



TESTING LABORATORY
CERTIFICATE #4820.01



FCC PART 22H, PART 24E MEASUREMENT AND TEST REPORT

For

WTS Positioning Solutions AB

Wallingatan 18, Stockholm, Sweden, 111 24

FCC ID: 2AR8M-TRAX2G

| | |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Report Type: Original Report | Product Type: Trax G+ |
| Report Number: RDG180906012-00B | |
| Report Date: 2018-12-24 | |
| Reviewed By: | Jerry Zhang EMC Manager |
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

| | |
|----------------------------------------------|---------------------------------------------------------------------------------------------|
| EUT Name: | Trax G+ |
| EUT Model: | Trax 2.5 |
| Operation modes: | GPRS Data |
| Operation Frequency: | GSM 850: 824-849 MHz(TX); 869-894 MHz(RX) PCS 1900: 1850-1910 MHz(TX); 1930-1990 MHz(RX) |
| Maximum Output Power: (Conducted) | GSM 850 : 31.22 dBm; PCS 1900: 29.01 dBm |
| Modulation Type: | GMSK |
| Rated Input Voltage: | DC 3.7V from battery or Charged by wireless charger |
| External Dimension: | 55mm(L)*38mm(W)*10.7mm(H) |

Objective

This report is prepared on behalf of *WTS Positioning Solutions AB* in accordance with: Part 2-Subpart J, Part 22-Subpart H, and Part 24-Subpart E of the Federal Communications Commission's rules.

The objective is to determine compliance with FCC Rules for output power, modulation characteristic, occupied bandwidth, spurious emissions at antenna terminal, spurious radiated emission, frequency stability and band edge.

Related Submittal(s)/Grant(s)

FCC Part 15C DTS submissions with FCC ID: 2AR8M-TRAX2G.

Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of Federal Regulations Title 47 Part 2, Sub-part J as well as the following parts:

Part 22 Subpart H - Public Mobile Services
Part 24 Subpart E - Personal Communication Services

Applicable Standards: TIA/EIA 603-D-2010.

All radiated and conducted emissions measurements were performed at Bay Area Compliance Laboratories Corp.(Dongguan).

Measurement Uncertainty

| Parameter | Measurement Uncertainty |
|-------------------------------|----------------------------------------------|
| Occupied Channel Bandwidth | ±5 % |
| RF output power, conducted | ±0.61dB |
| Unwanted Emissions, radiated | 30MHz ~ 1GHz: 5.85 dB 1G~26.5GHz: 5.23 dB |
| Unwanted Emissions, conducted | ±1.5 dB |
| Temperature | ±1 °C |
| Humidity | ±5% |
| DC and low frequency voltages | ±0.4% |
| Duty Cycle | 1% |

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 897218, the FCC Designation No. : CN1220.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0022.

SYSTEM TEST CONFIGURATION

Justification

The EUT was configured for testing according to TIA/EIA-603-D 2010.

The test items were performed with the EUT operating at testing mode. This device only supports GPRS mode.

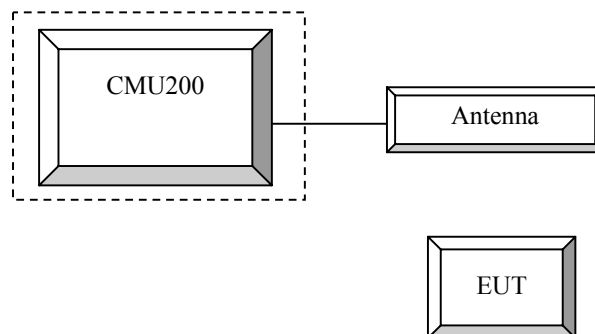
Equipment Modifications

No modification was made to the EUT.

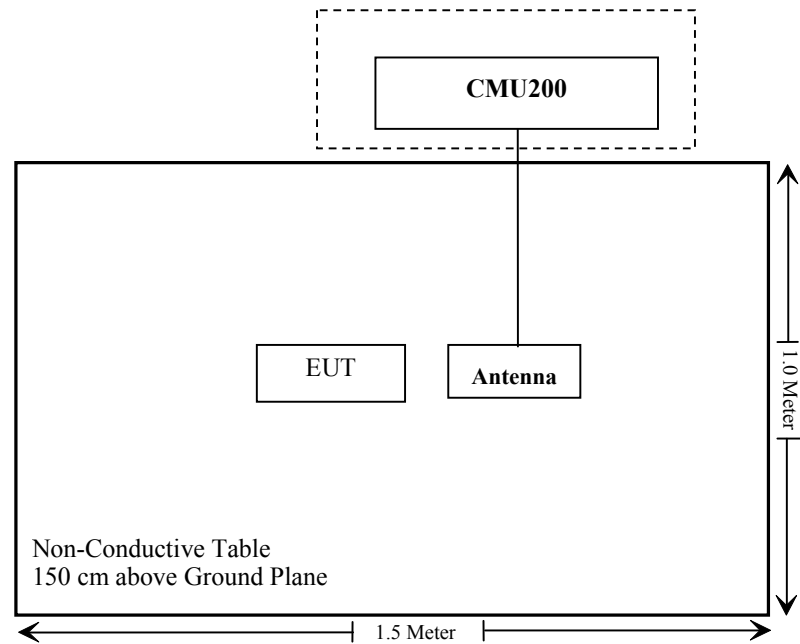
Support Equipment List and Details

| Manufacturer | Description | Model | Serial Number |
|--------------|--------------------------------------|----------|---------------|
| R&S | Universal Radio Communication Tester | CMU200 | 109038 |
| Un-Known | ANTENNA | Un-Known | Un-Known |

Configuration of Test Setup



Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

| FCC Rules | Description of Test | Result |
|------------------------------------------|------------------------------------------------------------------------|----------------|
| §1.1310, §2.1093 | RF Exposure | Compliance |
| §2.1046; § 22.913 (a); § 24.232 (c); | RF Output Power | Compliance |
| § 2.1047 | Modulation Characteristics | Not Applicable |
| § 2.1049; § 22.905 § 22.917; § 24.238 | Occupied Bandwidth | Compliance |
| § 2.1051, § 22.917 (a); § 24.238 (a) | Spurious Emissions at Antenna Terminal | Compliance |
| § 2.1053 § 22.917 (a); § 24.238 (a) | Spurious Radiation Emissions | Compliance |
| § 22.917 (a); § 24.238 (a) | Out of band emission, Band Edge | Compliance |
| § 2.1055 § 22.355; § 24.235 | Frequency stability vs. temperature Frequency stability vs. voltage | Compliance |

FCC §1.1310 & §2.1093- RF EXPOSURE

Applicable Standard

According to §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB447498 D01 General RF Exposure Guidance v06:

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f}(\text{GHz})]$
 ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- $f(\text{GHz})$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

When an antenna qualifies for the standalone SAR test exclusion of 4.3.1 and also transmits simultaneously with other antennas, the standalone SAR value must be estimated according to the following to determine the simultaneous transmission SAR test exclusion criteria: $[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f}(\text{GHz})/x]$ W/kg, for test separation distances ≤ 50 mm; where $x = 7.5$ for 1-g SAR and $x = 18.75$ for 10-g SAR.

