AMPS / TACS Smart Module

Operating Instructions

Chapter Introduction

This chapter covers the operating instruction and procedures for using the CyberTest AMPS/TACS Smart Module instruments. It is to be used in conjunction with the information contained in the section on CyberTest Platform operations and instruments. The areas that will be covered are:

- Basic instrument descriptions
- Selecting a test environment
- Making the connections required for testing
- Selecting instruments
- Selecting display methods
- Setting testing parameters

These instructions cover the basic operation of each instrument built into the CyberTest system. 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 Connections

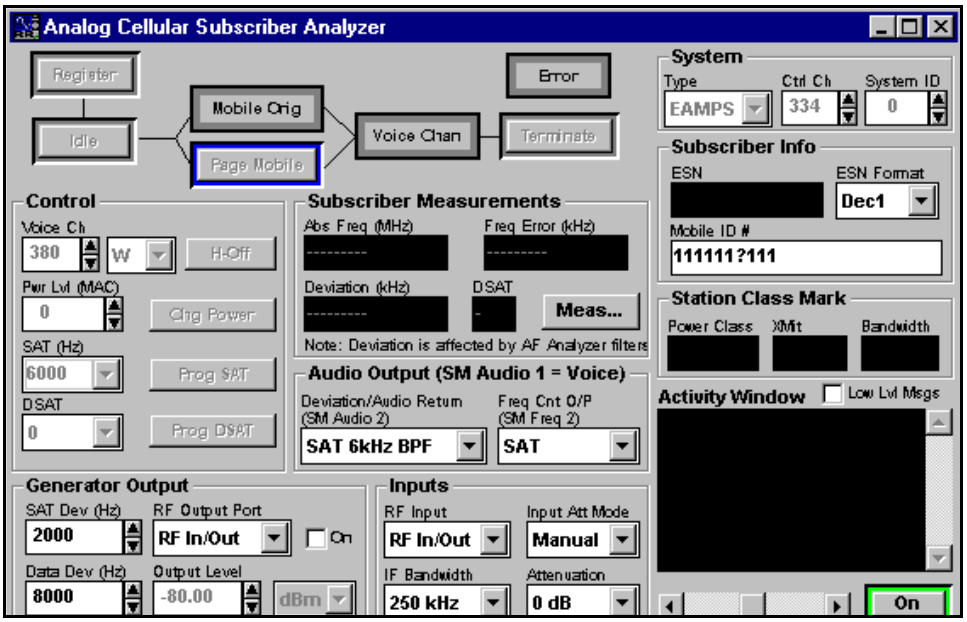
Connections made directly to the Smart Module are through a cable directly to the Unit Under Test (UUT). The number and type of connections on the Smart Module depends on the particular module installed.

Analog Smart Module Instrument Descriptions

Analog Cellular Subscriber Analyzer

The Analog Cellular Subscriber Analyzer instrument (Figure 1) within the CyberTAME software environment allows you to perform testing of AMPS and TACS (and their variations) cellular telephones. This CyberTAME instrument is useful for repair and alignment duties as it allows you to place the unit under test into particular call processing states without accessing special test modes in the telephone. Once the phone is in a particular state, you can use this and other CyberTAME instruments to make measurements such as power, carrier frequency, frequency error, SAT frequencies and deviation, DSAT code, etc. The instrument displays all of the pertinent call processing data from the phone as well as parametric measurements.

Figure 1. **Analog Cellular Subscriber Analyzer Controls**



Click and Go State Diagram

A graphical display allows you to monitor the present state of the telephone as you command the telephone to take particular actions. The actions are commanded by simply pointing to the appropriate box and clicking the mouse. When this

happens, the CyberTest unit takes the appropriate cellular steps necessary to perform the selected action. The CyberTest analyzes checksum verified messages back from the phone to ensure that the phone is responding correctly. As the phone progresses through the diagram, the present state illuminates. An error state illuminates when a fatal protocol error condition is encountered.

Activity Window

A convenient activity window displays pertinent call processing protocol status and information about the subscriber unit under test. Information about error conditions is also displayed. Display messages are listed in order of occurrence and can be scrolled through for review during or after a test.

Baseboard Routing and Filtering

A series of filters and return paths allow you to make a variety of audio frequency measurements. Individual bandpass filters allow you to single out SAT or ST signals for further analysis. You can also choose to look at the signaling and control data on both normal and narrowband (NAMPS/NTACS) cellular systems. Or, you can select no filtering and route the composite received signal over to the AF Analyzer instrument where another bank of selectable filters is available for testing to TIA standards. Multiple audio return paths allow you to run different signals to different places in the CyberTest platform. For example, while you have a phone on a voice channel, you can simultaneously:

- Listen to the voice audio on the CyberTest speaker.
- Strip off the SAT and measure its frequency on the frequency counter.
- Look at the composite signal on the oscilloscope.

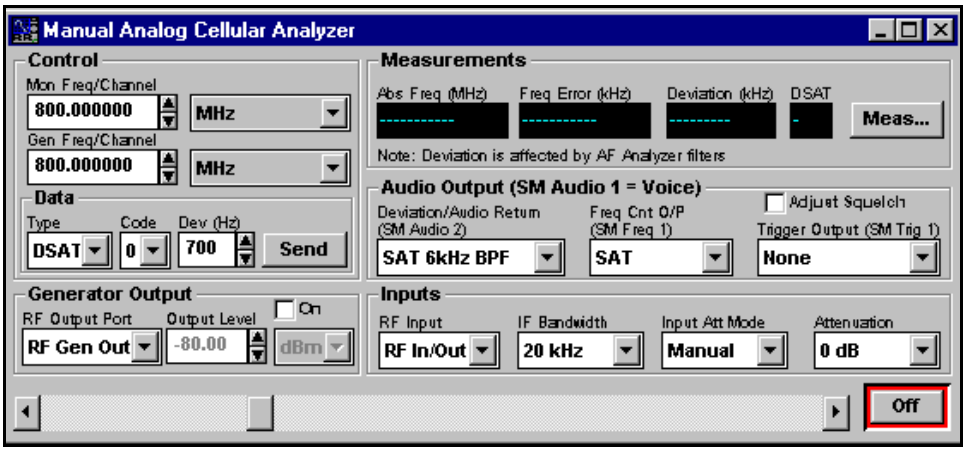
Manual Analog Cellular Analyzer

This instrument (Figure 2) is used for manual testing and alignment of analog cellular base stations. It is also used for general over the air testing in the cellular band. It provides control and measurement capabilities such as:

- Control of the RF generator.
- Deviation measurements.
- Frequency error measurements.
- DSAT generation and detection, and more.

The Manual Analog Cellular Analyzer instrument in conjunction with the other CyberTAME instruments, performs comprehensive base station testing.

