



**Microtest**  
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# Test Report

**Report No.:** MTi220613010-05E2

**Date of issue:** 2022-08-02

**Applicant:** Shenzhen Silver Storm Technology Co., Ltd.

**Product:** F97 Mechanical Keyboard

**Model(s):** F97 Hitchhiker, F97 Coral Sea, F97 Knight, F97 Typing Lab, F97 Variable X, F97 Cosmic Traveller, F97 Wintertide, F97 Dark Side

**FCC ID:** 2A7G9-F97

Shenzhen Microtest Co., Ltd.  
<http://www.mtitest.com>

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2. The test results of this report are only responsible for the samples submitted;
3. This report is invalid without the seal and signature of the laboratory;
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5. Any objection to this report shall be submitted to the laboratory within 15 days from the date of receipt of the report.



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| TEST RESULT CERTIFICATION                                                                                                                                                                                                                                      |                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| Applicant's name:                                                                                                                                                                                                                                              | Shenzhen Silver Storm Technology Co., Ltd.                                                                     |
| Address:                                                                                                                                                                                                                                                       | A905, Rongchaobinhai Bldg., Haixiu Rd., Xin'an Subdistrict, Bao'an District, Shenzhen, China                   |
| Manufacturer's Name:                                                                                                                                                                                                                                           | Shenzhen Silver Storm Technology Co., Ltd.                                                                     |
| Address:                                                                                                                                                                                                                                                       | A905, Rongchaobinhai Bldg., Haixiu Rd., Xin'an Subdistrict, Bao'an District, Shenzhen, China                   |
| Factory's Name:                                                                                                                                                                                                                                                | Dongguan Ranre Metalware Technology Co., Ltd.                                                                  |
| Address:                                                                                                                                                                                                                                                       | No. 288 Siweixi Rd., Xitailong Village, Shatian Town, Dongguan, Guangdong, China                               |
| <b>Product description</b>                                                                                                                                                                                                                                     |                                                                                                                |
| Product name:                                                                                                                                                                                                                                                  | F97 Mechanical Keyboard                                                                                        |
| Trademark :                                                                                                                                                                                                                                                    | IQUNIX                                                                                                         |
| Model Name :                                                                                                                                                                                                                                                   | F97 Hitchhiker                                                                                                 |
| Serial Model                                                                                                                                                                                                                                                   | F97 Coral Sea, F97 Knight, F97 Typing Lab, F97 Variable X, F97 Cosmic Traveller, F97 Wintertide, F97 Dark Side |
| Standards:                                                                                                                                                                                                                                                     | FCC Part 15.249                                                                                                |
| Test procedure:                                                                                                                                                                                                                                                | ANSI C63.10-2013                                                                                               |
| <b>Date of Test</b>                                                                                                                                                                                                                                            |                                                                                                                |
| Date (s) of performance of tests .....                                                                                                                                                                                                                         | 2022-06-21 ~ 2022-08-02                                                                                        |
| Test Result.....                                                                                                                                                                                                                                               | Pass                                                                                                           |
| This device described above has been tested by Shenzhen Microtest Co., Ltd. and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report. |                                                                                                                |

**Testing Engineer**

:

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(Leon Chen)

**Authorized Signatory**

:

*Tom Xue*

(Tom Xue)



## 1 General description

### 1.1 Feature of equipment under test (EUT)

|                      |                                                                                                                |
|----------------------|----------------------------------------------------------------------------------------------------------------|
| Equipment:           | F97 Mechanical Keyboard                                                                                        |
| Model Name:          | F97 Hitchhiker                                                                                                 |
| Serial Model:        | F97 Coral Sea, F97 Knight, F97 Typing Lab, F97 Variable X, F97 Cosmic Traveller, F97 Wintertide, F97 Dark Side |
| Model Difference:    | All the models are the same circuit and module, except the model name and color.                               |
| Operation Frequency: | 2402 - 2480 MHz                                                                                                |
| Modulation Type:     | GFSK                                                                                                           |
| Antenna Type:        | ANT: FPC antenna(PCB antenna not being used)                                                                   |
| Antenna Gain:        | 2dBi                                                                                                           |
| Max. Field Strength: | 85.16dBuV/m                                                                                                    |
| Power Source:        | Input: Micro: DC 5V/1A                                                                                         |
| Accessories:         | Cable: USB-A to USB-C cable 1.5m                                                                               |
| Battery:             | DC 3.7V 4000mAh                                                                                                |
| Hardware version:    | IQUNIX-F97-NRF52833-VS12L17A-V01-A-20211123                                                                    |
| Software version:    | V0004                                                                                                          |

### 1.2 Operation channel list

| Channel No. | Frequency (MHz) | Channel No. | Frequency (MHz) | Channel No. | Frequency (MHz) | Channel No. | Frequency (MHz) |
|-------------|-----------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|
| 0           | 2402            | 10          | 2422            | 20          | 2442            | 30          | 2462            |
| 1           | 2404            | 11          | 2424            | 21          | 2444            | 31          | 2464            |
| 2           | 2406            | 12          | 2426            | 22          | 2446            | 32          | 2466            |
| 3           | 2408            | 13          | 2428            | 23          | 2448            | 33          | 2468            |
| 4           | 2410            | 14          | 2430            | 24          | 2450            | 34          | 2470            |
| 5           | 2412            | 15          | 2432            | 25          | 2452            | 35          | 2472            |
| 6           | 2414            | 16          | 2434            | 26          | 2454            | 36          | 2474            |
| 7           | 2416            | 17          | 2436            | 27          | 2456            | 37          | 2476            |
| 8           | 2418            | 18          | 2438            | 28          | 2458            | 38          | 2478            |
| 9           | 2420            | 19          | 2440            | 29          | 2460            | 39          | 2480            |



### 1.3 Test Frequency Channel

| Channel | Frequency(MHz) |
|---------|----------------|
| Low     | 2402           |
| Middle  | 2440           |
| High    | 2480           |

### 1.4 EUT operation mode

During testing, RF test program provided by the manufacture to control the Tx operation followed the test requirement.

