




# RF Test Report


## For

**Applicant Name:** Shenzhen Guli Tech Co., Ltd  
**Address:** No.A603, G4 building, TCL International E-city, Nanshan District, Shenzhen, China, 518052  
**EUT Name:** KK3 Controller  
**Brand Name:**  GuliKit  
**Model Number:** NS39  
**Series Model Number:** Refer to section 2

## Issued By


**Company Name:** BTF Testing Lab (Shenzhen) Co., Ltd.  
**Address:** F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China  
**Report Number:** BTF240117R00202  
**Test Standards:** 47 CFR Part 15 Subpart C Section 15.225  
**FCC ID:** 2AQNP-NS39  
**Test Conclusion:** Pass  
**Test Date:** 2024-01-18 to 2024-04-01  
**Date of Issue:** 2024-04-01

**Prepared By:**

  
Chris Liu / Project Engineer  
2024-04-01

**Date:**

**Approved By:**

  
Ryan.CJ / EMC Manager  
2024-04-01

**Date:**

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| Revision History |            |  |
|------------------|------------|--|
| Version          | Issue Date | Revisions Content  |
| R_V0             | 2024-04-01 | Original   |
|                  |            |  |
| Note:            |            | Once the revision has been made, then previous versions reports are invalid. |

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## 1. Introduction

### 1.1 Identification of Testing Laboratory

|               |   |
|---------------|---|
| Company Name: | BTF Testing Lab (Shenzhen) Co., Ltd.  |
| Address:      | F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China |
| Phone Number: | +86-0755-23146130   |
| Fax Number:   | +86-0755-23146130   |

### 1.2 Identification of the Responsible Testing Location

|                          |  |
|--------------------------|--|
| Test Location:           | BTF Testing Lab (Shenzhen) Co., Ltd.   |
| Address:                 | F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China  |
| Description:             | All measurement facilities used to collect the measurement data are located at F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street, Bao'an District, Shenzhen, China |
| FCC Registration Number: | 518915   |
| Designation Number:      | CN1330   |

### 1.3 Laboratory Condition

|                            |                    |
|----------------------------|--------------------|
| Ambient Temperature:       | 20°C to 25°C       |
| Ambient Relative Humidity: | 45% to 55%         |
| Ambient Pressure:          | 100 kPa to 102 kPa |

### 1.4 Announcement

- (1) The test report reference to the report template version v0.
- (2) The test report is invalid if not marked with the signatures of the persons responsible for preparing, reviewing and approving the test report.
- (3) The test report is invalid if there is any evidence and/or falsification.
- (4) This document may not be altered or revised in any way unless done so by BTF and all revisions are duly noted in the revisions section.
- (5) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.
- (6) The laboratory is only responsible for the data released by the laboratory, except for the part provided by the applicant.

## 2. Product Information

### 2.1 Application Information

|               |   |
|---------------|---|
| Company Name: | Shenzhen Guli Tech Co., Ltd   |
| Address:      | No.A603, G4 building, TCL International E-city, Nanshan District, Shenzhen, China, 518052 |

### 2.2 Manufacturer Information

|               |   |
|---------------|---|
| Company Name: | Shenzhen Guli Tech Co., Ltd   |
| Address:      | No.A603, G4 building, TCL International E-city, Nanshan District, Shenzhen, China, 518052 |

### 2.3 Factory Information

|               |   |
|---------------|---|
| Company Name: | Shenzhen Guli Tech Co., Ltd   |
| Address:      | No.A603, G4 building, TCL International E-city, Nanshan District, Shenzhen, China, 518052 |

### 2.4 General Description of Equipment under Test (EUT)

|   |   |
|---|---|
| EUT Name                                  | KK3 Controller  |
| Under Test Model Name                     | NS39  |
| Series Model Name                         | NS38  |
| Description of Model name differentiation | Only the model name is different, everything else is the same |
| Hardware Version                          | NS39 KK3 V1.7   |
| Software and Firmware Version             | N/A   |

### 2.5 Technical Information

|                     |              |
|---------------------|--------------|
| Modulation Type     | ASK          |
| Operation Frequency | 13.56 MHz    |
| Number of Channel   | 1            |
| Antenna Type        | Coil Antenna |

### 3. Summary of Test Results

#### 3.1 Test Standards

| No. | Identity                                   | Document Title   |
|-----|--|--|
| 1   | 47 CFR Part 15 Subpart C<br>Section 15.225 | Operation within the band 13.110-14.010 MHz                        |
| 2   | ANSI C63.10-2013                           | American National Standard for Testing Unlicensed Wireless Devices |

#### 3.2 Summary of Test Result

| No. | Description   | FCC Part No.        | Test Result | Test By   | Verdict | Remark |
|-----|---|---------------------|-------------|-----------|---------|--------|
| 1   | Antenna Requirement                                       | 15.203              | --          | Chris Liu | Pass    | --     |
| 2   | 20dB Bandwidth  | 15.215              | ANNEX A.1   | Chris Liu | Pass    | --     |
| 3   | Field Strength of the Fundamental<br>and Mask Measurement | 15.225(a)(b)(c)     | ANNEX A.2   | Chris Liu | Pass    | --     |
| 4   | Conducted Emission  | 15.207              | ANNEX A.3   | Chris Liu | Pass    | --     |
| 5   | Radiated Spurious Emission                                | 15.225(d)<br>15.209 | ANNEX A.4   | Chris Liu | Pass    | --     |
| 6   | Frequency Stability                                       | 15.225(e)           | ANNEX A.5   | Chris Liu | Pass    |        |

#### 3.3 Uncertainty of Test

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2 and TR100 028-1/-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

| Measurement                    | Value   |
|--------------------------------|---------|
| Occupied Channel Bandwidth     | 69 KHz  |
| All emissions, radiated(<1GHz) | 4.12 dB |
| Temperature                    | 0.82 °C |
| Humidity                       | 4.1 %   |

## 4. Test Configuration

### 4.1 Environment Condition

| Environment Parameter                     | Selected Values During Tests |                      |                   |                    |
|---|------------------------------|----------------------|-------------------|--------------------|
|   | Temperature                  | Voltage              | Relative Humidity | Ambient Pressure   |
| Normal Temperature, Normal Voltage (NTNV) | 20°C to 25°C                 | DC 3.7V from battery | 30% to 60%        | 100 kPa to 102 kPa |

