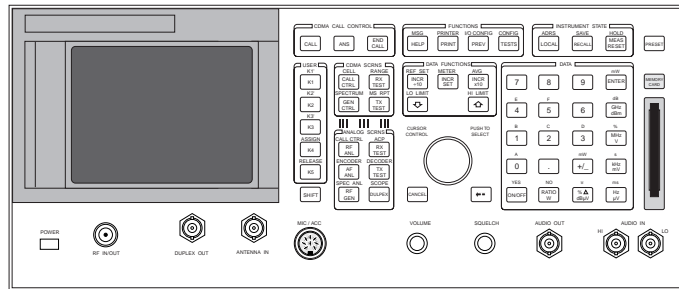


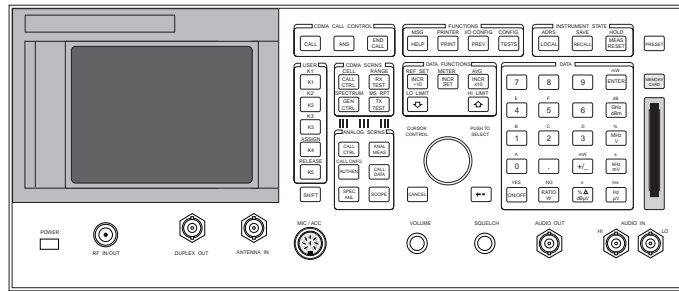
Positioning Paper: The HP 8924E versus the HP 8924C

Product Note

HP 8924C CDMA MOBILE STATION TEST SET



HP 8924E CDMA MS SERVICE TEST SET



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Product Positioning

The HP 8924C CDMA Mobile Station Test Set and HP 8924E CDMA MS Service Test Set act as calibrated, high performance base stations to provide the essential set of measurements required to test the parametric and functional characteristics of cellular, dual-mode CDMA phones.

Additionally, when combined with the HP 83236B PCS Interface adapter, these test sets support dual-mode, dual-band CDMA mobile phone testing. The HP 83217A CDMA (dual-mode) Mobile Station Test Software automates testing to improve consistency and reduce operator errors, resulting in lower operation costs and improved product quality.

This paper summarizes the key differences between the HP 8924C and the HP 8924E, that is:

- The HP 8924E only supports the AUTO MS ID.
- The HP 8924E does not support:
 - closed loop power control changes
 - mobile parameter retrieval and setting
- The HP 8924E's spectrum analyzer is optional.
- The HP 8924E has no second sector for softer handoffs.
- Two HP 8924E Test Sets cannot be synchronized for testing soft handoffs.
- The HP 8924E does not have access to certain general purpose analog screens.
- The HP 8924E generally takes twice as long to make the same measurement.
- There are rear panel differences between the HP 8924C and the HP 8924E.
- There are technical specification differences between the HP 8924C and the HP 8924E.

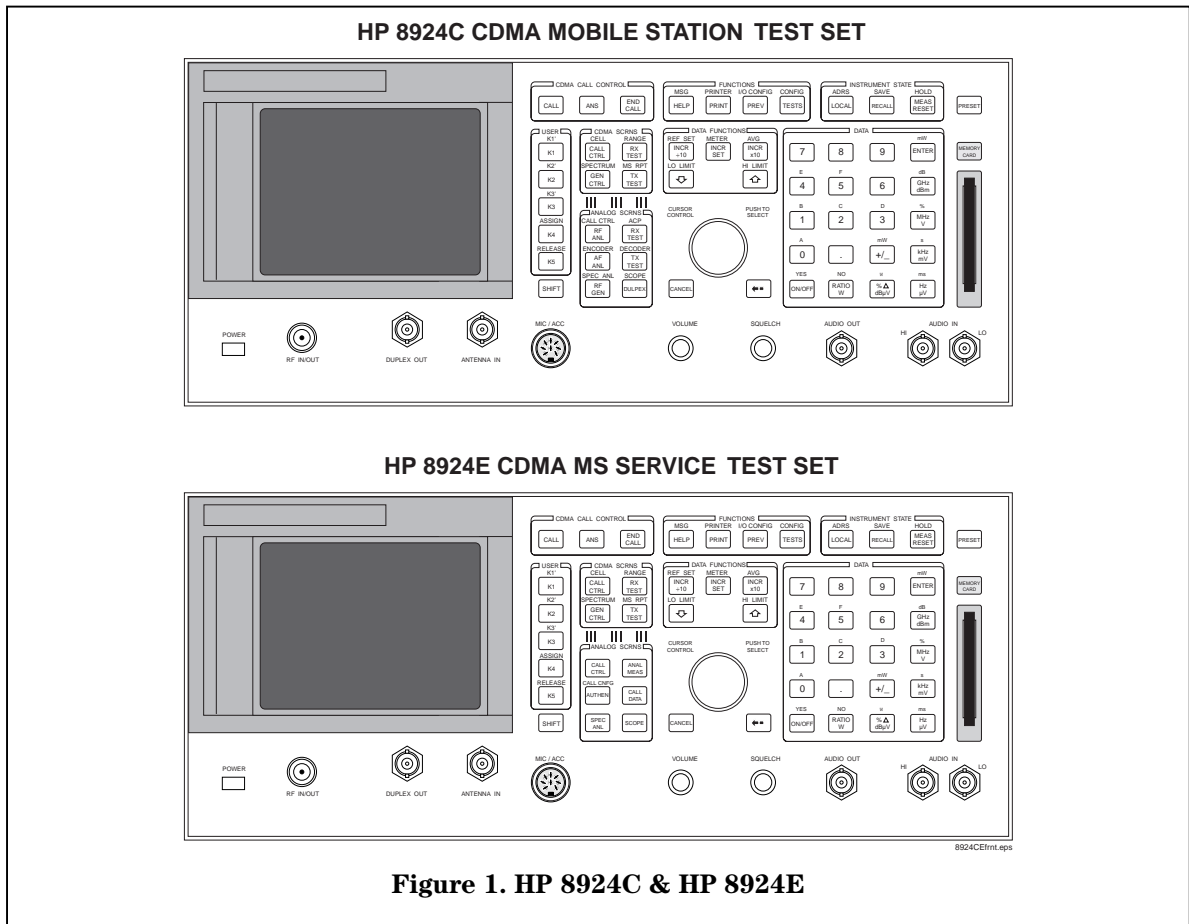


Figure 1. HP 8924C & HP 8924E

Typical Customer Applications

The HP 8924C was HP's first one-box solution for CDMA Mobile Phone testing. The HP 8924C is optimized for the following applications:

- CDMA research and development for mobile phone design
- High volume CDMA manufacturing for mobile phone calibration, final test and repair
- High volume CDMA mobile phone incoming inspection and return testing

Even though the HP 8924E has

- reduced flexibility (fewer user programmable fields, no front panel access to certain general purpose analog screens),
 - reduced functionality (no spectrum analyzer, no soft or softer handoff capability, fewer rear panel connections, less range in certain technical specifications),
 - as well as slower measurement speed (100% difference in measurement speed for tests not requiring FER measurements, such as minimum and maximum power, rho and analog measurements),
- it does not sacrifice the quality, thoroughness, repeatability, and accuracy of the HP 8924C.

