

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

For

Cowa Robotic Co., Ltd

5F, Building 64, No 421, Hongcao Road, Shanghai, China

FCC ID: 2AIUO-CWL16R1L

Report Type: Original Report	Product Type: Robotic Suitcase
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Report Number: RSHA180907001-00C	
Report Date: 2018-12-13	
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Cowa Robotic Co., Ltd
Tested Model	CWL16R1L
Product Type	Robotic Suitcase
Dimension	380mm(L)*210mm(W)*550mm(H)
Power Supply	DC14.4V from battery (battery: DC 16.80V charging by adapter)

Adapter Information:

Model: A241-1681400I

Input: AC100-240 V 50/60Hz 0.8A

Output: 16.8V, 1400mA

* All measurement and test data in this report was gathered from production sample serial number: 20180907001. (Assigned by BACL, Kunshan). The EUT supplied by the applicant was received on 2018-09-07.

Objective

This type approval report is prepared on behalf of Cowa Robotic Co., Ltd in accordance with Part 2, Part 22-Subpart H and 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)

Part 15.247 DTS submissions with FCC ID: 2AIUO-CWL16R1L.

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%

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. 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/EDGE 850	Low	128	824.2
	Middle	190	836.6
	High	251	848.8
GPRS/EDGE 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

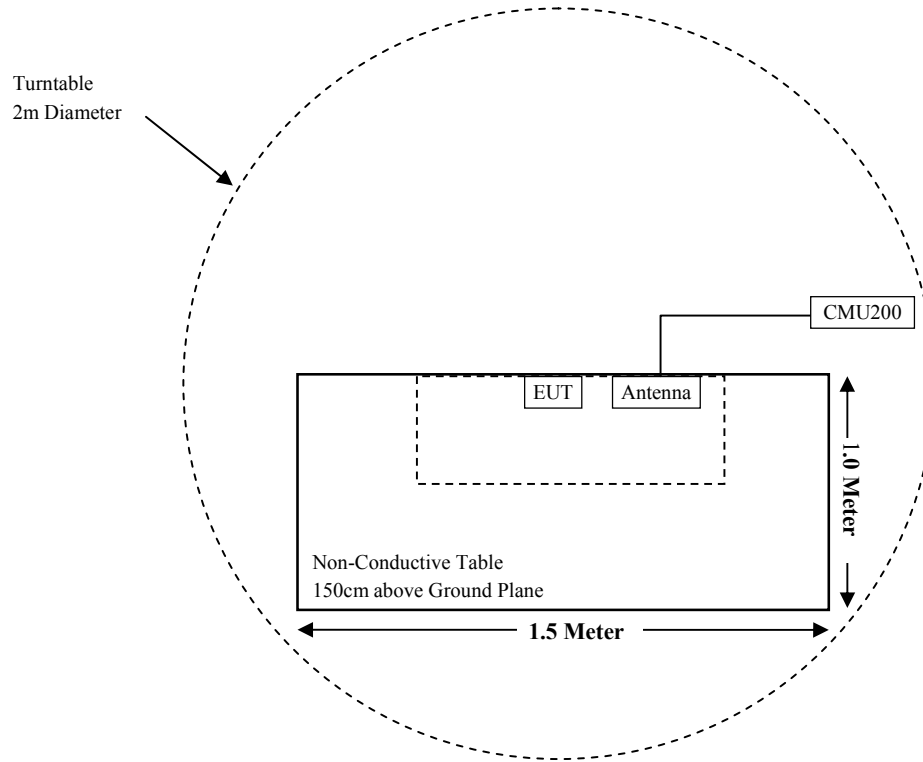
Manufacturer	Description	Model	Serial Number
Rohde & Schwarz	UNIVERSAL RADIO COMMUNICATION TESTER	CMU200	110605
Aihuaxin Technology	Antenna	/	/

External Cable List and Details

Cable Description	Length (m)	From Port	To
Antenna Cable	1.8	Antenna	CMU200

Block Diagram of Test Setup

For Radiated Emissions(Below & Above 1GHz)



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§1.1307(b)(1)& §2.1093	RF Exposure Information	Compliance
§2.1046; § 22.913 (a);§ 24.232 (c)	RF Output Power	Compliance
§ 2.1047	Modulation Characteristics	Not Applicable
§ 2.1049; § 22.905; § 22.917; § 24.238	Occupied Bandwidth	Compliance
§ 2.1051; § 22.917 (a); § 24.238 (a)	Spurious Emissions at Antenna Terminal	Compliance
§ 2.1053; § 22.917 (a); § 24.238 (a)	Spurious Radiated Emissions	Compliance
§ 22.917 (a); § 24.238 (a)	Band Edge	Compliance
§ 2.1055; § 22.355; § 24.235	Frequency stability	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test (Chamber 1#)					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2017-11-12	2018-11-11
HP	Signal Generator	HP 8341B	2624A00116	2017-11-12	2018-11-11
Sunol Sciences	Broadband Antenna	JB3	A090413-1	2016-12-26	2019-12-25
Sunol Sciences	Broadband Antenna	JB3	A090314-2	2016-01-09	2019-01-08
Sonoma Instrunent	Pre-amplifier	310N	171205	2018-08-15	2019-08-14
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	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	2017-11-12	2018-11-11
Radiated Emission Test (Chamber 2#)					
HP	Signal Generator	HP 8341B	2624A00116	2017-11-12	2018-11-11
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2018-08-27	2019-08-26
ETS-LINDGREN	Horn Antenna	3115	9311-4159	2016-01-11	2019-01-10
ETS-LINDGREN	Horn Antenna	3115	6229	2016-01-11	2019-01-10
ETS-LINDGREN	Horn Antenna	3116	00084159	2016-10-18	2019-10-17
ETS-LINDGREN	Horn Antenna	3116	2516	2016-12-12	2019-12-12
A.H.Systems, inc	Amplifier	2641-1	466	2018-09-11	2019-09-10
EM Electronics Corporation	Amplifier	EM18G40G	060726	2018-03-22	2019-03-21
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-11	011	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-16	016	2018-08-15	2019-08-14
Rohde & Schwarz	UNIVERSAL RADIO COMMUNICATION TESTER	CMU200	110605	2017-11-12	2018-11-11

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2017-11-12	2018-11-11
Rohde & Schwarz	UNIVERSAL RADIO COMMUNICATION TESTER	CMU200	110605	2017-11-12	2018-11-11
BACL	Temperature & Humidity Chamber	BTH-150	30023	2018-10-10	2019-10-09
EAST	Regulated DC Power Supply	MCH-303D-II	14070562	2018-10-10	2019-10-09
Cowa	RF Cable	Cowa01	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).

FCC §1.1307(b) & §2.1093 - RF EXPOSURE INFORMATION

Applicable Standard

FCC§1.1307, §2.1093.

Test Result

Compliance, please refer to the SAR report: RSH180907050-20.

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 Standards

According to FCC §2.1046 and §22.913 (a), the ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 watts (38.45dBm).

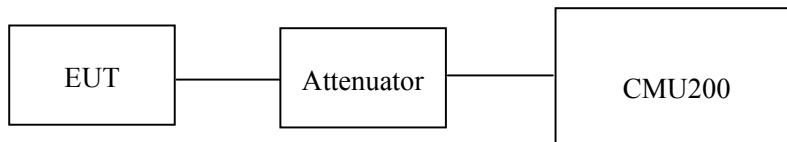
According to FCC §2.1046 and §24.232 (c), mobile and portable stations are limited to 2 watts(33dBm) EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications..

According to FCC §24.232 (d), the peak-to-average ratio (PAR) of the transmission must not exceed 13 dB.

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.

$$\text{LOSS} = \text{Generator Output Power (dBm)} - \text{Analyzer reading (dBm)}$$

e) Determine the effective radiated output power at each angular position from the readings in steps b) and

d) using the following equation:

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

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:

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

Test Data**Environmental Conditions**

Temperature:	22.8-23.3 °C
Relative Humidity:	48-50 %
ATM Pressure:	101.0-101.2kPa

The testing was performed by Alisa Gao from 2018-11-02 to 2018-11-03.

Conducted Power:**GPRS 850 Band**

Mode	Channel	Frequency (MHz)	Average Output Power (dBm)				Limit (dBm)
			1 slot	2 slots	3 slots	4 slots	
GPRS	128	824.2	31.52	29.84	27.95	25.95	38.45
	190	836.6	31.55	29.85	27.97	25.96	38.45
	251	848.8	31.58	29.87	27.98	25.99	38.45

EGPRS 850 Band

Mode	Channel	Frequency (MHz)	Average Output Power (dBm)				Limit (dBm)
			1 slot	2 slots	3 slots	4 slots	
GPRS	128	824.2	25.22	24.15	22.90	20.55	38.45
	190	836.6	25.55	24.40	23.16	20.76	38.45
	251	848.8	25.75	24.53	23.44	21.01	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	21.85	22.34	22.05
		HSDPA	1	21.83	22.29	22.07
			2	21.87	22.32	22.10
			3	21.91	22.31	22.09
			4	21.86	22.28	22.06
		HSUPA	1	21.82	22.25	22.02
			2	21.87	22.26	22.07
			3	21.83	22.24	22.08
			4	21.84	22.25	22.11
			5	21.90	22.23	22.09
		HSPA+	1	21.88	22.27	22.07

GPRS 1900 Band

Mode	Channel	Frequency (MHz)	Average Output Power (dBm)				Limit (dBm)
			1 slot	2 slots	3 slots	4 slots	
GPRS	512	1852.2	28.95	26.73	25.07	23.42	33
	661	1880.0	29.57	27.74	26.02	24.28	33
	810	1909.8	29.59	27.76	26.03	24.23	33

Mode	Channel	Frequency (MHz)	Average Output Power (dBm)				Limit (dBm)
			1 slot	2 slots	3 slots	4 slots	
EGPRS	512	1852.2	24.42	23.64	19.25	19.71	33
	661	1880.0	24.56	24.49	20.06	20.32	33
	810	1909.8	25.31	25.30	20.88	20.86	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	22.06	22.58	22.25
		HSDPA	1	22.05	22.60	22.24
			2	22.02	22.66	22.21
			3	21.98	22.65	22.14
			4	21.99	22.58	22.15
		HSUPA	1	22.00	22.64	22.23
			2	22.02	22.63	22.21
			3	22.03	22.59	22.25
			4	22.01	22.61	22.27
			5	21.97	22.58	22.22
		HSPA+	1	22.02	22.65	22.29

Peak-to-average ratio (PAR):**GPRS 1900 Band**

Mode	Channel	PAR (dB)	Limit (dB)
GPRS	Low	2.44	13
	Middle	2.42	13
	High	2.50	13

Mode	Channel	PAR (dB)	Limit (dB)
EGPRS	Low	2.31	13
	Middle	2.42	13
	High	2.45	13

WCDMA Band II

Mode	Channel	PAR (dB)	Limit (dB)
WCDMA	Low	2.91	13
	Middle	2.93	13
	High	2.31	13
HSDPA	Low	2.92	13
	Middle	2.90	13
	High	2.29	13
HSUPA	Low	2.89	13
	Middle	2.99	13
	High	2.30	13
HSPA+	Low	2.89	13
	Middle	2.91	13
	High	2.39	13

Radiated Power:

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 850 Band, Middle Channel(ERP)										
836.60	127.46	100	126	H	32.60	0.63	-1.14	30.83	38.45	7.62
836.60	128.87	205	138	V	30.55	0.63	-1.14	28.78	38.45	9.67
EGPRS 850 Band, Middle Channel(ERP)										
836.60	120.85	286	194	H	25.99	0.63	-1.14	24.22	38.45	14.23
836.60	123.28	211	129	V	24.96	0.63	-1.14	23.19	38.45	15.26
GSM1900 Band, Middle Channel(EIRP)										
1880.00	115.24	221	159	H	20.38	0.85	8.81	28.34	33.00	4.66
1880.00	117.63	307	146	V	19.31	0.85	8.81	27.27	33.00	5.73
GSM1900 Band, Middle Channel(EIRP)										
1880.00	110.73	313	223	H	15.87	0.85	8.81	23.83	33.00	9.17
1880.00	112.55	49	173	V	14.23	0.85	8.81	22.19	33.00	10.81

WCDMA 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)										
836.60	118.62	314	228	H	23.76	0.63	-1.14	21.99	33.00	11.01
836.60	121.05	330	238	V	22.73	0.63	-1.14	20.96	33.00	12.04
WCDMA Band II, Middle Channel(EIRP)										
1880.00	115.95	304	194	H	13.82	0.85	8.81	21.78	33.00	11.22
1880.00	115.23	1	224	V	12.67	0.85	8.81	20.63	33.00	12.37

Note:

All above data were tested with no amplifier.

Absolute Level = Submitted Level - Cable loss + Antenna Gain

Margin = Limit- Absolute Level

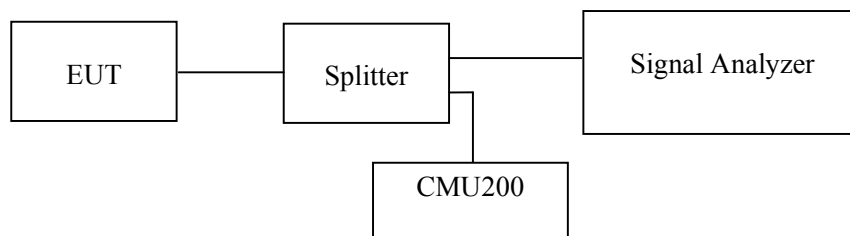
FCC §2.1049, §22.917, §22.905 & §24.238 - OCCUPIED BANDWIDTH**Applicable Standards**

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 5 kHz (Cellular /PCS) & 100 kHz (WCDMA), and the 26 dB & 99% bandwidth was recorded.

**Test Data****Environmental Conditions**

Temperature:	22.8-23.3 °C
Relative Humidity:	48-50 %
ATM Pressure:	101.0-101.2kPa

The testing was performed by Alisa Gao from 2018-11-02 to 2018-11-03.

EUT operation mode: Transmitting

Test Result: Compliance.

