# RFI / EMI TEST REPORT

| | | |
|---|---|---|
| **EUT Name** | : | Bluetooth Slim Pad |
| **Model No.** | : | FRK-9452, 056KB-FreeSlim |
| **FCC ID.** | : | RAC9452A01 |
| **Applicant** | : | PRECISION SQUARED TECHNOLOGY CORPORATION |
| **Address** | : | 5F-7, NO. 2, JIAN BA ROAD, CHUNG HO CITY,TAIPEI HSIENG, TAIWAN, R. O. C. |
| **Regulation** | : | CFR 47, Part 15 Subpart C |
| **Test Site** | : | PEP Testing Laboratory |
| **Test Engineer** | : | IVAN HUANG |
| **Test Date** | : | APR. 02, 2008 – JULY 04, 2008 |
| **Issued Date** | : | DEC. 05, 2008 |
| **Report No.** | : | E970169 |

# VERIFICATION

## WE HEREBY VERIFY THAT :

The EUT listed below has completed RFI testing by PEP Testing Laboratory and it does comply with the limitation of FCC Part 15 subpart C, Section 15.247 limitations.

The tested configurations and the facility comply with the radiated and AC line conducted test site criteria in ANSI C63. 4 - 2003.

Any data in this RFI report is **" reference "** only.

| | | |
|---|---|---|
| **APPLICANT** | : | **PRECISION SQUARED TECHNOLOGY CORPORATION** |
| **PRODUCT** | : | **Bluetooth Slim Pad** |
| **FCC ID.** | : | **RAC9452A01** |
| **MODEL NO.** | : | **FRK-9452, 056KB-FreeSlim** |

M. Y. TSUI / General Manager

**PEP Testing Laboratory**

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# 1. Product Information

| | |
|---|---|
| **EUT Name:** | Bluetooth Slim Pad |
| **Model Number:** | Those models have identical electrical design and construction except that they are different in model number for marketing purpose. |
| **Channel No. :** | 79 Channel |
| **Frequency Range:** | 2.402GHz~2.480GHz |
| **Modulation:** | FHSS |
| **Data Rate:** | 1MHz |
| **Internal Crystal / Osc. :** | 4MHz |
| **Power Rating:** | DC 3.6V--- supplied by battery |
| **Antenna Type:** | Integral |
| **Antenna Gain :** | 0.5 dBi (numeric 1.12) |
| **Case:** | ABS |

# 2. General Information

## 2.1 Test Mode and Procedure

Test Channel: As required by FCC Part15, Section 15.31(m) measurements on intentional radiators or receiver should be performed at three frequencies for operating frequency over 10MHz, one near top, one near middle and one near bottom.

Due to the support channels are 79 channels, the selected three frequencies for testing would be 2.402GHz near top for CH LOW, 2.441GHz near middle for CH MID and 2.480GHz near bottom for CH HIGH.

| Test Mode | Channel setting and Operating condition |
|---|---|
| Channel Low Mode (2402MHz) | Using controller that is customer provides to control EUT test under Channel Low frequency and transmit continuously. |
| Channel Mid Mode (2441MHz) | Using controller that is customer provides to control EUT test under Channel Mid frequency and transmit continuously. |
| Channel High Mode (2480MHz) | Using controller that is customer provides to control EUT test under Channel High frequency and transmit continuously. |

Test Procedure:

1. Putting the EUT on the platform and turning on the EUT (on/off button on the bottom of the EUT).
2. Setting test channel described as “Channel setting and operating condition”, and testing channel by channel.
3. For the maximum conducted output power measurement, we followed Part 15 Subpart 15.247, Measurement of Digital Transmission Systems “Alternative Test Procedure (1).
4. For the spurious emission test based on ANSI C63.4(2003), at the frequency where below 1GHz used quasi-peak detector mode; where above 1GHz used the peak and average detector mode. IF the peak value may be under average limit, the average mode will not be performed.
5. In this RFI test report, we provided the worst case conducted emission test data or/and radiated emission test data. The entire testing data was recorded and provided in this report.

## 2.2 Test Software(s) Used

BoueTool: Through controller to control transmit frequency of EUT.

## 2.3 Modification(s)

The applicant has been notified and agrees to incorporate the following modification into all production units. Please refer to the attached pages in this report.

(A) Mount one suppression core on USB cable.

# 3. Support Equipment Used

| | |
|---|---|
| **Personal Computer (PC4)** | **CPU :** Intel P4 3.06GHz<br>**FCC ID :** Declaration of Conformity(DoC)<br>**Manufacturer :** ACER<br>**Model Number :** Aspire T650<br>**Power Supply :** Switching<br>**Power Cord :** Non-Shielded, Detachable, 1.8m<br>**Data Cable :** N/A |
| **Modem (MOD1)** | **FCC ID :** IFAXDM1414<br>**Manufacturer :** ACEEX<br>**Model Number :** 1414<br>**Power Supply :** Linear, 9Vac O/P<br>**Power Cable :** Non-Shielded , Detachable,1.7m<br>**Data Cable : 1 >** Shielded , Detachable,1m<br>**2 >** Back Shell : Metal |
| **LCD (LCD1 17")** | **FCC ID :** Declaration of Conformity(DoC)<br>**Manufacturer :** MiTAC<br>**Model Number :** LC51<br>**Power Supply :** Switching<br>**Power Cord :** Non-Shielded, Detachable, 1.8m<br>**Data Cable : 1 >** Shielded , Detachable,1.2m<br>**2 >** Back Shell : Metal |
| **Printer (PRN1)** | **FCC ID :** B94C2642X<br>**Manufacturer :** Hewlett-Packard<br>**Model Number :** C2642E<br>**Power Supply :** Linear, 30Vdc O/P<br>**Power Cable :** Non-Shielded , Detachable,1.8m<br>**Data Cable : 1 >** Shielded , Detachable,1.2m<br>**2 >** Back Shell : Metal |
| **Mouse (MOUS/1 PS/2)** | **FCC ID :** DZL211106<br>**Manufacturer :** LOGITECH<br>**Model Number :** M-S43<br>**Power Supply :** +5Vdc from PS2 of PC<br>**Power Cord :** N/A<br>**Data Cable : 1 >** Shielded , Non-detachable,1.8m<br>**2 >** Back Shell : Metal |

# 4. Measurement Result Summary

Modulation: FHSS

| Test Item | Result |
|---|---|
| §15.247(b)(4)<br>Antenna gain<6dBi | ■Yes □No<br>Read: 0.5 dBi |
| Channel Listing | ■Ok |
| §15.247(a)(1) Hopping Channel Frequency Separated<br>Limit>25KHz or -20dB Bandwidth, whichever is greater | □N/A<br>■Pass □Fail<br>Read: 1000 kHz |
| §15.247(a)(1)(iii) Dwell Time Limit(t)<0.4(s) | □N/A<br>■Pass □Fail<br>Read: 0.176 s |
| §15.247(a)(2) -6dB Bandwidth Limit>500KHz | ■N/A<br>□Pass □Fail<br>Read: kHz |
| §15.247(b)(2) Maximum peak radiated output power<br>Non-overlapping channel>75<br>Limit<1 Watt | □N/A<br>■Pass □Fail<br>Low : $0.348*10^{-3}$ W (H)<br>Mid : $0.348*10^{-3}$ W (H)<br>High: $0.276*10^{-3}$ W (H) |
| §15.247(b)(3) Maximum peak conducted output power<br>Limit<1 Watt | ■N/A<br>□Pass □Fail<br>Read: W |
| §15.247(d) 100KHz outside band test<br>(i) Band edge measurement<br>(ii) 30MHz~24GHz spurious emission | ■Pass □Fail |
| §15.247(e) The power spectral density<br>Limit<8dBm (in 3KHz) | ■N/A<br>□Pass □Fail<br>Read: dBm |
| §15.247(e)(i) MPE calculation | ■Pass □Fail |

# 5. Channel Listing

| a. EUT Type：Bluetooth Slim Pad | | |
|---|---|---|
| b. EUT Model：FRK-9452 | | |
| c. TX Channel No.：79 | | |
| Channel 01: 2402 MHz | Channel 28: 2429 MHz | Channel 55: 2456 MHz |
| Channel 02: 2403 MHz | Channel 29: 2430 MHz | Channel 56: 2457 MHz |
| Channel 03: 2404 MHz | Channel 30: 2431 MHz | Channel 57: 2458 MHz |
| Channel 04: 2405 MHz | Channel 31: 2432 MHz | Channel 58: 2459 MHz |
| Channel 05: 2406 MHz | Channel 32: 2433 MHz | Channel 59: 2460 MHz |
| Channel 06: 2407 MHz | Channel 33: 2434 MHz | Channel 60: 2461 MHz |
| Channel 07: 2408 MHz | Channel 34: 2435 MHz | Channel 61: 2462 MHz |
| Channel 08: 2409 MHz | Channel 35: 2436 MHz | Channel 62: 2463 MHz |
| Channel 09: 2410 MHz | Channel 36: 2437 MHz | Channel 63: 2464 MHz |
| Channel 10: 2411 MHz | Channel 37: 2438 MHz | Channel 64: 2465 MHz |
| Channel 11: 2412 MHz | Channel 38: 2439 MHz | Channel 65: 2466 MHz |
| Channel 12: 2413 MHz | Channel 39: 2440 MHz | Channel 66: 2467 MHz |
| Channel 13: 2414 MHz | Channel 40: 2441 MHz | Channel 67: 2468 MHz |
| Channel 14: 2415 MHz | Channel 41: 2442 MHz | Channel 68: 2469 MHz |
| Channel 15: 2416 MHz | Channel 42: 2443 MHz | Channel 69: 2470 MHz |
| Channel 16: 2417 MHz | Channel 43: 2444 MHz | Channel 70: 2471 MHz |
| Channel 17: 2418 MHz | Channel 44: 2445 MHz | Channel 71: 2472 MHz |
| Channel 18: 2419 MHz | Channel 45: 2446 MHz | Channel 72: 2473 MHz |
| Channel 19: 2420 MHz | Channel 46: 2447 MHz | Channel 73: 2474 MHz |
| Channel 20: 2421 MHz | Channel 47: 2448 MHz | Channel 74: 2475 MHz |
| Channel 21: 2422 MHz | Channel 48: 2449 MHz | Channel 75: 2476 MHz |
| Channel 22: 2423 MHz | Channel 49: 2450 MHz | Channel 76: 2477 MHz |
| Channel 23: 2424 MHz | Channel 50: 2451 MHz | Channel 77: 2478 MHz |
| Channel 24: 2425 MHz | Channel 51: 2452 MHz | Channel 78: 2479 MHz |
| Channel 25: 2426 MHz | Channel 52: 2453 MHz | Channel 79: 2480 MHz |
| Channel 26: 2427 MHz | Channel 53: 2454 MHz | |
| Channel 27: 2428 MHz | Channel 54: 2455 MHz | |

