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Project No: TM-2411000242P Report No.: TMWK2411004016KR FCC ID: COF-WMBACBM25

Rev. 00

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# RADIO TEST REPORT FCC 47 CFR PART 15 SUBPART C (CLASS II PERMISSIVE CHANGE)

Test Standard FCC Part 15.247

Product name 802.11a/b/g/n/ac 1x1 + BT 5.0 Module

Brand Name USI

Model No. WM-BAC-BM-25-FF4, WM-BAC-BM-25,

WM-BAC-BM-25\_FF2, WM-BAC-BM-25-FF3

Test Result Pass

Statements of Determination of compliance is based on the results of the

compliance measurement, not taking into account

measurement instrumentation uncertainty.

The test Result was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were given in ANSI C63.10: 2013 and compliance standards.

The test results of this report relate only to the tested sample (EUT) identified in this report.

The test Report of full or partial shall not copy. Without written approval of Compliance Certification Services Inc. (Wugu Laboratory)

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Approved by:

Conformity

sehni. Hu

Sehni Hu Supervisor

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# **Revision History**

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	December 24, 2024	Initial Issue	ALL	Peggy Tsai



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# 1. GENERAL INFORMATION

# 1.1 EUT INFORMATION

Applicant	Universal Global Scientific Industrial Co., Ltd. No. 141, Lane 351, Sec. 1, Taiping Road, Tsaotuen, Nantou County 542007, Taiwan	
Manufacturer	Universal Global Scientific Industrial Co., Ltd. No. 141, Lane 351, Sec. 1, Taiping Road, Tsaotuen, Nantou County 542007, Taiwan	
Equipment	802.11a/b/g/n/ac 1x1 + BT 5.0 Module	
Brand Name	USI	
Test model	WM-BAC-BM-25-FF4	
Series model	WM-BAC-BM-25, WM-BAC-BM-25_FF2, WM-BAC-BM-25-FF3	
Model Discrepancy	WM-BAC-BM-25-FF4, Change Antenna matching.	
Received Date	November 15, 2024	
Date of Test	November 22 ~ 27, 2024	
Power Supply	Power from Power Supply. (DC 3.6V)	
HW Version	V30	
FW Version	dhd-100.10.65.0	
Class II Permissive Change	Modify Product Name: 802.11a/b/g/n/ac 1x1 + BT 5.0 Module     Add one Model Name: WM-BAC-BM-25-FF4     Change Antenna Matching.     Update Firmware.	

#### Remark:

- 1. For more details, please refer to the User's manual of the EUT.
- 2. Disclaimer: Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.
- 3. Disclaimer: Variant information between/among trademarks is provided by the applicant, test results of this report are applicable to the sample EUT received of main test model name.



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# **1.2 EUT CHANNEL INFORMATION**

Frequency Range	2402MHz-2480MHz
Modulation Type	GFSK for BLE 1 Mbps
Number of channels	40 Channels

### Remark:

Refer as ANSI C63.10: 2013 clause 5.6.1 Table 4 for test channels

Acier as Arvor 663.10. 2013 clause 5.0.1 Table 4 for test charmers						
Number of frequencies to be tested						
Frequency range in Number of Location in frequency which device operates frequencies range of operation						
1 MHz or less	1	Middle				
1 MHz to 10 MHz 2 1 near top and 1 near bottom						
More than 10 MHz	3	1 near top, 1 near middle, and 1 near bottom				

# 1.3 ANTENNA INFORMATION

Antenna Specification	☐ PIFA ☐ PCB ☐ Dipole ☒ Ceramic Chip Antenna
Antenna Gain	Gain: 1.59 dBi
Brand / Model	YAGEO / ANT3216A063R2455A

#### Notes:

<sup>1.</sup>The antenna(s) of the EUT are permanently attached and there are no provisions for connection to an external antenna. So the EUT complies with the requirements of §15.203.