Measurement Result

| Operation modes | Frequency (MHz) | Maximum Peak Power (dBm) | Duty Cycle (%) | Time based average Power (mW) | Separated distance from user (mm) | Calculated value | Exempt from Test? (Yes/No) |
|-----------------|-----------------|--------------------------|----------------|-------------------------------|-----------------------------------|------------------|----------------------------|
| GSM 850 | 824-849 | 32 | 0.175 | 2.77 | 0 | 0.5 | Yes |
| PCS 1900 | 1850-1910 | 30 | 0.175 | 1.75 | 0 | 0.5 | Yes |
| BLE | 2402-2480 | 4 | 100 | 2.51 | 0 | 0.8 | Yes |

The maximum transmission rate when active is once every 10 second and the data consist of 140bytes. At the lowest data rate 8 kbit/s every transmission will last for less than 0,0175s with a resulting dutycycle of <0.175%. Please refer to the attention letter for more detail.

WWAN and Bluetooth can transmit Simultaneously:

| Operation modes | Frequency (MHz) | Maximum Peak Power (dBm) | Duty Cycle (%) | Time based average Power (mW) | Separated distance from user (mm) | SAR estimation (W/kg) |
|-----------------|-----------------|--------------------------|----------------|-------------------------------|-----------------------------------|-----------------------|
| GSM 850 | 824-849 | 32 | 0.175 | 2.77 | 0 | 0.068 |
| PCS 1900 | 1850-1910 | 30 | 0.175 | 1.75 | 0 | 0.065 |
| BLE | 2402-2480 | 4 | 100 | 2.51 | 0 | 0.105 |

SAR estimation=

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}/x]$
W/kg, for test separation distances ≤ 50 mm; where $x = 7.5$ for 1-g SAR and $x = 18.75$ for 10-g SAR.

$\Sigma\text{SAR} = 0.068 + 0.105 = 0.173 \text{ W/kg} < 1.6 \text{ W/kg}$

So the SAR test is not necessary.

FCC §2.1047 - MODULATION CHARACTERISTIC

According to FCC § 2.1047(d), Part 22H & 24E there is no specific requirement for digital modulation, therefore modulation characteristic is not presented.

FCC § 2.1046, § 22.913 (a) & § 24.232 (c) - RF OUTPUT POWER

Applicable Standard

According to FCC §2.1046 and §22.913 (a), the ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 watts.

According to FCC §2.1046 and §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 §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 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.

Test Procedure

GSM/GPRS/EGPRS

Function: Menu select > GSM Mobile Station > GSM 850/1900

Press Connection control to choose the different menus

Press RESET > choose all the reset all settings

Connection Press Signal Off to turn off the signal and change settings

Network Support > GSM + GPRS or GSM + EGSM

Main Service > Packet Data

Service selection > Test Mode A – Auto Slot Config. off

MS Signal Press Slot Config Bottom on the right twice to select and change the number of time slots and power setting

> Slot configuration > Uplink/Gamma

> 33 dBm for GPRS 850

> 30 dBm for GPRS 1900

> 27 dBm for EGPRS 850

> 26 dBm for EGPRS 1900

BS Signal Enter the same channel number for TCH channel (test channel) and BCCH channel

Frequency Offset > + 0 Hz

Mode > BCCH and TCH

BCCH Level > -85 dBm (May need to adjust if link is not stable)

BCCH Channel > choose desire test channel [Enter the same channel number for TCH channel (test channel) and BCCH channel]

Channel Type > Off

P0 > 4 dB

Slot Config > Unchanged (if already set under MS signal)

TCH > choose desired test channel

Hopping > Off

Main Timeslot > 3

Network Coding Scheme > CS4 (GPRS) and MCS5 (EGPRS)

Bit Stream > 2E9-1 PSR Bit Stream

AF/RF Enter appropriate offsets for Ext. Att. Output and Ext. Att. Input

Connection Press Signal on to turn on the signal and change settings

Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|----------------|--------------------------------------|-----------|---------------|------------------|----------------------|
| R&S | EMI Test Receiver | ESCI | 100035 | 2018-08-03 | 2019-08-03 |
| Sunol Sciences | Antenna | JB3 | A060611-3 | 2017-07-21 | 2019-07-21 |
| EMCO | Adjustable Dipole Antenna | 3121C | 9109-753 | N/A | N/A |
| Unknown | Coaxial Cable | C-NJNJ-50 | C-1000-01 | 2018-09-05 | 2019-09-05 |
| Unknown | Coaxial Cable | C-NJNJ-50 | C-0400-02 | 2018-09-05 | 2019-09-05 |
| Unknown | Coaxial Cable | C-NJNJ-50 | C-0530-01 | 2018-09-24 | 2019-09-24 |
| Unknown | Coaxial Cable | C-NJNJ-50 | C-0200-02 | 2018-09-05 | 2019-09-05 |
| R&S | Universal Radio Communication Tester | CMU200 | 106 891 | 2017-12-14 | 2018-12-14 |
| Agilent | Signal Generator | E8247C | MY43321350 | 2018-12-10 | 2019-12-10 |
| Agilent | Spectrum Analyzer | E4440A | SG43360054 | 2018-01-04 | 2019-01-04 |
| TDK RF | Horn Antenna | HRN-0118 | 130 084 | 2016-01-05 | 2019-01-04 |
| ETS-Lindgren | Horn Antenna | 3115 | 000 527 35 | 2016-01-05 | 2019-01-04 |
| Unknown | Coaxial Cable | C-SJSJ-50 | C-0800-01 | 2018-09-05 | 2019-09-05 |
| Unknown | Coaxial Cable | C-NJNJ-50 | C-0200-02 | 2018-09-05 | 2019-09-05 |

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

| | |
|---------------------------|--------------|
| Temperature: | 21.3~21.5 °C |
| Relative Humidity: | 30~35 % |
| ATM Pressure: | 99.9 kPa |

* The testing was performed by Tyler Pan & Sunny Cen on 2018-12-14.