Figure 2. **Manual Analog Cellular Analyzer Controls**



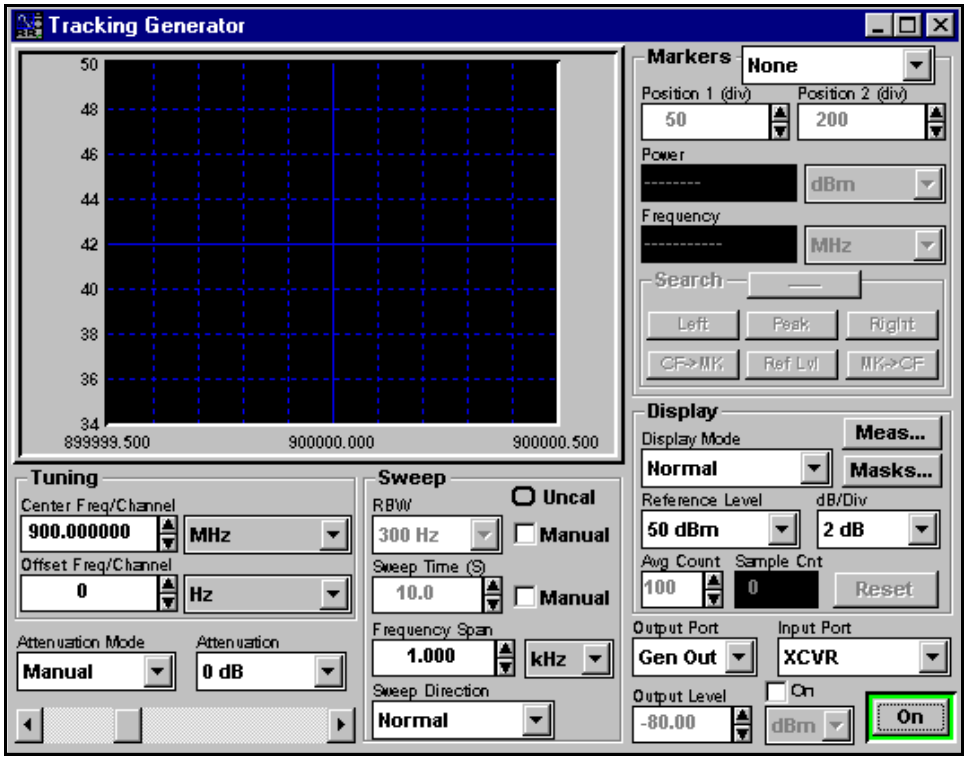
Baseband Routing and Filtering

A series of filters and return paths allow you to make audio frequency measurements in a variety of ways. Individual bandpass filters allow you to single out SAT or ST signals for further analysis. You can also choose to look at the signaling and control data on both normal and narrowband (NAMPS/NTACS) cellular systems. Or, you can select no filtering and route the composite received signal over to the AF Analyzer instrument where another bank of selectable filters is available for testing to TIS standards.

Tracking Generator

The Tracking Generator (Figure 3) built into the CyberTest platform is used for performing antenna sweeps and measuring tuned networks like duplexors, site filters and combiners. The instrument combines most features of the Spectrum Analyzer with a sweep generator. It has 80 dB of display range.

Figure 3. **Tracking Generator**



CyberTAME Software Operations Review

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. 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.

Starting the CyberTAME Software

Review the CyberTAME software section in the section on Common CyberTest operations and instruments.

Starting the CyberTAME Software

The CyberTAME software starts from the Program Manager in Windows.

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.

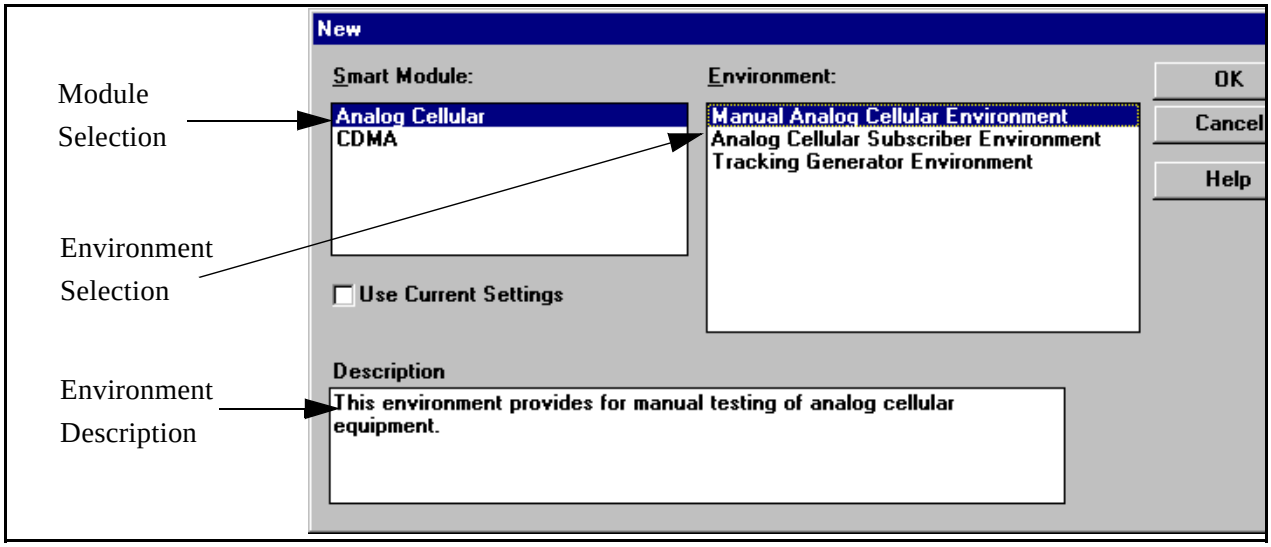
New File Command

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. The Smart Modules presently installed in the analyzer will be listed here.
- Allows you to select and setup desired testing operating environment to perform a particular test.

Figure 4 shows the screen that appears when the New command is selected.

Figure 4. **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 4, the analog cellular Smart Module is selected giving three environment choices in the Environment window.

- Manual Analog Cellular
- Analog Cellular Subscriber
- Tracking Generator

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.

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

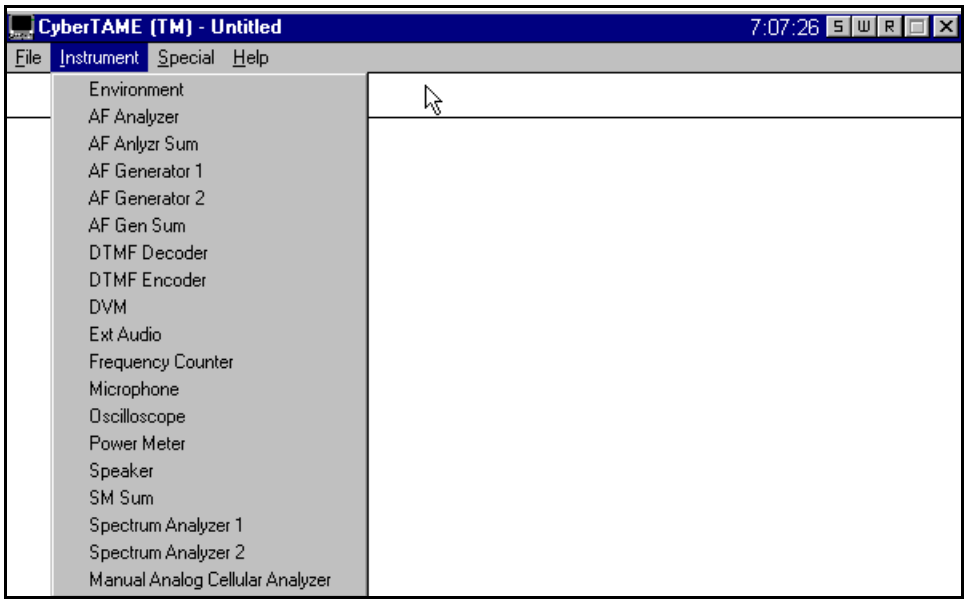
The Instrument menu lists all available instruments for use with the selected environment. In addition, there are more commands that appear on the Special menu. These are:

Special Menu

- Defaults
- IEEE-488
- Version

The CyberTAME main window with the Instrument menu chosen is shown in Figure 5.

Figure 5. **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 appear 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

In Figure 5, the Manual Analog Cellular Analyzer is specific to this Smart Module and environment.

