# FCC PART 22H, PART 24E

# MEASUREMENT AND TEST REPORT

For

## Collage Investments LLC.

11437 NW 34 STREET,Doral,Florida,United States

**FCC ID: GAO-MAX5PRO**

| **Report Type:** | **Product Type:** |
|---|---|
| Original Report | Mobile phone |

| | |
|---|---|
| **Report Number:** | RDG170721007-00D |
| **Report Date:** | 2017-09-20 |
| **Reviewed By:** | Jerry Zhang<br>EMC Manager |
| **Test Laboratory:** | Bay Area Compliance Laboratories Corp. (Dongguan)<br>No.69 Pulongcun, Puxinhu Industry Area,<br>Tangxia, Dongguan, Guangdong, China<br>Tel: +86-769-86858888<br>Fax: +86-769-86858891<br>www.baclcorp.com.cn |

# TABLE OF CONTENTS

# GENERAL INFORMATION

## Product Description for Equipment under Test (EUT)

The ***Collage Investments LLC.***'s product, model number: ***Max 5 Pro (FCC ID: GAO-MAX5PRO)*** (the "EUT") in this report was a ***Mobile phone,*** which was measured approximately: 14.8 cm (L) x 7.3 cm (W) x 0.8 cm (H), DC3.7V from Battery or DC 5V from adapter.

*Adapter Information:*
*Input: AC100-240V,50/60Hz,0.15A*
*Output: DC5V, 800mA*

**All measurement and test data in this report was gathered from production sample serial number: 170721007 (Assigned by BACL, Dongguan). The EUT was received on 2017-07-21.*

## Objective

This report is prepared on behalf of *Collage Investments LLC.* 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 DSS submissions with FCC ID: GAO-MAX5PRO.
FCC Part 15C DTS submissions with FCC ID: GAO-MAX5PRO.
FCC Part 15B JBP submissions with FCC ID: GAO-MAX5PRO.

## 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, Part 22 Subpart H, Part 24 Subpart E.

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<br>1G~26.5GHz: 5.23 dB |
| Unwanted Emissions, conducted | ±1.5 dB |
| Temperature | ±1℃ |
| 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

Bay Area Compliance Laboratories Corp. (Dongguan) has been accredited to ISO 17025 by CNAS(Lab code: L5662). And accredited to ISO 17025 by NVLAP(Test Laboratory Accreditation Certificate Number 500069-0), the FCC Designation No. CN5002 under the KDB 974614 D01.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 273710. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

Bay Area Compliance Laboratories Corp. (Dongguan) was registered with ISED Canada under ISED Canada Registration Number 3062D.

# 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.

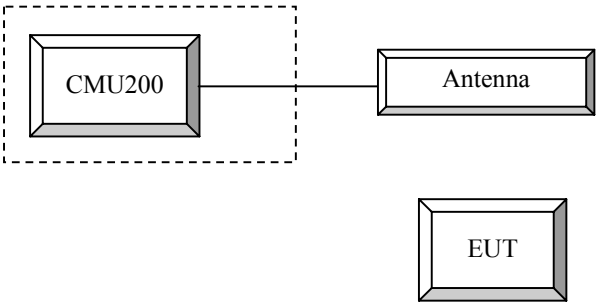
## Equipment Modifications

No modification was made to the EUT.

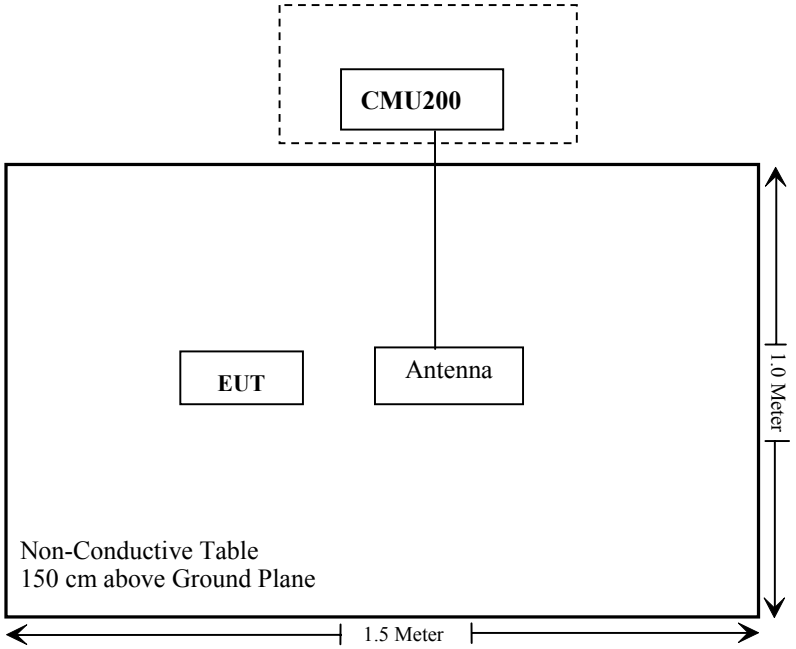
## Support Equipment List and Details

| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| R&S | Universial Radio Communication Tester | CMU200 | 109038 |

## 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;<br>§ 22.913 (a); § 24.232 (c) | RF Output Power | Compliance |
| § 2.1047 | Modulation Characteristics | Not Applicable |
| § 2.1049; § 22.905<br>§ 22.917; § 24.238 | Occupied Bandwidth | Compliance |
| § 2.1051,<br>§ 22.917 (a); § 24.238 (a) | Spurious Emissions at Antenna Terminal | Compliance |
| § 2.1053<br>§ 22.917 (a); § 24.238 (a) | Field Strength of Spurious Radiation | Compliance |
| § 22.917 (a); § 24.238 (a) | Out of band emission, Band Edge | Compliance |
| § 2.1055<br>§ 22.355; § 24.235 | Frequency stability vs. temperature<br>Frequency stability vs. voltage | Compliance |

# FCC §1.1310 & §2.1093- RF EXPOSURE

## Applicable Standard

FCC§1.1310 and §2.1093.

## Test Result

Compliant, please refer to the SAR report: RDG170721007-20.

# 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

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)

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

**WCDMA-Release 99**

The following tests were conducted according to the test requirements outlines in section 5.2 of the 3GPP TS34.121-1 specification. The EUT has a nominal maximum output power of 24dBm (+1.7/-3.7).

| | | |
|---|---|---|
| **WCDMA General Settings** | Loopback Mode | Test Mode 1 |
| | Rel99 RMC | 12.2kbps RMC |
| | Power Control Algorithm | Algorithm2 |
| | **βc / βd** | 8/15 |

**WCDMA HSDPA**

The following tests were conducted according to the test requirements outlines in section 5.2 of the 3GPP TS34.121-1 specification.

| | Mode | HSDPA | HSDPA | HSDPA | HSDPA |
|---|---|---|---|---|---|
| | Subset | 1 | 2 | 3 | 4 |
| WCDMA General Settings | Loopback Mode | Test Mode 1 | | | |
| | Rel99 RMC | 12.2kbps RMC | | | |
| | HSDPA FRC | H-Set1 | | | |
| | Power Control Algorithm | Algorithm2 | | | |
| | βc | 2/15 | 12/15 | 15/15 | 15/15 |
| | βd | 15/15 | 15/15 | 8/15 | 4/15 |
| | βd (SF) | 64 | | | |
| | βc/ βd | 2/15 | 12/15 | 15/8 | 15/4 |
| | βhs | 4/15 | 24/15 | 30/15 | 30/15 |
| | MPR(dB) | 0 | 0 | 0.5 | 0.5 |
| HSDPA Specific Settings | DACK | 8 | | | |
| | DNAK | 8 | | | |
| | DCQI | 8 | | | |
| | Ack-Nack repetition factor | 3 | | | |
| | CQI Feedback | 4ms | | | |
| | CQI Repetition Factor | 2 | | | |
| | Ahs=βhs/ βc | 30/15 | | | |

**WCDMA HSUPA**

The following tests were conducted according to the test requirements outlines in section 5.2 of the 3GPP TS34.121-1 specification.

| | Mode | HSUPA | HSUPA | HSUPA | HSUPA | HSUPA |
|---|---|---|---|---|---|---|
| | Subset | 1 | 2 | 3 | 4 | 5 |
| WCDMA General Settings | Loopback Mode | Test Mode 1 | | | | |
| | Rel99 RMC | 12.2kbps RMC | | | | |
| | HSDPA FRC | H-Set1 | | | | |
| | HSUPA Test | HSUPA Loopback | | | | |
| | Power Control Algorithm | Algorithm2 | | | | |
| | βc | 11/15 | 6/15 | 15/15 | 2/15 | 15/15 |
| | βd | 15/15 | 15/15 | 9/15 | 15/15 | 0 |
| | βec | 209/225 | 12/15 | 30/15 | 2/15 | 5/15 |
| | βc/ βd | 11/15 | 6/15 | 15/9 | 2/15 | - |
| | βhs | 22/15 | 12/15 | 30/15 | 4/15 | 5/15 |
| | CM(dB) | 1.0 | 3.0 | 2.0 | 3.0 | 1.0 |
| | MPR(dB) | 0 | 2 | 1 | 2 | 0 |
| HSDPA Specific Settings | DACK | 8 | | | | |
| | DNAK | 8 | | | | |
| | DCQI | 8 | | | | |
| | Ack-Nack repetition factor | 3 | | | | |
| | CQI Feedback | 4ms | | | | |
| | CQI Repetition Factor | 2 | | | | |
| | Ahs=βhs/ βc | 30/15 | | | | |
| HSUPA Specific Settings | DE-DPCCH | 6 | 8 | 8 | 5 | 7 |
| | DHARQ | 0 | 0 | 0 | 0 | 0 |
| | AG Index | 20 | 12 | 15 | 17 | 21 |
| | ETFCI | 75 | 67 | 92 | 71 | 81 |
| | Associated Max UL Data Rate kbps | 242.1 | 174.9 | 482.8 | 205.8 | 308.9 |
| | Reference E_FCIs | E-TFCI 11 E<br>E-TFCI PO 4<br>E-TFCI 67<br>E-TFCI PO 18<br>E-TFCI 71<br>E-TFCI PO23<br>E-TFCI 75<br>E-TFCI PO26<br>E-TFCI 81<br>E-TFCI PO 27 | | E-TFCI 11<br>E-TFCI PO4<br>E-TFCI 92<br>E-TFCI PO 18 | E-TFCI 11 E<br>E-TFCI PO 4<br>E-TFCI 67<br>E-TFCI PO 18<br>E-TFCI 71<br>E-TFCI PO23<br>E-TFCI 75<br>E-TFCI PO26<br>E-TFCI 81<br>E-TFCI PO 27 | |

*Radiated method:*

ANSI/TIA-603-D section 2.2.17

## Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| R&S | EMI Test Receiver | ESCI | 100224 | 2016-09-01 | 2017-09-01 |
| Sunol Sciences | Antenna | JB3 | A060611-1 | 2014-11-06 | 2017-11-05 |
| R&S | Spectrum Analyzer | FSU 26 | 200256 | 2016-12-08 | 2017-12-08 |
| ETS LINDGREN | Horn Antenna | 3115 | 000 527 35 | 2016-01-05 | 2019-01-04 |
| HP | Signal Generator | 1026 | 320408 | 2016-12-08 | 2017-12-08 |
| EMCO | Adjustable Dipole Antenna | 3121C | 9109-753 | N/A | N/A |
| TDK RF | Horn Antenna | HRN-0118 | 130 084 | 2016-01-05 | 2019-01-04 |
| Unknown | Coaxial Cable | Chamber A-1 | 4m | 2016-09-01 | 2017-09-01 |
| Unknown | Coaxial Cable | Chamber B-1 | 0.75m | 2016-09-01 | 2017-09-01 |
| Unknown | Coaxial Cable | Chamber A-2 | 10m | 2016-09-01 | 2017-09-01 |
| Unknown | Coaxial Cable | Chamber B-2 | 8m | 2016-09-01 | 2017-09-01 |
| Unknown | Coaxial Cable | 0.1m | C-1 | Each Time | / |
| R&S | Universal Radio Communication Tester | CMU200 | 109 038 | 2017-07-18 | 2018-07-18 |

*** 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:** | 25.7 °C |
| **Relative Humidity:** | 49 % |
| **ATM Pressure:** | 99.8 kPa |

*The testing was performed by Emily Wang on 2017-08-09.*

**Conducted Output Power**

**Cellular Band (Part 22H) & PCS Band (Part 24E)**

| Band | Channel No. | Conducted Average Output Power (dBm) | | | | |
|---|---|---|---|---|---|---|
| | | GSM | GPRS 1 TX Slot | GPRS 2 TX Slot | GPRS 3 TX Slot | GPRS 4 TX Slot |
| Cellular | 128 | 31.40 | 31.25 | 29.62 | 27.94 | 26.07 |
| | 190 | 31.40 | 31.27 | 29.70 | 28.07 | 26.20 |
| | 251 | 31.40 | 31.37 | 29.87 | 28.24 | 26.35 |
| PCS | 512 | 29.10 | 29.09 | 27.34 | 25.81 | 23.81 |
| | 661 | 28.90 | 28.80 | 27.22 | 25.81 | 23.72 |
| | 810 | 28.90 | 28.97 | 27.18 | 25.82 | 23.71 |

