

Cover Letter

Federal Communications Commission
Authorization and Evaluation Division

Re: Application for Cellular Transceiver Type Acceptance

QUALCOMM herein submits the Application for Equipment Authorization (FCC Form 731) and Exhibits for Type Acceptance of a Cellular Transceiver, FCC ID J9CQCP-1960.

Applicant: QUALCOMM, INC.
6455 Lusk Blvd.
San Diego, California 92121

Manufacture: QUALCOMM, INC.
10300 Campus Point Drive
San Diego, California 92121

The equipment, QUALCOMM model # QCP 1960, is for mobile station cellular system use, and is in full compliance with all parts of ANSI J-STD-008, Personal Station-Base Station Compatibility Requirements for 1.8 to 2.0 GHz Code Division Multiple Access (CDMA) Personal Communications Systems, issue August 1995.

Request of Confidentiality

Federal Communications Commission
Authorization and Evaluation Division

Re: Request of Confidentiality

Pursuant to Sections 0.457 and 0.459 of the Commission's Rules, the Applicant hereby requests confidential treatment of information accompanying this Application as outlined below:

Description

All schematics/block diagrams
All parts lists

The above materials contain trade secrets and proprietary information not customarily released to the public. The public disclosure of these matters might be harmful to the Applicant and provide unjustified benefits to its competitors.

The Applicant understands that pursuant to Rule 0.457, disclosure of this Application and all accompanying documentation will not be made before the date of the Grant for this Application.

QUALCOMM, INC.

Jay Moulton
Director, Engineer

List of Exhibits

<u>Exhibit</u>	<u>Description</u>	<u>FCC Reference</u>
1	Certification of Test Data	2.911
2	General Information	2.983(c), (d), 2.1061,
3	RF Output Power Measured Data	2.985
4	Occupied Bandwidth Measured Data	2.989, 22.917
5	Conducted Spurious Emissions Measured Data	2.991
6	Frequency Stability vs. Temperature and Voltage Measured Data	2.995
7	Measurement Procedures and Techniques	

Exhibit 1

Certification of Test Data

The data , data evaluation and equipment configuration represented herein are a true and accurate representation of the measurements of the sample's radio frequency interference emissions characteristics as of the dates and at the times of the test under the conditions herein specified. This applies to all tests that where performed that did not require an Open Area Test Site (OATS). Test that required an OATS site were performed by TUV Product Services.

Equipment Tested:

Dates of Test: December 17 – 30, 1998

Test Performed by:

Engineer: Robert J. Scodellaro,

Exhibit 2

General Information

1. Production Plans - Section 2.983 (c)

Quantity Production Planned

2. Technical Description - Section 2.983 (d)

(1) Types of emission

1M25F9W

(2) Frequency range

The frequency range of the equipment is the Personal Communications Services (PCS) bands, 1851.25 – 1908.75 MHz and 1931.25 – 1988.75 MHz. The channel spacing is 1.25 MHz for CDMA.

(3) Operating power levels

The equipment will respond to commands from the Land Station to change power levels as defined in the J-STD 008 Specification.

(4) Maximum output power

The equipment is within the limited 2 watts E.I.R.P. peak power of CFR 47 Part 24.232 (b) and is able to limit the output power to the minimum necessary for successful communications.

(5) DC supply voltage and current range

The equipment is powered by lithium ion rechargeable batteries which have a voltage range of 6.6 to 8.6 Vdc.

(6) List of semiconductor active devices

See separate parts list.

(7) Circuit diagram

See separate schematics.

(8) User's manual

See separate user's guide.

(9) Transmitter adjustment procedure

All frequency adjustments are set at the factory and there are no frequency field adjustments for this product. Under digital mode, frequency is locked to the base station and controlled by VCTCXO adjustments to offset any possible errors.

(10) Frequency stability device

A voltage controlled, temperature compensated, crystal oscillator (VCTCXO) is employed as a frequency reference for all of the transceiver local oscillators. This crystal oscillator is specified to remain within +/- 2.5 ppm over temperature and voltage variations. The lock status indicator of all synthesizers is monitored by the microprocessor and an out of lock condition will inhibit transmission. The mobile receiver monitors the received signal and adjusts the frequency of the VCTCXO, this corrects any errors between the mobile frequency and the base station transmitter. The mobile is locked to the base station.

