



# FCC RADIO TEST REPORT

**FCC ID** : UZ7RFD4030  
**Equipment** : RFID Sled  
**Brand Name** : ZEBRA  
**Model Name** : RFD4030  
**Applicant** : Zebra Technologies Corporation  
1 Zebra Plaza, Holtsville, NY 11742-1300, USA  
**Manufacturer** : Zebra Technologies Corporation  
1 Zebra Plaza, Holtsville, NY 11742-1300, USA  
**Standard** : FCC Part 15 Subpart C §15.247

The product was received on Mar. 12, 2021 and testing was started from Mar. 16, 2021 and completed on Apr. 13, 2021. We, Sporton International Inc. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Approved by: Louis Wu

**Sporton International Inc. EMC & Wireless Communications Laboratory**  
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)



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### History of this test report

| Report No. | Version | Description                  | Issued Date   |
|------------|---------|------------------------------|---------------|
| FR111940   | 01      | Initial issue of report      | Apr. 16, 2021 |
| FR111940   | 02      | Revise antenna gain and type | Apr. 21, 2021 |
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## Summary of Test Result

| Report Clause | Ref Std. Clause       | Test Items   | Result (PASS/FAIL) | Remark                                  |
|---------------|-----------------------|--|--------------------|---|
| 3.1           | 15.247(a)(1)          | Number of Channels                                 | Pass               | -                                       |
| 3.2           | 15.247(a)(1)          | Hopping Channel Separation                         | Pass               | -                                       |
| 3.3           | 15.247(a)(1)          | Dwell Time of Each Channel                         | Pass               | -                                       |
| 3.4           | 15.247(a)(1)          | 20dB Bandwidth                                     | Pass               | -                                       |
| 3.4           | 2.1049                | 99% Occupied Bandwidth                             | Reporting Only     | -                                       |
| 3.5           | 15.247(b)(1)          | Output Power                                       | Pass               | -                                       |
| 3.6           | 15.247(d)             | Conducted Band Edges                               | Pass               | -                                       |
| 3.7           | 15.247(d)             | Conducted Spurious Emission                        | Pass               | -                                       |
| 3.8           | 15.247(d)             | Radiated Band Edges and Radiated Spurious Emission | Pass               | Under limit<br>3.03 dB at<br>43.580 MHz |
| 3.9           | 15.207                | AC Conducted Emission                              | Pass               | Under limit<br>11.12 dB at<br>0.501MHz  |
| 3.10          | 15.203 &<br>15.247(b) | Antenna Requirement                                | Pass               | -                                       |

**Note:** Not required means after assessing, test items are not necessary to carry out.

**Declaration of Conformity:**

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

**Comments and Explanations:**

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

**Reviewed by: Wii Chang**

**Report Producer: Dara Chiu**



# 1 General Description

## 1.1 Product Feature of Equipment Under Test

| Product Feature                 |                     |
|---------------------------------|---------------------|
| Equipment                       | RFID Sled           |
| Brand Name                      | ZEBRA               |
| Model Name                      | RFD4030             |
| FCC ID                          | UZ7RFD4030          |
| EUT supports Radios application | UHF RFID            |
| HW Version                      | EV1                 |
| SW Version                      | SAAFKS00-001-N19    |
| MFD                             | 05MAR21             |
| EUT Stage                       | Identical Prototype |

Remark: The above EUT's information was declared by manufacturer.

| Specification of Accessories |            |       |             |           |
|------------------------------|------------|-------|-------------|-----------|
| Battery                      | Brand Name | ZEBRA | Part Number | BT-000380 |

| Supported Unit Used in Test Configuration and System |            |       |              |                    |
|--|------------|-------|--------------|--------------------|
| Terminal   | Brand Name | ZEBRA | Model Number | TC26BK             |
| Adapter  | Brand Name | ZEBRA | Part Number  | PWR-WUA5V12W0US    |
| USB Cable  | Brand Name | ZEBRA | Part Number  | CBL-TC5X-USBC2A-01 |
| Battery  | Brand Name | ZEBRA | Part Number  | BT-000409A         |

## 1.2 Product Specification of Equipment Under Test

| Standards-related Product Specification |                                  |
|---|----------------------------------|
| Tx/Rx Frequency Range                   | 902.75 MHz ~ 927.25 MHz          |
| Number of Channels                      | 1                                |
| Maximum Output Power to Antenna         | 29.97dBm (0.9931 W)              |
| 20dB Bandwidth                          | 0.084 MHz                        |
| 99% Occupied Bandwidth                  | 0.077 MHz                        |
| Antenna Type / Gain                     | Helix Antenna with gain 0.17 dBi |
| Type of Modulation                      | ASK                              |

Remark: The above EUT's information was declared by manufacturer. Please refer to Comments and Explanations in report summary.

## 1.3 Modification of EUT

No modifications are made to the EUT during all test items.



### 1.4 Testing Location

|                           |   |         |
|---------------------------|---|---------|
| <b>Test Site</b>          | Sporton International Inc. EMC & Wireless Communications Laboratory   |         |
| <b>Test Site Location</b> | No.52, Huaya 1st Rd., Guishan Dist.,<br>Taoyuan City 333, Taiwan (R.O.C.)<br>TEL: +886-3-327-3456<br>FAX: +886-3-328-4978 |         |
| <b>Test Site No.</b>      | <b>Sporton Site No.</b>   |         |
|                           | TH05-HY   | CO05-HY |

**Note:** The test site complies with ANSI C63.4 2014 requirement.

|                           |  |  |
|---------------------------|--|--|
| <b>Test Site</b>          | Sporton International Inc. Wensan Laboratory   |  |
| <b>Test Site Location</b> | No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist.,<br>Taoyuan City 333010, Taiwan (R.O.C.)<br>TEL: +886-3-327-0868<br>FAX: +886-3-327-0855 |  |
| <b>Test Site No.</b>      | <b>Sporton Site No.</b>  |  |
|                           | 03CH11-HY (TAF Code: 3786)   |  |
| <b>Remark</b>             | The Radiated Spurious Emissions test item subcontracted to Sporton International Inc. Wensan Laboratory.   |  |

**Note:** The test site complies with ANSI C63.4 2014 requirement.

FCC designation No.: TW1190 and TW0007

### 1.5 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ FCC Part 15 Subpart C §15.247
- ♦ FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r01
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01
- ♦ ANSI C63.10-2013

**Remark:**

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. The TAF code is not including all the FCC KDB listed without accreditation.
3. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.



## 2 Test Configuration of Equipment Under Test

### 2.1 Carrier Frequency Channel

| Frequency Band    | Channel | Freq. (MHz) | Channel | Freq. (MHz) |
|-------------------|---------|-------------|---------|-------------|
| 902.75-927.25 MHz | 0       | 902.75      | 27      | 916.25      |
|                   | 1       | 903.25      | 28      | 916.75      |
|                   | 2       | 903.75      | 29      | 917.25      |
|                   | 3       | 904.25      | 30      | 917.75      |
|                   | 4       | 904.75      | 31      | 918.25      |
|                   | 5       | 905.25      | 32      | 918.75      |
|                   | 6       | 905.75      | 33      | 919.25      |
|                   | 7       | 906.25      | 34      | 919.75      |
|                   | 8       | 906.75      | 35      | 920.25      |
|                   | 9       | 907.25      | 36      | 920.75      |
|                   | 10      | 907.75      | 37      | 921.25      |
|                   | 11      | 908.25      | 38      | 921.75      |
|                   | 12      | 908.75      | 39      | 922.25      |
|                   | 13      | 909.25      | 40      | 922.75      |
|                   | 14      | 909.75      | 41      | 923.25      |
|                   | 15      | 910.25      | 42      | 923.75      |
|                   | 16      | 910.75      | 43      | 924.25      |
|                   | 17      | 911.25      | 44      | 924.75      |
|                   | 18      | 911.75      | 45      | 925.25      |
|                   | 19      | 912.25      | 46      | 925.75      |
|                   | 20      | 912.75      | 47      | 926.25      |
|                   | 21      | 913.25      | 48      | 926.75      |
|                   | 22      | 913.75      | 49      | 927.25      |
|                   | 23      | 914.25      |         |             |
|                   | 24      | 914.75      |         |             |
|                   | 25      | 915.25      |         |             |
|                   | 26      | 915.75      |         |             |



## 2.2 Test Mode

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Z plane) were recorded in this report.
  
- b. AC power line Conducted Emission was tested under maximum output power.

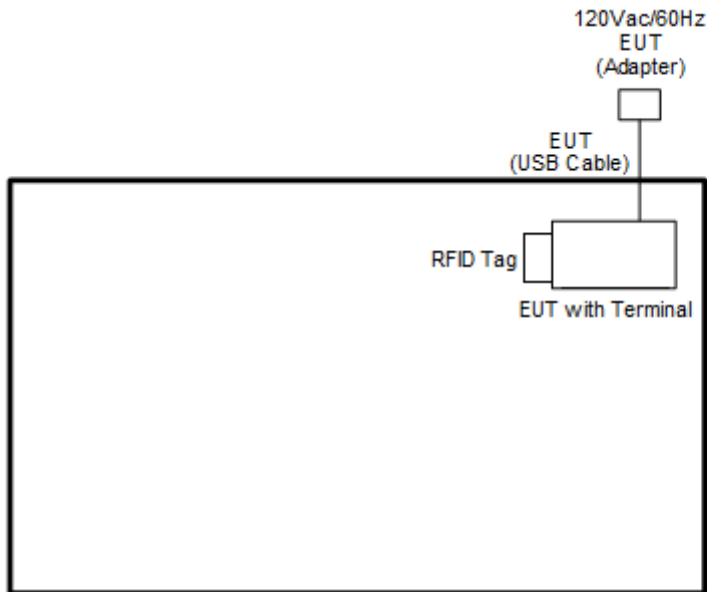
The following summary table is showing all test modes to demonstrate in compliance with the standard.

| Summary table of Test Cases |   |
|-----------------------------|---|
| Test Item                   | UHF RFID  |
| Conducted Test Cases        | Mode 1: UHF RFID Tx CH00_902.75 MHz<br>Mode 2: UHF RFID Tx CH24_914.75 MHz<br>Mode 3: UHF RFID Tx CH49_927.25 MHz |
| Radiated Test Cases         | Mode 1: UHF RFID Tx CH00_902.75 MHz<br>Mode 2: UHF RFID Tx CH24_914.75 MHz<br>Mode 3: UHF RFID Tx CH49_927.25 MHz |
| AC Conducted Emission       | Mode 1: EUT with Terminal PDA + RFID Link + USB Cable (Charging from AC Adapter)                                  |

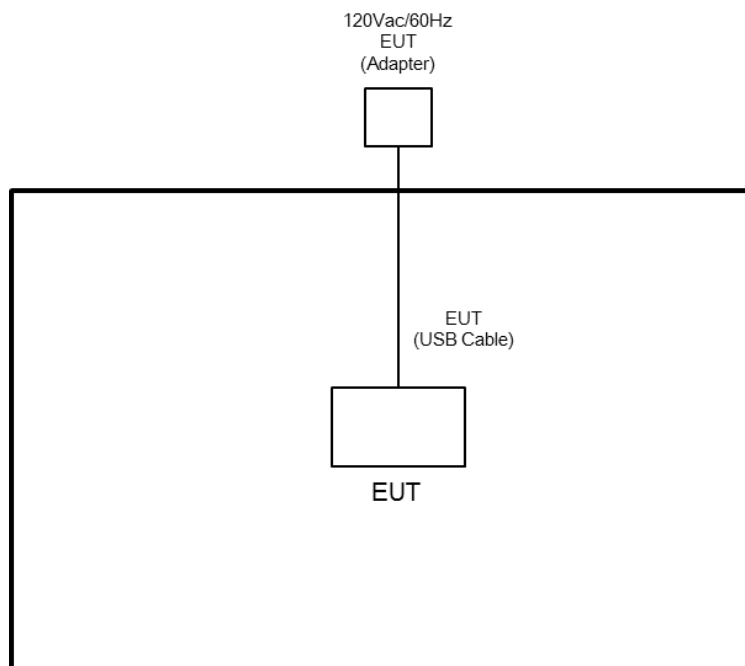


## 2.3 Connection Diagram of Test System

<AC Conducted Emission Mode>



<Radiated Spurious Emission Mode>





## 2.4 Support Unit used in test configuration and system

| Item | Equipment | Brand Name | Model Name | FCC ID | Data Cable | Power Cord |
|------|-----------|------------|------------|--------|------------|------------|
| 1.   | RFID Tag  | N/A        | N/A        | N/A    | N/A        | N/A        |

## 2.5 EUT Operation Test Setup

The RF test items, utility “Tera Term” was installed in EUT which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

## 2.6 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

*Offset = RF cable loss + attenuator factor.*

Following shows an offset computation example with cable loss 4.2 dB and 10 dB attenuator.

$$\begin{aligned} \text{Offset}(dB) &= \text{RF cable loss}(dB) + \text{attenuator factor}(dB). \\ &= 4.2 + 10 = 14.2 \text{ (dB)} \end{aligned}$$

### 3 Test Result

#### 3.1 Number of Channel Measurement

##### 3.1.1 Limits of Number of Hopping Frequency

Frequency hopping systems in the 902.75-927.25 MHz band shall use at least 25 channels.

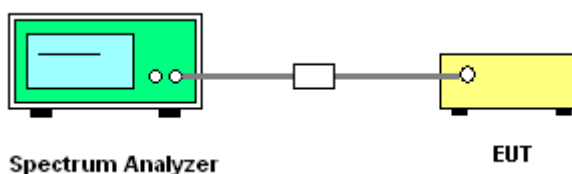
##### 3.1.2 Measuring Instruments

See list of measuring equipment of this test report.

