

## RF Test Report

Applicant : unitech electronics co., ltd.  
Product Type : Rugged Handheld Computer  
Trade Name : unitech  
Model Number : EA630  
Applicable Standard : FCC 47 CFR PART 15 SUBPART C  
ANSI C63.10:2013  
Received Date : May 11, 2020  
Test Period : May 19 ~ Jul. 01, 2020  
Issued Date : Jul. 01, 2020

### Issued by

A Test Lab Techno Corp.  
No. 140-1, Changan Street, Bade District,  
Taoyuan City 33465, Taiwan (R.O.C.)  
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Taiwan Accreditation Foundation accreditation number: 1330  
Test Firm MRA designation number: TW0010

### Note:

1. The test results are valid only for samples provided by customers and under the test conditions described in this report.
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3. The relevant information is provided by customers in this test report. According to the correctness, appropriateness or completeness of the information provided by the customer, if there is any doubt or error in the information which affects the validity of the test results, the laboratory does not take the responsibility.



### **Revision History**

| Rev. | Issued Date   | Revisions                  | Revised By |
|------|---------------|----------------------------|------------|
| 00   | Jun. 17, 2020 | Initial Issue              | Snow Wang  |
| 01   | Ju1. 01, 2020 | Update Test Results (P.23) | Snow Wang  |
|      |               |                            |            |
|      |               |                            |            |

## Verification of Compliance

Issued Date: Ju1. 01, 2020

Applicant : unitech electronics co., ltd.  
Product Type : Rugged Handheld Computer  
Trade Name : unitech  
Model Number : EA630  
FCC ID : HLEEA630BTNFL  
EUT Rated Voltage : DC 5 V, 2.5 A / DC 9 V, 2 A  
Test Voltage : 120 Vac / 60 Hz, DC 3.85 V  
Applicable Standard : FCC 47 CFR PART 15 SUBPART C  
ANSI C63.10:2013  
Test Result : Complied

Performing Lab. : A Test Lab Techno Corp.  
No. 140-1, Changan Street, Bade District,  
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Taiwan Accreditation Foundation accreditation number: 1330  
<http://www.atl-lab.com.tw/e-index.htm>



A Test Lab Techno Corp. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by A Test Lab Techno Corp. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Approved By : Fly Lu  
(Manager) (Fly Lu)

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## 1 General Information

### 1.1. Summary of Test Result

| Standard                              | Item                        | Results      | Remark |
|---------------------------------------|-----------------------------|--------------|--------|
| 15.203                                | Antenna Requirement         | Meet Require | ---    |
| 15.207(a)                             | Conducted Emissions Voltage | PASS         | ---    |
| 15.225 (a), (b), (c), (d)<br>15.209   | Radiated Emission Limits    | PASS         | ---    |
| 15.225(e)                             | Frequency Stability         | PASS         | ---    |
| 15.215(c)                             | 20 dB Bandwidth             | -----        | ---    |
| CFR 47 Part 15.225 / ANSI C63.10:2013 |                             |              |        |

| Standard                  | Description                                                                                    |
|---------------------------|------------------------------------------------------------------------------------------------|
| CFR47, Part 15, Subpart C | Intentional Radiators                                                                          |
| ANSI C63. 10: 2013        | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices |

### 1.2. Measurement Uncertainty

| Test Item           | Frequency Range       | Uncertainty          |
|---------------------|-----------------------|----------------------|
| Conducted Emission  | 150 kHz ~ 30 MHz      | 2.68                 |
| Radiated Emission   | 9 kHz ~ 30 MHz        | 2.14                 |
|                     | 30 MHz ~ 1000 MHz     | 4.99                 |
|                     | 1000 MHz ~ 18000 MHz  | 4.99                 |
|                     | 18000 MHz ~ 26500 MHz | 4.23                 |
|                     | 26500 MHz ~ 40000 MHz | 4.39                 |
| RF Bandwidth        |                       | 4.79 %               |
| Frequency Stability |                       | $4.1 \times 10^{-8}$ |

Decision Rule

- ☒ Uncertainty is not included.
- ☐ Uncertainty is included.

## 2 EUT Description

|                     |                                                                                                                |
|---------------------|----------------------------------------------------------------------------------------------------------------|
| Applicant           | unitech electronics co., ltd.<br>5F., No.136, Lane 235, Pao-Chiao Rd., Hsin-Tien Dist, New Taipei City, Taiwan |
| Manufacturer        | unitech electronics co., ltd.<br>5F., No.136, Lane 235, Pao-Chiao Rd., Hsin-Tien Dist, New Taipei City, Taiwan |
| Product             | Rugged Handheld Computer                                                                                       |
| Trade Name          | unitech                                                                                                        |
| Model Number        | EA630                                                                                                          |
| FCC ID              | HLEEA630BTNFL                                                                                                  |
| Frequency Range     | 13.56 MHz                                                                                                      |
| Modulation Type     | ASK                                                                                                            |
| Number of Channels  | 1 Channel                                                                                                      |
| Antenna Type        | Loop Antenna                                                                                                   |
| Operate Temp. Range | -10 ~ +50 °C                                                                                                   |

### 3 Test Methodology

#### 3.1. Mode of Operation

The following test mode(s) were scanned during the preliminary test :

| Test Mode                  |
|----------------------------|
| Mode 1: Transmit Mode      |
| Mode 2: Continuous TX Mode |

After verification, all tests were carried out with the worst case test modes.

ATL has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation.

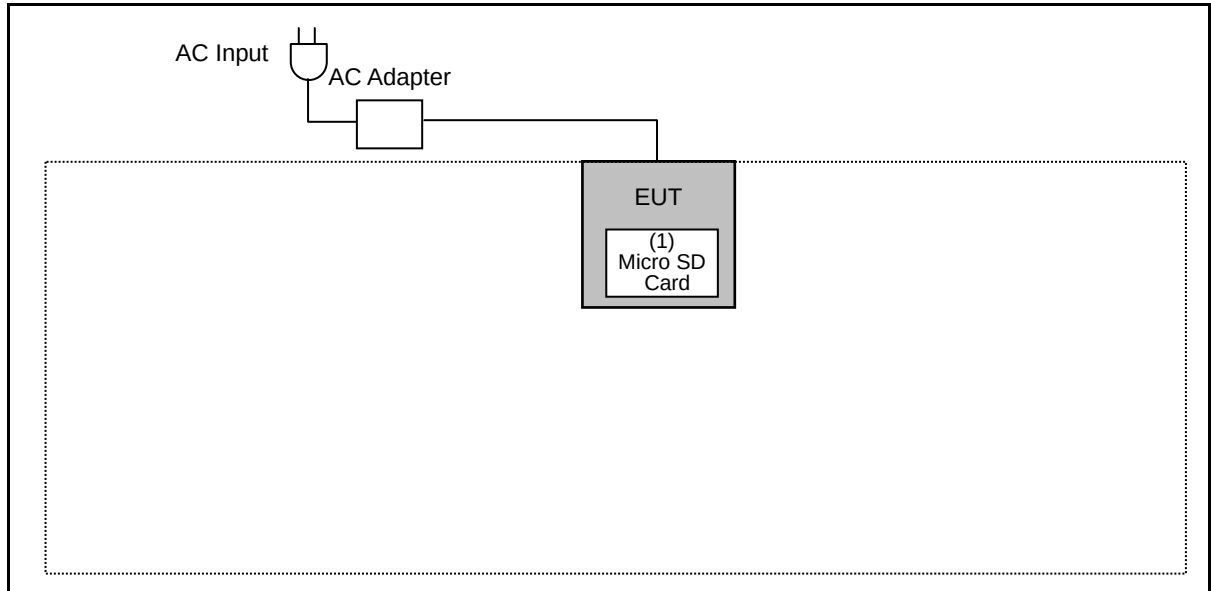
#### 3.2. EUT Test Step

|    |                                                                |
|----|----------------------------------------------------------------|
| 1. | Setup the EUT shown on "Configuration of Test System Details." |
| 2. | Turn on the power of all equipment.                            |
| 3. | The EUT will start to operate function.                        |