GSM 850 Band

Mode	Frequency (MHz)	26 dB Emission Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
GPRS (GMSK)	836.6	0.324	0.245
EGPRS (8PSK)	836.6	0.311	0.244

WCDMA Band V

Mode	Frequency (MHz)	26 dB Emission Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
WCDMA (Rel 99)	836.6	4.649	4.108
WCDMA (HSDPA)	836.6	4.649	4.108
WCDMA (HSUPA)	836.6	4.629	4.088
WCDMA (HSPA+)	836.6	1.649	4.088

PCS 1900 Band

Mode	Frequency (MHz)	26 dB Emission Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
GPRS (GMSK)	1880.0	0.316	0.245
EGPRS (8PSK)	1880.0	0.309	0.244

WCDMA Band II

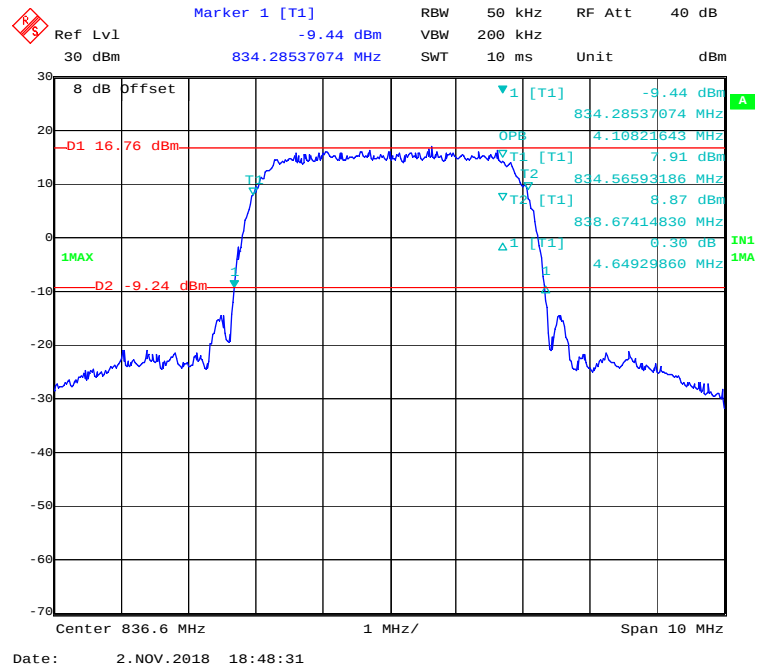
Mode	Frequency (MHz)	26 dB Emission Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
WCDMA (Rel 99)	1880.0	4.689	4.108
WCDMA (HSDPA)	1880.0	4.649	4.088
WCDMA (HSUPA)	1880.0	4.669	4.108
WCDMA (HSPA+)	1880.0	4.669	4.108

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

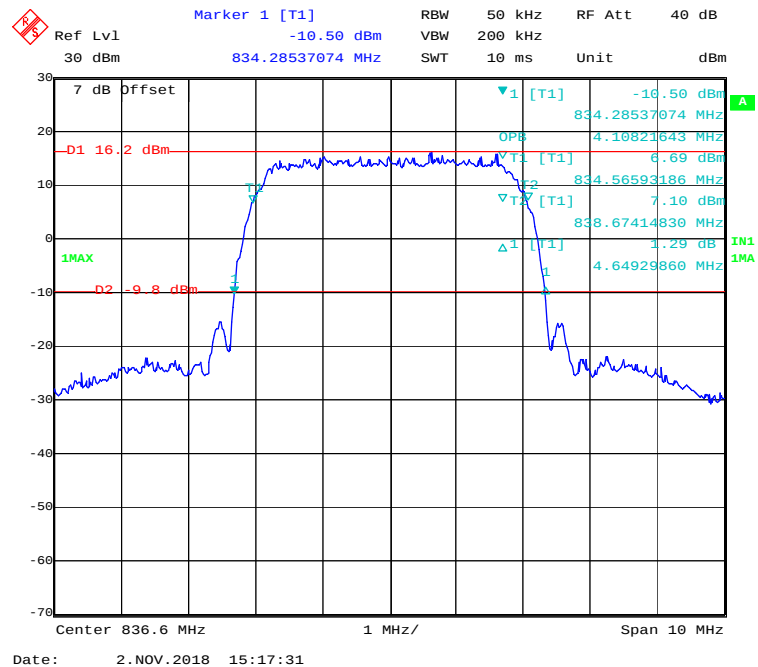


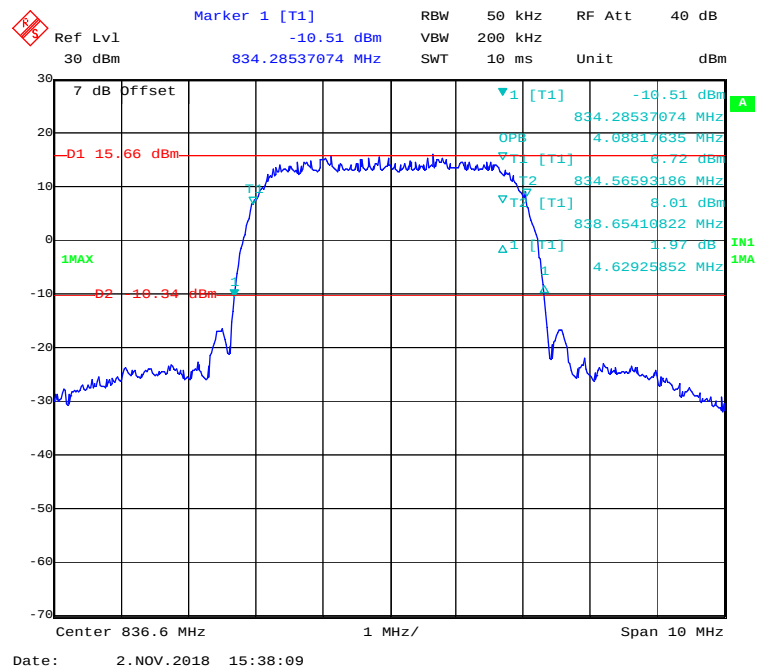
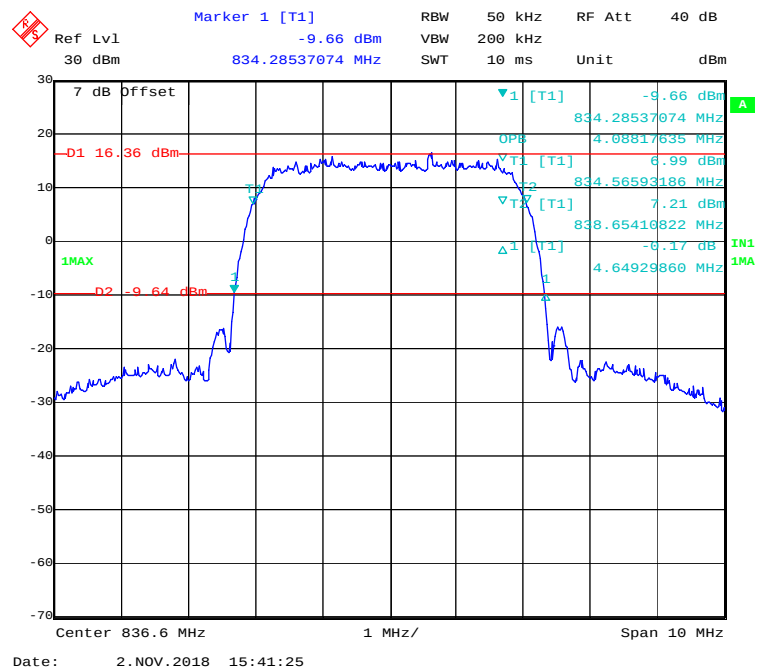
WCDMA Band V

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



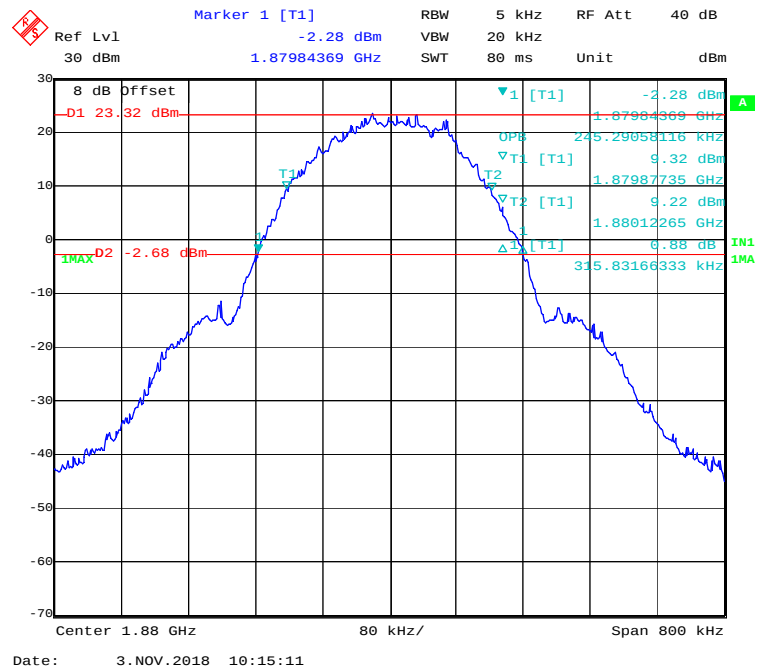
99% Occupied & 26 dB Emissions Bandwidth for WCDMA (HSDPA) Mode



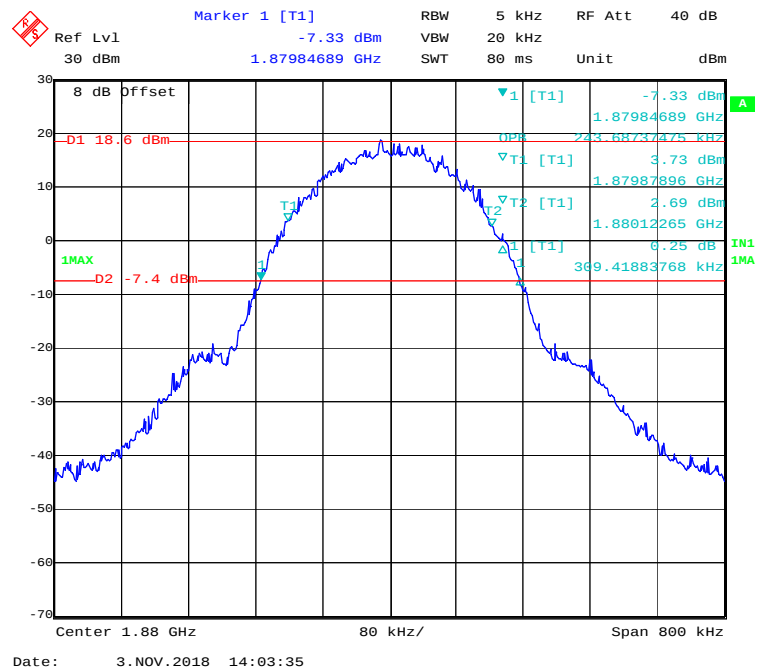
99% Occupied & 26 dB Emissions Bandwidth for WCDMA (HSUPA) Mode**99% Occupied & 26 dB Emissions Bandwidth for WCDMA (HSPA+) Mode**

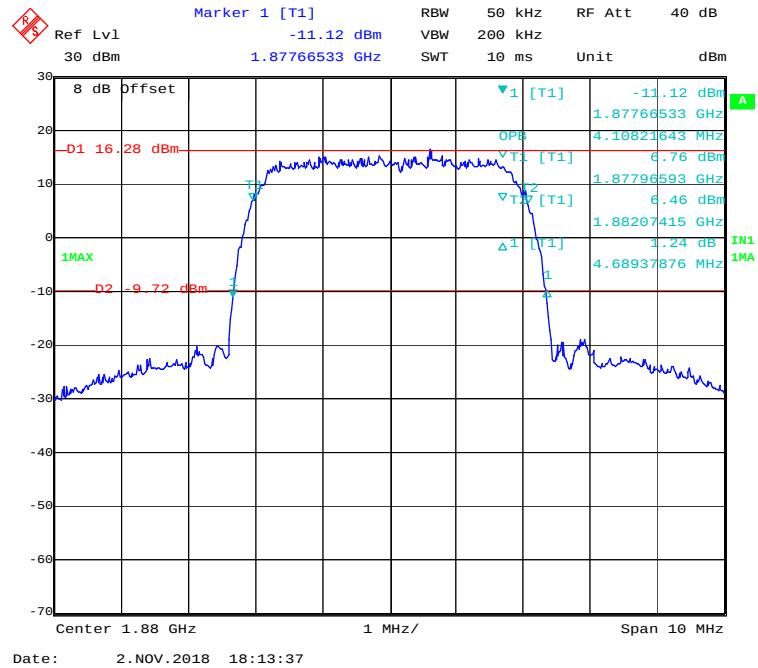
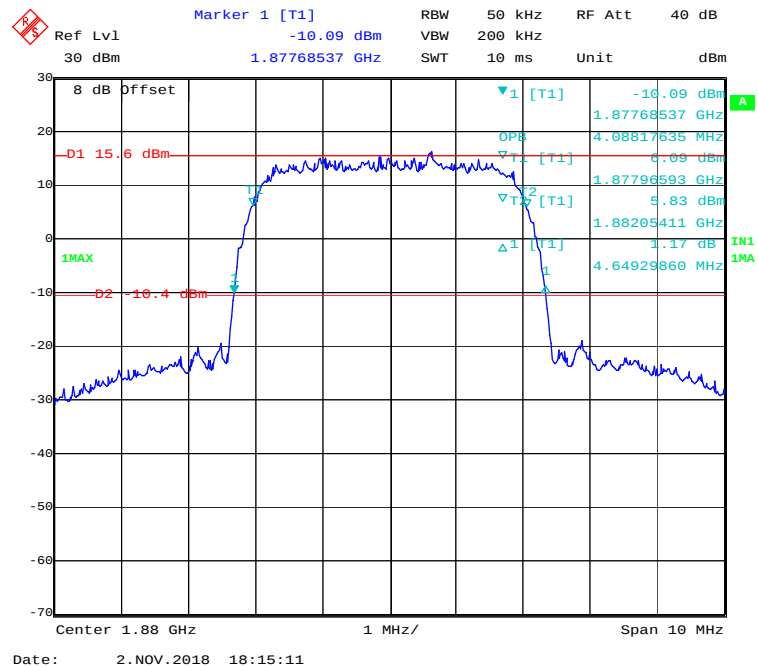
PCS 1900Band

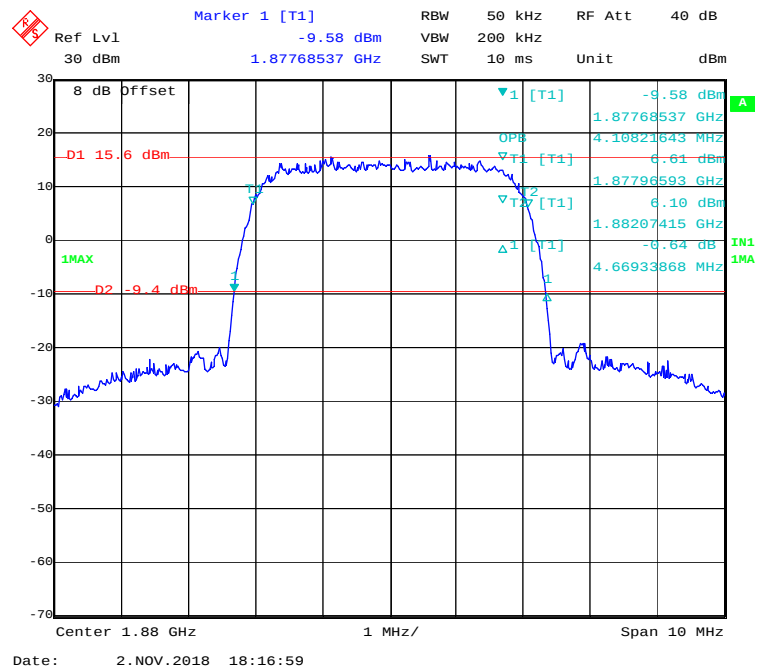
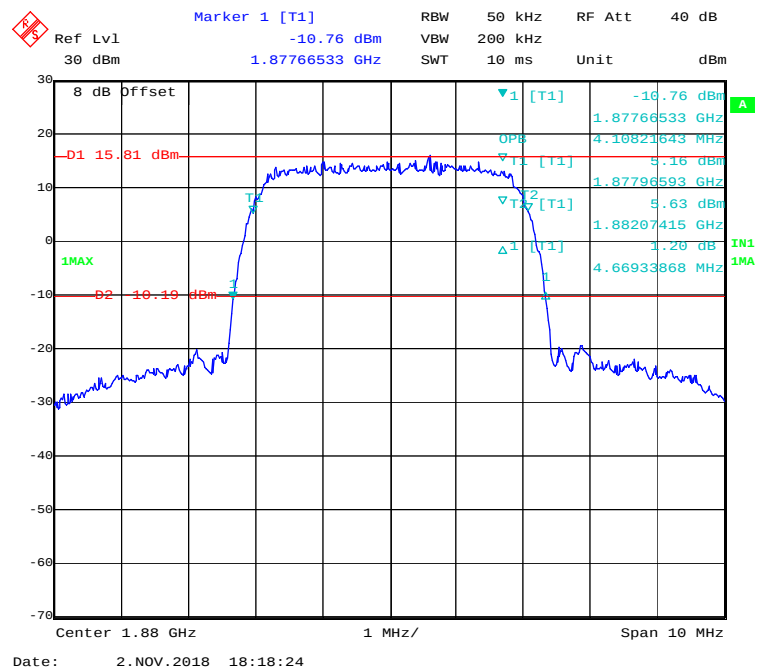
99% Occupied & 26 dB Emissions Bandwidth for GPRS (GMSK) Mode



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



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

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

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

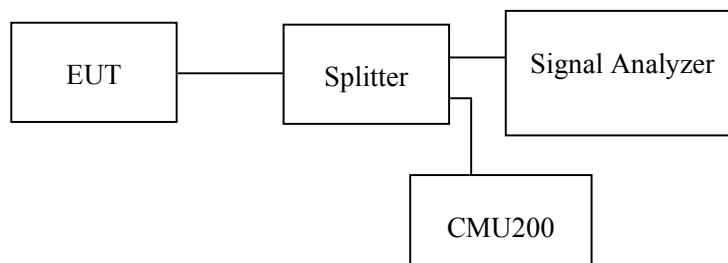
Applicable Standards

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. The resolution bandwidth of the spectrum analyzer was set at 100kHz for below 1GHz & 1MHz/3MHz for above 1GHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.



