DX836
Overview

Cellular System Access Monitor

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Welcome

This guidebook presents a “big picture” view of the key features of the DX836 series System Access Monitor (SAM) from ZK Celltest, Inc.

There are four types of ZK-SAM instruments in the DX836 series, as shown in the table below:

TABLE 1: ZK-SAM/DX836 SERIES

ZK SAM Model Number	Hand-held Portable	Vehicle Mounted	GPS Receiver
ZK-SAM/DX836P	◆		
ZK-SAM/DX836PG	◆		◆
ZK-SAM/DX836V		◆	
ZK-SAM/DX836VG		◆	◆

The DX836 is a state-of-the-art test instrument, designed to save users significant time and effort when optimizing and troubleshooting both analog and digital cellular systems. Two things that help make this possible, are the two basic types of DX836 information displays:

- Data Displays: The real-time information you will use in the field to optimize and troubleshoot cellular systems. These displays are discussed in this overview.

- Configuration Displays: Used to control the information presented with the data displays, and to transfer information to and from any ordinary PC. These displays are discussed in the DX836 Field Guidebook. (A model-specific guidebook is shippped with every unit.)

DX836 Features

The raw speed of the DX836 scanning receiver is more than 300 channels per second, including an 8 sample RSSI measurement of each channel. This means that all control and voice channels, in both systems, can be scanned every few seconds.

When the need for live data storage exceeds the capacity of the DX836, live data can be streamed in real-time mode to a conventional PC desktop or laptop computer via a 9-pin RS-232 serial connection.

The data is presented in real time on graphical displays showing both spectrum and 5 minute history. The data is also stored in non-volatile memory for later dump to a PC, if desired. The unit's data collection capabilities can be configured in numerous ways, to capture cellular and GPS data.

Call Following

Based on ZK Celltest's experience with interfacing with many different cellular phone models, call-processing event monitoring is provided by directly hard-wiring the cellular phone to the master DX836 controller or by using a hands-free kit. This permits call processing event tracking by the most reliable means possible, and without having to devote any of the fast scanning test receiver resources to this function. Consequently, all active control and voice channels and interference levels are continuously monitored while the call is in progress.

The DX836 ability to track call processing events, ensures that data will be available to compare both control and voice channels that are serving the phone and proving the strongest signal in the phone's location.

Select Channel

Another custom feature is the provision for the use of concentrated measurements on user-designated channels. These designated channels are measured continuously, with their RSSI, DCC or SAT measurements displayed on screen and saved in memory for later data dump to a PC.

A/B Comparison

A dynamic spectrum display of all control channels in both systems gives a complete picture of the instantaneous coverage of both systems. Also, a scrolling 5 minute RSSI history of the best control channel and voice channel sectors for both systems is displayed for real-time comparison of System A and B coverage.

User Alerts

Battery and memory status are presented on the display. Different beeps alert the user when:

- Call is placed
- Hand-off occurs
- Interference occurs
- Battery is low

When interference occurs, the DX836 can be configured to automatically change to the interference display, while simultaneously following events.

Data Logging

Data is collected in non-volatile memory (log memory) with hour, minute, second time tag. For those instruments with a GPS Receiver, the latitude, longitude, and speed values are also stored in log memory. The data log memory may be transferred to a PC and then cleared to reset the data log and the memory indicator.

GPS Positioning

DX836 models with the GPS option, feature an embedded, miniature, 8 channel Trimble GPS module. It provides automatic, continuous, all-weather latitude and longitude position and time information, which makes for an effortless data gathering activity. The Trimble GPS module provides position accuracy in accordance with USA Government GPS specifications.

About This Guidebook

This overview guidebook is applicable to four DX836 models, and is solely focused on the data displays. For the purpose of this guidebook, the only real difference between the DX836 models is the GPS Receiver option, which is noted wherever applicable.

Whether you are a seasoned Performance Engineer or a Cell Site Technician just beginning your career, you'll really appreciate your DX836 and this guidebook will show you why!

The remainder of this guidebook is divided into the following sections:

- History & Terminology: Summary of relevant industry terminology as it applies to DX836 users. These terms are presented in building-block fashion, so as to demonstrate their relevance to one another.

- Status Elements: Status elements are incorporated into every data display. They tell you things such as the current time and how much memory is available for data.

- Display Graphics: The DX836 features three types of display graphics, designed to help users quickly pinpoint desired test data.

- Data Display Sections: These sections demonstrates the use of DX836 data displays, and the general interpretation of their results when used to evaluate and test the cellular network.

If you have never used a DX836 or a competitive model before, we strongly urge you to read this entire guidebook straight through.

History & Terminology

Prior to the development of SAM instruments, troubleshooting problems in the early cellular systems was at best, a difficult and time-consuming process.

Seeing the need for reliable mobile System Access Monitor (SAM) for probing cellular systems, the founders of ZK Celltest (formerly of Bell Labs) designed, built and marketed their first SAMs in the mid-seventies. Their efforts were rewarded with immediate success, because cellular troubleshooters could mount their SAMs in their vehicles and go to work. Consequently, SAMs are now popular with cellular troubleshooters worldwide.