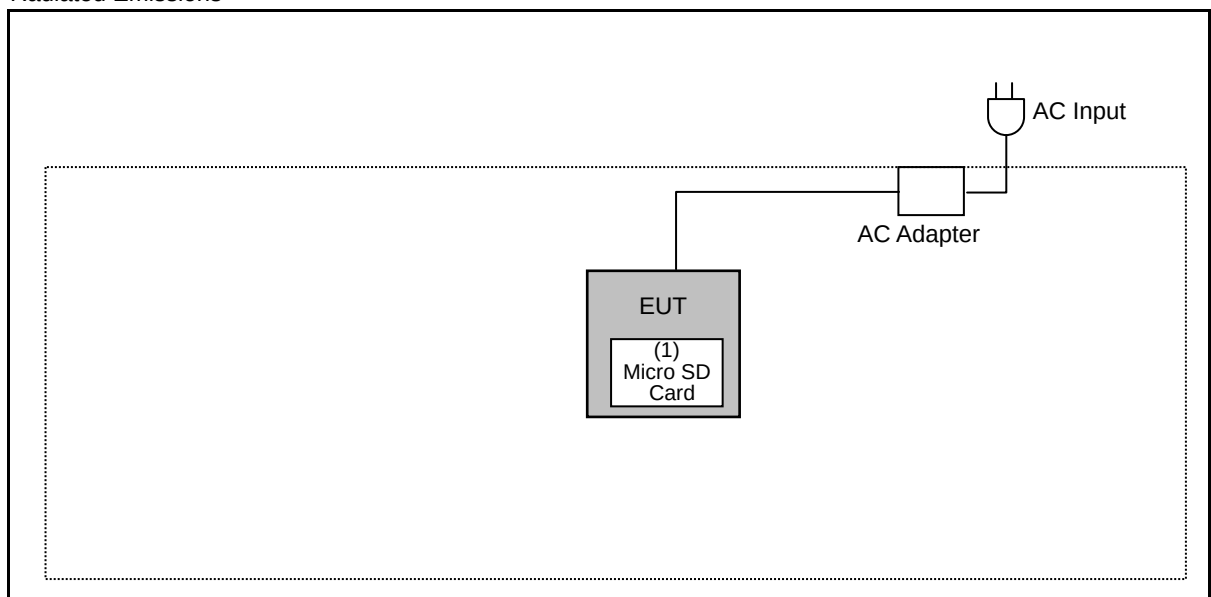
| Measurement Software |                    |          |         |
|----------------------|--------------------|----------|---------|
| No.                  | Description        | Software | Version |
| 1                    | Conducted Emission | EZ EMC   | 1.1.4.3 |
| 2                    | Radiated Emission  | EZ EMC   | 1.1.4.4 |

### 3.3. Configuration of Test System Details

#### Conducted Emission



#### Radiated Emissions



| Devices Description |               |              |                 |               |            |
|---------------------|---------------|--------------|-----------------|---------------|------------|
| Product             |               | Manufacturer | Model Number    | Serial Number | Power Cord |
| (1)                 | Micro SD Card | Transcend    | 9153BA 8G 07DS1 | ---           | ---        |





### 3.4. Test Instruments

Conducted Emission

Test Period: May 26, 2020

Testing Engineer: Louis Shen

| 名稱            | 廠牌    | 型號                 | 序號       | 本次校驗日期     | 校驗年限   |
|---------------|-------|--------------------|----------|------------|--------|
| Test Receiver | R&S   | ESCI               | 100367   | 05/22/2020 | 1 year |
| LISN          | R&S   | ENV216             | 101040   | 03/23/2020 | 1 year |
| LISN          | R&S   | ENV216             | 101041   | 04/06/2020 | 1 year |
| RF Cable      | Woken | 00100D138019<br>4M | TE-02-03 | 05/22/2020 | 1 year |

Conducted

Test Period: May 19, 2020 / Jul. 01, 2020

Testing Engineer: Peter Shui

| 名稱                                    | 廠牌       | 型號        | 序號         | 本次校驗日期     | 校驗年限   |
|---------------------------------------|----------|-----------|------------|------------|--------|
| Spectrum Analyzer<br>(20 Hz~26.5 GHz) | Agilent  | N9020A    | US47520902 | 09/18/2019 | 1 year |
| Temperature &<br>Humidity Chamber     | TERCHY   | MHU-225LA | 980729     | 03/31/2020 | 1 year |
| Power Supply                          | KEITHLEY | 2303      | 4045290    | 02/11/2020 | 1 year |

Note: N.C.R. = No Calibration Request.



#### Radiated Emissions

Test Period: May 19, 2020

Testing Engineer: Bradley. Liao

| 名稱                                  | 廠牌                       | 型號                     | 序號         | 本次校驗日期     | 校驗年限   |
|-------------------------------------|--------------------------|------------------------|------------|------------|--------|
| Spectrum Analyzer<br>(10 Hz~44 GHz) | Keysight                 | N9010A                 | MY52221312 | 01/13/2020 | 1 year |
| Pre Amplifier<br>(100 kHz~1.3 GHz)  | Agilent                  | 8447D                  | 2944A11119 | 01/15/2020 | 1 year |
| Broadband Antenna                   | Schwarzbeck              | VULB9168               | 416        | 10/23/2019 | 1 year |
| Loop Antenna                        | COM-POWER<br>CORPORATION | AL-130                 | 121014     | 03/27/2020 | 1 year |
| RF Cable                            | EMCI                     | EMC104-N-N-6<br>000    | TE01-1     | 02/20/2020 | 1 year |
| Microwave Cable                     | EMCI                     | EMC104-SM-S<br>M-13000 | 170814     | 10/29/2019 | 1 year |

Note: N.C.R. = No Calibration Request.

### 3.5. Test Site Environment

| Items                      | Required (IEC 60068-1) | Actual   |
|----------------------------|------------------------|----------|
| Temperature (°C)           | 15-35                  | 20-30    |
| Humidity (%RH)             | 25-75                  | 45-75    |
| Barometric pressure (mbar) | 860-1060               | 990-1005 |

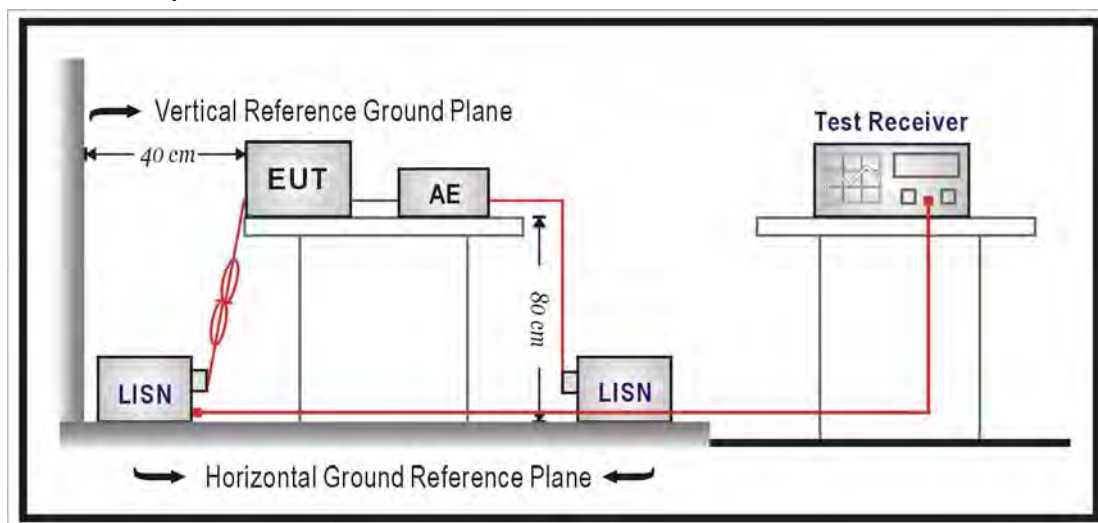
## 4 Measurement Procedure

### 4.1. AC Power Line Conducted Emission Measurement

#### ■ Limit

| Frequency (MHz) | Quasi-peak | Average  |
|-----------------|------------|----------|
| 0.15 - 0.5      | 66 to 56   | 56 to 46 |
| 0.50 - 5.0      | 56         | 46       |
| 5.0 - 30.0      | 60         | 50       |

#### ■ Test Setup



## ■ Test Procedure

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a  $50\ \Omega // 50\ \mu\text{H}$  coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a  $50\ \Omega // 50\ \mu\text{H}$  coupling impedance with 50 ohm termination.

Tabletop device shall be placed on a non-conducting platform, of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The wall of screened room shall be located 40 cm to the rear of the EUT. Other surfaces of tabletop or floor standing EUT shall be at least 80 cm from any other ground conducting surface including one or more LISNs. For floor-standing device shall be placed under the EUT with a 12 mm insulating material.

Conducted emissions were investigated over the frequency range from 0.15 MHz to 30 MHz using a resolution bandwidth of 9 kHz. The equipment under test (EUT) shall be meet the limits in section 4.1, as applicable, including the average limit and the quasi-peak limit when using respectively, an average detector and quasi-peak detector measured in accordance with the methods described of related standard. When all of peak value were complied with quasi-peak and average limit from 150 kHz to 30 MHz then quasi-peak and average measurement was unnecessary.

