960B

960B Multi-Channel Test Unit

Hardware/Software

User Manual

Rev 2.0 8/07

Contents

Quick Start Steps

The following are the three steps required to setup your 960 and start testing with a minimum of effort. Follow the links to the relevant sections of the manual.

Step 1: Setup the GUI Software:
      Standard 960 GUI Setup
      960 With Option 800 Setup

      What is Option 800?

Step 2: Review the Quick Start Guide

Step 3: Review the Tests You Need To Run

Topics of Interest

General Testing:
Manual Mode Operation
Command Line Description

Configure Test Interfaces:
IP Interface
T1/E1 Interface
Analog Interface

Running Tests:
Test Control Window
List of Tests

Contents *(continued)*

Section 1
Installation and Administration

The following section describes the installation and administrative procedures for the 960 and its accompanying GUI software. Refer to this section to perform the initial setup and configuration the 960 and the GUI software. Subsequent sections cover the configuration and running of tests.

1. Overview

Introduction

The 960B is a powerful multi-channel IP Telephony precision test instrument combining TDM, Ethernet and Analog interfaces and simultaneous test capability to comprehensively test and monitor Next Generation Networks in Real-Time. The 960B can generate one or many end-to-end test calls from the packet, TDM, and/or Analog interfaces while monitoring the bearer channel (TDM, RTP, Analog) to flush out real-time performance issues.

1.1 Quick Start Process

Getting setup and testing with the 960 involves three basic steps outlined below.

Step 1 - Load PC Software:
Load the PC GUI software and connect to the 960. If your 960B has option 800, additional procedures are required to configure the IP address and connect to the remote 960B. Refer to the Configuration section of the manual for descriptions of these setups. Refer to the Identifying Option 800 section if you do not know if option 800 is installed.

Step 2 - Review the PC GUI Quick Start Guide:
The GUI Quick Start Guide gives a brief description of each of the common configuration and control windows as well as a description of how to navigate among the windows to configure tests.

Step 3 - Review Running Tests Section
For each test to be performed, review the test setup and results description in the Running Tests section, located in the 960 GUI Software Description section of the manual.

1.2 Using This Manual

The 960B is a complex instrument with extensive test capabilities for analog, TDM and Ethernet networks. This manual covers all tests and interface configurations supported by the 960B. As such it is an extensive volume of information; however the manual is intended as a reference guide, where most users will only need to refer to the relevant sections that cover the tests they are running. The following Quick start guide outlines the process of getting setup and testing with a minimum of reading.

Manual Organization

The 960B manual is divided into four sections, each one is outlined below.

Section 1
Setup and Administration
Setting up 960 GUI software
Setting up and Connecting to a Remote 960
Software Upgrade
Purchased Option Upgrade

Section 2
GUI Common Controls Description
Quick Start Guide
Detailed Window Descriptions
    Home
    Span Edit
    Span View
    Test Control
Manual Mode Testing Description

Section 3
Individual Test Descriptions
Voice Band Tests
Digital Tests
IP Tests

Section 4
Appendix
Command Line Mode Control
Specifications
Warranty

1.3 Unpacking

When your new 960B multi-channel test instrument arrives from the factory, the shipping box should contain the following components:

Packing List
• SAGE 960B Multi-Channel Test Unit (Fig. 1.3.1)
• Power Cord (Fig. 1.3.2)
• USB Cord (Fig. 1.3.3)
• Software Compact Disk (Fig. 1.3.4)
• SAGE 960B User Manual, supplied on the software installation disk in printable PDF format. (Fig. 1.3.5)

Remove the components from the shipping carton and inspect contents. Notify SAGE Instruments immediately of any damage.
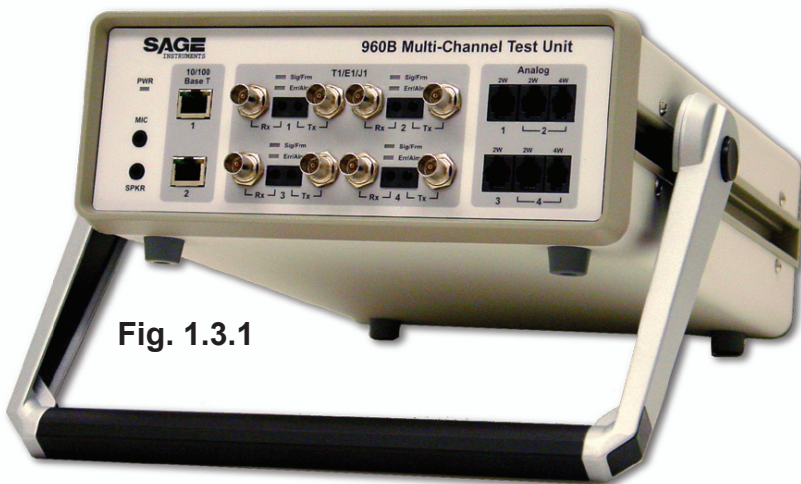
Fig. 1.3.4
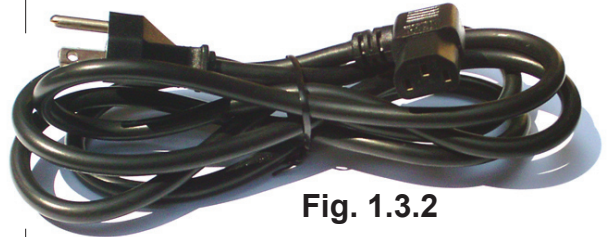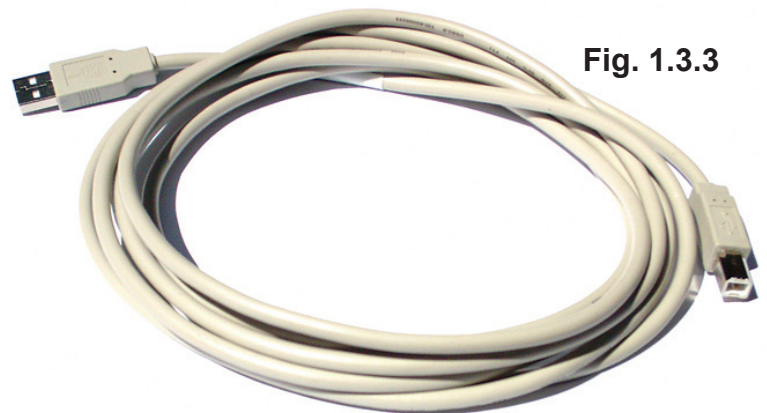
Fig. 1.3.1
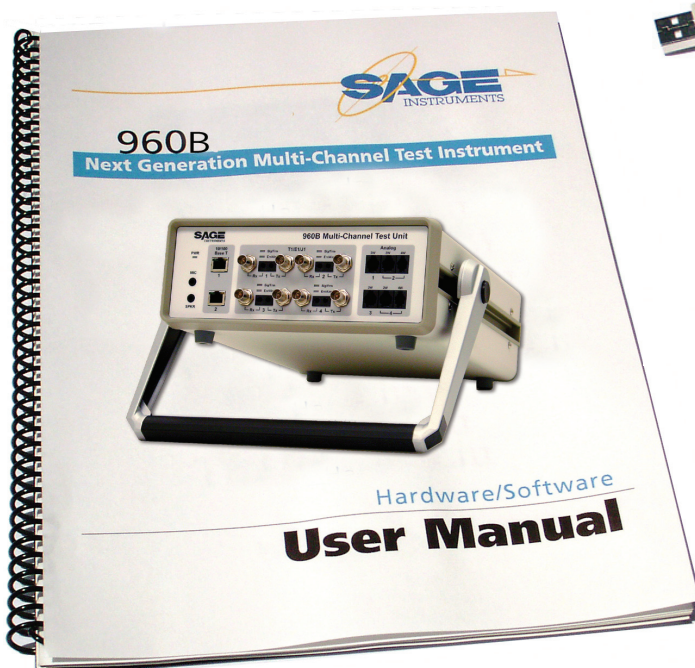
Fig. 1.3.2

Fig. 1.3.3

Fig. 1.3.5 Located on the 960B software installation CD in printable PDF format.

2. Physical Properties

2.1 Case and Handle

The 960B is packaged in a rugged sheet metal enclosure designed specifically for instrumentation systems. The unit is ideal for airborne, shipboard, ground, or mobile applications where precision test instrumentation is utilized.

Handy, robust and portable

The SAGE 960B has been designed as a robust, portable Multi-Channel Test Instrument that can also be used in the field.

The 960B can, of course, also be used on the lab bench. The 960B features an adjustable, fold-out handle that doubles as a stand to position the instrument at an optimal working angle.

1. To reposition the handle from it's carrying position to a bench-top position, depress both round black buttons located on each side of the case (see Figure 2.1).

2. With the round black buttons depressed the handle will lock into place at any of six (6) positions. Position the 960B Handle/Stand in a configuration that fits your needs (see Figure 2.2).

2.2 Front Panel

Use this section to familiarize yourself with the 960B front panel input/output connectors.

1. The 960B front panel contains four (3) types of cabling input areas, each defined by a light gray shade. (see Figure 2.3).
2. From left to right the first cabling area is for 10/100 Base T Ethernet cabeling.

3. The second shaded area contains four (4) Pulse Code Modulation (PCM) inputs. Each PCM area contains four (4) input connectors: Two (2) Bantam RX and TX and two (2) BNC RX and TX.

4. The third shaded area is for 2 and 4-wire analog connections.

3. In addition the 960B features mini-jacks for an external speaker and microphone. The microphone and speaker ports are located on the left of the panel directly under the green PWR LED (see figure 2.3).

To reposition the grip from handle to stand, simultaneously press the round black buttons on both sides of the 960B.

Figure 2.1

Figure 2.2

Figure 2.3

10/100 Base T Ethernet

BNC Transmit & Receive

2 and 4-Wire Analog Module

Mic

Speaker

Bantam 100 ohm Balanced Transmit & Receive

LED Activity Indicators
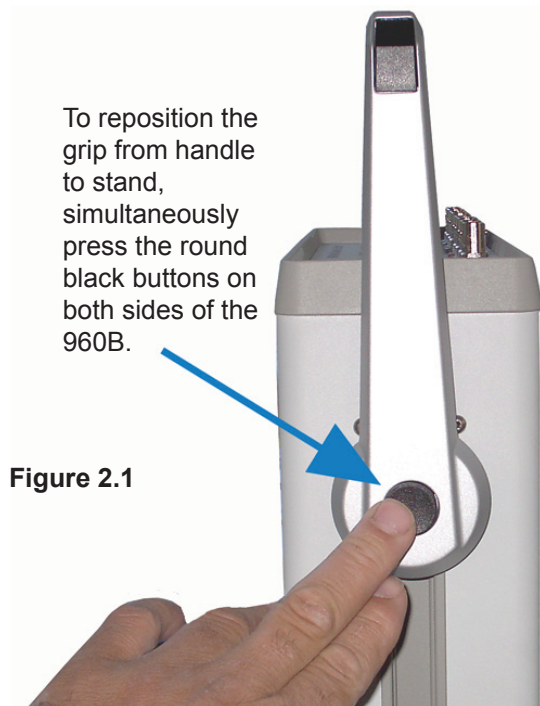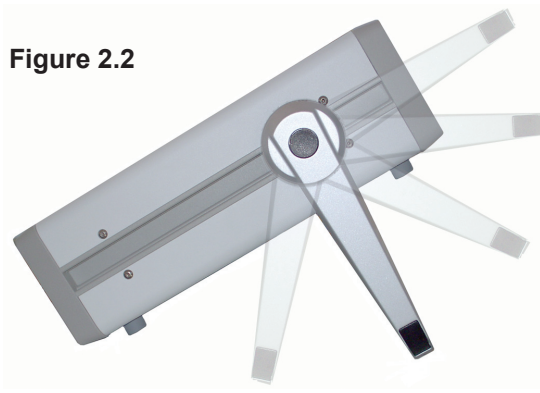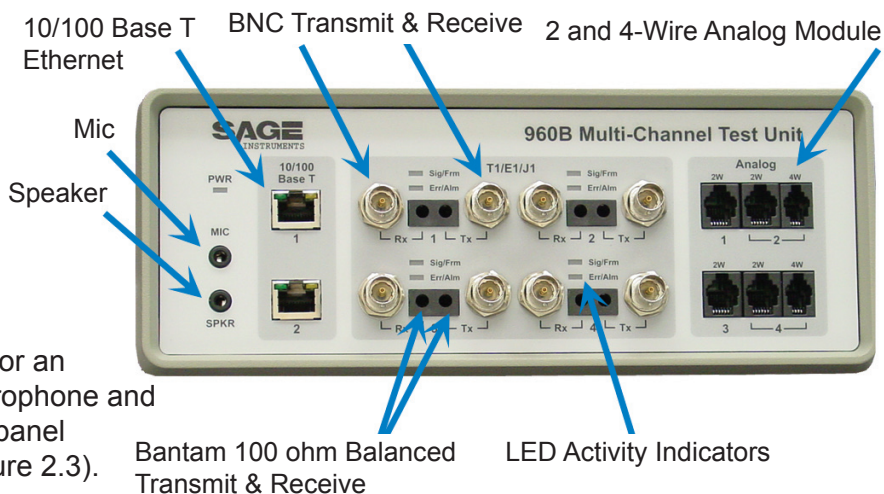
2.3 Rear Panel

Use this section to familiarize yourself with the 960B rear panel input/output connectors.

Located on the rear panel of the SAGE 960B is the On/Off switch, power cord receptacle, USB Type "B" receptacle, and TenBaseT connector. Also located on the rear panel is a label containing bar codes and corresponding Model and Serial Numbers (see Figure 2.4).

Power Cord   On -Off Switch   Model Number   Serial Number   Ethernet   USB 1.0

Figure 2.4
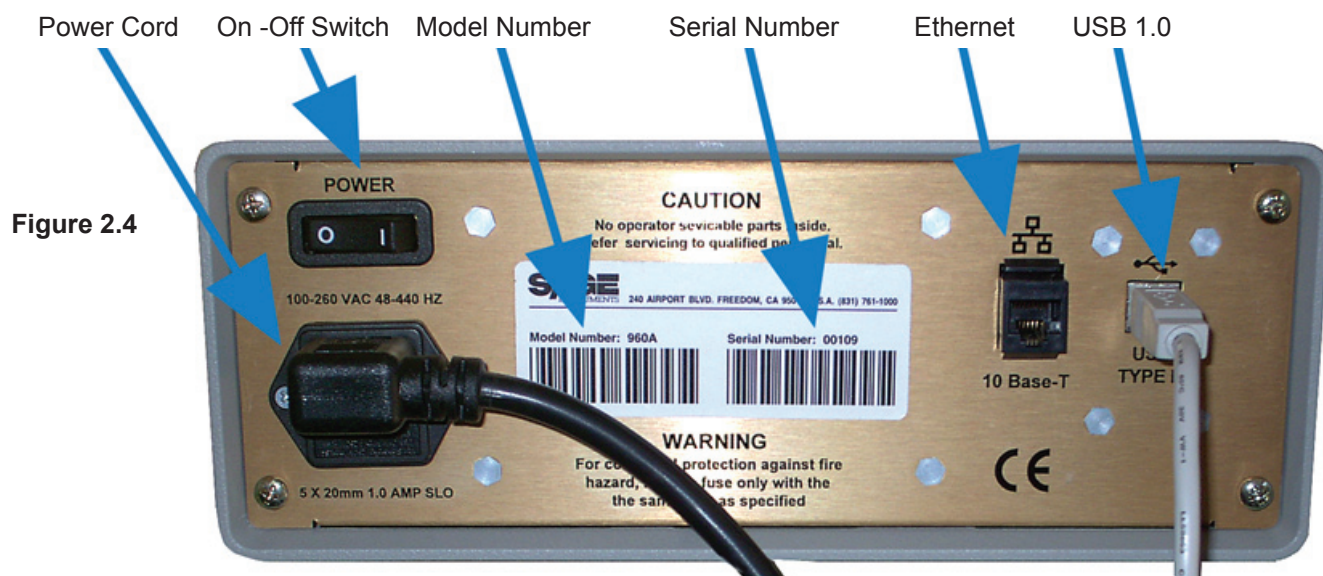
3. 960B PC GUI Software For Standard and Option 800 Units

Introduction
The 960B GUI software is designed to run on PC's. The software is available on CD and is shipped with the 960B. The software is also available form the Sage website at www.sageinst.com/files. The website requires a username (sagesupport) and password (sage935) for accessing the files. The 960B GUI software is contained in a single executable file. The name is 960setupxxxxx.exe, where xxxxx is the software version number.

3.1 Minimum System Requirements
The minimum system requirements for the 960 GUI software are listed below:

Operating System Windows 2000, Windows Server 2003, XP or Vista

Ram 128 MB
Note, this is only a 960 GUI requirement, your operating system may require more than 128 MB of RAM to run on your PC. Consult your operating system hardware requirements for more information.

Video Resolution 1024 X 768

USB 1.1

LAN 10BaseT (For 960B's Equipped with Option 800)

3.2 USB Compatibility with Your PC
Your PC must have a USB port installed and enabled. Some PC's may have a disabled USB port. If your USB port doesn't seem to be working, there may be jumpers on the motherboard or a menu option in the BIOS to enable a PC's USB port.

3.3 960B Units with Option 800
Option 800 for the 960B adds the ability to remotely control the 960 over an ethernet interface. Units with option 800 also support a command line and web browser interface in addition to the PC GUI software described here. Due to the internal architecture, option 800 units are setup and administered differently than standard units. The following configuration procedures in this manual have separate sections for setting up standard units and option 800 units.
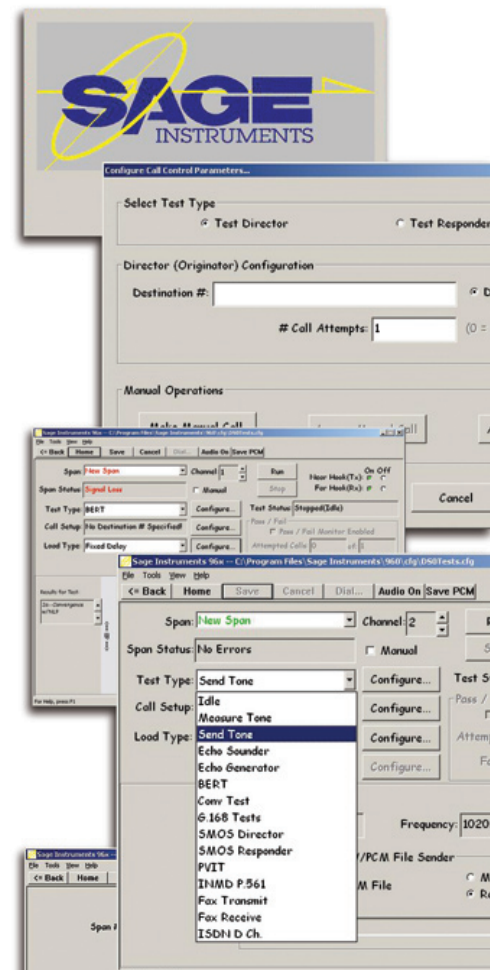
Identifying Option 800 Units
To determine if your 960 has option 800 installed, check the rear panel. Option 800 units have a Windows CE label on the right side of the rear panel.
Option 800 can also be identified by looking for the option titled "7960-0800-02 Onboard Controller" in the 960 installed options list. To view the list of installed options in a 960 see the View Options description section.

Important Note: *The following instructions only apply to 960B Units Not Equipped with Option 800, TCP/IP Remote Command Interface.*

4.1 Introduction

The 960B Multi-Channel Test Unit can be ordered at initial purchase with the factory installed Option 800 (TCP/IP Remote Command Interface), which employs an ethernet communications port. 960B units configured with this feature cannot be administered via ethernet. Instead, you must carry out administrative functions
(i.e. updating operating software, changing IP address, etc) through the 960B USB (Universal Serial Bus) port.

If the 960B unit you are installing is equipped with the Option 800 TCP/IP Remote Command Interface **DO NOT USE** this **BASIC** software installation instruction written for non TCP/IP units. See Instructions for TCP/IP Remote Command Interface units in the next section of this manual. See the Identifying Option 800 units section if you are unsure of the configuration of your unit.

4.2 Basic Software Update

(for non option 800 TCP/IP Remote enabled units)
Install the Software Update
1. To complete this procedure, you must have a Windows 2000/ Windows 2003 Server/XP/Vista PC compatible computer with a USB port, and the software update file "960setupxxxxx.exe" on your computer. Note that the xxxxx in the above file name stands for the current version of software, I.E 960setup70427.exe.

Warning: *If you are currently running Sage 960 software prior to v5.7.8, your 960 configuration files may no longer be useable due to a file format change. The installation program will automatically create a new one for you.*

2. If the 960B is not powered up, turn it on. Do not connect the USB cable, yet.

Basic Software Update

(for non option 800 TCP/IP Remote enabled units) *(continued)*

3. Launch the 960 software installer program:

    a. Using Windows Explorer, navigate to the subdirectory where you previously placed the 960setupXXXXX.exe file

    b. Double-click on the file. You may be presented a Security Warning window. Simply click on "Run".

> **Note: Depending on your PC operating system version, the installer may prompt you at some point to reboot your PC before continuing with the install. During the install process, the installer will place an icon labeled "Launch Sage960" on your PC desktop.**

    c. At the "Sage Instruments" splash screen; click on "Next".

    d. At the "InstallShield" opening screen; click on "Next".

    e. The installer will now display the license agreement. Read it ,then click on "I accept the terms...." then click on "Next".

    f. You will now be presented the Customer Information screen. Shown in Figure 4.2.1. Fill in the User Name and Organization boxes.

    g. Then, select "Anyone who uses this computer (all users)" and click on "Next".

    h. The installer will now present the Custom Setup screen shown in Figure 4.2.2.

    i. Click on "Next".

    j. The Ready to Install screen will now appear. Click on "Install"

    k. During the install process, the installer will place an icon labeled "Launch Sage960" on your PC desktop.

    l. At completion of the installation, click on "Finish".

4. Once the software installation is complete, you may connect the USB cable between the powered up 960B and your computer. The found new hardware bubble should appear in the lower right corner of your screen.

5. Launch the 960 application by clicking on the Launch960 Icon on your desktop. The 960 home window shown in Figure 4.2.3 should be displayed on your screen.
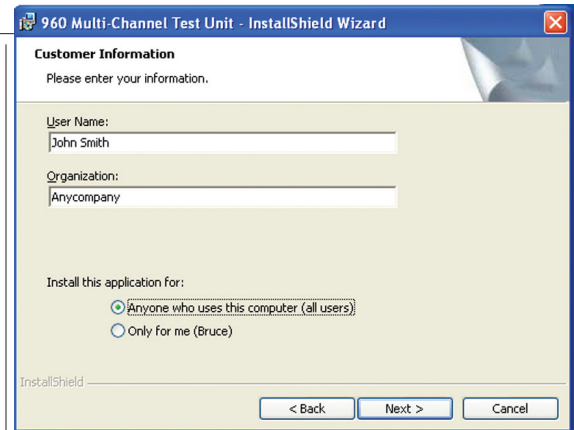
Figure 4.2.1 Customer Info Dialog Box
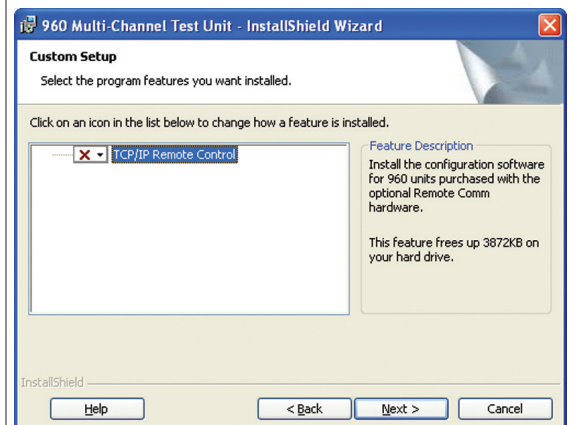
Figure 4.2.2 Custom Setup Dialog Box
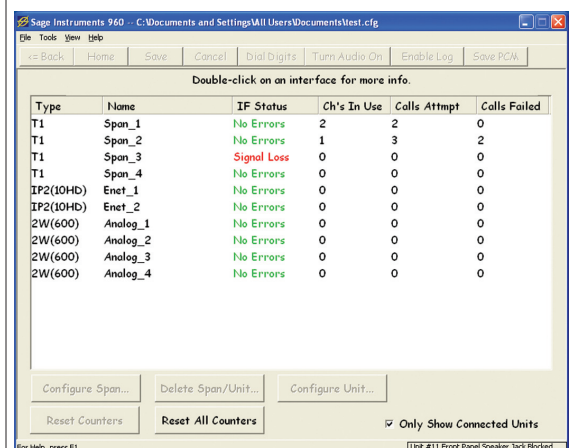
Figure 4.2.3 Home Window

If any questions or problems arise during installation, please call SAGE Technical Support at **(831) 761-1000 ext. 4.**

5. GUI Software Installation - Option 800

Important Note: *The following instructions only apply to 960B Units Equipped with the Sage Option 800, TCP/IP Remote Command Interface.*

5.1 Installation

1. To complete this procedure, you must have a Windows 2000/ Windows 2003 Server/XP/Vista PC compatible computer with a USB port, and the software update file "960_setupxxxx.exe".

Warning: *If you are currently running Sage 960 software prior to v5.7.8, your 960 configuration files may no longer be useable due to a file format change. The installation program will automatically create a new one for you.*

Warning: *DO NOT CONNECT the 960x USB port to your PC USB port, yet. If you have previously made that connection while both PC and 960x were powered up, you must first go to the end of this document and complete the section titled "If You Connected the TCP/IP 960B USB Too Soon" before proceeding to step 3 below.*

2. If the 960B is not powered up, turn it on. ***Do not connect ethernet or USB cables, yet.***

3. Launch the 960 software installer program:
    a. Using Windows Explorer, navigate to the subdirectory where you previously placed the 960_setupxxxx.exe file

    b. Double-click on the file. You may be presented a Security Warning window. Simply click on "Run".

Note: Depending on your PC operating system version, the installer may prompt you at some point to reboot your PC before continuing with the install.
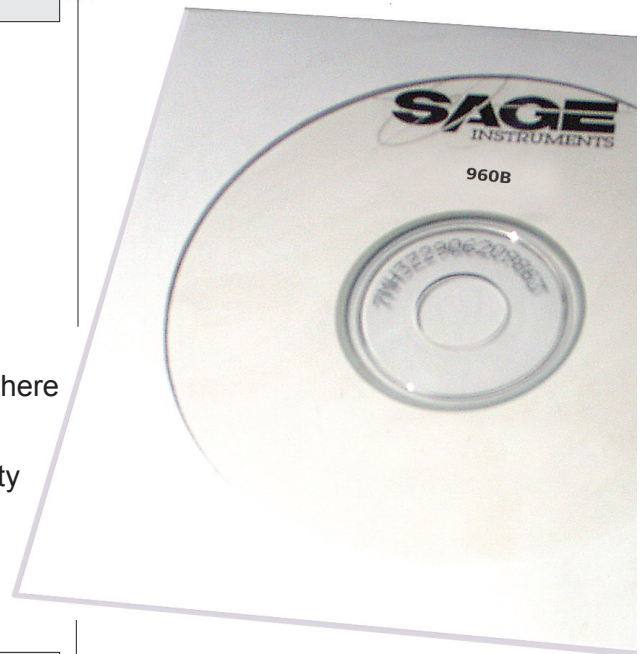
Software Installation

c. You will now see a "Sage Instruments" splash screen; click on "Next".

d. You will now see the InstallShield opening screen; click on "Next".

e. The installer will now display the license agreement. Click on "I accept the terms...." then click on "Next".

f. You will now be presented the Customer Information screen. Fill in the User Name and Organization boxes.

g. Then, click on "Anyone who uses this computer (all users)" and click on "Next".

h. The installer will now present the Custom Setup screen.

i. Click on the drop-down box just to the left of the text "TCP/IP Remote Control", and select "This feature will be installed on local hard drive" as shown in Figure 5.1.1.

j. Click on "Next".

k. The Ready to Install screen will now appear. Click on "Install".

l. At completion of the installation, click on "Finish".

m. You will see a text file "remoteControlInstall.txt" displayed. Close that window.

n. The software installation will now proceed. When it is done, a new window titled "Set Up Microsoft ActiveSync 3.8" will appear.

o. Click "Next," then click "Next" again. A "Copying File" window will open. The progress bar may pause at "92%" for 30 seconds to several minutes, depending on the speed of your PC.

p. After ActiveSync is installed, you may see a Windows Security Alert box appear. Click on "Unblock"

q. You will now see a "Get Connected" box. Connect the supplied USB cable between your PC and the 960B.

r. The "Found New Hardware Wizard" will appear as shown in Figure 5.1.2. Choose ""No, not this time," then click "Next".

s. Choose "Install from a list or specific location," as shown in Figure 5.1.3, then click "Next".
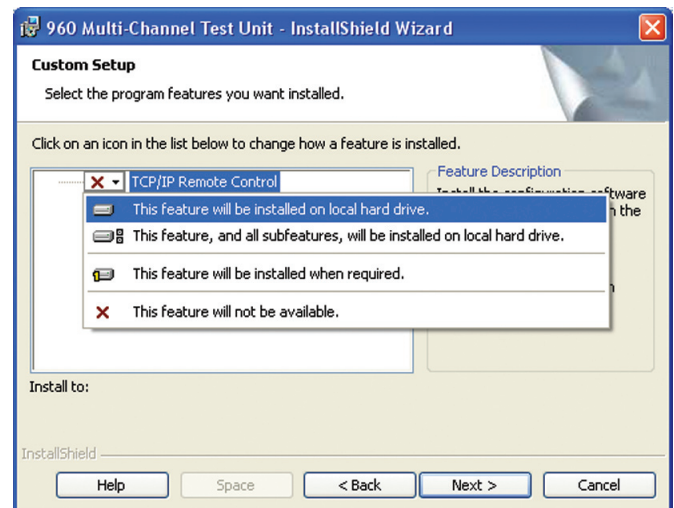
Figure 5.1.1 Custom Setup
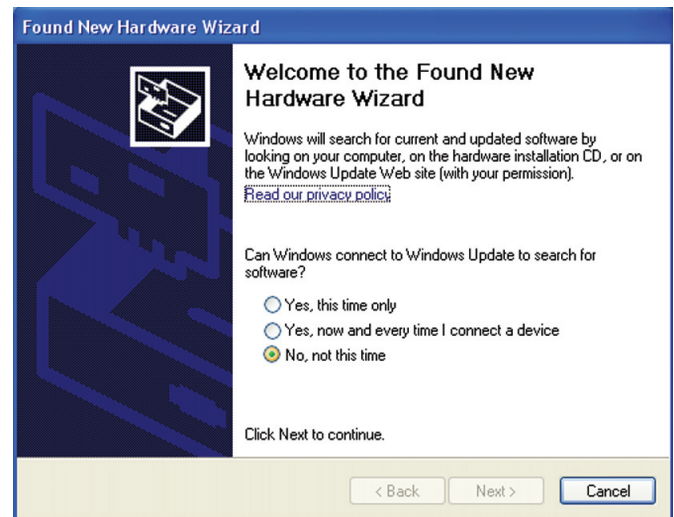
Figure 5.1.2 Use Windows Update Dialog
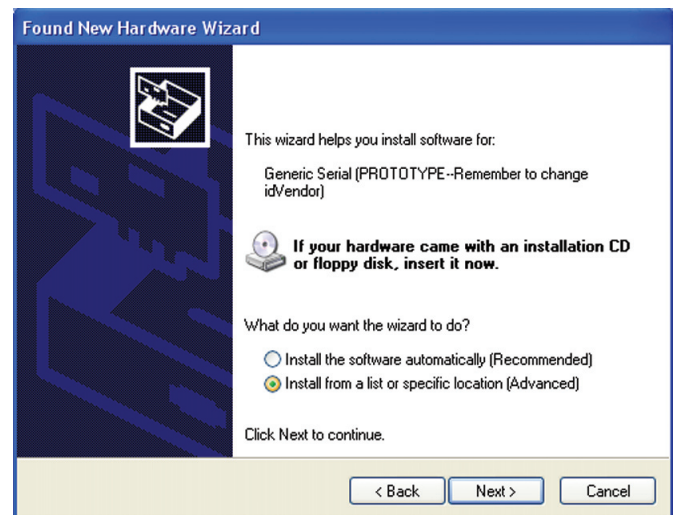
Figure 5.1.3 Install From A Specific Location

t. Click on "Include this location in the search" check box, circled in Figure 5.1.4. Then click on the Browse button to select the folder for the drivers.

u. In the Browse for Folder dialog box select the folder C:\ Program Files\Sage Instruments\960\ce\drivers Drivers folder as shown in Figure 5.1.5.

Note: Alternately the file path and name (without quotes), "C:\Program Files\Sage Instruments\960\ce\drivers", can be typed directly into the Search Location text box in Figure 5.1.4.

v. Click on "Next". You may see an alert box that warns that the driver has not passed "Windows Logo testing..." . Click on "Continue Anyway".

w. Once ActiveSync 'sees' the 960B, it will present a New Partnership dialogue box. Click on "No," then click "Next".

x. The Microsoft ActiveSync application window shown in Figure 5.1.6 will then appear. It may be obscuring part of the "Found New Hardware Wizard" window. Click on that "Wizard" window to bring it to the front, then click on "Finish"

y. If the ActiveSync application window does not come up then try power cycling the 960 and resume this procedure at step w.

z. The software installation is now complete. You will now need to configure the 960 ethernet remote control interface via the USB interface. See the following section on assigning the 960 IP address for more information.
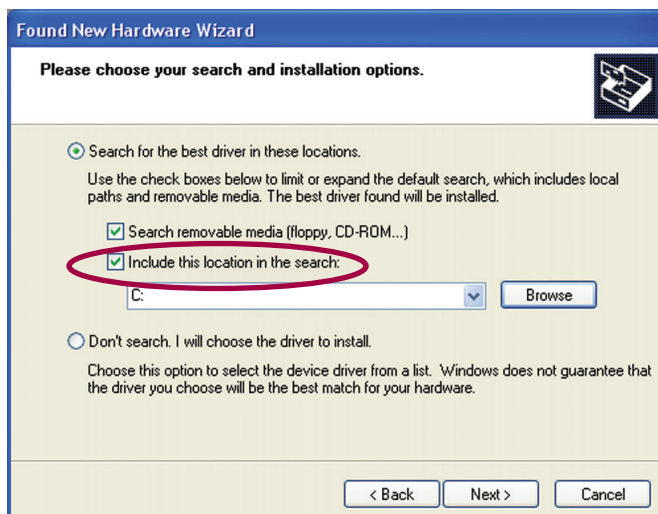
Figure 5.1.4 Search Dialog

Figure 5.1.5 960 Drivers Folder

If You Connected the USB Cable Too Soon

If you prematurely connected the 960B USB port to your computer, your PC was not able to find the proper "driver" and has disabled communication attempts to the 960B. This section describes how to recover from this situation and relaunch the Windows **"Found New Hardware Wizard"**.

1. If the TCP/IP 960x USB port is still connected to your PC, disconnect it now.
2. In Windows XP, use your PC mouse to click on Start, Control Panel, System, Hardware, Device Manager.
3. In the Device Manager dialog box, look for an **"Unknown USB Device"** preceded by a yellow question mark. Highlight it and press the DEL (delete) key on your keyboard.
4. Close the Device Manager and all its 'parent' windows that opened up on your way there.
5. Now connect the 960B USB cable and the **"Found New Hardware Wizard"** application will launch.
6. Resume the software installation procedure at step R.

Figure 5.1.6 ActiveSync Application

5.2 Assigning the 960B IP Address

960B users who's machines are equipped with the 800 TCP/IP Remote Command interface option will need to assign the 960B an IP address and port identifier. The 960B will accept a static IP address or a Dynamic Host Configuration Protocol (DHCP) address. Setting up the IP address is performed via the USB interface.

1. After the 960B unit is configured as a node on your network do the following:

   A. Connect the 960B via USB cable to a PC or laptop pre loaded with the 960B GUI software and Microsoft ActiveSync.

   B. Launch the 960B application by double clicking on it's alias icon on your desktop.

   C. In the Home window menu bar click on "Tools" and select "Configure TCP/IP Unit via USB..."

   D. The TCP/IP Configuration window is shown in Figure 5.2.1. Enter the static IP, Netmask and Gateway addresses, or select DHCP addressing. If you are not sure which way to configure the port ask your network administrator.

   E. Click "Save" to save the configuration. Provide the 960B IP Address to all users.
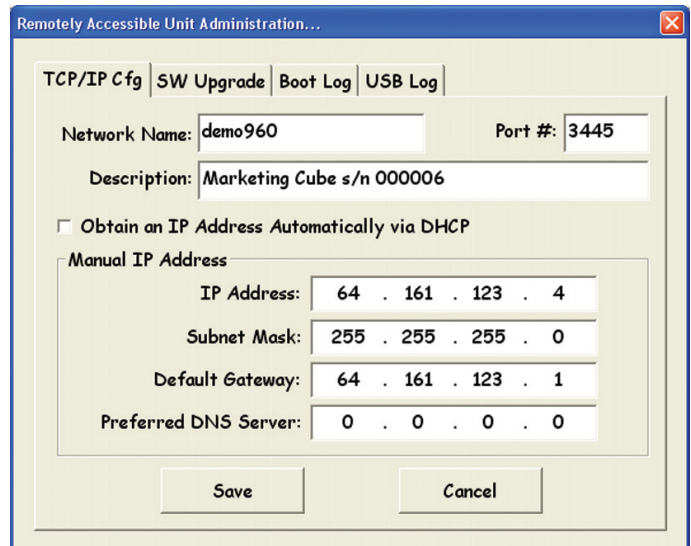
Figure 5.2.1 Remote Control TCP/IP Configuration

5.3 Connect to the Remote 960B

The first time a 960B user logs onto the machine he or she will have to enter the IP address. This will only have to be done once as the 960B software residing on the users local machine will remember the connection path.

1. Launch the 960B application.

2. From the blank configure screen click on "Tools" from the top menu, then select "Connect to Remote Unit".

3. This action presents a dialog box like the one pictured in Figure 5.3.1. Enter the IP Address and click the "Connect" button. The system uses the default port number 3445. This default value should be used unless network requirements dictate otherwise.
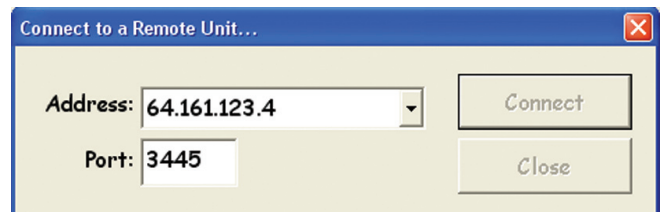
Figure 5.3.1 Connect to Remote Unit Dialog Box

Connecting To a Remote 960B

(Continued)

Figure 5.3.2 Successful Remote Connection Dialog

5.3.1 Connection Successful

The 960 GUI software will attempt to communicate with the remote 960 unit. Figure 5.3.2 shows a successful connection dialog box. Once the connection has been established this dialog box will disappear, leaving the Home window displaying the status of the remote 960 test interfaces.

5.3.2 Connection Timed Out

If the 960 GUI software is unable to communicate with the remote 960 the software will display the error message, "Connect Fails! Connection timed out" as shown in figure 5.3.3. This error message indicates that the remote 960 is unreachable. Check network connections and verify the IP address if applicable, is correct. If connection problems persist try power cycling the remote 960.
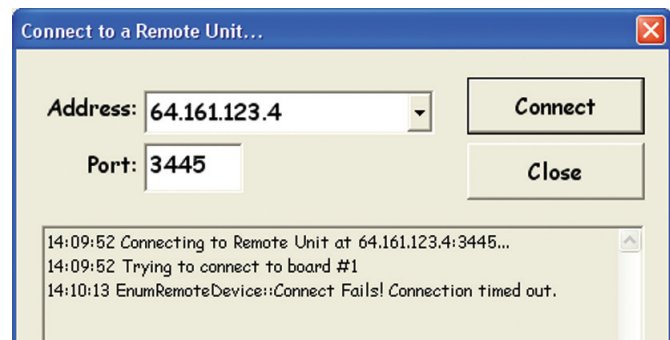
Figure 5.3.3 Connection Timed Out

5.3.3 Connection Refused

If the 960 is unavailable because another user is logged in, or the remote 960 is setup in multi-user mode, or the system is otherwise busy, the error message "Connect Fails! Connection Refused (no one is listening)" is displayed as shown in Figure 5.3.4.
Try telnetting to the remote 960 to see if it is in multi-user mode. Also keep in mind that the 960 takes several minutes to boot up and initialize its ethernet interface. Be sure to wait long enough for the initialization processes to complete before attempting to connect to the remote 960.
If connection problems persist try power cycling the remote 960.
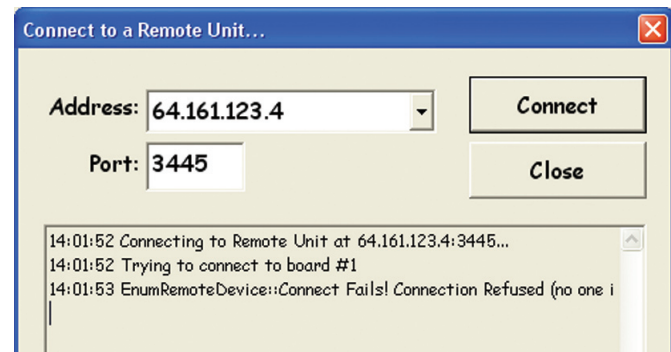
Figure 5.3.4 Connection Refused

6. 960B Software Upgrade

Introduction

The software residing in the 960B can be field upgraded. The following section details the upgrade procedure. 960B units equipped with Option 800, the TCP/IP remote control option, use a different procedure for software upgrade. This section contains upgrade procedures for both types of units.

6.1 Software Upgrade for Units without Option 800

When the 960 GUI software starts, and detects a 960B connected without option 800, it first loads the current software into the 960B. This software is stored in the 960B's RAM memory where it is used to run tests. In this instance, upgrading the 960B software is simply a matter of obtaining the new GUI software containing the 960 updates. Install this update on the computer controlling the 960B. Then connect the 960B USB to the computer and launch the 960 GUI. This will load the latest software into the 960B. You can verify the current versions of software for T1/E1, IP and Analog interfaces by verifying the DSP Version number displayed in the Span Edit window for each of the three interface types.

6.2 Software Upgrade for Option 800 Units

960B's equipped with option 800 utilize flash memory for storing internal software. This flash memory can be upgraded via the USB connection, or over the ethernet interface. The following two procedures describe the upgrade process.

6.2.1 Option 800 Upgrade via USB Interface

This procedure is used when the 960B is not remotely located. It is simpler than upgrading over the ethernet interface, so it is the preferred method for upgrading an Option 800 960B.

This procedure assumes that the 960 GUI software has already been installed, is properly configured and can remotely connect to the 960 to be upgraded. See the sections on Software installation, Assigning an IP address, and Connecting to a Remote 960 for more detail on setting this up.

A. To insure Microsoft ActiveSync is running, click on Start/Programs/Microsoft ActiveSync. The ActiveSync window should appear. As shown in Figure 6.2.1.

B. Launch the 960B PC GUI program.

C. Connect a USB cable from your PC to the 960B rear panel USB connector. If the the 960B is not powered up, turn it on.

D. Once ActiveSync 'sees' the 960B, it will present a New Partnership dialogue box. Click on "No," then click
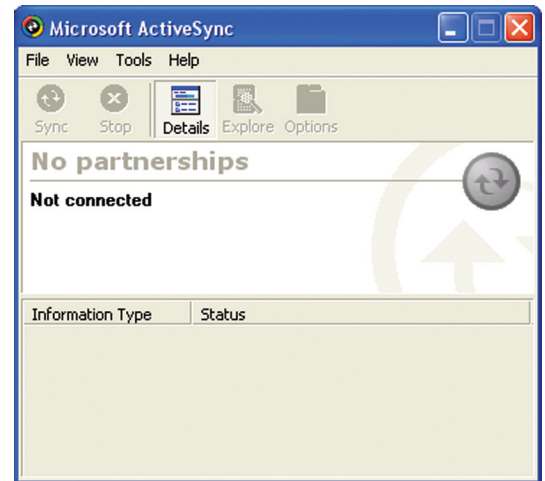
Figure 6.2.1 ActiveSync Not Connected
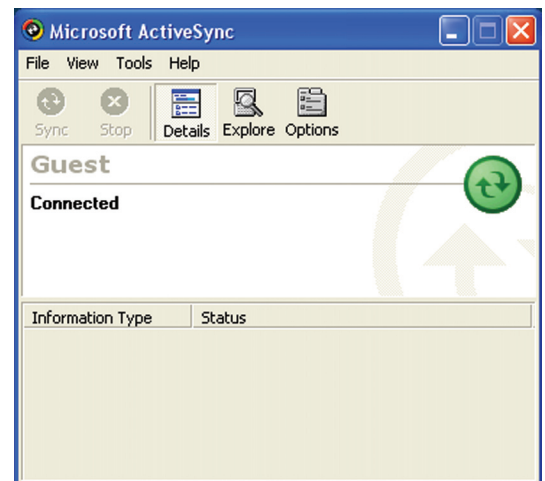
Figure 6.2.2 ActiveSync Connected

"Next" . The ActiveSync guest window will appear as shown in Figure 6.2.2.

E. Click on the Tools Menu at the top of the 960 Home window. Then select Configure TCP/IP unit via USB. This will bring up the Remote Control TCP/IP Configuration Dialog box shown in Figure 6.2.3.

F. Click on the SW Upgrade tab circled in Figure 6.2.3. You will see a short instructional paragraph, as shown in Figure 6.2.4

G. Click the "Next" button. The software update process will start, and the window will display the name of each file as it is being copied to 960B FLASH memory.

H. Once the file updates are complete, you will see another short instructional paragraph. Click on the "Finish" button to complete the upgrade.

*Note that you must power cycle the 960B to complete the software update process.*

6.2.2 Upgrading 960B Software Via Ethernet

960B units with option 800 can be upgraded remotely via the ethernet control interface.

A. Insure your PC and the 960B are both connected to the Ethernet, and powered up.

B. Place the remote 960 in Command Line Mode. See the Command Line Interface section of this manual for instructions on putting the 960 into command line mode.

C. Download the file "remote960FTPupdate2.exe" from the Sage Web site. It is at <http://www.sageinst.com/files/>. You will have to enter a user name (sagesupport) and password (sage935) to gain access to the site.

D. The file "remote960FTPupdate2.exe" is a self-extracting 'zip' file. Double clicking on it will extract the contained files and place them in the c:\tempy subdirectory on your hard disk. If c:\tempy does not exist, it will be automatically created for you.

E. Using Windows Explorer, navigate to the c:\tempy subdirectory on your PC's hard disk. You should see the following two (2) files there:
remote960FTPupdate2.bat - - FTP update batch file program
TST10.exe - - helper application

F. Start the installation program by double-clicking on the "remote960FTPupdate2.bat" file.

G. A 'DOS' window will open and prompt for the IP address of the 96x. The address can be the numeric address, or an alphanumeric alias that you normally use when telnetting to the unit.
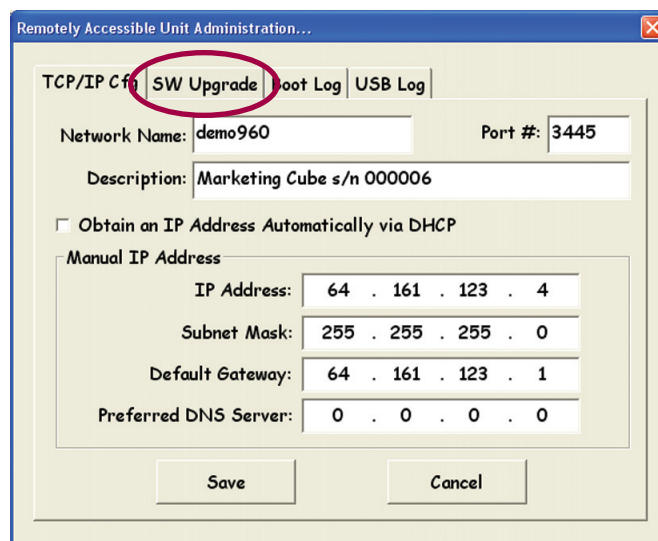
Figure 6.2.3 Configure TCP/IP Window
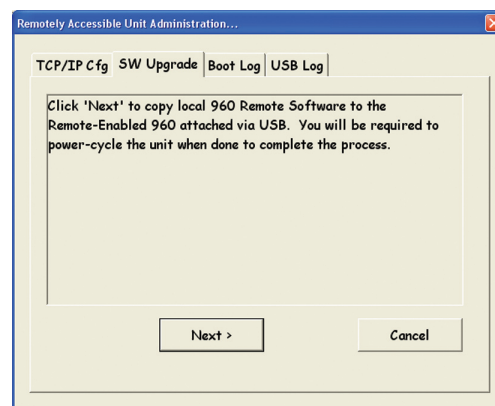
Figure 6.2.4 Software Upgrade

H. You will then be prompted for the "admin" user password for the target 960B.

I. Once you answer password prompt, the program will proceed to FTP all appropriate software update files from your PC to the on-board Flash memory in the 960B.

