



TESTING LABORATORY  
CERTIFICATE#4323.01



## FCC PART 22H, PART 24E

# MEASUREMENT AND TEST REPORT

For

## Shanghai HowayGIS Co., Ltd

RM230,Fawkes Building, No. 1985, Road Chunshen, Shanghai, China

**FCC ID: 2AAZD-IRHC21WE**

<b>Report Type:</b> Original Report	<b>Product Type:</b> Industrial Rugged Handheld Computer
<b>Test Engineer:</b> Winnie Yang	<i>Winnie Yang</i>
<b>Report Number:</b> RKSA190514001-00D	
<b>Report Date:</b> 2019-12-05	
<b>Reviewed By:</b> Oscar Ye EMC Manager	<i>Oscar Ye</i>
<b>Prepared By:</b> Bay Area Compliance Laboratories Corp. (Kunshan) No.248 Chenghu Road, Kunshan, Jiangsu province, China Tel: +86-0512-86175000 Fax: +86-0512-88934268 <a href="http://www.baclcorp.com.cn">www.baclcorp.com.cn</a>	

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**TABLE OF CONTENTS**

**GENERAL INFORMATION.....3**

    PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT) .....3

    OBJECTIVE .....3

    RELATED SUBMITTAL(S)/GRANT(S).....3

    TEST METHODOLOGY .....3

    MEASUREMENT UNCERTAINTY.....4

    TEST FACILITY .....4

**SYSTEM TEST CONFIGURATION.....5**

    JUSTIFICATION .....5

    CHANNEL LIST .....5

    EQUIPMENT MODIFICATIONS .....5

    SUPPORT EQUIPMENT LIST AND DETAILS .....5

    EXTERNAL CABLE LIST AND DETAILS .....6

    BLOCK DIAGRAM OF TEST SETUP .....6

**SUMMARY OF TEST RESULTS .....7**

**TEST EQUIPMENT LIST .....8**

**§1.1310 & §2.1093 –RF EXPOSURE .....10**

    APPLICABLE STANDARD .....10

    TEST RESULT .....10

**FCC §2.1047 - MODULATION CHARACTERISTIC .....11**

**§2.1046; § 22.913 (A); § 24.232 (C) - RF OUTPUT POWER.....12**

    APPLICABLE STANDARDS.....12

    TEST PROCEDURE .....12

    TEST DATA .....13

**FCC §2.1049, §22.917, §22.905, §24.238 - OCCUPIED BANDWIDTH .....20**

    APPLICABLE STANDARDS.....20

    TEST PROCEDURE .....20

    TEST DATA .....20

**§ 2.1051; § 22.917 (A); § 24.238 (A) - SPURIOUS EMISSIONS AT ANTENNA TERMINALS .....27**

    APPLICABLE STANDARDS.....27

    TEST PROCEDURE .....27

    TEST DATA .....27

**FCC § 2.1053; § 22.917 (A); § 24.238 (A) - SPURIOUS RADIATED EMISSIONS.....34**

    APPLICABLE STANDARDS.....34

    TEST PROCEDURE .....34

    TEST DATA .....34

**FCC § 22.917 (A); § 24.238 (A) - BAND EDGES.....37**

    APPLICABLE STANDARDS.....37

    TEST PROCEDURE .....37

    TEST DATA .....37

**FCC § 2.1055; § 22.355; § 24.235 - FREQUENCY STABILITY .....48**

    APPLICABLE STANDARDS.....48

    TEST PROCEDURE .....48

    TEST DATA .....49

## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

Applicant	Shanghai HowayGIS Co., Ltd
Test Model	T21
Series Model	T21M, T21P, T21T, T21N, T20
Product	Industrial Rugged Handheld Computer
Rate Voltage	DC 5V from adapter; 3.7 V from rechargeable battery
Dimension	283mm (L)* 158mm (W)* 50mm(H)

*Adapter information:*

*Model: PSM10R-050*

*Input: AC 100-240V, 50/60Hz, 0.3A*

*Output: DC 5V, 2.0A MAX*

*\*All measurement and test data in this report was gathered from production sample serial number: 20190514001.  
(Assigned by the BACL. The EUT supplied by the applicant was received on 2019-05-14)*

### Objective

This type approval report is prepared on behalf of *Shanghai HowayGIS Co., Ltd* in accordance with Part 2, Part 22-Subpart H, Part 24-Subpart E of the Federal Communication Commission's rules.

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

### Related Submittal(s)/Grant(s)

FCC Part 15.247 DSS and FCC Part 15.247 DTS submissions with FCC ID: 2AAZD-IRHC21WE.

### 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.

All radiated and conducted emissions measurements were performed at Bay Area Compliance Laboratories Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

**Measurement Uncertainty**

Item		Uncertainty
AC Power Lines Conducted Emissions		3.19dB
RF conducted test with spectrum		0.9dB
RF Output Power with Power meter		0.5dB
Radiated emission	30MHz~1GHz	6.11dB
	1GHz~6GHz	4.45dB
	6GHz~18GHz	5.23dB
	18GHz~40GHz	5.65dB
Occupied Bandwidth		0.5kHz
Temperature		1.0°C
Humidity		6%

Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

**Test Facility**

The test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01) and the FCC designation No. CN1185 under the FCC KDB 974614 D01 and CAB identifier CN0004 under the ISED requirement. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

## SYSTEM TEST CONFIGURATION

### Justification

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

The final qualification test was performed with the EUT operating at normal mode.

### Channel List

Mode	Channel		Frequency
GPRS/EGPRS 850	Low	128	824.2
	Middle	190	836.6
	High	251	848.8
GPRS/EGPRS 1900	Low	512	1850.2
	Middle	661	1880.0
	High	810	1909.8
WCDMA Band II	Low	9262	1852.4
	Middle	9400	1880.0
	High	9538	1907.6
WCDMA Band V	Low	4132	826.4
	Middle	4183	836.6
	High	4233	846.6

### Equipment Modifications

No modifications were made to the EUT.

### Support Equipment List and Details

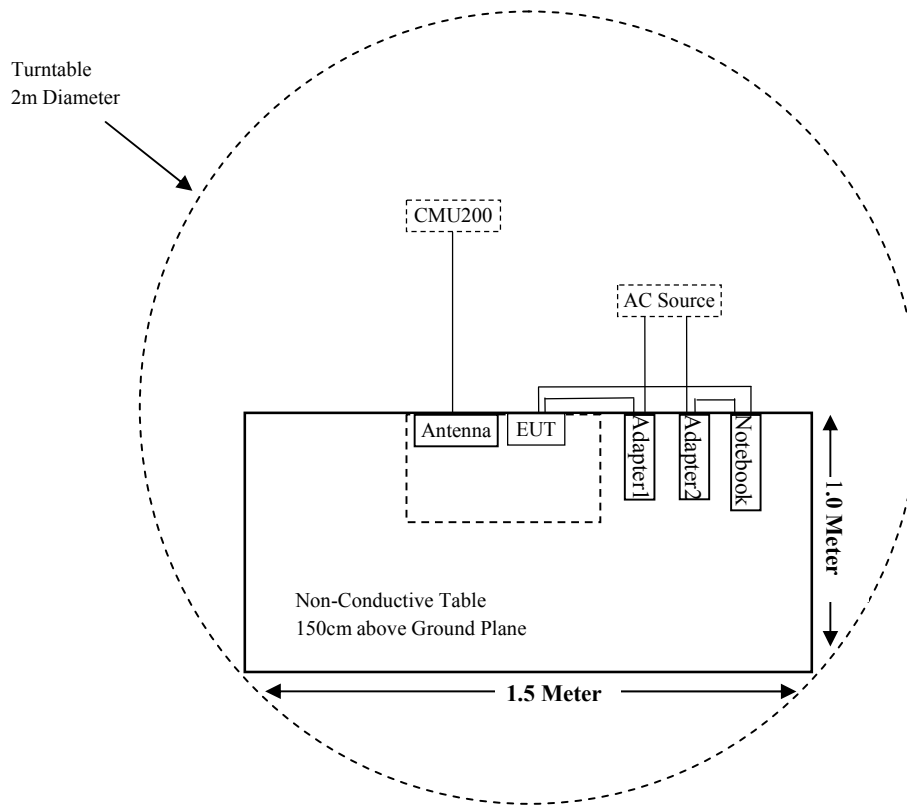
Manufacturer	Description	Model	Serial Number
DELL	Notebook	GX620	D65874152
DELL	Adapter2	LA65NS0-00	DF263

**External Cable List and Details**

Cable Description	Length (m)	From Port	To
USB Cable	1.0	EUT	Notebook
Power Cable	1.0	Adapter1	AC Source
Power Cable	1.0	Adapter2	AC Source

**Block Diagram of Test Setup**

For Radiated Emissions(Below &Above 1GHz)



**SUMMARY OF TEST RESULTS**

<b>FCC Rules</b>	<b>Description of Test</b>	<b>Result</b>
§1.1310 & §2.1093	RF EXPOSURE	Compliant
§2.1046; § 22.913 (a); § 24.232 (c)	RF Output Power	Compliant
§ 2.1047	Modulation Characteristics	Not Applicable
§ 2.1049; § 22.905; § 22.917; § 24.238	Occupied Bandwidth	Compliant
§ 2.1051; § 22.917 (a); § 24.238 (a)	Spurious Emissions at Antenna Terminal	Compliant
§ 2.1053; § 22.917 (a); § 24.238 (a)	Spurious Radiated Emissions	Compliant
§ 22.917 (a); § 24.238 (a)	Band Edge	Compliant
§ 2.1055; § 22.355; § 24.235	Frequency stability	Compliant

**TEST EQUIPMENT LIST**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
<b>Radiated Emission Test (Chamber 1#)</b>					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2018-11-30	2019-11-29
HP	Signal Generator	HP 8341B	2624A00116	2018-11-30	2019-11-29
Sunol Sciences	Broadband Antenna	JB3	A090413-1	2016-12-26	2019-12-25
Sunol Sciences	Bilog antenna	JB3	A060217	2017-08-04	2020-08-03
Sonoma Instrunent	Pre-amplifier	310N	171205	2018-08-14	2019-08-13
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-7	007	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-8	008	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2018-08-15	2019-08-14
Rohde & Schwarz	UNIVERSAL RADIO COMMUNICATION TESTER	CMU200	110605	2018-11-30	2019-11-29
<b>Radiated Emission Test (Chamber 2#)</b>					
HP	Signal Generator	HP 8341B	2624A00116	2018-11-30	2019-11-29
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2019-08-27	2020-08-26
ETS-LINDGREN	Horn Antenna	3115	9207-3900	2017-07-15	2020-07-14
ETS-LINDGREN	Horn Antenna	3115	6229	2016-12-12	2019-12-11
ETS-LINDGREN	Horn Antenna	3116	00084159	2016-12-12	2019-12-11
ETS-LINDGREN	Horn Antenna	3116	2516	2016-12-12	2019-12-11
A.H.Systems, inc	Amplifier	2641-1	491	2019-02-20	2020-02-19
SELECTOR	Amplifier	EM18G40G	060726	2019-03-22	2020-03-21
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-11	011	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-16	016	2019-08-15	2020-08-14
Rohde & Schwarz	UNIVERSAL RADIO COMMUNICATION TESTER	CMU200	110605	2018-11-30	2019-11-29



Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
<b>RF Conducted Test</b>					
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2018-11-12	2019-11-11
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2019-11-12	2020-11-11
Rohde & Schwarz	UNIVERSAL RADIO COMMUNICATION TESTER	CMU200	110605	2018-11-30	2019-11-29
BACL	Temperature & Humidity Chamber	BTH-150	30023	2018-12-20	2019-12-19
HowayGIS	RF Cable	HowayGIS C01	C01	Each Time	/

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

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## **§1.1310 &§2.1093 –RF EXPOSURE**

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### **Applicable Standard**

FCC§1.1310 &§2.1093.

### **Test Result**

Compliant, please refer to the SAR report: RKS190819050-20A.

## **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.

## **§2.1046; § 22.913 (a); § 24.232 (c) - RF OUTPUT POWER**

### **Applicable Standards**

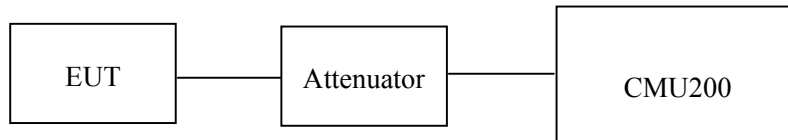
According to FCC §2.1046 and §22.913 (a), the ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 watts.

According to FCC §2.1046 and §24.232 (c), mobile and portable stations are limited to 2 watts(33dBm) EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications..

### **Test Procedure**

#### *Conducted method:*

The RF output of the transmitter was connected to the CMU200 through sufficient attenuation.



