960B

Next Generation Multi-Channel Test Instrument

Hardware/Software

User Manual

Contents

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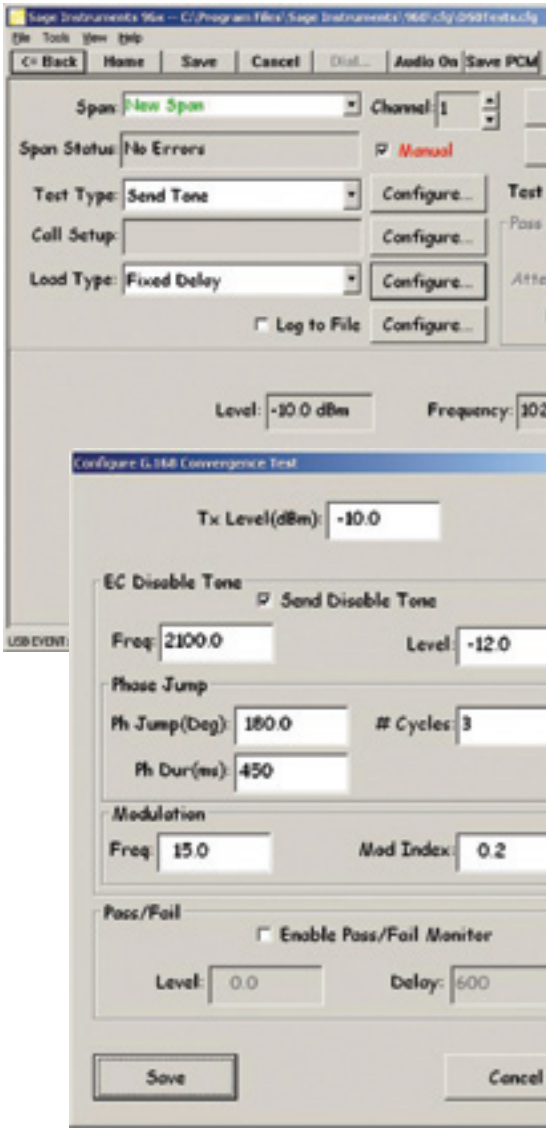

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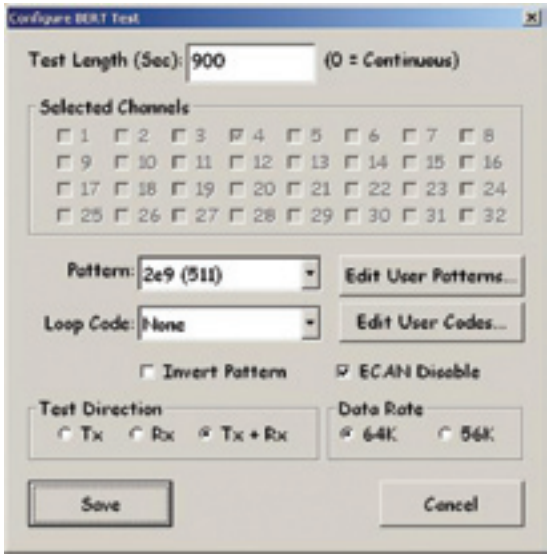
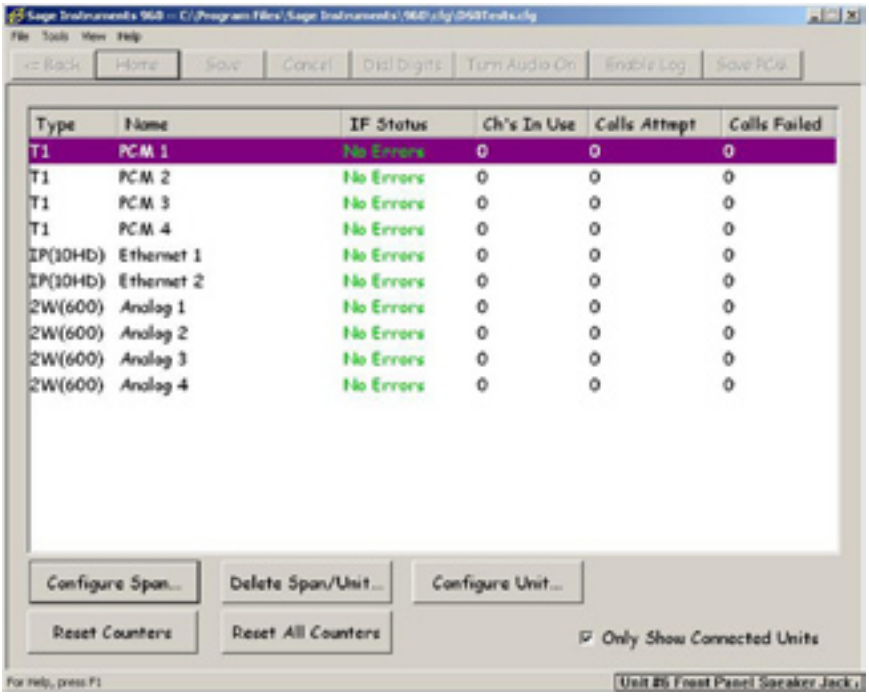
Running Tests





Overview

Purpose

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.

- ***Voice Processing & IP Telephony Transparency design verification***
- ***VoIP service readiness, turn-up testing, and trouble shooting***
- ***Voip security monitoring***

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.

- Passively and/or actively detect & measure AUDIO LEVELS & ECHO
- Assess voice quality - MOS, DELAY, NOISE, etc.
- Qualify Echo Cancellers - Dispersive Echo and programmable delay
- Verify FAX/data modem transparency
- Verify VAD, Jitter Buffer, Comfort Noise, and silence suppression
- Emulate Fax and True IP phones with jitter buffers and real RTP
- Filter, decode and analyze RTP/RTCP
- Detect and monitor rogue/illigal VoIP calls

Whether you are a Next Generation operator or designer, the 960B reduces rollout and design cycle time for new packet voice services.

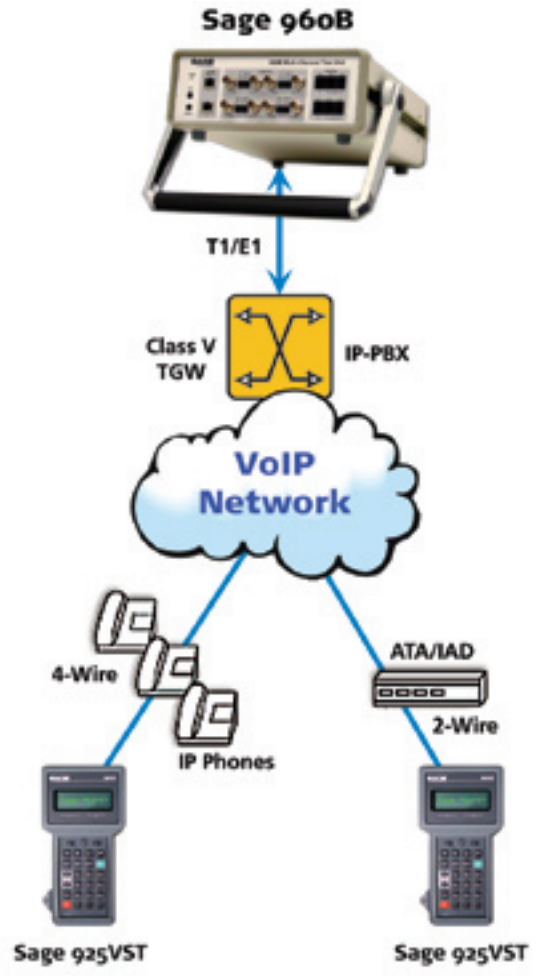
Applications and Capabilities

960B features a powerful Next Generation Voice Suite

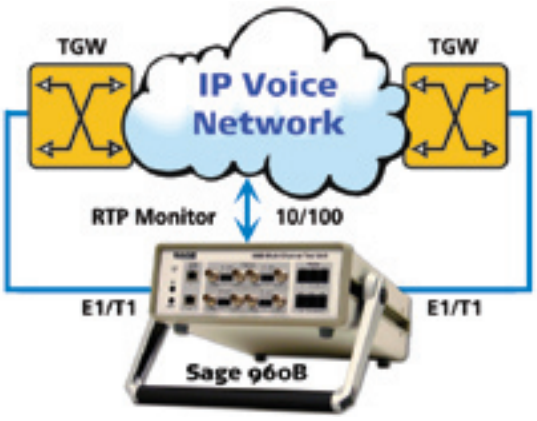
Echo Cancellation Performance

- Passive Echo Monitor (INMD ITU-P.561)
- Multi-Echo Detection
- Echo Level, Echo Delay
- Echo Canceller Disabler Tone(s)
- Dispersive Echo Emulation
- Double Talk Test and Emulation
- Echo Cancellation Convergence Testing
- Echo Cancellation Depth
- G.168 Test Suite and Echo Can Control

Typical Applications and Configurations



Edge Network Service Qualification
(End-to-End Voice Quality & Troubleshooting)



Packet Tandem & LD Network
(Voice Quality, Fax & Data Transparency)

Applications and Capabilities *(continued)*

Voice Quality and Telephony Transparency
- Mean Opinion Score (MOS)
- One-way and Round Trip Delay
- Comfort Noise Level (CNG)
- Audio Level (Gain/Attenuation)
- Jitter Buffer Performance
- Packet/Frame Loss (% Average burst length)
- DTMF/MF Verification
- Fax Transparency
- V.xx Modem Transparency
- RTP Traffic Generation
- Call Loading

Digital Facility Turn-up & Validation
- Multi-Channel BERT and Fractional E1/T1

Test Interfaces
- Two T1/E1 - 48/64 Simultaneous Tests
- Four T1/E1 - 96/124 Simultaneous Tests
- Dual 0/100 BT - 128 Simultaneous Tests
- Quad 2-wire FXO
- Dual 4-wire Dry

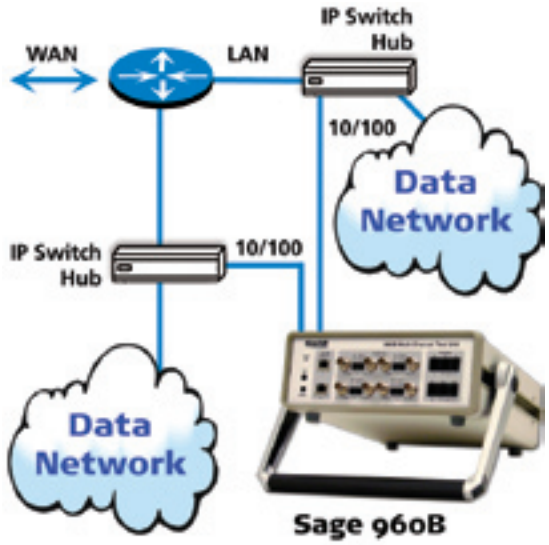
Call Setup Signaling
- CAS • PRI-ISDN • SIP

Passive Monitor
- SIP Call Monitor
- RTP decode and Monitor
- RTCP decode and Monitor
- Echo Level and Delay
- PRI-ISDN Call Monitor

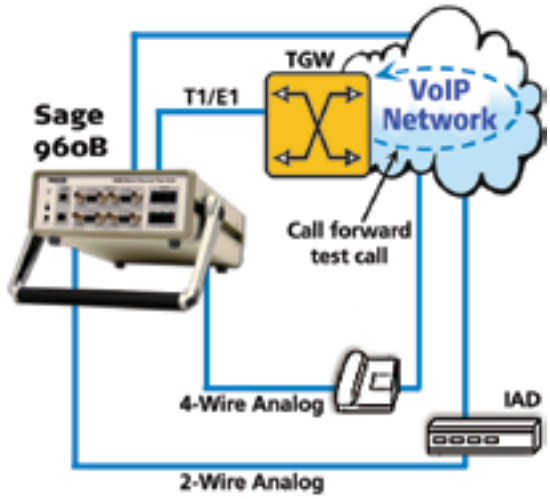
Standard Features
- Send/Measure Tone, Spectrum Analyzer
- Graphical User Interface PC Software
- PCM Data Capture
- Channel Selectable Remote and Local Audio Monitor
- Programmable Pass/Fail Parameters

Physical Characteristics
- 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

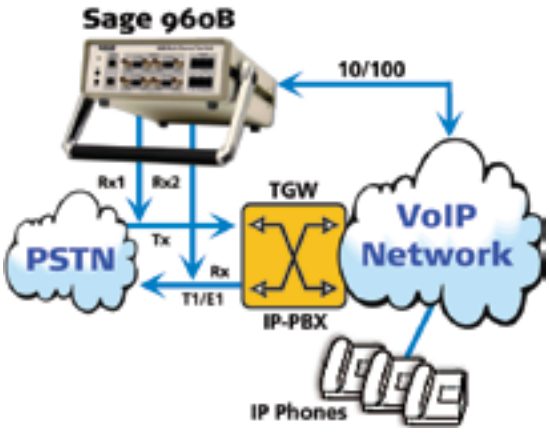
Typical Applications and Configurations (continued)



VoIP Pre-Qualification
(Generate and Monitor SIP and RTP Traffic)



Access Gateway Design Verification
(Delay, Clarity, Echo Cancellers, etc.)
Generate, decode and Monitor SIP & RTP/RTCP

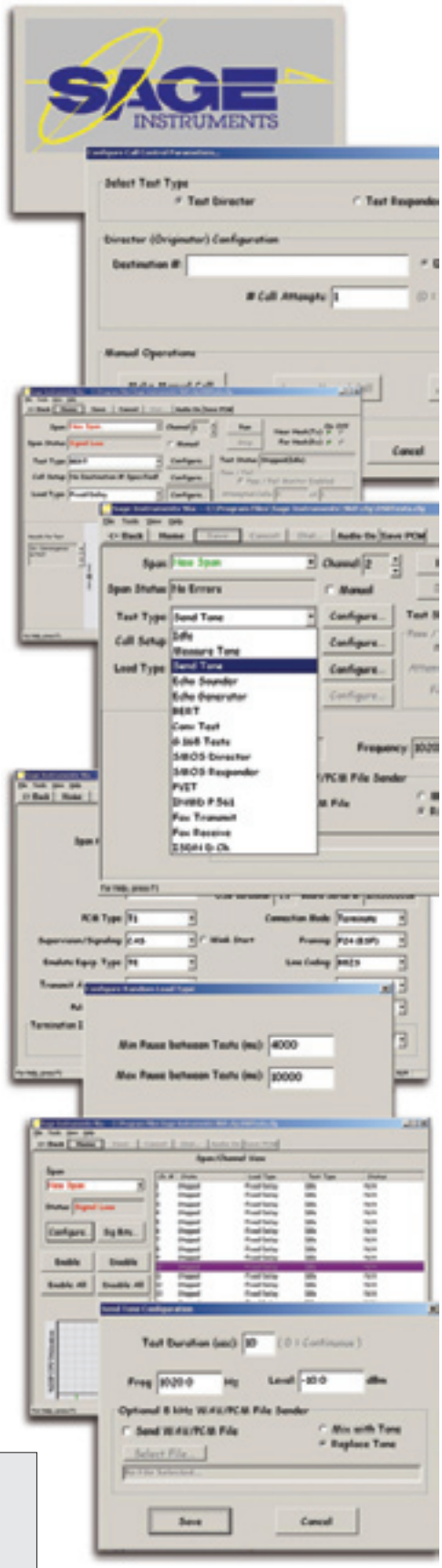


VoIP Pre-Qualification
(Generate and Monitor SIP and RTP Traffic)

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 programable interfaces
7960-0200-02	Quad E1/T1 programable interfaces
7960-0300-02	Dual Ethernet programable interfaces
7960-0400-02	Dual 2-Wire & 4-Wire Analog Interface
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
7960-5000-02	ITUG.107 Conversational Quality Test
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 Monitor
7960-5800-02	Fax - T.30 Transmit & Reciever Emulation
7960-6110-02	SIP Protocol Mon/Decode
7960-6120-02	SIP Call Setup - Orig/Term plus Dual Spectrum Analyzer
7960-6130-02	RTP Mon & Decode plus Dual Spectrum Analyzer
796X-8980-01	One (1) year extended warranty.
796X-8980-02	Two (2) year extended warranty.
796X-8980-03	Three (3) year extended warranty.



It is important to note that the SAGE 960B is a completely PC Controlled device. With the exception of the "On" and "Off" switch there are no controls of any kind on the 960B unit itself. If the unit is disconnected from the PC outputs are "idled" after 30 seconds.

Intuitive
Graphical User Interface
provides a
Virtual Instrument Control Panel
with individual control of each bearer channel.

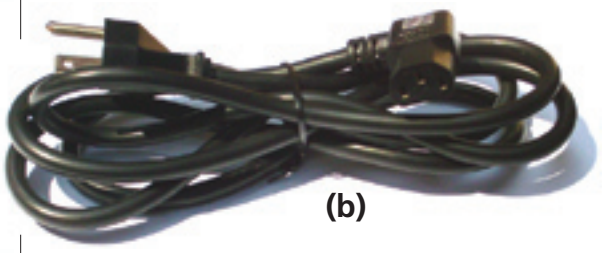
Unpacking

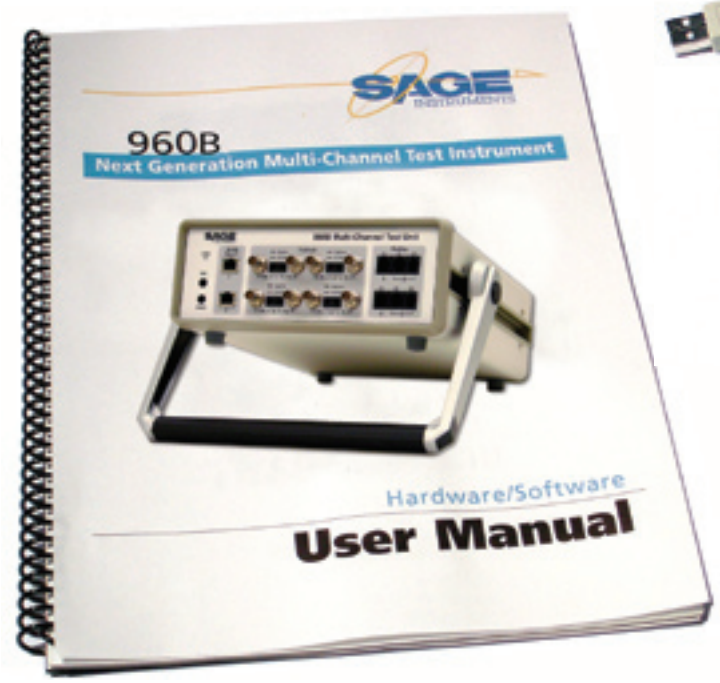
When your new 960B multi-channel test instrument arrives from the factory, the shipping box should contain the following components:

Packout

- SAGE 960B Multi-Channel Test Unit (a)
- Power Cord (b)
- USB Cord (c)
- Software Compact Disk (d)
- SAGE 960B User Manual, supplied on the software installation disk in printable PDF format. (e)

Remove the components from the shipping carton and inspect contents. Notify SAGE Instruments immediately if any damage from shipping is detected.





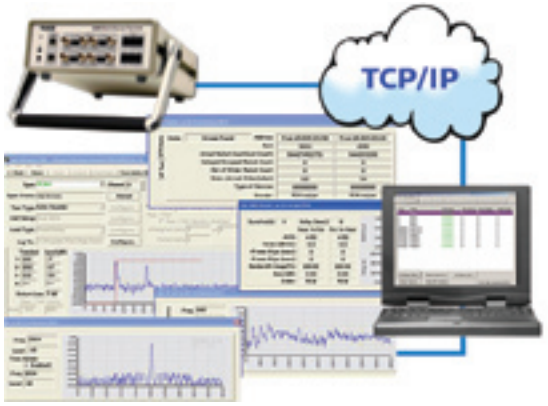
(e) Located on the 960B software installation CD in printable PDF format.

960B New Features

1. SIP (Session Initiation Protocol) support — 960B Units Equipped with Option 800, TCP/IP Remote Command Interface can now initiate and answer SIP calls over an IP network via an ethernet interface.

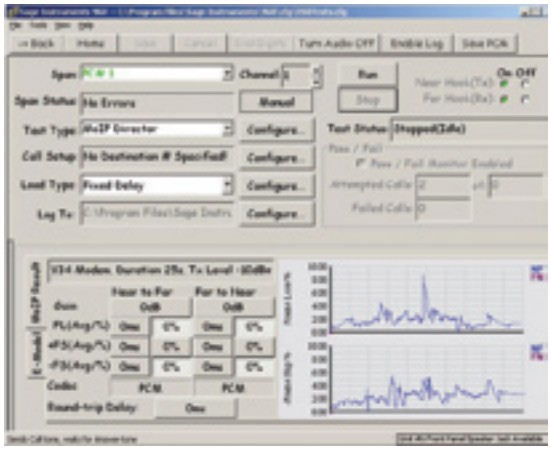
2. Dual Direction Audio Level Meter — 960B Units Equipped with Option 800, TCP/IP Remote Command Interface can now, using RTP (Real-Time Transport Protocol) monitor access, simultaneously measure the signal level of a tone in both directions of transmission. This function also simultaneously presents a spectrum analyzer display of each direction of transmission, making it easy to see foreign/spurious tones which may also be on the circuit.

TCP/IP Remote Command Interface



3. MoIP (Modem-over-IP) — With this director/responder test, a user can quickly determine whether or not the device and network under test can handle various MoIP (Modem over IP) or VoIP (Voice over IP) calls. The test sends standards-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.

MoIP Director and Responder

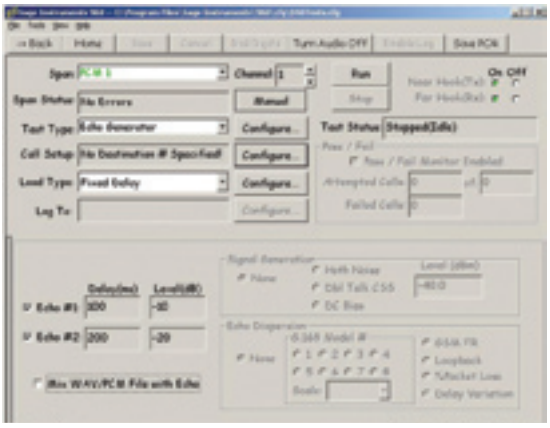


ENHANCEMENTS

1. Unavailable choices greyed-out — Considerable work was done to make it easy for a user to identify available choices in the various selection screens. This was done by disabling and "greying out" the unavailable choices.

For example, when in the test selection drop-down window, the INMD choice is greyed out if the T1/E1 is not configured for Dual Monitor mode. As another example, if the Test Type is "Idle", the Call Setup, Load Type and Log to Configuration buttons are all disabled (greyed out).

Unavailable or Out-of-Sequence Menu settings, options and choices



2. Enhanced results logging:

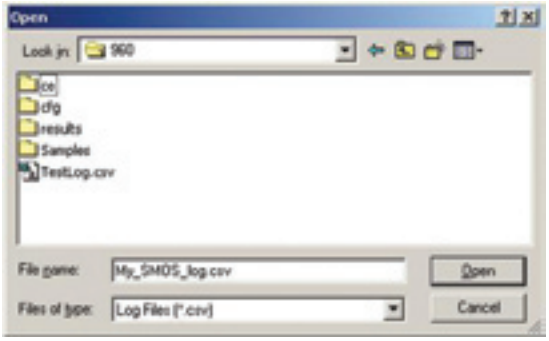
a. When PVIT results logging is enabled, the GUI now automatically logs events (such as frame slips, noise hits, etc.), too. The events are logged in a separate file. For example, if you defined the PVIT log name as PVIT_log, The GUI would generate two files: PVIT_log.csv and PVIT_log_events.csv

b. Final results are now always logged, and the user can choose whether to also log interim results.

Note: When configuring a test After selecting the test type always click **"Save"**. This action changes the main screen attributes to those of the selected test activating or un-greying relevant menu choices and options.

Enhancements *(continued)*

c. In the "Log to" configuration window, the program now presents a standard Windows file browser to make it easier for the user to specify the desired log file location.
d. In the Span/Channel view, a user can now select multiple channels and enable logging on all of them with a single click on the new "Enable Log" button at the top of the screen. The logging function will use settings contained in the "Log Configuration" screen for each channel.



3. Expanded Windows 'tool tips' provide additional test results information:
a. In the SMOS and MOIP tests, hovering the PC mouse pointer over a graph point will display the x and y coordinates of that point. On other tests it will display the y coordinate value.

Mouse-Over Coordinates

4. On SMOS and MOIP tests, the left side of the 'status bar' at the bottom of the screen will display informative test progress messages. You can enable or disable the status bar by clicking on View/Status Bar.

5. When making a Manual call from the test setup screen, you can now dial additional digits such as an access code or automated attendant control: a Dial Digits button was added at the top of the screen. Once you initiate a Manual call, the Dial Digits button is enabled. Clicking on it brings up a Send Digits screen resembling a dial pad You can select DTMF or MF digit type, then manually send additional digits by clicking on the appropriate digit buttons.

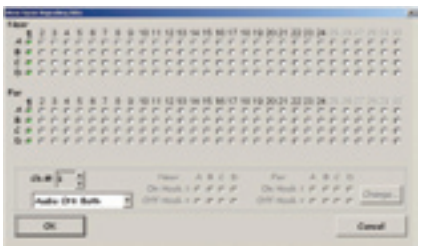
Manual Send Digits Pad

6. For ISDN calls, the call setup dialog box now has a window to enter the call originator's phone number.

7. PVIT results enhancements:
a. Under the TOTALS tab, if you hover your mouse pointer in the "Avg." column of Frame Loss, + and – Frame Slips, and Voice Clips to see a Windows "tool tip" displaying the Minimum and Maximum duration of each type of event. It also reports whether the frame slips were expansive or compressive in nature.
b. Clicking on a parameter will plot the events on a graph
c. The graphs are "un-dockable" so you can display multiple graphs simultaneously.
d. The EVENTS tab reveals a time-stamped event log view that can be paused, resumed, or cleared.
You also have the option of recording the log to a disk file for archiving or later review/analysis.

Click-to-Plot Frame Loss & Frame Slips

8. Added Audio Monitor Capability: Now, when you click on the Sig Bits button in the Span/Channel View, the resulting View Span Signaling Bits screen provides the ability to monitor audio being transmitted by the Far End, Near End, Both, or None. A scroll button is provided to select which channel to monitor.



Enhancements *(continued)*

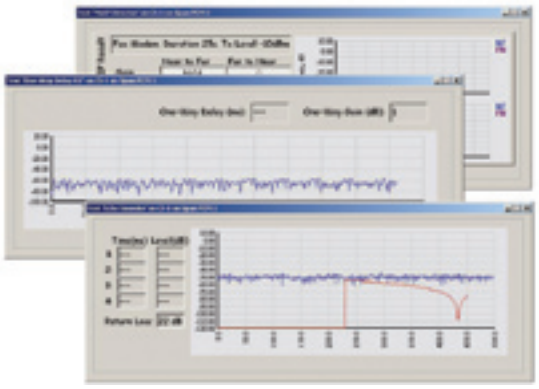
9. The Fax test now presents a real-time display of the test progress. The display is a scrollable screen of the time-stamped events.

Fax Test Real-time Display

10. You can now initiate a reboot from within the 960x GUI — In the unlikely event of a misbehaving unit, you can remotely force the 960x to reboot: Go to the GUI "Home" page, click on the "Configure Unit" button, then click on the "Reboot" button.

11. Support multiple test result windows: Previously, although the 960A could run multiple tests simultaneously, only one channel's results window could be viewed. Now, a user can 'undock' the result panel, and keep it alive while using another channel. In this way, a user can simultaneously monitor more than one channel. The undocked panel will be destroyed when the test it is tied to is killed when the user changes the test on that channel, or exits the program. To undock a results window panel, click on the thin vertical bar at the left of the results window.

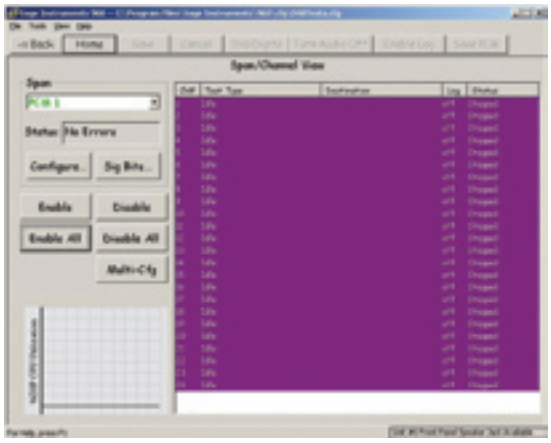
Un-dockable Graphs for simultaneous results display



12. In the IP Interface Configuration screen, you can now have the 960B automatically obtain a dynamic IP address from a DHCP (Dynamic Host Configuration Protocol) server.

13. On a TCP/IP 960B, the Span/Channel View will automatically display the maximum number of channel end points you can test, based on the provisioning of the 960B Ethernet interface:

— 10BaseT Half duplex will support 24 end points
— 10Base T Full duplex will support 32 end points
— 100BaseT Half duplex will support 48 end points
— 100Base T Full duplex will support 64 end points.



960A Issues Corrected in 960B

1. BERT Testing

a. The Configure BERT Test dialogue window:

1) Will now remember what loop code the user specifies.

2) Will now accept user entered binary strings as valid entries.

b. The BERT test log now identifies the test pattern that was used.

2. If, while in the Span/Channel View, the <Enter> key was pressed one or more times, the Back button would appear not to function. This no longer happens.

3. When switching between an active and unused T1 span, the Audio monitor function no longer stopes stop when the user switches to an inactive span.

Basic Software Installation *(Without Remote Command Option)*

Important Note: *The following instructions only apply to 960B Units Not Equipped with Option 800, TCP/IP Remote Command Interface. Version 5.11.9.0 Software Update.*

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 on page 13.

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 98SE/2000/ME/XP PC compatible computer with a USB port, and the software update file "960Asetup_051109.exe".

Note: Windows 98SE users installing the 960 software for the first time may be prompted to insert their Windows 98 Installation CD. If this prompt appears, the installation will not proceed until software drivers are loaded from that CD.

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 ethernet or USB cables, yet.

3. If 960x software exists on the PC, you must **UNINSTALL** it now:
   a. Go to Start, Control Panel, Add/Remove Programs, then double-click the Sage 960 entry and follow the on screen instructions.

Note: If a Sage 960 entry does not appear in the PC Add/Remove Programs list, you must manually delete the old 960 program subdirectory and its contents: Using Windows Explorer, navigate to C:\Program Files\Sage Instruments, then delete the subdirectory named "960".

(continued on page 12)

Post Installation

Depending on your PC operating system version, the software installer may prompt you to reboot your PC before continuing with the program.

During the install process, the installer will place an alias icon labeled "Launch Sage960" on your PC's desktop. After installation is complete use this icon to launch the software for conducting tests with the 960B

Once the software installation is complete, you may power up the 960B and conduct tests .

Basic Software Update

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

4. Launch the 960 software installer program:
   a. Using Windows Explorer, navigate to the subdirectory where you previously placed the 960Asetup_051109.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.***

Click Here

Use this desktop alias icon to launch the software for conducting tests with the SAGE 960B

4. Launch the 960 software installer program:
   a. Using Windows Explorer, navigate to the subdirectory where you previously placed the 960Asetup_051109.exe file
   b. Double-click on the file. You may be presented a Security Warning window. Simply click on "Run".
   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. 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.
   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".

5. Once the software installation is complete, you may power up the 960 and conduct tests.

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

Software Installation Remote Command Option Enabled

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

Installation

1. To complete this procedure, you must have a Windows 98SE/2000/ME/XP PC compatible computer with a USB port, and the software update file "960Asetup_0578.exe".

Note: Windows 98SE users installing the 960B software for the first time may be prompted to insert their Windows 98 Installation CD. If this prompt appears, the installation will not proceed until software drivers are loaded from that CD.

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 TCP/IP 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.

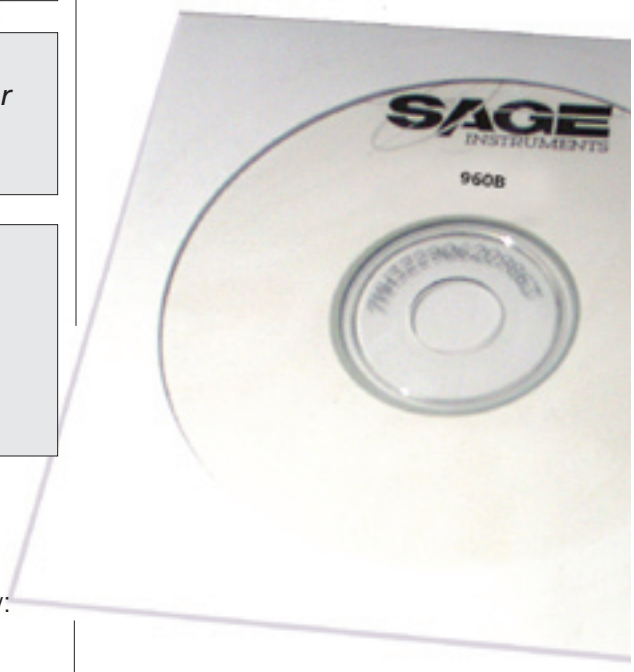
3. If 960x software exists on the PC, you must UNINSTALL it now:
   a. Go to Start, Control Panel, Add/Remove Programs, then double-click the Sage 960 entry and follow the on screen instructions.

Note: If a Sage 960 entry does not appear in the PC Add/Remove Programs list, you must manually delete the old 960 program subdirectory and its contents: Using Windows Explorer, navigate to C:\Program Files\Sage Instruments, then delete the subdirectory named "960".

4. Launch the 960 software installer program:
   a. Using Windows Explorer, navigate to the subdirectory where you previously placed the 960Asetup_06113eng.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.

(continued on page 14)



Post Installation

Depending on your PC operating system version, the software installer may prompt you to reboot your PC before continuing with the program.

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Once the software installation is complete, you may power up the 960B and conduct tests .

Software Installation

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

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"

At this point connect your 960B USB Cable

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. Choose ""No, not this time," then click "Next"
s. Choose "Install from a list or specific location," then click "Next"
t. Click on "Include this location in the search"

Note: If the following search path does not appear in the "location" window, CAREFULLY type it in (without quotes): "C:\Program Files\Sage Instruments\960\ce\drivers"

u. Click on "Next". You may see an alert box that warns that the driver has not passed "Windows Logo testing..." Click on "Continue Anyway"
v. Once ActiveSync 'sees' the 960B, it will present a New Partnership dialogue box. Click on "No," click "Next"
w. The Microsoft ActiveSync application window will then appear. It will be obscuring part of the las "Found New Hardware Wizard" window. Click on that "Wizard" window to bring it to the front. Click on "Finish"

5. The software installation is now complete, you may power up the 960 and conduct tests.

If You Connected the TCP/IP 960B 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.

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

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 the port identifier. The 960B will accept a static IP address or a Dynamic Host Configuration Protocol (DHCP) address.

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 software and Microsoft ActiveSync 3.7.

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

c. In the configuration window located above the greyed-out buttons "Back" and "Home" are the drop-down menus File, Tools, View and Help. Click on "Tools" and select "Configure TCP/IP Unit via USB..."

d. Follow the on screen steps to configure the 960B's Name, IP Address and Port Identification.

e. Provide the 960B IP Address to all users.

