

| | | | | | |
|--|--|--|---|------------|--|
| Prüfbericht-Nr.: <i>Test report no.:</i> | CN210UH4 (P15C-BT) 001 | | Auftrags-Nr.: <i>Order no.:</i> | 238494087 | Seite 1 von 29 Page 1 of 29 |
| Kunden-Referenz-Nr.: <i>Client reference no.:</i> | N/A | | Auftragsdatum: <i>Order date:</i> | 2020-11-11 | |
| Auftraggeber: <i>Client:</i> | Protech Systems Co., Ltd. No. 24, Lane 365, Yang Kuang Street, Neihu District, Taipei 114, Taiwan, R.O.C. | | | | |
| Prüfgegenstand: <i>Test item:</i> | WiFi 802.11 a/b/g/n/ac & BT 4.1 M.2 module | | | | |
| Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i> | P-WFBT_AP6356SD | | | | |
| Auftrags-Inhalt: <i>Order content:</i> | FCC Part 15C Test report (BT) | | | | |
| Prüfgrundlage: <i>Test specification:</i> | FCC 47CFR Part 15: Subpart C Section 15.247 | | | | |
| Wareneingangsdatum: <i>Date of sample receipt:</i> | 2020-11-25 | | | |  Brenda Chen Senior Project Manager |
| Prüfmuster-Nr.: <i>Test sample no.:</i> | A003056031-001 A002956452-002 | | | | |
| Prüfzeitraum: <i>Testing period:</i> | 2020-12-03 - 2021-05-23 | | | | |
| Ort der Prüfung: <i>Place of testing:</i> | EMC/RF Taipei Testing Site | | | | |
| Prüflaboratorium: <i>Testing laboratory:</i> | Taipei Testing Laboratories | | | | |
| Prüfergebnis*: <i>Test result*:</i> | Pass | | | | |
| überprüft von: <i>reviewed by:</i> |  Ryan Chen Senior Project Manager | | | | |
| Datum: <i>Date:</i> | 2021-06-16 | | | | genehmigt von: <i>authorized by:</i> |
| Stellung / Position: | | | | | Ausstellungsdatum: <i>Issue date:</i> |
| Sonstiges / Other: | | | | | Stellung / Position: |
| Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i> | | Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i> | | | |
| * Legende: 1 = sehr gut 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft P(ass) = entspricht o.g. Prüfgrundlage(n) F(all) = entspricht nicht o.g. Prüfgrundlage(n) * Legend: 1 = very good 2 = good 3 = satisfactory 4 = sufficient 5 = poor P(ass) = passed a.m. test specification(s) F(all) = failed a.m. test specification(s) Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i> | | | | | |

TEST SUMMARY

| Report Section | FCC Clause | Test Item | Result |
|----------------|-----------------------------|--|--------|
| 5.1.1 | 15.247(b) & 15.203 | Antenna Requirement | Pass |
| 5.1.2 | 15.247(b)(1) | Peak Output Power | Pass |
| 5.1.3 | 15.247(a)(1) | 20 dB Bandwidth | Pass |
| 5.1.3 | 2.1049 | 99% Occupied Bandwidth | Pass |
| 5.1.4 | 15.247(d) | Conducted Spurious Emission and Band Edges | Pass |
| 5.1.5 | 15.247(d) & 15.205 & 15.209 | Radiated Spurious Emissions and Band Edges | Pass |
| 5.1.6 | 15.247(a)(1) | Hopping Channel Separation | Pass |
| 5.1.7 | 15.247(a)(1) (iii) | Number of Hopping Frequency Used | Pass |
| 5.1.8 | 15.247(a)(1) (iii) | Dwell Time on Each Channel | Pass |
| 5.2.1 | 15.207 | Mains Conducted Emission | Pass |

Note:

1. If the Frequency Hopping Systems operating in 2400-2483.5 MHz band and the output power less than 125 mW. The hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of hopping channel whichever is greater.
2. Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

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APPENDIX A - TEST RESULT OF CONDUCTED

APPENDIX B - TEST RESULT OF RADIATED EMISSIONS & MAINS CONDUCTED EMISSION

APPENDIX SP - PHOTOGRAPHS TEST SETUP

APPENDIX EP - PHOTOGRAPHS OF EUT

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HISTORY OF THIS TEST REPORT

| Report No. | Description | Date Issued |
|---------------------------|------------------|-------------|
| CN210UH4 (P15C-BT) 001 | Original Release | 2021-06-16 |

1. General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix A - Test Result of Conducted

Appendix B - Test Result of Radiated Emissions & Mains Conducted Emission

Appendix SP - Photographs Test Setup

Appendix EP - Photographs of EUT

Applied Standard and Test Levels

| Radio |
|---|
| FCC 47CFR Part 15: Subpart C Section 15.247 |
| FCC 47CFR Part 2: Subpart J Section 2.1049 |
| ANSI C63.10:2013 |
| KDB 558074 D01 15.247 Meas Guidance v05r02 |

1.2 Decision Rule of Conformity

The decision rule of conformity of this test report is following the requirements of the requested standard in the quotation, and agreed among testing laboratory and manufacturer (applicant) to exclude the consideration of Measurement Uncertainty, unless it is required by the specific standard.