The HP 8924E has a more user-friendly interface optimized for manual operation. It is a lower cost product designed for the CDMA mobile phone service market. The HP 8924E is optimized for the following applications:

- Incoming inspection for service providers
- Failure and repair verification for service organizations

Common Features of the HP 8924C and the HP 8924E

CDMA and Analog Testing

With the HP 8924C and/or HP 8924E, you save space, cost, and training expenses by making both analog (AMPS, NAMPS, TACS, and JTACS) and digital CDMA measurements with the same instrument. With the press of a single button, the instruments automatically handle the complex, over-the-air call processing required to make a CDMA phone call. Mobile and base station initiated calls and disconnects are supported. The test sets also support a number of service options and protocol stacks that offer a variety of formats for easy and convenient testing.

CDMA Transmitter Measurements

The test sets measure transmitted waveform quality by the IS-98A/J-STD-018 recommended correlated power method, also known as the rho (ρ) measurement. The rho measurement also reports frequency error, amplitude error, time offset, phase error, and carrier feedthrough.

The Test Sets incorporate a next generation average power measurement that allows the maximum power of the phone to be measured. The channel power is calibrated against the average power measurement, thereby enabling the Test Sets to achieve accurate low level CDMA power measurements for all cellular/PCS bands. Furthermore, Access Probe Power Measurements reports the power in a 1.23 MHz bandwidth by automatically triggering a power measurement each time the mobile station registers, originates a call, or is paged.

CDMA Receiver Tests

The instruments have a high accuracy CDMA source that generates all of the channels required by the TIA/EIA-95-B air interface, just like an operational CDMA base station. An additive white noise source (AWGN) is also included to provide the interference generated by adjacent cells in a working CDMA network

The key performance parameter for CDMA mobile station receivers is frame error rate (FER) in the presence of AWGN. The test sets fully support Service Options 002 and 009 (9600 bps and 14,400 bps data loopback modes) to test FER performance. For complete receiver characterization, the Test Sets measure FER at all four data rates used in the CDMA system: full, half, quarter, and one-eighth.

Hard Hand-off and CDMA to Analog Handoff Verification

To speed testing, the Test Sets support hard handoffs between RF channels. Furthermore, CDMA to analog handoffs from both the cellular and PCS bands are supported.

Authentication and Short Message Service Support

The HP 8924C and the HP 8924E provide the necessary features for testing a CDMA mobile station's ability to perform call-processing functions with Authentication for Korea and the United States. Once a mobile station is registered, valid A-Key Check Digits are generated. Unique Challenge and Shared Secret Data Update are fully supported. A table displays the authentication parameters sent by the mobile station, along with the expected value and a passed/failed indication.

Mobile terminated SMS is supported by the HP 8924C and the HP 8924E, which provide fields for entering and sending messages to the mobile station over both the Traffic and Paging channels. Alert, priority, and privacy options can be added to the SMS message to test whether the phone responds properly.

Detailed Product Differences between the HP 8924E and the HP 8924C

The reduced functionality and flexibility of the HP 8924E is evident when comparing the screens of the two instruments.

CDMA CALL CONTROL Screen

When the Test Sets power up, both the HP 8924C and the HP 8924E default to the CDMA CALL CONTROL screen, see Figure 2. Note that the HP 8924E only supports the **AUTO MS ID** and not the PHONE NUM or MIN options. Also, the HP 8924E has a fixed **ECHO DELAY** of 0 seconds.