### 4.2 Test Equipment List

| Conducted Method Test                              |   |           |             |            |            |                                     |
|--|---|-----------|-------------|------------|------------|-------------------------------------|
| Description  | Manufacturer                                    | Model     | Serial No.  | Cal. Date  | Cal. Due   | Use                                 |
| MXA Signal Analyzer                                | KEYSIGHT  | N9020A    | MY50410020  | 2023.11.16 | 2024.11.15 | <input checked="" type="checkbox"/> |
| WIDEBAND RADIO COMMUNICATION TESTER                | Rohde & Schwarz                                 | CMW500    | 161997      | 2023.11.16 | 2024.11.15 | <input checked="" type="checkbox"/> |
| ESG VECTOR SIGNAL GENERATOR                        | Agilent   | E4438C    | MY45094854  | 2023.11.16 | 2024.11.15 | <input checked="" type="checkbox"/> |
| MXG Vector Signal Generator                        | Agilent   | N5182A    | MY46240163  | 2023.11.16 | 2024.11.15 | <input checked="" type="checkbox"/> |
| Adjustable Direct Current Regulated Power Supply   | Dongguan Tongmen Electronic Technology Co., LTD | etm-6050c | 20211026123 | 2023.11.16 | 2024.11.15 | <input checked="" type="checkbox"/> |
| Programmable constant temperature and humidity box | ZZCKONG   | ZZ-K02A   | 20210928007 | 2023.11.16 | 2024.11.15 | <input checked="" type="checkbox"/> |

| Radiated Method Test        |               |               |            |            |            |                                     |
|-----------------------------|---------------|---------------|------------|------------|------------|-------------------------------------|
| Description                 | Manufacturer  | Model         | Serial No. | Cal. Date  | Cal. Due   | Use                                 |
| SIGNAL ANALYZER             | ROHDE&SCHWARZ | FSQ40         | 100010     | 2023.11.16 | 2024.11.15 | <input checked="" type="checkbox"/> |
| EMI TEST RECEIVER           | ROHDE&SCHWARZ | ESCI7         | 101032     | 2023.11.16 | 2024.11.15 | <input checked="" type="checkbox"/> |
| Log periodic antenna        | SCHWARZBECK   | VULB 9168     | 01328      | 2023.11.16 | 2024.11.15 | <input checked="" type="checkbox"/> |
| Horn Antenna                | SCHWARZBECK   | BBHA9170      | 01157      | 2023.11.16 | 2024.11.15 | <input checked="" type="checkbox"/> |
| POSITIONAL CONTROLLER       | SKET          | PCI-GPIB      | /          | /          | /          | <input checked="" type="checkbox"/> |
| RE Cable                    | REBES Talent  | UF2-NMNM-10m  | 21101570   | 2023.11.16 | 2024.11.15 | <input checked="" type="checkbox"/> |
| RE Cable                    | REBES Talent  | UF2-NMNM-2.5m | 21101573   | 2023.11.16 | 2024.11.15 | <input checked="" type="checkbox"/> |
| RE Cable                    | REBES Talent  | UF2-NMNM-1m   | 21101576   | 2023.11.16 | 2024.11.15 | <input checked="" type="checkbox"/> |
| Coaxial cable Multiflex 141 | Schwarzbeck   | N/SMA 0.5m    | 517386     | 2023.3.24  | 2024.3.23  | <input checked="" type="checkbox"/> |

|                           |                  |                        |          |            |            |   |
|---------------------------|------------------|------------------------|----------|------------|------------|---|
| RE Cable                  | Talent Microwave | A40-2.92M2.92<br>M-14M | 22080539 | 2023.11.16 | 2024.11.15 | ☒ |
| RE Cable                  | Talent Microwave | A81-SMAMNM-<br>14M     | 22080538 | 2023.11.16 | 2024.11.15 | ☒ |
| Preamplifier              | SCHWARZBECK      | BBV9744                | 00246    | 2023.11.16 | 2024.11.15 | ☒ |
| Horn Antenna              | Schwarzbeck      | BBHA9120D              | 2597     | 2022.5.22  | 2024.5.21  | ☒ |
| Broadband<br>Preamplifier | Schwarzbeck      | BBV9718D               | 00008    | 2023.3.24  | 2024.3.23  | ☒ |

| Conducted disturbance Test |               |                |             |            |            |     |
|----------------------------|---------------|----------------|-------------|------------|------------|-----|
| Description                | Manufacturer  | Model          | Serial No.  | Cal. Date  | Cal. Due   | Use |
| EMI Receiver               | ROHDE&SCHWARZ | ESCI3          | 101422      | 2023.11.16 | 2024.11.15 | ☒   |
| V-LISN                     | SCHWARZBECK   | NSLK 8127      | 01073       | 2023.11.16 | 2024.11.15 | ☒   |
| LISN                       | AFJ           | LS16/110VAC    | 16010020076 | 2023.11.16 | 2024.11.15 | ☒   |
| Coaxial Switcher           | SCHWARZBECK   | CX210          | CX210       | 2023.11.16 | 2024.11.15 | ☒   |
| Pulse Limiter              | SCHWARZBECK   | VTSD 9561-F    | 00953       | 2023.11.16 | 2024.11.15 | ☒   |
| EZ EMC                     | Frad          | EMC-CON 3A1.1+ | /           | /          | /          | ☒   |

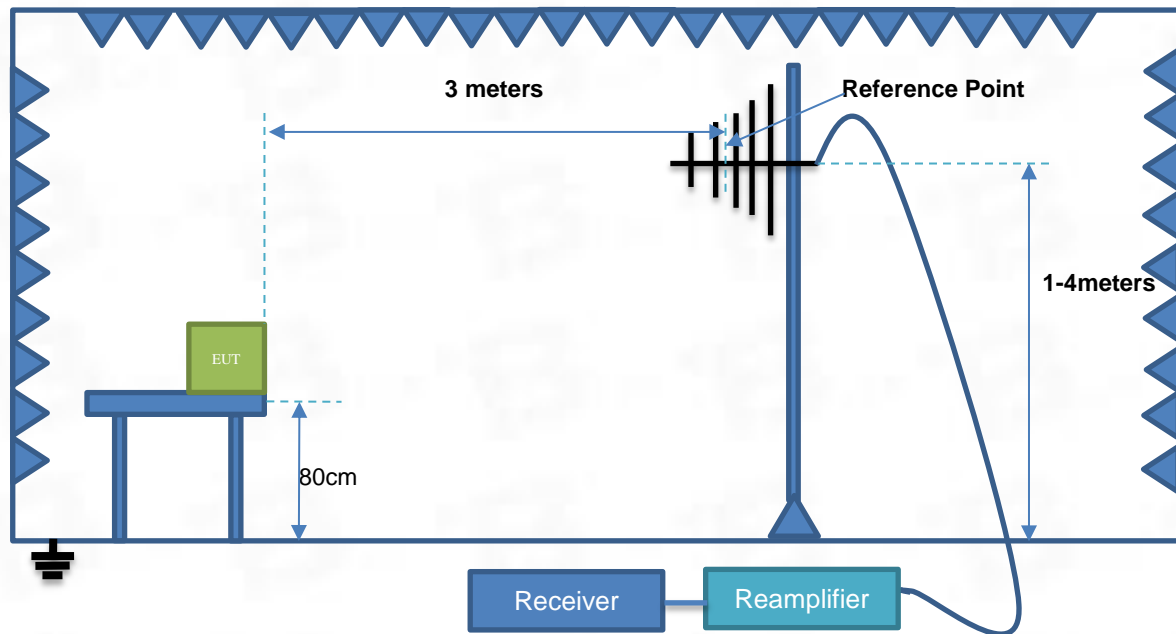


### 4.3 Test Auxiliary Equipment

| Title   | Manufacturer | Model No.    | Serial No. |
|---------|--------------|--------------|------------|
| Adapter | Huawei       | HW-059200CHQ | /          |

