

TEST REPORT

FCC ID: SY4-A020012

Product: GNSS Infrastructure

Model No.: P5E-Net

Additional Model No.: N/A

Trade Mark: 
Report No.: TCT171222E011

Issued Date: June 5, 2018

Issued for:

Shanghai Huace Navigation Technology LTD.
Building C, 599 Gaojing Road, Qingpu District, Shanghai, China

Issued By:

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Appendix A: Photographs of Test Setup

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1. Test Certification

| | |
|------------------------------|---|
| Product: | GNSS Infrastructure |
| Model No.: | P5E-Net |
| Additional Model No.: | N/A |
| Trade Mark: |  |
| Applicant: | Shanghai Huace Navigation Technology LTD. |
| Address: | Building C, 599 Gaojing Road, Qingpu District, Shanghai, China |
| Manufacturer: | Shanghai Huace Navigation Technology LTD. |
| Address: | Building C, 599 Gaojing Road, Qingpu District, Shanghai, China |
| Date of Test: | Dec. 24, 2017 – June 5, 2018 |
| Applicable Standards: | FCC CFR Title 47 Part 2; FCC CFR Title 47 Part 22H; FCC CFR Title 47 Part FCC PART 24E |

The above equipment has been tested by Shenzhen Tongce Testing Lab. and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product/system, which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Tested By:



Date: June 5, 2018

Brews Xu

Reviewed By:



Date: June 5, 2018

Approved By:



Tomsin

Date: June 5, 2018



2. Test Result Summary

| Requirement | CFR 47 Section | Result |
|---|-------------------------------------|--------|
| Conducted Output Power | §22.913; §2.1046 §24.232; | PASS |
| Peak-to-Average Ratio | §2.1046; §24.232(d) | PASS |
| Effective Radiated Power | §2.1046; §22.913(a) §24.232; | PASS |
| Equivalent Isotropic Radiated Power | §2.1046; §22.913(a) §24.232; | PASS |
| Occupied Bandwidth | §2.1049 | PASS |
| Band Edge | §2.1051 §22.917(a) §24.238(a) | PASS |
| Conducted Spurious Emission | §2.1051; §22.917 §24.238; | PASS |
| Field Strength of Spurious Radiation | §2.1053; §22.917(a) §24.238; | PASS |
| Frequency Stability for Temperature & Voltage | §2.1055; §22.355 §24.235; | PASS |

Note:

1. PASS: Test item meets the requirement.
2. Fail: Test item does not meet the requirement.
3. N/A: Test case does not apply to the test object.
4. The test result judgment is decided by the limit of test standard.

3. EUT Description

| | |
|---|---|
| Product: | GNSS Infrastructure |
| Model No.: | P5E-Net |
| Additional Model No.: | N/A |
| Trade Mark: |  |
| 3G Version: | Rel-6 |
| Tx Frequency: | WCDMA BAND II: 1852.4MHz—1907.6MHz WCDMA BAND V: 826.4MHz—846.6MHz |
| Maximum Output Power to Antenna: | WCDMA BAND II: 23.48dBm WCDMA BAND V: 23.95dBm |
| 99% Occupied Bandwidth: | WCDMA BAND II: 4136.3KHz WCDMA BAND V: 4118.2KHz |
| Type of Modulation: | WCDMA: QPSK |
| Antenna Type: | External Antenna |
| Antenna Gain: | WCDMA BAND II: 0.35dBi WCDMA BAND V: 0.5 dBi |
| Power Supply: | DC 7.4V from battery or 12-36VDC, DC 12V From adapter |
| Remark: | N/A |

4. General Information

4.1. Test environment and mode

| Operating Environment: | |
|---|--|
| Temperature: | 25.0 °C |
| Humidity: | 56 % RH |
| Atmospheric Pressure: | 1010 mbar |
| Test Mode: | |
| Operation mode: | Keep the EUT in communication with CMU200 and select channel with modulation |
| Remark: This product has a built-in rechargeable battery, so in an independent test, the EUT battery was fully-charged. | |
| The sample was placed (0.8m below 1GHz, 0.8m above 1GHz) above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages. | |

Description Operation Frequency

| WCDMA Band V | | WCDMA Band II | |
|--------------|-----------------|---------------|-----------------|
| Channel: | Frequency (MHz) | Channel: | Frequency (MHz) |
| 4132 | 826.40 | 9262 | 1852.40 |
| 4133 | 826.60 | 9263 | 1852.60 |
| | | | |
| 4182 | 836.40 | 9399 | 1879.80 |
| 4183 | 836.60 | 9400 | 1880.00 |
| 4184 | 836.80 | 9401 | 1880.20 |
| ... | ... | ... | ... |
| 4233 | 846.60 | 9538 | 1907.60 |

Final test channel:

| WCDMA Band V | | WCDMA Band II | |
|--------------|-----------------|---------------|-----------------|
| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
| 4132 | 826.40 | 9262 | 1852.40 |
| 4183 | 836.60 | 9400 | 1880.00 |
| 4233 | 846.60 | 9538 | 1907.60 |

4.2. Test Mode

Antenna port conducted and radiated test items were performed according to KDB 971168 D01 Power Meas. License Digital Systems v02r02 with maximum output power. Radiated measurements were performed with rotating EUT in different three orthogonal test planes to find the maximum emission.

Radiated emissions were investigated as following frequency range:

30 MHz to 20000 MHz for WCDMA Band II and WCDMA Band IV.

All modes and data rates and positions were investigated.

Test modes are chosen to be reported as the worst case configuration below:

| Test Mode | | |
|---------------|-------------------|-------------------|
| Band | Radiated TCs | Conducted TCs |
| WCDMA Band V | RMC 12.2Kbps Link | RMC 12.2Kbps Link |
| WCDMA Band II | RMC 12.2Kbps Link | RMC 12.2Kbps Link |

Note: The maximum power levels are chosen to test as the worst case configuration as follows:

GPRS multi-slot class 12 mode for GMSK modulation, EDGE multi-slot class 10 mode for 8PSK modulation.

RMC 12.2Kbps mode for WCDMA band V and WCDMA band II, only these modes were used for all tests. In addition to above worst-case test, below investigating on all data rates and all modes are compliance with each FCC test case which has specific test limits. For spurious emissions at antenna port, the EUT was investigated the band edges on low and high channels, and the unwanted spurious emissions on middle channel for all modes, the results are PASS, then only the worst-results were reported in the test report. The Radiated Spurious emissions for GPRS and EDGE modes were investigated on the middle channel and the PASS results were not worst than those data tested from the highest power channels.

4.3. Description of Support Units

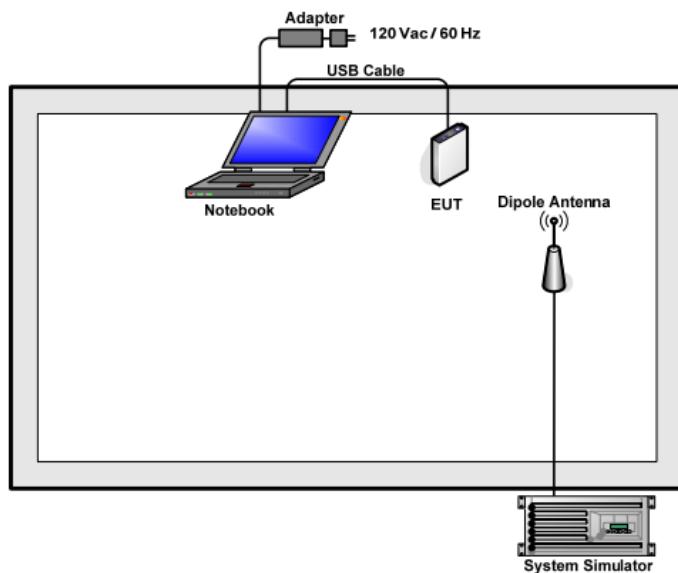
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

| Equipment | Model No. | Serial No. | FCC ID | Trade Name |
|---------------|-------------|------------|--------|------------|
| AC/DC Adapter | DPS-40AB-11 | / | / | / |

Note:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

4.4. Configuration of Tested System



4.5. Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between RF conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level will be exactly the RF output level. The spectrum analyzer offset is derived from RF cable loss and attenuator factor.
Offset = RF cable loss + attenuator factor.