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## 1.4 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
RF output power (Power Meter + Power sensor)	± 0.243 dB
Radiated Emission_9kHz-30MHz	± 3.761 dB
Radiated Emission_30MHz-200MHz	± 3.473 dB
Radiated Emission_200MHz-1GHz	± 3.946 dB
Radiated Emission_1GHz-6GHz	± 3.797 dB
Radiated Emission_6GHz-18GHz	± 4.803 dB
Radiated Emission_18GHz-26GHz	± 3.459 dB
Radiated Emission_26GHz-40GHz	± 3.297 dB

#### Remark:

- 1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2
- 2. ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report.

## 1.5 FACILITIES AND TEST LOCATION

All measurement facilities used to collect the measurement data are located at

No.11, Wugong 6th Rd., Wugu Dist., New Taipei City, Taiwan.

CAB identifier: TW1309

Test site	Test Engineer	Remark	
Radiation	Tony Chao ⋅ Ray Li	-	
RF Conducted	Jerry Chang	-	

**Remark:** The lab has been recognized as the FCC accredited lab. under the KDB 974614 D01 and is listed in the FCC pubic Access Link (PAL) database, FCC Registration No.:444940, the FCC Designation No.:TW1309



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# 1.6 INSTRUMENT CALIBRATION

	Conducted_FCC/IC/NCC (All)						
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due		
PXA Signal Analyzer	Keysight	N9030B	MY62291089	2024-10-04	2025-10-03		
Power Sensor	Anritsu	MA2411B	1911386	2024-07-19	2025-07-18		
Power Meter	Anritsu	ML2496A	2136002	2024-07-19	2025-07-18		
DC Blocks	Marvelous Microwave	MVE6411	MVE-002	2024-08-08	2025-08-07		
DC Power Source	GWINSTEK	SPS-3610	GPE880163	2024-11-06	2025-11-05		
Software		Radio	Test Software Ve	er. 21			

966A_Radiated						
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due	
Signal Analyzer	KEYSIGHT	N9010A	MY52220817	2024-03-15	2025-03-14	
Thermo-Hygro Meter	WISEWIND	1206	D07	2023-12-08	2024-12-07	
Active Loop Antenna	SCHWARZBEC K	FMZB 1513-60	1513-60-028	2023-12-13	2024-12-12	
Bi-Log Antenna	Sunol Sciences	JB3	A030105	2024-07-12	2025-07-11	
Preamplifier	EMEC	EM330	060609	2024-02-21	2025-02-20	
Cable	Huber+Suhner	104PEA	20995+21000+ 182330	2024-08-07	2025-08-06	
Horn Antenna	ETC	MCTD 1209	DRH13M02003	2023-12-28	2024-12-27	
Preamplifier	HP	8449B	3008A00965	2023-12-22	2024-12-21	
Cable	EMCI	EMC101G	221011+221012 +221213	2024-10-11	2025-10-10	
Attenuator	Mini-Circuits	BW-S9W5	BWS9W5-09- 966A-01	2024-02-07	2025-02-06	
High Pass Filters	Titan Microwave	T04H30001800 070S01	22011402-4	2024-06-12	2025-06-11	
Horn Antenna	SCHWARZBEC K	BBHA9170	1047	2023-12-13	2024-12-12	
Pre-Amplifier	EMCI	EMC184045SE	980860	2023-12-12	2024-12-11	
Turn Table	ccs	CC-T-1F	N/A	N.C.R	N.C.R	
Controller	ccs	CC-C-1F	N/A	N.C.R	N.C.R	
Antenna Tower	ccs	CC-A-1F	N/A	N.C.R	N.C.R	
Site Validation	ccs	966A	N/A	2024-08-03	2025-08-02	
Software			e3 V9-210616c			

#### Remark:

- 1. Each piece of equipment is scheduled for calibration once a year.
- 2. N.C.R. = No Calibration Required.



