TEST REPORT

Product Name : LTE CAT1 ASSET GNSS TRACKER
Model Number : LL301, LL301L, LL301E
FCC ID : 2AMLFJM-LL301L

Prepared for	:	Shenzhen Jimi IoT Co., Ltd.
Address	:	3-4/F, Block A, Building #7, Shenzhen International Innovation Valley, Dashi 1st Road, Nanshan District, Shenzhen, Guangdong, China
Prepared by	:	EMTEK (SHENZHEN) CO., LTD.
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Report Number	:	ENS2109260016W00402R
Date(s) of Tests	:	Sept. 26, 2021 to December 1, 2021
Date of issue	:	December 1, 2021

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1 TEST RESULT CERTIFICATION

Applicant	:	Shenzhen Jimi IoT Co., Ltd.
Address	:	3-4/F, Block A, Building #7, Shenzhen International Innovation Valley, Dashi 1st Road, Nanshan District, Shenzhen, Guangdong, China
Manufacturer	:	Shenzhen Jimi IoT Co., Ltd.
Address	:	3-4/F, Block A, Building #7, Shenzhen International Innovation Valley, Dashi 1st Road, Nanshan District, Shenzhen, Guangdong, China
EUT/Product Name	:	LTE CAT1 ASSET GNSS TRACKER
EUT/Product Model	:	LL301, LL301L, LL301E
Trademark	:	JIMI

Measurement Procedure Used:

APPLICABLE STANDARDS	
STANDARD	**TEST RESULT**
FCC 47 CFR Part 2, Subpart J FCC 47 CFR Part 22, Subpart H FCC 47 CFR Part 24, Subpart E	**PASS**

The device described above is tested by EMTEK (Shenzhen) Co., Ltd. to determine the maximum emission levels emanating from the device and the severe levels of the device can endure and its performance criterion. The measurement results are contained in this test report and EMTEK (Shenzhen) Co., Ltd. is assumed full of responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT (Equipment Under Test) is technically compliant with the part 2 ,part 22 and part 24 requirements.

This report applies to above tested sample only and shall not be reproduced in part without written approval of EMTEK (Shenzhen) Co., Ltd.

Date of Test : Sept. 26, 2021 to December 1, 2021

Prepared by : Yu Xiaolan/Editor

Reviewer : Joe Xia/Supervisor

Approve & Authorized Signer : Lisa Wang/Manager

EMTEK (SHENZHEN) CO., LTD. TESTING

2 EUT TECHNICAL DESCRIPTION

Product:	LTE CAT1 ASSET GNSS TRACKER
Model Number:	LL301, LL301L, LL301E (The product is the same, only the name is different. LL301 is the main model of the product, LL301L is sold to North America for model identification, LL301E is sold to Europe for model identification)
Sample Number:	2#
Support Networks:	GPRS
Support Bands:	GSM850,PCS1900
Frequency Range:	Uplink Frequency: GSM/GPRS 850: 824~849MHz GSM/GPRS 1900: 1850~1910MHz
	Downlink Frequency: GSM/GPRS 850: 869~894MHz GSM/GPRS 1900: 1930~1990MHz
Modulation Mode:	GMSK
GPRS Class:	Class 12
RF Power:	GSM 900:32.24dBm DCS 1800: 28.76dBm
Type of Antenna:	External Antenna
Antenna Gain:	GSM900：-3.0dBi DCS1800：-2.5dBi
Power supply	DC 3.7V from battery DC 5V from Adapter
Temperature Extreme Range:	-20°C ~ +70°C

Note: *for more details, please refer to the User's manual of the EUT.*

3 SUMMARY OF TEST RESULT

FCC Rule	Test Parameter	Verdict	Remark
2.1046 22.913 (a), 24.232 (c)	RF Power Output	PASS	
2.1049 22.917 (b), 24.238 (b)	Occupied Bandwidth	PASS	
2.1051, 22.917, 24.238, 27.53	Spurious Emissions at Antenna Terminal	PASS	
2.1053, 22.917, 24.238, 27.53	Field Strength of Spurious Radiation	PASS	
22.917 (a), 24.238 (a)	Out of Band Emissions	PASS	
2.1055, 22.355, 24.235, 27.54	Frequency Stability	PASS	
24.232, 27.50	Peak-to-average Ratio (PAR) of Transmitter	PASS	
NOTE: N/A :means not applicable			

RELATED SUBMITTAL(S) / GRANT(S):

This submittal(s) (test report) is intended for FCC ID: 2AMLFJM-LL301L filing to comply with FCC 47 CFR Part 2, 22(H), 24(E),

