



TESTING LABORATORY  
CERTIFICATE#4323.01



## FCC PART 22H, PART 24E

### TEST REPORT

For

# SHANGHAI WANWAY DIGITAL TECHNOLOGY CO., LTD

FLOOR 23 NO. 1999 WENCHUAN ROAD BAOSHAN DISTRICT, SHANGHAI, China

**FCC ID: 2AWBA-G19S**

<b>Report Type:</b> Original Report	<b>Product Type:</b> GPS Tracker
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## GENERAL INFORMATION

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

Applicant	SHANGHAI WANWAY DIGITAL TECHNOLOGY CO., LTD
Tested Model	G19S
Series Model:	G19, G19H, G19A, G19O, G19F, G19H, G19L, G19P
Model Difference:	Model name
Product Type	GPS Tracker
Power Supply	DC 9-90V, DC 3.7V from battery
RF Function	GSM/GPRS 850,GSM/GPRS 1900
Operating Band/Frequency	GSM/GPRS: 824-849 MHz(TX), 869-894 MHz(RX) GSM/GPRS 1900: 1850-1910 MHz(TX), 1930-1990MHz(RX)
Modulation Type	GSM/GPRS: GMSK
Antenna Type	PIFA antenna
*Maximum Antenna Gain:	GSM/GPRS:2.0 dBi

*Note: The maximum antenna gain was provided by the applicant.*

*\*All measurement and test data in this report was gathered from production sample serial number: 20200921004. (Assigned by the BACL. The EUT supplied by the applicant was received on 2020-09-21)*

### Objective

This type approval report is prepared on behalf of *SHANGHAI WANWAY DIGITAL TECHNOLOGY 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)

No related submittal(s).

## **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: C63.26-2015.

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	5.91dB
	1GHz~6GHz	4.68dB
	6GHz~18GHz	4.92dB
	18GHz~40GHz	5.21dB
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 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 C63.26-2015.

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

### Channel List

Mode	Channel		Frequency (MHz)
GSM/GPRS 850	Low	128	824.2
	Middle	190	836.6
	High	251	848.8
GSM/GPRS 1900	Low	512	1850.2
	Middle	661	1880.0
	High	810	1909.8

### Equipment Modifications

No modifications were made to the EUT.

### Support Equipment List and Details

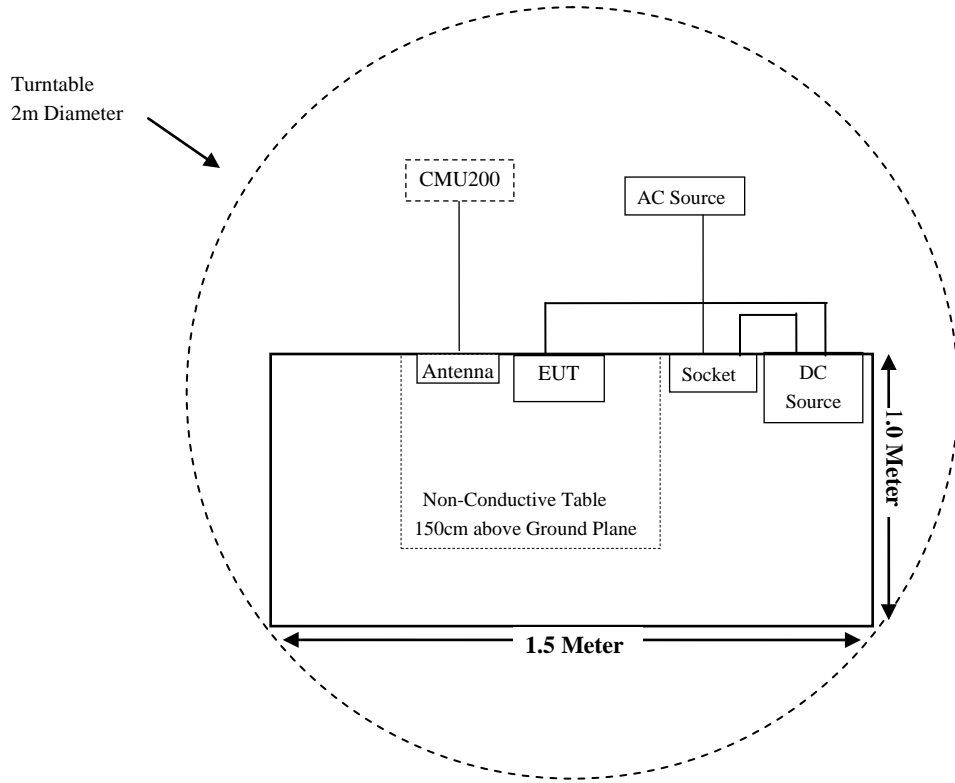
Manufacturer	Description	Model	Serial Number
Waylens Inc.	Antenna	/	/
Rohde & Schwarz	Universal Radio Communication Tester	CMU200	110605
MCH	DC Source	MCH-303D-II	14070562

### External I/O Cable

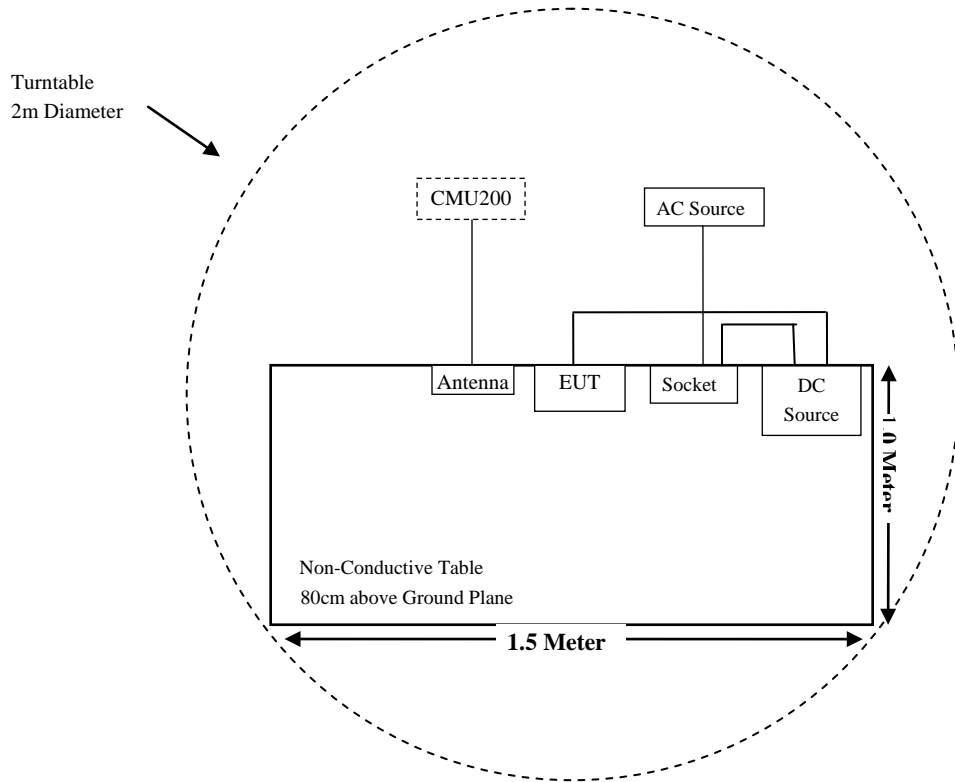
Cable Description	Length (m)	From/Port	To
Power Cable	1.2	EUT	DC Source
Power Cable	1.0	DC Source	Socket
Power Cable	0.8	Socket	AC Source

### Block Diagram of Test Setup

For Radiated Emissions (Above 1GHz):



For Radiated Emissions (Below 1GHz):



**SUMMARY OF TEST RESULTS**

<b>FCC Rules</b>	<b>Description of Test</b>	<b>Result</b>
§1.1310 & §2.1091	Maximum Permissible Exposure(MPE)	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	2019-12-14	2020-12-13
HP	Signal Generator	HP 8341B	2624A00116	2019-11-30	2020-11-29
Sunol Sciences	Broadband Antenna	JB3	A090314-1	2017-12-26	2020-12-25
Sunol Sciences	Bilog Antenna	JB3	A060217	2020-08-04	2023-08-03
Sonoma Instrument	Pre-amplifier	310N	171205	2020-08-14	2021-08-13
Rohde & Schwarz	Auto Test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2019-12-12	2020-12-11
MICRO-COAX	Coaxial Cable	Cable-8	008	2020-08-15	2021-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2020-08-15	2021-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2020-08-15	2021-08-14
Rohde & Schwarz	Universal Radio Communication Tester	CMU200	110605	2020-04-01	2021-03-31
<b>Radiated Emission Test (Chamber 2#)</b>					
HP	Signal Generator	HP 8341B	2624A00116	2019-11-30	2020-11-29
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2020-04-01	2021-03-31
ETS-LINDGREN	Horn Antenna	3115	9207-3900	2020-07-15	2023-07-14
ETS-LINDGREN	Horn Antenna	3115	6229	2020-01-10	2023-01-09
ETS-LINDGREN	Horn Antenna	3116	84159	2019-12-12	2022-12-11
ETS-LINDGREN	Horn Antenna	3116	2516	2020-01-07	2023-01-06
A.H.Systems,inc	Amplifier	PAM-0118P	512	2020-02-20	2021-02-19
EM Electronics Corporation	Amplifier	EM18G40G	060726	2020-03-22	2021-03-21
Rohde & Schwarz	Auto Test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2019-12-12	2020-12-11
MICRO-COAX	Coaxial Cable	Cable-11	011	2020-08-15	2021-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2020-08-15	2021-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2020-08-15	2021-08-14
MICRO-COAX	Coaxial Cable	Cable-16	016	2020-08-15	2021-08-14
Rohde & Schwarz	Universal Radio Communication Tester	CMU200	110605	2020-04-01	2021-03-31

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
<b>RF Conducted Test</b>					
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2019-11-30	2020-11-29
Narda	Attenuator	10dB	010	2020-01-10	2021-01-09
Rohde & Schwarz	Universal Radio Communication Tester	CMU200	110605	2020-04-01	2021-03-31
Mini-Circuits	Power splitter	ZFRSC-14-S+	SF019411452	2019-11-10	2020-11-09
BACL	Temperature & Humidity Chamber	BTH-150	30023	2019-12-20	2020-12-19
EAST	Regulated DC Power Supply	MCH-303D-II	14070562	2020-10-10	2021-10-09
WANWAY	RF Cable	WANWAY 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).

## FCC §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

### Applicable Standard

According to subpart 15.247 (i) and subpart 1.1310, 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Averaging Time (minutes)
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz; \* = Plane-wave equivalent power density

### Calculated Formulary:

Predication of MPE limit at a given distance

$S = PG/4 \pi R^2$  = power density (in appropriate units, e.g. mW/cm<sup>2</sup>);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

### Calculated Data:

Mode	Frequency Range (MHz)	Antenna Gain		Target Output Power		Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )
		(dBi)	(numeric)	(dBm)	(mW)			
GSM 850	824~849	2.0	1.58	24.0	251.19	20	0.0792	0.55
GPRS 850	824~849	2.0	1.58	29.5	891.25	20	0.2810	0.55
GSM 1900	1850~1910	2.0	1.58	23.0	199.53	20	0.0627	1.00
GPRS 1900	1850~1910	2.0	1.58	27.0	501.19	20	0.1575	1.00

GSM 850: Maximum Tune-up output power with 1 slot is 33.00 dBm, so the max tune-up time based Ave. power compared to slot Ave. power is 24.00 dBm.

GPRS 850: Maximum Tune-up output power with 1 slot is 34.00 dBm, 2 slots is 33.50 dBm, 3 slots is 33.00 dBm, 4 slots is 32.50 dBm, so the max tune-up time based Ave. power compared to slot Ave. power are 29.50 dBm.

GSM 1900: Maximum Tune-up output power with 1 slot is 32.00 dBm, so the max tune-up time based Ave. power compared to slot Ave. power is 23.00 dBm .

GPRS 1900: Maximum Tune-up output power with 1 slot is 32.00 dBm, 2 slots is 31.00 dBm, 3 slots is 30.00 dBm, 4 slots is 30.00 dBm, so the max tune-up time based Ave. power compared to slot Ave. power are 27.00 dBm .

Number of Time slot	1	2	3	4
Duty Cycle	1:8	1:4	1:2.66	1:2
Time based Ave. power compared to slotted Ave. power	-9 dB	-6 dB	-4.26 dB	-3 dB

**Note:**

1. Antenna Gain (numeric): 2.0dBi (1.58).

**Result:** The device meet FCC MPE at 20 cm distance.

## **FCC §2.1047 - MODULATION CHARACTERISTIC**

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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).

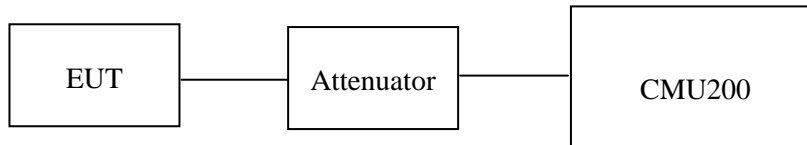
According to FCC §2.1046 and §24.232 (c), mobile and portable stations are limited to 2 watts (33dBm) EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

The peak-to-average power ratio (PAPR) of the transmitter output power 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.  $LOSS = \text{Generator Output Power (dBm)} - \text{Analyzer reading (dBm)}$

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:

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

## Test Data

### Environmental Conditions

<b>Temperature:</b>	24.5 °C
<b>Relative Humidity:</b>	54 %
<b>ATM Pressure:</b>	101.1 kPa

The testing was performed by Jack Jiao on 2020-10-14.