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# 1.7 SUPPORT AND EUT ACCESSORIES EQUIPMENT

	EUT Accessories Equipment								
No.	. Equipment	Brand	Model	Series No.	FCC ID	IC			
С	Test Kit	N/A	N/A	N/A	N/A	N/A			

	Support Equipment (Conducted)								
No.	Equipment	Series No.	FCC ID	IC					
1	LCD Monitor	Lenovo	A20238FT0	N/A	N/A	N/A			
2	HDMI Cable	High Speed	E342987	N/A	N/A	N/A			
3	DC Power Cable	MISUMI	MCR3S-RE	N/A	N/A	N/A			
Α	PC	ASUS	WM-BAC-BM25-FF3	N/A	N/A	N/A			
В	Mini to USB Cable	N/A	N/A	N/A	N/A	N/A			

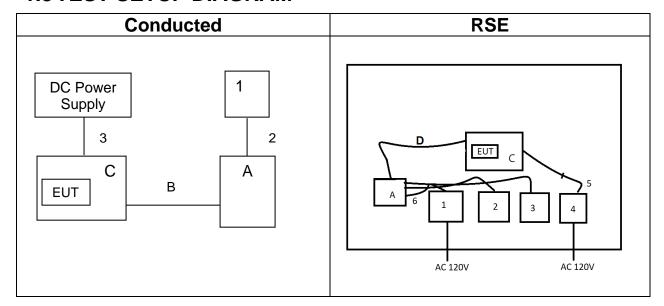
	Support Equipment (RSE)									
No.	Equipment	Brand	Model	Series No.	FCC ID	IC				
1	Monitor	View sonic	VS16263	N/A	N/A	N/A				
2	MOUSE	Lenovo	300 USB	N/A	N/A	N/A				
3	KeyBoard	Logitech	K120	N/A	N/A	N/A				
4	DC Power Source	GWINSTEK	SPS-3610	GPE880163	N/A	N/A				
5	DC Cable	MISUMI	MCR3S-RE	N/A	N/A	N/A				
6	HDMI Cable	UGREEN	HD104	N/A	N/A	N/A				
Α	PC	ASUS	D320MT	N/A	N/A	N/A				
В	Test Kit	N/A	N/A	N/A	N/A	N/A				
D	Mini Usb Cable	N/A	N/A	N/A	N/A	N/A				



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# **1.8 TEST SETUP DIAGRAM**



## 1.9 TEST PROGRAM

The EUT connection corresponds to the surrounding fixture control board. This EUT uses setup command to set the frequency, modulation, and power to allow the sample to continuously transmit.

# 1.10 TEST METHODOLOGY AND APPLIED STANDARDS

The test methodology, setups and results comply with all requirements in accordance with ANSI C63.10:2013, FCC Part 2, FCC Part 15.247, KDB 558074.



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# 2. TEST SUMMARY

FCC Standard Section	Report Section	Test Item	Result
15.203	1.3	Antenna Requirement	Pass
15.247(b)(3)	4.1	Output Power Measurement	Verify
15.247(d) 15.205	4.2	Radiation Band Edge	Pass
15.247(d) 15.209 15.205	4.2	Radiation Spurious Emission	Pass

#### Note:

Modified antenna path matching and update FW, but do not modify any RF related parameters. Therefore, the Conducted performance is the same as the quoted modular certification [FCC ID: COF-WMBACBM25, Date of Grant:07/10/2023]. However, worst case model harmonic and band edge radiation performance will be evaluated and will be evaluated to ensure product compliance.



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# 3. DESCRIPTION OF TEST MODES

## 3.1 THE WORST MODE OF OPERATING CONDITION

Operation mode	BLE Mode (1Mbps)
Test Channel Frequencies	1.Lowest Channel : 2402MHz 2.Middle Channel : 2440MHz 3.Highest Channel : 2480MHz

#### Remark:

1. EUT pre-scanned data rate of output power for each mode, the worst data rate were recorded in this report.



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# 3.2 THE WORST MODE OF MEASUREMENT

Radiated Emission Measurement Above 1G			
Test Condition	Radiated Emission Above 1G		
Power supply Mode	Mode 1: EUT power by Power Supply		
<b>Worst Mode</b>			
Worst Position	<ul> <li>□ Placed in fixed position.</li> <li>□ Placed in fixed position at X-Plane (E2-Plane)</li> <li>□ Placed in fixed position at Y-Plane (E1-Plane)</li> <li>☑ Placed in fixed position at Z-Plane (H-Plane)</li> </ul>		
Rac	diated Emission Measurement Below 1G		
Test Condition	Radiated Emission Below 1G		
Power supply Mode	Mode 1: EUT power by Power Supply		
Worst Mode			
Radia	ated Emission Measurement [Co-Location]		
Test Condition	Radiated Emission [Co-Location]		
Power supply Mode	Mode 1: EUT Power by Wi-Fi 2.4G+BT BR Mode 2: EUT Power by Wi-Fi 5G+BT BR		
Worst Mode	☐ Mode 1 ☐ Mode 2		

