



# FCC PART 22H, PART 24E

## MEASUREMENT AND TEST REPORT

For

**Vilant Systems Oy**

Tietajantie 2, 02130 ESPOO, FINLAND

**FCC ID: SEY-EA920**

<b>Report Type:</b> Original Report	<b>Product Type:</b> GSM-Tracker
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<b>Report Number:</b> <u>R1DG120807002-00A</u>	
<b>Report Date:</b> <u>2012-08-23</u>	
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Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Dongguan).

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## GENERAL INFORMATION

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

The *Vilant Systems Oy*'s product, model number: *Vilant Tracker (FCC ID: SEY-EA920)* (the "EUT") in this report was a GSM-Tracker, which was measured approximately: 8.6cm (L) x 6.1cm (W) x 0.8cm (H), rated input voltage: DC 3.7V from Lithium battery.

Frequency Range:

GSM850:824-849MHz (TX); 869-894MHz (RX)  
PCS1900:1850-1910MHz (TX); 1930-1990 (RX)

*\* All measurement and test data in this report was gathered from production sample serial number: 120807002 (Assigned by BACL, Dongguan). The EUT was received on 2012-08-07.*

### Objective

This report is prepared on behalf of *Vilant Systems Oy* in accordance with Part 2-Subpart J, Part 22-Subpart H, and Part 24-Subpart E of the Federal Communication Commissions rules.

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

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

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: TIA/EIA 603-D-2010, ANSI C63.4-2003.

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

The uncertainty of any RF tests which use conducted method measurement is  $\pm 2.4$  dB, the uncertainty of any radiation on emissions measurement is  $\pm 4.0$  dB

## 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 Industrial Zone, Tangxia, Dongguan, Guangdong, China

Test site at Bay Area Compliance Laboratories Corp. (Dongguan) has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 02, 2012. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

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

## SYSTEM TEST CONFIGURATION

### Justification

The EUT was configured for testing according to TIA/EIA-603-D-2010.

The GSM/PCS item test was performed with the EUT operating at testing mode.

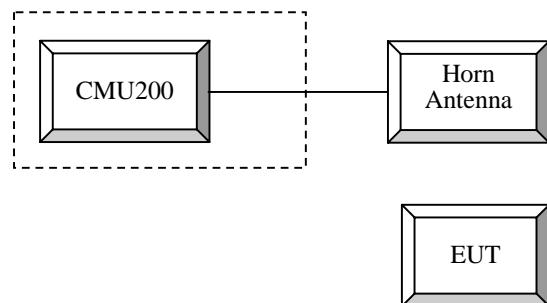
### Equipment Modifications

No modification was made to the EUT.

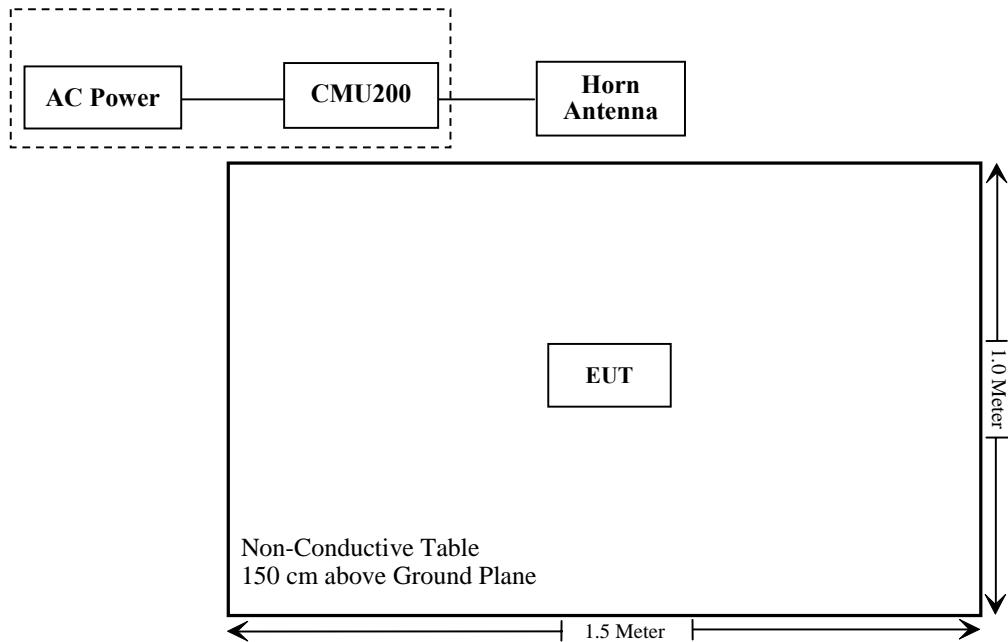
### Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
R & S	Universal Radio Communication Tester	CMU200	109038

### Configuration of Test Setup



### Block Diagram of Test Setup



## SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§1.1310, §2.1091	Maximum Permissible Exposure	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)	Field Strength of Spurious Radiation	Compliance
§ 22.917 (a); § 24.238 (a)	Out of band emission, Band Edge	Compliance
§ 2.1055 § 22.355; § 24.235	Frequency stability vs. temperature Frequency stability vs. voltage	Compliance

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

### Applicable Standard

According to subpart FCC §1.1310 and §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

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

### Test Data

Predication of MPE limit at a given distance

$$S = PG/4\pi R^2$$

Where:

S = 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)

Mode	Frequency (MHz)	Antenna Gain		Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )
		(dBi)	(numeric)	(dBm)	(mW)			
Cellular Band	836.6	-1.00	0.79	31.78	1506.61	20	0.2382	0.56
PCS Band	1909.8	-1.00	0.79	29.08	809.10	20	0.1279	1.0

Result: The device meets FCC MPE limit at 20 cm distance.