Early-on, SAM users recognized the need to boost SAM performance in two primary areas: Measurement speed and multi-tasking. The need for these improvements was answered by the DX836, which features:

- Powerful onboard controller with data logging
- High-speed scanning receiver
- AMPS, IS54 and IS136 measurement capability
- Real-time graphical displays
- Simultaneous multiple built-in measurement tasks
- Lightweight and compact
- In-building measurement portability
- GPS data gathering
- Superior price performance

What this means to troubleshooters is that they now have a real-time graphical way to display call-events, control and voice channel coverage and interference data in a compact and easy-to-use package. Furthermore, this data can be stored for post processing with a PC. This is the DX836 edge!

Important DX836 & Cellular Terminology

All of the key terms used in this chapter appear below. If this is your first time with the DX836, we strongly suggest that you acquaint yourself with this list of terms.

TABLE 2: DX836 TERMINOLOGY

Term	Definition
EAMPS (ANALOG SYSTEM)	Cellular systems that use a combination of digital control channels and analog voice channels.
TDMA IS54 (PURE DIGITAL)	Cellular systems that use digital control channels (313-354) , and both analog and digital voice channels.
TDMA IS136 (PURE DIGITAL PCS)	Cellular systems that utilize IS-136 control channels and offer PCS services such as: Voice mail alert, caller ID and numeric paging.
PERSONAL COMMUNICATION SYSTEM (PCS)	Cellular systems offering enhanced caller features such as: • Voice mail alert • Caller ID • Numeric paging
SYSTEM	In accordance with Federal Communication Licensing guidelines, all cellular service areas, must have the capacity to support two competitive cellular system operators. These cellular system operators are respectively referred to as System A and System B. DX836 users can configure the instrument to monitor both systems simultaneously, or just one system at a time. Recently, frequencies in the 1.9Ghz range have been licensed to service providers.
For the purpose of this overview, the terms shown in this table appear in building-block order, so as to demonstrate their relevance to one another.	

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Term	Definition
CONTROL CHANNELS	All cellular systems, use digital control channels. In essence, a digital control channel is a continuous stream of data that is transmitted by a cell site for the purpose of controlling caller access to the cellular system. Although there are only 42 control channels, and hundreds of cell phones can share a common control channel. When a caller presses the send button on his or her phone, it will find the strongest control channel and send a short burst requesting a voice channel. The site will process the voice channel request, and instruct the phone via the control channel to use a specific voice channel. Digital control channels (DCCH) are used in IS136 systems for PCS features.
CELL SITE SECTORS	Sectors are used to increase capacity and to reduce interference. There are usually three sectors per cell, and each sector covers an area that is 120 degrees wide.
VOICE CHANNELS	There are two types of voice channels, analog and digital. Analog voice channels are used by the EAMPS systems, whereas digital voice channels are used by IS54 and IS136 systems. Caller access to voice channels is controlled by a cell site control channel.
CHANNEL NUMBER	Every voice and control channel is assigned a specific one to four digit channel number, consisting of a pair of frequencies for full duplex (simultaneous send and receive) operation.
CHANNEL NUMBER TIME SLOT	Used by digital channels. Allows three users to share the same channel number. Time slots are displayed by the DX836 as the value A, B and C.
CHANNEL SET	A channel set is a collection of channels. The default channel grouping scheme for the DX836 is the industry standard of: n=7. Channel sets are displayed at either numeric values (1 to 21) or as alphanumeric values (A1 to G3).

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RECEIVED SIGNAL STRENGTH INDICATOR (RSSI)	The radio signal strength of a given voice or control channel, given in units of dBm.
DELTARSSI (DR)	The difference in signal strength in dbm, before or after a channel change or hand-off. The DX836 only displays this value for channels that maintain a measurable RSSI.
DIGITAL VERIFICATION COLOR CODE (DVCC)	Used to differentiate the same digital voice and control channels shared by two or more cells. Valid values are 0 to 255.
DIGITAL COLOR CODE (DCC)	Used to differentiate the same EAMPS System control channel shared by two or more cells. Valid values are 0, 1, 2 and 3. A DCC value of 4, indicates that no DCC is available.
SUPERVISORY AUDIO TONE (SAT):	Used to differentiate the same EAMPS System voice channel shared by two or more cells. Valid values are 0, 1 and 2. A SAT value of 3 indicates that no SAT is available.
COLOR CODE (CC)	A generic term used interchangeably with DVCC, DCC and SAT.
POWER LEVEL (PL)	Indicates how much power the cellular phone must use in order to transmit to the cell site. The DX836 can display a scale value between 0 and 10. The scale begins at 3 watts, which is represented by a zero. The scale then lowers 4 db for each whole number. For example, a power level of 2 equals 0.6 watts. As the cell phone travels closer to the cell site, the number should increase. This is because the cell phone can begin transmitting at lower power levels, as it approaches the cell site.
BIT ERROR RATE (BER)	The percentage of bit errors the phone is receiving from the network. This number represents units of percentage. Therefore, 0 = 0%, 1 = 1%, 2 = 2% and so on.

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TABLE 2: DX836 TERMINOLOGY

Term	Definition
TIME ALIGNMENT (TA)	This measurement is only used with digital voice channels. In general, the higher the TA value, the further you are from the cell. As a phone moves farther away from the cell, it must begin compensating for the distance by advancing the transmission timing of the digital voice channel. Likewise, the voice channel timing is retarded as the phone nears the cell.
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