### Remark:

- 1. The worst mode was record in this test report.
- 2. EUT pre-scanned in three axis ,X,Y, Z and two polarity, for radiated measurement. The worst case(Z -Plane) were recorded in this report
- 3. Radiation emission was performed the EUT transmit at the highest output power channel as worse case. The worst case was recorded in this report.



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## 4. TEST RESULT

# **4.1 OUTPUT POWER MEASUREMENT**

### 4.1.1 Test Limit

According to §15.247(b)(3),

### Peak output power:

#### **FCC**

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

**Average output power**: For reporting purposes only.

### 4.1.2 Test Procedure

Test method Refer as KDB 558074 D01

- 1. The EUT RF output connected to the power meter by RF cable.
- 2. Setting maximum power transmit of EUT.
- 3. The path loss was compensated to the results for each measurement.
- 4. Measure and record the result of Peak output power and Average output power. in the test report.

# 4.1.3 Test Setup

Refer to section 1.8.



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## 4.1.4 Test Result

**Temperature:**  $21.2 \sim 23.7^{\circ}$  **Test date:** November  $22 \sim 25$ , 2024

**Humidity:** 54 ~ 58% RH **Tested by:** Jerry Chang

### Peak & Average output power:

### BLE 1M mode:

СН	Frequency (MHz)	Power Setting	Peak Output Power (dBm)	Required Limit (dBm)
0	2402	default	6.31	30
19	2440	default	6.44	30
39	2480	default	6.17	30
СН	Frequency (MHz)	Power Setting	Avg. Output Power (dBm)	Required Limit (dBm)
0	2402	default	6.25	30
19	2440	default	6.39	30
39	2480	default	6.12	30

#### Note:

<sup>1.</sup> Measured by power meter, cable loss dB + Duty cycle factor has been offseted to the power meter for Avg. power and cable loss has been offseted for Peak power measurement.

<sup>2.</sup> The Conducted performance is the same as the quoted modular certification [FCC ID: COF-WMBACBM25, Date of Grant: 07/10/2023].



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## 4.2 RADIATION BANDEDGE AND SPURIOUS EMISSION

### 4.2.1 Test Limit

FCC according to §15.247(d), §15.209 and §15.205,

In any 100 kHz bandwidth outside the authorized frequency band, all harmonic and spurious must be least 20 dB below the highest emission level with the authorized frequency band. Radiation emission which fall in the restricted bands must also follow the FCC section 15.209 as below limit in table.

### **Below 30 MHz**

Frequency	Field Strength (microvolts/m)	Magnetic H-Field (microamperes/m)	Measurement Distance (metres)
9-490 kHz	2,400/F (F in kHz)	2,400/F (F in kHz)	300
490-1,705 kHz	24,000/F (F in kHz)	24,000/F (F in kHz)	30
1.705-30 MHz	30	N/A	30

### **Above 30 MHz**

Frequency	Field Strength microvolts/m at 3 metres (watts, e.i.r.p.)				
(MHz)	Transmitters	Receivers			
30-88	100 (3 nW)	100 (3 nW)			
88-216	150 (6.8 nW)	150 (6.8 nW)			
216-960	200 (12 nW)	200 (12 nW)			
Above 960	500 (75 nW)	500 (75 nW)			

#### Remark:

Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.



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### 4.2.2 Test Procedure

1. The EUT is placed on a turntable, Above 1 GHz is 1.5m and below 1 GHz is 0.8m above ground plane. The EUT Configured un accordance with ANSI C63.10: 2013, and the EUT set in a continuous mode.

- 2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level. And EUT is set 3m away from the receiving antenna, which is scanned from 1m to 4m above the ground plane to find out the highest emissions. Measurement are made polarized in both the vertical and the horizontal positions with antenna.
- 3. Span shall wide enough to full capture the emission measured. The SA from 9KHz to 26.5GHz set to the high power channels with the EUT transmit.
- 4. No emission found between lowest internal used/generated frequency to 30MHz (9KHz~30MHz).

