FCC PART 22H, PART 24E
RSS-132 ISSUE 3, JANUARY 2013
RSS-133 ISSUE 6, JANUARY 2013
RSS-GEN ISSUE 4, NOVEMBER 2014

MEASUREMENT AND TEST REPORT

For

Hammerhead Navigation Inc.

450 W 33rd Street, 12th Floor New York, NY 10001 United States

FCC ID: 2ADMX-HK1
IC: 12534A-HK1

Report Type:	**Product Type:**
Original Report	Hammerhead Karoo

Report Number:	RDG171206006-00C
Report Date:	2018-01-15
Reviewed By:	Jerry Zhang EMC Manager
Test Laboratory:	Bay Area Compliance Laboratories Corp. (Dongguan) No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China Tel: +86-769-86858888 Fax: +86-769-86858891 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:	Hammerhead Karoo
EUT Model:	Karoo
FCC ID:	2ADMX-HK1
IC:	12534A-HK1
Rated Input Voltage:	DC3.8V from battery or DC 5V from USB port
External Dimension:	Length (99.4mm)*Width (72mm)*High (27.8mm)
Serial Number:	171206006
EUT Received Date:	2017.12.13

Objective

This report is prepared on behalf of ***Hammerhead Navigation Inc.*** in accordance with: Part 2-Subpart J, Part 22-Subpart H, and Part 24-Subpart E of the Federal Communications Commission's rules and RSS-132, Issue 3, January 2013, RSS-133, Issue 6, January 2013 of the Innovation, Science and Economic Development Canada.

Related Submittal(s)/Grant(s)

FCC Part 15C DSS submissions with FCC ID: 2ADMX-HK1.
FCC Part 15C DTS submissions with FCC ID: 2ADMX-HK1.
FCC Part 15.249 DXX submission with FCC ID: 2ADMX-HK1.
RSS-247 DTSs,FHSs, RSS-247 DSSs, RSS-210 submissions with IC: 12534A-HK1.

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, RSS-132 and RSS-133.

Applicable Standards: TIA/EIA 603-D-2010, RSS-132, Issue 3, January 2013, Cellular Telephone Systems Operating in the Bands 824-849 MHz and 869-894 MHz; RSS-133, Issue 6, January 2013, 2 GHz Personal Communication Services

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℃
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 test site has been approved by the FCC 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 test site has been 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.

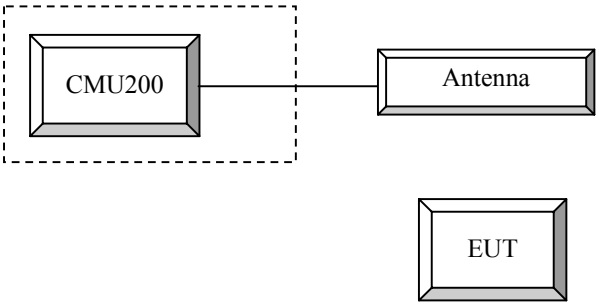
Equipment Modifications

No modification was made to the EUT.

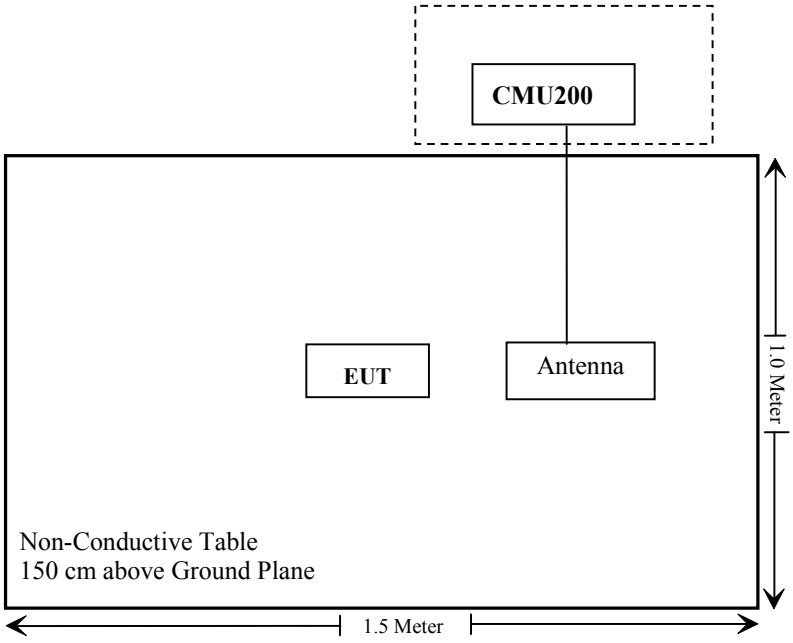
Support Equipment List and Details

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

Rules	Description of Test	Result
FCC§1.1310, §2.1093 RSS-102 § 4	RF Exposure	Compliance
§2.1046; § 22.913 (a); § 24.232 (c) RSS-132 §5.4 RSS-133 §6.4	RF Output Power	Compliance
§ 2.1047	Modulation Characteristics	Not Applicable
RSS-132 §5.2 RSS-133 §6.2	Types of Modulation	Compliance
RSS-132 §4.1 RSS-133 §6.1	Frequency Sub-bands Frequency Plan	Compliance
§ 2.1049; § 22.905 § 22.917; § 24.238 RSS-Gen §6.6	Occupied Bandwidth	Compliance
§ 2.1051, § 22.917 (a); § 24.238 (a) RSS-132 §5.5 RSS-133 §6.5	Spurious Emissions at Antenna Terminal	Compliance
§ 2.1053 § 22.917 (a); § 24.238 (a) RSS-132 §5.5 RSS-133 §6.5	Field Strength of Spurious Radiation	Compliance
§ 22.917 (a); § 24.238 (a) RSS-132 §5.5 RSS-133 §6.5	Out of band emission, Band Edge	Compliance
§ 2.1055 § 22.355; § 24.235 RSS-132 §5.3 RSS-133 §6.3	Frequency stability vs. temperature Frequency stability vs. voltage	Compliance

FCC §1.1310, §2.1093& RSS-102 §4- RF EXPOSURE

Applicable Standard

FCC§1.1310 and §2.1093, RSS-102 §4

Test Result

Compliant, please refer to the SAR report: RDG171206006-20.

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.

RSS-132 §5.1 & RSS-133 §6.1 - CHANNELLING ARRANGEMENTS & FREQUENCY PLAN

Applicable Standard

According to RSS-132 §5.1, the frequency bands 824-849 MHz and 869-894 MHz are divided into sub-bands as described in SRSP-503. These sub-bands are:

824-835 MHz, 835-845 MHz, 845-846.5 MHz, and 846.5-849 MHz for mobile transmit; and
869-880 MHz, 880-890 MHz, 890-891.5 MHz, and 891.5-894 MHz for base transmit.

According to RSS-133 §6.1, the frequency plan is described in SRSP-510.

Test Result

According to the test data, channeling arrangement meets all relevant conditions specified in SRSP-503, SRSP-510.

RSS-132 §5.2 & RSS-133 §6.2 - TYPES OF MODULATION

Applicable Standard

According to RSS-132 §5.2, equipment certified under this standard shall use digital modulation.

According to RSS-133 §6.2, the devices shall employ digital modulation techniques.

Test Result

The EUT uses GMSK, QPSK, 16QAM modulation.

FCC § 2.1046, § 22.913 (a), § 24.232 (c) AND RSS-132 §5.4 & RSS-133 §6.4 - 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.

According to RSS-132 §5.4

The transmitter output power shall be measured in terms of average power. The equivalent isotropically radiated power (e.i.r.p.) for mobile equipment shall not exceed 11.5 watts. Refer to SRSP-503 for base station e.i.r.p. limits.

In addition, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.

Refer to SRSP-510 5.1.2 Mobile Stations
Mobile stations and hand-held portables are limited to 2 watts maximum e.i.r.p. The equipment shall employ means to limit the power to the minimum necessary for successful communication.

According to RSS-133 §6.4

The equivalent isotropically radiated power (e.i.r.p.) for transmitters shall not exceed the limits given in SRSP-510. Moreover, base station transmitters operating in the band 1930-1995 MHz shall not have output power exceeding 100 watts.

In addition, the transmitter's peak-to-average power ratio (PAPR) shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.

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
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
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 E-TFCI PO 4 E-TFCI 67 E-TFCI PO 18 E-TFCI 71 E-TFCI PO23 E-TFCI 75 E-TFCI PO26 E-TFCI 81 E-TFCI PO 27		E-TFCI 11 E-TFCI PO4 E-TFCI 92 E-TFCI PO 18	E-TFCI 11 E E-TFCI PO 4 E-TFCI 67 E-TFCI PO 18 E-TFCI 71 E-TFCI PO23 E-TFCI 75 E-TFCI PO26 E-TFCI 81 E-TFCI PO 27	

HSPA+

The following tests were conducted according to the test requirements in Table C.11.1.4 of 3GPP TS 34.121-1

Sub-test	β_c (Note3)	β_d	β_{HS} (Note1)	β_{ec}	β_{ed} (2xSF2) (Note 4)	β_{ed} (2xSF4) (Note 4)	CM (dB) (Note 2)	MPR (dB) (Note 2)	AG Index (Note 4)	E-TFCI (Note 5)	E-TFCI (boost)
1	1	0	30/15	30/15	β_{ed}1: 30/15 β_{ed}2: 30/15	β_{ed}3: 24/15 β_{ed}4: 24/15	3.5	2.5	14	105	105

Note 1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with β_{hs} = 30/15 * β_c.
Note 2: CM = 3.5 and the MPR is based on the relative CM difference, MPR = MAX(CM-1,0).
Note 3: DPDCH is not configured, therefore the β_c is set to 1 and β_d = 0 by default.
Note 4: β_{ed} can not be set directly; it is set by Absolute Grant Value.
Note 5: All the sub-tests require the UE to transmit 2SF2+2SF4 16QAM EDCH and they apply for UE using E-DPDCH category 7. E-DCH TTI is set to 2ms TTI and E-DCH table index = 2. To support these E-DCH configurations DPDCH is not allocated. The UE is signalled to use the extrapolation algorithm.

