Motorola Communication Test Equipment

CyberTest™

CyberTest
Communications System Analyzer
Operator's Manual

MOTOROLA

Motorola Communication Test Equipment

8201 East McDowell Road

M/S H-1192

Scottsdale, Arizona 85257

Internet: http://www.mot.com/GSS/SSTG/CTG.html

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Ordering: (800) 505-TEST

Test Equipment Service Centers:

UNITED STATES
Motorola Inc., Test Equipment Service Depot
1308 Plum Grove Road
Schaumburg, IL 60173
Phone: (708) 576-7025
FAX: (708) 576-8113

Other to be announced

Other Applicable Manuals

In addition to this Operator’s Manual, the following manuals also provide information on using the CyberTest Communications System Analyzer.

- 68-P37716P001 — *Remote Programmers Reference Manual*. This manual provides information necessary for controlling the CyberTest unit via the IEEE-488 remote control port.
- 68-P37255P001 — *CyberFLASH Operators Manual*. This document describes operation of the CyberFLASH program used to download application code to the CyberTest Analyzer unit.

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CUSTOMER'S PURCHASE ORDER NUMBER:	DATE:
MODEL NUMBER:	SERIAL NUMBER:
DESCRIPTION OF PROBLEM:	
REQUESTED SERVICE:	
SHIP TO ADDRESS:	
SHIP VIA:	

Providing the information below will reduce the turnaround time on your Test Equipment Service.

MOTOROLA CUSTOMER NUMBER	BILL TAG	SHIP TAG	INTERNATIONAL MOTOROLA ACCOUNT NO.

SIGNED ____

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Introduction to CyberTest

Chapter Introduction

The CyberTest system is a new concept Service Monitor used for testing wireless communications components and systems. It contains several general purpose test instruments such as RF and Audio Generators, Spectrum Analyzers, Oscilloscope, Voltmeters, Frequency Counters, etc. The CyberTest system can also be tailored to provide specific test instrumentation needed for the particular communications device under test. It is different from traditional service monitor products in that the unit has no built-in user interface and is controlled locally via a personal computer or remotely via an IEEE-488 controller.

Key to the architecture is the use of Smart Modules which permits the unit to be expanded and reconfigured by the user simply by plugging in the appropriate module into one of the two available slots. The Smart Modules provide instant customization of the hardware platform for testing multiple digital and analog wireless system in both the cellular and PCS bands. It also has the capability to expand to future applications with the replacement of one or both of the modules. The instrument flexibility allows one or both of the modules to be replaced with the latest equipment. The CyberTest platform is totally self-contained. It is 5.2 inches high with a built-in carrying handle and is designed for portability.

The CyberTest system consists of two main parts:

- A CyberTest unit which provides the test and measurement functions
- A controller (either a local PC with the CyberTAME™ software or remote device using IEEE-488 control)

This manual will primarily concentrate on local control of the Analyzer through the use of the CyberTAME software as the Graphical User Interface. For those who will be using the CyberTest system under IEEE-488 Remote control, there is a Programming Reference manual that provides the details of the IEEE-488 CyberTest Analyzer commands.

Windows® Based GUI

The CyberTest system features a layered Graphical User Interface (GUI) that is based on the PC Windows® operating system. This layered approach provides flexibility and manual control for the advanced user, while still delivering automation and ease-of-use for the novice.

CyberTAME™ Software

The foundation for the CyberTest GUI is the standard personal computer with the CyberTAME software installed. When working in the CyberTAME test environment, you have the flexibility to manually control and interconnect all of the built-in test instruments through a virtual switchyard of signal paths. The CyberTAME user interface is analogous to working in a laboratory with several individual instruments on a bench. Each one can be individually controlled. Instruments are displayed either as icons or as graphical windows. The graphical representations present data to the user in a familiar manner — the same way that a piece of laboratory test equipment would. Instruments can be connected to each other and the external ports by use of this graphical user interface.

Instruments

Just like their stand-alone laboratory counterparts, the CyberTest instruments are represented in familiar forms. The Oscilloscope and Spectrum Analyzer show real-time traces. From controls to functions and settings, the GUI displays duplicate those found on a stand-alone instrument. As with any Windows application, instrument windows can be sized, copied and pasted into other applications, or printed.

Auto Test Applications

Test applications perform a variety of functions including automatically testing cellular subscriber units and base stations, sweeping antennas, performing cable fault analysis and more.

Manual Overview

This manual contains information for using the CyberTest system in the testing and alignment of wireless systems. It discusses local operation with an operator manipulating the controls. Remote control operation via IEEE-488 is covered in another manual. This manual contains the following:

Section I - Introduction

- Introduction to CyberTest — A quick overview of the system, service information, installation and set-up information.
- Equipment Description — General description of the CyberTest analyzer, general description of the instruments provided, and general description of the instruments installed in the Smart Modules.

Section II - CyberTest Platform

- Operating Instructions Standard Instruments — Connecting the CyberTest analyzer to the PC, starting the CyberTAME software, setting up the work environment, selecting the instruments to use, connecting the ancillary equipment, and running tests.

Section III - AMPS/TACS Smart Module

- Operating Instructions AMPS/TACS Smart Module Instruments — Starting the CyberTAME software, setting up the work environment, selecting the instruments to use, and running tests.

Section IV - CDMA Infrastructure Smart Module

- Operating Instructions CDMA Infrastructure Smart Module Instruments — Starting the CyberTAME software, setting up the work environment, selecting the instruments to use, and running tests.

CyberTest Configuration

The following table shows the present configuration options for the CyberTest system. Some of the items discussed in this manual may not be included or may be optional on the particular analyzer model you have purchased. New model numbers and product configurations will continue to be developed. Contact your Motorola Sales person for current information The model number and descriptions are shown on the first two rows and the various components of the system are shown in the left column. The entries in the matrix show whether the component is optional or standard.

Configuration /Matrix	*Analog Infra-structure 800-1000 MHz*	*CDMA In-frastructure 800-1000 MHz*	*Analog Subscriber 800-1000 MHz*	*CDMA PCS In-frastructure 1.7 - 2.0 GHz*	*Paging Test System 800-1000 MHz*
Order Number:	**CBT-1101A**	**CBT-1102A**	**CBT-1103A**	**CBT-2102A**	**CBT-1202A**
CyberTest Analyzer Platform					
800 - 1000 MHz RF Frequency Coverage	STD	STD	STD	N/A	STD
1.7 - 2.0 GHz RF Frequency Coverage	N/A	N/A	N/A	STD	N/A
High Stability Oscillator	STD	STD	STD	STD	STD
50 Watt Internal RF Load	STD	STD	STD	STD	OPT
4 Watt Internal RF Load (for low pwr measurements)	OPT	OPT	OPT	OPT	STD
CyberTest Platform Instruments					
Programmable Audio Signal Generator	STD	STD	STD	STD	STD
Additional Audio Signal Generator w/High Output	STD	STD	STD	STD	STD
Programmable DTMF Generator	STD	STD	STD	STD	STD
Digital Oscilloscope	STD	STD	STD	STD	STD
DC Voltmeter	STD	STD	STD	STD	STD
DTMF Decoder	STD	STD	STD	STD	STD
Audio Frequency Counter	STD	STD	STD	STD	STD
Audio Frequency Analyzer/AC Voltmeter	STD	STD	STD	STD	STD
True-RMS Terminated RF Power Meter	STD	STD	STD	STD	STD
Spectrum Analyzer w/Markers	STD	STD	OPT	STD	STD
Second Spectrum Analyzer	STD	STD	OPT	STD	STD
Tracking Generator	STD	STD	OPT	STD	STD

Configuration /Matrix (cont)	*Analog Infra-structure 800-1000 MHz*	*CDMA In-frastructure 800-1000 MHz*	*Analog Subscriber 800-1000 MHz*	*CDMA PCS In-frastructure 1.7 - 2.0 GHz*	*Paging Test System 800-1000 MHz*
Order Number:	**CBT-1101A**	**CBT-1102A**	**CBT-1103A**	**CBT-2102A**	**CBT-1202A**
Smart Modules & Related Instruments					
AMPS/TACS Test Smart Module	STD	STD	STD	STD	OPT
Manual Cellular Analyzer Instrument	STD	STD	STD	STD	OPT
Analog Subscriber Analyzer Instrument	OPT	OPT	STD	OPT	OPT
CDMA BTS Test Smart Module	OPT	STD	OPT	STD	OPT
CDMA Reverse Link Waveform Generator Inst	OPT	STD	OPT	STD	OPT
CDMA Forward Link Signal Analyzer Inst	OPT	STD	OPT	STD	OPT
CDMA Error Vector Analyzer Instrument	OPT	STD	OPT	STD	OPT
Reflex/Inflexion Subscriber Test Smart Module	OPT	OPT	OPT	OPT	STD
Modulation Analyzer Instrument	OPT	OPT	OPT	OPT	STD
Narrowband Encoder/Decoder	OPT	OPT	OPT	OPT	STD
PC Software					
CyberTAME Graphical User Interface Program	STD	STD	STD	STD	STD
Antenna Sweep Application Program	OPT	OPT	OPT	OPT	OPT
Cable Fault Application Program	OPT	OPT	OPT	OPT	OPT
Analog Cellular Subscriber AutoTest Program	OPT	OPT	OPT	OPT	OPT
Accessories					
CyberTest Analyzer Accessory Kit (see details below)	STD	STD	STD	STD	STD
Soft Carrying Case w/ “Y” AC Line Cord	STD	STD	OPT	STD	OPT

The instruments listed above are installed at the factory. Those that are optional may be field-installable if ordered at a later time. Consult your Motorola Sales Representative.

Accessories in the Kit

The Accessory Kit contains the following:

- 3 - N to BNC RF adapters - Used on the ANT, GEN and RF I/O ports to connect common BNC cables to these ports. Base stations use N cables, but most other test applications use BNC cables.

- 1 - External DC connector - This is used to interface with the DC connector mounted on the back of the Analyzer. It is basically the mate for the connector with a pigtail of wire so you can make your own cable to connect to whatever external DC source you want.
- 1 - Oscilloscope Probe - This is a 1:1 probe for use with the Oscilloscope probing audio circuits. You connect the probe to the “Meas IN” connector on the front of the Analyzer.
- 1 - AC Line Cord - This is a straight cord. It is not the “Y” version that is used with the carrying case. It is for use with the Analyzer when it is in a fixed location (not with the bag).
- 1 - Computer to Analyzer Connection Cable - Connects one end to the PC Printer port and the other to the Analyzer connector on the rear of the unit.
- 1 - Right-angle BNC adapter - This adapter allows you to connect an external 10 MHz reference signal to the unit without stressing the cable when the unit is standing up or in the bag.

Installation and Setup

PC Requirements

Minimum PC Hardware Requirements

- 75 MHz 486
- 16 MB RAM
- At least 10 MB free space on the Hard disk for software installation and storage of test results.
- Windows 3.1, Windows 3.11 for Workgroups, or Windows 95 operating system.

Recommended PC Hardware Requirements

- 100 MHz Pentium
- 32 MB RAM
- 500 MB Hard Disk Storage with 100 MB free space
- Windows 3.1, Windows 3.11 for Workgroups, or Windows 95 operating system.

The operation of the CyberTest system uses extensive internal multiplexing operations to display the various instruments. The slower the PC, the slower the screen instrument display becomes. The recommended PC Hardware gives near real-time results with good screen refresh capability. Faster machines will show improved screen refresh performance.

Installation Instructions

Unpack the analyzer from its carton. Foam pieces protect the analyzer, which is packed to prevent damage during shipping. Save the packing container and materials for future use. Refer to the connections shown on the front and back of the unit shown in Figures 1 and 2. Follow the procedures listed below.

Figure 1. **Back of CyberTest Analyzer**

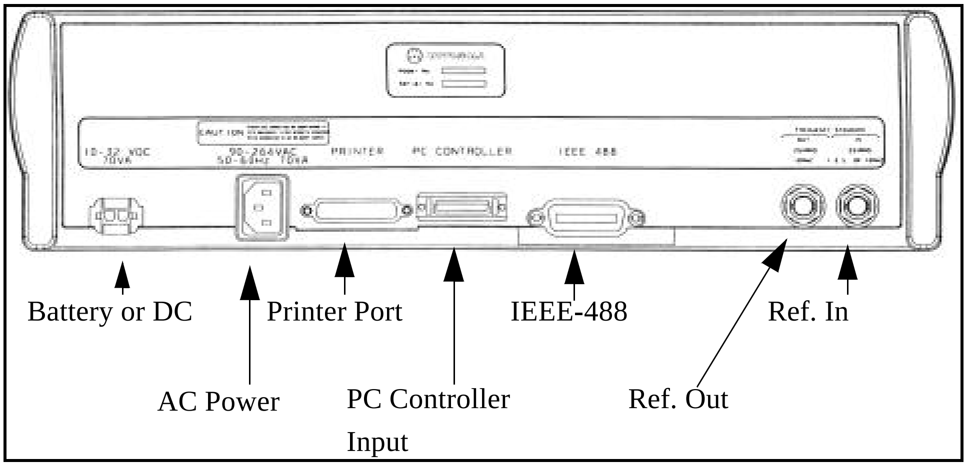
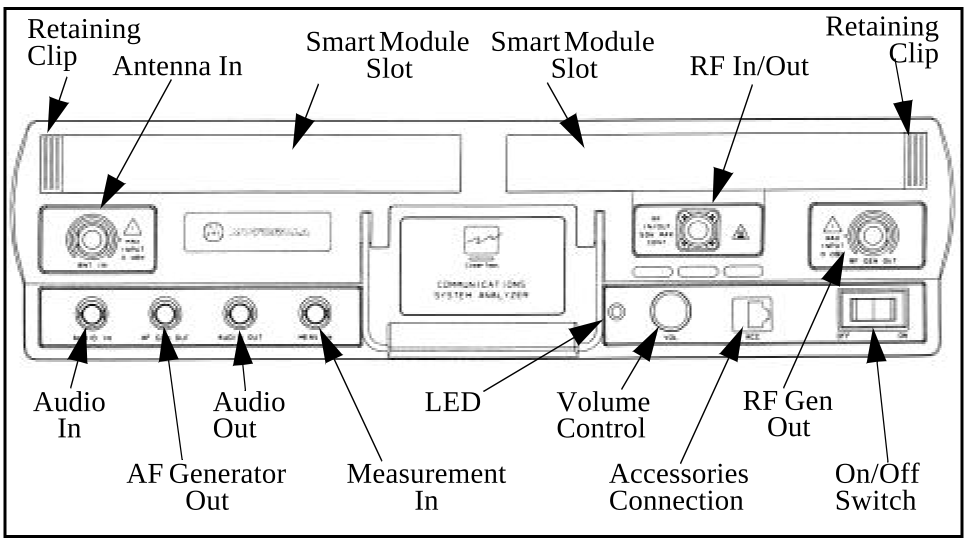


Figure 2. **Front of CyberTest Analyzer**



Smart Module Installation

The Smart Module Retaining clips shown in Figure 2 should be positioned to the outer position. Slide the Smart Module into the slot until it is all the way in and the Module connection in the back of the slot are engaged. Then slide the Smart Module Retaining clip toward the center of the platform to lock the Smart Module in place. When removing, be sure to slide the Smart Module Retaining clips back to the outer position prior to Module removal. Always install Smart Modules with the power to the analyzer turned off.

Set-up Procedure

1. Place the analyzer in its operating location.
   - The platform contains a thermostatically controlled (two speed) fan that draws air through the bottom of the unit. **Do not place unit on anything that can block the air flow.**

2. Connect the power cable and plug it into an appropriate power source. Be sure to use a grounded outlet when using AC power.

3. Connect the analyzer to the PC using the cable provided. The analyzer is connected from the PC Controller on the rear of the analyzer to the parallel printer port on the PC. Communication between the analyzer and the Cyber-TAME software is through this connection. (Figure 1)
   - Printing capability is maintained with a parallel printer port on the back of the analyzer. (Figure 3)

4. Install the Smart Module(s) if not already installed.

5. Turn on the PC and start the Windows operating system.

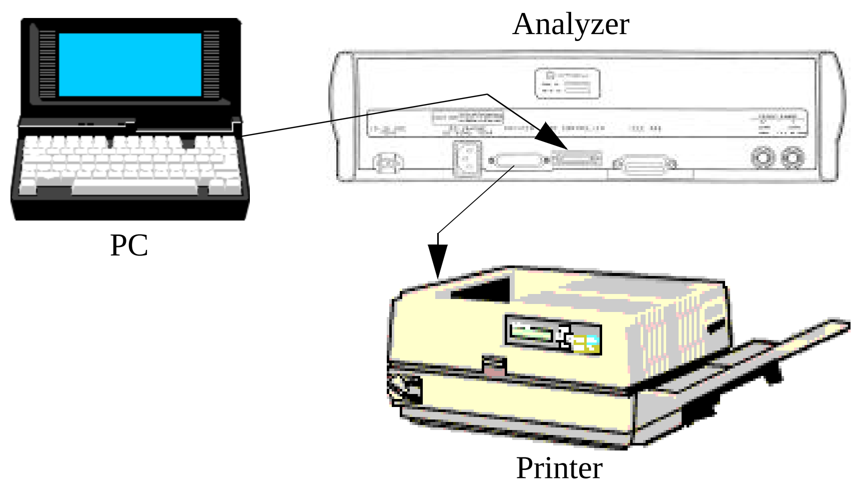
6. From the Windows Program Manager, start the CyberTAME software installation using these steps:
   – Insert the Installation Disk in Drive A.
   – From the Program Manager File Menu, choose the **Run** command.
   – Type "a:setup" in response to the prompt.
   – Follow the installation instructions on your screen.
   - Installation of the Software adds a line to the system.ini file in the {386enh} section. The line that is added is "device=D:\cybertst.386" where D:\ represents the drive and subdirectory where the software is installed.

7. Connect the ancillary equipment and test leads. (Figure 2)

8. Turn the analyzer **on**.

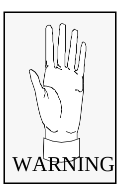
The analyzer is now ready for use. Before operating the analyzer, review the operating procedures described in the manual.

Figure 3. **Printer Connections**



CyberBag Operations

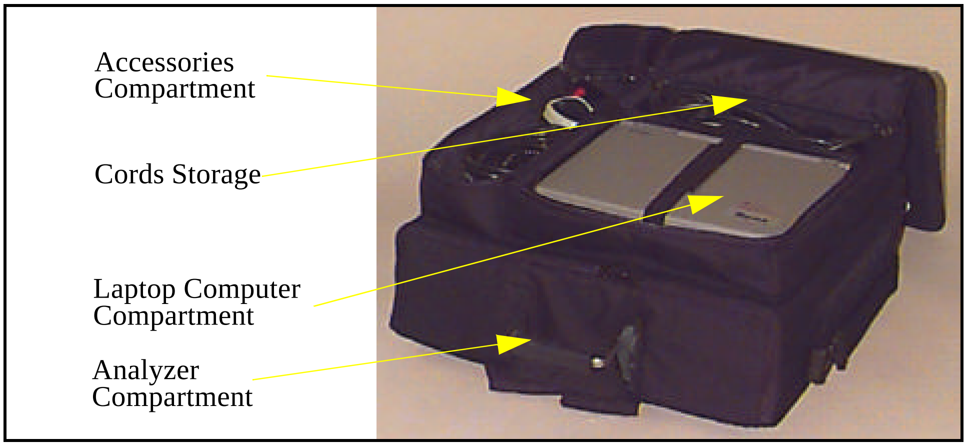
An option that may be purchased with the CyberTest system is the Cyberbag. This bag provides a carrying, storage, and operating capability for the entire CyberTest system. The bag consists of three main compartments shown in Figure 4. These compartments are: the main compartment for the CyberTest platform, a smaller compartment on the top of the bag to hold a Laptop PC and associated cords, and a third compartment that con hold all of the optional accessory equipment such as the Mic, headset, etc.



The CyberTest unit, its accessories, a laptop computer and its power supply have a total weight of approximately 44 lbs. Carrying this equipment in the carrying case on your back or shoulder could cause loss of balance or injury.