#### *Radiated Output Power:*

The measurements procedures specified in ANSI/TIA-603-D were applied.

a) Connect the equipment as illustrated. Mount the equipment with the manufacturer specified antenna in a vertical orientation on a manufacturer specified mounting surface located on a non-conducting rotating platform of a RF anechoic chamber (preferred) or a standard radiation site.

b) Key the transmitter, then rotate the EUT 360o azimuthally and record spectrum analyzer power level (LVL) measurements at angular increments that are sufficiently small to permit resolution of all peaks. If a standard radiation test site is used, raise and lower the test antenna to obtain a maximum reading at each angular increment. (Note: several batteries may be needed to offset the effect of battery voltage droop, which should not exceed 5% of the manufactured specified battery voltage during transmission).

c) Replace the transmitter under test with a vertically polarized half-wave dipole (or an antenna whose gain is known relative to an ideal half-wave dipole). The center of the antenna should be at the same location as the center of the antenna under test.

d) Connect the antenna to a signal generator with a known output power and record the path loss (in dB) as LOSS. If a standard radiation test site is used,raise and lower the test antenna to obtain a maximum reading.  
 $LOSS = \text{Generator Output Power (dBm)} - \text{Analyzer reading (dBm)}$

e) Determine the effective radiated output power at each angular position from the readings in steps b) and d) using the following equation:

$$ERP \text{ (dBm)} = LVL \text{ (dBm)} + LOSS \text{ (dB)}$$

f) The maximum ERP is the maximum value determined in the preceding step.

(Note: Effective Isotropic Radiated Power (EIRP) can be computed using the following:

$$EIRP \text{ (dBm)} = ERP \text{ (dBm)} + 2.15 \text{ (dB.)}$$

**Test Data**

**Environmental Conditions**

<b>Temperature:</b>	24.6°C
<b>Relative Humidity:</b>	50%
<b>ATM Pressure:</b>	101.2kPa

*The testing was performed by Winnie Yang on 2019-11-28.*

**Conducted Power:**

**Cellular Band**

Mode	Channel	Frequency (MHz)	Average Output Power (dBm)				Limit (dBm)
			1 slot	2 slots	3 slots	4 slots	
GPRS	128	824.2	31.55	29.65	28.35	27.25	38.45
	190	836.6	31.65	29.46	28.31	27.41	38.45
	251	848.8	31.57	29.47	28.32	27.23	38.45

Mode	Channel	Frequency (MHz)	Average Output Power (dBm)				Limit (dBm)
			1 slot	2 slots	3 slots	4 slots	
EGPRS	128	824.2	27.30	25.75	23.23	21.46	38.45
	190	836.6	27.34	25.64	23.39	21.42	38.45
	251	848.8	27.51	25.83	23.75	21.55	38.45

**WCDMA Band V**

Mode	Test Condition	Test Mode	3GPP Sub Test	Average Output Power (dBm)		
				Low Frequency	Middle Frequency	High Frequency
WCDMA (Band V)	Normal	Rel 99	1	22.67	22.66	22.75
			1	22.55	22.19	22.27
		HSDPA	2	22.19	22.16	22.29
			3	22.59	22.17	22.27
			4	22.39	22.21	22.29
			1	22.27	22.19	22.27
		HSUPA	2	22.43	22.18	22.27
			3	22.61	22.22	22.26
			4	22.59	22.17	22.28
			5	22.47	22.21	22.26

**PCS 1900 Band**

Mode	Channel	Frequency (MHz)	Average Output Power (dBm)				Limit (dBm)
			1 slot	2 slots	3 slots	4 slots	
GPRS	512	1850.2	29.79	27.87	26.83	24.79	33
	661	1880.0	29.65	27.55	26.53	24.47	33
	810	1909.8	29.71	27.36	26.64	24.62	33

Mode	Channel	Frequency (MHz)	Average Output Power (dBm)				Limit (dBm)
			1 slot	2 slots	3 slots	4 slots	
EGPRS	512	1850.2	25.91	24.77	22.36	21.26	33
	661	1880.0	25.78	24.54	22.64	21.06	33
	810	1909.8	25.63	24.62	22.42	20.99	33

**WCDMA Band II**

Mode	Test Condition	Test Mode	3GPP Sub Test	Average Output Power (dBm)		
				Low Frequency	Middle Frequency	High Frequency
WCDMA (Band II)	Normal	Rel 99	1	20.36	21.42	21.57
			1	20.02	21.05	21.08
		HSDPA	2	20.01	21.04	21.08
			3	20.09	21.03	21.11
		HSUPA	4	20.07	21.04	21.08
			1	20.31	21.03	21.11
			2	20.18	21.07	21.08
			3	20.01	21.06	21.12
			4	19.92	21.05	21.14
			5	20.32	21.05	21.08

**Peak-to-average ratio (PAR):**

**Cellular Band**

Mode	Channel	PAR (dB)	Limit (dB)
GPRS	Low	2.52	13
	Middle	2.24	13
	High	2.04	13

Mode	Channel	PAR (dB)	Limit (dB)
EGPRS	Low	2.47	13
	Middle	2.25	13
	High	2.10	13

**WCDMA Band V**

Mode	Channel	PAR (dB)	Limit (dB)
WCDMA (Rel99)	Low	3.16	≤ 13
	Middle	3.09	≤ 13
	High	3.01	≤ 13
WCDMA (HSDPA)	Low	2.64	≤ 13
	Middle	2.64	≤ 13
	High	2.65	≤ 13
WCDMA (HSUPA)	Low	2.47	≤ 13
	Middle	2.55	≤ 13
	High	2.52	≤ 13



**PCS 1900 Band**

Mode	Channel	PAR (dB)	Limit (dB)
GPRS	Low	2.60	13
	Middle	2.08	13
	High	2.52	13

Mode	Channel	PAR (dB)	Limit (dB)
EGPRS	Low	2.70	13
	Middle	2.10	13
	High	2.50	13

**WCDMA Band II**

Mode	Channel	PAR (dB)	Limit (dB)
WCDMA (Rel99)	Low	2.33	13
	Middle	2.59	13
	High	2.93	13
WCDMA (HSDPA)	Low	2.63	13
	Middle	2.44	13
	High	2.14	13
WCDMA (HSUPA)	Low	2.07	13
	Middle	2.22	13
	High	2.54	13

**Radiated Power:****GPRS Mode**

Frequency (MHz)	Receiver Reading (dBμV)	Turntable Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Submitted Level (dBm)	Cable loss (dB)	Antenna Gain (dBd/dBi)			
Cellular Band, Middle Channel (ERP)										
836.6	89.59	57	115	H	25.9	0.63	-1.14	24.13	38.45	14.32
836.6	93.23	245	134	V	26.08	0.63	-1.14	24.31	38.45	14.14
PCS Band, Middle Channel (EIRP)										
1880.0	86.13	228	157	H	15.34	0.85	8.81	23.30	33.00	9.70
1880.0	86.77	134	163	V	15.67	0.85	8.81	23.63	33.00	9.37

**EGPRS Mode**

Frequency (MHz)	Receiver Reading (dBμV)	Turntable Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Submitted Level (dBm)	Cable loss (dB)	Antenna Gain (dBd/dBi)			
Cellular Band, Middle Channel (ERP)										
836.6	84.53	57	132	H	20.84	0.63	-1.14	19.07	38.45	19.38
836.6	88.67	245	174	V	21.52	0.63	-1.14	19.75	38.45	18.70
PCS Band, Middle Channel (EIRP)										
1880.0	82.35	228	165	H	11.56	0.85	8.81	19.52	33.00	13.48
1880.0	83.57	134	128	V	12.47	0.85	8.81	20.43	33.00	12.57

**WCDMA Band V & Band II Mode**

Frequency (MHz)	Receiver Reading (dBμV)	Turntable Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Submitted Level (dBm)	Cable loss (dB)	Antenna Gain (dBd/dBi)			
WCDMA Band V, Middle Channel(ERP)										
836.6	81.03	345	121	H	17.34	0.63	-1.14	15.57	38.45	22.88
836.6	84.37	255	114	V	17.22	0.63	-1.14	15.45	38.45	23.00
WCDMA Band II, Middle Channel(EIRP)										
1880.0	78.32	219	179	H	7.53	0.85	8.81	15.49	33	17.51
1880.0	79.48	179	211	V	8.38	0.85	8.81	16.34	33	16.66

**Note:**

Absolute Level = Submitted Level - Cable loss + Antenna Gain

Margin = Limit- Absolute Level

**FCC §2.1049, §22.917, §22.905, §24.238 - OCCUPIED BANDWIDTH**

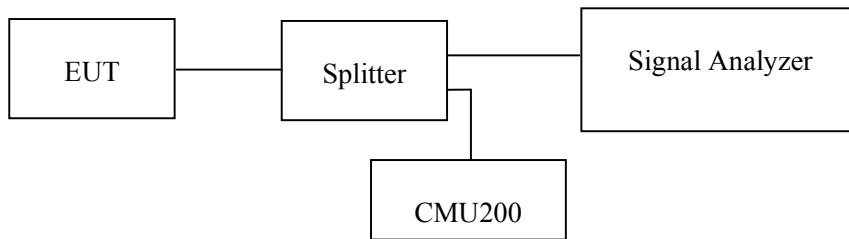
**Applicable Standards**

FCC 47 §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 resolution bandwidth of the spectrum analyzer was set at 1% to 5% of the anticipated emission bandwidth and the 26 dB & 99% bandwidth was recorded.



**Test Data**

**Environmental Conditions**

<b>Temperature:</b>	24.2~25.0℃
<b>Relative Humidity:</b>	48~50%
<b>ATM Pressure:</b>	101.0~101.3kPa

*The testing was performed by Winnie Yang from 2019-06-12 to 2019-6-24.*

*EUT operation mode: Transmitting*

*Test Result: Compliant.*

**Cellular Band**

Mode	Frequency (MHz)	26 dB Emission Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
GPRS (GMSK)	836.6	0.317	0.246
EGPRS (8PSK)	836.6	0.311	0.246

**WCDMA Band V**

Mode	Frequency (MHz)	26 dB Emission Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
WCDMA (Rel99)	836.6	4.669	4.088
WCDMA (HSDPA)	836.6	4.689	4.088
WCDMA (HSUPA)	836.6	4.669	4.088

**PCS 1900 Band**

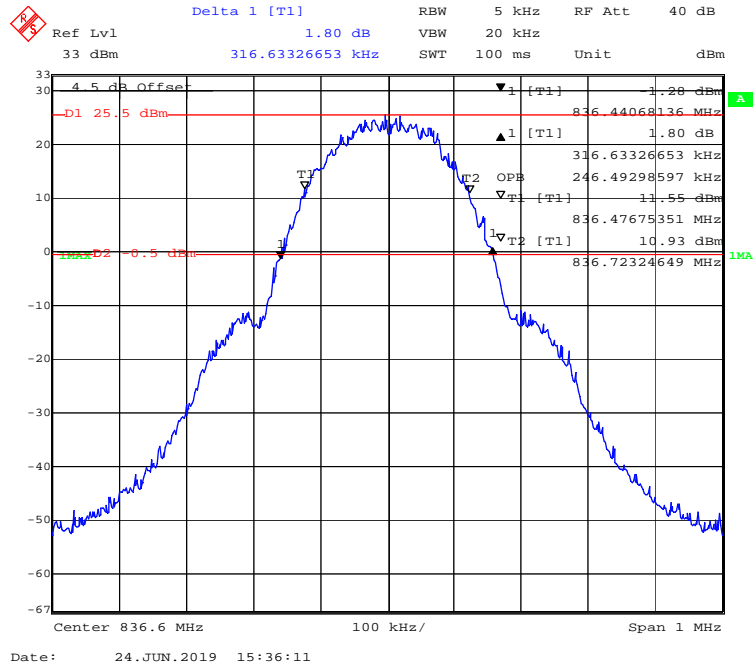
Mode	Frequency (MHz)	26 dB Emission Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
GPRS (GMSK)	1880.0	0.323	0.246
EGPRS (8PSK)	1880.0	0.317	0.244

**WCDMA Band II**

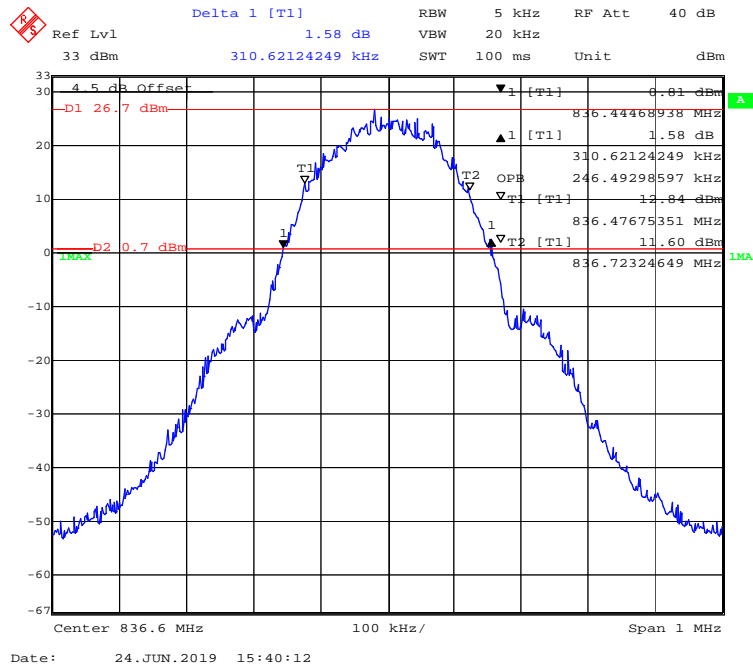
Mode	Frequency (MHz)	26 dB Emission Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
WCDMA (Rel99)	1880.0	4.669	4.088
WCDMA (HSDPA)	1880.0	4.669	4.088
WCDMA (HSUPA)	1880.0	4.649	4.088

