

RF

TEST REPORT

ISSUED BY
Shenzhen BALUN Technology Co., Ltd.



FOR
GNSS Tracker

ISSUED TO
Queclink Wireless Solutions Co., Ltd

No.30, Lane 500, Xinlong Road, Minhang District, Shanghai, China
201101



Tested by: Jiamin Lu

Jiamin Lu

Date Mar. 11, 2022

Approved by: Wei Yanquan

Wei Yanquan
(Chief Engineer)

Date Mar. 11, 2022

Report No.: BL-EC2210570-501

EUT Name: GNSS Tracker

Model Name: GV55W

Brand Name: Queclink

Test Standard: 47 CFR Part 2
47 CFR Part 22
47 CFR Part 24
(refer section 3.1)

FCC ID: YQDGV55W

Test Conclusion: Pass

Test Date: Jan. 20, 2022 ~ Feb. 20, 2022

Date of Issue: Mar. 11, 2022

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Revision History

Version	Issue Date	Revisions Content
<u>Rev. 01</u>	<u>Feb. 22, 2022</u>	<u>Initial Issue</u>
<u>Rev. 02</u>	<u>Mar. 11, 2022</u>	<u>Modify the FCC ID</u>

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1 ADMINISTRATIVE DATA (GENERAL INFORMATION)

1.1 Identification of the Testing Laboratory

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

1.2 Identification of the Responsible Testing Location

Test Location	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China.
Description	All measurement facilities used to collect the measurement data are located at Block B, FL 1, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China 518055

1.3 Laboratory Condition

Ambient Temperature	20 °C to 35 °C
Ambient Relative Humidity	30 % to 60 %
Ambient Pressure	98 kPa to 102 kPa

1.4 Announce

- (1) The test report reference to the report template version v6.2.
- (2) The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.
- (3) The test report is invalid if there is any evidence and/or falsification.
- (4) The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein.
- (5) This document may not be altered or revised in any way unless done so by BALUN and all revisions are duly noted in the revisions section.
- (6) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.
- (7) The laboratory is only responsible for the data released by the laboratory, except for the part provided by the applicant. The applicant is responsible for the impact of the information provided on the validity of the results.

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	N/A
Address	N/A

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	R107V1.03
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; 3G Network WCDMA/HSDPA Band 2/ 5; Bluetooth
About the Product	The equipment is GV55W, 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 WCDMA/HSDPA Band 2/ 5	
Modulation Type	GPRS	GMSK
	WCDMA	QPSK
	HSDPA	QPSK
		16QAM
TX Frequency Range	GPRS 850: 824 MHz ~ 849 MHz GPRS 1900: 1850 MHz ~ 1910 MHz WCDMA/HSDPA Band 2: 1850 MHz ~ 1910 MHz WCDMA/HSDPA Band 5: 824 MHz ~ 849 MHz	
Rx Frequency Range	GPRS 850: 869 MHz ~ 894 MHz GPRS 1900: 1930 MHz ~ 1990 MHz WCDMA/HSDPA Band 2: 1930 MHz ~ 1990 MHz WCDMA/HSDPA Band 5: 869 MHz ~ 894 MHz	
Power Class	GPRS 850: 4 GPRS 1900: 1 WCDMA/HSDPA Band 2: 3 WCDMA/HSDPA Band 5: 3	
Multislot Class	GPRS: 12	
Antenna Type	PIFA Antenna	
Antenna Gain	GPRS 850: 3.29 dBi GPRS 1900: 5.3 dBi WCDMA/HSDPA Band 2: 5.3 dBi WCDMA/HSDPA Band 5: 3.29 dBi	
The Max RF Output Power (EIRP/ERP)	GPRS 850: 32.66 dBm GPRS 1900: 30.04 dBm WCDMA/HSDPA Band 2: 24.39 dBm WCDMA/HSDPA Band 5: 21.05 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 22.913 24.232	ANNEX A.1	Pass
3	Peak to Average Ratio	2.1046 24.232(d)	ANNEX A.2	Pass
4	Occupied Bandwidth	2.1049 22.917 24.238	ANNEX A.3	Pass
5	Frequency Stability	2.1055 22.355 24.235	ANNEX A.4	Pass
6	Spurious Emission at Antenna Terminals	2.1051 22.917 24.238	ANNEX A.5	Pass
7	Band Edge	2.1051 22.917 24.238	ANNEX A.6	Pass
8	Field Strength of Spurious Radiation	2.1053 22.917 24.238	ANNEX A.7	Pass

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

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Software /Firmware Version	Cal. Date	Cal. Due
Conducted Test System						
Test Software 1	R&S	CMUgo	N/A	V2.0.1	N/A	N/A
Test Software 2	R&S	CMWRun	N/A	V1.9.8	N/A	N/A
Test Software 3	BALUN	BL410R	N/A	V2.1.1.48 8	N/A	N/A
Universal Radio Communication Tester	R&S	CMU 200	119280	V5.13	2022.02.10	2023.01.09
Wideband Radio Communication Tester	R&S	CMW 500	127794	V3.5.137	2021.06.01	2022.05.31
Wideband Radio Communication Tester	R&S	CMW 500	120598	V3.5.137	2022.01.05	2023.01.04
Spectrum Analyzer	R&S	FSV-40	101544	2.30.SP4	2021.06.01	2022.05.31
Spectrum Analyzer	Agilent	E4440A	MY45304434	A.11.21	2021.09.08	2022.09.07
Spectrum Analyzer	Agilent	E4440A	MY46181663	A.11.21	2021.10.11	2022.10.10
Temperature Chamber	AHK	SP20	1412	N/A	2021.06.04	2022.06.03
DC Power Supply	ITECH	IT6863A	8000140207 57120008	N/A	2021.09.12	2022.09.11
Power Sensor	Agilent	E9304A H18	MY41497164	N/A	2021.09.08	2022.09.07
Power Splitter	KMW	DCPD- LDC	1305003215	N/A	N/A	N/A
Attenuator (20 dB)	KMW	ZA-S1-201	110617091	N/A	N/A	N/A

