# TEST REPORT

| | | |
|---|---|---|
| **Applicant** | : | B&PLUS K.K. |
| **Address** | : | 2452-5 Koya Ogawa-machi Hiki-gun Saitama Japan |
| **Products** | : | 5bit RFID Reader |
| **Model No.** | : | Z5-EA05P-FCC-02 |
| **FCC ID** | : | 2AT4D-Z5EA05PFCC02 |
| **Serial No.** | : | - |
| **Test Standard** | : | CFR 47 FCC Rules and Regulations Part 15 |
| **Test Results** | : | **Passed** |
| **Date of Test** | : | April 8 ~ 10, 2020 |

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Lab Accreditation
VLAC-001-5

- The test results in this test report was made by using the measuring instruments which are traceable to national standards of measurement in accordance with ISO/IEC 17025.
- The applicable standard, testing condition and testing method which were used for the tests are based on the request of the applicant.
- The test results presented in this report relate only to the offered test sample.
- The contents of this test report cannot be used for the purposes, such as advertisement for consumers.
- This test report shall not be reproduced except in full without the written approval of JQA.
- VLAC does not approve, certify or warrant the product by this test report.

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## Definitions for Abbreviation and Symbols Used In This Test Report

"EUT" means Equipment Under the Test.
"AE" means Associated Equipment.
"N/A" means that Not Applicable.
"N/T" means that Not Tested.

☑ - indicates that the listed condition, standard or equipment is applicable for this report.
☐ - indicates that the listed condition, standard or equipment is not applicable for this report.

## 1 Description of the Equipment Under Test

The following contents such as identification information in this clause were provided by the applicant, if the information is difference, it can affect the validity of results.

| | | | |
|---|---|---|---|
| 1 | Manufacturer | : | B&PLUS K.K.<br>2452-5 Koya Ogawa-machi Hiki-gun Saitama Japan |
| 2 | Products | : | 5bit RFID Reader |
| 3 | Model No. | : | Z5-EA05P-FCC-02 |
| | Derivative model | : | Z5-EA05BKP-FCC-02<br>The only difference is the color of the housing. |
| 4 | Serial No. | : | - |
| 5 | Product Type | : | Mass Production |
| 6 | Date of Manufacture | : | - |
| 7 | Power Rating | : | 24 VDC |
| 8 | Grounding | : | None |
| 9 | Transmitting Frequency | : | 13.56 MHz |
| 10 | Receiving Frequency | : | 13.56 MHz |
| 11 | Modulation | : | ASK |
| 12 | Antenna Type | : | Internal Antenna |
| 13 | Operating Temperature / Humidity | : | 0 ~ 50 degree/ 30 ~ 90%RH |
| 14 | EUT Authorization | : | Certification |
| 15 | Received Date of EUT | : | April 7, 2020 |

<EUT Description>
The EUT is an ID system that reads 5bit data, this Read-Only system needs no particular program to read data, for the Reader reads data of a Data carrier automatically when the Data carrier come into the reading area of the reader. The 5bit system uses the ISO 15693 compliant ID tag and occupies the first 3 bytes (00, 01, 02 address) of the tag memory as the data area.

## 2 Summary of Test Results

Applied Standard : CFR 47 FCC Rules and Regulations Part 15

The EUT described in clause 1 was tested according to the applied standard shown above.
Details of the test configuration is shown in clause 6.
The conclusion for the test items of which are required by the applied standard is indicated under the test result.

☑ - The test result was passed for the test requirements of the applied standard.

☐ - The test result was failed for the test requirements of the applied standard.

☐ - The test result was not judged the test requirements of the applied standard.

In the approval of test results,
- Determining compliance with the limits in this report was based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.
- No deviations were employed from the applied standard.
- No modifications were conducted by JQA to achieve compliance to the limitations.

Reviewed by:

K. Makimoto

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Manager
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Tested by:

N. Ueno

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## 3 Test Procedure

Test Requirements: §15.225, §15.207 and §15.209

Test Procedure : ANSI C63.10–2013
Testing unlicensed wireless devices.
KDB937606 (Publication Date: October 10, 2014)
Test Site Requirements for Part 15 and 18 Devices Operating Below 30MHz.

## 4 Test Location

Japan Quality Assurance Organization
SAFETY & EMC CENTER
Testing Dept.
EMC Testing Div.
4-4-4, Minamiosawa, Hachioji-shi, Tokyo 192-0364, Japan

## 5 Recognition of Test Laboratory

Japan Quality Assurance Organization, Safety & EMC Center Testing Dept. EMC Testing Div. is accredited under ISO/IEC 17025 by following accreditation bodies and the test facility of Testing Division is registered by the following bodies .

VLAC Code : VLAC-001-5 (Effective through : March 30, 2022)
VCCI Registration Number : A-0001 (Effective through : March 30, 2022)
FCC Registration Number : 349652 (Effective through : March 30, 2022)

Accredited as conformity assessment body for Japan electrical appliances and material law by METI. (Effective through : February 22, 2022)

# 6 Description of Test Setup

The following contents such as identification information in this clause were provided by the applicant.

## 6.1 Test Configuration

The EUT consists of :

| Sign | Item | Manufacturer | Model No. | Serial No. | FCC ID |
|---|---|---|---|---|---|
| A | 5bit RFID Reader | B&PLUS K.K. | Z5-EA05P-FCC-02 | - | 2AT4D-Z5EA05P FCC02 |

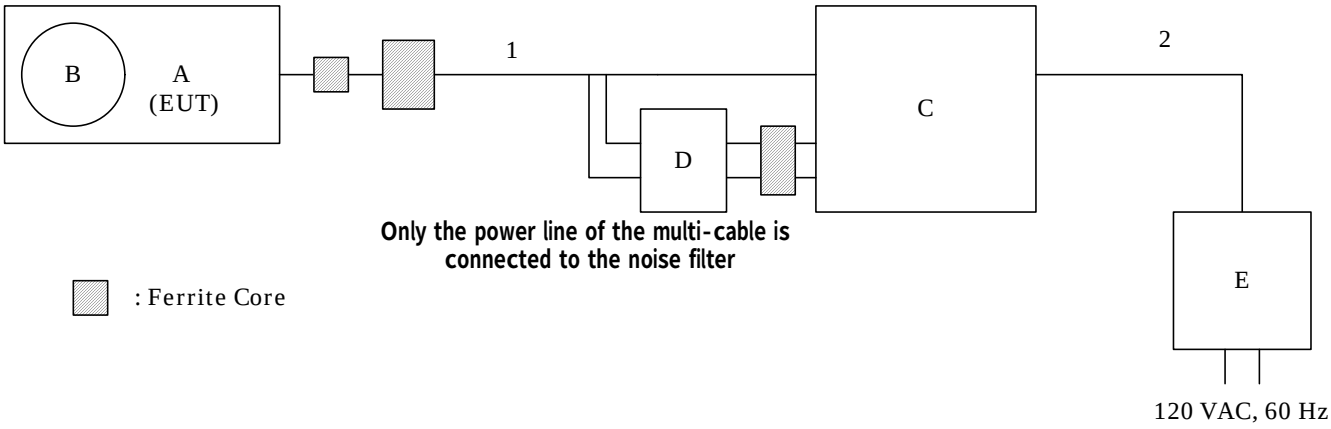
The AE used for testing :

| Sign | Item | Manufacturer | Model No. | Serial No. |
|---|---|---|---|---|
| B | RFID tag | B&PLUS K.K. | Z1-EA02 | - |
| C | Power supply Board | B&PLUS K.K. | PCB-30/60X70DEM | - |
| D | EMC Noise Filter | TDK | RSEL-2001W | - |
| E | AC Adapter | GO FORWARD ENTERPRISE CORP. | GF12-US2405 | - |

Type of Cable used for testing :

| No. | Description | Identification (Manu. Etc.) | Connector Shielded | Cable Shielded | Ferrite Core | Length (m) |
|---|---|---|---|---|---|---|
| 1 | Connection Cable | - | No | No | Yes | 2.0 |
| 2 | DC Power Cable | - | No | No | No | 1.6 |

## 6.2 Test Arrangement (Drawings)




## 6.3 Operating Condition

Power Supply Voltage : 24 VDC

The test were carried under 1 mode shown as follows:
1. TX modulation (Maximum Power setting)

The Radiated Emission test were carried under 1) and 2) test configurations shown in clause 6.2.

