



Part 22

TEST REPORT

Product Name	LMU-200C CDMA
Model Name	LMU-200C
Brand Name	CalAmp
FCC ID	APV-200C
Applicant	CalAmp
Manufacturer	AsiaTelco Technologies Co.
Date of issue	October 10, 2014

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GENERAL SUMMARY

Reference Standard(s)	<p>FCC CFR47 Part 2 (2013) Frequency Allocations And Radio Treaty Matters; General Rules And Regulations</p> <p>FCC CFR 47 Part 22H (2013) Public Mobile Services(850MHz)</p> <p>ANSI/TIA-603-C(2004) Land mobile FM or PM Communications Equipment Measurements and Performance Standards.</p> <p>KDB 971168 D01 Power Meas License Digital Systems v02r01 Measurement Guidance for Certification of Licensed Digital Transmitters</p>
Conclusion	<p>This fixed equipment has been measured in all cases requested by the relevant standards. Test results in Chapter 2 of this test report are below limits specified in the relevant standards.</p> <p>General Judgment: Pass</p>
Comment	<p>The test result only responds to the measured sample.</p>

Approved by Kai Xu

Kai Xu
Director

Revised by Lingling Kang

Lingling Kang
RF Manager

Performed by Changxu Wan

Changxu Wan
RF Engineer

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1. General Information

1.1. Notes of the test report

TA Technology (Shanghai) Co., Ltd. has obtained the accreditation of China National Accreditation Service for Conformity Assessment (CNAS), and accreditation number: L2264.

TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements. The site recognition number is 428261.

TA Technology (Shanghai) Co., Ltd. has been listed by industry Canada to perform electromagnetic emission measurement. The site recognition number is 8510A.

TA Technology (Shanghai) Co., Ltd. guarantees the reliability of the data presented in this test report, which is the results of measurements and tests performed for the items under test on the date and under the conditions stated in this test report and is based on the knowledge and technical facilities available at TA Technology (Shanghai) Co., Ltd. at the time of execution of the test.

TA Technology (Shanghai) Co., Ltd. is liable to the client for the maintenance by its personnel of the confidentiality of all information related to the items under test and the results of the test. The sample under test was selected by the Client. This report only refers to the item that has undergone the test.

This report standalone does not constitute or imply by its own an approval of the product by the certification Bodies or competent Authorities. This report cannot be used partially or in full for publicity and/or promotional purposes without previous written approval of **TA Technology (Shanghai) Co., Ltd.** and the Accreditation Bodies, if it applies.

If the electrical report is inconsistent with the printed one, it should be subject to the latter.

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1.2. Testing laboratory

Company: TA Technology (Shanghai) Co., Ltd.
Address: No.145, Jintang Rd, Tangzhen Industry Park, Pudong
City: Shanghai
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Website: <http://www.ta-shanghai.com>
E-mail: xukai@ta-shanghai.com

1.3. Applicant Information

Company: CalAmp
Address: 2177 Salk Ave Suite 200 Carlsbad
California/United States

1.4. Manufacturer Information

Company: AsiaTelco Technologies Co.
Address: #289 Bisheng Road, Building-8, 3F, Zhangjiang Hi-Tech Park, Pudong,
Shanghai-201204, China

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1.5. Information of EUT

General information

MEID :	270113184403145728		
Hardware Version:	P2		
Software Version:	2.1.6		
Antenna Type:	Internal Antenna		
Device Operating Configurations:			
Test Mode(s):	CDMA Cellular		
Support mode:	1x RTT		
Test Modulation:	QPSK		
Maximum E.R.P.	22.61 dBm		
Rated Power Supply Voltage:	12V		
Extreme Voltage:	Minimum: 10V Maximum: 36V		
Extreme Temperature:	Lowest: -40°C Highest: +85°C		
Test Channel: (Low - Middle - High)	1013 - 384 - 777 (tested)		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	CDMA Cellular	824.7 ~ 848.31	869.7 ~ 893.31

1.6. Test Date

The test is performed from September 16, 2014 to September 18, 2014.

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2. Test Information

2.1. Summary of test results

Number	Test Case	Clause in FCC rules	Verdict
1	RF power output	2.1046	PASS
2	Effective Radiated Power	22.913(a)(2)	PASS
3	Occupied Bandwidth	2.1049	PASS
4	Band Edge Compliance	22.917	PASS
5	Peak-to-Average Power Ratio	KDB 971168 D01(5.7)	PASS
6	Frequency Stability	2.1055 / 22.355	PASS
7	Spurious Emissions at Antenna Terminals	2.1051 / 22.917(a)	PASS
8	Radiates Spurious Emission	2.1053 / 22.917 (a)	PASS

PASS: The EUT complies with the essential requirements in the standard.

FAIL: The EUT does not comply with the essential requirements in the standard.

2.2. RF Power Output

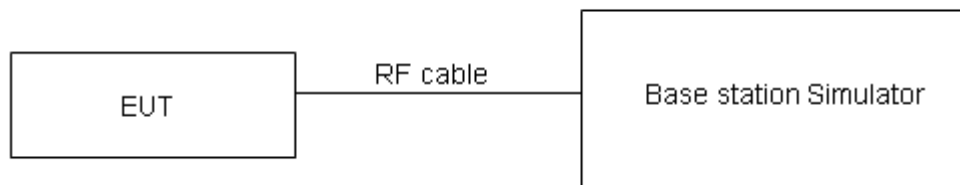
Ambient condition

Temperature	Relative humidity
21°C ~25°C	40%~60%

Methods of Measurement

During the process of the testing, The EUT is controlled by the Base Station Simulator to ensure max power transmission and proper modulation.

Test Setup



The loss between RF output port of the EUT and the input port of the tester has been taken into consideration.

Limits

No specific RF power output requirements in part 2.1046.

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 0.4$ dB.

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Test Results

CDMA Cellular			Conducted Power(dBm)		
			Channel 1013	Channel 384	Channel 777
			824.7(MHz)	836.52(MHz)	848.31(MHz)
1x RTT	RC1	SO55(Loopback)	24.18	23.84	23.53
		SO2(Loopback)	24.19	23.83	23.55
	RC3	SO55(Loopback)	24.14	23.82	23.51
		SO2(Loopback)	24.15	23.84	23.54

Note:

- 1) The maximum RF Output Power numbers are marks in bold.
- 2) The following testing is set to RC1 SO2 based on the maximum RF Output Power.

2.3. Effective Radiated Power

Ambient condition

Temperature	Relative humidity
21°C ~25°C	40%~60%

Methods of Measurement

The measurement procedures in TIA- 603C are used.

1. The EUT was placed on a turntable with 1.5 meter height in a fully anechoic chamber.
2. The EUT was set at 3 meters from the receiving antenna, which was mounted on the antenna tower.
3. GSM operating modes: Set RBW= 1MHz, VBW= 3MHz, RMS detector over burst;
UMTS operating modes: Set RBW= 100 KHz, VBW= 300 KHz, RMS detector over frame, and use channel power option with bandwidth=5MHz, per section 4.0 of KDB 971168 D01.
4. The table was rotated 360 degrees to determine the position of the highest radiated power.
5. The height of the receiving antenna is adjusted to look for the maximum ERP/EIRP.
6. Taking the record of maximum ERP/EIRP.
7. A dipole antenna was substituted in place of the EUT and was driven by a signal generator.
8. The conducted power at the terminal of the dipole antenna is measured.
9. Repeat step 3 to step 5 to get the maximum ERP/EIRP of the substitution antenna.
10. $ERP/EIRP = P_s + E_t - E_s + G_s = P_s + R_t - R_s + G_s$

P_s (dBm) : Input power to substitution antenna.

