



SPORTON International Inc.

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FCC RADIO TEST REPORT

| | |
|------------------------|--|
| Applicant's company | Cybertan Technology Inc. |
| Applicant Address | No. 99, Park Avenue III, Science-based Industrial Park, Hsinchu, 308 Taiwan |
| FCC ID | N89-ZE250 |
| Manufacturer's company | Cybertan Technology Inc. |
| Manufacturer Address | No. 99, Park Avenue III, Science-based Industrial Park, Hsinchu, 308 Taiwan |

| | |
|-------------------|---------------------------------------|
| Product Name | Quark IoT gateway |
| Brand Name | CyberTAN |
| Model No. | ZE250-A-IN |
| Test Rule Part(s) | 47 CFR FCC Part 15 Subpart C § 15.249 |
| Test Freq. Range | 902~928MHz |
| Received Date | Mar. 09, 2016 |
| Final Test Date | May 24, 2016 |
| Submission Type | Original Equipment |

Statement

Test result included is only for the Z-wave of the product.

The test result in this report refers exclusively to the presented test model / sample.

Without written approval of SPORTON International Inc., the test report shall not be reproduced except in full.

The measurements and test results shown in this test report were made in accordance with the procedures and found in compliance with the limit given in **ANSI C63.10-2013** and **47 CFR FCC Part 15 Subpart C**.

The test equipment used to perform the test is calibrated and traceable to NML/ROC.



Table of Contents

| | |
|--|----------------|
| 1. VERIFICATION OF COMPLIANCE | 1 |
| 2. SUMMARY OF THE TEST RESULT | 2 |
| 3. GENERAL INFORMATION | 3 |
| 3.1. Product Details..... | 3 |
| 3.2. Accessories..... | 3 |
| 3.3. Table for Filed Antenna..... | 4 |
| 3.4. Table for Carrier Frequencies | 5 |
| 3.5. Table for Test Modes | 5 |
| 3.6. Table for Testing Locations..... | 5 |
| 3.7. Table for Supporting Units | 6 |
| 3.8. Duty Cycle..... | 6 |
| 3.9. Test Configurations | 7 |
| 4. TEST RESULT | 11 |
| 4.1. AC Power Line Conducted Emissions Measurement..... | 11 |
| 4.2. Field Strength of Fundamental Emissions Measurement | 15 |
| 4.3. 20dB Spectrum Bandwidth Measurement | 18 |
| 4.4. Radiated Emissions Measurement | 20 |
| 4.5. Band Edge Emissions Measurement | 27 |
| 4.6. Antenna Requirements | 29 |
| 5. LIST OF MEASURING EQUIPMENTS | 30 |
| 6. MEASUREMENT UNCERTAINTY..... | 31 |
| APPENDIX A. TEST PHOTOS | A1 ~ A5 |

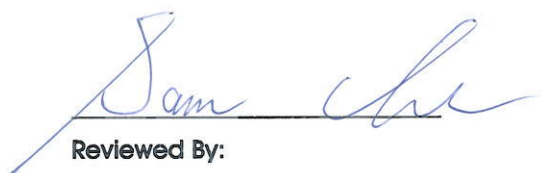
History of This Test Report

| REPORT NO. | VERSION | DESCRIPTION | ISSUED DATE |
|------------|---------|-------------------------|--------------|
| FR632503AD | Rev. 01 | Initial issue of report | May 27, 2016 |
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1. VERIFICATION OF COMPLIANCE

Product Name : Quark IoT gateway
Brand Name : CyberTAN
Model Name : ZE250-A-IN
Applicant : Cybertan Technology Inc.
Test Rule Part(s) : 47 CFR FCC Part 15 Subpart C § 15.249

Sporton International as requested by the applicant to evaluate the EMC performance of the product sample received on Mar. 09, 2016 would like to declare that the tested sample has been evaluated and found to be in compliance with the tested rule parts. The data recorded as well as the test configuration specified is true and accurate for showing the sample's EMC nature.



Reviewed By:

Sam Chen

SPORTON INTERNATIONAL INC.

2. SUMMARY OF THE TEST RESULT

| Applied Standard: 47 CFR FCC Part 15 Subpart C | | | |
|--|---------------|---|----------|
| Part | Rule Section | Description of Test | Result |
| 4.1 | 15.207 | AC Power Line Conducted Emissions | Complies |
| 4.2 | 15.249(a) | Field Strength of Fundamental Emissions | Complies |
| 4.3 | 15.215(c) | 20dB Spectrum Bandwidth | Complies |
| 4.4 | 15.249(a)/(d) | Radiated Emissions | Complies |
| 4.5 | 15.249(d) | Band Edge Emissions | Complies |
| 4.6 | 15.203 | Antenna Requirements | Complies |

3. GENERAL INFORMATION

3.1. Product Details

| Items | Description |
|---------------------------|-----------------------------|
| Power Type | From power adapter |
| Modulation | GFSK |
| Data Rate | 100kbps |
| Frequency Range | 902~928MHz |
| Operation Frequency Range | 916MHz |
| Channel Number | 1 |
| Channel Band Width (99%) | 0.11 MHz |
| Max. Field Strength | 93.87 dBuV/m at 3m (QP) |
| Carrier Frequencies | Please refer to section 3.3 |
| Antenna | Please refer to section 3.3 |

3.2. Accessories

| Power | Brand | Model | Rating |
|-------------------------------|-------|------------------|--|
| Adapter | Ktec | KSAS0120500200HU | INPUT: 100-240V, 50/60Hz, 0.4A OUTPUT: 5.0V, 2.0A |
| Others | | | |
| RJ-45 cable, non-shielded, 1m | | | |

3.3. Table for Filed Antenna

For WiFi and Bluetooth Antenna:

| Ant. | Brand | Model Name | Antenna Type | Connector | Gain (dBi) |
|------|---------|------------|--------------|-----------|------------|
| 1 | Airgain | M2410CMRSU | PIFA Antenna | U.FL | 2.4 |
| 2 | Airgain | M2410DCR | PIFA Antenna | U.FL | 1.5 |

For Zigbee and Z-wave Antenna:

| Ant. | Brand | Model Name | Antenna Type | Connector | Gain (dBi) | |
|------|---------|------------|--------------|-----------|------------|--------|
| | | | | | Zigbee | Z-wave |
| 3 | Airgain | M815DSU | PIFA Antenna | U.FL | 2.2 | 0.8 |

Note: The EUT has three antennas.

For IEEE 802.11b/g/n mode (1TX/1RX):

The EUT supports the antenna with TX and RX diversity functions.

Both Ant.1 and Ant.2 support transmit and receive functions, but only one of them will be used at one time.

The Ant.1 generated the worst case, so it was selected to test and record in the report.

For Bluetooth mode (1TX, 1RX):

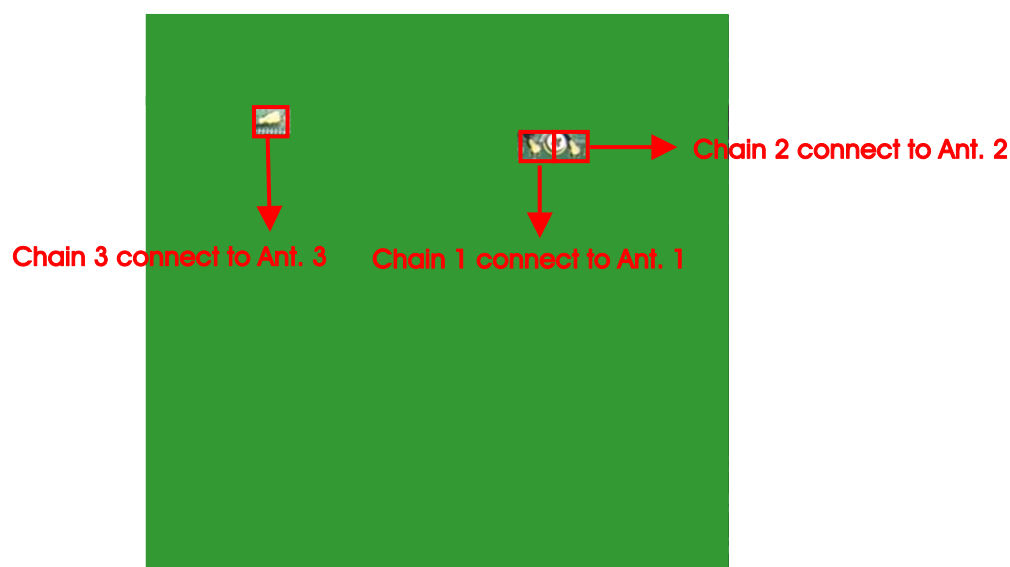
The EUT supports the antenna with TX and RX diversity functions.