The following shows an offset computation example with RF cable loss 3 dB and a 5dB attenuator.

Example: $\text{Offset (dB)} = \text{RF cable loss (dB)} + \text{attenuator factor (dB)}$.
= 8(dB)

5. Facilities and Accreditations

5.1. Facilities

The test facility is recognized, certified, or accredited by the following organizations:

- FCC - Registration No.: 645098

Shenzhen Tongce Testing Lab

The 3m Semi-anechoic chamber has been registered and fully described in a report with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

- IC - Registration No.: 10668A-1

The 3m Semi-anechoic chamber of Shenzhen TCT Testing Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing

5.2. Location

Shenzhen Tongce Testing Lab

Address: 1B/F., Building 1, Yibaolai Industrial Park, Qiaotou, Fuyong, Baoan District, Shenzhen, Guangdong, China

TEL: +86-755-27673339

5.3. Measurement Uncertainty

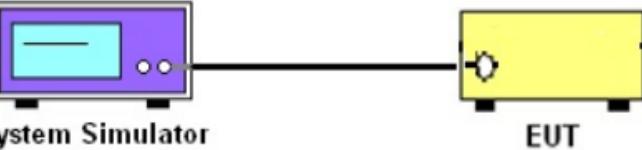
The reported uncertainty of measurement $y \pm U$, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %.

| No. | Item | MU |
|-----|-------------------------------|-------------------------|
| 1 | Conducted Emission | $\pm 2.56\text{dB}$ |
| 2 | RF power, conducted | $\pm 0.12\text{dB}$ |
| 3 | Spurious emissions, conducted | $\pm 0.11\text{dB}$ |
| 4 | All emissions, radiated(<1G) | $\pm 3.92\text{dB}$ |
| 5 | All emissions, radiated(>1G) | $\pm 4.28\text{dB}$ |
| 6 | Temperature | $\pm 0.1^\circ\text{C}$ |
| 7 | Humidity | $\pm 1.0\%$ |

6. Test Results and Measurement Data

6.1. Conducted Output Power Measurement

6.1.1. Test Specification

| | |
|--------------------------|---|
| Test Requirement: | FCC part 22.913(a) and FCC part 24.232(b) FCC part 27.50(d); |
| Test Method: | FCC part 2.1046 |
| Operation mode: | Refer to item 4.1 |
| Limits: | GSM 850 7W PCS 1900 2W WCDMA Band V:7W WCDMA Band II: 2W |
| Test Setup: |  |
| Test Procedure: | <ol style="list-style-type: none"> 1. The transmitter output port was connected to the system simulator. 2. Set EUT at maximum power through system simulator. 3. Select lowest, middle, and highest channels for each band and different modulation. 4. Measure the maximum burst average power for GSM and maximum average power for other modulation signal. |
| Test Result: | PASS |

6.1.2. Test Instruments

| Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|--------------------------|--------------|--------|---------------|-----------------|
| System simulator | R&S | CMU200 | 111382 | Sep. 27, 2018 |
| RF cable (9kHz-40GHz) | TCT | RE-05 | N/A | Sep. 27, 2018 |
| Antenna Connector | TCT | RFC-02 | N/A | Sep. 27, 2018 |

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI)

6.1.3. Test data**Conducted Power Measurement Results:**

| Average Conducted Power (*Unit: dBm) | | | | | | |
|--------------------------------------|---------------|--------|--------|--------------|-------|-------|
| Band | WCDMA Band II | | | WCDMA Band V | | |
| Channel | 9262 | 9400 | 9538 | 4132 | 4183 | 4233 |
| Frequency | 1852.4 | 1880.0 | 1907.6 | 826.4 | 836.6 | 846.6 |
| RMC 12.2Kbps | 23.35 | 23.33 | 23.41 | 23.95 | 23.88 | 23.85 |
| HSDPA Subtest-1 | 22.97 | 23.09 | 23.07 | 23.67 | 23.61 | 23.63 |
| HSDPA Subtest-2 | 23.18 | 23.48 | 23.41 | 21.53 | 23.18 | 21.85 |
| HSDPA Subtest-3 | 22.80 | 23.09 | 22.12 | 20.49 | 22.80 | 21.21 |
| HSDPA Subtest-4 | 22.50 | 23.03 | 22.05 | 21.12 | 22.50 | 20.61 |
| HSUPA Subtest-1 | 21.82 | 22.03 | 22.07 | 22.27 | 22.72 | 22.28 |
| HSUPA Subtest-2 | 19.99 | 19.62 | 20.10 | 19.70 | 20.59 | 20.56 |
| HSUPA Subtest-3 | 20.83 | 21.26 | 21.07 | 19.40 | 21.50 | 21.54 |
| HSUPA Subtest-4 | 20.13 | 20.33 | 20.90 | 19.77 | 20.97 | 21.24 |
| HSUPA Subtest-5 | 21.36 | 22.29 | 22.25 | 20.64 | 23.14 | 22.46 |

6.2. Peak to Average Ratio

6.2.1. Test Specification

| | |
|--------------------------|---|
| Test Requirement: | FCC part 24.232(d) ; FCC part 22.913; FCC part 27.50(d); |
| Test Method: | FCC KDB 971168 v02r02 Section 5.7.1 |
| Operation mode: | Refer to item 4.1 |
| Limit: | The peak-to-average ratio (PAR) of the transmission may not exceed 13 dB. |
| Test Setup: | |
| Test Procedure: | <ol style="list-style-type: none"> 1. The testing follows FCC KDB 971168 v02r02 Section 5.7.1. 2. The EUT was connected to spectrum analyzer and system simulator via a power divider. 3. Set EUT to transmit at maximum output power. 4. For GSM/EGPRS operating modes, signal gating is implemented on the spectrum analyzer by triggering from the system simulator. 5. Set the CCDF (Complementary Cumulative Distribution Function) option of the spectrum analyzer. Record the maximum PAPR level associated with a probability of 0.1%. |
| Test Result: | PASS |

6.2.2. Test Instruments

| Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|--------------------------|--------------|--------|---------------|-----------------|
| System simulator | R&S | CMU200 | 111382 | Sep. 27, 2018 |
| Spectrum Analyzer | Agilent | N9020A | MY49100060 | Sep. 27, 2018 |
| RF cable (9kHz-40GHz) | TCT | RE-05 | N/A | Sep. 27, 2018 |
| Antenna Connector | TCT | RFC-02 | N/A | Sep. 27, 2018 |

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

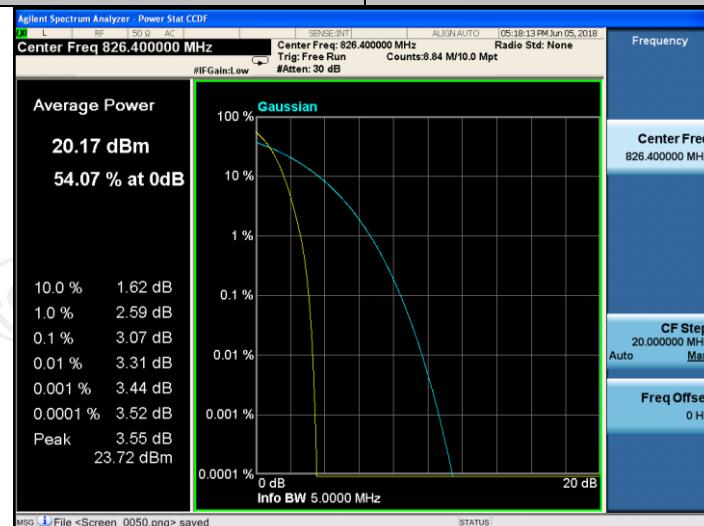
6.2.3. Test Data

| Test mode | Peak to Average Ratio (dB) | | | Limit (dB) | Result |
|---------------|-------------------------------|------------|----------|---------------|--------|
| | Low Ch. | Middle Ch. | High Ch. | | |
| WCDMA Band II | 3.01 | 3.04 | 2.97 | 13 | PASS |
| WCDMA Band V | 3.07 | 2.99 | 3.10 | | |

Test plots as follows:

Test band:

WCDMA Band V (RMC 12.2Kbps link)



