



Test Report

FCC Part15 Subpart F & RSS 220

Product Name : UWB device
Model No. : X4M02
FCC ID : 2AD9QX4M02
IC : 22782-X4M02

Applicant : Novelda AS

Address : Garverivegen 2, NO-3850 Kviteseid, Norway

Date of Receipt : Jul. 05th, 2017
Test Date : Jun. 29th, 2017~ Jun. 30th, 2017
Issued Date : Aug. 17th, 2017
Report No. : 1772022R-RF-US-P06V02
Report Version : V1.2

The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standard through the calibration of the equipment and evaluated measurement uncertainty herein.

This report must not be used to claim product endorsement by any agency of the government.

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Test Report Certification

Issued Date : Aug. 17th, 2017
Report No. : 1772022R-RF-US-P06V02



Product Name : UWB device
Applicant : Novelda AS
Address : Garverivegen 2, NO-3850 Kviteseid, Norway
Manufacturer : Novelda AS
Address : Garverivegen 2, NO-3850 Kviteseid, Norway
Model No. : X4M02
FCC ID : 2AD9QX4M02
IC : 22782-X4M02
EUT Voltage : DC 3V~5.5V
Applicable Standard : FCC CFR Title 47 Part 15 Subpart F: 2015
RSS-GEN Issue4; RSS-220 Issue1
ANSI C63.10: 2013; ANSI C63.4: 2014
Test Result : Complied
Performed Location : DEKRA Testing & Certification (Suzhou) Co., Ltd.
No.99 Hongye Rd., Suzhou Industrial Park, Suzhou, 215006,
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FCC Registration Number: 800392; IC Lab Code: 4075B

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(Engineering Manager: Harry Zhao)

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History of This Test Report

| REPORT NO. | VERSION | DESCRIPTION | ISSUED DATE |
|-----------------------|---------|---|-----------------|
| 1772022R-RF-US-P06V02 | V1.0 | Initial Issued Report | Jul. 12th, 2017 |
| 1772022R-RF-US-P06V02 | V1.1 | Added 18~40GHz data in the report and separate Radiated Emission in GPS band and Operational Limitations two items in the report. | Aug. 11th, 2017 |
| 1772022R-RF-US-P06V02 | V1.2 | Update the operational limitations data. | Aug. 17th, 2017 |
| | | | |

1. General Information**1.1. EUT Description**

| | |
|------------------|------------------|
| Product Name | UWB device |
| Model No. | X4M02 |
| Working Voltage | DC 3V~5.5V |
| Hardware version | 000164-010 |
| Software version | XE 2.5.0-alpha.7 |
| Frequency Range | 6~8.5GHz |
| Channel Number | 1 |
| Antenna Type | PCB Antenna |

1.2. Mode of Operation

| |
|------------------|
| Test Mode |
| Mode 1: Transmit |

Note:

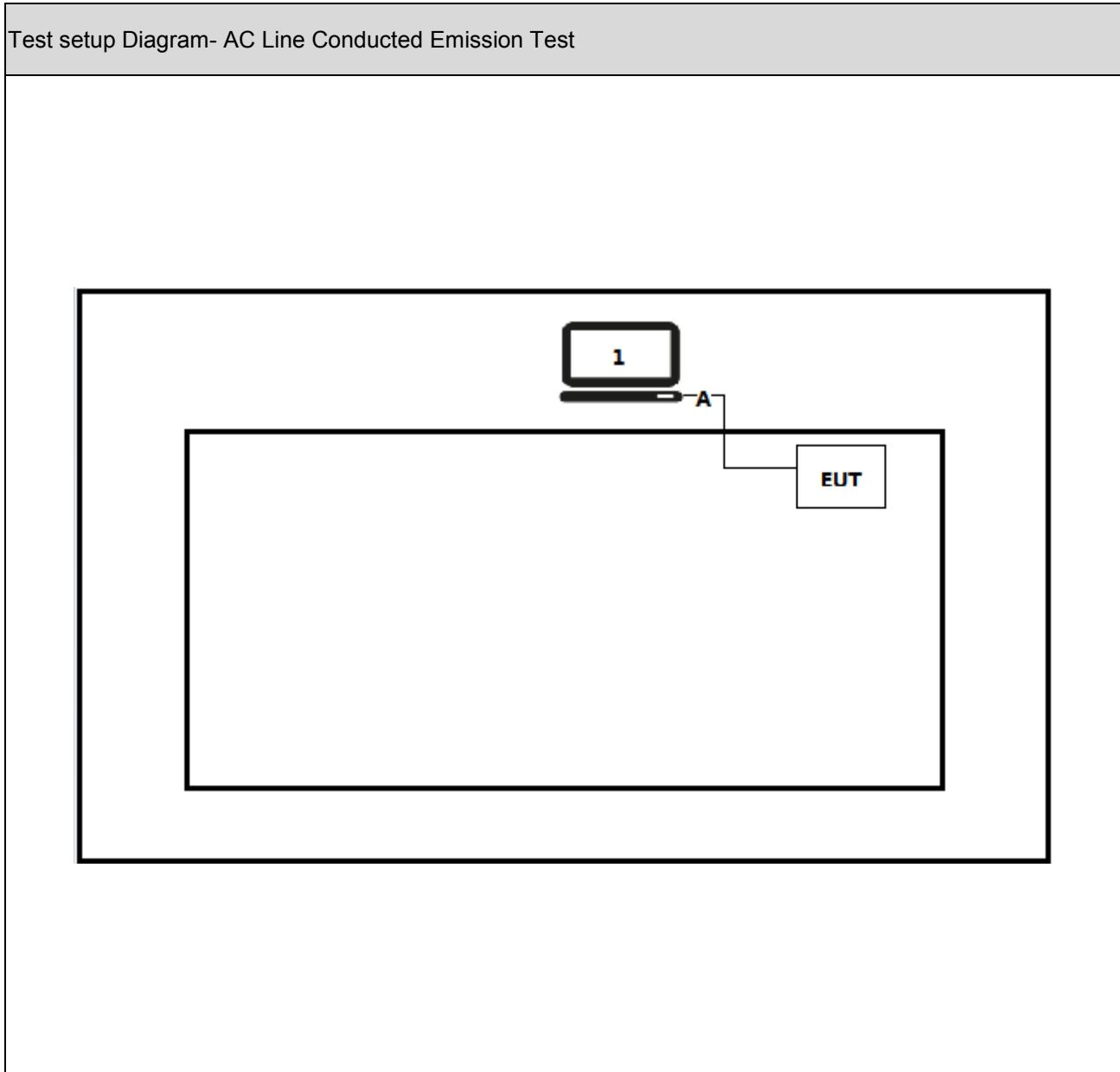
1. Regards to the frequency band operation: the lowest, middle and highest frequency of channel were selected to perform the test, then shown on this report.
2. For portable device, radiated spurious emission was verified over X, Y, Z Axis, and shown the worst case on this report.

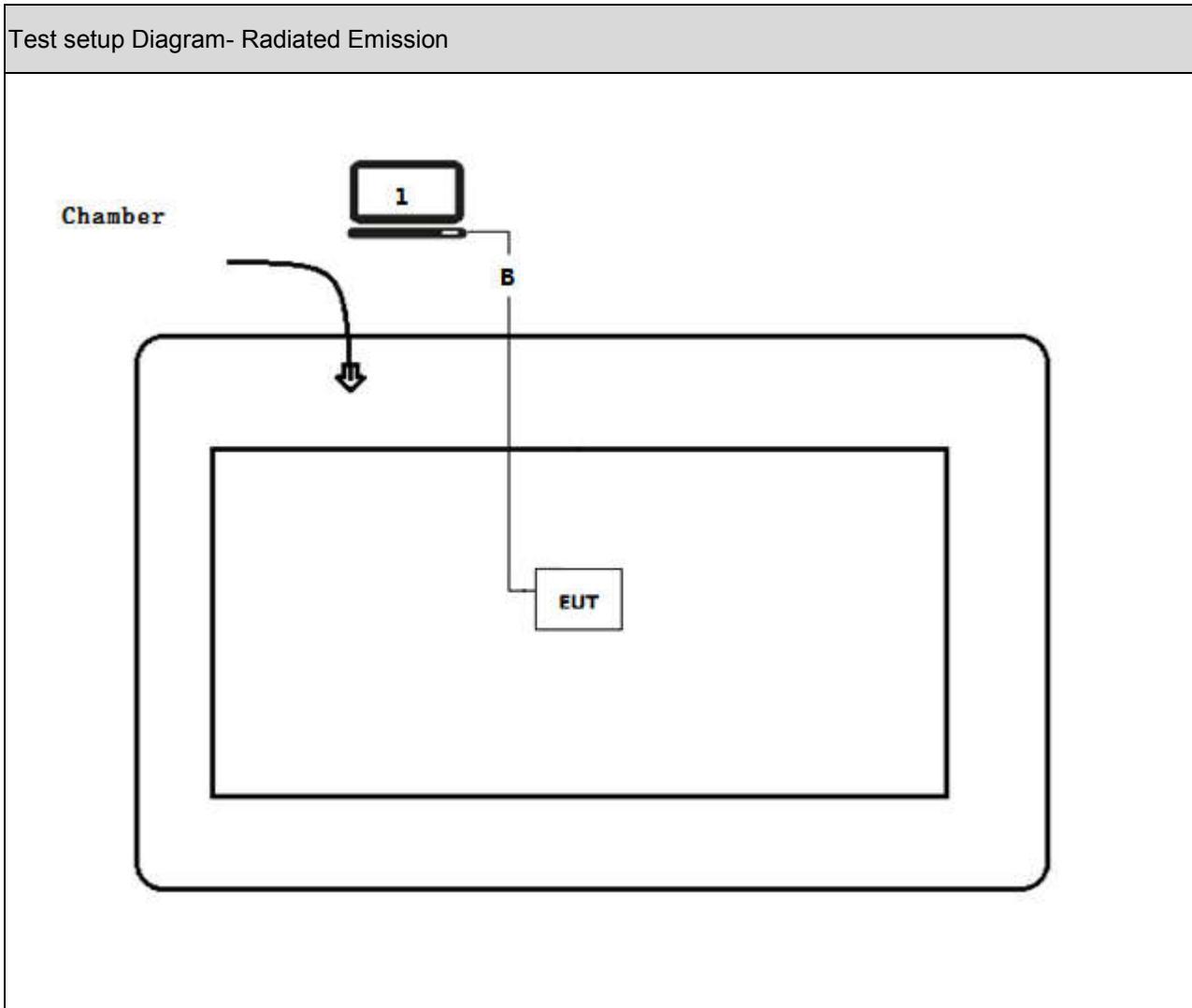
1.3. Tested System Details

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

| Product | Manufacturer | Model No. | Serial No. | Power Cord |
|---------|--------------|-----------|------------|------------|
| 1 N/A | N/A | N/A | N/A | N/A |

1.4. Configuration of Tested System





| Signal Cable Type | | Signal Cable Description |
|-------------------|-----------|--------------------------|
| A | USB cable | 3m with shield |
| B | USB cable | 3m with shield |

1.5. EUT Exercise Software

| | |
|---|---|
| 1 | Setup the EUT and simulators as shown on above. |
| 2 | Turn on the power of all equipment. and start to test |

2. Technical Test

2.1. Summary of Test Result

No deviations from the test standards
 Deviations from the test standards as below description:

| Performed Test Item | Normative References | Test Performed | Deviation |
|-------------------------------|--|----------------|-----------|
| Conducted Emission | FCC CFR Title 47 Part 15 Subpart C: 2015 Section 15.207 | Yes | No |
| Radiated Emission | FCC CFR Title 47 Part 15 Subpart C: 2015 Section 15.209; FCC CFR Title 47 Part 15 Subpart F: 2015 15.519(c) | Yes | No |
| Radiated Emission in GPS band | FCC CFR Title 47 Part 15 Subpart F: 2015 15.519(d) | Yes | No |
| Operational Limitations | FCC CFR Title 47 Part 15 Subpart F: 2015 15.519(a) | Yes | No |
| 10dB Bandwidth | FCC CFR Title 47 Part 15 Subpart F: 2015 Section 15.503(a) | Yes | No |
| EIRP | FCC CFR Title 47 Part 15 Subpart F: 2015 Section 15.521(g) | Yes | No |
| Antenna Requirement | FCC CFR Title 47 Part 15 Subpart F: 2015 Section 15.203 | Yes | No |

| Performed Test Item | Normative References | Test Performed | Deviation |
|-------------------------------|--|----------------|-----------|
| Conducted Emission | RSS GEN Issue4 Clause 8.8 | Yes | No |
| Radiated Emission | RSS GEN Issue4 Clause 8.9; RSS 220 Issue1 Clause 5.3(c) | Yes | No |
| Radiated Emission in GPS band | RSS 220 Issue1 Clause 5.3(d) | Yes | No |
| Operational Limitations | RSS 220 Issue1 Clause 5.3(b) | Yes | No |
| 10dB Bandwidth | RSS 220 Issue1 Clause 5.1(a) | Yes | No |
| EIRP | RSS 220 Issue1 Clause 5.3(e) | Yes | No |
| Antenna Requirement | RSS GEN Issue4 Clause 8.3 | Yes | No |