Detailed Transmitter portion:
Transmitter frequency : 13.560 MHz

Detailed Receiver portion:
Receiver frequency : 13.560 MHz

The EUT was rotated through three orthogonal axis (X, Y and Z axis) in radiated measurement.

The test mode is instructed by the applicant.
RFID tag continuous transmission / reception mode

# 7 Test Requirements

| Test Item | FCC Specification | Reference of the Test Report | Results | Remarks |
|---|---|---|---|---|
| Antenna Requirement | Section 15.203 | Section 1.11 | Passed | - |
| AC Powerline Conducted Emission | Section 15.207 | Section 7.1 | Passed | - |
| Radiated Emission | Section 15.225 (a)(b)(c)(d) | Section 7.2 | Passed | - |
| Occupied Bandwidth | Section 15.215 (c) | Section 7.3 | Passed | - |
| Frequency Stability | Section 15.225 (e) | Section 7.4 | Passed | - |

## 7.1 AC Powerline Conducted Emission

### 7.1.1 Test Results

For the standard, ☑ - Passed ☐ - Failed ☐ - Not judged

Min. Limit Margin (Quasi-Peak) 6.1 dB at 13.56 MHz
Min. Limit Margin (Average) 1.4 dB at 13.56 MHz

Uncertainty of Measurement Results ± 2.9 dB(2σ)

Remarks : The measurement results is within the range of measurement uncertainty.

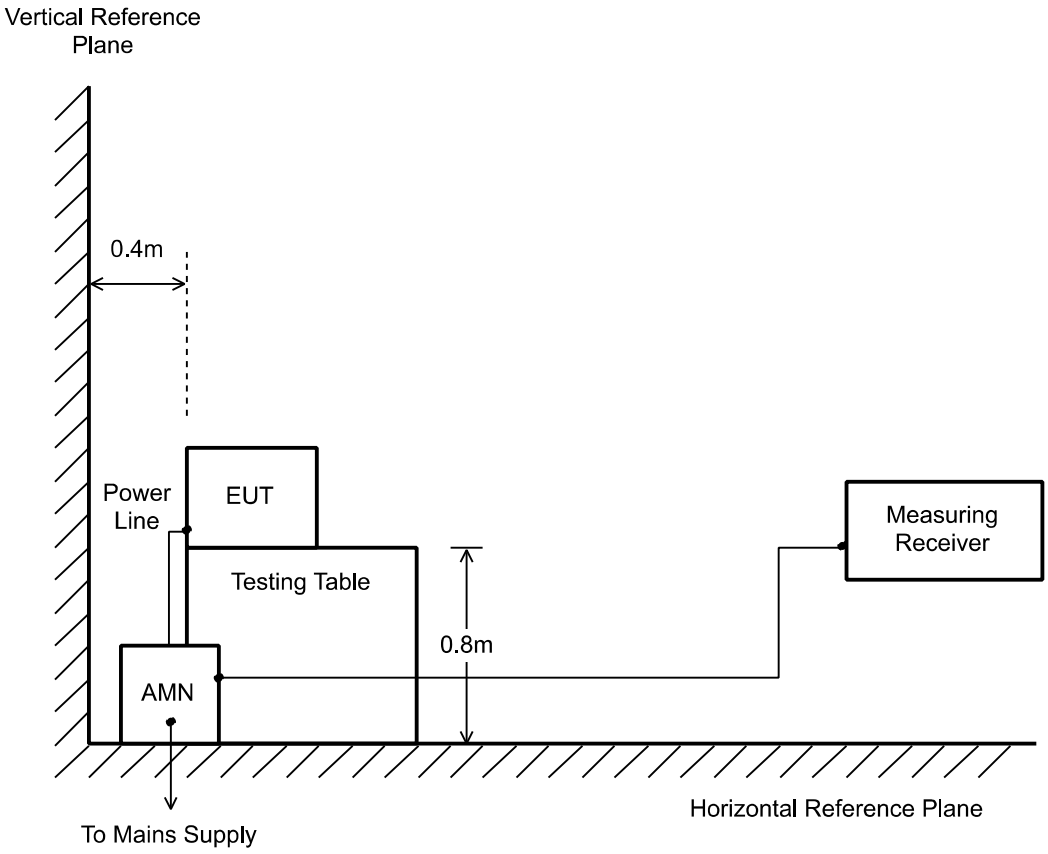
### 7.1.2 Test Instruments

| ID No. | Type | Model No. | Manufacturer | Serial No. | Last Cal. | Interval |
|---|---|---|---|---|---|---|
| M-1 | Shield Room | - | TDK | - | - | - |
| R04 | Test Receiver | ESW44 | Rohde & Schwarz | 101602 | 2019/11 | 1 Year |
| CB03 | RF Cable | RG223/U | Suhner | - | 2019/10 | 1 Year |
| L03 | LISN | KNW-407 | Kyoritsu | 8-1130-6 | 2019/10 | 1 Year |
| PL02 | Pulse Limiter | ESH3-Z2 | Rohde & Schwarz | - | 2020/04 | 1 Year |
| F02 | High Pass Filter | KFL-009 | Kyoritsu | 8-2072-5 | 2020/04 | 1 Year |

### 7.1.3 Test Method and Test Setup (Diagrammatic illustration)

The preliminary tests were performed using the scan mode of test receiver or spectrum analyzer to observe the emissions characteristics of the EUT.
The EUT configuration, cable configuration and mode of operation were determined for producing the maximum level of emissions.
This configurations was used for final tests.