### Conducted Power:

#### GSM/GPRS 850 Band

Mode	Channel	Frequency (MHz)	Average Output Power (dBm)	Limit (dBm)
GSM	128	824.20	32.84	38.45
	190	836.60	32.49	38.45
	251	848.80	32.58	38.45

Mode	Channel	Frequency (MHz)	Average Output Power (dBm)				Limit (dBm)
			1 slot	2 slots	3 slots	4 slots	
GPRS	128	824.20	33.52	33.15	32.54	32.01	38.45
	190	836.60	33.69	33.06	32.85	32.21	38.45
	251	848.80	33.55	33.24	32.65	32.12	38.45

#### PCS 1900 Band

Mode	Channel	Frequency (MHz)	Average Output Power (dBm)	Limit (dBm)
GSM	512	1850.2	31.51	33
	661	1880.0	31.21	33
	810	1909.8	31.82	33

Mode	Channel	Frequency (MHz)	Average Output Power (dBm)				Limit (dBm)
			1 slot	2 slots	3 slots	4 slots	
GPRS	512	1850.2	31.58	30.51	29.52	28.79	33
	661	1880.0	31.58	30.54	29.43	28.84	33
	810	1909.8	31.29	30.46	29.58	28.96	33

**Peak-to-average ratio (PAR):****GSM/GPRS 850 Band**

Mode	Channel	PAR (dB)	Limit (dB)
GSM	Low	1.96	≤ 13
	Middle	2.10	≤ 13
	High	2.15	≤ 13

Mode	Channel	PAR (dB)	Limit (dB)
GPRS	Low	1.88	≤ 13
	Middle	2.09	≤ 13
	High	2.06	≤ 13

**PCS 1900**

Mode	Channel	PAR (dB)	Limit (dB)
GSM	Low	1.98	≤ 13
	Middle	1.93	≤ 13
	High	2.08	≤ 13

Mode	Channel	PAR (dB)	Limit (dB)
GPRS	Low	2.04	≤ 13
	Middle	1.97	≤ 13
	High	2.01	≤ 13



**ERP/EIRP:**

**GSM/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)			
GSM 850, Low Channel (ERP)										
824.20	98.27	77	200	H	33.47	0.62	-1.18	31.67	38.45	6.78
824.20	99.17	310	157	V	34.37	0.62	-1.18	32.57	38.45	5.88
GPRS 850, Low Channel (ERP)										
824.20	99.45	56	152	H	34.65	0.62	-1.18	32.85	38.45	5.60
824.20	99.81	254	175	V	35.01	0.62	-1.18	33.21	38.45	5.24
GSM 1900, Low Channel (EIRP)										
1850.20	94.87	225	198	H	22.95	0.84	8.76	30.87	33.00	2.13
1850.20	93.13	350	174	V	21.21	0.84	8.76	29.13	33.00	3.87
GPRS 1900, Low Channel (EIRP)										
1850.20	94.95	275	163	H	23.03	0.84	8.76	30.95	33.00	2.05
1850.20	93.42	300	112	V	21.5	0.84	8.76	29.42	33.00	3.58

**GSM/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)			
GSM 850, Middle Channel (ERP)										
836.60	97.82	303	100	H	32.96	0.63	-1.14	31.19	38.45	7.26
836.60	98.74	18	150	V	33.88	0.63	-1.14	32.11	38.45	6.34
GPRS 850, Middle Channel (ERP)										
836.60	98.99	212	150	H	34.13	0.63	-1.14	32.36	38.45	6.09
836.60	99.93	280	100	V	35.07	0.63	-1.14	33.30	38.45	5.15
GSM 1900, Middle Channel (EIRP)										
1880.00	93.38	188	150	H	23.25	0.85	8.81	31.21	33.00	1.79
1880.00	92.24	326	100	V	22.11	0.85	8.81	30.07	33.00	2.93
GPRS 1900, Middle Channel (EIRP)										
1880.00	93.97	137	150	H	23.84	0.85	8.81	31.80	33.00	1.20
1880.00	92.93	184	100	V	22.80	0.85	8.81	30.76	33.00	2.24

**GSM/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)			
GSM 850, High Channel (ERP)										
848.80	98.36	77	200	H	33.56	0.63	-1.10	31.83	38.45	6.62
848.80	99.5	310	157	V	34.70	0.63	-1.10	32.97	38.45	5.48
GPRS 850, High Channel (ERP)										
848.80	98.94	56.00	152.00	H	34.14	0.63	-1.10	32.41	38.45	6.04
848.80	99.98	254.00	175.00	V	35.18	0.63	-1.10	33.45	38.45	5.00
GSM 1900, High Channel (EIRP)										
1909.80	94.49	225	198	H	22.57	0.85	8.85	30.57	33.00	2.43
1909.80	93.56	350	174	V	21.64	0.85	8.85	29.64	33.00	3.36
GPRS 1900, High Channel (EIRP)										
1909.80	94.30	275	163	H	22.38	0.85	8.85	30.38	33.00	2.62
1909.80	93.41	300	112	V	21.49	0.85	8.85	29.49	33.00	3.51

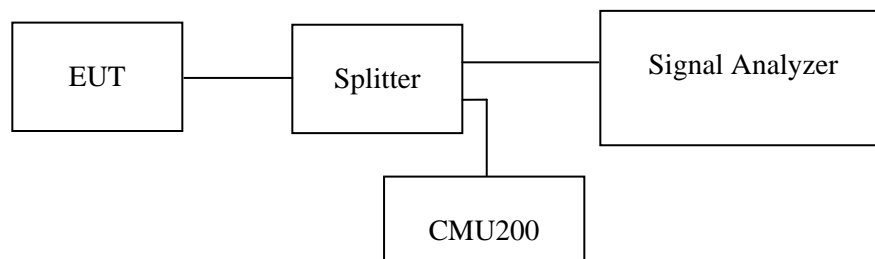
**FCC §2.1049, §22.917, §22.905 & §24.238; - OCCUPIED BANDWIDTH****Applicable Standards**

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) and the 26 dB & 99% bandwidth was recorded.

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

<b>Temperature:</b>	24.5 °C
<b>Relative Humidity:</b>	54 %
<b>ATM Pressure:</b>	101.1 kPa

*The testing was performed by Jack Jiao on 2020-10-14.*

*EUT operation mode: Transmitting*

*Test Result: Compliant.*

**GSM 850 Band**

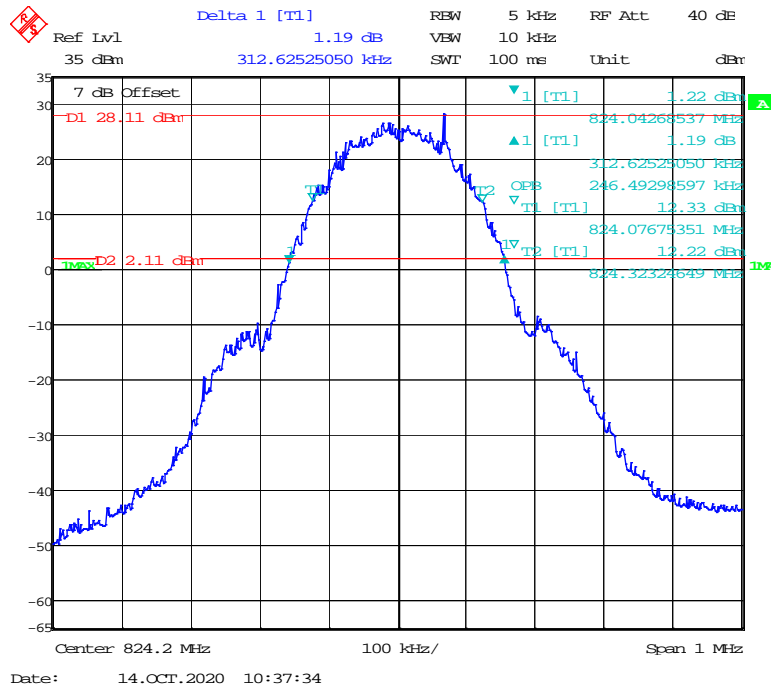
<b>Mode</b>	<b>Frequency (MHz)</b>	<b>26 dB Emission Bandwidth (MHz)</b>	<b>99% Occupied Bandwidth (MHz)</b>
GSM (GMSK)	824.2	0.313	0.246
	836.6	0.315	0.246
	848.8	0.323	0.244
GPRS (GMSK)	824.2	0.325	0.246
	836.6	0.319	0.244
	848.8	0.315	0.244

**PCS 1900**

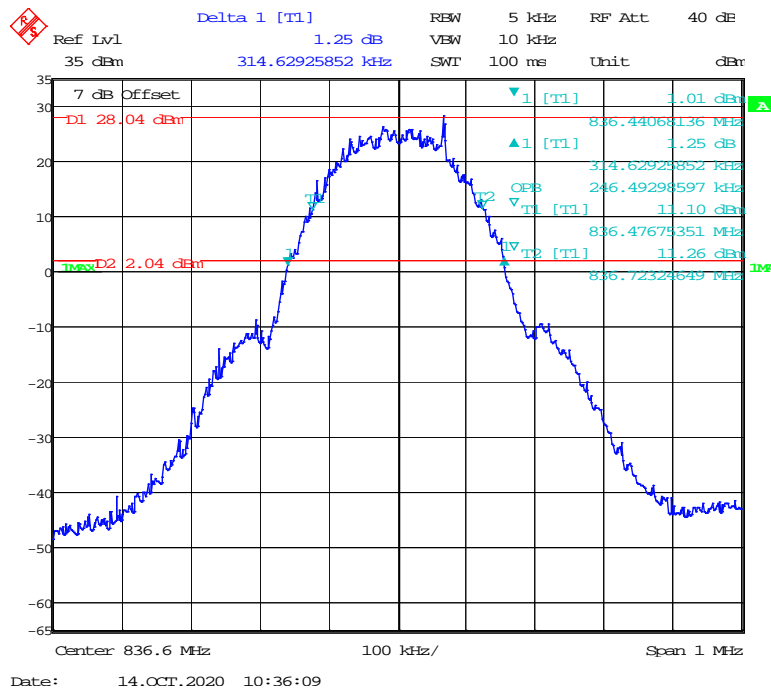
<b>Mode</b>	<b>Frequency (MHz)</b>	<b>26 dB Emission Bandwidth (MHz)</b>	<b>99% Occupied Bandwidth (MHz)</b>
GSM (GMSK)	1850.2	0.313	0.246
	1880.0	0.317	0.246
	1909.8	0.317	0.246
GPRS (GMSK)	1850.2	0.321	0.244
	1880.0	0.321	0.244
	1909.8	0.315	0.244

GSM 850 Band

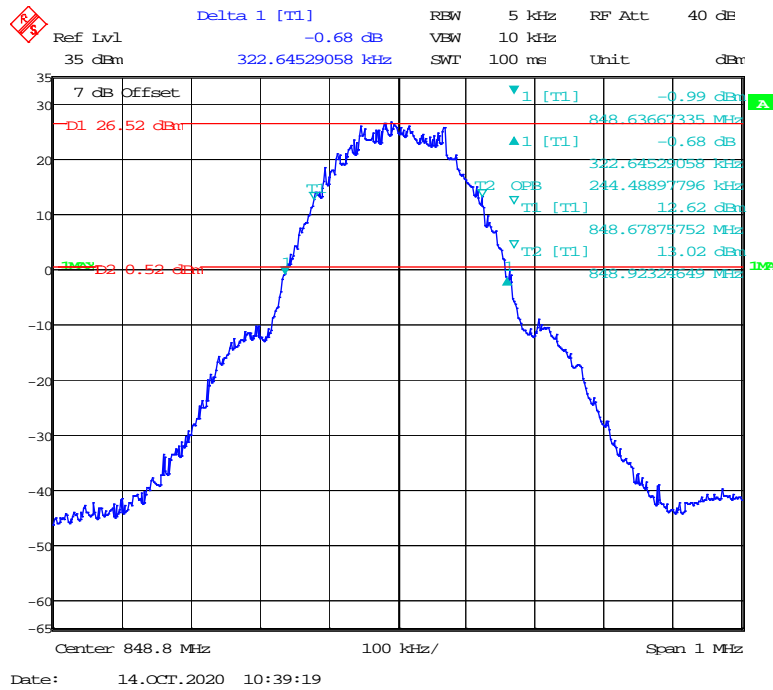
99% Occupied & 26 dB Emissions Bandwidth for GSM (GMSK) Low channel



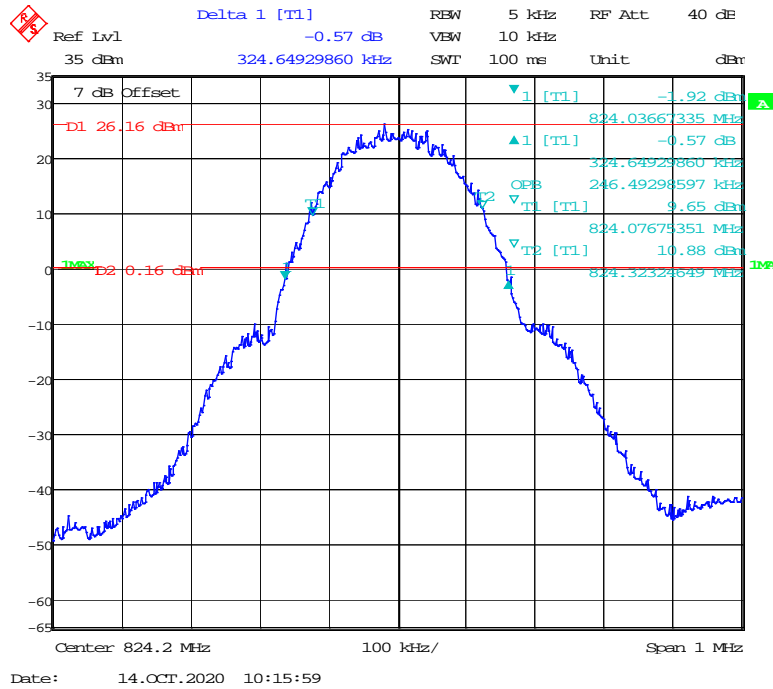
99% Occupied & 26 dB Emissions Bandwidth for GSM (GMSK) Middle channel



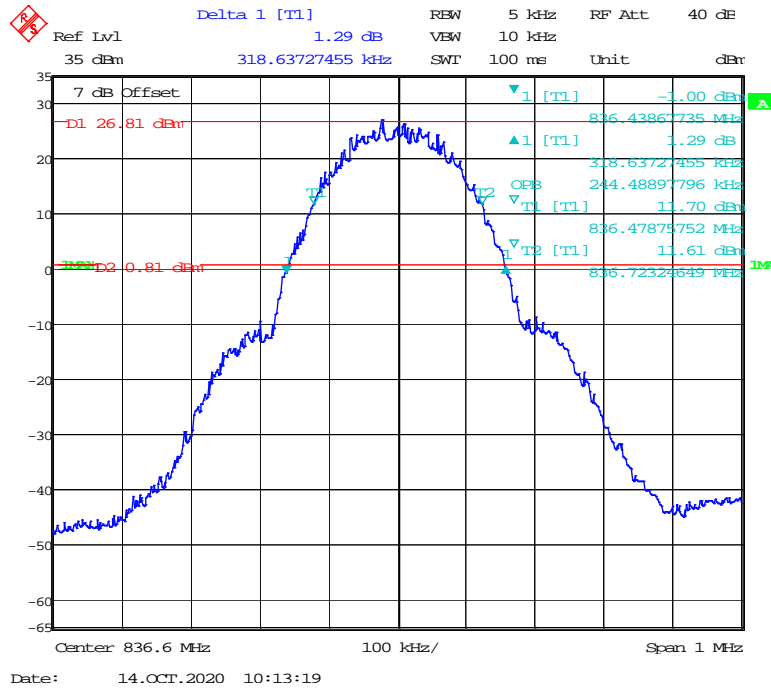
**99% Occupied & 26 dB Emissions Bandwidth for GSM (GMSK) High channel**



