Using the Agilent E7473A CDMA Drive Test System

Product Note

Application of Code Domain Power Measurements to CDMA Network Optimization
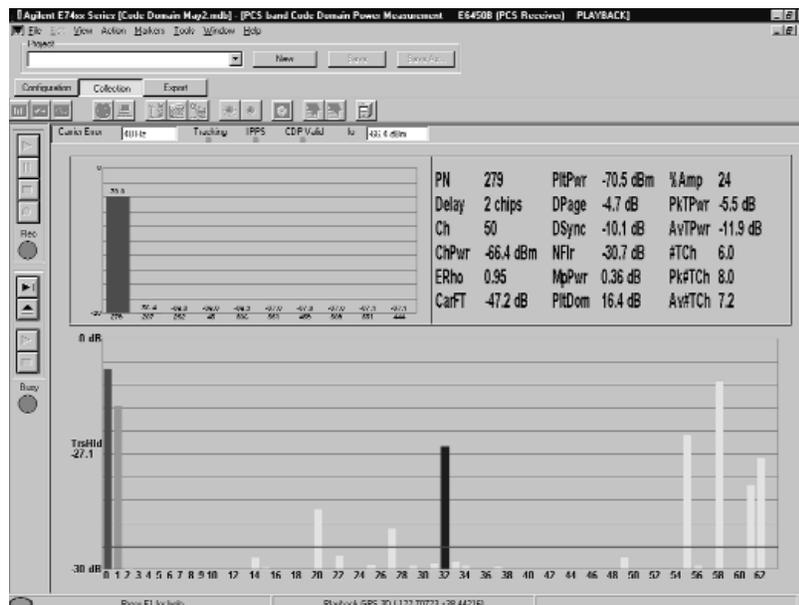
Agilent Technologies

Innovating the HP Way

Table of Contents

Introduction

Agilent Technologies can provide complete, end-to-end solutions and services to help you plan, install, optimize and manage your wireless network. Agilent's CDMA drive-test system platform can help you maintain your network operating at peak performance while allowing you to gain insight into how your network is functioning.

Base stations are becoming increasingly more difficult to access and maintain; this is especially true for pole-top mounted base stations. Combined with the shortage of experienced personnel and the need for proactive base station maintenance, you need an efficient and quick solution for testing base stations.

Agilent's code domain power measurements and the traffic statistics derived from these measurements provide powerful new capability to RF engineers responsible for CDMA network optimization. These measurements reveal traffic loading and power distribution enabling maximum utilization of infrastructure equipment. Agilent's E7473A CDMA drive-test system, versions A.06.00 and later, have optional capability to measure code domain power.

This product note was developed to assist engineers in using the code domain power functionality of the E7473A, and applying the functionality to network optimization.

1. Traffic Monitoring

The code domain power measurement provides real-time traffic monitoring. All 64 Walsh codes are displayed for the dominant sector. Logical channels are color-coded:

Pilot channel   -   Red

Paging channel   -   Green

Sync channel   -   Blue

Traffic channels -   Yellow
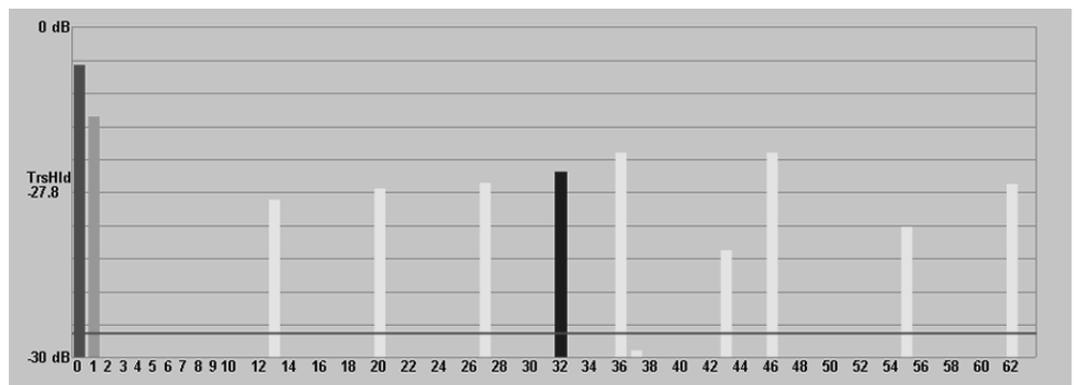
Figure 1. Code domain power bar graph

2

Key traffic indicators are extracted from the code domain power measurement and displayed in text:

#TCh: **Number of active traffic channels** for that sweep of the code domain measurement

Pk#TCh: **Peak number of active traffic channels** across all sweeps since the current dominant pilot channel became dominant

Av#TCh: **Average number of active traffic channels** across all sweeps since the current dominant pilot channel became dominant

MpPwr	0.20 dB	AvTPwr	-14.2 dB
PltDom	15.9 dB	#TCh	9.0
%Amp	25	Pk#TCh	11.0
PkTPwr	-9.3 dB	Av#TCh	7.1

Figure 2. Code domain power traffic statistics, channel statistics highlighted.

Is the capacity that is already in place at that site being utilized efficiently?

Monitoring traffic on a specific sector provides insight into the capacity utilization of that sector. This is important in high use areas where a decision needs to be made with regard to adding additional capacity. Data can be recorded to the database and exported for in depth traffic analysis.

Traffic monitoring can also be done while driving through the network. This data allows you to see the balance of capacity utilization among the different cells and sectors. For example, a situation where adjacent cells have significantly different traffic statistics may indicate the need to change hand-off parameters to shift traffic from the more heavily loaded cell to the less loaded cell.

Section 3, *Use Models* discusses the methods of collection and interpretation of code domain measurement data for both parked and mobile data collection scenarios.

Typically, in multi-carrier deployments it is desirable to balance the amount of traffic on each of the different carrier frequencies. Code domain power is an excellent tool for verifying traffic balance against different carriers by monitoring the traffic statistics.

If the traffic statistics vary greatly from the different carriers for a particular site, it may be indicative of a problem associated with frequency assignments for that site. If the traffic statistics are significantly dissimilar on the different carriers for all sites, it is probably due to a higher concentration of mobiles with one frequency preference than another. Figures 3 and 4 show code domain measurements screens with well balanced and poorly balanced traffic.
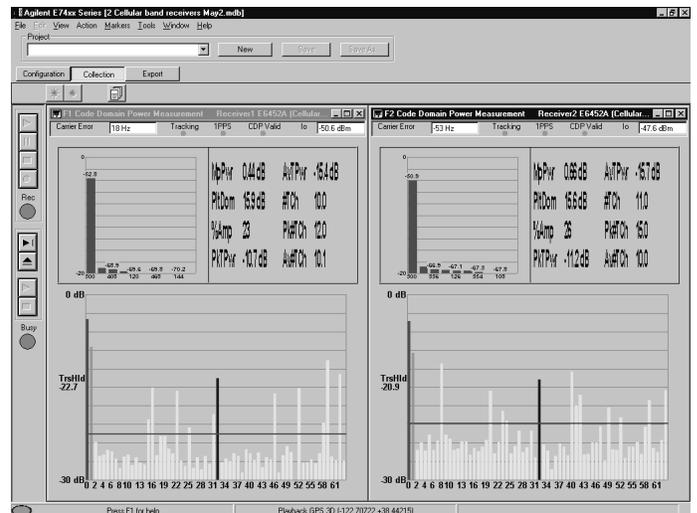
Figure 3. Code domain - well balanced 2 carrier traffic.
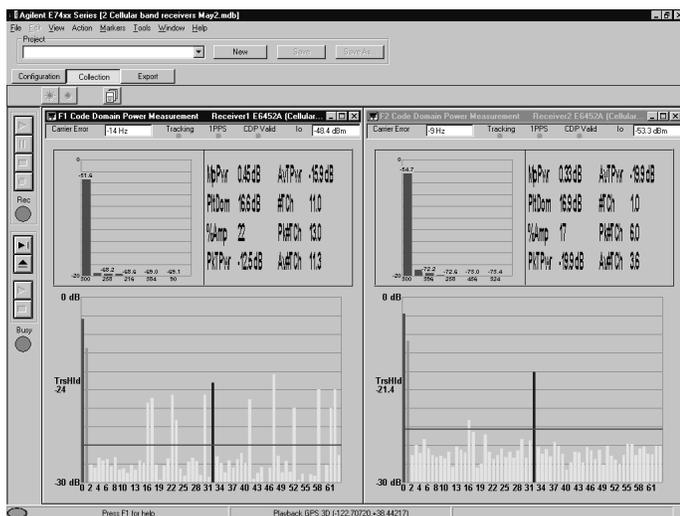
Figure 4. Code domain - poorly balanced 2 carrier traffic.

2.   Forward-link power distribution

Key parameters are displayed to enhance understanding of forward-link power distribution:

%Amp: **Percentage of amplifier capacity** -   An estimate of the amount of the forward-link power amplifier capacity that is being used, expressed in percent of maximum.

PkTPwr:**Peak traffic channel power** -   Power of the strongest active traffic channel for that sweep of the code domain measurement, expressed in dB relative to total channel power.

AvTPwr:**Average traffic channel power** - Average power of all active traffic channels for that sweep of the code domain measurement, expressed in dB relative to total channel power.

Figure 5. Code domain power traffic statistics, power parameters
            highlighted.