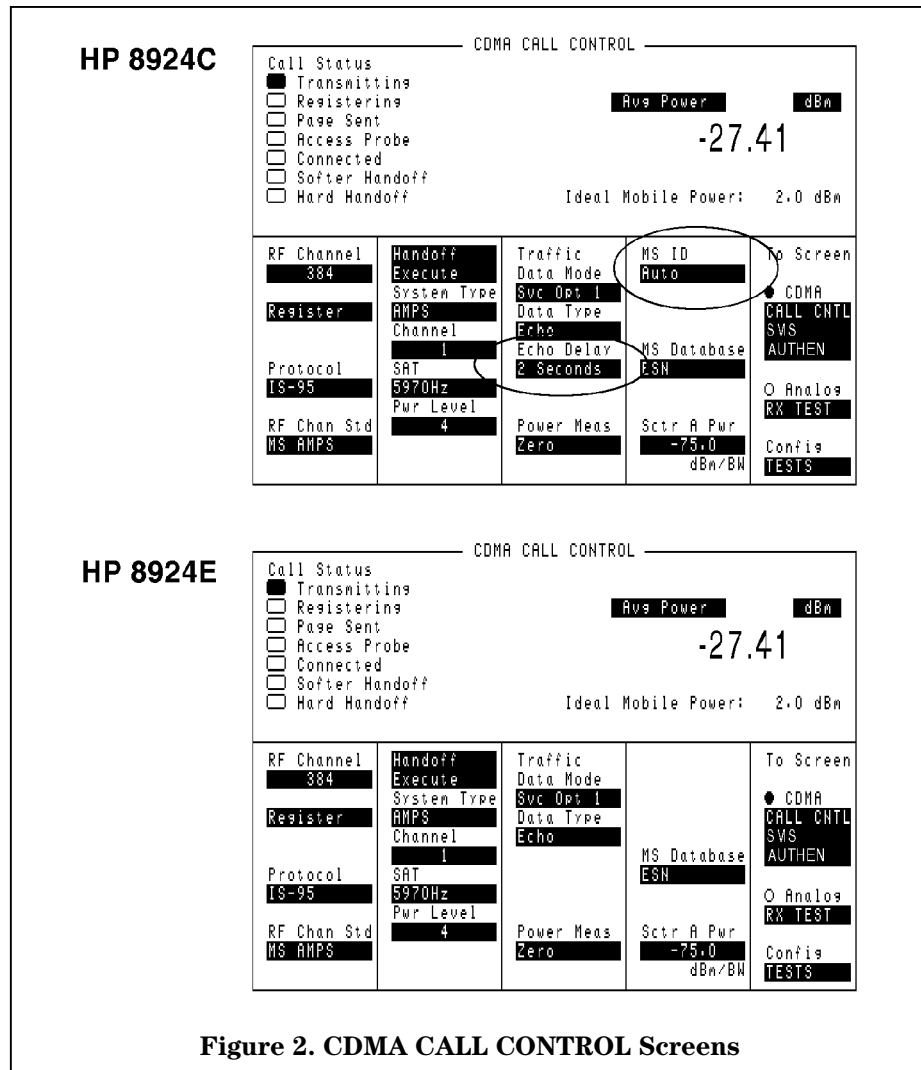


Figure 2. CDMA CALL CONTROL Screens

CDMA CELL SITE CONFIGURATION Screen

Figure 3 shows that many user programmable fields in the CDMA CELL SITE CONFIGURATION screen of the HP 8924C are fixed in the HP 8924E, and therefore not visible to the user.

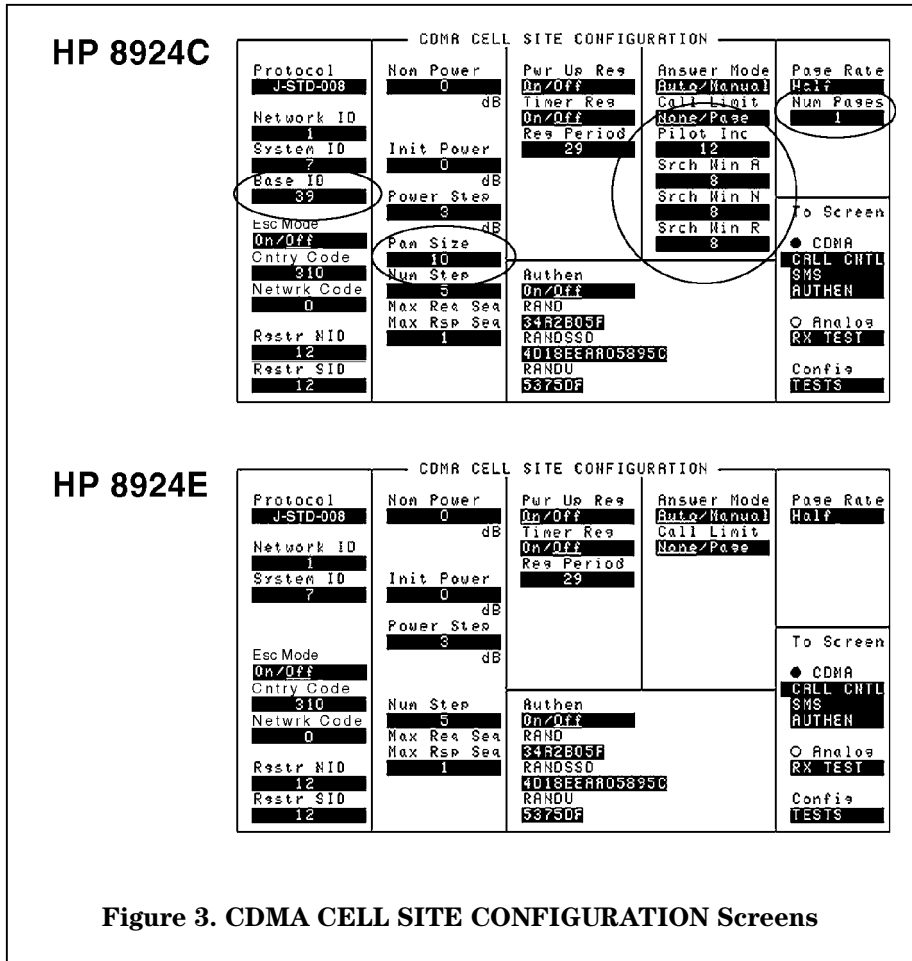
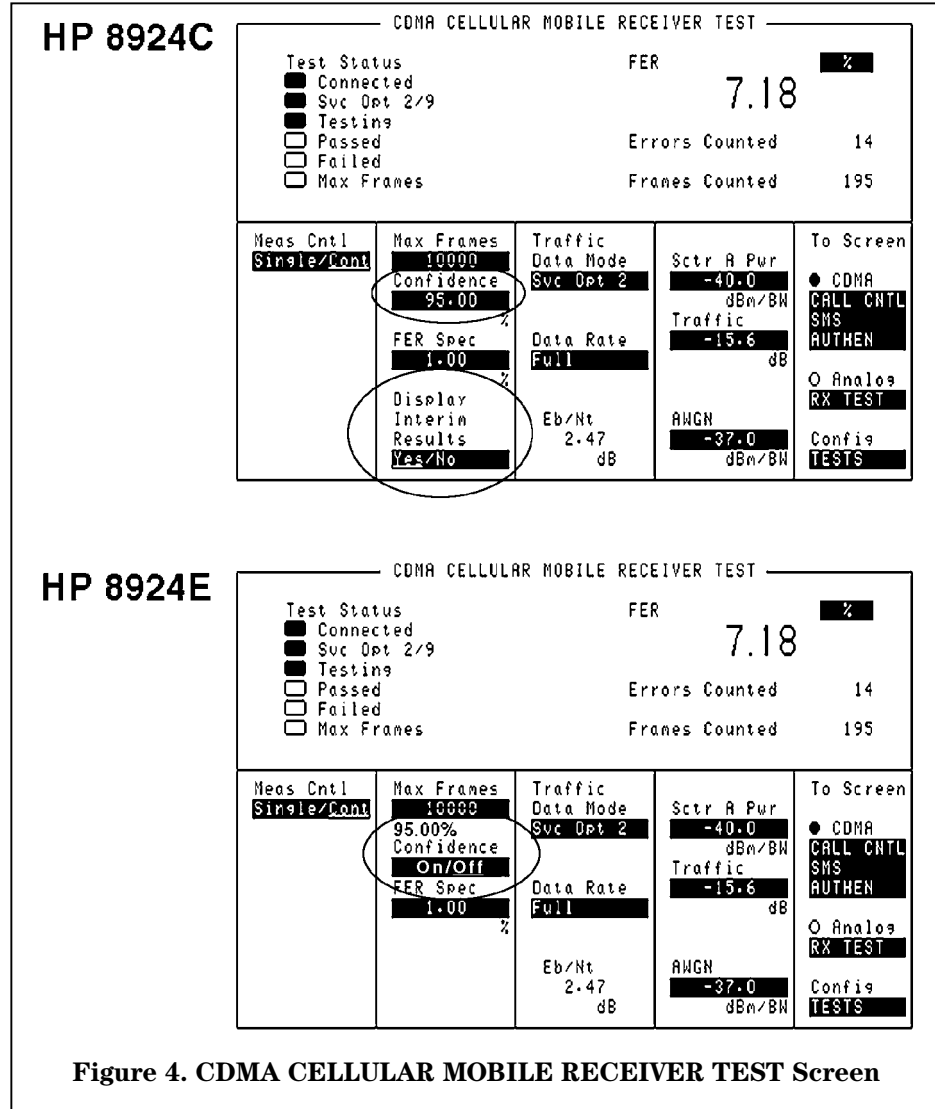