J. Upon completion of the file transfer, the program will open a Telnet connection to the 96x and issue a 'warmboot' command to insure the 96x will use the newly transferred files.

K. A 'DOS' window will open announcing completion of the file transfers and notification that the warmboot command was issued, press <ENTER> to close the window.

L. Wait two (2) minutes or more before re-accessing the 96x via Telnet, Web, or GUI methods.

7. 960B Options

Sage 960B options are sold separately. Please contact your Sage sales representative for pricing and availability.
831-761-1000 (press 2).

Part Id	Description
7960-0100-02	Dual E1/T1 interfaces
7960-0200-02	Quad E1/T1 interfaces
7960-0300-02	Dual ENT (10/100 BaseT) Interfaces
7960-0450-02	Quad 2-Wire & 4-Wire Analog Interface
7960-0800-02	Onboard TCP/IP Remote Controller
7960-1000-02	PRI-ISDN Call Setup Protocol
7960-1010-02	Remote Audio Monitor
7960-5000-02	E-Model ITUG.107 Conversational Quality Test
7960-5010-02	Analog ITU P.862 PESQ, License
7960-5020-02	TDM ITU P.862 PESQ, License
7960-5030-02	Ethernet ITU P.862 PESQ, License
7960-5040-02	PESQ Tools Offline GUI (Single User)
7960-5050-02	PESQ Bundle Analog/TDM(2)/ENT
7960-5100-02	Digit Analyzer
7960-5200-02	ROTL 100, 102, 105 Test Lines & Directors
7960-5300-02	MoIP Test Line & Director
7960-5400-02	BERT - DS0, DS1, FT1, and FE1 BERT
7960-5500-02	NGEN Tests - SMOS, PVIT, Echo Sounder, Echo Generator Test Lines and Directors
7960-5600-02	G.168 Suite - ITU G.168 Echo Canceller Conformance Test
7960-5700-02	INMD - ITU P.561 (Passive Echo)
7960-5800-02	Fax - T.30 Transmit & Receiver Emulation
7960-5900-02	V.9X Modem Protocol Analyzer
7960-6110-02	SIP Protocol Mon/Decode
7960-6120-02	SIP Call Setup
7960-6130-02	RTP Mon & Decode plus Dual Spectrum Analyzer
7960-6140-02	RTCP Monitor & Decode
7960-6150-02	RFC 2833/4733 Telephony Event Monitor
7960-6155-02	RFC 2833/4733 Special Event Emulator
7960-6160-02	T.38 Fax Relay Protocol Monitor
7960-6170-02	ITU T.38 Fax Relay Emulation
7960-6180-02	VOIP Impairment Generator
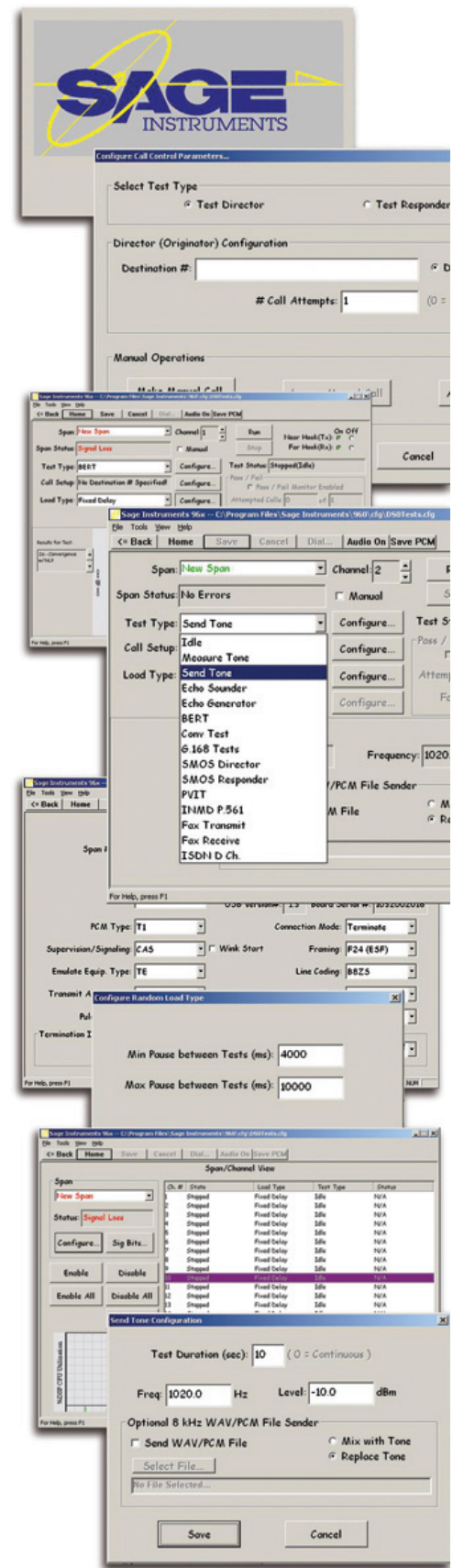
8. Installing Newly Purchased Options

8.1 Verify 960 Serial Number in Firmware

The options key for enabling new options can only be used with a 960B that matches its serial number ID. The following procedure is used to verify that the 960B firmware serial number matches the option file.

A. Power up the 960B Multi-Channel Test Instrument and launch the SAGE 960B software application by double clicking on the alias icon created on your desktop by the installer.

B. From the SAGE 960B application's home page, highlight one of the spans by clicking on it.

C. Click on the 'Configure Span' button. Verify that the displayed 'unit Serial #' matches the serial number located on the rear panel of the currently connected 960B unit. If the serial numbers didn't match, contact SAGE Customer Service **1-831-761-1000**...press 1.

8.2 Configuring Options

The following procedure is used to view or activate new options. Activating new options requires an option file purchased from Sage.

A. From the SAGE 960B application's home page, highlight one of the spans by clicking on it. Then click on the "Configure Unit" button.

B. Next click on the "View Purchased Options" button. This action presents a screen of all available options shown in Figure 8.2.1. Enabled options are shown in green. Inactivated options are greyed-out.

C. To install a 960B new options file click on the "Activate Options" button circled in Figure 8.2.1. A dialog box containing a blank "Key Field" will appear as shown in Figure 8.2.2.

D. Get the purchased option registration key. Using Windows Explorer, navigate to the 960B 'Options' file you downloaded after purchase and double click on It (The filename will typically be in the form of xxxxx.txt, where xxxxx.txt is the serial number of your 960B).

E. Windows Note pad will automatically open with the encrypted options string displayed.

F. Highlight the options string and copy it to the Windows clipboard. To copy, type Ctrl-C (press and hold the 'Control' key while you type 'c'). To install the new Option File into the 960B return to the activate options dialog box containing the blank "Key Field" shown in Figure 8.2.2.

G. Place your mouse over the bank key field and click once to
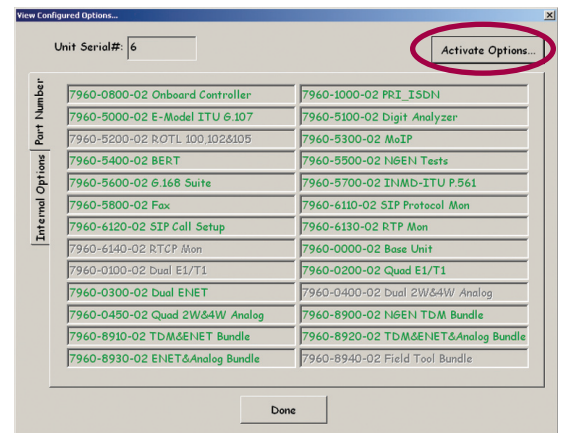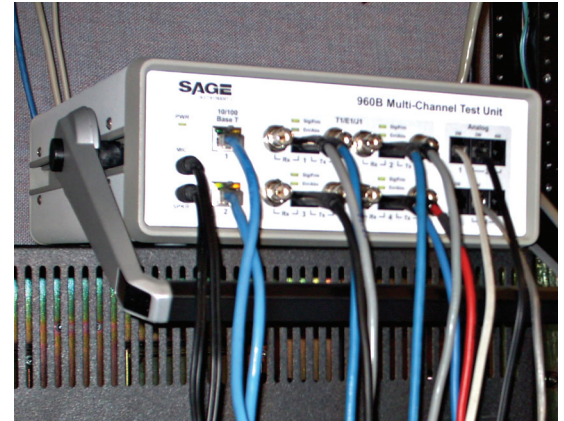
Figure 8.2.1 Purchased Options Window
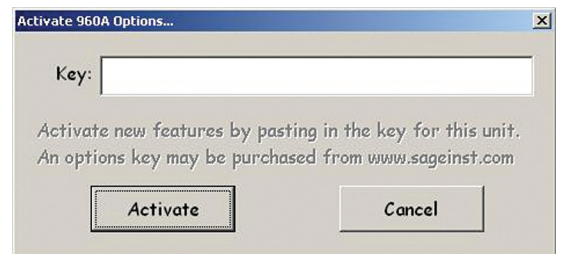
Figure 8.2.2 Activate Options Dialog

place a blinking curser in the text box.

H. Paste the options string into the text box. To paste, type Ctrl-V. To finish, click on the "Activate" button.

I. Close the 960B GUI and relaunch the application to complete the activation.

Section 2
960 GUI Common Setup and Control Windows

The following Section covers the common configuration and control windows of the 960 GUI. These windows are used to configure interfaces, and tests as well as managing the test session. Refer to Section 3 for information on configuring running and viewing results for any of the 960 tests.

Section 2 Contents

1. PC GUI Quick Start

1.1 Basic Menu Operations

The following section is intended to get users up and testing with a minimum of reading. For a more detailed description of test windows and parameters refer to the relevant sections in the manual.

The windows used for basic operation are the Home, or Interface View window, Span View window, Span Edit window, Test Control window and Test Results window. These five windows are the basis for configuring, running and viewing tests. Additional windows that are unique to each test type are also used in setting up the tests. For information on these windows refer to the relevant test description in the Running Tests section of this manual.

Figure 1.1 Home Window

1.2 Home Window

The Home window is shown in Figure 1.1. Notice the **tool bar** circled in red. This tool bar is present in most 960 windows, it is an important control for navigating windows and saving configurations. The **Back** button on the tool bar will return the user to the previously viewed window, the **Home** button returns the user to the home window.

Below the tool bar is a list of the test interfaces and their status. Double clicking on one of the interfaces brings up the Span View window for the selected interface.

1.3 Span View Window

The Span View window is shown in Figure 1.2. This window displays the channels or test resources associated with the selected test interface. The Span View window has a tool bar at the top of the window, it is the same tool bar that is found on the Home window. The right half of the Span View window displays a list of channels as well as the status of any test on a channel. To specify or change the status of a test double click on the desired channel to bring up the Test Control Window.

To start multiple tests from the Span View window see the Multi-Channel test section.

The configuration of the selected interface can be viewed or modified from the Span View window by pressing the **Configure** button, This button is highlighted in Figure 1.2.

Figure 1.2 Span View Window

1.4 Span Edit Window

The Span Edit window is shown in Figure 1.3. This window is used to view or change the interface parameters and name. This window also contains the same tool bar found in the Home and and Span View windows. The **Save** button of the toolbar is used to apply and save any changes made to the fields in this window.
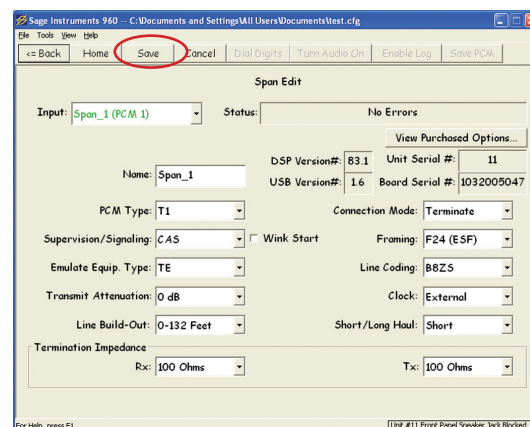
Figure 1.3 Span Edit Window

1.5 Test Control Window

The Test Control window is shown in Figure 1.4. To select or change a test to be run, click on the button in the **Test Type** list box highlighted in Figure 1.5, and select a test from the list. Once the desired test is selected press the **Save** button on the tool bar (see highlighted tool bar button at the top of Figure 1.4). This will complete the test selection and update the test results display in the lower portion of the Test Control window.

Click on the **Configure** button next to the Test Type box to make any necessary test configuration changes.

1.6 Call Setup Window

Click on the **Configure** button next to the **Call Setup** box. This will launch the Call Setup window shown in Figure 1.6. The **Select Test Type** box highlighted in the top of Figure 1.6 is used to designate the test resource as a Test Director or Test Responder. Generally tests that receive, I.E. PESQ Receive are setup as directors while test with transmit in their name are setup as responders. In a two way test like Send/Measure Tone or DS0 Bert, one side of the test is configured as a director while the other side is configured as a responder. For more information on director, responder testing review the Director/Responder Terminology section of this manual.

The director Call Setup also requires a destination number and dialing format. Enter these values and click on the save button highlighted in Figure 1.6.

1.7 Running Tests

To place a test call and run the test, click on the **Run** button highlighted on the right side of the Test Control window in Figure 1.4. The 960 will place the test call and start the test. Call progress can be viewed in the **Test Status** box located below the Run/Stop buttons in the Test Control window. As the tests are run the results are displayed on the lower portion of the Test Control window.

1.8 Test Results Window

The results undocking button is highlighted in the left edge of the window in Figure 1.4. This button allows the test results to be displayed in a separate window as shown in Figure 1.7.

1.9 Running and Viewing Multiple Tests

Multiple tests can be setup and run by defining additional tests on other unused interfaces or channels. The Test window undocking button can be used to display results windows for each running test.
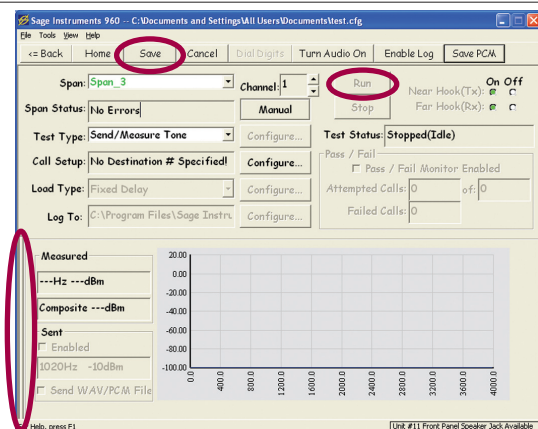
Figure 1.4 Test Control Window
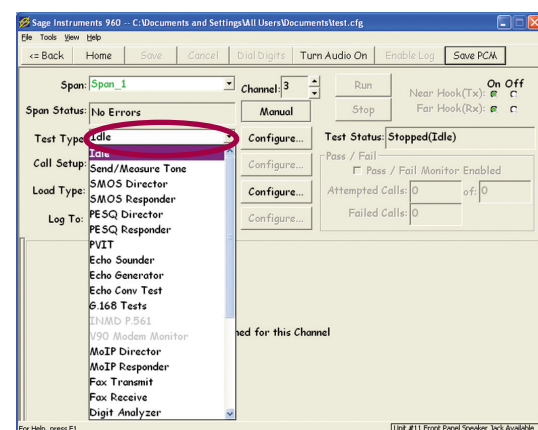
Figure 1.5 Test Type Selection
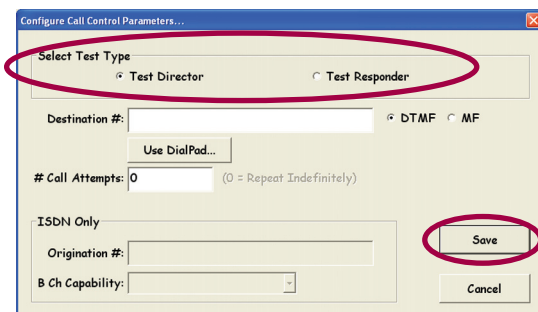
Figure 1.6 Call Setup Window
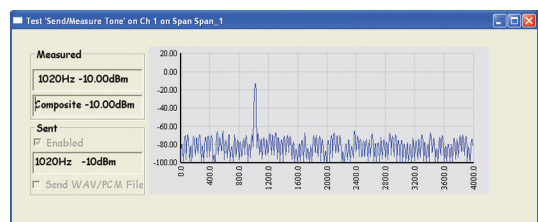
Figure 1.7 Test Results Window

1.10 Test Menu Overview

Figure 1.8 illustrates the relationship between the five basic testing windows and the navigation between them.

Home Window

Double Click An Interface

Click Configure Button

Span View Window

Double Click A Channel

Span Edit Window

Test Control Window

Click to Undock Results

Test Results Window
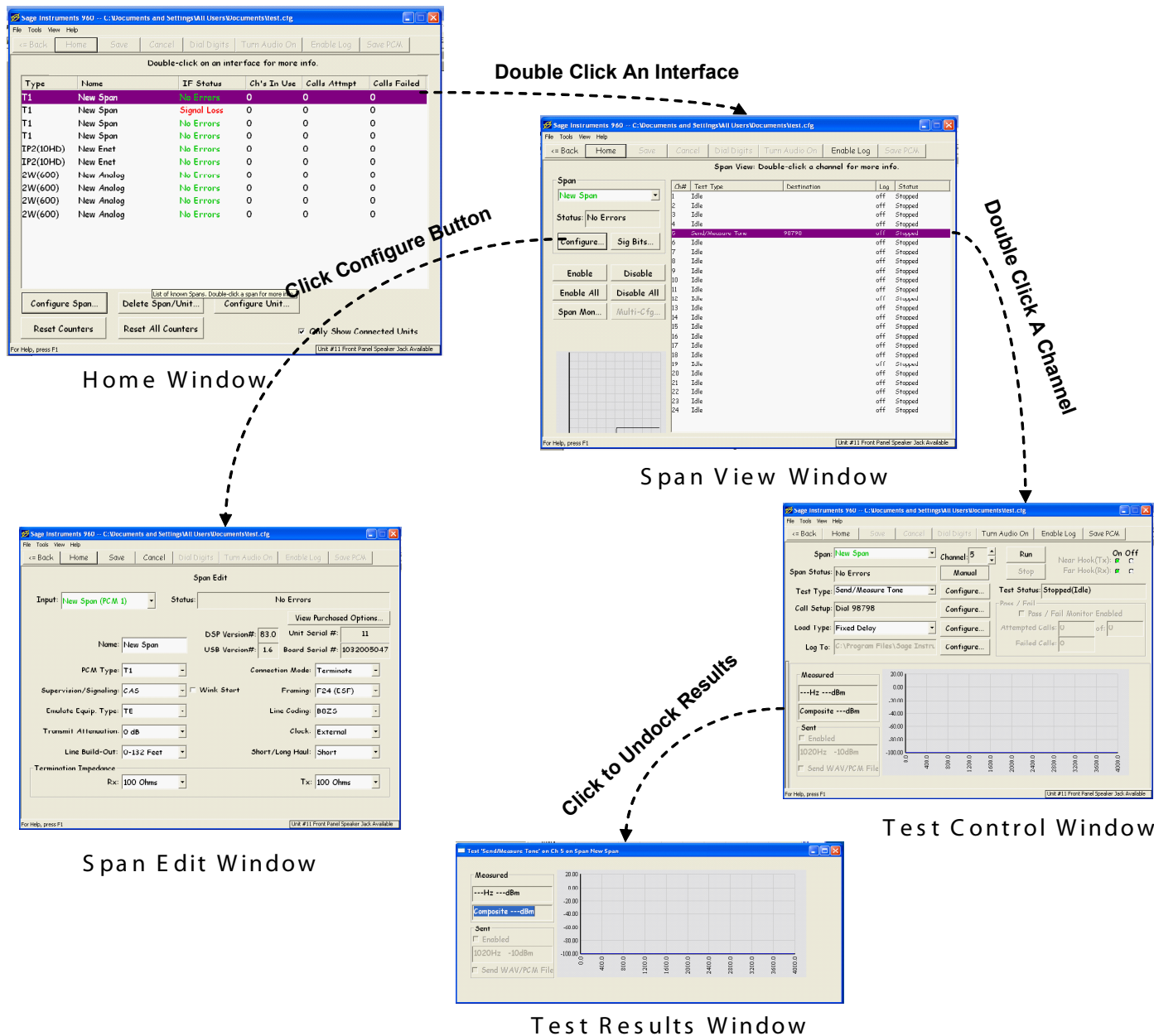
Figure 1.8 Basic Test Windows

2. PC GUI Description

Introduction

This section covers the configuration and control windows of the 960B user interface software. Detailed information on the individual tests and their associated windows can be found in the Running Tests section of the manual.

2.1 Home Window Description

The Home window displays a list all the 960B test interfaces and their respective states. In addition to the states there are also three counters for each interface. These counters indicate the number of channels in use, total calls attempted and total calls failed for each interface. From the Home Window the user can select an interface and open the Span Edit window to view or modify the configuration of the interface. There is a menu bar and tool bar at the top of the window, and a group of configuration buttons at the bottom of the window. The following is an in depth description of each of the configuration buttons and menu items in the Home window,
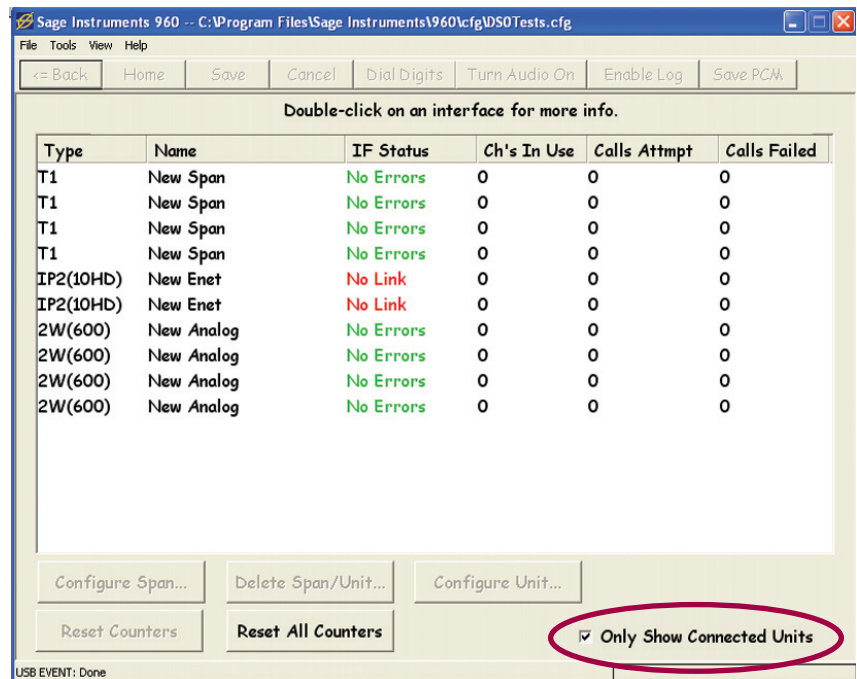
Figure 2.1.1 Home Window

2.1.1 Only Show Connected Units Check Box

The **Only Show Connected Units** check box is located in the lower right corner of the Home window. See the box highlighted in red in Figure 2.1.1. By default this check box is normally checked. This limits the displayed interfaces to only show interfaces that are present in the currently connected 960. The 960 user interface software uniquely identifies any 960 and its interface boards, therefore every time a different 960 is attached to the User Interface software, the software keeps track of the interface names and internal identifications. When the Only Show Connected Units box is unchecked, the software will display a list of all test interfaces that have ever been connected to the user interface software. If the user interface software has only been connected to one unit, then the Only Show Connected Units check box will not change the number of displayed interfaces.

2.1.2 Home Window Menus

Just below the colored bar at the top of the Home window are four menu options labeled File, Tools, View and Help. The following describes the function of each of these menu items.

2.1.3 File

The **File** menu shown in Figure 2.1.2, allows the user to manage configuration files and exit the 960 program.

2.1.4 Configuration Files

Configuration files are used to save and restore test setups. These include interface configurations and names, tests defined on channels including the state of the test and any log file setup information. When the 960 software is run for the first time, it opens the default DS0Tests configuration file that is shipped with the software. Upon exiting the 960 software the associated configuration file is updated to reflect the current configuration of the unit. When the 960 software is restarted the

last configuration file used will be automatically be loaded and associated with the test session. Configuration files are intended to work with the particular 960 unit the file was created for. To use configuration files from different 960's see Import Cfg File located under the Tools menu.

2.1.5 Loading and Saving Configuration Files

The File Menu has two menu items called "Load Cfg File..." and "Save Cfg File as...". These entries are used for loading and saving configuration files. Once a configuration file is loaded into the program any changes to the configuration of the 960 will be automatically updated in the associated .cfg file.

Below the Load and Save Cfg File menu items is a list of recently accessed configuration files. Clicking on one of these entries loads the named configuration file.

2.1.6 Tools

The tools menu shown in Figure 2.1.3 contains three selections; "Connect to remote Unit", "Configure Audio", "Import Cfg File" and Configure TCP/IP Unit viaUSB". The following section describes the Configure Audio and Import Configuration File selections. For a procedure for configuring the 960 IP address or connecting to a remote unit, refer to the GUI Installation for Option 800 Units section of this manual.

2.1.7 Configure Audio

The 960 has the ability to monitor the audio, i.e. speech or test tones, on the channel under test. This audio is sent to the computer running the 960 User Interface Software and is available via the system sound card and speakers if so equipped. The Configure Audio menu item is used to setup this audio monitor feature. Clicking on the Configure Audio menu item brings up the dialog box shown in Figure 2.1.4. Select the direction to monitor and click OK to save.

2.1.8 Import Configuration File

This menu item is used to import a configuration file that was created for another 960. Clicking on this menu item brings up a warning dialog box asking to confirm the import of another units configuration file. Clicking OK brings up the dialog box shown in figure 2.1.5. In this box click No if the hardware configuration of the two 960's is identical. Otherwise click Yes. After making a selection, the windows open file dialog box will appear allowing the user to select the configuration file to import.
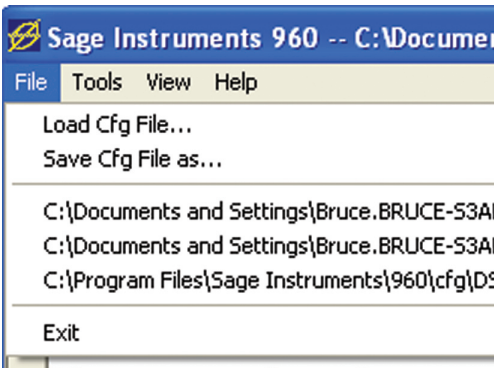
Figure 2.1.2 Home File Menu
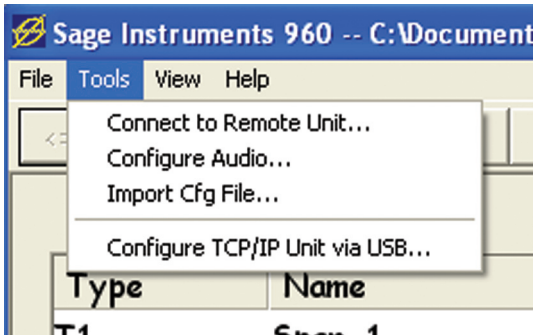
Figure 2.1.3 Home Tools Menu
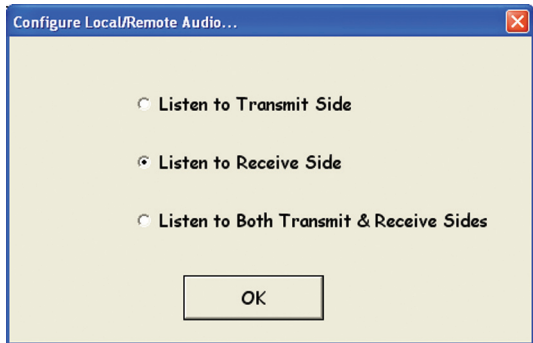
Figure 2.1.4 Configure Audio Dialog
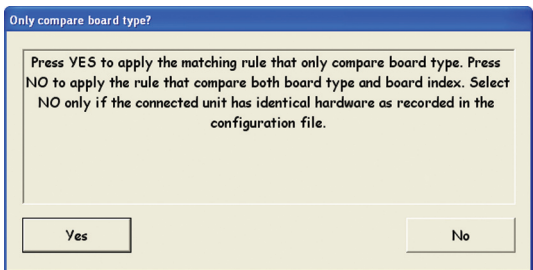
Figure 2.1.5 Import Cfg File Dialog

Home Window Menus and Controls

2.1.9 View

The view menu shown in Figure 2.1.6 offers two options; "Status Bar" and "Context Help". Both are checked on by default. These menu items don't launch any further windows, but simply turn on or off the context help and the status bar at the bottom of each window where the context help is displayed.

2.1.10 Help

At this release "Help" is under development. The only menu item in the Help menu is About. The About selection launches the application start-up screen, the version number of the 960B GUI software is displayed here.
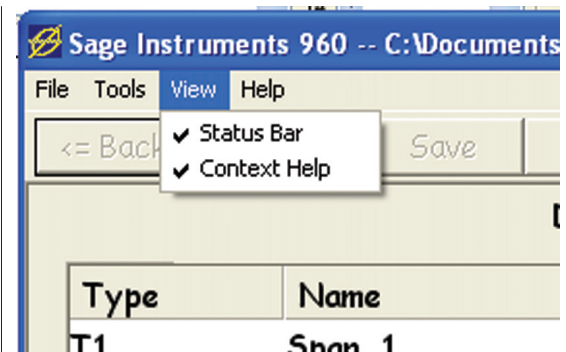
Figure 2.1.6 Home View Menu

2.1.11 Home Window Buttons

In the lower left hand portion of the Home Window are five buttons used for managing spans for testing; "Configure Span", "Delete Span/Unit", "Configure Unit", "Reset Counters"and "Reset All Counters". These buttons are circled in Figure 2.1.7.

2.1.12 Delete Span/Unit

Selecting a span and clicking the "Delete Span/Unit" button, launches a dialog box requesting confirmation of the delete action. Upon confirmation all configuration data and any test setups for the selected 960 unit will be deleted. All tests and test interface configurations will also be deleted from the current test configuration file. If the 960B is connected and powered up, the spans will reappear with all tests cleared.
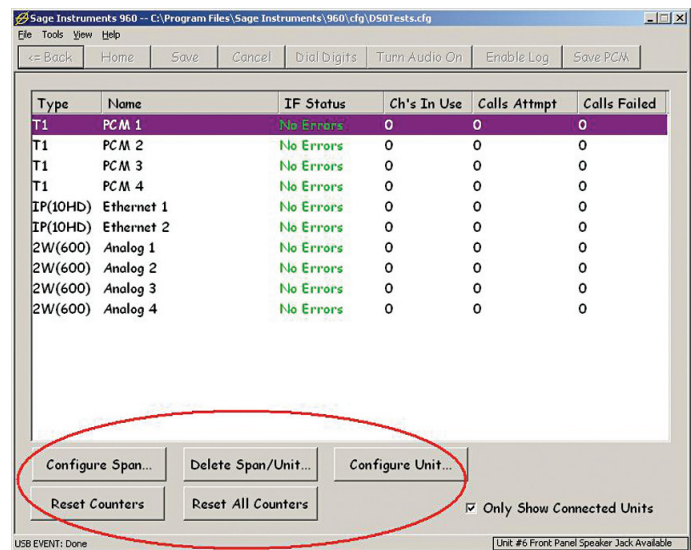
Figure 2.1.7 Span Configuration Buttons

2.1.13 Reset Counters and Reset All Counters

Located across the center of the Span Screen above the available spans are three categories; Type, Name and Interface Status. In addition there are three "Counters"; "Chs in Use", Calls Attempted and Calls Failed. The Calls Attempted and Calls Failed count can be reset at any time by highlighting the interface and clicking on the Reset Counters button. Clicking on the Reset All button will reset the counters on all the interfaces of the 960.

2.2 Span Edit Window Description

After highlighting the desired span clicking the Configure Span button will bring up the Edit Span window. This window is used to view or change the test interface configuration including the interface name. Additionally, the unit and board serial numbers as well as DSP and USB code versions are displayed in this window. The button labelled View Purchased options is also in the Span Edit Window. Clicking on this button will bring up a list of purchased options for the connected 960. The option list also contains a button for activating new options. Refer to the Purchased Options

section of the manual for more information on activating purchased options.

2.2.0.1 Configuring Test Interfaces

The Span Edit window for configuring T1 and

Span Edit Window (continued)

E1 spans is shown in Figure 2.2.1. The Span Edit window has a different format for each interface type, T1/E1, Ethernet and Analog. The following describes common elements to all three of the Span Edit window types. Subsequent sections describe the windows for each interface type.

2.2.0.2 Menu and Toolbar
The Menu and toolbar at the top of the window is identical to the one in the Home window. The Save button in the toolbar is important for saving any changes made to this window. If the Save button is not used any changes made in this window will be discarded.

2.2.0.3 Input Box
The **Input** box is highlighted in Figure 2.2.1. The input box and associated button displays the currently selected interface. Clicking on the button to the right of the box displays a list of all similar type interfaces in the connected 960. Clicking on an interface in the list brings up the selected interface in the Span Edit window.

2.2.0.4 Name Box
The **Name** box located below the input box displays the interface name. The name can be changed by typing the new name into the box. Make sure to click on the save button to make any changes permanent.

> **Note:** Naming the spans other than the default name "New Span" is very helpful especially when running multiple span tests.

2.2.0.5 Board and Unit Info
In the upper right portion of the Span edit window are the **Status** and board information fields. These fields display the status of the selected interface as well as the **Unit** and **Board Serial** number and associated **DSP** software version. The **USB** software version is also shown here. For IP interfaces the **MAC** address is also included here.

2.2.0.6 View Purchased Options
The span edit window has a button in the upper right portion of the window labeled **View Purchased Options**. Clicking on this button brings up a list of the software and hardware options in the selected unit. This list of options has a button for activating additional options. See the Activating Options section for more
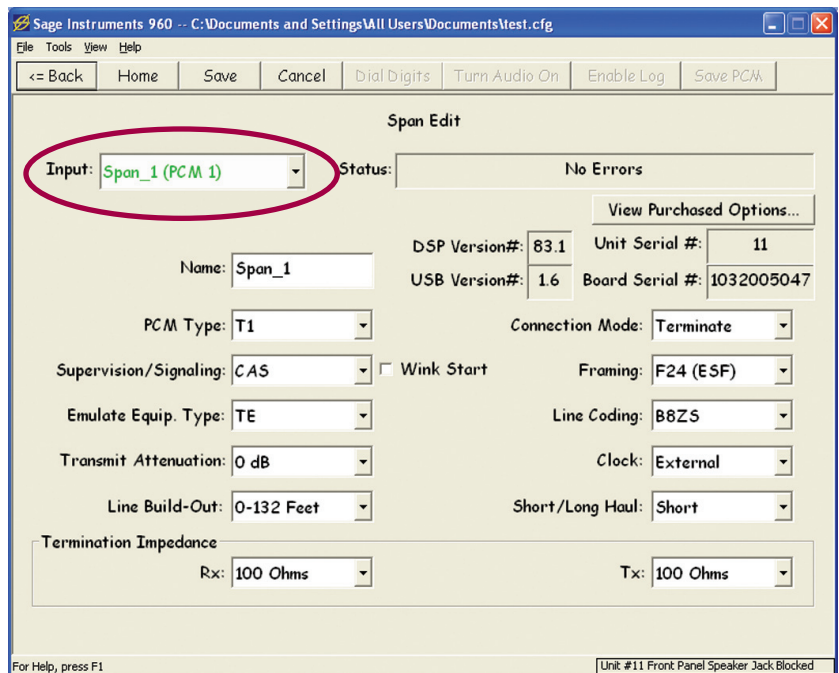
Figure 2.2.1 T1/E1 Span Edit Window

information on activating new options.

2.2.1 Span Edit Window T1/E1 Elements
The Span Edit window for T1 and E1 interfaces is shown in figure 2.2.1. Since this window handles both T1 and E1 interfaces, several of the interface configuration values are different for T1 or E1 interfaces. The fields PCM Type, Emulate Equip Type, Connection Mode, Clock and Short/Long Haul are common in both T1 and E1 interfaces. The following section describes these fields. T1 and E1 specific configuration will be covered in separate subsections.

2.2.1.1 PCM Type Box

Span Edit Window T1/E1 Elements (Continued)

Below the name box is the **PCM Type** box. This is used to select **T1** or **E1** formatted PCM interfaces. Click on the button to the right of the box and select the appropriate interface type.

2.2.1.2 Emulate Equipment Type

The **Emulate Equip. Type** list box field shown in Figure 2.2.2 is used to specify the side of the network connection to emulate. There are two choices presented, **TE** for Terminating Equipment and **NT** for Network Termination.

When the 960 is terminating the end of a circuit TE is selected. When the 960 is inserted into a network, or is testing toward a piece of terminating equipment NT is selected.
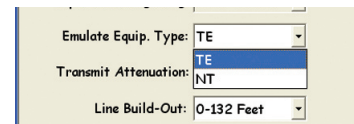
Figure 2.2.2 T1/E1 Emulate Equipment Type List Box

2.2.1.3 Connection Mode

The **Connection Mode** parameter shown in Figure 2.2.3 is used to define the type of test access. Available values are: Terminate, D&I, Monitor and Dual Monitor.

Terminate is used when the 960 terminates the end of a span i.e. when both transmit and receive sides of the span are connected to the 960.

D&I stands for Drop and Insert. In this access mode, the 960 uses one of the T1/E1 channels for intrusive testing, while the traffic on the other channels is passed through the 960 with 48 milliseconds of delay added. This test access mode is commonly used when testing in-service spans.

Monitor testing is used to perform non intrusive tests on a circuit. Traffic on the span is not affected by monitor mode access.

Dual Monitor mode is a special test access mode used for correlating events in the 960. This mode should only be used when performing INMD and the V.90 Modem Monitor tests. This test mode requires using interfaces in pairs, I.E. 1&2 or 3&4. For other instances where two T1/E1 monitors are required, setup two spans in the Monitor mode.
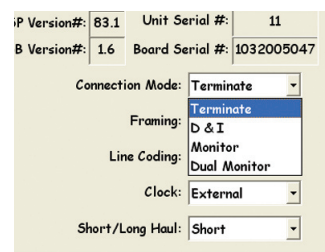
Figure 2.2.3 T1/E1 Connection Mode List Box

> **Warning:** performing non-dual monitor tests in the dual monitor mode can cause measurement errors.
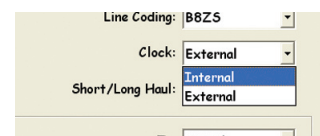
Figure 2.2.4 T1/E1 Clock List Box

Figure 2.2.5 T1/E1 Short/Long Haul List Box

2.2.1.4 Clock

The **Clock** parameter shown in Figure 2.2.4 is used to set the timing for the transmit side if the selected span. The available

values for this field are external and internal. In **External** mode, the 960 uses the recovered clock from the receive side of the span for the transmit clock source. In the **Internal** mode, the 960 uses it's own internal clock for the transmit clock source.

2.2.1.5 Short/Long Haul
The **Short/Long Haul** parameter shown in Figure 2.2.5 controls the receive sensitivity of the 960 T1/E1 interfaces. The **Short Haul** setting is used for Intra-office or inside TELCO applications. The receiver sensitivity is limited to 6 dB of cable attenuation plus 3 dB of of additional flat or cable attenuation in the short haul mode. In the **Long Haul** mode the receiver sensitivity is much greater, up to 36 dB for T1 spans, and 43 dB for E1 spans.

2.2.2 Span Edit Window T1 Elements
The Span Edit window for T1 interfaces is shown in Figure 2.2.1. The following covers the unique T1 parameters that are set by the Span Edit window.

2.2.2.1 Supervision/Signaling Box
The Supervision/Signaling box shown in Figure 2.2.6 is used to set the type of signaling on the T1 interface. The following is a list of choices the user can select from.

CAS, Channel Associated Signaling also known as robbed bit or inband signaling. When this option is selected, a check box appears labeled wink start. When this box is checked the 960 will implement the wink start protocol for initiating and terminating calls. When the wink start box is unchecked the 960 will use basic on-hook, off-hook signaling to supervise the channels of the selected T1.

In **Clear Channel** mode, there is no inband supervision. All channels are 64 Kbs. This mode is often associated with B8ZS linecoding to fulfill ones density requirements. The Clear-Channel mode is used when performing DS-1/E-1 level bert tests on a span.

The **PRI-ISDN** signaling mode is for Primary Rate ISDN service. When this mode is selected a text box with a button next to it appears as shown in the highlighted circle in Figure 2.2.7. The number in the text box determines which T1 channel the ISDN signaling or D-channel will reside on. The default channel is 24 for T1 spans and 16 for E1 spans. Next to the text box is a button that allows advanced ISDN setup. Clicking on this button brings up the advanced ISDN parameter dialog box. This dialog box allows setting the ISDN Number Type and ID.

Setting ISDN Number Type and ID
The advanced ISDN dialog box has two list boxes containing

Figure 2.2.6 T1 Channel Supervision

Figure 2.2.7 ISDN Configuration

Figure 2.2.8 ISDN Number Type

Figure 2.2.9 ISDN Number ID

the different ISDN number types and Id's supported by the 960. This number type list is shown in Figure 2.2.8, the number Id list is shown in Figure 2.2.9. The list of number types and Id's correspond to the types and Id's defined in ITU Q.931 Table 4-9. Refer to this document for more information on these parameters.

The **FXS/FXO,** Foreign exchange subscriber or Foreign Exchange office signaling protocol is selected by this parameter. When this signaling mode is selected a check box appears, as circled in Figure 2.2.6. These check boxes allow **Loop** or **Ground** start signaling modes to be selected.

2.2.2.2 Transmit Attenuation
The **Transmit Attenuation** list box allows setting the level of the T1 transmit signal. Available options are **0db**, **7.5db**, **15db** and **22.5db**.

2.2.2.3 Line Build-Out
The **Line Build-Out** or pulse shape parameter is used to compensate for cable attenuation to the 960 transmit signal. The line build-out number corresponds to the number of feet of cable between the first repeater or network equipment and the test access point where the 960B is connected. Available options for this field are: **0-132** feet, **133-265** feet, **266-398** feet, **399-532** and **533-655** feet.

2.2.2.4 T1 Framing Selection
The T1 framing format is selected in the **Framing** list box shown in Figure 2.2.1. This list box contains entries for each T1 framing format supported by the 960. The following is a description of each framing type.

F12 (D3/D4), Super Frame (SF) format with 12 frames per super frame

F4 (4 Multi), Multiframe format with 4-frames per multiframe

F24 (ESF), Extended Super Frame format with 24 frames per super frame.

F72 (SLC96), SLC-96, used in conjunction with T1 as a digital loop carrier system which provides service for up to 96 subscribers over 3 to 5 separate T1 lines.

The **Unframed** framing selection is only used to perform BERT testing over the entire span. No other tests are supported in this mode.

2.2.2.5 T1 Linecoding
The **Linecoding** format for the T1 span is selected in the Line Coding list box shown in Figure 2.2.1. This list box contains

entries AMI and B8ZS Coding. The following is a description of the different line codes.

B8ZS, Bipolar 8 Zeroes Substitution. A method for coding a T1 line to meet 1s density, thus providing a clear channel. Often used with ESF framing.

AMI, Alternate Mark Inversion. A. Line coding where ones are represented by voltage pulses and zeros are represented by the lack of a voltage pulse. In AMI, the polarity of each pulse is the opposite of the previous pulse. Does not meet 1s density requirement.

2.2.2.6 T1 Termination Impedance
At the bottom of the Span Edit window shown in Figure 2.2.1 are list boxes labeled **Rx** and **Tx**. These list boxes are used for selecting the transmit and receive termination impedances. The transmit impedance is set at **100 Ohms**. The receive impedance can be set to **100 Ohms** or **100K Ohms** (High Impedance). Note the 100K setting is normally used in conjunction with the monitor connection mode.

Span Edit Window (Continued)

Figure 2.2.10 E1 Span Edit Window

2.2.3 Span Edit Window E1 Elements
Configuring E1 interfaces
The Span Edit window for E1 interfaces is shown in Figure 2.2.10. The following covers the unique parameters that are set by the E1 Span Edit window.

2.2.3.1 E1 Supervision/Signaling
The **Supervision/Signaling** list box shown in Figure 2.2.11 contains the different E1 signaling formats supported by the 960. The formats are PCM 30, PCM 31 and PRI-ISDN. The following is a description of each signaling format.

The **PCM 30** signaling format has 30 channels with common channel signaling on timeslot 16. When this signaling format is selected, a check box appears labeled Wink Start. Checking this box selects the Wink Start signaling protocol for controlling calls.

PCM 31 format has 31 channels with no signaling, all 31 timeslots are available for data.

The **PRI-ISDN**, Primary Rate ISDN for E1 is setup with the same windows and controls as T1. Refer to the T1 section on PRI ISDN configuration for details on configuring this option.

2.2.3.2 E1 Framing
The **Framing** list box shown in Figure 2.2.12 contains the different framing modes supported by the 960. The framing modes are **DF** for the Double frame format, **DFS** for the special double frame format, **CRC4**, CRC4 error checking, **CRC4 -- ITU,** CRC4 with ITU G.706 alignment algorithm and **Unframed**.

2.2.3.3 E1 Line Coding
The **Line Coding** list box contains the different line coding formats supported by the 960. The E1 line coding formats available are **AMI** and **HDB3**.

2.2.3.4 E1 Termination Impedances
At the bottom of the E1 Span Edit window shown in Figure 2.2.10 are the **Tx** and **Rx** list boxes for selecting the transmit and receive termination impedances. The transmit impedance can be set to **75 Ohms** or **120 Ohms**. The receive impedance can be set to **100 Ohms**, **75 Ohms** or **100K Ohms** (High Impedance). Note the 100K setting is normally used in conjunction with the monitor connection mode.
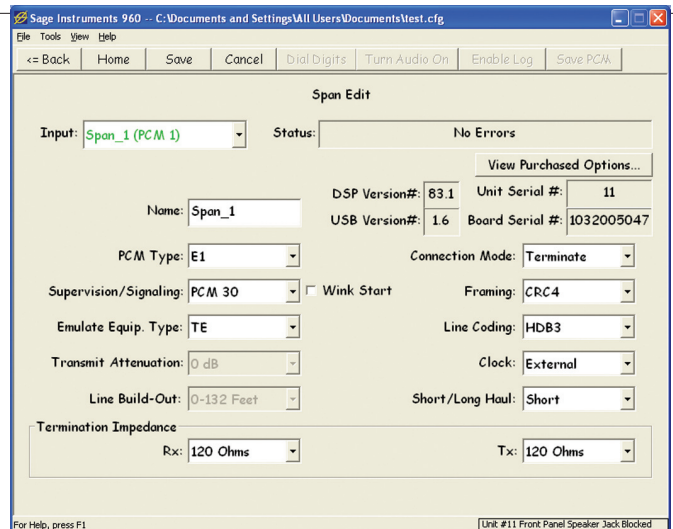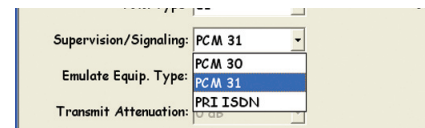
Figure 2.2.11 E1 Supervision/Signaling List Box
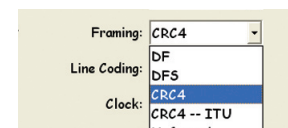
Figure 2.2.12 E1 Framing List Box

2.2.4 Span Edit Window IP Elements
The Span Edit window for IP interfaces is shown in figure 2.2.13. IP specific configuration values include speed, static or dynamic address, IP monitor and impairment emulator and VLAN support. The following describes each of these configuration parameters.

2.2.4.1 Speed
The Speed list box is shown in figure 2.2.14. The 960 supports 10BaseT and 100BaseT in full and half duplex modes.

There is also an Auto Negotiation option which allows the 960 to sense and configure itself to the appropriate configuration for the circuit under test. The table below shows the relationship between the speed value and the number of test channels allocated to the interface.

Half Duplex 10BaseT	25 Channels
Full Duplex 10BaseT	50 Channels
Half Duplex 100BaseT	100 Channels
Full Duplex 100BaseT	200 Channels

2.2.4.2 IP Addressing

The user can select one of four IP addressing/test modes. These selection boxes are circled in Figure 2.2.13. **Static IP** and **DHCP** are for assigning an IP address to the selected interface. When Static IP is selected the text boxes to the right are used to enter the **IP Address**, **Gateway Address** and **Subnet Mask**. If DHCP is selected the 960 will query the DHCP server for an address.

