



FCC RADIO TEST REPORT

FCC ID : XMR2020EM120RGL2
Equipment : LTE-A Cat 12 M.2 Module
Brand Name : Quectel Wireless Solutions Company Limited
Model Name : EM120R-GL
Applicant : Quectel Wireless Solutions Co., Ltd.
Building 5, Shanghai Business Park Phase III
(Area B), No.1016 Tianlin Road, Minhang
District, Shanghai 200233, China
Manufacturer : Quectel Wireless Solutions Co., Ltd.
Building 5, Shanghai Business Park Phase III
(Area B), No.1016 Tianlin Road, Minhang
District, Shanghai 200233, China
Standard : FCC 47 CFR Part 2, 90(R)

Equipment: Quectel EM120R-GL tested inside of Lenovo Notebook Computer.

The product was received on Nov. 26, 2020 and testing was started from Jan. 06, 2021 and completed on Jan. 07, 2021. We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures given in ANSI / TIA-603-E and has been in compliance with the applicable technical standards.

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

Louis Wu

Approved by: Louis Wu

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan



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History of this test report

| Report No. | Version | Description | Issued Date |
|------------|---------|-------------------------|---------------|
| FG0D0427D | 01 | Initial issue of report | Feb. 08, 2021 |
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Summary of Test Result

| Report Clause | Ref Std. Clause | Test Items | Result (PASS/FAIL) | Remark |
|---------------|--|--|--------------------|--|
| - | §2.1046 | Conducted Output Power | - | See Note |
| - | §90.542 (a)(7) | Effective Radiated Power | - | See Note |
| - | - | Peak-to-Average Ratio | - | See Note |
| - | §2.1049 | Occupied Bandwidth | - | See Note |
| - | §2.1053 §90.543 (e)(2) | Conducted Band Edge Measurement | - | See Note |
| - | §2.1051 §90.210 (n) | Emission Mask | - | See Note |
| - | §2.1053 §90.543 (e)(3) | Conducted Spurious Emission | - | See Note |
| - | §2.1055 §90.539 (e) | Frequency Stability Temperature & Voltage | - | See Note |
| - | §90.542 (a)(7) | Effective Radiated Power | - | See Note |
| 3.2 | §2.1053 §90.543 (e)(3) §90.543 (f) | Radiated Spurious Emission | Pass | Under limit 18.36 dB at 1586.000 MHz |

Note: The module (Model: EM120R-GL) makes no difference after verifying output power, this report reuses test data from the module report.

Declaration of Conformity:

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

Comments and Explanations:

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

Reviewed by: Wii Chang

Report Producer: Celery Wei



1 General Description

1.1 Product Feature of Equipment Under Test

| Product Feature | |
|---------------------------------|--|
| Equipment | LTE-A Cat 12 M.2 Module |
| Brand Name | Quectel Wireless Solutions Company Limited |
| Model Name | EM120R-GL |
| FCC ID | XMR2020EM120RGL2 |
| Sample 1 | EUT with Host 1 |
| Sample 2 | EUT with Host 2 |
| EUT supports Radios application | WCDMA/HSPA/LTE/GNSS |
| EUT Stage | Production Unit |

Remark:

1. The above EUT's information was declared by manufacturer.
2. Equipment: Quectel EM120R-GL tested inside of Lenovo Notebook Computer.

The product was installed into Notebook Computer (Brand Name: Lenovo, Model Name: TP00129A) during test, and the host information was recorded in the following table.

| Host Information | |
|------------------|---------------------------------|
| Host 1 | Host with Novocomms/JYT Antenna |
| Host 2 | Host with Amphenol Antenna |

| WWAN Antenna Information | | | | |
|--------------------------|--------------|-----------------|-----------------|------|
| Main Antenna | Manufacturer | Amphenol | Peak gain (dBi) | 1.95 |
| | Part number | TKC116-16-000-C | Type | PIFA |
| | Manufacturer | Novocomms/JYT | Peak gain (dBi) | 1.83 |
| | Part number | JYAAE0150HR | Type | PIFA |

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to Comments and Explanations in report summary.
2. All test items were performed with Amphenol Antenna.