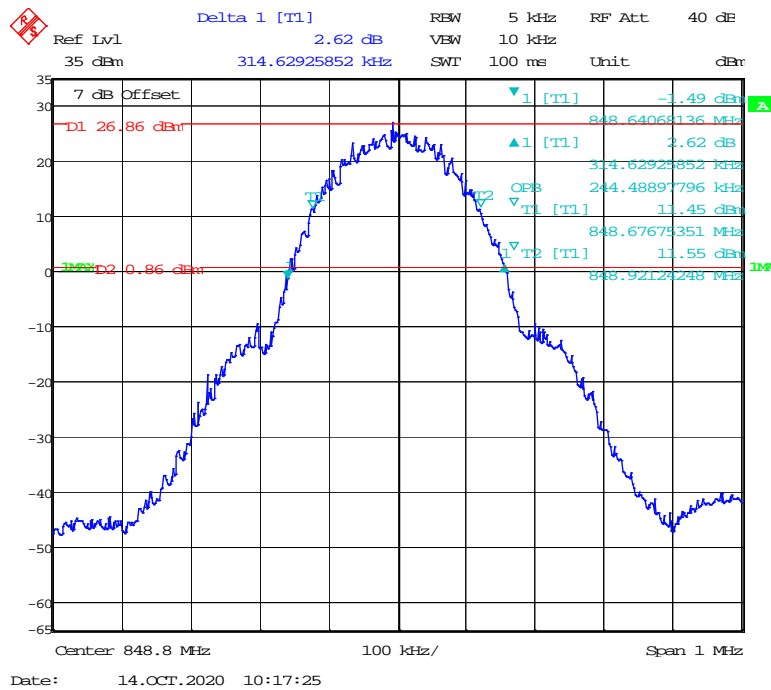
**99% Occupied & 26 dB Emissions Bandwidth for GPRS (GMSK) Low channel**



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

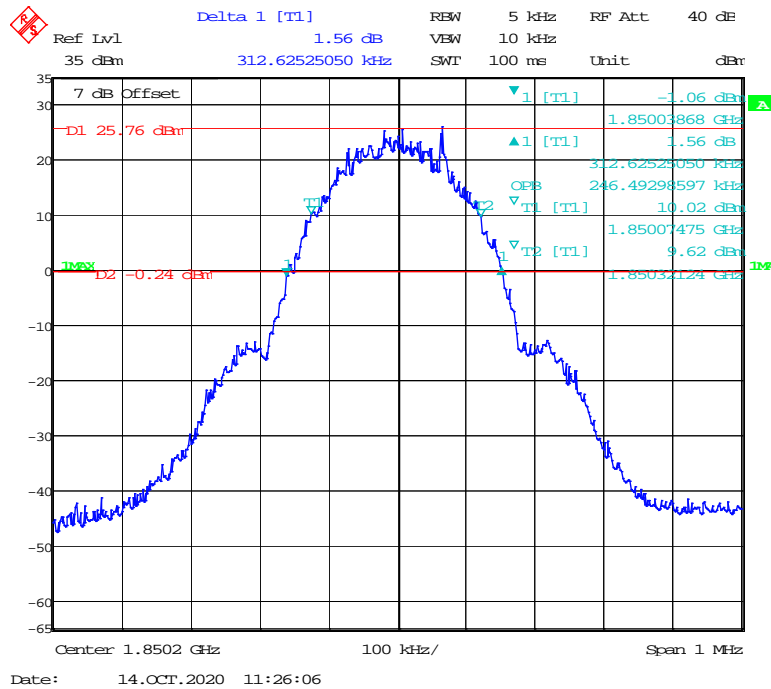


**99% Occupied & 26 dB Emissions Bandwidth for GPRS (GMSK) High channel**

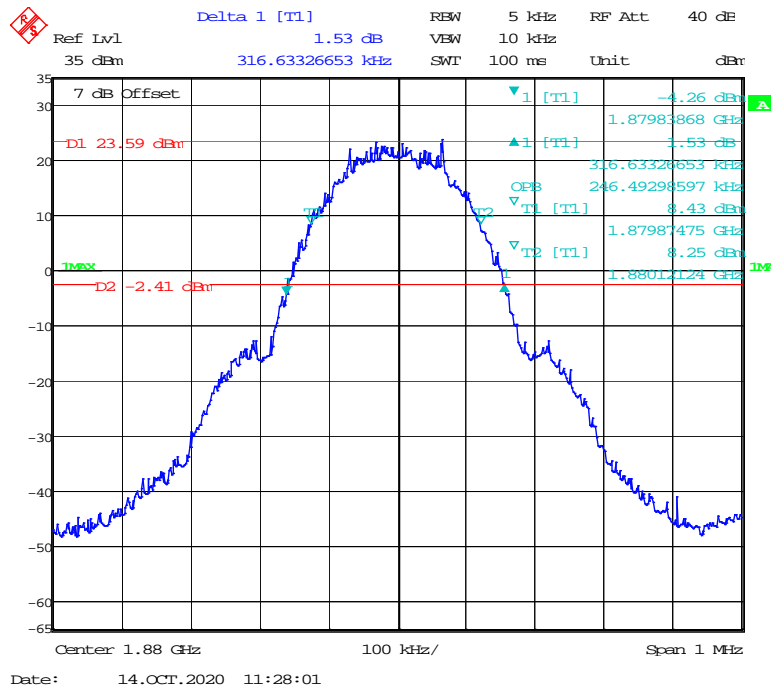


PCS 1900 Band

99% Occupied & 26 dB Emissions Bandwidth for GSM (GMSK) Low channel

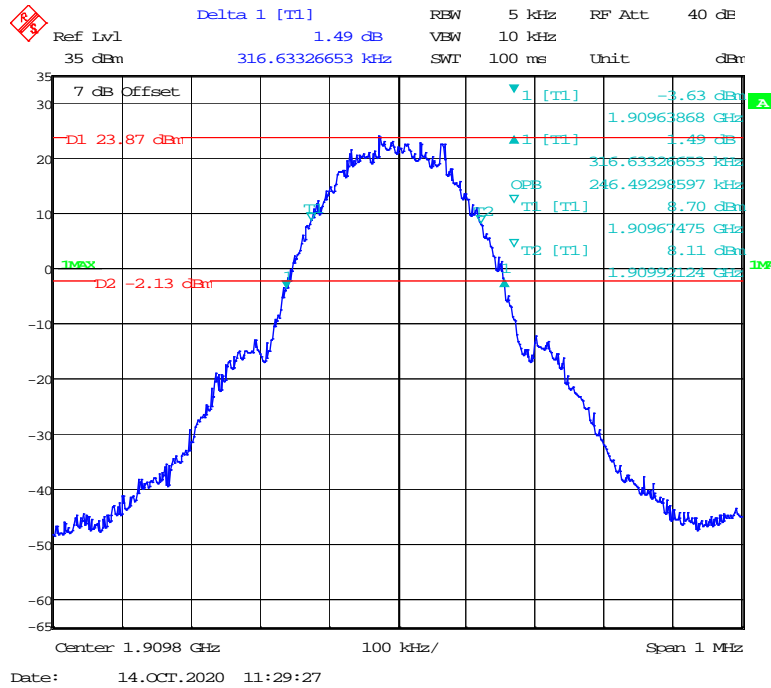


99% Occupied & 26 dB Emissions Bandwidth for GSM (GMSK) Middle channel

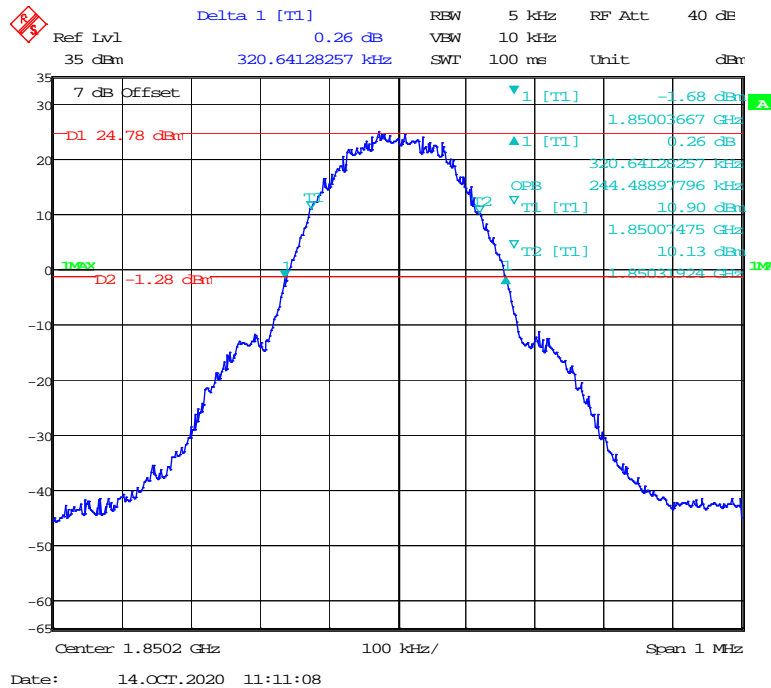




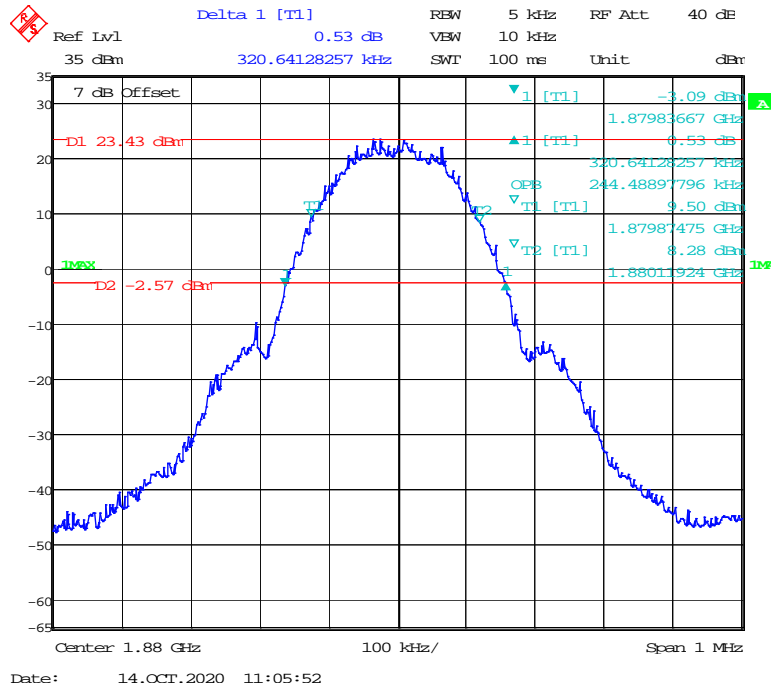
**99% Occupied & 26 dB Emissions Bandwidth for GSM (GMSK) High channel**



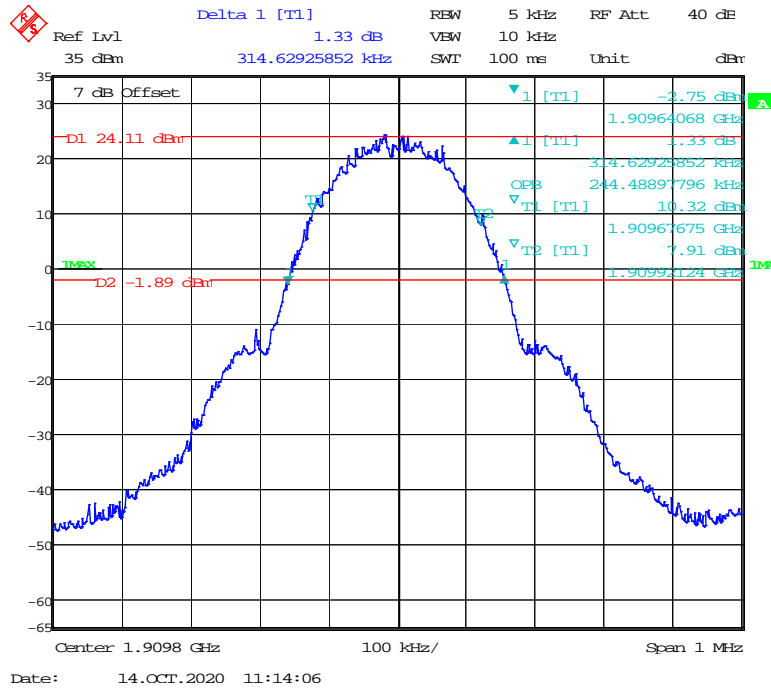
**99% Occupied & 26 dB Emissions Bandwidth for GPRS (GMSK) Low channel**



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



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



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

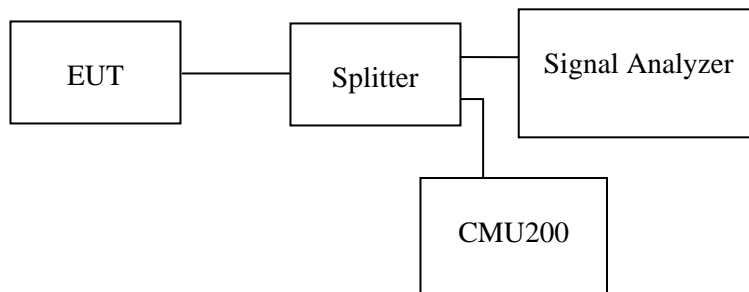
**Applicable Standards**

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 100 kHz 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>	23.7~24.5 °C
<b>Relative Humidity:</b>	49~54 %
<b>ATM Pressure:</b>	100.7~101.1 kPa