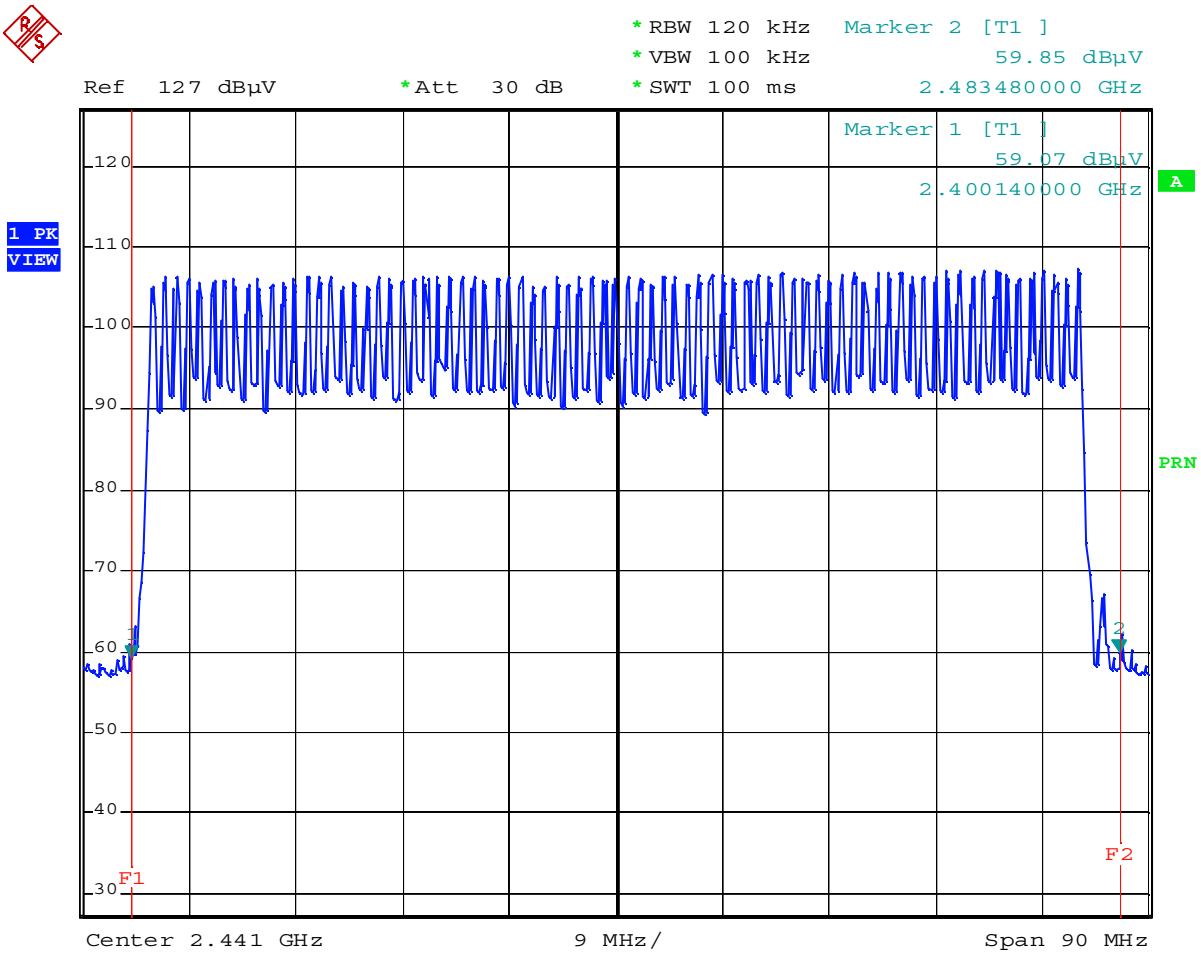
Frequency Range: 2.402 GHz to 2.480 GHz

Note: All channels located in the frequency range as below:

2.402 GHz --- 2.480 GHz ■ Yes ☐ No

Typical Channel for testing:

| Channel | Channel Number | Frequency (GHz) |
|---|---|---|
| LOW | 1 | 2.402 |
| MID | 40 | 2.441 |
| HIGH | 79 | 2.480 |



# 6. §15.247(a)(1): Hopping Channel Frequency Separation

**Limit > 25KHz or -20dB Bandwidth, whichever is greater**

## 6.1 Test Procedure

(1)The Hopping Channel Frequency Separation was measured in max hold analyzer mode with span wide enough to capture the peaks of two adjacent channels.

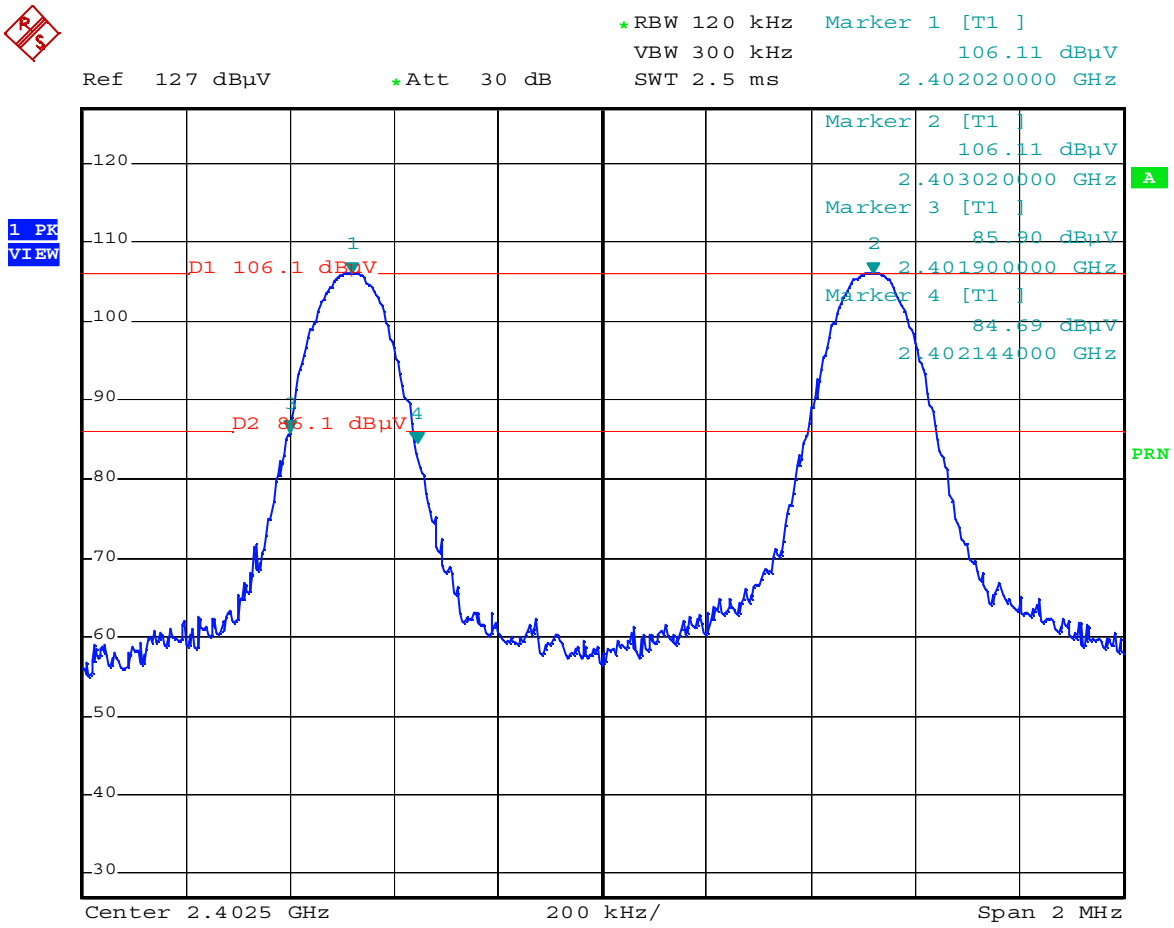
(2)Set the Spectrum as RBW=120KHz, VBW=300KHz

(3)6.3 Spectrum Plot Data show the Frequency Separation test results.

