# TEST REPORT

| | |
|---|---|
| **Applicant:** | Queclink Wireless Solutions Co., Ltd |
| **Address:** | No.30, Lane 500, Xinlong Road, Minhang District, Shanghai, China 201101 |
| **Equipment Type:** | GNSS Tracker |
| **Model Name:** | GV55W |
| **Brand Name:** | Queclink |
| **FCC ID:** | YQDGV55W |
| **Test Standard:** | 47 CFR Part 2<br>(Others refer to chapter 3.1) |
| **Test Date:** | Aug. 31, 2022 - Sep. 22, 2022 |
| **Date of Issue:** | Sep. 27, 2022 |

**ISSUED BY:**

Shenzhen BALUN Technology Co., Ltd.

**Tested by:** Zhong Weiqiang **Checked by:** Wu Huihui **Approved by:** Wei Yanquan (Chief Engineer)

**Revision History**

| Version | Issue Date | Revisions Content |
|---|---|---|
| Rev. 01 | Sep. 27, 2022 | Initial Issue |

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# 1 GENERAL INFORMATION

## 1.1 Test Laboratory

| | |
|---|---|
| Name | Shenzhen BALUN Technology Co., Ltd. |
| Address | Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China |
| Phone Number | +86 755 6685 0100 |

## 1.2 Test Location

| | |
|---|---|
| Name | Shenzhen BALUN Technology Co., Ltd. |
| Location | ☑ Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China |
| | ☐ 1/F, Building B, Ganghongji High-tech Intelligent Industrial Park, No. 1008, Songbai Road, Yangguang Community, Xili Sub-district, Nanshan District, Shenzhen, Guangdong Province, P. R. China |
| Accreditation Certificate | The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196. |

# 2 PRODUCT INFORMATION

## 2.1 Applicant Information

| | |
|---|---|
| Applicant | Queclink Wireless Solutions Co., Ltd |
| Address | No.30, Lane 500, Xinlong Road, Minhang District, Shanghai, China 201101 |

## 2.2 Manufacturer Information

| | |
|---|---|
| Manufacturer | Queclink Wireless Solutions Co., Ltd |
| Address | No.30, Lane 500, Xinlong Road, Minhang District, Shanghai, China 201101 |

## 2.3 Factory Information

| | |
|---|---|
| Factory | N/A |
| Address | N/A |

## 2.4 General Description for Equipment under Test (EUT)

| | |
|---|---|
| EUT Name | GNSS Tracker |
| Model Name Under Test | GV55W |
| Series Model Name | N/A |
| Description of Model name differentiation | N/A |
| Hardware Version | R112V1.04 |
| Software Version | A08V05 |
| Dimensions (Approx.) | N/A |
| Weight (Approx.) | N/A |

## 2.5 Technical Information

Note: The information provided by the applicant, except for The Max RF Output Power (EIRP/ERP).

| | |
|---|---|
| All Network and Wireless connectivity for EUT | 2G Network GPRS 850/ 1900 MHz;<br>3G Network WCDMA/HSDPA Band 2/ 5;<br>Bluetooth |
| About the Product | The equipment is GNSS Tracker, intended for used with information technology equipment. |

The requirement for the following technical information of the EUT was tested in this report:

| | | |
|---|---|---|
| Operating Bands | GPRS 850/ 1900 MHz<br>WCDMA/HSDPA Band 2/ 5 | |
| Modulation Type | GPRS | GMSK |
| | WCDMA | QPSK |
| | HSDPA | QPSK |
| | | 16QAM |
| TX Frequency Range | GPRS 850: 824 MHz ~ 849 MHz<br>GPRS 1900: 1850 MHz ~ 1910 MHz<br>WCDMA/HSDPA Band 2: 1850 MHz ~ 1910 MHz<br>WCDMA/HSDPA Band 5: 824 MHz ~ 849 MHz | |
| Rx Frequency Range | GPRS 850: 869 MHz ~ 894 MHz<br>GPRS 1900: 1930 MHz ~ 1990 MHz<br>WCDMA/HSDPA Band 2: 1930 MHz ~ 1990 MHz<br>WCDMA/HSDPA Band 5: 869 MHz ~ 894 MHz | |
| Power Class | GPRS 850: 4<br>GPRS 1900: 1<br>WCDMA/HSDPA Band 2: 3<br>WCDMA/HSDPA Band 5: 3 | |
| Multislot Class | GPRS: 12 | |
| Antenna Type | PIFA Antenna | |
| Antenna Gain | GPRS 850: 3.29 dBi<br>GPRS 1900: 5.3 dBi<br>WCDMA/HSDPA Band 2: 5.3 dBi<br>WCDMA/HSDPA Band 5: 3.29 dBi | |
| The Max RF Output Power (EIRP/ERP) | GPRS 850: 30.745 dBm<br>GPRS 1900: 29.274 dBm<br>WCDMA/HSDPA Band 2: 21.254 dBm<br>WCDMA/HSDPA Band 5: 20.399 dBm | |

Note 1: The EUT information are declared by manufacturer. For more detailed features description, please refer to the manufacturer's specifications or user's manual.

# 3 SUMMARY OF TEST RESULTS

## 3.1 Test Standards

| No. | Identity | Document Title |
|---|---|---|
| 1 | 47 CFR Part 2 | Frequency Allocations and Radio Treaty Matters; General Rules and Regulations |
| 2 | 47 CFR Part 22 Subpart H | Cellular Radiotelephone Service |
| 3 | 47 CFR Part 24 Subpart E | Broadband PCS |
| 4 | ANSI/TIA-603-E-2016 | Land Mobile FM or PM Communications Equipment Measurement and Performance Standards |
| 5 | KDB 971168 D01 v03 | Measurement Guidance for Certification of Licensed Digital Transmitters |

## 3.2 Test Verdict

| No. | Test Description | FCC Part No. | Test Result | Test Verdict |
|---|---|---|---|---|
| 1 | Conducted RF Output Power | 2.1046 | Reporting only (ANNEX A.1) | Pass |
| 2 | Effective (Isotropic) Radiated Power | 2.1046<br>22.913<br>24.232 | ANNEX A.1 | Pass |
| 3 | Peak to Average Radio | 2.1046<br>24.232(d) | ANNEX A.2 | Pass |
| 4 | Occupied Bandwidth | 2.1049<br>22.917<br>24.238 | ANNEX A.3 | Pass |
| 5 | Frequency Stability | 2.1055<br>22.355<br>24.235 | ANNEX A.4 | Pass |
| 6 | Spurious Emission at Antenna Terminals | 2.1051<br>22.917<br>24.238 | ANNEX A.5 | Pass |
| 7 | Band Edge | 2.1051<br>22.917<br>24.238 | ANNEX A.6 | Pass |
| 8 | Field Strength of Spurious Radiation | 2.1053<br>22.917<br>24.238 | ANNEX A.7 | Pass |

Note: Compared with the EUT of test report BL-EC2210570-501, the changes of the EUT of this report as below:

1. Change of the CPU Peripheral circuit(no change of whole schematic and PCB Layout).
2. Change the CPU model: MKL03Z32VFK4 to model: LPC824.
3. Changed hardware version.

Other hardware circuit and software are the same as EUT referred in test report BL-EC2210570-501.

Therefore, only Conducted RF Output Power, Effective (Isotropic) Radiated Power, Field Strength of Spurious Radiation, were tested in this report, other test datas please refer to report BL-EC2210570-501, which was issued by Shenzhen BALUN Technology Co., Ltd. on Mar. 11, 2022.