Test Result: Compliance

Conducted Output Power**Cellular Band & PCS Band**

| Band | Channel No. | Conducted Peak Output Power (dBm) | |
|----------|-------------|-----------------------------------|----------------|
| | | GPRS 1 TX Slot | GPRS 2 TX Slot |
| Cellular | 128 | 31.22 | 29.86 |
| | 190 | 31.20 | 29.84 |
| | 251 | 31.05 | 29.68 |
| PCS | 512 | 29.01 | 27.44 |
| | 661 | 28.67 | 27.08 |
| | 810 | 28.47 | 26.92 |

ERP & EIRP**Part 22H**

| Frequency (MHz) | Polar (H/V) | Receiver Reading (dBμV) | Substituted Method | | | Absolute Level (dBm) | Limit (dBm) | Margin (dB) |
|-------------------------|----------------|-------------------------------|-------------------------------|------------------------------|--------------------|----------------------------|----------------|----------------|
| | | | Substituted Level (dBm) | Antenna Gain (dBd/dBi) | Cable Loss (dB) | | | |
| GPRS 850 Middle Channel | | | | | | | | |
| 836.60 | H | 89.42 | 15.19 | 0.00 | 0.50 | 14.69 | 38.45 | 23.76 |
| 836.60 | V | 97.01 | 25.75 | 0.00 | 0.50 | 25.25 | 38.45 | 13.20 |

Part 24E

| Frequency (MHz) | Polar (H/V) | Receiver Reading (dBμV) | Substituted Method | | | Absolute Level (dBm) | Limit (dBm) | Margin (dB) |
|--------------------------|----------------|-------------------------------|-------------------------------|------------------------------|--------------------|----------------------------|----------------|----------------|
| | | | Substituted Level (dBm) | Antenna Gain (dBd/dBi) | Cable Loss (dB) | | | |
| GPRS 1900 Middle Channel | | | | | | | | |
| 1880.00 | H | 91.04 | 18.43 | 11.66 | 2.66 | 27.43 | 33.00 | 5.57 |
| 1880.00 | V | 90.15 | 17.68 | 11.66 | 2.66 | 26.68 | 33.00 | 6.32 |

Note:

- 1) The unit of Antenna Gain is dBd for frequency below 1GHz, and the unit of Antenna Gain is dBi for frequency above 1GHz.
- 2) Absolute Level = Substituted Level - Cable loss + Antenna Gain
- 3) Margin = Limit-Absolute Level

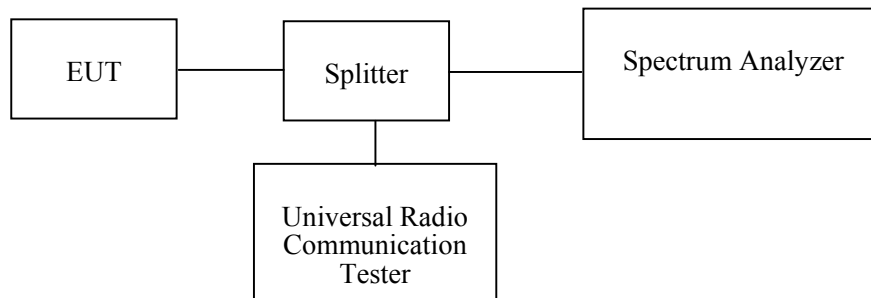
FCC §2.1049, §22.917, §22.905 & §24.238 - OCCUPIED BANDWIDTH**Applicable Standard**

FCC §2.1049, §22.917, §22.905, §24.238

Test Procedure

The RF output of the transmitter was connected to the simulator and the spectrum analyzer through sufficient attenuation.

The 26 dB & 99% bandwidth was recorded.

**Test Equipment List and Details**

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|--------------|-------------------|---------------|---------------|------------------|----------------------|
| R&S | EMI Test Receiver | ESPI | 100120 | 2018-12-10 | 2019-12-10 |
| E-Microwave | Two-way Splitter | ODP-1-6-2S | OE0120142 | Each time | N/A |
| yzjingcheng | Coaxial Cable | KTRFBU-141-50 | 41010012 | Each time | N/A |
| Unknown | Coaxial Cable | C-SJ00-0010 | C0010/01 | Each time | N/A |

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

| | |
|---------------------------|----------|
| Temperature: | 25.2 °C |
| Relative Humidity: | 49 % |
| ATM Pressure: | 99.8 kPa |

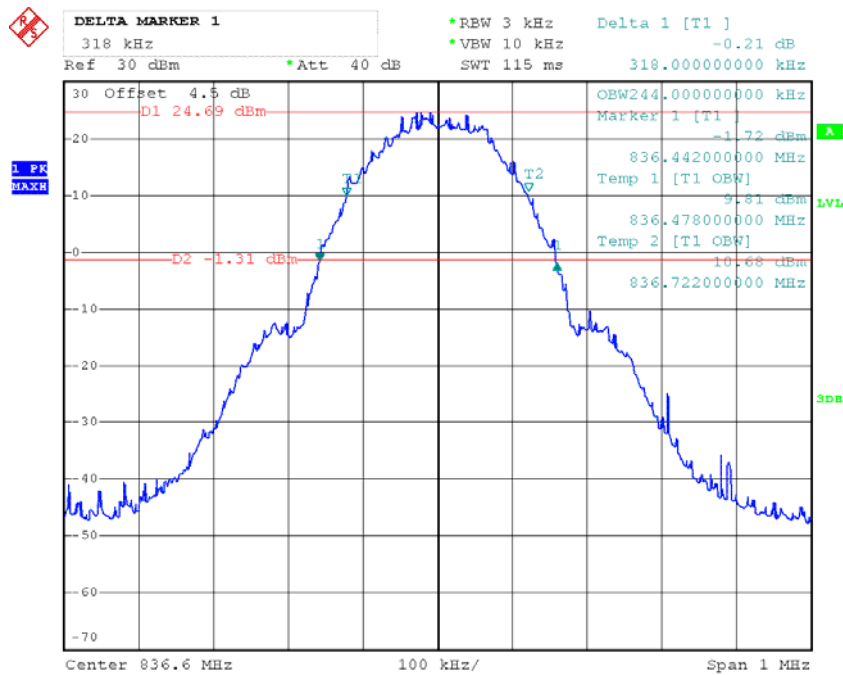
** The testing was performed by Carrie He on 2018-12-20.*

Test Mode: Transmitting

Test Result: Compliance. Please refer to the following table and plots.