Lowest channel



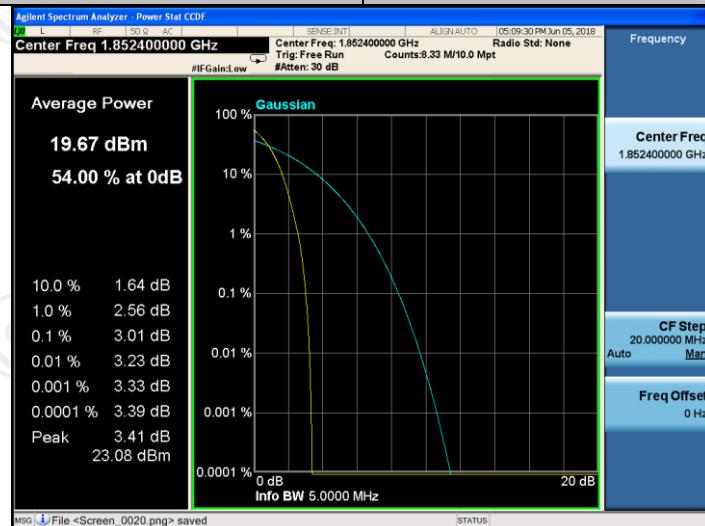
Middle channel



Highest channel

Test band:

WCDMA Band II (RMC 12.2Kbps link)



Lowest channel



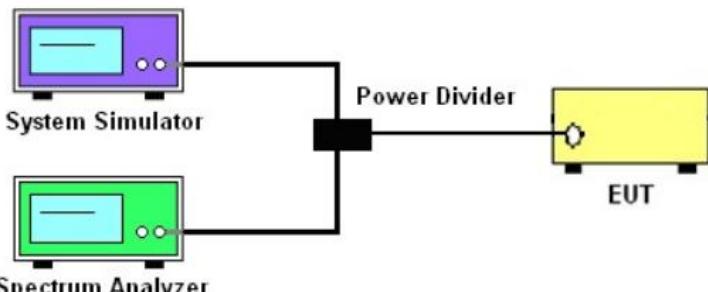
Middle channel



Highest channel

6.3. 99% Occupied Bandwidth and 26dB Bandwidth Measurement

6.3.1. Test Specification

| | |
|--------------------------|--|
| Test Requirement: | FCC part 2.1049 |
| Test Method: | FCC part 2.1049 |
| Operation mode: | Refer to item 4.1 |
| Limit: | N/A |
| Test Setup: |  |
| Test Procedure: | <ol style="list-style-type: none"> 1. The testing follows FCC KDB 971168 v02r02 Section 4.2. 2. The EUT was connected to the spectrum analyzer and system simulator via a power divider. 3. The RF output of the EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 4. The 99% occupied bandwidth were measured, set RBW= 1% of span, VBW= 3*RBW, sample detector, trace maximum hold. 5. The 26dB bandwidth were measured, set RBW= 1% of EBW, VBW= 3*RBW, peak detector, trace maximum hold. |
| Test Result: | PASS |

6.3.2. Test Instruments

| Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|--------------------------|--------------|--------|---------------|-----------------|
| System simulator | R&S | CMU200 | 111382 | Sep. 27, 2018 |
| Spectrum Analyzer | Agilent | N9020A | MY49100060 | Sep. 27, 2018 |
| RF cable (9kHz-40GHz) | TCT | RE-05 | N/A | Sep. 27, 2018 |
| Antenna Connector | TCT | RFC-02 | N/A | Sep. 27, 2018 |

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

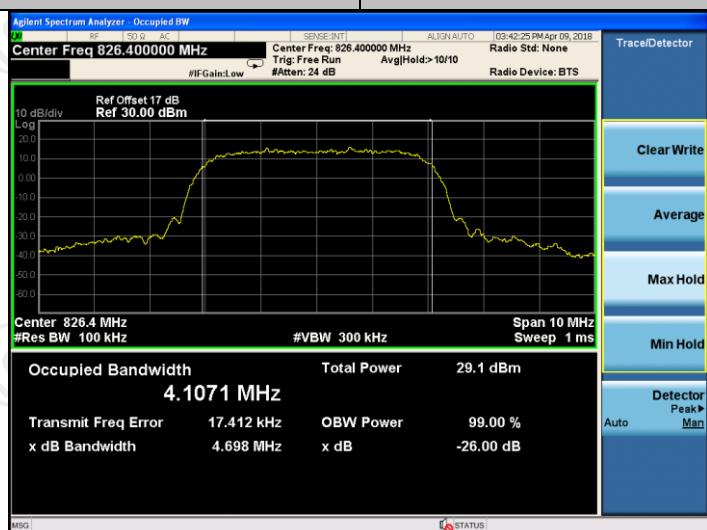
6.3.3. Test Data

| EUT Mode | Channel | Frequency (MHz) | 99% Occupy bandwidth (KHz) | -26dB bandwidth (KHz) |
|--------------------------------------|---------|-----------------|----------------------------|-----------------------|
| WCDMA Band V (RMC 12.2Kbps link) | 4132 | 826.40 | 4107.1 | 4698 |
| | 4183 | 836.60 | 4136.3 | 4709 |
| | 4233 | 846.60 | 4108.8 | 4722 |
| WCDMA Band II (RMC 12.2Kbps link) | 9262 | 1852.4 | 4118.2 | 4718 |
| | 9400 | 1880.0 | 4111.7 | 4708 |
| | 9538 | 1907.6 | 4108.7 | 4697 |

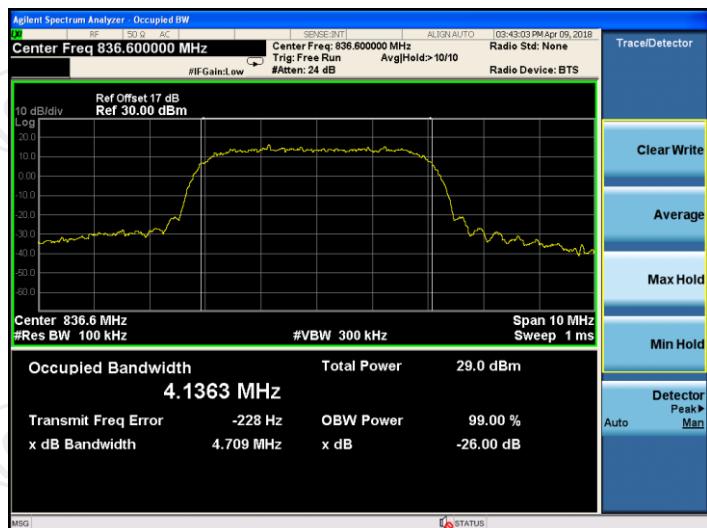
Test plots as follows:

Test band:

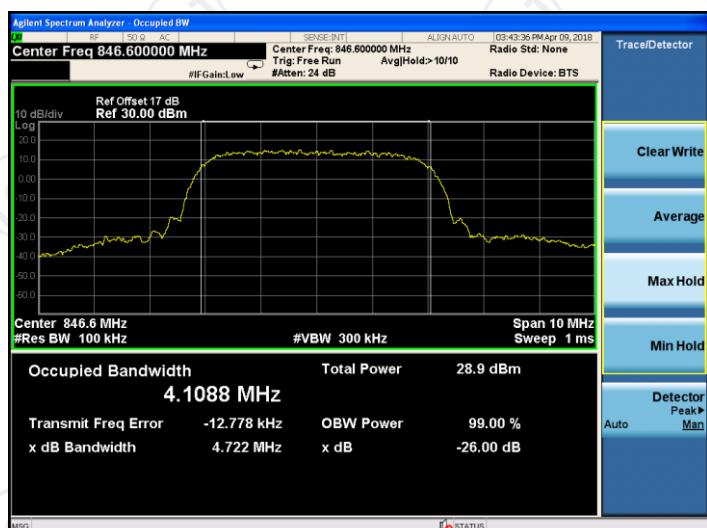
WCDMA Band V (RMC 12.2Kbps link)