Both Ant.1 and Ant.2 support transmit and receive functions, but only one of them will be used at one time.

The Ant.2 generated the worst case, so it was selected to test and record in the report.

For Zigbee and Z-wave mode (1TX, 1RX):

Only Ant. 3 can be used as transmitting antenna and receiving antenna.



3.4. Table for Carrier Frequencies

| Frequency Band | Channel No. | Frequency |
|----------------|-------------|-----------|
| 902~928MHz | 1 | 916 MHz |

3.5. Table for Test Modes

Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

| Test Items | Mode | Channel | Antenna |
|--|-------------|---------|---------|
| AC Power Line Conducted Emissions | Normal Link | - | - |
| Field Strength of Fundamental Emissions 20dB Spectrum Bandwidth | CTX | 1 | 3 |
| Radiated Emissions 30MHz ~ 1GHz | Normal Link | - | - |
| Radiated Emissions 1GHz~10 th Harmonic | CTX | 1 | 3 |
| Band Edge Emissions | CTX | 1 | 3 |

Note1: The EUT can only be used at Z axis position.

Note2: The micro USB port is upgrading firmware only.

The following test modes were performed for all tests:

For Conducted Emission test:

Mode 1. Normal Link - EUT

For Radiated Emission test (Below 1GHz):

Mode 1. Normal Link - EUT

For Radiated Emission test (Above 1GHz):

Mode 1. CTX

For Co-location MPE Test:

The EUT could be applied with 2.4GHz WLAN function, Bluetooth function, Zigbee and Z-wave function; therefore Co-location Maximum Permissible Exposure (Please refer to FA632503) test is added for simultaneously transmit among 2.4GHz WLAN function, Bluetooth function, Zigbee and Z-wave function.

3.6. Table for Testing Locations

| Test Site Location | | | | | |
|--------------------|--|----------|---------------------|-------------|--------------|
| Address: | No.8, Lane 724, Bo-ai St., Jhubei City, Hsinchu County 302, Taiwan, R.O.C. | | | | |
| TEL: | 886-3-656-9065 | | | | |
| FAX: | 886-3-656-9085 | | | | |
| Test Site No. | Site Category | Location | FCC Designation No. | IC File No. | VCCI Reg. No |
| 03CH01-CB | SAC | Hsin Chu | TW0006 | IC 4086D | - |
| CO01-CB | Conduction | Hsin Chu | TW0006 | IC 4086D | - |
| TH01-CB | OVEN Room | Hsin Chu | - | - | - |

Open Area Test Site (OATS); Semi Anechoic Chamber (SAC).

3.7. Table for Supporting Units

For Test Site No: CO01-CB

| Support Unit | Brand | Model | FCC ID |
|---------------|---------------|----------------|--------|
| NB*3 | DELL | E6430 | DoC |
| Z-wave | Sigma Designs | ZM5202AU-CME3R | DoC |
| Zigbee | MMB Networks | MMB ZM100A10 | DoC |
| Bluetooth | Azurewave | AW-NB165NF | DoC |
| AP | CBT | EW605-A1 | DoC |
| Flash disk3.0 | Transcend | 639205 7755 | DoC |

For Test Site No: 03CH01-CB (Below 1GHz)

| Support Unit | Brand | Model | FCC ID |
|---------------|---------------|----------------|--------|
| NB*3 | DELL | E4300 | DoC |
| Z-wave | Sigma Designs | ZM5202AU-CME3R | DoC |
| Zigbee | MMB Networks | MMB ZM100A10 | DoC |
| Bluetooth | Azurewave | AW-NB165NF | DoC |
| AP | CBT | EW605-A1 | DoC |
| Flash disk3.0 | Transcend | 639205 7755 | DoC |

For Test Site No: 03CH01-CB (Above 1GHz)

| Support Unit | Brand | Model | FCC ID |
|--------------|-------|-------|--------|
| NB | DELL | E4300 | DoC |

For Test Site No: TH01-CB

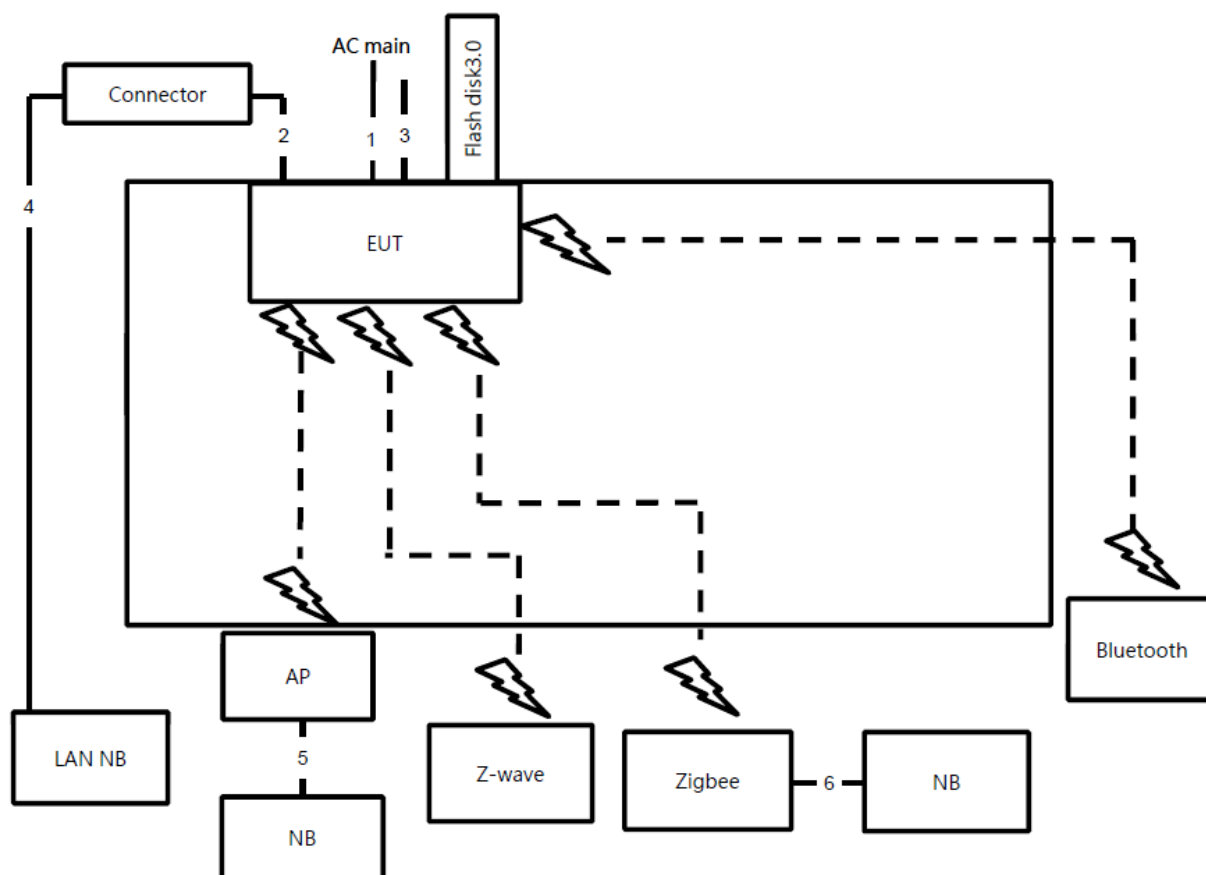
| Support Unit | Brand | Model | FCC ID |
|--------------|-------|-------|--------|
| NB | DELL | E4300 | DoC |

3.8. Duty Cycle

| On Time (ms) | On+Off Time (ms) | Duty Cycle (%) | Duty Factor (dB) | 1/T Minimum VBW (kHz) |
|-----------------|---------------------|-------------------|---------------------|--------------------------|
| 3.400 | 58.050 | 5.86 | 12.32 | 0.29 |

