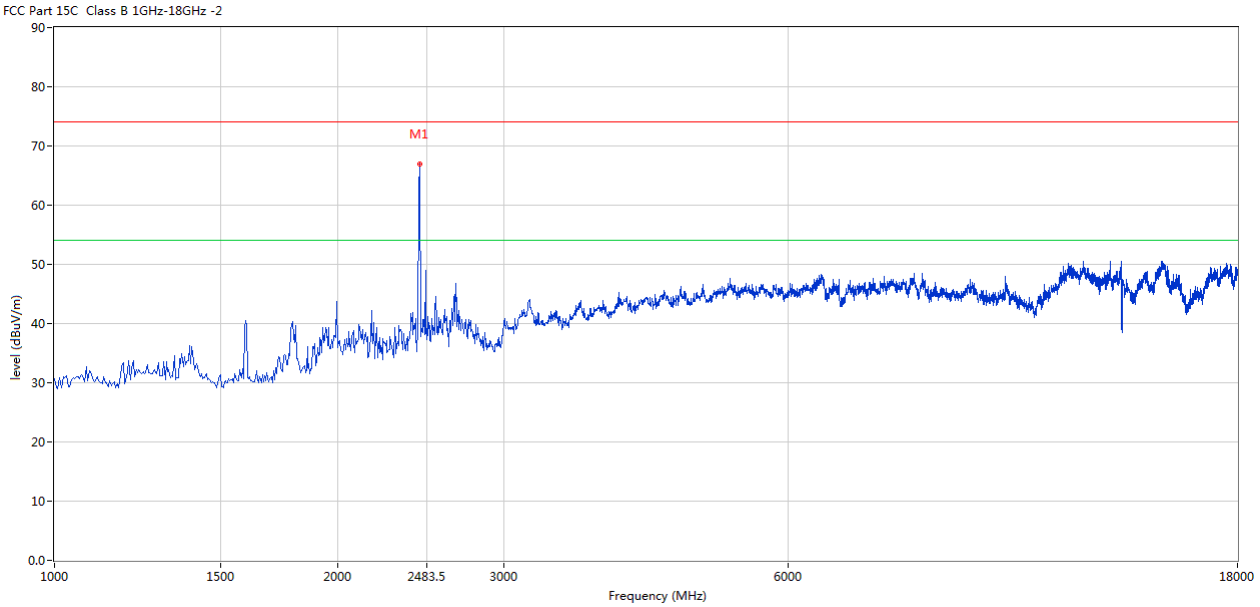


Middle Channel: Horizontal

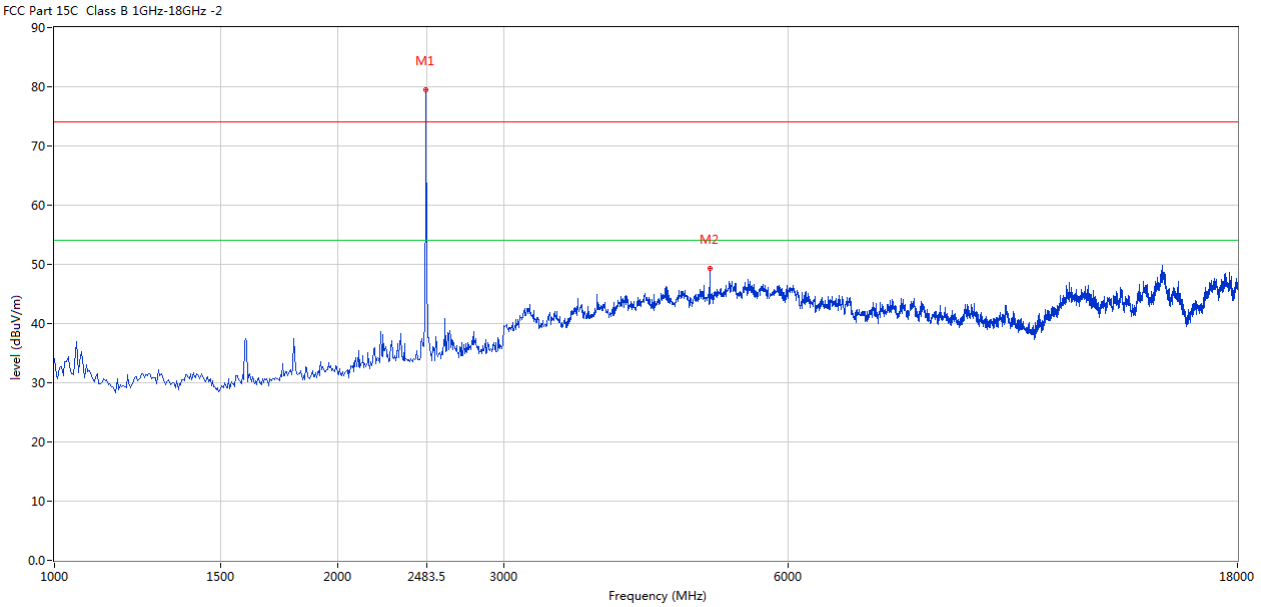


No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
2	4880.250	47.50	3.20	74.0	-26.50	Peak	360.00	100	Horizontal	Pass

Middle Channel: Vertical

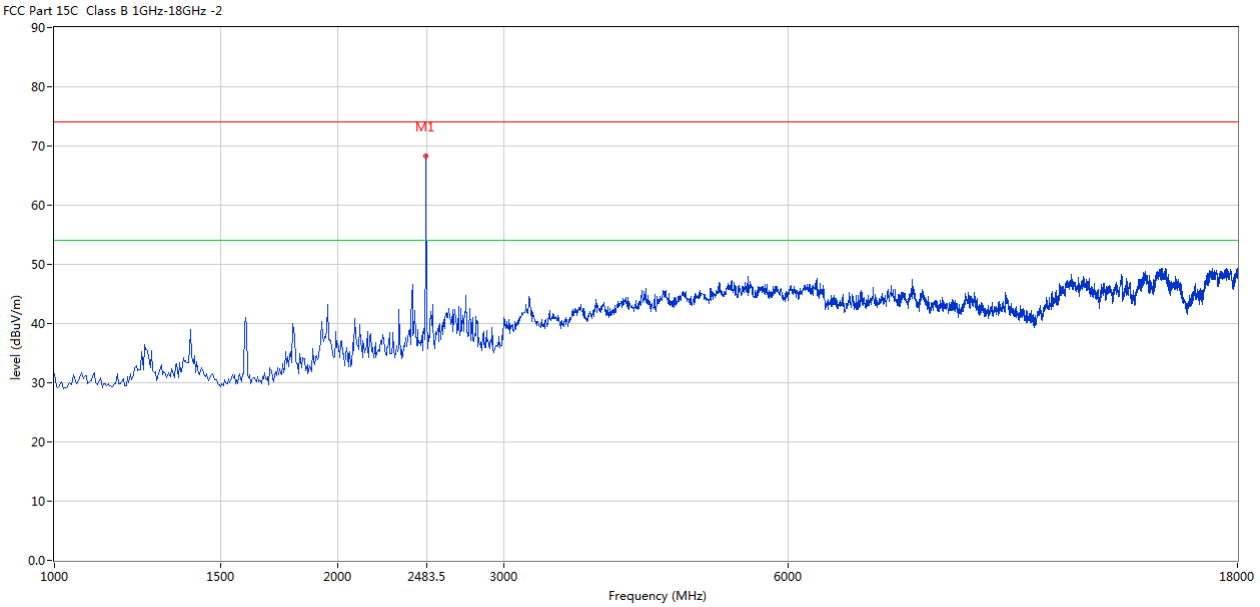


High Channel: Horizontal



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
2	4961.000	49.25	3.36	74.0	-24.75	Peak	3.00	100	Horizontal	Pass

High Channel: Vertical



Note: 1. for the radiated emissions above 18G and below 30MHz, it is the floor noise.

2. the measured PK radiated emissions level less than the AV limit, so no necessary to take down the AV result

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.

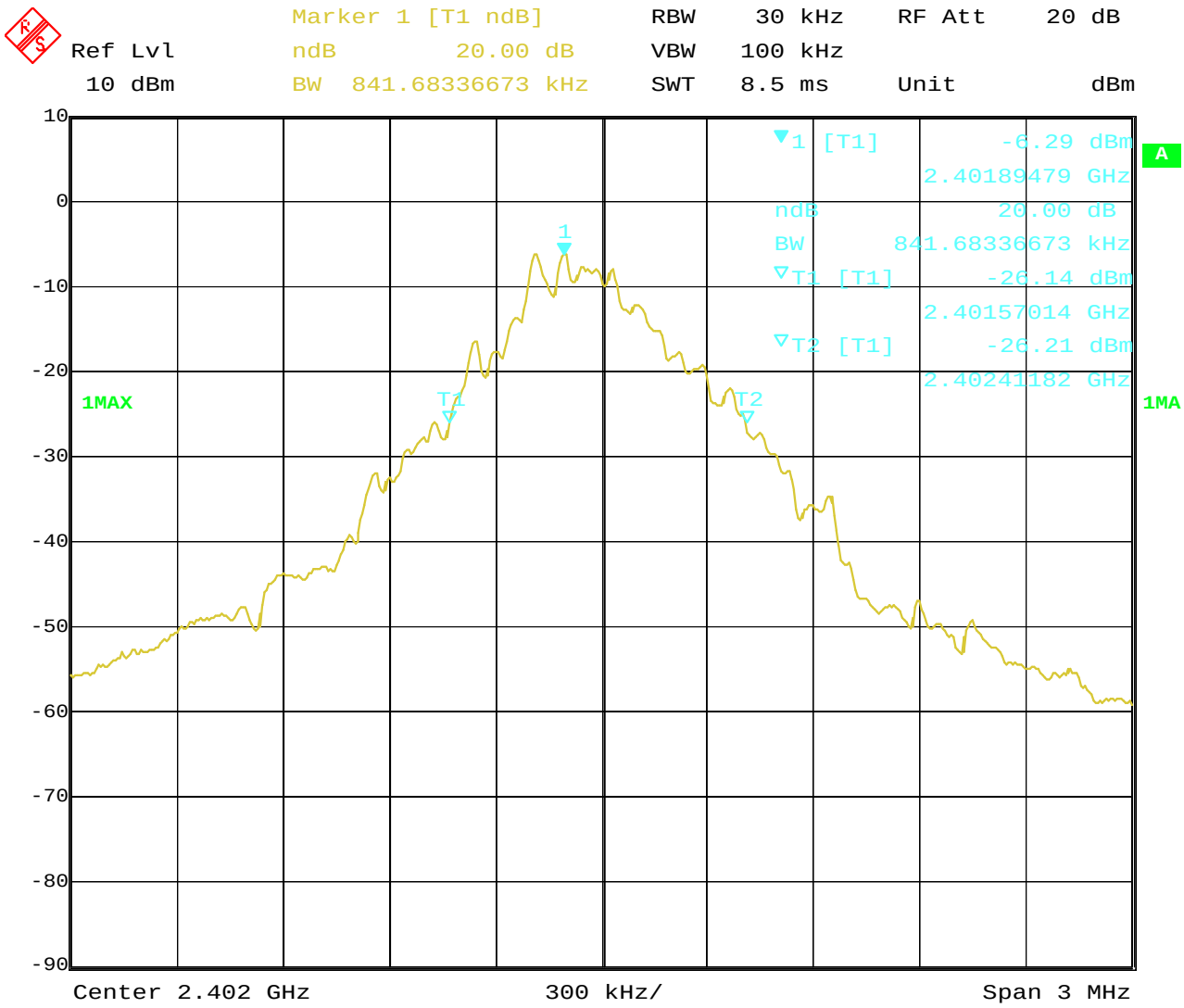
7.4 Test Result

Type of Modulation: GFSK

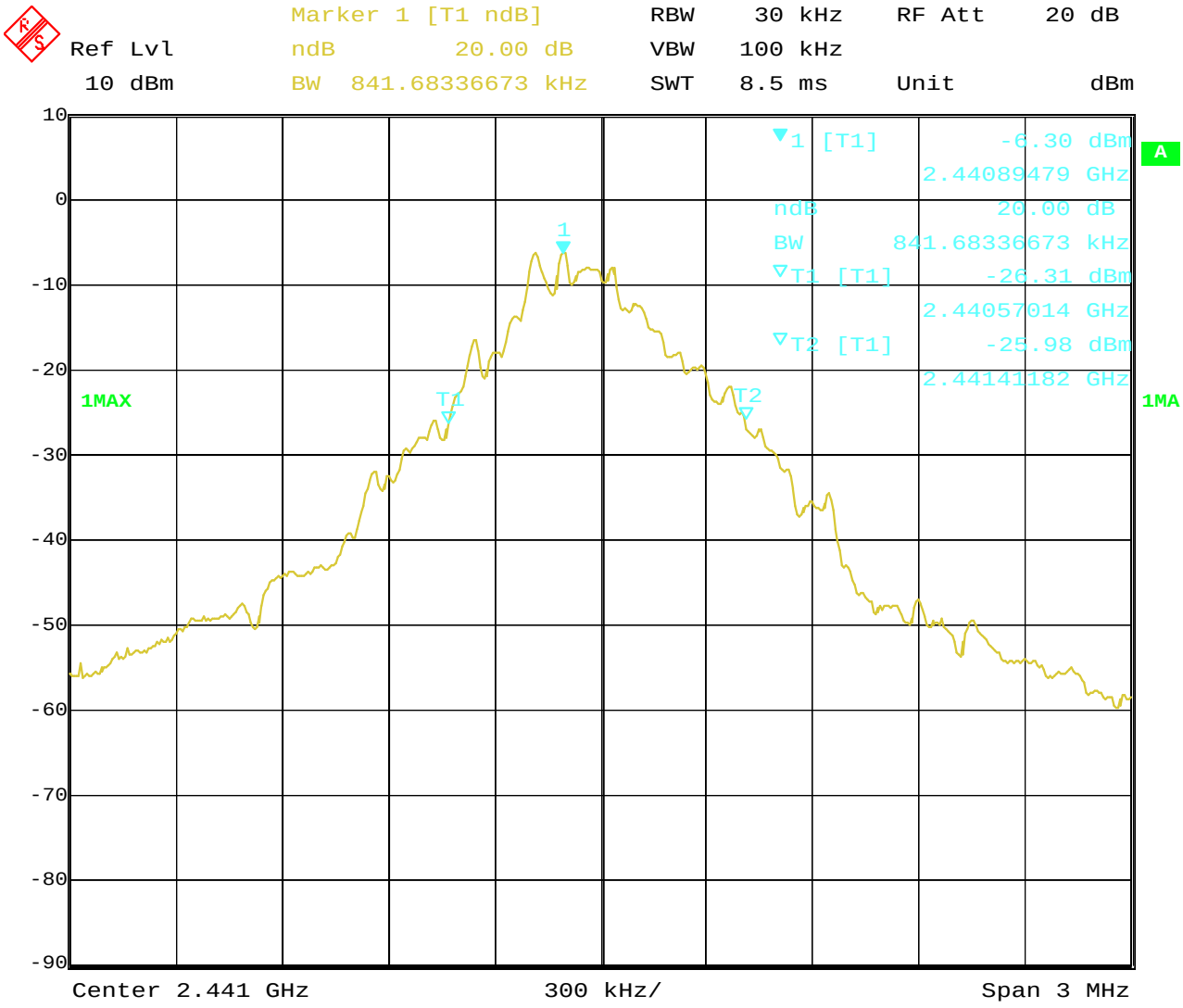
EUT	TWS Earphone		Model	TWS105
Mode	Keep Transmitting		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Channel	Channel Frequency (MHz)	20 dB Bandwidth (kHz)	Minimum Limit (kHz)	Pass/ Fail
Low	2402	842	--	Pass
Middle	2441	842	--	Pass
High	2480	848	--	Pass

Test Figure:

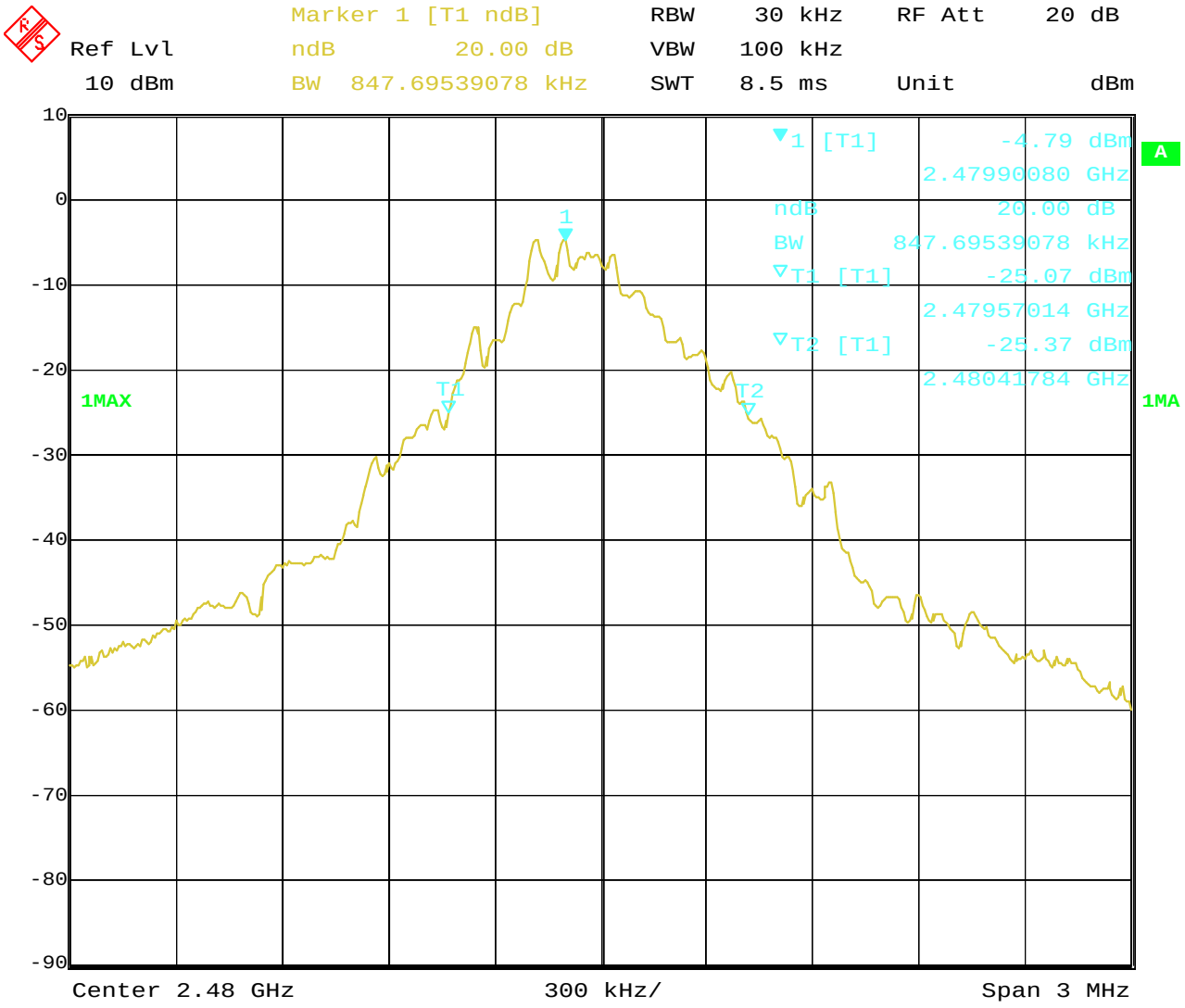
1. Condition: Low Channel



2. Condition: Middle Channel



3. High Channel



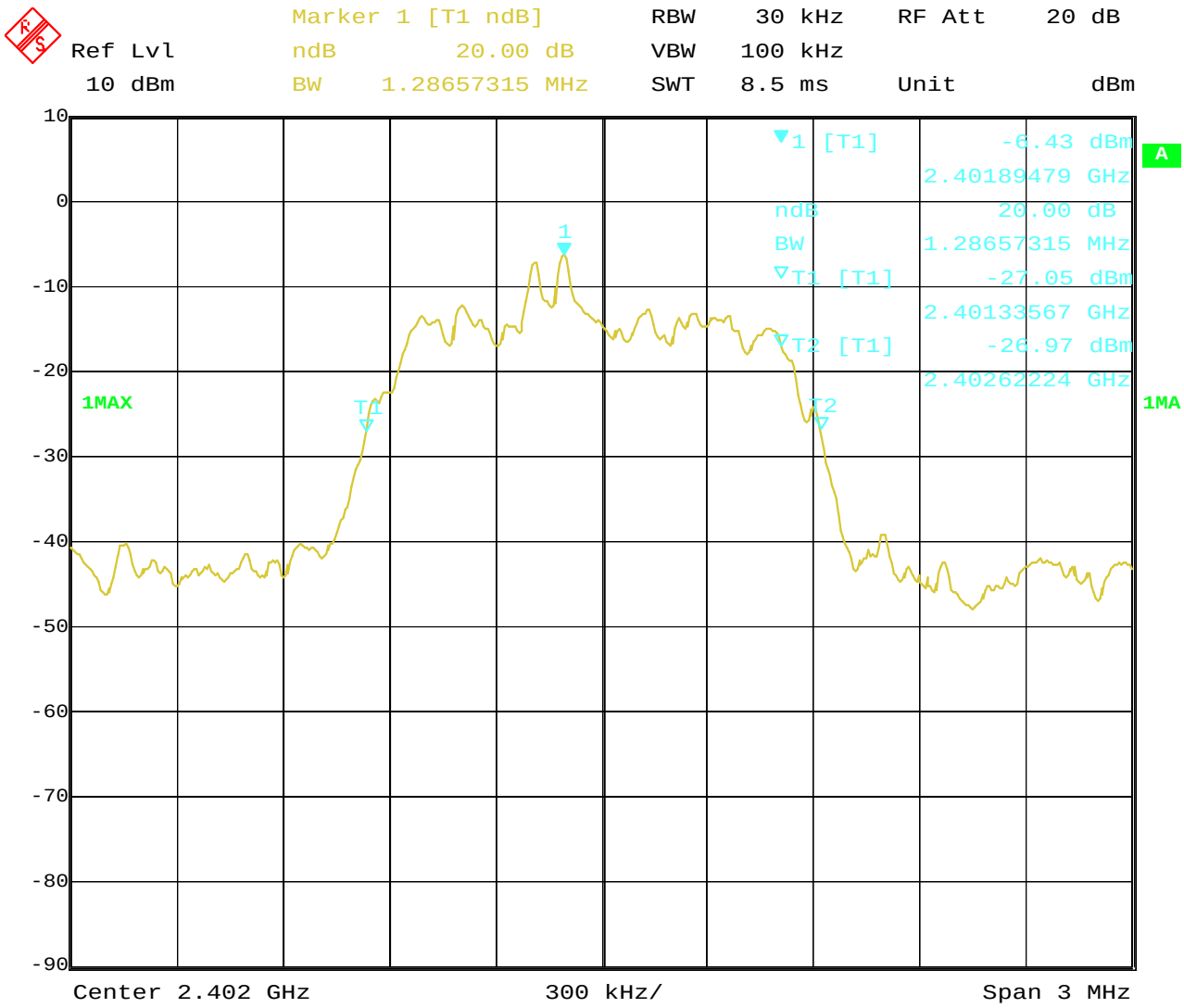
Test Result

Type of Modulation: Л/4DQPSK

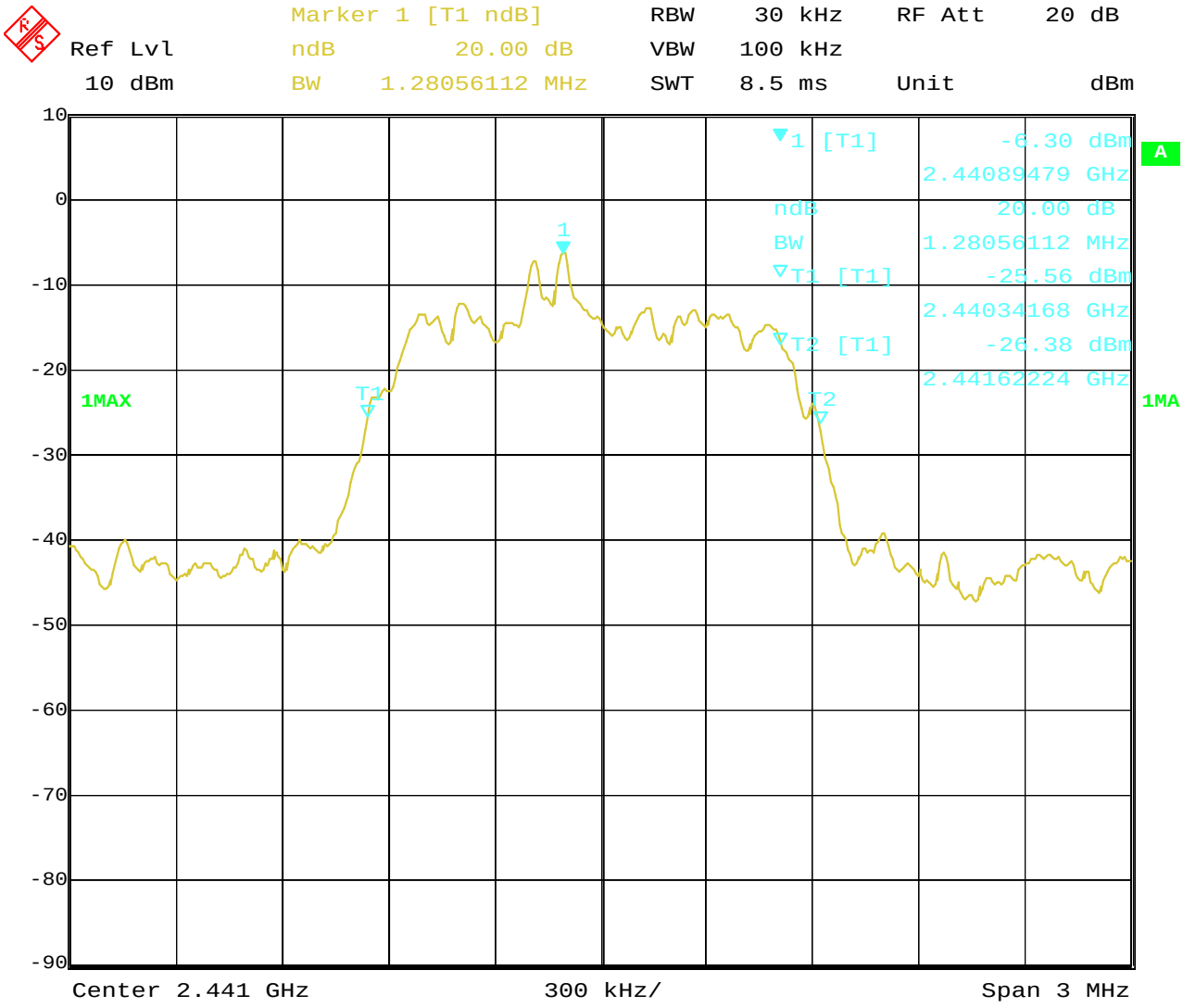
EUT	TWS Earphone		Model	TWS105
Mode	Keep Transmitting		Input Voltage	DC3.7V
Temperature	24 deg. C,		Humidity	56% RH
Channel	Channel Frequency (MHz)	20 dB Bandwidth (kHz)	Maximum Limit (kHz)	Pass/ Fail
Low	2402	1287	--	Pass
Middle	2441	1281	--	Pass
High	2480	1281	--	Pass

Test Figure:

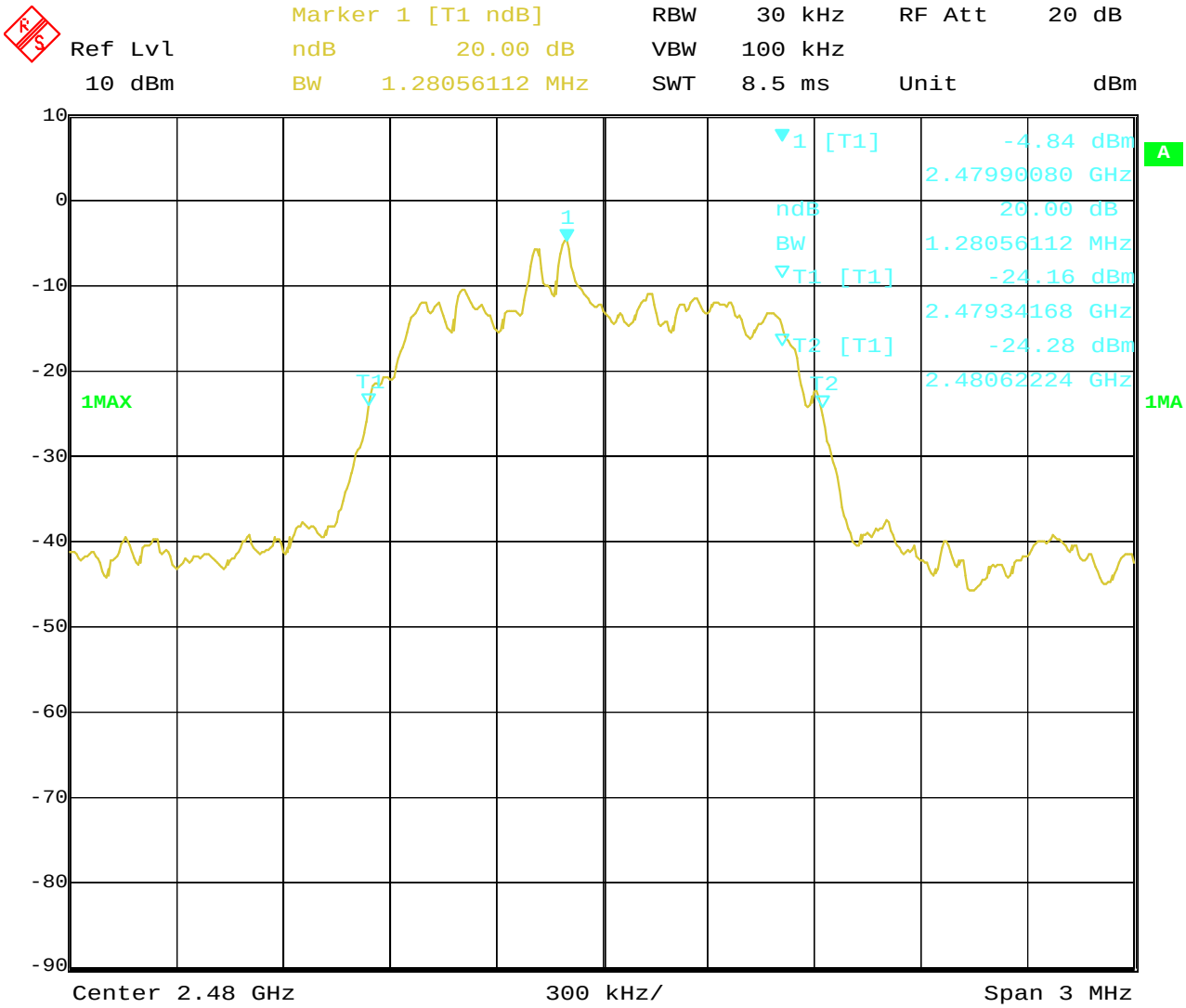
1. Condition: Low Channel



2. Condition: Middle Channel



3. High Channel



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

The RF power output was measured with a Power meter connected to the RF Antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate centre frequency.

8.4Test Results

Type of Modulation: GFSK

EUT	TWS Earphone		Model	TWS105
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	-5.35	30	Pass
Middle	2441	-5.58	30	Pass
High	2480	-3.98	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	TWS Earphone		Model	TWS105
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	-1.87	30	Pass
Middle	2441	-1.74	30	Pass
High	2480	-0.20	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

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.

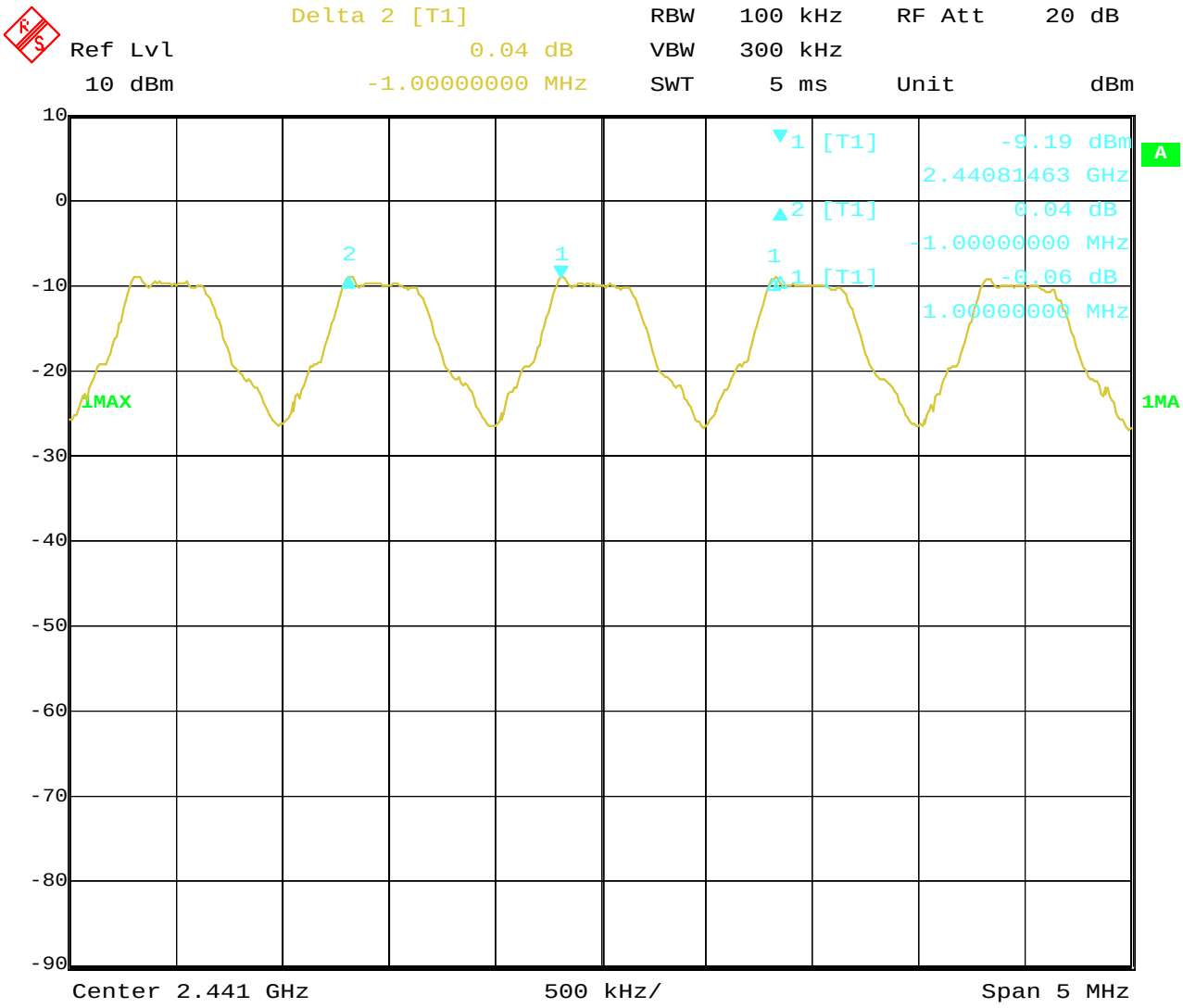
9.4Test Result

Type of Modulation: GFSK

EUT	TWS Earphone	Model	TWS105
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

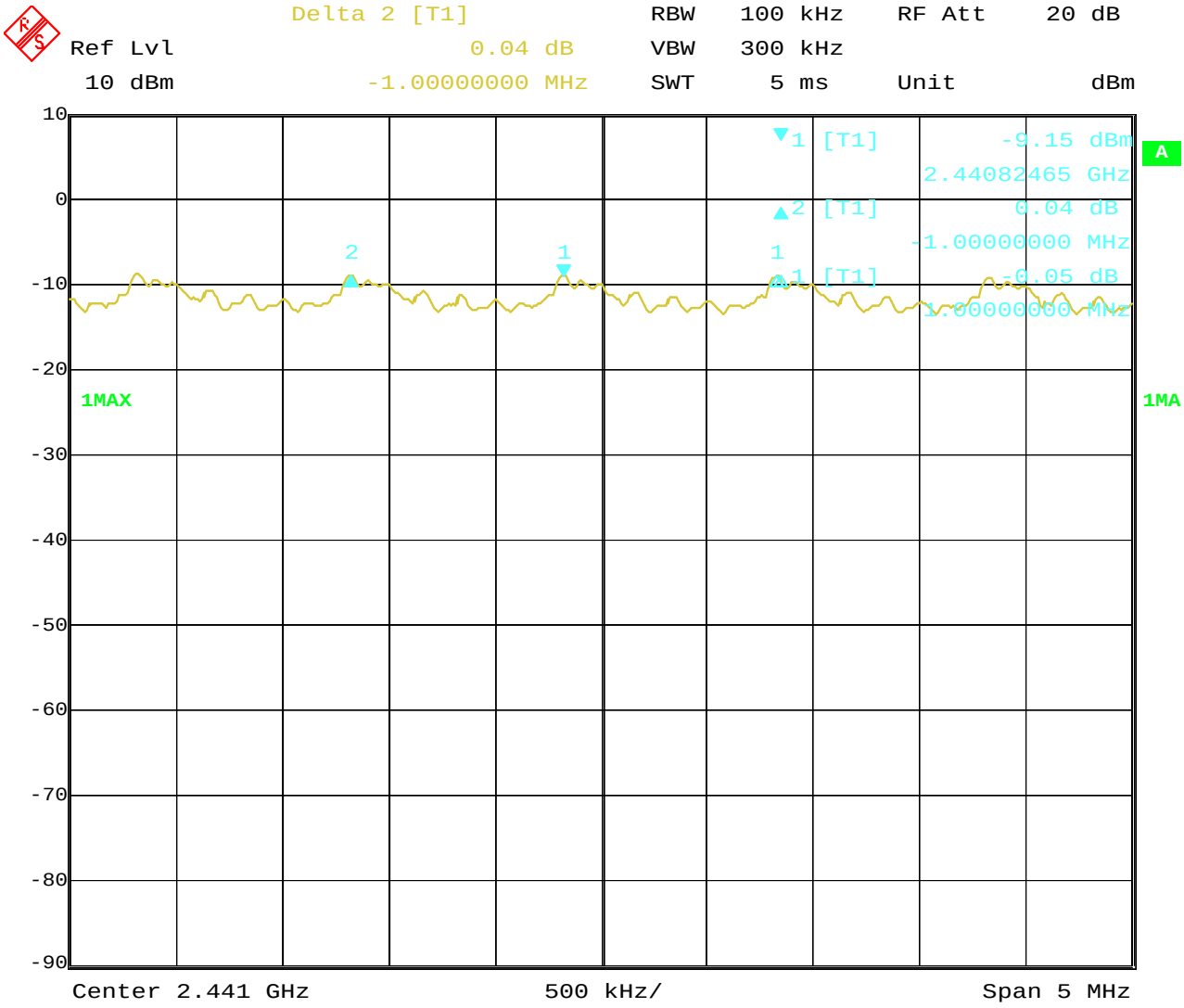


Type of Modulation: Л/4DQPSK

EUT	TWS Earphone	Model	TWS105
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



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.