Lowest channel



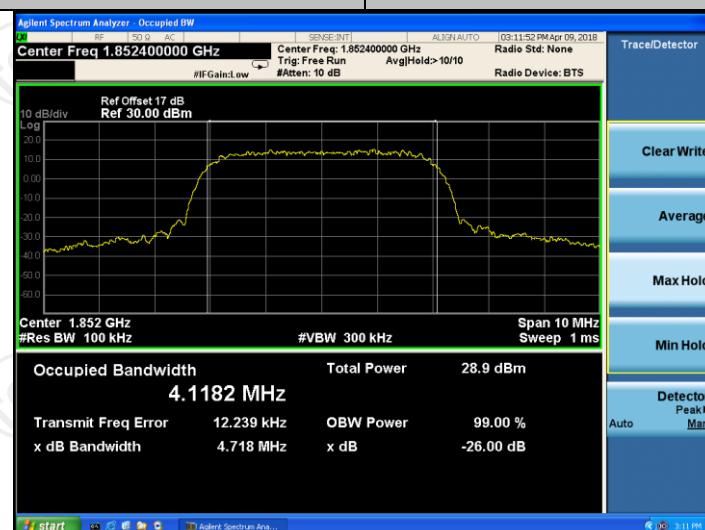
Middle channel



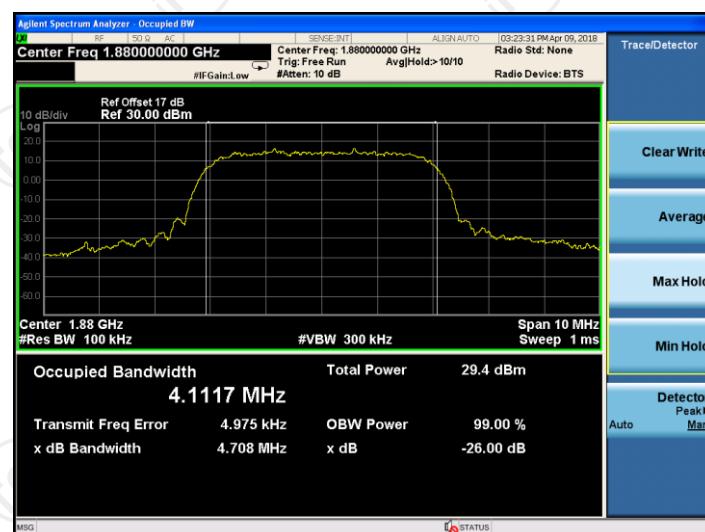
Highest channel

Test band:

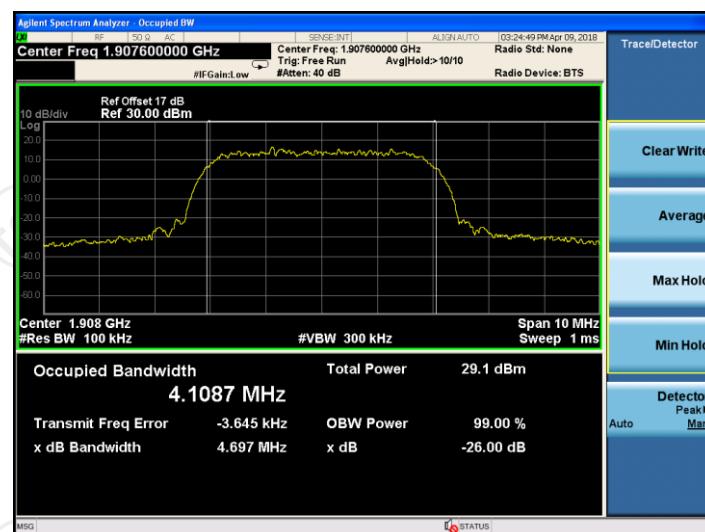
WCDMA Band II (RMC 12.2Kbps link)



Lowest channel



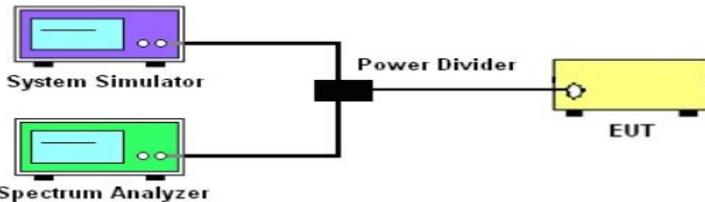
Middle channel



Highest channel

6.4. Band Edge and Conducted Spurious Emission Measurement

6.4.1. Test Specification

| | |
|--------------------------|---|
| Test Requirement: | FCC part22.917(a) and FCC part24.238(a) FCC part27.53(g) |
| Test Method: | FCC part2.1051 |
| Operation mode: | Refer to item 4.1 |
| Limit: | -13dBm |
| Test Setup: |  |
| Test Procedure: | <ol style="list-style-type: none"> 1. The testing follows FCC KDB 971168 v02r02 Section 6. 2. The EUT was connected to the spectrum analyzer and system simulator via a power divider. 3. The RF output of EUT was connected to the spectrum analyzer by an RF cable and attenuator. The path loss was compensated to the results for each measurement. 4. The band edges of low and high channels for the highest RF powers were measured. 5. The conducted spurious emission for the whole frequency range was taken. 6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band. 7. The limit line is derived from $43 + 10\log(P)$ dB below the transmitter power $P(\text{Watts}) = P(\text{W}) - [43 + 10\log(P)] \text{ (dB)} = [30 + 10\log(P)] \text{ (dBm)} - [43 + 10\log(P)] \text{ (dB)} = -13\text{dBm}.$ |
| Test Result: | PASS |

6.4.2. Test Instruments

| Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|--------------------------|--------------|--------|---------------|-----------------|
| System simulator | R&S | CMU200 | 111382 | Sep. 27, 2018 |
| Spectrum Analyzer | Agilent | N9020A | MY49100060 | Sep. 27, 2018 |
| RF cable (9kHz-40GHz) | TCT | RE-05 | N/A | Sep. 27, 2018 |
| Antenna Connector | TCT | RFC-02 | N/A | Sep. 27, 2018 |

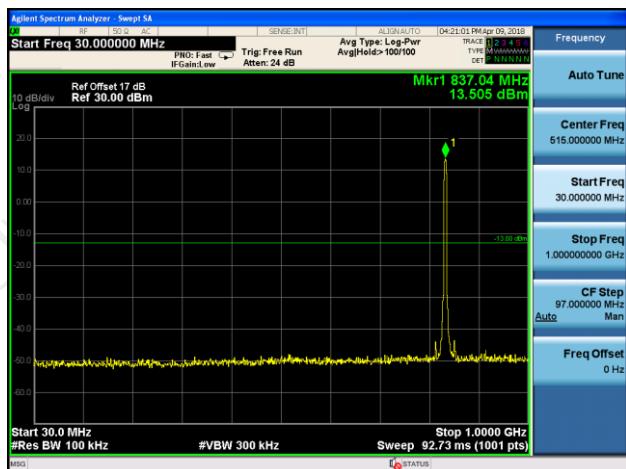
Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.4.3. Test Data

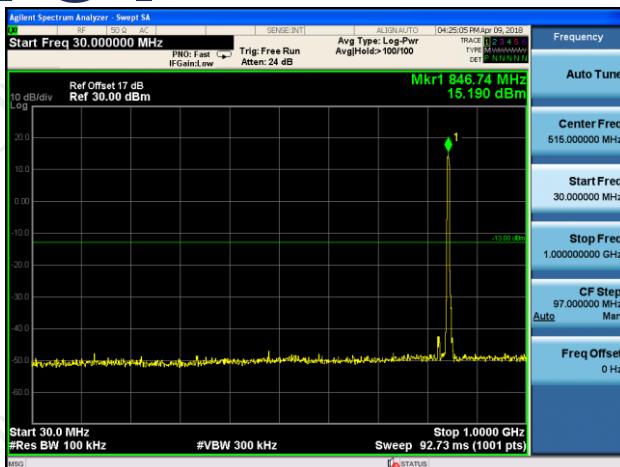
Test plots as follows:



Lowest channel

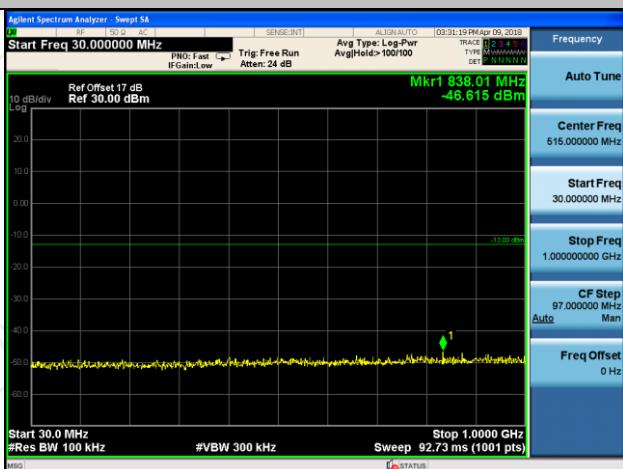


Middle channel

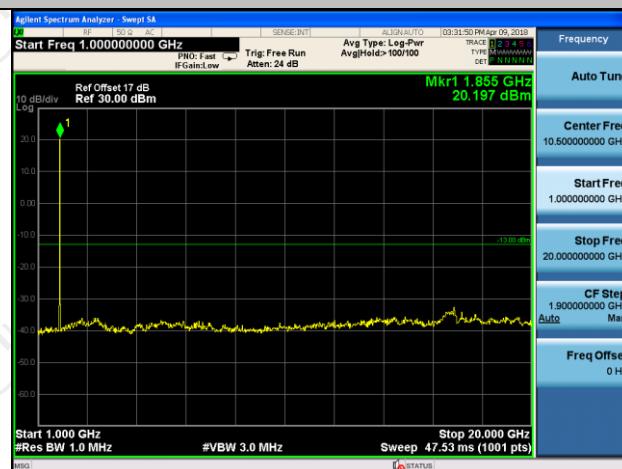


Highest channel

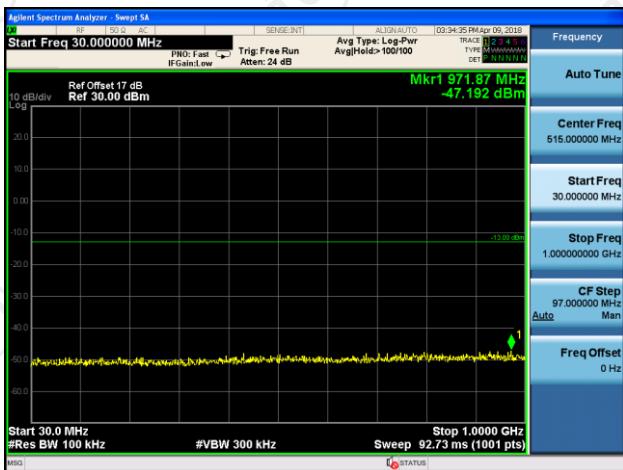
Test Mode: Traffic mode



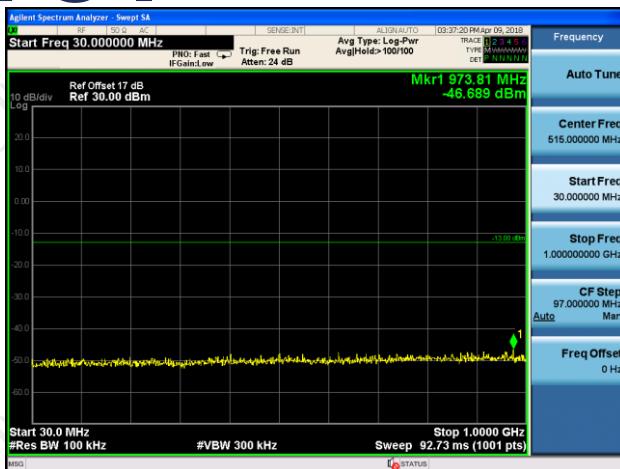
WCDMA Band II (RMC 12.2Kbps link)



Lowest channel



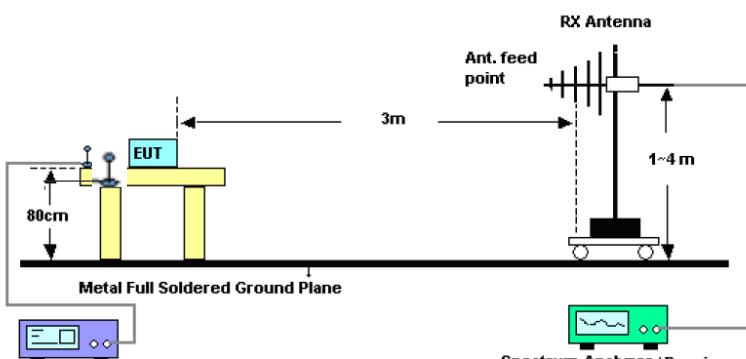
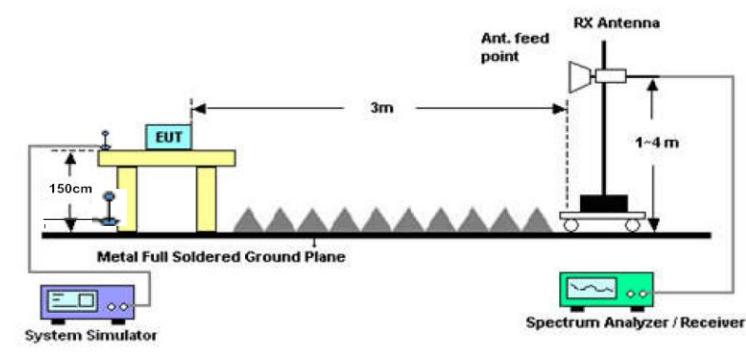
Middle channel



Highest channel

6.5. Effective Radiated Power and Effective Isotropic Radiated Power Measurement

6.5.1. Test Specification

| Test Requirement: | FCC part 22.913(a) and FCC part 24.232(b) FCC part 27.50(d) | | | | | | | | | | | | | | | | | | | | | | | | |
|--------------------------|---|------------|---------------|------------|------|--------|-------|-----|-------|--------|-----|-------|--------|----------|-----|-----|-------|---------|---------|--------------|-------|-------|-------------|-----|-----|
| Test Method: | FCC part 2.1046 | | | | | | | | | | | | | | | | | | | | | | | | |
| Receiver Setup: | <table border="1"> <thead> <tr> <th></th> <th>GSM/GPRS/EDGE</th> <th>WCDMA/HSPA</th> </tr> </thead> <tbody> <tr> <td>SPAN</td> <td>500kHz</td> <td>10MHz</td> </tr> <tr> <td>RBW</td> <td>10kHz</td> <td>100kHz</td> </tr> <tr> <td>VBW</td> <td>30kHz</td> <td>300kHz</td> </tr> <tr> <td>Detector</td> <td>RMS</td> <td>RMS</td> </tr> <tr> <td>Trace</td> <td>Average</td> <td>Average</td> </tr> <tr> <td>Average Type</td> <td>Power</td> <td>Power</td> </tr> <tr> <td>Sweep Count</td> <td>100</td> <td>100</td> </tr> </tbody> </table> | | GSM/GPRS/EDGE | WCDMA/HSPA | SPAN | 500kHz | 10MHz | RBW | 10kHz | 100kHz | VBW | 30kHz | 300kHz | Detector | RMS | RMS | Trace | Average | Average | Average Type | Power | Power | Sweep Count | 100 | 100 |
| | GSM/GPRS/EDGE | WCDMA/HSPA | | | | | | | | | | | | | | | | | | | | | | | |
| SPAN | 500kHz | 10MHz | | | | | | | | | | | | | | | | | | | | | | | |
| RBW | 10kHz | 100kHz | | | | | | | | | | | | | | | | | | | | | | | |
| VBW | 30kHz | 300kHz | | | | | | | | | | | | | | | | | | | | | | | |
| Detector | RMS | RMS | | | | | | | | | | | | | | | | | | | | | | | |
| Trace | Average | Average | | | | | | | | | | | | | | | | | | | | | | | |
| Average Type | Power | Power | | | | | | | | | | | | | | | | | | | | | | | |
| Sweep Count | 100 | 100 | | | | | | | | | | | | | | | | | | | | | | | |
| Limit: | <p>GSM850 7W ERP PCS1900 2W EIRP WCDMA Band V: 7W ERP WCDMA Band II: 2W EIRP</p> | | | | | | | | | | | | | | | | | | | | | | | | |
| Test Setup: | <p>From 30MHz to 1GHz</p>  <p>Above 1GHz</p>  | | | | | | | | | | | | | | | | | | | | | | | | |
| Test Procedure: | <ol style="list-style-type: none"> 1. The testing follows FCC KDB 971168 v02r02 Section 5.8. and ANSI / TIA-603-D-2010 Section 2.2.17. | | | | | | | | | | | | | | | | | | | | | | | | |