# 4 GENERAL TEST CONFIGURATIONS

## 4.1 Test Environments

During the measurement, the environmental conditions were within the listed ranges:

| | | |
|---|---|---|
| Test Voltage of the EUT | NV (Normal Voltage) | 12&24 V |
| | LV (Low Voltage) | 8 V |
| | HV (High Voltage) | 32 V |
| Test Temperature of the EUT | NT (Normal Temperature) | +25 °C |
| | LT (Low Temperature) | -30 °C |
| | HT (High Temperature) | +70 °C |

## 4.1 Test Equipment and Test Software List

| Description | Manufacturer | Model | Serial No. | Version | Cal. Date | Cal. Due |
|---|---|---|---|---|---|---|
| **2/3/4/5G RF Test System** | | | | | | |
| BL410 Test Software | BALUN | BL410R | N/A | 2.1.1.496 | N/A | N/A |
| Temperature Chamber | AHK | SP20 | 1412 | N/A | 2021.11.30 | 2022.11.29 |
| Wideband Radio Communication Tester | R&S | CMW 500 | 167190 | V4.0.60 | 2022.05.19 | 2023.05.18 |
| Wideband Radio Communication Tester | R&S | CMW 500 | 102318 | V3.2.71 | 2022.05.19 | 2023.05.18 |
| Spectrum Analyzer | keysight | N9020A | MY50531628 | A.16.09 | 2022.05.23 | 2023.05.22 |
| DC Power Supply | ITECH | IT6863A | 800014020757120005 | N/A | 2021.09.22 | 2022.09.21 |
| | | | | | 2022.09.09 | 2023.09.08 |
| **Radiated Test System** | | | | | | |
| Radiated Test System Test Software | BALUN | BL410-E | N/A | V19.918 | N/A | N/A |
| Wideband Radio Communication Tester | R&S | CMW 500 | 167190 | V4.0.60 | 2022.05.19 | 2023.05.18 |
| Wideband Radio Communication Tester | R&S | CMW 500 | 102318 | V3.2.71 | 2022.05.19 | 2023.05.18 |
| DC Power Supply | ITECH | IT6863A | 800014020757120005 | N/A | 2021.09.22 | 2022.09.21 |
| | | | | | 2022.09.09 | 2023.09.08 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Test Antenna-Bi-Log(30 MHz-3 GHz) | Schwarzbeck | VULB 9163 | 9163-624 | N/A | 2021.08.20 | 2024.08.19 |
| Test Antenna-Horn(1-18 GHz) | Schwarzbeck | BBHA 9120D | 9120D-1917 | N/A | 2022.06.09 | 2025.06.08 |
| Anechoic Chamber | YIHENG | 9m*6m*6m | #3 | N/A | 2022.02.09 | 2024.09.03 |
| EMI Receiver | Keysight | N9038A | MY53220118 | A.14.16 | 2021.09.13 | 2022.09.12 |
| | | | | | 2022.09.08 | 2023.09.07 |

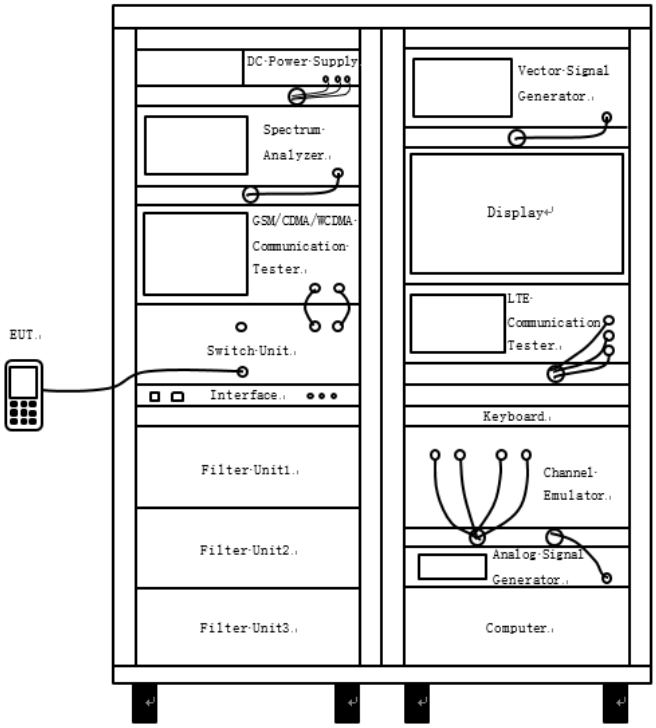
## 4.3 Test Configurations

| Test Items | Test Mode | Test Channel | | |
|---|---|---|---|---|
| | | LCH | MCH | HCH |
| Effective (Isotropic) Radiated Power | GPRS 850 | v | v | v |
| | GPRS 1900 | v | v | v |
| | WCDMA Band 2 | v | v | v |
| | WCDMA Band 5 | v | v | v |
| Field Strength of Spurious Radiation | GPRS 850 | v | v | v |
| | GPRS 1900 | v | v | v |
| | WCDMA Band 2 | v | v | v |
| | WCDMA Band 5 | v | v | v |
| Note 1: The mark “v” means that this configuration is chosen for testing. | | | | |

| Test Mode | UL Channel | UL Channel No. | UL Frequency (MHz) |
|---|---|---|---|
| GPRS 850 | Low Channel | 128 | 824.2 |
| | Middle Channel | 190 | 836.6 |
| | High Channel | 251 | 848.8 |
| GPRS 1900 | Low Channel | 512 | 1850.2 |
| | Middle Channel | 661 | 1880.0 |
| | High Channel | 810 | 1909.8 |
| WCDMA Band 2 | Low Channel | 9262 | 1852.4 |
| | Middle Channel | 9400 | 1880.0 |
| | High Channel | 9538 | 1907.6 |
| WCDMA Band 5 | Low Channel | 4132 | 826.4 |
| | Middle Channel | 4182 | 836.4 |
| | High Channel | 4233 | 846.6 |