##### 3.1.3 Test Procedure

1. The testing follows ANSI C63.10-2013 clause 7.8.3.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = the frequency band of operation; RBW = 300 kHz; VBW  $\geq$  RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. The number of hopping frequency used is defined as the number of total channel.
7. Record the measurement data derived from spectrum analyzer.

##### 3.1.4 Test Setup



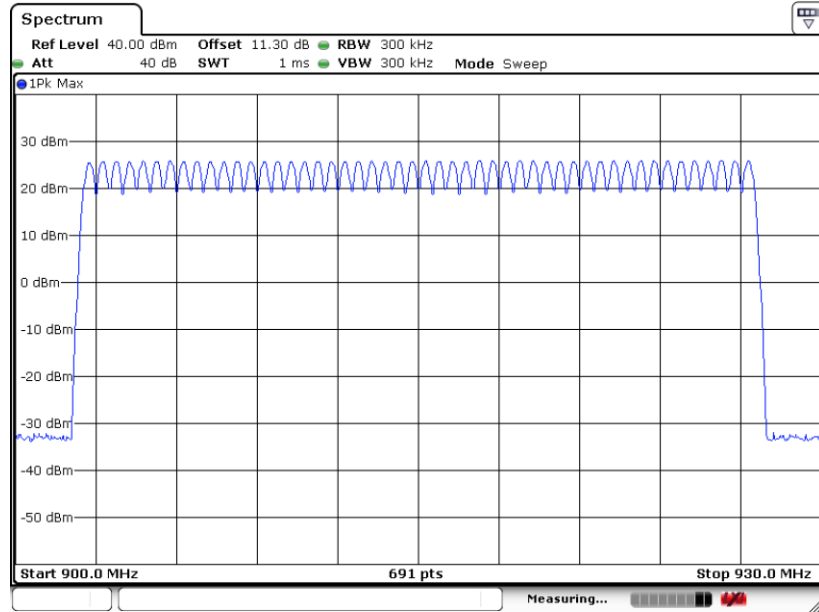
##### 3.1.5 Test Result of Number of Hopping Frequency

|                        |           |                            |         |
|------------------------|-----------|----------------------------|---------|
| <b>Test Mode :</b>     | UHF       | <b>Temperature :</b>       | 21~25°C |
| <b>Test Engineer :</b> | Tommy Lee | <b>Relative Humidity :</b> | 51~54%  |

| <b>Number of Hopping (Channel)</b> | <b>Limits (Channel)</b> | <b>Pass/Fail</b> |
|------------------------------------|-------------------------|------------------|
| 50                                 | > 25                    | Pass             |



Number of Hopping Channel Plot on Channel 00 - 49



Date: 12.APR.2021 22:33:33

## 3.2 Hopping Channel Separation Measurement

### 3.2.1 Limit of Hopping Channel Separation

Frequency hopping systems operating in the 902.75-927.25 MHz band may have hopping channel carrier frequencies that are 20 dB bandwidth of the hopping channel, whichever is greater.

### 3.2.2 Measuring Instruments

See list of measuring equipment of this test report.

### 3.2.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.2.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings:  
Span = wide enough to capture the peaks of two adjacent channels;  
RBW = 300 kHz; VBW  $\geq$  RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

### 3.2.4 Test Setup



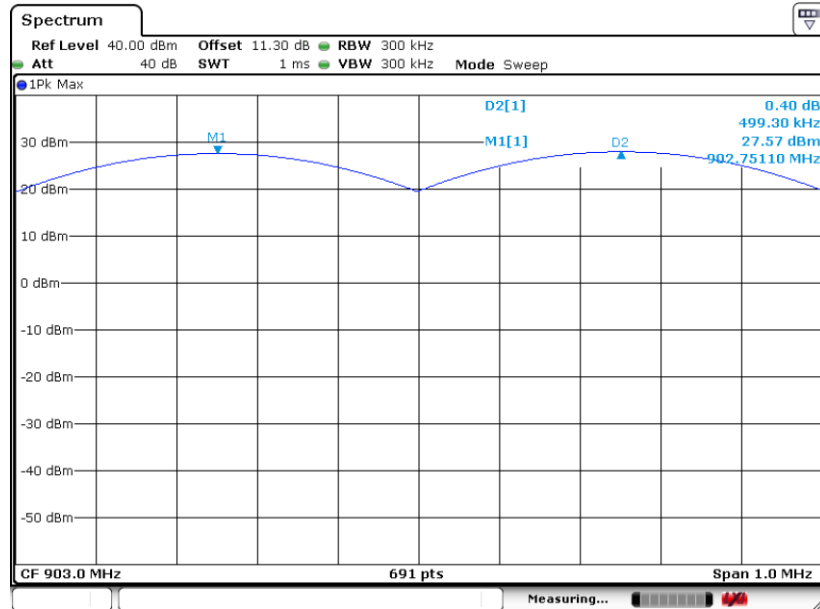


3.2.5 Test Result of Hopping Channel Separation

|                 |           |                     |         |
|-----------------|-----------|---------------------|---------|
| Test Mode :     | UHF       | Temperature :       | 21~25°C |
| Test Engineer : | Tommy Lee | Relative Humidity : | 51~54%  |

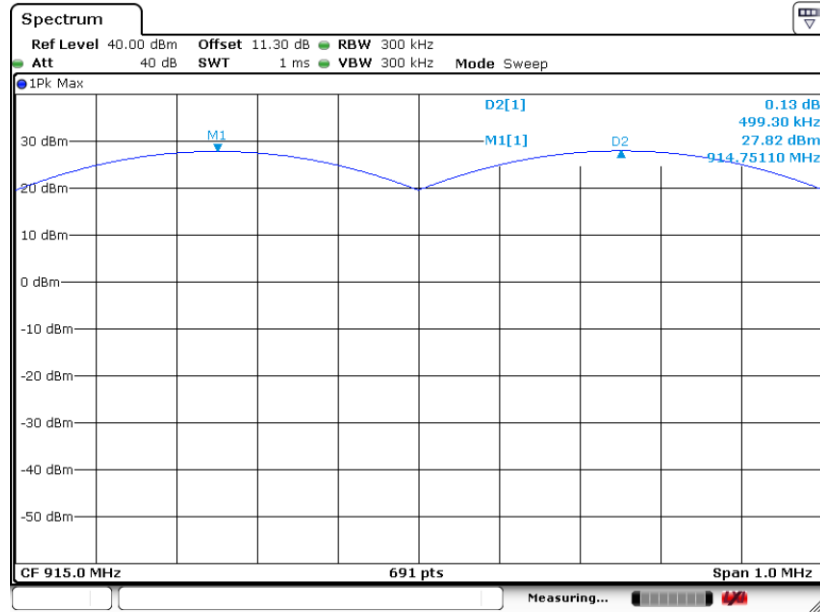
| Mod.     | NTX | CH. | Freq. (MHz) | Hopping Channel Separation Measurement (MHz) | Hopping Channel Separation Measurement Limit (MHz) | Pass/Fail |
|----------|-----|-----|-------------|--|--|-----------|
| UHF RFID | 1   | 0   | 902.75      | 0.499  | 0.0825   | Pass      |
| UHF RFID | 1   | 24  | 914.75      | 0.499  | 0.0810   | Pass      |
| UHF RFID | 1   | 49  | 927.25      | 0.499  | 0.0839   | Pass      |

Channel Separation Plot on Channel 00 - 01



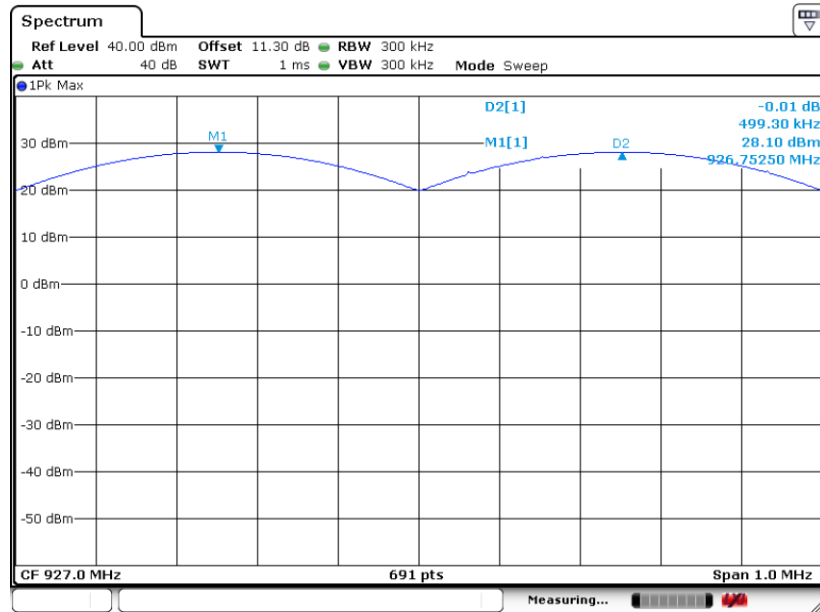


Channel Separation Plot on Channel 24 - 25



Date: 12.APR.2021 21:09:30

Channel Separation Plot on Channel 48 - 49



Date: 12.APR.2021 21:01:49

### 3.3 Dwell Time Measurement

#### 3.3.1 Limit of Dwell Time

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 20 seconds multiplied by the number of hopping channels employed.

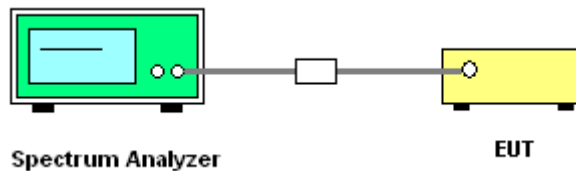
#### 3.3.2 Measuring Instruments

See list of measuring equipment of this test report.

#### 3.3.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.4.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW = 1 MHz; VBW  $\geq$  RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

#### 3.3.4 Test Setup



#### 3.3.5 Test Result of Dwell Time

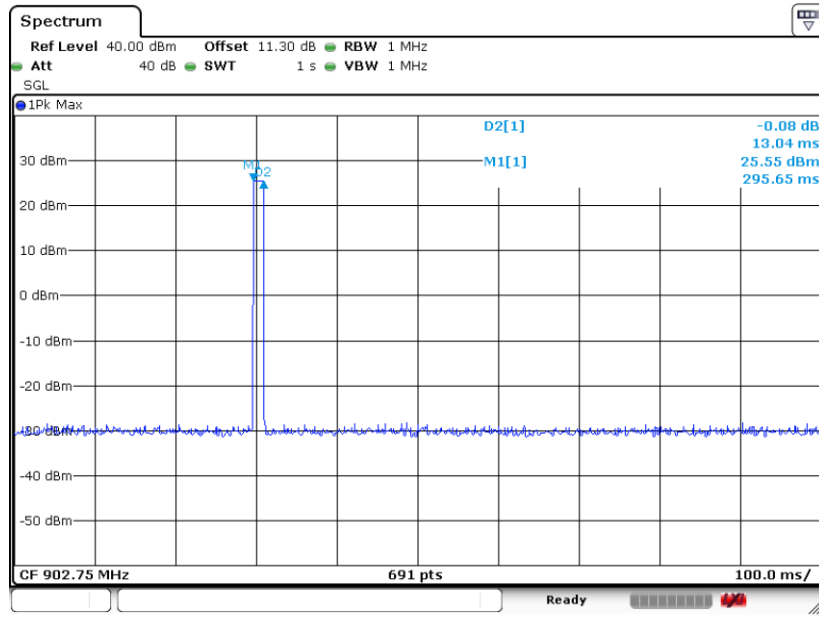
|                        |           |                            |         |
|------------------------|-----------|----------------------------|---------|
| <b>Test Mode :</b>     | UHF       | <b>Temperature :</b>       | 21~25°C |
| <b>Test Engineer :</b> | Tommy Lee | <b>Relative Humidity :</b> | 51~54%  |

| Mod.  | Channel Number Rate | Package Transfer Time (msec) | Hops Over Occupancy Time (hops) | Dwell Time (sec) | Limits (sec) | Pass/Fail |
|-------|---------------------|------------------------------|---------------------------------|------------------|--------------|-----------|
| Nomal | 50                  | 13.04                        | 1                               | 0.013            | 0.4          | Pass      |

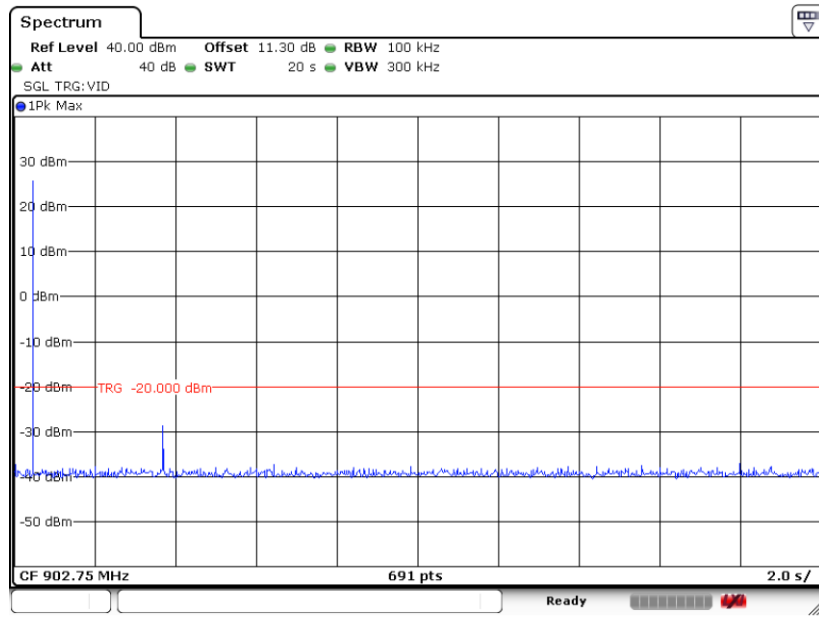




Package Transfer Time Plot



Date: 12.APR.2021 22:43:49



Date: 12.APR.2021 22:53:32

Remark: Dwell Time(s) = Hops Over Occupancy Time (hops) x Package Transfer Time

### 3.4 20dB and 99% Bandwidth Measurement

#### 3.4.1 Limit of 20dB and 99% Bandwidth

Reporting only

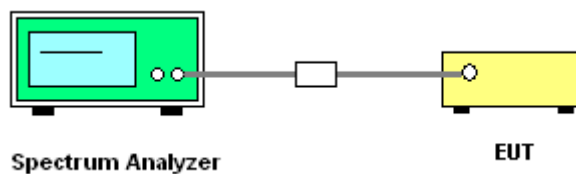
#### 3.4.2 Measuring Instruments

See list of measuring equipment of this test report.

