Agilent E7470A and E7472A

CDMA Integrated Air Interface Measurement Systems

Data Sheet

The Agilent Technologies E7470A and E7472A integrated air interface measurement systems are used to obtain comprehensive RF measurement and call performance data versus location to assess the service coverage of wireless communications networks using IS-95 and J-STD-008 CDMA technologies. A PC interfaces to an Agilent digital receiver and a CDMA mobile phone. Each system includes PC software, a digital receiver (with a cigarette lighter power adapter, an ac/dc power adapter, and an RS-232 cable), and a PCMCIA serial port card to connect the phone to the PC. The systems can be integrated with a GPS receiver and mapping software. The E7470A system operates in the 1900 MHz band using the E6450B digital receiver, and the E7472A system operates in the 850 MHz band using the E6452A digital receiver.

Other frequency bands are available. Please consult an Agilent representative for more information.

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System software

The system software controls an Agilent digital receiver and a CDMA mobile phone. Multiple measurements can be made simultaneously. All measurements can be displayed in real-time and logged to the database.

Up to four receivers and four phones can be integrated into a single system controlled from a single user interface.

Receiver functionality

The receiver components of the systems provide four primary measurement classes:

- Spectrum analysis
- CW power
- Channel power
- CDMA pilot channel analysis

The controls listed below are available for each receiver measurement class:

Measurement interval
- Time
- Distance

Averaging
- Running
- Group
- Max hold

Measurement interval defines the duration between measurements. This can be specified in terms of time (e.g., execute a measurement every 200 milliseconds) or distance (e.g., execute a measurement every 10 meters).

Multiple receiver capability

The standard E7470A and E7472A systems include one receiver. Up to four receivers can be controlled simultaneously by the system software. The systems support any combination of E6450B or E6452A digital receivers, up to a total of four. Using multiple receivers simultaneously can greatly improve drive test efficiency for applications such as those involving multiple CDMA carrier frequencies, measuring 850/1900 MHz borders, monitoring simultaneously forward and reverse links, and monitoring competitive networks.

For ordering instructions regarding multiple receivers, please refer to the *Agilent E74XX Series CDMA Drive Test Solutions* Configuration Guide.

Spectrum analysis

The spectrum display provides the controls listed below. Frequencies can be specified in terms of frequency units or channel number.

Measurement controls

- Frequency, tunable range
  - E7470A
    - 1850–1910 MHz
    - 1930–1990 MHz
  - E7472A
    - 824–849 MHz
    - 869 –894 MHz
- Frequency, maximum span
  - E7470A
    - 60 MHz
  - E7472A
    - 25 MHz
- IF bandwidth
  - 1.25 MHz (wideband mode)
  - 30 kHz (narrowband mode)
- Resolution bandwidth
  - 8.36 kHz to 1 MHz in wideband mode
  - 246 Hz to 28 kHz in narrowband mode

Markers

- Multiple markers
- Delta markers
- To Max function
- Drag and drop

Spectrum noise floor (characteristic):[1]

	Average	Peak
Narrowband mode / 300 kHz span	–139 dBm	–131 dBm
Wideband mode / 300 kHz span	–128 dBm	–119 dBm
Narrowband mode / 25 MHz span	–132 dBm	–129 dBm
Wideband mode / 25 MHz span	–123 dBm	–117 dBm

CW power and channel power

The E7470A and E7472A can measure the peak power **(CW Power)** at user-defined frequencies within a user-defined resolution bandwidth. The systems can also measure the total power **(Channel Power)** within a user-defined bandwidth at a user-defined set of frequencies. This differs from the CW power measurement in that the total power is integrated across the specified channel width. The user can define the frequencies to be measured in two different ways.

Frequency entry methods

- List: Enter an arbitrary list of frequencies.

- Trace: Enter a start frequency, step size, and count. The system measures at the start frequency, at the (start + step) frequency,…, (start + (count –1)[1] step) frequency. For example, if the start frequency is set to 1900 MHz, the step size is set to 1 MHz, and the count is set to 4; then measurements are made at 1900 MHz, 1901 MHz, 1902 MHz, and 1903 MHz.

Frequencies can be specified in term of frequency units or channel number.

1. Does not imply warranted performance, but rather characteristic performance. Tested with minimum resolution bandwidth: 246 Hz in narrowband mode, 8.46 kHz in wideband mode.