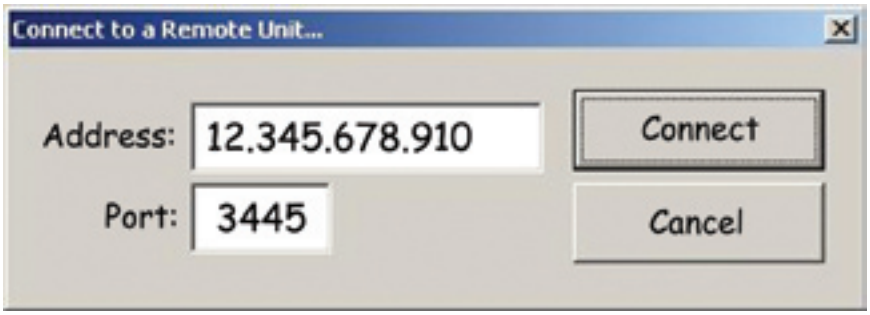
Connect to the Remote 960B

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.

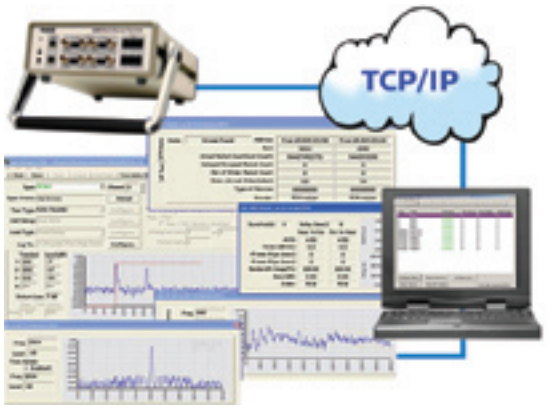
1. Launch the 960B application.

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

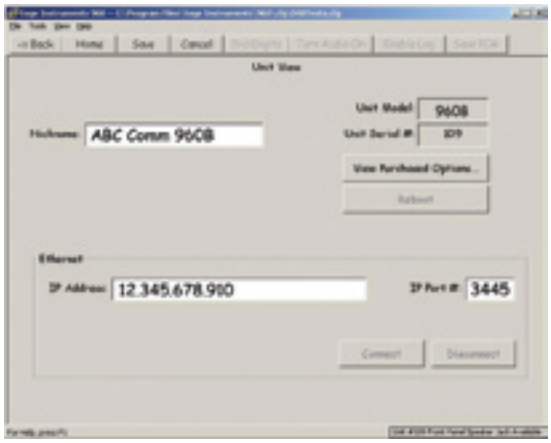
3. This action presents a dialog box like the one pictured below. Enter the IP Address and Port ID and click the "Connect" button.



TCP/IP Remote Command Interface



960B Remote Unit Configuration



960B Physical Installation No Remote Command Option

Hardware Configuration

1. Position the SAGE 960B on a flat stable surface within eight (8') feet of a *USB compatible workstation, desktop computer or laptop, and insure the rear panel power switch is off.

USB Compatibility with Your PC*

To use the USB port on the SAGE 960B you must have Windows 98, SE, 2000, Millennium, or XP installed on your PC. USB cannot run in a Windows 95 or NT environment.

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.

Some motherboards have USB interfaces, but no ports. You can install your own USB card to your computers motherboard using hardware purchased at a retail computer store. See your PC's User Guide for instructions.

*** Compatible with USB 1.1 or 2.0.**

2. The ten (10') foot USB cord has two different size terminations. (see figure 1).

3. At one end of the USB cord is the small Type B "device side" connector. Plug the small end of the USB cord into the rear panel of the SAGE 960B unit (see figure 2).

4. Plug the large Type A "CPU side" USB connector into the USB port of a compatible desktop or laptop computer.

5. Plug the power cord firmly and completely into the recessed power socket on the back of the 960B and plug the other end into a grounded outlet, UPS (recomended) or power strip (see figure 3).

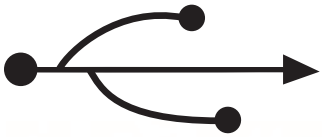
Note: Be sure to route the power cable from the 960B to the outlet or power strip in a manner that doesn't bend or pinch the power cable between a wall or another object.

10BaseT Ethernet Port

The SAGE 960B also offers an optional 10BaseT port to facilitate connection to IP LAN and WAN Ethernet networks. Located on the rear panel of the 960B unit, the 10BaseT port utilizes the 10 Megabit per second baseband Ethernet specification using two pairs of twisted-pair cabling (Category 3, 4 or 5): one pair for transmitting data and the other for receiving data. 10BaseT has a distinct limit of approximately 100 meters per segment.

Figure 1

The USB icon denotes the presence of a USB port or connector



Small USB Type B connector to 960B

Large USB Type A connector to Computer

Figure 2

Figure 3

Configuring 960B Purchased Options

Before configuring Options verify that Hardware, Firmware and Version match

Use these instructions to verify your software installation

1. 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.

2. From the SAGE 960B application's home page, one-click to highlight any displayed span.

3. 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.

Configuring Options

Use these instructions to add purchased options to your SAGE 960B software installation.

1. From the SAGE 960B application's home page, one-click to highlight any span. Then click on the 'Configure Unit' button.

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

3. To install a 960B new options file click on the "Activate Options" button. A dialog box containing a blank "Key Field" will appear.

4. 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).

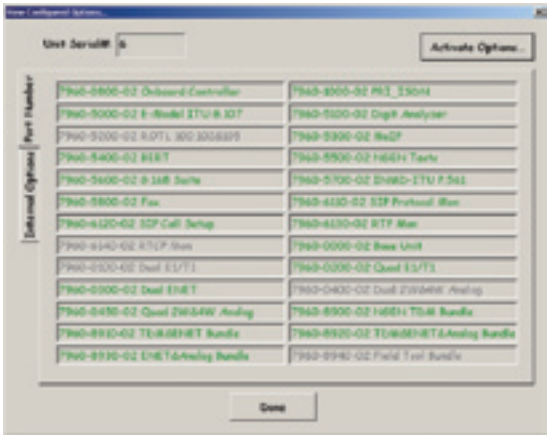
5. Windows Note pad will automatically open with the encrypted options string displayed.

6. Highlight the options string and copy it to the Windows clipboard. To copy, type Control-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" described in step 1.

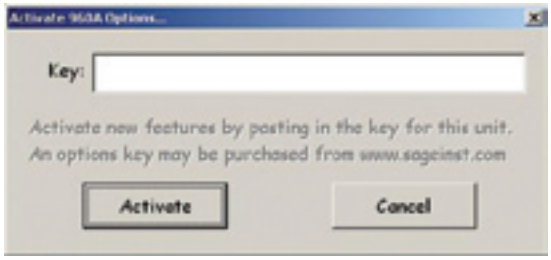
7. Place your mouse over the bank key field and click once to place a blinking curser in the text box.

8. Paste the options string into the text box. To paste, type Control-V (press and hold the 'Control' key while you type 'v'). To finish, click on the 'Activate' button.

960B Purchased Options Screen



960B Activate Options Dialog Box



Physical Properties

Case/Handle/Stand

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 to 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 5).

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 6).

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 7).

2. From left to right the first cabeling 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 7).

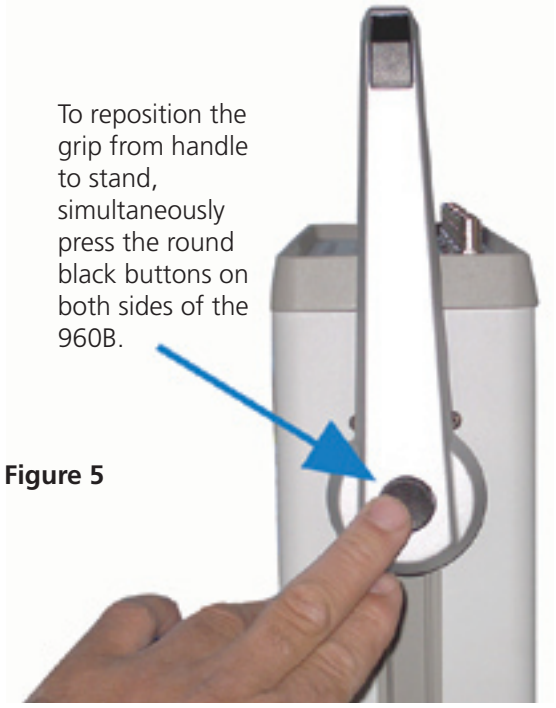


Figure 5

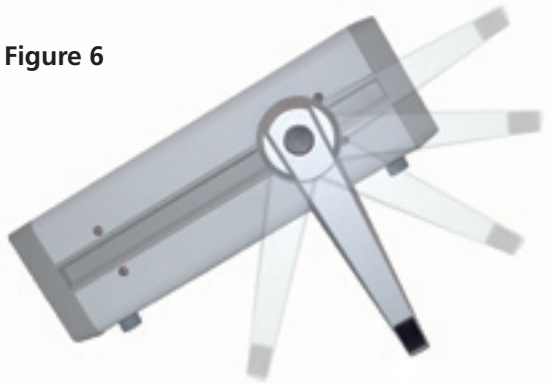


Figure 6

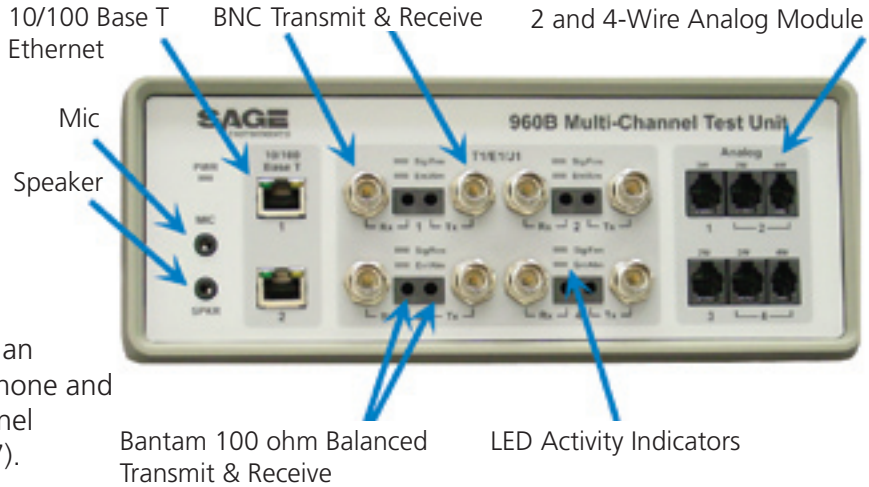


Figure 7

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 9).

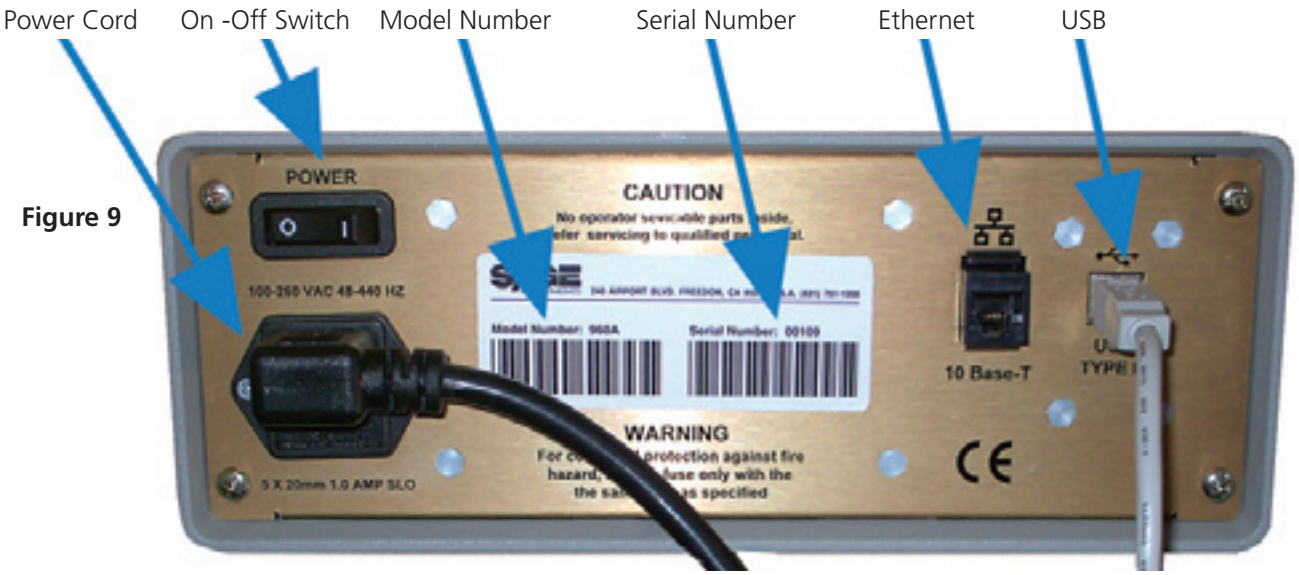


Figure 9

User Interface

Software Overview

Use this information to familiarize yourself with the PC based controls of the SAGE 960B.

1. After software installation the 960B is now ready to run tests. Turn on the power switch located on the rear panel of the 960B.

2. On your computer desktop double-click the SAGE 960B icon to launch the application (see figure 10). A launch screen will appear while the software detects connections and Initializes the 960B circuit boards (see figure 11).

3. After a few seconds the T1, IP Ethernet and Analog Span screen will appear displaying connected spans and their status (see figure 12). From this window users can select and configure a span for testing.

Span Screen in Depth

By default the box at the bottom right labeled "Only Show Connected Units" is checked. In this state the Span Screen is for the configuration of spans on any currently connected 960B's.

Span Screen Menus

Just below the colored bar at the top of the window are four windows type menus labeled "File", "Tools", "View" and "Help".

File: The file menu offers two entries; "Load Cfg File..." and "Save Cfg File...". The Load Cfg file selection is used to load an existing test configuration file and does not affect the PCM set-up. Clicking the Load Cfg File selection launches a familiar windows dialog box enabling the user to browse to the location of the configuration files which by default are stored in the cfg folder located in the SAGE 960B application directory found under Program Files. The "Save Cfg File" also launches a familiar windows dialog box enabling the user to "Name" and "Save a configuration file to a desired location (see figure 12 a)

> **Note:** When naming configuration files for the SAGE 960B it is important to add the suffix ".cfg".

Tools: The tools menu offers three selections; "Configure Audio", "Connect to remote Unit" and"Configure TCP/IP Unit" (Selections 1 and 3 have already been discussed. Selecting the Configure Audio launches an Audio Configuration window where users can select to monitor transmit only, receive only or both transmit and receive (see figure 12b).

Figure 10

Click Here

Figure 11

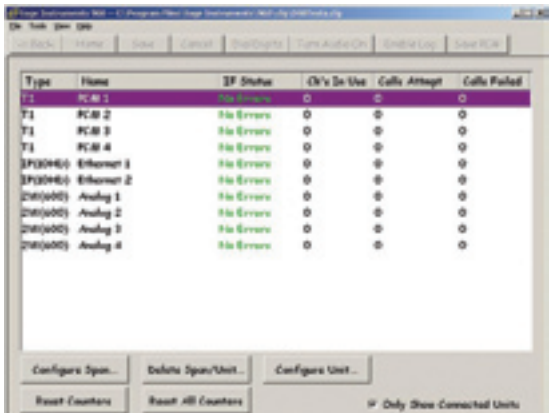


Figure 12

Figure 12a

(continued on page 13)

Span Screen Menus *(continued)*

View: The tools menu 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.

Note: At this release Context Help is minimal.

Help: The help menu contains two entries; "Help Topics" and " "About". At this release "Help" is under development. The About selection launches the application start-up screen, the version number of your SAGE 960B software is displayed here.

Span Screen Buttons

In the lower left hand portion of the Span Screen are five buttons used for managing spans for testing; "Configure Span", "Delete Span/Unit", "Configure Unit"Reset Counters"and "Reset All Counters", see figure 12c.

Configure Span: After selecting the desired span clicking this button launches the Configure Span window described in detail in the Configure a Span for Testing section (next page).

Delete Span: Spans can also be cleared by selecting a span and clicking the "Delete Span" button. This will delete the 960B Unit data associated with the selected Span. All spans & tests associated with this unit will be deleted from the current test configuration file. If the 960B is connected and powered up, the span will reappear with all tests cleared. A single click on the Delete Span button launches a confirmation screen to make sure this is the desired action, see figure 12d.

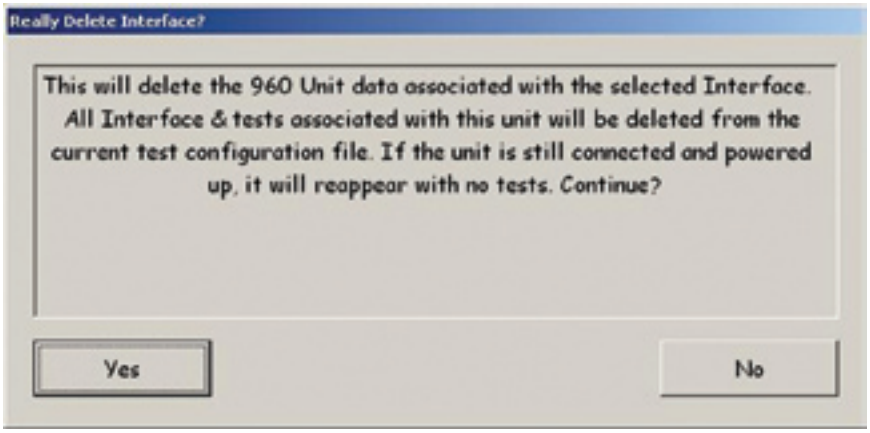
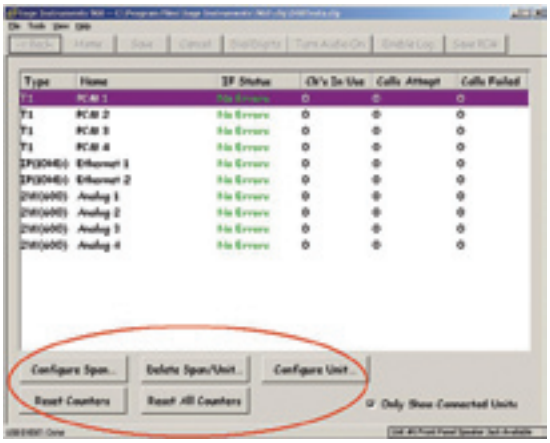


Figure 12d

Reset Counters and Reset All Counters: Located across the center of the Span Screen above the available spans are three categories; Type, Name and Span Status. In addition there are three "Counters"; "Chs in Use", Calls Attept and Calls Failed. The Calls Attempted and Calls Failed count can be reset at any time using the Reset Counters and Reset All Counters buttons.

Figure 12b

Figure 12c



Configure T1/E1 spans for testing

The Span Edit screen allows users to set the parameters of a span.

Important Note: Always save your settings before changing screens. The "Save" button is located at the top of all screens.

1. Select any span by clicking on it once. The span is now highlighted (see figure 13). (Note, it is not possible to select multiple spans).

2. Click the "Configure Span" button. This action brings up the Span Edit Screen (see figure 14).

At the Span Edit screen configure the following parameters:

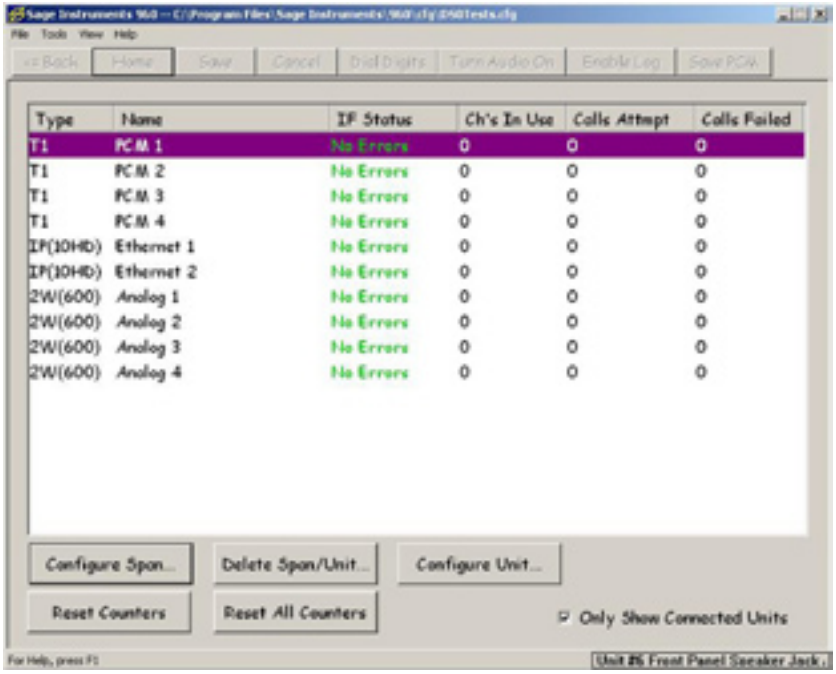


Figure 13

a. Name the span.

Note: Naming the spans other than the default name "New Span" is very important especially when running multiple span testing.

b. Select Pulse Code Modulation type T1 or E1.

c. Select Supervision/Signaling type and whether your equipment requires a "Wink Start" or not. For T1 selection the following choices are available:

c1). **CAS —** (Channel Associated Signaling) or in-band signaling. This refers to transmission of signaling information within the information band (voice).

c2). **Clear Channel** — Full 64 kbps per channel/DSO where no robbed bit signaling is used to fulfill 1s density. Often associated with B8ZS.

c3). **PRI-ISDN** — (Primary Rate ISDN) provides 23 bearer 64 kbps channels to carry voice or data and one 64 kbps signaling D channel.

c4). **FXS/FXO** — Select Foreign Exchange Subscriber or Foreign Exchange Office.

Figure 14

(continued on next page)

Configure T1/E1 spans for testing *(continued)*

d. Next tell the 960B what type of equipment you wish to emulate, Terminal Equipment (TE) or Network Switch (NT).

e. Select the desired Transmit Attenuation and Pulse Shaper.

e1). **Transmit Attenuation:** 0db, 7.5db, 15db, 22.5db

e2). **Pulse Shaper** — (Line build out): ***0 to 132 feet***
133 to 265 feet
266 to 398 feet
399 to 532 feet

Pulse Shaper (line build out) is set for the design criteria furnished, or based on the number of feet away from the first repeater.

Figure 14

Note: Attenuation and Pulse Shaper (line build out) are not used in E1 test configurations.

f. Continue by selecting the connection mode, framing line coding, clock location and whether it is a long or short haul line.

f1). **Terminate:** TERMINATE mode enables the 960B to act as a channel bank or switch terminating one end of the span.

f2). **D&I (Drop & Insert)** is used on live spans between two switches or multiplexers, etc. One of the 24 channels is dropped-out for testing while the other 23 pass through undisturbed. See setup diagram below (figure 14a):

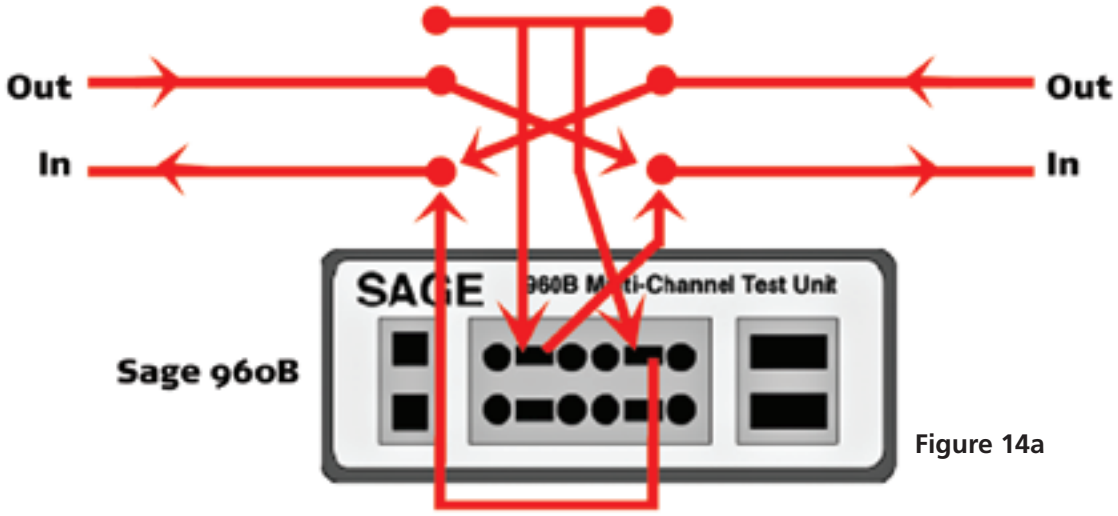


Figure 14a

f3). **Monitor** is used for monitoring one direction of transmission.

f4). **Dual Monitor** is used to monitor traffic in both directions simultaneously by activating both of the 960B's receivers.

(continued on next page)

Configure T1/E1 spans for testing *(continued)*

Configurations specific to T1

f5). **T1 Framing:** F12 (D3/D4) = Group of 12 Frames to make a Super Frame (SF)
F4 (4 Multi) = 4-frame multiframe
F24 (ESF) = Group of 24 Frames to make an Extended Super Frame (ESF)
F72 (SLC96) = 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. SLC-96 was the first widely deployed digital loop carrier system.

f60.**Coding: B8ZS** (Bipolar 8 Zeroes Substitution). Method for coding a T1 line to meet 1s density, thus providing a clear channel. This method substitutes known violation patterns to replace 8 successive 0s. This substitution is removed at the far end device.

AMI (Alternate Mark Inversion). 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.

f6). **Clock:** External—timing provided by external source. Only available in Terminate connection mode. Internal—timing provided by internal clock

f7). **Short/Long Haul:** Short Haul—Use this setting primarily for intra-office or inside TELCO applications. It's receiver reach is limited to 6dB of cable attenuation plus 3dB of additional flat or cable attenuation ` gives a total of 9dB.

Long Haul—Use this setting primarily for Inter-office applications. It's receiver reach (sensitivity) is much greater than for short haul, up to 36 dB of cable attenuation (22AWG) for the T1 and up to 43 dB of cable attenuation (0.5mm) for E1.

g. Finally, select the desired Receive and Transmit Ohms.
Termination Impedance:
Rx: 100 ohms or 100K ohms(high impedance).
Tx: 100 ohms only

Before continuing you must click on the "**SAVE"** button to save your configuration.

3. Also found on the Span Edit window is the DSP firmware version, the 960B serial numbers, the USB firmware version number and the "View Purchased Options" button (described on page 17).

At the Span Configuration window if you are finished setting parameters for the selected span be sure to click on save to retain your settings and then click on the "Home" button to return to the Span Window. Repeat these steps to configure all spans desired.

Configurations notes for E1
Supervision/Signaling:
PCM 30: PCM-30 channels
PCM 31: PCM-31 channels
PRI-ISDN: Primary Rate ISDN

Emulation equipment type:
TE = Terminal Equipment
NT = Network Equpment

Transmit Attenuation: N/A in E1
Pulse Shaper: N/A in E1
Connection Mode: See T1
Framing:
DF = Double frame format
DFS = special double frame format
CRC-4 = CRC4 multiframe format
CRC4_ITU: modified CRC4 with ITU G.706 alignment algorithm
Line coding:
AMI = Alternate Mark Inversion
HDB3 = High Density Bipolar 3
Clock: See T1
Short/Long Haul: See T1

(continued on next page)

Configuring T1/E1 channels for tests

Use these instructions to configure a single T1/E1 channel, a specific group of channels or all 24 channels for a specific test.

From the SAGE 960B application's home page the T1 Span you just configured will still be highlighted. Double click on the highlighted span to bring up the "Span/Channel View" window (see figure 15). In this view all channels of a T1 or E1 are displayed. Channel information provided includes: Channel Number, Test Type, Destination, Log and Status.

Multiple channel T1/E1 tests

1. To configure multiple channels for the same test select the desired channels by holding down the "Control" or "Shift Key" while highlighting the channels. As soon as multiple channels are selected the greyed-out "Multi-Cfg" button will become enabled.

2. Hold down the "Control Key" and select all 24 channels. Click on the "Multi-Cfg" button. This action brings up a small Multi-Cfg window with four variables to set. (see figure 16).

3. The first variable is test selection. In the drop-down menu there are various tests available to run on multiple channels. After selecting the desired test you must configure the test parameters. Depending on what test you select you will be presented with a different set of parameters to set.

4. As an example, from the test drop-down menu select PVIT. After selecting the PVIT test from the drop-down menu click the "Configure" button next to the test selection. This action brings up the configuration window for the PVIT test.

> **Note:** Multiple channel testing must be configured separately. If clicking the configure button does not launch a window no configuration is necessary for that specific test.

5. In the PVIT configuration window set the desired parameters for the PVIT test. Click "Save"

6. In the Multi-Cfg window below the test selection click "Configure" to enter a destination number and other parameters of the PVIT test call (see figure 17).

7. Next, again in the Multi-Cfg window below the call set up is the "Load Type" drop-down menu. Select Fixed or Random delay.

8. Place a check mark in the "Log to File" box if you want the test results saved to a log file. If no other "Configure" buttons are lit you are ready to run the PVIT test on all 24 channels. Click "Done" to return to the Span/Channel View window.

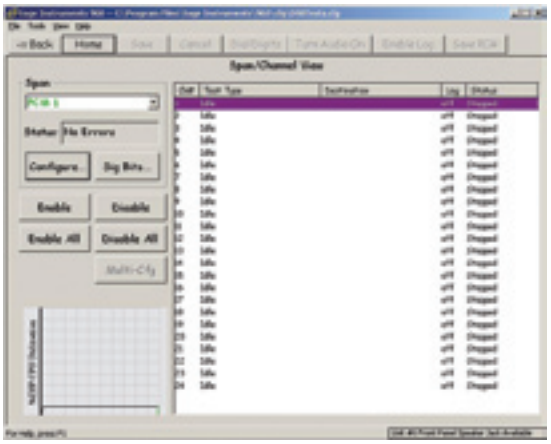


Figure 15

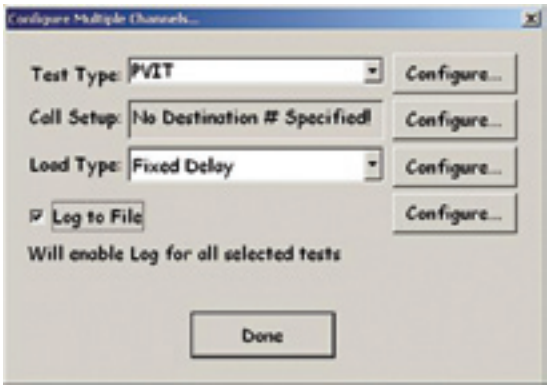


Figure 16

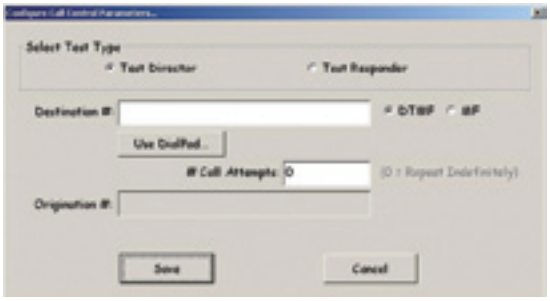


Figure 17

9. In the Span/Channel View window, click "Enable All". The PVIT test is now running on all 24 channels.

Repeat the above 9 steps for PVIT Test, and Test Responders on all Multiple Channel tests.

> **Note:** Located in the Call Control Parameters screen is the "Use Dial Pad..." button. Clicking this link brings up an on-sceen manual dial pad. Use this dial pad with any test or situation requiring manual send digits.

Configuring T1/E1 single channel tests

Unless you selected a duration factor of "0" (continuous) let the multiple channel PVIT test complete running. In the Span/Channel View window click on the "Home" button to return to the Span View window. The span the PVIT test was just run on will still be selected. Click on the "Delete Span" button and then click "Yes" when prompted to clear the PVIT test from the Span. (see figure 18).

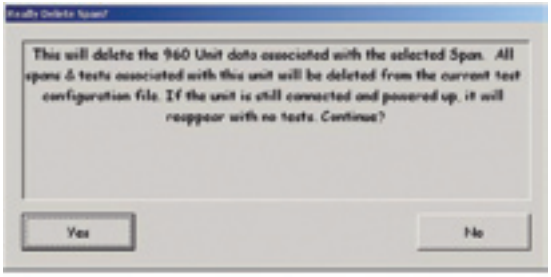


Figure 18

1. To configure single channels for individual tests from the Span View window double-click on the desired span.

2. Next, double click on the desired channel, selecting from 1 to 24. This action brings up the Single Channel Configuration window (see figure 19). The Single Channel Configuration window is much like the Multi Channel window with a few additions. These include at the top of the window a turn "Audio On/Off" toggle button and a "Save PCM" log file feature. You can also select another channel from this window without going back to the Span/Channel View. The window also offers Near and Far end hook (on/off) transmit and receive display. Users can also run and stop test from this window.

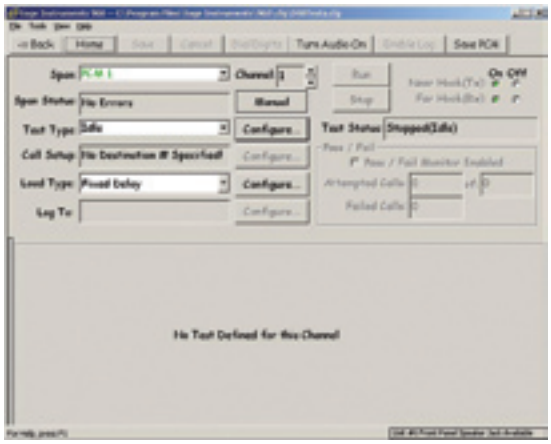


Figure 19

Turn Audio On/Off: Audio of any test can be monitored through the PC's internal or external speaker. If the PC used does not have a sound card, an external speaker can be plugged into the front of the SAGE 960B via the mini-jack speaker port.

Save PCM: Audio log files of tests run on a span channel can be save to the PC's hard disc or other media by clicking on the Save PCM Button. This action launches the audio data capture window (see figure 20). From this window you can enter the channel and duration as well as select the mode Transmit Only, Receive Only or Transmit and Receive. The path to where the .dat files are stored can also be modified to the desired location or drive. The default path places the .dat files in C:\Program Files\Sage Instruments\960\xxx.dat. The saved PCM files can be opened with Cooledit or any PCM friendly application. When opening the audio.dat, make sure the PCM application is set for:
T1: u-law, 1-channel mono, sampling rate 8khz.
E1: a-law, 1-channel mono, sampling rate 8khz.