Figure 3. CDMA CELL SITE CONFIGURATION Screens

CDMA CELLULAR MOBILE RECEIVER TEST Screen

Figure 4 shows differences in the CDMA CELLULAR MOBILE RECEIVER TEST screens. For example, to reduce the CDMA receiver test time to an absolute minimum, both Test Sets use confidence limit technology to determine FER test results. The confidence limit can be set in the HP 8924C whereas it is fixed at 95% in the HP 8924E. Also, the HP 8924E is set to always display interim results.



CDMA CELLULAR MOBILE TRANSMITTER TEST Screen

The HP 8924C Test Set supports both test mode rho (**TM Rho**) and traffic mode rho (**Traffic Rho**). The HP 8924E Test Set does not support test mode rho but does support traffic mode rho, see Figure 5.

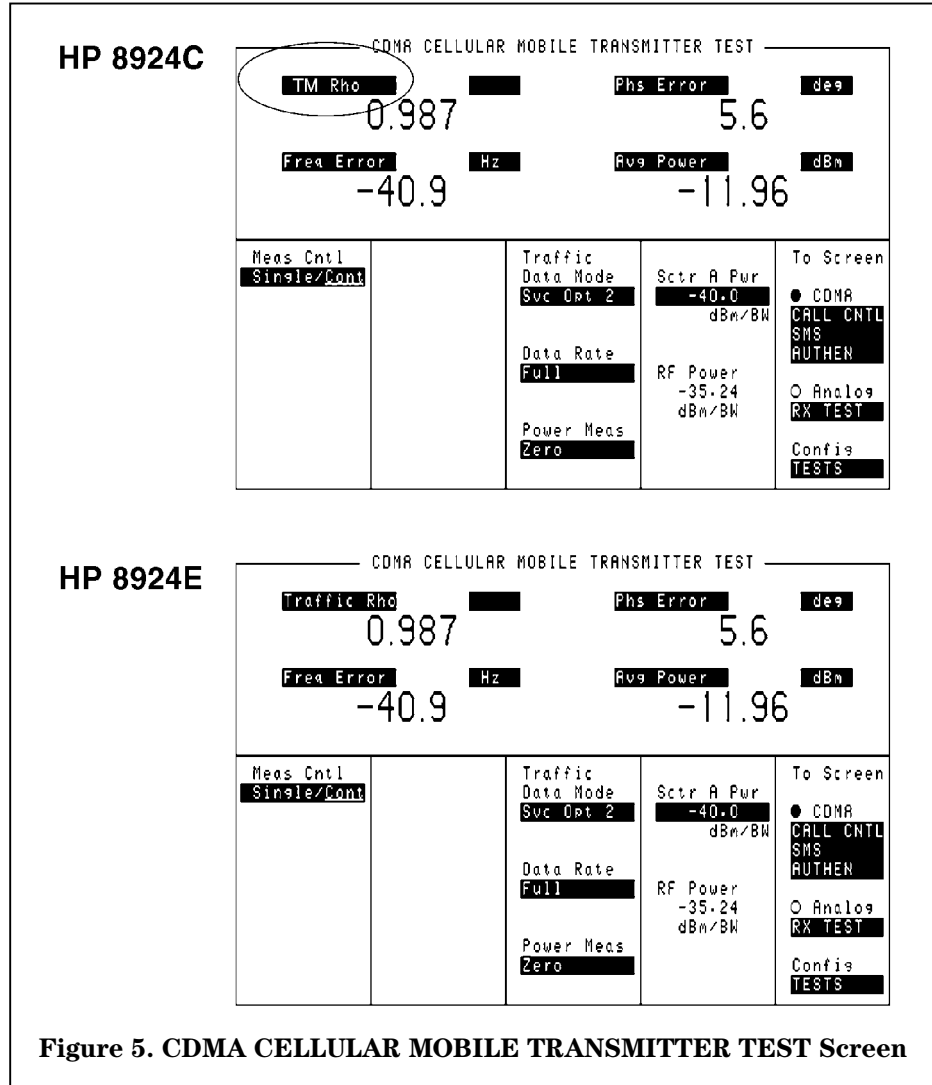
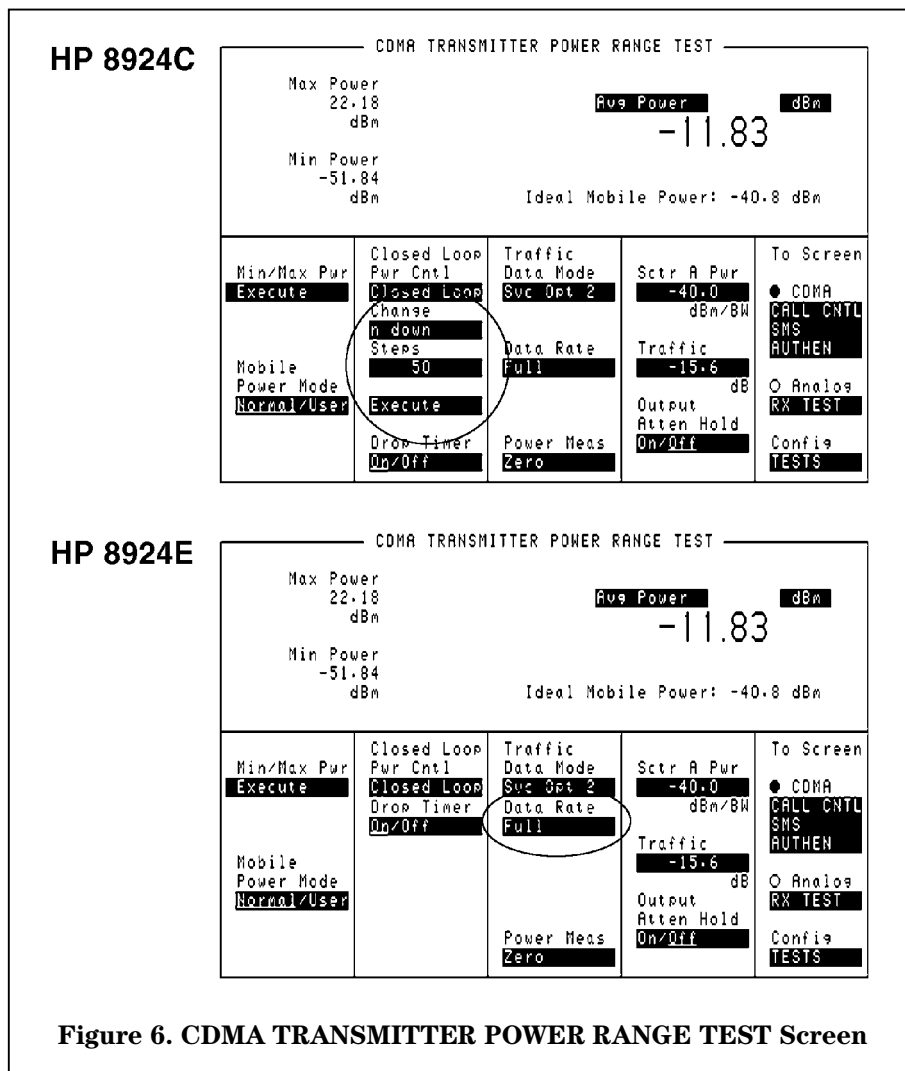