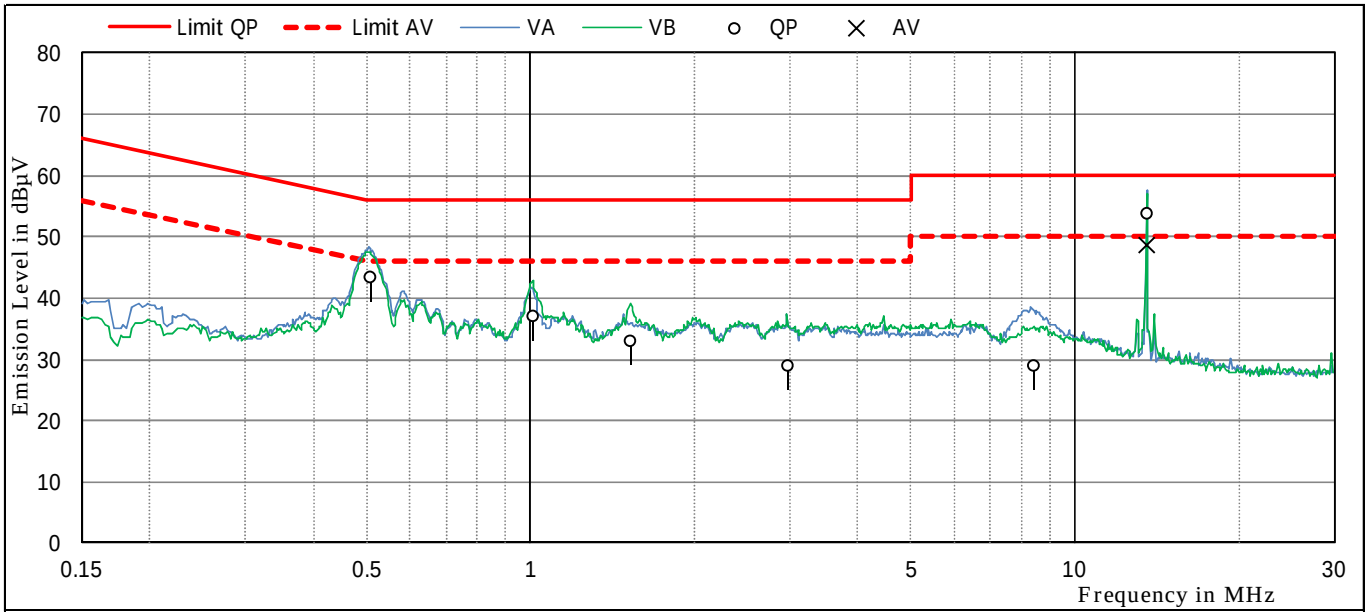
– Side View –




NOTE
AMN : Artificial Mains Network

### 7.1.4 Test Data

| Measurement Date | Ambient Temperature | Relative Humidity | Atmospheric pressure |
|---|---|---|---|
| April 8, 2020 | 23 ℃ | 38 % | 1005 hPa |




| Frequency [MHz] | Terminal | Factor [dB] | Meter Reading [dBµV] QP | Meter Reading [dBµV] AV | Limit [dBµV] QP | Limit [dBµV] AV | Emission Level [dBµV] QP | Emission Level [dBµV] AV | Margin [dB] QP | Margin [dB] AV |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.51 | VA | 20.1 | 23.3 | - | 56.0 | 46.0 | 43.4 | - | 12.6 | - |
| 0.51 | VB | 20.1 | 23.3 | - | 56.0 | 46.0 | 43.4 | - | 12.6 | - |
| 1.01 | VA | 20.0 | 14.5 | - | 56.0 | 46.0 | 34.5 | - | 21.5 | - |
| 1.01 | VB | 20.0 | 17.0 | - | 56.0 | 46.0 | 37.0 | - | 19.0 | - |
| 1.53 | VA | 20.0 | 8.9 | - | 56.0 | 46.0 | 28.9 | - | 27.1 | - |
| 1.53 | VB | 20.0 | 13.1 | - | 56.0 | 46.0 | 33.1 | - | 22.9 | - |
| 2.97 | VA | 20.1 | 7.7 | - | 56.0 | 46.0 | 27.8 | - | 28.2 | - |
| 2.97 | VB | 20.1 | 8.9 | - | 56.0 | 46.0 | 29.0 | - | 27.0 | - |
| 8.43 | VA | 20.3 | 8.6 | - | 60.0 | 50.0 | 28.9 | - | 31.1 | - |
| 8.43 | VB | 20.3 | 7.8 | - | 60.0 | 50.0 | 28.1 | - | 31.9 | - |
| 13.56 | VA | 20.5 | 33.4 | 27.1 | 60.0 | 50.0 | 53.9 | 47.6 | 6.1 | 2.4 |
| 13.56 | VB | 20.5 | 32.4 | 28.1 | 60.0 | 50.0 | 52.9 | 48.6 | 7.1 | 1.4 |

Note
1) QP:Quasi-Peak, AV:Average
2) VA:One end & Ground, VB:Other end & Ground
3) The symbol of '<' means 'or less' .
4) The symbol of '>' means 'or greater' .
5) The symbol of '-' means 'Not applicable' .
6) Factor includes Artificial Mains Network factor,Hi-Pass Filter loss,Pulse Limiter loss and a cable loss.
7) A sample calculation was made at 13.56MHz
Factor + Meter Reading = 20.5 + 32.4 = 52.9

## 7.2 Radiated Emission

For the requirements, ☑ - Applicable [ ☑ - Tested. ☐ - Not tested by applicant request. ]
☐ - Not Applicable

### 7.2.1 Test Results

#### 7.2.1.1 Radiated Emission (§15.225(a)(b)(c))

For the standard, ☑ **- Passed** ☐ **- Failed** ☐ **- Not judged**

| | | | | | |
|---|---|---|---|---|---|
| Min. Limit Margin (§15.225(a)) (Quasi-Peak) | 78.5 | dB | at | 13.560 | MHz |
| Min. Limit Margin (§15.225(b)) (Quasi-Peak) | >60.3 | dB | at | 13.567 | MHz |
| Min. Limit Margin (§15.225(c)) (Quasi-Peak) | 51.4 | dB | at | 13.410 | MHz |

| | | | |
|---|---|---|---|
| Uncertainty of Measurement Results | 9 kHz – 30 MHz | ± 2.5 | dB(2σ) |

Remarks : The Radited Emission at 30m of 13.560 MHz is 12.3 dB(uV/m). Y axis position. Antenna Orientation: parallel. The emission mask (§15.225(a), (b) and (c)) complies with the limits.

#### 7.2.1.2 Radiated Emission (§15.225(d))

For the standard, ☑ **- Passed** ☐ **- Failed** ☐ **- Not judged**

| | | | | | |
|---|---|---|---|---|---|
| Min. Limit Margin (Quasi-Peak) | 4.2 | dB | at | 420.4 | MHz |

| | | | |
|---|---|---|---|
| Uncertainty of Measurement Results | 9 kHz – 30 MHz | ± 2.5 | dB(2σ) |
| | 30 MHz – 200 MHz | ± 4.5 | dB(2σ) |
| | 200 MHz – 1000 MHz | ± 4.5 | dB(2σ) |

Remarks : X axis position. The measurement results is within the range of measurement uncertainty.