Description	Manufacturer	Model	Serial No.	Software /Firmware Version	Cal. Date	Cal. Due
Attenuator (6 dB)	KMW	ZA-S1-61	1305003189	N/A	N/A	N/A
Radiated Test System						
Test Software	BALUN	BL410_E	N/A	V19.918	N/A	N/A
Test Antenna- Bi-Log(30 MHz-3 GHz)	Schwarzbeck	VULB 9163	9163-624	N/A	2019.07.02	2022.07.01
Test Antenna- Horn(1-18 GHz)	Schwarzbeck	BBHA 9120D	9120D-1917	N/A	2019.07.02	2022.07.01
Test Antenna- Horn(18-40 GHz)	A-INFO	LB- 180400KF	J211060273	N/A	2021.01.04	2023.01.03
Anechoic Chamber	YIHENG	9m*6m*6m	#3	N/A	2018.07.18	2022.07.17
EMI Receiver	KEYSIGHT	N9038A	MY53220118	A.14.16	2021.09.13	2022.09.12
Wideband Radio Communication Tester	R&S	CMW 500	127794	V3.2.73	2021.06.01	2022.05.31

4.3 Test Configurations

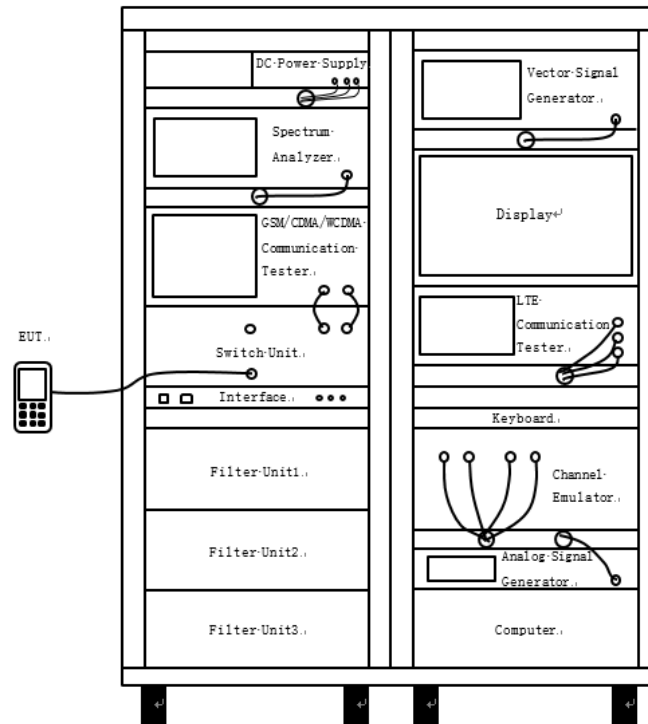
Test Items	Test Mode	Test Channel		
		LCH	MCH	HCH
Effective (Isotropic) Radiated Power	GPRS 850	v	v	v
	GPRS 1900	v	v	v
	WCDMA Band 2	v	v	v
	WCDMA Band 5	v	v	v
Peak to Average Ratio	WCDMA Band 2	v	v	v
	WCDMA Band 5	v	v	v
Occupied Bandwidth	GPRS 850	v	v	v
	GPRS 1900	v	v	v
	WCDMA Band 2	v	v	v
	WCDMA Band 5	v	v	v
	GPRS 850	v	v	v
	GPRS 1900	v	v	v
	WCDMA Band 2	v	v	v
	WCDMA Band 5	v	v	v
Spurious Emission at Antenna Terminals	GPRS 850	v	v	v
	GPRS 1900	v	v	v
	WCDMA Band 2	v	v	v
	WCDMA Band 5	v	v	v
Band Edge	GPRS 850	v	--	v
	GPRS 1900	v	--	v
	WCDMA Band 2	v	--	v
	WCDMA Band 5	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

