RF TEST REPORT

Applicant	Panasonic Corporation of North America
FCC ID	ACJ-TNPA7911
Product	Wireless module
Brand	Panasonic
Model	P24VS_01
Report No.	R2306A0670-R2V2
Issue Date	October 13, 2023

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 15C (2022)**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Prepared by: Xu Ying

Approved by: Xu Kai

TA Technology (Shanghai) Co., Ltd.

Building 3, No.145, Jintang Rd, Pudong Shanghai, P.R.China
TEL: +86-021-50791141/2/3
FAX: +86-021-50791141/2/3-8000

TABLE OF CONTENT

1 Test Laboratory 5
1.1 Notes of the Test Report 5
1.2. Test facility 5
1.3 Testing Location 5
2 General Description of Equipment under Test 6
2.1 Applicant and Manufacturer Information 6
2.2 General information 6
3 Applied Standards 7
4 Information about the FHSS characteristics 8
4.1 Frequency Hopping System Requirement 8
4.2 Pseudorandom Frequency Hopping Sequence 9
4.3 Equal Hopping Frequency Use 10
4.4 System Receiver Input Bandwidth 10
4.5 Test Configuration 11
5 Test Case Results 12
5.1 Peak Power Output 12
5.2 99% Bandwidth and 20dB Bandwidth 25
5.3 Frequency Separation 38
5.4 Time of Occupancy (Dwell Time) 51
5.5 Band Edge Compliance 72
5.6 Number of hopping Frequency 97
5.7 Spurious RF Conducted Emissions 104
5.8 Unwanted Emission 124
5.9 Conducted Emission 145
6 Main Test Instruments 147
ANNEX A: The EUT Appearance 148
ANNEX B: Test Setup Photos 149

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Version	Revision Description	Issue Date
Rev.0	Initial issue of report.	August 31, 2023
Rev.1	Update information.	September 15, 2023
Rev.2	Update information and description.	October 13, 2023
Note: This revised report (Report No.: R2306A0670-R2V2) supersedes and replaces the previously issued report (Report No.: R2306A0670-R2V1). Please discard or destroy the previously issued report and dispose of it accordingly.		

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Summary of Measurement Results

Number	Test Case	Clause in FCC rules	Verdict
1	Frequency Hopping System	15.247 (g), (h)	PASS
2	Peak Power Output	15.247(b)(1)	PASS
3	99% Bandwidth and 20dB Bandwidth	15.247(a)(1) C63.10 6.9	PASS
4	Frequency Separation	15.247(a)(1)	PASS
5	Time of Occupancy (Dwell Time)	15.247(a)(1)(iii)	PASS
6	Band Edge Compliance	15.247(d)	PASS
7	Number of Hopping Frequency	15.247(a)(1)(iii)	PASS
8	Spurious RF Conducted Emissions	15.247(d)	PASS
9	Unwanted Emissions	15.247(d),15.205,15.209	PASS
10	Conducted Emissions	15.207	NA
Date of Testing: July 6, 2023 ~ August 4, 2023 Date of Sample Received: June 12, 2023			
Note: PASS: The EUT complies with the essential requirements in the standard. FAIL: The EUT does not comply with the essential requirements in the standard. All indications of Pass/Fail in this report are opinions expressed by TA Technology (Shanghai) Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only.			

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

1 Test Laboratory

1.1 Notes of the Test Report

This report shall not be reproduced in full or partial, without the written approval of **TA Technology (Shanghai) Co., Ltd.** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein .Measurement Uncertainties were not taken into account and are published for informational purposes only. This report is written to support regulatory compliance of the applicable standards stated above.

1.2. Test facility

FCC (Designation number: CN1179, Test Firm Registration Number: 446626)

TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform measurements.

A2LA (Certificate Number: 3857.01)

TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform measurement.

1.3 Testing Location

Company:	TA Technology (Shanghai) Co., Ltd.
Address:	Building 3, No.145, Jintang Rd, Pudong Shanghai, P.R.China
City:	Shanghai
Post code:	201201
Country:	P. R. China
Contact:	Xu Kai
Telephone:	+86-021-50791141/2/3
Fax:	+86-021-50791141/2/3-8000
Website:	http://www.ta-shanghai.com
E-mail:	xukai@ta-shanghai.com

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

2 General Description of Equipment under Test

2.1 Applicant and Manufacturer Information

Applicant	Panasonic Corporation of North America
Applicant address	Two Riverfront Plaza, Newark, NJ 07102-5490, United States
Manufacturer	Panasonic Entertainment & Communication Co., Ltd.
Manufacturer address	1-10-12 Yagumo-higashi-machi, Moriguchi City, Osaka 570-0021, Japan

2.2 General information

EUT Description			
Model	P24VS_01		
Lab internal SN	R2306A0670/S02		
Hardware Version	1		
Software Version	1		
Power Supply	External power supply		
Antenna Type	Internal Antenna / External Antenna		
Antenna Connector	A permanently attached antenna (meet with the standard FCC Part 15.203 requirement)		
Antenna Gain	Internal Antenna	-8.10 dBi	
	External Antenna	0.60 dBi	
Test Mode(s)	Basic Rate	Enhanced Data Rate(EDR)	
Modulation Type	Frequency Hopping Spread Spectrum (FHSS)		
	GFSK	π/4 DQPSK	8DPSK
Packet Type (Maximum Payload)	DH5	2DH5	3DH5
Max. Output Power	10.75 dBm		
Operating Frequency Range(s)	2402-2480 MHz		
Note: 1. The EUT is sent from the applicant to TA and the information of the EUT is declared by the applicant. 2. The EUT is connected to 5V DC power supply. And EUT is connected a computer was used to configure the DUT using the tool QA Tool_Dbg to transmit all different modes			

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

3 Applied Standards

According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

Test standards:

FCC CFR47 Part 15C (2022) Radio Frequency Devices

ANSI C63.10-2013

Reference standard:

KDB 558074 D01 15.247 Meas Guidance v05r02

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

4 Information about the FHSS characteristics

4.1 Frequency Hopping System Requirement

Standard requirement:
(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.
(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.
Compliance for section 15.247(g):
According to Bluetooth Core Specification, the Bluetooth system transmits the packets with the pseudorandom hopping frequency with a continuous data and short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.
Compliance for section 15.247(h):
According to Bluetooth Core Specification, the Bluetooth system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels.
According to Bluetooth Core Specification, the Bluetooth system is designed not have the ability to coordinate with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

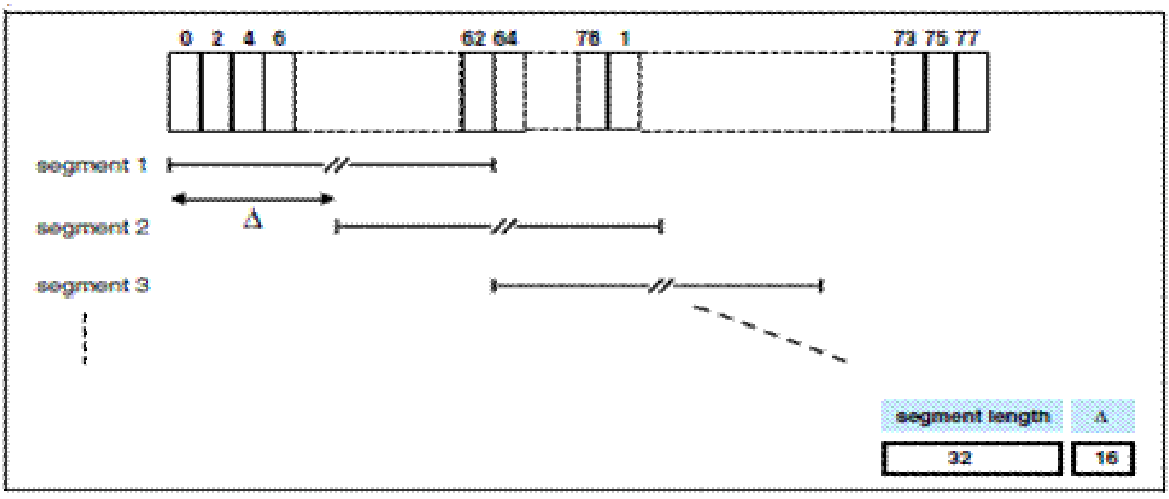
4.2 Pseudorandom Frequency Hopping Sequence

Frequency Hopping Systems. A spread spectrum system in which the carrier is modulated with the coded information in a conventional manner causing a conventional spreading of the RF energy about the frequency carrier. The frequency of the carrier is not fixed but changes at fixed intervals under the direction of a coded sequence. The wide RF bandwidth needed by such a system is not required by spreading of the RF energy about the carrier but rather to accommodate the range of frequencies to which the carrier frequency can hop. The test of a frequency hopping system is that the near term distribution of hops appears random, the long term distribution appears evenly distributed over the hop set, and sequential hops are randomly distributed in both direction and magnitude of change in the hop set.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its pioneer to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no impact on the bandwidth used.

The selection scheme chooses a segment of 32 hop frequencies spanning about 64 MHz and visits these hops in a pseudo-random order. Next, a different 32-hop segment is chosen, etc. In the page, master page response, slave page response, page scan, inquiry, inquiry response and inquiry scan hopping sequences, the same 32-hop segment is used all the time (the segment is selected by the address; different devices will have different paging segments).

When the basic channel hopping sequence is selected, the output constitutes a pseudo-random sequence that slides through the 79 hops. The principle is depicted in the figure below.



Hop selection scheme in CONNECTION state.

Pseudorandom Frequency Hopping Sequence Table as below:

Channel: 08, 24, 40, 56, 40, 56, 72, 09, 01, 09, 33, 41, 33, 41, 65, 73, 53, 69, 06, 22, 04, 20, 36, 52, 38, 46, 70, 78, 68, 76, 21, 29, 10, 26, 42, 58, 44, 60, 76, 13, 03, 11, 35, 43, 37, 45, 69, 77, 55, 71, 08, 24, 08, 24, 40, 56, 40, 48, 72, 01, 72, 01, 25, 33, 12, 28, 44, 60, 42, 58, 74, 11, 05, 13, 37, 45, etc.

Each frequency used equally on the average by each transmitter.

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

4.3 Equal Hopping Frequency Use

All Bluetooth units participating in the Pico net are time and hop-synchronized to the channel. Each new transmission event begins on the next channel in the hopping sequence after the final channel used in the previous transmission event.

4.4 System Receiver Input Bandwidth

Each channel bandwidth is 1MHz. The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

4.5 Test Configuration

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

The radiated emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in lie-down position (X axis) and the worst case was recorded.

The test software is used WCN_Combo_Tool.

Test Cases	Test Modes
Peak Power Output -Conducted	DH5/2DH5/3DH5
Occupied Bandwidth (20dB)	DH5/2DH5/3DH5
Frequency Separation	DH5/2DH5/3DH5
Time of Occupancy (Dwell Time)	DH5/2DH5/3DH5
Band Edge Compliance	DH5/2DH5/3DH5
Number of Hopping Frequency	DH5/2DH5/3DH5
Spurious RF Conducted Emissions	DH5/2DH5/3DH5
Unwanted Emission	DH5/2DH5/3DH5
Conducted Emission	DH5/2DH5/3DH5

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

5 Test Case Results

5.1 Peak Power Output

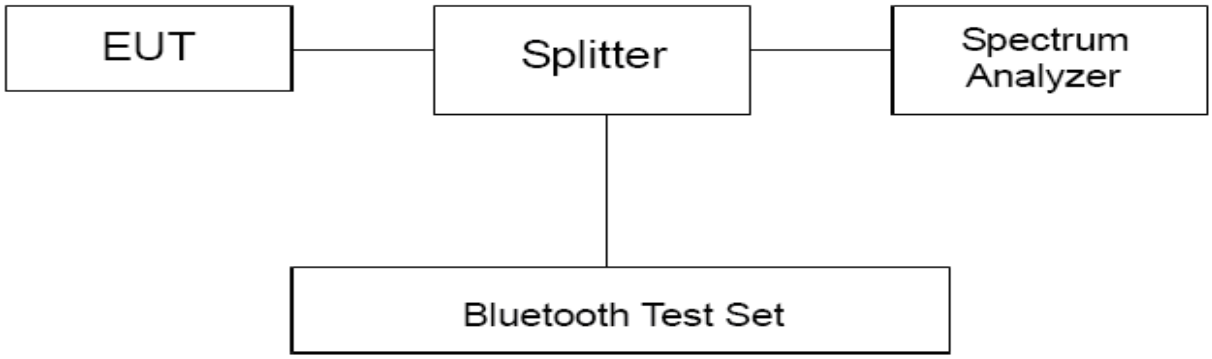
Ambient condition

Temperature	Relative humidity
20°C ~ 25°C	45% ~ 50%

Methods of Measurement

During the process of the testing, The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. The EUT is controlled by the Bluetooth test set to ensure max power transmission with proper modulation. The peak detector is used. RBW is set to 2 MHz; VBW is set to 6 MHz. These measurements have been tested at following channels: 0, 39, and 78.

Test Setup



Limits

Rule Part 15.247 (b) (1)specifies that " 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."

Peak Output Power	≤ 125 mW (21dBm)

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U=0.44 dB.

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Test Results

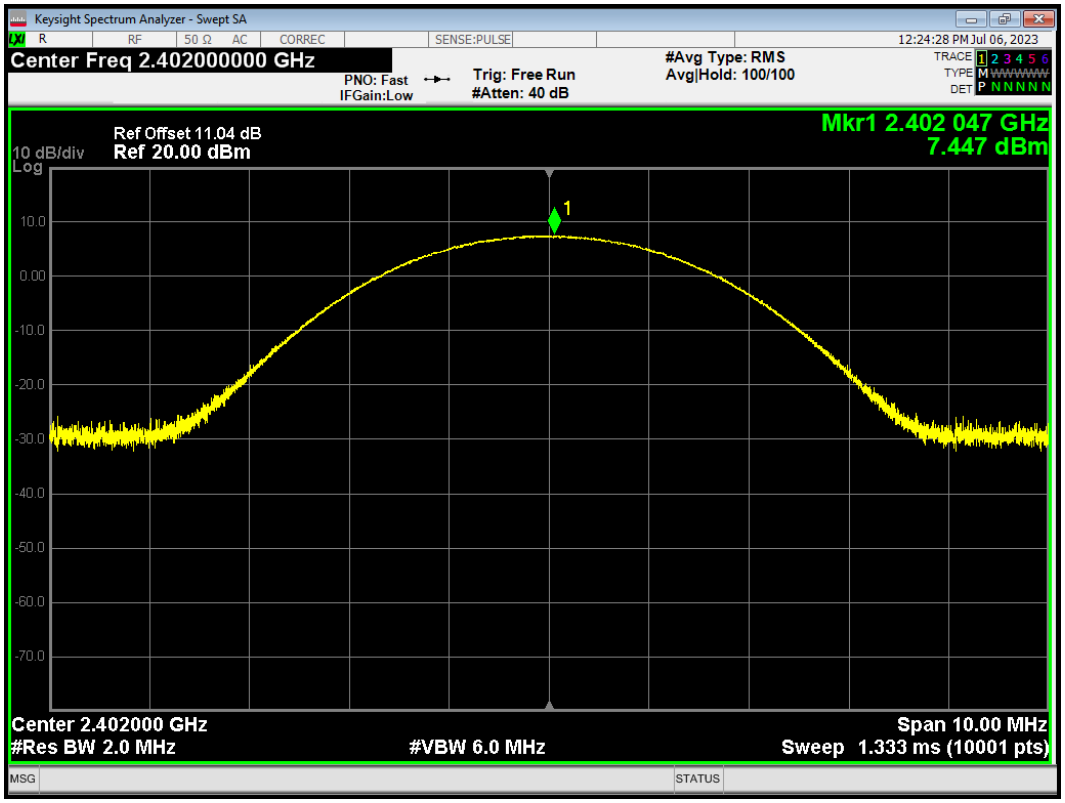
Internal Antenna

Power Index	
Channel	Bluetooth
CH0	7
CH19	7
CH39	7

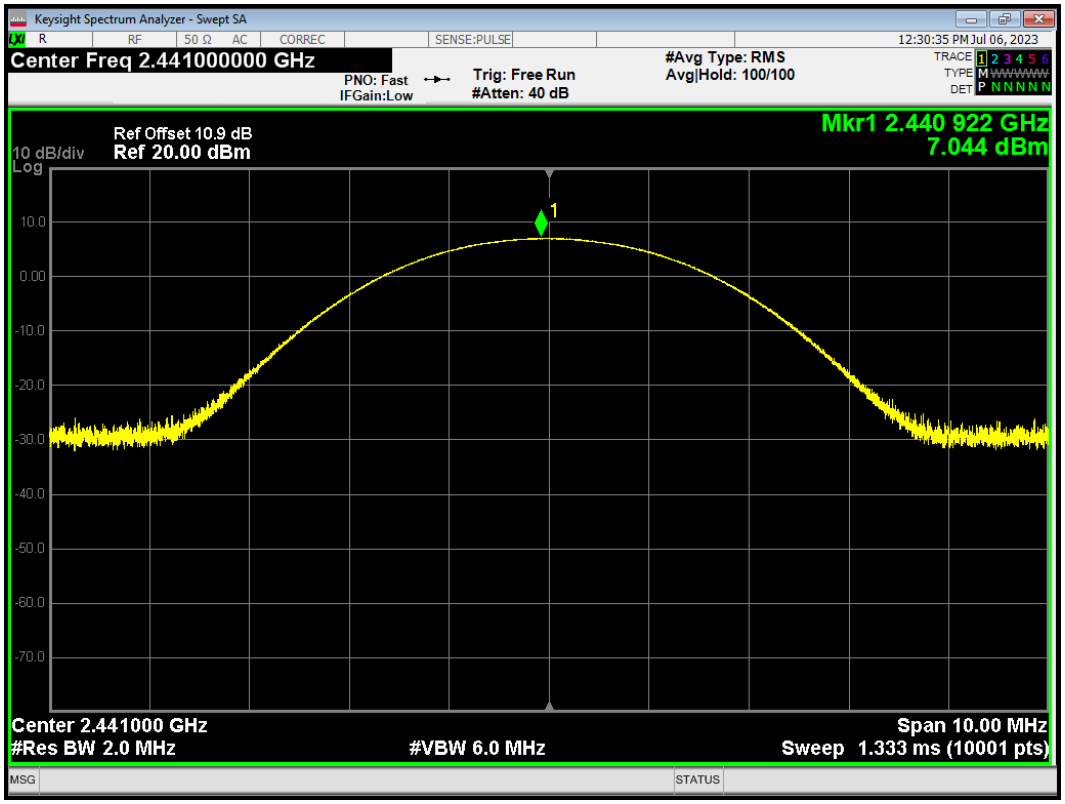
Channel	Frequency (MHz)	Peak Output Power (dBm)			Limit (dBm)	Conclusion
		DH5	2D H5	3DH5		
0	2402	7.45	9.88	10.21	30	PASS
39	2441	7.04	9.68	10.17	30	PASS
78	2480	6.97	9.41	9.99	30	PASS

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Power 1-DH5 2402MHz

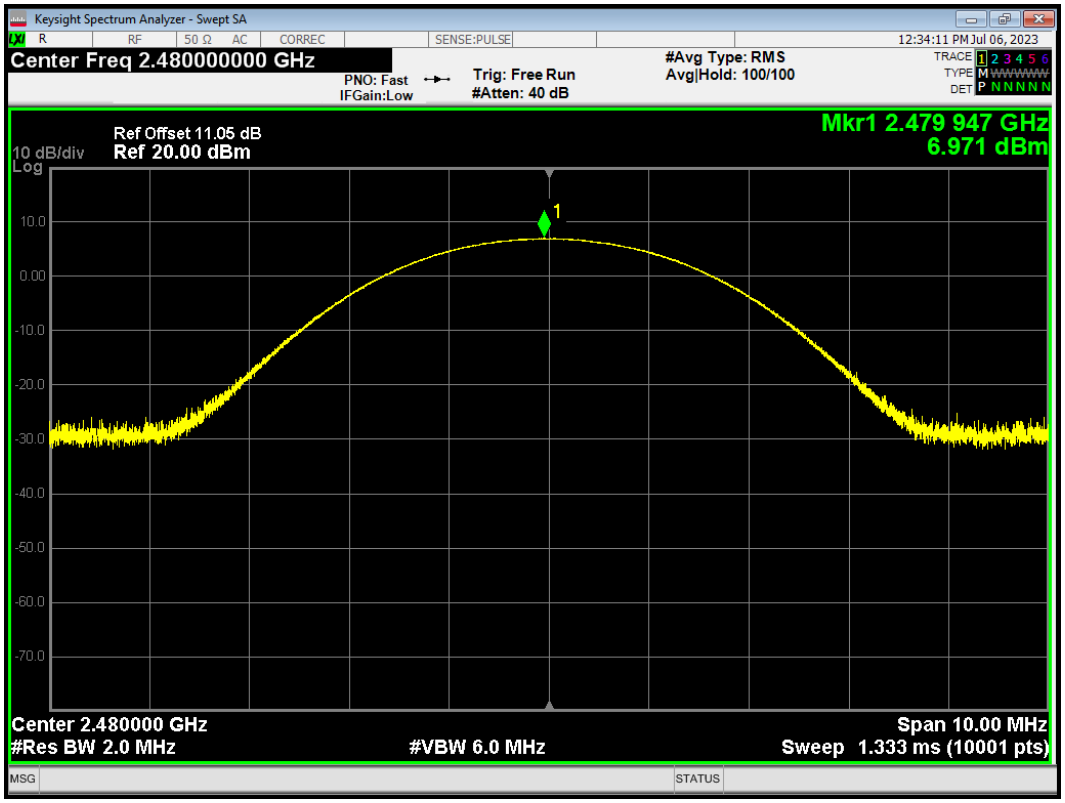


Power 1-DH5 2441MHz

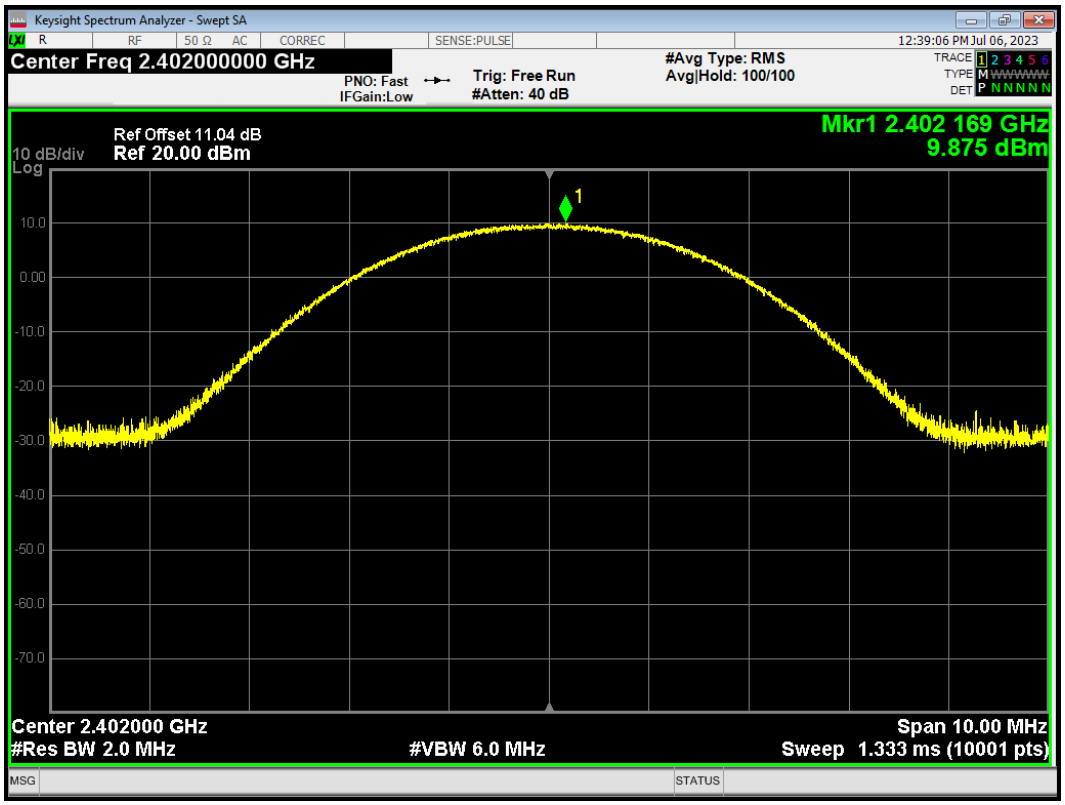


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Power 1-DH5 2480MHz

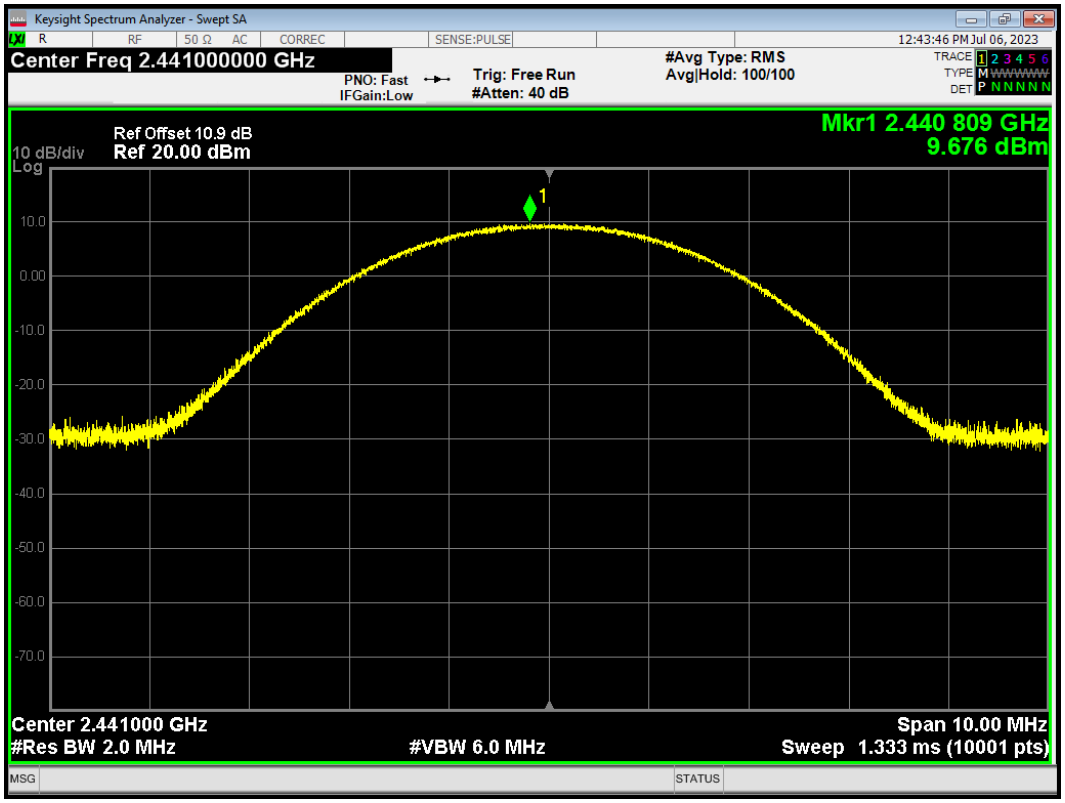


Power 2-DH5 2402MHz

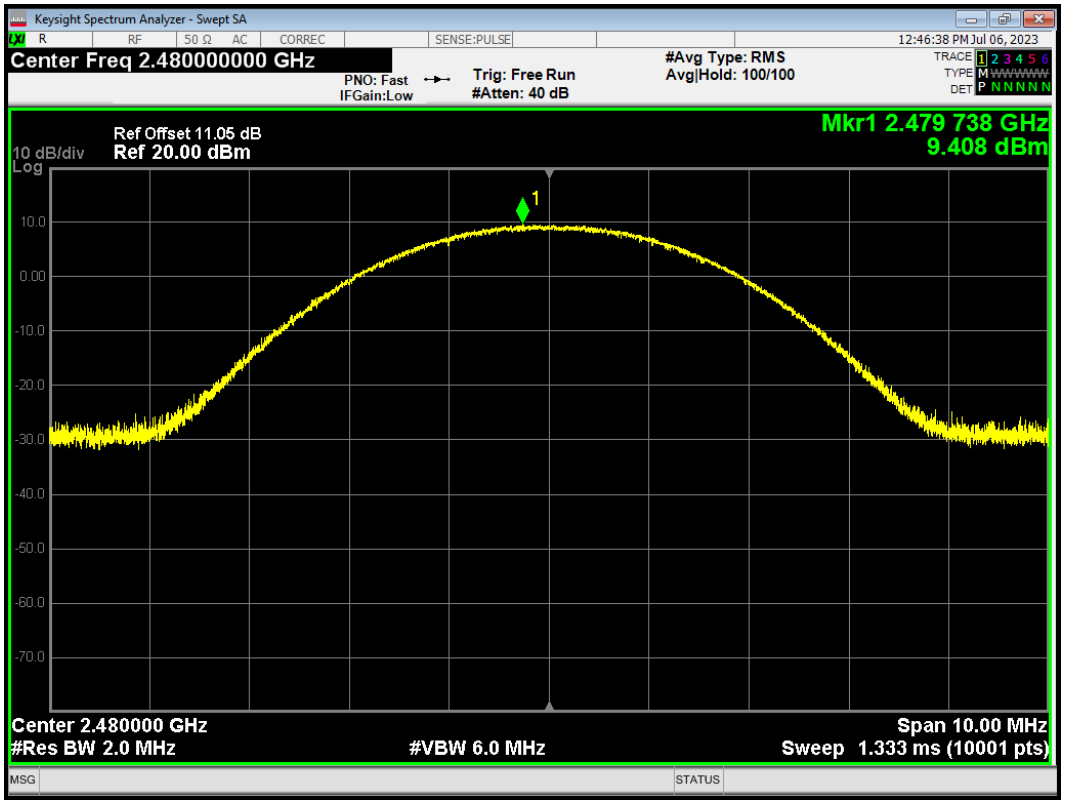


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Power 2-DH5 2441MHz

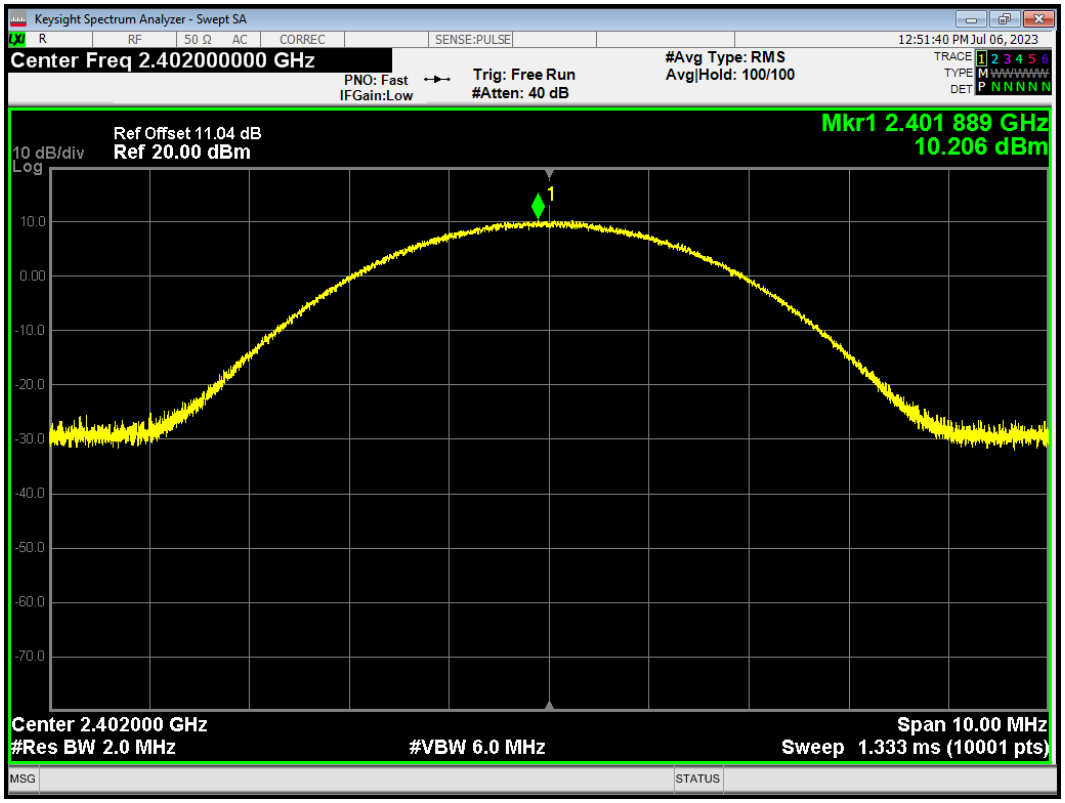


Power 2-DH5 2480MHz

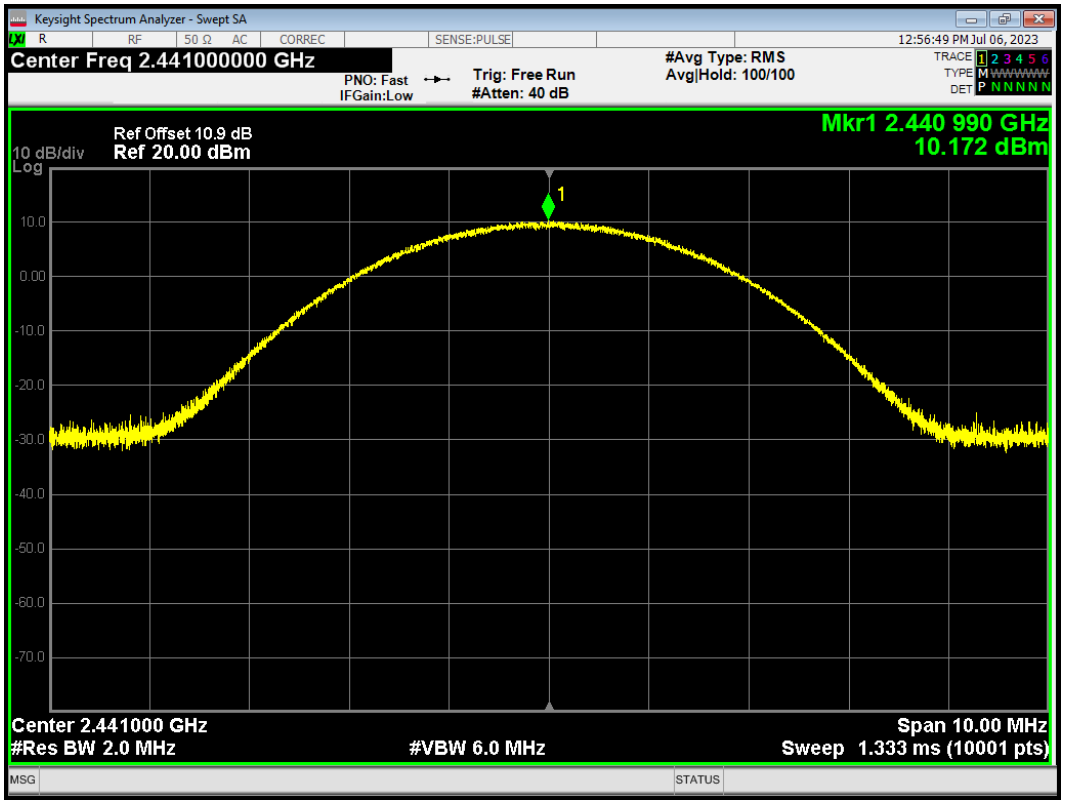


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Power 3-DH5 2402MHz

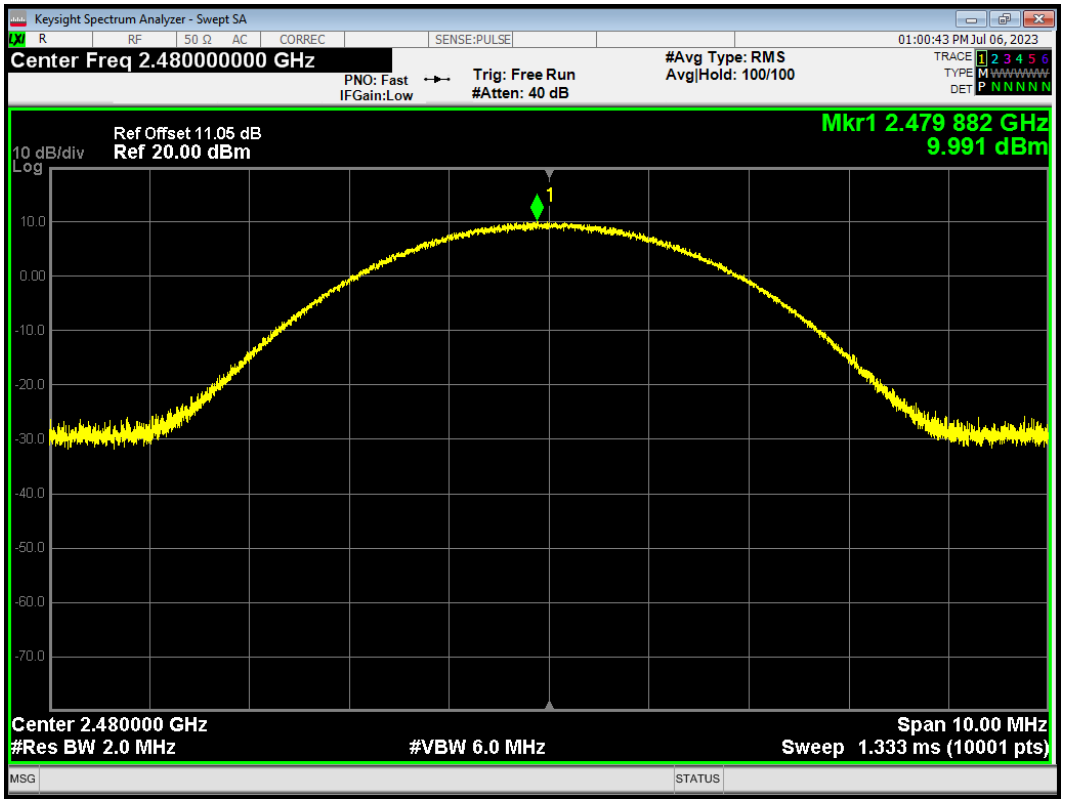


Power 3-DH5 2441MHz



This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Power 3-DH5 2480MHz



This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

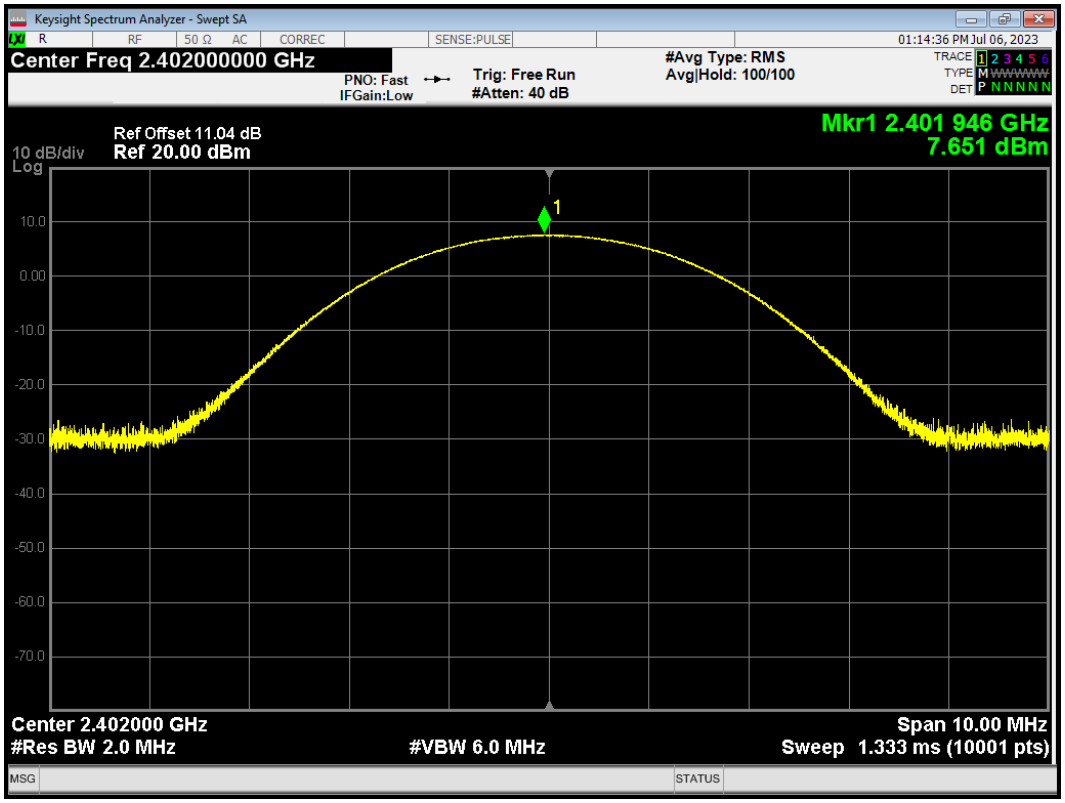
External Antenna

Power Index	
Channel	**Bluetooth**
CH0	7
CH19	7
CH39	7

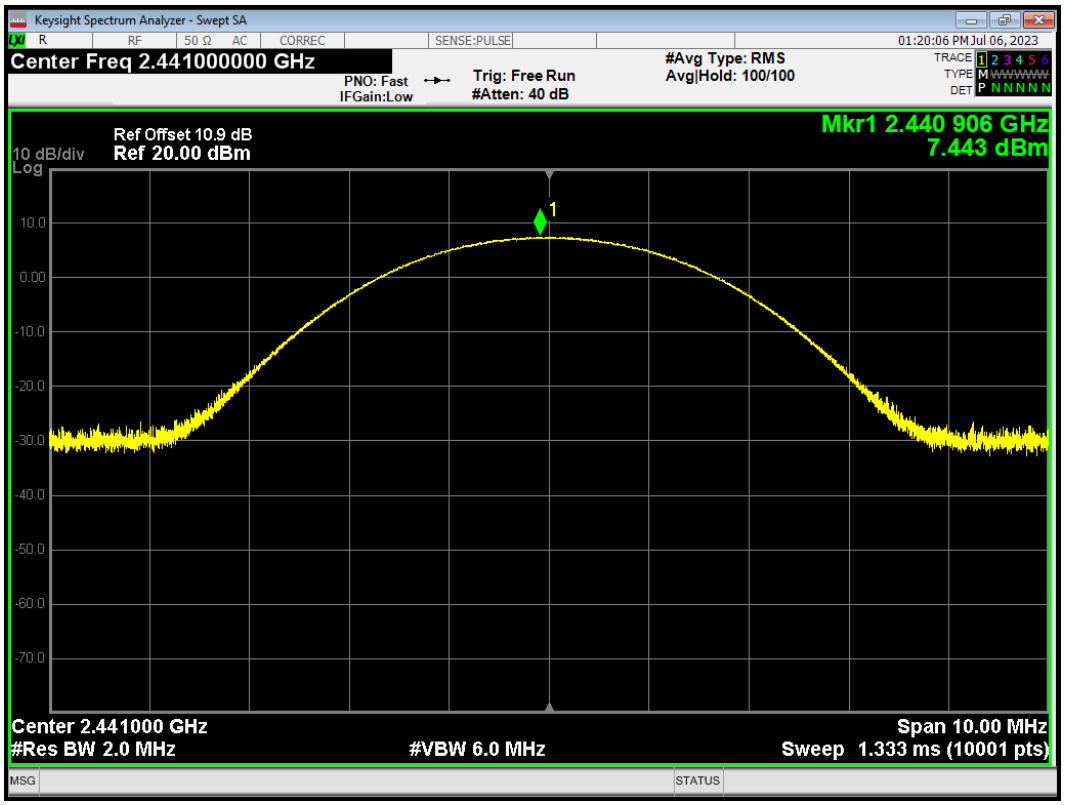
Channel	Frequency (MHz)	Peak Output Power (dBm)			Limit (dBm)	Conclusion
		DH5	2DH5	3DH5		
0	2402	7.65	10.03	10.43	30	PASS
39	2441	7.44	9.97	10.75	30	PASS
78	2480	7.51	10.10	10.54	30	PASS