Measurement controls

- Frequency
  – Arbitrary list (list)
  – Start / step / count (trace)
- IF bandwidth
  – 1.25 MHz (wideband mode)
  – 30 kHz (narrowband mode)
- Resolution bandwidth (CW power only)
  – 8.36 kHz to 1 MHz in wideband mode
  – 246 Hz to 28 kHz in narrowband mode
- Channel width (channel power only)
  - E7470A
    – 8.36 kHz to 60 MHz in wideband mode
    – 246 Hz to 60 MHz in narrowband mode
  - E7472A
    – 8.36 kHz to 25 MHz in wideband mode
    – 246 Hz to 25 MHz in narrowband mode

CDMA pilot channel analysis

The E7470A and E7472A systems are capable of measuring IS-95 and J-STD-008 CDMA pilot channels. These measurements are independent of network parameter settings. The systems execute four different types of CDMA pilot channel measurements (listed below). Any or all of them can be executed simultaneously.

Measurement types

- All pilots: The system measures the power, both Ec and Ec/Io, of all 512 pilot channels. The results are displayed as a trace with one point for each of the 512 PN offsets.

- Top N: The system measures all of the pilots in the network and returns the 'N' strongest pilot channels received, where 'N' is a user definable integer from 1 to 20. The results are displayed in bar graph format.

- Zoomed pilots: The user sets the center and span in terms of chips (or PN offsets). The results are displayed as a trace.

- User list: The user manually inputs a list of up to 20 PN offsets to be measured. The measurements are displayed in bar graph format.

Measurement controls	Display controls
• Carrier frequency	• Power display (Y-axis parameter)
– Frequency	– Ec/Io
– Channel	– Ec
• Measurement types	• Show value (bar graphs only)
– All pilots	– Peak Ec/Io
– TopN pilots	– Peak Ec
– Zoomed pilots	– Aggregate Ec/Io
– User list of pilots	– Aggregate Ec
• PN increment	– Aggregate - peak
	– Delay spread
	– Pilot delay

Markers (trace displays only)	Measurement results
• Multiple markers	• Peak Ec/Io
• Delta markers	• Peak Ec
• To Max function	• Io
• Drag and drop	• Aggregate Ec/Io (TopN and user list only)
	• Aggregate Ec (TopN and user list only)
	• Aggregate - peak (TopN and user list only)
	• Delay spread (TopN and user list only)
	• Pilot delay
	• Carrier frequency error

Peak pilot power (both Ec and Ec/Io) are computed by selecting the strongest peak of the correlation for each pilot. Io is the total received power integrated across the entire 1.2288 MHz signal bandwidth.

Aggregate pilot power (both Ec and Ec/Io) are computed for a given pilot by integrating the power received over the time dispersion of that pilot. **Delay spread** is the duration of time over which this power is dispersed. Both aggregate pilot power and delay spread are determined with respect to an Ec/Io threshold of –17 dB. The system also reports the difference between the aggregate and peak pilot power **(aggregate-peak)**. This difference along with the delay spread provides a characterization of the multipath effect on that pilot. Aggregate pilot power and delay spread are only measured for the TopN and user list measurement types.

Pilot delay is defined as the difference in time between when a pilot signal is received and when it *should* have been transmitted, as defined by GPS timing. For example, a base station transmitting PN offset 0 is expected to start a new short-code pattern synchronous with the GPS even second clock. If the signal is received 3 chips after the GPS even second clock, then the pilot delay is said to be 3 chips (1 chip ≈ 0.8 microseconds). Timing offsets can be due to both propagation delay and base station timing problems.

Carrier frequency error is defined as the difference between the measured carrier frequency and the user-specified carrier frequency. The measured carrier frequency is of the dominant pilot signal. Carrier frequency error can be due to both base station carrier error and doppler shift (if moving).

Phone functionality

The phone component of the E7470A and E7472A systems comprise three main functions. Each function has an associated control/display window called a virtual front panel.

- Phone control
- Measurement data
- Messaging display

Multiple phone capability

The E7470A and E7472A systems can control up to four phones simultaneously. The software will control any combination of the supported handsets (see "Handset compatibility" on page 8), up to a total of four. Use of multiple phones can significantly improve optimization efficiency. For example, you can execute origination, termination, and dropped call testing simultaneously. Additionally, you can execute measurements on your network and a competitive network simultaneously.

For ordering instructions regarding multiple phone capability, please refer to the *Agilent E74XX Series CDMA Drive Test Solutions* Configuration Guide.

Phone control

This functionality provides automated control of the handset from the PC. The phone control virtual front panel provides the control functions listed below.