4 TEST METHODOLOGY

4.1 GENERAL DESCRIPTION OF APPLIED STANDARDS

According to its specifications, the EUT must comply with the requirements of the following standards:
FCC 47 CFR Part 2, Subpart J
FCC 47 CFR Part 22, Subpart H
FCC 47 CFR Part 24, Subpart E
KDB971168 D01: V03r01
ANSI/TIA-603-E-2016
ANSI C63.26:2015

4.2 MEASUREMENT EQUIPMENT USED

For Spurious Emissions Test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
EMI Test Receiver	Rohde & Schwarz	ESU 26	100154	2021/5/15	1 Year
Pre-Amplifie	Lunar EM	LNA30M3G-25	J10100000070	2021/5/15	1 Year
Bilog Antenna	Schwarzbeck	VULB9163	659	2021/8/22	2 Year
Horn antenna	Schwarzbeck	BBHA9120D	9120D-1177	2020/7/4	2 Year
Pre-Amplifie	SKET	LNPA_0118G-45	SK2019051801	2021/5/15	1 Year
Loop Antenna	Schwarzbeck	FMZB1519	1519-012	2021/6/12	2 Year
Spectrum Analyzer	Rohde & Schwarz	FSV40	100967	2021/5/15	1 Year
Horn antenna	Schwarzbeck	BBHA9120D	9120D-1178	2020/7/4	2 Year
Bilog Antenna	Schwarzbeck	VULB9163	660	2021/6/12	2 Year
Cable	H+B	NmSm-05-C15052	N/A	2021/5/15	1 Year
Cable	H+B	NmSm-2-C15201	N/A	2021/5/15	1 Year
Cable	H+B	NmNm-7-C15702	N/A	2021/5/15	1 Year
Cable	H+B	SAC-40G-1	414	2021/5/15	1 Year
Cable	H+B	SUCOFLEX104	MY14871/4	2021/5/15	
Cable	H+B	BLU18A-NmSm-6500	D8501	2021/5/15	1 Year
Band reject Filter(50dB)	WI/DE	WRCGV-2400(2400-2485MHz)	2	2021/5/15	1 Year

For other test items:

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
Vector Signal Generater	Agilent	N5182B	My53050553	2021/5/15	1 Year
Analog Signal Generator	Agilent	N5171B	My53050878	2021/5/15	1 Year
Signal Analyzer	Agilent	N9010A	My53470879	2021/5/16	1 Year
Power Analyzer	Agilent	PS-X10-200	N/A	2021/5/15	1 Year
Wideband Radio Communication Tester	R&S	CMW500	1201.0002K50-140822zk	2021/5/15	1 Year
Test Accessories	Agilent	PS-X10-100	N/A	2021/5/15	1 Year
Temperature&Humidity test chamber	ESPEC	EL-02KA	12107166	2021/7/3	1 Year
Blocking Box	Agilent	AD211	N/A	2021/5/15	1 Year

4.3 DESCRIPTION OF TEST MODES

The EUT has been tested under its typical operating condition. The CMW500 used to control the EUT staying in continuous transmitting and receiving mode for testing.

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

During all testing, EUT is in link mode with base station emulator at maximum power level.

The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

Test of channel included the lowest and middle and highest frequency to perform the test, then record on this report.

Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Test Mode List		
Test Mode	Description	Remark
TM1	GPRS 850	Low, Middle, High Channels
TM2	GPRS 1900	Low, Middle, High Channels

Testing Configure			
Support Band	Support Standard	Channel Frequency	Channel Number
GSM 850	GPRS	824.2 MHz	128
		836.6 MHz	190
		848.8 MHz	251
PCS 1900	GPRS	1850.2 MHz	512
		1880.0 MHz	661
		1909.8 MHz	810
Note: the transmitter has been tested on the communications mode of GPRS compliance test and record the worst case.			

■ Test Environment

Environment Parameter	Selected Values During Tests	
Relative Humidity	Ambient	
Temperature	TN	Ambient
Ambient	VL	DC4.5V
	VN	DC 5.0V
	VH	DC 5.5V
NOTE: VL= Lower Extreme Test Voltage VN= Nominal Voltage VH= Upper Extreme Test Voltage TN= Normal Temperature		

5 FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

Building 69, Majialong Industry Zone District, Nanshan District, Shenzhen, China
The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.26 and CISPR Publication 22.

