

# Agilent PN 8935/8921-1

## Optimum Power Measurements Using Agilent Base Station Test Sets

Product Note



- 8935 Series E6380A CDMA Cellular/PCS Base Station Test Set
- 8921A Option 600 CDMA Cell Site Test System



### Introduction

In wireless communications, it is critical to accurately measure the power transmitted by the base station to maximize the capacity of the system and improve the quality of communication. The objective of this paper is to assist you in using the E6380A and the 8921A Option 600 to make optimum power measurements of the signal transmitted by the base station.

The paper is divided into eight sections. The first two sections briefly discuss the definition of power, different terms used to describe power, and the units used to express power values. The third section in the paper establishes the importance of power measurement in wireless communication. Finally, the last five sections are dedicated to discussing the power measurement methods available on the E6380A and the 8921A Option 600. The sections are:

1. Peak power measurement
2. Average power measurement
3. Channel power measurement
4. Power measurement using the spectrum analyzer
5. Code domain power measurement

### The discussion will include the following:

- Description of the power measurement method
- Availability of the power measurement method on the E6380A and the 8921A Option 600
- How each power measurement method is implemented on the E6380A and the 8921A Option 600
- When each power measurement method should be used
- Step-by-step procedure using the E6380A or the 8921A Option 600 to perform each power measurement method



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## 1. What is Power?

Power is defined as the rate of energy transfer. The unit of power, watt, is the energy transfer at the rate of one joule per second. In the DC world, the power dissipating through a circuit element is calculated by taking the product of the current through this element and the voltage drop across the element,

$$P_{dc} = V \times I$$

The power dissipated is constant over time as long as no changes are applied to the signal source. On the other hand, when dealing with AC signals, the product of the voltage and current varies with time and so does the instantaneous power. As a result, when measuring the power of an AC signal, we typically report the power dissipated over a period of time.

## 2. Units of Power

The International System unit for power is the Watt. This unit provides an absolute measure of the power and is equivalent to one joule of energy transfer over one second of time. In many cases the ratio of two powers is desired instead of the absolute power. When measuring the gain through a system, for example, we would like to measure the ratio of the output power from the system to the input power to the system. This relative power measurement is typically expressed in decibels (dB). Power ratios are expressed in decibels using the following equation:

$$\text{relative power (dB)} = 10 \log_{10} \frac{P_2(\text{watt})}{P_1(\text{watt})}$$

For example, 0 dB corresponds to a power ratio in which  $P_2$  is equal to  $P_1$  and, similarly, -3 dB corresponds to a power ratio in which  $P_2$  is equal to half  $P_1$ . Decibels provide a simple and compact notation for expressing relative power values. Because of the simplicity of using decibels, an absolute power decibel unit is also used, dBm. This unit measures the absolute power levels relative to 1 milliwatt. Absolute powers are expressed in dBm using the following equation:

$$\text{absolute power (dBm)} = 10 \log_{10} \frac{P(\text{milliwatt})}{1 \text{ milliwatt}}$$

For example, 1 watt is equal to 30 dBm and 1 milliwatt is equal to 0 dBm. While dBm is a power measurement unit, dB can be also used to express voltage ratios as shown below:

$$\begin{aligned} \text{relative measurement (dB)} &= 10 \log_{10} \frac{P_2}{P_1} \\ &= 10 \log_{10} \frac{V_2^2}{V_1^2} = 10 \log_{10} \left( \frac{V_2}{V_1} \right)^2 \\ &= 20 \log_{10} \frac{V_2 \text{ (Volts)}}{V_1 \text{ (Volts)}} \end{aligned}$$

For example, 0 dB corresponds to a voltage ratio in which  $V_2$  is equal to  $V_1$  and, similarly, -6 dB corresponds to a voltage ratio in which  $V_2$  is equal to half  $V_1$ .

### 3. Power Measurement is Important

The basic components of a wireless communication system are shown in Figure 1. The base station (BTS) links the mobile telephones to the Mobile Telephone Switching Office (MTSO). The MTSO controls the base station and links the wireless system to the landline network (Public Switched Telephone Network).

When a base station is installed, it is configured to cover a specific geographic area. The coverage area depends on the power of the signal transmitted by the base station. To enable communication between the base station and the mobiles existing in its defined coverage area, the base station has to transmit at a minimum power level. If the power of the transmitted signal drops below this minimum level, the area covered by the base station shrinks, calls are dropped, and revenue is lost.

At the same time service providers want to maintain the planned coverage area for the base station, they also want to minimize the power transmitted by the base station. The higher the power of the signal transmitted by one base station site, the more the interference with other signals transmitted by neighboring sites on the same frequency. In CDMA, all channels within one cell can be transmitted at the same frequency and, as a result, higher transmission power increases the interference among the active channels inside any one cell. High interference results in poor communication quality, reduced system capacity and, in the end, customer dissatisfaction and loss of revenue and market share.