(11) Spurious radiation suppression devices

Reference Designator	Part Name	Function
FL1	duplexer	Provides protection against transmitter spurious emissions and receiver local oscillator leakages.
FL2	RX ceramic filter	Provides protection against receiver local oscillator leakages.
FL 3 and 4	TX filter	Provides suppression of spurious energy and transmitter harmonics.

(12) Modulation techniques

CDMA

The CDMA modulation is described in the following pages from the TIA/EIA /IS-95 Standard. The justification for the CDMA bandwidth of 1.25 MHz is that the chip rate is 1.228 MHz (see page 6-10 of IS-95). When we look 3 dB down from the signal we find 1.25 MHz. Channel spacing is normally set at this 1.25 MHz. Also, one can reference baseband filtering requirements (page 6-27 TIA/EIA/IS-95) for filtering frequency response limits.

6.1.3 Modulation Characteristics

6.1.3.1 Reverse CDMA Channel Signals

The Reverse CDMA Channel is composed of Access Channels and Reverse Traffic Channels. These channels shall share the same CDMA frequency assignment using direct-sequence CDMA techniques. Figure 6.1.3.1-1 shows an example of all of the signals received by a base station on the Reverse CDMA Channel. Each Traffic Channel is identified by a distinct user long code sequence; each Access Channel is identified by a distinct Access Channel long code sequence. Multiple Reverse CDMA Channels may be used by a base station in a frequency division multiplexed manner.

The Reverse CDMA Channel has the overall structure shown in Figure 6.1.3.1-2. Data transmitted on the Reverse CDMA Channel is grouped into 20 ms frames. All data transmitted on the Reverse CDMA Channel is **convolutionally** encoded, block interleaved, modulated by the **64-ary** orthogonal modulation, and direct-sequence spread prior to transmission.

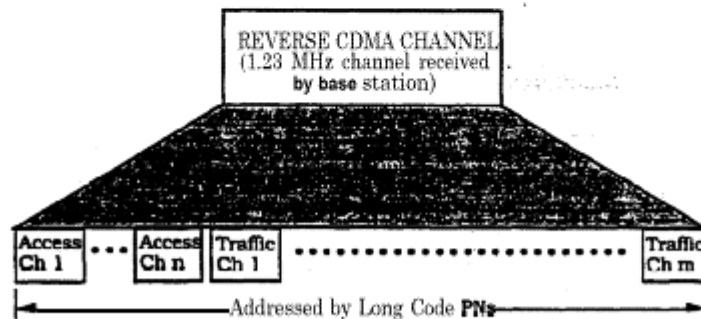


Figure 6.1.3.1-1. Example of Logical Reverse CDMA Channels Received at a Base Station