2.2.4.3 Full Duplex Monitor

The full duplex monitor mode allows the 960 to monitor both directions of traffic on the Ethernet interface. This test requires using an Ethernet TAP to access both transmit and receive sides of the Ethernet link. See Figure 2.2.15 for the connection diagram. Note that both Ethernet interfaces must be from the same 960 interface board. 960 monitor tests available in this mode are SIP Monitor, RTP Monitor, RTCP Monitor and T38 Fax Monitor. For additional information on these tests refer to the Running Tests section of the manual.

2.2.4.4 IP Impairment Emulator

The impairment emulator requires both Ethernet interfaces from a common board to be configured in this mode. The 960 is inserted in series with the IP network. The unit can be configured to insert impairments and delay into the traffic. For more information on this test refer to the IP Impairment test description. *Warning, do not connect the two Ethernet interfaces into the same hub or network overload can occur.*

2.2.4.5 VLAN Support

The 960 supports virtual Lan networks. The **Support Virtual LAN** check box at the bottom of the IP Span Edit Window enables VLAN support. There are two text boxes labeled **VLan Priority** for entering the Virtual LAN priority and **VLan ID Tag** for entering the Virtual LAN ID tag..
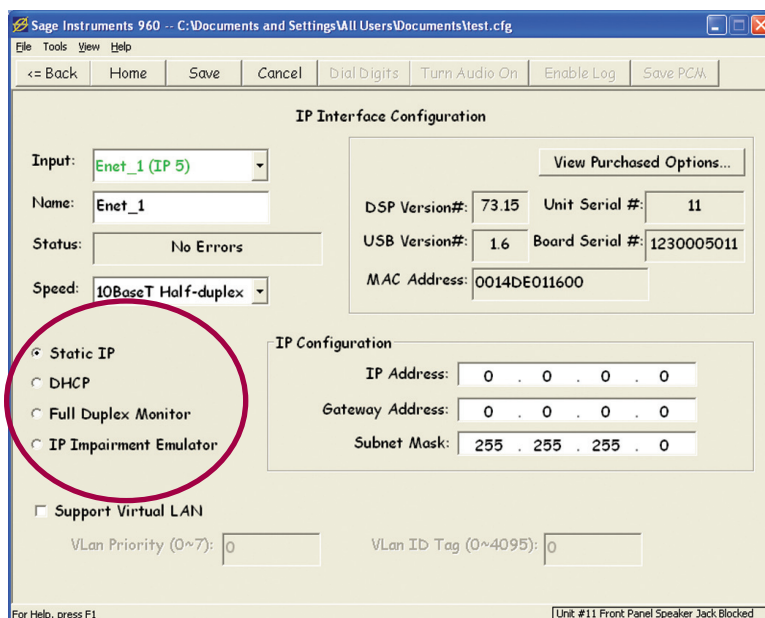
Figure 2.2.13 Span Edit IP Interface Window
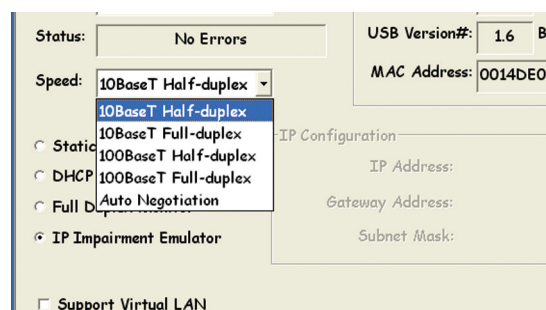
Figure 2.2.14 IP Interface Type
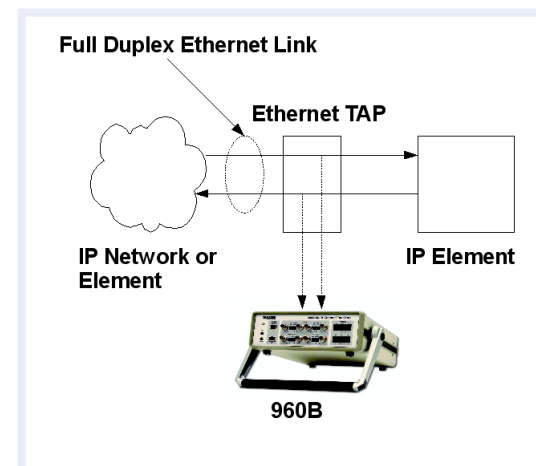
Figure 2.2.15 Full Duplex Monitor Connection

2.2.5 Span Edit Window Analog Elements

The window for configuring the 960 analog test interfaces is shown in figure 2.2.16.
analog specific configuration parameters in this window are the interface mode and received ring signal characteristics. The following section describes these parameters.

2.2.5.1 Mode

The analog interface **Mode** list box is shown in Figure 2.2.17. Note that analog interfaces 7 and 9, the odd interfaces, are only **2-Wire**, while interfaces 8 and 10, the even ones are available in both 2-wire and **4-Wire**. The 2-wire analog interfaces can be setup as 600 or 900 Ohm terminations. The termination impedance can be simple resistive, or complex (2.16 uf in series with resistor). Additional types of complex impedances are available from the factory by special order. In addition to the impedances, the user can select normal or dry interfaces for the 2-wire circuits. Normal interfaces present a DC load that draws holding current for on and off hook supervision. Dry circuits draw no DC current and do not have any on or off hook supervision.

The **4-Wire Normal** mode is a four wire interface without any signaling.

The **4-Wire Cellphone** interface is for interfacing the 960 with cell phones. Special cables are available from Sage for connecting cell phones to the 960.

2.2.5.2 Min Ring Voltage

This text box specifies the minimum ring voltage that the 960 will respond to. The minimum ring voltage can be set from **1** to **105** Volts RMS, the default value is 20 Volts.

2.2.5.3 Min Ring Duration

This text box specifies the minimum ring duration that the 960 will respond to. Valid values for this text box are **100** to **20,000** milliseconds, the default value is 500 milliseconds.

2.2.5.4 Max Ring Duration

This text box specifies the maximum ring duration that the 960 will respond to. Valid values for this text box are **100** to **20,000** milliseconds, the default value is 8000 milliseconds.

2.3 Span View Window

Figure 2.3.1 shows the Span View window for T1/E1 interfaces. The Span View windows are slightly different for T1/E1, IP and Analog interfaces. The following section describes the common elements of the Span View window that are common to all interface types.
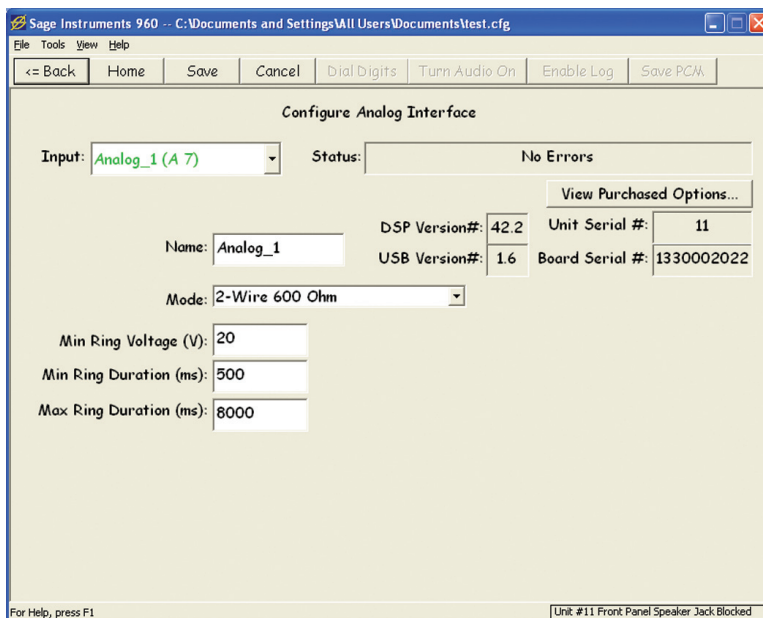
Figure 2.2.16 Analog Span Edit Window
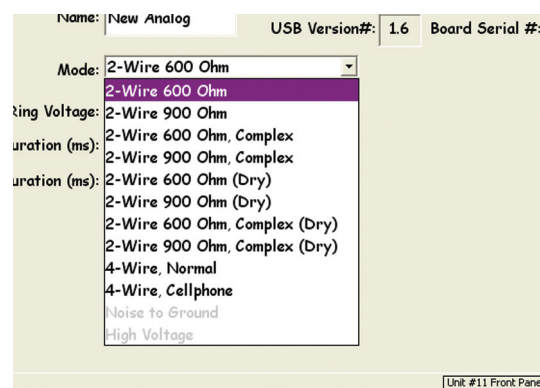
Figure 2.2.17 Analog Mode Selection

2.3.0.1 Span View Window Common Elements

The Span View window contains a menu and tool bar at the top of the window. These elements are identical to the ones in the Home and Span Edit window. For a description of these elements refer to the Home Window description.

2.3.0.2 Span List Box

The **Span** list box is located in the upper left portion of the window, below the tool bar. This box displays the name of the currently selected span. Clicking on the button in the list box displays a list of all the interfaces in the 960. This allows the

user to switch from one interface to another without having to return to the Home window.

2.3.0.3 Status Box

Below the Span List box is the interface **Status** indicator. This field displays the status of the currently selected interface. Status conditions include, **No Errors**, **Signal Loss**, **No Link**. This field is continually updated, so any change in the interface status will be reflected in the window as it occurs.

2.3.0.4 Configure Button

Clicking on the **Configure** button, located below the Status Box, will bring up the Span Edit window for the selected interface.

2.3.0.5 Enable/Disable Test Buttons

Below the configure button are a group of 4 buttons labeled Disable, Enable and **Disable All**, **Enable All**. These buttons are used for starting and stopping individual or groups of highlighted tests in the Channel list.

2.3.0.6 Channel List

The right half of the Span View window contains a list of all channels available on the selected interface. Any tests defined on the channels are displayed as well as, **Destination** number, **Log** file and the **Status** of any tests, I.E. running or stopped. Clicking on one of the channels highlights the resource. The **Enable** and **Disable** buttons can then be used to start or stop any tests defined on the channel. If any tests are configured on the highlighted channel the **Enable/Disable Log** button in the tool bar is enabled allowing logging to be turned on and off. Double clicking on a channel will bring up the Test Control window where tests can be selected, configured and controlled. Additionally a group of channels can be highlighted to configure and control multiple tests.

2.3.1 Setting Up Multi-Channel Tests

The Span View window can be used to setup and control tests on multiple channels. To select multiple channels to test click on the first channel, then hold the shift key and click on the last channel. This will highlight the range of channels selected as shown in Figure 2.3.2. Once the channels are selected click on the **Multi-Cfg..** button circled in Figure 2.3.2. This will launch the Configure Multiple Channels dialog box shown in figure 2.3.3.

2.3.1.1 Configure Multiple Channels Dialog Box

The configure multiple test dialog box is used to setup the test type, call setup and testing load on the range of channels high-
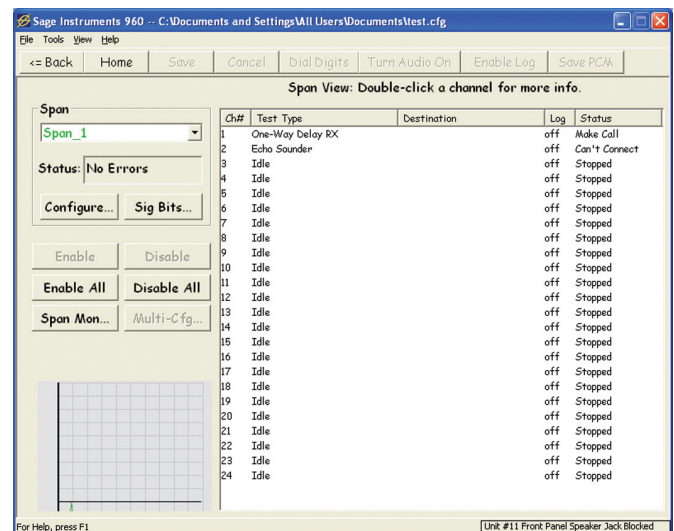
Figure 2.3.1 T1/E1 Span View Window
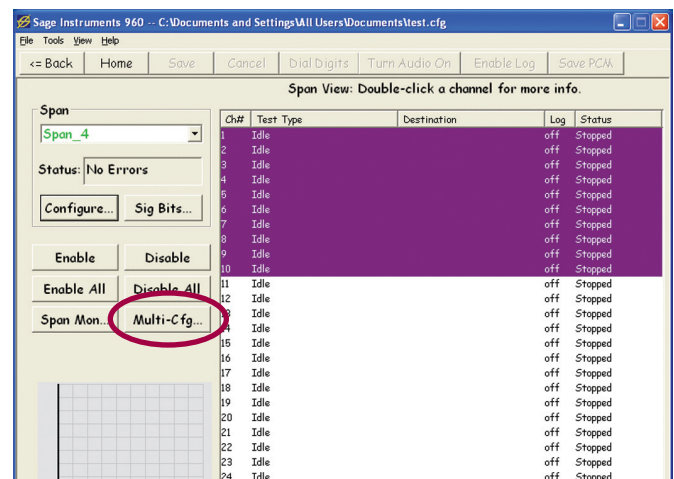
Figure 2.3.2 Multiple Channel Selection

lighted in the Span View window. The following procedure describes the test setup. This test setup is identical to what is found in the Test Control window. See this section of the manual for a more detailed description of setting up tests.

A. Click on the button in the **Test Type** list box and select the desired test from the list.

B. Once the test is selected click on the **Configure** button next to the test type box to configure the test.

C. Click on the **Configure** button next to the **Call Setup** box and enter the destination number, dialing format and

test type.

D. Click on the button in the **Call Load Type** box and select a **Fixed** or **Random** delay.

E. Click on the **Configure** button next to the Load Type box to set the time between calls.

F. Click on the **Done** button to save and close the dialog box.

G. Click on the **Enable** button of the Span View window shown in Figure 2.3.2 to start the tests.

2.3.2 T1/E1 Span View Elements

The T1/E1 Span Vew window is shown in Figure 2.3.4. This section covers the T1/E1 specific controls in the Span View window.

Figure 2.3.3 Multiple Channel Dialog

2.3.2.1 960 Resource Graph

In the lower left corner of the Span View window is a graph that displays the 960 DSP usage. This usage is indicated graphically via the Red (Max CPU Usage) and Blue (instantaneous CPU Usage) lines. While these are representative of the DSP CPU usage, the true software deadlines are determined by the ability to service the PCM data in a timely manner. Failure to service the PCM data could cause dropouts or erroneous tests, this is the ultimate metric used by both the host and DSP to determine if "Overuse" has occurred, independent of perceived CPU usage. The black line represents this PCM Overuse indicator (**Black** = Max, **Green** = instantaneous). If the black line ever reaches the %40 line, overuse is declared and the tests are stopped. However, the software has several built-in "throttles" that should prevent Overuse from ever occurring. It is also possible to zoom in to view CPU usage by holding down the left mouse button and dragging over the zoom area and releasing the mouse button.

Figure 2.3.4 T1/E1 Span View Window

2.3.2.2 View Span Signaling Bits

Clicking on the **Sig Bits...** button will launch the Span Signaling Bits window shown in Figure 2.3.5. This display shows the signaling bit status for all channels in both directions for the selected span. The signaling bit window is continuously updated so any changes in signaling bits will be reflected in the window. At this time the near and far signaling bit controls at the bottom of the Span Signaling Bits window are not functional.

2.3.2.3 Remote Audio Control

The two boxes circled in Figure 2.3.5 are for controlling the remote audio function of the 960 when the signaling bits window is opened. The upper control labeled **Ch #** sets the channel to monitor. The list box below selects the direction to monitor I.E. Near, Far, Both or Off. For more information on setting up the remote audio function refer to the Remote Audio section.

Figure 2.3.5 Signaling Bit Window

2.3.2.4 Span Monitor

Clicking on the **Span Mon...** button will launch the Span Monitor window shown in figure 2.3.6. This window displays the ITU-G.826 T1/E1 span alarm and error statistics for the selected span.

2.3.2.5 Span Monitor Window

Controls

At the bottom of the Span Monitor window are four buttons labeled Reset, Logging..., Print and Close. These controls are described below.

The **Reset** button zeros all counters.

The **Logging** button brings up a dialog box where logging can be enabled, and a log file name and location can be specified.

The **Print** button will bring up a printer dialog box for printing a current snapshot of the Span Monitor window.

2.3.3 Span View Window IP Elements

The Span View window for IP interfaces is shown in Figure 2.3.7. The number of channels displayed in the Span View window depend upon the setup of the IP interface. The following table shows the relationship between the IP configuration and the number of channels allocated.

Half Duplex 10BaseT	25 Channels
Full Duplex 10BaseT	50 Channels
Half Duplex 100BaseT	100 Channels
Full Duplex 100BaseT	200 Channels

Packet Counter Window

Clicking on the **Details** button circled in Figure 2.3.7 will bring up the Packet Counter window shown in Figure 2.3.8. This window displays packet statistics for the selected interface. In the left half of the window packet counts and percentages are displayed.
at the bottom of the window is the **Reset** button for resetting the counters and percentages.

2.3.3.1 Packet Status Display

The packet status display is in both the Span View and Packet Counter windows. This display is circled in Figure 2.3.8. The first two lines, **Total Tx** & **Rx** give a count of the total packets sent and received by the selected interface. The next two lines, **Failed Tx** & **Rx** indicate failures the 960 is experiencing. A Tx failure occurs when there is not sufficient bandwidth on the IP connection to transmit the test signal. If this occurs either eliminate some of the tests, or increase the available bandwidth of the network. An Rx failure occurs when the 960 is unable to receive a packet because it's resources are oversubscribed. If this occurs, reduce the number of tests running on the interface. The next two lines are **Avg & Max Loop**. This gives an indication of DSP loading in the 960. If either value is greater than 20,000 then the DSP resources are over subscribed. Reduce the number of tests if this occurs.
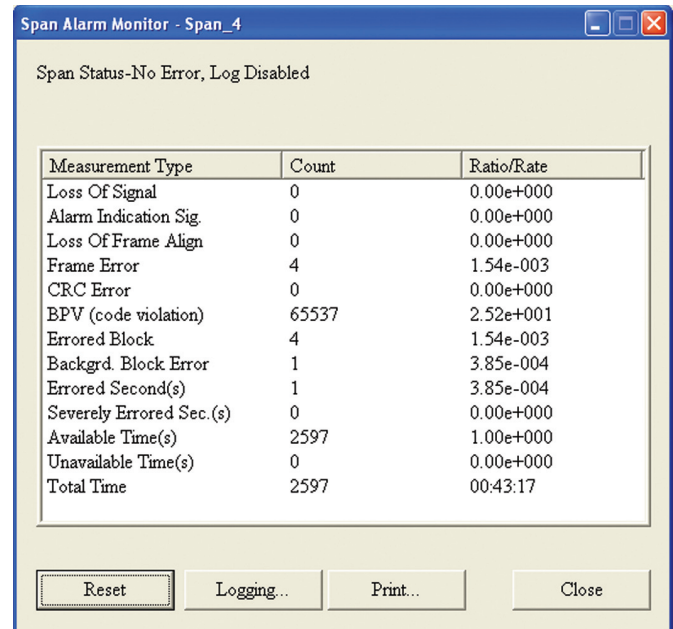
Figure 2.3.6 Span Monitor Window
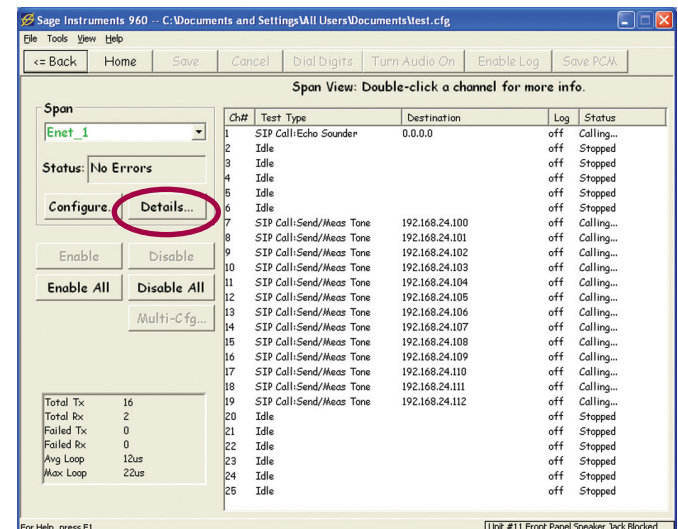
Figure 2.3.7 Span View IP Interfaces
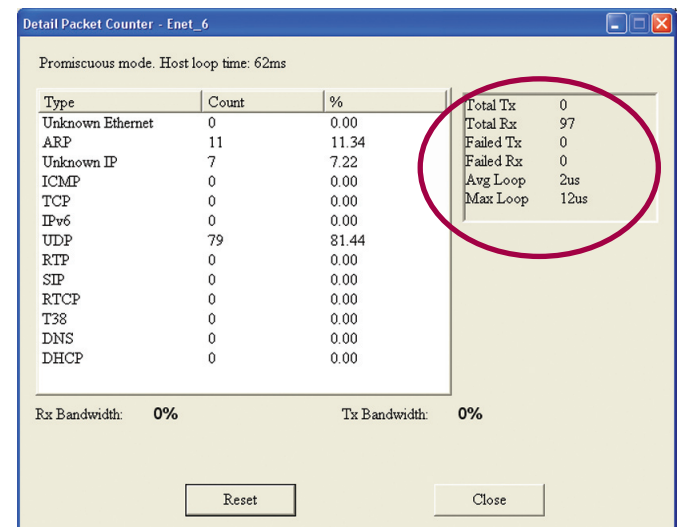
Figure 2.3.8 Packet Counter Window

2.3.4 Span View Window Analog Elements

The Span View window for configuring analog interfaces is shown in Figure 2.3.9. The 960 supports one channel per analog interface, so only one channel is listed in the Channel list box. Clicking on the channel highlights the entry. Tests can be started or stopped by clicking the **Enable/Disable** buttons, and logging can be toggled by clicking on the **Enable/Disable Log** button in the tool bar. Double clicking on the channel brings up the Test Control Window.

2.4 Test Control Window Common Elements

The Test Control window is shown in Figure 2.4.1. This window is used to select and configure tests and call setup. the window is also used to run and stop tests and view results. There are three variations of this window for the three interface types on the 960. The following section describes the window controls and indicators that are common to the three versions of the Test Control window. Subsequent sections describe the windows for each interface type.

2.4.0.1 Menu and Tool Bars

The menu and tool bars at the top of the window are identical to ones described in the Home Window section. The following paragraphs describe the important tool bar controls for this window.

The **Save** button in the tool bar is important in this window. Once the test type is selected clicking on the Save button will bring up new configuration and results fields associated with the test and call setup.

The **Turn Audio On/Off** toggle button allows the 960 to send the audio of the selected channel to the computer running the 960B GUI software. The audio will be sent to the sound card and can be heard on the computer's speakers if so equipped. Note that this feature may not work satisfactory when remotely controlling the 960 over an ethernet link due to network delays and bandwidth availability.

The **Enable/Disable** Log toggle button turns on or off the log file for the selected channel. The **Configure** button circled in Figure 2.4.1 is used to setup the logging function and log file location.

The **Save PCM** button allows the 960 to capture and save the raw PCM stream from a selected channel to a file. This feature is only available when a voice frequency test is setup on the

capture channel. Clicking on the Save PCM button brings up the PCM Data Capture window shown in Figure 2.4.2. On the left side of the window are the interfaces, there are four capture files, one for each T1/E1 interface. For IP and analog interfaces, there is one

Figure 2.3.9 Span View Window Analog Interfaces
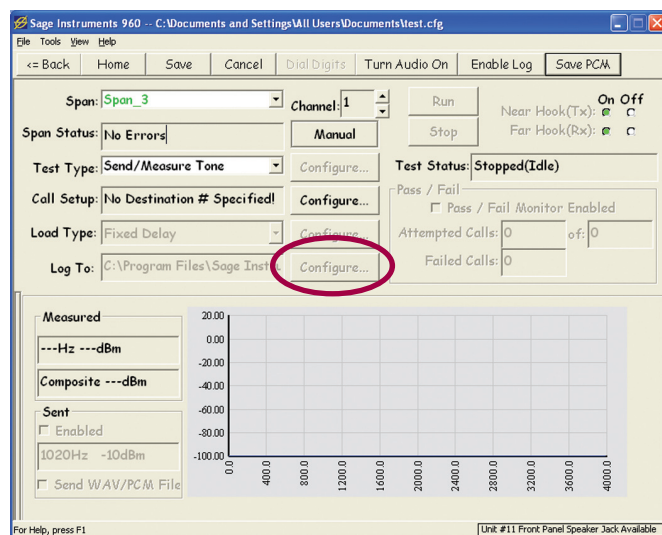
Figure 2.4.1 Test Control Window
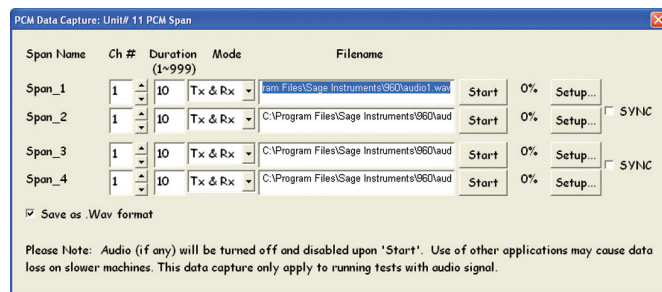
Figure 2.4.2 PCM Data Capture Window

capture file per interface. To the right of the interface labels are the **Ch #** text selection boxes to select the channel to log, analog interfaces only have one channel. To the right of the Channels is the log **Duration**. For analog interfaces the maximum log file duration is 256 seconds. For T1/E1 interfaces the maximum log file duration is 999 seconds. For IP interfaces the maximum log file duration is 512 seconds.

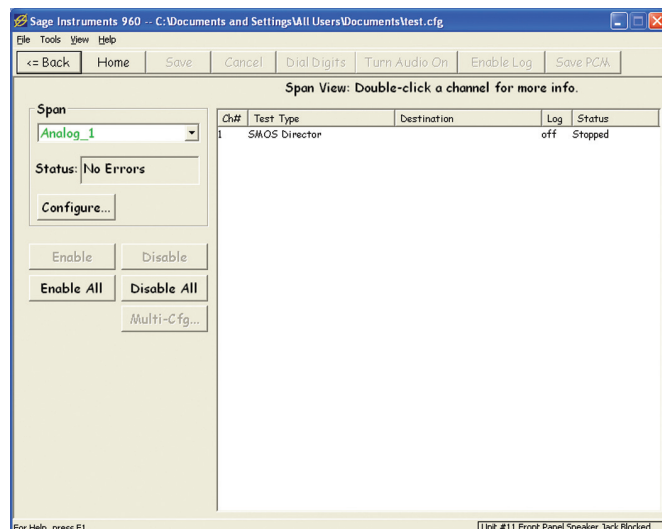To the right of duration boxes are the **Mode** list boxes. These specify the direction of capture, choices here are **Rx** and **Tx**. For T1/E1 and IP interfaces there is an additional mode **Rx+Tx** for capturing the sum of both directions.

The **Filename** text boxes to the right are for entering the file location for the PCM capture files.

The **Start** buttons to the right of the file boxes start the capture process.

The percentage (**%**) indicators to the right of the Start buttons show capture progress.

The Setup buttons to the right of the percentage indicators allow trigger points to be set to initiate the capture. Clicking on this button launches the Setup PCM Data Capture dialog box shown in Figure 2.4.2. This box allows triggering the log capture when the audio level on the channel exceeds a given threshold. In addition there is a pre-trigger field that allows the logging to start before the trigger event.

The **Sync** check box on the right side of the PCM Data Capture window in Figure 2.4.2 is used to synchronize two adjacent interfaces capture triggers. When this box is checked one trigger point will simultaneously start PCM capture on both interfaces.

The **Save as Wav File** check box in the bottom left corner of the Window in Figure 2.4.2 is used to select the file format the 960 uses to capture the PCM stream. If the box is not checked the file is saved in a raw PCM format.

2.4.0.2 Test and Call Configuration Controls

The controls inside the highlighted square in figure 2.4.4 are used to setup tests, destination numbers, call load and results logging on the selected channel. The following describes functions of each of these controls.

2.4.0.3 Span/Interface, Channel and Status Elements

The **Span** list box is located under the Tool bar, when working with IP and analog interfaces the list box is labeled **Interface**. The box displays the currently selected interface. Clicking in the button in the box displays a selectable list of all test interfaces. To the right of the Span/Interface list box is the **Channel** selection control. This control is used to select a channel to run tests on. This control is not present when working with analog interfaces.
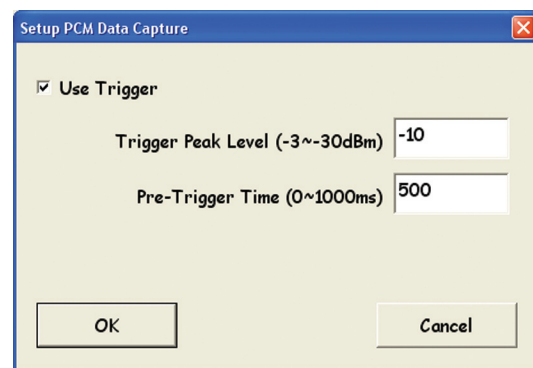
Figure 2.4.3 PCM Capture Setup
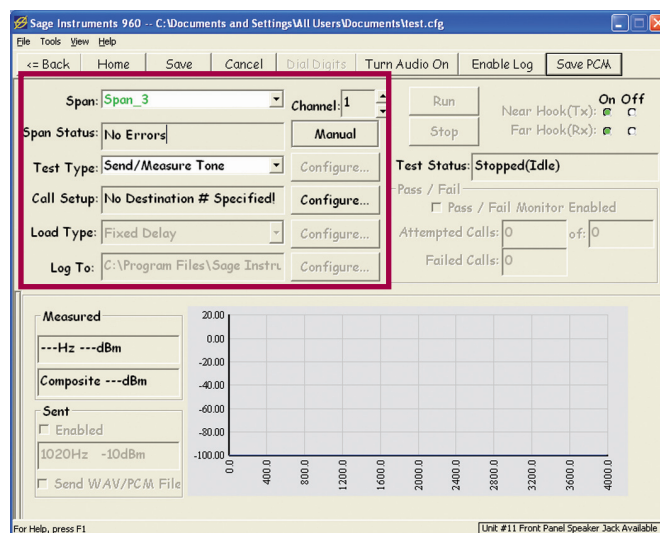
Figure 2.4.4 Test Control Window

Below the Span list box is the **Span/IF Status** box. This indicates the status of the selected interface.

2.4.0.4 Manual Button

The **Manual** button is located to the left of the IF/Span Status box. This button is used to manually dial or answer a test call. Clicking on this button launches a dialog box for entering a test call number. The dialog box also contains two buttons for initiating a test call and answering a test call. Refer to the Manual Mode section of the manual for more information on this function.

2.4.0.5 Test Type List Box

The **Test Type** list box is located below the Span/Interface Status box. Clicking on the button in the box brings up a selectable list of all tests available for the

selected interface. Clicking on a test in the list selects the test. Once the test is selected click in the **Save** button in the tool bar. This will save the selected test and make other disabled controls available.

Once the test is selected and saved click on the **Configure** button to the right of the list box to configure the test. See the Running Tests section of this manual for more detail on setting up each test type.

2.4.0.6 Call Setup Configuration

The **Call Setup** text box and Configure button are located below the Test Type list box. The Call Setup facility in the 960 allows the 960 to initiate and answer test calls automatically. To manually initiate or answer calls use the Manual button. Clicking on the **Configure** button to the right of the call setup text box brings up the Configure Call Control dialog box shown in Figure 2.4.5. The two radio buttons at the top of the dialog box select the call setup functionality for the test. The **Director** test type is for initiating calls while the **Responder** type is for answering test calls. Generally tests that transmit, I.E. PESQ Transmit are setup as responders while tests that receive are setup as directors. In a two way test like Send/Measure Tone or DS0 Bert, one side of the test is configured as a director while the other side is configured as a responder. For more information on director and responder configuration refer to the Director/Responder Terminology section.

If Test Director is selected, enter a test call number in the **Destination #** box. The **Use Dialpad** button brings up a dial pad that is useful when entering special non numeric MF or DTMF characters.

Below the Use Dialpad button is a **# Call Attempts** test box. This text box is used to specify how many test calls the 960 will initiate. Entering 0 in this field causes the 960 to continuously initiate calls until stopped by the user. At the bottom of the dialog box are the **ISDN** call configuration boxes for entering the **Origination** number and **B Channel Capability** when working with Primary Rate ISDN spans. When finished configuring the call setup parameters click on the **Save** button in the dialog box to save the configuration.

2.4.0.7 Load Type

Below the Call Setup box is the **Load Type** List Box and Configure button. These controls are used to setup how often the 960 will repeat the test calls. Note that the number of test calls is configured in the Call Control dialog in Figure 2.4.5, while the test duration is defined in the test setup dialog boxed described in the Running Tests section of the manual.

In the Load Type test box the user can select Fixed or Random delays. Clicking on the **Configure** button next to the Load Type box will bring up a dialog box for setting delay values. For **Fixed Delay** the user can specify how many seconds between calls. For the **Random Delay** the user can select the minimum and maximum delay between tests.
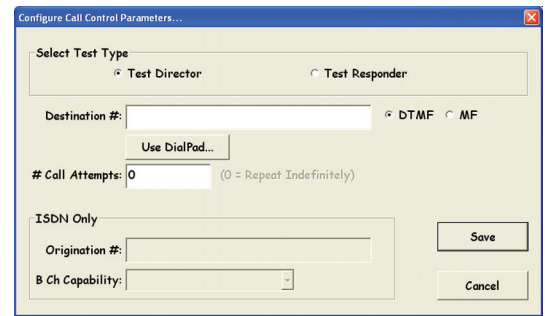
Figure 2.4.5 Configure Call Control
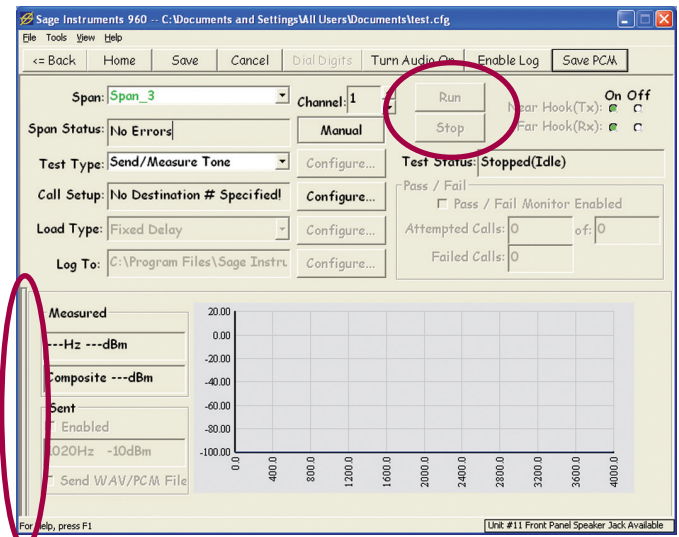
Figure 2.4.6 Test Control Window

2.4.0.8 Test Results Log

The **Log To** text box displays the log file location. Clicking on the **Configure** button next to the text box brings up the log configuration dialog box. The user can enter the logging mode and change the log file name and location.

2.4.0.9 Run & Stop Buttons

The **Run** and **Stop** buttons are circled in Figure 2.4.6. Clicking on the Run button causes the 960 to place the configured test call and start the specified test. If the channel under test has been setup as a Responder in the Call Setup configuration, the Run button will enable the responder allowing it to look for an incoming call to answer. Once a test or responder has been started the test and call setup configurations cannot be modified until the test has been stopped by clicking on the Stop button.

2.4.0.10 Near & Far Hook Indicators

To the right of the Run/Stop buttons are the **Near & Far Hook** indicators. These display the channel supervision status. The indications are On Hook and Off Hook. These indicators are disabled when working with channels that have no supervision, I.E. T1 Clear Channel and Analog 4-Wire.

2.4.0.11 Pass/Fail Status Indicator

Below the Test Status box is a set of indicators labeled **Pass/Fail**. This function is not implemented at this time, however the Attempted Calls indicator does work.

2.4.0.12 Test Status Indicator

The **Test Status** indicator text box is located below the Run/Stop buttons in Figure 2.4.6. This indicator box displays the test status. The test status indicator has two parts. The first part is the run state. This indicates the top level status of the calls I.E. Stopped, Running, Make Call. The second part of the status message in parenthesis is the call machine state, this gives a more detailed look at the call state, I.E. Hook Off, Dial Digits. Call machine state messages are only supported by the T1/E1 and Analog interfaces.

These status messages are displayed in the Test Status text box in real time. The following tables list the run and call machine state status and error messages.

Normal Run States:	
Status Message	**Description**
Stopped	The test is not running
Cycling or Recycling Test	The test is starting or restarting
Pause or Pause with duration	The test is pausing prior to start (allows responders to recycle)
Running	The test is considered to be running
Stopping	The test is stopping (initiating call tear down)
Make Call	The call is being set up for the test
Wait for Call	A responder is waiting for a call
Running/Responder (or Running)	Run state for Responder
Hybrid	Echo Generator under active G.168 Control
Manual Dial...	The user is manually sending digits
Load PCM or Load Wav and % done	The test is sending the associated PCM file to the DSP

Error States:	
Status Message	**Description**
DSP Detected Error	Certain tests indicate that they are in Error and need to be restarted
Span In Alarm...	The PCM span is not healthy. Tests are stopped
Can't Connect	The call failed; the test never started
Channel Blocked	The requested channel is no longer available
Error: Test won't start!	The DSP did not report the test started
Error: Test won't stop!	The DSP continues to report the test running in Stopped state
Error: Wrong DSP Test!?	The wrong test is running on the DSP
Error: DSP Test Died!	The test was running, but it suddenly stopped
Error: Near Hook Off Timeout	
Error: Near Hook On Timeout	
Failure: Far Hook Off Timeout	
Too many SMOS/PSQM Tests!	The User attempted to run too many SMOS or PSQM tests, so some were terminated to protect the PCM stream

(continued on next page)

Call Control Normal States - T1/E1 and Analog Interfaces:	
Status Message	**Description**
Acquire Channel	ISDN, Making Call -- Acquire necessary resources for call
Acquire Digits	The far end is expected to send digits, near end waits for them.
Acquire Dial Tone	Waiting for dial tone
Connect	Call up state for FXS/FXO calls
Call Up	Call up state
Dial, Dial Digits	Dialing digits
Dial Tone	Same as Acquire Dial Tone
Hook Off	Command near hook off
Hook On	Near hook is commanded on prior to going off hook, in case it wasn't on to begin with
Hook On(1s)	Wait for 1 second in the hook on state to avoid false signaling transients
Idle	No call is up; no intent to put one up
Initiate(0)", etc.	Initiate States indicate the beginning of a particular call sequence
Loop Closure?	FXO, Ground-start, NT, Making Call -- waiting for far end to answer
Manual Call	
Measure Wink	Measure a wink sent by far end
Near Hook Off	Near hook commanded OFF
Near Hook On(180), etc.	Command near hook ON
Ring?	FXO, Loop start, NT, Making Call -- Sending ringing signal, waiting for FXS to answer
Ring Down	FXS/FXO, wait for "Ringing" to go away after 'Tripping the Ring' (answering the call)
Ring Ground?	FXO, Ground-start, NT, Making Call -- waiting for 'ring ground' from FXS (far) side
Send Dial Tone	NT, issue dial tone to far end
Setup Call	ISDN, Making Call -- Issue actual ISDN Call Setup message
Tip Ground?	FXS, Ground-Start, Waiting for 'Tip-Grounding' from FXO side
Wait Connect	Call setup is done on our side, wait for far end to finalize
Wait 4 Call	PRI ISDN, TE, Answer Call -- waiting for call setup message
Wait 4 Hook Off	Near is answering a call, waiting for far hook off, which means a call is incoming (if wink start, set near hook off to start a wink)
Wait 4 Hook On	Near is answering a call, first make sure far hook is ON
Wait for Ring, Wait Ring	FXS/FXO Answer call, waiting for incoming 'ringing' state
Wait Tip-Ground	FXS, Ground-start, TE, Answer Call -- Need to see Tip-ground state before proceeding
Wait for Wink	Wait for the far end to send a wink to the near end
Wink Off	Command near hook off as part of a wink
Wink", "Wink On	Command near hook on as part of a wink
Call Control Error States - T1/E1 and Analog Interfaces:	
Far-End Busy	Can't complete call, Farend Off Hook
User Aborted	Test stopped by user
No Wink	Can't initiate call, no wink received
Wink too Long	Excessive wink duration, can't initiate call
Far End Abort	Far end stopped test
No Answer	No Answer from Farend
PCM/Frame Loss	Can't initiate call, span in alarm
No Dial Tone	Can't initiate call, no dial tone detected

2.4.0.13 Test Results

The bottom half of the Test Control window displays the test results. Each type of test has its own results format. For a more detailed description of the test results formats refer to the Running Tests section of the

manual.

2.4.0.14 Results Un-Docking Button

The Button circled on the left hand edge of the window in Figure 2.4.6 is used to create a separate results window shown in Figure 2.4.7. This results window can remain on the computer desktop, while another test is setup in the Test Control window. In this way multiple tests can be run and their results viewed simultaneously.
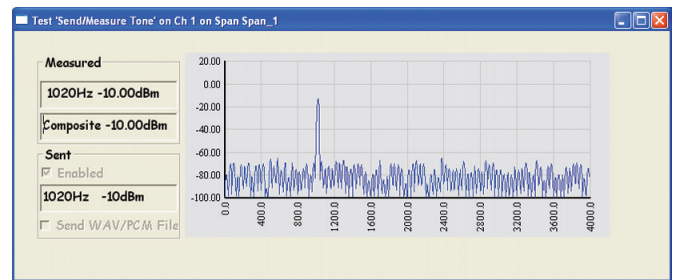
2.4.1 Test Control Window T1/E1 Elements

The controls and indicators for T1 and E1 interfaces are described in the Test Control Common Elements section.

2.4.2 Test Control Window IP Elements

The following describes the controls and indicators in the Test Control window that are specific to IP interfaces. Refer to the Test Control Common Elements section for descriptions of the rest of the window controls and indicators.

2.4.2.1 IP and VF Test Setup

The Test Control window for IP interfaces has two test type list boxes labeled **IP Test** and **VF Test**, these are circled in Figure 2.4.8. When setting up an IP test, first select the IP test from the IP Tests list box, then click on the **Save** button in the tool bar. Next click on the **Configure** button next to the IP Test list box to launch the IP test configuration dialog box. Once the IP test is configured, select a VF test from the VF Tests list box if applicable. Save the test using the **Save** button in the tool bar, then click on the **Configure** button to the right of the VF Test list box and configure the selected VF test.

2.4.3 Test Control Window Analog Elements

The following describes the controls and indicators in the Test Control window that are specific to Analog interfaces. Refer to the Test Control Common Elements section for descriptions of the rest of the window controls and indicators.

2.4.3.1 Gain Adjustment

The Gain Adjustment control labeled **Gain Tx**, **Rx** is circled in Figure 2.4.9. This control appears when working with analog interfaces that have been configured as 4-Wire Normal or 4-Wire Cellphone circuits. This control allows independent adjustment of the transmit and receive levels.

2.4.3.2 Near Hook Indicator

When working with 2-wire circuits, the Gain control is replaced with the **Near Hook** indicator shown in Figure 2.4.10.

Figure 2.4.7 Test Results Window

Figure 2.4.8 Test Control Window IP Interfaces

Figure 2.4.9 Test Control Analog Interfaces
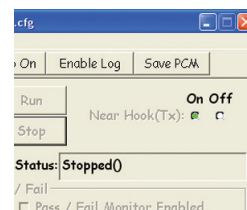
Figure 2.4.10 Analog Near Hook Indicators

3. 960B Manual Mode

3.1 Running Tests in Manual Mode

The primary benefit of running test in manual mode is the ability to change from one test or call direction to another without dropping the line. The 960B allows users two ways to place manual test calls:

1. In the center of the main test screen next to the Span Status text field is the "Manual" button (see figure 3.1.1). It is good practice to set all other test parameters prior to clicking the manual button. When clicked the Manual button launches the "Manual Call Dialog box. In this box after entering the destination number, and selecting tone type clicking the "Make Manual Call" button initiates the selected test. As the manual call runs notice the Manual button is in a depressed state. To stop the manually initiated test click again to release the manual button and the test stops.

2. The second method for placing a manual test call is via the "Send Digits" dial pad. In this scenario, again it is good practice to set all test parameters first saving the Call Setup configuration for last. Clicking the Call Setup configuration button launches the Call Control dialog box. Rather than entering the test call destination number click the button directly under the destination field named "Use DialPad" (see figure 3.1.2). This action launches a numeric dial pad similar to that of a telephone. The pad also provides the characters *, # A, B, C and D. In addition the "Pause 1s" button next to the dial pad will insert a one second pause in the digit string for every time clicked.

3.2 Manual Test Call Example

For this example we will set up and run the "Send/Measure Tone" test on PCM 1 as a "Test Director" and "Measure Tone" on PCM 2 as the "Test Responder". Then we will reverse test directions without dropping the call.

> **Note:** The physical connection is PCM1 Tx to PCM2 Rx and PCM1 Rx to PCM2 Tx.

1. Name the spans. In the span view window highlight the first span which by default is named "New Span". Click on the "Configure Span" button. In the configure span window change the span name from "New Span" to "PCM 1 (see figure 3.1.3). Click save and then back to return to the span view window.
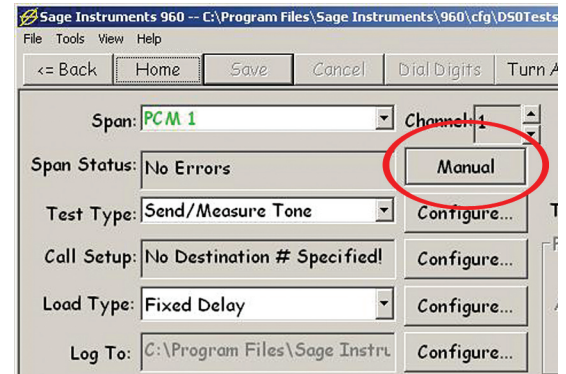
Figure 3.1.1

Figure 3.1.2
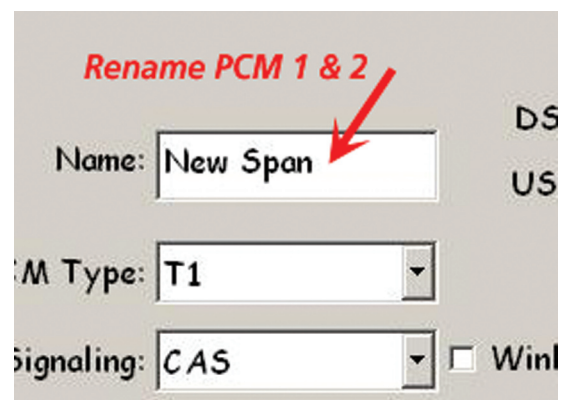
Figure 3.1.3
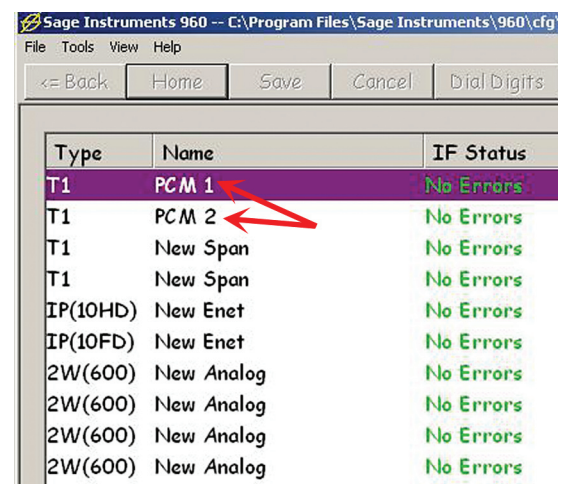
Figure 3.1.4

Repeat this process to name the second "New Span" to "PCM 2". Accept all other defaults, click save and back. The span view window should now look like figure 3.1.4.

Running Tests in Manual Mode *(continued)*

2. Configure PCM1 for the Send Tone test. From the span view window double-click on PCM1 to bring up the channel view. Double-click on channel 1 to bring up the main test configuration screen. From the test type pull down menu select "Send/Measure Tone" and click save (see figure 3.1.5).