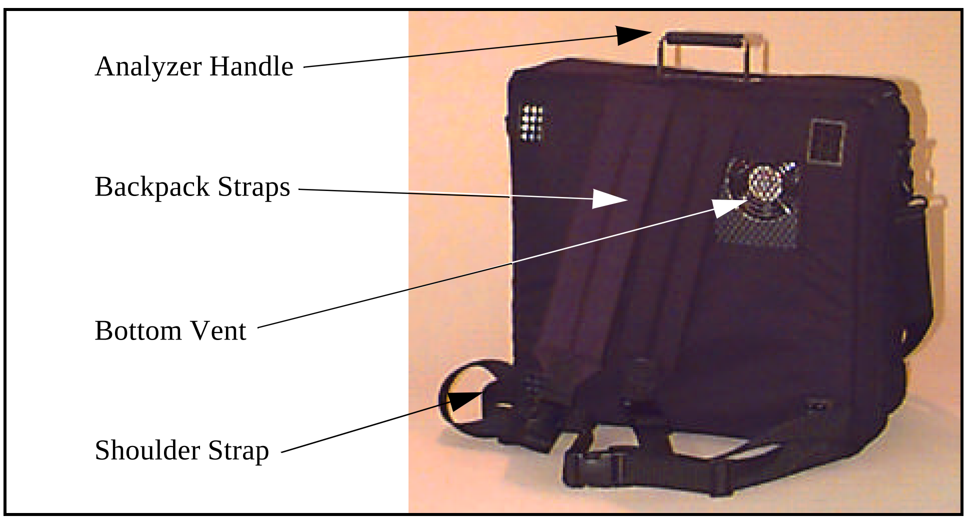
Evenly distribute the weight within the carrying case, do not add additional items to the case, and use extreme care when transporting the equipment on stairs, ladders, or other uneven surfaces.

Figure 4. **CyberBag Compartments**



The unit can be transported three ways (Figure 5). It can be carried like a suitcase by the Analyzer Handle, carried over the shoulder using the long single strap, and as a backpack using the backpack straps on the bottom.

Figure 5. **CyberBag Vent, Handle, and Straps**



The analyzer can be operated while in the CyberBag either with the unit vertical as shown in Figure 6 with the PC separate, or lying flat with the PC in place in its compartment as shown in Figure 7.

Figure 6. **Analyzer Vertical**

Figure 7. **Analyzer Flat**

In either case, prior to operation, the power cord and cable that connects the analyzer to the PC must be fed through the Cord Storage compartment to the analyzer. (Figure 8)

Figure 8. **Feeding the Cords**

The power cord is a Y-cord with two female receptacles. One is a right angle receptacle to be used to connect power to the analyzer and the other is a straight receptacle for power to the PC. The PC control cable should also be hooked up prior to inserting the analyzer into the Analyzer Compartment of the CyberBag.

CyberBag Set-up Procedure

1. Place the analyzer in its operating location.
   - The unit can be operated in the CyberBag from an upright position or from a flat position.
   - The platform contains a thermostatically controlled (two speed) fan that draws air through the bottom of the unit. The CyberBag has a mesh covered opening on the bottom to allow air to the fan. **Do not place unit on anything that can block the air flow. Also be careful that the CyberBag straps do not cover the fan opening when lying flat. (Figure 7)**
2. Connect the power cable and plug it into an appropriate power source.
   - The power cable is a Y cord that provides for power connections to both the CyberTest platform and the PC from one plug.
   - This cord is routed through an opening in the rear of the cord storage area in the CyberBag. See Figure 8.
3. Connect the analyzer to the PC using the cable provided.
   - The analyzer is connected from the PC Controller on the rear of the analyzer to the parallel port on the PC. Communication between the analyzer and the CyberTAME software is through this connection. (Figure 8) This cable is routed the same as the power cord.
4. Turn on the PC and start the Windows operating system.
5. Connect the ancillary equipment and test leads. (Figure 2)
6. Turn the analyzer **on**.

The analyzer is now ready for use. Before operating the analyzer, review the operating procedures described in the manual.

Cleaning and Care

When cleaning the CyberTest platform, use a soft cloth and a non-abrasive cleaner. Wipe the surface to remove all dust. Use a clean compressed air container to remove dust and debris from the Smart Module slots and connections on both the front and back of the unit.

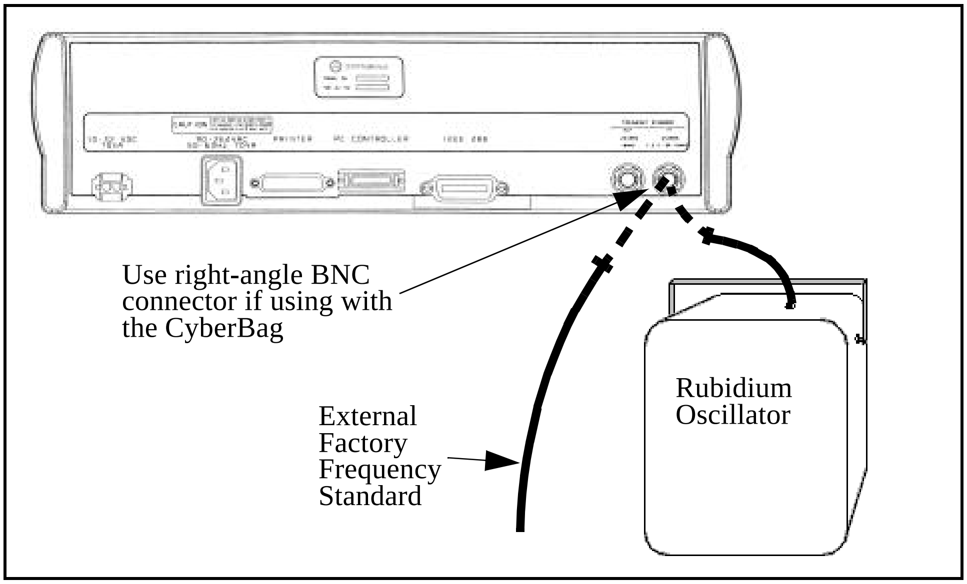
General Handling Instructions

It is possible to stack units on top of one another. However, the CyberTest platform is designed to support no more than 50 pounds. When the weight of items stacked on top of the platform increases, it may make the installation and removal of the Smart Modules more difficult.

External Reference Oscillator Connection

The CyberTest Analyzer automatically senses the presence of an external standard signal when it is applied and uses it for the frequency reference. A message is displayed on the screen notifying the user that an external reference is present. If for some reason the unit cannot lock to the applied signal, an error message is displayed to the user on the CyberTAME GUI software. The external frequency reference is connected to the analyzer as shown in Figure 9. Frequency references of 1 MHz, 2 MHz, 5 MHz or 10 MHz can be used.

Figure 9. **External Frequency Reference**



Equipment Description

Chapter Introduction

This chapter provides the basic description of the hardware and software that make up the CyberTest analyzer system. It also provides a basic description of the individual instruments that are available depending on which Smart Modules are installed in the analyzer. The descriptions in this chapter give an overview of the basic capabilities of the system. The actual operation of the equipment, the software, and the individual instruments that make up the system will be covered in the following chapter.

Description

Hardware

The heart of the CyberTest system is the CyberTest platform component. This is the main case that contains the basic electronics to connect to the installed Smart Modules, the power supply, and the various connections to the input and output devices. The platform contains the hardware and firmware required for the various test instrumentation. Smart Modules interface with the Analyzer platform to provide additional capabilities.

Hardware (Cont.)

The Analyzer platform consists of five major assemblies that include:

- An RF Upconverter
- An RF Downconverter
- An Audio Frequency Processor
- The Power Supply
- Smart Modules

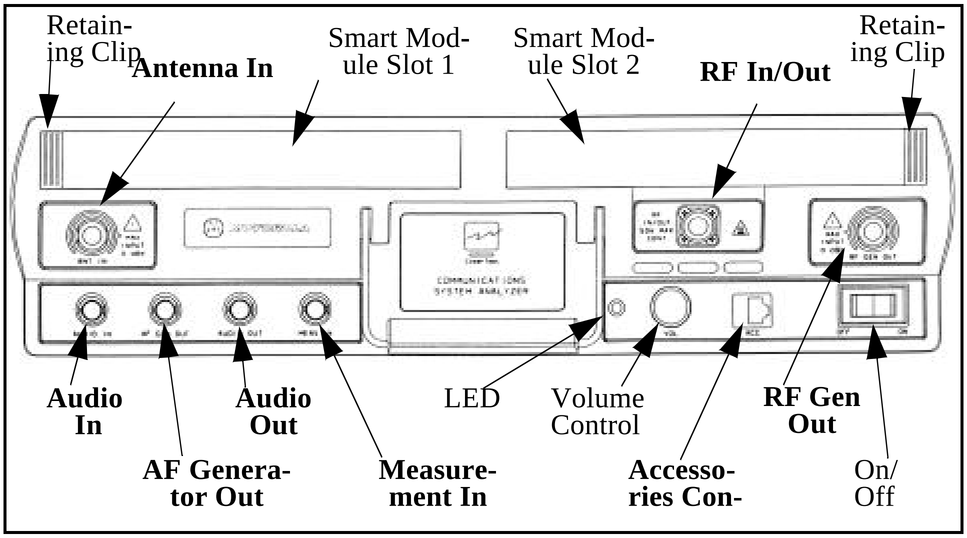
With no Smart Modules installed, the Analyzer is capable of providing general purpose audio frequency instruments and some RF measurement capability. A Smart Module is required for any functions requiring modulation or demodulation (such as an FM generator or receiver) since the Analyzer itself only performs a calibrated radio frequency (RF) to intermediate frequency (IF) conversion. Because the Analyzer contains separate RF Up Converter and Downconverter circuitry, the unit is capable of generating signals independently from the configuration of the receiver.

Smart Modules

Each Smart Module has its own connections that are dependent on the function of the individual module. A Smart module is roughly the size of a small notebook. It is configured like a cartridge in that the electronics are protected inside a metal housing. Smart Modules are designed to be installed by the user by simply inserting them into either one of the two slots. The Smart Modules are held in by retainer clips. Any unique external interconnections required by the Smart Module are provided by connectors mounted on the Smart Module face. Figure 1 shows an overall drawing of the analyzer. The two slots on the top of the unit have doors which flip up when there is no Smart Module present to keep dust out of the unit and to allow for proper airflow.

Do not insert the Smart Module while the unit is powered on. These modules need to be installed prior to turn-on in order for the platform to recognize their presence and to avoid possible damage.

Figure 1. **Cyber Test Unit Front View**



Power Supply

TABLE 1: AC DC Power Requirements

AC Power	90-264VAC 50-60Hz 70VA
DC Power	10-32VDC 70VA

The AC/DC Power Supply is an auto sensing device. There is no selector switch. If both AC and DC sources are applied, the power supply will tend to operate from the AC source.

Connections & Controls

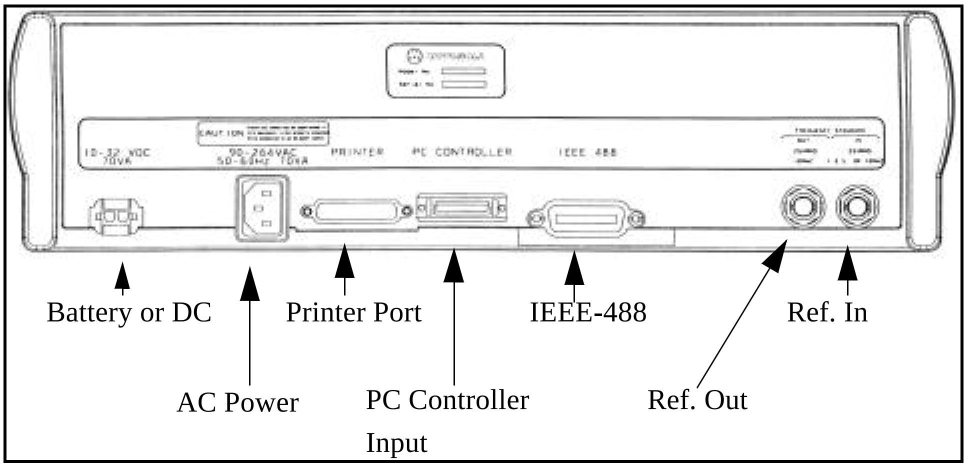
The following connections (shown in Figure 1) are available on the front of the CyberTest unit to connect to the equipment under test:

- Antenna Input - "Ant In"
- Audio In
- AF Generator Out - "AF Gen Out"
- Audio Out
- Measurement Input - "Meas In"
- RF In/Out
- RF Gen Out
- Accessories Connection - Used for Microphone or Headset. May also be used for sourcing a 5V DC for use powering preamps.

Additional connections specific to Smart Module operations are provided on the face of the Module.

The primary connection from the analyzer to the computer used for control and display purposes is on the back of the unit. Also included in this area are other connections that include one for IEEE-488 remote capabilities. These connections are shown in Figure 2.

Figure 2. **CyberTest Back View**



Virtual Instruments - A Definition

Throughout this manual you will see references to the words “virtual instrument” and “environment”. It is important to understand the meaning of these terms in order to avoid confusion as you read the manual and use the CyberTest Communications Analyzer System.

The CyberTest Analyzer unit consists of common hardware (RF and baseband) which is manipulated by software to perform specific test and measurement functions that are grouped into categories called instruments or “virtual” instruments. The word “virtual” is used to denote that there is not dedicated hardware within the CyberTest analyzer for each of the many instruments it contains. The virtual instruments in the CyberTest analyzer were designed to provide the type of functionality traditionally offered in actual stand-alone laboratory instrumentation. Essentially, the CyberTest Analyzer is instrument-based. It contains a number of virtual instruments which can be used in many different ways via either the IEEE-488 port or via the CyberTAME graphical user interface (GUI) that runs on the PC. Instruments are provided in the CyberTest Analyzer Platform itself and also on the various Smart Modules. When you insert a Smart Module into the CyberTest platform, you are, in effect, adding additional instruments that can be used for your testing needs.

Software

The CyberTAME software is a Windows® based application that offers features and flexibility not usually available on a Service Monitor. The system provides complete flexibility to manually control and interconnect all of the built-in test instruments.

Environment - A Definition

To make operations easier for the user, the concept of the "test environment" was developed in the design of the CyberTAME GUI. An "environment" is a collection of virtual instruments. The instruments in a particular environment are selected based on:

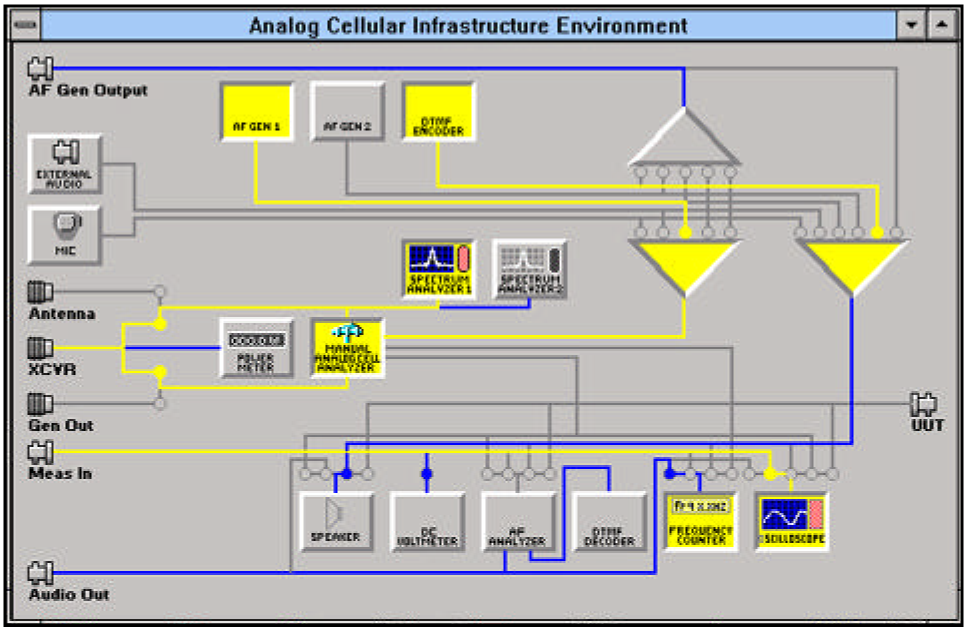
- Their applicability to the testing application at hand (i.e. is it needed to do this kind of testing?)
- How compatible they are with each other. Virtual instruments which cannot operate at the same time because they each require the common hardware to be configured differently are not included in the same environments.

If you need to use instruments that are contained in different environments, it is possible to quickly switch between environments without interrupting analyzer operations.

Environment Screen Example

An example of an environment screen is shown in Figure 3. This environment screen will change based on the Smart Module that you are using and the tests that you have set up. The environment screen shows all of the available test instruments that can be used along with the various interconnections between the instruments and the external devices for the test. Any instruments in the environment which are provided by Smart Modules are shown in a Cyan color. Instruments can be connected to each other and the external ports by clicking with the mouse on a block diagram representation of the CyberTest unit or via controls on the individual instruments.

Figure 3. **CyberTest Environment Screen Example**



Instrument Displays

You can open several instrument displays simultaneously and arrange them on the screen wherever you like. Instrument windows can be sized so that only the most important display areas are shown. For example, multiple graphical displays such as the Spectrum Analyzer and the Oscilloscope can be opened and active at the same time providing true power for test and debug activities. Within the Windows operating system, CyberTAME instrument displays can be copied and pasted into other Windows applications like Microsoft Word or Excel. This gives you unprecedented capability for documenting your test results. Using this feature, you can embed a copy of the actual instrument display in your test reports.

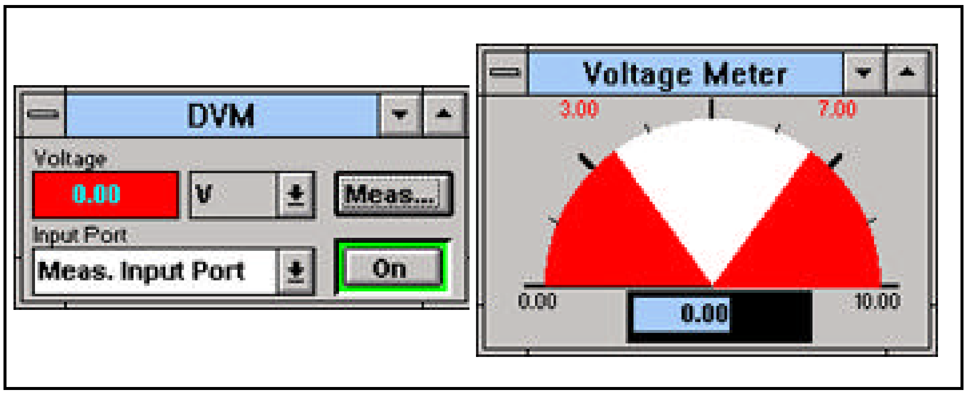
Flexible Display of Results

The CyberTAME test environment can display instrument readouts both in analog or digital form. You have the choice of both at the same time. The system allows the capability to program in test limits. For example:

- On analog meters, colored regions allow you to see the high and low limits for a quick tell of a “good” reading.
- On digital displays, colors notify of a reading outside the programmed limits.

Other functions like user-selectable averaging and programmable reference values for relative measurements give you added flexibility. The two types of display are shown in Figure 4.

Figure 4. **Digital vs Analog Displays**



The CyberTAME Instrument Descriptions

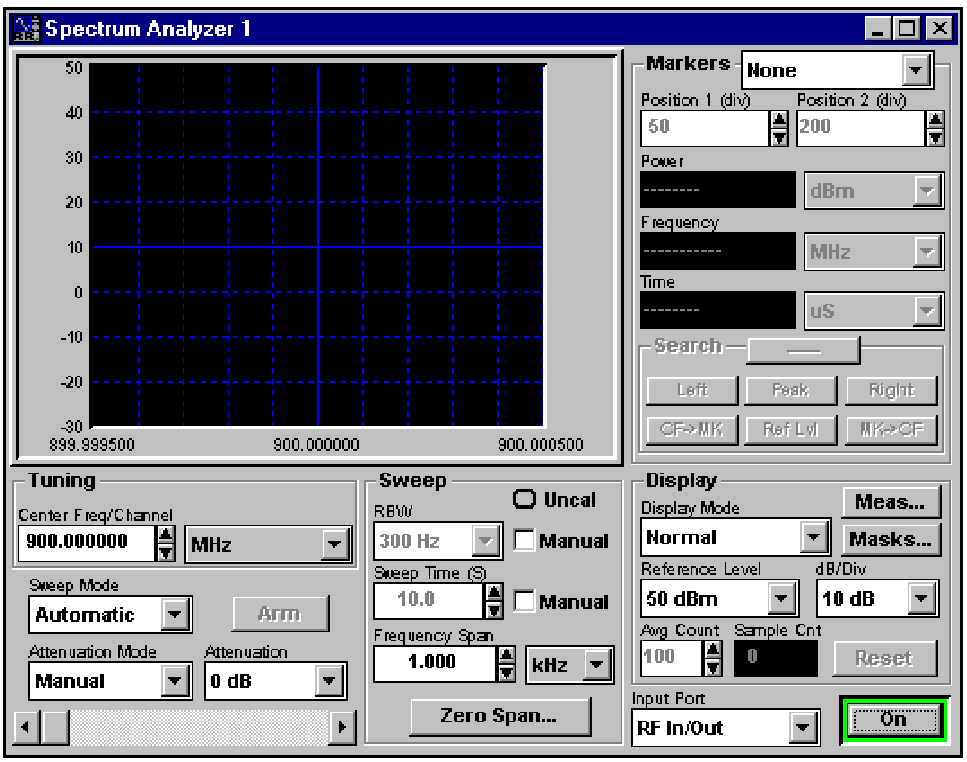
Introduction

The remainder of this chapter will give an overall description of the instruments installed in the CyberTest platform. These instruments are common to any CyberTest system. Instruments specific to the Smart Modules will be covered in their own section. Operating instructions for these instruments are provided in a later chapter in this manual.