## 6.2 Test Result of Frequency Separation

| | Measured Separation (KHz) | Separation at -20dB (KHz) | Limit (KHz) | Test Result |
|---|---|---|---|---|
| Channel Separation | 1000 | 732 | 25 | PASS |

## 6.3 Spectrum Plot Data



# 7. §15.247(a)(1): Time of Occupancy (Dwell Time)

**Limit (t) <0.4(s)**

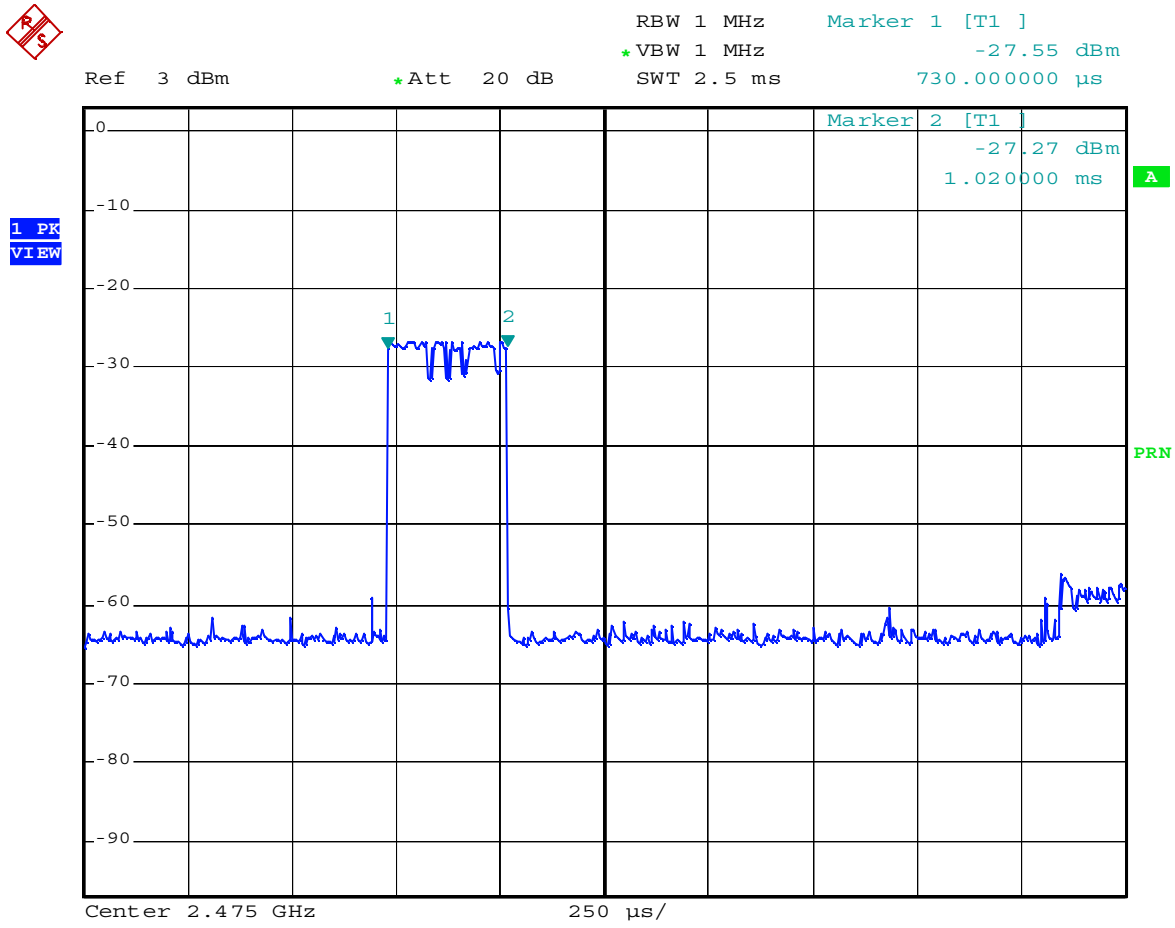
## 7.1 Test Procedure

(1)The Time of Occupancy was measured in " max hold" analyzer mode with zero span and different sweep time to calculate the Time of Occupancy.
(2)Set the Spectrum as RBW=VBW=1MHz
(3)7.3 Spectrum Plot Data show the Time of Occupancy test results.

## 7.2 Test Result of Dwell Time

Dwell Time= 30(1600/79)*t=30*20.25*0.29 Sec = 0.176 Sec < 0.4s

## 7.3 Spectrum Plot Data



# 8. §15.247(b)(2): Maximum Peak Radiated Output Power

**Non-overlapping channel >75, Limit <1 Watt**

## 8.1 Testing Description

(A) The testing procedures followed “Measurement of Digital Transmission Systems Operating under Section 15.247 (2005)” Alternative Test Procedure (1)

**ALTERNATIVE TEST PROCEDURES**

If antenna conducted tests cannot be performed on this device, radiated tests to show compliance with the various conducted requirements of Section 15.247 are acceptable. As stated previously, a pre-amp must be used in making the following measurements.

(1) Calculate the transmitter's peak power using the following equation:

Where:

E = the measured maximum field strength in V/m.

Set the RBW > 6dB bandwidth of the emission or use a peak power meter.

$P = (E \times d)^2 / (30 \times G)$

G = the numeric gain of the transmitting antenna over an isotropic radiator.

d = the distance in meters from which the field strength was measured.

P = the power in watts for which you are solving:

(B) Three channels were tested: CH LOW, CH MID AND CH HIGH Measurements were taken by using both horizontal and vertical antenna polarization, and the receiving antenna was raised between 1m and 4m to find the worst emission levels.

## 8.2 Test Result of Fundamental Emissions

Temperature: **26** ℃ Humidity: **52** %

RBW = 3MHz

VBW = 3MHz

SWT = AUTO

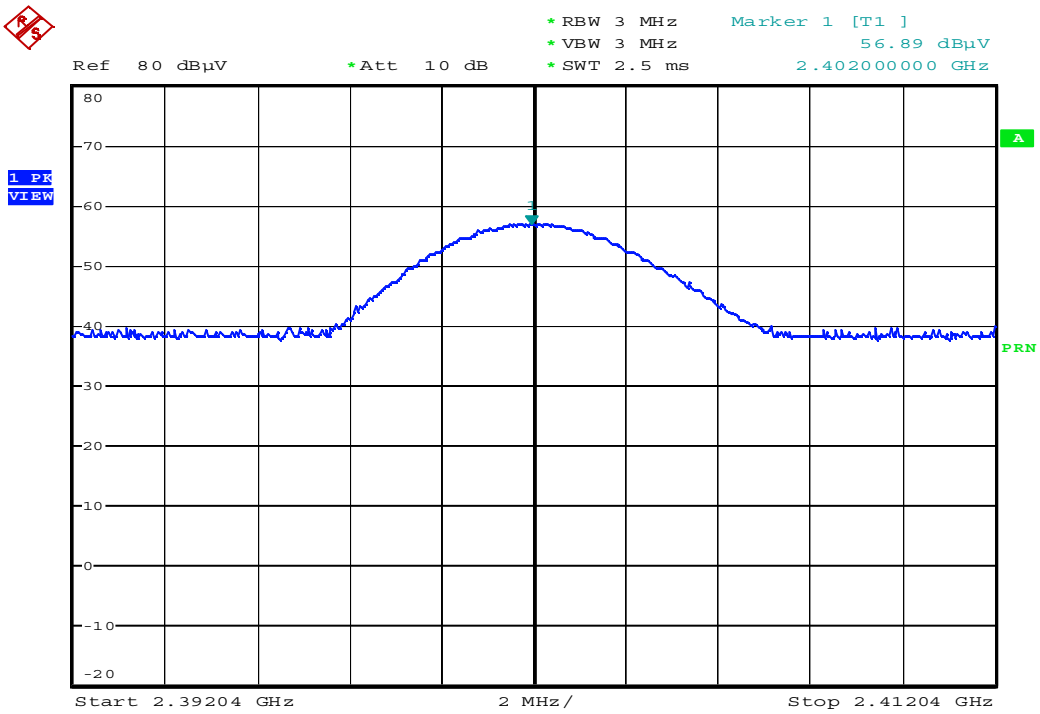
Test distance=3m

| Channel | A.P. | Frequency (GHz) | S.A. Read (dBμV/m) | C. L. (dB) | A. F. (dB) | E (dBμV/m) | E (V/m) | P (W) | Test Result |
|---|---|---|---|---|---|---|---|---|---|
| 1 | H | 2.402 | 56.89 | 5.43 | 28.46 | 90.78 | $36.06*10^{-3}$ | $0.348*10^{-3}$ | PASS |
| | V | | 53.15 | | | 87.04 | $22.49*10^{-3}$ | $0.135*10^{-3}$ | PASS |
| 9 | H | 2.441 | 57.09 | 5.52 | 28.53 | 91.14 | $36.06*10^{-3}$ | $0.348*10^{-3}$ | PASS |
| | V | | 54.45 | | | 88.5 | $26.61*10^{-3}$ | $0.189*10^{-3}$ | PASS |
| 16 | H | 2.480 | 55.98 | 5.57 | 28.58 | 90.13 | $32.1*10^{-3}$ | $0.276*10^{-3}$ | PASS |
| | V | | 55.52 | | | 89.67 | $30.44*10^{-3}$ | $0.248*10^{-3}$ | PASS |