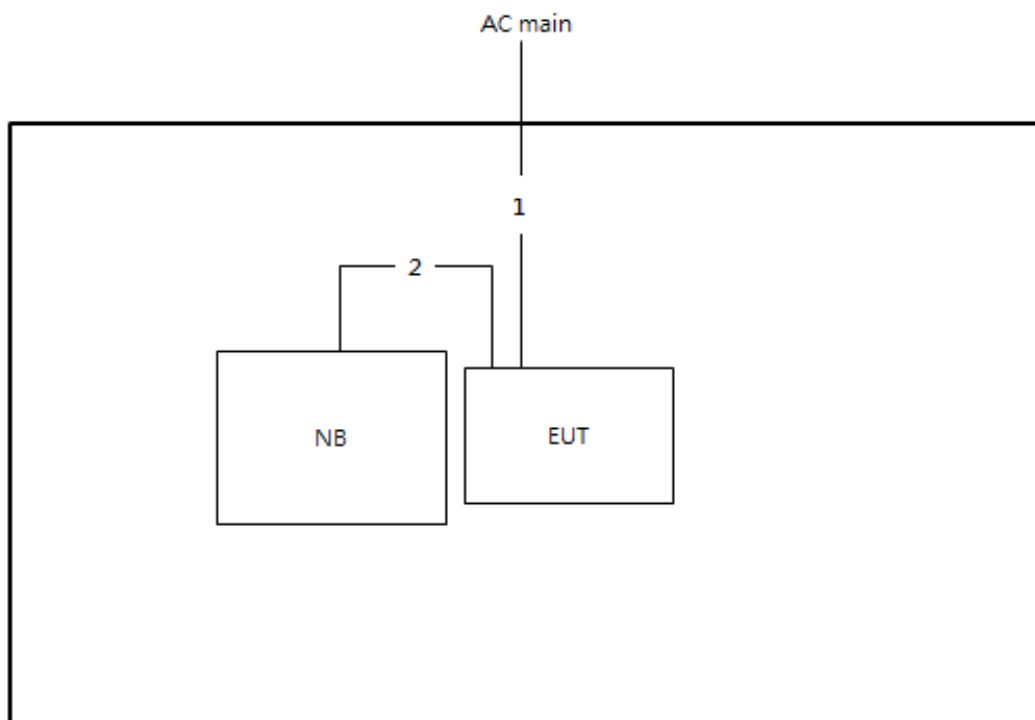
3.9. Test Configurations

3.9.1. AC Power Line Conduction Emissions Test Configuration



| Item | Connection | Shielded | Length |
|------|-------------|----------|--------|
| 1 | Power cable | No | 1.5m |
| 2 | RJ-45 cable | No | 1m |
| 3 | USB cable | Yes | 1m |
| 4 | RJ-45 cable | No | 10m |
| 5 | RJ-45 cable | No | 1.5m |
| 6 | USB cable | Yes | 1m |

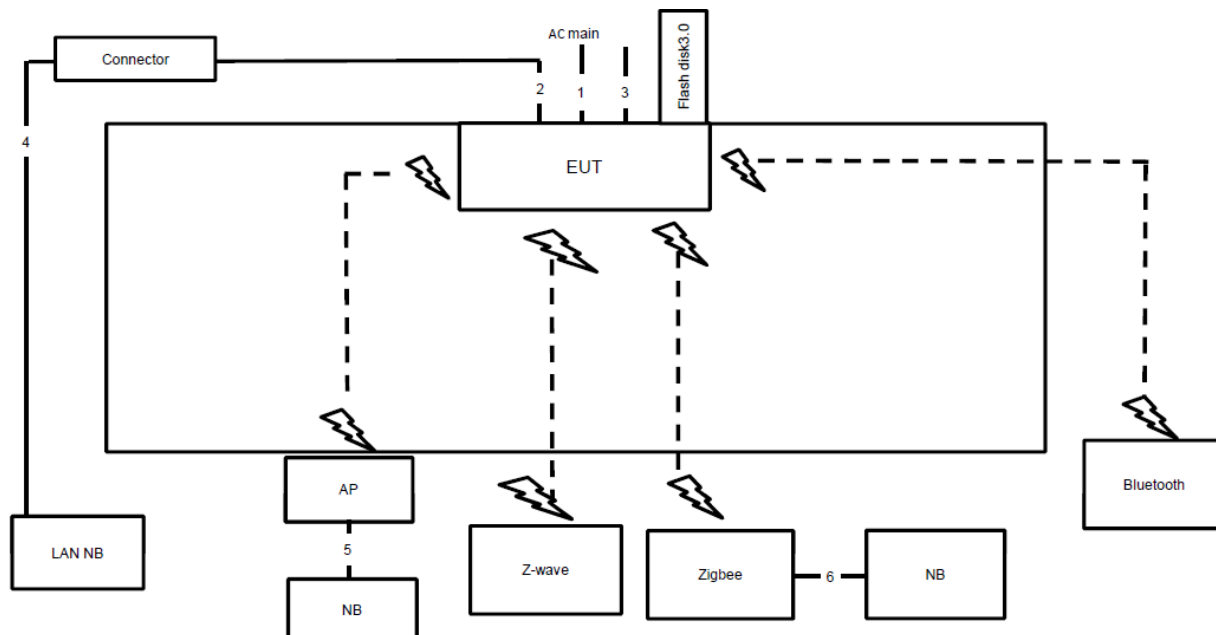
3.9.2. Field Strength of Fundamental Emissions Test Configuration



| Item | Connection | Shielded | Length |
|------|-------------|----------|--------|
| 1 | Power cable | No | 1.5m |
| 2 | RJ-45 cable | No | 1m |

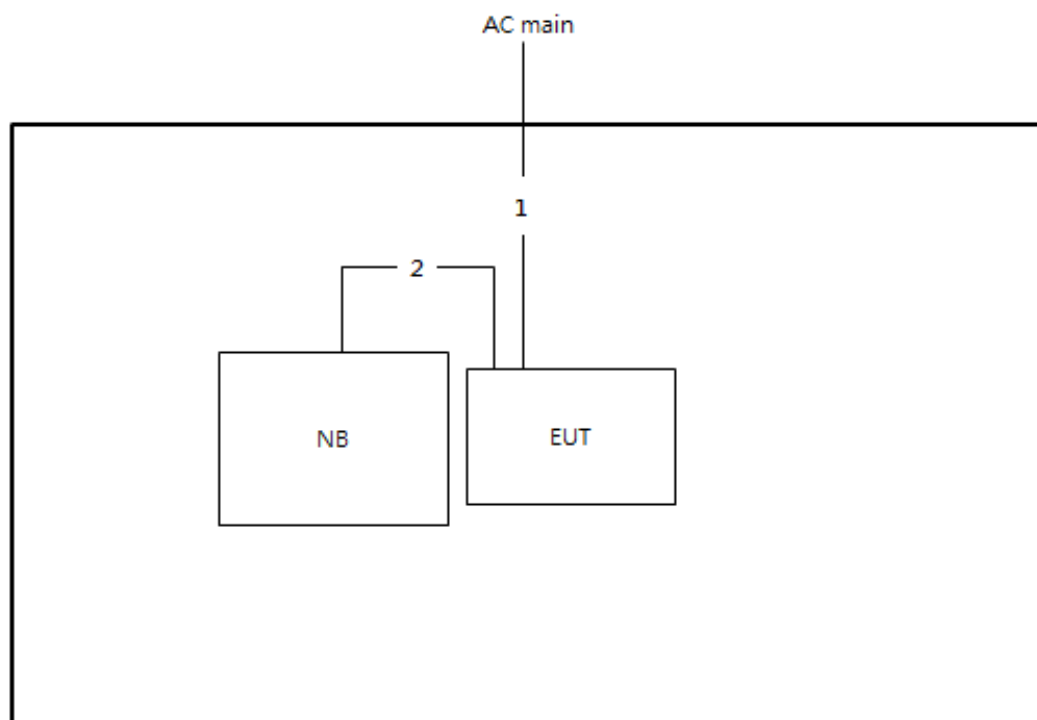
3.9.3. Radiation Emissions Test Configuration