**WCDMA Band Ⅱ**

| Mode | 3GPP Sub Test | Average Output Power (dBm) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Low Channel (Ave. Power) | Low Channel (PAR) | Middle Channel (Ave. Power) | Middle Channel (PAR) | High Channel (Ave. Power) | High Channel (PAR) |
| Rel 99 | 1 | 21.38 | 1.84 | 21.27 | 3.04 | 21.24 | 2.00 |
| HSDPA | 1 | 21.16 | 1.83 | 20.87 | 3.14 | 21.15 | 2.12 |
| | 2 | 20.73 | 1.79 | 20.72 | 3.05 | 21.50 | 2.21 |
| | 3 | 20.96 | 1.86 | 21.03 | 3.04 | 20.85 | 2.00 |
| | 4 | 21.24 | 1.82 | 20.36 | 3.06 | 20.75 | 2.34 |
| HSUPA | 1 | 20.50 | 1.81 | 20.97 | 3.10 | 20.98 | 2.24 |
| | 2 | 20.22 | 1.82 | 20.86 | 3.04 | 20.81 | 2.01 |
| | 3 | 20.55 | 1.83 | 20.83 | 3.07 | 20.79 | 2.00 |
| | 4 | 20.61 | 1.88 | 20.74 | 3.12 | 20.82 | 2.03 |
| | 5 | 20.41 | 1.80 | 20.15 | 3.08 | 20.98 | 2.05 |
| HSPA+ | 1 | 21.18 | 1.76 | 21.14 | 3.02 | 20.88 | 2.08 |

**WCDMA Band V**

| Mode | 3GPP Sub Test | Average Output Power (dBm) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Low Channel (Ave. Power) | Low Channel (PAR) | Middle Channel (Ave. Power) | Middle Channel (PAR) | High Channel (Ave. Power) | High Channel (PAR) |
| Rel 99 | 1 | 21.26 | 3.36 | 21.25 | 3.04 | 21.29 | 3.12 |
| HSDPA | 1 | 21.13 | 3.37 | 21.10 | 3.08 | 21.27 | 3.13 |
| | 2 | 21.26 | 3.39 | 21.20 | 3.11 | 21.07 | 3.16 |
| | 3 | 21.05 | 3.36 | 21.10 | 3.16 | 20.13 | 3.12 |
| | 4 | 21.01 | 3.23 | 20.03 | 3.17 | 20.16 | 3.15 |
| HSUPA | 1 | 20.86 | 3.35 | 20.96 | 3.14 | 20.69 | 3.13 |
| | 2 | 20.72 | 3.39 | 20.59 | 3.18 | 20.86 | 3.16 |
| | 3 | 20.80 | 3.31 | 21.10 | 3.21 | 21.03 | 3.19 |
| | 4 | 21.15 | 3.32 | 20.63 | 3.19 | 20.78 | 3.12 |
| | 5 | 21.04 | 3.37 | 20.96 | 3.22 | 20.76 | 3.11 |
| HSPA+ | 1 | 20.81 | 3.32 | 20.84 | 3.24 | 20.61 | 3.08 |

Peak-to-average ratio (PAR)<13dB

ERP & EIRP

**Part 22H**

| Frequency (MHz) | Polar (H/V) | Receiver Reading (dBμV) | Substituted Method | | | Absolute Level (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| | | | Level (dBm) | Antenna Gain (dBd/dBi) | Cable Loss (dB) | | | |
| **GSM 850 Middle Channel** | | | | | | | | |
| 836.600 | H | 89.70 | 14.8 | 0.0 | 1 | 13.8 | 38.5 | 24.7 |
| 836.600 | V | 101.40 | 29.6 | 0.0 | 1 | 28.6 | 38.5 | 9.9 |
| **WCDMA Band V Middle Channel** | | | | | | | | |
| 836.600 | H | 82.60 | 7.7 | 0.0 | 1 | 6.7 | 38.5 | 31.8 |
| 836.600 | V | 93.01 | 21.2 | 0.0 | 1 | 20.2 | 38.5 | 18.3 |

**Part 24E**

| Frequency (MHz) | Polar (H/V) | Receiver Reading (dBμV) | Substituted Method | | | Absolute Level (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| | | | Level (dBm) | Antenna Gain (dBd/dBi) | Cable Loss (dB) | | | |
| **PCS 1900 Middle Channel** | | | | | | | | |
| 1880.000 | H | 94.16 | 19.6 | 11.7 | 2.7 | 28.6 | 33.0 | 4.4 |
| 1880.000 | V | 91.37 | 17.9 | 11.7 | 2.7 | 26.9 | 33.0 | 6.1 |
| **WCDMA Band II Middle Channel** | | | | | | | | |
| 1880.000 | H | 86.45 | 13.6 | 11.7 | 2.7 | 22.6 | 33.0 | 10.4 |
| 1880.000 | V | 83.36 | 10.4 | 11.7 | 2.7 | 19.4 | 33.0 | 13.6 |

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 = SG Level - Cable loss + Antenna Gain
3) Margin = Limit-Absolute Level

# FCC §2.1049, §22.917, §22.905 & §24.238 - OCCUPIED BANDWIDTH

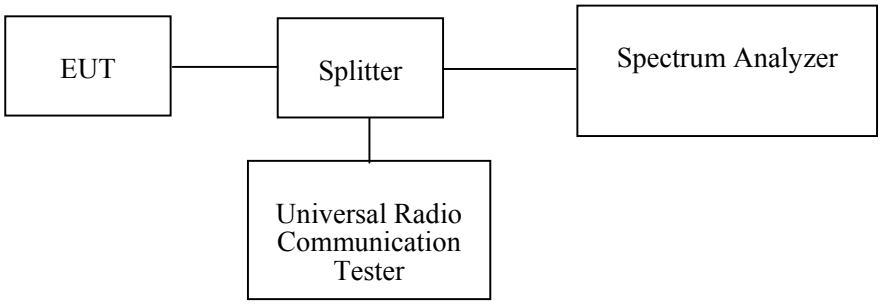
## Applicable Standard

FCC §2.1049, §22.917 and §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 | Spectrum Analyzer | FSP 38 | 100478 | 2016/12/08 | 2017/12/08 |
| R&S | Universal Radio Communication Tester | CMU200 | 109 038 | 2017-07-18 | 2018-07-18 |
| Unknown | Coaxial Cable | 0.1m | C-1 | Each Time | / |
| E-Microwave | RF Attenuator | 6dB | 6dB-2 | Each Time | / |
| Pasternack | RF Coaxial Cable | 0.5m | C-5 | Each Time | / |
| E-Microwave | Two-way Spliter | ODP-1-6-2S | OE0120142 | Each Time | / |

*** 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:** | 25.7°C |
| **Relative Humidity:** | 49 % |
| **ATM Pressure:** | 99.8 kPa |

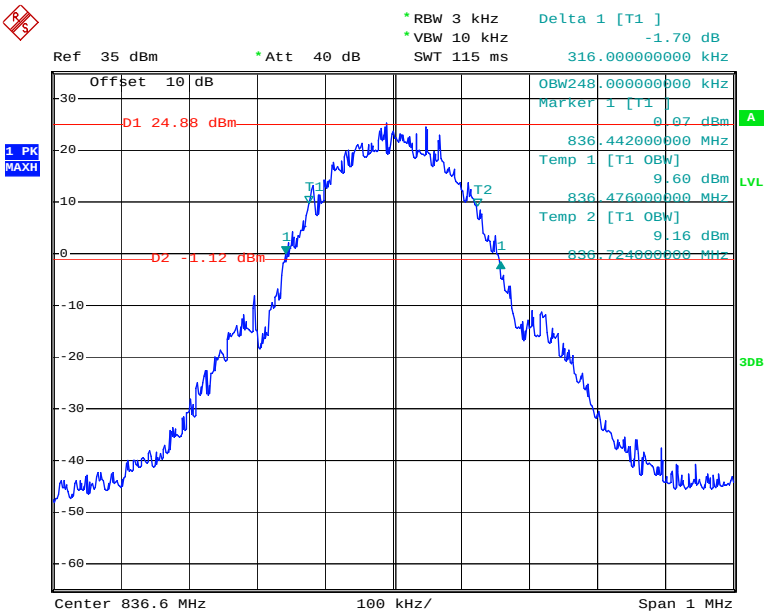
*The testing was performed by Emily Wang on 2017-08-09.*

*Test Mode: Transmitting*

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

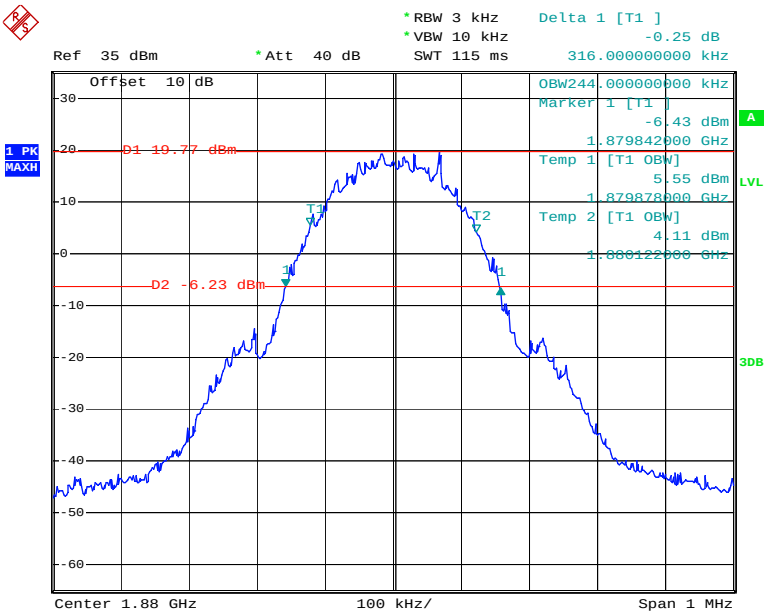
| Band | Test Channel | Mode | 99% Occupied Bandwidth (kHz) | 26 dB Occupied Bandwidth (kHz) |
|---|---|---|---|---|
| Cellular | M | GSM | 248 | 316 |
| PCS | | GSM | 244 | 316 |
| WCDMA Band II | | Rel 99 | 4100 | 4700 |
| | | HSDPA | 4120 | 4680 |
| | | HSUPA | 4140 | 4720 |
| WCDMA Band V | | Rel 99 | 4100 | 4680 |
| | | HSDPA | 4100 | 4740 |
| | | HSUPA | 4160 | 4740 |