Figure 5. CDMA CELLULAR MOBILE TRANSMITTER TEST Screen

CDMA TRANSMITTER POWER RANGE TEST Screen

The HP 8924E does not support closed loop power control changes, as shown in Figure 6.



No Synchronization for Soft Handoff

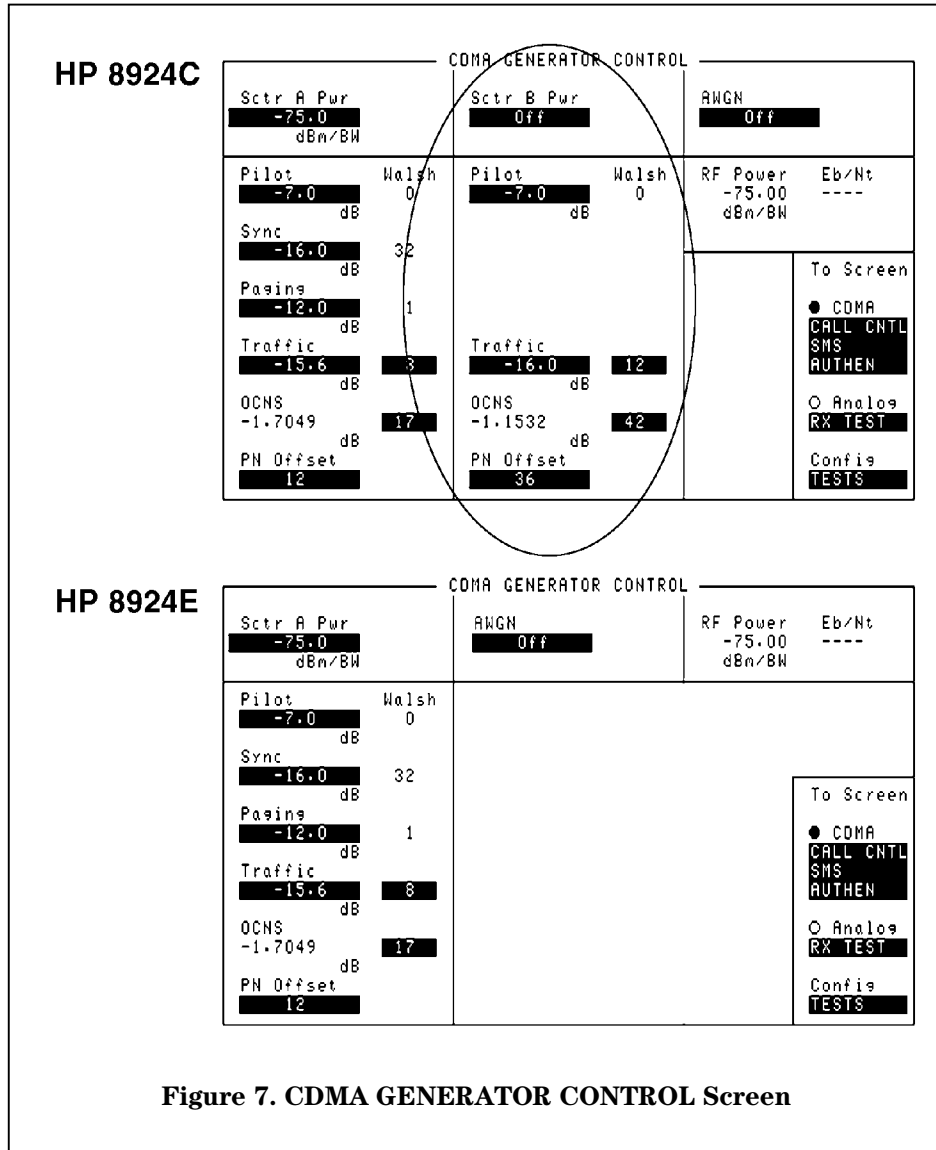
The HP 8924C has the ability to synchronize two Test Sets to the same system time clock. This feature allows testing of a mobile station's demodulation performance during idle and soft handoffs. The HP 8924E does not have this capability.