5.2 LABORATORY ACCREDITATIONS AND LISTINGS

Site Description EMC Lab.	:	**Accredited by CNAS** The Certificate Registration Number is L2291. The Laboratory has been assessed and proved to be in compliance with CNAS-CL01 (identical to ISO/IEC 17025:2017) **Accredited by FCC** Designation Number: CN1204 Test Firm Registration Number: 882943 **Accredited by A2LA** The Certificate Number is 4321.01. **Accredited by Industry Canada** The Conformity Assessment Body Identifier is CN0008
Name of Firm	:	EMTEK (SHENZHEN) CO., LTD.
Site Location	:	Building 69, Majialong Industry Zone, Nanshan District, Shenzhen, Guangdong, China

6 TEST SYSTEM UNCERTAINTY

The following measurement uncertainty levels have been estimated for tests performed on the apparatus:

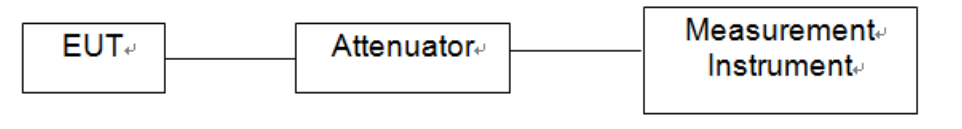
Parameter	Uncertainty
Radio Frequency	±1x10^-5
RF Power Output	±1.0dB
Radiated Emission Test	±2.0dB
Occupied Bandwidth Test	±1.0dB
Band Edge Test	±3dB
All emission, radiated	±3dB
Antenna Port Emission	±3dB
Temperature	±0.5℃
Humidity	±3%

Measurement Uncertainty for a level of Confidence of 95%

7 SETUP OF EQUIPMENT UNDER TEST

7.1 RADIO FREQUENCY TEST SETUP 1

The component's antenna ports(s) of the EUT are connected to the measurement instrument per an appropriate attenuator. The EUT is controlled by PC/software to emit the specified signals for the purpose of measurements.



7.2 RADIO FREQUENCY TEST SETUP 2

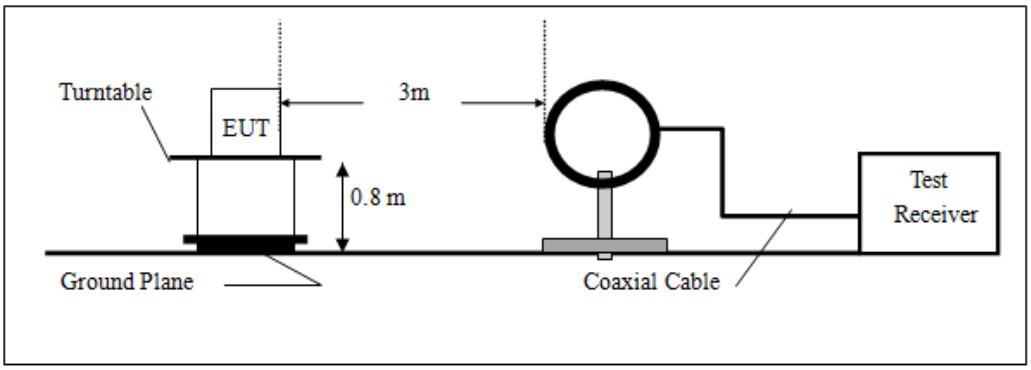
The test site semi-anechoic chamber has met the requirement of NSA tolerance 4 dB according to the standards: ANSI C63.10. The test distance is 3m.The setup is according to the requirements in Section 13.1.4.1 of ANSI C63.26-2015 and CAN/CSA-CEI/IEC CISPR 32.

Below 30MHz：
The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna (loop antenna). The Antenna should be positioned with its plane vertical at the specified distance from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. The center of the loop shall be 1 m above the ground. For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT.

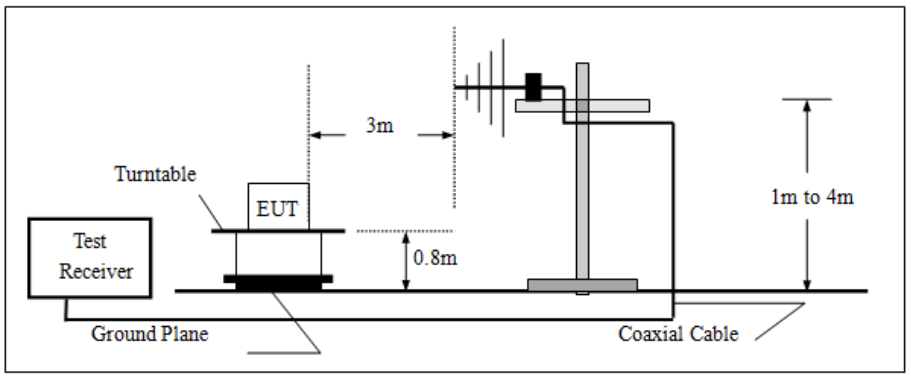
Above 30MHz：
The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

Above 1GHz:
(Note: the FCC's permission to use 1.5m as an alternative per TCBC Conf call of Dec. 2, 2014.)
The EUT is placed on a turntable 1.5 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