#### 3.4.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 6.9.2 and 6.9.3.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Use the following spectrum analyzer settings for 20 dB Bandwidth measurement.  
Span = approximately 2 to 5 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.
5. Use the following spectrum analyzer settings for 99 % Bandwidth measurement.  
Span = approximately 1.5 to 5 times the 99% bandwidth, centered on a hopping channel;  
RBW  $\geq$  1-5% of the 99% bandwidth; VBW  $\geq$  3 \* RBW; Sweep = auto; Detector function = peak;  
Trace = max hold.
6. Measure and record the results in the test report.

#### 3.4.4 Test Setup



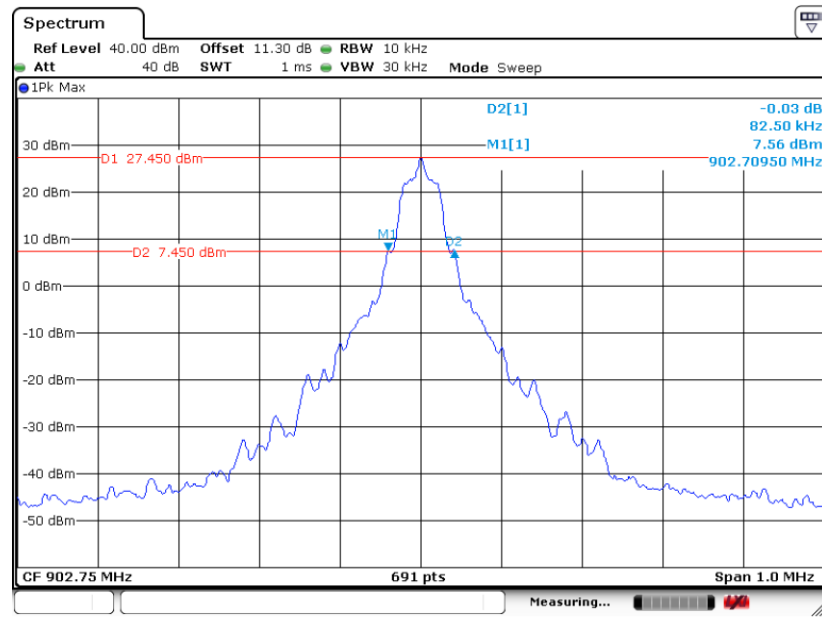


3.4.5 Test Result of 20dB Bandwidth

|                 |           |                     |         |
|-----------------|-----------|---------------------|---------|
| Test Mode :     | UHF       | Temperature :       | 21~25°C |
| Test Engineer : | Tommy Lee | Relative Humidity : | 51~54%  |

| Mod.     | N <sub>TX</sub> | CH. | Freq.(MHz) | 20db BW (MHz) | Pass/Fail |
|----------|-----------------|-----|------------|---------------|-----------|
| UHF RFID | 1               | 0   | 902.75     | 0.083         | Pass      |
| UHF RFID | 1               | 24  | 914.75     | 0.081         | Pass      |
| UHF RFID | 1               | 49  | 927.25     | 0.084         | Pass      |

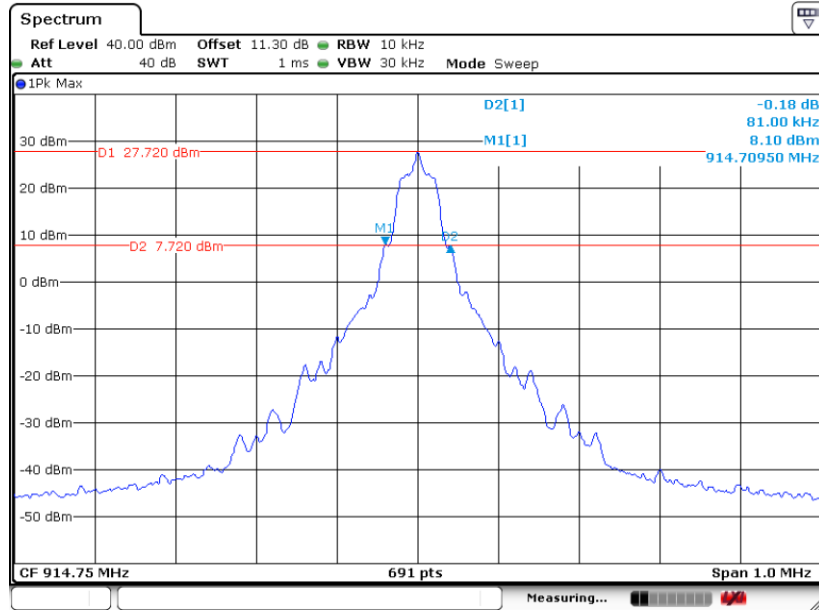
20 dB Bandwidth Plot on Channel 00



Date: 12.APR.2021 17:19:06

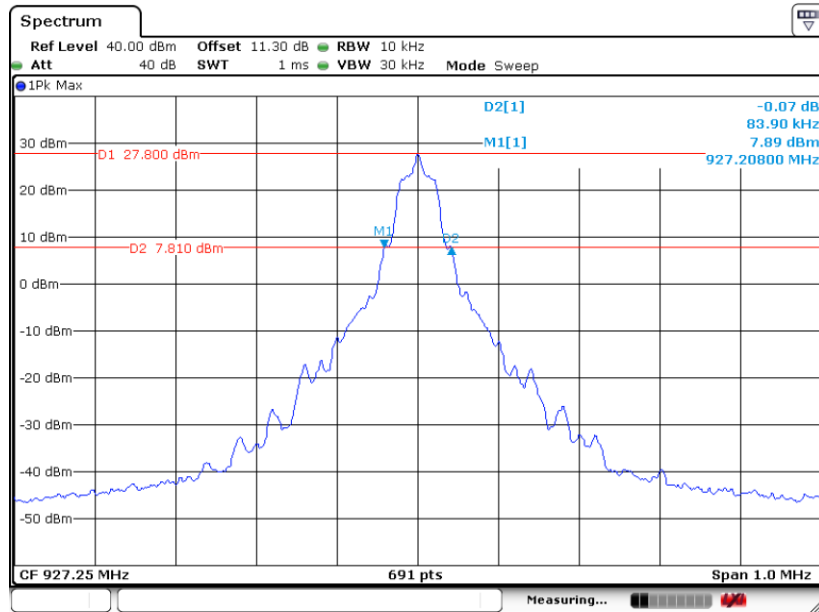


20 dB Bandwidth Plot on Channel 24



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20 dB Bandwidth Plot on Channel 49



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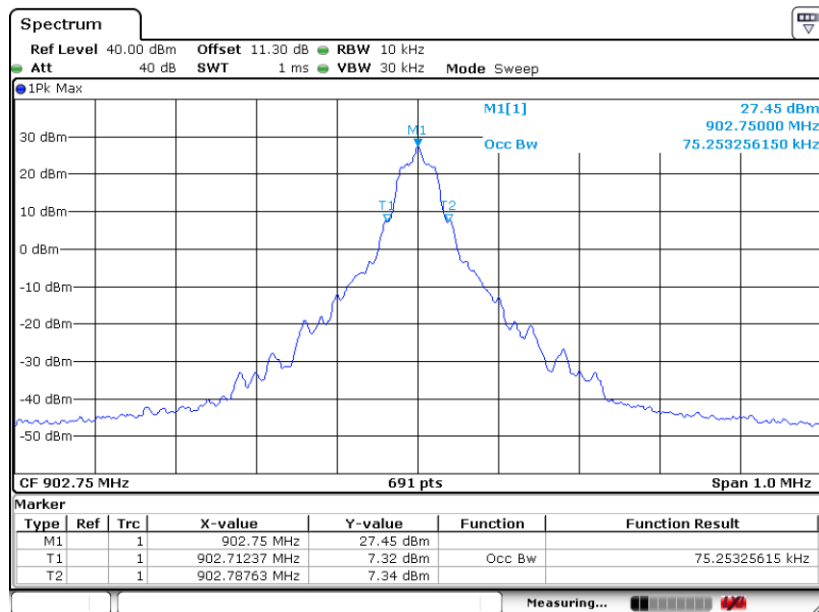


3.4.6 Test Result of 99% Occupied Bandwidth

|                 |           |                     |         |
|-----------------|-----------|---------------------|---------|
| Test Mode :     | UHF       | Temperature :       | 21~25°C |
| Test Engineer : | Tommy Lee | Relative Humidity : | 51~54%  |

| Mod.     | NTX | CH. | Freq. (MHz) | 99% Bandwidth (MHz) | Pass/Fail |
|----------|-----|-----|-------------|---------------------|-----------|
| UHF RFID | 1   | 0   | 902.75      | 0.075               | Pass      |
| UHF RFID | 1   | 24  | 914.75      | 0.075               | Pass      |
| UHF RFID | 1   | 49  | 927.25      | 0.077               | Pass      |

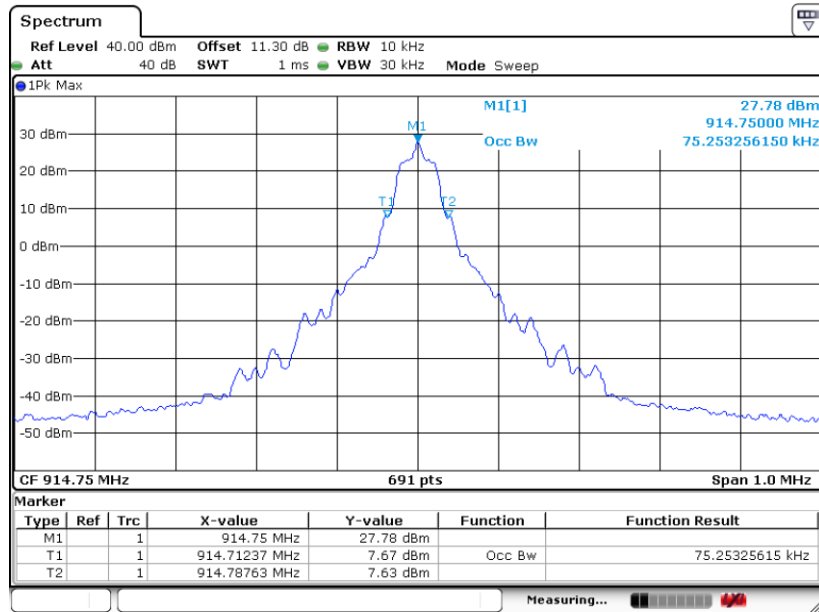
99% Occupied Bandwidth Plot on Channel 00



Date: 12.APR.2021 17:13:56

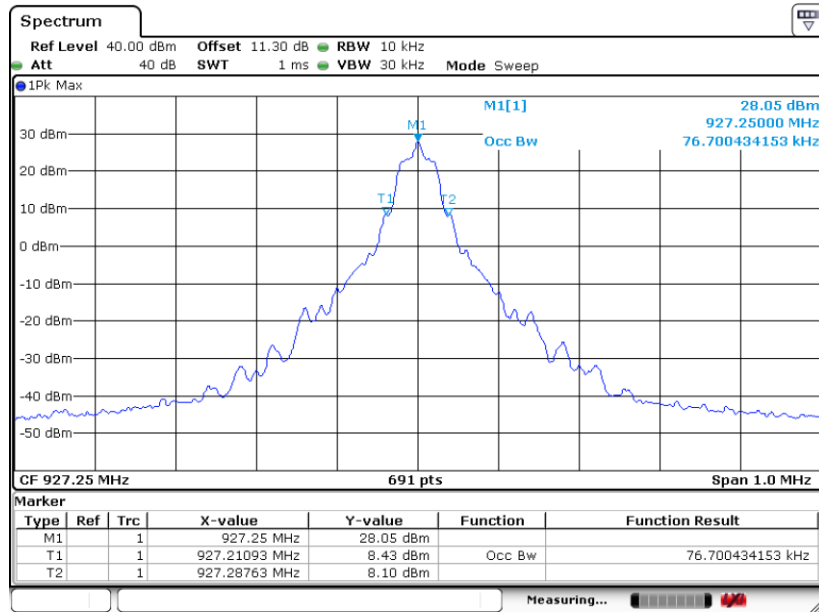


99% Occupied Bandwidth Plot on Channel 24



Date: 12.APR.2021 19:00:30

99% Occupied Bandwidth Plot on Channel 49



Date: 12.APR.2021 20:11:12

Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

## 3.5 Output Power Measurement

### 3.5.1 Limit of Output Power

Section 15.247 (a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions: (1)(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Section 15.247 (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

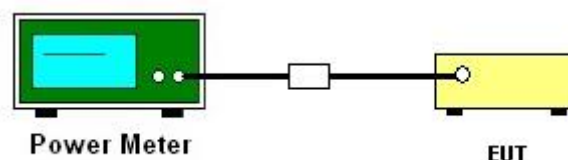
### 3.5.2 Measuring Instruments

See list of measuring equipment of this test report.