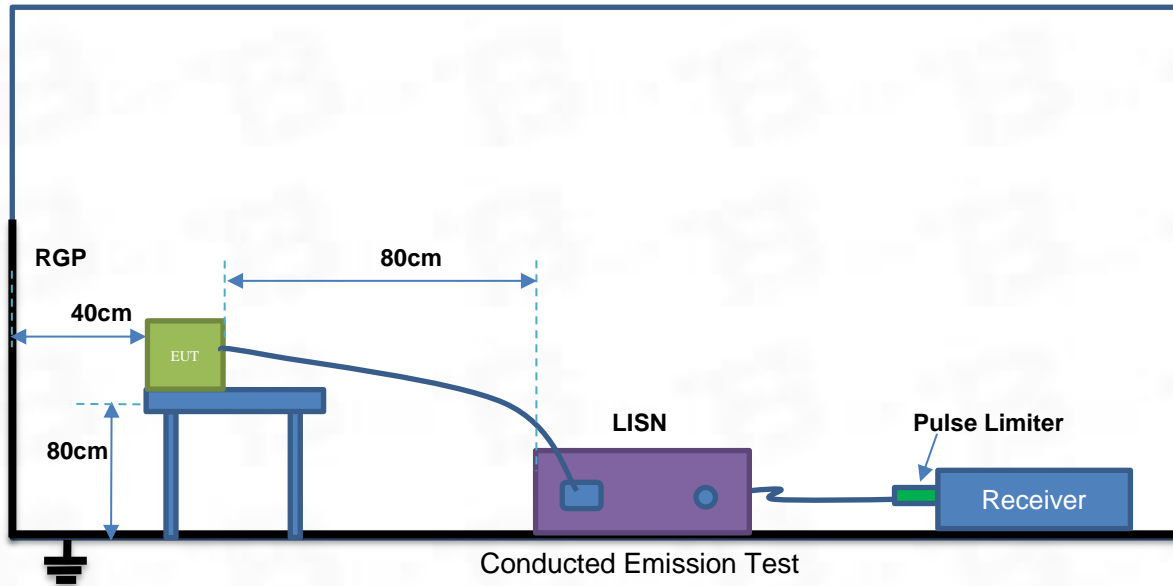
### 4.4 Test Setup

#### Test Setup 1

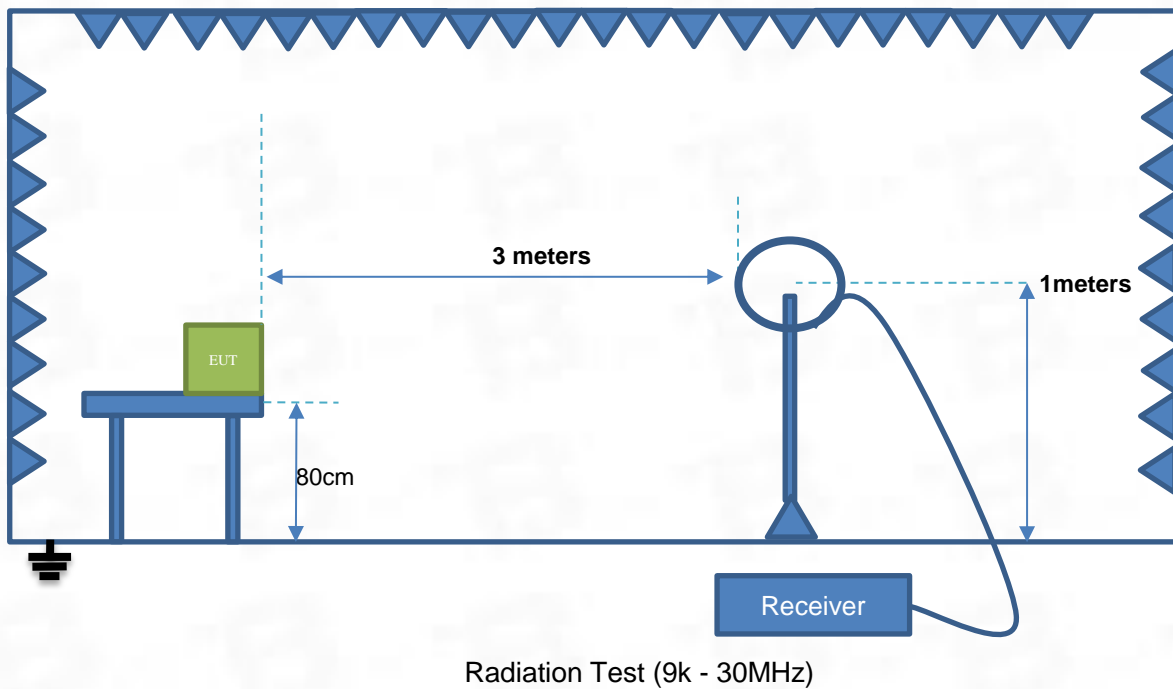


Radiation Test (30MHz – 1GHz)

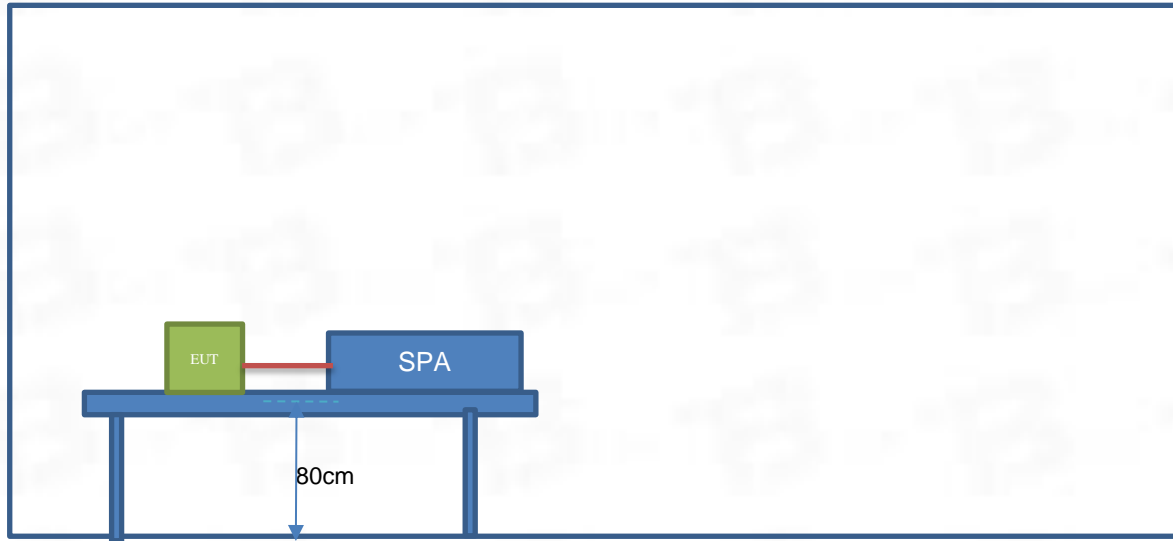
## Test Setup 2



## Test Setup 3



#### Test Setup 4



## 5. Test Items

### 5.1 Antenna Requirements

#### 5.1.1 Relevant Standards

FCC §15.203; RSS-247, 5.4(f)

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, or § 15.221. 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 Antenna Anti-Replacement Construction

| Protected Method                        | Description                            |
|---|--|
| The antenna is embedded in the product. | An embedded in antenna design is used. |

| Reference Documents | Item                                     |
|---------------------|--|
| Photo               | Please refer to the EUT Photo documents. |

## 5.2 20dB Bandwidth

### 5.2.1 Limit

Intentional radiators must be designed to ensure that the 20dB emission bandwidth in the specific band 13.553~13.567MHz.