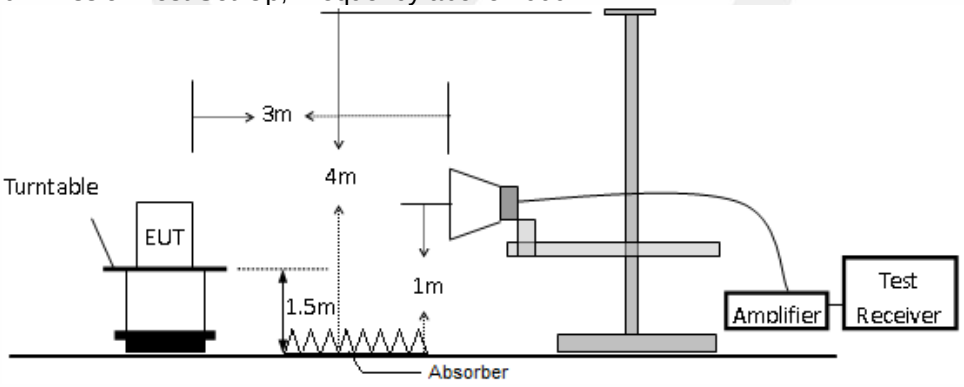
(a) Radiated Emission Test Set-Up, Frequency Below 30MHz



(b)Radiated Emission Test Set-Up, Frequency Below 1000MHz



(c) Radiated Emission Test Set-Up, Frequency above 1000MHz



7.3 SUPPORT EQUIPMENT

EUT Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Auxiliary Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
/	/	/	/

Notes:

1. *All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.*
2. *Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.*
3. *Unless otherwise denoted as EUT in『Remark』column , device(s) used in tested system is a support equipment*

8 TEST REQUIREMENTS

8.1 RF POWER OUTPUT

8.1.1 Conformance Limit

According to §22.913(a)(5), The ERP of mobile and portable stations transmitters and auxiliary test transmitters must not exceed 7 Watts.

According to §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.

According to §27.50(d)(4), Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP.

8.1.2 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

8.1.3 Test Procedure

Connect the EUT to Universal Radio Communication Tester CMU500 via the antenna connector. A call is set up by the SS according to the generic call set up procedure on a channel with ARFCN in the ARFCN range, power control level set to Max power. The frequency band is set as selected frequency,

The RF output of the transmitter was connected to base station simulator.
Set EUT at maximum average power by base station simulator.
Set RBW = 1-5% of the OBW, not to exceed 1 MHz.
Set VBW ≥ 3 × RBW.
Number of points in sweep ≥ 2 × span / RBW. (This gives bin-to-bin spacing ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
Sweep time = auto.
Detector = RMS (power averaging).
Set sweep trigger to “free run”.
Trace average at least 100 traces in power averaging (i.e., RMS) mode; however, the number of traces to be averaged shall be increased above 100 as needed such that the average accurately represents the true average over the on and off periods of the transmitter.
Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band power measurement function with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.
Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission). For example, add 10 log (1/0.25) = 6 dB if the duty cycle is a constant 25%.
Measure lowest, middle, and highest channels for each bandwidth and different modulation.
Measure and record the results in the test report.

8.1.4 Test Results

PASS

Please refer to the Appendix GSM 850 and DCS1900

8.2 EFFECTIVE (ISOTROPIC) RADIATED POWER

8.2.1 Conformance Limit

For FCC Part 22.913
Extend coverage on a secondary basis into cellular unserved areas, as those areas are defined in §22.949, the ERP of base transmitters and cellular repeaters of such systems must not exceed 1000 Watts. The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.
For FCC Part 24.232
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.
For FCC Part 27.50
Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP. Fixed stations operating in the 1710-1755 MHz band are limited to a maximum antenna height of 10 meters above ground. Mobile and portable stations operating in these bands must employ a means for limiting power to the minimum necessary for successful communications.

8.2.2 Test Configuration

Test according to clause 7.3 radio frequency test setup 3

8.2.3 Test Procedure

Connect the EUT to Universal Radio Communication Tester CMU500 via the antenna connector. A call is set up by the SS according to the generic call set up procedure on a channel with ARFCN in the Mid ARFCN range, power control level set to Max power. MS TXPWR_MAX_CCH is set to the maximum value supported by the Power Class of the Mobile under test
The instrument must have an available measurement/resolution bandwidth that is equal to or exceeds the OBW. If this capability is available, then the following procedure can be used to determine the total peak output power.

a) Set the RBW ≥ OBW.
b) Set VBW ≥ 3 × RBW.
c) Set span ≥ 2 × RBW
d) Sweep time = auto couple.
e) Detector = peak.
f) Ensure that the number of measurement points ≥ span/RBW.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the peak amplitude level.