DC-HSDPA

The following tests were conducted according to the test requirements in Table C.8.1.12 of 3GPP TS 34.121-1

Table C.8.1.12: Fixed Reference Channel H-Set 12

Parameter	Unit	Value
Nominal Avg. Inf. Bit Rate	kbps	60
Inter-TTI Distance	TTI's	1
Number of HARQ Processes	Processes	6
Information Bit Payload (N_{INF})	Bits	120
Number Code Blocks	Blocks	1
Binary Channel Bits Per TTI	Bits	960
Total Available SML's in UE	SML's	19200
Number of SML's per HARQ Proc.	SML's	3200
Coding Rate		0.15
Number of Physical Channel Codes	Codes	1
Modulation		QPSK

Note 1: The RMC is intended to be used for DC-HSDPA mode and both cells shall transmit with identical parameters as listed in the table.
Note 2: Maximum number of transmission is limited to 1, i.e., retransmission is not allowed. The redundancy and constellation version 0 shall be used.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2017-12-11	2018-12-11
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2020-11-10
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2017-08-31	2018-08-31
ETS LINDGREN	Horn Antenna	3115	000 527 35	2016-01-05	2019-01-04
Agilent	Signal Generator	E8247C	MY43321350	2017-12-11	2018-12-11
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
N/A	Coaxial Cable	C-NJNJ-50	C-0400-01	2017-09-05	2018-09-05
N/A	Coaxial Cable	C-NJNJ-50	C-0075-01	2017-09-05	2018-09-05
N/A	Coaxial Cable	C-NJNJ-50	C-1000-01	2017-09-05	2018-09-05
N/A	Coaxial Cable	C-SJSJ-50	C-0800-01	2017-09-05	2018-09-05
N/A	Coaxial Cable	C-SJ00-0010	C0010/01	Each Time	/
R&S	Universal Radio Communication Tester	CMU200	106 891	2017-12-14	2018-12-14

*** 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:	26.3°C
Relative Humidity:	29.8 %
ATM Pressure:	101.3 kPa

** The testing was performed by Sunny Cen on 2017-12-14.*

Conducted Output Power

Cellular Band & PCS Band

Band	Channel No.	Conducted Peak Output Power (dBm)			
		GPRS 1 TX Slot	GPRS 2 TX Slot	GPRS 3 TX Slot	GPRS 4 TX Slot
Cellular	128	32.37	31.63	29.77	28.35
	190	32.41	31.57	29.83	28.44
	251	32.35	31.42	29.89	28.50
PCS	512	29.23	28.41	26.73	25.61
	661	29.16	28.35	26.69	25.62
	810	29.11	28.37	26.54	25.55

WCDMA Band Ⅱ

Mode	3GPP Sub Test	Low Channel		Middle Channel		High Channel	
		Ave. Power (dBm)	PAR (dB)	Ave. Power (dBm)	PAR (dB)	Ave. Power (dBm)	PAR (dB)
Rel 99	1	22.63	2.68	22.46	2.72	22.21	2.52
HSDPA	1	22.58	2.53	22.48	2.48	22.23	2.44
	2	22.42	2.57	22.40	2.58	22.13	2.41
	3	22.67	2.51	22.27	2.64	22.19	2.32
	4	22.45	2.55	22.27	2.57	22.16	2.31
HSUPA	1	22.67	2.45	22.41	2.65	22.13	2.49
	2	22.45	2.68	22.43	2.49	22.10	2.47
	3	22.54	2.52	22.31	2.69	22.10	2.43
	4	22.42	2.46	22.30	2.65	22.04	2.44
	5	22.43	2.65	22.45	2.48	22.02	2.43
DC-HSDPA	1	22.58	2.67	22.44	2.61	22.18	2.42
	2	22.57	2.47	22.39	2.62	22.00	2.44
	3	22.61	2.53	22.34	2.61	22.15	2.46
	4	22.49	2.54	22.44	2.63	22.04	2.51
HSPA+	1	22.41	2.52	22.33	2.60	22.06	2.52

WCDMA Band V

Mode	3GPP Sub Test	Low Channel		Middle Channel		High Channel	
		Ave. Power (dBm)	PAR (dB)	Ave. Power (dBm)	PAR (dB)	Ave. Power (dBm)	PAR (dB)
Rel 99	1	22.67	3.00	22.58	3.24	22.61	3.04
HSDPA	1	22.57	2.95	22.57	3.22	22.40	2.87
	2	22.43	2.82	22.56	3.03	22.60	2.95
	3	22.46	2.83	22.57	3.07	22.59	2.94
	4	22.53	2.88	22.52	3.03	22.43	2.99
HSUPA	1	22.43	2.97	22.39	3.15	22.37	2.87
	2	22.62	2.78	22.44	3.08	22.50	2.81
	3	22.65	2.78	22.41	3.19	22.41	2.91
	4	22.65	2.99	22.42	3.12	22.44	2.83
	5	22.64	2.86	22.46	3.17	22.43	2.93
DC-HSDPA	1	22.48	2.76	22.54	3.10	22.52	2.83
	2	22.62	2.89	22.47	3.19	22.58	2.95
	3	22.63	2.78	22.42	3.14	22.52	3.03
	4	22.54	2.75	22.46	3.20	22.47	3.00
HSPA+	1	22.59	2.94	22.53	3.21	22.49	2.85

ERP & EIRP

FCC Part 22H&RSS-132

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								
836.600	H	93.24	18.3	0.0	1	17.3	38.5	21.2
836.600	V	99.33	27.5	0.0	1	26.5	38.5	12.0
WCDMA Band V Middle Channel								
836.600	H	87.01	12.1	0.0	1	11.1	38.5	27.4
836.600	V	91.42	19.6	0.0	1	18.6	38.5	19.9

FCC Part 24E& RSS-133

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								
1880.000	H	90.43	17.5	11.1	1.6	27.0	33.0	6.0
1880.000	V	88.96	15.8	11.1	1.6	25.3	33.0	7.7
WCDMA Band II Middle Channel								
1880.000	H	83.46	10.5	11.1	1.6	20.0	33.0	13
1880.000	V	81.99	8.8	11.1	1.6	18.3	33.0	14.7

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 RSS-GEN §6.6 - OCCUPIED BANDWIDTH

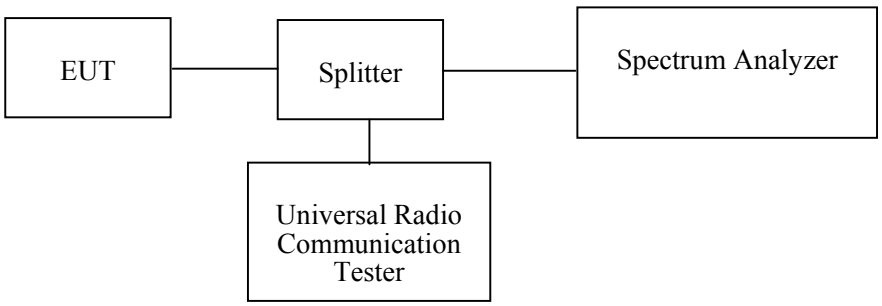
Applicable Standard

FCC §2.1049, §22.917, §22.905, §24.238, RSS-GEN §6.6

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
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2017-08-31	2018-08-31
R&S	Universal Radio Communication Tester	CMU200	106 891	2017-12-14	2018-12-14
N/A	Coaxial Cable	C-SJ00-0010	C0010/01	Each Time	/
N/A	Coaxial Cable	C-SJ00-0010	C0010/05	Each Time	/
E-Microwave	Coaxial Attenuators	EMCA10-5RN-6	OE01203239	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:	23.5~25.4°C
Relative Humidity:	39~41 %
ATM Pressure:	101.2~102 kPa

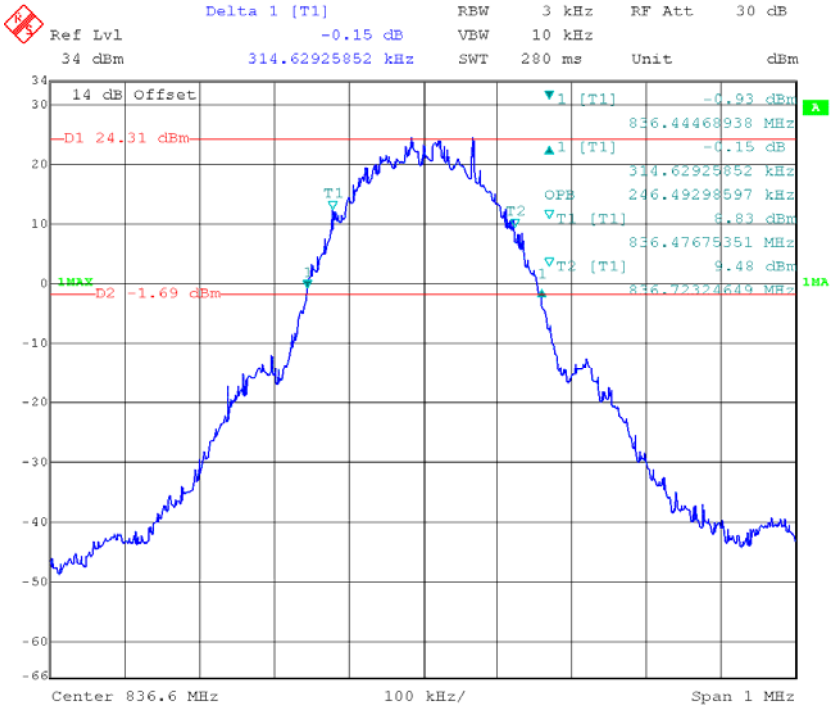
The testing was performed by Pean Zhu on 2017-12-15 and 2017-12-23.

Test Mode: Transmitting

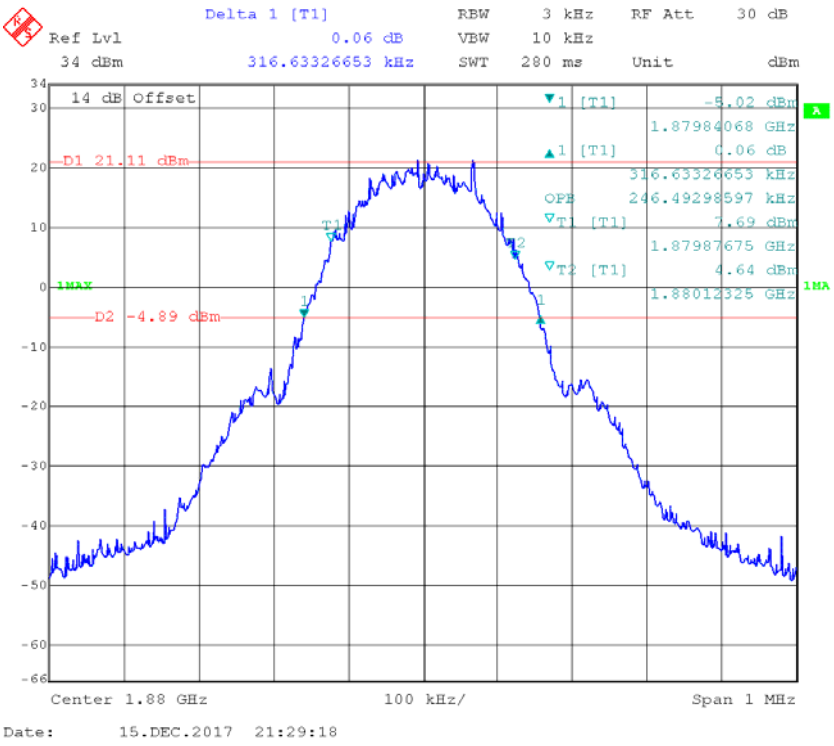
Test Result: Compliant. Please refer to the following table and plots.

Band	Test Channel	Mode	99% Occupied Bandwidth (MHz)	26 dB Occupied Bandwidth (MHz)
Cellular	M	GPRS	0.246	0.315
PCS		PCS	0.246	0.317
WCDMA Band II		Rel 99	4.208	4.910
		HSDPA	4.228	4.890
		HSUPA	4.208	4.910
WCDMA Band V		Rel 99	4.228	4.890
		HSDPA	4.228	4.910
		HSUPA	4.248	4.89