## GMSK 850 Cellular Band



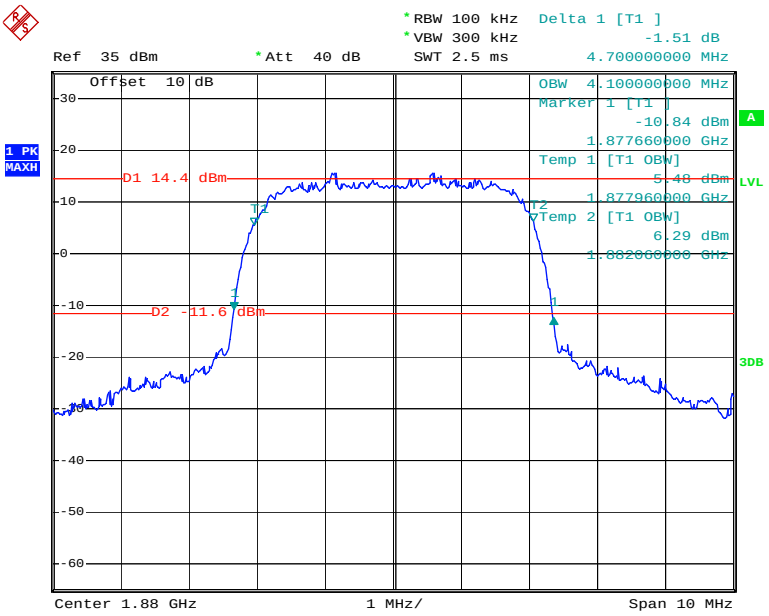

Date: 9.AUG.2017 16:03:05

## GMSK PCS1900 Cellular Band



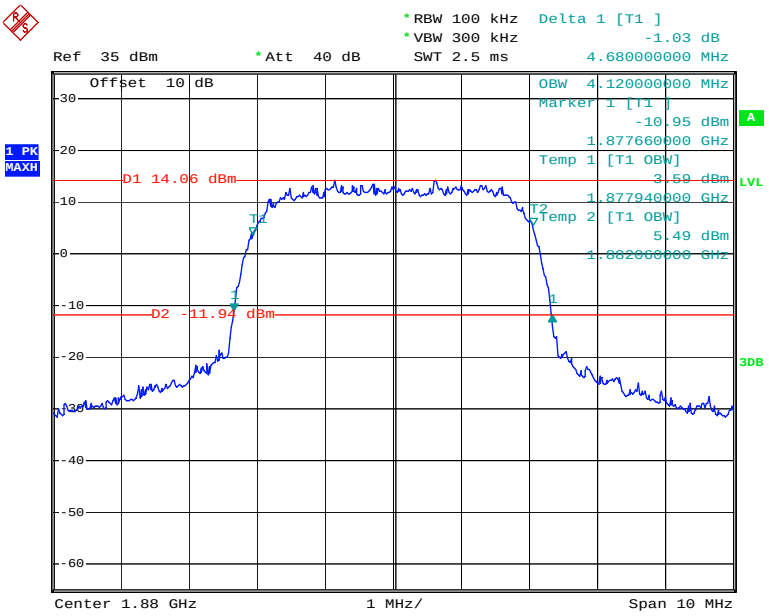

Date: 9.AUG.2017 15:28:16

## REL99 Band II



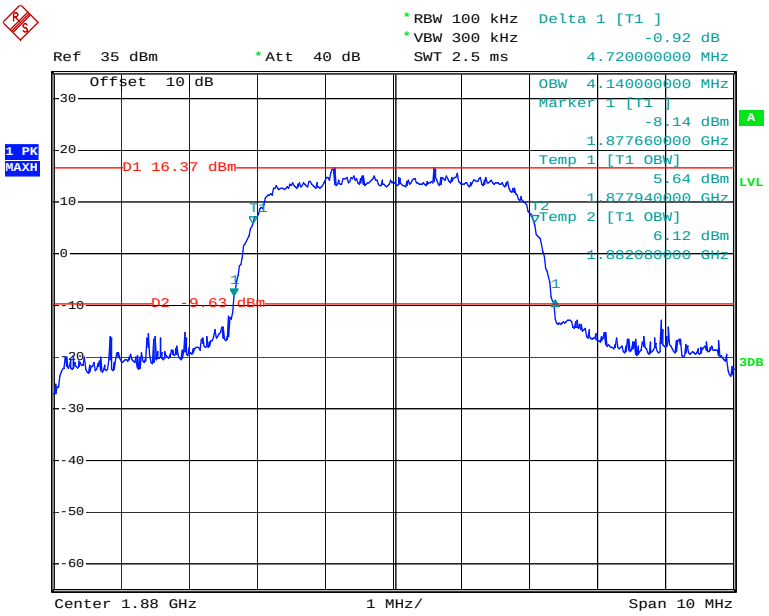

Date: 9.AUG.2017 15:38:15

## HSDPA Band II



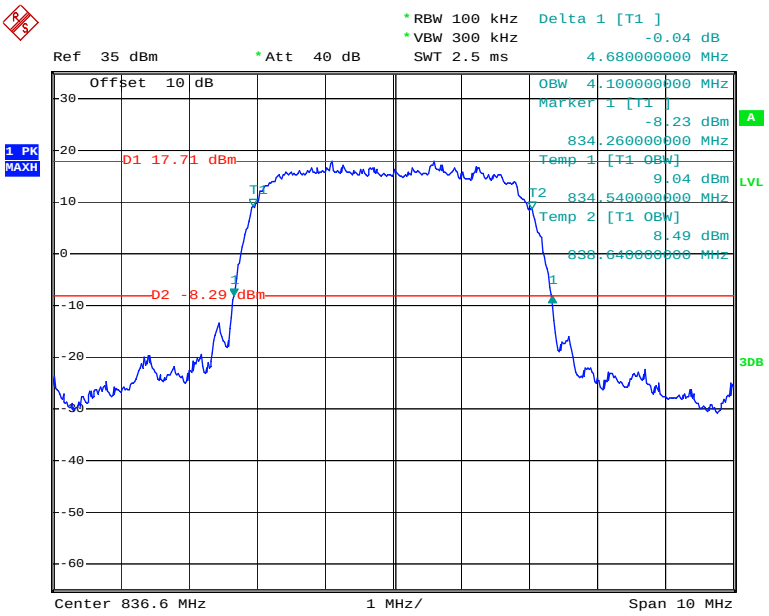

Date: 9.AUG.2017 15:51:25

## HSUPA Band II



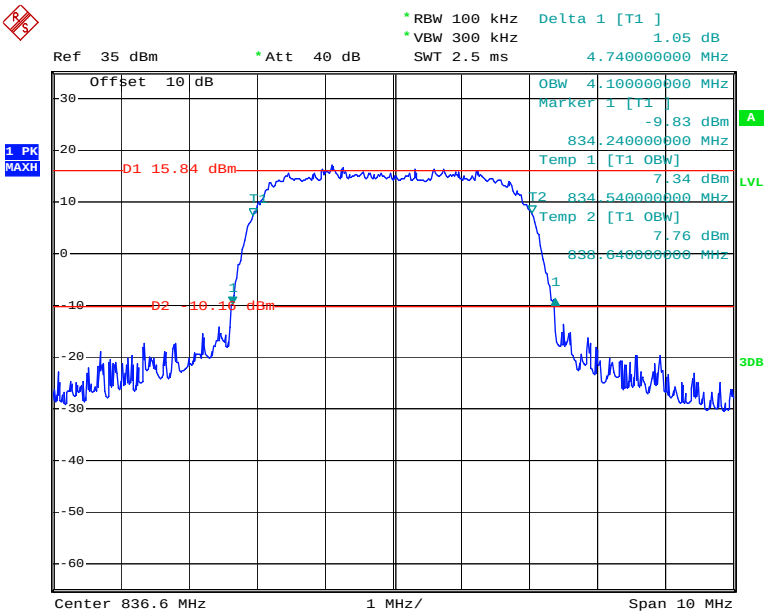

Date: 9.AUG.2017 15:57:49

## REL99 Band V



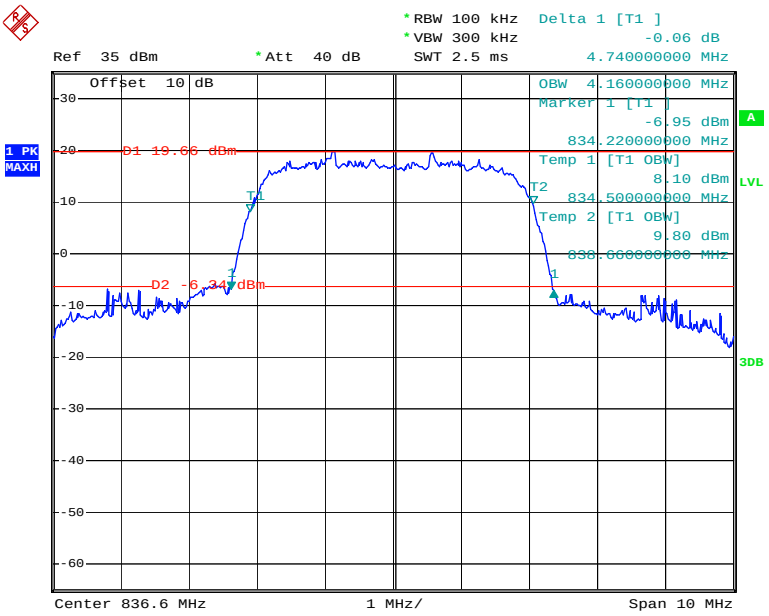

Date: 9.AUG.2017 15:43:19

## HSDPA Band V




Date: 9.AUG.2017 15:53:03

## HSUPA Band V




Date: 9.AUG.2017 15:56:20

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

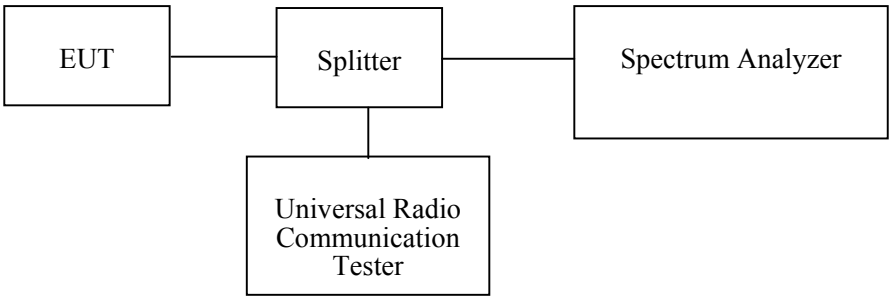
## Applicable Standard

FCC §2.1051, §22.917(a) and §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 | Universal Radio Communication Tester | CMU200 | 109 038 | 2017-07-18 | 2018-07-18 |
| Unknown | Coaxial Cable | 0.1m | C-1 | Each Time | / |
| E-Microwave | RF Attenuator | 6dB | 6dB-2 | Each Time | / |
| Pasternack | RF Coaxial Cable | 0.5m | C-5 | Each Time | / |
| E-Microwave | Two-way Spliter | ODP-1-6-2S | OE0120142 | Each Time | / |
| R&S | Spectrum Analyzer | FSP 38 | 100478 | 2016/12/08 | 2017/12/08 |

*** 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

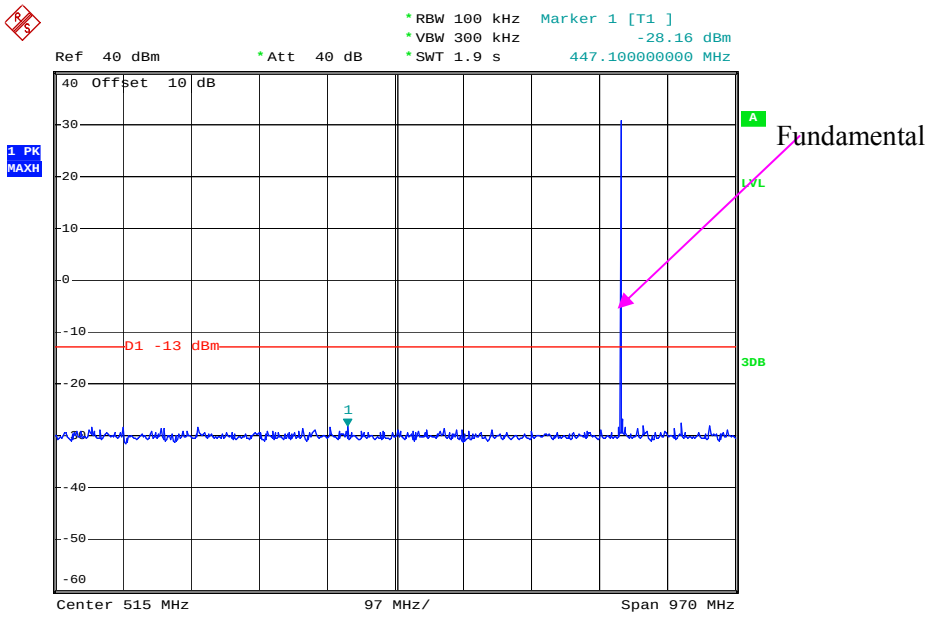
### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 25.7~27.1°C |
| **Relative Humidity:** | 49~50 % |
| **ATM Pressure:** | 99.8~99.9 kPa |

*The testing was performed by Emily Wang on 2017-08-09, 2017-08-21.*

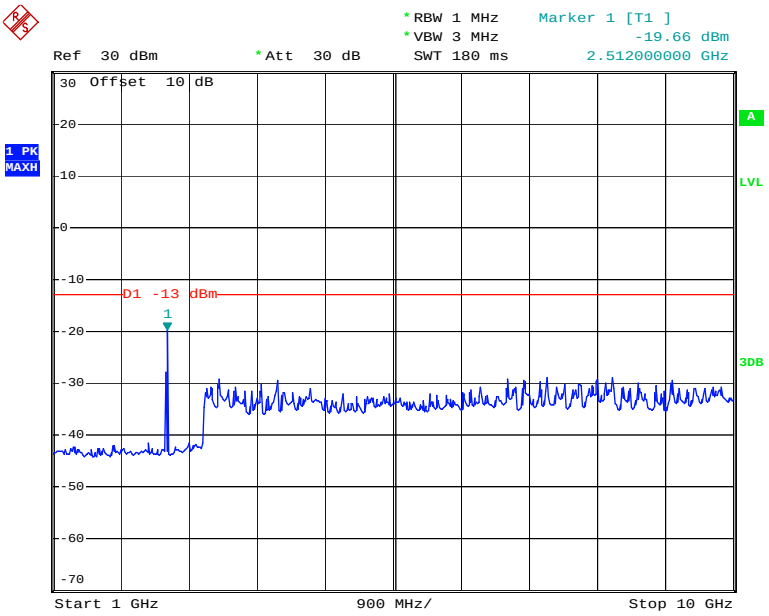
Please refer to the following plots.