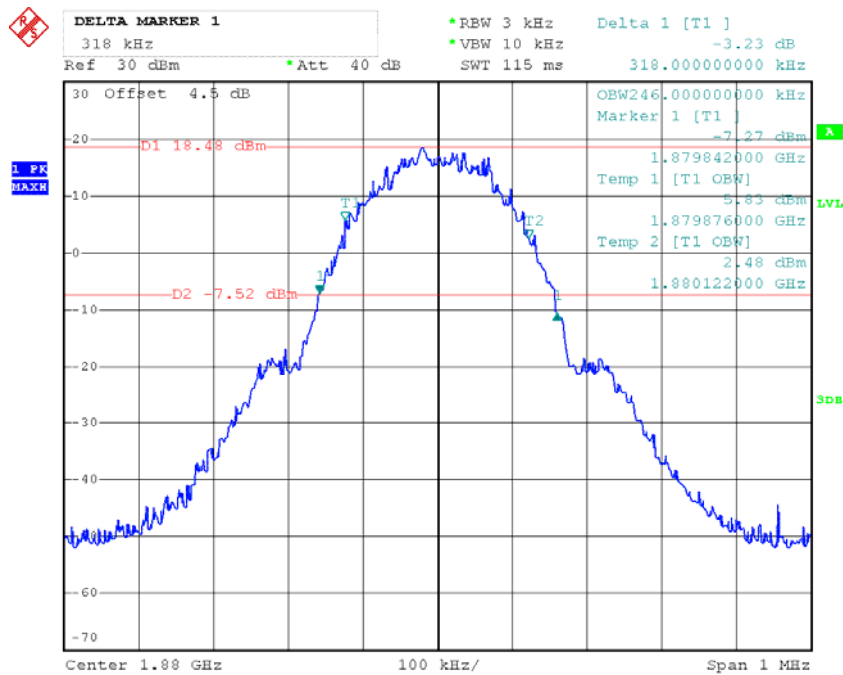
| Band | Test Channel | 99% Occupied Bandwidth (MHz) | 26 dB Occupied Bandwidth (MHz) |
|-------------|---------------------|-------------------------------------|---------------------------------------|
| Cellular | M | 0.244 | 0.318 |
| PCS | | 0.246 | 0.318 |

GPRS 850 Cellular Band



Date: 20.DEC.2018 15:59:41

GPRS PCS1900 Cellular Band



Date: 20.DEC.2018 16:02:40

FCC §2.1051, §22.917(a) & §24.238(a) - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

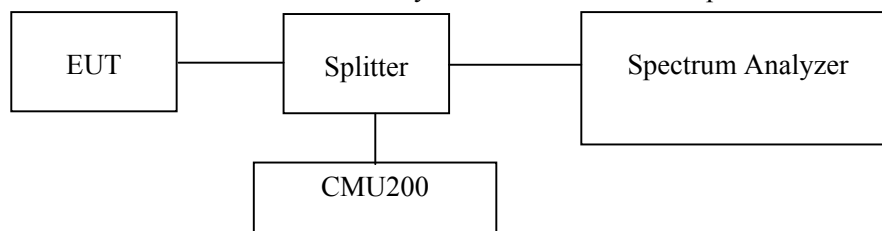
Applicable Standard

FCC §2.1051, §22.917(a) , §24.238(a).

The spectrum was to be investigated to the tenth harmonics of the highest fundamental frequency as specified in § 2.1051.

Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer and simulator through appropriate attenuation. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.



Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|--------------|-------------------|---------------|---------------|------------------|----------------------|
| R&S | EMI Test Receiver | ESPI | 100120 | 2018-12-10 | 2019-12-10 |
| E-Microwave | Two-way Splitter | ODP-1-6-2S | OE0120142 | Each time | N/A |
| yzjingcheng | Coaxial Cable | KTRFBU-141-50 | 41010012 | Each time | N/A |
| Unknown | Coaxial Cable | C-SJ00-0010 | C0010/01 | Each time | N/A |

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

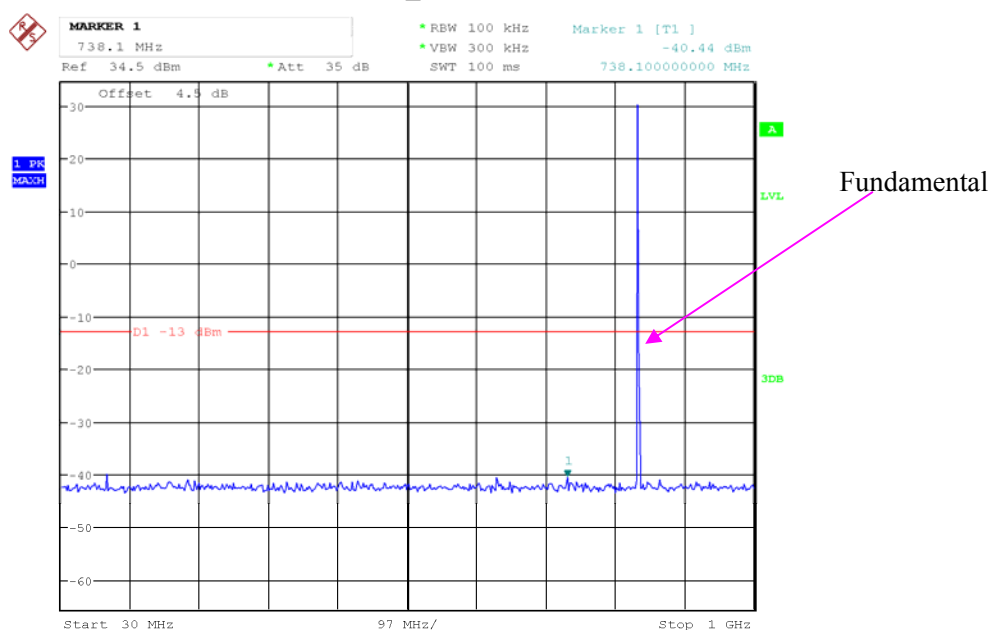
Environmental Conditions

| | |
|--------------------|----------|
| Temperature: | 25.2 °C |
| Relative Humidity: | 49 % |
| ATM Pressure: | 99.8 kPa |