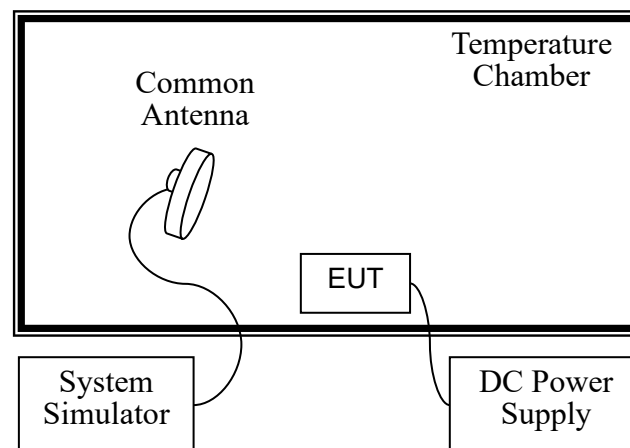
4.4 Test Setup

4.4.1 For Antenna Port Test



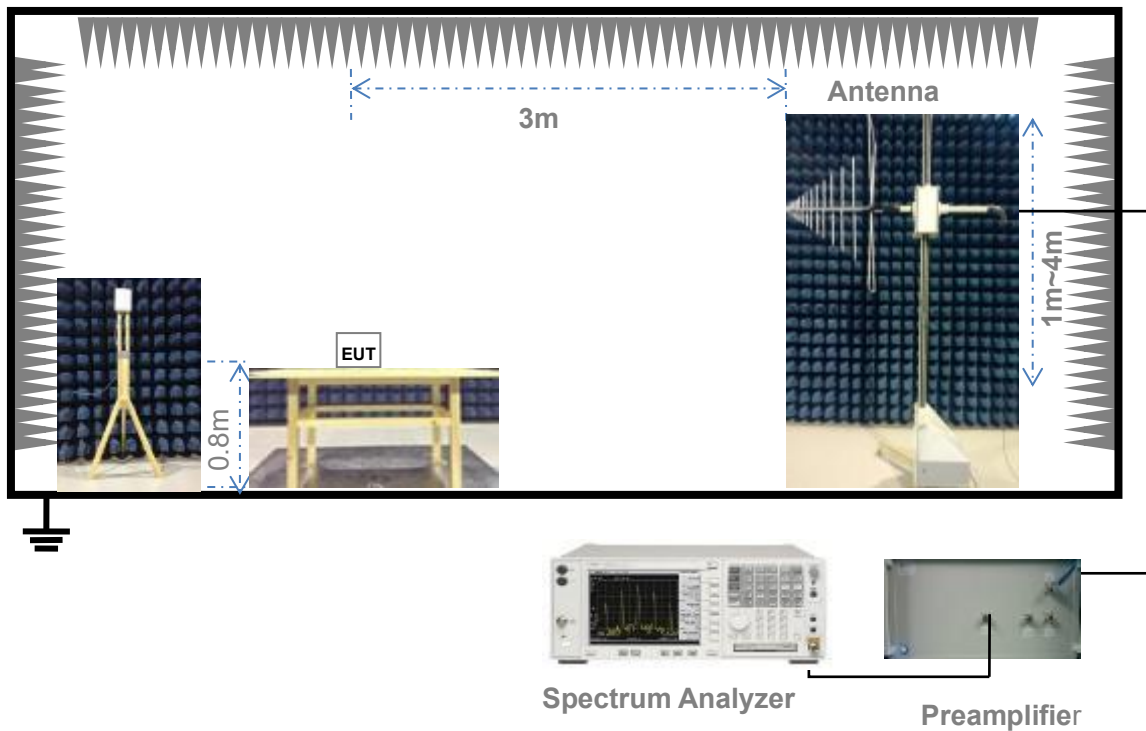
(Diagram 1)

4.4.2 For Frequency Stability Test



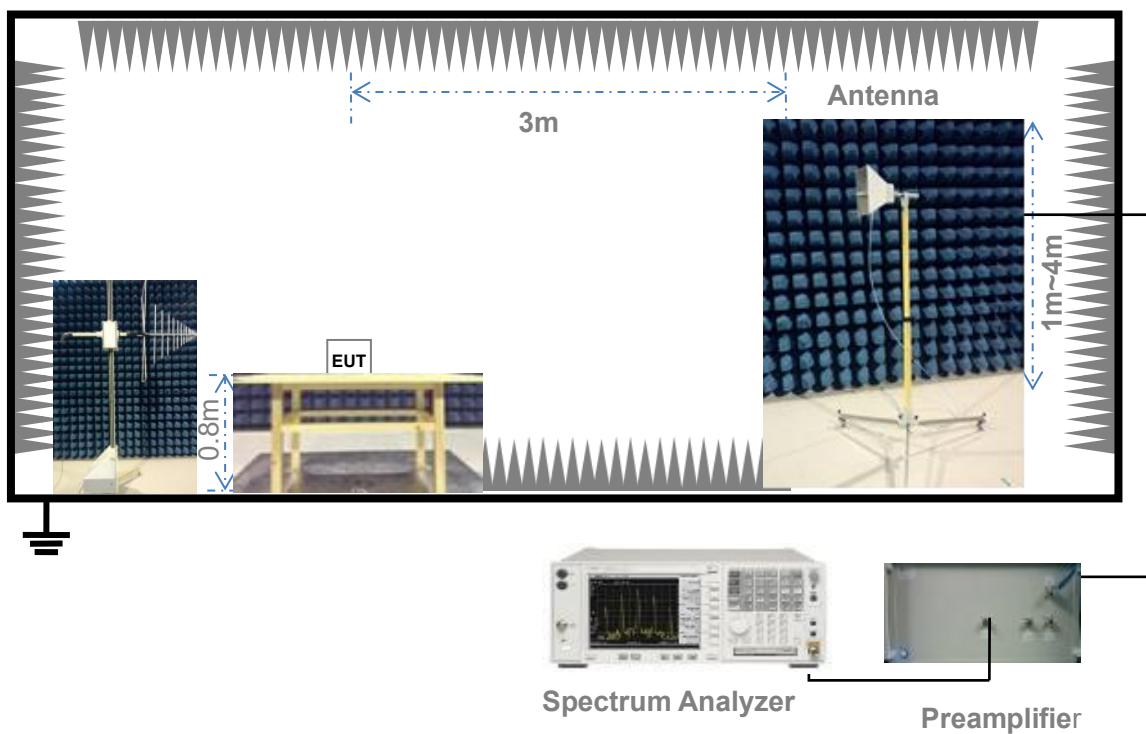
(Diagram 2)