Test Configuration: 30MHz~1GHz



| Item | Connection | Shielded | Length |
|------|-------------|----------|--------|
| 1 | Power cable | No | 1.5m |
| 2 | RJ-45 cable | No | 1m |
| 3 | USB cable | Yes | 1m |
| 4 | RJ-45 cable | No | 10m |
| 5 | RJ-45 cable | No | 1.5m |
| 6 | USB cable | Yes | 1m |

Test Configuration: Above 1GHz



| Item | Connection | Shielded | Length |
|------|-------------|----------|--------|
| 1 | Power cable | No | 1.5m |
| 2 | RJ-45 cable | No | 1m |

4. TEST RESULT

4.1. AC Power Line Conducted Emissions Measurement

4.1.1. Limit

For this product which is designed to be connected to the 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 below limits table.

| Frequency (MHz) | QP Limit (dBuV) | AV Limit (dBuV) |
|-----------------|-----------------|-----------------|
| 0.15~0.5 | 66~56 | 56~46 |
| 0.5~5 | 56 | 46 |
| 5~30 | 60 | 50 |

4.1.2. Measuring Instruments and Setting

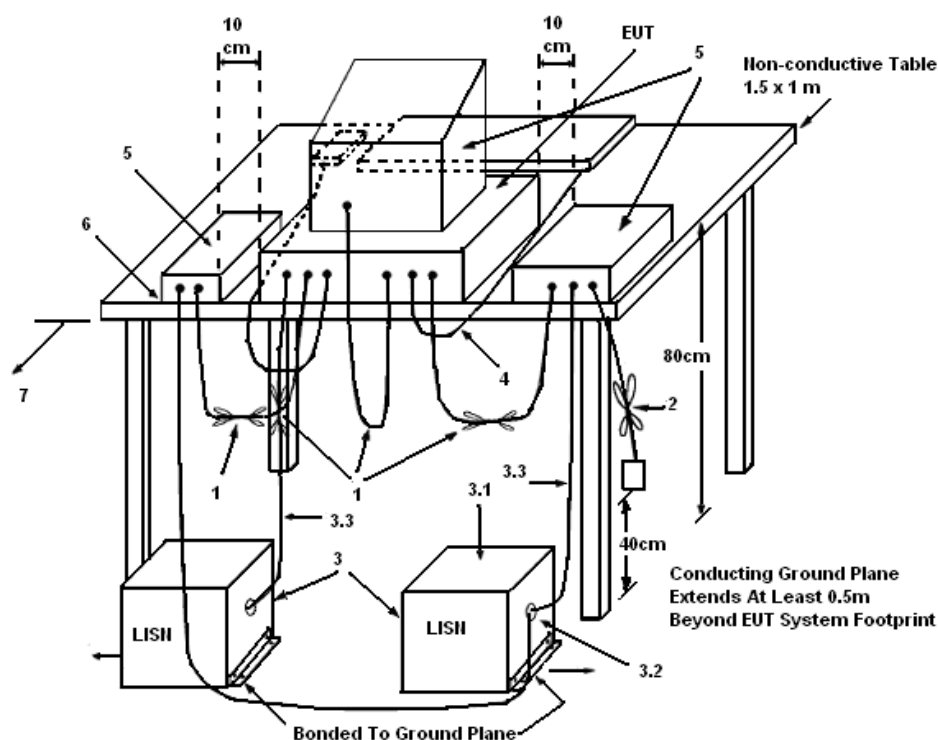
Please refer to section 5 of equipments list in this report. The following table is the setting of the receiver.

| Receiver Parameters | Setting |
|---------------------|----------|
| Attenuation | 10 dB |
| Start Frequency | 0.15 MHz |
| Stop Frequency | 30 MHz |
| IF Bandwidth | 9 kHz |

4.1.3. Test Procedures

1. Configure the EUT according to ANSI C63.10. The EUT or host of EUT has to be placed 0.4 meter far from the conducting wall of the shielding room and at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT or host of EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connected to the other LISNs. The LISN should provide 50uH/50ohms coupling impedance.
4. The frequency range from 150 kHz to 30 MHz was searched.
5. Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. The measurement has to be done between each power line and ground at the power terminal.

4.1.4. Test Setup Layout



LEGEND:

(1) Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

(2) I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

(3) EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω . LISN can be placed on top of, or immediately beneath, reference ground plane.

(3.1) All other equipment powered from additional LISN(s).

(3.2) Multiple outlet strip can be used for multiple power cords of non-EUT equipment.

(3.3) LISN at least 80 cm from nearest part of EUT chassis.

(4) Cables of hand-operated devices, such as keyboards, mice, etc., shall be placed as for normal use.

(5) Non-EUT components of EUT system being tested.

(6) Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop.

(7) Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane.

4.1.5. Test Deviation

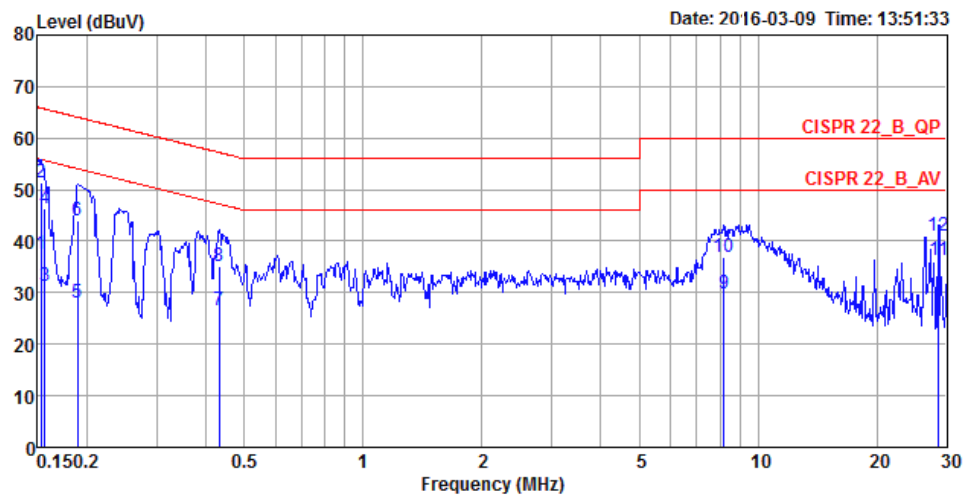
There is no deviation with the original standard.

4.1.6. EUT Operation during Test

The EUT was placed on the test table and programmed in normal function.

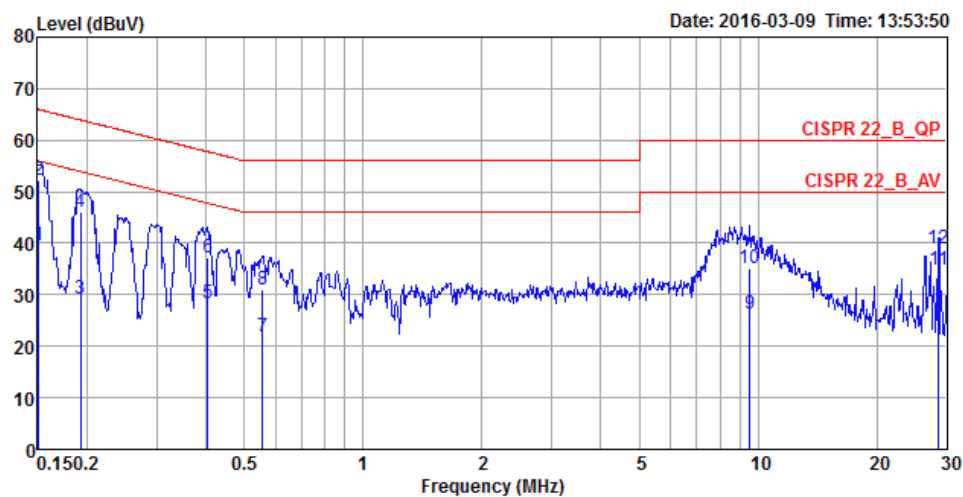
4.1.7. Results of AC Power Line Conducted Emissions Measurement

| | | | |
|---------------|-------------|----------|------|
| Temperature | 20°C | Humidity | 60% |
| Test Engineer | Deven Huang | Phase | Line |
| Configuration | Normal Link | | |