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2. Test Sites

2.1 Test Laboratory

Taipei Testing Laboratories

11F. No.758, Sec. 4, Bade Rd., Songshan Dist.
Taipei City 105
Taiwan (R.O.C.)

2.2 Test Facility

Taipei Testing Laboratories

No.458-18, Sec. 2, Fenliao Rd., Linkou Dist.,
New Taipei City 244
Taiwan (R.O.C.)
FCC Registration No.: 226631
ISED Registration No.: 25563

2.3 Traceability

All measurement equipment calibrations are traceable to NML(Taiwan)/NIST(USA) or where calibration is performed outside Taiwan, to equivalent nationally recognized standards organizations.

2.4 Calibration

Equipment requiring calibration is calibrated periodically in a suitably accredited Calibration Lab. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

2.5 Measurement Uncertainty

All measurement uncertainty values are shown with a coverage factor of k=2 to indicate a 95% level of confidence.

Emission Measurement Uncertainty

| Parameter | Uncertainty |
|--------------------------------------|-------------|
| Radiated Emission (9 kHz ~ 30 MHz) | ± 1.15 dB |
| Radiated Emission (30 MHz ~ 200 MHz) | ± 1.32 dB |
| Radiated Emission (200 MHz ~ 1 GHz) | ± 1.31 dB |
| Radiated Emission (1 GHz ~ 18 GHz) | ± 1.53 dB |
| Radiated Emission (18 GHz ~ 40 GHz) | ± 2.50 dB |
| Mains Conducted Emission | ± 1.65 dB |

3. General Product Information

3.1 Product Function and Intended Use

The EUT is a WiFi 802.11 a/b/g/n/ac & BT 4.1 M.2 module. It contains a Bluetooth compatible module enabling the user to communicate data through a Wireless interface.

For details refer to the User Guide, Data Sheet and Circuit Diagram.

3.2 System Details and Ratings

Basic Information of EUT

| Item | EUT information |
|-----------------------------|--|
| Kind of Equipment/Test Item | WiFi 802.11 a/b/g/n/ac & BT 4.1 M.2 module |
| Type Identification | P-WFBT_AP6356SD |
| FCC ID | 2AMRAP-WFBT-AP6356 |

Technical Specification of EUT

| Item | EUT information |
|---------------------------|-----------------------------|
| Operating Frequency | 2402 MHz ~ 2480 MHz |
| Channel Number | 79 |
| Operation Voltage | 3.3 Vdc |
| Modulation | GFSK, $\pi/4$ -DQPSK, 8DPSK |
| Maximum Output Power (mW) | 0.99 |
| Antenna Information | Refer to 5.1.1 |
| Accessory Device | Refer to 4.4 |

Note: Only WLAN 5 GHz and BT can transmit at the same time.

3.3 Noise Generating and Noise Suppressing Parts

Refer to the Circuit Diagram.

3.4 Submitted Documents

- Circuit Diagram
- Instruction Manual
- Rating Label
- Technical Description

4. Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

The test modes were adapted accordingly in reference to the instructions for use.

During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output expected by the customer and is going to be fixed on the firmware of the final end product.

Table for Parameters of Test Software Setting

| Frequency (MHz) | Power Setting | | |
|-----------------|---------------|----------------|---------|
| | GFSK | $\pi/4$ -DQPSK | 8DPSK |
| 2402 | Default | Default | Default |
| 2441 | Default | Default | Default |
| 2480 | Default | Default | Default |