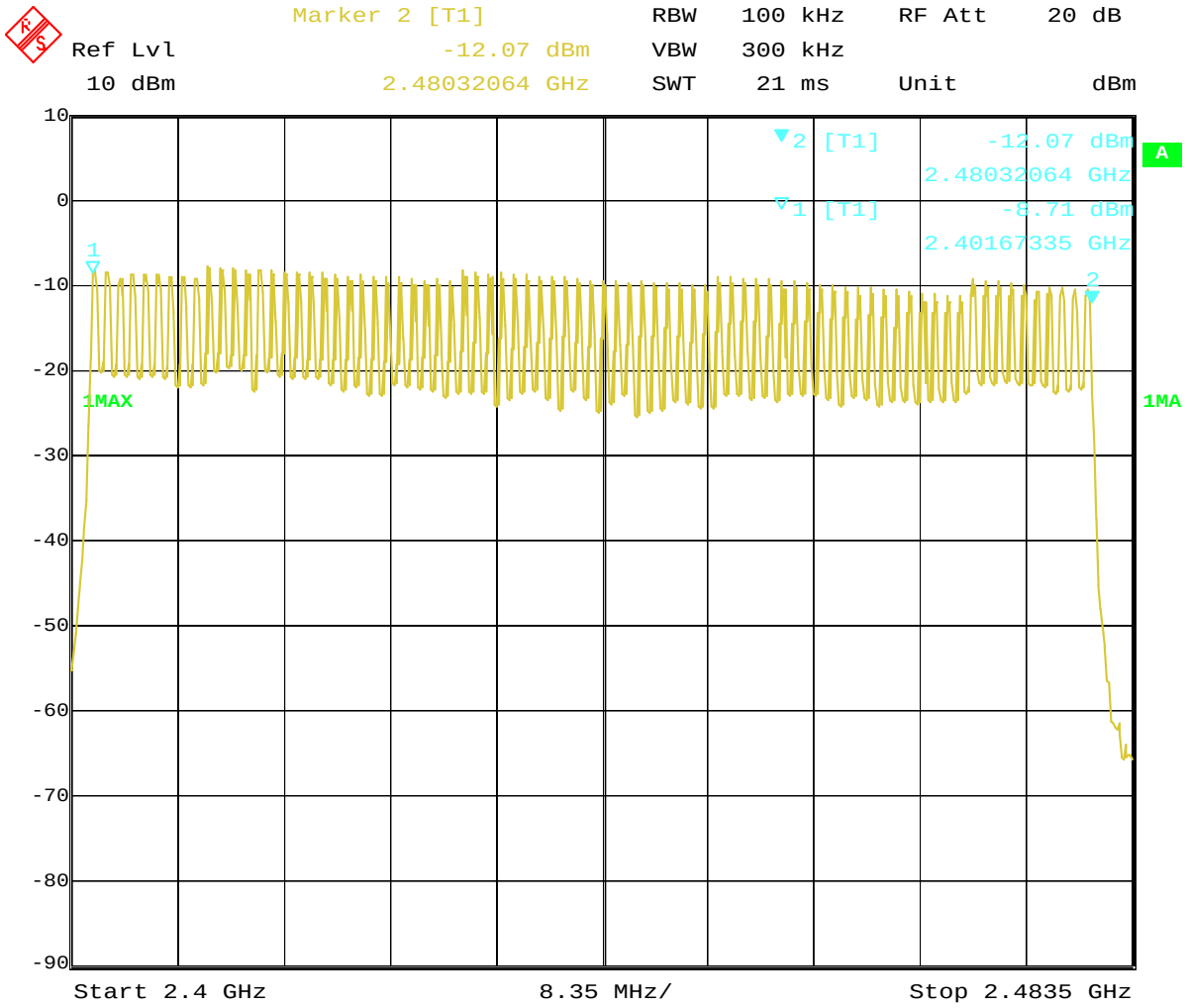
10.4Test Result

Type of Modulation: GFSK

EUT	TWS Earphone	Model	TWS105
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

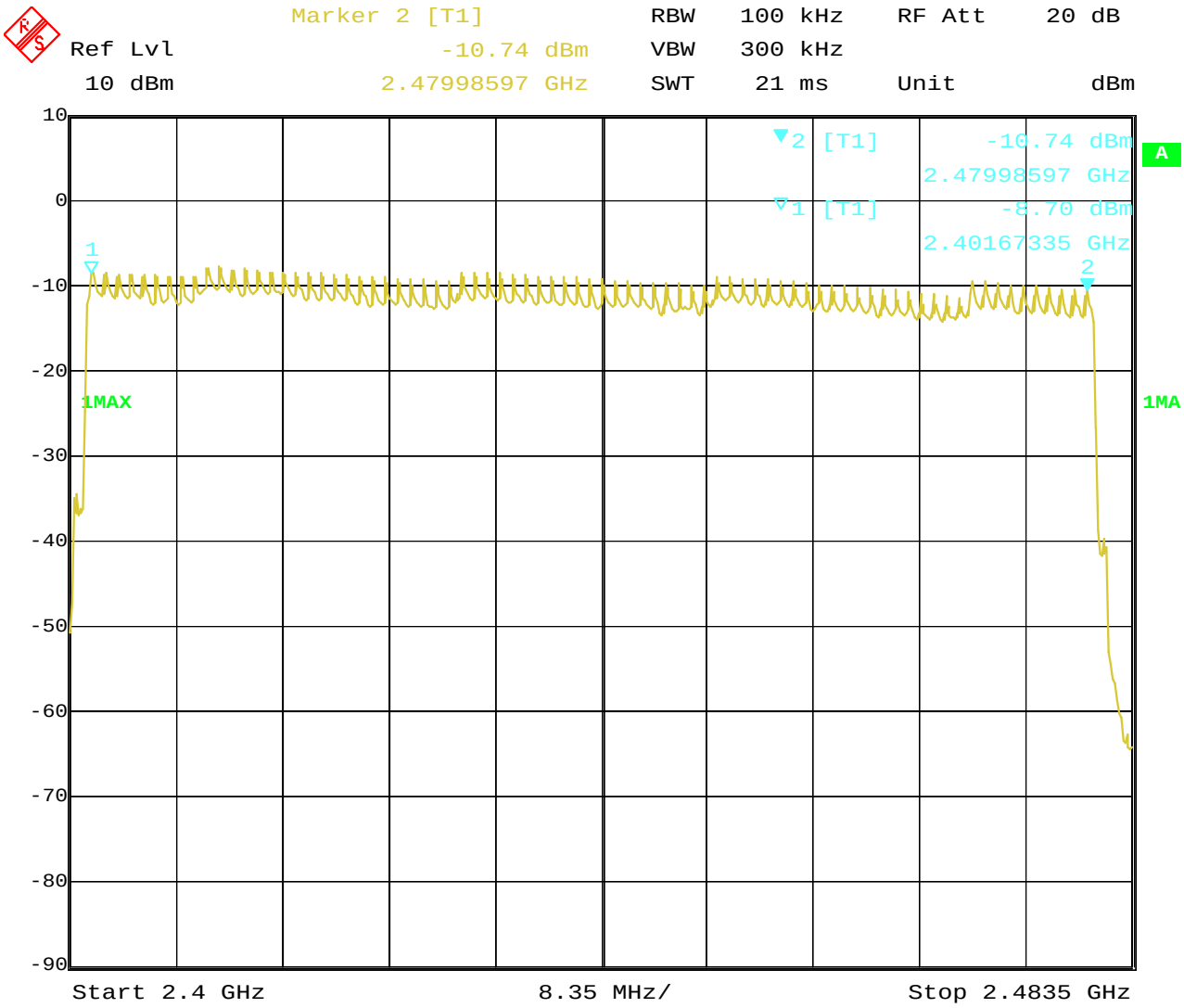


Type of Modulation: Л/4DQPSK

EUT	TWS Earphone	Model	TWS105
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



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.

11.4 Test Result

Type of Modulation: GFSK

EUT	TWS Earphone	Model	TWS105
Mode	Keep Transmitting	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH

Channel	Reading	Hoping Rate	Actual	Limit
DH5				
Middle	2.986ms	266.667 hop/s	0.319s	0.4s
DH3				
Middle	1.743ms	400 hop/s	0.279s	0.4s
DH1				
Middle	0.461ms	800 hop/s	0.148s	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.

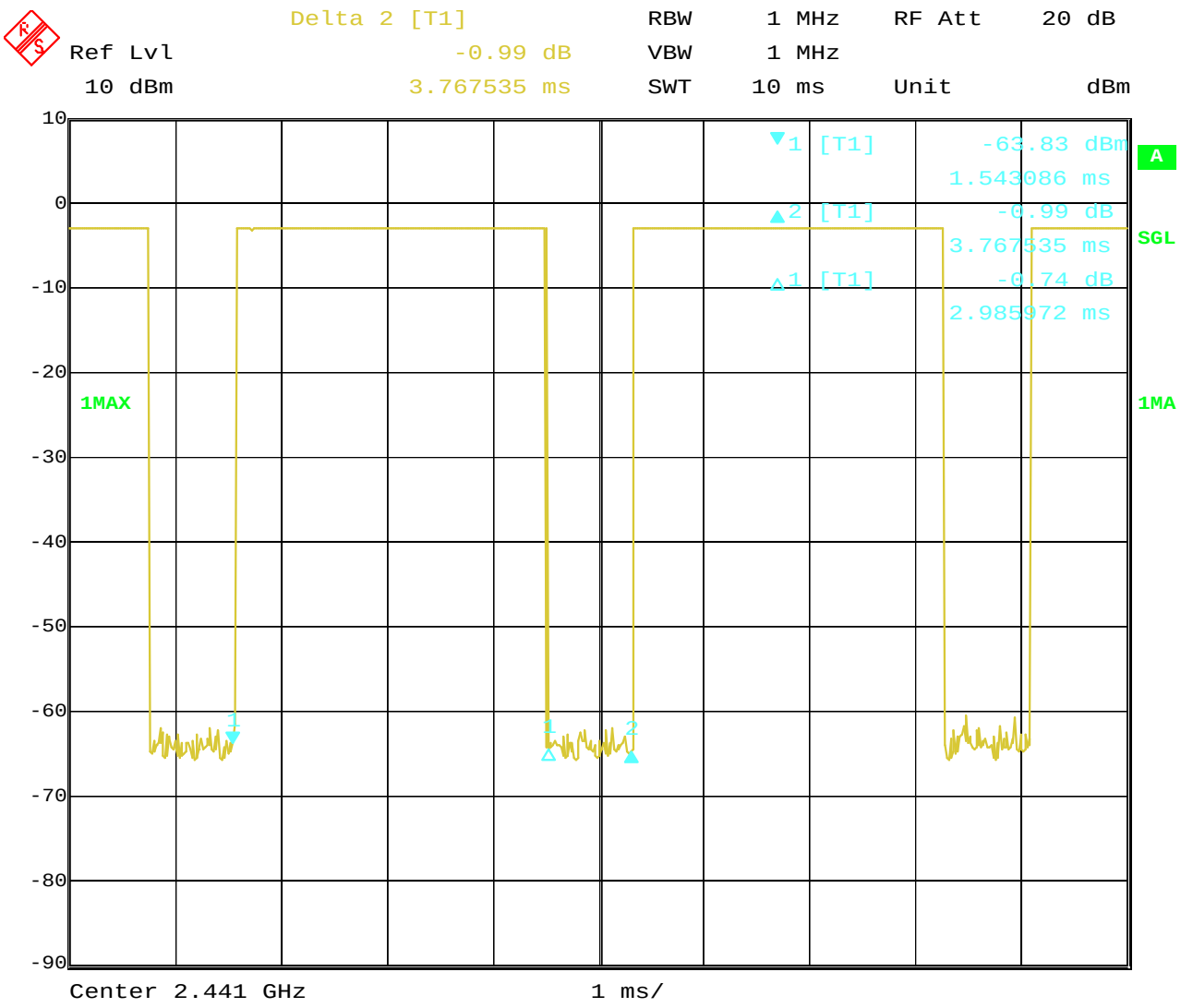
A DH5 Packet needs 5 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 266.667 hops per second with 79 channels.

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.

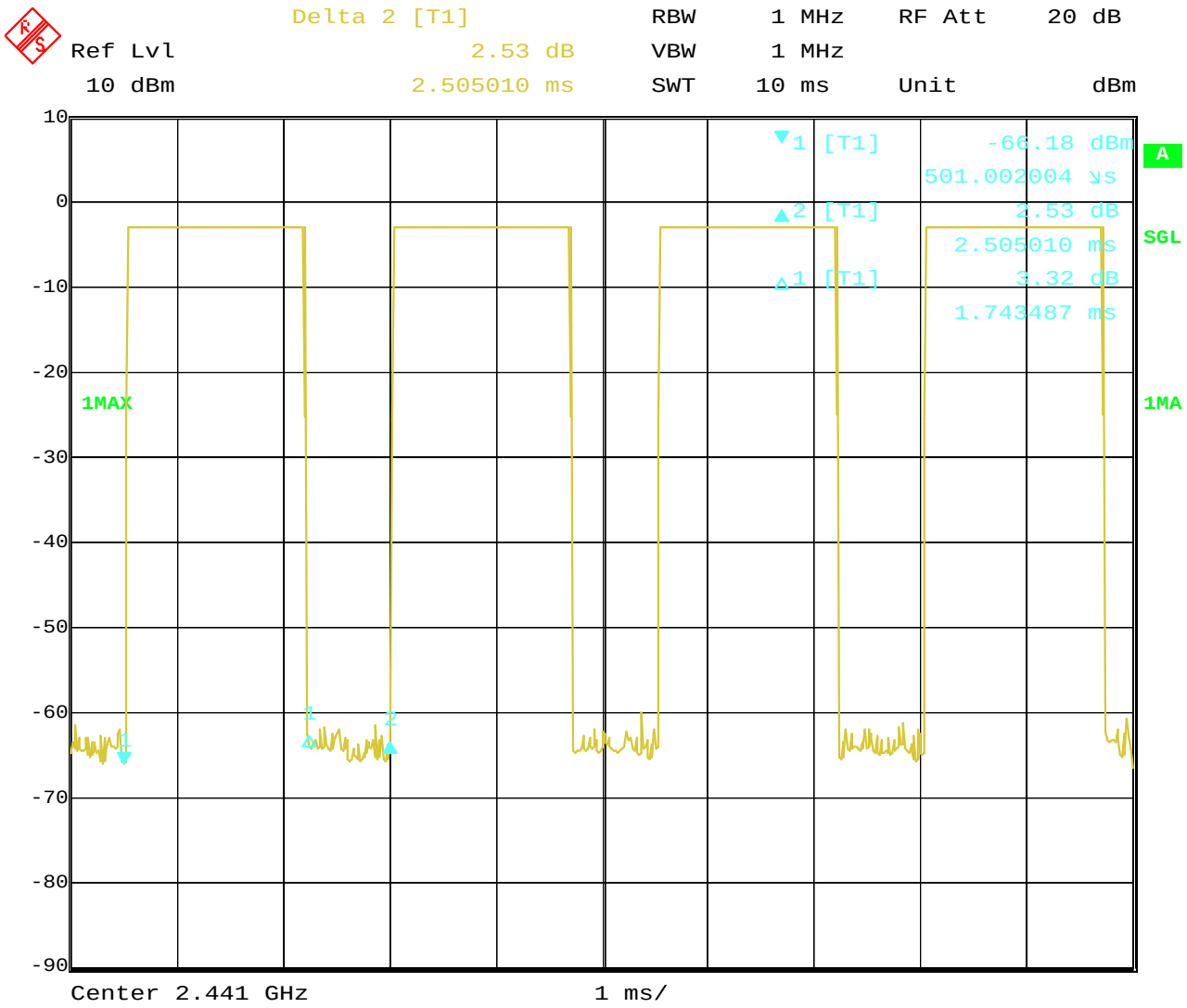
A DH1 Packet needs 1 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 800 hops per second with 79 channels.

Test Plots:

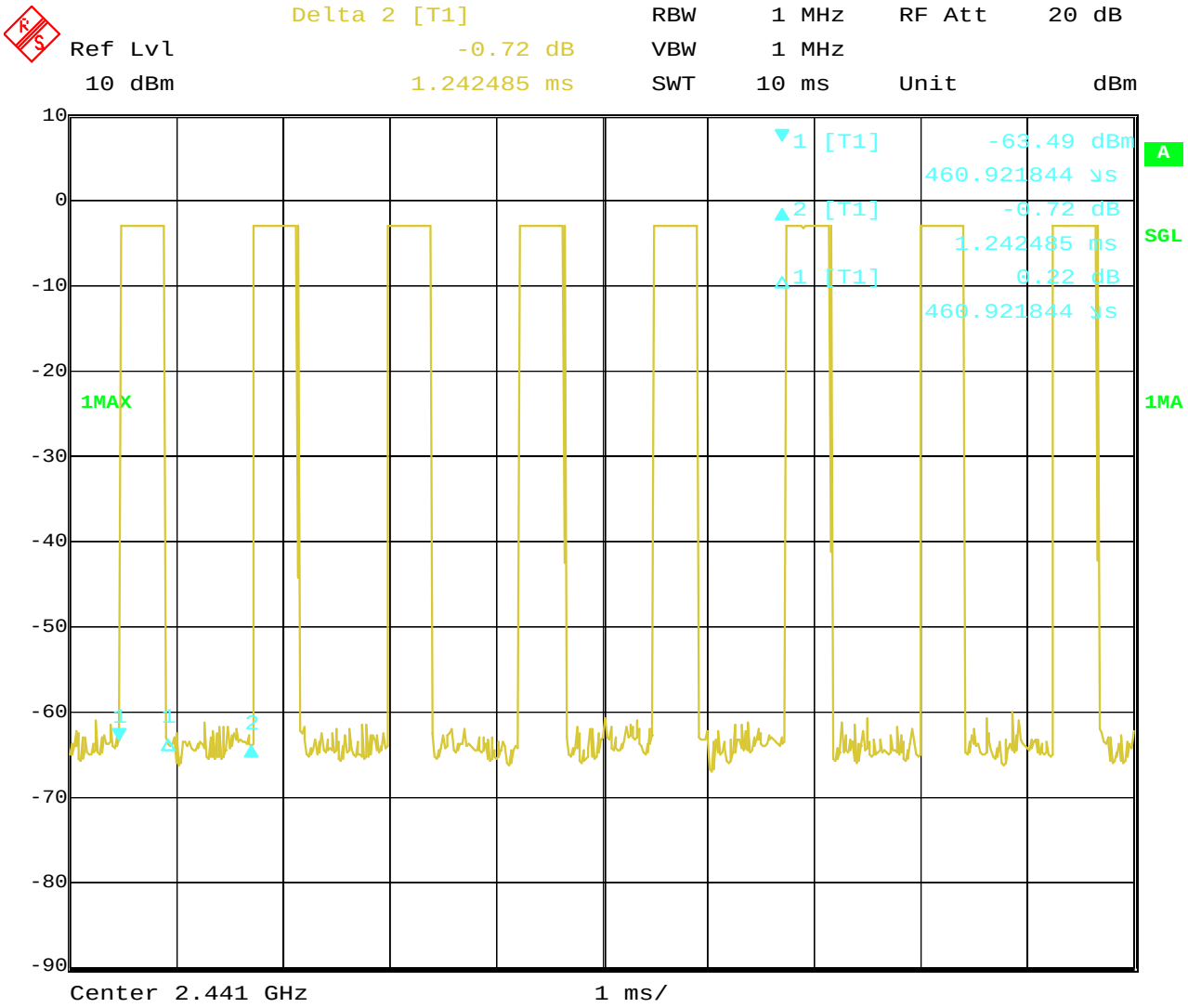
DH5



DH3



DH1



Test Result

Type of Modulation: Л/4DQPSK

EUT	TWS Earphone	Model	TWS105
Mode	Keep Transmitting	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH

Channel	Reading	Hoping Rate	Actual	Limit
2DH5				
Middle	2.986ms	266.667 hop/s	0.319s	0.4s
2DH3				
Middle	1.723ms	400 hop/s	0.276s	0.4s
2DH1				
Middle	0.481ms	800 hop/s	0.154s	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.