2.2. Test Environment

| Items | Required (IEC 68-1) | Actual |
|----------------------------|---------------------|----------|
| Temperature (°C) | 15-35 | 21 |
| Humidity (%RH) | 25-75 | 50 |
| Barometric pressure (mbar) | 860-1060 | 950-1000 |

3. Conducted Emission

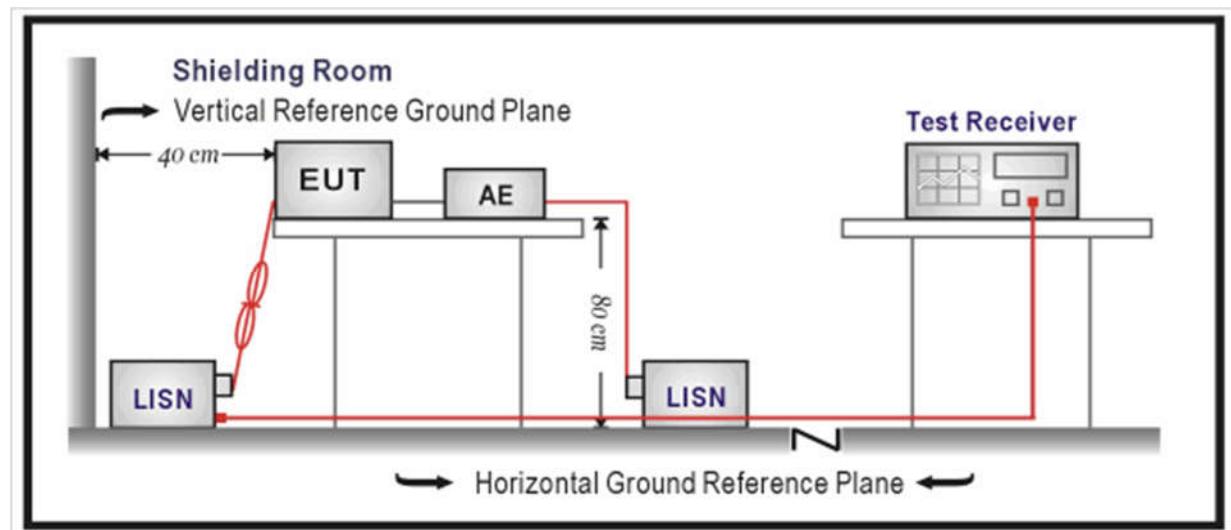
3.1. Test Equipment

Conducted Emission / TR-1

| Instrument | Manufacturer | Type No. | Serial No. | Cal. Due Date |
|----------------------------|--------------|----------|------------|---------------|
| EMI Test Receiver | R&S | ESCI | 100726 | 2017.09.16 |
| Two-Line V-Network | R&S | ENV216 | 100043 | 2017.08.07 |
| Two-Line V-Network | R&S | ENV216 | 100044 | 2017.09.16 |
| 50ohm Coaxial Switch | Anritsu | MP59B | 6200464462 | N/A |
| 50ohm Termination | SHX | TF2 | 07081401 | 2017.09.16 |
| Temperature/Humidity Meter | zhicheng | ZC1-2 | TR1-TH | 2018.01.07 |

Note: All equipment are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

3.2. Test Setup



3.3. Limit

| FCC Part 15 Subpart C Paragraph 15.207 Limits | | |
|---|-----------|-----------|
| Frequency (MHz) | QP (dBuV) | AV (dBuV) |
| 0.15 - 0.50 | 66 - 56 | 56 – 46 |
| 0.50 - 5.0 | 56 | 46 |
| 5.0 - 30 | 60 | 50 |

Note 1: The lower limit shall apply at the transition frequencies.

Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

3.4. Test Procedure

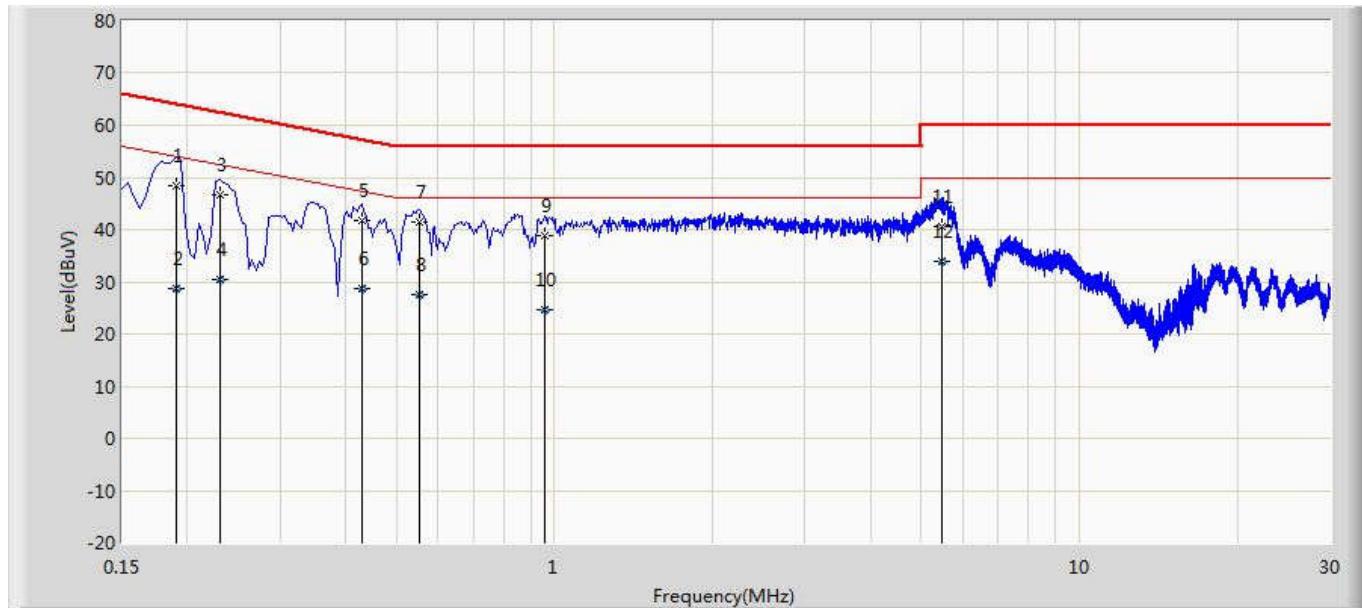
The EUT was setup according to ANSI C63.4: 2014, and tested according to FCC 47CFR 15.207 requirements. The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface. The EUT and simulators are connected to the main power through a line impedance stabilization network (LISN). The LISN provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs) Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source. The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length. Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.

3.5. Uncertainty

The measurement uncertainty is defined as \pm 2.02 dB

3.6. Test Result

| | |
|--|--------------------------|
| Site: TR1 | Time: 2017/07/09 - 08:41 |
| Limit: FCC_Part15.107_CE_AC Power_ClassB | Margin: 0 |
| Probe: ENV216_101044(0.009-30MHz) | Polarity: Line |
| EUT: UWB device | Power: AC 120V/60Hz |
| Note: Mode 1 | |



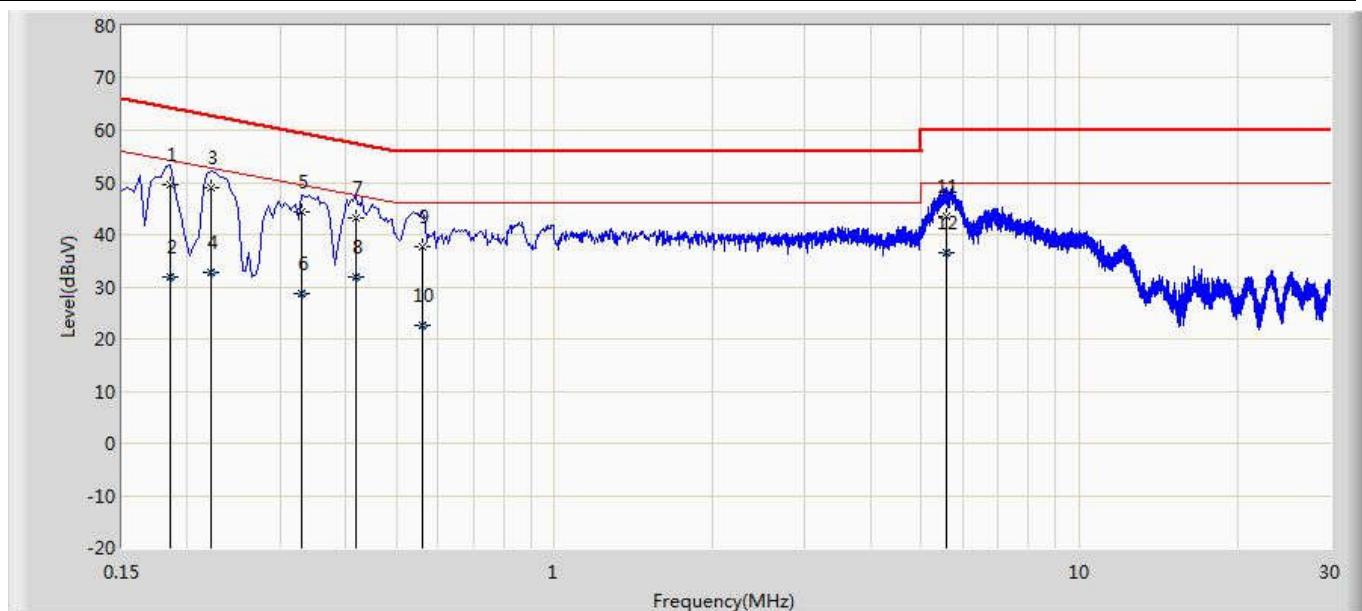
| No | Mark | Frequency (MHz) | Measure Level (dBuV) | Reading Level (dBuV) | Over Limit (dB) | Limit (dBuV) | Probe (dB) | Cable (dB) | Amp (dB) | Type |
|----|------|-----------------|----------------------|----------------------|-----------------|--------------|------------|------------|----------|------|
| 1 | | 0.190 | 48.418 | 38.798 | -15.619 | 64.037 | 9.592 | 0.028 | 0.000 | QP |
| 2 | | 0.190 | 28.759 | 19.140 | -25.277 | 54.037 | 9.592 | 0.028 | 0.000 | AV |
| 3 | | 0.230 | 46.712 | 37.092 | -15.738 | 62.450 | 9.590 | 0.030 | 0.000 | QP |
| 4 | | 0.230 | 30.361 | 20.740 | -22.089 | 52.450 | 9.590 | 0.030 | 0.000 | AV |
| 5 | | 0.430 | 41.769 | 32.138 | -15.484 | 57.253 | 9.590 | 0.041 | 0.000 | QP |
| 6 | | 0.430 | 28.685 | 19.054 | -18.568 | 47.253 | 9.590 | 0.041 | 0.000 | AV |
| 7 | * | 0.554 | 41.474 | 31.837 | -14.526 | 56.000 | 9.590 | 0.047 | 0.000 | QP |
| 8 | | 0.554 | 27.538 | 17.901 | -18.462 | 46.000 | 9.590 | 0.047 | 0.000 | AV |
| 9 | | 0.958 | 38.978 | 29.316 | -17.022 | 56.000 | 9.599 | 0.064 | 0.000 | QP |
| 10 | | 0.958 | 24.517 | 14.855 | -21.483 | 46.000 | 9.599 | 0.064 | 0.000 | AV |
| 11 | | 5.466 | 40.679 | 30.902 | -19.321 | 60.000 | 9.625 | 0.153 | 0.000 | QP |
| 12 | | 5.466 | 33.846 | 24.068 | -16.154 | 50.000 | 9.625 | 0.153 | 0.000 | AV |