4.2 Carrier Frequency and Channel

| Channel | Freq. (MHz) |
|---------|-------------|---------|-------------|---------|-------------|---------|-------------|
| 0 | 2402 | 20 | 2422 | 40 | 2442 | 60 | 2462 |
| 1 | 2403 | 21 | 2423 | 41 | 2443 | 61 | 2463 |
| 2 | 2404 | 22 | 2424 | 42 | 2444 | 62 | 2464 |
| 3 | 2405 | 23 | 2425 | 43 | 2445 | 63 | 2465 |
| 4 | 2406 | 24 | 2426 | 44 | 2446 | 64 | 2466 |
| 5 | 2407 | 25 | 2427 | 45 | 2447 | 65 | 2467 |
| 6 | 2408 | 26 | 2428 | 46 | 2448 | 66 | 2468 |
| 7 | 2409 | 27 | 2429 | 47 | 2449 | 67 | 2469 |
| 8 | 2410 | 28 | 2430 | 48 | 2450 | 68 | 2470 |
| 9 | 2411 | 29 | 2431 | 49 | 2451 | 69 | 2471 |
| 10 | 2412 | 30 | 2432 | 50 | 2452 | 70 | 2472 |
| 11 | 2413 | 31 | 2433 | 51 | 2453 | 71 | 2473 |
| 12 | 2414 | 32 | 2434 | 52 | 2454 | 72 | 2474 |
| 13 | 2415 | 33 | 2435 | 53 | 2455 | 73 | 2475 |
| 14 | 2416 | 34 | 2436 | 54 | 2456 | 74 | 2476 |
| 15 | 2417 | 35 | 2437 | 55 | 2457 | 75 | 2477 |
| 16 | 2418 | 36 | 2438 | 56 | 2458 | 76 | 2478 |
| 17 | 2419 | 37 | 2439 | 57 | 2459 | 77 | 2479 |
| 18 | 2420 | 38 | 2440 | 58 | 2460 | 78 | 2480 |
| 19 | 2421 | 39 | 2441 | 59 | 2461 | | |

4.3 Test Operation and Test Software

Setup for testing: Test samples are provided with a USB interface which makes it possible to control them through a test software installed on a notebook computer.

This software was running on the laptop computer connected to the EUT. It was used to enable the operation modes listed as below.

| | |
|---------------|----------------|
| Test Software | Win8DUTApp.exe |
|---------------|----------------|

The samples were used as follows:

A003056031-001

A002956452-002

Full test was applied on all test modes, but only worst case was shown.

| EUT Configure Mode | Applicable To | | | | Description |
|--------------------|------------------------------------|---|---|--------------------------|-------------|
| | Antenna Port Conducted Measurement | Radiated Spurious Emissions above 1 GHz | Radiated Spurious Emissions below 1 GHz | Mains Conducted Emission | |
| - | √ | √ | √ | √ | - |

Note:

1. For Radiated emission test, pre-tested GFSK, $\pi/4$ -DQPSK, 8DPSK modulation type and found GFSK was the worse, therefore chosen for the final test and presented in the test report.
2. The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when position on **Y-plane**.
3. "-" means no effect.

Antenna Port Conducted Measurement

Pre-Scan full test was applied on all test modes, but only worst case was shown.

Following channel(s) was (were) selected for the final test as listed below.

| EUT Configure Mode | Available Frequency (MHz) | Tested Frequency (MHz) | Modulation Type | Packet Type |
|--------------------|---------------------------|------------------------|-----------------|-------------|
| - | 2402 to 2480 | 2402, 2441, 2480 | GFSK | 1DH5 |
| - | 2402 to 2480 | 2402, 2441, 2480 | 8DPSK | 3DH5 |

Radiated Spurious Emissions (Above 1 GHz)

Pre-Scan full test was applied on all test modes, but only worst case was shown.

Following channel(s) was (were) selected for the final test as listed below.

| EUT Configure Mode | Available Frequency (MHz) | Tested Frequency (MHz) | Modulation Type | Packet Type |
|--------------------|---------------------------|------------------------|-----------------|-------------|
| - | 2402 to 2480 | 2402, 2441, 2480 | GFSK | 1DH5 |
| - | 2402 to 2480 | 2402, 2441, 2480 | 8DPSK | 3DH5 |
| - | 2402 to 2480 5180-5240 | 2480 + 5180 | - | - |

Radiated Spurious Emissions (Below 1 GHz)

Pre-Scan full test was applied on all test modes, but only worst case was shown.

Following channel(s) was (were) selected for the final test as listed below.

| EUT Configure Mode | Available Frequency (MHz) | Tested Frequency (MHz) | Modulation Type | Packet Type |
|--------------------|---------------------------|------------------------|-----------------|-------------|
| - | 2402 to 2480 | 2480 | GFSK | 3DH5 |

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Mains Conducted Emission Test

- Pre-Scan full test was applied on all test modes, but only worst case was shown.
- Following channel(s) was (were) selected for the final test as listed below.

| EUT Configure Mode | Available Frequency (MHz) | Tested Frequency (MHz) | Modulation Type | Packet Type |
|--------------------|---------------------------|------------------------|-----------------|-------------|
| - | 2402 to 2480 | 2480 | GFSK | 3DH5 |