The AMN shall be placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for AMNs mounted on top of the ground reference plane. This distance is between the closest points of the AMN and the EUT. All other units of the EUT and associated equipment shall be at least 0.8 m from the AMN. If the mains power cable is longer than 1 m then the cable shall be folded back and forth at the centre of the lead to form a bundle no longer than 0.4 m. All of 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 cm to 40 cm long. All of EUT and AE shall be separate place more than 0.1 m. All  $50\ \Omega$  ports of the LISN shall be resistively terminated into  $50\ \Omega$  loads when not connected to the measuring instrument.

If the reading of the measuring receiver shows fluctuations close to the limit, the reading shall be observed for at least 15 s at each measurement frequency; the higher reading shall be recorded with the exception of any brief isolated high reading which shall be ignored.

## 4.2. Radiated Emission Measurement

### ■ Limit

According to §15.225,

- (a) The field strength of any emissions within the band 13.553 – 13.567 MHz shall not exceed 15,848 microvolt / meter at 30 meters.
- (b) Within the bands 13.410 – 13.553 MHz and 13.567 -13.710 MHz, the field strength of any emissions shall not exceed 334 microvolt / meter at 30 meters.
- (c) Within the bands 13.110 – 13.410 MHz and 13.710 – 14.010 MHz the field strength of any emissions shall not exceed 106 microvolt / meter at 30 meters.
- (d) The field strength of any emissions appearing outside of the 13.110 – 14.010 MHz and shall not exceed the general radiated emission limits in §15.209.

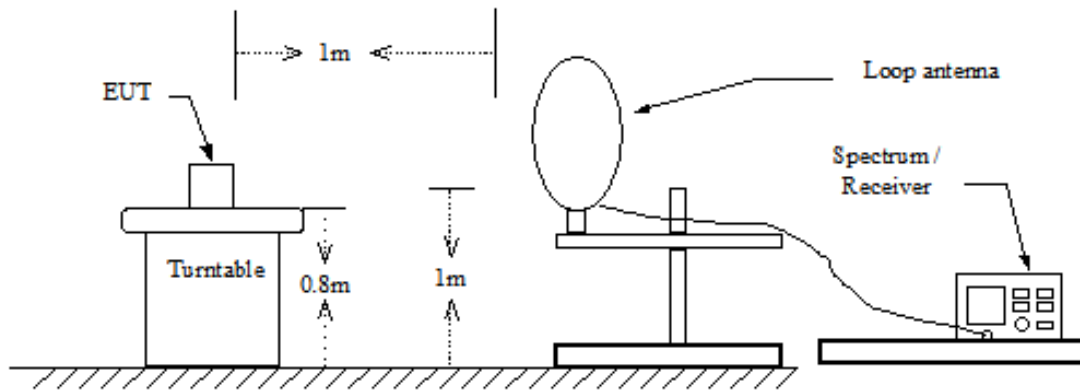
According to §15.225(a), except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency<br>(MHz) | Field Strength<br>( $\mu$ V/m at meter) | Measurement Distance<br>(meter) |
|--------------------|-----------------------------------------|---------------------------------|
| 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                               |

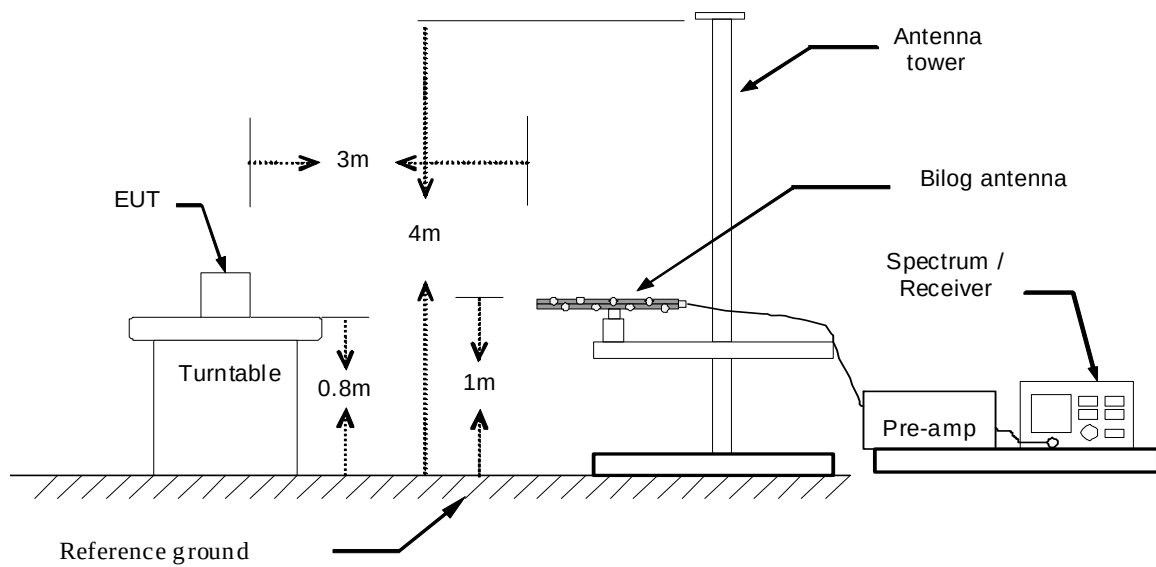
\*\* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

■ Setup

9 kHz ~ 30 MHz



30 MHz ~ 1 GHz



## ■ Test Procedure

Final radiation measurements were made on a three-meter Semi Anechoic Chamber. The EUT system was placed on a nonconductive turntable which is 0.8 meters height, top surface 1.0 x 1.5 meter. The spectrum was examined from 3 Hz to 44 GHz in order to cover the whole spectrum below 10th harmonic which could generate from the EUT. During the test, EUT was set to transmit continuously.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 3 MHz for peak measurements and 10 Hz for average measurements.

A nonconductive material surrounded the EUT to supporting the EUT for standing on three orthogonal planes. At each condition, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters to find the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarization.

Broadband/Horn Antenna were used in frequency 30 MHz to 18 GHz at a distance of 3 meter. Loop/Horn Antenna was used in frequency 9 kHz to 30 MHz and 18 to 26.5 GHz at a distance of 1 meter. All test results were extrapolated to equivalent signal at 3 meters utilizing an inverse linear distance extrapolation Factor (20 dB/decade).

For testing above 1 GHz, the emission level of the EUT in peak mode was 20 dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

Appropriate preamplifiers were used for improving sensitivity and precautions were taken to avoid overloading or desensitizing the spectrum analyzer. No post – detector video filters were used in the test.

The spectrum analyzer's 6 dB bandwidth was set to 1 MHz, and the analyzer was operated in the peak detection mode, for frequencies both below and up 1 GHz. The average levels were obtained by subtracting the duty cycle correction factor from the peak readings.

The following procedures were used to convert the emission levels measured in decibels referenced to 1 microvolt (dBuV) into field intensity in microvolt pre-meter (uV/m).

The actual field intensity in decibels referenced to 1 microvolt in to field intensity in microvolt per-meter (dBuV/m).

The actual field intensity in referenced to 1 microvolt per meter (dBuV/m) is determined by algebraically adding the measured reading in dBuV, the antenna factor (dB), and cable loss (dB) and Subtracting the gain of preamplifier (dB) is auto calculate in spectrum analyzer.

$$(1) \text{ Amplitude (dBuV/m) = FI (dBuV) + AF (dBuV) + CL (dBuV) - Gain (dB)}$$

FI= Reading of the field intensity.

AF= Antenna factor.

CL= Cable loss.

P.S Amplitude is auto calculate in spectrum analyzer.

$$(2) \text{ Actual Amplitude (dBuV/m) = Amplitude (dBuV) - Dis(dB)}$$

The FCC specified emission limits were calculated according the EUT operating frequency and by following linear interpolation equations:

(a) For fundamental frequency : Transmitter Output < +30 dBm

(b) For spurious frequency : Spurious emission limits = fundamental emission limit /10

Data of measurement within this frequency range without mark in the table above means the reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.

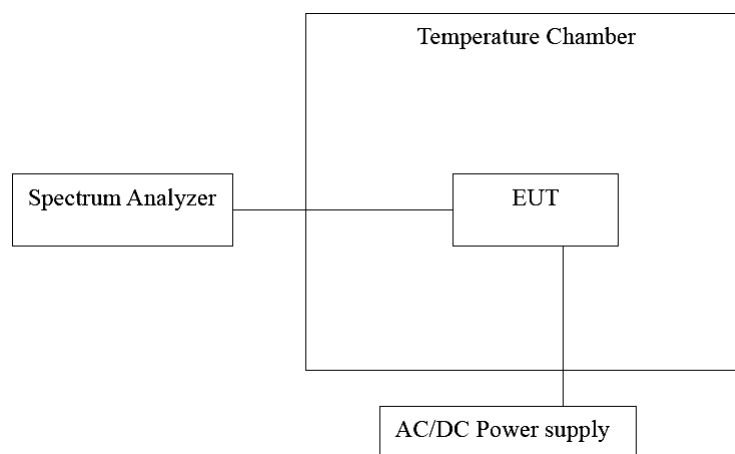


### 4.3. Frequency Stability Measurement

#### ■ Limit

According to §15.207(e), 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.