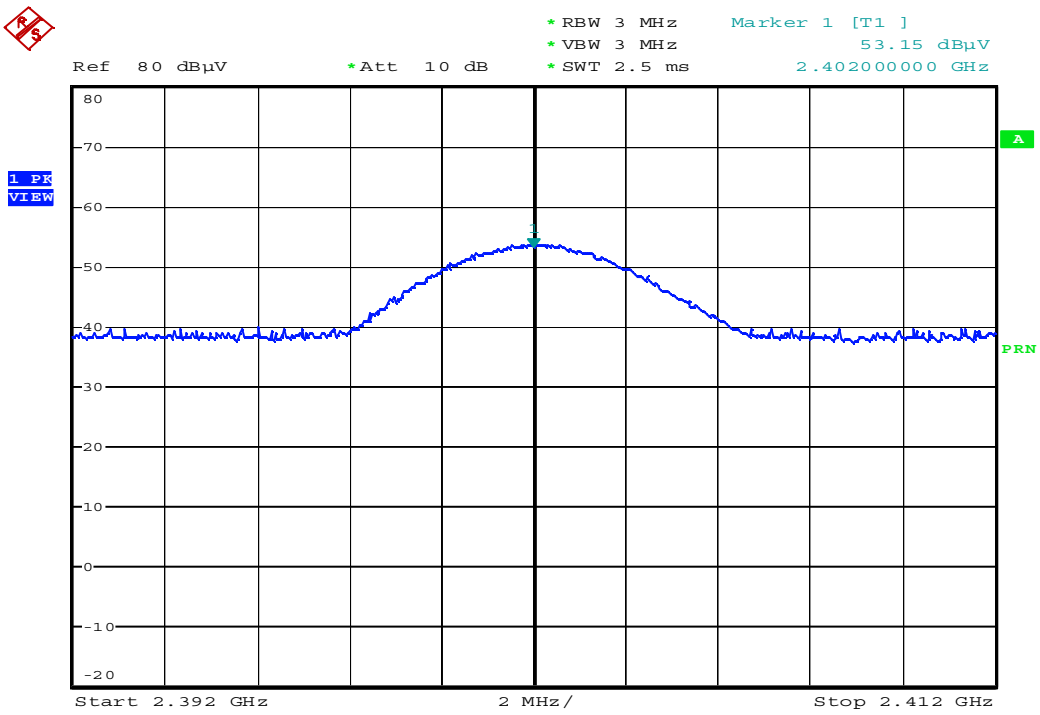
## 8.3 Spectrum Plot Data

### Channel : 1

**Horizontal**

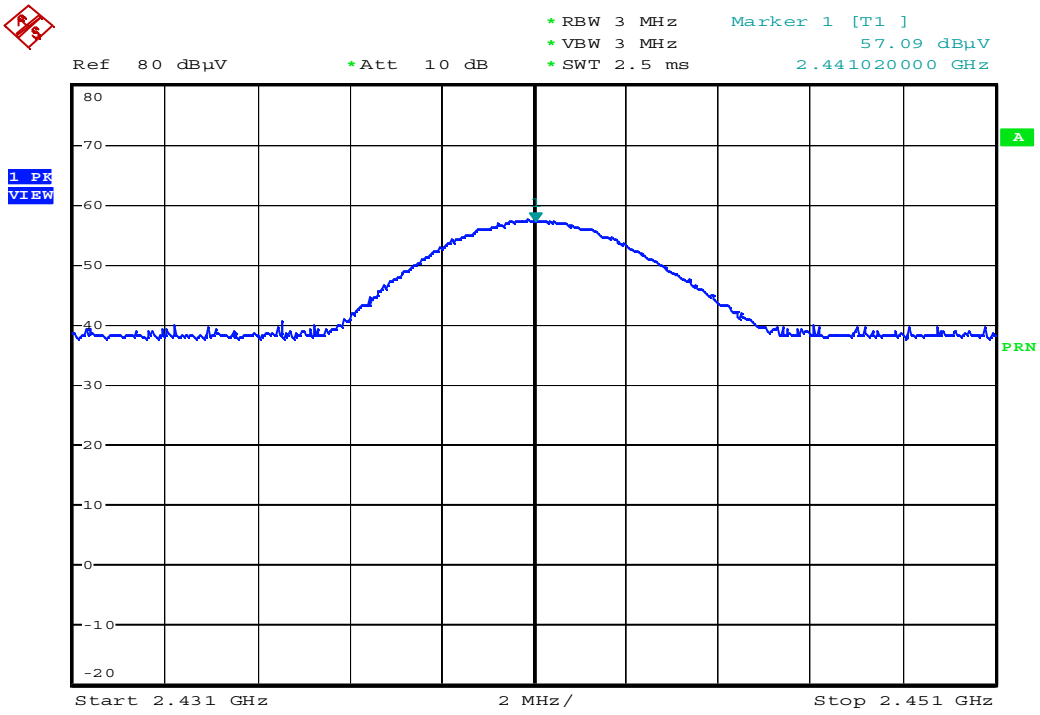



**Vertical**

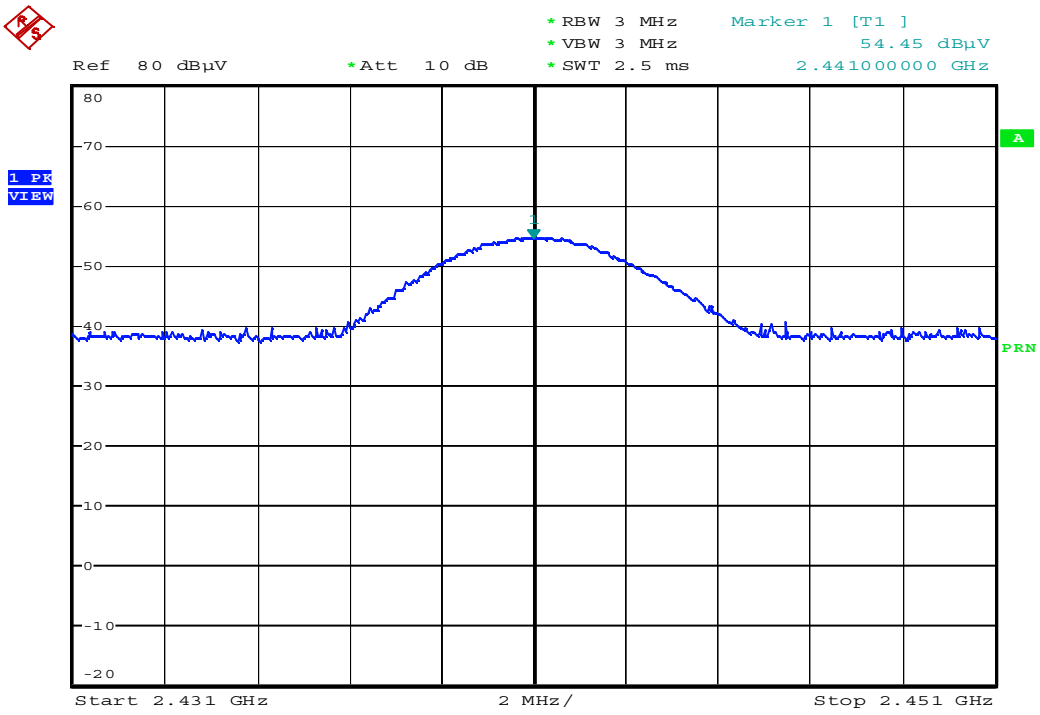


**Channel : 40**

## Horizontal

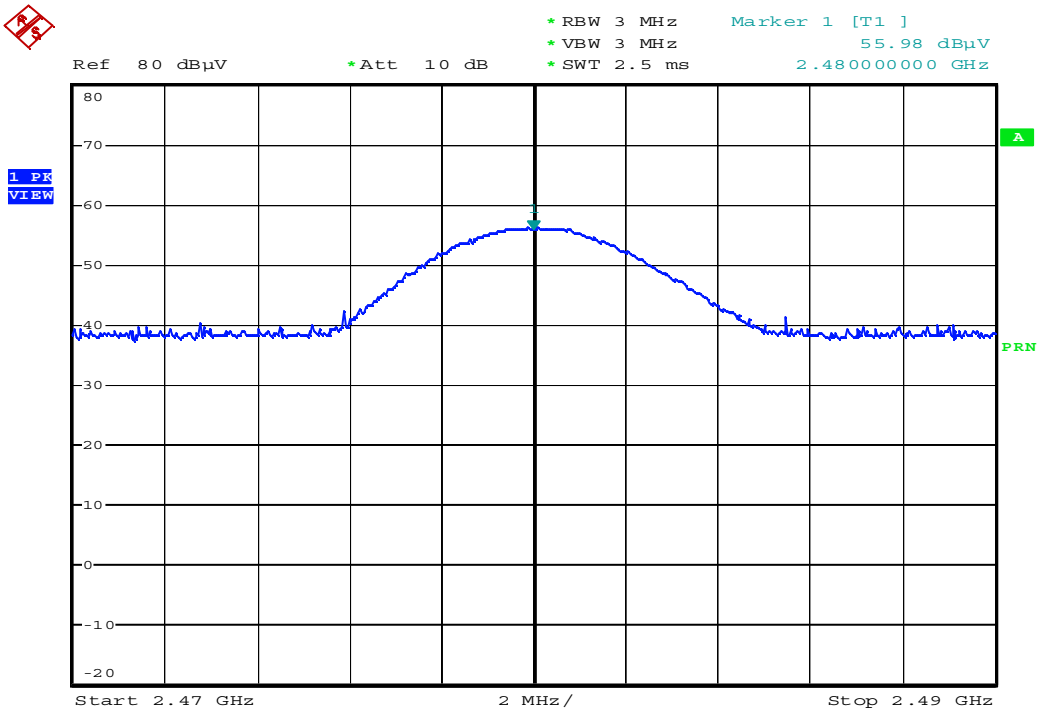



## Vertical

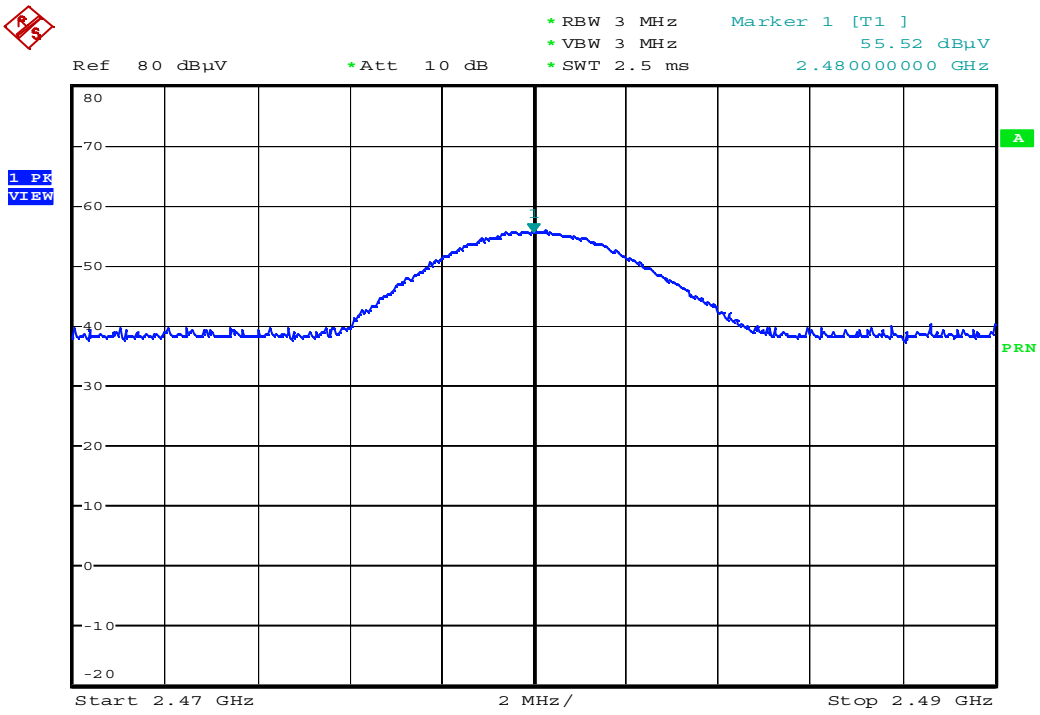


**Channel : 79**

## Horizontal




## Vertical



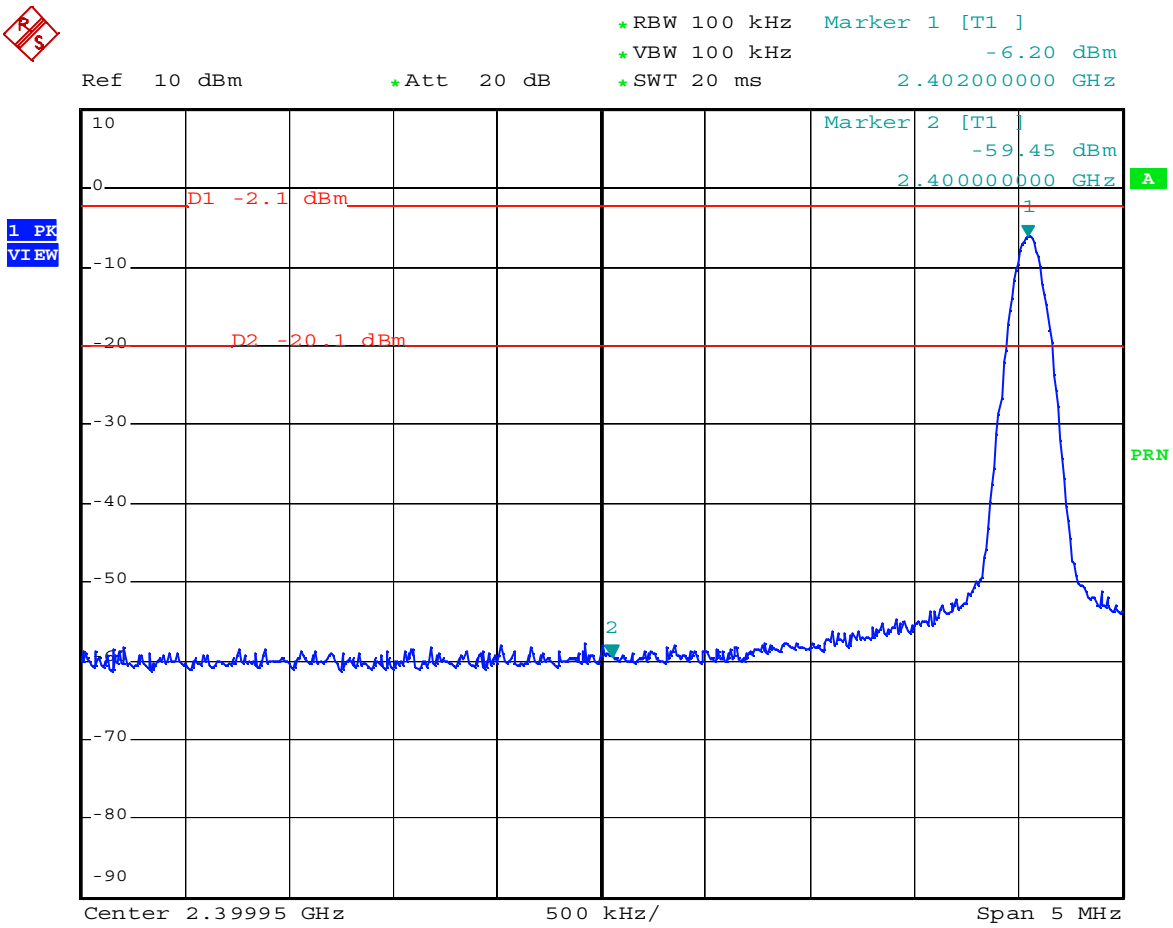
## 8.4 Test Setup Photo

# 9. §15.247(d): 100KHz Outside Band Test

## 9.1 Band Edge Measurement

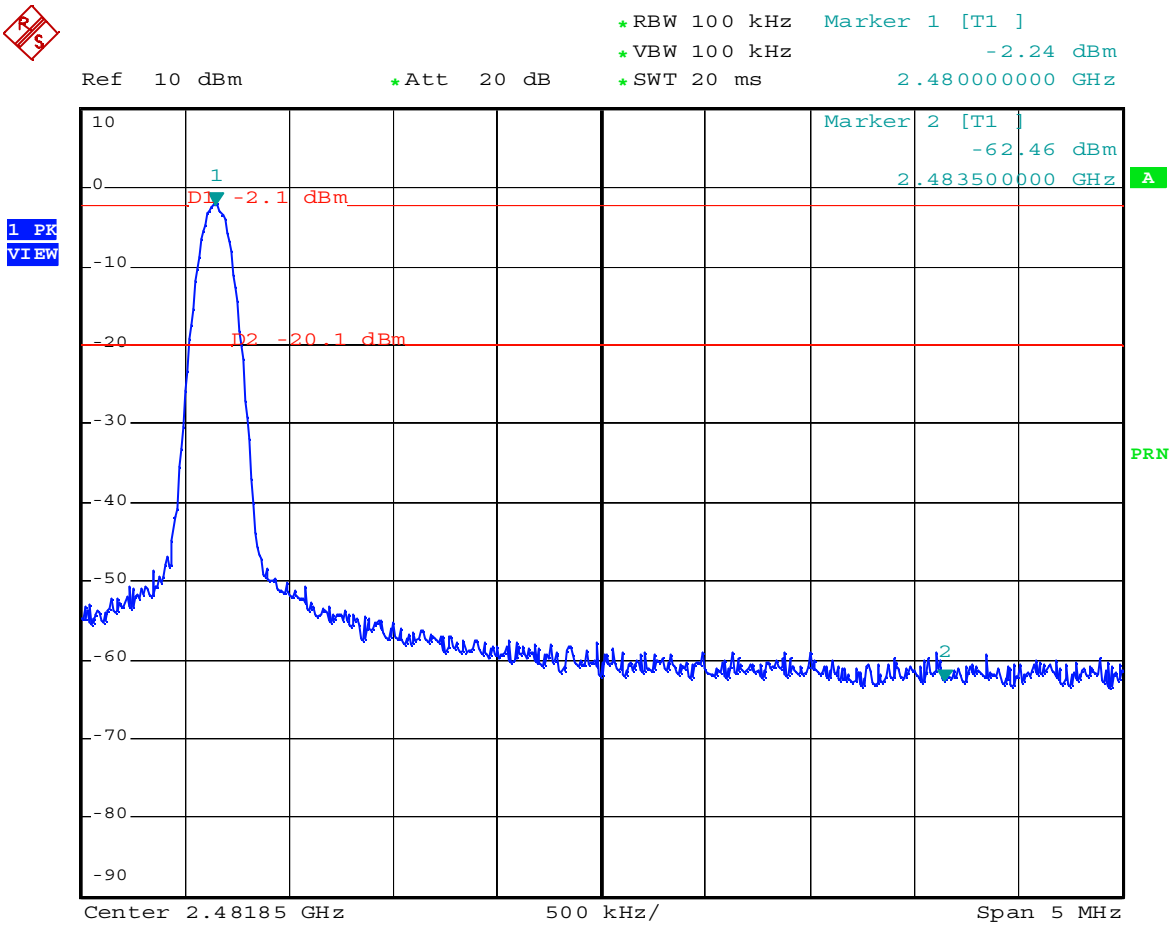