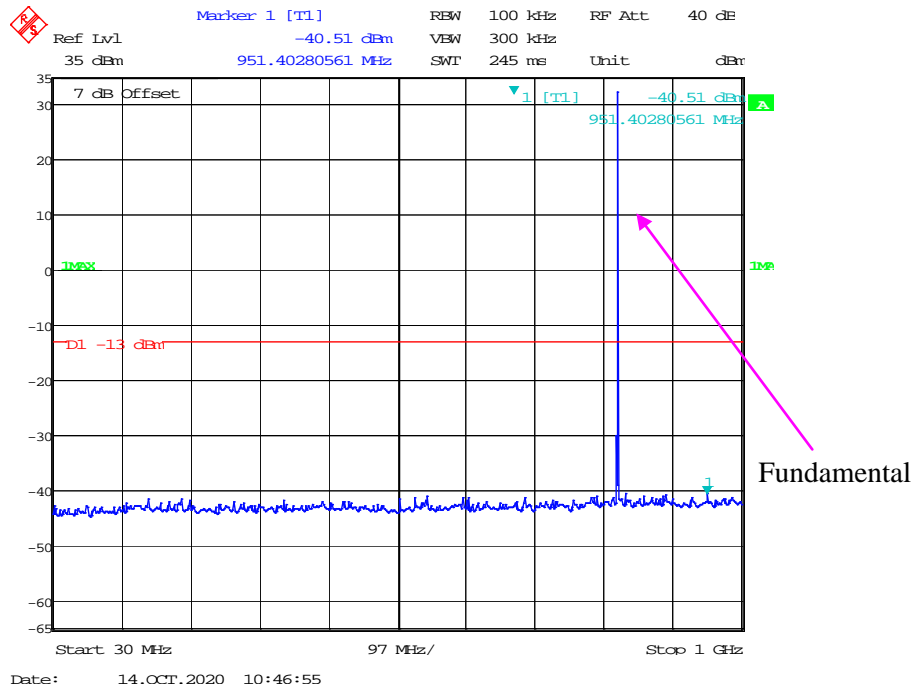
*The testing was performed by Jack Jiao from 2020-10-14 to 2020-11-24.*

*EUT operation mode: Transmitting*

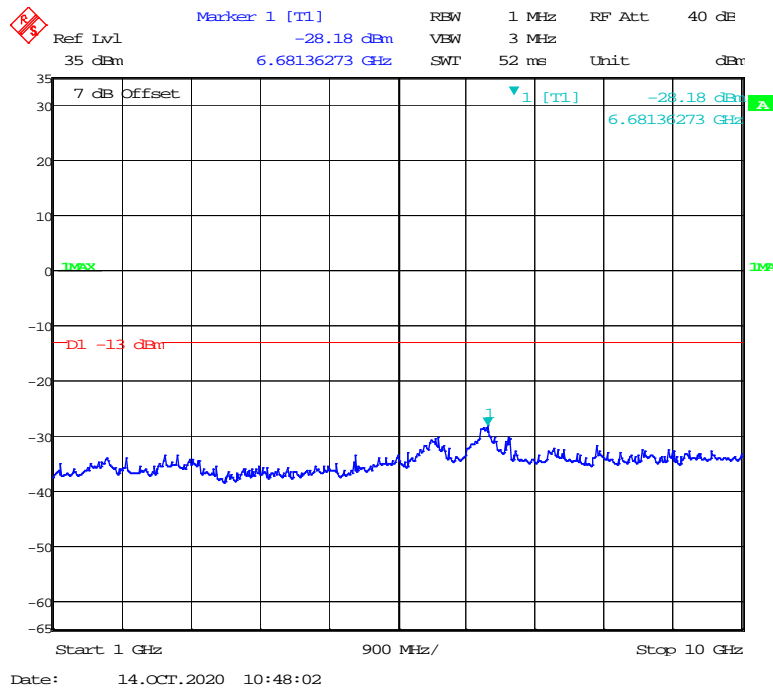
*Test Result: Compliant.*

**GSM 850 Band:**

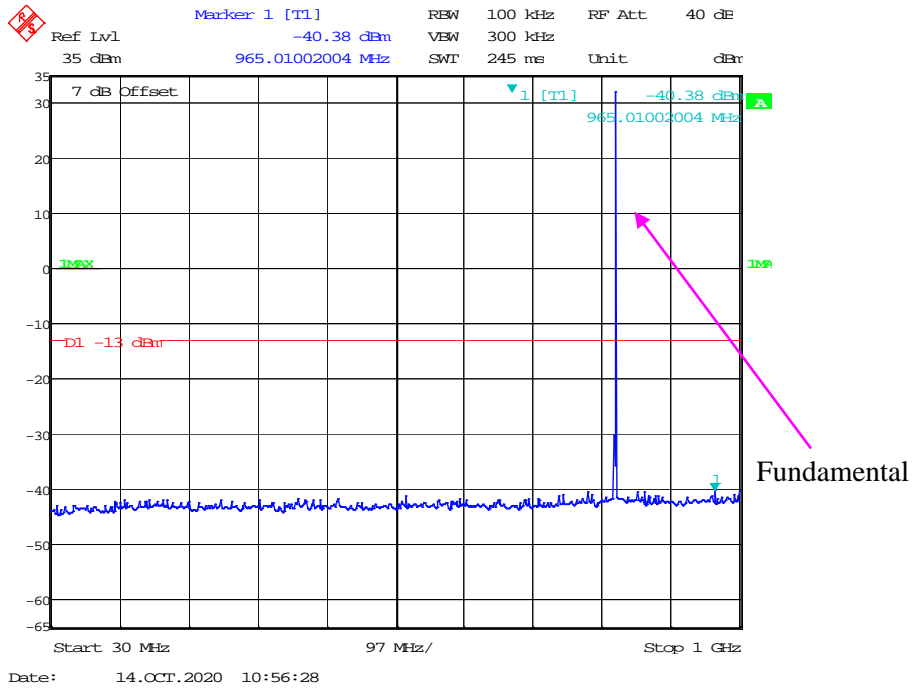
**30 MHz – 1GHz(GSM Mode), Low channel**



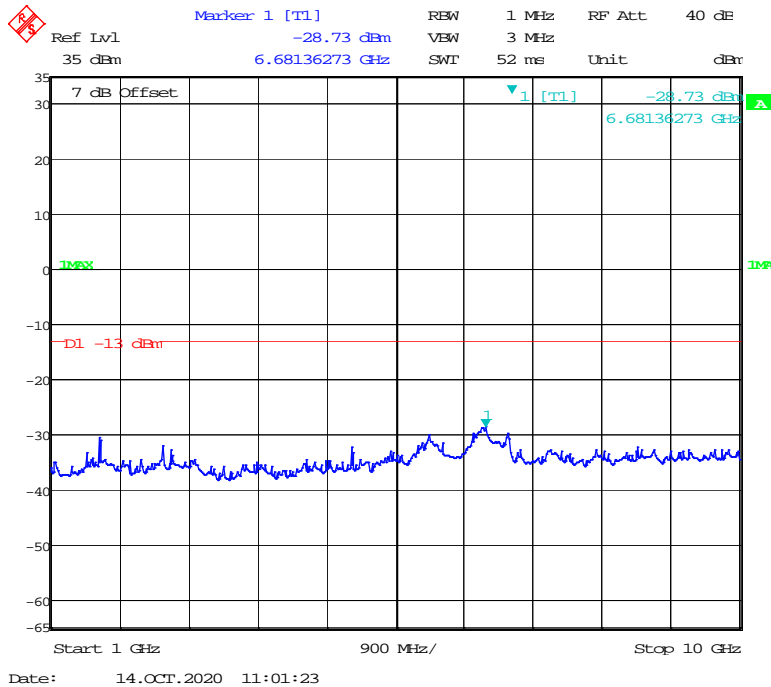
**1 GHz – 10 GHz (GSM Mode), Low channel**



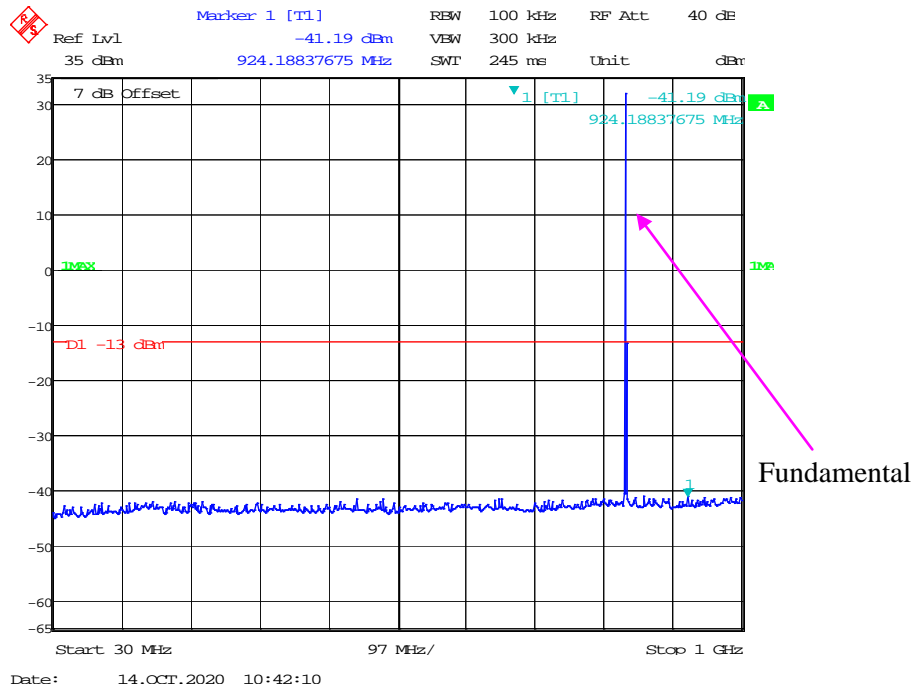
**30 MHz – 1GHz(GPRS Mode) ), Low channel**



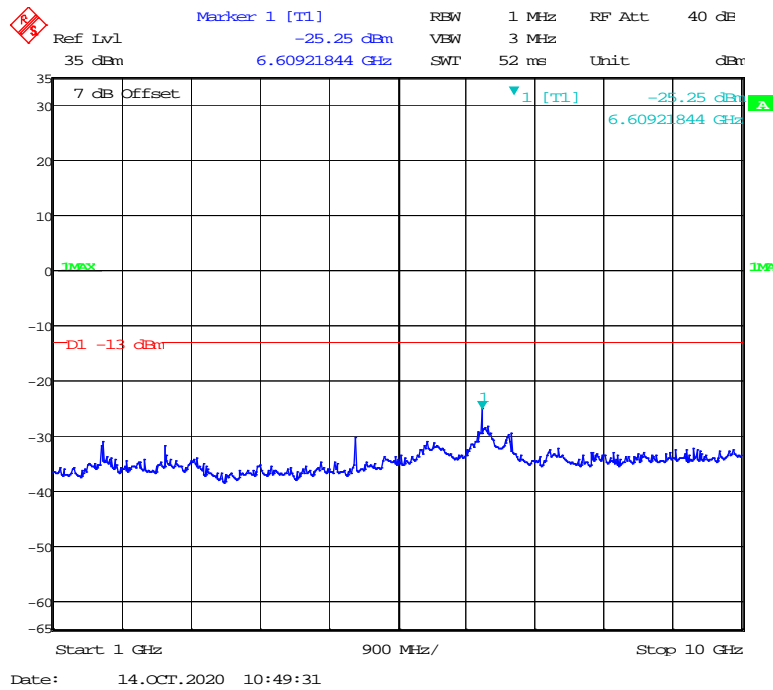
**1 GHz – 10 GHz (GPRS Mode) ), Low channel**



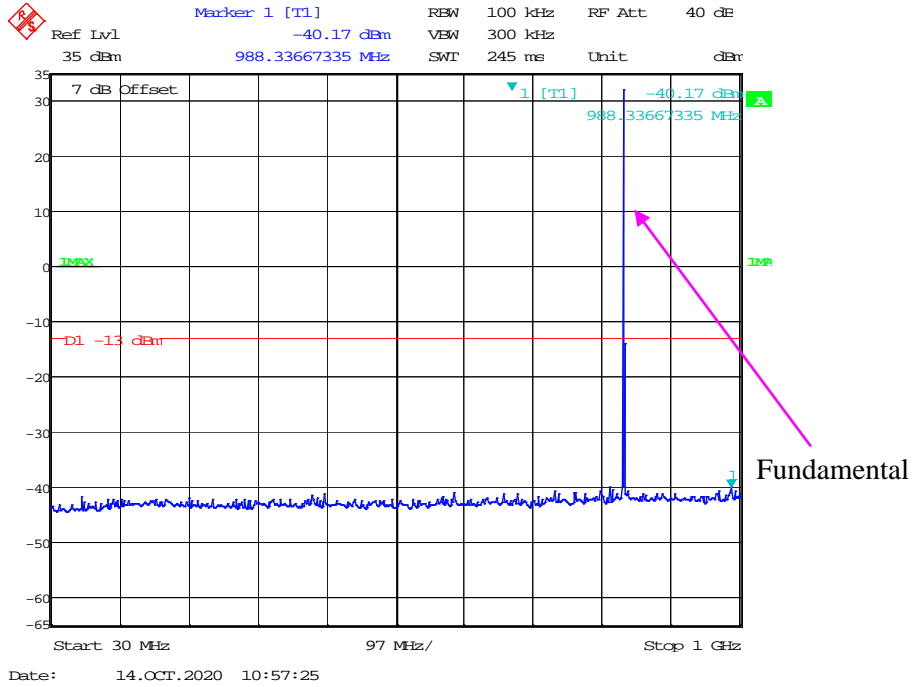
### 30 MHz – 1GHz(GSM Mode) , Middle channel