Test Condition

| Test Item | Ambient Temperature | Relative Humidity | Tested by |
|---|---------------------|-------------------|-------------------|
| Conducted Measurement | 20.3 °C | 66 % | Stanislas Charles |
| Radiated Spurious Emissions above 1 GHz | 20.5-23.3 °C | 59.3-63.1 % | Simon Tsai |
| Radiated Spurious Emissions below 1 GHz | 20.5-23.3 °C | 59.3-63.1 % | Simon Tsai |
| Mains Conducted Emission | 21.9 °C | 59 % | Temo Chen |

4.4 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

Accessory of EUT

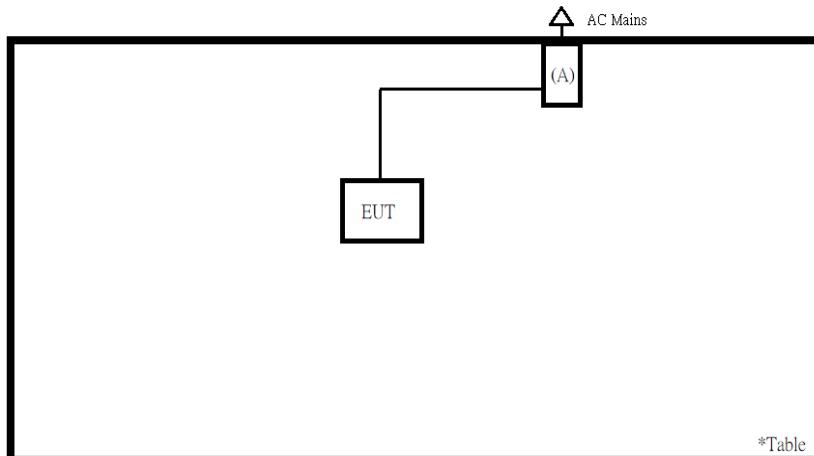
None

Support Unit

| Support Unit | | | | | | | | |
|--------------|--------------|---------|----------------|-----|----------|--------------------|-------------|-------------------|
| No | Description | Brand | Model | S/N | Shielded | Ferrite Core (Qty) | Length (cm) | Remark |
| A | Adapter | TUE | GQ24-120200-AX | N/A | No | 0 | 150 | Convert to 3.3Vdc |
| - | USB HUB | e-sense | 01-GUM430 | N/A | - | - | - | -- |
| - | USB Cable | Protech | E148000 | N/A | Yes | 0 | 50 | -- |
| - | USB Keyboard | Dell | KB4021 | N/A | Yes | 0 | 180 | -- |
| - | USB Mouse | Lenovo | SM-8823 | N/A | Yes | 0 | 180 | -- |

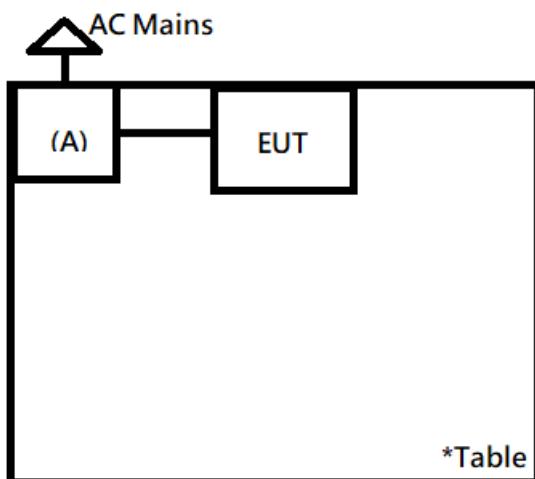
4.5 Test Setup Diagram

<Radiated Spurious Emissions mode>



*Table

<Mains Conducted Emission mode>



*Table

5. Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

Requirement Use of approved antennas only

According to the manufacturer declaration, the antenna information is as listed below. The antenna is with no possibility of replacement with a non-approved antenna by the end-user. Therefore, the EUT is considered to comply with this provision.

| ANT | Brand | Product No. | Product Name | Antenna Gain (dBi) | Antenna Type | Antenna Position | Remark |
|------|------------------------------|-----------------|-------------------------------|--------------------|--------------|------------------|----------------|
| ANT1 | Radiation Technology, Inc. | C0486-ANG0016 | MT-5750 2.4G/5G Antenna | 2.5 | PIFA | Main Antenna | - |
| ANT2 | Radiation Technology, Inc. | C0486-ANG0027 | MH-5102 Wi-Fi 2.4G/5G Antenna | 2.5 | PIFA | Main Antenna | - |
| ANT3 | Radiation Technology, Inc. | C0486-ANG0028 | MH-5102 WiFi/BT Antenna | 2.5 | PIFA | Aux. Antenna | Tested antenna |
| ANT4 | Joymax Electronics Co., Ltd. | TBF-RT03MPB-W70 | MT-5751 WiFi/BT Antenna B | 2.24 | PIFA | Aux. Antenna | - |

Antenna 3 and antenna 4 are the same type, they have similar characteristics on in-band and out-of-band. As for test, the higher gain antenna 3 was used for testing.