**Cellular Band**

**99% Occupied & 26 dB Emissions Bandwidth for GPRS (GMSK) Mode**

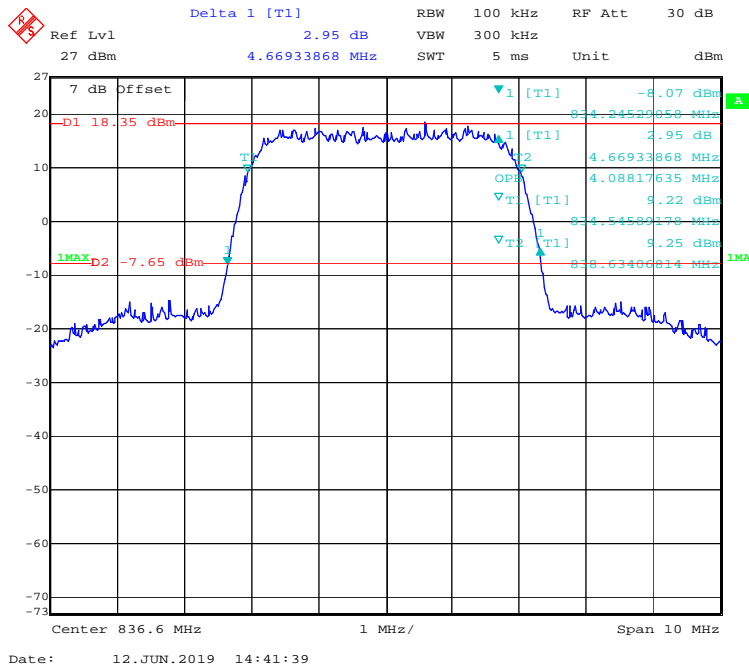


**99% Occupied & 26 dB Emissions Bandwidth for EGPRS (8PSK) Mode**

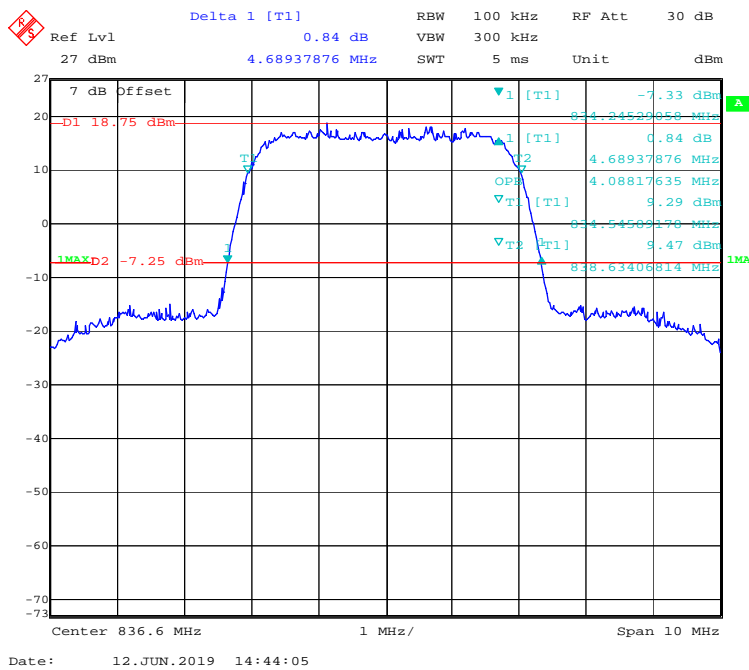


**WCDMA Band V**

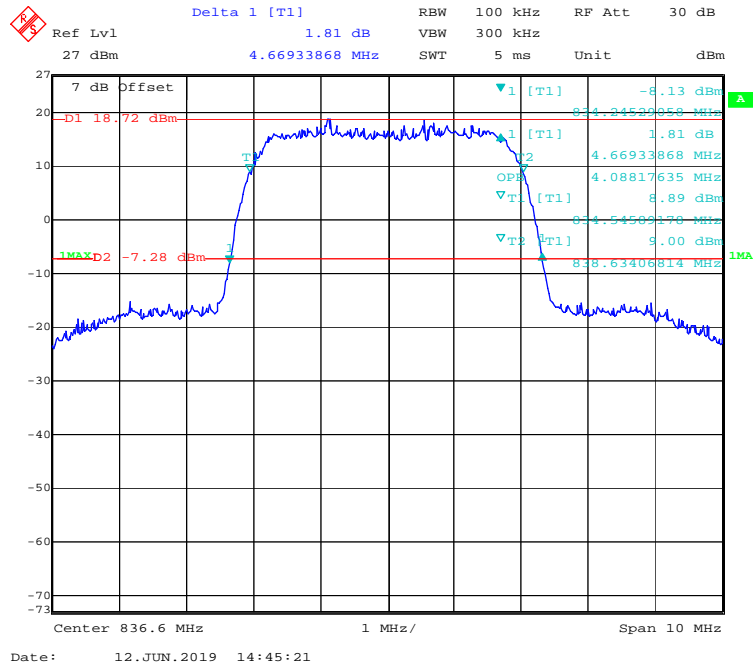
**99% Occupied & 26 dB Emissions Bandwidth for WCDMA (Rel99) Mode**



**99% Occupied & 26 dB Emissions Bandwidth for WCDMA (HSDPA) Mode**

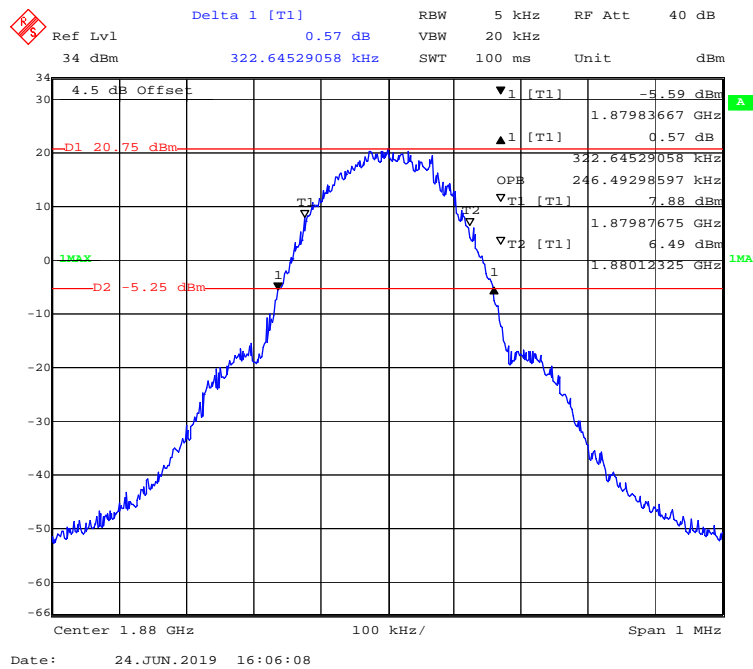


**99% Occupied & 26 dB Emissions Bandwidth for WCDMA (HSUPA) Mode**



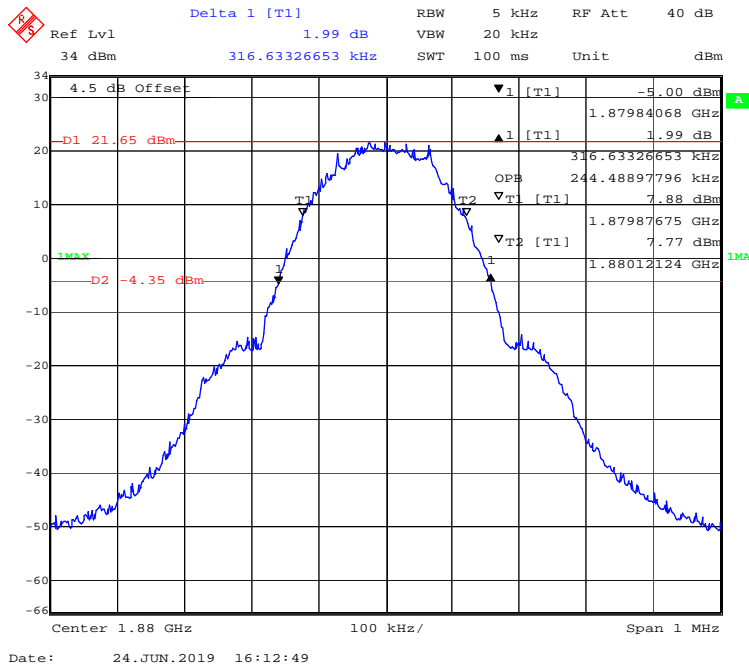
**PCS 1900 Band**

**99% Occupied & 26 dB Emissions Bandwidth for GPRS (GMSK) Mode**



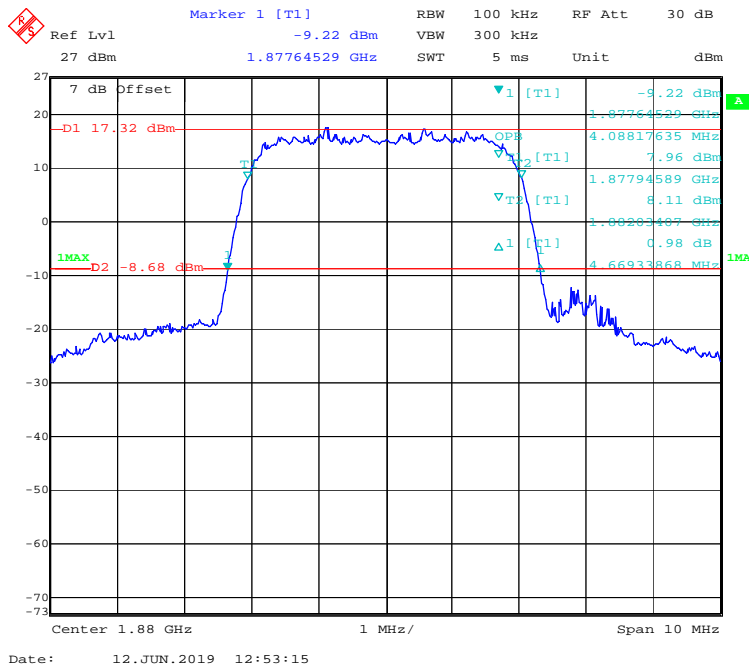


**99% Occupied & 26 dB Emissions Bandwidth for EGPRS (8PSK) Mode**

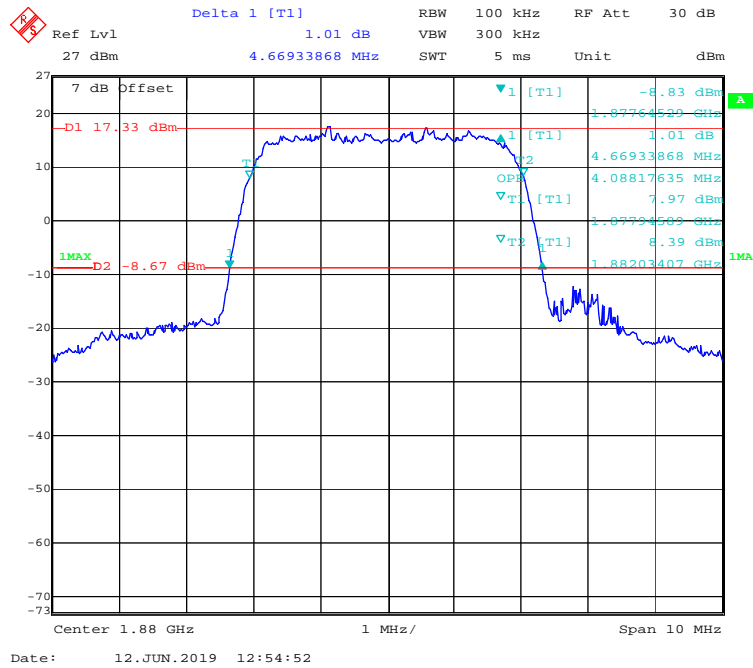


**WCDMA Band II**

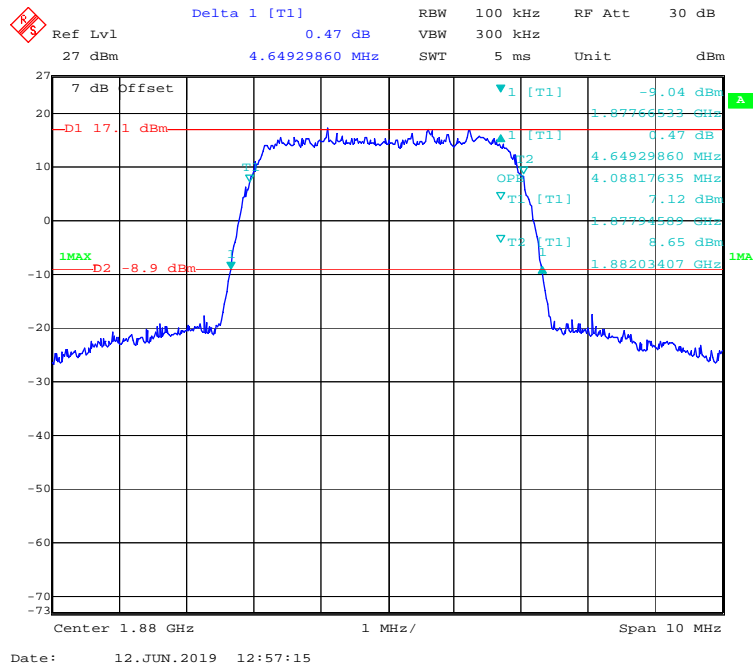
**99% Occupied & 26 dB Emissions Bandwidth for WCDMA (Rel99) Mode**