#### ■ Test Setup



#### ■ Test Procedure

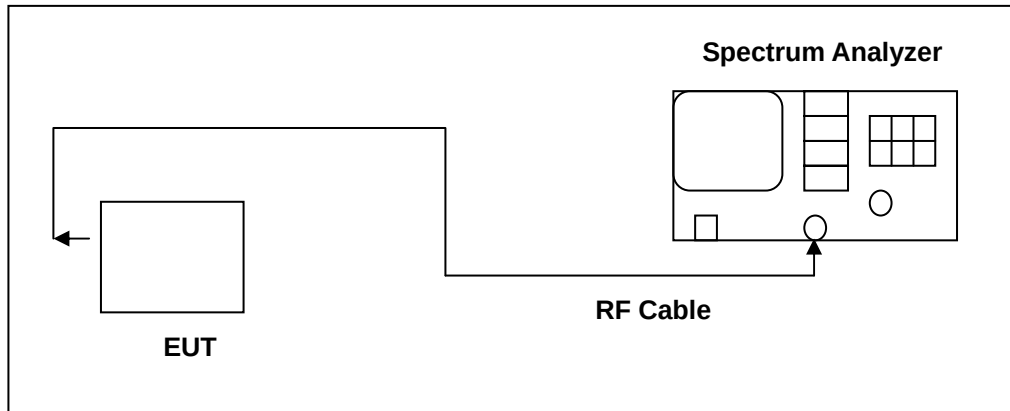
1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the environment into appropriate environment.
4. Set the spectrum analyzer as RBW = 1 kHz, VBW = RBW, Span = 200 kHz, Sweep = auto.
5. Mark the peak frequency and measure the frequency tolerance using frequency counter function.
6. Repeat until all the results are investigated.

#### 4.4. 20 dB Bandwidth Measurement

■ **Limit**

N/A

■ **Test Setup**



■ **Test Procedure**

Connect RF output port to the input of the spectrum analyzer. Connect the DUT to appropriate power supply. Turn RFID function of DUT on.

Analyzer used the following settings:

1. Span = 60 kHz
2. RBW  $\geq$  1 % of the 20 dB span
3. VBW  $\geq$  RBW
4. Sweep = auto
5. Detector function = peak
6. Trace = max hold

The trace was allowed to stabilize. The EUT was transmitting at its maximum data rate. The marker-to-peak function was used to set the marker to the peak of the emission. The marker-delta function was used to measure 20 dB down one side of the emission. The marker-delta function and marker was moved to the other side of the emission until it was even with the reference marker. The marker-delta reading at this point was the 20 dB bandwidth of the emission.



#### **4.5. Antenna Requirement**

- **Require**

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.

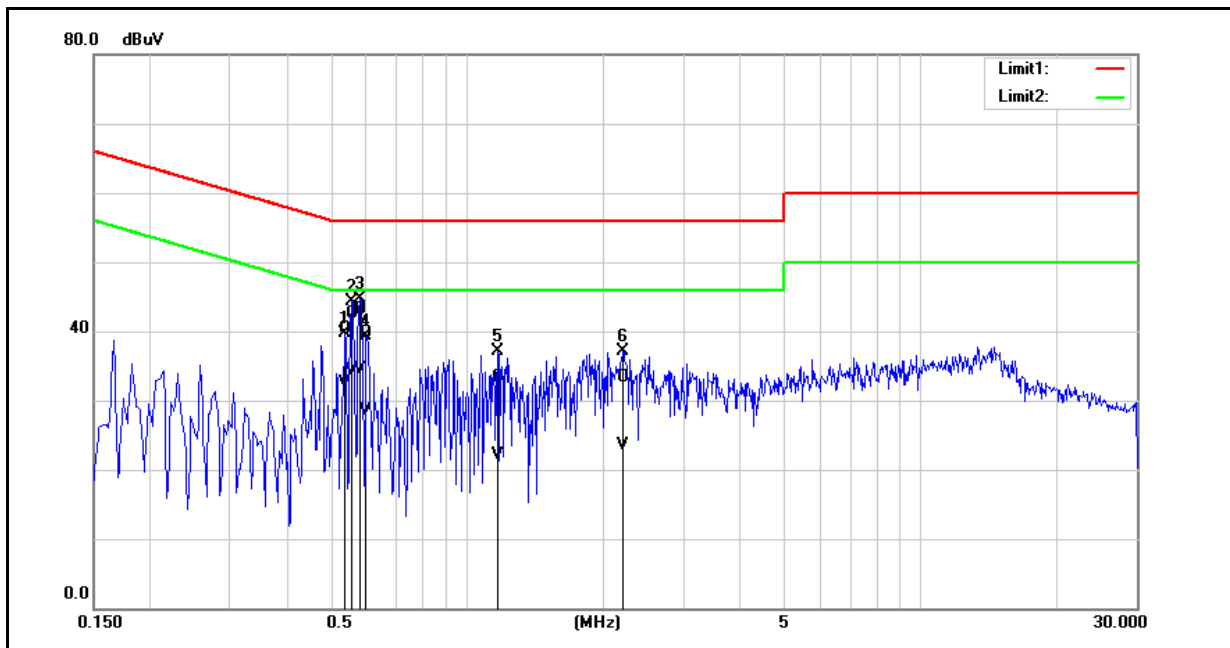
- **Antenna Connector Construction**

The antenna connector used in this product is internal antenna, cannot be replaced by the end-user. See section 2 – antenna information.

## 5 Test Results

### Annex A. Conducted Emission

|              |                    |                      |                |
|--------------|--------------------|----------------------|----------------|
| Standard:    | FCC Part 15.225    | Line:                | L1             |
| Test item:   | Conducted Emission | Power:               | AC 120 V/60 Hz |
| Mode:        | Mode 1             | Temp.(°C)/Hum.(%RH): | 26(°C)/60 %RH  |
| Description: |                    |                      |                |