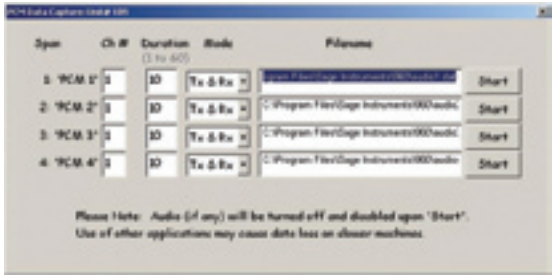
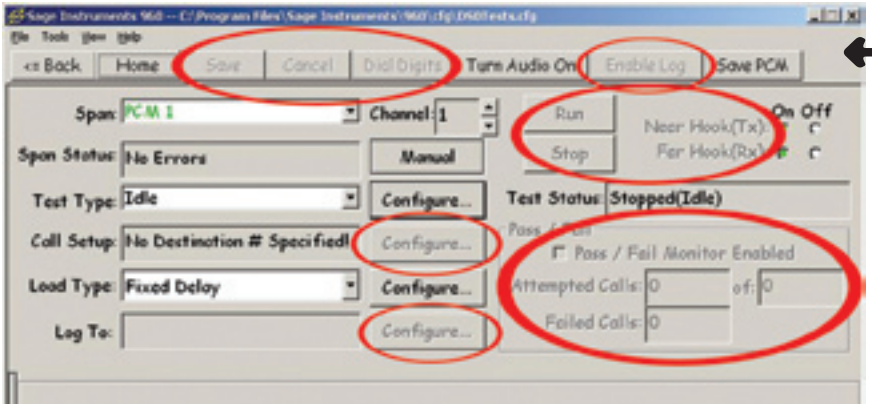


Figure 20

The **PCM Data Capture** can monitor up to four spans. Settings for Ch#, Duration (in seconds), Mode (Rx, Tx, Tx&Rx), Filename stored location are available. Additionally, by pressing the Setup…, a trigger can be used to start the PCM capture with Trigger Peak Level (dBm) and Pre-Trigger Time (ms) settings.

Figure 19b



Note: As illustrated in figure 19b many test elements are greyed-out until a test is selected and the "Save" button is clicked. The "Save" button remains greyed-out until a test is selected. After a test is selected and the save button is clicked all of the options for that test are displayed. Anything that remains greyed-out is not reletive to the selected test.

Configuring T1/E1 single channel tests

3. The channel tests drop-down menu contains 19 individual tests (see figure 21. For this example select the **Echo Sounder** test.

Note: After selecting the test type, It is important to click "Save" at the top of the main test screen. This action changes the main screen attributes to those of the selected test.

4. Next, click the "Configure" button located next to the test selection. In the Echo Sounder configuration window set the desired parameters for the Echo Sounder test (see figure 22) Click "Save" to return to the Channel Configuration window.

5. Configure call parameters. In the Channel Configuration window below the test selection click the "Configure" button next to the "Call Setup" field. This action launches the "Configure Call Control Parameters" screen (see figure 23). Enter a destination number, select Dual Tone Multi Frequency (DTMF) or the network version MF. Set the number of attempts you want the test call to perform, "0" which is the default will repeat indefinitely. From this window you can also choose to initiate the call manually by clicking on the "Use Dial Pad" button. This action brings up the "Send Digits" screen (see figure 24). In addition to the dial pad clicking the "Pause 1s" button will add a one second pause every time clicked. Click OK to exit the Send Digits window, then click "Save" to return to the Channel Configuration window.

A few words on Test Director & Test Responder: By default the Echo Sounder is a "test director" sending test tones to a network node via a telephone number. However in many cases it is necessary to test a node in the midle of a loop with a director on the near end and responder (Echo Generator) on the far end. Depending on the type of equipment being tested, in most cases this can be accomplished by setting up the responder on a different PCM channel on the same 960B.

6. Next, again in the Channel Configuration window below the call set up is the "Load Type" drop-down menu. Select Fixed or Random delay. Clicking the Load Type "Configure" button brings up a dialog box where the desired delay time can be set in milliseconds.

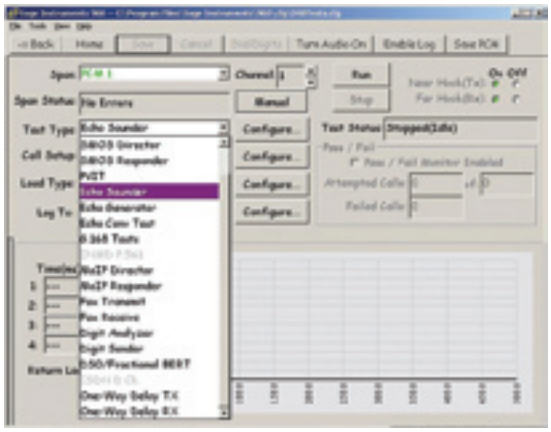


Figure 21

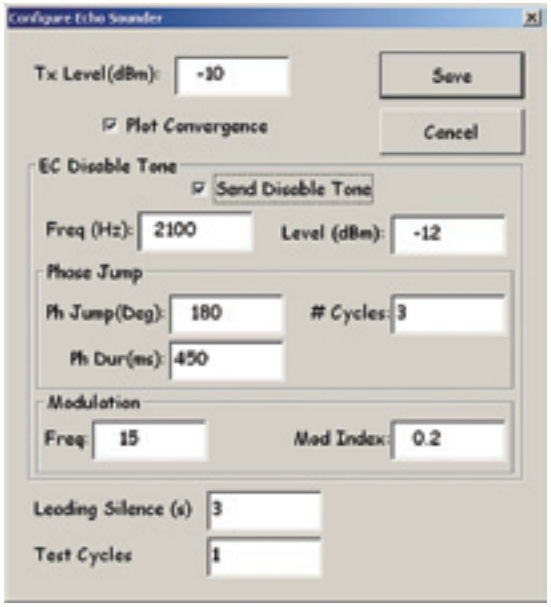


Figure 22

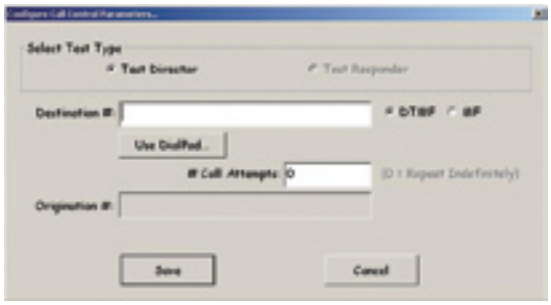


Figure 23

Figure 24

Configuring T1/E1 single channel tests

7. To save test results to a log file click the "Enable Log" button at the top of the Channel Configuration Window. This action un-greys the "Log To:" field. Clicking the Configure button next to the Log To field launches a dialog box, where you create a unique file name for your test log file ending in the suffix ".csv" (see figure 25). You can also browse to the location on your local machine or network where you want the log file to reside. Click OK to return to the Channel Configuration Window.

You are now ready to run the Echo Sounder test on the selected channel. Click "Run" to start the Echo Sounder test.

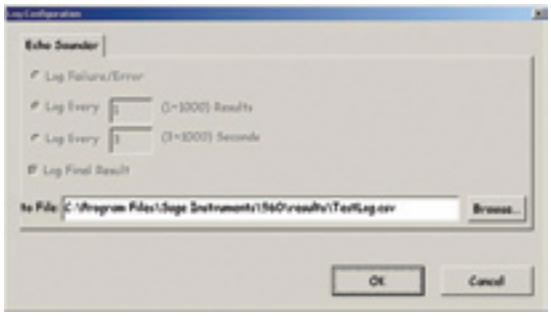


Figure 25

8 . If you prefer to monitor the tests progress from the Span/Channel View window don't use the start button on the Channel Configuration window. Instead click the "Back" button to return to the Span/Channel View window. Select the pre configured channel then click on the "Enable" button.

9. From the Span/Channel View window it is also possible to run identical or different tests on selected channels. Hold down the control key and select the desired pre configured channels, the channels are now highlighted. Click the "Enable" button to begin the test. To run pre configured tests on all channels click the "Enable All" button, tests will run on all configured channels.

10. From the Span/Channel View window it is also possible view Span Signaling Bits during the progression of a test. Clicking on the "Sig Bits..." button launches the View Signaling Bits window. This window displays near and far end signaling bits as well as the channel and near and far end hook switch (see figure 26).

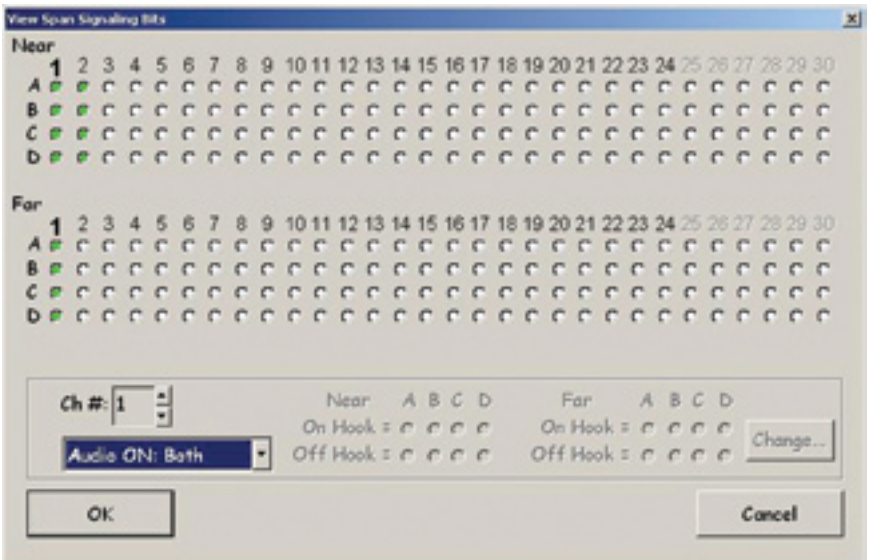
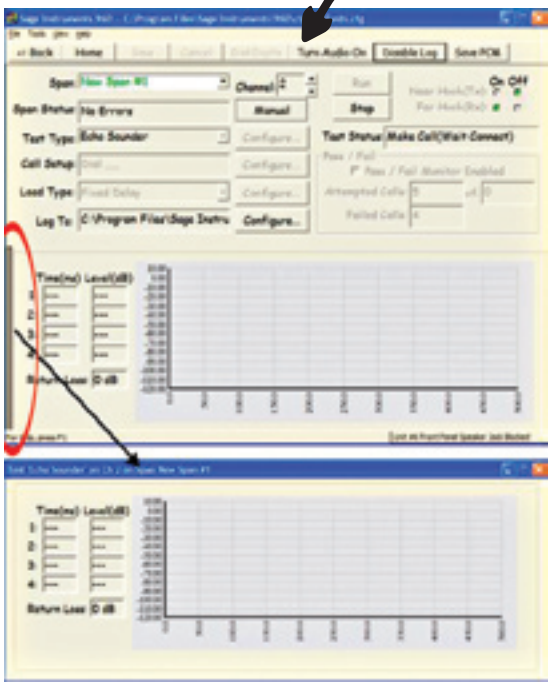


Figure 26

You can scroll between the channels and select either Audio ON: Both, Audio ON: Near, Audio ON: Far, Audio OFF

Note: As the Echo Sounder test runs notice that the Millisecond and decibel graph is displaying real time test data. Clicking the bar at the left of the graph launches the display in a separate window allowing the user to monitor the test(s) while performing other tasks. See example below (figure 26b) for undocking bar location.



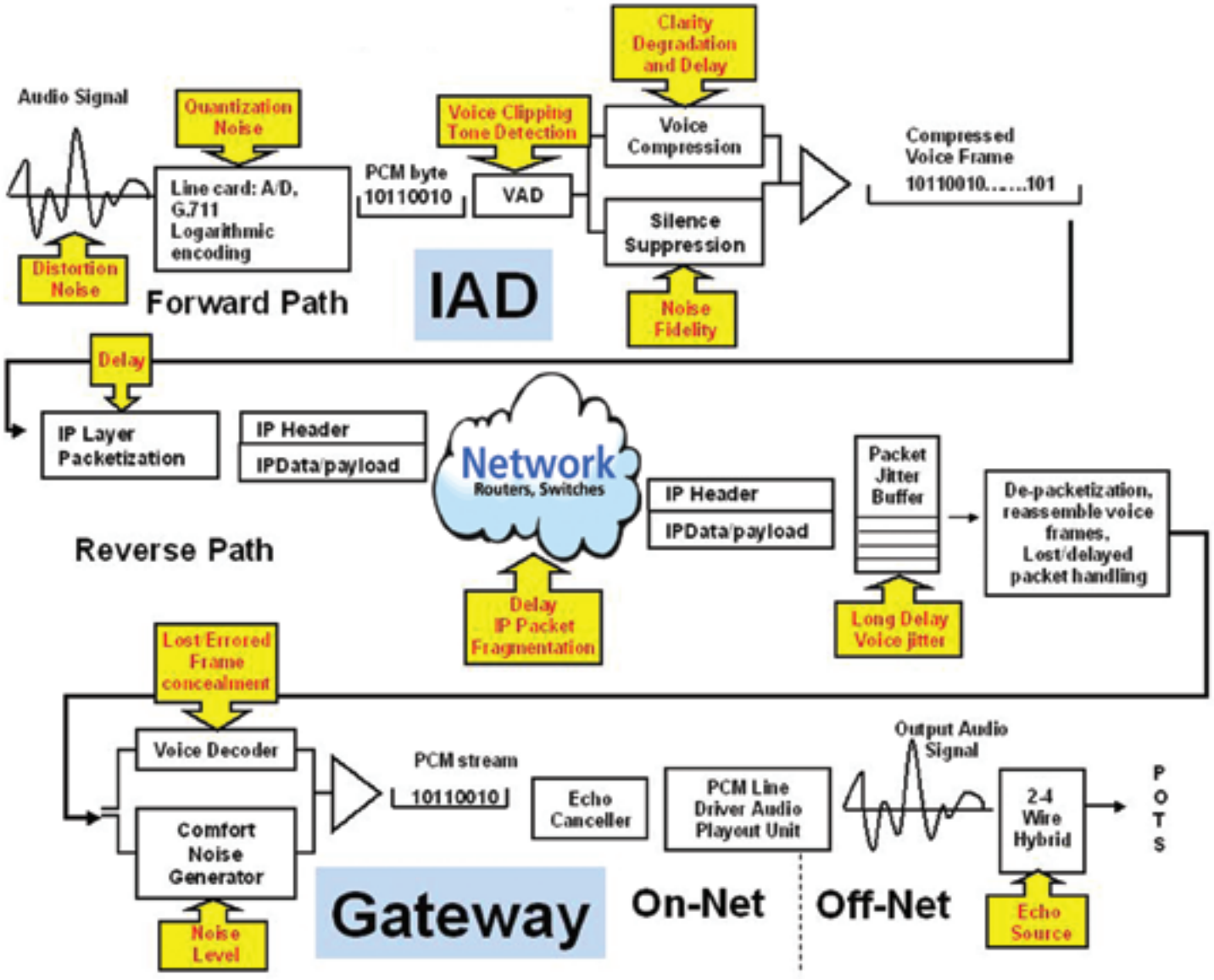
960B Technology and Applications

The 960B IP Telephony Multi-Channel Test instrument is specifically engineered to identify, measure and diagnose all IP Voice processing Impairments. All elements that degrade voice services can be tested and identified with the 960B including:

- **Excessive compression by low-bit vocoders**
- **Voice level too low/High**
- **Excessive packet/cell/frame loss/slip**
- **Excessive voice jitter (Jitter buffer resizing)**
- **Excessive voice clippings (VADs)**
- **Excessive noise (CNG) or not enough**
- **Excessive delay**
- **Echo**

The 960B supports a variety of real-time processing tasks for multiple channels. The following illustrates typical impairments identified with the 960B.

IP Voice Processing Impairments = *Impairments*



SMOS Director/SMOS Responder

Provides End-to-End Voice Quality Characterization. Tests the networks ability to transmit voice distortion free in both directions through gateways, IADs and IP Phones.

Artificial Voice Test Signal (All Accents)

Metrics	*Listener Impact*
Voice Clarity (MOS)	Distortion, Packet Loss
Voice Packet/Frame Slips	Voice Gapping, Jerking
Round Trip Delay	Talk-over
Audio Level	Too Loud or Quiet
Comfort Noise	Too High or Too low
Effective Bandwidth	In-band data qualification
Codec Type Detection	Provisioned incorrectly

PVIT (Packet Voice Impairment Test)

Provides Comprehensive Voice Quality Performance Metrics. Enableing field personnel to zero in on causes of poor voice quality. Considered the DS0 BERT test for VoIP.

Metrics	*Listener Impact*
Voice Clarity (MOS)	Distortion from Packet Loss
+/- Frame Slip Event Count	Voice Gapping and Jerking
Voice Clipping Event Count	Choppy Voice
Noise Hit Event Count	Impulse Noise During silence period

PVIT statistics provided for each event type:

- Average Burst Length (msec)
- Min/Max Burst length (msec)
- Percent of impairment over test duration (i.e. % packet loss)

FAX (Transmit and Receive)

During testing the SAGE 960B FAX 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.

Metrics and Features
Emulate Up to 120 Facsimile Transmitters and Receivers
Stress Gateway for In-band Data Transparency
Terminate Fax on TDM, Packet, and Analog
Decode V.21 (FSK) Two-way Fax Transmission
Support Data Rates for V.17 and V.27

(continued on next page)

MoIP (Modem over IP)

The 960B MoIP test objectively measures a packet networkís ability to carry telephony traffic including voice, data, and fax. The test process emulates three modes of operation: Voice, Data, & Fax. MoIP sends appropriate priming tones (i.e. CNG) to provoke tone detection for call type (Data Mode). MoIP tests also generate pseudo random test signals to verify data mode transparency (essentially 64 KB/s). Fax & Data modems use vulnerable FSK signaling (V.21).

MoIP Test	*Metrics*
Voice	Audio Level, Frame Loss, Frame Jitter (+/-), Codec Type and Round Trip Delay
Data	Frame Loss, Frame Jitter (+/-), Codec Type, and Round Trip Delay
Fax	Frame Loss, Frame Jitter (+/-), Codec Type, and Round Trip Delay

Digit Analyzer

Digit Tests	*Function/Results*
DTMF/MF Digit Verification	Next Gen Nets Encode & Decode Digits On/Off Times, Frequency & Level Detects ANSI Standards and RFC-2833 Digits
Digit Sender Envelope Testing	Settable Frequency and Level and On/Off times Send RFC-2833 Digits

Echo Sounder/Echo Generator

Provides Echo Detection and Echo Canceller verification. Enables field personnel to detect and isolates echo problems from a TDM, 10/100, or Analog interface.
• Echo Generator • Advanced Echo Emulation • Multi-channel to stress embedded echo cancellers

Metrics	*Listener Impact*
Echo Level(s)	Echo Loudness
Echo Delay(s)	As delay gets longer echo becomes more noticeable

Requirements Specified in ITU G.131

INMD (In-Service Non-intrusive Measurement Device) International Telecommunication Union-T P.561

INMD on the 960B platform focuses on echo characterization. More specifically, once the presence of echo is detected, 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 as further visual confirmation. If the monitored DS1 are PRI-ISDN lines, then the source and destination phonenumbers associated with the monitored DS0 channel are also presented.

Function
ITU P.561 Non-Intrusive VQ Characterization
Passively Detects Echo in both directions via Dual Monitor E1/T1 or RTP Monitor
Monitor up to 60 TDM Channels Simultaneously and/or Up to 256 RTP Streams
Measures and Captures both Echo Level and Delay with Option to Record Audio

(continued on next page)

INMD (In-Service Non-intrusive Measurement Device) *(continued)*

INMD P.561 Passive Echo Monitoring

To run INMD tests ,the SAGE 960B front panel PCM 1 and PCM2 connections need to be paired. Leaving PCM 3 and PCM 4 for connection to the reference signal (see figures 27 & 27a).

Note: For INMD, PCM 1 and PCM 3 must be connected to "Talker" reference signal.

INMD P.561 Typical Configurations

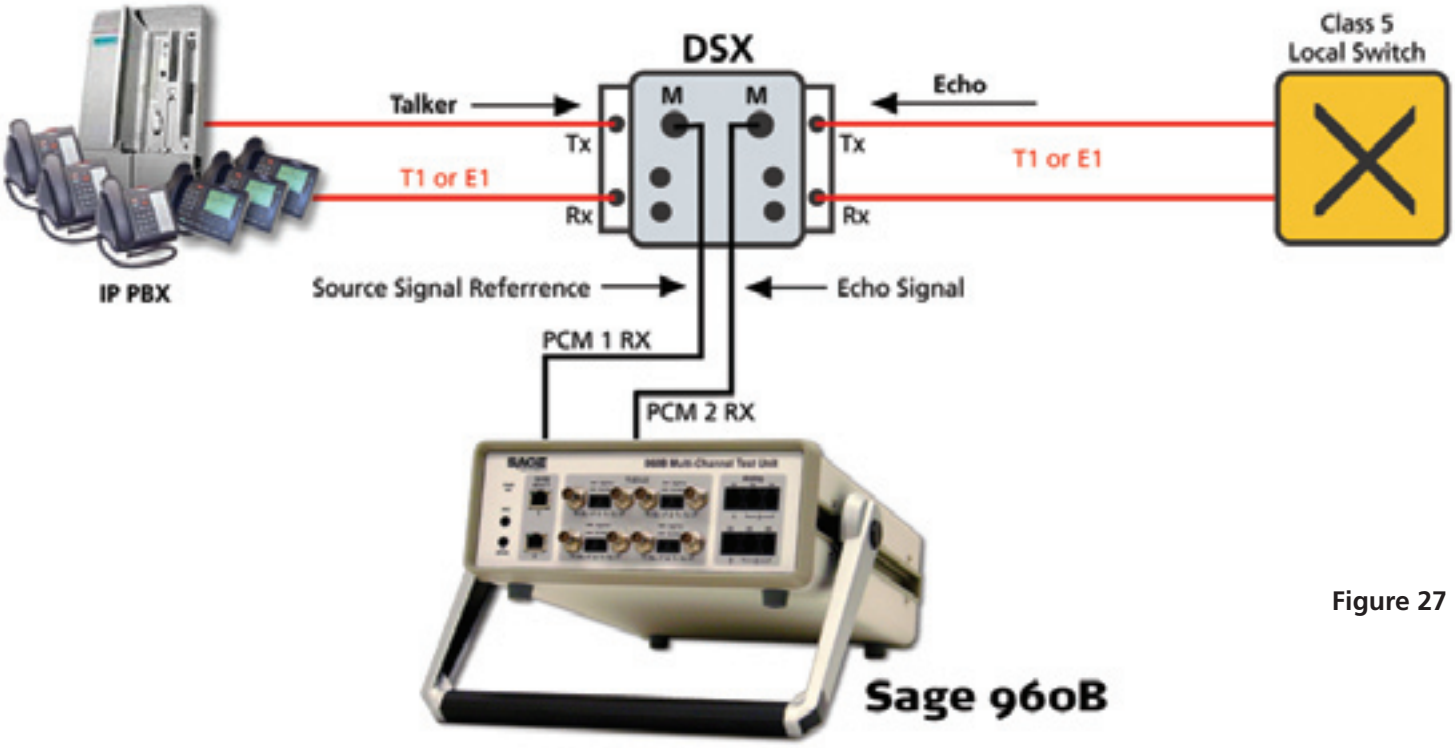


Figure 27

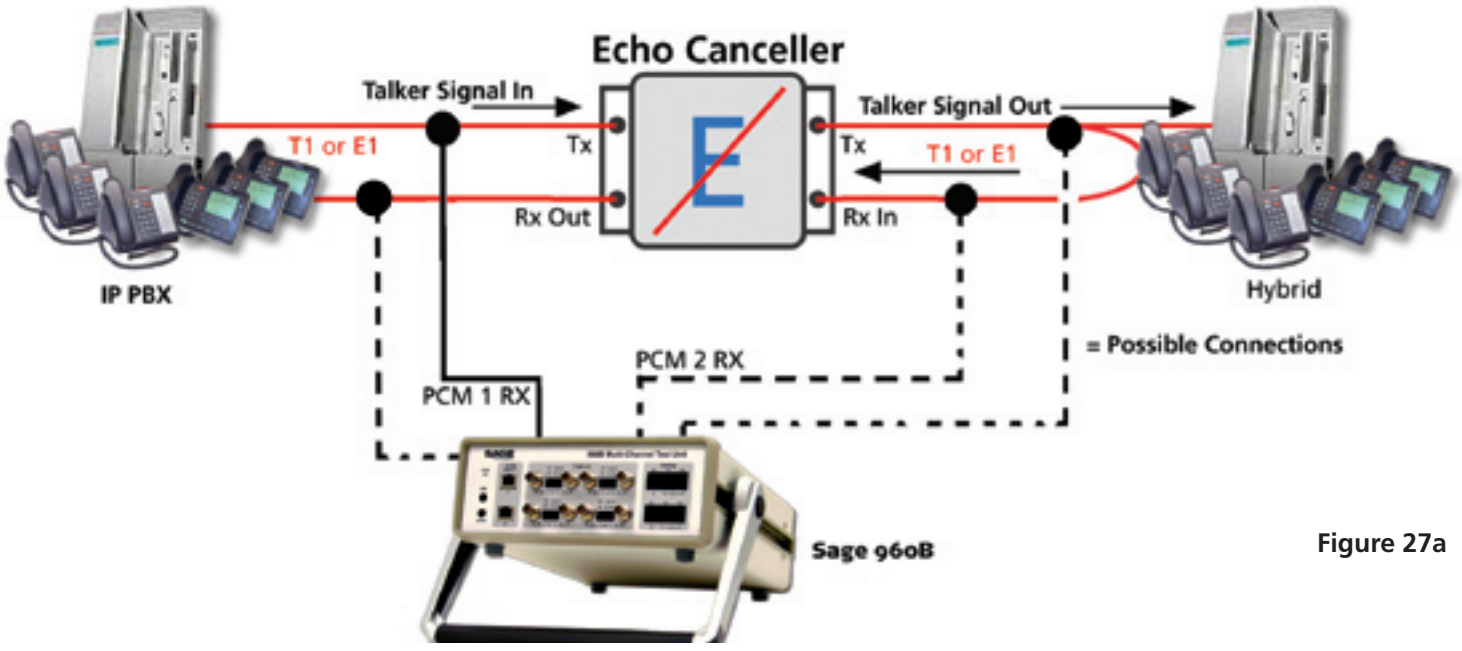


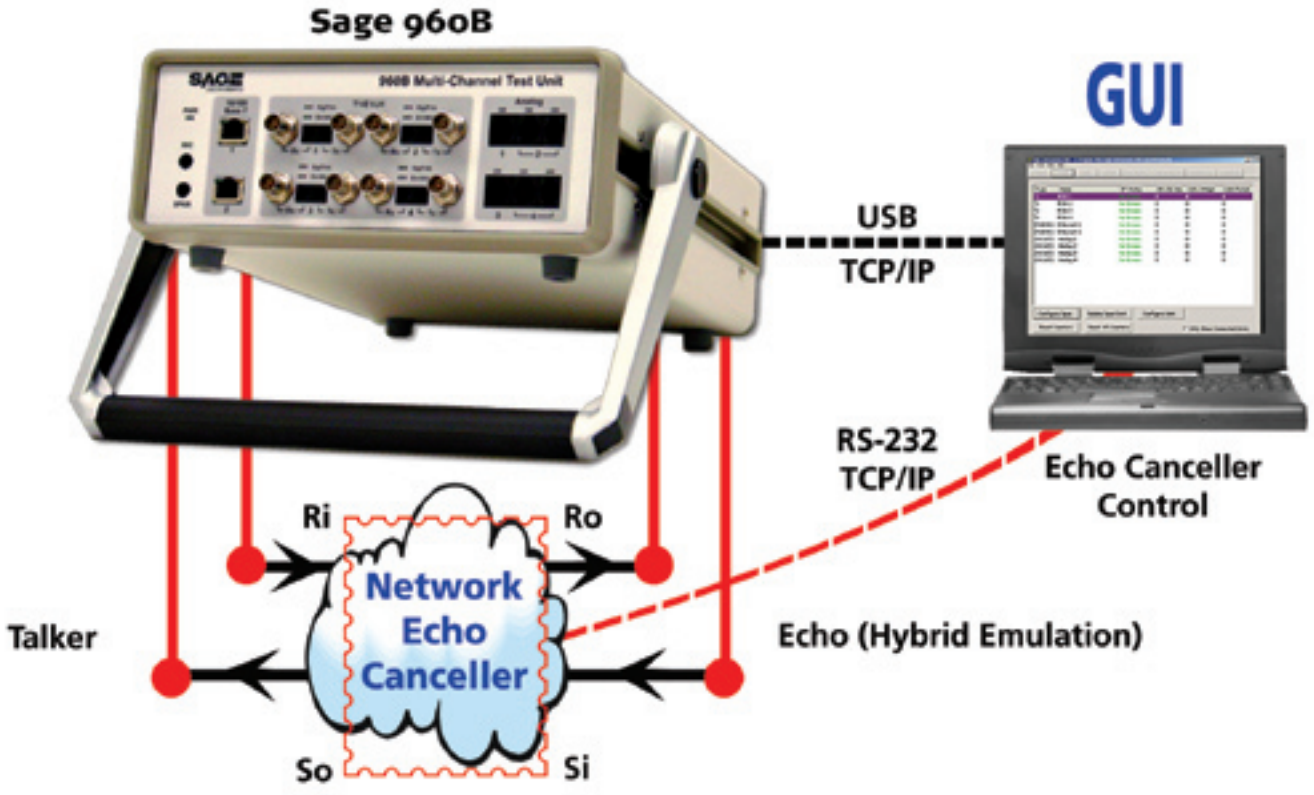
Figure 27a

ITU G.168 Conformance Testing

Run ITU G.168 conformance tests manually or automate in sequence with serial or TCP/IP echo control. supports all ITU standard hybrid dispersion models. Conduct tests while stressing canceller over multiple channels.

Test	*Function*
Test 2A	Convergence with NLP Enabled
Test 2B	Convergence with NLP Disabled
Test 2C	Convergence w/wo NLP Disabled
Test 3A	Low Level Double Talk
Test 3B	High Level Double Talk
Test 3C	Double Talk w/ Conversation
Test 4	Leak Rate Test
Test 5	Infinite Return Loss Convergence
Test 6	Non-divergence on Narrow Band Signals
Test 7	Stability Test
Test 8	Non-Divergence w/Misc
Test 9	Comfort Noise Test
Test 10A	FAX Test at Calling Side w/wo NLP
Test 10B	FAX Test at Called Side w/wo NLP
Test 13AB	GSMFR Echo w/wo NLP
Test 15AB	PCM Offset: S(in): R(in)

Typical Configuration



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RTP (Real-time Transport Protocol) Monitor

The 960B RTP Monitor can passively monitor & troubleshoot SIP, H.323, NCS, or MGCP VoIP calls from the 10/100 interface as well as qualify voice quality on turn-up. Select Auto Discovery or Specify up to 128 addresses to monitor (256 simultaneous RTP streams). Analyze RTP for Echo and Audio Levels (G.711 & G.729). Emulates Jitter Buffer filters to assess delays impacts on Audio Quality. Assess Two-way RTP Packet Impairments Half Duplex (Hub/Switch) or Full Duplex (Tap) Monitor points.

Metrics	*Description*
Lost, Discarded, & Out of Sequence Packets	Impaired Packet Counter
Packet Arrival Delay	Tracks One-Way Delay Variation
Inter-Arrival Jitter	Inter Packet Arrival Time Variation
Transient Packet Loss (Lost + Discarded)	Tracks Bursty Packet Loss
Lost & Dropped Packet Loss Distribution	Quantifies Contiguous Packet Loss

E-Model ITU G.107 Conversational Quality Test

Computational model for use in transmission planning Packet Loss, Jitter, Echo, Delay, Noise plus Service Type Degradation Factor. Sage's 960B E-Model is calculated with real measurements whenever possible.The internal DSP algorithm will use as many parameters as are available from the RTP handler and the VF test being selected. The unmeasurable parameters will assume their ITU default values.

R-Factor	*Rating 1-100*
GOB	Percentile 1-100
POW	Percentile 1-100
E-MOS	Rating 1-5
E-Model & RTP Monitor - When INMD is selected both Echo & delay along with lost and discarded packets	
E-Model & SIP Call Setup - Uses metrics from selected VF tests (i.e. Echo Sounder)	
E-Model & MoIP Test (Voice Mode) - E-model with measured values for frame loss, jitter, delay , echo & codec.	

SIP (Session Initiation Protocol)

SIP, the Session Initiation Protocol, is a signaling protocol for Internet conferencing, telephony, presence, events notification and instant messaging. The 960B uses the RFC Standard 3261, 2617 to support VF Test Setup (Clarity, Echo, etc.) as well as call Loading for VoIP Pre-Qualification Testing.

Metrics	*Description*
Lost, Discarded, & Out of Sequence Packets	Impaired Packet Counter
Packet Arrival Delay	Tracks One-Way Delay Variation
Inter-Arrival Jitter	Inter Packet Arrival Time Variation
Transient Packet Loss (Lost + Discarded)	Tracks Bursty Packet Loss
Lost & Dropped Packet Loss Distribution	Quantifies Contiguous Packet Loss
Simultaneous Endpoints (EP) per Ethernet Port	***Port Configuration***
24	10MB/s, Half Duplex
32	10MB/s, Full Duplex
48	10MB/s, Half Duplex
64	10MB/s, Full Duplex

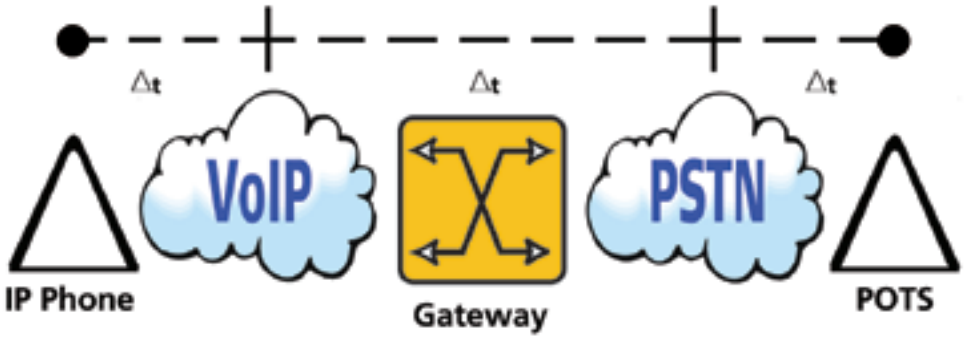
(continued on next page)

One-Way Delay Test

Use the 960B One-Way Delay test to measure one-way delay between disparate telephony interfaces in the lab.

- ***TDM to TDM***
- ***IP to TDM***
- ***TDM to Analog***
- ***IP to Analog***

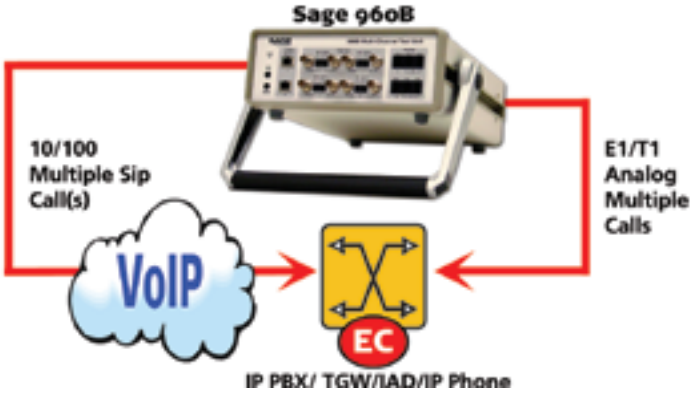
Pinpoint delay issues to segments of the network. Test works with multiple 960 B's as long as the real-time audio ports (mic & spk) are connected.