### 3.5.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.5.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Measure the conducted output power with cable loss and record the results in the test report.
5. Measure and record the results in the test report.

### 3.5.4 Test Setup





### 3.5.5 Test Result of Output Power

|                        |           |                            |         |
|------------------------|-----------|----------------------------|---------|
| <b>Test Mode :</b>     | UHF       | <b>Temperature :</b>       | 21~25°C |
| <b>Test Engineer :</b> | Tommy Lee | <b>Relative Humidity :</b> | 51~54%  |

| Channel | Frequency (MHz) | RF Power (dBm) |                   |           |
|---------|-----------------|----------------|-------------------|-----------|
|         |                 | UHF            | Max. Limits (dBm) | Pass/Fail |
| 0       | 902.75          | 29.96          | 30.00             | Pass      |
| 24      | 914.75          | 29.97          | 30.00             | Pass      |
| 49      | 927.25          | 29.84          | 30.00             | Pass      |

### 3.5.6 Test Result of Average Power (Reporting Only)

|                        |           |                            |         |
|------------------------|-----------|----------------------------|---------|
| <b>Test Mode :</b>     | UHF       | <b>Temperature :</b>       | 21~25°C |
| <b>Test Engineer :</b> | Tommy Lee | <b>Relative Humidity :</b> | 51~54%  |

| Channel | Frequency (MHz) | RF Power (dBm) |
|---------|-----------------|----------------|
|         |                 | UHF            |
| 0       | 902.75          | 29.57          |
| 24      | 914.75          | 29.62          |
| 49      | 927.25          | 29.43          |



## 3.6 Conducted Band Edges Measurement

### 3.6.1 Limit of Band Edges

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

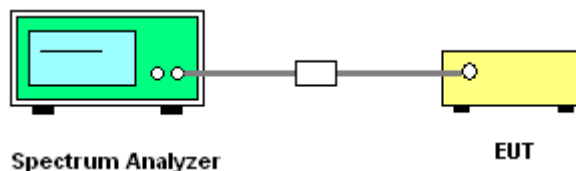
### 3.6.2 Measuring Instruments

See list of measuring equipment of this test report.

### 3.6.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.6.
2. Set the maximum power setting and enable the EUT to transmit continuously.
3. Set RBW = 100 kHz, VBW = 300 kHz. Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used.
4. Enable hopping function of the EUT and then repeat step 2 and 3.
5. Measure and record the results in the test report.

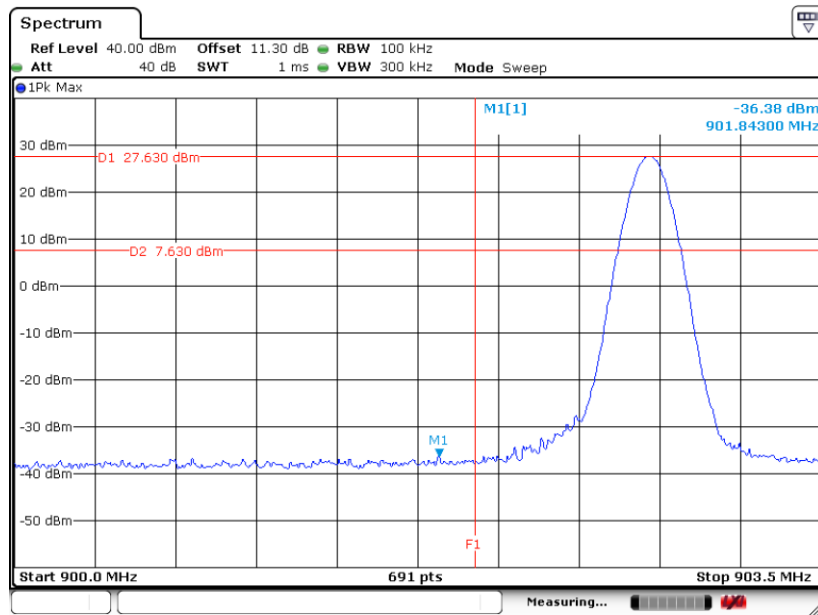
### 3.6.4 Test Setup





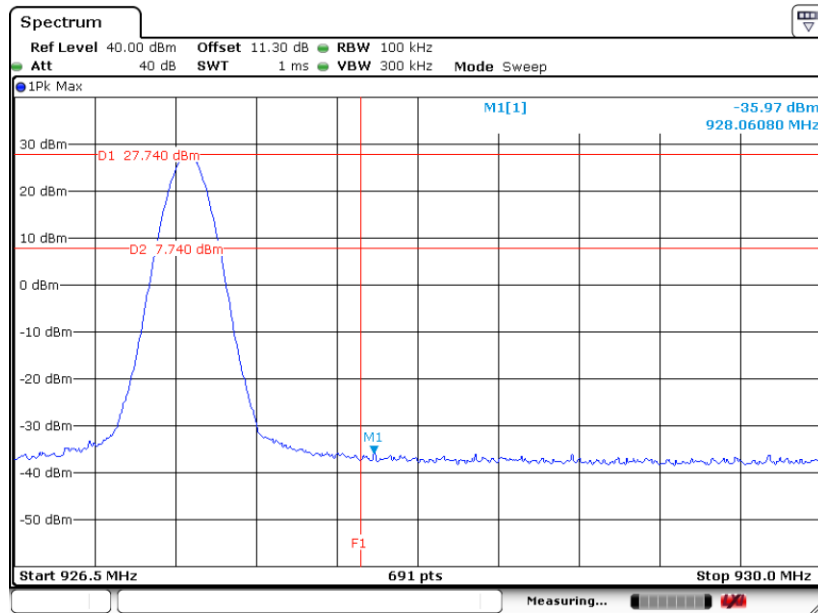
### 3.6.5 Test Result of Conducted Band Edges

#### Low Band Edge Plot on Channel 00



Date: 12.APR.2021 17:50:06

#### High Band Edge Plot on Channel 49

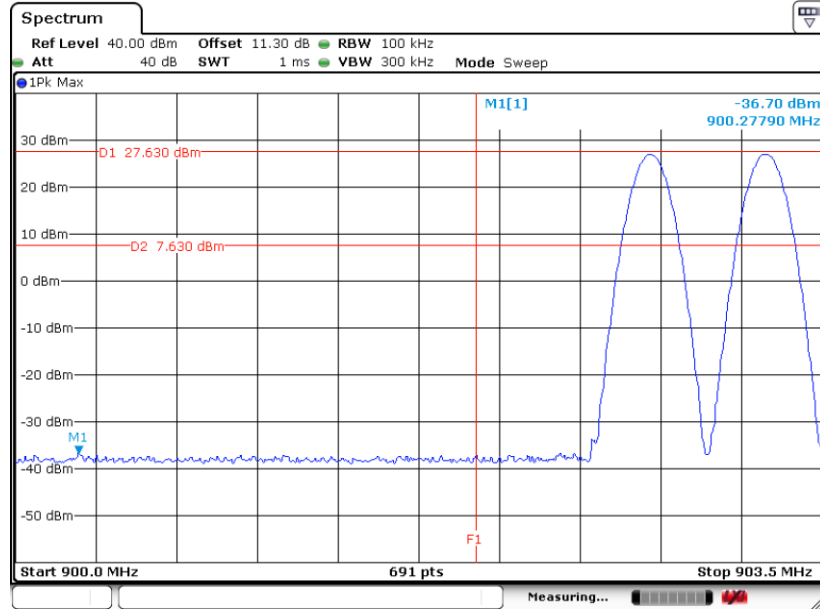


Date: 12.APR.2021 20:53:38



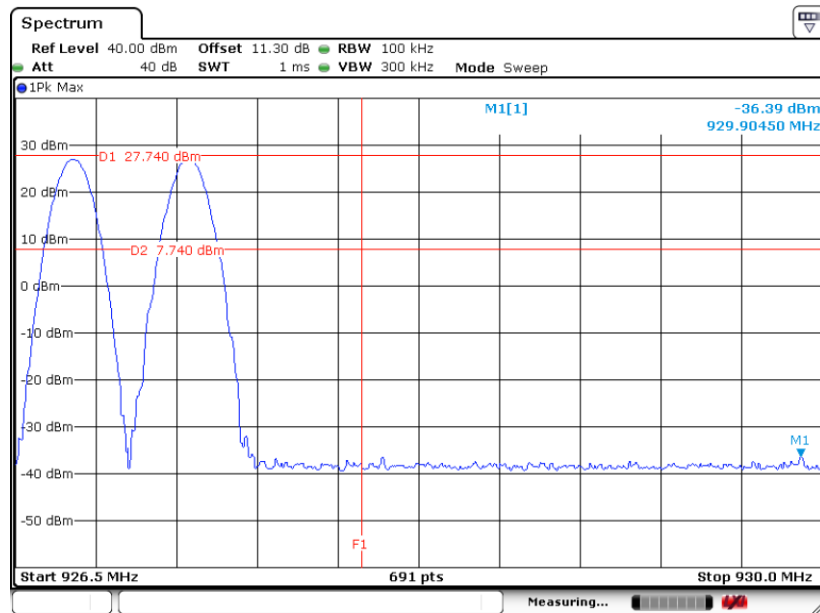
### 3.6.6 Test Result of Conducted Hopping Mode Band Edges

#### Hopping Mode Low Band Edge Plot



Date: 13.APR.2021 11:22:26

#### Hopping Mode High Band Edge Plot



Date: 13.APR.2021 11:17:34

## 3.7 Conducted Spurious Emission Measurement

### 3.7.1 Limit of Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

### 3.7.2 Measuring Instruments

See list of measuring equipment of this test report.

### 3.7.3 Test Procedure

1. The testing follows ANSI C63.10-2013 clause 7.8.8.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Set RBW = 100 kHz, VBW = 300 kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

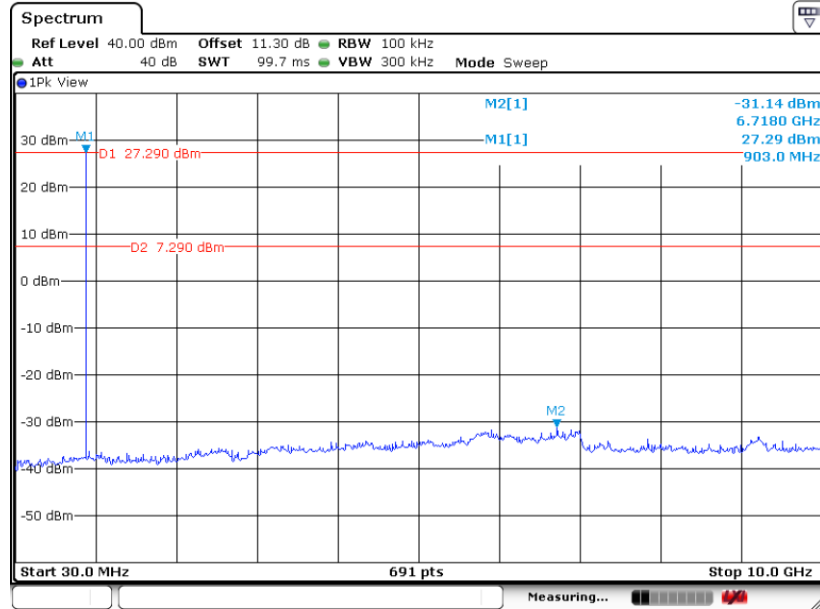
### 3.7.4 Test Setup





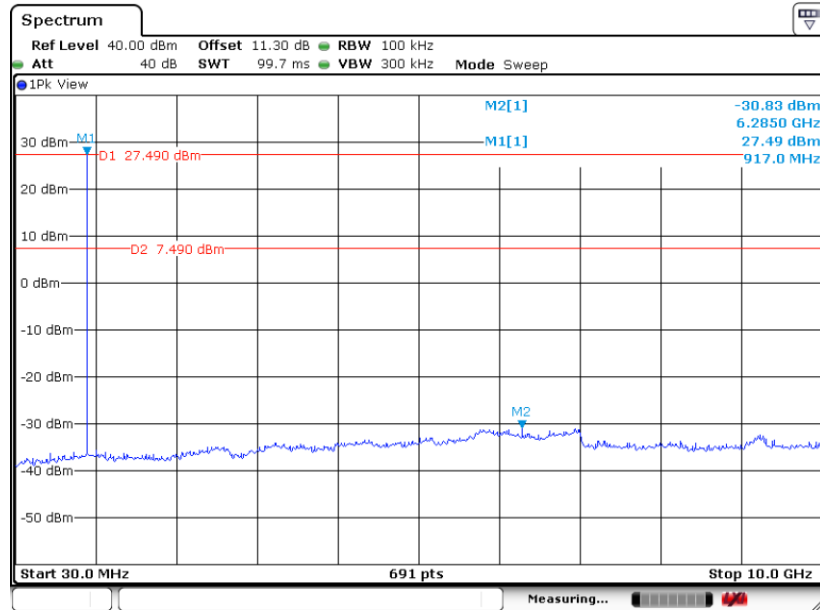
### 3.7.5 Test Result of Conducted Spurious Emission

CSE Plot on Ch 00 between 30MHz ~ 10 GHz



Date: 12.APR.2021 17:29:52

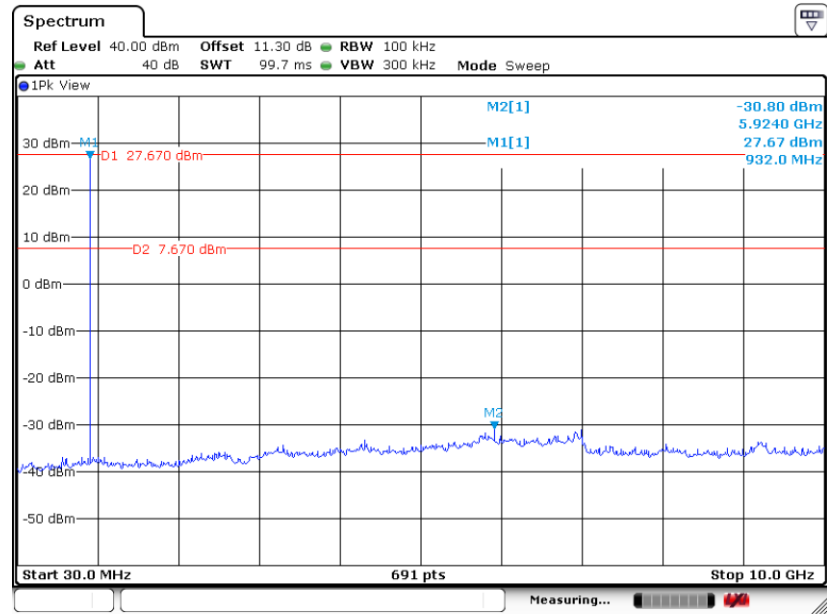
CSE Plot on Ch 24 between 30MHz ~ 10 GHz



Date: 12.APR.2021 19:48:45



CSE Plot on Ch 49 between 30MHz ~ 10 GHz



Date: 12.APR.2021 20:26:45



### 3.8 Radiated Band Edges and Spurious Emission Measurement

#### 3.8.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

| Frequency (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|-----------------|-----------------------------------|-------------------------------|
| 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                             |

#### 3.8.2 Measuring Instruments

See list of measuring equipment of this test report.