Spectrum Analyzer

The CyberTest Spectrum Analyzer packs the features and performance of sophisticated laboratory-grade units into a portable service monitor. The system contains two spectrum analyzers. The spectrum analyzers can be tuned and controlled independently of each other allowing you to perform tests such as observing two transmitted RF carriers “close-in” at the same time.

Figure 5. **Spectrum Analyzer**



Spectrum Analyzer Display

The Spectrum Analyzer display screen (Figure 5) features a full 80 dB of display range with a user-selectable reference level. When this is combined with the flexible attenuation control and the intermodulation performance, critical tests such as transmitter intermod are easy and accurate. In addition to absolute frequency, the analyzer can be tuned by channel number, allowing for quick channel checks. The single sweep mode allows capture and display of one-time events or message preambles.

Spectrum Analyzer Display Modes

Display modes provide additional capability to make and capture measurements. These display modes are:

- Max
- Hold
- Average
- Peak
- Freeze

You may also couple features and use copy and paste to insert instrument displays into other Windows applications.

Spectrum Analyzer Markers

The CyberTest Spectrum Analyzer features two markers which can be used for a variety of applications including:

- Absolute and delta power and frequency display.
- Automatic peak searching.
- Making occupied bandwidth measurements.

You can move the markers by simply clicking and dragging with the mouse.

Spectrum Analyzer Zero Span Mode

The Zero Span mode essentially turns the Spectrum Analyzer into a graphical time-swept power meter, allowing measurements such as:

- Transmitter rise/fall times.
- Ripple and droop.

This feature is used for testing burst transmission wireless systems such as TDMA, CDMA reverse link, GSM, iDen, etc.

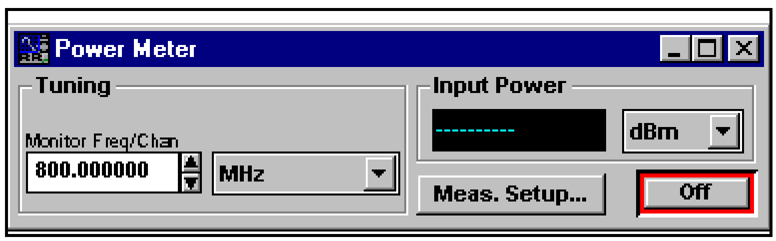
NOTE

This is a future capability not presently available.

Power Meter

The CyberTest Power Meter (Figure 6) provides for accurate power measurements. The unit contains a broadband, true-RMS power meter with a measurement accuracy of 5% or +/-0.2 dB. This Wattmeter allows you to accurately measure several RF carriers.

Figure 6. **Power Meter**



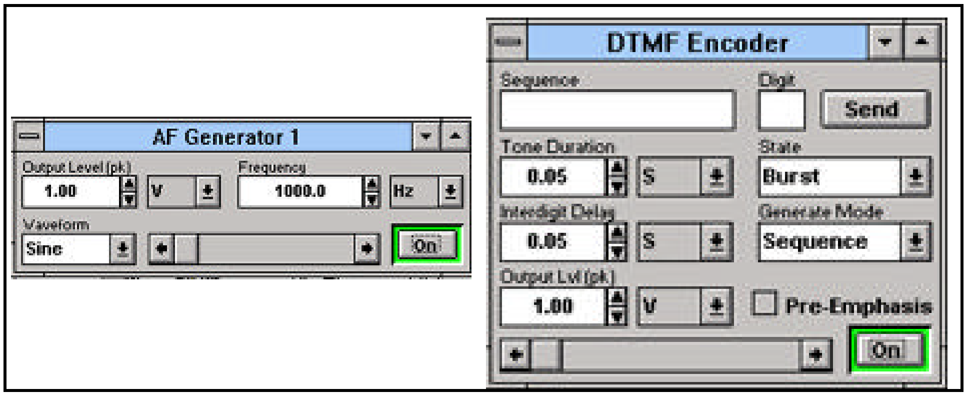
Power Measurement Options

The CyberTest platform can be fitted with either a 50 Watt capable High Power Meter or with a Low Power Wattmeter providing the capability of making accurate power measurements as low as 30 microwatts. Check the product matrix in the Introduction section to see which version is standard or optional on your particular product model.

Audio Generators

The CyberTest platform includes two independent programmable audio function generators and a DTMF generator (Figure 7). These generators can be connected to various places in the platform and summed together to create unique waveforms. The DTMF generator can generate individual or sequences of digits either continuously or in bursts. Programmable tone duration and interdigit delay allow you to adjust for your system's particular requirements. The audio generators can produce sine, square, pulse and ramp waveforms.

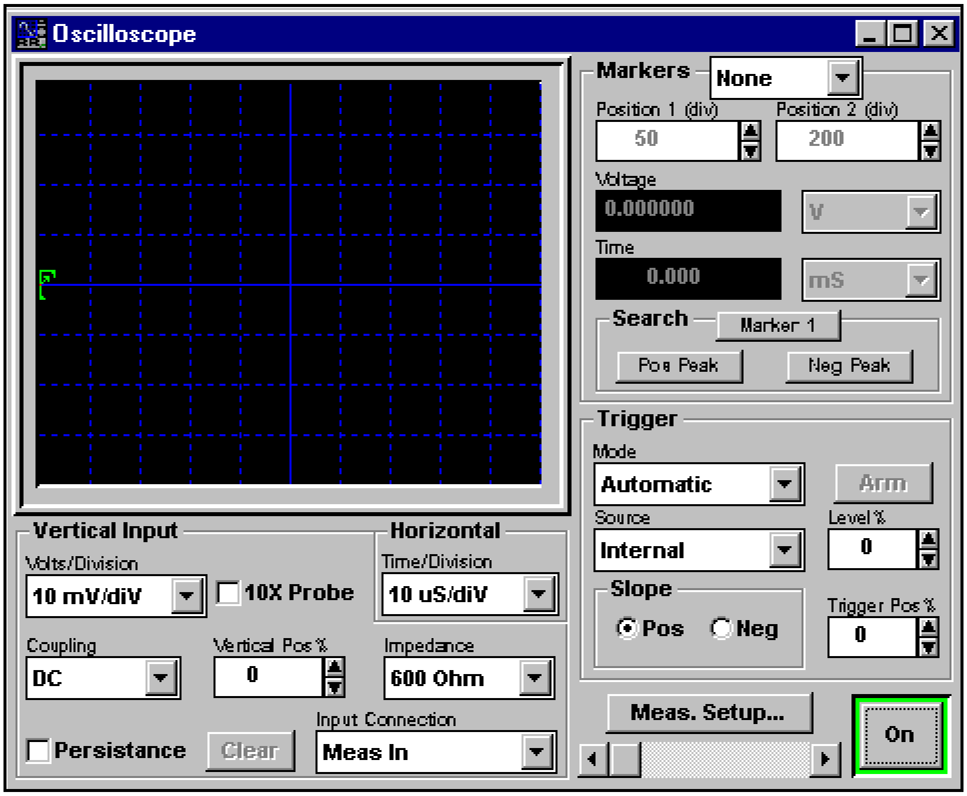
Figure 7. **Audio Generators**



Oscilloscope

The CyberTest Analyzer provides a full-featured audio frequency digital oscilloscope (Figure 8). This instrument offers you digital capabilities for triggering and waveform capture, and a selectable persistence mode that allows you to look at eye patterns.

Figure 8. **Oscilloscope**



Oscilloscope Markers

Using the two markers, delta time, frequency, and delta voltage measurements are easily made. Search functions allow you to quickly find the peaks. Just click and drag the markers with the mouse.

Audio Measurements

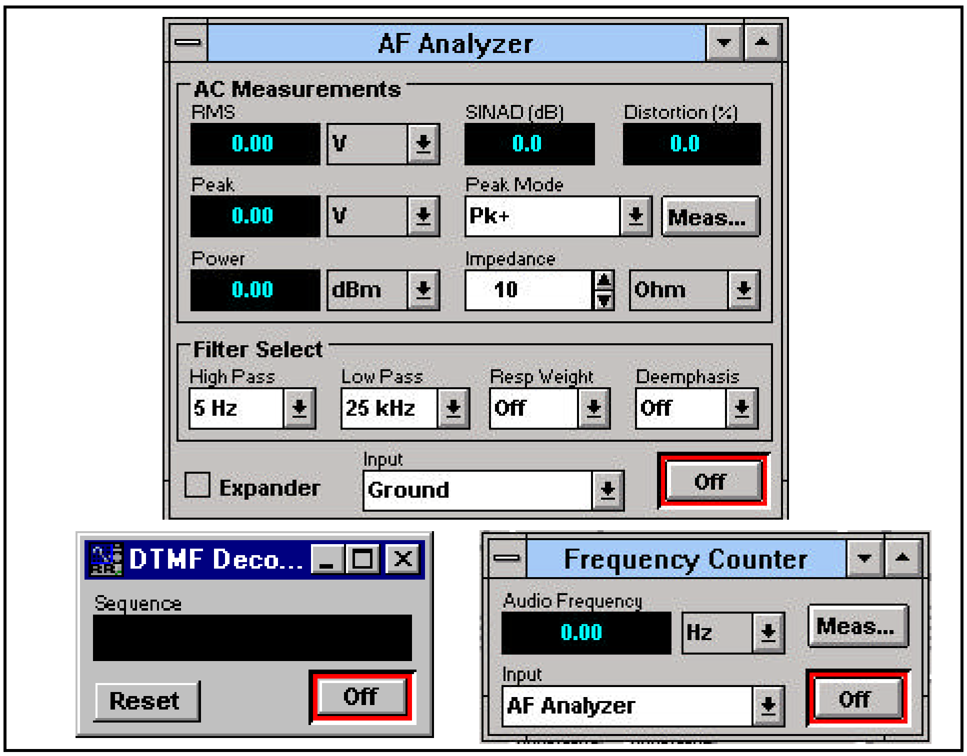
The audio frequency instruments in the CyberTest platform give you accuracy and flexibility for a variety of measurements. These instruments include:

- AF Analyzer
- Frequency Counter
- DTMF Decoder

AF Analyzer

The AF Analyzer instrument (Figure 9) measures distortion, SINAD, audio power, and AC voltage in rms and a wide range of peak modes. A selectable expander allows you to properly test audio from RF systems that use companding.

Figure 9. **Audio Measurement Instruments**



AF Analyzer Audio Filtering

Multiple audio filters are available for tailoring the audio bandwidth. The most common filters used for EIA standard tests are included. C-Message and CCITT weighting filters are also provided for audio tests of telecommunication systems. One of the features of the CyberTest unit's design is that unique audio filtering needed for a specific test application are provided by that application's Smart Module. As an example, since a 6 kHz bandpass filter is useful for testing SAT deviation of analog cellular phones, that filter is provided on the analog cellular Smart Module.

Selectable Inputs for Audio

The audio instruments can be connected to several different places within the CyberTest unit, to give you test flexibility. For example, you can hook the AC voltmeter to the audio generators at the same time that you are measuring the frequency of demodulated audio from one of the Smart Modules.

Frequency Counter

This instrument measures the frequency of baseband signals connected to it.

DTMF Decoder

The DTMF Decoder shown on the left in Figure 9 provides a direct readout of the DTMF signals received.

Operating Instructions

CyberTest Platform

Chapter Introduction

This chapter covers the operating instruction and procedures for using the CyberTest system. The areas that will be covered are:

- Setting up hardware
- Starting CyberTAME software
- Selecting a test environment
- Making the connections required for testing
- Selecting instruments
- Selecting display methods
- Setting testing parameters
- Using the various instruments in the CyberTest platform

These instructions cover the basic operation of each instrument built into the CyberTest platform. These instruments are covered individually, along with instructions on how to connect them in combinations. Since there are many possible combinations, the interconnect capabilities will be described but not specific combinations for specific tests. Specific test combinations will be left to the operator as the testing needs are determined. Smart Module instruments will be covered in other sections.

CyberTest Hardware Operations

Overview

The CyberTest hardware consists of the main CyberTest Analyzer with the appropriate Smart Modules installed and a personal computer (PC) with the CyberTAME software installed. The CyberTest Analyzer provides the instrument electronics with ports for connecting to the equipment under test and to the computer for the test displays (Figure 1). The analyzer and the PC operate as a complete unit for testing. If a PC is not present, the system can be operated for testing using the IEEE remote commands. The analyzer has two slots in the front to install the Smart Modules. At least one Smart Module must be installed for the system to be able to generate an RF Signal. Without a Smart Module, the basic audio measurement instruments and RF receive instruments can be used. The CyberTest Analyzer has two controls. One is the Power switch and the other is the Volume Control for adjusting the level of the audio to the speaker and accessories connector. A blinking LED indicates processor activity.

Analyzer Equipment Connections

The Main CyberTest platform has the following connections:

Figure 1. **Front Panel Connections**

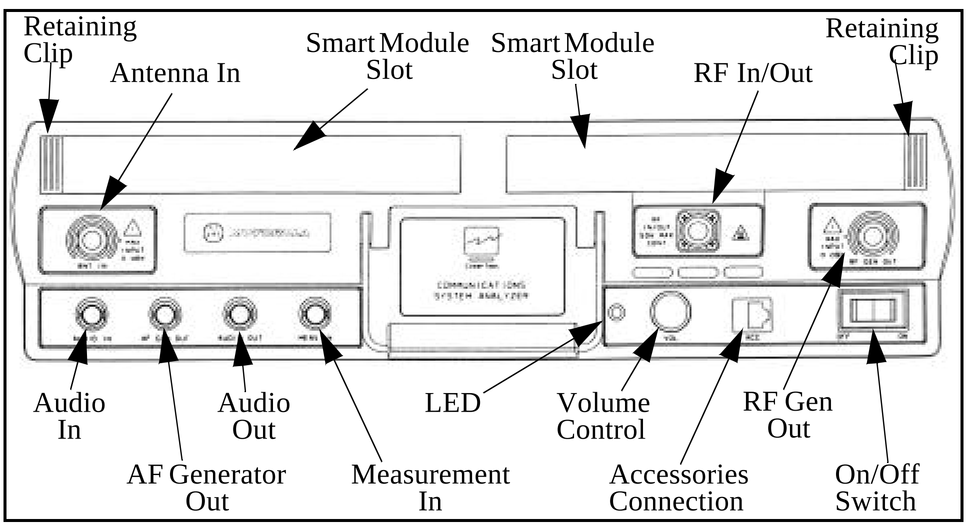
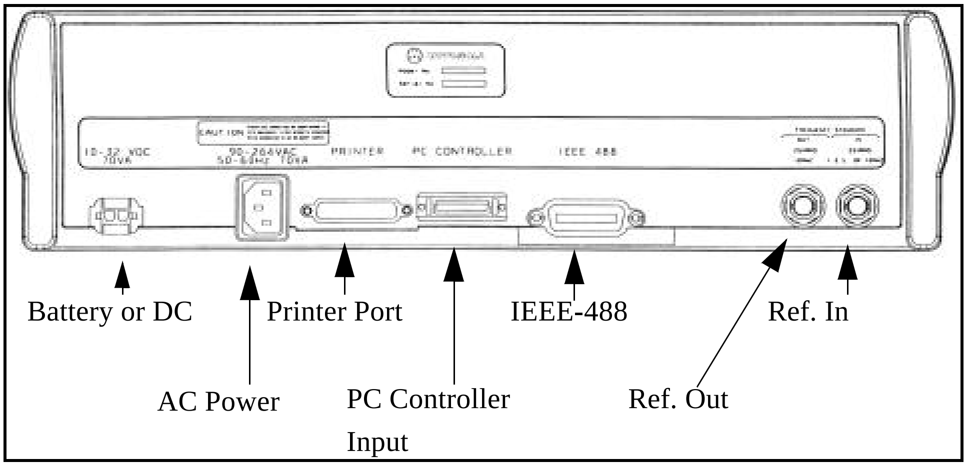


Figure 2. **Back Panel Connections**



Smart Module Connections

Some Smart Modules provide connectors for special purposes specific to the potential application (Figure 2). The number and type of connections on the Smart Module depends on the particular module installed and will be covered in the appropriate Smart Module section.

Front Panel Connections/ Indicators

Antenna Input Port - “Ant In”

This N-type connector is used for off-the-air measurements and for low power signals. The accessory kit supplied with the analyzer contains N-BNC adapters which can be used on this port.

This is a receive-only connection. For generating signals, use the RF Gen Out port or RF I/O port (Figure 1). The Ant In port is not designed for power measurements. Signals with a power level greater than 0 dBm (1 mw) must be connected to the RF I/O port.

Do not connect the Ant In port to any signal source stronger than 0 dBm or 1 mw as damage to the unit will occur.

This port does have clamping circuitry to protect it from short duration (less than 10 seconds) application of power of up to 10 watts.

RF In/Out Port

The RF In/Out connector is used for power measurements and for full duplex operation (simultaneous generate and receive). On the high power version of the analyzer, this port can handle up to 50 watts of continuous RF power. The low power version can handle up to 4 watts.

After extended application of high power signals to the RF In/Out port, the connector assembly can become hot. Use caution when removing the cable

The RF In/Out port can be used for generator signals, but the output level is limited to -26 dBm. For generating higher level RF signals, use the RF Gen Out port.

RF Gen Out

Use this N-type connector for generating RF signals. This port can output signals as high as 0 dBm or 1 mw. The supplied N-BNC adapters can be used for connecting to BNC cables. This is a generate-only port.

Do not connect the RF Gen Out port to any signal source stronger than 0 dBm or damage may occur. The port has clamping circuitry to protect it from short term accidental application of power, but if there is any chance that RF power may be present on the test cable, use the RF In/Out port.

Audio In

This BNC connector is used for inputting external audio to the analyzer for modulation. The analyzer can scale signals connected to this port up and down, and can invert them through GUI and IEEE-488 control.

AF Gen Out

This BNC connector is used to output audio frequency signals from the internal generators.

Audio Out

This is a multiple-purpose audio output port. Its primary purpose is to output recovered audio from the receiver instruments in the analyzer.

Meas In

The Meas In (measurement input) port is used for inputting signals to be measured on the baseband measurement instruments in the analyzer (i.e., DVM, AF Analyzer, Oscilloscope, Frequency Counter). This is the port where an oscilloscope probe would be connected. This port has a selectable input impedance (600 ohms or 1 Meg Ohm) which is controlled via the GUI software or via IEEE-488 commands.

LED

The LED on the front panel serves two purposes. It illuminates when the analyzer is powered on and it blinks to indicate activity in the internal processor circuitry. When the analyzer is operating normally, the LED will show three states of illumination; on, dim, and off. It will switch between these states in what appears to be a random pattern. If the LED is not blinking with these three states (e.g. off and on only - no dim state), this is an indication that one of the internal processors has stopped functioning. Cycle the power on the analyzer to correct the problem.

Volume Control

Turning the knob clockwise increases the volume of the speaker and of a handset plugged into the ACC jack. Counter-clock wise rotation decreases the volume.