### 1.5 Ancillary equipment list

| Equipment | Model        | S/N | Manufacturer                      |
|-----------|--------------|-----|-----------------------------------|
| Laptop    | e485         | /   | lenovo                            |
| Adapter   | HW-090200CH0 | /   | Huizhou BYD Electronics Co., Ltd. |

## 2 Summary of Test Result

Test procedures according to the technical standards:

| Item | FCC Part No.      | Description of Test              | Result |
|------|-------------------|----------------------------------|--------|
| 1    | FCC Part15.203    | Antenna Requirement              | Pass   |
| 2    | FCC Part15.207    | AC power line conducted emission | Pass   |
| 5    | FCC Part15.249(d) | Radiated spurious emission       | Pass   |
| 4    | FCC Part 15.215   | 20dB and 99% Bandwidth           | Pass   |

### 3 Test Facilities and Accreditations

#### 3.1 Test laboratory

|                      |                                                                                                                                        |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Test Laboratory      | Shenzhen Microtest Co., Ltd                                                                                                            |
| Location             | 101, No. 7, Zone 2, Xinxing Industrial Park, Fuhai Avenue, Xinhe Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China. |
| FCC Registration No. | 448573                                                                                                                                 |

#### 3.2 Environmental conditions

|                      |              |
|----------------------|--------------|
| Temperature:         | 15°C~35°C    |
| Humidity             | 20%~75%      |
| Atmospheric pressure | 98kPa~101kPa |

#### 3.3 Measurement uncertainty

The reported uncertainty of measurement  $y \pm U$ , where expended uncertainty  $U$  is based on a standard uncertainty multiplied by a coverage factor of  $k=2$ , providing a level of confidence of approximately 95 %

|                                    |                    |
|------------------------------------|--------------------|
| RF frequency                       | $1 \times 10^{-7}$ |
| RF power, conducted                | $\pm 1$ dB         |
| Conducted emission(9kHz~30MHz)     | $\pm 2.5$ dB       |
| Radiated emission (9 kHz ~ 30 MHz) | $\pm 4.0$ dB       |
| Radiated emission(30MHz~1GHz)      | $\pm 4.2$ dB       |
| Radiated emission (above 1GHz)     | $\pm 4.3$ dB       |
| Temperature                        | $\pm 1$ degree     |
| Humidity                           | $\pm 5$ %          |

#### 3.4 Test software

| Software Name                  | Manufacturer                 | Model    | Version     |
|--------------------------------|------------------------------|----------|-------------|
| Bluetooth and WiFi Test System | Shenzhen JS tonscond co.,ltd | JS1120-3 | 2.5.77.0418 |



#### 4 List of test equipment

| Equipment No. | Equipment Name                       | Manufacturer    | Model       | Serial No.     | Calibration date | Due date   |
|---------------|--------------------------------------|-----------------|-------------|----------------|------------------|------------|
| MTI-E043      | EMI Test Receiver                    | Rohde&schwarz   | ESCI7       | 101166         | 2022/05/05       | 2023/05/04 |
| MTI-E044      | TRILOG Broadband Antenna             | schwarzbeck     | VULB 9163   | 9163-1338      | 2021/05/30       | 2023/05/29 |
| MTI-E047      | Amplifier                            | Hewlett-Packard | 8447F       | 3113A06150     | 2022/05/05       | 2023/05/04 |
| MTI-E089      | ESG Vector Signal Generator          | Agilent         | N5182A      | MY49060455     | 2022/05/05       | 2023/05/04 |
| MTI-E058      | ESG Series Analog Signal Generator   | Agilent         | E4421B      | GB40051240     | 2022/05/05       | 2023/05/04 |
| MTI-E062      | PXA Signal Analyzer                  | Agilent         | N9030A      | MY51350296     | 2022/05/05       | 2023/05/04 |
| MTI-E066      | MXA Signal Analyzer                  | Agilent         | N9020A      | MY50143483     | 2022/05/05       | 2023/05/04 |
| MTI-E078      | Synthesized Sweeper                  | Agilent         | 83752A      | 3610A01957     | 2022/05/05       | 2023/05/04 |
| MTI-E079      | DC Power Supply                      | Agilent         | E3632A      | MY40027695     | 2022/05/05       | 2023/05/04 |
| MTI-E045      | Double Ridged Broadband Horn Antenna | schwarzbeck     | BBHA 9120D  | 9120D-2278     | 2021/05/30       | 2023/05/29 |
| MTI-E021      | EMI Test Receiver                    | Rohde&schwarz   | ESCS30      | 100210         | 2022/05/05       | 2023/05/04 |
| MTI-E022      | Pulse Limiter                        | Schwarzbeck     | VSTD 9561-F | 00679          | 2022/05/05       | 2023/05/04 |
| MTI-E023      | Artificial mains network             | Schwarzbeck     | NSLK 8127   | NSLK 8127 #841 | 2022/05/05       | 2023/05/04 |
| MTI-E046      | Active Loop Antenna                  | Schwarzbeck     | FMZB 1519B  | 00044          | 2021/05/30       | 2023/05/29 |
| MTI-E048      | Amplifier                            | Agilent         | 8449B       | 3008A02400     | 2022/05/05       | 2023/05/04 |
| MTI-E072      | Thermometer Clock Humidity Monitor   | -               | HTC-1       | /              | 2022/05/05       | 2023/05/04 |

Note: the calibration interval of the above test instruments is 12 or 24 months and the calibrations are traceable to international system unit (SI).



## 5 Test Result

### 5.1 Antenna requirement

#### 5.1.1 Standard requirement

FCC PART 15.203;

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

#### 5.1.2 EUT Antenna

The antenna are FPC antenna (PCB antenna not being used), which was permanently affixed to the device and un-replaced, complies with 15.203. In addition, the maximum antenna gain is 2dBi.