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

According to FCC § 2.1047(d), Part 22H & 24E there is no specific requirement for digital modulation, therefore modulation characteristic is not presented.

## FCC § 2.1046, § 22.913 (a) & § 24.232 (c) - RF OUTPUT POWER

### Applicable Standard

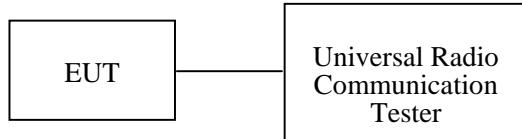
According to FCC §2.1046 and §22.913 (a), the ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 watts.

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

### Test Procedure

#### *Conducted method:*

The RF output of the transmitter was connected to Universal Radio Communication Tester through sufficient attenuation.



#### *Radiated method:*

ANSI/TIA 603-D section 2.2.17

### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Spectrum Analyzer	FSEM	1079 8500	2011-10-9	2012-10-8
R&S	EMI Test Receiver	ESCI	1166.5950.03	2011-10-8	2012-10-7
Sunol Sciences	Hybrid Antennas	JB3	A060611-3	2012-3-16	2013-3-15
Dayang	Horn Antenna	OMCDH10180	10279001A	2011-8-22	2013-8-21
EMCO	Adjustable Dipole Antenna System	3121C	9109-753	2012-4-24	2013-4-23
Dayang	Horn Antenna	OMCDH10180	10279001B	2011-7-30	2013-7-29
HP	Signal Generator	8648A	3426A00831	2011-10-9	2012-10-8
Giga	Signal Generator	1026	320408	2012-3-15	2013-3-14
Rohde & Schwarz	Universal Radio Communication Tester	CMU200	109038	2012-5-14	2013-5-13

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

<b>Temperature:</b>	25 °C
<b>Relative Humidity:</b>	56 %
<b>ATM Pressure:</b>	100.0kPa

*The testing was performed by Leon Chen on 2012-08-15.*

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

<b>Band</b>	<b>Channel No.</b>	<b>Test Result (dBm)</b>
Cellular	128	31.77
	190	31.78
	251	31.76
PCS	512	29.06
	661	28.97
	810	29.08

## ERP &amp; EIRP

## ERP for Cellular Band (Part 22H)

Frequency	Polar	S.A. Reading	S.G. Level	Antenna Gain	Cable Loss	Absolute Level	Limit
	H/V	dB $\mu$ V	dBm	dBd	dB	dBm	dBm
824.2	H	99.40	29.3	0.0	0.6	28.7	38.4
	V	98.01	30.7	0.0	0.6	30.1	38.4
836.6	H	97.71	25.9	0.0	0.6	25.3	38.4
	V	96.44	30.1	0.0	0.6	29.5	38.4
848.8	H	95.68	23.7	0.0	0.6	23.1	38.4
	V	94.35	29.1	0.0	0.6	28.5	38.4

## EIRP for PCS Band (Part 24E)

Frequency	Polar	S.A. Reading	S.G. Level	Antenna Gain	Cable Loss	Absolute Level	Limit
	H/V	dB $\mu$ V	dBm	dBi	dB	dBm	dBm
1850.2	H	85.27	15.7	8.0	0.9	22.9	33.0
	V	91.84	21.4	8.0	0.9	28.5	33.0
1880	H	82.73	13.7	8.0	0.9	20.9	33.0
	V	90.72	20.6	8.0	0.9	27.7	33.0
1909.8	H	84.93	15.8	8.4	0.9	23.3	33.0
	V	90.48	20.0	8.4	0.9	27.5	33.0

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

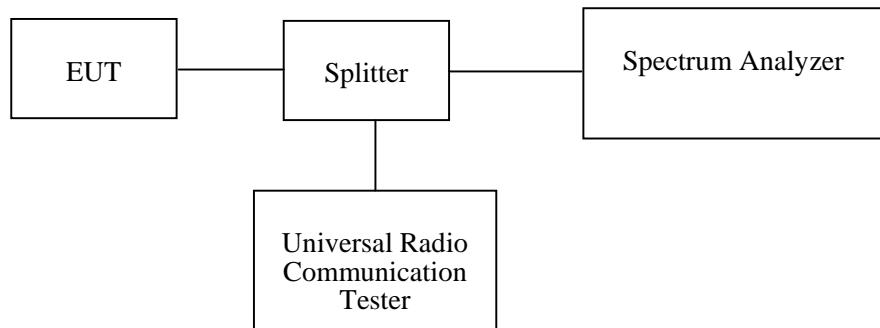
### **Applicable Standard**

FCC §2.1049, §22.917, §22.905 and §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 3 kHz (Cellular /PCS) and the 26 dB & 99% bandwidth was recorded.