ACC

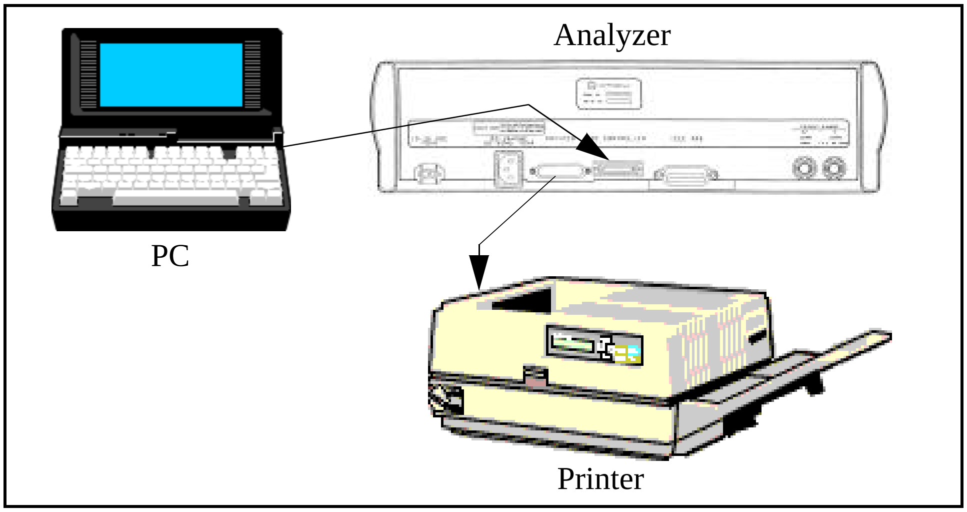
The ACC connector is a RJ-11 style connector. It is used for connecting a microphone or a handset.

Operating the Analyzer

The CyberTest Analyzer can be operated as a stand-alone test instrument or set up to operate remotely through the IEEE-488 connections. To operate the CyberTest Analyzer as a stand-alone instrument:

- Place the CyberTest Analyzer in a convenient location to perform the test.
- Connect the computer with the CyberTAME software installed to the Analyzer with a standard 25 Pin Parallel cable to the computer’s printer port.
- Connect the equipment to be tested to the appropriate analyzer connectors.
- If needed, connect an external frequency reference signal to the Ref-In connector.
- Turn the power on using the Power Switch.
- Start the CyberTAME software on the computer.
- If printing capability is desired, connect the printer to the Analyzer Parallel Pass-through port. The connection path is shown in Figure 3.

Figure 3. **Printer Connections**



The IEEE-488 remote operations are covered in a separate publication.

Thermostatically Controlled Fan

The CyberTest Analyzer has a thermostatically controlled fan to provide for cooling. Normally the fan operates at its low speed and is very quiet. As the unit warms up (with extended application of high power RF) the fan will automatically switch to a higher speed. At the higher speeds, the noise of the fan can be heard.

The CyberTAME software provides the main interface between the analyzer and the operator. The operation of the software and instruments are covered in the next section.

CyberTAME Software Operations

Overview

The CyberTAME software is the main display component of the CyberTest system. It provides the interface between the CyberTest Analyzer and the operator. This software sets up the operating environment and provides displays for all of the instrumentation built into the system. As designed, the CyberTAME software communicates with the analyzer unit and determines what features and performance level is available. In this regard, the CyberTAME program is a slave to the analyzer unit. This allows one common version of the CyberTAME GUI to be used on different analyzer models and allows you to mix and match your PCs and analyzers if you have more than one CyberTest System.

This section covers the basic operation of the CyberTAME Software. It details:

- Starting software.
- Selection and setup of the test environment.
- Saving the test environment.
- Using CyberTest instruments.

Also covered is the instrument display method setup that the operator desires.

Test Environment Described

A Test Environment must be selected and set up for testing to take place. The Test Environment consists of several components selected and set up to accomplish a test or series of tests. The main components of the Test Environment are:

- Selection of a Smart Module.
- Selection of a Smart Module instrument collection (environment).
- Selection of individual instruments from the collection to be used for a particular test.
- Selection of the connections between individual instruments within the collection and to and from the equipment under test.
- Selection and setup of display choices for individual instruments.

NOTE

Once an Environment is set up, it can be saved to disk for future use. Several Test Environments can be saved representing different commonly used tests.

CyberTAME Software Start Procedures

Starting the CyberTAME Software

The CyberTAME software starts from the Program Manager in Windows. Review the Installation and Setup in Chapter 1.

1. Open Program Manager if not already open.
2. Locate the CyberTAME icon in the appropriate Program Group.
3. Double-click the CyberTAME icon to start the software.

Figure 4 shows the screen that appears when starting this software.

Figure 4. **CyberTAME Program Window**

The CyberTAME software is a standard Windows program with all the normal components of Windows software such as a Title Bar, a Menu Bar and buttons used for quick access to selected commands.

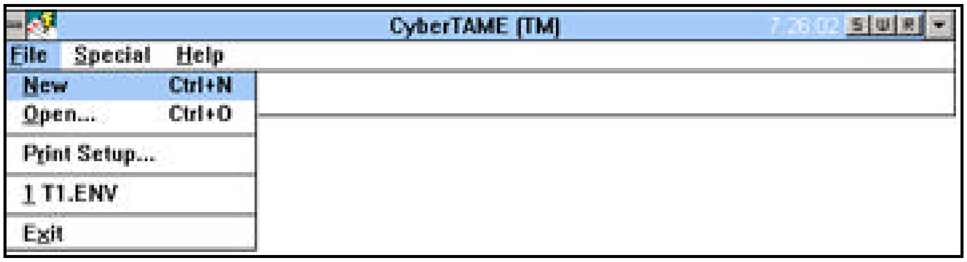
Menu Bar

The Menu Bar contains three menu choices for operating the system:

- File
- Special
- Help

Figure 5 shows the software with the File menu activated.

Figure 5. **CyberTAME File Menu**



If this is the first time for you to operate this software, the commands on the File menu will include:

- New
- Open
- Print Setup
- Exit commands

If you have operated the software previously and saved a test environment, you will also have numbered ".ENV" files listed that allow you to recall a previously setup test environment that was saved to the disk drive.

- New
- Open
- Print Setup
  – If printing capability is desired, connect the printer to the Analyzer Parallel Pass-through port.
- .ENV
- Exit commands

To open these environment files directly you have two options:

1. Type the underlined number next to the environment file.
2. Click on the environment file in the File menu.

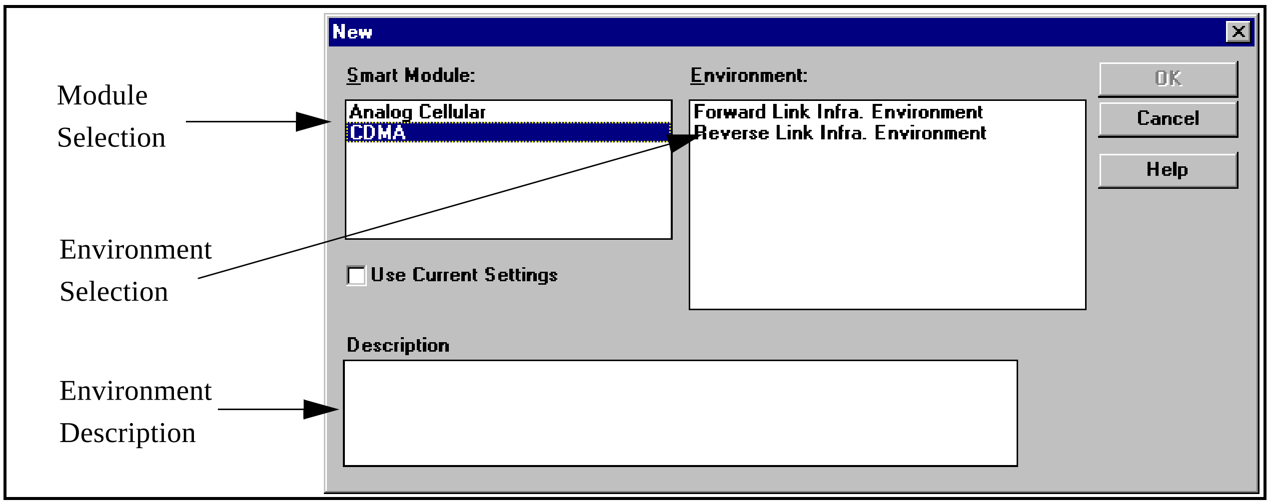
New File Command

The New File Command provides access to the operating environment and instrument selection and setup in the CyberTest system. It is used to define a new operating environment, including the instruments that will be used and the selected connections between the instruments and the equipment under test. Selection of the New command accomplishes the following operations in the start of the CyberTAME software.

- Allows you to select the Smart Module.
- Allows you to select and setup desired testing operating environment to perform a particular test.

Figure 6 shows an example of the screen that appears when the New command is selected. This will vary on Smart Module installation.

Figure 6. **Example New File Command Screen**



The Smart Module window in the New File screen lists the Smart Modules installed in the CyberTest system. The Environment window of this screen lists the environments associated with the Smart Module that is highlighted on the left. In Figure 6, the CDMA Smart Module is selected giving two environment choices in the Environment window.

- Forward Link Infra. Environment
- Reverse Link Infra. Environment

To choose an environment:

1. Highlight desired selections in the windows.

2. Click OK button.

The screen also provides a description of the currently highlighted environment. With different selections in the environment window, the description changes to briefly describe the purpose of the selected environment.

If the “Use Current Setting” checkbox on the New File Command Screen is not selected when you press the OK button, the CyberTAME software will initialize the analyzer with it normal start-up default values. If this box is selected, the CyberTAME software will query the analyzer for it present configuration and will open the GUI using those settings. This feature makes it easy to switch from test environment to test environment without having to restart from scratch.

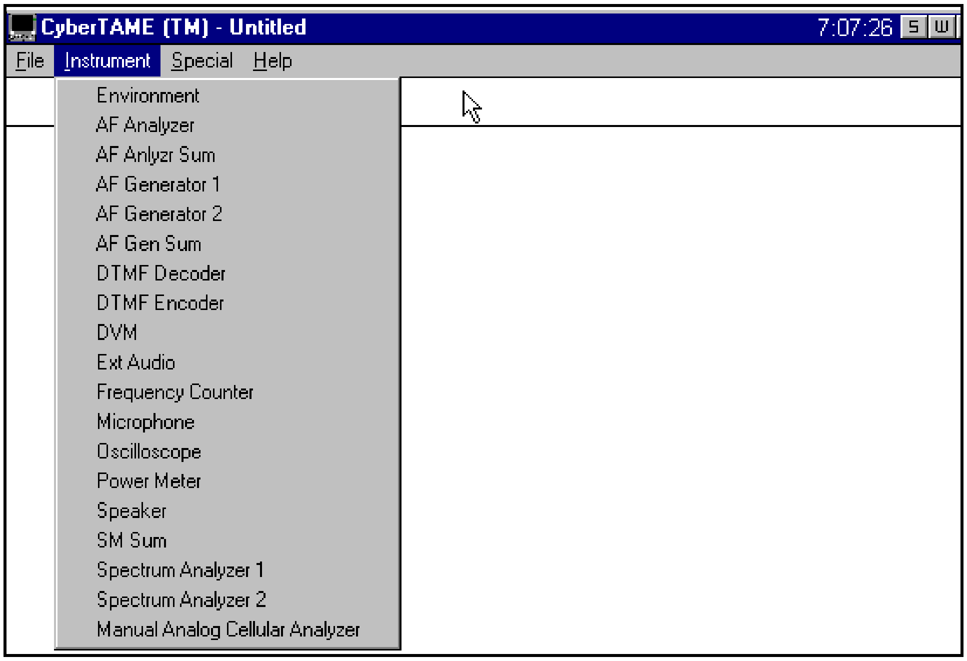
Operating Environment Selected

Once a Smart Module and operating environment is chosen, the CyberTAME software main program window changes to add an additional menu choice on the Menu Bar. The newly added Instrument menu appears to the left of the Special menu.

Instrument Menu

The Instrument menu lists all available instruments for use with the selected environment. Optional instruments which are not installed in your analyzer will still be listed in this menu. If you attempt to select an uninstalled instrument, an error message will be displayed. The CyberTAME main window with the Instrument menu chosen is shown in Figure 7.

Figure 7. **Instrument Menu Displayed**



Some of the instruments listed in the Instrument menu are dependent on the Smart Module and the selected operating environment. The following instruments are common and are available regardless of the Smart Module or environment chosen:

- AF Analyzer
- AF Generators
- DTMF Encoder
- DTMF Decoder
- Volt Meter (DVM)
- Frequency Counter
- Oscilloscope
- Power Meter
- Spectrum Analyzers

NOTE

The Spectrum Analyzers and the Tracking Generator are not available at the same time. If the Tracking Generator environment is selected with the Analog Cellular Smart Module installed, the Tracking Generator is available in place of the Spectrum Analyzers.

In the Figure 7 example, the Manual Analog Cellular Analyzer is specific to the Analog Cellular Smart Module and environment.

Other items listed on the Instrument menu are not really instruments, but are controls or displays that provide for interconnections between the various instruments and the equipment under test. Each of these listed items are covered in the following sections.

Special Menu

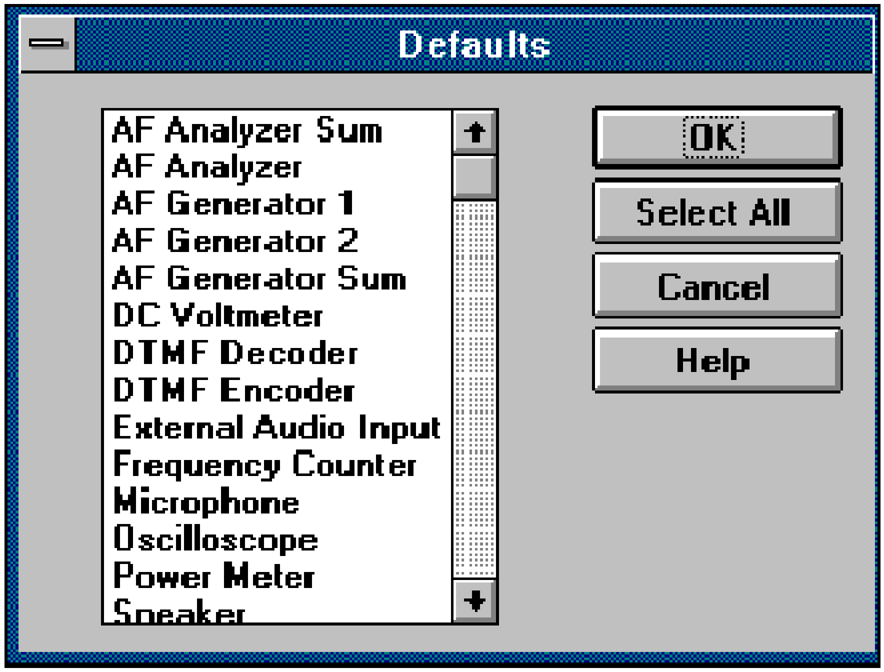
In addition, there are two more commands that appear on the Special menu. These are:

- Defaults
- IEEE-488
- Calibration
- Version

Defaults:

The defaults menu selection allows you to reset any of the available instruments in the environment to their default values. You can select the instruments one at a time by clicking on their names with the mouse or you can select them all with the "select all" button. Press OK to initiate the process.

Figure 8. **Defaults Menu**



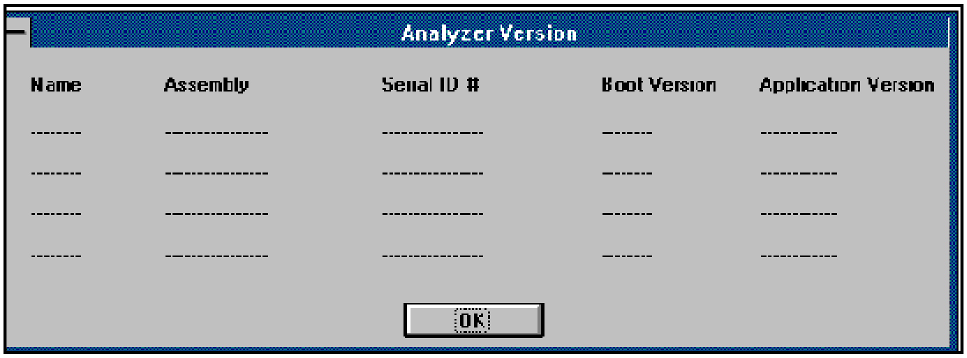
IEEE-488: The IEEE-488 menu selection allows you to set the bus address of the analyzer for IEEE-488 remote operation. Address numbers from 0 to 30 can be entered.

Figure 9. **IEEE-488 Menu**

Calibration: This menu selection is only available when a test environment has not been opened. It allows you to check the calibration status of the analyzer and to view the present internal temperatures of the various circuit assemblies. Please see the detailed calibration discussion later on in this chapter.

Version: The Version command allows you to view the software version numbers of the various software loads in the analyzer.

Figure 10. **Analyzer Version Screen**



Operating Environment

Environment Command

The first listed item on the Instrument menu is the Environment command. The Environment screen is the primary tool for setting up the desired test environment. The Environment command brings up a graphical representation of the available instruments for the Smart Module and environment chosen. This screen also shows all of the possible connections between instruments that can be made as well as the possible connections to the analyzer or Smart Module external ports. Figure 11 is an example of the Environment screen.

Environment Screen

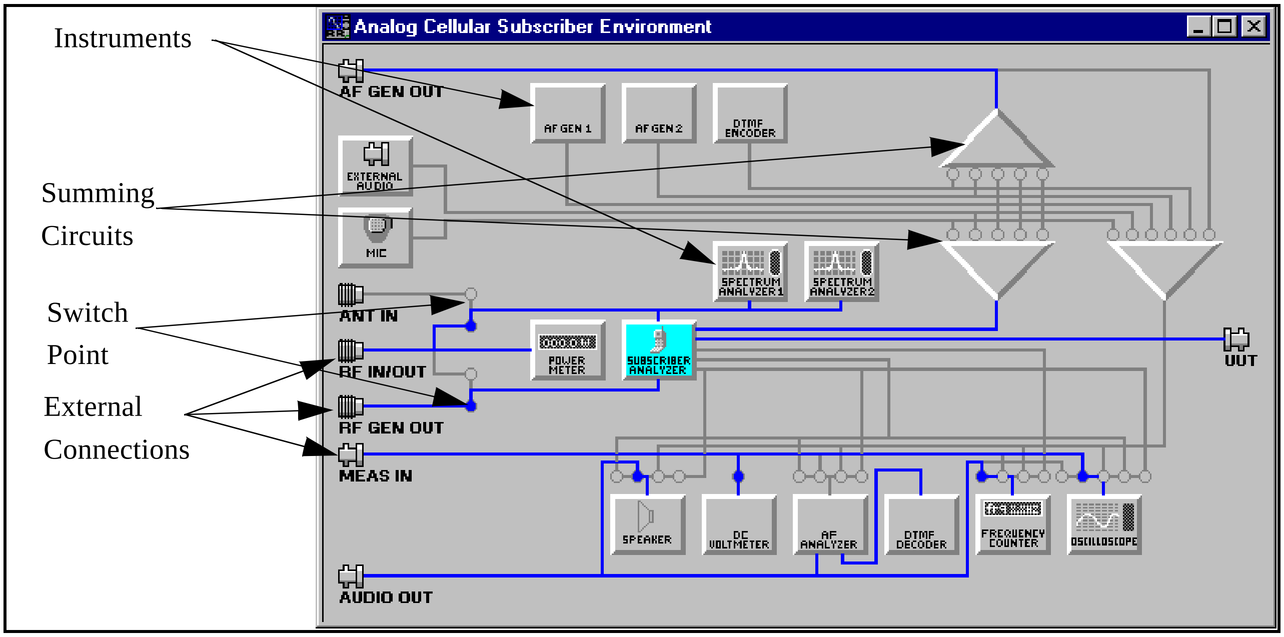
Shown along the left edge of the Environment screen (Figure 11) are the various connections that can be made between the analyzer and the equipment under test. Connections are illustrated by specific shapes.

Connection Shapes

- Rectangles represent various instruments available in chosen environment.
- Triangles represent summing circuits where various signals can be summed.
- Lines represent signal paths between instruments and connectors.
- Circles along the paths represent connecting points.

These are switch points where the signals are connected or disconnected to the summing circuits, selected instruments and the external connectors.

Figure 11. **Example Environment Screen**



Choosing Instruments from the Environment

The instrument or instruments that you desire to use for a particular test can be chosen using two different methods:

- Use Instrument menu to choose from a list of instruments.
- Use Environment screen to doubleclick on an instrument icon.

Double clicking will also cycle the power to that instrument. This will not damage the instrument but may disrupt any testing that may be going on.