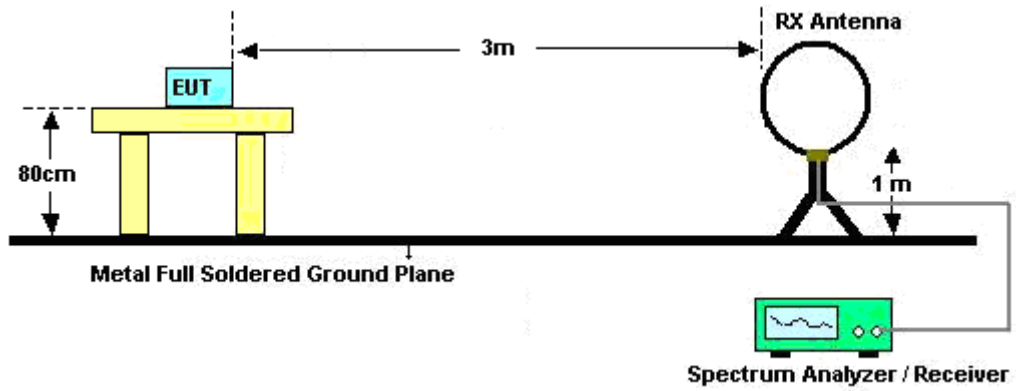
**3.8.3 Test Procedures**

1. The EUT was placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
4. Set the maximum power setting and enable the EUT to transmit continuously.
5. Use the following spectrum analyzer settings:
  - (1) Span shall wide enough to fully capture the emission being measured;
  - (2) Set RBW=100 kHz for  $f < 1$  GHz, RBW=1 MHz for  $f > 1$  GHz ; VBW  $\geq$  RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
  - (3) For average measurement: use duty cycle correction factor method per 15.35(c).  
Duty cycle = On time/100 milliseconds  
On time =  $N1*L1+N2*L2+...+Nn-1*LNn-1+Nn*Ln$   
Where N1 is number of type 1 pulses, L1 is length of type 1 pulses, etc.  
Average Emission Level = Peak Emission Level +  $20*\log(\text{Duty cycle})$
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

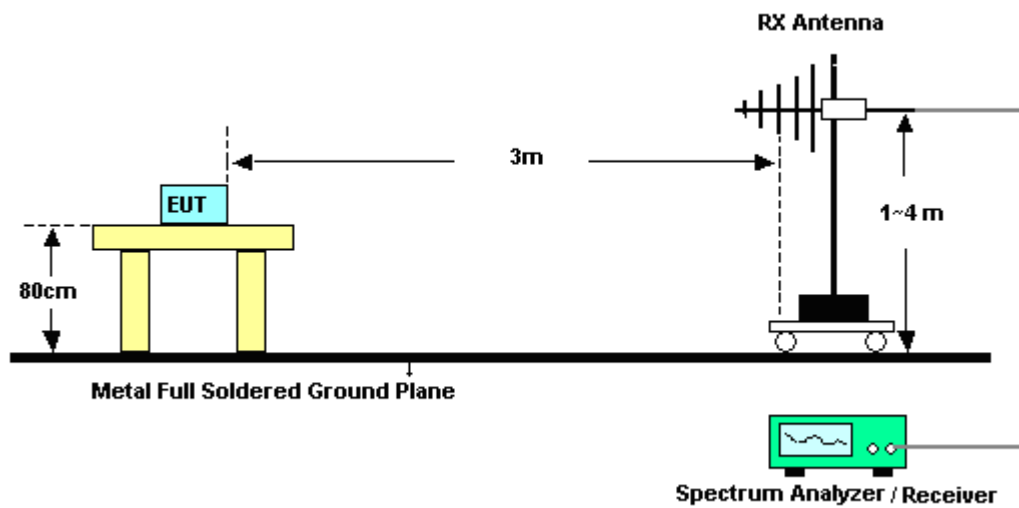


### 3.8.4 Test Setup

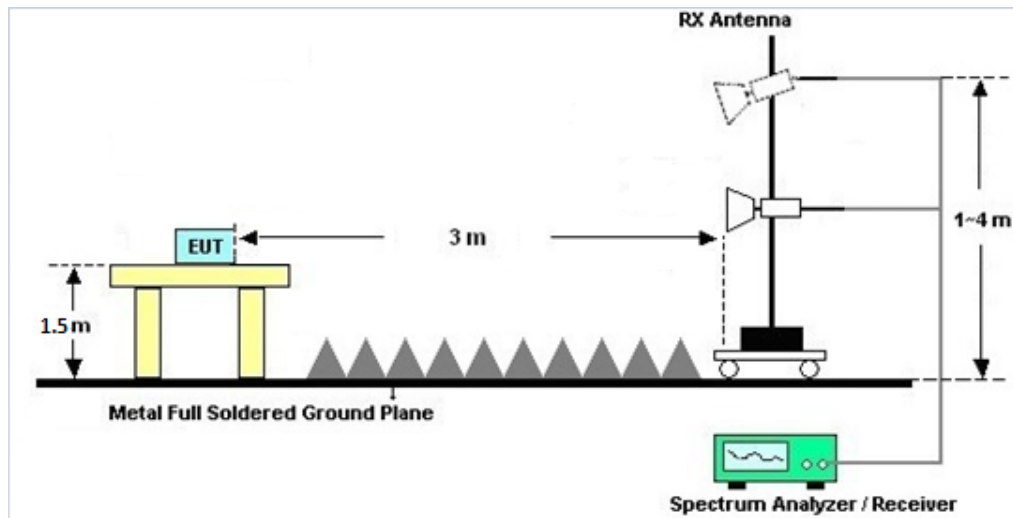
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



### 3.8.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.

### 3.8.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B and C.

### 3.8.7 Duty Cycle

Please refer to Appendix D.

### 3.8.8 Test Result of Radiated Spurious Emission

Please refer to Appendix B and C.



### 3.9 AC Power Line Conducted Emissions Measurement

#### 3.9.1 Limit of AC Conducted Emission

For equipment 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 or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

| Frequency of Emission (MHz) | Conducted Limit (dBµV) |           |
|-----------------------------|------------------------|-----------|
|                             | Quasi-Peak             | Average   |
| 0.15-0.5                    | 66 to 56*              | 56 to 46* |
| 0.5-5                       | 56                     | 46        |
| 5-30                        | 60                     | 50        |

\*Decreases with the logarithm of the frequency.

#### 3.9.2 Measuring Instruments

See list of measuring equipment of this test report.

#### 3.9.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room, and it was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN shall be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

### 3.9.4 Test setup



### 3.9.5 Test Result of AC Conducted Emission

Please refer to Appendix A.



## **3.10 Antenna Requirements**

### **3.10.1 Standard Applicable**

If directional gain of transmitting Antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. 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 rule.

### **3.10.2 Antenna Anti-Replacement Construction**

An embedded-in antenna design is used.

### **3.10.3 Antenna Gain**

The antenna peak gain of EUT is 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.



## 4 List of Measuring Equipment

| Instrument        | Brand Name        | Model No.                          | Serial No.          | Characteristics          | Calibration Date | Test Date                       | Due Date      | Remark                   |
|-------------------|-------------------|------------------------------------|---------------------|--------------------------|------------------|---------------------------------|---------------|--------------------------|
| Loop Antenna      | Rohde & Schwarz   | HFH2-Z2                            | 100488              | 9 kHz~30 MHz             | Jul. 14, 2020    | Apr. 10, 2021~<br>Apr. 11, 2021 | Jul. 13, 2021 | Radiation<br>(03CH11-HY) |
| Bilog Antenna     | TESEQ             | CBL 6111D &<br>N-6-06              | 35414 &<br>AT-N0602 | 30MHz~1GHz               | Oct. 11, 2020    | Apr. 10, 2021~<br>Apr. 11, 2021 | Oct. 10, 2021 | Radiation<br>(03CH11-HY) |
| Horn Antenna      | SCHWARZBE<br>CK   | BBHA 9120 D                        | 9120D-132<br>6      | 1GHz ~ 18GHz             | Nov. 03, 2020    | Apr. 10, 2021~<br>Apr. 11, 2021 | Nov. 02, 2021 | Radiation<br>(03CH11-HY) |
| Amplifier         | SONOMA            | 310N                               | 187312              | 9kHz~1GHz                | Dec. 02, 2020    | Apr. 10, 2021~<br>Apr. 11, 2021 | Dec. 01, 2021 | Radiation<br>(03CH11-HY) |
| Preamplifier      | Keysight          | 83017A                             | MY532700<br>80      | 1GHz~26.5GHz             | Nov. 12, 2020    | Apr. 10, 2021~<br>Apr. 11, 2021 | Nov. 11, 2021 | Radiation<br>(03CH11-HY) |
| Preamplifier      | EMEC              | EM1G18G                            | 060812              | 1GHz~18GHz               | Oct. 27, 2020    | Apr. 10, 2021~<br>Apr. 11, 2021 | Oct. 26, 2021 | Radiation<br>(03CH11-HY) |
| Spectrum Analyzer | Keysight          | N9010A                             | MY542004<br>86      | 10Hz~44GHz               | Oct. 23, 2020    | Apr. 10, 2021~<br>Apr. 11, 2021 | Oct. 22, 2021 | Radiation<br>(03CH11-HY) |
| EMI Test Receiver | Keysight          | N9038A(MXE<br>)                    | MY554201<br>70      | 20MHz~8.4GHz             | May 21, 2020     | Apr. 10, 2021~<br>Apr. 11, 2021 | May 20, 2021  | Radiation<br>(03CH11-HY) |
| Antenna Mast      | EMEC              | AM-BS-4500-<br>B                   | N/A                 | 1~4m                     | N/A              | Apr. 10, 2021~<br>Apr. 11, 2021 | N/A           | Radiation<br>(03CH11-HY) |
| Turn Table        | EMEC              | TT 2000                            | N/A                 | 0~360 Degree             | N/A              | Apr. 10, 2021~<br>Apr. 11, 2021 | N/A           | Radiation<br>(03CH11-HY) |
| Software          | Audix             | E3<br>6.2009-8-24                  | RK-00105<br>3       | N/A                      | N/A              | Apr. 10, 2021~<br>Apr. 11, 2021 | N/A           | Radiation<br>(03CH11-HY) |
| RF Cable          | HUBER +<br>SUHNER | SUCOFLEX<br>104                    | MY9837/4<br>PE      | 9kHz-30MHz               | Mar. 11, 2021    | Apr. 10, 2021~<br>Apr. 11, 2021 | Mar. 10, 2022 | Radiation<br>(03CH11-HY) |
| RF Cable          | HUBER +<br>SUHNER | SUCOFLEX<br>102                    | MY2859/2            | 30MHz-40GHz              | Mar. 11, 2021    | Apr. 10, 2021~<br>Apr. 11, 2021 | Mar. 10, 2022 | Radiation<br>(03CH11-HY) |
| RF Cable          | HUBER +<br>SUHNER | SUCOFLEX<br>104                    | MY9837/4<br>PE      | 30M-18G                  | Mar. 11, 2021    | Apr. 10, 2021~<br>Apr. 11, 2021 | Mar. 10, 2022 | Radiation<br>(03CH11-HY) |
| RF Cable          | HUBER +<br>SUHNER | SUCOFLEX<br>102                    | MY4274/2            | 30MHz-40GHz              | Mar. 11, 2021    | Apr. 10, 2021~<br>Apr. 11, 2021 | Mar. 10, 2022 | Radiation<br>(03CH11-HY) |
| Filter            | Wainwright        | WLK4-1000-1<br>530-8000-40S<br>S   | SN11                | 1.53G Low Pass           | Sep. 14, 2020    | Apr. 10, 2021~<br>Apr. 11, 2021 | Sep. 13, 2021 | Radiation<br>(03CH11-HY) |
| Filter            | Wainwright        | WHKX12-935<br>-1000-15000-<br>40ST | SN1                 | 1GHz High Pass<br>Filter | Apr. 30, 2020    | Apr. 10, 2021~<br>Apr. 11, 2021 | Apr. 29, 2021 | Radiation<br>(03CH11-HY) |
| Hygrometer        | TECEPEL           | DTM-303B                           | TP140325            | N/A                      | Nov. 18, 2020    | Apr. 10, 2021~<br>Apr. 11, 2021 | Nov. 17, 2021 | Radiation<br>(03CH11-HY) |
| Hygrometer        | TECEPEL           | DTM-303B                           | TP200880            | QA-3-031                 | Oct. 22, 2020    | Apr. 10, 2021~<br>Apr. 11, 2021 | Oct. 21, 2021 | Radiation<br>(03CH11-HY) |