Test Data

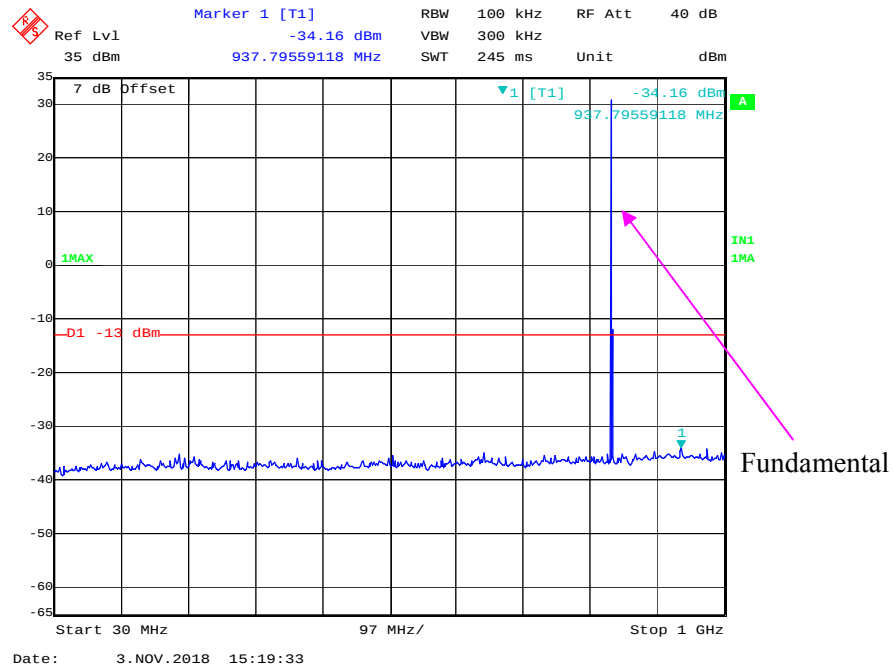
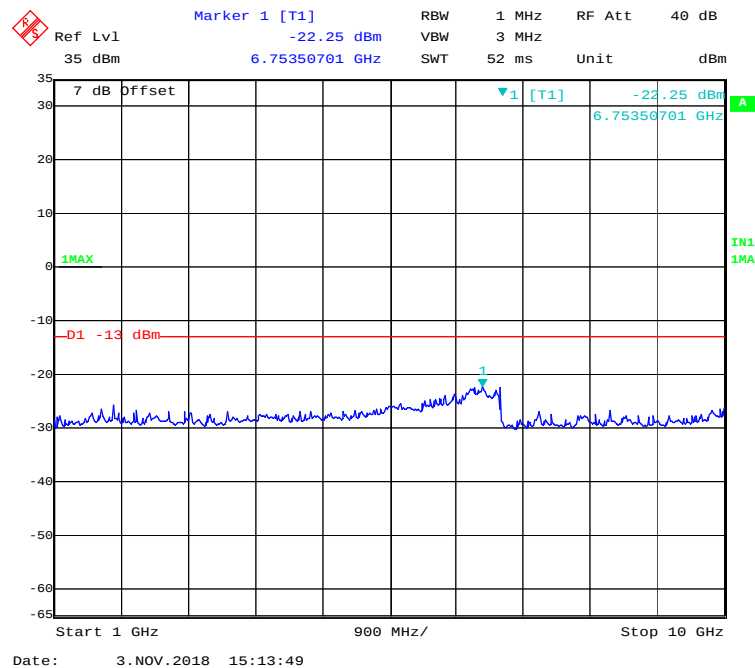
Environmental Conditions

Temperature:	22.8-23.3 °C
Relative Humidity:	48-50 %
ATM Pressure:	101.0-101.2kPa

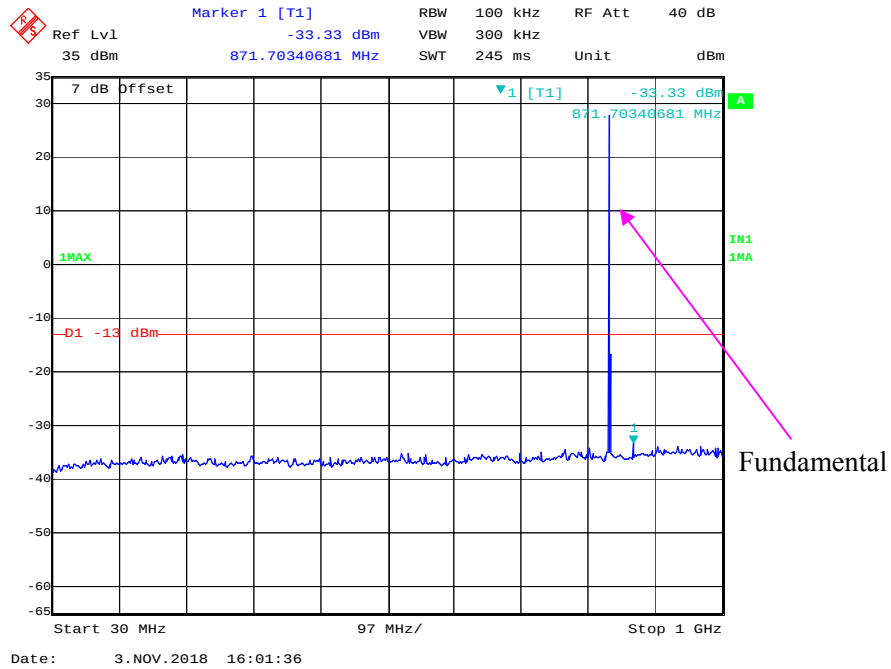
The testing was performed by Alisa Gao from 2018-11-02 to 2018-11-03.

EUT operation mode: Transmitting

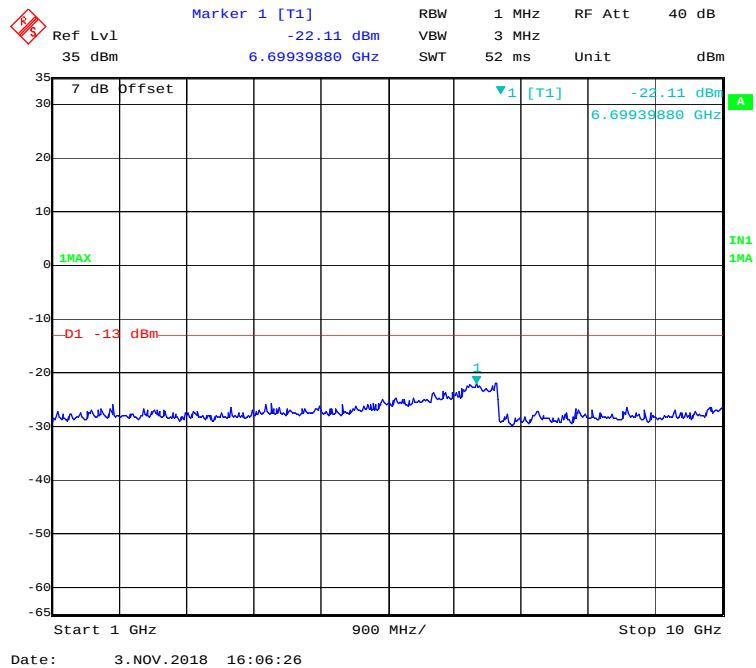
Test Result: Compliance.

GSM 850 Band:**30 MHz – 1GHz(GPRS Mode)****1 GHz – 10 GHz (GPRS Mode)**

30 MHz – 1GHz(EGPRS Mode)

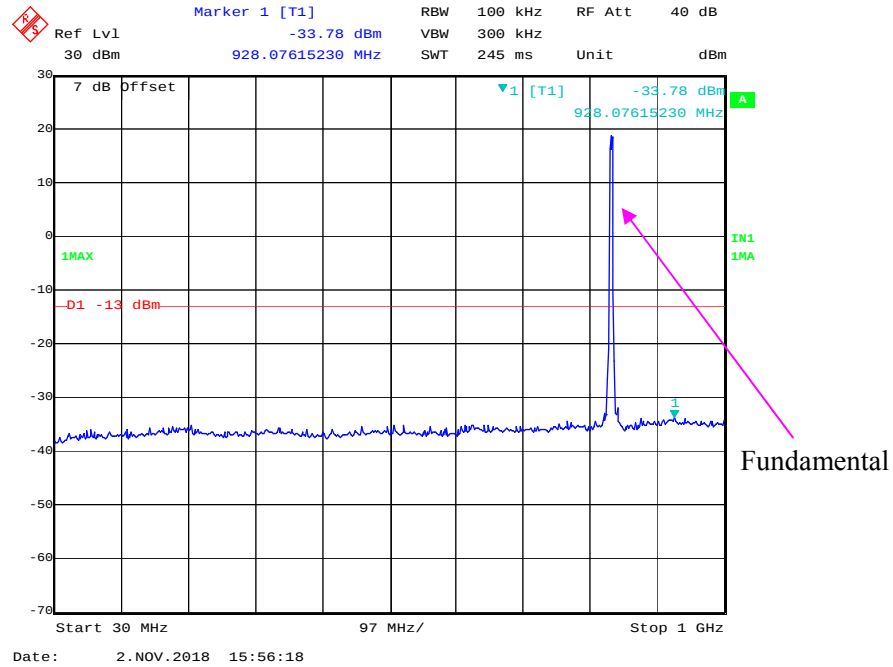


1 GHz – 10 GHz (EGPRS Mode)

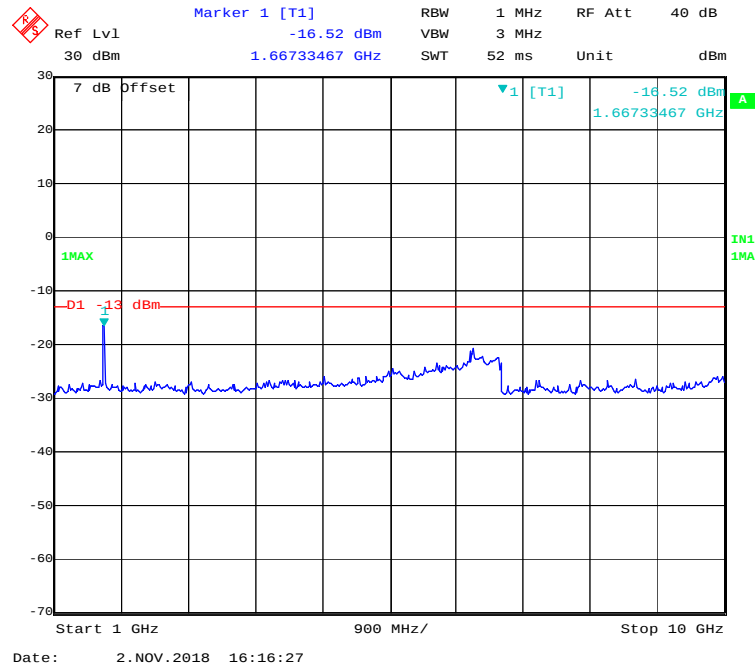


WCDMA Band V:

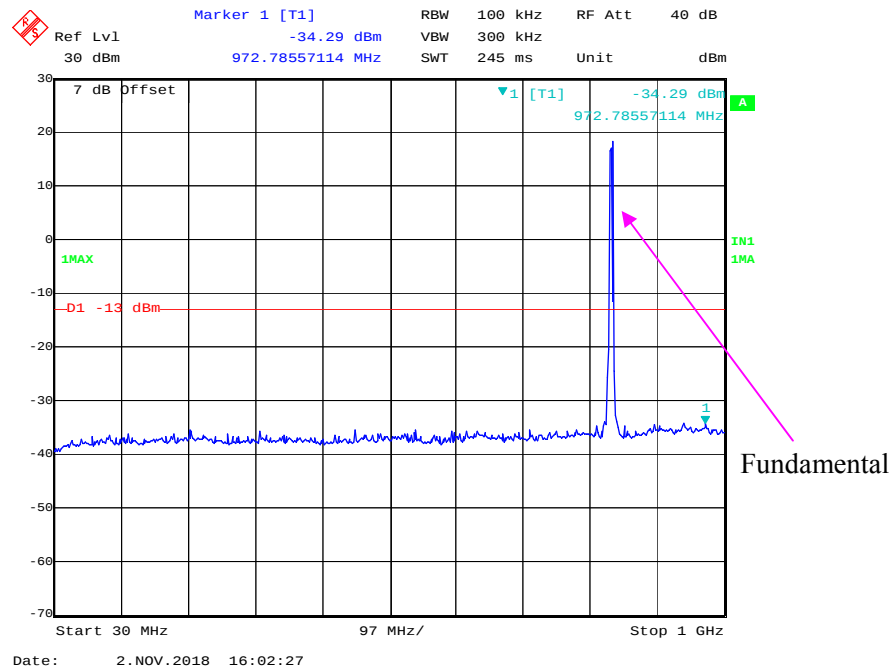
30 MHz – 1GHz WCDMA (Rel 99) Mode



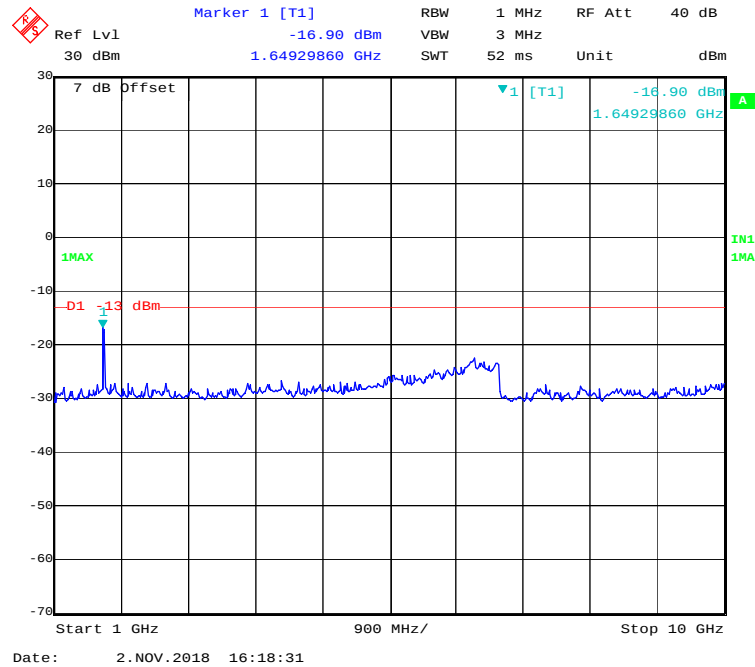
1 GHz – 10 GHz WCDMA (Rel 99) Mode



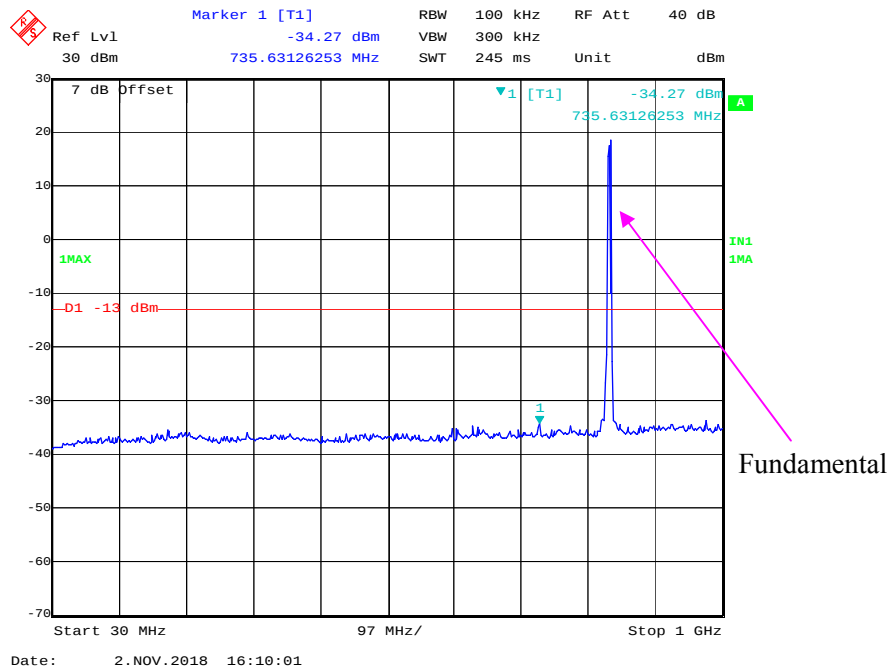
30 MHz – 1GHz WCDMA (HSDPA) Mode



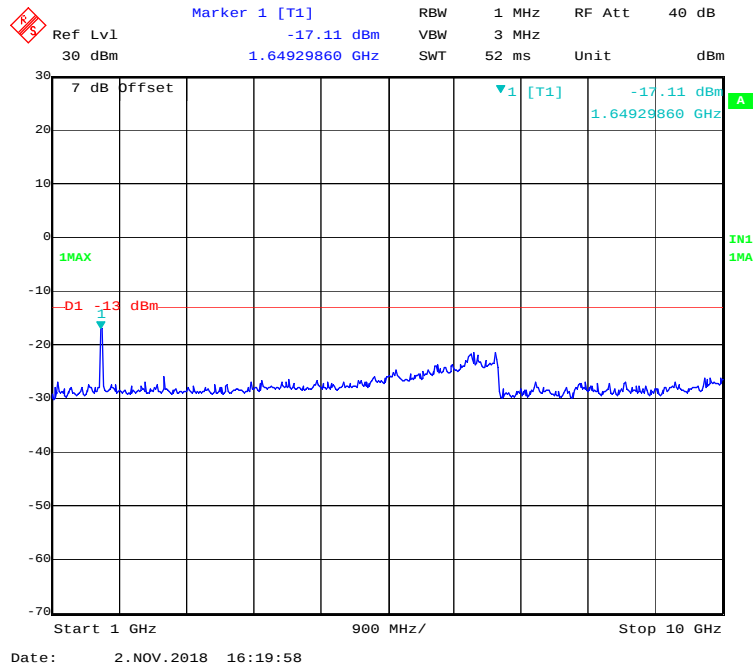
1 GHz – 10 GHz WCDMA (HSDPA) Mode



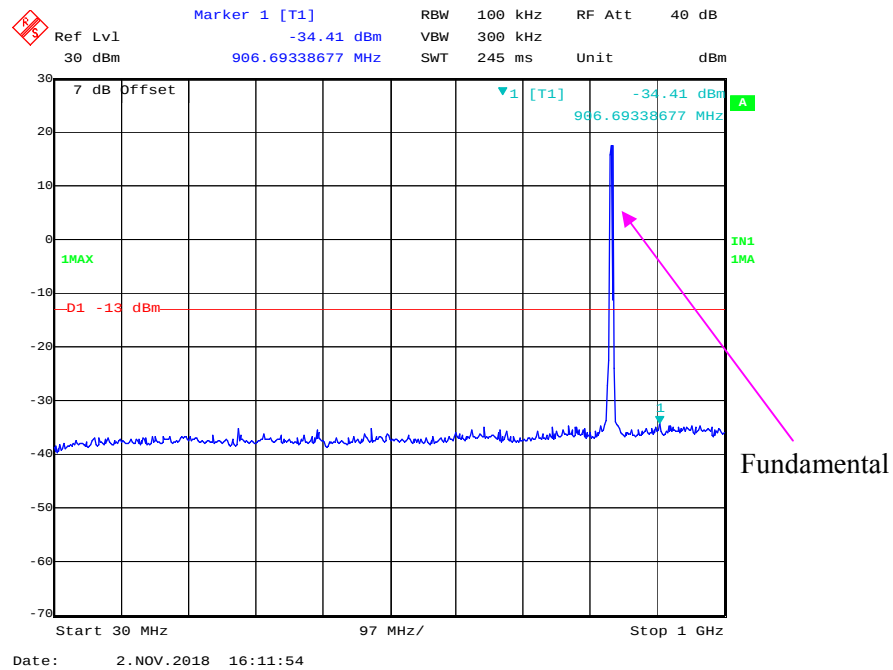
30 MHz – 1GHz WCDMA (HSUPA) Mode



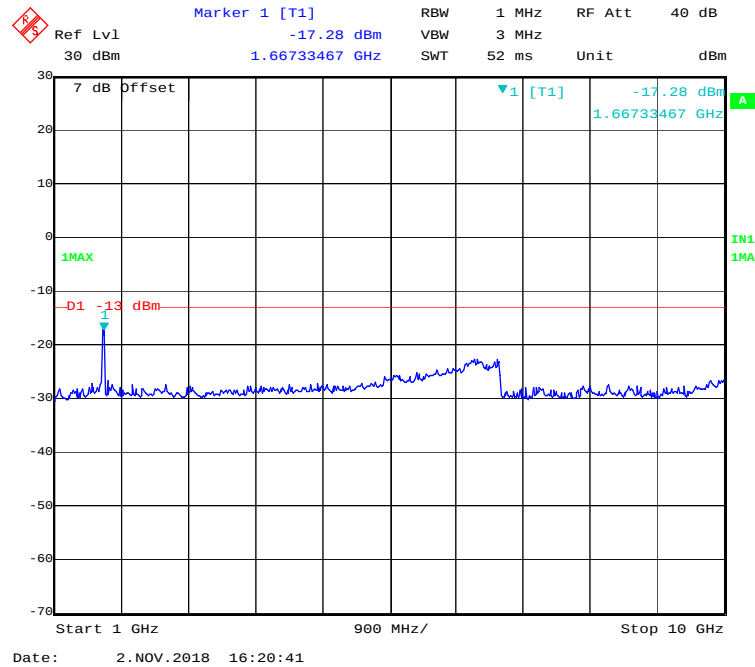
1 GHz – 10 GHz WCDMA (HSUPA) Mode



30 MHz – 1GHz WCDMA (HSPA+) Mode

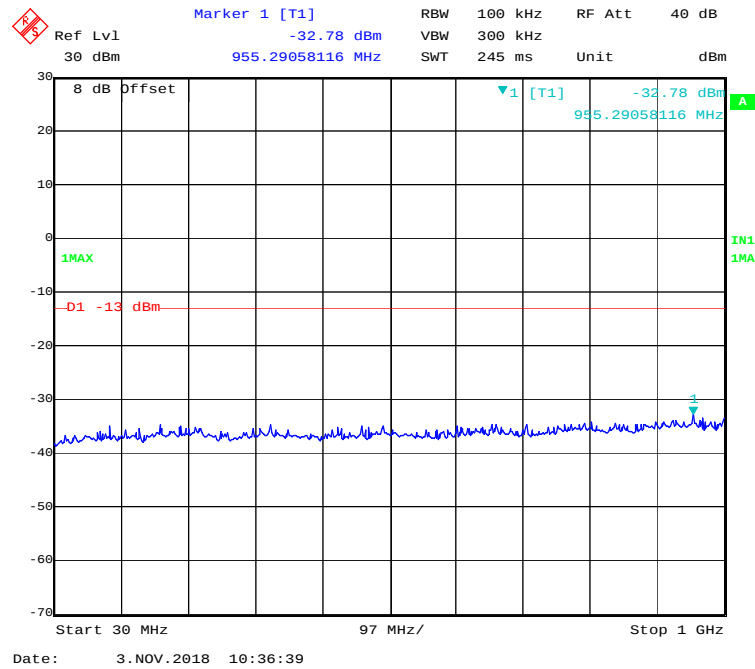


1 GHz – 10 GHz WCDMA (HSPA+) Mode

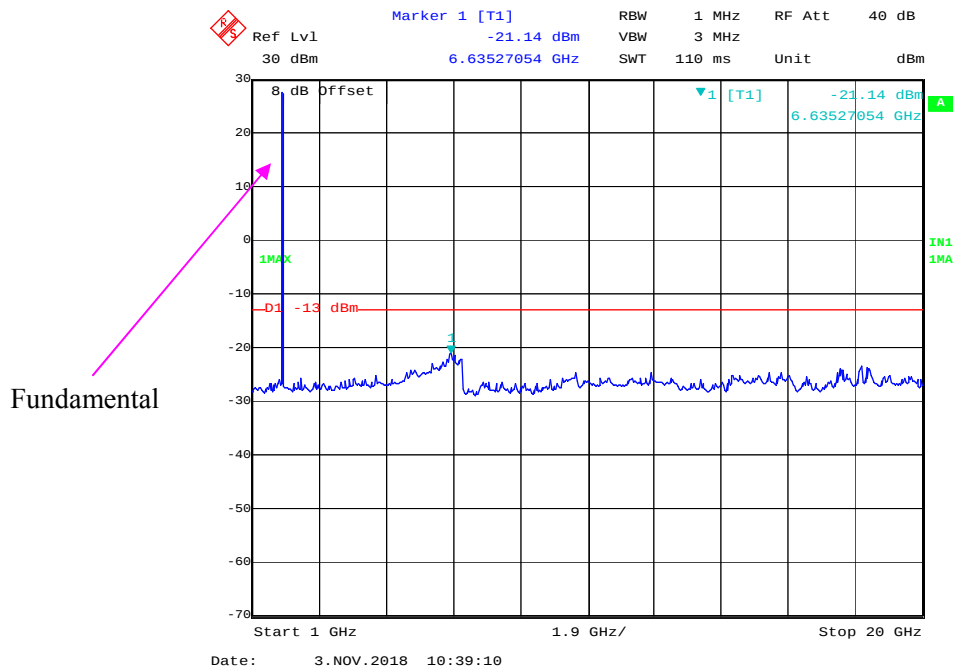


PCS 1900 Band:

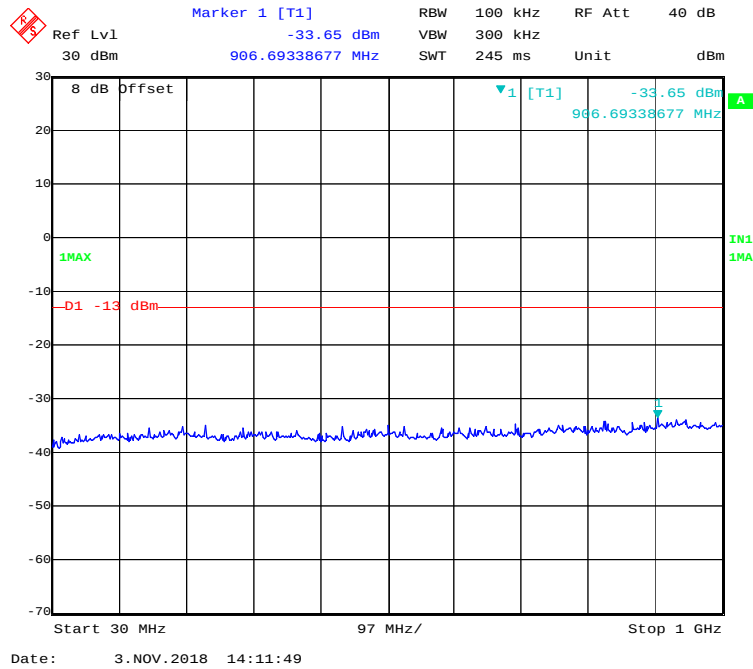
30 MHz – 1GHz(GPRS Mode)



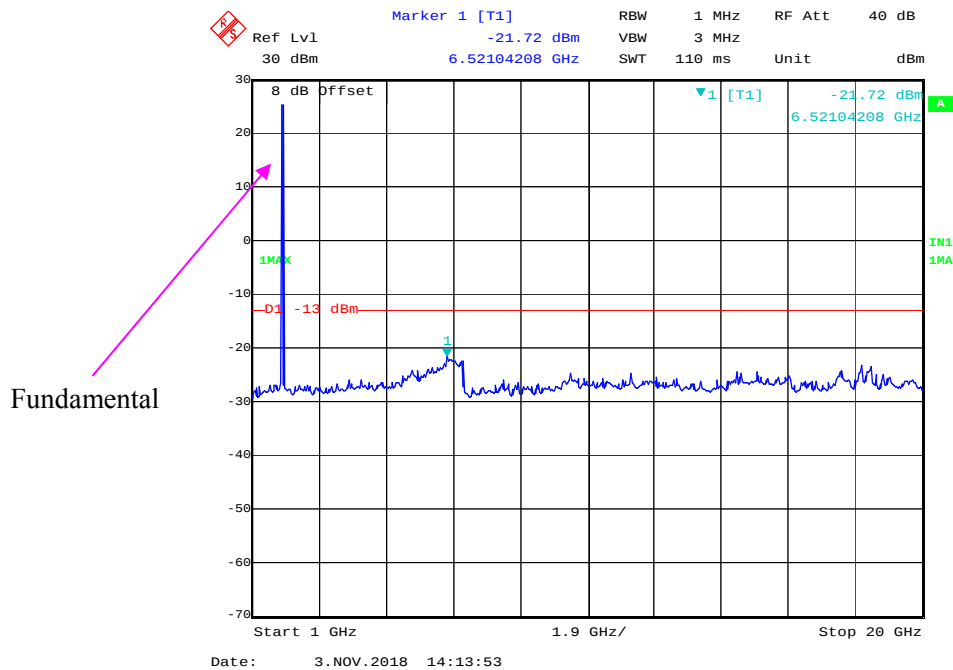
1 GHz – 20 GHz (GPRS Mode)