If you choose from the Environment menu list, the instrument is displayed on the computer screen. If you choose from the Environment screen, the instrument is displayed by double-clicking on the icon representing the desired instrument. Again, the instrument will be displayed on the computer screen. Using either method, the displayed instrument can be moved to any location on the computer screen. This instrument display contains all of the controls necessary for its operation and the typical display for that instrument. When an instrument is displayed on the computer screen, turning the instrument on changes the instrument color from grey to yellow.

NOTE

Instruments shown on the environment that are provided by the installed Smart Module are identified by their icon's cyan (light blue) color.

Optional Instruments

Some instruments in the CyberTest Analyzer are optional and may not be installed in your system. Check the Configuration Matrix in the Introduction section of this manual to see which instruments are included with your particular model number. If an optional instrument is not installed, its icon will still be seen in the environment screen and it will be listed in the "instrument" pull-down menu. However, if you attempt to select the instrument, an error message will display.

Signal Paths and Connections

The signal path lines on the Environment screen are color coded grey, blue or yellow to represent three states.

- Grey lines represent unused or disconnected signal paths.
- Blue lines represent potential signal paths.
- Yellow lines represent paths where is signal is actually flowing.

By default when the Environment screen is first opened, most of these signal path lines are grey. When an instrument is selected and turned on, the signal path line can turn either blue or yellow. These lines change state with the activation of an instrument and the connections chosen for that instrument.

Connections are made and broken through the use of the switch points on the Environment screen represented by the small circles. The Environment screen (Figure 8) shows some connections are hardwired into the system or are default connections and the appropriate signal paths are already coded in a blue color. Additional connections are made as needed by the tests being performed.

Path and Connection Example

EXAMPLE

To connect the AF Generator 1 to the top summing circuit that is connected to the AF Gen Output connector, click on the switch point at the end of the signal path from the AF Generator 1 to the bottom of the top summing circuit.

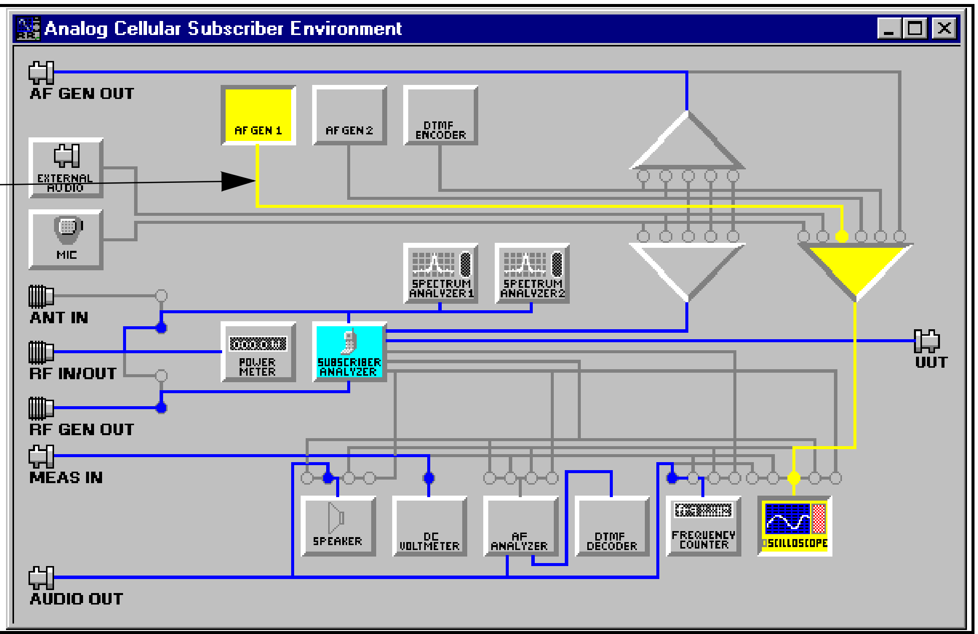
When you click on this switch point the signal path turns blue all the way from the AF Generator 1 through the summing circuit to the AF Gen Output connector.

Alternatively, you could connect the AF Generator 1 through the right hand summing circuit to the oscilloscope located in the lower right hand corner of the Environment screen. Again the appropriate signal path lines turn blue.

Assuming the connection from the AF Gen 1 is made to the oscilloscope as mentioned above, by clicking once on the AF Gen1 icon, you turn this generator on and the signal starts flowing to the summing circuit. This is indicated by the signal path from the AF Gen 1 to the summing circuit turning yellow in color. If you click once on the oscilloscope, that instrument is turned on and the signal flows all the way from the AF Gen 1 to the oscilloscope and the signal path turns yellow the rest of the way. To display these instruments, you can select them from the Instruments menu or double-click on their icons on the environment screen. Figure 12 shows this completed path in the Environment screen.

Figure 12. **Completed Path from AF Gen1 to Oscilloscope**

Completed path from AF Gen to Oscilloscope



By use of the built-in signal paths, the summing circuits, the switch points, and the various instruments, you can set up a very comprehensive testing environment.

Saving a Test Environment

Once you set up a test environment that you want to use again, you can save this environment to disk using the File menu Save command in the CyberTAME main window. The environment can be named so that it can be easily retrieved. The saved environment saves:

- Displayed Instruments.
- Connections in the Environment screen.
- Individual instrument settings for all of the set up instruments.

Switching between Test Environments

If you are currently operating in a selected environment and need to use an instrument in a different environment, you can switch to that environment and maintain the current analyzer setting that you have set up. This is accomplished by selecting the New command from the File menu and selecting the environment desired. Before clicking on the OK button, make sure that the “Use Current

Settings" checkbox is selected. This will maintain the present configuration and settings while opening the new environment.

Summing Circuits and Controls

The summing circuits shown on the Environment screen allow you to combine audio frequency signals and route the resulting signal to instruments or connectors of your choice. By using the switch points, you can combine multiple signals to create unique waveforms.

Summing and Routing AF Generators Example

EXAMPLE

To select and turn on both AF Generators, connecting both to the summing circuit and then route the combined signal out to the AF Gen Output port, accomplish the following:

1. Click once on both AF Generators

2. Click on both switch points below the top summing circuit on the lines coming from the AF Generators

The alternative method to accomplish this action is to use the AF Gen Sum command listed in the Instrument menu.

Summing Circuit Controls

The Instrument menu lists three summing circuit commands when the Analog Smart Module is chosen, and two summing circuit commands when the CDMA or Paging Smart Module is chosen. An example of these commands are:

- AF Anlyzr Sum.
- AF Gen Sum.
- SM Sum in the Analog Smart Module.

The Summing Circuit Controls are shown in Figure 13.

Figure 13. **Summing Circuit Controls**

The Summing Circuit Control windows contain a series of check boxes and labels. The window's labels describe the signal source for the summing circuit. Clicking once on the label or the check box places an X in that check box and connects the listed signal source to that summing circuit. This accomplishes that same action as clicking on the appropriate switch point going into that summing circuit.

Summing Circuit Hardware Constraints

The audio frequency summing circuits in the CyberTest analyzer are capable of a total maximum output voltage of 10 volts peak (20 V pk-pk). If the output voltages from the various sources you are summing together total more than 10 volts peak, signal clipping will occur.

Routing Example

The summing circuits are labeled by where the signal output is routed.

EXAMPLE

For example, the AF Gen summing circuit routes its signal to the AF Gen Output connector. Thus the summing circuit is controlled by the AF Gen Sum window. The AF Anlyzr Sum window controls the summing circuit that sends its output to the analyzer instruments. The SM Sum window controls the summing circuit that sends its output to the instrumentation contained in the Smart Module.

Working with Instruments in CyberTest

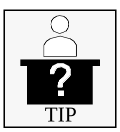
Introduction

The CyberTest analyzer platform contains a number of instruments (virtual instruments). These instruments each perform different functions, yet they share some common characteristics. This section discusses those common items. The operation of the individual instruments is discussed in the next section.

On/Off Button

In the lower right-hand corner of each instrument window is a button labelled “On” (or “Off”). Clicking on this button with the mouse will turn the instrument on. Clicking on it again will turn it off. The color ring around the button changes to green when the instrument is on and becomes red when the instrument is off.

When the instrument is off, you can make changes to any of the control fields. The changes become effective when the unit is switched on. Measurement displays are disabled when the instrument if off and the PC will not request the measurement data from the analyzer.



If you have several instruments open on your PC screen, yet are only working with one or two, you can speed up the response rate of these instruments by turning the others off with their respective Off buttons.

Tuning

RF instruments can be tuned in two ways - either by manually entering the frequency or by entering channel numbers from predefined channel plans (Figure 14).

Manual Tuning

Figure 14. **Tuning Controls - Manual**

You can move the mouse to the freq/channel box and double-click on the frequency to highlight the entire entry. Then type in the new frequency. When you press the Enter key, the new frequency becomes active.

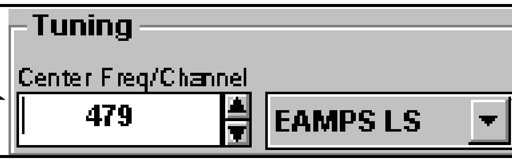
You can scroll frequencies by highlighting one digit and then clicking on the up or down arrows.

The units selection box allows you to choose between the various frequency units (Hz, KHz, MHz, or GHz).

Channel Plans

Figure 15. **Tuning Controls - Channel Plans**

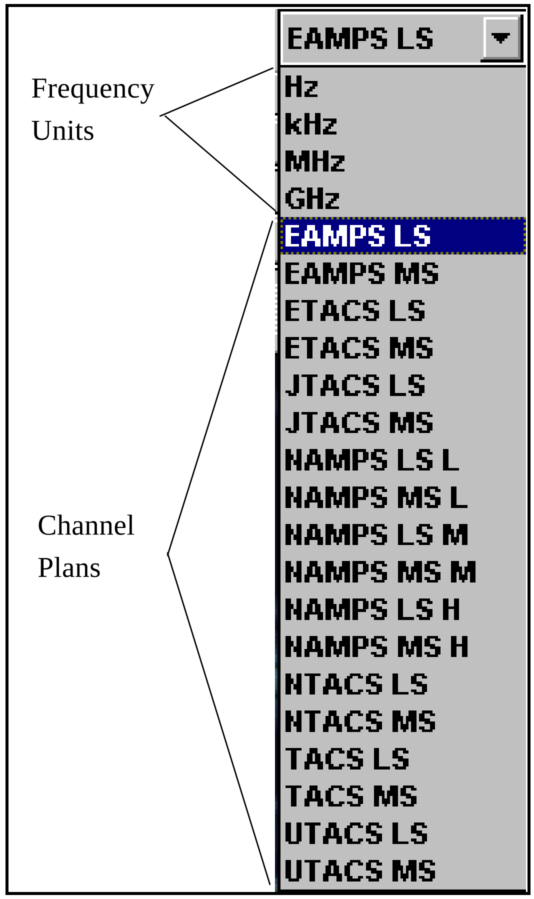
Manual Tuning



Units Selection

Tuning RF instruments with channel plans (Figure 15) is very similar to manual frequency tuning. First click on the down arrow of the Units Selection box. In the selection list that appears, you will see both frequency units and channel plans as shown in Figure 16.

Figure 16. **Units Drop-down Box Selections**



Select one of the channel plans. Then enter the channel number in the frequency/channel selection box. You can scroll through channel numbers by highlighting a digit and clicking on the up or down arrows.

The available Cellular band Channel Plans are shown in the following table.

Channel Plan Name	Description
EAMPS LS	Extended AMPS Land Station Channels (1-799, 991-1023)
EAMPS MS	Extended AMPS Mobile Station Channels (1-799, 991-1023)
ETACS LS	Extended TACS Land Station Channels (1-600, 1329-2047)
ETACS MS	Extended TACS Mobile Station Channels (1-600, 1329-2047)

Channel Plan Name	Description
JTACS LS	Japanese TACS Land Station Channels (2-798, even only)
JTACS MS	Japanese TACS Mobile Station Channels (2-798, even only)
NAMPS LS L	Narrowband AMPS Land Station Channels (1-799, 991-1023) - Lower Channel
NAMPS MS L	Narrowband AMPS Mobile Station Channels (1-799, 991-1023) - Lower Channel
NAMPS LS M	Narrowband AMPS Land Station Channels (1-799, 991-1023) - Middle Channel
NAMPS MS M	Narrowband AMPS Mobile Station Channels (1-799, 991-1023) - Middle Channel
NAMPS LS H	Narrowband AMPS Land Station Channels (1-799, 991-1023) - Upper Channel
NAMPS MS H	Narrowband AMPS Mobile Station Channels (1-799,991-1023) - Upper Channel
NTACS LS	Narrowband Japanese TACS Land Station Channels (1-799, 801-2160)
NTACS MS	Narrowband Japanese TACS Mobile Station Channels (1-799, 801-2160)
UTACS LS	Universal TACS Land Station Channels (1-600, 1649-2047)
UTACS MS	Universal TACS Mobile Station Channels (1-600, 1649-2047)

NOTE

The name "Land Station" refers to a cellular base station and the name "Subscriber Unit" refers to a cellular phone. If you accidentally select a mobile station channel when testing a base station (or vice versa), the transmit and receive frequencies will be reversed.

Input Selections

Most of the CyberTest instruments have input selections which allow you to connect the instrument to various signal sources within the analyzer. Selections are made by clicking on the “input selection” drop-down box and pointing at the desired input with the mouse.

If you use the Environment Screen to establish connections to instruments, when the instrument is opened, you will see the choice you made reflected in the input selection drop-down box.

Common instruments are not re-defined when used in the different testing environments. This means that each common instrument has a standard set of input selections to choose between even though some of those choices may not be used in the present environment. The Environment Screen is your guide for the presently available instrument connections.

EXAMPLE

The baseband measurement instruments in the analyzer (AF Analyzer, DVM, Frequency Counter, and Oscilloscope) have input selections for signal paths to the currently active Smart Module (labeled SM Audio 1 and SM Audio 2). When a test environment is being used with the AMPS/TACS Smart Module (Manual Analog Cellular Environment - for example), both the SM Audio 1 and SM Audio 2 input connections have valid signals present. However, if you switch to a CDMA Infrastructure environment, those lines are not used because there is no audio on the CDMA Smart Module. The instrument controls will still allow you to select those input connections but there will be no signal present.

Instrument Display Options

All of the CyberTest instruments provide digital readouts of various metered displays. You have the option to change any of these digital displays to an analog meter system. You also have the option to establish meter ranges, set upper and lower measurement limits, turn on averaging for the display and to establish a reference value for the display. To access these options, click on the Meas... or Meas Setup... button on the instrument control screen. The following instruments have the Meas... button:

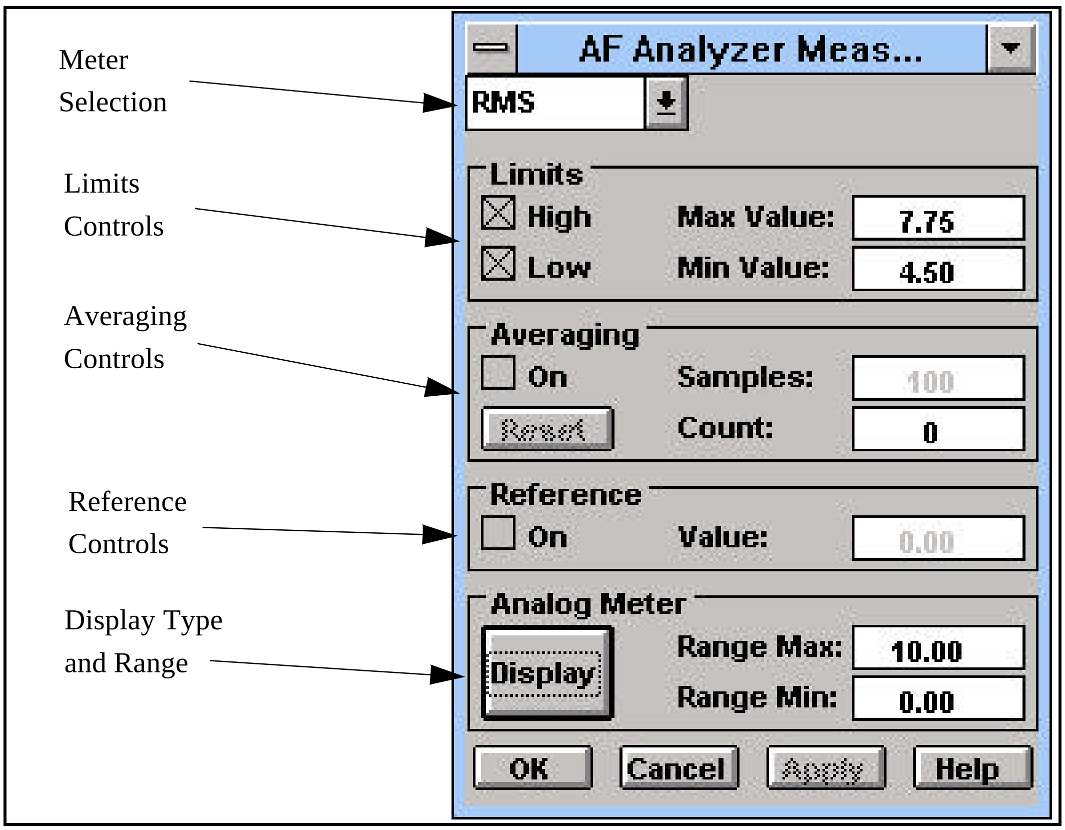
- AF Analyzer
- DC Voltmeter
- Frequency Counter
- Oscilloscope

- Power Meter
- Spectrum Analyzers

Measurement Setup

When the Meas... button is clicked on any one of these instruments, the Measurement Setup Window appears. The Measurement Setup Window is identical for all instruments except for the Title Bar that Lists the Instrument that you are controlling. This window is shown in Figure 17.

Figure 17. **Measurement Setup Window**



Measurement Setup Controls

The Measurement Setup window contains five distinct areas as shown in Figure 17. These are:

- Meter Selection drop-down box to select the particular meter to setup.
- Limits area used to set upper and lower limits desired for the test.

- Averaging area (turned on by clicking in the “On” box with the mouse) provides a rolling average value over a specified number of samples as well as a Reset control button to restart the averaging process. To return to normal display operation, click again in the “On” box to remove the X.
- Reference area provides an indication on the analog display of the desired reference value to measure against.
- Display and Range area provides the choice of an analog display with the upper and lower limits set for the meter.

After entering measurement controls such as high and low limits, averaging or reference levels, you must click on the “Apply” button to make the changes you have entered become effective.

Digital Measurement Displays

Values entered in the Limits, Averaging, Reference, or Range text boxes are reflected in both the digital and analog displays. The digital displays on the instrument are affected by the settings make in the Measurement Setup Controls. The effects are shown in the following table:

DIGITAL DISPLAY COLORS		
NUMBER	**BACKGROUND**	**WHAT’S BEING DISPLAYED**
cyan (lt. blue)	black	normal raw measurement results
dashes (---)	black	message that no input is present or too low to measure
green	black	averaged measurement
cyan	light red	measurement results beyond programmed limits
green	light red	averaged measurement results beyond programmed limits
cyan	dark red	measured results beyond specified range of instrument
cyan	yellow	unable to make valid measurements

When the reading is relative (using a reference number) the display is adjusted by the value of the reference number. For example, by setting the reference to 2 volts, a reading of 7 volts would appear with a 5 volt input.

If the "Display" button is pressed, the Analog Meter Display appears.

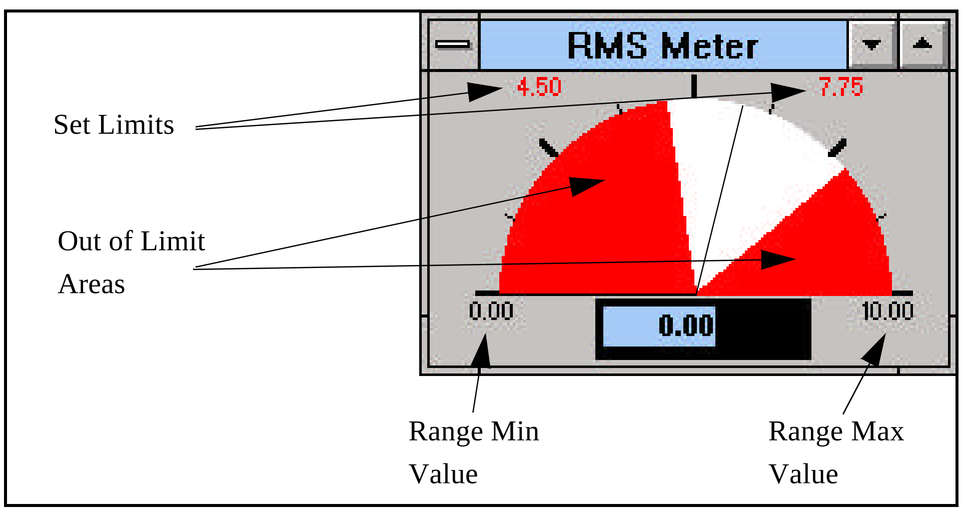
Analog Display

The Analog display has the following characteristics:

- Areas below the Min Value set in the Limits area or above the Max Value set in the Limits area are color coded in red.
- The numeric values for these max and min limits are displayed digitally above the meter needle swing region.
- Limits can be changed directly on the Analog meter display by dragging the edge of the limits area with the mouse.