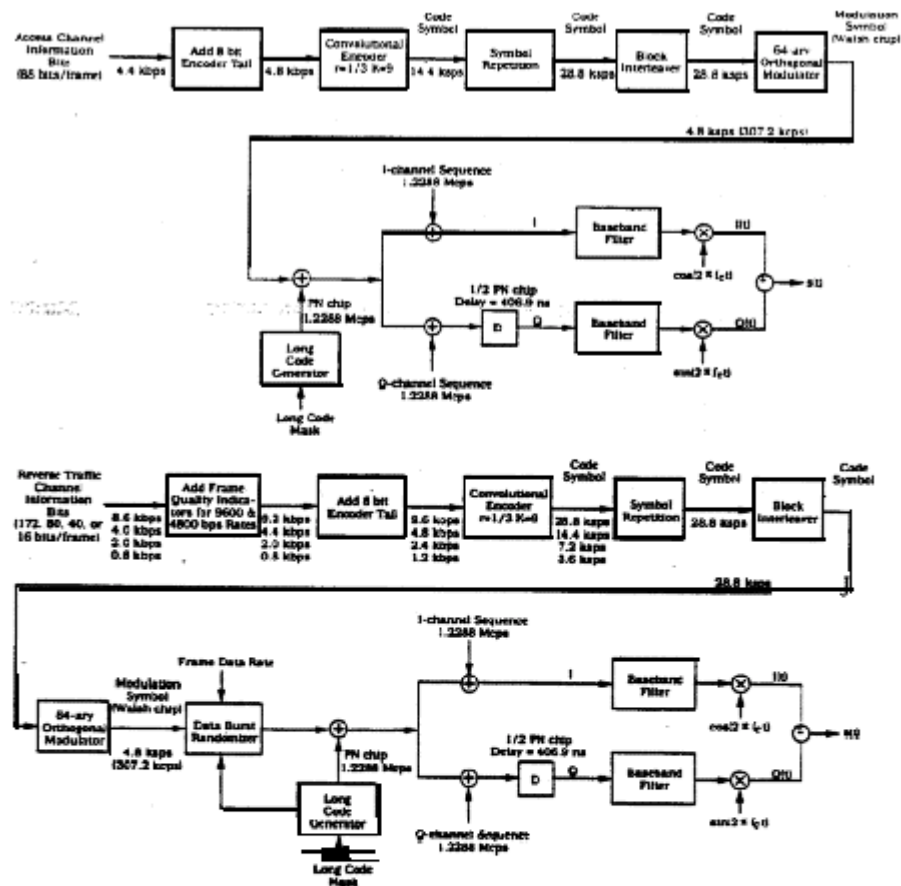


Figure 6.1.3.1-2. Reverse CDMA Channel Structure

After adding frame quality indicators for both the 9600 bps and 4800 bps rates (see 6.1.3.3.2.1) and adding eight Encoder Tail Bits (see 6.1.3.3.2.2), data frames may be transmitted on the Reverse **Traffic** Channel at data rates of 9600, **4800**, **2400**, and 1200 bps. The Reverse **Traffic** Channel may use any of these **data** rates for transmission. The transmission duty cycle on the Reverse Traffic Channel varies with the transmission data rate. Specifically, the transmission duty cycle for 9600 bps frames is 100 percent, the transmission duty cycle for 4800 bps frames is 50 percent, the transmission duty cycle for 2400 bps frames is 25 percent, and the **transmission** duty cycle for 1200 bps frames is 12.5 percent as shown in Table 6.1.3.1.1-1. As the duty cycle for transmission varies **proportionately** with the data rate, the actual burst transmission rate is fixed at 28.800

code symbols per second. Since ~~six~~ code symbols are modulated as one of 64 modulation symbols for transmission, the modulation **symbol** transmission rate is fixed at 4800 modulation symbols per second. This results in a **fixed** Walsh chip rate of 307.2 kcps. The rate of the spreading PN sequence is fixed at 1.2288 Mcps, so that each Walsh chip is spread by four PN chips. Table 6.1.3.1.1- 1 defines the signal rates and their relationship for the various transmission rates on the Reverse Traffic Channel.

The numerology is identical for the Access Channel except that the transmission rate is **fixed** at 4800 bps after adding eight Encoder Tail Bits (see 6.1.3.2.2). Each code symbol is repeated once, and the transmission duty cycle is 100 percent. Table 6.1.3.1.1-2 defines the signal rates and their relationship on the Access Channel.

6.1.3.1.1 Modulation Parameters

The modulation parameters for the Reverse Traffic Channel and the Access Channel are shown in Table 6.1.3.1.1- 1 and Table 6.1.3.1.1-2, respectively.

Table 6.1.3.1.1-1. Reverse Traffic Channel Modulation Parameters

Parameter	Data Rate (bps)				Units
	9600	4800	2400	1200	
PN Chip Rate	1.2288	1.2288	1.2288	1.2288	Mcps
Code Rate	1/3	1/3	1/3	1/3	bits/code sym
Transmit Duty Cycle	100.0	50.0	25.0	12.5	%
Code Symbol Rate	28,800	28,800	28,800	28,800	sps
Modulation	6	6	6	6	code sym/mod symbol
Modulation Symbol Rate	4800	4800	4800	4800	sps
Walsh Chip Rate	307.20	307.20	307.20	307.20	kcps
Mod Symbol Duration	208.33	208.33	208.33	208.33	μ s
PN Chips/Code Symbol	42.67	42.67	42.67	42.67	PN chip/code symbol
PN Chips/Mod symbol	256	256	256	256	PN chip/mod symbol
PN Chips/Walsh Chip	4	4	4	4	PN chips/Walsh chip