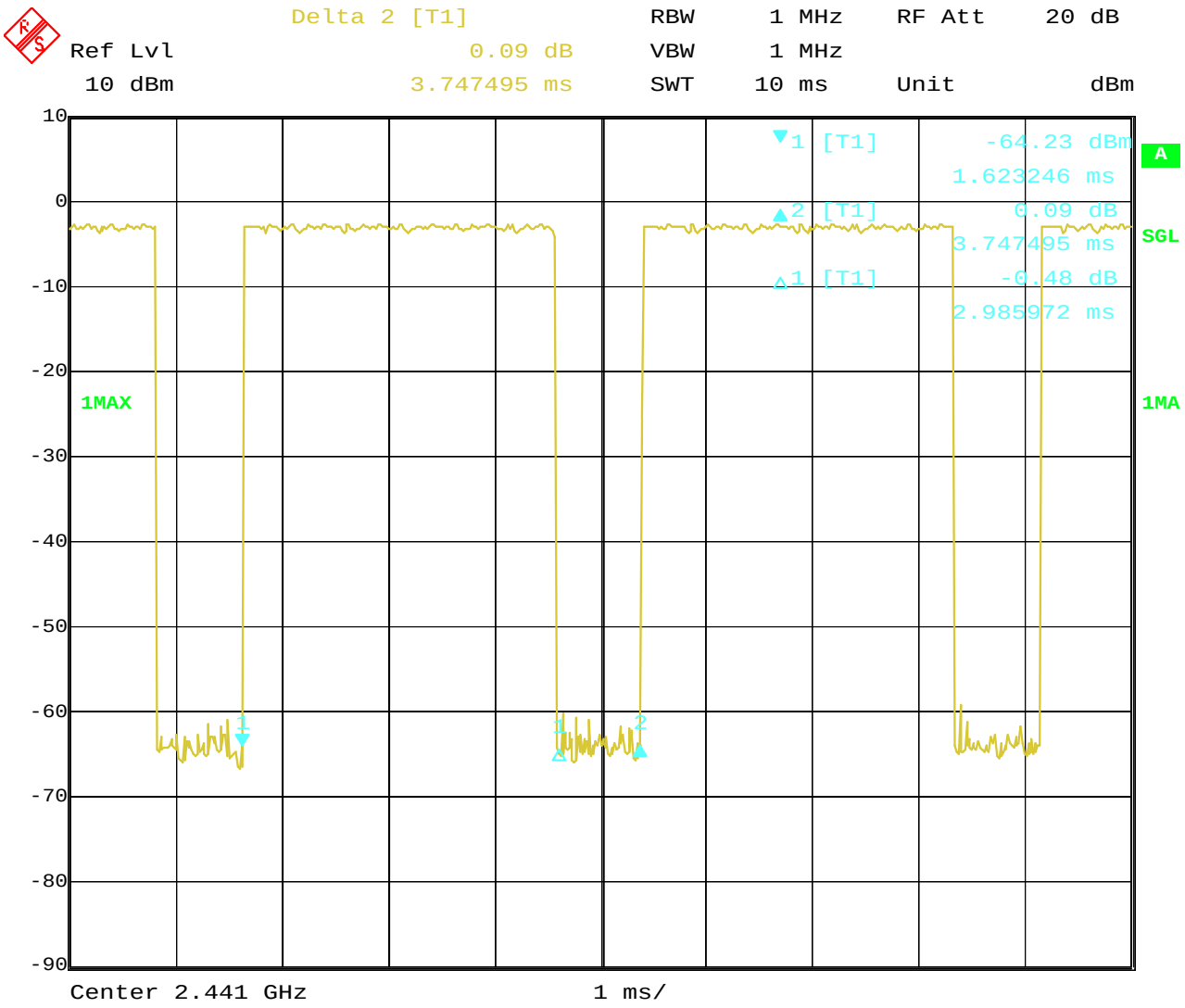
A DH5 Packet needs 5 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 266.667 hops per second with 79 channels.

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.

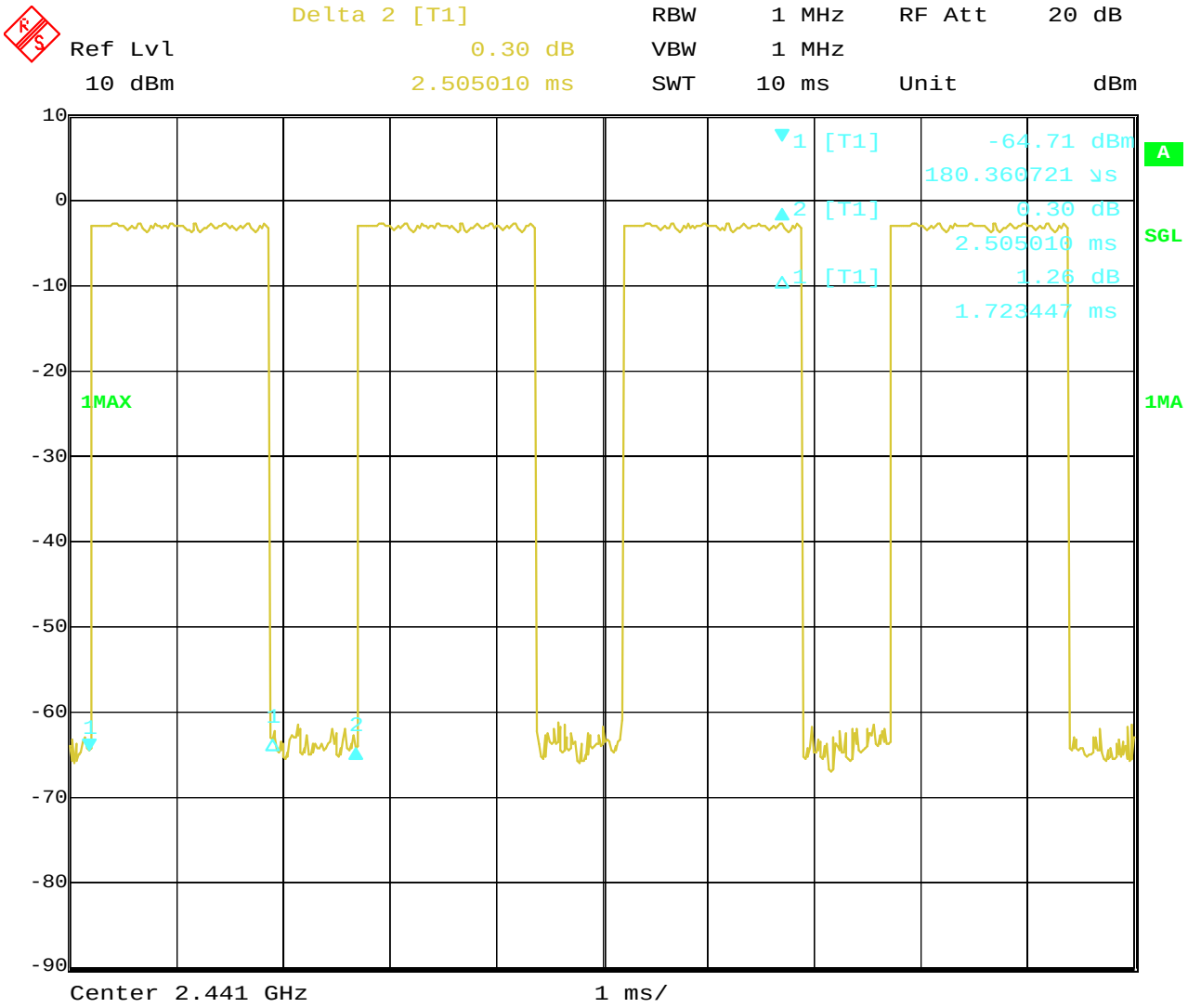
A DH1 Packet needs 1 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 800 hops per second with 79 channels.

Test Plots:

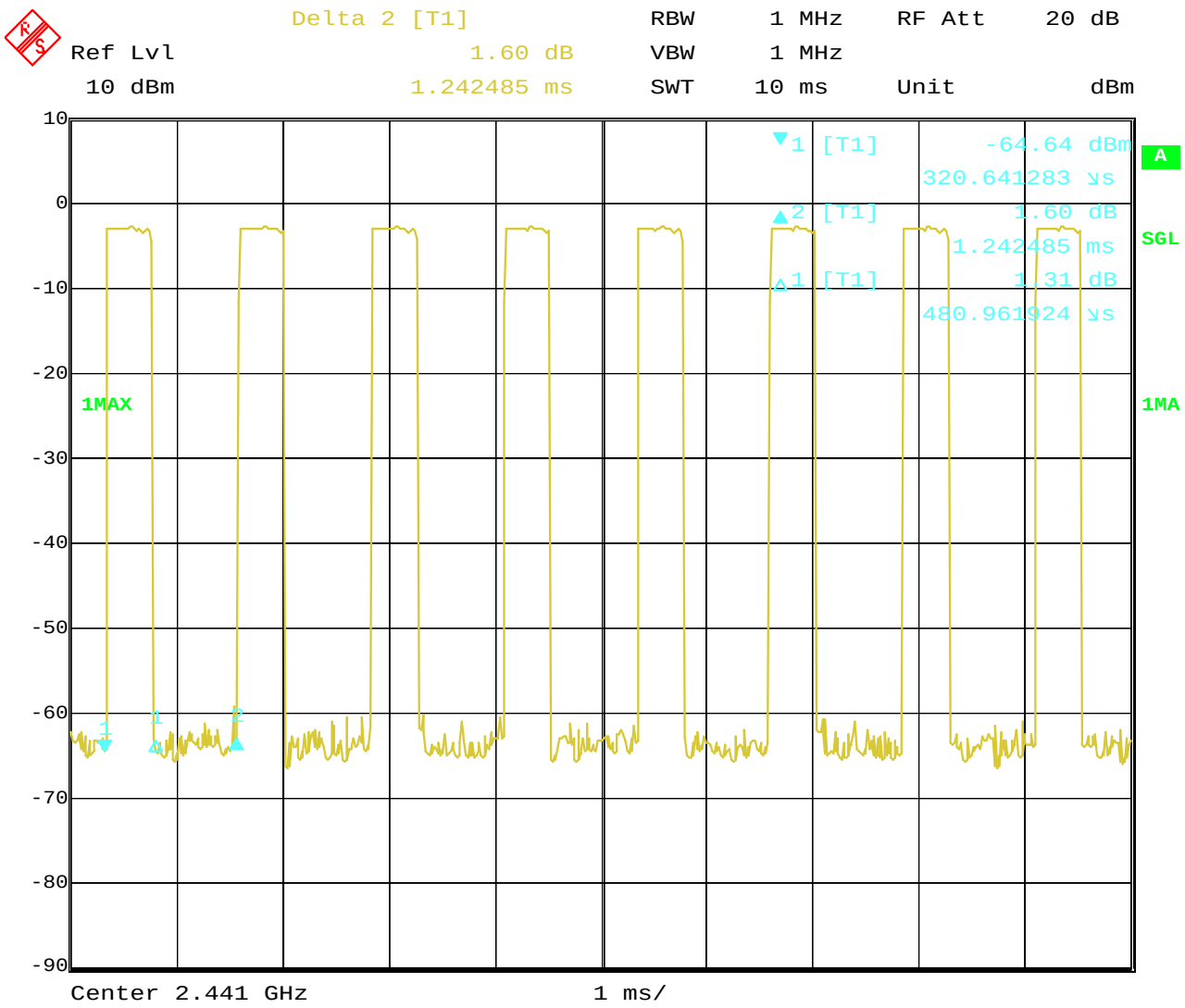
2DH5



2DH3

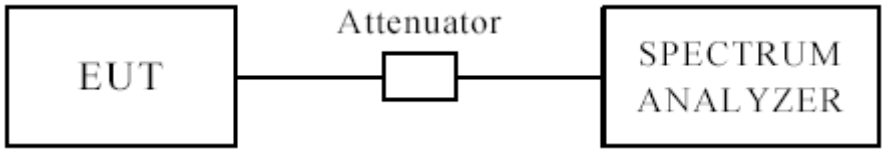


2DH1



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.

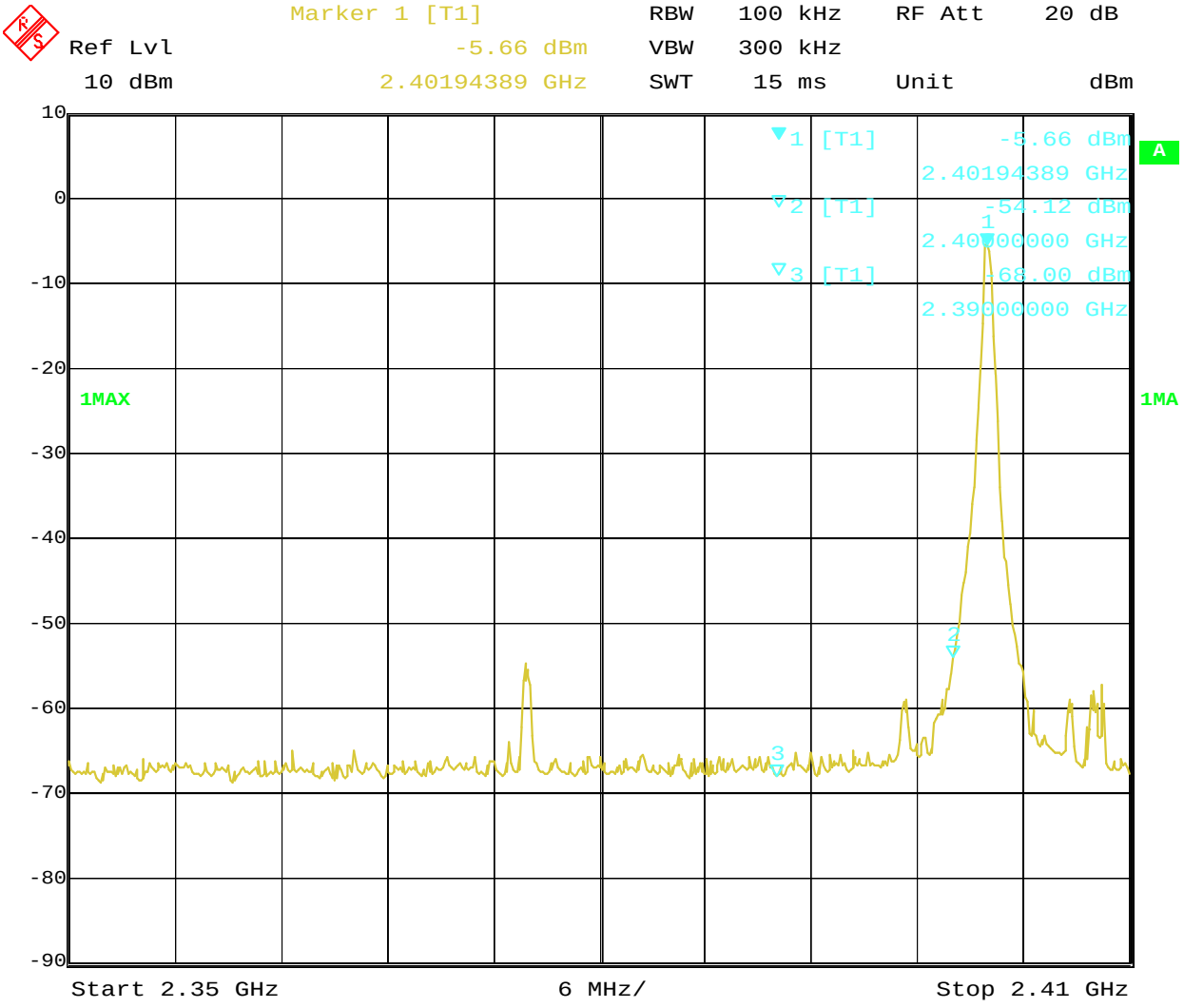
2. This is a handhold device. The radiated emissions should be tested under 3-axes position (Lying, Side, and Stand), After pre-test. It was found that the worse radiated emission was get at the lying position.

Type of Modulation: GFSK

12.4 Band Edge Test Result

Product:	TWS Earphone	Test Mode:	TWS105
Mode	Keeping Transmitting	Input Voltage	DC3.7V
Temperature	24 deg. C	Humidity	56% RH
Test Result:	Pass	Detector	PK

Test Figure:

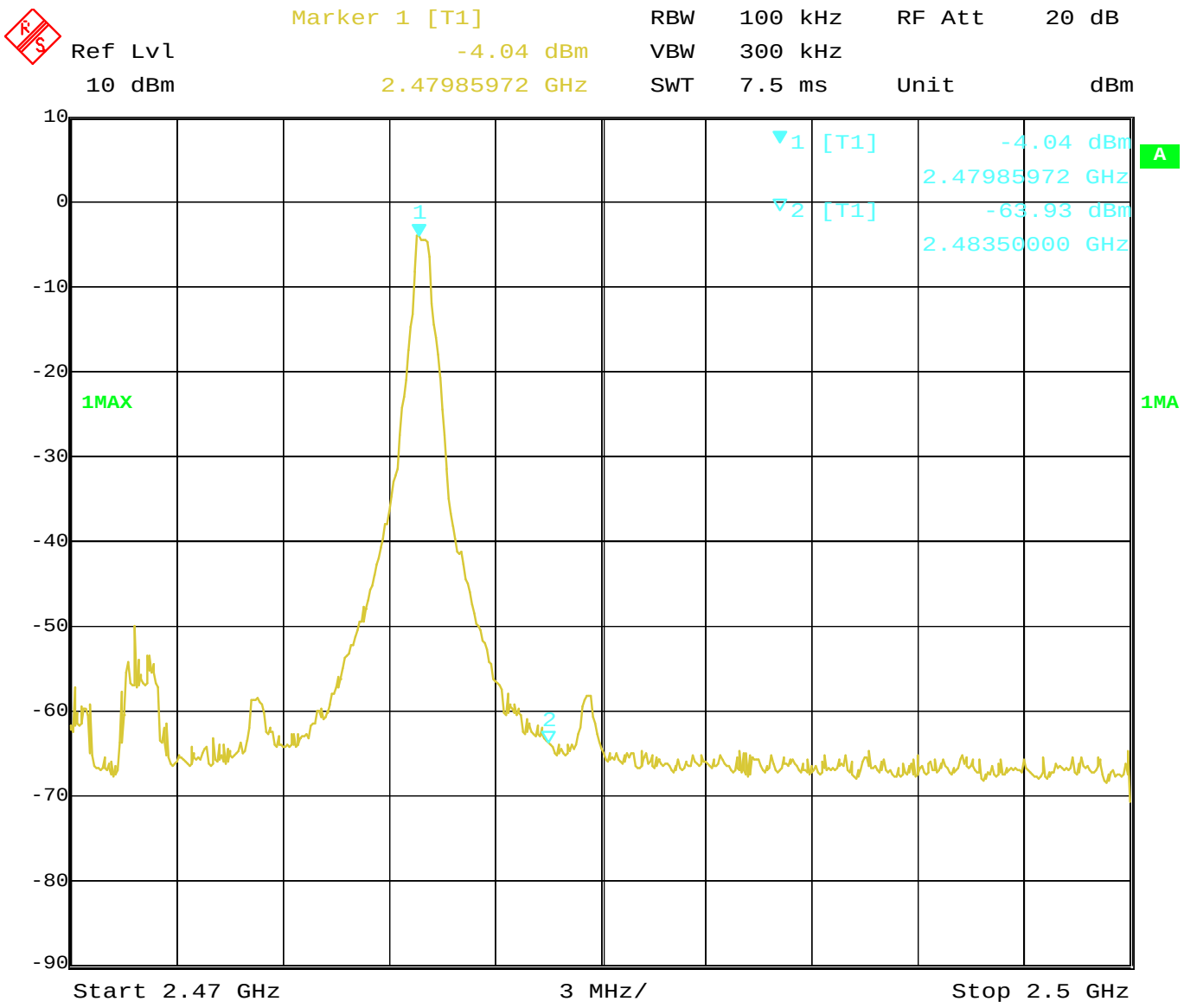


Type of Modulation: GFSK

12.4 Band Edge Test Result

Product:	TWS Earphone	Test Mode:	TWS105
Mode	Keeping Transmitting	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH
Test Result:	Pass	Detector	PK