Note:

1. All Readings below 1GHz are Quasi-Peak, above are performed with peak and/or average measurements as necessary.

2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Factor(Probe+Cable-Amp).

| | |
|--|--------------------------|
| Site: TR1 | Time: 2017/07/09 - 08:44 |
| Limit: FCC_Part15.107_CE_AC Power_ClassB | Margin: 0 |
| Probe: ENV216_101044(0.009-30MHz) | Polarity: Neutral |
| EUT: UWB device | Power: AC 120V/60Hz |
| Note: Mode 1 | |



| No | Mark | Frequency (MHz) | Measure Level (dBuV) | Reading Level (dBuV) | Over Limit (dB) | Limit (dBuV) | Probe (dB) | Cable (dB) | Amp (dB) | Type |
|----|------|-----------------|----------------------|----------------------|-----------------|--------------|------------|------------|----------|------|
| 1 | | 0.186 | 49.705 | 40.106 | -14.508 | 64.213 | 9.573 | 0.027 | 0.000 | QP |
| 2 | | 0.186 | 32.007 | 22.407 | -22.207 | 54.213 | 9.573 | 0.027 | 0.000 | AV |
| 3 | | 0.222 | 49.006 | 39.403 | -13.738 | 62.744 | 9.571 | 0.031 | 0.000 | QP |
| 4 | | 0.222 | 32.811 | 23.208 | -19.933 | 52.744 | 9.571 | 0.031 | 0.000 | AV |
| 5 | | 0.330 | 44.370 | 34.763 | -15.081 | 59.451 | 9.575 | 0.033 | 0.000 | QP |
| 6 | | 0.330 | 28.589 | 18.981 | -20.862 | 49.451 | 9.575 | 0.033 | 0.000 | AV |
| 7 | | 0.418 | 43.255 | 33.638 | -14.233 | 57.488 | 9.578 | 0.039 | 0.000 | QP |
| 8 | | 0.418 | 31.961 | 22.344 | -15.527 | 47.488 | 9.578 | 0.039 | 0.000 | AV |
| 9 | | 0.562 | 37.794 | 28.160 | -18.206 | 56.000 | 9.589 | 0.045 | 0.000 | QP |
| 10 | | 0.562 | 22.493 | 12.859 | -23.507 | 46.000 | 9.589 | 0.045 | 0.000 | AV |
| 11 | * | 5.586 | 43.378 | 33.608 | -16.622 | 60.000 | 9.616 | 0.154 | 0.000 | QP |
| 12 | * | 5.586 | 36.409 | 26.640 | -13.591 | 50.000 | 9.616 | 0.154 | 0.000 | AV |

Note:

1. All Readings below 1GHz are Quasi-Peak, above are performed with peak and/or average measurements as necessary.
2. " * ", means this data is the worst emission level.

4. Radiated Emission

4.1. Test Equipment

Radiated Emission / AC-2

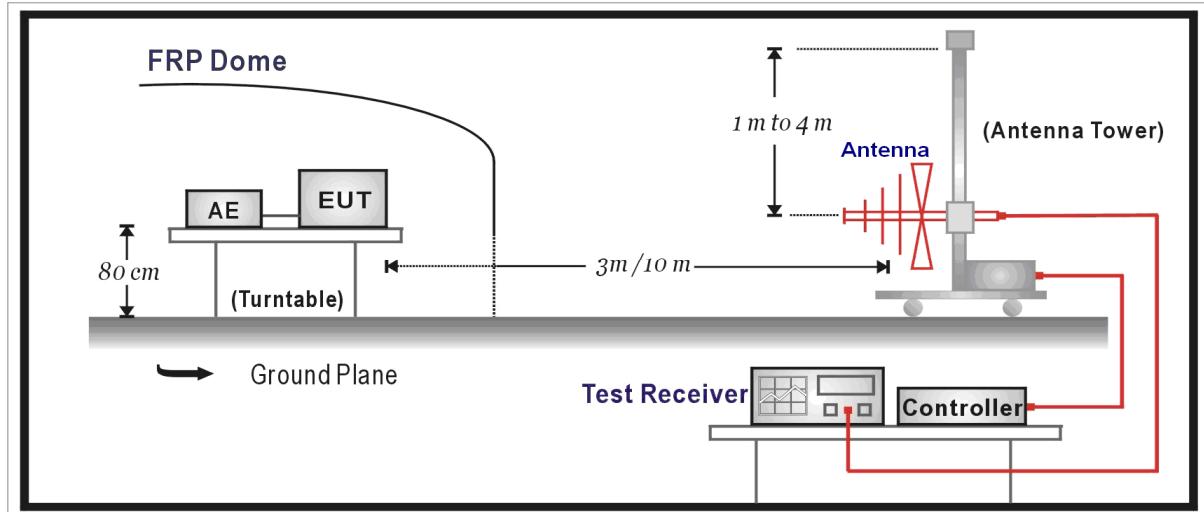
| Instrument | Manufacturer | Type No. | Serial No. | Cal. Due Date |
|--------------------------------|--------------|--------------|------------|---------------|
| EMI Test Receiver | R&S | ESCI | 100573 | 2018.03.10 |
| Loop Antenna | R&S | HFH2-Z2 | 833799/003 | 2017.11.25 |
| Bilog Antenna | Teseq GmbH | CBL6112D | 27611 | 2017.10.10 |
| Coaxial Cable | Huber+Suhner | SUCOFLEX 106 | AC2-C | 2018.02.28 |
| Temperature/Humidit y Meter | Zhicheng | ZC1-2 | AC2-TH | 2018.01.07 |

Radiated Emission / AC-5

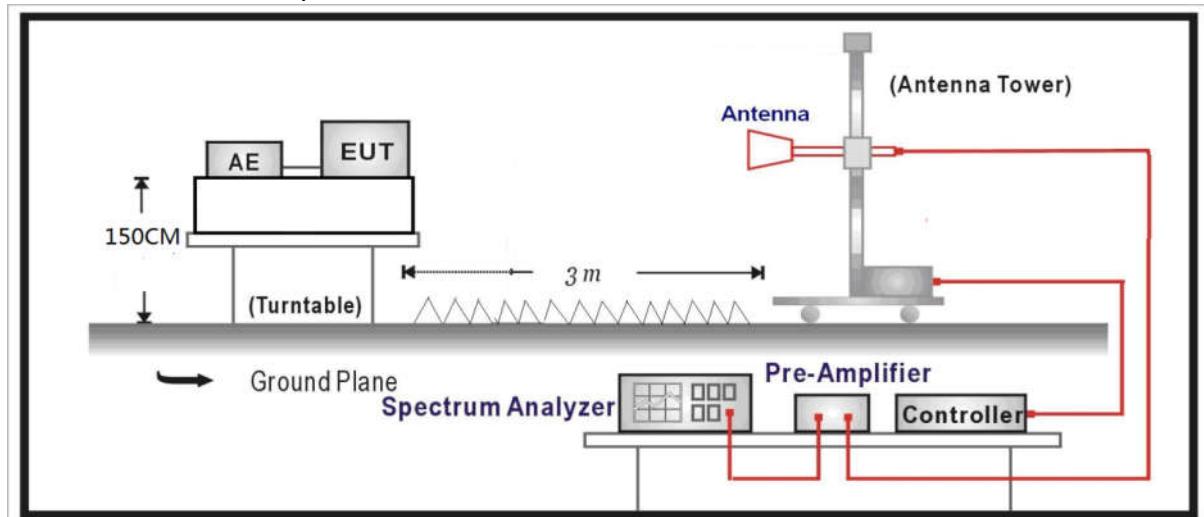
| Instrument | Manufacturer | Type No. | Serial No. | Cal. Due Date |
|--------------------------------|--------------|--------------|-------------|---------------|
| Spectrum Analyzer | Agilent | N9010A | MY48030494 | 2018.05.12 |
| Preamplifier | Miteq | NSP1800-25 | 1364185 | 2018.05.03 |
| Preamplifier | QuieTek | AP-040G | CHM-0906001 | 2018.05.03 |
| Bilog Antenna | Teseq GmbH | CBL6112D | 27612 | 2017.10.15 |
| Broad-Band Horn Antenna | Schwarzbeck | BBHA9120D | 733 | 2018.02.26 |
| DRG Horn | ETS-Lindgren | 3117 | 00167055 | 2017.07.16 |
| Broad-Band Horn Antenna | Schwarzbeck | BBHA9170 | 294 | 2018.04.10 |
| Coaxial Cable | Huber+Suhner | SUCOFLEX 106 | AC5-C1 | 2018.02.28 |
| Coaxial Cable | Huber+Suhner | SUCOFLEX 106 | AC5-C2 | 2018.02.28 |
| Coaxial Cable | Huber+Suhner | SUCOFLEX 102 | AC5-C3 | 2018.02.28 |
| Temperature/Humidit y Meter | Zhicheng | ZC1-2 | AC5-TH | 2018.01.07 |

4.2. Test Setup

Below 1GHz Test Setup:



Above 1GHz Test Setup:



4.3. Limit

| FCC Part 15 Subpart C Paragraph 15.209 | | |
|--|--------------|----------------------|
| Frequency (MHz) | Distance (m) | Level (dB μ V/m) |
| 30 - 88 | 3 | 40 |
| 88 - 216 | 3 | 43.5 |
| 216 - 960 | 3 | 46 |
| Above 960 | 3 | 54 |

Note 1: The lower limit shall apply at the transition frequency.

Note 2: Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

Note 3: E field strength (dB μ V/m) = 20 log E field strength (μ V/m)

Note 4: E field strength (dB μ V/m) = EIRP (dBm) + 95.2

The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in §15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

| Fundamental frequency (MHz) | EIRP in dBm |
|-----------------------------|-------------|
| 960-1610 | -75.3 |
| 1610-1990 | -63.3 |
| 1990-3100 | -61.3 |
| 3100-10600 | -41.3 |
| Above 10600 | -61.3 |

4.4. Test Procedure

The EUT was setup according to ANSI C63.4: 2014 & ANSI C63.10: 2013 for compliance to FCC 47CFR 15.519 requirements.

The EUT is placed on a turn table which is 0.8 meter above ground for below 1GHz and 1.5 meter above ground for above 1GHz. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.4: 2014 on radiated measurement.

The resolution bandwidth below 1GHz setting on the field strength meter is 120 kHz and above 1GHz is 1MHz. The video bandwidth are normally three times of resolution bandwidth.

The frequency range from 30MHz to 10th harmonic is checked.

Note: When doing emission measurement above 1GHz, the horn antenna will be bended down a little (as horn antenna has the narrow beamwidth) in order to keeping the antenna in the “cone of radiation” of EUT. The 3dB beamwidth is 10~60 degrees for H-plane and 10~90 degrees for E-plane.