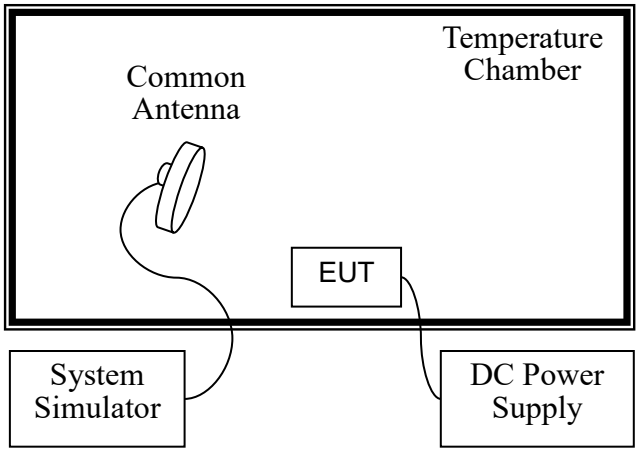
## 4.4 Test Setup

### 4.4.1 For Antenna Port Test



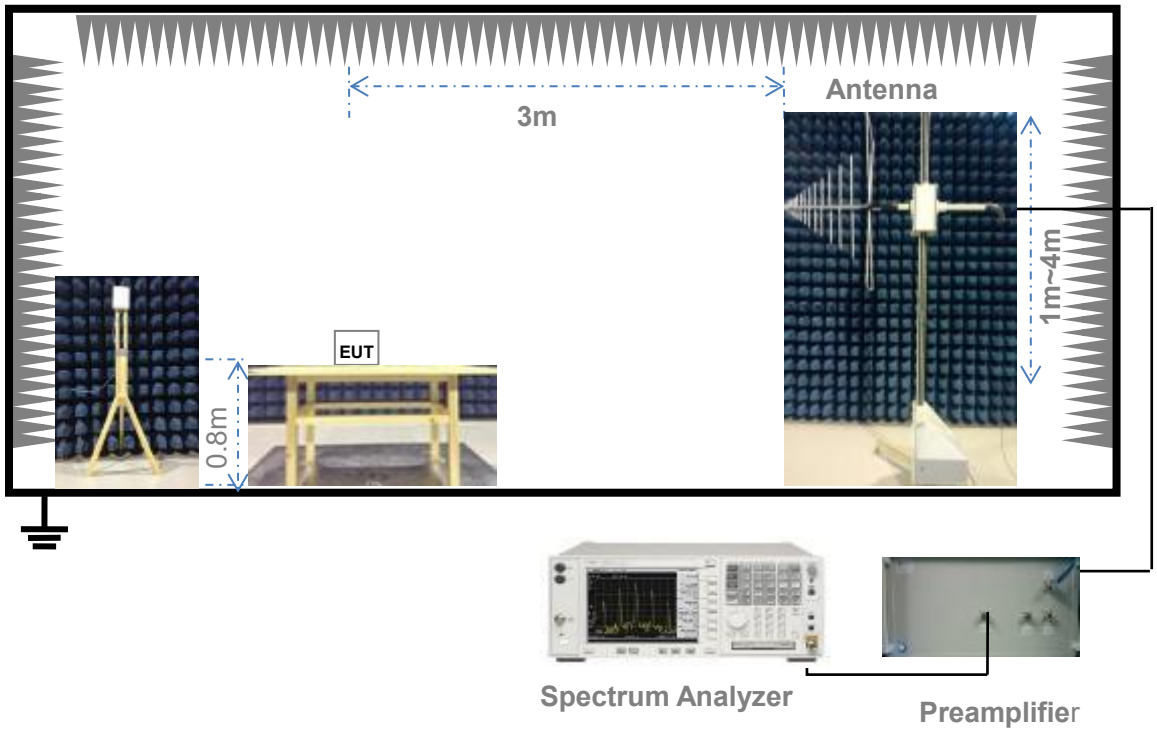

**(Diagram 1)**

### 4.4.2 For Frequency Stability Test



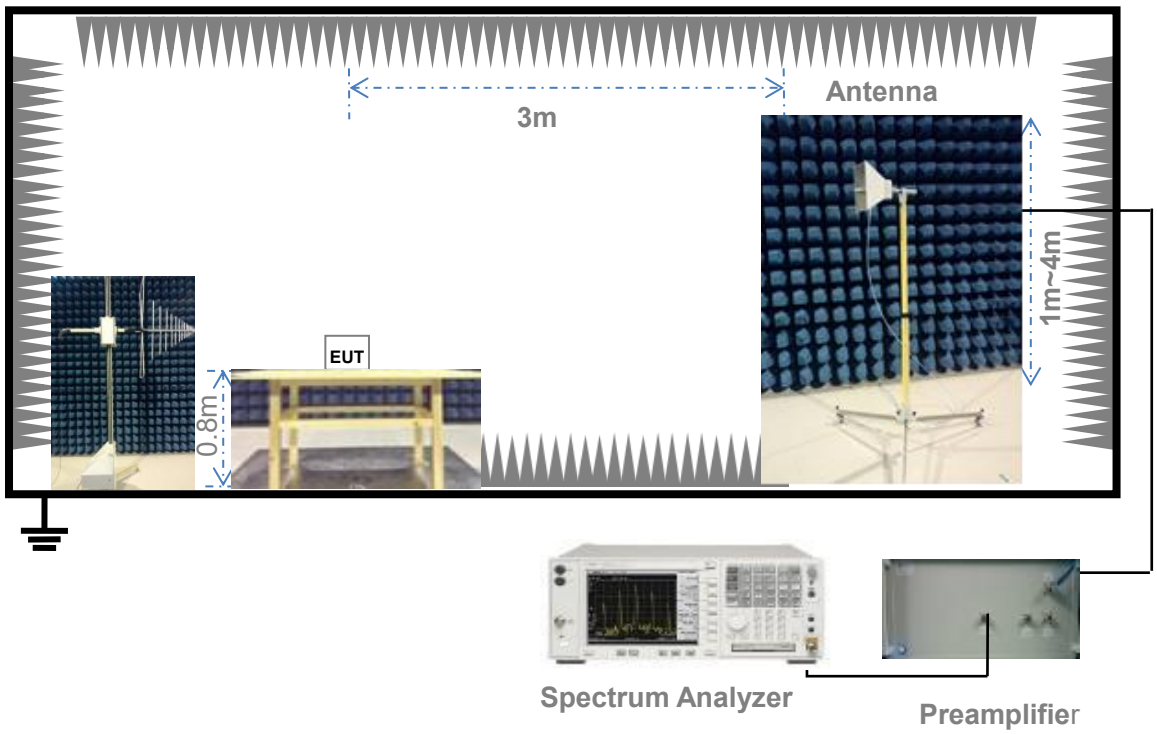

**(Diagram 2)**

### 4.4.3 For Radiated Test (30 MHz ~ 1 GHz)




**(Diagram 3)**

### 4.4.4 For Radiated Test (Above 1 GHz)




**(Diagram 4)**

# 5 TEST ITEMS

## 5.1 Transmitter Radiated Power (EIRP/ERP)

### 5.1.1 Limit

FCC § 2.1046 & 22.913(a) & 24.232(c)

According to FCC section 22.913(a) (5), the Effective Radiated Power (ERP) of mobile transmitters and auxiliary test transmitters must not exceed 7 watts.

According to FCC section 24.232(c), mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

### 5.1.2 Test Setup

The section 4.4.1 (Diagram 1) test setup description is used for conducted test, and the section 4.4.3 and 4.4.4 (Diagram 3, 4) test setup description is used for radiated test. The photo of test setup please refer to ANNEX B.

### 5.1.3 Test Procedure

**Description of the Conducted Output Power Measurement**

The EUT is coupled to the SS with attenuator through power splitter; the RF load attached to EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading. A system simulator is used to establish communication with the EUT, and its parameters are set to force the EUT transmitting at maximum output power. The measured power in the radio frequency on the transmitter output terminals shall be reported.

The relevant equation for determining the conducted measured value is:

Conducted Output Power Value (dBm) = Measured Value (dBm) + Path Loss (dB)

where:
Conducted Output Power Value = final conducted measured value in the conducted power test, in dBm;
Measured Value = measured conducted power received by spectrum analyzer or power meter, in dBm;
Path Loss = signal attenuation in the connecting cable between the transmitter and spectrum analyzer or power meter, including external cable loss, in dB;

During the test, the data of Path Loss (dB) is added in the spectrum analyzer or power meter, so Measured Value (dBm) is the final values which contains the data of Path Loss (dB).