Test Figure:

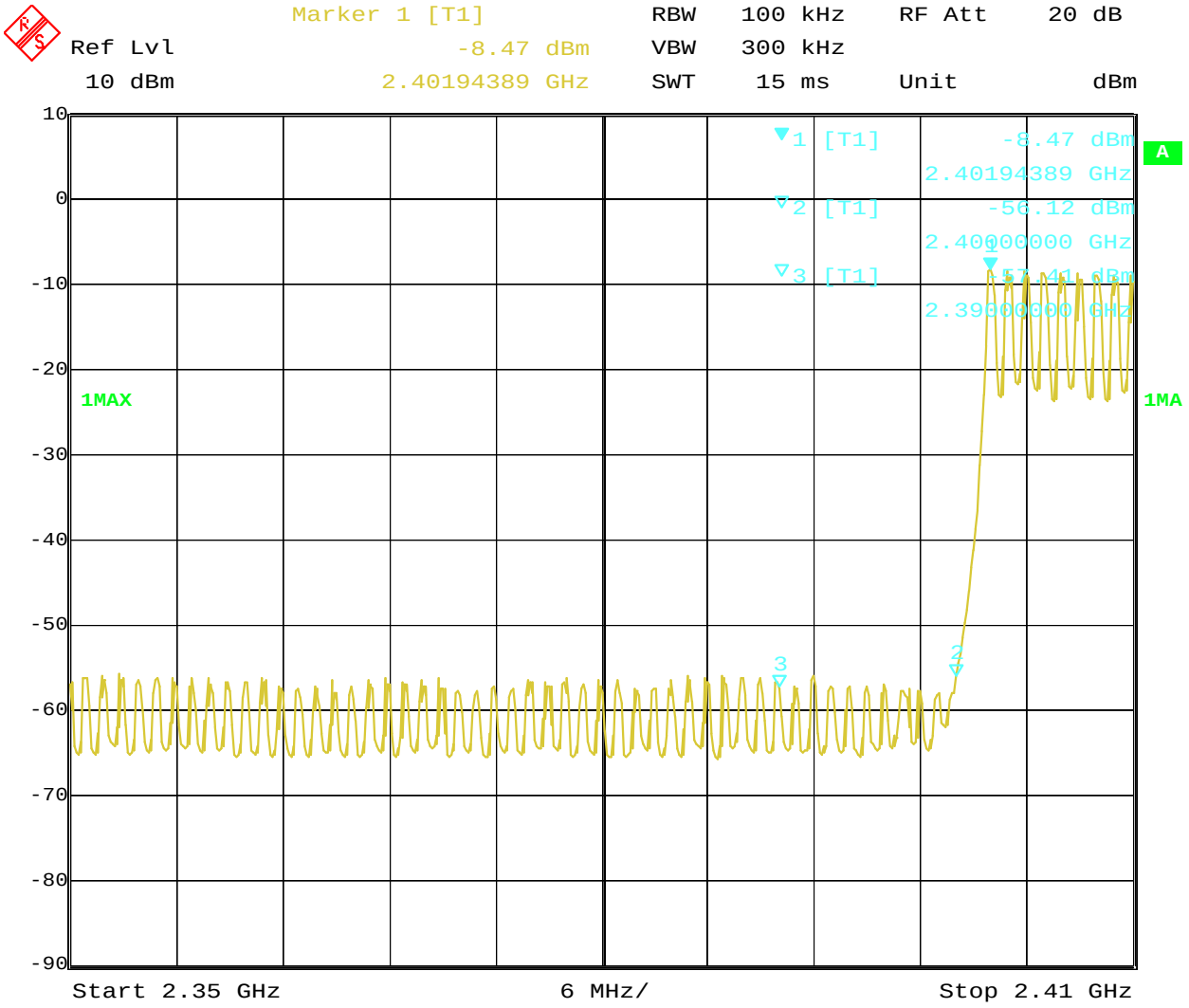


Type of Modulation: GFSK

12.4 Band Edge Test Result

Product:	TWS Earphone	Test Mode:	TWS105
Mode	Hopping On	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH
Test Result:	Pass	Detector	PK

Test Figure:

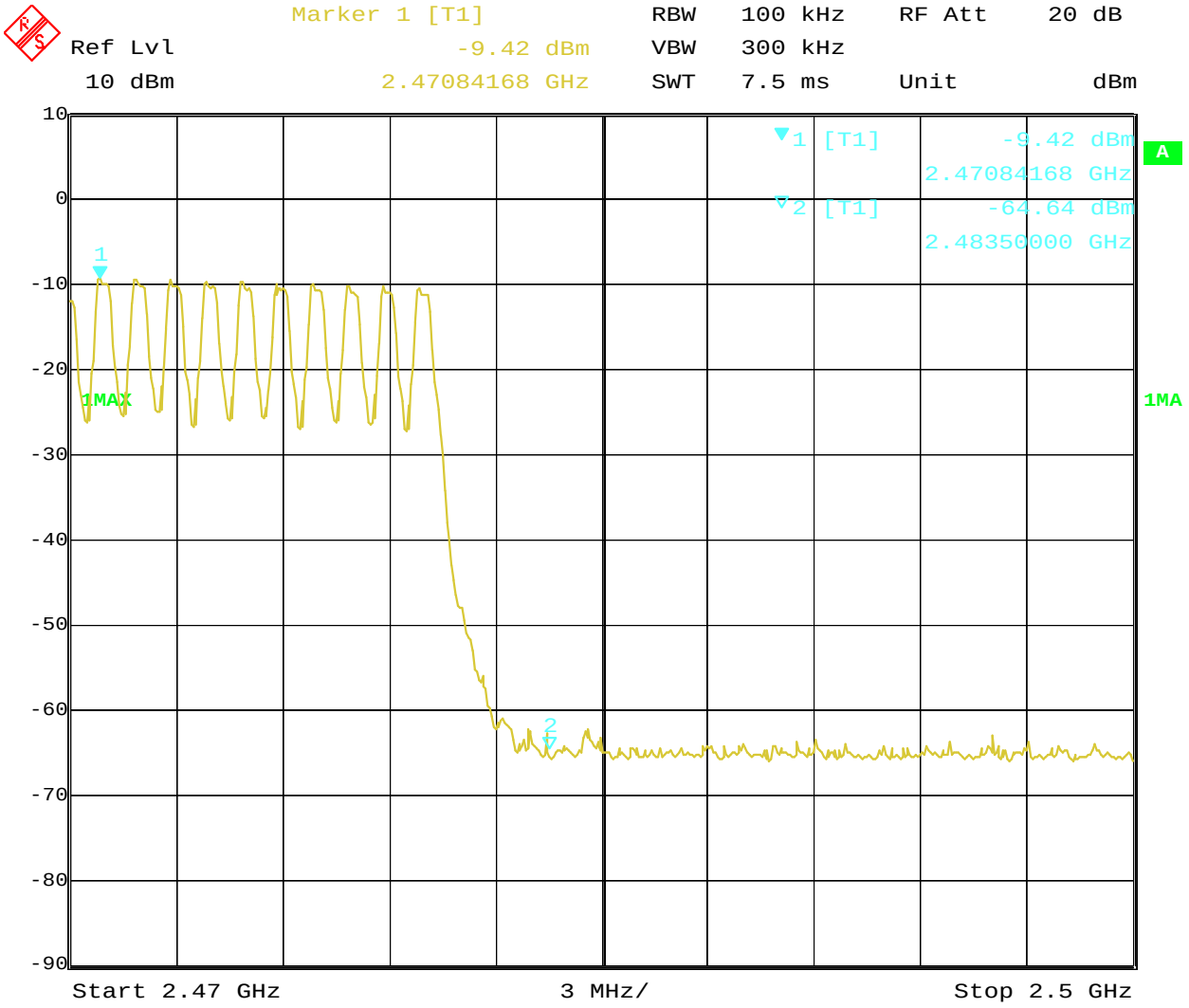


Type of Modulation: GFSK

12.4 Band Edge Test Result

Product:	TWS Earphone	Test Mode:	TWS105
Mode	Hopping On	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH
Test Result:	Pass	Detector	PK

Test Figure:

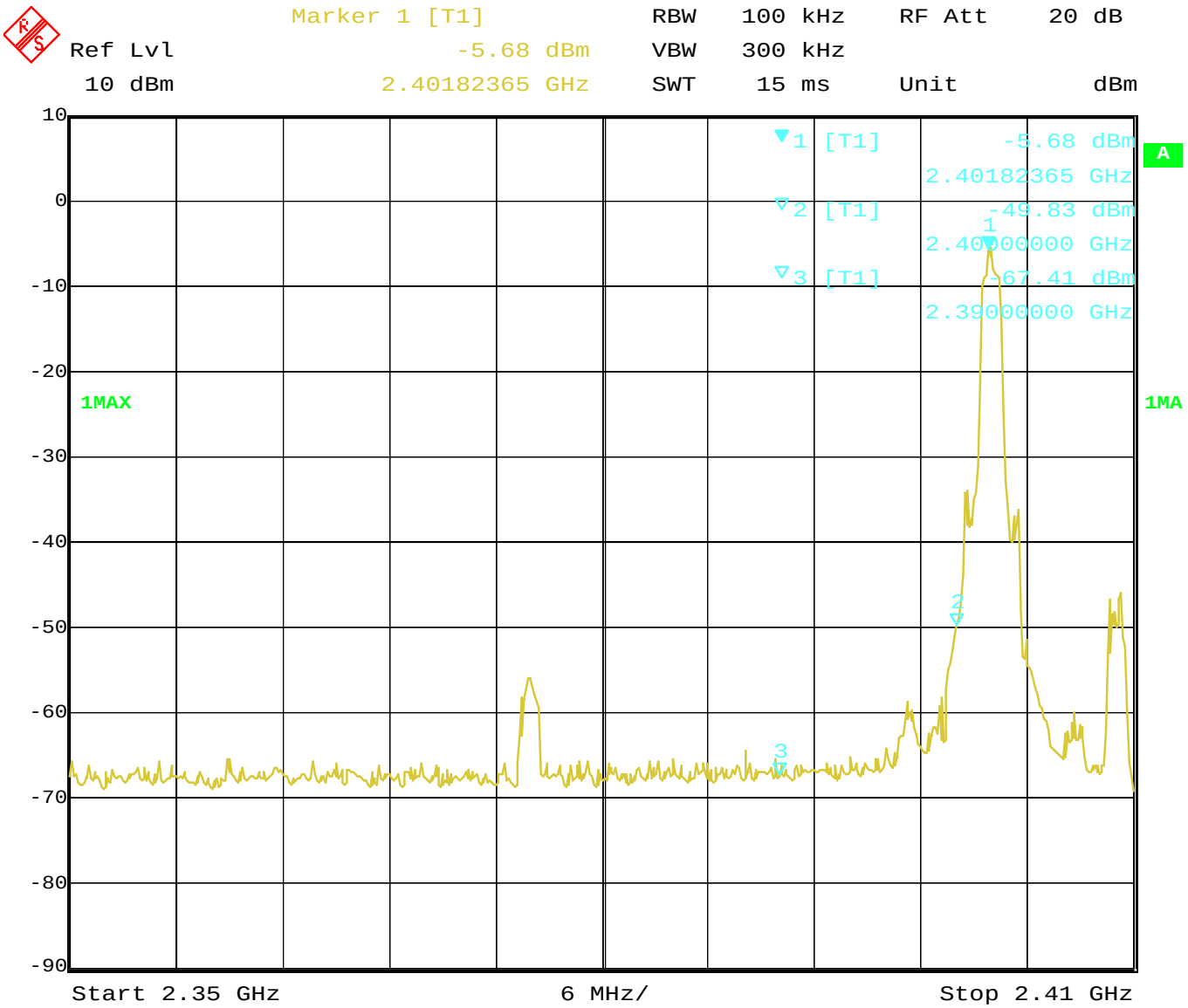


Type of Modulation: Л/4DQPSK

12.4 Out of Band Test Result

Product:	TWS Earphone	Test Mode:	TWS105
Mode	Keeping Transmitting	Input Voltage	DC3.7V
Temperature	24 deg. C	Humidity	56% RH
Test Result:	Pass	Detector	PK

Test Figure:

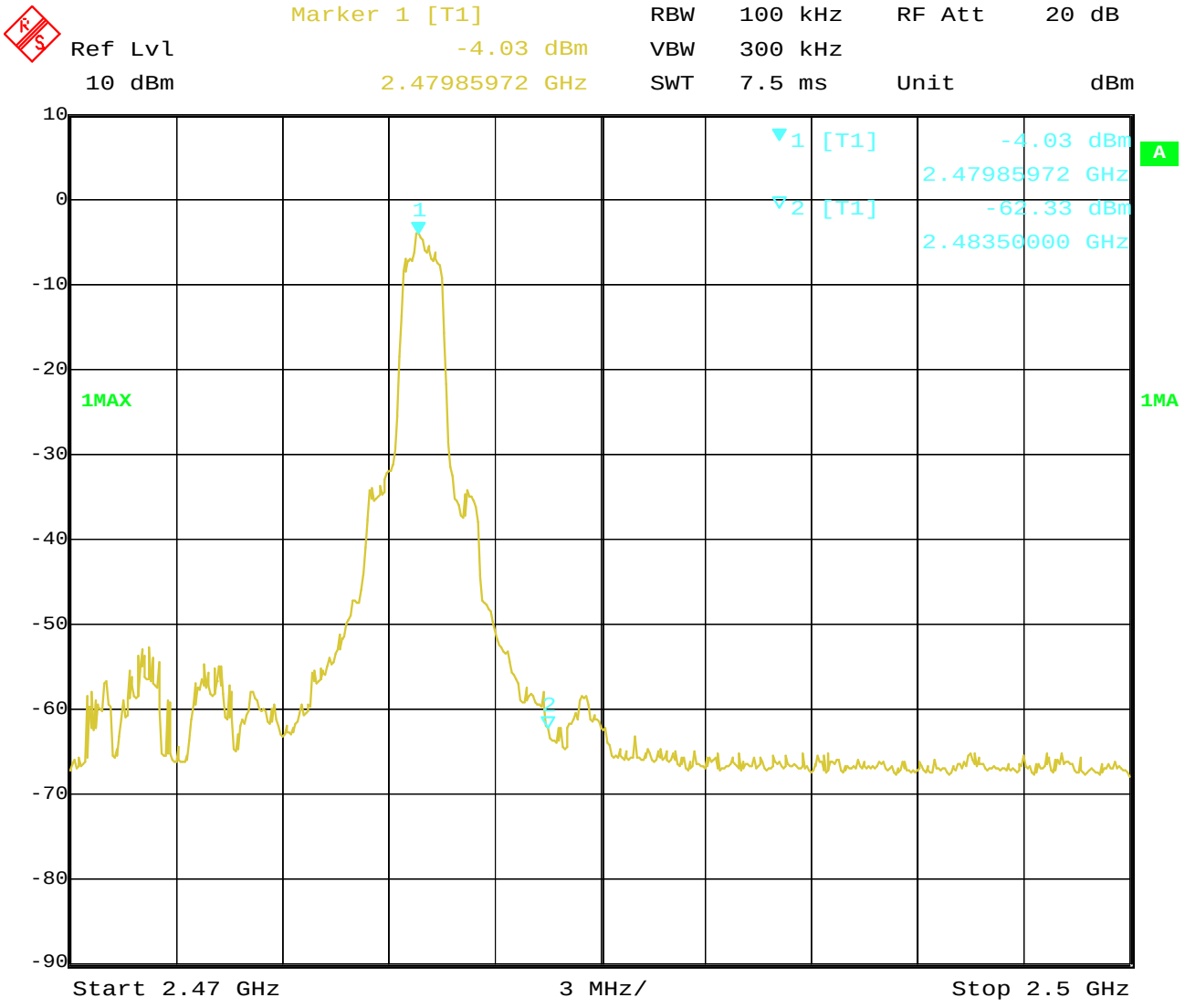


Type of Modulation: Л/4DQPSK

12.4 Band Edge Test Result

Product:	TWS Earphone	Test Mode:	TWS105
Mode	Keeping Transmitting	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH
Test Result:	Pass	Detector	PK

Test Figure:

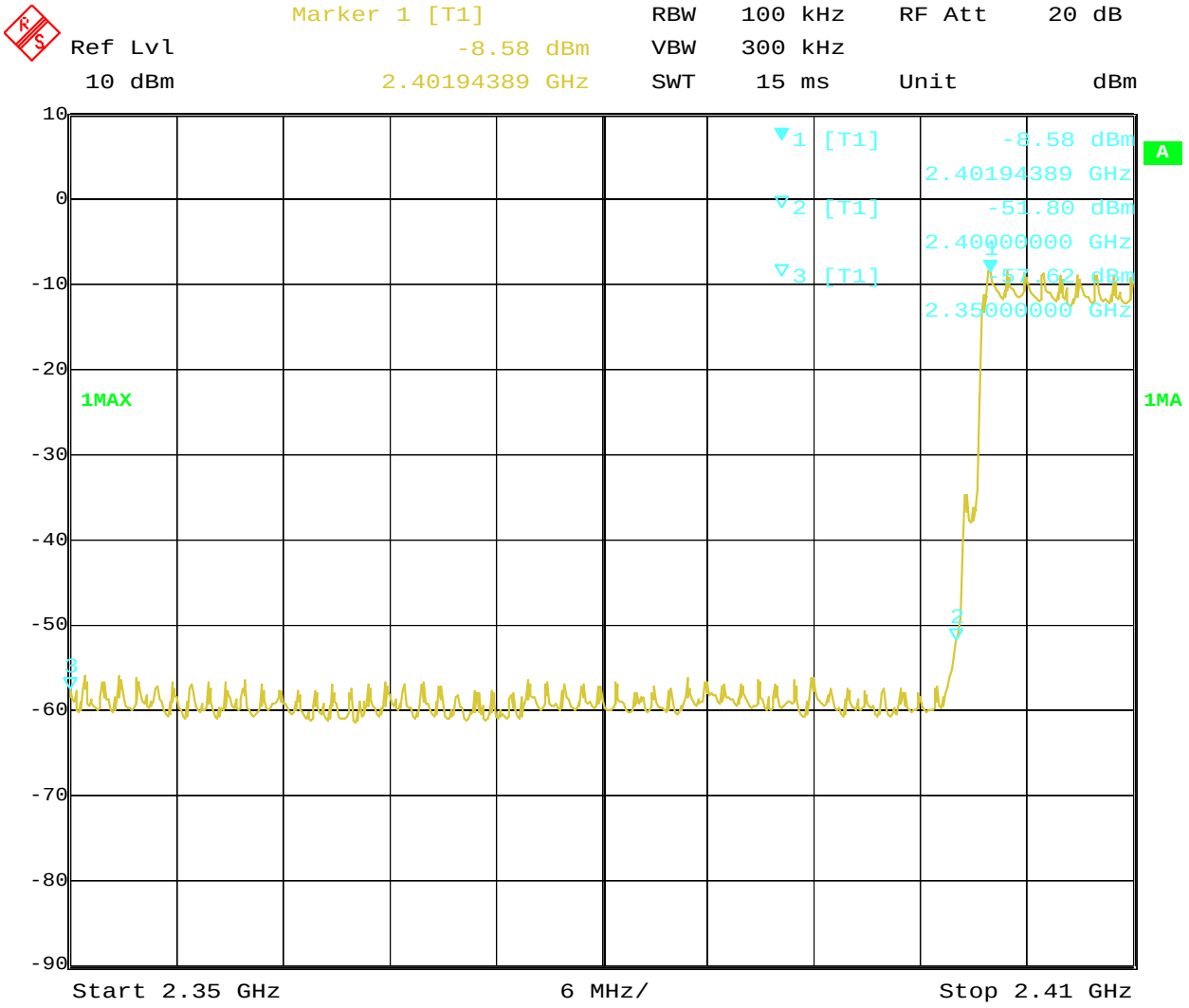


Type of Modulation: Л/4DQPSK

12.4 Out of Band Test Result

Product:	TWS Earphone	Test Mode:	TWS105
Mode	Hopping On	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH
Test Result:	Pass	Detector	PK