### **Test Equipment List and Details**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Spectrum Analyzer	FSEM	1079 8500	2011-10-9	2012-10-8

### **Test Data**

#### **Environmental Conditions**

Temperature:	25 °C
Relative Humidity:	56%
ATM Pressure:	100.0kPa

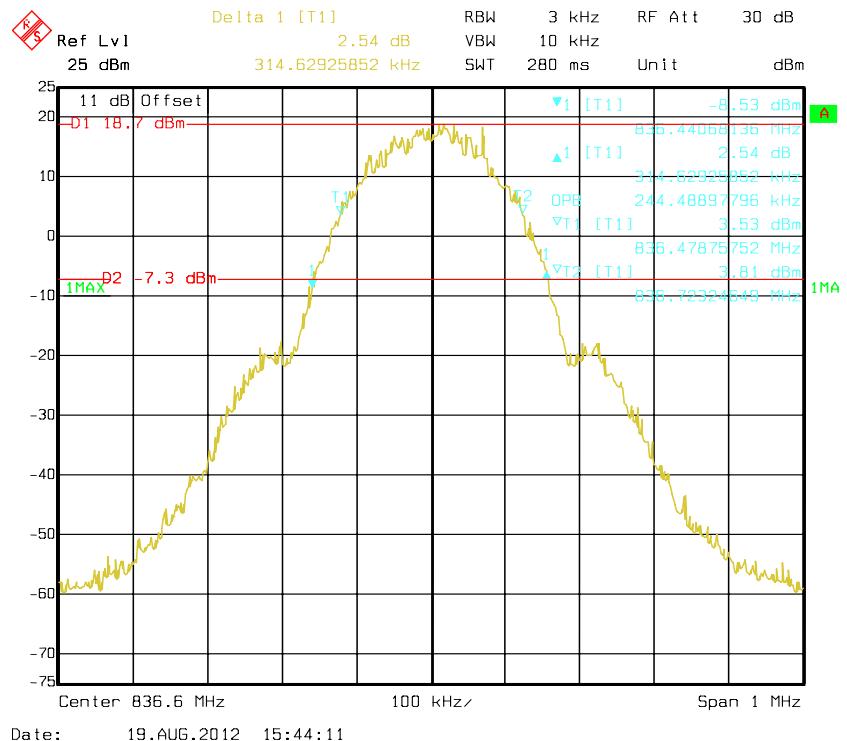
*The testing was performed by Leon Chen on 2012-08-19.*

## Cellular Band (Part 22H) &amp; PCS Band (Part 24E)

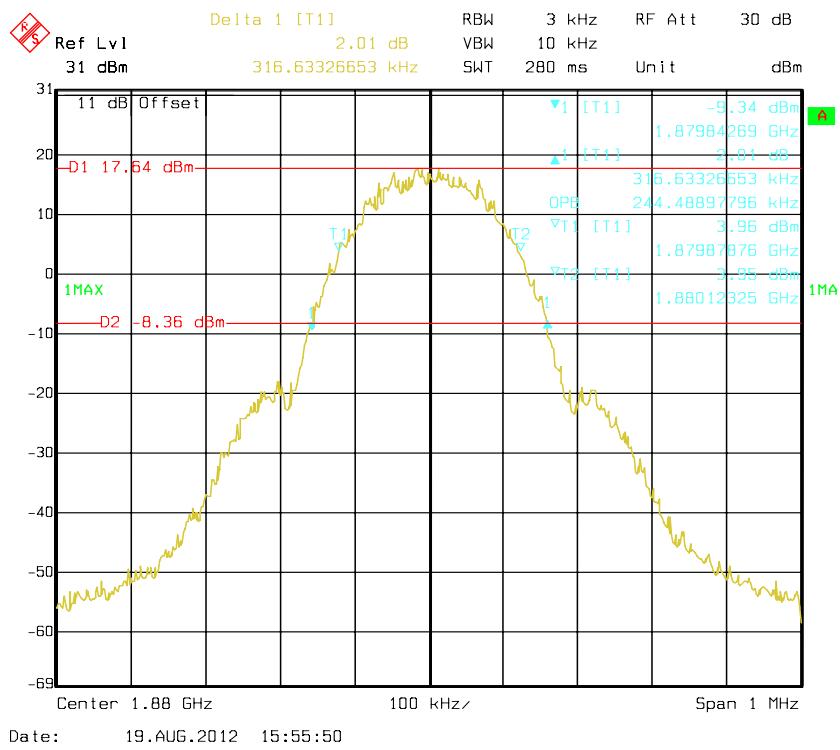
Band	Channel No.	99% Occupied Bandwidth		26 dB Occupied Bandwidth	
		kHz	kHz	kHz	kHz
Cellular	190	244.489		314.629	
PCS	661	244.489		316.633	

Please refer to the following plots.