**99% Occupied & 26 dB Emissions Bandwidth for WCDMA (HSDPA) Mode**



**99% Occupied & 26 dB Emissions Bandwidth for WCDMA (HSUPA) Mode**



**§ 2.1051; § 22.917 (a); § 24.238 (a) - SPURIOUS EMISSIONS AT ANTENNA TERMINALS**

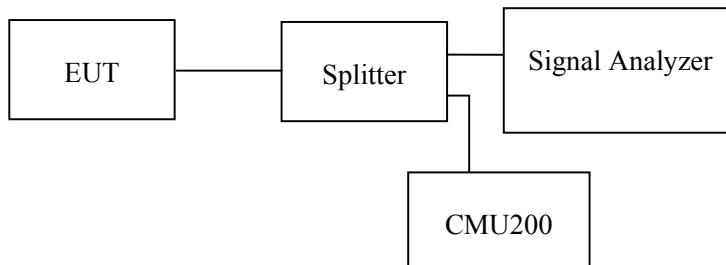
**Applicable Standards**

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. The resolution bandwidth of the spectrum analyzer was set at 100kHz for below 1GHz & 1MHz for above 1GHz. Sufficient scans were taken to show any out of band emissions up to 10<sup>th</sup> harmonic.



**Test Data**

**Environmental Conditions**

<b>Temperature:</b>	24.6~25.0℃
<b>Relative Humidity:</b>	48~50%
<b>ATM Pressure:</b>	101.0~101.2kPa

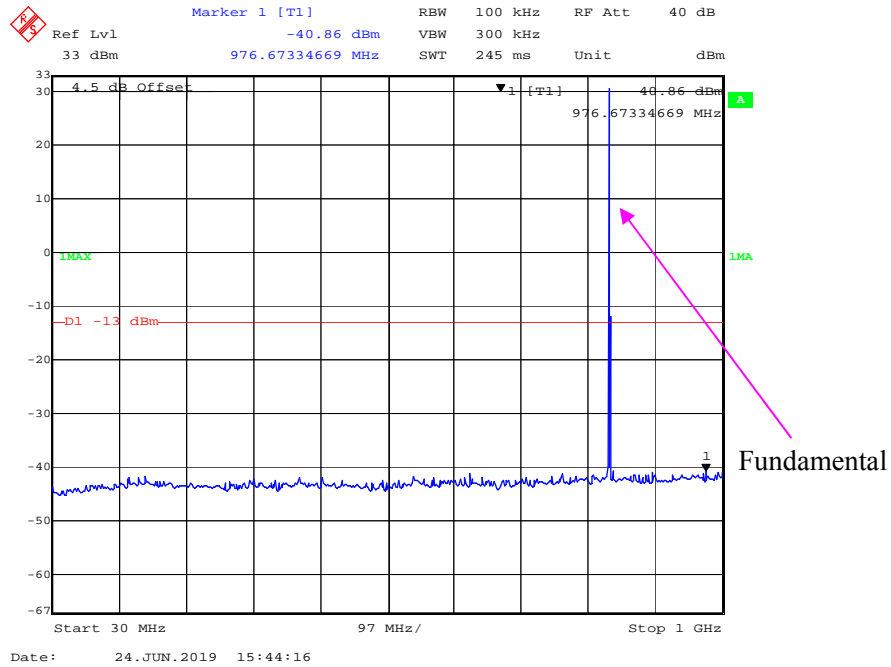
*The testing was performed by Winnie Yang from 2019-06-12 to 2019-06-24.*