| Instrument               | Brand Name         | Model No.       | Serial No.     | Characteristics | Calibration Date | Test Date                       | Due Date      | Remark                  |
|--------------------------|--------------------|-----------------|----------------|-----------------|------------------|---------------------------------|---------------|-------------------------|
| Hygrometer               | TECPEL             | TR-32           | HE17XB24<br>68 | N/A             | Mar. 09, 2021    | Mar. 29, 2021~<br>Apr. 13, 2021 | Mar. 08, 2022 | Conducted<br>(TH05-HY)  |
| Power Meter              | Anritsu            | ML2495A         | 1218006        | N/A             | Oct. 18, 2020    | Mar. 29, 2021~<br>Apr. 13, 2021 | Oct. 17, 2021 | Conducted<br>(TH05-HY)  |
| Power Sensor             | Anritsu            | MA2411B         | 1207363        | N/A             | Oct. 18, 2020    | Mar. 29, 2021~<br>Apr. 13, 2021 | Oct. 17, 2021 | Conducted<br>(TH05-HY)  |
| Signal Analyzer          | Rohde &<br>Schwarz | FSV40           | 101566         | 10Hz ~ 40GHz    | Jul. 22, 2020    | Mar. 29, 2021~<br>Apr. 13, 2021 | Jul. 21, 2021 | Conducted<br>(TH05-HY)  |
| Switch Box & RF<br>Cable | EM Electronics     | EMSW18SE        | SW200302       | N/A             | Mar. 17, 2021    | Mar. 29, 2021~<br>Apr. 13, 2021 | Mar. 16, 2022 | Conducted<br>(TH05-HY)  |
| AC Power Source          | ChainTek           | APC-1000W       | N/A            | N/A             | N/A              | Mar. 16, 2021                   | N/A           | Conduction<br>(CO05-HY) |
| EMI Test Receiver        | Rohde &<br>Schwarz | ESR3            | 102388         | 9kHz~3.6GHz     | Nov. 30, 2020    | Mar. 16, 2021                   | Nov. 29, 2021 | Conduction<br>(CO05-HY) |
| Hygrometer               | Testo              | 608-H1          | 34913912       | N/A             | Nov. 18, 2020    | Mar. 16, 2021                   | Nov. 17, 2021 | Conduction<br>(CO05-HY) |
| LISN                     | Rohde &<br>Schwarz | ENV216          | 100081         | 9kHz~30MHz      | Nov. 16, 2020    | Mar. 16, 2021                   | Nov. 15, 2021 | Conduction<br>(CO05-HY) |
| Software                 | Rohde &<br>Schwarz | EMC32<br>V10.30 | N/A            | N/A             | N/A              | Mar. 16, 2021                   | N/A           | Conduction<br>(CO05-HY) |
| Pulse Limiter            | Rohde &<br>Schwarz | ESH3-Z2         | 100851         | N/A             | Feb. 25, 2021    | Mar. 16, 2021                   | Feb. 24, 2022 | Conduction<br>(CO05-HY) |
| LISN Cable               | MVE                | RG-400          | 260260         | N/A             | Dec. 31, 2020    | Mar. 16, 2021                   | Dec. 30, 2021 | Conduction<br>(CO05-HY) |



## 5 Uncertainty of Evaluation

### Uncertainty of Conducted Emission Measurement (150kHz ~ 30MHz)

|   |     |
|---|-----|
| Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ ) | 2.3 |
|---|-----|

### Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

|   |     |
|---|-----|
| Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ ) | 5.2 |
|---|-----|

### Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

|   |     |
|---|-----|
| Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ ) | 5.5 |
|---|-----|

### Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

|   |     |
|---|-----|
| Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ ) | 5.2 |
|---|-----|





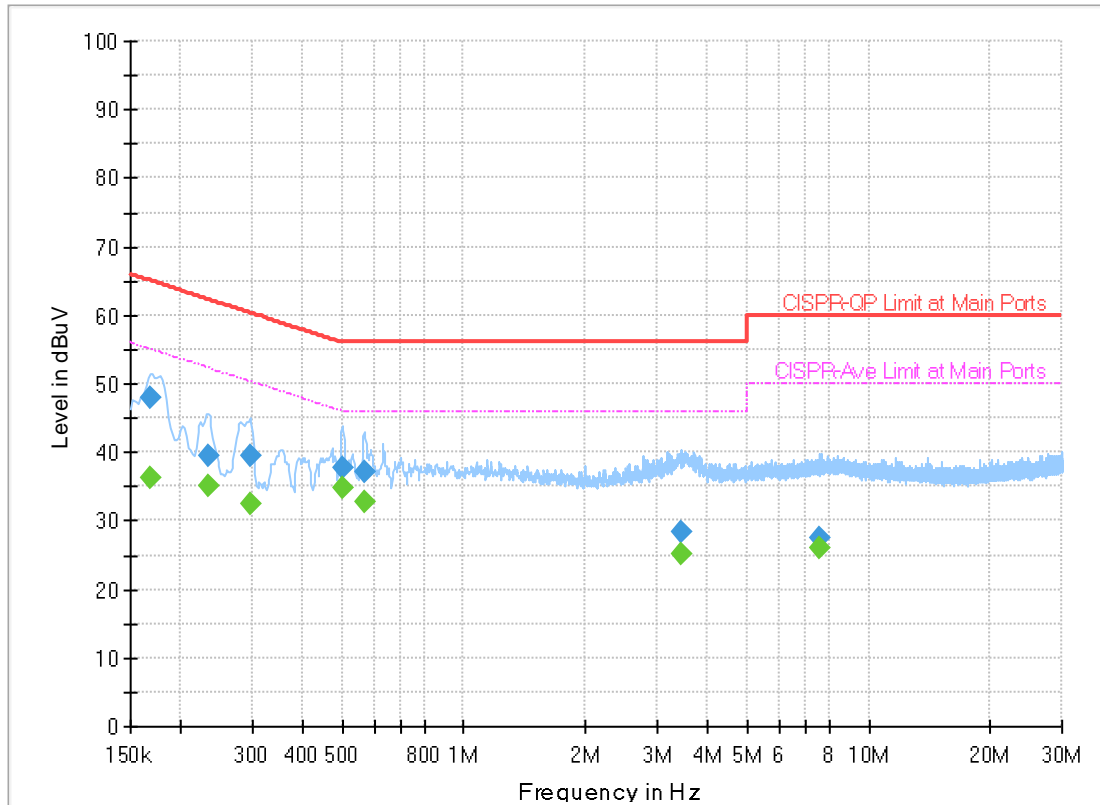
## **Appendix A. AC Conducted Emission Test Results**

|                                |                                   |
|--------------------------------|-----------------------------------|
| <b>Test Engineer :</b> Tom Lee | <b>Temperature :</b> 23~26°C      |
|                                | <b>Relative Humidity :</b> 40~50% |

## EUT Information

Report NO : 111940  
 Test Mode : Mode 1  
 Test Voltage : 120Vac/60Hz  
 Phase : Line

Full Spectrum



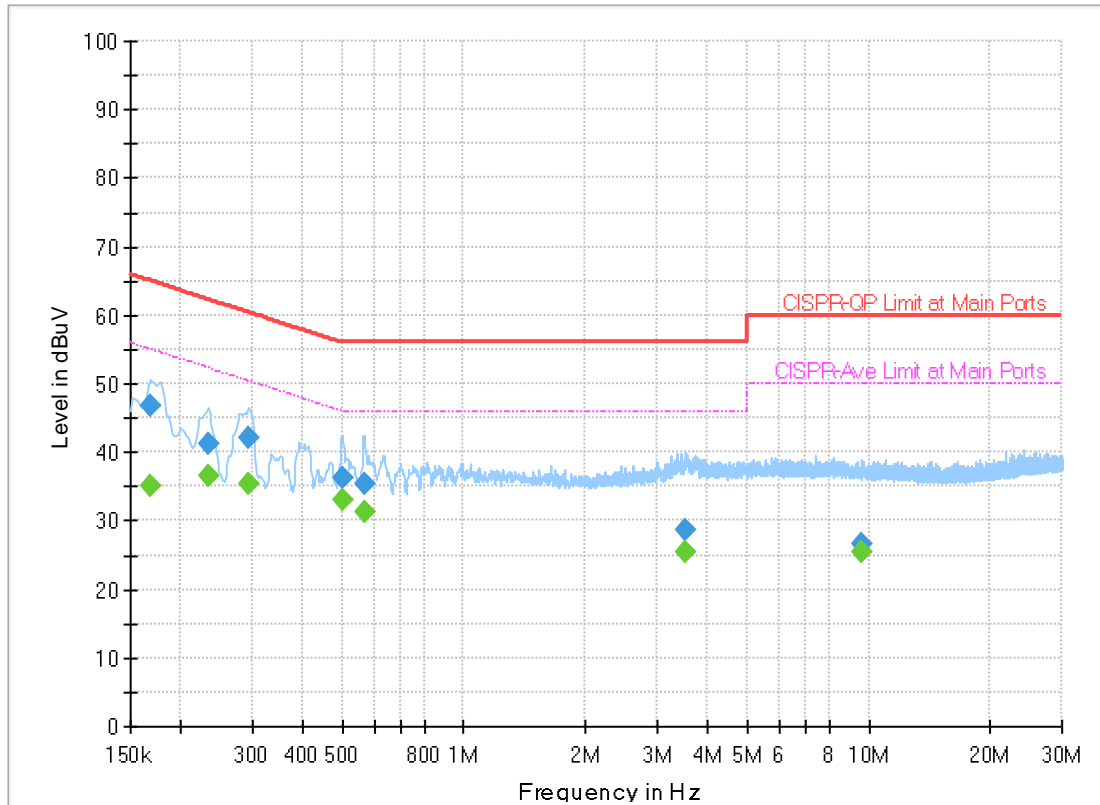
## Final\_Result

| Frequency (MHz) | QuasiPeak (dBuV) | CAverage (dBuV) | Limit (dBuV) | Margin (dB) | Line | Filter | Corr. (dB) |
|-----------------|------------------|-----------------|--------------|-------------|------|--------|------------|
| 0.168000        | ---              | 36.23           | 55.06        | 18.83       | L1   | OFF    | 19.7       |
| 0.168000        | 47.96            | ---             | 65.06        | 17.10       | L1   | OFF    | 19.7       |
| 0.233250        | ---              | 34.96           | 52.33        | 17.37       | L1   | OFF    | 19.7       |
| 0.233250        | 39.37            | ---             | 62.33        | 22.96       | L1   | OFF    | 19.7       |
| 0.296250        | ---              | 32.48           | 50.35        | 17.87       | L1   | OFF    | 19.7       |
| 0.296250        | 39.47            | ---             | 60.35        | 20.88       | L1   | OFF    | 19.7       |
| 0.501000        | ---              | 34.88           | 46.00        | 11.12       | L1   | OFF    | 19.9       |
| 0.501000        | 37.72            | ---             | 56.00        | 18.28       | L1   | OFF    | 19.9       |
| 0.566250        | ---              | 32.78           | 46.00        | 13.22       | L1   | OFF    | 19.9       |
| 0.566250        | 37.01            | ---             | 56.00        | 18.99       | L1   | OFF    | 19.9       |
| 3.435000        | ---              | 25.25           | 46.00        | 20.75       | L1   | OFF    | 20.1       |
| 3.435000        | 28.31            | ---             | 56.00        | 27.69       | L1   | OFF    | 20.1       |
| 7.559250        | ---              | 25.94           | 50.00        | 24.06       | L1   | OFF    | 20.1       |
| 7.559250        | 27.57            | ---             | 60.00        | 32.43       | L1   | OFF    | 20.1       |

## EUT Information

Report NO : 111940  
 Test Mode : Mode 1  
 Test Voltage : 120Vac/60Hz  
 Phase : Neutral

Full Spectrum



## Final\_Result

| Frequency (MHz) | QuasiPeak (dBuV) | CAverage (dBuV) | Limit (dBuV) | Margin (dB) | Line | Filter | Corr. (dB) |
|-----------------|------------------|-----------------|--------------|-------------|------|--------|------------|
| 0.168000        | ---              | 34.95           | 55.06        | 20.11       | N    | OFF    | 19.7       |
| 0.168000        | 46.87            | ---             | 65.06        | 18.19       | N    | OFF    | 19.7       |
| 0.233250        | ---              | 36.47           | 52.33        | 15.86       | N    | OFF    | 19.7       |
| 0.233250        | 41.21            | ---             | 62.33        | 21.12       | N    | OFF    | 19.7       |
| 0.294000        | ---              | 35.25           | 50.41        | 15.16       | N    | OFF    | 19.8       |
| 0.294000        | 42.21            | ---             | 60.41        | 18.20       | N    | OFF    | 19.8       |
| 0.501000        | ---              | 33.15           | 46.00        | 12.85       | N    | OFF    | 19.9       |
| 0.501000        | 36.23            | ---             | 56.00        | 19.77       | N    | OFF    | 19.9       |
| 0.568500        | ---              | 31.40           | 46.00        | 14.60       | N    | OFF    | 20.0       |
| 0.568500        | 35.28            | ---             | 56.00        | 20.72       | N    | OFF    | 20.0       |
| 3.540750        | ---              | 25.48           | 46.00        | 20.52       | N    | OFF    | 20.1       |
| 3.540750        | 28.56            | ---             | 56.00        | 27.44       | N    | OFF    | 20.1       |
| 9.595500        | ---              | 25.51           | 50.00        | 24.49       | N    | OFF    | 20.2       |
| 9.595500        | 26.73            | ---             | 60.00        | 33.27       | N    | OFF    | 20.2       |