Call controls

- One-button originate (dial)/One-button end (hang-up)
- Automatic call sequencing
  – Access time (duration of call)
  – Redial wait (duration between calls)
  – Total calls (number of calls to be executed)
- Automatic redial
  – On a dropped call
  – On a blocked call (failed origination)
  – Redial interval (wait duration after drop or block)
  – Maximum redial attempts
- Phone number pick list
- Call type pick list
  – Voice (8 or 13 kbps)
  – Markov (set 1 or set 2)
  – Loopback (8 or 13 kbps)

State controls

- No analog (forces dual mode phone to stay in digital mode)
- Channel
  – Channel number
  – Frequency units

Statistics logging controls

- Attempted calls
- Dropped calls
- Blocked calls (failed originations)
- Markov data

In addition to control functionality, the phone control virtual front panel displays the information listed below.

Display fields (text)

- Dropped call rate
- Blocked call rate
- Total attempts
- Total drops
- Total blocks
- Access time counter
- Redial time counter

Measurement data

The E7470A and E7472A systems extract various measurement data from the mobile handset. Extraction of the specific measurement types is controlled by a set of check boxes. The data types are listed below.

Display fields (text)

- Status (mode)
- RSSI (mobile received power)
- Mobile transmit power
- FER (frame erasure rate)
- Ec/Io
  – Aggregate
  – Dominant

Tabular displays

- PN list

Bar graph displays

- Finger data (TA fingers)
- Pilot data
  – Active
  – Candidate
  – Neighbor

Line graph displays

- Rx / Tx level
- Temporal analyzer (TA searcher)

Messaging

The E7470A and E7472A extract and decode the over-the-air messaging from the handset. The user can select any or all of the channel types listed below to extract and decode messaging from.

Message type selection controls

- Access
- Paging
- Sync
- Forward traffic
- Reverse traffic

In the messaging display the user can double-click on any message to expand it to next level of detail. A snapshot function captures the last 50 messages to a separate display while the main display continues to update with the new messages.

- Log to display
- Log to file (creates MDM binary file)
- Snapshot

Amps display fields (text)

- Status (mode)
- RSSI (mobile received power)
- Mobile transmit power
- Channel number

Data recording and playback

Logging and playback of data are controlled by VCR-like buttons. While logging data the user can enter notes into the data. Two methods of user note entry are provided. One prompts the user to enter a text string, for example, "entering a tunnel." The other automatically enters a numbered note into the database requiring minimum interaction with the keyboard. A summary of record and playback features are listed below.

Record features	Playback features
• User note	• Play forward
• Automatically numbered note	• Play reverse
• Display on/off	• Step forward
• Pause/resume	• Step reverse
	• Variable speed
	• Advance to alert/alarm
	• Advance to user note/
	auto-numbered note

In addition to logging to the database, the E7470A and E7472A can also log to a binary file. The format of this binary file is equivalent to the binary output of the Qualcomm mobile diagnostic monitor (MDM).

Data export

Data can be exported from the E7470A and E7472A databases for display and post-processing. Any measurement data can be exported. The export function provides flexible filtering capability to define the specific data to be exported. Several different operations can be executed in order to provide the desired data in the desired format.

Processing functions

- All values
- Count
- Count with summary
- Maximum
- Minimum
- Value(x)

Conditionals

- Greater than (>) a threshold
- Less than (<) a threshold
- All values
- Qualified against another measurement

Sorting

- Ascending
- Descending
- None

The output formats supported by the E7470A and E7472A are listed below. The system is designed to work with MapInfo in an integrated manner via an object link embedded (OLE) link to the MapInfo application. This exports the data, launches MapInfo, creates the necessary MapInfo tables, and creates a thematic map display in MapInfo. This functionality does require MapInfo be present. MapInfo can be purchased as Option 310 on the system or purchased separately.

Data output formats

- MapInfo OLE
- MapInfo text file
- ArcView text file
- Plain text file (no headers)
- PlaNET result
- Raw binary

Geographic binning can be applied to the data as part of the export function. Binning is a data-reduction process in which the driven area is overlaid by a grid of user-definable size, and the average of the data over each square is reported.

Alerts and alarms

The E7470A and E7472A have sophisticated alarm capability. An alert is defined as a single condition on a single measurement. An alarm is a boolean expression made up of multiple conditions on multiple measurements. When an alert or alarm condition occurs, any or all of the actions listed below can be executed. If the alert or alarm condition occurs while data is being logged, each data record includes the alert/alarm information.