| | |
|----------------------|--|
| | <p>2. The EUT was placed on a non-conductive rotating platform 0.8 meters high below 1GHz and a non-conductive rotating platform 1.5 meters high above 1GHz in a semi-anechoic chamber. The radiated emission at the fundamental frequency was measured at 3 m with a test antenna and a spectrum analyzer with RMS detector per section 5. of KDB 971168 D01.</p> <p>3. Key the transmitter, then rotate the EUT 360° azimuthally and record spectrum analyzer power level (LVL) measurements at angular increments that are sufficiently small to permit resolution of all peaks. If a standard radiation test site is used, raise and lower the test antenna to obtain a maximum reading at each angular increment.</p> <p>4. Replace the transmitter under test with a substitution antenna. The center of the antenna should be at the same location as the center of the antenna under test.</p> <p>5. Connect the antenna to a signal generator with a known output power and record the path loss (in dB) as LOSS. If a standard radiation test site is used, raise and lower the test antenna to obtain a maximum reading.</p> <p>$LOSS = \text{Generator Output Power (dBm)} - \text{Analyzer reading (dBm)}$</p> <p>6. Determine the effective radiated output power at each angular position from the readings in steps 3) and 5) using the following equation:</p> <p>$ERP (\text{dBm}) = LVL (\text{dBm}) + LOSS (\text{dB})$</p> <p>7. The maximum ERP is the maximum value determined in the preceding step.</p> <p>8. Calculating ERP:</p> <p>$ERP (\text{dBm}) = \text{Output Power (dBm)} - \text{Losses (dB)} + \text{Antenna Gain (dBd)}$</p> <p>$\text{Antenna Gain (dBd)} = \text{Antenna Gain (dBi)} - 2.15$</p> <p>$EIRP = ERP + 2.15$</p> |
| Test results: | PASS |

6.5.2. Test Instruments

| Radiated Emission Test Site (966) | | | | |
|-----------------------------------|---------------------|------------|---------------|-----------------|
| Name of Equipment | Manufacturer | Model | Serial Number | Calibration Due |
| System simulator | R&S | CMU200 | 111382 | Sep. 27, 2018 |
| Spectrum Analyzer | ROHDE&SCHW ARZ | R&S | FSQ | Sep. 27, 2018 |
| Signal Generator | HP | 83623B | 3614A00396 | Sep. 27, 2018 |
| Broadband Antenna | Schwarzbeck | VULB9163 | 340 | Sep. 27, 2018 |
| Horn Antenna | Schwarzbeck | BBHA 9120D | 631 | Sep. 27, 2018 |
| Broadband Antenna | Schwarzbeck | VULB9163 | 412 | Sep. 27, 2018 |
| Horn Antenna | Schwarzbeck | BBHA 9120D | 1201 | Mar. 05, 2018 |
| Dipole Antenna | TCT | TCT-RF | N/A | Sep. 27, 2018 |
| Coax cable (9kHz-1GHz) | TCT | RE-low-01 | N/A | Sep. 27, 2018 |
| Coax cable (9kHz-40GHz) | TCT | RE-high-02 | N/A | Sep. 27, 2018 |
| Coax cable (9kHz-1GHz) | TCT | RE-low-03 | N/A | Sep. 27, 2018 |
| Coax cable (9kHz-40GHz) | TCT | RE-High-04 | N/A | Sep. 27, 2018 |
| Antenna Mast | Keleto | CC-A-4M | N/A | N/A |
| EMI Test Software | Shurples Technology | EZ-EMC | N/A | N/A |

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

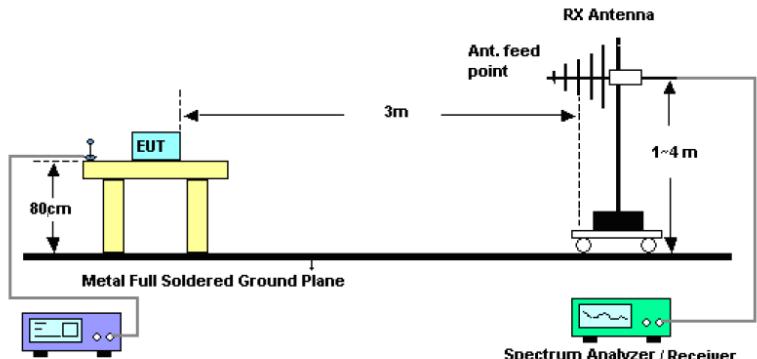
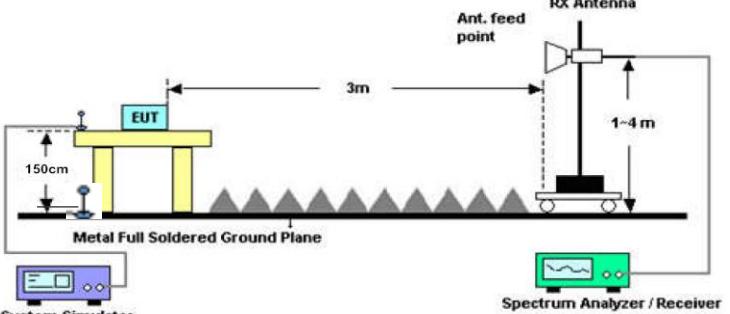
6.5.3. Test Data

| EUT mode | Channel | EUT Pol. | Antenna Pol. | ERP(dBm) | Limit (dBm) | Result |
|-----------------|---------|----------|--------------|----------|-------------|--------|
| WCDMA Band V | Lowest | H | V | 15.74 | 38.45 | Pass |
| | | | H | 22.30 | | |
| | | E1 | V | 14.31 | | |
| | | | H | 20.12 | | |
| | | E2 | V | 14.69 | | |
| | | | H | 19.96 | | |
| | Middle | H | V | 16.26 | 38.45 | Pass |
| | | | H | 22.23 | | |
| | | E1 | V | 14.13 | | |
| | | | H | 19.87 | | |
| | | E2 | V | 14.02 | | |
| | | | H | 18.25 | | |
| | Highest | H | V | 16.57 | 38.45 | Pass |
| | | | H | 22.20 | | |
| | | E1 | V | 13.33 | | |
| | | | H | 17.69 | | |
| | | E2 | V | 14.42 | | |
| | | | H | 19.01 | | |

| EUT mode | Channel | EUT Pol. | Antenna Pol. | EIRP(dBm) | Limit (dBm) | Result |
|------------------|---------|----------|--------------|-----------|-------------|--------|
| WCDMA Band II | Lowest | H | V | 16.89 | 33.01 | Pass |
| | | | H | 23.85 | | |
| | | E1 | V | 15.38 | | |
| | | | H | 21.66 | | |
| | | E2 | V | 15.89 | | |
| | | | H | 21.97 | | |
| | Middle | H | V | 16.62 | 33.01 | Pass |
| | | | H | 23.83 | | |
| | | E1 | V | 15.12 | | |
| | | | H | 20.98 | | |
| | | E2 | V | 16.21 | | |
| | | | H | 21.17 | | |
| | Highest | H | V | 16.66 | 33.01 | Pass |
| | | | H | 23.91 | | |
| | | E1 | V | 14.23 | | |
| | | | H | 18.97 | | |
| | | E2 | V | 15.35 | | |
| | | | H | 19.65 | | |