*EUT operation mode: Transmitting*

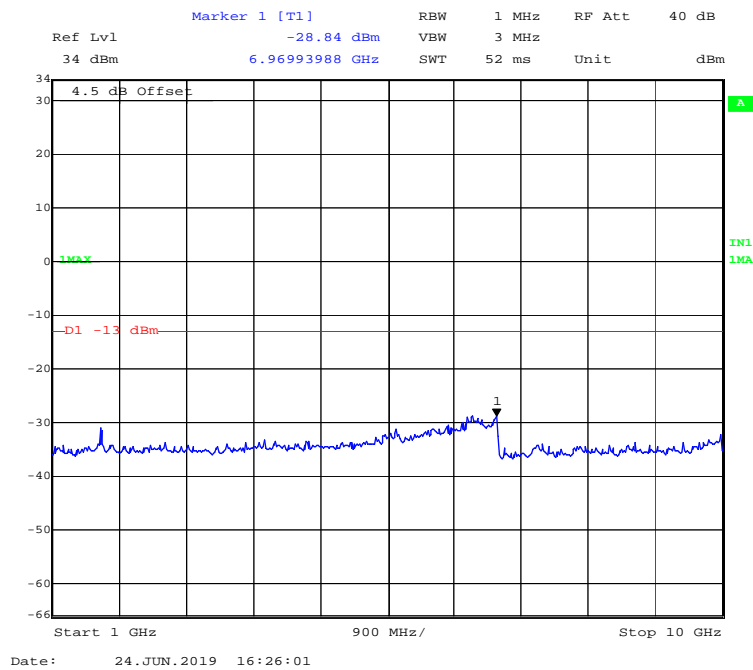
*Test Result: Compliant.*

**Cellular Band**

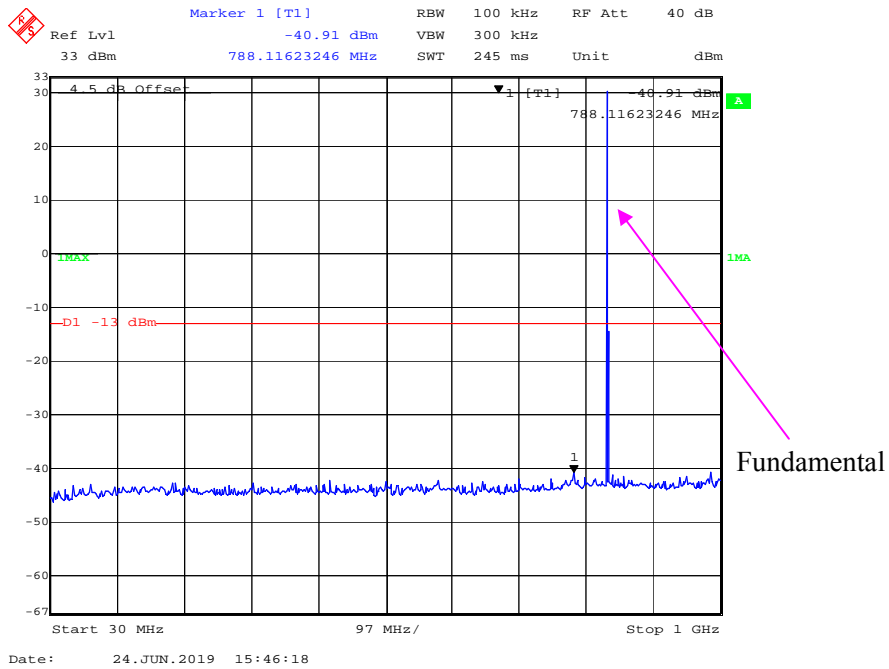
**30 MHz – 1 GHz(GPRS Mode)**



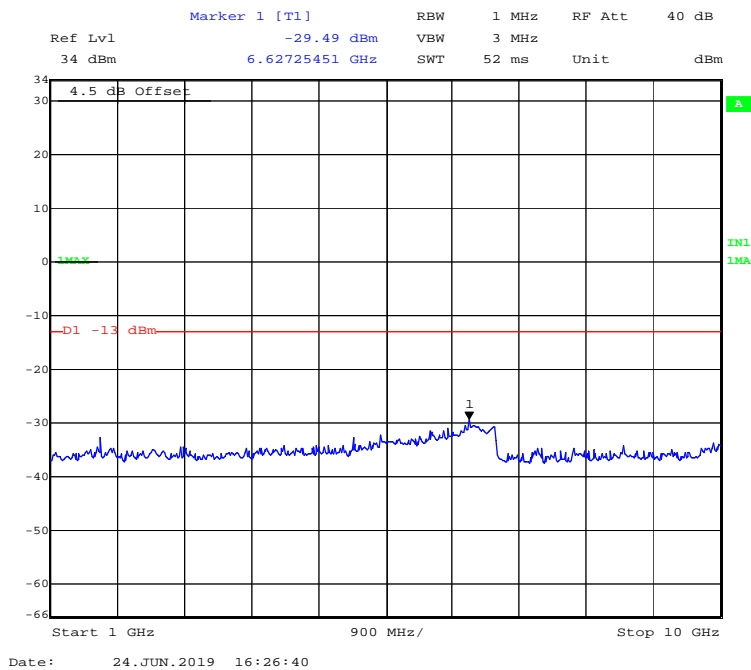
**1 GHz – 10 GHz (GPRS Mode)**



**30 MHz – 1 GHz(EGPRS Mode)**

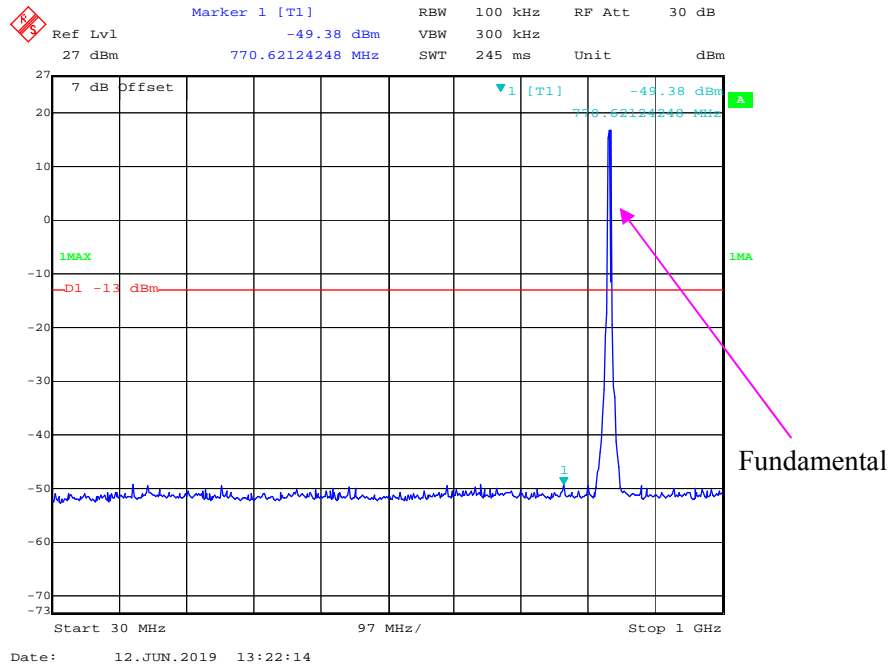


**1 GHz – 10 GHz (EGPRS Mode)**

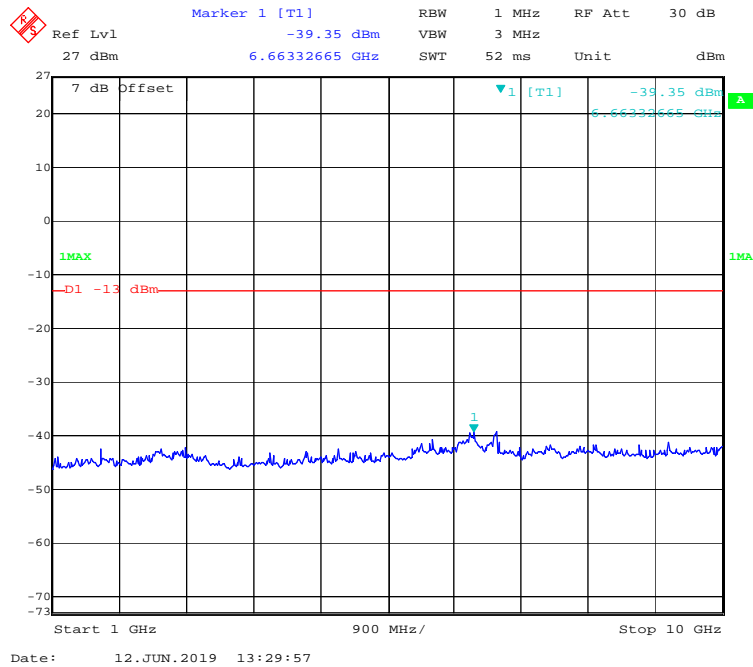


**WCDMA Band V:**

**30 MHz – 1GHz(WCDMA Mode)**

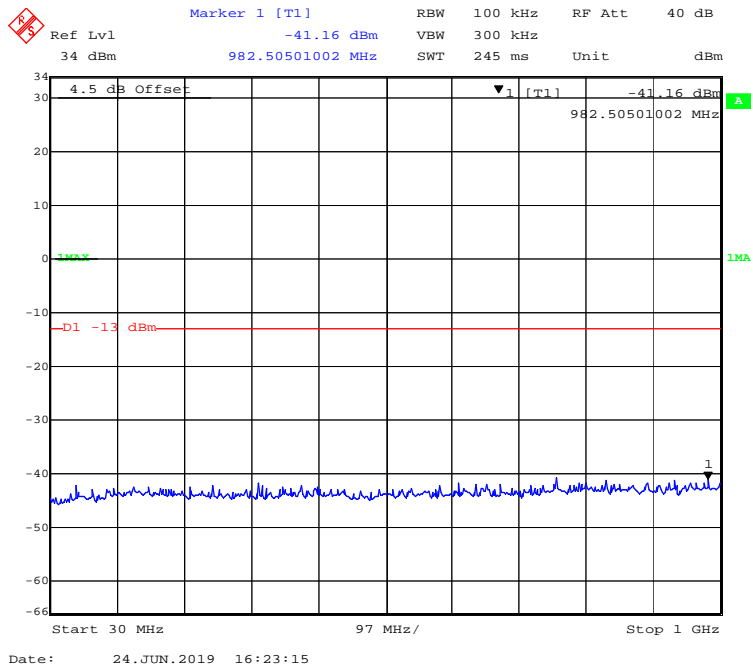


**1 GHz – 10 GHz (WCDMA Mode)**

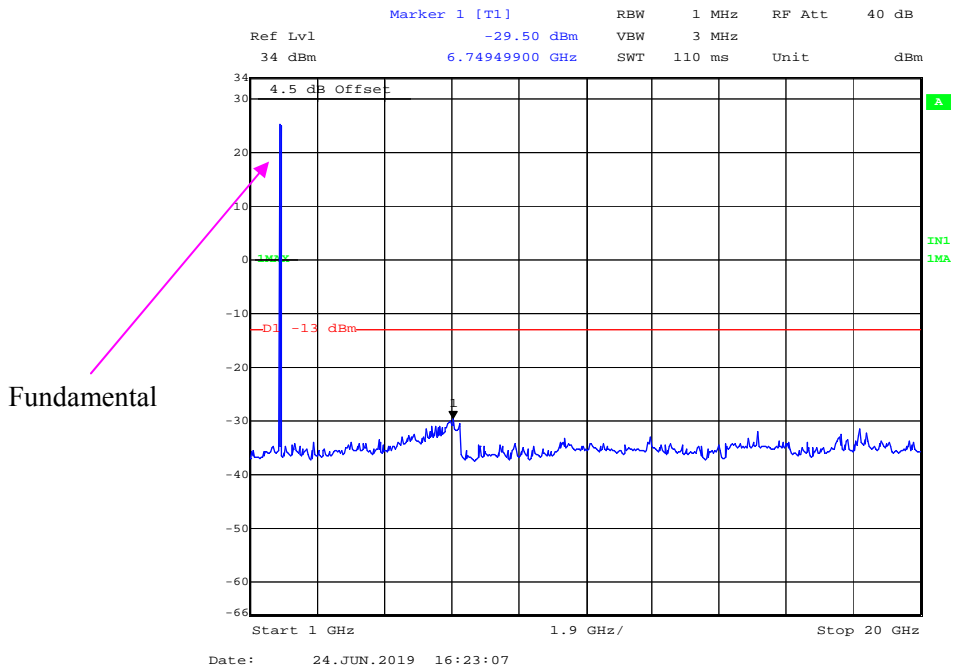




**30 MHz – 1 GHz(EGPRS Mode)**



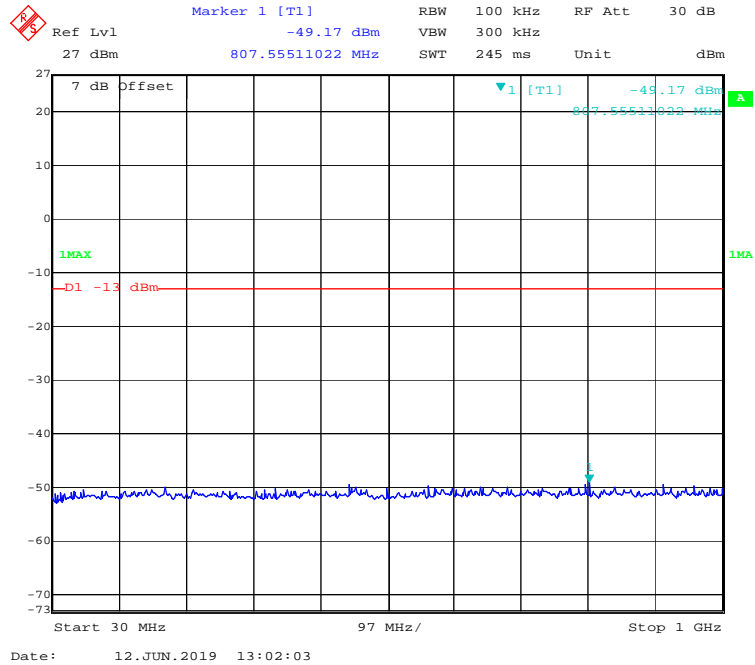
**1 GHz – 20 GHz (EGPRS Mode)**



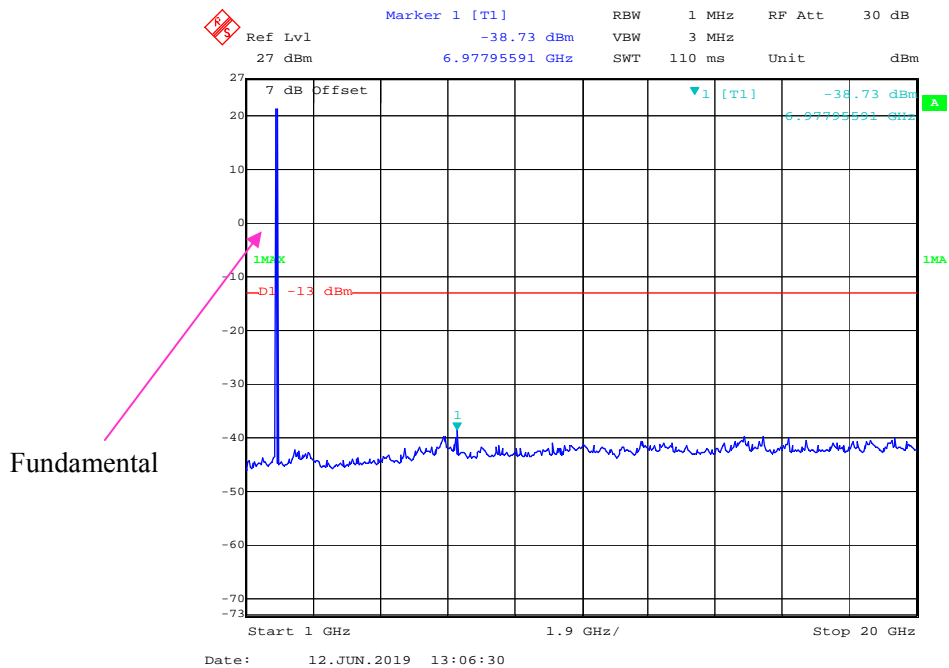


**WCDMA Band II:**

**30 MHz – 1 GHz (WCDMA Mode)**



**1 GHz – 20 GHz (WCDMA Mode)**



## FCC § 2.1053; § 22.917 (a); § 24.238 (a) - SPURIOUS RADIATED EMISSIONS

### Applicable Standards

FCC § 2.1053, §22.917(a), § 24.238 (a)

22.917 (a) 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.

24.238 (a) 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.

### 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 =  $10 \lg(\text{TX pwr in Watts}/0.001)$  – the absolute level

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

### Test Data

#### Environmental Conditions

Temperature:	24.6°C
Relative Humidity:	50%
ATM Pressure:	101.2kPa

*The testing was performed by Winnie Yang on 2019-11-28.*

*Test mode: Transmitting (Pre-scan with Low, Middle, High channel, and the worse case data as below)*

**30 MHz ~ 10 GHz:**

**Cellular Band**

Frequency (MHz)	Receiver Reading (dBµV)	Turntable Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Submitted Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd/dBi)			
GPRS Mode, Middle channel										
380.70	42.33	91	100	H	-64.13	0.51	-1.50	-66.14	-13	53.14
380.70	40.18	204	100	V	-64.15	0.51	-1.50	-66.16	-13	53.16
1673.20	49.83	27	150	H	-61.12	0.84	8.48	-53.48	-13	40.48
1673.20	45.36	233	150	V	-65.84	0.84	8.48	-58.20	-13	45.20
2509.80	64.31	34	200	H	-44.31	0.89	10.09	-35.11	-13	22.11
2509.80	60.35	168	200	V	-48.34	0.89	10.09	-39.14	-13	26.14

**WCDMA Band V**

Frequency (MHz)	Receiver Reading (dBµV)	Turntable Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Submitted Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd/dBi)			
WCDMA Mode, Middle channel										
380.70	39.32	358	100	H	-67.14	0.51	-1.50	-69.15	-13	56.15
380.70	38.77	357	100	V	-65.56	0.51	-1.50	-67.57	-13	54.57
1673.20	43.32	172	200	H	-67.63	0.84	8.48	-59.99	-13	46.99
1673.20	41.36	161	200	V	-69.84	0.84	8.48	-62.20	-13	49.20
2509.80	58.36	86	150	H	-50.26	0.89	10.09	-41.06	-13	28.06
2509.80	55.31	248	150	V	-53.38	0.89	10.09	-44.18	-13	31.18

**30 MHz ~ 20 GHz:**

**PCS 1900 Band**

Frequency (MHz)	Receiver Reading (dBµV)	Turntable Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Submitted Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd/dBi)			
GPRS Mode, Middle channel										
380.70	44.32	5	100	H	-62.14	0.51	-1.50	-64.15	-13	51.15
380.70	43.77	353	100	V	-60.56	0.51	-1.50	-62.57	-13	49.57
3760.00	43.32	247	150	H	-60.37	0.95	9.74	-51.58	-13	38.58
3760.00	41.32	223	150	V	-62.69	0.95	9.74	-53.90	-13	40.90
5640.00	40.11	52	200	H	-60.40	1.15	10.47	-51.08	-13	38.08
5640.00	38.32	53	200	V	-62.49	1.15	10.47	-53.17	-13	40.17

**WCDMA Band II**

Frequency (MHz)	Receiver Reading (dBµV)	Turntable Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Submitted Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd/dBi)			
WCDMA Mode, Middle channel										
380.70	40.32	101	150	H	-66.14	0.51	-1.50	-68.15	-13	55.15
380.70	39.11	251	150	V	-65.22	0.51	-1.50	-67.23	-13	54.23
3760.00	38.11	312	200	H	-65.58	0.95	9.74	-56.79	-13	43.79
3760.00	36.31	250	200	V	-67.70	0.95	9.74	-58.91	-13	45.91
5640.00	35.33	348	200	H	-65.18	1.15	10.47	-55.86	-13	42.86
5640.00	32.14	191	200	V	-68.67	1.15	10.47	-59.35	-13	46.35

**Note:**

- 1) Absolute Level = Submitted Level - Cable loss + Antenna Gain
- 2) Margin = Limit- Absolute Level

**FCC § 22.917 (a); § 24.238 (a) - BAND EDGES**

**Applicable Standards**

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.