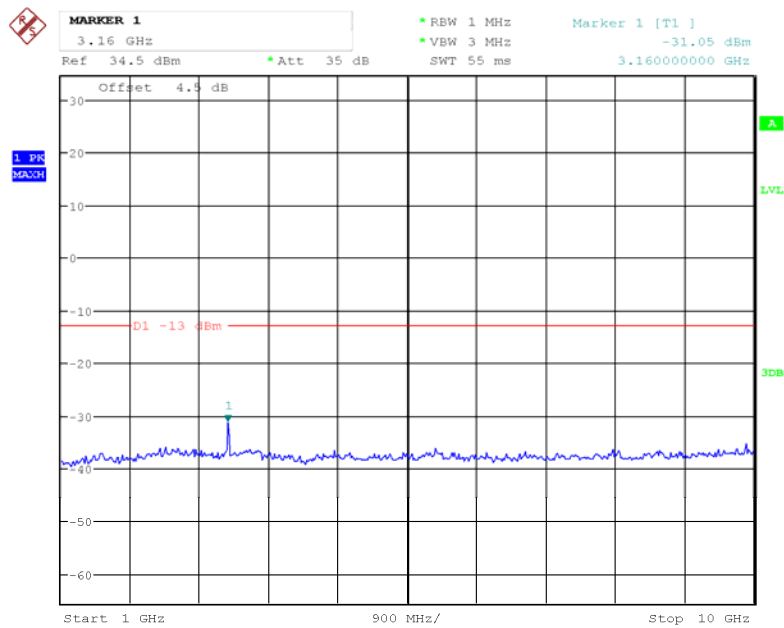
* The testing was performed by Carrie He on 2018-12-20.

Test Result: Compliance. Please refer to the following plots.

GPRS850_Middle Channel

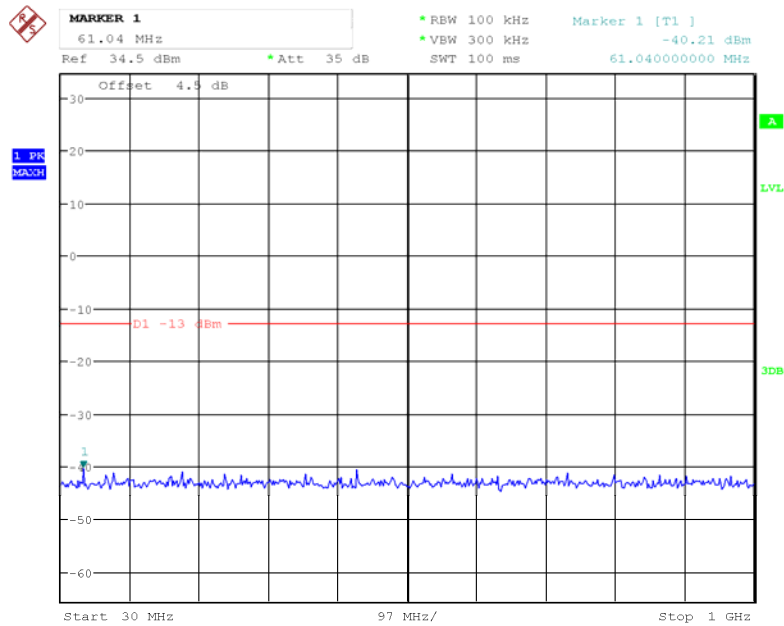


Date: 20.DEC.2018 17:33:36

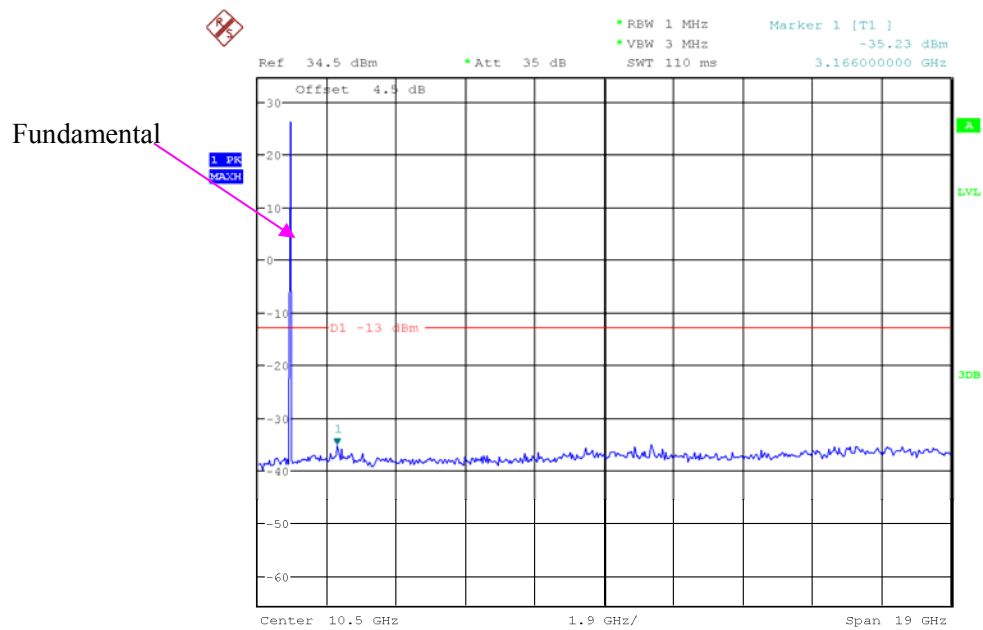


Date: 20.DEC.2018 17:54:41

GPRS 1900_ Middle Channel



Date: 20.DEC.2018 17:52:33



Date: 20.DEC.2018 17:52:12

FCC §2.1053, §22.917 & §24.238 & §27.53 - SPURIOUS RADIATED EMISSIONS

Applicable Standard

FCC § 2.1053, §22.917, § 24.238 and § 27.53.

Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = $10 \lg (\text{TXpwr in Watts}/0.001)$ – the absolute level

Spurious attenuation limit in dB = $43 + 10 \text{Log}_{10} (\text{power out in Watts})$

Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|-----------------------|---------------------------|------------------------|--------------------|------------------|----------------------|
| R&S | EMI Test Receiver | ESCI | 100035 | 2018-08-03 | 2019-08-03 |
| Sunol Sciences | Antenna | JB3 | A060611-3 | 2017-07-21 | 2019-07-21 |
| EMCO | Adjustable Dipole Antenna | 3121C | 9109-753 | N/A | N/A |
| Unknown | Coaxial Cable | C-NJNJ-50 | C-1000-01 | 2018-09-05 | 2019-09-05 |
| Unknown | Coaxial Cable | C-NJNJ-50 | C-0400-02 | 2018-09-05 | 2019-09-05 |
| Unknown | Coaxial Cable | C-NJNJ-50 | C-0530-01 | 2018-09-24 | 2019-09-24 |
| Unknown | Coaxial Cable | C-NJNJ-50 | C-0200-02 | 2018-09-05 | 2019-09-05 |
| Sonoma | Amplifier | 310N | 185914 | 2018-10-13 | 2019-10-13 |
| Sinoscite | Band-stop filter | BSF824-862MS-1438-001 | 1438001 | 2018-06-16 | 2019-06-16 |
| Agilent | Signal Generator | E8247C | MY43321350 | 2018-12-10 | 2019-12-10 |
| Agilent | Spectrum Analyzer | E4440A | SG43360054 | 2018-01-04 | 2019-01-04 |
| TDK RF | Horn Antenna | HRN-0118 | 130 084 | 2016-01-05 | 2019-01-04 |
| ETS-Lindgren | Horn Antenna | 3115 | 000 527 35 | 2016-01-05 | 2019-01-04 |
| Ducommun Technologies | Horn Antenna | ARH-4223-02 | 1007726-01 1304 | 2016-11-18 | 2019-11-18 |
| Ducommun Technologies | Horn Antenna | ARH-4223-02 | 1007726-02 1304 | 2016-11-18 | 2019-11-18 |
| Unknown | Coaxial Cable | C-SJSJ-50 | C-0800-01 | 2018-09-05 | 2019-09-05 |
| Unknown | Coaxial Cable | C-NJNJ-50 | C-0200-02 | 2018-09-05 | 2019-09-05 |
| MITEQ | Amplifier | AFS42-00101800-25-S-42 | 2001271 | 2018-09-05 | 2019-09-05 |
| Sinoscite | Band-stop filter | BSF1850-1910MS-0935V2 | 0935V2 | 2018-06-16 | 2019-06-16 |

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

| | |
|---------------------------|--------------|
| Temperature: | 21.3~21.5 °C |
| Relative Humidity: | 30~35 % |
| ATM Pressure: | 99.9 kPa |

* The testing was performed by Tyler Pan & Sunny Cen on 2018-12-14.

Test Result: Compliance.

*EUT Operation Mode: Transmitting***Cellular Band (PART 22H)****30 MHz-10 GHz:**

| Frequency (MHz) | Polar (H/V) | Receiver Reading (dBμV) | Substituted Method | | | Absolute Level (dBm) | Limit (dBm) | Margin (dB) |
|--------------------------------|----------------|-------------------------------|-------------------------------|------------------------------|--------------------|----------------------------|----------------|----------------|
| | | | Substituted Level (dBm) | Antenna Gain (dBd/dBi) | Cable Loss (dB) | | | |
| GPRS850, Frequency:836.600 MHz | | | | | | | | |
| 1673.200 | H | 58.89 | -55.32 | 10.6 | 0.73 | -45.4 | -13.0 | 32.4 |
| 1673.200 | V | 54.77 | -60.04 | 10.6 | 0.73 | -50.2 | -13.0 | 37.2 |
| 2509.800 | H | 48.22 | -64.8 | 13.1 | 1.25 | -52.9 | -13.0 | 39.9 |
| 2509.800 | V | 47.12 | -65.93 | 13.1 | 1.25 | -54.1 | -13.0 | 41.1 |
| 3346.400 | H | 46.53 | -64.13 | 13.8 | 1.61 | -51.9 | -13.0 | 38.9 |
| 3346.400 | V | 46.05 | -64.66 | 13.8 | 1.61 | -52.4 | -13.0 | 39.4 |
| 486.000 | H | 45.87 | -59.73 | 0.0 | 0.35 | -60.1 | -13.0 | 47.1 |
| 486.000 | V | 47.88 | -55.04 | 0.0 | 0.35 | -55.4 | -13.0 | 42.4 |

PCS Band (PART 24E)**30 MHz-20 GHz:**

| Frequency (MHz) | Polar (H/V) | Receiver Reading (dBμV) | Substituted Method | | | Absolute Level (dBm) | Limit (dBm) | Margin (dB) |
|----------------------------------|----------------|-------------------------------|-------------------------------|------------------------------|--------------------|----------------------------|----------------|----------------|
| | | | Substituted Level (dBm) | Antenna Gain (dBd/dBi) | Cable Loss (dB) | | | |
| GPRS1900, Frequency:1880.000 MHz | | | | | | | | |
| 3760.000 | H | 54.95 | -53.85 | 13.8 | 1.63 | -41.7 | -13.0 | 28.7 |
| 3760.000 | V | 49.88 | -58.79 | 13.8 | 1.63 | -46.7 | -13.0 | 33.7 |
| 5640.000 | H | 48.21 | -57.82 | 14.0 | 1.31 | -45.1 | -13.0 | 32.1 |
| 5640.000 | V | 46.47 | -59.44 | 14.0 | 1.31 | -46.7 | -13.0 | 33.7 |
| 635.000 | H | 46.69 | -55.2 | 0.0 | 0.37 | -55.6 | -13.0 | 42.6 |
| 635.000 | V | 47.31 | -51.83 | 0.0 | 0.37 | -52.2 | -13.0 | 39.2 |

Note:

- 1) The unit of Antenna Gain is dBd for frequency below 1GHz, and the unit of Antenna Gain is dBi for frequency above 1GHz.
- 2) Absolute Level = Substituted Level - Cable loss + Antenna Gain
- 3) Margin = Limit-Absolute Level

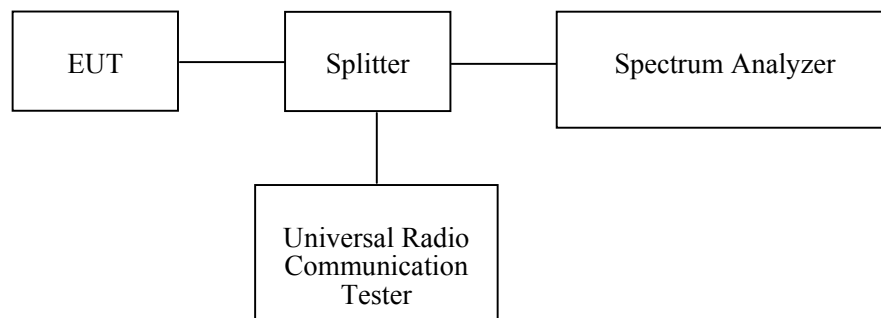
FCC §22.917(a) & §24.238(a)- BAND EDGES**Applicable Standard**

FCC § 2.1053, §22.917, § 24.238.