The EUT was placed on a turn table which is 0.8m above ground plane.Maximum procedure was performed on the six highest emissions to ensure EUT compliance.And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.Repeat above procedures until all frequency measured was complete.
A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The height of receiving antenna is 1.5m. The test setup refers to figure below. Detected emissions were maximized at each frequency by rotating the EUTthrough 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all transmit frequencies in three channels (High, Middle, Low) weremeasured with peak detector.
The EUT is then put into continuously transmitting mode at its maximum power level during the test. And the maximum value of the receiver should be recorded as (Pr).
The EUT shall be replaced by a substitution antenna. The test setup refers to figure below. In the chamber, an substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (PMea) is applied to the input of the substitution antenna, and adjust the level of the signal generator output until the value of the receiver reach the previously recorded (Pr). The power of signal source

(PMea) is recorded. The test should be performed by rotating the test item and adjusting the receiving antennapolarization.
A amplifier should be connected to the Signal Source output port. And the cable should be connect between the Amplifier and the Substitution Antenna.
The cable loss (Pcl) ,the Substitution Antenna Gain (Ga) and the Amplifier Gain (PAg) should be recorded after test.
The measurement results are obtained as described below:
Power(EIRP)=PMea- PAg - Pcl - Ga
This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power.
ERP can be calculated from EIRP by subtracting the gain of the dipole,
ERP = EIRP -2.15dBi.

8.2.4 Test Results

Pass

For GPRS Mode GSM850

Frequency (MHz)	Antenna Polarization	RBW (kHz)	ERP (dBm)	Limit (dBm)	Over (dB)	Verdict
Low Channel						
824.4	H	100	29.27	38.45	-9.18	PASS
824.4	V	100	30.11	38.45	-8.34	PASS
Middle Channel						
836.8	H	100	28.55	38.45	-9.9	PASS
836.8	V	100	30.46	38.45	-7.99	PASS
High Channel						
848.7	H	100	29.49	38.45	-8.96	PASS
848.7	V	100	30.59	38.45	-7.86	PASS

Note: (1) Emission Level= Reading Level+ Correct Factor +Cable Loss.
(2) Correct Factor= Ant_F + Cab_L - Preamp
(3) Data of measurement within this frequency range shown " -- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

For GPRS Mode PCS1900

Frequency (MHz)	Antenna Polarization	RBW (kHz)	EIRP (dBm)	Limit (dBm)	Over (dB)	Verdict
Low Channel						
1850.3	H	100	26.27	33	-6.73	PASS
1850.3	V	100	27.15	33	-5.85	PASS
Middle Channel						
1880.0	H	100	26.15	33	-6.85	PASS
1880.0	V	100	26.98	33	-6.02	PASS
High Channel						
1909.8	H	100	26.69	33	-6.31	PASS
1909.8	V	100	27.22	33	-5.78	PASS

Note: (1) Emission Level= Reading Level+ Correct Factor +Cable Loss.
(2) Correct Factor= Ant_F + Cab_L - Preamp
(3) Data of measurement within this frequency range shown " -- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

8.3 OCCUPIED BANDWIDTH

8.3.1 Conformance Limit

According to §22.917(b), 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.

According to §24.238(b), 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.

According to §27.53, 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.

8.3.2 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

8.3.3 Test Procedure

Connect the EUT to Universal Radio Communication Tester CMU200 or CMU500 via the antenna connector. A call is set up by the SS according to the generic call set up procedure on a channel with ARFCN in the Mid ARFCN range, power control level set to Max power. MS TXPWR_MAX_CCH is set to the maximum value supported by the Power Class of the Mobile under test,

■ 99% Occupied bandwidth

The following procedure shall be used for measuring (99 %) 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 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) Set the detection mode to peak, and the trace mode to max hold..

f) Use the 99 % power bandwidth function of the spectrum analyzer (if available) and report the measured bandwidth.

g) 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) 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).

■ 26 dB Occupied bandwidth

The reference value is the highest level of the spectral envelope of the modulated signal.

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be between two and five times the anticipated OBW.

b) The nominal resolution bandwidth (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 prevent 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) The dynamic range of the spectrum analyzer at the selected RBW shall be at least 10 dB below the target “-X dB down” requirement (i.e., if the requirement calls for measuring the –26 dB OBW, the spectrum analyzer noise floor at the selected RBW shall be at least 36 dB below the reference value).
f) Set the detection mode to peak, and the trace mode to max hold.
g) 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).
h) 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.
i) 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 the “–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.
j) The occupied bandwidth 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)

8.3.4 Test Results

PASS

Please refer to the Appendix GSM 850 and DCS1900

8.4 BAND EDGE EMISSION

8.4.1 Conformance Limit

According to §22.917(a), the power of any emissions 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.

According to §24.238(a), the power of any emissions 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.