1.2 Product Specification of Equipment Under Test

| Product Specification subjective to this standard | |
|---|------------------------------------|
| Tx Frequency | LTE Band 14 :790.5 MHz ~ 795.5 MHz |
| Rx Frequency | LTE Band 14 :760.5 MHz ~ 765.5 MHz |
| Bandwidth | 5MHz / 10MHz |
| Type of Modulation | QPSK / 16QAM / 64QAM |

1.3 Modification of EUT

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



1.4 Testing Site

| | |
|--------------------|--|
| Test Site | SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory |
| Test Site Location | No.58 , Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City, Taiwan |
| Test Site No. | Sporton Site No. 03CH15-HY |
| Test Engineer | Leo Lee, Mancy Chou and Bigshow Wang |
| Temperature | 22.4~23.1℃ |
| Relative Humidity | 48~56% |

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

FCC Designation No.: TW0007

1.5 Applied Standards

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

- ♦ ANSI C63.26-2015
- ♦ FCC 47 CFR Part 2, Part 90(R)
- ♦ ANSI / TIA-603-E
- ♦ FCC KDB 971168 D01 Power Meas. License Digital Systems v03r01
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. The TAF code is not including all the FCC KDB listed without accreditation.

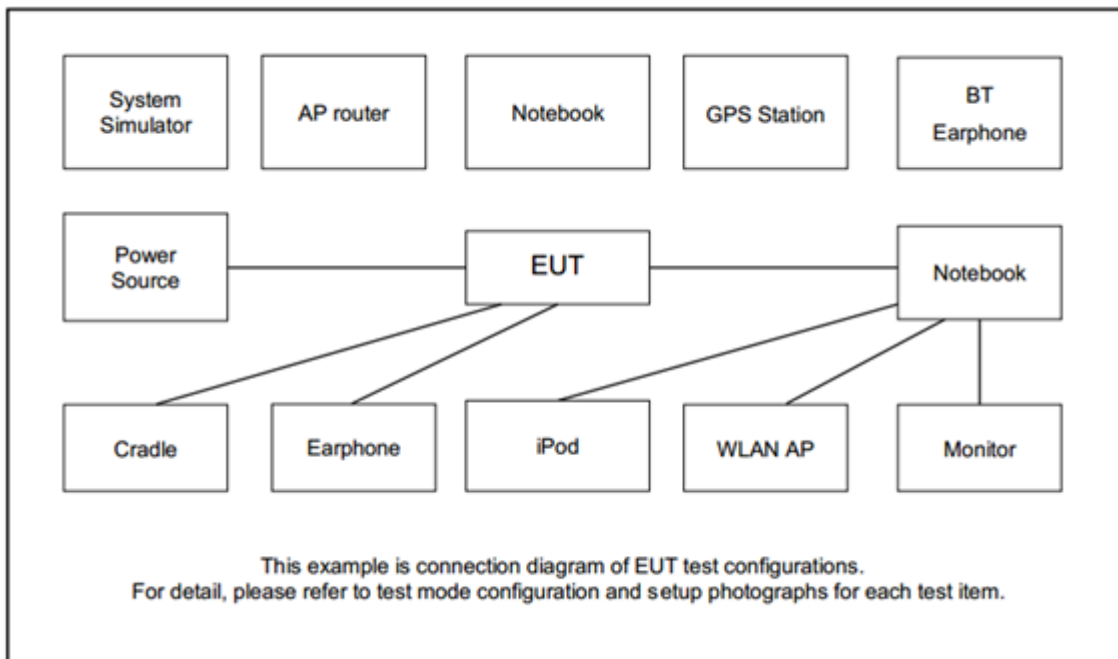
2 Test Configuration of Equipment Under Test

2.1 Test Mode

Antenna port conducted and radiated test items listed below are performed according to KDB 971168 D01 Power Meas. License Digital Systems v03r01 with maximum output power.

| Conducted Test Cases | Band | Bandwidth (MHz) | | | | | | Modulation | | | | RB # | | | Test Channel | | |
|----------------------------|---|-----------------|---|---|----|----|----|------------|-------|-------|--------|------|------|------|--------------|---|---|
| | | 1.4 | 3 | 5 | 10 | 15 | 20 | QPSK | 16QAM | 64QAM | 256QAM | 1 | Half | Full | L | M | H |
| Radiated Spurious Emission | 14 | - | - | v | v | - | - | v | | | | v | | | v | v | v |
| Remark | <ol style="list-style-type: none"> The mark "v" means that this configuration is chosen for testing The mark "-" means that this bandwidth is not supported. The device is investigated from 30MHz to 10 times of fundamental signal for radiated spurious emission test under different RB size/offset and modulations in exploratory test. Subsequently, only the worst case emissions are reported. | | | | | | | | | | | | | | | | |