Refer to EUT photo for details.

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5.1.2 Peak Output Power

Limit

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt.
For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

Kind of Test Site Shielded room

Test Setup



Test Instruments

| Kind of Equipment | Manufacturer | Type | S/N | Calibration Date | Calibration Due Date | Test Date | |
|-------------------|--------------|---------|---------|------------------|----------------------|-----------|-----------|
| | | | | | | From | Until |
| Power Meter | Anritsu | ML2495A | 1901008 | 2020/4/6 | 2021/4/5 | 2020/12/3 | 2020/12/3 |
| Power Sensor | Anritsu | MA2411B | 1725269 | 2020/4/7 | 2021/4/6 | 2020/12/3 | 2020/12/3 |

Test Procedures

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

Average power sensor was used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

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Test Result

Peak Output Power

<GFSK>

| Channel | Channel Frequency | Peak Output Power | | Limit |
|----------------|-------------------|-------------------|------|-------|
| | (MHz) | (dBm) | (mW) | |
| Low Channel | 2402 | -1.26 | 0.75 | 125 |
| Middle Channel | 2441 | -0.35 | 0.92 | 125 |
| High Channel | 2480 | -0.06 | 0.99 | 125 |

<8DPSK>

| Channel | Channel Frequency | Peak Output Power | | Limit |
|----------------|-------------------|-------------------|------|-------|
| | (MHz) | (dBm) | (mW) | |
| Low Channel | 2402 | -1.81 | 0.66 | 125 |
| Middle Channel | 2441 | -0.69 | 0.85 | 125 |
| High Channel | 2480 | -0.38 | 0.92 | 125 |

Average Power

<GFSK>

| Channel | Channel Frequency | Average Power | |
|----------------|-------------------|---------------|-------|
| | (MHz) | (dBm) | (mW) |
| Low Channel | 2402 | -2.35 | 0.582 |
| Middle Channel | 2441 | -1.21 | 0.757 |
| High Channel | 2480 | -0.80 | 0.832 |

<8DPSK>

| Channel | Channel Frequency | Average Power | |
|----------------|-------------------|---------------|-------|
| | (MHz) | (dBm) | (mW) |
| Low Channel | 2402 | -5.12 | 0.308 |
| Middle Channel | 2441 | -3.66 | 0.431 |
| High Channel | 2480 | -3.45 | 0.452 |

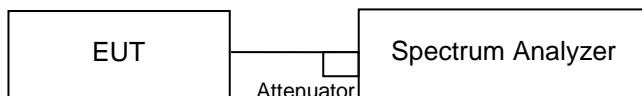
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5.1.3 20 dB Bandwidth and 99% Occupied Bandwidth

Kind of Test Site Shielded room

Test Setup



Test Instruments

| Kind of Equipment | Manufacturer | Type | S/N | Calibration Date | Calibration Due Date | Test Date | |
|-------------------|--------------|-------|--------|------------------|----------------------|-----------|-----------|
| | | | | | | From | Until |
| Spectrum Analyzer | R&S | FSV40 | 101512 | 2020/2/18 | 2021/2/16 | 2020/12/3 | 2020/12/3 |

Test Procedure

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
- Repeat above procedures until all frequencies measured were complete.
- The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with resolution bandwidth in the range of 1 % to 5 % of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth and set the detector to PEAK. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 % of the total mean power of a given emission.

Test Results

Please refer to Appendix A.

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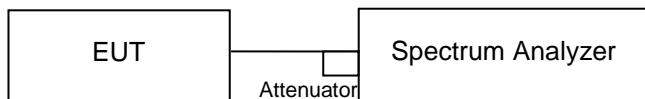
5.1.4 Conducted Spurious Emissions and Frequency Band Edges Measured in 100 kHz Bandwidth

Limit

20 dB (below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.)

Kind of Test Site Shielded room

Test Setup



Test Instruments

| Kind of Equipment | Manufacturer | Type | S/N | Calibration Date | Calibration Due Date | Test Date | |
|-------------------|--------------|-------|--------|------------------|----------------------|-----------|-----------|
| | | | | | | From | Until |
| Spectrum Analyzer | R&S | FSV40 | 101512 | 2020/2/18 | 2021/2/16 | 2020/12/3 | 2020/12/3 |

Test Procedure

The transmitter output was connected to the spectrum analyzer via a low loss cable. Set both RBW and VBW of spectrum analyzer to 100 kHz and 300 kHz with suitable frequency span including 100 MHz bandwidth from band edge. The band edges was measured and recorded.