## Cellular Band (Part 22H)



## PCS Band (Part 24E)



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

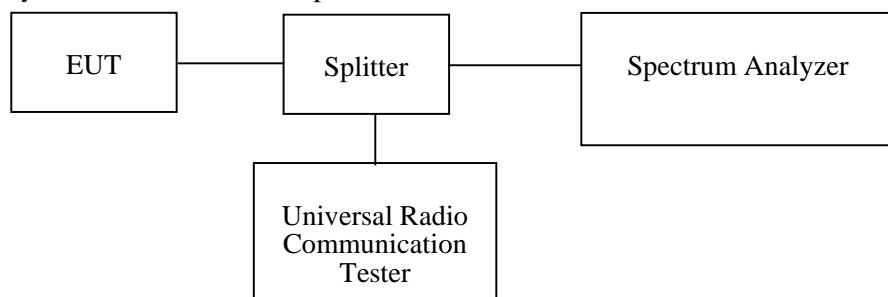
### Applicable Standard

FCC §2.1051, §22.917(a) and §24.238(a).

The spectrum was to be investigated to the tenth harmonics of the highest fundamental frequency as specified in § 2.1051.

### Test Procedure

The RF output of the transceiver was connected to a spectrum analyzer and simulator through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10<sup>th</sup> harmonic.



### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Spectrum Analyzer	FSEM	1079 8500	2011-10-9	2012-10-8

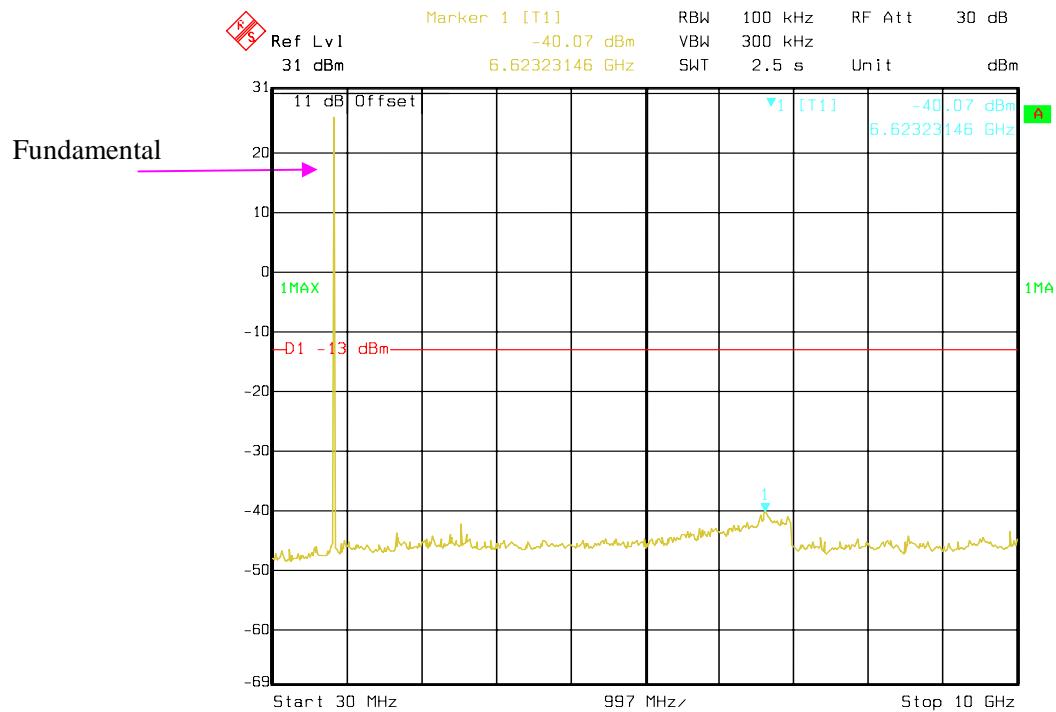
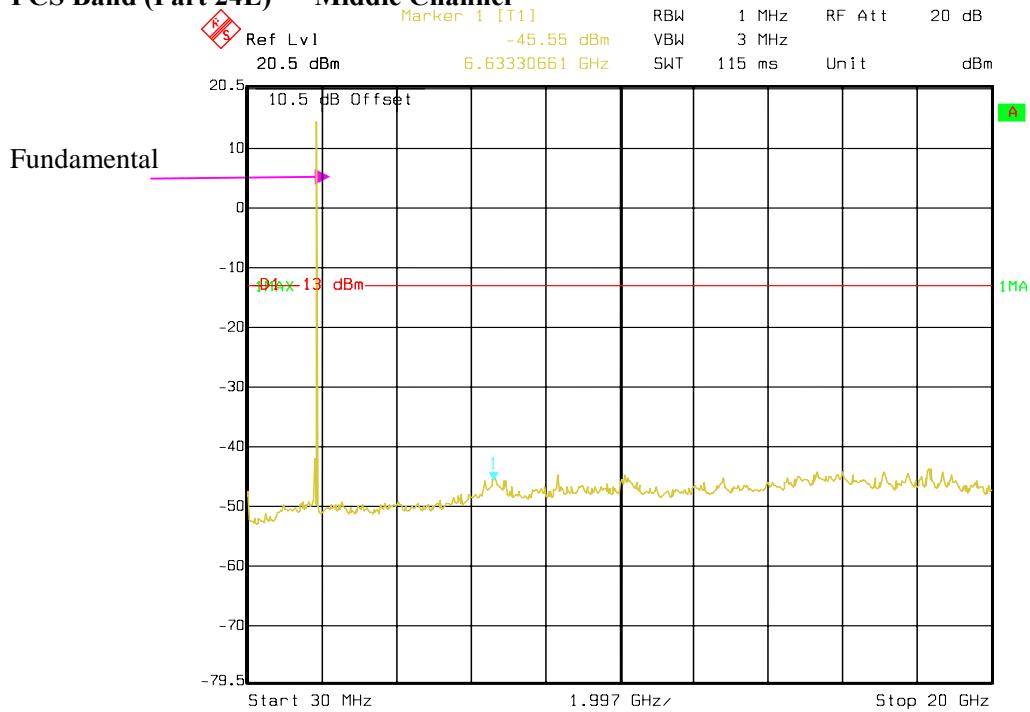
### Test Data