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Power 1-DH5 2402MHz

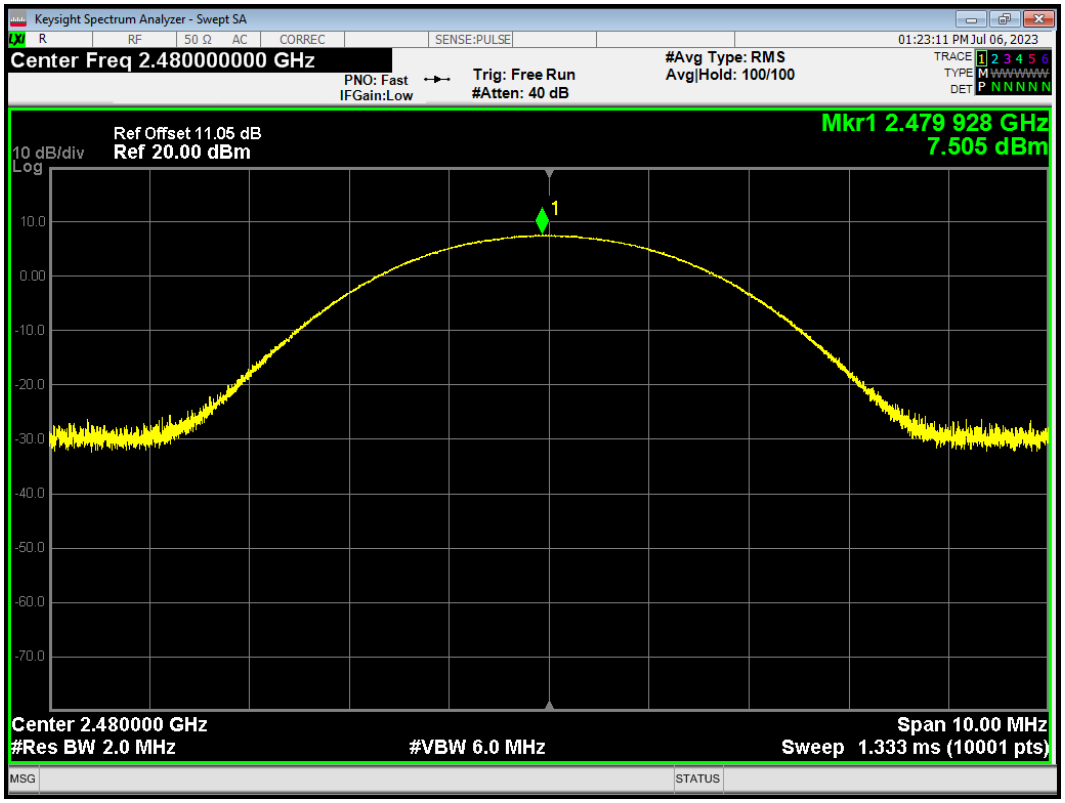


Power 1-DH5 2441MHz

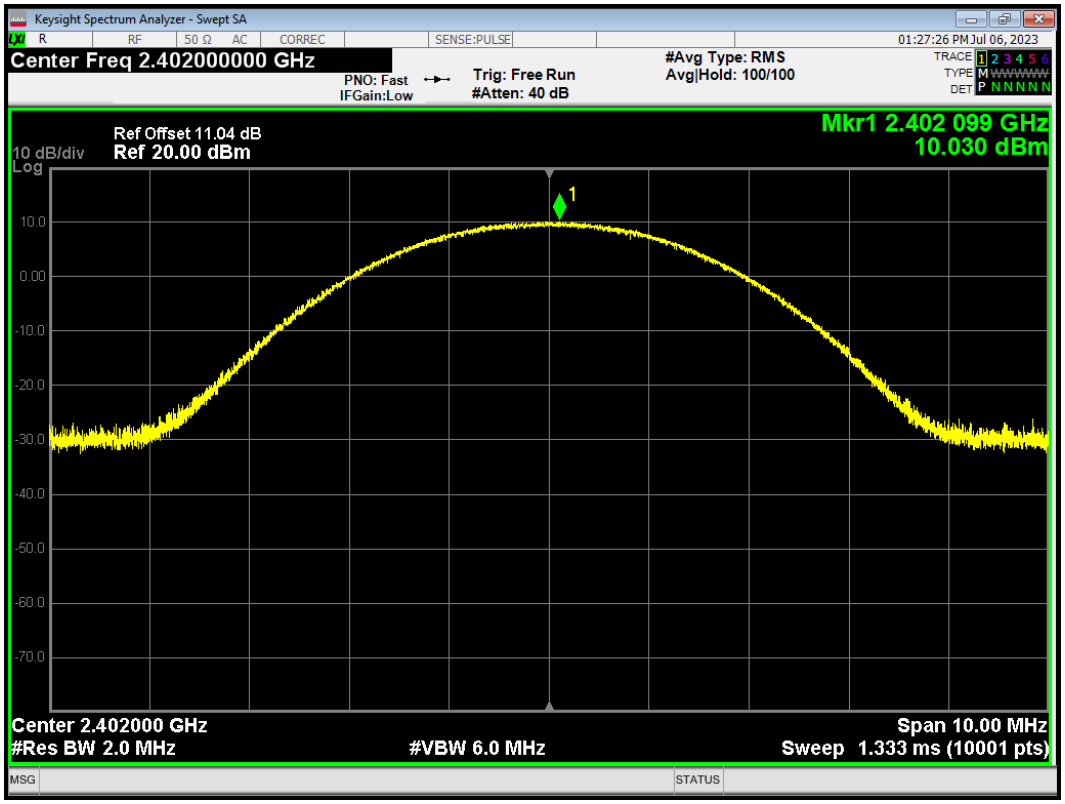


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Power 1-DH5 2480MHz

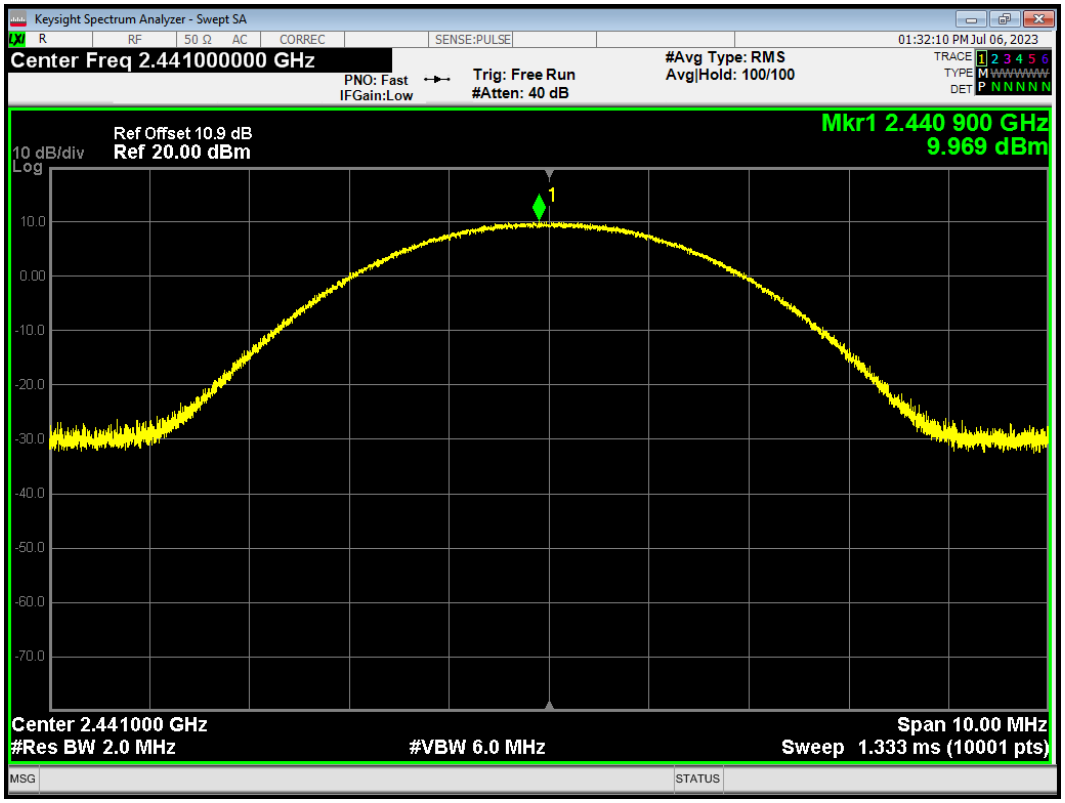


Power 2-DH5 2402MHz

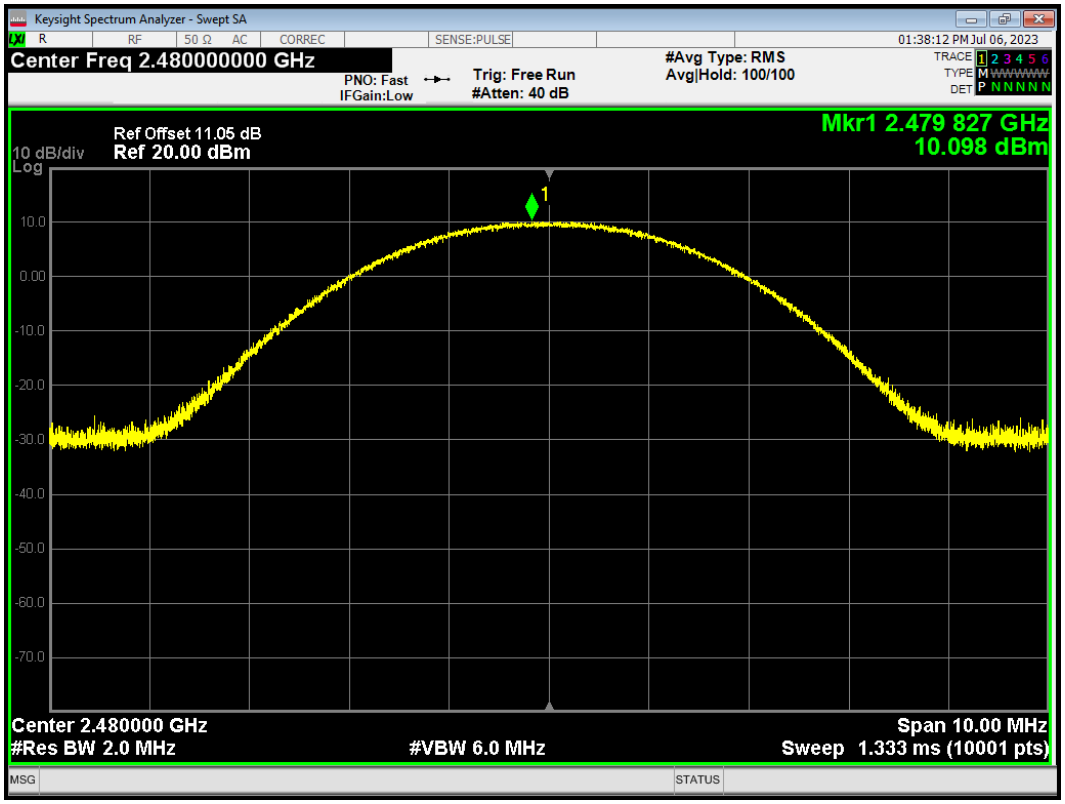


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Power 2-DH5 2441MHz

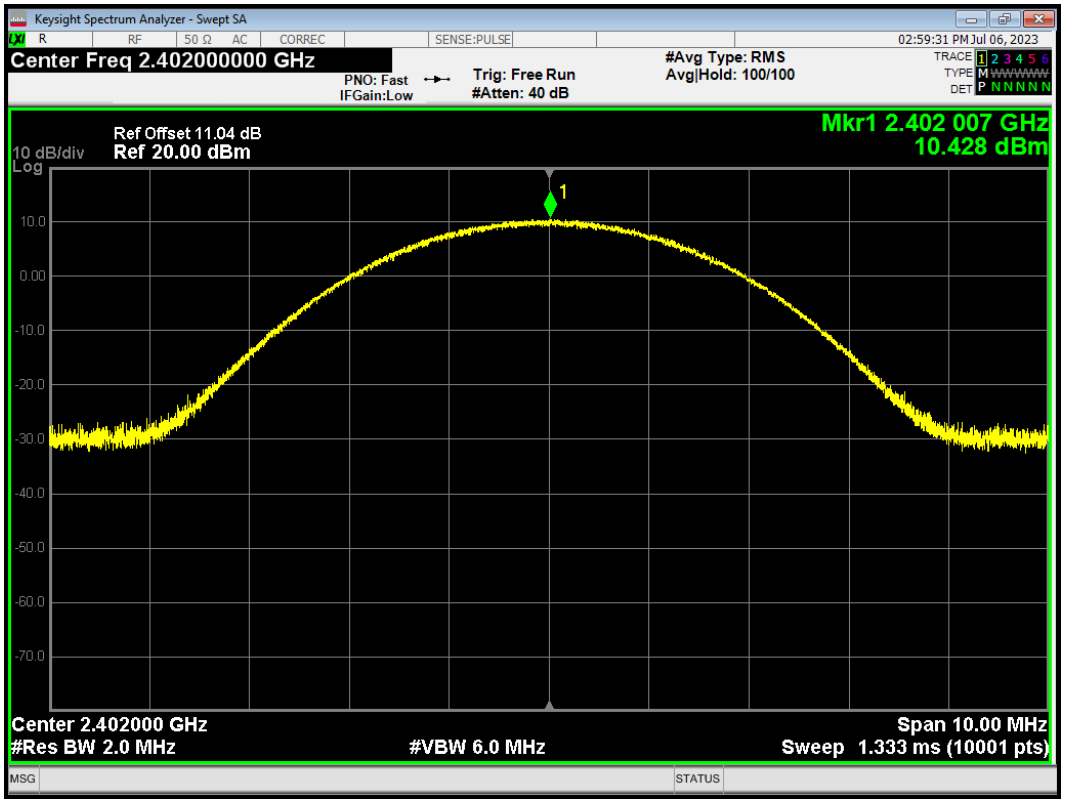


Power 2-DH5 2480MHz

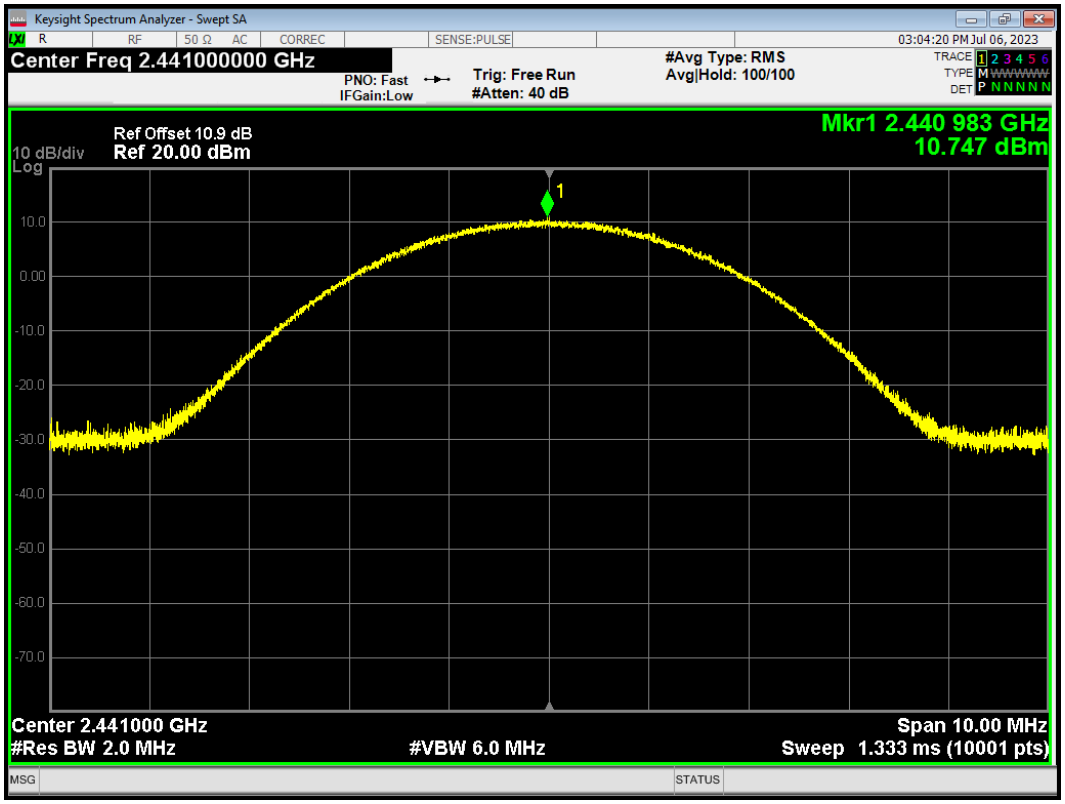


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Power 3-DH5 2402MHz

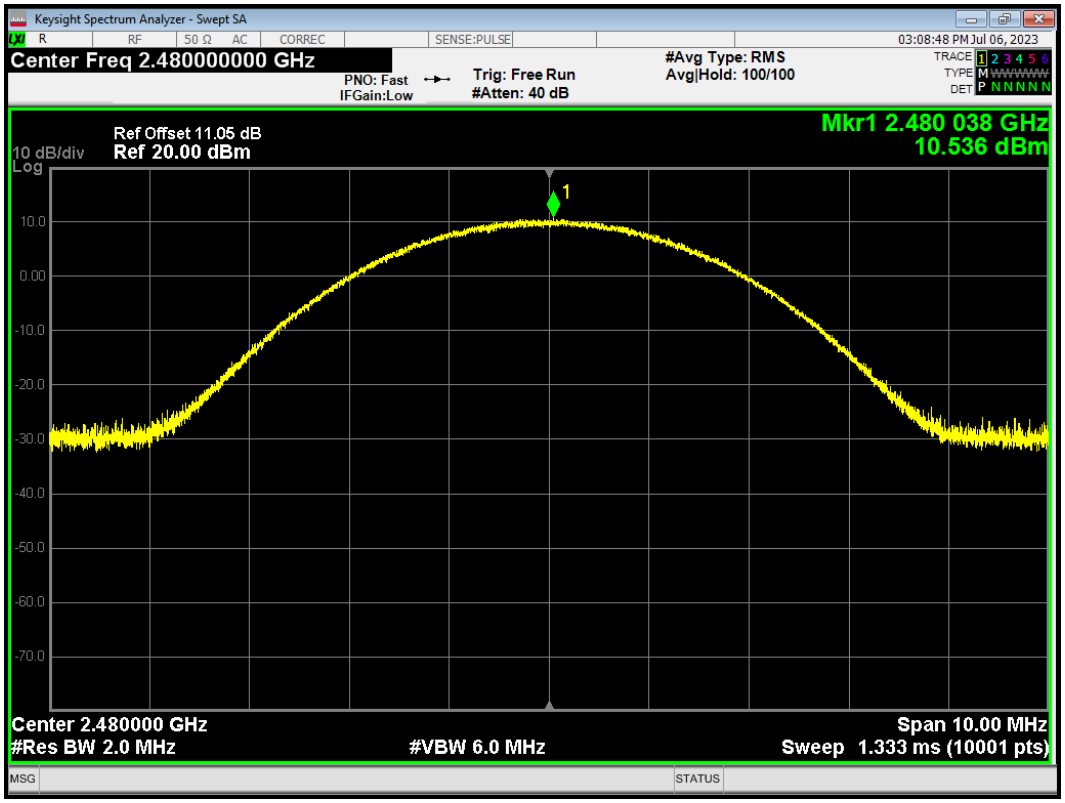


Power 3-DH5 2441MHz



This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Power 3-DH5 2480MHz



This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

5.2 99% Bandwidth and 20dB Bandwidth

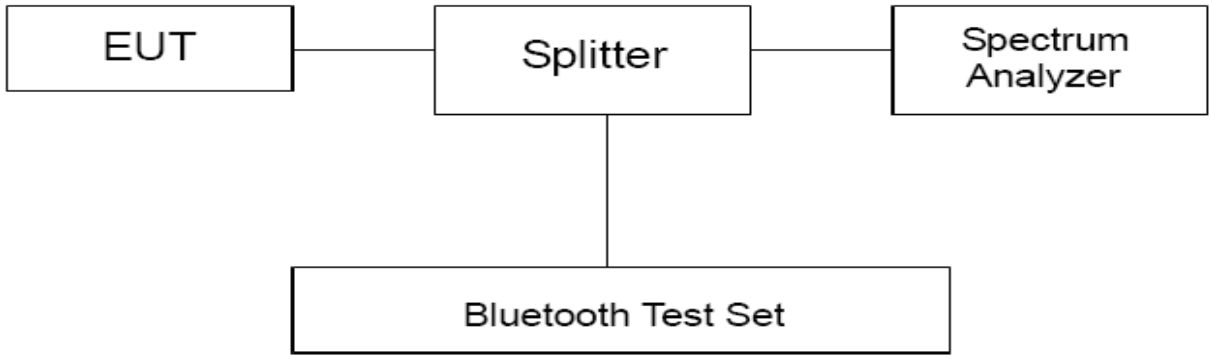
Ambient condition

Temperature	Relative humidity
20°C ~ 25°C	45% ~ 50%

Method of Measurement

The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. The occupied bandwidth is measured using spectrum analyzer. RBW is set to 30kHz and VBW is set to 100kHz on spectrum analyzer. -20dB occupied bandwidths are recorded.

Test Setup



Limits

No specific occupied bandwidth requirements in part 15.247(a) (1).

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U=936 Hz.

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

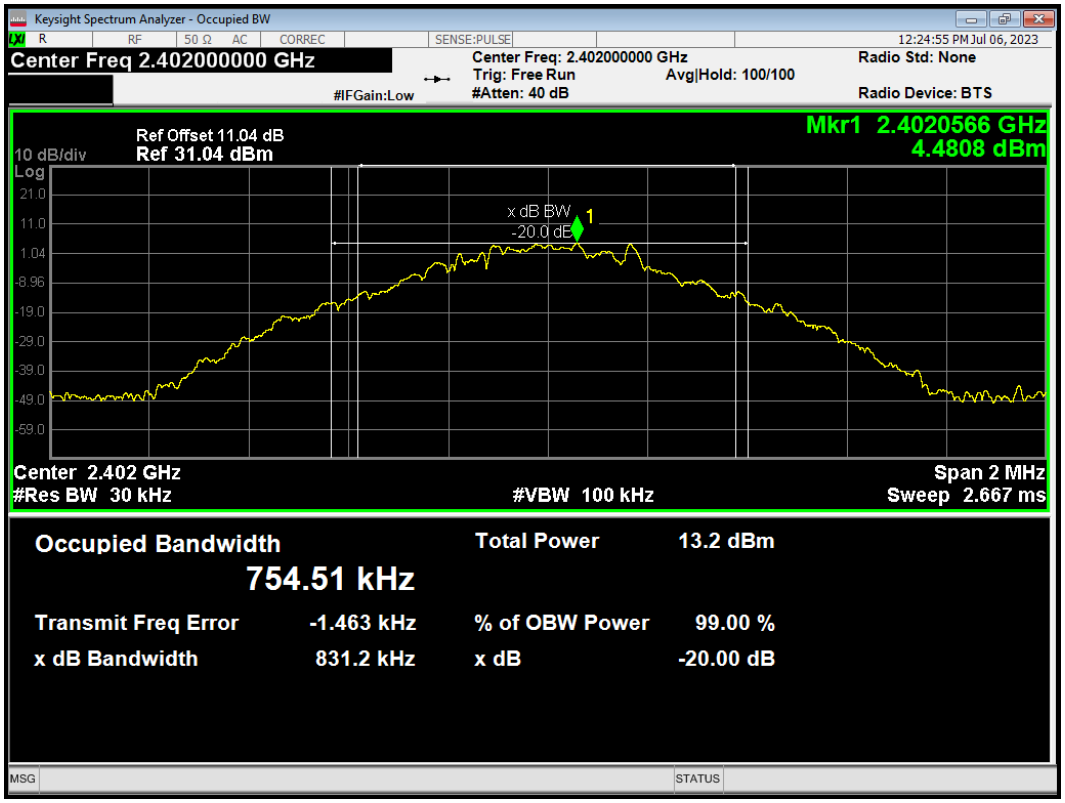
Test Results

Internal Antenna

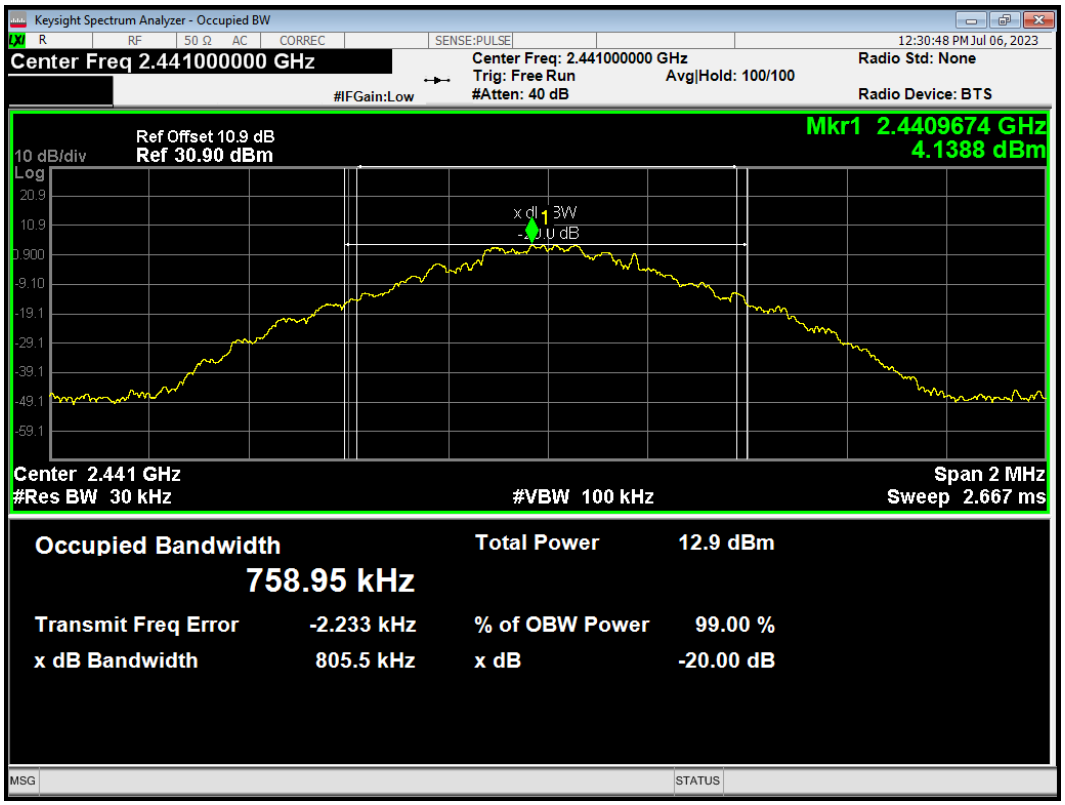
Test Mode		Channel	Frequency (MHz)	99% bandwidth(MHz)	20dB Bandwidth(MHz)
Bluetooth	DH5	0	2402	0.755	0.831
		39	2441	0.759	0.806
		78	2480	0.754	0.838
	2DH5	0	2402	1.177	1.312
		39	2441	1.186	1.334
		78	2480	1.178	1.320
	3DH5	0	2402	1.188	1.299
		39	2441	1.176	1.311
		78	2480	1.192	1.319

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

-20dB Bandwidth 1-DH5 2402MHz

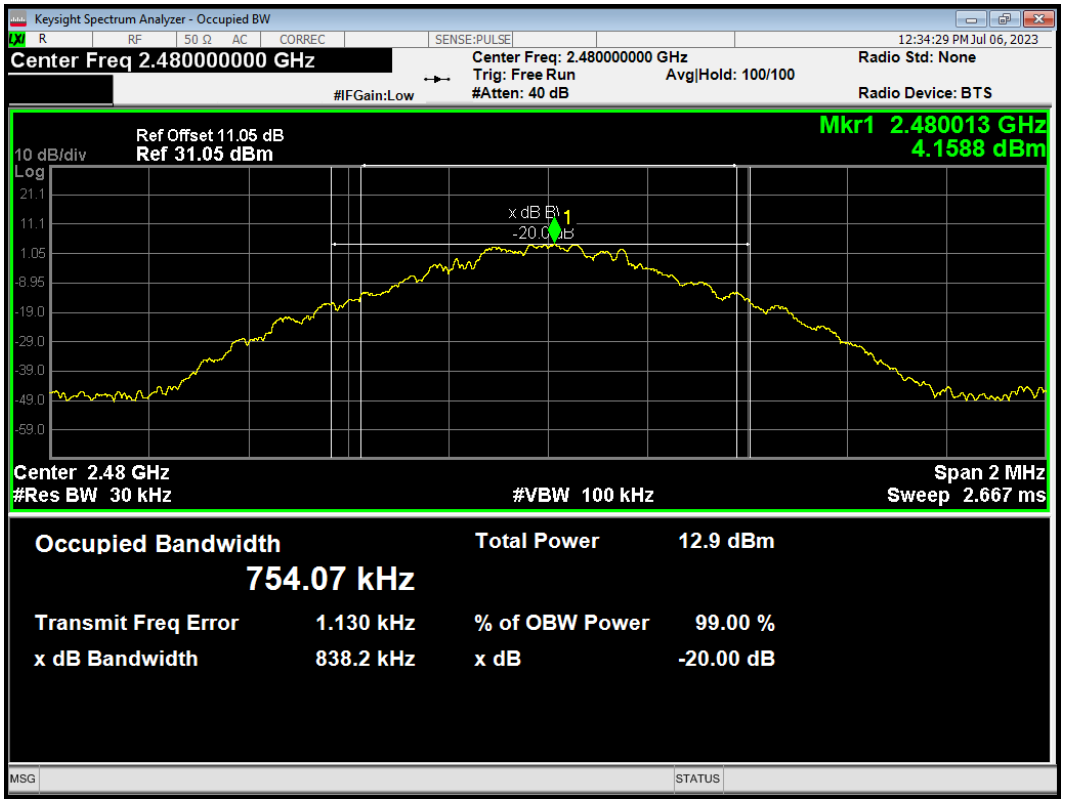


-20dB Bandwidth 1-DH5 2441MHz

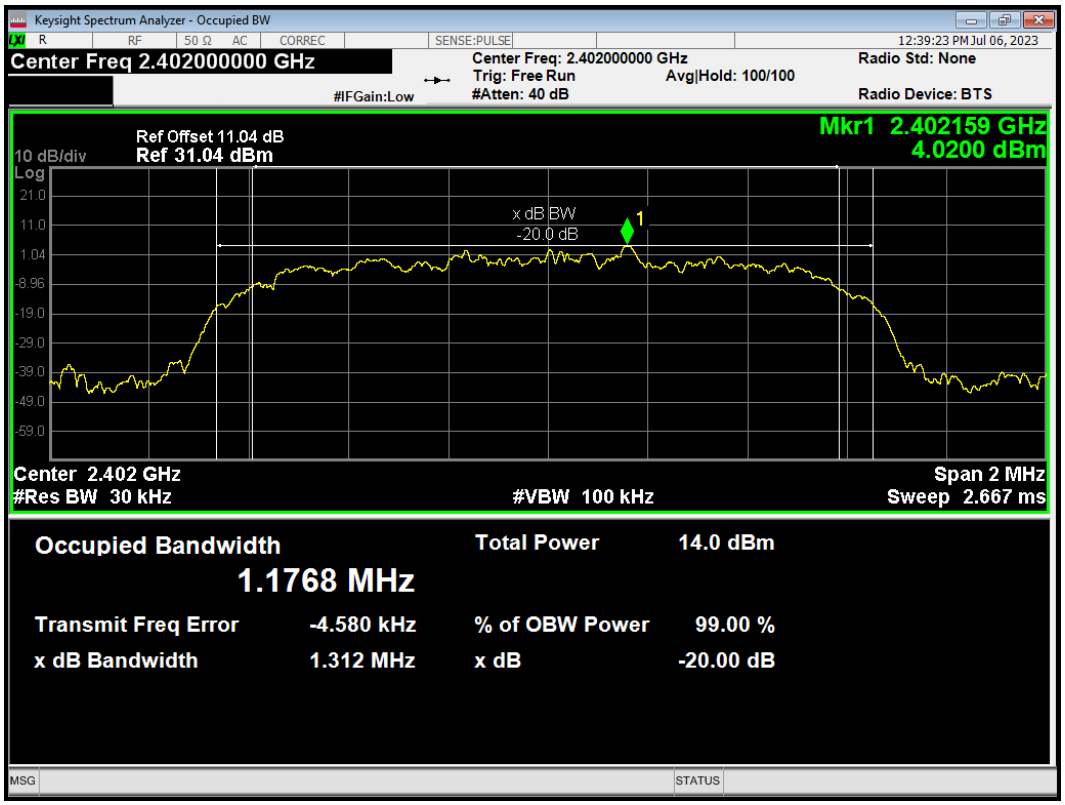


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

-20dB Bandwidth 1-DH5 2480MHz

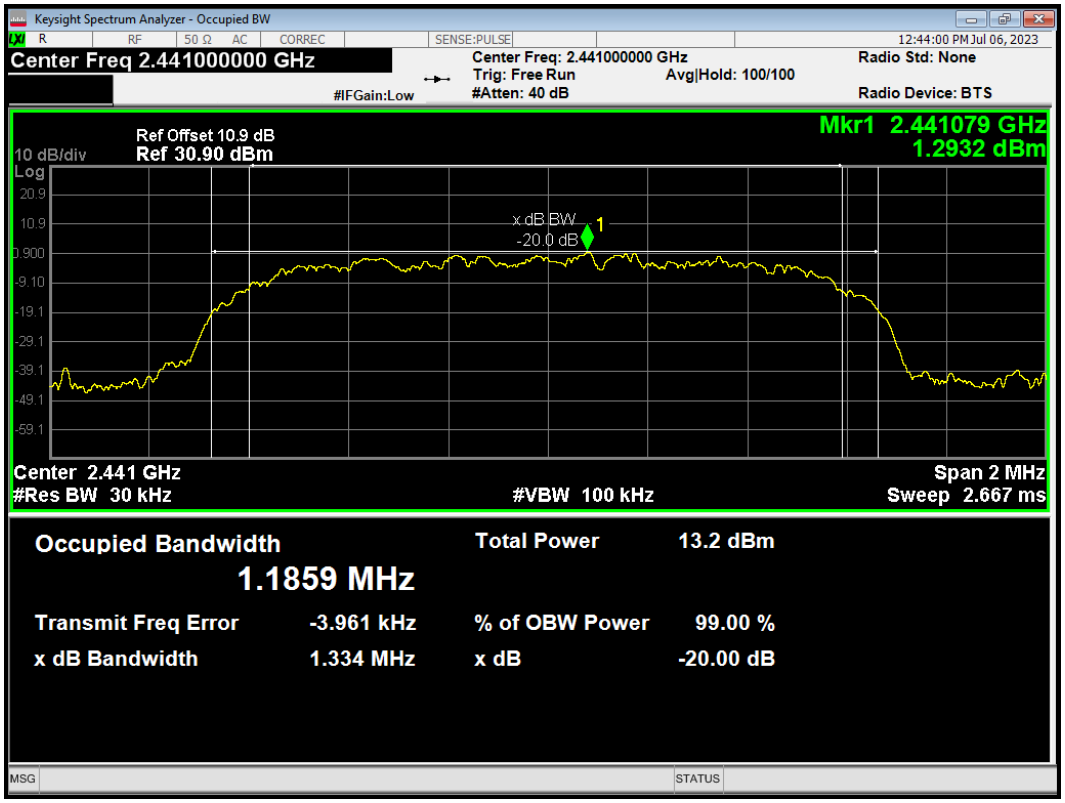


-20dB Bandwidth 2-DH5 2402MHz

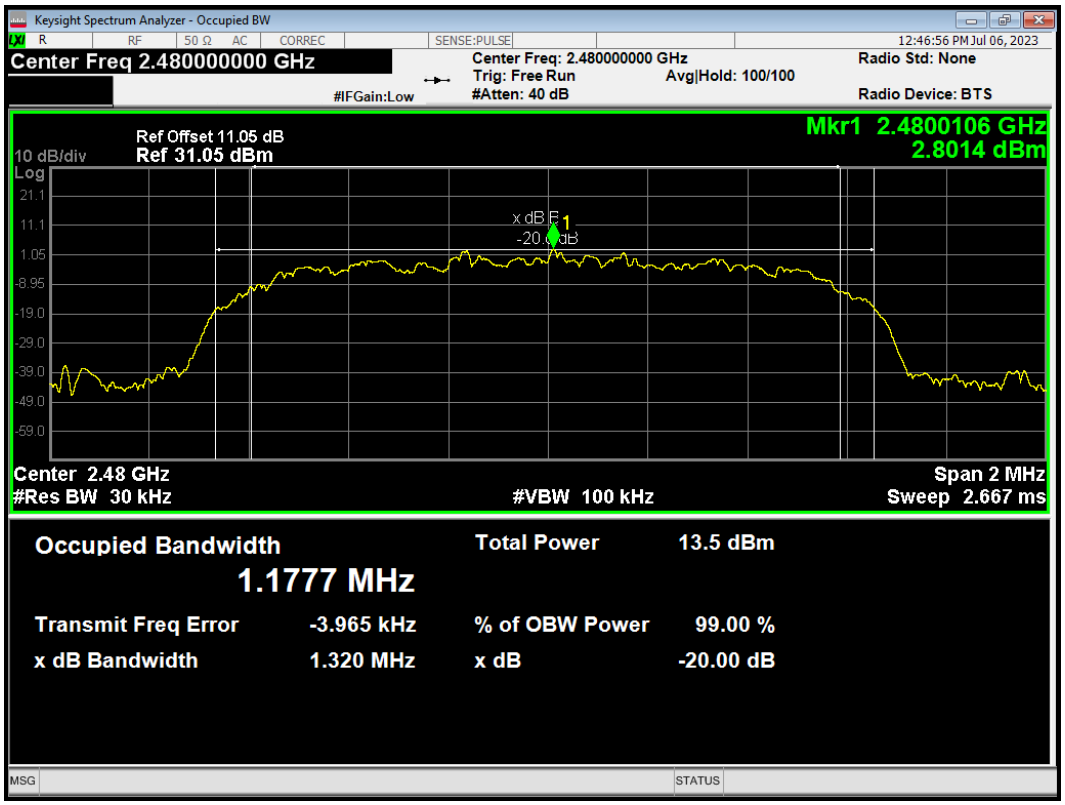


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

-20dB Bandwidth 2-DH5 2441MHz

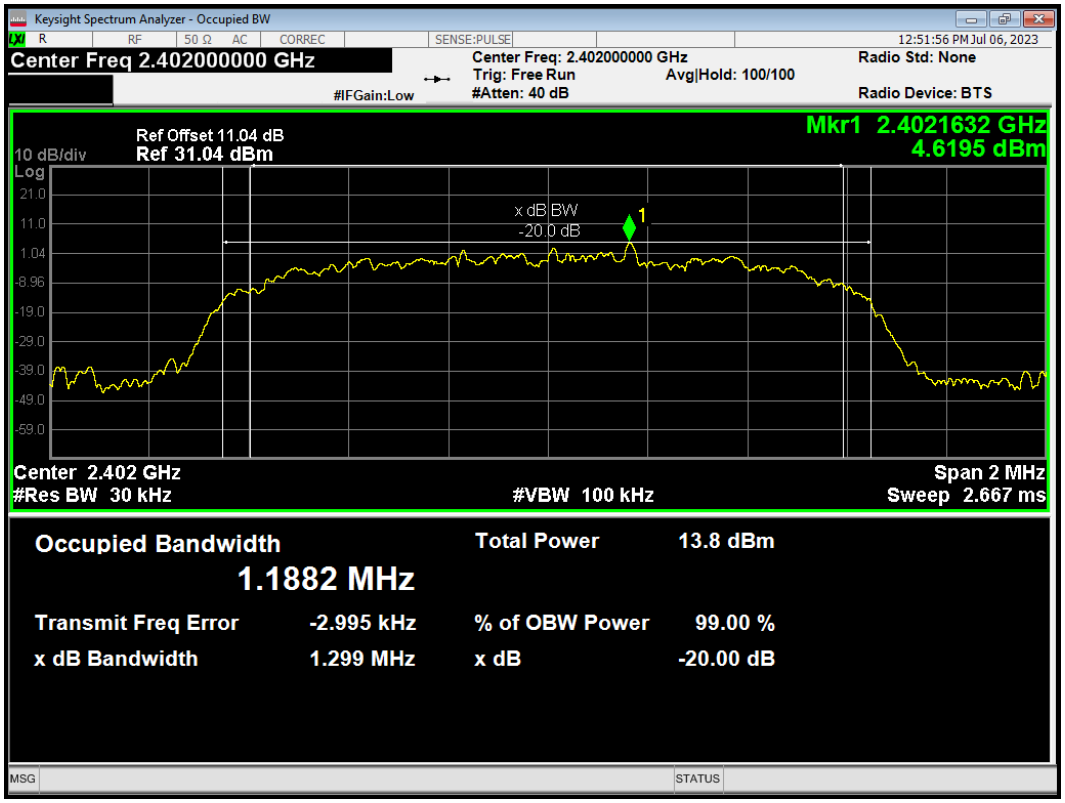


-20dB Bandwidth 2-DH5 2480MHz

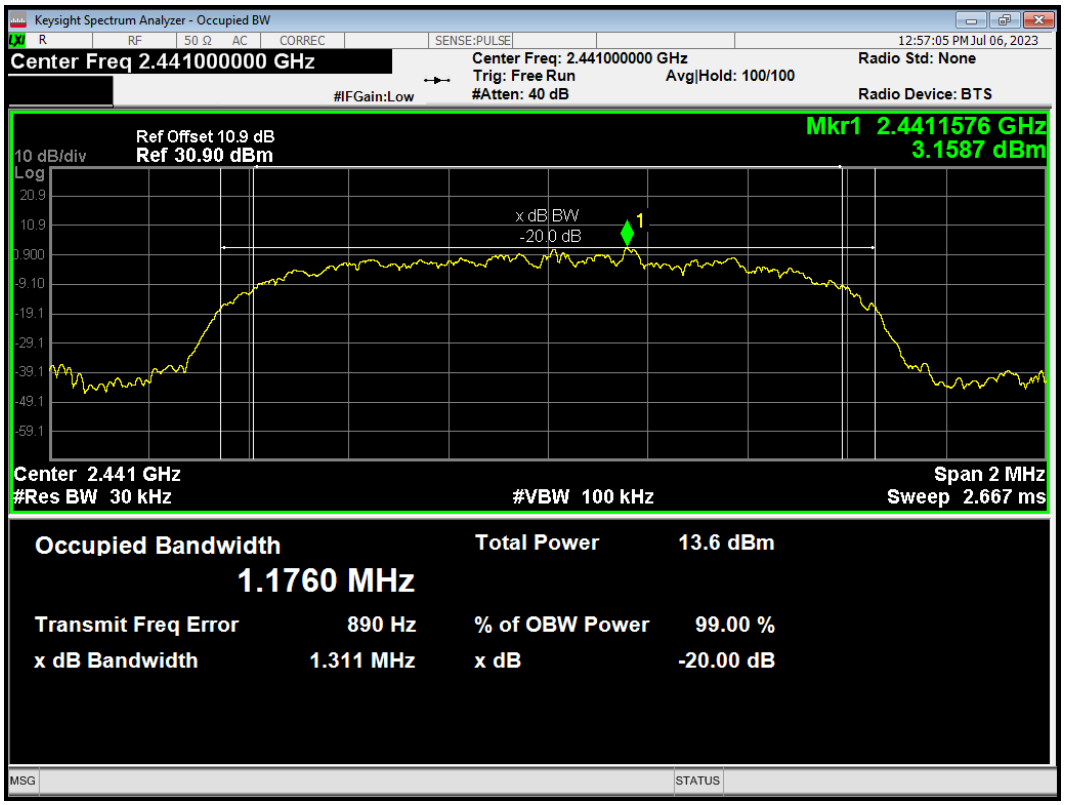


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

-20dB Bandwidth 3-DH5 2402MHz

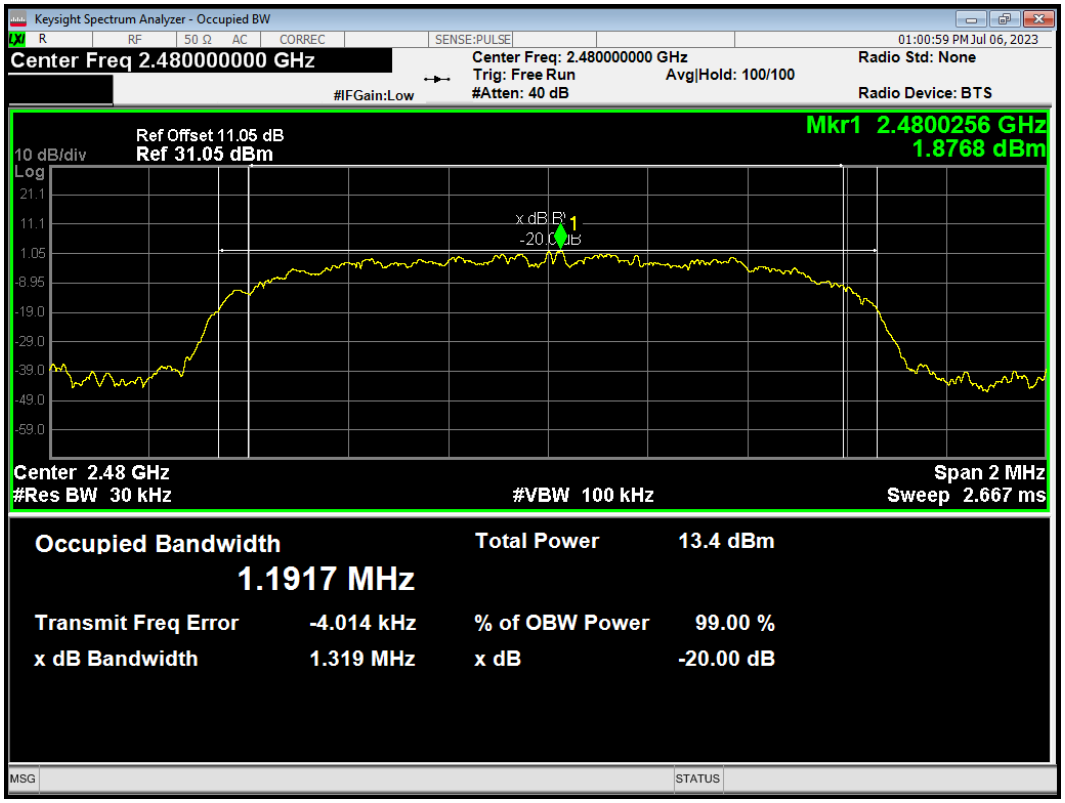


-20dB Bandwidth 3-DH5 2441MHz



This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

-20dB Bandwidth 3-DH5 2480MHz



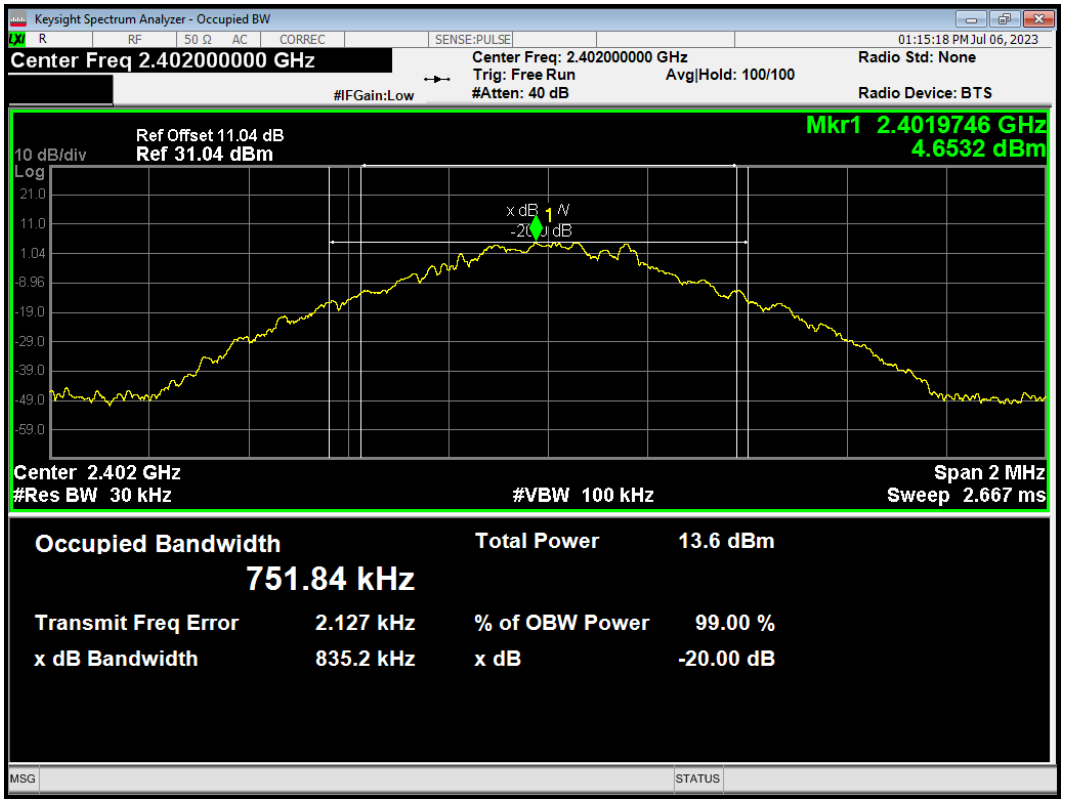
This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

External Antenna

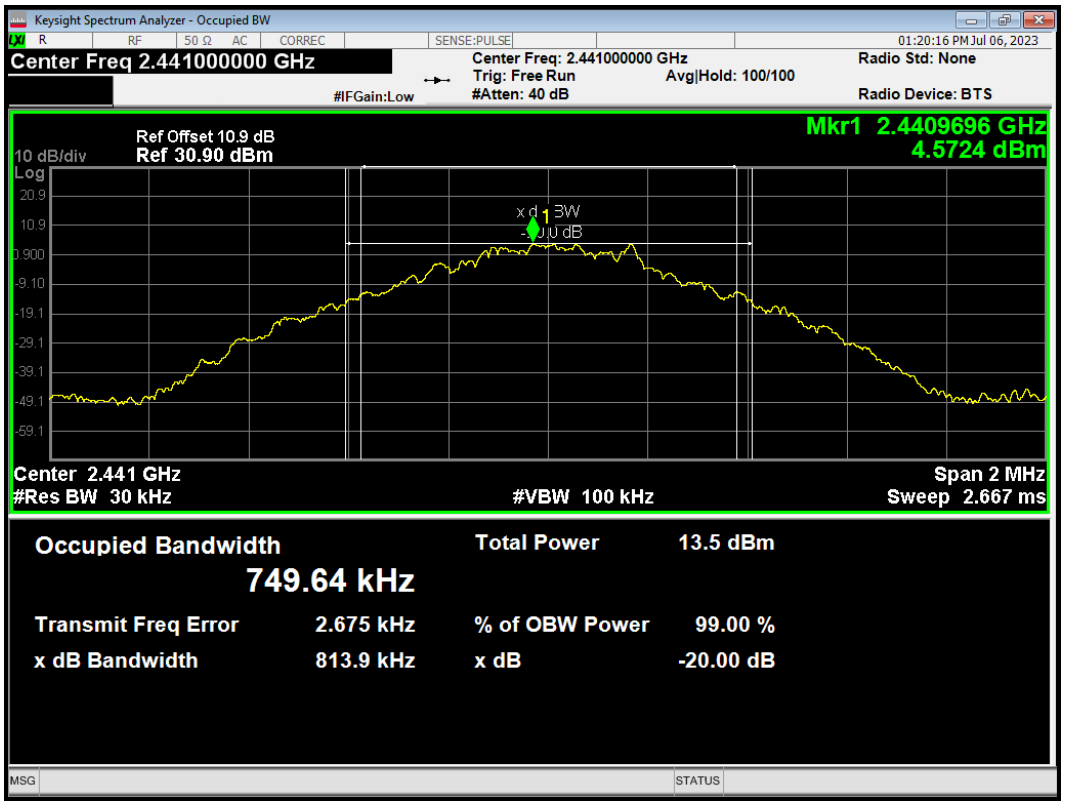
Test Mode		Channel	Frequency (MHz)	99% bandwidth(MHz)	20dB Bandwidth(MHz)
BT	DH5	0	2402	0.752	0.835
		39	2441	0.750	0.814
		78	2480	0.752	0.835
	2DH5	0	2402	1.177	1.320
		39	2441	1.184	1.318
		78	2480	1.178	1.309
	3DH5	0	2402	1.187	1.313
		39	2441	1.192	1.315
		78	2480	1.181	1.297