Other items listed on the Instrument menu are not really instruments, but are controllers or displays that provide for interconnections between the various

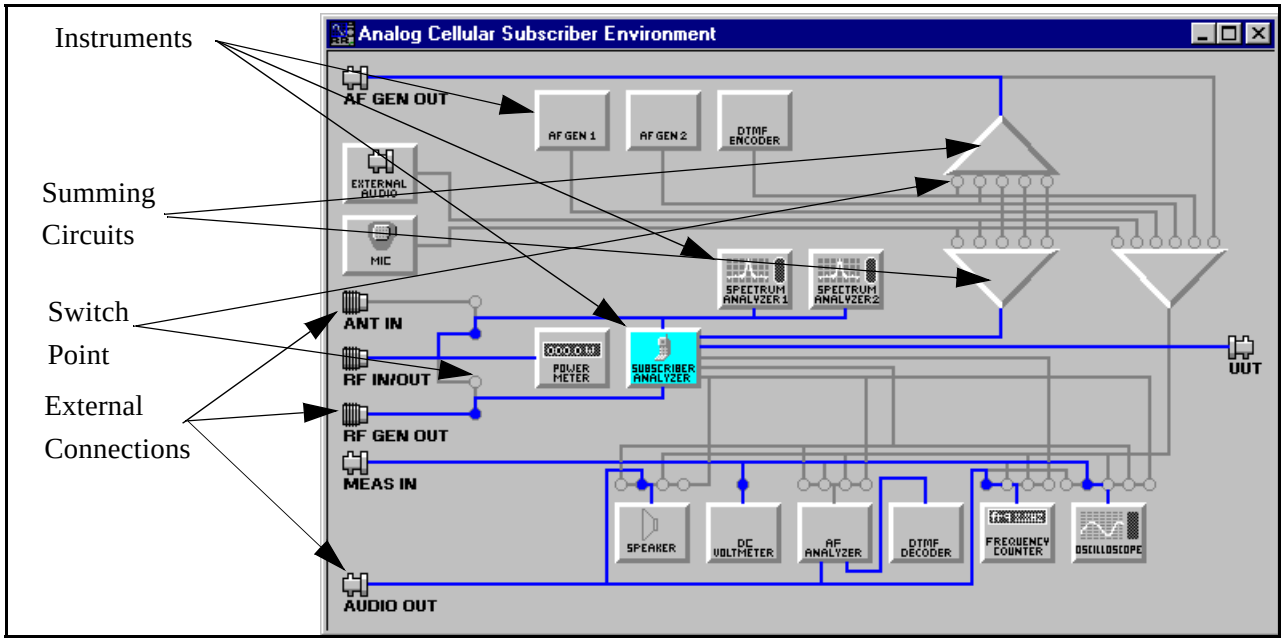
instruments and the equipment under test. Each of these listed items are covered in the following sections.

Operating Environment

Analog Environment Selected

With the selection of the Analog Smart Module through the use of the New File Command or the retrieval of a saved Analog environment, the Environment Screen (Figure 6) will be available.

Figure 6. **Analog 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 Environment menu to choose from a list of instruments.
- Use Environment screen to doubleclick on an instrument icon.

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.

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 6) 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.

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 and described 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.

CyberTAME Instruments - AMPS / TACS Smart Module

Introduction

The instruments contained in the CyberTest Analyzer are designed to provide testing capability for Cellular Infrastructure and Cellular Subscriber equipment. In addition, it provides general over the air testing in the cellular band. This section covers the operation of the controls for all Analog instruments. These controls are covered in general. The specific procedures to accomplish a particular test are left to the technician.

Common Instruments

The instruments installed in the basic CyberTest Analyzer package include:

- Audio Frequency Analyzer
- Two Audio Frequency Generators
- DTMF Decoder
- DTMF Encoder, DC Voltmeter
- Frequency counter, Oscilloscope
- Power Meter
- Two Spectrum Analyzers

Smart Module Environments

The AMPS / TACS Smart Module includes the following environments:

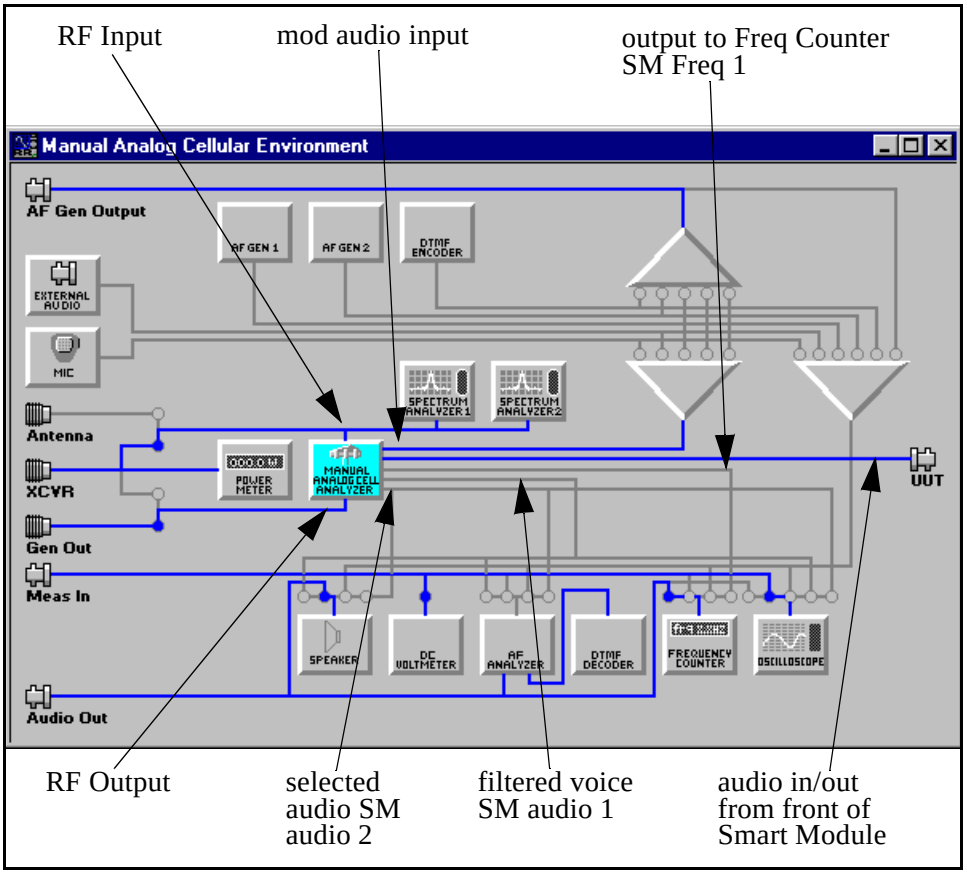
- Manual Analog Cellular Environment
- Analog Cellular Subscriber Environment
- Tracking Generator Environment

The remainder of this section covers the instruments in each of these environments.

Manual Analog Cellular Environment

Below in Figure 1 is the Manual Analog Cellular Environment. It shows all of the virtual instruments that are available to use in addition to the Manual Analog Cellular Analyzer instrument. It also shows the various interconnection paths that exist between these instruments. You can use this test environment for testing analog cellular base stations or for testing analog cellular phones--provided that you can bypass the phone's normal call-processing protocol and can manually control the phone via test modes.

Figure 1. **Manual Analog Cellular Environment**



This test environment is nearly identical to most of the other test environments. The difference is the Manual Analog Cellular Analyzer Instrument. This instrument is available when the AMPS/TACS Smart Module is inserted into the

CyberTest Analyzer and is identified by the extra color ring around the icon (as are all smart module instruments). The top of the environment shows the various sources for audio signals, (i.e., microphone jack, external audio, Audio Frequency Generators 1 & 2, and the DTMF Encoder). These audio sources can be summed together in various combinations and 1) routed directly out of the analyzer, 2) routed to the various internal measurement instruments, or 3) routed to the Manual Analog Cellular Analyzer Instrument and used as a modulation source to create a narrowband FM signal. To set the FM deviation level, multiply the amplitude of the composite audio signal by the factor of 5 KHz/Volt.

Background Processing

The CyberTAME software uses a technique called background processing in order to display the Absolute Frequency, the Frequency Error and the Deviation on the Manual Analog Cellular Analyzer instrument. The Absolute Frequency and the Frequency Error measurements are actually made by the Frequency Counter instrument in the analyzer platform. They are displayed on the Manual Cellular Analyzer Instrument for ease of viewing. Likewise, the deviation measurement is actually made on the AF Analyzer using the AC voltmeter. In using background processing, the CyberTAME software rapidly re-routes the test signals to the applicable instruments, makes the measurements, applies any necessary factors, and reconfigures the analyzer hardware back to the original settings. Depending on what signal routing you have set up, you may notice some side effects of this background processing--particularly on the oscilloscope or on the speaker.