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:

$$\text{Conducted Output Power Value (dBm)} = \text{Measured Value (dBm)} + \text{Path Loss (dB)}$$

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:

$$\text{ERP/EIRP} = P_{\text{Meas}} + \text{GT} - \text{LC}$$

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:

$$\text{EIRP for GSM1900} = 30.2 \text{ dBm} - 3.4 \text{ dBi} - 0.6 \text{ dB} = 26.2 \text{ dBm}$$

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

$$\text{ERP/EIRP (dBm)} = \text{SA Read Value (dBm)} + \text{Correction Factor (dB)}$$

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:

$$\text{ERP (dBm)} = 21\text{dBm} + 8\text{dB} = 29\text{dBm}$$

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 \geq 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 one 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 $10\log(\text{OBW} / \text{RBW})$ 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 $43 + 10 \cdot \log(P)$ 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 50 Ohm; 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 $1\% \cdot \text{cBW}$ (RBW), and sweep point number referred to following formula.

$$\text{Sweep point number} = 2 \cdot \text{Span} / \text{RBW}$$

$$\text{VBW} = 3 \cdot \text{RBW}$$

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 receiver, 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:

$$\text{ERP/EIRP (dBm)} = \text{SA Read Value (dBm)} + \text{Correction Factor (dB)}$$

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:

$$\text{ERP (dBm)} = 21\text{dBm} + 8\text{dB} = 29\text{dBm}$$

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)	Conducted Output Peak Power (W)
GPRS 850	LCH	5	33.53	2.254
	MCH	5	33.65	2.317
	HCH	5	33.72	2.355

Test Band	Test Channel	PCL	Conducted Output Peak Power (dBm)	Conducted Output Peak Power (W)
GPRS 1900	LCH	0	30.92	1.236
	MCH	0	30.90	1.230
	HCH	0	30.80	1.202

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

Note 2: Set PCL to 5 for GSM/GPRS 850 (power class 4) and 0 for GSM/GPRS 1900 (power class 1).
Set PCL to 8 for EGPRS850 (power class E2) and 2 for EGPRS1900 (power class E2).

GPRS Conducted Output Power

Band	Channel	Conducted Output Peak Power							
		Slot 1 (dBm)	Slot 1 (W)	Slot 2 (dBm)	Slot 2 (W)	Slot 3 (dBm)	Slot 3 (W)	Slot 4 (dBm)	Slot 4 (W)
GPRS 850	LCH	33.53	2.254	30.61	1.149	29.60	0.912	28.63	0.729
	MCH	33.65	2.317	30.72	1.180	29.72	0.937	28.76	0.752
	HCH	33.72	2.355	30.81	1.204	29.80	0.956	28.85	0.768
GPRS 1900	LCH	30.92	1.236	28.81	0.759	27.83	0.607	26.83	0.482
	MCH	30.90	1.230	28.57	0.719	27.58	0.573	26.60	0.457
	HCH	30.80	1.202	28.36	0.685	27.37	0.546	26.41	0.438

WCDMA Mode Test Data

Test Band	Test Channel	Conducted Output Average Power (dBm)	Conducted Output Average Power (W)
WCDMA Band 2	LCH	21.89	0.155
	MCH	22.10	0.162
	HCH	22.02	0.159
HSDPA Band 2	LCH	21.41	0.138
	MCH	21.63	0.146
	HCH	21.36	0.137

Test Band	Test Channel	Conducted Output Average Power (dBm)	Conducted Output Average Power (W)
WCDMA Band 5	LCH	21.88	0.154
	MCH	21.91	0.155
	HCH	22.33	0.171
HSDPA Band 5	LCH	21.38	0.137
	MCH	21.42	0.139
	HCH	21.68	0.147

Note 1: For the HSDPA and HSUPA 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)	(W)	(dBm)	(W)	(dBm)	(W)	(dBm)	(W)
HSDPA Band 2	LCH	21.38	0.137	21.41	0.138	20.40	0.110	19.42	0.087
	MCH	21.61	0.145	21.63	0.146	20.61	0.115	19.62	0.092
	HCH	21.36	0.137	21.27	0.134	20.35	0.108	19.35	0.086
HSDPA Band 5	LCH	21.32	0.136	21.38	0.137	20.39	0.109	19.19	0.083
	MCH	21.28	0.134	21.42	0.139	20.35	0.108	19.31	0.085
	HCH	21.68	0.147	21.68	0.147	20.81	0.121	19.71	0.094

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

GSM Mode Test Data

Test Band	Channel	PCL	Measured ERP		Limit (W)	Verdict
			ERP (dBm)	ERP (W)		
GPRS 850	LCH	5	28.81	0.760	7	Pass
	MCH	5	31.73	1.489		Pass
	HCH	5	32.66	1.844		Pass

Test Band	Channel	PCL	Measured ERP		Limit (W)	Verdict
			ERP (dBm)	ERP (W)		
GPRS 1900	LCH	5	30.04	1.010	2	Pass
	MCH	5	29.34	0.858		Pass
	HCH	5	30.04	1.010		Pass