| | Freq | Level | Over Limit | Limit Line | Read Level | LISN Factor | Cable Loss | Pol/Phase | Remark |
|----|---------|-------|------------|------------|------------|-------------|------------|-----------|---------|
| | MHz | dBuV | dB | dBuV | dBuV | dB | dB | | |
| 1 | 0.1532 | 37.51 | -18.31 | 55.82 | 27.56 | 9.93 | 0.02 | LINE | Average |
| 2 | 0.1532 | 51.22 | -14.60 | 65.82 | 41.27 | 9.93 | 0.02 | LINE | QP |
| 3 | 0.1565 | 31.15 | -24.50 | 55.65 | 21.20 | 9.93 | 0.02 | LINE | Average |
| 4 | 0.1565 | 46.39 | -19.26 | 65.65 | 36.44 | 9.93 | 0.02 | LINE | QP |
| 5 | 0.1894 | 28.03 | -26.03 | 54.06 | 18.08 | 9.93 | 0.02 | LINE | Average |
| 6 | 0.1894 | 43.98 | -20.08 | 64.06 | 34.03 | 9.93 | 0.02 | LINE | QP |
| 7 | 0.4328 | 26.49 | -20.71 | 47.20 | 16.52 | 9.93 | 0.04 | LINE | Average |
| 8 | 0.4328 | 35.17 | -22.03 | 57.20 | 25.20 | 9.93 | 0.04 | LINE | QP |
| 9 | 8.1916 | 29.69 | -20.31 | 50.00 | 19.37 | 10.14 | 0.18 | LINE | Average |
| 10 | 8.1916 | 36.85 | -23.15 | 60.00 | 26.53 | 10.14 | 0.18 | LINE | QP |
| 11 | 28.6825 | 36.42 | -13.58 | 50.00 | 25.49 | 10.65 | 0.28 | LINE | Average |
| 12 | 28.6825 | 41.01 | -18.99 | 60.00 | 30.08 | 10.65 | 0.28 | LINE | QP |

| | | | |
|---------------|-------------|----------|---------|
| Temperature | 20°C | Humidity | 60% |
| Test Engineer | Deven Huang | Phase | Neutral |
| Configuration | Normal Link | | |



| | Freq | Level | Over Limit | Limit Line | Read Level | LISN Factor | Cable Loss | Pol/Phase | Remark |
|----|---------|-------|------------|------------|------------|-------------|------------|-----------|---------|
| | MHz | dBuV | dB | dBuV | dBuV | dB | dB | | |
| 1 | 0.1508 | 39.68 | -16.28 | 55.96 | 29.88 | 9.78 | 0.02 | NEUTRAL | Average |
| 2 | 0.1508 | 52.39 | -13.57 | 65.96 | 42.59 | 9.78 | 0.02 | NEUTRAL | QP |
| 3 | 0.1924 | 29.31 | -24.62 | 53.93 | 19.50 | 9.79 | 0.02 | NEUTRAL | Average |
| 4 | 0.1924 | 46.06 | -17.87 | 63.93 | 36.25 | 9.79 | 0.02 | NEUTRAL | QP |
| 5 | 0.4040 | 28.45 | -19.32 | 47.77 | 18.62 | 9.79 | 0.04 | NEUTRAL | Average |
| 6 | 0.4040 | 37.14 | -20.63 | 57.77 | 27.31 | 9.79 | 0.04 | NEUTRAL | QP |
| 7 | 0.5552 | 21.93 | -24.07 | 46.00 | 12.09 | 9.80 | 0.04 | NEUTRAL | Average |
| 8 | 0.5552 | 31.02 | -24.98 | 56.00 | 21.18 | 9.80 | 0.04 | NEUTRAL | QP |
| 9 | 9.5521 | 26.31 | -23.69 | 50.00 | 16.08 | 10.00 | 0.23 | NEUTRAL | Average |
| 10 | 9.5521 | 35.16 | -24.84 | 60.00 | 24.93 | 10.00 | 0.23 | NEUTRAL | QP |
| 11 | 28.6840 | 34.69 | -15.31 | 50.00 | 24.08 | 10.33 | 0.28 | NEUTRAL | Average |
| 12 | 28.6840 | 38.95 | -21.05 | 60.00 | 28.34 | 10.33 | 0.28 | NEUTRAL | QP |

Note:

Level = Read Level + LISN Factor + Cable Loss

4.2. Field Strength of Fundamental Emissions Measurement

4.2.1. Limit

The field strength of fundamental emissions within these bands specified at a distance of 3 meters (measurement instrumentation employing an average detector) shall comply with the following table.

| Frequency Band (MHz) | Fundamental Emissions Limit (dBuV/m) at 3m |
|----------------------|--|
| 902~928MHz | 94 (QP) |

4.2.2. Measuring Instruments and Setting

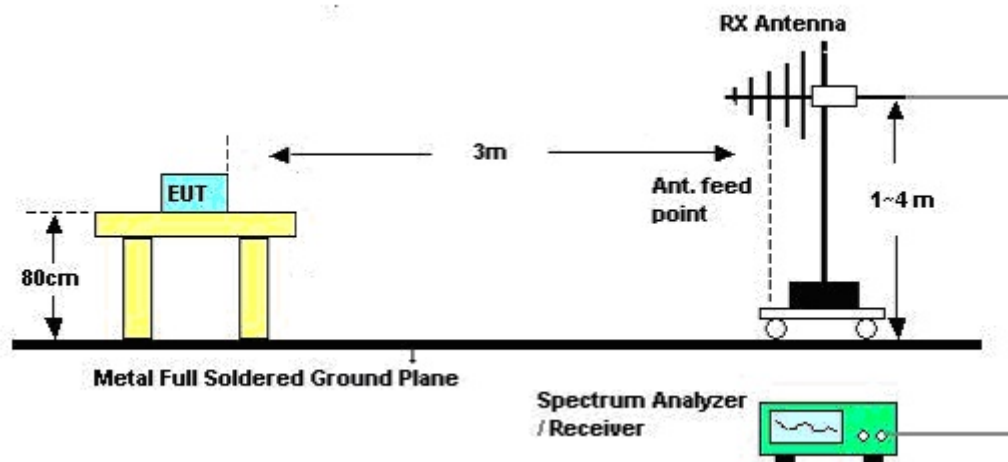
Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer.

| Power Meter Parameter | Setting |
|-----------------------|----------|
| RBW | 100 kHz |
| VBW | 300 kHz |
| Detector | QP |
| Trace | Max Hold |
| Sweep Time | Auto |

4.2.3. Test Procedures

1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 0.8 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. For Fundamental emissions, use 100kHz VBW and 300kHz RBW for QP reading in spectrum analyzer.
6. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

4.2.4. Test Setup Layout



4.2.5. Test Deviation

There is no deviation with the original standard.

4.2.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.2.7. Test Result of Field Strength of Fundamental Emissions

| | | | |
|---------------|-----------------------------|----------------|-----------|
| Temperature | 22°C | Humidity | 54% |
| Test Engineer | Clemens Fang/ Gino Huang | Configurations | Channel 1 |
| Test Date | May 17, 2016 | | |

Channel 1

| | Freq | Level | Limit Line | Over Limit | Read Level | Cable Loss | Antenna Factor | Preamp Factor | A/Pos | T/Pos | Remark | Pol/Phase |
|---|--------|--------|---------------|---------------|---------------|---------------|-------------------|------------------|-------|-------|--------|-----------|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | cm | deg | | |
| 1 | 898.20 | 28.83 | 46.00 | -17.17 | 31.60 | 2.40 | 27.28 | 32.45 | 100 | 265 | QP | VERTICAL |
| 2 | 916.00 | 93.87 | 93.98 | -0.11 | 96.50 | 2.41 | 27.42 | 32.46 | 100 | 269 | QP | VERTICAL |
| 3 | 928.00 | 38.95 | 46.00 | -7.05 | 41.48 | 2.42 | 27.51 | 32.46 | 100 | 301 | QP | VERTICAL |

Note:

Emission level (dBuV/m) = 20 log Emission level (uV/m)

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

4.3. 20dB Spectrum Bandwidth Measurement

4.3.1. Limit

Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emissions in the specific band (902~928MHz).