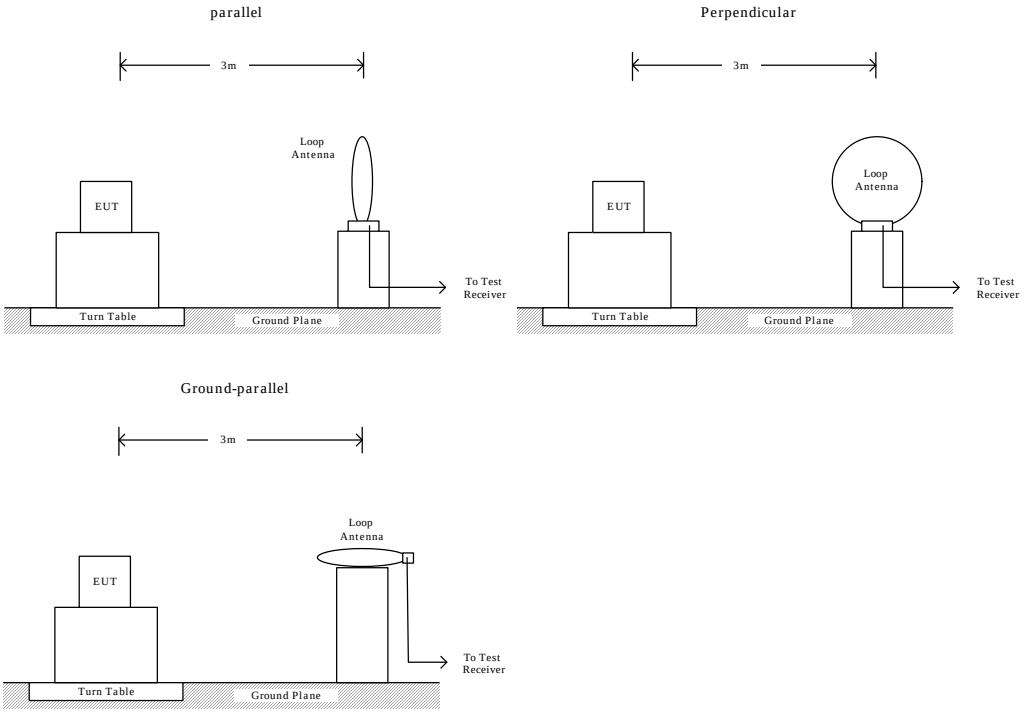
### 7.2.2 Test Instruments

| ID No. | Type | Model No. | Manufacturer | Serial No. | Last Cal. | Interval |
|---|---|---|---|---|---|---|
| A-1 | Anechoic Chamber | - | TDK | - | 2019/06 | 1 Year |
| R04 | Test Receiver | ESW44 | Rohde & Schwarz | 101602 | 2019/11 | 1 Year |
| CS02 | RF Cable | MWX221 | Junkosha Inc. | 1701S347 | 2019/07 | 1 Year |
| CS12 | RF Cable | MWX122 | Junkosha Inc. | J12J104317-00 | 2019/07 | 1 Year |
| C-2 | Loop Antenna | HFH2-Z2 | Rohde & Schwarz | 872096/25 | 2019/08 | 1 Year |
| AB01 | Biconical Antenna | BBA9106 | Schwarzbeck | VHA91032399 | 2019/08 | 1 Year |
| AL04 | Log-periodic Antenna | VULP9118A | Schwarzbeck | 00776 | 2019/08 | 1 Year |

### 7.2.3 Test Method and Test Setup (Diagrammatic illustration)

#### 7.2.3.1 Radiated Emission 9 kHz – 30 MHz

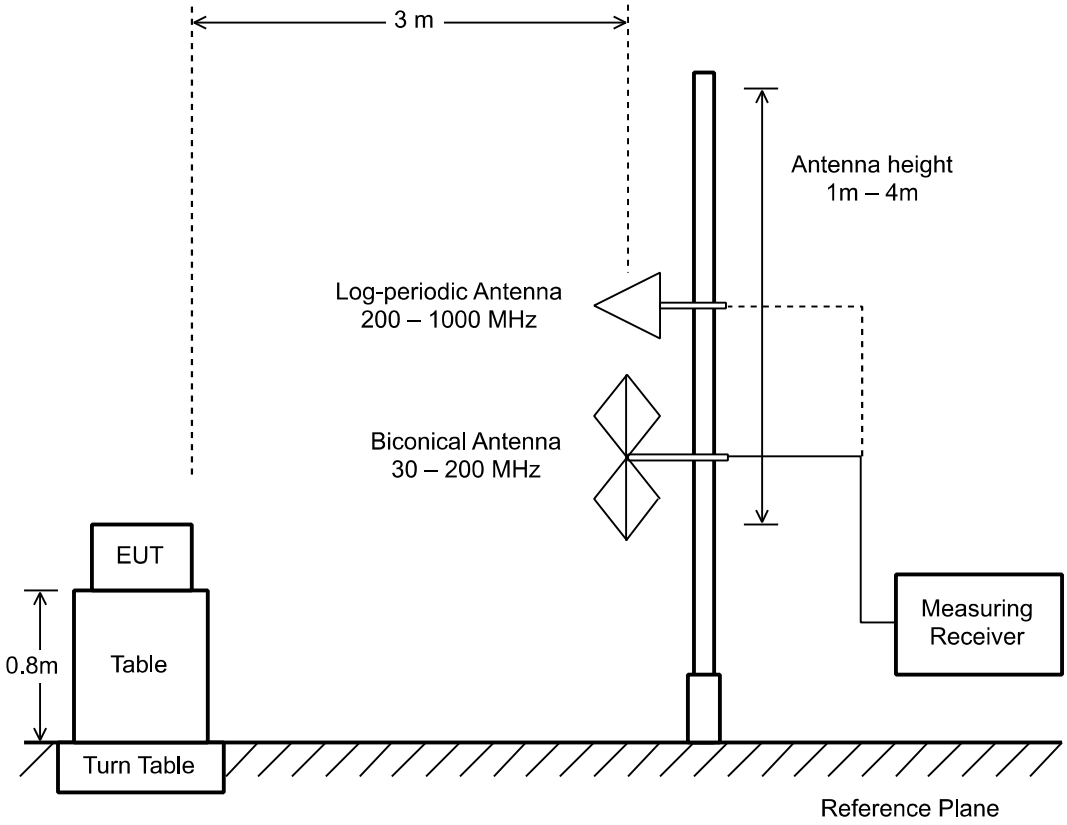
The preliminary tests were performed at the measurement distance that specified for compliance to determine the emission characteristics of the EUT.
The EUT configuration(in X, Y and Z axis), cable configuration and mode of operation were determined for producing the maximum level of emissions.
The measurement were performed about three antenna orientations (parallel, perpendicular, and ground-parallel).
According to KDB 414788, a used anechoic chamber were equivalent to those on an open fields site based on comparison measurements.
This configurations was used for the final tests.
– Side View –



### 7.2.3.2 Radiated Emission 30 MHz – 1000 MHz

The preliminary tests were performed at the measurement distance that specified for compliance to determine the emission characteristics of the EUT.
The EUT configuration(in X, Y and Z axis), cable configuration and mode of operation were determined for producing the maximum level of emissions.
This configurations was used for the final tests.