Table 6.1.3.1.1-2. Access Channel Modulation Parameters

Parameter	Data Rate (bps)	Units
	4800	
PN Chip Rate	1.2288	Mcps
Code Rate	1/3	bits/code sym
Code Symbol Repetition	2	symbols/code sym
Transmit Duty Cycle	100.0	%
Code Symbol Rate	28.800	sps
Modulation	6	code sym/mod symbol
Modulation Symbol Rate	4 8 0 0	sps
Walsh Chip Rate	307.20	kcps
Mod Symbol Duration	208.33	μs
PN Chips/Code Symbol	42.67	PN chip/code sym
PN Chips/Mod symbol	256	PN chip/mod symbol
PN Chips/Walsh Chip	4	PN chips/Walsh chip

6.1.3.1.2 Data Rates

The Access Channel shall support fixed data rate operation at 4800 bps.

The Reverse Traffic Channel shall support variable data rate operation at 9600, 4800, 2400, and 1200 bps.

6.1.3.1.3 Convolutional Encoding

The mobile station shall convolutionally encode the data transmitted on the Reverse Traffic Channel and the Access Channel prior to interleaving. The convolutional code shall be rate 1/3 and has a constraint length of 9. The generator functions for this code shall be g_0 equals 557 (octal), g_1 equals 663 (octal), and g_2 equals 711 (octal). This is a rate 1/3 code generating three code symbols for each data bit input to the encoder. These code symbols shall be output so that the code symbol (c_0) encoded with generator function g_0 shall be output first, the code symbol (c_1) encoded with generator function g_1 shall be output second, and the code symbol (c_2) encoded with generator function g_2 shall be output last. The state of the convolutional encoder, upon initialization, shall be the all-zero state. The first code symbol output after initialization shall be a code symbol encoded with generator function g_0 .

Convolutional encoding involves the modulo-2 addition of selected taps of a serially time-delayed data sequence. The length of the data sequence delay is equal to $K-1$, where K is the constraint length of the code. Figure 6.1.3-1 illustrates the encoder for the code specified in this section.

6.1.3.1.10 Baseband Filtering

Following the spreading operation, the **I** and **Q** impulses are applied to the inputs of the **I** and **Q** baseband filters as shown in Figure 6.1.3.1-Z. The baseband filters shall have a frequency response $S(f)$ that satisfies the limits given in Figure 6.1.3.1.10-1. Specifically, the normalized frequency response of the filter shall be contained within $\pm\delta_1$ in the **passband** $0 \leq f \leq f_p$ and shall be less than or equal to -62 in the **stopband** $f \geq f_s$. The numerical values for the parameters are $\delta_1 = 1.5$ dB, $\delta_2 = 40$ dB, $f_p = 590$ kHz, and $f_s = 740$ kHz.