For example:

In the conducted output power test, when measured value for GSM850 is 24.7 dBm, and path loss is 8.5 dB, then final conducted output power value is:

Conducted Output Power Value (dBm) = 24.7 dBm + 8.5 dB = 33.2 dBm

**Description of the Transmitter Radiated Power Measurement**

In many cases, the RF output power limits for licensed digital transmission devices is specified in terms of effective radiated power (ERP) or equivalent isotropic radiated power (EIRP). Typically, ERP is specified when the operating frequency is less than or equal to 1 GHz and EIRP is specified when the operating frequency is greater than 1 GHz. Both are determined by adding the transmit antenna gain to the conducted RF output power with the primary difference between the two being that when determining the ERP, the transmit antenna gain is referenced to a dipole antenna (i.e., dBd) whereas when determining the EIRP, the transmit antenna gain is referenced to an isotropic antenna (dBi).

Final measurement calculation as below:

The relevant equation for determining the ERP or EIRP from the conducted RF output power measured using the guidance provided above is:

ERP/EIRP = $P_{Meas}$ + GT − LC

where:
ERP/EIRP = effective or equivalent radiated power, respectively (expressed in the same units as $P_{Meas}$, typically dBW or dBm);
$P_{Meas}$ = measured transmitter output power or PSD, in dBm or dBW;
GT = gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP);
dBd (ERP)=dBi (EIRP) -2.15 dB
LC = signal attenuation in the connecting cable between the transmitter and antenna, in dB.

For devices utilizing multiple antennas, KDB 662911 provides guidance for determining the effective array transmit antenna gain term to be used in the above equation.

For example:
In the EIRP test, when $P_{Meas}$ value for GSM1900 is 30.2 dBm, LC is 0.6 dB, and GT is -3.4 dB, then final EIRP value is:
EIRP for GSM1900 = 30.2 dBm - 3.4 dBi - 0.6 dB = 26.2 dBm

The relevant equation for determining the ERP/EIRP from the radiated RF output power is:
ERP/EIRP (dBm) = SA Read Value (dBm) + Correction Factor (dB)

where:
ERP/EIRP = effective or equivalent radiated power, in dBm;
SA Read Value = measured transmitter power received by EMI receiver or spectrum analyzer, in dBm;
Correction Factor = total correction factor including cable loss, in dB;

During the test, the data of Correction Factor (dB) is added in the EMI receiver or spectrum analyzer, so SA Read Value (dBm) is the final values which contains the data of Correction Factor (dB).

For example:

In the ERP test, when SA read value for GSM850 is 21dBm, and correction factor is 8dB, then final ERP value for GSM850 is:

ERP (dBm) = 21dBm + 8dB = 29dBm

### 5.1.4 Test Result

Please refer to ANNEX A.1.

## 5.2 Peak to Average Ratio

### 5.2.1 Limit

FCC § 2.1046 & 24.232(d)

In addition, when the transmitter power is measured in terms of average value, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.

According to FCC section 24.232(d), power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with 24.232 (e) of this section. In both instances, equipment employed must be authorized in accordance with the provisions of § 24.51. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

FCC section 24.232(e), peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

### 5.2.2 Test Setup

The section 4.4.1 (Diagram 1) test setup description is used for this test. The photo of test setup please refer to ANNEX B.

### 5.2.3 Test Procedure

Here the lowest, middle and highest channels are selected to perform testing to verify the peak-to-average ratio.

According to KDB 971168 D01, there is CCDF procedure for PAPR:

a) Refer to instrument’s analyzer instruction manual for details on how to use the power statistics/CCDF function;

b) Set resolution/measurement bandwidth ≥ signal’s occupied bandwidth;

c) Set the number of counts to a value that stabilizes the measured CCDF curve;

d) Set the measurement interval as follows:

1) for continuous transmissions, set to 1 ms,

2) for burst transmissions, employ an external trigger that is synchronized with the EUT burst timing sequence, or use the internal burst trigger with a trigger level that allows the burst to stabilize and set the measurement interval to a time that is less than or equal to the burst duration.

e) Record the maximum PAPR level associated with a probability of 0.1%.

Alternate procedure for PAPR:

Use one of the procedures presented in 4.1 to measure the total peak power and record as $P_{Pk}$. Use one of the applicable procedures presented 4.2 to measure the total average power and record as $P_{Avg}$. Both the peak and average power levels must be expressed in the same logarithmic units (e.g., dBm). Determine the PAPR from:

PAPR (dB) = $P_{Pk}$ (dBm) - $P_{Avg}$ (dBm).

### 5.2.4 Test Result

Please refer to ANNEX A.2.

## 5.3 Occupied Bandwidth

### 5.3.1 Limit

FCC § 2.1049

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

Many of the individual rule parts specify a relative OBW in lieu of the 99% OBW. In such cases, the OBW is defined as the width of the signal between two points, one below the carrier center frequency and on above the carrier center frequency, outside of which all emissions are attenuated by at least X dB below the transmitter power, where the value of X is typically specified as 26.

### 5.3.2 Test Setup

The section 4.4.1 (Diagram 1) test setup description is used for this test. The photo of test setup please refer to ANNEX B.

### 5.3.3 Test Procedure

The following procedure shall be used for measuring power bandwidth.

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (i.e., two to five times the anticipated OBW).

b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1 to 5 % of the anticipated OBW, and the VBW shall be at least 3 times the RBW.

c) Set the reference level of the instrument as required to keep the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope must be at least 10log (OBW / RBW) below the reference level.

d) NOTE—Steps a) through c) may require iteration to adjust within the specified tolerances.

e) For -26 dB OBW, the dynamic range of the spectrum analyzer at the selected RBW shall be at least 10dB below the target “-X dB down” requirement, e.g. -26 dB OBW, the spectrum analyzer noise floor at the selected RBW shall be 36dB below the reference value.

f) Set the detection mode to peak, and the trace mode to max hold.

g) For 99% OBW, use the 99 % power bandwidth function of the spectrum analyzer (if available) and report the measured bandwidth.

If the instrument does not have a 99 % power bandwidth function, the trace data points are to be recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached; that frequency is

recorded as the lower frequency. The process is repeated until 99.5 % of the total is reached; that frequency is recorded as the upper frequency. The 99 % power bandwidth is the difference between these two frequencies.

h) For -26 dB OBW, determine the reference value: Set the EUT to transmit a modulated signal. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).

Determine the “-X dB down amplitude” as equal to (reference value -X). Alternatively, this calculation can be performed by the analyzer by using the marker-delta function.

Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display such that each marker is at or slightly below “-X dB down amplitude” determined in step g). If a marker is below this “-X dB down amplitude” value it shall be placed as close as possible to this value. The OBW is the positive frequency difference between the two markers.

i) The OBW shall be reported by providing plot(s) of the measuring instrument display. The frequency and amplitude axes and scale shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

j) Change variable modulations, coding, or channel bandwidth settings, then repeat above test procedures.

### 5.3.4 Test Result

Please refer to ANNEX A.3.

## 5.4 Frequency Stability

### 5.4.1 Limit

FCC § 2.1055 & 22.355 & 24.235

FCC § 2.1055

The frequency stability shall be measured with variation of ambient temperature as follows:

(1) The temperature is varied from -30°C to +50°C.

(2) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10°C through the range.

The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating and point which shall be specified by the manufacture.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided.

FCC § 22.355

Except as otherwise provided in this part, the carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in Table C-1 of this section.