**GSM850_Middle Channel**



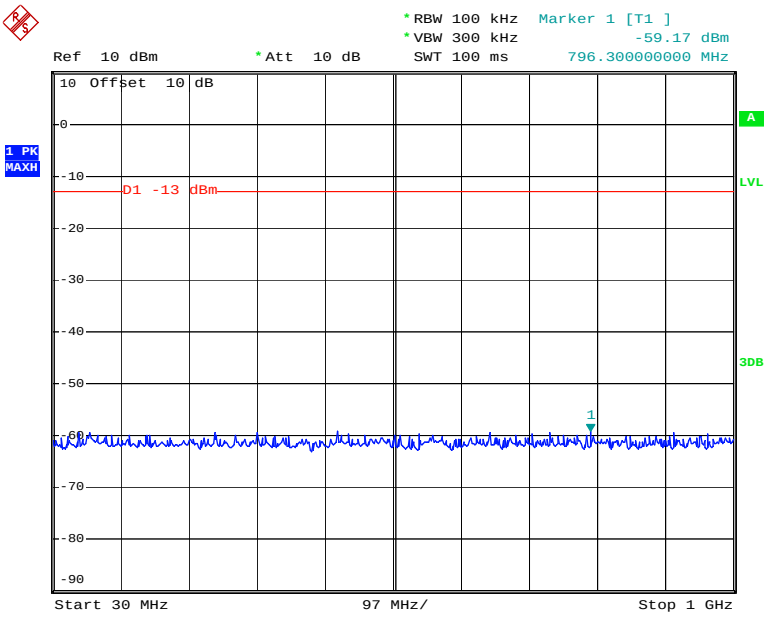

Date: 21.AUG.2017 09:30:24

## GSM850_Middle Channel



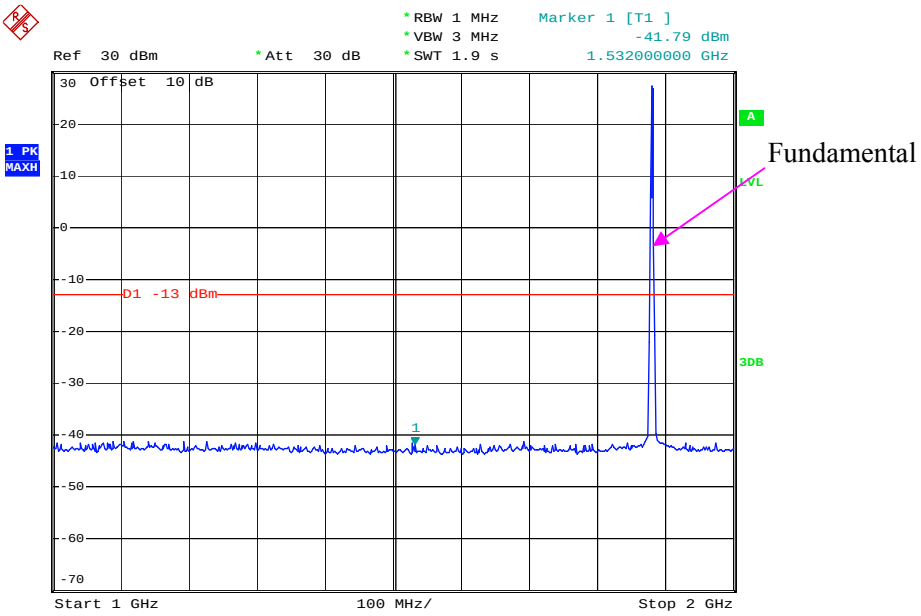

Date: 9.AUG.2017 17:52:30

## PCS 1900_ Middle Channel



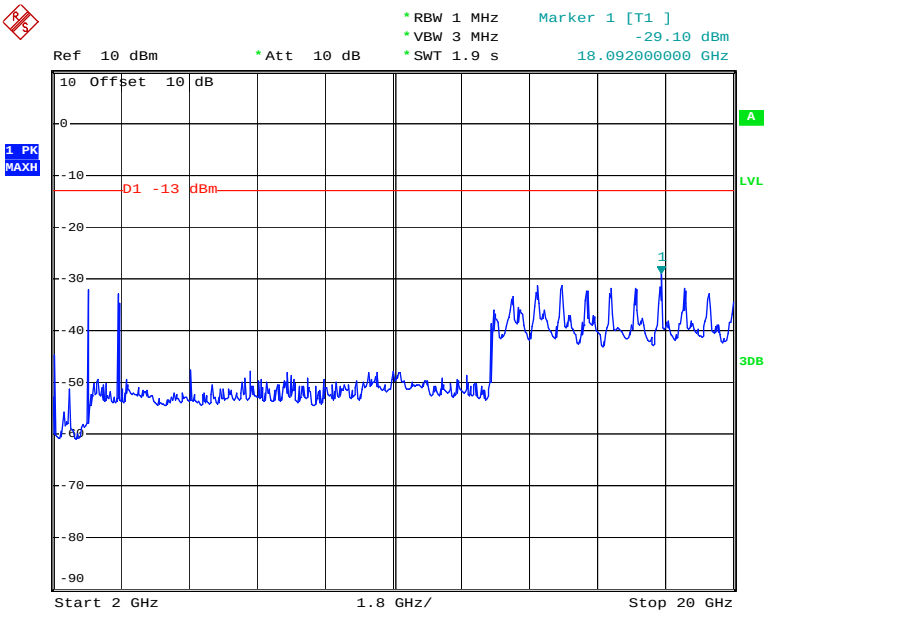

Date: 21.AUG.2017 09:56:46

**PCS 1900_ Middle Channel**



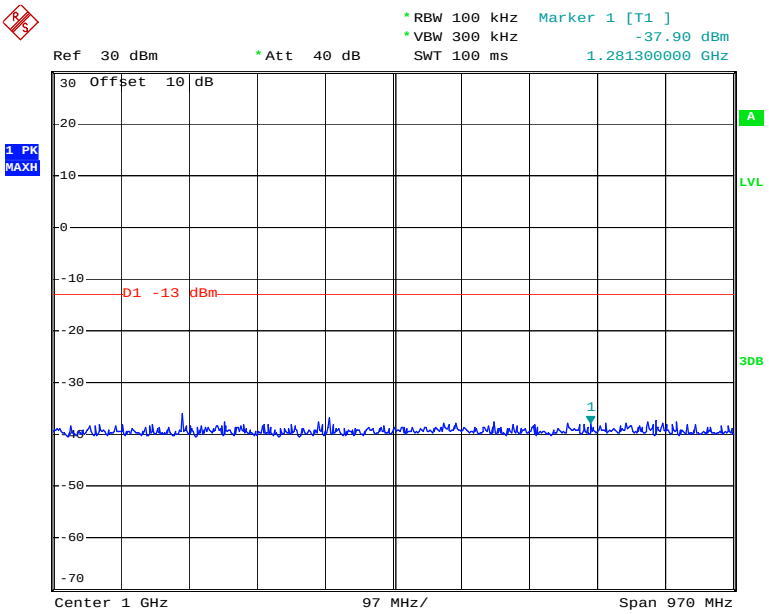

Date: 21.AUG.2017 09:37:58

**PCS 1900_ Middle Channel**



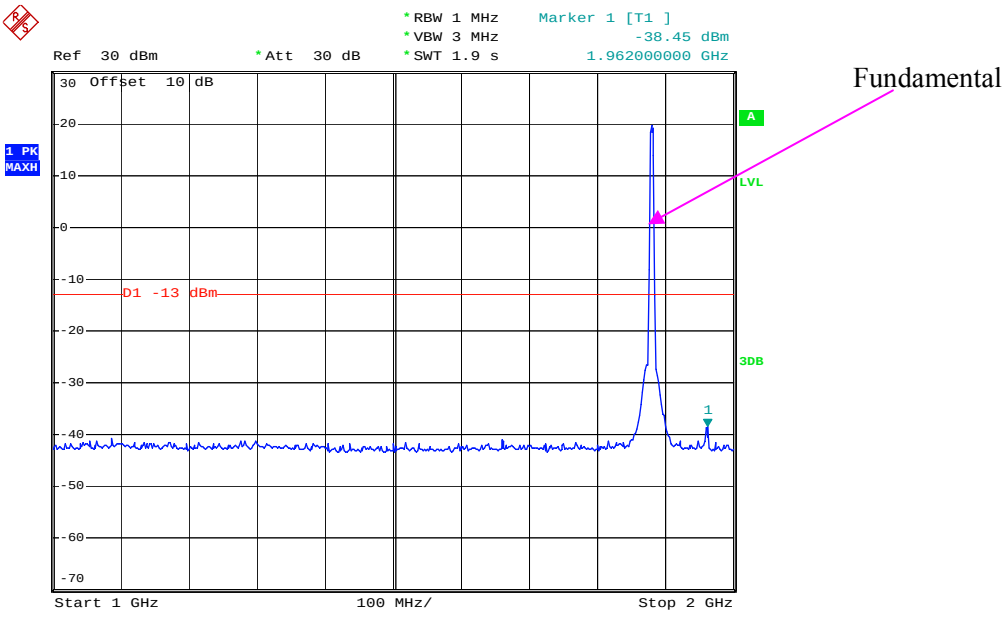

Date: 21.AUG.2017 09:40:39

**REL99 Band II_ Middle Channel**



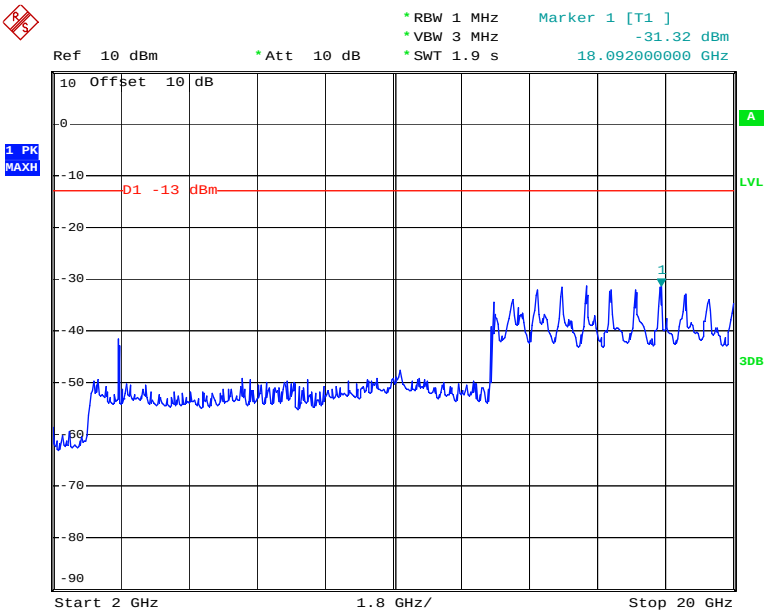

Date: 9.AUG.2017 17:28:18

**REL99 Band II_ Middle Channel**



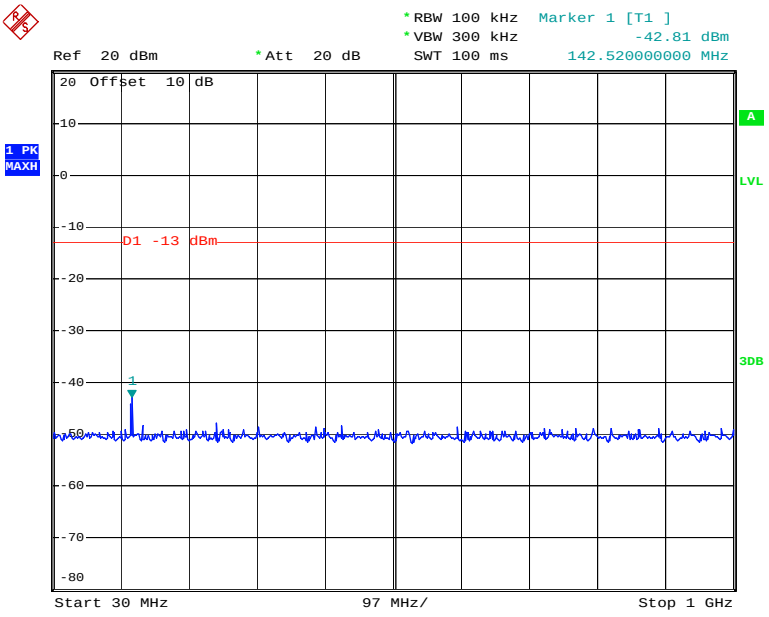

Date: 21.AUG.2017 09:50:23

## REL99 Band II_ Middle Channel



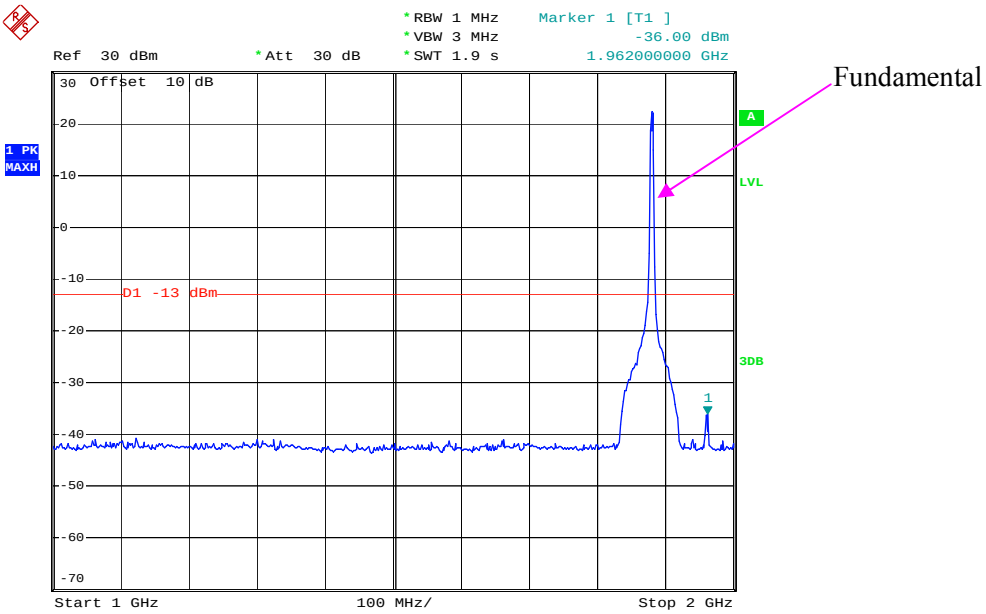

Date: 21.AUG.2017 09:51:06

## HSDPA Band II_ Middle Channel



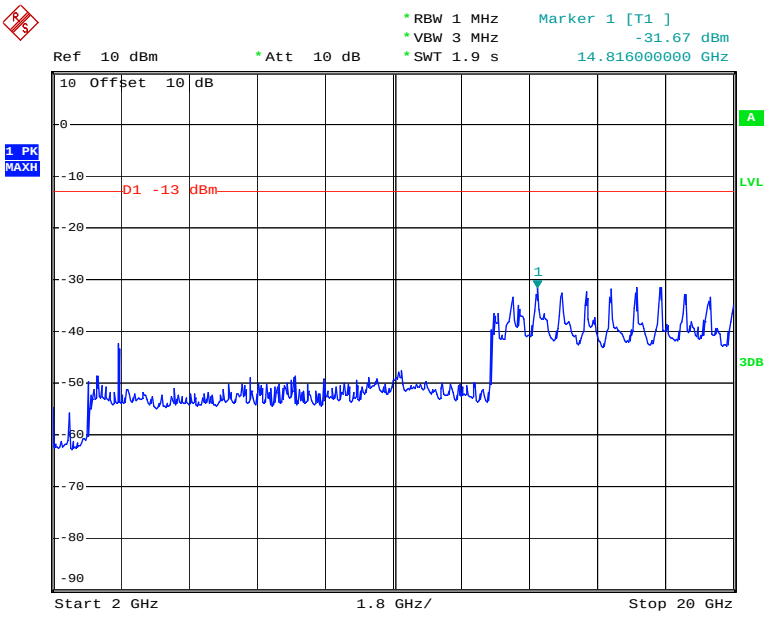

Date: 9.AUG.2017 17:34:19

**HSDPA Band II_ Middle Channel**



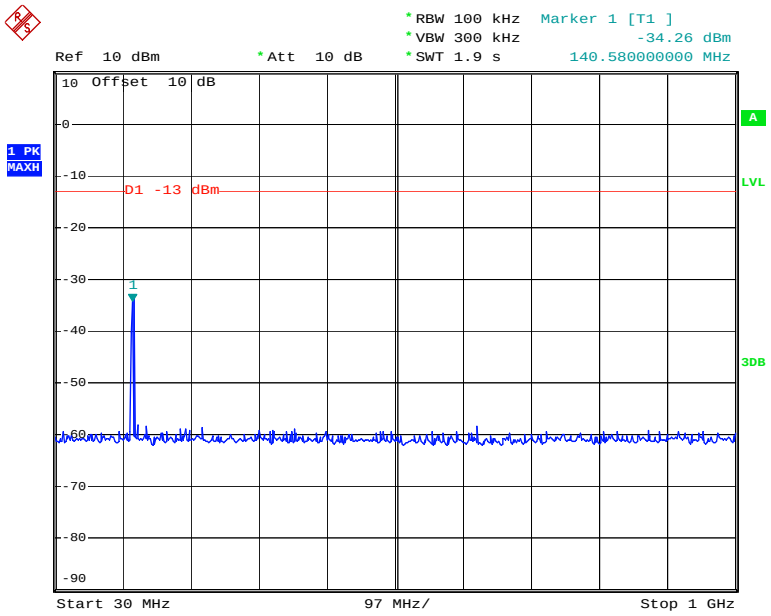