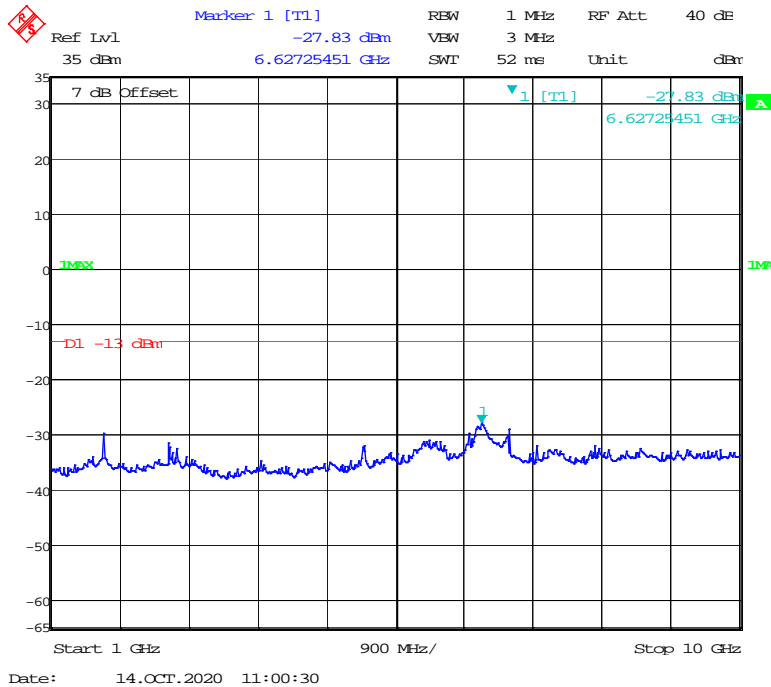
### 1 GHz – 10 GHz (GSM Mode) , Middle channel



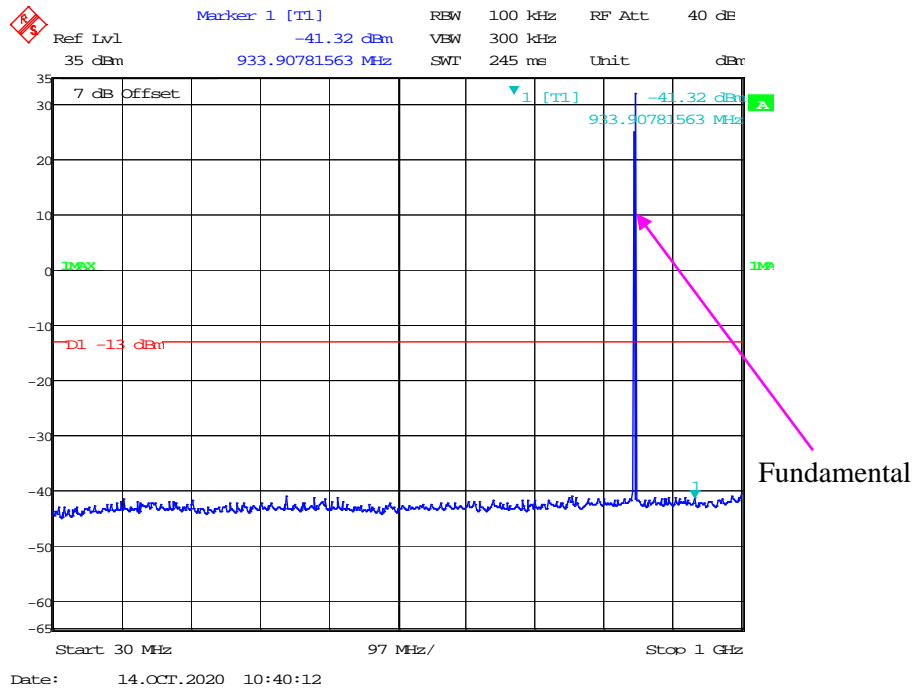
### 30 MHz – 1GHz(GPRS Mode) , Middle channel



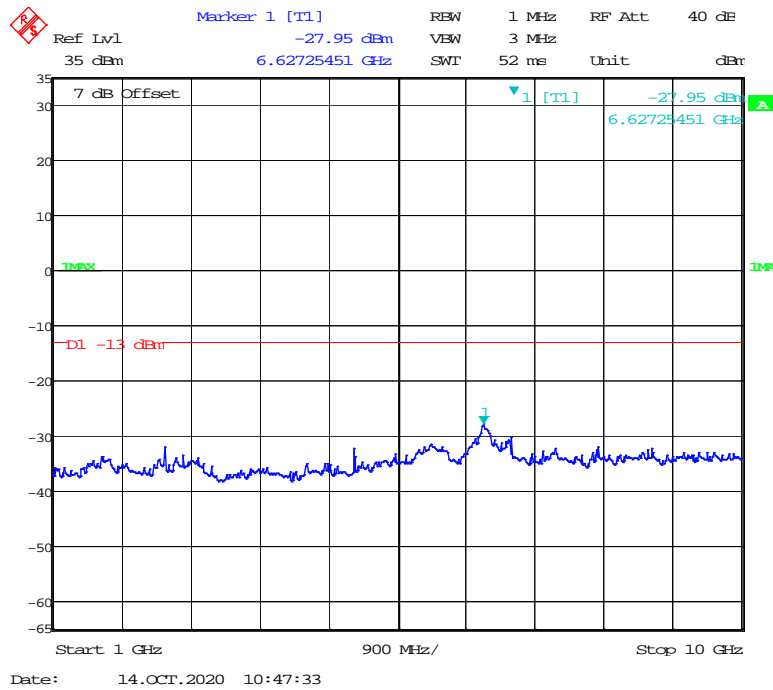
### 1 GHz – 10 GHz (GPRS Mode), Middle channel



### 30 MHz – 1GHz(GSM Mode), High channel

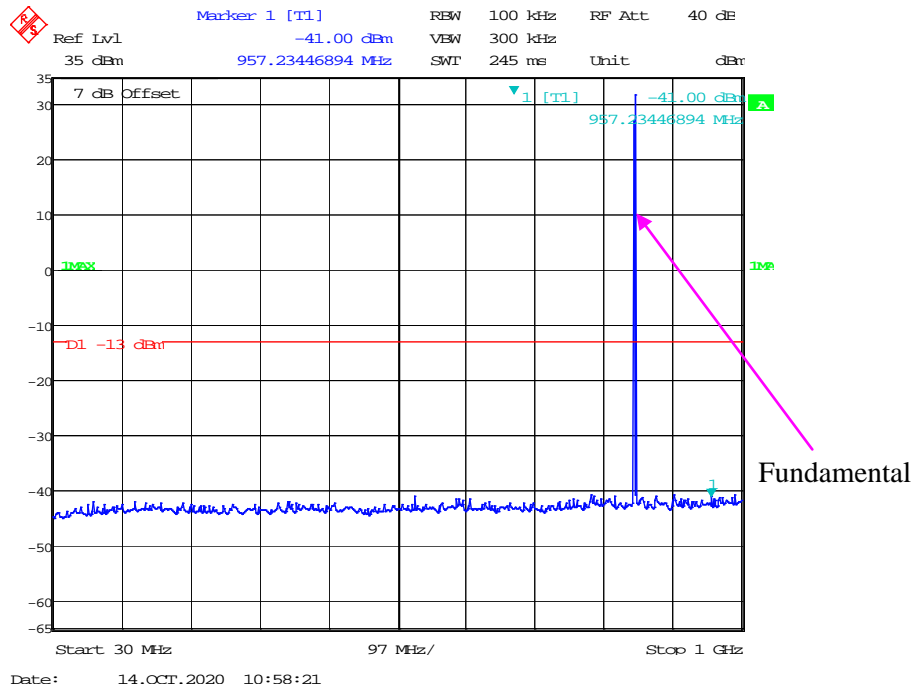


### 1 GHz – 10 GHz (GSM Mode), High channel

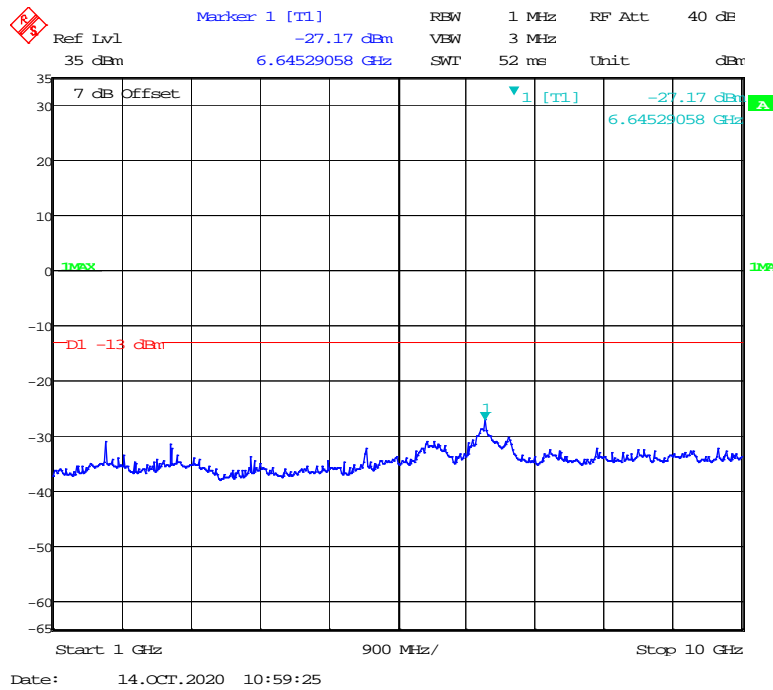




### 30 MHz – 1GHz(GPRS Mode), High channel

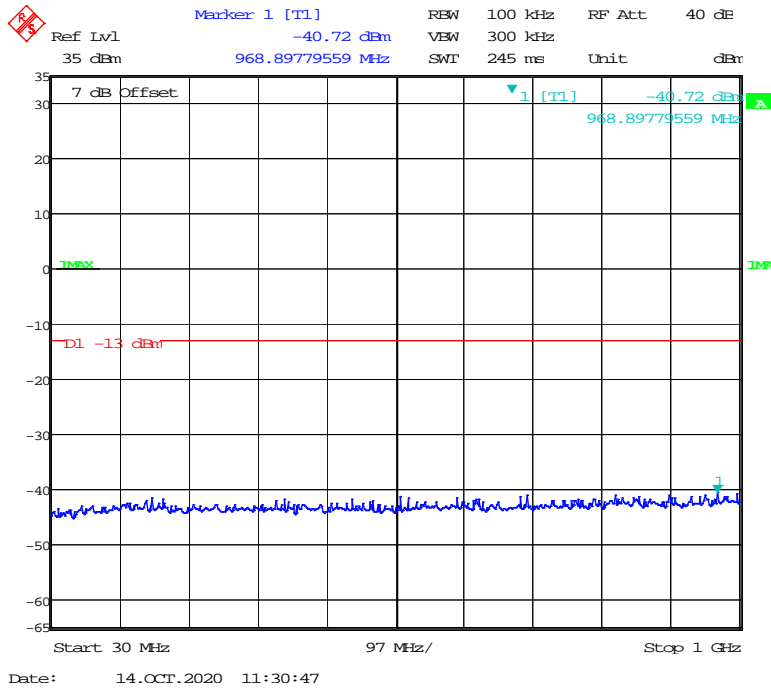


### 1 GHz – 10 GHz (GPRS Mode), High channel

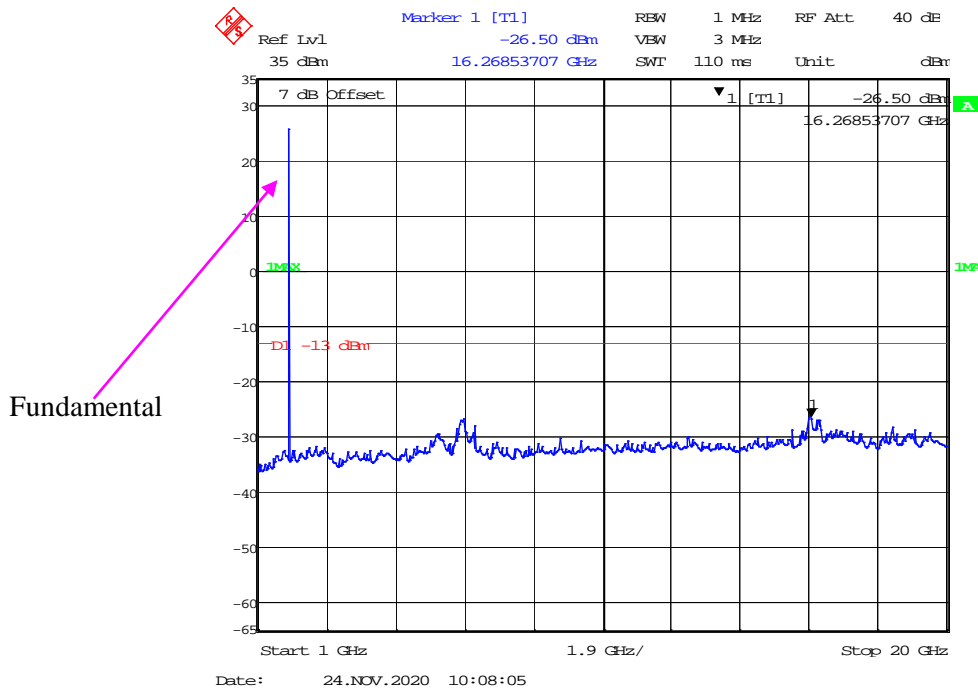


PCS 1900 Band:

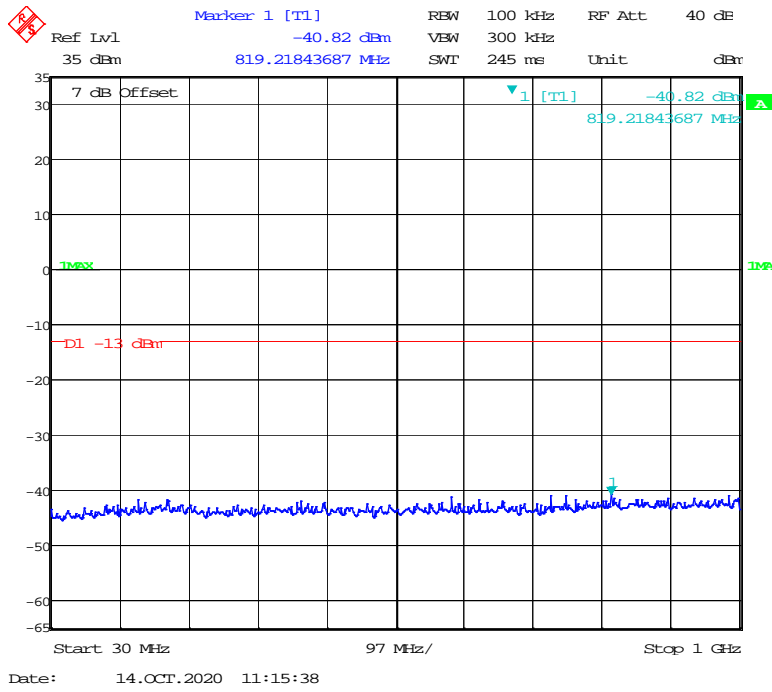
30 MHz – 1GHz(GSM Mode) , Low channel



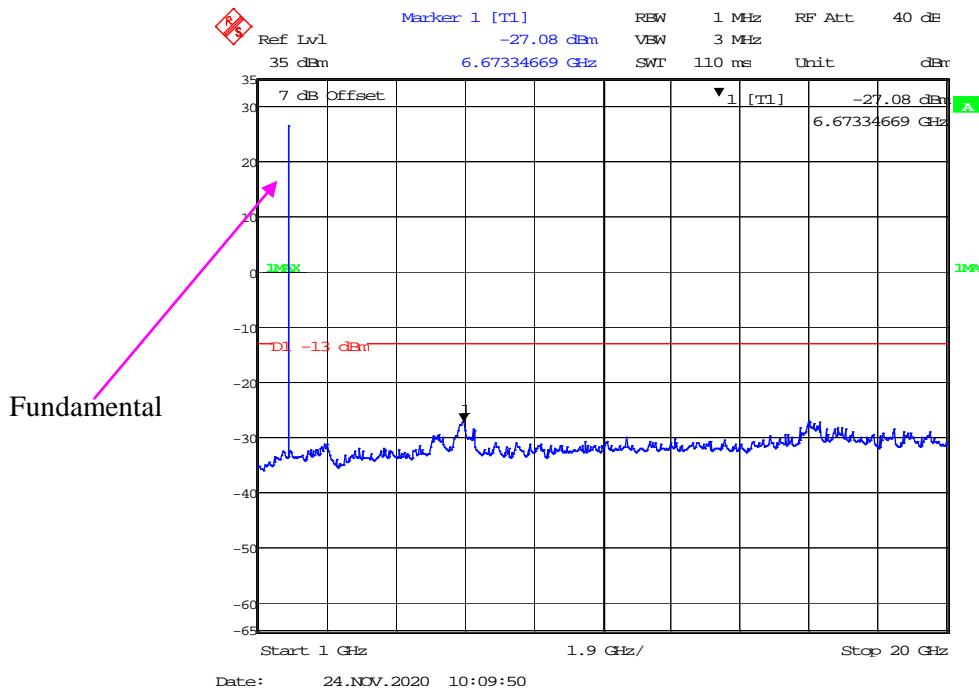
1 GHz – 20 GHz (GSM Mode) , Low channel



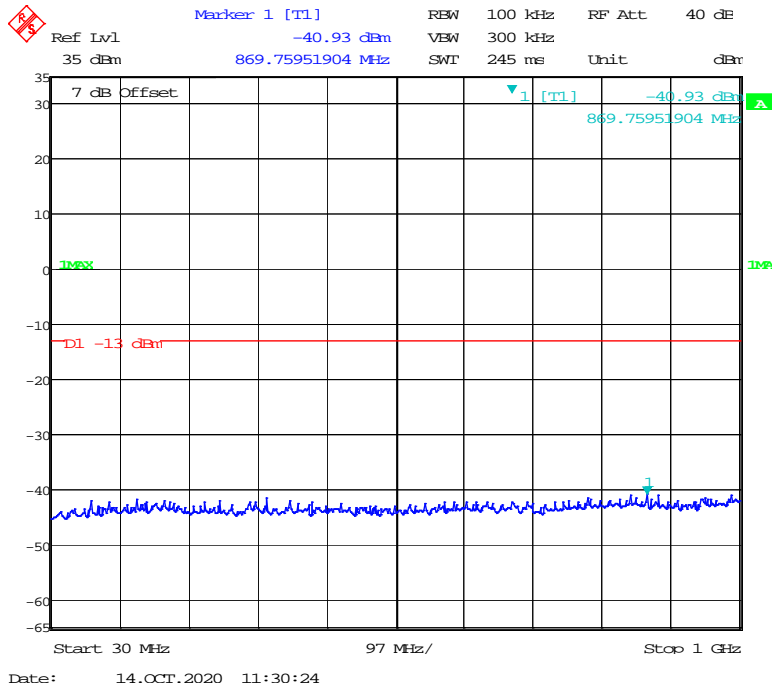
**30 MHz – 1GHz(GPRS Mode) , Low channel**



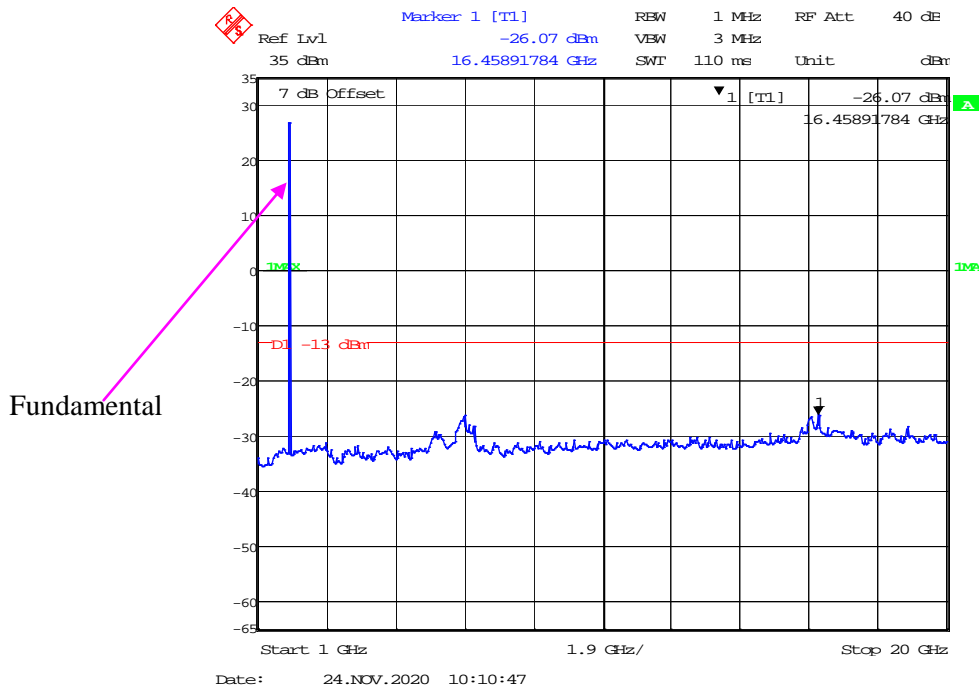
**1 GHz – 20 GHz (GPRS Mode) , Low channel**



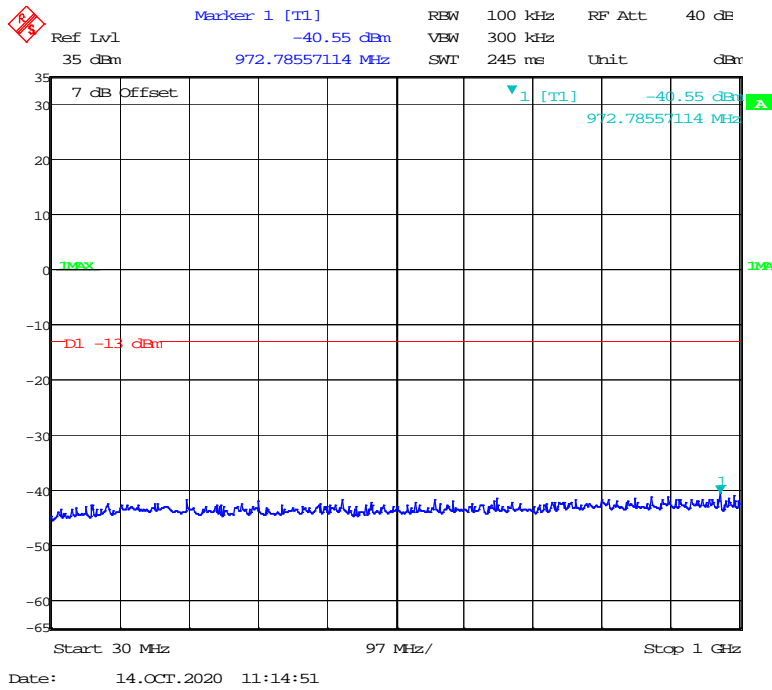
### 30 MHz – 1GHz(GSM Mode) , Middle channel



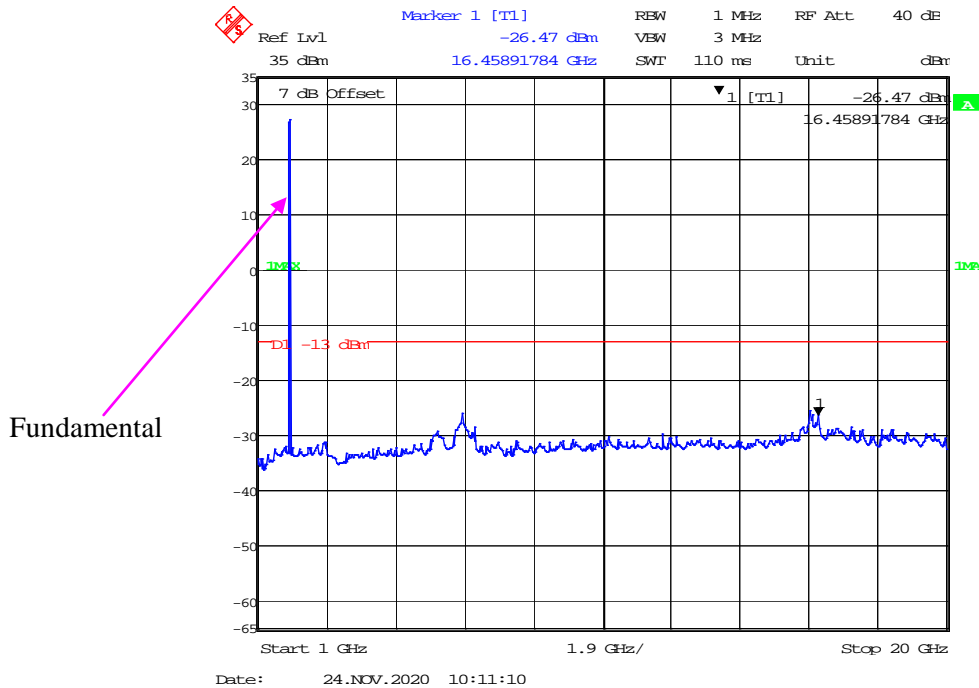
### 1 GHz – 20 GHz (GSM Mode) , Middle channel



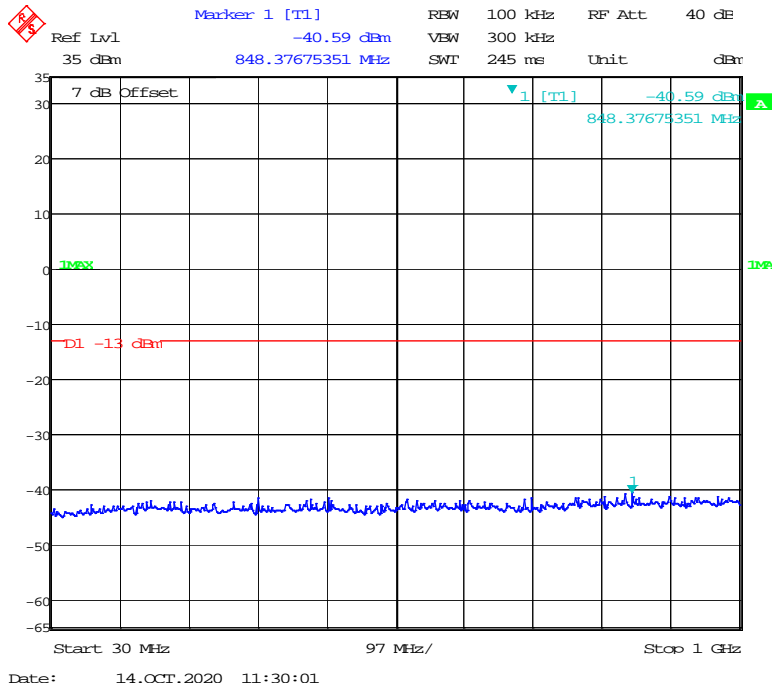
**30 MHz – 1GHz(GPRS Mode) , Middle channel**



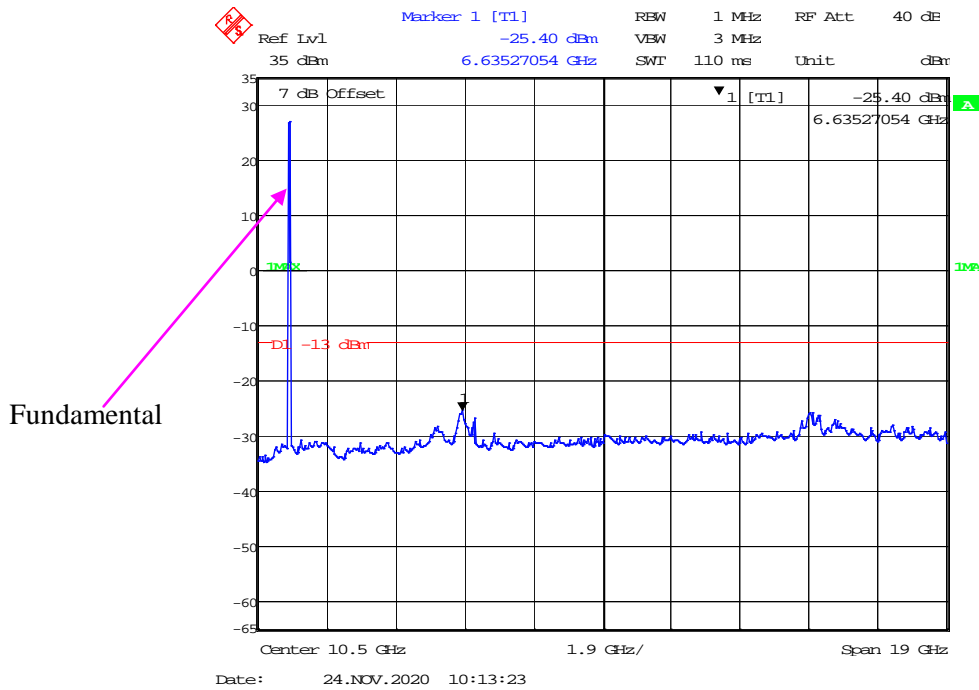
**1 GHz – 20 GHz (GPRS Mode) , Middle channel**