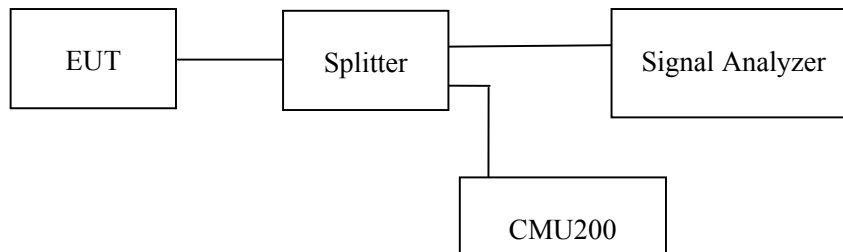
According to §24.238(a), the power of any emissions outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

For mobile digital stations, the attenuation factor shall be not less than  $40 + 10 \log (P)$  dB on all frequencies between the channel edge and 5 megahertz from the channel edge,  $43 + 10 \log (P)$  dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and  $55 + 10 \log (P)$  dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less that  $43 + 10 \log (P)$  dB on all frequencies between 2490.5 MHz and 2496 MHz and  $55 + 10 \log (P)$  dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

**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 Data**

**Environmental Conditions**

<b>Temperature:</b>	24.2~24.6°C
<b>Relative Humidity:</b>	48~50%
<b>ATM Pressure:</b>	101.2~101.3kPa

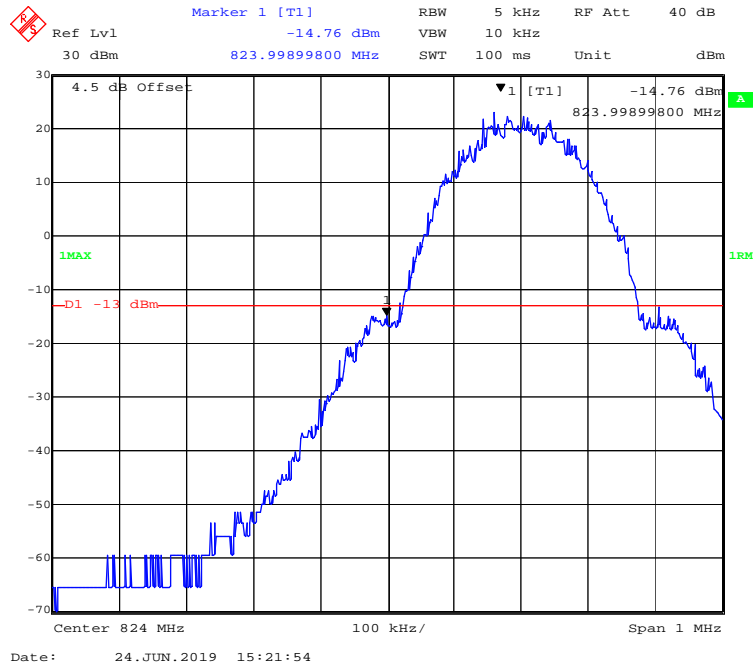
*The testing was performed by Winnie Yang from 2019-06-12 to 2019-11-18.*