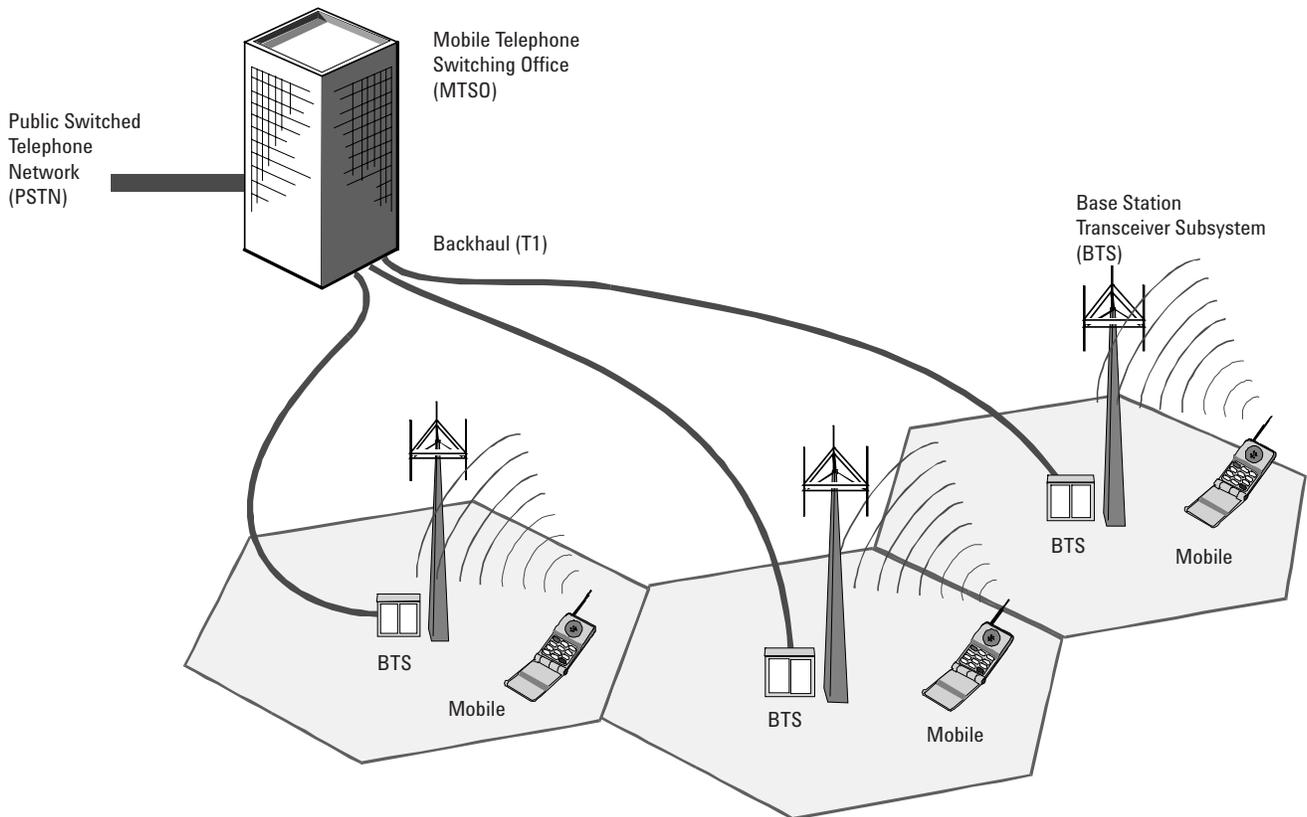


Figure 1. Main Components of a Communication Network

As you see, it is critical that the base station transmits accurate power levels to maximize the system performance. To achieve an accurate power level transmission, service providers need an accurate power measurement tool. Let's look at an example to better understand the kind of accuracy needed. An inaccuracy in the measured power of 1 dB can equate to reducing the transmitted power output by more than 20.5%:

$$\text{Power Inaccuracy} = 10 \log \frac{\text{Actual Transmitted Power}}{\text{Needed Power}}$$

$$\frac{\text{Actual Transmitted Power}}{\text{Needed Power}} = 10^{\frac{\text{Power Inaccuracy (dB)}}{10}} = 10^{\frac{-1}{10}} \approx 0.795$$

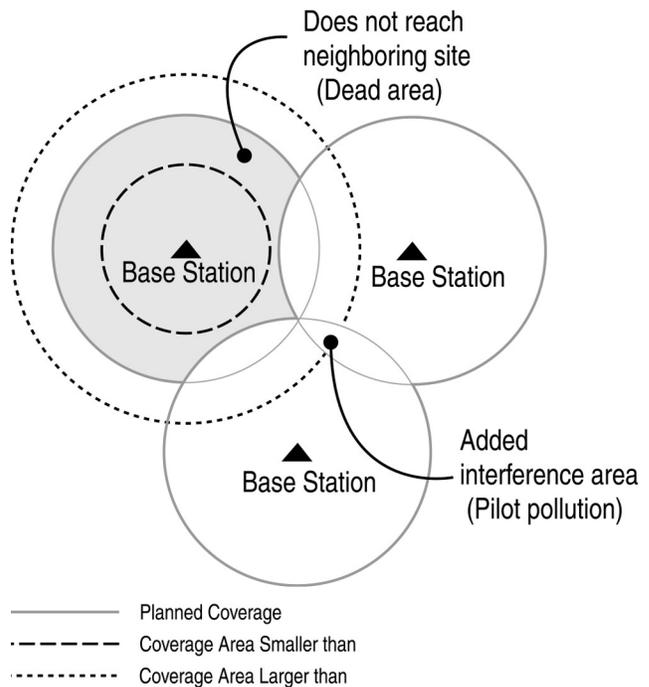
Since the coverage distance is proportional to the square root of the transmitted power, then a 20.5% reduction in the transmitted power results in approximately 11.8% reduction in the radial coverage distance and, as a result, the coverage area is reduced by approximately 20.5%,

$$\frac{\text{Actual Coverage Area}}{\text{Planned Coverage Area}} = \frac{\pi \times \left( \frac{\text{Actual Radial Coverage}}{\text{Planned Radial Coverage}} \right)^2}{\pi \times \left( \frac{\text{Planned Radial Coverage}}{\text{Planned Radial Coverage}} \right)^2} = \frac{\pi \times (0.892)^2}{\pi \times (1.0)^2} \approx 0.795$$

Figure 2 shows a graphical depiction of a system of three CDMA base stations. The solid line shows the planned coverage area for each of the three base stations, while the dotted lines show the actual coverage area when the transmitted power is lower or higher than planned.

As shown, if the transmitted power from the base station is lower than planned, the actual coverage area is smaller (internal dashed circle), resulting in a dead area. Mobiles within the dead area are not able to start or receive a call. Also, other mobiles traveling inside the dead area drop their existing calls. Another situation arises when the power transmitted from the base station is higher than planned. A mobile normally receiving two pilot signals, as shown in Figure 3, now receives three pilot signals. This "Pilot Pollution" condition adds to the interference in the system and reduces the overall capacity.

We have established the importance of accurately measuring the power transmitted from the base station. The remainder of this paper will discuss the different power measurement methods that are available using the Agilent E6380A and the 8921A Option 600. Focus will be on measuring the power transmitted from the base station to the mobile (Forward link).



**Figure 2. Graphical Depiction of a CDMA System**

## 4. Peak Power Measurement

This measurement is intended to accurately measure the peak power in the envelope of the RF signal. An RF detector diode is used to detect the envelope of the RF carrier. Then a modulation peak detector captures the peak excursions of the envelope and converts them to DC voltage values. Every DC voltage value is, in turn, converted to power and displayed.

### Availability

Both the Agilent 8921A and the E6380A provide peak power measurements using the RF Analyzer screen.

### Implementation

As shown in Figure 3, two diode detectors are used. The first detector (Envelope Detector) converts the envelope of the RF signal to baseband, while the second detector (Modulation Peak Detector) detects the peak voltage of the envelope. The measurement starts by discharging the modulation peak detector using the discharge switch. The discharge switch is then opened to allow the modulation peak detector to charge. After a specific period of time, the voltage across CPD is measured using an internal voltmeter.

Now that the voltage value is measured, it is taken through a number crunching algorithm that performs temperature and frequency compensations and calculates the peak power. The calculated peak power value is then displayed. Figure 3 shows how the peak power of a simple amplitude modulated signal is measured using the 8921A or the E6380A.