**Table C-1—Frequency Tolerance for Transmitters in the Public Mobile Services**

| Frequency range (MHz) | Base, fixed (ppm) | Mobile > 3 watts (ppm) | Mobile ≤ 3 watts (ppm) |
|---|---|---|---|
| 25 to 50 | 20.0 | 20.0 | 50.0 |
| 50 to 450 | 5.0 | 5.0 | 50.0 |
| 450 to 512 | 2.5 | 5.0 | 5.0 |
| 821 to 896 | 1.5 | 2.5 | 2.5 |
| 928 to 929 | 5.0 | n/a | n/a |
| 929 to 960 | 1.5 | n/a | n/a |
| 2110 to 2220 | 10.0 | n/a | n/a |

FCC § 24.235

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

### 5.4.2 Test Setup

The section 4.4.2 (Diagram 2) test setup description is used for this test. The photo of test setup please refer to ANNEX B.

### 5.4.3 Test Procedure

1. The EUT is placed in a temperature chamber.

2. The temperature is set to 25°C and allowed to stabilize. After sufficient soak time, the transmitting frequency error is measured.

3. The temperature is increased by not more than 10 degrees, allowed to stabilize and soak, and then repeat the frequency error measurement.

4. Repeat procedure 3 until +50°C and -30°C is reached.

5. Change supply voltage, and repeat measurement until extreme voltage is reached.

### 5.4.4 Test Result

Please refer to ANNEX A.4.

## 5.5 Spurious Emission at Antenna Terminals

### 5.5.1 Limit

FCC § 2.1051 & 22.917(a) & 24.238(a)

In the 1 MHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

FCC § 22.917(a) & 24.238(a)

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43+10*log(P) dB. This is calculated to be -13 dBm.

### 5.5.2 Test Setup

The section 4.4.1 (Diagram 1) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

### 5.5.3 Test Procedure

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. On any frequency outside a licensee’s frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log(P) dB. Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency blocks a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

1. The EUT is coupled to the system simulator and spectrum analyzer; the RF load attached to EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

2. CMW500 is used to establish communication with the EUT, and its parameters are set to force the EUT transmitting at maximum output power.

3. The RF output of the transmitter is connected to the input of the spectrum analyzer through sufficient attenuation.

4. Spurious emissions are tested with 0.001MHz RBW for frequency less than 150kHz, 0.01MHz RBW for frequency less than 30MHz, 0.1MHz RBW for frequency less than 1GHz, and 1MHz RBW for frequency above 1GHz. And sweep point number are at least 401, referring to following formula.

Sweep point number = Span/RBW

VBW=3*RBW

Detector Mode=mean or average power

5. Record the frequencies and levels of spurious emissions.

### 5.5.4 Test Result

Please refer to ANNEX A.5.

## 5.6 Band Edge

### 5.6.1 Limit

FCC § 2.1051 & 22.917(a) & 24.238(a)

In the 1 MHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

FCC § 22.917(a) & 24.238(a)

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43+10*log(P) dB. This is calculated to be -13 dBm.

### 5.6.2 Test Setup

The section 4.4.1 (Diagram 1) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

### 5.6.3 Test Procedure

The EUT, which is powered by the Battery, is coupled to the Spectrum Analyzer (SA) and the System Simulator (SS) with attenuators through the Power Splitter; the RF load attached to the EUT antenna terminal is 50 Ohm; the path loss as the factor is calibrated to correct the reading.

1.The EUT is coupled to the system simulator and spectrum analyzer; the RF load attached to EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

2. CMW500 is used to establish communication with the EUT, and its parameters are set to force the EUT transmitting at maximum output power.

3. The RF output of the transmitter is connected to the input of the spectrum analyzer through sufficient attenuation.

4. The center of the spectrum analyzer was set to block edge frequency.

5. Band edge are tested with 1%*cBW (RBW), and sweep point number referred to following formula.

Sweep point number = 2*Span/RBW

VBW=3RBW

6. Record the frequencies and levels of spurious emissions.

### 5.6.4 Test Result

Please refer to ANNEX A.6.

## 5.7 Field Strength of Spurious Radiation

### 5.7.1 Limit

FCC § 2.1053 & 22.917(a) & 24.238(a)

FCC § 22.917(a) & 24.238(a)

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43+10*log(P) dB. This is calculated to be -13 dBm.

### 5.7.2 Test Setup

The section 4.4.3 and 4.4.4 (Diagram 3, 4) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

### 5.7.3 Test Procedure

1. On a test site, the EUT shall be placed at 80cm height on a turn table, and in the position close to normal use as declared by the applicant.

2. The test antenna shall be oriented initially for vertical polarization located 3 m from EUT to correspond to

the fundamental frequency of the transmitter.

3. The output of the test antenna shall be connected to the measuring receiver and the peak detector is used

for the measurement.

4. During the measurement of the EUT, the resolution bandwidth was to 1 MHz and the average bandwidth

was set to 1 MHz.

5. The transmitter shall be switched on; the measuring receiver shall be tuned to the frequency of the transmitter under test.

6. The test antenna shall be raised and lowered through the specified range of height until the maximum signal level is detected by the measuring receiver.

7. The transmitter shall be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver.

8. The test antenna shall be raised and lowered again through the specified range of height until the maximum signal level is detected by the measuring receiver.

9. The maximum signal level detected by the measuring receiver shall be noted.

10. The EUT was replaced by half-wave dipole (824 ~ 849 MHz) or horn antenna (1 850 ~ 1 910 MHz) connected to a signal generator.

11. In necessary, the input attenuator setting on the measuring receiver shall be adjusted in order to increase

the sensitivity of the measuring receiver.

12. The test antenna shall be raised and lowered through the specified range of height to ensure that the maximum signal is received.

13. The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring received, which is equal to the level noted while the transmitter radiated power was measured, corrected for the change of input attenuator setting of the measuring receiver.

14. The input level to the substitution antenna shall be recorded as power level in dBm, corrected for any change of input attenuator setting of the measuring receiver.

15. The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.

Final measurement calculation as below:

The relevant equation for determining the ERP/EIRP from the radiated RF output power is:

ERP/EIRP (dBm) = SA Read Value (dBm) + Correction Factor (dB)

where:
ERP/EIRP = effective or equivalent radiated power, in dBm;
SA Read Value = measured transmitter power received by EMI receiver or spectrum analyzer, in dBm;
Correction Factor = total correction factor including cable loss, in dB;

During the test, the data of Correction Factor (dB) is added in the EMI receiver or spectrum analyzer, so SA Read Value (dBm) is the final values which contains the data of Correction Factor (dB).

For example:

In the ERP test, when SA read value for GSM850 is 21dBm, and correction factor is 8dB, then final ERP value for GSM850 is:

ERP (dBm) = 21dBm + 8dB = 29dBm

### 5.7.4 Test Result

Please refer to ANNEX A.7.

# ANNEX A TEST RESULTS

## A.1 Transmitter Output Power

### A.1.1 Transmitter Conducted Output Power

GPRS Mode Test Data

| Test Band | Test Channel | PCL | Conducted Output Peak Power (dBm) |
|---|---|---|---|
| GPRS 850 | LCH | 5 | 33.47 |
| | MCH | 5 | 33.54 |
| | HCH | 5 | 33.54 |

| Test Band | Test Channel | PCL | Conducted Output Peak Power (dBm) |
|---|---|---|---|
| GPRS 1900 | LCH | 0 | 30.92 |
| | MCH | 0 | 30.86 |
| | HCH | 0 | 30.59 |

Note 1: For the GPRS mode, all slots were tested and just the worst data were recorded in this table.
Note 2: Set PCL to 5 for GPRS 850 (power class 4) and 0 for GPRS 1900 (power class 1).