2.2 Connection Diagram of Test System





2.3 Support Unit used in test configuration and system

| Item | Equipment | Brand Name | Model No. | FCC ID | Data Cable | Power Cord |
|------|------------------|------------|-----------|--------------|-------------------|-------------------|
| 1. | System Simulator | Anritsu | MT8820C | N/A | N/A | Unshielded, 1.8 m |
| 2. | iPod Earphone | Apple | N/A | Verification | Unshielded, 1.0 m | N/A |

2.4 Frequency List of Low/Middle/High Channels

| LTE Band 14 Channel and Frequency List | | | | |
|--|------------------------|--------|--------|---------|
| BW [MHz] | Channel/Frequency(MHz) | Lowest | Middle | Highest |
| 10 | Channel | - | 23330 | - |
| | Frequency | - | 793 | - |
| 5 | Channel | 23305 | 23330 | 23355 |
| | Frequency | 790.5 | 793 | 795.5 |

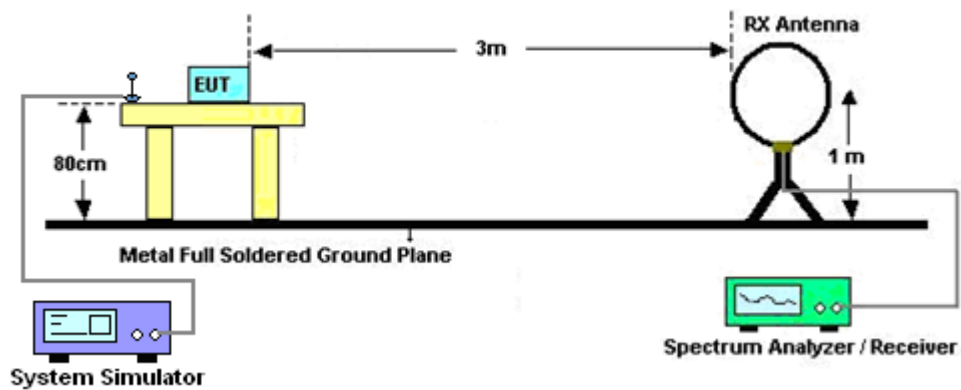
3 Radiated Test Items

3.1 Measuring Instruments

See list of measuring instruments of this test report.

3.1.1 Test Setup

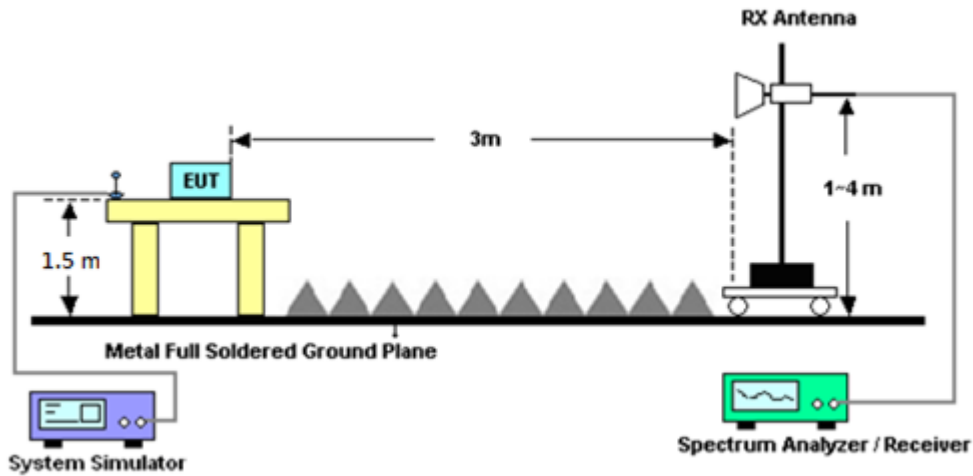
For radiated test below 30MHz



For radiated test from 30MHz to 1GHz



For radiated test above 1GHz



3.1.2 Test Result of Radiated Test

Please refer to Appendix A.