Manual Analog Cellular Analyzer

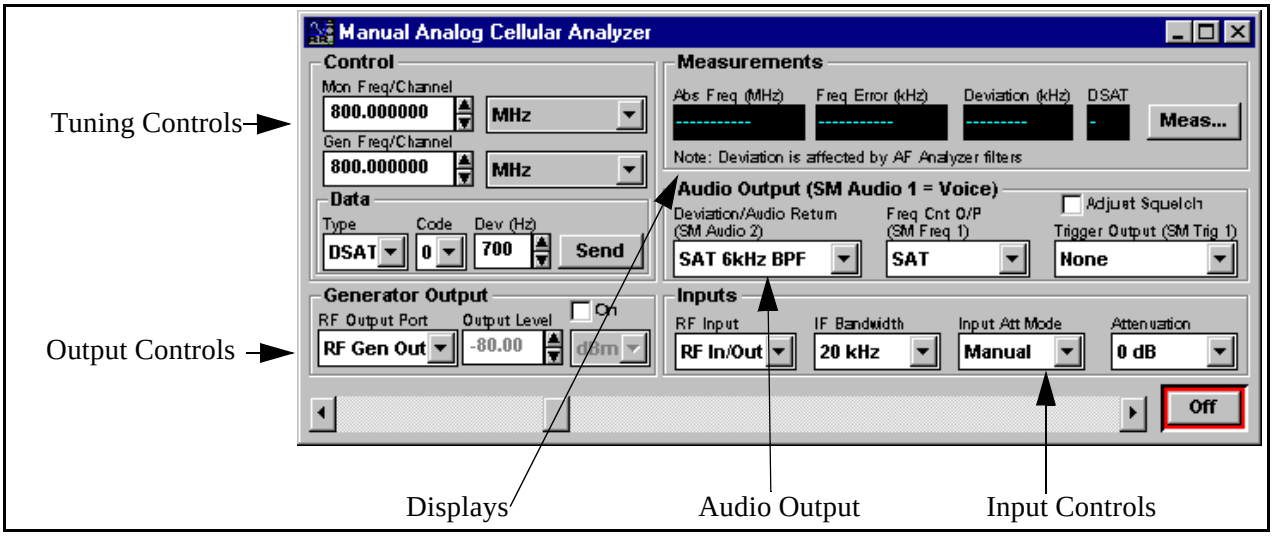
Purpose

The Manual Analog Cellular Analyzer is designed for testing and alignment of analog cellular base stations. It is also used for general over the air testing in the cellular band. It provides the following control and measurement capabilities:

- RF Generator Control.
- Frequency error measurements.
- Deviation measurements.
- DSAT generation and detection.
- DST generation.
- Audio Output controls and filters.

The controls for this instrument are shown in Figure 2.

Figure 2. **Manual Analog Cellular Analyzer Controls**



Tuning Controls

The Manual Analog Cellular Analyzer tuning controls include:

- Monitored Frequency/Channel - provides tuning in the Cellular band by frequency or preset channel.

Manual Analog Cellular Analyzer (Cont)

- Generator Frequency/Channel - provides tuning of the Generator by frequency or preset channel.

Data Generation

These controls allow you to control the generation of DSAT and DST signals:

- DSAT - can generate any of seven DSAT signals from 0 to 6.
- DST - can generate any of sevel DST signals from 0 to 6.
- DSAT/DST Deviation - controls the DSAT/DST Deviation in Hz from 0 to 1000 Hz.
- Send Button - generates selected DSAT/DST signal when clicked.

Output Controls

These controls affect the operation of the internal generator. They provide control of:

- RF Output Port - selects the desired output port for the RF Generator signal.
- Output Level - controls the Generator output level measured in dB, Watts, or milli-Watts. The dB level is settable from -110 to 0.
- Off Checkbox - allows the Generator to be turned off.

Displays

There are four display readouts on the Manual Analog Cellular Analyzer:

- Absolute Frequency - frequency received by the analyzer measured in MHz.
- Frequency Error - difference between the true frequency and the measured frequency in MHz.
- Deviation - measure of modulation of the signals received. Measured in kHz.
- DSAT - readout of the DSAT signal received. It is only active if DSAT modulation is present.

Audio Output Controls

This area controls the output of the audio to the analyzer speaker or other platform instrument. The controls include:

- Deviation/Audio Return - selection of filters to provide the desired audio output. These are selected using the drop-down box.
- Freq CNT O/P - selects the type of Audio signal received:

– SAT
– ST
– Received Data

- Adjust Squelch - turns Squelch adjustment on by Clicking in the Check box. The scroll bar at the bottom of the screen is then used to adjust the squelch level. Moving the bar to the left lowers the squelch level (loosens) and moving the bar to the right raises (tightens) the squelch level.

If you are tuned to a weak RF signal and the instrument measurement displays are not showing any data and no received audio can be seen on the Oscilloscope or heard on the speaker, adjust the squelch to a lower setting.

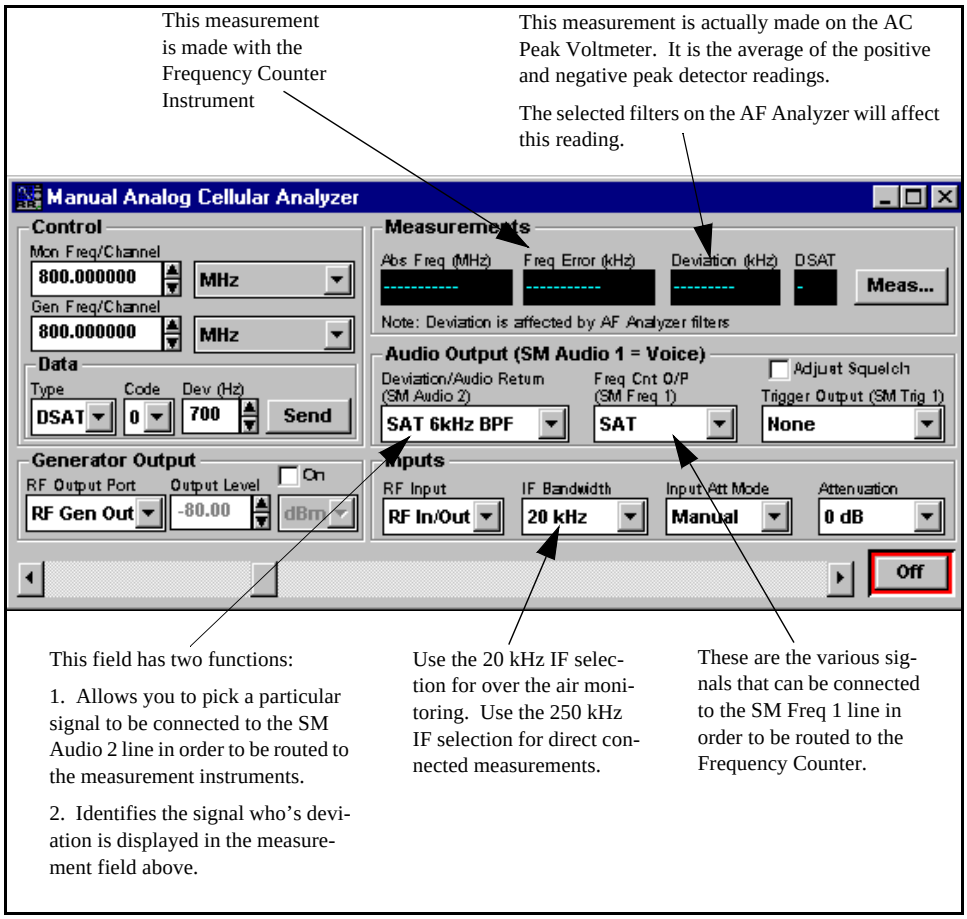
- Trigger Output - selectable as None or Rx Word Sync. Used to have another instrument triggered by the output from the Manual Analog Cellular Analyzer.

Input Controls

The Manual Analog Cellular Analyzer input controls provide:

- RF Input drop-down box - selects either RF In/Out or Ant In analyzer input ports.
- IF Bandwidth - selects the Intermediate Frequency Bandwidth as either 20 kHz or 250 kHz via drop-down box.
- Input Attenuation Mode drop-down box - selects either Manual or Automatic.
- Attenuation - selects the attenuation value if Manual attenuation is selected. Selectable in increments of 10 dB to 50 dB.