End-to-End Trunking Gateway

Gateway pass through transparency testing.

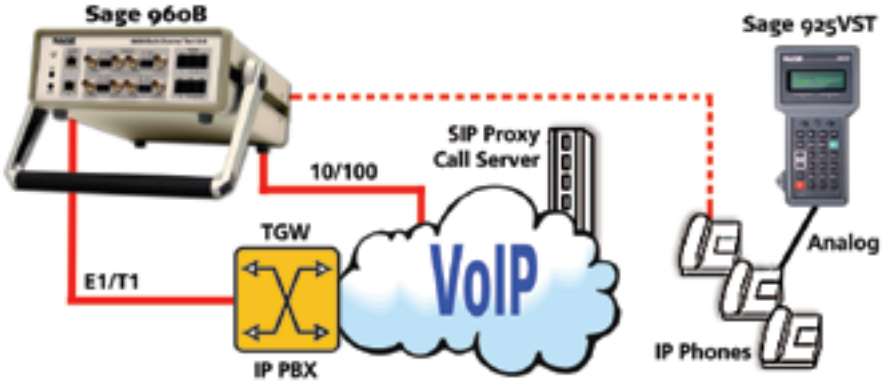
- ***Test Cancellers***
- ***Verify In-band data or T.38 testing***
- ***Voice Quality***
- ***DTMF encoding/decoding (E911 testing)***



Access Gateway

Access Gateway test configuration

- ***Turn-up, and Certification Testing (SIP, RTP MON, TDM Call)***
- ***Voice Quality***
- ***Echo***
- ***Fax***



IXC Long Distance Gateway

LD or Packet Tandem configuration (Class IV)

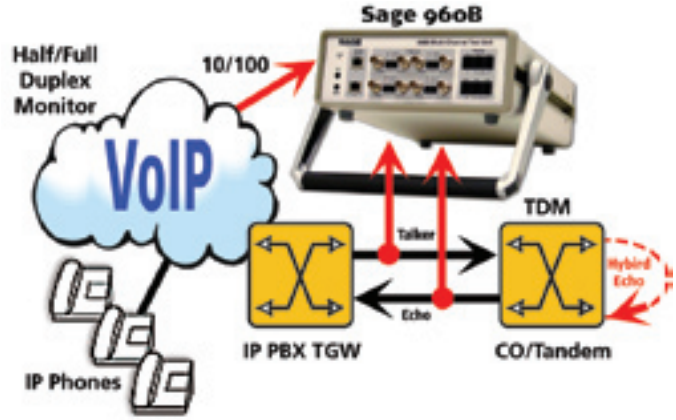
- ***Certification Testing***
- ***Voice Clarity***
- ***Delay***
- ***Echo***
- ***Data***
- ***Fax***

(continued on next page)

Echo Troubleshooting

Passively Monitor Echo, Audio Level and RTP (G.711/G.729)

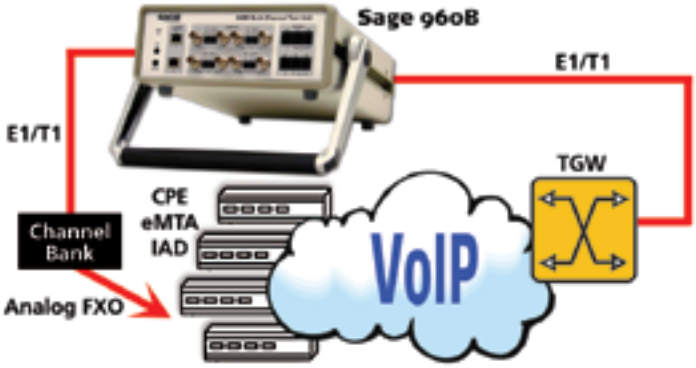
- ***INMD ITU P.561 (Level and Delay)***
- ***Monitor 100's of channels simultaneously***



CPE/QA/Cert Testing

Functional Customer Premise Equipment (CPE) Testing

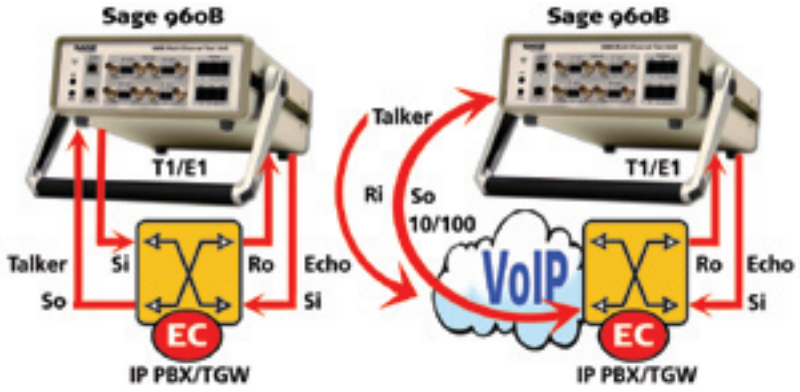
- ***Regression or parametric testing***
- ***Functional testing for Clarity, Delay, Echo, Fax and Data***
- ***Multiple channels via FXO channel bank***



Canceller Performance

Echo detection & canceller performance testing

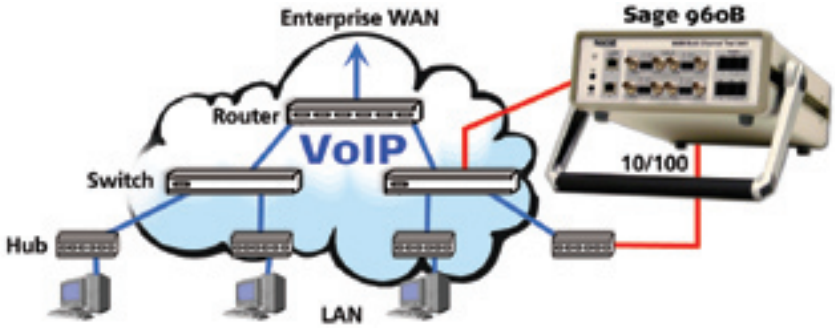
- ***Complete Echo and Double-Talk Emulation (with ITU Standard Dispersive Hybrid Models)***
- ***G.168 Test Suite Manual or Automated Modes***
- ***Test Cancellers over Multiple Channels***



VoIP Pre-Qualification

Place multiple SIP calls to access readiness (up to 128 in full duplex mode)

- ***Test Segments and Backplanes***
- ***Emulate Real IP Phones with Jitter Buffers***



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SAGE Online Referrence 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

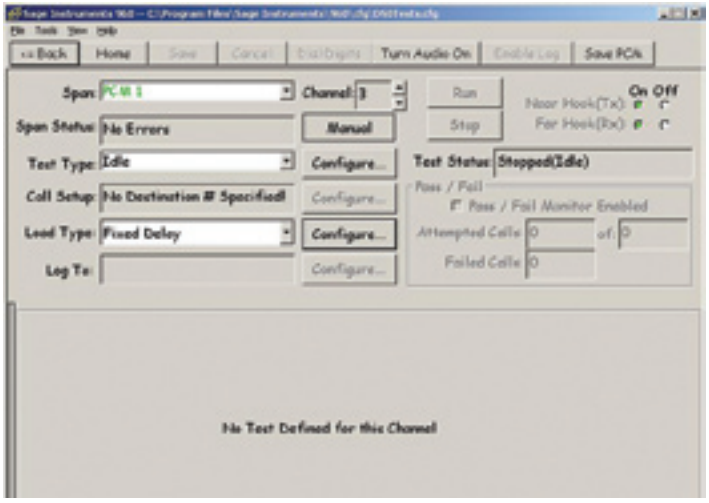
Visit SAGE Instruments at www.sageinst.com

960B Common Test Variables

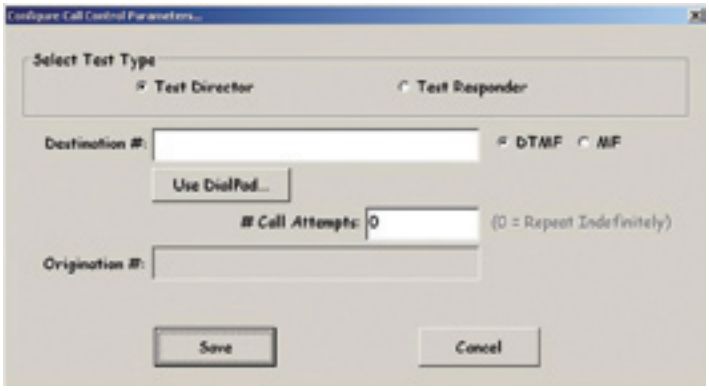
Test configuration steps common to the SAGE 960B's tests and their related PC based controls.

While some tests have more, most test associated with the SAGE 960B utilize five (5 to 10) individual screens or windows. Other than the main test configuration window some screens are specific to the selected test and the others are common.

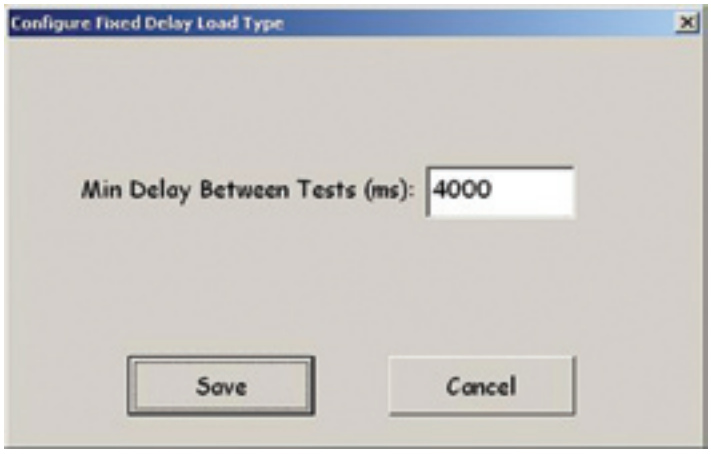
Common Configuration Windows



Main Test Screen at Idle

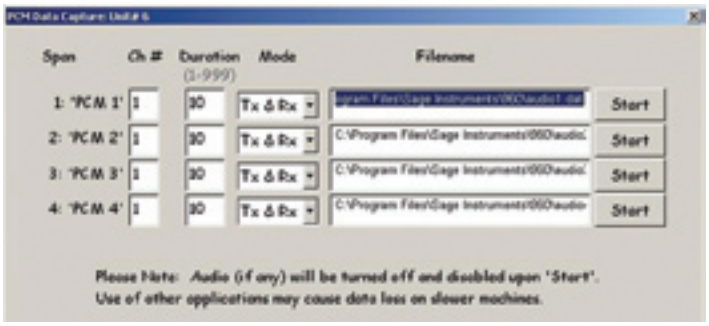


Call Control Parameters

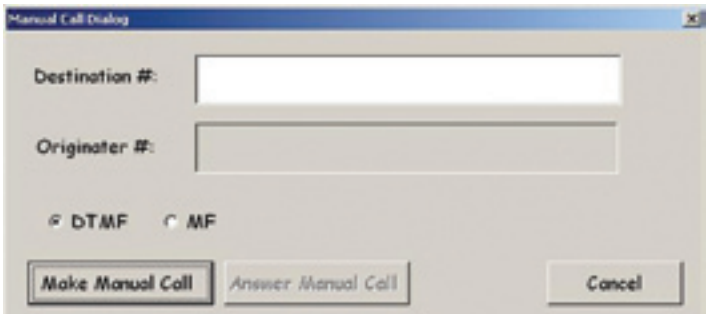


Select Load Time and Configure Fixed Delay

Note: In tests when "Responder" is the selected mode the "load Type" is not used.



PCM Data Capture (PCM Spans Only)



Manual Call Dialog

Send Digits Dial Pad

Log Configuration

Variables Common to all SAGE 960B Tests *(continued)*

Use this table as a reference to ensure tests are completely configured prior to running.

Test Name	Total Screens	Sub Menus	Log, Save and Send Options	Test Platform(s)	Director/ Responder	Multiple or Single Config.
Send/Measure Tone	7	1 (Analog)	Send File when measuring tone, WAV/PCM, Save PCM, Log to File	PCM, Analog and Ethernet (SIP Call)	Director or Responder	Multiple or Single
SMOS Director	6	None	Save PCM, Log to File	PCM, Analog and Ethernet (SIP Call)	Director or Responder	Multiple or Single
SMOS Responder	5	None	Save PCM, Log to File	PCM, Analog and Ethernet (SIP Call)	Director or Responder	Multiple or Single
PVIT	7	1	Save PCM, Log to File, Rx Only, Tx Only, Send and Receive	PCM and Analog	Director or Responder	Multiple or Single
Echo Sounder	5	None	Save PCM, Log to File, Send Disable Tone	PCM, Analog and Ethernet (SIP Call)	Director	Multiple or Single
Echo Generator	5	None	Mix Wave/PCM File with Echo Save PCM, Log to File	PCM, Analog and Ethernet (SIP Call)	Director or Responder	Multiple or Single
Echo Conv Test	6	None	Save PCM, Log to File, Send Disable Tone	PCM Only	Director or Responder	Multiple or Single
G.168	9	7	Save PCM, Log to File, Connect to eCan	PCM Only	Director	Single Only
INMD P.561	4	None	Save PCM, Log to File	PCM Only	Director or Responder	Single Only
MoIP Director	5	1	Save PCM, Log to File	PCM and Analog	Director or Responder	Multiple or Single
MoIP Responder	3	None	Save PCM, Log to File	PCM and Analog	Responder	Multiple or Single
Fax Transmit	5	None	Save PCM, Log to File	PCM and Analog	Director or Responder	Multiple or Single
Fax Receive	5	1 (Analog)	Save PCM, Log to File	PCM and Analog	Director or Responder	Multiple or Single
Digit Analyzer	5	1 (Analog)	Save PCM, Log to File	PCM and Analog	Director or Responder	Multiple or Single
Digit Sender	5	1 (Analog)	Save PCM	PCM and Analog	Director or Responder	Multiple or Single
DSO/Fractional BERT	6	2	Save PCM, Log to File, User Defined Patterns	PCM Only	Director or Responder	Multiple or Single
ISDN D Channel	2	3	Save PCM	PCM Only	NA	Single Only
SIP Call	5	15	Save PCM, Log to File	Ethernet Only	Director or Responder	Multiple or Single
SIP Monitor	3	None	None	Ethernet Only	NA	Multiple or Single
RTP Monitor	4	3	Save PCM, Log to File	Ethernet Only	NA	Multiple or Single
RTCP Monitor	4	6	Save PCM, Log to File, PID	Ethernet Only	NA	Multiple or Single
Echo Ping	4	None	Save PCM, Log to File	Ethernet Only	NA	Multiple or Single
One-Way Delay Tx	3	1	Save PCM, Log to File	PCM, Analog and Ethernet	Responder	Single Ethernet (SIP Call)
One-Way Delay Rx	5	1	Save PCM, Log to File	PCM, Analog and Ethernet	Director	Multiple or Single

Batch Mode

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.

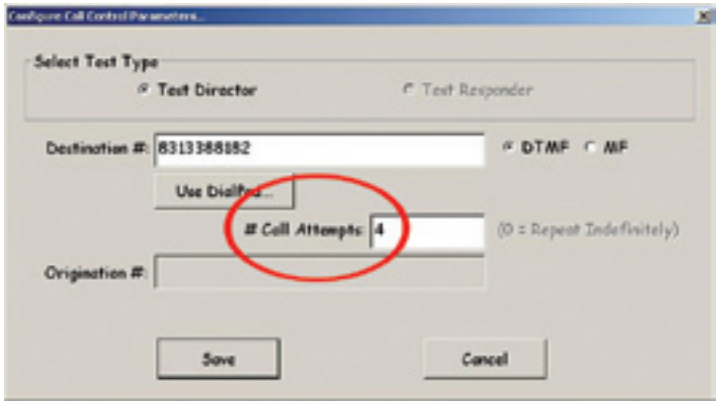


Figure 28

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**

CPU Usage Display

The DSP CPU usage is indicated on the Span/Channel View 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 (see figure 29). 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.

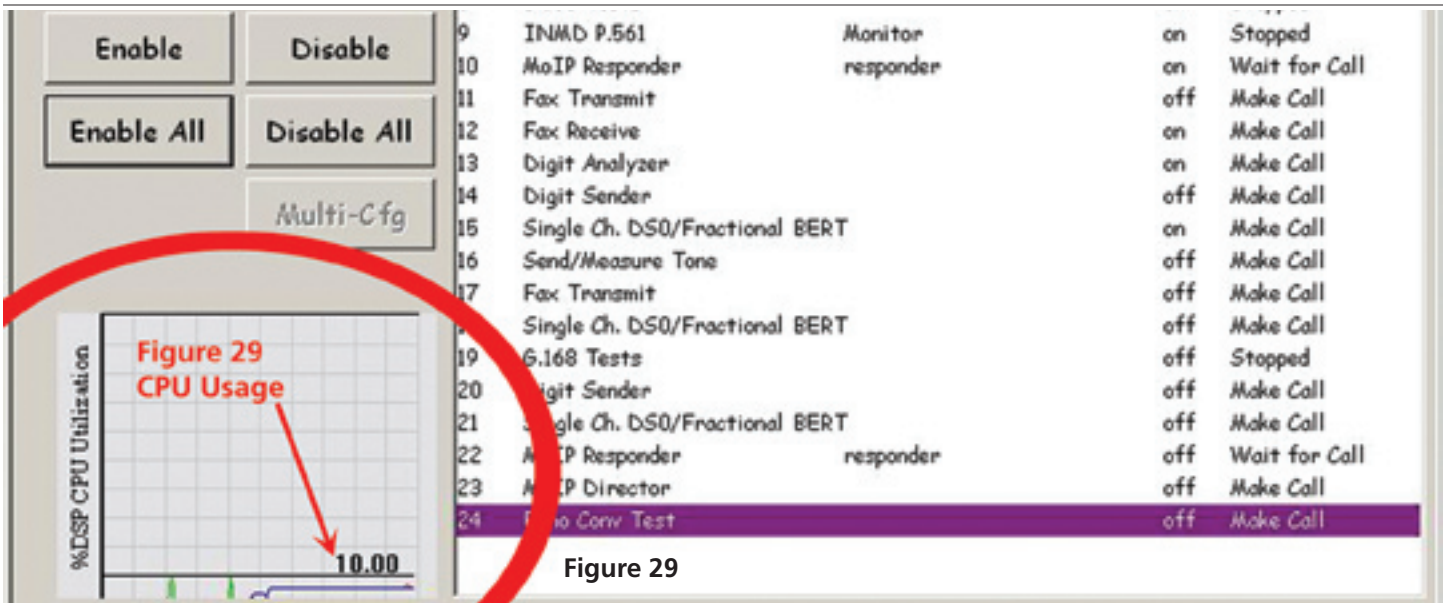


Figure 29

Run State, Call Control Status

Located on the Main Test screen, is a field labeled "Test Status" (see figure 30). This field contains two states: the Run state, and the Call state (in parenthesis). For example, a stopped test would say "Stopped(Idle)" indicating that the test is stopped and the call state is idle. A running test would say "Running(Call Up)", indicating that the run state is "Running" and the call state is "Call Up". The Test Status field is also used to message the user with important test state information.

The following are the possible Run States and descriptions:

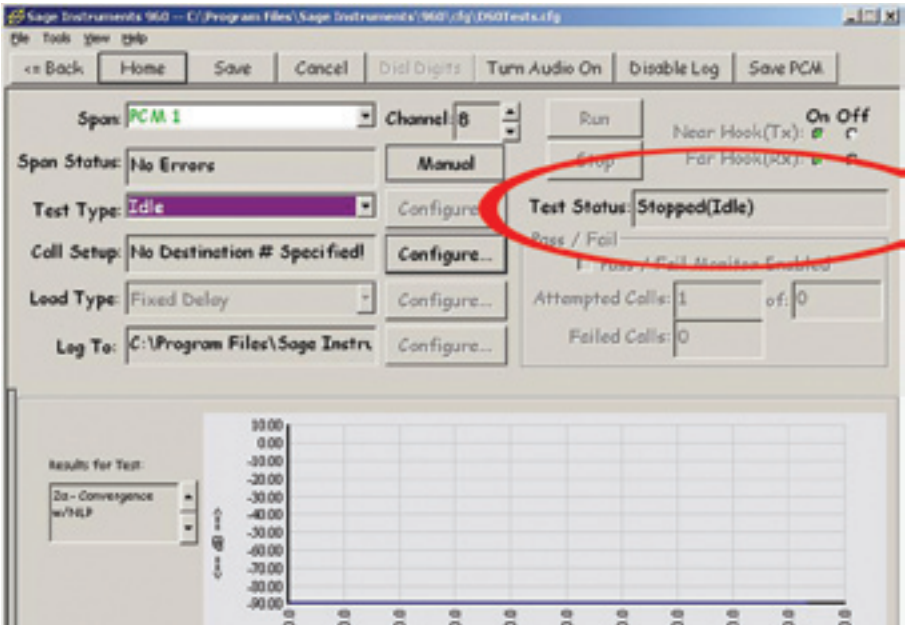


Figure 30

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 (call is being torn down, etc.)
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 aLaw, Load uLaw, or Load Wav and % done	The test is sending the associated PCM file to the DSP

Error States:	
Status Message	**Description**
Error: DSP Error State	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
Too many SMOS Tests!	The User attempted to run too many SMOS tests, so some were terminated to protect the PCM stream

(continued on next page)

Variables Common to all SAGE 960B Tests *(continued)*

Call Control Normal States:	
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
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:	
Far-End Busy	
User Aborted	
No Wink	
Wink too Long	
Far End Abort	
No Answer	
PCM/Frame Loss	
No Dial Tone	

960B Manual Mode

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 31). 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 32). 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.

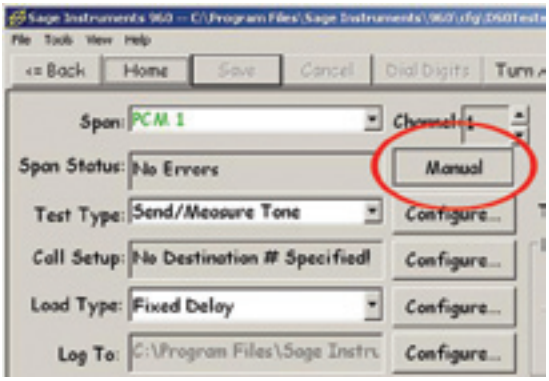


Figure 31

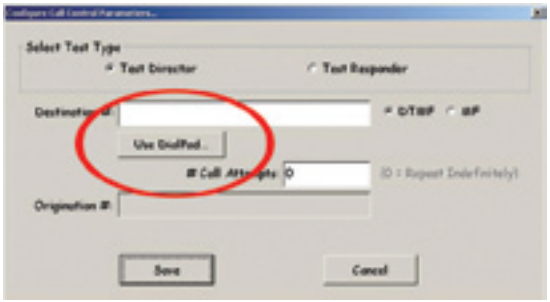


Figure 32

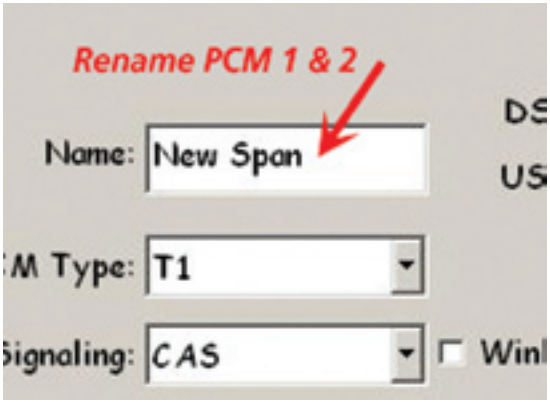


Figure 33

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 phisical 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 33). Click save and then back to return to the span view window.

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 34.

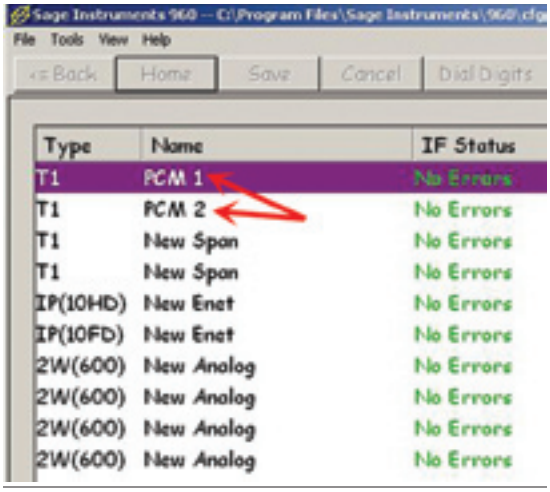


Figure 34

(continued on next page)

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 35).

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 36). Click save to close and return to the main test screen.

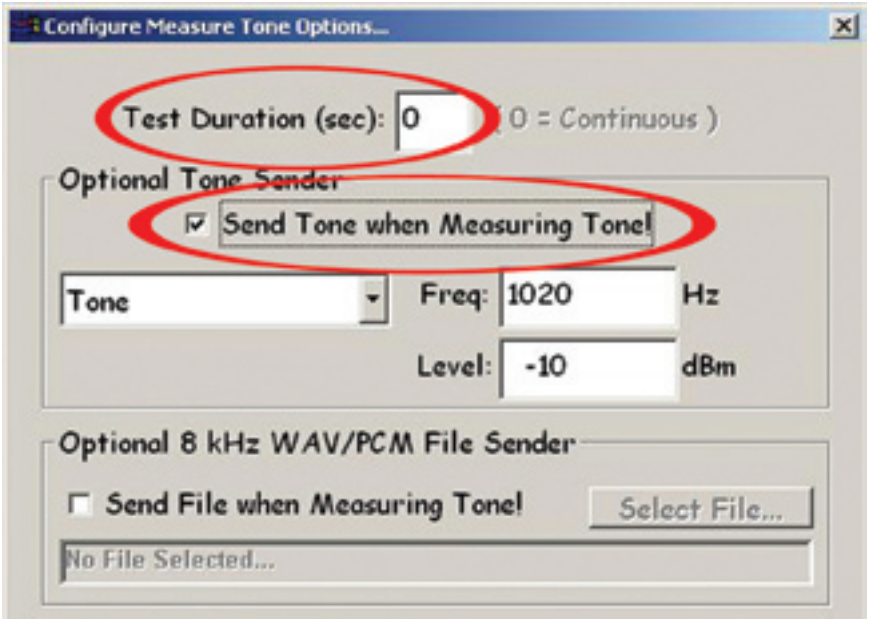


Figure 36

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 37). 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 38).

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)

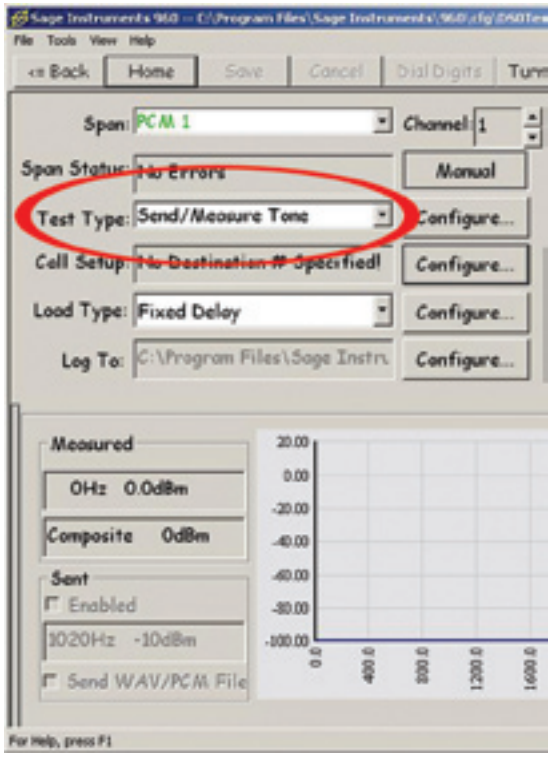


Figure 35

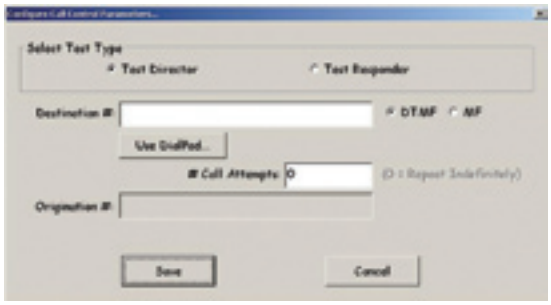


Figure 37

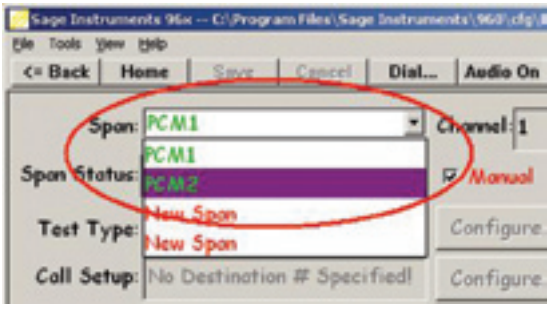


Figure 38

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.

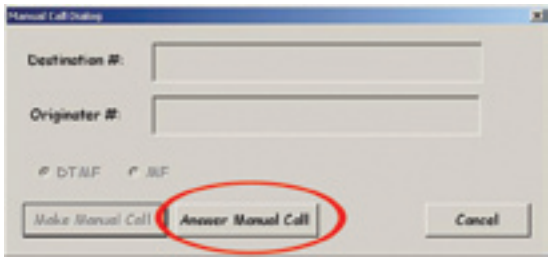


Figure 39

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 39). 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 40 with the test status message reading "Stopped (Wait Far Hook Off)".

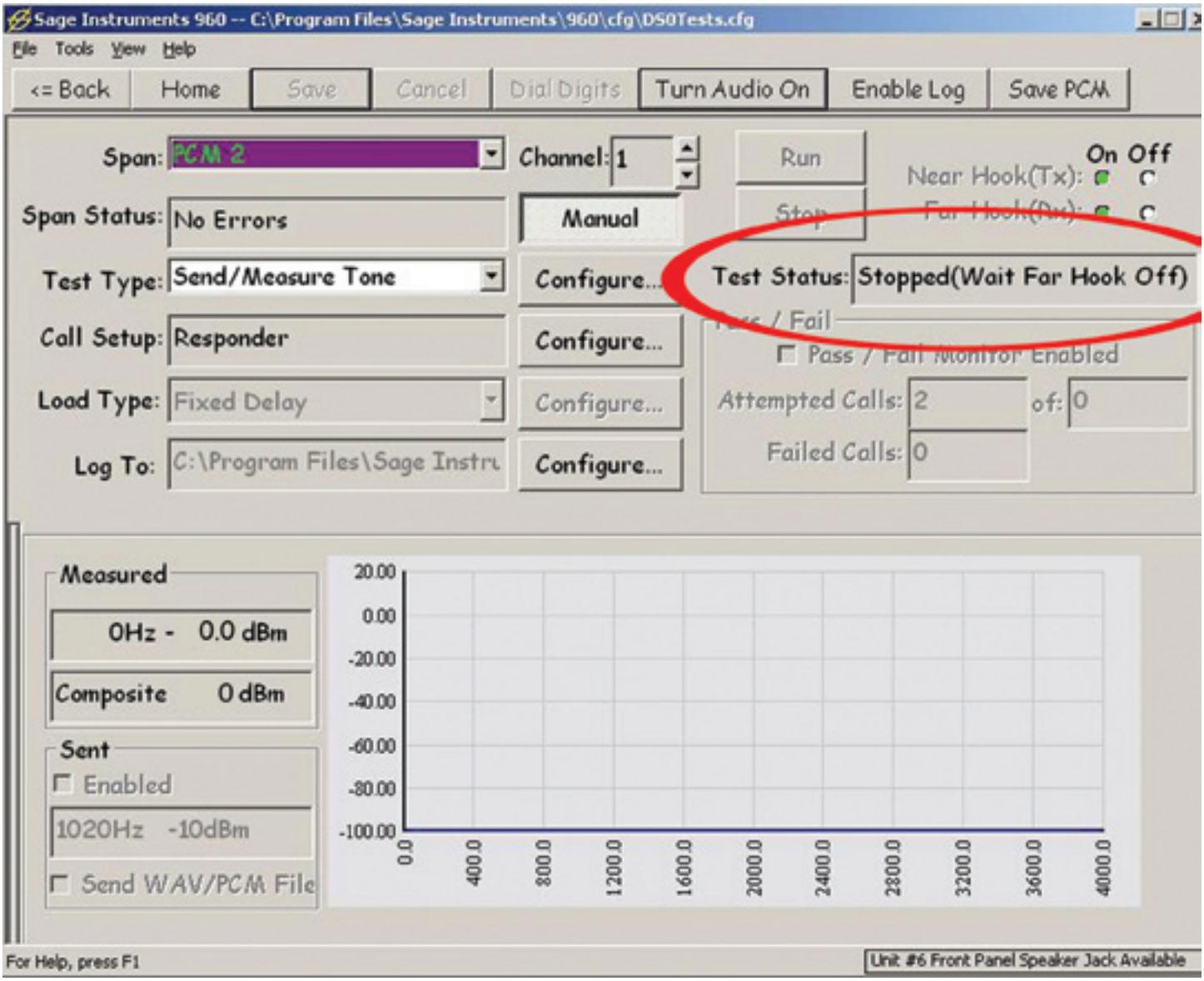


Figure 40

(continued on next page)

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 41). 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.

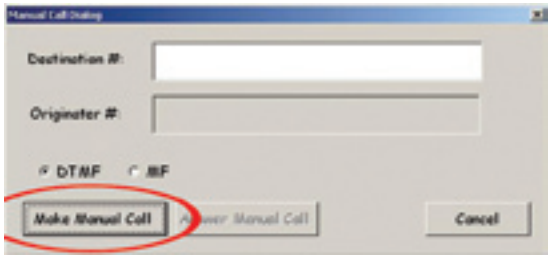


Figure 41

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 42).