## 5.2 AC power line conducted emission

### 5.2.1 Limits

FCC §15.207;

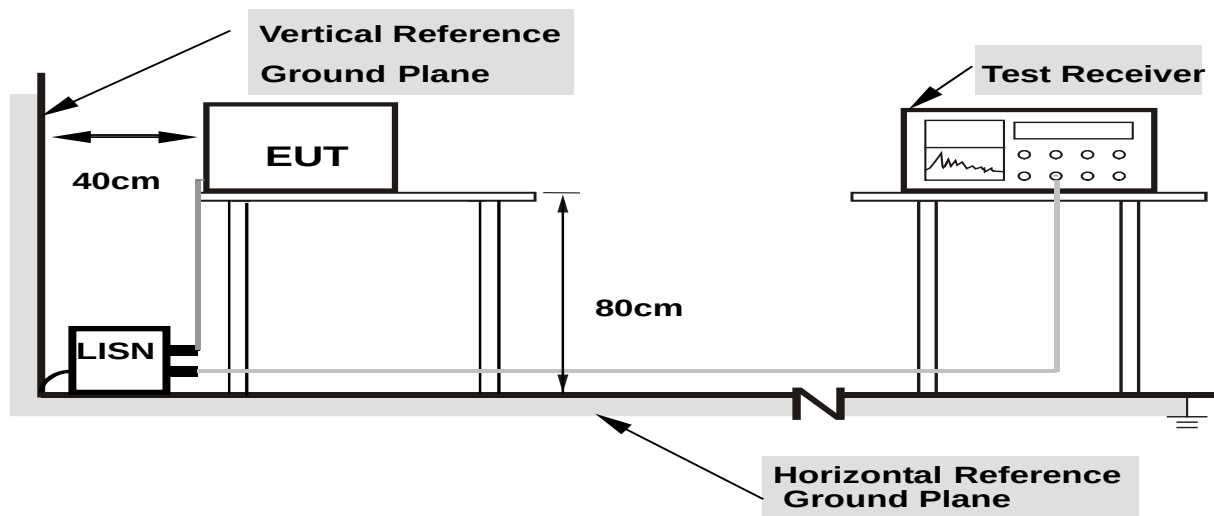
For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 $\mu$ H/50 $\Omega$  line impedance stabilization network (LISN).

| Frequency (MHz) | Quasi-peak               | Average                  |
|-----------------|--------------------------|--------------------------|
| 0.15 -0.5       | 66 - 56 <sup>note2</sup> | 56 - 46 <sup>note2</sup> |
| 0.50 -5.0       | 56.00                    | 46.00                    |
| 5.0 -30.0       | 60.00                    | 50.00                    |

Note1: The tighter limit applies at the band edges.

Note2: The limit of " \* " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

### 5.2.2 Test setup



**Note: 1.Support units were connected to second LISN.**

**2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes**

### 5.2.3 Test procedure

a. EUT Operating Conditions

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

b. The following table is the setting of the receiver

| Receiver Parameters | Setting  |
|---------------------|----------|
| Attenuation         | 10 dB    |
| Start Frequency     | 0.15 MHz |
| Stop Frequency      | 30 MHz   |
| IF Bandwidth        | 9 kHz    |

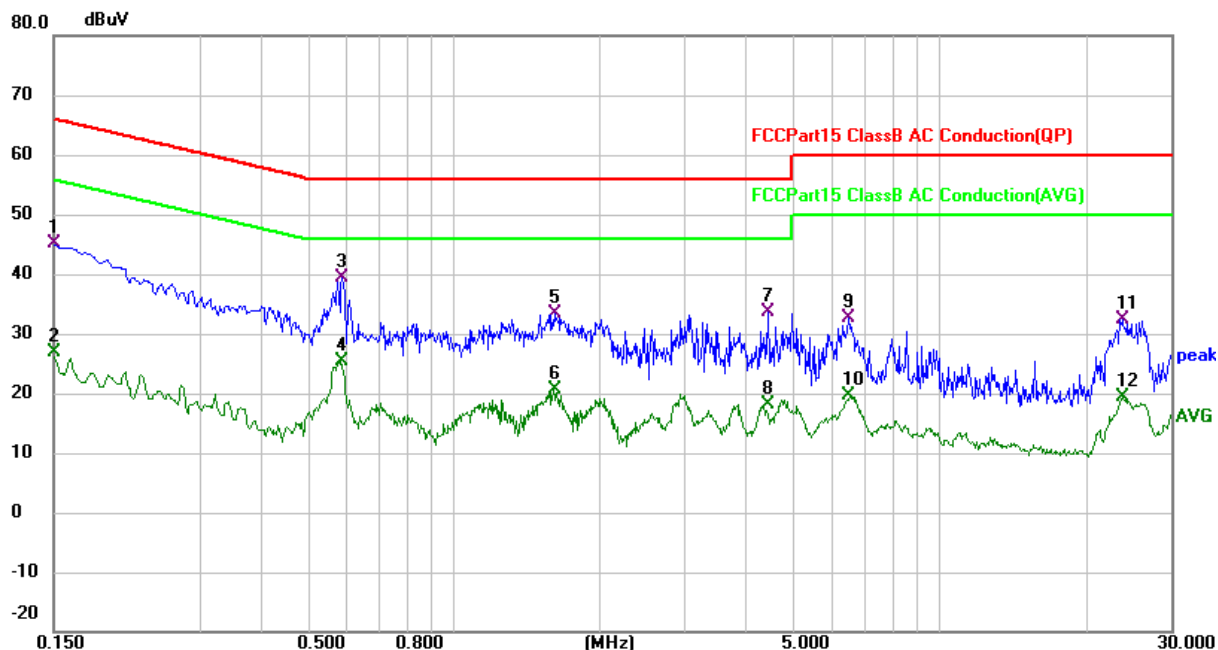
- c. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipment's powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- d. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- e. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- f. LISN at least 80 cm from nearest part of EUT chassis.

For the actual test configuration, please refer to the related Item –EUT Test Photos.