G_s (dBi or dBd) : Substitution antenna Gain.

$E_t = R_t + AF$

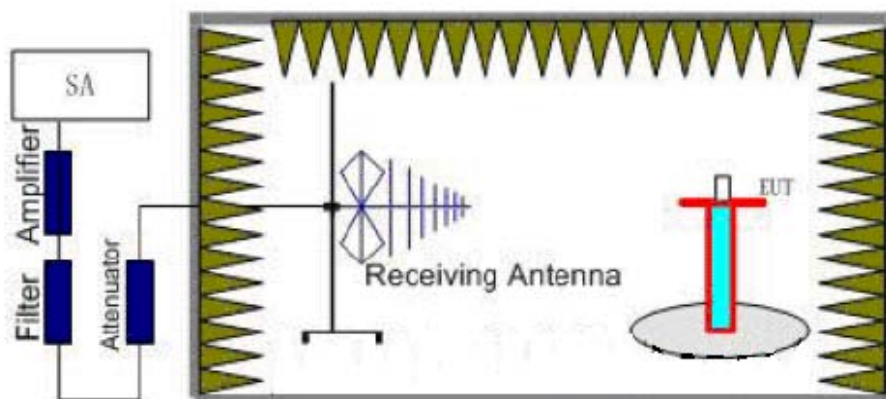
$E_s = R_s + AF$

AF (dB/m) : Receive antenna factor

R_t : The highest received signal in spectrum analyzer for EUT.

R_s : The highest received signal in spectrum analyzer for substitution antenna.

Test Setup



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Limits

Rule Part 22.913(a) specifies that "Mobile/portable stations are limited to 7 watts ERP".

Limit	$\leq 7 \text{ W}$ (38.45 dBm)
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Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 1.19 \text{ dB}$

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Test Results: Pass

	Channel	Polarization	Rt (dBm)	Rs (dBm)	Ps (dBm)	Gs (dBi)	E.R.P. (dBm)
CDMA Cellular	1013	Vertical	-25.02	-46.19	0	1.06	20.08
	384	Vertical	-24.75	-45.96	0	1.24	20.40
	777	Vertical	-24.89	-45.69	0	1.68	20.43
	1013	Horizontal	-22.74	-46.03	0	1.06	22.30
	384	Horizontal	-22.45	-45.88	0	1.24	22.52
	777	Horizontal	-22.49	-45.57	0	1.68	22.61

Note: 1. EIRP= E.R.P+2.15

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2.4. Occupied Bandwidth

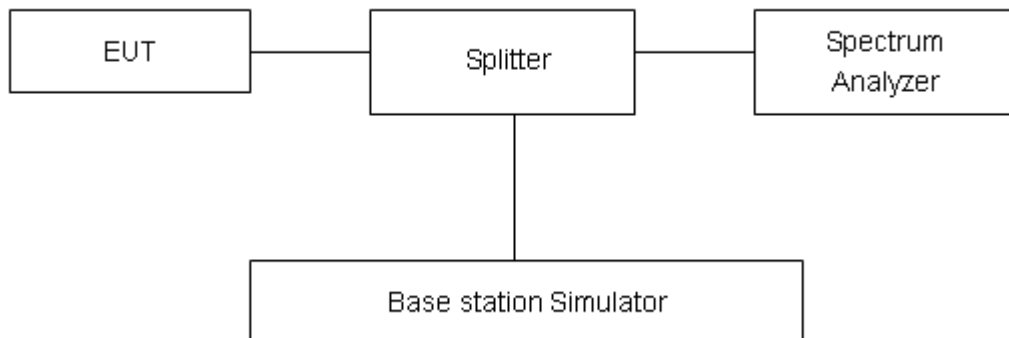
Ambient condition

Temperature	Relative humidity
21°C ~25°C	40%~60%

Method of Measurement

The EUT was connected to Spectrum Analyzer and Base Station Simulator via power Splitter. The occupied bandwidth is measured using spectrum analyzer. RBW is set to 30kHz, VBW is set to 300kHz for CDMA Cellular. 99% power and -26dBc occupied bandwidths are recorded. Spectrum analyzer plots are included on the following pages.

Test Setup



Limits

No specific occupied bandwidth requirements in part 2.1049.

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 624\text{Hz}$.

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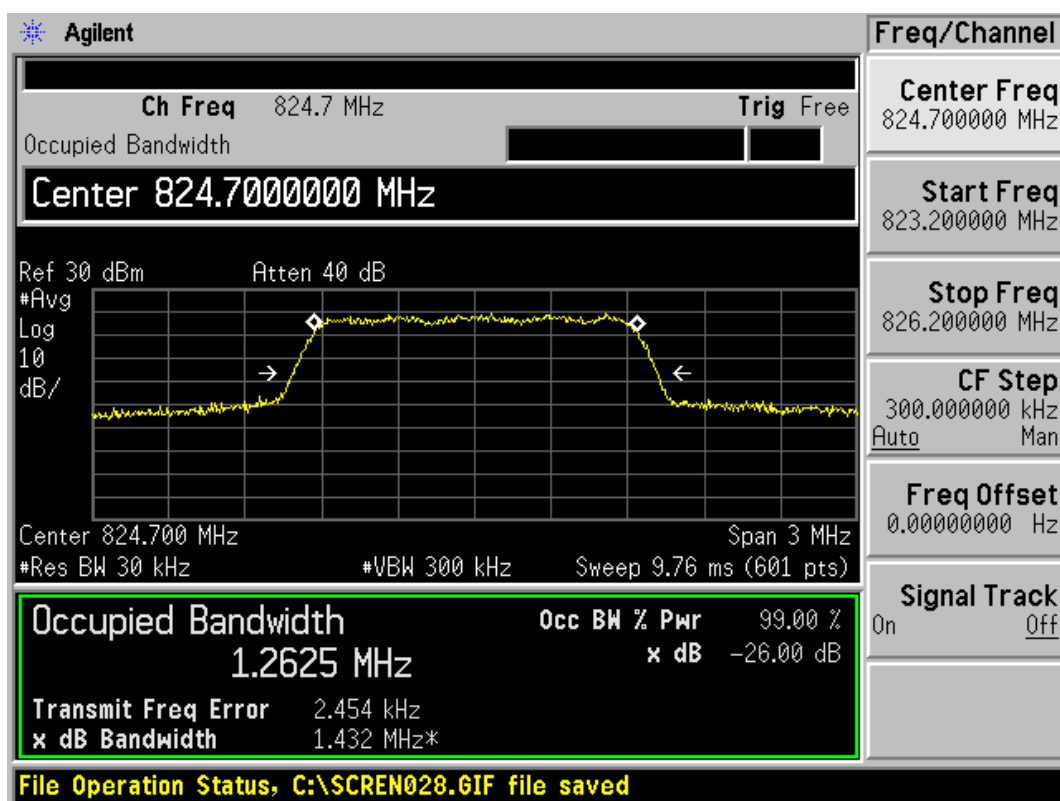
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Test Result

CDMA Cellular	Channel	Frequency (MHz)	99% Power Bandwidth (MHz)	-26dBc Bandwidth(MHz)
RC1 (SO2)	1013	824.7	1.2625	1.432
	384	836.52	1.2662	1.444
	777	848.31	1.2674	1.420