Figure 3. **Manual Analog Cellular Analyzer**



Deviation Measurement - How it is Done

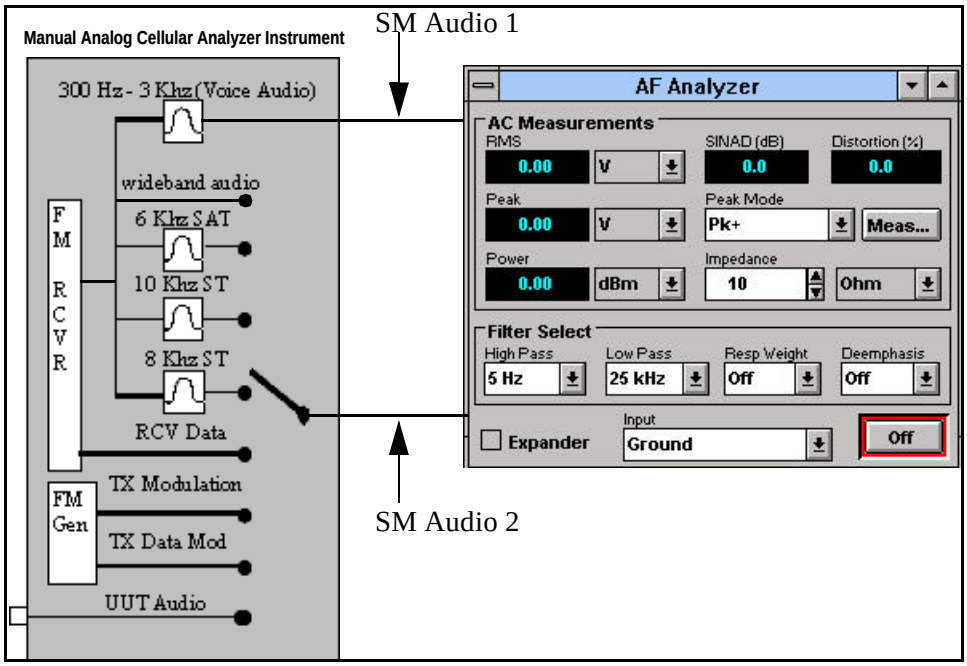
As stated above, the Deviation Measurement is actually made by routing demodulated audio from the FM receiver on the smart module to the AC Voltmeter on the AF Analyzer. On the Manual Analog Cellular Analyzer instrument (Figure 3), you can select which audio signal you want to route to the AF Analyzer for the deviation measurement. This is done with the "Deviation/ Audio Return - SM Audio 2" pull-down selection.

The (PEAK+ + PEAK-)/2 mode of the peak AC Voltmeter is used for the deviation measurement. The measured voltage is multiplied by a factor of 5 KHz per volt and the resulting number is displayed as deviation. Since the measurement is made with the AF Analyzer, the signal passes through the

selectable audio filters before its voltage is measured. Therefore, the filters that you select on the AF Analyzer instrument (low pass, high pass, response weight, de-emphasis, and expandor) will have an effect on the deviation measurement that is displayed on the Manual Analog Cellular Analyzer Instrument.

If you desire a more detailed look at the measured deviation level from a signal under test, you can use the AF Analyzer directly. This is done by routing the demodulated signal to the AF Analyzer and selecting the peak mode of the AC Voltmeter that corresponds with the type of deviation measurement you want to make. You can select from several different peak measuring modes, like PEAK+, PEAK-, (PEAK+ + PEAK-)/2 (this one is already used for the deviation measurement displayed on the manual cellular analyzer instrument), PEAK+ HOLD, PEAK- HOLD, etc. When directly using the AC Voltmeter for measuring deviation, you must manually multiply the displayed voltage (in volts) by 5 (5 Khz per volt) to convert voltage to deviation. See Figure 4 which shows the various audio paths that can be selected to route signals to the AF Analyzer and other instruments like the Oscilloscope.

Figure 4. **Manual Analog Cellular Analyzer Signal Flows**



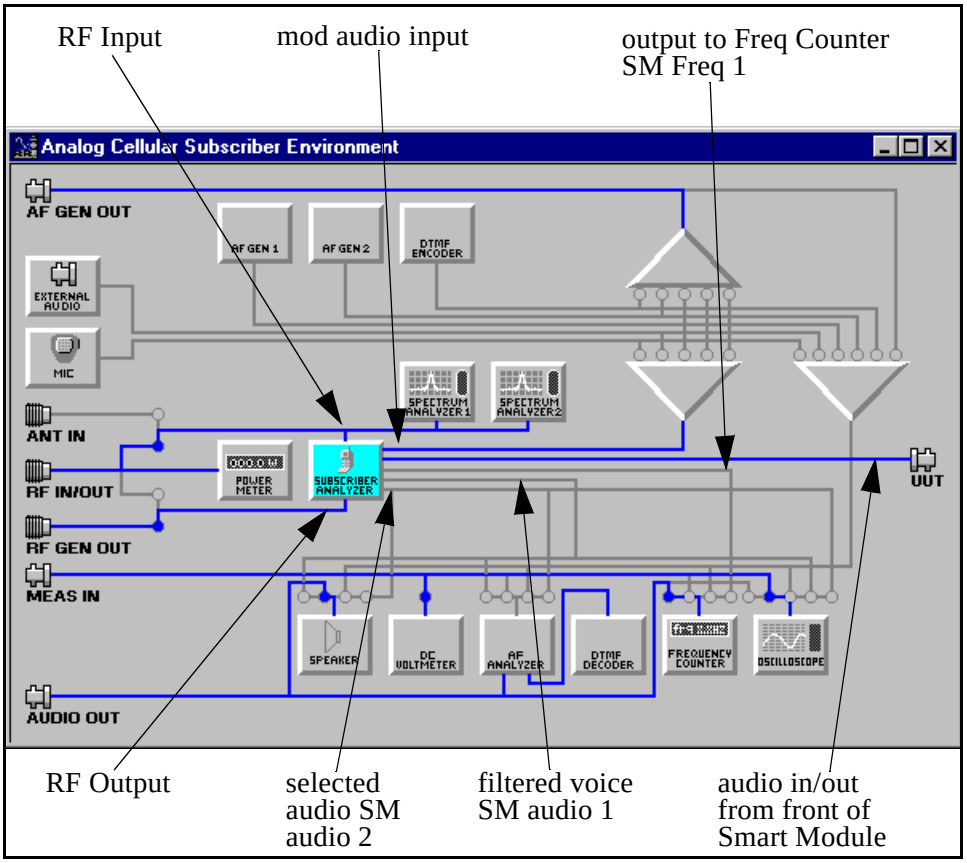
Manual Analog Cellular Analyzer Operating Procedure

1. Set the desired Frequency to monitor or select the desired channel to monitor.
2. Set the Generator output Frequency of the Generator preset channel.
3. Select the Generator output port desired.
4. Set the Generator output level needed for the test.
5. Route the modulation source you desire (AF Gen 1, AF Gen 2, DTMF Encoder, External Audio or Microphone) to the Manual Analog Cellular Analyzer instrument via the Smart Module summer. To set the deviation, multiply the summed audio voltage by the factor of 5 KHz/Volt.
6. Select the desired RF Input port and set the attenuation mode.
7. Select the Audio Output filter and data type.
8. If you are using this system to trigger another instrument, select the Trigger Output for Rx Word Sync.
9. Click the **On** Button.

Analog Cellular Subscriber Environment

Figure 1 shows the Analog Cellular Subscriber Environment. It shows all of the virtual instruments that are available to use in addition to the Analog Cellular Subscriber Analyzer instrument. It also shows the various interconnection paths that exist between these instruments. You can use this test environment for testing analog cellular phones.