– Side View –

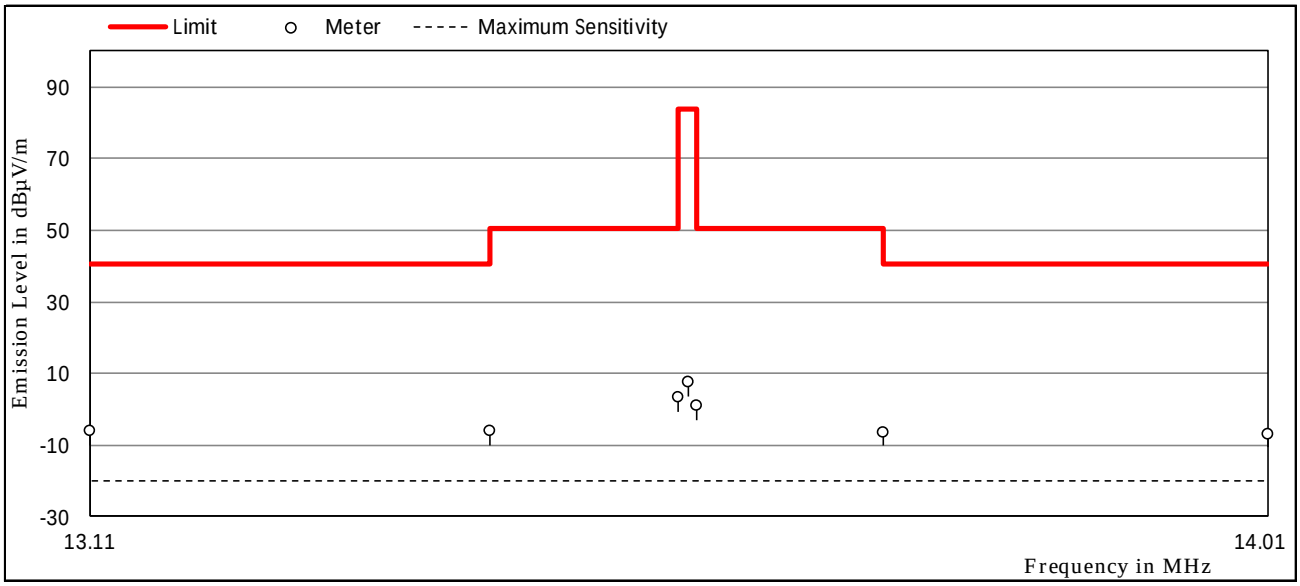


### 7.2.4 Test Data

### 7.2.4.1 Radiated Emission (§15.225(a)(b)(c) & §15.209(a))

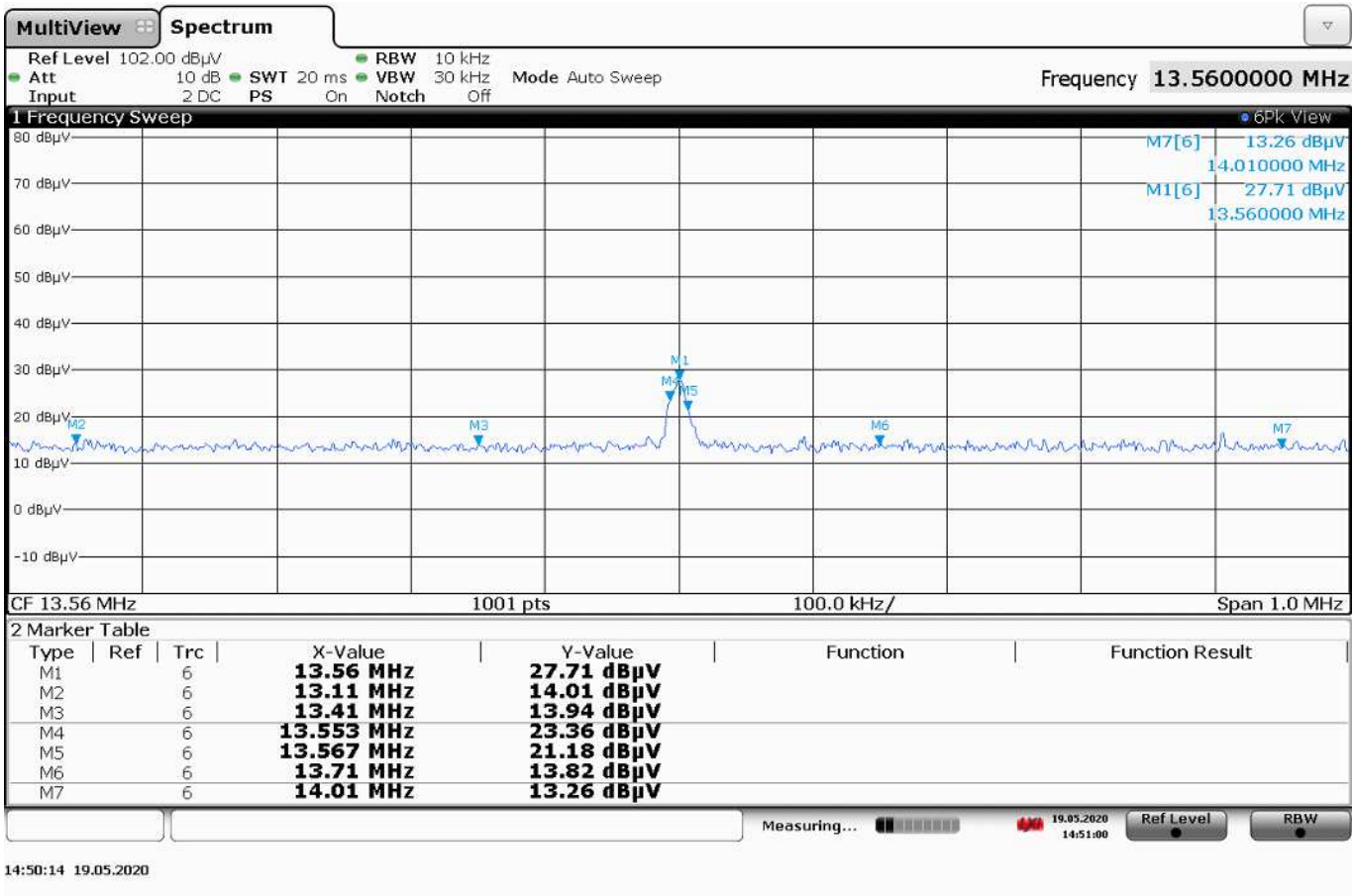
### 7.2.4.1.1 Emission Mask (§15.225(a)(b)(c))

| Measurement Date | Ambient Temperature | Relative Humidity | Atmospheric pressure |
|---|---|---|---|
| May 19, 2020 | 23 ℃ | 42 % | 998 hPa |




| Frequency [MHz] | Correction Factor [dB(1m)] | Meter Readings at 3m [dBµV] | Limits [dBµV/m] | Specified Distance [m] | Extrapolated Result [ dBµV/m ] | Margin [dB] | Note |
|---|---|---|---|---|---|---|---|
| 13.11 | 20.0 | 14.0 | 40.5 | 30.0 | - 6.0 | 46.5 | |
| 13.41 | 20.0 | 13.9 | 40.5 | 30.0 | - 6.1 | 46.6 | |
| 13.553 | 20.0 | 23.4 | 50.5 | 30.0 | 3.4 | 47.1 | |
| 13.56 | 20.0 | 27.7 | 84.0 | 30.0 | 7.7 | 76.3 | |
| 13.567 | 20.0 | 21.2 | 50.5 | 30.0 | 1.2 | 49.3 | |
| 13.71 | 20.0 | 13.8 | 40.5 | 30.0 | - 6.2 | 46.7 | |
| 14.01 | 20.0 | 13.3 | 40.5 | 30.0 | - 6.7 | 47.2 | |