Radiated emission below 30MHz is measured in a 9m\*6m\*6m semi-ane choic chamber, the measurements correspond to those obtained at an open-field test site. There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

- 5. The SA setting following:
  - (1) Below 30MHz:
    - (1.1) 9KHz-490KHz: RBW=200Hz / VBW=1kHz / Sweep=AUTO
    - (1.2) 490KHz-30MHz: RBW=10kHz / VBW=30kHz / Sweep=AUTO
  - (2) 30MHz to 1GHz : RBW = 100kHz, VBW  $\geq$  3\*RBW, Sweep = Auto,

Detector = Peak, Trace = Max hold.

- (3) Above 1GHz:
  - (3.1) For Peak measurement : RBW = 1MHz, VBW ≥ 3 RBW, Sweep = Auto, Detector = Peak, Trace = Max hold.
  - (3.2) For Average measurement : RBW = 1MHz, VBW

If Duty Cycle ≥ 98%, VBW=10Hz.

If Duty Cycle < 98%, VBW=1/T.

6. Data result:

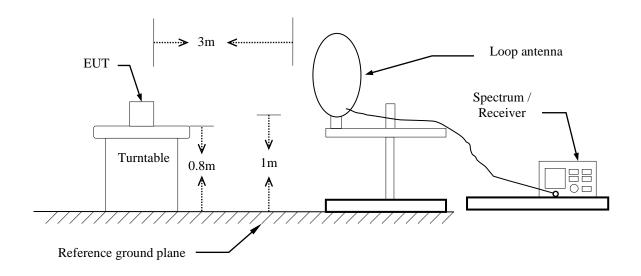
Actual FS=Spectrum Reading Level + Factor Margin=Actual FS- Limit



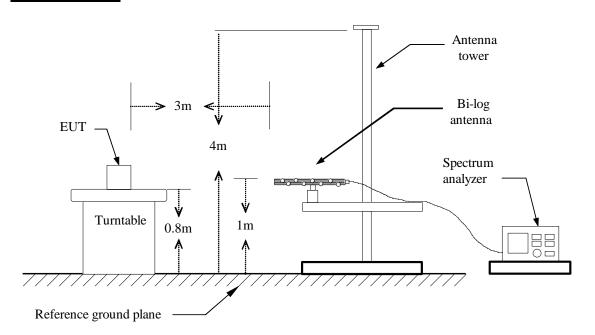
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# 4.2.3 Test Setup

# 9kHz ~ 30MHz



# 30MHz ~ 1GHz

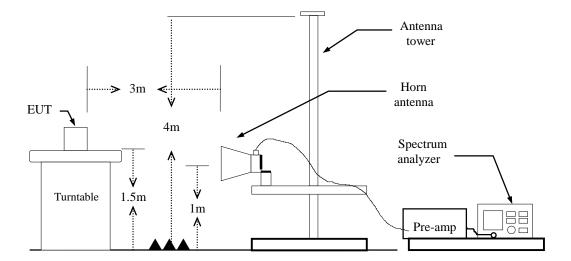




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# Above 1 GHz





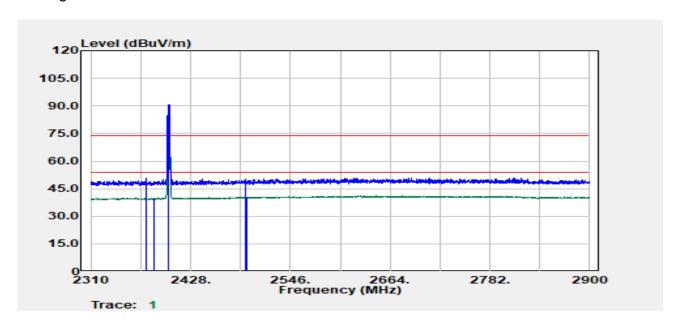
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## 4.2.4 Test Result