When an amplifier is transmitting at maximum output power it is said to be at 100% of its capacity. Similarly, when an amplifier is transmitting half of its maximum power it is said be at 50% of capacity. For example, an amplifier with a maximum output power of 12 watts would be at 50% of capacity when transmitting 6 watts and at 100% of capacity when transmitting 12 watts. %Amp is an estimate of this percentage.

The forward-link RF power amplifier capacity (the RF capacity) and the digital channel element capacity (digital capacity) of a CDMA cell should remain well-balanced. The code domain power measurement estimates the percentage of RF capacity that is being used. The percentage of RF capacity being used will increase as the number of active traffic channels increases.

In most CDMA network designs, it is not desirable for a cell to use up a lot of RF capacity with a low number of active traffic channels. This condition indicates a significant amount of the RF capacity is being allocated to a low number of subscriber units. This condition indicates the cell is serving mobile(s) that are a long distance away or in-building user(s).

Alarms can be set for specific conditions. Two examples are given in figures 6 and 7 with the procedures for setting them up.

Figure 6 shows the percentage of amplifier capacity that exceeds a threshold.
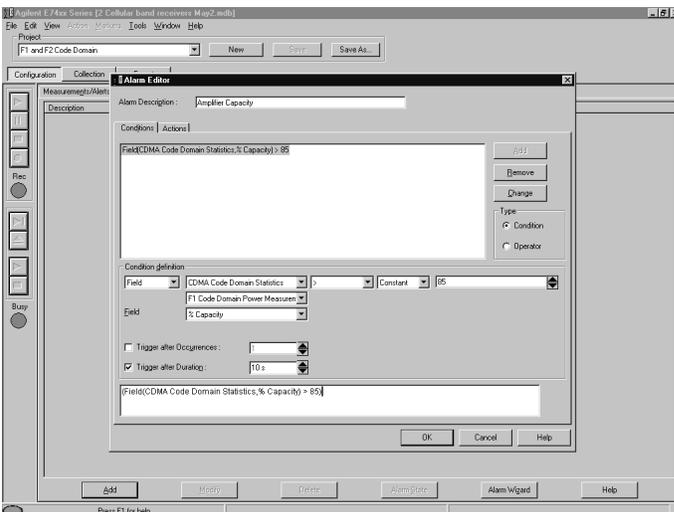
Figure 6. Alarm editor, Conditions tab: % Amplifier Capacity
            exceeds 85%.
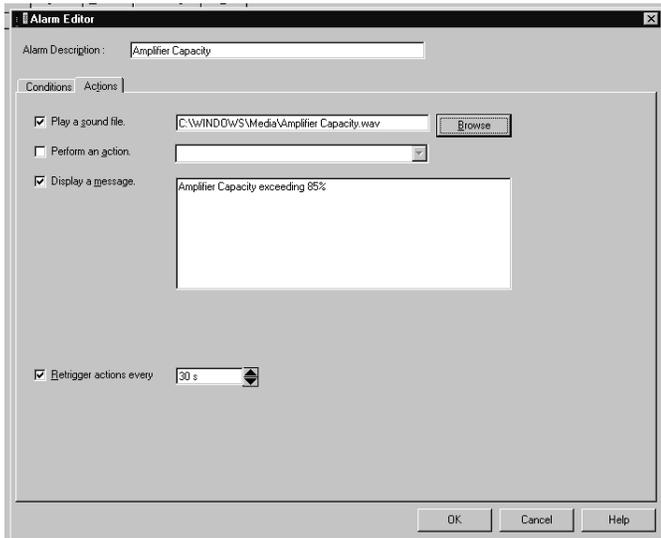
Figure 7. Alarm editor, Actions tab: % Amplifier Capacity exceeds 85%.

This alarm will be triggered any time the percentage of amplifier capacity being used exceeds 85% for more than 10 seconds. If the condition persists, the alarm will be re-triggered every 30 seconds.

Figure 7 shows the percentage of amplifier capacity exceeds a threshold and number of traffic channels is less than a threshold.
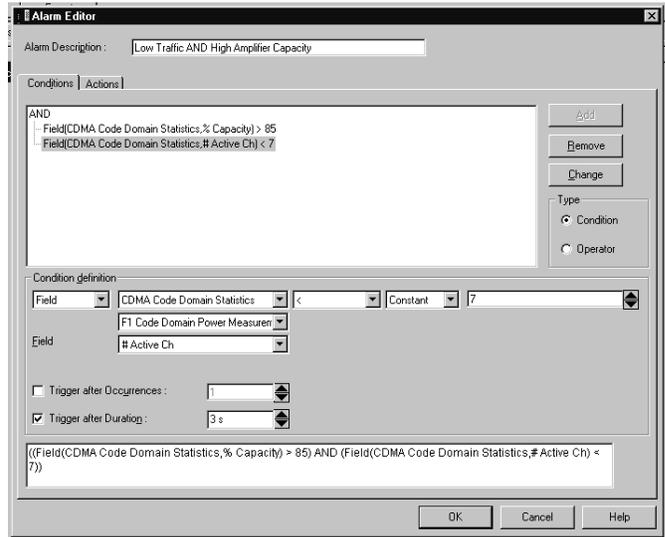
Figure 8. Alarm editor, Conditions tab: # Active Traffic Channels < 7 AND % Amplifier Capacity exceeds 85%.
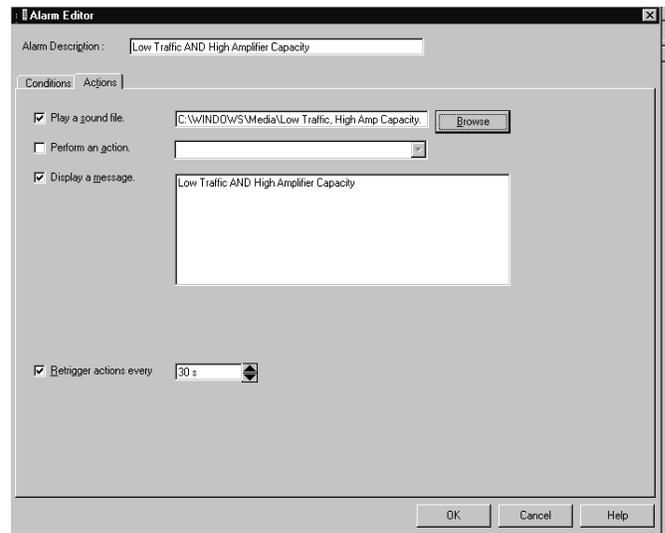
Figure 9. Alarm editor, Actions tab: # Active Traffic Channels < 7 AND % Amplifier Capacity exceeds 85%.

This alarm will be triggered any time the percentage of amplifier capacity being used exceeds 85% AND the number of active traffic channels is less than 7, for more than 3 seconds.

The maximum power that a cell can allocate to a single traffic channel is limited by a base station setup parameter. If the setting is input incorrectly or the cell is not functioning correctly, the maximum traffic channel power limit may be exceeded. The example in figure 10 shows an alarm setup that will trigger when the power of the strongest traffic channel exceeds the power of the pilot channel.
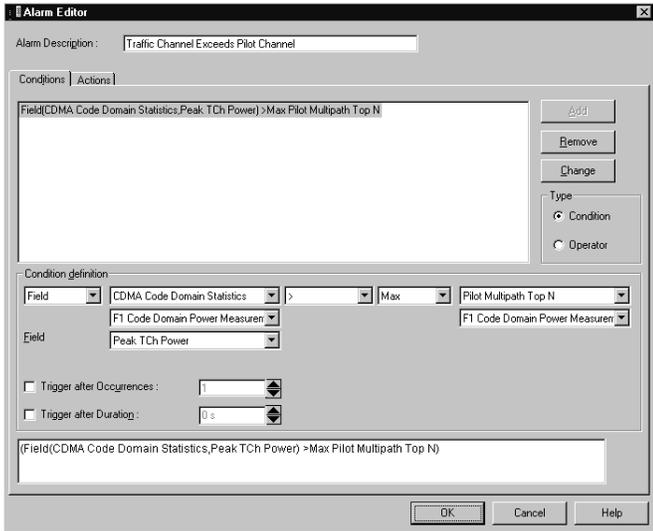
Figure 10. Alarm editor, Conditions tab: Peak Traffic Channel Power > Pilot Channel Power.

Is the capacity already in place at the site being utilized efficiently? Monitoring the power distribution on a specific sector allows you to observe the RF capacity utilization of that sector as well as the balance of RF and digital capacity. This is important in high use areas where a decision needs to be made with regard to adding additional capacity.

Power distribution monitoring can also be done while driving through the network. This drive test provides you with the information regarding the balance of capacity utilization among different cells and sectors. For example, a situation where adjacent cells have significantly different percentage of amplifier capacity utilization may indicate the need to change hand-off parameters to shift traffic from the more heavily loaded cell to the less loaded cell.

Section 3, *Use Models* discusses the methods of collection and interpretation of code domain measurement data for both parked and mobile data collection scenarios.

3. Use Models

Two use models are presented below for application of code domain power to network optimization.

3.1 Measuring code domain power while parked at specific sector

Select a location to park where the signal conditions are good for code domain measurements — high pilot dominance and low multipath power. The CDP valid light should be green. Refer to Section 5, *Measurement Conditions* for a description of the effects of multipath and interference. Refer to Section 6, *Measurement Setup* for a description of the threshold settings that define validity for code domain power measurements.