GPRS Conducted Output Power

| Band | Channel | Conducted Output Peak Power | | | |
|---|---|---|---|---|---|
| | | 1 Slot (dBm) | 2 Slots (dBm) | 3 Slots (dBm) | 4 Slots (dBm) |
| GPRS 850 | LCH | 33.47 | 30.91 | 29.15 | 27.93 |
| | MCH | 33.54 | 30.91 | 29.19 | 27.98 |
| | HCH | 33.54 | 30.87 | 29.18 | 27.99 |
| GPRS 1900 | LCH | 30.92 | 27.68 | 26.47 | 25.39 |
| | MCH | 30.86 | 27.49 | 26.32 | 25.24 |
| | HCH | 30.59 | 27.24 | 26.10 | 25.04 |

WCDMA Mode Test Data

| Test Band | Test Channel | Conducted Output Average Power (dBm) |
|---|---|---|
| WCDMA Band 2 | LCH | 21.67 |
| | MCH | 21.75 |
| | HCH | 21.78 |
| HSDPA Band 2 | LCH | 21.05 |
| | MCH | 21.10 |
| | HCH | 20.99 |

| Test Band | Test Channel | Conducted Output Average Power (dBm) |
|---|---|---|
| WCDMA Band 5 | LCH | 21.76 |
| | MCH | 21.92 |
| | HCH | 21.84 |
| HSDPA Band 5 | LCH | 21.34 |
| | MCH | 21.66 |
| | HCH | 21.39 |

Note 1: For the HSDPA mode, all subtests were tested and just the worst data were recorded in this table.

HSDPA Conducted Output Power

| Band | Channel | Conducted Output Average Power | | | |
|---|---|---|---|---|---|
| | | Subtest1 | Subtest2 | Subtest3 | Subtest4 |
| | | (dBm) | (dBm) | (dBm) | (dBm) |
| HSDPA Band 2 | LCH | 21.04 | 21.05 | 20.08 | 19.09 |
| | MCH | 21.05 | 21.10 | 20.04 | 19.03 |
| | HCH | 20.98 | 20.99 | 19.99 | 19.06 |
| HSDPA Band 5 | LCH | 21.22 | 21.34 | 20.34 | 19.45 |
| | MCH | 21.62 | 21.66 | 20.58 | 19.68 |
| | HCH | 21.33 | 21.39 | 20.42 | 19.45 |

## A.1.2 Transmitter Radiated Output Power (EIRP/ERP)

GPRS Mode Test Data

| Test Band | Channel | PCL | Measured ERP | | Limit (W) | Verdict |
|---|---|---|---|---|---|---|
| | | | ERP (dBm) | ERP (W) | | |
| GPRS 850 | LCH | 5 | 28.17 | 0.656 | 7 | Pass |
| | MCH | 5 | 30.59 | 1.146 | | Pass |
| | HCH | 5 | 30.745 | 1.187 | | Pass |

| Test Band | Channel | PCL | Measured EIRP | | Limit (W) | Verdict |
|---|---|---|---|---|---|---|
| | | | EIRP (dBm) | EIRP (W) | | |
| GPRS 1900 | LCH | 5 | 29.274 | 0.846 | 2 | Pass |
| | MCH | 5 | 28.706 | 0.742 | | Pass |
| | HCH | 5 | 28.778 | 0.755 | | Pass |

Note 1: For the GPRS mode, all slots were tested and just the worst data were recorded in this table.

Note 2: ERP/EIRP = SA Read Value + Correction Factor

where:

ERP/EIRP = effective or equivalent radiated power, in dBm;

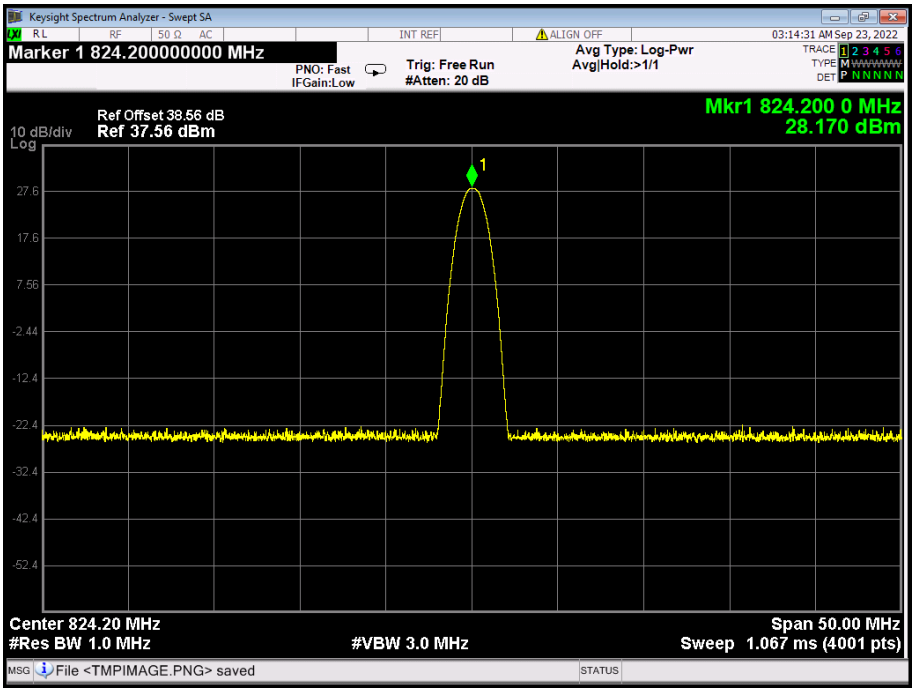
SA Read Value = measured transmitter power received by EMI receiver or spectrum analyzer, in dBm;

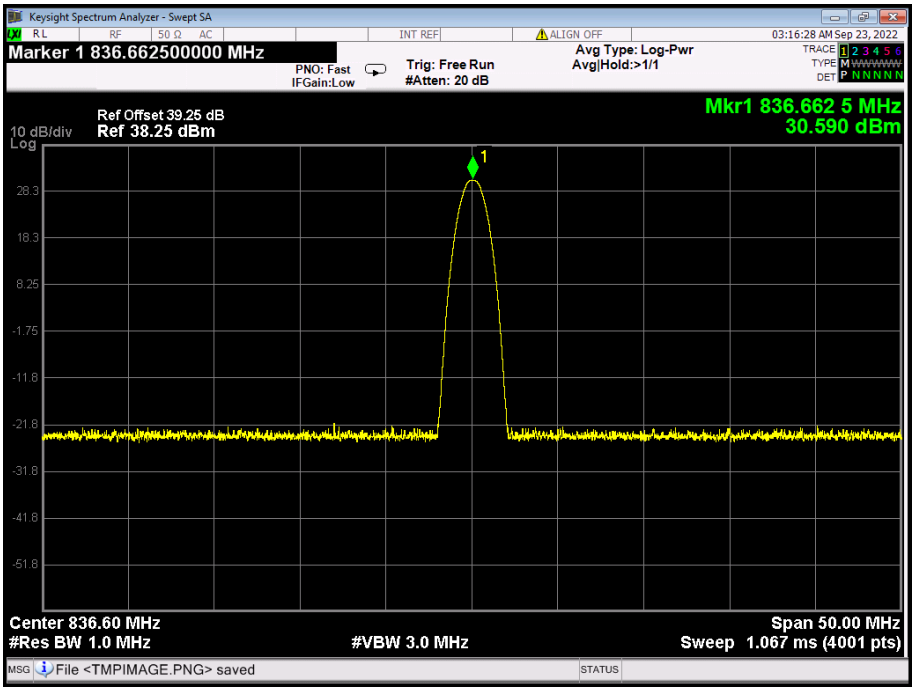
Correction Factor = total correction factor including cable loss, in dB;