Test Procedure

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

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

**Test Equipment List and Details**

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|--------------|-------------------|---------------|---------------|------------------|----------------------|
| R&S | EMI Test Receiver | ESPI | 100120 | 2018-12-10 | 2019-12-10 |
| E-Microwave | Two-way Splitter | ODP-1-6-2S | OE0120142 | Each time | N/A |
| yzjingcheng | Coaxial Cable | KTRFBU-141-50 | 41010012 | Each time | N/A |
| Unknown | Coaxial Cable | C-SJ00-0010 | C0010/01 | Each time | N/A |

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

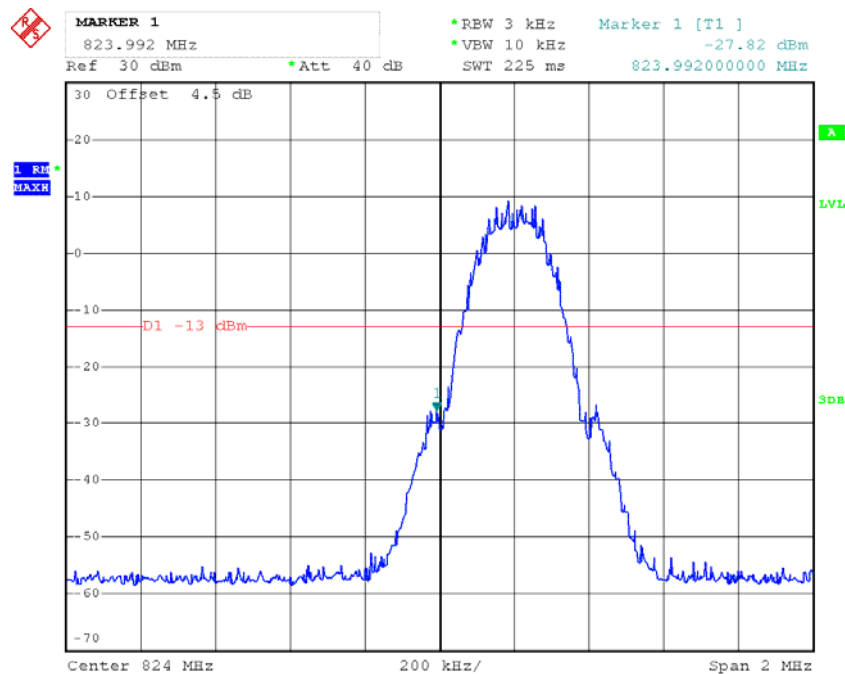
Test Data**Environmental Conditions**

| | |
|---------------------------|----------|
| Temperature: | 25.2 °C |
| Relative Humidity: | 49 % |
| ATM Pressure: | 99.8 kPa |

* The testing was performed by Carrie He on 2018-12-20.

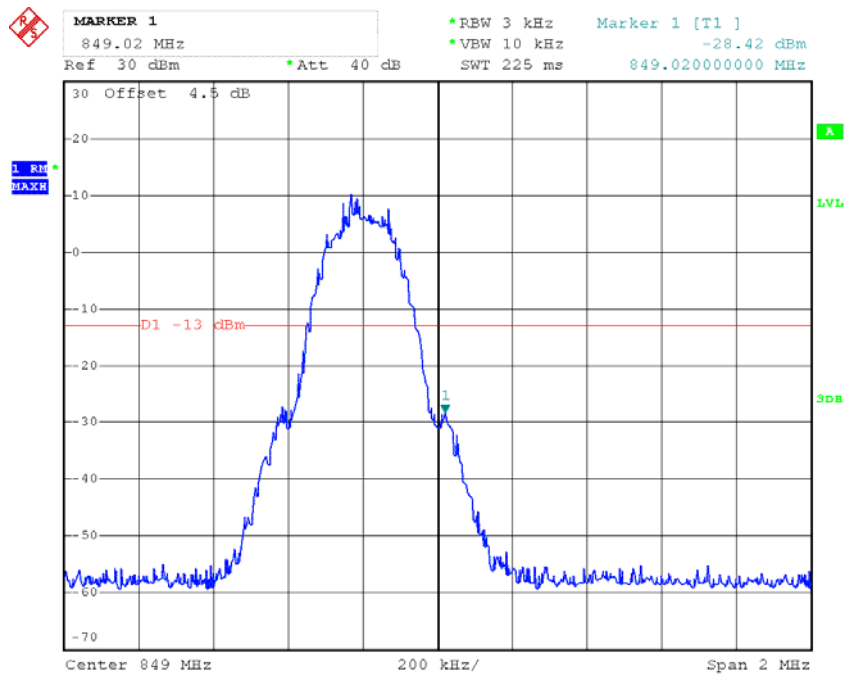
Test Mode: Transmitting

Test Result: Compliance. Please refer to the following plots.