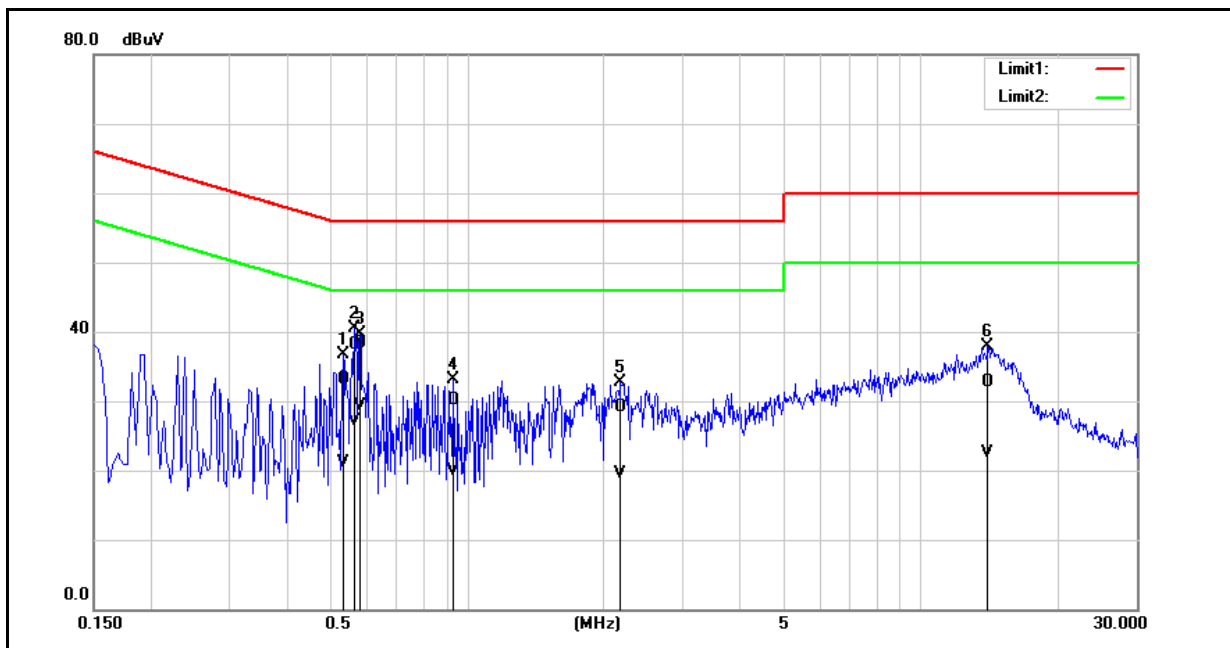


| No. | Frequency (MHz) | QP reading (dBuV) | AVG reading (dBuV) | Correction factor (dB) | QP result (dBuV) | AVG result (dBuV) | QP limit (dBuV) | AVG limit (dBuV) | QP margin (dB) | AVG margin (dB) | Remark |
|-----|-----------------|-------------------|--------------------|------------------------|------------------|-------------------|-----------------|------------------|----------------|-----------------|--------|
| 1   | 0.5380          | 30.55             | 22.72              | 9.71                   | 40.26            | 32.43             | 56.00           | 46.00            | -15.74         | -13.57          | Pass   |
| 2   | 0.5580          | 32.78             | 24.54              | 9.71                   | 42.49            | 34.25             | 56.00           | 46.00            | -13.51         | -11.75          | Pass   |
| 3   | 0.5820          | 33.45             | 24.78              | 9.71                   | 43.16            | 34.49             | 56.00           | 46.00            | -12.84         | -11.51          | Pass   |
| 4   | 0.5980          | 29.96             | 18.77              | 9.71                   | 39.67            | 28.48             | 56.00           | 46.00            | -16.33         | -17.52          | Pass   |
| 5   | 1.1700          | 23.55             | 12.40              | 9.72                   | 33.27            | 22.12             | 56.00           | 46.00            | -22.73         | -23.88          | Pass   |
| 6   | 2.2100          | 23.48             | 13.80              | 9.76                   | 33.24            | 23.56             | 56.00           | 46.00            | -22.76         | -22.44          | Pass   |

Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).

2. Correction factor (dB) = Cable loss (dB) + L.I.S.N. factor (dB).

|              |                    |                      |                |
|--------------|--------------------|----------------------|----------------|
| Standard:    | FCC Part 15.225    | Line:                | N              |
| Test item:   | Conducted Emission | Power:               | AC 120 V/60 Hz |
| Mode:        | Mode 1             | Temp.(°C)/Hum.(%RH): | 26(°C)/60 %RH  |
| Description: |                    |                      |                |



| No. | Frequency<br>(MHz) | QP<br>reading<br>(dBuV) | AVG<br>reading<br>(dBuV) | Correction<br>factor<br>(dB) | QP<br>result<br>(dBuV) | AVG<br>result<br>(dBuV) | QP<br>limit<br>(dBuV) | AVG<br>limit<br>(dBuV) | QP<br>margin<br>(dB) | AVG<br>margin<br>(dB) | Remark |
|-----|--------------------|-------------------------|--------------------------|------------------------------|------------------------|-------------------------|-----------------------|------------------------|----------------------|-----------------------|--------|
| 1   | 0.5340             | 23.49                   | 11.37                    | 9.70                         | 33.19                  | 21.07                   | 56.00                 | 46.00                  | -22.81               | -24.93                | Pass   |
| 2   | 0.5660             | 28.50                   | 17.49                    | 9.70                         | 38.20                  | 27.19                   | 56.00                 | 46.00                  | -17.80               | -18.81                | Pass   |
| 3   | 0.5820             | 28.65                   | 19.66                    | 9.70                         | 38.35                  | 29.36                   | 56.00                 | 46.00                  | -17.65               | -16.64                | Pass   |
| 4   | 0.9340             | 20.37                   | 10.24                    | 9.70                         | 30.07                  | 19.94                   | 56.00                 | 46.00                  | -25.93               | -26.06                | Pass   |
| 5   | 2.1860             | 19.38                   | 9.68                     | 9.75                         | 29.13                  | 19.43                   | 56.00                 | 46.00                  | -26.87               | -26.57                | Pass   |
| 6   | 14.0780            | 22.71                   | 12.61                    | 9.97                         | 32.68                  | 22.58                   | 60.00                 | 50.00                  | -27.32               | -27.42                | Pass   |

Note: 1. Result (dBuV) = Correction factor (dB) + Reading(dBuV).  
2. Correction factor (dB) = Cable loss (dB) + L.I.S.N. factor (dB).



## Annex B. Conducted Test Results

### Frequency Stability Measurement

#### Temperature Variations

| Test Mode  |                  | Mode 2                           |                                   |                                   |                                    |           |                    |
|------------|------------------|----------------------------------|-----------------------------------|-----------------------------------|------------------------------------|-----------|--------------------|
| Temp. (°C) | Voltage (VAC)    | 0 minute Frequency Tolerance (%) | 2 minutes Frequency Tolerance (%) | 5 minutes Frequency Tolerance (%) | 10 minutes Frequency Tolerance (%) | Limit (%) | Result (Pass/Fail) |
| -20        | V <sub>Nom</sub> | -0.0066                          | -0.0081                           | -0.0081                           | -0.0066                            | ±0.01     | Pass               |
| -10        | V <sub>Nom</sub> | 0.0007                           | 0.0015                            | 0.0007                            | 0.0015                             | ±0.01     | Pass               |
| 0          | V <sub>Nom</sub> | 0.0007                           | -0.0052                           | -0.0037                           | -0.0007                            | ±0.01     | Pass               |
| 10         | V <sub>Nom</sub> | -0.0037                          | 0.0015                            | -0.0015                           | -0.0037                            | ±0.01     | Pass               |
| 20         | V <sub>Nom</sub> | 0.0022                           | 0.0044                            | 0.0044                            | -0.0022                            | ±0.01     | Pass               |
| 30         | V <sub>Nom</sub> | 0.0022                           | -0.0007                           | 0.0044                            | -0.0015                            | ±0.01     | Pass               |
| 40         | V <sub>Nom</sub> | 0.0044                           | 0.0066                            | 0.0022                            | 0.0059                             | ±0.01     | Pass               |
| 50         | V <sub>Nom</sub> | 0.0074                           | 0.0037                            | 0.0059                            | 0.0066                             | ±0.01     | Pass               |

#### Voltage Variations

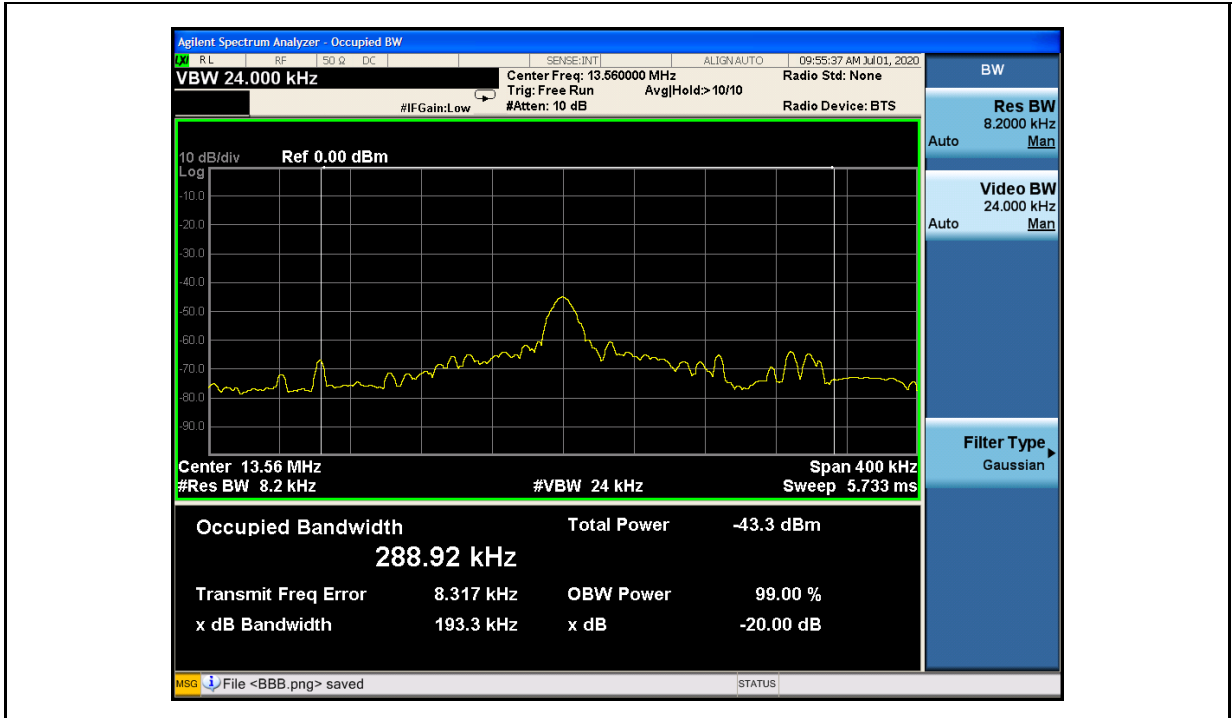
| Test Mode  |                   | Mode 2                           |                                   |                                   |                                    |           |                    |
|------------|-------------------|----------------------------------|-----------------------------------|-----------------------------------|------------------------------------|-----------|--------------------|
| Temp. (°C) | Voltage (VAC)     | 0 minute Frequency Tolerance (%) | 2 minutes Frequency Tolerance (%) | 5 minutes Frequency Tolerance (%) | 10 minutes Frequency Tolerance (%) | Limit (%) | Result (Pass/Fail) |
| 20         | V <sub>Low</sub>  | -0.0022                          | -0.0022                           | -0.0015                           | 0.0000                             | ±0.01     | Pass               |
|            | V <sub>Nom</sub>  | 0.0022                           | 0.0044                            | 0.0044                            | 0.0044                             | ±0.01     | Pass               |
|            | V <sub>High</sub> | 0.0052                           | -0.0022                           | 0.0000                            | 0.0015                             | ±0.01     | Pass               |