The selected Analog Meter Display is shown in Figure 18.

Figure 18. **Analog Meter Display**



Instrument Interaction

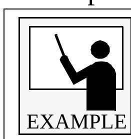
When using the CyberTest system, it is important to understand the concept of virtual instrumentation. The hardware architecture of the Analyzer unit was briefly described earlier. The Analyzer firmware manipulates that common hardware to provide a series of virtual instruments. It is via these virtual instruments that the user interfaces with the CyberTest system (locally or via the IEEE-488 remote port).

The virtual instruments appear to be completely separate entities when viewed on the CyberTAME environment screens or when described in this manual. They each show input and output port connections. Those that involve tuning have their own tuning controls. It is important to remember that there is physically only one set of unit connection ports and one set of radio frequency and measurement hardware circuits inside the CyberTest analyzer unit. The multiple independent instrument capabilities of the system are provided by the software performing rapid switching and hardware reconfiguration “behind the scenes”. In most cases this software multiplexing of the common hardware is done without any effects to the user. However, it is possible that configuration changes made to one instrument will affect others in that same environment. The instruments have been arranged in the various environments and the software is designed to minimize these issues. Keep in mind that THESE ARE OPERATIONAL ISSUES AND DO NOT AFFECT THE ACCURACY OF ANY NUMERICAL TEST RESULTS. These types of instrument interactions will be described in more specific detail in the individual test environment sections located in the various Smart Module chapters of this manual.

There are essentially three different categories of CyberTAME instrument interactions:

1. Dependent Instruments - Changing something on one instrument (which obviously shares that attribute with another instrument) causes changes in the second instrument. This type of interaction is the most obvious and is relatively easy to understand.

Example #1



The Spectrum Analyzer instrument has been tuned to a particular center frequency. The user then tunes the Analog Cellular Subscriber Analyzer instrument to a different frequency. Since there is physically only one RF Downconverter circuit in the unit, tuning the Analog Cellular Subscriber Analyzer instrument will cause the center frequency of the Spectrum Analyzer to change as well.

Example #2

EXAMPLE

When you set the measurement input port to have an impedance of 600 Ohms on the Oscilloscope instrument, this affects voltage readings on the AF Analyzer when it is connected to the Measurement Input port.

2. Independent Instruments - Some instruments are independent from one another even though they share common hardware. The software multiplexes the hardware to make the instruments appear to be independent. This type of interaction is also straightforward like the first category mentioned above.

Example #3

EXAMPLE

You are monitoring a particular paging carrier signal. You have tuned the receiver instrument to the center frequency and have the detected audio routed over to the oscilloscope and speaker for observation. You also have Spectrum Analyzer #1 turned on and are observing the carrier signal's spectrum. At this point, you turn on Spectrum Analyzer #2 and tune it to a different frequency in order to observe something else. Since there is only one set of RF receiver hardware in the unit, the software begins to quickly retune back and forth between the original frequency on the 1st Spectrum Analyzer and the new one on the 2cnd Spectrum Analyzer. The retuning is not noticeable on the Spectrum Analyzer displays, but you will see the detected signal that you had been watching on the oscilloscope begin to show bursts and the audio on the speaker will begin pulsing due to the re-tuning that is occurring.

3. Background Processing - This is when the software uses attributes from one instrument to make measurements and display the results in another instrument. In this case, the interaction between instruments is not obvious and is likely unexpected by the operator. The fact that the instrument which uses background processing is open causes the interactions to happen.

Example #4

EXAMPLE

The Manual Analog Cellular Analyzer instrument makes its deviation measurement on the AF Analyzer in the background. It switches the AF Analyzer to SmAud 2, makes the voltage measurement and then switches it back without the GUI reflecting this. Depending on the way you have the signals routed and the instruments open, you may be able to see side-effects of this switching.

Keeping the Analyzer and CyberTAME GUI Synchronized

When using the CyberTAME graphical user interface (GUI) PC program to control the CyberTest analyzer, it is important that the two maintain synchronization. The GUI program and the analyzer communicate through a data link that guarantees the delivery of messages between the two. The PC does not routinely query the status of the analyzer - it knows what commands it has already sent and is sure that they were received by the analyzer. Having the PC regularly ask the analyzer what its present settings are would add a lot of traffic to the data link and slow down the measurement updates on the display. In normal use, the GUI and the analyzer will remain synchronized. However, it is possible for the PC and the analyzer to get out of synch with each other when:

- The analyzer power is cycled off and on, causing it to re-boot with its default settings.
- Communication is lost between the PC and analyzer due to a loose cable or other anomaly.

If during you testing, the data link between the analyzer and PC is interrupted, you must re-establish synchronization by either completely re-starting the CyberTAME program or by simply re-loading the present environment.

A simple procedure to re-establish synchronization without having to re-enter all of the current settings is as follows:

1. With the mouse, go to the File pulldown menu in the CyberTAME title bar and select Save AS.
2. Choose a name for your present setup and click on OK or press the Enter key.
3. Still in the File pulldown menu, select Open.
4. Choose the name of the file you just saved and click on OK or press Enter. This action will cause the CyberTAME program to send all of the configuration data to the analyzer and will re-establish synchronization.

CyberTAME Special Warning Screens

The CyberTAME GUI shows special warning screens when the system senses conditions that need immediate attention by the operator. The following screens can appear depending on the condition encountered:

- RF Overtemp - When the system exceeds the operating limits of temperature, this warning screen appears to warn the operator to shut down the system for cooling or to restrict input power from the items under test.
- Measurement Input Port Overload - This screen appears when too much input power is applied to the Measurement Input Port. This warns the operator to change the input impedance to correct the overload.
- External Reference Unlock - Warns the operator that the CyberTest system is no longer synchronized with the external reference.
- Calibration Required - This screen warns the operator of an internal temperature change that could affect the measurement accuracy and that recalibration of the system should be run. (See the Calibration Discussion)

Calibration Discussion

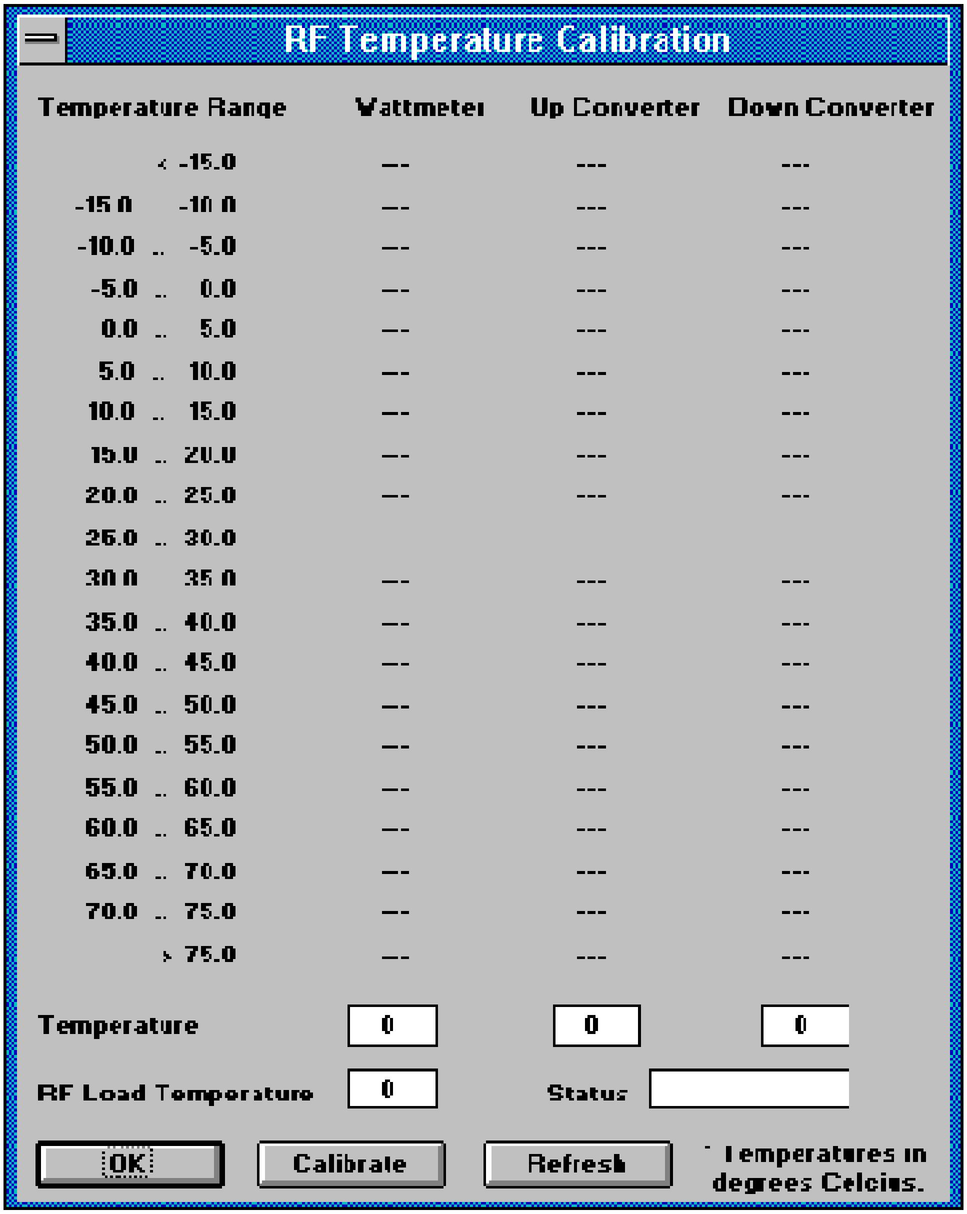
What Calibration Factors are:

In order to meet its stated accuracies across the specified range of operating temperatures, the CyberTest Analyzer platform uses a series of calibration factors that compensate for changes in the hardware performance. Calibration factors are used to compensate the following measurements/instruments.

1. Wattmeter power measurement accuracy
2. Signal Generator output level accuracy
3. Spectrum Analyzer accuracy

Only these three functions are affected by the calibration factors.

Figure 19. **Calibration Screen**



The Calibration Table

Figure 19 is a picture of the CyberTAME calibration screen which can be accessed under the "special" pulldown menu. It is important to note that these calibration factors are stored in the analyzer unit and not in the PC. The CyberTAME calibration screen is only a way for the user to see the temperatures for which the unit has been calibrated. For IEEE-488 remote operation where a local PC (and

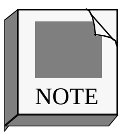
CyberTAME) is not used, the calibration factors are equally important. They are accessible via another method as described in the CyberTEST Remote Programmer's Reference Manual. The calibration table stored in the analyzer has entries in 5º C steps. ranging from -15º C to +75º C. The temperatures listed in the table are the actual temperatures of the various circuit assemblies inside the CyberTest analyzer and not the temperature of the external environment. The three columns in the table are for calibration factors for the Wattmeter, the Upconverter, and the Downconverter. The calibration values in the Upconverter column affect the absolute accuracy of the signal generator output levels of all of the CyberTest analyzer virtual instruments (including those on Smart Modules). The calibration factors in the Downconverter column affect the accuracy and performance of the Spectrum Analyzer and Tracking Generator instruments. As is obvious by the name, those calibration factors in the Wattmeter column affect the accuracy of the Power Meter RF power measurement. If valid calibration data exists for a particular spot in the calibration table, the word "yes" is displayed. Otherwise, "no" will be seen. Unless special arrangements were made with the factory, your unit was shipped with one valid calibration point which corresponds to room temperature.

On the calibration screen, there is a temperature display for each of the circuit assemblies. You will see in actual operation that the internal temperatures of the different circuits can be quite different from each other--particularly if high power RF measurements are being made.

How the Internal Calibration works:

In actual operation, the CyberTest analyzer firmware continuously monitors the three internal temperatures discussed above and uses the appropriate calibration factors from the stored table. To ensure that the CyberTest analyzer is operating per its stated accuracies, the calibration table must be filled with valid data ("yes" entries) for the actual operating temperatures. If there is no stored calibration data for that spot in the table, the analyzer firmware uses an algorithm to estimate what the factor should be based on how far away in temperature that spot is from one with valid data. This allows operation to continue, however the results may not be as accurate as specified. It should be noted that the calibration data is only used to make extremely fine adjustments to the CyberTest performance. If you are operating the unit at a temperature that does not have valid calibration data, the test results will not be grossly in error and may likely still be within the unit's published specifications.

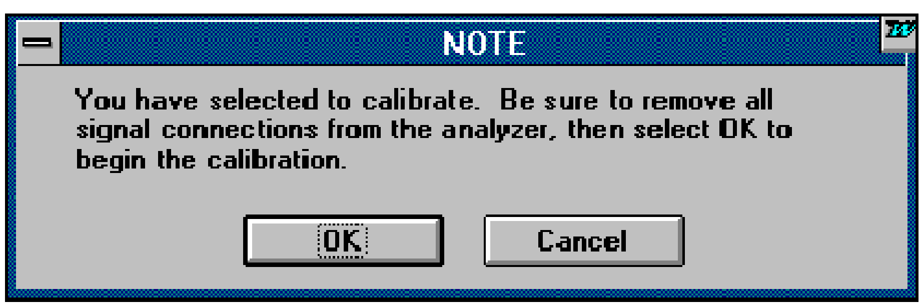
When the CyberTAME software detects that the analyzer's calibration table does not have valid entries for the internal temperatures of either the Wattmeter, the Upconverter, or the Downconverter, it displays a prompt giving you the opportunity to run the calibration routine for that particular temperature. If you do not wish to run the calibration routine, you can ignore the prompt and continue working. However, the resulting data will not be as accurate as it could be.



Note: when operating the analyzer remotely via the IEEE-488 interface, you will not automatically be notified that a calibration point is needed. There is a status bit which should be monitored by the controller code. This is not necessary if the calibration table is completely filled with valid data points.

Once the CyberTest analyzer has been calibrated at a particular temperature, that data is stored and you will not be prompted by the software to do it again. This is accomplished by simply clicking on the "calibrate" button on the calibration screen and following the instructions that appear as shown in Figure 20.

Figure 20. **Calibration Start**



WARNING

It is very important that all signal connections be removed from the analyzer before initiating the process or an improper calibration data point will be inserted in the table which can cause erroneous readings.

NOTE

The calibration process takes a few minutes. During that time, the analyzer will appear to be frozen. This is normal.

Calibration Considerations

When the CyberTest unit is first powered on after having sat for a few hours at a particular temperature (either hot or cold), the internal temperature will change rapidly for the first few minutes and will approach a stabilized value. This condition is exaggerated if the unit has been stored at an extreme temperature (e.g. left overnight in a vehicle in freezing conditions or in the trunk of a vehicle on a hot and sunny day in the Summer). As the unit is either warming up (or cooling down with the help of the fan), the internal temperatures can rapidly pass through the 5^{o} C steps of the calibration table--perhaps faster than the calibration routine can complete its operation. It is best to wait until the unit’s internal temperature has stabilized before performing the calibration routine. In this case, you would want to ignore the calibration prompts that are displayed when the unit is first powered up. Temperature stabilization should occur within 20 minutes of powering the unit on--provided that the ambient temperature that the unit is exposed to is not rapidly changing as well.

This completes the documentation of controls and windows that allow you to set up the desired test environment. The remainder of this chapter covers the individual instruments included in the analyzer and Smart Modules in the CyberTest package. How these instruments are used in your area depends on the equipment under test.

CyberTest Analyzer Instruments

Introduction

The instruments contained in the CyberTest platform are designed to provide basic testing capability. The Analyzer contains two series of instruments. These are:

- Instruments common to the basic platform.
- Specific instruments contained within the installed Smart Module.

This section covers the operation of the controls for all common instruments. The specific procedures to accomplish a particular test are left to the technician using the Analyzer. The Smart Module instruments will be covered in Tabbed sections specific to the particular Smart Module.

Common Instruments

The instruments which can be installed in the basic CyberTest Analyzer package include:

- Audio Frequency Analyzer
- Two Audio Frequency Generators
- DTMF Encoder
- DTMF Decoder
- DC Voltmeter
- Frequency counter
- Oscilloscope
- Power Meter
- Two Spectrum Analyzers
- External Audio Control
- Microphone Control
- Speaker Control
- Measurement Input Control

Whether or not they are available depends on the model number of the unit and if any options were purchased.

Smart Module Instruments

In addition to the basic instruments contained in the basic CyberTest platform, there is room to install two Smart Modules that provide additional instrumentation which is described in the Smart Module tabbed sections.

Common Analyzer Instruments

This section describes the operation of the common analyzer instruments. It covers these are the instruments that are common to all testing environments selected.

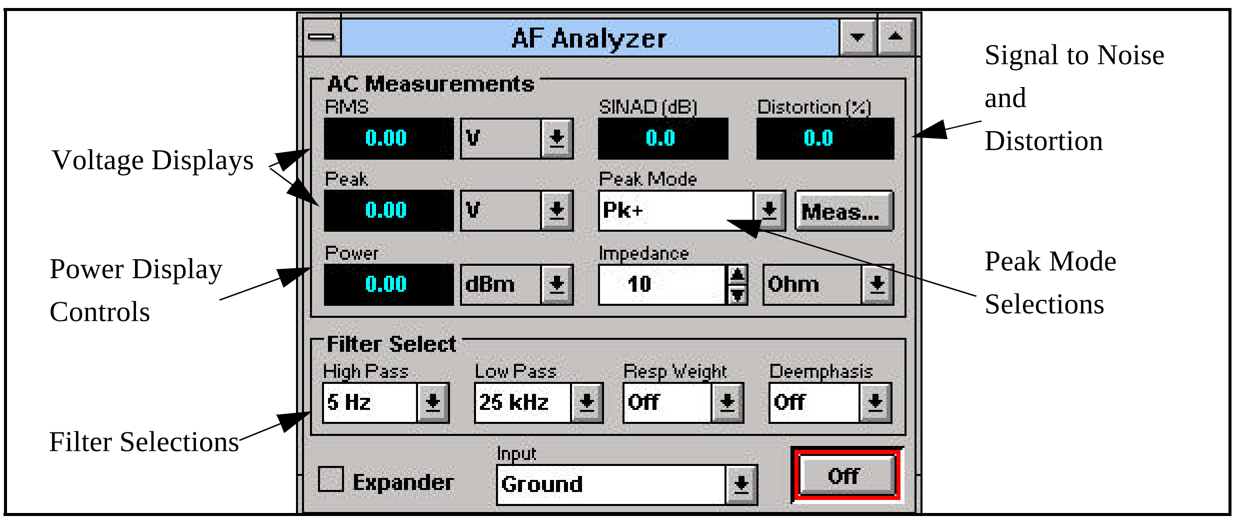
Audio Frequency Analyzer

The Audio Frequency Analyzer provides several Audio Frequency measurements simultaneously:

- AC voltage in rms
- Audio power
- SINAD
- Audio distortion in percent

This instrument also contains controls for various filters to enhance the tests being performed. The controls for the Audio Frequency Analyzer are shown in Figure 21.

Figure 21. **Audio Frequency Analyzer Controls**



Voltage Displays

The AC Measurements provides displays for:

- AC Voltage in RMS
- Peak Voltage by Mode selected
- AC Signal power

The units drop-down boxes provide a selection of:

- Volts

Audio Frequency Analyzer (Cont)

- Milli-Volts
- Micro-Volts

NOTE

The input impedance of the measurement input port is controlled by the input impedance selection on the oscilloscope instrument. It can be set to either 600 Ohms or 1 Meg Ohm. When the AF Analyzer instrument is connected to the measurement input port, the input impedance value — set in the oscilloscope instrument — will affect the voltage readings.