4.5. Uncertainty

The measurement uncertainty above 1G is defined as \pm 3.9 dB
below 1G is defined as \pm 3.8 dB

4.6. Test Result

Mode 1: Transmitter

| Chain | CH | Antenna | Frequency (MHz) | Reading Level (dBm) | Factor (dB) | Measure Level (dBm) | Limit (dBm) | Over Limit (dB) | Detector |
|-------|----|---------|-----------------|---------------------|-------------|---------------------|--------------|-----------------|----------|
| Ant 0 | 1 | H | 6916.000 | -49.165 | 4.195 | -44.970 | -41.3(Note3) | -3.67 | PK |
| | | H | 7086.000 | -51.085 | 4.301 | -46.784 | -41.3(Note3) | -5.484 | PK |
| | | V | 7018.000 | -36.347 | 3.435 | -32.912 | N/A | N/A | PK |
| | | V | 7018.000 | -49.109 | 3.435 | -45.674 | -41.3 | -4.374 | AV |
| | | V | 14580.000 | -59.886 | 11.752 | -48.134 | N/A | N/A | PK |
| | | V | 14580.000 | -76.938 | 11.752 | -65.186 | -61.3 | -3.886 | AV |

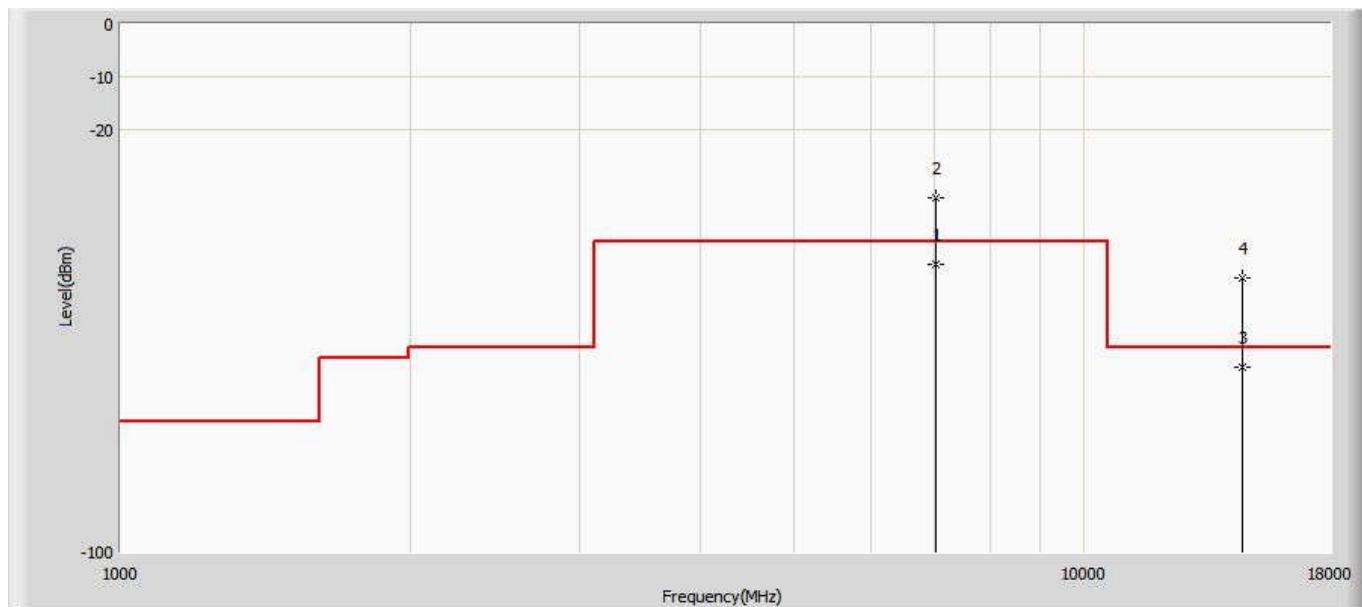
Note: 1. Measure Level = Reading Level + Factor.

Note: 2. The test frequency range, 9kHz~30MHz, 18GHz~40GHz, both of the worst case are at least 20dB below the limits, therefore no data appear in the report.

Note: 3. This limit applies for using average detector, if the test result on peak is lower than average limit, then average measurement needn't be performed.

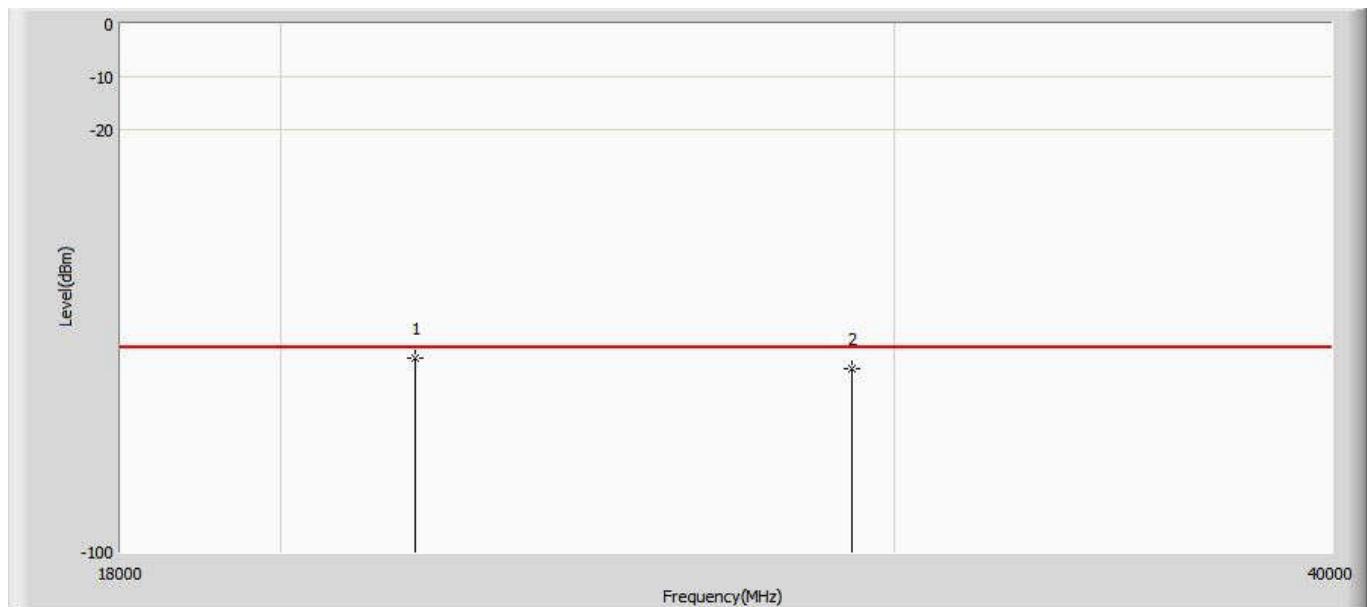
Note 4: E field strength (dB μ V/m) = EIRP (dBm) + 95.2

| | |
|--------------------------------|--------------------------|
| Site: AC5 | Time: 2017/07/11 - 14:02 |
| Limit: UWB-1 | Margin: 0 |
| Probe: 1-18G(2016.12.1 Change) | Polarity: Vertical |
| EUT: X4M02 | Power: DC5V |
| Note: Mode1 | |



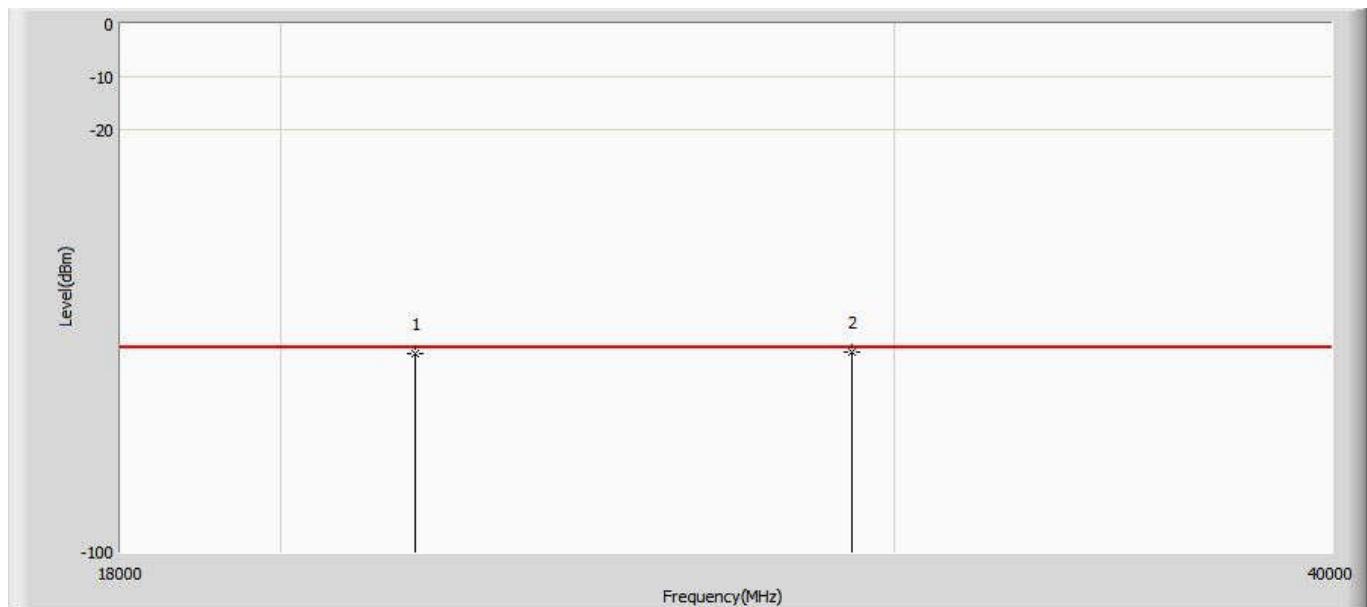
| No | Mark | Frequency (MHz) | Measure Level (dBm) | Reading Level (dBm) | Over Limit (dB) | Limit (dBm) | Factor (dB) | Type |
|----|------|-----------------|---------------------|---------------------|-----------------|-------------|-------------|------|
| 1 | | 7018.000 | -45.674 | -49.109 | -4.374 | -41.300 | 3.435 | AV |
| 2 | | 7018.000 | -32.912 | -36.347 | 8.388 | -41.300 | 3.435 | PK |
| 3 | | 14580.000 | -65.186 | -76.938 | -3.886 | -61.300 | 11.752 | AV |
| 4 | * | 14580.000 | -48.134 | -59.886 | 13.166 | -61.300 | 11.752 | PK |

| | |
|---------------------------------|-------------------------|
| Site: AC5 | Time: 2017/08/08- 17:29 |
| Limit: UWB-1 | Margin: 0 |
| Probe: 18-40G(2016.12.1 Change) | Polarity: Horizontal |
| EUT: X4M02 | Power: DC5V |
| Note: Mode1 | |



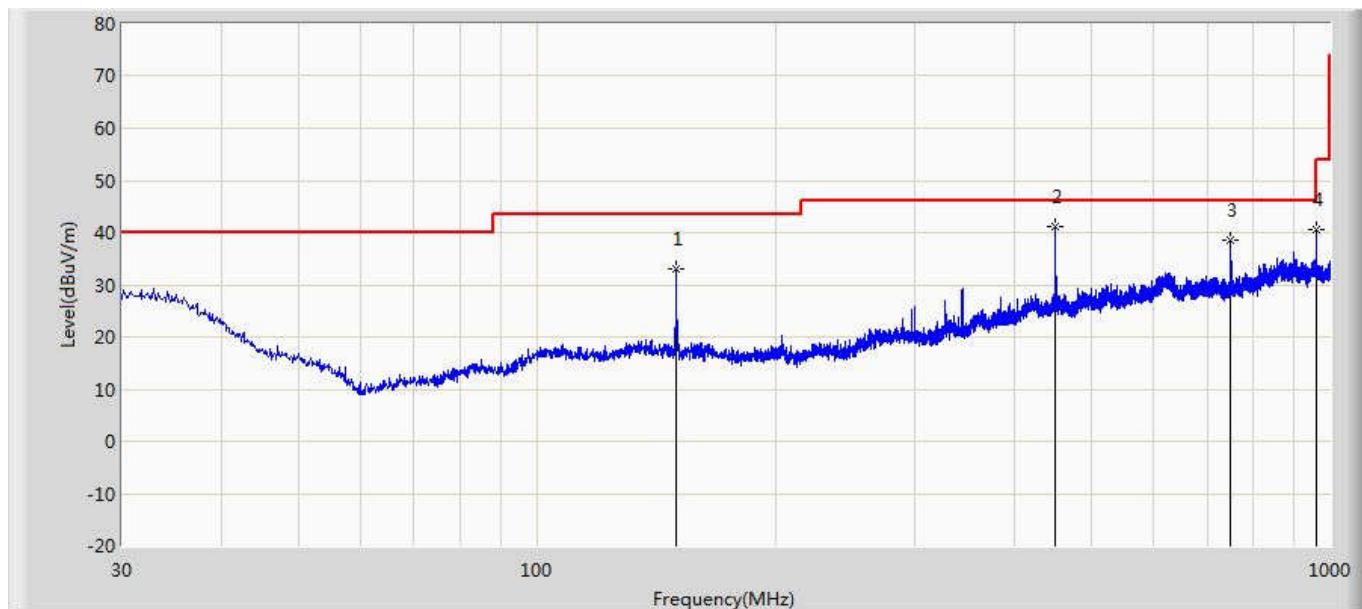
| No | Mark | Frequency (MHz) | Measure Level (dBm) | Reading Level (dBm) | Over Limit (dB) | Limit (dBm) | Factor (dB) | Type |
|----|------|-----------------|---------------------|---------------------|-----------------|-------------|-------------|------|
| 1 | * | 21870.000 | -63.354 | -56.722 | -2.054 | -61.300 | -6.632 | PK |
| 2 | | 29160.000 | -65.461 | -69.045 | -4.161 | -61.300 | 3.584 | PK |

| | |
|---------------------------------|--------------------------|
| Site: AC5 | Time: 2017/08/08 - 17:29 |
| Limit: UWB-1 | Margin: 0 |
| Probe: 18-40G(2016.12.1 Change) | Polarity: Vertical |
| EUT: X4M02 | Power: DC5V |
| Note: Mode1 | |