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

-20dB Bandwidth 1-DH5 2402MHz

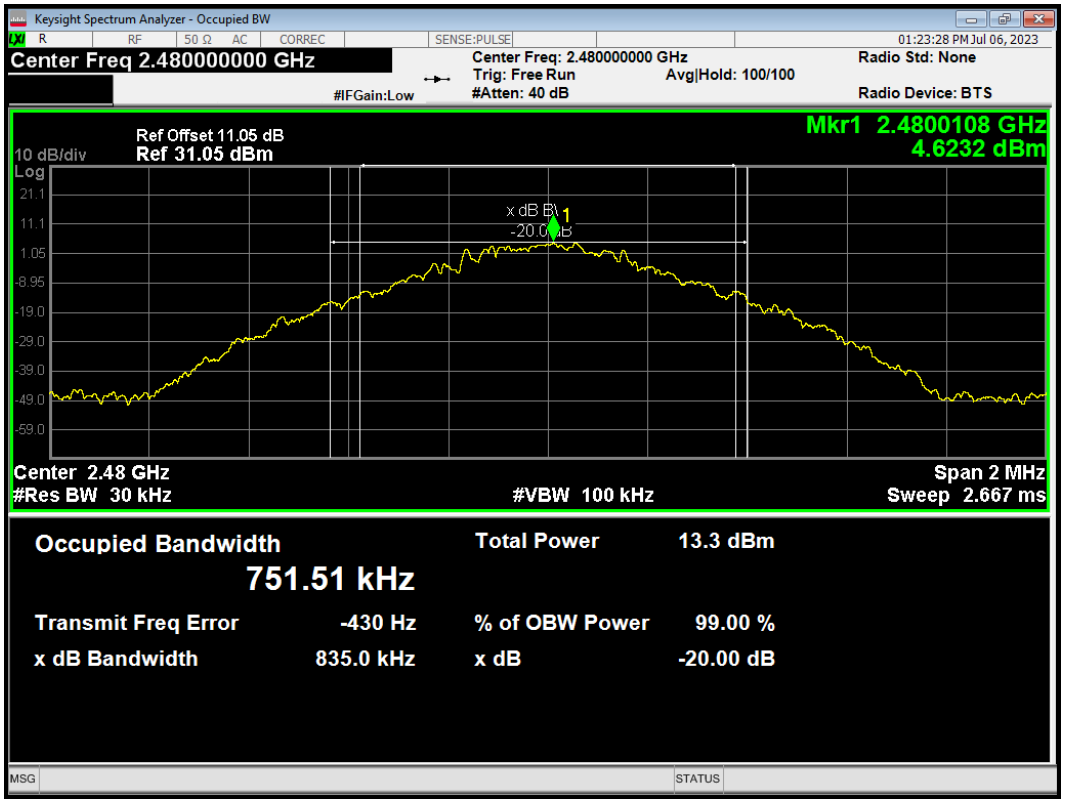


-20dB Bandwidth 1-DH5 2441MHz

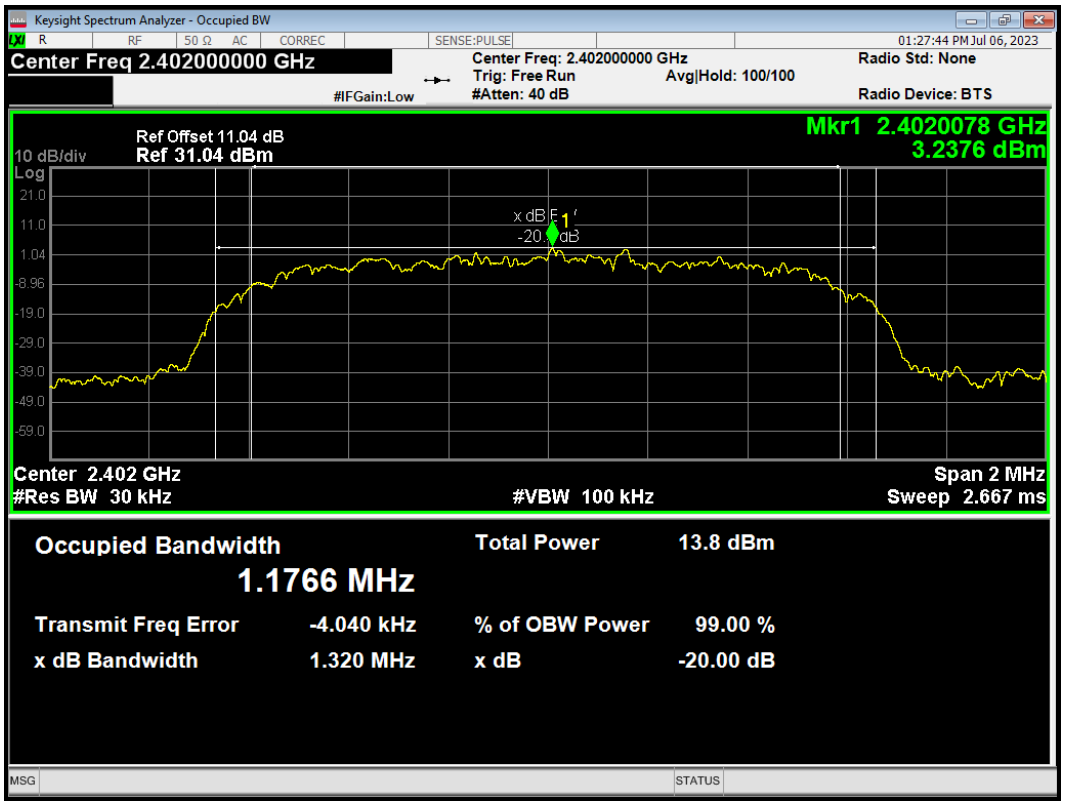


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

-20dB Bandwidth 1-DH5 2480MHz

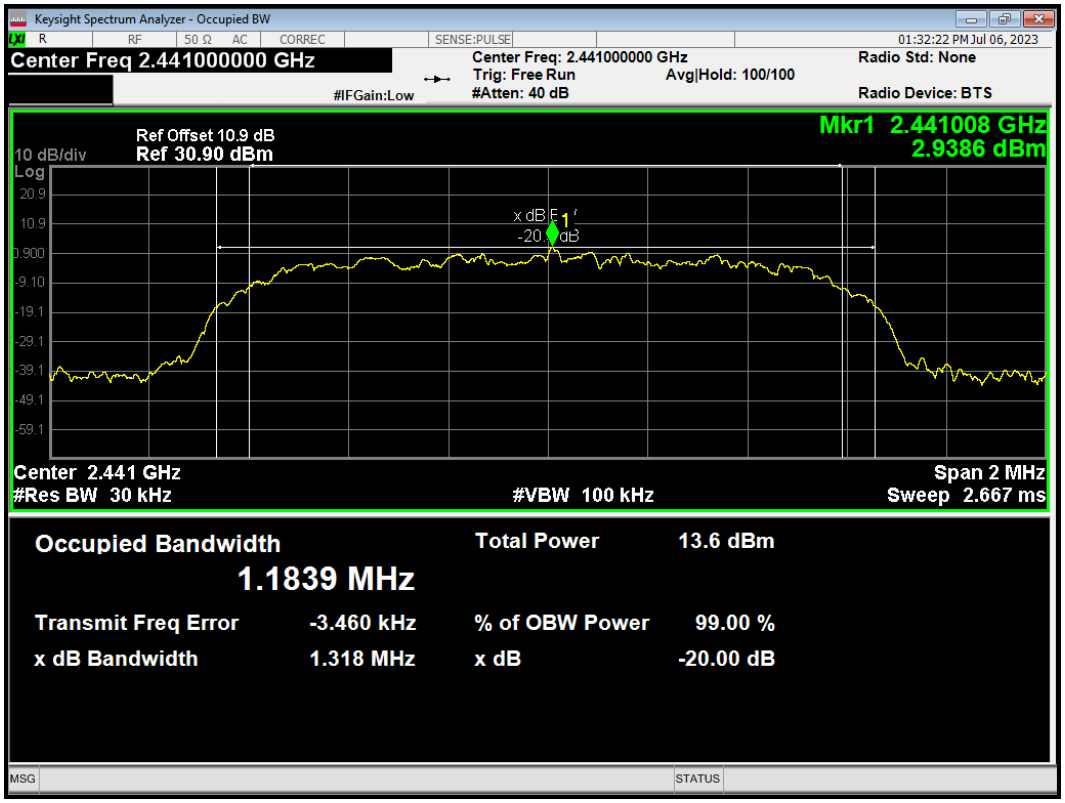


-20dB Bandwidth 2-DH5 2402MHz

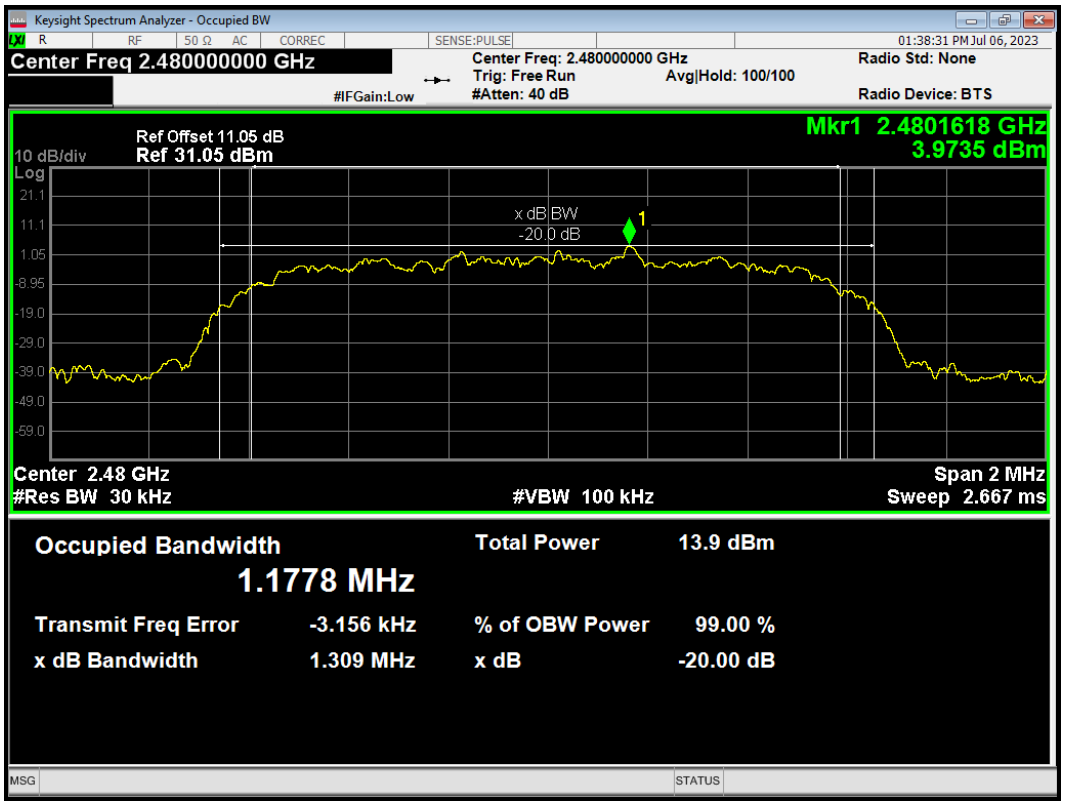


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

-20dB Bandwidth 2-DH5 2441MHz

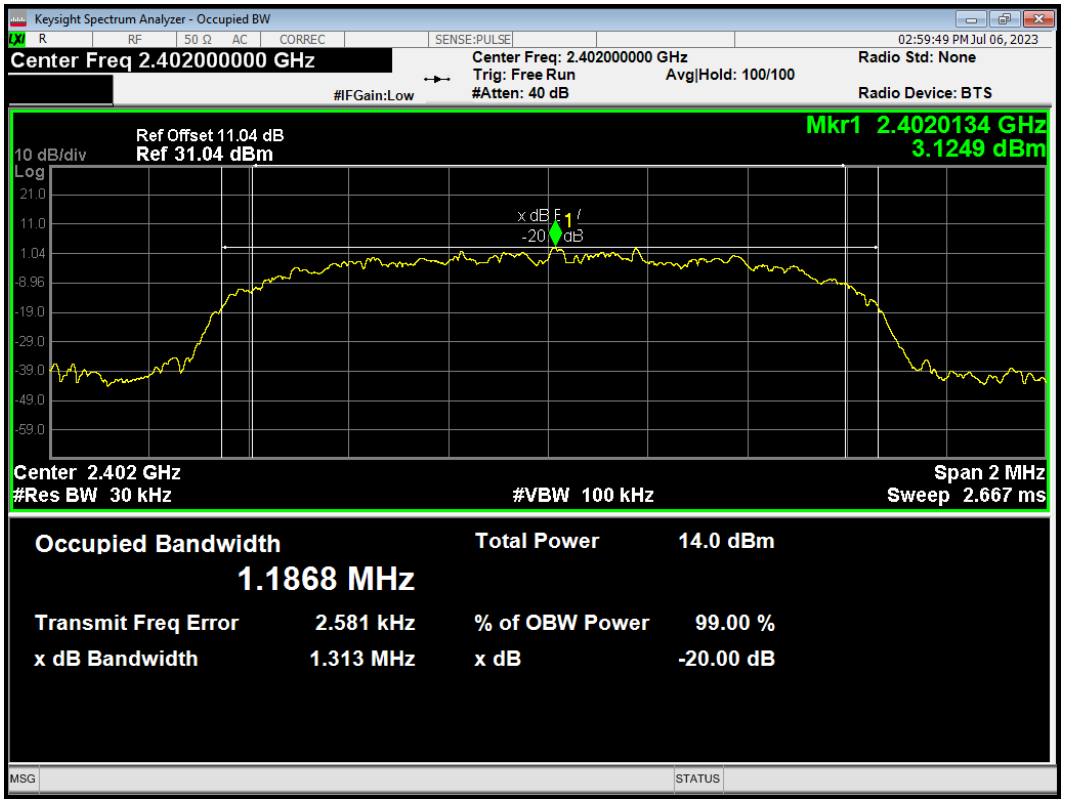


-20dB Bandwidth 2-DH5 2480MHz

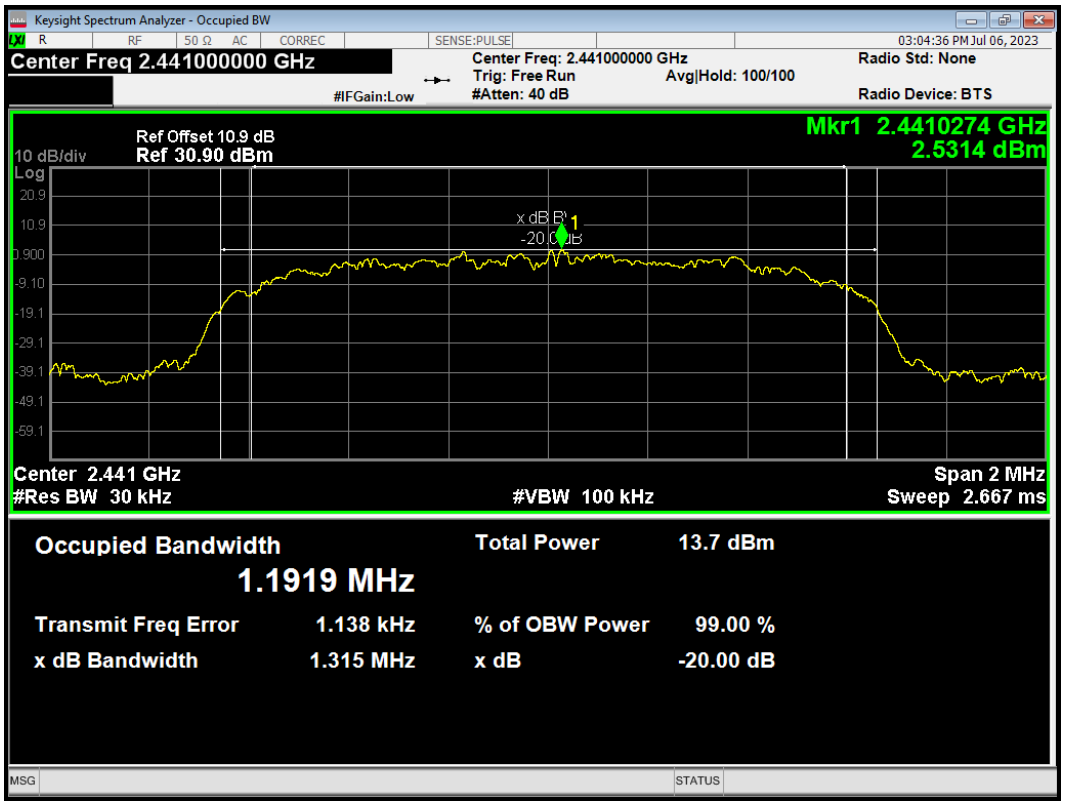


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

-20dB Bandwidth 3-DH5 2402MHz

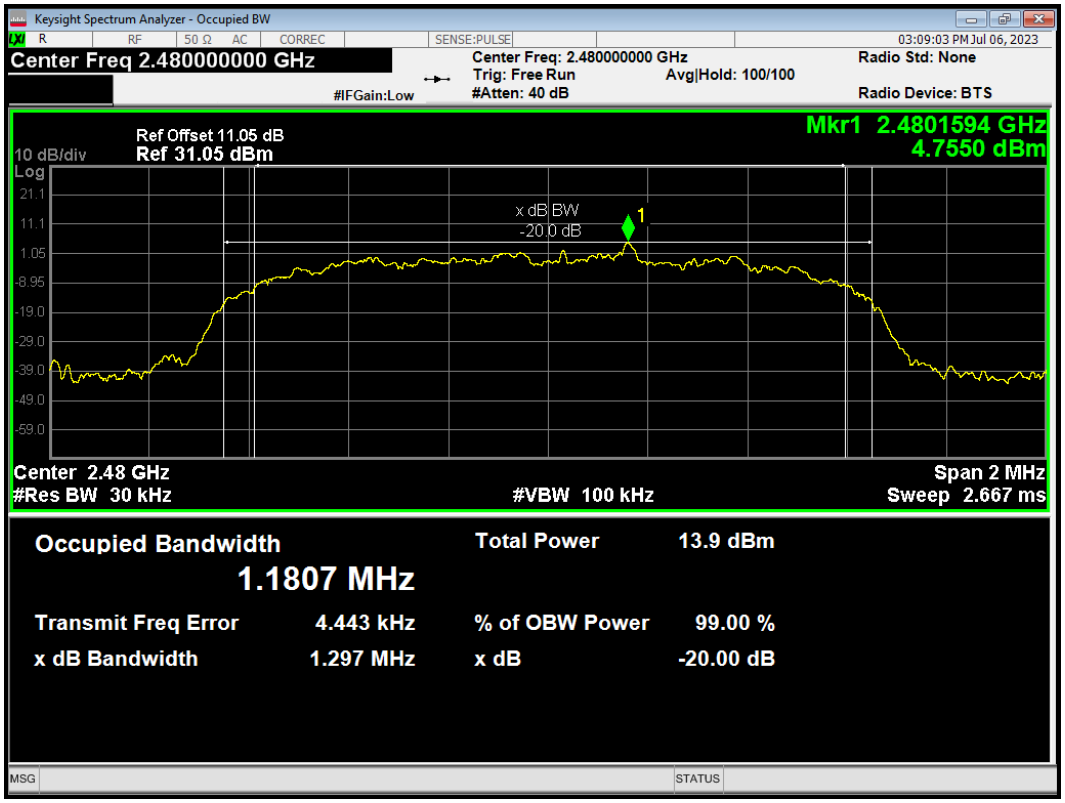


-20dB Bandwidth 3-DH5 2441MHz



This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

-20dB Bandwidth 3-DH5 2480MHz



This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

5.3 Frequency Separation

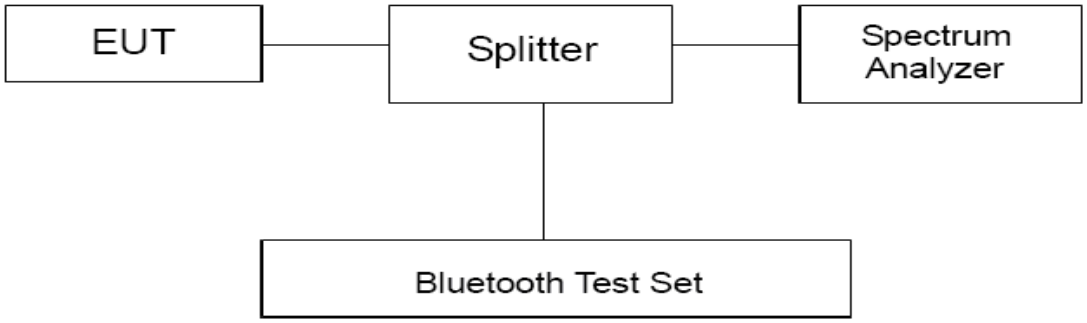
Ambient condition

Temperature	Relative humidity
20°C ~ 25°C	45% ~ 50%

Method of Measurement

The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. RBW is set to 30 kHz and VBW is set to 100 kHz on spectrum analyzer. Set EUT on Hopping on mode.

Test setup



Limits

Rule Part 15.247(a)(1)specifies that “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. ”

Note: The value of two-thirds of 20 dB bandwidth is always greater than 25 kHz.

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U=936 Hz.

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

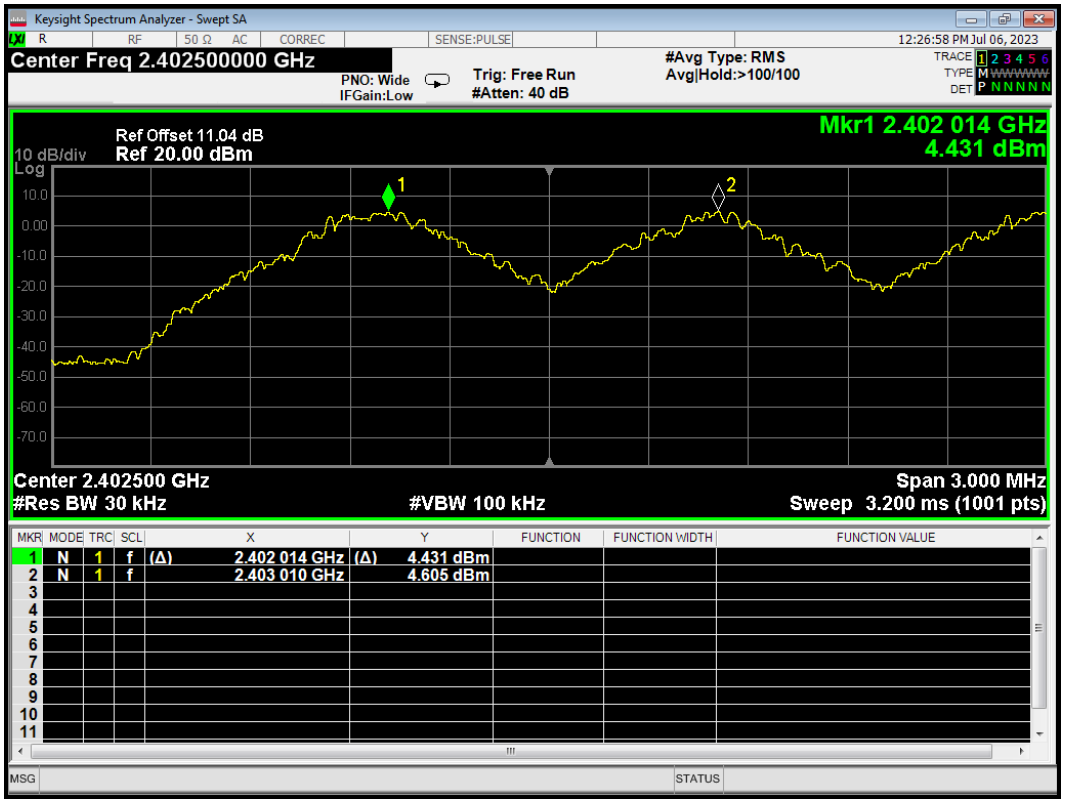
Test Results:

Internal Antenna

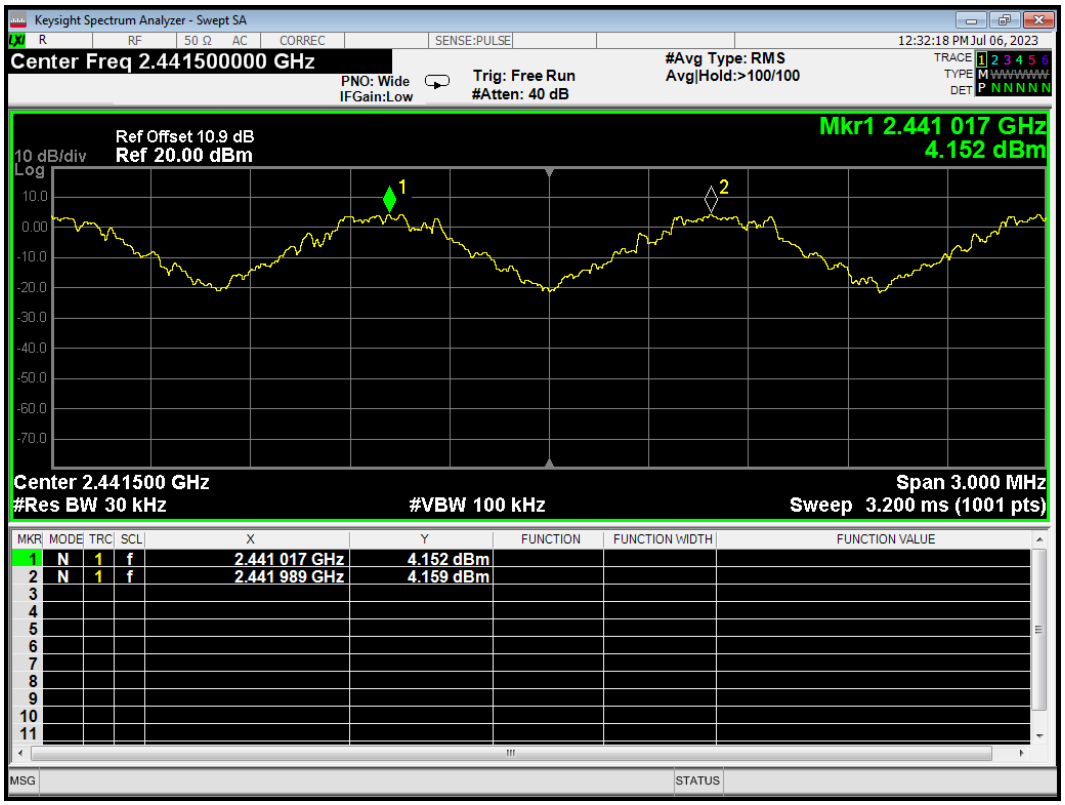
Test Mode	Carrier frequency (MHz)	Carrier frequency separation(MHz)	20dB Bandwidth(MHz)	Limit (MHz)	Conclusion
DH5	2402	1.000	0.831	0.554	PASS
	2441	0.970	0.806	0.537	PASS
	2480	1.030	0.838	0.559	PASS
2DH5	2402	0.970	1.312	0.875	PASS
	2441	1.170	1.334	0.889	PASS
	2480	1.020	1.320	0.880	PASS
3DH5	2402	1.060	1.299	0.866	PASS
	2441	0.980	1.311	0.874	PASS
	2480	0.990	1.319	0.879	PASS
Note: The limit is two-thirds of 20 dB bandwidth.					

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

CFS 1-DH5 2402MHz

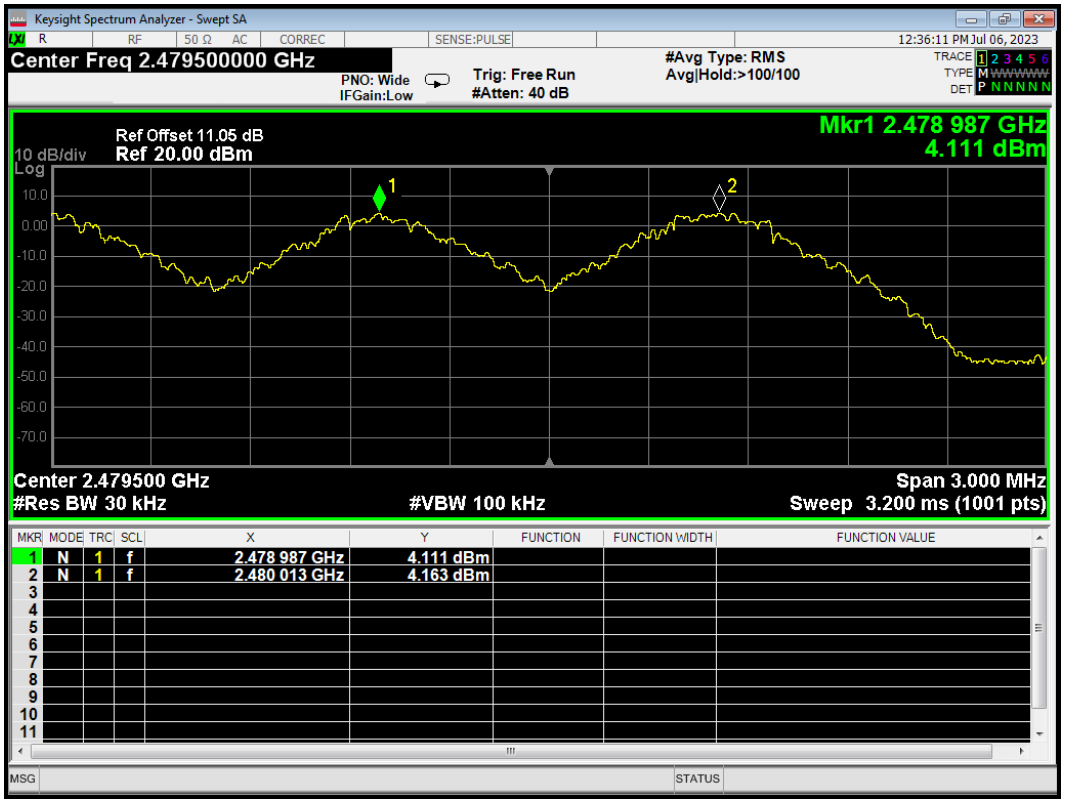


CFS 1-DH5 2441MHz

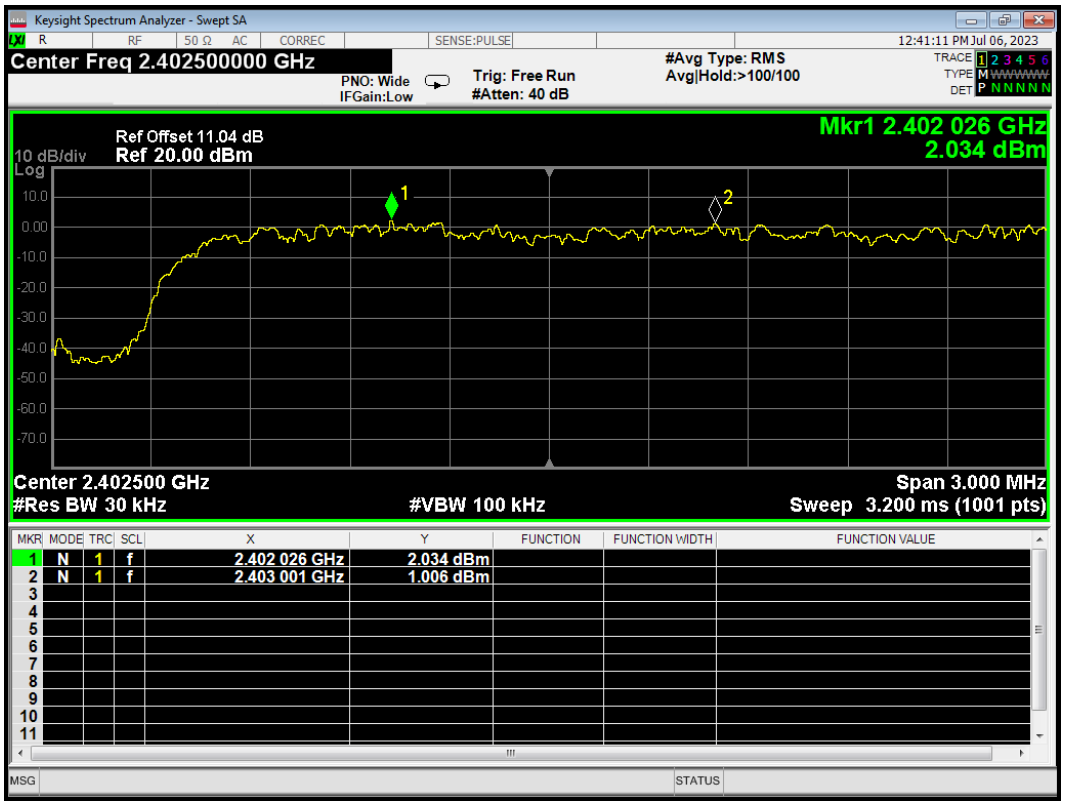


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

CFS 1-DH5 2480MHz

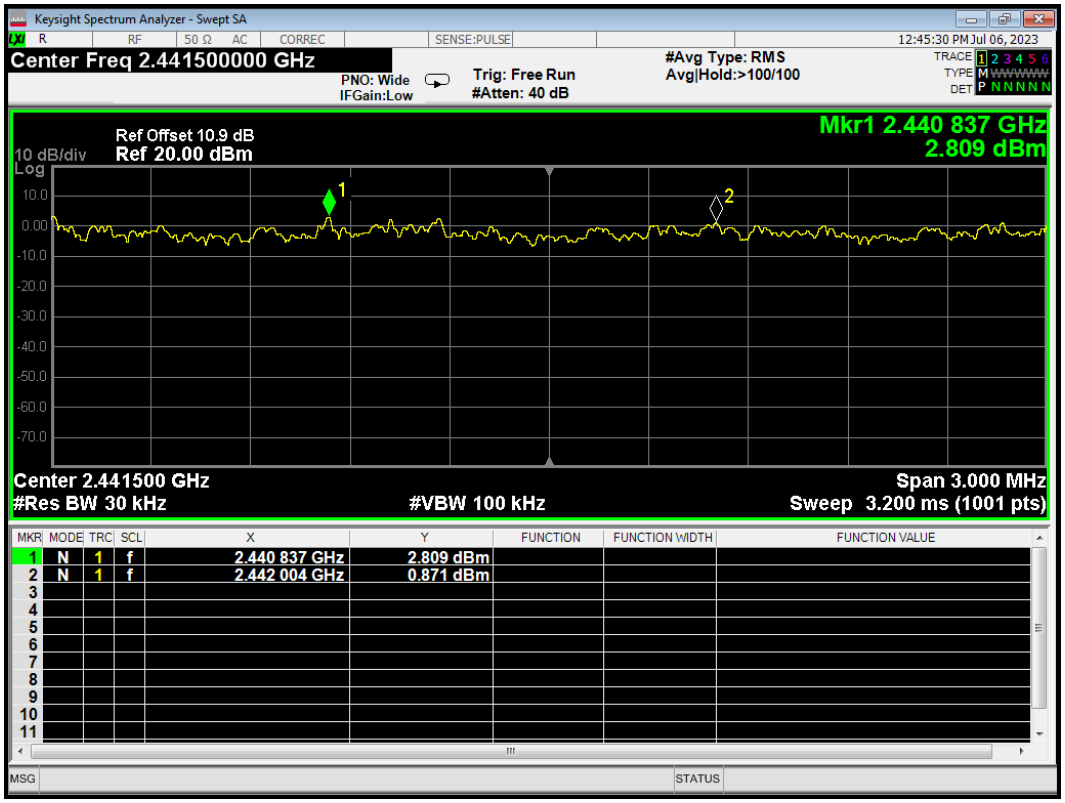


CFS 2-DH5 2402MHz

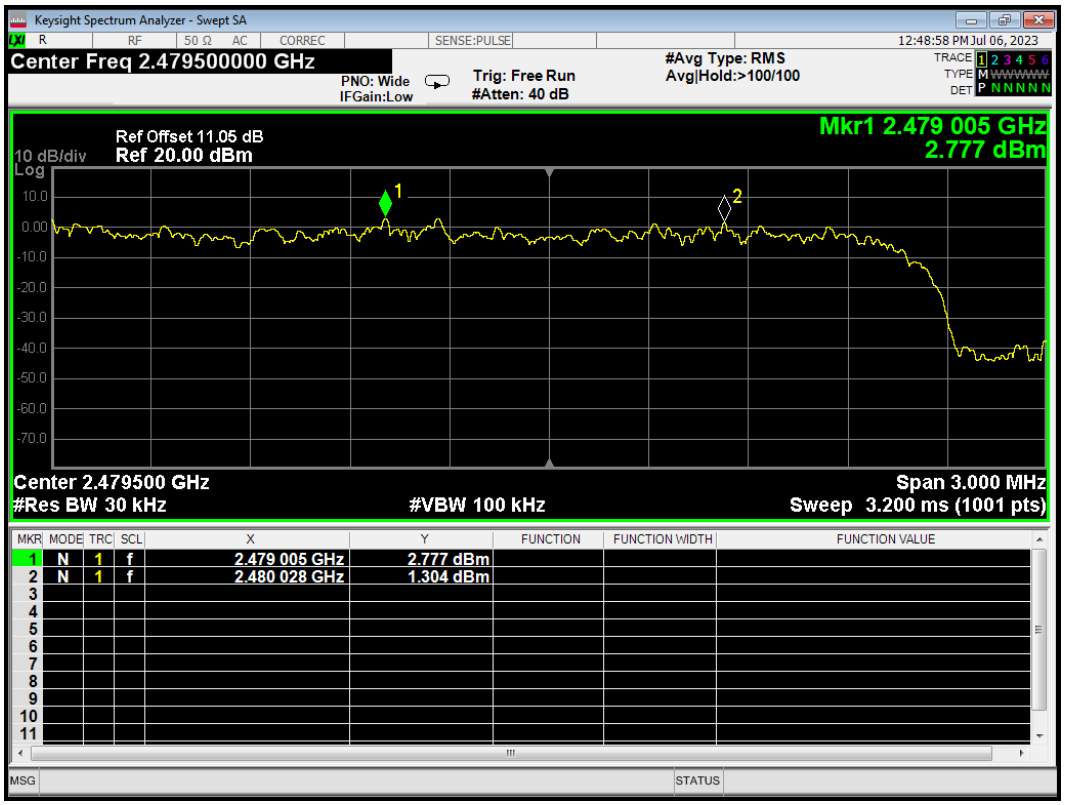


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

CFS 2-DH5 2441MHz

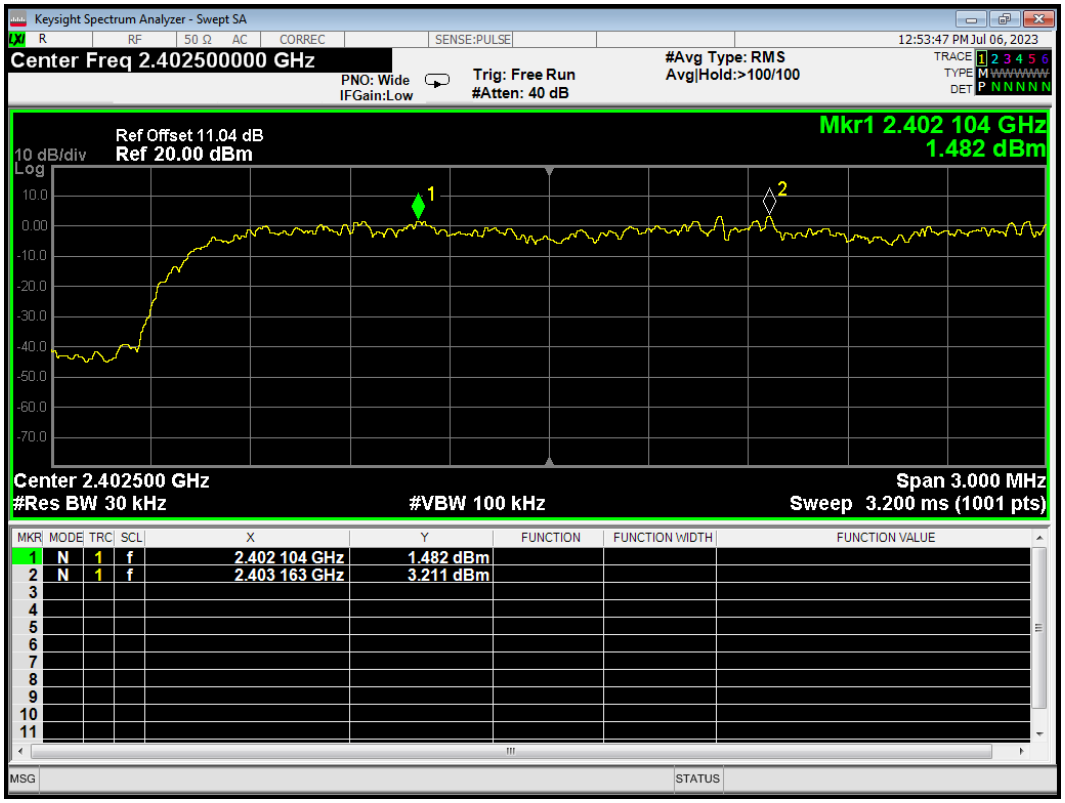


CFS 2-DH5 2480MHz

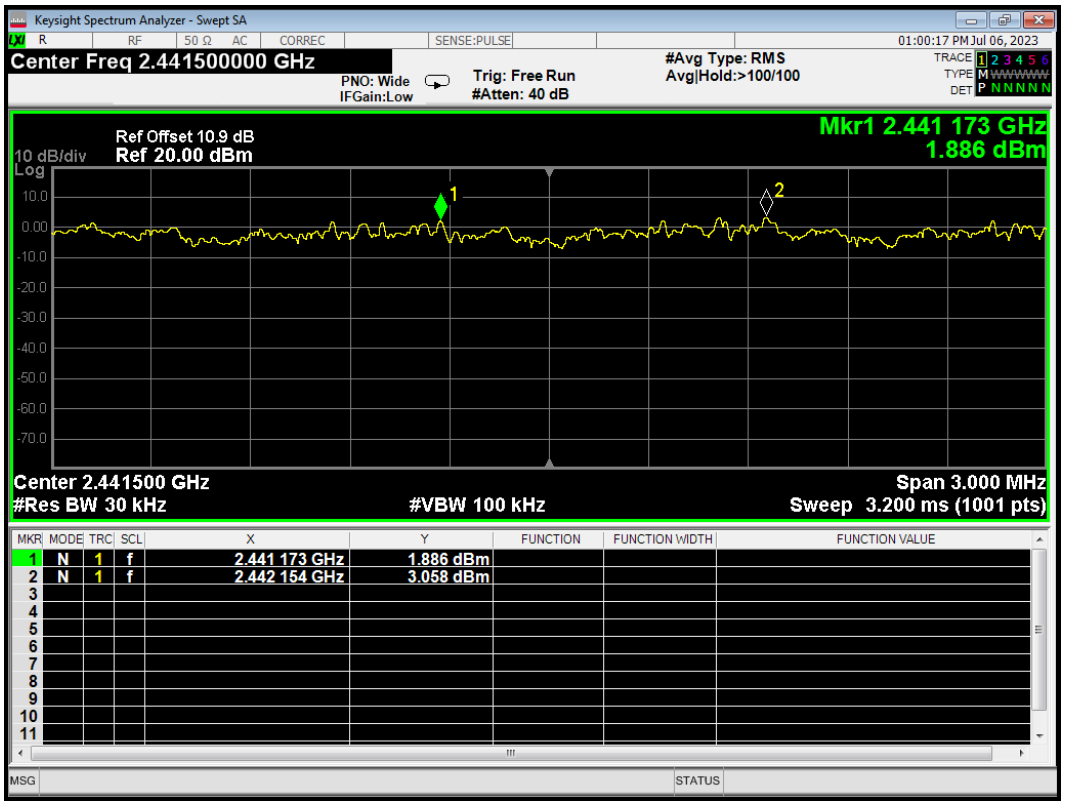


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

CFS 3-DH5 2402MHz

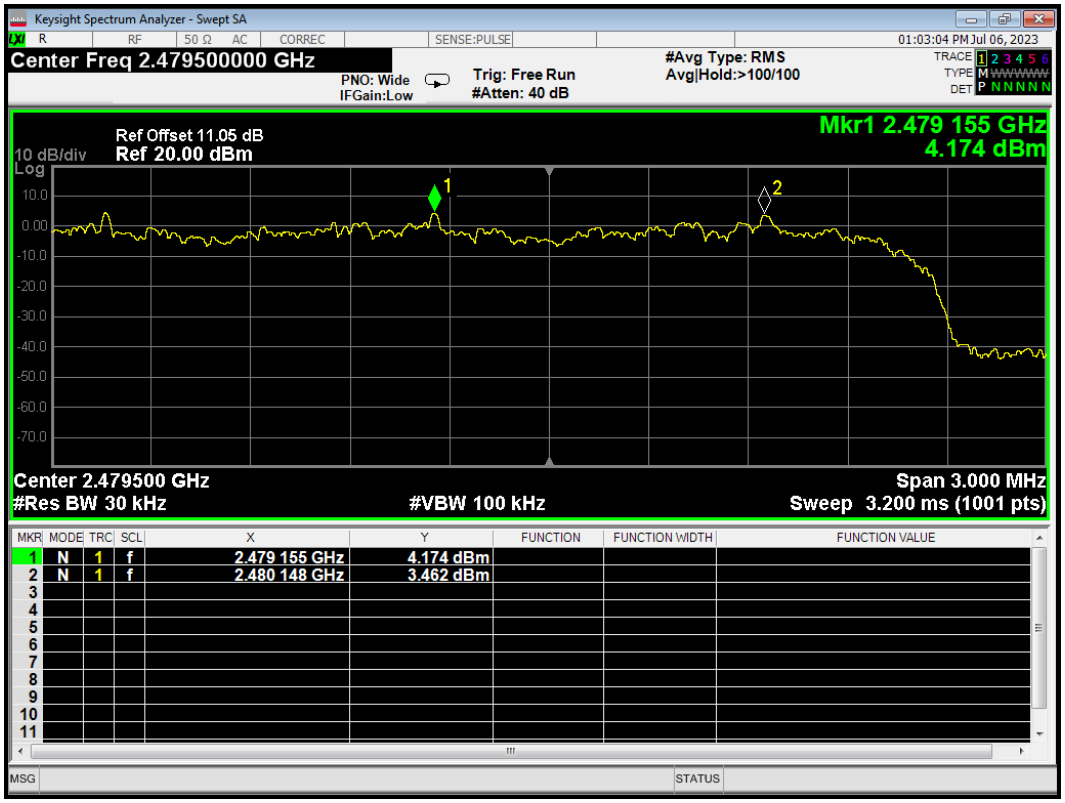


CFS 3-DH5 2441MHz



This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

CFS 3-DH5 2480MHz



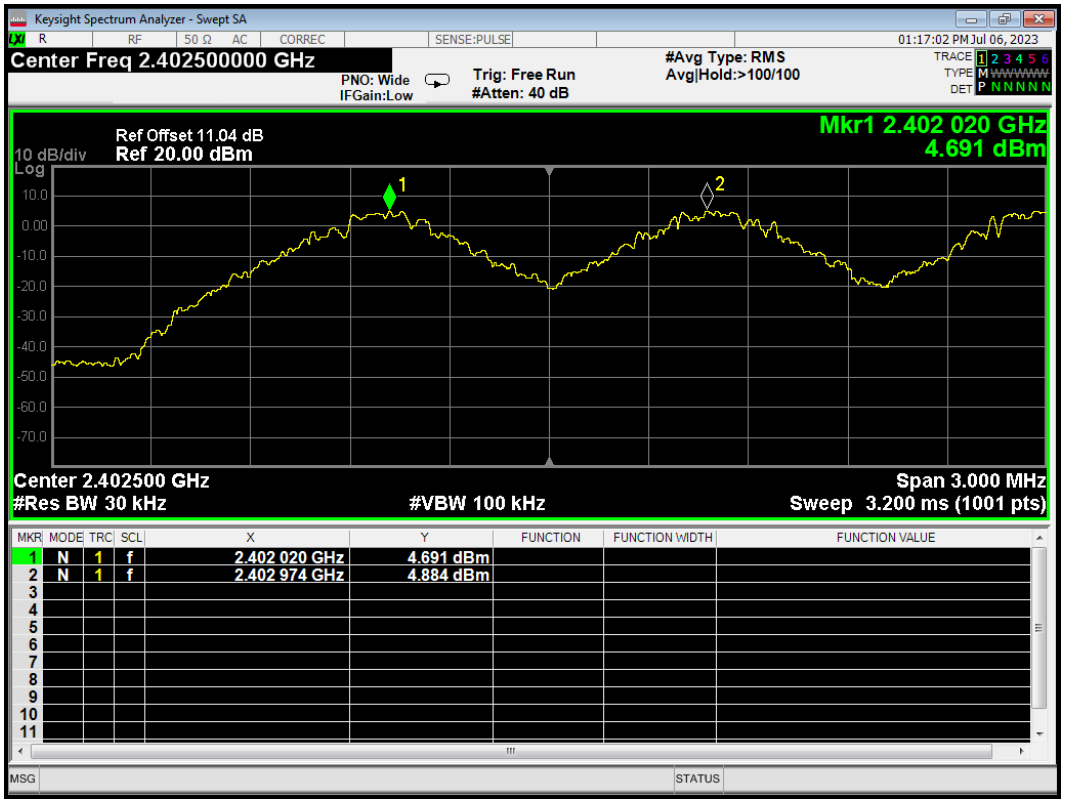
This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

External Antenna

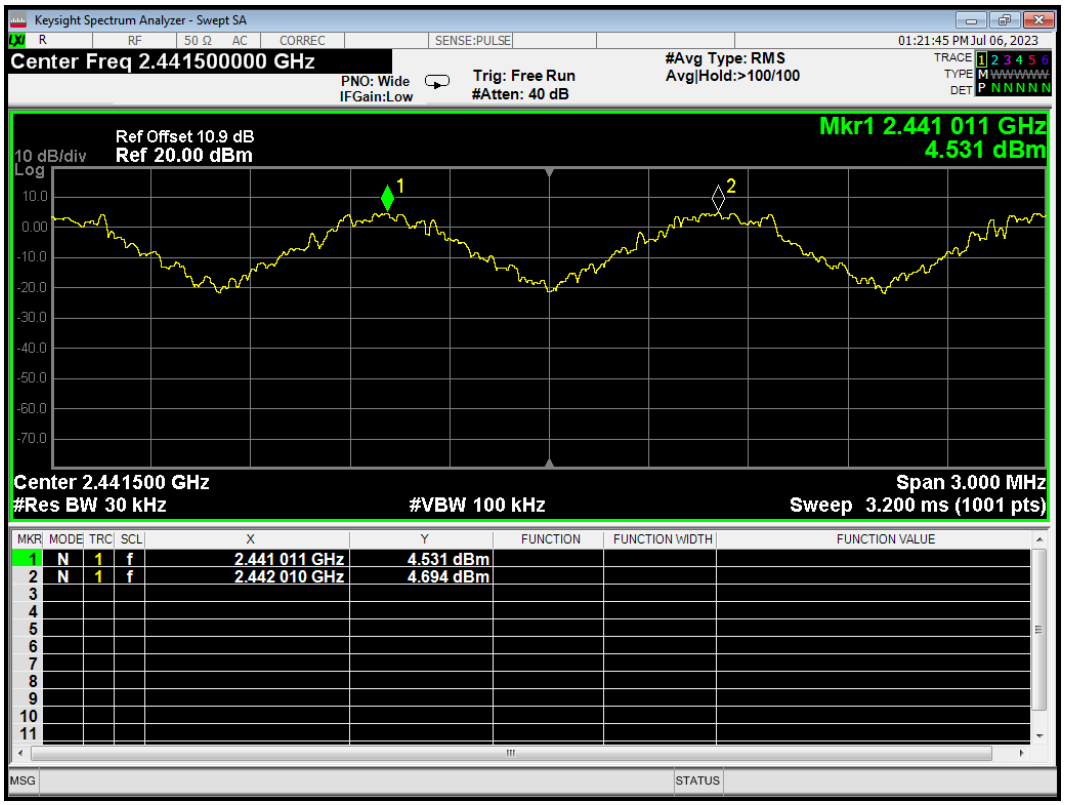
Test Mode	Carrier frequency (MHz)	Carrier frequency separation(MHz)	20dB Bandwidth(MHz)	Limit (MHz)	Conclusion
DH5	2402	0.950	0.835	0.557	PASS
	2441	1.000	0.814	0.543	PASS
	2480	1.010	0.835	0.557	PASS
2DH5	2402	0.940	1.320	0.880	PASS
	2441	0.990	1.318	0.879	PASS
	2480	1.190	1.309	0.873	PASS
3DH5	2402	0.910	1.313	0.875	PASS
	2441	0.990	1.315	0.877	PASS
	2480	1.010	1.297	0.865	PASS
Note: The limit is two-thirds of 20 dB bandwidth.					