4.3.2. Measuring Instruments and Setting

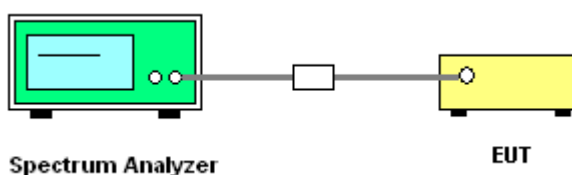
Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer.

| Spectrum Parameters | Setting |
|---------------------|------------------|
| Attenuation | Auto |
| Span Frequency | > 20dB Bandwidth |
| RBW | 10 kHz |
| VBW | 10 kHz |
| Detector | Peak |
| Trace | Max Hold |
| Sweep Time | Auto |

4.3.3. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyser in peak hold mode.
2. The resolution bandwidth of 10 kHz and the video bandwidth of 10 kHz were used.
3. Measured the spectrum width with power higher than 6dB below carrier.

4.3.4. Test Setup Layout



4.3.5. Test Deviation

There is no deviation with the original standard.

4.3.6. EUT Operation during Test

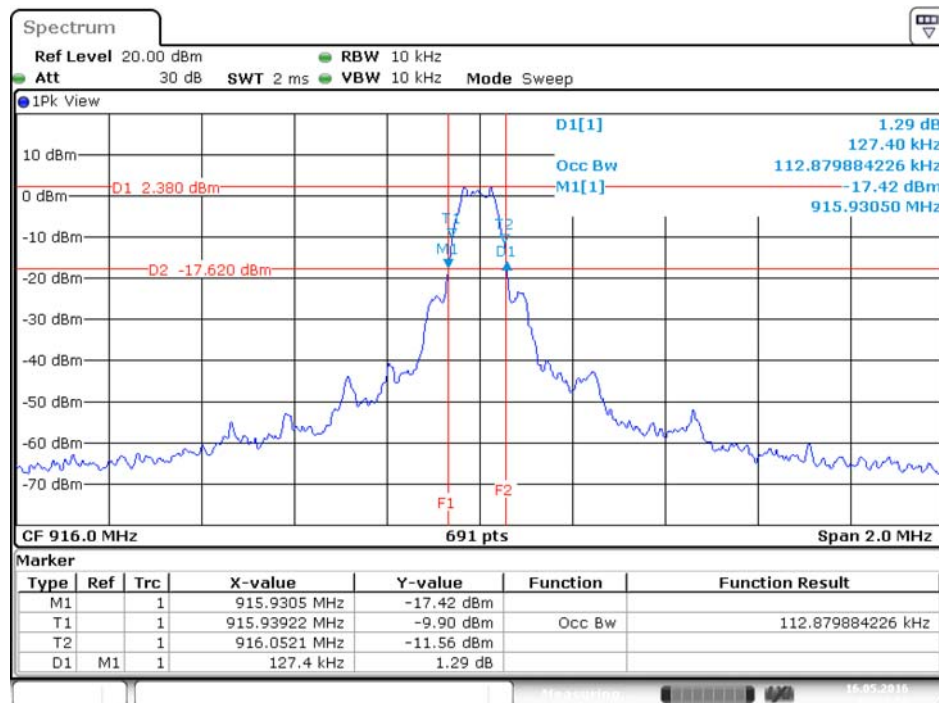
The EUT was programmed to be in continuously transmitting mode.

4.3.7. Test Result of 20dB Spectrum Bandwidth

| | | | |
|---------------|-----------|----------------|-----------|
| Temperature | 25°C | Humidity | 65% |
| Test Engineer | Andy Tsai | Configurations | Channel 1 |

| Frequency | 20dB BW (MHz) | 99% OBW (MHz) | Frequency range (MHz) $f_L > 902\text{MHz}$ | Frequency range (MHz) $f_H < 928\text{MHz}$ | Test Result |
|-----------|---------------|---------------|--|--|-------------|
| 916 MHz | 0.13 | 0.11 | 915.9305 | 916.0579 | Complies |

20 dB/99% Bandwidth Plot on 916 MHz



Date: 16.MAY.2016 14:17:51

4.4. Radiated Emissions Measurement

4.4.1. Limit

Harmonic emissions limits comply with below 54 dBuV/m at 3m. Other emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or comply with the radiated emissions limits specified in section 15.209(a) limit in the table below has to be followed.

| Frequencies (MHz) | Field Strength (micorvolts/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 |

4.4.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer and receiver.

| Spectrum Parameter | Setting |
|---|--|
| Attenuation | Auto |
| Start Frequency | 1 000 MHz |
| Stop Frequency | 10th carrier harmonic |
| RBW / VBW (Emission in restricted band) | 1 MHz / 3MHz for Peak, 1 MHz / 1/T for Average |
| RBW / VBW (Emission in non-restricted band) | 100kHz / 300kHz for Peak |

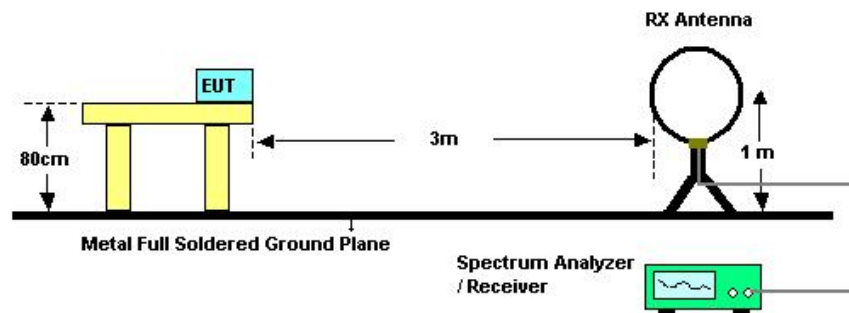
| Receiver Parameter | Setting |
|------------------------|-----------------------------------|
| Attenuation | Auto |
| Start ~ Stop Frequency | 9kHz~150kHz / RBW 200Hz for QP |
| Start ~ Stop Frequency | 150kHz~30MHz / RBW 9kHz for QP |
| Start ~ Stop Frequency | 30MHz~1000MHz / RBW 120kHz for QP |

4.4.3. Test Procedures

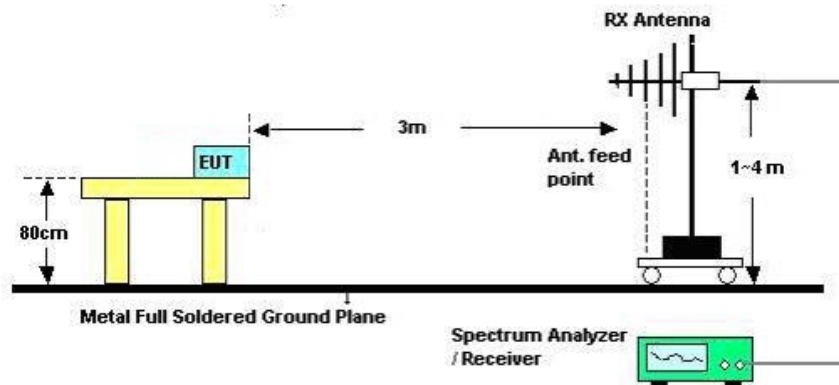
1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz VBW and 3MHz RBW for peak reading. Then 1MHz RBW and 1/T VBW for average reading in spectrum analyzer.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High – Low scan is not required in this case.

4.4.4. Test Setup Layout

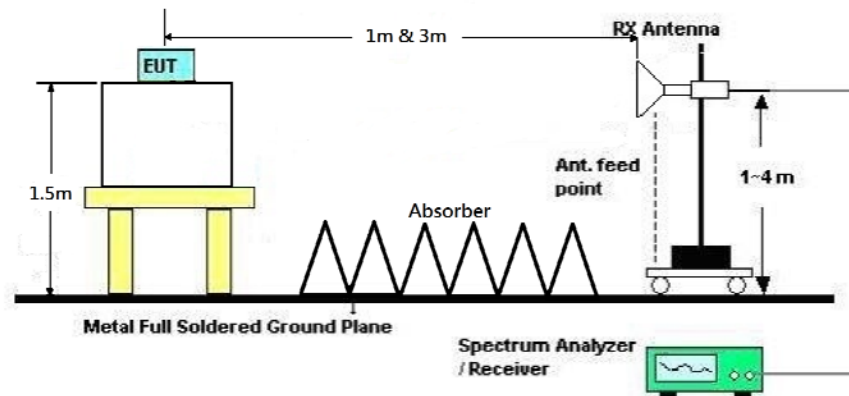
For Radiated Emissions: 9kHz ~30MHz



For Radiated Emissions: 30MHz~1GHz



For Radiated Emissions: Above 1GHz



4.4.5. Test Deviation

There is no deviation with the original standard.