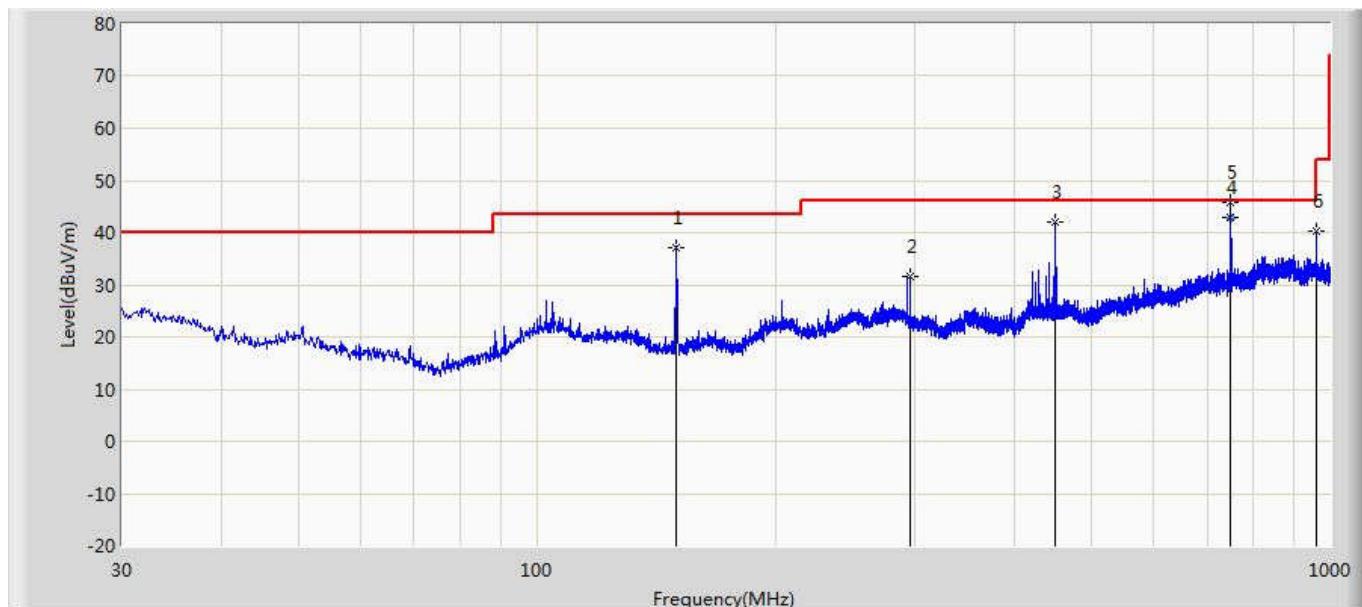
| No | Mark | Frequency (MHz) | Measure Level (dBm) | Reading Level (dBm) | Over Limit (dB) | Limit (dBm) | Factor (dB) | Type |
|----|------|-----------------|---------------------|---------------------|-----------------|-------------|-------------|------|
| 1 | | 21870.000 | -62.476 | -55.675 | -1.176 | -61.300 | -6.801 | PK |
| 2 | * | 29160.000 | -62.112 | -64.598 | -0.812 | -61.300 | 2.486 | PK |

| | |
|-------------------------------------|--------------------------|
| Site: AC2 | Time: 2017/07/03 - 15:01 |
| Limit: FCC_Part15.109_RE(3m)_ClassB | Margin: 0 |
| Probe: AC2_3M(30-1000M) | Polarity: Horizontal |
| EUT: UWB device | Power: DC5V |
| Note: Mode1 | |



| No | Mark | Frequency (MHz) | Measure Level (dBuV/m) | Reading Level (dBuV) | Over Limit (dB) | Limit (dBuV/m) | Factor (dB) | Type |
|----|------|-----------------|------------------------|----------------------|-----------------|----------------|-------------|------|
| 1 | | 149.916 | 32.972 | 15.984 | -10.528 | 43.500 | 16.988 | PK |
| 2 | * | 450.010 | 41.266 | 14.341 | -4.734 | 46.000 | 26.925 | PK |
| 3 | | 750.104 | 38.682 | 9.081 | -7.318 | 46.000 | 29.601 | PK |
| 4 | | 960.109 | 40.654 | 7.722 | -13.346 | 54.000 | 32.932 | PK |

| | |
|-------------------------------------|--------------------------|
| Site: AC2 | Time: 2017/07/03 - 15:02 |
| Limit: FCC_Part15.109_RE(3m)_ClassB | Margin: 0 |
| Probe: AC2_3M(30-1000M) | Polarity: Vertical |
| EUT: UWB device | Power: DC5V |
| Note: Mode1 | |



| No | Mark | Frequency (MHz) | Measure Level (dBuV/m) | Reading Level (dBuV) | Over Limit (dB) | Limit (dBuV/m) | Factor (dB) | Type |
|----|------|-----------------|------------------------|----------------------|-----------------|----------------|-------------|------|
| 1 | | 149.916 | 37.023 | 18.989 | -6.477 | 43.500 | 18.034 | PK |
| 2 | | 295.538 | 31.649 | 7.651 | -14.351 | 46.000 | 23.998 | PK |
| 3 | | 450.010 | 42.169 | 16.115 | -3.831 | 46.000 | 26.054 | PK |
| 4 | | 749.923 | 42.957 | 12.100 | -3.043 | 46.000 | 30.857 | QP |
| 5 | * | 749.982 | 45.838 | 14.977 | -0.162 | 46.000 | 30.861 | PK |
| 6 | | 960.109 | 40.211 | 7.348 | -13.789 | 54.000 | 32.863 | PK |

| | |
|-------------|------|
| Test Result | Pass |
|-------------|------|

5. Radiated Emission in GPS Band

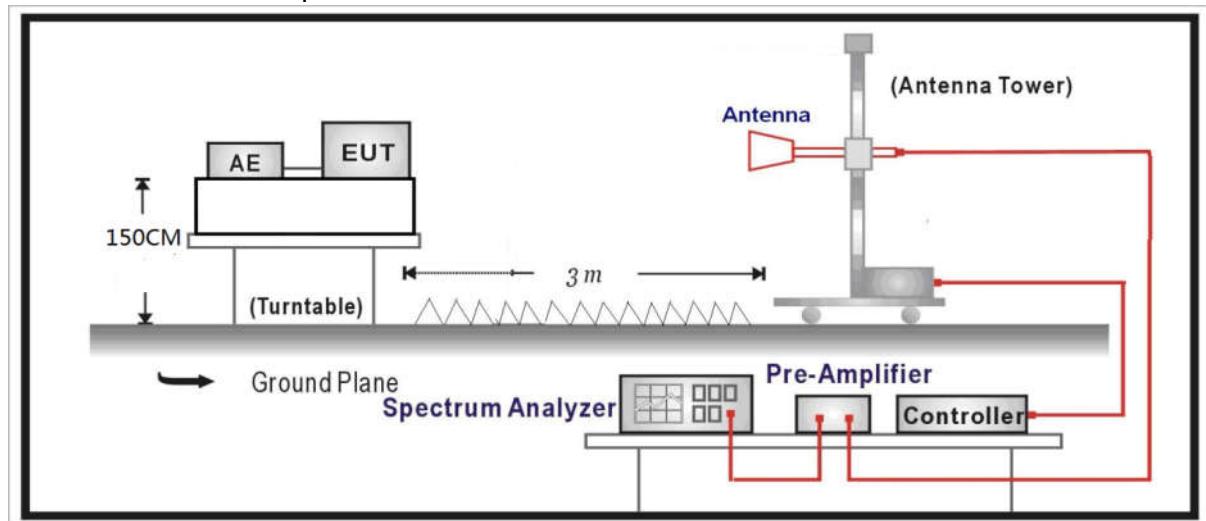
5.1. Test Equipment

Radiated Emission in GPS Band/ AC-5

| Instrument | Manufacturer | Type No. | Serial No. | Cali. Due Date |
|----------------------------|--------------|--------------|-------------|----------------|
| Spectrum Analyzer | Agilent | N9010A | MY48030494 | 2018.05.12 |
| Preamplifier | Miteq | NSP1800-25 | 1364185 | 2018.05.03 |
| Preamplifier | QuieTek | AP-040G | CHM-0906001 | 2018.05.03 |
| Bilog Antenna | Teseq GmbH | CBL6112D | 27612 | 2017.10.15 |
| Broad-Band Horn Antenna | Schwarzbeck | BBHA9120D | 733 | 2018.02.26 |
| DRG Horn | ETS-Lindgren | 3117 | 00167055 | 2017.07.16 |
| Broad-Band Horn Antenna | Schwarzbeck | BBHA9170 | 294 | 2018.04.10 |
| Coaxial Cable | Huber+Suhner | SUCOFLEX 106 | AC5-C1 | 2018.02.28 |
| Coaxial Cable | Huber+Suhner | SUCOFLEX 106 | AC5-C2 | 2018.02.28 |
| Coaxial Cable | Huber+Suhner | SUCOFLEX 102 | AC5-C3 | 2018.02.28 |
| Temperature/Humidity Meter | Zhicheng | ZC1-2 | AC5-TH | 2018.01.07 |

5.2. Test Setup

Above 1GHz Test Setup:



5.3. Limit

In addition to the radiated emission limits specified in the table in paragraph (c) of this section, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

| Fundamental frequency (MHz) | EIRP in dBm |
|-----------------------------|-------------|
| 1164-1240 | -85.3 |
| 1559-1610 | -85.3 |

5.4. Test Procedure

The EUT was setup according to ANSI C63.4: 2014 & ANSI C63.10: 2013 for compliance to FCC 47CFR 15.519 requirements.

The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.4: 2014 on radiated measurement.

The resolution bandwidth is 1kHz. The video bandwidth are normally three times of resolution bandwidth.

The frequency range from 1164-1240MHz & 1559-1610MHz is checked.

Note: When doing emission measurement above 1GHz, the horn antenna will be bended down a little (as horn antenna has the narrow beamwidth) in order to keeping the antenna in the “cone of radiation” of EUT. The 3dB beamwidth is 10~60 degrees for H-plane and 10~90 degrees for E-plane.

5.5. Uncertainty

The measurement uncertainty above 1G is defined as \pm 3.9 dB

5.6. Test Result

Mode 1: Transmitter

| Chain | CH | Antenna | Frequency (MHz) | Reading Level (dBm) | Factor (dB) | Measure Level (dBm) | Limit (dBm) | Over Limit (dB) | Detector |
|-------|----|---------|-----------------|---------------------|-------------|---------------------|--------------|-----------------|----------|
| Ant 0 | 1 | H | 1214.623 | -84.668 | -4.908 | -89.576 | -85.3(Note2) | -4.276 | PK |
| | | V | 1226.745 | -85.242 | -4.794 | -90.036 | -85.3(Note2) | -4.736 | PK |
| | | H | 1586.736 | -82.808 | -4.356 | -87.164 | -85.3(Note2) | -1.864 | PK |
| | | V | 1580.471 | -81.534 | -4.394 | -85.928 | -85.3(Note2) | -0.628 | PK |

Note: 1. Measure Level = Reading Level + Factor.

Note: 2. This limit applies for using average detector, if the test result on peak is lower than average limit, then average measurement needn't be performed.