SINAD and Distortion

There are displays for SINAD and distortion levels The units are fixed at dB for the SINAD reading and percent for Distortion. You must use a 1 kHz tone for performing these measurements

Peak Mode Selection

Peak voltage measurement modes are selectable using the following choices in the Peak Mode drop-down box:

- Both positive and negative peak voltages.
- Maximum peak voltage.
- Average peak voltage.
- Selections to capture and hold one of these values.

Power Display Controls

The Power Display and Controls area contains:

- Power display with selections for dBm, Watts, or milli-Watts.
- Input impedance that can be set in values of Ohms or kOhms.

NOTE

Entries made in this area do not change the actual input impedance. They are only used as a factor to calculate AC power.

Filter Selections

Filter selections are made using four drop-down boxes that control the type and values of the input filters. These selections include the following:

- High Pass provides a selection of 5 Hz, 50 Hz, or 300 Hz filters.
- Low Pass provides a selection of 25kHz, 15kHz, 3kHz, or 300 Hz.

Audio Frequency Analyzer (Cont)

- Response Weight provides a selection of Cmessage, CCITT or none.
- Deemphasis is either off or provides a 750uS deemphasis filter.

Displays and Limits

These are accessed through the use of the Meas.. button.

Expander

The AF Analyzer has an expander which can be enabled by clicking on the Expander box. The expander is used for testing audio circuitry in wireless systems which use companding (compression on the transmitter and expanding on the receiver).

Inputs

Available inputs for the AF Analyzer are:

- Ground
- Measurement Input *
- SM Audio 1 **
- SM Audio 2 **
- AF Analyzer

* The input impedance of the Measurement Input port is chosen by the "input impedance" control on the Oscilloscope.

** These are dedicated hardware lines that connect to the active Smart Modules which may or may not be used.

Auto Zero

Every ten minutes, the AF Analyzer instrument undergoes an automatic zeroing routine where it switches its input to ground and makes a reading of "zero." The purpose of this is to ensure maximum measurement accuracy. This automatic function only takes less than 4 seconds to complete. While this auto zeroing routine is running, the AF Analyzer measurements will freeze at their present values and will not resume updating until the routine is complete. Any other instruments connected to the AF Analyzer will also be affected as well. (e.g., Oscilloscope, DTMF Decoder, Speaker, etc.)

Audio Frequency Generators

The CyberTest system contains two Audio Frequency Generators. They are essentially the same except that the second generator has higher output voltage capability. The output ranges are:

- 0-5 Volts peak for AF Gen 1 and 0-10 Volts peak for AF Gen 2
- 0-25,000 Hz in frequency

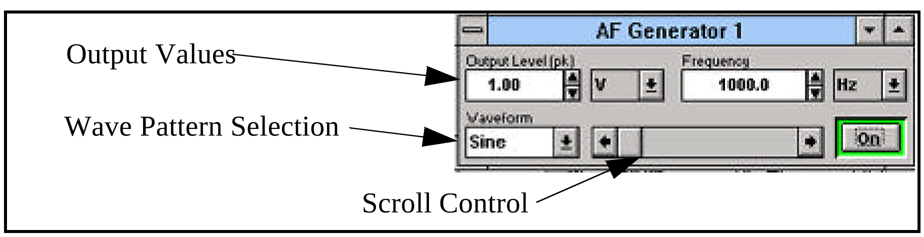
These generators develop waveforms in the Audio Frequency range and can send them to a variety of instruments or connectors depending on the settings on the environment screen. The output can be:

- Sine wave
- Square wave
- Ramp wave
- Pulse

AF Generator Controls

The controls for both of these generators are the same and one is shown in Figure 22.

Figure 22. **Audio Frequency Generator Controls**



Units Selection:

- Output Level - expressed in Peak Voltage
  - Volts
  - Milli-Volts
  - Micro-Volt
- Frequency
  - Hz

Audio Frequency Generators (Cont)

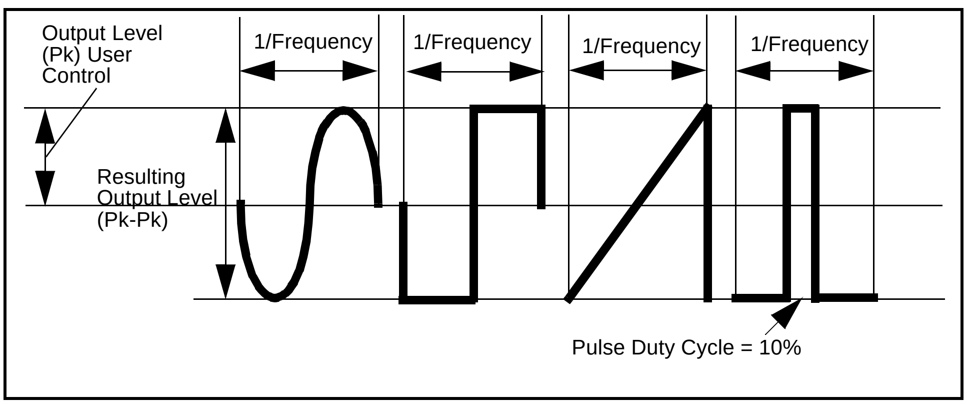
– kHz
– MHz
– GHz

The desired setting for Voltage or Frequency can be changed in any one of three ways:

1. Type in setting desired.
2. Use up and down arrows to right of setting text box to raise or lower displayed value.
3. Click in window and use scrolling control to raise or lower displayed value.

The AF Generator Waveform Types are shown in Figure 23.

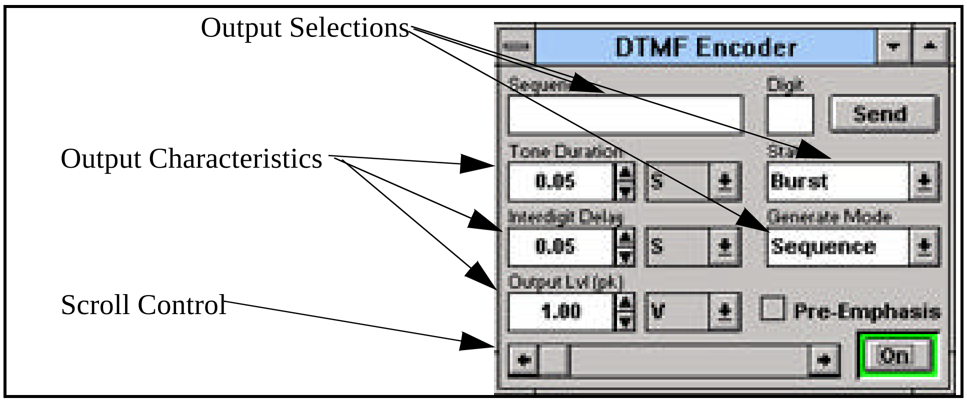
Figure 23. **AF Generator Waveform Types**



DTMF Encoder

Like the Audio Frequency Generators, the DTMF Encoder generates an audio signal. In this case it generates a combination of two tones out of a group of 8 used to transmit information. The output can be either a sequence of digits or a single digit. This output can be either continuous or sent as a single burst. The Output Level can vary between 0-5 Volts. In addition, controls are provided to set the Tone Duration and the Interdigit Delay to adjust for the tested system's particular requirements. The controls are shown in Figure 24.

Figure 24. **DTMF Encoder**



Output Selections

The Sequence box provides a place to type in a series of digits or letters to transmit. The alternative is to type in a single digit using the Digit box just to the right. Two other drop-down boxes in the Output Selections area control how the information is transmitted. These two boxes are:

- State - controls the transmission for either continuous or burst.
- Generate Mode - selects the information from the Sequence box or the Digit box.

DTMF Encoder(Cont)

Output Characteristics

Output Characteristics are set using the following controls:

- Setting Values
  - – Tone Duration - enter in seconds between 0.01 seconds and 9.99 seconds.
  - – Interdigit Delay - enter in seconds between 0.01 seconds and 9.99 seconds.
  - – Output Level - adjustable between 0 and 5 volts.
- Setting Units
  - – Time Units - set as seconds, milli-seconds, or micro-seconds.
  - – Output Level - set as volts, milli-volts, or micro-volts.

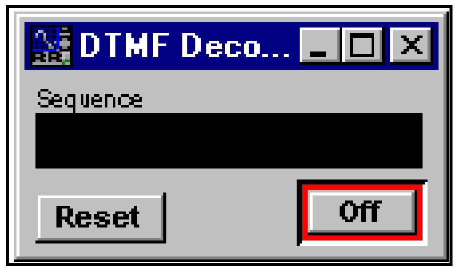
DTMF Encoder Operating Procedure

1. Enter a sequence of digits in the sequence box or a single digit in the Digit box.
2. Set the Output Characteristics.
3. Set the Encoder for Burst or Continuous.
4. Select the information entered from the Sequence or Digit source.
5. Click the **ON** button
6. Click the **Send** button to begin generating.

DTMF Decoder

The DTMF Decoder shown on the left in Figure 25 provides a direct readout of the DTMF signals received.

Figure 25. **DTMF Decoder Controls**

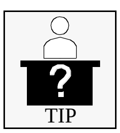


DTMF Decoder Operating Procedure

1. Turn the unit on by clicking the **ON** button.

2. Click the **ARM** button to begin the decoding process and display the digit sequence received.

3. Click the **RESET** button to clears the display for the next sequence.

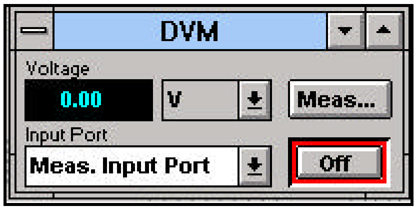


To properly decode DTMF digits, you must have an audio path established with a bandwidth of at least 300 Hz to 3 KHz. The filters which you select on the AF Analyzer will affect the DTMF Decoder instrument's performance and must be set appropriately.

DC Voltmeter

Shown in Figure 26 are the controls for the DC Voltmeter. This instrument displays the DC Voltage of selected inputs.

Figure 26. **DC Voltmeter Controls**



DVM Units

The display unit options are:

- Volts
- Milli-Volts
- Micro-Volts

DVM Connections

This meter can be connected to a variety of different sources. In addition to the connection options covered in the Environment section, the input can be selected from the Input Port box drop-down list of the DC Voltmeter window. If the Input selection is made on the control screen, it will show in the Environment screen. If the Input selection is made on the Environment screen, it will show here. The input selections are:

- Meas In *
- SM DC 1 **
- SM DC 2 **

* The input impedance of the measurement input port is chosen by the “Input Impedance” control on the Oscilloscope instrument.

** These are dedicated lines to the active Smart Modules which may or may not have signals present.

DC Voltmeter (Cont)

DVM Display Options

Measurement Ranges, Limits, Averaging, Reference values for the DC Voltmeter can be set. An analog display is also available through the use of the Meas... button.

NOTE

The input impedance of the measurement input port is controlled by the input impedance selection on the Oscilloscope instrument. It can be set to either 600 Ohms or 1 Meg Ohm. When the DVM instrument is connected to the measurement input port, the input impedance value — set in the Oscilloscope instrument — will affect the voltage readings.

DVM Operating Procedure

1. Select the Units desired with the drop-down box.
2. Select the input connection with the drop-down box.
3. If the measurement input port is being used as the input to the DVM, select the input impedance using the control on the Oscilloscope.
4. Set the Display options using the **Meas...** button.
5. Click the **ON** button.

Frequency Counter

The Frequency Counter shown in Figure 27 displays the Audio Frequency of baseband signals connected to it.

Unit Options

The display unit options are:

- Hz
- kHz
- MHz
- GHz

Frequency Counter Connections

This Frequency Counter can be connected to a variety of different sources. Connections are made using the Environment screen or using the drop-down list in the Input box of the Frequency Counter window. The available selections are:

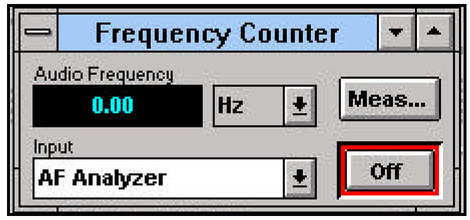
- AF Analyzer
- Meas In Port *
- AF Analyzer Summing Circuit
- SM Freq A - direct line to the active Smart Module **
- SM Freq B - direct line to the active Smart Module **

* The input impedance of the measurement input port is chosen by the “Input Impedance” control on the Oscilloscope instrument.

** These are dedicated lines to the active Smart Module which may or may not have signals present.

Frequency Counter (Cont)

Figure 27. **Frequency Counter Controls**



Frequency Counter Display Options

Measurement Ranges, Limits, Averaging, Reference values for the Frequency Counter is set by clicking on the Meas... button and entering the values for each. An analog display is also available through the use of this button.

Frequency Counter Operating Procedure

1. Select the Units desired with the drop-down box.
2. Select the input connection with the drop-down box.
3. If the measurement input port is being used as the input to the Frequency Counter, select the input impedance using the control on the Oscilloscope.
4. Set the Display options using the **Meas...** button.
5. Click the **ON** button.

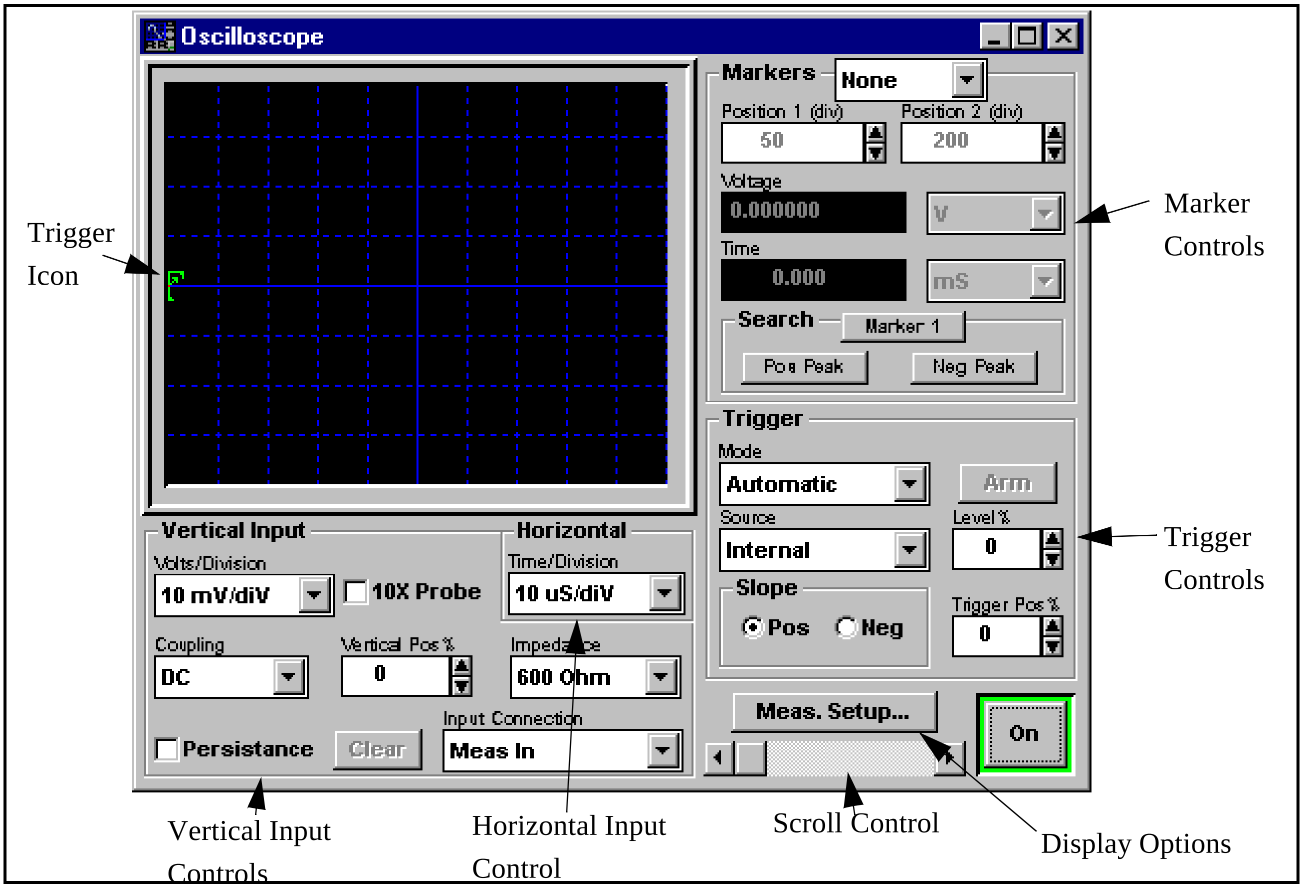
Oscilloscope

The oscilloscope provided is an audio frequency Digital Oscilloscope with these features:

- Selectable trigger control.
- Built-in markers.
- Persistence mode.

The vertical input scale is selectable from 10 milli-Volts per scope division to 10 volts per division depending on the input connection selected. The horizontal sweep scale is selectable from 10 micro-seconds per division to 1 second per division. The scope can be connected to a variety of points in the environment. Controls for the oscilloscope are shown in Figure 28.

Figure 28. **Oscilloscope Controls**



Oscilloscope (Cont)

Vertical Input Controls

The vertical controls include:

- Vertical scaling control labeled Volts/Division. This is a drop-down box with selected scale choices. The selections are discrete and range from 10 milli-Volts per division to 10 Volts per division when the oscilloscope is connected to the Meas In port. This range will vary with other input selections.
- Check box that when selected will give the proper input scale for a 10X Probe. The oscilloscope probe supplied with the unit is a 1:1 probe. When using this probe, do not click on the 10X selection.
- Coupling can be either AC or DC with the selection in a drop-down box labeled Coupling.
- Trace vertical positioning on the scope can be adjusted by using the Vertical Pos% box. This allows a -50% to +50% adjustment.
- Persistence mode is turned on by clicking on a check box.
  - Once you have enough traces displayed, you can use the Clear button to clear the screen for additional traces.

Input Impedance

The input impedance control allows you to select between 600 Ohms and 1 Meg Ohm terminations on the measurement input port. This control does not affect the input impedance on any of the other Oscilloscope inputs.

The selection mode for input impedance on the Oscilloscope also affects any other instrument connected to the measurement input port.

Horizontal Input Controls

The horizontal sweep is controlled by time per division. The selections in the drop-down box are discrete and range from 10 micro-seconds per division to 1 second per division.

Oscilloscope (Cont)

Connections

Connections to the oscilloscope can be made by use of the Input Connection drop-down box or on the Environment screen. These inputs include:

- Ground
- Measurement Input *
- SM Audio 1 **
- SM Audio 2 **
- AF Analyzer

* The input impedance of the measurement input port is chosen by the “input impedance” control on the Oscilloscope instrument.

** These are dedicated hardware lines that connect to the active Smart Module which may or may not be used.

Markers Controls

You can place two markers on the display screen. The controls for these are:

- The Markers drop-down box giving you a choice of no markers, Delta t markers, 1/Delta t markers, and Delta v markers.
- Once a marker set has been chosen, you can change the position of the markers on the screen by dragging them with the mouse, or by changing the settings in the Position 1 or Position 2 boxes.
- If the Delta v marker set is chosen, the Voltage readout is active.
- The time readout is active when the Delta t markers are chosen.
- Search controls search for and set the markers by using the buttons in the Search area. Choose the marker you want to set by clicking on the Marker button. It will change back and forth between 1 and 2. Then choose whether to search for a positive peak or a negative peak for that marker by clicking on the appropriate button.

Oscilloscope (Cont)

Trigger Controls

Oscilloscope Trigger controls include:

- Mode - selects Normal, Automatic, or Single by use of the drop-down box. If Single is chosen, click on the Arm button to start the sweep. The last trigger mode selection made prior to selecting the single mode will be the trigger mode used for the single sweep. For example, if you select automatic and then select single, when the Arm button is pushed, the scope will automatically trigger once. Similarly, if you select Normal and then select Single, when the Arm button is pushed, the scope will trigger once if the input exceeds the trigger level.
- Source - selects Internal, from SM Trigger A, or SM Trigger B.
- Slope - selects either positive or negative.
- Level and position can be controlled from -50% to +50% by using the Level and Trigger Pos boxes. They also can be controlled using the Trigger Icon on the display screen.

Scroll Control

The following controls on the oscilloscope are text boxes into which information can be typed:

- Marker Position 1
- Marker Position 2
- Vertical Position
- Level
- Trigger Position

The information in these boxes can also be changed using the Up and Down arrows on each box or by clicking in the specific box and using the Scroll Control.