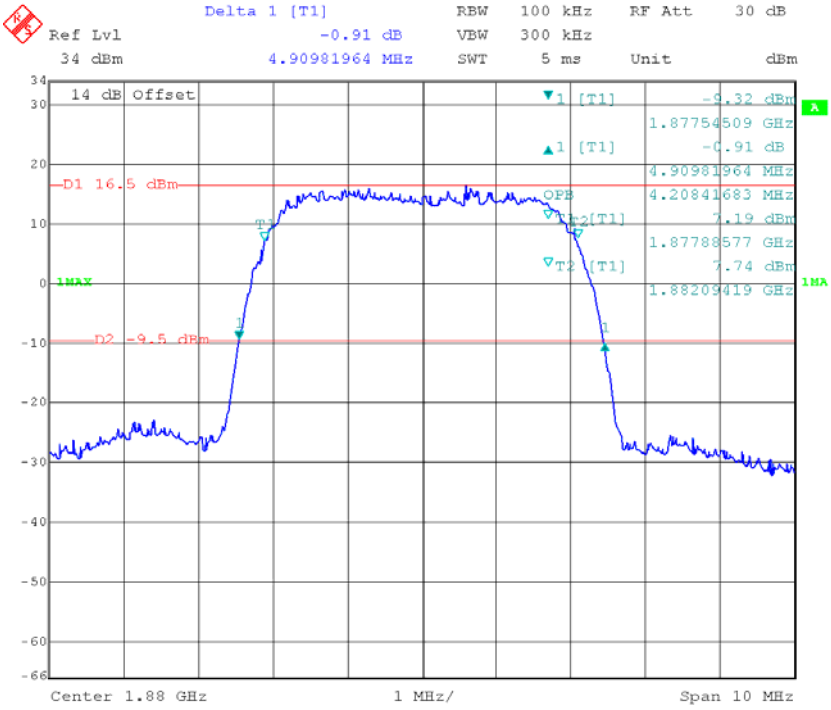
GPRS 850 Cellular Band



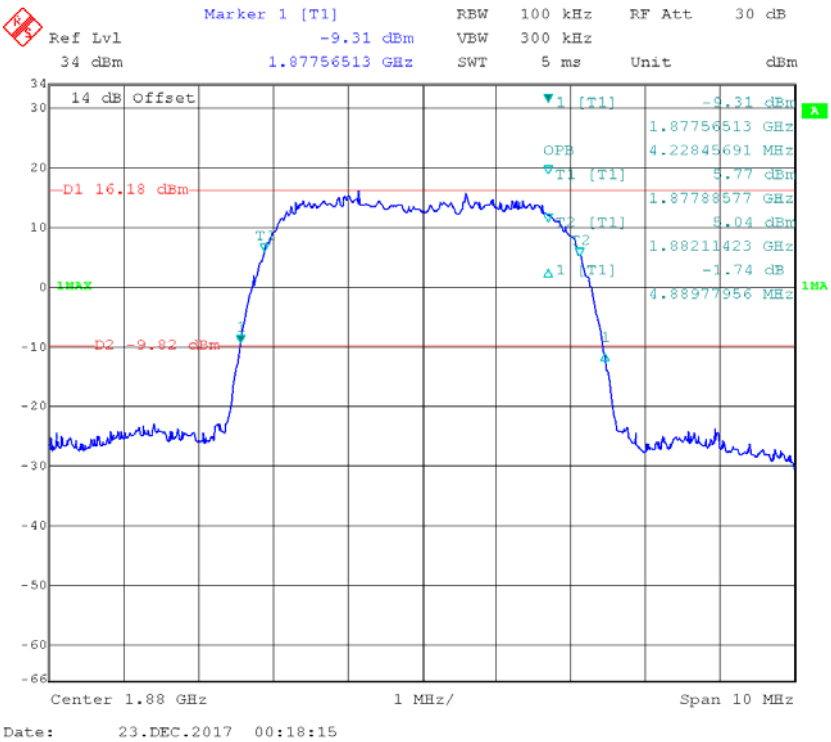
GPRS1900 Cellular Band



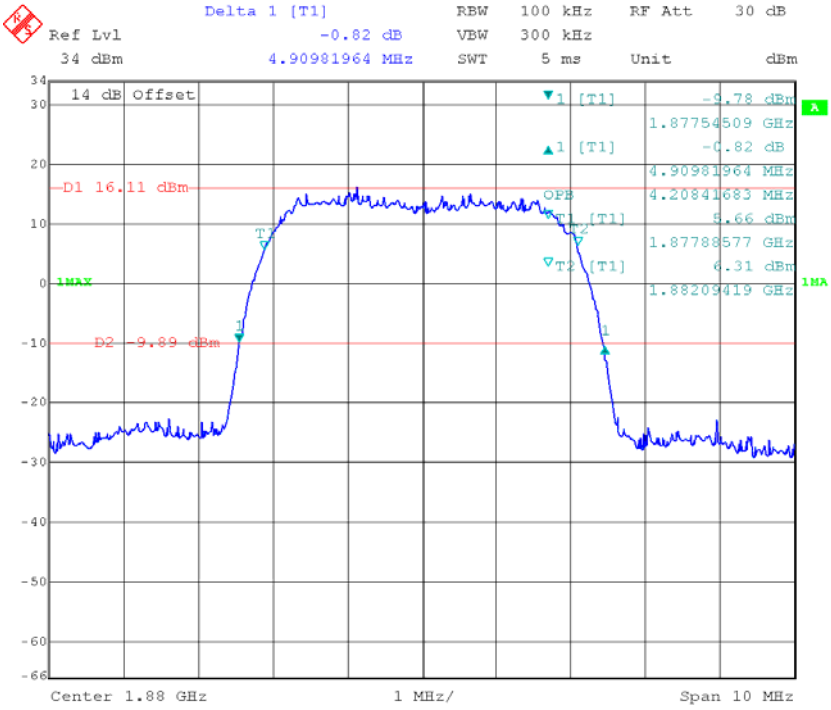
REL99 Band II



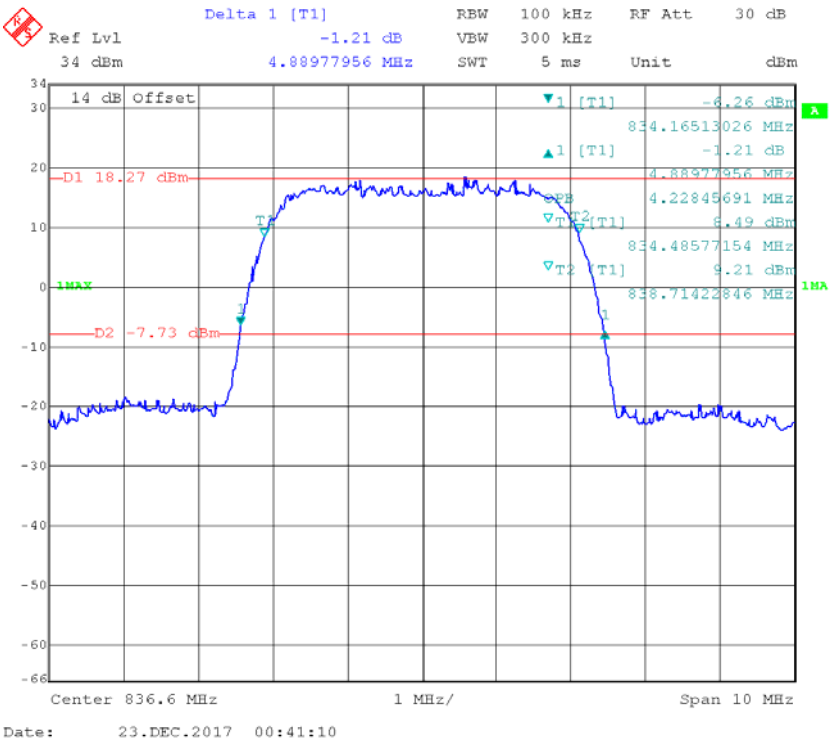
HSDPA Band II



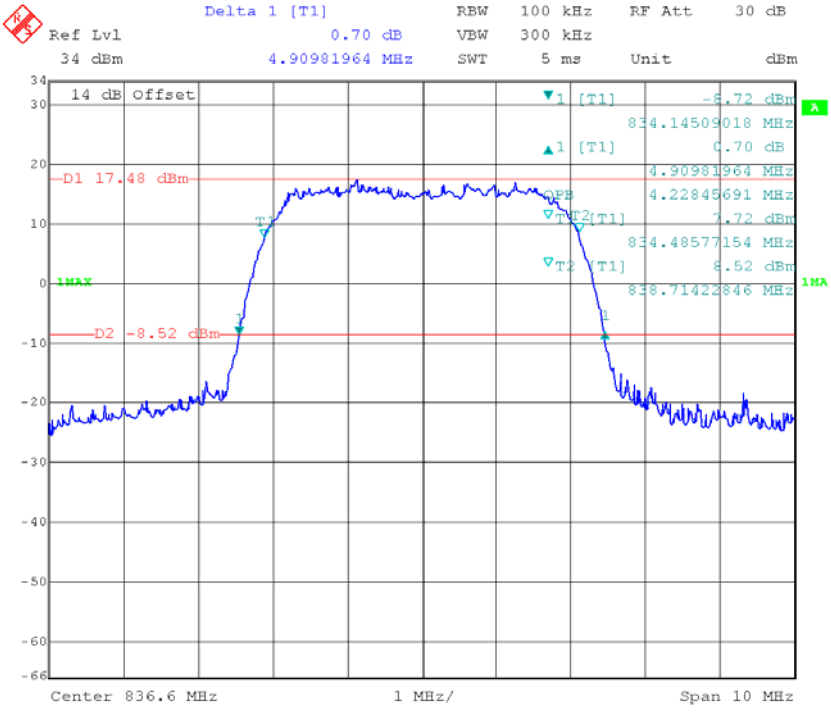
HSUPA Band II



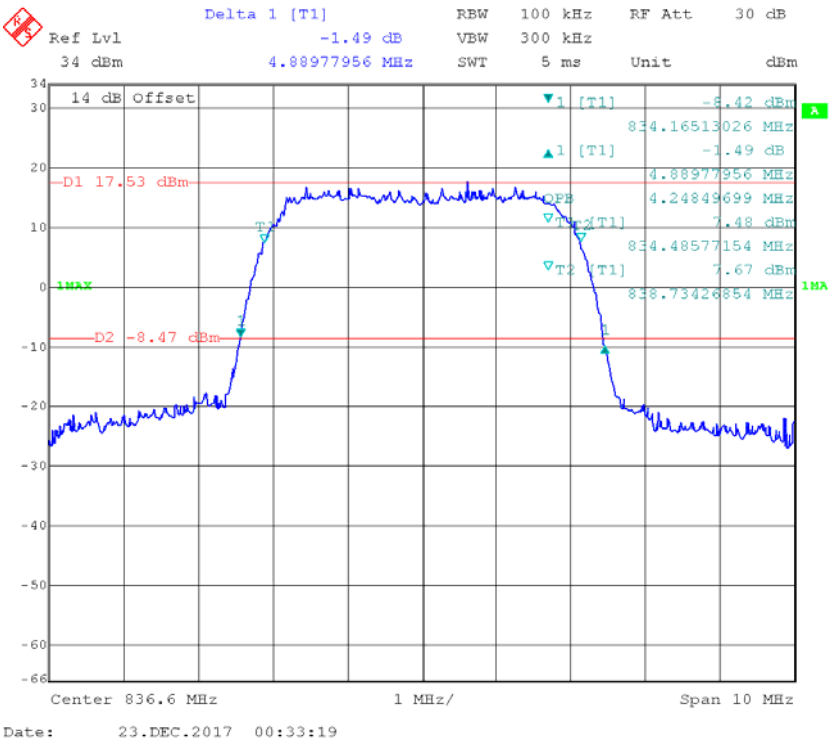
REL99 Band Ⅴ



HSDPA Band Ⅴ



HSUPA Band Ⅴ



FCC §2.1051, §22.917(a),§24.238(a)& RSS-132 §5.5 & RSS-133 §6.5 - 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.

According to RSS-132 §5.5

Mobile and base station equipment shall comply with the limits in (i) and (ii) below.

(i) In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10 p (watts).

(ii) (ii) After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10 p (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

According to RSS-133 §6.5

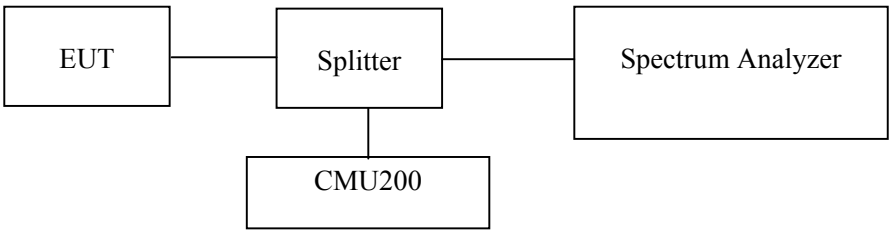
Equipment shall comply with the limits in (i) and (ii) below.

(i) In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10 p(watts).

(ii) After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10 p(watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.