## Appendix B. Radiated Spurious Emission

|                 |                        |                     |             |
|-----------------|------------------------|---------------------|-------------|
| Test Engineer : | Bill Chang and Fu Chen | Temperature :       | 19.1~21.9°C |
|                 |                        | Relative Humidity : | 54.2~67.8%  |



902~928MHz

UHF (Band Edge @ 3m)

| UHF           | Note  | Frequency | Level      | Over   | Limit      | Read     | Antenna  | Path   | Preamp | Ant    | Table   | Peak    | Pol.    |   |
|---------------|---|-----------|------------|--------|------------|----------|----------|--------|--------|--------|---------|---------|---------|---|
|               |   | ( MHz )   | ( dBμV/m ) | ( dB ) | ( dBμV/m ) | ( dBμV ) | ( dB/m ) | ( dB ) | ( dB ) | ( cm ) | ( deg ) | ( P/A ) | ( H/V ) |   |
| 902.75MHz     |   | 43.58     | 27.36      | -12.64 | 40         | 31.67    | 17.3     | 10.91  | 32.52  | -      | -       | P       | H       |   |
|               |   | 87.23     | 32.47      | -7.53  | 40         | 39.44    | 14.24    | 11.3   | 32.51  | -      | -       | P       | H       |   |
|               |   | 135.73    | 29.96      | -13.54 | 43.5       | 33.42    | 17.39    | 11.66  | 32.51  | -      | -       | P       | H       |   |
|               |   | 747.8     | 39.17      | -6.83  | 46         | 29.18    | 27.99    | 14.01  | 32.01  | 100    | 0       | P       | H       |   |
|               |   | 871.96    | 42.32      | -64.67 | 106.99     | 29.95    | 29.28    | 14.4   | 31.31  | -      | -       | P       | H       |   |
|               | *   | 902.75    | 126.99     | 80.99  | 46         | 114.55   | 29.12    | 14.5   | 31.18  | 150    | 283     | P       | H       |   |
|               |   | 945.68    | 43.57      | -63.42 | 106.99     | 29.41    | 30.46    | 14.6   | 30.9   | -      | -       | P       | H       |   |
|               |   |           |            |        |            |          |          |        |        |        |         |         |         | H |
|               |   |           |            |        |            |          |          |        |        |        |         |         |         | H |
|               |   |           |            |        |            |          |          |        |        |        |         |         |         | H |
|               |   |           |            |        |            |          |          |        |        |        |         |         |         | H |
|               |   |           |            |        |            |          |          |        |        |        |         |         |         | H |
|               |   |           |            |        |            |          |          |        |        |        |         |         |         | H |
|               |   |           | 43.58      | 36.97  | -3.03      | 40       | 41.28    | 17.3   | 10.91  | 32.52  | 100     | 27      | QP      | V |
|               |   |           | 63.95      | 30.66  | -9.34      | 40       | 40.33    | 11.77  | 11.1   | 32.54  | -       | -       | P       | V |
|               |   |           | 87.23      | 31.8   | -8.2       | 40       | 38.77    | 14.24  | 11.3   | 32.51  | -       | -       | P       | V |
|               |   |           | 674.08     | 38.3   | -7.7       | 46       | 30.59    | 26.47  | 13.76  | 32.52  | -       | -       | P       | V |
|               |   |           | 854.5      | 41.8   | -64.48     | 106.28   | 29.62    | 29.22  | 14.34  | 31.38  | -       | -       | P       | V |
|               | *   |           | 902.75     | 126.28 | 80.28      | 46       | 113.84   | 29.12  | 14.5   | 31.18  | 117     | 269     | P       | V |
|               |   |           | 944.71     | 43.15  | -63.13     | 106.28   | 29.06    | 30.4   | 14.6   | 30.91  | -       | -       | P       | V |
|               |   |           |            |        |            |          |          |        |        |        |         |         | V       |   |
|               |   |           |            |        |            |          |          |        |        |        |         |         | V       |   |
|               |   |           |            |        |            |          |          |        |        |        |         |         | V       |   |
|               |   |           |            |        |            |          |          |        |        |        |         |         | V       |   |
|               |   |           |            |        |            |          |          |        |        |        |         |         | V       |   |
| <b>Remark</b> | 1. No other spurious found.<br>2. All results are PASS against limit line.<br>3. Non restricted band limit is radio frequency level down 20db |           |            |        |            |          |          |        |        |        |         |         |         |   |



| UHF           | Note  | Frequency<br>( MHz ) | Level<br>( dBμV/m ) | Over<br>Limit<br>( dB ) | Limit<br>Line<br>( dBμV/m ) | Read<br>Level<br>( dBμV ) | Antenna<br>Factor<br>( dB/m ) | Path<br>Loss<br>( dB ) | Preamp<br>Factor<br>( dB ) | Ant<br>Pos<br>( cm ) | Table<br>Pos<br>( deg ) | Peak<br>Avg.<br>( P/A ) | Pol.<br>( H/V ) |   |
|---------------|---|----------------------|---------------------|-------------------------|-----------------------------|---------------------------|-------------------------------|------------------------|----------------------------|----------------------|-------------------------|-------------------------|-----------------|---|
| 914.75MHz     |   | 30.97                | 30.87               | -9.13                   | 40                          | 28.84                     | 23.79                         | 10.69                  | 32.45                      | -                    | -                       | P                       | H               |   |
|               |   | 89.17                | 32.3                | -11.2                   | 43.5                        | 38.94                     | 14.54                         | 11.33                  | 32.51                      | -                    | -                       | P                       | H               |   |
|               |   | 183.26               | 29.88               | -13.62                  | 43.5                        | 35.87                     | 14.53                         | 12.01                  | 32.53                      | -                    | -                       | P                       | H               |   |
|               |   | 742.95               | 39.66               | -6.34                   | 46                          | 29.76                     | 27.95                         | 14                     | 32.05                      | 100                  | 0                       | P                       | H               |   |
|               |   | 856.44               | 41.33               | -66.68                  | 108.01                      | 29.1                      | 29.25                         | 14.35                  | 31.37                      | -                    | -                       | P                       | H               |   |
|               | *   | 914.75               | 128.01              | 82.01                   | 46                          | 115.37                    | 29.21                         | 14.53                  | 31.1                       | 151                  | 279                     | P                       | H               |   |
|               |   | 952.47               | 44.03               | -63.98                  | 108.01                      | 29.48                     | 30.79                         | 14.62                  | 30.86                      | -                    | -                       | P                       | H               |   |
|               |   |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         |                 | H |
|               |   |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         |                 | H |
|               |   |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         |                 | H |
|               |   |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         |                 | H |
|               |   |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         |                 | H |
|               |   |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         |                 | H |
|               |   |                      | 44.55               | 36.61                   | -3.39                       | 40                        | 41.32                         | 16.88                  | 10.93                      | 32.52                | 100                     | 21                      | QP              | V |
|               |   |                      | 63.95               | 30.87                   | -9.13                       | 40                        | 40.54                         | 11.77                  | 11.1                       | 32.54                | -                       | -                       | P               | V |
|               |   |                      | 89.17               | 31.48                   | -12.02                      | 43.5                      | 38.12                         | 14.54                  | 11.33                      | 32.51                | -                       | -                       | P               | V |
|               |   |                      | 662.44              | 37.61                   | -8.39                       | 46                        | 30.1                          | 26.35                  | 13.74                      | 32.58                | -                       | -                       | P               | V |
|               |   |                      | 859.35              | 42.82                   | -65.02                      | 107.84                    | 30.51                         | 29.3                   | 14.37                      | 31.36                | -                       | -                       | P               | V |
|               | *   |                      | 914.75              | 127.84                  | 81.84                       | 46                        | 115.2                         | 29.21                  | 14.53                      | 31.1                 | 117                     | 270                     | P               | V |
|               |   |                      | 945.68              | 43.19                   | -64.65                      | 107.84                    | 29.03                         | 30.46                  | 14.6                       | 30.9                 | -                       | -                       | P               | V |
|               |   |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         | V               |   |
|               |   |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         | V               |   |
|               |   |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         | V               |   |
|               |   |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         | V               |   |
|               |   |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         | V               |   |
| <b>Remark</b> | 1. No other spurious found.<br>2. All results are PASS against limit line.<br>3. Non restricted band limit is radio frequency level down 20db |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         |                 |   |



| UHF           | Note  | Frequency<br>( MHz ) | Level<br>( dBµV/m ) | Over<br>Limit<br>( dB ) | Limit<br>Line<br>( dBµV/m ) | Read<br>Level<br>(dBµV) | Antenna<br>Factor<br>( dB/m ) | Path<br>Loss<br>( dB ) | Preamp<br>Factor<br>( dB ) | Ant<br>Pos<br>( cm ) | Table<br>Pos<br>( deg ) | Peak<br>Avg.<br>(P/A) | Pol.<br>(H/V) |   |
|---------------|---|----------------------|---------------------|-------------------------|-----------------------------|-------------------------|-------------------------------|------------------------|----------------------------|----------------------|-------------------------|-----------------------|---------------|---|
| 927.25MHz     |   | 31.94                | 29.84               | -10.16                  | 40                          | 28.53                   | 23.06                         | 10.71                  | 32.46                      | -                    | -                       | P                     | H             |   |
|               |   | 89.17                | 32.37               | -11.13                  | 43.5                        | 39.01                   | 14.54                         | 11.33                  | 32.51                      | -                    | -                       | P                     | H             |   |
|               |   | 137.67               | 32.2                | -11.3                   | 43.5                        | 35.73                   | 17.31                         | 11.68                  | 32.52                      | -                    | -                       | P                     | H             |   |
|               |   | 761.38               | 39.99               | -6.01                   | 46                          | 29.75                   | 28.1                          | 14.05                  | 31.91                      | 100                  | 0                       | P                     | H             |   |
|               |   | 903.97               | 42.18               | -65.49                  | 107.67                      | 29.75                   | 29.1                          | 14.5                   | 31.17                      | -                    | -                       | P                     | H             |   |
|               | *   | 927.25               | 127.67              | 81.67                   | 46                          | 114.58                  | 29.55                         | 14.56                  | 31.02                      | 147                  | 288                     | P                     | H             |   |
|               |   | 959.26               | 42.81               | -64.86                  | 107.67                      | 27.89                   | 31.11                         | 14.62                  | 30.81                      | -                    | -                       | P                     | H             |   |
|               |   |                      |                     |                         |                             |                         |                               |                        |                            |                      |                         |                       |               | H |
|               |   |                      |                     |                         |                             |                         |                               |                        |                            |                      |                         |                       |               | H |
|               |   |                      |                     |                         |                             |                         |                               |                        |                            |                      |                         |                       |               | H |
|               |   |                      |                     |                         |                             |                         |                               |                        |                            |                      |                         |                       |               | H |
|               |   |                      |                     |                         |                             |                         |                               |                        |                            |                      |                         |                       |               | H |
|               |   |                      |                     |                         |                             |                         |                               |                        |                            |                      |                         |                       |               | H |
|               |   |                      | 44.55               | 36.78                   | -3.22                       | 40                      | 41.49                         | 16.88                  | 10.93                      | 32.52                | 100                     | 25                    | QP            | V |
|               |   |                      | 63.95               | 30.93                   | -9.07                       | 40                      | 40.6                          | 11.77                  | 11.1                       | 32.54                | -                       | -                     | P             | V |
|               |   |                      | 87.23               | 32.88                   | -7.12                       | 40                      | 39.85                         | 14.24                  | 11.3                       | 32.51                | -                       | -                     | P             | V |
|               |   |                      | 760.41              | 39.65                   | -6.35                       | 46                      | 29.42                         | 28.09                  | 14.05                      | 31.91                | -                       | -                     | P             | V |
|               |   |                      | 901.06              | 41.86                   | -65.28                      | 107.14                  | 29.41                         | 29.14                  | 14.5                       | 31.19                | -                       | -                     | P             | V |
|               | *   |                      | 927.25              | 127.14                  | 81.14                       | 46                      | 114.05                        | 29.55                  | 14.56                      | 31.02                | 116                     | 270                   | P             | V |
|               |   |                      | 947.62              | 43.08                   | -64.06                      | 107.14                  | 28.81                         | 30.56                  | 14.6                       | 30.89                |                         |                       | P             | V |
|               |   |                      |                     |                         |                             |                         |                               |                        |                            |                      |                         |                       | V             |   |
|               |   |                      |                     |                         |                             |                         |                               |                        |                            |                      |                         |                       | V             |   |
|               |   |                      |                     |                         |                             |                         |                               |                        |                            |                      |                         |                       | V             |   |
|               |   |                      |                     |                         |                             |                         |                               |                        |                            |                      |                         |                       | V             |   |
|               |   |                      |                     |                         |                             |                         |                               |                        |                            |                      |                         |                       | V             |   |
|               |   |                      |                     |                         |                             |                         |                               |                        |                            |                      |                         |                       | V             |   |
| <b>Remark</b> | 1. No other spurious found.<br>2. All results are PASS against limit line.<br>3. Non restricted band limit is radio frequency level down 20db |                      |                     |                         |                             |                         |                               |                        |                            |                      |                         |                       |               |   |