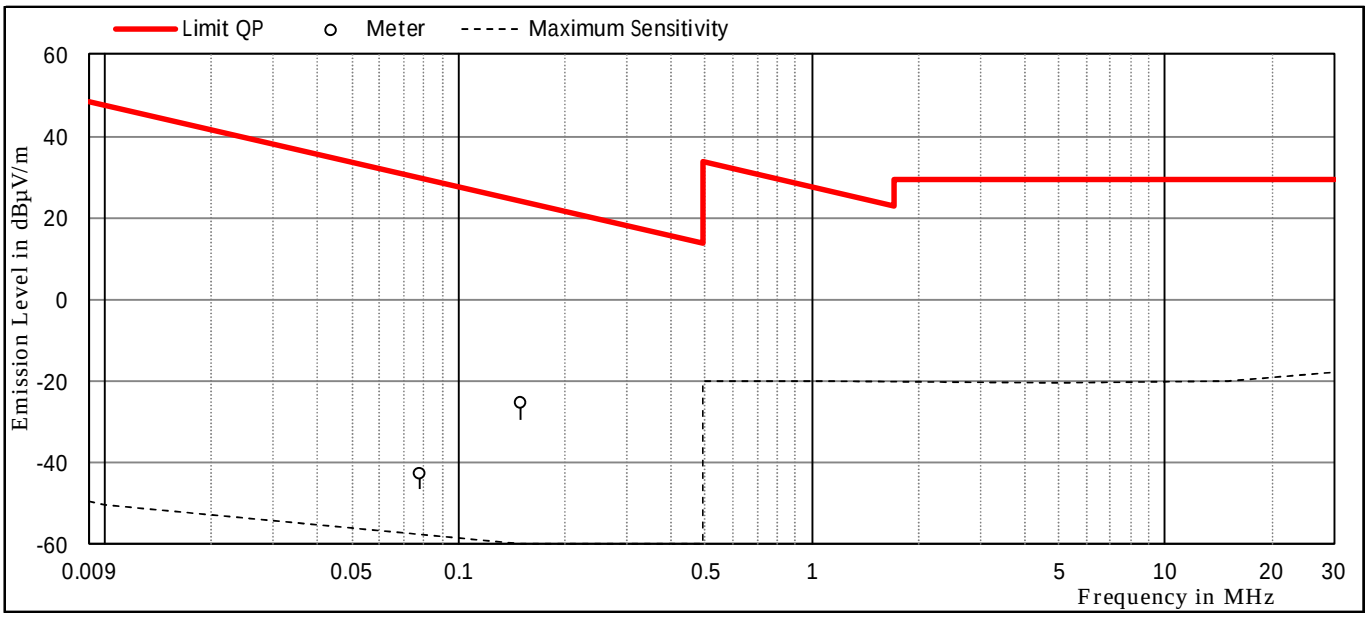
NOTES
1. Test Distance : 3 m
2. The spectrum was checked from 9 kHz to 30 MHz.
3. The correction factor includes the antenna factor and the cable loss.
4. The symbol of "<" means "or less".
5. The symbol of ">" means "more than".
6. The testing loop antenna was rotated at the vertical and horizontal axis to maximize received emissions.
   The above Meter Reading was maximum emission level.
7. Calculation:
   For fundamental, the measured field strength was extrapolated to distance 30m, using the formula that field strength using the formula that field strength aries as the inverse distance square(40 dB per decade of distance).
   Fundamental : Correction Factor + Meter Reading = 20.0 + 27.7 = 47.7 dB(µV/m)
   Result at 30 m = -40 + 47.7 = 7.7 dB(µV/m) (Conversion Factor : 40dB/decade)
   Limits for 13.553-13.567MHz(§15.225(a)) = 20log10(15848) = 84.0 dBµV/m
   Limits for 13.410-13.553,13.567-13.710MHz(§15.225(b)) = 20log10(334) = 50.5 dBµV/m
   Limits for 13.110-13.410,13.710-14.010MHz (§15.225(c)) = 20log10(106) = 40.5 dBµV/m
7. Test receiver setting(s) :
   Quasi-Peak Detector IF Bandwidth: 9kHz or 200Hz(Except for 9 kHz -90 kHz, 110 kHz -490 kHz)
   Average Detector, IF Bandwidth: 9kHz or 200Hz(9 kHz -90 kHz, 110 kHz -490 kHz)




Fundamental Emission (Detector: Peak)

### 7.2.4.1.2 Radiated Emission (§15.209(a))( 9kHz – 30MHz)

| Measurement Date | Ambient Temperature | Relative Humidity | Atmospheric pressure |
|---|---|---|---|
| April 8, 2020 | 23 ℃ | 38 % | 1005 hPa |

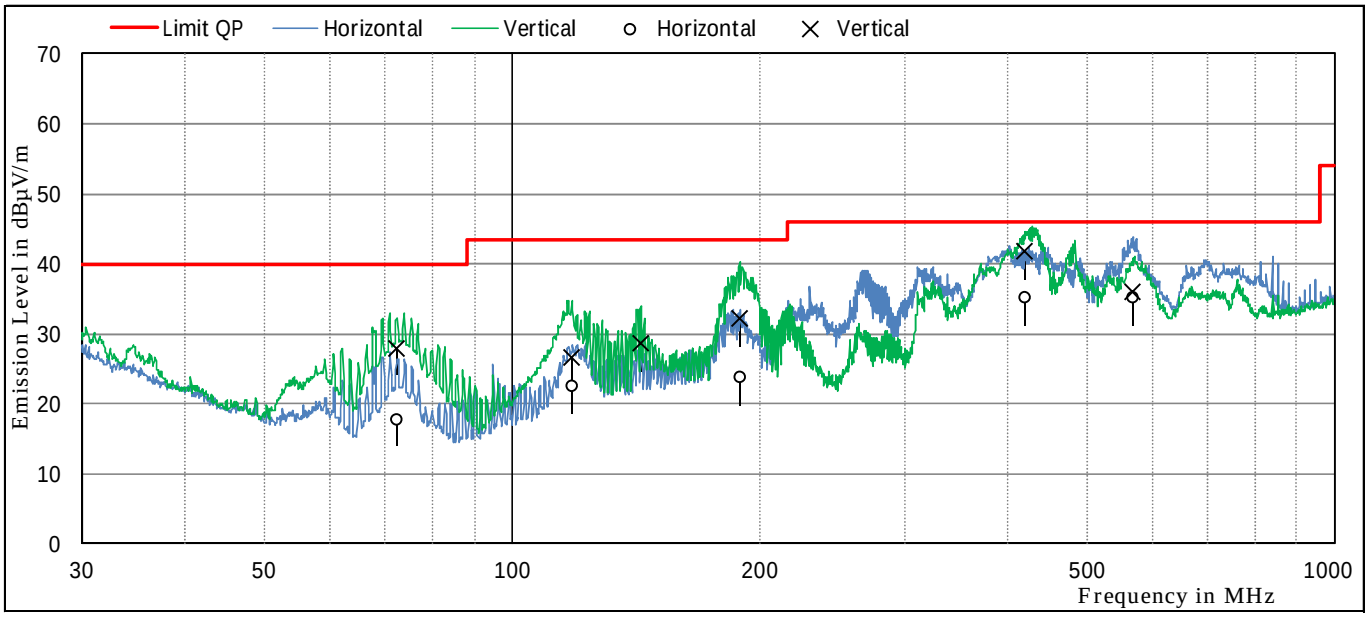



| Frequency [MHz] | Factor [dB] | Meter Reading [dBµV] | Limit [dBµV/m] QP | Emission Level [ dBµV/m ] | Margin [dB] | Azimuth |
|---|---|---|---|---|---|---|
| 0.078 | -57.5 | 15.2 | 29.8 | - 42.3 | 72.1 | 270deg |
| 0.15 | -59.8 | 34.5 | 24.1 | - 25.3 | 49.4 | 242deg |

Note
1) QP:Quasi-Peak
2) The symbol of '<' means 'or less' .
3) The symbol of '>' means 'or greater' .
4) The symbol of '-' means 'Not applicable' .
5) Factor includes Antenna factor,Conversion Factor and a cable loss.
6) A sample calculation was made at 0.15MHz
   Factor + Meter Reading = -59.8 + 34.5 = -25.3
7) The measured field strength was extrapolated to distance 30m/300m, using the formula that field strength using the formula that field strength aries as the inverse distance square(40 dB per decade of distance).