Test Results

Please refer to Appendix A.

5.1.5 Radiated Spurious Emissions and Band Edges

Limit

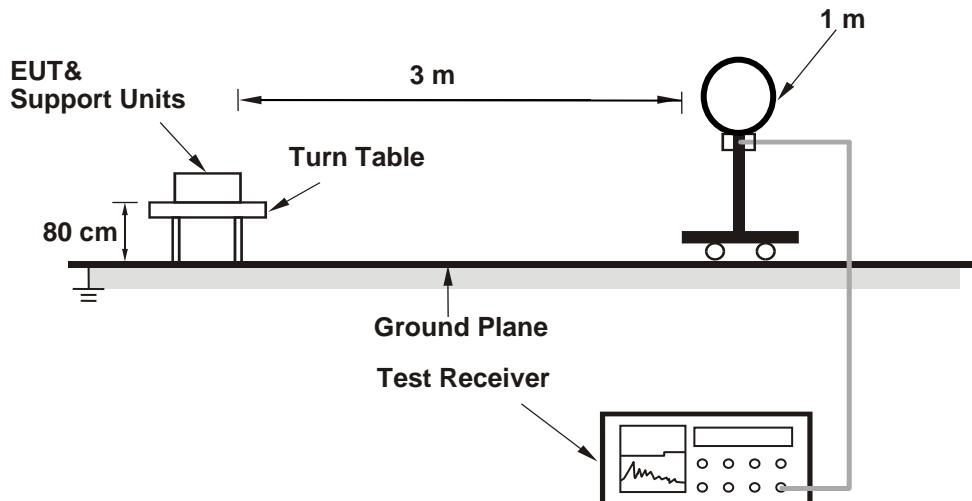
Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a).

Emissions radiated outside the restricted and authorized frequency bands must either comply with the radiated emission limits specified for the restricted bands or in §15.247(d).

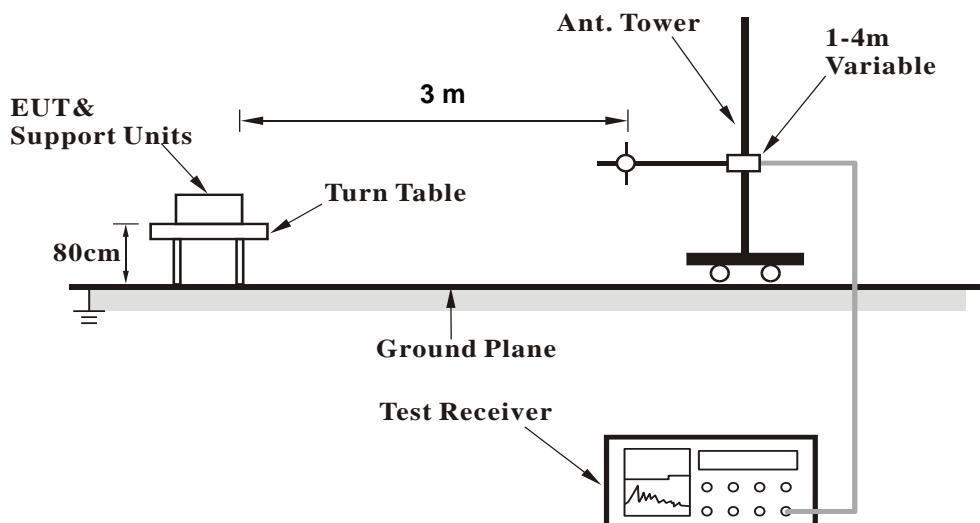
Kind of Test Site 3m Semi-Anechoic Chamber