According to §27.53 (h), the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

8.4.2 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

8.4.3 Test Procedure

Connect the EUT to Universal Radio Communication Tester CMU200 or CMU500 via the antenna connector. A call is set up by the SS according to the generic call set up procedure on a channel with ARFCN in the Mid ARFCN range, power control level set to Max power. MS TXPWR_MAX_CCH is set to the maximum value supported by the Power Class of the Mobile under test,

Spectrum Analyzer is set as below:
SET RBW ≥ 1% of Emission BW.
SET VBW about three times of RBW
Detector: RMS
Trace mode= max hold.
Span= 2MHz

8.4.4 Test Results

PASS

Please refer to the Appendix GSM 850 and DCS1900

8.5 OUT OF BAND EMISSIONS AT ANTENNA TERMINAL

8.5.1 Conformance Limit

For FCC Part 22.917
Out of band emissions. 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.
For FCC Part 24.238
Out of band emissions. 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.
For FCC Part 27.53
Out of band emissions. 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.

The specification that emissions shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, translates in the relevant power range (1 to 0.001 W) to -13 dBm. At 1 W the specified minimum attenuation becomes 43 dB and relative to a 30 dBm (1 W) carrier becomes a limit of -13 dBm. At 0.001 W (0 dBm) the minimum attenuation is 13 dB, which again yields a limit of -13 dBm. In this way a translation of the specification from relative to absolute terms is carried out.

8.5.2 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

8.5.3 Test Procedure

The transmitter output (antenna port) was connected to the spectrum analyzer
Connect the EUT to Universal Radio Communication Tester CMU200 or CMU500 via the antenna connector. A call is set up by the SS according to the generic call set up procedure on a channel with ARFCN in the Mid ARFCN range, power control level set to Max power. MS TXPWR_MAX_CCH is set to the maximum value supported by the Power Class of the Mobile under test,

Spectrum Analyzer is set as below:
9kHz~150kHz, RBW = 1KHz, VBW ≥ 3×RBW,
150kHz~30MHz, RBW = 10KHz, VBW ≥ 3×RBW,
30MHz~1GHz, RBW = 100 kHz, VBW = 300 kHz. Above 1GHz, RBW = 1 MHz, VBW = 3 MHz.
Detector: Peak
Trace mode= max hold.

8.5.4 Test Results

PASS

Please refer to the Appendix GSM 850 and DCS1900

8.6 FIELD STRENGTH OF SPURIOUS RADIATION

8.6.1 Conformance Limit

For FCC Part 22.917
Out of band emissions. 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.
For FCC Part 24.238
Out of band emissions. 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.
For FCC Part 27.53
Out of band emissions. 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.

The specification that emissions shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, translates in the relevant power range (1 to 0.001 W) to -13 dBm. At 1 W the specified minimum attenuation becomes 43 dB and relative to a 30 dBm (1 W) carrier becomes a limit of -13 dBm. At 0.001 W (0 dBm) the minimum attenuation is 13 dB, which again yields a limit of -13 dBm. In this way a translation of the specification from relative to absolute terms is carried out.

8.6.2 Test Configuration

Test according to clause 7.3 radio frequency test setup 3

8.6.3 Test Procedure

Connect the EUT to Universal Radio Communication Tester CMU500 via the antenna connector. A call is set up by the SS according to the generic call set up procedure on a channel with ARFCN in the Mid ARFCN range, power control level set to Max power. MS TXPWR_MAX_CCH is set to the maximum value supported by the Power Class of the Mobile under test.

Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. 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. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 100 kHz or 1 percent of emission bandwidth, as specified). 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.

then the following procedure can be used to determine spurious emission

a) RBW = 1 MHz for f ≥ 1 GHz(1GHz to 25GHz), 100 kHz for f < 1 GHz(30MHz to 1GHz), 200Hz for f<150KHz(9KHz to 150KHz), 9KHz for f<30MHz(150KHz to 30KHz)
b) Set VBW ≥ 3 × RBW.
c) Set span wide enough to fully capture the emission being measured
d) Sweep time = auto couple.
e) Detector = peak.
f) Ensure that the number of measurement points ≥ span/RBW.
g) Trace mode = max hold.

h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the peak amplitude level.

Step1. The EUT was placed on a rotatable wooden table with 0.8 meter above ground.

Step2. The EUT was set 3 meters from the receiving antenna, which was mounted on the antenna tower.

Step3. The table was rotated 360 degrees to determine the position of the highest spurious emission.

Step4. 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.

Step5. Make the measurement with the spectrum analyzer's RBW , VBW , taking the record of maximum spurious emission.

Step6. A horn antenna was substituted in place of the EUT and was driven by a signal generator.

Step7. Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.

Step8. Taking the record of output power at antenna port.

Step9. Repeat step 7 to step 8 for another polarization.