3. Click the configure button next to the test type selection menu. This action launches the send tone configuration window. Set the test duration to 0 seconds making the test a continuous run. Then click the check box "Send Tone when measuring Tone" (see figure 3.1.6). Click save to close and return to the main test screen.
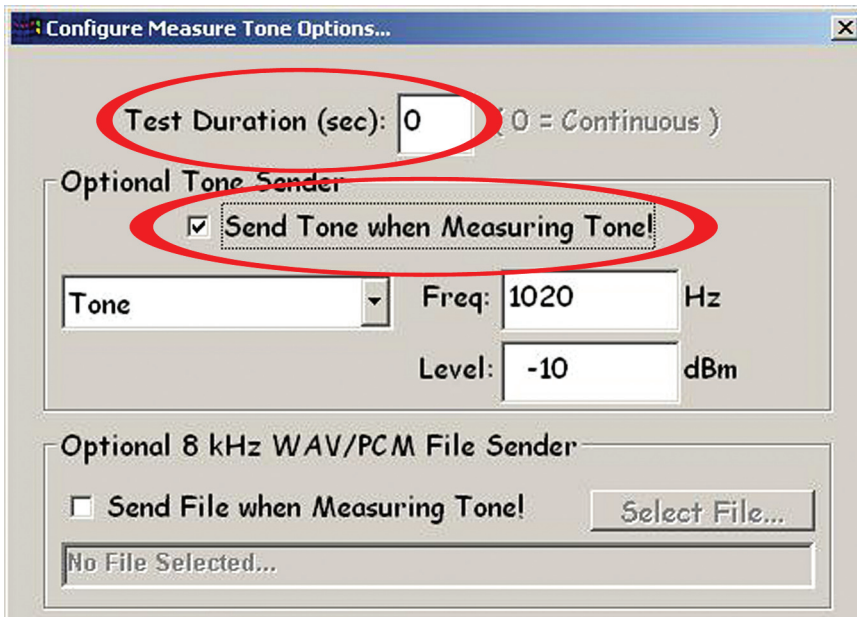
Figure 3.1.6

4. From the main test screen click the configure button next to the call setup field. This action launches the configure call parameters window, choose "Test Director" as the test type and enter the destination number (see figure 3.1.7). Click save to close the window.

5. Without leaving the main test window use the 'Span' pull down menu in the upper left hand corner to switch span selection to PCM 2 (see close-up figure 3.1.8).

6. You should now be looking at a new main test window set to channel 1 on PCM2. From the test type pull down menu select the "Send Measure Tone" test and then click on save.

(continued on next page)
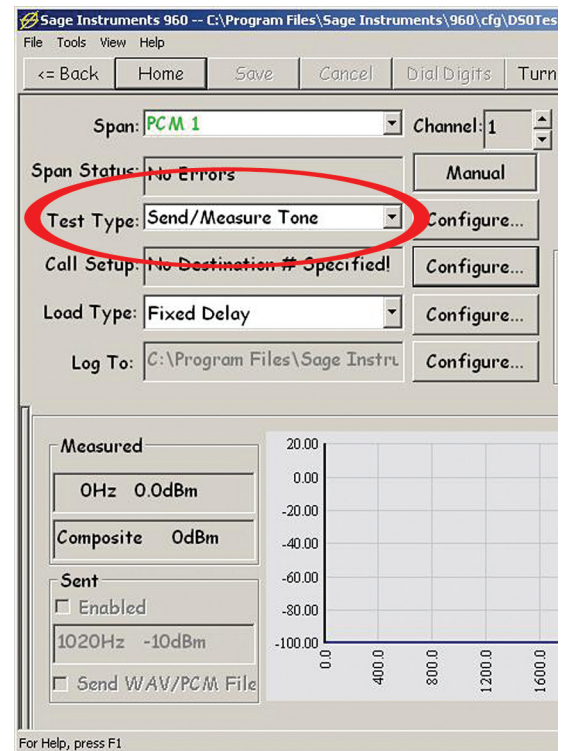
Figure 3.1.5

Figure 3.1.7

Figure 3.1.8

960 GUI Common Setup and Control Windows
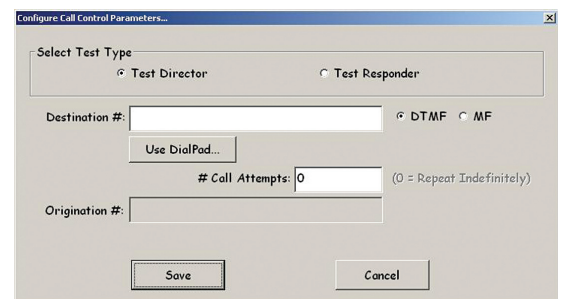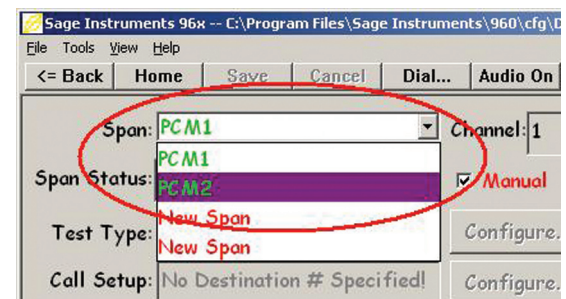
Running Tests in Manual Mode *(continued)*

7. Just as in step 3, click the configure button next to the test type selection menu. This action launches the measure tone configuration window. Set the test duration to 0 seconds making the test a continuous run. Click save to close the window.

8. Like step 4 click the configure button next to the call setup field. This action launches the configure call parameters window, choose "Test Responder" as the test type. Click save to close the window.

Figure 3.1.9

9. While still on PCM 2, Channel 1 click the manual button. This action launches the "Manual Call Dialog" box. Because the selected test on PCM 2, Channel 1 is a responder only the "Answer Manual Call" button is active (see figure 3.1.9). To place the Send/Measure Tone responder in a wait to answer call state click the "Answer Manual Call" Button.
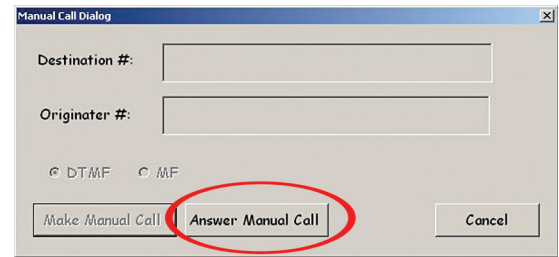
Your screen should now look like figure 3.1.10 with the test status message reading "Stopped (Wait Far Hook Off)".
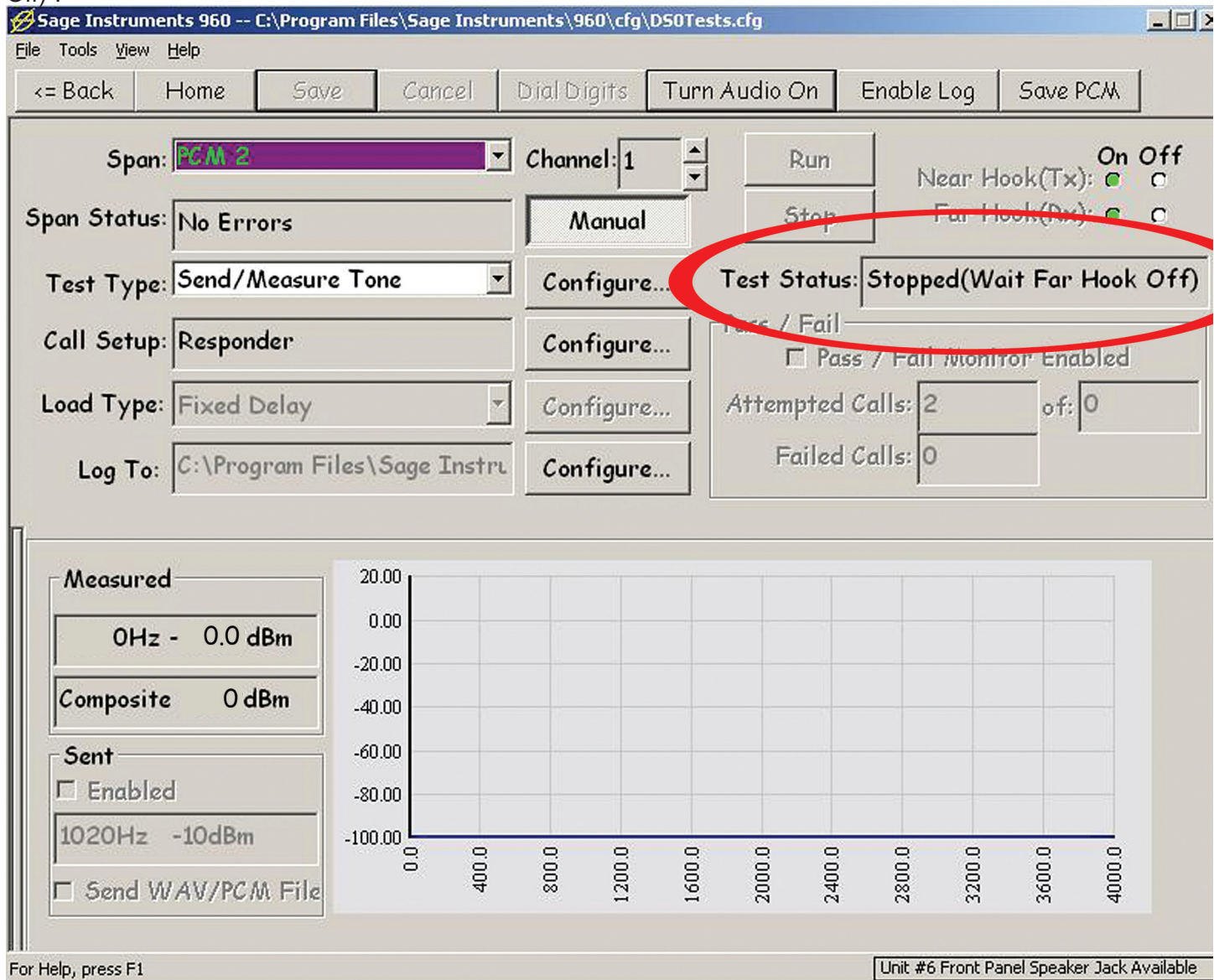
Figure 3.1.10

(continued on next page)

Running Tests in Manual Mode *(continued)*

10. Without leaving the main test window use the 'Span" pull down menu in the upper left hand corner to switch span selection back to PCM 1, Channel 1. Click the "Manual" button. This action launches the "Manual Call Dialog" box. Because the selected test on PCM 1, Channel 1 is a director only the "Make Manual Call" button is active (see figure 3.1.11). To manually place the Send/ Measure Tone test call click the "Make Manual Call" Button. To run the tests, press the "RUN" button on PCM 1, Channel 1 and PCM 2, Channel 1.

Figure 3.1.11

The "Send/Measure Tone test is now running a test director on PCM 1, Channel 1 and a test responder on PCM 2, Channel 1. The test status message on both PCM 1 and 2 now reads "Running (call Up)" (see figure 3.1.12).
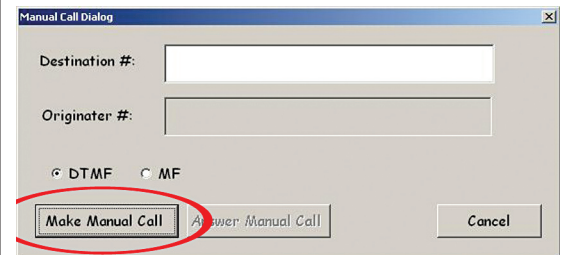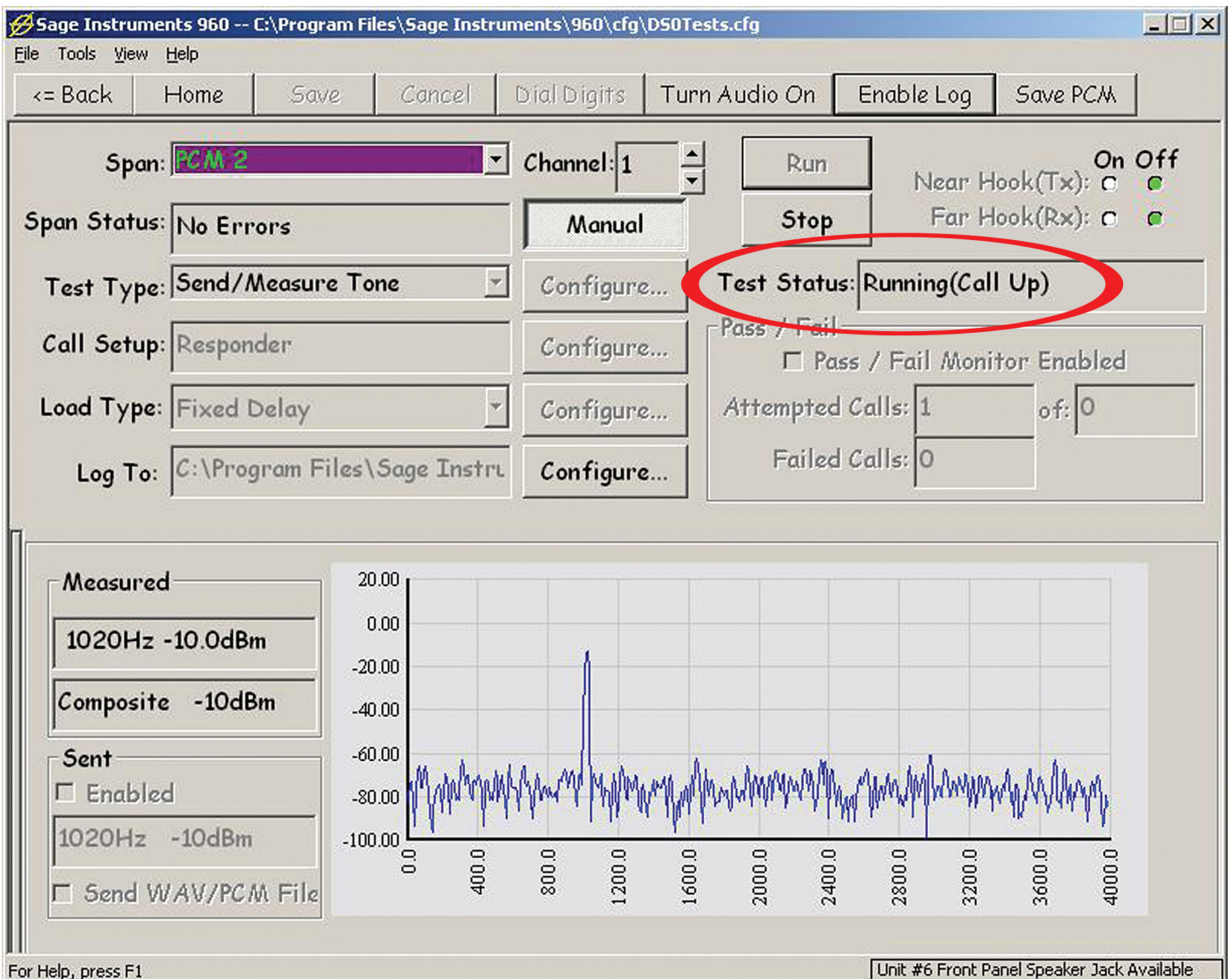
Figure 3.1.12

(continued on next page)

3.3 Change Test and Reverse Test Direction

In a continuance of this example we will now change the test and reverse the test direction without dropping the call.

1. From the PCM 2, Channel 1 window that is running the Send/Measure Tone responder test press the stop button. Notice that while the test has stopped the call is still up as indicated in the Test Status field (see close-up figure 3.1.13).

Figure 3.1.13

2. From the test type pull down menu change the test type from Send/Measure Tone to "SMOS Director" and click save. Next click the configure button next to the test type selection menu. This action launches the SMOS configuration window. Set the test duration 60 seconds. Click save to close the window.

3. Next click the configure button next to the call setup field. This action launches the configure call parameters window, choose Test Director as the test type and enter the destination number. Click save to close the window.

4. Without leaving the main test window use the 'Span" pull down menu to switch span selection to PCM 1, Ch.1.

5. Press stop. From the test type pull down menu change the test type from "Send/Measure Tone" to "SMOS Responder" and then click save.

6. Next, click the configure button next to the test type selection menu. Notice "No Configuration Required!" for the responder side, click OK.

7. Click the configure button next to the call setup field. This action launches the configure call parameters window, choose Test Responder as the test type. Click "Save" to close the window. At the main test press "Run" on both PCM 1 and PCM 2. Your screen should now look like figure 44. The SMOS Director test is now running on channel 1 PCM 2 and the SMOS responder is running on channel 1 PCM 1.

You have just used the SAGE 960B Manual operation mode to change tests and call direction without dropping the call. This same procedure is common for all tests with the exception of the ISDN D Channel test which uses another method for manual operation described later in this manual.
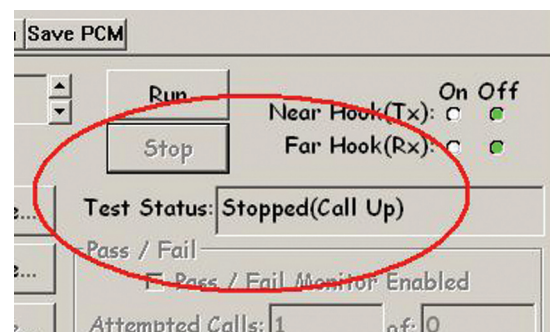
Figure 3.1.14
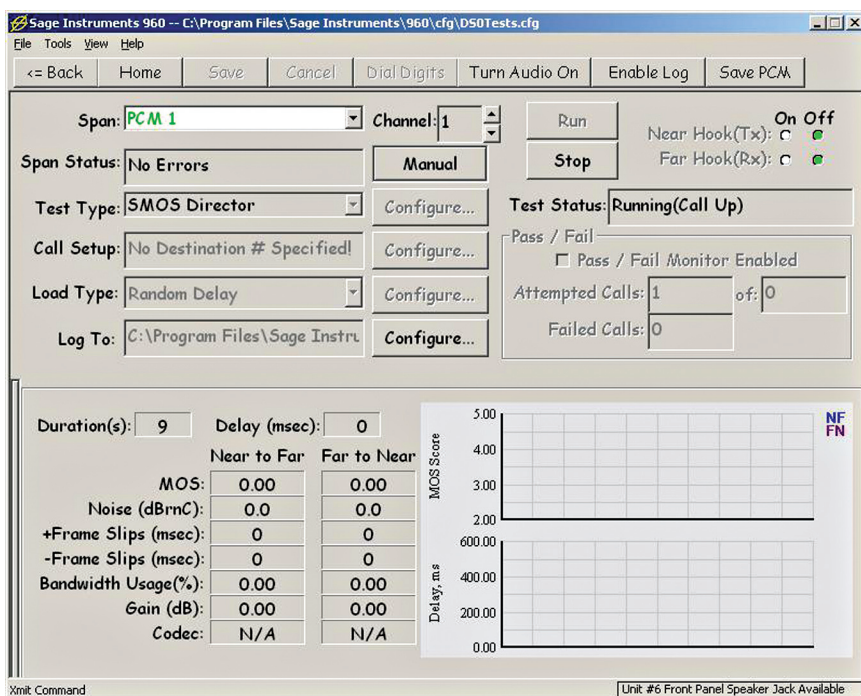
Introduction

The following section of the manual describes configuring, running and viewing results for all of the 960 tests. All test descriptions assume the user has previously configured the applicable test interfaces, and is currently at the Test Control, or Multi-Channel configuration window ready to select a test. For more information on configuring interfaces and the Test Control window refer to Section 2.

The following section is divided into three parts, Voice Band tests, Digital tests and IP tests.

Note that many of the Voice Band tests can be run over digital T1/E1 interfaces, or over Ethernet interfaces using a SIP call. The tables below list all the 960 tests along with applicable interfaces and call origination Director/ Responder functionality.

| Test Name/ (Option #)	Test Interfaces	Call Setup Director/ Responder
105 Director (7960-5200-02)	PCM, Analog	Director or Responder
10X Responder (7960-5200-02)	PCM, Analog	Director or Responder
Digit Analyzer (7960-5100-02)	PCM and Analog	Director or Responder
Digit Sender (NA*)	PCM, Analog and Ethernet (SIP Call)	Director or Responder
DSO/Fractional BERT (7960-5400-02)	PCM Only	Director or Responder
Dual Spectrum Analyzer (7960-5100-02)	Ethernet Only (SIP Call)	NA
Echo Conv Test (7960-5500-02)	PCM Only	Director or Responder
Echo Generator (7960-5500-02)	PCM, Analog and Ethernet (SIP Call)	Director or Responder
Echo Ping (NA*)	Ethernet Only	NA
Echo Sounder (7960-5500-02)	PCM, Analog and Ethernet (SIP Call)	Director or Responder
Fax Receive (7960-5800-02)	PCM and Analog	Director or Responder
Fax Transmit (7960-5800-02)	PCM and Analog	Director or Responder
G.168 (7960-5600-02)	PCM and Ethernet (SIP Call)	Director or Responder
INMD P.561 (7960-5700-02)	PCM Only	Director or Responder
ISDN D Channel (7960-1000-02)	PCM Only	NA
MoIP Director (7960-5300-02)	PCM and Analog	Director or Responder
MoIP Responder (7960-5300-02)	PCM and Analog	Director or Responder
MOS Receive (7960-5500-02)	PCM, Analog and Ethernet (SIP Call)	Director or Responder
MOS Transmit (7960-5500-02)	PCM, Analog and Ethernet (SIP Call)	Director or Responder
One-Way Delay Rx (7960-5500-02)	PCM, Analog and Ethernet (SIP Call)	Director or Responder

Test Name	Test Interfaces	Call Setup Director/ Responder
One-Way Delay Tx (7960-5500-02)	PCM, Analog and Ethernet (SIP Call)	Responder
PESQ Director (7960-5050-02)	PCM, Analog and Ethernet (SIP Call)	Director or Responder
PESQ Responder (7960-5050-02)	PCM, Analog and Ethernet (SIP Call)	Director or Responder
PESQ Transmit (7960-5050-02)	PCM, Analog and Ethernet (SIP Call)	Director or Responder
PESQ Receive (7960-5050-02)	PCM, Analog and Ethernet (SIP Call)	Director or Responder
PVIT (7960-5500-02)	PCM and Analog	Director or Responder
Remote Audio (7960-1010-02)	PCM, Analog and Ethernet	NA
RFC2833 Monitor (7960-6150-02)	Ethernet Only	NA
RTCP Monitor (7960-6140-02)	Ethernet Only	NA
RTP Loader (7960-6120-02)	Ethernet Only (SIP Call)	Director or Responder
RTP Monitor (7960-6130-02)	Ethernet Only	NA
Send/Measure Tone (NA*)	PCM, Analog and Ethernet (SIP Call)	Director or Responder
SIP Call (7960-6120-02)	Ethernet Only	Director or Responder
SIP Monitor (7960-6110-02)	Ethernet Only	NA
SMOS Director (7960-5500-02)	PCM, Analog and Ethernet (SIP Call)	Director or Responder
SMOS Responder (7960-5500-02)	PCM, Analog and Ethernet (SIP Call)	Director or Responder
T.38 Fax Rx (7960-6160-02)	Ethernet Only (SIP Call)	Director or Responder
T.38 Fax Tx (7960-6160-02)	Ethernet Only (SIP Call)	Director or Responder
V90 Modem Monitor (7960-5900-02)	PCM	NA
VIOP Impairment Generator (7960-6180-02)	Ethernet Only	NA

* Test Options marked NA are part of the base unit.

Director/Responder Terminology

Note that Sage uses the director and responder designations in two ways: to describe test functionality, and to describe the call setup function.

Test Functionality

When describing test functionality, the director side of the test, I.E. PESQ Director, controls the test progress and collects and displays the results. The responder side of the test provides farend test resources controlled by the director. Most of the Sage responder tests do not have any results display.

Call Setup

When describing the call setup function the director and responder designations are used for call origination and call answering functions respectively. In this context the director originates the call, sending digits or the address for the farend. The responder waits idle, upon seeing a ringing signal it will answer the call.

Director Responder Tests

In most test environments it is convenient, but not mandatory, to pair the director and responder test functions with the director and responder call setup functions. When this is done, the director both controls and displays the call state as well as the test results. In this scenario, the responder is somewhat autonomous, waiting for a call, then being controlled by the director when a test call is received, and forwarding any results to the director.

Transmit Receive Tests

When configuring transmit and receive tests, I.E. PESQ Transmit/Receive the 960 by default will usually pair the Transmit test with the Responder call setup function, and the Receive test with the Director call setup function. This is not a mandatory pairing, but is done for the convenience of the user. When the Receive test is paired with the Director call setup function the user can control and view the test call status and view the test results from the same window.

1. Voice Band Tests

1.1. 105 Director

The 105 Director test can perform test calls to industry standard 100, 102 and 105 testlines and responders. This test is only applicable to T1/E1 and analog interfaces.

The 100 type testline sends 1000Hz at 0 dBm for approximately 5.5 seconds. After the tone is disconnected, a quiet term is applied until the calling party disconnects. The 102 type testline is a milliwat source, sending 1004 Hz and 0 dBm for the duration of the call.

The 105 type testline can measure loss, noise, C-noched noise, and echo return loss. In the 105 test, both the director and responder make measurements, resulting in measurements for both directions of transmission.

Figure 1.1.1 105 Director Test

Test Setup

To select the 105 Director test, click on the button in the circled Test Type list box in Figure 1.1.1. This will bring up a list of tests, click on the **105 Director** test and click on the **Save** button in the tool bar to save and enable configuration of the test.

Click on the **Configure** button to the right of the circled list box in Figure 1.1.1. This will launch the 105 Director configuration dialog box shown in Figure 1.1.2.

The three radio buttons in the **Test Type** frame at the top of the dialog box in Figure 1.1.2 are for selecting the testline type. This should be set to match the type of testline called by the director. If the Director and Responder testline types do not match the tests will not run properly.

Below the Test Type buttons is the **Comm Level** text box. This text box specifies the the level of the MF control tones sent by the Director to the Responder. This text box is only enabled when the 105 Test Type is selected. Do not change this value unless there are problems with the Director/Responder communications.

Below the Comm Level test box is the **Inter-test Pause** text box. This text box specifies the pause in milliseconds between each of the tests in the 105 suite. This text box is only enabled when the 105 Test Type is selected. The inter test time is normally left at the default value of 100 milliseconds. Some third party responders may require a different inter-test pause duration. Consult the responder manufacturer for more information on this setting.

Below the Inter-test Pause text box is the list of tests with accompanying check boxes. When a test is checked the selected test will be run during the test call. Note that only the 1004 Hz at 0 dBm,

Figure 1.1.2 105 Director Dialog

Note: When inserting a WAV file, the maximum file length should be no more than 256K samples or approximately 32 seconds of raw PCM (a-Law or µ-Law), 8 Khz encoding at 8, 16, or 32 bits.
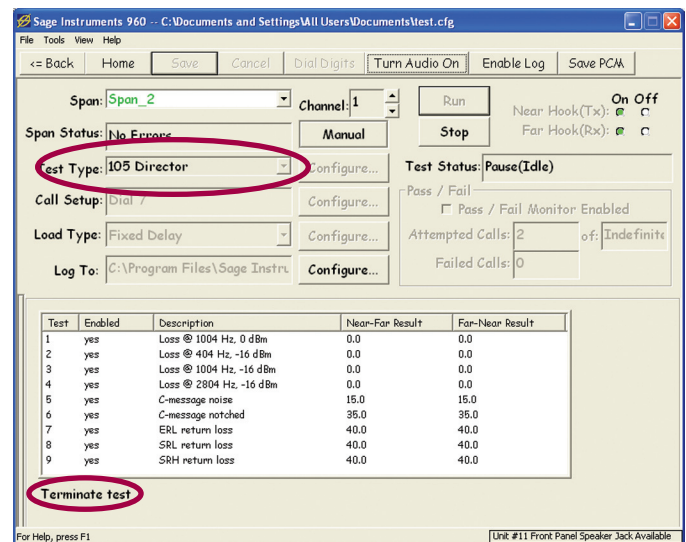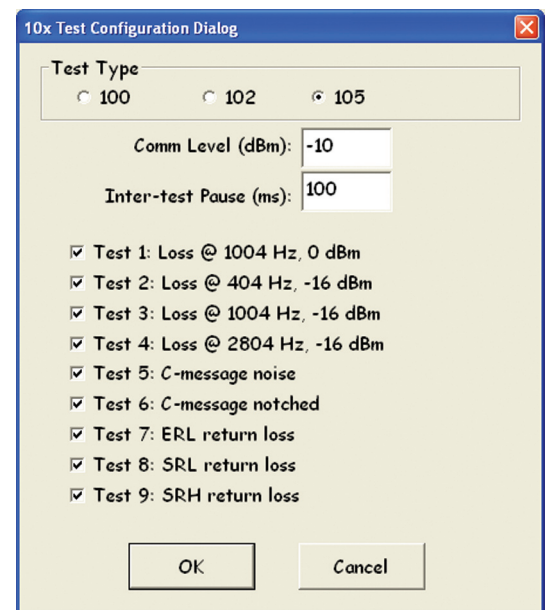
and C-message noise tests are applicable to 100 and 102 type testlines, the rest of the test check boxes are disabled.

Test results

The 105 Director test results are shown in the bottom half of the test window in Figure 1.1.1. Note that these results are for the 105 test. The 100 and 102 type testline results are Loss at 1004 Hz at 0 dBm, and Cmsg noise. The 100 and 102 tests only provide results in the far to near direction.

The first column labeled **Test** is the test number. This corresponds with the test numbers in the 105 Test Configuration dialog box in Figure 1.1.2.

The column to the right of of the Test number is the **Enabled** status. If a test check box is checked in the Director configuration dialog, the test will be enabled. To the right of the enabled column is the **Test Description**.

To the right of the description column is the **Near to Far** results. These are measurements made at the farend by the responder. Results for this direction are only available when the 105 test type is selected.

To the right of the Near to Far results are the **Far to Near** results. These are measurements made at the nearend by the Director. The text circled at the bottom of Figure 1.1.1 is the test status indicator. This will show real time test progress messages indicating which tests are currently running.

1.2. 10X Responder

The 10X responder allows the 960 to emulate a 100, 102, 105 or 108 type testline.

The 100 type testline sends 1000Hz at 0 dBm for approximately 5.5 seconds. After the tone is disconnected, a quiet term is applied until the calling party disconnects.

The 102 type testline is a milliwatt source, sending a cadenced 1004 Hz and 0 dBm for the duration of the call.

The 105 type testline can measure loss, noise, C-noched noise, and echo return loss. In the 105 test, both the director and responder make measurements, resulting in measurements for both directions of transmission. The 108 testline is a digital loopback testline mainly used for DS-0 rate digital tests; however the 108 testline can also be used as a 0 dB loopback for voice band tests.

Test Setup

To select the 10X Responder test, click on the button in the circled Test Type list box in Figure 1.2.1. This will bring up a list of tests, click on the **10X Responder** test and click on the **Save** button in the toolbar to save and enable configuration of the test.

Click on the **Configure** button to the right of the circled list box in Figure 1.2.1. This will launch the 10X Responder configuration dialog box shown in Figure 1.2.1.

Figure 1.2.1 10X Responder Test
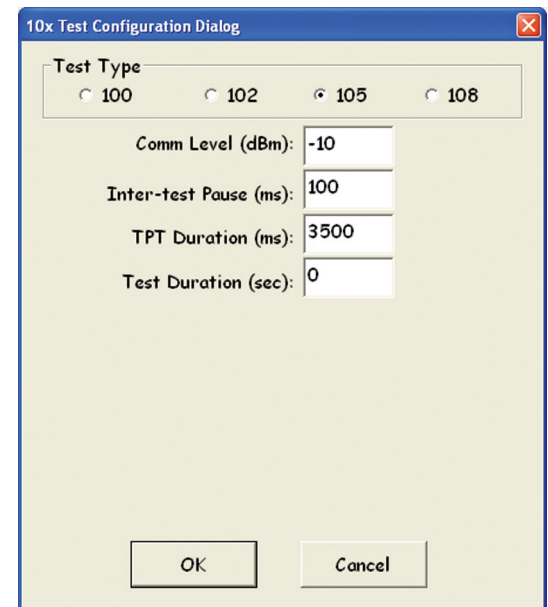
Figure 1.2.2 10X Responder Dialog

The three radio buttons in the **Test Type** frame at the top of the dialog box in Figure 1.2.2 are for selecting the testline type. If the Director and Responder testline types do not match the tests will not run properly.

Below the Test Type buttons is the **Comm Level** text box. This text box specifies the the level of the MF control tones sent by the Responder to the Director. This text box is only enabled when the 105 Test Type is selected. Do not change this value unless there are problems with the Director/Responder communications.

Below the Comm Level text box is the **Inter-test Pause** text box. This text box specifies the pause in milliseconds between each of the tests in the 105 suite. This text box is only enabled when the 105 Test Type is selected. The inter test time is normally left at the default value of 100 milliseconds. Some third party equipment may require a different inter-test pause duration. Consult the manufacturer for more information on this setting. Below the Inter-test Pause text box is the **TPT Duration** text box. This text box specifies the duration of the Test Progress Tone(TPT) that the responder sends upon answering a call. The default value of 3,500 milliseconds should not be changed unless there are operational problems with other directors that require a different TPT duration. Below the TPT text box is the **Test duration** text box. This text box specifies how many seconds the responder will stay off-hook to perform tests. Note that if the duration is set too short the responder will hang up before tests are completed. This is especially true of the 105 and 108 tests which can have an indeterminate duration.
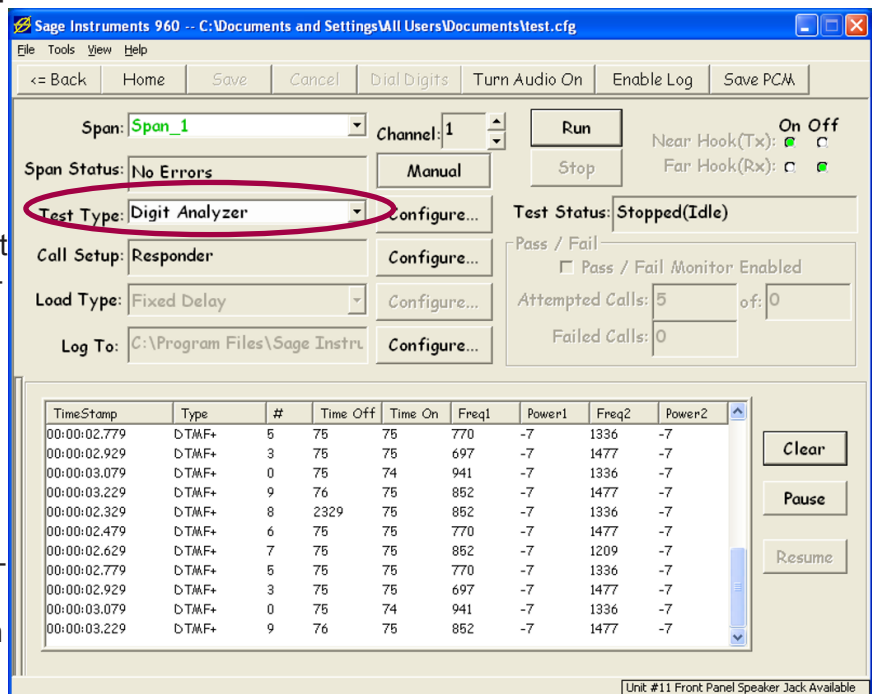
Figure 1.3.1 Digit Analyzer Test

Test Results

Test results for the 10X responder are limited. Results for both directions of test are available from the director side of the test. The responder results are shown in the lower half of Figure 1.2.1. The **Status** text box at the top of the results indicates the testline mode. When a incoming call is received, the Status text box will indicate Test line 102 mode, Test Line 100 mode or Test line 105 mode. Note that there are no Status indicators or responder messages logged in the 108 test mode.

Below the Status box is a log of responder messages indicating the test state of the responder. The messages are time stamped for correlation purposes. The **Clear Pause** and **Resume** buttons located on the right side of the results display are for controlling the log messages. Note that clicking on the Pause button will freeze the display but will not stop the capture of messages.

1.3. Digit Analyzer Test

Sage's Digit Analyzer verifies received DTMF/MF digits with displayed On/Off times, frequency, and level for each digit received.

Test Setup

To select the Digit Analyzer test, click on the button in the circled **Test Type** list box in Figure 1.3.1. This will bring up a list of tests, click on the **Digit Analyzer** test and click on the **Save** button in the toolbar to save and enable configuration of the test.

Click on the **Configure** button to the right of the circled list box in Figure 1.3.1. This will launch the Configure Digit Analyzer dialog box shown in Figure 1.3.2.

Enter the test duration in seconds in the **Test Duration** text box at the top of Figure 1.3.2. Below the duration test box are timeout values for the digit analyzer. The **Time out before first digit** text box is used to specify how long the 960 will wait for the first digit. If no digits are received before the timeout value, the 960 will timeout and no digits will be analyzed. The Time out after the last digit specifies the amount of time in milliseconds that the 960 will wait before declaring the end of digit string. Below the Time out text boxes are digit parameters the 960 uses for declaring valid digits. Digits that are outside the parameters will be displayed as errored digits. The parameters are **Minimum On-Duration**, **Minimum Level of each**

tone, **Max level difference of the tones** and **Maximum frequency deviation**.

Below the digit parameters is a check box labeled **Only show detected digits (hide errors)**. When this check box is checked, only valid digits meeting the specified digit parameters will be displayed.

Digit Analyzer Results

The digit analyzer results are shown in the bottom half of Figure 1.3.1. The first column of the results is a time stamp for the received digit. The next column to the right labeled **Type** indicates the format of digit received, DTMF or MF. The column to the right of Type labeled **#** displays the value of the digit received. The next two columns to the right labled **Time Off** and **Time On** are used to display the tone on and tone off time intervals. The next four columns to the right are two pairs of Frequency and Level measurements for each of the two tones.

The three buttons to the right of the results labeled **Clear**, **Pause** and **Resume** are for controlling the displayed results. Note that the Pause button pauses the displayed messages for readability, but does not stop the logging of results.

1.4. Digit Sender Test

Sage's Digit Sender sends MF and DTMF digits. This test is applicable to all 960 test interfaces. For Ethernet interfaces the Digit sender is selected as a VF test under the SIP Call. For more information on setting up a SIP call refer to the SIP Call description in Section 3.

Test Setup

To select the Digit Sender test, click on the button in the circled **Test Type** list box in Figure 1.4.1. This will bring up a list of tests, click on the **Digit Sender** test and click on the **Save** button in the toolbar to save and enable configuration of the test. Click on the **Configure** button to the right of the circled list box in Figure 1.4.1. This will launch the Configure Digit Sender dialog box shown in Figure 1.4.2.

First select the type of digits by clicking on one of the circled radio buttons, **DTMF**, **MF** or **RFC2833/4733** in Figure 1.4.2. Note that the RFC2833/4733 option is only available when making a SIP call. The text box labeled **Digits** is for entering the digits to dial. A digit string of up to 64 digits can be entered in this text box. The **Use DialPad** button will launch a dial pad that can be used to enter a number into the Dial text box. This is useful when enter-

Figure 1.3.2 Configure Digit Analyzer Dialog

Figure 1.4.1 Digit Sender Test

ing the non-numeric DTMF, MF and RFC digit types. The text boxes below the circled radio buttons in Figure 1.4.2 are used to set the tone **Time On** and **Time Off** as well as the **Frequency Deviation** and **Level** of the sent tones. Only modify these parameters if your application requires non standard values.

Test Results

There are no test results associated with the digit sender. The test setup is shown in the lower half of the Digit Sender test window in Figure 1.4.1.

1.5. Echo Convergence Test
Introduction

The SAGE 960B Convergence is adopted from the G.168 2A convergence test. The test uses the G.168 Composite Signal Source (CSS) to test echo canceller convergence.

Test Setup

Figure 1.5.1 shows the convergence test window. To select the convergence test click on the button in the circled **Test Type** list box in Figure 1.5.1. Select the **Echo Convergence** test from the list and click on the **Save** button in the tool bar. Clicking on the **Configure** button to the right of Test Type list box will launch the Echo Convergence configuration dialog box shown in Figure 1.5.1.

The **Tx Level** text box will set the level in dBm of the CSS sent by the sent by the 960. Below the Tx Level text box is The **EC Disable Tone** frame. In this frame are controls for setting an echo canceller disable tone, including the V.8 specified AMSam modified answer tone. In normal testing of echo canceller convergence the echo canceller disable tone should not be enabled. Below the EC Disable frame is the **Pass/Fail Monitor** controls. Clicking on the Enable Pass/Fail Monitor check box will cause the 960 to perform a pass/fail test on the convergence performance of the echo canceller. Enter the maximum residual echo level in the **Level** text box. Enter the echo canceler convergence time in milliseconds in the **Delay** text box. For each test call, the 960 will determine if the echo canceller reduced the echo level below the Pass/Fail level threshold within the requested Delay time. Calls that do not meet this criteria are marked as Failed Calls.

Running Tests

The echo convergence test is normally run as a test director, initiating calls over circuits containing echo cancellers. Once the **Call Setup** information is configured click on the **Run** button to start the test.

Echo Convergence Results

The echo convergence test provides a graphical display of the returned echo energy verses time. The **Pass/Fail** indicators are located in the red square in the upper right portion of Figure 1.5.1.
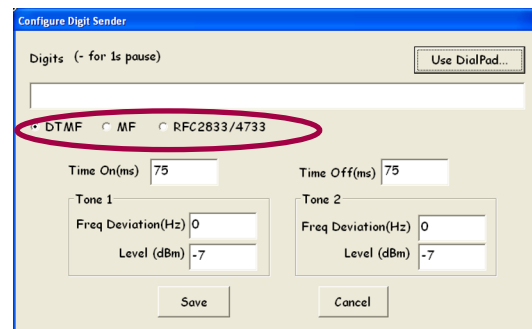

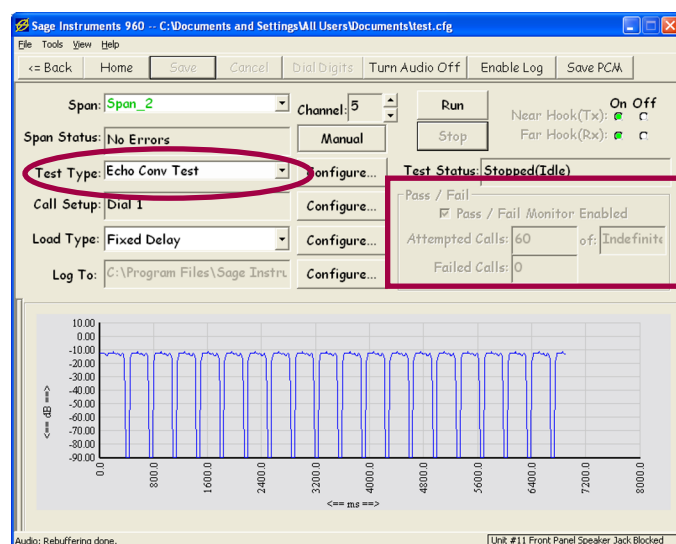**Figure 1.4.2 Configure Digit Sender Dialog**
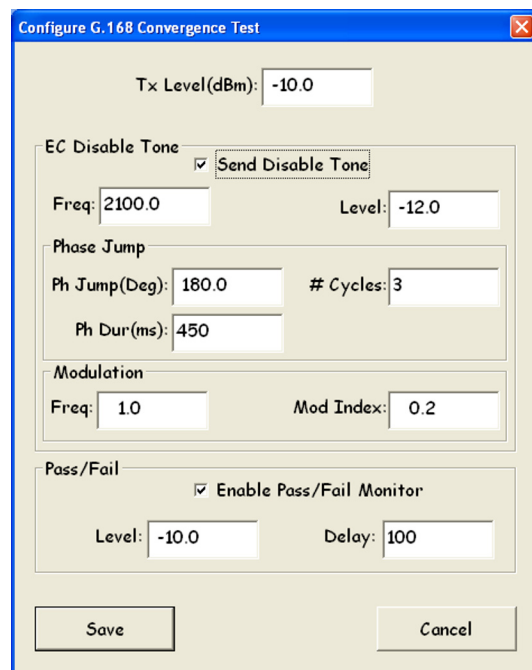

Figure 1.5.1 Echo Convergence Test

Figure 1.5.2 Configure Test Parameters

1.6. Echo Generator

Introduction

Sage Instruments Echo Generator generates multiple echoes with programmable echo delay and echo level. When combined with Echo Sounder, Echo Generator facilitates the G.168-type [1] of echo canceller test and the measurements of round-trip delay and round-trip attenuation. When working alone, Echo Generator serves as a simple remotely-programmable loop-back providing:

• Programmable echoes and levels
• Global echo disable in manual mode
• Hoth Noise and Double Talk Generation
• Jitter and Packet Loss Generation
• Send WAV/PCM file with Echo

Figure 1.6.1 Configure Test Parameters

Test Setup

Clicking on the button in the circled **Test Type** text box in Figure 1.6.1 will bring up a list of tests. Click on the **Echo Generator** test to select the test. Click on the **Save** button in the tool bar to save and enable configuration of the test. Clicking on the **Configure** button to the right of the Test Type test box launches the Configure Echo Generator dialog box shown in Figure 1.6.2.

The four text boxes in the upper left corner labeled **Echo #1** and **Echo #2** are for specifying echo **Delay** and Level**.** The Delay range is 0 to 500 milliseconds for IP interfaces, 7 to 500 milliseconds for analog interfaces, 24 to 500 milliseconds for T1/E1 interfaces in terminate mode, and 48 to 500 milliseconds for T1/E1 interfaces in drop and insert mode. If the GSM FR option is selected, the minimum delay is 40 milliseconds for all interfaces. Note, for IP interfaces, the jitter buffer and transmit packitization delays are added to the specified delay. The **level** range is 3.0 to -50 dBm. The check boxes to the left of the echo text boxes are for enabling the echo. Unchecking the check box disables the associated echo.

To the right of the echo text boxes are the **Signal Generation** controls. These controls allow the addition of **Hoth Noise**, **Double Talk** and **DC bias** into the returned echo signal. Click on one of the signal types and enter the desired **Level** in dBm.

At the bottom of the dialog box in Figure 1.6.2 is the **Test Duration** text box. Enter the desired duration in seconds.

> **Note:** For Analog 2-wire, EGEN requires an allotment of time to allow for 2-wire interface calibration (~ 6 seconds). So when performing an echo sounder test to an echo gene on a 2-wire circuit, the lead delay time on the echo sounder must allow for calibration. If lead delay is not long enough, echo gen will not complete its calibration cycle and echo emulation will malfunction thus reporting incorrect results.

Above the test duration text box is **WAV/PCM File Sender**.
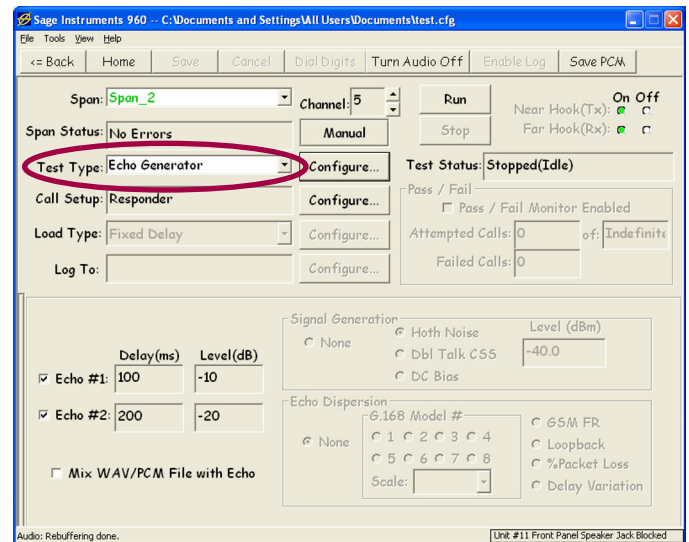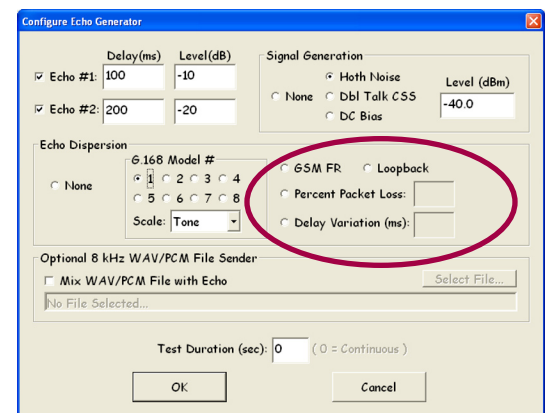
Figure 1.6.2 Configure Test Parameters

Checking the associated check box will enable the **Select File** button on the right side of the window. Clicking on this button will launch a Windows Open File dialog box. Select the desired file to send. Note that the maximum file size is 32 seconds of audio.

The controls inside the red circle in Figure 1.6.2 are special loopback selections. When one is selected, the Echo #1 and Echo #2 and any Signal Generation options are disabled. The Echo #1 text box is used to enter the delay for the loopback.

Clicking on the **GSM FR** selects a loopback with GSM full rate encode/decode process to simulate signals going over a GSM network.

Clicking on the **Percent Packet Loss** button and entering an percentage value

will cause 10 millisecond drop outs to be inserted at the rate specified by the percentage value.

Clicking on the **Delay Variation** button and entering a delay value in milliseconds will cause the loopback to have variable delay with the specified amplitude. The delay varies at a 1 Hz rate.