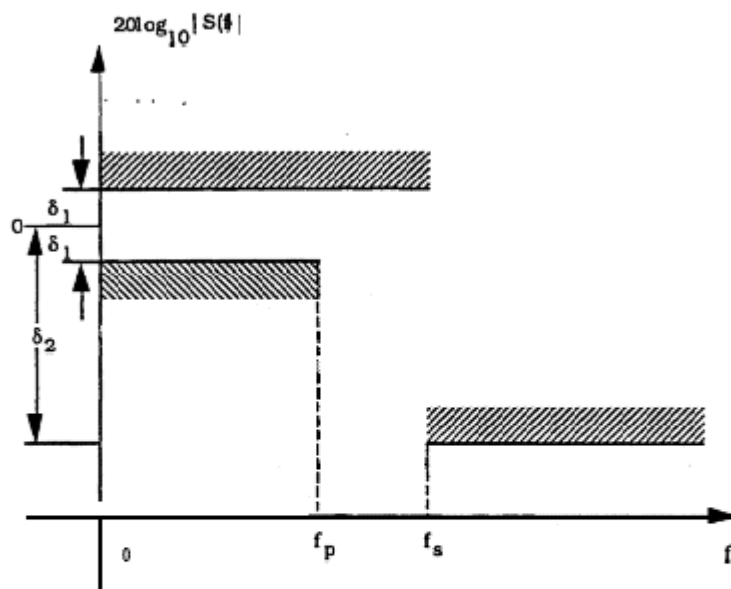


Figure 6.1.3.1.10-L Baseband Filters Frequency Response Limits

Let $s(t)$ be the impulse response of the baseband filter. Then $s(t)$ should satisfy the following equation:

$$\text{Mean Squared Error} = \sum_{k=0}^{\infty} [\alpha s(kT_s + \tau) - h(k)]^2 \leq 0.03,$$

where the constants α and τ are used to minimize the mean squared error. The constant T_s is equal to 203.451... ns, which equals one quarter of a PN chip. The values of the coefficients $h(k)$, for $k < 48$, are given in Table 6.1.3.1.10-1: $h(k) = 0$ for $k \geq 48$. Note that $h(k)$ equals $h(47 - k)$.

Exhibit 3**Transmitter RF Power - FCC part 2.985 (a)****Transmitter RF Power Output - FCC part 2, Paragraph 2.985 (a)**

The RF output power was measured using a HP 8594 Spectrum Analyzer that has the CDMA personality option. Terminated to a resistive coaxial load of 50 ohms.

		RF output power (W)
carrier frequency (MHz)	channel	CDMA
		measured
1851.25	25	0.15
1880	600	0.15
1908.75	1175	0.14

Transmitter RF Power Output - FCC part 24, Paragraph 24.232 (b)

The RF output power was measured using the isotropic equation, $P = (E \times D)^2 / 30$, where E is the field strength in V/m, D is the distance at 3 meters and P is the output power in watts.

carrier frequency (MHz)	channel	RF output power (W)
		CDMA
		measured
1851.25	25	0.403
1880	600	0.403
1908.75	1175	0.370

Exhibit 4

Occupied Bandwidth Measured Data

Plots are in a separate PDF file.

Exhibit 5**Conducted Emissions Test Results****Conducted Emission Test Results - FCC Part 2.991, 24.238**

Measured with a HP 8593 spectrum analyzer.

Total measured cable loss in front of spectrum analyzer :

0.8 dB

	low band - channel 25				mid band - channel 600			
	freq (MHz)	measured level (dBm)	actual level (dBm)	specification limit (dBm)	freq (MHz)	measured level (dBm)	actual level (dBm)	specification limit (dBm)
1	1851.25	21.7	22.5	-	1880	21.7	22.5	-
2	3702.5	-48.4	-47.6	-13	3760	-49.9	-49.1	-13
3	5553.75	-49.3	-48.5	-13	5640	-48.6	-47.8	-13
4	7405	-55.8	-55.0	-13	7520	-55.1	-54.3	-13
5	9256.25	-57.8	-57.0	-13	9400	-67.1	-66.3	-13
6	11107.5	<-78.3	<-77.5	-13	11280	<-79.8	<-79.0	-13
7	12958.75	<-76.8	<-76.0	-13	13160	<-77.0	<-76.2	-13
8	14810	<-76.9	<-76.1	-13	15040	<-87.7	<-86.9	-13
9	16661.25	<-88.2	<-87.4	-13	16920	<-85.1	<-84.3	-13
10	18512.5	<-87.6	<-86.8	-13	18800	<-86.5	<-85.7	-13

Exhibit 6**Transmitter RF Carrier Frequency Stability****Transmitter RF Carrier Frequency Stability - FCC part 2, Paragraph 2.995
Phone transmitting in CDMA mode, but with no modulation on the
carrier**