30 MHz – 1GHz(EGPRS Mode)

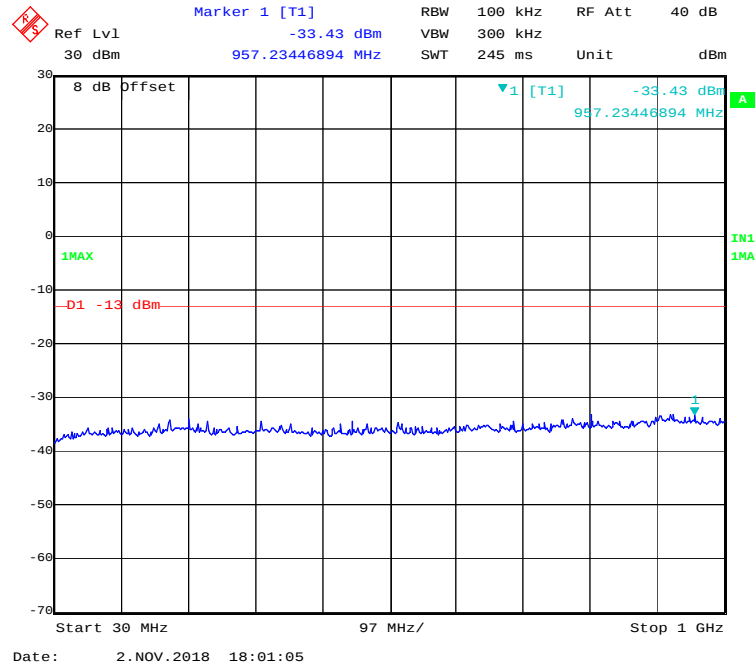


1 GHz – 20 GHz (EGPRS Mode)

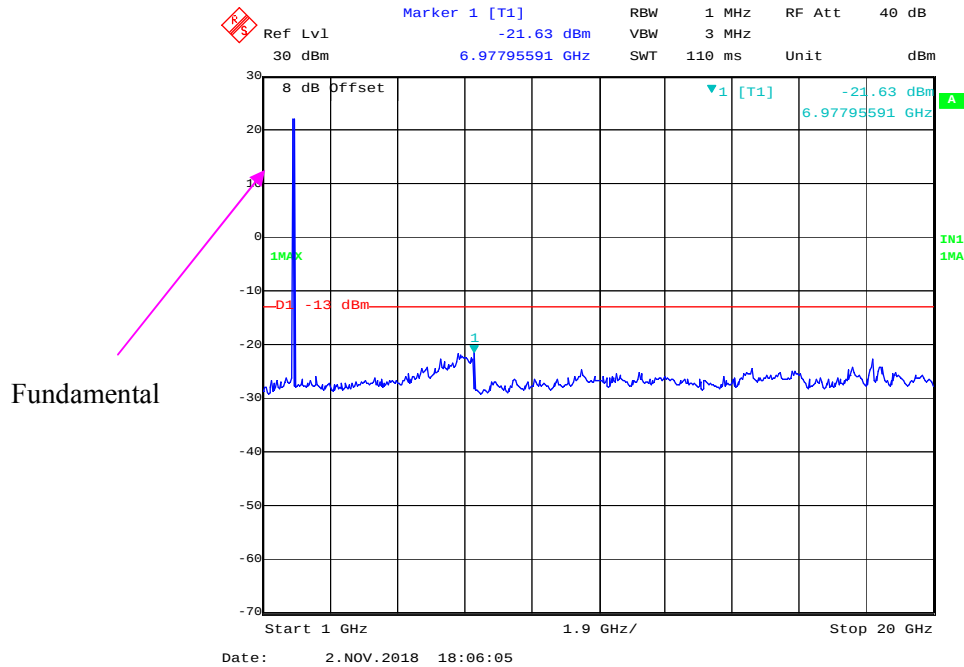


WCDMA Band II:

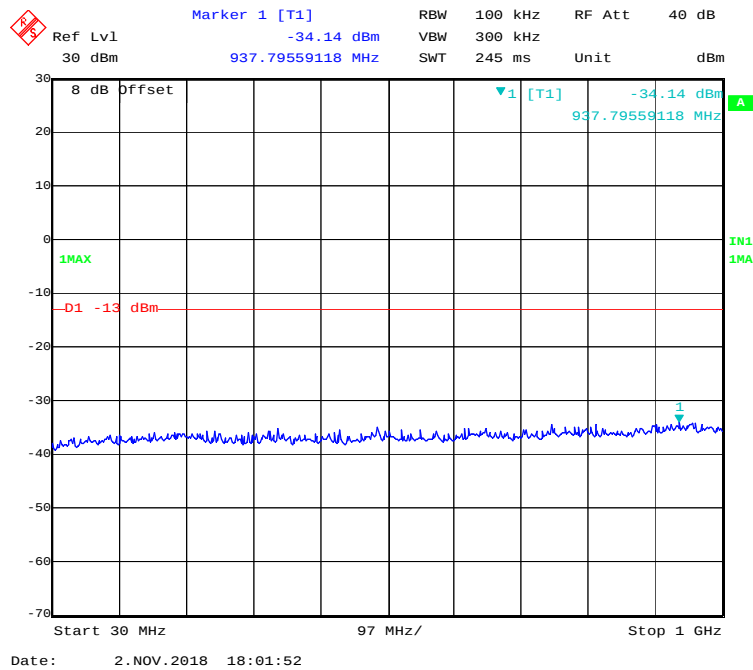
30 MHz – 1GHz WCDMA (Rel 99) Mode



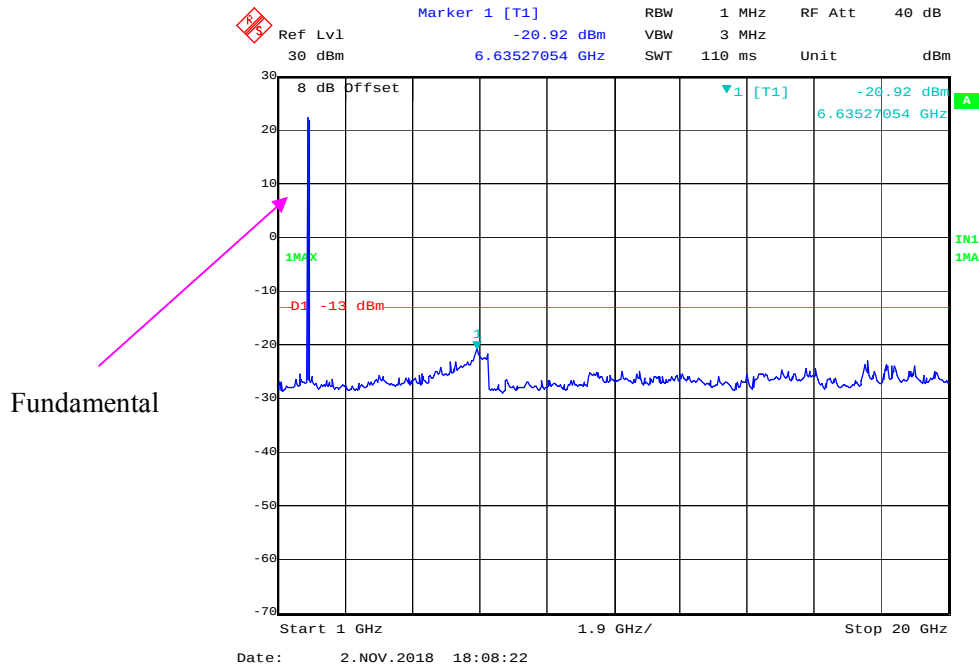
1 GHz – 10 GHz WCDMA (Rel 99) Mode



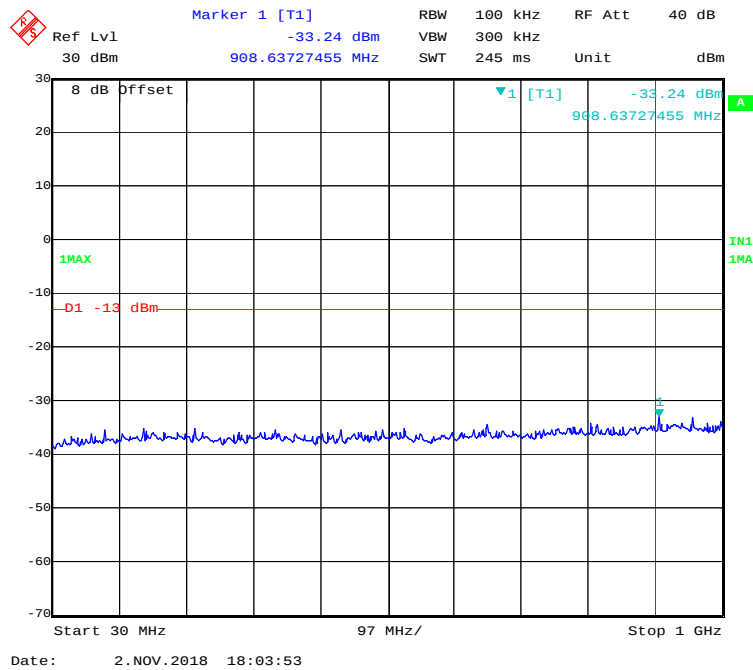
30 MHz – 1GHz WCDMA (HSDPA) Mode



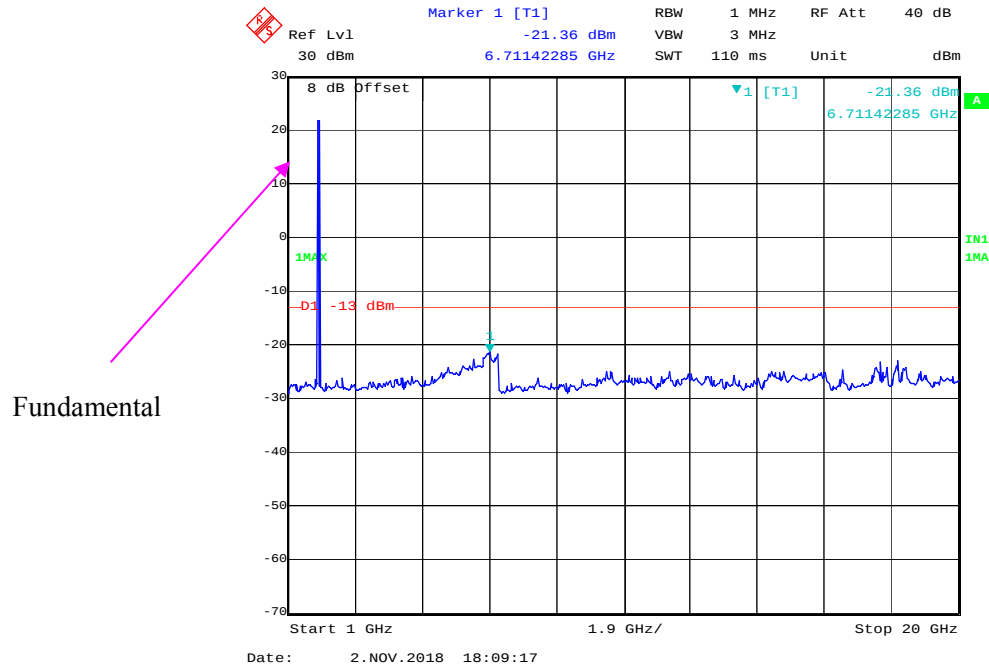
1 GHz – 10 GHz WCDMA (HSDPA) Mode



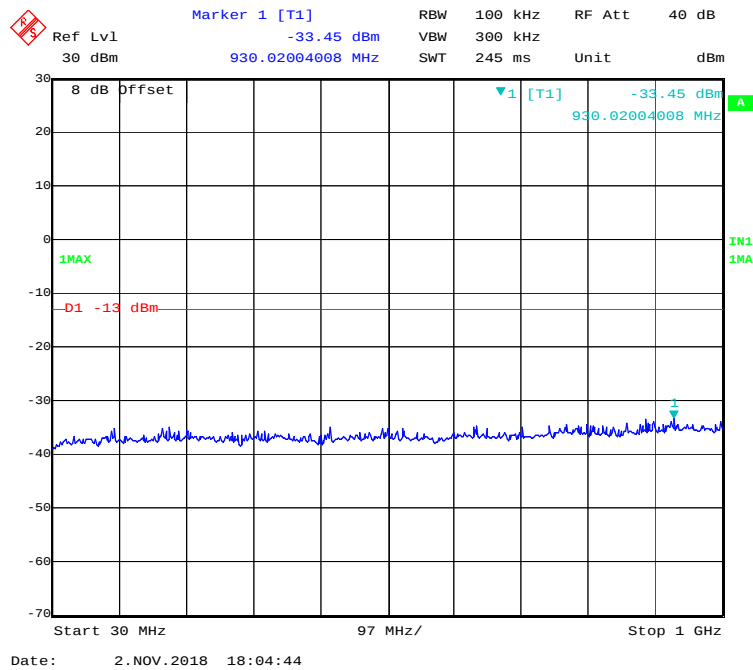
30 MHz – 1GHz WCDMA (HSUPA) Mode



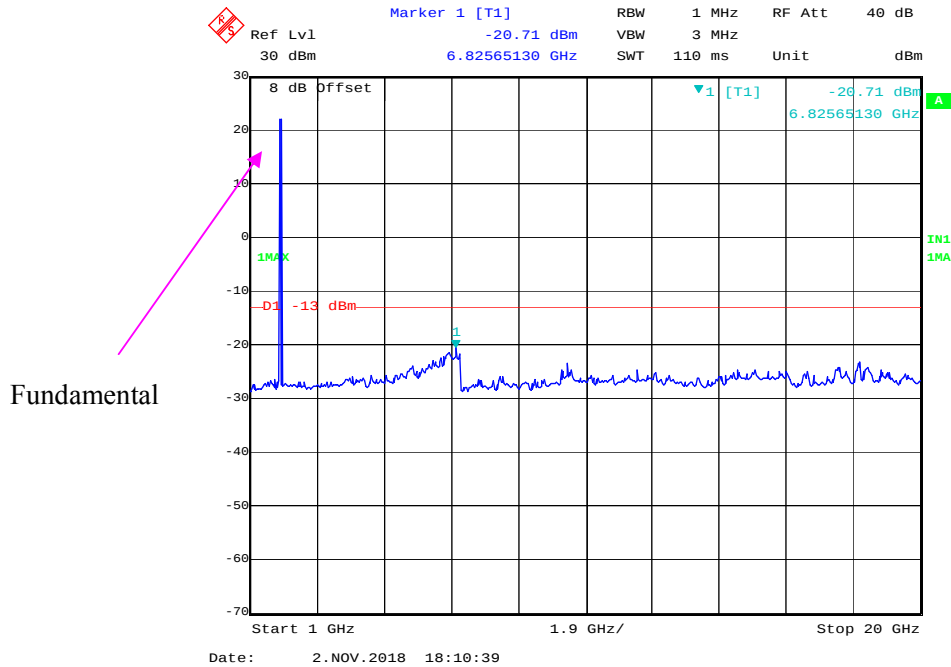
1 GHz – 10 GHz WCDMA (HSUPA) Mode



30 MHz – 1GHz WCDMA (HSPA+) Mode



1 GHz – 10 GHz WCDMA (HSPA+) Mode



FCC § 2.1053; § 22.917 (a);§ 24.238 (a) - SPURIOUS RADIATED EMISSIONS**Applicable Standards**

FCC § 2.1053, §22.917(a) and § 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:	22.8-23.3 °C
Relative Humidity:	48-50 %
ATM Pressure:	101.0-101.2kPa

The testing was performed by Alisa Gao from 2018-11-02 to 2018-11-03.