Test Figure:

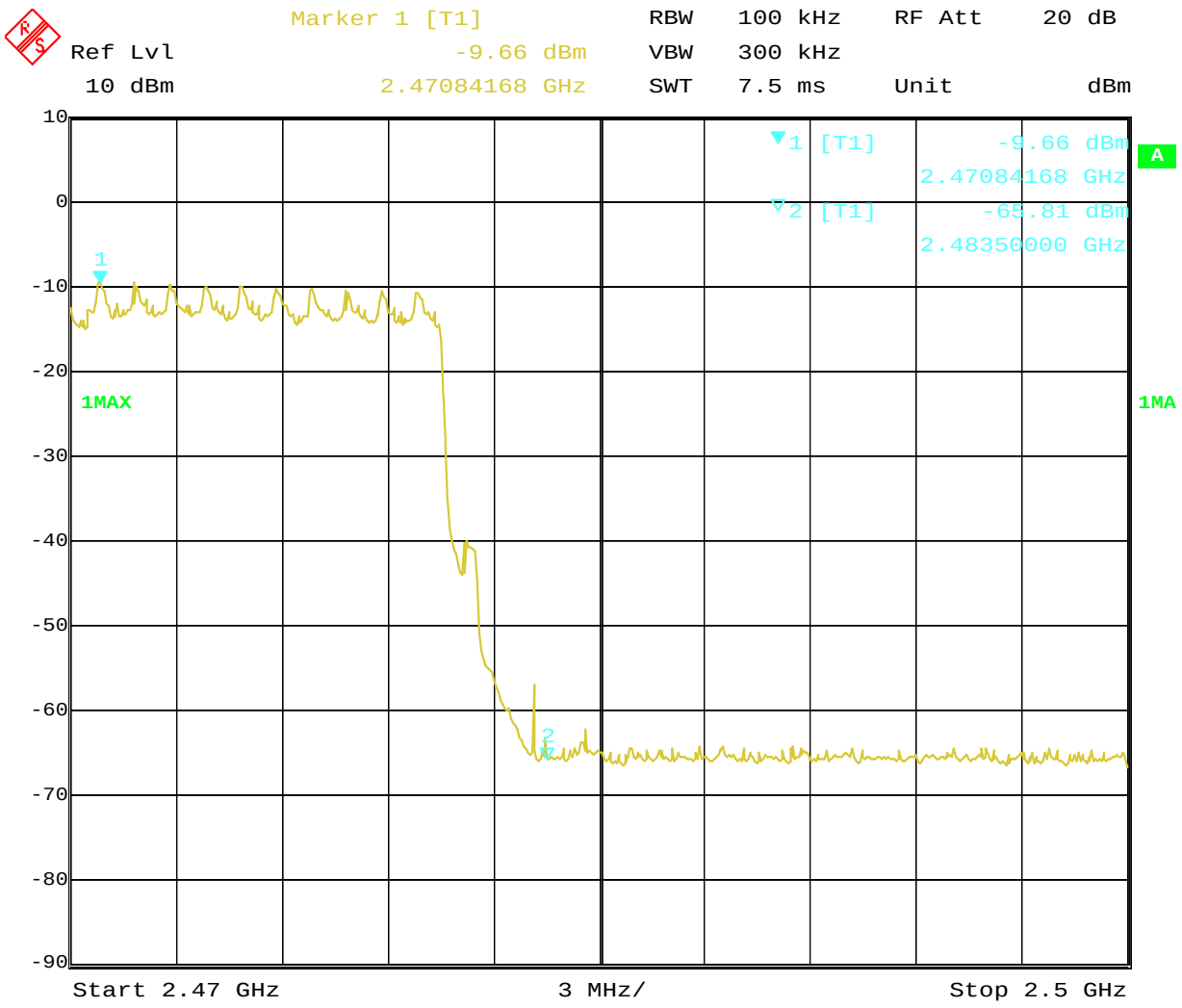


Type of Modulation: Л/4DQPSK

12.4 Out of Band Test Result

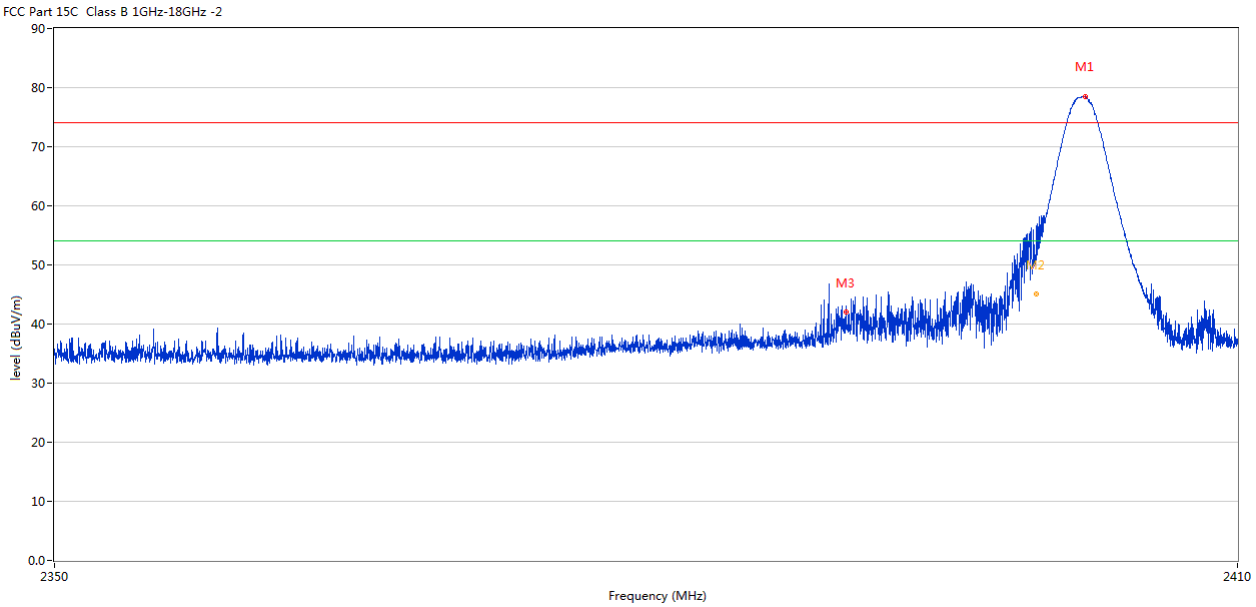
Product:	TWS Earphone	Test Mode:	TWS105
Mode	Hopping On	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH
Test Result:	Pass	Detector	PK

Test Figure:



12.4 Restrict Band Measurement

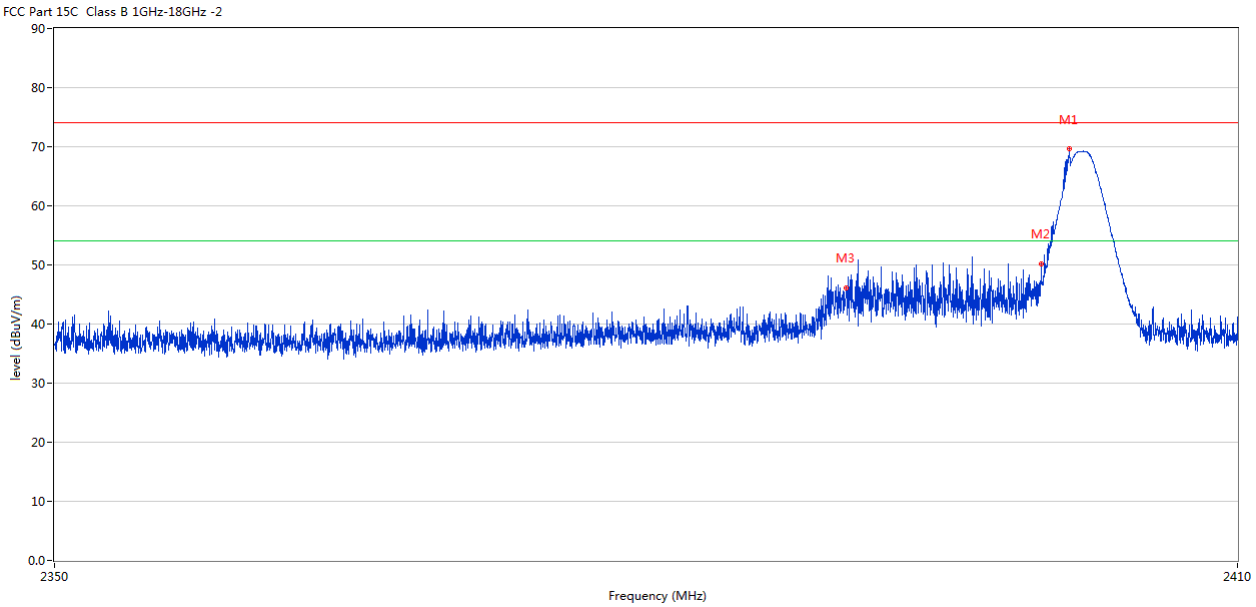
EUT	TWS Earphone	Model	TWS105
Mode	Keep Transmitting	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH
Test Result:	Pass	Modulation Type	Л/4DQPSK



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
2	2399.680	54.27	-3.57	74.0	-19.73	Peak	156.00	100	Horizontal	Pass
2**	2399.680	45.12	-3.57	54.0	-8.88	AV	156.00	100	Horizontal	Pass
3	2389.975	42.00	-3.53	74.0	-32.00	Peak	147.00	100	Horizontal	Pass

12.4 Restrict Band Measurement

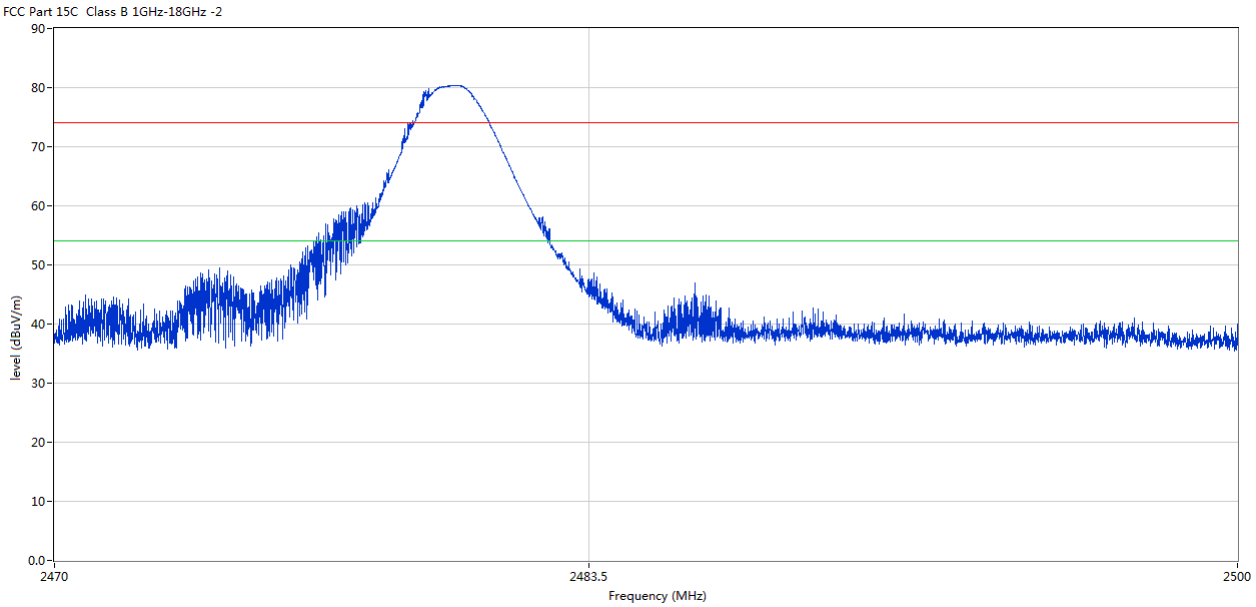
EUT	TWS Earphone	Model	TWS105
Mode	Keep Transmitting	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH
Test Result:	Pass	Modulation Type	Л/4DQPSK



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
2	2399.950	50.14	-3.57	74.0	-23.86	Peak	99.00	100	Vertical	Pass
3	2389.975	46.05	-3.53	74.0	-27.95	Peak	13.00	100	Vertical	Pass

12.4 Restrict Band Measurement

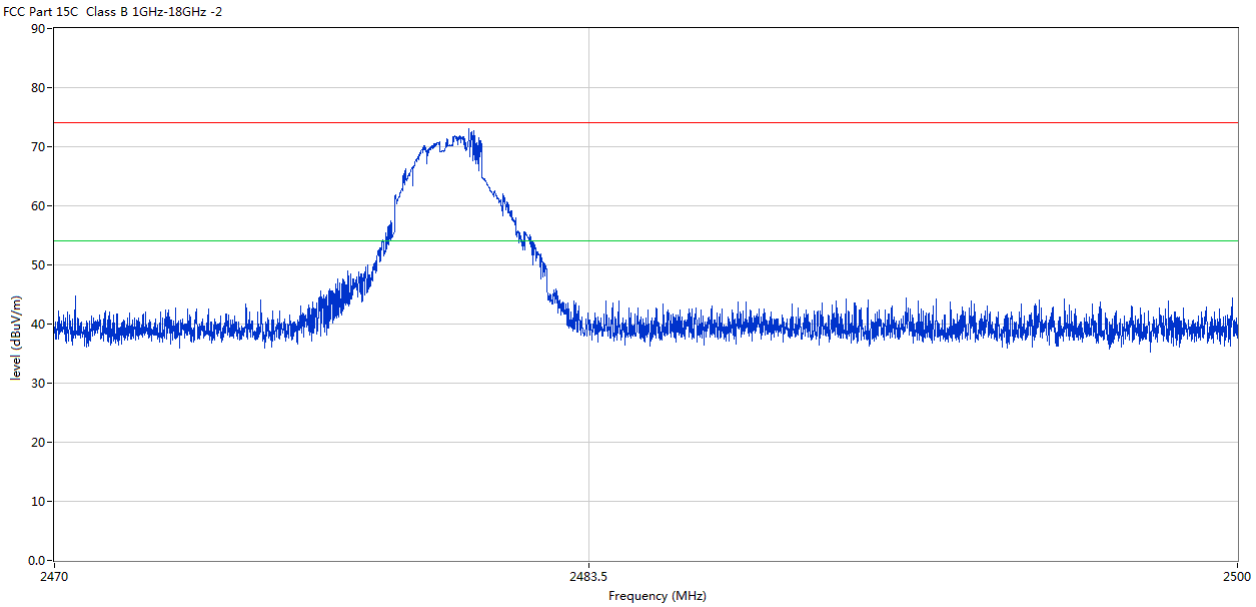
EUT	TWS Earphone	Model	TWS105
Mode	Keep Transmitting	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH
Test Result:	Pass	Modulation Type	Л/4DQPSK



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
2	2483.500	47.97	-3.57	74.0	-26.03	Peak	192.00	100	Horizontal	Pass

12.4 Restrict Band Measurement

EUT	TWS Earphone	Model	TWS105
Mode	Keep Transmitting	Input Voltage	DC3.7V
Temperature	24 deg. C,	Humidity	56% RH
Test Result:	Pass	Modulation Type	Л/4DQPSK



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Over Limit (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
2	2483.500	41.73	-3.57	74.0	-32.27	Peak	95.00	100	Vertical	Pass

Note: 1. For Restricted band test, only the worst case was reported and Л/4DQPSK was the worst case

2. The measured PK radiated emissions level less than the AV limit, so no necessary to take down the AV result

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

Chip antenna used. The gain is 1.06dBi.

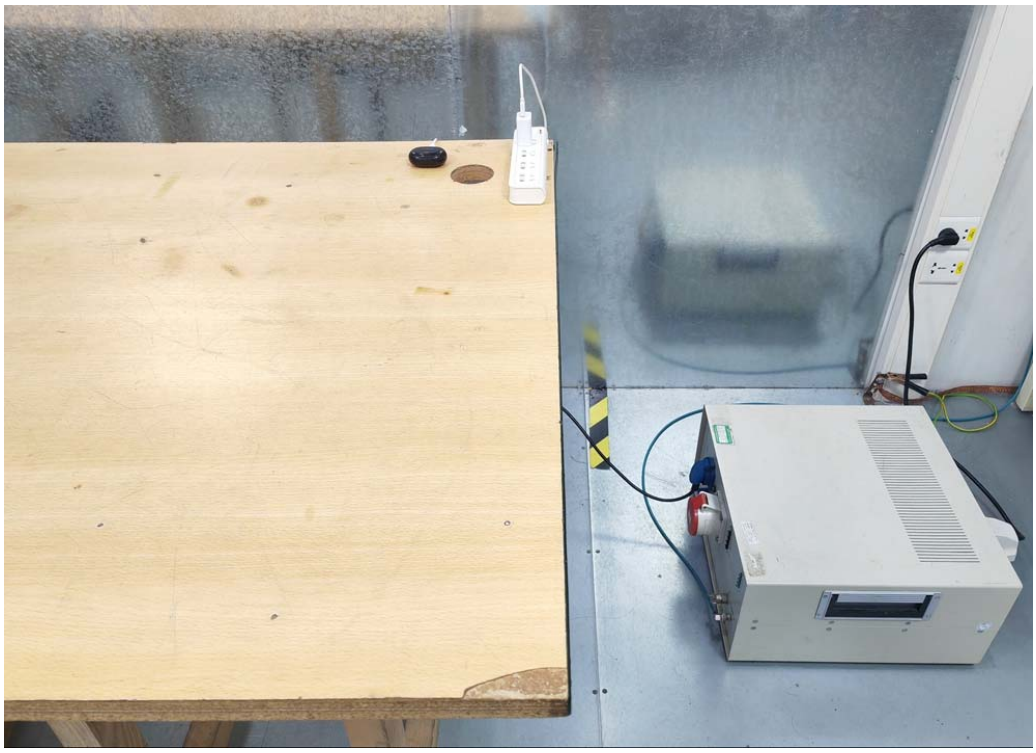
14.0 FCC ID Label

FCC ID: 2AS7V-TWS105

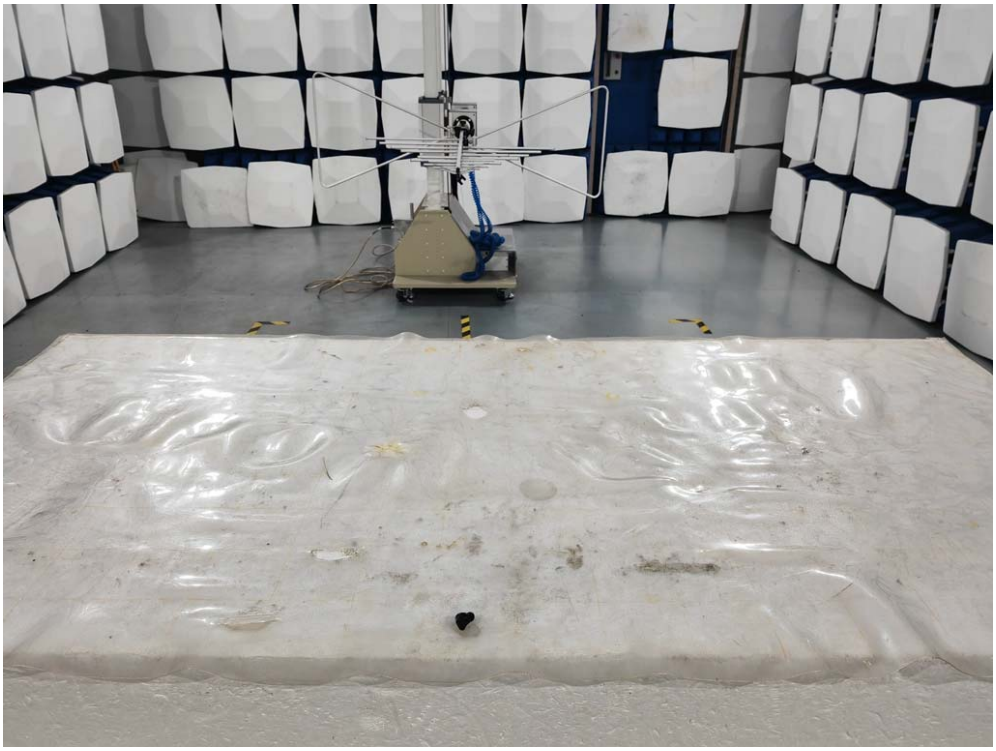
The label must not be a stick-on paper label. The label on these products must be permanently affixed to the product and readily visible at the time of purchase and must last the expected lifetime of the equipment not be readily detachable.