*EUT operation mode: Transmitting*

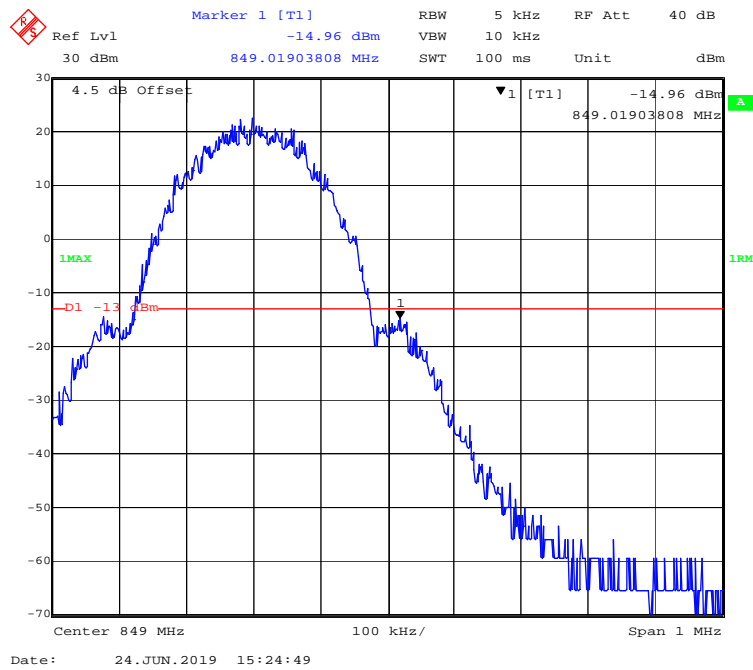
*Test Result: Compliant.*

**Cellular Band:**

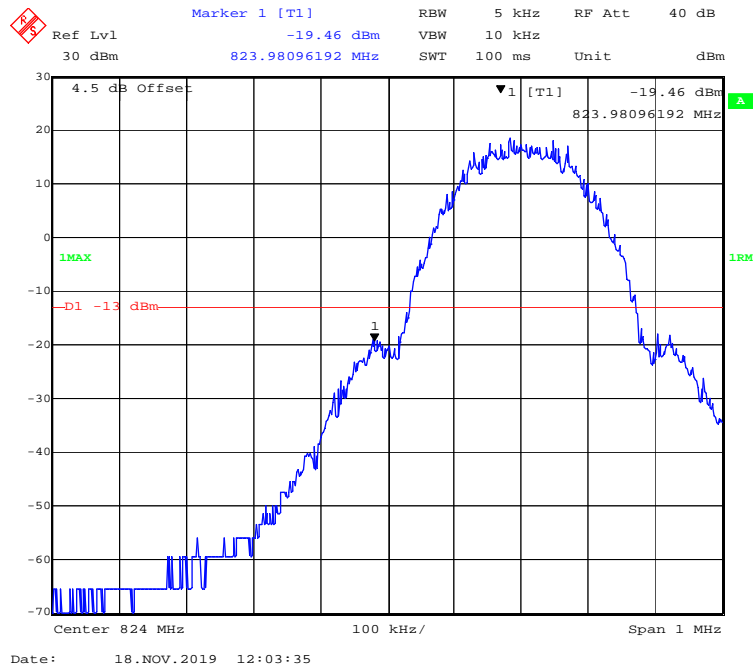
**GPRS Mode, Left Band Edge**



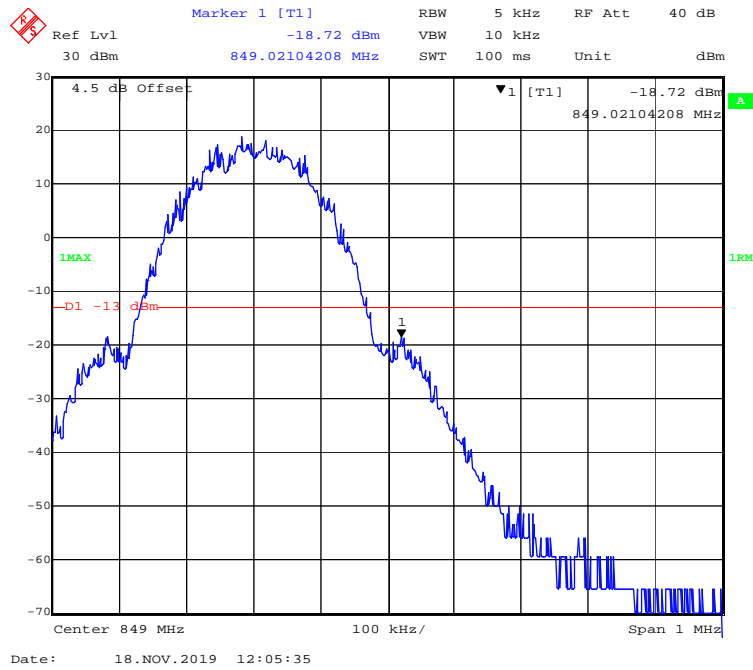
**GPRS Mode, Right Band Edge**



**EGPRS Mode, Left Band Edge**

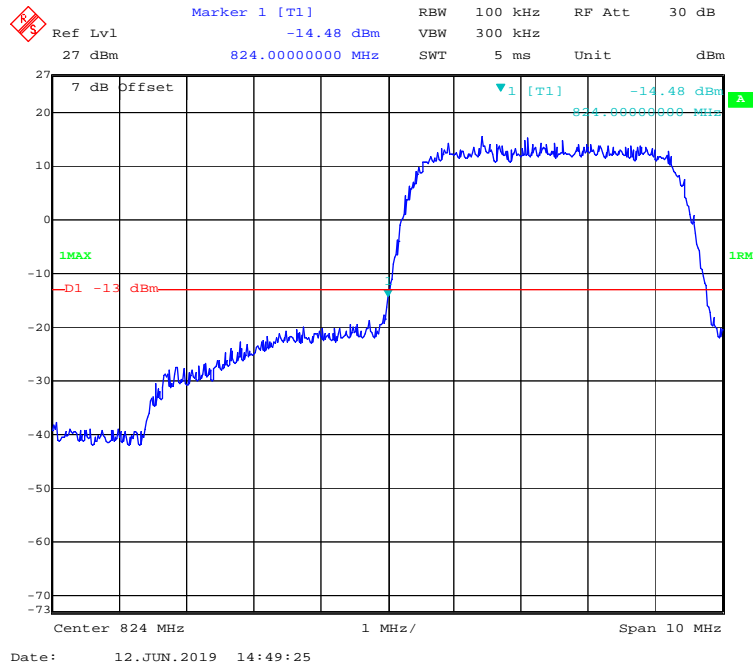


**EGPRS Mode, Right Band Edge**

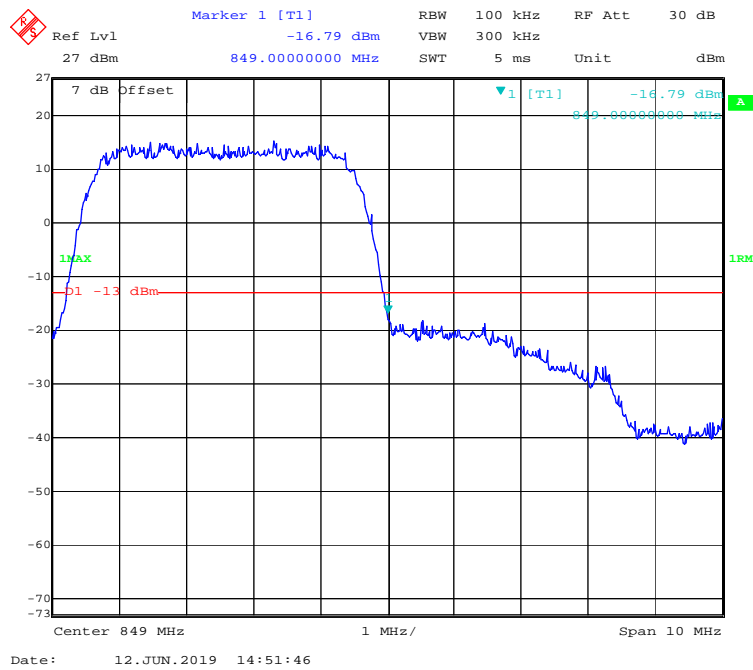


**WCDMA Band V:**

**Re99 Mode, Left Band Edge**

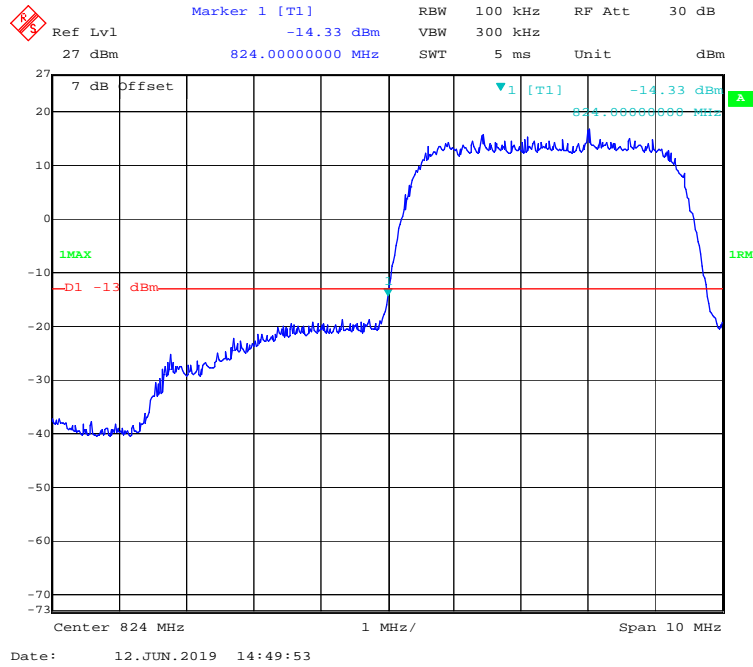


**Re99 Mode, Right Band Edge**

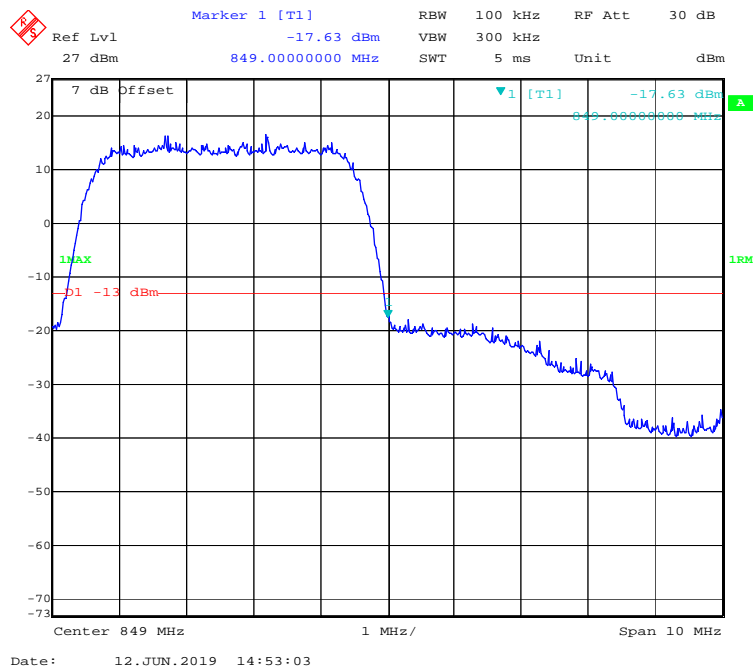




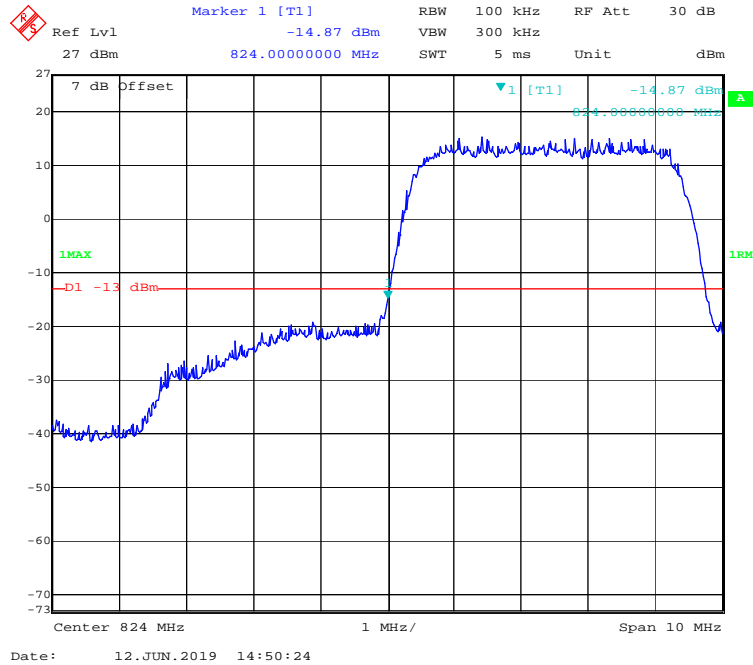
### HSDPA Mode, Left Band Edge



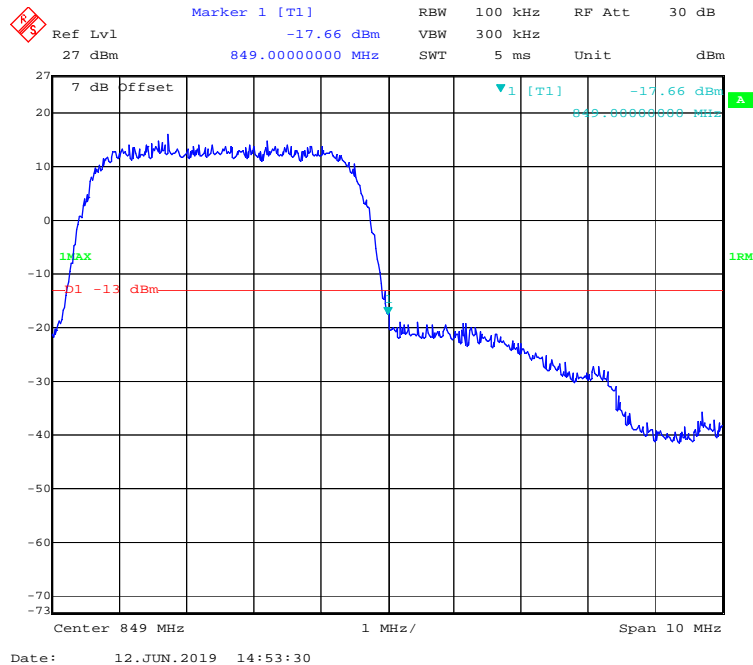
### HSDPA Mode, Right Band Edge



### HSUPA Mode, Left Band Edge

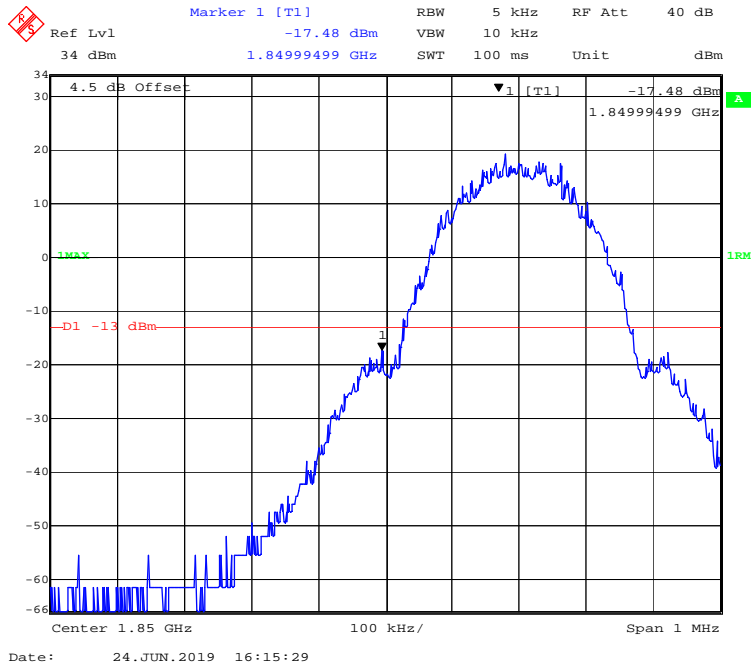


### HSUPA Mode, Right Band Edge

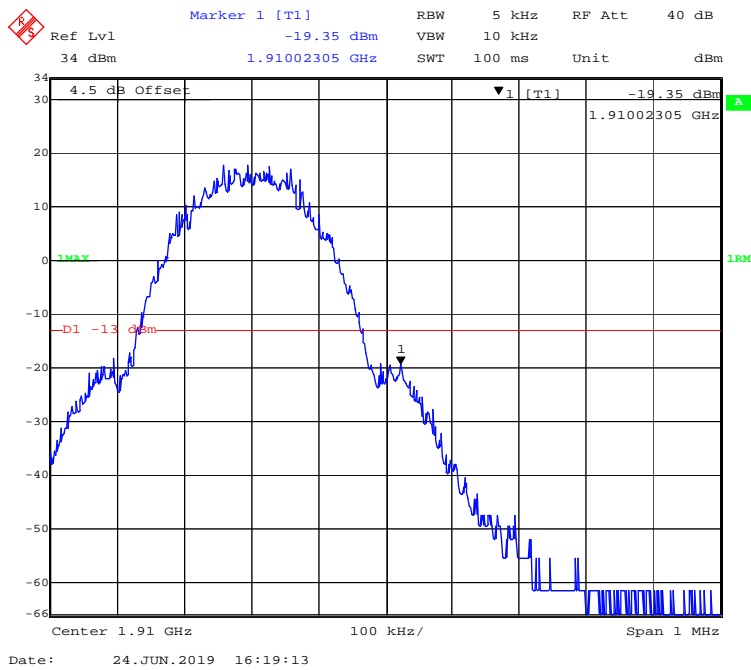


**PCS 1900 Band:**

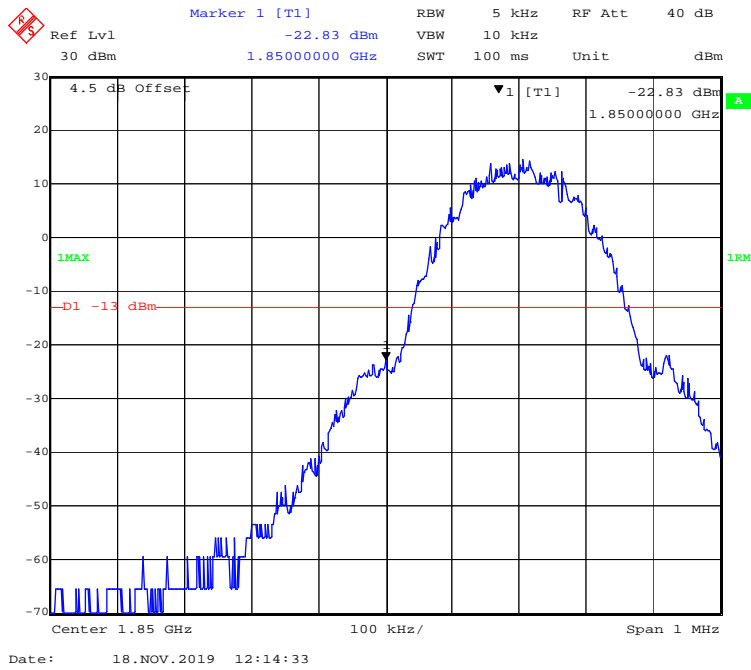
**GPRS Mode, Left Band Edge**



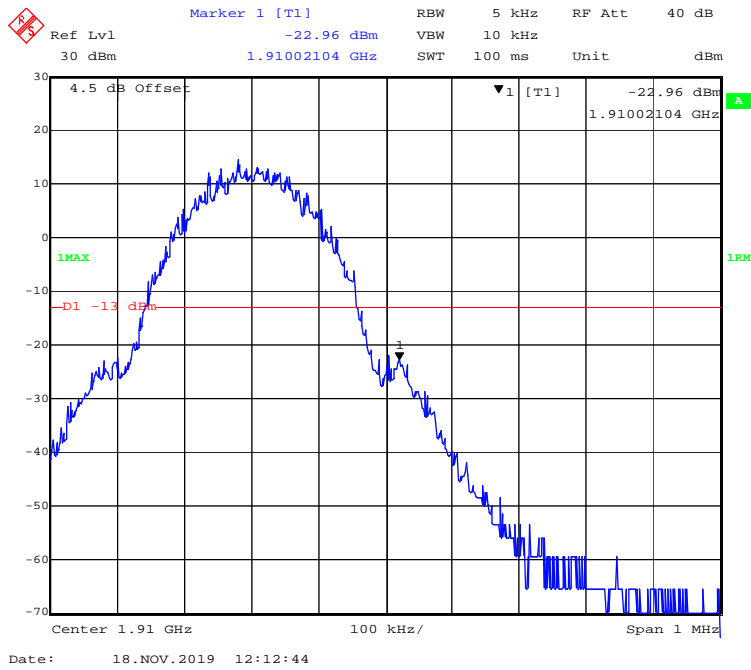
**GPRS Mode, Right Band Edge**



**EGPRS Mode, Left Band Edge**

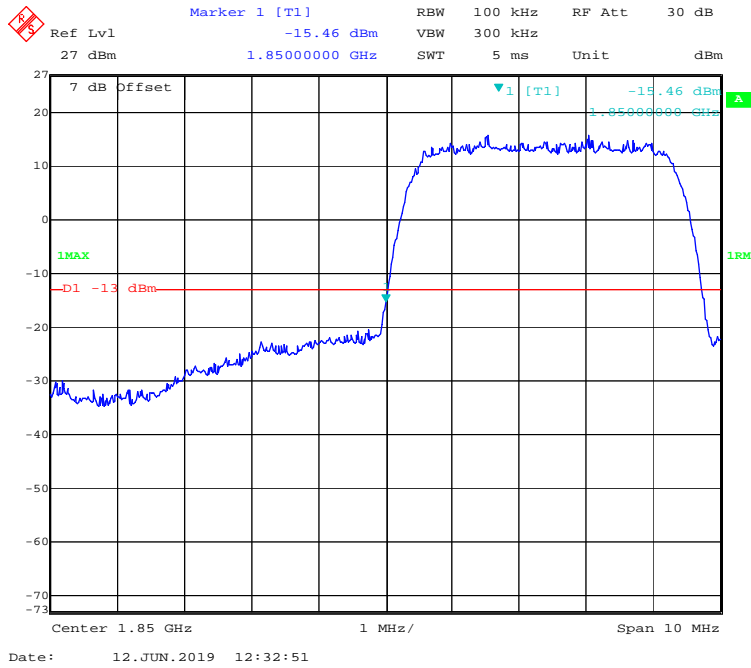


**EGPRS Mode, Right Band Edge**

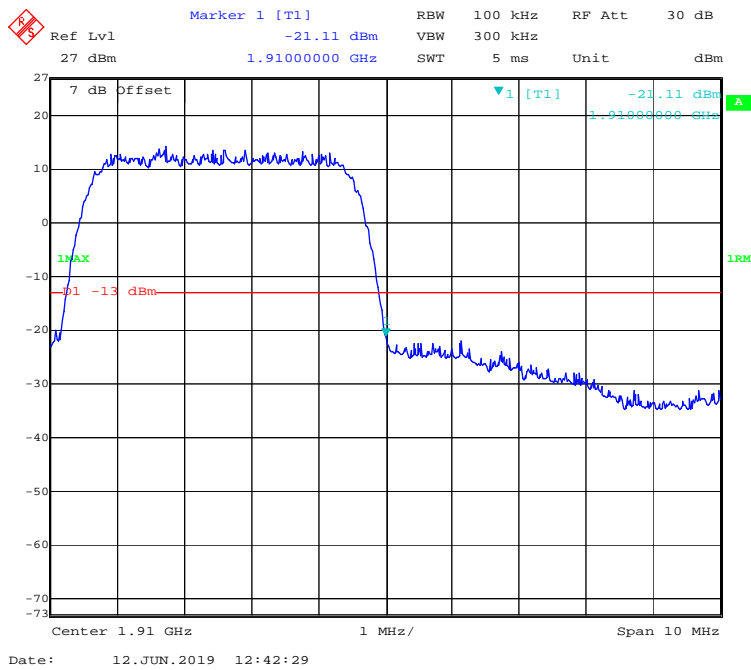


**WCDMA Band II**

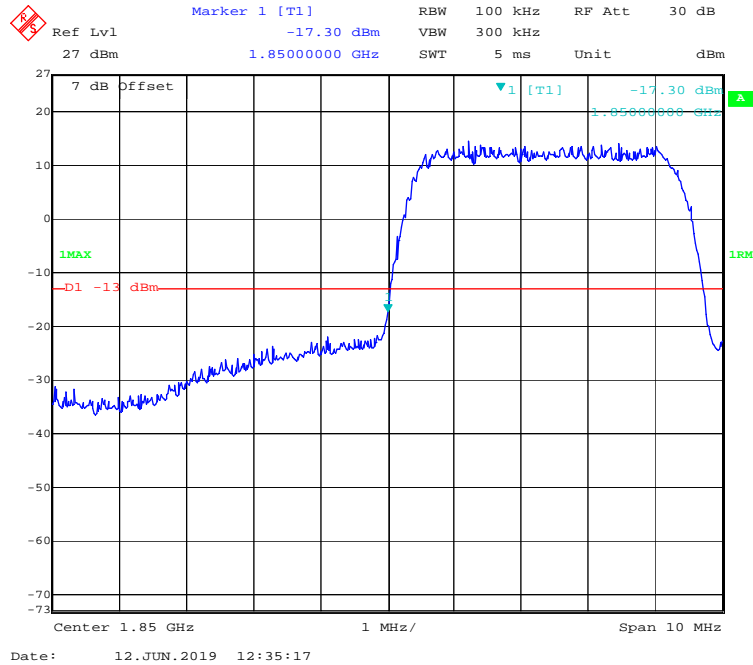
**Re99 Mode, Left Band Edge**



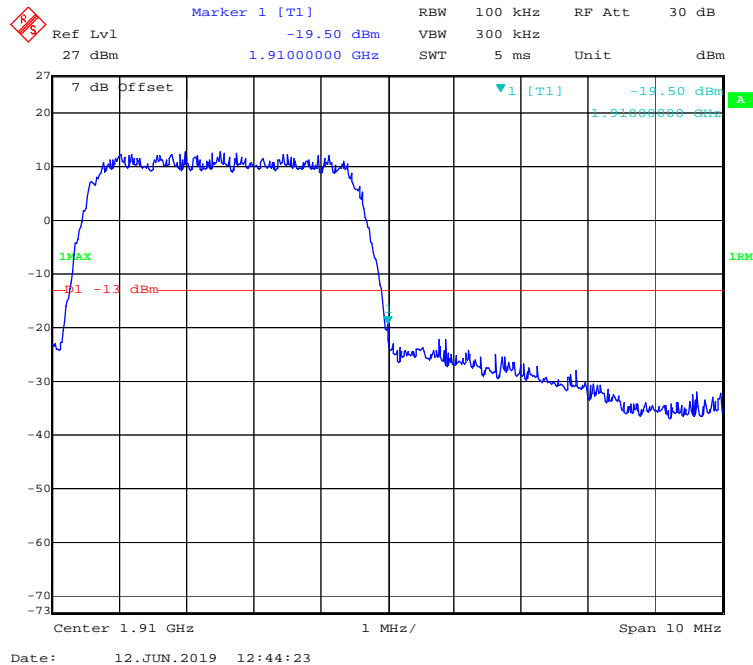
**Re99 Mode, Right Band Edge**



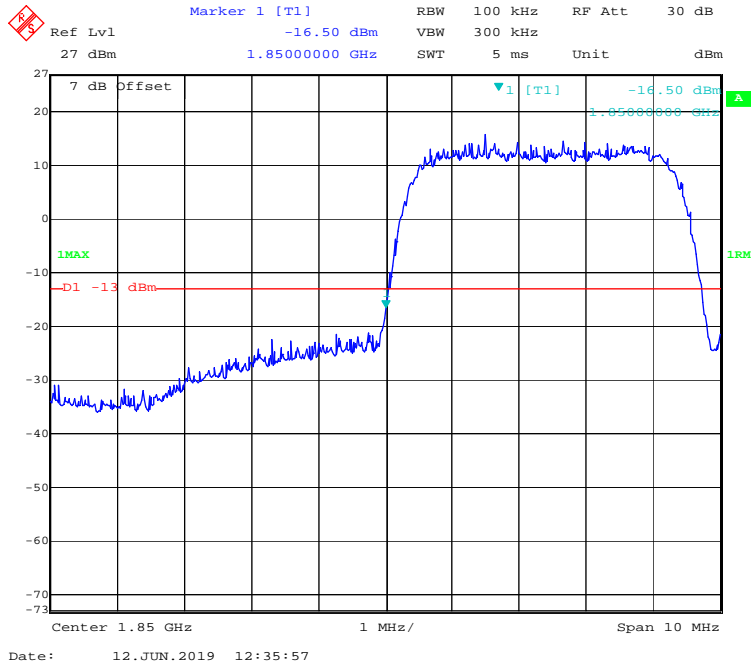
### HSDPA Mode, Left Band Edge



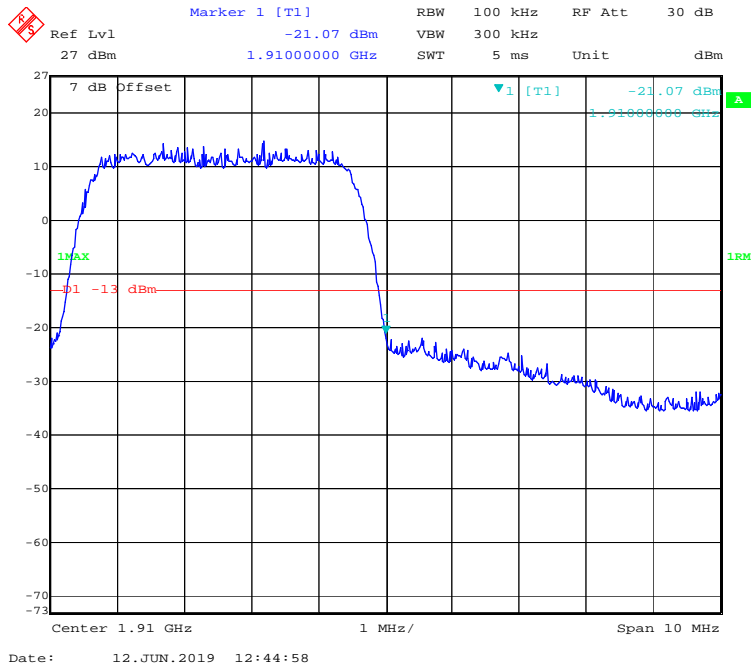
### HSDPA Mode, Right Band Edge



### HSUPA Mode, Left Band Edge



### HSUPA Mode, Right Band Edge



**FCC § 2.1055; § 22.355; § 24.235 - FREQUENCY STABILITY**

**Applicable Standards**

FCC § 2.1055, §22.355, § 24.235

According to FCC §2.1055, the frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

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

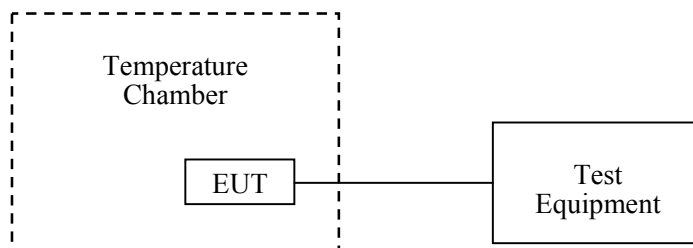
According to §24.235, the frequency stability shall be sufficient to ensure that the fundamental emissions stays within the authorized frequency block.

**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: For hand carried, battery powered equipment; reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.





**Test Data**

**Environmental Conditions**

<b>Temperature:</b>	24.6°C
<b>Relative Humidity:</b>	50%
<b>ATM Pressure:</b>	101.2kPa

The testing was performed by Winnie Yang on 2019-08-28.

EUT operation mode: Transmitting

Test Result: Compliant.

**Cellular Band**

GPRS Mode, Middle Channel, f <sub>0</sub> =836.6 MHz				