Note: V<sub>Low</sub>=V<sub>Nom</sub>-15 % ; V<sub>High</sub>=V<sub>Nom</sub>+15 %



## 20 dB Bandwidth Measurement

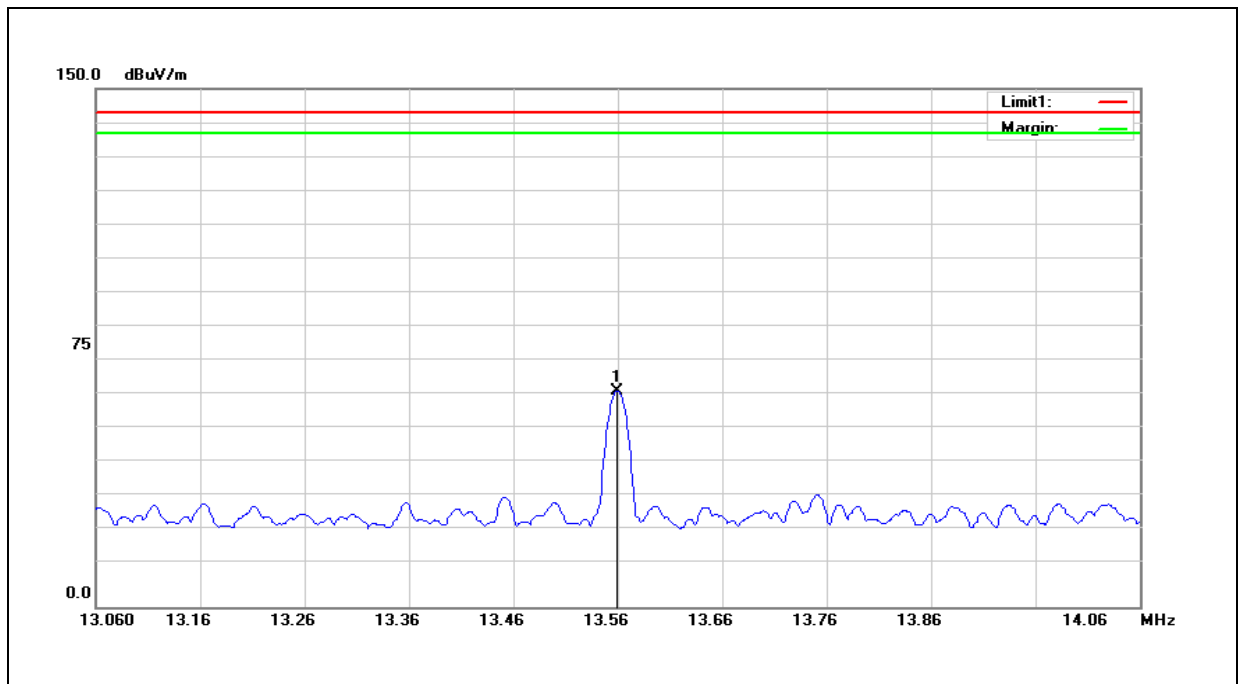
### ■ Test Graphs



## Annex C. Radiated Emission Measurement

### Fundamental

|             |                 |                      |                |
|-------------|-----------------|----------------------|----------------|
| Standard:   | FCC Part 15.225 | Test Distance:       | 1 m            |
| Test item:  | Fundamental     | Power:               | AC 120 V/60 Hz |
| Mode:       | Mode 2          | Temp.(°C)/Hum.(%RH): | 26(°C)/60 %RH  |
| Ant.Polar.: | Horizontal      |                      |                |



| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Correct Factor<br>(dB/m) | Near-Field<br>Result<br>(dBuV/m) | Derived<br>Value<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Remark |
|-----|--------------------|-------------------|--------------------------|----------------------------------|------------------------------|-------------------|----------------|--------|
| 1   | 13.5590            | 47.21             | 15.31                    | 62.52                            | 22.05                        | 84.00             | -61.95         | peak   |

Note: The level is measured at 1 meter and is converted into result at 30 meter.

The converted formula listed below:

Measure result (1 meter distance): a

Compute result (30 meter distance): A

$d_{\text{near field}} = \lambda/2\pi$ ,  $d_{\text{measure}} = 1$  meter distance

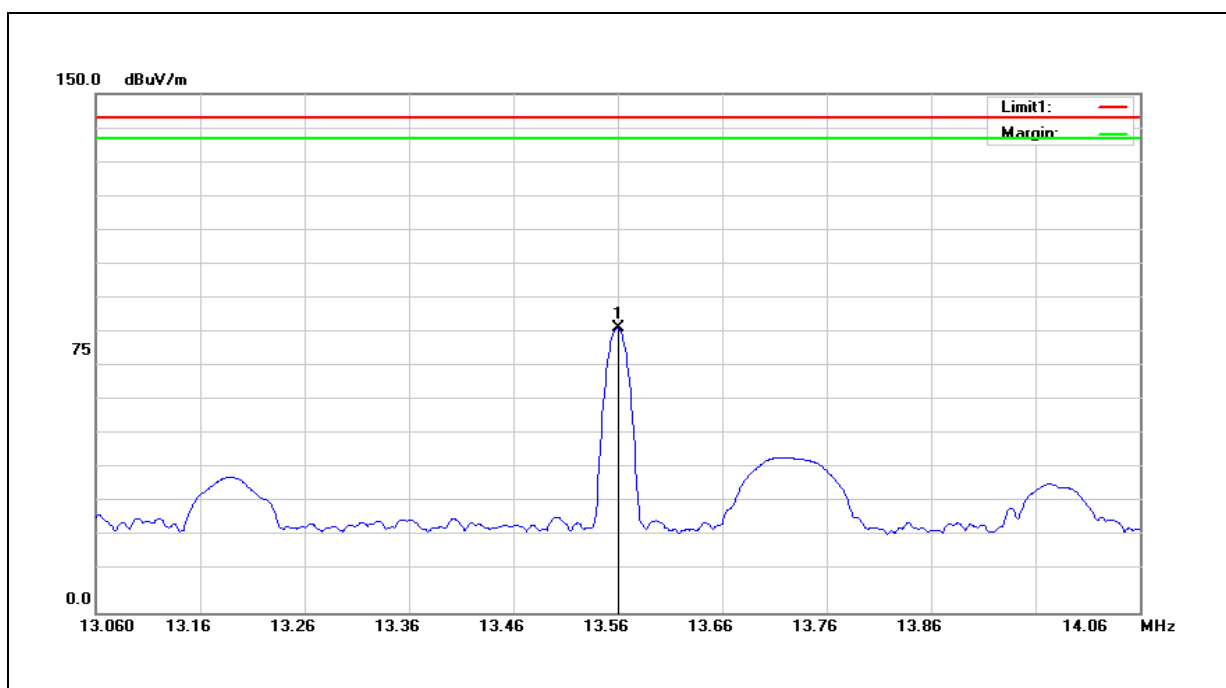
$A = a - 40 \cdot \log(d_{\text{near field}} / d_{\text{measure}}) - 20 \cdot \log(d_{\text{limit}} / d_{\text{near field}})$

ex.  $a = 62.52$  dBuV/m,  $A = 62.52 - 40 \cdot \log(3.52 / 1) - 20 \cdot \log(30 / 3.52)$  dBuV/m = 22.05 dBuV/m





|             |                 |                      |                |
|-------------|-----------------|----------------------|----------------|
| Standard:   | FCC Part 15.225 | Test Distance:       | 1 m            |
| Test item:  | Fundamental     | Power:               | AC 120 V/60 Hz |
| Mode:       | Mode 2          | Temp.(°C)/Hum.(%RH): | 26(°C)/60 %RH  |
| Ant.Polar.: | Vertical        |                      |                |