4.4.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.4.7. Results of Radiated Emissions (9kHz~30MHz)

| | | | |
|---------------|-----------------------------|----------------|-------------|
| Temperature | 22°C | Humidity | 54% |
| Test Engineer | Clemens Fang/ Gino Huang | Configurations | Normal Link |
| Test Date | Mar. 09, 2016 | | |

| Freq. (MHz) | Level (dBuV) | Over Limit (dB) | Limit Line (dBuV) | Remark |
|----------------|-----------------|--------------------|----------------------|----------|
| - | - | - | - | See Note |

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

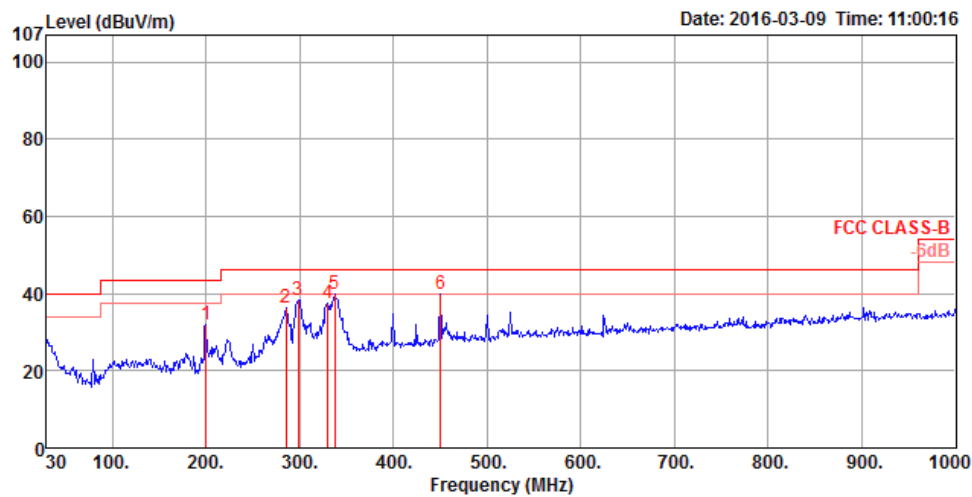
Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

4.4.8. Results of Radiated Emissions (30MHz~1GHz)

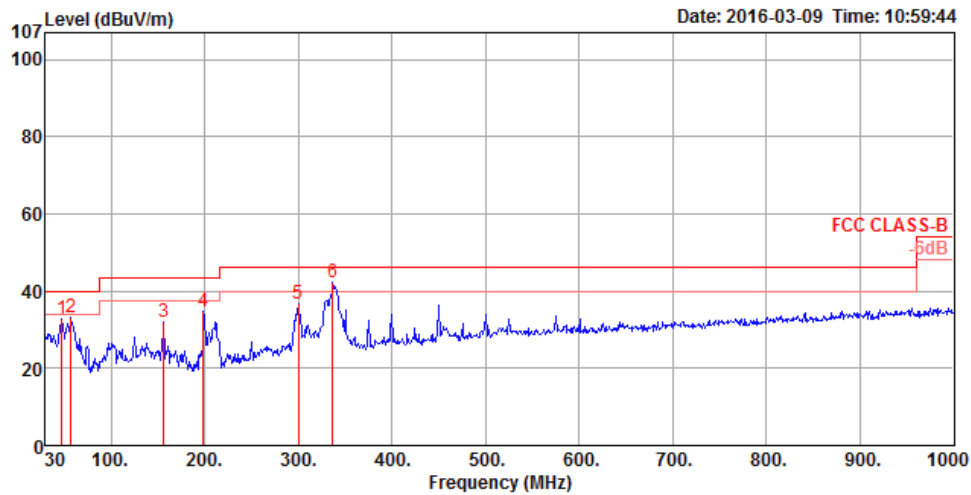
| | | | |
|---------------|-----------------------------|----------------|-------------|
| Temperature | 22°C | Humidity | 54% |
| Test Engineer | Clemens Fang/ Gino Huang | Configurations | Normal Link |

Horizontal



| | Freq | Level | Limit | Over | Read | CableAntenna | Preamp | A/Pos | T/Pos | Remark | Pol/Phase |
|---|--------|--------|--------|--------|-------|--------------|--------|-------|-------|----------|------------|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | cm | deg | |
| 1 | 199.75 | 32.08 | 43.50 | -11.42 | 46.93 | 1.70 | 16.00 | 32.55 | 125 | 88 Peak | HORIZONTAL |
| 2 | 285.11 | 36.38 | 46.00 | -9.62 | 47.59 | 2.01 | 19.30 | 32.52 | 100 | 136 Peak | HORIZONTAL |
| 3 | 298.69 | 38.42 | 46.00 | -7.58 | 49.34 | 2.04 | 19.56 | 32.52 | 125 | 104 Peak | HORIZONTAL |
| 4 | 329.73 | 37.43 | 46.00 | -8.57 | 47.37 | 2.13 | 20.46 | 32.53 | 100 | 279 Peak | HORIZONTAL |
| 5 | 337.49 | 40.00 | 46.00 | -6.00 | 49.73 | 2.15 | 20.65 | 32.53 | 125 | 65 Peak | HORIZONTAL |
| 6 | 450.01 | 39.75 | 46.00 | -6.25 | 46.91 | 2.42 | 23.00 | 32.58 | 100 | 112 Peak | HORIZONTAL |

Vertical



| | Freq | Level | Limit Line | Over Limit | Read Level | Cable Loss | Antenna Factor | Preamp Factor | A/Pos | T/Pos | Remark | Pol/Phase |
|---|--------|--------|------------|------------|------------|------------|----------------|---------------|-------|-------|--------|-----------|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | cm | deg | | |
| 1 | 47.46 | 32.71 | 40.00 | -7.29 | 48.89 | 0.95 | 15.50 | 32.63 | 100 | 328 | Peak | VERTICAL |
| 2 | 57.16 | 33.29 | 40.00 | -6.71 | 52.02 | 1.02 | 12.87 | 32.62 | 125 | 8 | Peak | VERTICAL |
| 3 | 156.10 | 31.90 | 43.50 | -11.60 | 46.37 | 1.53 | 16.56 | 32.56 | 100 | 82 | Peak | VERTICAL |
| 4 | 198.78 | 34.58 | 43.50 | -8.92 | 49.53 | 1.69 | 15.91 | 32.55 | 100 | 195 | Peak | VERTICAL |
| 5 | 299.66 | 36.70 | 46.00 | -9.30 | 47.59 | 2.05 | 19.58 | 32.52 | 100 | 291 | Peak | VERTICAL |
| 6 | 336.52 | 42.11 | 46.00 | -3.89 | 51.88 | 2.14 | 20.62 | 32.53 | 200 | 130 | Peak | VERTICAL |

Note:

Add band-reject filter to filter fundamental signal of 916MHz.