Clicking on the **Loopback** button will configure a plain loopback with delay as specified in the Echo #1 Delay text box.

Setting Echo Dispersion using G.168 Models

Located across the center of the Echo Generator window is the Echo Dispersion settings section (see close-up figure 1.6.3).

The following G.168 echo path models are used with the SAGE 960B Echo Generator test. The echo path is simulated by a linear digital filter with the scaling factor K_i as referenced in the table below. The eight G.168 models represent echo paths with various dispersion characteristics and different time widths. For tests that use CCS (Composite Source Signal) or white noise as the scaling factor the values of K_i are provided in the table below.

$$g(k) = (10^{-ERL/20} K_i)m_i (k\text{-}§)$$

Echo Path Model	Scaling Factor K_i	Minimum ERL for CCS (dB)*
1	1.39×10^{-5}	6
2	1.44×10^{-5}	6.55
3	1.52×10^{-5}	6
4	1.77×10^{-5}	6
5	9.33×10^{-6}	6
6	1.51×10^{-5}	6
7	2.33×10^{-5}	11.06
8	1.33×10^{-5}	9.27

Echo Path Model	Scaling Factor K_i	Minimum ERL for Tones (dB)*
For tests that use Tones as the scaling factor the values of K_i are provided in the table below.		
1	1.22×10^{-5}	6
2	6.78×10^{-6}	6
3	9.66×10^{-6}	6
4	1.07×10^{-5}	6
5	7.05×10^{-6}	6
6	8.60×10^{-6}	6
7	6.58×10^{-6}	6
8	4.58×10^{-6}	6
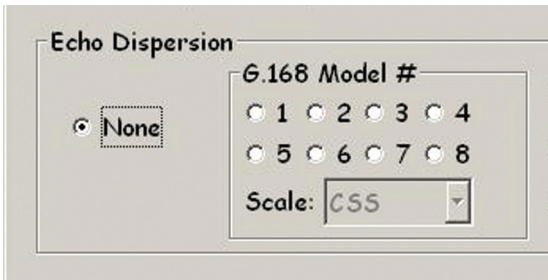
Figure 1.6.3 G.168 Model Selection

* A minimum ERL value of 6 db should be used in the tests for echo path models 1, 3, 4. 5 and 6. For echo path models 2, 7 and 8 the minimum ERL values used in the tests should be, respectively, 6.55 db, 11.06 db and 9.27 db. This ensures that the magnitude response of the scaled echo-path g(k) does not exceed 0 db over the appropriate frequency range.

Single-talk CSS: Composite-Source-Signal. This is the signal used in most of the tests for G.168. In time-domain, it consists of 3 portions, the active voice portion, the random noise portion and the silence (pause)p ortion. The exact duration ,power-spectral-density and peak-to-RMS ratio characteristics are specified in ANNEX C of G.168

See also the "Echo Sounder & Echo Generator" White Papers available via www.sageinst.com

1.7. Echo Sounder
Introduction
The Echo Sounder measures and graphically displays echo sources in the circuit under test. One of the echo sounder tests unique advantages is its ability to measure far end echo from a two-wire interface. In addition to measuring echo sources, the test can detect transient echo caused by the adaptive filtering of an echo canceller. The test can be configured to plot the convergence curve of the echo canceller. In addition to making echo measurements the echo sounder can be used to make round trip delay and far end return loss measurements. From a POTS interface, the 960 can call a standard telephone set at the far end and measure the round trip delay and far end return loss.
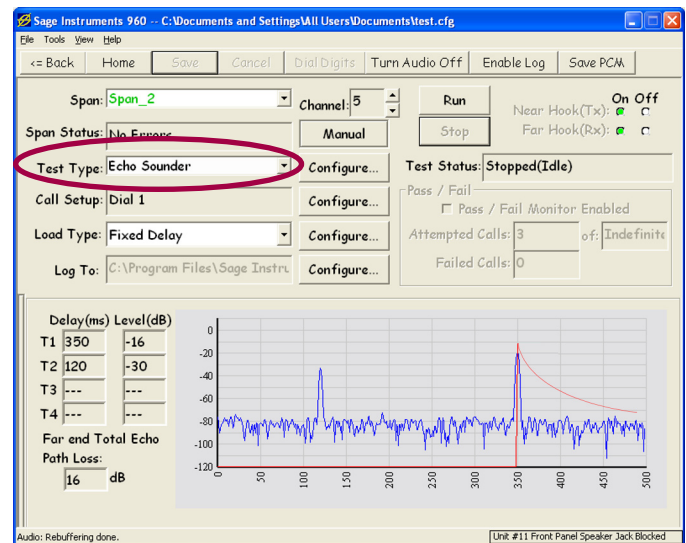
Figure 1.7.1 Echo Sounder Test

Test Setup
Clicking on the button in the circled **Test Type** text box in Figure 1.7.1 will bring up a list of tests. Click on the **Echo Sounder** test to select the test. Click on the **Save** button in the tool bar to save and enable configuration of the test. Clicking on the **Configure** button to the right of the Test Type test box launches the Configure Echo Sounder dialog box shown in Figure 1.7.2.The **Tx Level** text box located at the top of the dialog box is used to set the level of the echo sounder test signal. The level range is 0 to -20 dBm, the default level is -10 dBm. Checking the **Plot Convergence** check box will cause the 960 to plot a convergence curve showing the adaptive filtering of the echo canceler. This curve is superimposed on the echo sounder delay graph. The convergence curve is the red curve in the graph in Figure 1.7.1. Below the convergence check box is the **EC Disable** Tone frame. The controls in this frame are used to enable and configure an echo canceller disable tone. This can be used to disable the echo canceller in the circuit under test so the echo sounder can measure the echo paths in the circuit. Consult your echo canceller manual for the disable tone configuration. Below the EC Disable frame is the **Leading Silence** text box. This text box is used to specify a silent period in seconds, before the echo sounder test signal starts. Below this text box is the **Test Cycles** text box. This text box is used to specify how many cycles of the echo sounder signal is sent out for each test. A test cycle is slightly less than 2 seconds. Normally one cycle is sufficient to characterize the echo paths on a circuit. If the test cycle is set to zero the test repeats continuously.

Figure 1.7.2 Echo Sounder Setup

strongest echo detected.

Test Results
The echo sounder test results are shown in the bottom portion of Figure 1.7.1. On the left side of the results display are the **Delay** and **Level** indicator boxes for up to four echo sources the echo sounder has identified. The strongest echo sources are listed first. Below the Delay and Level indicators is the **Far End Total Echo Path Loss.** This indicator displays echo path loss in dB for the

1.8. FAX Transmit/Receive Tests

The SAGE 960B Fax Emulator (SFE) emulates both FAX transmitt and a FAX receive functions. SFE originates a call from the SAGE FAX transmitter to another FAX machine or the SAGE 960B FAX receiver across the network. The FAX transmitter will then communicate with the destination FAX machine or the SAGE FAX receiver with the protocols specified in ITUT T.30. Test pages are sent from the transmitter to the receiver. The test pages are encoded according to formats specified in ITU-T T.4. During testing the SAGE 960B emulators will report in real time the test progress, such as what signal is being sent; what signal is being received; whether or not a certain stage is being retried; whether or not an unexpected invalid protocol packet is received; whether or not timing errors have occurred, and whether or not the page transmission has succeeded.
For detailed SFE test information and operation principles see the link "Information on Sage's Fax Emulator" found at www.sageinst.com/960_B_Tech.html.

Figure 1.8.1 FAX Test

Test Setup
The Fax Transmit and Receive tests have similar configuration parameters. Once the FAX parameters are configured, setup the FAX Transmit test as a Director, and the FAX Receive test, if applicable as a responder in the **Call Setup** text box.
Clicking on the button in the circled **Test Type** text box in Figure 1.8.1 will bring up a list of tests. Click on the **Fax Transmit**, or **Fax Receive** test to select the appropriate test. Click on the **Save** button in the tool bar to save and enable configuration of the test. Clicking on the **Configure** button to the right of the Test Type text box launches the Fax Configuration dialog box shown in Figure 1.8.2. The **Type** frame contains radio buttons to select the type of Fax protocol to select. Note this selection is only applicable to the Fax Transmit test. To the right of the Type frame is the **TX Level** text box. This text box specifies the level of the transmitted Fax signal for the Fax Transmit and Fax Receive tests. Below the Tx Level text box is the **Pages** text box. This text box specifies the number of pages the Fax Transmit test will send. Note that this text box is disabled for the Fax receive test.

Figure 1.8.2 FAX Test Configuration

Fax Test Results
The Fax test results are shown in the lower portion of Figure 1.8.1. The transmit and receive tests have identical results displays, with each side displaying its sent and received Fax protocol messages. The log display on the left shows time stamped Fax protocol messages, while the log on the right shows Fax protocol events. The events are time stamped to facilitate correlation with the Fax message log. Each Fax event has **From** and **To** values that are millisecond time stamps showing the timing and duration of each event.

1.9. G.168 Tests

Description

ITU-T recommendation G.168 (titled "Digital network echo cancellers") defines a suite of objective tests that will ensure the minimum level of performance of an echo canceller when installed in the network. These tests are applicable to echo cancellers using digital signal processing techniques.

Digital network echo cancellers are designed to eliminate echo for the user and to allow successful transmission of voice band data and fax. G.168 tests should be performed on an echo canceller to assess its performance under conditions likely to be experienced in the network. A total of 21 tests are specified in G.168/2000. Sage has implemented the first 15 of them (from test No.1 to test No. 10B). The last 6 tests are still under study by ITU. The 960B can run tests manually or automate in sequence with serial or TCP/IP Echo Control interface. All ITU Standard Hybrid Dispersion Models are supported. Tests can be conducted while stressing canceller over multiple channels.

For detailed operation procedures on each of the G.168 tests please reference the G.168 White Paper found on the SAGE web site at www.sageinst.com/960_A_Tech.html.

Figure 1.9.1 shows the main test screen with the "G.168" test selected and saved. Clicking on the circled Configure button will launch the Configure G.168 Tests dialog box shown in Figure 1.9.2.

Figure 1.9.2

The G.168 Configuration window differs from those discussed up to this point because the G.168 Configuration menu has sub-menus. The additional windows are viewed by clicking on the tabs labeled Summary, Setup Tests and Setup ECon (Echo Canceller. The Summary tab is the default configuration window. Under the Summary tab select the desired g.168 tests, hybrid selection span and channel.

Figure 1.9.3
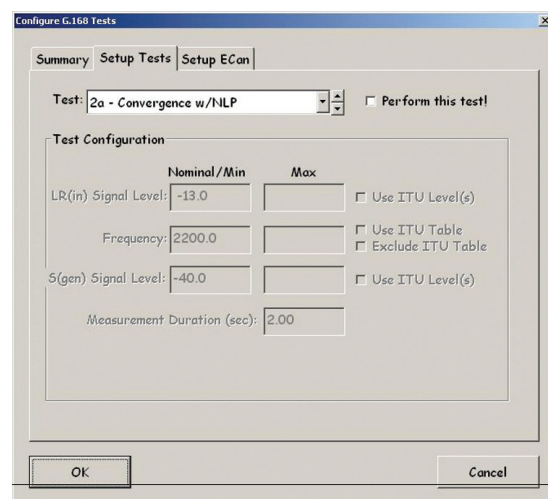
Next, select the Setup Tests tab. In this window select from the 15 G.168 tests available. Then place a check mark in the box labeled "Perform this test!".
Depending on test selected, user definable parameters, if any, will appear in the Test Configuration box below the test selection pull down menu.

Figure 1.9.1 G.168 Test Window

Tests and GUI Configuration

G.168 Tests *(continued)*

Set Up Echo Canceller Device Window

Like the Summary tab the Setup ECan tab's configuration window uses sub-menus in the form of tabs. The additional windows are viewed by clicking on the tabs labeled TCP/IP, Serial and None (see figure 86).
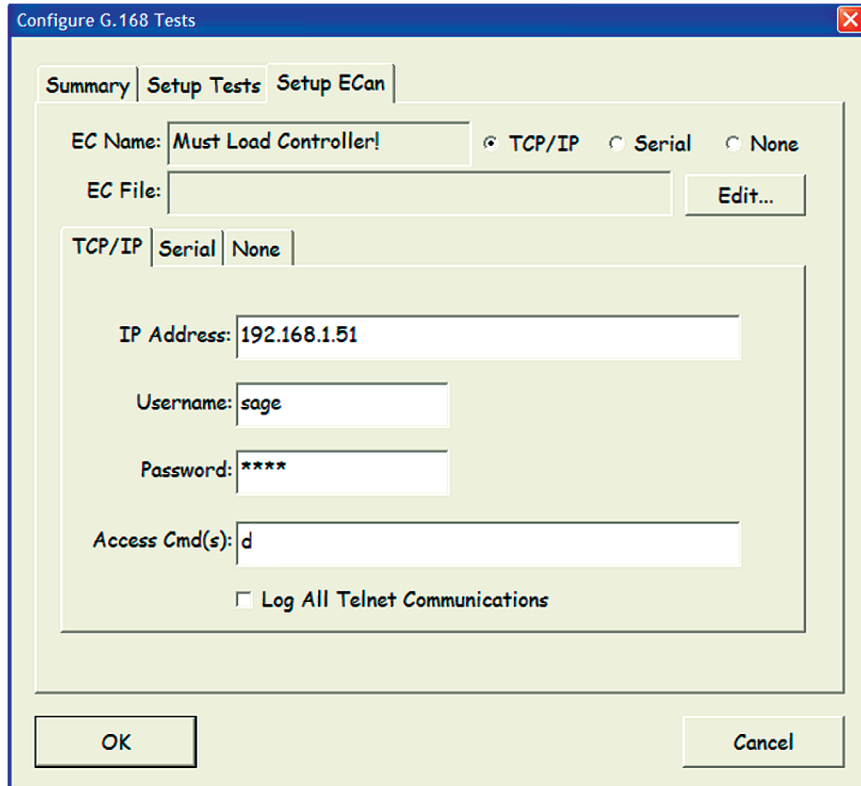
Figure 1.9.4 Echo Canceller Setup

Note: If the G.168 test to be conducted includes an echo canceller the SAGE Echo Generator option must be installed.

The primary function of the Setup E Can window is to tell the SAGE 960B where the Echo Canceller node is located on the network and to provide access. If the Echo Canceller is part of a TCP/IP network click the TCP/IP tab and enter in the device's IP Address, Username, Password, and any required Access Commands.

If the Echo Canceller is a serial device click the Serial tab and select the appropriate parameters for connection from the five pull down menus and the Data Bit radial buttons (see figure 1.9.5). Logging of all serial communications is also possible.

If the G.168 test to be conducted does not involve an Echo Canceller node click the tab labeled "None".

Figure 1.9.5

Figure1.9.6 *In the Configure Call Parameters window select Test Director or Test Responder, enter the test call destination number and number of attempts. From this window you can also click the "Use DialPad" to enter digits. Click save.*

Figure 1.9.7 *Select and set Fixed or Random delay.*
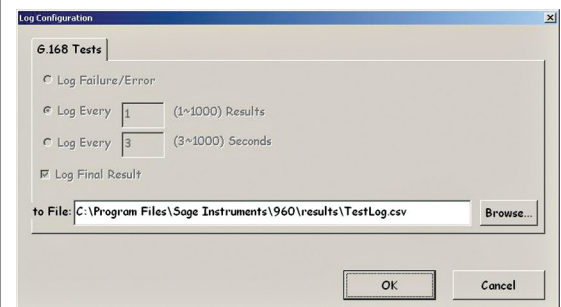
Figure 1.9.8 *Set-up Log Capture, click OK. Configuration complete, click run.*

1.10. INMD P.561

Introduction

INMD stands for In-service Non-intrusive Measurement Device. It is a passive voice quality monitoring method based on ITU-T P.56. Two types of measurements are covered by INMD: 1, speech and noise characterization; 2, echo characterization. Sage's current implementation of INMD on the 960B platform focuses only on echo characterization. More specifically, once the presence of echo is detected, Sage's INMD in the 960B will report in real time the detected echo level and echo delay. A graphical snapshot of the reference and echo signals is also displayed on the main test window as further visual confirmation. If the monitored DS1 are PRI-ISDN lines, then the source and destination phone numbers associated with the monitored DS0 channel are also presented. Simply speaking, INMD detects echo by principle of cross-correlation. More specifically, as implemented in the SAGE 960B, INMD has an internal signal analyzing window of 256ms long (2048 samples at 8000Hz sampling rate). For detailed INMD P.561 network connection and operation principles see the link "Information in SAGE's P.561 INMD Test" found at www.sageinst. com/960_B_Tech.html.

Figure 1.10.1 shows the main test screen with the "INMD" test selected and saved. When clicked the three (3) "Configure" buttons down the center of the screen display the test set-up windows at right.
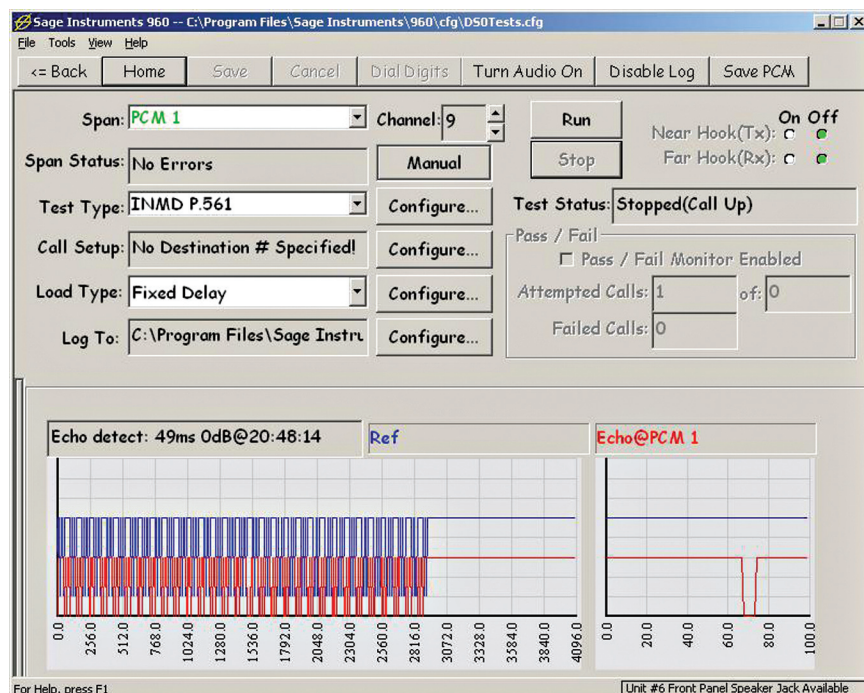
Figure 1.10.1

In Figure 1.10.1, there is an echo detected of 49ms delay and 0 dB level at 20:48:14 In the left plot, the blue line represents the reference signal on PCM2 while the red line represents the measured echo signal on PCM1. The signal is plotted for the last 4096 ms. The right plot shows the last 100 ms of signal activity for both monitored lines.

Note: Although the top INMD P.561 "Configuration" button is not dimmed, clicking on it has no affect. **No Configuration is Necessary.** Please continue on to set destination number, load type and log to file.
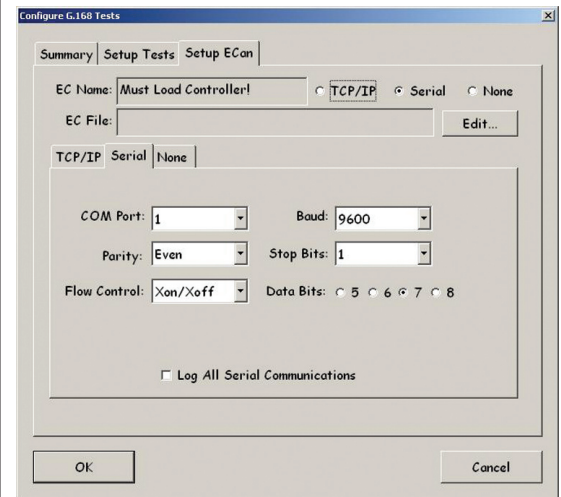
Figure 1.10.2 *In the Configure Call Parameters window select Test Director or Test Responder, enter the test call destination number and number of attempts. From this window you can also click the "Use DialPad" to enter digits. Click save.*
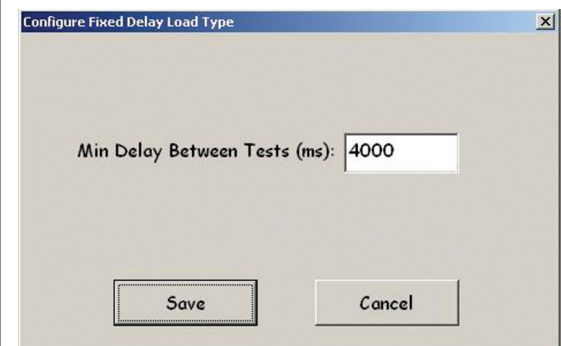
**Figure 1.10.3** *Select and set Fixed or Random delay.*
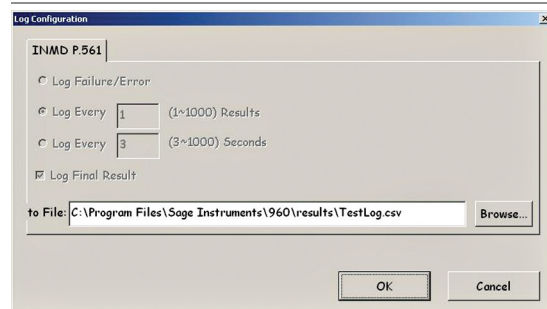
Figure 1.10.4 *Choose the timing of log capture, then enter a path or browse to the location where you want the log file to be saved.*

(continued on next page)
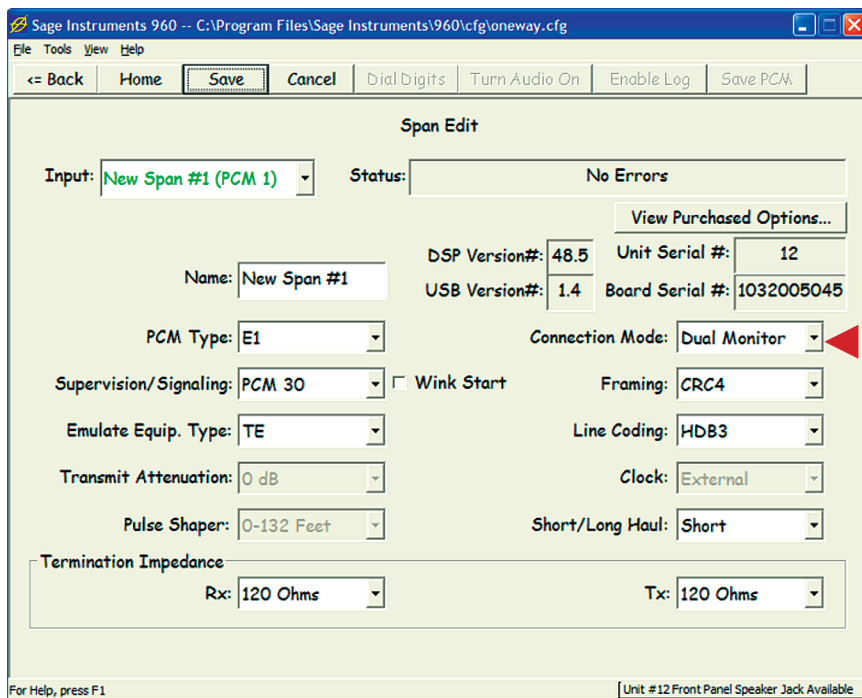
In Dual Monitor mode, some selections will not also be available as found in terminate mode. You will need to return to terminate mode in order to access these selections.

INMD P.561 Test Configuration

When using INMD, a user should connect Sage's 960 to the network as shown in figure 1.10.5.

The 960B has four DS1 (T1/E1/ISDN) spans, numbered as 1, 2, 3 and 4 with Rx and Tx ports (Use only the Rx ports to make the connections). Internally, 1 and 2 are a pair controlled by one embedded processor, whereas 3 and 4 are another pair controlled by another embedded processor. Since INMD entails precise relative delay measurement between two input signals, Sage's 960B must be configured in the following ways:

1. Two DS1 spans are used for INMD, although only the receiving ports need to be connected. The two DS1 spans must be either the 1 and 2 pair, or the 3 and 4 pair. Other combinations such as 1 and 4 or 2 and 3 etc are not allowed.

Figure 1.10.5
INMD Connection

Sage 960B

2. The chosen DS1 pair must be configured to "DUAL MONITOR" mode. When performing span configuration through 960B's GUI, one only needs to (and must) configure the first span (1 or 3) of each DS1 pair. The partner DS1 span (2 or 4) will be configured automatically for you. A user configuration on the second DS1 span (2 or 4) has no effect. In "DUAL MONITOR" mode, the internal software will always set the DS1 clock source to "EXTERNAL" clock regardless what the user selects on the GUI.

3. If the DS1 lines being monitored are PRI-ISDN lines, then the D-channel must be specified correctly when performing the span configuration in order for INMD to intercept the source and destination phone numbers associated with the DS0 channel(s) being monitored. If one is also interested in decoding all the ISDN call messages, one should also specify the TE and NT modes correctly. As in "TERMINATE" mode, the 960B DS1 span should be set to match the incoming NT or TE mode. For example, as shown in Figure 1.10.5, if the signal goes into the receiving port of 1 is from the NT equipment, then 960B's PCM1 must be set to TE mode. Internally, 2 will automatically be set to NT mode to match the signal from the TE equipment.

1.11. MoIP Director

Description

The SAGE MoIP Director test utilizes five (5) screens for configuration of the test parameters (see figures 1.11.1 through 1.11.5).

Purpose and Function

MoIP stands for Modem over IP. Sage Instruments designed this IP Telephony Service Transparency and E-model Test to specifically verify a gateway or IADís ability to handle a MoIP call or a VoIP call. More specifically, the test sends standard-based precursor signature tones by emulating a FAX call, a V34/V90 modem call or a voice call to test the gateway's call discrimination capability. After the signature tones, the test then measures the round-trip delay as the delay is a good indicator of the internal jitter buffer size. The test then starts simplex, full-duplex or half-duplex packet network impairments test by measuring in detail each individual packet loss event and its duration, and each individual voice jitter (gapping or jerking) event and its duration. The signal level change (gain) is also measured, and the codec type (PCM, ADPCM or VOCODER) is also detected. When voice test mode is chosen, echoes (in terms of levels and delays) are also measured from both directions using Sage's proprietary Echo Sounder algorithm. All of the measured parameters (round-trip delay, vocoder type, packet losses and echoes) are then used as inputs into the ITU-T G.107 E-model to produce a transmission rating factor R value, and the derivative GoB (Good or Better), PoW(Poor or Worse) and E-MOS (E-model-based mean-opinion- score) numbers. With this test, a user can quickly determine whether or not the device and network under test can handle various MoIP or VoIP calls. Figure 1.11.1 shows the main test screen with the "MoIP Director" test selected and saved. When clicked the four (4) "Configure" buttons down the center of the screen display the set-up windows at right.

Figure 1.11.1

Figure 1.11.2 *In the Configure MoIP Test window set the signal duration in seconds, the transmit level and finally select the test type; Voice, Fax Modem or V34/V90 Modem.*
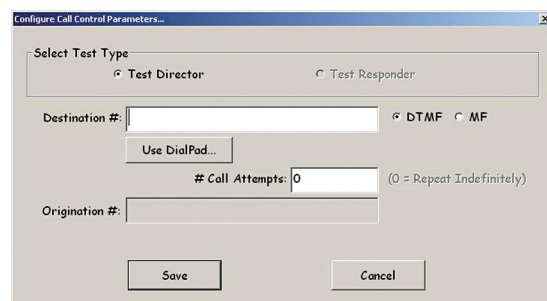
Figure 1.11.3 *In the Configure Call Parameters window select Test Director or Test Responder, enter the test call destination number and number of attempts. From this window you can also click the "Use DialPad" to enter digits. Click save.*
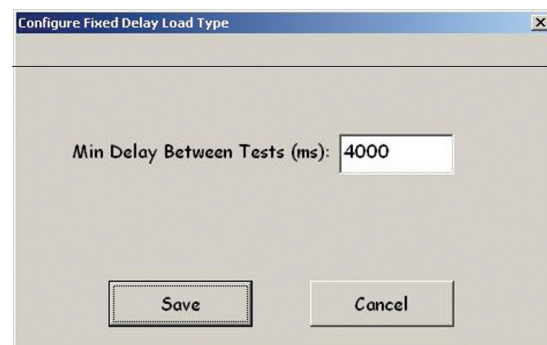
Figure 1.11.4 *Select and set Fixed or Random delay.*

Figure 1.11.5 *Next, Choose the timing of log capture, then enter a path or browse to the location on your local machine or network where the log file is to be saved.* **Configuration complete, click run.**

1.12. MoIP Responder

Description
The SAGE MoIP Responder test utilizes four (4) screens for configuration of the test parameters (see figures 1.12.1 through .112.3).

Purpose and Function
(See MoIP Director). See also the ' New IP Telephony Transparency Test, MoIP, Fax, Data & Voice White Paper' available via
www.sageinst.com.

Figure 1.12.1 shows the main test screen with the "MoIP Responder" test selected and saved. When clicked the three (3) "Configure" buttons down the center of the screen display the set-up windows at right.
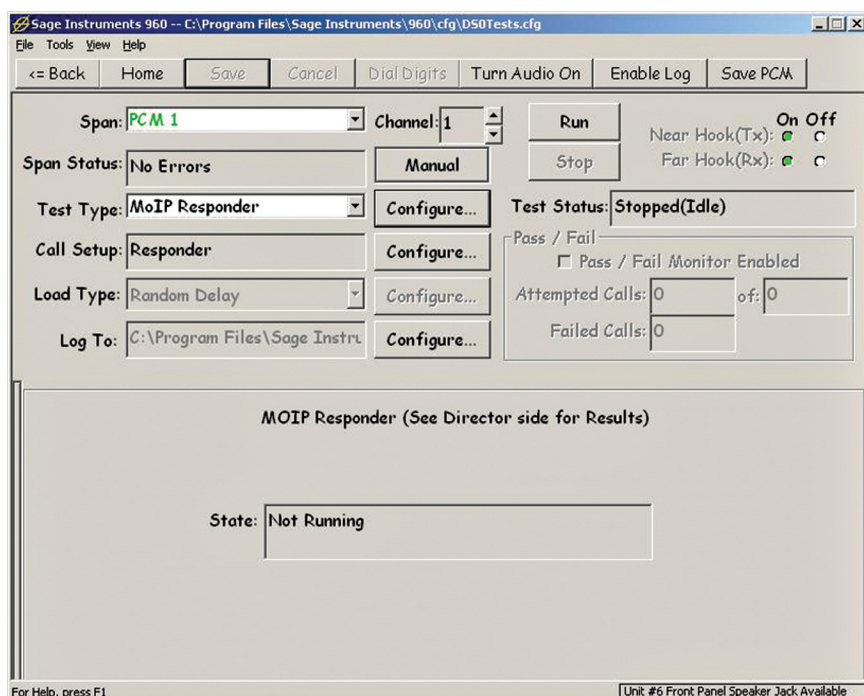
Figure 1.12.2 *In Responder mode no configuration is required.*

Note: that the Load Type configuration is not used in the MoIP Responder test, and the button is dimmed.
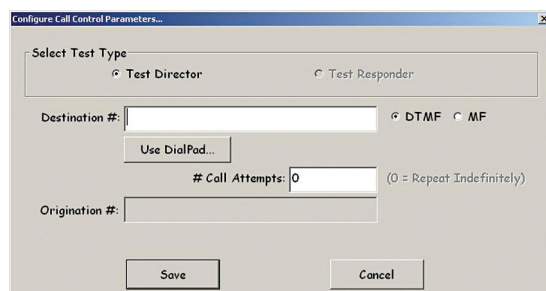
Figure 1.12.3 *In the Configure Call Parameters window select Test Director or Test Responder, enter the test call destination number and number of attempts. From this window you can also click the "Use DialPad" to enter digits. Click save.*
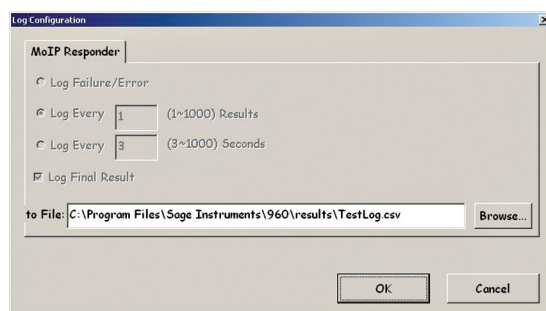
Figure 1.12.1

Figure 1.12.4 *Next, Choose the timing of log capture, then enter a path or browse to the location on your local machine or network where you want the log file to be saved.*

Configuration complete, click run.

1.13. MOS Transmit & Receive

The 960 MOS test performs a Mean Opinion Score test. The voice clip sent by the MOS transmitter is the ITU-P.50 test signal. The MOS test can be performed over T1/E1, IP or Analog interfaces. The MOS Receive window is shown in Figure 1.13.1.

MOS Receive Configuration

Select the MOS Receive test by clicking on the button in the circled **Test Type** text box in Figure 1.13.1. Select the **MOS Receive** test from the list. Click on the **Save** button in the toolbar to save and enable configuration of the test. Click on the **Configure** button to the right of the Test Type text box. This will launch the MOS Receive Configuration dialog box shown in Figure 1.13.2.

The first input box labeled **Test Duration** determines the test duration in seconds. If zero is set as the duration, the test will run until stopped by the user.

The second input box labeled **Measure Average Window**, specifies the measurement interval in seconds. Measurements will be averaged over this period, and measurement results will be displayed and logged at the end of each interval.

Figure 1.13.1 MOS Receive Window

Figure 1.13.2 MOS Rx Configuration

MOS Results

The MOS results are shown in the bottom half Figure 1.13.1. Numeric results are tabulated on the left side, and a graph of the MOS readings are displayed on the right. Note that the view of the graph can be zoomed in by clicking and dragging a highlight square over the area to be magnified. Placing the mouse on one of the data points displays the measurement value as shown in Figure 1.13.3.

The MOS numeric results start with the **MOS** score, a measurement of voice quality that ranges from 5 (highest quality) to 1 (lowest quality. Below the MOS measurement is the **Noise** measurement. This is a C-message weighted noise measurement in dBrnC units. The **Bandwidth Usage** displays the percentage of the total channel bandwidth that was used by the test signal. **Gain** shows the audio level gain in dB. The **+Frame Slips** measurement indicates when a jitter buffer overflow occurred, and some speech was deleted. The **-Frame Slips** indicates a jitter buffer underflow occurred and additional speech, usually silence, was inserted. The Frame Slip measurements are in Milliseconds. The last item at the bottom of the MOS results is the **Codec** used for the test. T1/E1 interfaces use PCM codecs while Ethernet interfaces can use G.729 codec types.

Figure 1.13.3 MOS Results Graph

MOS Transmit

The MOS Transmit window is shown if Figure 1.13.4. Clicking on the **Configure** button to the right of the **Test Type** list box in Figure 1.13.4 will launch the MOS Transmit configuration dialog box shown in Figure 1.13.5. The only item to setup for this test is the test duration. If the durations for the MOS Transmit and Receive tests are set to different values, the side with the shortest duration will end the test first.

There are no measurement results in the Test Control window for the MOS Transmit, navigate to the MOS Receive side of the test to view test results.
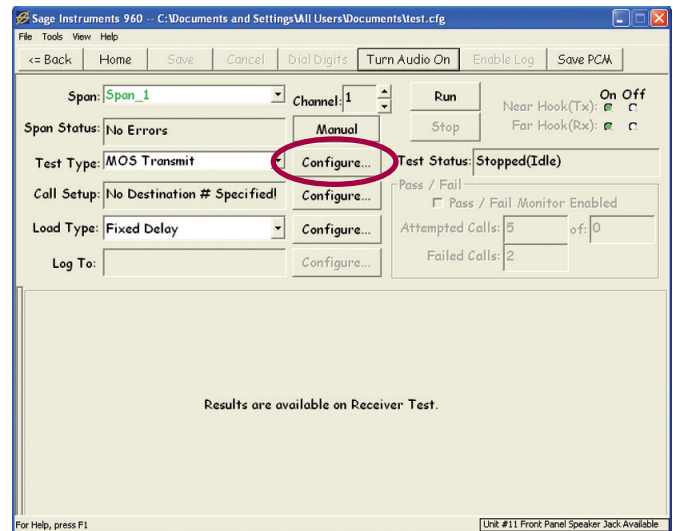
Figure 1.13.4 MOS Transmit Window

1.14. One-Way Delay Transmit and Receive

The SAGE 960B One-Way Delay test measures one-way delay of up to 511 ms on a circuit. The test can be performed between disparate telephony interfaces including: IP to TDM, TDM to Analog and IP to Analog. The test must be run with the one-way delay transmit test on one end of the circuit and the one-way delay receive on the other end. The one-way delay test requires a separate reference signal path in addition to the circuit under test. When testing to/from the same 960 this reference path is provided by a cable connecting the 960 front panel MIC and SPKR jacks together. When separate 960's are used to perform the test, the SPKR jack from the 960 running the one-way transmit test must be connected to the MIC jack on the 960 running the one-way receive test. See the section on measurements between two locations for information on running the test between two separate geographic locations.
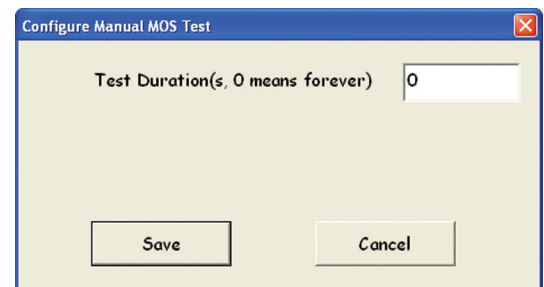
Figure 1.13.5 MOS Transmit Configuration

One-Way Delay Transmit Setup

Only one-way delay Tx can be RUN on one interface at a time. For example, if a one-way delay Tx is running on ethernet interface, then it must be stopped before a one-way delay Tx can be RUN on a TDM or analog interface. Otherwise, the GUI will grey out the RUN button for any additional one-way delay Tx configuration screens. Figure 1.14.1 shows the one-way delay setup for T1/E1 and analog interfaces. For ethernet interfaces the test is selected form the VF Test list box, refer to the SIP Call section for more information on setting up voice frequency tests on a SIP call.

Click on the button in the circled **Test Type** list box in Figure 1.14.1 and select the **One-Way Delay Tx** test from the list. Clicking on the **Configure** button to the
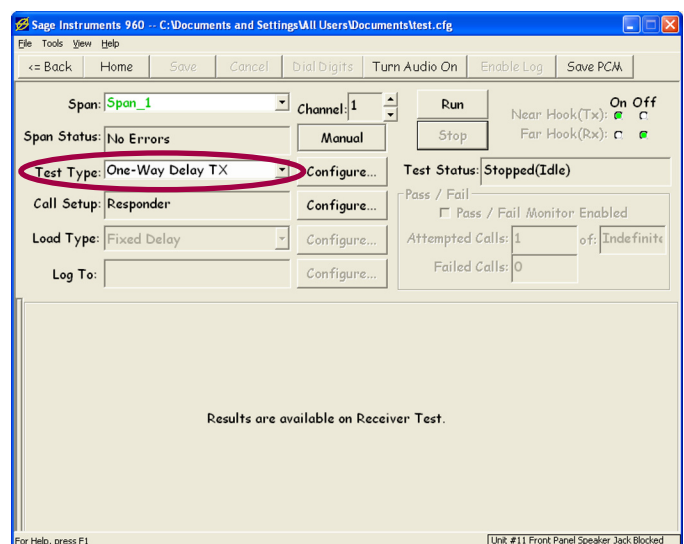
Figure 1.14.1 One-Way Delay Transmit

right of the circled list box will launch the Configure One-Way Delay dialog box shown in Figure 1.14.2. The only setting here is for the **Test Duration**. Enter the test duration in seconds. Setting the duration to zero will cause the test to run continuously. Click on OK to save the configuration, then click on the Run button in Figure 1.14.1 to start the test.

One-Way Delay Receive Setup

The one-way delay receive test is shown in Figure 1.14.3. The test setup is the same as the transmit test, except that the **One-Way Delay Rx** test is selected from the Test Type list box. The configuration dialog box for the receive test is shown in Figure 1.14.2. Note that if the transmit and receive test durations are set to different values, the side with shortest duration will end the test first. Click on OK to save the configuration, then click on the Run button in Figure 1.14.3 to start the test.

Measurements Between Two Locations

In order to perform the one-way delay test between tow separate locations, a reference signal path must be provided between the locations. A voice circuit with fixed delay is the most convenient method. The round trip delay of the voice circuit can be measured with the SMOS or PESQ test. The SPKR output jack from the 960 running the One-way transmit test should be connected to one end of the voice circuit. The MIC input jack from the 960 running the one-way receive test should be connected to the other end of the voice circuit. Once the reference signal path is setup, configure and run the one-way delay test as described in the previous sections. To determine the actual one-way delay measurement, subtract half of the round trip delay measured on the voice circuit from the one-way delay measurement.

One Way Delay Results

The one-way test results are available from the receive side of the test, the transmit side has no results display. The results are shown in the lower half of Figure 1.14.4. The text box circled in Figure 1.14.4 displays the state of the reference and transmit signals. Displayed states include: Ref: connect Ref cable, Ref: Acquired, Ref: No Ref/No Tx. Note that the Ref: connect Ref cable is displayed when the test is stopped to remind the user to connect the reference signal cable or circuit. The **One-Way Delay** test box displays the one-way delay measurement in milliseconds. To the right of the one-way delay test box is the **One-Way Gain** measurement in dB's. The graph below the text boxes displays the delay correlation function. Notice the peak at 60 ms showing the delay measurement. Compare this with the 0 ms delay measurement in Figure 1.14.3. Note that like most graphs on the 960, dragging a box around a section of interest on the graph with the mouse will cause the selected section of the graph to be
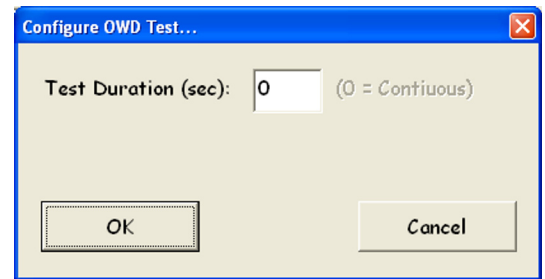
Figure 1.14.2 Configure One-Way Delay
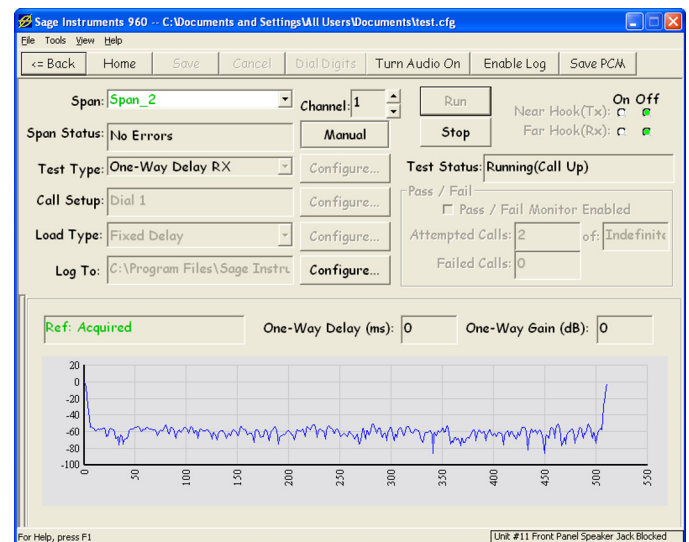
Figure 1.14.3 Configure One-Way Delay

magnified. Right clicking on the magnified graph will bring up the **Zoom Out** button.

Delays form Ethernet Interfaces

While the analog and T1/E1 interfaces have negligible delays measuring 0 ms when directly connected together. The Ethernet interfaces introduce significant delay that must be subtracted from the measurement to determine the actual delay. Figure 1.14.4 shows the delay measurement between two Ethernet interfaces directly connected together. The one-way delay is measured as 60 ms. This 60 ms delay is caused by the 960 Ethernet interface packtiazation and jitter buffer delays. These can be measured by making a back to back test, or they can be calculated based on the SIP call packet size and jitter buffer size settings. Refer to the SIP Call section for information on viewing or modifying the packet size and jitter buffer parameters. The 960 Ethernet interfaces introduce delay in the transmit and receive directions. In the transmit direction the packet size parameter will determine the transmit delay contribution. This delay is equal to the packet size in milliseconds. On the receive side, the jitter buffer parameter will determine the receive delay contribution. This delay is equal to the size of the jitter buffer in milliseconds. In the example in Figure 1.14.4 the packet size is 20 ms and the jitter buffer is 40 ms (the default settings for SIP calls). Adding the two delay contributions together we get 60 ms of delay introduced by the 960. This additional delay must be subtracted from the measurement to get the actual delay between interfaces.

1.15. PESQ Transmit and Receive

The PESQ Transmit and Receive tests are one-way tests that perform measurements confirming to ITU-T P.862. These measurements can be performed over analog, T1/E1 or Ethernet interfaces. The measurements performed include, MOS, Noise, frame slips, bandwidth utilization, gain and codec type. The following section describes configuring tests and viewing results.

PESQ Receive Setup

The PESQ Receive window is shown in Figure 1.15.1. Select the test by clicking on the button in the circled Test Type list box in Figure 1.15.1. Select the PESQ Receive from the list, then click on the Save button in the tool bar. Clicking on the **Configure** button to the right of the Test Type list box will launch the Configure PESQ dialog box shown in Figure 1.15.2. The **Test Duration** in seconds and **Measure Average Window** in seconds are entered in this dialog box. The Measure Average Window specifies the measurement interval where mea-
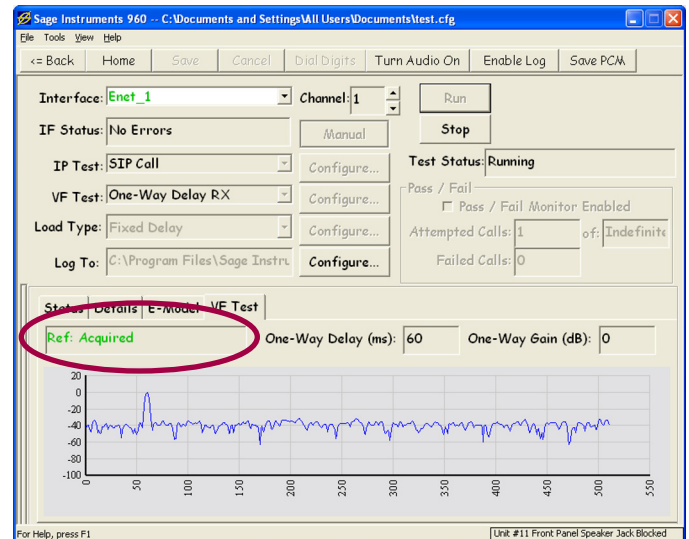
Figure 1.14.4 SIP Call One Way Delay
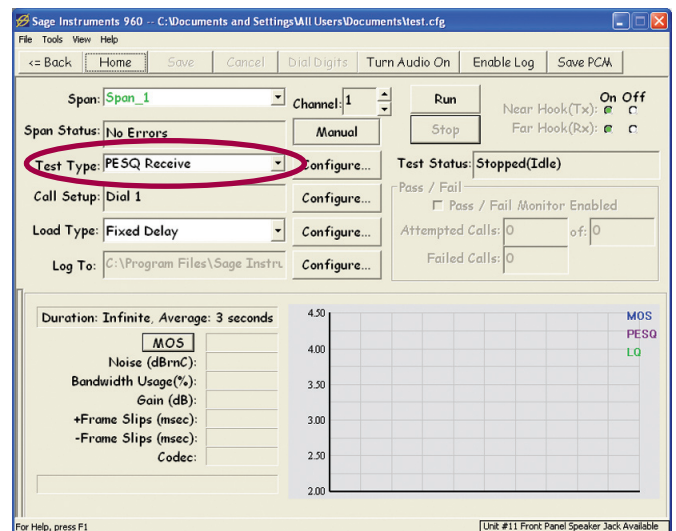
Figure 1.15.1 PESQ Receive Window

surements are averaged over. Test results are updated to the display and logs at the end of each measurement averaging interval. Setup any destination information in the **Call Cetup** list box then click on the **Run** button to start the test.

PESQ Transmit Setup
The PESQ Transmit side of the test is setup by clicking on the PESQ Transmit item in the Test Type list box. Click on the **Configure** button to the right of the Test Type list box launches the Configure PESQ dialog box. Enter the **Test Duration** in seconds in this dialog box. Note that if the PESQ Transmit and Receive durations are set to different values, the side with the shortest duration will end the test first.

This is the only configuration for the PESQ Transmit test. There are no test results available at the transmit side of the test.