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

Note 2: $ERP/EIRP = SA \text{ Read Value} + \text{Correction Factor}$

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;

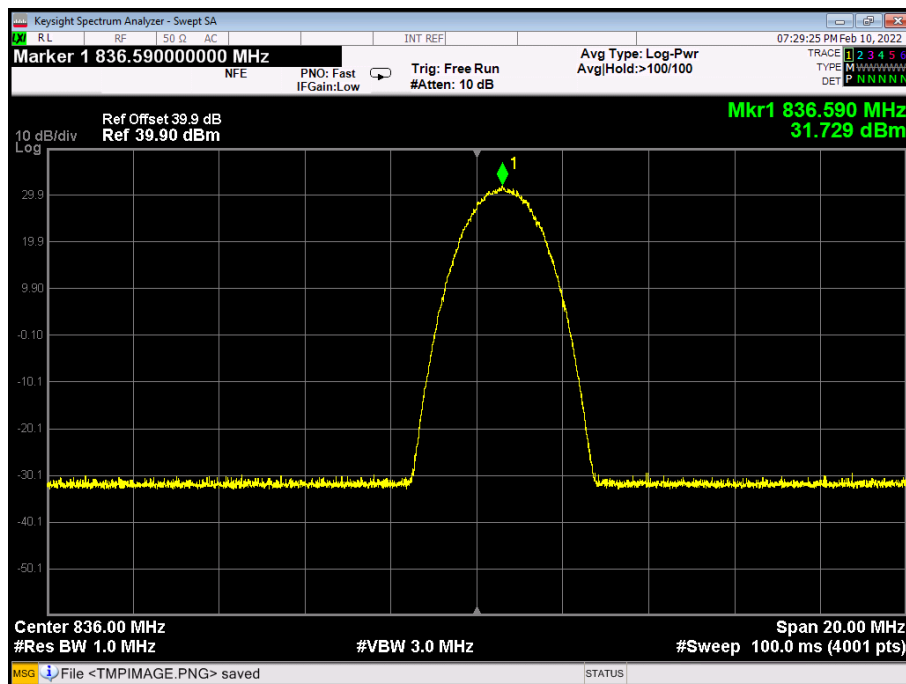
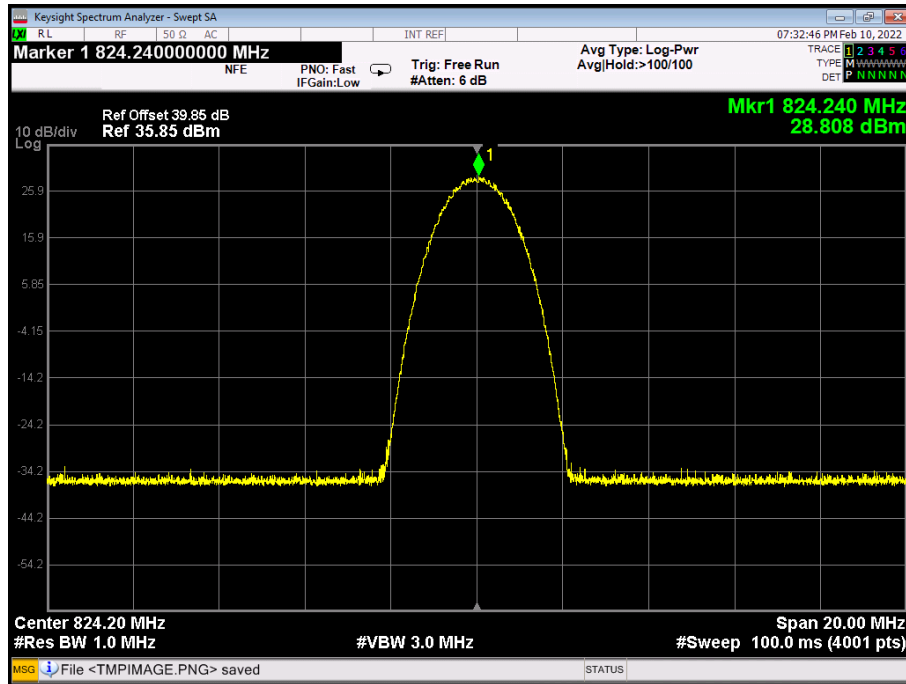
Correction Factor = total correction factor including cable loss, in dB;