Monitor and record the code domain power.

The duration of recording should be as long as is practical – at least five minutes. Longer collection will provide a broader statistical measure of the traffic and power, but the time requirement must be balanced against all other activities that personnel must execute. During collection, watch key traffic and power statistics for the conditions described in sections 1 and 2.

Real-time statistics displayed on the screen described in sections 1 and 2, will provide some key metrics to traffic and power for the sector. Recorded data can be exported for in -depth statistical analysis. Section 7, *Exporting Data* discusses the data export process and walks through an example of an export plan for code domain power. Once a plan is created it can be reused. The following example uses a pre-defined export plan to export the power values for all of the Walsh codes.
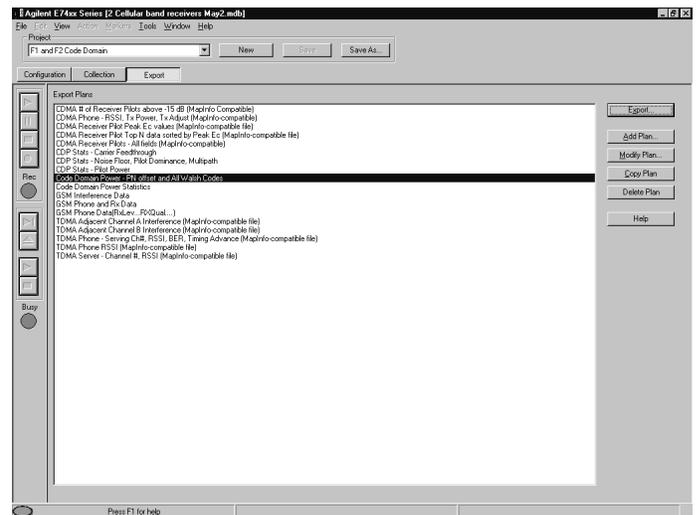
Figure 11. Data Export of: code domain power displaying- all Walsh codes.

After the data is exported, Microsoft Excel® is used to compute statistics. Figure 12 shows an Excel spreadsheet with a number of results computed from code domain power data. All of the Walsh code data as well as the code domain power statistics were exported. The data is integrated in a single Excel file and a number of results are computed. This is an example of a number of useful parameters; it is not a comprehensive list of all the activities that can be computed from the code domain data.

Computed Measurements		Computed Statistics		
Pilot-to-Active Traffic Ratio (dB)	Pilot-to-(Paging+Sync+ActiveTraffic) Ratio (dB)			
0.39	-1.33	Average Channel Power	-46.18	dBm
-1.88	-3.01	Average Pilot Power	-51.59	dBm
-1.47	-2.75	Average Delta Paging	-4.56	dB
-3.74	-4.42	Average Delta Sync	-9.74	dB
-1.91	-3.01	Average Total Active Traffic Power	-49.19	dBm
-1.27	-2.44	Peak Total Active Traffic Power	-42.72	dBm
0.89	-0.94	Average Active Traffic Channel Power	-14.00	dB
-1.34	-2.56	Peak Active Traffic Channel Power	-5.64	dB
1.11	-0.86	Average Number of Active Traffic Channels	11.91	channels
-0.47	-1.90	Peak Number of Active Traffic Channels	15	channels
-2.01	-3.06	Minimum Number of Active Traffic Channels	8	channels
-3.87	-4.62	Average Percentage of Amplifier Capacity	32.92	%
0.13	-1.54	Peak Percentage of Amplifier Capacity	54.72	%
		Minimum Percentage of Amplifier Capacity	23.36	%

Figure 12. Excel spreadsheet with - results computed from code domain power measurement data.

Pilot-to-Active Traffic Ratio is the difference between the pilot channel power and the total power in all of the active traffic channels on that sector.
Pilot-to-(Paging+Sync+Active Traffic) Ratio is the difference between the pilot channel power and the total power of all of the other active channels on that sector. Each of these parameters is computed for each code domain power measurement.

There are a number of computed statistics displayed. Each of these statistics is computed across the entire collection time as shown in figure 15.
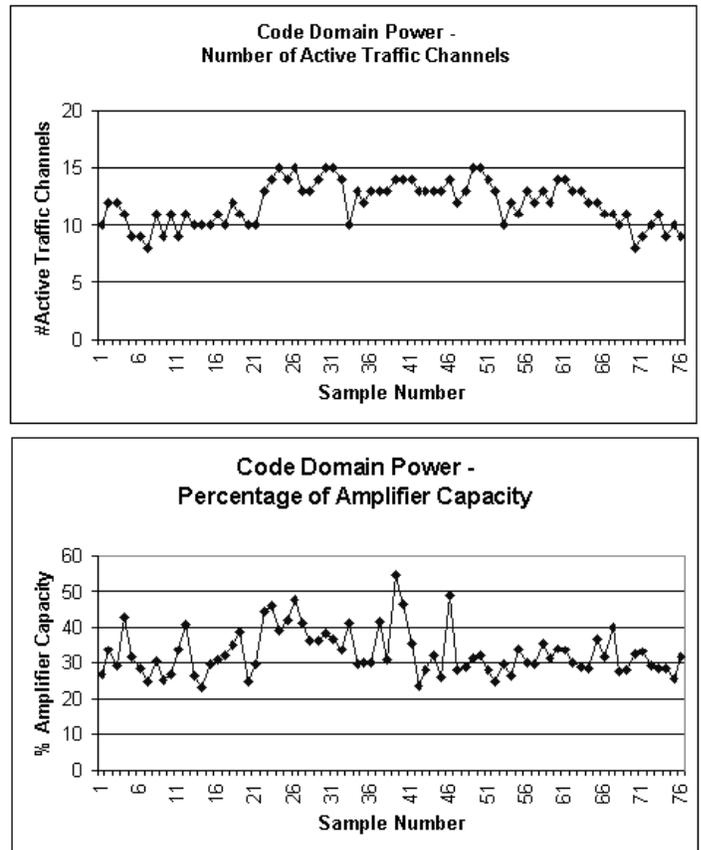
Figure 13. Shows percentage of amplifier capacity and number of active traffic channels plotted as a function of time.

7

3.2 Measuring code domain power while driving

Code domain power data can be collected while driving. The E7473A can collect code domain data simultaneously with traditional drive test data (pilot scanning, FER, call statistics, etc.).

Performing traffic measurements while driving provide significant additional insight into the balance of traffic amongst different cells and sectors in the network.

The quality of the measurement conditions will change significantly while driving.– Refer to *Section 5, Measurement Conditions* for a description of the effects of multipath and interference. Refer to *Section 6, Measurement Setup* for a description of the threshold settings that define validity for code domain power measurements.

Multipath power and pilot dominance will vary with motion and location. The result is a mixture of valid and invalid code domain power measurements. The ratio of valid to invalid measurements will depend on terrain and network design. Due to multipath, dense urban environments will have a lower percentage of valid measurements than a suburban or rural environment. Networks designed with large amounts of cell overlap will have a lower percentage of valid measurements due to sector-to-sector interference.

During a typical drive there will be enough valid code domain power measurements to provide information into to the traffic and power distribution throughout the drive area. Some valid measurements will be made on each sector that becomes dominant during the drive.

Similar statistical analyses can be done on mobile code domain power data as described in section 3.1 for stationary data collection. It is important to sort the data by PN offset, so that statistics are computed on a sector-by-sector basis. The statistics shown in figure 12 should be computed for each sector that was dominant at some point during the drive.

The data can also be mapped to provide a geographic visual of key traffic and power distribution. In the example shown in figures 15 and 16, the number of active traffic channels and percentage of amplifier capacity are plotted using MapInfo.
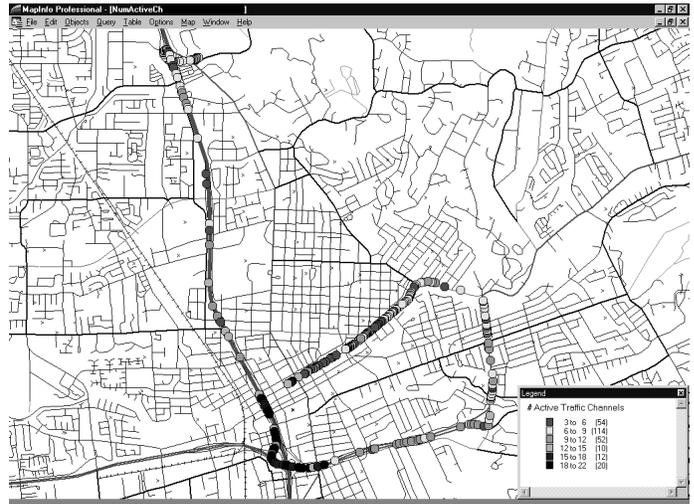
Figure 15. Map display of number of active traffic channels.
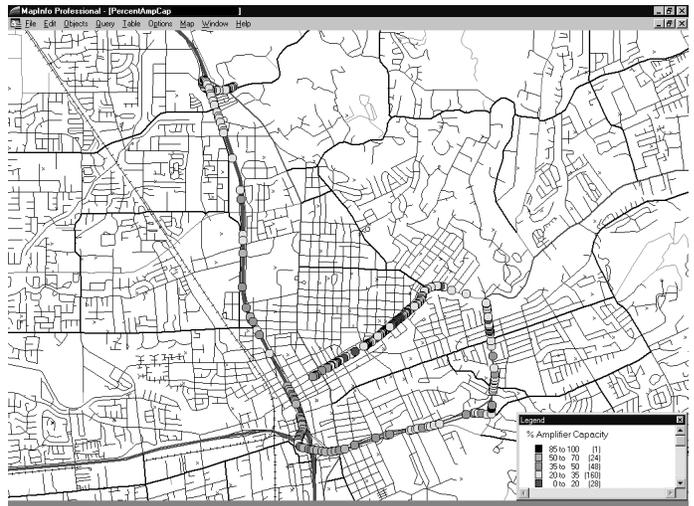
Figure 16. Map display of percentage of amplifier capacity.
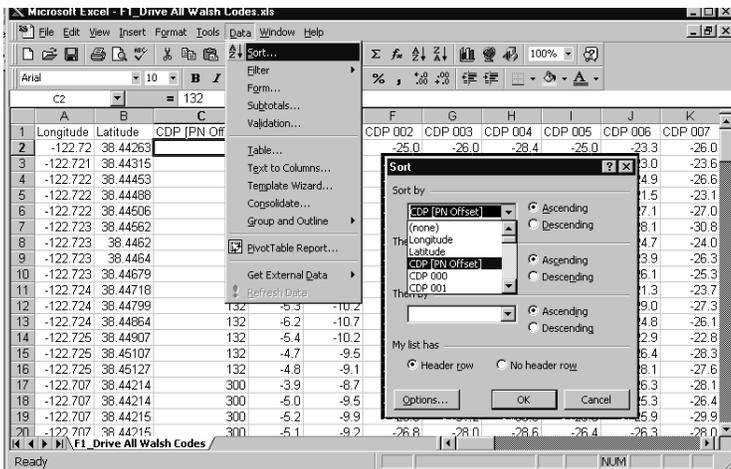
Figure 14. Sort code domain drive test data by PN offset.