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

CFS 1-DH5 2402MHz

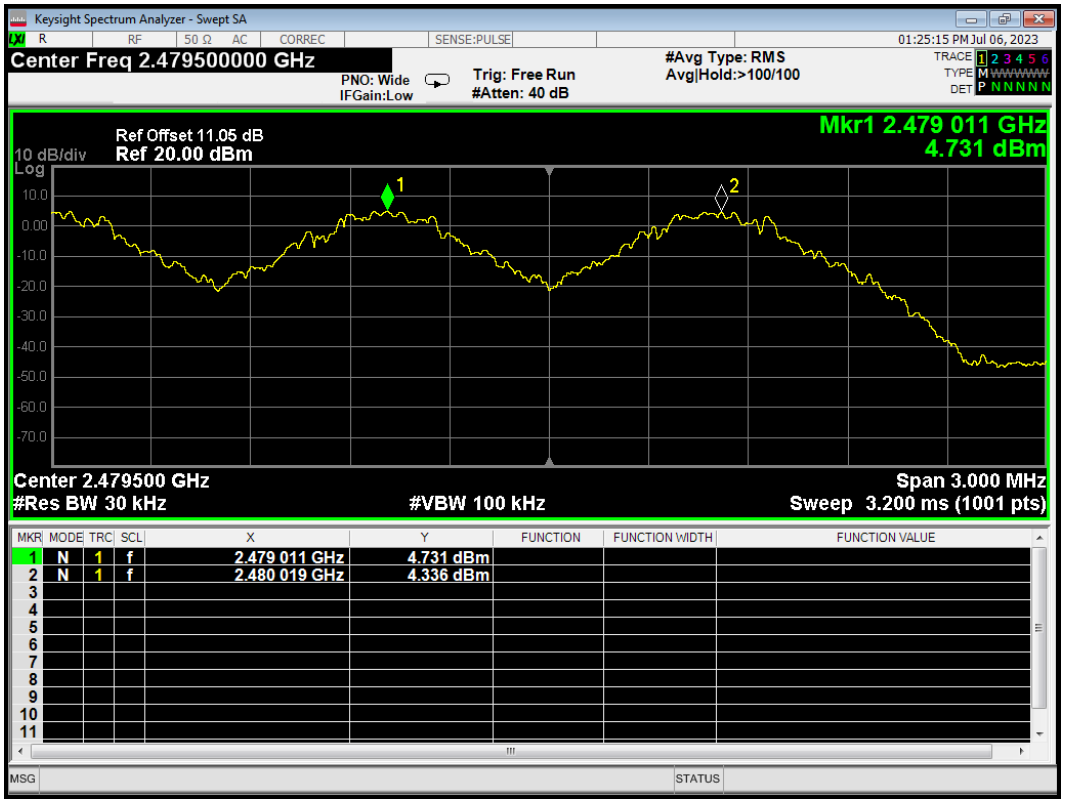


CFS 1-DH5 2441MHz

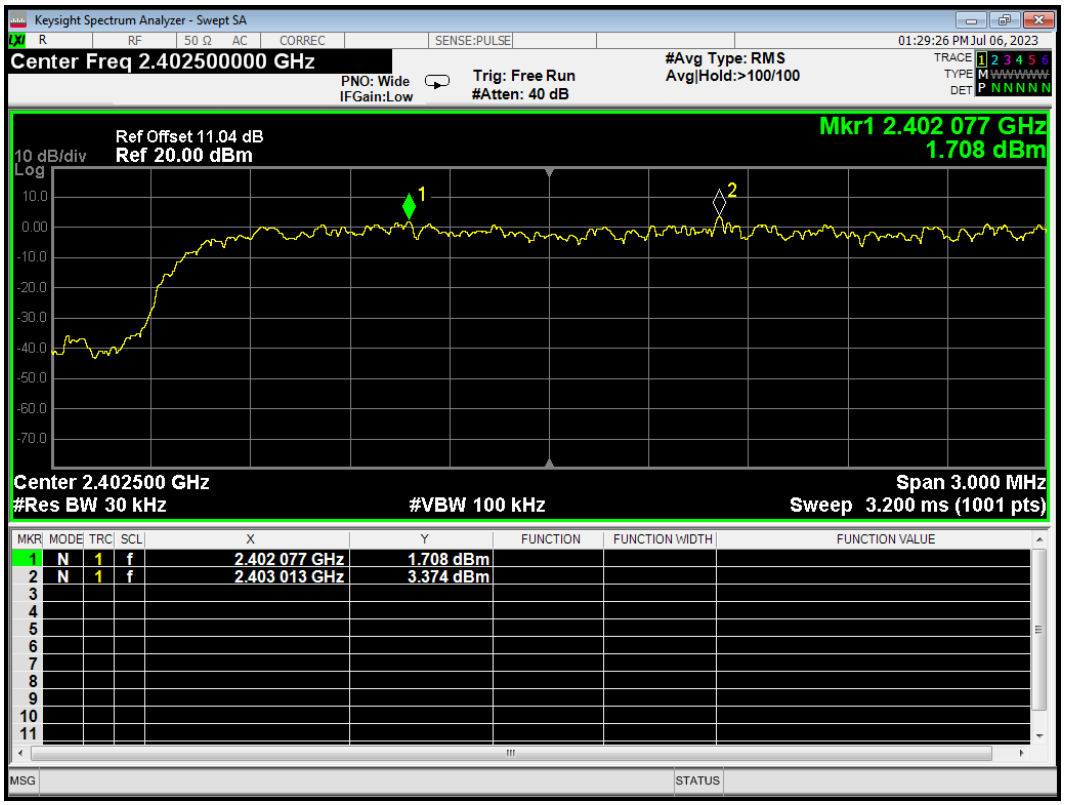


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

CFS 1-DH5 2480MHz

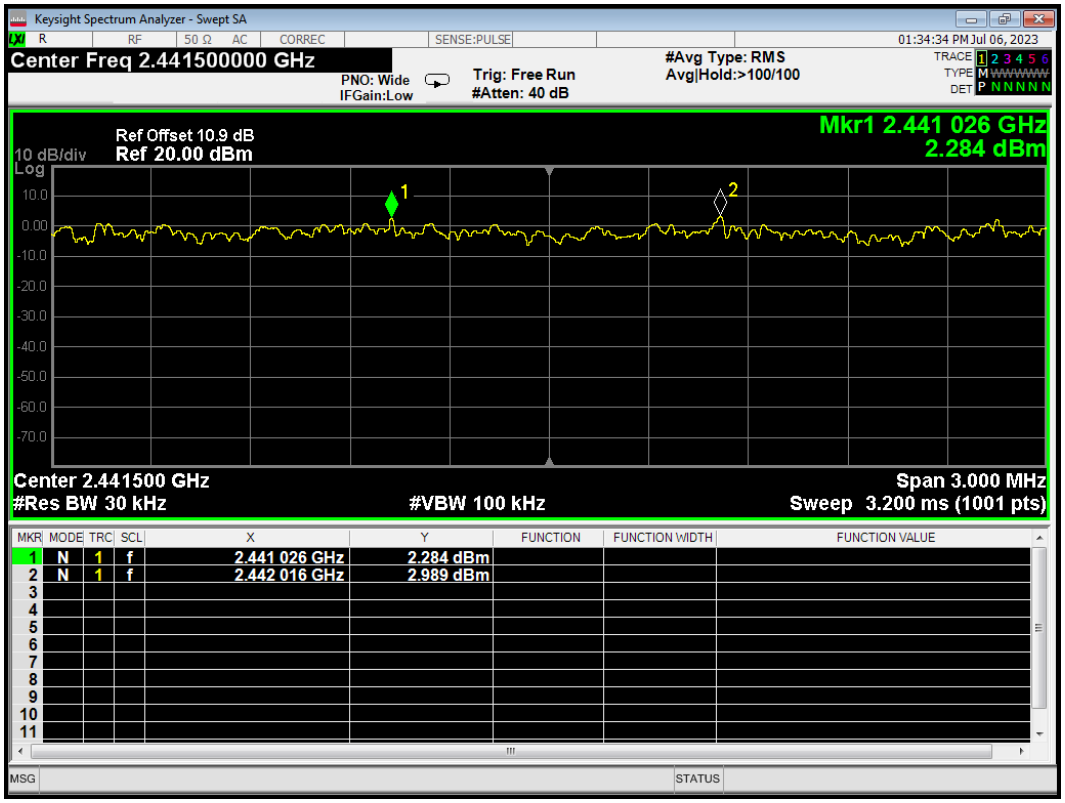


CFS 2-DH5 2402MHz

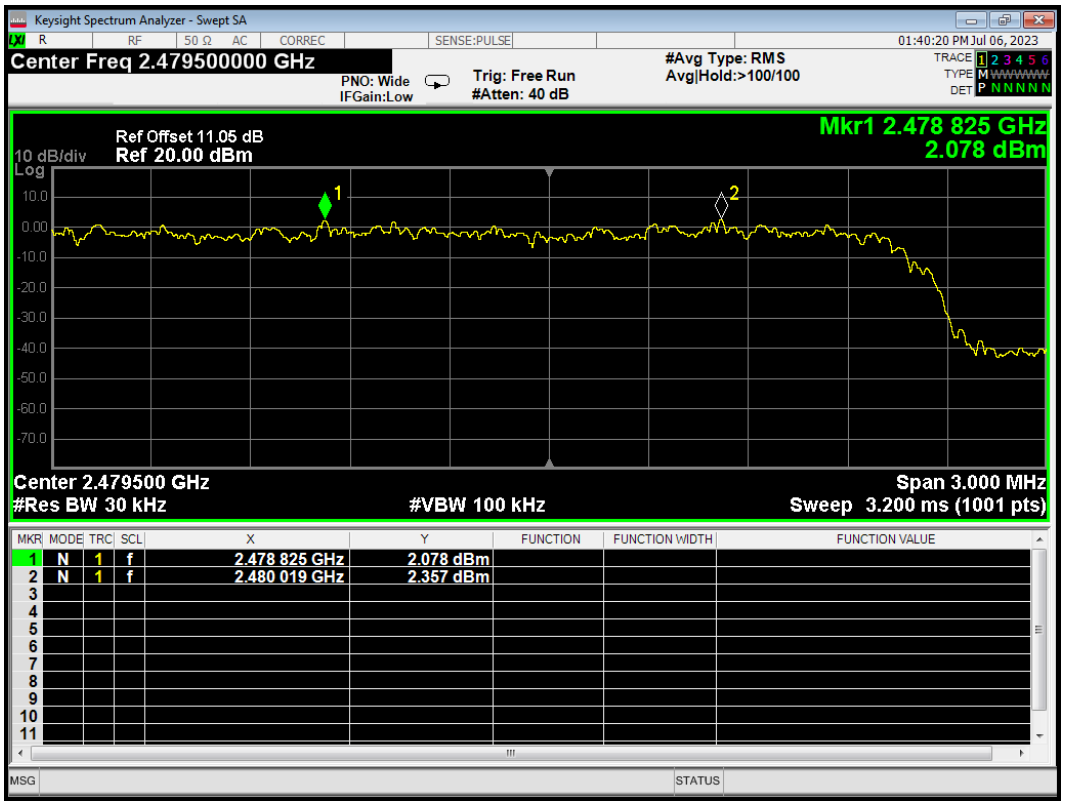


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

CFS 2-DH5 2441MHz

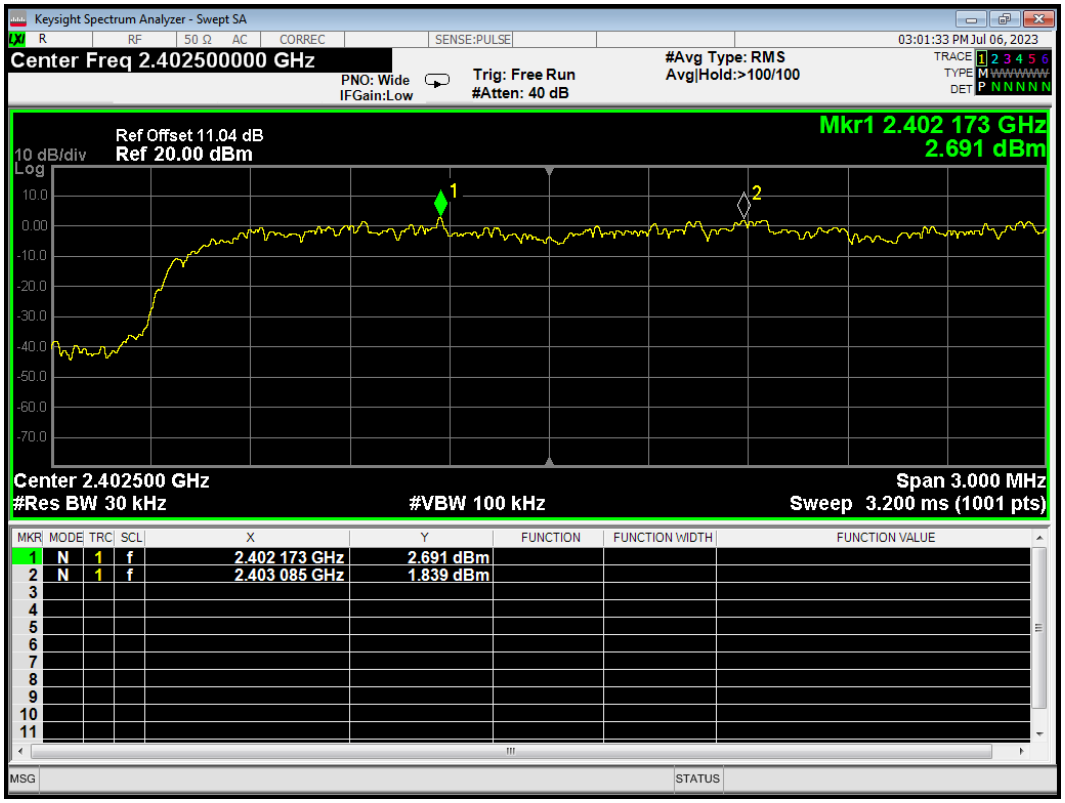


CFS 2-DH5 2480MHz

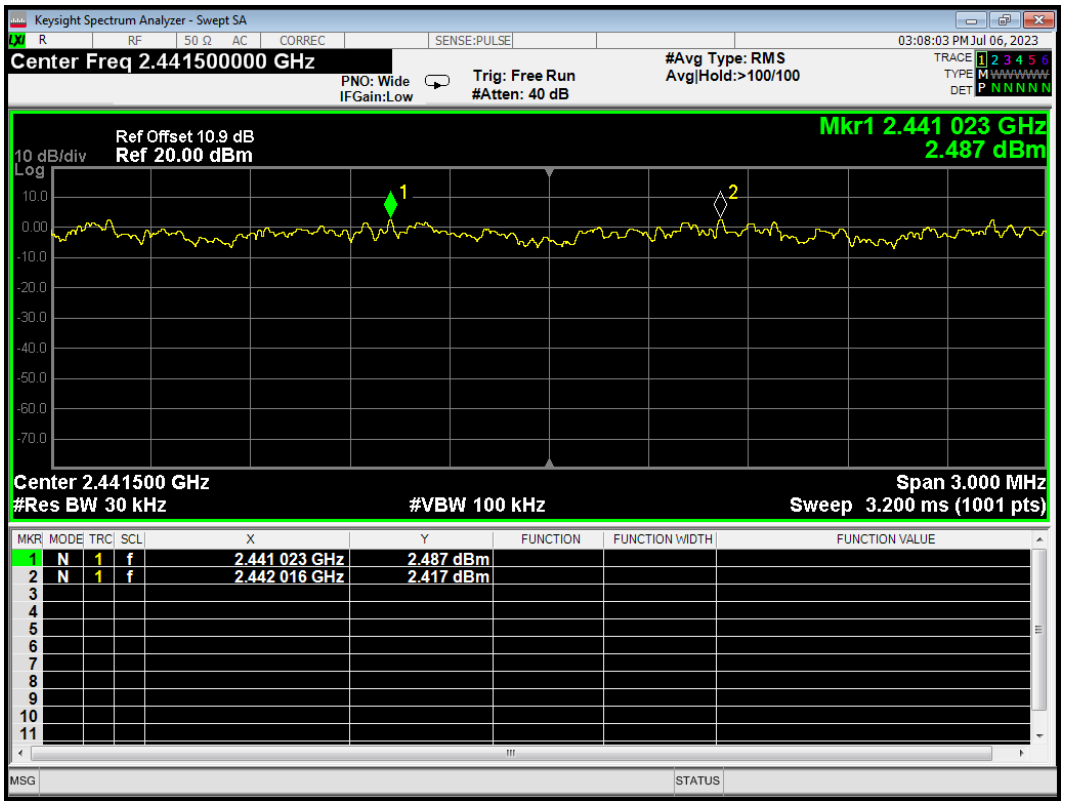


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

CFS 3-DH5 2402MHz

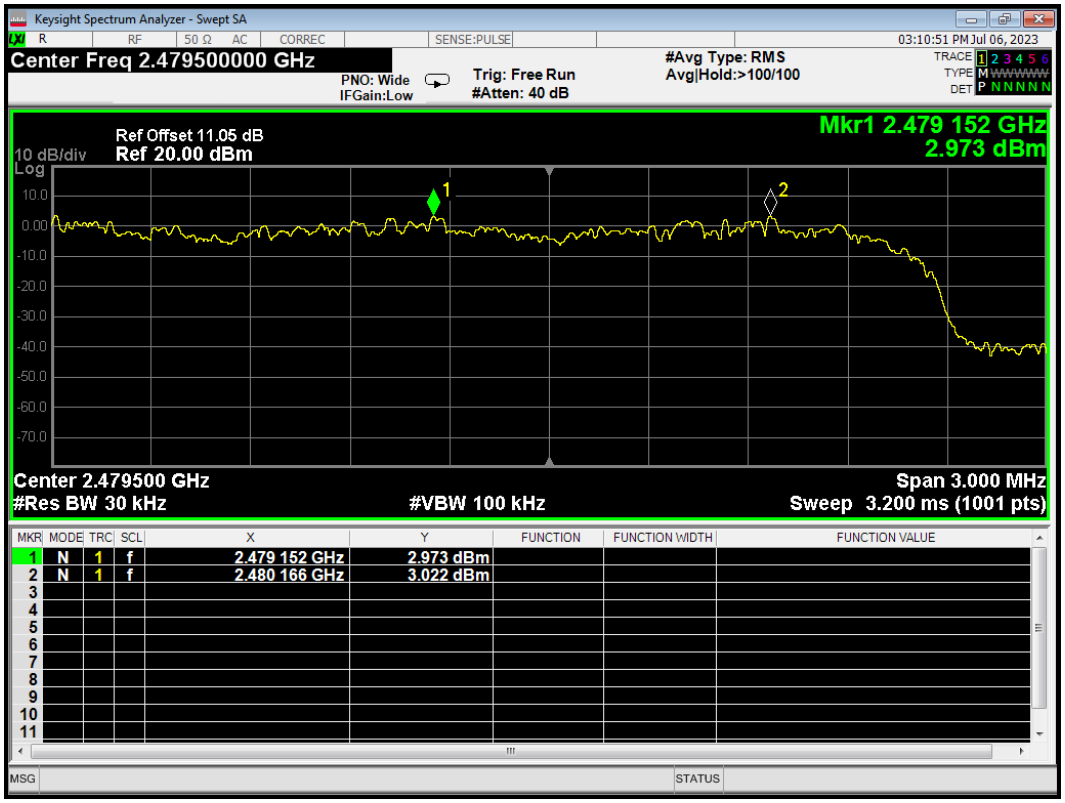


CFS 3-DH5 2441MHz



This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

CFS 3-DH5 2480MHz



This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

5.4 Time of Occupancy (Dwell Time)

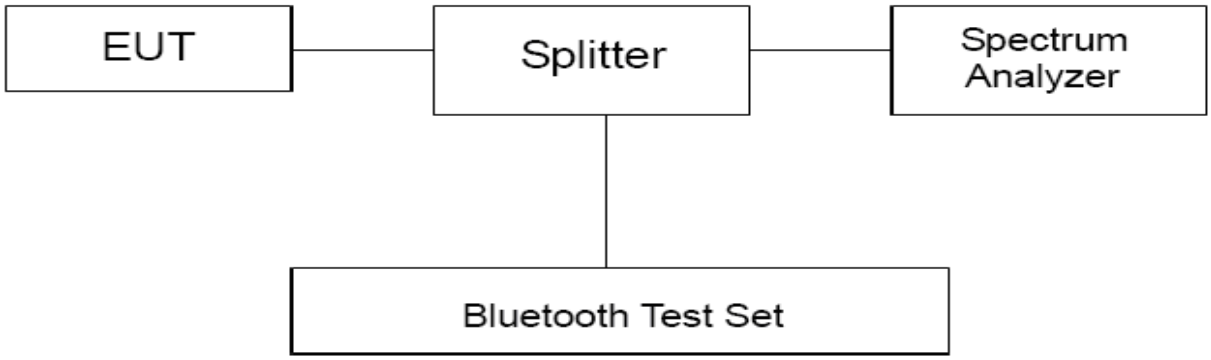
Ambient condition

Temperature	Relative humidity
20°C ~ 25°C	45% ~ 50%

Methods of Measurement

The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. RBW is set to 1MHz and VBW is set to 1MHz on spectrum analyzer. The dwell time is calculated by:
Dwell time = Pulse Time * Number of Pulses in 31.6 seconds:
In normal mode, The selected EUT Packet type uses a slot type of DH5 packet and a hopping rate of 1600(ch*hop/s) for all channels. So the final hopping rate for all channel is 1600/5=320(ch*hop/s)
In AFH mode, The selected EUT Packet type uses a slot type of DH5 packet and a hopping rate of 800(ch*hop/s) for all channels. So the final hopping rate for all channel is 800/5=160(ch*hop/s)

Test Setup



Limits

Rule Part15.247(a) specifies that " 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."

Dwell time	≤ 400ms

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2.

Requirements	Uncertainty					
Dwell Time	DH5	U=0.70ms	2DH5	U=0.70ms	3DH5	U=0.70ms

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Test Results:

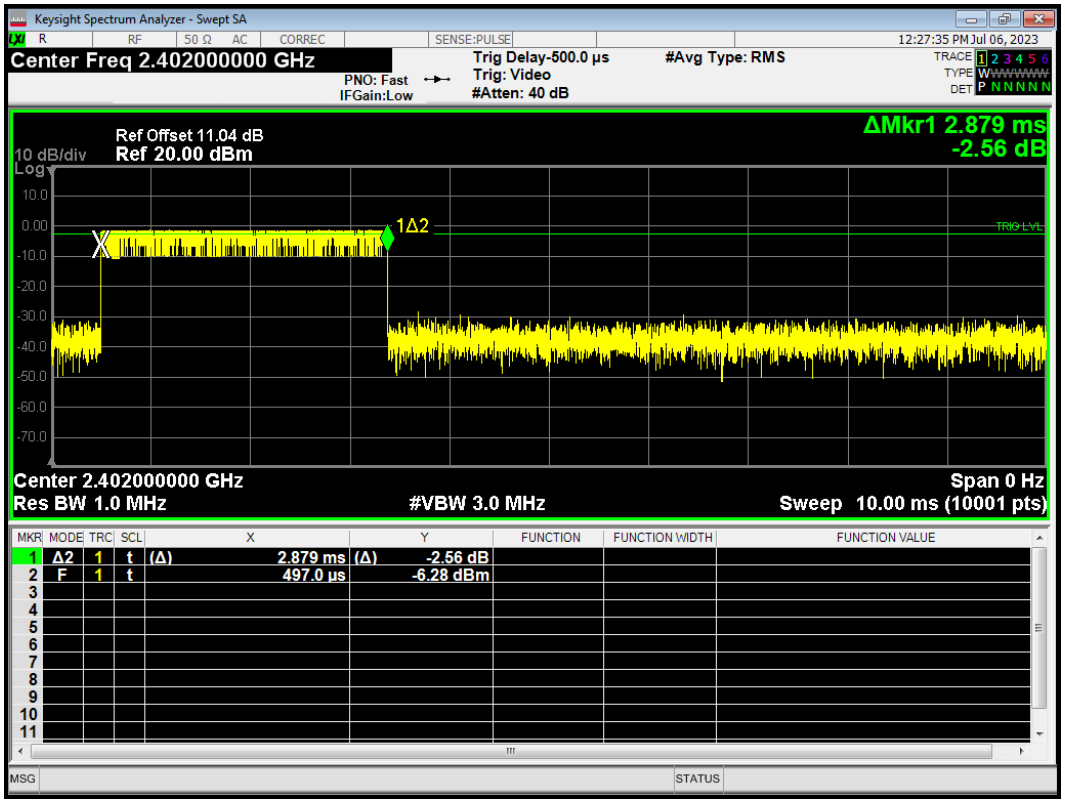
Internal Antenna

In normal mode:

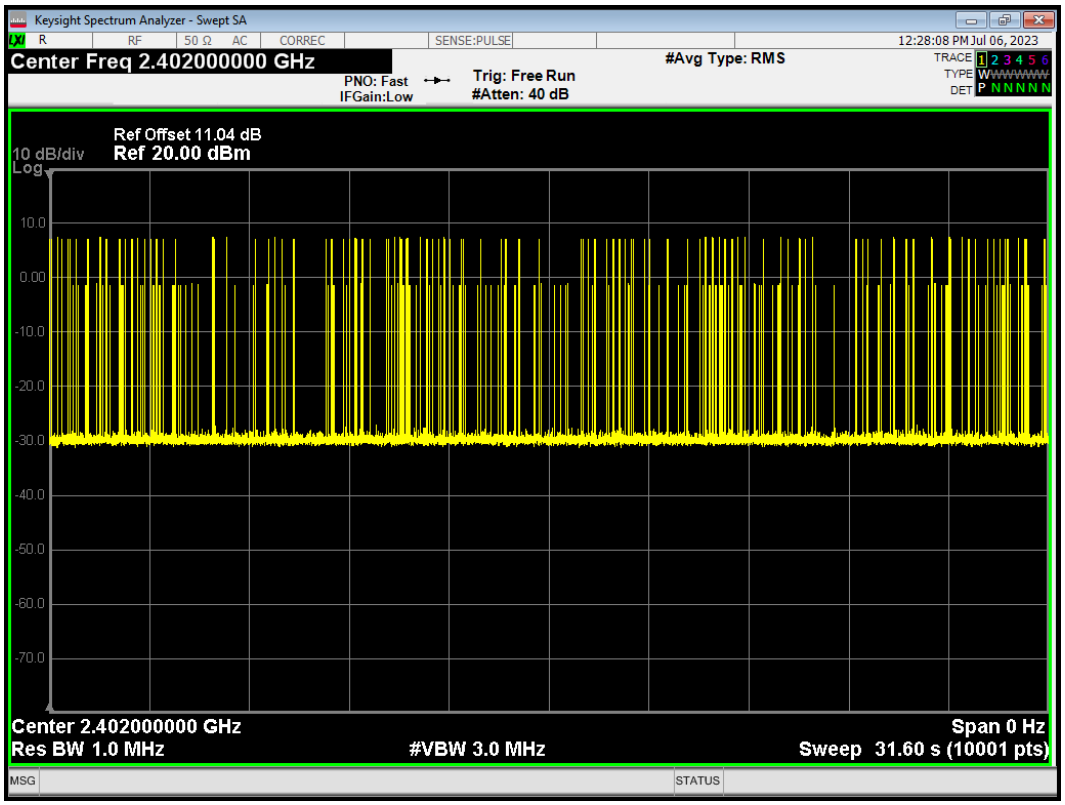
Test Mode	Frequency (MHz)	Number of Pulses in 31.6 seconds	Pulse Time (ms)	Dwell time (ms)	Limit (ms)	Conclusion
DH5	2402	118	2.879	339.722	400	PASS
	2441	105	2.877	302.085	400	PASS
	2480	98	2.878	282.044	400	PASS
2DH5	2402	126	2.880	362.880	400	PASS
	2441	103	2.880	296.640	400	PASS
	2480	109	2.883	314.247	400	PASS
3DH5	2402	111	2.884	320.124	400	PASS
	2441	97	2.884	279.748	400	PASS
	2480	100	2.885	288.500	400	PASS
Note: Dwell time = Pulse Time * Number of Pulses in 31.6 seconds						

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Dwell 1-DH5 2402MHz One Burst

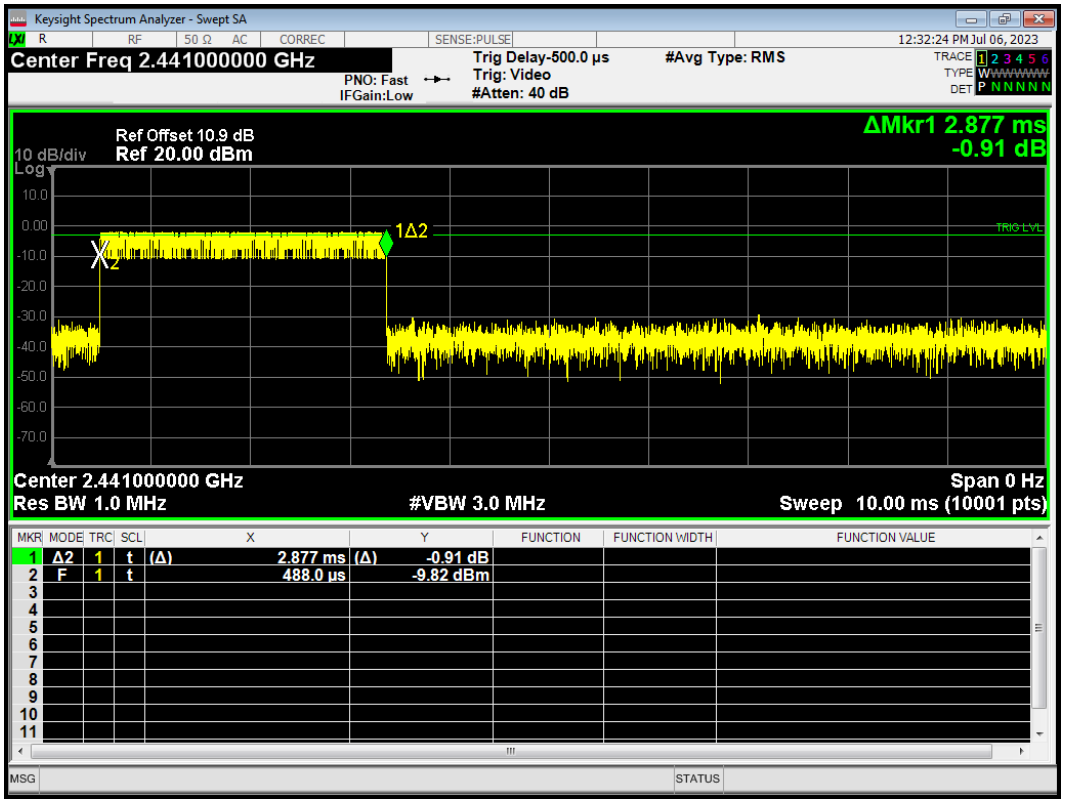


Dwell 1-DH5 2402MHz Accumulated

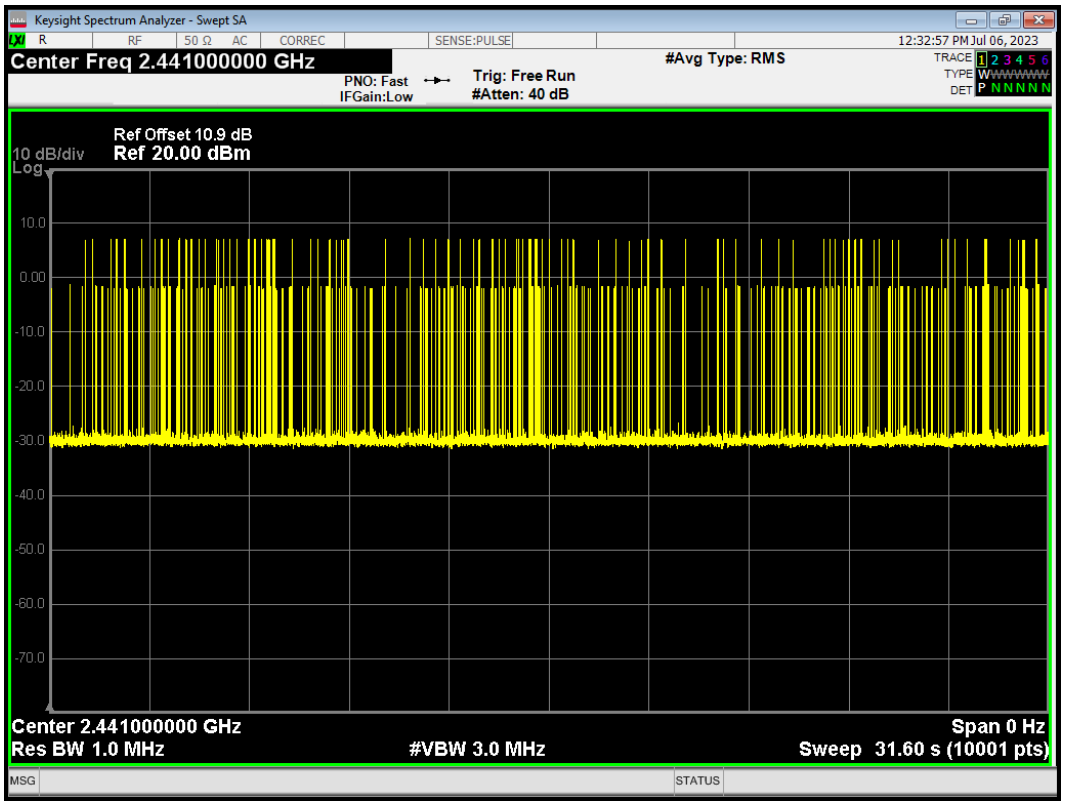


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Dwell 1-DH5 2441MHz One Burst

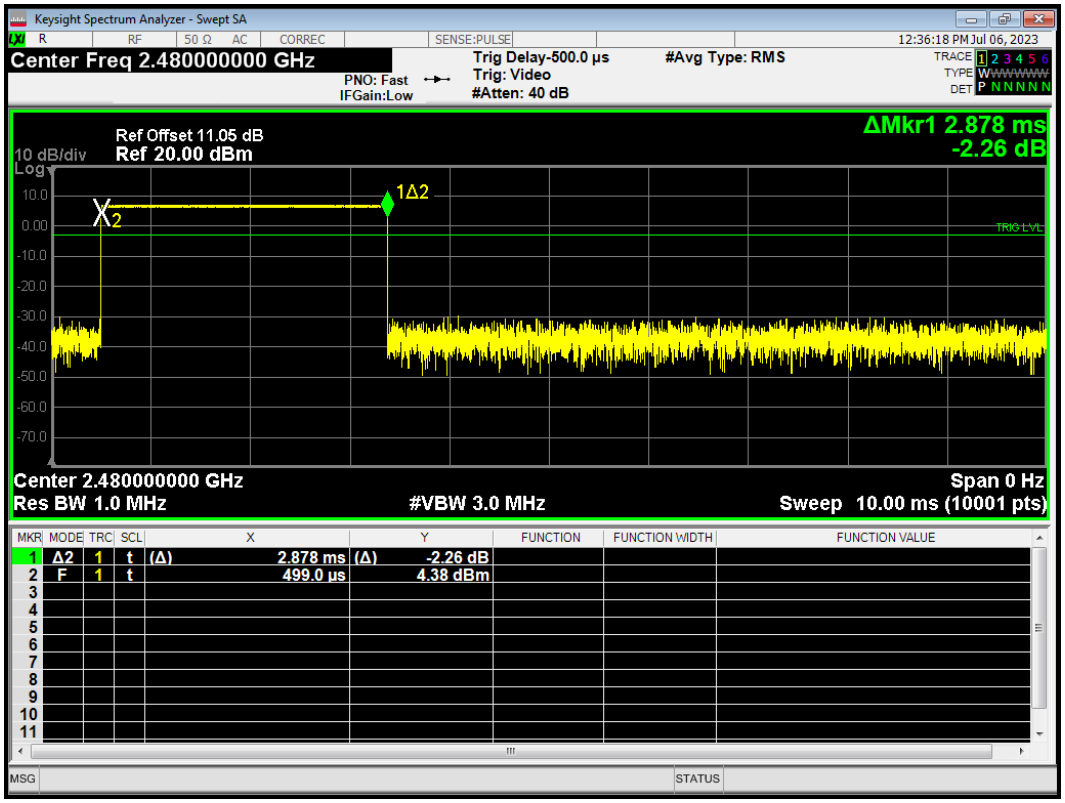


Dwell 1-DH5 2441MHz Accumulated

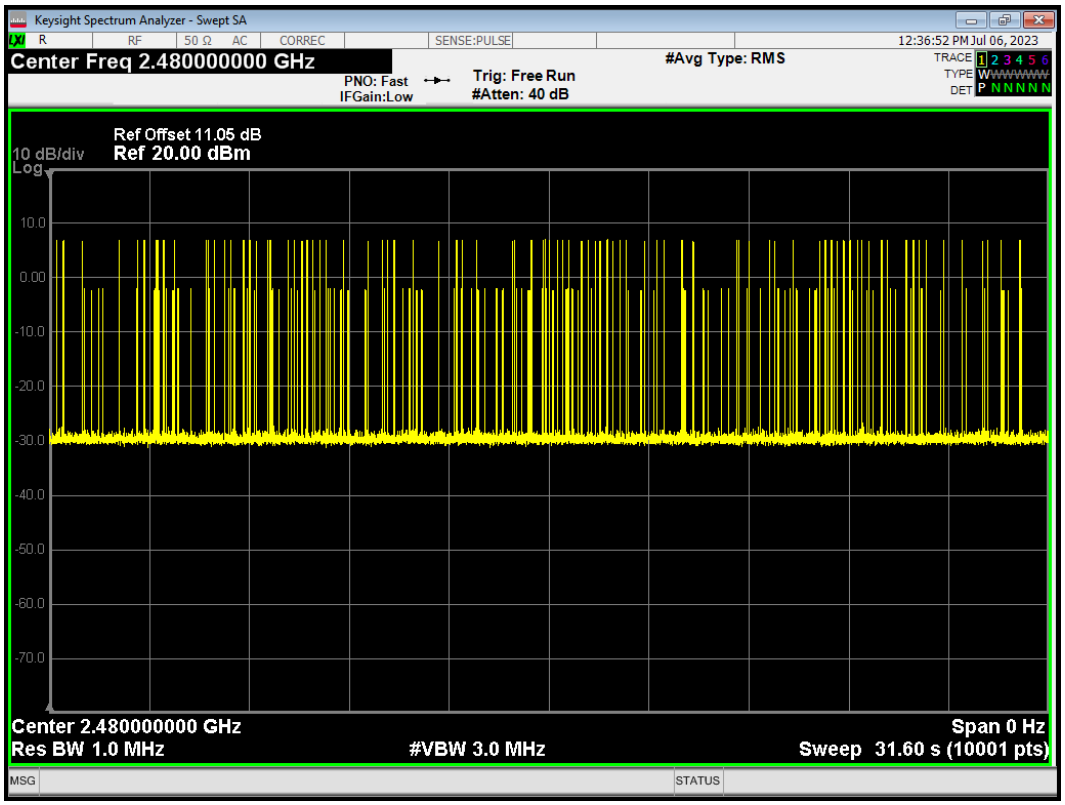


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Dwell 1-DH5 2480MHz One Burst

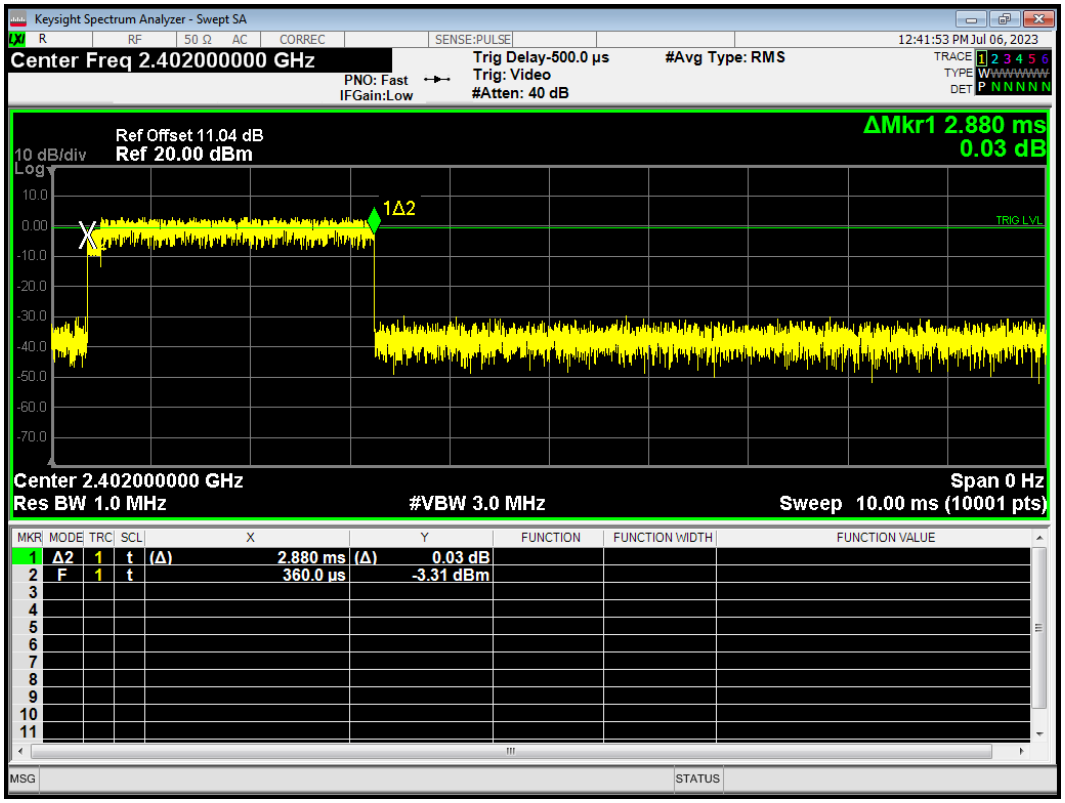


Dwell 1-DH5 2480MHz Accumulated

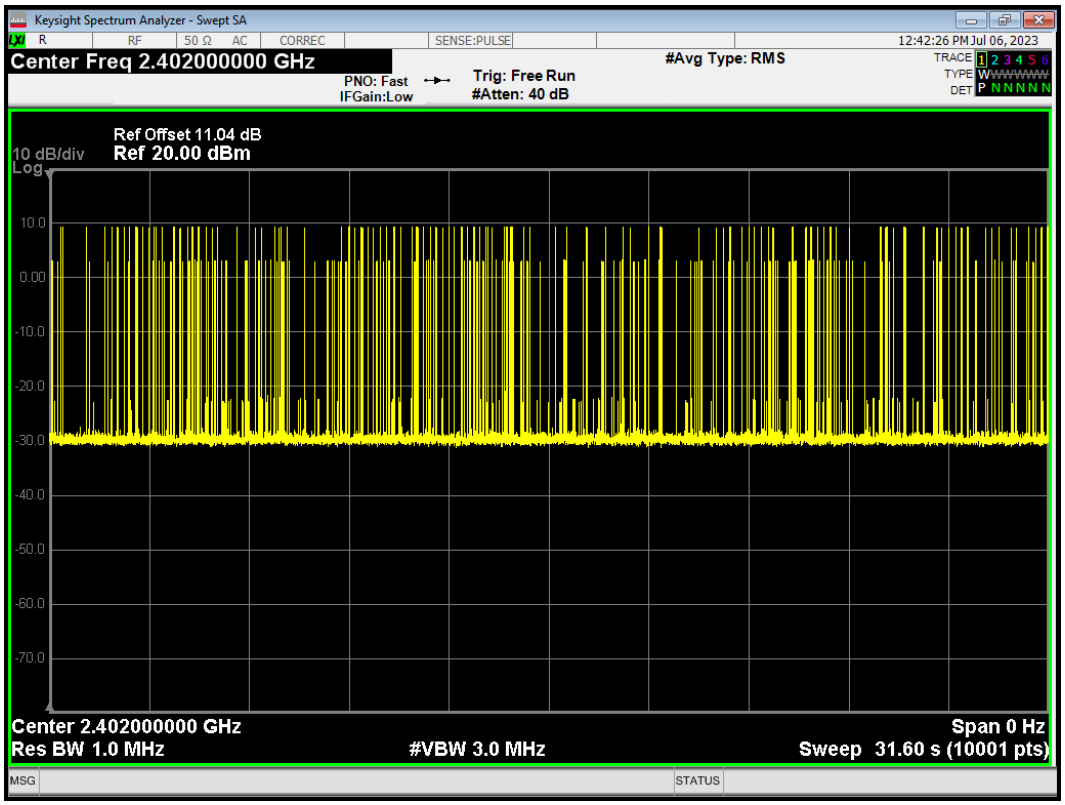


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Dwell 2-DH5 2402MHz One Burst

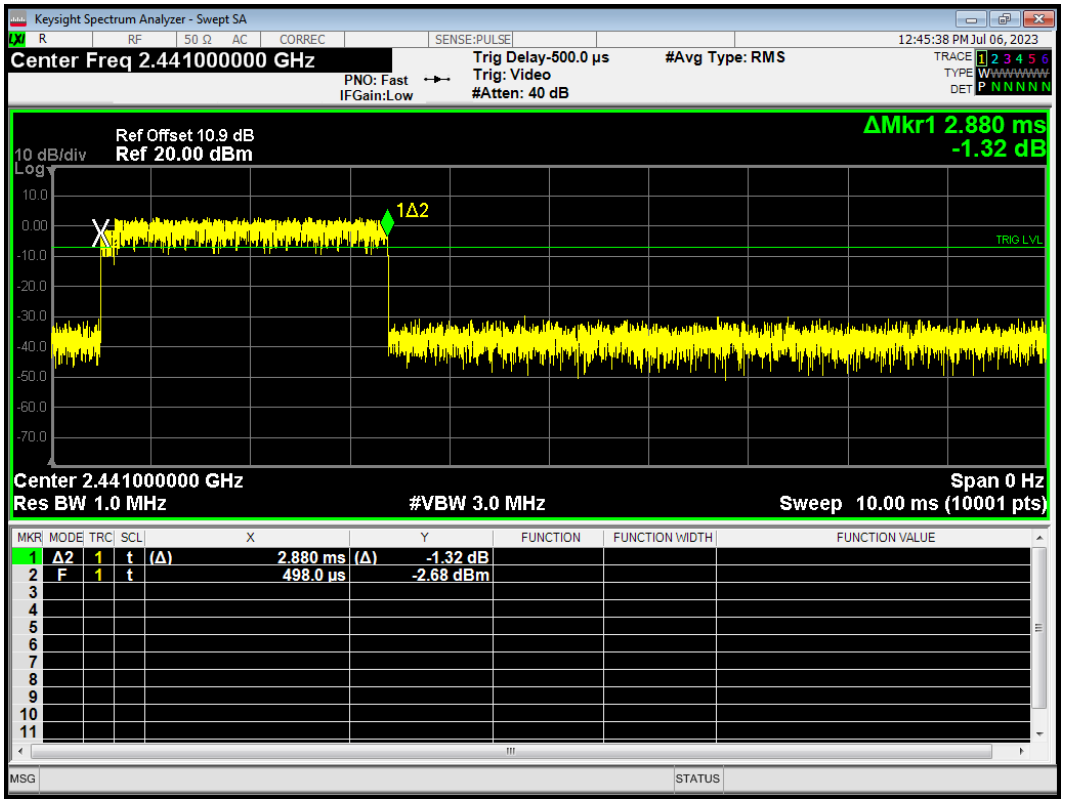


Dwell 2-DH5 2402MHz Accumulated

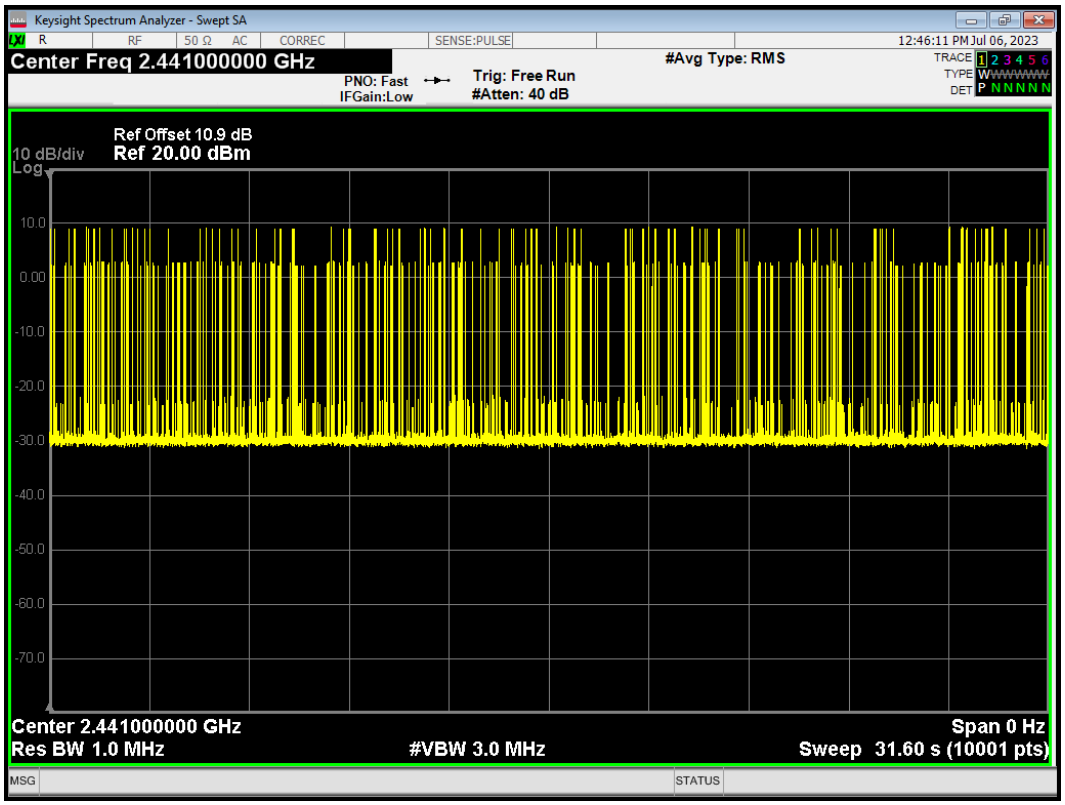


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Dwell 2-DH5 2441MHz One Burst

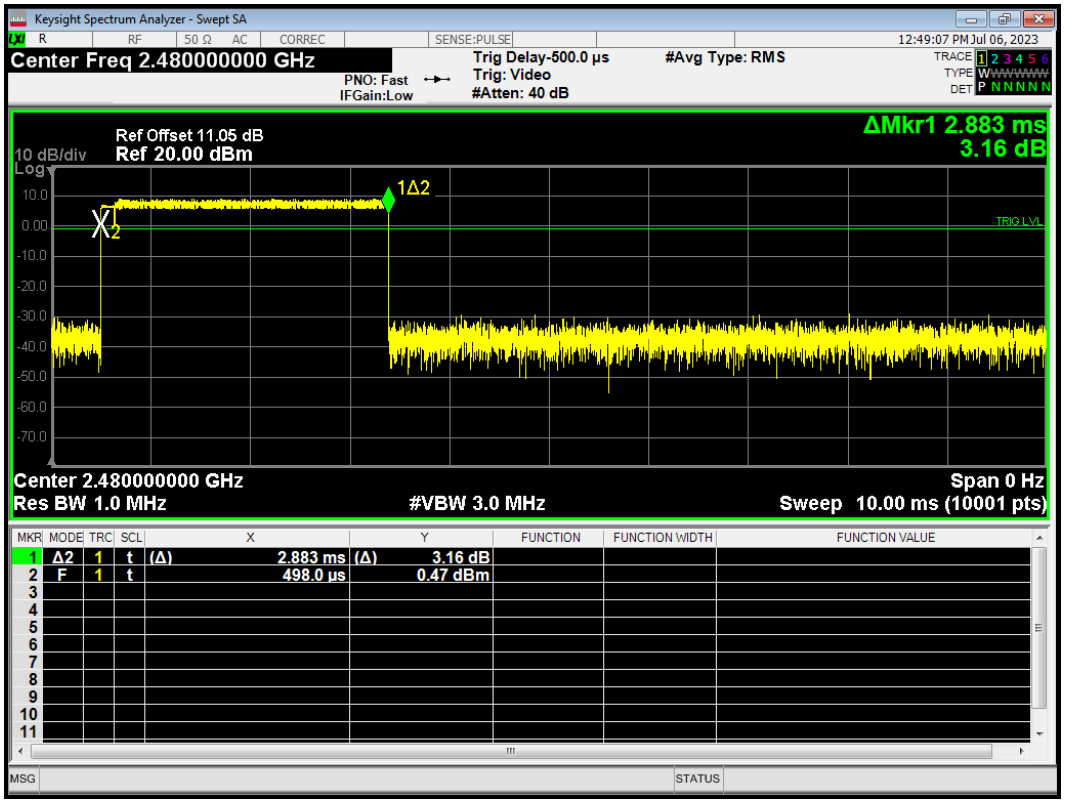


Dwell 2-DH5 2441MHz Accumulated

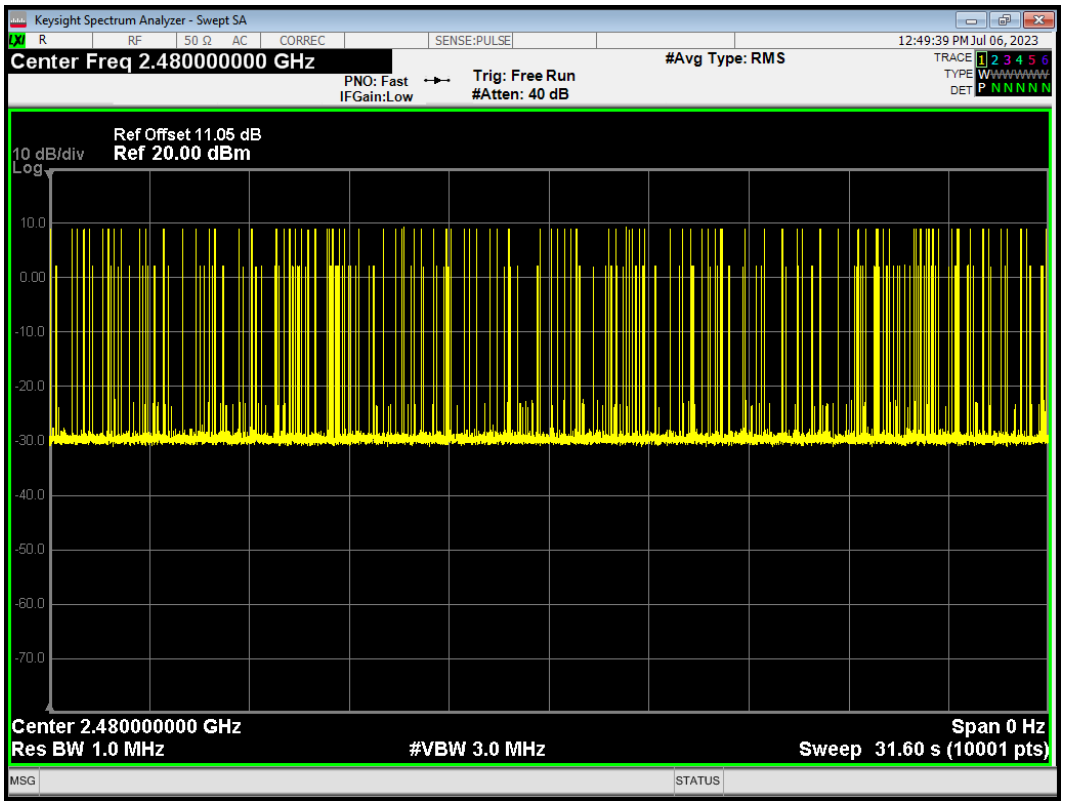


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Dwell 2-DH5 2480MHz One Burst

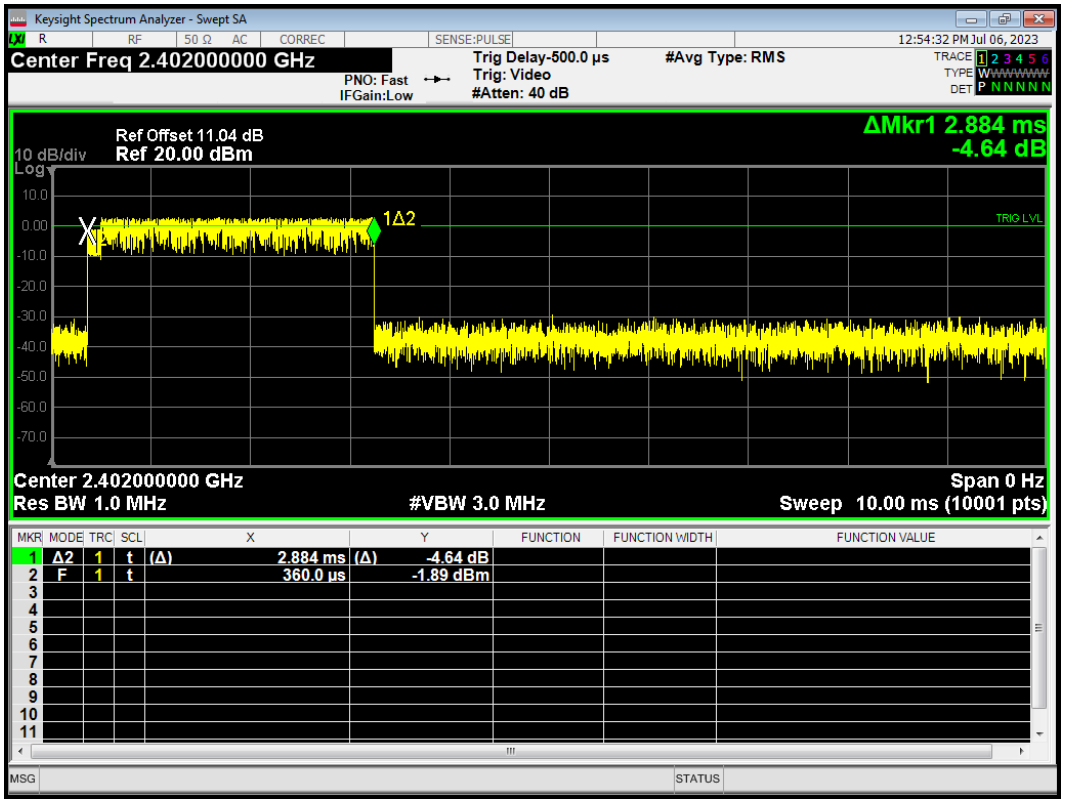


Dwell 2-DH5 2480MHz Accumulated

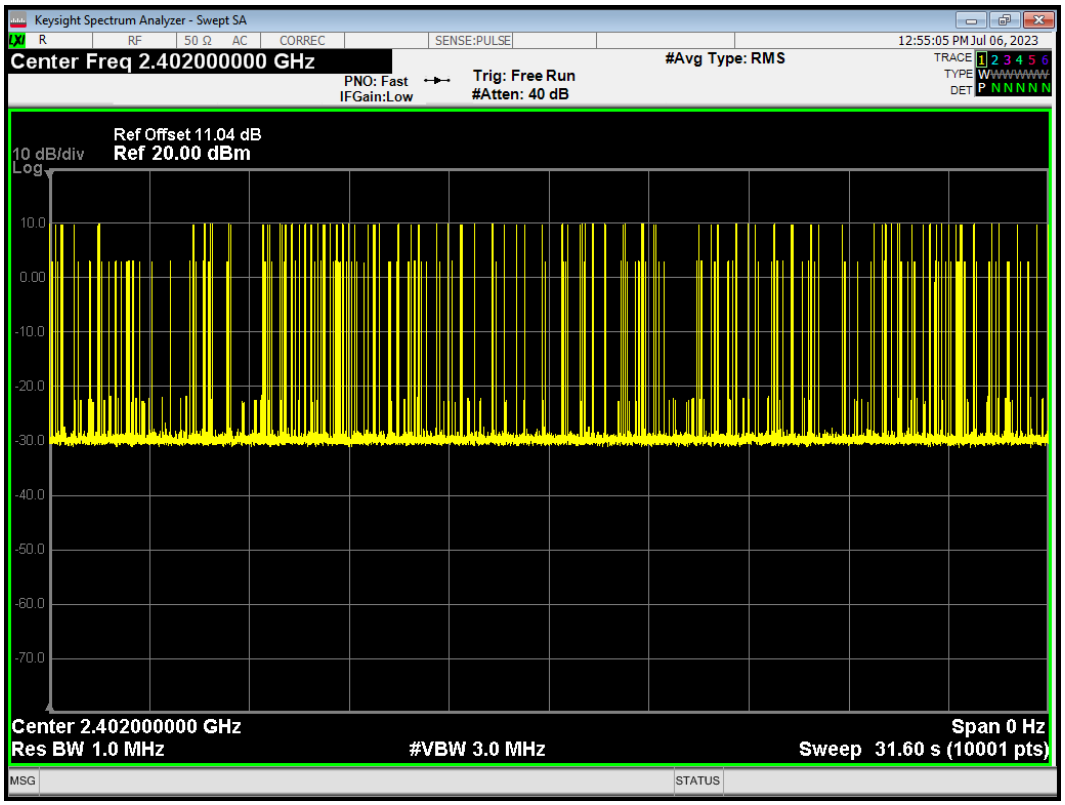


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Dwell 3-DH5 2402MHz One Burst