Step10. Emission level (dBm) = output power + substitution Gain.Test Results

8.6.4 Test Results

PASS

■ Spurious Emission below 30MHz (9KHz to 30MHz)

Temperature:	23.7℃	Test By:	XW
Humidity:	53 %	Test Mode:	Middle Channel

Freq. (MHz)	H/V	Bandwidth (MHz)	Test RB	Emission Level(dBm)	Limit (dBm)	Margin (dBm)	Verdict
--	--	--	--	--	--	--	--

Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

■ Spurious Emission Above 30MHz (30MHz to 1 GHz)

Radiated Spurious Emission emitted by the MS allocated a channel for GSM850

Temperature: 23.7℃ Mode GPRS
Humidity: 53% Test Mode: ARFCN
Air Pressure 106kPa Traffic Channel: ☐CH128 ☒CH190 ☐ CH251

Frequency (MHz)	Antenna Polarization	RBW (kHz)	Emission level (dBm)	Limit (dBm)	Over (dB)	Verdict
52.7600	V	100	-66.06	-13.00	-53.06	PASS
64.2074	V	100	-67.25	-13.00	-54.25	PASS
189.7385	V	100	-75.04	-13.00	-62.04	PASS
432.5457	V	100	-69.57	-13.00	-56.57	PASS
744.8661	V	100	-63.34	-13.00	-50.34	PASS
972.3374	V	100	-57.92	-13.00	-44.92	PASS
45.3755	H	100	-72.75	-13.00	-59.75	PASS
53.1313	H	100	-72.39	-13.00	-59.39	PASS
63.3132	H	100	-74.39	-13.00	-61.39	PASS
277.0935	H	100	-80.07	-13.00	-67.07	PASS
535.7073	H	100	-75.94	-13.00	-62.94	PASS
996.4996	H	100	-63.70	-13.00	-50.70	PASS

Radiated Spurious Emission emitted by the MS allocated a channel for GSM1900

Temperature: 23.7℃ Mode GPRS
Humidity: 53% Test Mode: ARFCN
Air Pressure 106kPa Traffic Channel: ☐CH512 ☒CH661 ☐ CH810

Frequency (MHz)	Antenna Polarization	RBW (kHz)	Emission level (dBm)	Limit (dBm)	Over (dB)	Verdict
52.7600	V	100	-71.04	-13.00	-58.04	PASS
104.1701	V	100	-77.66	-13.00	-64.66	PASS
155.9101	V	100	-74.16	-13.00	-61.16	PASS
216.0240	V	100	-75.11	-13.00	-62.11	PASS
854.0247	V	100	-66.45	-13.00	-53.45	PASS
996.4996	V	100	-63.16	-13.00	-50.16	PASS
52.5753	H	100	-70.93	-13.00	-57.93	PASS
63.0916	H	100	-73.61	-13.00	-60.61	PASS
178.7584	H	100	-81.79	-13.00	-68.79	PASS
396.2415	H	100	-76.87	-13.00	-63.87	PASS
706.7000	H	100	-71.88	-13.00	-58.88	PASS
979.1804	H	100	-63.07	-13.00	-50.07	PASS

Note: (1) Emission Level= Reading Level+ Correct Factor +Cable Loss.
(2) Correct Factor= Ant_F + Cab_L - Preamp
(3) Data of measurement within this frequency range shown " -- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

■ Spurious Emission Above 1GHz (1GHz to 10th harmonics)

Radiated Spurious Emission emitted by the MS allocated a channel for GSM850

Temperature:	23.7℃	Mode	GPRS
Humidity:	53%	Test Mode:	ARFCN
Air Pressure	106kPa	Traffic Channel:	☐CH128 ☒CH190 ☐ CH251

Frequency (MHz)	Antenna Polarization	RBW (kHz)	Emission level (dBm)	Limit (dBm)	Over (dB)	Verdict
2499.893	V	1000	-46.52	-13.00	-33.52	PASS
4482.150	V	1000	-43.80	-13.00	-30.80	PASS
7015.420	V	1000	-48.35	-13.00	-35.35	PASS
11566.86	V	1000	-36.79	-13.00	-23.79	PASS
14325.37	V	1000	-38.30	-13.00	-25.30	PASS
18000	V	1000	-32.81	-13.00	-19.81	PASS
2400.753	H	1000	-48.27	-13.00	-35.27	PASS
4482.150	H	1000	-47.62	-13.00	-34.62	PASS
6267.553	H	1000	-49.05	-13.00	-36.05	PASS
10822.92	H	1000	-39.59	-13.00	-26.59	PASS
12114.35	H	1000	-38.43	-13.00	-25.43	PASS
18000	H	1000	-32.27	-13.00	-19.27	PASS