Actions

• Play a .wav audio file
• Display a text message
• Pause or stop measurements

Alert operators	Alarm operators
• Value	• Value
• Maximum	• Maximum
• Minimum	• Minimum
	• Sub-set
	• OR
	• AND
	• XOR (exclusive OR)

Alert conditions	Alarm conditions
• Greater than (>)	• Greater than (>)
• Greater than or equal to (≥)	• Greater than or equal to (≥)
• Less than (<)	• Less than (<)
• Less than or equal to (≤)	• Less than or equal to (≤)
• Equal to (=)	• Equal to (=)
• Not equal to (≠)	• Not equal to (≠)
	• Is a sub-set
	• Is not a sub-set
	• Sets intersect

Any measurement can be an operand in an alert or alarm. Below are some examples to illustrate alerts and alarms. In example number 4 the alarm triggers when the receiver measures a pilot signal above –18 dB Ec/Io that the handset does not measure. This provides very quick identification of neighbor list problems.

Alerts: 1. Value(FER) > 2.0%
         2. Maximum(TopN Ec/Io) < –10 dB

Alarms: 3. (Value(FER) > 2.0%) AND
            (Maximum(TopN Ec/Io) < –10 dB)
         4. Subset(TopN Ec/Io > –18 dB)
            IS-NOT-A-SUBSET (PNlist)

System status parameters can also be used as operands in alerts and alarms. For example, an alert can be defined to trigger when the available disk space on the PC drops below 10 MB or when the GPS position fix is lost.

System status parameters

• Available disk space
• GPS fix
• Location
• Velocity
• Percent CPU usage
• PC battery level
• PC AC power
• Time of day

Alarm wizard

Setting up alarms is fast and easy using the alarm wizard feature. Commonly desired alarms that are available via the alarm wizard are listed below.

• Missing neighbor
• Pilot pollution
• Dropped call
• High FER
• Low phone Ec/Io
• No coverage
• Weak CW
• Lost GPS fix
• No location fix
• Low disk space
• Low battery
• No AC power
• High CPU usage

Agilent E6450B and E6452A receiver specifications[1]

Frequency

Frequency range	
E6450B	1850–1910 MHz
	1930–1990 MHz
E6452A	824–849 MHz
	869–894 MHz
Frequency accuracy	± 1 ppm
with GPS time synchronization	± .05 ppm characteristic
IF bandwidth	1.25 MHz characteristic
	30 kHz characteristic
Aging of TCXO	± 1 ppm/year

Amplitude

Accuracy	
1.25 MHz IF bandwidth	± 1 dB; ±0.5 dB typical
	(20 – 30° C, –40 to –100 dBm)
	± 2 dB (0 – 55° C, –40 to –100 dBm)
30 kHz IF bandwidth	± 1.5 dB; ±0.5 dB typical
	(20 – 30° C, –40 to –100 dBm)
	± 2.5 dB
	(0 – 55° C, –40 to –100 dBm)
Noise figure	8 dB typical
Internally generated spurious	–120 dBm
Maximum safe input level	+10 dBm = , 20V DC characteristic
1 dB compression point	–15 dBm characteristic
Adjacent channel desensitization[2]	–25 dBm typical
Adjacent channel rejection[3]	45 dB typical

Input/Output

RF input	50 Ω type-N

Connectors

Computer	RS-232 (DB9) Male
GPS	RS-232 (DB9) Male
Power	DC power jack 100 mils, positive center

Misc

Operating temperature range	0 to 55° C
Storage temperature range	–40 to 70° C
Dimensions	6 in x 3 5/8 in x 8 3/4 in
Weight	4.5 lbs
Power	9–34 V DC, 9W
with Option 200	9–34 V DC, 10W

GPS

The E7470A and E7472A systems have the ability to work with several types of GPS interfaces. The system is compatible with the communications protocols listed below. The physical interface is RS-232 with a DB9 connector.

Compatible protocols
- TAIP
- TSIP
- NMEA

Two different GPS receivers are available as options on the E7470A and E7472A systems. Option 200 adds a GPS receiver mounted internally to the E6450B or E6452A receiver, providing excellent portability and convenience. Option 210 adds a Trimble Placer GPS 455 receiver with dead reckoning for external connection to the system.

Option 200: internal GPS receiver[1]
- 8 channel GPS receiver
- Mounted inside E6450B or E6452A enclosure
- SMB antenna connector
- Bulkhead mount antenna with cable
- Magnetic mount antenna with cable
- Differential compatible
- Not dead reckoning compatible

Option 210: external GPS receiver with DR
- Trimble Placer GPS 455 with dead reckoning
- Heading sensor
- Interconnect adapter
  (to connect to the E6450B or E6452A receiver)
- Interconnect cables
- Bulkhead mount antenna with cable
- Magnetic mount antenna with cable
- Differential compatible

The E7470A and E7472A software include a virtual front panel for the GPS receiver. This window displays a bar graph with the individual satellite signal strengths, a text display of the GPS statistics and a map of location history. This map also displays the base-station locations, names, and PN offsets.