### 5.2.2 Test Setup

See section 4.4 for test setup 4. The photo of test setup please refer to ANNEX B

### 5.2.3 Test Procedure

- a) The transmitter output was connected to the spectrum analyzer through an attenuator, the path loss was compensated to the results for each measurement.
- b) Set to the maximum power setting and enable the EUT transmit continuously.
- c) Use the following spectrum analyzer settings:  
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.
- d) Measure and record the results in the test report.

### 5.2.4 Test Result

Please refer to ANNEX A.1

## 5.3 Field Strength of the Fundamental and Mask Measurement

### 5.3.1 Limit

FCC §15.225(a)(b)(c)

| Fundamental frequency(MHz)  | Field strength of fundamental<br>( $\mu\text{V/m}$ @30m) | Field strength of fundamental<br>(dBuV/m @3m) |
|-----------------------------|--|---|
| 13.553-13.567               | 15848  | 124.0   |
| 13.410-13.553&13.567-13.710 | 334  | 90.5  |
| 13.110-13.410&13.710-14.010 | 106  | 80.5  |

Note: Limit dBuV/m @3m =Limit dBuV/m @30m +40\*log(30/3)= Limit dBuV/m @30m + 40.

### 5.3.2 Test Setup

See section 4.4 for test setup 3. The photo of test setup please refer to ANNEX B

### 5.3.3 Test Procedure

- The EUT was setup and tested according to ANSI C63.10 requirements.
- The EUT is placed on a turn table which is 0.8 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
- The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
- The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10 on radiated measurement.

### 5.3.4 Test Result

Please refer to ANNEX A.2

## 5.4 Conducted Emission

### 5.4.1 Limit

FCC §15.207; RSS-GEN, 8.8

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 range<br>(MHz) | Conducted Limit (dB $\mu$ V) |          |
|--------------------------|------------------------------|----------|
|                          | Quai-peak                    | Average  |
| 0.15 - 0.50              | 66 to 56                     | 56 to 46 |
| 0.50 - 5                 | 56                           | 46       |
| 0.50 - 30                | 60                           | 50       |

### 5.4.2 Test Setup

See section 4.4 for test setup 2. The photo of test setup please refer to ANNEX B

### 5.4.3 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz) for which the device is capable of operation. A device rated for 50/60 Hz operation need not be tested at both frequencies provided the radiated and line conducted emissions are the same at both frequencies.

### 5.4.4 Test Result

Please refer to ANNEX A.3

#### NOTE:

- Results (dB $\mu$ V) = Reading (dB $\mu$ V) + Factor (dB)  
The reading level is calculated by software which is not shown in the sheet
- Factor = Insertion loss + Cable loss
- Over limit = Results – Limit.

## 5.5 Radiated Spurious Emission

### 5.5.1 Limit

FCC §15.209&15.225

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a). 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 (μV/m) | Measurement Distance (m) |
|-----------------|-----------------------|--------------------------|
| 0.009 - 0.490   | 2400/F(kHz)           | 300                      |
| 0.490 - 1.705   | 24000/F(kHz)          | 30                       |
| 1.705 - 30.0    | 30                    | 30                       |
| 30 - 88         | 100                   | 3                        |
| 88 - 216        | 150                   | 3                        |
| 216 - 960       | 200                   | 3                        |
| Above 960       | 500                   | 3                        |

Note:

1. Field Strength (dBμV/m) = 20\*log[Field Strength (μV/m)].
2. In the emission tables above, the tighter limit applies at the band edges.
3. For Above 1000 MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
4. For above 1000 MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK).

### 5.5.2 Test Setup

See section 4.4 for test setup 1 and 3. The photo of test setup please refer to ANNEX B

### 5.5.3 Test Procedure

Since the emission limits are specified in terms of radiated field strength levels, measurements performed to demonstrate compliance have traditionally relied on a radiated test configuration. Radiated measurements remain the principal method for demonstrating compliance to the specified limits; however antenna-port conducted measurements are also now acceptable to demonstrate compliance (see below for details). When radiated measurements are utilized, test site requirements and procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 shall be followed.

Antenna-port conducted measurements may also be used as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious



emissions is required.

General Procedure for conducted measurements in restricted bands:

- a) Measure the conducted output power (in dBm) using the detector specified (see guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).
- b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see guidance on determining the applicable antenna gain)
- c) Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies  $\leq 30$  MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies  $> 1000$  MHz).
- d) For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW).
- e) Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:

$$E = \text{EIRP} - 20\log D + 104.8$$

where:

E = electric field strength in dB $\mu$ V/m,

EIRP = equivalent isotropic radiated power in dBm D = specified measurement distance in meters.

- f) Compare the resultant electric field strength level to the applicable limit.

- g) Perform radiated spurious emission test.

#### Quasi-Peak measurement procedure

The specifications for measurements using the CISPR quasi-peak detector can be found in Publication 16 of the International Special Committee on Radio Frequency Interference (CISPR) of the International Electrotechnical Commission.

As an alternative to CISPR quasi-peak measurement, compliance can be demonstrated to the applicable emission limits using a peak detector.

Peak power measurement procedure:

Peak emission levels are measured by setting the instrument as follows:

- a) RBW = as specified in Table 1.
- b) VBW  $\geq 3 \times$  RBW.
- c) Detector = Peak.
- d) Sweep time = auto.
- e) Trace mode = max hold.
- f) Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time may be longer

for low duty cycle applications).

Table 1—RBW as a function of frequency

| Frequency   | RBW         |
|-------------|-------------|
| 9-150 kHz   | 200-300 Hz  |
| 0.15-30 MHz | 9-10 kHz    |
| 30-1000 MHz | 100-120 kHz |
| > 1000 MHz  | 1 MHz       |

If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

Trace averaging across on and off times of the EUT transmissions followed by duty cycle correction:

If continuous transmission of the EUT (i.e., duty cycle  $\geq 98$  percent) cannot be achieved and the duty cycle is constant (i.e., duty cycle variations are less than  $\pm 2$  percent), then the following procedure shall be used:

- The EUT shall be configured to operate at the maximum achievable duty cycle.
- Measure the duty cycle,  $x$ , of the transmitter output signal as described in section 6.0.
- RBW = 1 MHz (unless otherwise specified).
- VBW  $\geq 3 \times$  RBW.
- Detector = RMS, if  $\text{span}/(\# \text{ of points in sweep}) \leq (\text{RBW}/2)$ . Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.
- Averaging type = power (i.e., RMS).
  - As an alternative, the detector and averaging type may be set for linear voltage averaging.
  - Some instruments require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used.
- Sweep time = auto.
- Perform a trace average of at least 100 traces.
- A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:
  - If power averaging (RMS) mode was used in step f), then the applicable correction factor is  $10 \log(1/x)$ , where  $x$  is the duty cycle.
  - If linear voltage averaging mode was used in step f), then the applicable correction factor is  $20 \log(1/x)$ , where  $x$  is the duty cycle.
  - If a specific emission is demonstrated to be continuous ( $\geq 98$  percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

NOTE: Reduction of the measured emission amplitude levels to account for operational duty factor is not permitted. Compliance is based on emission levels occurring during transmission - not on an average across on and off times of the transmitter.

Determining the applicable transmit antenna gain:

A conducted power measurement will determine the maximum output power associated with a restricted band emission; however, in order to determine the associated EIRP level, the gain of the transmitting antenna (in dBi) must be added to the measured output power (in dBm).

Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.

See KDB 662911 for guidance on calculating the additional array gain term when determining the effective antenna gain for a EUT with multiple outputs occupying the same or overlapping frequency ranges in the same band.