Test mode: Transmitting (Pre-scan with low, middle and high channels, and the worse case data as below)

30 MHz ~ 10 GHz:**GPRS 850 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										
88.54	55.93	63	171	H	-51.22	0.31	-7.09	-58.62	-13	45.62
88.54	59.87	324	146	V	-43.65	0.31	-7.09	-51.05	-13	38.05
1673.20	69.59	234	101	H	-33.8	0.84	8.48	-26.16	-13	13.16
1673.20	73.37	41	216	V	-30.52	0.84	8.48	-22.88	-13	9.88
2509.80	55.63	192	244	H	-45.31	0.89	10.09	-36.11	-13	23.11
2509.80	51.32	291	130	V	-49.63	0.89	10.09	-40.43	-13	27.43

EGPRS 850 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										
88.54	56.91	146	117	H	-50.24	0.31	-7.09	-57.64	-13	44.64
88.54	60.29	149	226	V	-43.23	0.31	-7.09	-50.63	-13	37.63
1673.20	64.22	328	139	H	-39.17	0.84	8.48	-31.53	-13	18.53
1673.20	66.06	6	149	V	-37.83	0.84	8.48	-30.19	-13	17.19
2509.80	46.10	95	178	H	-54.84	0.89	10.09	-45.64	-13	32.64
2509.80	44.33	280	151	V	-56.62	0.89	10.09	-47.42	-13	34.42

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										
88.46	56.78	328	176	H	-50.37	0.31	-7.09	-57.77	-13	44.77
88.46	60.51	221	225	V	-43.03	0.31	-7.09	-50.43	-13	37.43
1673.20	80.99	158	131	H	-22.4	0.84	8.48	-14.76	-13	1.76
1673.20	79.63	263	199	V	-24.26	0.84	8.48	-16.62	-13	3.62
2509.80	61.42	335	176	H	-39.52	0.89	10.09	-30.32	-13	17.32
2509.80	56.45	40	185	V	-44.5	0.89	10.09	-35.3	-13	22.3

30 MHz ~ 20 GHz:

GPRS 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										
99.93	58.29	43	210	H	-49.3	0.33	-6.06	-55.69	-13	42.69
99.93	63.14	162	157	V	-35.25	0.33	-6.06	-41.64	-13	28.64
3760.00	57.57	75	134	H	-39.14	0.95	9.74	-30.35	-13	17.35
3760.00	49.43	170	179	V	-47.45	0.95	9.74	-38.66	-13	25.66
5640.00	51.51	354	193	H	-42.42	1.15	10.47	-33.10	-13	20.10
5640.00	46.68	61	244	V	-47.28	1.15	10.47	-37.96	-13	24.96

EGPRS 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										
99.93	57.87	298	106	H	-49.72	0.33	-6.06	-56.11	-13	43.11
99.93	62.65	178	200	V	-35.74	0.33	-6.06	-42.13	-13	29.13
3760.00	53.93	235	229	H	-42.78	0.95	9.74	-33.99	-13	20.99
3760.00	43.17	16	236	V	-53.71	0.95	9.74	-44.92	-13	31.92
5640.00	46.15	143	110	H	-47.78	1.15	10.47	-38.46	-13	25.46
5640.00	42.33	154	116	V	-51.63	1.15	10.47	-42.31	-13	29.31

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										
119.98	54.26	83	184	H	-52.2	0.95	9.74	-43.41	-13	30.41
119.98	57.87	338	202	V	-41.41	0.95	9.74	-32.62	-13	19.62
3760.00	58.45	70	219	H	-38.26	0.95	9.74	-29.47	-13	16.47
3760.00	48.54	320	179	V	-48.34	0.95	9.74	-39.55	-13	26.55
5640.00	55.84	340	213	H	-38.09	1.15	10.47	-28.77	-13	15.77
5640.00	50.50	297	135	V	-43.46	1.15	10.47	-34.14	-13	21.14

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**

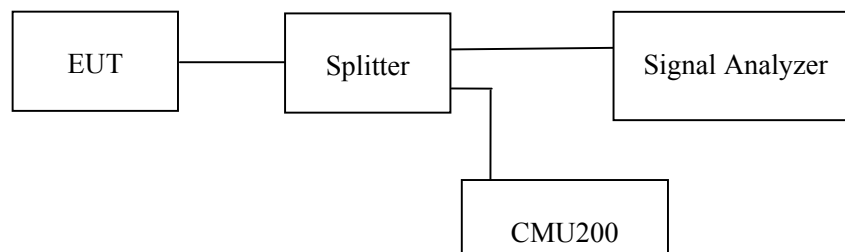
According to § 22.917(a), the power of any emissions outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

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.

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**

Temperature:	22.8-23.3 °C
Relative Humidity:	48-50 %
ATM Pressure:	101.0-101.2kPa

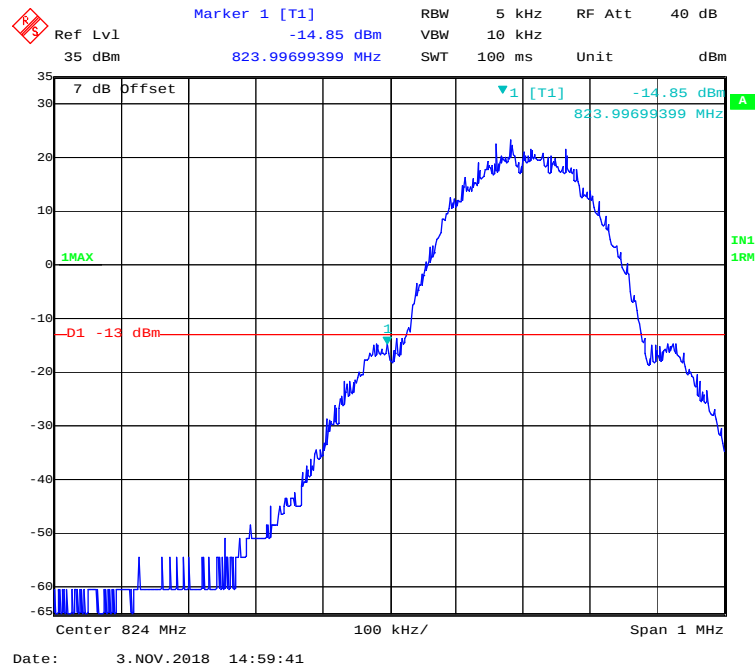
The testing was performed by Alisa Gao from 2018-11-02 to 2018-11-03.

EUT operation mode: Transmitting

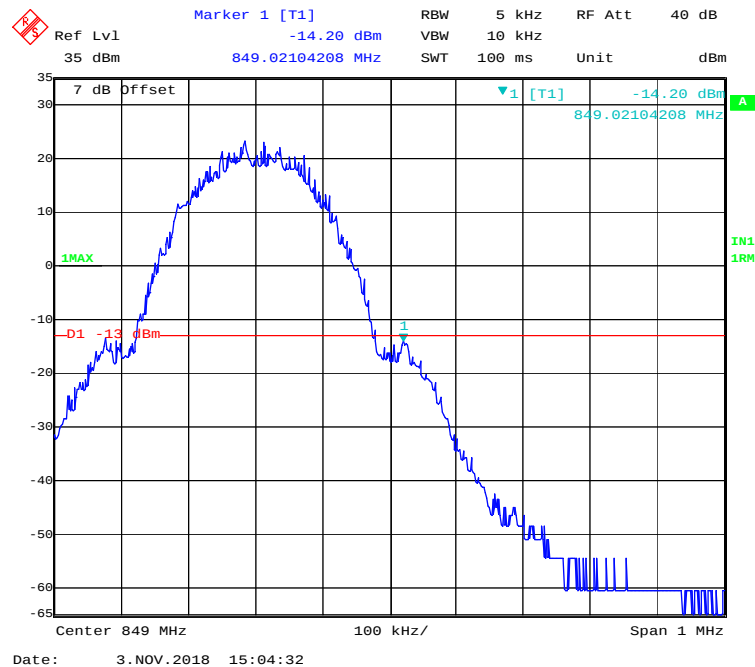
Test Result: Compliance.

GSM 850 Band:

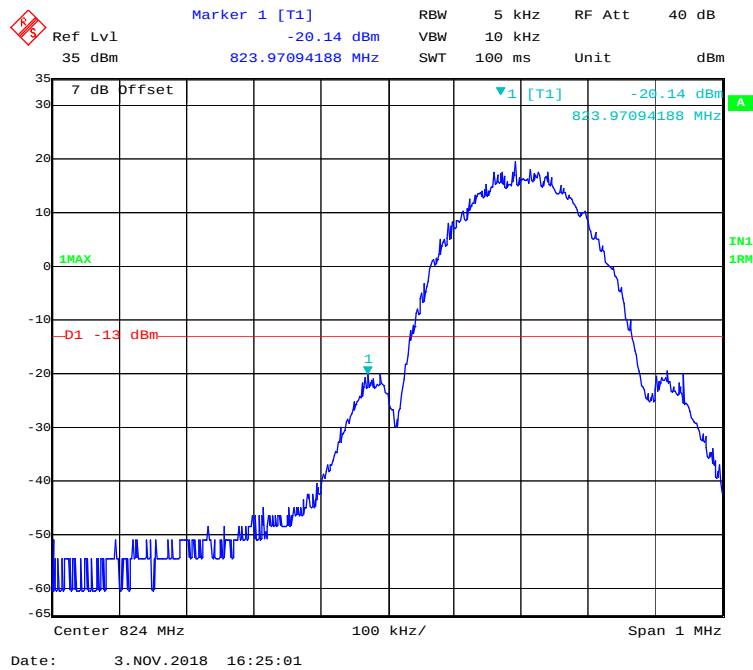
GPRS Mode, Left Band Edge



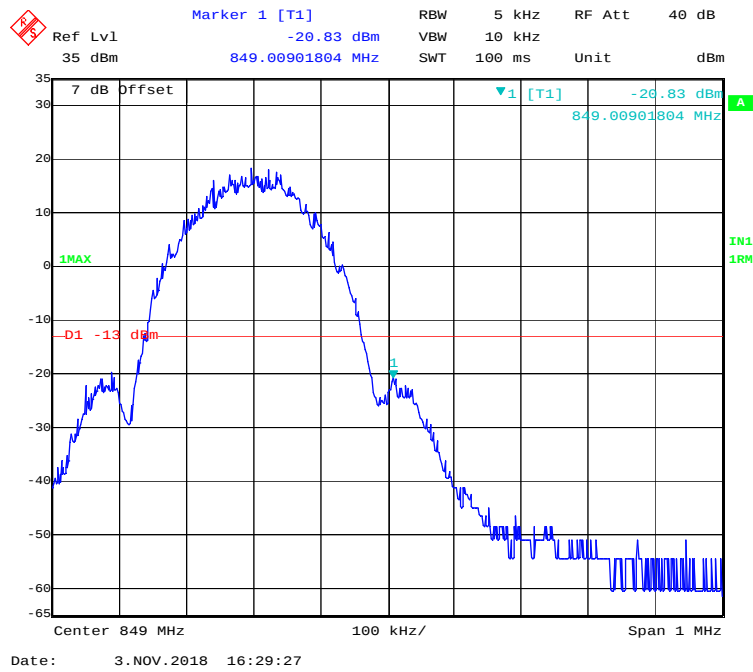
GPRS Mode, Right Band Edge



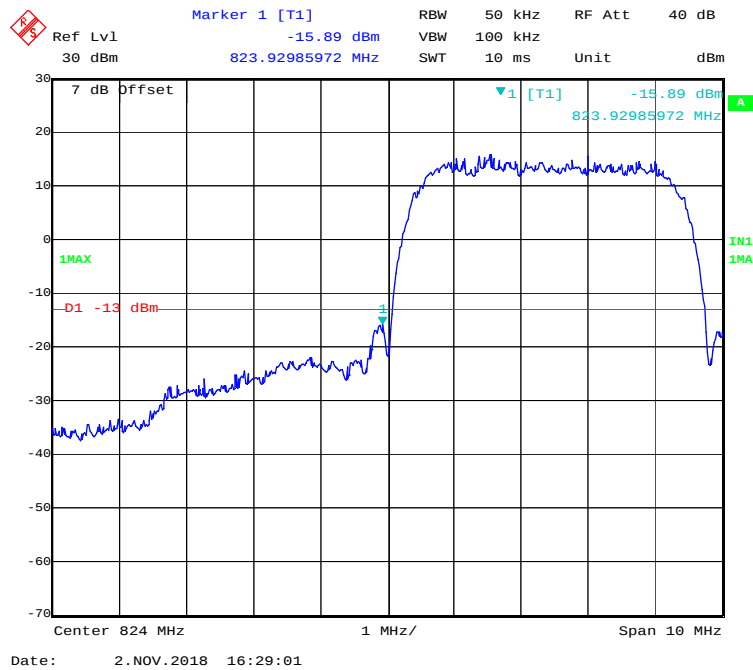
EGPRS Mode, Left Band Edge



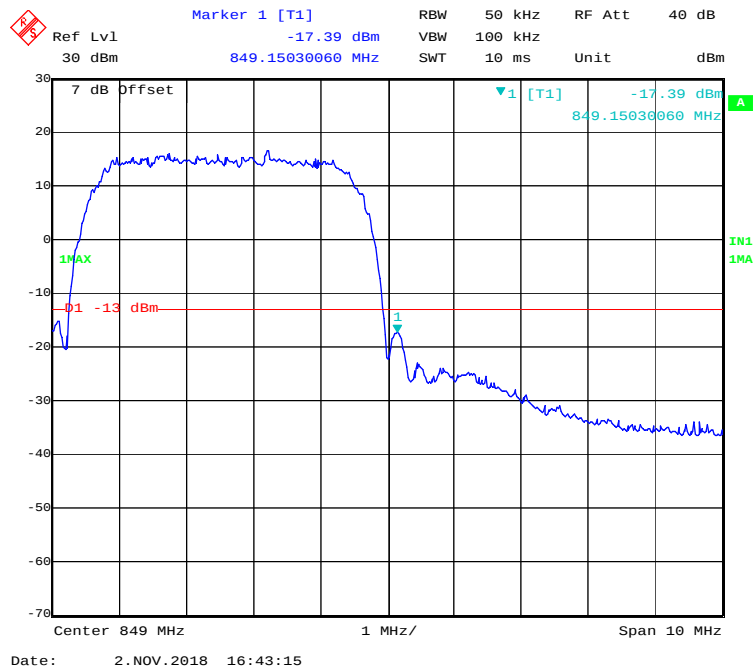
EGPRS Mode, Right Band Edge



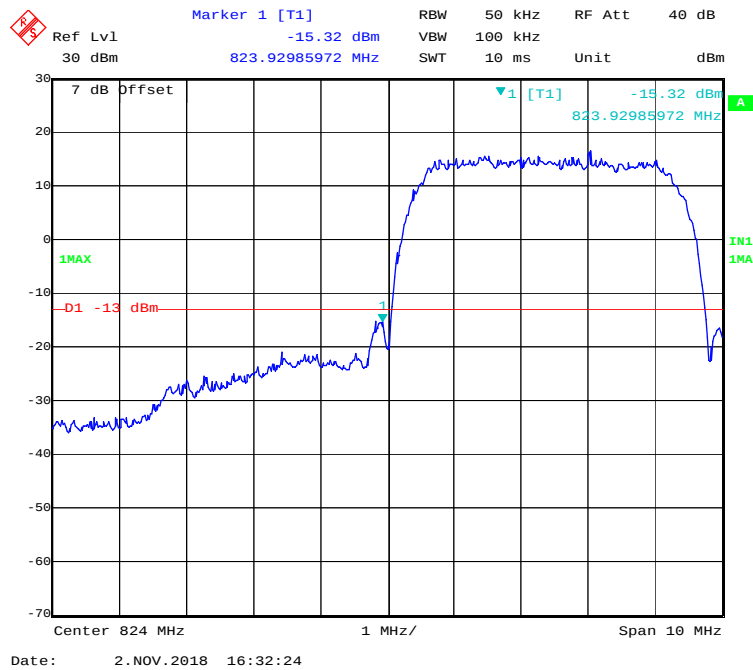
WCDMA (Rel 99) Mode Band V, Left Band Edge



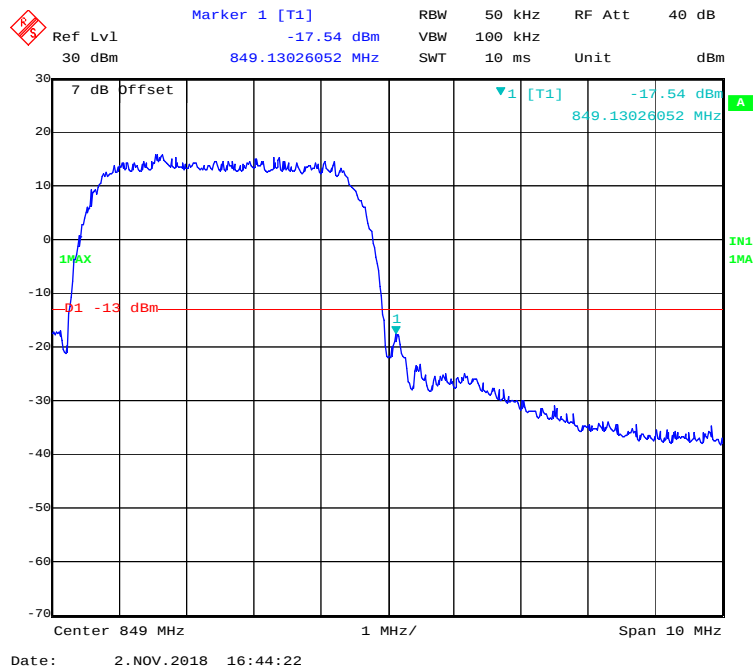
WCDMA (Rel 99) Mode Band V, Right Band Edge