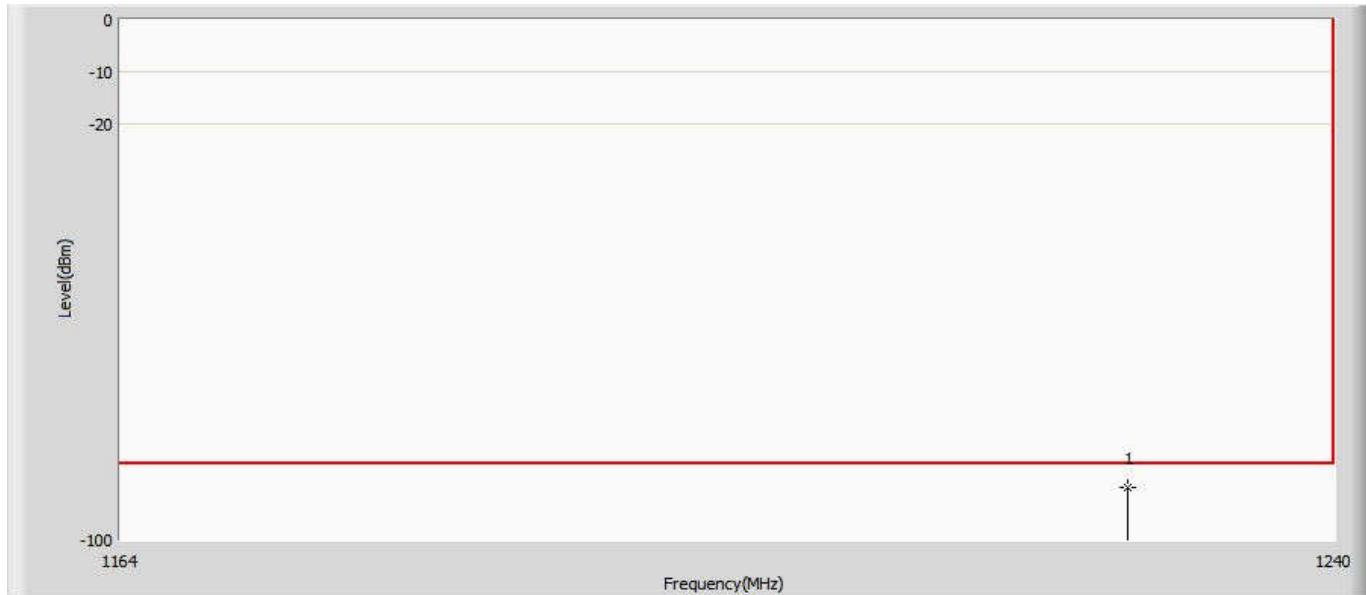
Note 3: E field strength (dB μ V/m) = EIRP (dBm) + 95.2

| | |
|--------------------------------|--------------------------|
| Site: AC5 | Time: 2017/07/11 - 14:02 |
| Limit: UWB-4 | Margin: 0 |
| Probe: 1-18G(2016.12.1 Change) | Polarity: Horizontal |
| EUT: X4M02 | Power: DC5V |
| Note: Mode1 | |



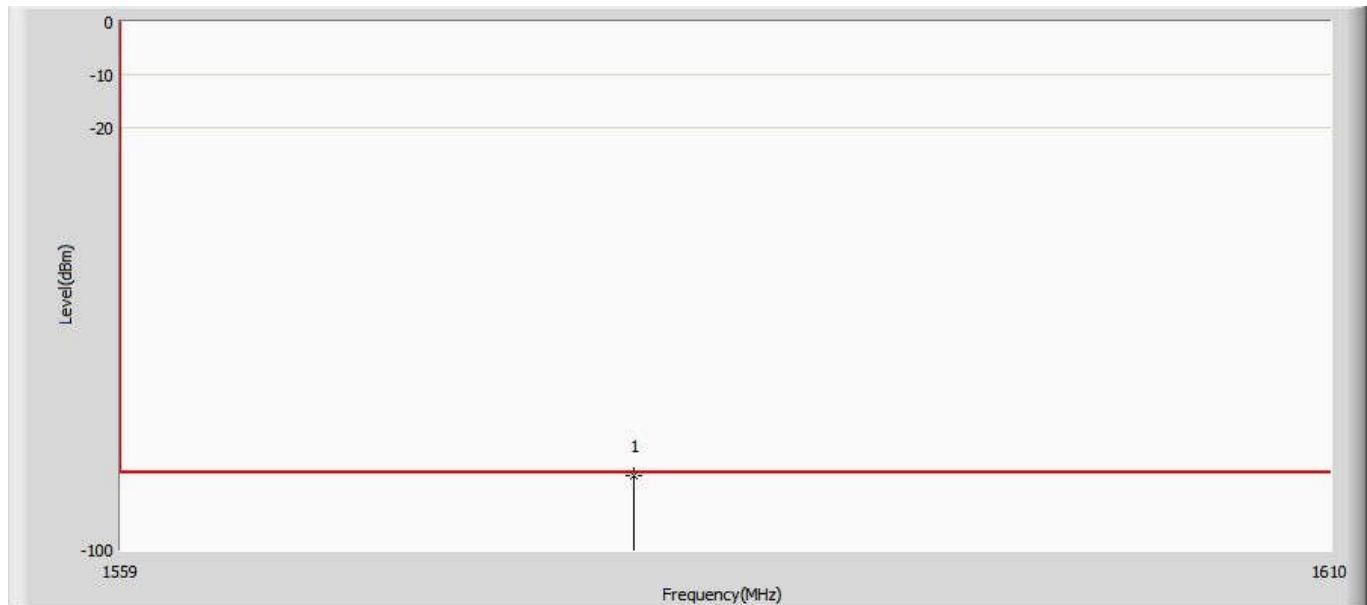
| No | Mark | Frequency (MHz) | Measure Level (dBm) | Reading Level (dBm) | Over Limit (dB) | Limit (dBm) | Factor (dB) | Type |
|----|------|--------------------|------------------------|------------------------|--------------------|----------------|----------------|------|
| 1 | * | 1214.623 | -89.576 | -84.668 | -4.276 | -85.300 | -4.908 | PK |

| | |
|--------------------------------|--------------------------|
| Site: AC5 | Time: 2017/07/11 - 14:04 |
| Limit: UWB-4 | Margin: 0 |
| Probe: 1-18G(2016.12.1 Change) | Polarity: Horizontal |
| EUT: X4M02 | Power: DC5V |
| Note: Mode1 | |



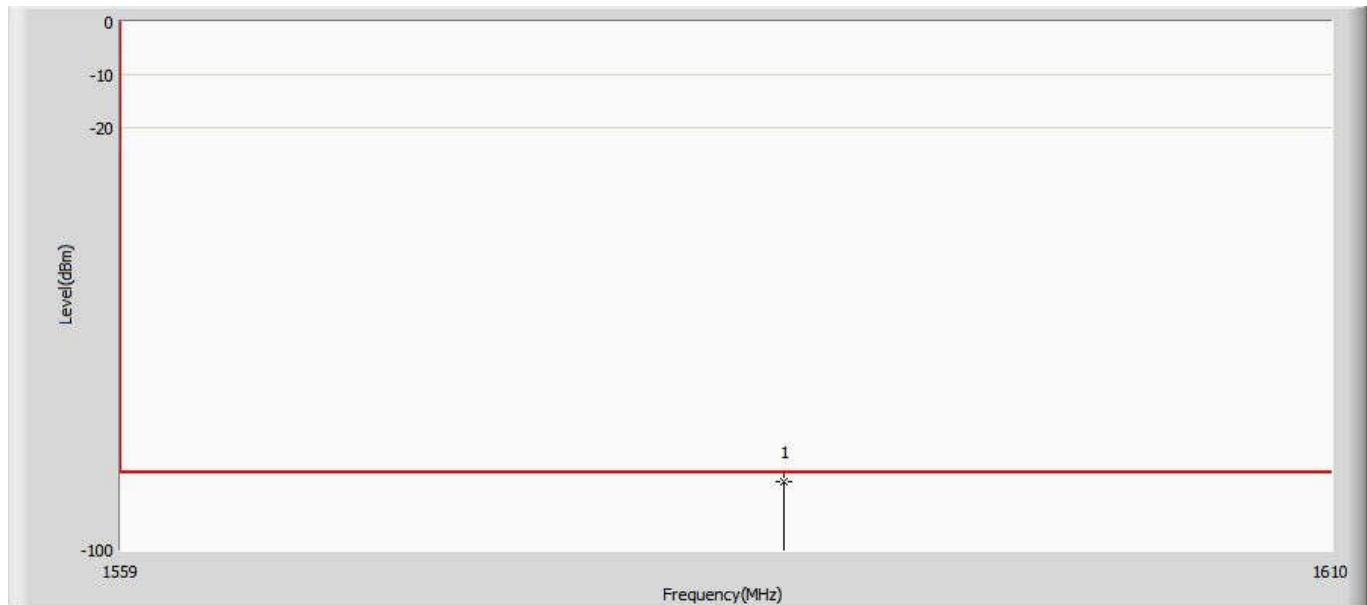
| No | Mark | Frequency (MHz) | Measure Level (dBm) | Reading Level (dBm) | Over Limit (dB) | Limit (dBm) | Factor (dB) | Type |
|----|------|--------------------|------------------------|------------------------|--------------------|----------------|----------------|------|
| 1 | * | 1226.745 | -90.036 | -85.242 | -4.736 | -85.300 | -4.794 | PK |

| | |
|--------------------------------|--------------------------|
| Site: AC5 | Time: 2017/07/11 - 14:03 |
| Limit: UWB-4 | Margin: 0 |
| Probe: 1-18G(2016.12.1 Change) | Polarity: Vertical |
| EUT: X4M02 | Power: DC5V |
| Note: Mode1 | |



| No | Mark | Frequency (MHz) | Measure Level (dBm) | Reading Level (dBm) | Over Limit (dB) | Limit (dBm) | Factor (dB) | Type |
|----|------|--------------------|------------------------|------------------------|--------------------|----------------|----------------|------|
| 1 | * | 1580.471 | -85.928 | -81.534 | -0.628 | -85.300 | -4.394 | PK |

| | |
|--------------------------------|--------------------------|
| Site: AC5 | Time: 2017/07/11 - 14:05 |
| Limit: UWB-4 | Margin: 0 |
| Probe: 1-18G(2016.12.1 Change) | Polarity: Vertical |
| EUT: X4M02 | Power: DC5V |
| Note: Mode1 | |



| No | Mark | Frequency (MHz) | Measure Level (dBm) | Reading Level (dBm) | Over Limit (dB) | Limit (dBm) | Factor (dB) | Type |
|----|------|--------------------|------------------------|------------------------|--------------------|----------------|----------------|------|
| 1 | * | 1586.736 | -87.164 | -82.808 | -1.864 | -85.300 | -4.356 | PK |