Radiated spurious emission test:

An additional consideration when performing conducted measurements of restricted band emissions is that unwanted emissions radiating from the EUT cabinet, control circuits, power leads, or intermediate circuit elements will likely go undetected in a conducted measurement configuration. To address this concern, a radiated test shall be performed to ensure that emissions emanating from the EUT cabinet (rather than the antenna port) also comply with the applicable limits.

For these cabinet radiated spurious emission measurements the EUT transmit antenna may be replaced with a termination matching the nominal impedance of the antenna. Procedures for performing radiated measurements are specified in ANSI C63.10. All detected emissions shall comply with the applicable limits.

The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured RBW = 1 MHz for  $f \geq 1$  GHz, 100 kHz for  $f < 1$  GHz

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak Trace = max hold

#### 5.5.4 Test Result

Please refer to ANNEX A.4

##### NOTE:

1. Results (dBuV) = Reading (dBuV) + Factor (dB)

The reading level is calculated by software which is not shown in the sheet

2. Factor = Insertion loss + Cable loss

3. Over limit = Results – Limit.

## 5.6 Frequency Stability

### 5.6.1 Limit

The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

### 5.6.2 Test Setup

See section 4.4 for test setup 4. The photo of test setup please refer to ANNEX B

### 5.6.3 Test Procedure

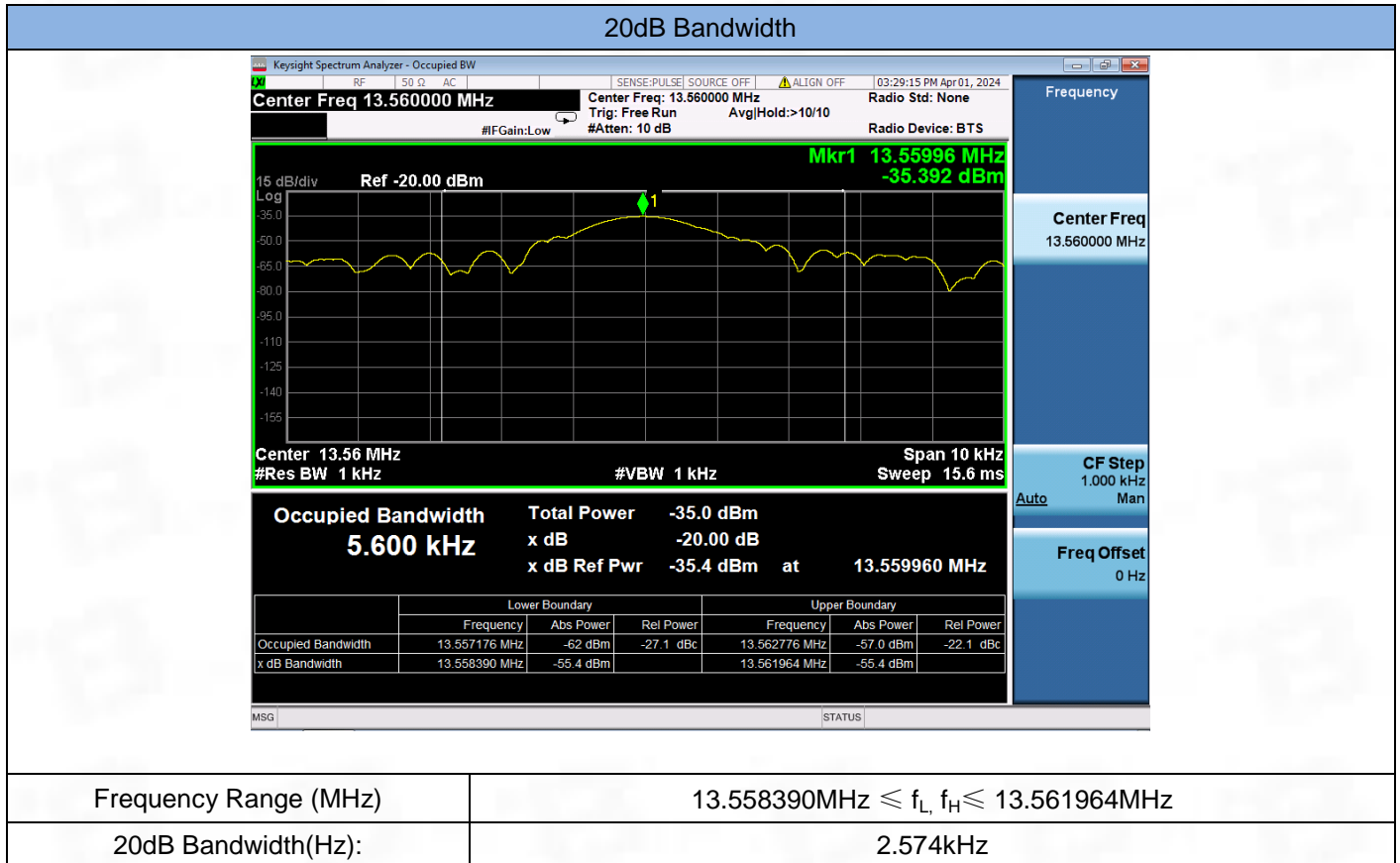
- a) The equipment under test was connected to an external power supply.
- b) RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators.
- c) The EUT was placed inside the temperature chamber.
- d) Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 25°C operating frequency as reference frequency.
- e) Turn EUT off and set the chamber temperature to -20°C. After the temperature stabilized for approximately 30 minutes recorded the frequency.
- f) Repeat step measure with 10°C increased per stage until the highest temperature of +50°C reached.