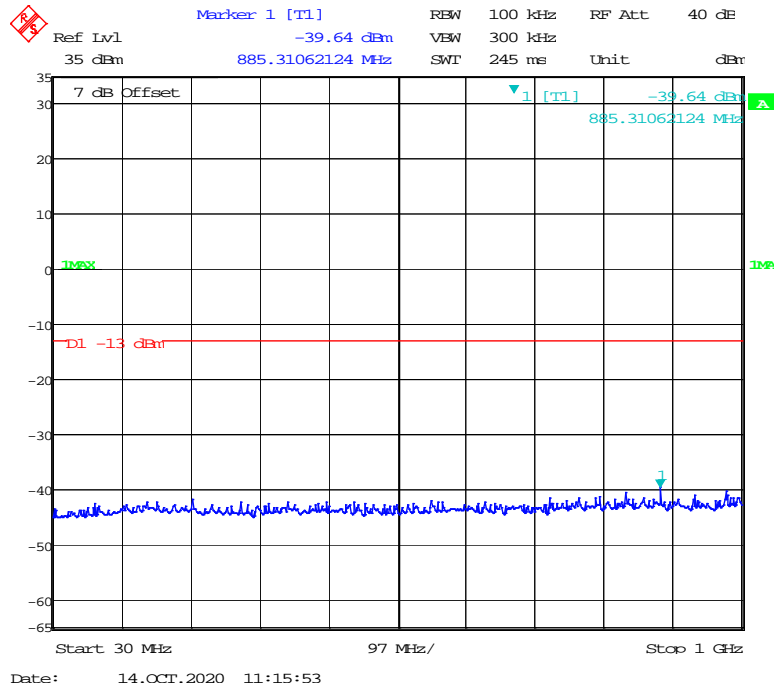
### 30 MHz – 1GHz(GSM Mode) , High channel



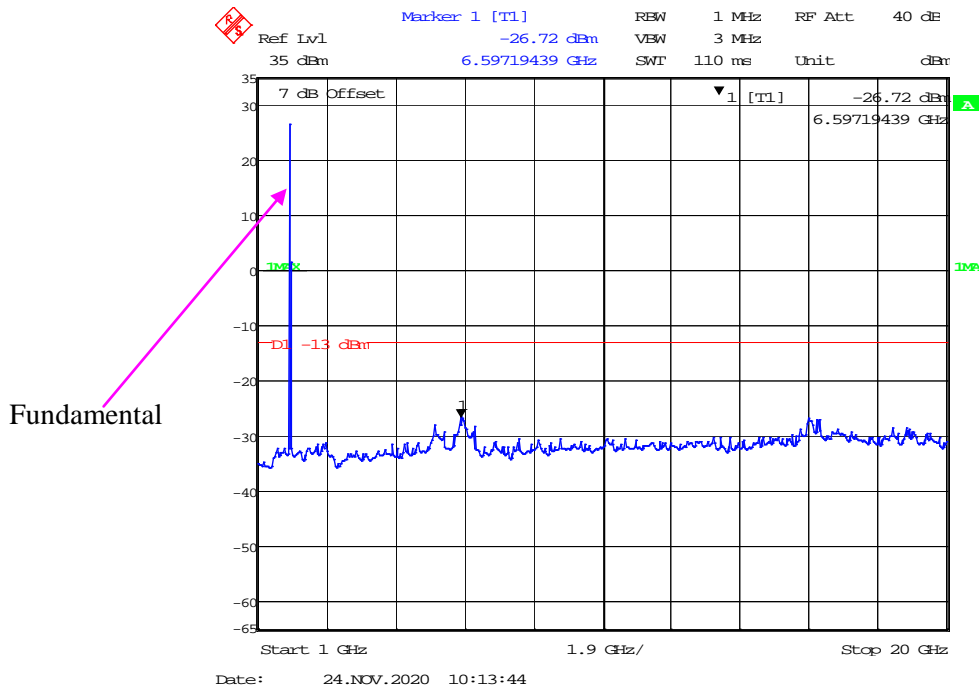
### 1 GHz – 20 GHz (GSM Mode) , High channel



### 30 MHz – 1GHz(GPRS Mode) , High channel



### 1 GHz – 20 GHz (GPRS Mode) , High channel



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

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### **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**

<b>Temperature:</b>	24.5 °C
<b>Relative Humidity:</b>	54 %
<b>ATM Pressure:</b>	101.1 kPa

The testing was performed by Jack Jiao on 2020-10-14.

Test mode: Transmitting

**For GSM Mode:  
30 MHz ~ 10 GHz:**

**GSM 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)			
GSM Mode, Low channel										
296.99	55.14	195	210	H	-51.73	0.46	-2.16	-54.35	-13	41.35
296.99	55.04	56	158	V	-51.83	0.46	-2.16	-54.45	-13	41.45
1648.40	50.37	78	125	H	-62.98	0.84	8.44	-55.38	-13	42.38
1648.40	50.37	96	139	V	-62.98	0.84	8.44	-55.38	-13	42.38
GSM Mode, Middle channel										
296.99	55.36	353	100	H	-51.51	0.46	-2.16	-54.13	-13	41.13
296.99	55.65	357	150	V	-51.22	0.46	-2.16	-53.84	-13	40.84
1673.20	50.22	235	150	H	-63.17	0.84	8.48	-55.53	-13	42.53
1673.20	50.19	170	150	V	-63.2	0.84	8.48	-55.56	-13	42.56
GSM Mode, High channel										
296.99	55.77	195	210	H	-51.1	0.46	-2.16	-53.72	-13	40.72
296.99	55.51	56	158	V	-51.36	0.46	-2.16	-53.98	-13	40.98
1697.60	50.27	78	125	H	-62.74	0.84	8.52	-55.06	-13	42.06
1697.60	49.53	96	139	V	-63.48	0.84	8.52	-55.80	-13	42.80

30 MHz ~ 20 GHz:

## PCS 1900 Band

Frequency (MHz)	Receiver Reading (dB $\mu$ V)	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)			
GSM Mode, Low channel										
296.99	55.14	55	145	H	-51.73	0.46	-2.16	-54.35	-13	41.35
296.99	55.39	302	156	V	-51.48	0.46	-2.16	-54.10	-13	41.10
3700.40	42.31	225	189	H	-64.66	0.95	9.78	-55.83	-13	42.83
3700.40	42.65	110	200	V	-64.32	0.95	9.78	-55.49	-13	42.49
GSM Mode, Middle channel										
296.99	55.04	357	100	H	-51.83	0.46	-2.16	-54.45	-13	41.45
296.99	55.87	160	100	V	-51	0.46	-2.16	-53.62	-13	40.62
3760.00	42.34	340	200	H	-64.44	0.95	9.74	-55.65	-13	42.65
3760.00	42.28	173	200	V	-64.5	0.95	9.74	-55.71	-13	42.71
GSM Mode, High channel										
296.99	55.4	55	145	H	-51.47	0.46	-2.16	-54.09	-13	41.09
296.99	55.61	302	156	V	-51.26	0.46	-2.16	-53.88	-13	40.88
3819.60	41.95	225	189	H	-64.64	0.96	9.71	-55.89	-13	42.89
3819.60	42.19	110	200	V	-64.4	0.96	9.71	-55.65	-13	42.65

**For GPRS Mode:**  
**30 MHz ~ 10 GHz:**

**GSM 850 Band**

Frequency (MHz)	Receiver Reading (dB $\mu$ V)	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, Low channel										
296.99	55.67	195	210	H	-51.2	0.46	-2.16	-53.82	-13	40.82
296.99	55.82	56	158	V	-51.05	0.46	-2.16	-53.67	-13	40.67
1648.40	49.89	78	125	H	-63.46	0.84	8.44	-55.86	-13	42.86
1648.40	50.06	96	139	V	-63.29	0.84	8.44	-55.69	-13	42.69
GPRS Mode, Middle channel										
296.99	55.19	211	100	H	-51.68	0.46	-2.16	-54.30	-13	41.30
296.99	55.16	110	150	V	-51.71	0.46	-2.16	-54.33	-13	41.33
1673.20	50.26	158	150	H	-63.13	0.84	8.48	-55.49	-13	42.49
1673.20	50.18	231	150	V	-63.21	0.84	8.48	-55.57	-13	42.57
GPRS Mode, High channel										
296.99	55.10	195	210	H	-51.77	0.46	-2.16	-54.39	-13	41.39
296.99	56.07	56	158	V	-50.8	0.46	-2.16	-53.42	-13	40.42
1697.60	49.28	78	125	H	-62.94	0.84	8.52	-55.26	-13	42.26
1697.60	50.04	96	139	V	-63.37	0.84	8.52	-55.69	-13	42.69

**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, Low channel										
296.99	55.78	55	145	H	-51.09	0.46	-2.16	-53.71	-13	40.71
296.99	56.14	302	156	V	-50.73	0.46	-2.16	-53.35	-13	40.35
3700.40	42.53	225	189	H	-64.12	0.95	9.78	-55.29	-13	42.29
3700.40	42.57	110	200	V	-64.61	0.95	9.78	-55.78	-13	42.78
GPRS Mode, Middle channel										
296.99	55.90	335	100	H	-50.97	0.46	-2.16	-53.59	-13	40.59
296.99	55.71	53	100	V	-51.16	0.46	-2.16	-53.78	-13	40.78
3760.00	42.70	39	200	H	-64.08	0.95	9.74	-55.29	-13	42.29
3760.00	42.73	147	200	V	-64.05	0.95	9.74	-55.26	-13	42.26
GPRS Mode, High channel										
296.99	55.65	55	145	H	-51.22	0.46	-2.16	-53.84	-13	40.84
296.99	55.76	302	156	V	-51.11	0.46	-2.16	-53.73	-13	40.73
3819.60	42.84	225	189	H	-64.6	0.96	9.71	-55.85	-13	42.85
3819.60	42.40	110	200	V	-64.65	0.96	9.71	-55.90	-13	42.90

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

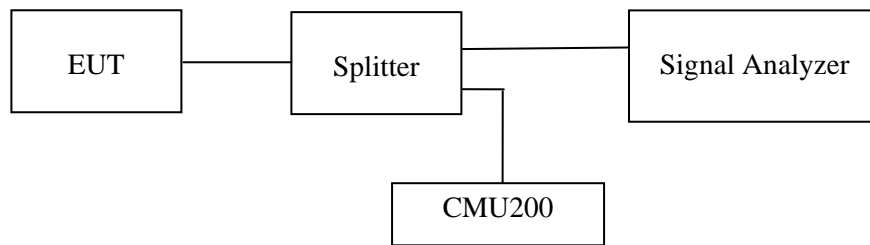
**Applicable Standards**

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**

<b>Temperature:</b>	24.5 °C
<b>Relative Humidity:</b>	54 %
<b>ATM Pressure:</b>	101.1 kPa

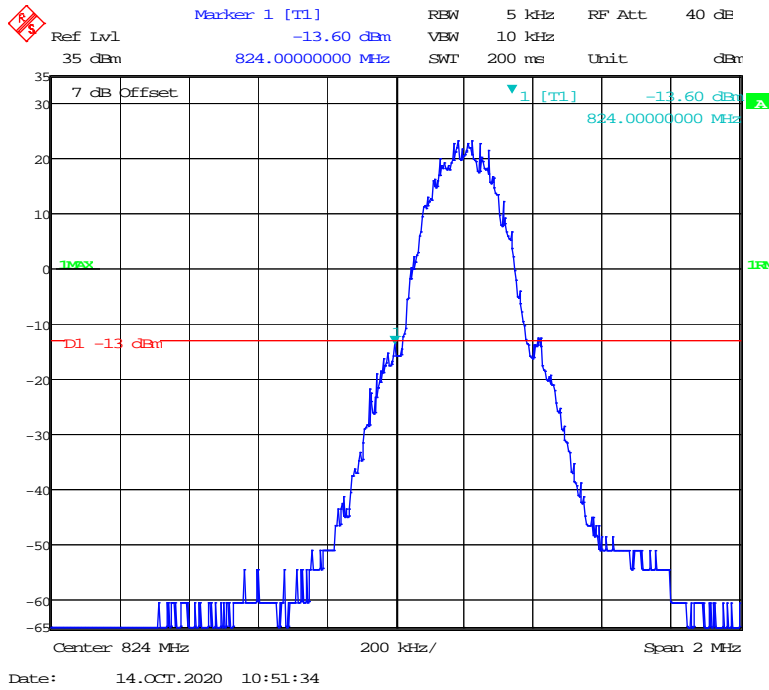
*The testing was performed by Jack Jiao on 2020-10-14.*

*EUT operation mode: Transmitting*

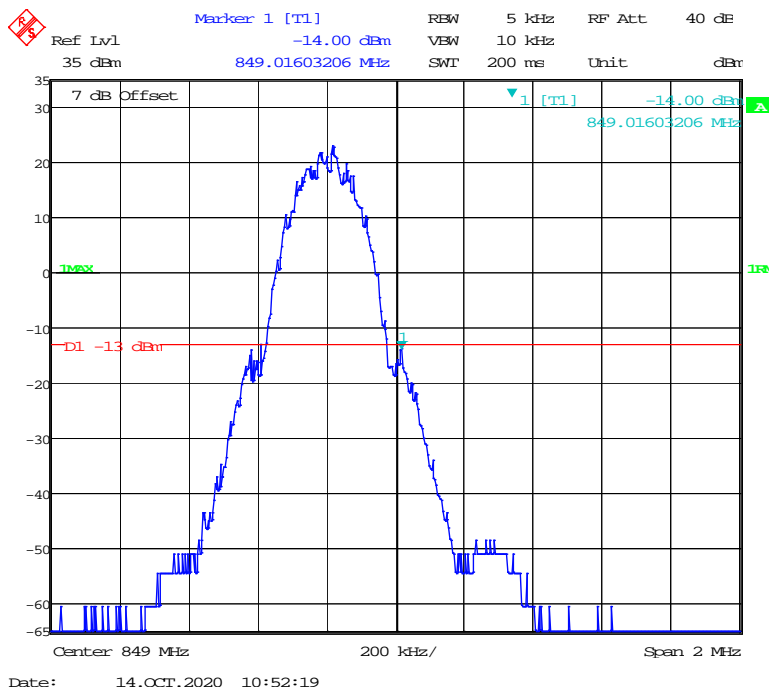
Test Result: Compliant.