### 5.2.4 Test results



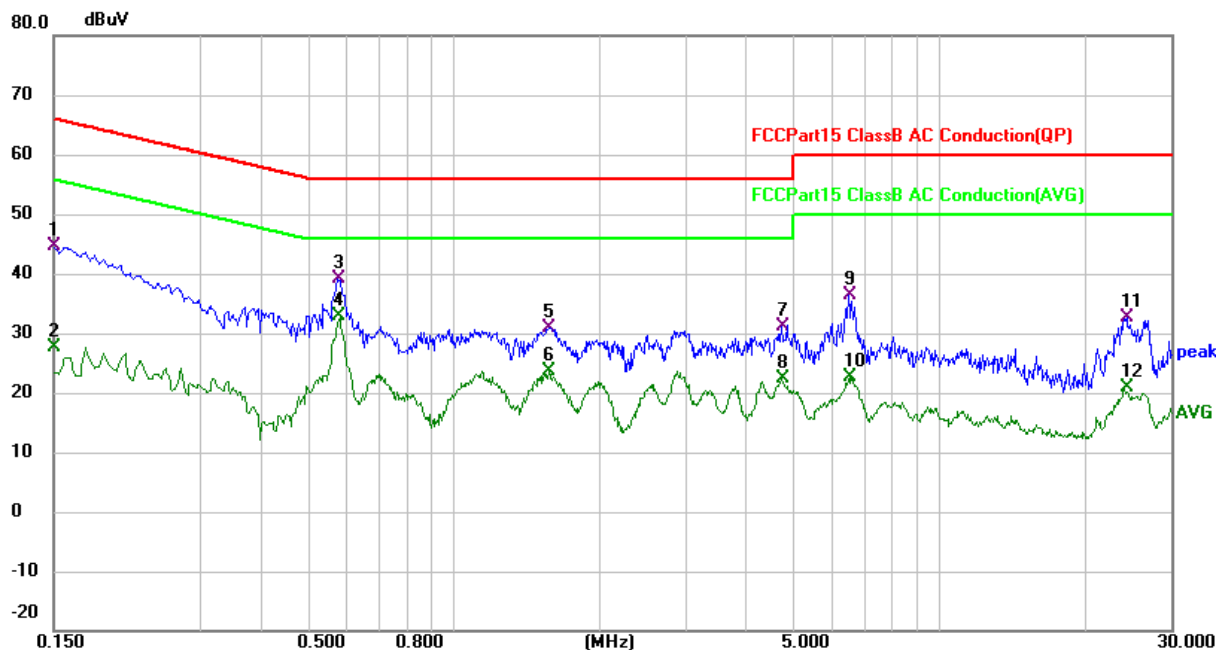
|               |                                          |               |                |
|---------------|------------------------------------------|---------------|----------------|
| EUT:          | F97 Mechanical Keyboard                  | Model Name :  | F97 Hitchhiker |
| Pressure:     | 101kPa                                   | Polarization: | N              |
| Test voltage: | Power by AC/DC adapter<br>(AC 120V/60Hz) | Test mode:    | Charging+TX    |



| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV | Limit<br>dBuV | Over<br>dB | Detector |
|-----|-----|--------------|--------------------------|-------------------------|--------------------------|---------------|------------|----------|
| 1   |     | 0.1500       | 34.02                    | 10.99                   | 45.01                    | 66.00         | -20.99     | QP       |
| 2   |     | 0.1500       | 15.88                    | 10.99                   | 26.87                    | 56.00         | -29.13     | AVG      |
| 3   | *   | 0.5899       | 28.25                    | 11.07                   | 39.32                    | 56.00         | -16.68     | QP       |
| 4   |     | 0.5899       | 14.32                    | 11.07                   | 25.39                    | 46.00         | -20.61     | AVG      |
| 5   |     | 1.6180       | 18.84                    | 14.60                   | 33.44                    | 56.00         | -22.56     | QP       |
| 6   |     | 1.6180       | 5.91                     | 14.60                   | 20.51                    | 46.00         | -25.49     | AVG      |
| 7   |     | 4.4500       | 22.09                    | 11.46                   | 33.55                    | 56.00         | -22.45     | QP       |
| 8   |     | 4.4500       | 6.75                     | 11.46                   | 18.21                    | 46.00         | -27.79     | AVG      |
| 9   |     | 6.5100       | 21.13                    | 11.58                   | 32.71                    | 60.00         | -27.29     | QP       |
| 10  |     | 6.5100       | 8.03                     | 11.58                   | 19.61                    | 50.00         | -30.39     | AVG      |
| 11  |     | 23.8420      | 20.66                    | 11.79                   | 32.45                    | 60.00         | -27.55     | QP       |
| 12  |     | 23.8420      | 7.57                     | 11.79                   | 19.36                    | 50.00         | -30.64     | AVG      |



|               |                                          |               |                |
|---------------|------------------------------------------|---------------|----------------|
| EUT:          | F97 Mechanical Keyboard                  | Model Name :  | F97 Hitchhiker |
| Pressure:     | 101kPa                                   | Polarization: | L              |
| Test voltage: | Power by AC/DC adapter<br>(AC 120V/60Hz) | Test mode:    | Charging+TX    |



| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV | Limit<br>dBuV | Over<br>dB | Detector |
|-----|-----|--------------|--------------------------|-------------------------|--------------------------|---------------|------------|----------|
| 1   |     | 0.1500       | 33.61                    | 10.99                   | 44.60                    | 66.00         | -21.40     | QP       |
| 2   |     | 0.1500       | 16.59                    | 10.99                   | 27.58                    | 56.00         | -28.42     | AVG      |
| 3   |     | 0.5780       | 28.05                    | 10.97                   | 39.02                    | 56.00         | -16.98     | QP       |
| 4   | *   | 0.5780       | 21.96                    | 10.97                   | 32.93                    | 46.00         | -13.07     | AVG      |
| 5   |     | 1.5740       | 16.44                    | 14.45                   | 30.89                    | 56.00         | -25.11     | QP       |
| 6   |     | 1.5740       | 9.09                     | 14.45                   | 23.54                    | 46.00         | -22.46     | AVG      |
| 7   |     | 4.7380       | 19.82                    | 11.38                   | 31.20                    | 56.00         | -24.80     | QP       |
| 8   |     | 4.7380       | 10.92                    | 11.38                   | 22.30                    | 46.00         | -23.70     | AVG      |
| 9   |     | 6.5060       | 25.06                    | 11.39                   | 36.45                    | 60.00         | -23.55     | QP       |
| 10  |     | 6.5060       | 11.33                    | 11.39                   | 22.72                    | 50.00         | -27.28     | AVG      |
| 11  |     | 24.3060      | 20.81                    | 11.78                   | 32.59                    | 60.00         | -27.41     | QP       |
| 12  |     | 24.3060      | 9.04                     | 11.78                   | 20.82                    | 50.00         | -29.18     | AVG      |



### 5.3 Radiated spurious emission

#### 5.3.1 Limit

FCC PART 15.249(a);