6.6. Field Strength of Spurious Radiation Measurement

6.6.1. Test Specification

| | |
|--------------------------|---|
| Test Requirement: | FCC part 22.917(a) and FCC part 24.238(a) FCC part 27.53(g) |
| Test Method: | FCC part 2.1053 |
| Operation mode: | Refer to item 4.1 |
| Limit: | -13dBm |
| Test setup: | <p>For 30MHz~1GHz</p>  <p>Above 1GHz</p>  |
| Test Procedure: | <ol style="list-style-type: none"> 1. The testing follows FCC KDB 971168 v02r02 Section 5.8 and ANSI / TIA-603-D-2010 Section 2.2.12. 2. The EUT was placed on a rotatable wooden table 0.8 meters below 1GHz and a rotatable wooden table 1.5 meters above 1GHz above the ground. 3. The EUT was set 3 meters from the receiving antenna, which was mounted on the antenna tower. 4. The table was rotated 360 degrees to determine the position of the highest spurious emission. 5. The height of the receiving antenna is varied between one meter and four meters to search for the maximum spurious emission for both horizontal and vertical polarizations. |

| | |
|----------------------|---|
| | <p>6. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, taking record of maximum spurious emission.</p> <p>7. A horn antenna was substituted in place of the EUT and was driven by a signal generator.</p> <p>8. Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.</p> <p>9. Taking the record of output power at antenna port.</p> <p>10. Repeat step 7 to step 8 for another polarization.</p> <p>11. EIRP (dBm) = S.G. Power – Tx Cable Loss + Tx Antenna Gain</p> <p>12. ERP (dBm) = EIRP - 2.15</p> <p>13. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.</p> <p>14. The limit line is derived from $43 + 10\log(P)$ dB below the transmitter power P(Watts)</p> $= P(W) - [43 + 10\log(P)] \text{ (dB)}$ $= [30 + 10\log(P)] \text{ (dBm)} - [43 + 10\log(P)] \text{ (dB)}$ $= -13 \text{ dBm.}$ |
| Test results: | PASS |
| Remark: | All modulations have been tested, but only the worst modulation show in this test item. |

6.6.2. Test Instruments

| Radiated Emission Test Site (966) | | | | |
|-----------------------------------|--------------------|------------|---------------|-----------------|
| Name of Equipment | Manufacturer | Model | Serial Number | Calibration Due |
| System simulator | R&S | CMU200 | 111382 | Sep. 27, 2018 |
| Spectrum Analyzer | ROHDE&SCHW ARZ | R&S | FSQ | Sep. 27, 2018 |
| Signal Generator | HP | 83623B | 3614A00396 | Sep. 27, 2018 |
| Broadband Antenna | Schwarzbeck | VULB9163 | 340 | Sep. 27, 2018 |
| Horn Antenna | Schwarzbeck | BBHA 9120D | 631 | Sep. 27, 2018 |
| Broadband Antenna | Schwarzbeck | VULB9163 | 412 | Sep. 27, 2018 |
| Horn Antenna | Schwarzbeck | BBHA 9120D | 1201 | Mar. 05, 2018 |
| Horn Antenna | Schwarzbeck | BBH 9170 | 582 | Jun. 07, 2018 |
| Dipole Antenna | TCT | TCT-RF | N/A | Sep. 27, 2018 |
| Coax cable (9kHz-1GHz) | TCT | RE-low-01 | N/A | Sep. 27, 2018 |
| Coax cable (9kHz-40GHz) | TCT | RE-high-02 | N/A | Sep. 27, 2018 |
| Coax cable (9kHz-1GHz) | TCT | RE-low-03 | N/A | Sep. 27, 2018 |
| Coax cable (9kHz-40GHz) | TCT | RE-High-04 | N/A | Sep. 27, 2018 |
| Antenna Mast | Keleto | CC-A-4M | N/A | N/A |
| EMI Test Software | Shurple Technology | EZ-EMC | N/A | N/A |

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.6.3. Test Data

| Test mode: | WCDMA Band V | | Test channel: | Lowest |
|-----------------|-------------------|-------------|---------------|---------|
| Frequency (MHz) | Spurious Emission | | Limit (dBm) | Result |
| | Polarization | Level (dBm) | | |
| 1652.80 | Vertical | -53.19 | -13.00 | Pass |
| 2479.20 | V | -50.35 | | |
| 3305.60 | V | -46.62 | | |
| 4132.00 | V | -44.17 | | |
| 4958.40 | V | -41.49 | | |
| 1652.80 | Horizontal | -53.30 | | |
| 2479.20 | H | -50.47 | | |
| 3305.60 | H | -46.67 | | |
| 4132.00 | H | -44.19 | | |
| 4958.40 | H | -42.19 | | |
| Test mode: | WCDMA Band V | | Test channel: | Middle |
| Frequency (MHz) | Spurious Emission | | Limit (dBm) | Result |
| | Polarization | Level (dBm) | | |
| 1672.80 | Vertical | -52.61 | -13.00 | Pass |
| 2509.20 | V | -51.13 | | |
| 3345.60 | V | -47.07 | | |
| 4182.00 | V | -45.23 | | |
| 5018.40 | V | -41.52 | | |
| 1672.80 | Horizontal | -53.29 | | |
| 2509.20 | H | -51.01 | | |
| 3345.60 | H | -46.95 | | |
| 4182.00 | H | -44.08 | | |
| 5018.40 | H | -41.35 | | |
| Test mode: | WCDMA Band V | | Test channel: | Highest |
| Frequency (MHz) | Spurious Emission | | Limit (dBm) | Result |
| | Polarization | Level (dBm) | | |
| 1693.20 | Vertical | -52.56 | -13.00 | Pass |
| 2539.80 | V | -50.87 | | |
| 3386.40 | V | -47.39 | | |
| 4233.00 | V | -44.71 | | |
| 5079.60 | V | -41.12 | | |
| 1693.20 | Horizontal | -52.35 | | |
| 2539.80 | H | -50.22 | | |
| 3386.40 | H | -46.87 | | |
| 4233.00 | H | -44.29 | | |
| 5079.60 | H | -41.87 | | |

Remark :

1. The emission behaviour belongs to narrowband spurious emission.
2. Remark"---" means that the emission level is too low to be measured
3. The emission levels of below 1 GHz are very lower than the limit and not show in test report.

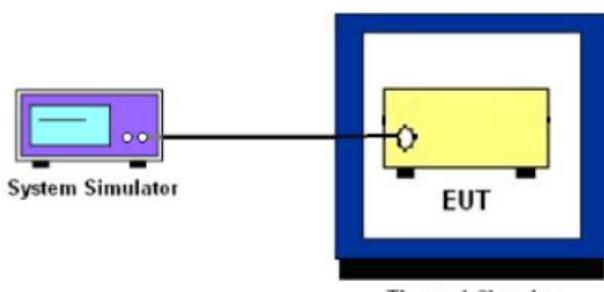
| Test mode: | | WCDMA Band II | | Test channel: | Lowest |
|-----------------|-------------------|---------------|-------------|---------------|---------|
| Frequency (MHz) | Spurious Emission | | Limit (dBm) | Result | |
| | Polarization | Level (dBm) | | | |
| 3704.80 | Vertical | -53.09 | -13.00 | Pass | |
| 5557.20 | V | -50.76 | | | |
| 7409.60 | V | -47.07 | | | |
| 9262.00 | V | -44.32 | | | |
| 11114.40 | V | -41.19 | | | |
| 3704.80 | Horizontal | -53.05 | | | |
| 5557.20 | H | -50.18 | | | |
| 7409.60 | H | -47.63 | | | |
| 9262.00 | H | -43.99 | | | |
| 11114.40 | H | -41.81 | | | |
| Test mode: | | WCDMA Band II | | Test channel: | Middle |
| Frequency (MHz) | Spurious Emission | | Limit (dBm) | Result | |
| | Polarization | Level (dBm) | | | |
| 3760.00 | Vertical | -52.55 | -13.00 | Pass | |
| 5640.00 | V | -50.67 | | | |
| 7520.00 | V | -47.64 | | | |
| 9400.00 | V | -44.92 | | | |
| 11280.00 | V | -42.52 | | | |
| 3760.00 | Horizontal | -53.42 | | | |
| 5640.00 | H | -50.42 | | | |
| 7520.00 | H | -46.98 | | | |
| 9400.00 | H | -44.85 | | | |
| 11280.00 | H | -41.50 | | | |
| Test mode: | | WCDMA Band II | | Test channel: | Highest |
| Frequency (MHz) | Spurious Emission | | Limit (dBm) | Result | |
| | Polarization | Level (dBm) | | | |
| 3815.20 | Vertical | -53.15 | -13.00 | Pass | |
| 5722.80 | V | -49.99 | | | |
| 7630.40 | V | -47.31 | | | |
| 9538.00 | V | -44.19 | | | |
| 11445.60 | V | -42.03 | | | |
| 3815.20 | Horizontal | -52.55 | | | |
| 5722.80 | H | -50.35 | | | |
| 7630.40 | H | -47.16 | | | |
| 9538.00 | H | -45.23 | | | |
| 11445.60 | H | -42.23 | | | |

Remark :

1. The emission behaviour belongs to narrowband spurious emission.
2. Remark"---" means that the emission level is too low to be measured
3. The emission levels of below 1 GHz are very lower than the limit and not show in test report.