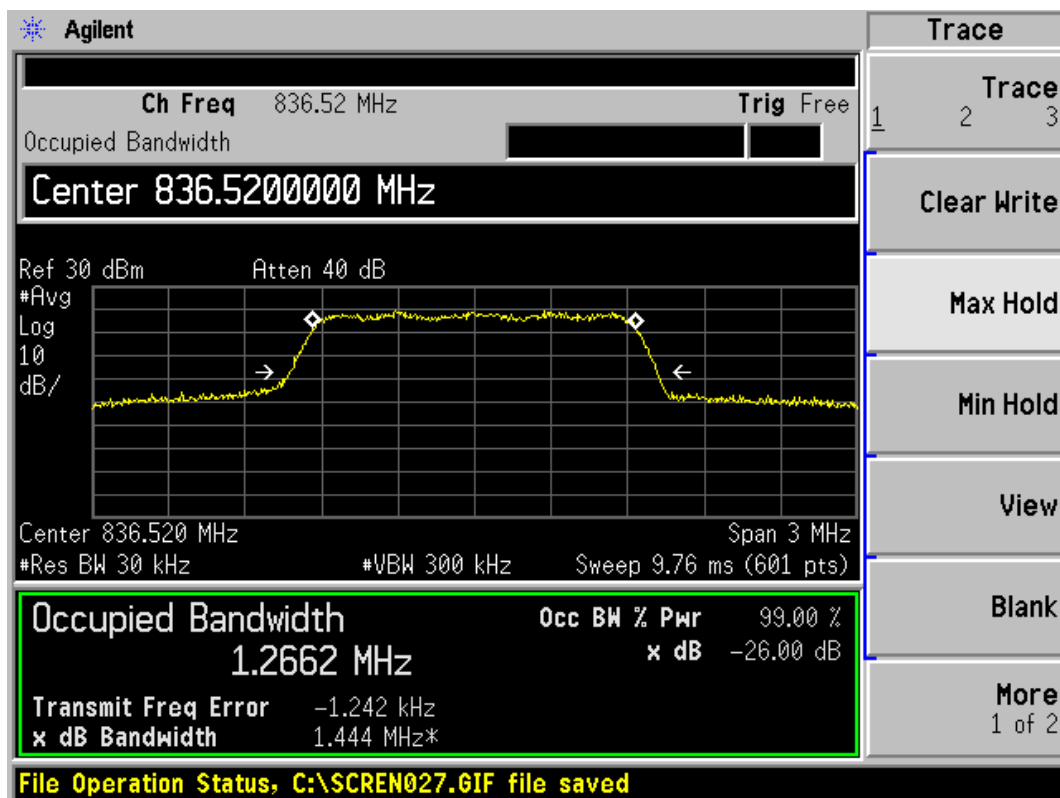


CDMA Cellular RC1 (SO2) CH1013 Occupied Bandwidth

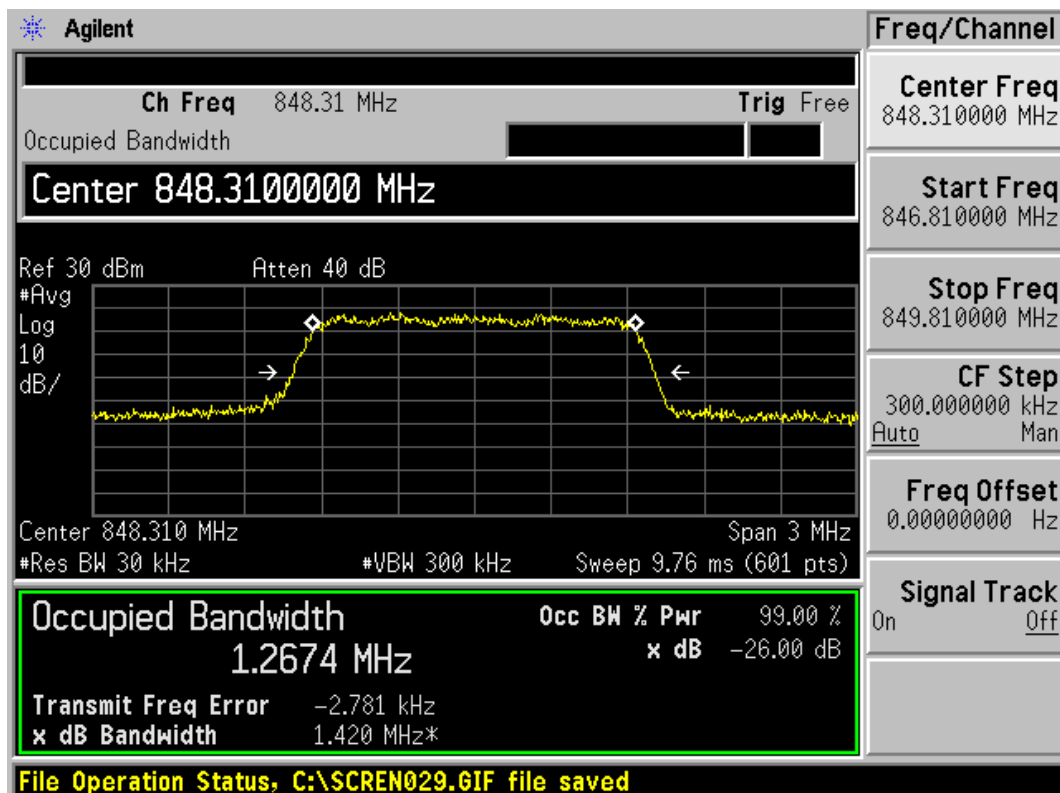
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CDMA Cellular RC1 (SO2) CH384 Occupied Bandwidth



CDMA Cellular RC1 (SO2) CH777 Occupied Bandwidth

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2.5. Band Edge Compliance

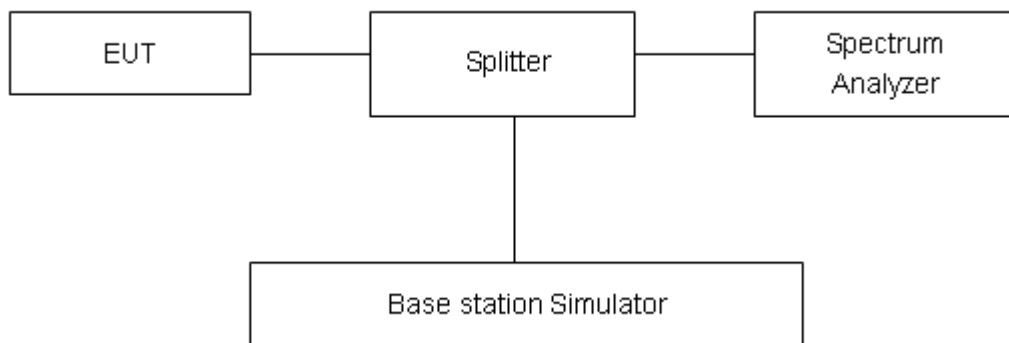
Ambient condition

Temperature	Relative humidity
21°C ~25°C	40%~60%

Method of Measurement

The EUT was connected to Spectrum Analyzer and Base Station Simulator via power Splitter. The band edge of the lowest and highest channels were measured. The average detector is used. RBW is set to 15kHz, VBW is set to 30kHz for CDMA Cellular. Spectrum analyzer plots are included on the following pages.

Test Setup



Limits

Rule Part 22.917(a) specifies that “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.”

Limit	-13 dBm
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Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$, $U=0.684\text{dB}$.