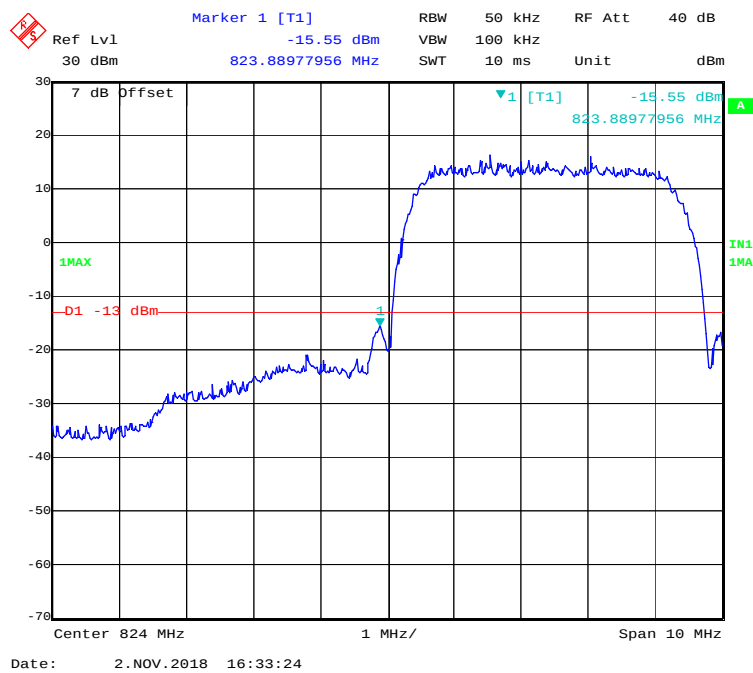
WCDMA (HSDPA) Mode Band V, Left Band Edge



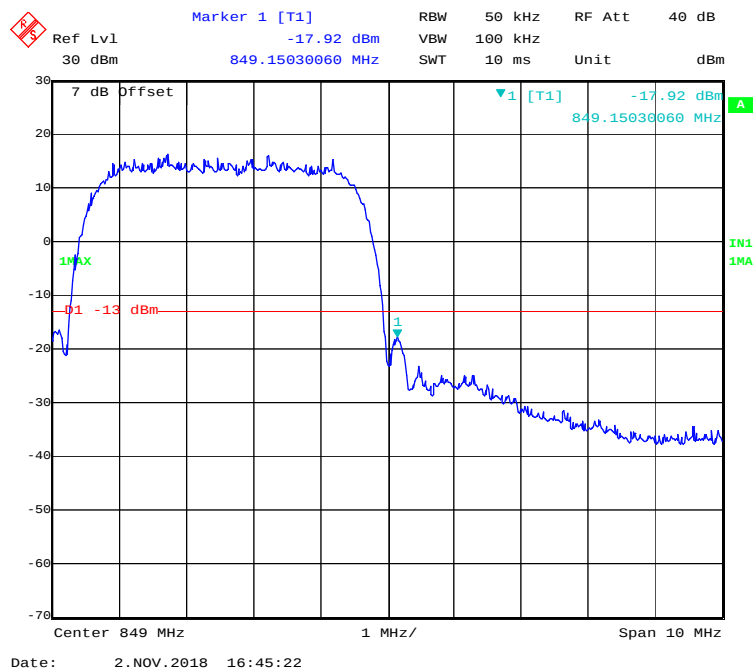
WCDMA (HSDPA) Mode Band V, Right Band Edge



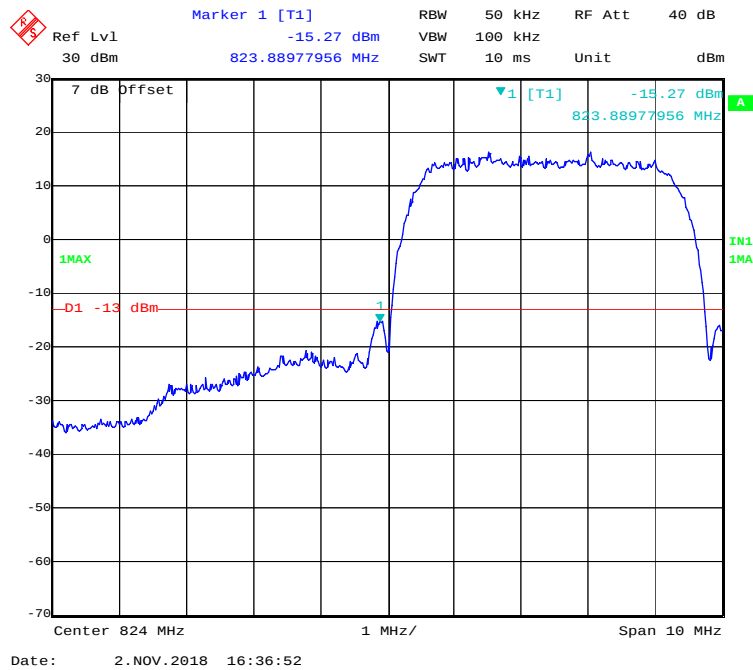
WCDMA (HSUPA) Mode Band V, Left Band Edge



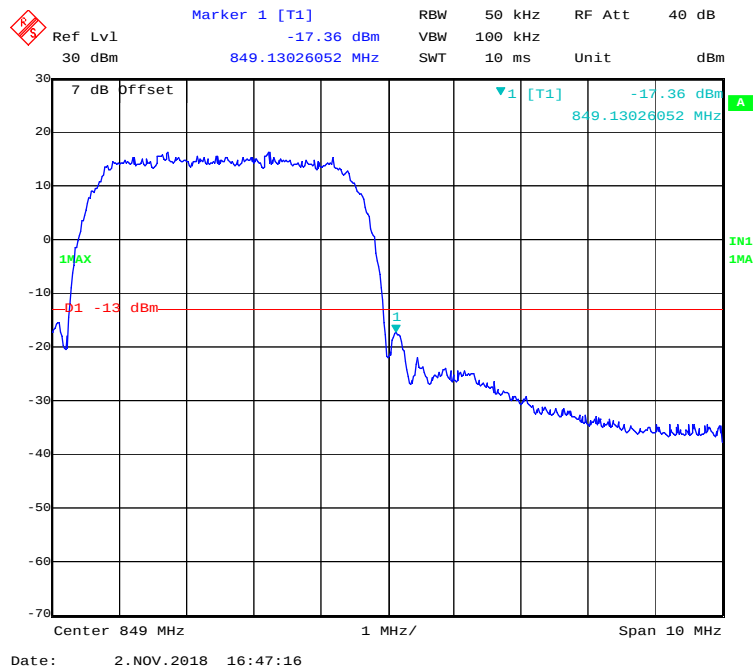
WCDMA (HSUPA) Mode Band V, Right Band Edge



WCDMA (HSPA+) Mode Band V, Left Band Edge

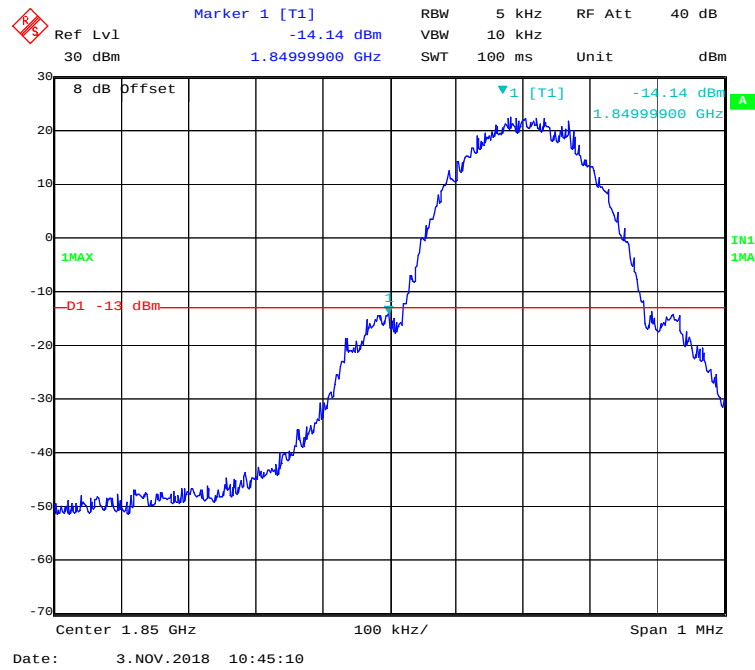


WCDMA (HSPA+) Mode Band V, Right Band Edge

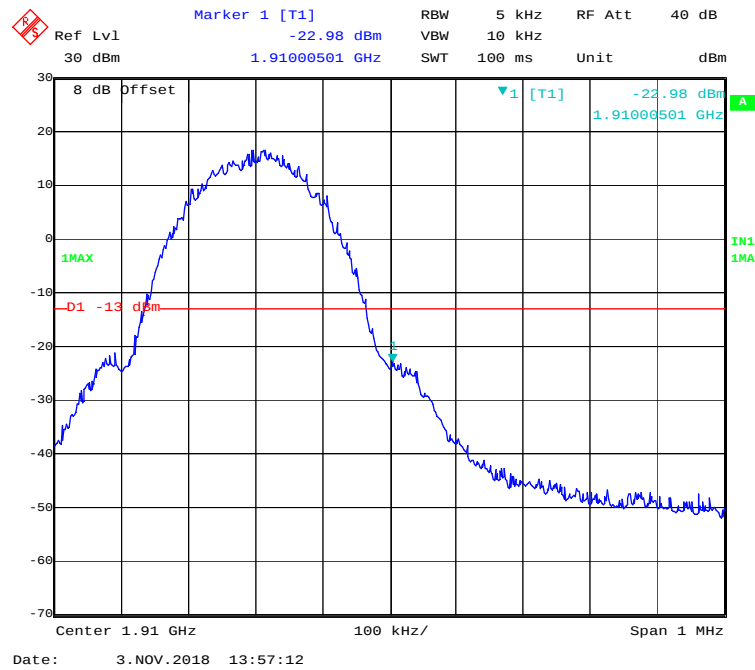


PCS 1900 Band:

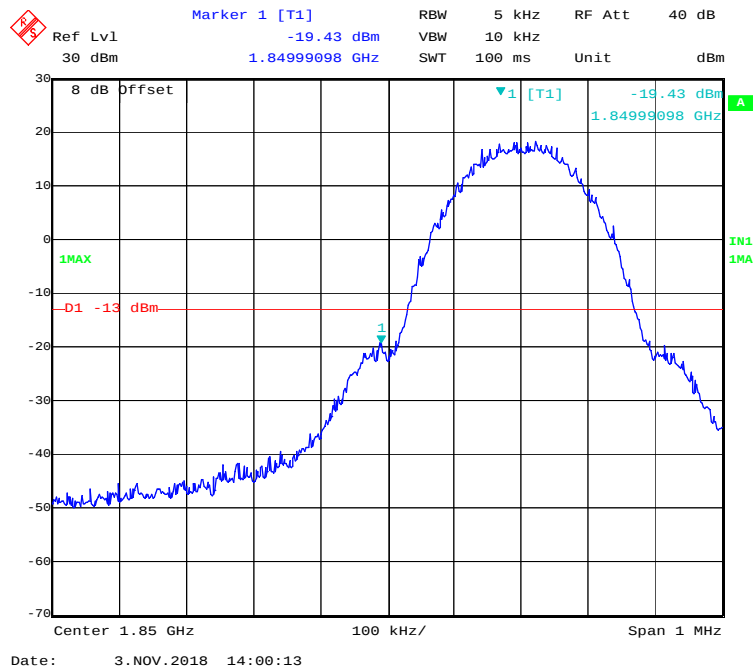
GPRS Mode, Left Band Edge



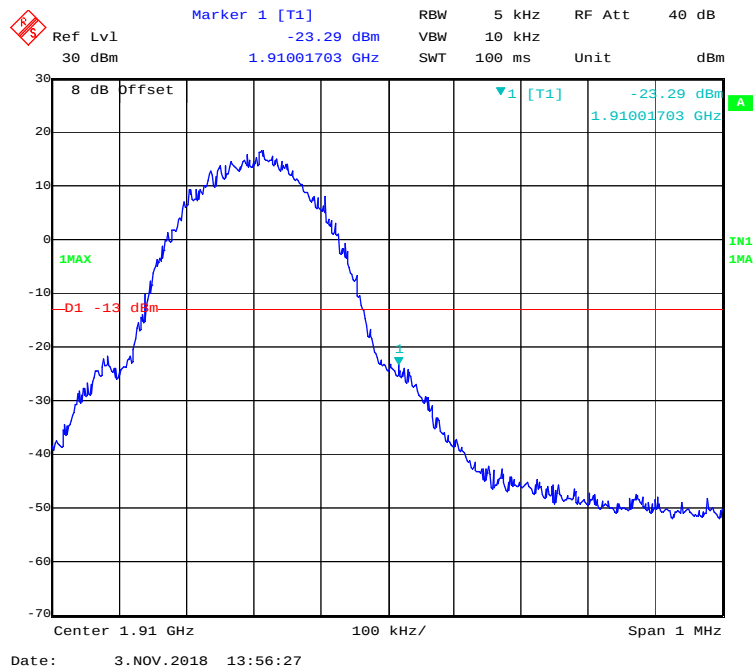
GPRS Mode, Right Band Edge



EGPRS Mode, Left Band Edge

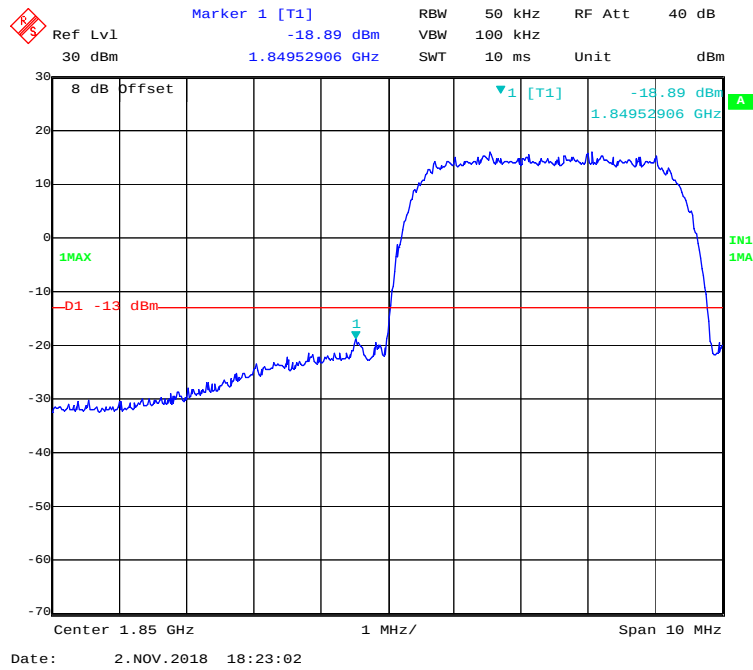


EGPRS Mode, Right Band Edge

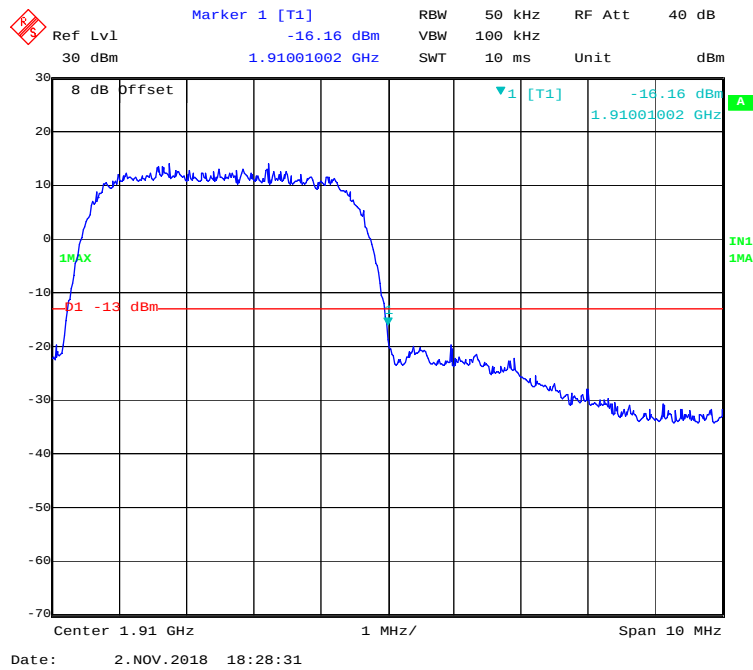


WCDMA Band II

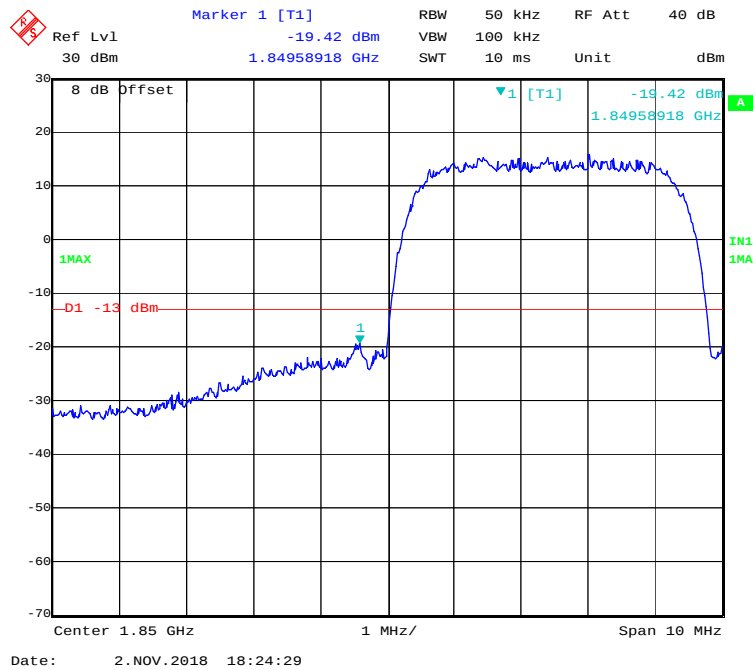
WCDMA (Rel 99) Mode Band II, Left Band Edge



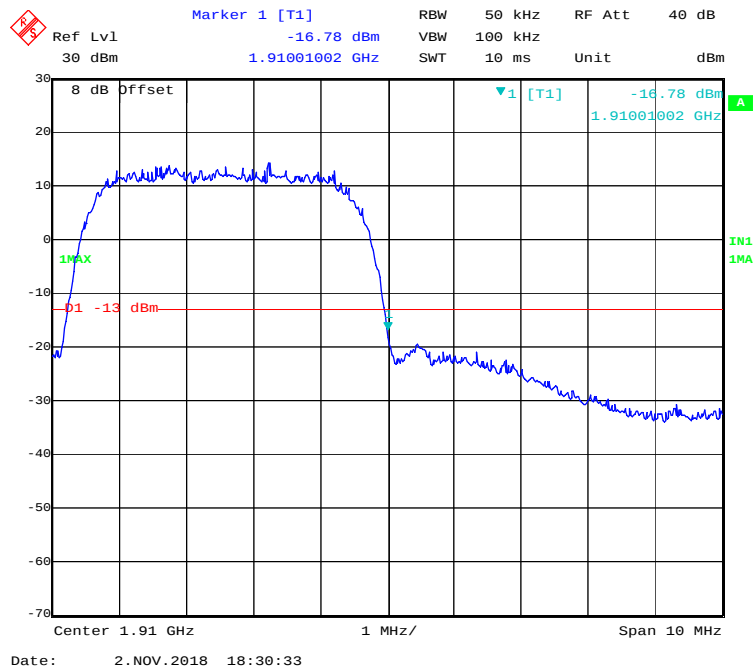
WCDMA (Rel 99) Mode Band II, Right Band Edge



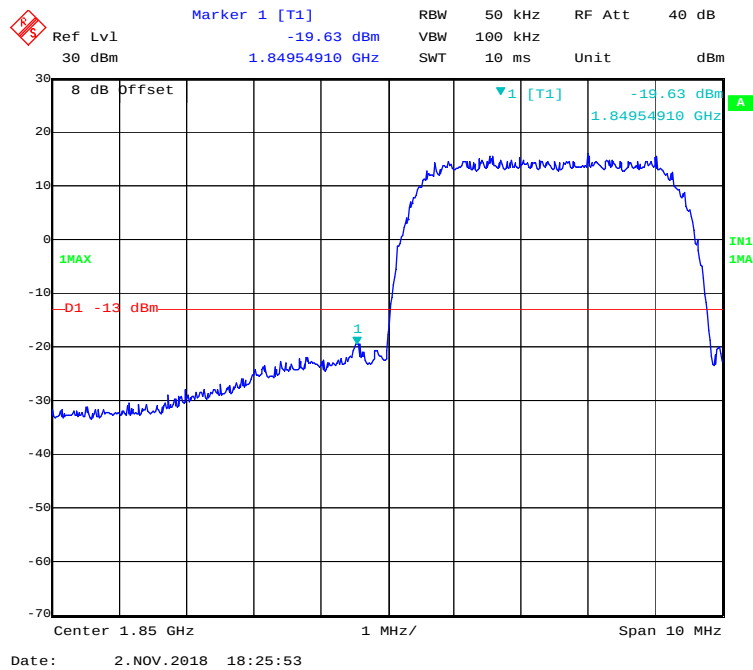
WCDMA (HSDPA) Mode Band II, Left Band Edge



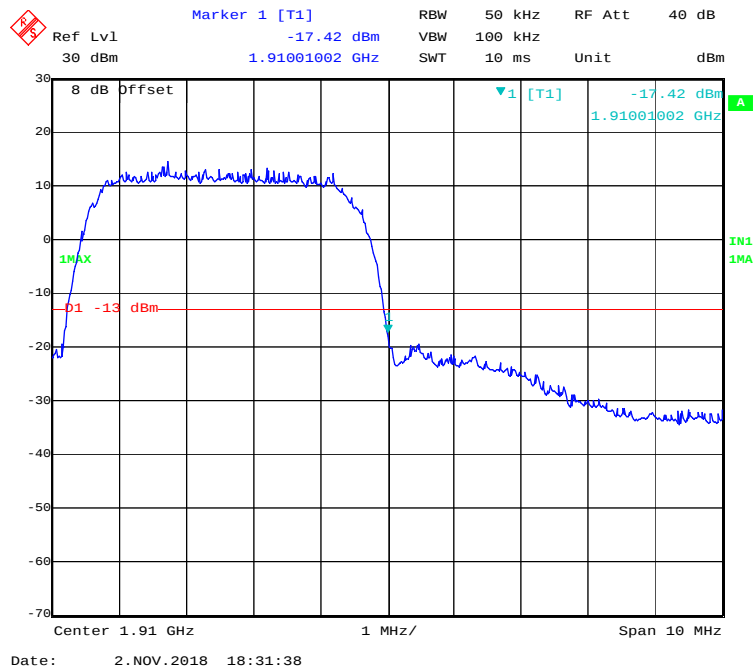
WCDMA (HSDPA) Mode Band II, Right Band Edge



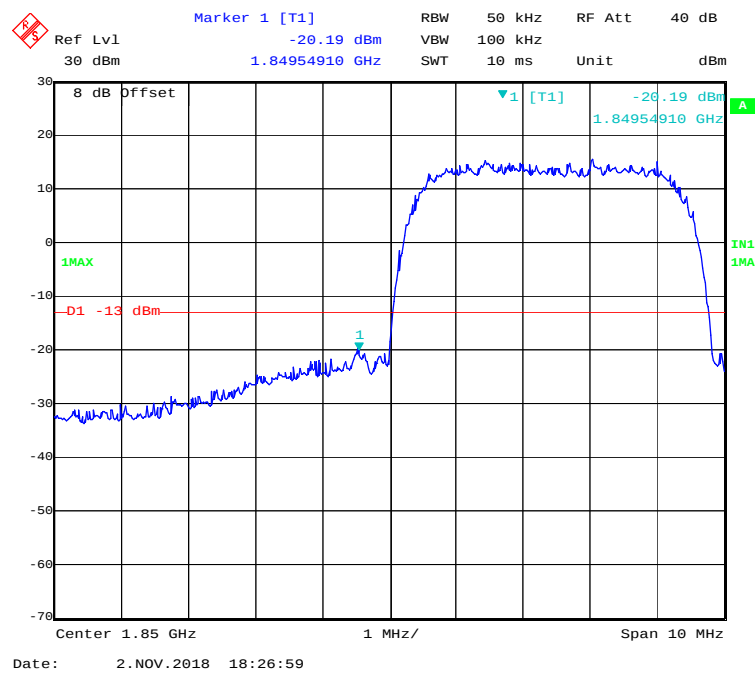
WCDMA (HSUPA) Mode Band II, Left Band Edge



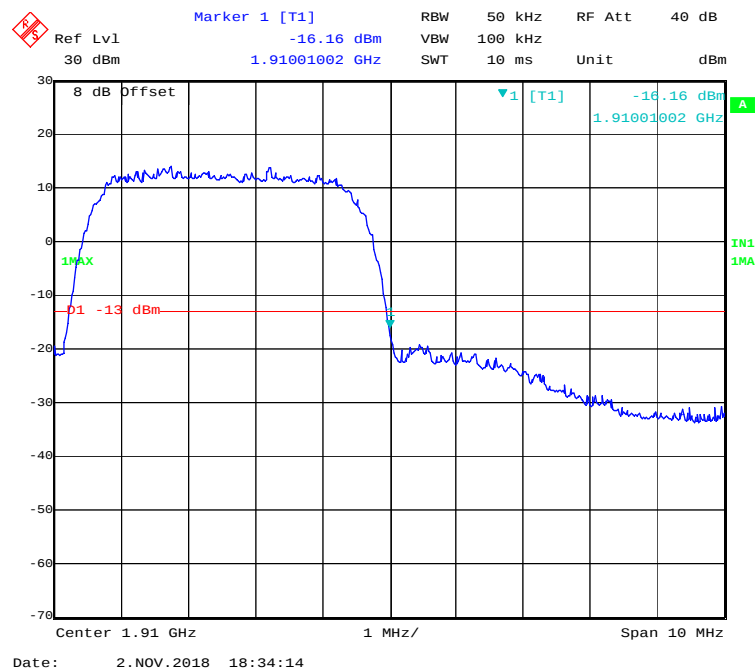
WCDMA (HSUPA) Mode Band II, Right Band Edge



WCDMA (HSPA+) Mode Band II, Left Band Edge



WCDMA (HSPA+) Mode Band II, 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

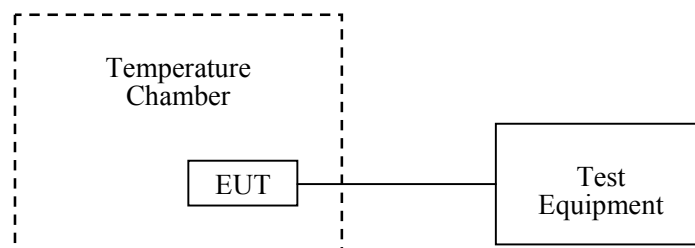
According to §24.235, the frequency stability shall be sufficient to ensure that the fundamental emissions stays within the authorized frequency block.

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**

Temperature:	23.3 °C
Relative Humidity:	50 %
ATM Pressure:	101.2kPa

The testing was performed by Alisa Gao on 2018-11-03.

EUT operation mode: Transmitting

Test Result: Compliance.

GSM 850 Band:

GPRS Mode, Middle Channel, $f_0 = 836.6$ MHz				
Temperature (°C)	Power Supplied (V _{DC})	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)
-30	14.40	-12	-0.0143	2.5
-20		-11	-0.0131	2.5
-10		-13	-0.0155	2.5
0		-10	-0.0120	2.5
10		-14	-0.0167	2.5
20		-12	-0.0143	2.5
30		-11	-0.0131	2.5
40		-11	-0.0131	2.5
50		-10	-0.0120	2.5
20	V min.= 12.24	-22	-0.0263	2.5
20	V max.= 16.80	-12	-0.0143	2.5

EGPRS Mode, Middle Channel, $f_0=836.6$ MHz				
Temperature (°C)	Power Supplied (V_{DC})	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)
-30	14.40	-8	-0.0096	2.5
-20		-9	-0.0108	2.5
-10		-7	-0.0084	2.5
0		-10	-0.0120	2.5
10		-11	-0.0131	2.5
20		-9	-0.0108	2.5
30		-9	-0.0108	2.5
40		-8	-0.0096	2.5
50		-10	-0.0120	2.5
20	V min.= 12.24	-9	-0.0108	2.5
20	V max.= 16.80	-8	-0.0096	2.5

WCDMA Band V:

Middle Channel, $f_0=836.6$ MHz				
Temperature (°C)	Power Supplied (V_{DC})	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)
-30	14.40	1	0.0012	2.5
-20		3	0.0036	2.5
-10		2	0.0024	2.5
0		5	0.0060	2.5
10		4	0.0048	2.5
20		2	0.0024	2.5
30		1	0.0012	2.5
40		1	0.0012	2.5
50		2	0.0024	2.5
20	V min.= 12.24	1	0.0012	2.5
20	V max.= 16.80	2	0.0024	2.5

PCS 1900 Band:

GPRS Mode, Middle Channel, $f_0=1880.0$ MHz				
Temperature (°C)	Power Supplied (V_{DC})	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)
-30	14.40	-10	-0.0053	pass
-20		-11	-0.0059	pass
-10		-9	-0.0048	pass
0		-10	-0.0053	pass
10		-13	-0.0069	pass
20		-12	-0.0064	pass
30		-9	-0.0048	pass
40		-12	-0.0064	pass
50		-16	-0.0085	pass
20	V min.= 12.24	-20	-0.0106	pass
20	V max.= 16.80	-8	-0.0043	pass

EGPRS Mode, Middle Channel, $f_0=1880.0$ MHz				
Temperature (°C)	Power Supplied (V_{DC})	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)
-30	14.40	-20	-0.0106	pass
-20		-19	-0.0101	pass
-10		-18	-0.0096	pass
0		-22	-0.0117	pass
10		-21	-0.0112	pass
20		-20	-0.0106	pass
30		-19	-0.0101	pass
40		-20	-0.0106	pass
50		-22	-0.0117	pass
20	V min.= 12.24	-16	-0.0085	pass
20	V max.= 16.80	-23	-0.0122	pass

WCDMA Band II:

WCDMA Mode, Middle Channel, f_o =1880.0 MHz				
Temperature (°C)	Power Supplied (V_{DC})	Frequency Error (Hz)	Frequency Error (ppm)	Result
-30	14.40	5	0.0027	pass
-20		4	0.0021	pass
-10		2	0.0011	pass
0		7	0.0037	pass
10		8	0.0043	pass
20		6	0.0032	pass
30		5	0.0027	pass
40		1	0.0005	pass
50		6	0.0032	pass
20	V min.= 12.24	6	0.0032	pass
20	V max.= 16.80	7	0.0037	pass

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