Radiated Spurious Emission emitted by the MS allocated a channel for GSM1900

Temperature:	23.7℃	Mode	GPRS
Humidity:	53%	Test Mode:	ARFCN
Air Pressure	106kPa	Traffic Channel:	☐CH512 ☒CH661 ☐ CH810

Frequency (MHz)	Antenna Polarization	RBW (kHz)	Emission level (dBm)	Limit (dBm)	Over (dB)	Verdict
4482.150	V	1000	-47.69	-13.00	-34.69	PASS
9258.909	V	1000	-40.95	-13.00	-27.95	PASS
10917.17	V	1000	-40.00	-13.00	-27.00	PASS
13917.24	V	1000	-38.74	-13.00	-25.74	PASS
14916.94	V	1000	-37.75	-13.00	-24.75	PASS
18000	V	1000	-32.14	-13.00	-19.14	PASS
2499.893	H	1000	-47.90	-13.00	-34.90	PASS
4495.124	H	1000	-47.01	-13.00	-34.01	PASS
7606.788	H	1000	-43.74	-13.00	-30.74	PASS
10885.66	H	1000	-39.76	-13.00	-26.76	PASS
14366.84	H	1000	-37.28	-13.00	-24.28	PASS
18000	H	1000	-32.27	-13.00	-19.27	PASS

Note: (1) Emission Level= Reading Level+ Correct Factor +Cable Loss.
(2) Correct Factor= Ant_F + Cab_L - Preamp
(3) Data of measurement within this frequency range shown " -- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

8.7 FREQUENCY STABILITY

8.7.1 Conformance Limit

According to §22.355, the carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in Table below:

Frequency Tolerance for Cellular Band

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

According to §24.235, the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

According to §27.54 The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

8.7.2 Test Configuration

Test according to clause 7.2 conducted emission test setup2.

8.7.3 Test Procedure

Connect the EUT to Universal Radio Communication Tester CMU500 via the antenna connector. A call is set up by the SS according to the generic call set up procedure on a channel with ARFCN in the ARFCN range, power control level set to Max power. MS TXPWR_MAX_CCH is set to the maximum value supported by the Power Class of the Mobile under test.
EUT was placed at temperature chamber and connected to an external power supply.
Temperature and voltage condition shall be tested to confirm frequency stability.
(a) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short-term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.
(b) The frequency stability shall be measured with variation of primary supply voltage as follows:
(1) Vary primary supply voltage from 95 to 105 percent of the nominal value for other than hand carried battery equipment.
(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point, which shall be specified by the manufacturer.

8.7.4 Test Results

PASS

Please refer to the Appendix GSM 850 and DCS1900

8.8 PEAK-TO-AVERAGE RATIO (PAR) OF TRANSMITTER

8.8.1 Conformance Limit

For FCC Part 24.232
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 paragraph (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.
For FCC Part 27.50
Equipment employed must be authorized in accordance with the provisions of §24.51. 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 paragraph (d)(6) of this section. 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.

8.8.2 Test Configuration

Test according to clause 7.1 conducted emission test setup1.

8.8.3 Test Procedure

The EUT was connected to Spectrum Analyzer and Base Station via power divider.
The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
Set the number of counts to a value that stabilizes the measured CCDF curve.
Set the measurement interval to 1 ms.
Record the maximum PAPR level associated with a probability of 0.1%.
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%.

8.8.4 Test Results

PASS

Please refer to the Appendix GSM 850 and DCS1900

Detail of factor for radiated emission

Frequency(MHz)	Ant_F(dB)	Cab_L(dB)	Preamp(dB)	Correct Factor(dB)
0.009	20.6	0.03	\	20.63
0.15	20.7	0.1	\	20.8
1	20.9	0.15	\	21.05
10	20.1	0.28	\	20.38
30	18.8	0.45	\	19.25
30	11.7	0.62	27.9	-15.58
100	12.5	1.02	27.8	-14.28
300	12.9	1.91	27.5	-12.69
600	19.2	2.92	27	-4.88
800	21.1	3.54	26.6	-1.96
1000	22.3	4.17	26.2	0.27
1000	25.6	1.76	41.4	-14.04
3000	28.9	3.27	43.2	-11.03
5000	31.1	4.2	44.6	-9.3
8000	36.2	5.95	44.7	-2.55
10000	38.4	6.3	43.9	0.8
12000	38.5	7.14	42.3	3.34
15000	40.2	8.15	41.4	6.95
18000	45.4	9.02	41.3	13.12
18000	37.9	1.81	47.9	-8.19
21000	37.9	1.95	48.7	-8.85
25000	39.3	2.01	42.8	-1.49
28000	39.6	2.16	46.0	-4.24
31000	41.2	2.24	44.5	-1.06
34000	41.5	2.29	46.6	-2.81
37000	43.8	2.30	46.4	-0.3
40000	43.2	2.50	42.2	3.5

END OF REPORT