Except as provided in paragraph (a) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

| Frequency (MHz) | Field Strength of Fundamental (mV/m) | Field Strength of Harmonics ( $\mu$ V/m) |
|-----------------|--------------------------------------|------------------------------------------|
| 902-928         | 50                                   | 500                                      |
| 2400-2483.5     | 50                                   | 500                                      |
| 5725-5875       | 50                                   | 500                                      |

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field Strength ( $\mu$ V/m) | Measurement Distance (m) |
|-----------------|-----------------------------|--------------------------|
| 0.009 - 0.490   | $2400/F(\text{kHz})$        | 300                      |
| 0.490 - 1.705   | $24000/F(\text{kHz})$       | 30                       |
| 1.705 - 30.0    | 30                          | 30                       |
| 30 - 88         | 100                         | 3                        |
| 88 - 216        | 150                         | 3                        |
| 216 - 960       | 200                         | 3                        |
| Above 960       | 500                         | 3                        |

#### 5.3.2 Test method

- The EUT is placed on a turntable, which is 0.8m above ground plane for test frequency range below 1GHz, and 1.5m above ground plane for test frequency range above 1GHz.
- EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
- Use the following spectrum analyser settings:
  - Span = wide enough to fully capture the emission being measured
  - RBW = 1 MHz for  $f \geq 1\text{GHz}$ , 100 kHz for  $f < 1\text{GHz}$
  - VBW  $\geq$  RBW, Sweep = auto
  - Detector function = peak
  - Trace = max hold
- Follow the guidelines in ANSI C63.4-2014 with respect to maximizing the emission by rotating the EUT, adjusting the measurement antenna height and polarization, etc. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, submit this data. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.



- e) The peak level, once corrected, must comply with the limit specified in Section 15.209. Set the RBW = 1MHz, VBW = 10Hz, Detector = PK for AV value, while maintaining all of the other instrument settings.

### 5.3.3 Test Result

Below 30MHz

|            |                         |                |                |
|------------|-------------------------|----------------|----------------|
| EUT:       | F97 Mechanical Keyboard | Model name. :  | F97 Hitchhiker |
| Pressure:  | 1010 hPa                | Test voltage:  | AC 120V/60Hz   |
| Test mode: | Charging+TX             | Polarization : | --             |

| Freq. | Reading  | Limit    | Margin | State |
|-------|----------|----------|--------|-------|
| (MHz) | (dBuV/m) | (dBuV/m) | (dB)   | P/F   |
| --    | --       | --       | --     | Pass  |
| --    | --       | --       | --     | Pass  |

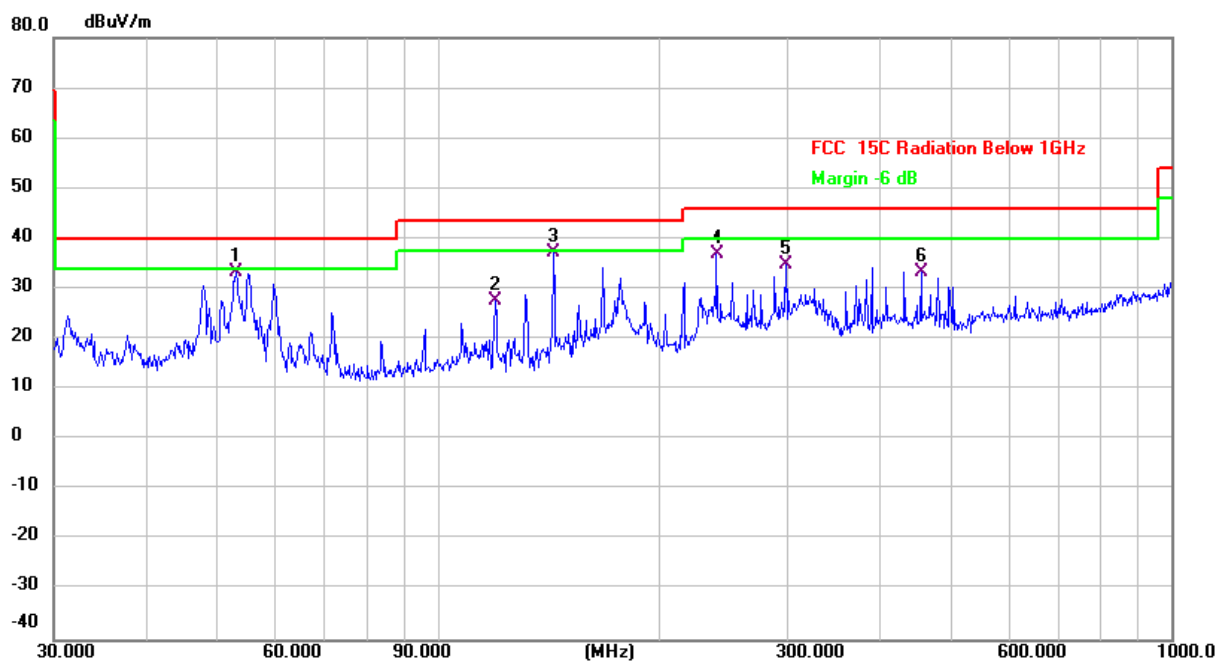
Note:

1. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
2. Distance extrapolation factor =  $40 \log (\text{specific distance}/\text{test distance})(\text{dB})$ ;
3. Limit line = specific limits (dBuV) + distance extrapolation factor.



30MHz-1GHz

|               |                         |               |                |
|---------------|-------------------------|---------------|----------------|
| EUT:          | F97 Mechanical Keyboard | Model Name:   | F97 Hitchhiker |
| Pressure:     | 101kPa                  | Polarization: | Horizontal     |
| Test voltage: | DC 3.7V                 | Test Mode:    | TX-2480MHz     |