Figure 1. **Analog Cellular Subscriber Environment**



This test environment is nearly identical to most of the other test environments. The difference is the Analog Cellular Subscriber Analyzer Instrument. This instrument is available when the AMPS/TACS Smart Module is inserted into the CyberTest Analyzer and is identified by the icon's cyan (light blue) color (as are all smart module instruments). The top of the environment shows the various

sources for audio signals, (i.e., microphone jack, external audio, Audio Frequency Generators 1 & 2, and the DTMF Encoder). These audio sources can be summed together in various combinations and 1) routed directly out of the analyzer, 2) routed to the various internal measurement instruments, or 3) routed to the Analog Cellular Subscriber Analyzer Instrument and used as a modulation source to create a narrowband FM signal. To set the FM Deviation level, multiply the amplitude of the audio signal by the factor of 5 KHz/Volt.

AF Generator 2 is used to automatically generate the SAT tone needed in phone testing. In general, this instrument should not be used during normal phone testing.

Background Processing

The CyberTAME software uses a technique called background processing in order to display the Absolute Frequency, the Frequency Error and the Deviation on the Analog Cellular Subscriber Analyzer instrument. The Absolute Frequency and the Frequency Error measurements are actually made by the Frequency Counter instrument in the analyzer platform. They are displayed on the Analog Cellular Subscriber Analyzer Instrument for ease of viewing. Likewise, the deviation measurement is actually made on the AF Analyzer using the AC voltmeter. In using background processing, the CyberTAME software rapidly re-routes the test signals to the applicable instruments, makes the measurements, applies any necessary factors, and reconfigures the analyzer hardware back to the original settings. Depending on what signal routing you have set up, you may notice some side effects of this background processing--particularly on the oscilloscope or on the speaker.

Analog Cellular Subscriber Analyzer

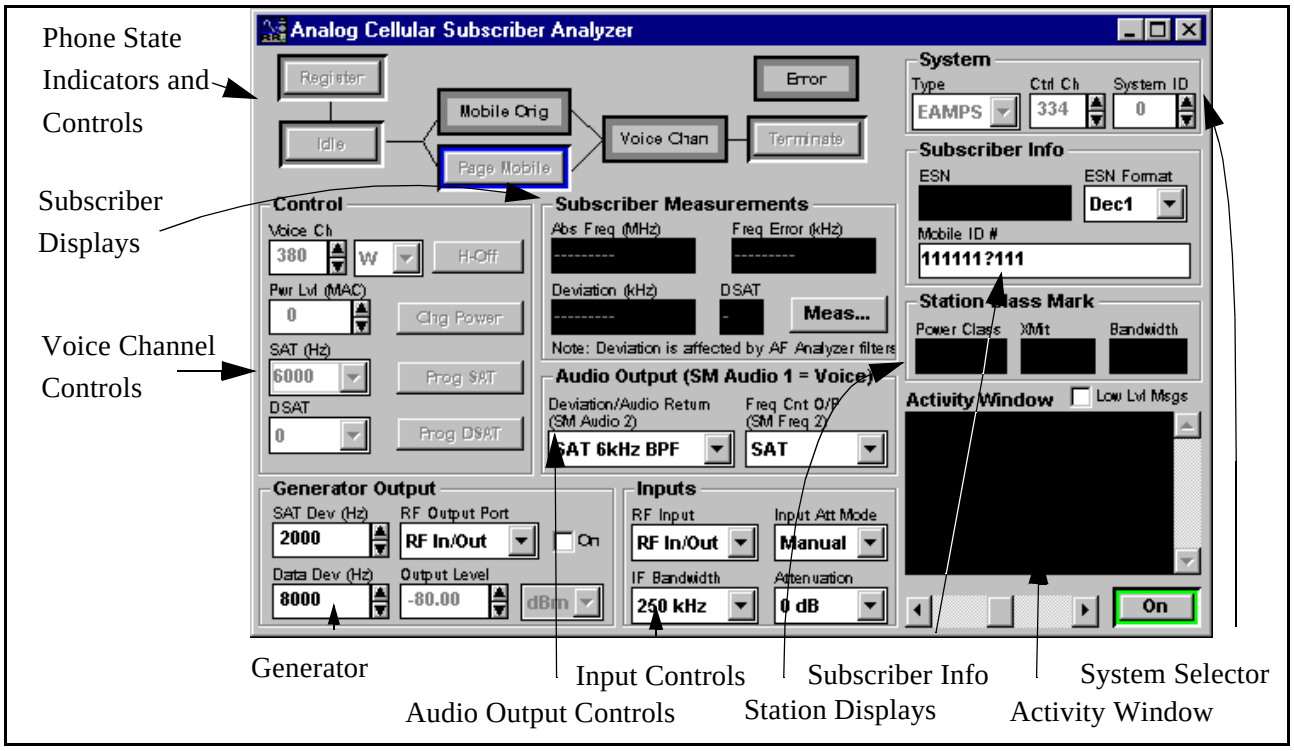
The Analog Cellular Subscriber Analyzer instrument is designed to test AMPS and TACS cellular telephones (specifically AMPS, EAMPS, NAMPS, TACS, ETACS, UTACS, JTACS, NTACS). It provides:

- Monitoring of call processing states of the phone under test.
- Commanding a particular call processing action of the phone.
- Control of phone Voice Channel, Power Level, SAT and DSAT.
- Control of Audio Output type and filtration.
- Measurement of various phone operating parameters.
- Detailed information readouts on message activity to and from the phone and within the CyberTest.

The controls for the Analog Cellular Subscriber Analyzer are shown in Figure 2.

Analog Cellular Subscriber Analyzer (Cont)

Figure 2. **Analog Cellular Subscriber Analyzer Controls**



Conventional Hookup

The phone to be tested is usually attached via a cable to the RF In/Out port of the CyberTest unit. Other hookups are also possible through the ANT IN and RF GEN OUT ports.

Phone State Indicators and Controls

This graphical diagram is used to both control the call processing state of the phone or to command the phone to make a particular call processing action. It includes these controls and indicators:

- Register - both an indicator and a control. As an indicator, it shows that the CyberTest is attempting to Register the phone. By clicking on the Register button, the CyberTest takes the necessary protocol actions to force the phone to register.

Analog Cellular Subscriber Analyzer (Cont)

- Idle - both an indicator and a control. As an indicator, it shows that the CyberTest is transmitting a forward control channel. Clicking on this button starts the forward control channel.
- Mobile Originate - if a call is started from the phone, this indicator turns on.
- Page Mobile - both an indicator and a control. By clicking on this button, it simulates a call being made to the cellular phone. During the call process the indicator turns on.
- Voice Channel - once the call is established, this indicator is turned on to indicate that the phone is now established on a voice channel for normal operation.
- Terminate - both an indicator and a control. When the call is terminating, this indicator is turned on. By clicking on this button, the CyberTest performs the call processing necessary to terminate the call. If the phone initiates the termination, this indicator is also turned on.
- Error - if an incorrect protocol condition is encountered that is fatal, this indicator turns on.

System Selector

This area of the Analog Cellular Subscriber Analyzer allows you to select System Type, Control Channel, and system ID. The selections are by drop-down or text box with these parameters:

- Type drop-down box - selects the System Type from:
  - AMPS
  - EAMPS
  - TACS
  - ETACS
  - JTACS
  - NAMPS
  - NTACS
  - UTACS
- Control Channel text box - chooses any control channel from 1 to 2160.
- System ID text box - chooses any System ID from 0 to 16383.

Analog Cellular Subscriber Analyzer (Cont)

Voice Channel Controls

This area contains the controls for the voice channel, voice channel power, SAT frequencies and DSAT signals. The various controls are:

- Voice Channel text box - selects any voice channel from 1 to 2160. This channel can be selected as Wide Band, Narrow Band, Upper, Mod, or Lower depending on the System Type selected (W, N, L, M, U). The band is selected by a drop-down box.
- Power Level text box - selects any power level from 0 to 7 MAC.
- SAT (Hz) drop-down box - selects the SAT frequency as 5970, 6000, or 6030 Hz. Unique to this control is the ability to also select a frequency from 5000 to 7000 in 1 Hz steps.
- H-Off button - clicking on this button simulates a voice channel handoff from one cell to another (Only functional while the voice channel indicator is on.)
- Chg Power button - clicking on this button commands the phone to change to the new power level setting (Only functional while the voice channel indicator is on.)
- Prog SAT button - clicking on this button commands the CyberTest to change SAT to the new SAT selected (Only functional while the voice channel indicator is on.) This action only changes the CyberTest's SAT so it serves as a drop test. Use the H-Off button (Handoff) to change both the CyberTest and the phone's SAT.
- Prog DSAT button - clicking on this button commands the phone to change to the new DSAT selected. (Only functional while the voice channel indicator is on.) This action only changes the CyberTest's DSAT so it serves as a drop test. Use the H-Off button (Handoff) to change both the CyberTest and the phone's DSAT.