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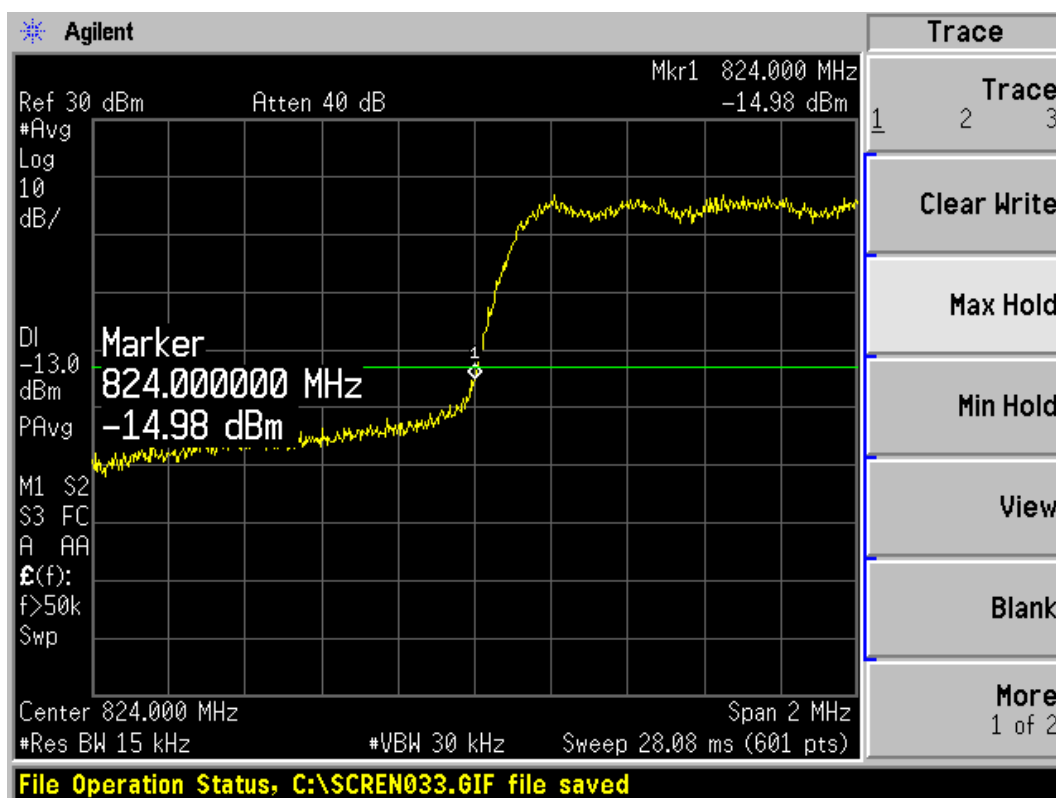
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Test Result:

CDMA Cellular	Carrier frequency (MHz)	Reference value (dBm)	Limit	Conclusion
RC1 (SO2)	824.0	-14.98	-13	PASS
	849.0	-15.89	-13	PASS

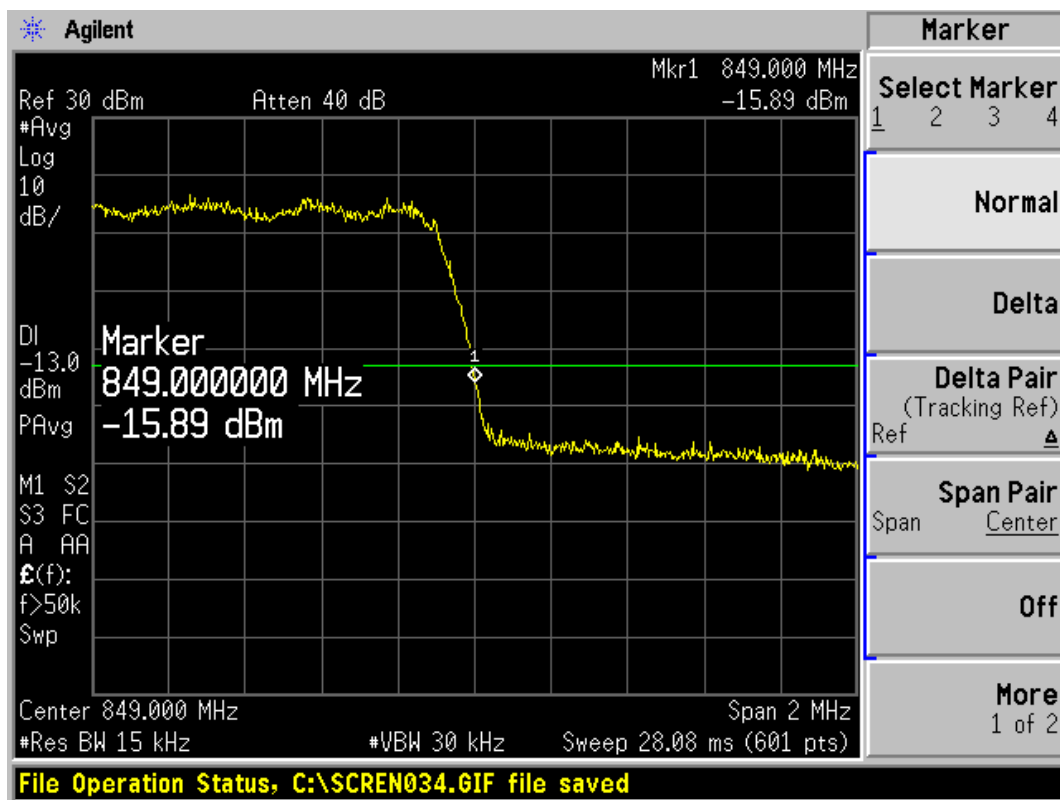


CDMA Cellular RC1 (SO2) 1013 Channel

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CDMA Cellular RC1 (SO2) 777 Channel

2.6. Peak-to-Average Power Ratio (PAPR)

Ambient condition

Temperature	Relative humidity
21°C ~25°C	40%~60%

Methods of Measurement

The measurement procedures in KDB971168 are used.

The inherent randomness of the power peaks in a noise-like signal makes it difficult to quantify the peak power using traditional measurement techniques for determining the peak power of an analog signal. The peak power of a digitally-modulated signal is predictable only on a statistical basis. Thus, for these types of signals, a statistical measurement of the peak power is necessary.

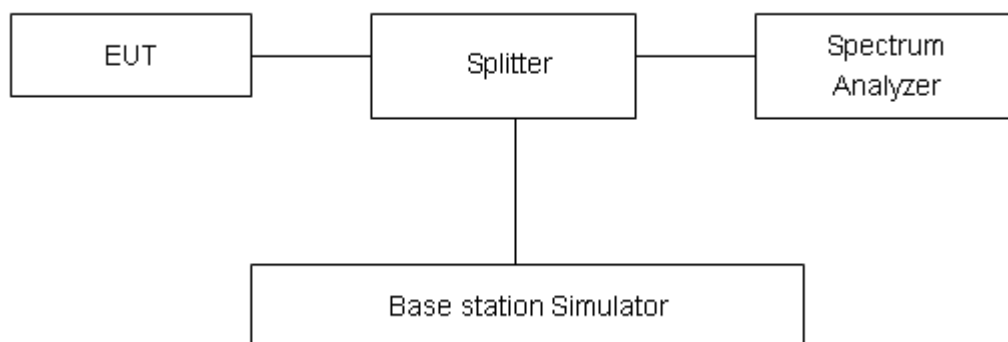
Power Complementary Cumulative Distribution Function (CCDF) curves provide a means for characterizing the power peaks of a digitally modulated signal on a statistical basis. A CCDF curve depicts the probability of the peak signal amplitude exceeding the average power level. Most contemporary measurement instrumentation include the capability to produce CCDF curves for an input signal provided that the instrument's resolution bandwidth can be set wide enough to accommodate the entire input signal bandwidth.