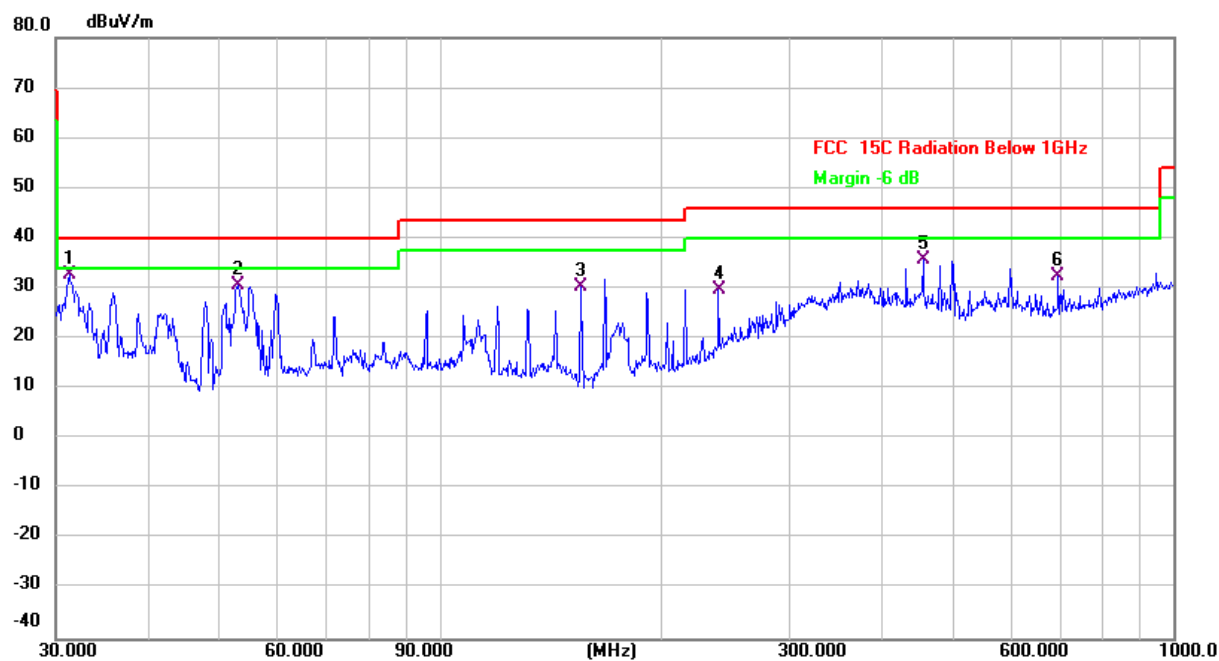


| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Over<br>dB | Detector |
|-----|-----|--------------|--------------------------|-------------------------|----------------------------|-----------------|------------|----------|
| 1   |     | 53.1313      | 41.45                    | -8.23                   | 33.22                      | 40.00           | -6.78      | QP       |
| 2   |     | 119.8556     | 37.93                    | -10.21                  | 27.72                      | 43.50           | -15.78     | QP       |
| 3   | *   | 143.8295     | 47.96                    | -10.69                  | 37.27                      | 43.50           | -6.23      | QP       |
| 4   |     | 239.9874     | 43.11                    | -6.30                   | 36.81                      | 46.00           | -9.19      | QP       |
| 5   |     | 298.2681     | 40.63                    | -5.86                   | 34.77                      | 46.00           | -11.23     | QP       |
| 6   |     | 455.9058     | 36.92                    | -3.52                   | 33.40                      | 46.00           | -12.60     | QP       |





|               |                         |               |                |
|---------------|-------------------------|---------------|----------------|
| EUT:          | F97 Mechanical Keyboard | Model Name:   | F97 Hitchhiker |
| Pressure:     | 101kPa                  | Polarization: | Vertical       |
| Test voltage: | DC 3.7V                 | Test Mode:    | TX-2480MHz     |



| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Over<br>dB | Detector |
|-----|-----|--------------|--------------------------|-------------------------|----------------------------|-----------------|------------|----------|
| 1   | *   | 31.2893      | 41.38                    | -8.70                   | 32.68                      | 40.00           | -7.32      | QP       |
| 2   |     | 53.1313      | 38.96                    | -8.23                   | 30.73                      | 40.00           | -9.27      | QP       |
| 3   |     | 155.9101     | 40.36                    | -10.05                  | 30.31                      | 43.50           | -13.19     | QP       |
| 4   |     | 239.9874     | 36.18                    | -6.30                   | 29.88                      | 46.00           | -16.12     | QP       |
| 5   |     | 455.9058     | 39.15                    | -3.52                   | 35.63                      | 46.00           | -10.37     | QP       |
| 6   |     | 696.8567     | 32.42                    | 0.02                    | 32.44                      | 46.00           | -13.56     | QP       |

Note:

1. Emission Level = Meter Reading + Factor, Margin= Emission Level- Limit, Factor = Antenna Factor + Cable Loss – Pre-amplifier.
2. The three modulated high, medium and low channels have been tested. The report only shows the worst mode. The worst mode is CH39.



1GHz-26.5GHz:

| Frequency                      | Reading Level | Correct Factor | Measurement | Limits   | Over   | Detector | Polarization |
|--------------------------------|---------------|----------------|-------------|----------|--------|----------|--------------|
| (MHz)                          | (dBμV)        | (dB/m)         | (dBμV/m)    | (dBμV/m) | (dB)   | Peak/AVG | H/V          |
| <b>GFSK - 2402 MHz TX mode</b> |               |                |             |          |        |          |              |
| 4804                           | 53.97         | 1.52           | 55.49       | 74.00    | -18.51 | Peak     | V            |
| 4804                           | 49.33         | 1.52           | 50.85       | 54.00    | -3.15  | AVG      | V            |
| 7206                           | 40.99         | 5.46           | 46.45       | 74.00    | -27.55 | Peak     | V            |
| 7206                           | 36.75         | 5.46           | 42.21       | 54.00    | -11.79 | AVG      | V            |
| 9608                           | 42.10         | 6.33           | 48.43       | 74.00    | -25.57 | Peak     | V            |
| 9608                           | 37.87         | 6.33           | 44.20       | 54.00    | -9.80  | AVG      | V            |
| 4804                           | 52.44         | 1.52           | 53.96       | 74.00    | -20.04 | Peak     | H            |
| 4804                           | 47.69         | 1.52           | 49.21       | 54.00    | -4.79  | AVG      | H            |
| 7206                           | 41.31         | 5.46           | 46.77       | 74.00    | -27.23 | Peak     | H            |
| 7206                           | 36.56         | 5.46           | 42.02       | 54.00    | -11.98 | AVG      | H            |
| 9608                           | 41.73         | 6.33           | 48.06       | 74.00    | -25.94 | Peak     | H            |
| 9608                           | 37.77         | 6.33           | 44.10       | 54.00    | -9.90  | AVG      | H            |
| <b>GFSK - 2440 MHz TX mode</b> |               |                |             |          |        |          |              |
| 4880                           | 50.25         | 1.68           | 51.93       | 74.00    | -22.07 | Peak     | V            |
| 4880                           | 45.85         | 1.68           | 47.53       | 54.00    | -6.47  | AVG      | V            |
| 7320                           | 41.44         | 5.45           | 46.89       | 74.00    | -27.11 | Peak     | V            |
| 7320                           | 36.91         | 5.45           | 42.36       | 54.00    | -11.64 | AVG      | V            |
| 9760                           | 41.64         | 6.37           | 48.01       | 74.00    | -25.99 | Peak     | V            |
| 9760                           | 37.73         | 6.37           | 44.10       | 54.00    | -9.90  | AVG      | V            |
| 4880                           | 50.25         | 1.68           | 51.93       | 74.00    | -22.07 | Peak     | H            |
| 4880                           | 45.44         | 1.68           | 47.12       | 54.00    | -6.88  | AVG      | H            |
| 7320                           | 41.44         | 5.45           | 46.89       | 74.00    | -27.11 | Peak     | H            |
| 7320                           | 37.08         | 5.45           | 42.53       | 54.00    | -11.47 | AVG      | H            |
| 9760                           | 41.21         | 6.37           | 47.58       | 74.00    | -26.42 | Peak     | H            |
| 9760                           | 36.84         | 6.37           | 43.21       | 54.00    | -10.79 | AVG      | H            |