### Application

Peak power measurement is useful whenever the peak power value of an RF signal is needed. For example, peak power measurement can be used to measure the peak transmit power of an AM radio station. In constant envelope signals, the peak power is equal to the average power of the signal. As a result, peak power measurements can be used to measure the average power of signals with constant envelope modulation such as FM and GSM.

**NOTE:** This measurement should NOT be used to measure the average power of signals with varying modulation envelope such as CDMA or TDMA signals. CDMA has a high crest factor that causes the peak power of the signal to be significantly higher than its average power.

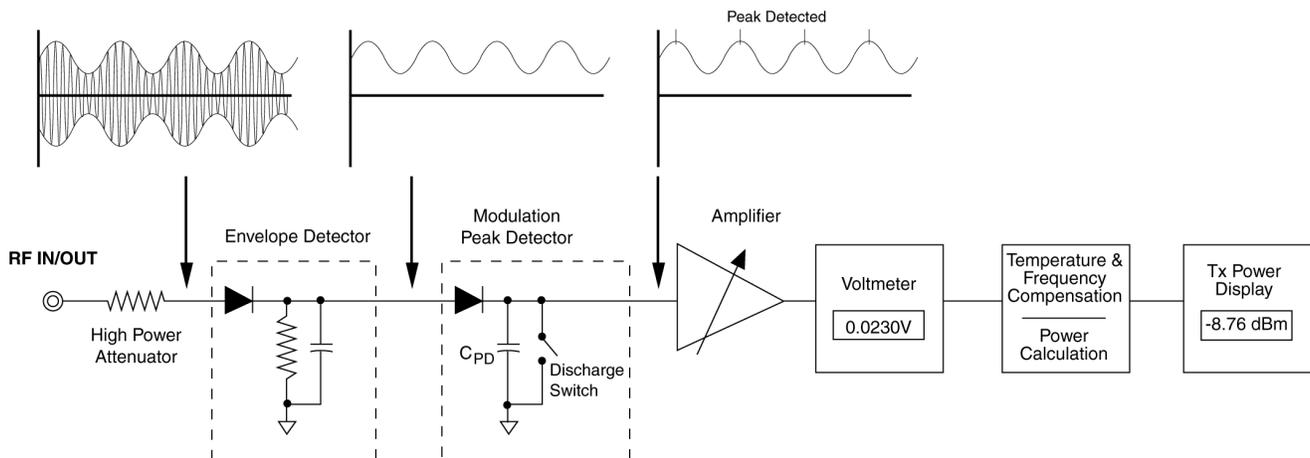


Figure 3. Peak Power Measurement Using the Agilent E6380A or 8921A Test Set

### Procedure Using the E6380A Test Set

1. Connect the RF signal to the RF IN/OUT port on the side panel of the E6380A.
2. Press the **RF Analyzer** key on the front panel of the E6380A. The RF ANALYZER screen appears (see Figure 4).
3. Under the **Tune Freq** field, enter the carrier frequency of the RF signal.
4. Under **Input Port** field, select **RF In**.

**NOTE:** To measure the power using the RF Analyzer, the signal must be supplied to the RF IN/OUT port. The ANT IN port can not be used to make this measurement.

5. Under **TX Pwr Meas**, select **Peak**.
6. Under **TX Pwr Zero**, select **Zero** to zero the power meter. You do NOT have to remove the signal from the RF IN/OUT port.

**NOTE:** The E6380A has an internal RF switch to remove the power from the power detector. This insures accurate zeroing without the need to remove the signal from the RF IN/OUT port.

7. The peak power measurement appears under **TX Power**. To change the unit of measurement, place the cursor on the current unit field and press the key for the desired unit on the front panel of the E6380A.

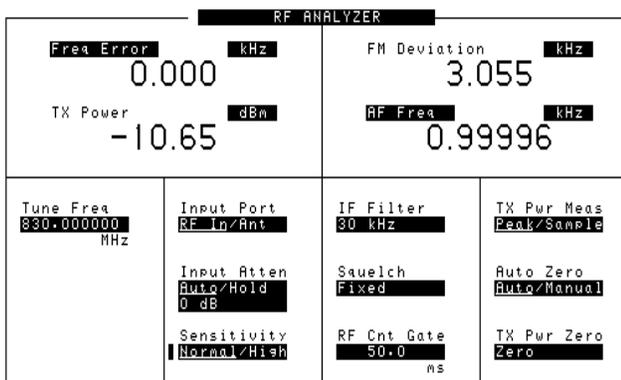


Figure 4. RF ANALYZER Screen on the E6380A Test Set

### Procedure Using the 8921A Option 600

1. From the **To Screen** menu, select **RF ANL**. The RF ANALYZER screen appears, see Figure 3.
2. Under the **Tune Freq** field, enter the carrier frequency of the RF signal.
3. Under **Input Port**, select **RF In**.

**NOTE:** To measure the power using the RF Analyzer, the signal must be supplied to the RF IN/OUT port. The ANT IN port cannot be used to make this measurement.

4. Under **TX Pwr Zero**, select **Zero** to zero the power meter. Disconnect any signals connected to the RF IN/OUT port before performing this step.
5. Connect the RF signal to the RF IN/OUT port on the front panel of the 8921A.
6. The peak power measurement appears under the **TX Power** field. To change the unit of measurement, place the cursor on the current unit field and press the key for the desired unit on the front panel of the 8921A.

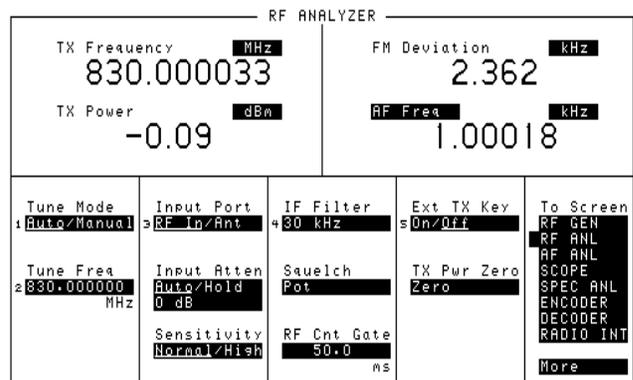


Figure 5. RF ANALYZER Screen on the 8921A

### 5. Average Power Measurement

The purpose of this measurement is to measure the average power of the RF signal. This measurement is designed to handle signals with changing modulation envelope such as CDMA (defined by IS-95). In general, there are two main methods for measuring the average power of a signal. The first method uses a diode operating in its square law region, while the second method uses a thermal detection element such as a thermocouple or a thermistor.