Figure 1.15.2 PESQ Receive Setup

PESQ Results
The PESQ results are shown in the lower half of PESQ Receive window shown in Figure 1.15.3. The numeric results are on the left side and a graphical representation of the MOS, PESQ and LQ measurements are on the right.

MOS/PESQ and LQ Measurements
The results button circled in Figure 1.15.3 is used to toggle between **MOS**, **PESQ** and **LQ** results. The measurement value is displayed in the text box to the right of the button. As the button is clicked it's label will change from MOS, to PESQ to LQ, indicating the measurement displayed. The PESQ score ranges from, 4.5 for perfect voice quality to -0.5 for the lowest voice quality. The MOS score ranges from 4.5, perfect voice quality to 1, worst voice quality. The LQ measurement ranges from 4.5, perfect voice quality to 1, worst voice quality. See ITU-T P.862 for more detail on these measurements.

Figure 1.15.3 PESQ Results

Other Measurements
Below the MOS/PESQ/LQ indicator is the **Noise** reading, this is a C-msg weighted noise measurement. Below the noise measurement is the **Bandwidth Usage**. This measurement gives the percentage of the channel bandwidth that was used by the test signal. Below the bandwidth measurement is the **Gain** measurement, this shows the audio level gain in dB. Below the bandwidth measurement is the +/-Frame Slips indicator. The **+Frame Slips** measurement indicates when a jitter buffer overflow occurred, and some speech was deleted. The **-Frame Slips** indicates a jitter buffer underflow occurred and additional speech, usually silence, was inserted. The Frame Slip measurements are in milliseconds. The last item at the bottom of the MOS results is the type of **Codec** detected.

Test Status Indicators
There are test status indicators at the top and bottom of the numeric results, they are circled in Figure 1.15.4. The upper text

box indicates the test **Duration** and **Averaging** interval. The lower status box displays the test progress showing each step of the measurement process.

1.16. PESQ Director and Responder
The PESQ Director and Responder tests are automated two-way tests that perform measurements confirming to ITU-T P.862. These measurements can be performed over analog, T1/E1 or Ethernet interfaces. The measurements performed include, MOS, Noise, frame slips, bandwidth utilization, gain, delay and codec type. The following section describes configuring

tests and viewing results.

PESQ Responder Setup
Selecting and saving the **PESQ Responder** in the circled **Test Type** list box in Figure 1.16.1 will cause the **Call Setup** type to be set as a responder. Click on the **Run** button to start the responder. There is no other call or test setup for the responder side of the test.

PESQ Director Setup
The PESQ Director window is shown in Figure 1.16.1. Select the **PESQ Director** from the circled Test Type list box in Figure 1.16.1. Click on the **Save** button in the tool bar to save and enable configuration of the test. Clicking on the **Configure** button to the right of the Test Type list box launches the PESQ configuration dialog box shown in Figure 1.16.2. The test signal **Duration** in seconds is entered in this dialog box. Note that since this is a two way test, the total test duration will be twice the test signal duration plus 5 to 10 seconds of negotiation and overhead.

PESQ Results
The PESQ results are shown in the lower half of the window in Figure 1.16.1. There are numerical results on the left side and a graphical representation of measurements on the right side. Since this is a two-way test there are results for both directions of test, Near to Far and Far to Near. The director performs the nearend measurements while the responder performs the farend measurements.

MOS/PESQ and LQ Measurements
The results button circled in Figure 1.16.1 is used to toggle between **MOS**, **PESQ** and **LQ** results. The measurement value is displayed in the text boxes to the right of the button and the upper graph. As the button is clicked it's label will change from MOS, to PESQ to LQ, indicating the measurement displayed and graphed. The PESQ score ranges from, 4.5 for perfect voice quality to -0.5 for the lowest voice quality. The MOS score ranges from 4.5, perfect voice quality to 1, worst voice quality. The LQ measurement ranges from 4.5, perfect voice quality to 1, worst voice quality. See ITU-T P.862 for more detail on these measurements.

Other Measurements
Below the MOS/PESQ/LQ indicator is the **Noise** reading, this is a C-msg weighted noise measurement. Below the noise measurement is the +/-Frame Slips indicator. The **+Frame Slips** measurement indicates when a jitter buffer overflow occurred, and some speech was deleted. The **-Frame Slips** indicates a jitter buffer underflow occurred and additional speech, usually silence, was inserted. The Frame Slip measurements are in Milliseconds. Below the frame slip measurement is the **Bandwidth Usage**. This
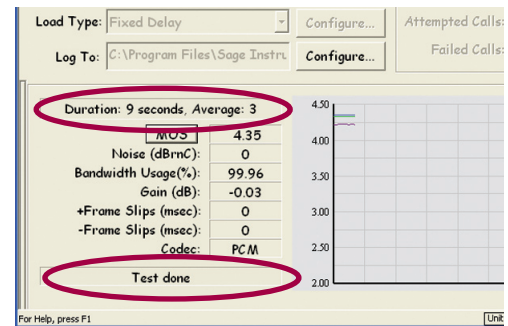
Figure 1.15.4 PESQ Test Status
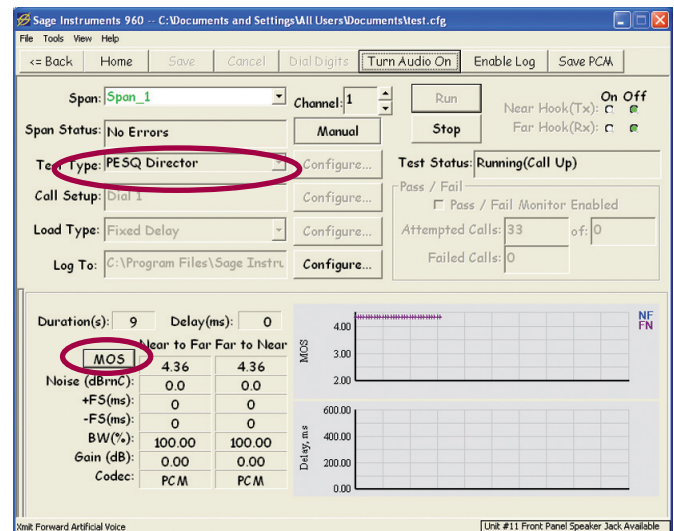
Figure 1.16.1 PESQ Director Window
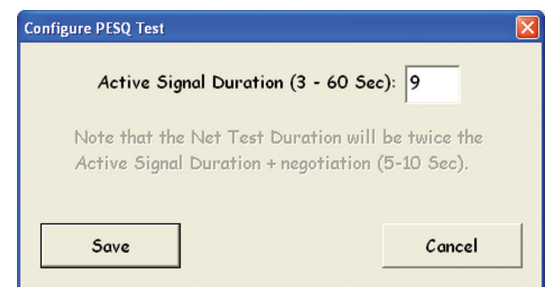
Figure 1.16.2 PESQ Director Setup

measurement gives the percentage of the channel bandwidth that was used by the test signal. Below the bandwidth measurement is the **Gain** measurement, this shows the audio level gain in dB. The last item at the bottom of the PESQ results is the type of **Codec** detected.

1.17. Packet Voice Impairment Test (PVIT)

PVIT provides detailed diagnostic information about events that impact voice clarity over packet switched networks, including: voice frame losses, voice frame slips (also know as jitters), voice clippings and noise hits**.** PVIT works by sending a complex test signal over the network, and measuring events that degrade that signal. The PVIT signal is a carrier-modulated spread spectrum signal with silence insertion.
• Measures four types of impairment events
• Displays cumulative event counts in real time
• Displays details about events as they occur
• Accumulates data over the test period

Setting Up Test

The PVIT test window is shown in Figure 1.17.1. Unlike other 960 tests the PVIT test has no Responder/Director or Transmit/Receive versions of the test. Instead, the PVIT Configuration dialog box allows selecting the test mode as Transmit, Receive or both Transmit and Receive. A one way test can be performed by setting one side as a Transmit and the other side as a Receive. For a two way test set both sides to Transmit & Receive. In the **Call Setup** configuration. Configure one side as a director and the other as a responder.

Select the test by clicking on the button in the circled **Test Type** list box in Figure 1.17.1. Select **PVIT** from the list, then click on the **Save** button in the tool bar. Clicking on the **Configure** button to the right of the Test Type list box will launch the Configure PVIT dialog box shown in Figure 1.17.2. The first text box is the **Test Duration**, enter a test time in seconds, entering zero for the duration will cause the test to run continuously. Below the Test Duration is the **Tx Level** text box. This value determines the transmit signal level. This text box is disabled when the Receive Only radio button is selected. Below the level test box is the **Event Mask**. This value is used to ignore PVIT detected error events that are less than or equal to the Event Mask duration. The **Receive Only**, **Send Only** and **Send & Receive** radio buttons are used to select the direction of the test. Note that the Send only and Receive only modes are one-way tests, while the Send & Receive mode is a two way test. Once the configuration is complete click on the **Save** button to save the configuration and exit the dialog box. Perfrom any call setup configuration and click on the Run button in the upper right corner of Figure1.17.1 to start the test. If applicable, configure the other side of the PVIT test.

PVIT Results

The PVIT results are shown in the lower half of Figure 1.17.1. Tests that are configured as Receive Only or Transmit & Receive will have the results display enabled. Tests configured as Transmit Only will have the results display disabled, I.E. greyed out.
On the left side of the results display are the numeric results for
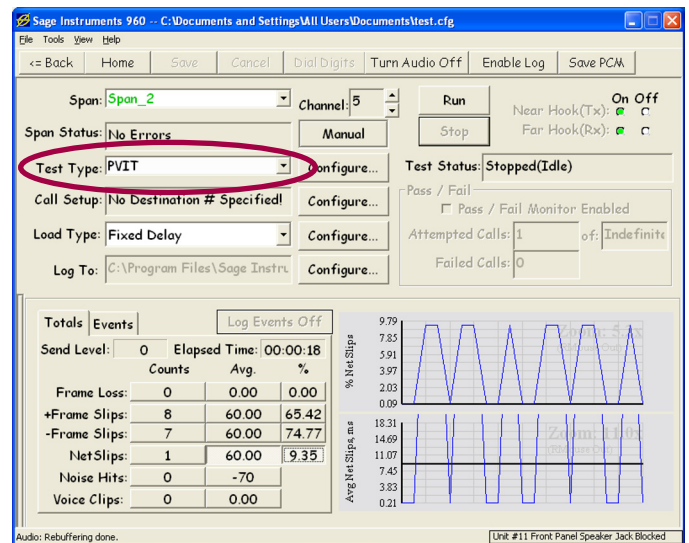
Figure 1.17.1 PVIT Test Window
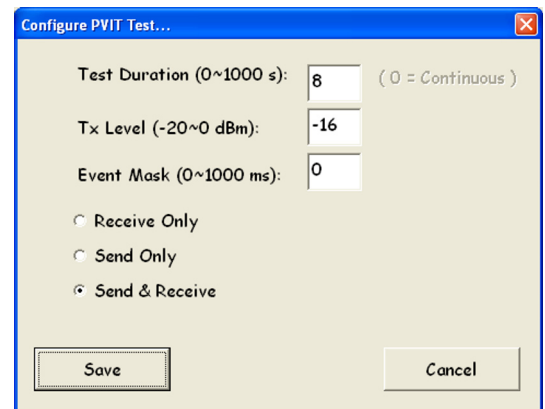
Figure 1.17.2 PVIT Configuration Dialog

each test. On the right side are graphs of the result values. Clicking on one of the measurement values on the left will cause the value to be displayed on the graph. A portion of the graph can be magnified by dragging a selection box around the area of interest. To zoom out right click on the graph to bring up the **Zoom Out** button.

The numeric results display is shown in Figure 1.17.3. The **Send Level** text box displays the level of the transmit signal in dBm. If the test is configured as receive only, the Send Level indicates "None". To the right of the Send Level is the **Elapsed Time** Text box. This displays the elapsed test time in a hh:mm:ss format, where h is hours, m is minutes and s is seconds. The elapsed time starts counting when the PVIT receive function detects a valid PVIT signal. If no PVIT signal is detected the elapsed time will stay at zero. The elapsed time indicator along with the other measurement results are disabled when Transmit Only mode is selected. The measurement results are arranged in three columns labeled Counts, Avg and %. The **Counts** column shows a total count of the impairment events for the test session. The **Avg** column displays the average duration of the event for all measurements except Noise Hits. The **%** column displays the percentage of the total test time that the impairment was present.

A **Frame Loss** event is declared when there is a dropout or severe corruption of the measured test signal that is not classified as a Frame Slip or Voice Clip by the PVIT test. The duration of these frame loss events is recorded and the average duration is calculated and displayed in the Avg column.

The **+Frame Slips**, (+FS) and **-Frame Slips**, (-FS) measurements are intended to detect jitter buffer adjustments. When the jitter buffer overflows and a packet is deleted a +FS event is declared. When the jitter buffer under flows and a packet is added or repeated, a -FS event is declared. The duration of these frame slip events is recorded and the average duration is calculated and displayed in the Avg column.

The **NetSlips** measurement is equal to positive slips minus negative slips. This measurement indicates the net time shift due to accumulated slips. If the number and duration of +FS and -FS is equal, the NetSlips measurement is zero.

The PVIT test signal is a carrier modulated psudo random sequence with a 384 millisecond silent period every 1024 milliseconds. When any noise above -45 dBm is detected during the silence period a **Noise Hit** is declared. The noise readings made during the silent periods are averaged and this value is displayed in the Avg column.

Voice Clip events are declared when the leading edge of the test signal is clipped by 10 milliseconds or less. Clipping that is longer than 10 milliseconds is counted as a frame loss event. This measurement is intended to detect overly aggressive Voice-Activity-Detectors in the circuit under test.

In addition to the measurements, there is an **Event** display that
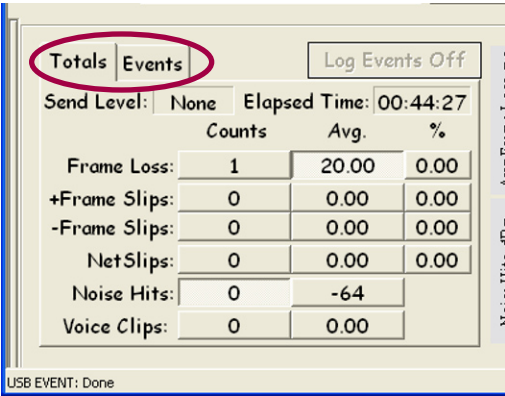
Figure 1.17.3 PVIT Results
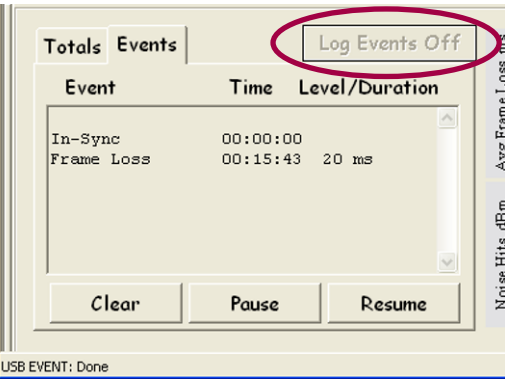
Figure 1.17.4 PVIT Event Display

contains a time stamped list of all PVIT events. Clicking on the Event tab circled in Figure 1.17.3 will bring up the Event display shown in Figure 1.17.4. Notice that the frame loss measurement in Figure 1.17.3 shows up in the event display in Figure 1.17.4.

The **Log Events Off** indicator circled in Figure 1.17.4 shows the state of the log file. Clicking on the **Enable Log** button in the tool bar will start logging events to the file specified in the **Log To** text box in the Test Control Window shown in Figure 1.17.1.

1.18. Remote Audio

The Remote Audio feature allows the user to establish an external link for monitoring a channel under test. For example, in a digital switching environment, one of the channels of a T1 span can be provisioned for making calls through the switch. This can be used to setup a call through the switch to a technician's phone for the purpose of monitoring a channel under test. Selecting the enable talk option allows the user to talk over the remote audio channel, however this will interfere with the 960 or any other device sending signals over the channel under test. This feature should not be confused with the audio monitor function of the GUI that is access by clicking on the Turn Audio On/Off button in the toolbar.

The Remote Audio window is shown in Figure 1.18.1. The bottom half of the Test Control Window contains the controls and status indicator for the remote audio feature.
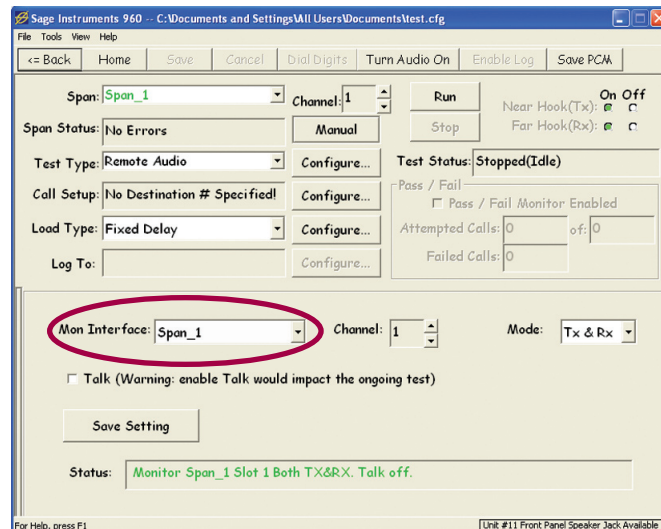
Figure 1.18.1 Remote Audio

Interface Selection

The **Mon Interface** list box circled in Figure 1.18.1 allows selecting the interface to monitor. The Remote Audio function is limited to monitoring interfaces and channels that are on the same 960 internal board. The 960 internal boards contain two T1/E1 or Ethernet interfaces, or four analog interfaces.

Channel Selection

The **Channel** selection box is only present for T1/E1 and Ethernet interfaces. This box is used to select the channel to monitor.

Mode

The **Mode** list box is located on the right side of the configuration window. The modes supported include Tx, Rx, Tx + Rx and OFF. These modes allow monitoring one or both directions simultaneously.

Save Settings Button

The **Save Settings** button is used to apply and save the remote audio settings. When the button is clicked, the **Status** indicator box at the bottom of the window will change showing the new configuration.

1.19. Send/Measure Tone

The Send/Measure Tone is a test feature that enables sending and receiving a user specified tone. Send/Measure tone is useful in measuring the difference in level from sending to receiving end points. In addition to measuring the frequency and level of the tone, the Send/Measure tone test performs several noise measurements and provides a real time spectrum analysis graph
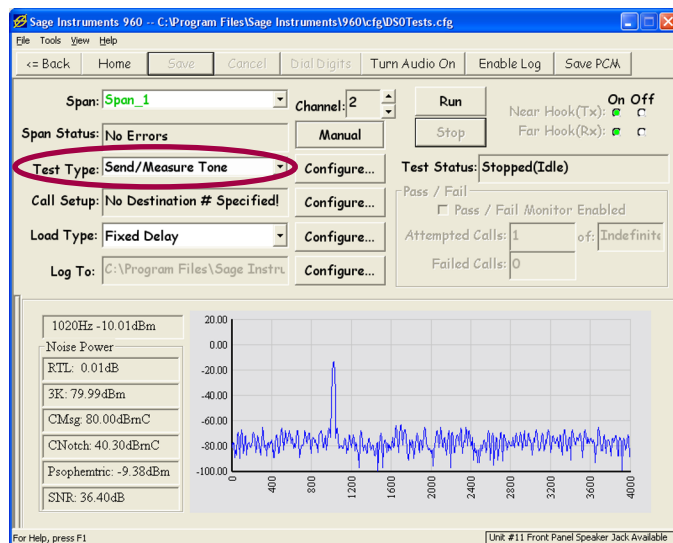
Figure 1.19.1 Send/Measure Tone Test

of the signals on the channel.

Test Setup

Clicking on the button in the circled **Test Type** list box in Figure 1.19.1 will bring up a list of tests. Select the **Send/Measure Tone** item from the list, and click on the **Save** button in the tool bar to save and enable configuration of the test. Clicking on the Configure button to the right of the Test Type test box will launch the Send/Measure Tone Configuration dialog box shown in Figure 1.19.2.

The **Test Duration** text box at the top of the dialog box is used to set the test

duration in seconds. If zero is entered here, the test will run continuously.

Below the Test Duration text box are the **Optional Tone Sender** controls. When the **Sent Tone** check box is checked the 960 will send the specified tone or test signal while measuring the received test signal. The list box circled in Figure 1.19.1 is used to select the test signal sent by the 960. Test signal choices are Tone, White Noise, Hoth Noise, ERL Noise, SRL Low-Noise, SRL High-Noise. To the right of the test signal text box are the frequency(**Freq**.) and **Level** text entry boxes. When Tone is selected, the frequency and level of the tone can be specified. When a noise test signal is selected only the level can be specified.

Below the Tone Sender controls are the controls for sending a PCM or WAV file. Clicking on the **Send File when Measuring** check box will enable the file sending controls. Clicking on the **Select File** button to the right of the check box will bring up a file selection dialog box for selecting the file to send. When the file is selected it's name and path will appear in the box below the Send File check box. The maximum file size is 32 seconds of audio. The Optional **Pass/Fail Metric** control at the bottom of the dialog box is not implemented at this time.
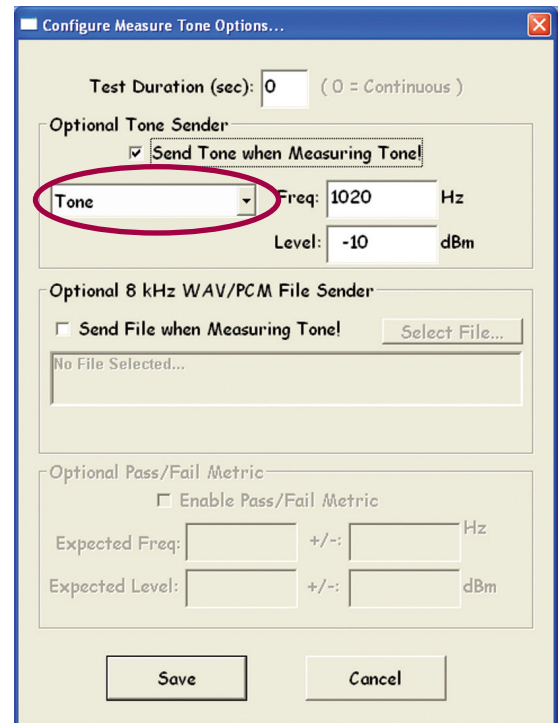
Figure 1.19.2 Send/Measure Tone Dialog

Send/Measure Tone Results

The Send/Measure Tone results window is shown in the lower portion of Figure 1.19.1. The text boxes on the left side of the results display the single tone frequency and level and noise measurements. The first text box displays the levle and frequency of the received tone. Below the level text box are the noise mea-surements. **RTL**, return loss, **3K**, 3K Flat Noise, **CMsg**, Cmsg noise, **CNotch** noise, **Psophemetric** noise and **SNR**, Signal to Noise Ratio.

The right half of the Measure Tone Results dialog box is a real time spectrum analysis graph of the received test signal. Clicking on the graph and dragging a selection square around an area of interest will cause the graph to zoom in to the selected area. Right clicking on the graph will bring up a zoom out button.

1.20. SMOS Director Responder Test

Description

The Sage Instruments Mean Opinion Score (SMOS) test provides an accurate assessment of how telephone users perceive speech quality over a live VoIP network. Besides the MOS number, SMOS also provides a set of other orthogonal measurements that are vitally important in determining the overall voice quality of a network, or trouble-shooting a problematic network. These measurements are orthogonal to MOS because they are not properly reflected in the MOS number, yet they are also important indicators of the overall QoS of the network. These other measurements are round-trip delay, codec type, effective bandwidth, voice-band gain, silence noise level, total amount of

compressive jitters (positive frame slips or shortening of delays) and the total amount of expansive jitters/ frame slips (lengthening of delays).The SMOS test uses a robust algorithm to deliver accurate results in the presence of jitter, bandwidth limitations, and dropouts. The test produces both near-to-far and far-to-near measurements.

SMOS Responder Setup

Selecting and saving the **SMOS Responder** in the circled **Test Type** list box in Figure 1.20.1 will cause the Call Setup type to be set as a responder. Click on the **Run** button to start the responder. There is no other call or test setup for the responder side of the test.

SMOS Director Setup

The SMOS Director window is shown in Figure 1.20.1. Select the **SMOS Director** from the circled **Test Type** list box in Figure 1.20.1. Click on the **Save** button in the tool bar to save and enable configuration of the test. Clicking on the circled **Configure** button to the right of the Test Type list box launches the SMOS configuration dialog box shown in Figure 1.20.2. The test signal duration in seconds is entered in this dialog box. Note that since this is a two way test, the total test duration will be twice the test signal duration plus 5 to 10 seconds of negotiation and overhead.

SMOS Results

The SMOS results are shown in the bottom half Figure 1.20.1. Numeric results are tabulated on the left side, and a graph of the MOS score and delay measurements are displayed on the right. Note that the view of the graph can be zoomed in by clicking and dragging a highlight square over the area to be magnified. Placing the mouse on one of the data points displays the measurement value.

The SMOS numeric results start with the **MOS** score, a measurement of voice quality that ranges from 5 (highest quality) to 1 (lowest quality. Below the MOS measurement is a C-message weighted **Noise** measurement in dBrnC. The **+Frame Slips** measurement indicates when a jitter buffer overflow occurred, and some speech was deleted. The **-Frame Slips** indicates a jitter buffer underflow occurred and additional speech, usually silence, was inserted. The Frame Slip measurements are in Milliseconds. The **Bandwidth Usage** displays the percentage of the total channel bandwidth that was used by the test signal. **Gain** shows the audio level gain in dB. The last item at the bottom of the SMOS results is the **Codec** used for the test. The SMOS test detects the different codec types listed in Table 1.
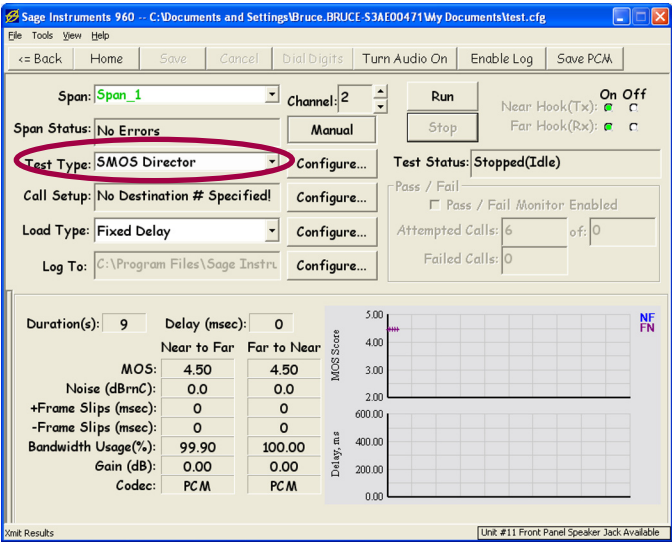
Figure 1.20.1 SMOS Test Window
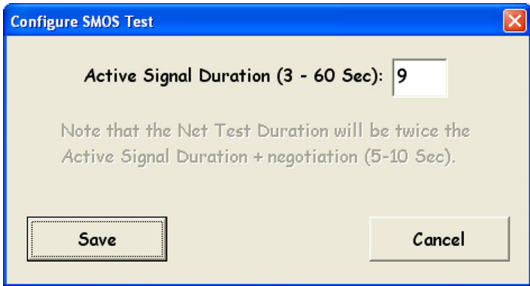
Figure 1.20.2 SMOS Dir. Configuration

Table 1 Codec Types

SMOS Test Result	Codec Type Description
VCD4K	Sub-4kbs vocoders
VCD8K	5-8kbps vocoders
VCD16K	12-16kbps vocoders
ADPCM16	16kbps G.726 ADPCM
ADPCM24	24kbps G.726 ADPCM
ADPCM32	32kbps G.726 ADPCM
ADPCM40	40kbps G.726 ADPCM
ADPCM	G.726 ADPCM with unknown data rates
PCM	G.711 µ/A-law PCM or pure analog
UNSURE	Distortion prevents codec type detection

1.21. V.9X Modem Monitor

The V.9X Modem Monitor analyzes the protocols of V.90, V.91, V.92 and V.34 modems during the negotiation and renegotiation phases of the call. The V.9X test simultaneously analyzes the signals from both modems, and displays the relevant time-stamped information in real-time. The V.90 modem monitor is only supported on T1/E1 interfaces. The test requires two interfaces. These interfaces should be on the same DSP board. The test must be configured and run on the primary interface, (the odd numbered interface). The channel on the other T1/E1 interface should not be used for other tests.

Test Setup

The V.90 Modem Monitor can only be run when the DS1/E1 interfaces for testing are placed in the dual monitor mode. The Dual Monitor mode is selected in the circled Connection Mode field in the Span Edit window shown in Figure 1.21.1. Refer to the T1/E1 Span Edit window description in Section 1 for more information on the dual monitor mode.

To select the V.90 Modem Monitor, click on the button in the circled Test Type list box in Figure 1.21.2. This will bring up a list of tests, click on the **V.90 Modem Monitor** test and click on the **Save** button in the tool bar to save and enable configuration of the test. There is no additional configuration required for this test. Click on the **Run** button of the Test Control window to start the test.

Test Results

The V.90 Modem Monitor results are shown in the lower portion of Figure a. The modem negotiation messages are displayed in real time as they are detected. Messages that may indicate modem problems include: Frequent rate renegotiation and retraining messages during a call. Any disconnect messages sent shortly after a call is established, or any timeout messages. Refer to the ITU-T V.90 recommendation for more detail on the modem messages.

The four buttons to the right of the log are for controlling the logging functions. The first button labeled **Log Messages** will cause the modem messages to be logged to a file. Placing the mouse over the button will cause the log file name to be displayed. The **Clear**, **Pause** and **Resume** buttons are for controlling the log display. Note that the pause button pauses the display, but does not stop the capture of V.90 messages.
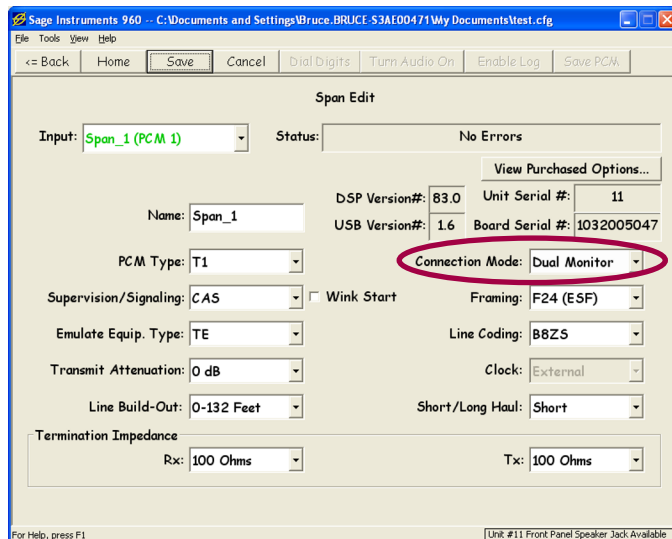
Figure 1.21.1 Dual Monitor Mode
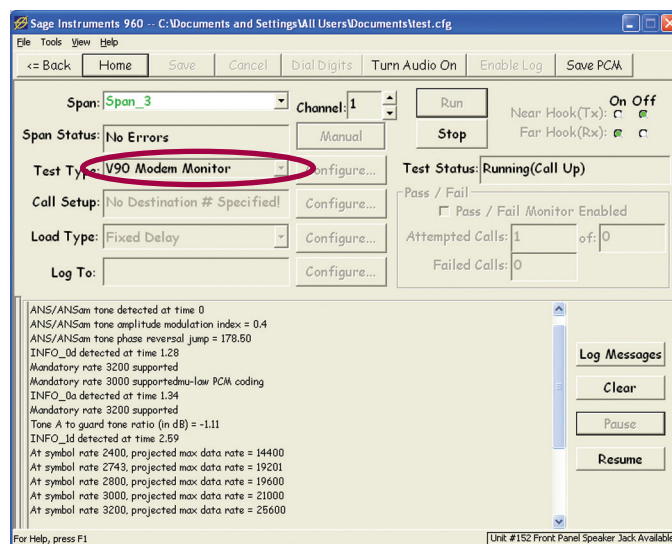
Figure 1.21.2 V.90 Modem Monitor

2. Digital Tests

2.1. DS1/DSO/Fractional Bit Error Rate Test

The Bit Error Rate Test (BERT) option in the 960 performs digital testing at the DS1, DS0 or Fractional T1 rates. These tests are only applicable to T1/E1 interfaces. The following section describes setting up and running each type of test.

DS1/DSO/Fractional BERT Setup

The following section describes the common configuration elements for DS1, DS0 and Fractional tests. Subsequent sections for DS1, DS0 and Fractional cover any test specific configurations.

Once the test is selected Click on the Configure button to the right of the circled text box to launch the Configure BERT Test dialog box shown in Figure 2.1.2.

The **Test Length** text box at the top of the dialog box is used to set the test duration in seconds. Setting this value to zero will cause the test to run continuously. Below the Test Length text box is the **Selected Channels** check boxes. These boxes are only enabled for selection when Fractional testing is performed, they are not used in DS0 and DS1 testing. The **Select All** and **Clear Al**l buttons are used to select all channels for testing, or to clear channels respectively. Below the Select and Clear buttons are two text boxes for specifying the BERT **Pattern** and **Loop Code** for the test. Bert patterns supported by the 960 are listed in Table 2.1.1.

Figure 2.1.**1 DS0 BERT Test**

Table 2.1.1 DS0 and Fractional BERT Test Patterns

2E3 (7)	2E4 (15)	2E5 (31)
2E6 (63)	2E7 (127)	2E7LB (127)
2E9 (511)	2E10 (511)	2E11 (2047)
2E15	2E17	2E18
2E20	2E20 'ITU'	2E21
2E22	2E23	2E25
2E28	2E29	2E31
QRSS	All Ones	All Zeros
1010...	1100...	3 in 24
1 in 16	1 in 8	1 in 4
3 in 4	7 in 8	55 Daly
FOX	T1_1	T1_2
T1_3	T1_4	T1_5
T1_6	DDS1	DDS2
DDS3	DDS4	DDS5

In addition to the patterns listed in Table 1, there are four user de-
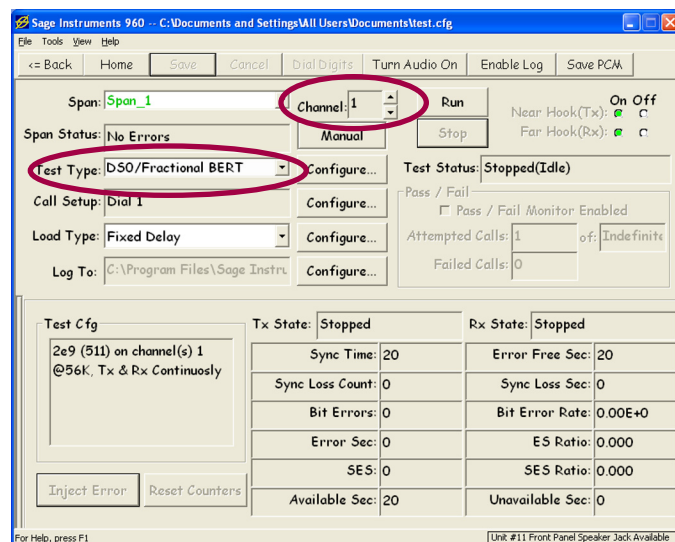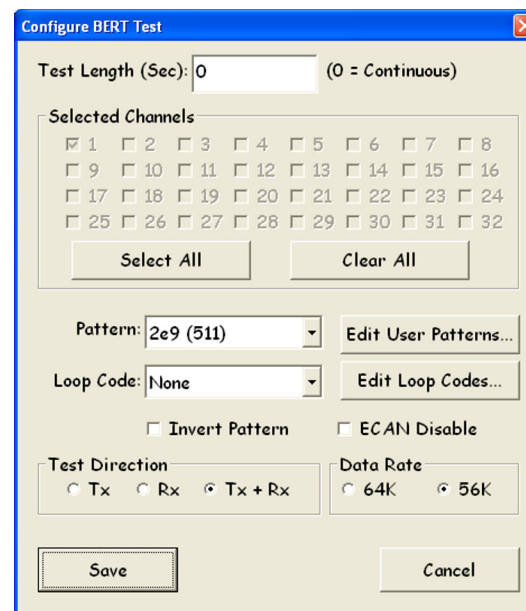
Figure 2.1.2 Configure BERT Test

fined patterns that can be selected. See the section on Editing User Patterns and Loop Codes for more information on creating custom BERT patterns. Click on the button in the **Pattern** list box and select a BERT pattern.

The 960 can send Loopback codes to activate remote loopback devices. Table 2.1.2 lists the DS0 loopback codes sup-

ported by the 960. If selected, the loopback code is sent at the beginning of the test to activate the remote loopback. At the end of the test the loopdown code is sent to reset the remote loopback device. In addition to the loopback codes listed in Table 2.1.2, there are four user defined loopback codes that can be selected. See the section on Editing User Patterns and Loop Codes for more information on creating custom loop codes.
Click on the button in the **Loop Code** list box and select a loop code if applicable.

Table 2.1.2 960 Loop Codes

V.54	CSU	NIU
DDS Latch DP	CSU Unframed	NIU Unframed
DDS Latch OCU	DDS Latch CSU	DDS Latch NIE
DDS Alt OCU	DDS Alt CSU	DDS Alt DSU

Below the Loop Code list box is a check box labeled **Invert Pattern**. When this box is checked the 960 will send an inverted version of the selected pattern. To the right of the Invert Pattern check box is the **ECAN Disable** check box. When this box is checked the 960 will send an echo canceller disable tone before the test begins to disable any echo cancelers which might corrupt the BERT pattern. If the circuit under test contains echo cancelers this box should be checked. Note that checking this box when no echo cancelers are present will not cause any BERT testing errors.

The **Test Direction** radio buttons are used to determine if test will only transmit the BERT pattern, only receive and analyze the BERT pattern, or both transmit and receive simultaneously. To the right of the Test Direction buttons are the **Data Rate** radio buttons. These are used to select 64K or 56K data rates. Note that if CAS signaling is selected for the T1 interface, the 56K data rate should be selected or erroneous BERT testing errors will occur.

DS0 BERT Setup
Clicking on the button in the circled **Test Type** list box in Figure 2.1.1 will bring up a list of tests. Scroll through the list and click on the **DS0/Fractional BERT** item to select the test. Click on the **Save** button on the tool bar to save and allow configuration of the test. Clicking on the **Configure** button to the right of the circled text box will launch the Configure BERT Test dialog box shown in Figure 2.1.2.
Notice that the **Selected Channels** check boxes indicate which channel is selected; however the check boxes are disabled for user entry or modification.

Fractional BERT Setup
In order to perform Fractional BERT testing the T1/E1 test interface must be have the **Supervision/Signaling** format set to **Clear Channel** for T1 interfaces, and **PCM 31** for E1 interfaces. This configuration is performed in the **Span Edit window,** refer to the
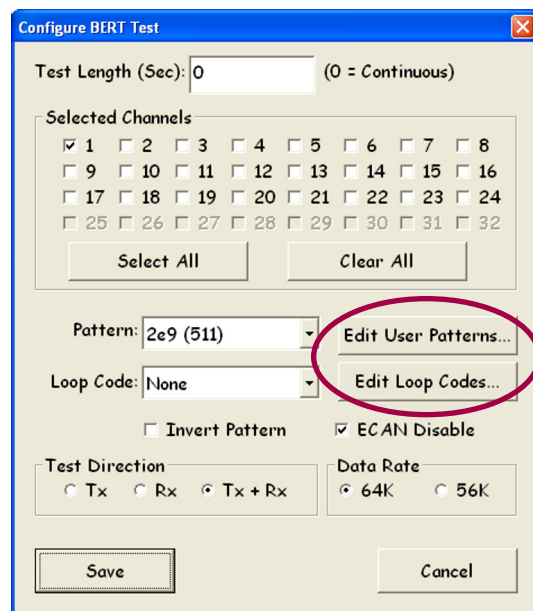
Figure 2.1.3 Fractional BERT Config.

T1/E1 Span Edit Section for more details on configuring the test interfaces.
Using the **Channel** selection control circled at the top of Figure 2.1.1. select the first timeslot or channel that the fractional test will start on. Select the **DS0/ Fractional BERT** test from the Test Type list box circled in Figure 2.1.1. Click the **Save** button to save and enable configuration of the test. Click on the **Configure** button next to the circled Test Type list box in Figure 2.1.1. This will launch the Configure Fractional BERT test dialog box shown in Figure 2.1.3.
In the fractional test the **Selected Channels** check boxes are enabled. Click on the check boxes for the channels that are part of the fractional test.

DS1/E1 BERT Setup
The 960 can perform full span T1 or E1 tests. These tests can only be performed with an unframed span. The Framing parameter in the Span Edit window must be set to unframed for the test interfaces. Refer to the T1/E1 Span Edit Section for more details on configuring the test interfaces.
Clicking on the button in the circled **Test Type** list box in Figure 2.1.1 will bring up a list of tests. Scroll through the list and click on the **DS0/Fractional BERT** item

to select the test. Click on the **Save** button on the tool bar to save and allow configuration of the test. Clicking on the **Configure** button to the right of the circled text box will launch the Configure BERT Test dialog box shown in Figure 2.1.4.

Notice that the **Selected Channels** check boxes are disabled for user entry. They indicate all channels are selected, I.E. 1-24 for T1 spans and 1-31 for E1 spans. Also notice that the **Data Rate** buttons, the **Edit User Patterns** button and the **Invert Pattern** check box are all disabled.

Patterns available for DS1/E1 testing are 2E15 and 2E20. User defined patterns are not supported in T1/E1 testing.

Editing User Patterns and Loop Codes

The 960 supports user defined test patterns and loop codes. The Edit User Pattern and Edit Loop Codes buttons circled in Figure 2.1.3 launch the edit loop codes and test pattern dialog boxes. The **Edit User Patterns** dialog box is shown in Figure 2.1.5. The four radio buttons labeled 1-4 are for selecting one of the 4 user defined patterns. Below the radio buttons is the **User Pattern** entry text box. The pattern must be entered in binary and can be 1 to 127 bits in length. Below the User Pattern text box are text boxes displaying the total number of bits in the pattern and the user pattern in Hex format. After defining the user patterns click on the **Done** button to save the user patterns. The user patterns will show up in the Pattern list box as Custom1 - Custom4. Note that DS1/E1 tests do not support user defined patterns.

The **Edit Loop Codes** dialog box is shown in Figure 2.1.6. The four radio buttons labeled 1-4 are for selecting one of the 4 user defined loop codes. Below the radio buttons are the Loop Up and Loop Down text boxes. The loop codes are entered in the **Pattern** test boxes as binary ones and zeros. The **#Bits** test boxes display the total number of bits in each loop code. After defining the loop codes click on the **Done** button to save the codes. The user defined loop codes will show up in the Loop Code list box as Custom1 - Custom4.

BERT Results

The results for the BERT test are shown in Figure 2.1.7. The **Test Cfg** box on the left side of the results display shows the test setup for the transmit and receive sides of the test if applicable. To the right of the Test Cfg box is the **Tx State** text box. This text box displays the state of the BERT test transmit function. States displayed include Stopped, Tx Pattern, Unknown!, Sending ECAN Disable, Sending Loopup and Sending Loopdown.

To the right of the Tx State text box is the **Rx State** text box. This text box displays the state of the BERT test receiver function. Displayed states include Stopped, Detecting Loopup, Detecting Loopdown, Unknown!, Attempting Sync and In Sync. Note that the Unknown! state is displayed when the test function is not selected, I.E. when Test Direction Rx and Tx+Rx is not selected in the configure BERT dialog box, the Rx State will indicate Unknown!.

Below the Tx and Rx State text boxes are the results for the

Figure 2.1.4 DS1/E1 BERT Configuration

Figure 2.1.5 Edit User Patterns Dialog

Figure 2.1.6 Edit User Loop Codes

receive BERT test. The **Sync Time** text box displays the time in seconds that pattern sync has been established. The **Sync Loss Count** text box indicates the number of times that pattern sync has been lost. The **Bit Errors** text box displays the total pattern errors detected. The **Error Sec** text box displays the total count of errored seconds. The SES text box displays the severely errored second count, these are errored seconds with a bit error rate greater than or equal to 10E-3. The **Available Sec** text box displays the available seconds which is equal to the Sync Time minus the Unavailable seconds count. The **Error Free Sec** text box displays the total error free seconds for the test. The **Sync Loss Sec** Text box displays the sync loss seconds count. Sync loss seconds are incremented each second when one or more sync loss events are present. The **Bit Error Rate** text box displays the bit error ratio, defined as the bit error count divided by the total bits received during the test period. The **ES Ratio** text box displays the Errored Seconds ratio, defined as the Error Seconds count divided by the Available Seconds count. The **SES Ratio** text box displays the Severely Errored Seconds ratio, defined as the SES count divided by the Available Seconds count.

The **Unavailable Sec** text box displays the Unavailable Seconds count. Unavailable Seconds are declared after 10 consecutive Severely Errored seconds are counted, and include the initial 10 severely errored seconds. The Unavailable Seconds count is stopped when 10 consecutive seconds occur with no SES counts, these 10 seconds with no SES counts are not counted as Unavailable Seconds.

Figure 2.1.5 DS0 BERT Results

2.2. ISDN D Ch. Test

Description

The SAGE 960B ISDN D Channel test utilizes a different method than previously described tests. For configuration of the ISDN D Ch. test parameters, see figures 2.2.1 through 2.2.3.

Purpose and Function

Integrated Service Digital Network Primary Rate Interface (ISDN PRI) is a standard, all digital access technology that allows for integrated voice and data over existing telephone lines. ISDN PRI circuits are also known generically as PRI or Voice T1/E1 trunks. The SAGE 960B offers a complete solution for testing and trouble-shooting, of devices and networks implementing PRI ISDN. It is useful to test ISDN products designed for either U or S/T interface, including network terminations, Type 1 terminating equipment, and terminal adapters. In addition to 23 B (or 30 in the case of E1 PRI) channels for voice traffic, an ISDN line has an extra D channel for data communications. The D channel is used for applications such as payment transmissions, PIN terminals, credit card readers, alarm systems, PCs and computer systems.

Unlike the previous tests described, the ISDN D Channel cannot be configured from the main test window because it is a span configuration parameter that allocates a channel for the "D-Channel". Although it appears in the test drop down selection menu it cannot be selected. To bring the test to a selected and running state follow the steps below.

1. At the top of the main test window click on "Home". Select PCM 1 by highlighting the span, then click on

Figure 2.2.1

the "Configure Span" button (see figure 2.2.1).

2. In the configure span window for PCM 1 change the "Supervision/Signaling" pull down menu from "CAS" to "PRI ISDN".

3. For the ISDN D Channel Test to run it is important to establish a crossover on the "Emulate Equipment Type". While still in the configure span window for PCM 1 change the "Emulate Equipment Type" pull down menu from "NT" to "TE" (see figure 2.2.2). Click save and return to the span window.

Figure 2.2.2

4. Select PCM 2 by highlighting the span, then click on the "Configure Span" button. In the configure span window for PCM 2 change the "Supervision/Signaling" pull down menu from "CAS" to "PRI ISDN". Make sure the "Emulate Equipment Type" pull down menu for PCM2 is set to "NT". For E1 PRI, the screen will look similar to figure 2.2.3.
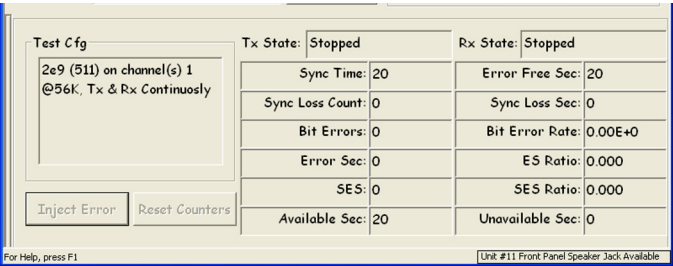

Figure 2.2.3

ISDN D Channel Tests *(continued)*

5. For ISDN D Channel test where the connection mode desired is "Monitor or Dual Monitor" the status will display "D-Link Not Ready". This status is OK, continue with the test configuration.