It is important to look for large differences in the values of these parameters between adjacent sectors. If a significant difference is detected, it may indicate the hand-off parameters should be adjusted in order to shift some traffic from the more heavily loaded sector to the less loaded sector.

4.0 Quick checks of base station health

During network optimization drive testing, an RF engineer will encounter a network performance problem that may be caused by a base station. Traditional troubleshooting of a basestation usually requires the responsible technician to be dispatched to that site. Over-air basestation measurements enable the RF engineer to execute a fast and easy first-level diagnostic of the suspect cell while in the field without dispatching a technician.

4.1 Code domain power measurements

• Drive up near the suspect sector and select a location to park where the signal conditions are good for code domain measurements – high pilot dominance and low multipath power. The CDP valid light should be green. *See Section 5, Measurement Conditions* for a description of the effects of multipath and interference.

• Use the code domain power measurement (CDP Stats) - to look at key base station parameters:

PN: **PN offset** of the current dominant (strongest) pilot. If this value is different from the assigned value for this sector, it is likely that a configuration error was made when setting up the parameters for this sector. Alternatively, it may indicate a severe timing problem with this sector.

Delay: **Absolute delay** of the dominant pilot with respect to GPS time, expressed in chips (1chip ª 0.81 microseconds). Delay is a combination of propagation delay and basestation timing error. IS-95 specifies that the basestation timing must be within +/-10 microsecond (approximately +/-12 chips) of its assigned value, and it recommends that it be within +/-3 microseconds (approximately +/-4 chips). Propagation delay is approximately 0 when parked near the transmit antenna. The measured value of delay should be within the recommended limits, that is greater than –4 chips and less than +4 chips. As you move away from the transmit antenna, propagation delay needs to be considered – about 4 chips per kilometer. So, if you are parked 500 meters (1/2 km) from the transmit antenna, the measured value of delay should be greater than –2 chips and less than +6 chips. If the measured value of delay falls outside of the expected range, there is likely a timing problem with the basestation.

ERho: **Estimated Rho** is the estimate of the IS-95 CDMA waveform quality metric Rho (unitless). Rho is a measure of the percentage of the transmit power that is being modulated into the intended waveform. A value of 1.0 is perfect indicating that all of the power is being transmitted as intended. IS-95 specifies that Rho must be greater than 0.912. Typical values for a healthy base station are greater than 0.94. When measuring this value over the air, it is critical to consider the effects of multipath and interference. Refer to Section 5, *Measurement Conditions* for a description of the effects of multipath and interference on ERho.

CarFT: **Carrier feedthrough** expressed in dBc relative to the channel power. IS-95 CDMA basestations use QPSK modulation. QPSK is a suppressed carrier modulation meaning that a perfectly modulated signal will have no power at the exact carrier frequency. Quite often QPSK transmitters degrade power increases at the exact carrier frequency. This condition is called carrier feedthrough. The measured value for carrier feedthrough should be less than –20 dBc (preferably less than –25 dBc).

PltPwr: **Pilot power** is the total power in the dominant pilot signal, expressed in dBm. The transmit power of the pilot channel signal for a given basestation is constant. When measured over the air, pilot power will vary somewhat due to varying propagation conditions. The measured value of pilot power should be within +/-3 dB of values previously measured from the same location, assuming similar environmental conditions. If the power has varied significantly, it may indicate there has been a change made to the power setting, or that the transmit antenna system has been changed or damaged.

Dpage: **Delta paging** is the amplitude difference between the paging channel and pilot channel, expressed in dB. The transmit power of the paging channel is constant and it is set at a value relative to the pilot channel power. A common value is –4 dB relative to the pilot. It is important to know what the intended settings are for each sector. If the measured value of Dpage is more than +/-0.5 dB different from the intended setting, it may indicate the value has been changed.

Dsync: **Delta sync** is the amplitude difference between the sync channel and pilot channel, expressed in dB. The transmit power of the sync channel is constant, and it is set at a value relative to the pilot channel power. A common value is –10 dB relative to the pilot. It is important to know what the intended settings are for each sector. If the measured value of Dsync is more than +/-0.5 dB different from the intended setting, it may indicate the value has been changed.

PN	279	PltPwr	-70.5 dBm
Delay	2 chips	DPage	-4.7 dB
Ch	50	DSync	-10.1 dB
ChPwr	-66.4 dBm	NFlr	-30.7 dB
ERho	0.95	MpPwr	0.36 dB
CarFT	-47.2 dB	PltDom	16.4 dB

Figure 17. Code domain power statistics, base station health parameters highlighted.

4.2 Spectrum measurements

Use the basestation spectrum with mask to check for spectral problems.

The spectrum mask virtual front panel (VFP) is intended to provide a quick-check for over the air spectral problems. The control set is reduced as compared to the general-purpose spectrum VFP.

It is important to note the spectrum mask defined by IS-97 is defined at power (intended to be measured at the output of the power amplifier). When making this measurement over the air, the signal is at significantly lower power due to propagation loss. When using the spectrum mask over the air, it is a guideline rather than a specification. If there are significant spectral problems they will be detected. If a "borderline" condition exists, more investigation should be done before making a judgement based on over the air measurements.
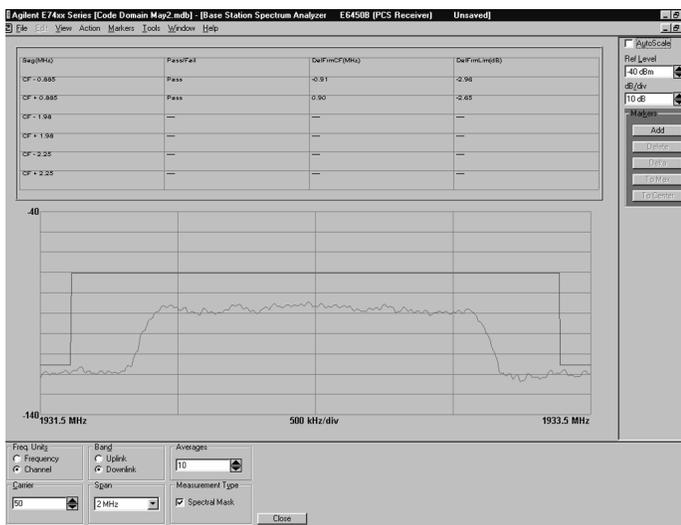
Figure 18. Spectrum display with IS-97mask.

4.3 Automated MOST test

The MOST test is an optional software function available in the Lucent infrastructure. Virtually every CDMA network using Lucent infrastructure has this function. The user places a call from their mobile phone to a special number that terminates in the switch. The network reports back via a flash message: RF channel, Cell site, Sector, Cluster controller, Channel unit, and Channel element. The user enters a key sequence (usually "426"), and the basestation steps to the next available channel element. This process provides a mechanism for verifying the functionality of the individual channel elements in a base station.

The MOST new virtual front panel automates the MOST test, greatly simplifying the process. The summary line gives a clear indication of which channel elements have been tested. The FER column provides a coarse measure of the call quality on the specific channel element. The report generator provides a simple way of getting a record of the test.

4.4 Automated report generation

The automated report generator captures each of the measurement displays and all measurement results into an HTML file. This provides a very fast and easy mechanism to get a snapshot of health conditions for the base station. In the case where there is a problem with the base station, the report provides the optimization engineer with a powerful tool to help explain the problem to the responsible technician.

One computer mouse click starts the report generator and brings up a text header entry form. The user can enter specific information with respect to the test or accept the defaults.

Figure 20. Automated report generator - text header entry form.