GSM 850, Left Band Edge

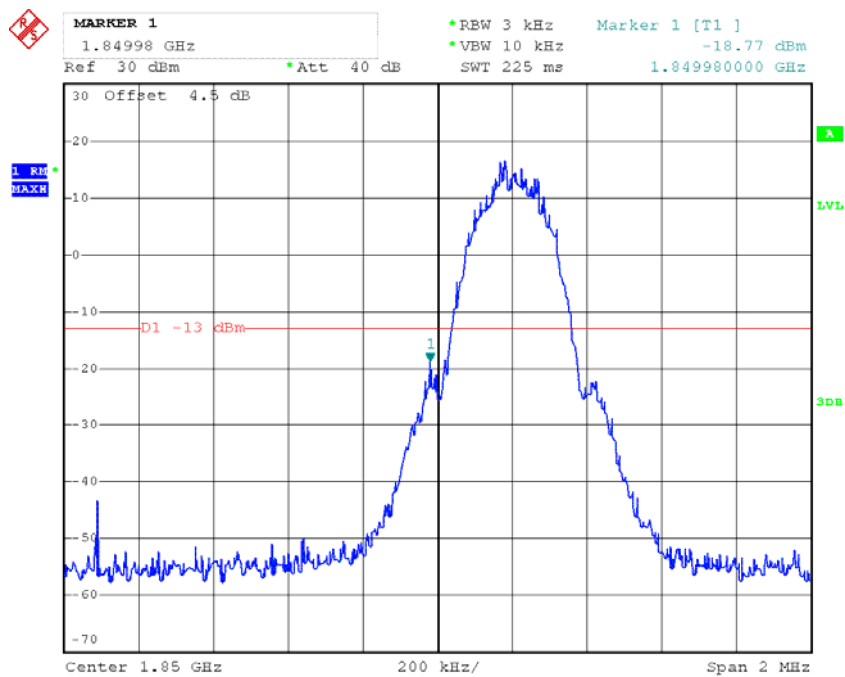
Date: 20.DEC.2018 15:52:42

GSM 850, Right Band Edge



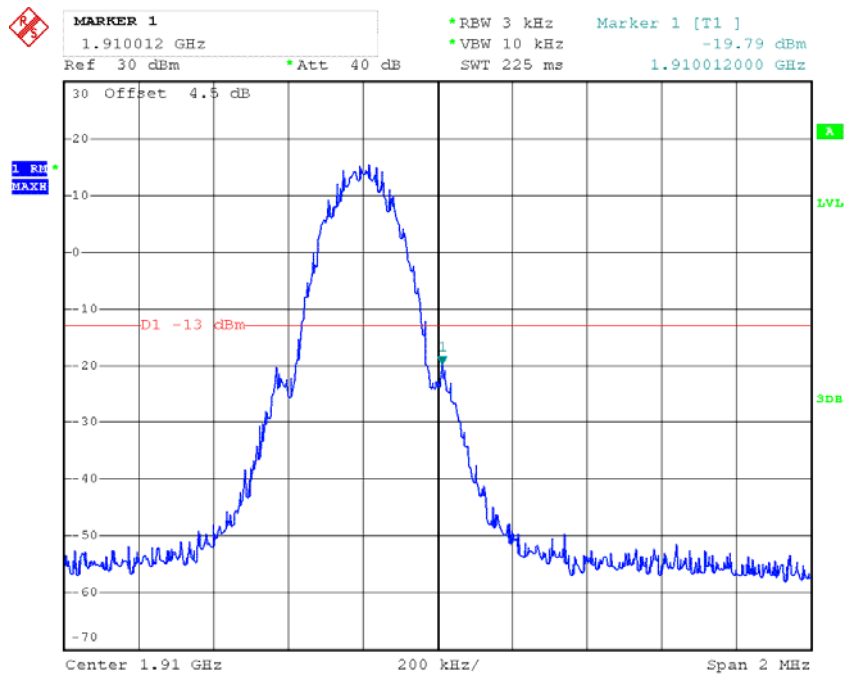
Date: 20.DEC.2018 15:54:23

GSM 1900, Left Band Edge



Date: 20.DEC.2018 16:04:06

GSM 1900, Right Band Edge



Date: 20.DEC.2018 16:05:40

FCC §2.1055, §22.355 & §24.235 - FREQUENCY STABILITY**Applicable Standard**

FCC § 2.1055 (a), § 2.1055 (d), §22.355, §24.235

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 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 |

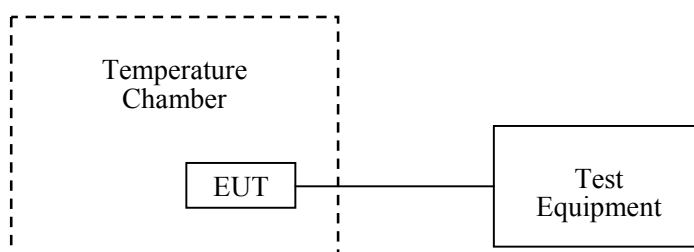
According to §24.235, the frequency stability shall be sufficient to ensure that the fundamental emissions stays within the authorized frequency block.

Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external DC power supply and the RF output was connected to communication test set via feed-through attenuators. The EUT was placed inside the temperature chamber. The DC leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the communication test set.

Frequency Stability vs. Voltage: An external variable DC power supply was connected to the battery terminals of the equipment under test. The voltage was set from 85% to 115% of the nominal value and was then decreased until the transmitter light no longer illuminated; i.e., the battery end point. The output frequency was recorded for each battery voltage.



Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|----------------|------------------------------------------|-------------|---------------|------------------|----------------------|
| R&S | Universal Radio Communication Tester | CMU200 | 106 891 | 2018-12-14 | 2019-12-14 |
| ESPEC | Constant temperature and humidity Tester | ESX-4CA | 018 463 | 2018-03-26 | 2019-03-26 |
| Unknown | Coaxial Cable | C-SJ00-0010 | C0010/01 | Each time | N/A |
| UNI-T | Multimeter | UT39A | M130199938 | 2018-07-24 | 2019-07-24 |
| Pro instrument | DC Power Supply | pps3300 | 3300012 | N/A | N/A |

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

| | |
|---------------------------|----------|
| Temperature: | 25.2 °C |
| Relative Humidity: | 49 % |
| ATM Pressure: | 99.8 kPa |

* The testing was performed by Carrie He on 2018-12-20.

Test Result: Compliance.

Cellular Band

| GMSK, Middle Channel, $f_c = 836.6$ MHz | | | | |
|-----------------------------------------|-----------------|-----------------|-----------------|-------|
| Temperature | Voltage | Frequency Error | Frequency Error | Limit |
| °C | V _{DC} | Hz | ppm | ppm |
| -30 | 3.7 | -8 | -0.00956 | 2.5 |
| -20 | | -6 | -0.00717 | |
| -10 | | -4 | -0.00478 | |
| 0 | | -3 | -0.00359 | |
| 10 | | -5 | -0.00598 | |
| 20 | | -9 | -0.01076 | |
| 30 | | -8 | -0.00956 | |
| 40 | | -9 | -0.01076 | |
| 50 | | -6 | -0.00717 | |
| 20 | 3.5 | -5 | -0.00598 | |
| 20 | 4.2 | -7 | -0.00837 | |

PCS Band

| GMSK, Middle Channel, $f_c = 1880.0$ MHz | | | | |
|------------------------------------------|-----------------|-----------------|-----------------|---------|
| Temperature | Voltage | Frequency Error | Frequency Error | Results |
| °C | V _{DC} | Hz | ppm | |
| -30 | 3.7 | -5 | -0.00266 | Pass |
| -20 | | -2 | -0.00106 | |
| -10 | | 0 | 0.00000 | |
| 0 | | -4 | -0.00213 | |
| 10 | | -1 | -0.00053 | |
| 20 | | 0 | 0.00000 | |
| 30 | | -3 | -0.00160 | |
| 40 | | -1 | -0.00053 | |
| 50 | | 0 | 0.00000 | |
| 20 | 3.5 | -2 | -0.00106 | |
| 20 | 4.2 | -3 | -0.00160 | |

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