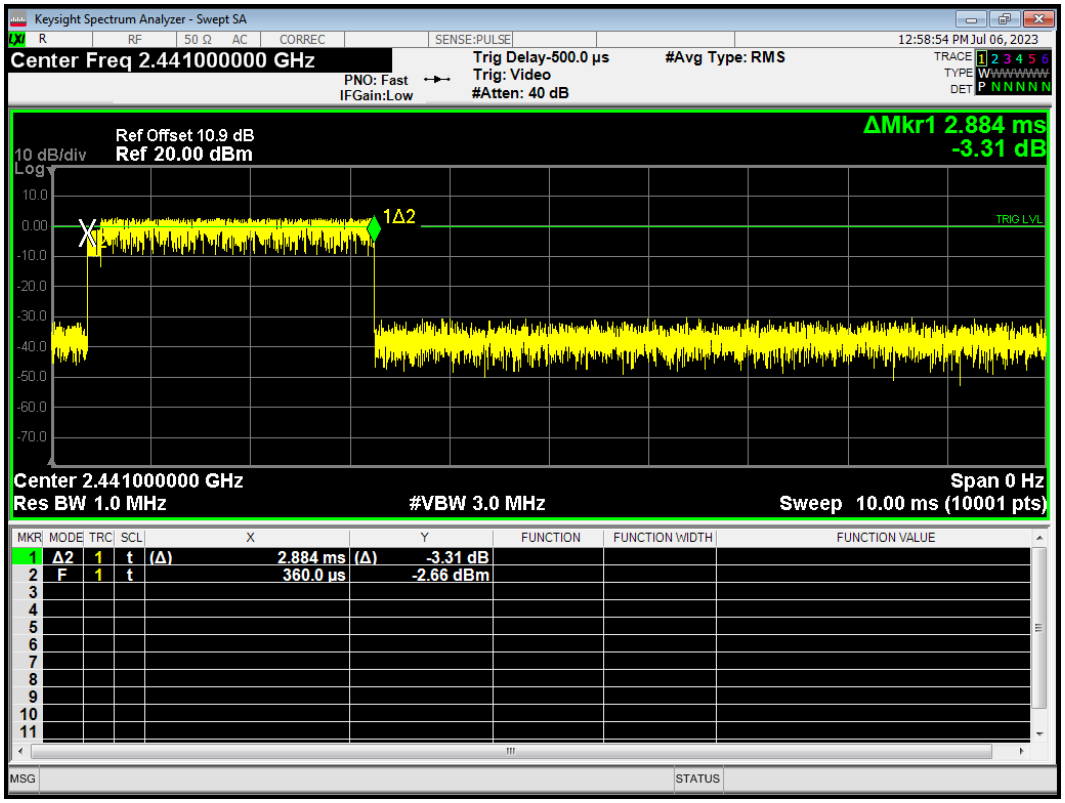


Dwell 3-DH5 2402MHz Accumulated

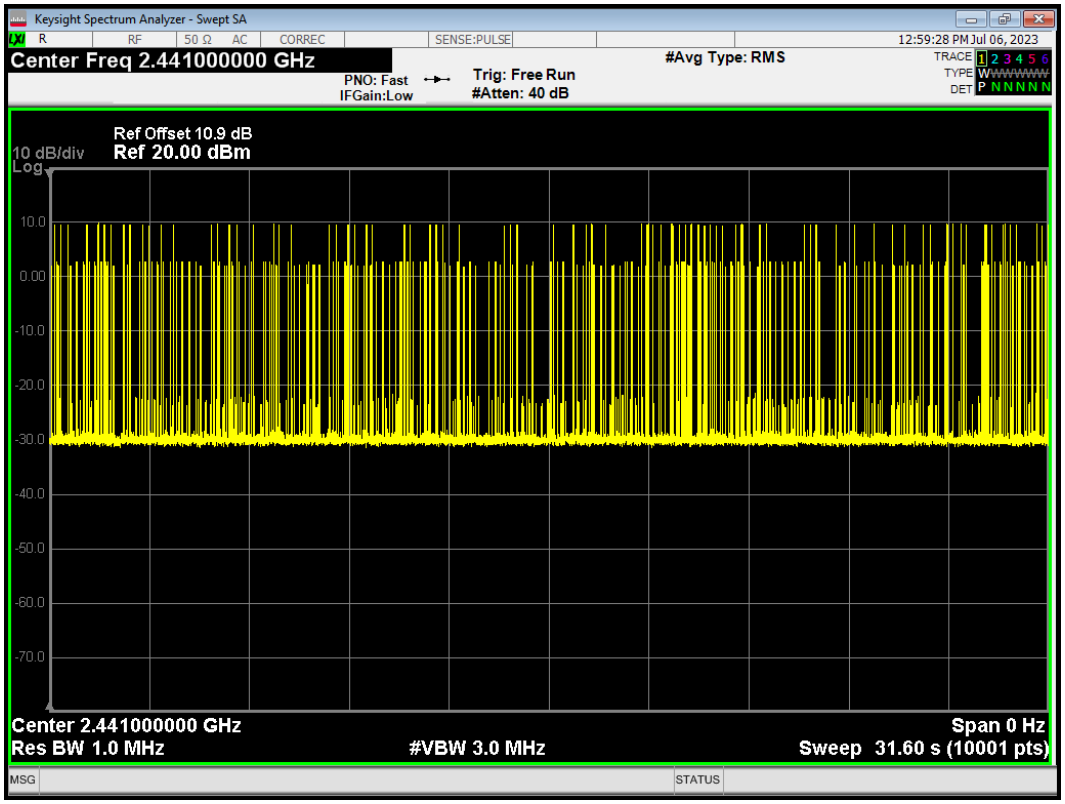


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Dwell 3-DH5 2441MHz One Burst

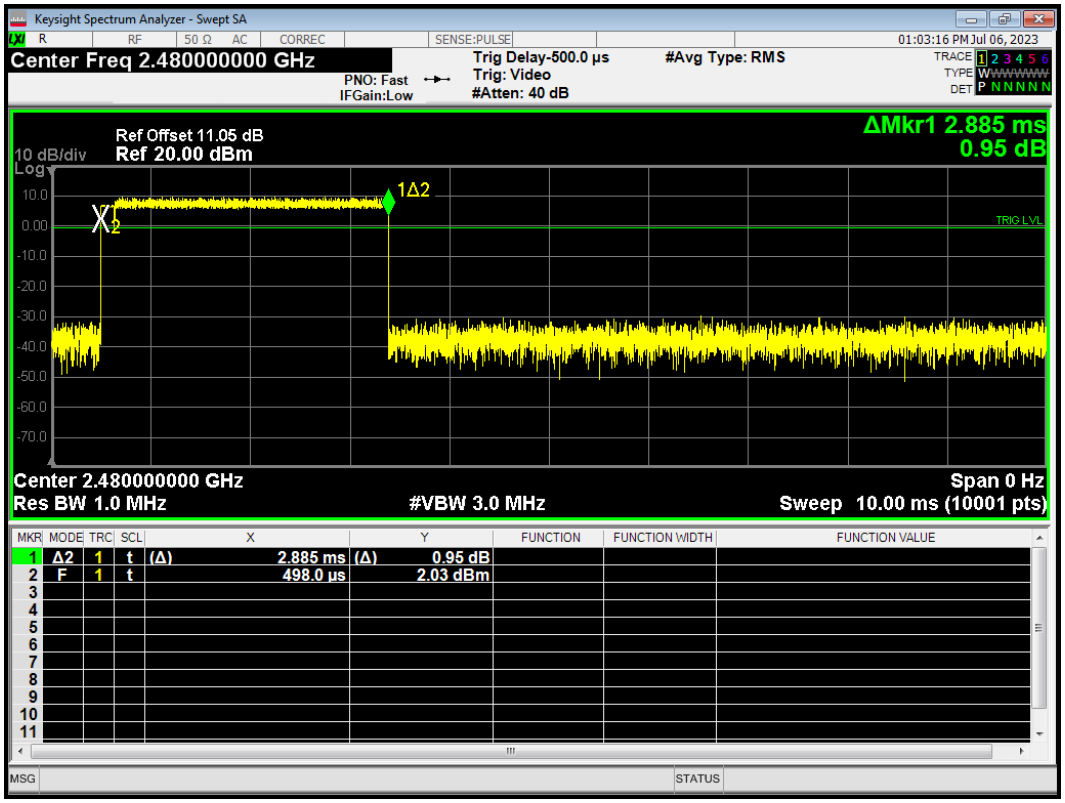


Dwell 3-DH5 2441MHz Accumulated

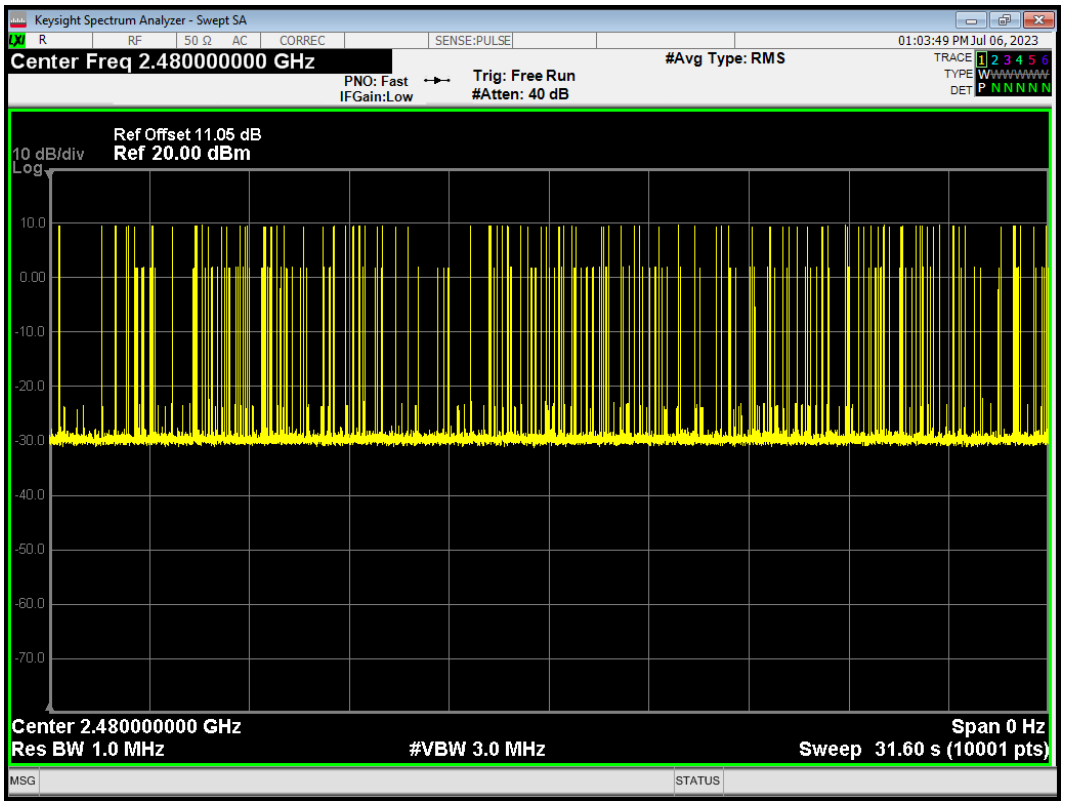


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Dwell 3-DH5 2480MHz One Burst



Dwell 3-DH5 2480MHz Accumulated



This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

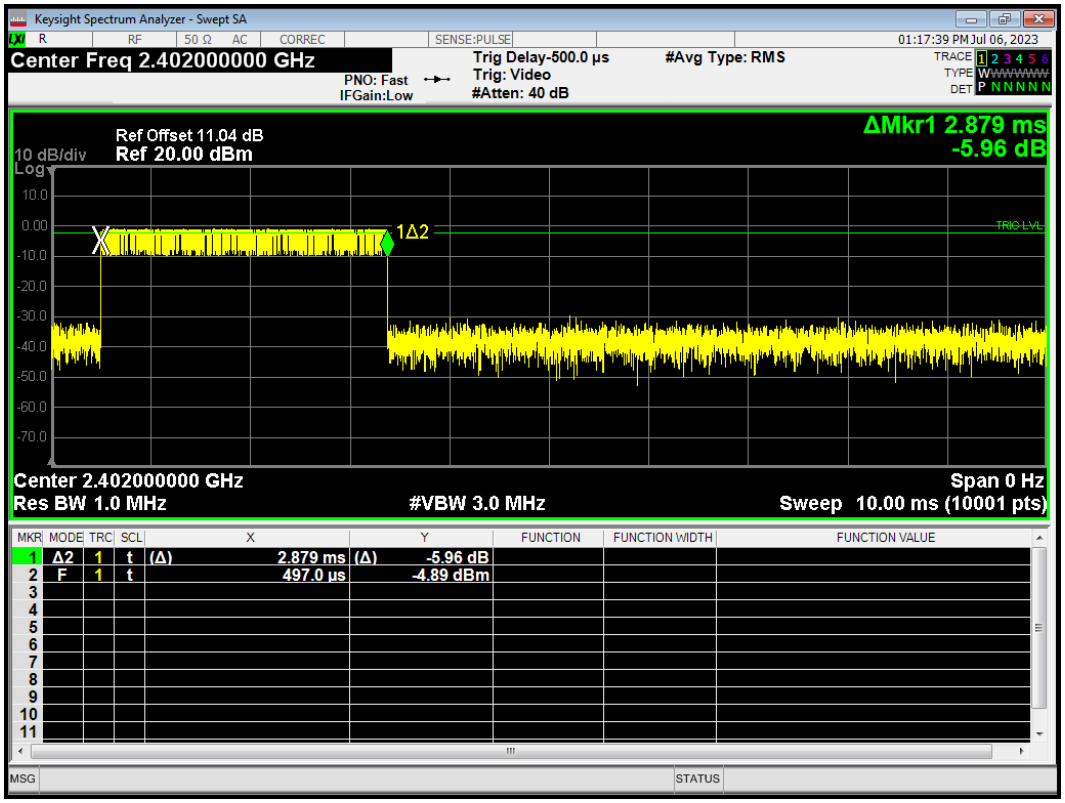
External Antenna

In normal mode:

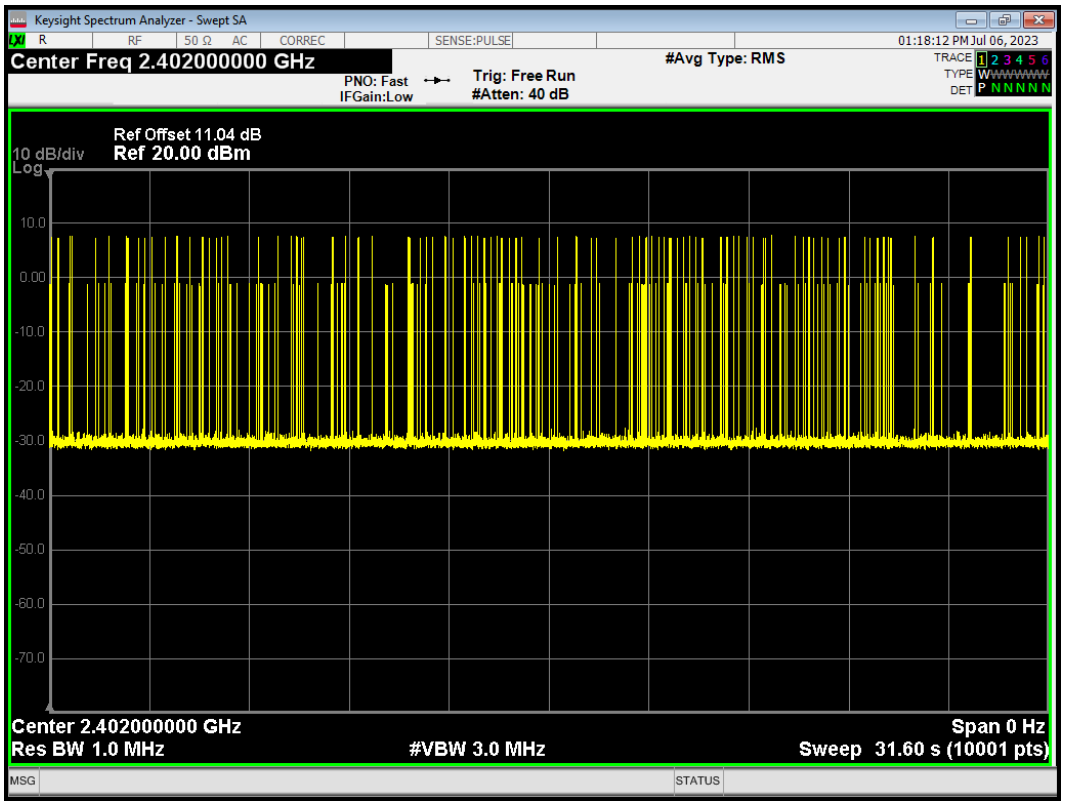
Test Mode	Frequency (MHz)	Number of Pulses in 31.6 seconds	Pulse Time (ms)	Dwell time (ms)	Limit (ms)	Conclusion
DH5	2402	105	2.879	302.295	400	PASS
	2441	100	2.877	287.700	400	PASS
	2480	103	2.879	296.537	400	PASS
2DH5	2402	105	2.880	302.400	400	PASS
	2441	101	2.880	290.880	400	PASS
	2480	115	2.882	331.430	400	PASS
3DH5	2402	126	2.885	363.510	400	PASS
	2441	104	2.884	299.936	400	PASS
	2480	112	2.885	323.120	400	PASS
Note: Dwell time = Pulse Time * Number of Pulses in 31.6 seconds						

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Dwell 1-DH5 2402MHz One Burst

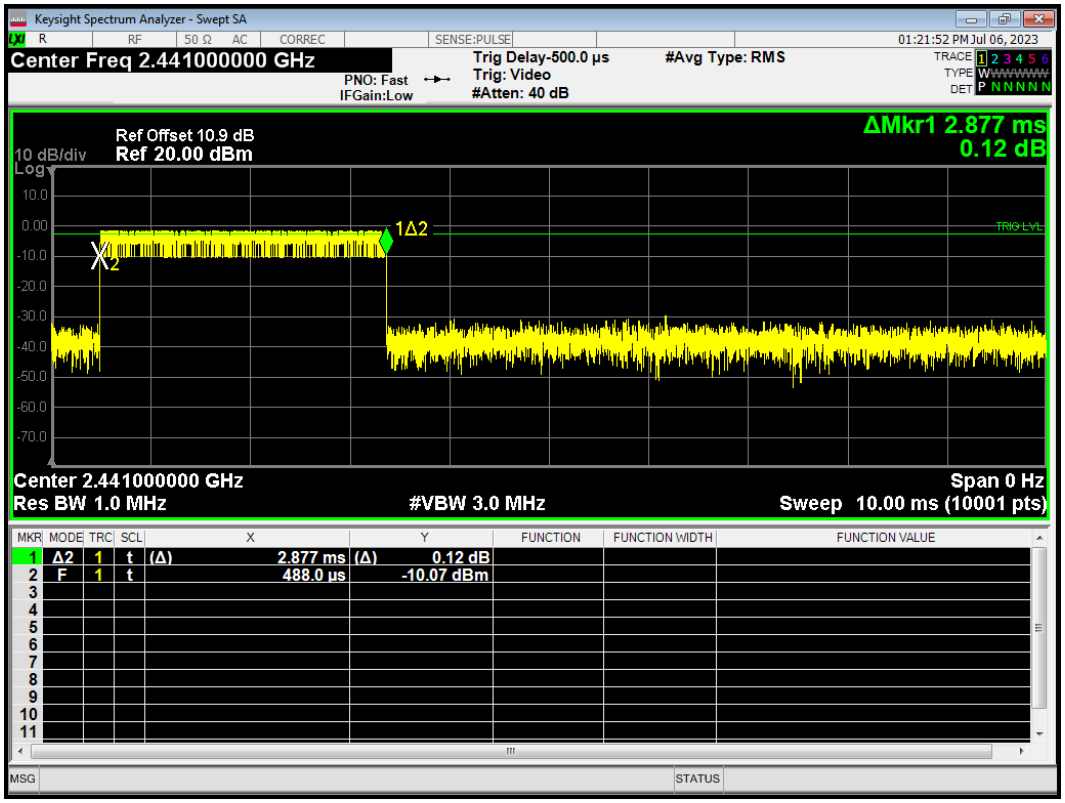


Dwell 1-DH5 2402MHz Accumulated

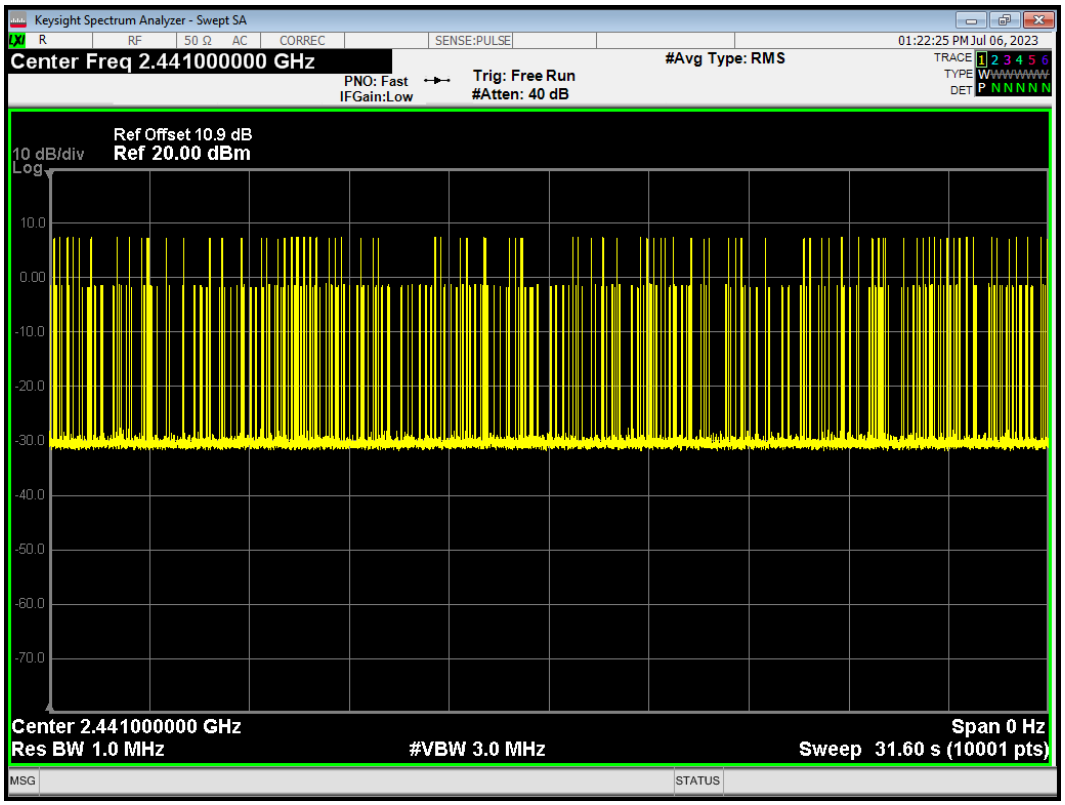


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Dwell 1-DH5 2441MHz One Burst

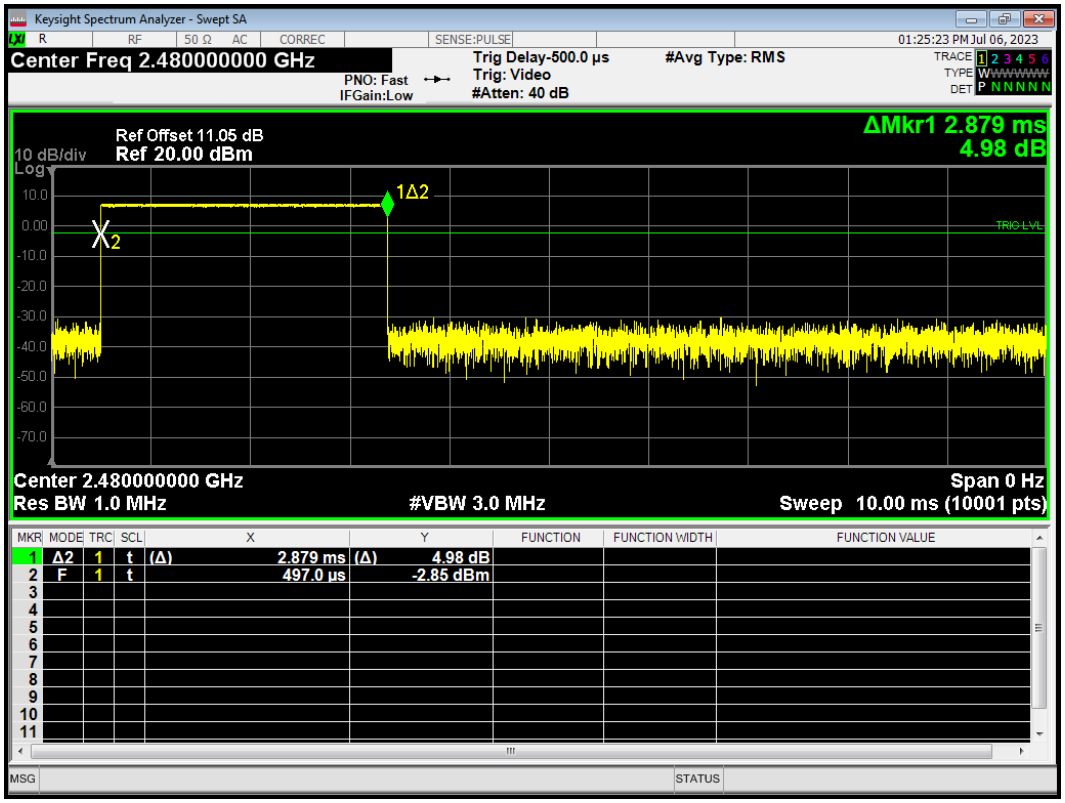


Dwell 1-DH5 2441MHz Accumulated

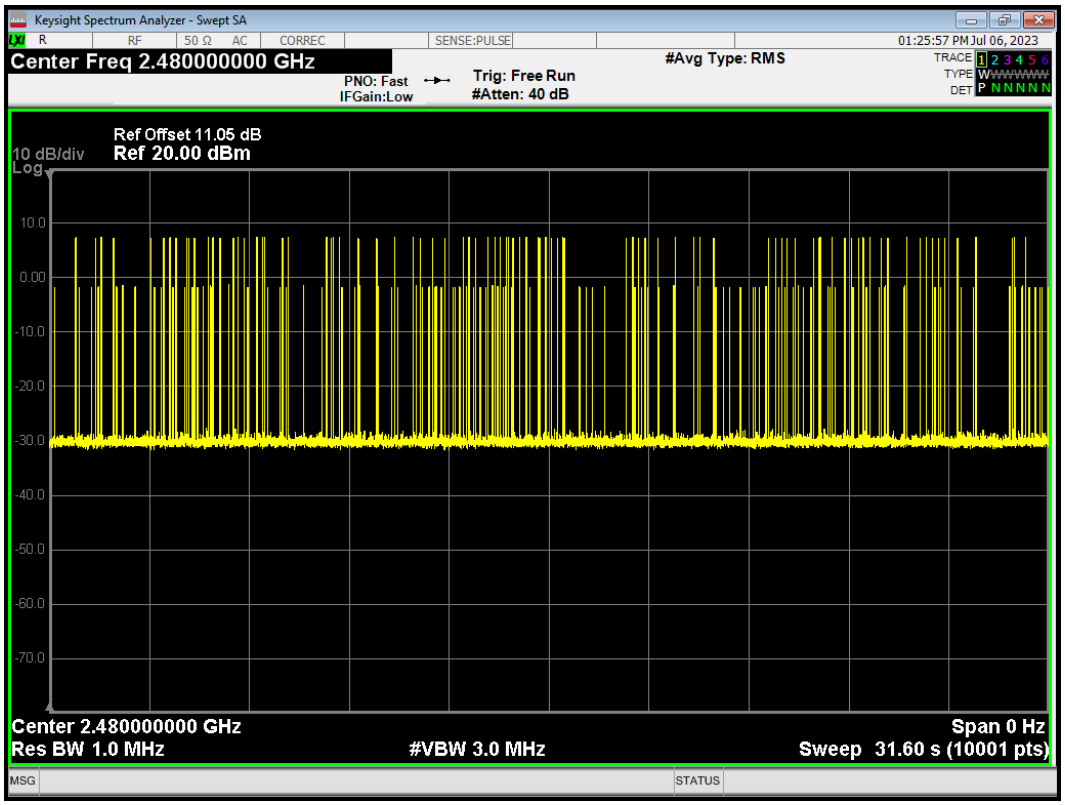


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Dwell 1-DH5 2480MHz One Burst

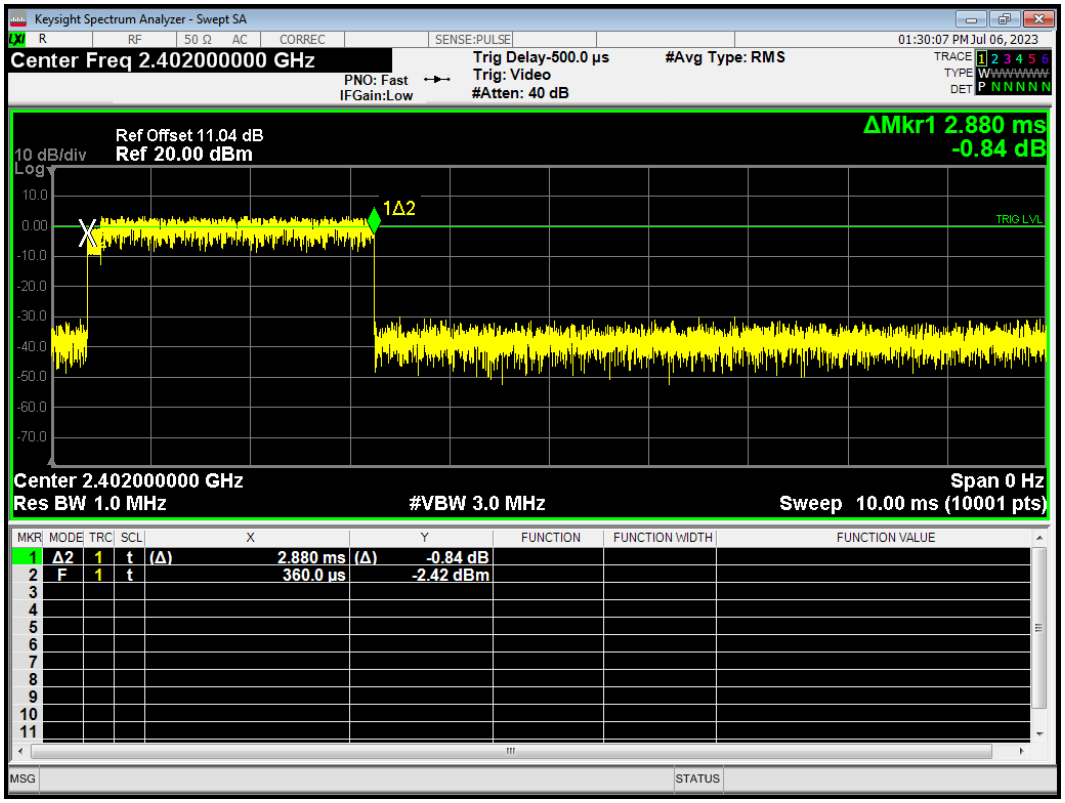


Dwell 1-DH5 2480MHz Accumulated

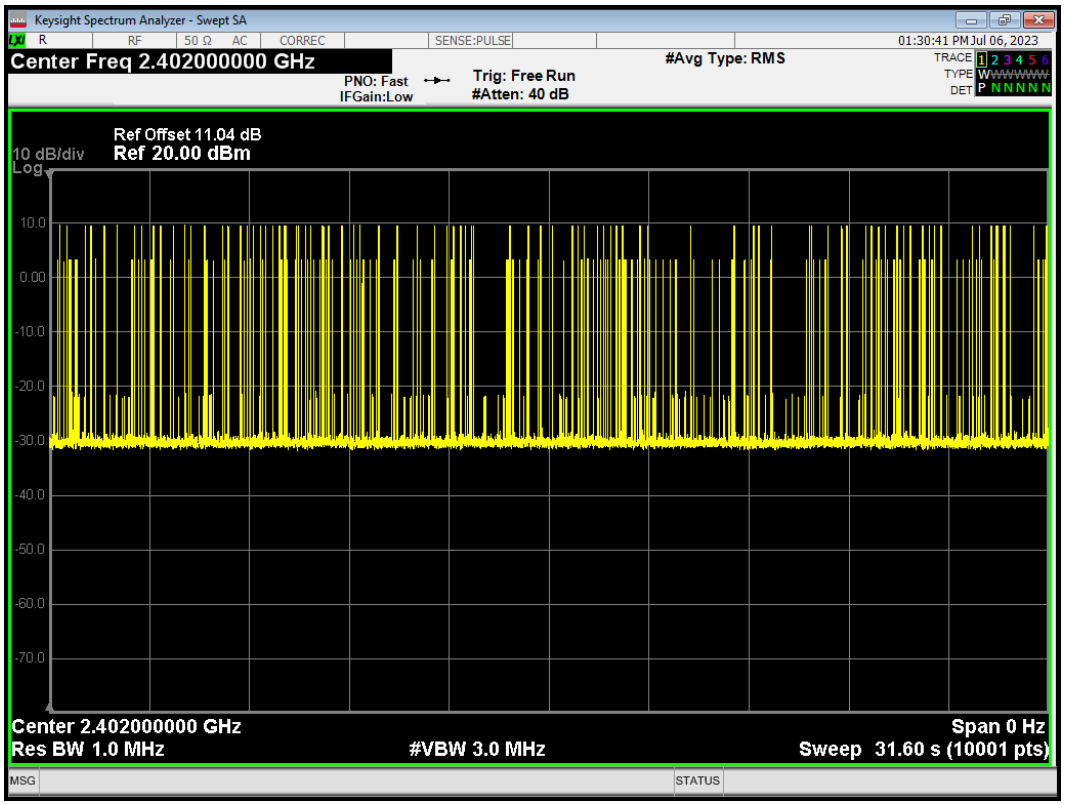


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Dwell 2-DH5 2402MHz One Burst

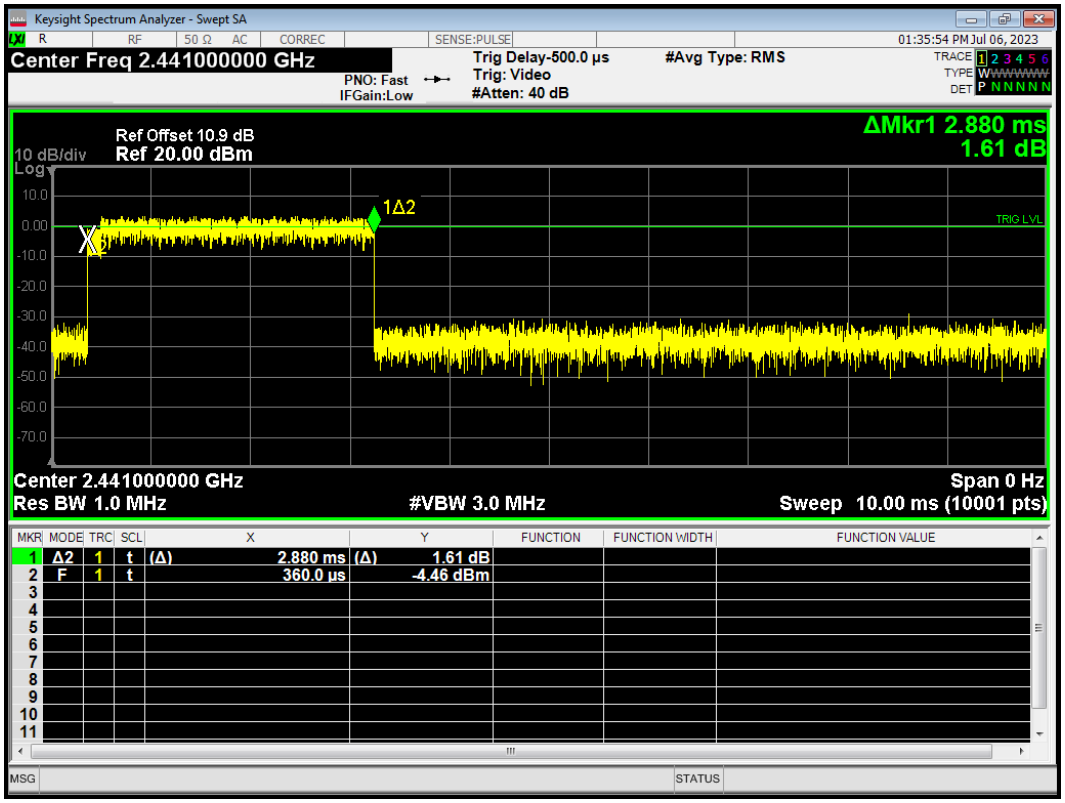


Dwell 2-DH5 2402MHz Accumulated

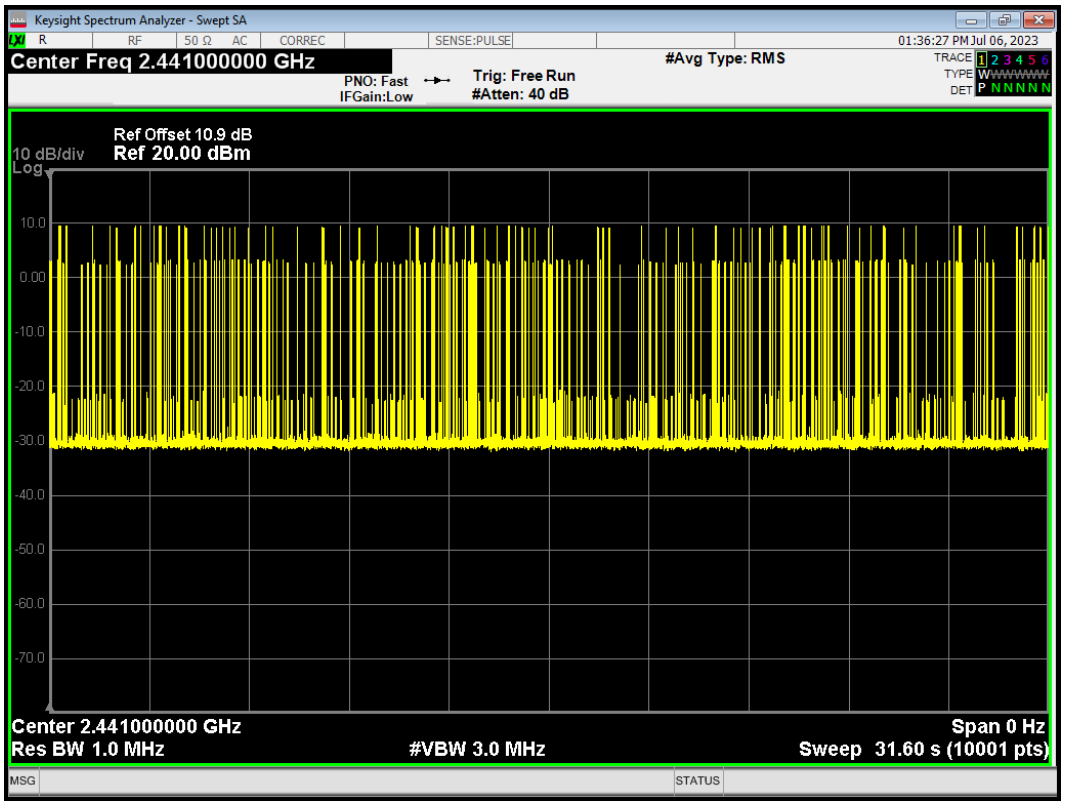


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Dwell 2-DH5 2441MHz One Burst

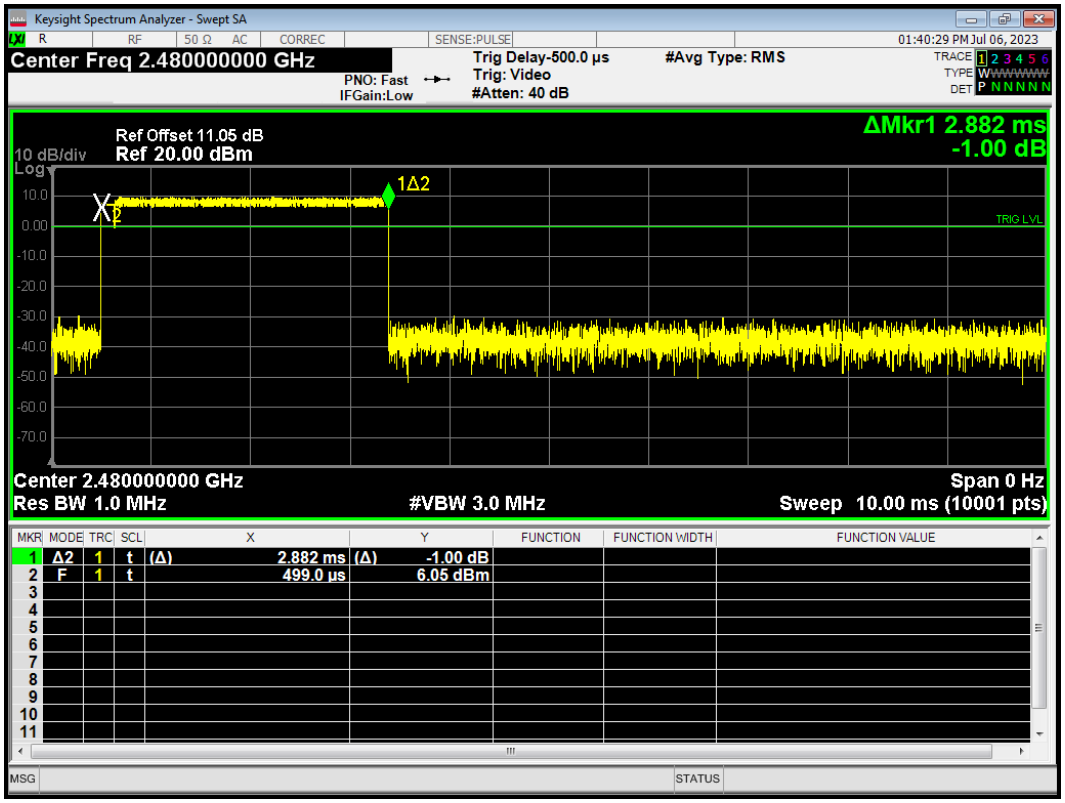


Dwell 2-DH5 2441MHz Accumulated

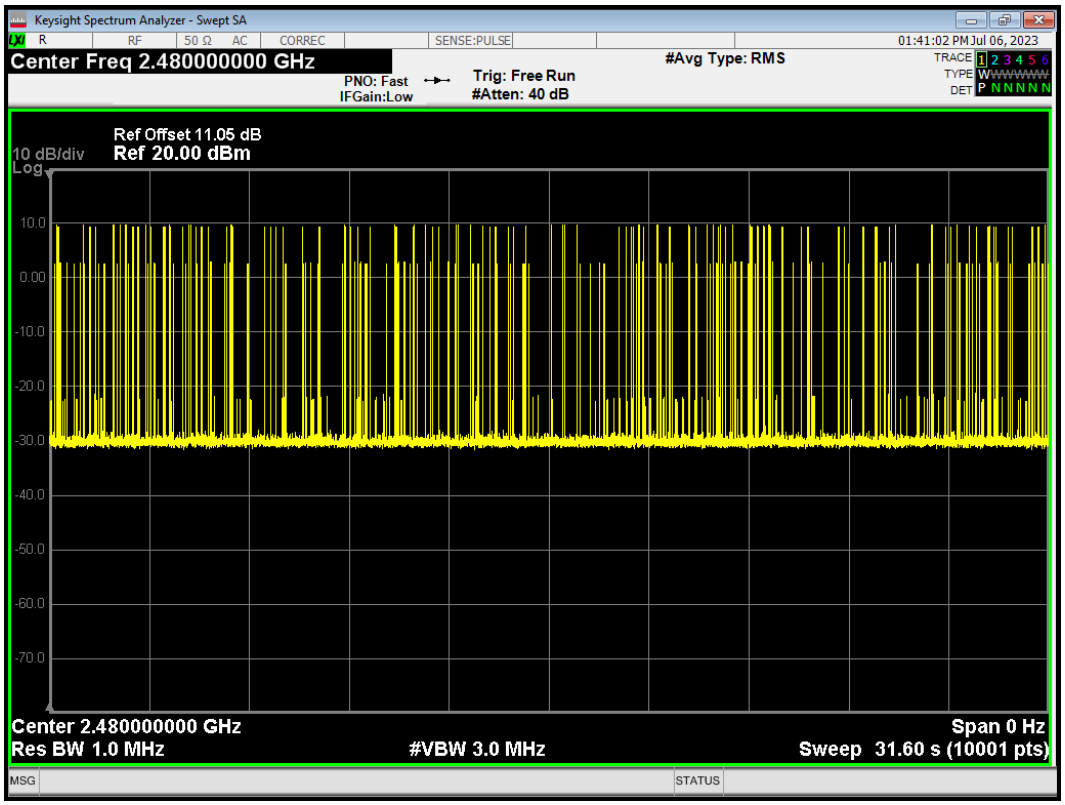


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Dwell 2-DH5 2480MHz One Burst

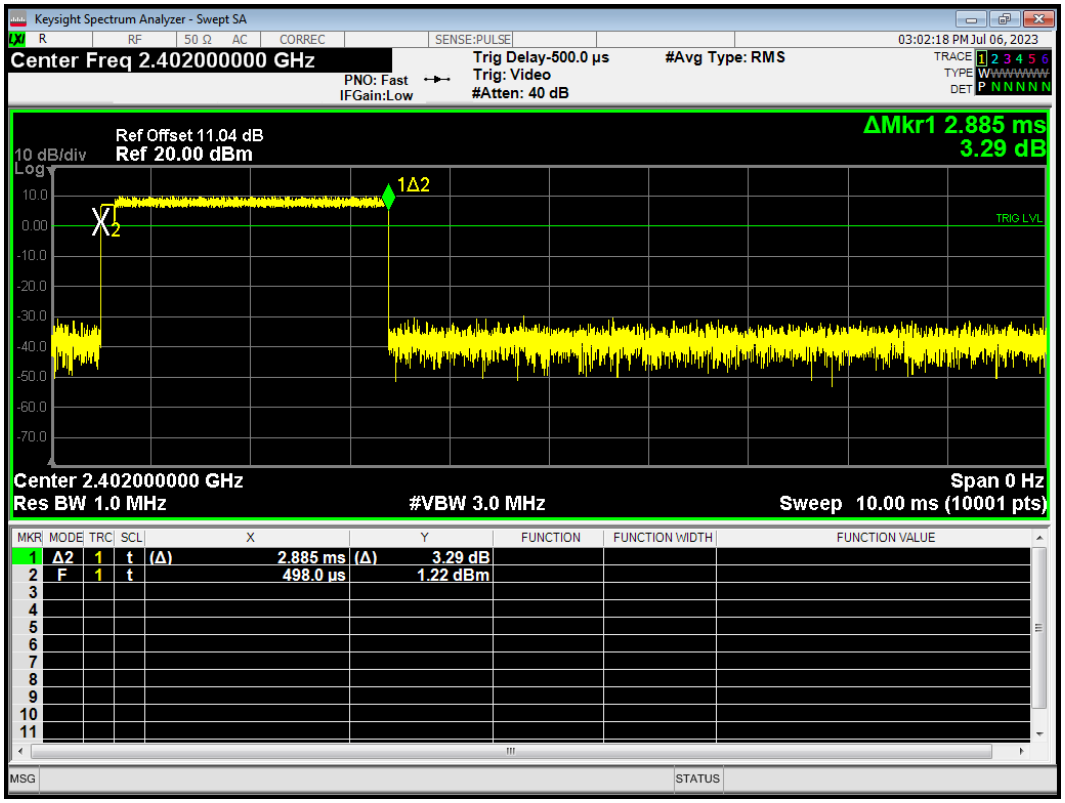


Dwell 2-DH5 2480MHz Accumulated

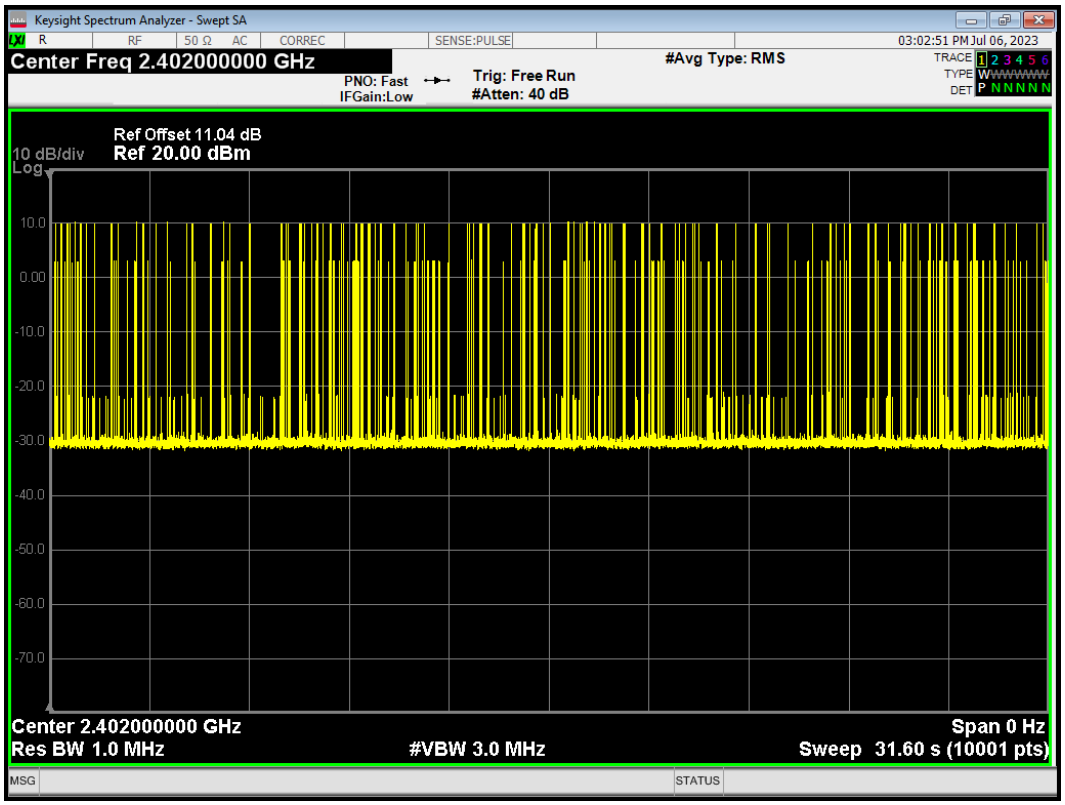


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Dwell 3-DH5 2402MHz One Burst