Test Setup

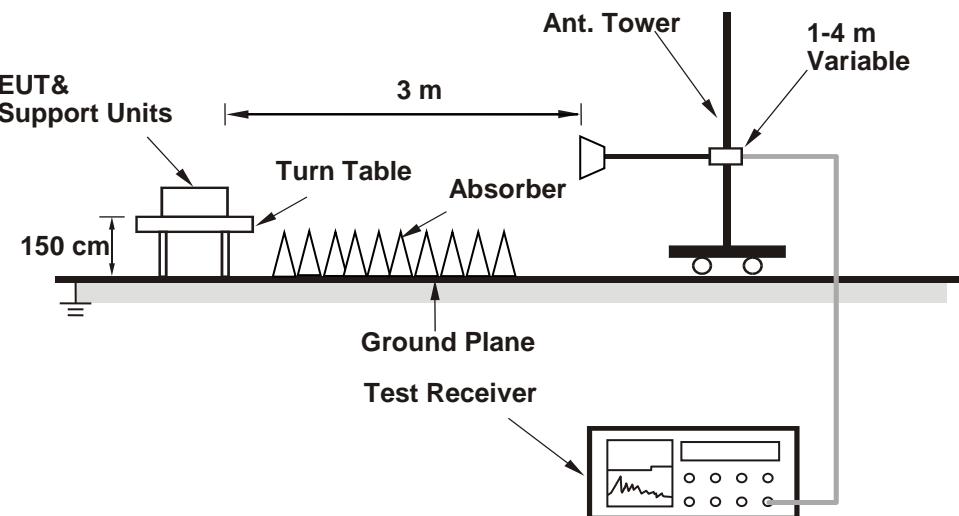
<Radiated Emissions below 30 MHz>



<Radiated Emissions 30 MHz to 1 GHz>



<Radiated Emissions above 1 GHz>



For the actual test configuration, please refer to the attached file (Test Setup Photo).

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Test Instruments

Test Date: 2021-05-22

| Kind of Equipment | Manufacturer | Type | S/N | Calibration Date | Calibration Due Date |
|--------------------|--------------|-------------------------|------------|------------------|----------------------|
| Signal Analyzer | R&S | FSV40 | 101509 | 2021/3/24 | 2022/3/23 |
| Receiver | R&S | ESR7 | 102108 | 2021/3/17 | 2022/3/16 |
| Bilog Antenna | SCHWARZBECK | VULB-9168 | 00950 | 2021/1/25 | 2022/1/24 |
| Horn Antenna | ETS-Lindgren | 3117 | 00218929 | 2020/11/6 | 2021/11/5 |
| LF-AMP | Agilent | 8447D | 2727A05146 | 2021/2/1 | 2022/1/31 |
| HF-AMP + AC source | EMCI | EMC051845SE | 980635 | 2021/2/1 | 2022/1/31 |
| HF-AMP + AC source | EMCI | EMC184045SE | 980656 | 2021/2/9 | 2022/2/8 |
| Horn Antenna | SCHWARZBECK | BBHA 9170 | 00890 | 2021/4/14 | 2022/4/13 |
| Microwave Cable | HUBER+SUHNER | SUCOFLEX 104EA | 800057/4EA | 2021/4/14 | 2022/4/13 |
| Microwave Cable | HUBER+SUHNER | SUCOFLEX 104 | 802244/4 | 2021/4/14 | 2022/4/13 |
| Microwave Cable | HUBER+SUHNER | SUCOFLEX 104 | MY37203/4 | 2021/4/14 | 2022/4/13 |
| Microwave Cable | HUBER+SUHNER | SUCOFLEX 102EA | 800897/2EA | 2021/3/11 | 2022/3/10 |
| Microwave Cable | HUBER+SUHNER | SUCOFLEX 102EA | 800902/2EA | 2021/3/11 | 2022/3/10 |
| Microwave Cable | HUBER+SUHNER | SUCOFLEX 102EA | 801026/2EA | 2021/3/11 | 2022/3/10 |
| Loop Antenna | Chance Most | EMCILPA600 +calibration | 287 | 2021/1/18 | 2022/1/17 |

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Test Procedures

For Radiated Emissions below 30 MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Parallel (OPEN), perpendicular (CLOSE), and ground-parallel (GROUND) orientations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9 kHz at frequency below 30 MHz.
2. All modes of operation were investigated and the worst-case emissions are reported.

For Radiated Emissions above 30 MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30 MHz ~ 1 GHz) / 1.5 meters (for above 1 GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detected function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) or Peak detection (PK) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is $\geq 1/T$ (Duty cycle $< 98\%$) or 10 Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1 GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

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5. The Radiated Emissions testing was performed in the X(E1), Y(H) and Z(E2) axis orientation. The worst-case Axis orientation is recorded in this test report.
6. The calculation formula is explained as follows:
Factor (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB)
Level (dBuV/m) = Reading (dBuV) + Factor (dB/m)

Test Results

Please refer to Appendix B.

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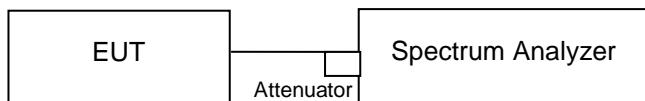
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5.1.6 Hopping Channel Separation

Limit $\geq 25 \text{ kHz}$ or $2/3$ of 20 dB bandwidth, whichever is greater

Kind of Test Site Shielded room

Test Setup



Test Instruments

| Kind of Equipment | Manufacturer | Type | S/N | Calibration Date | Calibration Due Date | Test Date | |
|-------------------|--------------|-------|--------|------------------|----------------------|-----------|-----------|
| | | | | | | From | Until |
| Spectrum Analyzer | R&S | FSV40 | 101512 | 2020/2/18 | 2021/2/16 | 2020/12/3 | 2020/12/3 |

Test Procedure

Measurement Procedure REF

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
- By using the MaxHold function record the separation of two adjacent channels.
- Measure the frequency difference of these two adjacent channels by SA MARK function. And then plot the result on SA screen.
- Repeat above procedures until all frequencies measured were complete.