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

4.4.9. Results for Radiated Emissions (1GHz~10th Harmonic)

| | | | |
|---------------|-----------------------------|----------------|-----------|
| Temperature | 22°C | Humidity | 54% |
| Test Engineer | Clemens Fang/ Gino Huang | Configurations | Channel 1 |
| Test Date | May 13, 2016 | | |

Horizontal

| | Freq | Level | Limit Line | Over Limit | Read Level | CableAntenna Loss Factor | Preamp Factor | A/Pos | T/Pos | Remark | Pol/Phase | |
|---|---------|--------|---------------|---------------|---------------|-----------------------------|------------------|-------|-------|--------|-----------|------------|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | cm | deg | | |
| 1 | 1831.98 | 38.87 | 54.00 | -15.13 | 43.69 | 4.49 | 27.40 | 36.71 | 104 | 108 | Average | HORIZONTAL |
| 2 | 1832.01 | 44.19 | 74.00 | -29.81 | 49.01 | 4.49 | 27.40 | 36.71 | 104 | 108 | Peak | HORIZONTAL |

Vertical

| | Freq | Level | Limit Line | Over Limit | Read Level | CableAntenna Loss Factor | Preamp Factor | A/Pos | T/Pos | Remark | Pol/Phase | |
|---|---------|--------|---------------|---------------|---------------|-----------------------------|------------------|-------|-------|--------|-----------|----------|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | cm | deg | | |
| 1 | 1832.00 | 40.88 | 54.00 | -13.12 | 45.70 | 4.49 | 27.40 | 36.71 | 208 | 353 | Average | VERTICAL |
| 2 | 1832.06 | 44.87 | 74.00 | -29.13 | 49.69 | 4.49 | 27.40 | 36.71 | 208 | 353 | Peak | VERTICAL |

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

4.5. Band Edge Emissions Measurement

4.5.1. Limit

Band edge emissions radiated outside of the specified frequency bands shall be attenuated by at least 50 dB below the level of the fundamental or comply with the radiated emissions limits specified in section 15.209(a) limit in the table below has to be followed.

| Frequencies (MHz) | Field Strength (micorvolts/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 |

4.5.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer.

| Spectrum Parameter | Setting |
|---|------------------------|
| Attenuation | Auto |
| Span Frequency | 100 MHz |
| RBW / VBW (Emission in restricted band) | RBW 120kHz for QP |
| RBW / VBW (Emission in non-restricted band) | 100kHz/300kHz for Peak |

4.5.3. Test Procedures

The test procedure is the same as section 4.4.3.

4.5.4. Test Setup Layout

This test setup layout is the same as that shown in section 4.4.4.

4.5.5. Test Deviation

There is no deviation with the original standard.

4.5.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.5.7. Test Result of Band Edge and Fundamental Emissions

| | | | |
|---------------|-----------------------------|----------------|-----------|
| Temperature | 22°C | Humidity | 54% |
| Test Engineer | Clemens Fang/ Gino Huang | Configurations | Channel 1 |
| Test Date | May 17, 2016 | | |

Channel 1

| | Freq | Level | Limit Line | Over Limit | Read Level | Cable Loss | Antenna Factor | Preamp Factor | A/Pos | T/Pos | Remark | Pol/Phase |
|---|--------|--------|---------------|---------------|---------------|---------------|-------------------|------------------|-------|-------|--------|-----------|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | cm | deg | | |
| 1 | 898.20 | 28.83 | 46.00 | -17.17 | 31.60 | 2.40 | 27.28 | 32.45 | 100 | 265 | QP | VERTICAL |
| 2 | 916.00 | 93.87 | | | 96.50 | 2.41 | 27.42 | 32.46 | 100 | 269 | QP | VERTICAL |
| 3 | 928.00 | 38.95 | 46.00 | -7.05 | 41.48 | 2.42 | 27.51 | 32.46 | 100 | 301 | QP | VERTICAL |

Item 2 is the fundamental frequency at 916 MHz.

Note:

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

4.6. Antenna Requirements

4.6.1. Limit

Except for special regulations, the Low-power Radio-frequency Devices must not be equipped with any jacket for installing an antenna with extension cable. 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 the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited.

4.6.2. Antenna Connector Construction

Please refer to section 3.3 in this test report, antenna connector complied with the requirements.

5. LIST OF MEASURING EQUIPMENTS

| Instrument | Manufacturer | Model No. | Serial No. | Characteristics | Calibration Date | Remark |
|-------------------|--------------|------------------|---------------|------------------|------------------|-----------------------|
| EMI Receiver | Agilent | N9038A | My52260123 | 9kHz ~ 8.45GHz | Jan. 27, 2016 | Conduction (CO01-CB) |
| LISN | F.C.C. | FCC-LISN-50-16-2 | 04083 | 150kHz ~ 100MHz | Dec. 08, 2015 | Conduction (CO01-CB) |
| LISN | Schwarzbeck | NSLK 8127 | 8127647 | 9kHz ~ 30MHz | Dec. 23, 2015 | Conduction (CO01-CB) |
| COND Cable | Woken | Cable | 01 | 150kHz ~ 30MHz | May 25, 2015 | Conduction (CO01-CB) |
| Software | Audix | E3 | 6.120210n | - | N.C.R. | Conduction (CO01-CB) |
| Loop Antenna | Teseq | HLA 6120 | 24155 | 9kHz - 30 MHz | Mar. 12, 2015* | Radiation (03CH01-CB) |
| BILOG ANTENNA | TESEQ | CBL6112D | 37880 | 20MHz ~ 2GHz | Sep. 03, 2015 | Radiation (03CH01-CB) |
| Horn Antenna | EMCO | 3115 | 00075790 | 750MHz ~ 18GHz | Oct. 22, 2015 | Radiation (03CH01-CB) |
| Horn Antenna | Schwarzbeck | BBHA 9170 | BBHA9170252 | 15GHz ~ 40GHz | Jul. 21, 2015 | Radiation (03CH01-CB) |
| Pre-Amplifier | Agilent | 8447D | 2944A10940 | 0.1MHz ~ 1.3GHz | Feb. 24, 2016 | Radiation (03CH01-CB) |
| Pre-Amplifier | Agilent | 8449B | 3008A02310 | 1GHz ~ 26.5GHz | Jan. 18, 2016 | Radiation (03CH01-CB) |
| Pre-Amplifier | WM | TF-130N-R1 | 923365 | 26GHz ~ 40GHz | Nov. 13, 2015 | Radiation (03CH01-CB) |
| Spectrum Analyzer | R&S | FSP40 | 100056 | 9kHz ~ 40GHz | Oct. 27, 2015 | Radiation (03CH01-CB) |
| RF Cable-low | Woken | Low Cable-1 | N/A | 30 MHz ~ 1 GHz | Nov. 02, 2015 | Radiation (03CH01-CB) |
| RF Cable-high | Woken | High Cable-16 | N/A | 1 GHz ~ 18 GHz | Nov. 02, 2015 | Radiation (03CH01-CB) |
| RF Cable-high | Woken | High Cable-17 | N/A | 1 GHz ~ 18 GHz | Nov. 02, 2015 | Radiation (03CH01-CB) |
| RF Cable-high | Woken | High Cable-40G-1 | N/A | 18GHz ~ 40 GHz | Nov. 02, 2015 | Radiation (03CH01-CB) |
| RF Cable-high | Woken | High Cable-40G-2 | N/A | 18GHz ~ 40 GHz | Nov. 02, 2015 | Radiation (03CH01-CB) |
| Test Software | Audix | E3 | 6.2009-10-7 | N/A | N/A | Radiation (03CH01-CB) |
| Spectrum analyzer | R&S | FSV40 | 100979 | 9kHz~40GHz | Dec. 09, 2015 | Conducted (TH01-CB) |
| RF Cable-high | Woken | RG402 | High Cable-6 | 1 GHz ~ 26.5 GHz | Nov. 02, 2015 | Conducted (TH01-CB) |
| RF Cable-high | Woken | RG402 | High Cable-7 | 1 GHz ~ 26.5 GHz | Nov. 02, 2015 | Conducted (TH01-CB) |
| RF Cable-high | Woken | RG402 | High Cable-8 | 1 GHz ~ 26.5 GHz | Nov. 02, 2015 | Conducted (TH01-CB) |
| RF Cable-high | Woken | RG402 | High Cable-9 | 1 GHz ~ 26.5 GHz | Nov. 02, 2015 | Conducted (TH01-CB) |
| RF Cable-high | Woken | RG402 | High Cable-10 | 1 GHz ~ 26.5 GHz | Nov. 02, 2015 | Conducted (TH01-CB) |

Note: Calibration Interval of instruments listed above is one year.

"*" Calibration Interval of instruments listed above is two years.

N.C.R. means Non-Calibration required.

6. MEASUREMENT UNCERTAINTY

| Test Items | Uncertainty | Remark |
|--------------------------------------|-------------|--------------------------|
| Conducted Emission (150kHz ~ 30MHz) | 3.2 dB | Confidence levels of 95% |
| Radiated Emission (30MHz ~ 1,000MHz) | 3.6 dB | Confidence levels of 95% |
| Radiated Emission (1GHz ~ 18GHz) | 3.7 dB | Confidence levels of 95% |
| Conducted Emission | 1.7 dB | Confidence levels of 95% |