Generator Controls

The Generator Controls in the Analog Cellular Subscriber Analyzer contain:

- SAT Deviation text box - sets the modulation level for the SAT signal. It is settable from 0 to 4000 Hz.
- Data Dev text box - sets the modulation level for the data signal. It is settable from 0 to 10,000 Hz.

Analog Cellular Subscriber Analyzer (Cont)

- Output Level text box - sets the RF In/Out or the RF Generator output level. It is settable from -110 to -26 dB for the RF In/Out selection and from 110 to 0 dB for the RF Gen Out selection.
- RF Output Port drop-down box - selects the analyzer output port for the generated signal. The selections are RF In/Out or RF Gen Out (The normal test hookup uses the RF In/Out selection.)
- Off Checkbox - turns off the transmitted RF if checked.

Audio Output Controls

This region contains two drop-down boxes for you to select the appropriate filter and audio type. They are:

- Deviation/Audio Return - a selection of filters to provide the desired audio output. These are selected using the drop-down box.
- Freq CNT O/P - selects the type of Audio signal received. Includes:
  - SAT
  - ST
  - Received Data

Input Controls

Inputs to the Analog Cellular Subscriber Analyzer are controlled by four drop-down boxes:

- RF Input - selects either RF In/Out or ANT IN.
- IF Bandwidth - selects the Intermediate Frequency Bandwidth as either 20 kHz or 250 kHz.
- Input Att Mode - selects the attenuation mode as Manual or Automatic.
- Attenuation - if Manual Attenuation is selected above, this selects the attenuation values in 10 dB increments from 0 to 50 dB.

Subscriber Information

Once the call processing reaches the Voice Channel, the displays for various measurements are available on the Analog Cellular Subscriber Analyzer. In the Subscriber Information section, there are two basic items displayed. They are:

Analog Cellular Subscriber Analyzer (Cont)

- ESN - electronic serial number of the phone under test. This information is displayed in either two decimal or a hexadecimal format selectable by means of a drop-down box. (This information is automatically updated if a register call processing action is taken or if the phone originates a call.)
- Mobile ID - basic identification of the phone under test. (This field is automatically updated if the register call processing action is taken or if the phone originates a call.)

Station Displays

The information on the overall phone type is displayed in the Station Display section. The displays include:

- Power Class - indicates the basic power class of the phone.
- Xmit - indicates the transmitted power.
- Bandwidth - displays the bandwidth of the phone under test.

Subscriber Displays

The subscriber Displays, listed on the instrument controls as Subscriber Measurements, display the measured information from the phone under test. This section shows four readouts:

- ABS Freq - displays the Frequency of the signal received from the phone under test, measured in MHz.
- Freq Error - displays Frequency error in kHz of the received signal.
- Deviation - displays the FM modulation level of the received signal, measured in kHz.
- DSAT - if a DSAT is transmitted, displays the DSAT code received.

Deviation Measurement - How it is done

As stated above, the Deviation Measurement is actually made by routing demodulated audio from the FM receiver on the smart module to the AC Voltmeter on the AF Analyzer. On the Manual Analog Cellular Analyzer instrument, you can select which audio signal you want to route to the AF Analyzer for the deviation measurement. This is done with the “Deviation/Audio Return - SM Audio 2” pull-down selection.

The (PEAK+ + PEAK-)/2 mode of the peak AC Voltmeter is used for the deviation measurement. The measured voltage is multiplied by a factor of 5 KHz per volt and the resulting number is displayed as deviation. Since the measurement is made with the AF Analyzer, the signal passes through the selectable audio filters before its voltage is measured. Therefore, the filters that you select on the AF Analyzer instrument (low pass, high pass, response weight, de-emphasis, and expandor) will have an effect on the deviation measurement that is displayed on the Manual Analog Cellular Analyzer Instrument.

If you desire a more detailed look at the measured deviation level from a signal under test, you can use the AF Analyzer directly. This is done by routing the demodulated signal to the AF Analyzer and selecting the peak mode of the AC Voltmeter that corresponds with the type of deviation measurement you want to make. You can select from several different peak measuring modes, like PEAK+, PEAK-, (PEAK+ + PEAK-)/2 (this one is already used for the deviation measurement displayed on the manual cellular analyzer instrument), PEAK+ HOLD, PEAK- HOLD, etc. When directly using the AC Voltmeter for measuring deviation, you must manually multiply the displayed voltage (in volts) by 5 (5 Khz per volt) to convert voltage to deviation.

Activity Window

The Activity window of the Analog Subscriber Analyzer displays various call processing milestones and general information. If the Low Lvl Msgs box is not clicked on, only high level call processing milestone information is shown. If the Low Lvl Msgs is clicked on, then additional helpful status information is also displayed indicating finer detail on activities in the smart module. If the Low Lvl Msgs box is clicked off and back on again, a 3rd layer of messaging is displayed. This is all of the raw data received from the mobile during call processing or any tests commanded once on a voice channel.

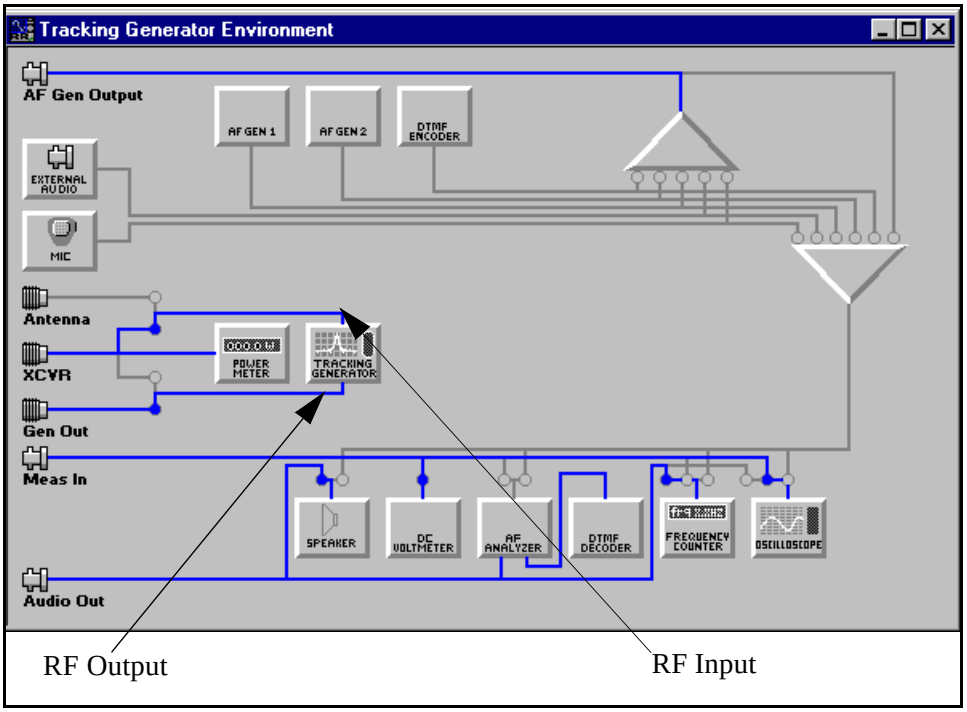
Analog Cellular Subscriber Analyzer Operating Procedure

1. Connect the phone to be tested to the RF In/Out port.
2. Select the System Type, Control Channel and System ID.
3. Select the desired Voice Channel.
4. Set the Power Level.
5. Select the SAT frequency.
6. Select the DSAT code if narrowband testing.
7. Set up the Generator Output using the SAT Deviation, Data Deviation, and Output Level.
8. Route any audio you wish to modulate the generator by using the Smart Module summer on the Environment Screen. The deviation is set by multiplying the voltage of the composite modulating audio signal by the factor of 5 KHz/Volt.
9. Set up the Audio Output controls for Audio type and filters desired.
10. Select the Input and Output connections. Normally this is RF In/Out for both.
11. Click the **ON** button.
12. Press the Idle box.
13. Use the buttons in the Phone State Indicators and Control section, or initiate a call from the phone under test to initiate the testing procedure.