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	106 891	2017-12-14	2018-12-14
N/A	Coaxial Cable	C-SJ00-0010	C0010/01	Each Time	/
N/A	Coaxial Cable	C-SJ00-0010	C0010/05	Each Time	/
E-Microwave	Two-way Spliter	ODP-1-6-2S	OE0120142	Each Time	/
E-Microwave	Coaxial Attenuators	EMCA10-5RN-6	OE01203239	2017-09-05	2018-09-05
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2017-08-31	2018-08-31

*** 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

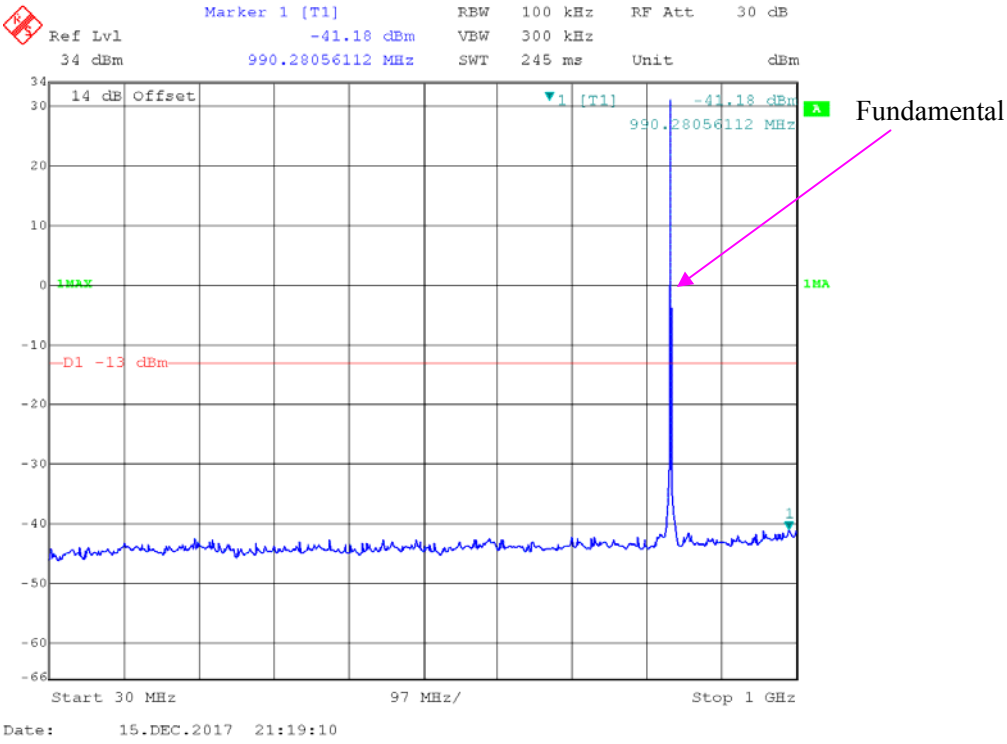
Environmental Conditions

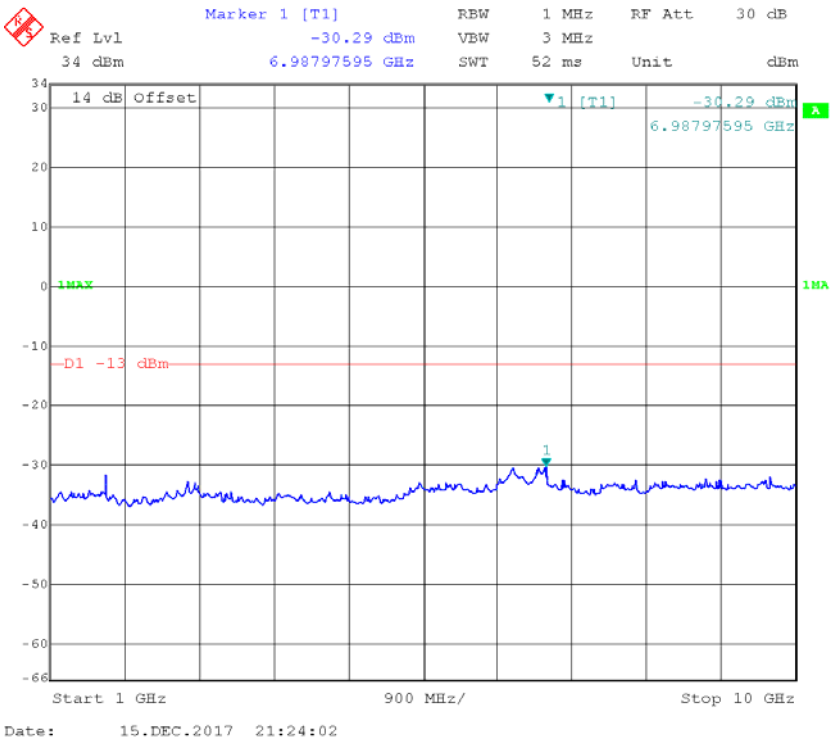
Temperature:	25.4 °C
Relative Humidity:	41 %
ATM Pressure:	102 kPa

The testing was performed by Pean Zhu on 2017-12-15.

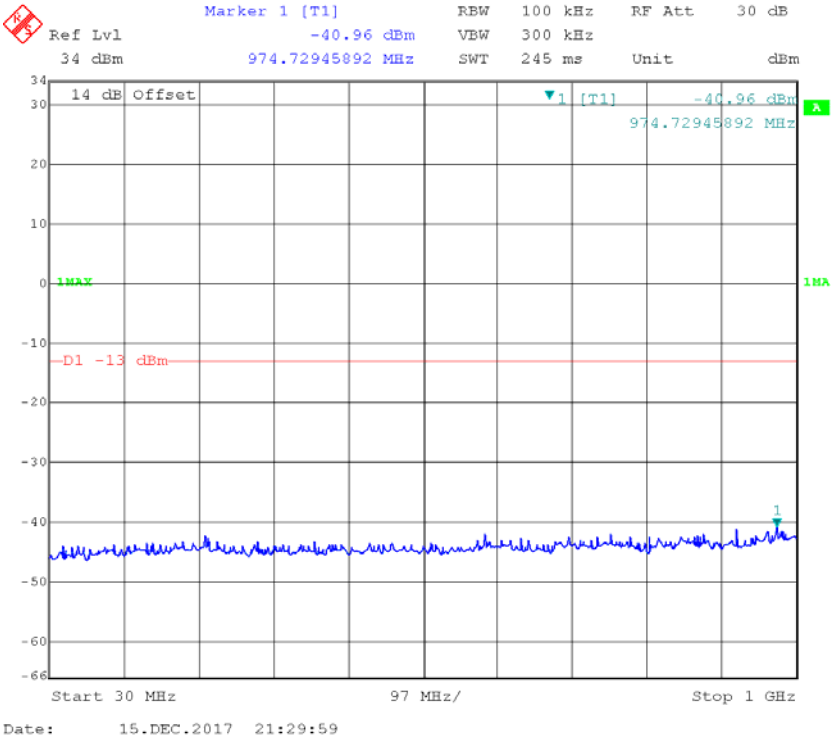
Please refer to the following plots.