Temperature (°C)	Power Supplied (V <sub>DC</sub> )	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)
-30	3.7	12	0.010758	2.5
-20		8	0.008367	2.5
-10		10	0.014344	2.5
0		8	0.008367	2.5
10		7	0.014344	2.5
20		4	0.005977	2.5
30		10	0.010758	2.5
40		8	0.013148	2.5
50		6	0.005977	2.5
25		V min.= 3.5	10	0.010758
25	V max.= 4.2	16	0.016734	2.5

EGPRS Mode, Middle Channel, $f_0 = 836.6$ MHz				
Temperature (°C)	Power Supplied (V <sub>DC</sub> )	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)
-30	3.7	15	0.017930	2.5
-20		9	0.010758	2.5
-10		11	0.013148	2.5
0		9	0.010758	2.5
10		5	0.005977	2.5
20		13	0.015539	2.5
30		8	0.009563	2.5
40		5	0.005977	2.5
50		14	0.016734	2.5
25		V min.= 3.5	9	0.010758
25	V max.= 4.2	6	0.007172	2.5

**WCDMA Band V:**

Middle Channel, $f_0 = 836.6$ MHz				
Temperature (°C)	Power Supplied (V <sub>DC</sub> )	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)
-30	3.7	14	0.016734	2.5
-20		9	0.010758	2.5
-10		11	0.013148	2.5
0		7	0.008367	2.5
10		1	0.001195	2.5
20		3	0.003586	2.5
30		5	0.005977	2.5
40		10	0.011953	2.5
50		9	0.010758	2.5
25		V min.= 3.5	8	0.009563
25	V max.= 4.2	12	0.014344	2.5

**PCS 1900 Band:**

<b>GPRS Mode, Middle Channel, f<sub>0</sub> =1880.0 MHz</b>				
<b>Temperature (°C)</b>	<b>Power Supplied (V<sub>DC</sub>)</b>	<b>Frequency Error (Hz)</b>	<b>Frequency Error (ppm)</b>	<b>Result</b>
-30	3.7	27	0.014362	pass
-20		23	0.012234	pass
-10		44	0.023404	pass
0		36	0.019149	pass
10		23	0.012234	pass
20		31	0.016489	pass
30		15	0.007979	pass
40		23	0.012234	pass
50		35	0.018617	pass
25	V min.= 3.5	27	0.014362	pass
25	V max.= 4.2	19	0.010106	pass

<b>EGPRS Mode, Middle Channel, f<sub>0</sub> =1880.0 MHz</b>				
<b>Temperature (°C)</b>	<b>Power Supplied (V<sub>DC</sub>)</b>	<b>Frequency Error (Hz)</b>	<b>Frequency Error (ppm)</b>	<b>Result</b>
-30	3.7	30	0.015957	pass
-20		25	0.0132979	pass
-10		21	0.011170	pass
0		13	0.006915	pass
10		16	0.008511	pass
20		15	0.007979	pass
30		22	0.011702	pass
40		18	0.009574	pass
50		17	0.009043	pass
25	V min.= 3.5	23	0.012234	pass
25	V max.= 4.2	18	0.009574	pass

**WCDMA Band II:**

<b>WCDMA Mode, Middle Channel, f<sub>0</sub> =1880.0 MHz</b>				
<b>Temperature (°C)</b>	<b>Power Supplied (V<sub>DC</sub>)</b>	<b>Frequency Error (Hz)</b>	<b>Frequency Error (ppm)</b>	<b>Result</b>
-30	3.7	29	0.015426	pass
-20		23	0.012234	pass
-10		21	0.011170	pass
0		15	0.007979	pass
10		6	0.003191	pass
20		13	0.006915	pass
30		19	0.010106	pass
40		24	0.012766	pass
50		15	0.007979	pass
25	V min.= 3.5	11	0.005851	pass
25	V max.= 4.2	20	0.010638	pass

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