One more computer mouse click finalizes the report and brings it up in the user's default web browser.
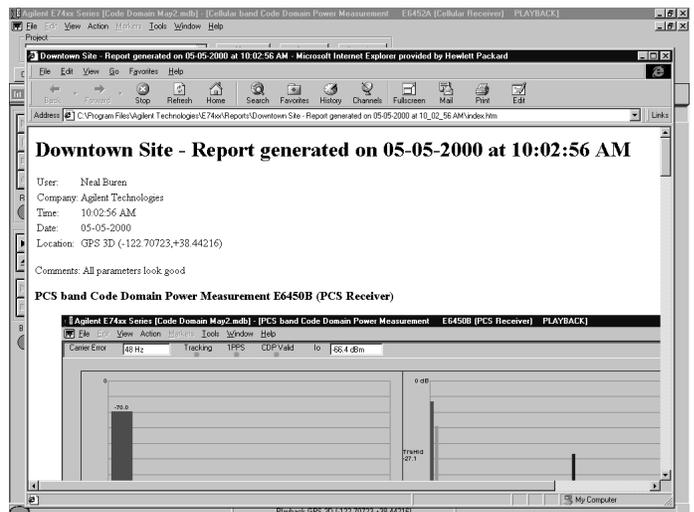
Figure 21. Report automatically displayed by default web browser.

Reports can be generated from live or playback data. So, if data was recorded but no report was generated in the field, the report can still be generated.

5.0 Measurement conditions over-the-air code domain power

Historically, code domain power measurements have been made with a cabled connection to the transmitter. The over-the-air environment introduces some effects that need to be considered when making these measurements.

The ideal conditions for measuring code domain power over-the-air is:

1) A very dominant signal from one sector (one PN offset), and

2) No multipath echoes

Interfering signals and multipath echoes raise the noise floor of the code domain power measurement. Over-the-air measurements inherently will experience both interference and multipath. The goal is to minimize their contribution and quantify the effect they have on these measurements. The code domain power VFP measures and displays two key parameters to monitor these effects:

- Pilot Dominance (PltDom) – The difference in amplitude of the strongest pilot channel and the second strongest pilot channel (expressed in dB). Ideally, this value will be very large (> 16 dB).

- Multipath Power (MpPwr) – The amount of power, of the dominant pilot signal, that is dispersed outside the main correlation peak due to multipath echoes (expressed in dB). Ideally, this value will be very small (< 0.1 dB).

The table below describes the quality, with respect to pilot dominance and multipath power, of over-the-air conditions for code domain power measurements. Section 6, *Measurement Setup* describes the setup of threshold levels for pilot dominance and multipath power that define the validity conditions for code domain power measurements.

Condition	Pilot Dominance	Multipath Power
Very Good	> 16 dB	< 0.1 dB
Fair	> 10 dB	< 0.7 dB
Marginal	> 8 dB	< 1.0 dB

5.1 Positioning to make measurements

When positioning to make code domain power measurements over the air, the goal is to select a location where pilot dominance is high and multipath power is low. The pilot channel bar graph, the text displays of pilot dominance and multipath power, and the CDP valid light are all visual indicators intended to assist the user in selecting a position to make measurements. Figures 22 and 23 show two code domain power measurements of the same sector taken from different locations. Figure 22 has better measurement conditions than Figure 23. When making these measurements, effort should be made to have conditions similar to Figure 22, but if this is not possible, the conditions in Figure 23 are acceptable.
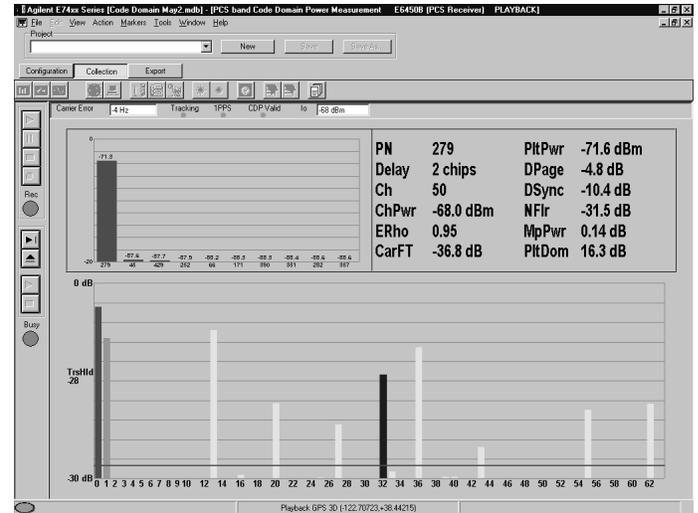
Figure 22. Code domain power display with very good measurement conditions.
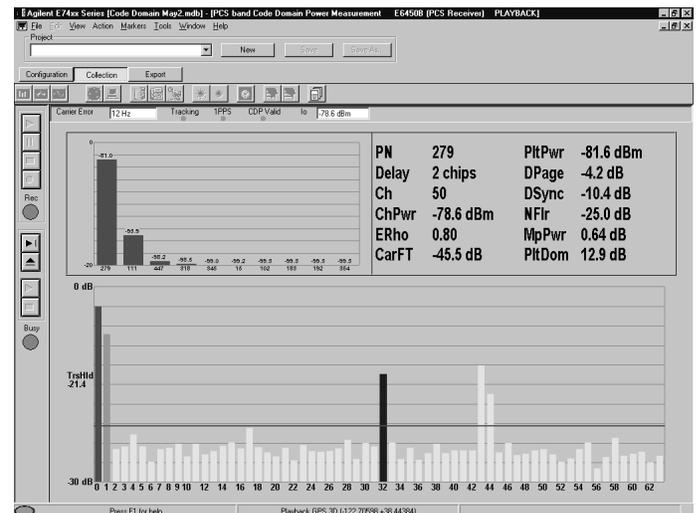
Figure 23. Code domain power display with fair measurement conditions.

5.2 Effects of pilot dominance and mulitpath power on maximum estimated Rho

Estimated Rho is a measure of CDMA waveform quality and is typically made at the transmitter output. In an over-the-air scenario the system measures the waveform quality of the received signal which has been subjected to the effects of interference and multipath. As interference and multipath raise the noise floor of the code domain power measurement, the maximum expected reading of estimated Rho decreases. As pilot dominance decreases and/or multi-path power increases, the maximum reading you should expect from the estimated Rho metric decreases.

The table below shows the degradation of the estimated Rho metric expected for various values of pilot dominance. This table assumes the ratio of the traffic power received from the two sectors (strongest and second strongest) is approximately the same as the ratio of the pilots (pilot dominance). If the traffic power from the sector with the strongest pilot is much higher, the degradation will be slightly less. If the traffic power from the second sector is much higher, the degradation will be slightly more.

Table 1. Estimated Rho degradation due to interfering sector

Pilot Dominance	Est-Rho Degradation (X)
5 dB	0.25
6 dB	0.21
7 dB	0.17
8 dB	0.14
9 dB	0.12
10 dB	0.10
11 dB	0.08
12 dB	0.06
13 dB	0.05
14 dB	0.04
15 dB	0.03
16 dB	0.025
17 dB	0.02

Table 2. Shows the degradation of the estimated Rho metric expected for various values of multipath power.

Multipath Power	Est-Rho Degradation (Y)
0.75 dB	0.17
0.70 dB	0.16
0.65 dB	0.15
0.60 dB	0.14
0.55 dB	0.135
0.50 dB	0.13
0.45 dB	0.12
0.40 dB	0.10
0.35 dB	0.09
0.30 dB	0.08
0.25 dB	0.06
0.20 dB	0.05
0.15 dB	0.04
0.10 dB	0.03

When measuring estimated Rho over-the-air, the degradation due to an interfering sector and multipath echoes must be considered when interpreting the results.

The maximum estimated Rho you should expect to measure is calculated as

Maximum estimated Rho = 1.0 - X - Y

where, X is the degradation due to the interfering sector - as shown in Table 1, and Y is the degradation due to multi-path echoes - see Table 2.

Example calculation:

Pilot dominance = 12 dB => X = 0.06

Multipath power = 0.4 dB => Y = 0.10

Maximum estimated Rho = 1.0 - 0.06 - 0.10 = 0.84

In this case, measurements of estimated Rho substantially less than 0.84 indicate poor waveform quality from the sector under test, or possible interference from outside of the CDMA system (refer to 5.3).

5.3 Effect of external interference on maximum estimated Rho

Interfering signals may come from sources outside of the CDMA network. External interference occurs less frequently than internal interference (signals from other sectors). In-band external interference will raise the noise floor of the code domain power measurement and degrade estimated Rho. If a poor estimated Rho is detected, a quick check of the spectrum should be done using the base station spectrum analyzer VFP. If no external interference is detected in-band, the poor measurement can be attributed to poor waveform quality.

5.4 Effect of pilot dominance on amplifier capacity measurement

The percentage of amplifier capacity estimate assumes that all of the channel power that is measured is being transmitted by the dominant sector. If a significant amount of the channel power is coming from other sources (other sectors and/or external interference) the estimate of percentage of amplifier capacity will be higher than the amount that is actually being used. The most accurate estimate of percentage of amplifier capacity will come when pilot dominance is very large.

6.0 Measurement setup

6.1 Code domain power

Figure 24 shows the code domain power virtual front panel. There are three different measurement selections that are enabled and disabled via checkboxes:

CDP Trace: Measures all 64 Walsh codes for the dominant sector and displays the results in a color-coded bar graph.