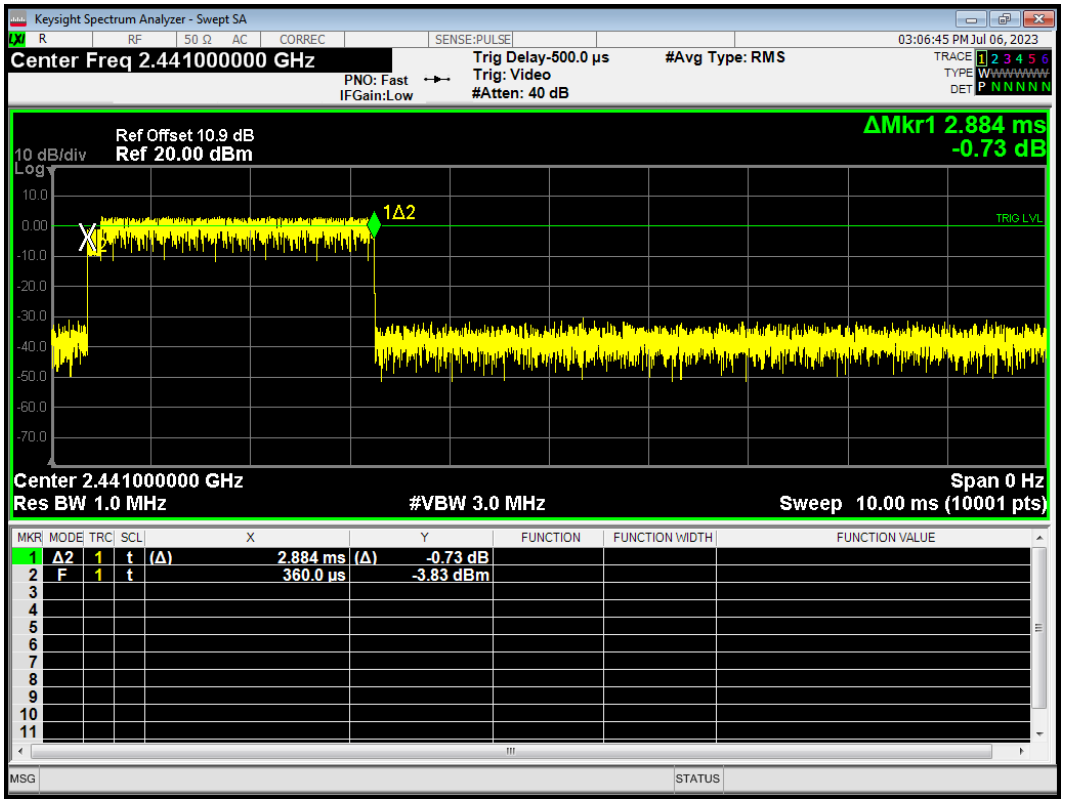


Dwell 3-DH5 2402MHz Accumulated

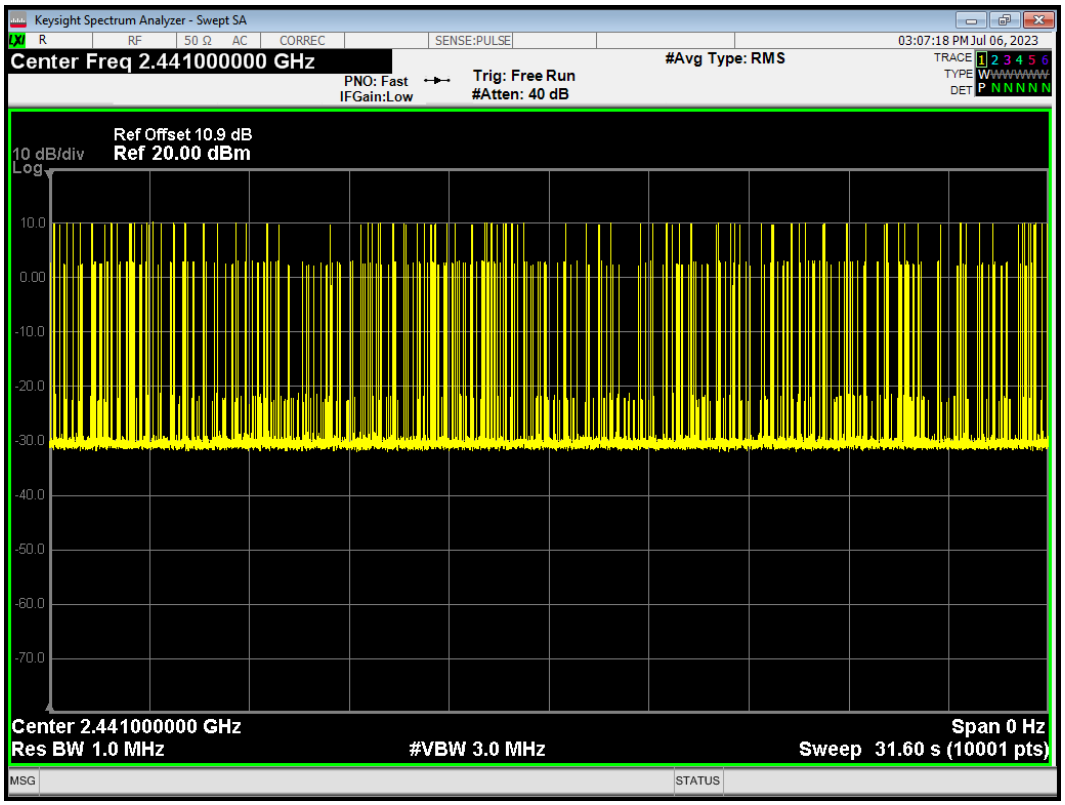


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Dwell 3-DH5 2441MHz One Burst

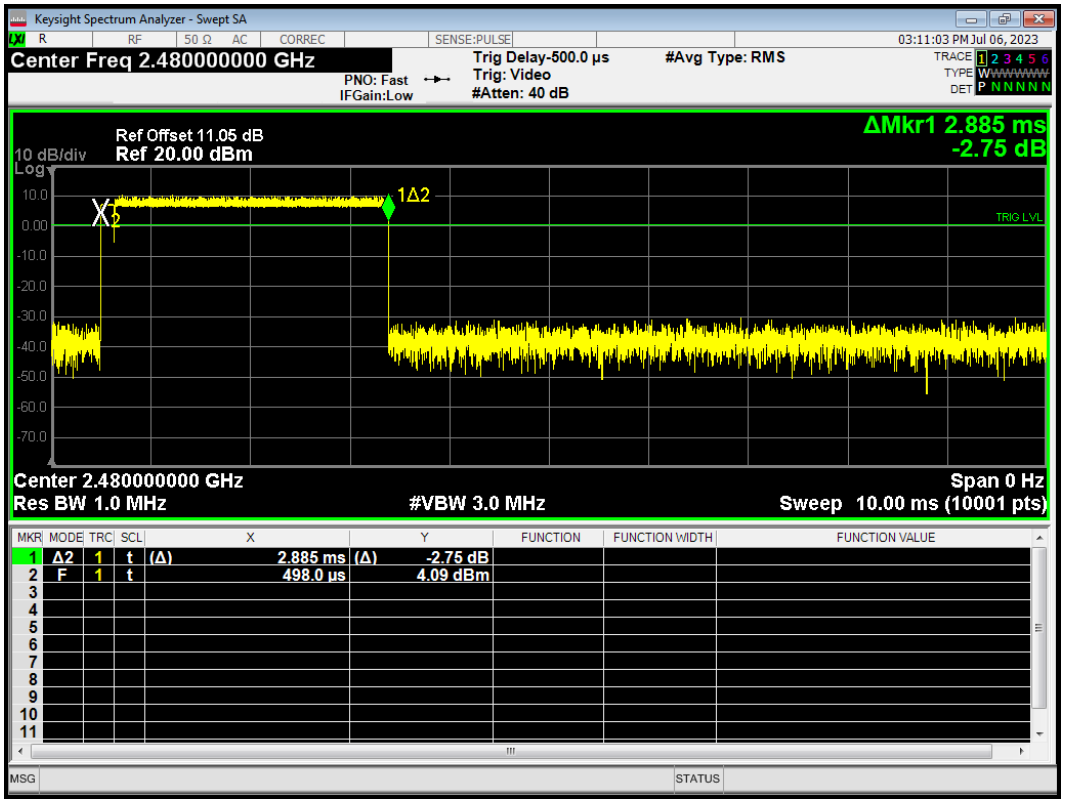


Dwell 3-DH5 2441MHz Accumulated

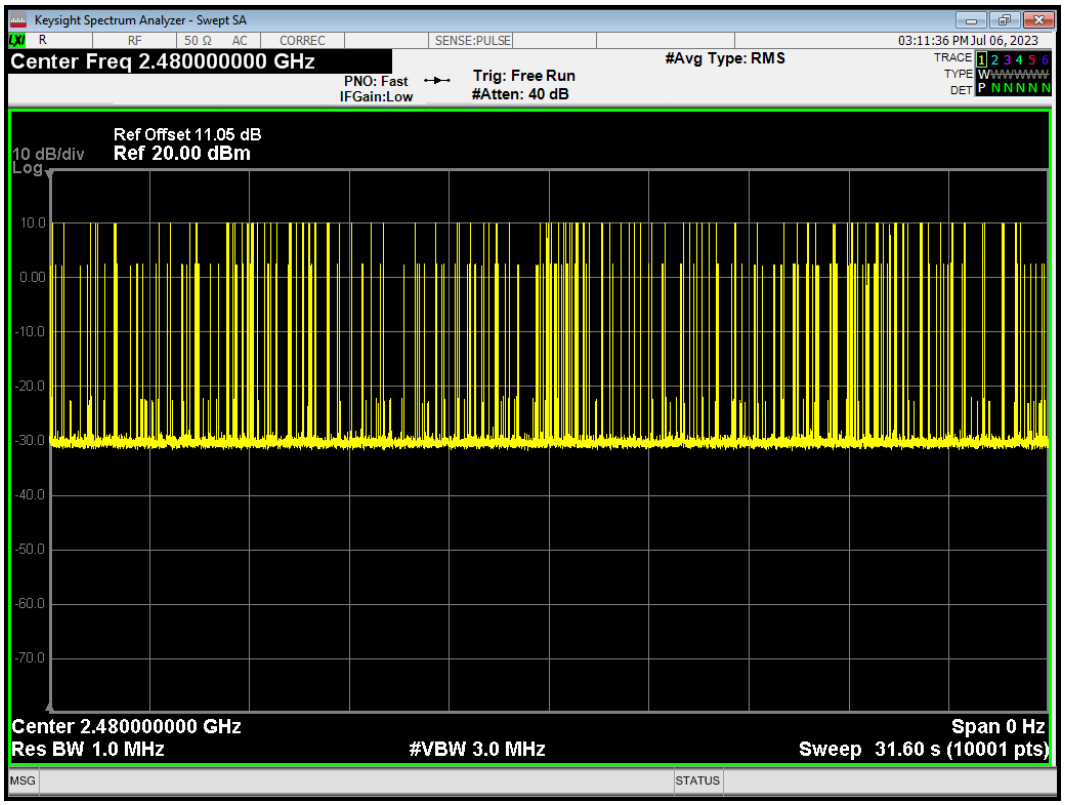


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Dwell 3-DH5 2480MHz One Burst



Dwell 3-DH5 2480MHz Accumulated



This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

5.5 Band Edge Compliance

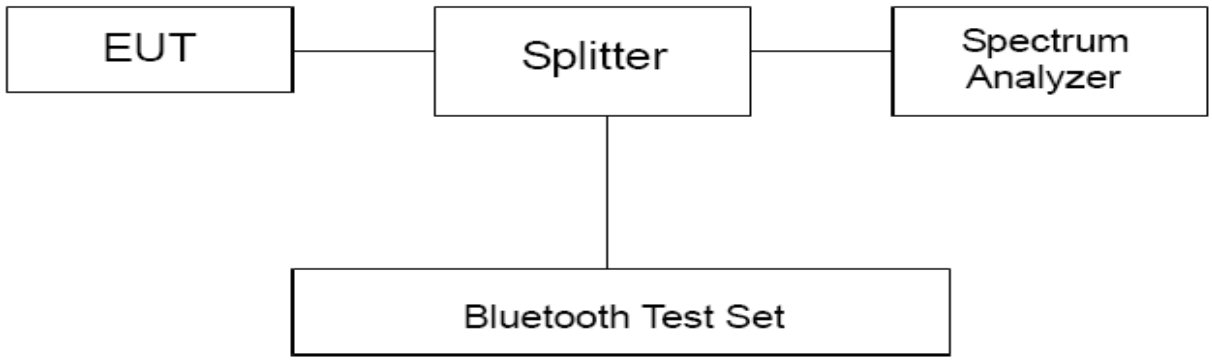
Ambient condition

Temperature	Relative humidity
20°C ~ 25°C	45% ~ 50%

Method of Measurement

The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. The lowest and highest channels were measured. The peak detector is used. RBW is set to 100 kHz and VBW is set to 300 kHz on spectrum analyzer. EUT test for Hopping On mode and Hopping Off mode.

Test Setup



Limits

Rule Part 15.247(d) specifies that “In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.”

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 1.96.

Frequency	Uncertainty
2GHz-3GHz	1.407 dB

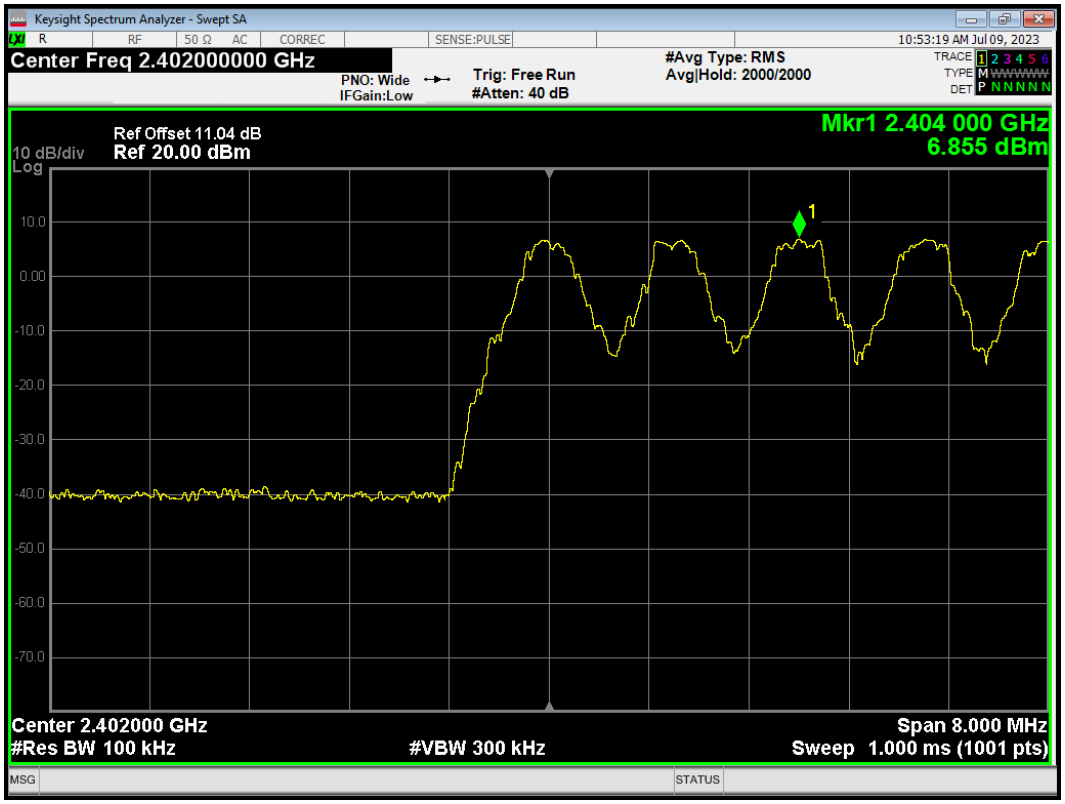
This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Test Results

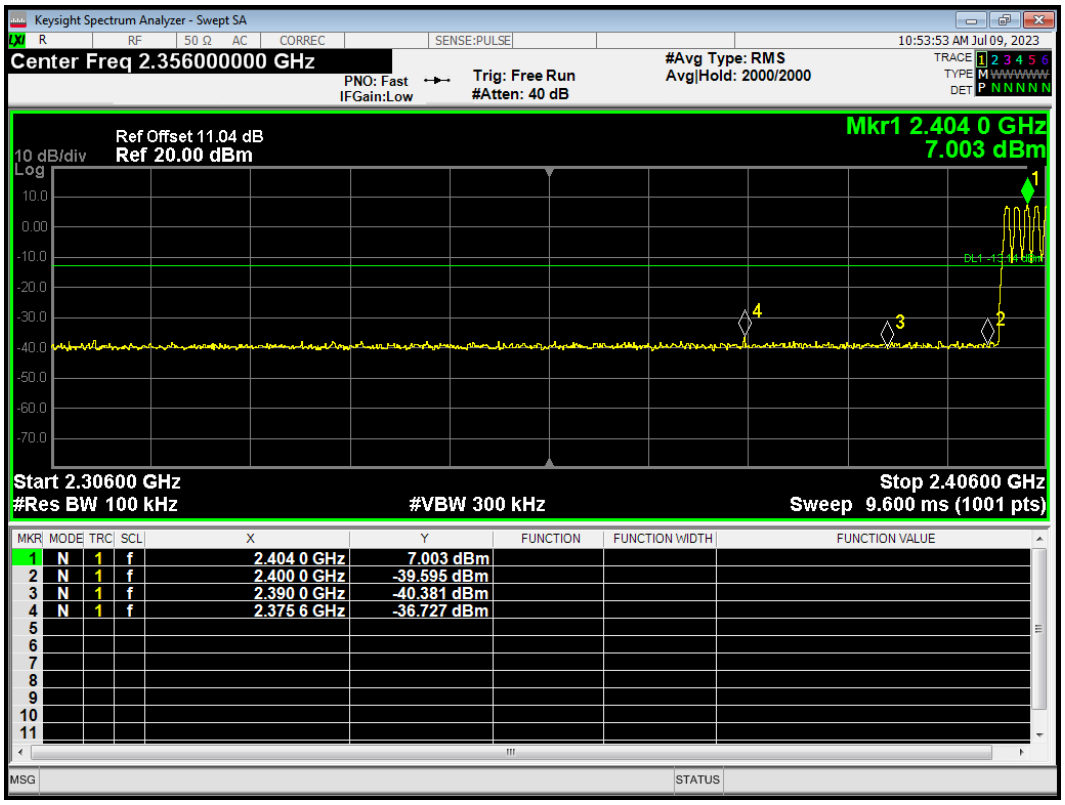
Hopping On

Internal Antenna

Band Edge(Hopping) 1-DH5 2402MHz Hopping Ref

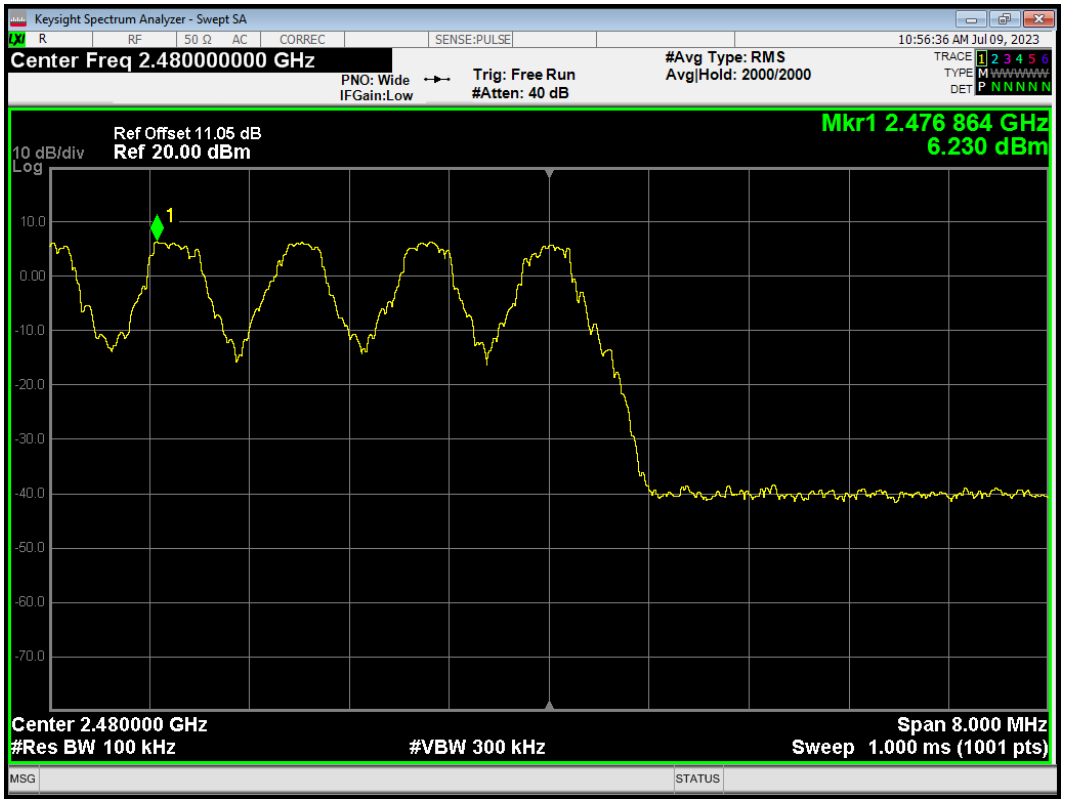


Band Edge(Hopping) 1-DH5 2402MHz Hopping Emission

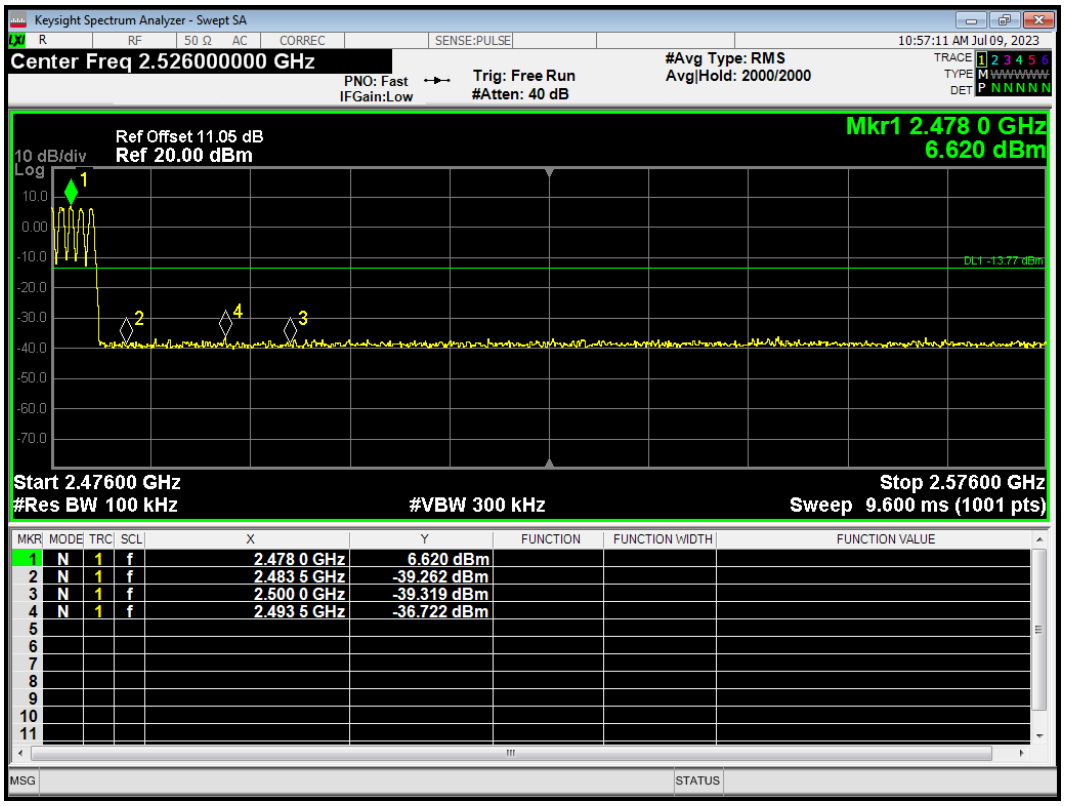


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge(Hopping) 1-DH5 2480MHz Hopping Ref

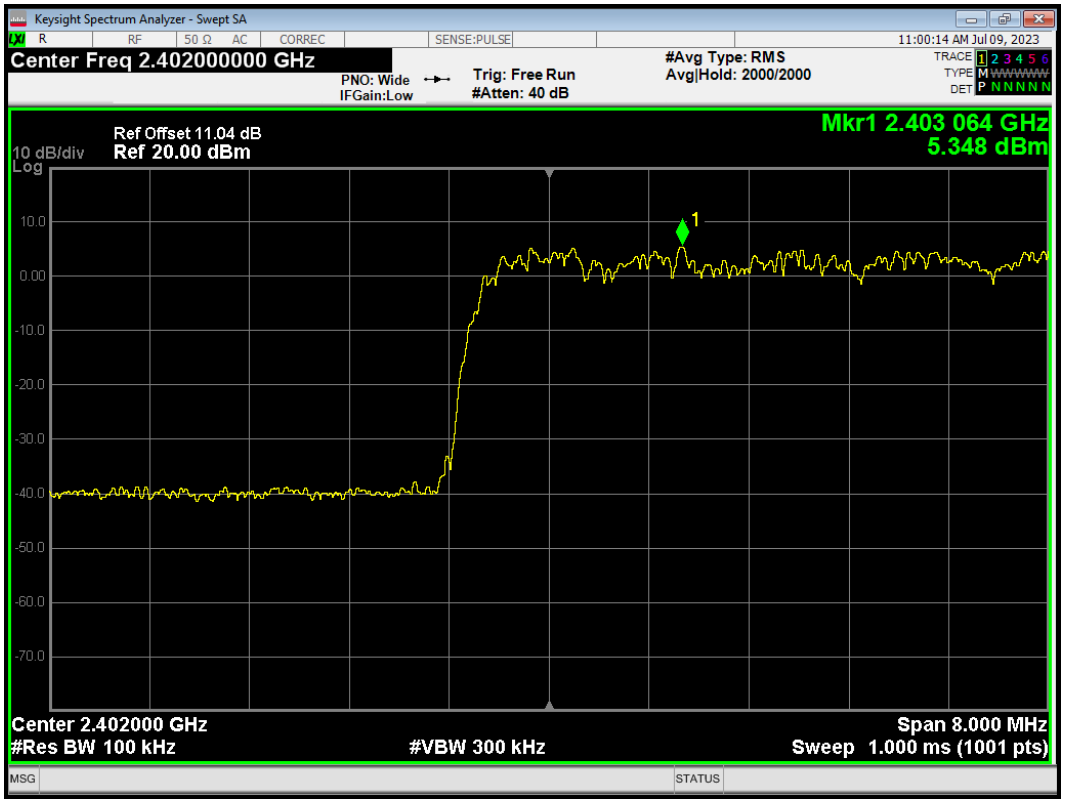


Band Edge(Hopping) 1-DH5 2480MHz Hopping Emission

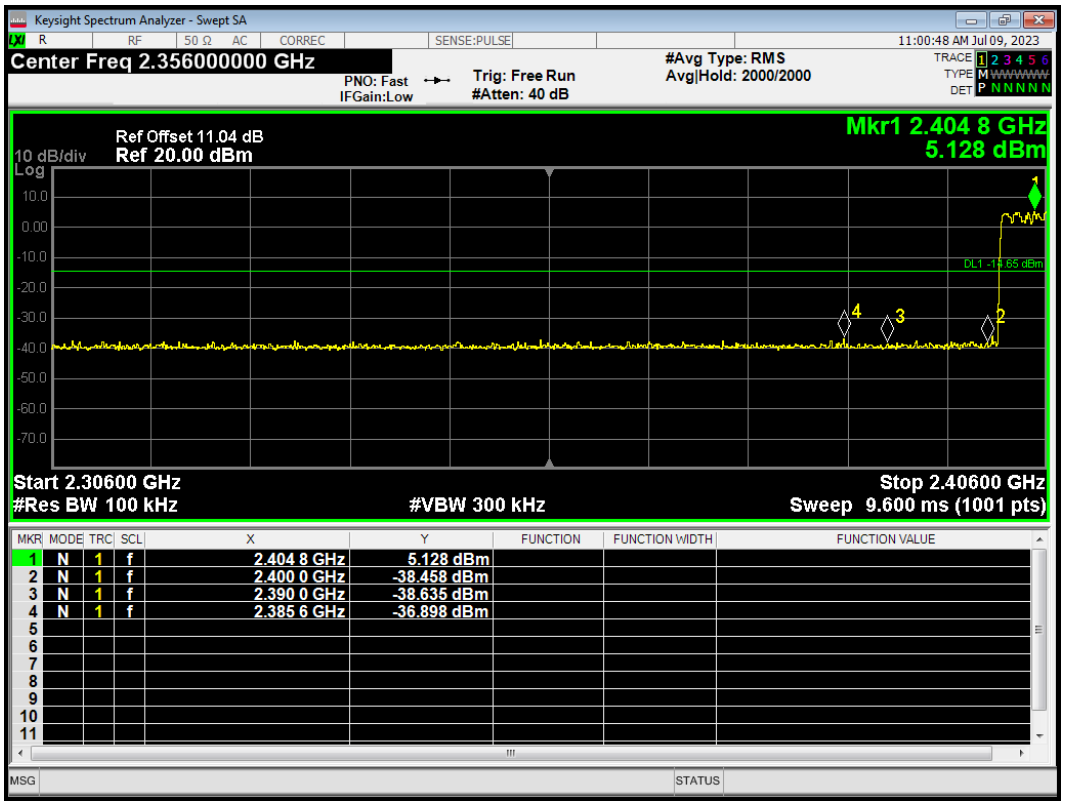


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge(Hopping) 2-DH5 2402MHz Hopping Ref

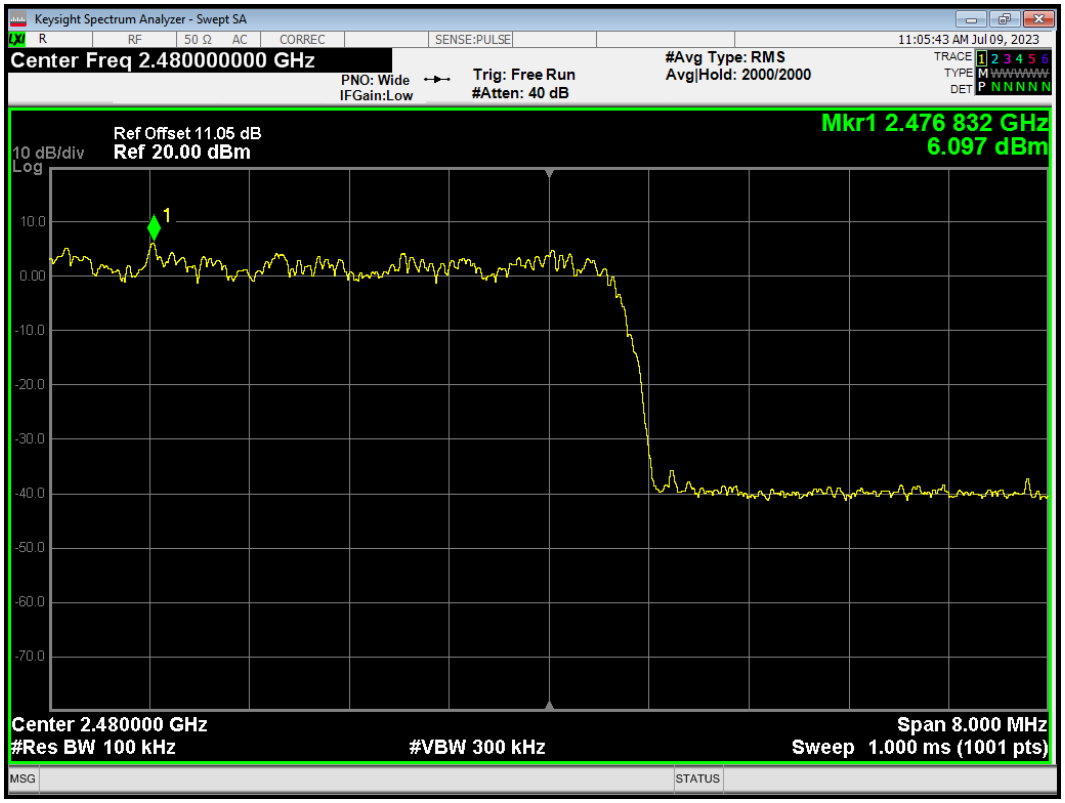


Band Edge(Hopping) 2-DH5 2402MHz Hopping Emission

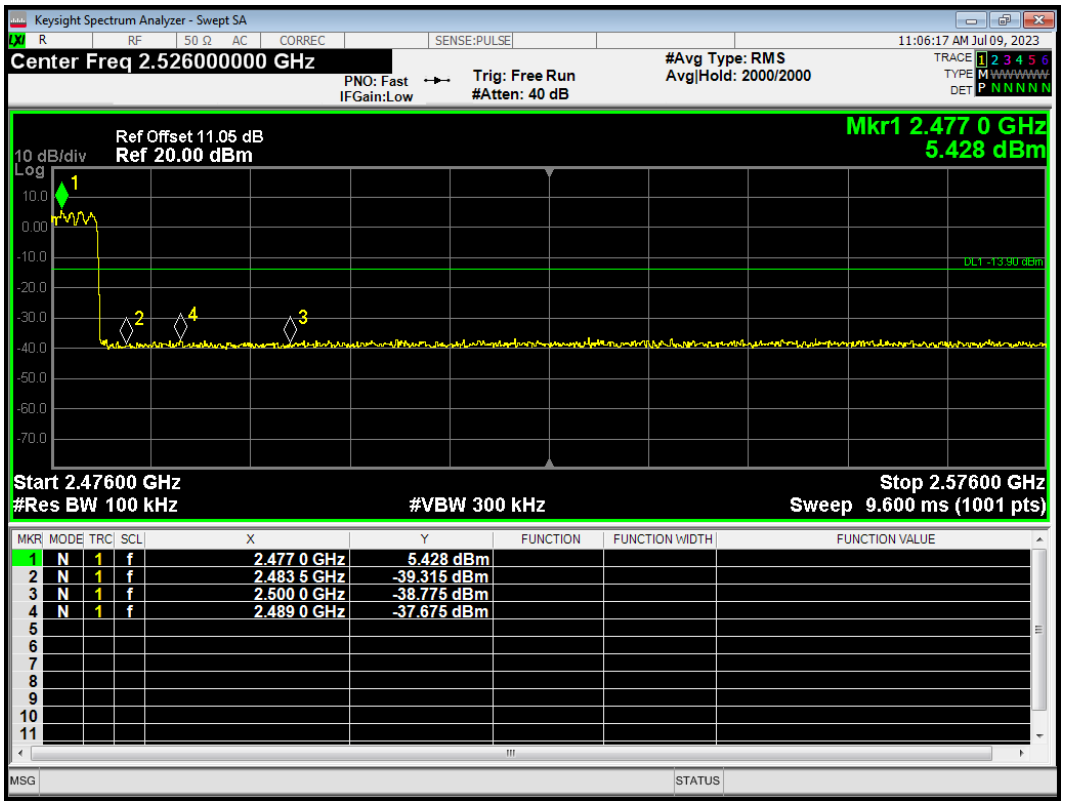


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge(Hopping) 2-DH5 2480MHz Hopping Ref

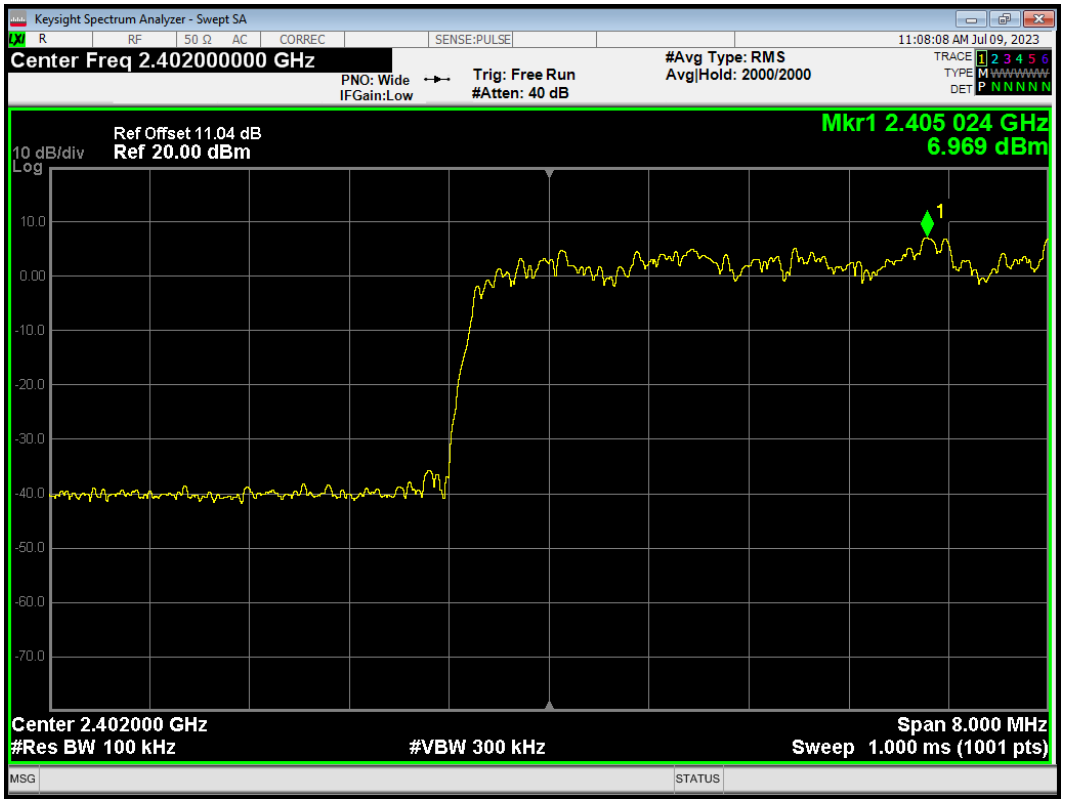


Band Edge(Hopping) 2-DH5 2480MHz Hopping Emission

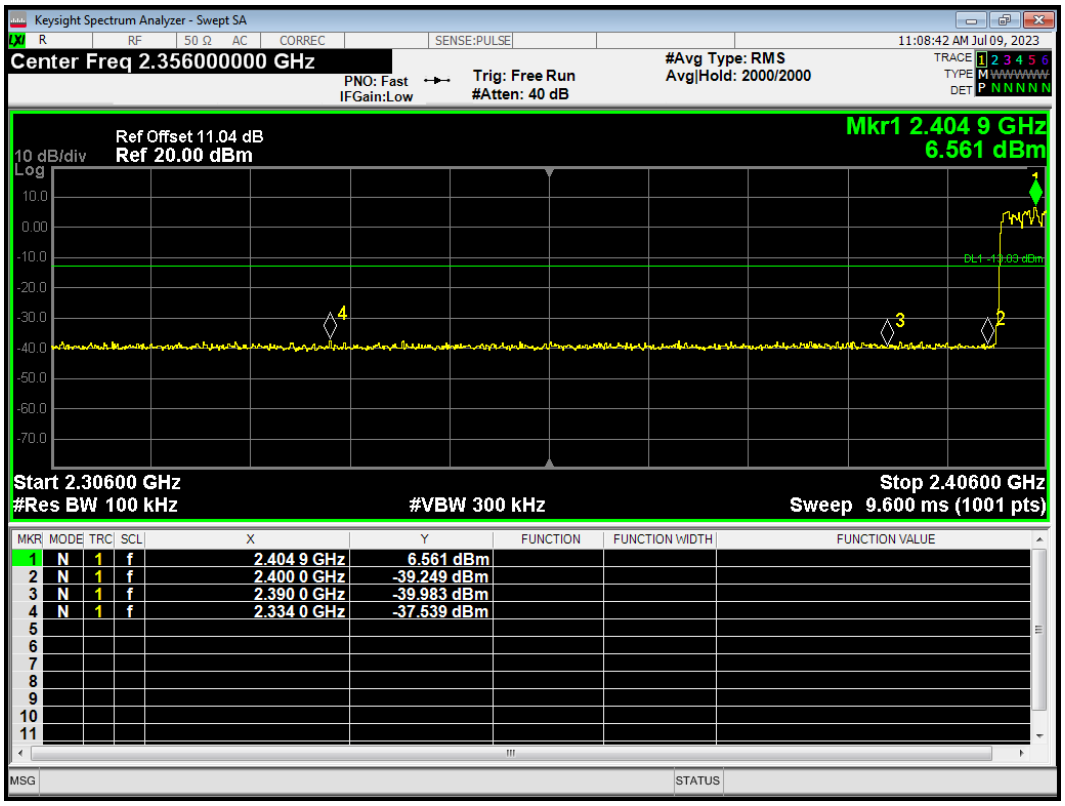


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge(Hopping) 3-DH5 2402MHz Hopping Ref

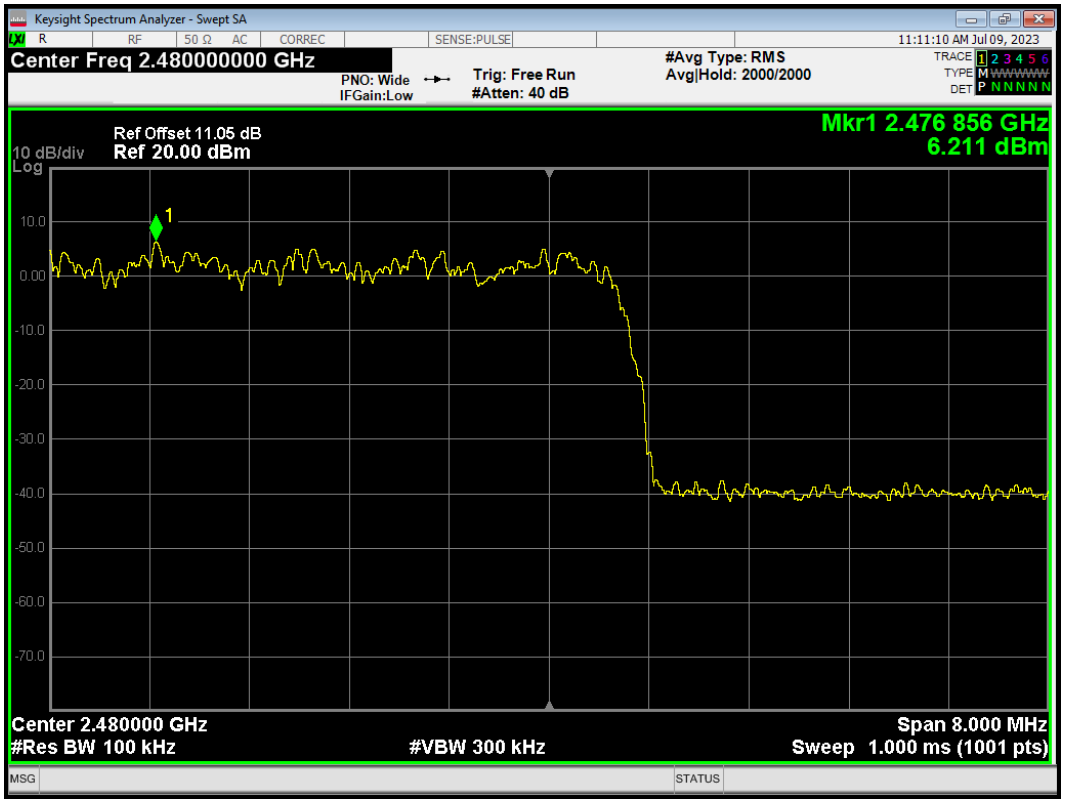


Band Edge(Hopping) 3-DH5 2402MHz Hopping Emission

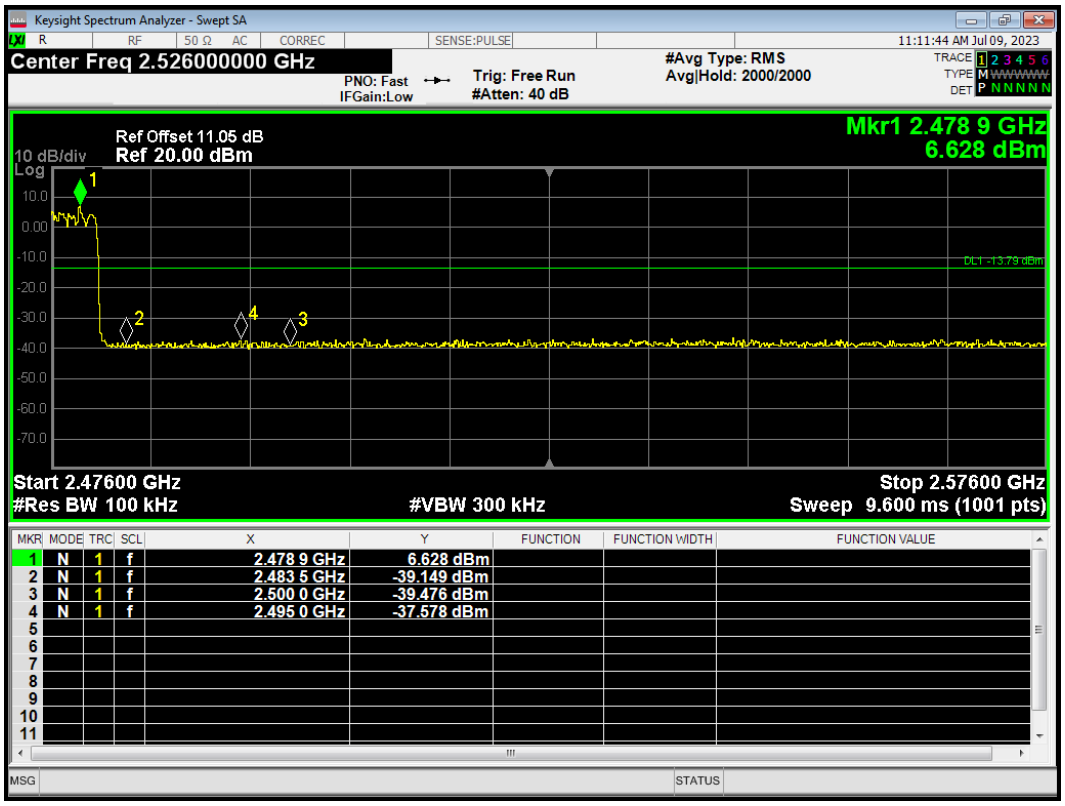


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge(Hopping) 3-DH5 2480MHz Hopping Ref



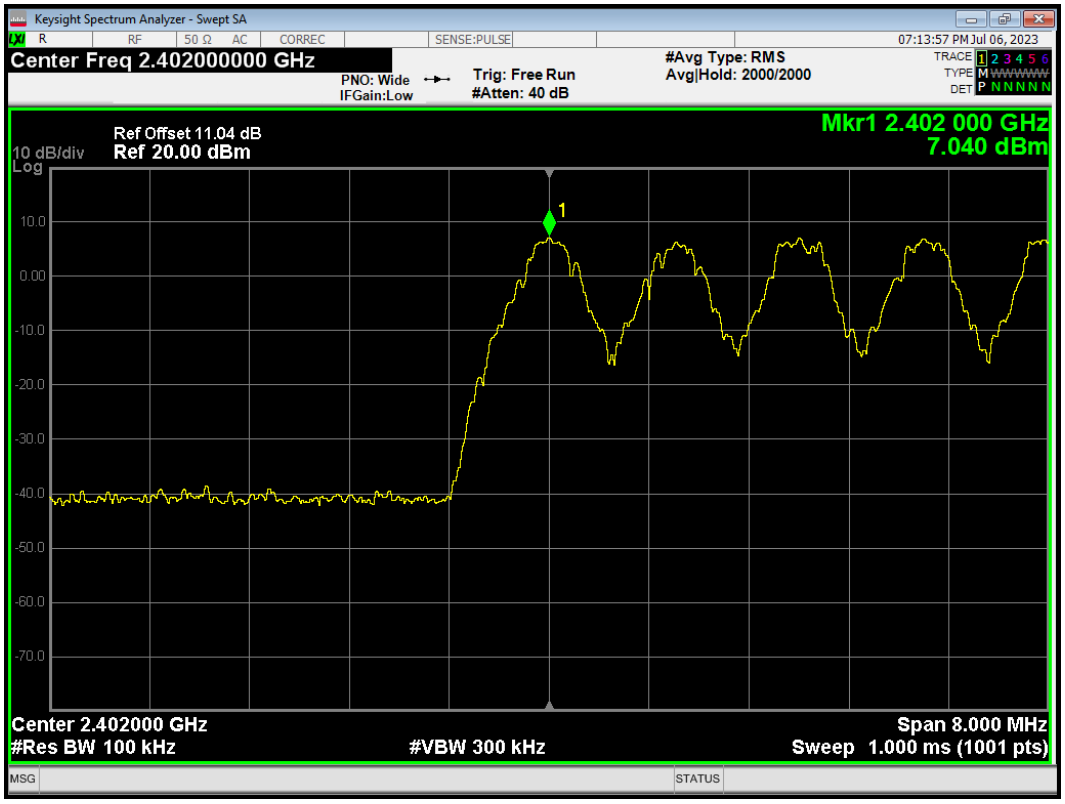
Band Edge(Hopping) 3-DH5 2480MHz Hopping Emission



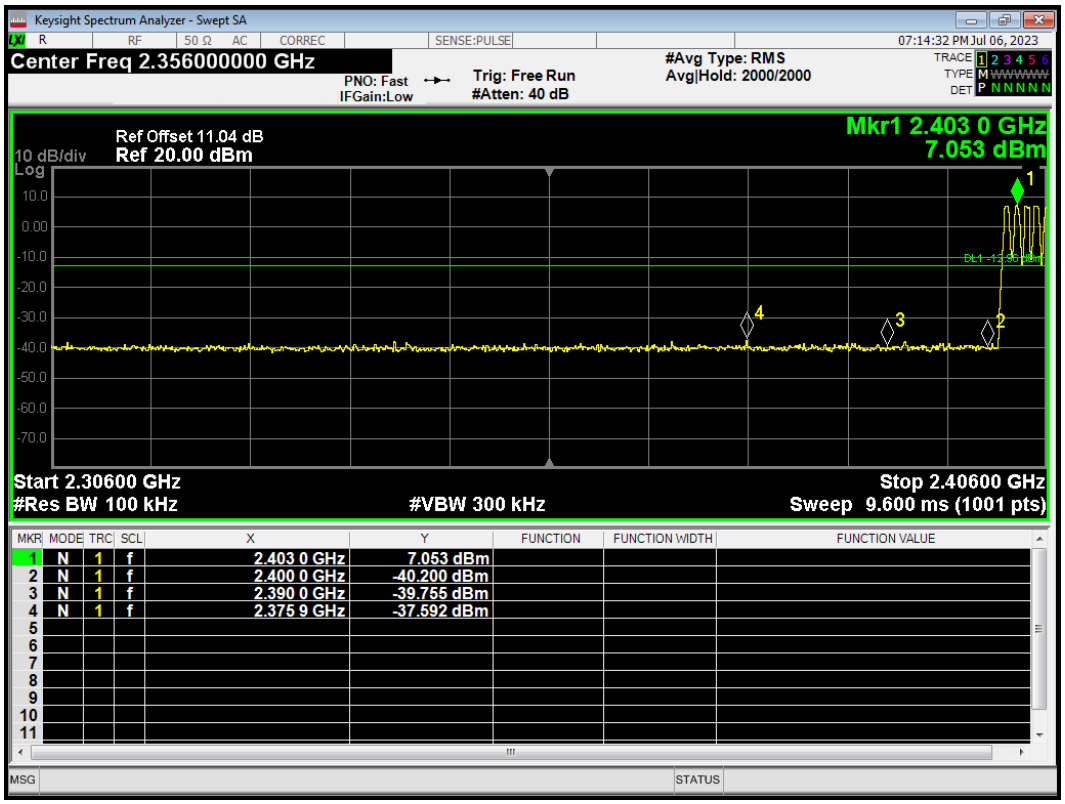
This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