Step 1. The EUT was connected to Spectrum Analyzer and Base Station via power divider.

Step 2. Set the CCDF option in Spectrum analyzer.

Step 3. Record the maximum PAPR level associated with a probability of 0.1%.

Test Setup



Limits

No specific Peak-to-Average Ratio requirements in KDB 971168.

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 0.4$ dB.

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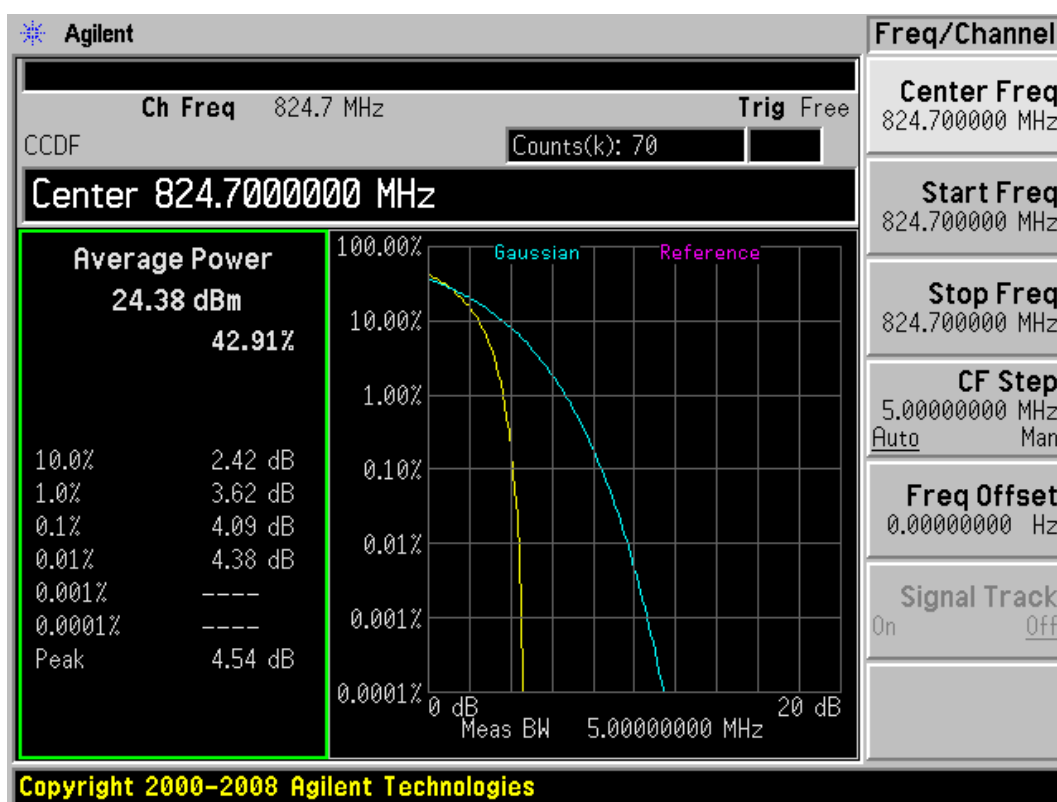
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Test Result:

Test Results

Mode	Channel	Frequency (MHz)	Test Result(dB)
RC1 (SO2)	1013	824.7	4.09
	384	836.52	3.78
	777	848.31	4.20