Channel: 1 Peak read: -6.20dBm, limit < -20.1dBm

Band-edges: 2.4GHz Peak read: -59.45dBm < -20.1dBm



Channel: 79 Peak read: -2.24dBm, limit < -20.1dBm

Band-edges: 2.4835GHz Peak read: -62.46dBm < -20.1dBm

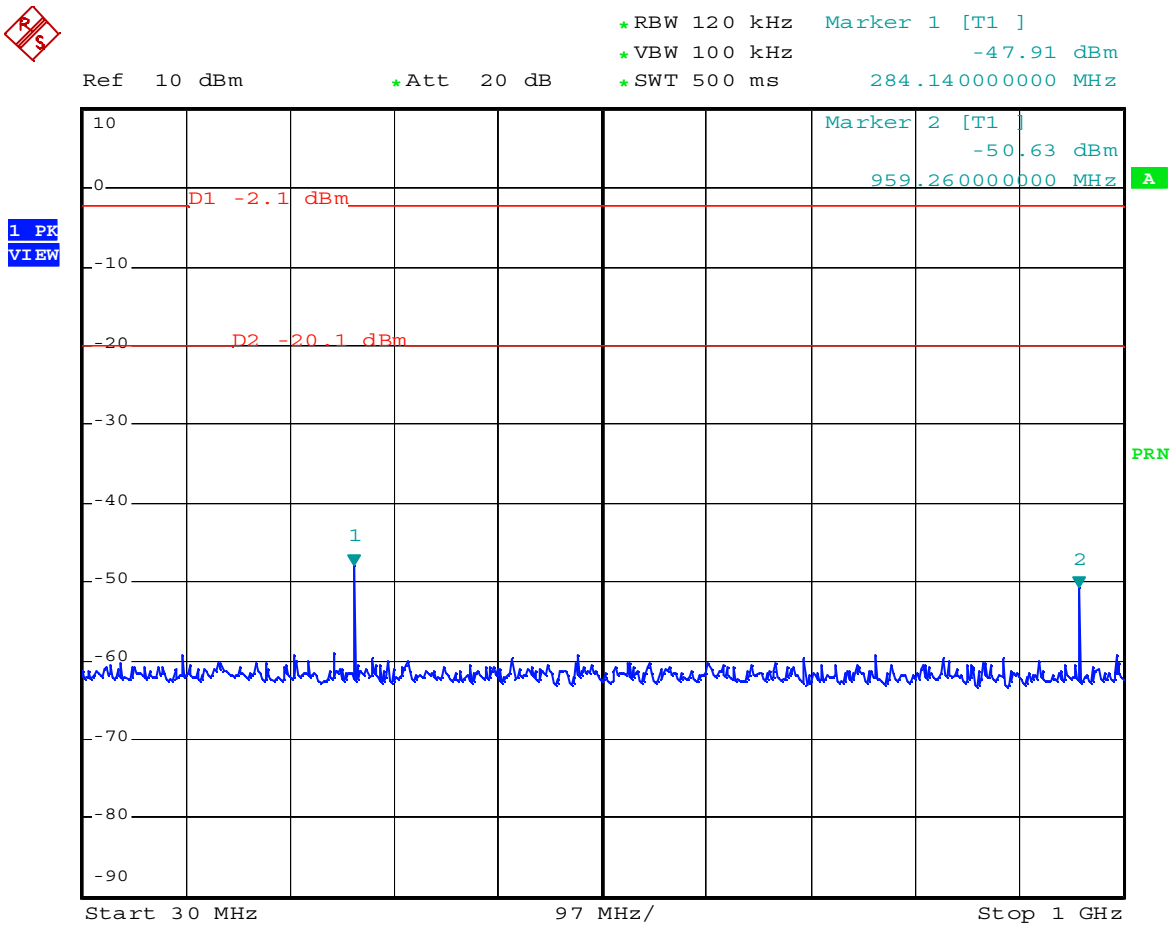


## 9.2 Spurious Emissions [Conducted]

### Test Results:

| | | | |
|---|---|---|---|
| **Model No.** | **: FRK-9452** | | |
| **Frequency range** | **: 30MHz to 1GHz** | **Detector** | **: Peak Value** |
| **Temperature** | **: 26 ℃** | **Humidity** | **: 52 %** |