Note:

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

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



3.2 Radiated Spurious Emission

3.2.1 Description of Radiated Spurious Emission

The radiated spurious emission was measured by substitution method according to ANSI / TIA-603-E. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB.

For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559–1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

The spectrum is scanned from 30 MHz up to a frequency including its 10th harmonic.

3.2.2 Test Procedures

The testing follows FCC KDB 971168 D01 v03r01 Section 7 and ANSI / TIA-603-E Section 2.2.12.

1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the receiving antenna, which was mounted on the antenna tower.
3. The table was rotated 360 degrees to determine the position of the highest spurious emission.
4. The height of the receiving antenna is varied between one meter and four meters to search the maximum spurious emission for both horizontal and vertical polarizations.
5. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, Sweep = 500ms, Taking the record of maximum spurious emission.
6. A horn antenna was substituted in place of the EUT and was driven by a signal generator.
7. Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.
8. Taking the record of output power at antenna port.
9. Repeat step 7 to step 8 for another polarization.
10. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
11. The limit line is derived from $43 + 10\log(P)$ dB below the transmitter power P(Watts)



4 List of Measuring Equipment

| Instrument | Brand Name | Model No. | Serial No. | Characteristics | Calibration Date | Test Date | Due Date | Remark |
|-------------------|-------------------|-------------------------------------|--|----------------------------|------------------|---------------------------------|---------------|--------------------------|
| Loop Antenna | Rohde & Schwarz | HFH2-Z2 | 100488 | 9 kHz~30 MHz | Jul. 14, 2020 | Jan. 06, 2021~ Jan. 07, 2021 | Jul. 13, 2021 | Radiation (03CH15-HY) |
| Bilog Antenna | TESEQ | CBL 6111D & 00800N1D01N- 06 | 37059 & 01 | 30MHz~1GHz | Oct. 11, 2020 | Jan. 06, 2021~ Jan. 07, 2021 | Oct. 10, 2021 | Radiation (03CH15-HY) |
| Bilog Antenna | TESEQ | CBL6111D&008 00N1D01N-06 | 41912&05 | 30MHz to 1GHz | Feb. 09, 2020 | Jan. 06, 2021~ Jan. 07, 2021 | Feb. 08, 2021 | Radiation (03CH15-HY) |
| Amplifier | SONOMA | 310N | 363440 | 9kHz~1GHz | Dec. 28, 2020 | Jan. 06, 2021~ Jan. 07, 2021 | Dec. 27, 2021 | Radiation (03CH15-HY) |
| Horn Antenna | SCHWARZB ECK | BBHA 9120 D | 9120D-02114 | 1-18GHz | Aug. 04, 2020 | Jan. 06, 2021~ Jan. 07, 2021 | Aug. 03, 2021 | Radiation (03CH15-HY) |
| Horn Antenna | SCHWARZB ECK | BBHA 9120 D | 9120D-1326 | 1GHz~18GHz | Nov. 03, 2020 | Jan. 06, 2021~ Jan. 07, 2021 | Nov. 02, 2021 | Radiation (03CH15-HY) |
| Preamplifier | Jet-Power | JPA0118-55-30 3 | 1710001800 055006 | 1GHz~18GHz | May 07, 2020 | Jan. 06, 2021~ Jan. 07, 2021 | May 06, 2021 | Radiation (03CH15-HY) |
| Preamplifier | Keysight | 83017A | MY53270195 | 1GHz~26.5GHz | Aug. 21, 2020 | Jan. 06, 2021~ Jan. 07, 2021 | Aug. 20, 2021 | Radiation (03CH15-HY) |
| Spectrum Analyzer | Keysight | N9010A | MY54200485 | 10Hz~44GHz | Feb. 10, 2020 | Jan. 06, 2021~ Jan. 07, 2021 | Feb. 09, 2021 | Radiation (03CH15-HY) |
| Spectrum Analyzer | Agilent | E4446A | MY50180136 | 3Hz~44GHz | May 04, 2020 | Jan. 06, 2021~ Jan. 07, 2021 | May 03, 2021 | Radiation (03CH15-HY) |
| Antenna Mast | ChainTek | MBS-520-1 | N/A | 1m~4m | N/A | Jan. 06, 2021~ Jan. 07, 2021 | N/A | Radiation (03CH15-HY) |
| Turn Table | ChainTek | T-200-S-1 | N/A | 0~360 Degree | N/A | Jan. 06, 2021~ Jan. 07, 2021 | N/A | Radiation (03CH15-HY) |
| Software | Audix | E3 6.2009-8-24 (k5) | RK-000451 | N/A | N/A | Jan. 06, 2021~ Jan. 07, 2021 | N/A | Radiation (03CH15-HY) |
| RF Cable | HUBER + SUHNER | SUCOFLEX 104, 102E | MY36980/4, MY9838/4PE ,508405/2E | 30MHz~18G | Nov. 16, 2020 | Jan. 06, 2021~ Jan. 07, 2021 | Nov. 15, 2021 | Radiation (03CH15-HY) |
| RF Cable | HUBER + SUHNER | SUCOFLEX 102 | 505134/2 | 30MHz-40GHz | Feb. 25, 2020 | Jan. 06, 2021~ Jan. 07, 2021 | Feb. 24, 2021 | Radiation (03CH15-HY) |
| RF Cable | HUBER + SUHNER | SUCOFLEX 102 | 800740/2 | 30MHz-40GHz | Feb. 25, 2020 | Jan. 06, 2021~ Jan. 07, 2021 | Feb. 24, 2021 | Radiation (03CH15-HY) |
| RF Cable | HUBER + SUHNER | SUCOFLEX 104 | MY9837/4PE | 9kHz~30MHz | Mar. 12, 2020 | Jan. 06, 2021~ Jan. 07, 2021 | Mar. 11, 2021 | Radiation (03CH15-HY) |
| Filter | Wainwright | WLK4-1000-15 30-8000-40SS | SN4 | 1.53G Low Pass | Jul. 03, 2020 | Jan. 06, 2021~ Jan. 07, 2021 | Jul. 02, 2021 | Radiation (03CH15-HY) |
| Filter | Wainwright | WHKX12-1080- 1200-15000-60 ST | SN5 | 1.2GHz High Pass Filter | Jul. 01, 2020 | Jan. 06, 2021~ Jan. 07, 2021 | Jun. 30, 2021 | Radiation (03CH15-HY) |
| Filter | Wainwright | WHKX12-2700- 3000-18000-60 ST | SN4 | 3GHz High Pass Filter | Sep. 16, 2020 | Jan. 06, 2021~ Jan. 07, 2021 | Sep. 15, 2021 | Radiation (03CH15-HY) |
| Signal Generator | Anritsu | MG3694C | 163401 | 0.1Hz~40GHz | Feb. 15, 2020 | Jan. 06, 2021~ Jan. 07, 2021 | Feb. 14, 2021 | Radiation (03CH15-HY) |