Date: 21.AUG.2017 09:46:23

**REL99 Band II_ Middle Channel**



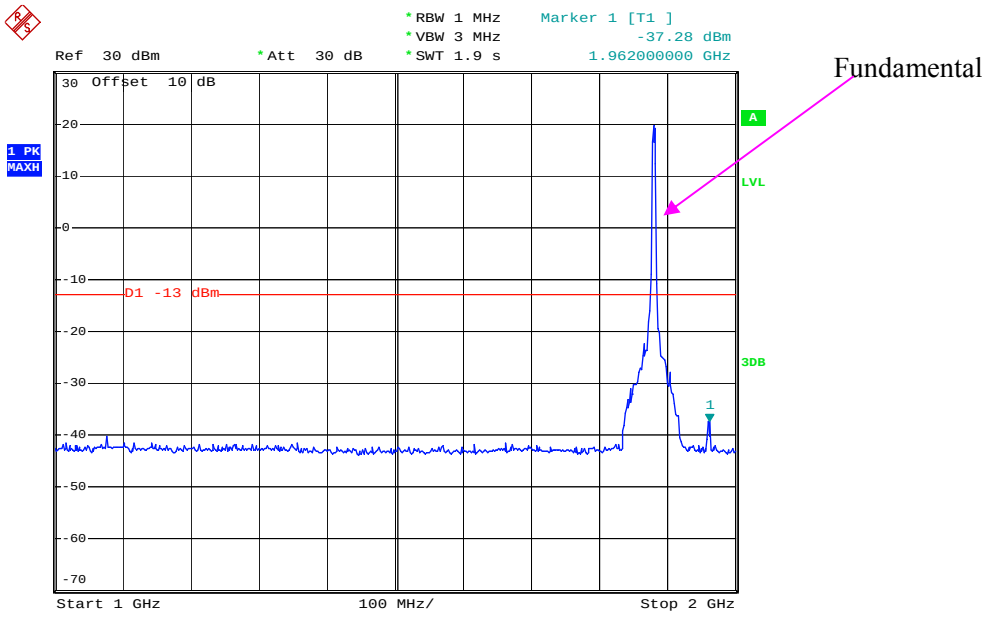

Date: 21.AUG.2017 09:47:08

**HSUPA Band II_ Middle Channel**



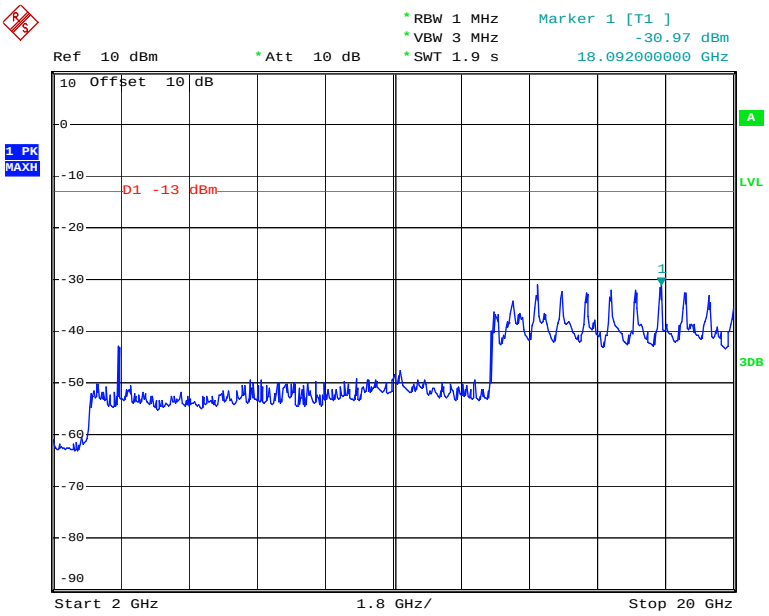

Date: 21.AUG.2017 09:55:06

**HSUPA Band II_ Middle Channel**



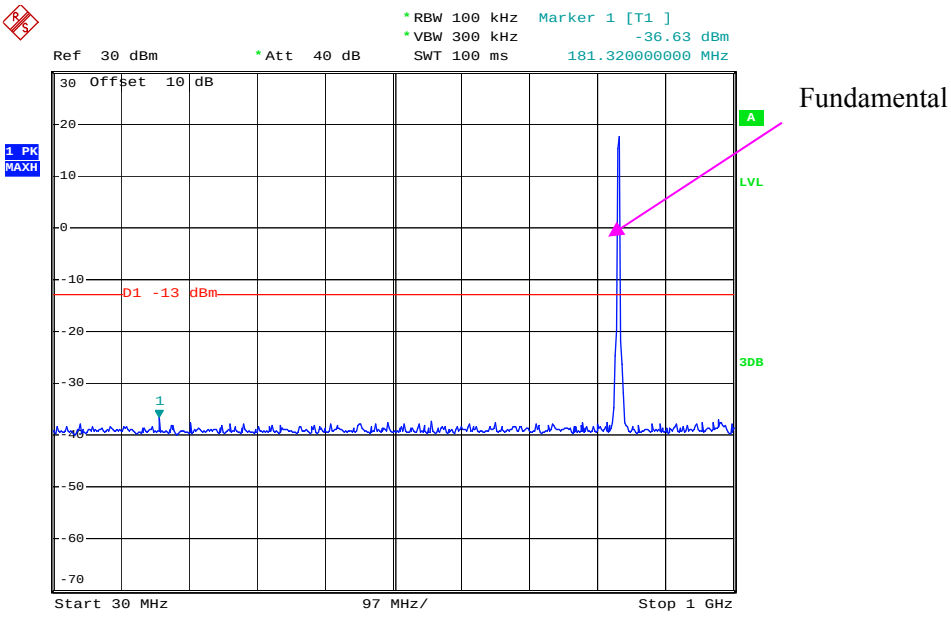

Date: 21.AUG.2017 09:56:20

## HSUPA Band II_ Middle Channel



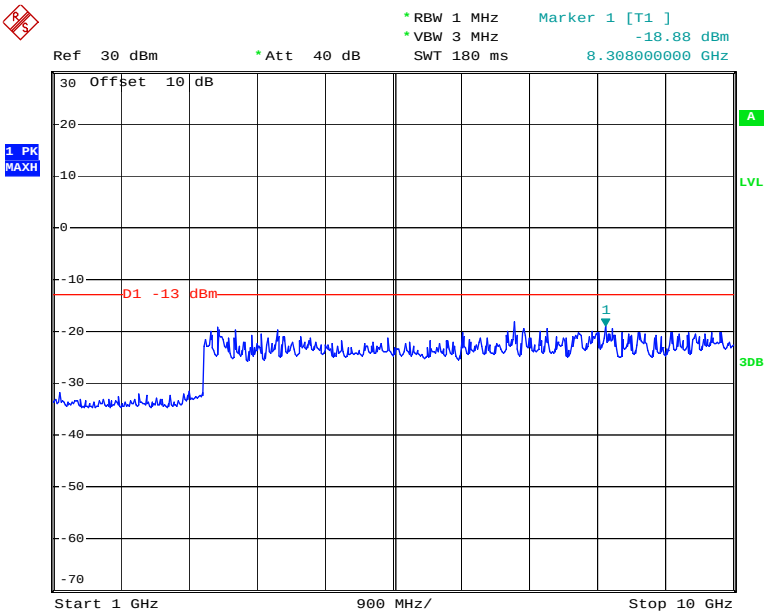

Date: 21.AUG.2017 09:56:59

## Rel 99 Band V_ Middle Channel



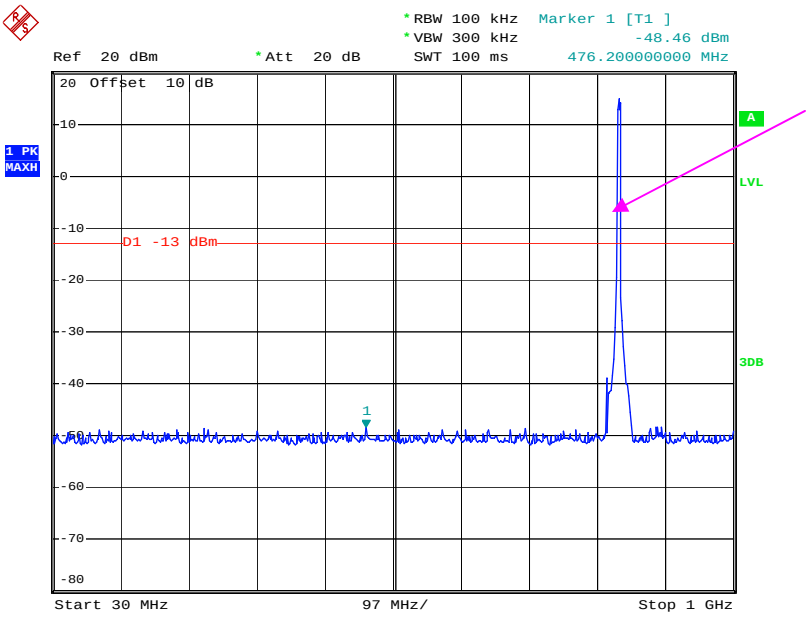

Date: 9.AUG.2017 17:22:25

## Rel 99 Band V_ Middle Channel



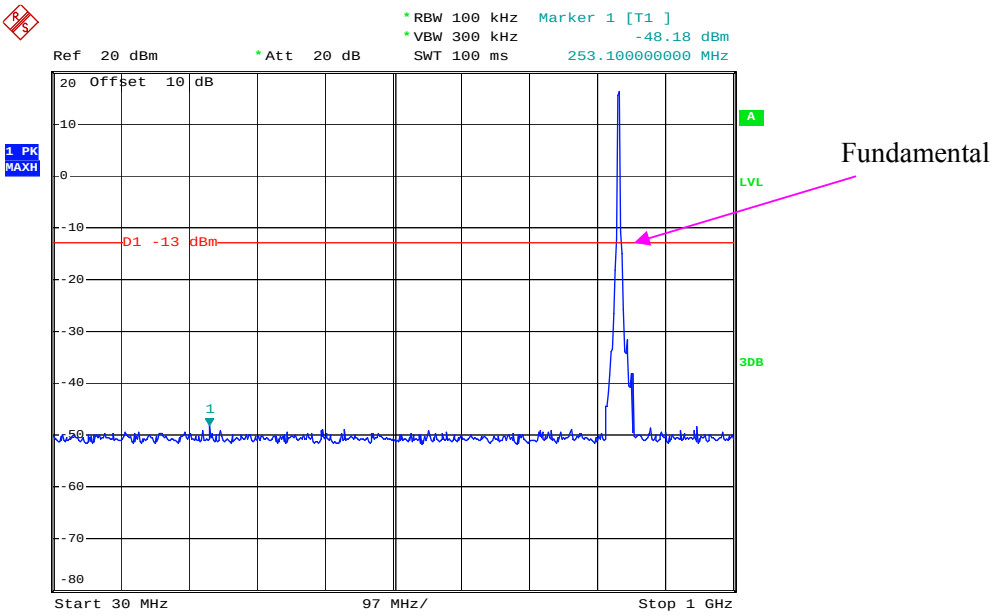

Date: 9.AUG.2017 17:25:00

## HSDPA Band V_ Middle Channel



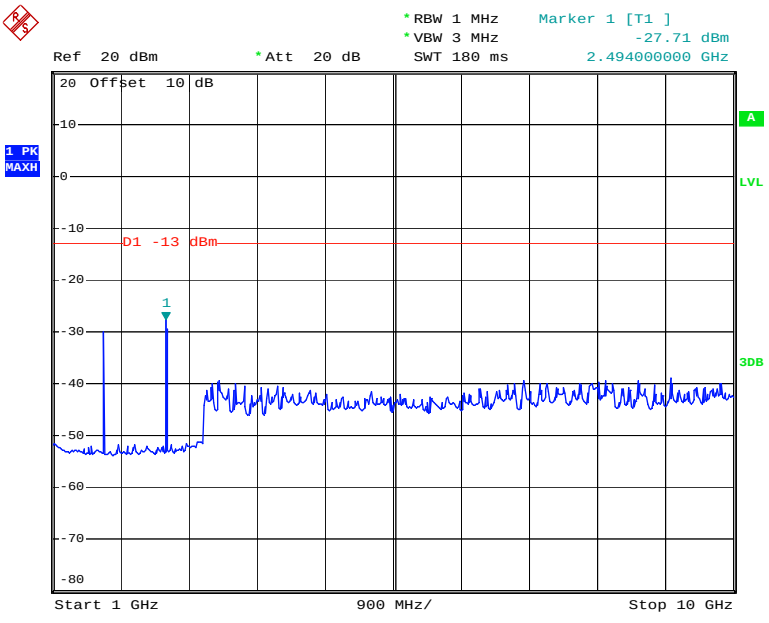

Date: 9.AUG.2017 17:39:19

**HSUPA Band V_ Middle Channel**




Date: 9.AUG.2017 17:45:12

**HSUPA Band V_ Middle Channel**




Date: 9.AUG.2017 17:44:12

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

## Applicable Standard

FCC § 2.1053, §22.917 and § 24.238.