6. In the span window click on either PCM 1 or PCM 2. Notice that the ISDN D Channel test now shows an "Running" state on the default channel 24 or the channel you designated (see figure 2.2.4).
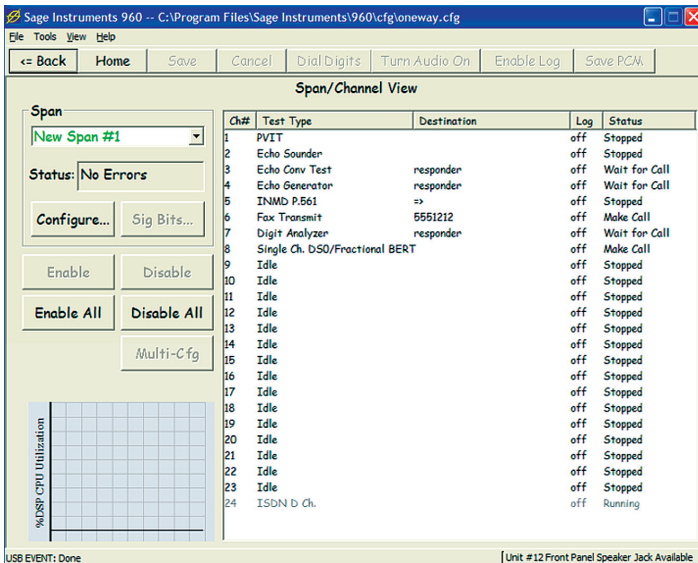

Figure 2.2.4

7. To monitor the ISDN D Channel test in progress, double click on channel 24 to return to the main test screen. Notice that the ISDN D Ch. test is now selected in the test pull down menu and the test status is "Running" (see figure 2.2.5).
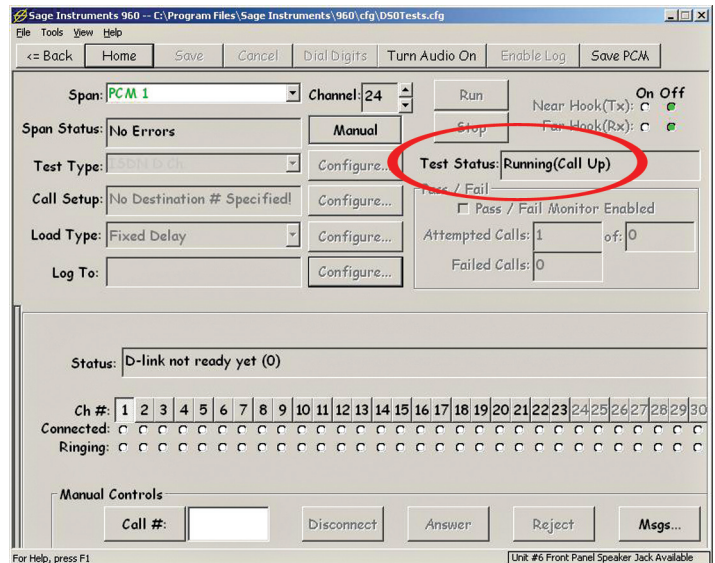

Figure 2.2.5

8. Located at the bottom right hand corner of the main test screen for ISDN D Channel test is a button labeled "msg...". This button is not used for configuration set-tings, but is useful for ISDN debug situations. Clicking on this button launches a real time display of the ISDN traffic (see figure 2.2.6).
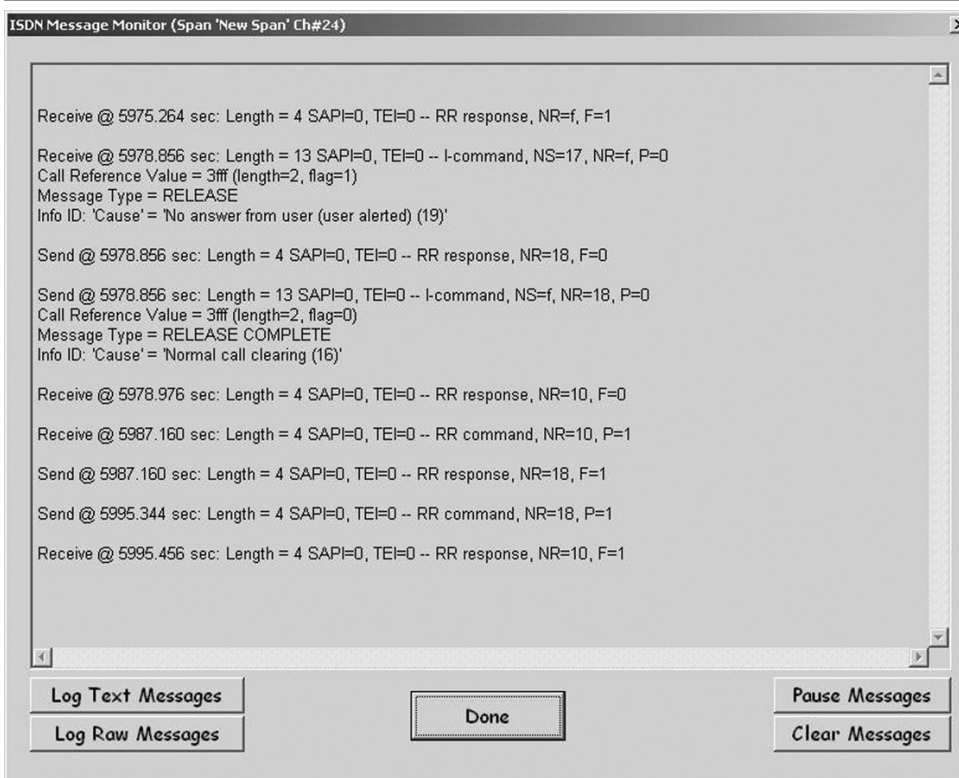

Figure 2.2.6

Selecting ISDN Call Type

1. Also in the configure span window for the ISDN D Channel test advanced parameters can be set for the ISDN D Channel. Next to the supervision/ Signaling menu in the middle of the window is a text box labeled "D Ch:" displaying channel 24 or 16 as the default. Use this box to change to the desired channel (see figure 2.2.7).
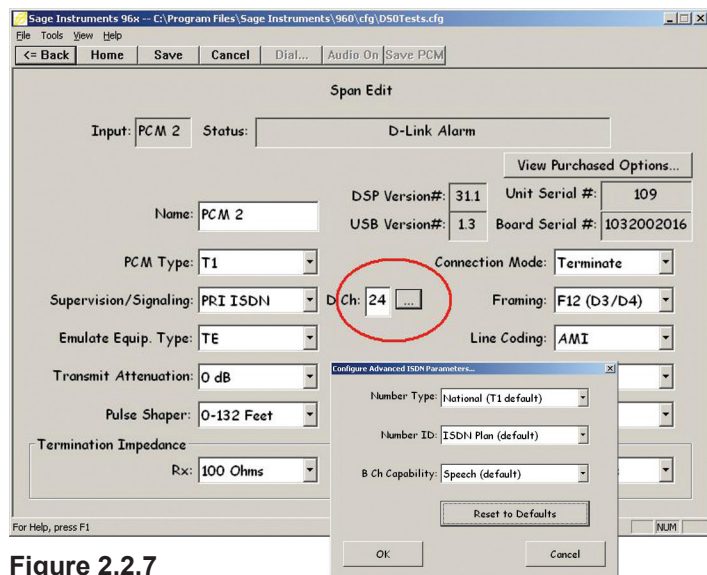

Figure 2.2.7

2. Located to the right of the channel number text box is a small button with three dots (see close-up figure 2.2.8).
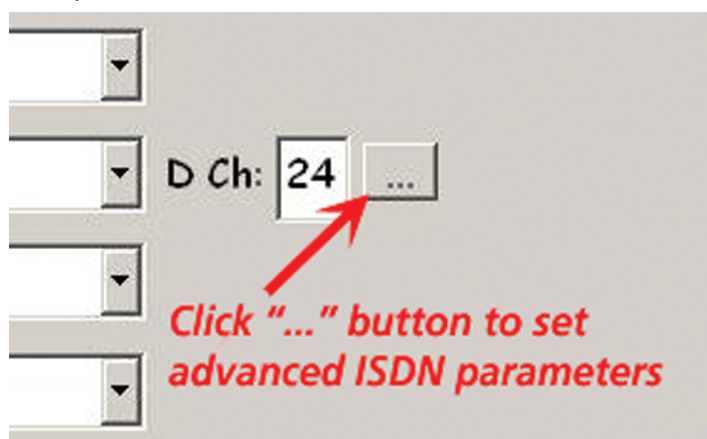
Figure 2.2.8

Clicking this button launches the "Advanced ISDN Parameters" window. The window contains three pull down menus for fine tuning the tests Number Type, Number ID and B Channel Capability (see figures 2.2.9 through 2.2.11). When finished configuration settings for the ISDN D Channel test click" OK" and return to the span window.

Figure 2.2.9 *Choose between International (E1 default), National (T1 default), Network Specific, Subscriber, or Abbreviated number*

Figure 2.2.10 *Choose between Unknown, ISDN plan (default), Data plan, Telex plan, National plan, or Private plan.*

Figure 2.2.11 *Choose between Speech, 3.1Khz audio, 56 Kbps Data call or 64 Kbps Data call.*

ISDN D Channel Tests *(continued)*

Manual procedure to connect calls to the ISDN D Ch. test

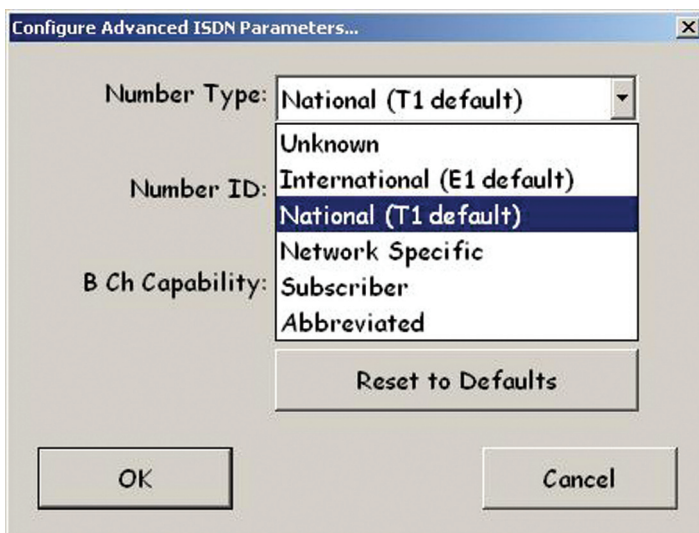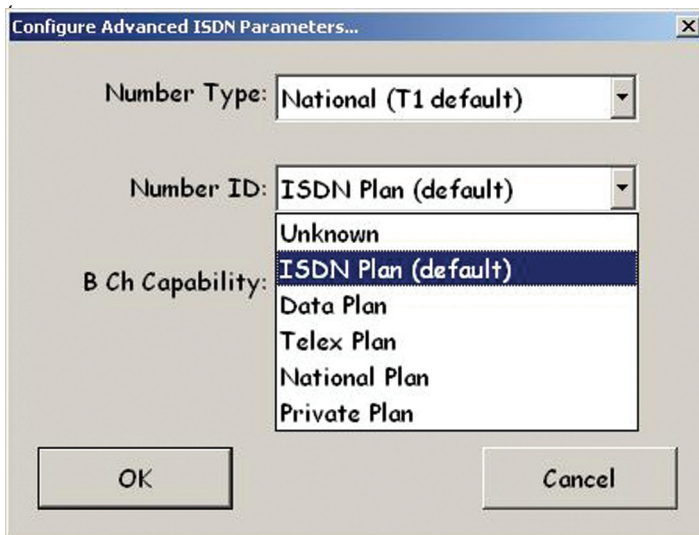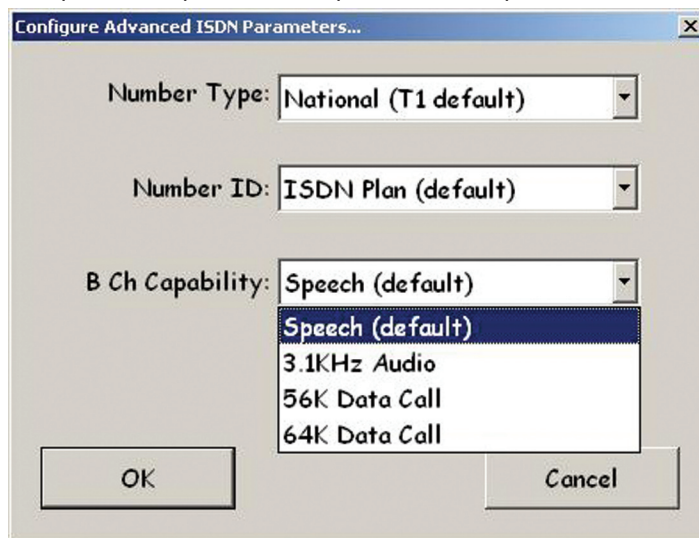**1.** Configure the ISDN D Channel test on PCM1 as described in the previous section using the default channel 24. Repeat the steps and configure PCM2. Now the ISDN D Channel test is running on PCM1 and PCM2 on the default channel 24. Check to make sure this is the case. Your main test screen on both PCM1 and PCM2 for channel 24 should look like figure 2.2.12. Verify the following; Span Status: **No Errors**, Test Status: **Running(Idle)**, Status: **ISDN is Functioning OK (D-link ready (0).**

Figure 2.2.13
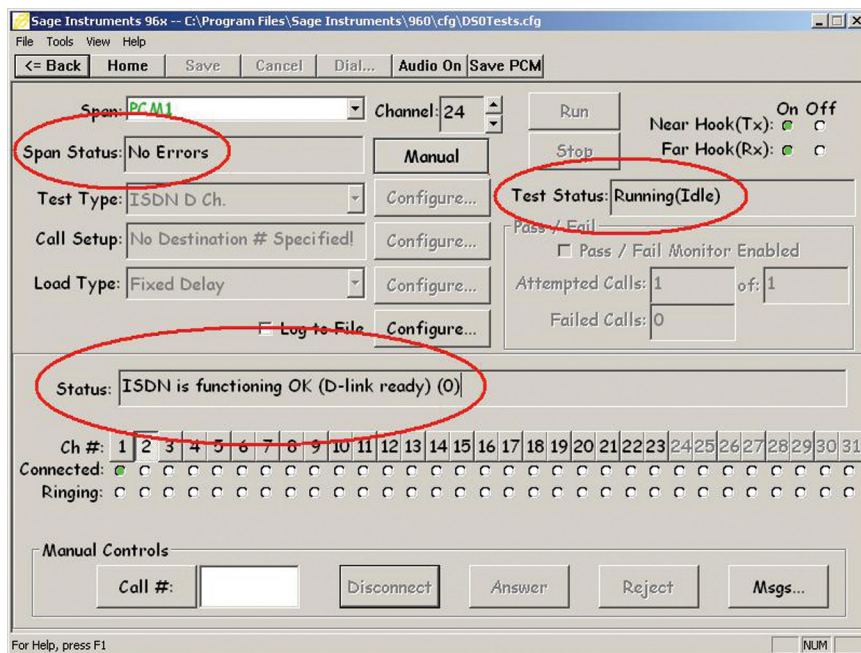
Figure 2.2..12

Now available

2. Manually connecting multiple calls to the ISDN D Channel test is simple. The bottom half of the screen consists of three rows. Ch# is a row of buttons for selection available channels. The next two rows Connected: and Ringing: indicate with the color green channels that are in use and channels that are awaiting answer. Located at the bottom of the section are the "Manual Controls"; Call, Disconnect, Answer and Reject.

3. For this example we will connect a call to the ISDN D Channel test on Channel 15. From the PCM1 main test screen for channel 24 click the channel "15" button once and move the mouse away. The "15" button should now look like figure 2.2.13.

4. Next enter a destination number in the field labeled Call #: Click the button labeled "Call #: once. At the top left of the screen change the "Span" pull-down menu to PCM2. This action causes the far end to ring twice. Click the "Answer" button once. The call is now connected. Repeat this procedure alternating between PCM1 and PCM2 to connect up to 23 calls.

3. IP Tests

Introduction

The following section covers 960 tests that are applicable to Ethernet networks. Most of the tests in this section can only be run over Ethernet interfaces. Several of these Ethernet tests utilize 960 Voice Frequency Tests to test and characterize the voice path on the Ethernet interface.
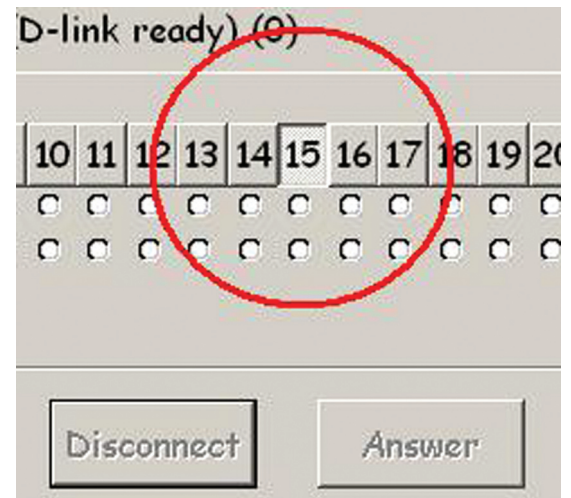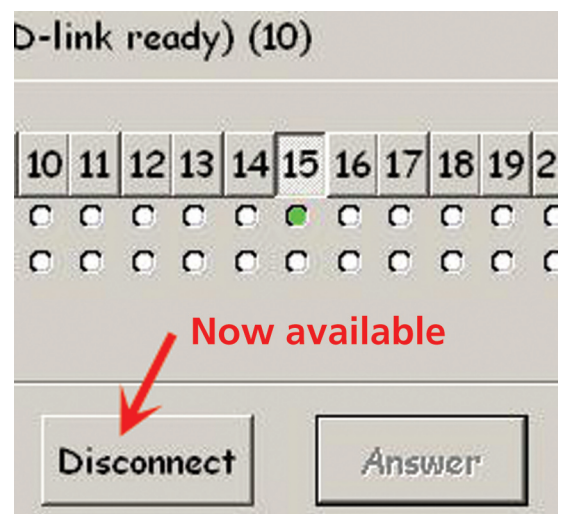
3.1. E-model Calculations

The 960 equipped with option 5000 can perform E-model calculations as specified in ITU-T G.107. The E-model calculates the Transmission Rating Quality Factor, R as well as Percentage Good or Better (GoB), Percentage Poor or Worse (PoW) and Mean Opinion Score (MOS). Depending on the type of Voice Frequency test being performed, the 960 uses delay, echo, codec type, noise and packet loss measurements to calculate the E-model R number. Table 3.1.1 and 3.1.2 below show the measured impairments that are used in the E-model calculation for each test type. Where the measured impairments are not available, the 960 substitutes the default values shown in Table 3.1.3.

Table 3.1.1 DS-1 and Analog Interfaces

Test Type	Delay	Echo	Codec	Noise	Packet Loss
MoIP	√	√	√	√	√

Table 3.1.2 IP Interfaces

VF Test Type	Delay	Echo	Codec	Noise	Packet Loss
SMOS/ PESQ	√	x	√	√	√
Echo Sounder	√	√	√	x	√
INMD	x	x	√	x	√
All Others	x	x	√	x	√

Table 3.1.3 E-model Default Values

Measurement	Delay	Echo	Noise
Default Value	0 ms	65 dB	-64 dBmp

E-Model Results

The E-model results are displayed in the lower portion of the Test Control Window. Examples of the different E-model results formats are shown in Figures 3.1.1-4.

Figure 3.1.1 shows the E-model results for the MoIP test on T1 and E1 interfaces. Except for the address line, the E-model results format is the same for all interfaces.

Below the address are the E-model calculations.

There are three result numbers for each measurement, these are a raw data sample, the minimum and maximum measured values during the sample interval.
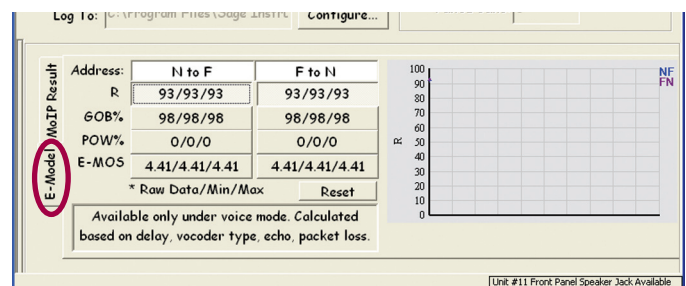

Figure 3.1.1 E-model Results MoIP on DS-1 and E-1

The first result below the address is the **R** rating. The E-model R rating ranges from 0 to 100. Table 3.1.4 shows how the R values relate to transmission quality and user satisfaction.

Table 3.1.4 E-model R Values

E-model R Rating	Speech Transmission Quality	User Satisfaction
90 ≤ R < 100	Best	Very Satisfied
80 ≤ R < 90	High	Satisfied
70 ≤ R < 80	Medium	Some Dissatisfied
60 ≤ R < 70	Low	Many Dissatisfied
50 ≤ R < 60	Poor	Most All Dissatisfied

Below the R value is the Percentage Good or Better (**GOB%**), this measurement ranges from 0 to 100, 100 being excellent speech quality. Below the GOB% reading is the Percentage Poor or Worse (**POW%**), this measurement ranges from 100 to 0, 100 being the worst speech quality. Below the POW% reading is the

E-MOS measurement. This value ranges from 5 to 1, 5 being excellent speech quality. For more information on these measurements refer to the ITU-T G.107. Clicking on one of the results will cause the measurement to be displayed on the graph on the right side of the window.

Figure 3.1.2 E-Model Results MoIP on Analog

E-model Results T1 and E1 Interfaces

While most of the E-model test results are for tests running on Ethernet interfaces, the MoIP test performed over the DS1 or E1 interfaces also has E-model results when the MoIP test is run in the voice mode. The E-model results are located under the **E-model** tab circled in Figure 3.1.1. The first line of the results is the **Address**, for TDM interfaces the address field is N to F and F to N signifying Near to Far direction and Far to Near direction. In this test the Director side is the near end direction.

Figure 3.1.3 E-Model Results SIP Call

E-model Results Analog Interfaces

While most of the E-model test results are for tests running on Ethernet interfaces, the MoIP test performed over the analog interface also has E-model results when the MoIP test is run in the voice mode. Note, in this window the E-model results are located in a separate tab under the **VF Test** tab, both tabs are circled in Figure 3.1.2. The first line of the results is the **Address**, for analog and TDM interfaces the address field is N to F and F to N signifying Near to Far direction and Far to Near direction. In this test the Director side is the near end direction.
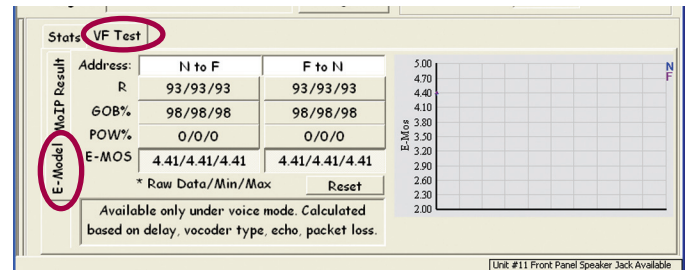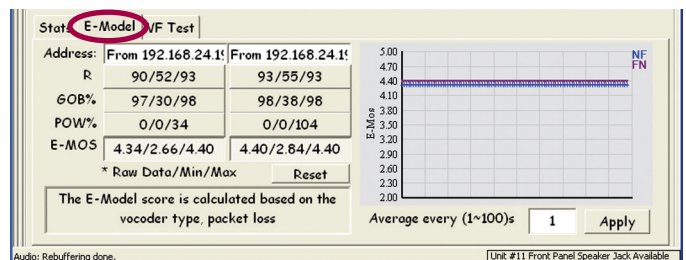

Figure 3.1.4 E-Model Results RTP Monitor

E-model Results Ethernet Interfaces

Figure 3.1.3 and 3.1.4 show E-model results for tests run on **Ethernet** interfaces. When running IP tests, the E-model results are located under the E-model tab circled in Figure 3.1.4. The E-model results for the IP tests are identical to the Analog/TDM MoIP test except for the address field at the top of the results. In the bottom right corner is a text box labeled **Average** with an accompanying **Apply** button. These controls are used to set the data sampling interval for the E-model calculations.

SIP Call E-model Results

Sip calls have the results format shown in Figure 3.1.2. Notice that there is no address field in the E-model results. The IP address is the farend address shown under the SIP Status tab circled in Figure 3.1.2. These E-model results show the measurements made on the farend network the 960 is connecting to.

RTP Monitor E-model Results

RTP Monitor tests have the results format shown in Figure 3.1.3. These are two way results with quality measurements for each direction of transmission. The IP address at the top of each result column indicate the direction the measurements were made from.

3.2. Echo PING

The Echo Ping test is a packet utility service test that supports Internet Control Message Protocol (ICMP-RFC 792) PING requests. This test is only applicable to Ethernet interfaces. By specifying an Echo PING test on an ethernet test port, the 960B will respond to a ICMP PING request when PING host IP address matches the IP address of the ethernet test port. Only one channel per ethernet test port can be defined as a Echo PING test. This test is commonly used to determine the connectivity, availability and response time of the 960's Ethernet test port.

Test Setup

Figure 3.2.1 shows the Test Control window with the Echo Ping test selected. The Echo Ping test has no configuration parameters to set. Select the test from the circled **IP Test** list box in Figure 3.2.1. Save the test by clicking the **Save** button on the tool bar and click on the **Run** button to start the test. There is no result display associated with this test.

3.3. RTP Monitor

The RTP Monitor test monitors Real Time Protocol streams adhering to RFC 3550. The test allows passive monitoring of SIP, H.323, NCS, or MGCP VoIP calls from the 10/100BaseT interface. Using an accompanying Voice Fre-

Figure 3.2.1 Echo Ping Test

Figure 3.3.1 RTP Monitor Test

quency test, the RTP monitor can analyze RTP streams for Echo and Audio Levels (G.711 & G.729). Up to 128 instances of the RTP monitor can be started on an interface (100BaseT Full-duplex), allowing 256 RTP streams to be simultaneously monitored. The test gives a real time display of the origination and termination addresses as well as packet and impairment counts. There is also a graphical display of the packet impairment distribution and lost or discarded packets verses time. While in the RTP Monitor mode the following VF tests can also be run, Dual Spectrum Analyzer, INMD, One-Way Delay and RFC2833 monitor. Refer to the descriptions of these tests for more information on setting up and running them.

Test Setup

Select the RTP Monitor test in the **IP Test** list box circled in Figure 3.3.1. Click on the **Save** button in the tool bar to save the test. Clicking on the **Configure** button to the right of the list box will launch the RTP Monitor configuration dialog box shown in Figure 3.3.2.

A **Target IP Address** and **Port** number to monitor can be specified here, or click on the **Any Port**, or **Any Address** to let the 960 pick the RTP stream. Note that if you start multiple instances of the RTP Monitor on an Ethernet interface, and the Any Address and Port are checked, each of the monitors will automatically scan for different streams, so each stream on the link can be separately monitored. Also if the Any Address and Port are checked, the RTP Monitor will step through the different RTP streams on the link each time the test is restarted.

The jitter buffer size and no packet time out parameters are entered in the lower portion of the RTP Monitor dialog box in Figure 3.3.2. The **Jitter Buffer** parameter sets the size of the jitter buffer in the 960. The **No Packet Timeout** parameter is used by the RTP Monitor to detect when to stop monitoring a stream and start searching for another. In some VoIP phones, no packets are sent during silence periods. The No Packet Timeout parameter is used to prevent the 960 from searching for another RTP stream to monitor when there are no packets sent due to a silence in the conversation.

RTP Monitor Results

The RTP Monitor results are shown in the lower portion of the window in Figure 3.3.1. The **State** box on the left side of the results display indicates the state of the monitor. The following is a list of the possible states:
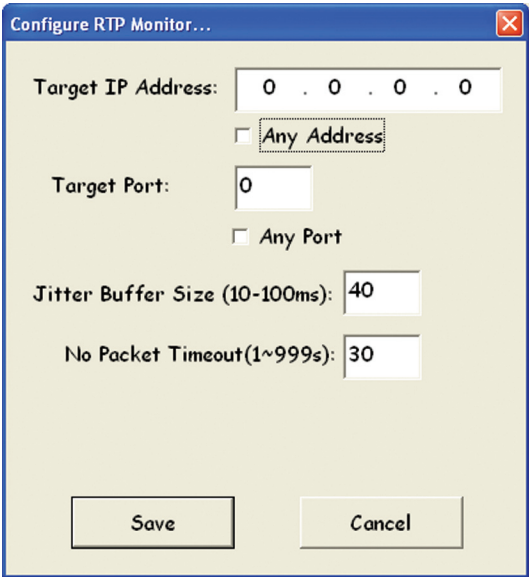
Stopped
Searching...
Found One Side...
Stream Found
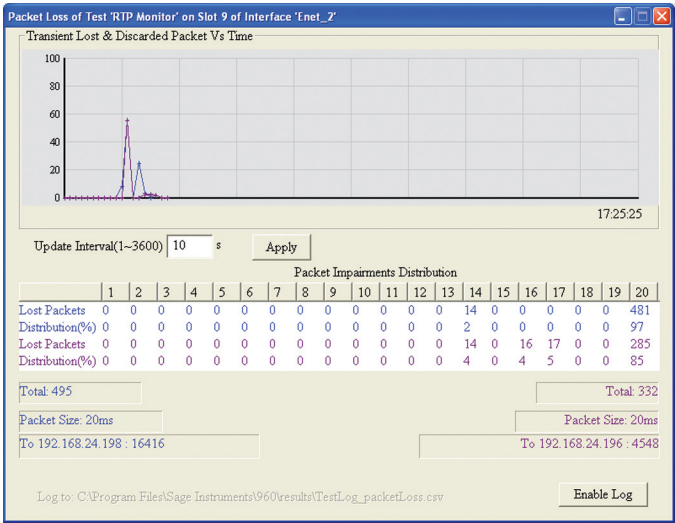

Figure 3.3.2 RTP Monitor Configuration

Figure 3.3.3 RTP Monitor Results Graph

Error: Unknown state!

On the right side of the results display are two columns of results. At the top of each column is the IP **Address** for each end of the stream. Below the address is the **RTP Port** number. Below the port is the **Actual Packet Count** showing the number of packets received by each side. Next to the actual count is the **Lost Count** in parenthesis. This count represents the number of packets that were sent but not received by the other side. The **Delayed/Discarded** Packet Count indicates the packets that arrived too late to process and were discarded. The **Out of Order Packet Count** displays a total of the number of packets that were received out of order by each side. The **Inter-Arrival Jitter** measurement shows the difference in the relative transit time for a pair of received packets.

The **Type-of-Service** field displays the type of service byte that is embedded in the packets coming from each direction.

The last item in the results is the **Vocoder**. This indicates the type of vocoder used to digitize the audio content. The vocoder type is embedded in the RTP packets. Types of vocoders recognized by the 960 are listed below in Table 3.3.1.

Table 3.3.1 RTP Monitor Vocoder Types

Comfort Noise	GSM
DVI11025	L16_MONO
DVI16000	L16_STEREO
DVI22050	LPC
DVI8000	MPA
G722	PCM aLaw
G723	PCM muLaw
G728	QCELP
G729	Not Specified
Error: Unknown Vocoder Type	

RTP Results Graph

Clicking on the graph button circled to the right of the results display in Figure 3.3.1 will launch the **Packet Impairment Distribution** and **Packet Loss Verses Time** graphs shown in Figure 3.3.3. The top graph shows the lost and discarded packets versus time. The loss values are percentages. The graphs are color coded to identify each direction, they match the color coded IP addresses at the bottom of the window.

The lower table shows the packet impairments distribution. This table has twenty columns labeled 1 to 20. These columns represent bins where errors are totaled. Single lost packets are totaled in bin 1, packet losses involving two consecutive packets are totaled in bin 2.

This continues through bin 19. Losses totaled in bin 20 are losses of 20 or more packets. Below the Lost Packets row is the **Distribution(%)**. This indicates the percentage of the total loss that this bin represents. The rows of the table are color coded to identify direction and match the color coded IP addresses at the bottom of the window.

The **Total Packet Loss** for each side is displayed at the bottom of the window along with the **Packet Size** in milliseconds. At the bottom of the window is the IP addresses and port numbers for each direction.

The **Update Interval** text box and accompanying **Apply** button are used to specify the number of seconds between sampling intervals for the data points on the graph. The **Enable Log** button in the bottom right corner of the window is used to enable the logging of test results to the log file specified at the bottom of the screen.

3.4. Dual Spectrum Analyzer

The Dual Spectrum Analyzer test displays a real time spectrum analysis graph of the audio content of the selected RTP stream. This test is a VF test that can be run under the RTP Monitor test.

Test Setup

After setting up the RTP Monitor, Select the Dual Spectrum Analyzer from the list box circled in Figure 3.4.1 and click on the Run button. There are no configuration options for this test.

Dual Spectrum Analyzer Results

The results graph for the Dual Spectrum Analysis test is shown in the lower portion of the window in Figure 3.4.1. Notice that these results are found under the VF Test tab. On the left side of the results display are numeric results for each direction, labeled with the originating IP address. Below the addresses are the frequency and level measurements. This measures the strongest single frequency signal on the channel. Below these measurements are the composite level measurement for the channel. To the right of the numeric results is a graph of level versus frequency. The graphs are color coded to identify each end and match the respective color of the numeric results on the left. Like most graphs in the 960, any portion of the graph can be magnified by dragging a highlight square around a portion of interest on the graph.
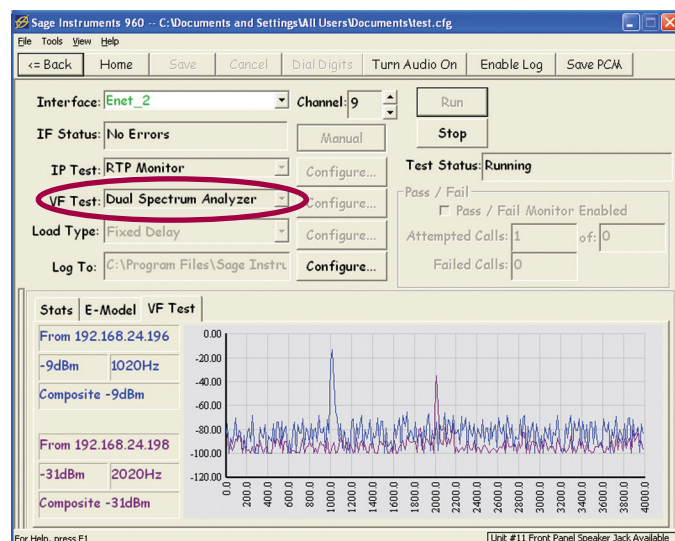

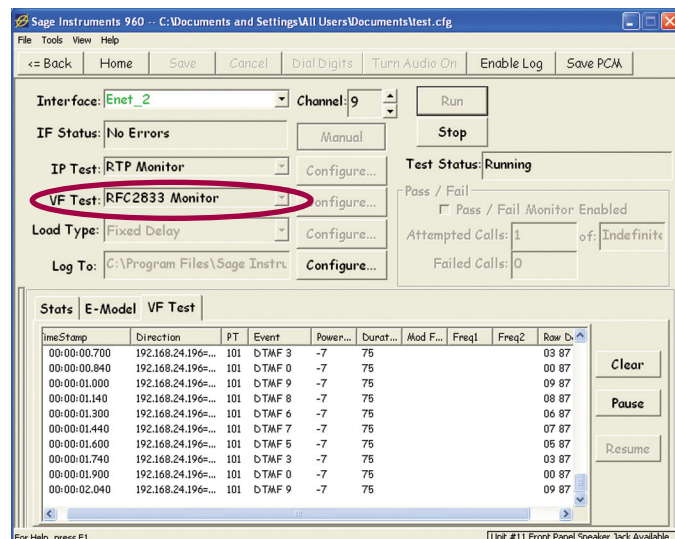**Figure 3.4.1 Dual Spectrum Analyzer**

3.5. RFC2833 Monitor

The RFC2833 Monitor captures and displays RFC2833 messages used to send network tones across IP interfaces. This test is only applicable to Ethernet interfaces. This test is available as a VF test while performing the RTP Monitor test.

Figure 3.5.1 RFC2833 Test

Test Setup

After setting up the RTP Monitor, Select the **RFC2833** test from the list box circled in Figure 3.5.1 and click on the **Run** button. There are no configuration options for this test.

RFC2833 Test Results

RFC2833 test results are shown in lower half of the window in Figure 3.5.1. Note that these results are located under the **VF Test** tab. The first column on the left is a **TimeStamp** for each event. This time stamp starts from zero and increments for an active test session. When the 960 starts monitoring a new RCF2833 stream, it restarts the timestamp to zero. To the right of the timestamp is the **Direction** indicator. The direction takes the form 192.168.24.196<=192.164.24.198, however to pre-

serve screen space the direction field in Figure 3.5.1 has been reduced so only the first address is visible. To the right of the direction field is the **Payload Type**, this number is extracted from the associated RTP packets and defines the type of payload and it's treatment. See RFC3551 for a description of the different payload types. To the right of the Payload field is the **Event** field. The Event Field displays the network tone sent. In the example in Figure 3.5.1 the events were DTMF digits. To the right of the events is the signal **Power** expressed as a level in dBm. To the right of the power is the signal **Dura-**

tion. The duration is measured in Milliseconds. To the right of the duration are three frequency fields. These display the modulation frequency as well as frequency components of tone sources. The last column on the right displays the **Raw Data** bytes extracted from the RFC2833 messages.

To the right of the results display are three buttons labeled **Clear**, **Pause** and **Resume**. These are used to control the results display. Note that clicking on the pause button only pauses the log and does not stop the test or the capture of RFC2833 messages.

3.6. RTCP Monitor

The RTCP Monitor test displays RTP Control Protocol messages as defined in RFC 3550. This test is only applicable to Ethernet interfaces.

Test Setup

Select the **RTCP Monitor** from the **IP Test** list box circled in Figure 3.6.1. Click on the **Save** button in the tool bar and click on **Run**. There are no configuration options for this test.

RTCP Monitor Results

RTCP messages are displayed in the lower portion of the window in Figure 3.6.1. Refer to RFC 3550 for more information on the message descriptions.

The buttons to the right of the results are used to manage the results display. The top button labeled **Log Messages**, starts logging the messages to a log file. Placing the mouse over the button will display the log file name and location.

The **Clear**, **Pause** and **Resume** buttons control the displayed log messages. Note that Pausing the log does not pause the RTCP capture, it only freezes the display for better readability.
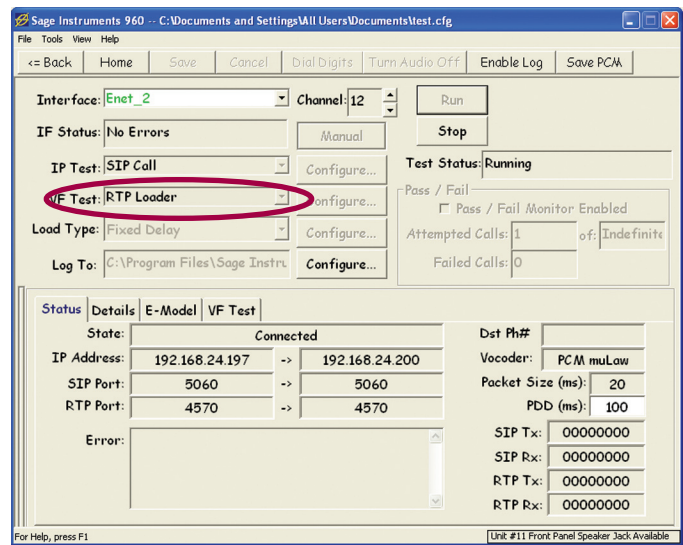
3.7. RTP Loader

The RTP Loader test window is shown in Figure 3.7.1. This test is used to generate RTP traffic over a link. Each instance of RTP Loader uses 128 Kb of bandwidth. The RTP Loader is a VF Test that runs under the SIP Call IP test.

Test Setup

First configure the IP Test for SIP Calls. Configure the SIP call as a director or responder depending on your test configuration. If the 960 is providing both sides of the test then configure one side as a director and the other side as a responder. Select the **RTP Loader** test from the **VF Test** list box circled in Figure 3.7.1. Then click on the **Run** button to start the test. There is no configuration options for this test.

Figure 3.6.1 RTCP Monitor

Figure 3.7.1 RTP Loader

Test Results

There are no results for the RTP loader. The results shown in the lower portion of Figure 3.7.1 are the Status indicators for the SIP call portion of the test.

3.8. SIP Call

The SIP Call test in the 960 can place and receive SIP calls over IP networks per RFC 3261. This test is only applicable to Ethernet interfaces. In addition to placing a call, the SIP Call test can also run voice frequency or IP tests. Table 3.8.1 lists the tests the SIP Call can run.

Table 3.8.1 SIP Call Tests

Send/Measure Tone	Talk
Echo Sounder	Echo Generator
SMOS Director	SMOS Responder
PESQ Director	PESQ Responder
MOS Transmit	MOS Receive
PESQ Transmit	PESQ Receive
G.168	Digit Sender
One-Way Delay Tx	One-Way Delay Rx
T.38 FAX Transmit	T.38 FAX Receive
RTP Loader	

Figure 3.8.1 SIP Call Test

Figure 3.8.2 Configure SIP Call Dialog

General Test Setup

The following section describes the general setup for a SIP call. Subsequent sections cover configuration of the director, (call origination) and responder, (answer call) functions. The SIP Call test is selected by clicking on the button in the **IP Test** list box circled in Figure 3.8.1. This will bring up a list of all IP tests, select **SIP Call** from the list by clicking on it. Click on the **Save** button on the tool bar to save and enable configuration the test. Next choose a Voice Frequency test to run by clicking on the button in the **VF Test** listbox located below the circled IP list box in Figure 3.8.1. This will bring up a list of all tests contained in Table 3.8.1. Select a test from the list. Click on the **Configure** button next to the VF Test list box to modify the Voice Frequency test parameters if necessary. Refer to the applicable section of the manual for information on configuring the Voice Frequency test.

Click on the **Configure** button to the right of the IP Test listbox circled in Figure 3.8.1. This will launch the Configure SIP Call dialog box shown in Figure 3.8.2.

The text box at the top of the SIP dialog box in Figure 3.8.2 contains the originating, or **Local IP** address. This field picks up the IP address of the associated ethernet test interface.

Note: *if the Ethernet test interface is configured for DHCP addressing, the interface must be configured by the DHCP server before any IP tests are configured.*

This address can be changed by entering an address in the Local IP test box. The **Local Port** text box contains the Port number that the 960 will use for SIP calls. Do not change this port number unless your application requires using a different port.

The **Local MAC ID** is located under the Local Port text box. This picks up the MAC ID of the associated Ethernet interface. The MAC ID can be changed

by entering a new number in the Local MAC text box.

The **Local Phone#** text box is located under the Local MAC text Box. This text box is used to specify a local phone number to associate with the SIP call. If the local number is specified and the SIP call is setup as a responder, the calling party will need to use the IP address and local number in a proxy server style call to contact the responder. The **Jitter Buffer Size** text box is located under the Local Phone# text box. This test box specifies the size of the jitter buffer in the 960.

There are two Type of Service (ToS) text boxes at the bottom of the SIP dialog box in Figure 3.8.2. These are labeled **RTP ToS** and **SIP ToS**. These text boxes are used to specify the ToS byte that is sent in the SIP and RTP protocol headers by the 960. These ToS bytes are used by some networks to give priority service to time sensitive applications.

Figure 3.8.3 SIP Call User Account

User Account Setup

Some SIP configurations require user name and password authentication. Clicking on the **User Account** tab circled in Figure 3.8.2 will bring up the User Account dialog box shown in Figure 3.8.3.

If applicable enter a user name, password and screen name in the **User Name**, **Password** and **Display Name** text boxes. The **IMS Authentication String** text box is provided for users employing IMS services. Enter an authentication string in this text box if applicable.

Figure 3.8.4 SIP Call Registration

Registration Server Setup

Some VoIP system providers use a registration server for processing SIP calls. Clicking on the **Registration** tab located to the right of the circled tab in Figure 3.8.2 will bring up the Registration dialog box shown in Figure 3.8.4.

If a registration server is not used for SIP calls, then make sure the **Do not register** check box circled in Figure 3.8.4 is checked.

The top two text boxes in Figure 3.8.4 labeled **Registration Server** and **Port** are for entering the IP address and port number for the registration server. These should be available from your VoIP provider or network administrator. Below the Port text box is the **Expiration** text box. This is used to specify the time in minutes that the registration is effective.

The **Interval** text box located under the Expiration text box will set the time interval between re-registration messages sent to the server by the 960.

The **User Name** text box is a value returned by the registration server.

Figure 3.8.5 SIP Call Advanced Settings

Advanced Settings

Clicking on the **Advanced** tab located to the right of the circled tab in Figure 3.8.2 will launch the Advanced settings dialog box shown in Figure 3.8.5. This dialog box is used when compatibility problems arise when with other vendors SIP implementations.

The text box labeled **How many BYE or CANCEL commands upon disconnect?**, is used to control how many BYE or CANCEL commands the 960 will send upon disconnect.

The checking the check box labeled **Send 2nd INVITE ...** will cause the 960 to send an additional INVITE message when performing the T.38 FAX test.

Director Setup

Clicking on the **Make Call** tab circled tab in Figure 3.8.6 will bring up the Make Call dialog shown in Figure 3.8.6. Clicking on the **Director** radio button at the top of the dialog box will allow the SIP call test to originate calls.

The two top text boxes in Figure 3.8.6 labeled **Dest** and **Port** are for the call destination address and port number. Do not change the port number unless your application requires a different number.

The text boxes and controls in the highlighted square in Figure 3.8.6 are used to specify a destination number on a proxy server. To set up a call to a proxy server, click on the **Via Proxy Server** check box. This will enable the **Dst Ph#**, **Proxy Server** address and **Port** text boxes for text entry. Enter the Proxy Server address, Port number and Destination Phone Number in the appropriate text boxes.

Below the highlighted square in Figure 3.8.6 is the **Packet Size** control. Drag the control with the mouse to set the Packet size for SIP calls. To the right of the Packet Size control is the **Decoder** selection box. This specifies the type of codec used for the call. Decoder types supported by the 960 are PCM muLaw, PCM aLaw and G.729.

The **# Call Attempts** text box is located at the bottom of Figure 3.8.6. This text box specifies how many times the 960 will attempt to initiate the SIP call before giving up. Placing a zero in this text box will cause the 960 to repeatedly place the test call until it is successful, or until stopped by the user.

Responder Setup

Clicking on the **Responder** radio button at the top of Figure 3.8.6 will set the 960 in the responder mode, allowing it to answer incoming SIP calls. This is the only responder specific configuration for SIP calls.

Multi Channel Configuration

The SIP call configuration dialog box contains **Auto** fill buttons for automatically populating a contiguous range of IP addresses, port numbers, MAC ID's and phone numbers. These are used in conjunction with the multi channel configuration dialog box that is launched by the **Multi-Cfg...** button in the Span View window. Refer to the Span View section of the manual for more information on the multi channel configuration utility.

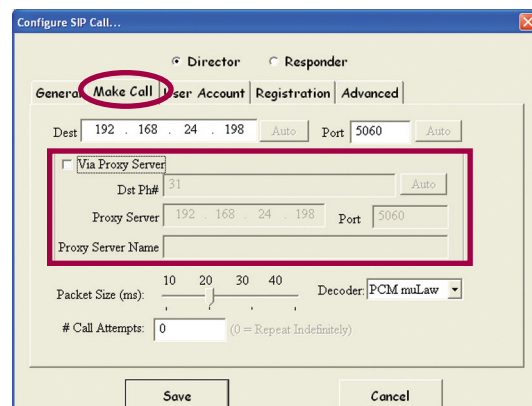The multi channel configuration dialog box is shown in Figure
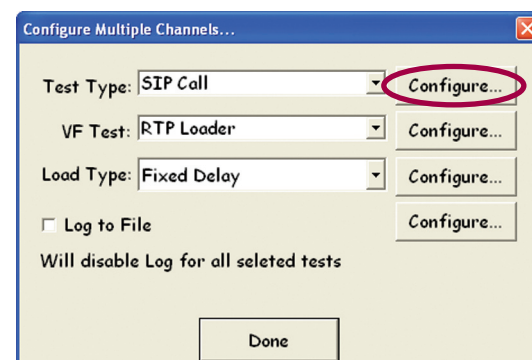

Figure 3.8.6 SIP Make Call Dialog

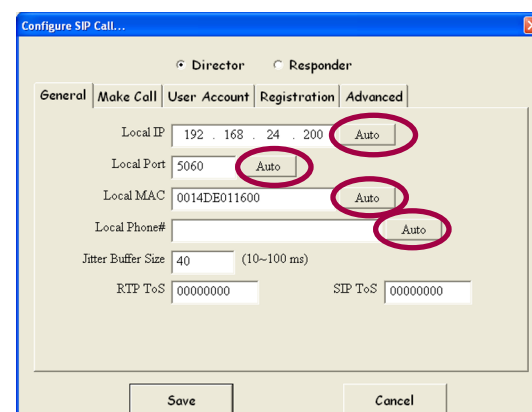
Figure 3.8.7 Multi Channel Config.