When using the first method, the diode equation describes the relationship between the current flowing through the diode and the voltage drop across it as shown below

$$i = I_s(e^{aV} - 1)$$

Where  $a = q/nKT$ ,  $I_s$  is the saturation current,  $i$  is the diode current,  $V$  is the voltage across the diode,  $K$  is Boltzmann's constant,  $T$  is the absolute temperature,  $q$  is the charge of one electron, and  $n$  is a factor that is used to fit the equation to experimental data.

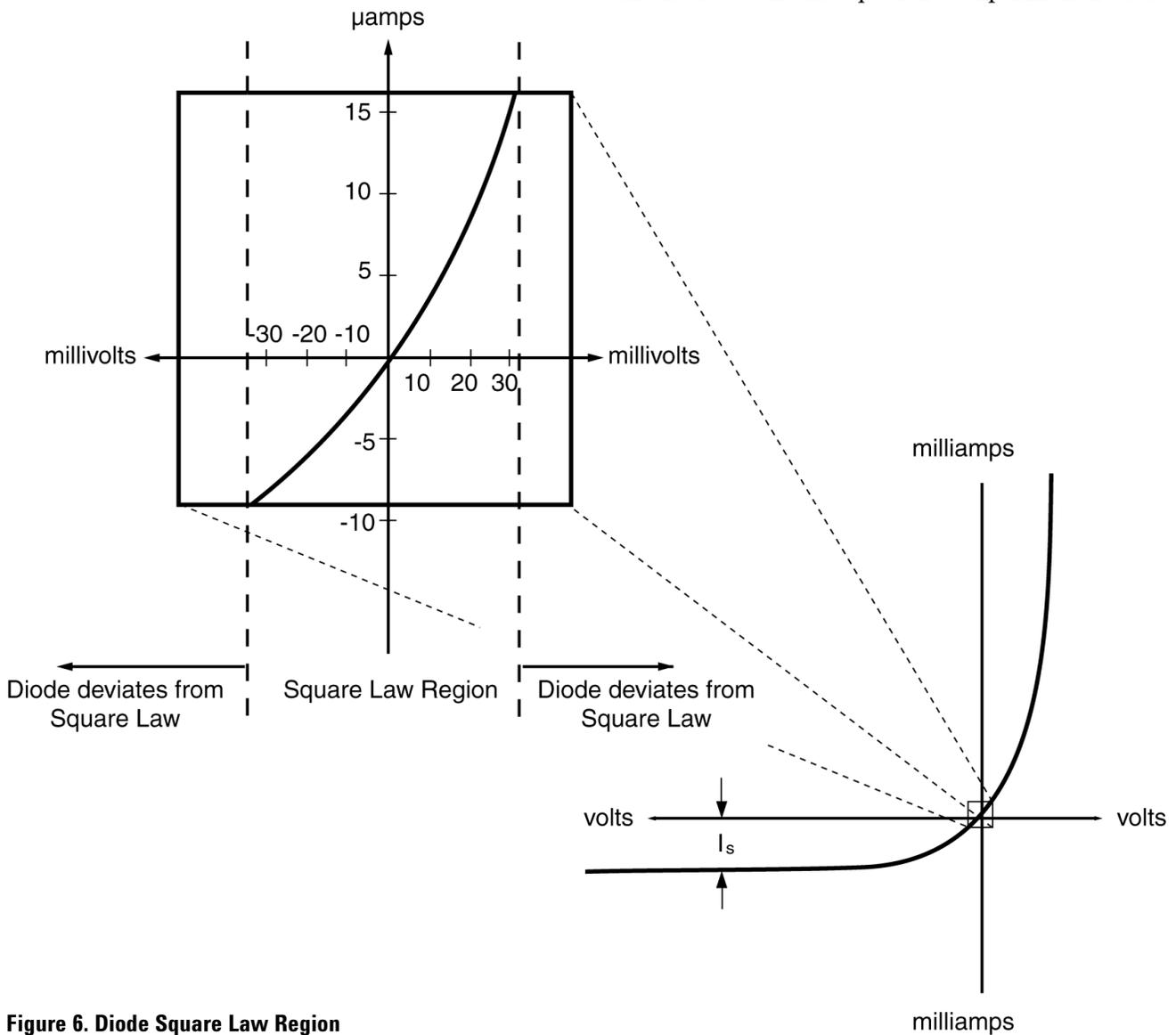


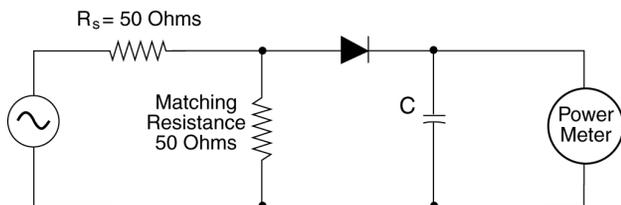
Figure 6. Diode Square Law Region

Using the power series, the diode equation can be expressed as follows:

$$i = I_s \left( \alpha v + \frac{(\alpha v)^2}{2!} + \frac{(\alpha v)^3}{3!} + \dots \right)$$

The even-order terms of the power series describe the diode rectification property. For small signals, only the second-order term is significant and thus when small signals are used the diode is said to be operating in the square law region (See Figure 6).

Notice that when the diode is operating in the square law region, the diode current is proportional to the square of the voltage drop across the diode. In other words, the diode current is proportional to the power dissipated in the diode. The diode current can then be used to provide a measure of the average power dissipated in the diode. To get an accurate average power measurement, it is important the diode provides a good impedance match to the power source. Since a typical diode has a high impedance value, matching impedance is used to minimize the reflection coefficient at the diode (See Figure 7).