Tracking Generator Environment

Figure 1 shows the Tracking Generator Environment. It shows all of the virtual instruments that are available to use in addition to the Tracking Generator instrument. It also shows the various interconnection paths that exist between these instruments. You can use this test environment for sweeping antennas, tuning combiners, measuring the frequency response of filters, etc.

Figure 1. **Tracking Generator Environment**



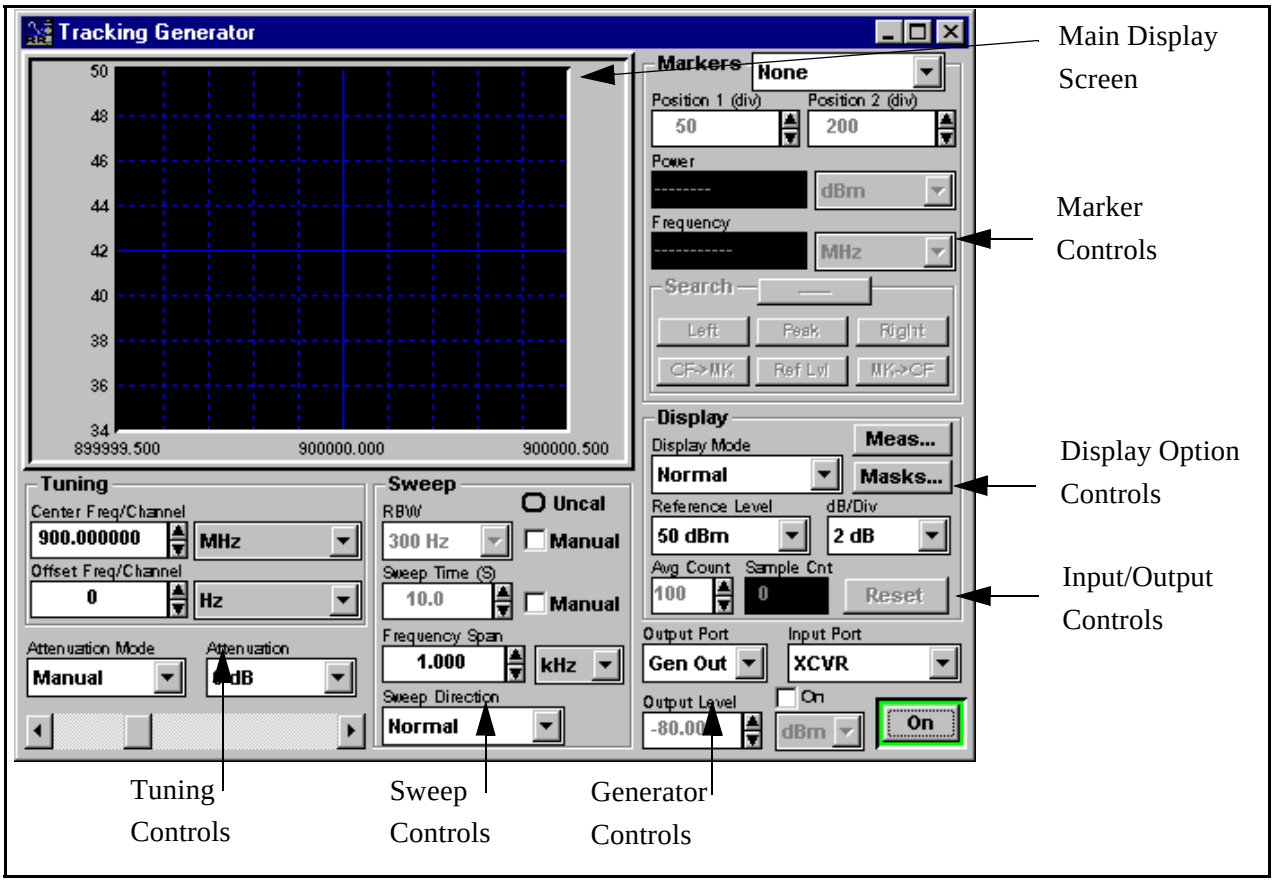
This test environment is nearly identical to most of the other test environments. The difference is the Tracking Generator Instrument. This instrument is available when the AMPS/TACS Smart Module is inserted into the CyberTest Analyzer and is identified by the icon's cyan (light blue) color (as are all smart module instruments). The top of the environment shows the various sources for audio signals, (i.e., microphone jack, external audio, Audio Frequency Generators 1 & 2, and the DTMF Encoder). These audio sources can be summed together in various combinations and 1) routed directly out of the analyzer, 2) routed to the

various internal measurement instruments, or 3) routed to the Tracking Generator Instrument.

Tracking Generator

The Tracking Generator is primarily designed for performing antenna sweeps and measuring turned networks like duplexors, site filters and combiners. The instrument combines most of the features of the Spectrum Analyzer with a sweep generator. If the Tracking Generator environment is chose, the Tracking Generator instrument replaces the Spectrum Analyzers in the instrument choice menu. The controls for the Tracking Generator are shown in Figure 2.

Figure 2. **Tracking Generator Controls**



Tracking Generator (Cont)

Tuning Controls

The Tracking Generator Tuning Controls consist of:

- Center Freq/Channel drop-down box - sets the Center Frequency in the range from 800 - 1000 MHz.
- Units selection drop-down box - selects the Center Frequency units or Cellular present channel.
- Offset Freq/Channel - sets the Offset Frequency from 0 to 200 MHz.
- Units selection drop-down box - selects the Offset Frequency units in Hz, kHz, MHz, or GHz.
- Attenuation drop-down box - selects attenuation settings in 10 dB increments from 0 to 50 dB.

Sweep Controls

Sweep controls in the Tracking Generator include:

- Sweep RBW - selected as automatic or manual. If Manual check box is selected, RBW setting of 300 Hz, 1 kHz, 3 kHz, 30 kHz, or >1JHz are selectable in the RBW drop-down box.
- Sweep Time - selected as automatic or manual. If Manual check box is selected, Sweep Time can be set from 0.2 seconds to 10 seconds.
- Frequency Span - settable from 1 kHz to 20 MHz. The range set is indicated on the bottom of the Main Display screen along with the set center frequency.
- Sweep Direction - selects the sweep direction as normal or inverted by the drop-down box.

Display Controls

Display controls the Tracking Generator consist of:

- Display Mode - selectable for Normal, Freeze, Max Hold, Peak Hold, or Average modes. When average mode is chosen, the Av 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.

Tracking Generator (Cont)

- Reference Level and dB/Div controls - sets the vertical scale displayed on the display screen. Reference Level is selectable in 10 dBm increments from -60 dBm to +50 dBm. The vertical scale is set at either 2 dB or 10 dB.
- Meas...button - the Power Meter, Frequency Meter, or 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

Marker controls in the Tracking Generator consist of:

- 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 to set marker position. These can also be set by dragging the mouse.

Input/Output Controls

The Tracking Generator Input/Output Controls consists of the external connections and include:

- Output Port - selects the output port for the built-in generator. Selectable as Gen Out or SCVR.
- Input Port - selects the input port for the equipment under test. Selectable as SCVR or Antenna.
- Output Level - sets the generator output level. This level is settable from -110 dBm to 0 dBm.
- Output Level Units drop-down box allows selection of dBm, Watts, or milli-Watts.

Tracking Generator (Cont)

Tracking Generator Operating Procedure

1. Set the Tracking Generator Center Frequency.
2. Set the Tracking Generator Offset Frequency.
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 and Output connections.
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.