UHF (Harmonic @ 3m)

| UHF           | Note   | Frequency<br>( MHz ) | Level<br>( dBμV/m ) | Over<br>Limit<br>( dB ) | Limit<br>Line<br>( dBμV/m ) | Read<br>Level<br>( dBμV ) | Antenna<br>Factor<br>( dB/m ) | Path<br>Loss<br>( dB ) | Preamp<br>Factor<br>( dB ) | Ant<br>Pos<br>( cm ) | Table<br>Pos<br>( deg ) | Peak<br>Avg.<br>( P/A ) | Pol.<br>( H/V ) |
|---------------|--|----------------------|---------------------|-------------------------|-----------------------------|---------------------------|-------------------------------|------------------------|----------------------------|----------------------|-------------------------|-------------------------|-----------------|
| 902.75MHz     |  | 1805.5               | 35.35               | -71.64                  | 106.99                      | 71.04                     | 25.1                          | 7.18                   | 67.97                      | 100                  | 0                       | P                       | H               |
|               |  | 2708.25              | 39.42               | -34.58                  | 74                          | 69.82                     | 28                            | 8.63                   | 67.03                      | 100                  | 0                       | P                       | H               |
|               |  |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         | H               |
|               |  |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         | H               |
|               |  | 1805.5               | 34.44               | -71.84                  | 106.28                      | 70.13                     | 25.1                          | 7.18                   | 67.97                      | 100                  | 0                       | P                       | V               |
|               |  | 2708.25              | 36.87               | -37.13                  | 74                          | 67.27                     | 28                            | 8.63                   | 67.03                      | 100                  | 0                       | P                       | V               |
|               |  |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         | V               |
|               |  |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         | V               |
| 914.75MHz     |  | 1829.5               | 38.67               | -69.34                  | 108.01                      | 74.29                     | 25.1                          | 7.24                   | 67.96                      | 100                  | 0                       | P                       | H               |
|               |  | 2744.25              | 38.54               | -35.46                  | 74                          | 68.87                     | 28                            | 8.69                   | 67.02                      | 100                  | 0                       | P                       | H               |
|               |  |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         | H               |
|               |  |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         | H               |
|               |  | 1829.5               | 39.45               | -68.39                  | 107.84                      | 75.07                     | 25.1                          | 7.24                   | 67.96                      | 100                  | 0                       | P                       | V               |
|               |  | 2744.25              | 37.7                | -36.3                   | 74                          | 68.03                     | 28                            | 8.69                   | 67.02                      | 100                  | 0                       | P                       | V               |
|               |  |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         | V               |
|               |  |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         | V               |
| 927.25MHz     |  | 1854.5               | 48.5                | -59.17                  | 107.67                      | 84.03                     | 25.13                         | 7.29                   | 67.95                      | 100                  | 0                       | P                       | H               |
|               |  | 2781.75              | 42.86               | -31.14                  | 74                          | 72.99                     | 28.13                         | 8.75                   | 67.01                      | 100                  | 0                       | P                       | H               |
|               |  |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         | H               |
|               |  |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         | H               |
|               |  | 1854.5               | 48.1                | -59.04                  | 107.14                      | 83.63                     | 25.13                         | 7.29                   | 67.95                      | 100                  | 0                       | P                       | V               |
|               |  | 2781.75              | 44.7                | -29.3                   | 74                          | 74.83                     | 28.13                         | 8.75                   | 67.01                      | 100                  | 0                       | P                       | V               |
|               |  |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         | V               |
|               |  |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         | V               |
| <b>Remark</b> | 1. No other spurious found.<br>2. All results are PASS against Peak and Average limit line.<br>3. Non restricted band limit is radio frequency level down 20db |                      |                     |                         |                             |                           |                               |                        |                            |                      |                         |                         |                 |





**Note symbol**

|     |  |
|-----|--|
| *   | <b>Fundamental Frequency</b> which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency. |
| !   | Test result is <b>over limit</b> line.   |
| P/A | <b>Peak</b> or <b>Average</b>  |
| H/V | <b>Horizontal</b> or <b>Vertical</b>   |



A calculation example for radiated spurious emission is shown as below:

| BLE                     | Note | Frequency | Level      | Over   | Limit      | Read     | Antenna  | Path   | Preamp | Ant    | Table   | Peak    | Pol.    |
|-------------------------|------|-----------|------------|--------|------------|----------|----------|--------|--------|--------|---------|---------|---------|
|                         |      | ( MHz )   | ( dBμV/m ) | ( dB ) | ( dBμV/m ) | ( dBμV ) | ( dB/m ) | ( dB ) | ( dB ) | ( cm ) | ( deg ) | ( P/A ) | ( H/V ) |
| BLE<br>CH 00<br>2402MHz |      | 2390      | 55.45      | -18.55 | 74         | 54.51    | 32.22    | 4.58   | 35.86  | 103    | 308     | P       | H       |
|                         |      | 2390      | 43.54      | -10.46 | 54         | 42.6     | 32.22    | 4.58   | 35.86  | 103    | 308     | A       | H       |

$$1. \text{ Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)}$$

$$2. \text{ Level(dB}\mu\text{V/m) =}$$

$$\text{Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dB}\mu\text{V) - Preamp Factor(dB)}$$

$$3. \text{ Over Limit(dB) = Level(dB}\mu\text{V/m) - Limit Line(dB}\mu\text{V/m)}$$

**For Peak Limit @ 2390MHz:**

$$1. \text{ Level(dB}\mu\text{V/m)}$$

$$= \text{Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dB}\mu\text{V) - Preamp Factor(dB)}$$

$$= 32.22(\text{dB/m}) + 4.58(\text{dB}) + 54.51(\text{dB}\mu\text{V}) - 35.86(\text{dB})$$

$$= 55.45(\text{dB}\mu\text{V/m})$$

$$2. \text{ Over Limit(dB)}$$

$$= \text{Level(dB}\mu\text{V/m) - Limit Line(dB}\mu\text{V/m)}$$

$$= 55.45(\text{dB}\mu\text{V/m}) - 74(\text{dB}\mu\text{V/m})$$

$$= -18.55(\text{dB})$$

**For Average Limit @ 2390MHz:**

$$1. \text{ Level(dB}\mu\text{V/m)}$$

$$= \text{Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dB}\mu\text{V) - Preamp Factor(dB)}$$

$$= 32.22(\text{dB/m}) + 4.58(\text{dB}) + 42.6(\text{dB}\mu\text{V}) - 35.86(\text{dB})$$

$$= 43.54(\text{dB}\mu\text{V/m})$$

$$2. \text{ Over Limit(dB)}$$

$$= \text{Level(dB}\mu\text{V/m) - Limit Line(dB}\mu\text{V/m)}$$

$$= 43.54(\text{dB}\mu\text{V/m}) - 54(\text{dB}\mu\text{V/m})$$

$$= -10.46(\text{dB})$$

Both peak and average measured complies with the limit line, so test result is "PASS".



## Appendix C. Radiated Spurious Emission Plots

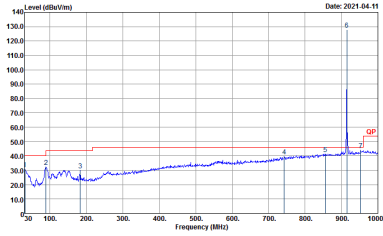
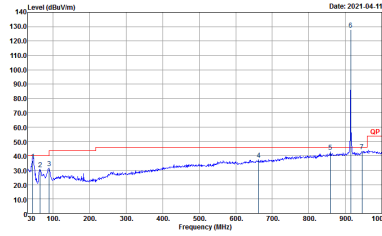
|                 |                        |                     |             |
|-----------------|------------------------|---------------------|-------------|
| Test Engineer : | Bill Chang and Fu Chen | Temperature :       | 19.1~21.9°C |
|                 |                        | Relative Humidity : | 54.2~67.8%  |

902~928MHz

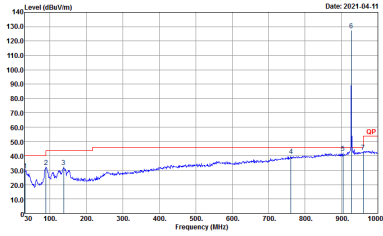
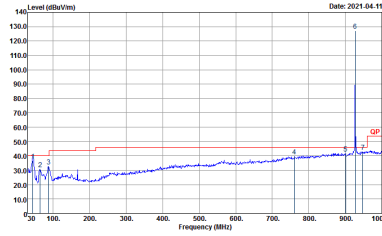
UHF (Band Edge @ 3m)

| UHF       | 902.75MHz   |   |
|-----------|---|---|
|           | Horizontal  | Vertical  |
| QP / Peak | <p>Site : 03CHI1-HY<br/>           Condition : QP 3m BT-LOG 6111D-LF_ETC HORIZONTAL<br/>           Detector : Peak<br/>           Project : 111940<br/>           Setting : 295</p> | <p>Site : 03CHI1-HY<br/>           Condition : QP 3m BT-LOG 6111D-LF_ETC VERTICAL<br/>           Detector : Peak<br/>           Project : 111940<br/>           Setting : 295</p> |



| UHF                  | 914.75MHz   |  |
|----------------------|---|--|
|                      | Horizontal  | Vertical   |
| <p>QP /<br/>Peak</p> |  <p>Site : 03CH11-HY<br/>Condition : QP 3m 8E-LOG 6111D-LF_ETC HORIZONTAL<br/>Detector : Peak<br/>Project : 111940<br/>Setting : Z95</p> |  <p>Site : 03CH11-HY<br/>Condition : QP 3m 8E-LOG 6111D-LF_ETC VERTICAL<br/>Detector : Peak<br/>Project : 111940<br/>Setting : Z95</p> |

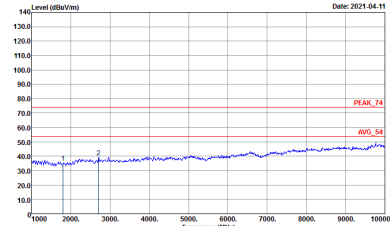
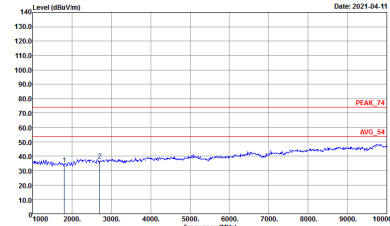


| UHF                                | 927.25MHz   |  |
|------------------------------------|---|--|
|                                    | Horizontal  | Vertical   |
| <p><b>Peak</b><br/><b>Avg.</b></p> |  <p>Site : 03CH11-HY<br/>Condition : QP 3m 8E-LOG 6111D-LF_ETC HORIZONTAL<br/>Detector : Peak<br/>Project : 111940<br/>Setting : 294</p> |  <p>Site : 03CH11-HY<br/>Condition : QP 3m 8E-LOG 6111D-LF_ETC VERTICAL<br/>Detector : Peak<br/>Project : 111940<br/>Setting : 294</p> |

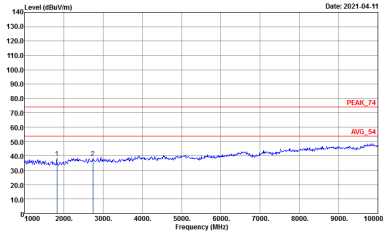
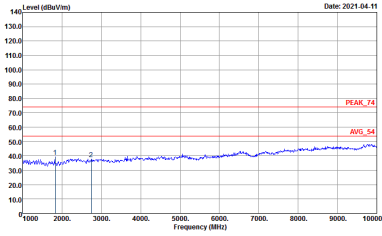


902~928MHz

UHF (Harmonic @ 3m)

| UHF                                   | 902.75MHz  |   |
|---------------------------------------|--|---|
|                                       | Horizontal   | Vertical  |
| <p><b>Peak</b></p> <p><b>Avg.</b></p> |  <p>Site : 03CH11-14Y<br/> Condition : PEAK_74 3m HORN 91200-HF_1326 HORIZONTAL<br/> Detector : Peak<br/> Project : 111940<br/> Setting : 295</p> |  <p>Site : 03CH11-14Y<br/> Condition : PEAK_74 3m HORN 91200-HF_1326 VERTICAL<br/> Detector : Peak<br/> Project : 111940<br/> Setting : 295</p> |



| UHF                                | 914.75MHz   |  |
|------------------------------------|---|--|
|                                    | Horizontal  | Vertical   |
| <p><b>Peak</b><br/><b>Avg.</b></p> |  <p>Site : 03CH11-HY<br/>Condition : PEAK_74 3m HORN 91200-HF_1326 HORIZONTAL<br/>Detector : Peak<br/>Project : 111940<br/>Setting : Z95</p> |  <p>Site : 03CH11-HY<br/>Condition : PEAK_74 3m HORN 91200-HF_1326 VERTICAL<br/>Detector : Peak<br/>Project : 111940<br/>Setting : Z95</p> |



| UHF                        | 927.25MHz   |   |
|----------------------------|---|---|
|                            | Horizontal  | Vertical  |
| <b>Peak</b><br><b>Avg.</b> | <p>Site : 03CH11-HY<br/>Condition : PEAK_74 3m HORN 91200-HF_1326 HORIZONTAL<br/>Detector : Peak<br/>Project : 111940<br/>Setting : 294</p> | <p>Site : 03CH11-HY<br/>Condition : PEAK_74 3m HORN 91200-HF_1326 VERTICAL<br/>Detector : Peak<br/>Project : 111940<br/>Setting : 294</p> |





### Appendix D. Duty Cycle Plots

| Band | Duty Cycle(%) | T(us) | 1/T(kHz) | VBW Setting | Duty Factor(dB) |
|------|---------------|-------|----------|-------------|-----------------|
| UHF  | 87.63         | 4928  | 0.20     | 300Hz       | 0.57            |