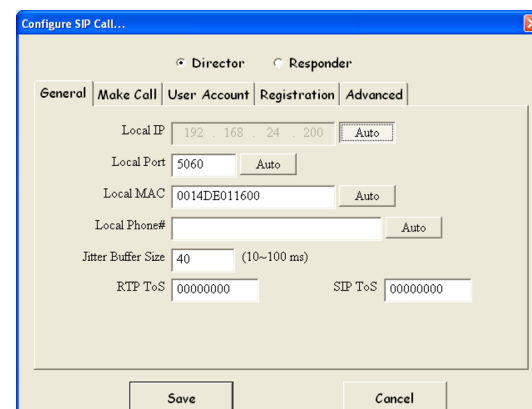**Figure 3.8.8 SIP Multi Channel Setup**

Figure 3.8.9 SIP Multi Channel Setup

3.8.7. Clicking on the **Configure** button circled in Figure 3.8.7 will launch the SIP Call configuration dialog box shown in Figure 3.8.8. Notice that the circled Auto buttons in Figure 3.8.8 are enabled because multiple channels are being configured. In figure 3.8.9, the Auto Fill button for the Destination IP address has been clicked. This will cause the destination IP address to increment for each channel. Any valid value can be entered in the appropriate text boxes, when the Auto Fill button is clicked, the auto increment range will start with the number entered and increment for the range of channels selected. Figure 3.8.10 shows the resulting Span View window with channels 12 through 25 configured as SIP Directors running the RTP loader test. Notice that the destination IP addresses start at 192.168.24.200 and end at 192.168.24.213.
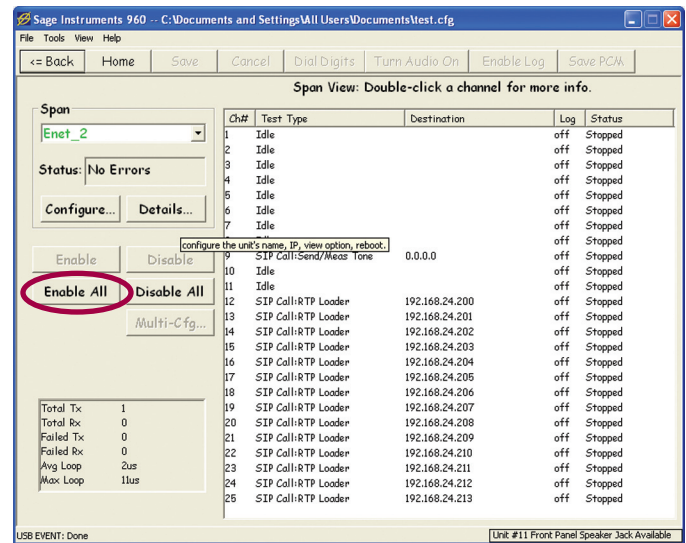

Figure 3.8.10 SIP Multi Channel Tests

Running Tests

Once the SIP call is configured, click on the **Save** button at the bottom of the configure SIP dialog box shown in Figure 3.8.9.

To start a single channel test . Click on the circled **Run** button in the Test Control window in Figure 3.8.11.

To start Multi Channel tests click on the circled **Enable All** button in the Span View window in Figure 3.8.10 to start all of the tests. Alternatively, in the Span View window, highlight a range of channels and click on the **Enable** button located directly above the Enable All button.
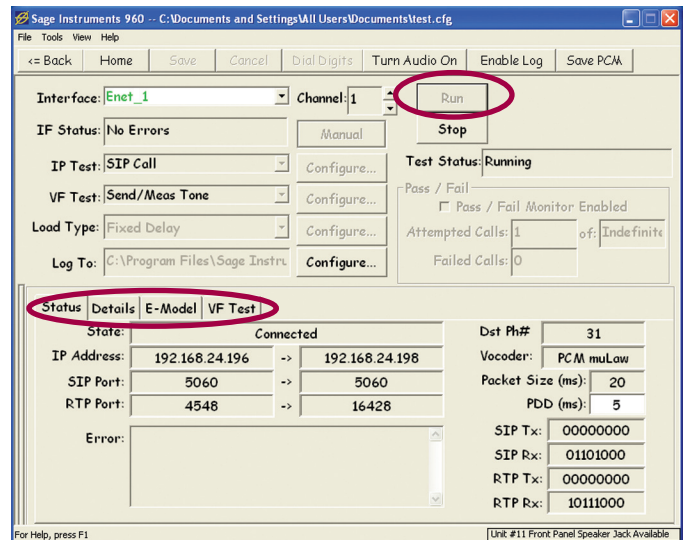
SIP Call Results

Figure 3.8.11 shows a running SIP call test. This SIP call is configured as a director. The Voice Frequency test running under the SIP call is Send/Measure Tone. Notice the circled result tabs in the middle of Figure 3.8.11. These are labeled Status, Details, E-model and VF Test. The **Status** tab displays the originating and terminating IP and port addresses and other information about the SIP call. The **Details** tab displays packet statistics including packet count, lost and discarded packets. The **E-model** tab displays the E-model results described in the E-model section of the manual. The **VF Test** tab displays the results for the running Voice Frequency test. Note that some Voice Frequency tests like RTP Loader have no VF Test results.

Figure 3.8.11 Running SIP Call, Status Display

this indicates the call connected successfully. Table 3.8.2 shows the various call states displayed in the SIP Call State text box.

Table 3.8.2 SIP Call States

State	Description
Calling	Initiating a Call
Connected	Successful Connection
Disconnected	Call Torn Down
Idle	No Calls In Progress
Ringing...	Incoming Call Detected
Ringing(180)...	Ring Back from Farend
Wait For Call...	Responder Waiting for Test Call

Status Display

The results under the Status tab are shown in the lower portion of Figure 3.8.11. The **State** text box is first test box in the results display. This text box is a call progress display for the SIP call. In Figure 3.8.11 the State text box displays the word "Connected",

Below the Call State text box are the IP addresses. The **IP Address** text box on the left is the 960 resource involved in the SIP call. The address on the right is the other end of the SIP call. Below the IP addresses are the **SIP** and **RTP Port** numbers for both sides of the call. Below the RTP Port text box is the **Error** text box where SIP call error messages are displayed when the call fails.

Refer to RFC 3261 for a listing and description of SIP error messages. To the Left of the State text Box in Figure 3.8.11 is the **Dst Ph#** Text box. This displays the Phone Number at the destination if a proxy server was specified for the call. In a responder SIP call the DsT Ph# test box label changes to **Local #** and the displayed number is the local number entered into the SIP configuration dialog, circled in Figure 3.8.13. The **Vocoder** Text box below the Dst Ph# text box, displays the Vocoder specified for the call. Below the Vocoder text box is the **Packet Size** text box. This displays the size of the packets in milliseconds. Below the Packet Sixe text box is the **PDD** text box. This displays the Post dial delay. This is the delay between the last digit sent and the detection of the farend ring back signal. This measurement is only applicable for the director side of the SIP call. The PDD result is disabled in the results display for the responder side of the SIP call. Below the PDD text box are four test boxes labeled **SIP Tx**, **Rx** and **RTP Tx**, **Rx**. These text boxes are used to display the Type of Service byte embedded in the SIP and RTP packets for both directions.
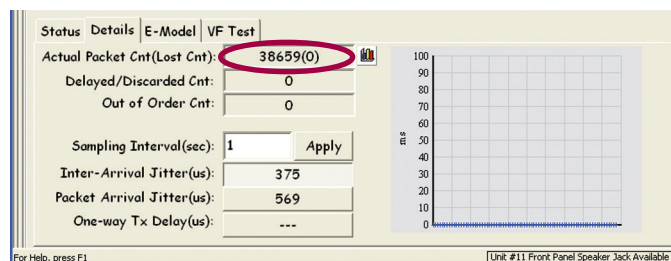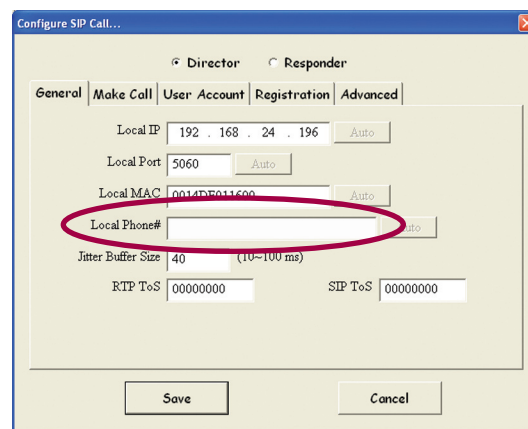
Details Display

The results under the **Details** tab are shown in Figure 3.8.12. These results show the real-time packet statistics for the SIP call. The top text box labeled **Actual Packet Cnt(Lost Cnt)** displays the number of packets received. The number in parenthesis is the lost packet count. This indicates the number of packets that were expected but never received. The **Delayed/Discarded** Packet Count indicates the packets that arrived to late to process and were discarded. Note, that discarded packets are not included in the lost packet count. The **Out of Order Packet Count** displays a total of the number of packets that were received out of sequence. The **Inter-Arrival** Jitter measurement shows the time difference in microseconds for the relative transit time of a pair of received packets. The **Packet Arrival** Jitter is the deviation in microseconds between the actual packet arrival time and the calculated ideal arrival time. The ideal arrival time is based on a system with no jitter or other time variants in transmission delay. The Packet Arrival Jitter value can be positive or negative depending on if the packet arrives later or earlier than the ideal time. At the bottom of the display is the **One-Way Transmit** delay test box. This displays the one way delay in microseconds. This measurement can only be made when both the director and responder sides of the SIP call are originating

Figure 3.8.12 SIP Call Detail Display

Figure 3.8.13 SIP Local Number Entry

from a common DSP board in a 960. There is a graph on the right side of the results display in Figure 3.8.12. Clicking on one of the results text boxes circled in Figure 3.8.12 will cause the selected results to be displayed on the graph. The **Sampling Interval** text box and accompanying **Apply** button are used to specify the sampling interval in seconds for graphing the results.

Packet Loss and Error Distribution Graphs

Clicking on the button with the graph icon to the right of the circled button in Figure 3.8.12 will launch the packet loss and impairment distribution graphs shown in Figure 3.8.14. The top graph shows the **Lost and Discarded Packets versus Time**. The loss values are percentages.

The lower table shows the **Packet Impairments Distribution**. This table has twenty columns labeled 1 to 20. These columns represent bins where errors are totaled. Single lost packets are totaled in bin 1, packet losses involving two consecutive packets are totaled in bin 2. This continues through bin 19. Losses totaled in bin 20 are losses of 20 or more packets. Below the Lost Packets row is the **Distribution(%)**. This indicates the percentage of the total loss that this bin represents.

The total packet loss, IP address and port number for the far end is displayed at the bottom of the window. The **Update Interval** text box and accompanying **Apply** button are used to specify the number of seconds between sampling intervals for the data points on the graph. The **Enable Log** button in the bottom right corner of the window is used to enable the logging of test results to the log file specified at the bottom of the screen.
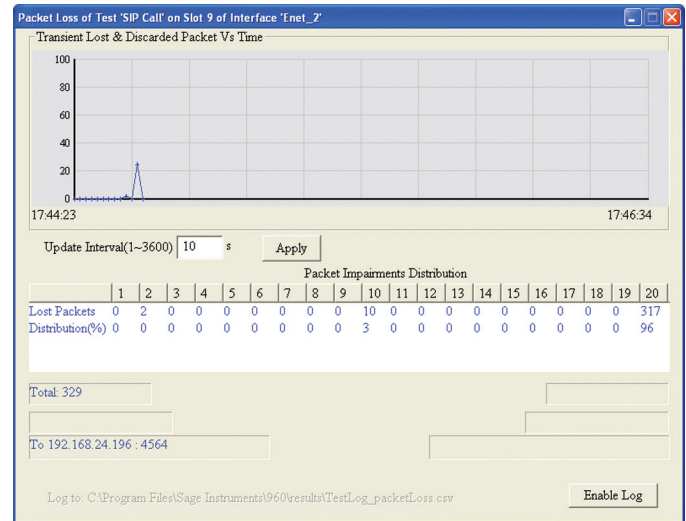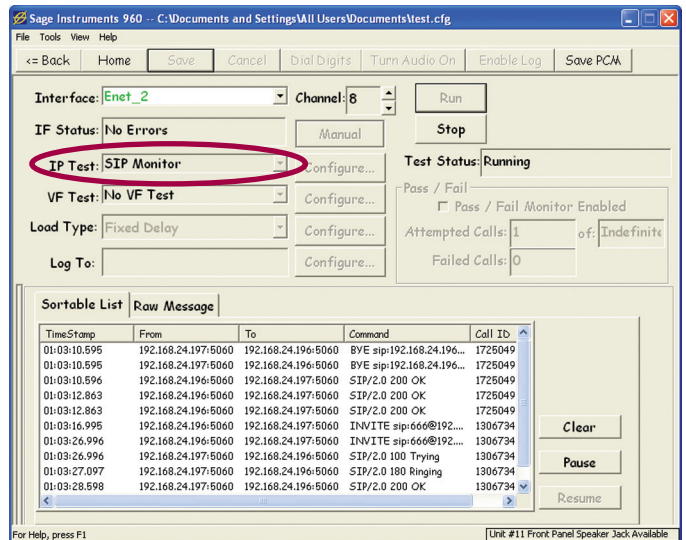
3.9. SIP Monitor

The SIP Monitor test allows the 960B to monitor and decode SIP protocol messages. The SIP monitor provides analysis of call setup messages in real-time. This test is only applicable to Ethernet interfaces. No Voice Frequency tests can be run under the SIP monitor test. The SIP Monitor test window is shown in Figure 3.9.1.

Figure 3.8.14 SIP Call, Impairment Graph

Figure 3.9.1 SIP Monitor

SIP Monitor Setup

Setup the SIP Monitor test by clicking on the button in the circled **IP Test** list box in Figure 3.9.1. This will bring up a list of the IP tests, click on the **SIP Monitor** to select the test. Click on the **Save** button in the tool bar to save and enable configuration of the test. Clicking on the **Configure** button to the right of the IP Test list box will launch the Configure SIP Monitor dialog box shown in Figure 27. When the **Any Address** check box in Figure 27 is checked, the SIP monitor will monitor all SIP traffic on the Ethernet link. Unchecking the Any Address box will enable the Target **IP Address** text box. Entering an IP address in the text box causes the SIP monitor to only capture messages from the specified address. Click on the **Save** button to save the configuration, then click on the **Run** button in the Test Control window to
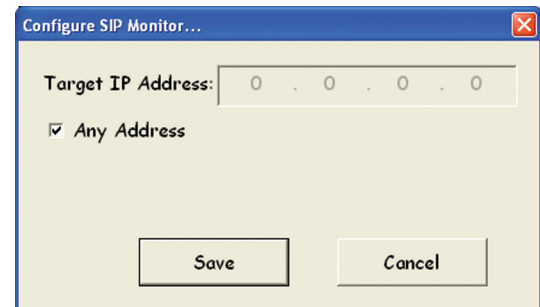

Figure 3.9.2 SIP Monitor Configuration

start the test.

SIP Monitor Results

The SIP Monitor results are shown in the lower portion of Figure 3.9.3 and 3.9.4. The SIP monitor test produces two result views. These are located under the circled tabs labeled **Sortable List** and **Raw Message** in Figure 3.9.4. Clicking on one of the tabs brings up the selected results view.
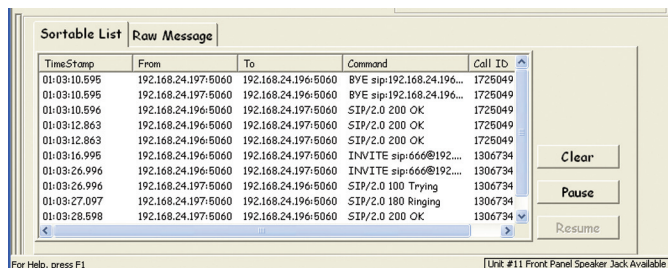
Sortable List Results View

The Sortable List results view is shown in Figure 3.9.3. The results are arranged in five columns, **Timestamp**, **From**, **To**, **Command** and Call ID. Clicking on one of the column labels will cause the results list to be sorted by that field value.

There are three buttons labeled Clear, Pause and Resume in the lower right corner of Figure 3.9.3. These are used to control the results display. The **Clear** button will clear the display, erasing all results. The **Pause** button freezes the results display, but does not stop the capture of messages. The **Resume** button causes a paused display to start showing new SIP messages as they arrive.

Raw Message Results View

The Raw message results view is shown in Figure 3.9.4. At the top of the results is the **Status** text box. This indicates the State of the SIP monitor. While waiting for SIP call messages, the Status will indicate Searching... When the SIP monitor detects and SIP messages the Status changes to Stream Found. Below the Status, is a large text box where the unformatted SIP messages are displayed.

Clicking on the **Log Messages** button circled in Figure 3.9.4 will cause the captured SIP messages to be stored in a log file. The Clear, Pause and Resume buttons located under the Log button are for controlling the results display. **Clear**, erases all messages from the display. The **Pause** and **Resume** buttons are used to pause the display for readability. Pausing the display does not stop the capture of messages.

Figure 3.9.3 SIP Monitor Sortable List

Figure 3.9.4 SIP Raw Message Display

3.10. T.38 Fax Transmit & Receive

The T38 Fax test can transmit and receive the T.38 fax protocol. The FAX transmitter can be setup to run at the ITU V.17 speeds of 7200 to 14400. The receiver includes a display of FAX progress and status messages. This test is only available on the Ethernet interface setup for SIP calls. The following section describes setting up the test and viewing the results.

T.38 Fax Receive Setup

First setup an Ethernet channel for SIP calls, configure the SIP call as a responder. For more information on setting up SIP calls refer to the SIP call test setup in this section of the manual.

Select the FAX test by clicking on the **VF Test** list box circled in Figure 3.10.1 and selecting **T.38 Fax Rx** from the list of tests. Click on the **Run** button to start the receiver and wait for an incoming call. This completes the configuration of the receive side.

T.38 Fax Transmit Setup

Setup another Ethernet channel for SIP calls. If the same 960 is performing the T.38 receive test, setup the transmit test on a separate Ethernet interface. Configure the SIP call as a director and include the destination IP address if applicable. For more information on setting up SIP calls refer to the SIP call test setup in this section of the manual.

Select the test by clicking on the **VF Test** list box circled in Figure 3.10.1 and selecting **T.38 Fax Tx** from the list of tests. Then click on the **Configure** button to the right of the list box. This will launch the Fax Configuration dialog box shown in Figure 3.10.2. In the Type frame, select the desired Fax protpcol and the number of **Pages** to send. Clicking on the **Run** button will start the test.

T.38 Test Status

The test status for the T.38 test is located under the **Status** tab in the lower portion of the Test Control Window shown in Figure 3.10.1. The status display is present in both the Transmit and Receive sides of the test. A snapshot of a successful connection is shown in Figure 3.10.3.

T.38 Fax Results

The T.38 Fax results are located under the circled **VF Test** tab in Figure 3.10.4. A results display is present in both the Transmit and Receive sides of the test. The Left half of the results display contains call status messages while the right half displays event messages. The status and event messages are
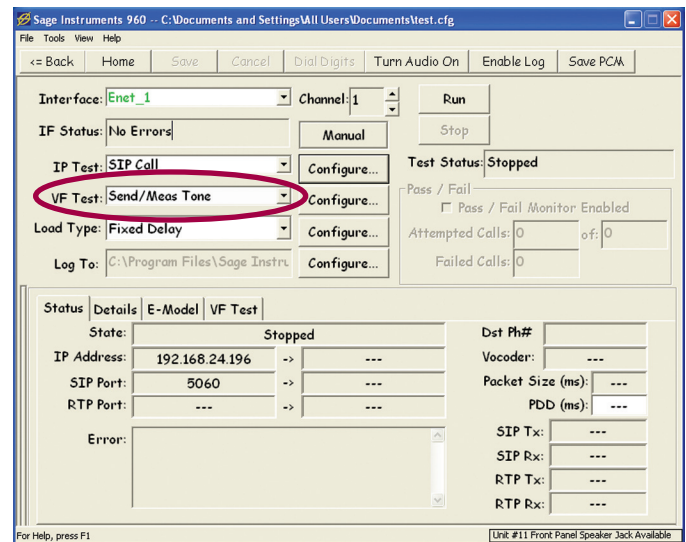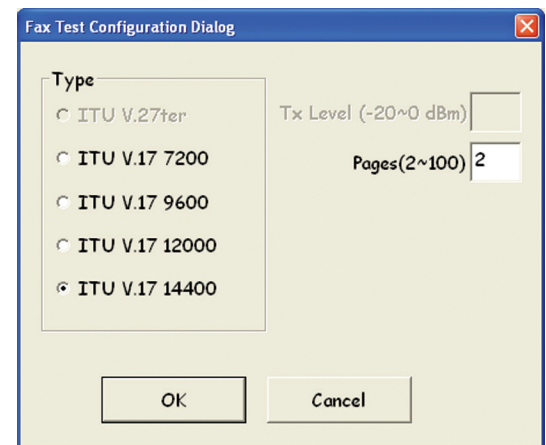

Figure 3.10.1 SIP Call VF Selection
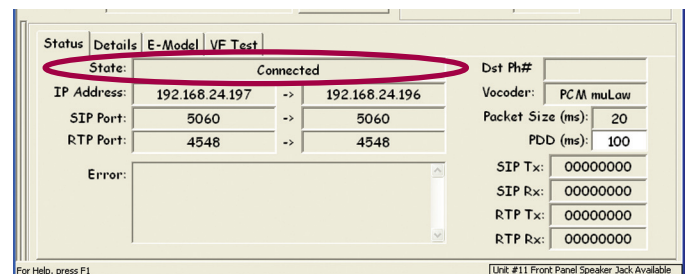

Figure 3.10.2 T.38 Fax Setup

Figure 3.10.3 T.38 Fax Connection Status

time stamped in order to facilitate correlation with each other. The **From** and **To** fields in the event message display, show the elapsed time in milliseconds for each event. The From To time counters are reset to zero at the beginning of the test and run till the end of the test when they are reset. For more detail on the event names refer to the ITU T.30 standard.

Figure 3.10.4 shows the call status messages for a complete test call for the Fax Transmit side.

Example messages for a complete 2 page call for the T.38 transmit test:

14:27:16 FAX test started; awaiting call-connection
14:27:20 Sending CNG and awaits CED
14:27:23 Received valid DIS; sending DCS
14:27:26 Transmitting page 1
14:27:40 Send MPS to indicate end of page
14:27:40 Waiting for MCF (positive confirmation on page 1 TX)
14:27:41 Transmitting page 2
14:27:55 Send EOP to indicate end of all pages
14:27:56 Waiting for MCF (positive confirmation on page 2 TX)
14:27:56 Send DCN
14:27:57 Test Completed Successfully

Example messages for a complete 2 page call for the T.38 receive test:

14:27:14 FAX test started; awaiting call-connection
14:27:30 Receiving page 1 transmission
14:27:42 Receiving page 2 transmission
14:27:58 Test Completed Successfully

Results Buttons

To the right of the T.38 results are three buttons labeled Clear, Pause and Resume. These are used to control the on screen logging of the results. Clicking on the **Clear** button will clear the display. The **Pause** button will pause the displayed messages so they can be read without scrolling new results. Note that the Pause button does not pause the test. Once the display is paused, clicking on the **Resume** button will allow the display to scroll and show new messages.

3.11. VOIP Impairment Generator

The VOIP Impairment Generator test allows introducing delayed or lost packets into an Ethernet link. The 960 can be configured to insert errors in any packet, or only packets matching user specified IP Source and Destination addresses. Two 960 Ethernet test ports from a common board, are configured and connected in series between the IP network and the device or network to test. As the network traffic passes through the 960 it can delete or delay designated packets.
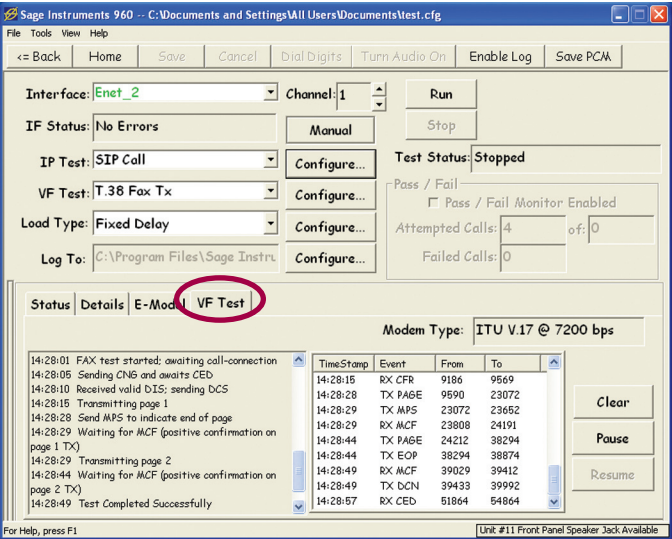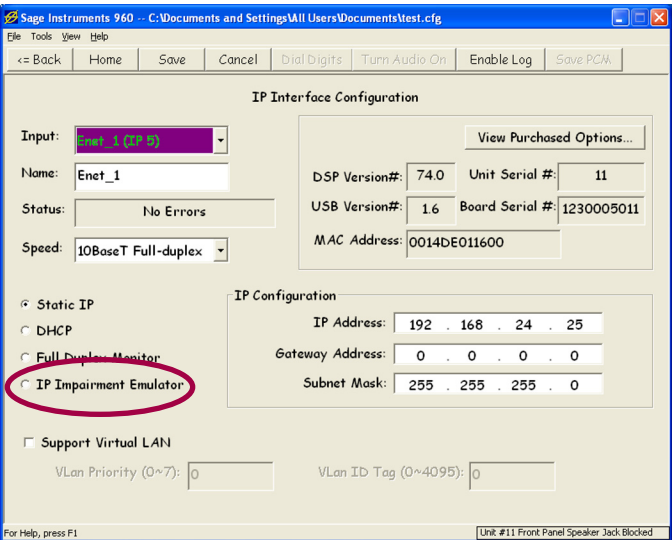

Figure 3.10.4 T.38 Fax Results

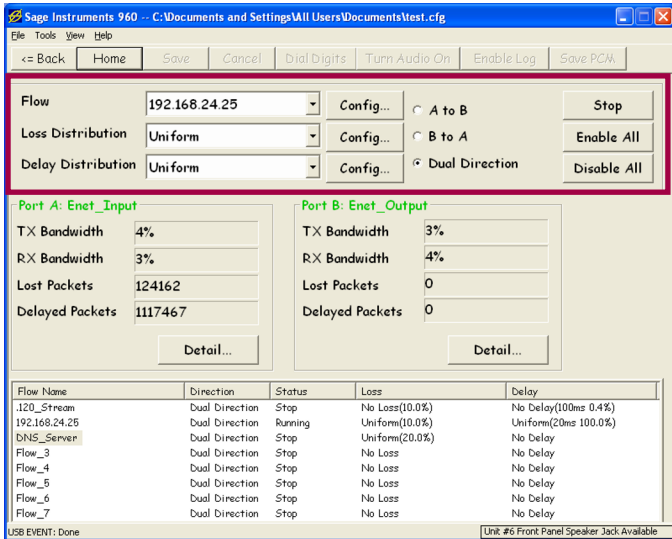**Figure 3.11.1 Impairment Test Setup**

Figure 3.11.2 Impairment Test Window

Test Configuration

Unlike most other 960 tests, the Impairment generator test is selected from the Span Edit window shown in Figure 3.11.1. Clicking on the circled **IP Impairment Emulator** button in the Span Edit window will configure both Ethernet interfaces on the 960 board for the impairment test. Note that no other tests can be run on these interfaces until the configuration is changed to another mode. Upon making the selection, a warning dialog box will appear displaying the message: "Please make sure do not connect both ports into the same Hub". Check the test connections to ensure they are not connected together, and click on the **OK** button in the warning dialog box. Click on the **Save** button in the Span Edit window in Figure 3.11.1 to save the configuration. This will start the impairment generator causing it to forward traffic between the two Ethernet interfaces. Click the **Home** button on the toolbar to display the test interfaces. Double clicking on one of the Ethernet interfaces will launch the IP Impairment Emulator test window shown in Figure 3.11.2.

IP Impairment Generator Setup

The impairment generator inserts errors based on "flows" configured by the user. The red square at the top of Figure 3.11.2 contains the controls for configuring each flow. The display box at the bottom of Figure 3.11.2 lists the individual flows, their status and configurations.

General and Packet Address Configuration

The **Flow** list box at the top of the window in Figure 3.11.2 is used to select one of the flows to configure. Once a flow is selected in the list box, the Direction, Loss and Delay controls will change the parameters in the selected flow. Selecting a flow and clicking on the **Configure** button to the right of the Flow list box launches the Configure IP Impairment Flow dialog box shown in Figure 3.11.3. This dialog box is used to name flows and to direct impairments to packets containing specific source and or destination address. The **Flow Name** text box at the top dialog box is used to change the name of the flow.

By default the **Any Address** and **Any Port** check boxes are checked, meaning any packet regardless of address or port number will be impaired. Unchecking these check boxes will allow an address or port number to be entered. Once the port name or any address or port numbers have been entered click on the **Save** button to save the configuration and exit the dialog box.

Packet Loss Configuration

Below the Flow list box in Figure 3.11.2 is the **Loss Distribution** list box. By default this is set to No Loss. To configure loss packet impairments on the flow, select **Uniform** from the loss Distribution list box, and click on the **Configure** button to the right of the list box. This will launch the Lost Packet Configuration dialog box shown in Figure 3.11.4 The **Loss Magnitude**

Figure 3.11.3 Configure Flow

Figure 3.11.4 Loss Configuration

Figure 3.11.5 Delay Configuration

text box at the top of the dialog specifies how many consecutive packets will be dropped during each loss event. The **Loss Rate** text box specifies the how often the loss events occur. This rate is specified as a packet count, I.E. create a loss event every 10 packets. The Lost Packet Percentage text box displays the specified packet loss as a percentage of the flow. Once the loss packet parameters have been entered, click on the **OK** button to save the configuration and exit the dialog box.

Packet Delay Configuration

Below the Loss Distribution list box is the **Delay Distribution** list box. By default this is set to No Delay. To configure delayed packet impairments on the flow, select **Uniform** from the Delay Distribution list box, and click on the **Configure** button to the right of the list box. This will launch the Delayed Packet Configuration dialog box shown in Figure 3.11.5. The **Delay Magnitude** text box at the top of the dialog specifies how many consecutive packets will be delayed during each delay event. The **Delay Rate** text box specifies the how often the delay events occur. This rate is specified as a packet count, I.E. create a delay event every 10 packets. The **Delay Time** text box specifies the period of time in milliseconds that the selected packets will be delayed. The **Delayed Packet Percentage** text box displays the specified packet delay as a percentage of the flow.

Specifying Impairment Direction

The 960 can be configured to insert errors into traffic in one or both directions as it travels through the 960. The directions are setup using the **A to B**, **B to A** and **Dual Direction** radio buttons circled in Figure 3.11.6. These directions correspond to the Port A, and Port B Ethernet interfaces enclosed in the red square in Figure 3.11.6.

Enabling Configured Impairments

Once all parameters of a flow have been specified, clicking on the **Run** button in the upper right corner of Figure 3.11.6 will enable the impairment generator on the specified flow. The **Enable All** and **Disable All** buttons located below the Run button are used to enable all flows, or disable all flows.

Results Display

The indicators inside the red square in Figure 3.11.6 are the **Port A** and **Port B** impairment and bandwidth indicators for each Ethernet interface. To the right of the Port A and Port B labels are the Ethernet interface names. The first Ethernet interface on the 960 Ethernet board (the odd numbered interface) is Port A, the second interface is Port B. Below the Port labels are the **TX** and **RX Bandwidth** indicators. These indicators show the
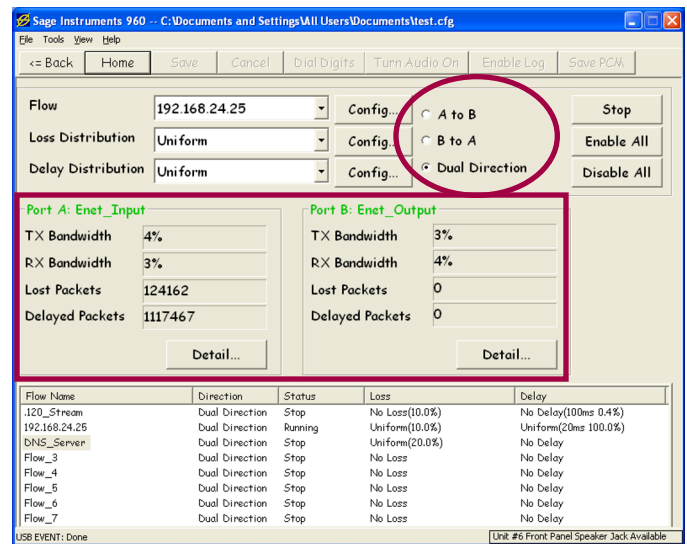
Figure 3.11.6 Impairment Test Window
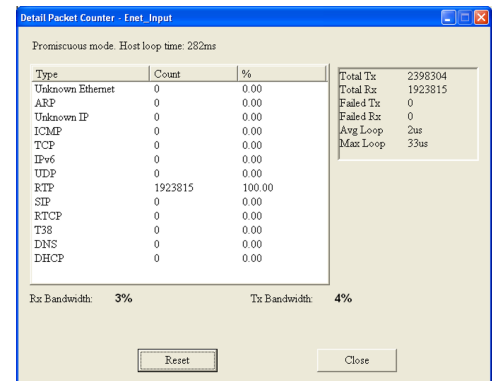
Figure 3.11.7 Packet Counters

receive and transmit traffic through the Ethernet interface as a percentage of its total capacity. Below the bandwidth indicators are the **Lost Packets** and **Delayed Packets** indicators. These indicators display the aggregate count of lost and delayed packets introduced by the 960 on the designated Ethernet port. Clicking on the **Details** button under the port indicators launches the packet counter window shown in Figure 3.11.7. This window displays packet and 960 performance statistics for the selected interface. Packet counts and percentages, listed by packet type, are displayed in the left half of the window. 960 performance and error indicators are displayed in the upper right corner. For more information on this window refer to the Packet Counter window description.

Section 4
Appendix

Section 4 Contents

1. Command and Batch Mode Control

1.1 Batch Mode Control

The 960B supports a "Batch Mode" in which one or more "Configuration Files" may be run, with the results saved to disk. Batch mode is entered by invoking the program with a filename. The filename parameter is assumed to be the Sage 960B configuration file to be run.

A "DOS Batch File" (.bat file) can be used to sequentially run multiple configuration files. Each Batch Mode invocation will run to completion; it won't stop until all the Director tests have stopped. If tests are configured to run forever, Batch Mode won't stop. So, be sure to set "# of Call Attempts" under the "Call Setup" configuration for each Director test to NOT be zero (see figure 28). Responders and the ISDN D-Channel are not counted as Director tests when determining when to shutdown.

Set up configuration (cfg) file(s) by running user interface as normal. Set up any log options for the tests of interest. Enable the tests you would like to run in "Batch Mode" and immediately exit the program. Optionally you can save your .cfg file via "File —"Save cfg file as...". When the 960B SW is invoked via the command line with a Sage 960B Configuration file as the parameter, the program will execute any enabled tests and run until all enabled "Director" tests stop.

On Windows 2000, the following line(s) in a batch file cause the program to execute the zzz.cfg file (in the "cfg" folder) and wait until it completes: **start /WAIT /Dc:\program files\Sage Instruments\960\ sage960.exe cfg\zzz.cfg**

1.2 Command Line Mode

The 960B equipped with option 800, supports a command line interface. When set in the Command Line mode, the 960 supports up to 10 simultaneous users. When the unit is placed in the GUI mode, it supports one user. The 960B command line mode shares many CLI commands with the Sage 966R Remote Digital Test Server.

When the 960 is placed in the command line mode the PC based GUI software will not be able to access the unit. The PC GUI will respond with the error message: Connection Fails! Connection Refused (No One is Listening). If this occurs follow the instructions below for placing the 960 in PC GUI mode.

1.2.1 Placing the 960 in Command Line Mode

The 960 is placed in the command line mode via the PC GUI. The
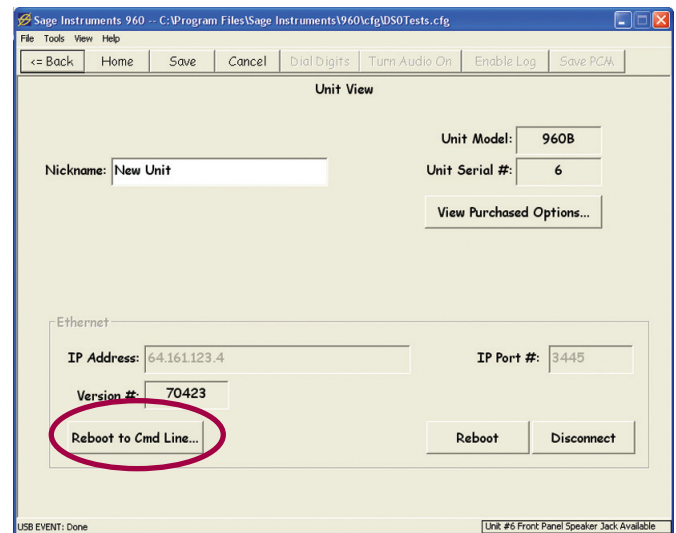
Figure 1 Configure Unit Window

following procedure describes the process.

A. From the Home window click on any interface, then click the "Configure Unit..." button. This will bring up the Configure Unit window in Figure 1.

B. Click on the "Reboot to Cmd Line..." button circled in Figure 1. This will cause the remote 960 to go into command line mode. Be sure to wait several minutes before attempting to access the 960 while the reboot process completes.

1.2.2 Placing the 960 in PC GUI Remote Control Mode

The following procedure describes the process for placing the 960B unit into remote control mode for working with the PC GUI.

A. Telnet to the 960.

B. login, the default user name and password are admin and sage, all lower case.

B. At the \> telnet prompt enter the command "remctrl" followed by <enter>.

C. The 960 will respond with a warning message asking to confirm the mode change by typing in "YES". Type "YES", in upper case followed by <enter>. After a few minutes the telnet session will disconnect and the 960 will be available for PC GUI access.

1.2.3 960 Command List

The following section lists the commands recognized by 960. For more detail on the setup of each command refer to the online documentation by typing "help" followed by the command name.

1.2.3.1 Navigational Commands

help   Allows all users to access help on the various built-in commands.
cd   Changes the current directory.
dir   Displays current directory contents.
exit   Exits the command interpreter and closes associated network resources

1.2.3.2 Administrative Commands

user   Access user information.
useradd   Creates a new user. Admin only.
userdel   Deletes a user. Admin only.
warmstart   Reboots the controller.
version   Displays the command interpreter.
passwd   Change the current user's password.
kick   Terminate a user's session. Admin only.
time   Displays or sets system time
date   Displays or sets system date

1.2.3.3 Interface and Unit Commands

intfc   View interface status; configure interfaces.
unit   Display unit information, activate options, Configure IP Address, Load/Save .cfg files and enable/disable echo ping.

1.2.3.4 Configuring 960 Interfaces in Command Mode

In order to conduct any of the tests, you will need the information about each interface. To get info about each interface, type 'intfc'
You will see a list of numbered interfaces available. To get more details about each interface, type 'intfc <interface number>'
important information about interfaces:
A 960 Unit is composed of one or more phyical 'interfaces'. An interface could be a PCM span, an ethernet port, or an analog jack. Each interface is composed of one or more 'resources'. For example, a T1 span has 24 resources (channels, in this case), and an analog interface has only one resource. The ethernet interface has a number of resources called 'slots' that allow for the definition of multiple, simultaneous tests on a single interface. Tests are defined at the resource level; if a resource doesn't have a test defined, it is considered an 'idle' resource.
These 'interface' and 'resource' abstractions allow for uniform command, control, and administration of completely different physical media. In this case Ethernet, PCM, and Analog media can all be manipulated via the same commands by specifying only the interface #. Likewise, individual tests are referenced by indicating the interface # and resource #. To allow the different interfaces to be reconfigured with this command, the configuration process is interactive (you will be prompted for appropriate input).

Important PCM Note: Note that there are two 'flavors' of PRI ISDN supported: the normal PRI_ISDN setting and the PRI_ISDN/Dyn setting. The Dyn setting means 'dynamic' B-Channel selection for responders that

define their originating number. When in this dynamic mode, if a call comes in, the responder 'originating' numbers are searched for a match to the incoming destination number. If a match is found, the responder is started on the B-Channel of the incoming call. Otherwise a responder without a originating number is started, if found. The upshot of all this is that in the dynamic ISDN mode, the resource numbers DO NOT directly correlate with B-Channels; they are merely test slots as they are on the Ethernet interfaces. As a consequence, in this mode outgoing calls will be put up on arbitrary B-Channels. Furthermore, no indication of the B-Channel in use is available to the user.

Examples:

To show high level status of all interfaces installed in the unit, use: intfc

To show detailed status of a specific interface, say #2, use: intfc 2

To (re)configure, say interface #2, (as Admin or owner of all tests on the interface), use: intfc -c 2

1.2.3.5 Test Management Commands

deltest	Delete the specified test.
del	Delete a file
report	Report the latest results for the specified test.
tests	View status of tests
type	Display a file.
remctrl	Switch Unit to UI 'Remote Control' mode.

1.2.3.6 Individual Test Commands

bert	Bit Error Rate Test
bertcntl	Reset Bert counters and/or inject bit error
bertpat	Display or set (Admin only)
	BERT user defined patterns and loop codes
digrecv	Digit Receiver Test
digsend	Digit Sender Test
dualspec	Dual Spectrum Analyzer
echoconv	Echo Convergence Test
echogen	Echo Generator Test
echosnd	Echo Sounder Test
echoping	ICMP Echo Server Test
faxrx	FAX Receiver Test
faxtx	Fax Transmitter Test
inmd	INMD Test
moipd	MoIP Director Test
moipr	MoIP Responder Test
mosrx	MOS Receive Test
mostx	MOS Transmit Test
pesqrx	PESQ Receive Test
pesqtx	PESQ Transmit Test
pvit	PVIT Test
remaudio	Remote Audio Test
rfc2833	RFC 2833 Monitor
sipmon	SIP Monitor Test
spesqd	SPESQ Director Test
spesqr	SPESQ Responder Test
smosd	SMOS Director Test
smosr	SMOS Responder Test
smtone	Send/MeasureTone Test

2. 960B Specifications

Except as otherwise noted, specifications are in accordance with ITU-T, 0.41, 0.42, 0.81, 0.91, 0.95, 0.132, and North American IEEE 743-01.

General
- Test Interface: 2/4 T1 or E1 Ports
- Bantam, BNC (Dual Mon, D&I, Term)
- Dual 10/100 BaseT, RJ-45 (Half, Full)
- Four 2-Wire FXO, RJ-11
- Two 4-Wire Dry, RJ-22
- Com Port: 10/100 BaseT, USB 1.0
- Power 120/240VAC; UL, CE
- Com Port: Single USB, Series B Receptacle
- Size 10" x 4 "x 14.5", max wt. 10 lbs.
- Operating Temp 0-40 Degrees C

Analog Interfaces
Send
(Transmitter terminated in 600 ohms)

Frequency Range	200-3500 Hz
Frequency Accuracy	+/- 1 Hz
Level Range	-60 to +3 dBm
Level Accuracy	0.1 dB
Source Impedance	600 ohms

The transmitter is a floating source.

Receive
(50 ohm generator input)

Frequency Range	200-3500 Hz
Frequency Accuracy	+/- 1 Hz
Level Range	-50 to +0 dBV
Level Accuracy	+/- 0.5 dB
Termination Impedance	200-3500 Hz > 2100 Ohms
	350-3500 Hz > 5000 Ohms

The receiver is transformer coupled.

PCM Interfaces
T1 Interfaces
Receiver
Input Mode Terminated: 100 Ohms nominal
Bridging: >1000 Ohms
Input Level 200 mV to 6 V base to peak
Transmitter
DS-1 Output 1.544 Mbps (Stratum 4) in INTERNAL clock mode ±5 ppm
Output Pulse Level 3.0 V ±0.3 V base to peak

Output Imbalance Positive and negative pulses are within 0.1 V base to

E1 Interfaces

Receiver
Input Sensitivity Bridge and Terminate:
-25 to +6 db at 2.048 Mbs (balanced)
-25 to +6 db at 2.048 Mbs (unbalanced)
Monitor:
Up to 30 db of flat gain
Impedance (unbalanced) Monitor and Terminate:
75 Ohms
Impedance (balanced) Monitor and Terminate:
120 Ohms
Bridged:
> 1,000 Ohms
Transmitter
Clock Sources Internal/External or recovered from received signal
Internal Frequencies 2.048 Mbs, ±5 ppm
Output Signal Compliant with G.703, Standard A-LAW (G.711)

Ethernet Interfaces

• Dual 10/100 BaseT, RJ-45 (Half, Full)
Per. IEEE 802.3

Measurements

Unless otherwise specified all measurements have the following accuracies:

Measurement	Accuracy
Level	+/- 0.1 dB
Frequency	+/- 1 Hz
Delay	+/- 1 ms

G.168 Measurements	Accuracy
Residual Level	+/- 1 dB
Return Loss	+/- 1 dB
Fax Timing	+/- .02 seconds

One Way Delay	Accuracy
All Interfaces	±1 ms

SMOS Signal	Accuracy
Artificial Voice	per ITU-T P.50
Active Speech Level	-20 dBTLP

SMOS/MOS/PESQ	Accuracy
MOS	+/- .05
Noise	+/- 1 dB
Frame Slips	+/- 1 msec
Effective Bandwidth	+/- .2%
Gain	+/- 1 dB
Delay	+/- .2 msec

PVIT Measurement	Accuracy
Noise	+/- 1 dB
Frame Loss	+/- 2 msec
Frame Slips (Jitter)	+/- 0.5 msec
Voice Clipping	+/- 2 msec
Percentage Voice Frame Loss	+/- 10% of Actual Percentage of frame loss
Codec	15% packet loss

Echo Generator	Level Accuracy	Delay Accuracy	Frequency Range
Analog 2-wire	±0.5 dB	±0.5 ms	300 to 3300 Hz
Analog 4-wire	±0.2 dB	±0.5 ms	300 to 3300 Hz
Digital T1/E1	±0.2 dB	±1 ms	20 to 3900 Hz

Echo Sounder	Echo Level Precision	Echo Delay Range/ Precision
2-Wire Analog	±1 dB	±1 msec
4-Wire Analog	±1 dB	±1 msec
T1/E1	±1 dB	±1 msec

INMD	Level Accuracy	Delay Accuracy
Digital T1/E1	+/- 2 dB	+/- 2 msec

SAGE Online Reference Material

SMOS (Sage Mean Opinion Score) White Paper available via www.sageinst.com located at:
http://www.sageinst.com/downloads/900series/SMOS-Spec.pdf

Packet Voice Impairment Test White Paper available via www.sageinst.com located at:
http://www.sageinst.com/downloads/925/pvitwp1.pdf

Echo Sounder & Echo Generator White Paper available via www.sageinst.com located at:
http://www.sageinst.com/downloads/925/ecegwp1.pdf

New IP Telephony Transparency Test, MoIP, Fax, Data & Voice White Paper available via www.sageinst.com located at:
http://www.sageinst.com/downloads/moip.pdf

Fax Emulator Test White Paper via www.sageinst.com located at:
http://www.sageinst.com/downloads/**960A**/faxtrx6_04.pdf

P.561 INMD Test White Paper available via www.sageinst.com located at:
http://www.sageinst.com/downloads/inmd.pdf

G.168 Test Suite White Paper available via www.sageinst.com located at:
http://www.sageinst.com/downloads/925/g168wp.pdf

3. 960B Warranty

Product Warranty

Sage Instruments products are warranted to be free from defects in materials or workmanship for a period of one year from the date of shipment. Sage Instruments further warrants that each product will execute its software programming instructions. During the one year warranty period, Sage will, at its option and expense, either repair or replace products which prove to be defective.

Limitation Of Warranty

This warranty does not cover repairs for damages from accident, misuse (including modification to or addition of software), tampering, improper maintenance, repair by anyone not authorized by Sage Instruments, or shipment in unapproved packaging. Out-of-warranty repairs performed by Sage Instruments are billed to the customer. Sage Instruments does not warrant that the operation of its products will be continuous or error free.

Exclusive Remedies

The remedies provided in this warranty are available exclusively to the original buyer of the Sage Instruments product. Sage Instruments is not liable for consequential damages or damages to any party other than the original buyer. Sage Instruments specifically disclaims any implied warranty of merchantability or fitness for a particular purpose. No other warranty is expressed or implied.

Repaired Products Warranty

Sage Instruments products that are repaired during the initial one year warranty period by Sage Instruments or its authorized representative are further warranted for a period of 90 days from the date of shipment from the repair facility. All out-of-warranty repairs performed by Sage Instruments are warranted for a period of 90 days.

Shipping Instructions

To exercise the Sage Instruments warranty, contact a Sage Instruments customer service representative and obtain a returned material authorization number RNA). Include a detailed description of the problem and the conditions and circumstances under which the symptoms occurred. Ship the product in its original packaging, or in packaging approved by Sage Instruments. If unapproved packaging is used, this warranty is void. Shipping charges, duties, and taxes must be prepaid. Return shipping to the customer is paid by Sage Instruments.