No Second Sector/Softer Hand-offs

The HP 8924C has a second sector for testing softer handoffs. Sector B is a partial sector that has a pilot channel, a traffic channel, and an OCNS channel. With two configurable CDMA sectors (A and B), the HP 8924C can verify the ability of a CDMA phone to support softer handoffs. Softer

handoffs are similar to soft handoffs and only differ in that the HP 8924C sends identical power control bits to both CDMA cell sectors. This capability provides a low cost method of verifying soft handoff functionality and diversity combining in CDMA mobile telephones. The HP 8924E does not have a second sector (Sector B) and therefore does not support softer handoffs. Thus, fields associated with Sector B on the CDMA GENERATOR CONTROL screen (see Figure 7) and CDMA MOBILE REPORTING screen (see Figure 8) do not appear in the HP 8924E.

CDMA GENERATOR CONTROL Screen



CDMA MOBILE REPORTING Screen

Figure 8 shows that many user programmable fields in the CDMA Mobile Reporting screen of the HP 8924C are fixed in the HP 8924E. The HP 8924E does not support mobile parameter retrieval and setting.

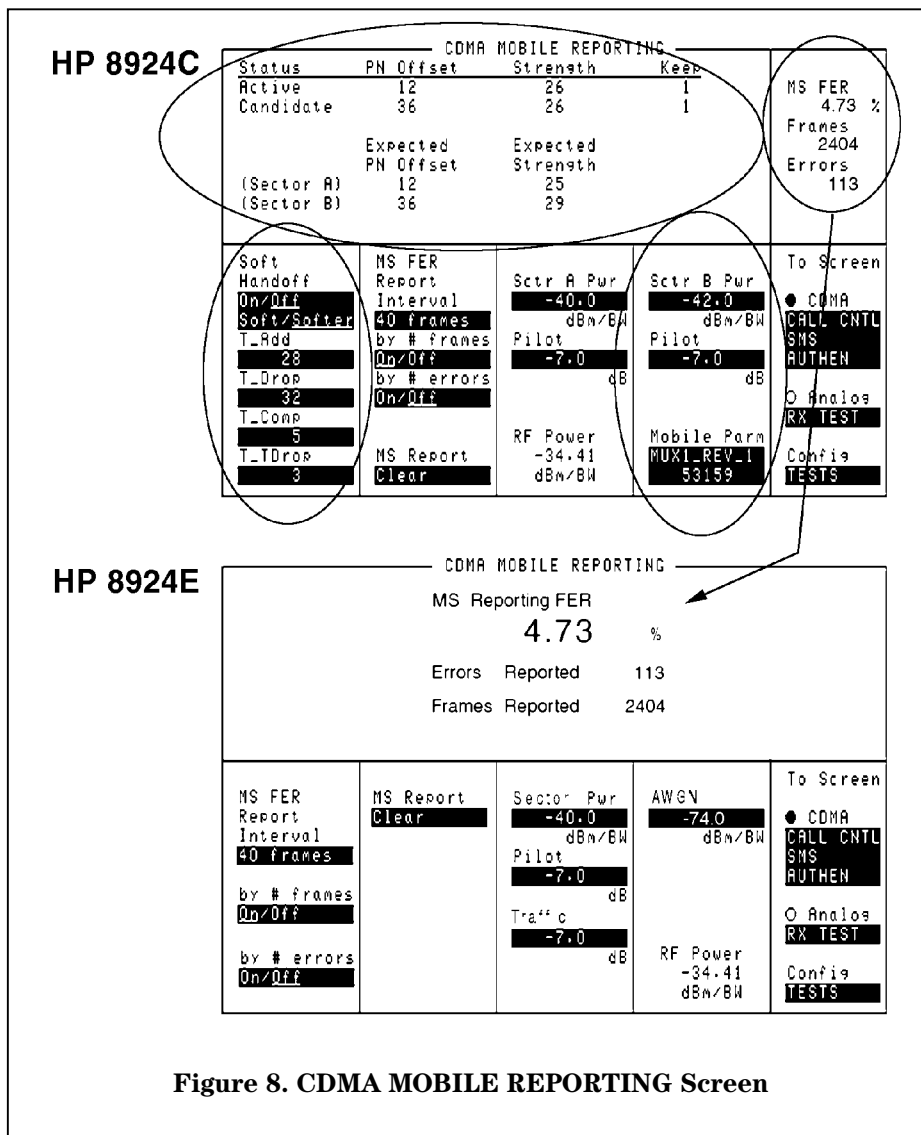


Figure 8. CDMA MOBILE REPORTING Screen

General Purpose Analog Screens

Front Panel

The ANALOG SCRNS keys on the HP 8924E have new labels for the analog call control environment, see Figure 9. The HP 8924E does not have front panel access to general-purpose analog screens such as:

- DUPLEX TEST
- RX TEST
- TX TEST
- RF GEN
- RF ANL
- ACP
- ENCODER
- DECODER

To-Screen Options

CALL BITS cannot be accessed from the **To SCREEN**. The HP 8924E's analog **To SCREEN** provides access to the following screens:

- CALL CONTROL
- CALL DATA
- CALL CONFIGURE
- AUTHENTICATION
- ANALOG MEAS
- SPECTRUM ANALYZER (optional)
- OSCILLOSCOPE

The keypad for the front panel appears as shown in Figure 9.

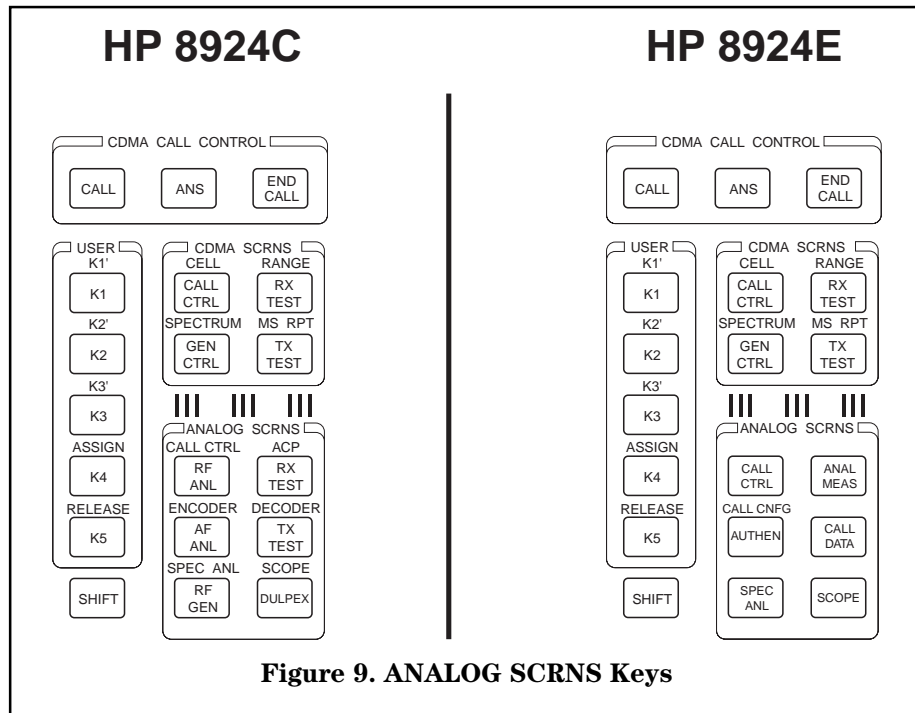


Figure 9. ANALOG SCRNS Keys

Optional Spectrum Analyzer

The HP 8924E's spectrum analyzer is optional.