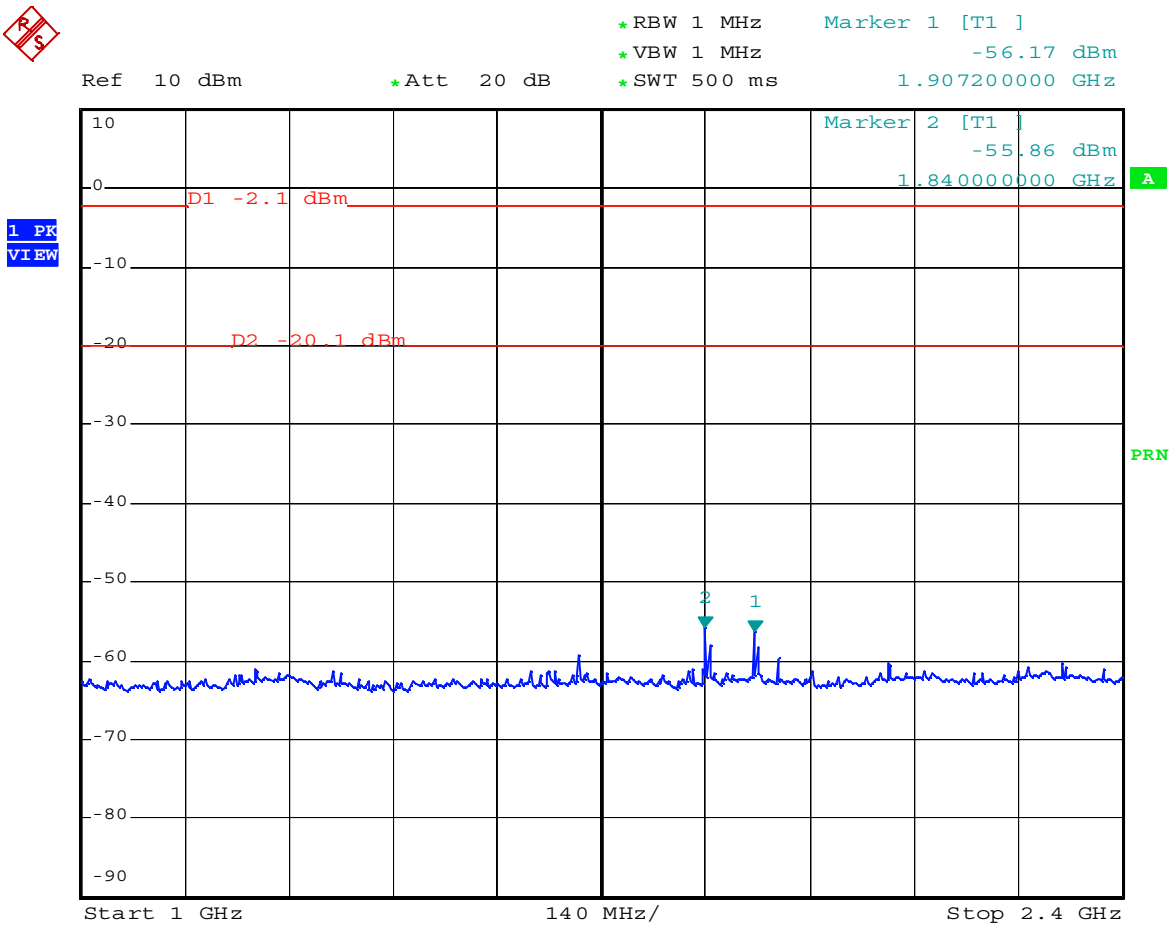
The highest value: 284.14MHz / -47.91dBm < -20.1dBm



## Test Results:

| | | | |
|---|---|---|---|
| **Model No.** | **: FRK-9452** | | |
| **Frequency range** | **: 1GHz to 2.4GHz** | **Detector** | **: Peak Value** |
| **Temperature** | **: 26 ℃** | **Humidity** | **: 52 %** |

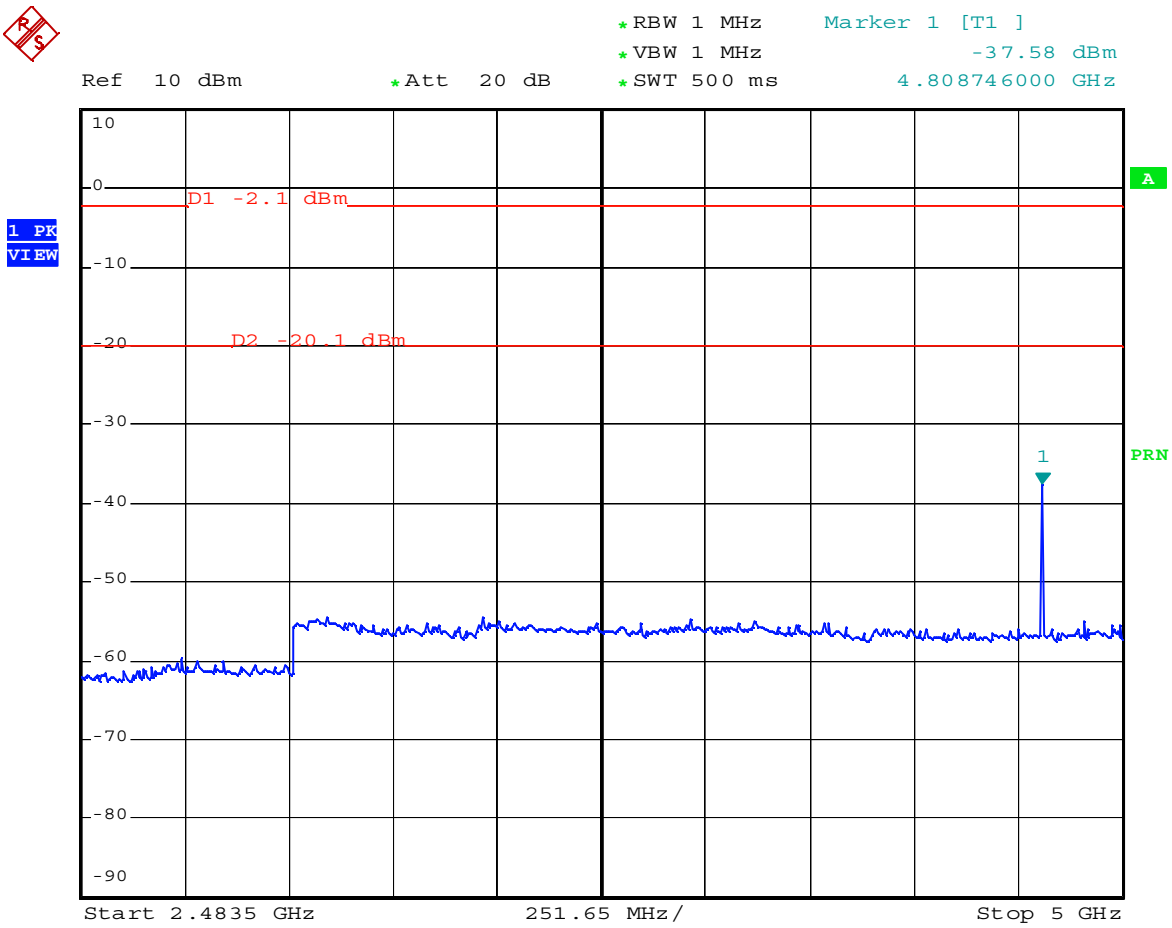
The highest value: 1.84GHz / -55.86dBm < -20.1dBm



## Test Results:

| | | | |
|---|---|---|---|
| **Model No.** | **: FRK-9452** | | |
| **Frequency range** | **: 2.4835GHz to 5GHz** | **Detector** | **: Peak Value** |
| **Temperature** | **: 26 ℃** | **Humidity** | **: 52 %** |