## **Band Edge Test Data**

Project No :TM-2411000242P Test Date :2024-11-26 Operation Band :BLE 1M Temp./Humi. :24.6/60 Frequency :2402 MHz Antenna Pol. :VERTICAL Operation Mode :Bandedge Engineer :Ray Li EUT Pol :H Test Chamber : 966A

Setting :



Freq.	Detector Mode	Spectrum Read Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dΒμV	dB	dBμV/m	dΒμV/m	dB
2375.28	Peak	44.63	5.95	50.58	74.00	-23.42
2385.28	Average	33.79	6.02	39.81	54.00	-14.19
2402.00	Peak	84.65	6.13	90.79		
2402.00	Average	84.41	6.13	90.54		
2493.33	Peak	43.51	6.66	50.18	74.00	-23.82
2494.58	Average	33.82	6.67	40.49	54.00	-13.51



2310

Trace: 1

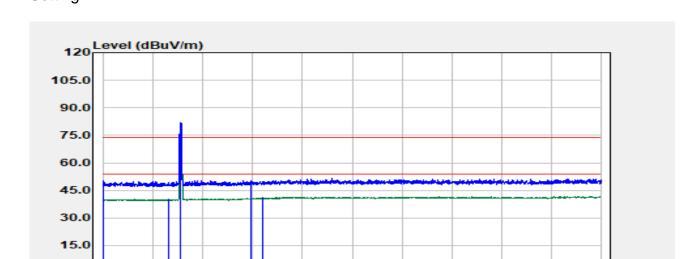
2428.

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Project No :TM-2411000242P Test Date :2024-11-26 Operation Band :BLE 1M Temp./Humi. :24.6/60

Frequency :2402 MHz Antenna Pol. :HORIZONTAL

Operation Mode :Bandedge :Ray Li EUT Pol :H Test Chamber : 966A Setting :



2546. 2664. Frequency (MHz) 2782.

2900

Freq.	Detector Mode	Spectrum Read Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	<u>dB</u>
2310.25	Peak	44.22	5.98	50.20	74.00	-23.80
2388.53	Average	34.04	6.09	40.13	54.00	-13.87
2402.00	Peak	75.82	6.13	81.95		
2402.00	Average	75.51	6.13	81.64		
2485.32	Peak	43.59	6.59	50.18	74.00	-23.82
2499.33	Average	34.32	6.69	41.00	54.00	-13.00

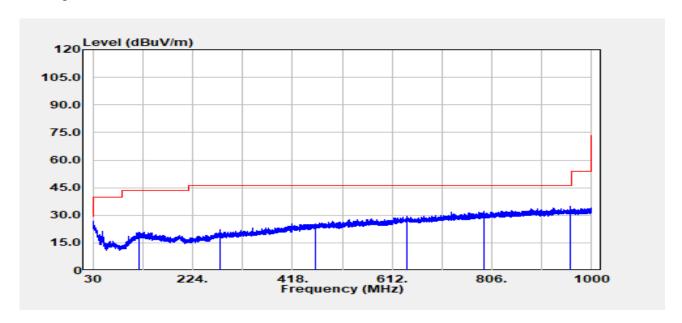


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## **TX Test Data**

Project No :TM-2411000242P **Test Date** :2024-11-27 Operation Band Temp./Humi. :BLE\_1M :24.8/57 Frequency :2440 MHz Antenna Pol. :VERTICAL Operation Mode :TX Engineer :Tony Chao **EUT Pol** Test Chamber :H : 966A

Setting :



Freq.	Detector Mode	Spectrum Read Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dΒμV/m	dB
119.20	Peak	30.23	-9.32	20.91	43.50	-22.59
277.00	Peak	30.83	-8.71	22.12	46.00	-23.88
462.20	Peak	29.42	-3.99	25.42	46.00	-20.58
641.80	Peak	29.73	-0.37	29.36	46.00	-16.64
791.70	Peak	30.16	1.80	31.96	46.00	-14.04
958.40	Peak	30.94	4.10	35.04	46.00	-10.96