### 7.2.4.1.3 Radiated Emission (§15.209(a))( 30MHz – 1000MHz)

| Measurement Date | Ambient Temperature | Relative Humidity | Atmospheric pressure |
|---|---|---|---|
| April 8, 2020 | 23 ℃ | 38 % | 1005 hPa |




| Frequency [MHz] | Polarity | Factor [dB/m] | Meter Reading [dBµV] | Limit [dBµV/m] QP | Emission Level [ dBµV/m ] | Margin [dB] | Azimuth / Ant.Height |
|---|---|---|---|---|---|---|---|
| 72.7 | Hori. | 9.9 | 8.0 | 40.0 | 17.9 | 22.1 | 177deg/2.53m |
| 72.7 | Vert. | 9.9 | 18.1 | 40.0 | 28.0 | 12.0 | 207deg/1.00m |
| 118.5 | Hori. | 16.6 | 5.9 | 43.5 | 22.5 | 21.0 | 168deg/1.56m |
| 118.5 | Vert. | 16.6 | 10.0 | 43.5 | 26.6 | 16.9 | 174deg/1.00m |
| 143.8 | Hori. | 18.4 | < - 2.0 | 43.5 | < 16.4 | > 27.1 | |
| 143.8 | Vert. | 18.4 | 10.2 | 43.5 | 28.6 | 14.9 | 86deg/1.00m |
| 189.6 | Hori. | 20.3 | 3.6 | 43.5 | 23.9 | 19.6 | 136deg/1.69m |
| 189.6 | Vert. | 20.3 | 11.9 | 43.5 | 32.2 | 11.3 | 148deg/1.00m |
| 420.4 | Hori. | 20.5 | 14.7 | 46.0 | 35.2 | 10.8 | 150deg/2.32m |
| 420.4 | Vert. | 20.5 | 21.3 | 46.0 | 41.8 | 4.2 | 172deg/1.18m |
| 568.8 | Hori. | 23.3 | 11.9 | 46.0 | 35.2 | 10.8 | 73deg/2.09m |
| 568.8 | Vert. | 23.3 | 12.8 | 46.0 | 36.1 | 9.9 | 356deg/1.00m |

Note
1) QP:Quasi-Peak
2) The symbol of '<' means 'or less' .
3) The symbol of '>' means 'or greater' .
4) The symbol of '-' means 'Not applicable' .
5) Factor includes Antenna factor, and a cable loss.
6) A sample calculation was made at 420.4MHz
Factor + Meter Reading = 20.5 + 21.3 = 41.8

## 7.3 Occupied Bandwidth

For the requirements, ☑ - Applicable [ ☑ - Tested. ☐ - Not tested by applicant request. ]
☐ - Not Applicable

### 7.3.1 Test Results

For the standard, ☑ **- Passed** ☐ **- Failed** ☐ **- Not judged**

Uncertainty of Measurement Results ± 0.9 %(2σ)

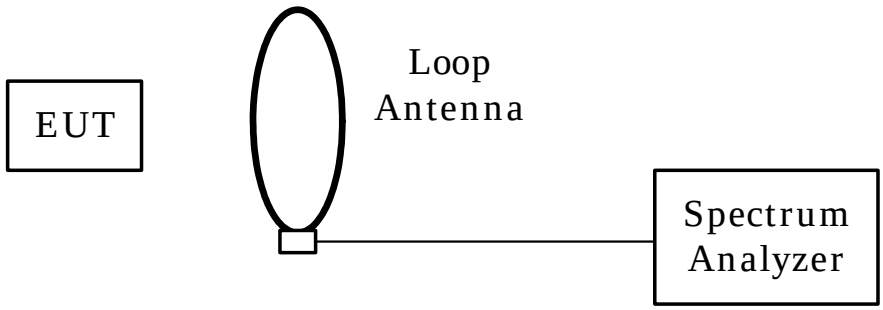
Remarks : " Because the measured signal is CW or CW like, adjusting the RBW per C63.10 would not be practical. Measured bandwidth will always follow the RBW and the result will be approximately twice the RBW."

### 7.3.2 Test Instruments

| ID No. | Type | Model No. | Manufacturer | Serial No. | Last Cal. | Interval |
|---|---|---|---|---|---|---|
| R04 | Test Receiver | ESW44 | Rohde & Schwarz | 101602 | 2019/11 | 1 Year |
| CB02 | RF Cable | RG223/U | Suhner | - | 2019/10 | 1 Year |
| - | Loop Antenna | L7-105ASC | Singer Instr. | 113 | - | - |

### 7.3.3 Test Method and Test Setup (Diagrammatic illustration)

The test system is shown as follows:




The setting of the spectrum analyzer are shown as follows:

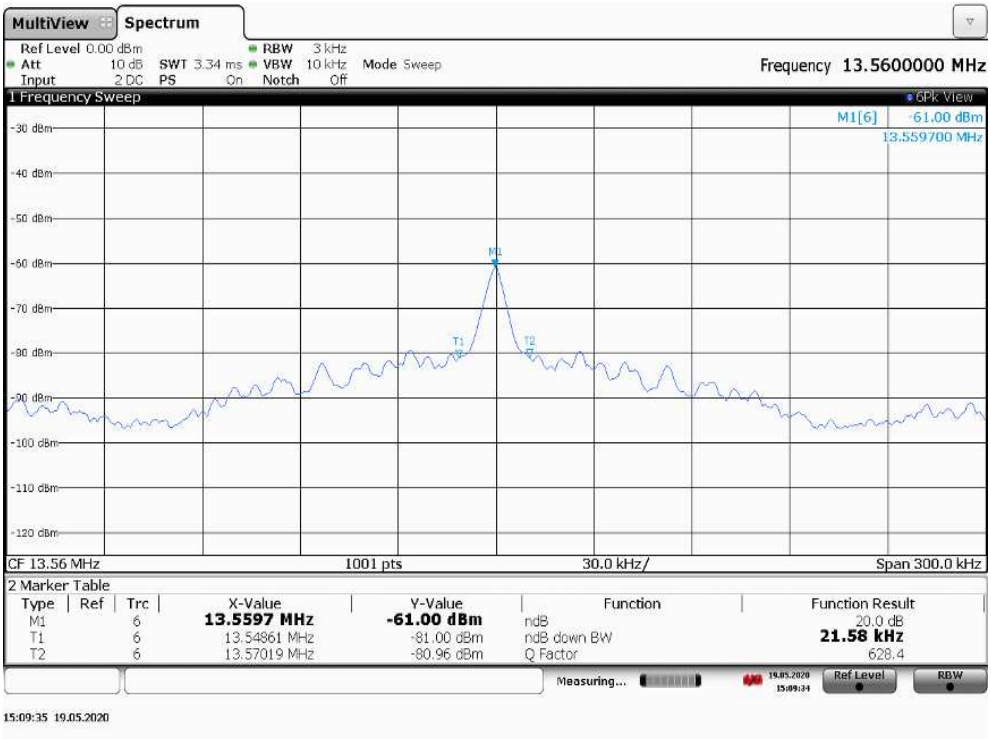
| | |
|---|---|
| Res. Bandwidth | 3 kHz |
| Video Bandwidth | 10 kHz |
| Span | 300 kHz |
| Sweep Time | AUTO |
| Trace | Maxhold |