15.0 Photo of testing

Conducted Emission Test Setup:



Radiated Emission Test Setup:



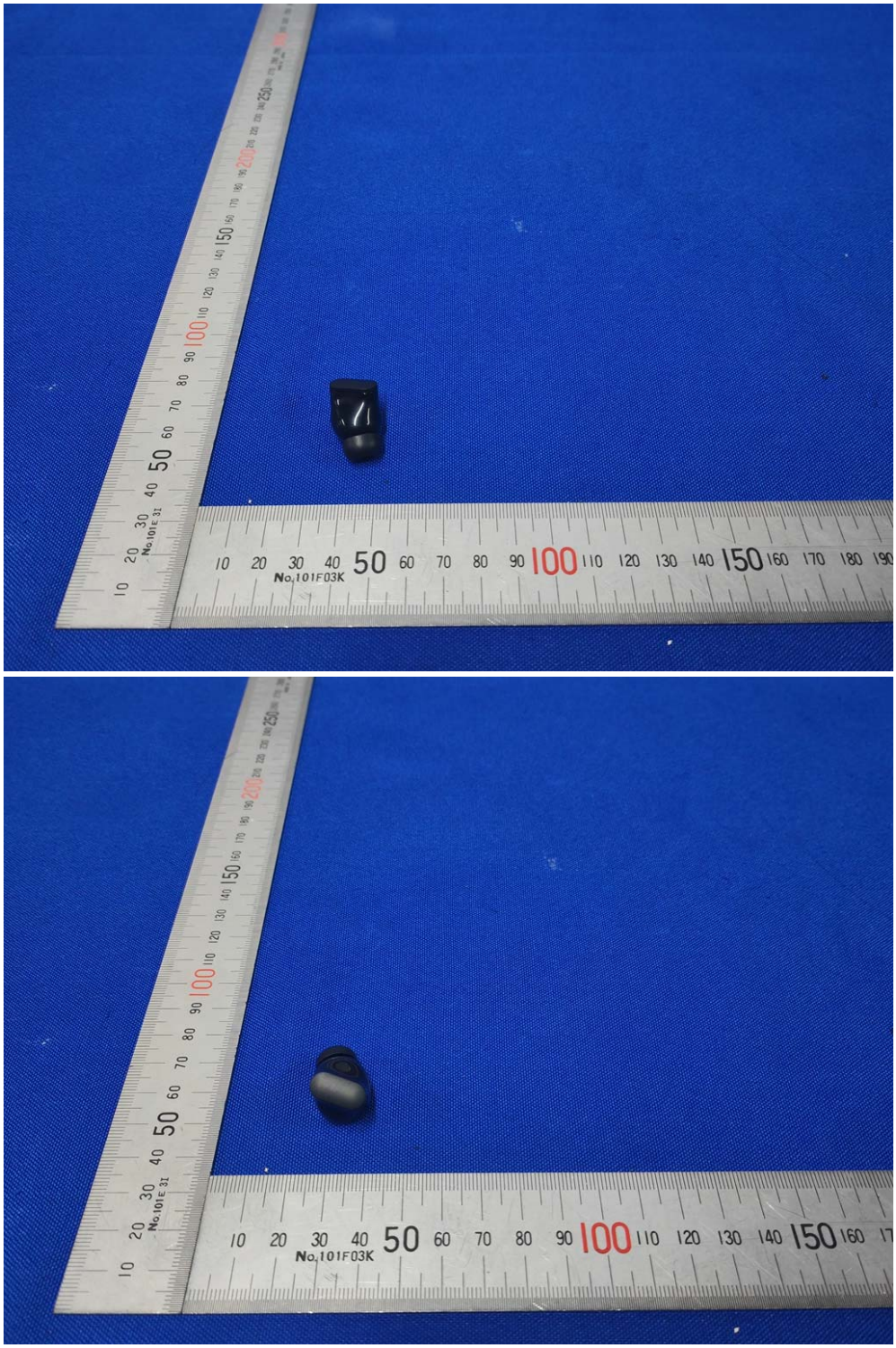
Photographs – EUT

Outside View - charger base

Outside View - charger base

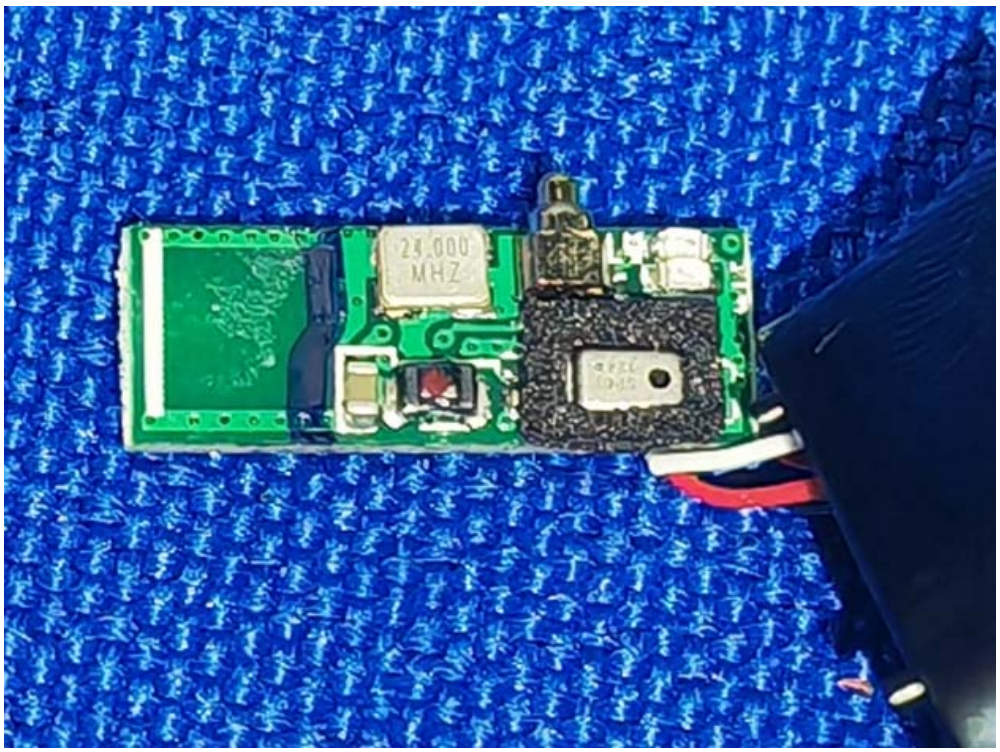
Outside View - charger base

Outside View - Left earphone

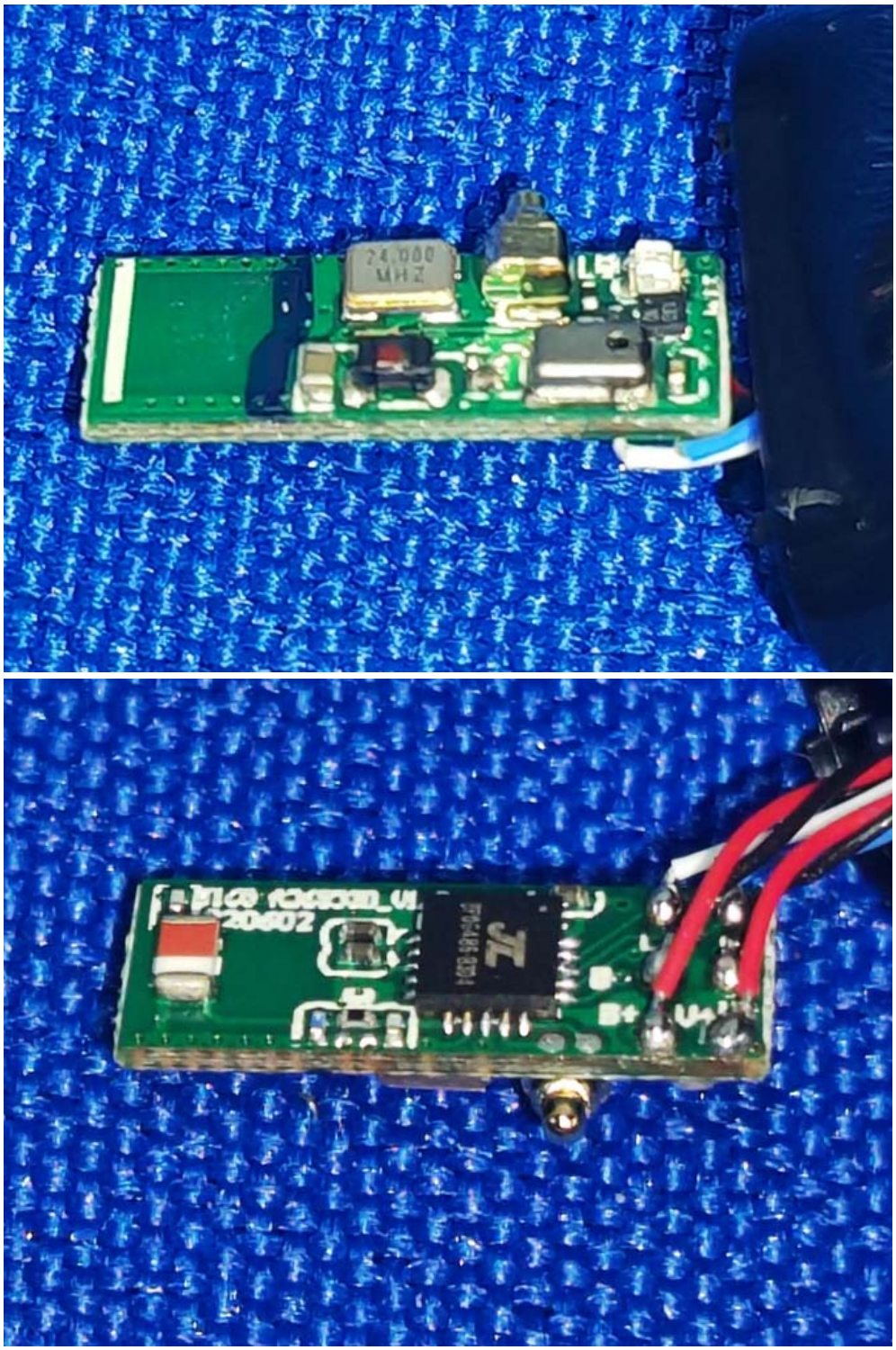


Outside View - Left earphone

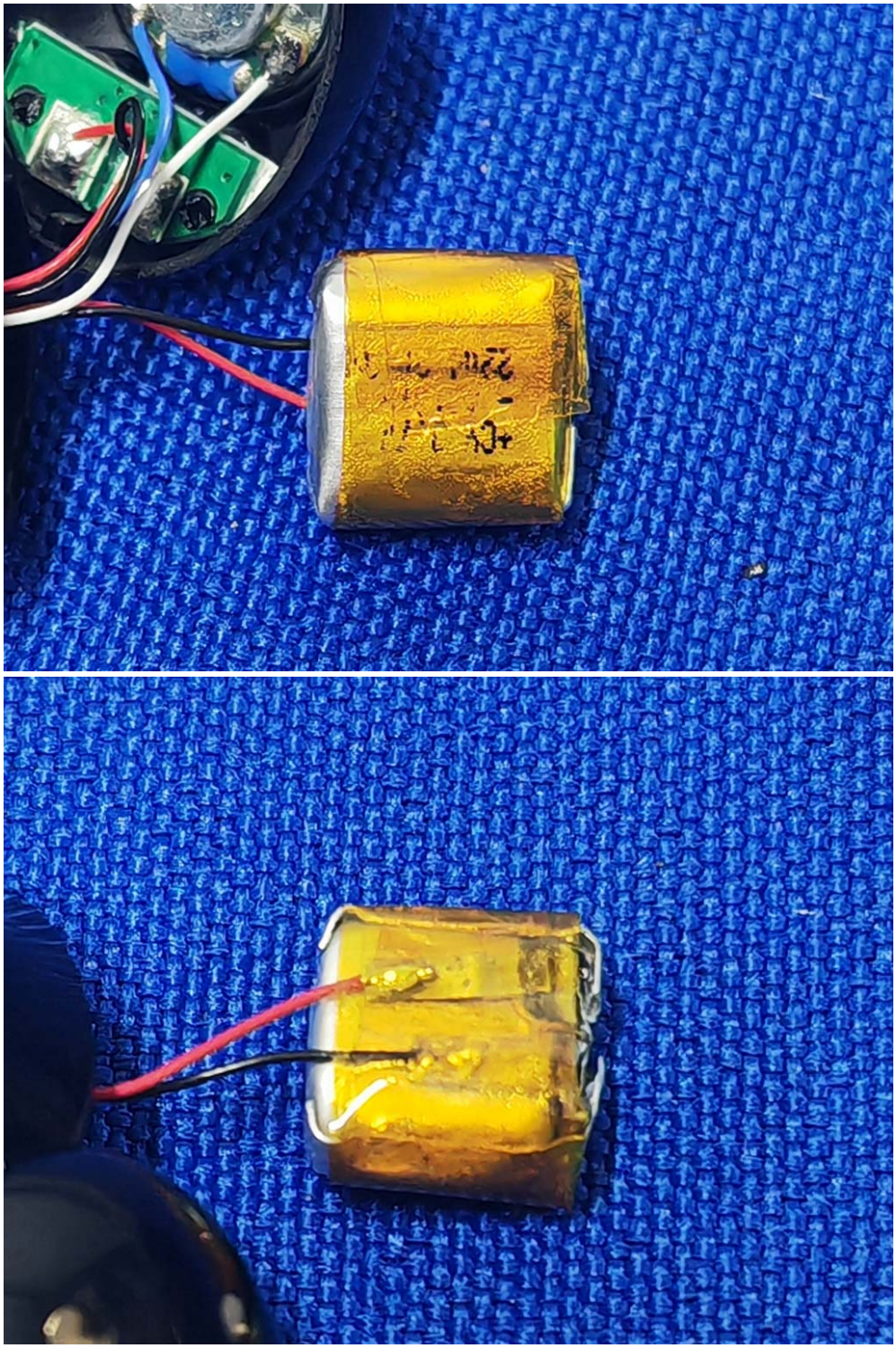
Inside View - Left earphone



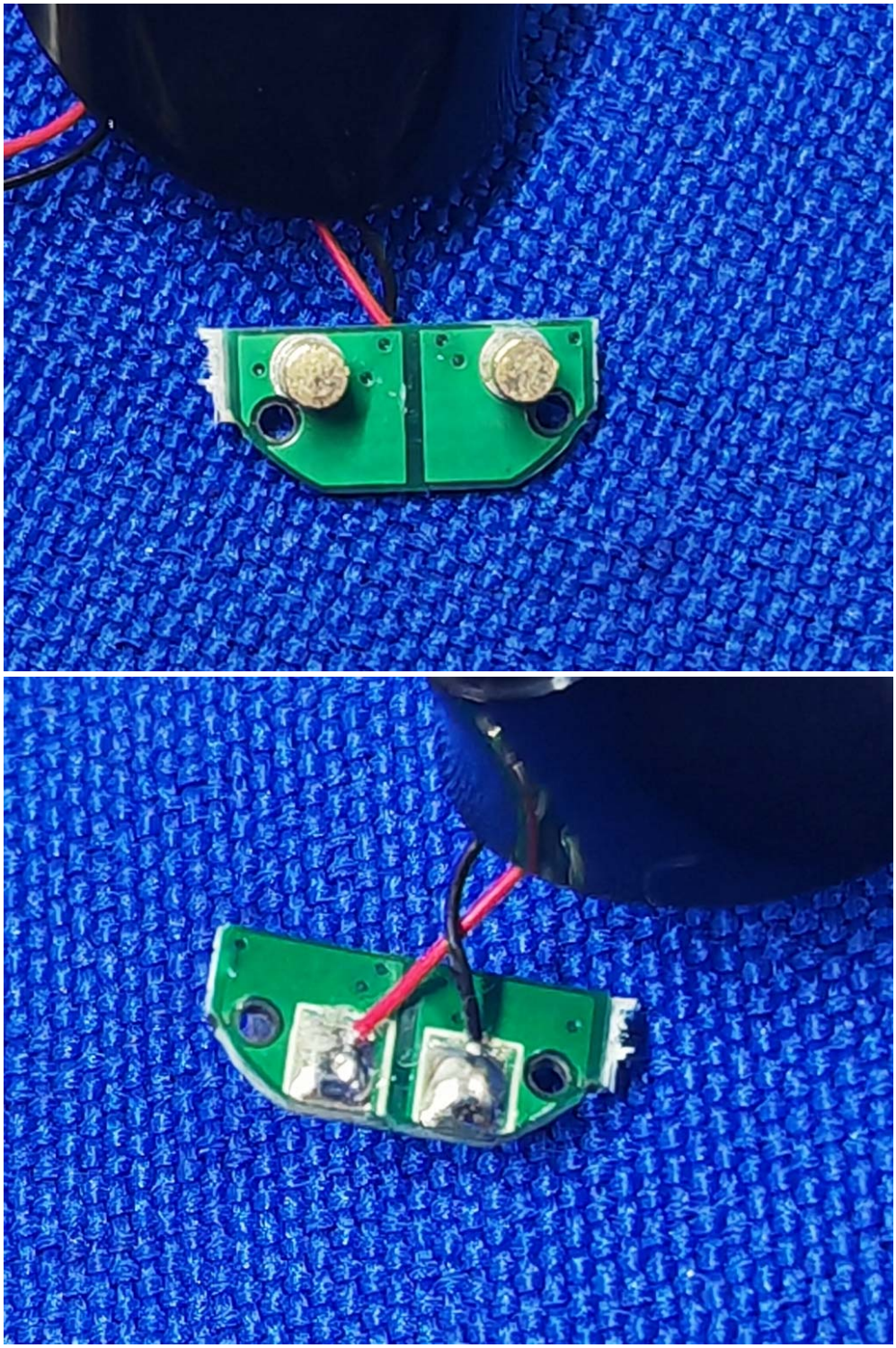
Inside View - Left earphone



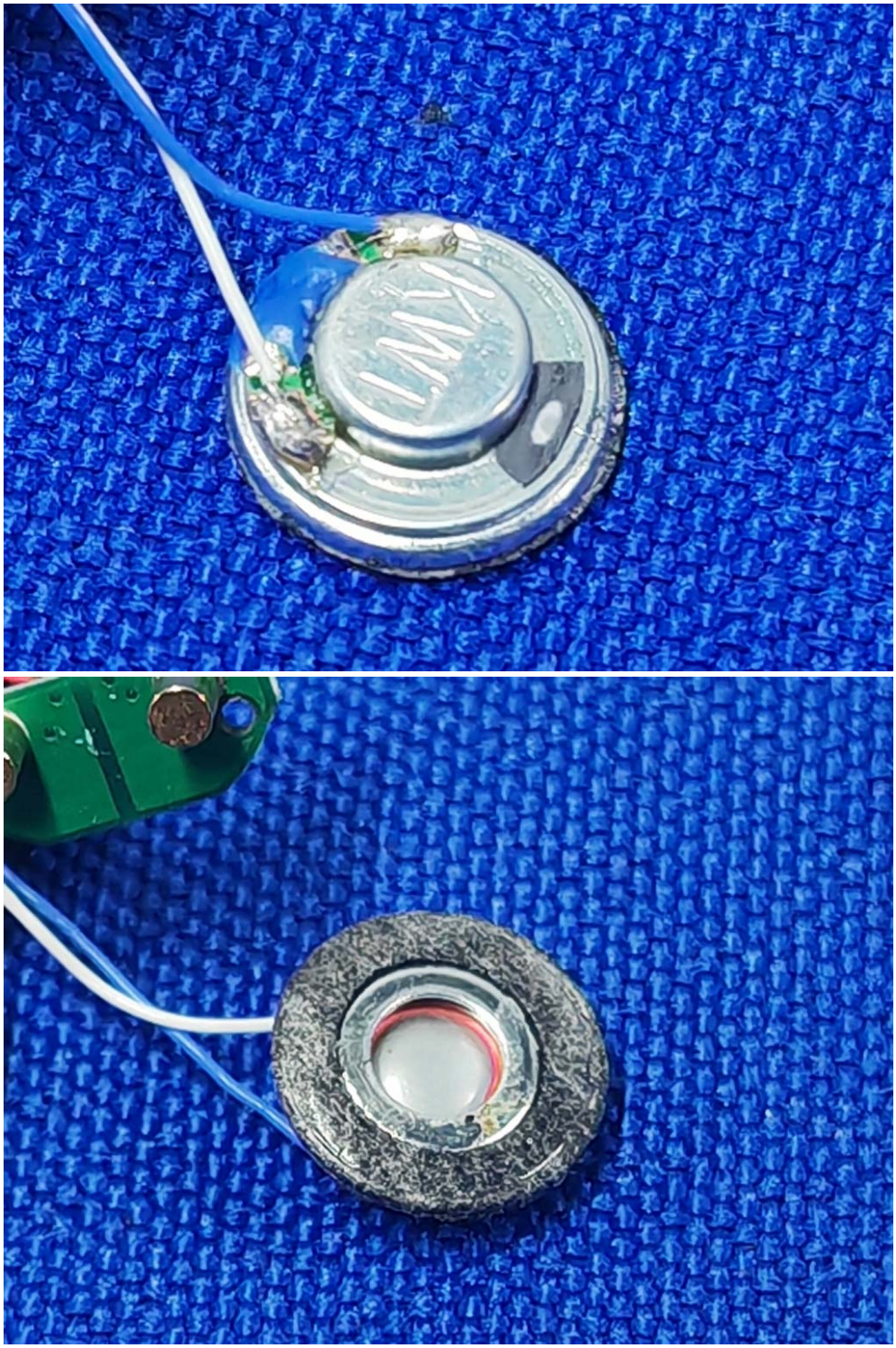