External Antenna

Band Edge(Hopping) 1-DH5 2402MHz Hopping Ref

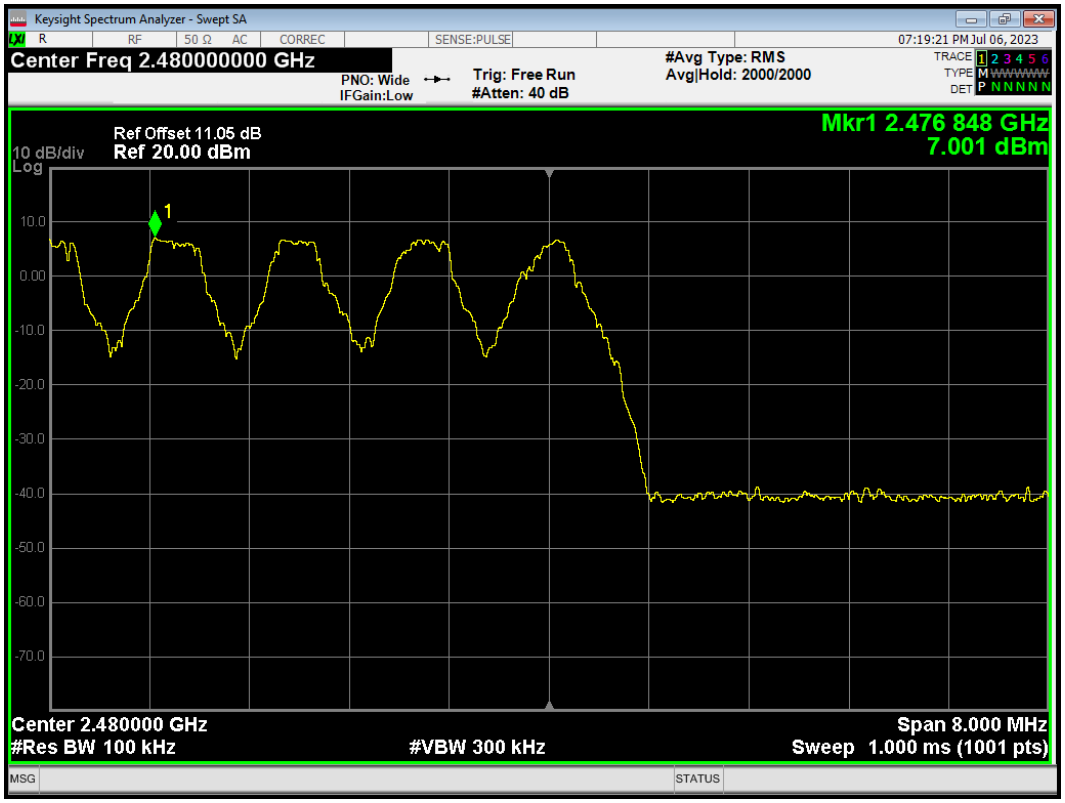


Band Edge(Hopping) 1-DH5 2402MHz Hopping Emission

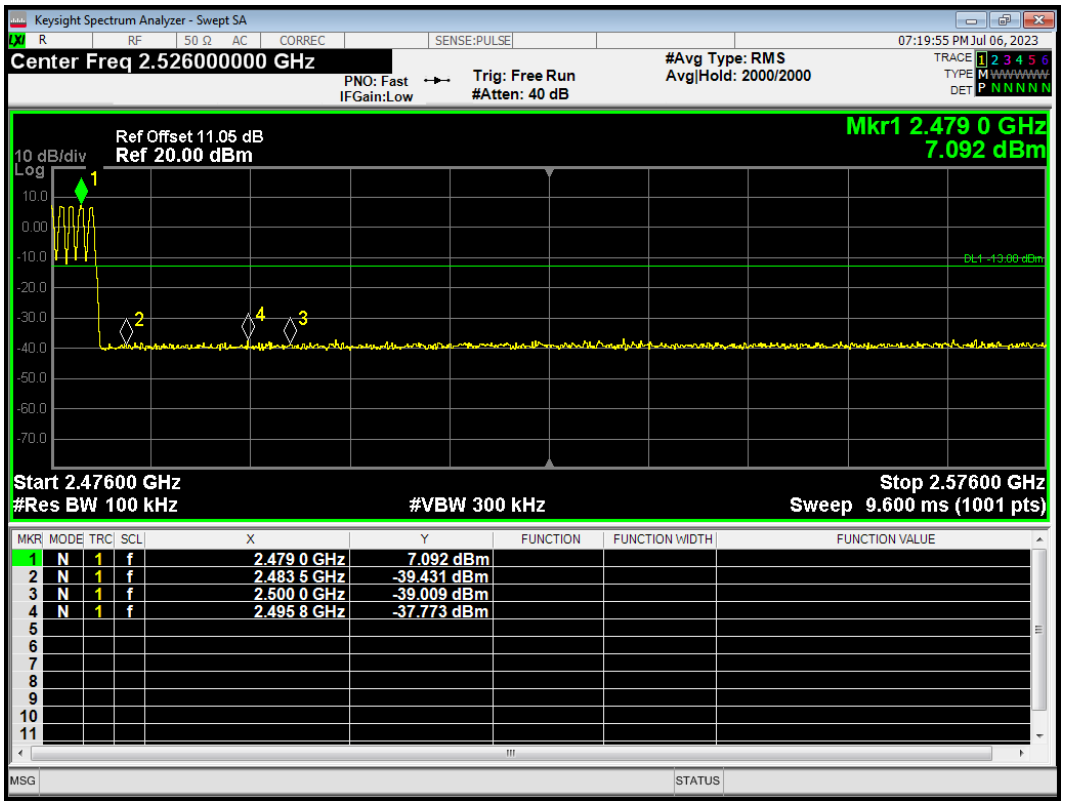


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge(Hopping) 1-DH5 2480MHz Hopping Ref

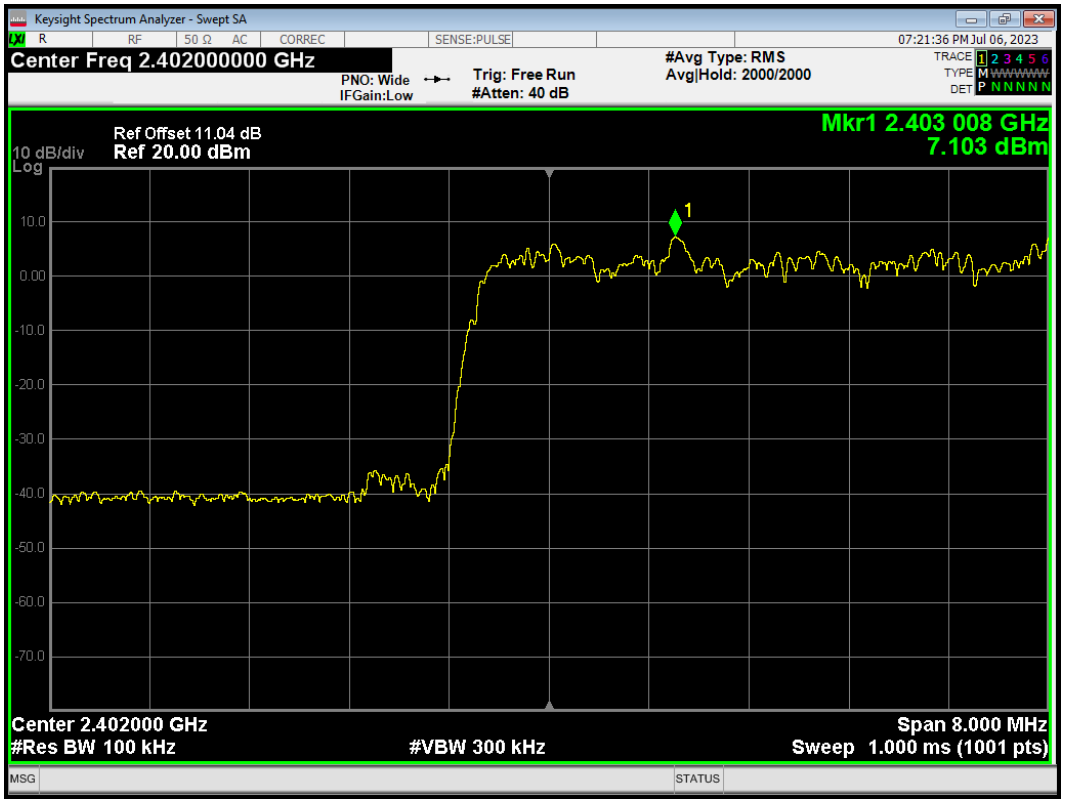


Band Edge(Hopping) 1-DH5 2480MHz Hopping Emission

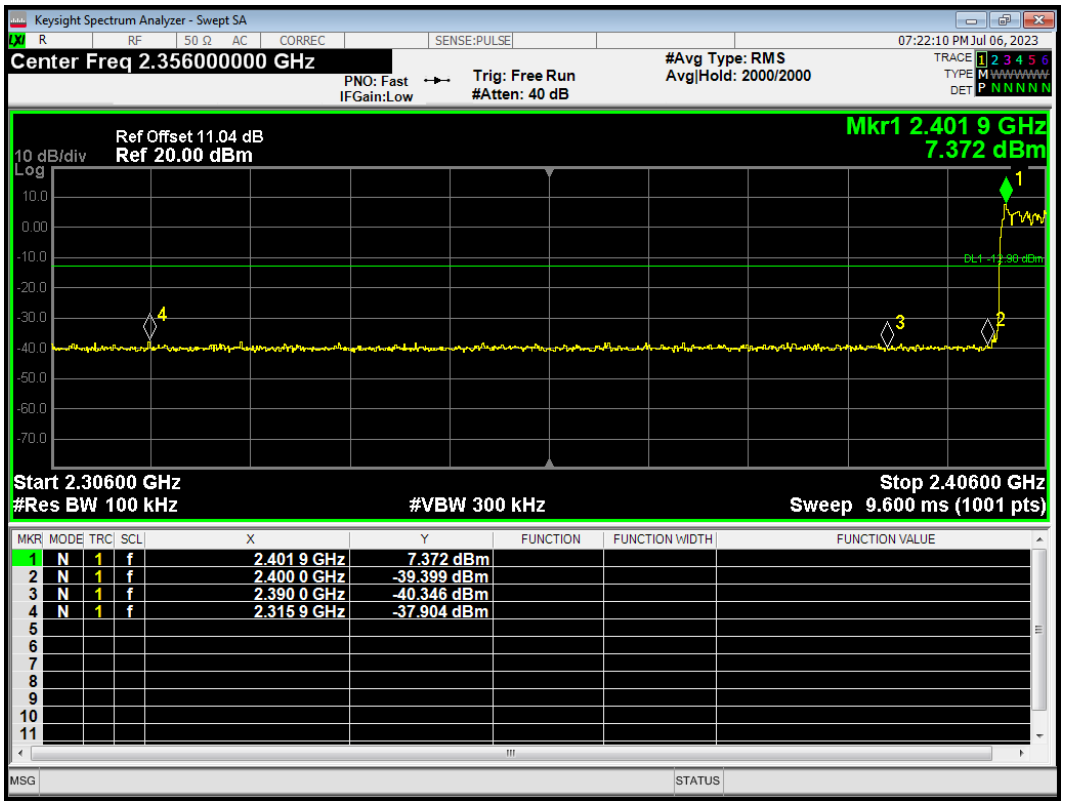


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge(Hopping) 2-DH5 2402MHz Hopping Ref

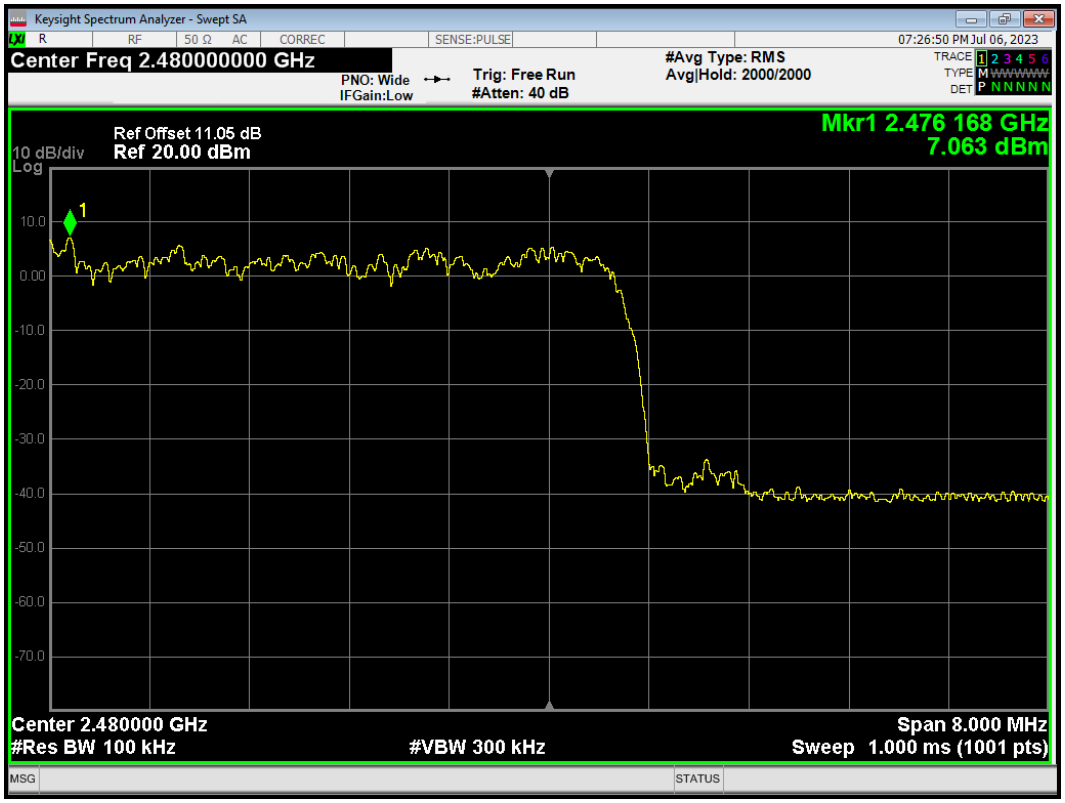


Band Edge(Hopping) 2-DH5 2402MHz Hopping Emission

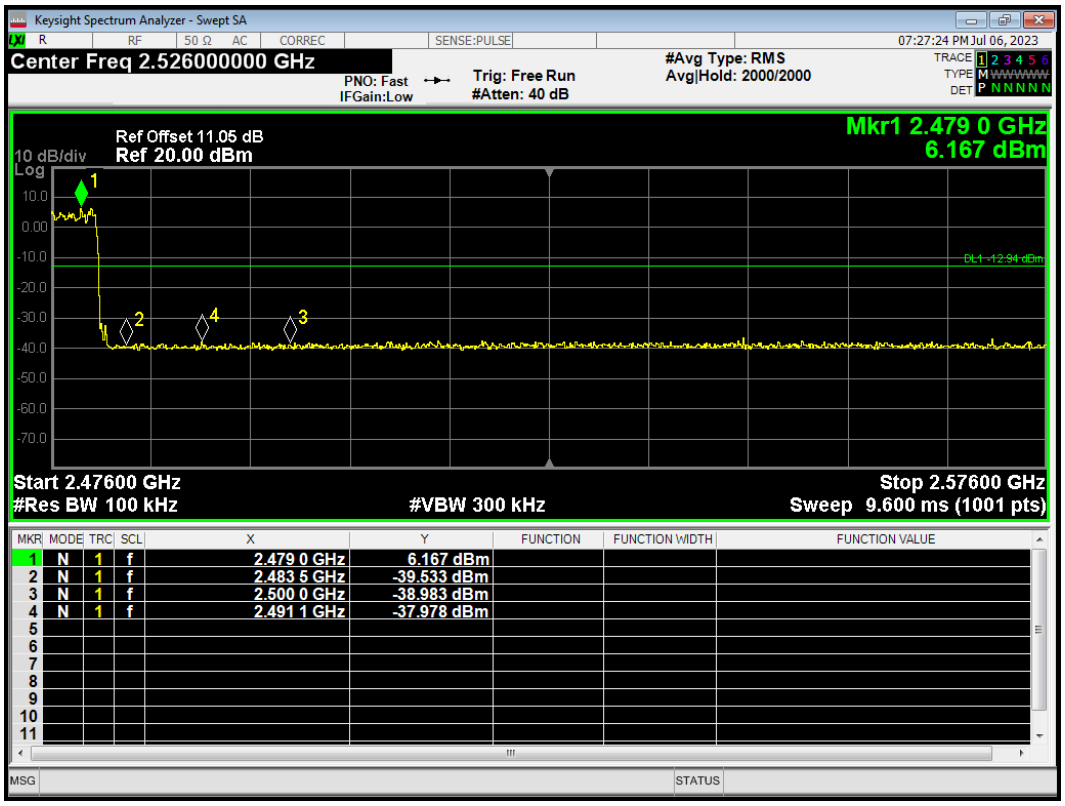


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge(Hopping) 2-DH5 2480MHz Hopping Ref

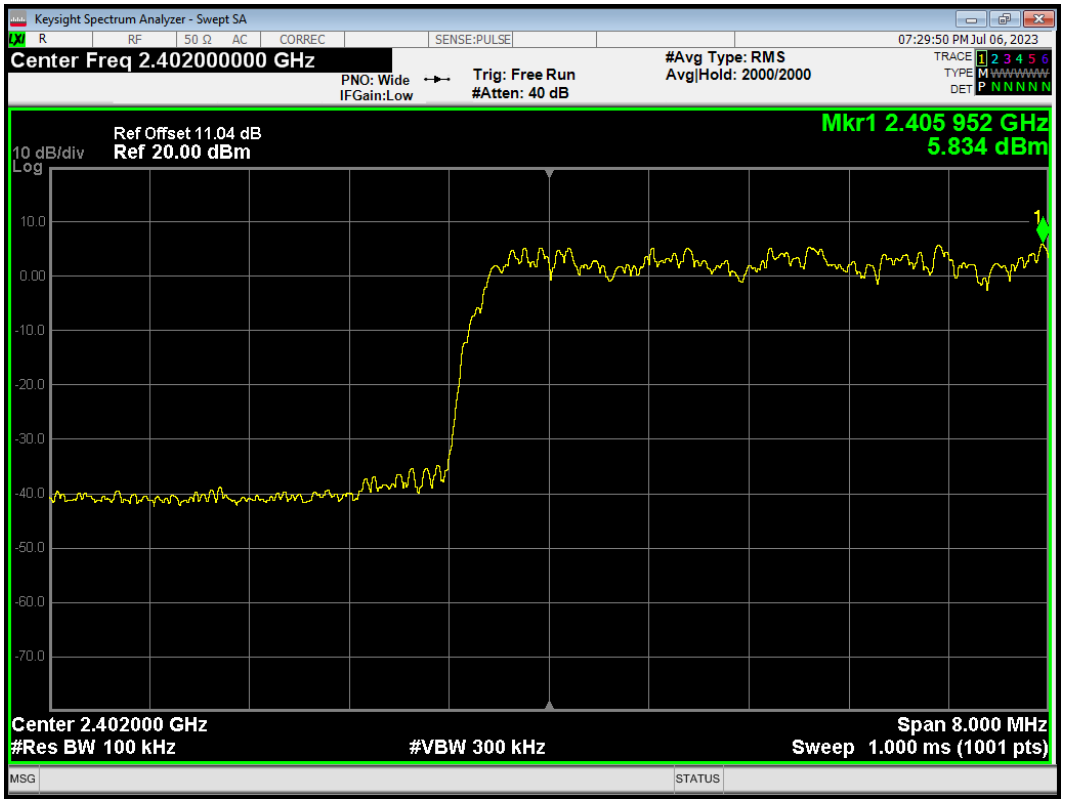


Band Edge(Hopping) 2-DH5 2480MHz Hopping Emission

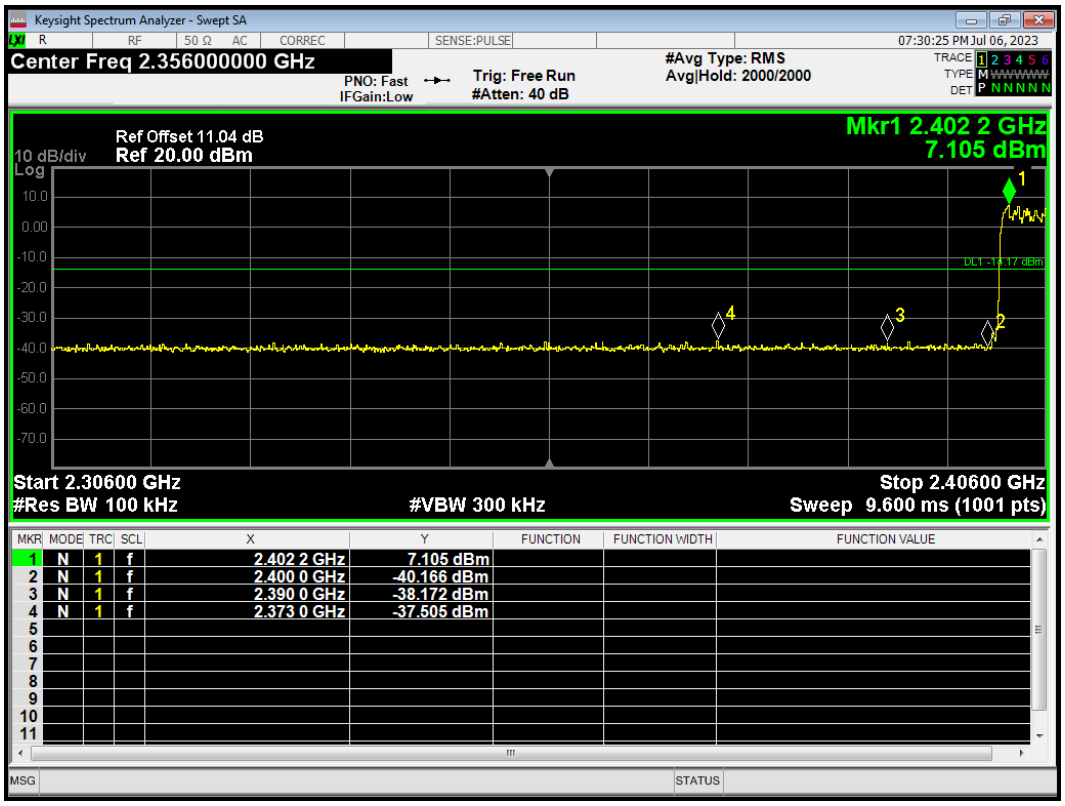


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge(Hopping) 3-DH5 2402MHz Hopping Ref

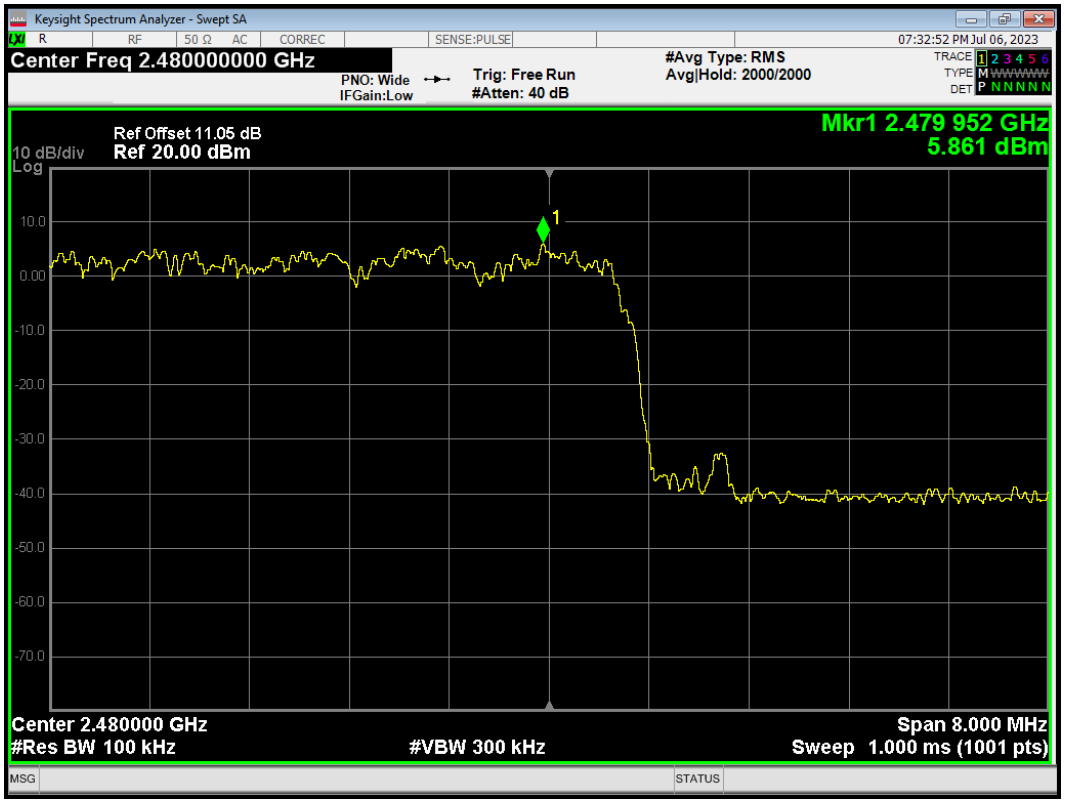


Band Edge(Hopping) 3-DH5 2402MHz Hopping Emission

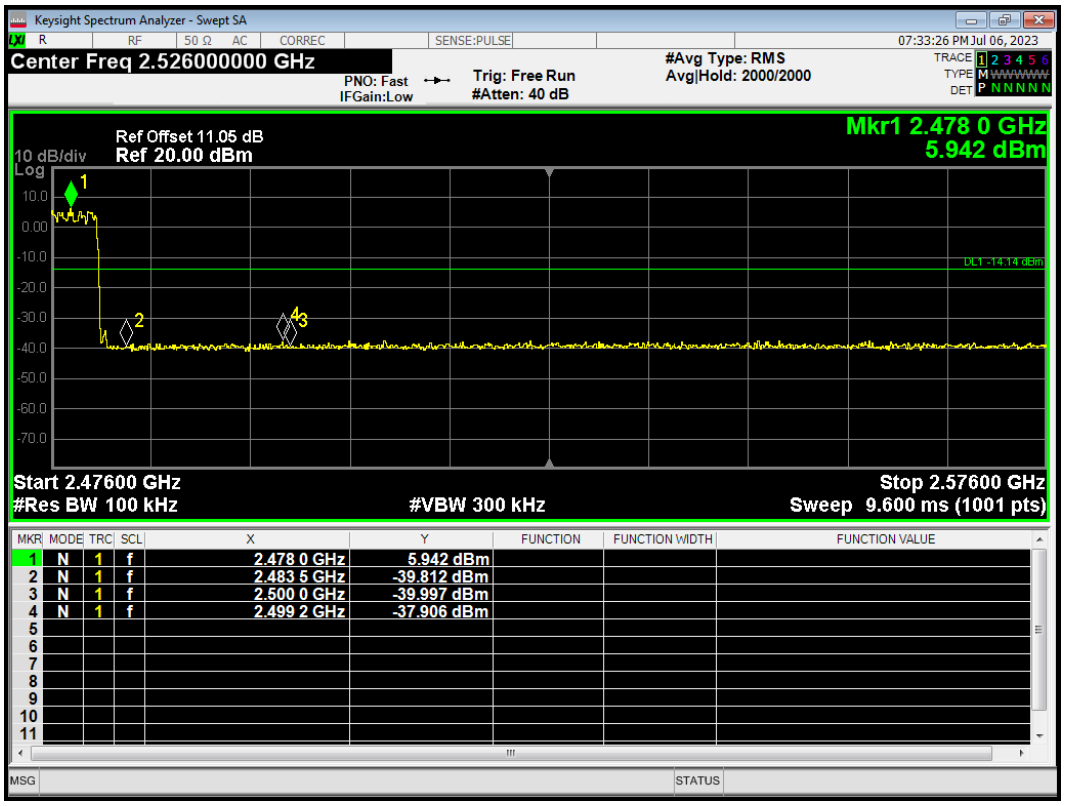


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge(Hopping) 3-DH5 2480MHz Hopping Ref



Band Edge(Hopping) 3-DH5 2480MHz Hopping Emission

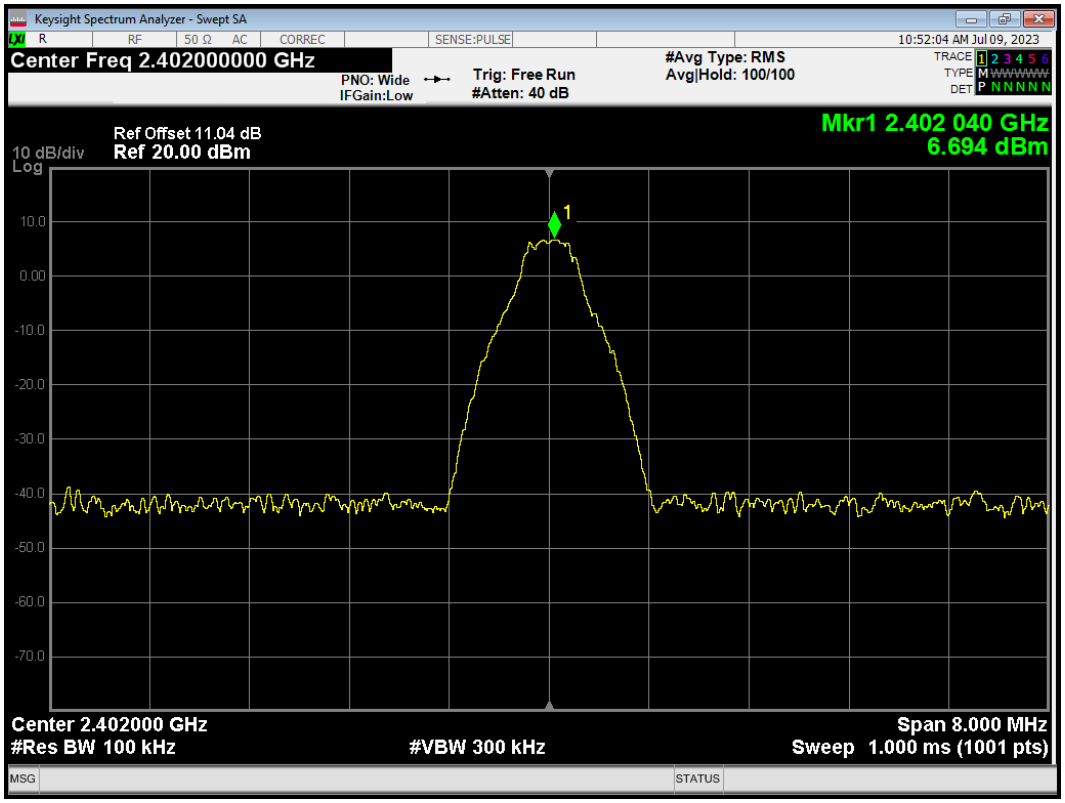


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

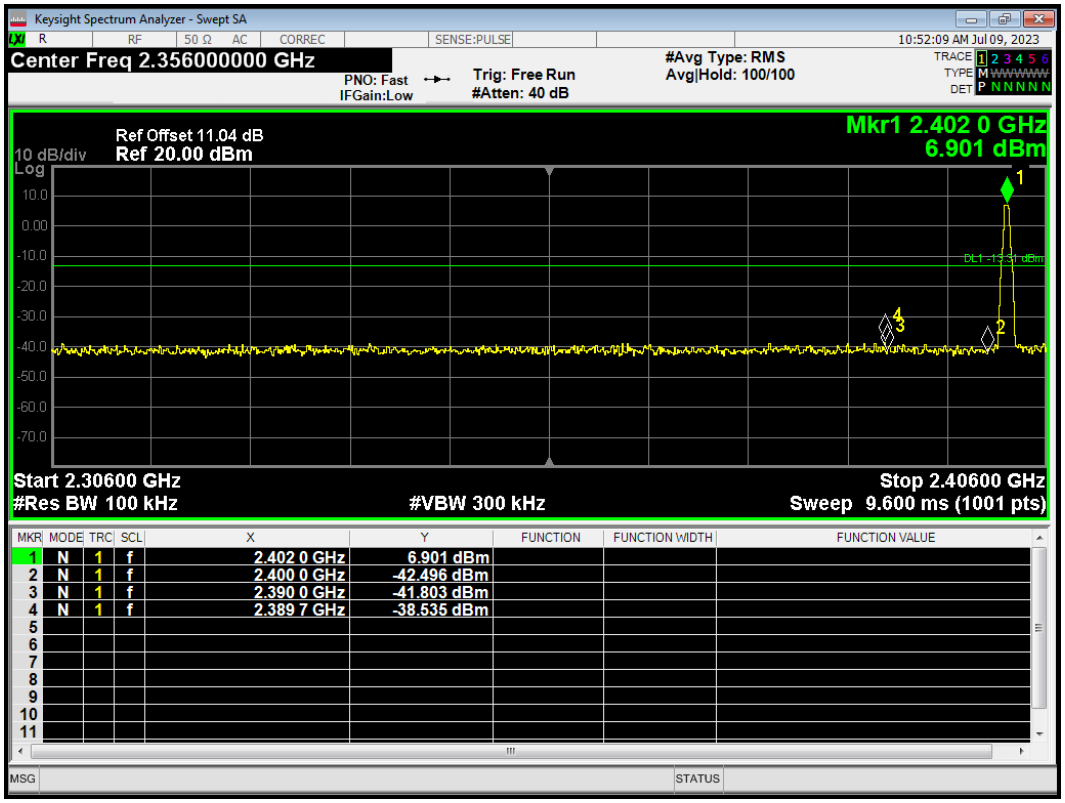
Hopping Off

Internal Antenna

Band Edge 1-DH5 2402MHz No-Hopping Ref

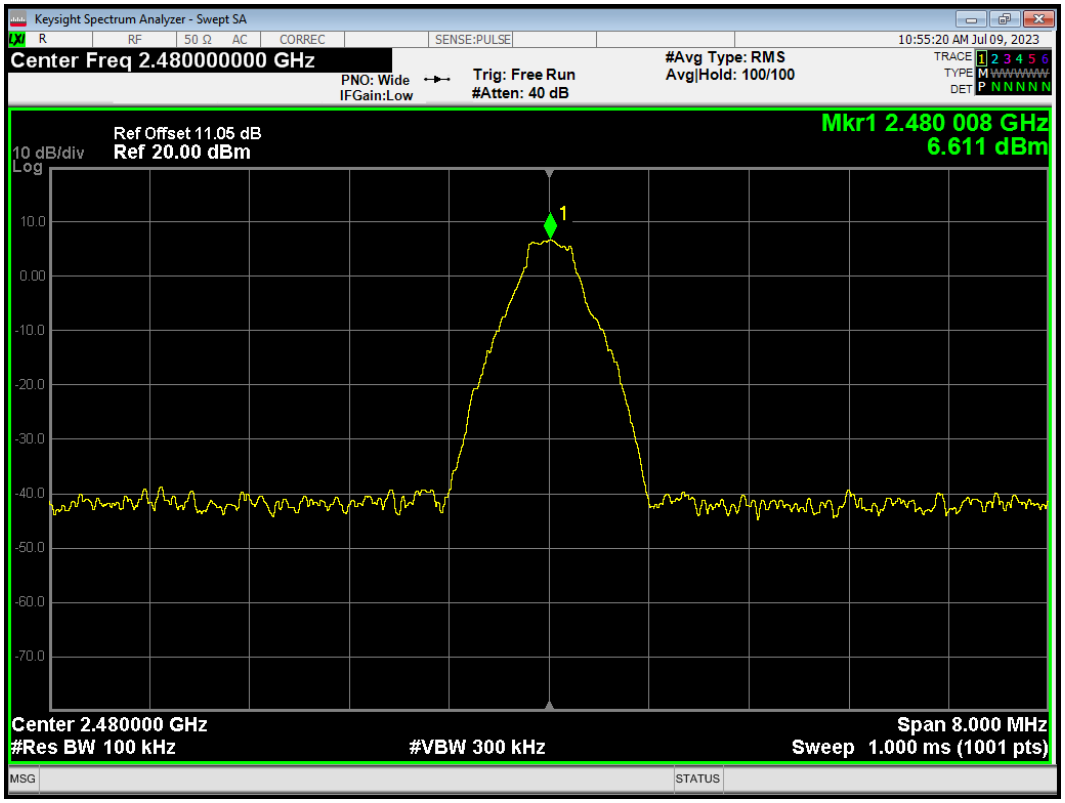


Band Edge 1-DH5 2402MHz No-Hopping Emission

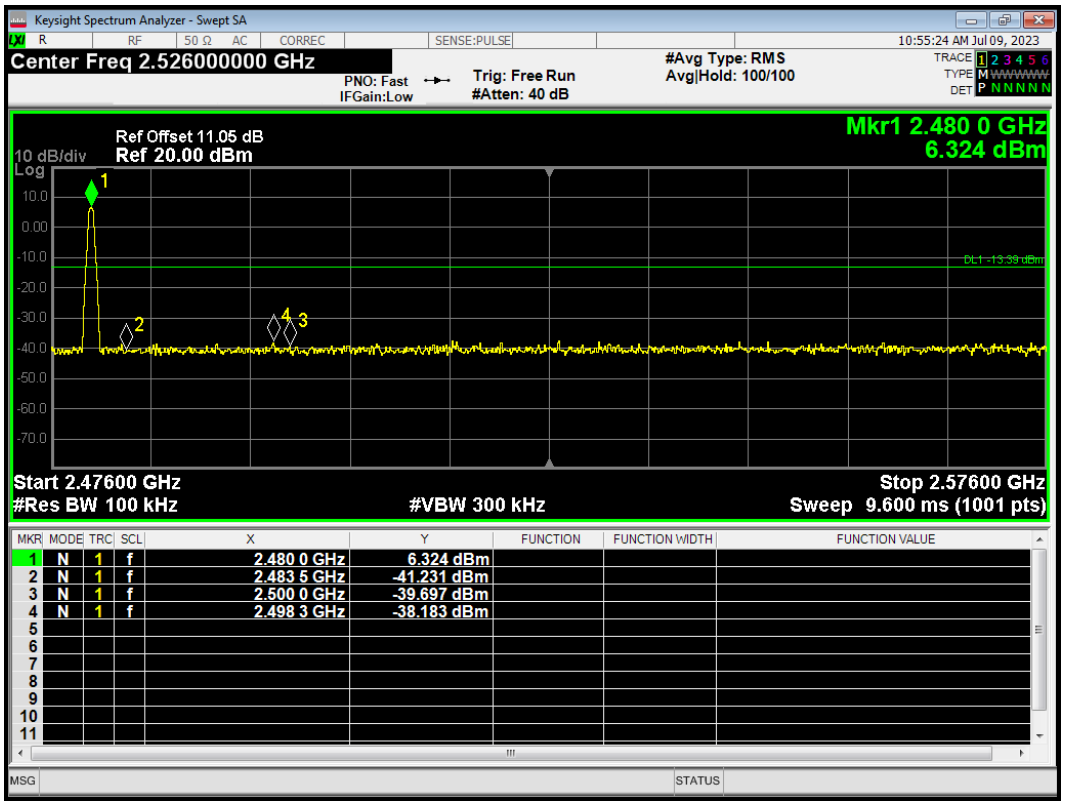


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge 1-DH5 2480MHz No-Hopping Ref

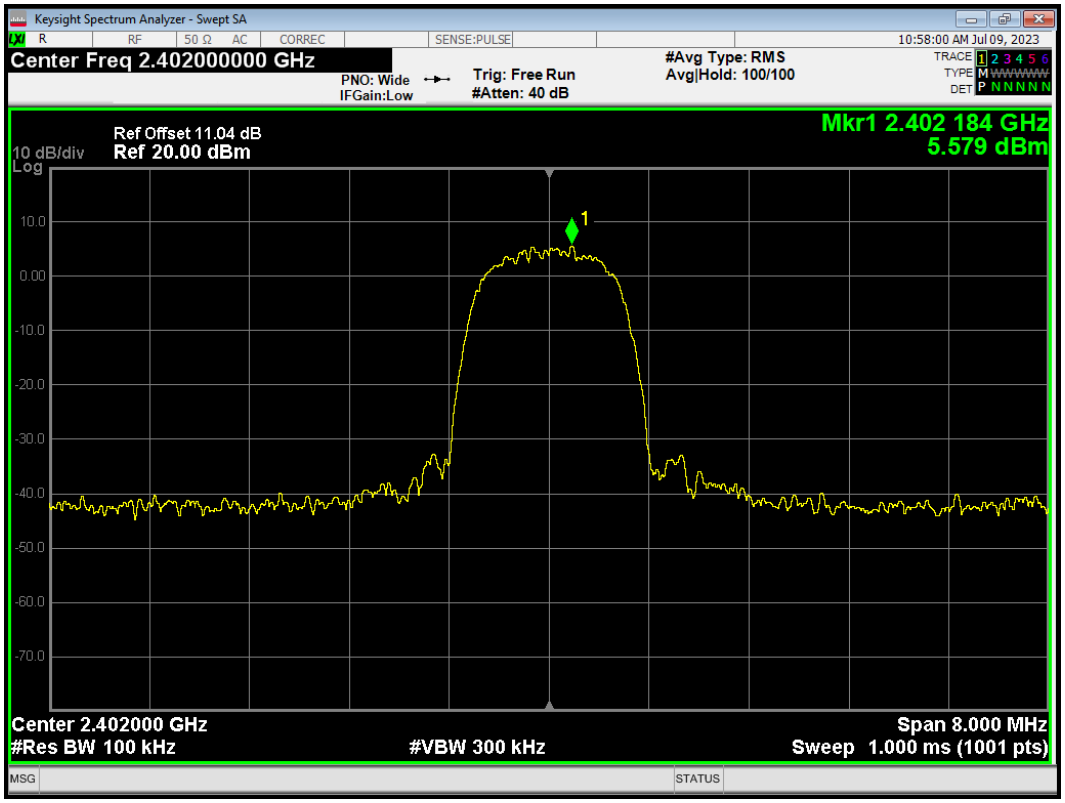


Band Edge 1-DH5 2480MHz No-Hopping Emission

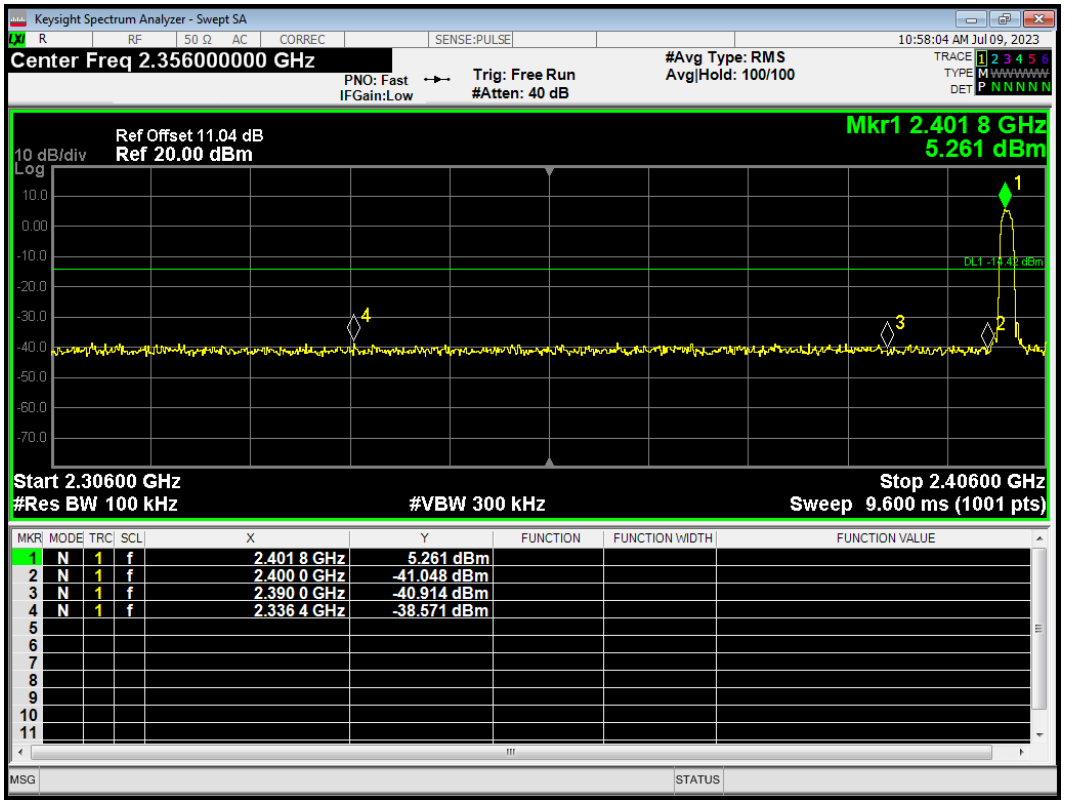


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge 2-DH5 2402MHz No-Hopping Ref

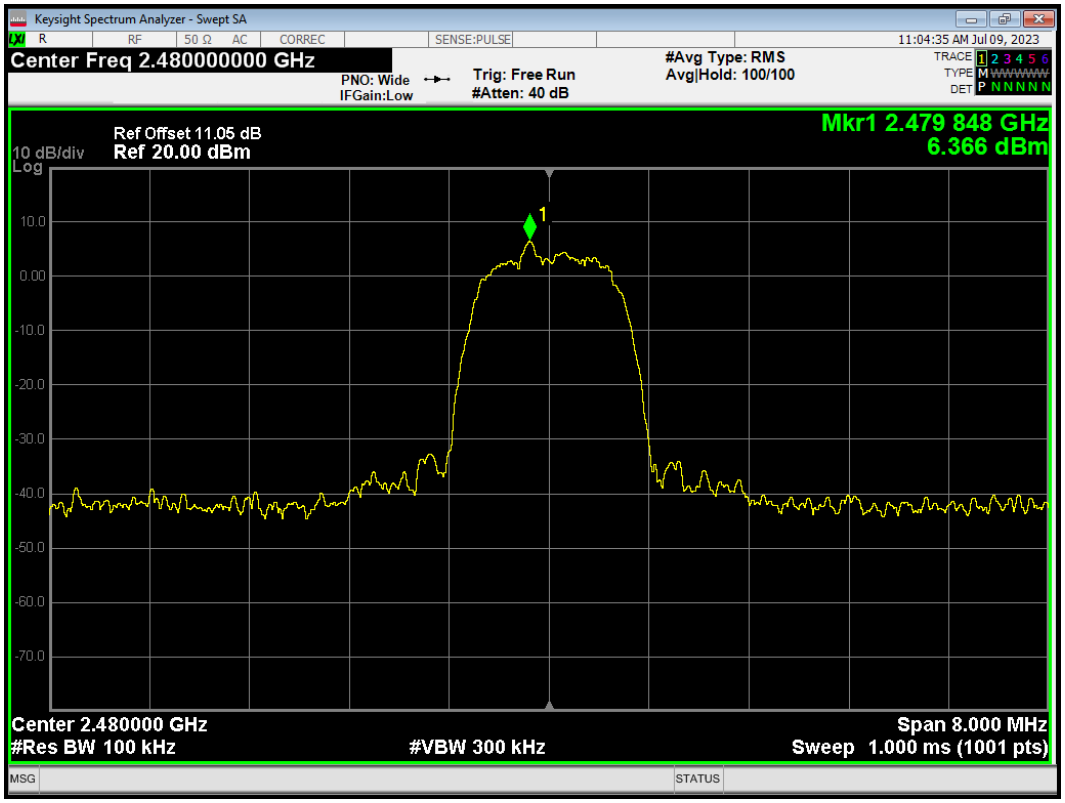


Band Edge 2-DH5 2402MHz No-Hopping Emission

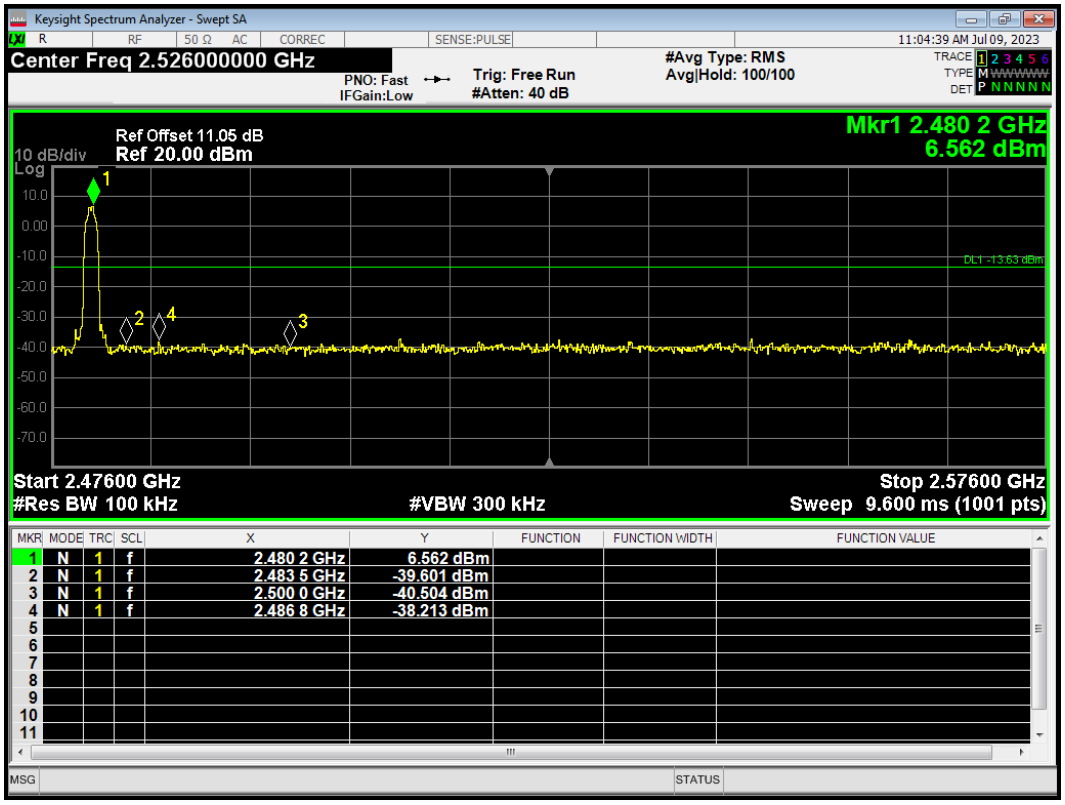


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge 2-DH5 2480MHz No-Hopping Ref