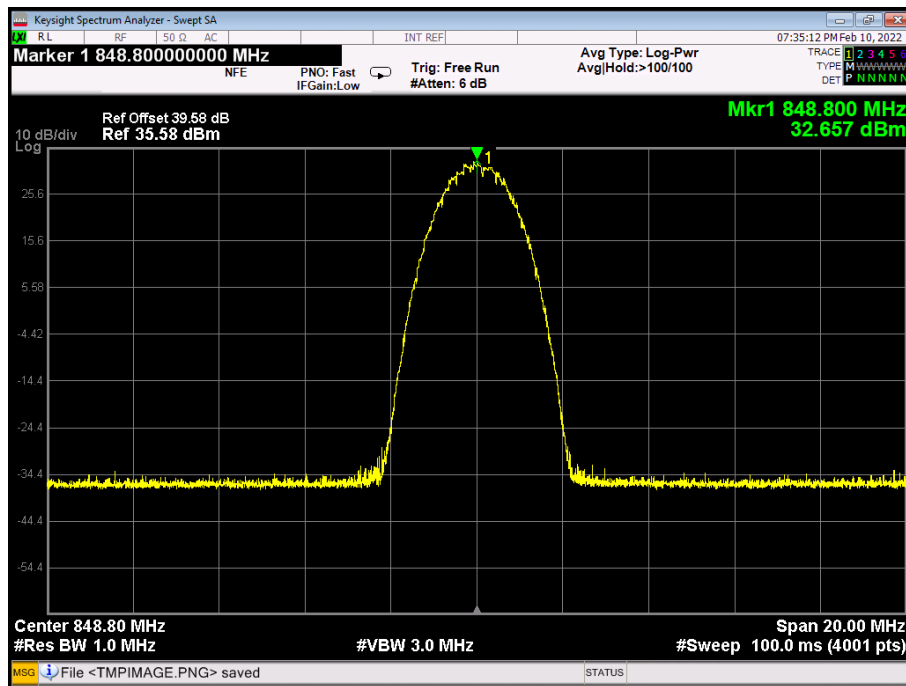
Note 3: Set PCL to 5 for GSM/GPRS 850 (power class 4) and 0 for GSM/GPRS 1900 (power class 1).

Set PCL to 8 for EGPRS850 (power class E2) and 2 for EGPRS1900 (power class E2).

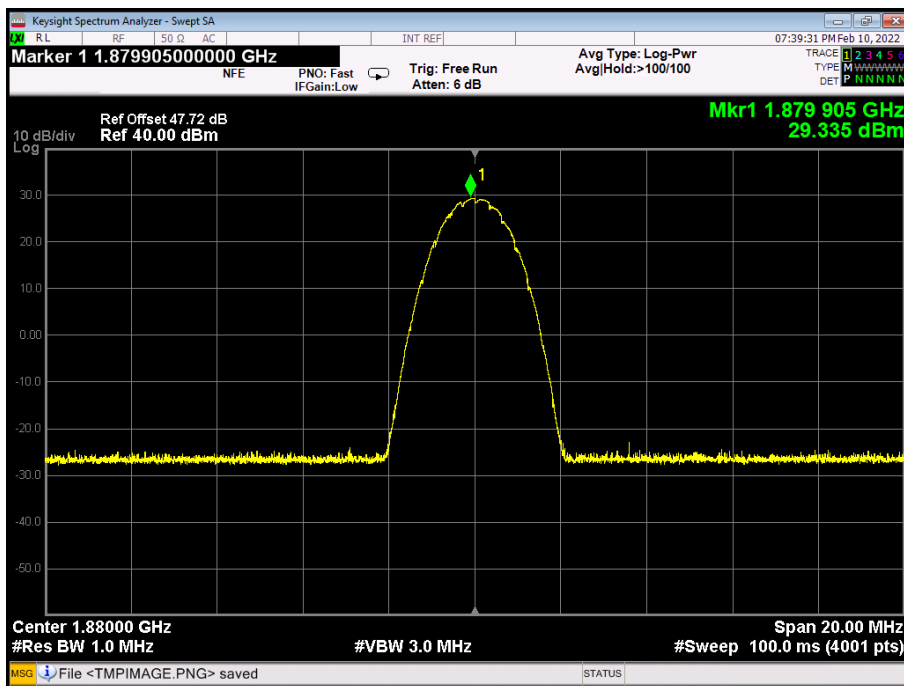
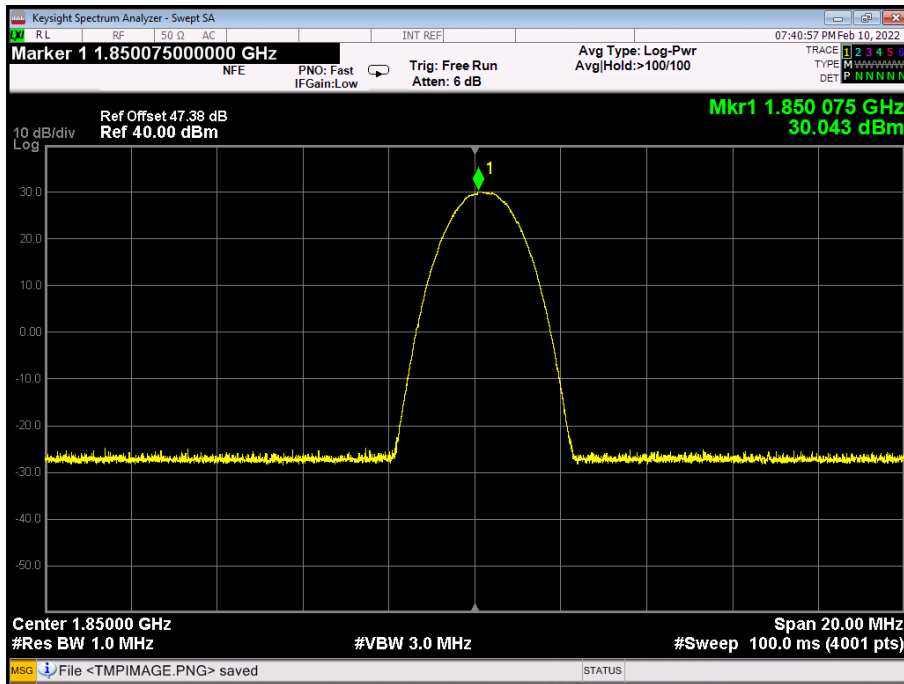
GSM Mode Test Plots