Measured with a HP8560A Spectrum Analyzer

Carrier Frequency : 1880 MHz CDMA

temperature (C)	transmitter carrier frequency (MHz)							specification	
	6.6V	7.0V	7.3V	7.6V	7.9V	8.2V	8.6V	lower limit	upper limit
-30	1105	1218	1176	1160	1151	1140	1093	-4700	4700
-20	378	365	356	428	398	390	381	-4700	4700
-10	380	386	343	358	362	370	375	-4700	4700
0	447	452	448	405	420	409	442	-4700	4700
10	423	428	405	412	429	430	427	-4700	4700
20	47	45	48	0	48	55	32	-4700	4700
30	215	192	185	273	245	228	210	-4700	4700
40	-486	-493	-388	-420	-436	-468	-485	-4700	4700
50	-686	-703	-718	-610	-631	-646	-673	-4700	4700
60	-1595	-1581	-1538	-1523	-1570	-1588	-1563	-4700	4700

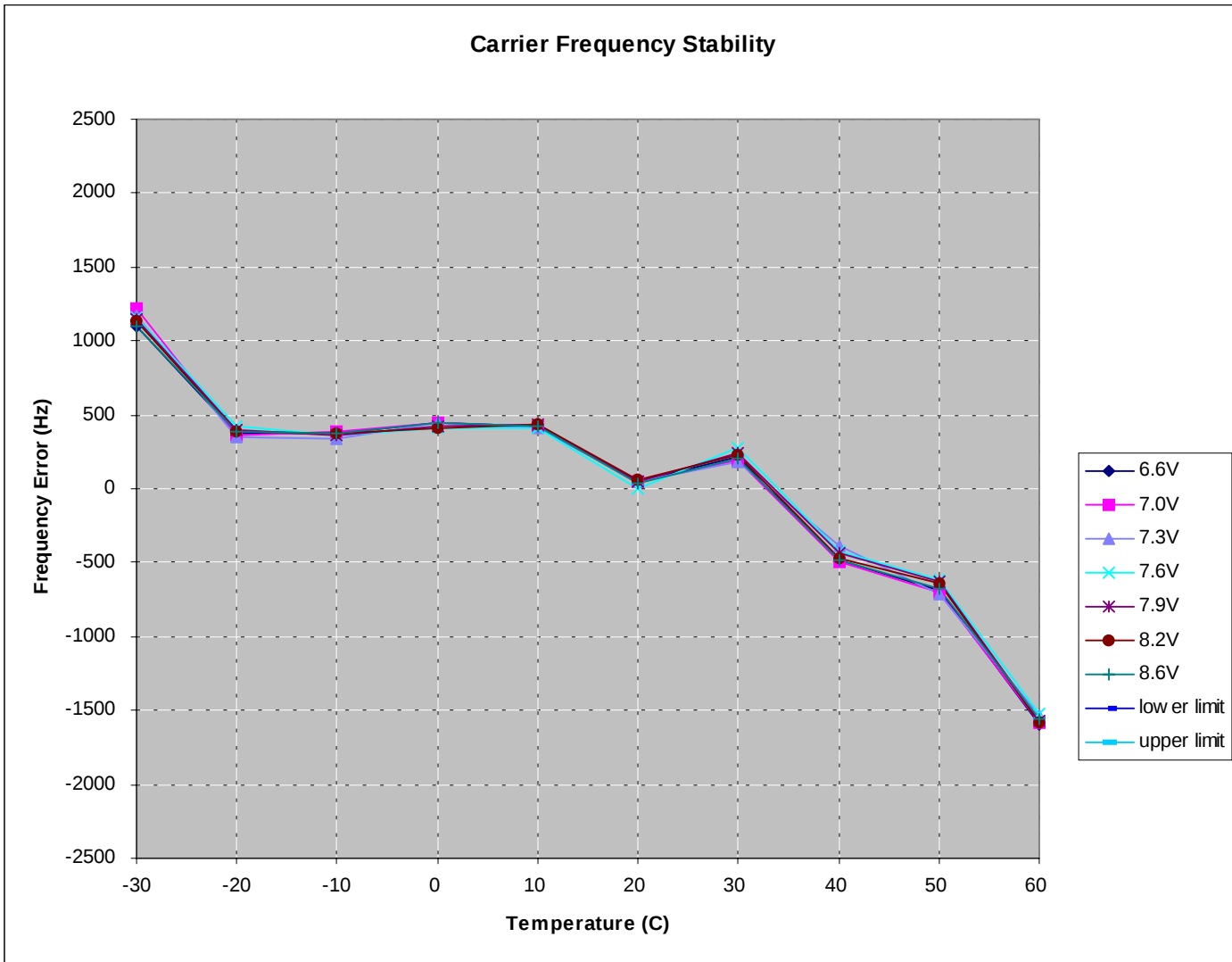


Exhibit 7**Measurement Procedures and Techniques***List of Equipment*