6.7. Frequency Stability Measurement

6.7.1. Test Specification

| | |
|--------------------------|--|
| Test Requirement: | FCC Part 2.1055 ; FCC Part 22.355 ; FCC Part 24.235 FCC Part 27.54 |
| Test Method: | FCC Part 2.1055(a)(1)(b) |
| Operation mode: | Refer to item 4.1 |
| Limit: | ±2.5 ppm |
| Test Setup: |  |
| Test Procedure: | <p>Test Procedures for Temperature Variation</p> <ol style="list-style-type: none"> 1. The testing follows FCC KDB 971168 v02r02 Section 9.0. 2. The EUT was set up in the thermal chamber and connected with the system simulator. 3. With power OFF, the temperature was decreased to -30°C and the EUT was stabilized before testing. Power was applied and the maximum change in frequency was recorded within one minute. 4. With power OFF, the temperature was raised in 10°C steps up to 50°C. The EUT was stabilized at each step for at least half an hour. Power was applied and the maximum frequency change was recorded within one minute. <p>Test Procedures for Voltage Variation</p> <ol style="list-style-type: none"> 1. The testing follows FCC KDB 971168 v02r02 Section 9.0. 2. The EUT was placed in a temperature chamber at $25\pm5^{\circ}\text{C}$ and connected with the system simulator. 3. The power supply voltage to the EUT was varied from BEP to 115% of the nominal value measured at the input to the EUT. 4. The variation in frequency was measured for the worst case. |
| Test Result: | PASS |
| Remark: | All three channels of all modulations have been tested, but only the worst channel and the worst modulation show in this test item. |

6.7.2. Test Instruments

| Equipment | Manufacturer | Model | Serial Number | Calibration Due |
|---|--------------|-------------------|---------------|-----------------|
| System simulator | R&S | CMU200 | 111382 | Sep. 27, 2018 |
| Programable temprature and humidity chamber | JQ | JQ-2000 | N/A | Sep. 27, 2018 |
| DC power supply | Kingrang | KR3005K 30V/5A | N/A | Sep. 27, 2018 |
| RF cable (9kHz-40GHz) | TCT | RE-04 | N/A | Sep. 27, 2018 |
| Antenna Connector | TCT | RFC-03 | N/A | Sep. 27, 2018 |

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

6.7.3. Test Data

Test Result of Temperature Variation

| Reference Frequency: WCDMA Band V Middle channel=4183 channel=836.6MHz | | | | | |
|--|------------------|-----------------|-------|-------------|--------|
| Power supplied (Vdc) | Temperature (°C) | Frequency error | | Limit (ppm) | Result |
| | | Hz | ppm | | |
| 7.40 | -30 | 4.0 | 0.005 | 2.5 | Pass |
| | -20 | 3.9 | 0.005 | | |
| | -10 | 3.7 | 0.004 | | |
| | 0 | 3.5 | 0.004 | | |
| | 10 | 3.5 | 0.004 | | |
| | 20 | 3.6 | 0.004 | | |
| | 30 | 3.1 | 0.004 | | |
| | 40 | 3.6 | 0.004 | | |
| | 50 | 4.3 | 0.005 | | |
| Reference Frequency: WCDMA Band II Middle channel=9400 channel=1880.0MHz | | | | | |
| Power supplied (Vdc) | Temperature (°C) | Frequency error | | Limit (ppm) | Result |
| | | Hz | ppm | | |
| 7.40 | -30 | 3.5 | 0.002 | 2.5 | Pass |
| | -20 | 4.4 | 0.002 | | |
| | -10 | 4.1 | 0.002 | | |
| | 0 | 3.6 | 0.002 | | |
| | 10 | 3.5 | 0.002 | | |
| | 20 | 3.6 | 0.002 | | |
| | 30 | 2.6 | 0.001 | | |
| | 40 | 3.4 | 0.002 | | |
| | 50 | 4.1 | 0.002 | | |

Test Result of Voltage Variation

| Reference Frequency: WCDMA Band V Middle channel=4183 channel=836.6MHz | | | | | |
|--|----------------------|-----------------|-------|-------------|--------|
| Temperature (°C) | Power supplied (Vdc) | Frequency error | | Limit (ppm) | Result |
| | | Hz | ppm | | |
| 25 | 8.5 | 2.9 | 0.003 | 2.5 | Pass |
| | 7.4 | 1.9 | 0.002 | | |
| | 6.3 | 4.7 | 0.006 | | |

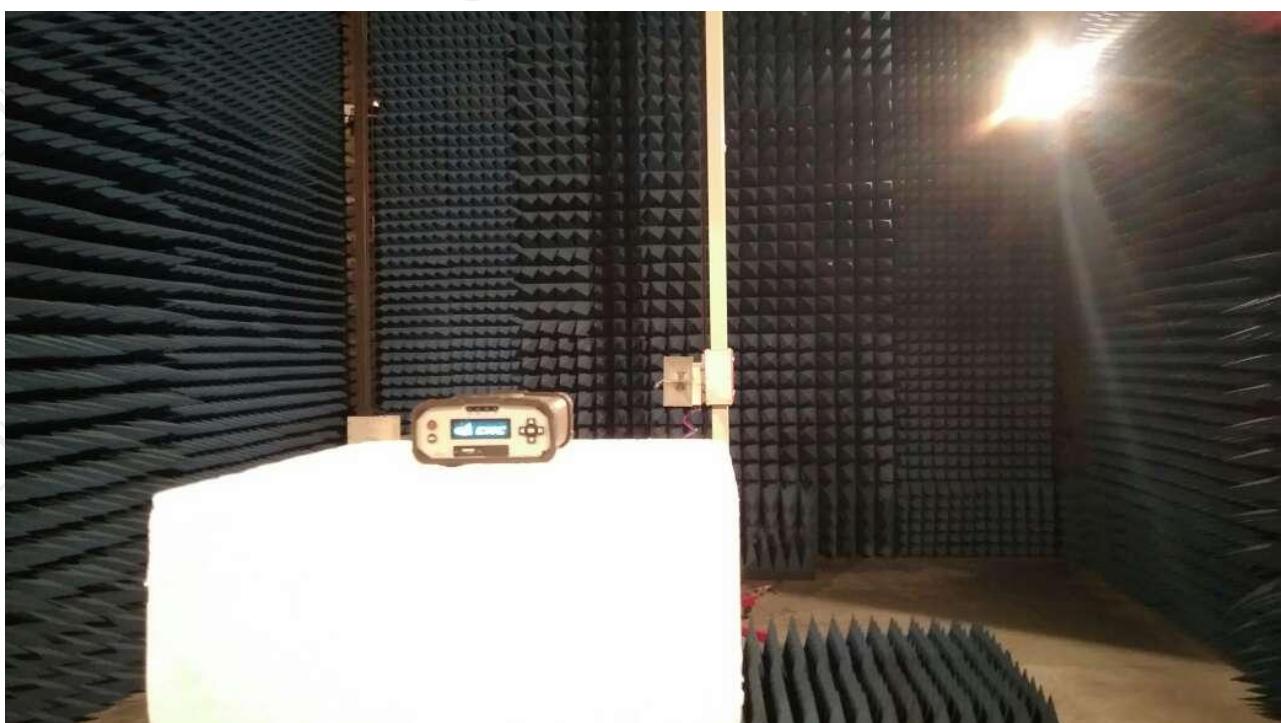
| Reference Frequency: WCDMA Band II Middle channel=940 channel=1880.0MHz | | | | | |
|---|----------------------|-----------------|-------|-------------|--------|
| Temperature (°C) | Power supplied (Vdc) | Frequency error | | Limit (ppm) | Result |
| | | Hz | ppm | | |
| 25 | 8.5 | 4.0 | 0.002 | 2.5 | Pass |
| | 7.4 | 4.3 | 0.002 | | |
| | 6.3 | 5.6 | 0.003 | | |

Appendix A: Photographs of Test Setup

Product: GNSS Infrastructure

Model: P5E-Net

Radiated Emission



Conducted Emission



Appendix B: Photographs of EUT

Refer to test report TCT171222E008

*******END OF REPORT*******