5 Uncertainty of Evaluation

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

| | |
|---|------|
| Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$) | 2.98 |
|---|------|

Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

| | |
|---|------|
| Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$) | 3.31 |
|---|------|



Appendix A. Test Results of Radiated Test

LTE Band 14

| LTE Band 14 / 5MHz / QPSK | | | | | | | | | |
|---------------------------|-------------------|-------------|---------------|-------------------|-------------------|--------------------|----------------------|-----------------------|--------------------|
| Channel | Frequency (MHz) | ERP (dBm) | Limit (dBm) | Over Limit (dB) | SPA Reading (dBm) | S.G. Power (dBm) | TX Cable loss (dB) | TX Antenna Gain (dBi) | Polarization (H/V) |
| Lowest | 1576 | -63.21 | -42.15 | -21.06 | -75.02 | -68.02 | 1.79 | 8.76 | H |
| | 2368 | -53.81 | -13 | -40.81 | -69.79 | -59.44 | 2.20 | 9.98 | H |
| | 3152 | -57.86 | -13 | -44.86 | -76.47 | -64.57 | 2.55 | 11.41 | H |
| | | | | | | | | | H |
| | | | | | | | | | H |
| | | | | | | | | | H |
| | | | | | | | | | H |
| | 1576 | -62.91 | -42.15 | -20.76 | -74.99 | -67.72 | 1.79 | 8.76 | V |
| | 2368 | -54.94 | -13 | -41.94 | -71.63 | -60.57 | 2.20 | 9.98 | V |
| | 3152 | -56.87 | -13 | -43.87 | -75.98 | -63.58 | 2.55 | 11.41 | V |
| | | | | | | | | | V |
| | | | | | | | | | V |
| | | | | | | | | | V |
| | | | | | | | | | V |