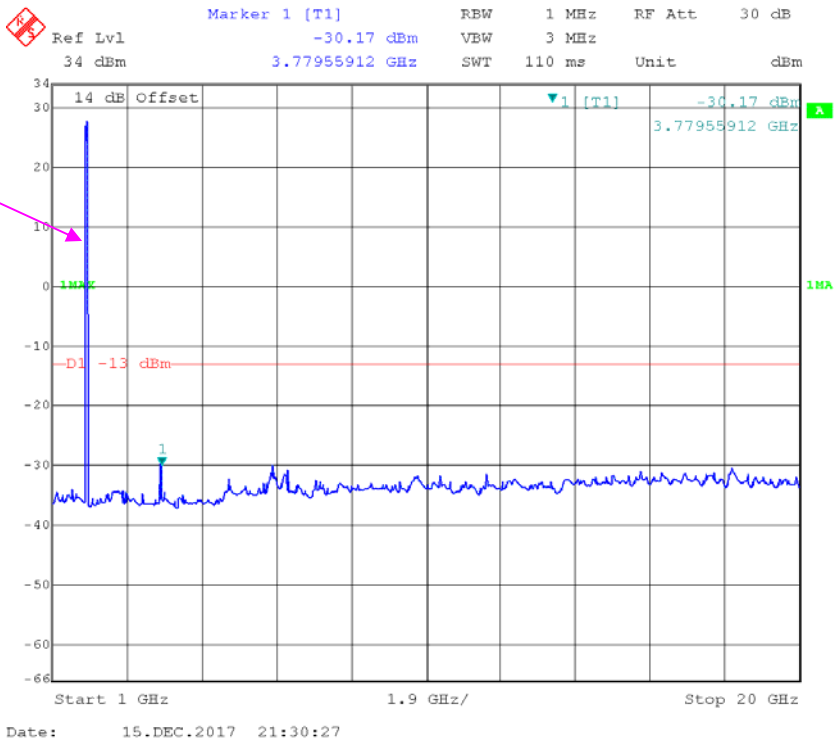
GPRS 850_Middle Channel





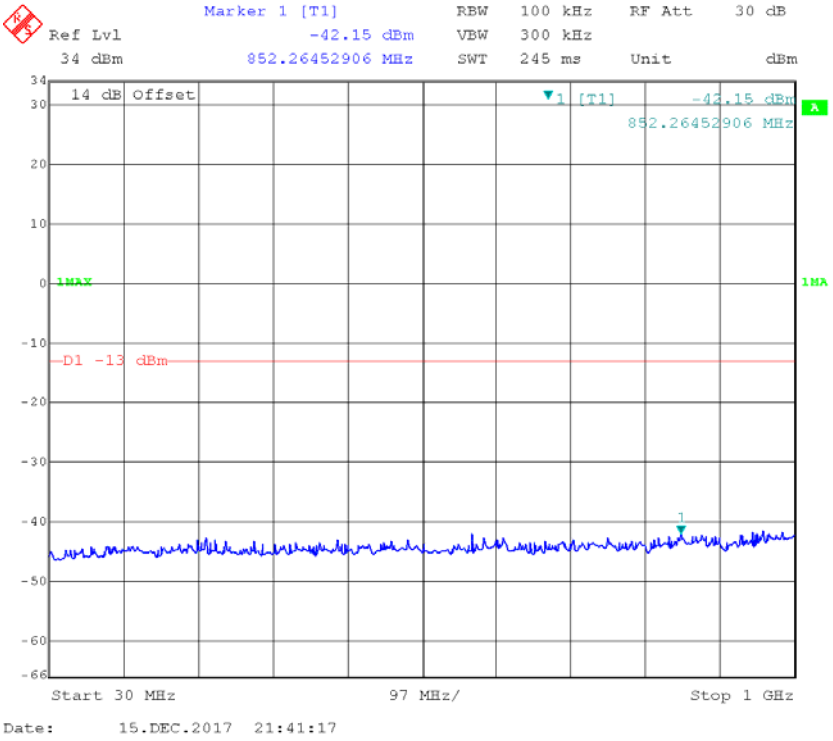
GPRS1900_ Middle Channel

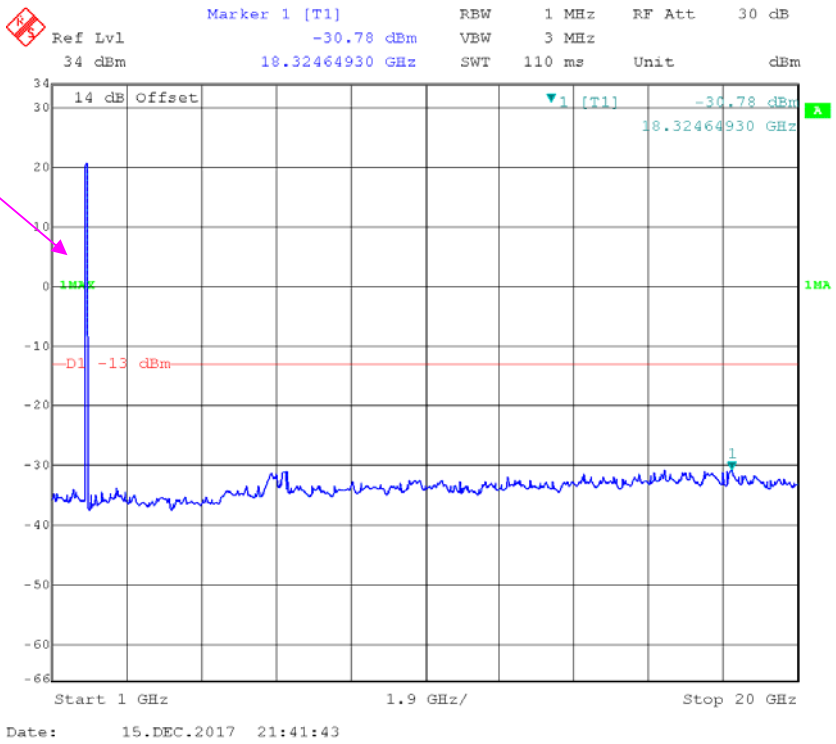




Fundamental

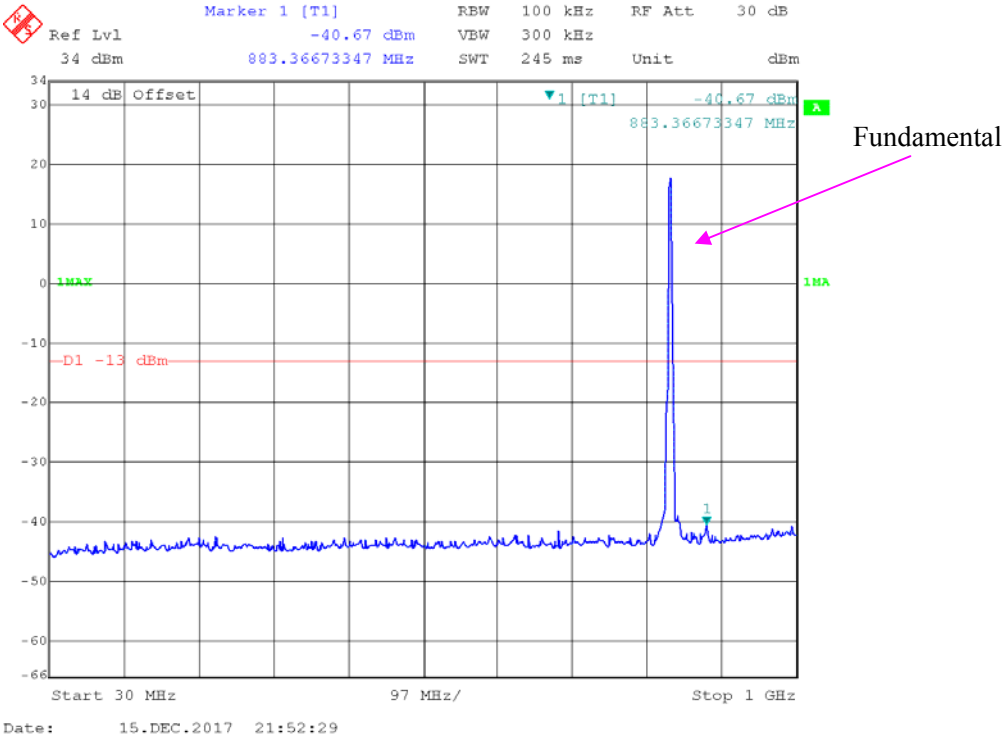
REL99 Band II_ Middle Channel

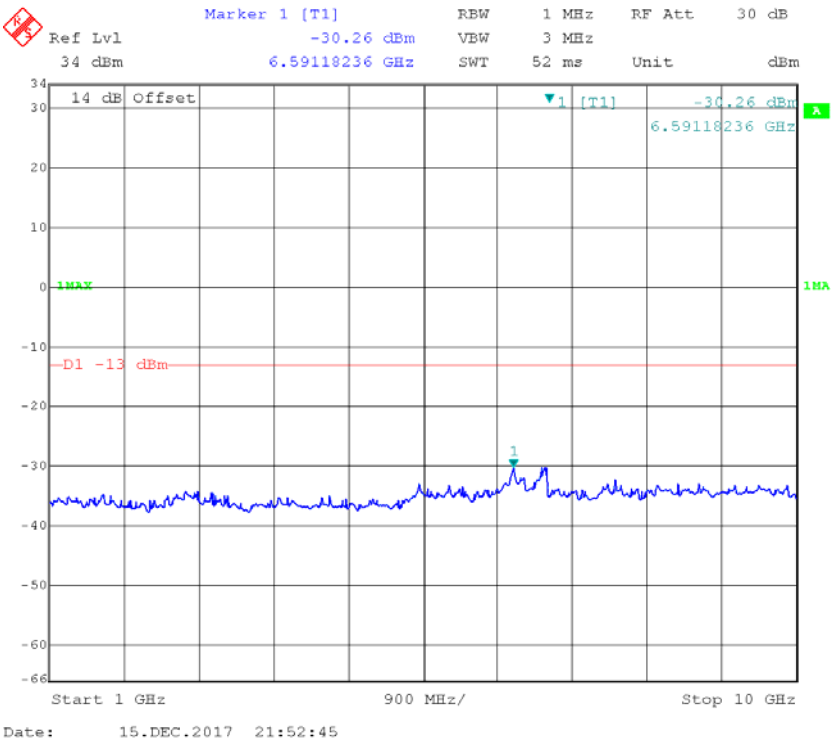




Fundamental

Rel 99 Band Ⅴ_ Middle Channel





FCC §2.1053, §22.917, §24.238 &RSS-132 §5.5 & RSS-133 §6.5- SPURIOUS RADIATED EMISSIONS

Applicable Standard

FCC § 2.1053, §22.917, § 24.238 &RSS-132 §5.5 & RSS-133 §6.5.

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 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	2017-12-11	2018-12-11
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2020-11-10
HP	Amplifier	8447D	2727A05902	2017-09-05	2018-09-05
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2017-08-31	2018-08-31
Agilent	Signal Generator	E8247C	MY43321350	2017-12-11	2018-12-11
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
ETS LINDGREN	Horn Antenna	3115	000 527 35	2016-01-05	2019-01-04
Ducommun Technolagies	Horn Antenna	ARH-4223-02	1007726-01 1304	2016-11-18	2019-11-18
Ducommun Technolagies	Horn Antenna	ARH-4223-02	1007726-02 1304	2016-11-18	2019-11-18
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2017-09-05	2018-09-05
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2017-06-27	2018-06-27
N/A	Coaxial Cable	C-2.4J2.4J-50	C-0700-01	2017-06-27	2018-06-27
N/A	Coaxial Cable	C-NJNJ-50	C-0400-01	2017-09-05	2018-09-05
N/A	Coaxial Cable	C-NJNJ-50	C-0075-01	2017-09-05	2018-09-05
N/A	Coaxial Cable	C-NJNJ-50	C-1000-01	2017-09-05	2018-09-05
N/A	Coaxial Cable	C-SJSJ-50	C-0800-01	2017-09-05	2018-09-05
N/A	Coaxial Cable	C-SJ00-0010	C0010/01	Each Time	/
R&S	Universal Radio Communication Tester	CMU200	106 891	2017-12-14	2018-12-14

*** 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:	26.3 °C
Relative Humidity:	29.8 %
ATM Pressure:	101.3 kPa

** The testing was performed by Blake Yang on 2017-12-14.*

EUT Operation Mode: Transmitting

Cellular Band

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	48.30	-54.4	10.5	1.5	-45.4	-13.0	32.4
1673.200	V	45.20	-57.4	10.5	1.5	-48.4	-13.0	35.4
2509.800	H	46.20	-54.5	12.2	1.8	-44.1	-13.0	31.1
2509.800	V	42.60	-59.5	12.2	1.8	-49.1	-13.0	36.1
3346.400	H	51.50	-47.5	12.3	2	-37.2	-13.0	24.2
3346.400	V	48.20	-49.7	12.3	2	-39.4	-13.0	26.4
2247.000	H	48.60	-52.9	11.8	1.7	-42.8	-13.0	29.8
2247.000	V	45.20	-56.9	11.8	1.7	-46.8	-13.0	33.8
434.000	H	42.50	-62.1	0.0	0.6	-62.7	-13.0	49.7
434.000	V	47.60	-60.3	0.0	0.6	-60.9	-13.0	47.9
WCDMA Band V R99,Frequency:836.600 MHz								
1673.200	H	53.40	-49.3	10.5	1.5	-40.3	-13.0	27.3
1673.200	V	49.50	-53.1	10.5	1.5	-44.1	-13.0	31.1
2509.800	H	48.20	-52.5	12.2	1.8	-42.1	-13.0	29.1
2509.800	V	42.80	-59.3	12.2	1.8	-48.9	-13.0	35.9
3346.400	H	46.80	-52.2	12.3	2	-41.9	-13.0	28.9
3346.400	V	42.50	-55.4	12.3	2	-45.1	-13.0	32.1
1861.000	H	45.70	-56.7	11.1	1.6	-47.2	-13.0	34.2
1861.000	V	43.30	-59	11.1	1.6	-49.5	-13.0	36.5
584.000	H	43.60	-58.9	0.0	0.8	-59.7	-13.0	46.7
584.000	V	46.80	-58.9	0.0	0.8	-59.7	-13.0	46.7

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	52.70	-45	12.3	2.1	-34.8	-13.0	21.8
3760.000	V	49.30	-48.1	12.3	2.1	-37.9	-13.0	24.9
5640.000	H	46.20	-46.2	13.0	2.4	-35.6	-13.0	22.6
5640.000	V	44.50	-48.2	13.0	2.4	-37.6	-13.0	24.6
2371.000	H	48.50	-52.6	12.0	1.7	-42.3	-13.0	29.3
2371.000	V	43.70	-58.5	12.0	1.7	-48.2	-13.0	35.2
381.000	H	42.80	-62.7	0.0	0.6	-63.3	-13.0	50.3
381.000	V	48.60	-59.9	0.0	0.6	-60.5	-13.0	47.5
WCDMA Band II, R99, Frequency:1880.000 MHz								
3760.000	H	53.40	-44.3	12.3	2.1	-34.1	-13.0	21.1
3760.000	V	51.10	-46.3	12.3	2.1	-36.1	-13.0	23.1
5640.000	H	48.50	-43.9	13.0	2.4	-33.3	-13.0	20.3
5640.000	V	44.80	-47.9	13.0	2.4	-37.3	-13.0	24.3
3278.000	H	49.60	-49.5	12.3	2	-39.2	-13.0	26.2
3278.000	V	45.40	-52.8	12.3	2	-42.5	-13.0	29.5
617.000	H	41.80	-60.2	0.0	0.8	-61.0	-13.0	48.0
617.000	V	47.50	-57.6	0.0	0.8	-58.4	-13.0	45.4

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) RSS-132 §5.5 & RSS-133- BAND EDGES