| Frequency                      | Reading Level | Correct Factor | Measurement | Limits   | Over   | Detector | Polarization |
|--------------------------------|---------------|----------------|-------------|----------|--------|----------|--------------|
| (MHz)                          | (dBμV)        | (dB/m)         | (dBμV/m)    | (dBμV/m) | (dB)   | Peak/AVG | H/V          |
| <b>GFSK - 2480 MHz TX mode</b> |               |                |             |          |        |          |              |
| 4960                           | 53.35         | 1.83           | 55.18       | 74.00    | -18.82 | Peak     | V            |
| 4960                           | 48.76         | 1.83           | 50.59       | 54.00    | -3.41  | AVG      | V            |
| 7440                           | 42.73         | 5.43           | 48.16       | 74.00    | -25.84 | Peak     | V            |
| 7440                           | 38.72         | 5.43           | 44.15       | 54.00    | -9.85  | AVG      | V            |
| 9920                           | 41.79         | 6.41           | 48.20       | 74.00    | -25.80 | Peak     | V            |
| 9920                           | 37.72         | 6.41           | 44.13       | 54.00    | -9.87  | AVG      | V            |
| 4960                           | 52.12         | 1.83           | 53.95       | 74.00    | -20.05 | Peak     | H            |
| 4960                           | 47.49         | 1.83           | 49.32       | 54.00    | -4.68  | AVG      | H            |
| 7440                           | 40.57         | 5.43           | 46.00       | 74.00    | -28.00 | Peak     | H            |
| 7440                           | 36.67         | 5.43           | 42.10       | 54.00    | -11.90 | AVG      | H            |
| 9920                           | 41.81         | 6.41           | 48.22       | 74.00    | -25.78 | Peak     | H            |
| 9920                           | 37.83         | 6.41           | 44.24       | 54.00    | -9.76  | AVG      | H            |

Note:

1. All Readings are Peak Value (VBW=3MHz) and AV Value (VBW=10Hz).
2. Emission Level= Antenna Factor + Cable Loss + Read Level - Preamp Factor
3. All the modulation modes have been tested, and the worst results are reflected in the report.



#### 5.3.4 Band edge-Field strength of fundamental

| Frequency | Ant.<br>Polarization | Emission level | Limits       | Detector | Result |
|-----------|----------------------|----------------|--------------|----------|--------|
| (MHz)     | H / V                | dB $\mu$ V/m   | dB $\mu$ V/m |          |        |
| 2402      | H                    | 85.16          | 114          | PK       | PASS   |
| 2402      | H                    | 84.63          | 94           | AV       | PASS   |
| 2402      | V                    | 80.94          | 114          | PK       | PASS   |
| 2402      | V                    | 80.40          | 94           | AV       | PASS   |

| Frequency | Ant.<br>Polarization | Emission level | Limits       | Detector | Result |
|-----------|----------------------|----------------|--------------|----------|--------|
| (MHz)     | H / V                | dB $\mu$ V/m   | dB $\mu$ V/m |          |        |
| 2440      | H                    | 83.12          | 114          | PK       | PASS   |
| 2440      | H                    | 81.76          | 94           | AV       | PASS   |
| 2440      | V                    | 78.35          | 114          | PK       | PASS   |
| 2440      | V                    | 77.64          | 94           | AV       | PASS   |

| Frequency | Ant.<br>Polarization | Emission level | Limits       | Detector | Result |
|-----------|----------------------|----------------|--------------|----------|--------|
| (MHz)     | H / V                | dB $\mu$ V/m   | dB $\mu$ V/m |          |        |
| 2480      | H                    | 80.18          | 114          | PK       | PASS   |
| 2480      | H                    | 79.61          | 94           | AV       | PASS   |
| 2480      | V                    | 74.28          | 114          | PK       | PASS   |
| 2480      | V                    | 73.65          | 94           | AV       | PASS   |