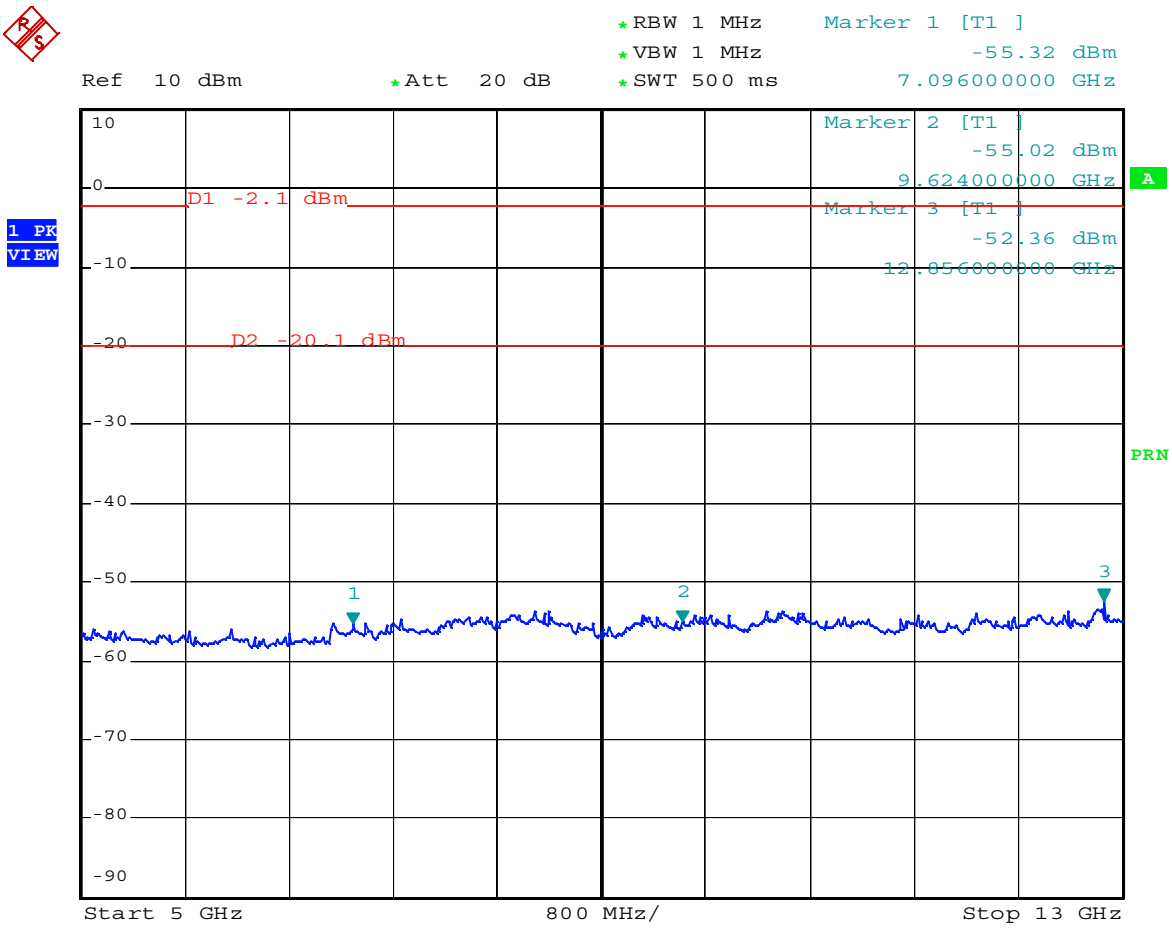
The highest value: 4.808GHz / -37.58dBm < -20.1dBm



## Test Results:

| | | | |
|---|---|---|---|
| **Model No.** | **: FRK-9452** | | |
| **Frequency range** | **: 5GHz to 13GHz** | **Detector** | **: Peak Value** |
| **Temperature** | **: 26 ℃** | **Humidity** | **: 52 %** |

The highest value: 12.856GHz / -52.36dBm < -20.1dBm



## 9.3 Spurious Emissions [Radiated]

Test method:
According to ANSI C63.4 (2003) paragraph 10.1.8.2, we indicate three highest spurious and three restrict band emission relative to the limit, as result.

When we performed “Spurious Radiated Emission”, the EUT was under continuous transmitting condition. It means the channel will transmit energy channel by channel, sequentially. Then the worst case data can be detected, we don’t set $F_L$, $F_M$, $F_H$ under test.

To avoid the pre-amplifier saturation by fundamental frequency, we added a “natch filter” (bandwidth from 2.4GHz to 2.4835GHz) between receiving antenna RF output and pre-amplifier’s RF input to bypass fundamental frequency , and only detected spurious emission.

Test result:

Measurement Range: 30MHz~24GHz

Resolution Bandwidth: 30MHz~1GHz, RBW=120KHz

Above 1GHz, RBW=1MHz

Temperature: **26** ℃ Humidity: **52** %

**Antenna polarization: HORIZONTAL ; Test distance : 3m ;**

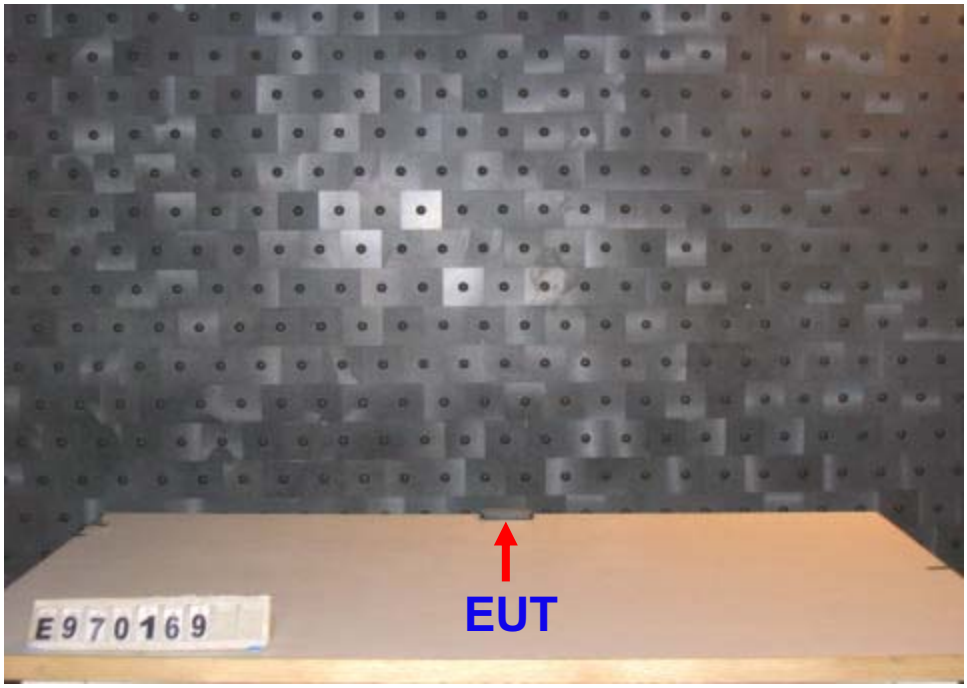
| Freq. (MHz) | Level (dBμV/m) | Over Limit (dB) | Limit Line (dBμV/m) | Read Level (dBμV) | Antenna Factor (dB) | Cable Loss (dB) | Preamp Factor (dB) | Detector Mode |
|---|---|---|---|---|---|---|---|---|
| 850.6 | 29.64 | -57.26 | 86.90 | 25.08 | 21.75 | 4.81 | 22.00 | Quasi-Peak |
| 7230.0 | 43.44 | -43.46 | 86.90 | 29.46 | 37.89 | 9.09 | 33.00 | Peak |
| 9595.0 | 46.83 | -40.07 | 86.90 | 30.41 | 39.50 | 9.92 | 33.00 | Peak |
| | | | Restrict Band | | | | | |
| 2268.4 | 43.29 | -10.71 | 54.00 | 42.76 | 28.29 | 5.24 | 33.00 | Peak |
| 4886.7 | 51.15 | - 2.85 | 54.00 | 43.02 | 33.11 | 8.02 | 33.00 | Peak |
| 12046.0 | 48.20 | - 5.80 | 54.00 | 30.84 | 39.85 | 10.51 | 33.00 | Average |

**Antenna polarization: VERTICAL ; Test distance : 3m ;**

| Freq. (MHz) | Level (dBμV/m) | Over Limit (dB) | Limit Line (dBμV/m) | Read Level (dBμV) | Antenna Factor (dB) | Cable Loss (dB) | Preamp Factor (dB) | Detector Mode |
|---|---|---|---|---|---|---|---|---|
| 928.2 | 29.91 | -56.99 | 86.90 | 23.76 | 23.07 | 5.08 | 22.00 | Quasi-Peak |
| 7195.0 | 43.69 | -43.21 | 86.90 | 29.68 | 37.93 | 9.08 | 33.00 | Peak |
| 9670.0 | 47.05 | -39.85 | 86.90 | 30.55 | 39.57 | 9.93 | 33.00 | Peak |
| | | | Restrict Band | | | | | |
| 2269.8 | 39.41 | -14.59 | 54.00 | 38.88 | 28.29 | 5.24 | 33.00 | Peak |
| 4783.5 | 48.61 | - 5.39 | 54.00 | 40.97 | 32.71 | 7.93 | 33.00 | Peak |
| 12034.0 | 47.60 | - 6.40 | 54.00 | 30.26 | 39.83 | 10.51 | 33.00 | Average |

Note: If the Peak level under Average limit, the Average detector will not be perform.

## 9.4 Test Setup Photo



# 10. §15.247(e)(i): Maximum Permissible Exposure (MPE)

## 10.1 MPE Calculation Method

$$E\ (V/m) = \frac{\sqrt{30*P*G}}{d} \qquad \text{Power Density} = Pd\ (W/m^2) = \frac{E^2}{377}$$

Combine these two formulas can be changed to

$$Pd = \frac{30*P*G}{377*d^2}$$

Note:

1. " E" means Electric field (V/m)
2. " P" means Peak RF output power (W)
3. " G" means EUT Antenna numeric gain (numeric)
4. " d" means the minimum mobile separation distance is 0.2m between radiator and human body.