| | |
|-------------|------|
| Test Result | Pass |
|-------------|------|

6. Operational Limitations

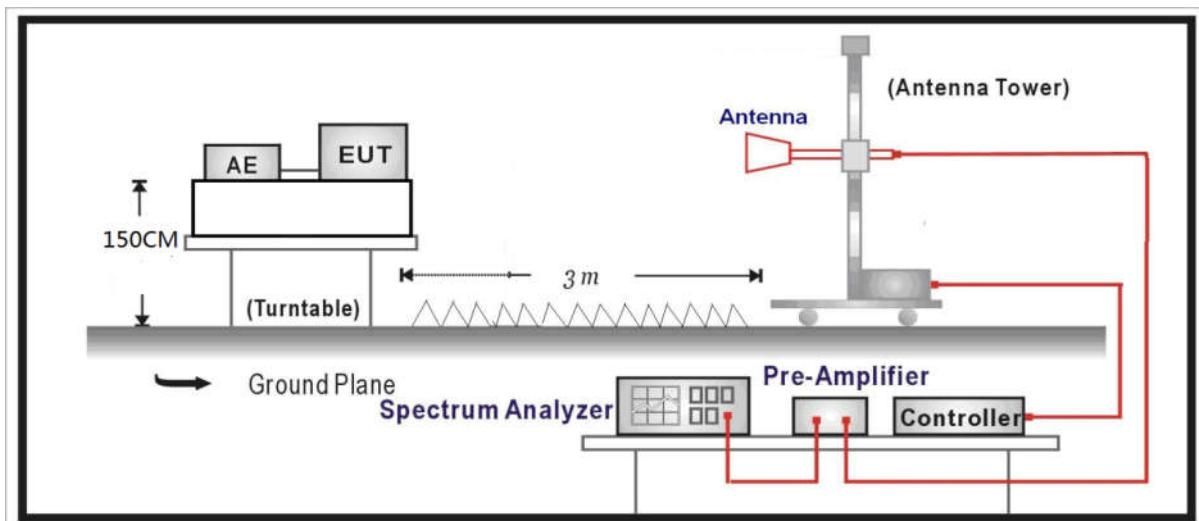
6.1. Test Equipment

Operational Limitations / AC-5

| Instrument | Manufacturer | Type No. | Serial No. | Cal. Due Date |
|----------------------------|--------------|--------------|-------------|---------------|
| Spectrum Analyzer | Agilent | N9010A | MY48030494 | 2018.05.12 |
| Preamplifier | Miteq | NSP1800-25 | 1364185 | 2018.05.03 |
| Preamplifier | QuieTek | AP-040G | CHM-0906001 | 2018.05.03 |
| Bilog Antenna | Teseq GmbH | CBL6112D | 27612 | 2017.10.15 |
| Broad-Band Horn Antenna | Schwarzbeck | BBHA9120D | 733 | 2018.02.26 |
| DRG Horn | ETS-Lindgren | 3117 | 00167055 | 2017.07.16 |
| Broad-Band Horn Antenna | Schwarzbeck | BBHA9170 | 294 | 2018.04.10 |
| Coaxial Cable | Huber+Suhner | SUCOFLEX 106 | AC5-C1 | 2018.02.28 |
| Coaxial Cable | Huber+Suhner | SUCOFLEX 106 | AC5-C2 | 2018.02.28 |
| Coaxial Cable | Huber+Suhner | SUCOFLEX 102 | AC5-C3 | 2018.02.28 |
| Temperature/Humidity Meter | Zhicheng | ZC1-2 | AC5-TH | 2018.01.07 |

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

6.2. Test Setup



6.3. Limit

A UWB device operating under the provisions of this section shall transmit only when it is sending information to an associated receiver. The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting.

6.4. Test Procedure

The EUT was tested according to ANSI C63.10: 2013 for compliance to FCC 47CFR 15F requirements.

Set RBW = 1 MHz, VBW = 3 MHz, Span = 0 Hz, remove the acknowledgement from the associated receiver to test the result.

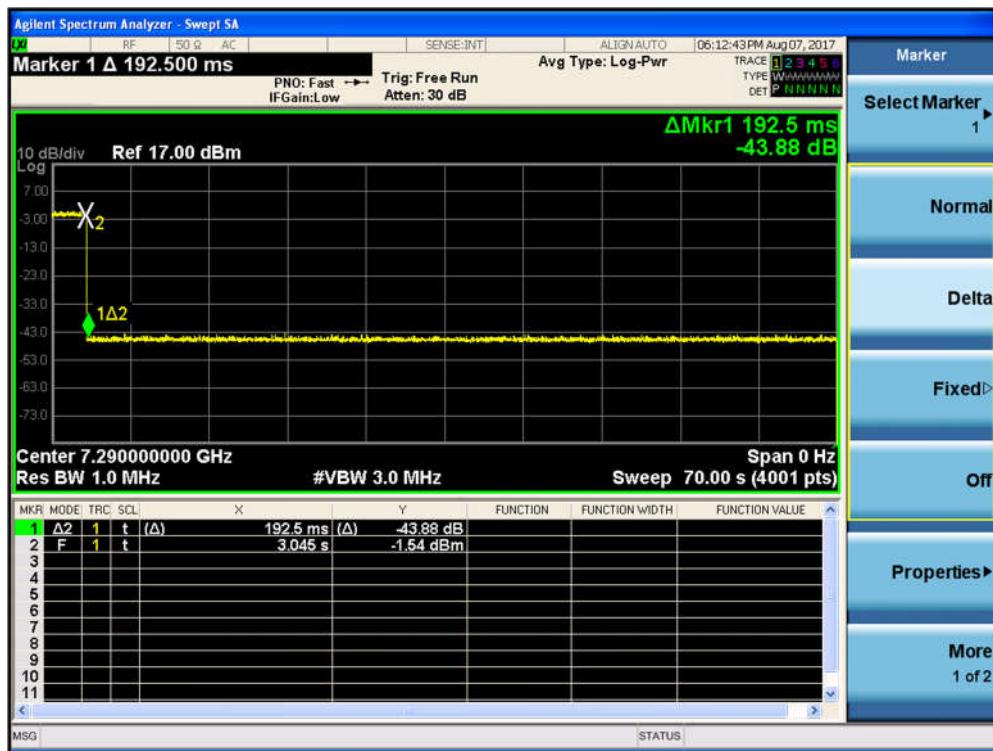
6.5. Uncertainty

The measurement uncertainty is defined as \pm 2ms

6.6. Test Result

| | | |
|-----------|---|-------------------------|
| Product | : | UWB device |
| Test Item | : | Operational Limitations |
| Test Site | : | AC-5 |
| Test Mode | : | Mode 1: Transmit |

| Frequency (MHz) | Duration from removing the acknowledgement from the associated receiver to stop transmission (ms) | Limit (s) | Result |
|-----------------|---|-----------|--------|
| 7290 | 780.0 | 10 | Pass |





Note: The device starts transmitting and it stops transmitting in 780ms without ACK .

7. 10dB Bandwidth

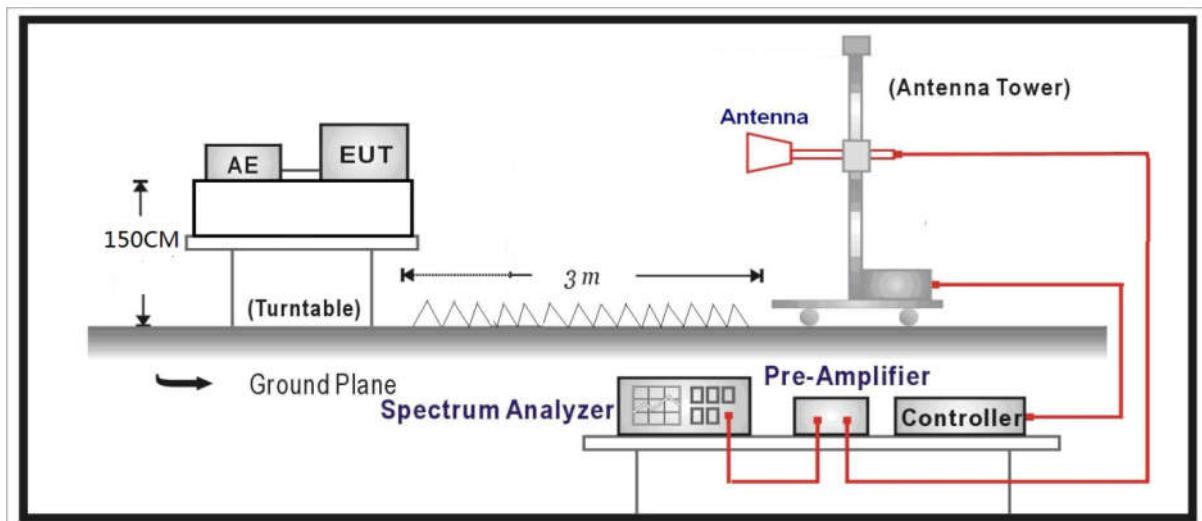
7.1. Test Equipment

10dB Bandwidth / AC-5

| Instrument | Manufacturer | Type No. | Serial No. | Cali. Due Date |
|-------------------------------|--------------|--------------|-----------------|----------------|
| Spectrum Analyzer | Agilent | N9010A | MY48030494 | 2018.05.12 |
| Preamplifier | Miteq | NSP1800-25 | 1364185 | 2018.05.03 |
| Preamplifier | QuieTek | AP-040G | CHM-090600 1 | 2018.05.03 |
| Bilog Antenna | Teseq GmbH | CBL6112D | 27612 | 2017.10.15 |
| Broad-Band Horn Antenna | Schwarzbeck | BBHA9120D | 733 | 2018.02.26 |
| DRG Horn | ETS-Lindgren | 3117 | 00167055 | 2017.07.16 |
| Broad-Band Horn Antenna | Schwarzbeck | BBHA9170 | 294 | 2018.04.10 |
| Coaxial Cable | Huber+Suhner | SUCOFLEX 106 | AC5-C1 | 2018.02.28 |
| Coaxial Cable | Huber+Suhner | SUCOFLEX 106 | AC5-C2 | 2018.02.28 |
| Coaxial Cable | Huber+Suhner | SUCOFLEX 102 | AC5-C3 | 2018.02.28 |
| Temperature/Humidity Meter | Zhicheng | ZC1-2 | AC5-TH | 2018.01.07 |

Note: All equipment are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

7.2. Test Setup



7.3. Limit

Ultra-wideband (UWB) transmitter. An intentional radiator that, at any point in time, has a fractional bandwidth equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth.

The UWB bandwidth of a device operating under the provisions of this section must be contained between 3100 MHz and 10,600 MHz.

7.4. Test Procedure

The EUT was tested according to ANSI C63.10: 2013 for compliance to FCC 47CFR 15.503(a) requirements.

Set RBW = 1 MHz, VBW = 3 MHz, Span = 2.5 GHz, use 10dB bandwidth function to test the result.