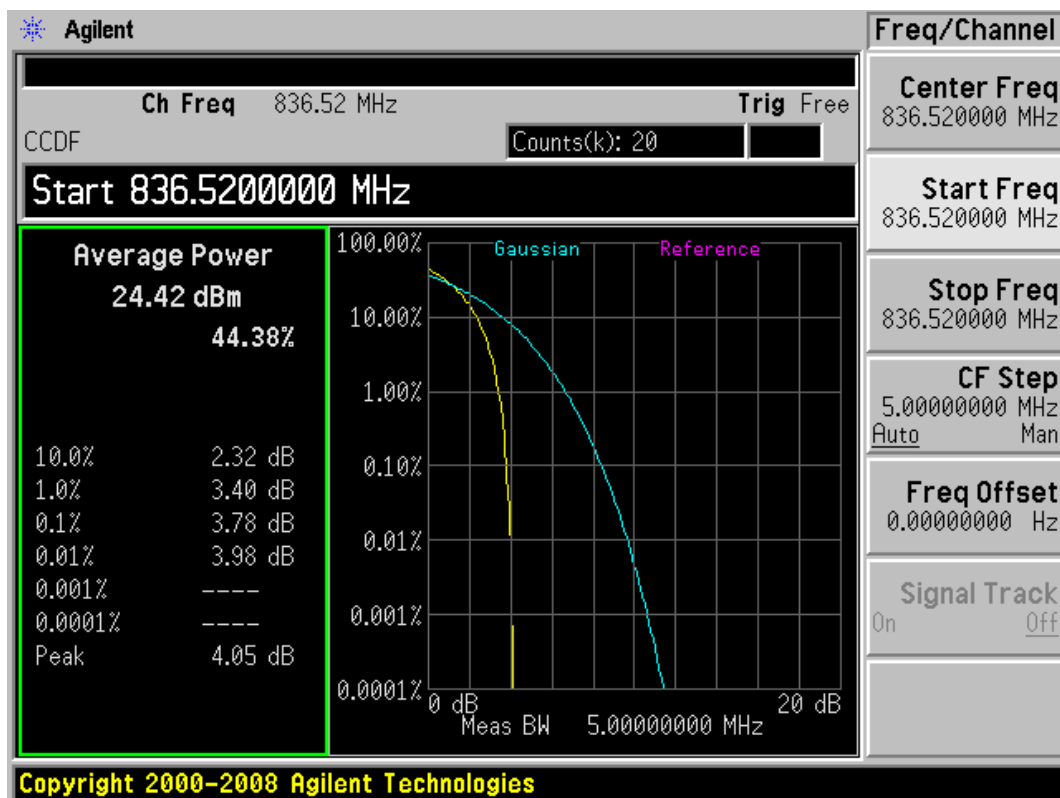
CDMA Cellular RC1 (SO2) CH1013

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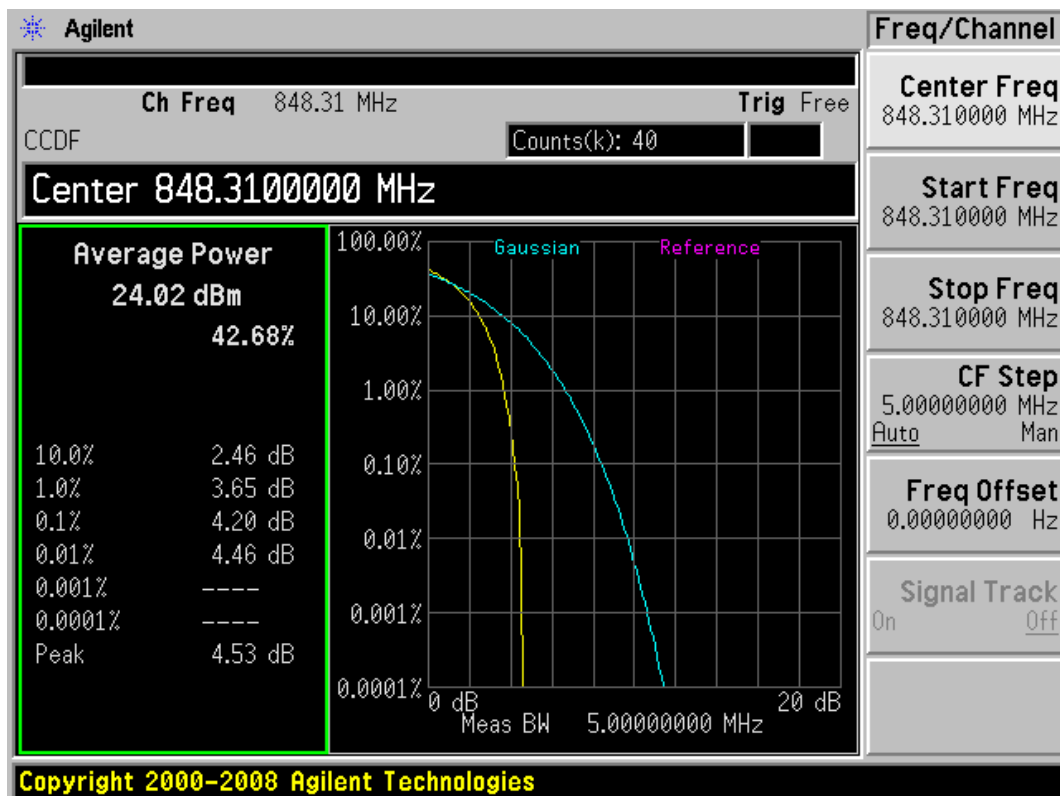
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CDMA Cellular RC1 (SO2) CH384



CDMA Cellular RC1 (SO2) CH777

2.7. Frequency Stability

Ambient condition

Temperature	Relative humidity
21°C ~25°C	40%~60%

Method of Measurement

1. Frequency Stability (Temperature Variation)

The temperature inside the climate chamber is varied from -40°C to +85°C in 10°C step size,

(1) With all power removed, the temperature was decreased to -40°C and permitted to stabilize for three hours.

(2) Measure the carrier frequency with the test equipment in a "call mode". These measurements should be made within 1 minute of powering up the mobile station, to prevent significant self warming.

(3) Repeat the above measurements at 10°C increments from -40°C to +85°C. Allow at least 1.5 hours at each temperature, un-powered, before making measurements.

2. Frequency Stability (Voltage Variation)

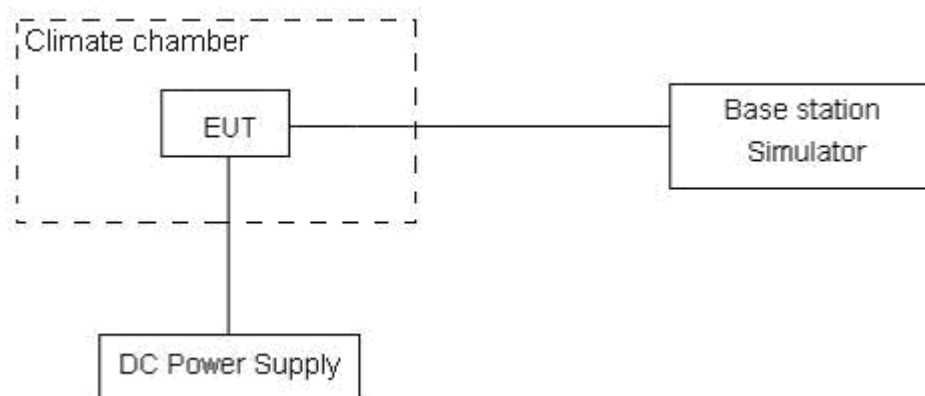
The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery-operating end point which shall be specified by the manufacturer.

This transceiver is specified to operate with an input voltage of between 10 V and 36 V, with a nominal voltage of 12V.

Test setup



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Limits

According to the Sec. 22.355, the frequency stability of the carrier shall be accurate to within 2.5 ppm of the received frequency for mobile stations.

Limits	≤ 2.5 ppm
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Measurement Uncertainty

The assessed measurement uncertainty to ensure 99.75% confidence level for the normal distribution is with the coverage factor $k = 3$, $U = 0.01$ ppm.

Test Result

Temperature (°C)	Test Results (ppm) / 12 V Power supply
	Channel 384
	RC1 (SO2)
-40	0.0045
-30	0.0046
-20	0.0043
-10	0.0053
0	0.0050
10	0.0037
20	0.0046
30	0.0032
40	0.0047
50	0.0044
60	0.0042
70	0.0031
80	0.0044
90	0.0041

Voltage (V)	Test Results(ppm) / 20°C
	Channel 384
	RC1 (SO2)
10	0.0045
12	0.0045
36	0.0043

2.8. Spurious Emissions at Antenna Terminals

Ambient condition

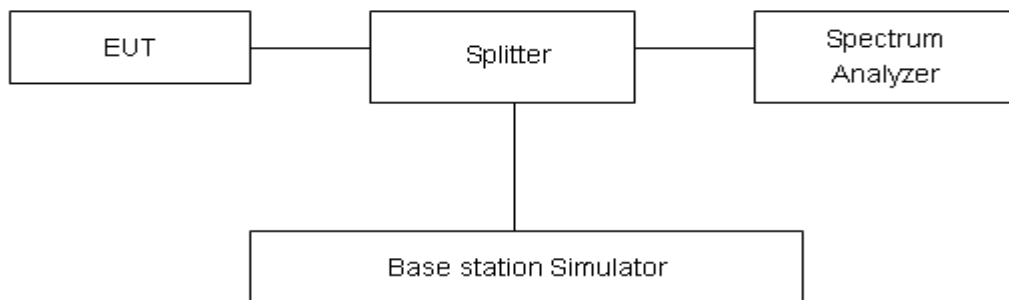
Temperature	Relative humidity
21°C ~25°C	40%~60%

Method of Measurement

The EUT was connected to Spectrum Analyzer and Base Station Simulator via power Splitter. The measurement is carried out using a spectrum analyzer. The spectrum analyzer scans from 30MHz to the 10th harmonic of the carrier. The peak detector is used. For CDMA Cellular, RBW and VBW are set to 100 kHz, Sweep is set to ATUO.

Of those disturbances below (limit – 20 dB), the mark is not required for the EUT

Test setup



Limits

Rule Part 22.917(a) specifies that “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.”

Limit	-13 dBm
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Measurement Uncertainty

The assessed measurement uncertainty to ensure 99.75 % confidence level for the normal distribution is with the coverage factor $k = 1.96$.