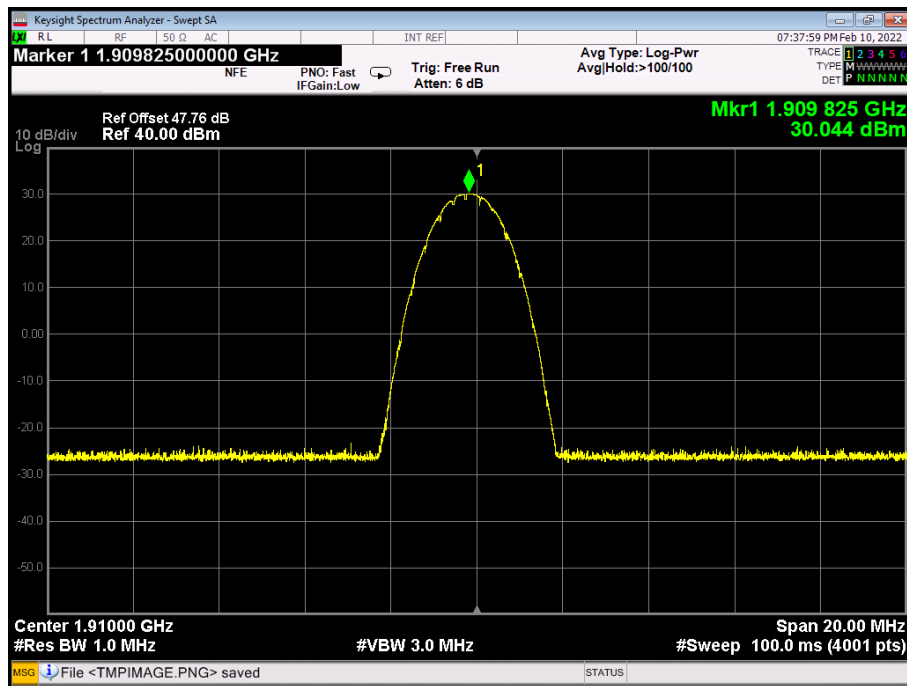
GPRS850





GPRS1900





WCDMA Mode Test Data

Test Band	Channel	Measured EIRP		Limit (W)	Verdict
		EIRP (dBm)	EIRP (W)		
WCDMA B2	LCH	24.39	0.275	2	Pass
	MCH	23.21	0.209		Pass
	HCH	21.14	0.130		Pass
HSDPA B2	LCH	21.53	0.142		Pass
	MCH	21.98	0.158		Pass
	HCH	20.01	0.100		Pass

Test Band	Channel	Measured EIRP		Limit (W)	Verdict
		EIRP (dBm)	EIRP (W)		
WCDMA B5	LCH	20.75	0.119	7	Pass
	MCH	20.17	0.104		Pass
	HCH	21.05	0.127		Pass
HSDPA B5	LCH	20.76	0.119		Pass
	MCH	20.13	0.103		Pass
	HCH	19.46	0.088		Pass

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

Note 2: $ERP/EIRP = SA \text{ Read Value} + \text{Correction Factor}$

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 1: For average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB. For GSM, GPRS and EGPRS, there are peak power to demonstrate compliance, PAR measurements are not required.

Note 2: Test plots please refer to the document "Annex No.:BL-EC2210570-501 Data Part 1.pdf".

WCDMA Mode Test Data

Test Band	Test Channel	Peak to Average Ratio (dB)	Limit (dB)	Refer to Plot ^{Note2}	Verdict
Band 2	LCH	3.05	13	1.1	Pass
	MCH	3.09	13	1.2	Pass
	HCH	3.19	13	1.3	Pass
Band 5	LCH	2.91	13	2.1	Pass
	MCH	3.00	13	2.2	Pass
	HCH	2.91	13	2.3	Pass

A.3 Occupied Bandwidth

Note 1: All modes were tested, but only the typical data were reported in this report.

Note 2: Test plots please refer to the document “Annex No.:BL-EC2210570-501 Data Part 2.pdf”.

GPRS and WCDMA Mode Test Data

Test Band	Test Channel	Measured 99% Occupied Bandwidth (MHz)	Measured -26 dB Occupied Bandwidth (MHz)	Refer to Plot ^{Note2}
GPRS 850	LCH	0.245	0.312	1.1
	MCH	0.245	0.311	1.2
	HCH	0.246	0.317	1.3
GPRS 1900	LCH	0.246	0.314	2.1
	MCH	0.244	0.312	2.2
	HCH	0.244	0.314	2.3
WCDMA Band 2	LCH	4.131	4.674	3.1
	MCH	4.143	4.67	3.2
	HCH	4.131	4.654	3.3
WCDMA Band 5	LCH	4.106	4.657	4.1
	MCH	4.134	4.677	4.2
	HCH	4.154	4.692	4.3