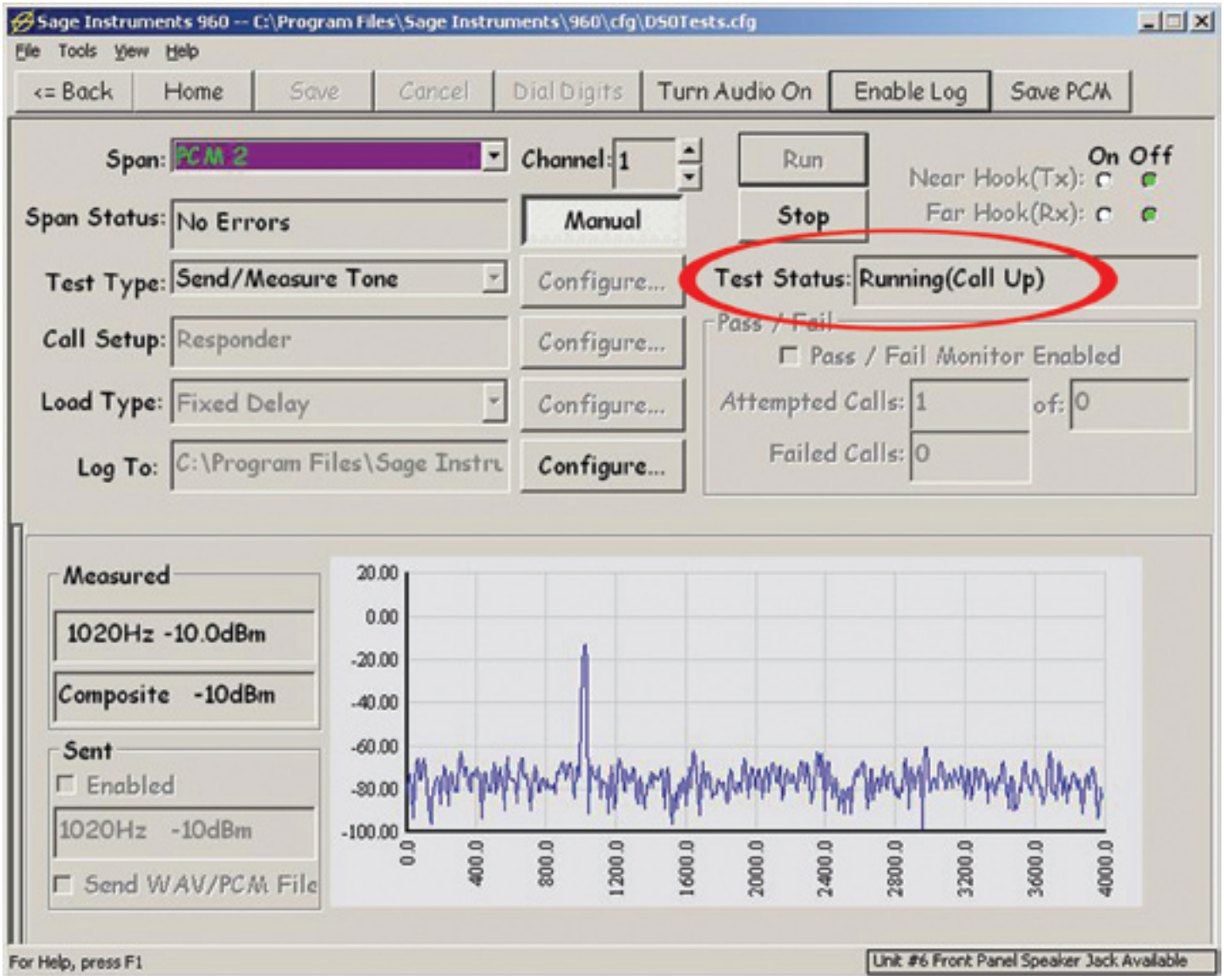


Figure 42

(continued on next page)

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.

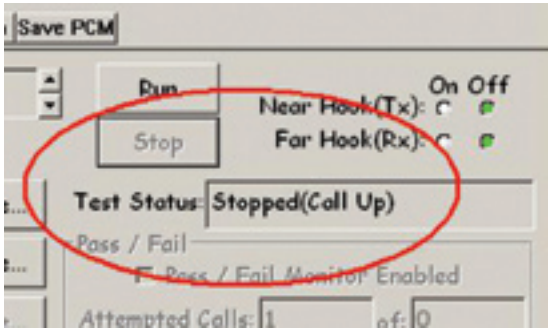


Figure 43

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 43).

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.

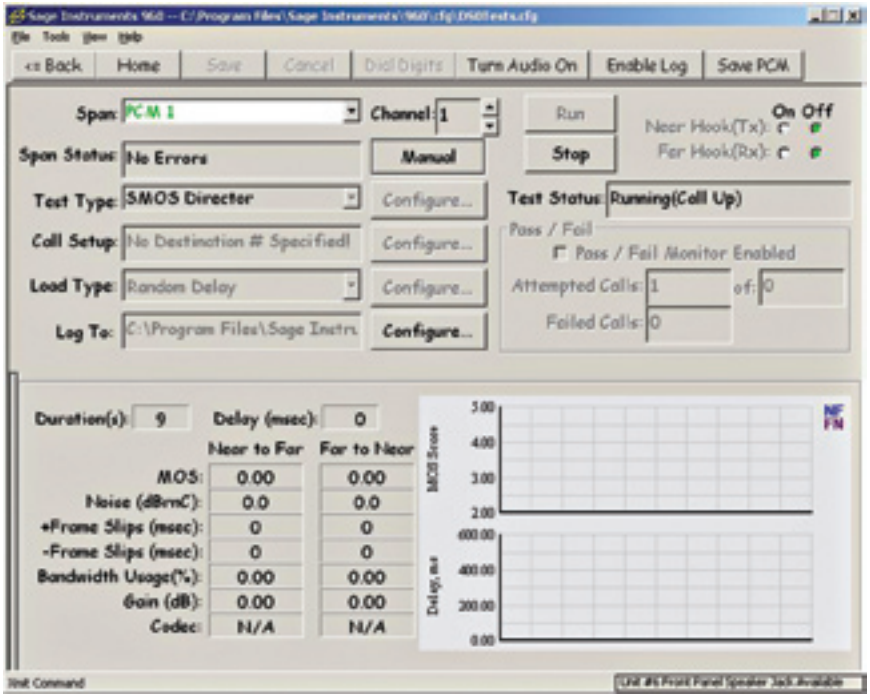


Figure 44

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.

960B Tests and GUI Configurations

Setting Test Variables

Note: After selecting the test type, It is important to click "Save" at the top of the main test screen. This action changes the main screen attributes to those of the selected test.

Send/Measure Tone Test (PCM and Analog)

The SAGE 960B Measure Tone test utilizes seven (7) screens for configuration of the test parameters (see figures 45 through 51). For manual mode (7th screen) see page 40. Sage's 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-to-end points. The tone level can be observed via the spectrum analyzer.

Specifications

Tone Test Transmit

Composite Level: -40 to 0 dBm
Individual Tones: Level: -13.6 dB below composite level
Flatness: ±0.2 dB
Frequencies: 203.125-3640.625 Hz in 156.25 Hz steps, ±10 ppm
Phase per IEEE 743 ±0.25∞
Peak to RMS Ratio 8.79

Tone Test Receive

Range:-40 dBm to -6 dBm
Accuracy: ±0.2 dB

Figure 47 shows the main test screen with the "Send/Measure Tone" test selected and saved. When clicked the four (4) "Configure" buttons down the center of the main screen display the test set-up windows at right.

Figure 47

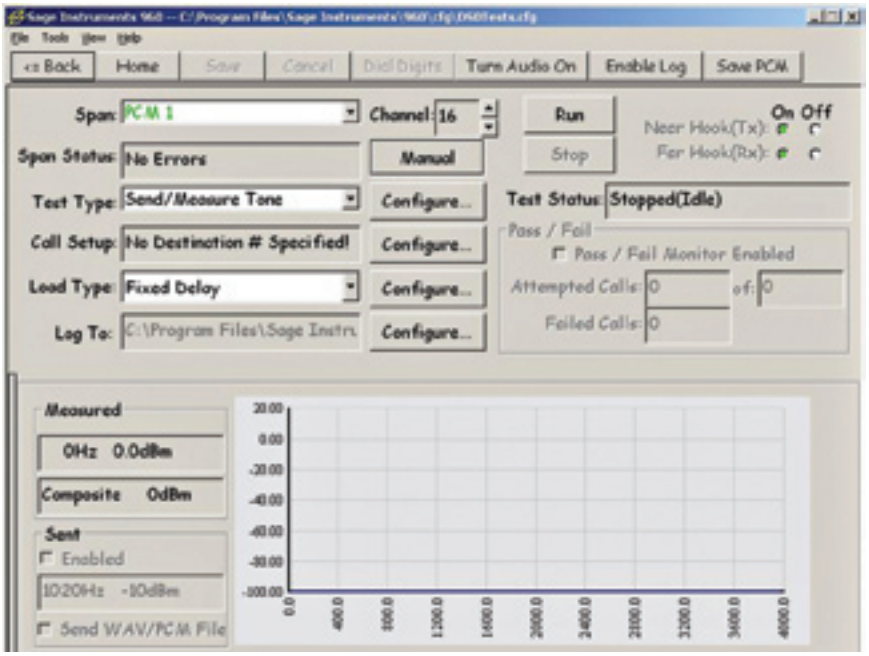
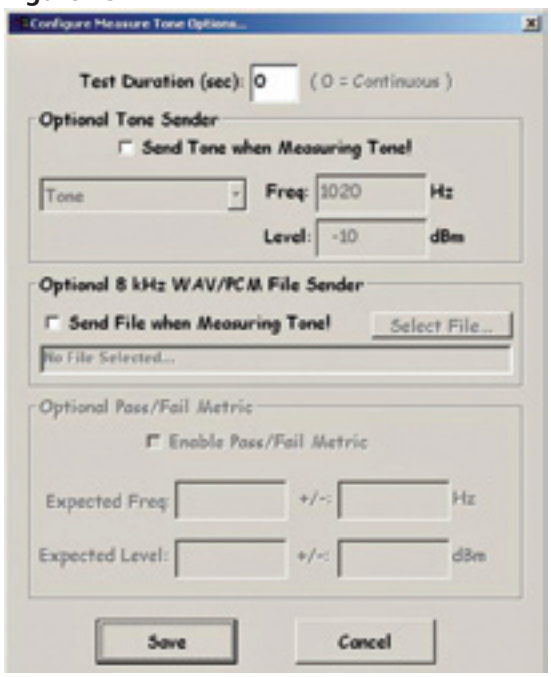


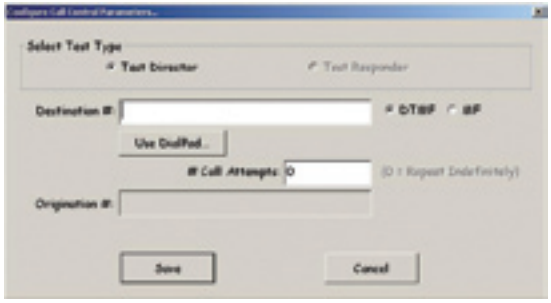
Figure 45



In the Measure Tone Options window set the duration, optional tone sender frequency and dBm level, of the test. You can also choose to replace the tone with a WAV or PCM file, as well as set the optional Pass/Fail Metrics. Click save to return to the main Measure Tone window.

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.

Figure 46



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.

Send/Measure Tone Test *(continued)*

Next, from the pull down menu select "Load type" Fixed or Random delay. Depending on your selection the window launched by the configure button will reflect the attributes of the load type chosen. Fixed load typewill cycle through tests based on a fixed minimum delay (see figure 48). Selecting Random will cycle through tests on a random basis between the mininum and maximum pulse between test settings (see figure 49).

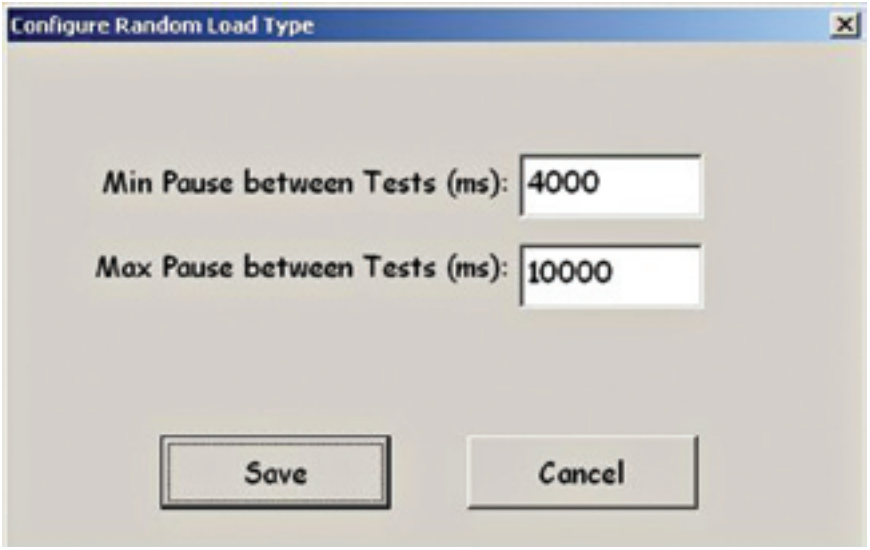


Figure 49
Set random delay minimum and maximum pause between tests in miliseconds.

The final screen to configure is the Log Configuration. If the path to the "Log To" file is greyed-out click the "Enable Log" button second from the right at the top of the main test window. Next click the "Configure" button next to the Log to path. This action launches the Log Configuration window (see figure 50).

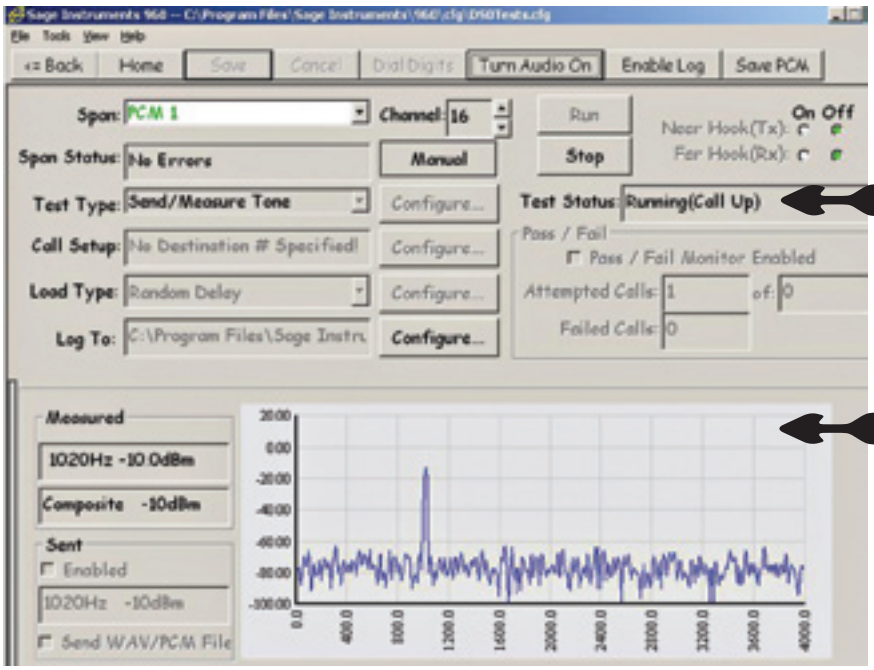


Figure 51

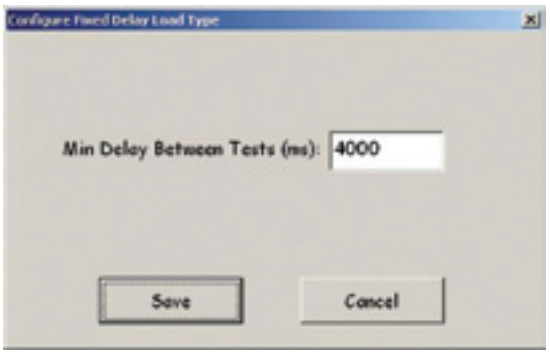


Figure 48
Set fixed delay in miliseconds.

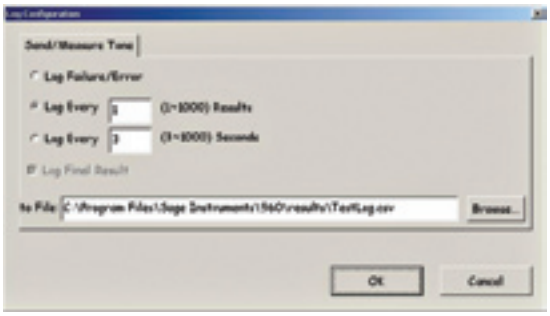


Figure 50
Choose to log events based on lof failure/error every "x" results or every "y" seconds, then enter a path or browse to the location on your local machine or network where you want the log file to be saved. Make sure "Enable Log" is clicked in order to input values.

Configuration Complete

Click the run button and your screen should look like figure 51.

Note: Test Status should read "Running(Call Up)".

Note: The real-time data display is detachable by clicking on the long grey bar at the far left of the main test window. Holding down the left mouse button and dragging over a section of the graph will zoom in on the area selected. Right click to zoom out.

SMOS Director Test *(PCM and Analog)*

Description

The SAGE 960B SMOS Director test utilizes six (6) screens for configuration of the test parameters (see figures 52 through 56). For manual mode (6th screen) see page 40.

Purpose and Function

The Sage Instruments Mean Opinion Score (SMOS) test provides an accurate assessment of how telephone users perceive speech quality over a live VoIP network. SMOS provides a comprehensive set of measurements that pertain to all aspects of voice quality. The SMOS test uses a robust algorithm to deliver accurate results in the presence of jitters, band limitations, and dropouts, producing both near-to-far and far-to-near measurements.

SMOS Measurements

- Clarity - Mean Opinion Score (MOS)
- Effective Bandwidth - % available in the 300 Hz to 3400 Hz range
- Voice Frame Slips - compressive and expansive jitters in milliseconds
- Comfort Noise Level - measured in dBrnC during silent period
- Gain - audio level change measured in dB
- Codec Type - detects and reports codec type used
- Delay - round trip measured in milliseconds
- Call Completion Time - completion time measured in seconds

Figure 52 shows the main test screen with the "SMOS Director" test selected and saved. When clicked the four (4) "Configure" buttons down the center of the main screen display the test configuration windows at right.

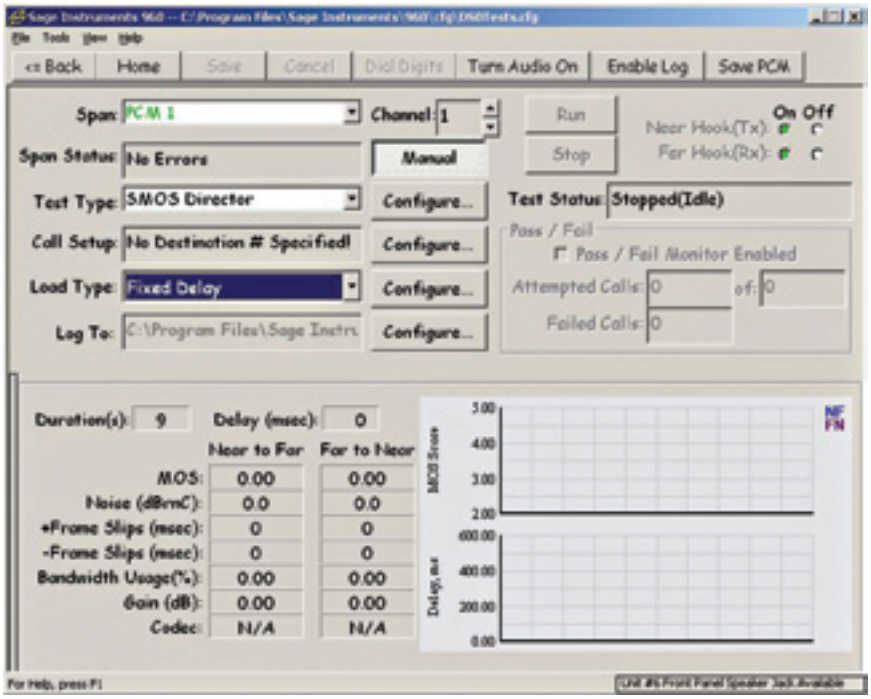


Figure 52

(continued on next page)

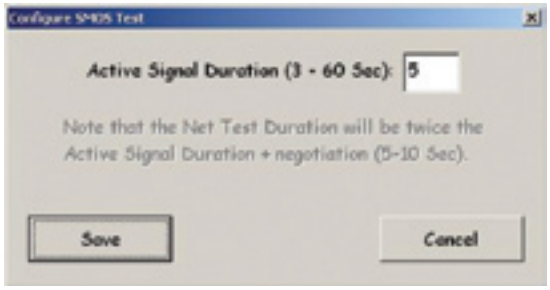


Figure 53

In the SMOS Configuration window set the duration to transmit the artificial voice. The default is 9 seconds

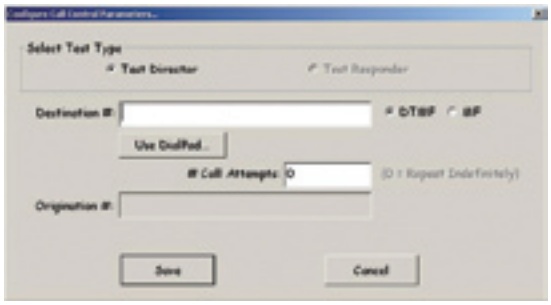


Figure 54

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.

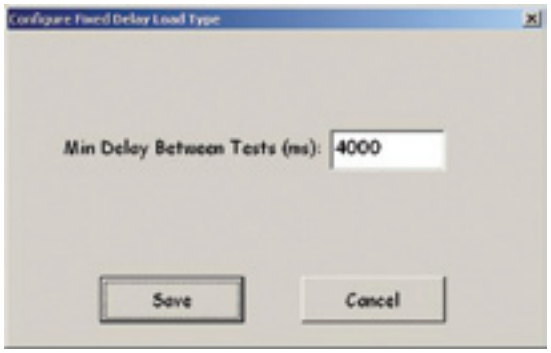


Figure 55 *Select and set Fixed or Random delay between tests..*

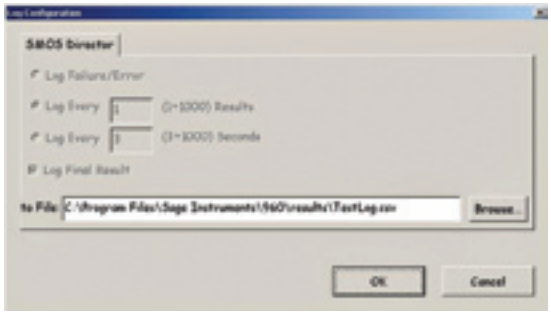


Figure 56 *Choose to log events based on lof failure/error every "x" results or every "y" seconds, then enter a path or browse to the location on your local machine or network where you want the log file to be saved. Make sure "Enable Log" is clicked in order to input values.*

SMOS Director Test *(continued)*

Specifications

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

SMOS Measurement	Range	Accuracy
MOS	1.00 to 5.00	+/- .05
Noise	0 to 90 dBrnC	+/- 1 dB
Frame Slips	0 to 2000 msecs	+/- 1 msec
Effective Bandwidth	0.0 to 99.9%	+/- .2%
Gain	-80 to +20 dB	+/- 1 dB
Delay	0.0 to 5000.0 msec	+/- .2 msec
Codec	See "Codec Types tolerates up to Detected"	15% packet loss

Codec Types Detected	
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

SMOS Test Parameters	Range	Default
Test Duration	3 to 60 seconds	10 seconds
Send TLP	-30.0 to +10.0 dBm	0.0 dBm
Receive TLP	-30.0 to +10.0 dBm	0.0 dBm

SMOS provides an automated, fast, convenient and accurate end-to-end assessment of voice quality for any VoX applications. SMOS follows the automated responder test format and employs robust in-band telemetry and synchronization with true real-time processing. The test can be conveniently used in both laboratory environment as well as across a real telephone network with literally the simple press of one button.

SMOS was developed largely out of Sage's prior experience with PSQM and PVIT.

SMOS provides an accurate MOS score that truly matches human perception even in a live VoP network where certain impairments such as voice jitters (sudden delay variations or frame slips) and attenuation distortion may render other voice quality tests such as PSQM inapplicable.

SMOS contains a reliable Bark-domain partial equalization along with a symmetric masking to properly account for attenuation distortion, and a robust de-jittering algorithm to remove and simultaneously measure any voice jitters (sudden delay variations).

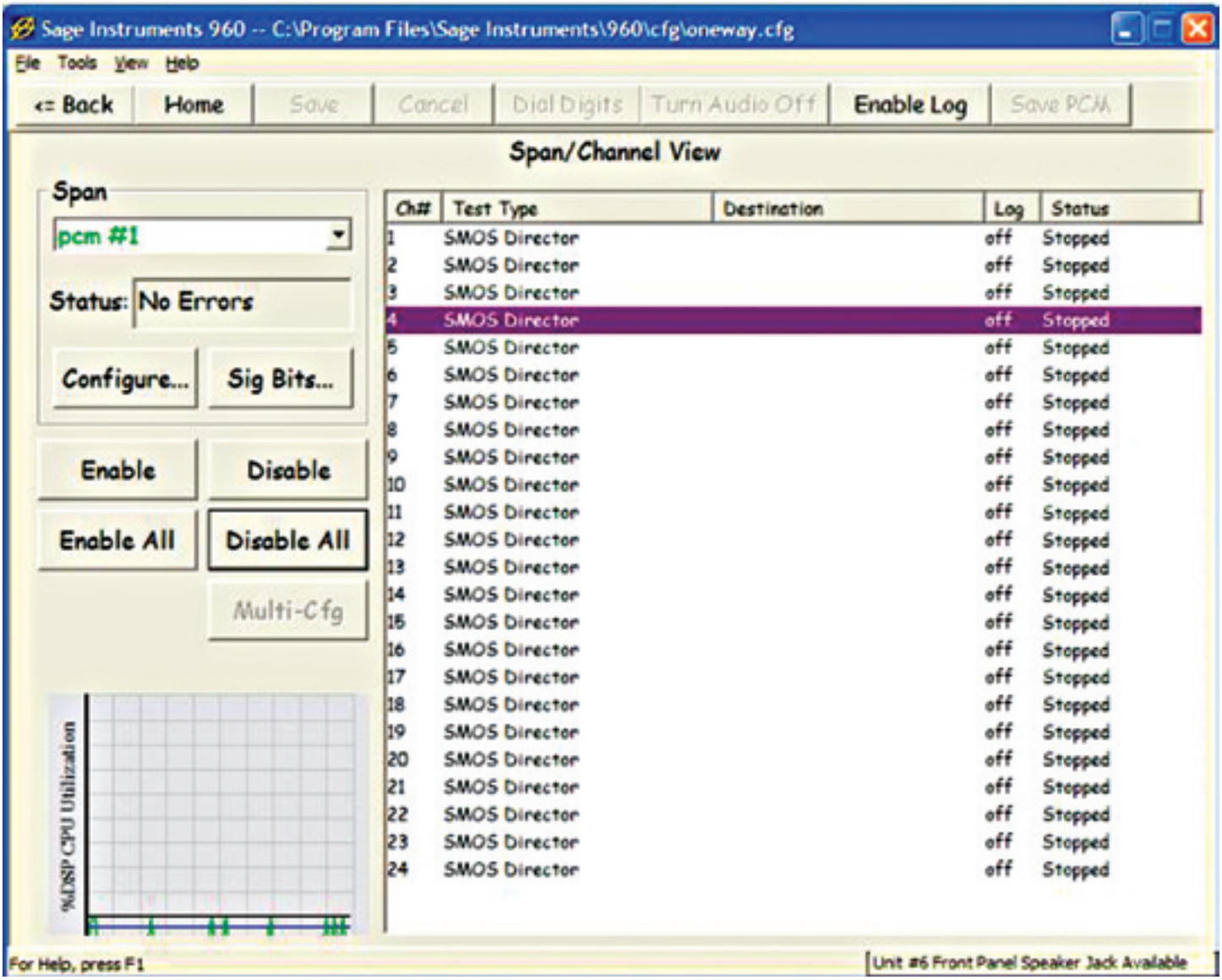
Besides the MOS number, SMOS also provides a set of other ìorthogonalî measurements that are vitally important in determining the overall voice quality of a network, or trouble-shooting the configuration and traffic engineering of a problematic network. These measurements are orthogonal to MOS because 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).

SMOS Director Test *(continued)*

SMOS specifications

SMOS Tests	Range
Director or Responder	1 to 12 SMOS director/responder tests can be RUN simultaneously on a single TDM interface.

Note: You will see a screen similar to the following when you are running more than 12 SMOS director/responder tests.



SMOS Responder *(PCM and Analog)*

Note: After selecting the test type, It is important to click "Save" at the top of the main test screen. This action changes the main screen attributes to those of the selected test.

Description

The SAGE 960B SMOS Responder test utilizes five (5) screens for configuration of the test parameters (see figures 73 through 76).

Purpose and Function

The Sage Instruments Mean Opinion Score (SMOS) test provides an accurate assessment of how telephone users perceive speech quality over a live VoP network. SMOS provides a comprehensive set of measurements that pertain to all aspects of voice quality. The SMOS test uses a robust algorithm to deliver accurate results in the presence of jitters, band limitations, and dropouts, producing both near-to-far and far-to-near measurements.

Figure 57 shows the main test screen with the "SMOS Responder" test selected and saved. When clicked the four (4) "Configure" buttons down the center of the main screen display the test set-up windows at right. Note that the Load Type configuration is not used in the SMOS Responder test, and the button is dimmed.

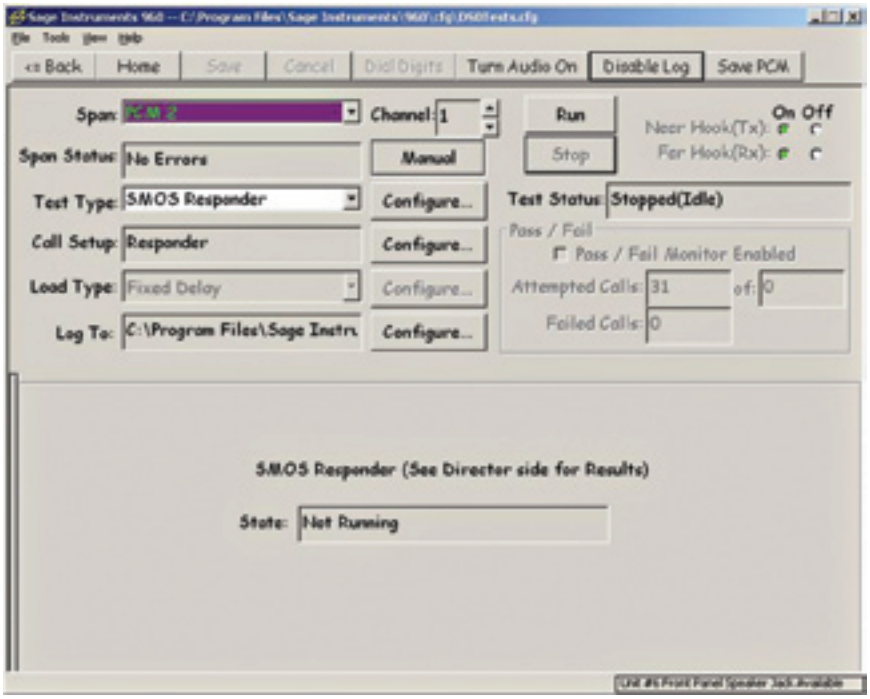


Figure 57

Note: After Configuration is complete click run. **To view results of the SMOS Responder test configure the same channel on a different PCM for a SMOS Director test.** See director side for results.

Figure 58

INo Configuration Required!

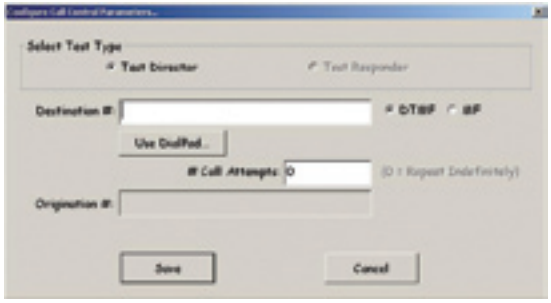


Figure 59

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.

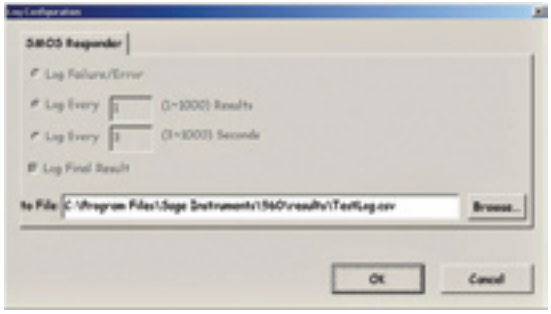


Figure 60 *Choose the timing of log capture, then enter a path or browse to the location on your local machine or network where you want the log file to be saved.*

Packet Voice Impairment Test (PVIT) *(PCM and Analog)*

Description

The SAGE PVIT test utilizes seven (7) screens for configuration of the test parameters (see figures 61 through 68). 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

Purpose and Function

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

Test Duration 15 minutes, 1 hour, 24 hours, or continuous (NOTE: The continuous duration operates for up to 1000 hours)

Specifications

PVIT Measurement Precision

- Voice Frame Loss: ±2 ms
- Voice Frame Slip (jitter): ±0.5 ms
- Voice Clipping: ±2 ms
- Noise Level: ±1 dB
- Percentage Voice Frame Loss: ±10% of actual % of frame loss

Figure 61 shows the main test screen with the "PVIT" test selected and saved. When clicked the four (4) "Configure" buttons down the

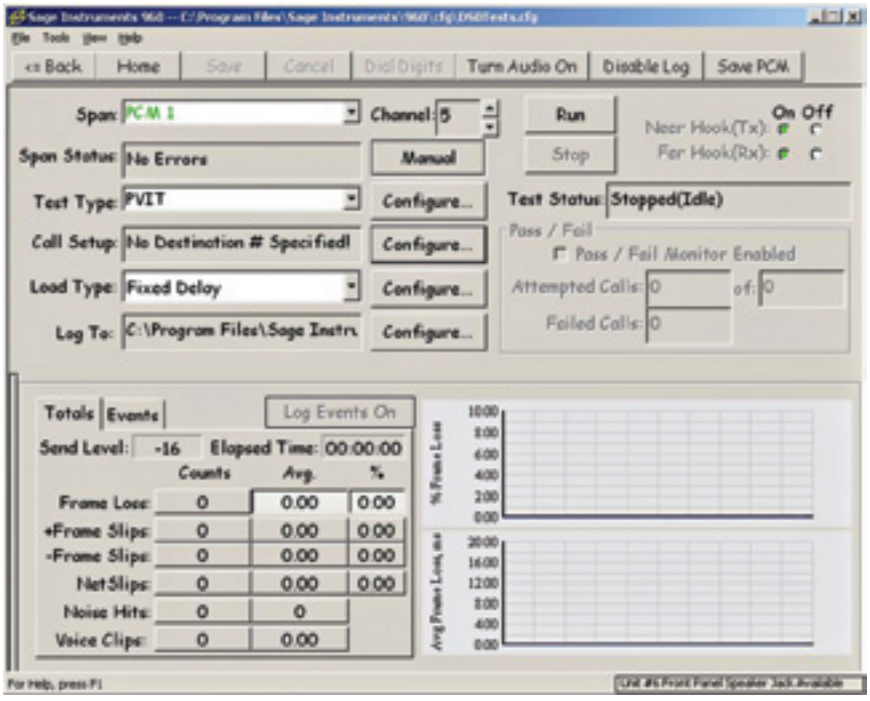


Figure 61

(continued on next page)

Figure 62

In the PVIT Configuration window set the test duration. (NOTE: The continuous duration "0" operates for up to 1000 hours). Set your transmit level in dBm, Then set the event mask in miliseconds. Finally set the transmission scenario, Receive only, Send only or Send and Receive. Click save.