### 7.3.4 Test Data

Test Date :May 19, 2020
Temp.:23°C, Humi.:42%, Atm.: 998hPa

Test Mode : TX

| Frequency (MHz) | -20dBc Bandwidth (kHz) |
|---|---|
| 13.56 | 21.58 |



## 7.4 Frequency Stability

For the requirements, ☑ - Applicable [ ☑ - Tested. ☐ - Not tested by applicant request. ]
☐ - Not Applicable

### 7.4.1 Test Results

For the standard, ☑ **- Passed** ☐ **- Failed** ☐ **- Not judged**

The Frequency Stability level is -0.000546 % at 13.560 MHz

Min. Limit Margin +0.009454 % at 13.560 MHz

Uncertainty of Measurement Results ± 1.3 ppm(2σ)

Remarks : _____

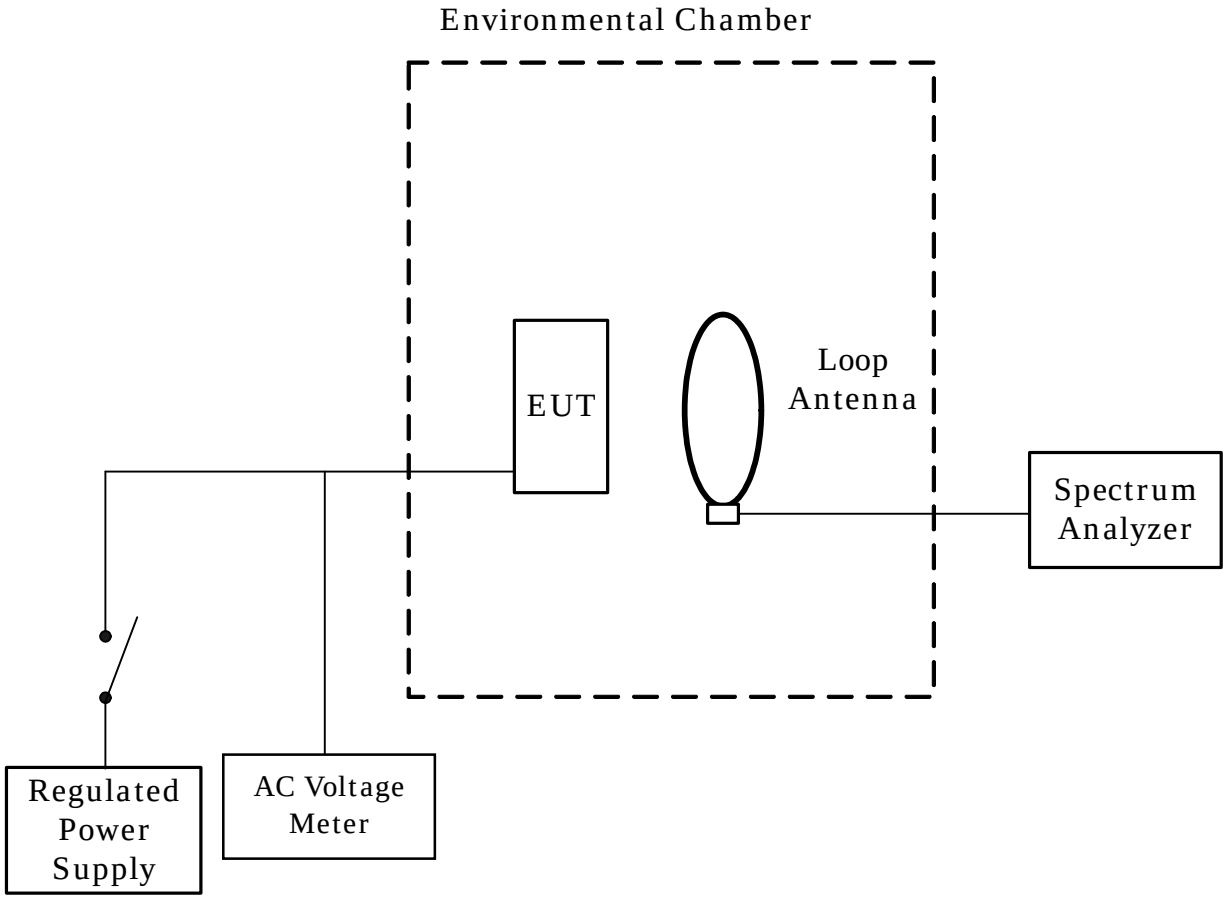
### 7.4.2 Test Instruments

| ID No. | Type | Model No. | Manufacturer | Serial No. | Last Cal. | Interval |
|---|---|---|---|---|---|---|
| R04 | Test Receiver | ESW44 | Rohde & Schwarz | 101602 | 2019/11 | 1 Year |
| CB02 | RF Cable | RG223/U | Suhner | - | 2019/10 | 1 Year |
| - | Loop Antenna | L7-105ASC | Singer Instr. | 113 | - | - |
| - | Environmental Test Chamber | PFL-3K | Espec | - | - | - |
| - | Mercury thermometer | - | SANSYO | 30206 | 2020/1 | 1 Year |

### 7.4.3 Test Method and Test Setup (Diagrammatic illustration)

**Frequency Stability versus Temperature**

The EUT was placed in an environmental chamber and was tested in the range from –20 to +50 degrees Celsius. The EUT was stabilized at each temperature. The power supplied was applied to the transmitter and allowed to stabilize for 10 minutes. The transmitting frequency was measured at startup and 2 minutes, 5 minutes and 10 minutes after startup. This procedure was repeated from –20, +20 and +50 degrees Celsius.



### 7.4.4 Test Data

Test Date : April 10, 2020

Transmitting Frequency : 13.560 MHz

| Power Supply [VDC] | Ambient Temperature [℃] | Frequency with time elapse [MHz] Startup | 2 minutes | 5 minutes | 10 minutes |
|---|---|---|---|---|---|
| 24 | -20 | 13.559958 | 13.560010 | 13.560010 | 13.560010 |
| 20.4 | 20 | 13.559958 | 13.559942 | 13.559942 | 13.559942 |
| 24 | 20 | 13.559942 | 13.559928 | 13.559928 | 13.559942 |
| 27.6 | 20 | 13.559958 | 13.559942 | 13.559942 | 13.559928 |
| 24 | 50 | 13.559942 | 13.559926 | 13.559942 | 13.559942 |

| Power Supply [VDC] | Ambient Temperature [℃] | Frequency with time elapse [MHz] Startup | 2 minutes | 5 minutes | 10 minutes | Limits [%] | Magin [%] |
|---|---|---|---|---|---|---|---|
| 24 | -20 | -0.000310 | 0.000074 | 0.000074 | 0.000074 | 0.01 | 0.009690 |
| 20.4 | 20 | -0.000310 | -0.000428 | -0.000428 | -0.000428 | 0.01 | 0.009572 |
| 24 | 20 | -0.000428 | -0.000531 | -0.000531 | -0.000428 | 0.01 | 0.009469 |
| 27.6 | 20 | -0.000310 | -0.000428 | -0.000428 | -0.000531 | 0.01 | 0.009469 |
| 24 | 50 | -0.000428 | -0.000546 | -0.000428 | -0.000428 | 0.01 | 0.009454 |

Sample of Calculated result at 13.560 MHz, as the Minimum Margin point:
Ambient Temperature : 20℃ / Startup
DC supply Voltage : 20.4 / 27.6 VDC

Minimum Margin : 0.010000 - 0.000310 = 0.009690(%)

Note : The measurement were made after all of components of the oscillator sufficiently stabilized at each temperature.