#### Environmental Conditions

Temperature:	25 °C
Relative Humidity:	56 %
ATM Pressure:	100.0kPa

*The testing was performed by Leon Chen on 2012-08-19.*

Please refer to the following plots.

**Cellular Band (Part 22H) — Middle Channel****PCS Band (Part 24E) — Middle Channel**

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

### Applicable Standard

FCC § 2.1053, §22.917 and § 24.238.

### Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB =  $10 \lg (\text{TXpwr in Watts}/0.001)$  – the absolute level

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

### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Spectrum Analyzer	FSEM	1079 8500	2011-10-9	2012-10-8
Rohde & Schwarz	EMI Test Receiver	ESCI	100224	2012-5-13	2013-5-12
Sunol Sciences	Hybrid Antennas	JB3	A060611-3	2012-3-16	2013-3-15
Dayang	Horn Antenna	OMCDH1018 0	10279001A	2011-8-22	2013-8-21
EMCO	Adjustable Dipole Antenna System	3121C	9109-753	2012-4-24	2013-4-23
Dayang	Horn Antenna	OMCDH1018 0	10279001B	2011-7-30	2013-7-29
HP	Pre-amplifier	8447E	2434A02181	2011-10-8	2012-10-7
mini-circuits	Wideband Amplifier	ZVA-183-S+	96901149	2012-4-24	2013-4-23
HP	Signal Generator	8648A	3426A00831	2011-10-9	2012-10-8
Giga	Signal Generator	1026	320408	2012-3-15	2013-3-14

## Test Data

### Environmental Conditions

Temperature:	25 °C
Relative Humidity:	56 %
ATM Pressure:	100.0kPa

The testing was performed by Leon Chen on 2012-08-19.

EUT Operation Mode: Transmitting

### GSM 850

Frequency	Polar	S.A Reading	S.G. Level	Antenna Gain	Cable Loss	Absolute Level	Limit	Margin
MHz	H/V	dB $\mu$ V	dBm	dBd/dBi	dB	dBm	dBm	dB
<b>Low Channel, fo = 824.2 MHz</b>								
1648.400	H	45.92	-54.7	7.3	0.9	-48.3	-13.0	35.3
1648.400	V	51.42	-48.1	7.3	0.9	-41.6	-13.0	28.6
2472.600	H	42.06	-59.7	9.8	0.9	-50.7	-13.0	37.7
2472.600	V	44.41	-52.6	9.8	0.9	-43.7	-13.0	30.7
3296.800	H	43.18	-50.8	10.0	0.8	-41.6	-13.0	28.6
3296.800	V	41.03	-50.5	10.0	0.8	-41.4	-13.0	28.4
4121.000	H	42.85	-51.4	9.9	1.1	-42.5	-13.0	29.5
4121.000	V	47.98	-46.8	9.9	1.1	-38.0	-13.0	25.0
<b>Middle Channel, fo = 836.6 MHz</b>								
1673.200	H	45.13	-54.4	7.3	0.9	-47.9	-13.0	34.9
1673.200	V	50.84	-46.1	7.3	0.9	-39.6	-13.0	26.6
2509.800	H	41.92	-60.2	10.1	0.9	-51.0	-13.0	38.0
2509.800	V	44.10	-57.1	10.1	0.9	-47.8	-13.0	34.8
3346.400	H	43.52	-49.2	10.0	0.8	-40.0	-13.0	27.0
3346.400	V	41.88	-48.7	10.0	0.8	-39.5	-13.0	26.5
4183.000	H	42.48	-44.6	9.9	1.1	-35.7	-13.0	22.7
4183.000	V	48.19	-40.5	9.9	1.1	-31.6	-13.0	18.6
<b>High Channel, fo = 848.8 MHz</b>								
1697.600	H	46.46	-54.3	7.3	0.9	-47.8	-13.0	34.8
1697.600	V	49.64	-46.6	7.3	0.9	-40.2	-13.0	27.2
2546.400	H	42.08	-61.2	10.1	0.9	-52.0	-13.0	39.0
2546.400	V	43.86	-54.7	10.1	0.9	-45.5	-13.0	32.5
3395.200	H	43.89	-46.4	10.0	0.8	-37.2	-13.0	24.2
3395.200	V	42.03	-49.8	10.0	0.8	-40.6	-13.0	27.6
4244.000	H	42.23	-51.5	10.3	1.1	-42.3	-13.0	29.3
4244.000	V	47.63	-46.6	10.3	1.1	-37.4	-13.0	24.4