## 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 (TXpwr in Watts/0.001) – the absolute level

Spurious attenuation limit in dB = 43 + 10 $\text{Log}_{10}$ (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 | 100224 | 2016-09-01 | 2017-09-01 |
| Sunol Sciences | Antenna | JB3 | A060611-1 | 2014-11-06 | 2017-11-05 |
| HP | Amplifier | 8447E | 2434A02181 | 2017-09-01 | 2018-09-01 |
| R&S | Spectrum Analyzer | FSU 26 | 200256 | 2016-12-08 | 2017-12-08 |
| ETS LINDGREN | Horn Antenna | 3115 | 000 527 35 | 2016-01-05 | 2019-01-04 |
| Mini-Circuit | Amplifier | ZVA-213-S+ | SN054201245 | 2017-02-19 | 2018-02-19 |
| HP | Signal Generator | 1026 | 320408 | 2016-12-08 | 2017-12-08 |
| EMCO | Adjustable Dipole Antenna | 3121C | 9109-753 | N/A | N/A |
| TDK RF | Horn Antenna | HRN-0118 | 130 084 | 2016-01-05 | 2019-01-04 |
| Ducommun Technolagies | Horn Antenna | ARH-4223-02 | 1007726-02 1304 | 2017-06-16 | 2020-06-15 |
| Ducommun Technolagies | Horn Antenna | ARH-4223-02 | 1007726-01 1304 | 2016-11-18 | 2019-11-18 |
| Unknown | Coaxial Cable | Chamber A-1 | 4m | 2016-09-01 | 2017-09-01 |
| Unknown | Coaxial Cable | Chamber B-1 | 0.75m | 2016-09-01 | 2017-09-01 |
| Unknown | Coaxial Cable | Chamber A-2 | 10m | 2016-09-01 | 2017-09-01 |
| Unknown | Coaxial Cable | Chamber B-2 | 8m | 2016-09-01 | 2017-09-01 |

*** 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:** | 27.9 °C |
| **Relative Humidity:** | 49 % |
| **ATM Pressure:** | 100.4 kPa |

** The testing was performed by Emily Wang on 2017-09-09.*

*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) |
|---|---|---|---|---|---|---|---|---|
| | | | S.G. Level (dBm) | Antenna Gain (dBd/dBi) | Cable Loss (dB) | | | |
| GSM850, Frequency:836.600 MHz | | | | | | | | |
| 1673.200 | H | 49.49 | -64.7 | 10.6 | 0.7 | -54.8 | -13.0 | 41.8 |
| 1673.200 | V | 48.53 | -66.3 | 10.6 | 0.7 | -56.4 | -13.0 | 43.4 |
| 2509.800 | H | 62.36 | -50.7 | 13.1 | 1.2 | -38.8 | -13.0 | 25.8 |
| 2509.800 | V | 60.28 | -52.8 | 13.1 | 1.2 | -40.9 | -13.0 | 27.9 |
| 3346.400 | H | 54.64 | -56 | 13.8 | 1.6 | -43.8 | -13.0 | 30.8 |
| 3346.400 | V | 53.23 | -57.5 | 13.8 | 1.6 | -45.3 | -13.0 | 32.3 |
| 2908.000 | H | 53.58 | -58.1 | 13.9 | 1.4 | -45.6 | -13.0 | 32.6 |
| 2908.000 | V | 53.16 | -58.8 | 13.9 | 1.4 | -46.3 | -13.0 | 33.3 |
| 181.000 | H | 49.80 | -59.9 | 0.0 | 0.4 | -60.3 | -13.0 | 47.3 |
| 353.000 | V | 57.20 | -51.8 | 0.0 | 0.6 | -52.4 | -13.0 | 39.4 |
| WCDMA Band V R99,Frequency:836.600 MHz | | | | | | | | |
| 1673.200 | H | 47.20 | -67 | 10.6 | 0.7 | -57.1 | -13.0 | 44.1 |
| 1673.200 | V | 47.13 | -67.7 | 10.6 | 0.7 | -57.8 | -13.0 | 44.8 |
| 2509.800 | H | 46.97 | -66 | 13.1 | 1.2 | -54.1 | -13.0 | 41.1 |
| 2509.800 | V | 46.61 | -66.4 | 13.1 | 1.2 | -54.5 | -13.0 | 41.5 |
| 3346.400 | H | 47.94 | -62.7 | 13.8 | 1.6 | -50.5 | -13.0 | 37.5 |
| 3346.400 | V | 47.76 | -62.9 | 13.8 | 1.6 | -50.7 | -13.0 | 37.7 |
| 5825.000 | H | 50.05 | -55.8 | 14.1 | 1.4 | -43.1 | -13.0 | 30.1 |
| 5825.000 | V | 46.61 | -59.3 | 14.1 | 1.4 | -46.6 | -13.0 | 33.6 |
| 881.000 | H | 59.10 | -38.3 | 0.0 | 1 | -39.3 | -13.0 | 26.3 |
| 881.000 | V | 51.20 | -48.6 | 0.0 | 1 | -49.6 | -13.0 | 36.6 |

## 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) |
|---|---|---|---|---|---|---|---|---|
| | | | S.G. Level (dBm) | Antenna Gain (dBd/dBi) | Cable Loss (dB) | | | |
| GSM1900, Frequency:1880.000 MHz | | | | | | | | |
| 3760.000 | H | 50.75 | -58.1 | 13.8 | 1.6 | -45.9 | -13.0 | 32.9 |
| 3760.000 | V | 49.07 | -59.6 | 13.8 | 1.6 | -47.4 | -13.0 | 34.4 |
| 5640.000 | H | 48.91 | -57.1 | 14.0 | 1.3 | -44.4 | -13.0 | 31.4 |
| 5640.000 | V | 48.52 | -57.4 | 14.0 | 1.3 | -44.7 | -13.0 | 31.7 |
| 4206.000 | H | 49.38 | -59.6 | 14.0 | 1.6 | -47.2 | -13.0 | 34.2 |
| 4206.000 | V | 48.23 | -60.7 | 14.0 | 1.6 | -48.3 | -13.0 | 35.3 |
| 88.000 | H | 50.70 | -60.9 | 0.0 | 0.4 | -61.3 | -13.0 | 48.3 |
| 53.000 | V | 56.80 | -46.4 | -13.5 | 0.2 | -60.1 | -13.0 | 47.1 |
| WCDMA Band II, R99, Frequency:1880.000 MHz | | | | | | | | |
| 3760.000 | H | 57.68 | -51.1 | 13.8 | 1.6 | -38.9 | -13.0 | 25.9 |
| 3760.000 | V | 57.39 | -51.3 | 13.8 | 1.6 | -39.1 | -13.0 | 26.1 |
| 5640.000 | H | 50.76 | -55.3 | 14.0 | 1.3 | -42.6 | -13.0 | 29.6 |
| 5640.000 | V | 50.59 | -55.3 | 14.0 | 1.3 | -42.6 | -13.0 | 29.6 |
| 3918.000 | H | 49.67 | -58.3 | 13.5 | 1.5 | -46.3 | -13.0 | 33.3 |
| 3918.000 | V | 49.23 | -58.7 | 13.5 | 1.5 | -46.7 | -13.0 | 33.7 |
| 198.000 | H | 49.30 | -59.5 | 0.0 | 0.5 | -60.0 | -13.0 | 47.0 |
| 701.000 | V | 44.80 | -59.1 | 0.0 | 0.9 | -60.0 | -13.0 | 47.0 |

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 = SG Level - Cable loss + Antenna Gain
3) Margin = Limit-Absolute Level

# FCC §22.917(a) & §24.238(a) - BAND EDGES

## Applicable Standard

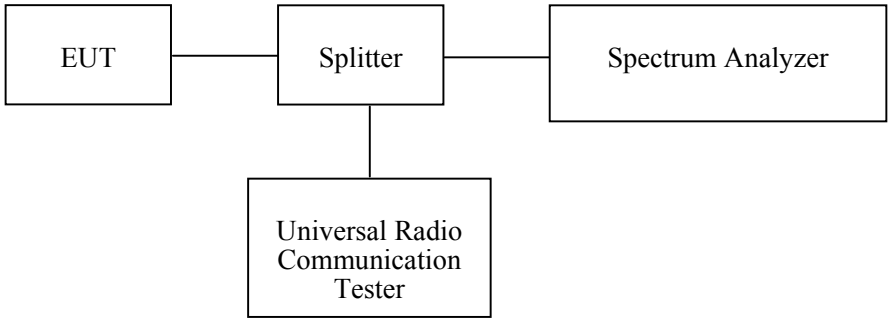
According to § 22.917(a), the power of any emissions outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

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.

## 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 | Universal Radio Communication Tester | CMU200 | 109 038 | 2017-07-18 | 2018-07-18 |
| Unknown | Coaxial Cable | 0.1m | C-1 | Each Time | / |
| E-Microwave | RF Attenuator | 6dB | 6dB-2 | Each Time | / |
| Pasternack | RF Coaxial Cable | 0.5m | C-5 | Each Time | / |
| E-Microwave | Two-way Spliter | ODP-1-6-2S | OE0120142 | Each Time | / |
| R&S | Spectrum Analyzer | FSP 38 | 100478 | 2016/12/08 | 2017/12/08 |

*** 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

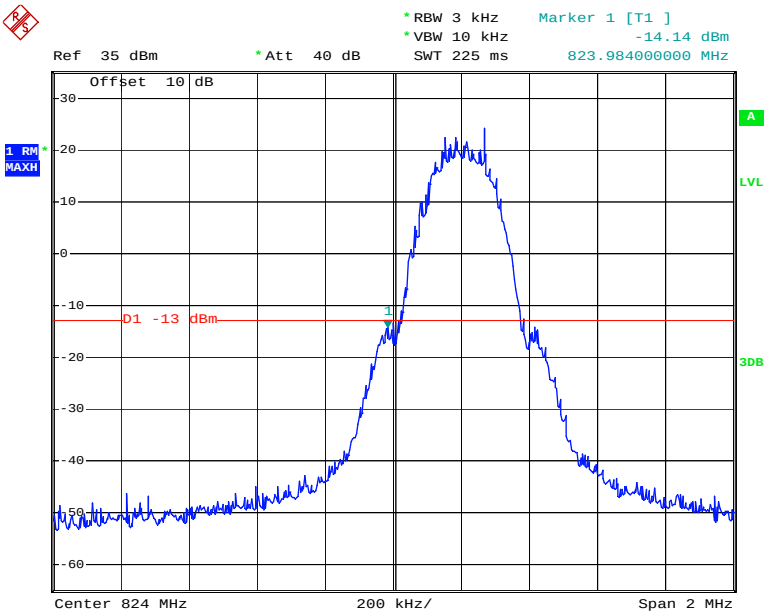
## Environmental Conditions

| | |
|---|---|
| **Temperature:** | 25.7°C |
| **Relative Humidity:** | 49 % |
| **ATM Pressure:** | 99.8 kPa |

*The testing was performed by Emily Wang on 2017-08-09.*
*Test Mode: Transmitting*

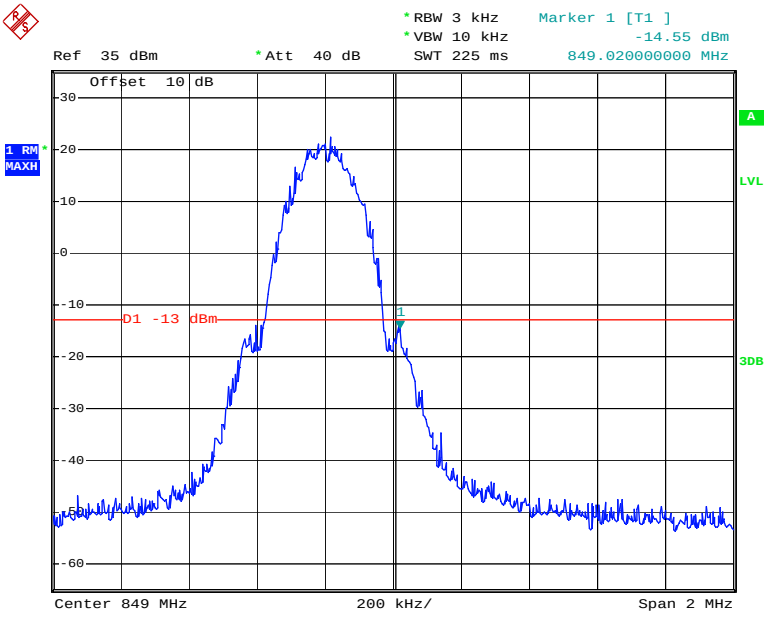
*Test Result: Compliant. Please refer to the following plots.*