## 10.2 Calculated Result and Limit

| Channel | Antenna Gain (numeric) | Peak Output Power (mW) | Power Density(S) (mW / $cm^2$) | Limit of Power Density(S) (mW / $cm^2$) | Test Result |
|---|---|---|---|---|---|
| 1 | 1.12 | 0.348 | $0.077*10^{-3}$ | <1 | PASS |
| 40 | 1.12 | 0.348 | $0.077*10^{-3}$ | <1 | PASS |
| 79 | 1.12 | 0.276 | $0.061*10^{-3}$ | <1 | PASS |

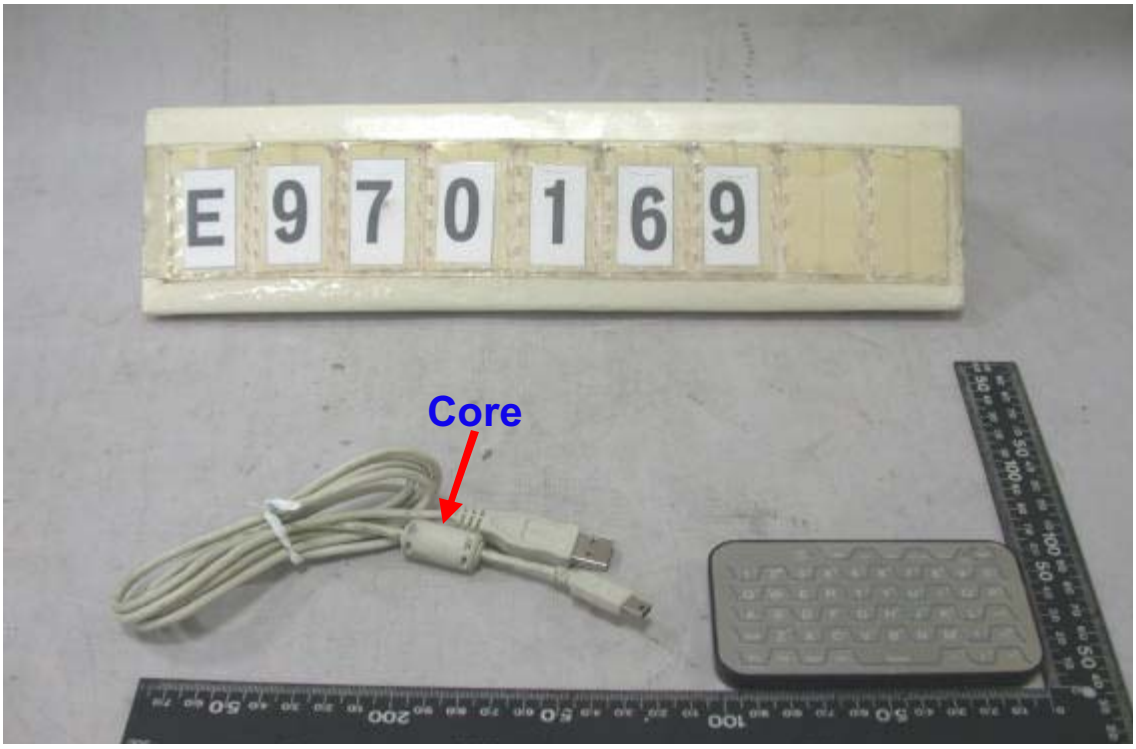
# 11. List of Test Instruments

| Test Site | Instrument | Manufacturer | Model No. | S/N | Next Cal. Date | Cal. Interval |
|---|---|---|---|---|---|---|
| **Chamber (No. 3)** | Spectrum Analyzer | ROHDE& SCHWARZ | FSP30 | 100157 | Sep. 01, 2009 | 1 Year |
| | 30MHz~1GHz RF Cable | YEIDA WIRE CABLE | NO.3 | N/A | Jan. 01, 2009 | 1 Year |
| | 1GHz~26.5GHz RF Cable | MITEQ | N/A | N/A | Sep. 28, 2010 | 2 Years |
| | Horn Antenna 1GHz~18GHz | COM-POWER | AH-826 | 10056 | Aug. 20, 2009 | 2 Years |
| | Horn Antenna 18GHz~26GHz | COM-POWER | AH-118 | 081000 | Oct. 02, 2010 | 2 Years |
| | SCHWARZBECK Antenna | SCHWARZBECK | VULB9161 | 4078 | July 19, 2009 | 1 Year |
| | Schaffner Pre-Amplifier | Schaffner | CPA-9232 | 1028 | Jan. 01, 2009 | 1 Year |
| | Preamplifier 1GHz~18GHz | MITEQ | 28-5A | 513015 | Sep. 29, 2009 | 1 Year |
| | Preamplifier 18GHz~26GHz | MITEQ | 30-5A | 808329 | May 15, 2009 | 1 Year |

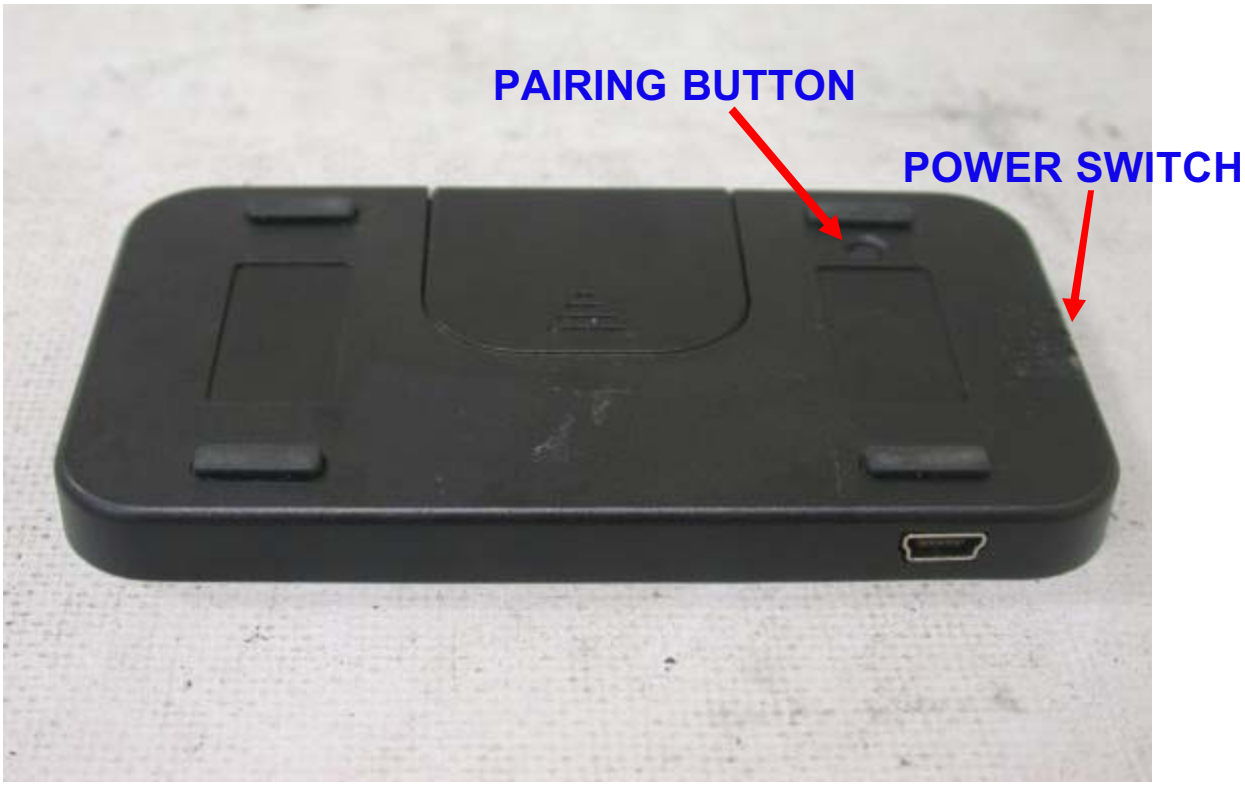
# 12. EUT Photos

**FCC ID : RAC9452A01**

**EUT FRONT VIEW**



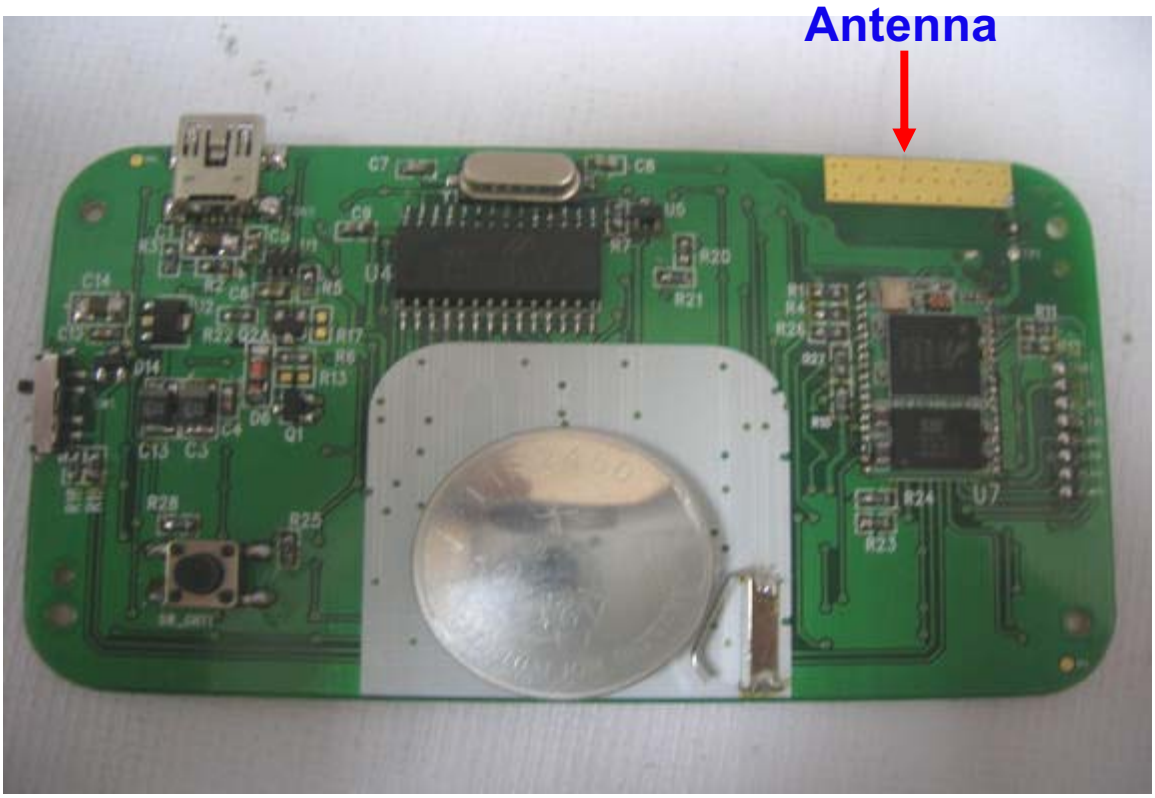

**EUT REAR VIEW**



**EUT INSIDE VIEW**


**EUT COMPONENT VIEW**

**EUT COMPONENT VIEW**




**EUT MODULE VIEW**