Computer with Phone_T software

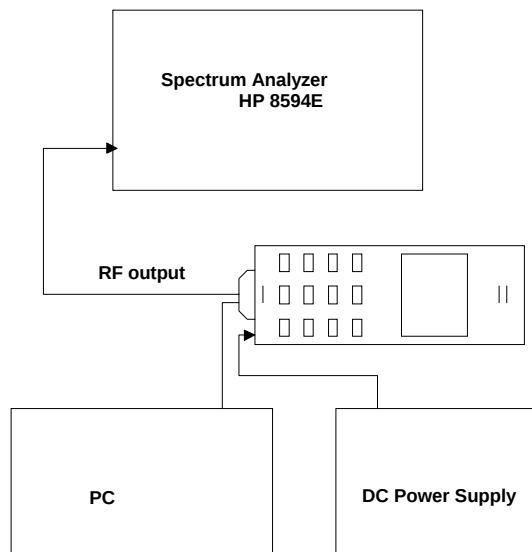
Spectrum Analyzers

HP8560E, S/N 3643A0680, CAL DUE 8/99

HP8594E, S/N 3733U03464, CAL DUE 12/17/99

HP8593E, S/N 3501A01547, CAL DUE 2/23/99

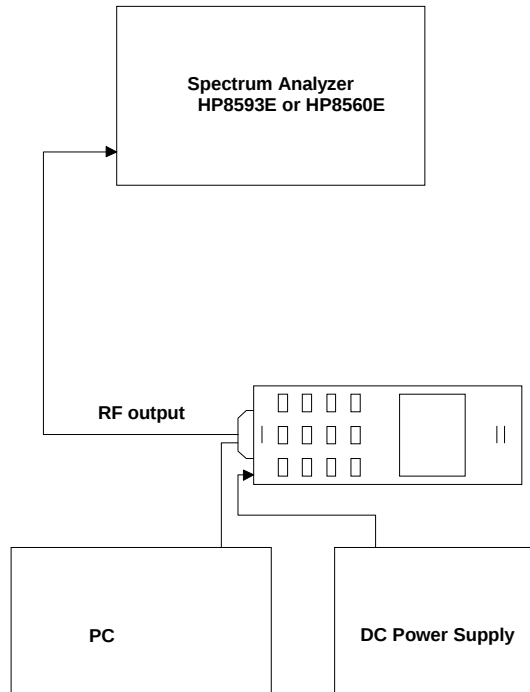
DC Power Supply

*Measurement Procedures***RF Output Power**

Definition - The output power rating of the transmitter is the power available at the output terminal of the transmitter when the terminal is connected to the normal load.

Method of Measurement - Measure the transmitter output carrier power with CDMA modulation. An HP 8594E spectrum analyzer with the CDMA personality was used to make the measurement.

Minimum Standard - The transmitter output power shall be maintained within +2 / -4 dB.