Measurement Speed Differences

In general, there is a 100% difference in measurement speed between the HP 8924E and the HP 8924C. That is, the HP 8924E generally takes approximately twice as long to make the same measurement. When actual tests are performed the difference in speed will depend on what tests are performed. **FER** measurements are limited to the frame rate of the system (20 ms) rather than the speed of the instrument. The greatest difference in speed is observed when the test sequence is made up of a majority of tests not requiring **FER** measurements, such as minimum and maximum power, rho and analog measurements.

For the first comparison, a relatively short test sequence is used. This test sequence would be typical of a quick go or no-go type of test to verify that a mobile is operational. These tests were performed using the HP 83217A Opt. 004 CDMA/PCS Test Software. The following test sequence was run on three channels.

- Registration
- Maximum RF Output Power
- Sensitivity & Dynamic Range
- CDMA Voice Quality

The same test parameters and test sequences were performed on the HP 8924C and HP 8924E. The results are shown below.

	Test Time	Channels Tested
HP 8924C	233 sec.	3
HP 8924E	291 sec.	3
Difference	58 sec.	
% Difference	24.89%	

The difference in speed between the HP 8924C and the HP 8924E is only 24.89% with this short test sequence.

The data below was taken at one channel using a mobile origination to speed up traffic channel setup. The first two tables show data from running tests using IBASIC and the HP 83217A Opt. 004 software. The second two tables show data from running the same tests on an external controller. Note that the controller reduced test time by about 12% in digital and about 4% in analog. These tests are typical of those performed to verify that a CDMA dual-mode mobile is meeting published specifications.

Digital Parametric Tests	Test Time	Channels Tested
IBASIC		
HP 8924C	277 s	1
HP 8924E	522 s	1
Difference	245 s	
%Difference	88%	

Analog Parametric Tests	Test Time	Channels Tested
IBASIC		
HP 8924C	271 s	1
HP 8924E	527 s	1
Difference	256 s	
%Difference	94%	

Digital Parametric Tests	Test Time	Channels Tested
EXTERNAL Controller		
HP 8924C	257 s	1
HP 8924E	453 s	1
Difference	196 s	
%Difference	76%	

Analog Parametric Tests	Test Time	Channels Tested
EXTERNAL Controller		
HP 8924C	258 s	1
HP 8924E	489 s	1
Difference	231 s	
%Difference	90%	

The test sequences performed to generate the data on the previous page are listed below:

Digital Parametric Tests:

- CDMA Origination
- TX Waveform Quality
- TX Open Loop Power Range
- TX Closed Loop Power Control
- TX Maximum RF Output Power
- TX Minimum RF Output Power
- RX Traffic Channel FER (with AWGN)
- RX Sensitivity and Dynamic Range
- TX Spectrum Emissions
- CDMA Release

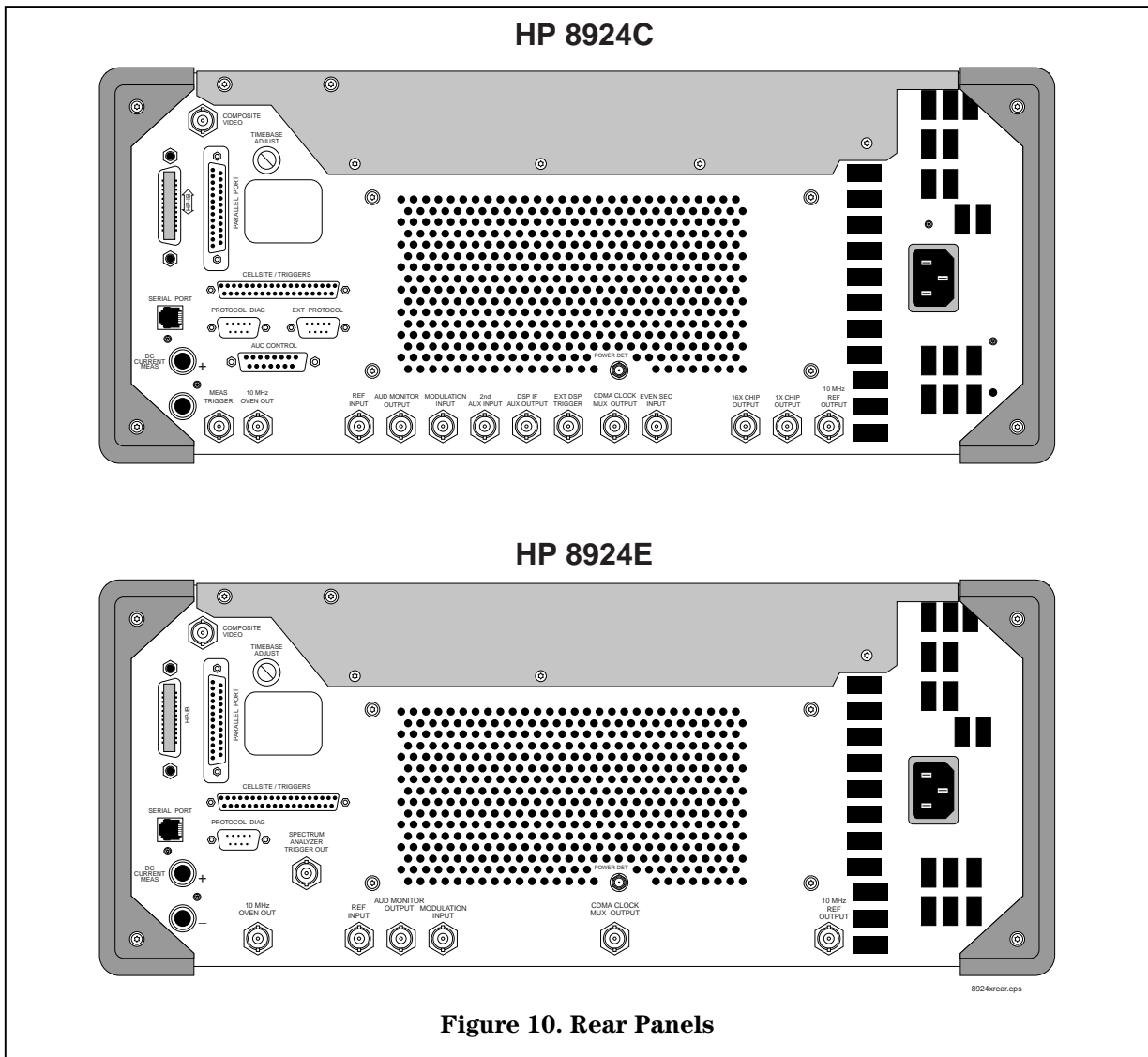
Analog Parametric Tests:

- Analog Origination
- TX Frequency Error
- TX RF Power Output
- TX Modulation Deviation Limiting
- TX Audio Frequency Response
- TX Audio Distortion
- TX Signaling Tone
- TX FM Hum and Noise
- TX SAT
- TX RVC Data Deviation
- TX Compressor Response
- RX Expander Response
- RX Audio Frequency Response
- RX Audio Distortion
- RX Hum and Noise
- RX Sinad
- RX FVC Order Message Error Rate
- TX Switch Channels
- TX DTMF Frequency Error Release

Rear Panel Differences

The HP 8924E does not have the following rear panel connections found on the HP 8924C:

- AUX CONTROL
- MEAS TRIGGER
- 2nd DSP IF INPUT
- DSP IF AUX OUTPUT (TBD production)
- EXT DSP TRIGGER
- EVEN SEC INPUT
- 16x CHIP OUTPUT
- 1x CHIP OUTPUT
- protocol's 9-pin "D" connector labeled "Protocol Logging"



Specification Differences

Analog Specifications

Description		HP 8924C	HP 8924E
Signal Generator	<u>Spectral Purity:</u> Output level at RF In/Out	-16.5 dBm	-15 dBm
	<u>FM:</u> External DC coupled FM rate	DC to 75 kHz (<i>typically -3 dB BW</i>)	N/A
Audio Source	<u>Frequency:</u> Range	DC to 20 kHz	300 Hz to 10 kHz
	<u>Output Level:</u> Residual Distortion	20 Hz to 25 kHz in an 80 kHz BW	300 Hz to 10 kHz in an 80 kHz BW
	<u>Output Level:</u> Offset in DC Coupled Mode	<50 mV	N/A
Adjacent Channel Power	<u>Relative & Absolute Meas.</u>	Level Range, Dynamic Range, Accuracy	N/A
Signaling	<u>Additional Formats</u>	EAMPS, ETACS NMT-450S, LTR, EDACS, MPT-1327	NONE

CDMA Specifications

Description		HP 8924C	HP 8924E
Call Processing Function	User Settable Parameters: Additional Base Station Parameters	BASE_ID, SRCH_WIN_A, SRCH_WIN_N, SRCH_WIN_R	Internally Fixed
	User Settable Parameters: Additional Access Probe Parameters	PAM_SZ	Internally Fixed
	User Settable Parameters: Threshold Parameters	T_ADD, T_DROP, T_COMP, T_TDROP	Internally Fixed
	User Settable Parameters: Additional Hand-off Support	CDMA Softer, CDMA Soft (requires two units)	NONE
	User Settable Parameters: Additional Status Indicators	Softer Handoff	NONE
	User Settable Parameters: Speech Echo Mode	Three user selectable fixed delays— 0 s, 2 s, 5 s	Fixed delay to 0 s
	User Settable Parameters: Close Loop Change Modes	Step n Up Step n Down Ramp of n Up followed by n Down power	N/A
	User Settable Parameters: Adjacent Cell Mobile Reporting	Displays status, PN offset strength, and keep bit for all pilots found by the CDMA mobile and reported via pilot strength messages. Also displays the current user set PN offsets and strengths of Sector A and Sector B to aid in verifying mobile performance	N/A
	User Settable Parameters: Neighbor List Support	Automatically generates a list of 7 neighbors based on the user entry of Sector A PN Offset, Sector B PN Offset and Pilot Increment	Automatically generates a list of 7 neighbors based on the user entry of CDMA Sector PN offset using a fixed value of 12 for the internal parameter Pilot Increment

CDMA Signal Generator	<u>CDMA Channels:</u> Additional CDMA Channels	Sector B with selectable PN offset	NONE
	<u>Amplitude:</u> Composite Signal Output Power	Sector A + Sector B + AWGN	Sector + AWGN
	<u>Amplitude:</u> Sector B OCNS Channel Relative Level Range	Automatically calculated from other Sector B channel relative levels to provide the set Sector A power	N/A
	<u>CDMA Modulation:</u> Carrier Feedthrough	Better than -30 dBc, <i>typically better than -30 dBc</i>	Better than -25 dBc, <i>typically better than -30 dBc</i>
CDMA Analyzer	<u>CDMA Average Power Measurement:</u> Measurement Update Rate	<i>Typically 1.5 readings/s (.67s/reading)</i>	<i>Typically 1.2 s/reading</i>
	<u>CDMA Tuned Channel Power Measurement:</u> Measurement Update Rate	<i>Typically 2 reading/s</i>	<i>Typically 1 reading/s</i>
	<u>CDMA Modulation Measurement:</u> Measurement Update Rate	<i>Typically 1.5 readings/s (.67s/reading)</i>	<i>Typically 1.7 s/reading</i>
	<u>CDMA FER Measurement Confidence Limit</u>	Range: User definable from 80.0% to 99.9% and Off	95% Confidence Limit: On or Off
	<u>One Button Min/Max Power Measurement</u>	<i>Approx. 7 s/measurement</i>	<i>Approx. 7.5 to 8 s/measurement</i>
	CDMA Triggers	<u>Output Trigger Signals</u>	Power control bit sent , Open Loop Power Trigger
<u>Trigger Inputs</u>		N/A	DSP Trigger

Notes

Notes

For more information about Hewlett-Packard test and measurement products, applications, services, and for a current sales office listing, visit our web site at <http://www.hp.com/go/tmdir>
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