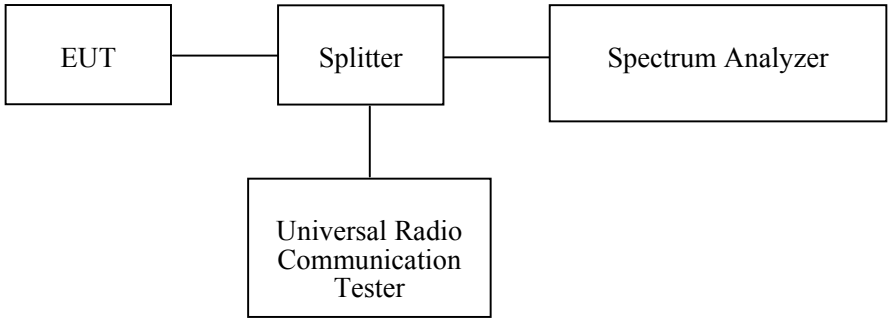
Applicable Standard

FCC § 2.1053, §22.917, § 24.238 and RSS-132 §5.5 & RSS-133

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	106 891	2017-12-14	2018-12-14
N/A	Coaxial Cable	C-SJ00-0010	C0010/01	Each Time	/
N/A	Coaxial Cable	C-SJ00-0010	C0010/05	Each Time	/
E-Microwave	Two-way Spliter	ODP-1-6-2S	OE0120142	Each Time	/
E-Microwave	Coaxial Attenuators	EMCA10-5RN-6	OE01203239	2017-09-05	2018-09-05
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2017-08-31	2018-08-31

*** 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

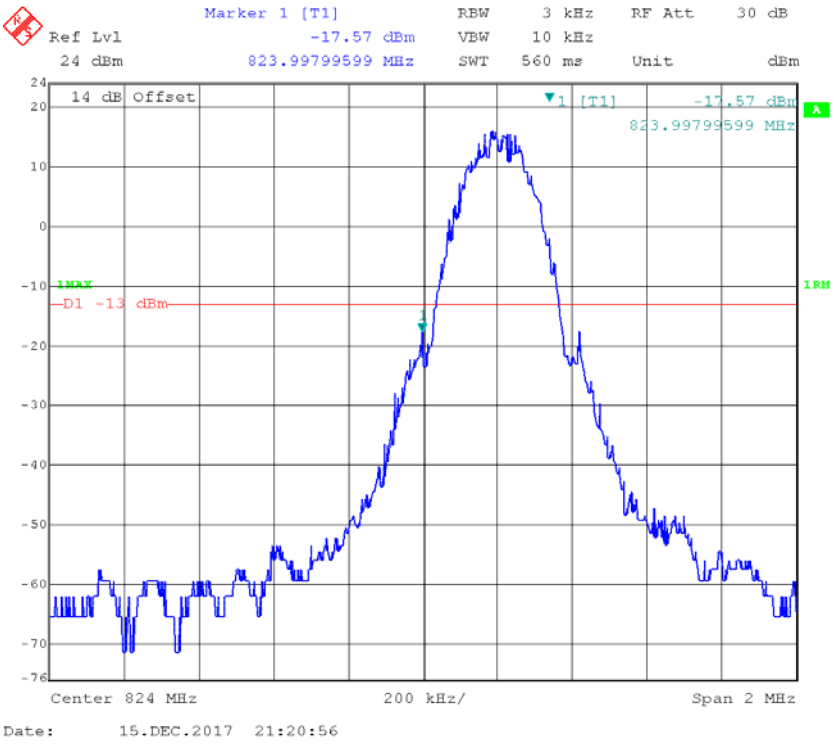
Temperature:	23.5~25.4°C
Relative Humidity:	39~41 %
ATM Pressure:	101.2~102 kPa

The testing was performed by Pean Zhu on 2017-12-15 and 2017-12-23.

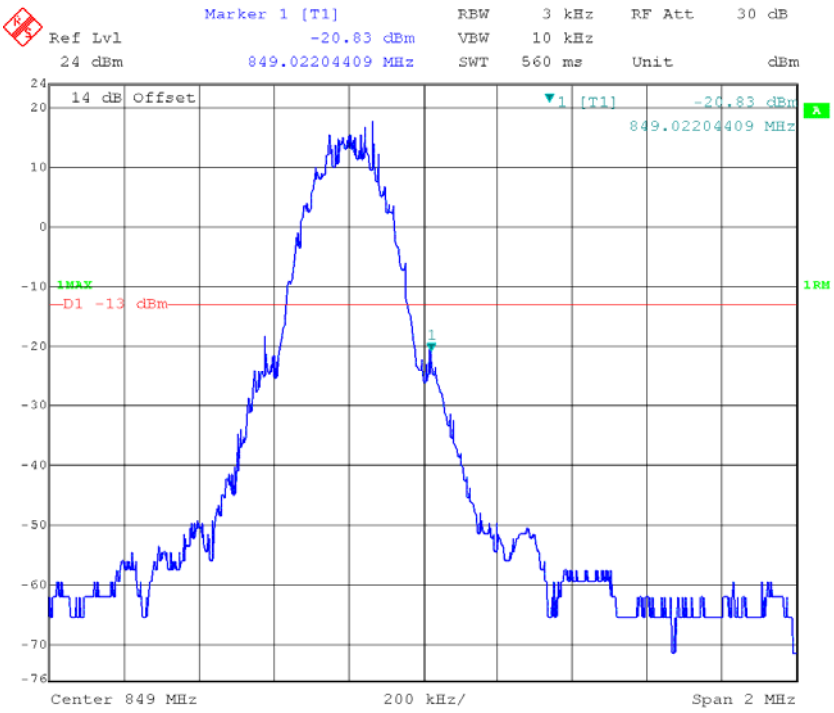
Test Mode: Transmitting

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

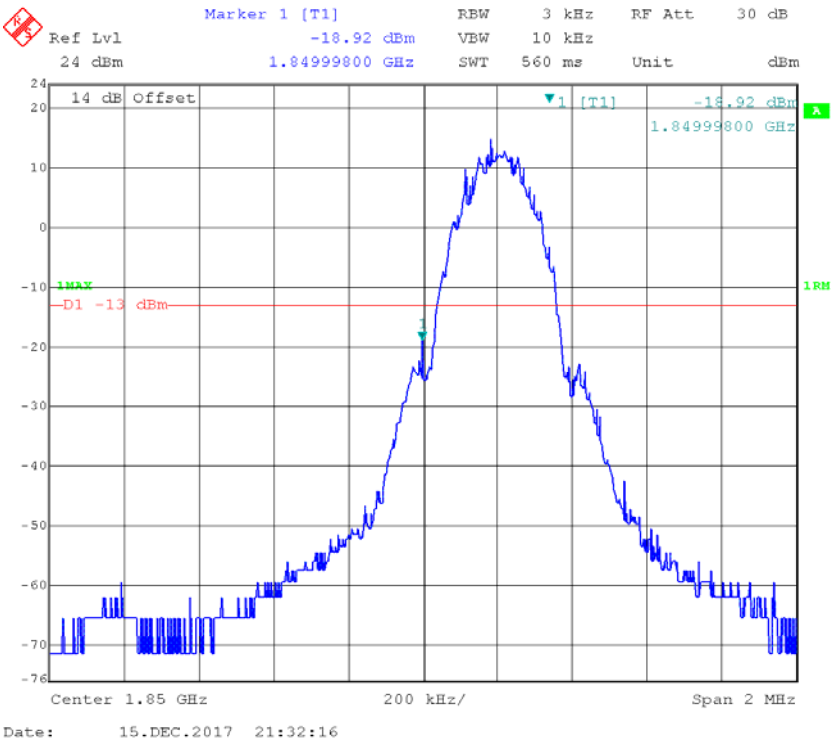
GPRS 850, Left Band Edge



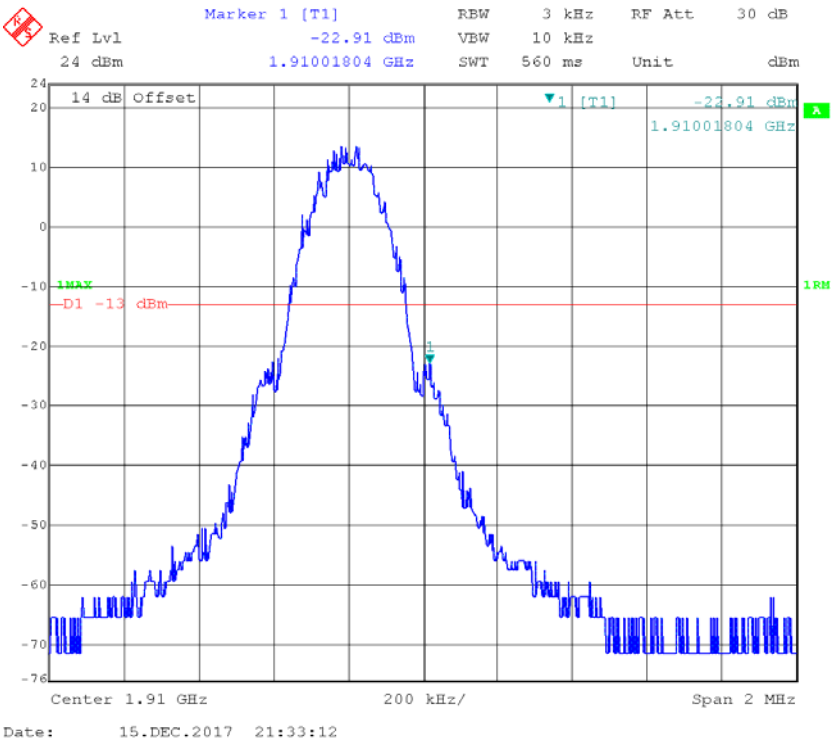
GPRS 850, Right Band Edge



GPRS 1900, Left Band Edge

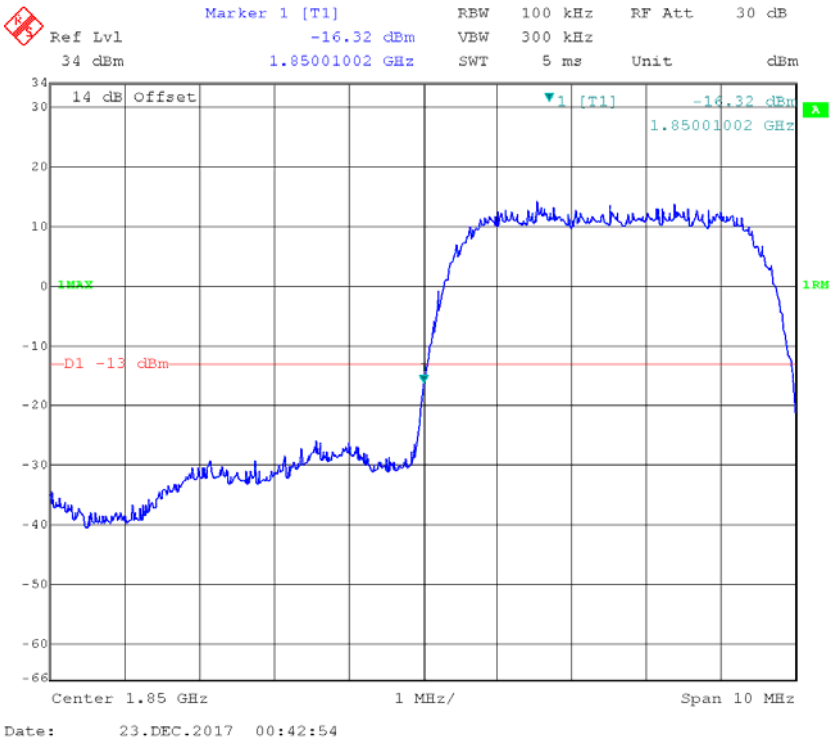


GPRS 1900, Right Band Edge

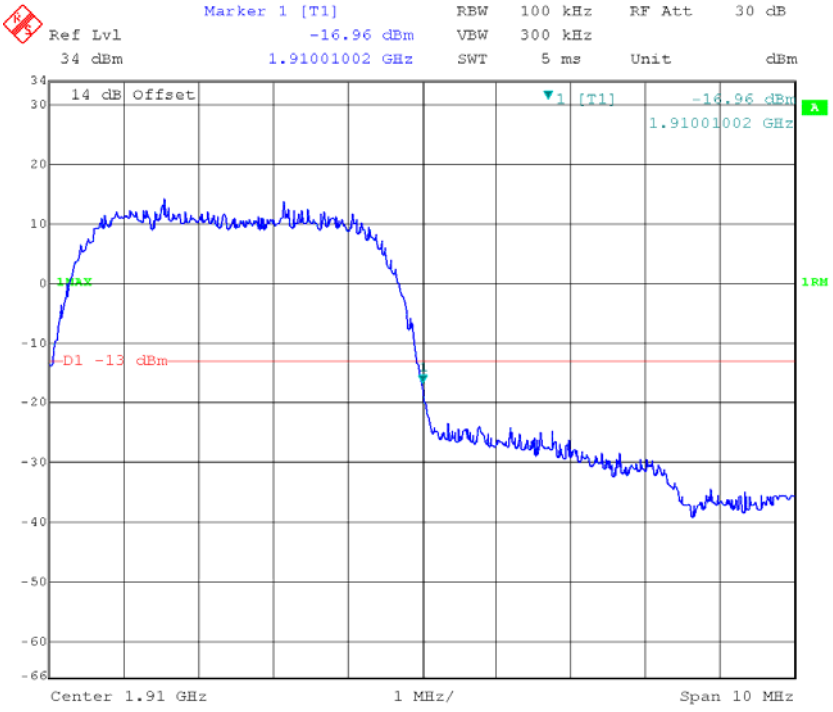


WCDMA Band II:

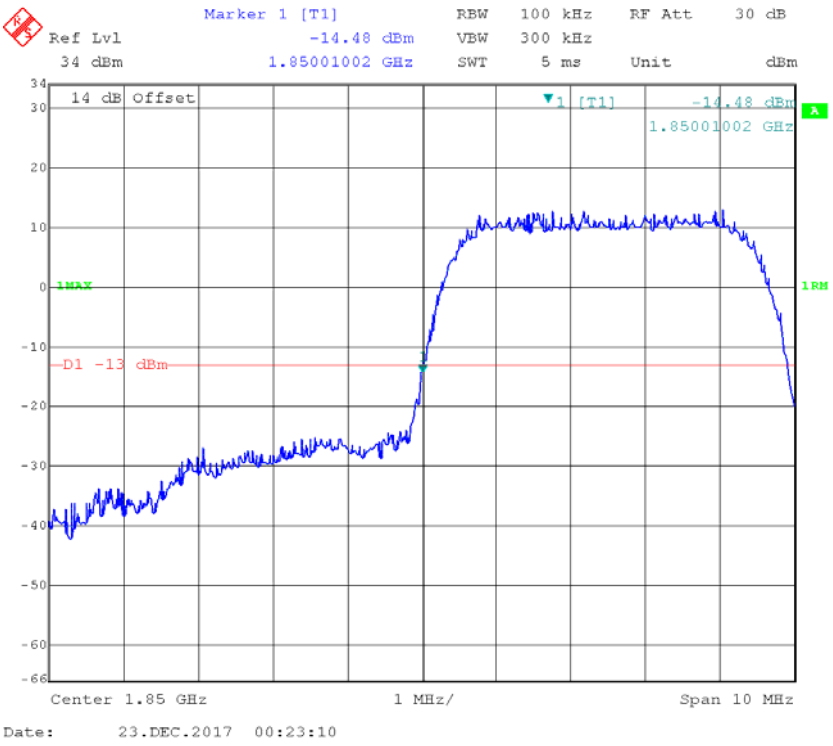
REL99 Band II, Left Band Edge



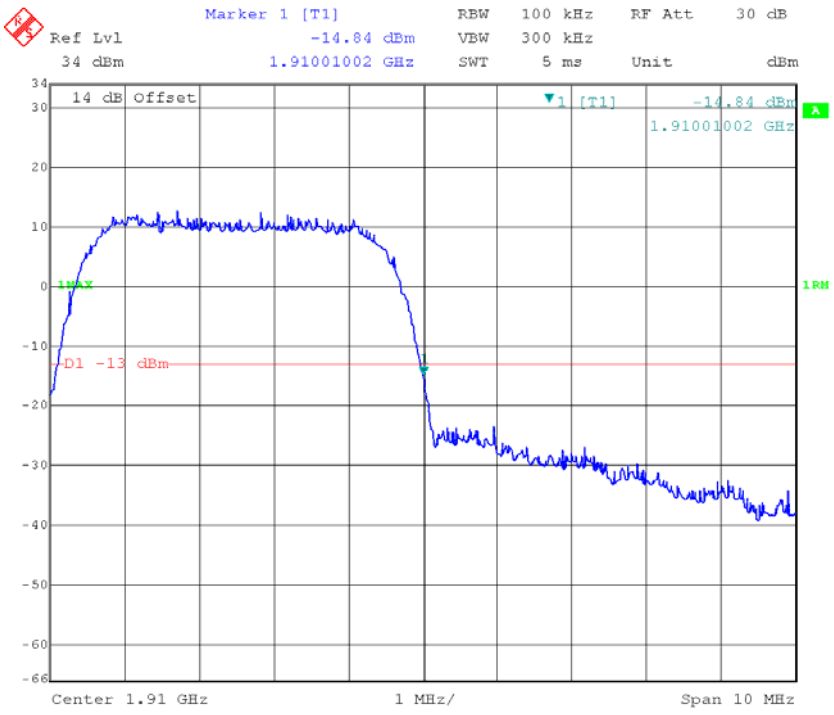
REL99 Band II, Right Band Edge



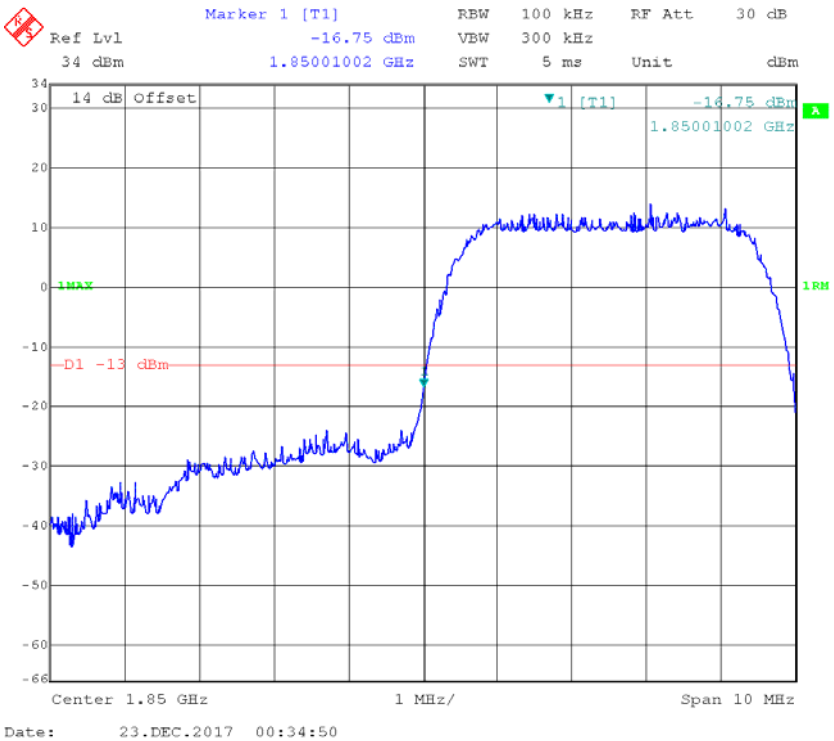
HSDPA Band II, Left Band Edge



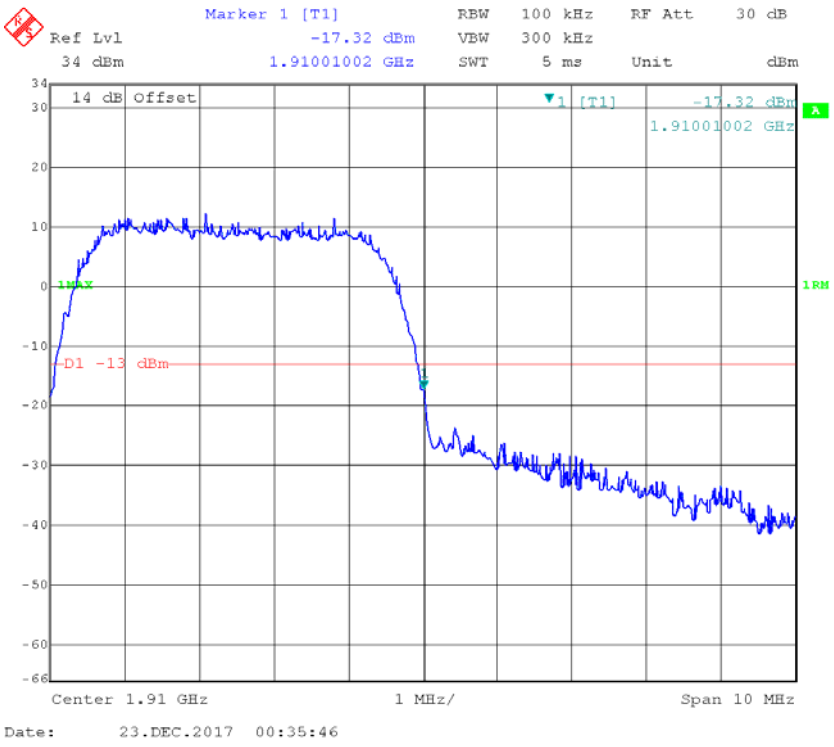
HSDPA Band II, Right Band Edge



HSUPA Band II, Left Band Edge

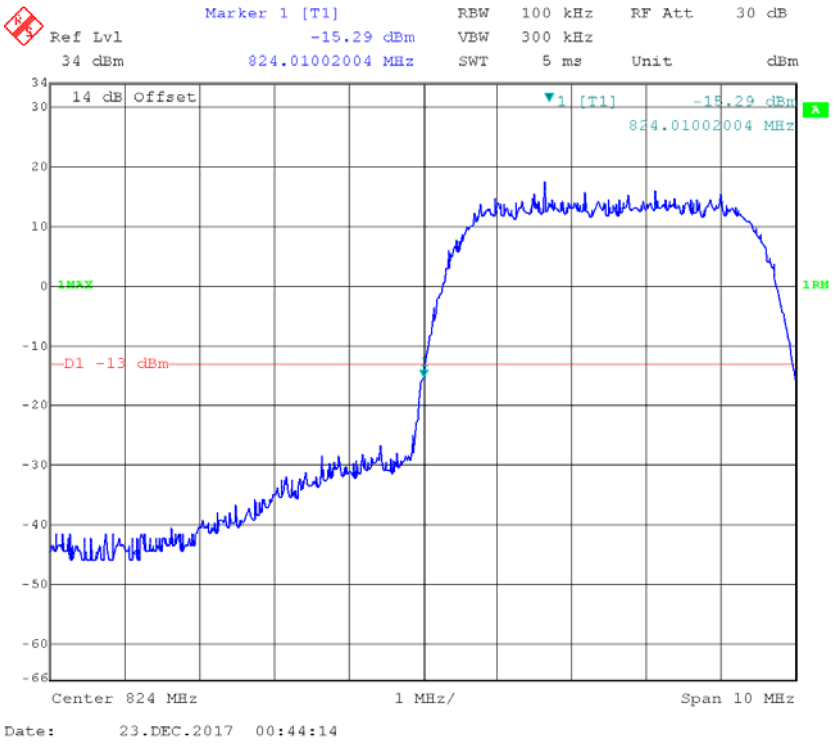


HSUPA Band II, Right Band Edge

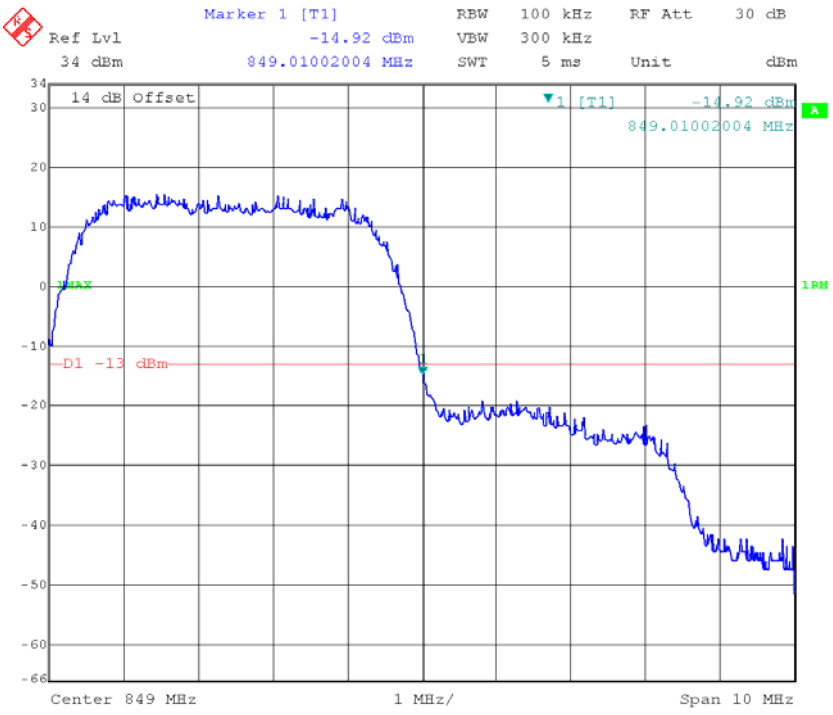


WCDMA Band V

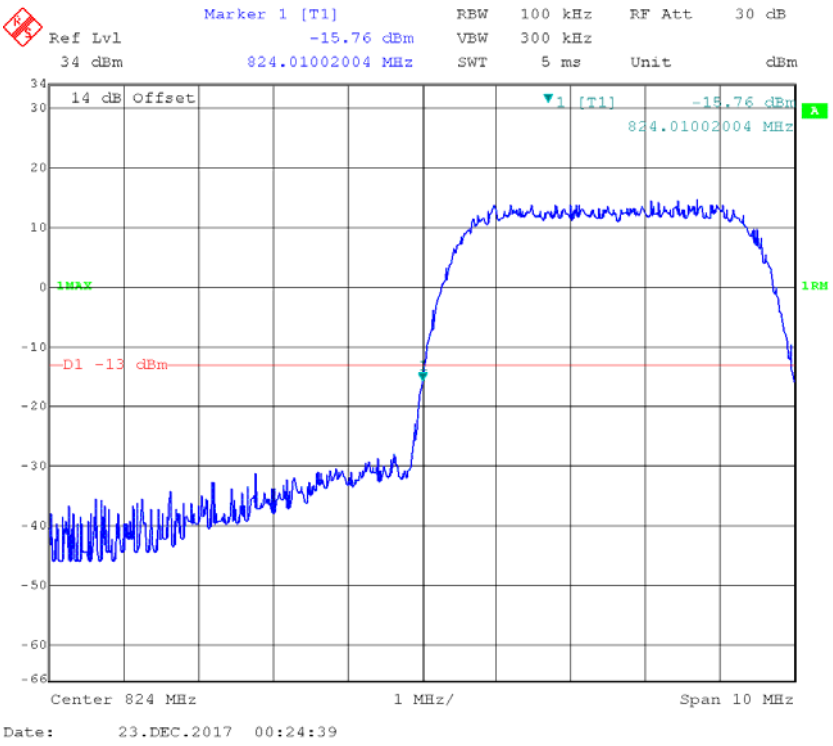
REL99 Band V, Left Band Edge



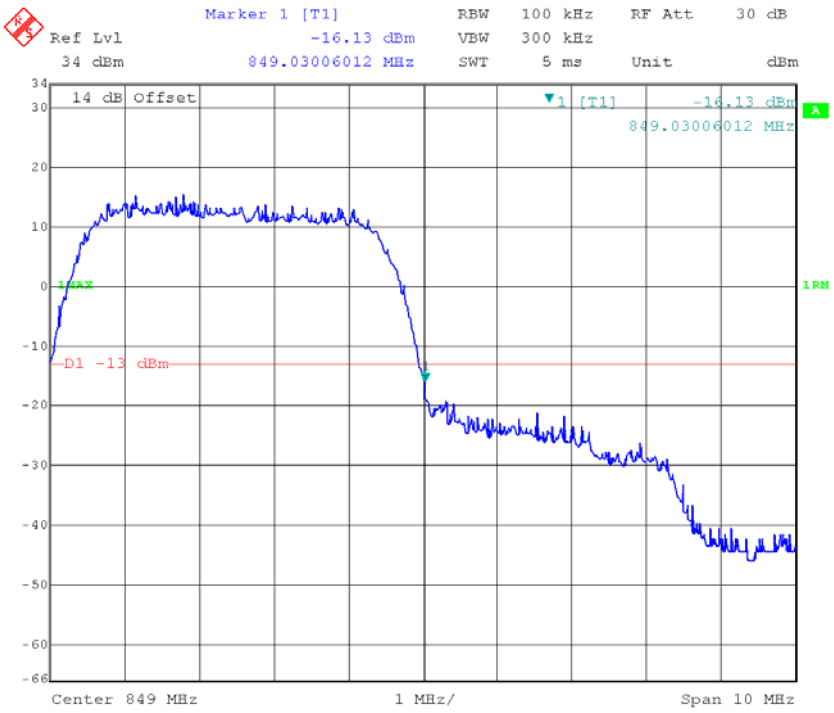
REL99 Band V Right Band Edge



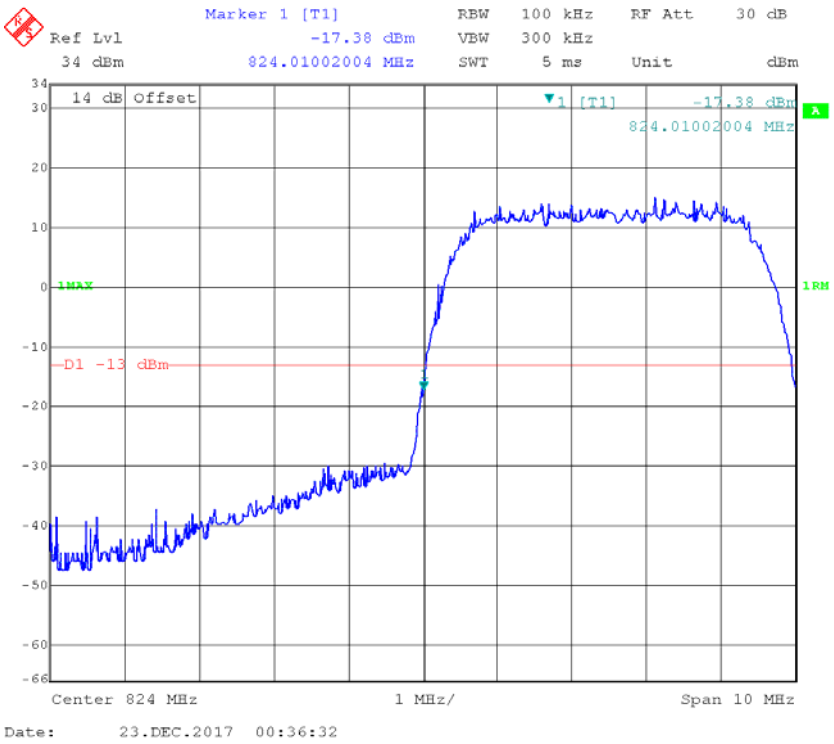
HSDPA Band V, Left Band Edge



HSDPA Band V, Right Band Edge



HSUPA Band V, Left Band Edge



HSUPA Band V, Right Band Edge

FCC §2.1055, §22.355 & §24.235 RSS-132 §5.3 & RSS-133 §6.3 - FREQUENCY STABILITY

Applicable Standard

FCC § 2.1055 (a), § 2.1055 (d), §22.355, §24.235 and RSS-132 §5.3 & RSS-133 §6.3

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.

According to RSS-132 §5.3

The carrier frequency shall not depart from the reference frequency in excess of ±2.5 ppm for mobile stations and ±1.5 ppm for base stations.

In lieu of meeting the above stability values, the test report may show that the frequency stability is sufficient to ensure that the occupied bandwidth stays within each of the sub-bands (see Section 5.1) when tested to the temperature and supply voltage variations specified in RSS-Gen.

According to RSS-133 §6.3

The carrier frequency shall not depart from the reference frequency, in excess of ±2.5 ppm for mobile stations and ±1.0 ppm for base stations.

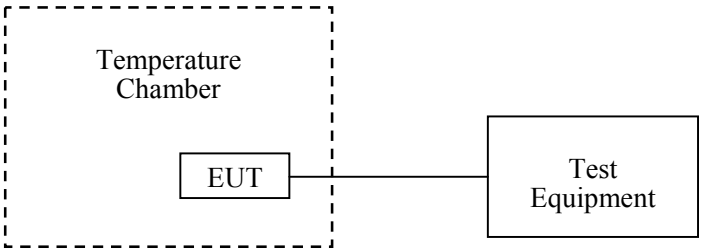
In lieu of meeting the above stability values, the test report may show that the frequency stability is sufficient to ensure that the emission bandwidth stays within the operating frequency block when tested to the temperature and supply voltage variations specified in RSS-Gen.