Inside View - Left earphone



Inside View - Left earphone



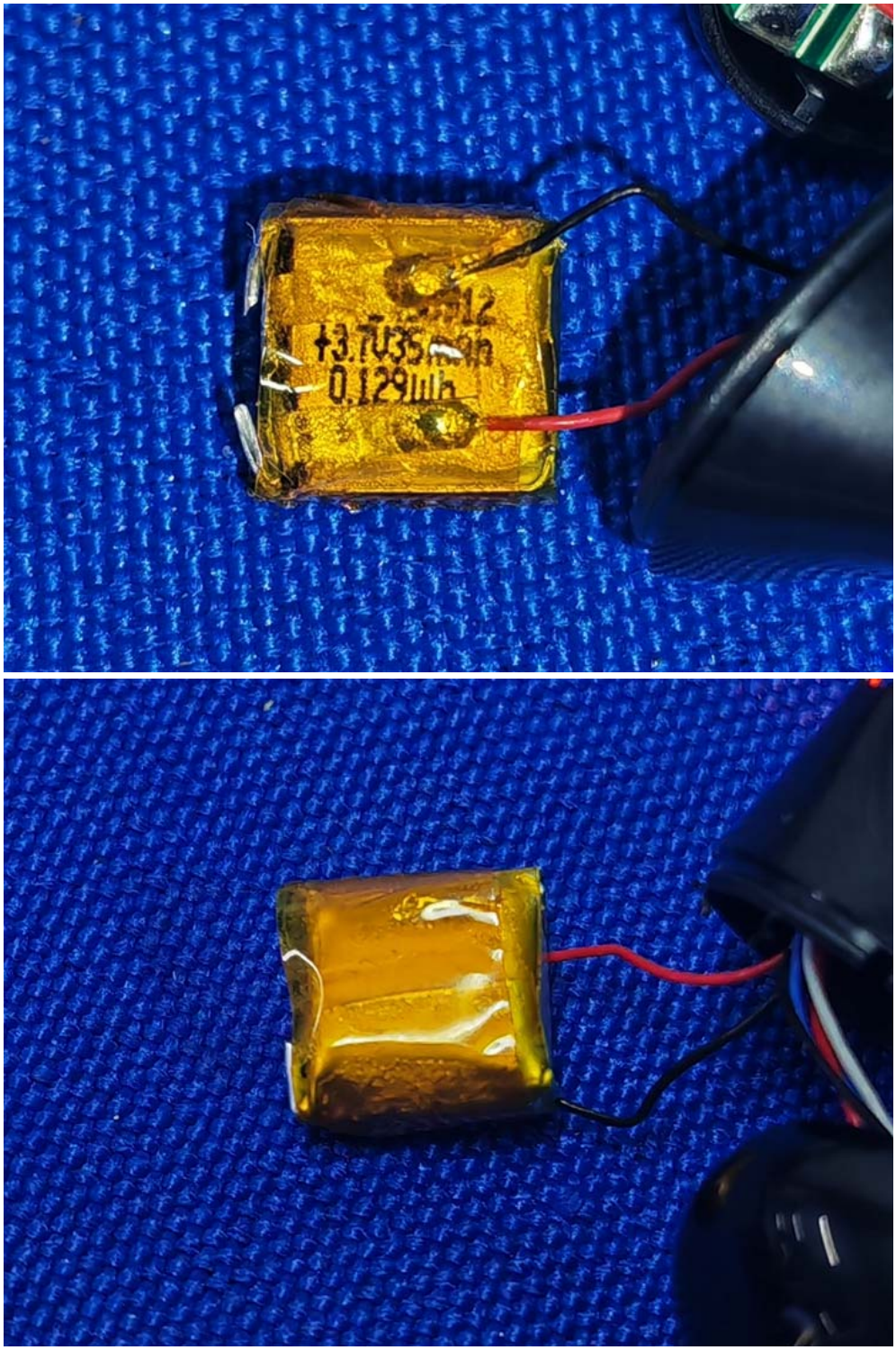
Inside View - Left earphone



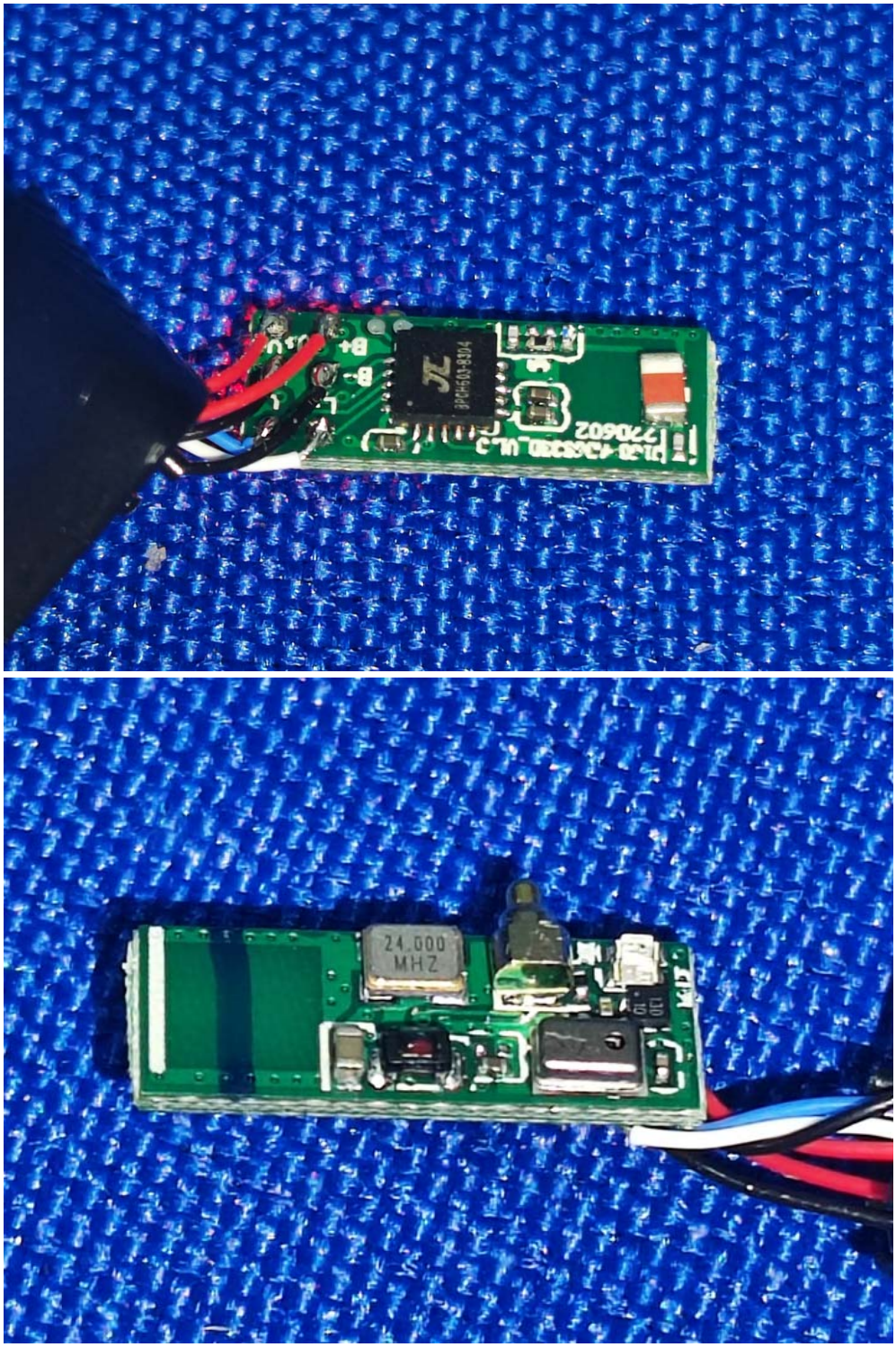
Outside View - Right earphone

Outside View - Right earphone

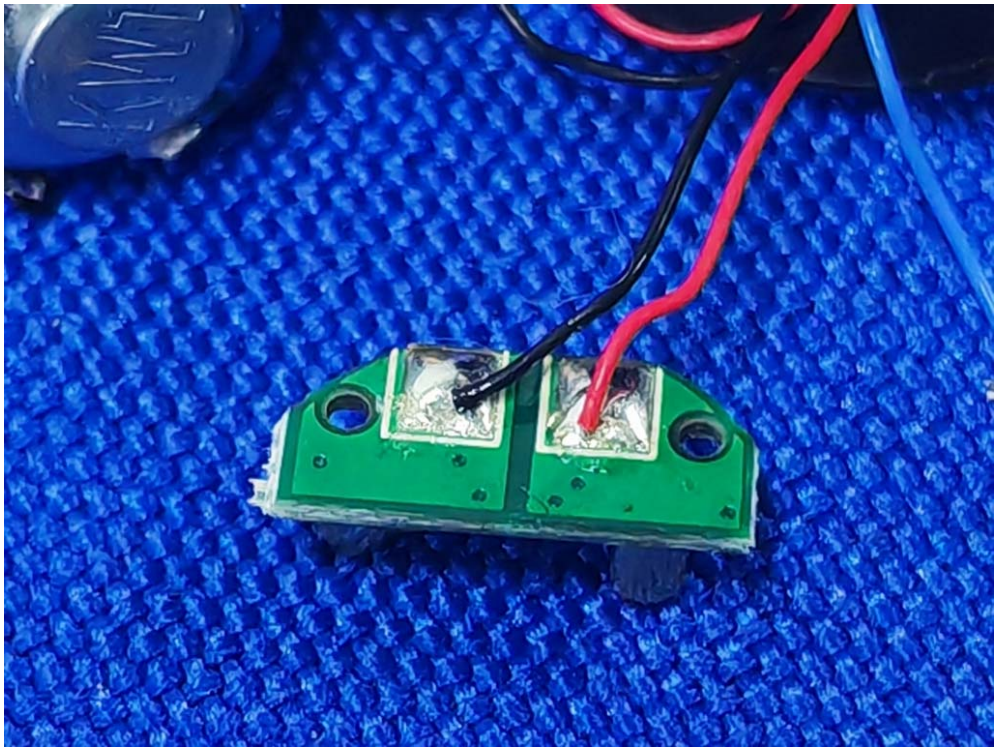
Inside View - Right earphone

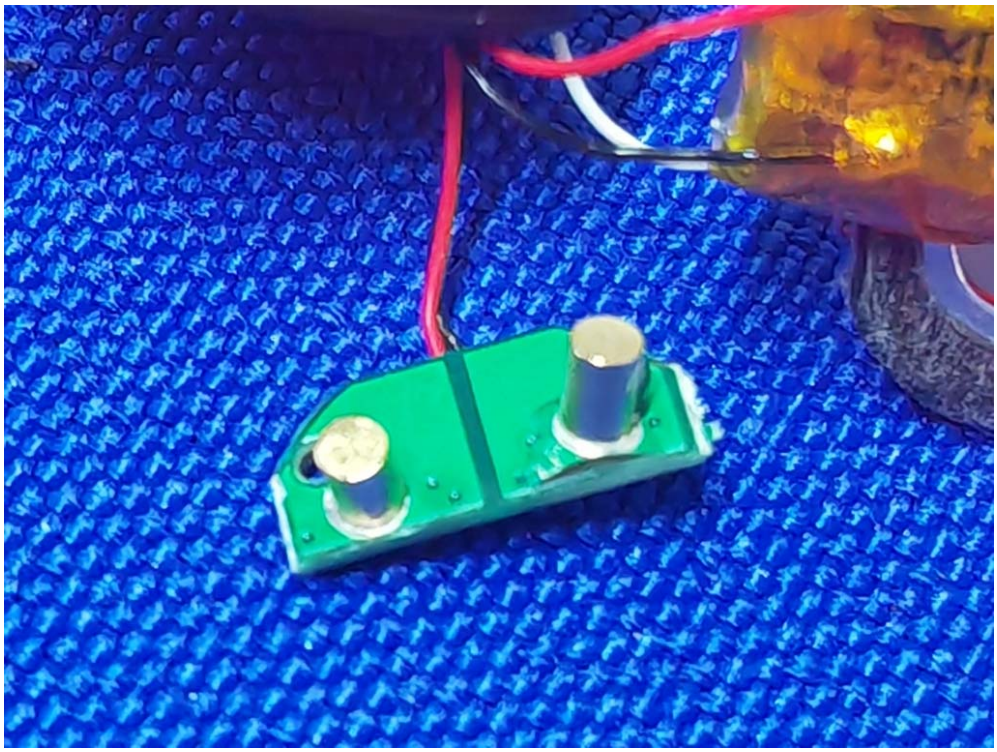


Inside View - Right earphone

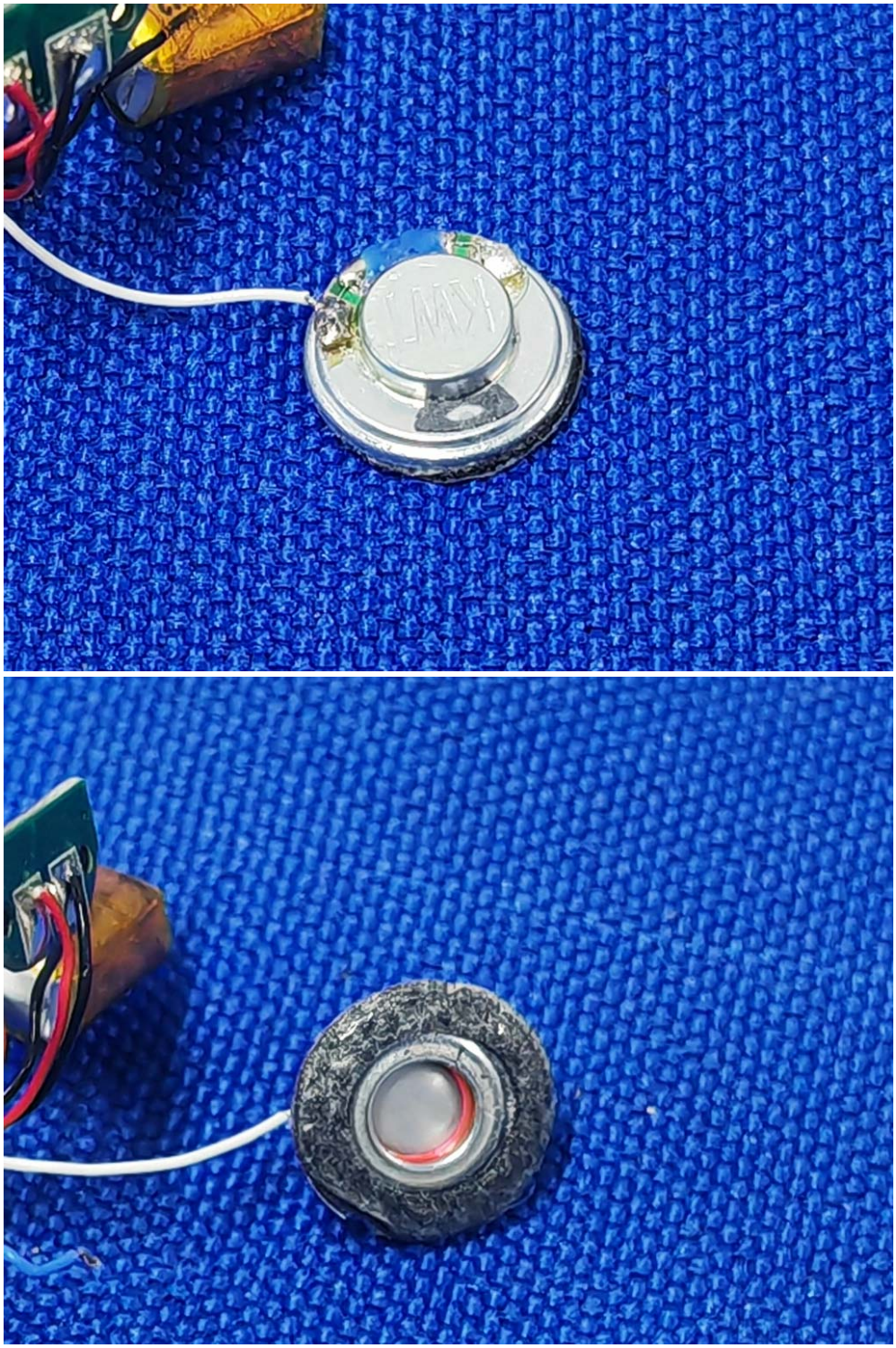


Inside View - Right earphone





Inside View - Right earphone



Inside View - Right earphone

End of Report