CDP Stats: Measures 18 different parameters and displays them in text.

TopN: Measures all of the pilot channels and displays the 'N' strongest, where 'N' is a user definable integer from 1 to 20. If the system has only option 111 (not 110 or 120), 'N' will be limited to 2.
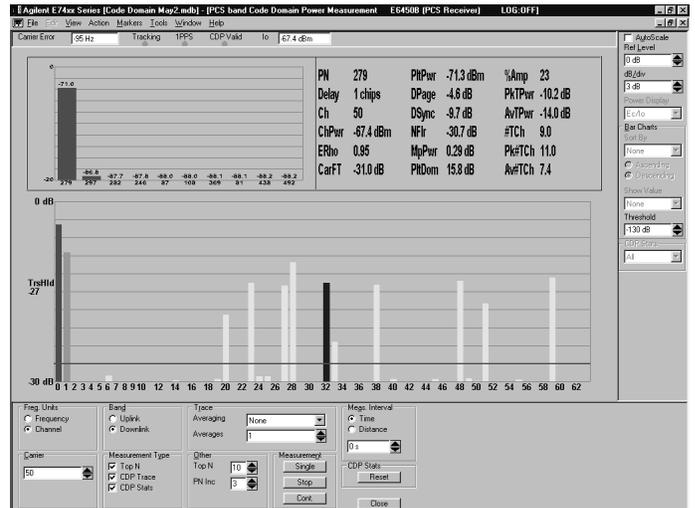
Figure 24. Code domain power virtual front panel with measurement type checkboxes and CDP Valid light circled.

6.1.1 Measurement validity

The validity of each code domain power measurement is defined by the threshold settings for pilot dominance and multipath power. Section 6.1.2.1 discusses the setup of these thresholds. If both thresholds are satisfied, the code domain power measurement is valid, and the *CDP Valid* light is green. If either threshold is violated, the code domain power measurement is invalid, and the *CDP Valid* light is red. When a code domain power measurement is invalid all of the parameters that are derived from it appear blanked on the screen. Figure 25 is an example of both a valid and an invalid code domain power measurement.
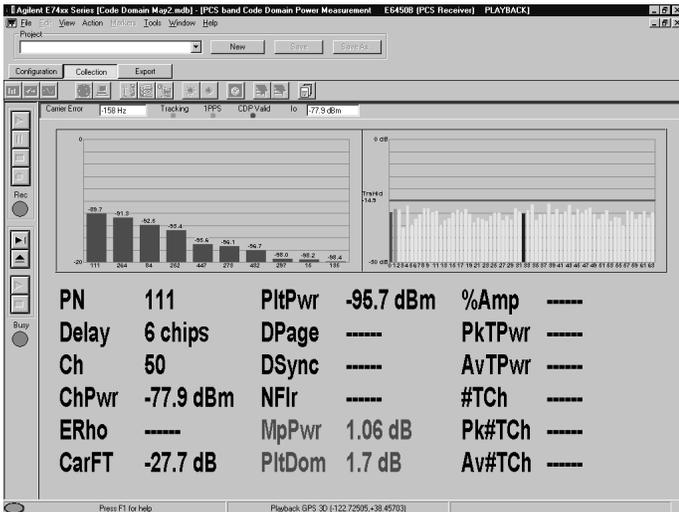
Figure 25. Code domain power measurement with invalid conditions.

Figure 27. Export exclusion rule entry box – PltDom >9 dB AND
MpPwr <0.8 dB

When a code domain power measurement is invalid, the parameters that appear blank on screen are still being measured. If data is being recorded to the database, these values will be saved. This allows different validity parameters to be applied to the data upon export for analysis. For example, during collection you may have the thresholds set at the default values, but the code domain power bar graph seemed to look good in many instances when the *CDP Valid* light was red. When you export this data, you may want to try several more aggressive scenarios in addition to the valid conditions defined for collection.

Figures 26, 27 and 28 show exclusion setting for exporting the data. In Figure 27 the exclusion rule eliminates from export all data where the *CDP Valid* light was red during collection. Figure 28 shows a more aggressive scenario where all data with pilot dominance greater than 9 dB and multipath power less than 0.8 dB is exported. These values can be manipulated for more conservative scenarios. You can also have several scenarios of export plans (named accordingly), as shown in Figure 28.

Figure 28. Export main menu with several different code domain power export plans.
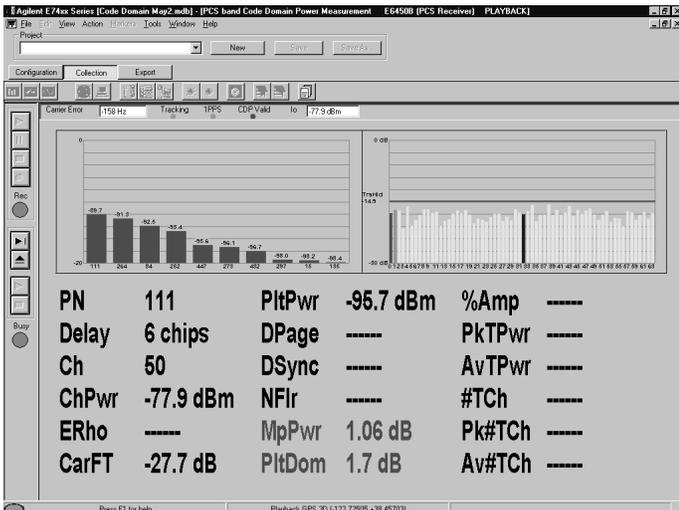
Figure 26. Export exclusion rule entry box - CDP Valid indicator= false

6.1.2 Configuration parameters

There are six code domain power measurement parameters that must be set up in the *Measurement Editor* under the *Configuration* context. The measurement editor form for code domain power is shown in Figure 29. The code domain power setup parameters are described in the following sections.

Figure 29. Code domain power measurement editor form

6.1.2.1 Measurement validity parameters

Pilot dominance threshold (default value = 10 dB): If the measured value of pilot dominance is less than this threshold setting, the CDP Valid light and the text display of PilDom will turn red.

Decreasing this value is a more aggressive approach that increases the likelihood that an unusable measurement will be interpreted as "valid".

Increasing this value is a more conservative approach that increases the likelihood that a usable measurement will be interpreted as "invalid".

Multipath power threshold (default value = 0.4 dB): If the measured value of multipath power exceeds this threshold setting, the CDP Valid light and the text display of MpPwr will turn red.

Increasing this value is a more aggressive approach that increases the likelihood that an unusable measurement will be interpreted as "valid".

Decreasing this value is a more conservative approach that increases the likelihood that a usable measurement will be interpreted as "invalid".

6.1.2.2 Number of control channels (default value = 3):

This is the number of Walsh channels used for overhead functions. Typically, this value is 3 (Pilot + Paging + Sync). In some cases, a cell may be using more than one Walsh code channel for paging. In this case, the number needs to be set accordingly, so traffic statistics are computed correctly. For example, if Walsh codes 1 and 2 are both being used for paging, number of control channels should be set to 4 (Pilot + 2 Paging + Sync).

6.1.2.3 Noise threshold offset (default value = 0 dB):

Defines the incremental placement of the active channel (indicated in red) threshold line on the code domain power bar graph display.

- The recommended setting is 0 dB (the default setting). Empirical experience has shown that 0 dB is the best setting for making accurate assessments of whether a given traffic channel is active or inactive.

- A negative value pushes the threshold lower. This is a more aggressive setting that increases the likelihood of interpreting an inactive channel as active.

- A positive value pushes the threshold higher. This is a more conservative approach that increases the likelihood of interpreting an active channel as inactive.

The reference for this incremental value is the 50th strongest Walsh code channel. There are 49 Walsh code channels with more power than the reference and 14 Walsh code channels with less power than the reference. The level of the active channel threshold line is determined as follows:

Active channel threshold level = Level of reference + 4.5 dB + Noise threshold offset

So, with the noise threshold offset set to 0 dB, the active channel threshold level will be set at 4.5 dB above the level of the 50th strongest Walsh code channel.

6.1.2.4 Amplifier capacity parameters

Two setup parameters are required for amplifier capacity - **Pilot level of** corresponds to Percentage of amplifier capacity.

Pilot level of (default value = -2 dB): The Ec/Io level of the pilot channel in a no-traffic state. The pilot Ec/Io when the sector is transmitting only pilot, paging, and sync channels.

Percentage of amplifier capacity (default value = 15%): The percentage of the forward link power amplifier capacity that is used in a no-traffic state. The percentage of the maximum output power that is used when the sector is transmitting only pilot, paging, and sync channels.

Typically, these two parameters are part of the network design, and they are known. If they are not known, they can be easily calculated as described on page 16.

A CDMA base station is typically setup with a specified amount of power allocated to the pilot channel and specified power settings of the paging and sync channels defined relative to the pilot channel. Occasionally, the paging and sync channels power settings will also be specified in absolute power units (watts). Given the pilot, paging, and sync power setup values and the maximum power output of the amplifier, the percentage amplifier capacity setup parameters can be determined. Two sets of formulas are provided below - one where the paging and sync powers are defined relative to the pilot, and the other where they are defined in absolute power units.