A.4 Frequency Stability

GPRS 850

Test Conditions		Frequency Deviation						Verdict
Power (VDC)	Temperature (°C)	LCH 824.2 MHz		MCH 836.6 MHz		HCH 848.8 MHz		
		Value (Hz)	Limits (Hz)	Value (Hz)	Limits (Hz)	Value (Hz)	Limits (Hz)	
12	-30	-43.23	±2060.5	-23.28	±2091.5	-28.06	±2122	Pass
	-20	-34.67		-35.45		-40.97		
	-10	-44.88		-45.01		-50.56		
	0	-54.63		-53.85		-69.77		
	10	-45.52		-47.3		-58.21		
	20	-41.75		-47.91		-46.04		
	25	-42.26		-54.89		-36.97		
	30	-31.09		-35.93		-48.78		
	40	-37.77		-40.13		-46.36		
	50	-42.71		-48.72		-67.12		
	60	-37.61		-40		-56.24		
	70	-46.52		-44.81		-46.78		
32	25	-50.17		-59.28		-69.22		
8	25	-41.39		-43.26		-42.46		

GPRS 1900

Test Conditions		Frequency Deviation						Verdict
Power (VDC)	Temperature (°C)	LCH 1850.2 MHz		MCH 1880 MHz		HCH 1909.8 MHz		
		Value (Hz)	Limits (Hz)	Value (Hz)	Limits (Hz)	Value (Hz)	Limits (Hz)	
12	-30	-52.53	±4625.5	-45.14	±4700.0	-36.52	±4774.5	Pass
	-20	-52.53		-41.1		-37.55		
	-10	-33.16		-39.42		-15.85		
	0	-40.39		-26.31		-36.74		
	10	-34.48		-49.98		-29.67		
	20	-54.34		-9.36		15.79		
	25	-34.64		15.98		-39.81		
	30	-16.63		16.5		57.34		
	40	-25.99		16.08		-30.22		
	50	-15.01		20.44		-36.42		
	60	-25.15		-15.63		-14.11		
	70	-31.06		-23.83		-19.44		
32	25	-34.8		-34.35		-30.74		
8	25	-29.06		-48.2		-9.75		

WCDMA Band 2

Test Conditions		Frequency Deviation						Verdict
Power (VDC)	Temperature (°C)	LCH 1852.4 MHz		MCH 1880 MHz		HCH 1907.6 MHz		
		Value (Hz)	Limits (Hz)	Value (Hz)	Limits (Hz)	Value (Hz)	Limits (Hz)	
12	-30	-2.21	±4631	-0.82	±4700	-4.07	±4769	Pass
	-20	-9.7		24.52		-8.96		
	-10	-7.7		-8.2		-3.9		
	0	-2.08		5.31		-8.55		
	10	-3.07		26.2		-2.21		
	20	-5.83		-3.96		-3.97		
	25	-2.79		-2.08		-1.07		
	30	-1.68		-5.13		0.14		
	40	-0.94		-8.12		-2.56		
	50	3.09		-0.65		-9.9		
	60	-5.49		-10.96		-7.57		
	70	-8.03		-2.65		-11.66		
32	25	-3.7		0.07		-4.96		
8	25	-2.57		-0.86		-9.28		

WCDMA Band B5

Test Conditions		Frequency Deviation						Verdict
Power (VDC)	Temperature (°C)	LCH 826.4 MHz		MCH 836.4 MHz		HCH 846.6 MHz		
		Value (Hz)	Limits (Hz)	Value (Hz)	Limits (Hz)	Value (Hz)	Limits (Hz)	
12	-30	-3.29	±2066	-2.18	±2091	-3.66	±2116.5	Pass
	-20	-7.25		-9.48		-5.97		
	-10	-2.8		-4.16		-7.85		
	0	-5.24		-8.59		-5.21		
	10	-4.35		-2.98		-4.59		
	20	-7.22		-7.12		-2.86		
	25	-0.65		-10		-4.81		
	30	-4.12		-6.27		-7.26		
	40	-5.84		-3.11		-5.99		
	50	-1.24		-0.16		0.69		
	60	3.6		-4.53		-1.37		
	70	-0.41		-4.76		-1.6		
32	25	-5.89		-5.74		-2.35		
8	25	-2.38		-4.5		-6.22		

A.5 Spurious Emission at Antenna Terminals

Note 1: GSM and EGPRS modes have been verified, and only the worst data with different bandwidth for LTE are shown here.

Note 2: The frequencies of verdict which are marked by "N/A" should be ignored because they are UE carrier frequency.

Note 3: Test plots please refer to the document "Annex No.:BL-EC2210570-501 Data Part 3.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

A.6 Band Edge

Note 1: Test plots please refer to the document “Annex No.:BL-EC2210570-501 Data Part 4.pdf”.

GPRS and WCDMA Mode Test Verdict

Test Band	Test Channel	Refer to Plot ^{Note1}	Verdict
GPRS 850	LCH	1.1	Pass
	HCH	1.2	Pass
GPRS 1900	LCH	2.1	Pass
	HCH	2.2	Pass
WCDMA Band 2	LCH	3.1	Pass
	HCH	3.2	Pass
WCDMA Band 5	LCH	4.1	Pass
	HCH	4.2	Pass

A.7 Field Strength of Spurious Radiation

Note 1: GSM and EGPRS modes have been verified, only the worst data with different transmit bandwidth for LTE are shown here.

Note 2: The frequencies of verdict which are marked by "N/A" should be ignored because they are UE carrier frequency.

Note 3: Test plots please refer to the document "Annex No.:BL-EC2210570-501 Data Part 5.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-EC2210570-AR.PDF".

ANNEX C EUT EXTERNAL PHOTOS

Please refer to the document "BL-EC2210570-AW.PDF".

ANNEX D EUT INTERNAL PHOTOS

Please refer to the document "BL-EC2210570-AI.PDF".

--END OF REPORT--