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1. Systems with Option 200 do not support connection to external GPS receivers.
2. Adjacent channel desensitization applies to the wideband mode (1.25 MHz IF filter) and is defined as: 1 dB compression of tuned signal with interfering signal ±1.25 MHz from tuned signal.
3. Adjacent channel rejection applies to the narrowband mode (30 kHz IF filter) and is defined as: Suppression of interfering signal ±30 kHz from tuned signal.

External GPS receivers used with the E7470A and E7472A systems must output the GPS 1 pulse per second signal for CDMA measurements. To use this signal, a special adapter may be required. Options 211 and 212 are interconnect adapters for connection of certain Trimble GPS receivers. The table below lists several GPS receiver models and the associated interconnect requirements. For other models of external GPS receivers, consult an Agilent Technologies representative for adapter availability.

GPS receiver model	Interconnect requirement
Trimble Placer GPS/DR	Option 211
Trimble Placer GPS 455	Option 212
Trimble SveeSix	Straight-through RS-232 cable
Trimble Placer GPS 400	Straight-through RS-232 cable

If a GPS receiver is purchased from Agilent as an option to the system, all necessary interconnect parts are provided.

Differential GPS can be used with the Agilent E7470A and E7472A systems, provided the GPS receiver being used is differential compatible. Option 230 adds a differential GPS receiver to the system.

Option 230: differential GPS receiver
• Differential corrections, incorporated RDS-3000
• Magnetic mount antenna
• Interconnect cables

Handset compatibility
The E7470A and E7472A can interface with the handsets listed below. This list is complete as of the time of printing. Also, at the time of printing handsets are not available from Agilent Technologies. Contact your Agilent representative regarding handset compatibility and availability plans.

Compatible handsets
• Qualcomm QCP-800
• Qualcomm QCP-820
• Qualcomm QCP-1900
• Qualcomm QCP-2700
• Samsung SCH-1000
• Sony CM-D500
• Sony CM-D600
• Sony CM-M1300
• Sony CM-S1100
• Sony CM-B1200

Option 700 must be ordered when using phones based on Qualcomm chip sets, including all of the phones listed above. Options 710, 711, and 712 provide interface cables for the supported handsets. The table below shows lists the phone cable options and the corresponding handsets. These cables can be purchased from Agilent or provided by the customer.

Cable	Handsets
Option 710	QCP-800, QCP-1900, CM-D500, CM-D600
Option 711	QCP-820, QCP-2700, CM-S1100, CM-B1200, CM-M1300
Option 712	SCH-1000

Computer hardware
The E7470A and E7472A systems require a PC. The minimum PC requirements are listed. If you wish to purchase a laptop computer with the system, Option 010 adds an HP Omnibook laptop PC.

Minimum PC requirements
• Pentium processor (clock rate $\geq$ 120 MHz)
• Windows 95® or Windows NT® (4.0 or later)
• RS-232 (DB9) serial port
• 32 MB RAM
• 40 MB disk space for software installation
• 200 MB disk space recommended for data
• CD-ROM drive recommended
• 800 x 600 display resolution

Option 010 PC specifications
• Pentium processor (266 MHz)
• Windows 95
• 48 MB RAM
• 4 GB hard disk
• 20x CD-ROM drive
• Enhanced lithium ion battery pack
• 13.3 in. active matrix display
• 1024 x 768 display resolution

More information on the HP Omnibook can be found at www.hp.com.

Mapping software

MapInfo can be launched from within the E7470A and E7472A, providing transparent integration between mapping information and measurement data. In addition, the E7470A and E7472A can output data in ASCII format, allowing the user to import data into other applications (see data export section). MapInfo can be purchased with the system as Option 310, and if a laptop computer is ordered, the software will be installed on the laptop.

Portability accessories

The E7470A and E7472A are lightweight, portable systems. The following options are offered with the system:

Option 510: vehicle mounting kit

Brackets and screws for mounting an E6450B or E6452A digital receiver.

Option 530: briefcase carrier

For transporting an E7470A or E7472A system. System is not intended to be operated from within case. Dimensions: 17 $\frac{3}{4}$ in. x 14 in. x 5 in.

Training

Training is provided with the E7470A and E7472A systems. For training information, please consult our web site at www.agilent.com/find/drive_test or contact your Agilent representative.

Warranty

One-year warranty on hardware components and one year of application support is included with the E7470A and E7472A systems.

Related literature	Pub. number
E7450A Brochure	5965-7426E
E7450B and E7452A Data Sheet	5966-3852E
E7460A Data Sheet	5966-3850E
E74XX Series Configuration Guide	5966-2976E

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