**GSM 1900**

Frequency	Polar	S.A.Reading	S.G.Level	Antenna Gain	Cable Loss	Absolute Level	Limit	Margin
MHz	H/V	dB $\mu$ V	dBm	dBd/dBi	dB	dBm	dBm	dB
<b>Low Channel, fo = 1850.2 MHz</b>								
3700.400	H	43.91	-45.6	10.0	1.1	-36.7	-13.0	23.7
3700.400	V	41.98	-46.2	10.0	1.1	-37.3	-13.0	24.3
5550.600	H	38.64	-51.1	11.3	1.5	-41.3	-13.0	28.3
5550.600	V	43.54	-49.0	11.3	1.5	-39.2	-13.0	26.2
<b>Middle Channel, fo = 1880.0 MHz</b>								
3760.000	H	46.48	-48.0	10.0	1.1	-39.1	-13.0	26.1
3760.000	V	47.63	-46.8	10.0	1.1	-37.9	-13.0	24.9
5640.000	H	38.14	-51.0	11.2	1.5	-41.3	-13.0	28.3
5640.000	V	41.94	-50.3	11.2	1.5	-40.6	-13.0	27.6
<b>High Channel, fo = 1909.8 MHz</b>								
3819.600	H	51.68	-38.5	9.8	1.1	-29.7	-13.0	16.7
3819.600	V	56.42	-33.2	9.8	1.1	-24.5	-13.0	11.5
5729.400	H	39.42	-49.5	11.1	1.5	-39.9	-13.0	26.9
5729.400	V	44.21	-47.0	11.1	1.5	-37.4	-13.0	24.4

Notes: No emissions were detected below 1GHz.

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

### Applicable Standard

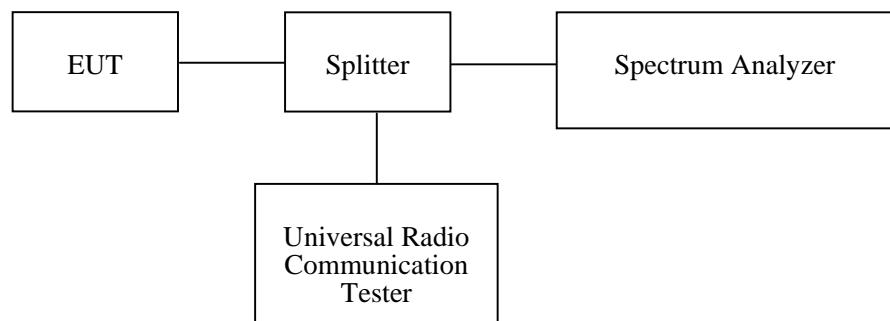
According to § 22.917(a), the power of any emissions outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

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

### Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

The center of the spectrum analyzer was set to block edge frequency, RBW set to 3 kHz.



### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Spectrum Analyzer	FSEM	1079 8500	2011-10-9	2012-10-8

### Test Data

#### Environmental Conditions

Temperature:	25 °C
Relative Humidity:	56 %
ATM Pressure:	100.0kPa

The testing was performed by Leon Chen on 2012-08-19.

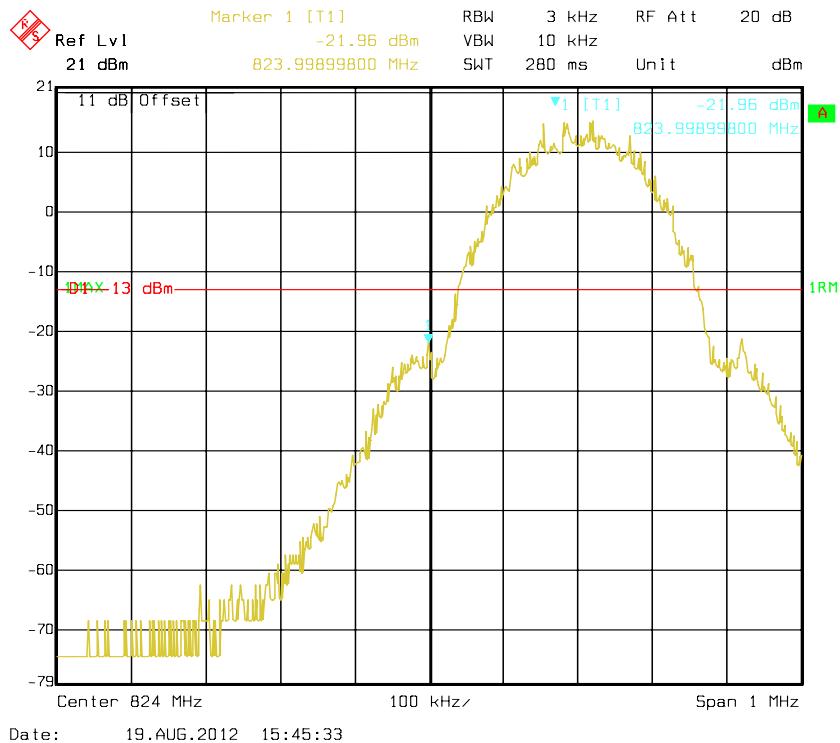
Please refer to the following tables and plots.