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	2017-08-28	2018-08-28
R&S	Universal Radio Communication Tester	CMU200	106 891	2017-12-14	2018-12-14
UNI-T	Multimeter	UT39A	M130199938	2017-05-09	2018-05-09
N/A	Coaxial Cable	C-SJ00-0010	C0010/02	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:	24.1 °C
Relative Humidity:	32 %
ATM Pressure:	102.2 kPa

The testing was performed by Pean Zhu on 2017-12-25.

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Cellular Band

GPRS, Middle Channel, f_c = 836.6 MHz				
Temperature	**Voltage**	**Frequency Error**	**Frequency Error**	**Limit**
℃	**V_{DC}**	**Hz**	**ppm**	**ppm**
-30	3.8	-16	-0.019	2.5
-20		-6	-0.007	
-10		-6	-0.007	
0		-10	-0.012	
10		-9	-0.011	
20		-9	-0.011	
30		-10	-0.012	
40		-4	-0.005	
50		-14	-0.017	
25	3.6	-10	-0.012	
25	4.3	-8	-0.010	

PCS Band

GPRS, Middle Channel, f_c = 1880.0 MHz				
Temperature	**Voltage**	**Frequency Error**	**Frequency Error**	**Results**
℃	**V_{DC}**	**Hz**	**ppm**	
-30	3.8	-11	-0.006	Pass
-20		-13	-0.007	
-10		-11	-0.006	
0		-11	-0.006	
10		-10	-0.005	
20		-10	-0.005	
30		-8	-0.004	
40		-11	-0.006	
50		-8	-0.004	
25	3.6	-14	-0.007	
25	4.3	-7	-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	3.8	-5	-0.003	Pass
-20		-5	-0.003	
-10		-5	-0.003	
0		-4	-0.002	
10		-2	-0.001	
20		-3	-0.002	
30		-1	-0.001	
40		-5	-0.003	
50		-5	-0.003	
25	3.6	-4	-0.002	
25	4.3	-6	-0.003	

WCDMA Band Ⅴ: R99

Middle Channel, f_c = 836.6 MHz				
Temperature	**Voltage**	**Frequency Error**	**Frequency Error**	**Limit**
℃	**V_{DC}**	**Hz**	**ppm**	**ppm**
-30	3.8	-5	-0.006	2.5
-20		7	0.008	
-10		-5	-0.006	
0		4	0.005	
10		-1	-0.001	
20		5	0.006	
30		-2	-0.002	
40		0	0.000	
50		6	0.007	
25	3.6	10	0.012	
25	4.3	-4	-0.005	

Note: The fundamental emissions stay within the authorized bands of operation based on the frequency deviation measured is small, the extreme voltage was declared by applicant.

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