**Figure 7. Average Power Measurement Using a Diode**

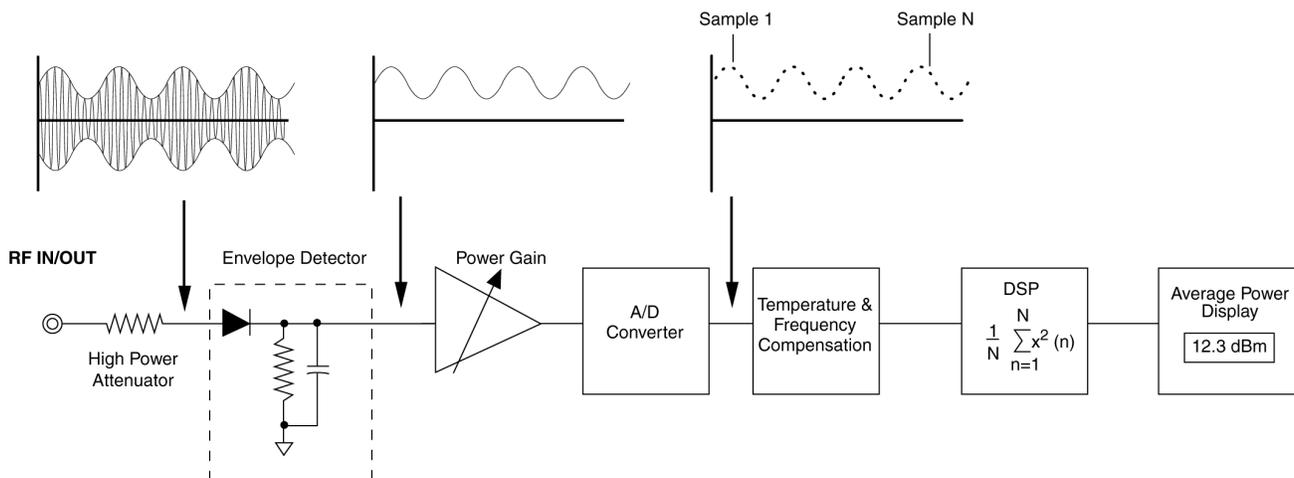
For a typical diode, the square law region extends from the noise floor up to about -20 dBm. To accurately measure average power values above -20 dBm, one must take into account the deviation of the diode curve from the square law region.

In the thermal detection method, the incident power causes the temperature of a thermocouple or a thermistor to increase. The increase in temperature, in turn, changes the DC voltage drop or resistance in proportion to the dissipated power. Typically, thermocouple sensors can accurately measure average power levels between -30 dBm and 40 dBm. As with the diode sensors, matching the impedance of the thermal detector to the power source is important to provide accurate power measurement.

The two average power measurement methods explained above have been traditionally used in average power meters such as the 437B. As explained below, the Agilent E6380A and the 8921A Option 600 use a different method to provide an accurate measure of the average power.

**Availability**

Average power measurement is available on the E6380A using the CDMA ANALYZER screen and on the 8921A Option 600 also using the CDMA ANALYZER screen.



**Figure 8. Average Power Measurement Using the E6380A or 8921A Option 600 Test Set**

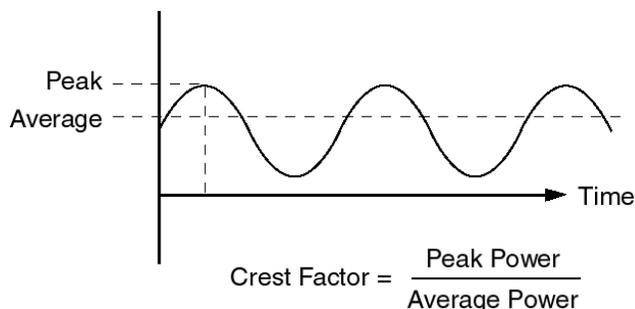
**Implementation**

The measurement is done by first passing the RF signal through a diode envelope detector which detects the envelope of the RF signal (see Figure 8). The analog to digital converter (ADC) samples the baseband envelope and sends the digitized data to the digital signal processor (DSP). Next, internal instrument temperature and frequency compensations are applied and the DSP processes the sampled data and calculates the average power. The user can specify the time interval (i.e. number of samples) over which the average power is calculated.

**Application**

This measurement provides a true measure of the average power in the signal regardless of the RF modulation type. As a result, average power measurement is ideal to handle signals in which the amplitude of the envelope of modulation changes with time such as CDMA and TDMA. In CDMA, for example, signals have high crest factors (the ratio of peak power to average power is high, see Figure 9) and peak power measurement will result in values that are higher than the average power of the CDMA signal.

The Average Power Measurement provides a broadband measure of the power in the RF signal. For example, if the base station under test has one active CDMA channel then Average Power Measurement can be used to provide an accurate measure of the average power in the CDMA signal transmitted over this channel. Assume that a second CDMA channel is activated at 1.25 MHz frequency offset from the first channel. In this case, Average Power Measurement provides a measure of the average total power transmitted on both CDMA channels. Because of its broadband nature, Average Power Measurement cannot be used to measure the average power of one specific channel when multiple channels are active (See Channel Power Measurement). Also, the measured noise level is relatively high and, as a result, low-level measurement capability is limited.



**Figure 9. Crest Factor of a Signal**

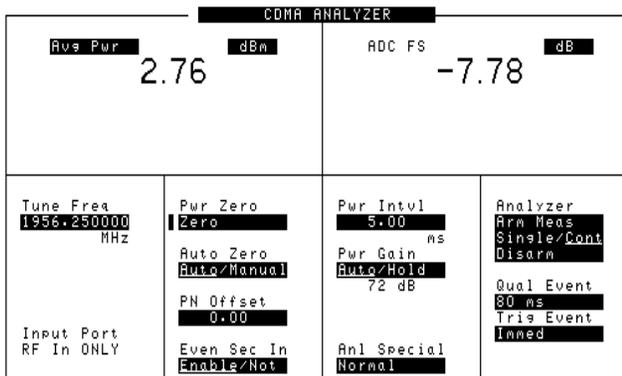
### Procedure Using the E6380A Test Set

1. Connect the RF signal to the RF IN/OUT port on the side panel of the E6380A.
2. Press the **CDMA Analyzer** key on the front panel of the E6380A. The CDMA ANALYZER screen appears (see Figure 10).
3. Move the cursor to the field on the upper-left part of the screen. Push the knob and select **Avg Pwr** from the pull down menu.
4. Under **Tune Freq**, enter the center frequency of the CDMA signal.
5. Under **Pwr Intvl**, enter the time interval over which you want the signal average power to be measured.
6. Under **Power Zero**, select **Zero** to zero the average power meter. You do NOT have to remove the signal from the RF IN/OUT port.

**NOTE:** The E6380A has an internal RF switch to remove the power from the power detector for accurate zeroing without the user having to remove the signal from the RF IN/OUT port.

7. The average power measurement appears under the **Avg Pwr** field in the upper-left part of the screen. To change the unit of measurement, place the cursor on the current unit field and press the key for the desired unit on the front panel of the E6380A.

**NOTE:** To measure the average power using the CDMA Analyzer, the signal must be supplied to the RF IN/OUT port. The ANT IN port cannot be used to make this measurement.