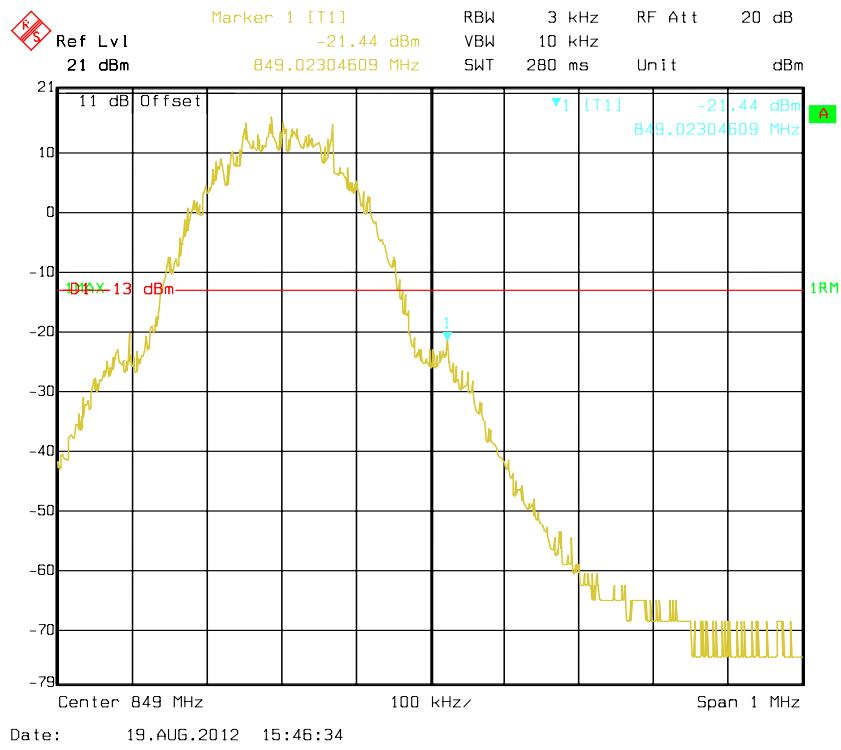
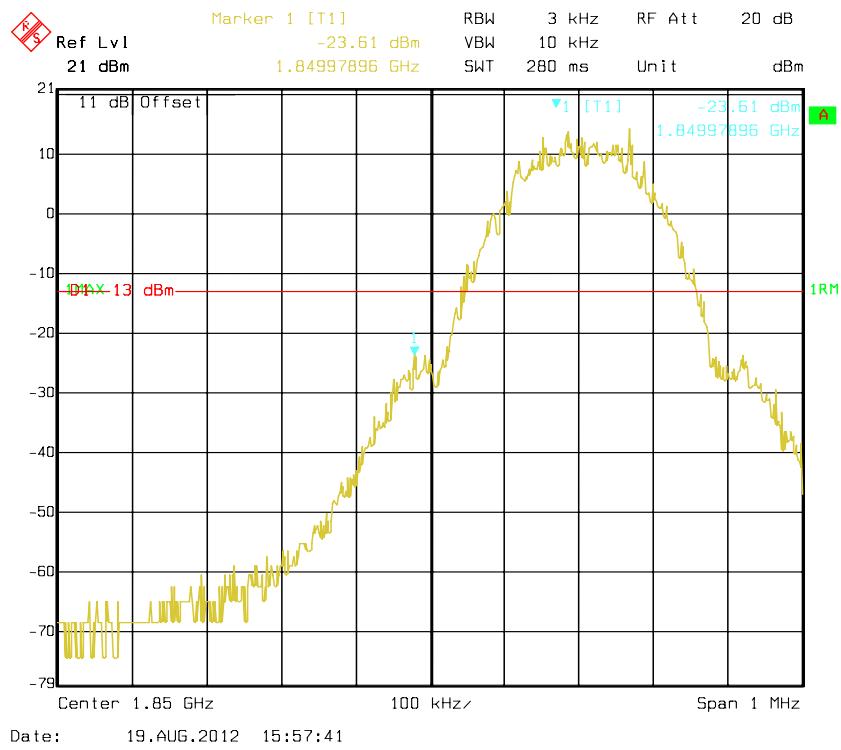
**Cellular Band (Part 22H)**