Test Results

Please refer to Appendix A.

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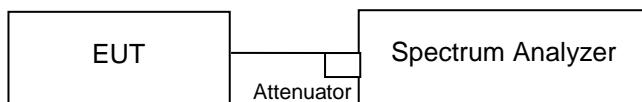
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5.1.7 Number of Hopping Frequency

 Limit ≥ 15 non-overlapping channels

Kind of Test Site Shielded room

Test Setup



Test Instruments

| Kind of Equipment | Manufacturer | Type | S/N | Calibration Date | Calibration Due Date | Test Date | |
|-------------------|--------------|-------|--------|------------------|----------------------|-----------|-----------|
| | | | | | | From | Until |
| Spectrum Analyzer | R&S | FSV40 | 101512 | 2020/2/18 | 2021/2/16 | 2020/12/3 | 2020/12/3 |

Test Procedure

- Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- Set the SA on MaxHold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
- Set the SA on View mode and then plot the result on SA screen.
- Repeat above procedures until all frequencies measured were complete.

Test Results

Please refer to Appendix A.

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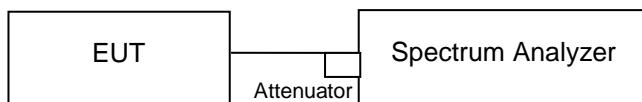
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5.1.8 Dwell Time

Limit 0.4s

Kind of Test Site Shielded room

Test Setup



Test Instruments

| Kind of Equipment | Manufacturer | Type | S/N | Calibration Date | Calibration Due Date | Test Date | |
|-------------------|--------------|-------|--------|------------------|----------------------|-----------|-----------|
| | | | | | | From | Until |
| Spectrum Analyzer | R&S | FSV40 | 101512 | 2020/2/18 | 2021/2/16 | 2020/12/3 | 2020/12/3 |

Test Procedures

- Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- Adjust the center frequency of SA on any frequency to be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
- Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
- Repeat above procedures until all different time-slot modes have been completed.

Test Results

Please refer to Appendix A.

5.2 Mains Emission

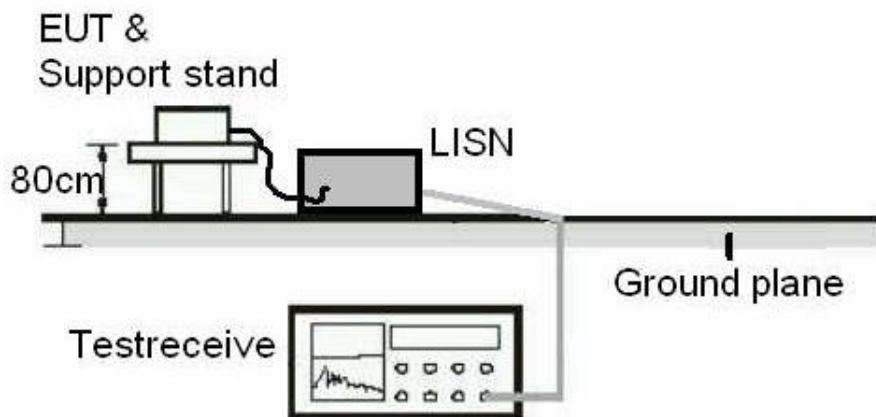
5.2.1 Mains Conducted Emission

Limit

Mains Conducted Emission as defined in §15.207 must comply with the mains conducted emission limits.

Kind of Test Site Shielded room

Test Setup



Test Instruments

Test Date: 2021-05-23

| Kind of Equipment | Manufacturer | Type | S/N | Calibration Date | Calibration Due Date |
|--------------------|--------------|--------|---------|------------------|----------------------|
| TWO-LINE V-NETWORK | R&S | ENV216 | 1816064 | 2020/9/10 | 2021/9/9 |
| EMI Test Receiver | R&S | ESCI | 1816063 | 2020/11/17 | 2021/11/16 |
| RF Cable | N/A | N/A | EMC-003 | 2020/11/15 | 2021/11/14 |

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Test Procedures

- a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/50 uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels under (Limit – 20 dB) was not recorded.

Note: The resolution bandwidth and video bandwidth of test receiver is 9 kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15 MHz – 30 MHz.

Test Results

Please refer to Appendix B.