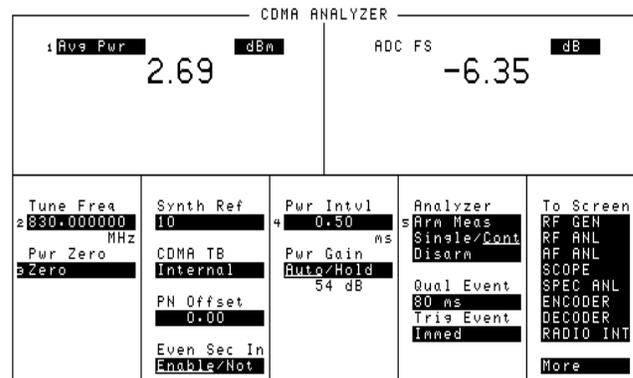


**Figure 10. CDMA ANALYZER Screen on the Agilent E6380A Test Set**

### Procedure Using the 8921A Option 600

1. From the **To Screen** menu, select **CDMA ANL**. The CDMA ANALYZER screen appears (see Figure 11).
2. Move the cursor to the field on the upper-left part of the screen. Push the knob and select **Avg Pwr** from the **Choices** menu.
3. Under the **Tune Freq** field, enter the center frequency of the CDMA signal.
4. Under **Pwr Intvl**, enter the time interval over which you want the signal average power to be measured.
5. Under **Pwr Zero**, select **Zero** to zero the power meter. Disconnect any signals connected to the RF IN/OUT port before performing this step.
6. Connect the RF signal to the RF IN/OUT port on the front panel of the 8921A.
7. The average power measurement appears under **Avg Pwr**. To change the unit of measurement, place the cursor on the current unit field and press the key for the desired unit on the front panel of the 8921A.

**NOTE:** To measure the average power using the CDMA Analyzer, the signal must be supplied to the RF IN/OUT port. The ANT IN port can not be used to make this measurement.



**Figure 11. CDMA ANALYZER Screen on the Agilent 8921A Option 600 Test Set**

## 6. Channel Power Measurement

The purpose of channel power measurement (also referred to as the Tuned Power) is to measure the power in the RF signal within a specific bandwidth of frequencies centered at the tune frequency of the RF signal. As with average power measurement, channel power measurement is designed to handle signals in which the amplitude of the envelope of modulation changes with time such as CDMA. Channel power measurement does not use a diode detector. Instead, the RF signal is down converted to an IF signal and then sampled to calculate the channel power.

### Availability

Channel power measurement is available on the E6380A and on the 8921A Option 600 by using the CDMA ANALYZER screen.

### Implementation

This measurement is performed by first downconverting the RF signal to an intermediate frequency (see Figure 12). The IF signal passes through multiple stages of mixing and filtering. As a result, the IF signal is downconverted to 3.6864 MHz (3X Chip). Next, the signal is amplified and then sampled using an analog-to-digital converter. The DSP processes the sampled data and calculates a power value that is then modified using the Calibration

Factor to result in the channel power. As with average power, the user can specify the time interval (i.e. number of samples) over which channel power is measured.

To find the Calibration Factor, a known signal is applied to the input of the test set and the power in the signal is measured using both average power measurement and channel power measurement. The Calibration Factor is calculated by taking into account the difference in power value and path gain between the two methods.

### Application

Channel power measurement is designed to measure the power in the RF signal within a specific bandwidth of frequencies centered at the tune frequency of the RF signal. This measurement is ideal for measuring the power of one CDMA channel in a system that has multiple CDMA channels active. Channel power measures the power in 1.23 MHz bandwidth centered at the tune frequency of the specific CDMA channel.

Because channel power measurement is band limited, the noise power in the signal is also limited. As a result, this measurement has a larger dynamic range than average power measurement and can be used to measure the power of low level RF signals.

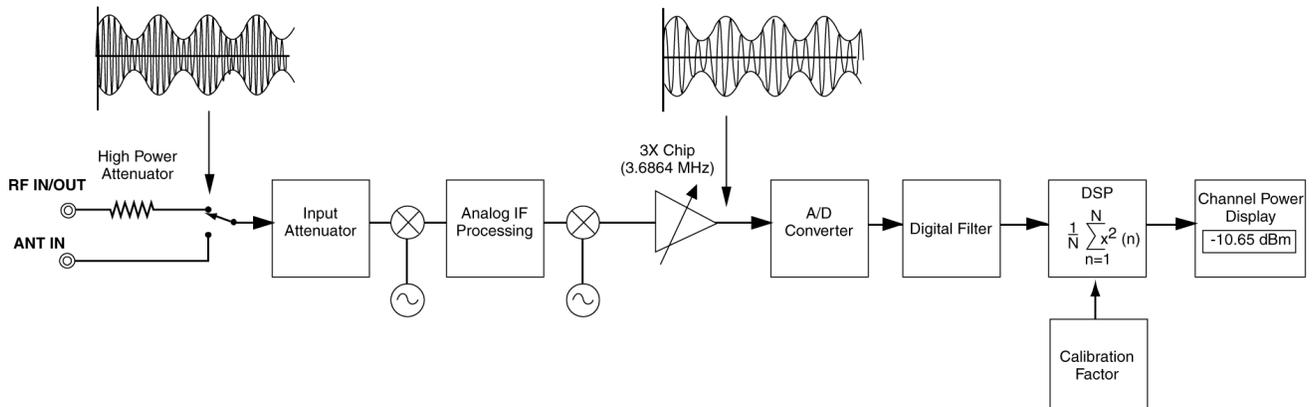


Figure 12. Channel Power Measurement Using the Agilent E6380A or 8921A Option 600 Test Set

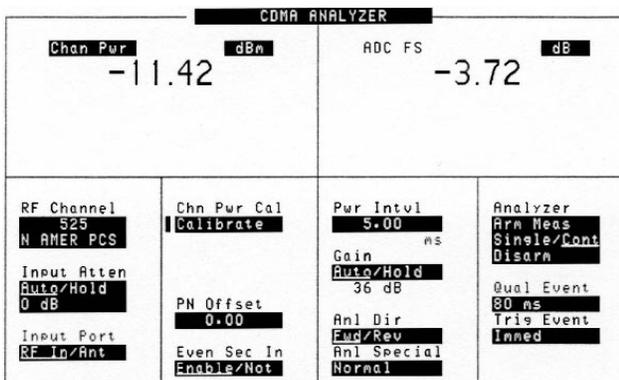
### Procedure Using the E6380A Test Set

1. Press the **CDMA Analyzer** key on the front panel of the E6380A. The CDMA ANALYZER screen appears (see Figure 13).
2. Move the cursor to the field on the upper-left part of the screen. Push the knob and select **Chan Pwr** from the pull down menu.
3. Under **RF Channel**, enter the channel number of the CDMA signal.
4. Under **Pwr Intvl**, enter the time interval over which you want the signal channel power to be measured.
5. Under **Input Port**, select the input port for the CDMA signal.

**NOTE:** You can use the RF IN/OUT or ANT IN port to measure channel power. Average power can be measured using the RF IN/OUT port only.

6. Under **Chn Pwr Cal**, select **Calibrate**. Remove any signals connected to the RF IN/OUT or ANT IN port before performing this step.