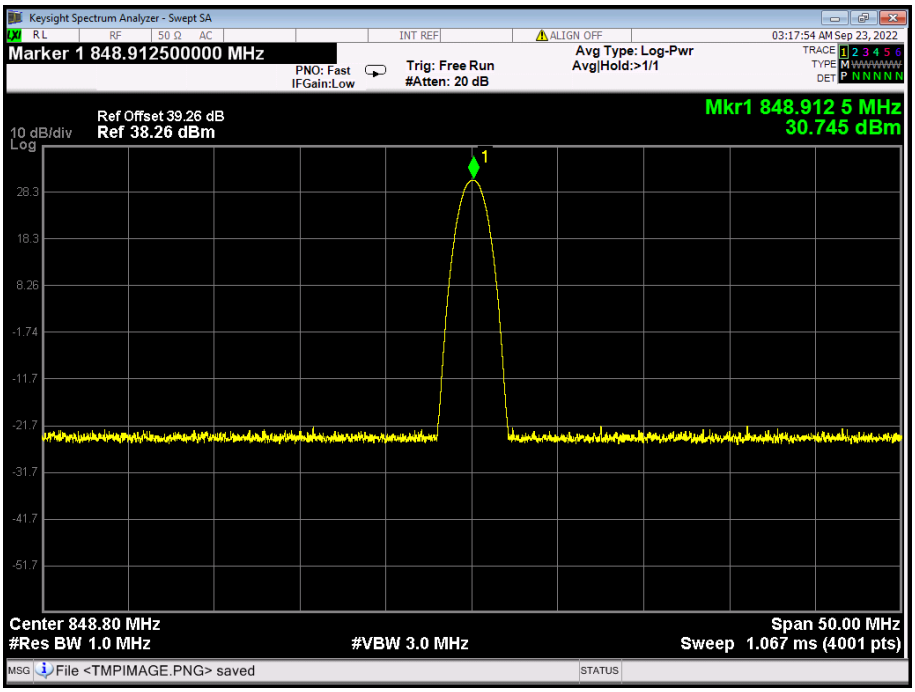
Note 3: Set PCL to 5 for GPRS 850 (power class 4) and 0 for GPRS 1900 (power class 1).