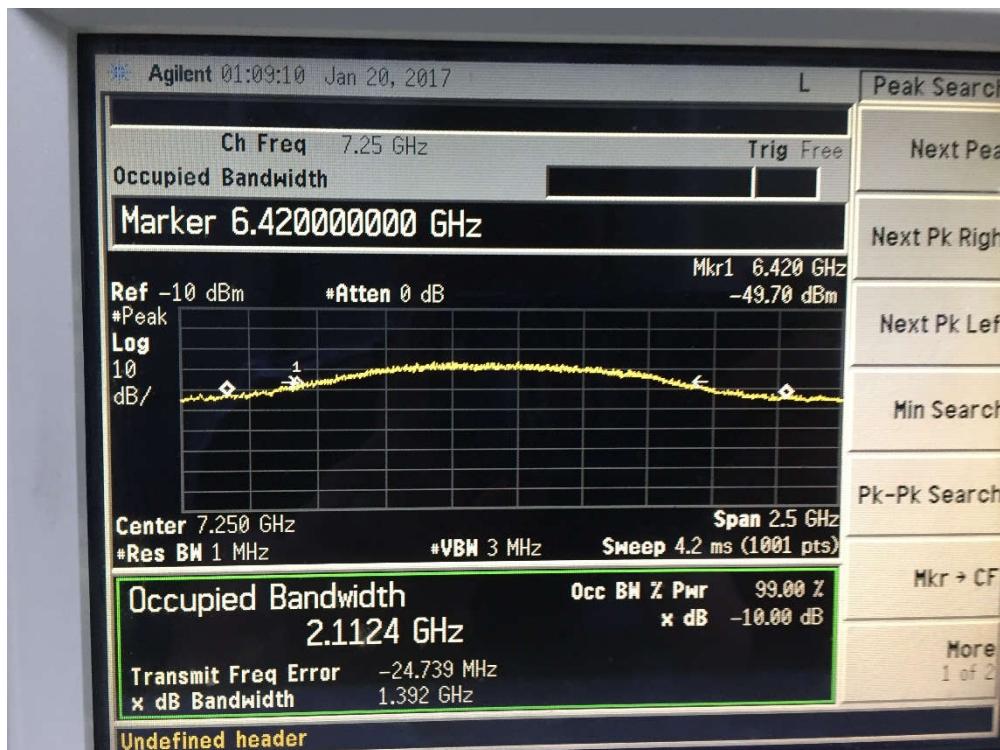
7.5. Uncertainty

The measurement uncertainty is defined as \pm 1 kHz

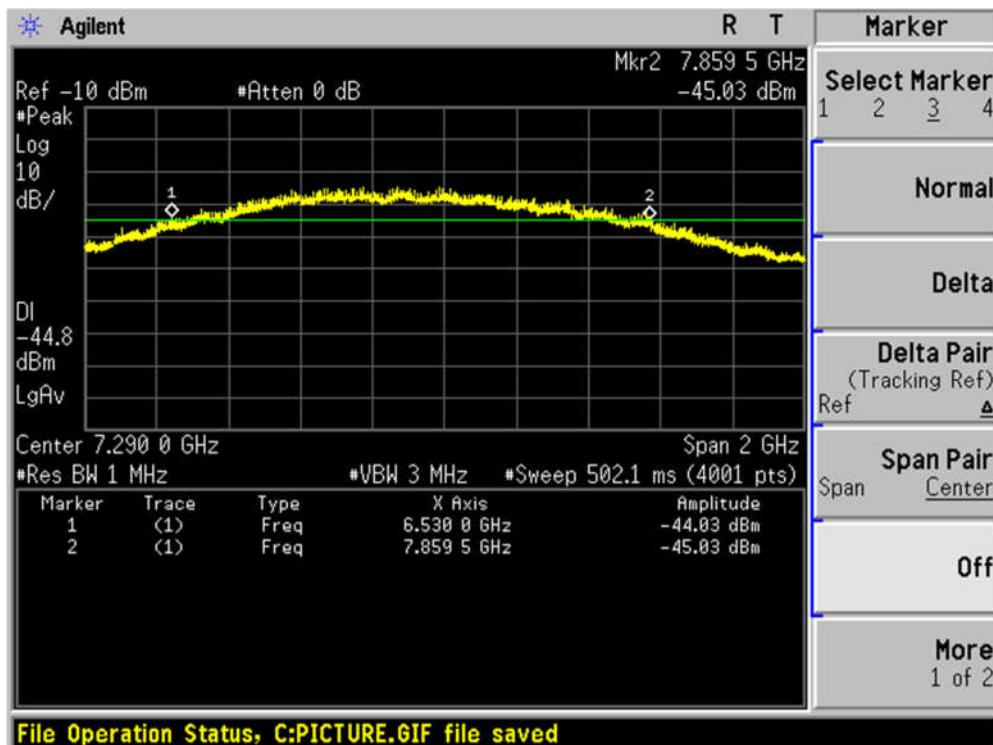
7.6. Test Result

| | | |
|-----------|---|------------------|
| Product | : | UWB device |
| Test Item | : | 10dB Bandwidth |
| Test Site | : | AC-5 |
| Test Mode | : | Mode 1: Transmit |

| Frequency (MHz) | 10dB Bandwidth (MHz) | 99% Bandwidth (MHz) | Limit (MHz) | Result |
|--------------------|-------------------------|------------------------|----------------|--------|
| 7290 | 1392 | 2112.4 | 500 | Pass |



| Frequency (MHz) | Lower Frequency (MHz) | Upper Frequency (MHz) | Limit (MHz) | | Result |
|--------------------|--------------------------|--------------------------|--------------------|--------------------|--------|
| | | | Lower Frequency | Upper Frequency | |
| 7290 | 6530.0 | 7859.5 | 3100 | 10600 | Pass |



8. EIRP

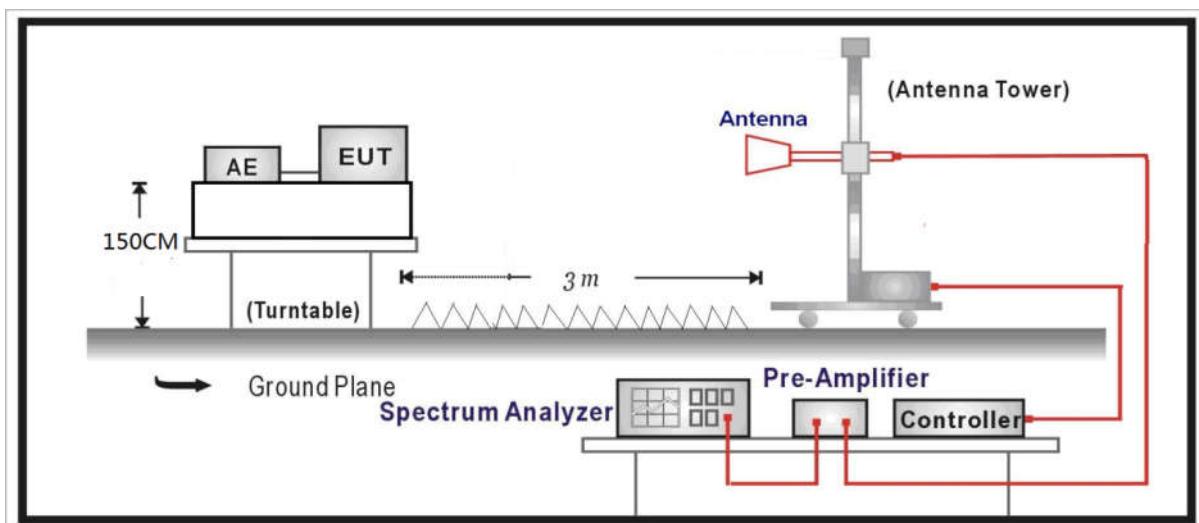
8.1. Test Equipment

EIRP / AC-5

| Instrument | Manufacturer | Type No. | Serial No. | Cal. Due Date |
|----------------------------|--------------|--------------|-------------|---------------|
| Spectrum Analyzer | Agilent | N9010A | MY48030494 | 2018.05.12 |
| Preamplifier | Miteq | NSP1800-25 | 1364185 | 2018.05.03 |
| Preamplifier | QuieTek | AP-040G | CHM-0906001 | 2018.05.03 |
| Bilog Antenna | Teseq GmbH | CBL6112D | 27612 | 2017.10.15 |
| Broad-Band Horn Antenna | Schwarzbeck | BBHA9120D | 733 | 2018.02.26 |
| DRG Horn | ETS-Lindgren | 3117 | 00167055 | 2017.07.16 |
| Broad-Band Horn Antenna | Schwarzbeck | BBHA9170 | 294 | 2018.04.10 |
| Coaxial Cable | Huber+Suhner | SUCOFLEX 106 | AC5-C1 | 2018.02.28 |
| Coaxial Cable | Huber+Suhner | SUCOFLEX 106 | AC5-C2 | 2018.02.28 |
| Coaxial Cable | Huber+Suhner | SUCOFLEX 102 | AC5-C3 | 2018.02.28 |
| Temperature/Humidity Meter | Zhicheng | ZC1-2 | AC5-TH | 2018.01.07 |

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

8.2. Test Setup



8.3. Limit

When a peak measurement is required, it is acceptable to use a resolution bandwidth other than the 50 MHz specified in this subpart. This resolution bandwidth shall not be lower than 1 MHz or greater than 50 MHz, and the measurement shall be centered on the frequency at which the highest radiated emission occurs, f_M . If a resolution bandwidth other than 50 MHz is employed, the peak EIRP limit shall be $20 \log (RBW/50)$ dBm where RBW is the resolution bandwidth in megahertz that is employed. This may be converted to a peak field strength level at 3 meters using $E(\text{dBuV/m}) = P(\text{dBm EIRP}) + 95.2$. If RBW is greater than 3 MHz, the application for certification filed with the Commission must contain a detailed description of the test procedure, calibration of the test setup, and the instrumentation employed in the testing.

8.4. Test Procedure

The EUT was setup according to ANSI C63.4: 2014 & ANSI C63.10: 2013 for compliance to FCC 47CFR 15.521(g) requirements.

The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.4: 2014 on radiated measurement.

Note: The RBW = 3MHz, VBW = 3MHz, so the EIRP limit is $20 \log (3/50) = -24.437$ dBm.

8.5. Uncertainty

The measurement uncertainty is defined as ± 3.9 dB

8.6. Test Result

| | | |
|-----------|---|------------------|
| Product | : | UWB device |
| Test Item | : | EIRP |
| Test Site | : | AC-5 |
| Test Mode | : | Mode 1: Transmit |

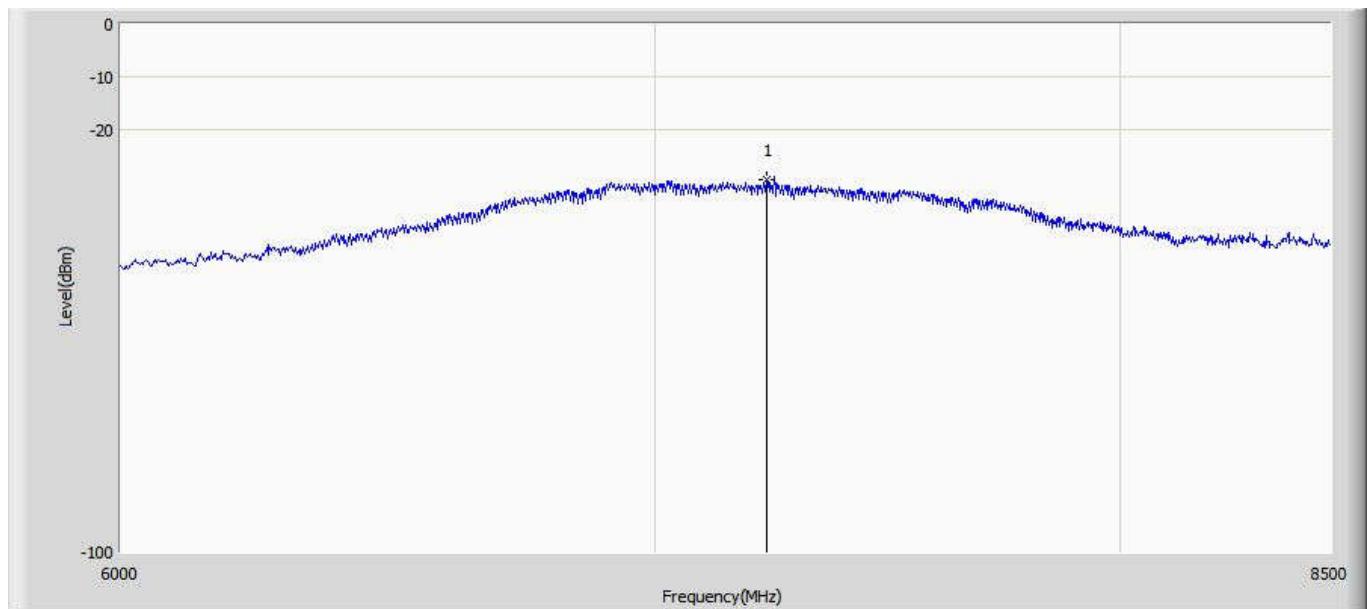
| Chain | CH | Antenna | Frequency (MHz) | Reading Level (dBm) | Factor (dB) | Measure Level (dBm) | Limit (dBm) | Over Limit (dB) | Detector |
|-------|----|---------|-----------------|---------------------|-------------|---------------------|-------------|-----------------|----------|
| Ant 0 | 1 | H | 7182.5 | -35.822 | 4.363 | -31.459 | -24.437 | -7.022 | PK |
| | | V | 7227.500 | -34.020 | 4.397 | -29.623 | -24.437 | -5.186 | PK |

Note 1: Measure Level = Reading Level + Factor.

Note 2: E field strength (dB μ V/m) = EIRP (dBm) + 95.2

Note 3: The RBW = 3MHz, so the EIRP limit is $20 \log (3/50) = -24.437$ dBm.

| | |
|--------------------------------|--------------------------|
| Site: AC5 | Time: 2017/07/11 - 14:02 |
| Limit: FCC 15.519 | Margin: 0 |
| Probe: 1-18G(2016.12.1 Change) | Polarity: Horizontal |
| EUT: X4M02 | Power: DC5V |
| Note: Mode1 | |



| No | Mark | Frequency (MHz) | Measure Level (dBm) | Reading Level (dBm) | Over Limit (dB) | Limit (dBm) | Factor (dB) | Type |
|----|------|--------------------|------------------------|------------------------|--------------------|----------------|----------------|------|
| 1 | | 7227.500 | -29.623 | -34.020 | -9.583 | -24.437 | 4.397 | PK |

9. Antenna Requirement

9.1. Limit

Antenna Requirement Limit

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

9.2. Result

The EUT use permanently attached antennas and comply with FCC 15.203.

Please refer to the attached “Internal Photograph”.

The End