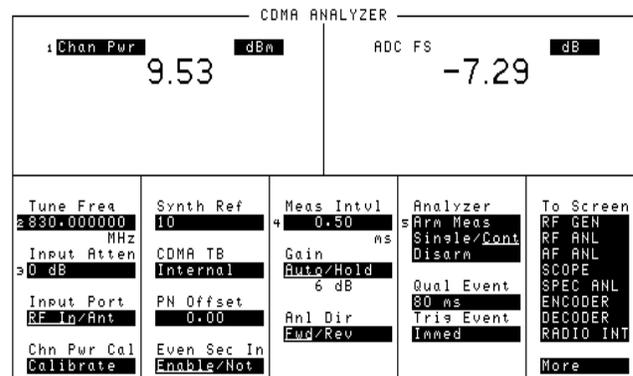
**NOTE:** Using the E6380A, calibration for the channel power measurement is done internally without any additional setup needed by the user. Compare to the procedure using the 8921A Option 600.



**Figure 13. Channel Power Measurement Using the CDMA ANALYZER Screen on the E6380A Test Set**

### Procedure Using the 8921A Option 600

1. From the **To Screen** menu, select **CDMA ANL**. The CDMA ANALYZER screen appears.
2. Move the cursor to the field on the upper-left part of the screen. Push the knob and select **Chan Pwr** from the **Choices** menu (see Figure 14).
3. Under **Tune Freq**, enter the center frequency of the CDMA signal.
4. Under **Pwr Intvl**, enter the time interval over which you want the signal channel power to be measured.

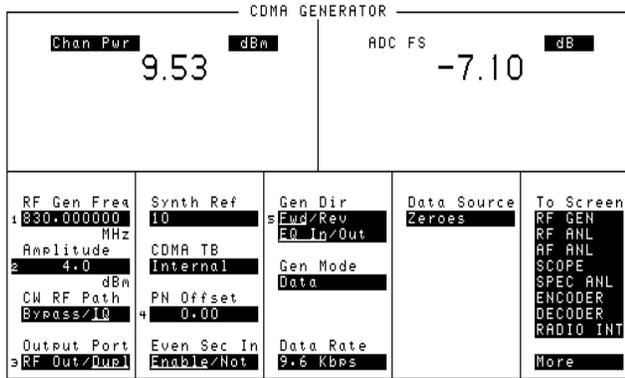


**Figure 14. Channel Power Measurement Using the CDMA ANALYZER Screen on the 8921A Option 600 Test Set**

**Use steps 5-13 below to calibrate the channel power measurement.**

5. Connect a short BNC-to-Type-N cable between the DUPLEX OUT and RF IN/OUT connectors.

6. Select **CDMA GEN** from the **To Screen** menu. The CDMA GENERATOR screen should appear (See Figure 15).



**Figure 15. CDMA GENERATOR Screen on the Agilent 8921A Option 600 Test Set**

7. Under **RF Gen Freq**, enter the center frequency of your CDMA signal.

8. Under **Amplitude**, enter **4.0 dBm**.

9. Under **CW RF Path**, select **IQ**.

10. Under **Output Port**, select **Dupl**.

11. Select **CDMA ANL** from the **To Screen** menu. The CDMA ANALYZER screen appears (see Figure 14).

12. Under **Chn Pwr Cal**, select **Calibrate**.

13. Wait until the channel power measurement is stabilized, then disconnect the cable connecting the DUPLEX OUT port to the RF IN/OUT port.

14. Connect the signal you want to measure to the RF IN/OUT port. The channel power measurement appears under **Chan Pwr**. To change the unit of measurement, place the cursor on the current unit field and press the key for the desired unit on the front panel of the 8921A.

**NOTE:** The ANT IN port can also be used to measure the channel power but with reduced measurement accuracy.

## 7. Power Measurement Using the Spectrum Analyzer

The spectrum analyzer is a tool that graphically displays voltage or power as a function of frequency. The purpose of the spectrum analyzer is to analyze signals in the frequency domain. The spectrum analyzer is designed to view a wide range of signal levels over a wide range of frequencies and thus allow the user to develop a general understanding of the characteristics of the signal displayed. For example, the user may want to check if a base station is actually transmitting a CDMA signal around a specific frequency. By viewing the spectrum around the desired frequency the user should be able to confirm the transmission. However, the user would not be able to accurately measure the power of the CDMA signal.

### Availability

The spectrum analyzer is available on the Spectrum Analyzer screen of the E6380A and the 8921A.

### Implementation

As shown in Figure 16, the RF signal is first passed through a variable input attenuator. The value of the attenuation can be automatically chosen to maximize the dynamic range of the spectrum analyzer.

The RF signal is then downconverted to an intermediate frequency of 114.3 MHz using a series of mixers and filters. Next, the IF signal is mixed with a local oscillator and the frequency of the local oscillator is increased linearly. The range of frequencies over which the local oscillator is swept is proportional to the span of the spectrum analyzer. The signal is then filtered using the resolution bandwidth filter.

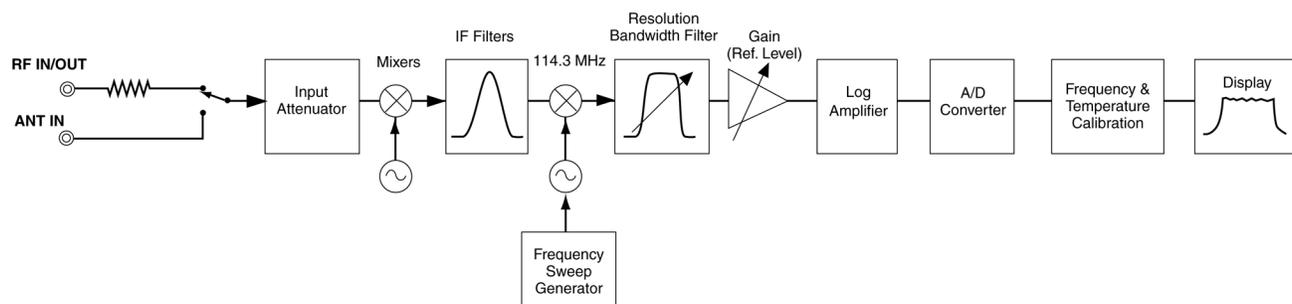


Figure 16. Simplified Spectrum Analyzer Block Diagram for the E6380A and the 8921A Option 600 Test Sets

In the E6380A and the 8921A, the resolution bandwidth is coupled to the span of the spectrum analyzer. The signal is then passed through a gain amplifier that adjusts the signal offset on the screen as a function of the specified spectrum analyzer reference level. Afterwards, the signal is amplified using a logarithmic amplifier and then digitized using an analog to digital converter. Finally, the signal level at each frequency is measured; frequency and temperature calibration values are applied; and signal level is displayed.