GPRS Mode Test Plots

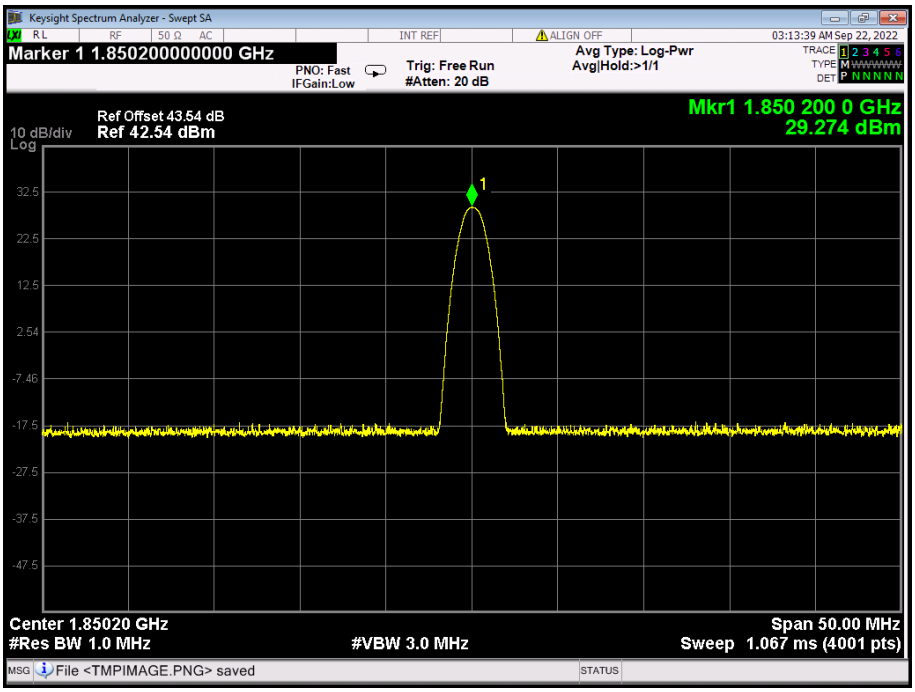
**GPRS850**

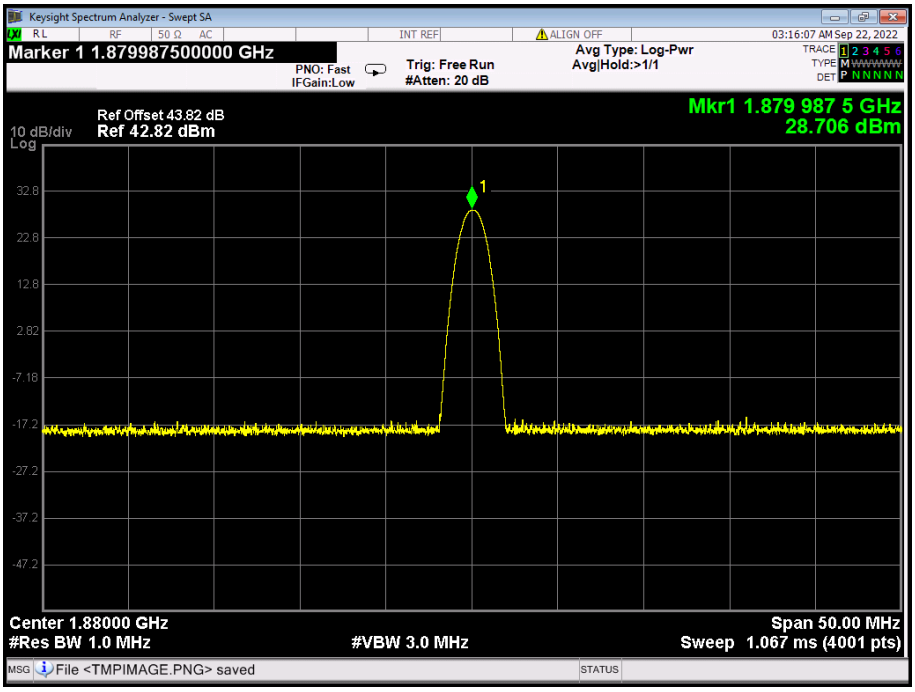


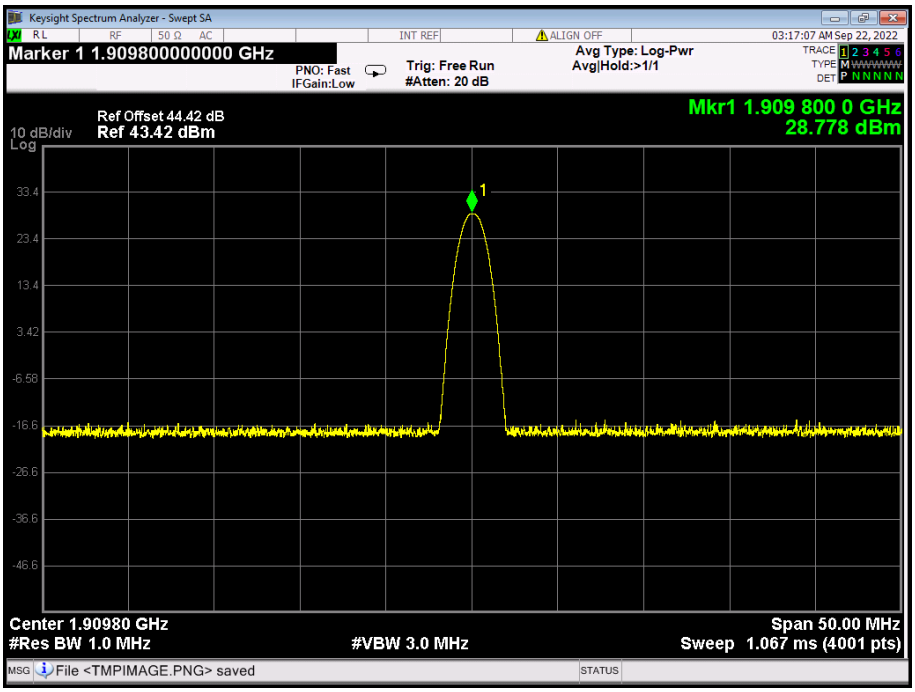




Keysight Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
INT REF
ALIGN OFF
03:17:54 AM Sep 23, 2022
Marker 1 848.912500000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>1/1
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 39.26 dB
10 dB/div
Log
Ref 38.26 dBm
Mkr1 848.912 5 MHz
30.745 dBm
28.3
18.3
8.26
-1.74
-11.7
-21.7
-31.7
-41.7
-51.7
1
Center 848.80 MHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Span 50.00 MHz
Sweep 1.067 ms (4001 pts)
MSG
File <TMPIMAGE.PNG> saved
STATUS

## GPRS1900


Keysight Spectrum Analyzer - Swept SA
Marker 1 1.850200000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>1/1
03:13:39 AM Sep 22, 2022
Ref Offset 43.54 dB
10 dB/div
Ref 42.54 dBm
Mkr1 1.850 200 0 GHz
29.274 dBm
Center 1.85020 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Span 50.00 MHz
Sweep 1.067 ms (4001 pts)
File <TMPIMAGE.PNG> saved


Keysight Spectrum Analyzer - Swept SA
Marker 1 1.879987500000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>1/1
03:16:07 AM Sep 22, 2022
Ref Offset 43.82 dB
10 dB/div
Ref 42.82 dBm
Mkr1 1.879 987 5 GHz
28.706 dBm
Center 1.88000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Span 50.00 MHz
Sweep 1.067 ms (4001 pts)
File <TMPIMAGE.PNG> saved


Keysight Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
INT REF
ALIGN OFF
03:17:07 AM Sep 22, 2022
Marker 1 1.909800000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>1/1
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 44.42 dB
10 dB/div
Log
Ref 43.42 dBm
Mkr1 1.909 800 0 GHz
28.778 dBm
33.4
23.4
13.4
3.42
-6.58
-16.6
-26.6
-36.6
-46.6
1
Center 1.90980 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Span 50.00 MHz
Sweep 1.067 ms (4001 pts)
MSG
File <TMPIMAGE.PNG> saved
STATUS

WCDMA Mode Test Data

| Test Band | Channel | Measured EIRP | | Limit (W) | Verdict |
|---|---|---|---|---|---|
| | | EIRP (dBm) | EIRP (W) | | |
| WCDMA B2 | LCH | 21.254 | 0.133 | 2 | Pass |
| | MCH | 20.399 | 0.110 | | Pass |
| | HCH | 19.346 | 0.086 | | Pass |
| HSDPA B2 | LCH | 20.905 | 0.123 | | Pass |
| | MCH | 20.815 | 0.121 | | Pass |
| | HCH | 19.132 | 0.082 | | Pass |

| Test Band | Channel | Measured ERP | | Limit (W) | Verdict |
|---|---|---|---|---|---|
| | | ERP (dBm) | ERP (W) | | |
| WCDMA B5 | LCH | 20.399 | 0.110 | 7 | Pass |
| | MCH | 19.676 | 0.093 | | Pass |
| | HCH | 19.863 | 0.097 | | Pass |
| HSDPA B5 | LCH | 20.251 | 0.106 | | Pass |
| | MCH | 19.358 | 0.086 | | Pass |
| | HCH | 19.209 | 0.083 | | Pass |

Note 1: For the HSDPA, all subtests were tested and just the worst data were recorded in this table.

Note 2: ERP/EIRP = SA Read Value + Correction Factor

where:

ERP/EIRP = effective or equivalent radiated power, in dBm;

SA Read Value = measured transmitter power received by EMI receiver or spectrum analyzer, in dBm;

Correction Factor = total correction factor including cable loss, in dB;

## A.2 Peak to Average Ratio

Note: The Peak to Average Ratio please refer to the report BL-EC2210570-501, which was issued by Shenzhen BALUN Technology Co., Ltd. on Mar. 11, 2022.

## A.3 Occupied Bandwidth

Note: The Occupied Bandwidth please refer to the report BL-EC2210570-501, which was issued by Shenzhen BALUN Technology Co., Ltd. on Mar. 11, 2022.

## A.4 Frequency Stability

Note: The Frequency Stability please refer to the report BL-EC2210570-501, which was issued by Shenzhen BALUN Technology Co., Ltd. on Mar. 11, 2022.

## A.5 Spurious Emission at Antenna Terminals

Note: The Spurious Emission at Antenna Terminals please refer to the report BL-EC2210570-501, which was issued by Shenzhen BALUN Technology Co., Ltd. on Mar. 11, 2022.

## A.6 Band Edge

Note: The Band Edge please refer to the report BL-EC2210570-501, which was issued by Shenzhen BALUN Technology Co., Ltd. on Mar. 11, 2022.

## A.7 Field Strength of Spurious Radiation

Note 1: The frequencies of verdict which are marked by "N/A" should be ignored because they are UE carrier frequency.

Note 2: Test plots please refer to the document “Annex No.:BL-EC2280992-501 Data Part 1.pdf”.

GPRS and WCDMA Mode Test Verdict

| Test Band | Test Channel | Refer to Plot[Note3] | Verdict |
|---|---|---|---|
| GPRS 850 | LCH | 1.1 | Pass |
| | MCH | 1.2 | Pass |
| | HCH | 1.3 | Pass |
| GPRS 1900 | LCH | 2.1 | Pass |
| | MCH | 2.2 | Pass |
| | HCH | 2.3 | Pass |
| WCDMA Band 2 | LCH | 3.1 | Pass |
| | MCH | 3.2 | Pass |
| | HCH | 3.3 | Pass |
| WCDMA Band 5 | LCH | 4.1 | Pass |
| | MCH | 4.2 | Pass |
| | HCH | 4.3 | Pass |

# ANNEX B TEST SETUP PHOTOS

Please refer to the document “BL-EC2280992-AR.PDF”.

# ANNEX C EUT EXTERNAL PHOTOS

Please refer to the document “BL-EC2280992-AW.PDF”.

# ANNEX D EUT INTERNAL PHOTOS

Please refer to the document “BL-EC2280992-AI.PDF”.

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