Pilot level of = $10\text{Log}(1/(P + 10D^{Pg/10} + 10D^{S/10}))$

corresponds to

Percentage of amplifier capacity =
$(P + 10D^{Pg/10} + 10D^{DS/10})/\text{MaxP}$

Where,

P = Pilot channel power setting in watts

DPg = Paging channel power setting in dB relative to the pilot channel

DS = Sync channel power setting in dB relative to the pilot channel

MaxP = Maximum output power of the amplifier

Pilot level of = $10\text{Log}(1/(P + Pg + S))$

corresponds to

Percentage of amplifier capacity = $(P + Pg + S)/\text{MaxP}$

Where,

P = Pilot channel power setting in watts

Pg = Paging channel power setting in watts

S = Sync channel power setting in watts

MaxP = Maximum output power of the amplifier

The Excel spreadsheet in figure 30 illustrates an example of each of the above formula sets.

6.1.3 Hint for increased measurement speed (stationary application only)

It is important to use this hint with caution and only after establishing a good dominant pilot parking location with TopN on. If the dominant pilot changes (most likely to happen while moving) while TopN is turned off, the code domain power measurement will degrade severely.

In order to improve the update rate of the code domain power measurement, you can turn off the TopN pilot measurement. **Only do this after a good dominant pilot location has been achieved.** With the TopN pilot measurement turned off, the code domain measurement will update about three times per second compared to about once per second with TopN on.

When TopN is turned off, all of the parameters that are dependent on the pilot channel measurement are grayed out. This provides a visual reminder that the measurement is no longer scanning for the dominant pilot, and the code domain power measurement validity is no longer being assessed.
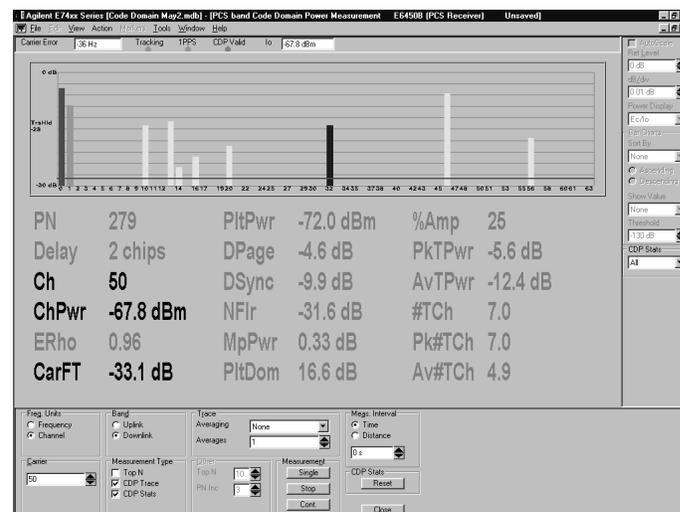
Figure 31. Code domain power VFP with TopN turned off.

Calculations with Delta-Paging and Delta-Sync as inputs				
Max PA power	8	watts		
Pilot power	1	watts		
Delta Paging setting	-4	dB wrt Pilot		
Delta Sync setting	-10	dB wrt Pilot		
Pilot level of	-1.76	dB	=Pilot Ec/Io with Pilot, Paging, Sync only	
Percentage of amplifier capacity	18.73%		=Percentage capacity with Pilot, Paging, Sync only	
Calculations with Paging channel power and Sync channel power as inputs				
Max PA power	8	watts		
Pilot power	1	watts		
Paging power	0.4	watts		
Sync power	0.2	watts		
Pilot level of	-2.04	dB	=Pilot Ec/Io with Pilot, Paging, Sync only	
Percentage of amplifier capacity	20.00%		=Percentage capacity with Pilot, Paging, Sync only	

Figure 30. Excel spreadsheet – Amplifier capacity measurement setup parameters.

6.1.4 Setup for multi-carrier code domain power measurements

Two different approaches can be used for multi-carrier applications:

1) Multiple-receiver, or

2) Single-receiver.

6.1.4.1 Multiple-receiver

Multiple-receiver is the preferred approach. It maximizes measurement performance and minimizes the amount of user interaction required during collection. The software is set up so that each receiver measures code domain power on one carrier frequency. Once the project is set up, the user doesn't need to modify any measurement parameters.

Each receiver is able to measure code domain at its maximum rate, so code domain is measured on each carrier at the maximum achievable speed. Speed is particularly important when comparing carriers that have very dynamic traffic conditions. Figure 32 shows a project with two receivers, each measuring one of two carriers.
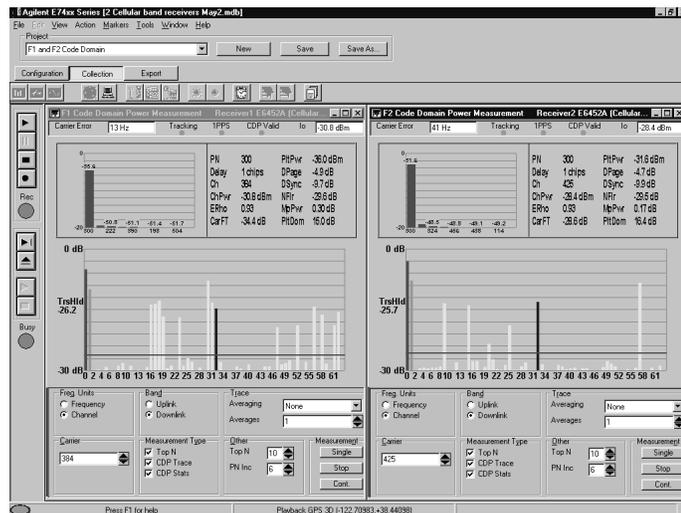
Figure 32. Simultaneous code domain power measurements on 2 carriers, using 2 receivers.

6.1.4.2 Single-receiver

Single-receiver is an alternative approach that requires less hardware than the multi-receiver approach.

A given receiver can execute a code domain power measurement on one carrier frequency at a time. Each time a different carrier frequency is to be measured the user must enter the new channel/frequency on the code domain VFP. This method does not allow for both carriers to be measured simultaneously, and it requires significantly more user interaction than the multi-receiver approaches. Figure 33 illustrates the manual process of changing carrier frequencies when using a single receiver for a two-carrier code domain application.

Given the level of user interaction, it is not practical to use the single-receiver method to measure multiple carriers while driving. It is recommended this method only be used for multi-carrier measurements when stationary.
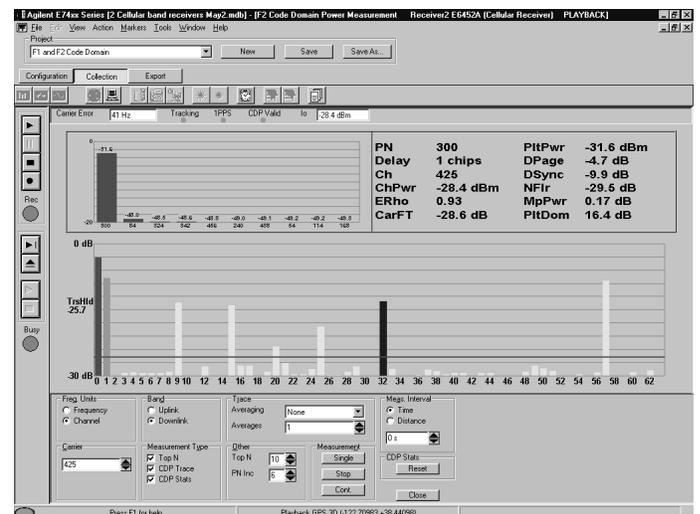
Figure 33. Sequential code domain power measurements of 2 carriers using 1 receiver.

7.0 Exporting Data

This section steps through the creation of an export plan. The export plan only needs to be created the first time; once a plan is created it can be reused. Typically, you will have a number of different export plans based on the specific type of data and analysis you are interested in.

To create an export plan:

1. Click the Export button on the context tool bar.

2. Click the Add Plan button. The Plan Wizard form will appear.

3. Enter the name of the export plan in the text entry field.

4. Click the Next button. The Specify Columns form will appear.
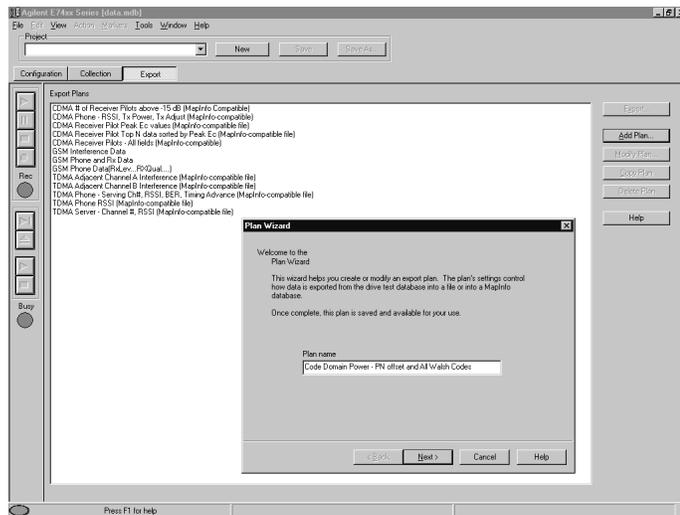
Figure 34a. Export context with Plan Wizard displayed.