| | | | | | | | | | |
|---------|------|--------|--------|--------|--------|--------|------|-------|---|
| Middle | 1581 | -63.21 | -42.15 | -21.06 | -74.97 | -68.05 | 1.80 | 8.79 | H |
| | 2368 | -54.24 | -13 | -41.24 | -70.20 | -59.87 | 2.20 | 9.98 | H |
| | 3163 | -57.82 | -13 | -44.82 | -76.50 | -64.56 | 2.56 | 11.45 | H |
| | | | | | | | | | H |
| | | | | | | | | | H |
| | | | | | | | | | H |
| | | | | | | | | | H |
| | 1581 | -62.46 | -42.15 | -20.31 | -74.53 | -67.30 | 1.80 | 8.79 | V |
| | 2368 | -55.59 | -13 | -42.59 | -72.28 | -61.22 | 2.20 | 9.98 | V |
| | 3163 | -57.23 | -13 | -44.23 | -76.39 | -63.97 | 2.56 | 11.45 | V |
| | | | | | | | | | V |
| | | | | | | | | | V |
| | | | | | | | | | V |
| | | | | | | | | | V |
| Highest | 1586 | -60.85 | -42.15 | -18.70 | -72.58 | -65.72 | 1.80 | 8.82 | H |
| | 2376 | -52.60 | -13 | -39.60 | -68.60 | -58.31 | 2.20 | 10.06 | H |
| | 3173 | -57.81 | -13 | -44.81 | -76.56 | -64.59 | 2.56 | 11.49 | H |
| | | | | | | | | | H |
| | | | | | | | | | H |
| | | | | | | | | | H |
| | | | | | | | | | H |
| | 1586 | -60.51 | -42.15 | -18.36 | -72.58 | -65.38 | 1.80 | 8.82 | V |
| | 2376 | -54.83 | -13 | -41.83 | -71.54 | -60.54 | 2.20 | 10.06 | V |
| | 3173 | -57.71 | -13 | -44.71 | -76.93 | -64.49 | 2.56 | 11.49 | V |
| | | | | | | | | | V |
| | | | | | | | | | V |
| | | | | | | | | | V |
| | | | | | | | | | V |
| | | | | | | | | V | |

Remark: Spurious emissions within 30-1000MHz were found more than 20dB below limit line.



| LTE Band 14 / 10MHz / QPSK | | | | | | | | | |
|----------------------------|-------------------|-------------|---------------|-------------------|-------------------|--------------------|----------------------|-----------------------|--------------------|
| Channel | Frequency (MHz) | ERP (dBm) | Limit (dBm) | Over Limit (dB) | SPA Reading (dBm) | S.G. Power (dBm) | TX Cable loss (dB) | TX Antenna Gain (dBi) | Polarization (H/V) |
| Middle | 1577 | -63.18 | -42.15 | -21.03 | -74.99 | -68.00 | 1.79 | 8.76 | H |
| | 2368 | -57.06 | -13 | -44.06 | -73.04 | -62.69 | 2.20 | 9.98 | H |
| | 3152 | -57.55 | -13 | -44.55 | -76.16 | -64.26 | 2.55 | 11.41 | H |
| | | | | | | | | | H |
| | | | | | | | | | H |
| | | | | | | | | | H |
| | | | | | | | | | H |
| | 1577 | -62.91 | -42.15 | -20.76 | -74.99 | -67.73 | 1.79 | 8.76 | V |
| | 2368 | -58.03 | -13 | -45.03 | -74.71 | -63.66 | 2.20 | 9.98 | V |
| | 3152 | -57.17 | -13 | -44.17 | -76.29 | -63.88 | 2.55 | 11.41 | V |
| | | | | | | | | | V |
| | | | | | | | | | V |
| | | | | | | | | | V |
| | | | | | | | | | V |

Remark: Spurious emissions within 30-1000MHz were found more than 20dB below limit line.