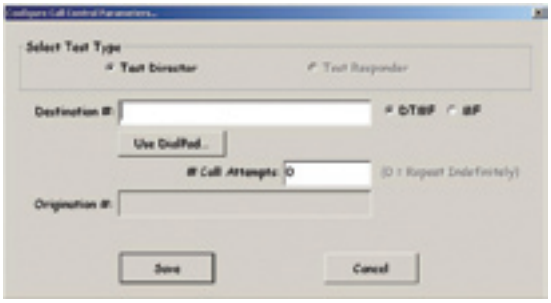


Figure 64 *Remember to run a PVIT test, one side should be set to Test Director and another to Test Responder. Enter the test call destination number and number of attempts. Click save.*

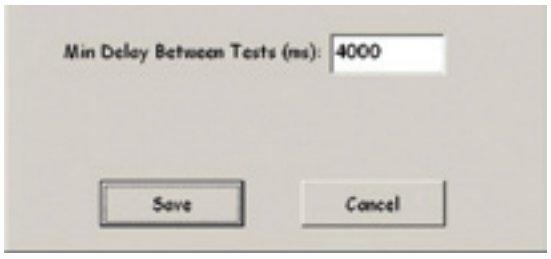


Figure 65 *Select and set Fixed or Random delay.*

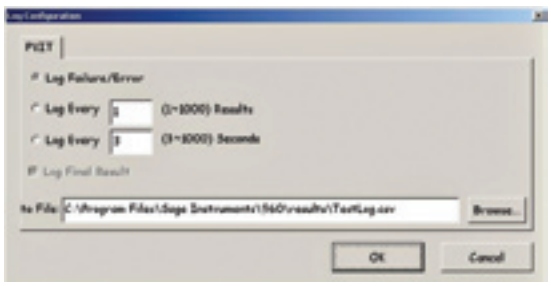


Figure 66 *Choose the timing of log capture, then enter a path or browse to the location on your local machine or network where you want the log file to be saved.*

PVIT Test Real Time Metrics

The bottom section of the Packet Voice Impairment Test main configuration screen is devoted to real time data that you can access during a PIVT test. In this area you can view test statistics and event results (see figure 67).

Totals and Events Tabs

The Totals tab displays a group of **metrics** that are near-end metrics of count average and percentage captured during measurement. The Events tab displays near-end results showing individual impairment events. Users have the ability to toggle between totals and events by clicking on the tabs (see figure 68).

The results for metric Totals are displayed in a table of 8 rows and 4 columns In the first row are two fields, one for "Send Level" or Transmit level and "Elapsed Time" (see example below) the remaining rows display test data. The cells 0 or 0.00 depicted in grey are buttons that not only display data, but when clicked control the graphic representation of that buttons data message (see close-up figure 69).

Send Level:		**Elapsed Time:**	
	Counts	**Avg.**	**%**
Frame Loss:	0	0.00	0.00
+Frame Slips:	0	0.00	0.00
-Frame Slips:	0	0.00	0.00
Net Slips:	0	0.00	0.00
Noise Hits:	0	0	
Voice Clips:	0	0.00	

Frame Loss: Packet/Frame Loss Includes total elapsed test time, net total PL/FL impairment time, PL/FL event count, PL/FL Average and PL/FL % of total time.

Positive Packet/Frame Slips: A measure of voice signal com-pression (jerking). Includes total elapsed test time, net total +PS impairment time, +PS event count, +PS/FS Average and +PS% of total time.

Negative Packet/Frame Slips: A measure of voice signal expansion (gapping). Includes total elapsed test time, net total -PS impairment time, -PS event count, -PS/FS Average and -PS% of total time.

Net Slips: Net slip counts, average and %.

Noise Hits: Transient Impulse Noise; Includes total elapsed test time, noise event count, and average event duration.

Voice Clippings: Includes total elapsed test time, net total VC impairment time, VC event count, and average event duration.

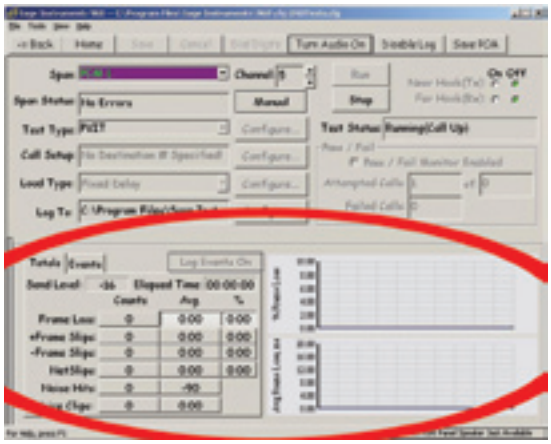


Figure 67

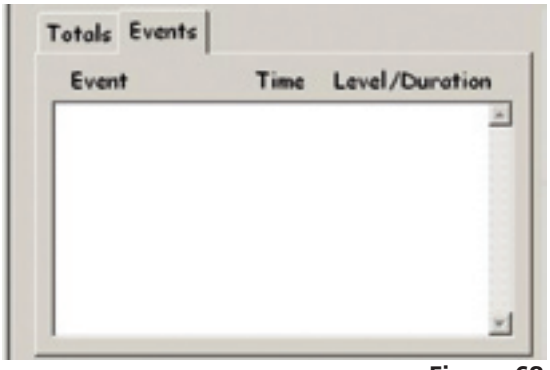


Figure 68

The results for Events are displayed above as recorded events. Results include event type, event duration, and time stamp.

Event types can be:

- **IS:** In_SYNC
- **RS:** SYNC Recovered
- **SL:** Signal Lost, SYNC Lost
- **SR:** Signal Recovered
- **PL:** Packet/Frame Loss
- **PS:** Packet/Frame Slip (Delay Variation)
- **VC:** Voice Clip
- **NH:** Noise Hit
- **DC:** Detection of Clock Drift

Figure 69

Echo Sounder *(PCM and Analog)*

The SAGE 960B Echo Sounder test utilizes five (5) screens for configuring test parameters (see figures 70 through 73).

Purpose and Function

Echo is one of the most important quality of service factors in a telephone network. Sage Instruments echo test suite includes a complete set of tools to characterize the level and delay of echoes on a network. It provides an objective measurement of this important aspect of overall voice quality.

Echo Sounder

The Sage Echo Sounder test measures echoes with the following:

- Echo levels and Echo delays
- Round trip delay and Round trip attenuation
- One way delay and One way attenuation

Specifications

The measurement ranges and precisions of Echo Sounder are shown in the table below. The echo delay ranges differ slightly with different interfaces.

Connection Interface	Echo Level Range/ Precision	Echo Delay Range/ Precision
2-Wire Analog	[-60,20]±1 dB	[7,900]±1ms
4-Wire Analog	[-60,20]±1 dB	[0,900]±1ms
T1/E1	[-60,20]±1 dB	[0,900]±1ms

Figure 70 shows the main test screen with the "Echo Sounder" test selected and saved. When clicked the four (4) "Configure" buttons down the center of the main screen display the test set-up windows.

Figure 70

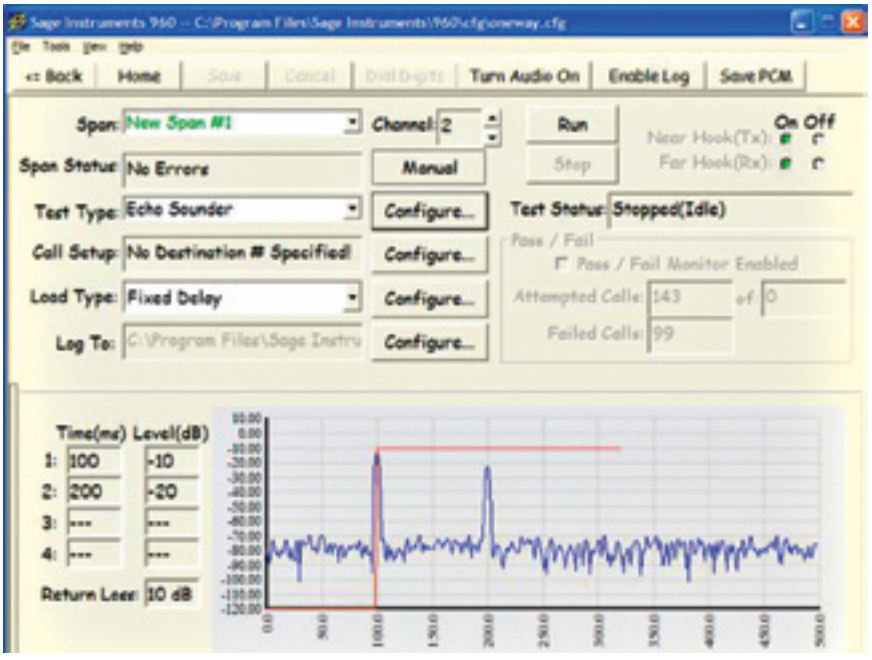
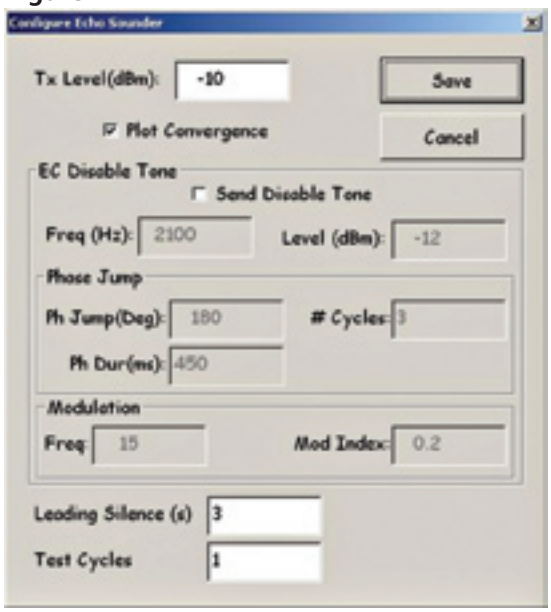


Figure 71



The EC Disabler Tone: This is the 2100Hz, -12 dBm tone with phase reversal every 450 ms. Total duration of this tone is 1800 (4×450) ms. It has exactly 3 phase reversals. At the phase reversal point, the phase jump is guaranteed to be greater than 170 deg. The purpose of this tone is to disable the echo cancellers under test. This tone is only sent upon user request. At default mode, this tone is not sent (i.e., leave the echo canceller in enabled mode).

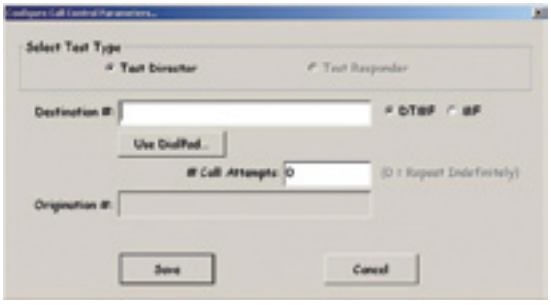


Figure 72 *In the Configure Call Parameters window select Test Director or Test Responder, enter the test call destination number and number of attempts. From this window you can also click the "Use Dial-Pad" to enter digits. Click save.*

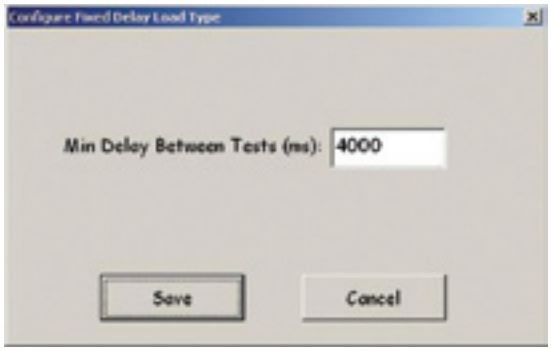


Figure 73 *Select and set Fixed or Random delay.*

Configuration complete, click Run.

Echo Generator *(PCM and Analog)*

The SAGE 960B Echo Generator test utilizes five (5) screens for setting test parameters (see figures 74 through 77).

Note: As a Responder the Load type configuration is inactive.

Purpose and Function

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.

- Programmable echoes and levels
- Global echo disable in manual mode
- Facilitates echo canceller tests

Specifications

Circuit Type	Level Range/ Accuracy	Delay Range/ Accuracy	Frequency Range
Analog 2-wire	[-40,9]±0.5 dB	[17,600]±0.5 ms	300 to 3300 Hz
Analog 4-wire	[-60,9]±0.2 dB	[17,600]±0.5 ms	300 to 3300 Hz
Digital T1/E1	[-60,9]±0.2 dB	[12,600]±1 ms	20 to 3900 Hz

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.

Figure 74 shows the main test screen with "Echo Generator" selected and saved. When clicked the four (4) "Configure" buttons down the center of the main screen display the test set-up windows.

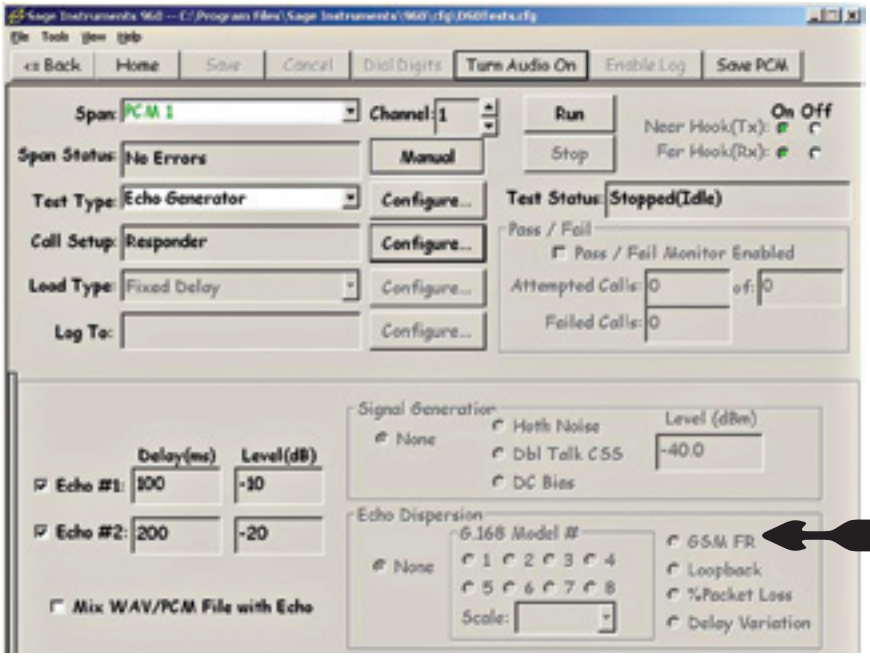


Figure 74

Figure 75

The Echo Generator Configuration window sets echo delay and dB level, signal generation characteristics and **echo dispersion characteristics***. You can also choose to mix with or replace the echo signal with a WAV or PCM file.*

**See following page for detailed Echo Dispersion regarding G.168 Echo Path Models, CCS (Composit Source Signal) white noise and Scaling.*

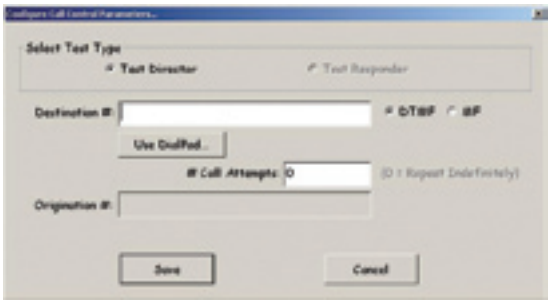


Figure 76 *In the Configure Call Parameters window select Test Director or Test Responder, enter the test call destination number and number of attempts. From this window you can also click the "Use Dial-Pad" to enter digits. Click save.*

Figure 77 *In Director mode only Select and set Fixed or Random delay.*

Note: The greyed-out area is a visual reference of the choices made during test configuration, and cannot be changed from this screen.

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 78).

Figure 78

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 (Composit Source Signal) or white noise as the scaling factor the values of K_i are provided in the table below.

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

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

* 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.

For tests that use Tones as the scaling factor the values of K_i are provided in the table below.

Echo Path Model	Scaling Factor K_i	Minimum ERL for Tones (dB)*
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

* A minimum ERL value of 6 db should be used in the tests for all 8 echo path models. Each scaling factor is used to limit the maximum of the magnitude response to the chosen ERL value.

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

Echo Convergence Test *(PCM only)*

Note: After selecting the test type, It is important to click "Save" at the top of the main test screen. This action changes the main screen attributes to those of the selected test.

Description
The SAGE 960B Convergence test utilizes six (6) screens for configuration of the test parameters (see figures 79 through 82).

Purpose and Function
The importance of echo control and echo measurement in a telephony network can never be overemphasized. The Sage 960B Convergence test measures the transient echo or echo convergence due to adaptive filtering inside an echo canceler. In addition far-end total return loss is also measured.

Using third generation Echo Sounder technology the SAGE 960B Convergence test measures delays and levels of multiple echoes, through common telephony interfaces such as analog 2-wire POTS and digital DS1.

Figure 79 shows the main test screen with the "Convergence" test selected and saved. When clicked the four (4) "Configure" buttons down the center of the main screen display the test set-up windows at right.

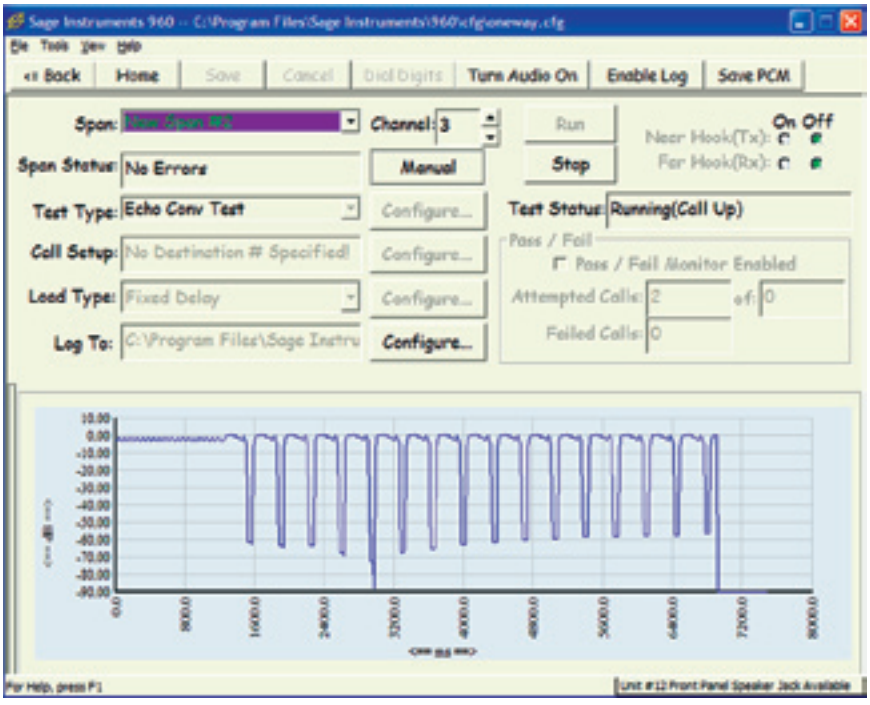
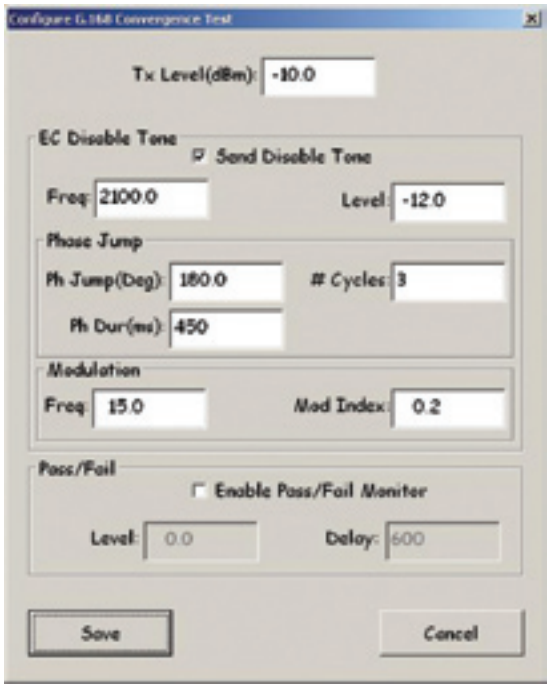


Figure 79

Figure 80



In the Convergence Configuration window set the disable tone frequency and level, the phase jump, number of cycles, modulation and the desired pass/fail parameters of the test.

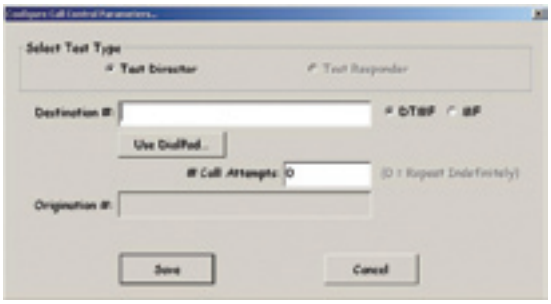


Figure 81 *In the Configure Call Parameters window select Test Director or Test Responder, enter the test call destination number and number of attempts. From this window you can also click the "Use Dial-Pad" to enter digits. Click save.*

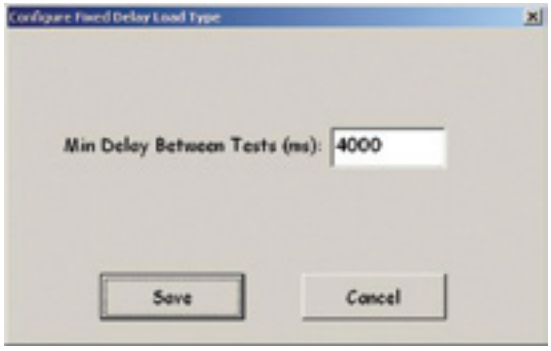


Figure 82 *Select and set Fixed or Random delay.*

Next, if desired enable and set up the Log Configuration. **Configuration complete, click run.**

G.168 Tests *(PCM only)*

Description

The SAGE 960B G.168 tests utilize nine (9) screens for configuration of the G.168 test parameters (see figures 83 through 90).

Purpose and Function

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 83 shows the main test screen with the "G.168" test selected and saved. When clicked the four (4) "Configure" buttons down the center of the main screen display the test set-up windows at right.

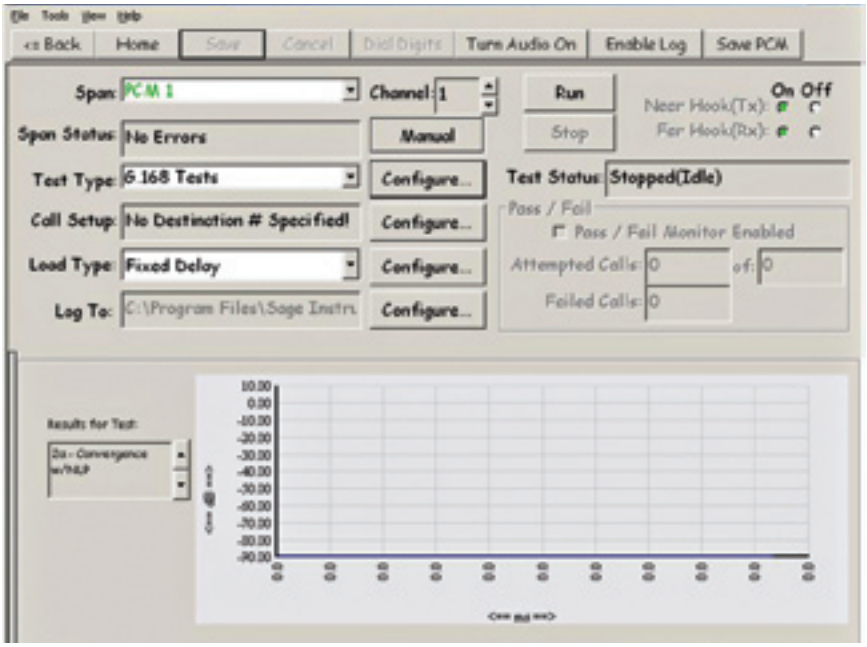
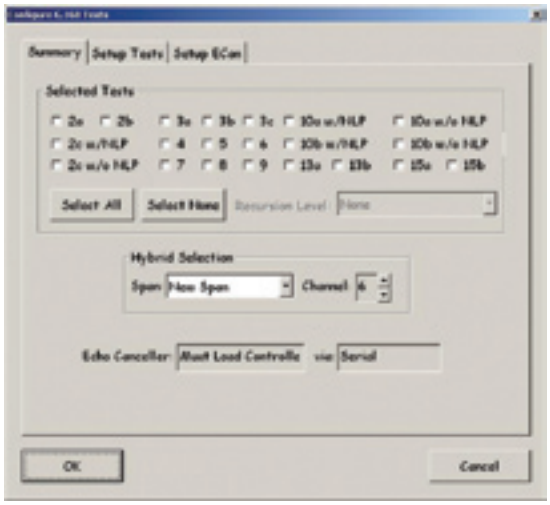


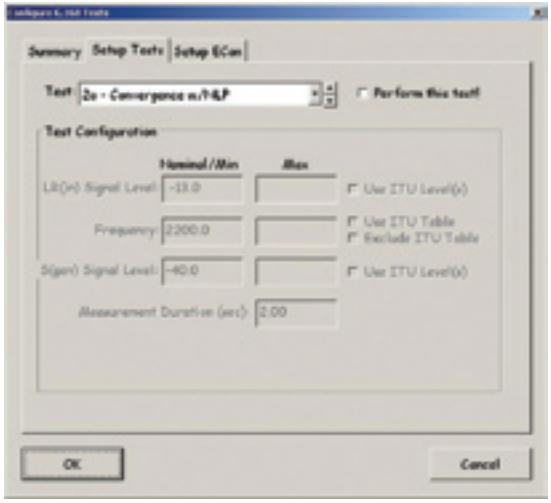
Figure 83

Figure 84



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 85



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.

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).

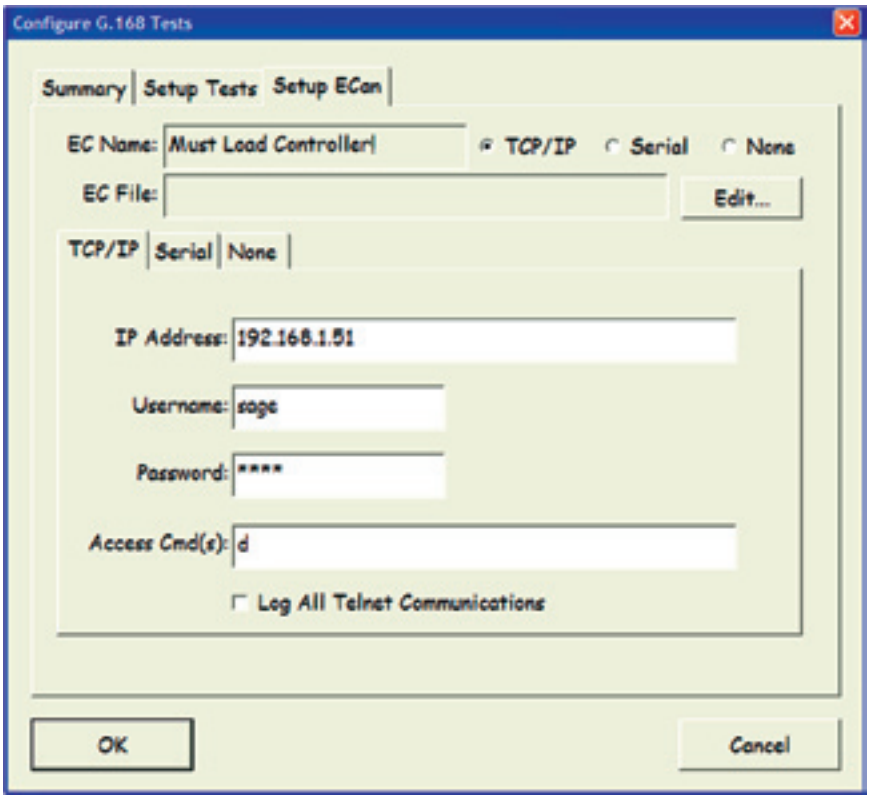


Figure 86

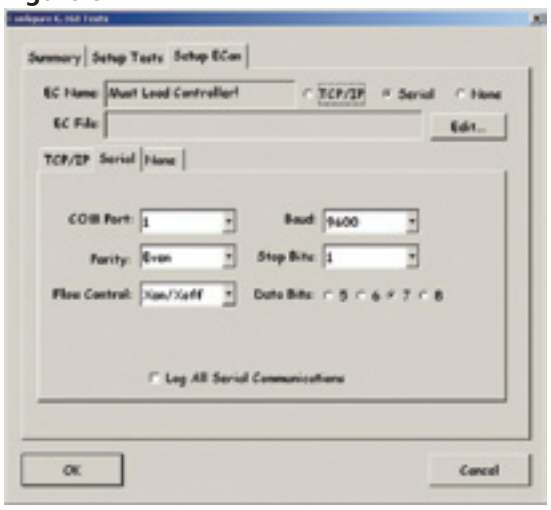
Note: If the G.168 test to be conducted includes an echo canceller the SAGE Echo Generator option must be installed.

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 87). 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 87



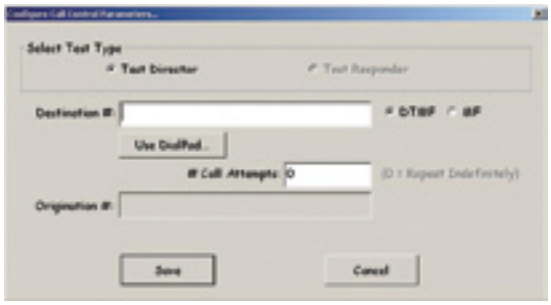


Figure 88 *In the Configure Call Parameters window select Test Director or Test Responder, enter the test call destination number and number of attempts. From this window you can also click the "Use Dial-Pad" to enter digits. Click save.*

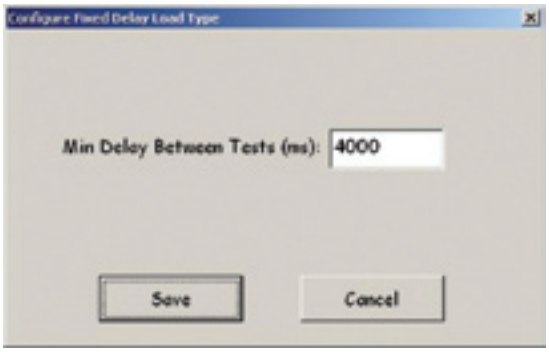


Figure 89 *Select and set Fixed or Random delay.*

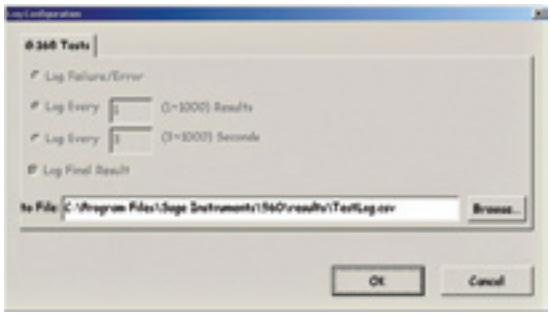


Figure 90 *Set-up Log Capture, click OK.*
Configuration complete, click run.

INMD P.561 *(PCM only)* utilizes four (4) screens for configuration of the test parameters (see figures 91 through 94).

Specifications

Interface	Range	Accuracy
TDM	0 to 511 ms	±one frame of uncertainty

Purpose and Function

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 91 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.

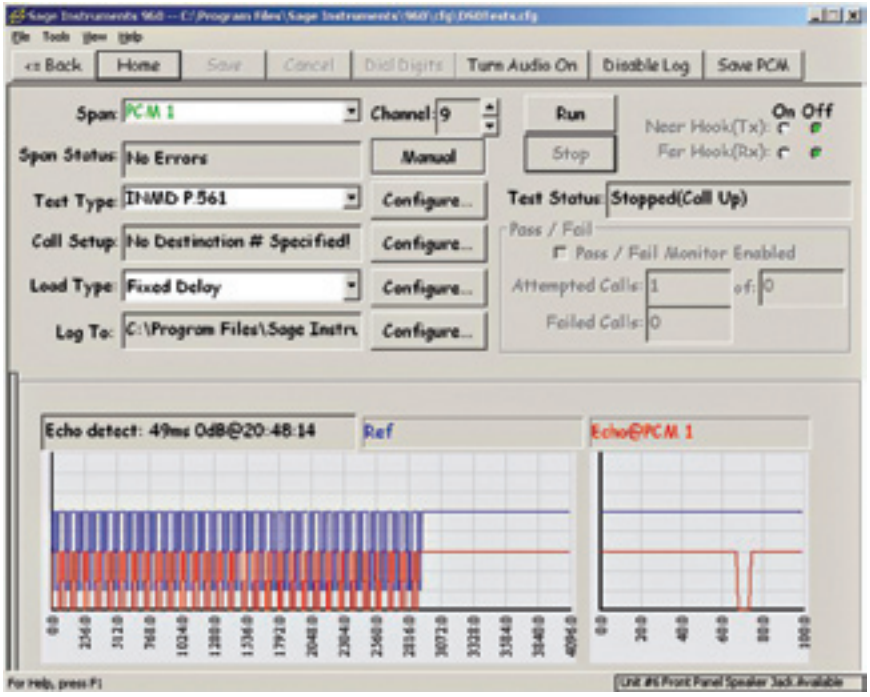


Figure 91
In Figure 91, there is an echo detected of 49ms delay and 0 dB level at 20:48:14 In the left plot, the blue line represents the reference signal on PCM2 while the red line represents the measured echo signal on PCM1. The signal is plotted for the last 4096 ms. The right plot shows the last 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 92 *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 Dial-Pad" to enter digits. Click save.*

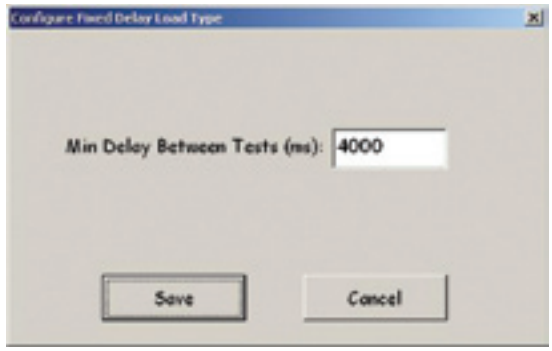


Figure 93 *Select and set Fixed or Random delay.*

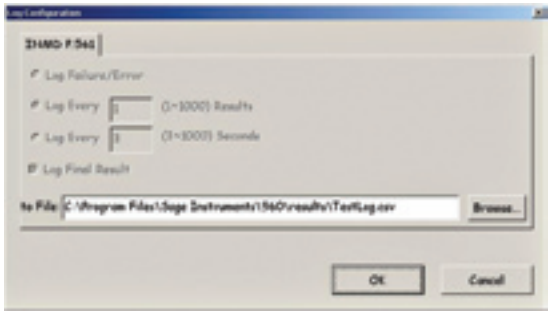
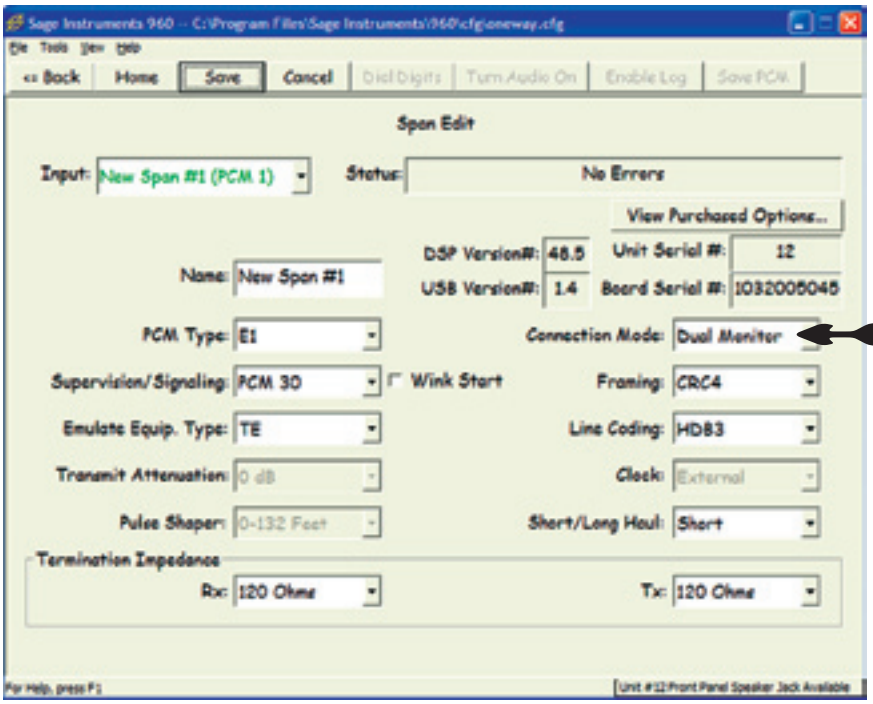
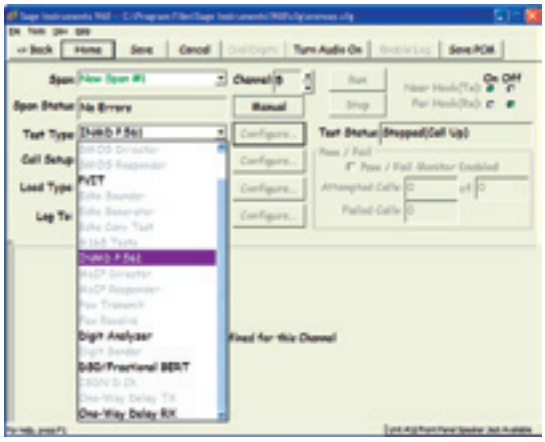


Figure 94 *Choose the timing of log capture, then enter a path or browse to the location where you want the log file to be saved.*

(continued on next page)



Note: for INMD to be available and not greyed out, 'Dual Monitor' mode must be configured, which will automatically configure the span associated with the PCM board. For example, if PCM 1 is selected as 'Dual Monitor', PCM 2 will also be configured as 'Dual Monitor', vice versa for PCM 2/PCM1. If PCM3 is selected as 'Dual Monitor', PCM 4 will also be configured as 'Dual Monitor', vice versa for PCM 4/PCM3.