Frequency	Uncertainty
100kHz-2GHz	0.684 dB
2GHz-12.75GHz	1.407 dB

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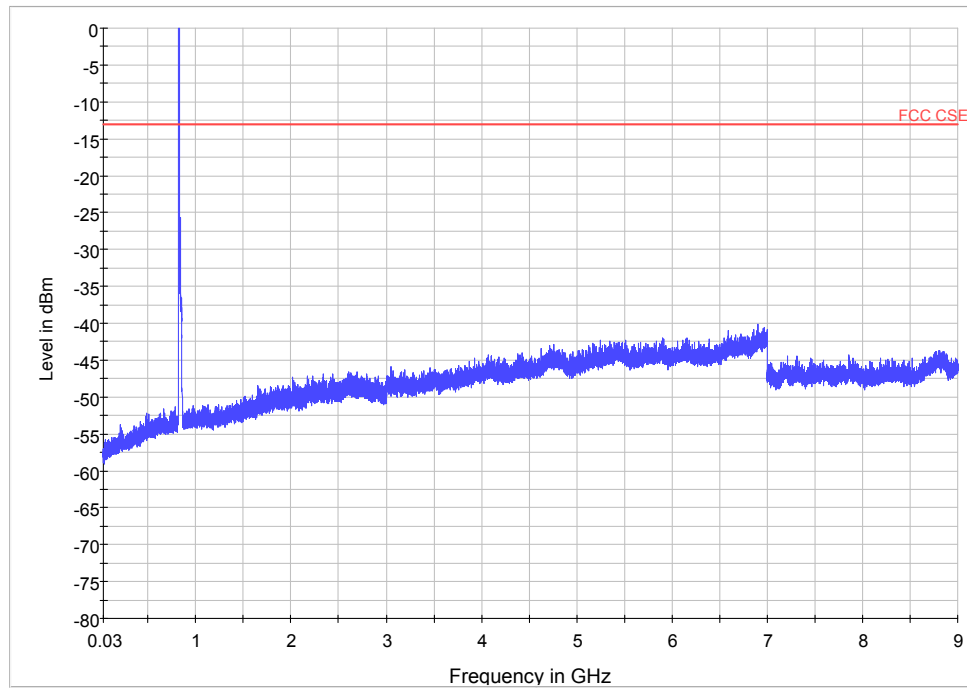
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Test Result

CDMA Cellular CH1013



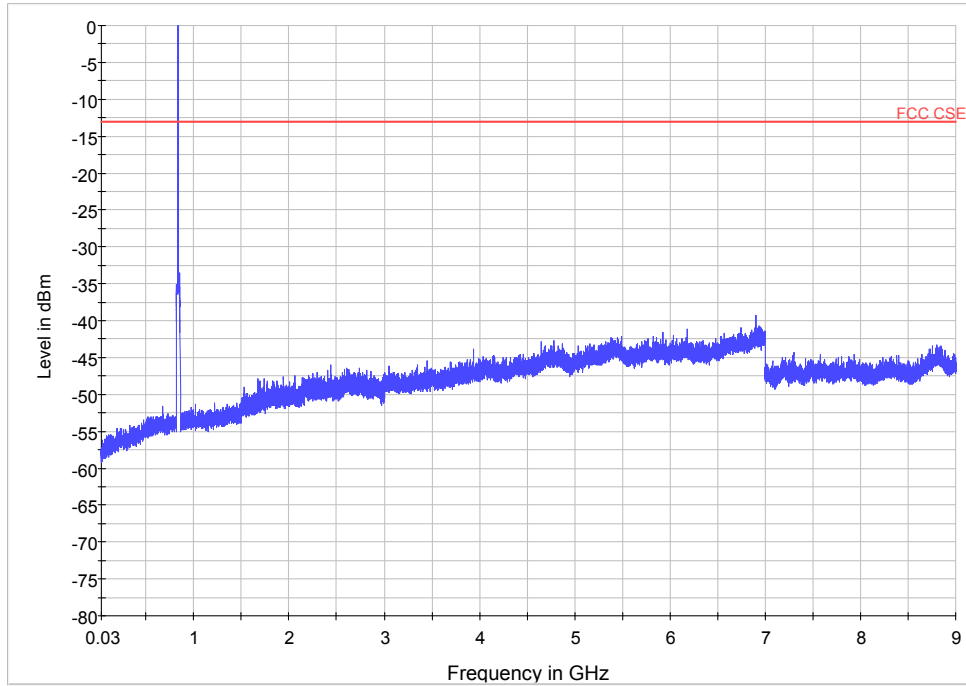
Note: The signal beyond the limit is carrier
CDMA Cellular CH1013 30MHz~9GHz

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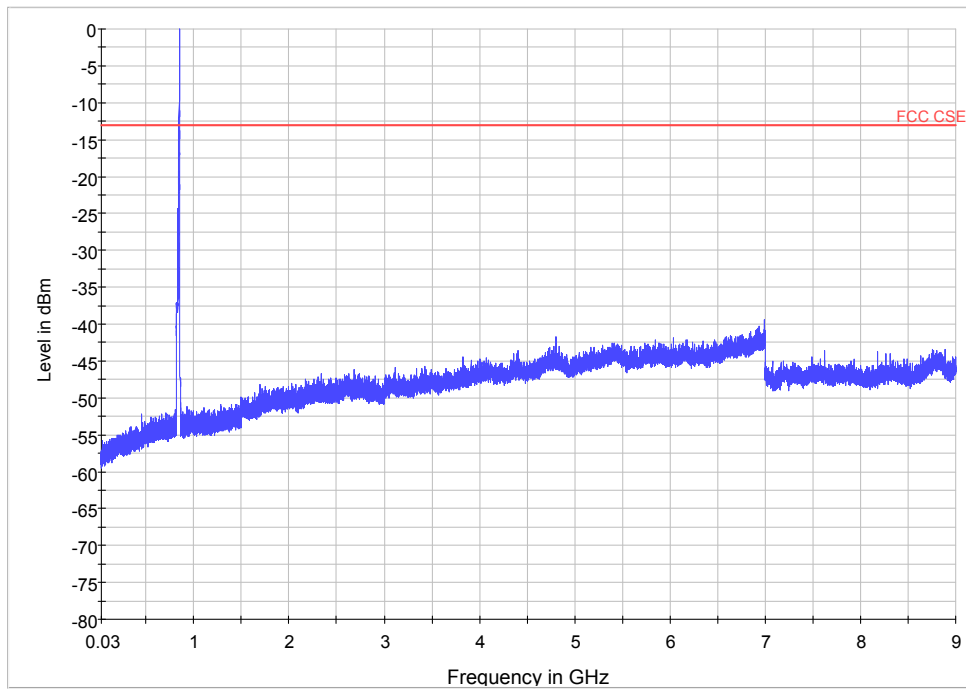
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CDMA Cellular CH384



Note: The signal beyond the limit is carrier
CDMA Cellular CH384 30MHz~9GHz

CDMA Cellular CH777



Note: The signal beyond the limit is carrier
CDMA Cellular CH777 30MHz~9GHz

2.9. Radiates Spurious Emission

Ambient condition

Temperature	Relative humidity
21°C ~25°C	40%~60%

Method of Measurement

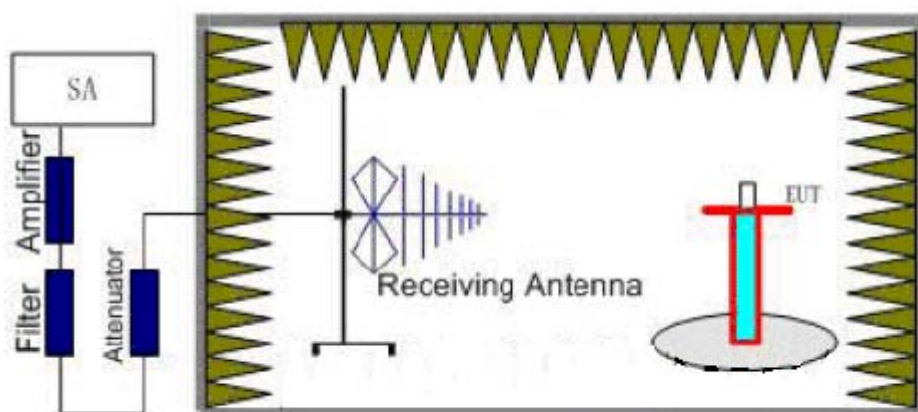
The measurements procedures in TIA -603C are used.