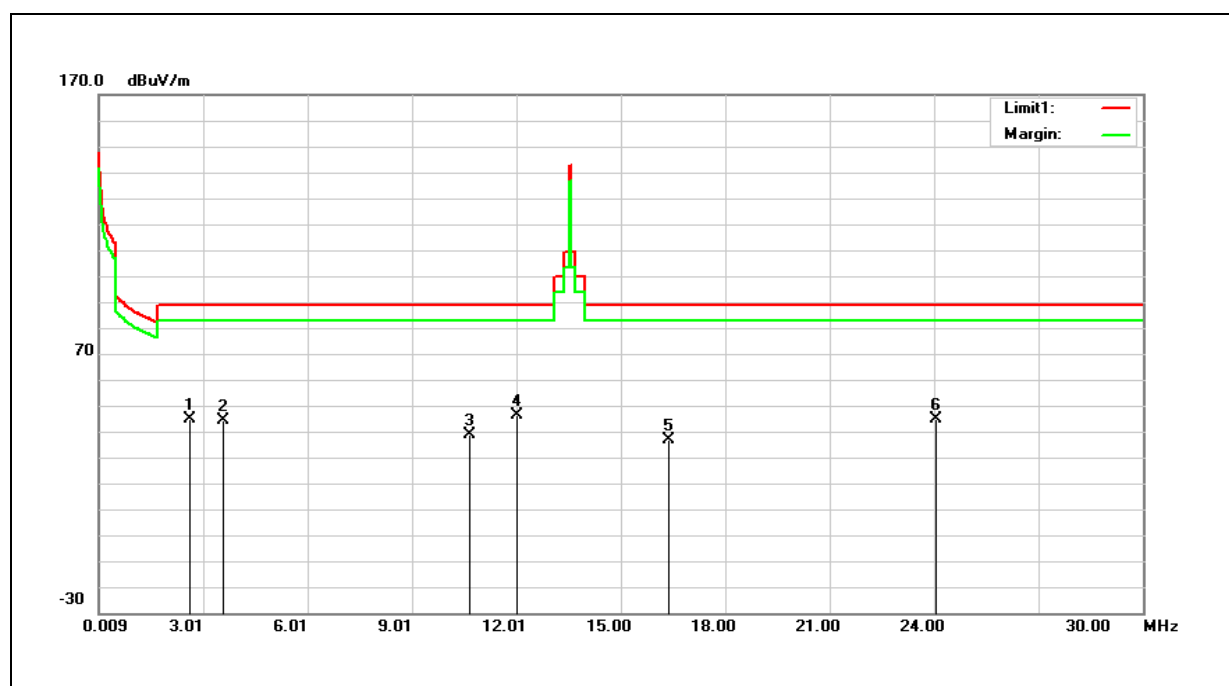
| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Correct Factor<br>(dB/m) | Near-Field<br>Result<br>(dBuV/m) | Derived<br>Value<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Remark |
|-----|--------------------|-------------------|--------------------------|----------------------------------|------------------------------|-------------------|----------------|--------|
| 1   | 13.5600            | 66.90             | 15.31                    | 82.21                            | 41.74                        | 84.00             | -42.26         | peak   |

Note: The level is measured at 1 meter and is converted into result at 30 meter.

## Harmonic

9 kHz ~ 30 MHz:

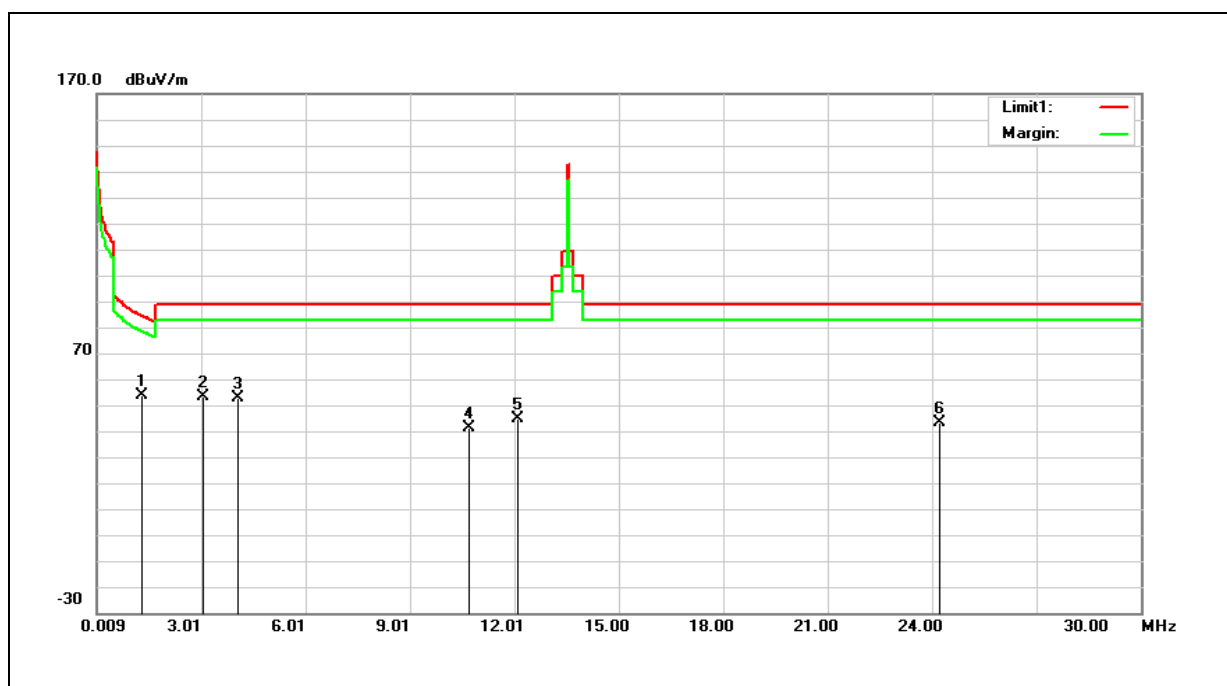
|             |                 |                      |                |
|-------------|-----------------|----------------------|----------------|
| Standard:   | FCC Part 15.225 | Test Distance:       | 300/30 m       |
| Test item:  | Harmonic        | Power:               | AC 120 V/60 Hz |
| Mode:       | Mode 2          | Temp.(°C)/Hum.(%RH): | 26(°C)/60 %RH  |
| Ant.Polar.: | Horizontal      |                      |                |



| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor (dB/m) | Near-Field Result (dBuV/m) | Derived Value (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----|-----------------|----------------|-----------------------|----------------------------|------------------------|----------------|-------------|--------|
| 1   | 2.6182          | 30.64          | 14.15                 | 44.79                      | -9.97                  | 29.54          | -39.52      | QP     |
| 2   | 3.578           | 29.75          | 14.46                 | 44.21                      | -7.84                  | 29.54          | -37.38      | QP     |
| 3   | 10.6558         | 23.28          | 15.57                 | 38.85                      | -3.72                  | 29.54          | -33.26      | QP     |
| 4   | 12.0354         | 30.84          | 15.52                 | 46.36                      | 4.84                   | 29.54          | -24.70      | QP     |
| 5   | 16.3841         | 21.54          | 15.11                 | 36.65                      | -2.17                  | 29.54          | -31.71      | QP     |
| 6   | 24.0618         | 30.70          | 13.96                 | 44.66                      | 9.18                   | 29.54          | -20.36      | QP     |

Note: The level is measured at 1 meter and is converted into result at 300 or 30 meter.

|             |                 |                      |                |
|-------------|-----------------|----------------------|----------------|
| Standard:   | FCC Part 15.225 | Test Distance:       | 300/30 m       |
| Test item:  | Harmonic        | Power:               | AC 120 V/60 Hz |
| Mode:       | Mode 2          | Temp.(°C)/Hum.(%RH): | 26(°C)/60 %RH  |
| Ant.Polar.: | Vertical        |                      |                |