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 94a.

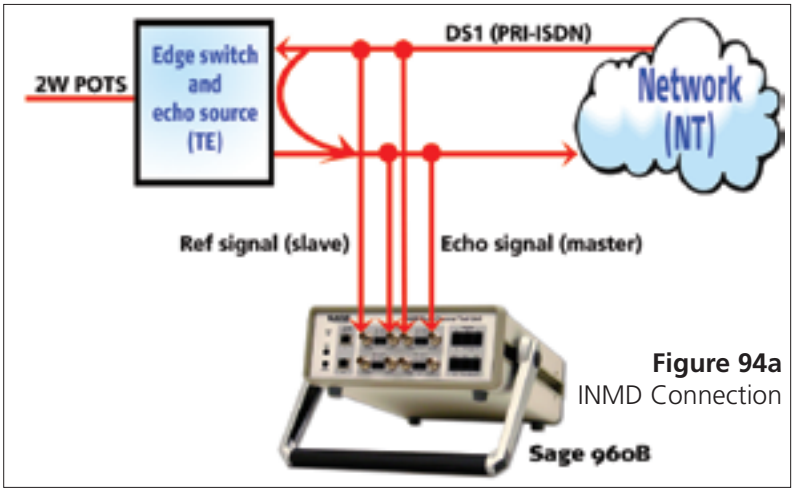


Figure 94a
INMD Connection

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.
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 94a, 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.

MoIP Director *(PCM and Analog)*

Description

The SAGE MoIP Director test utilizes five (5) screens for configuration of the test parameters (see figures 95 through 99).

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 Sageís 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 95 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.

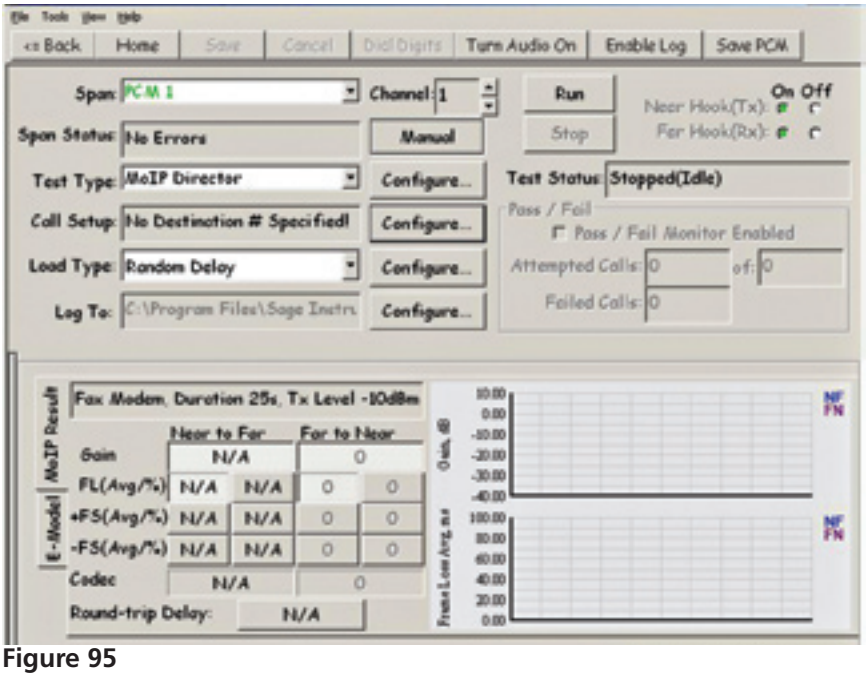


Figure 95

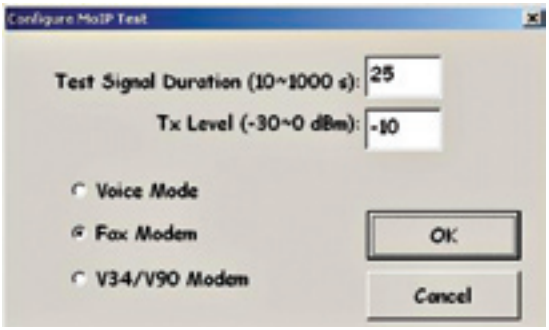


Figure 96 *In the Configure MoIP Test window set the signal duration in seconds, the transmit level and finally select the test type; Voice, Fax Modem or V34/V90 Modem.*

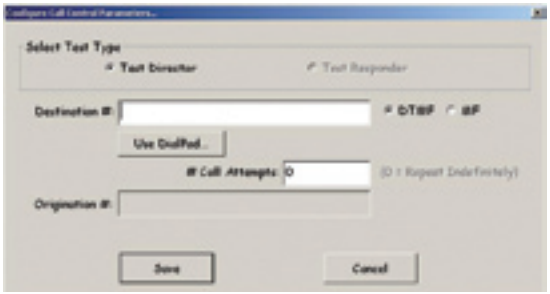


Figure 97 *In the Configure Call Parameters window select Test Director or Test Responder, enter the test call destination number and number of attempts. From this window you can also click the "Use Dial-Pad" to enter digits. Click save.*

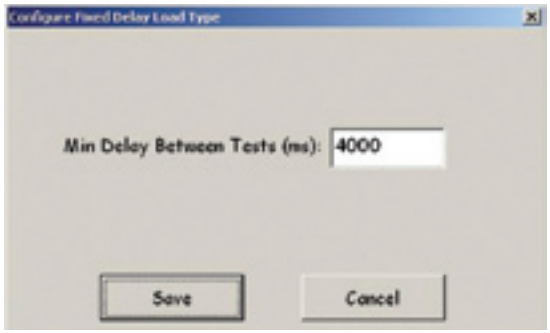


Figure 98 *Select and set Fixed or Random delay.*

Figure 99 *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.**

See also the ' New IP Telephony Transparency Test, MoIP, Fax, Data & Voice White Paper' available via www.sageinst.com.

MoIP Responder *(PCM and Analog)*

Description

The SAGE MoIP Responder test utilizes four (4) screens for configuration of the test parameters (see figures 100 through 102).

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 100 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.

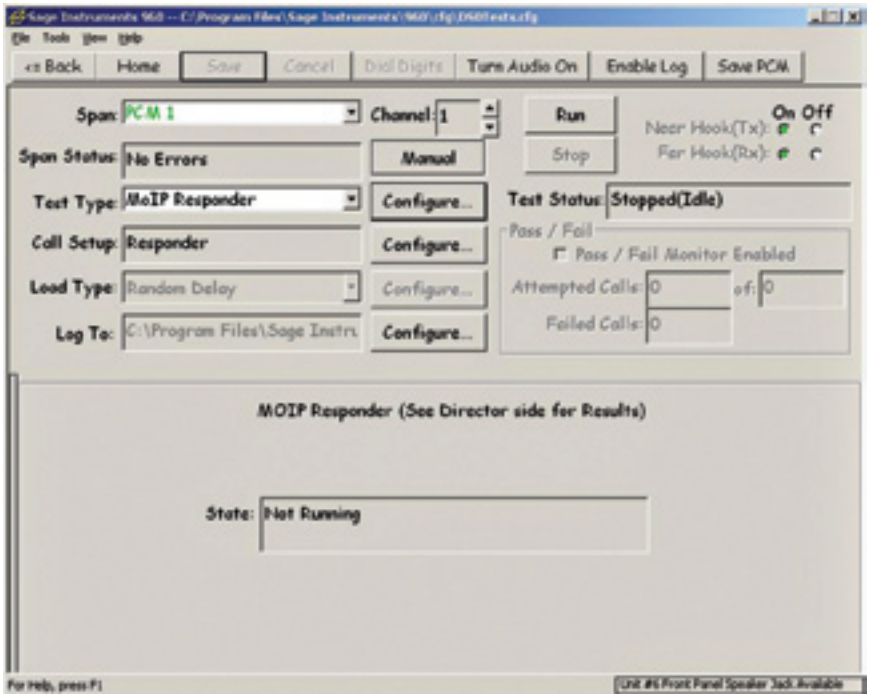


Figure 100

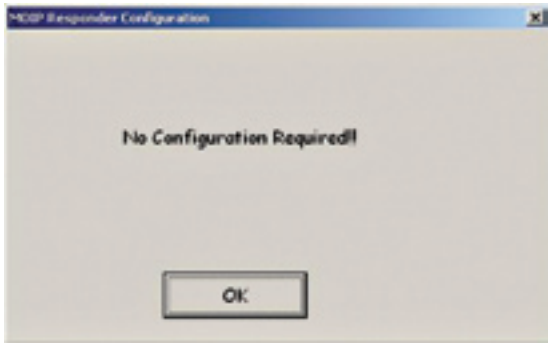


Figure 101 *In Responder mode no configuration is required.*

Note: that the Load Type configuration is not used in the MoIP Responder test, and the button is dimmed.

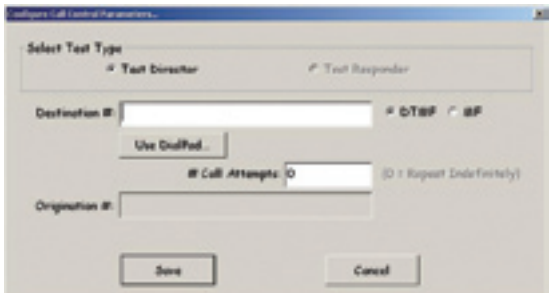


Figure 102 *In the Configure Call Parameters window select Test Director or Test Responder, enter the test call destination number and number of attempts. From this window you can also click the "Use DialPad" to enter digits. Click save.*

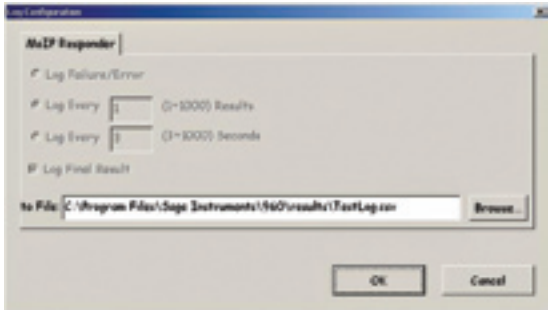


Figure 102 *Next, Choose the timing of log capture, then enter a path or browse to the location on your local machine or network where you want the log file to be saved.*

Configuration complete, click run.

FAX Transmit/Receive Tests *(PCM and Analog)*

Description

The SAGE 960B FAX Transmit test utilizes five (5) screens for configuration of the test parameters (see figures 103 through 107). The SAGE 960B Fax Emulator (SFE) emulates both a realistic FAX transmitter and a FAX receiver.

Purpose and Function

Under test the 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 Two test pages will be sent from the transmitter to the receiver. The test pages are encoded according to formats documented 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 103 shows the main test screen with the "FAX Transmit" test selected and saved. When clicked the four (4) "Configure" buttons down the center of the main screen display the test set-up windows at right.

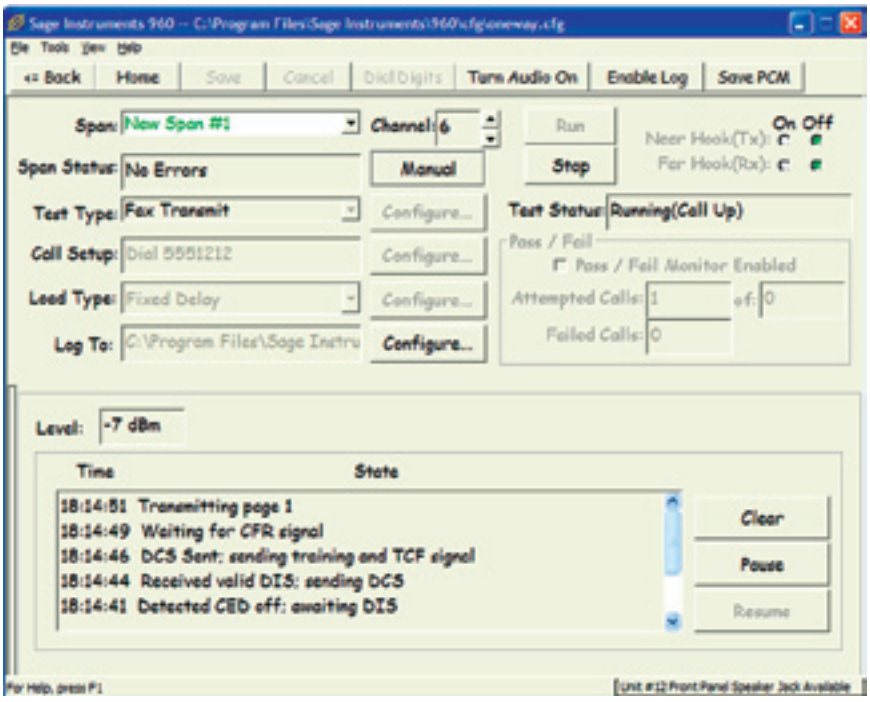


Figure 103 *FAX transmit sample screen*

Figure 104 *No setting required for Fax receive.*

Choose FAX type and transmit level.

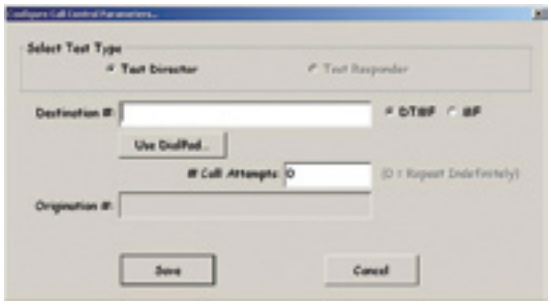


Figure 105 *In the Configure Call Parameters window select Test Director or Test Responder, enter the test call destination number and number of attempts. From this window you can also click the "Use DialPad" to enter digits. Click save.*

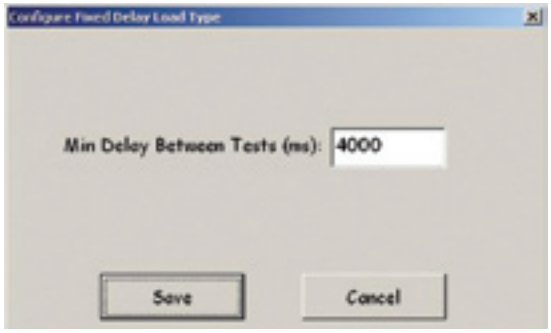


Figure 106 *Select and set Fixed or Random delay.*

Figure 107 *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.**

Digit Analyzer Test *(PCM and Analog)*

Description
The SAGE 960B Digit Analyzer test utilizes five (5) screens for configuration of the test parameters (see figures 108 through 111).

Purpose and Function
Sage's Digit Analyzer verifies received DTMF/MF digits with displayed On/Off times, frequency, and level for each digit received. Digit receiver detects ANSI Standards and RFC-2833 Digits.

Figure 108 shows the main test screen with the "Digit Analyzer" test selected and saved. When clicked the four (4) "Configure" buttons down the center of the main screen display the test set-up windows at right.

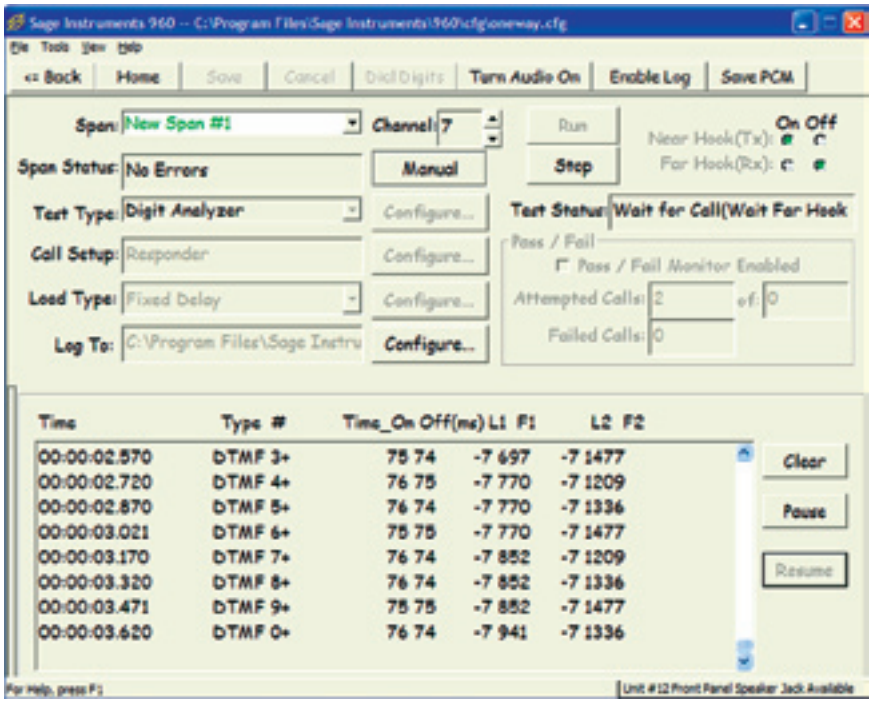


Figure 108
In the above figure, a time stamp (Time), DTMF or MF digit received (Type) and number 0-9 (#), time on and off the digit was received in ms(Time_On Off(ms)), the level (L1) and frequency (F1) of the first digit, and the level (L2) and frequency (F2) of the second digit. To scroll up or down, you can Pause the test and later Resume. Normally, you will see the received dialing digits first and then any DTMF or MF digits sent while the call is up.

Figure 109 *In the Configure Digit Analyzer screen set test duration, set time-outs before and after digits. Then set the minimum on-duration in milliseconds. The dBm level of each tone, the db difference level and finally the maximum frequency deviation in Hz. Click save. There is also a default setting available.*

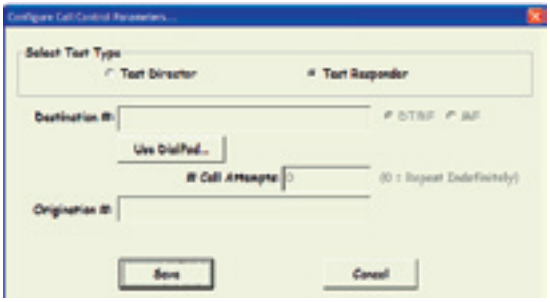


Figure 110 *In the Configure Call Parameters window select Test Director or Test Responder. Default is test responder. Click save.*

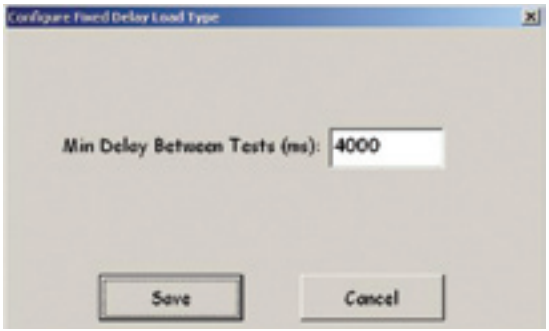


Figure 111 *Select and set Fixed or Random delay.*

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.

Digit Sender Test *(PCM and Analog)*

Description

The SAGE 960B Digit Analyzer test utilizes five (5) screens for configuration of the test parameters (see figures 112 through 115).

Purpose and Function

Sageís Digit Sender Envelope Testing allows a user to send RFC-2833 Digits with settable frequency, level, and On/Off times. Figure 112 shows the main test screen with the "Digit Sender" test selected and saved. When clicked the three (3) "Configure" buttons down the center of the main screen display the test set-up windows below and at right.

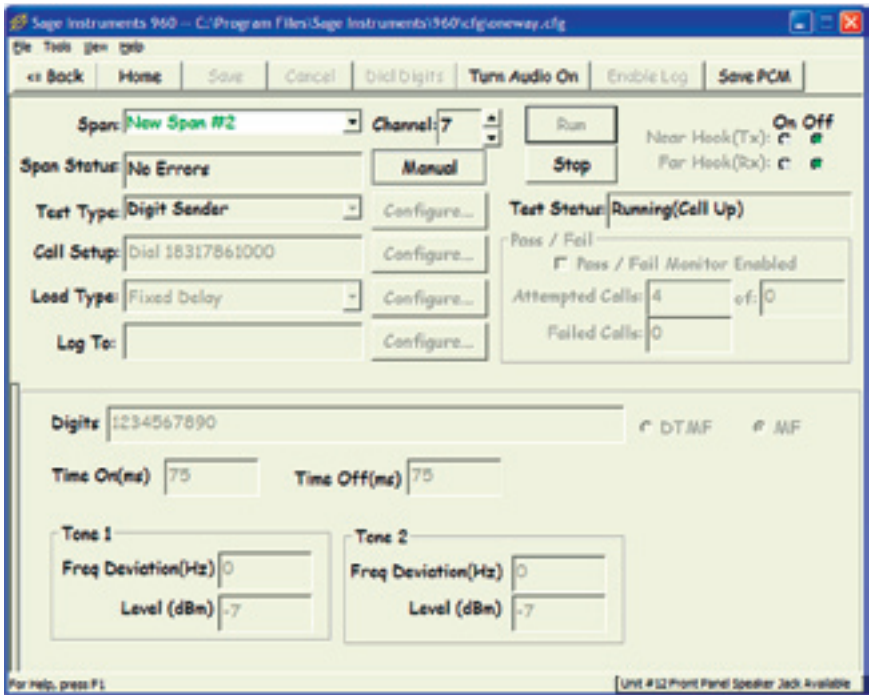


Figure 112

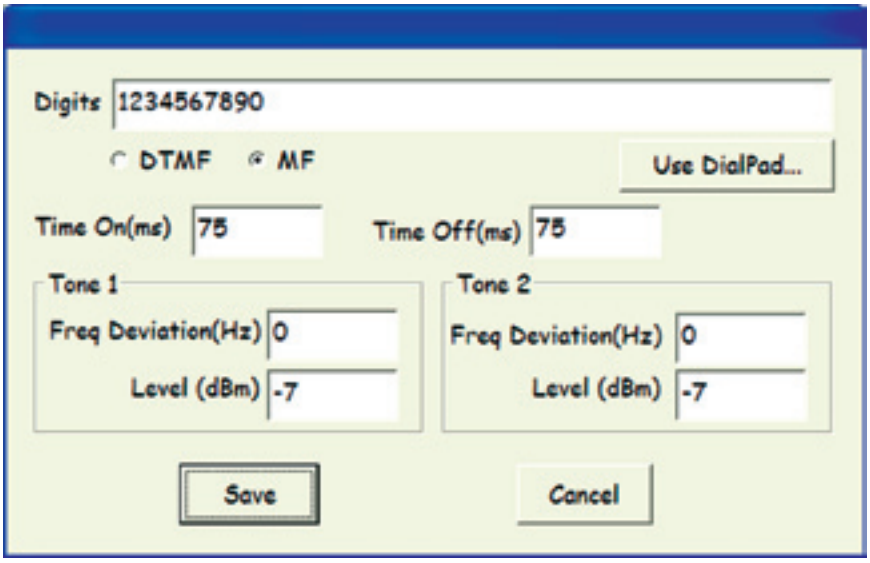


Figure 113 *In the Configure Digit Sender window enter the digits to be sent (you can also use the dial pad button). Next select tone type, and set time on and off in milliseconds. Finally set the frequency deviation in Hz and the level in dBm for both tone 1 and 2. Click save.*

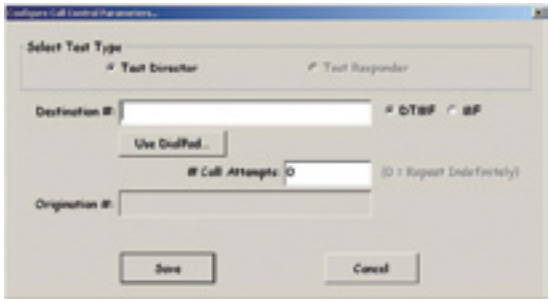


Figure 114 *In the Configure Call Parameters window select Test Director or Test Responder, enter the test call destination number and number of attempts. From this window you can also click the "Use DialPad" to enter digits. Click save.*

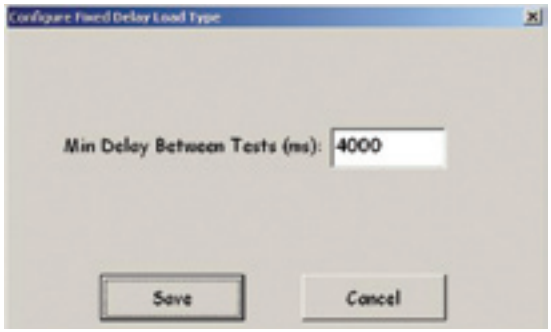


Figure 115 *Select and set Fixed or Random delay.*

Configuration complete, click run.

DSO/Fractional Bit Error Rate Test (BERT) *(PCM only)*

The SAGE 960B BERT test utilizes four (4) screens for setting test parameters (see figures 116 through 119).

Description

Bit Error Rate Test (BERT) is for verifying the integrity of synchronous data communication equipment and data circuit terminating equipment (DCE) at speeds up to 64 Kbps. BERT also verifies the integrity of asynchronous data communication equipment and data circuit terminating equipment (DCE) at speeds up to 38.4 Kbps

Purpose and Function

Verifying data integrity is vital to insuring the performance and reliability of Gigabit-rate networks and systems. Physical layer testing requires worst-case data loading and bit-by-bit data checking with results presented in an industry accepted format like ITU-T G.821 BERT. The SAGE 960B BERT test verifies data integrity by sending industry-standard worst-case data patterns through network devices. These data patterns are designed to stress the physical layer of the system, with patterns specifically developed to check frequency response, data dependencies and network interface components. With bit-by-bit comparison, any difference between the transmitted and received data is detected, counted and captured for analysis.

Figure 116 shows the main test screen with the "DSO/Fractional BERT" test selected and saved. When clicked the four (4) "Configure" buttons down the center of the main screen display the test set-up windows at right.

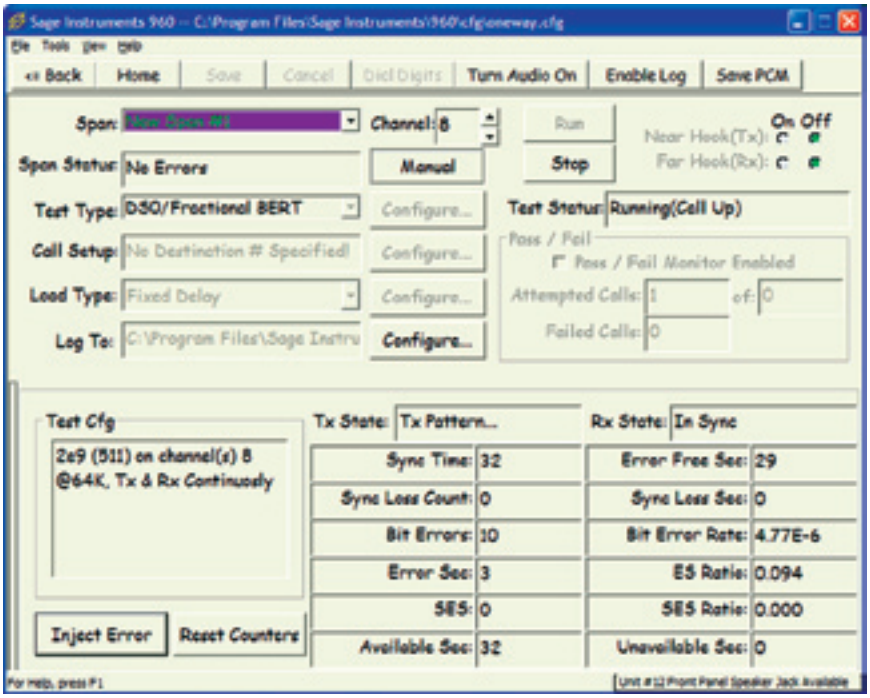
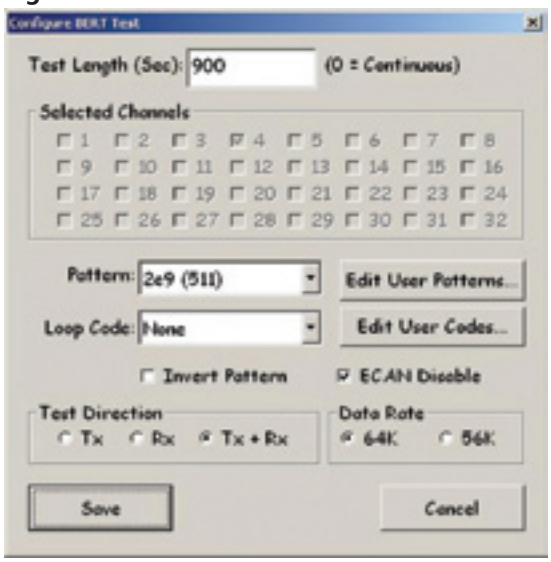


Figure 116

Presented are the Test Configuration, Tx State, Rx State, Sync time, Sync Loss Count, Bit Errors, Error Seconds, Severely Errored Seconds (SES), Available Seconds, Error Free Seconds, Sync Loss Seconds, Bit Error Rate, Errored Seconds (ES), Severely Errored Seconds Ratio (SES Ratio), Unavailable Seconds. Transmit one Bit Error via the Inject Error button and Reset Counters is also available.

Figure 117



In the BERT Configuration window set the test length, choose data pattern and loop code. Data pattern and loop codes can also be edited. Next select test direction and data rate.

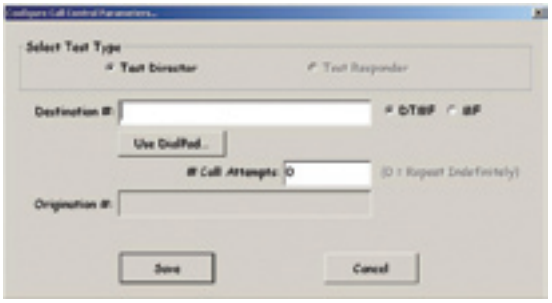


Figure 118 *In the Configure Call Parameters window select Test Director or Test Responder, enter the test call destination number and number of attempts. From this window you can also click the "Use DialPad" to enter digits. Click save.*

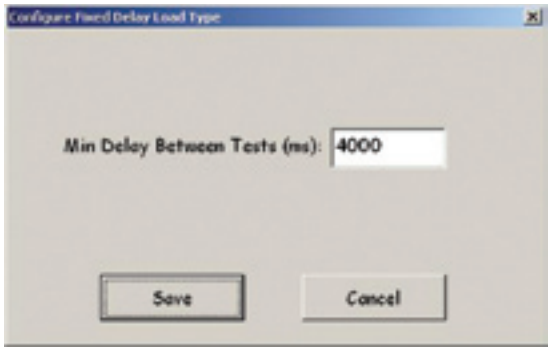


Figure 119 *Select and set Fixed or Random delay.*

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.

ISDN D Ch. Test *(PCM only)*

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 120 through 122.

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 the

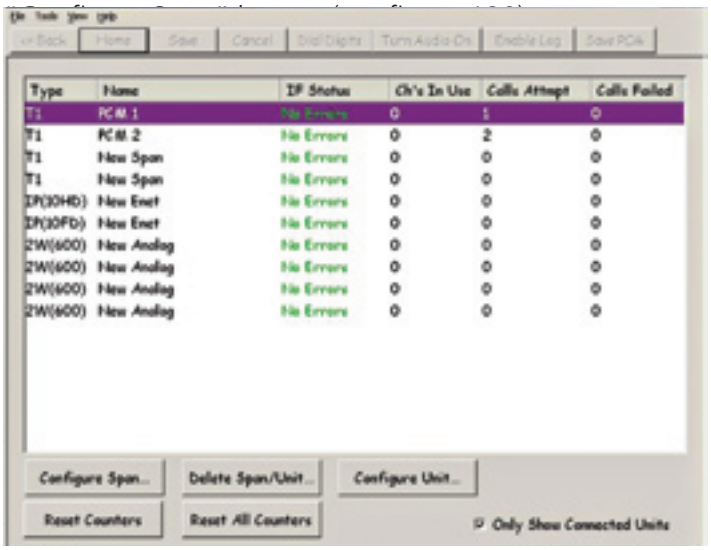


Figure 120

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 121). Click save and return to the span window.