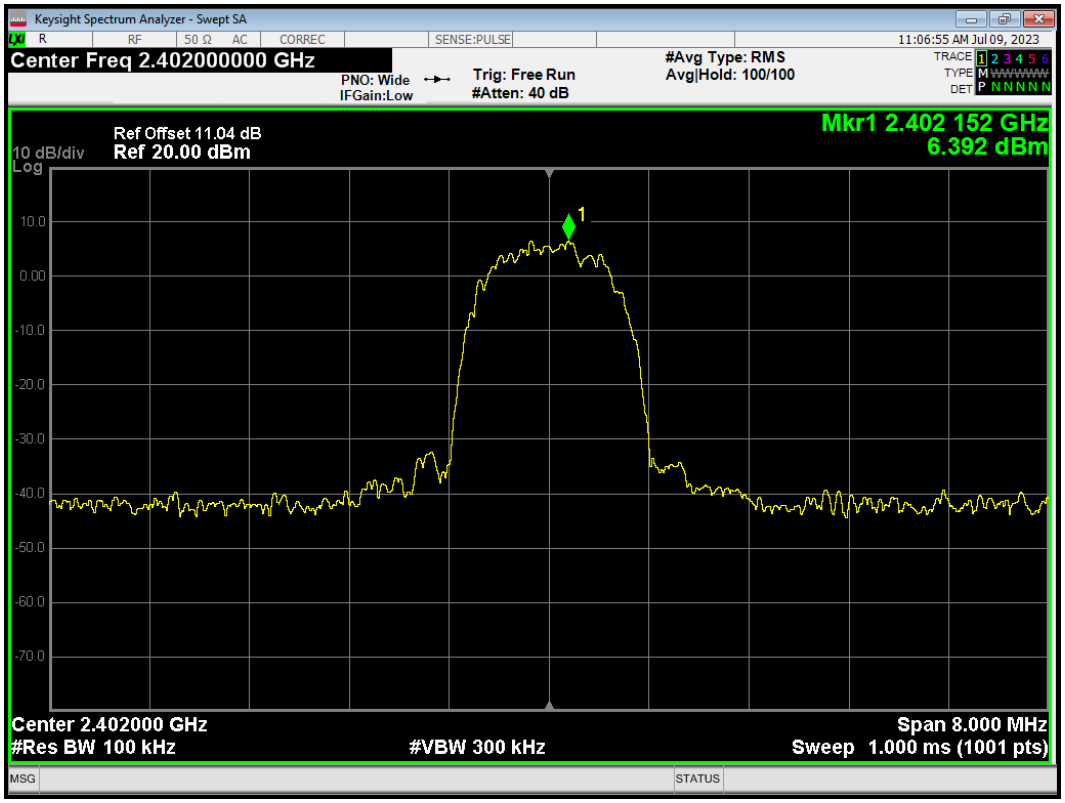


Band Edge 2-DH5 2480MHz No-Hopping Emission

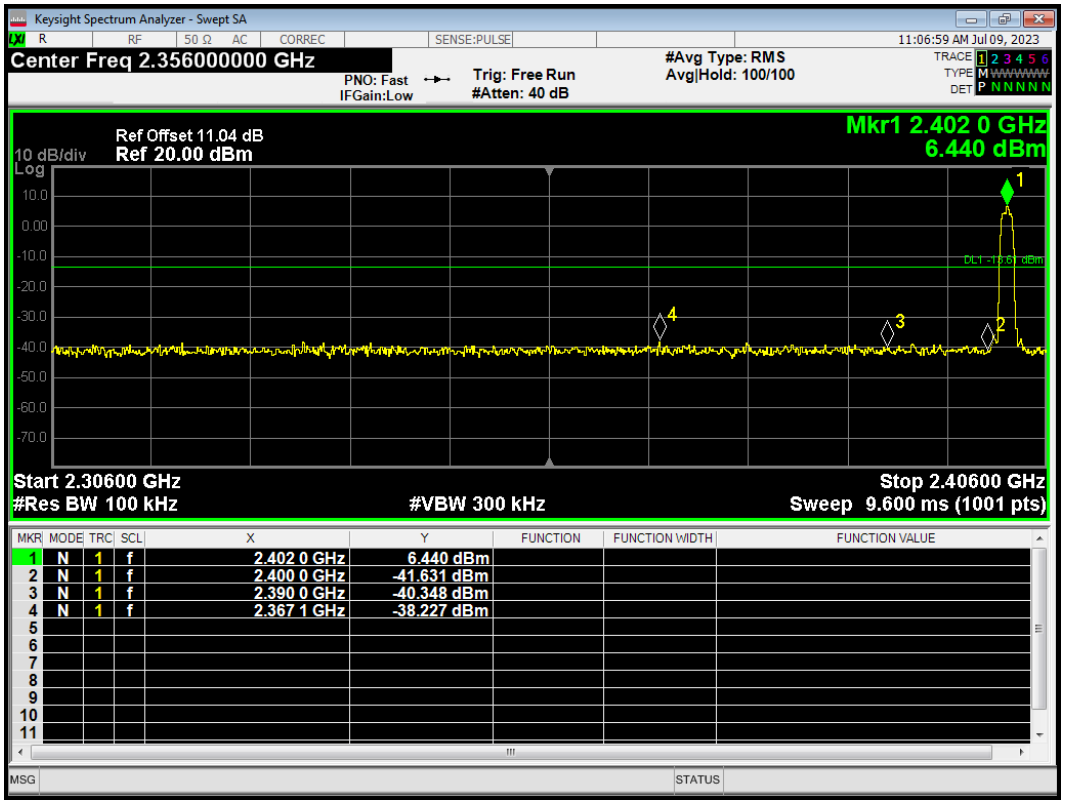


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge 3-DH5 2402MHz No-Hopping Ref

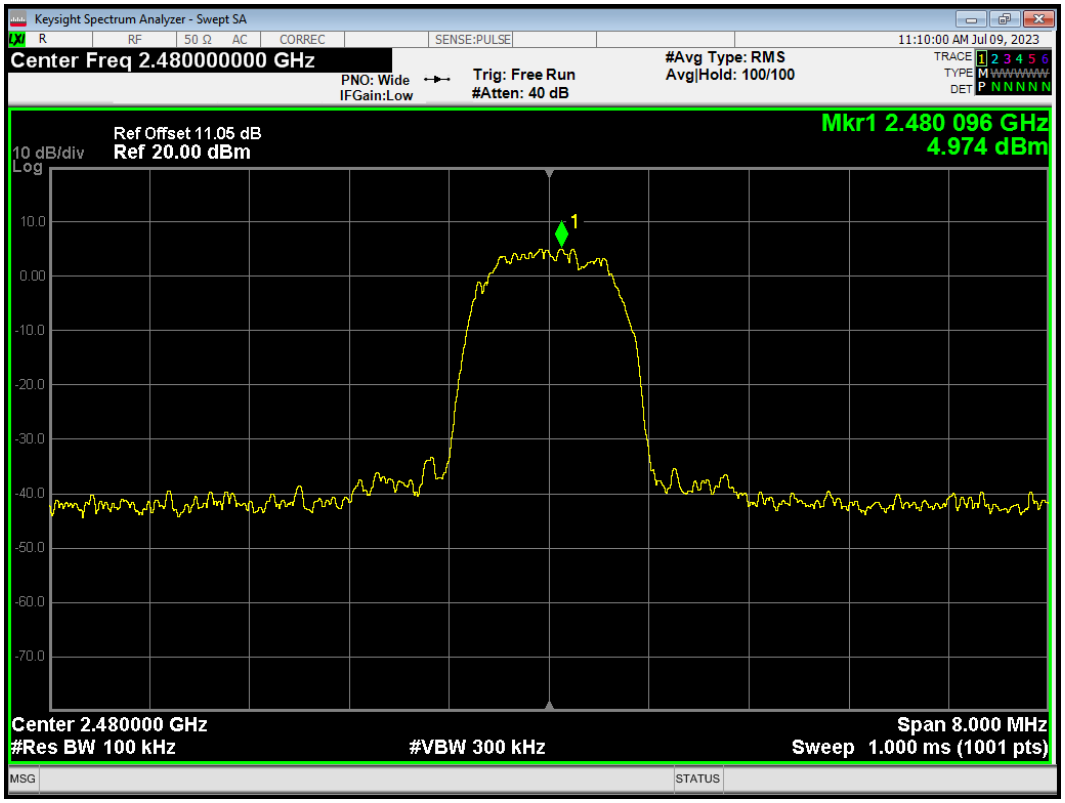


Band Edge 3-DH5 2402MHz No-Hopping Emission

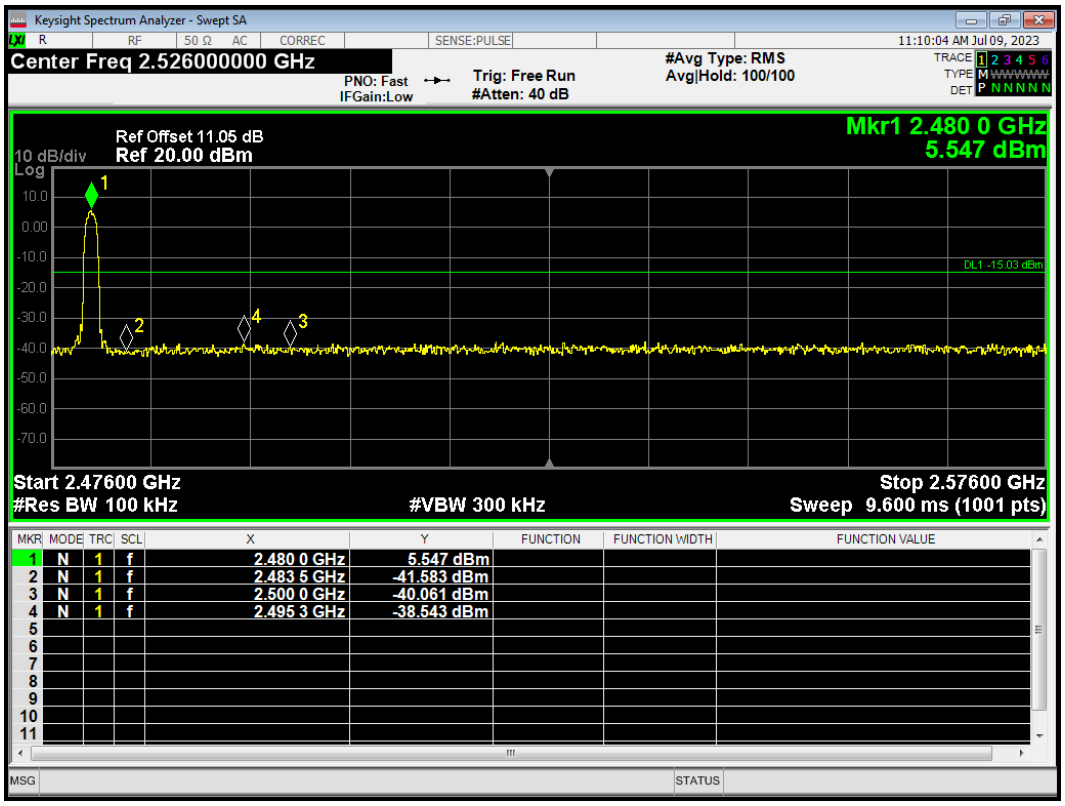


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge 3-DH5 2480MHz No-Hopping Ref



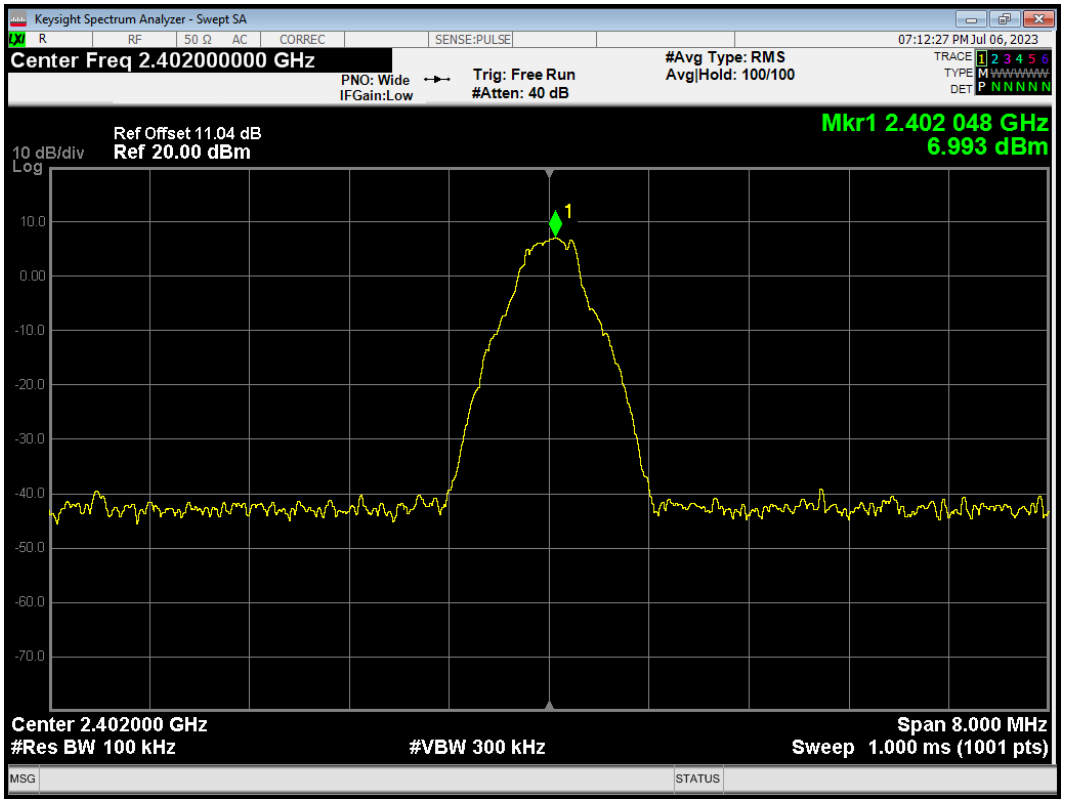
Band Edge 3-DH5 2480MHz No-Hopping Emission



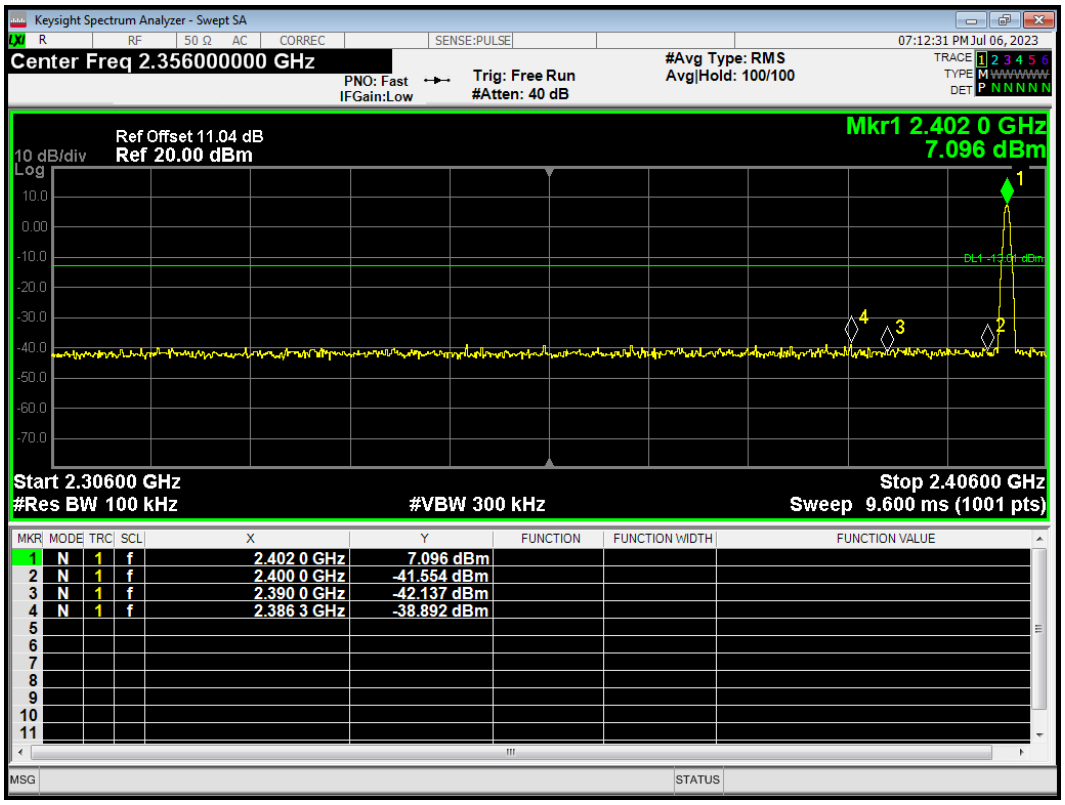
This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

External Antenna

Band Edge 1-DH5 2402MHz No-Hopping Ref

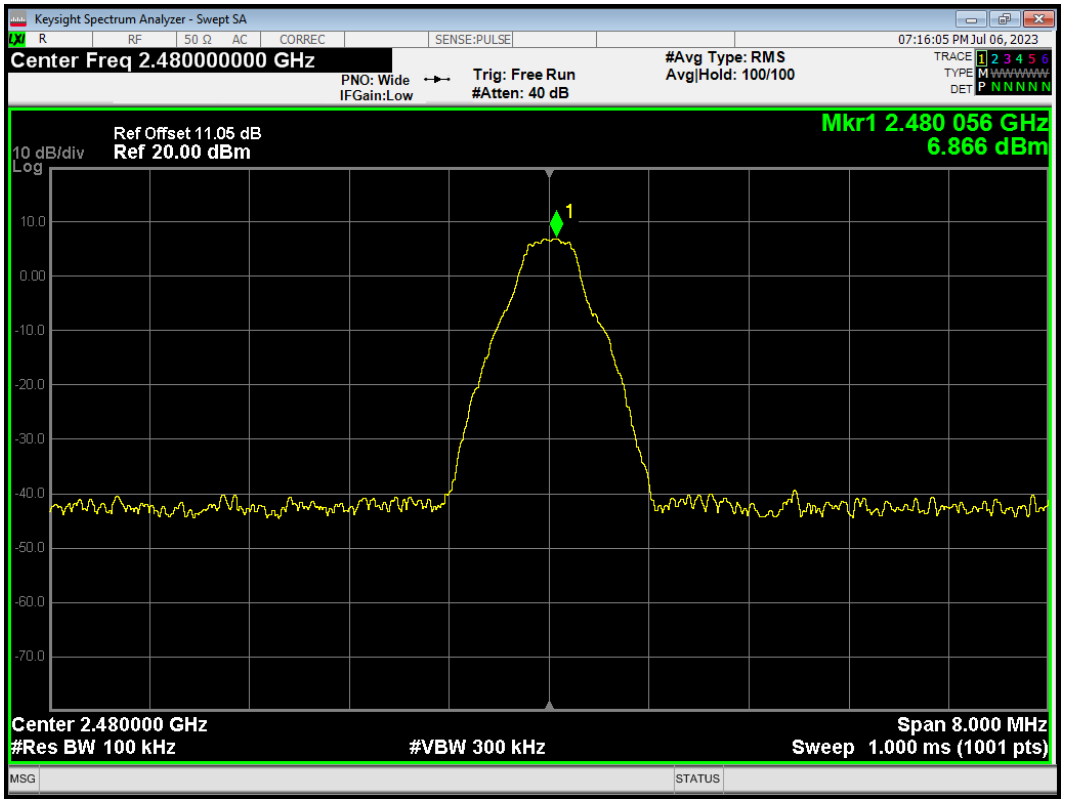


Band Edge 1-DH5 2402MHz No-Hopping Emission

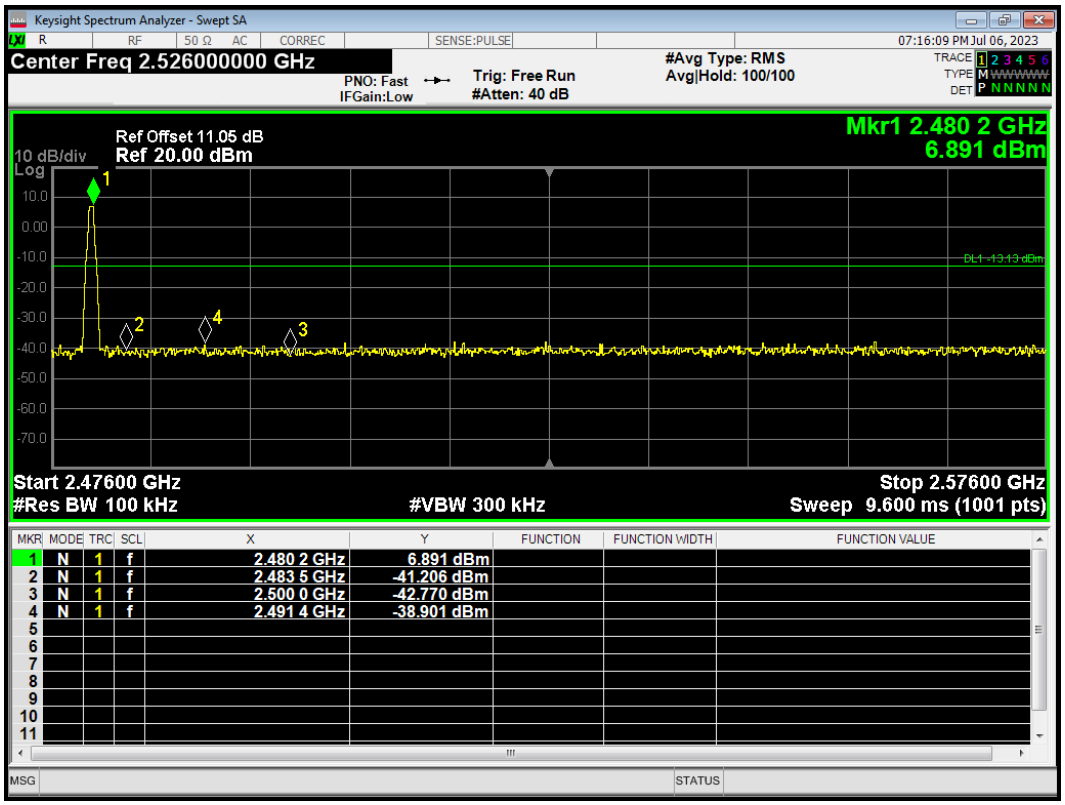


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge 1-DH5 2480MHz No-Hopping Ref

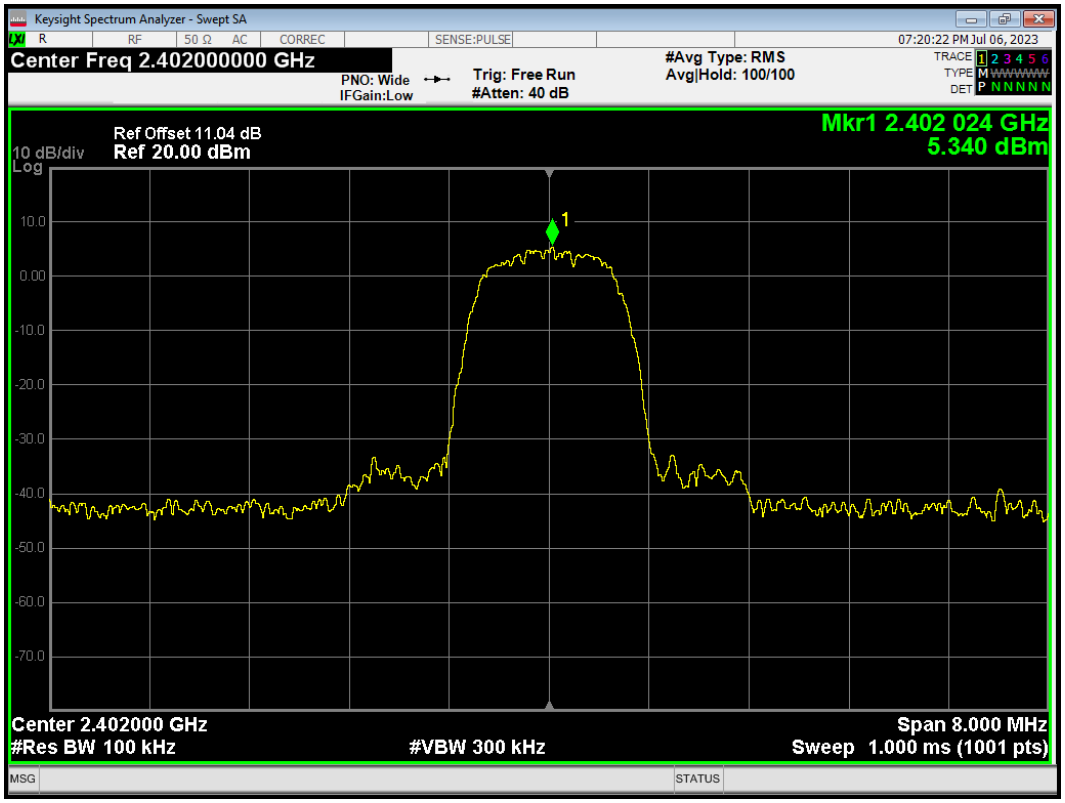


Band Edge 1-DH5 2480MHz No-Hopping Emission

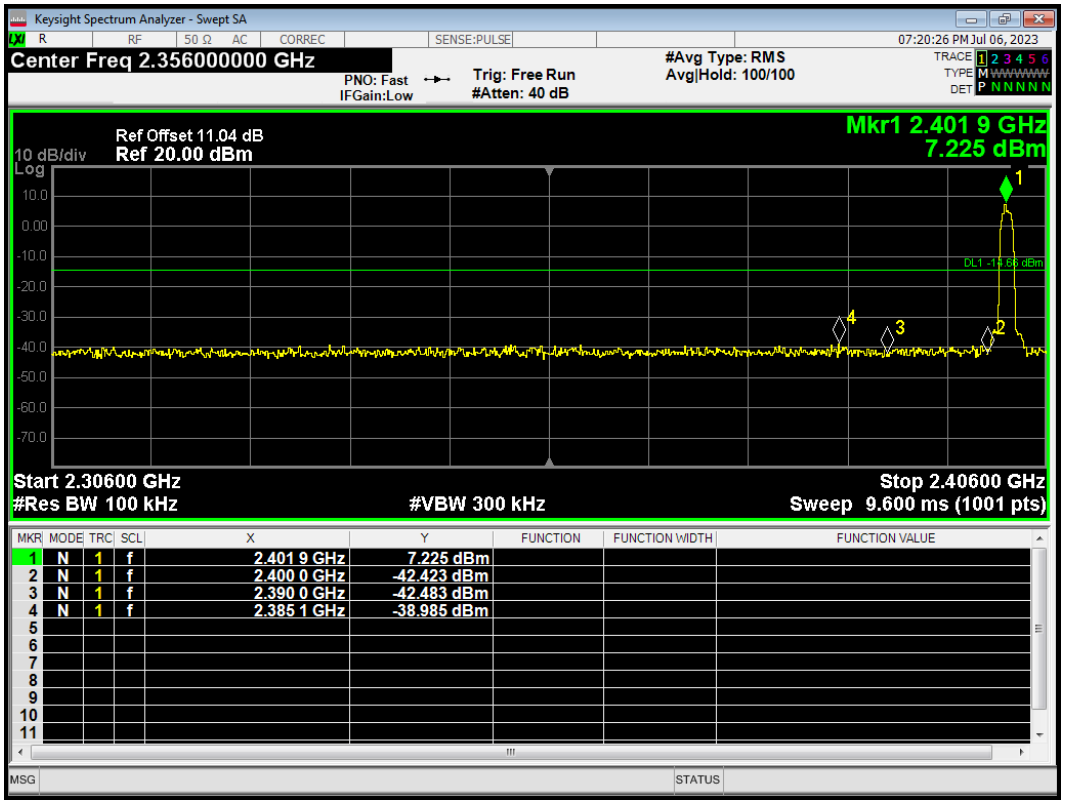


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge 2-DH5 2402MHz No-Hopping Ref

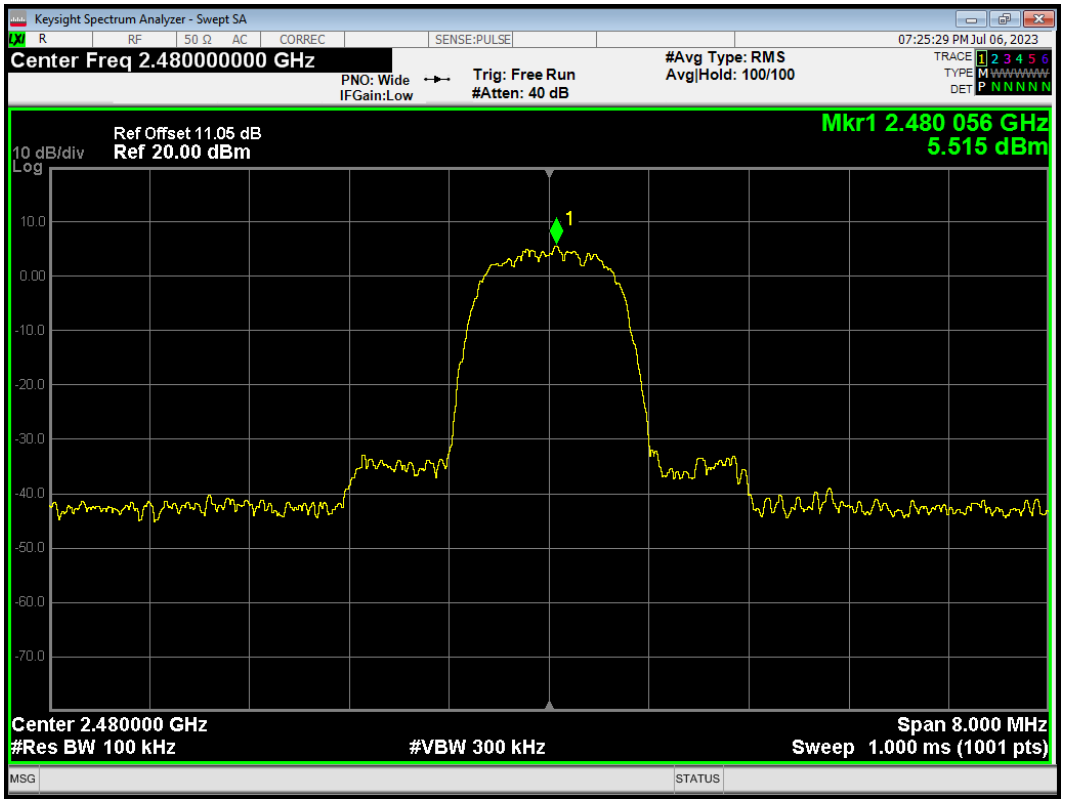


Band Edge 2-DH5 2402MHz No-Hopping Emission

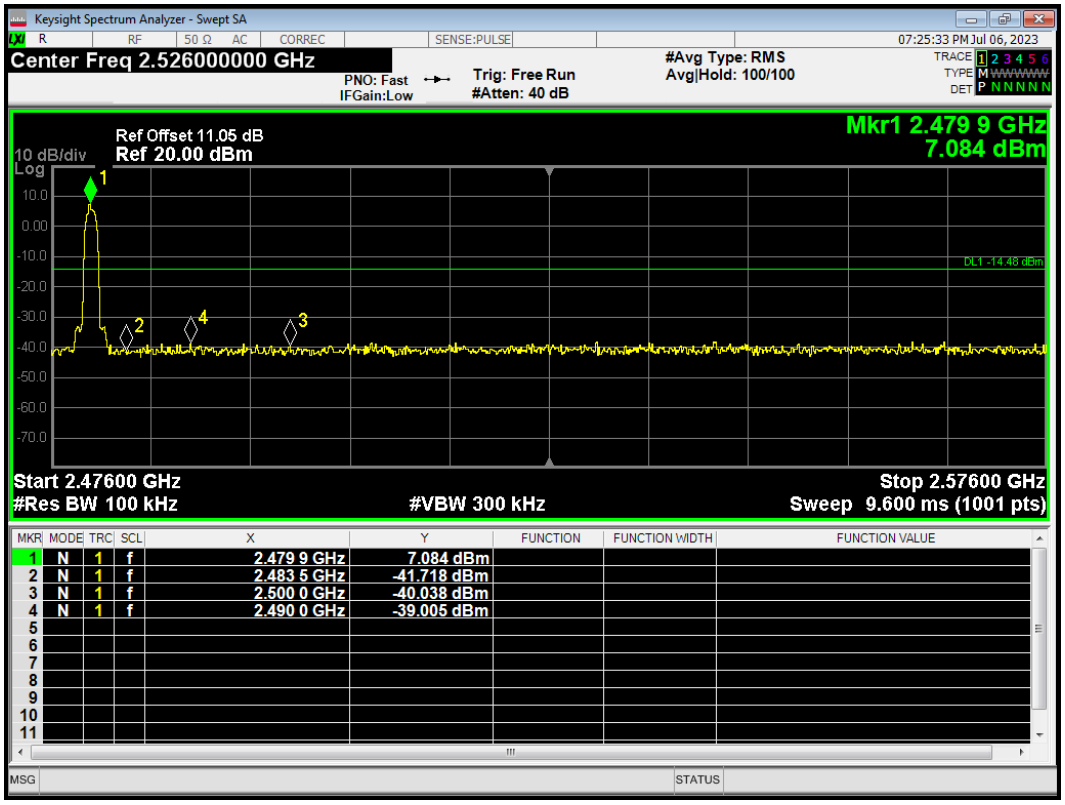


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge 2-DH5 2480MHz No-Hopping Ref

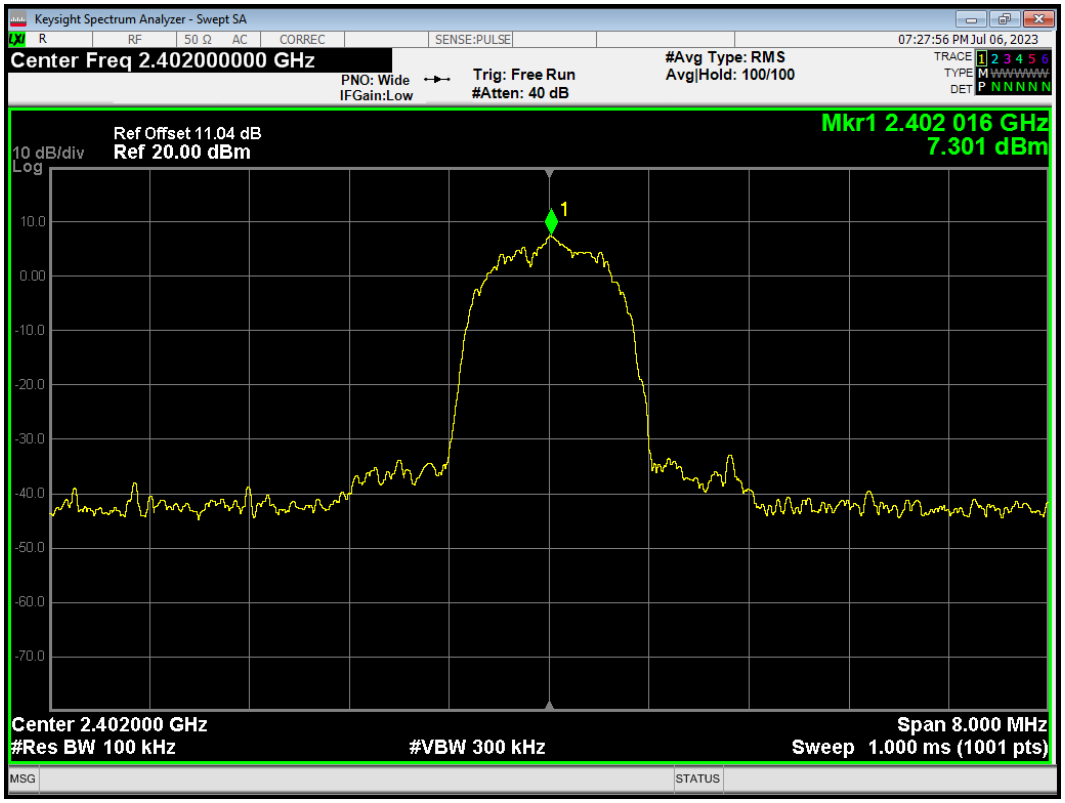


Band Edge 2-DH5 2480MHz No-Hopping Emission

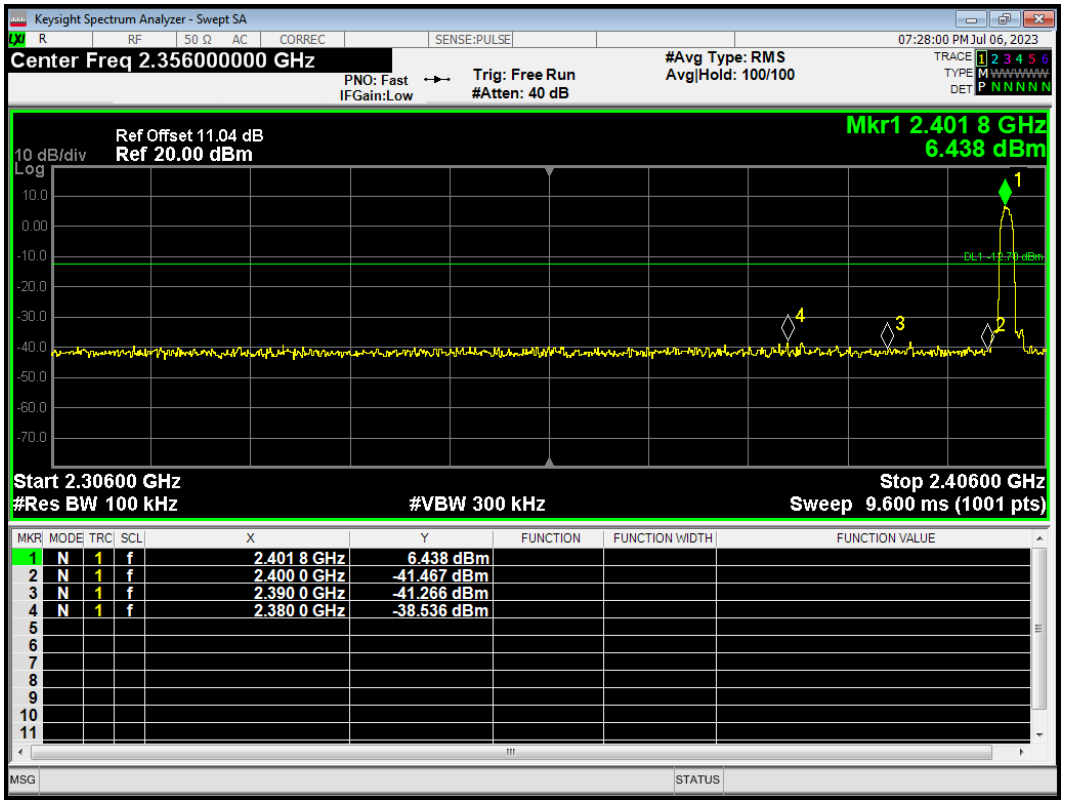


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge 3-DH5 2402MHz No-Hopping Ref

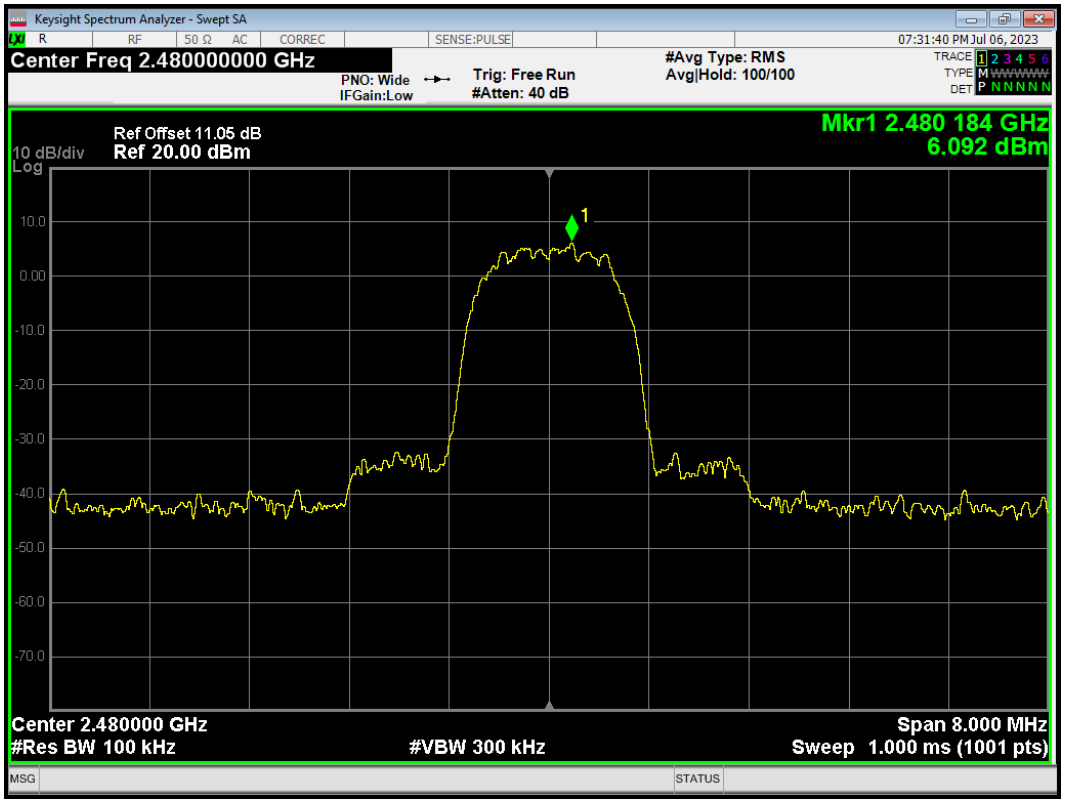


Band Edge 3-DH5 2402MHz No-Hopping Emission

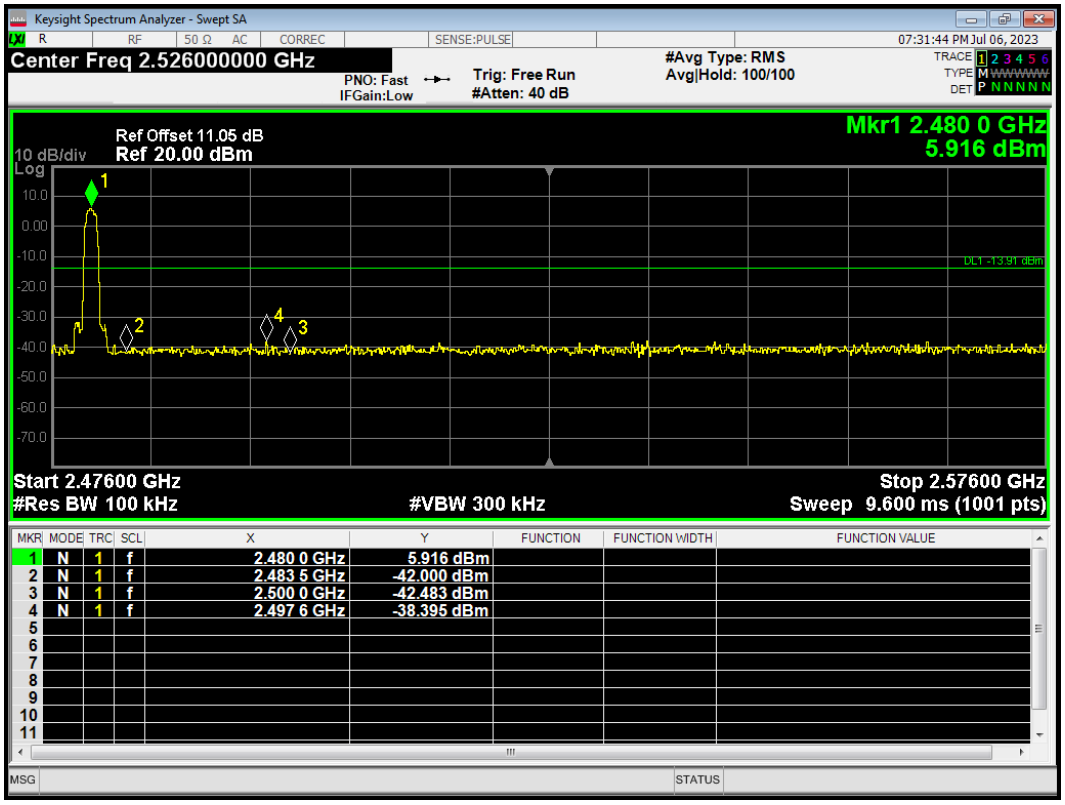


This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Band Edge 3-DH5 2480MHz No-Hopping Ref



Band Edge 3-DH5 2480MHz No-Hopping Emission



This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

5.6 Number of hopping Frequency

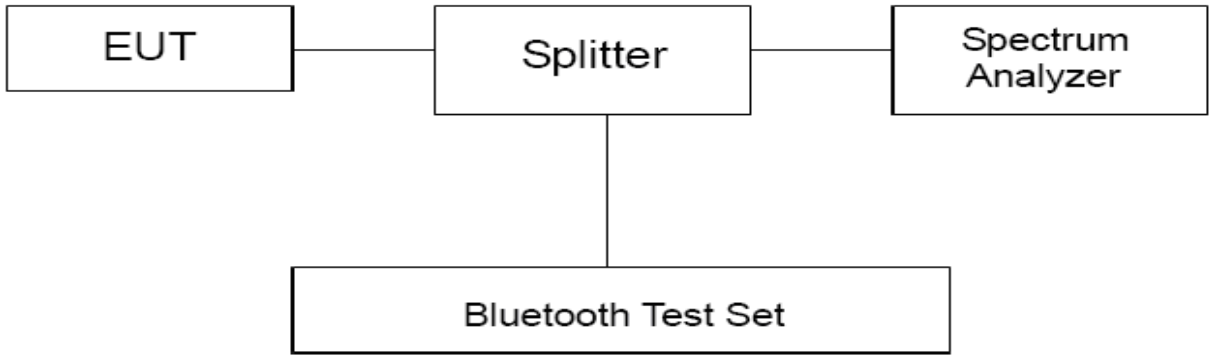
Ambient condition

Temperature	Relative humidity
20°C ~ 25°C	45% ~ 50%

Method of Measurement

The EUT was connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. RBW is set to 100kHz and VBW is set to 300kHz on spectrum analyzer. Set EUT on Hopping on mode.

Test setup



Limits

Rule Part 15.247(a) (1) (iii) specifies that" Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels."

Limits	≥ 15 channels

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

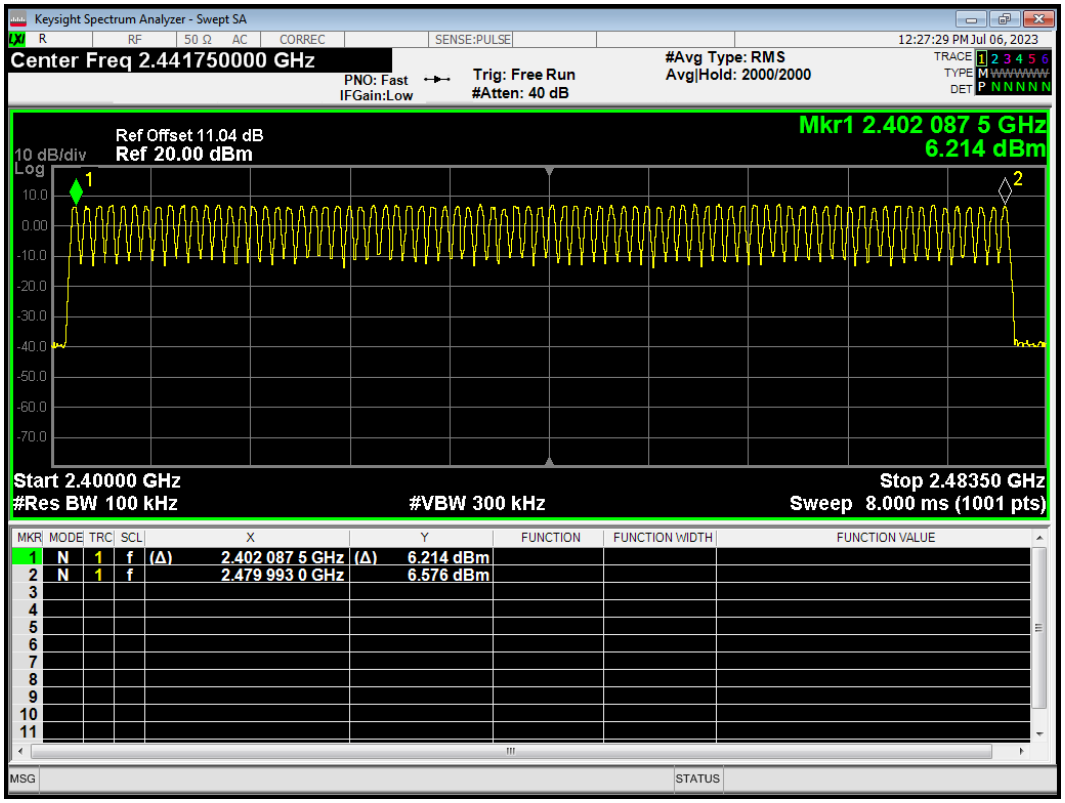
Test Results:

Internal Antenna

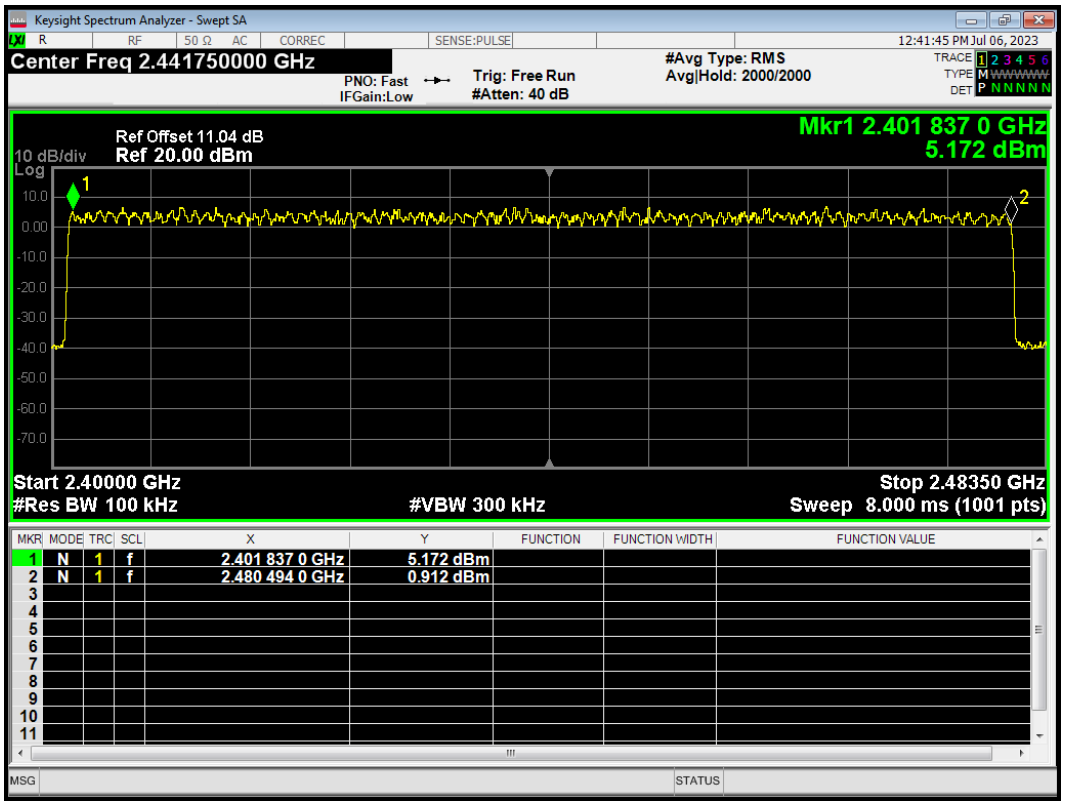
Test Mode		Number of hopping channels	conclusion
Bluetooth	DH5	79	PASS
	2DH5	79	PASS
	3DH5	79	PASS

This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Hopping No. 1-DH5 2402MHz

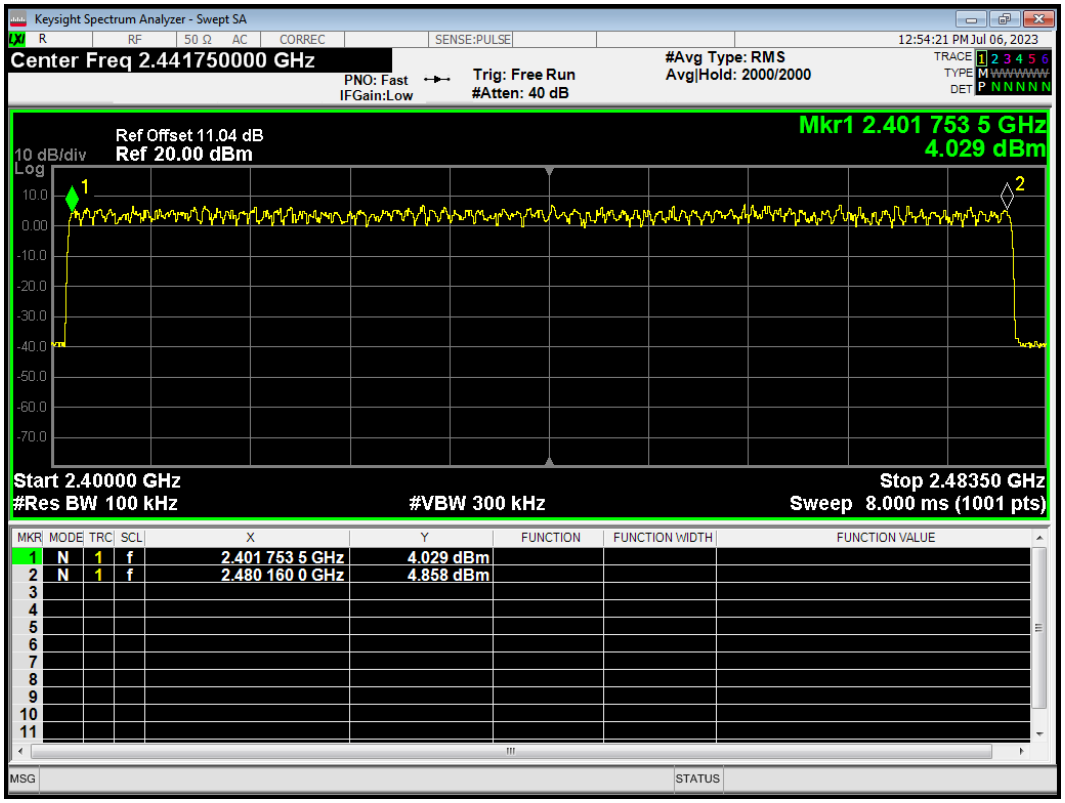


Hopping No. 2-DH5 2402MHz



This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.

Hopping No. 3-DH5 2402MHz



This report shall not be reproduced except in full, without the written approval of TA Technology (Shanghai) Co., Ltd.