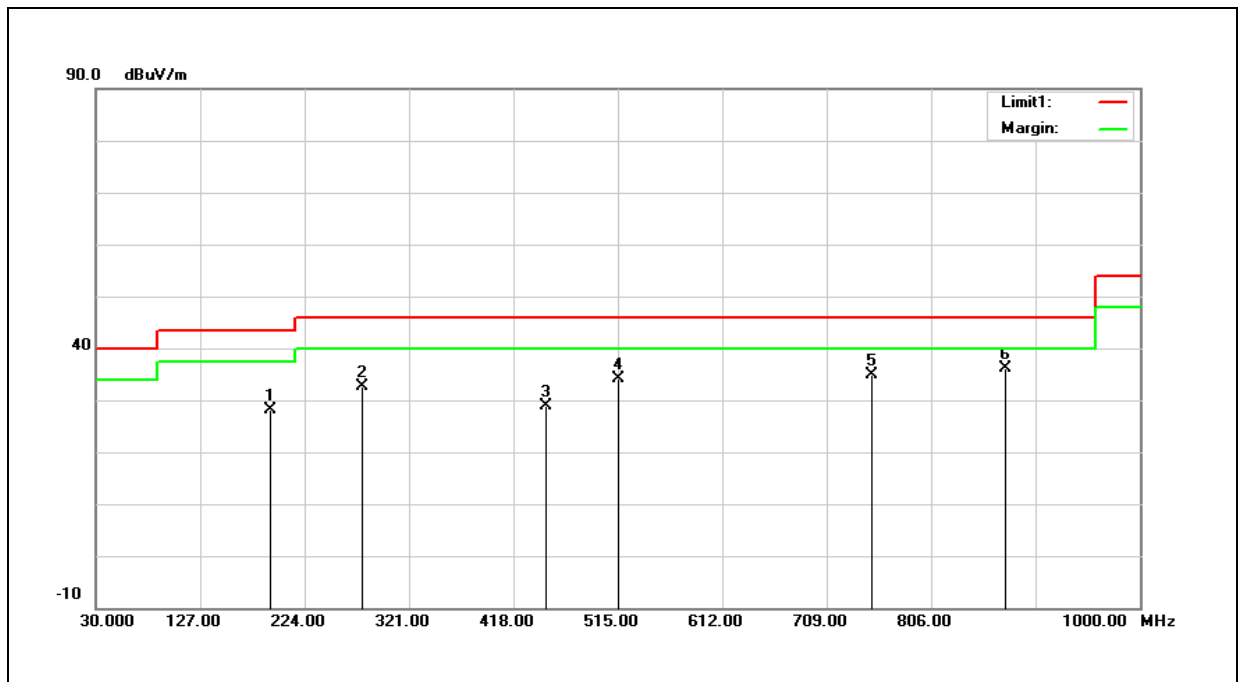


| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Correct Factor<br>(dB/m) | Near-Field<br>Result<br>(dBuV/m) | Derived Value<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Remark |
|-----|--------------------|-------------------|--------------------------|----------------------------------|---------------------------|-------------------|----------------|--------|
| 1   | 1.2986             | 39.79             | 13.98                    | 53.77                            | -7.08                     | 25.33             | -32.42         | QP     |
| 2   | 3.0681             | 39.17             | 14.24                    | 53.41                            | 0.03                      | 29.54             | -29.52         | QP     |
| 3   | 4.0577             | 38.18             | 14.67                    | 52.85                            | 1.89                      | 29.54             | -27.65         | QP     |
| 4   | 10.7157            | 25.52             | 15.57                    | 41.09                            | -1.44                     | 29.54             | -30.98         | QP     |
| 5   | 12.0954            | 29.32             | 15.50                    | 44.82                            | 3.35                      | 29.54             | -26.20         | QP     |
| 6   | 24.2117            | 29.55             | 13.93                    | 43.48                            | 8.05                      | 29.54             | -21.49         | QP     |

Note: The level is measured at 1 meter and is converted into result at 300 or 30 meter.

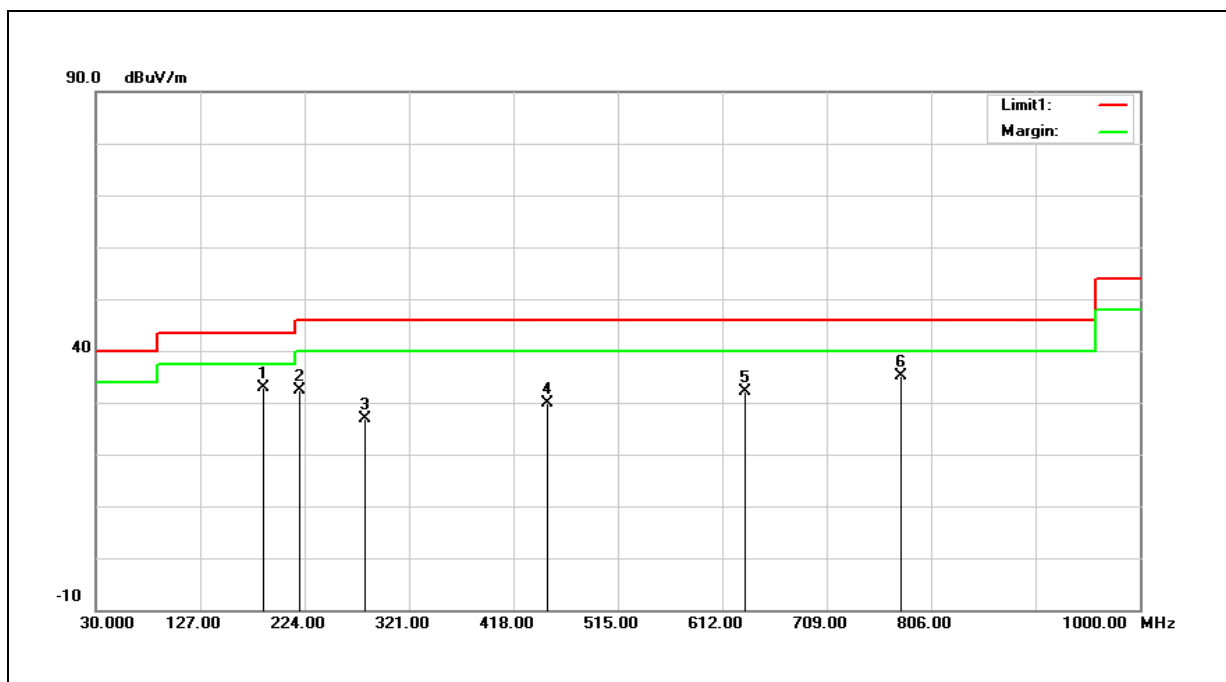
30 MHz ~ 1 GHz:

|             |                 |                      |                |
|-------------|-----------------|----------------------|----------------|
| Standard:   | FCC Part 15.225 | Test Distance:       | 3 m            |
| Test item:  | Harmonic        | Power:               | AC 120 V/60 Hz |
| Mode:       | Mode 2          | Temp.(°C)/Hum.(%RH): | 26(°C)/60 %RH  |
| Ant.Polar.: | Horizontal      |                      |                |



| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----|-----------------|----------------|-----------------------|-----------------|----------------|-------------|--------|
| 1   | 191.9900        | 35.49          | -7.42                 | 28.07           | 43.50          | -15.43      | QP     |
| 2   | 277.3500        | 37.35          | -4.81                 | 32.54           | 46.00          | -13.46      | QP     |
| 3   | 448.0700        | 29.53          | -0.76                 | 28.77           | 46.00          | -17.23      | QP     |
| 4   | 515.9700        | 33.98          | 0.24                  | 34.22           | 46.00          | -11.78      | QP     |
| 5   | 750.7100        | 29.55          | 5.22                  | 34.77           | 46.00          | -11.23      | QP     |
| 6   | 874.8700        | 29.05          | 7.11                  | 36.16           | 46.00          | -9.84       | QP     |

|             |                 |                      |                |
|-------------|-----------------|----------------------|----------------|
| Standard:   | FCC Part 15.225 | Test Distance:       | 3 m            |
| Test item:  | Harmonic        | Power:               | AC 120 V/60 Hz |
| Mode:       | Mode 2          | Temp.(°C)/Hum.(%RH): | 26(°C)/60 %RH  |
| Ant.Polar.: | Vertical        |                      |                |



| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----|-----------------|----------------|-----------------------|-----------------|----------------|-------------|--------|
| 1   | 185.2000        | 39.91          | -7.07                 | 32.84           | 43.50          | -10.66      | QP     |
| 2   | 219.1500        | 39.66          | -7.18                 | 32.48           | 46.00          | -13.52      | QP     |
| 3   | 280.2600        | 31.49          | -4.67                 | 26.82           | 46.00          | -19.18      | QP     |
| 4   | 449.0400        | 30.48          | -0.72                 | 29.76           | 46.00          | -16.24      | QP     |
| 5   | 633.3400        | 29.40          | 2.77                  | 32.17           | 46.00          | -13.83      | QP     |
| 6   | 777.8700        | 29.61          | 5.55                  | 35.16           | 46.00          | -10.84      | QP     |

--- END---