### 5.6.4 Test Result

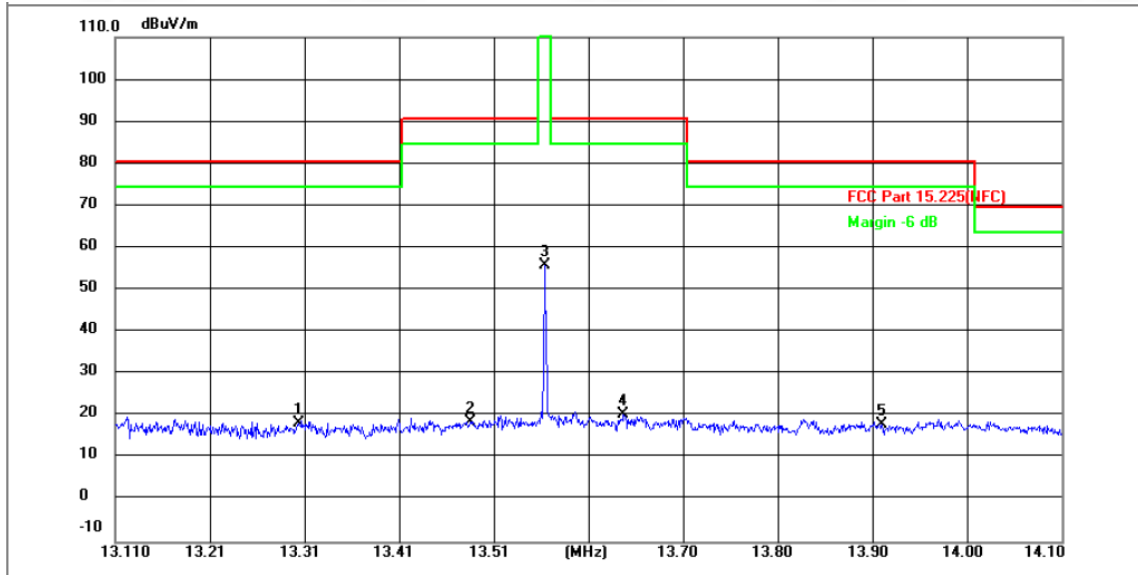
Please refer to ANNEX A.5

## ANNEX A Test Results

### A.1 20dB Bandwidth



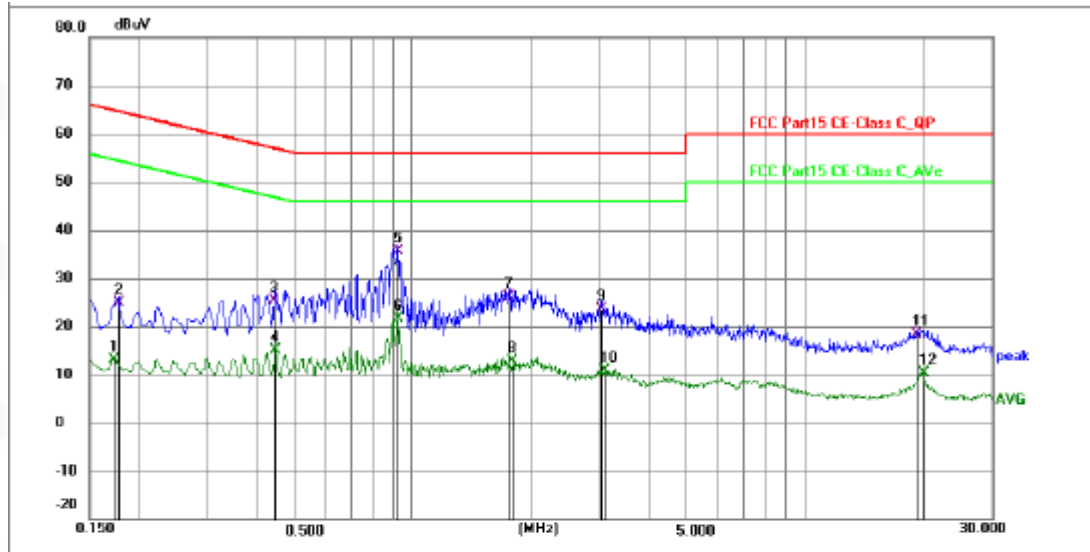
## A.2 Field Strength of the Fundamental and Mask Measurement



| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | P/F |
|-----|-----------------|----------------|---------------|----------------|----------------|-------------|----------|-----|
| 1 * | 13.3025         | 46.76          | -28.30        | 18.46          | 80.50          | -62.04      | peak     | P   |
| 2   | 13.4811         | 47.05          | -28.32        | 18.73          | 90.50          | -71.77      | peak     | P   |
| 3   | 13.5600         | 84.12          | -28.33        | 55.79          | 124.00         | -68.21      | peak     | P   |
| 4   | 13.6416         | 48.74          | -28.35        | 20.39          | 90.50          | -70.11      | peak     | P   |
| 5   | 13.9115         | 46.38          | -28.39        | 17.99          | 80.50          | -62.51      | peak     | P   |

### A.3 Conducted Emission

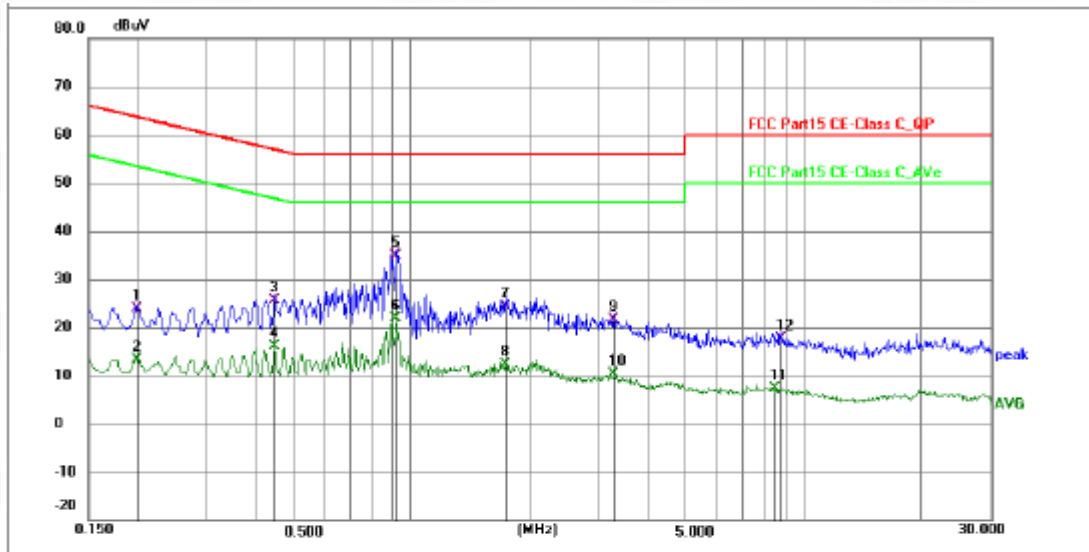
L:



| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | P/F | Remark |
|-----|-----------------|----------------|-------------|--------------|--------------|-------------|----------|-----|--------|
| 1   | 0.1724          | 2.67           | 10.49       | 13.16        | 54.84        | -41.68      | AVG      | P   |        |
| 2   | 0.1770          | 14.39          | 10.51       | 24.90        | 64.63        | -39.73      | QP       | P   |        |
| 3   | 0.4425          | 14.73          | 10.57       | 25.30        | 57.01        | -31.71      | QP       | P   |        |
| 4   | 0.4470          | 4.61           | 10.57       | 15.18        | 48.93        | -31.75      | AVG      | P   |        |
| 5 * | 0.9194          | 25.03          | 10.67       | 35.70        | 58.00        | -20.30      | QP       | P   |        |
| 6   | 0.9194          | 10.93          | 10.67       | 21.60        | 48.00        | -24.40      | AVG      | P   |        |
| 7   | 1.7655          | 15.43          | 10.67       | 26.10        | 58.00        | -29.90      | QP       | P   |        |
| 8   | 1.8015          | 2.26           | 10.67       | 12.93        | 48.00        | -33.07      | AVG      | P   |        |
| 9   | 3.0255          | 13.02          | 10.68       | 23.70        | 58.00        | -32.30      | QP       | P   |        |
| 10  | 3.1199          | 0.25           | 10.67       | 10.92        | 48.00        | -35.08      | AVG      | P   |        |
| 11  | 19.3964         | 7.27           | 11.03       | 18.30        | 60.00        | -41.70      | QP       | P   |        |
| 12  | 20.0625         | -0.63          | 11.04       | 10.41        | 50.00        | -39.59      | AVG      | P   |        |



N:

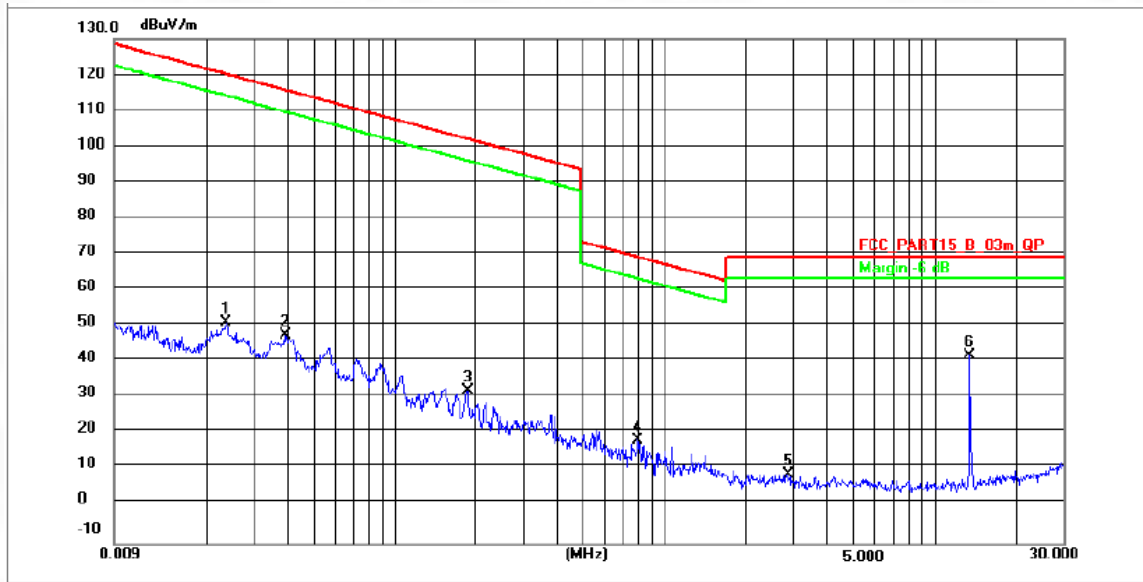


| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector | P/F | Remark |
|-----|-----------------|----------------|-------------|--------------|--------------|-------------|----------|-----|--------|
| 1   | 0.1995          | 13.24          | 10.56       | 23.80        | 63.63        | -39.83      | QP       | P   |        |
| 2   | 0.1995          | 2.80           | 10.56       | 13.36        | 53.63        | -40.27      | AVG      | P   |        |
| 3   | 0.4470          | 15.13          | 10.57       | 25.70        | 56.93        | -31.23      | QP       | P   |        |
| 4   | 0.4470          | 5.52           | 10.57       | 16.09        | 46.93        | -30.84      | AVG      | P   |        |
| 5 * | 0.9150          | 24.23          | 10.67       | 34.90        | 56.00        | -21.10      | QP       | P   |        |
| 6   | 0.9150          | 11.14          | 10.67       | 21.81        | 46.00        | -24.19      | AVG      | P   |        |
| 7   | 1.7384          | 13.83          | 10.67       | 24.50        | 56.00        | -31.50      | QP       | P   |        |
| 8   | 1.7384          | 1.74           | 10.67       | 12.41        | 46.00        | -33.59      | AVG      | P   |        |
| 9   | 3.2910          | 10.95          | 10.65       | 21.60        | 56.00        | -34.40      | QP       | P   |        |
| 10  | 3.2910          | -0.26          | 10.65       | 10.39        | 46.00        | -35.61      | AVG      | P   |        |
| 11  | 8.4570          | -3.39          | 10.82       | 7.43         | 50.00        | -42.57      | AVG      | P   |        |
| 12  | 8.7630          | 6.88           | 10.82       | 17.70        | 60.00        | -42.30      | QP       | P   |        |

## A.4 Radiated Spurious Emission

9KHz – 30MHz

coaxial



| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | P/F |
|-----|-----------------|----------------|---------------|----------------|----------------|-------------|----------|-----|
| 1   | 0.0234          | 81.65          | -30.35        | 51.30          | 120.21         | -68.91      | peak     | P   |
| 2   | 0.0390          | 78.13          | -30.33        | 47.80          | 115.77         | -67.97      | peak     | P   |
| 3   | 0.1840          | 62.44          | -29.86        | 32.58          | 102.30         | -69.72      | peak     | P   |
| 4   | 0.7858          | 47.53          | -28.48        | 19.05          | 69.67          | -50.62      | peak     | P   |
| 5   | 2.8658          | 33.61          | -24.17        | 9.44           | 69.50          | -60.06      | peak     | P   |
| 6 * | 13.5480         | 45.36          | -2.98         | 42.38          | 69.50          | -27.12      | peak     | P   |

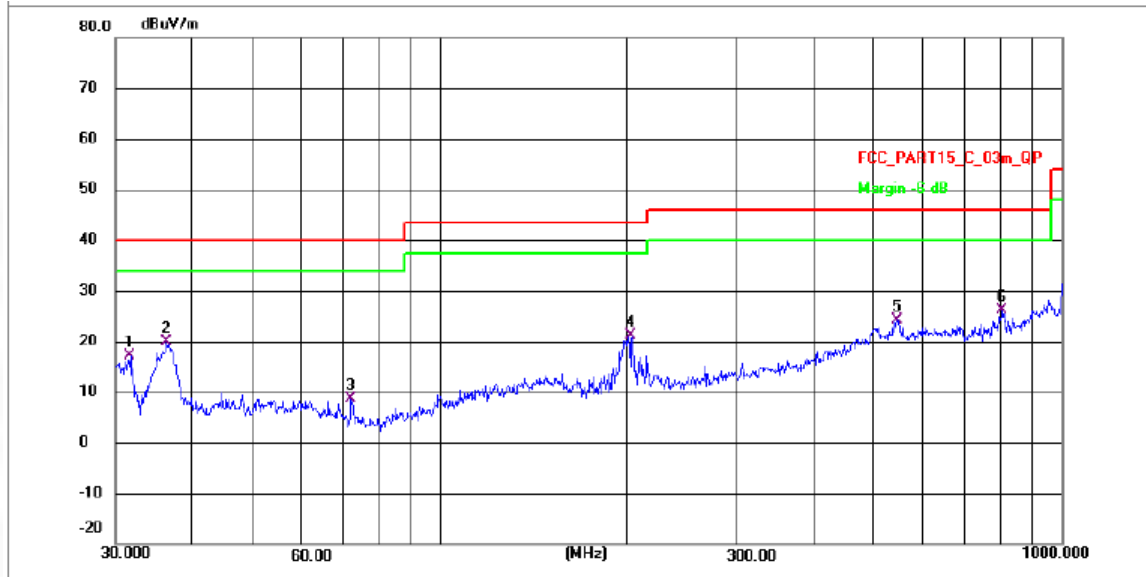
# Coplane



| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | P/F |
|-----|-----------------|----------------|---------------|----------------|----------------|-------------|----------|-----|
| 1   | 0.0230          | 81.99          | -30.35        | 51.64          | 120.35         | -68.71      | peak     | P   |
| 2   | 0.0390          | 81.06          | -30.33        | 50.73          | 115.77         | -65.04      | peak     | P   |
| 3   | 0.0890          | 71.81          | -30.26        | 41.55          | 108.61         | -67.06      | peak     | P   |
| 4   | 0.6012          | 49.65          | -28.91        | 20.74          | 72.01          | -51.27      | peak     | P   |
| 5   | 6.3456          | 25.17          | -17.04        | 8.13           | 69.50          | -61.37      | peak     | P   |
| 6 * | 13.5480         | 44.26          | -2.98         | 41.28          | 69.50          | -28.22      | peak     | P   |