Display Options

The Oscilloscope has two digital readouts of Voltage and Time for the markers. By using the Meas. Setup... button, the operator can set the following

Oscilloscope (Cont)

- ranges
- limits
- an analog display

Oscilloscope Operating Procedure

1. Select the Vertical Input scale, coupling, and impedance using the drop-down boxes.

2. Set the sweep vertical position.

3. Select the Horizontal sweep frequency using the Time/Division box.

4. Connect the Oscilloscope to the desired source using the Input Connection drop-down box.

5. Select the Trigger Mode using the Mode drop-down box.

6. Select the Trigger Source using the Source drop-down box.

7. Set the Trigger Level and Position using the Level and Trigger Position Text boxes.

8. Select the slope position for the Trigger using the Slope selection buttons.

9. Click the **ON** button to turn the Oscilloscope power on. If Trigger Mode was selected as *Single*, click the **Arm** button to start the sweep.

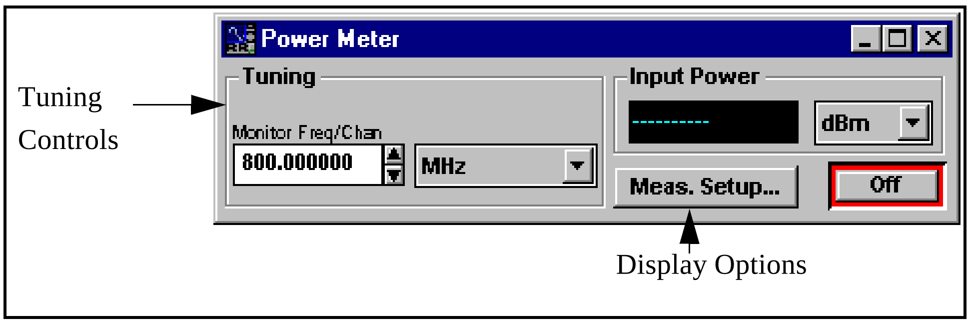
10. Set Markers as desired using the controls in the Markers area to set the number and type of markers wanted.

Power Meter

The CyberTest Power Meter provides for accurate RF power measurements. The unit contains a broadband, true-RMS power meter with a measurement accuracy of 5% or +/-0.2 dB. This Wattmeter allows you to accurately measure several RF carriers.

The Power Meter shown in Figure 29 gives a direct power readout for a selected frequency in dBm, Watts, or milli-Watts.

Figure 29. **Power Meter Controls**



Tuning Controls

The Power Meter uses two tuning controls:

- Freq/Chan Text box - frequencies can be directly entered or changed using the Up/Dn arrows.
- Unit Selection drop-down box - select Units or Cellular Preset channel.

The range of frequencies for the Power Meter are between 800 MHz to 1000 MHz or from 1700-2000MHz depending on the analyzer model.

NOTE

The Power Meter is not frequency selective. It will detect and display power from signals anywhere in the analyzer's operating frequency and regardless of the frequency or channel entered in the tuning control. The tuning controls are used to allow the unit to apply the proper calibration factor to the measurement in order to obtain maximum accuracy.

Power Meter (Cont)

Power Meter Connections

The Power Meter is permanently connected to the RF I/O port on the CyberTest Analyzer unit. It cannot be connected anywhere else. (e.g., the Antenna port)

Display and Option Controls

The input power is displayed on the Input Power digital display. The units for the display are selected using the drop-down box. Display ranges, limits, averaging parameters, and reference values can be set by clicking the Meas... button. This also provides for an analog display.

Power Meter Operating Procedure

1. Enter the test frequency or channel for maximum accuracy.
2. Set up the display options.
3. Click the **ON** button.
4. Connect the RF signal you wish to measure to the RF I/O port on the Analyzer.

TIP

If you want to be able to calibrate your test setup by entering the loss of the RF test cable and having the power meter subtract the effects of the cable loss on the measurement, use the Meas Setup button. When the measurement window appears, click in the "on" box in the "reference" area. Enter the cable loss factor as a negative number. (Example, a cable loss factor of 1.7 dB would be entered as -1.7 dB.)

NOTE

As the name implies, the Power Meter instrument is designed to measure the level of RF signals which have a significant amount of power. The high power version of the Power Meter can measure the power of signals between 0 dBm (1 mW) and +47 dBm (50 W). The low power version can measure signal powers ranging from -15 dBm (30 mW) to +36 dBm (4 W). To measure the level of signals that are smaller than this, use the Spectrum Analyzer instrument.

Spectrum Analyzers

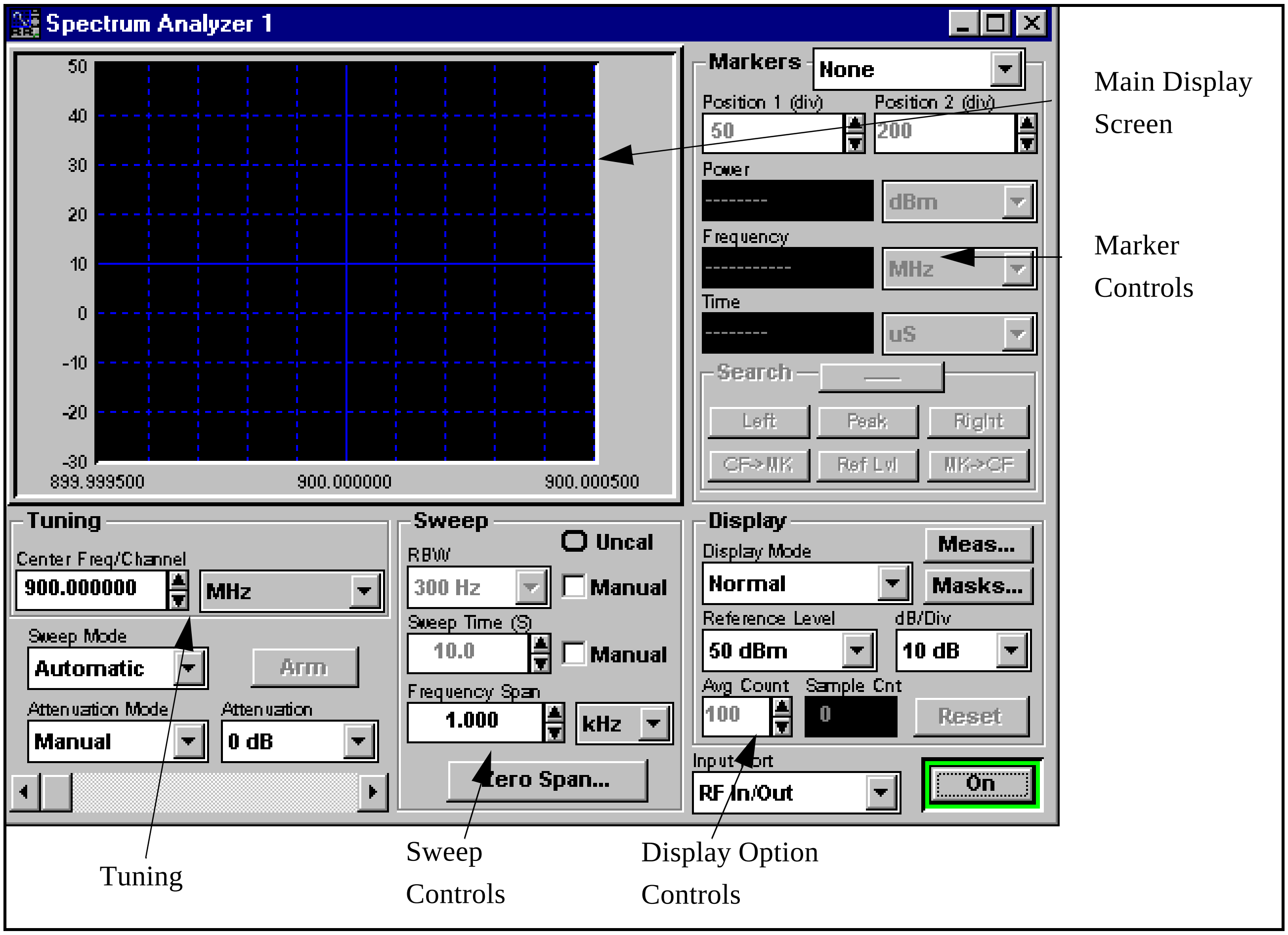
The CyberTest system contains up to two spectrum analyzers depending on the configuration of the unit. They can be tuned by entering a frequency or a channel number. The analyzers can be controlled separately allowing you to view two frequency ranges or channels simultaneously. The Main Display screen shows the power levels vertically and the frequency range horizontally. The screen features a full 80dB of display vertically that is selectable and scalable. Horizontally, the frequency spanning capability ranges from 1 kHz to the full frequency coverage of the analyzer. The controls for the spectrum analyzers are show in Figure 30.

Use of The Second Spectrum Analyzer

When properly equipped, the CyberTest Communications System Analyzer contains two Spectrum Analyzer Instruments. The two spectrum analyzers have identical controls and operate the same. They can be independently controlled which provides you with the ability to make powerful measurements like using one to look at a wide frequency span while using the other one to look close-in at a particular signal of interest. Spectrum Analyzer number 1 is tied to the frequency of the other receive instruments while spectrum analyzer number 2 can be tuned independently --not affecting other receive instruments.

Spectrum Analyzers (Cont)

Figure 30. **Spectrum Analyzer Controls**



Tuning Controls

The spectrum analyzer tuning controls consist of:

- Center Freq/Channel drop-down box - sets the Center Frequency in the range from 800-1000 MHz or from 1700-2000 MHz (depending on the analyzer).
- The units selection drop-down box - selects the Center Frequency units or Cellular preset channel.
- Sweep Mode drop-down box - selects either Automatic or Single. If the Single mode is chosen, click on the Arm button to start the sweep.
- Attenuation drop-down box - selects attenuation settings in 10 dB increments from 0 to 50 dB.

Spectrum Analyzers (Cont)

Sweep Controls

Spectrum Analyzer sweep controls include:

- Sweep RBW -selected as automatic or manual. If the Manual check box is selected, RBW setting of 300 Hz, 1 kHz, 3 kHz, 30 kHz, or 300 kHz are selectable in the RBW drop-down box.
- Sweep Time - selected as automatic or manual. If the Manual check box is selected, Sweep Time can be set from 0.2 seconds to 10 seconds.
- Frequency Span - settable from 1 kHz to the full RF band coverage of the analyzer. The range set will be shown on the bottom of the Main Display screen along with the center frequency that is set.
- Clicking on the Zero Span button runs the analyzer as a graphical time-swept power meter. (This is a future capability not presently available)

Control Relationships

The Spectrum Analyzer instrument has controls which allow you to select the sweep time, the frequency span and the resolution bandwidth. You can either set each of these controls individually or set one and let the unit automatically adjust the other two. In order for the Spectrum Analyzer to maintain its accuracy, it must be set to sweep across the selected frequency span slow enough to allow the resolution bandwidth filter to properly pass the signal. Selecting a narrower resolution bandwidth has the effect of lowering the noise floor on the display. However, using narrower resolution bandwidths requires slower sweep times. If you select an improper combination of the three settings which will result in inaccurate results (e.g. sweeping too fast for a given resolution bandwidth), the unit will notify you by illuminating the “uncal” indicator on the Spectrum Analyzer display.

Display Controls

The display controls consist of:

Spectrum Analyzers (Cont)

- Display Mode - selectable for Normal, Freeze, Max. Hold, Peak Hold, or Average modes. When the average mode is chosen, the Avg Count box is activated for settings ranging from 1-999.
- Sample Count window - displays the samples up to the number set in the Avg. Count box.
- Reset button - used to start the counting process over.
- Reference Level and dB/Div controls - sets the vertical scale displayed on the display screen. Reference Level is selectable in 10 dBm increments from -60dBm to +50dBm. The vertical scale is set at either 2 dB or 10 dB per division.
- Meas... button - the Power meter, the Frequency meter, or the Time meter in the Marker control area can have ranges, limits, reference values set using the Meas... button in the Display area. These meters can also be displayed as analog meters.

Marker Controls

The Spectrum Analyzer instrument offers a variety of marker and search function to allow you to make measurements easier.

- Marker Selection drop-down box - selects the type of marker displayed. Selections include a single marker, two markers for delta measurements or markers for Occupied Band Width.
- Marker search controls are provided to set marker position. These can also be set by dragging with the mouse.

Marker Modes

There are two markers which can be shown and moved on the display. The markers allow you to make a numerical measurement from the graphical Spectrum Analyzer trace. Wherever the marker is moved on the display, you can display the numerical value of the trace at that point. The following marker modes are available on the Spectrum Analyzer:

Spectrum Analyzers (Cont)

Marker 1

This gives you the absolute power level and frequency at the point of the trace that intersects Marker 1. Marker 1 is the marker shown as a solid line.

Marker 2

Similar to the above Marker 1 mode, the Marker 2 mode shows the power and frequency for Marker 2. Marker 2 is shown as a dashed line.

Marker Delta

This mode shows the differences between markers 1 and 2 for power and for frequency. The values shown in the numerical display under power and frequency are delta values.

Occupied Bandwidth

This mode displays the amount of power in the spectrum analyzer trace between the two markers. The value shown in the numerical power display is an absolute power value.

Search Functions

The various search functions work with the markers to make it easy to find and tune to signals of interest on the display.

Left

Pushing the Left button causes the selected marker (1 or 2) to move to the next signal peak to the left of the current position.

Peak

Pushing the Peak button causes the selected marker (1 or 2) to move to the highest peak on the spectrum analyzer display

Right

Pushing the Right button causes the selected marker (1 or 2) to move to the next signal peak to the right of the current position.

Spectrum Analyzers (Cont)

CF-> MK This button causes the spectrum analyzer to retune the center frequency to the frequency value of the selected marker. A quick way to tune to a particular frequency on the display is to move a marker to the desired location and then press this button.

Ref Lvl The Ref Lvl button causes the reference level setting to adjust to the next 10 dB multiple higher than the power reading in the numerical power display. For example, if the numerical power display is -5.26 dB and the current reference level setting is 20 dB, pressing the Ref Lvl button will change the reference level to 0 dB.

MK->CF Pushing this button moves the selected marker to the center frequency of the display.

How to Use the Spectrum Analyzer for Maximum Accuracy:

The Spectrum Analyzer instrument(s) in the CyberTest Analyzer offer you the type of flexibility and controls that are usually only found on laboratory spectrum analyzers. You have total control of the reference level, the input attenuation, the resolution bandwidth, sweep time and the frequency span. This gives you the ability to make complex measurements like transmitter intermodulation distortion (IM), spectral occupancy, etc., in the field. With all of this flexibility comes the responsibility for the user to ensure proper test setups so that inaccurate results do not occur. If too strong of a signal is applied to the Spectrum Analyzer for the selected input attenuation setting, the circuitry will become saturated. This will result in a lower power reading than the true value and the generation of IM products which will mask those that you may be trying to measure on the unit under test. Similarly, if too much input attenuation is selected for a given test signal, you will not experience the maximum measurement range of the unit and any IM products or interference you are looking for will be hidden under the noise floor of the display.

With that being said, there is an easy procedure to set the controls on the Spectrum Analyzer for optimum accuracy.

1. Select the desired RF measurement port on the CyberTest Analyzer unit. Select the ANT IN port for off-the-air or low power measurements. Select the RF I/O port for measuring signals from transmitting equipment or with RF power levels greater than -10 dBm.

2. Apply the signal.

3. Select the frequency span width you wish for the measurement.

4. For initial set-up, set the reference level to a value approximately 30 dB higher than the height of the trace on the display from the signal under test.

5. Add 10 dB of attenuation to the present value. Observe the height of the trace as you make the selection. You will see the noise floor of the display rise by 10 dB. The actual test signal may or may not rise. If it rises, even by a slight amount, the Spectrum Analyzer was in an overload condition. Continue to increase the attenuation value until the top of the Spectrum Analyzer trace no longer rises. If it does not rise, the unit was not in saturation and the extra 10 dB of attenuation is not required. For maximum measurement range, you want to have the least amount of attenuation required to keep the unit out of saturation. Additional attenuation will not degrade accuracy, but will reduce the measurement range.

6. After the input attenuation has been set as described above, readjust the reference level to move the top of the trace to the top of the display. Depending on the input level, you may not be able to move the trace right to the reference line. Set the reference level so that the trace is as close as possible to the top of the display without going above it.

7. With the attenuation and reference levels properly set, you now need to adjust the Resolution Bandwidth, the Sweep Time and the Frequency Span in order to move the noise floor low enough to satisfy the particular type of measurement you are making. For example, if you are measuring transmitter IM on a cellular base station, the noise level must be at least 62 dB lower than the top of the signal trace (in order to verify that the IM products are at least 60 dB down).

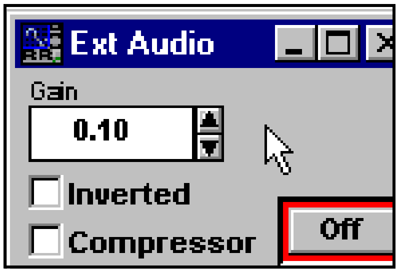
The basic Operating Procedures follow.

Spectrum Analyzer Operating Procedure

1. Set the Analyzer Center Frequency.
2. Select the Sweep Mode.
3. Select and Set the Attenuation Mode and values.
4. Set the Frequency Span.
5. If Manual Sweep control is desired, select the RBW values and Sweep Time values.
6. Select the Display Mode.
7. Set the Main Display scaling using the Reference Level controls and dB/ Div selector drop-down box.
8. Select the Input connection.
9. Click the **ON** button to start operation.
10. If Markers are needed, use the Marker controls to select Marker type and position. Set the Marker search controls as needed.

Ext Audio

Figure 31. **External Audio Control**



In figure 31 is the Ext Audio window. This window controls the gain of the audio signal that is coming into the analyzer through the External Audio connector. Gain can be adjusted by:

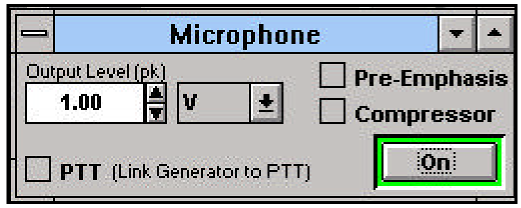
- Typing in the gain value directly in the text box.
- Clicking on the up or down arrows on the right end of the text box.

The displayed units for the gain are selected with the drop-down box. The units available are: Volts, milli-Volts, or micro-Volts. The signal can also be inverted by clicking on the inverted command or the small box next to it.

If you want to apply compression to the external audio signal, click on the Compressor box. For proper compressor operation, the external audio signal must have an amplitude of 1 volt peak.

Microphone Window (PTT)

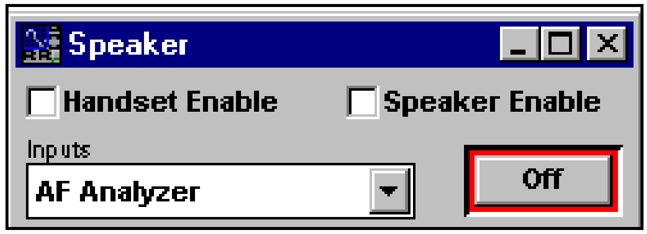
Figure 32. **Microphone Control**



The Microphone window shown in Figure 32 controls audio to the analyzer from the microphone. It also has a output level control and units selector. In addition, the signal can be modified with the selection of Pre-Emphasis, or the compressor. In both cases, before these controls are operational, you must click on the On button on the lower right corner of each window. If you are using a microphone or handset with a push-to-talk (PTT) button and wish to have the PTT automatically cause the signal generator instrument to transmit, click on the PTT box.

Speaker Control

Figure 33. **Speaker Controls**



The CyberTest Analyzer has a built-in speaker which is located on the left side of the unit towards the front. This speaker can be used for listening to various audio signals of interest (composite waveforms, demodulated audio from the AMPS/TACS Smart Module, etc.) The speaker control instrument as shown in Figure 33 allows you to connect the speaker to different signals within the analyzer and also lets you route audio to a handset which can be plugged into the accessory jack on the front of the unit.

Speaker Connections

The speaker can be connected to different audio signals in the analyzer by either using the Environment Screen or by using the drop-down list in the Input box of the speaker control window. The available selections are:

- AF Analyzer
- AF Analyzer Summer
- SM Audio 1 - direct line to the active Smart Module **
- SM Audio 2 - direct line to the active Smart Module **

** Depending on the Smart Module installed, there may or may not be signals present on these lines.

Speaker/ Handset Enable Selections

Clicking in one or both of these boxes enables the audio to route to the speaker and/or the handset (not supplied)