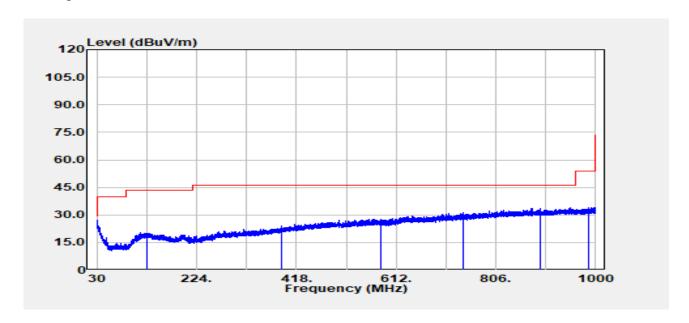


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Project No **Test Date** :TM-2411000242P :2024-11-27 Operation Band :BLE\_1M Temp./Humi. :24.8/57 Frequency :2440 MHz Antenna Pol. :HORIZONTAL Operation Mode Engineer :TX :Tony Chao : 966A

EUT Pol :H Test Chamber Setting :



Freq.	Detector Mode	Spectrum Read Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
127.20	Peak	28.94	-9.03	19.91	43.50	-23.59
388.60	Peak	30.04	-6.26	23.79	46.00	-22.21
581.90	Peak	29.63	-2.03	27.60	46.00	-18.40
742.40	Peak	30.06	0.97	31.03	46.00	-14.97
891.10	Peak	30.48	3.10	33.58	46.00	-12.42
986.30	Peak	29.46	4.42	33.88	54.00	-20.12

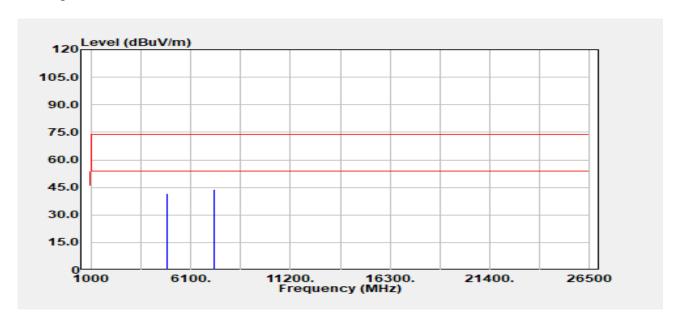


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**Test Date** Project No :TM-2411000242P :2024-11-27 Operation Band :BLE 1M Temp./Humi. :24.6/60 Frequency :2440 MHz Antenna Pol. :Vertical Operation Mode Engineer :TX :Ray Li **EUT Pol** :H Test Chamber : 966A

Setting :



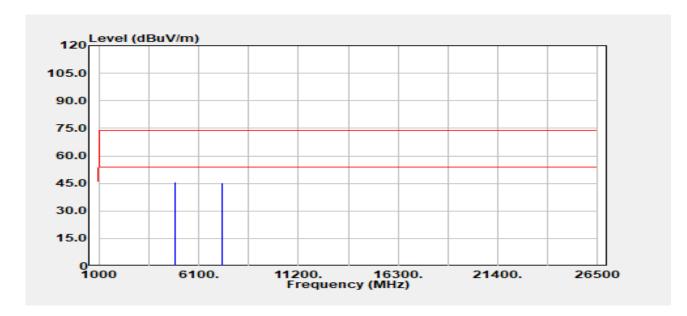
Freq.	Detector Mode	Spectrum Read Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4880.00	Peak	39.22	2.30	41.52	74.00	-32.48
4880.00	Average	36.20	2.30	38.49	54.00	-15.51
7320.00	Peak	35.35	8.70	44.05	74.00	-29.95
7320.00	Average	27.96	8.70	36.66	54.00	-17.34



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Project No :TM-2411000242P Test Date :2024-11-27 Operation Band :BLE 1M Temp./Humi. :24.6/60 Frequency :2440 MHz Antenna Pol. :Horizontal Operation Mode Engineer :TX :Ray Li **EUT Pol** :H Test Chamber : 966A

Setting :



Freq.	Detector Mode	Spectrum Read Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4880.00	Peak	43.57	2.30	45.87	74.00	-28.13
4880.00	Average	39.65	2.30	41.95	54.00	-12.05
7320.00	Peak	36.77	8.70	45.47	74.00	-28.53
7320.00	Average	30.31	8.70	39.01	54.00	-14.99

-- End of Test Report--