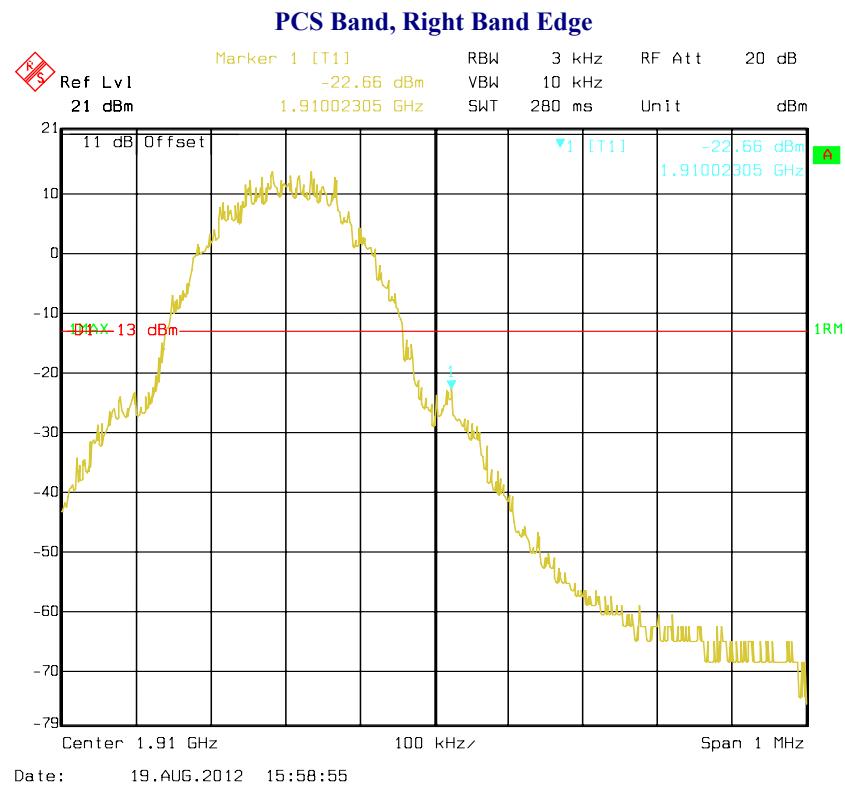
Frequency (MHz)	Emission (dBm)	Limit (dBm)
128	-21.96	-13
251	-21.44	-13

**PCS Band (Part 24E)**

Frequency (MHz)	Emission (dBm)	Limit (dBm)
512	-23.61	-13
810	-22.66	-13

**Cellular Band, Left Band Edge**

**Cellular Band, Right Band Edge****PCS Band, Left Band Edge**



## FCC §2.1055, §22.355 & §24.235 - FREQUENCY STABILITY

### Applicable Standard

FCC § 2.1055 (a), § 2.1055 (d), §22.355, §24.235

According to §22.355, the carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in Table below:

Frequency Tolerance for Transmitters in the Public Mobile Services

Frequency Range (MHz)	Base, fixed (ppm)	Mobile $\leq$ 3 watts (ppm)	Mobile $\leq$ 3 watts (ppm)
25 to 50	20.0	20.0	50.0
50 to 450	5.0	5.0	50.0
450 to 512	2.5	5.0	5.0
821 to 896	1.5	2.5	2.5
928 to 929.	5.0	N/A	N/A
929 to 960.	1.5	N/A	N/A
2110 to 2220	10.0	N/A	N/A

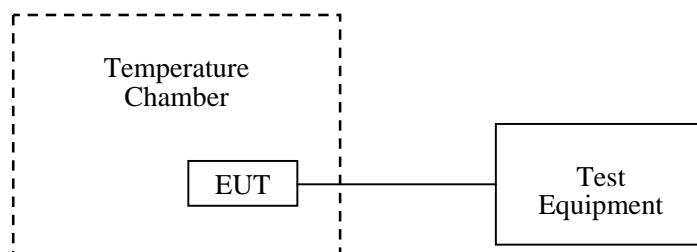
According to §24.235, the frequency stability shall be sufficient to ensure that the fundamental emissions stays within the authorized frequency block.

### Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external DC power supply and the RF output was connected to communication test set via feed-through attenuators. The EUT was placed inside the temperature chamber. The DC leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the communication test set.

Frequency Stability vs. Voltage: An external variable DC power supply was connected to the battery terminals of the equipment under test. The voltage was set 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
WUHUAN	Temperature & Humidity Chamber	HTP205	20021115	2012-06-04	2013-06-03
Rohde & Schwarz	Universal Radio Communication Tester	CMU200	109038	2012-04-11	2013-04-10

## Test Data

### Environmental Conditions

Temperature:	25 °C
Relative Humidity:	56 %
ATM Pressure:	100.0kPa

The testing was performed by Leon Chen on 2012-08-15.

### Cellular Band (Part 22H)

Middle Channel, $f_c = 836.6$ MHz				
Temperature	Voltage	Frequency Error	Frequency Error	Limit
°C	V <sub>DC</sub>	Hz	ppm	ppm
-30	3.7	13	0.016	2.5
-20	3.7	10	0.012	2.5
-10	3.7	6	0.007	2.5
0	3.7	8	0.010	2.5
10	3.7	5	0.006	2.5
20	3.7	1	0.001	2.5
30	3.7	-6	-0.007	2.5
40	3.7	-3	-0.004	2.5
50	3.7	-8	-0.010	2.5
25	V <sub>end point</sub> = 3.5	14	0.017	2.5

**PCS Band (Part 24E)**

Middle Channel, $f_c = 1880.0$ MHz				
Temperature	Voltage	Frequency Error	Frequency Error	Result
°C	V <sub>DC</sub>	Hz	ppm	
-30	3.7	23	0.012	Pass
-20	3.7	20	0.011	Pass
-10	3.7	18	0.010	Pass
0	3.7	10	0.005	Pass
10	3.7	16	0.009	Pass
20	3.7	6	0.003	Pass
30	3.7	0	0.000	Pass
40	3.7	-3	-0.002	Pass
50	3.7	-9	-0.005	Pass
25	V <sub>end point</sub> = 3.5	19	0.010	Pass

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