The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment.

The procedure of Radiates Spurious Emission is as follows:

Step 1:

The measurement is carried out in the semi-anechoic chamber. EUT was placed on a 1.5 meters high non-conductive table at a 3 meters test distance from the test receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT. A radio link shall be established between EUT and Tester. The output power of the cell signal of the tester will be decreased until the output power of the EUT reach a maximum value. A peak detector is used while RBW and VBW are both set to 3MHz. During the measurement, the highest emission was recorded from analyzer power level (LVL) from the 360 degrees rotation of the turntable and the test antenna moved up and down over a range from 1 to 4 meters in both horizontally and vertically polarized orientations. The test setup refers to figure below.



Step 2:

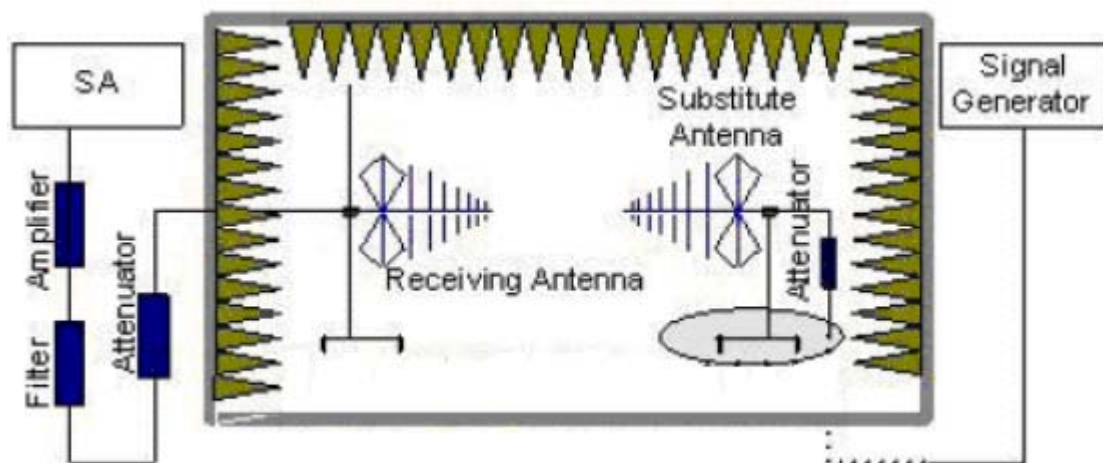
A dipole antenna shall be substituted in place of the EUT. The antenna will be driven by a signal generator with a adjustable S.G. applied through a Tx cable. Adjust the level of the signal generator output until the value of the receiver reach the previously recorded analyzer power level (LVL). Then The E.R.P. /E.I.R.P. of the EUT can be calculated through the level of the signal generator, Tx cable loss and the gain of the substitution antenna. The test setup refers to figure below.

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$E.R.P \text{ (peak power)} = S.G. - Tx \text{ Cable loss} + \text{Substitution antenna gain} - 2.15.$

$EIRP = E.R.P + 2.15$

The field strength of spurious emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in stand-up position (Z axis) and the antenna is vertical.

Of those disturbances below (limit – 20 dB), the mark is not required for the EUT

Limits

Rule Part 22.917(a) specifies that “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.”

Limit	-13 dBm
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Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$, $U = 3.55$ dB.

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Test Result

CDMA Cellular CH1013

Harmonic	TX ch.1013 Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	ERP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	1649.3	-47.01	2	10.15	Vertical	-41.01	-13	34.01	180
3	2473.7	-45.12	2.51	11.35	Vertical	-38.43	-13	32.12	90
4	3298.8	-64.45	4.2	10.85	Vertical	-59.95	-13	46.95	180
5	4123.5	-62.89	5.2	11.35	Vertical	-58.89	-13	45.89	90
6	4948.2	-63.43	5.5	11.95	Vertical	-59.13	-13	46.13	0
7	5772.9	-61.76	5.7	13.55	Vertical	-56.06	-13	43.06	270
8	6597.6	-61.10	6.3	13.75	Vertical	-55.80	-13	42.80	180
9	7422.3	-61.08	6.8	13.85	Vertical	-56.18	-13	43.18	0
10	8247	-61.86	6.9	14.25	Vertical	-56.66	-13	43.66	180

CDMA Cellular CH384

Harmonic	TX ch.384 Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	ERP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	1672.3	-52.28	2	10.75	Vertical	-45.68	-13	39.28	0
3	2509.56	-62.78	2.51	11.05	Vertical	-56.39	-13	43.39	0
4	3346.08	-64.61	4.2	11.15	Vertical	-59.81	-13	46.81	180
5	4182.6	-62.67	5.2	11.15	Vertical	-58.87	-13	45.87	90
6	5019.12	-61.23	5.5	11.95	Vertical	-56.93	-13	43.93	0
7	5855.64	-62.70	5.7	13.55	Vertical	-57.00	-13	44.00	270
8	6692.16	-61.77	6.3	13.75	Vertical	-56.47	-13	43.47	180
9	7528.68	-60.26	6.8	13.85	Vertical	-55.36	-13	42.36	0
10	8365.2	-61.88	6.9	14.25	Vertical	-56.68	-13	43.68	90

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CDMA Cellular CH777

Harmonic	TX ch.777 Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	ERP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	1695.9	-55.04	2	10.15	Vertical	-49.04	-13	36.04	0
3	2544.93	-56.6	2.51	11.05	Vertical	-50.21	-13	37.21	0
4	3393.24	-64.16	4.2	11.15	Vertical	-59.36	-13	46.36	0
5	4241.55	-61.50	5.2	11.15	Vertical	-57.70	-13	44.70	180
6	5089.86	-62.89	5.5	11.95	Vertical	-58.59	-13	45.59	90
7	5938.17	-63.04	5.7	13.55	Vertical	-57.34	-13	44.34	0
8	6786.48	-60.84	6.3	13.75	Vertical	-55.54	-13	42.54	270
9	7634.79	-60.52	6.8	13.85	Vertical	-55.62	-13	42.62	180
10	8483.1	-62.22	6.9	14.25	Vertical	-57.02	-13	44.02	0

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3. Main Test Instruments

No.	Name	Type	Manufacturer	Serial Number	Calibration Date	Valid Period
01	Base Station Simulator	CMU200	R&S	118133	2014-05-26	One year
02	Power Splitter	SHX-GF2-2-13	Hua Xiang	10120101	NA	NA
03	Spectrum Analyzer	E4445A	Agilent	MY46181146	2014-05-26	One year
04	Universal Radio Communication Tester	E5515C	Agilent	MY48367192	2014-05-26	One year
05	Signal Analyzer	FSV30	R&S	100815	2014-05-26	One year
06	Signal generator	SMB 100A	R&S	102594	2014-05-26	One year
07	EMI Test Receiver	ESCI	R&S	100948	2014-05-26	One year
08	Trilog Antenna	VUBL 9163	SCHWARZBECK	9163-201	2012-06-19	Three years
09	Horn Antenna	HF907	R&S	100126	2012-07-01	Three years
10	Climatic Chamber	PT-30B	Re Ce	20101891	2014-09-01	Three years
11	RF coaxial-cable	/	Agilent	/	2014-06-09	Half a year

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

ANNEX A: EUT Appearance and Test Setup

A.1 EUT Appearance



Picture 1 EUT and Auxiliary

A.2 Test Setup



Picture 2: Radiated Spurious Emissions Test setup