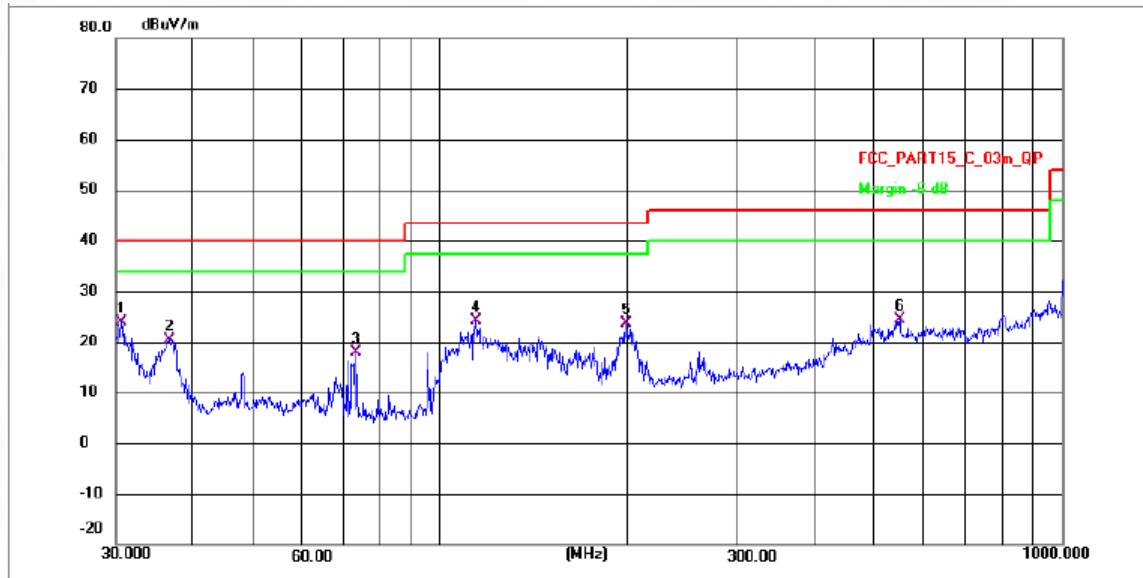
30MHz – 1GHz

H:



| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | P/F |
|-----|-----------------|----------------|---------------|----------------|----------------|-------------|----------|-----|
| 1   | 31.7869         | 35.65          | -18.50        | 17.15          | 40.00          | -22.85      | QP       | P   |
| 2   | 36.3177         | 38.45          | -18.45        | 20.00          | 40.00          | -20.00      | QP       | P   |
| 3   | 71.9581         | 26.81          | -18.09        | 8.72           | 40.00          | -31.28      | QP       | P   |
| 4   | 203.8799        | 38.39          | -17.32        | 21.07          | 43.50          | -22.43      | QP       | P   |
| 5   | 543.2742        | 35.95          | -11.94        | 24.01          | 46.00          | -21.99      | QP       | P   |
| 6 * | 803.1933        | 49.87          | -23.67        | 26.20          | 46.00          | -19.80      | QP       | P   |

V:



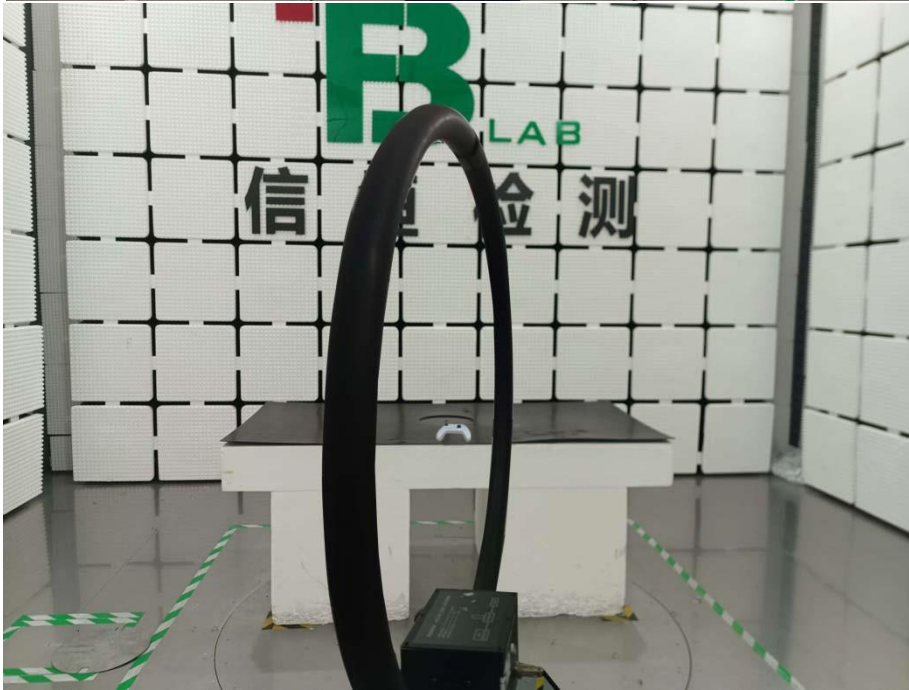
| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | P/F |
|-----|-----------------|----------------|---------------|----------------|----------------|-------------|----------|-----|
| 1 * | 30.7455         | 43.86          | -19.96        | 23.90          | 40.00          | -16.10      | QP       | P   |
| 2   | 36.7018         | 40.95          | -20.60        | 20.35          | 40.00          | -19.65      | QP       | P   |
| 3   | 73.2308         | 37.77          | -19.94        | 17.83          | 40.00          | -22.17      | QP       | P   |
| 4   | 114.3140        | 52.28          | -28.10        | 24.18          | 43.50          | -19.32      | QP       | P   |
| 5   | 198.5880        | 51.09          | -27.34        | 23.75          | 43.50          | -19.75      | QP       | P   |
| 6   | 549.0195        | 46.05          | -21.65        | 24.40          | 46.00          | -21.60      | QP       | P   |

## A.5 Frequency Stability

| Test Enviroment |                 | Frequency Reading(MHz) | Frequency Error(%) | Limit  | Result |
|-----------------|-----------------|------------------------|--------------------|--------|--------|
| Voltage         | Temperature(°C) |                        |                    |        |        |
| DC 3.7V         | -20             | 13.56069               | 0.0051             | ±0.01% | Pass   |
|                 | -10             | 13.56047               | 0.0035             | ±0.01% | Pass   |
|                 | 0               | 13.56029               | 0.0022             | ±0.01% | Pass   |
|                 | 10              | 13.56052               | 0.0039             | ±0.01% | Pass   |
|                 | 20              | 13.56052               | 0.0039             | ±0.01% | Pass   |
|                 | 30              | 13.56067               | 0.0050             | ±0.01% | Pass   |
|                 | 40              | 13.56119               | 0.0055             | ±0.01% | Pass   |
|                 | 50              | 13.56074               | 0.0043             | ±0.01% | Pass   |
| DC 4.1V         | Normal          | 13.56069               | 0.0051             | ±0.01% | Pass   |
| DC 3.3V         | Normal          | 13.56065               | 0.0048             | ±0.01% | Pass   |

## ANNEX B TEST SETUP PHOTOS

Emissions in restricted frequency bands (0.15-30 MHz)





**Emissions in restricted frequency bands (below 1GHz)**

## ANNEX C EUT Constructional Details (EUT Photos)

Please refer to the report No. BTF240117R00201





Test Report Number: BTF240117R00202



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**--END OF REPORT--**