In the Specify Columns form:

1. Click the Add button. The Column Setup form will appear.

2. Select the data result type you want to export. Figure 34b shows selection of PN Offset from the Code Domain Power Statistics measurement

3. Click the OK button.
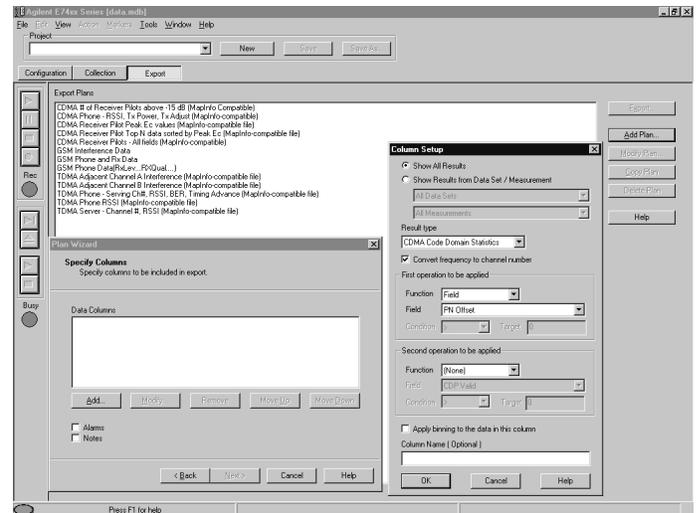
Figure 34b. Specify Columns form with Column Setup form for PN Offset.

To add another data type to the same export plan. In the Specify Columns form:

4. Click the Add button. The Column Setup form will appear.

5. Select the data result type you want to export. Figure 34c shows selection CDMA Code Domain Power which selects all of the Walsh code power measurements.

6. Click the OK button.

7. Click the Next button. The Specify Exclusion Rules form will appear. (If you wanted to add more data types, you would click Add again.)

Figure 34c. Specify Columns form with Column Setup form for
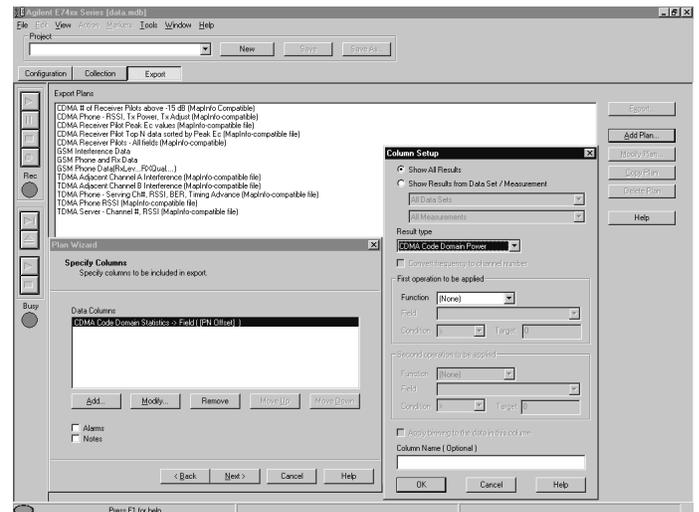
Walsh code power.

To filter out data records that you do not want to include in the Specify Exclusion Rules form:

1. Click the Add button. The Exclusion Rule Setup form will appear.

2. Select the data result type you want to base the exclusion on.

3. Click the OK button.

4. Click the Next button. The Specify Output form will appear. (If you wanted to add more exclusion rules, you would click Add again.)
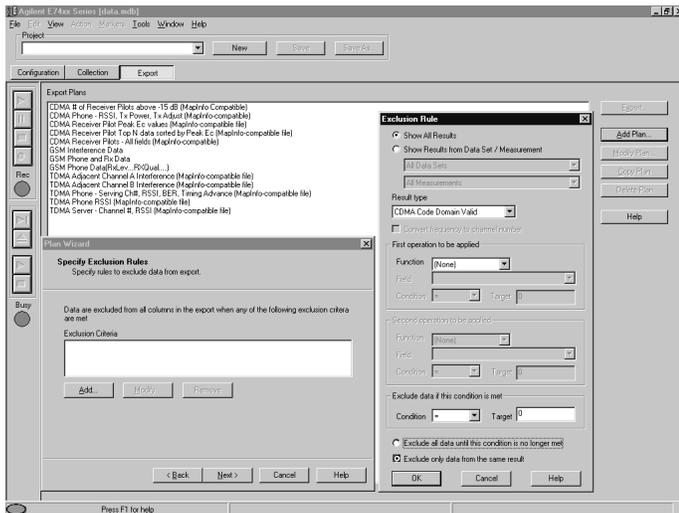
Figure 34d. Specify Exclusion Rules form with Exclusion Rule Setup form for excluding rules where CDP valid is false.

To define the specific format of the output file in the Specify Output form:

1. Select the output file type from the Output Destination pull-down list. Figure 34e shows a standard text file format.

2. Select the position format from the pull-down list usually Signed Decimal Degrees.

3. Select the datum from the pull-down list – usually NAD27.

4. Select the delimiter from the pull-down list.

5. Click the checkboxes of the optional elements that you want to include in the export.

6. Click the Next button.

7. Click the Next button. The Specify Output form will appear. (If you wanted to add more exclusion rules, you would click Add again.)
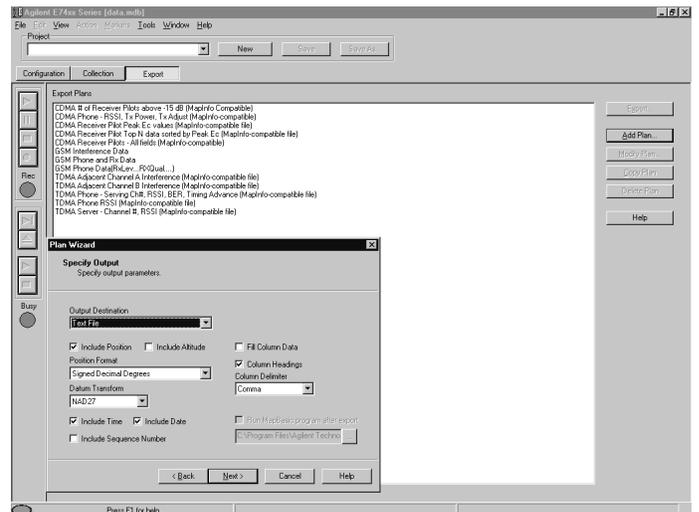
Figure 34e. Specify output window.

For the latest news, products and support information, and application literature, visit our Web site at: **www.agilent.com/find/networks**

Additional Agilent literature

E7490A CDMA Over-Air Maintenance Tool,
Configuration Guide 5968-8696E

E7490A CDMA Over-Air Maintenance Tool,
Product Overview 5968-8697E

E7473A CDMA Drive-Test System,
Configuration Guide 5968-5553E

CDMA Drive Test, Product Note 5968-5554E

E7473A CDMA Drive-Test System, Data Sheet 5968-5555E

**Agilent Technologies'
Test and Measurement Support,
Services, and Assistance**

Agilent Technologies aims to maximize the value you receive, while minimizing your risk and problems. We strive to ensure that you get the test and measurement capabilities you paid for and obtain the support you need. Our extensive support resources and services can help you choose the right Agilent products for your applications and apply them successfully. Every instrument and system we sell has a global warranty. Support is available for at least five years beyond the production life of the product. Two concepts underlay Agilent's overall support policy: "Our Promise" and "Your Advantage."

Our Promise
Our Promise means your Agilent test and measurement equipment will meet its advertised performance and functionality. When you are choosing new equipment, we will help you with product information, including realistic performance specifications and practical recommendations from experienced test engineers. When you use Agilent equipment, we can verify that it works properly, help with product operation, and provide basic measurement assistance for the use of specified capabilities, at no extra cost upon request. Many self-help tools are available.

Your Advantage
Your Advantage means that Agilent offers a wide range of additional expert test and measurement services, which you can purchase according to your unique technical and business needs. Solve problems efficiently and gain a competitive edge by contracting with us for calibration, extra-cost upgrades, out-of-warranty repairs, and on-site education and training, as well as design, system integration, project management, and other professional services. Experienced Agilent engineers and technicians worldwide can help you maximize your productivity, optimize the return on investment of your Agilent instruments and systems, and obtain dependable measurement accuracy for the life of those products.

By Internet, phone, or fax, get assistance with all your test and measurement needs

Online assistance:
www.agilent.com/find/assist

Phone or Fax
United States:
Agilent Technologies
(tel) 1 800 452 4844

Canada:
Agilent Technologies Canada Inc.
(tel) 1 877 894 4414

Europe:
Agilent Technologies
Test & Measurement
European Marketing Organisation
(tel) (31 20) 547 2000

Japan:
Agilent Technologies Japan Ltd.
(tel) (81) 426 56 7832
(fax) (81) 426 56 7840

Latin America:
Agilent Technologies
Latin American Region Headquarters, U.S.A.
(tel) (305) 267 4245
(fax) (305) 267 4286

Australia/New Zealand:
Agilent Technologies Australia Pty Ltd
(tel) 1-800 629 485 (Australia)
(fax) (61 3) 9272 0749
(tel) 0 800 738 378 (New Zealand)
(fax) (64 4) 802 6881

Asia Pacific:
Agilent Technologies, Hong Kong
tel: (852) 3197 7777
fax: (852) 2506 9284

Product specifications and descriptions in this document subject to change without notice.

Agilent Technologies
Innovating the HP Way