### 5.3.5 Band edge-radiated

| Frequency                    | Reading Level | Correct Factor | Measurement | Limits   | Over   | Detector | Polarization |
|------------------------------|---------------|----------------|-------------|----------|--------|----------|--------------|
| (MHz)                        | (dBμV)        | (dB/m)         | (dBμV/m)    | (dBμV/m) | (dB)   | Peak/AVG | H/V          |
| <b>GFSK – Low band-edge</b>  |               |                |             |          |        |          |              |
| (MHz)                        | (dBμV)        | (dB/m)         | (dBμV/m)    | (dBμV/m) | (dB)   | Peak/AVG | H/V          |
| 2310                         | 46.64         | -6.60          | 40.04       | 74.00    | -33.96 | Peak     | V            |
| 2310                         | 37.81         | -6.60          | 31.21       | 54.00    | -22.79 | AVG      | V            |
| 2390                         | 46.52         | -6.23          | 40.29       | 74.00    | -33.71 | Peak     | V            |
| 2390                         | 37.69         | -6.23          | 31.46       | 54.00    | -22.54 | AVG      | V            |
| 2400                         | 61.49         | -6.18          | 55.31       | 74.00    | -18.69 | Peak     | V            |
| 2400                         | 48.32         | -6.18          | 42.14       | 54.00    | -11.86 | AVG      | V            |
| 2310                         | 47.48         | -6.60          | 40.88       | 74.00    | -33.12 | Peak     | H            |
| 2310                         | 37.07         | -6.60          | 30.47       | 54.00    | -23.53 | AVG      | H            |
| 2390                         | 47.10         | -6.23          | 40.87       | 74.00    | -33.13 | Peak     | H            |
| 2390                         | 36.89         | -6.23          | 30.66       | 54.00    | -23.34 | AVG      | H            |
| 2400                         | 66.43         | -6.18          | 60.25       | 74.00    | -13.75 | Peak     | H            |
| 2400                         | 52.25         | -6.18          | 46.07       | 54.00    | -7.93  | AVG      | H            |
| <b>GFSK – High band-edge</b> |               |                |             |          |        |          |              |
| 2483.5                       | 47.88         | -5.79          | 42.09       | 74.00    | -31.91 | Peak     | V            |
| 2483.5                       | 37.61         | -5.79          | 31.82       | 54.00    | -22.18 | AVG      | V            |
| 2500                         | 47.07         | -5.72          | 41.35       | 74.00    | -32.65 | Peak     | V            |
| 2500                         | 37.82         | -5.72          | 32.10       | 54.00    | -21.90 | AVG      | V            |
| 2483.5                       | 49.37         | -5.79          | 43.58       | 74.00    | -30.42 | Peak     | H            |
| 2483.5                       | 39.14         | -5.79          | 33.35       | 54.00    | -20.65 | AVG      | H            |
| 2500                         | 47.87         | -5.72          | 42.15       | 74.00    | -31.85 | Peak     | H            |
| 2500                         | 37.80         | -5.72          | 32.08       | 54.00    | -21.92 | AVG      | H            |

## 5.4 20dB and 99% bandwidth

### 5.4.1 Limits

FCC §15.215(c)

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

### 5.4.2 Test method

Use the following spectrum analyzer settings:

For 20 dB bandwidth

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW  $\geq 1\%$  of the 20 dB bandwidth

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

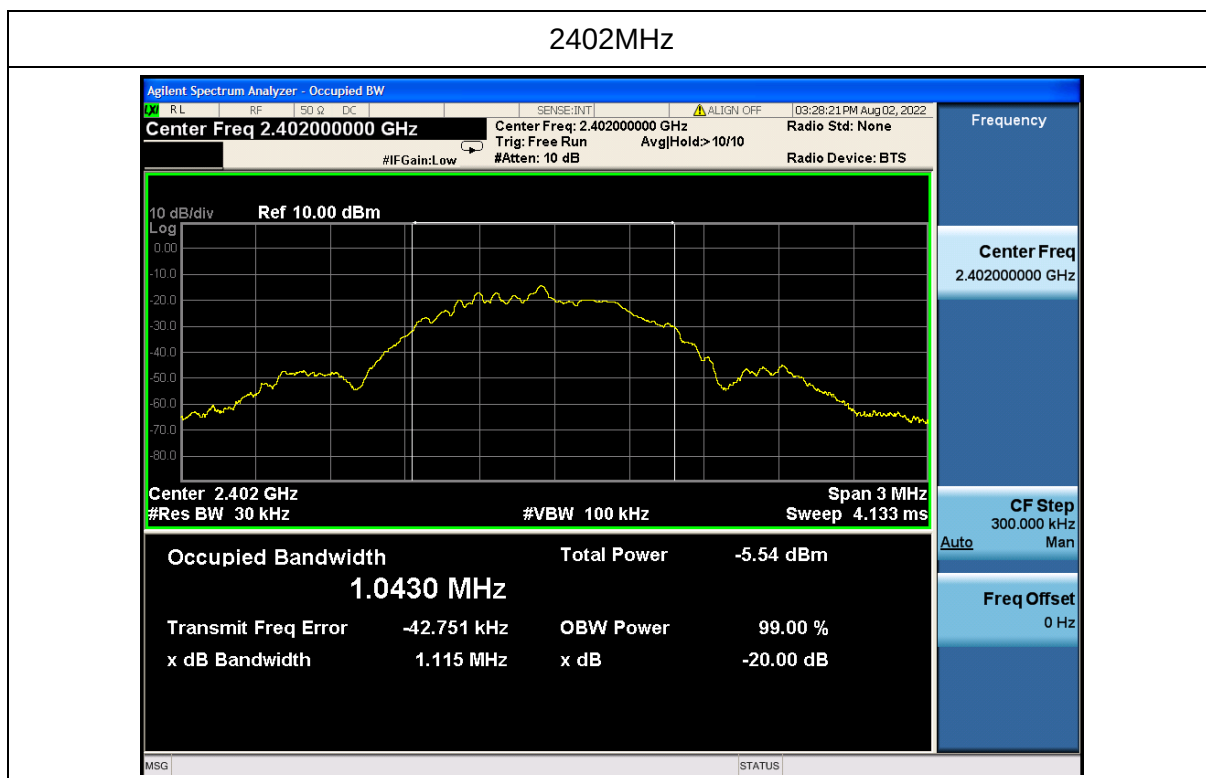
Trace = max hold

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth and 99% occupied bandwidth of the emission

### 5.4.3 Test result

| Frequency (MHz) | 20dB bandwidth (MHz) | 99% bandwidth (MHz) |
|-----------------|----------------------|---------------------|
| 2402            | 1.115                | 1.0430              |
| 2440            | 1.116                | 1.0450              |
| 2480            | 1.118                | 1.0473              |

#### Test plots





2440MHz



2480MHz







## **Photographs of the Test Setup**

See the Appendix: Test Setup Photos in the report No.: MTi220613010-05E1-2.



## **Photographs of the EUT**

See the Appendix: EUT Photos in the report No.: MTi220613010-05E1-1.

**----END OF REPORT----**