**GSM 850 Band:**

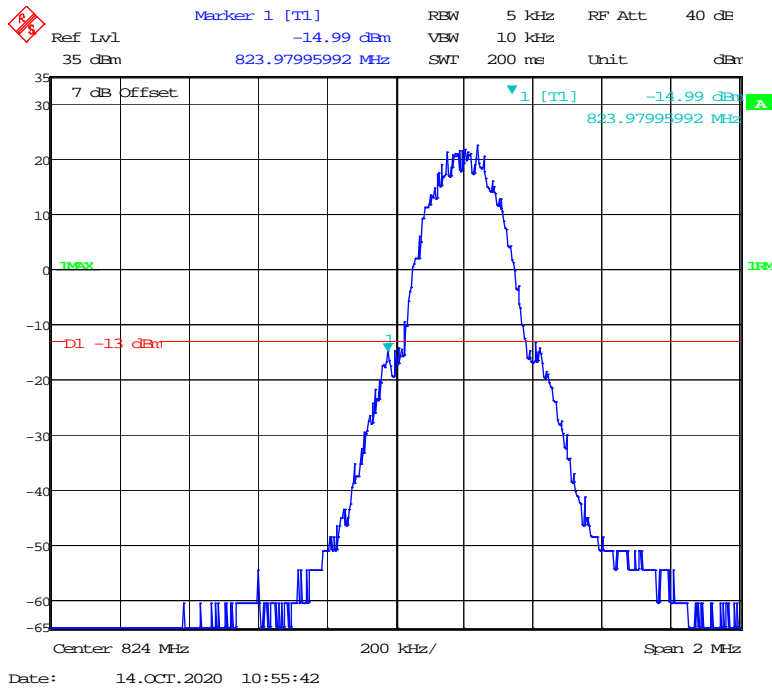
**GSM Mode, Left Band Edge**



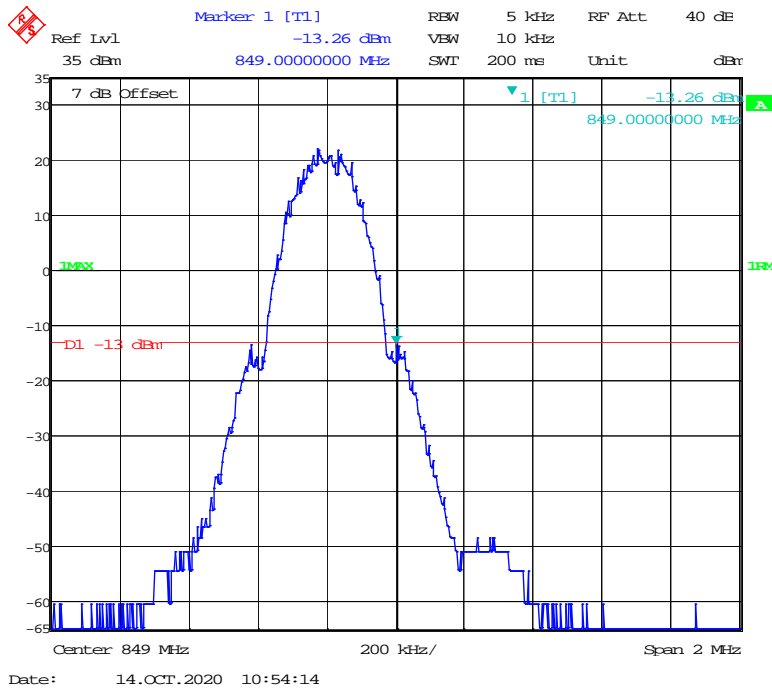
**GSM Mode, Right Band Edge**



### GPRS Mode, Left Band Edge

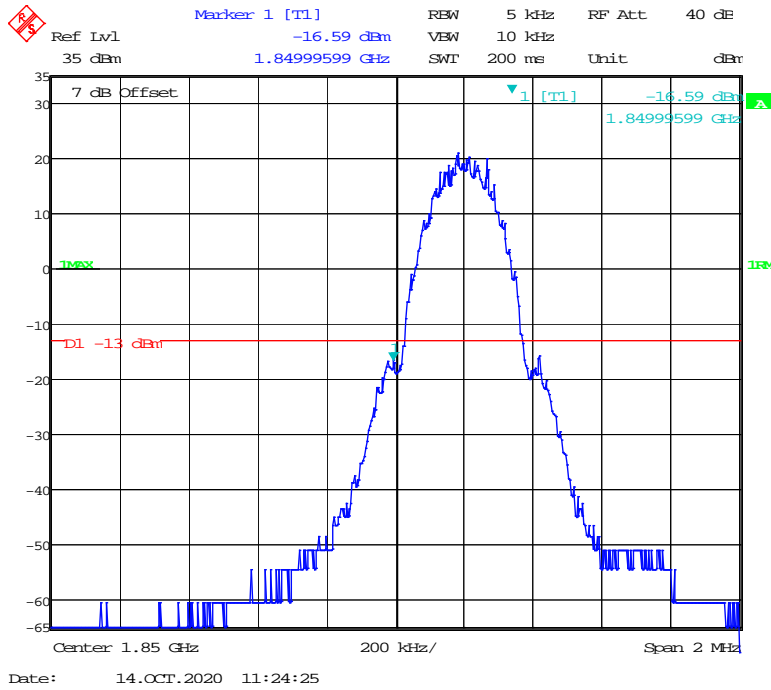


### GPRS Mode, Right Band Edge

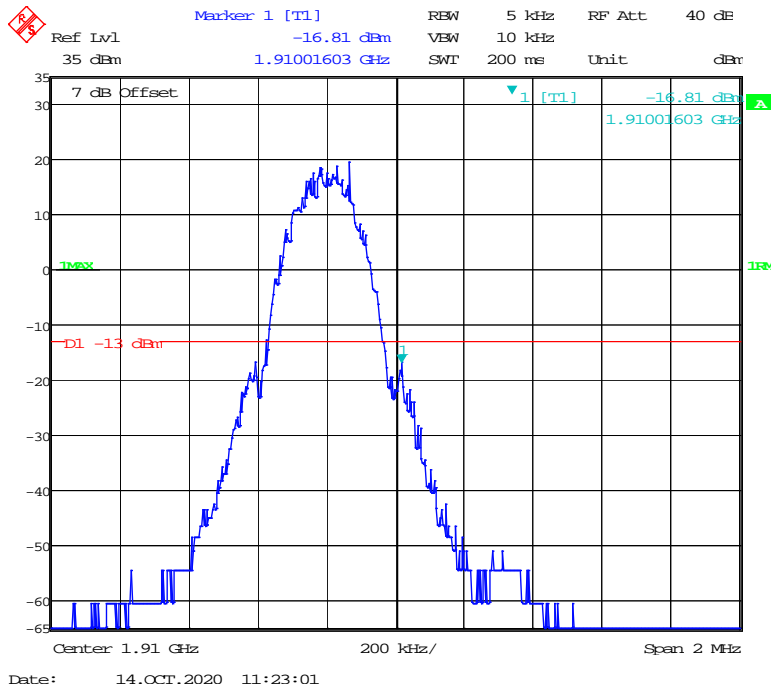


PCS 1900 Band:

GSM Mode, Left Band Edge

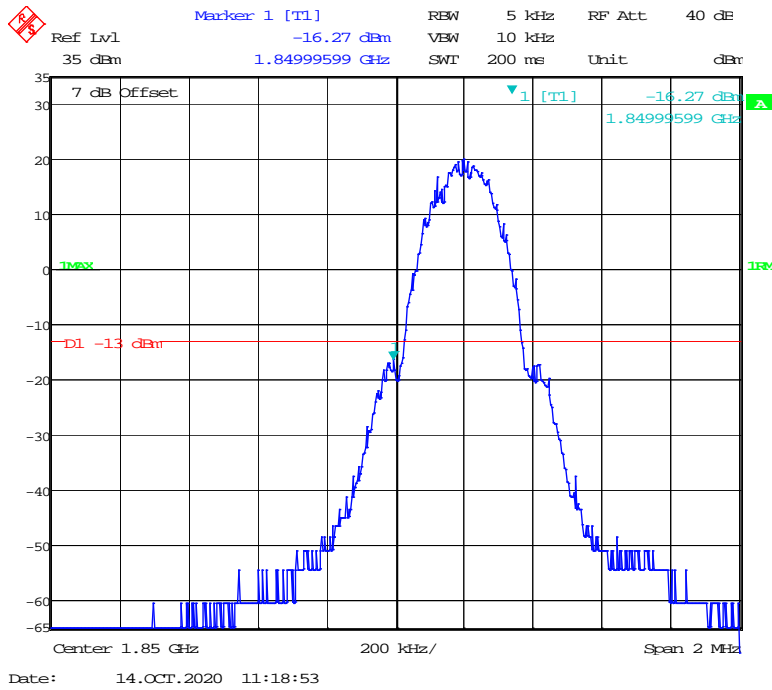


GSM Mode, Right Band Edge

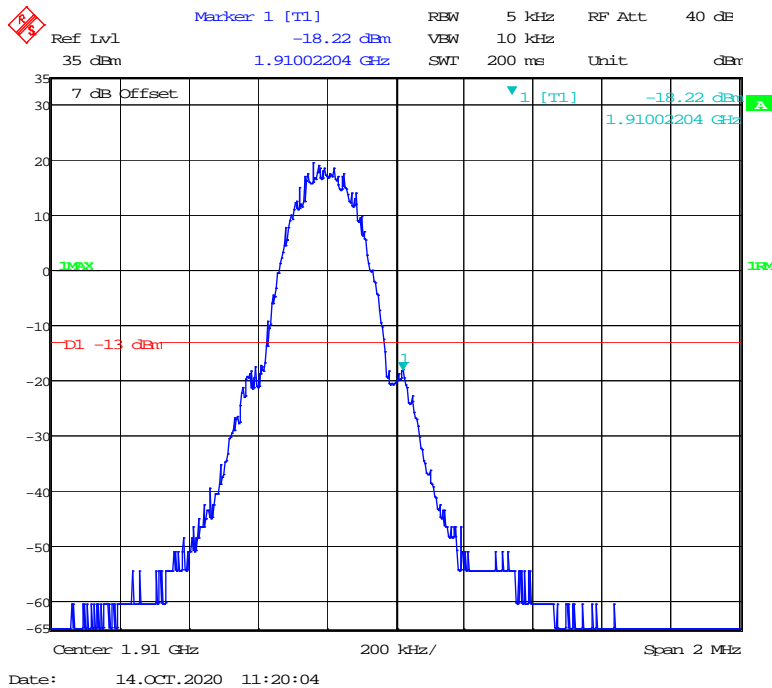




### GPRS Mode, Left Band Edge



### GPRS 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

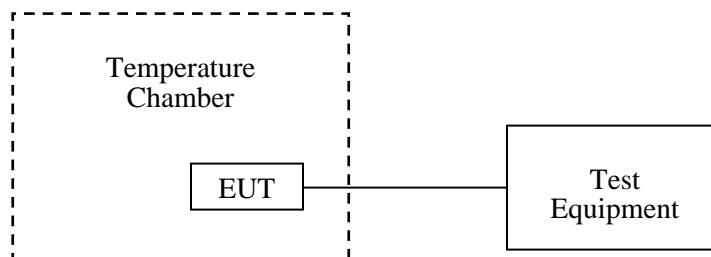
According to §24.235, the frequency stability shall be sufficient to ensure that the fundamental emissions stays within the authorized frequency block.

**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>	24.5 °C
<b>Relative Humidity:</b>	54 %
<b>ATM Pressure:</b>	101.1 kPa

The testing was performed by Jack Jiao on 2020-10-14.

EUT operation mode: Transmitting

Test Result: Compliant.

**DC 12V from DC Source:****GSM 850 Band (Worst case):**

GSM Mode, Middle Channel, $f_o = 836.6$ MHz				
Temperature (°C)	Power Supplied (V <sub>DC</sub> )	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)
-30	12	6	0.007172	2.5
-20		11	0.013148	2.5
-10		15	0.017930	2.5
0		15	0.017930	2.5
10		13	0.015539	2.5
20		12	0.014344	2.5
30		16	0.019125	2.5
40		10	0.011953	2.5
50		13	0.015539	2.5
20		V min.= 9	11	0.013148
20	V max.= 90	7	0.008367	2.5

**PCS 1900 Band (Worst case)**

<b>GSM Mode, Middle Channel, <math>f_0 = 1880.0</math> 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	12	14	0.007447	pass
-20		13	0.006915	pass
-10		16	0.008511	pass
0		19	0.010106	pass
10		11	0.005851	pass
20		16	0.008511	pass
30		12	0.006383	pass
40		13	0.006915	pass
50		14	0.007447	pass
20		V min.= 9	7	0.003723
20	V max.= 90	9	0.004787	pass

**DC 3.7V from Battery:****GSM 850 Band (Worst case):**

<b>GSM Mode, Middle Channel, <math>f_0 = 836.6</math> 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>Limit (ppm)</b>
-30	3.7	13	0.015539	2.5
-20		8	0.009563	2.5
-10		18	0.021516	2.5
0		20	0.023906	2.5
10		15	0.017930	2.5
20		18	0.021516	2.5
30		12	0.014344	2.5
40		17	0.020320	2.5
50		11	0.013148	2.5
20		V min.= 3.33	14	0.016734
20	V max.= 4.07	15	0.017930	2.5

**PCS 1900 Band (Worst case)**

<b>GSM Mode, Middle Channel, <math>f_0 = 1880.0</math> 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	11	0.005851	pass
-20		20	0.010638	pass
-10		20	0.010638	pass
0		19	0.010106	pass
10		18	0.009574	pass
20		16	0.008511	pass
30		14	0.007447	pass
40		21	0.011170	pass
50		16	0.008511	pass
20		V min.= 3.33	17	0.009043
20	V max.= 4.07	12	0.006383	pass

## Declarations

1: BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with an asterisk '\*'. Customer model name, addresses, names, trademarks etc. are not considered data.

2: Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

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

4: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor  $K$  with the 95% confidence interval.

5: This report cannot be reproduced except in full, without prior written approval of the Company.

6: This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

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