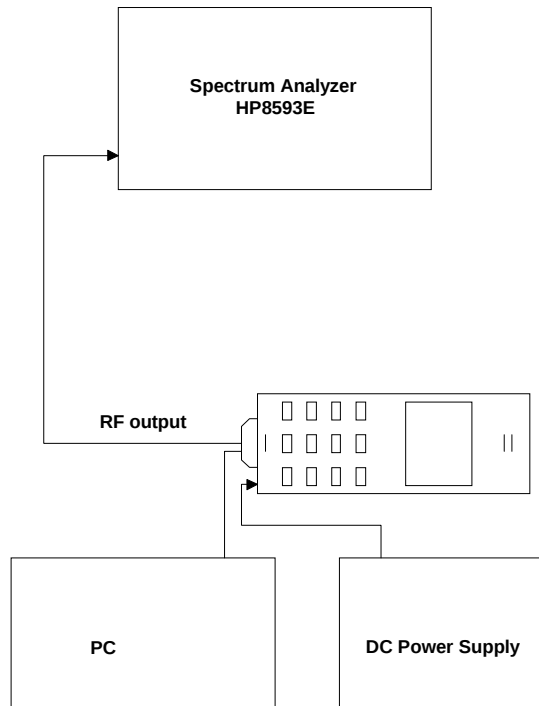
Occupied Bandwidth

Definition - The occupied bandwidth is defined as the spectrum noise produced at discrete frequency separations from the carrier due to all sources of unwanted noise within the transmitter in a modulated condition.

Method of Measurement - Use the spectrum analyzer and measure the CDMA spectrum, modulate with full rate.

Minimum Standard - The mean power of emissions from the transmitter with modulated carrier shall be attenuated below the mean power of the modulated carrier in accordance with the following.

- (1) Any frequency outside the licensed PCS frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least $43 + 10 \log (P)$ dB, which is 35 dB.
- (2) For the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

Conducted Spurious and Harmonic Emissions at Antenna Terminal

Definition - The conducted harmonic and spurious emissions are emissions at the antenna terminals on a frequency or frequencies that are outside the authorized bandwidth of the transmitter.

Method of Measurement - The transmitter shall be modulated with CDMA at full rate. The measurement shall be made with a spectrum analyzer from the lowest radio frequency generated in the equipment to the 10th harmonic of the carrier.

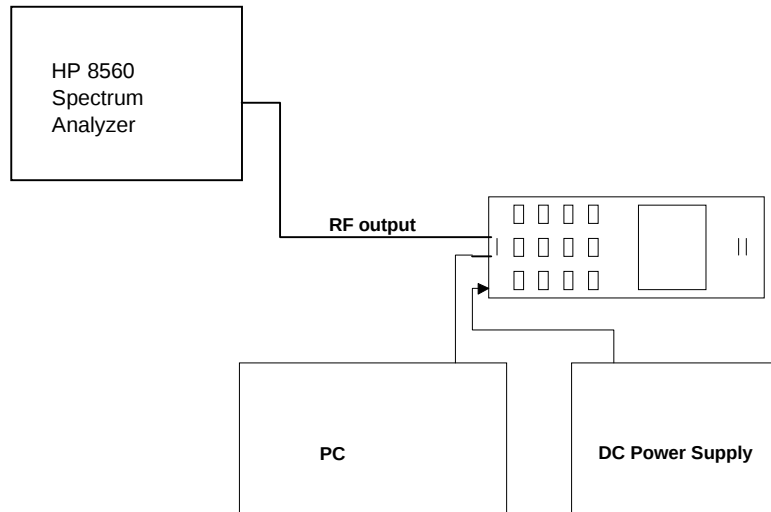
Minimum Standard - Conducted harmonic and spurious emissions shall be attenuated below the level of emissions of the carrier frequency by at least $43 + 10 \log$ (mean output power in Watts) dB.

Radiated Spurious and Harmonic Radiation

Definition - The radiated spurious emissions are emissions from the subscriber unit with the attached antenna fully extended. The radiated spurious emissions include those emissions radiated from the attached antenna as well as the equipment cabinet and attached cables.

Method of Measurement - The measurement shall be conducted at standard radiation test site with a search antenna which is movable vertically and is rotatable 90 degrees for vertically and horizontally polarized signals.

Minimum Standard - Radiated spurious emissions shall be attenuated below the maximum level of emission of the carrier frequency by at least $43 + 10 \log$ (mean output power in Watts) dB.

Frequency Stability

Definition - The frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

Method of Measurement - Use the spectrum analyzer to sample the transmitter RF output signal and measure its frequency. Vary the ambient temperature from -30 to +60 °C, and also vary the DC supply voltage to the equipment from 3.4 to 4.1 V at each temperature.

Minimum Standard - The transmitter carrier frequency shall be maintained within ± 2.5 ppm.