**GSM 850, Left Band Edge**



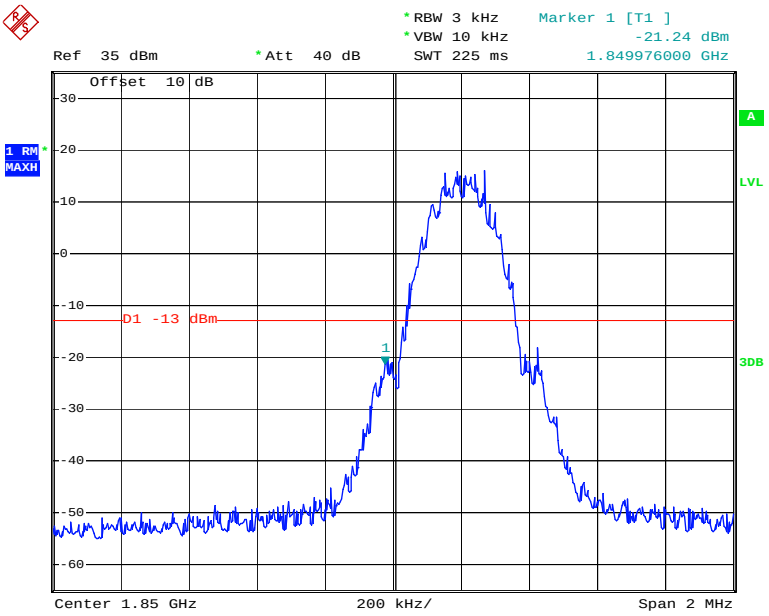

Date: 9.AUG.2017 16:10:50

**GSM 850, Right Band Edge**



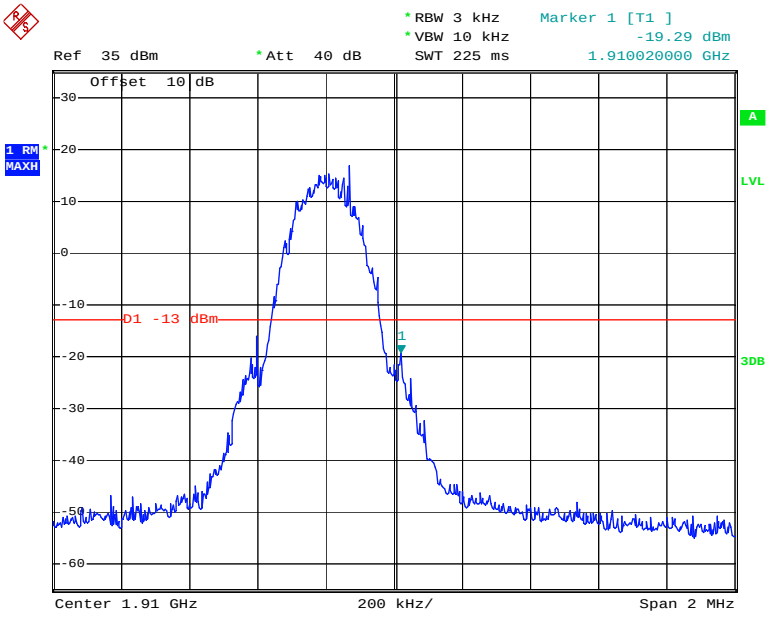

Date: 9.AUG.2017 16:12:29

**PCS 1900, Left Band Edge**




Date: 9.AUG.2017 16:14:52

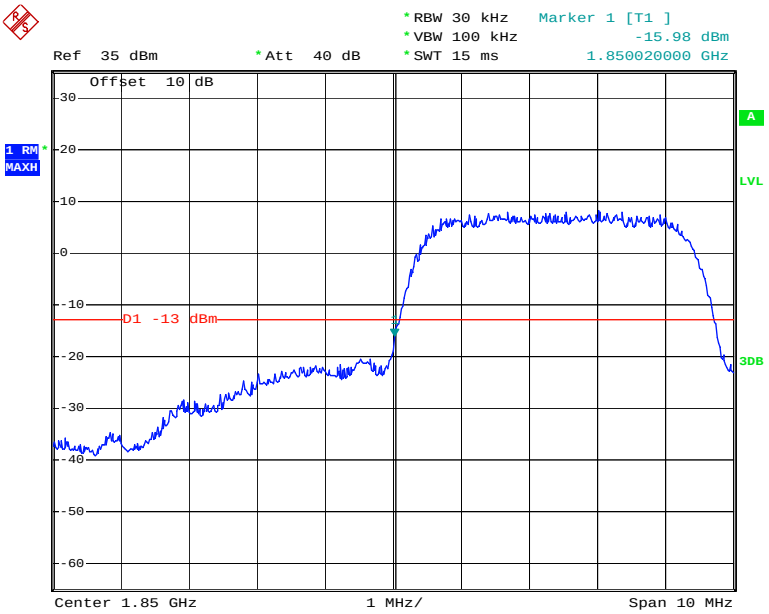
**PCS 1900, Right Band Edge**




Date: 9.AUG.2017 16:17:28

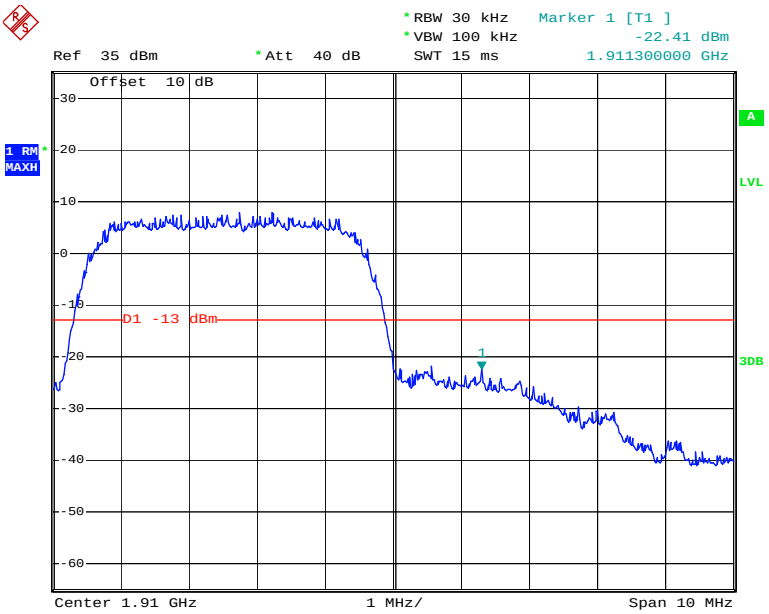
WCDMA Band II:

**REL99 Band II, Left Band Edge**



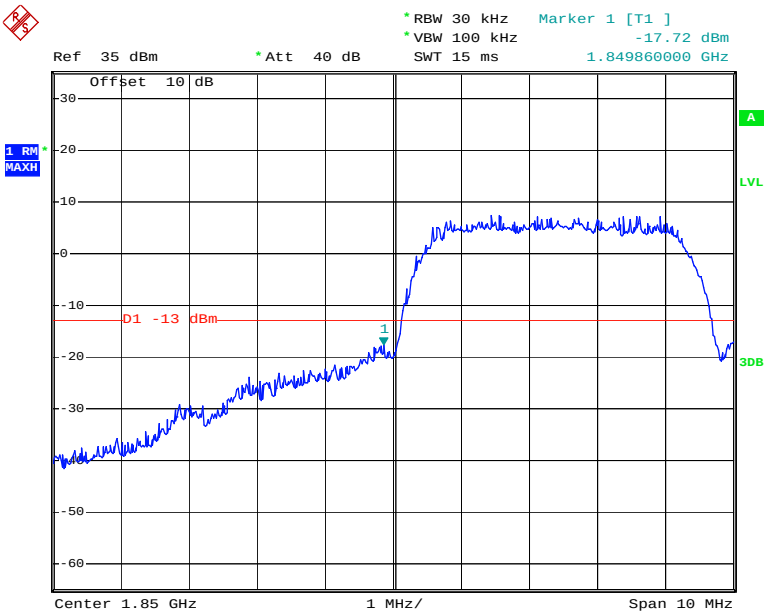

Date: 9.AUG.2017 16:58:16

**REL99 Band II, Right Band Edge**



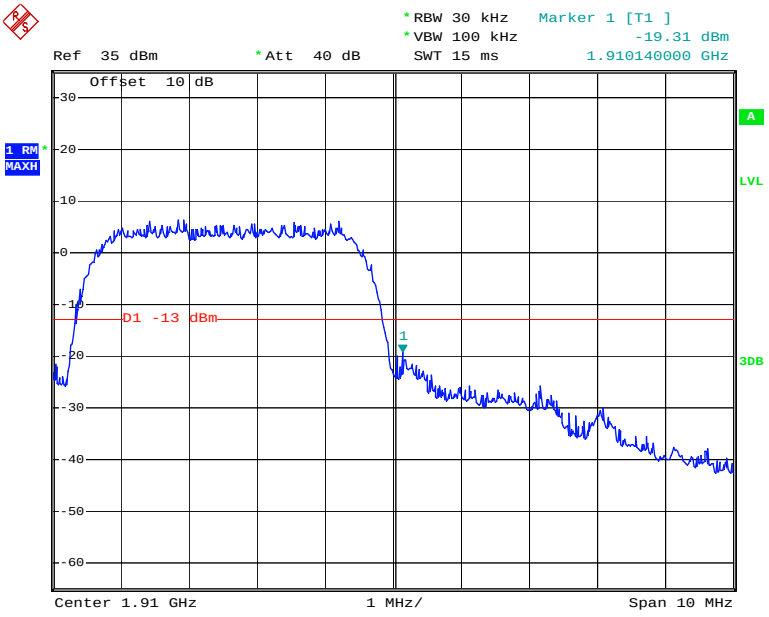

Date: 9.AUG.2017 16:22:49

**HSDPA Band II, Left Band Edge**



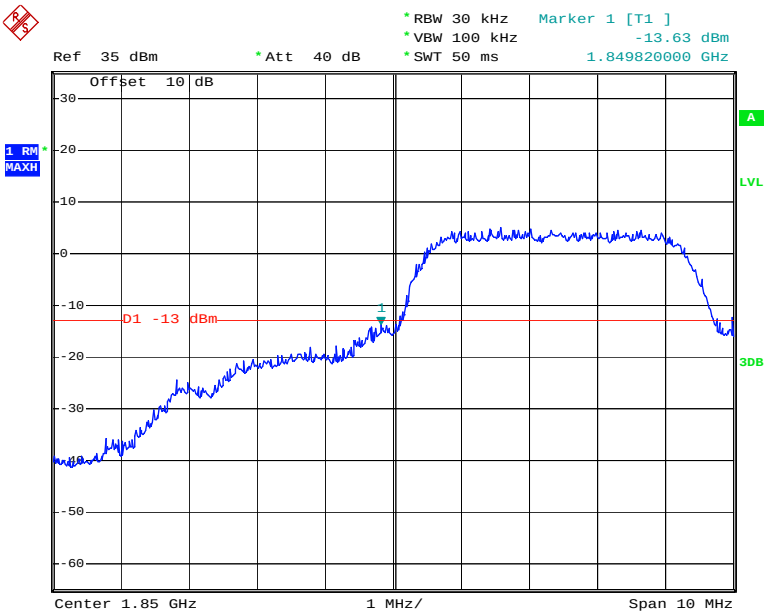

Date: 9.AUG.2017 16:35:29

**HSDPA Band II, Right Band Edge**



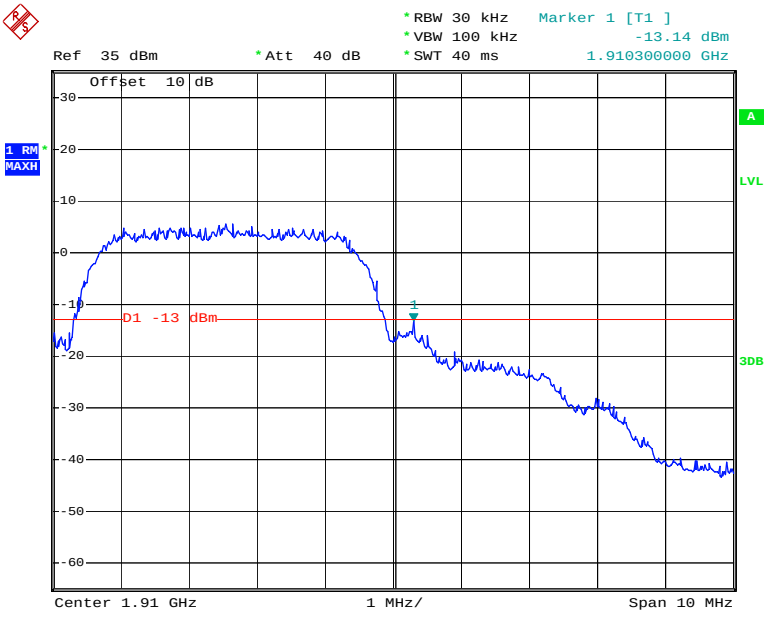

Date: 9.AUG.2017 16:37:29

**HSUPA Band II, Left Band Edge**




Date: 9.AUG.2017 16:48:57

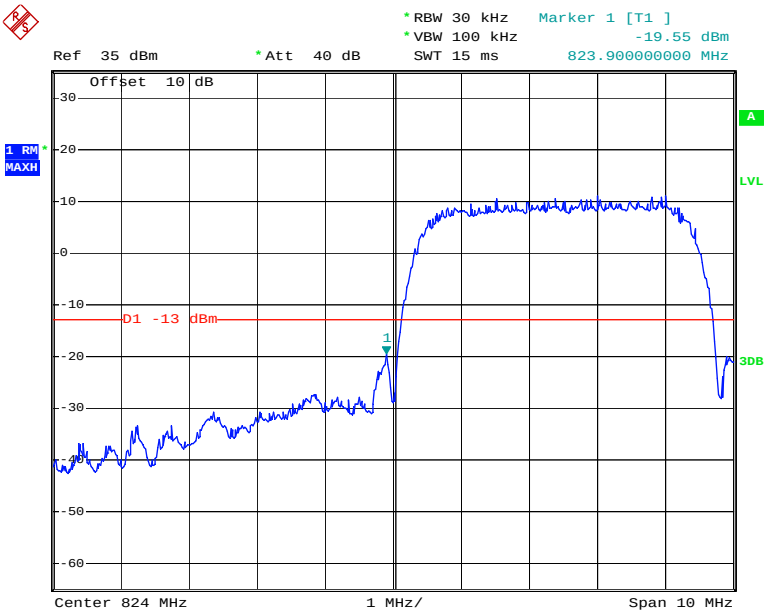
**HSUPA Band II, Right Band Edge**




Date: 9.AUG.2017 16:50:32

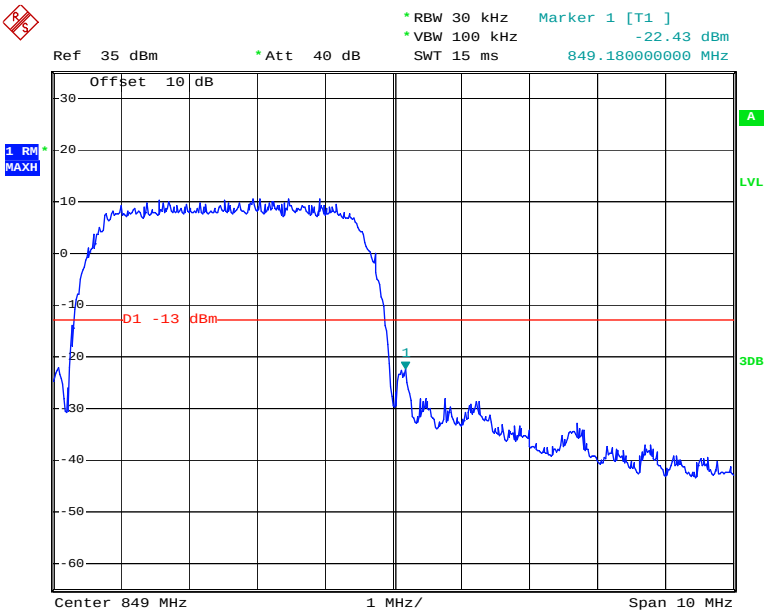
WCDMA Band V

**REL99 Band V, Left Band Edge**



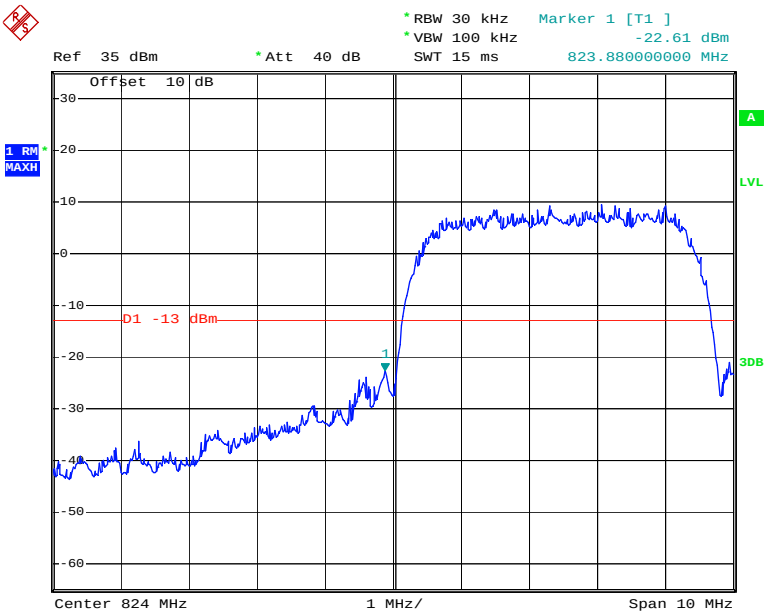

Date: 9.AUG.2017 16:25:07

**REL99 Band V Right Band Edge**



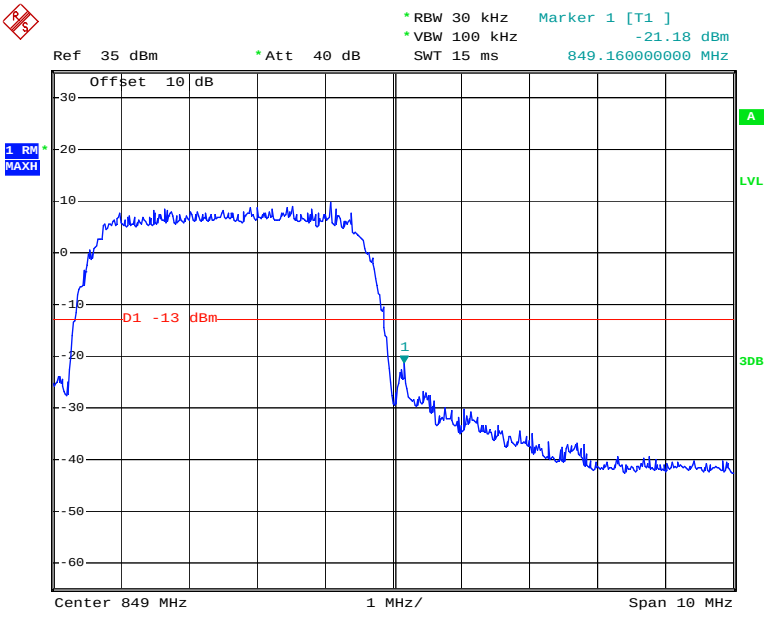

Date: 9.AUG.2017 16:25:59

**HSDPA Band V, Left Band Edge**



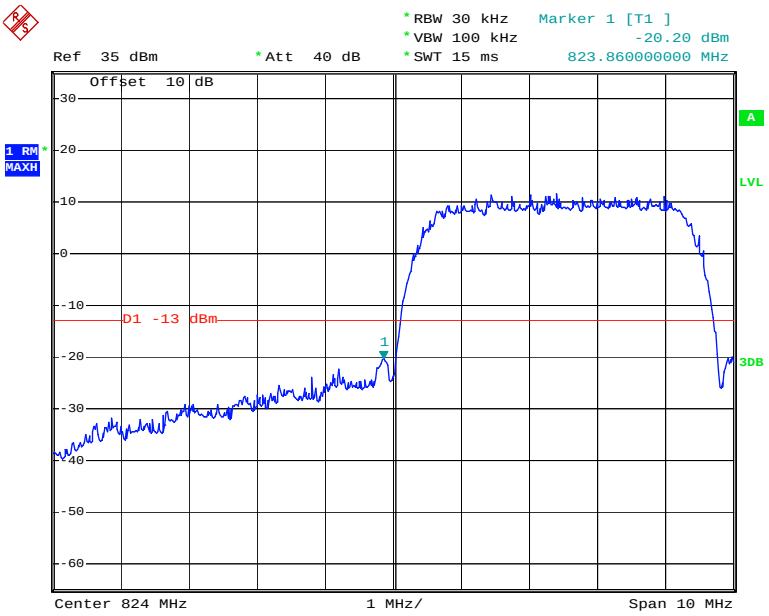

Date: 9.AUG.2017 16:38:41

**HSDPA Band V, Right Band Edge**



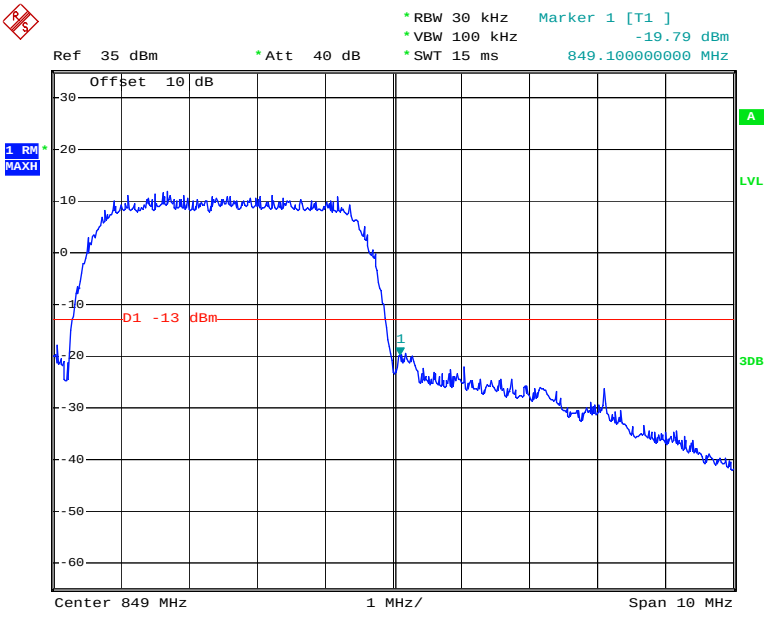

Date: 9.AUG.2017 16:41:53

**HSUPA Band V, Left Band Edge**




Date: 9.AUG.2017 16:53:07

**HSUPA Band V, Right Band Edge**




Date: 9.AUG.2017 16:54:52

# 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 |

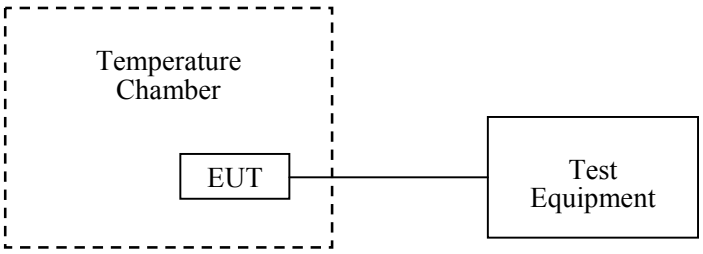
According to §24.235, the frequency stability shall be sufficient to ensure that the fundamental emissions stays within the authorized frequency block.

## 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 |
|---|---|---|---|---|---|
| Dongzhixu | High Temperature Test Chamber | DP1000 | 201105083-4 | 2016-09-10 | 2017-09-09 |
| R&S | Universal Radio Communication Tester | CMU200 | 109 038 | 2017-07-18 | 2018-07-18 |
| UNI-T | Multimeter | UT39A | M130199938 | 2017-04-02 | 2018-04-02 |
| Unknown | Coaxial Cable | 0.1m | C-1 | Each Time | / |
| Pro instrument | DC Power Supply | pps3300 | N/A | 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:** | 25.7°C |
| **Relative Humidity:** | 49 % |
| **ATM Pressure:** | 99.8 kPa |

*The testing was performed by Emily Wang on 2017-08-09.*

.

### Cellular Band (Part 22H)

| GMSK, Middle Channel, $f_c$ = 836.6 MHz | | | | |
|---|---|---|---|---|
| **Temperature** | **Voltage** | **Frequency Error** | **Frequency Error** | **Limit** |
| **℃** | **$V_{DC}$** | **Hz** | **ppm** | **ppm** |
| -30 | 3.7 | -7 | -0.008 | 2.5 |
| -20 | | -6 | -0.007 | |
| -10 | | -9 | -0.011 | |
| 0 | | -7 | -0.008 | |
| 10 | | -6 | -0.007 | |
| 20 | | -8 | -0.010 | |
| 30 | | -9 | -0.011 | |
| 40 | | -6 | -0.007 | |
| 50 | | -5 | -0.006 | |
| 25 | 3.5 | -8 | -0.010 | |
| 25 | 4.2 | -7 | -0.008 | |

**PCS Band (Part 24E)**

| GMSK, Middle Channel, $f_c$ = 1880.0 MHz | | | | |
|---|---|---|---|---|
| **Temperature** | **Voltage** | **Frequency Error** | **Frequency Error** | **Results** |
| **℃** | **$V_{DC}$** | **Hz** | **ppm** | |
| -30 | 3.7 | -8 | -0.004 | Pass |
| -20 | | -7 | -0.004 | |
| -10 | | -9 | -0.005 | |
| 0 | | -8 | -0.004 | |
| 10 | | -5 | -0.003 | |
| 20 | | -7 | -0.004 | |
| 30 | | -6 | -0.003 | |
| 40 | | -4 | -0.002 | |
| 50 | | -5 | -0.003 | |
| 25 | 3.5 | -6 | -0.003 | |
| 25 | 4.2 | -8 | -0.004 | |

**WCDMA Band II: R99**

| Middle Channel, $f_c$ = 1880.0 MHz | | | | |
|---|---|---|---|---|
| **Temperature** | **Voltage** | **Frequency Error** | **Frequency Error** | **Results** |
| **℃** | **$V_{DC}$** | **Hz** | **ppm** | |
| -30 | 3.7 | -5 | -0.003 | Pass |
| -20 | | -8 | -0.004 | |
| -10 | | -9 | -0.005 | |
| 0 | | -6 | -0.003 | |
| 10 | | -7 | -0.004 | |
| 20 | | -8 | -0.004 | |
| 30 | | -9 | -0.005 | |
| 40 | | -6 | -0.003 | |
| 50 | | -9 | -0.005 | |
| 25 | 3.5 | -8 | -0.004 | |
| 25 | 4.2 | -7 | -0.004 | |

**WCDMA Band V: R99**

| Middle Channel, $f_c$ = 836.6 MHz | | | | |
|---|---|---|---|---|
| **Temperature** | **Voltage** | **Frequency Error** | **Frequency Error** | **Limit** |
| **℃** | **$V_{DC}$** | **Hz** | **ppm** | **ppm** |
| -30 | 3.7 | -6 | -0.007 | 2.5 |
| -20 | | -8 | -0.010 | 2.5 |
| -10 | | -8 | -0.010 | 2.5 |
| 0 | | -7 | -0.008 | 2.5 |
| 10 | | -9 | -0.011 | 2.5 |
| 20 | | -10 | -0.012 | 2.5 |
| 30 | | -8 | -0.010 | 2.5 |
| 40 | | -9 | -0.011 | 2.5 |
| 50 | | -7 | -0.008 | 2.5 |
| 25 | 3.5 | -8 | -0.010 | 2.5 |
| 25 | 4.2 | -9 | -0.011 | 2.5 |

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