### Application

As mentioned earlier, the spectrum analyzer is ideal to view a wide range of signal levels over a wide range of frequencies and thus allows the user to develop a general idea about the signal analyzed. The power level measurement on the spectrum analyzer should not be used as an accurate measurement of the power in the signal.

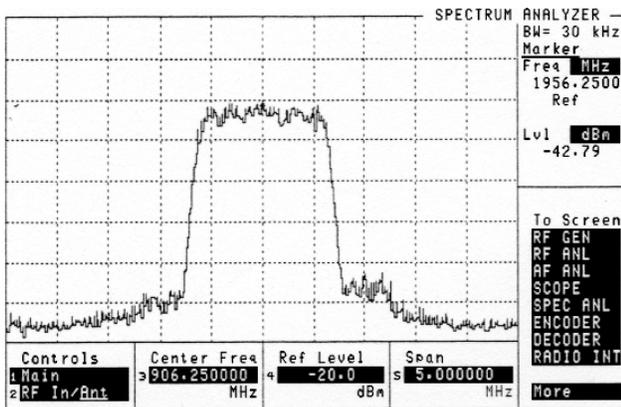
It is important to note here that the spectrum analyzer measures the power level within the resolution bandwidth. To determine the power in the total bandwidth of the signal (e.g. 1.23 MHz in CDMA) the difference between the resolution bandwidth of the spectrum analyzer and the bandwidth of the signal should be taken into account. For example, in Figure 17, the resolution bandwidth is 30 kHz and the displayed power value is -42.79 dBm. The total power in the CDMA signal can be calculated as follows:

$$\begin{aligned} \text{Total Power} &= -42.79 \text{ dBm} + 10 \log \frac{1.2288 \text{ MHz}}{30 \text{ KHz}} \\ &= -42.79 \text{ dBm} + 16.12 \text{ dB} = -26.79 \text{ dBm} \end{aligned}$$

### Procedure Using the E6380A Test Set or 8921A Option 600

1. Connect the RF signal to the RF IN/OUT or ANT IN port. These ports are located on the side panel of the E6380A (front panel of the 8921A).

2. Press the **Spec Anl** key on the front panel of the E6380A (if using the 8921A, select **SPEC ANL** from the **To Screen** menu). The SPECTRUM ANALYZER screen appears (see Figure 17).



**Figure 17. The SPECTRUM ANALYZER Screen on the Agilent 8921A Test Set**

3. Under **Controls**, select the input port that you are using. Select either **RF In** or **Ant**.

4. Under **Center Frequency**, enter the center frequency of the RF signal.

5. Under **Span**, enter a value that allows the part of the spectrum of interest to you to be displayed. For example, if using a CDMA signal, enter 5 MHz.

6. Under **Ref Level**, enter an appropriate value for the reference level. The top of the spectrum analyzer plot will be set to this value.

The spectrum analyzer should display the spectrum of the RF signal. If the RF signal is a CDMA signal, then the spectrum analyzer display should be similar to the one in Figure 17.

7. Under **Controls**, select **Marker**.

8. Under **Position**, enter the value of the position or turn the knob to the desired marker position.

9. The power level at the marker should be displayed under **Lvl**.

**NOTE:** The power level displayed is the power measured within the resolution bandwidth of the spectrum analyzer. Refer to the application section above to measure the power in the total bandwidth of the signal.

## 8. Code Domain Power Measurement

In CDMA, the base station transmits to all users on the same frequency. A set of 64 orthogonal Walsh codes are used to channelize the data to the appropriate users. All Walsh code channels are added together, modulated, and then transmitted over the air. The power measurement methods discussed earlier in this paper measure the power in the CDMA signal but do not provide any information about the individual Walsh code channels. Code domain power measurement is a new measurement method that provides a measure of the power in the individual Walsh codes.

### Availability

Code domain power measurement is available on the Code Domain Analyzer screen of the E6380A and the 8921A Option 600. The 8921A Option 600 provide a measure of the power in each of the Walsh code channels relative to the total power in the CDMA signal. In addition to the relative code domain power measurement, the E6380A also provides a measure of the absolute power in the individual Walsh code channels.

### Application

This measurement should be used to measure the power in the individual Walsh code channels in the CDMA signal (e.g. verify the power level of Walsh code 0, Pilot channel, or Walsh code 32, Sync Channel). Also, this measurement can be used to identify the active channels transmitted by the base station over time.

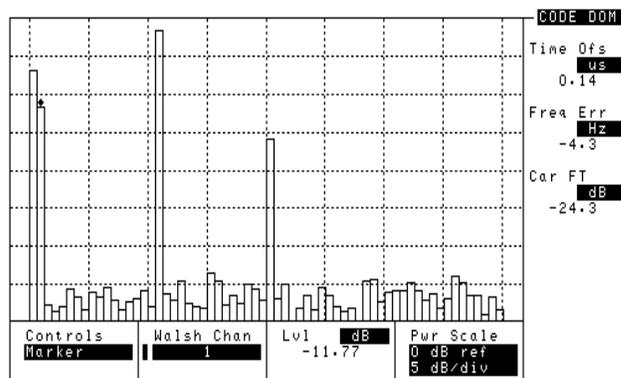
Another application for this measurement is to measure the power in the inactive Walsh code channels. This measurement is important because the power in the inactive Walsh code channels is an added interference to the system that service providers would want to minimize.

### Procedure Using the E6380A Test Set or 8921A Option 600

1. Connect the RF signal to the RF IN/OUT port or ANT IN port. These ports are located on the side panel of the E6380A Test Set, or, on the front panel of the 8921A Test Set.
2. Press the **Code Dom** key on the front panel of the E6380A; if using the 8921A, select **CODE DOM** from the **To Screen** menu. The **CODE DOM** screen appears (see Figure 18).
3. Under **Controls**, select the input port that you are using. Select either **RF In** or **Ant**.
4. Under **Tune Frequency**, enter the tune frequency of the RF signal.
5. Under **Measurement**, select **Power**.
6. Under **Controls**, select **Marker**.
7. Under **Walsh Chan**, enter the Walsh code channel number at which you want to measure the power (see Figure 18).
8. The power level for the specified channel relative to the total power in the signal appears under **Lvl**.

**NOTE:** The E6380A is also capable of measuring the absolute power in each of the Walsh code channels.

In the example shown in Figure 18, the marker is placed on Walsh code 1, the paging channel. The power level in this paging channel is 11.77 dB below the total power in the CDMA signal.



**Figure 18. Code Domain Power Measurement on the E6380A Test Set**

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