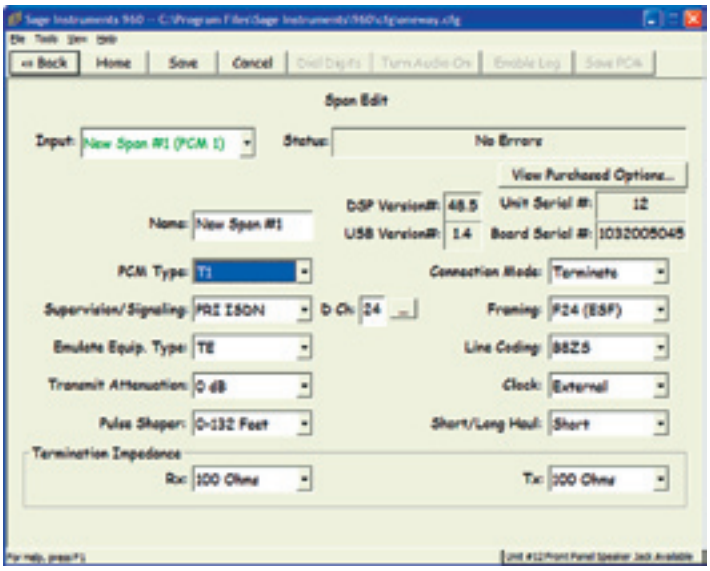
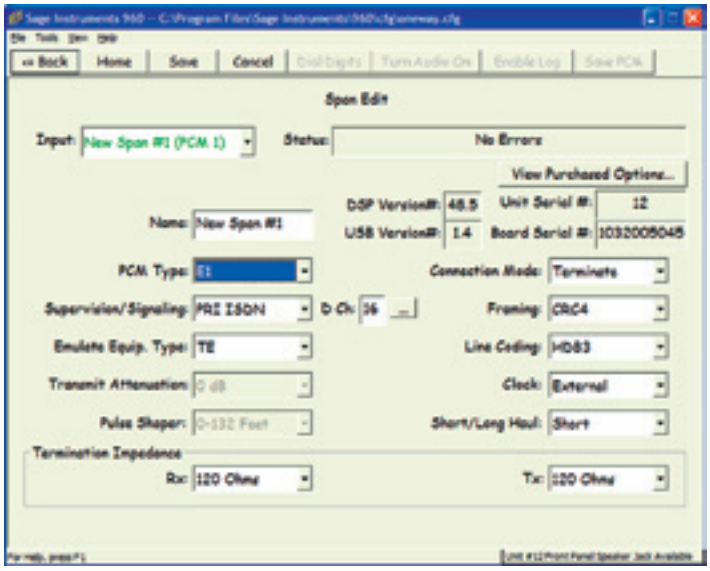


Figure 121

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 122.



(continued on next page)

Figure 122

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 123).

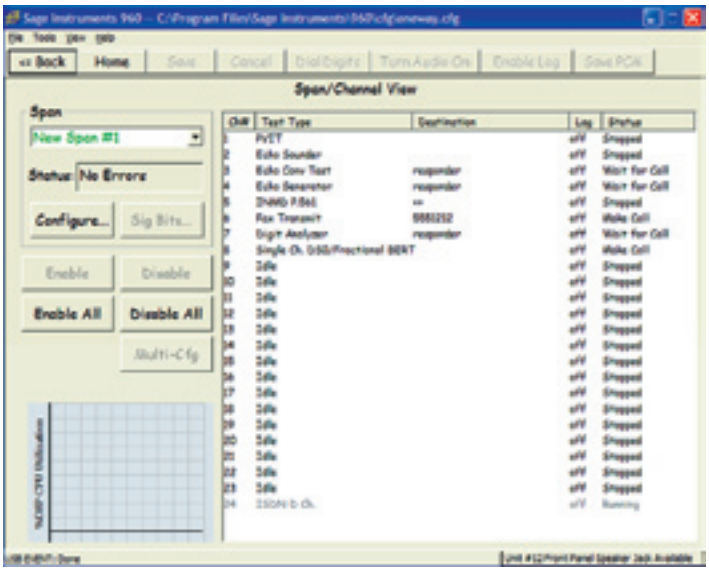


Figure 123

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 124.

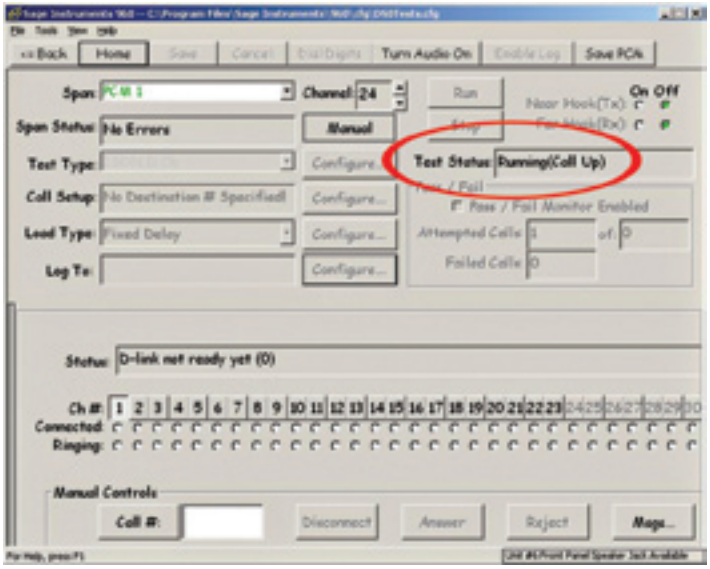


Figure 124

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 settings, but is useful for ISDN debug situations. Clicking on this button launches a real time display of the ISDN traffic (see figure 125).

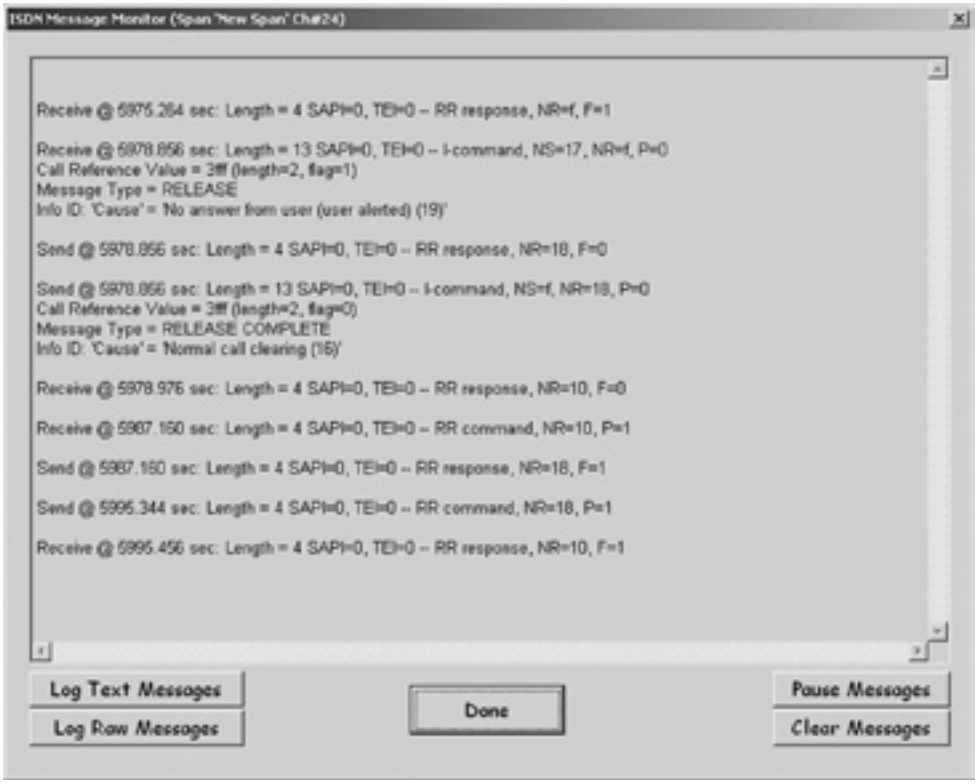


Figure 125

ISDN D Channel Tests

(continued on next page)

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 126).

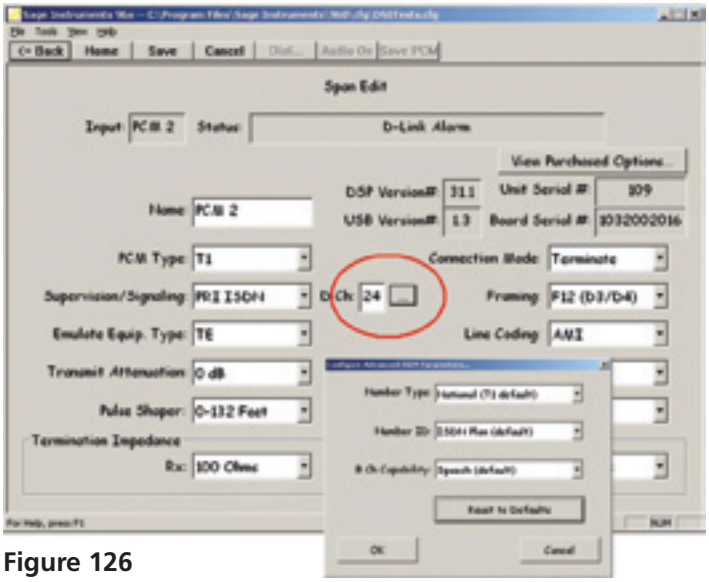


Figure 126

2. Located to the right of the channel number text box is a small button with three dots (see close-up figure 127).

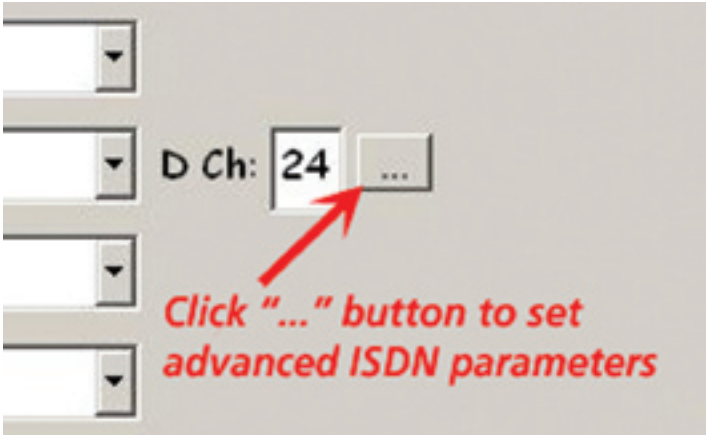


Figure 127

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 128 through 130). When finished configuration settings for the ISDN D Channel test click" OK" and return to the span window.

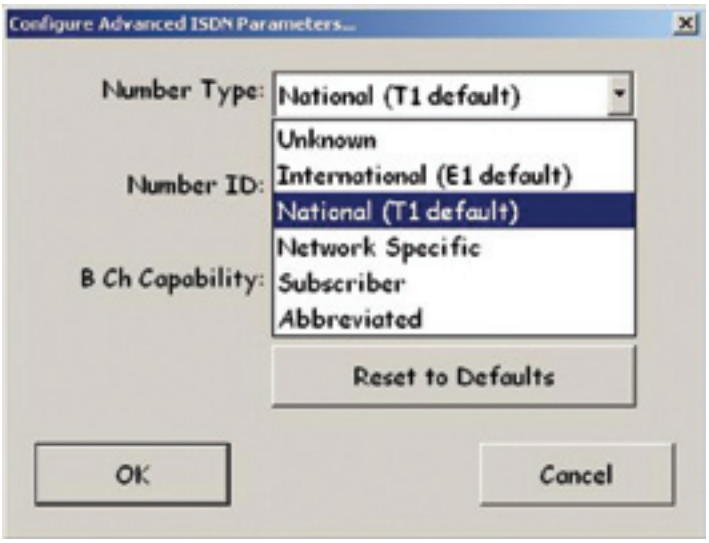


Figure 128 *Choose between International (E1 default), National (T1 default), Network Specific, Subscriber, or Abbreviated number types.*

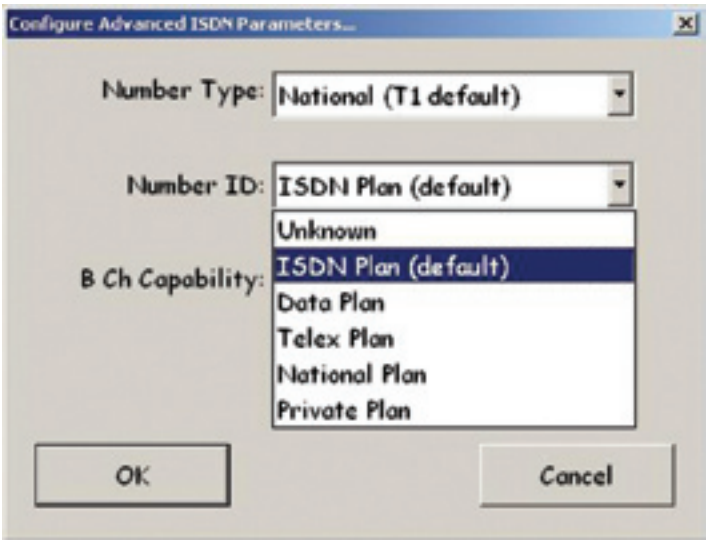


Figure 129 *Choose between Unknown, ISDN plan (default), Data plan, Telex plan, National plan, or Private plan.*

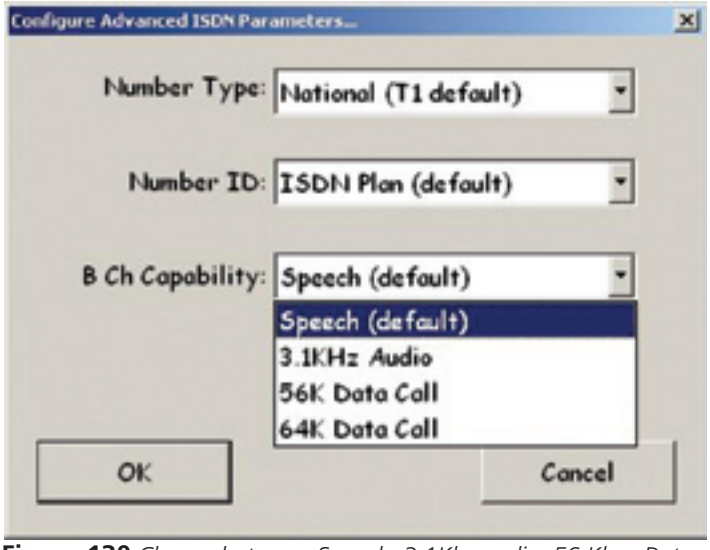


Figure 130 *Choose between Speech, 3.1Khz audio, 56 Kbps Data call or 64 Kbps Data call.*

(continued on next page)

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 on pages 44. 45 and 46 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 131. Verify the following; Span Status: **No Errors**, Test Status: **Running(Idle)**, Status: **ISDN is Functioning OK (D-link ready (0).**

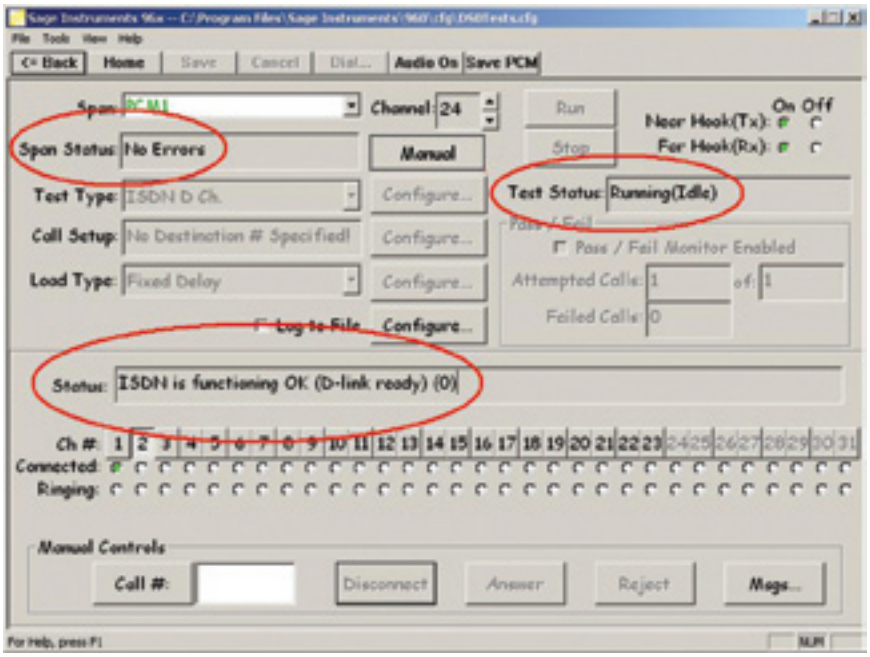


Figure 131

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 132.

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.

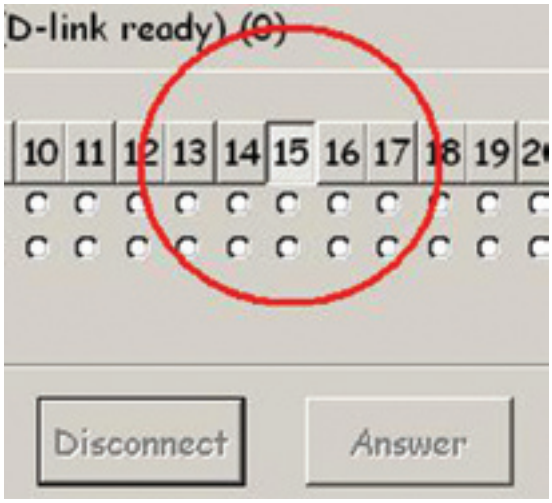
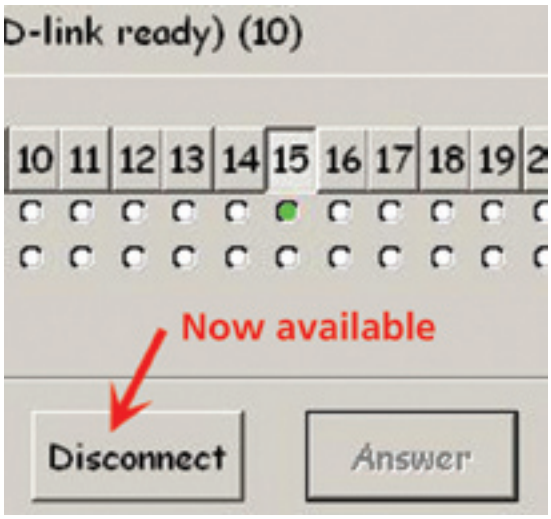


Figure 132



One-Way Delay Transmit and Receive *(PCM and Analog)*

Description

The SAGE 960B One-Way Delay test utilizes three (3) screens for configuration of the test parameters (see figures 133 through 135). 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 TDM or analog. Otherwise, the GUI will grey out the RUN button for these one-way delay Tx configuration screens.

Configuration

In order for the one-way delay to work properly, a reference signal must be provided via a physical loopback between the MIC and SPKR ports. Use a stereo male-to-male 3.5 mm stereo mini plug to make the connection.

Specifications

Interface	Range	Accuracy
All Interfaces	0 to 511 ms	±1 ms

Purpose and Function

The 960B can measure one-way delay between disparate telephony interfaces including:

• TDM to TDM • IP to TDM • TDM to Analog • IP to Analog • Range

By measuring one-way delay, a user can pinpoint delay issues to segments of the network. Multiple 960ís can be used as long as the real-time audio ports (mic & spk) are connected. Figure 133 shows the main test screen with the "One-Way Delay RX" test selected and saved. When clicked the three (3) "Configure" buttons down the center of the main screen display the test set-up windows at right.

Figure 133

For One-Way RX other that Call Setup and Load Type (figure 135) no configuration is required. For One-Way TX the only necessary configuration is the test duration (see figure 134).

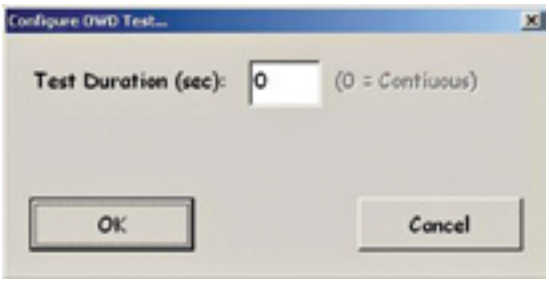


Figure 134

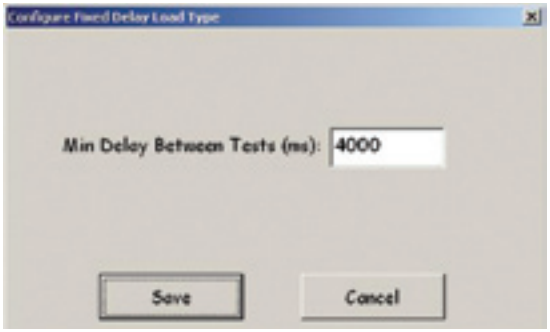


Figure 135 *Select and set Fixed or Random delay. Next, Choose the timing of log capture, then enter a path or browse to the location on your local machine or network where the log file is to be saved.*

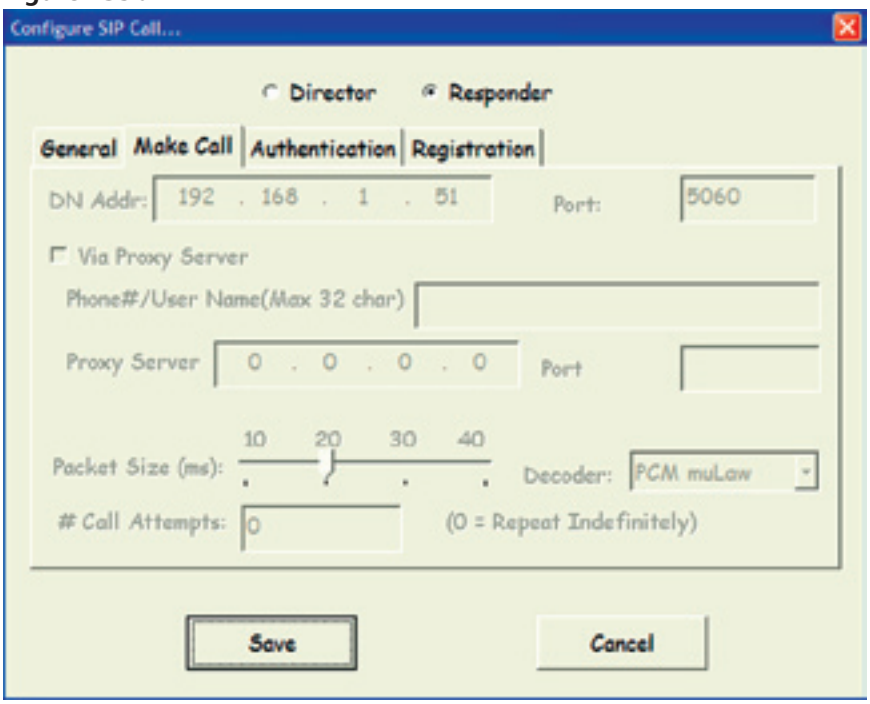
Note: When a 960's Ethernet port transmits a test signal via a SIP call, it contributes one packet worth of delay. This is called the packetization delay, where it must fill a packet before the packet can be transmitted. So, if the packet size is set to 20 milliseconds, it will introduce 20 ms of one way delay in it's transmit direction. Conversely, on the 960B's receive side, the Ethernet port contributes N x Packet Size delay, where N is the size of the Jitter Buffer in number of packets. So, if the packet size is set to 20 milliseconds, and the Jitter Buffer size to 2 packets, it will introduce 40 milliseconds of delay in it's receive direction. The Analog and PCM ports have negligible delay characteristics.

(continued on next page)

One-Way Delay Transmit and Receive *(continued)*

To give an example, figure 135a shows a One-Way Delay of 60 ms via a SIP call from Ethernet port #1 to Ethernet port #2 of the 960B. There is no external network delay associated with this example. The delay can be attributed to the 20 ms of packetization or Packet Size (ms) on the One-Way Delay Tx side and 40 ms of Jitter Buffer size setting on the One-Way Delay Rx side. On the One-way Tx side, the Packet Size (ms) setting for One-way delay Tx is 20 ms as shown in figure 135b.

Figure 135b



On the One-way Rx side, the Jitter Buffer Size is set to 2 or 2 x 20 ms = 40 ms of delay as shown in figure 135c.

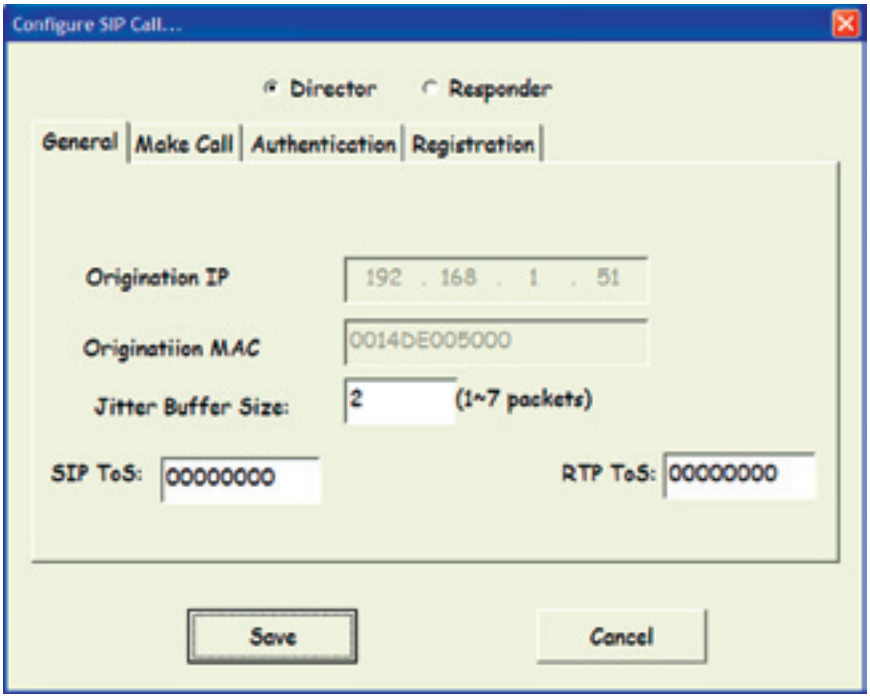
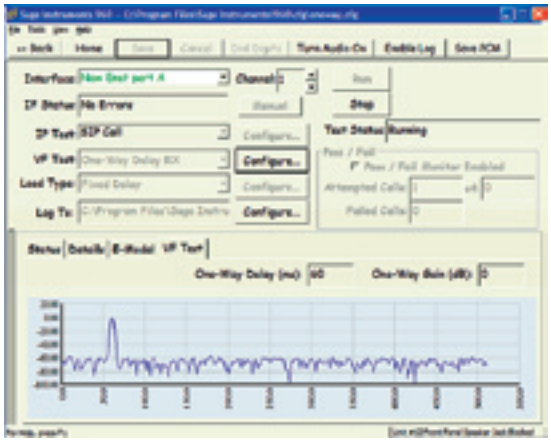


Figure 135c

Figure 135a



Now, if on the One-way Rx side, the Jitter Buffer Size is changed to 4 or 4 x 20 ms = 80 ms of delay. Then, we should expect an additional 40 ms of delay due to the Jitter Buffer size increase. See Figure 135d below.

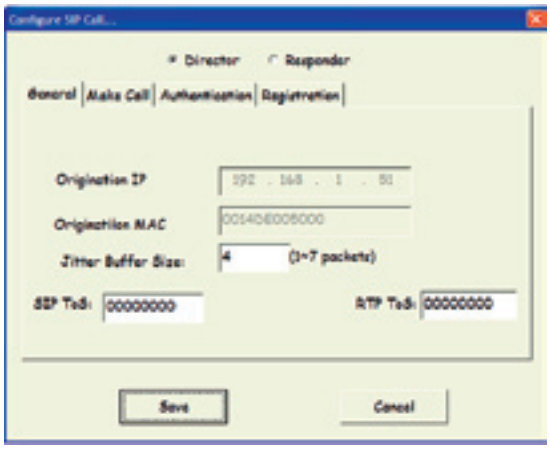


Figure 135d

(continued on next page)

One-Way Delay Transmit and Receive *(continued)*

Looking at the One-way delay Rx results, we see the one-way delay is now 100 ms as shown in Figure 135f.

Note: If trying to run One-way delay Tx from more than one interfaces, i.e. Ethernet and PCM, etc. The One-way delay Tx's RUN button will be greyed out to let you know that you are still running another One-way delay Tx on a different interface. You will need to stop all One-way delay Tx from the previous interface in order for the RUN button to work. See Figure 135g.

Figure 135f

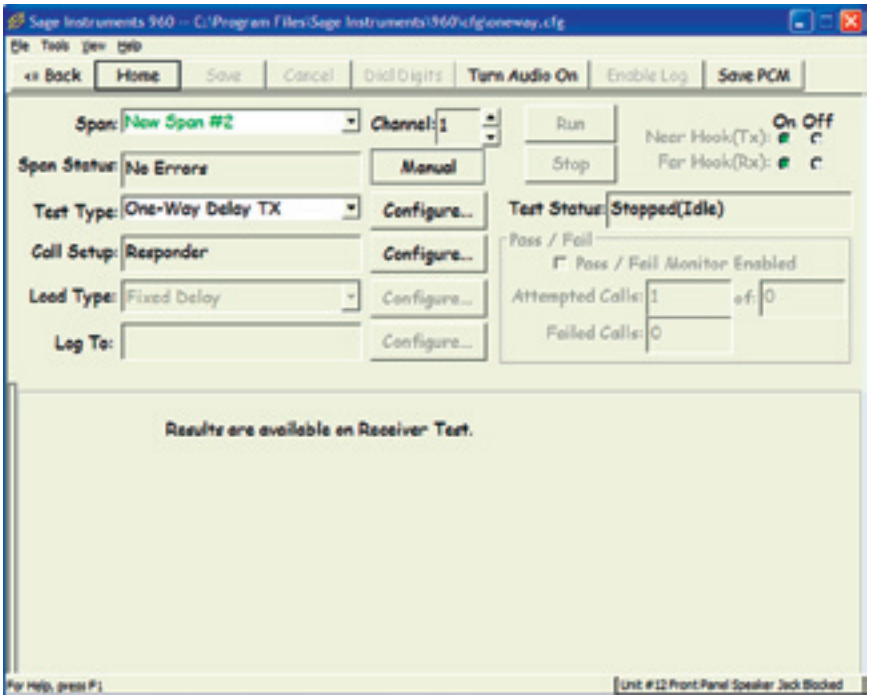


Figure 135g

SIP Call *(Ethernet only)*

Purpose and Function

The 960B can emulate SIP calls via RFC Standard 3261, 2617. VF tests such as clarity, echo, etc can be performed within the SIP call on multiple channels providing for call loading for VoIP Pre-Qualification Testing.

Description

Emulated SIP Calls can place the following test calls (see figure 136).

- ***Talk***
- ***Send/Measure Tone***
- ***Echo Sounder***
- ***Echo Generator***
- ***SMOS Director***
- ***SMOS Responder***
- ***One-Way Delay Tx***
- ***One Way Delay Rx***

Figure 136

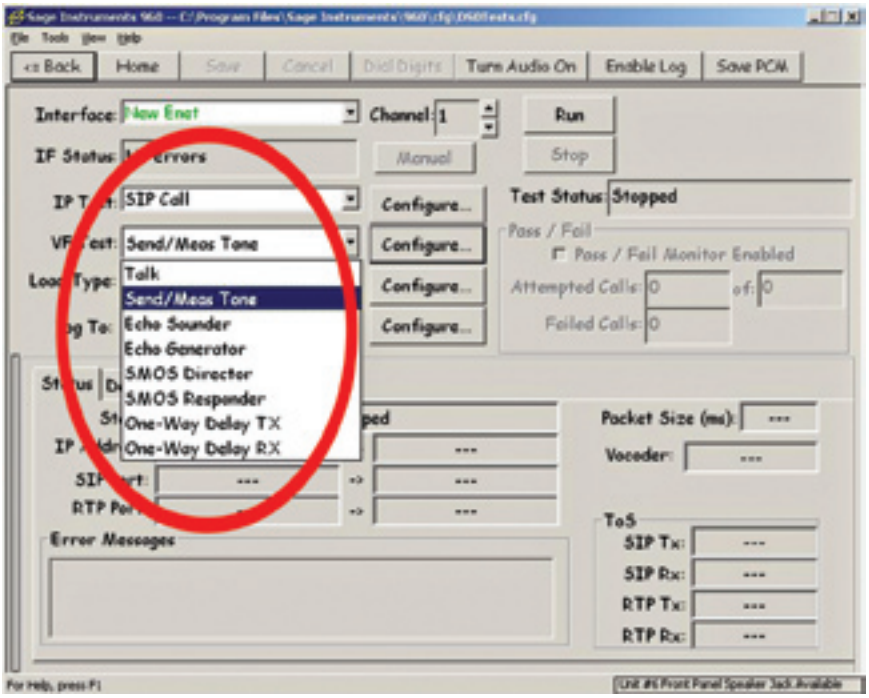


Figure 136 illustrates the main SIP Call screen. The "Configuration" buttons will launch the configuration specific to the VF test selected.

SIP Call, Director Settings

General: The Origination IP and Origination MAC will automatically be set as the IP Interface Configuration screen. You can choose to adjust the Jitter Buffer Size, SIP Type of Service (ToS), and RTP Type of Service (ToS) see figure 136a.

Make Call: There are two ways to make a SIP call, one is by setting the Destination Address (DN Address) directly and SIP Port as shown in figure 136b. A SIP call can also be made Via Proxy Server as shown in figure 136c.

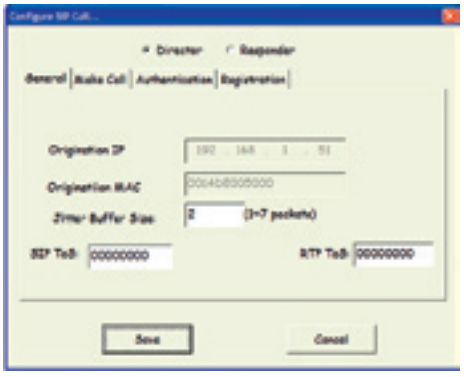


Figure 136a

Figure 136b

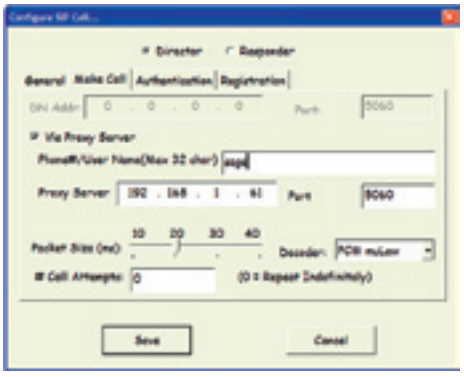


Figure 136c

In both cases, you can set the Packet Size (ms), Decoder (PCM muLaw or aLaw), and #Call Attempts. If Authentication is required, the Username and Password can be entered as shown in figure 136d.

(continued on next page)

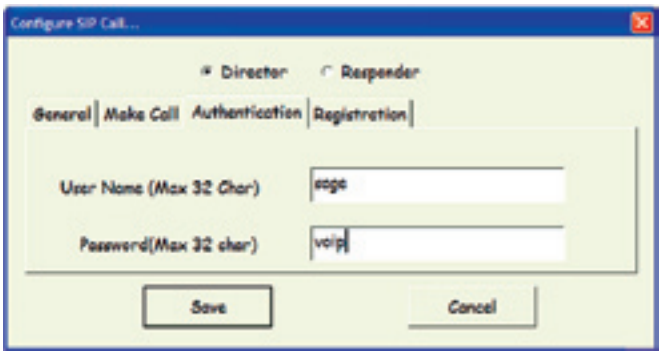


Figure 136d

SIP Call, Director Settings *(continued)*

Lastly, Registration Server settings will be made automatically by the 960B as set in Responder mode. If you need to change these settings, change test mode to Responder. Othewise, you will see a grey out screen as shown in figure 136e.

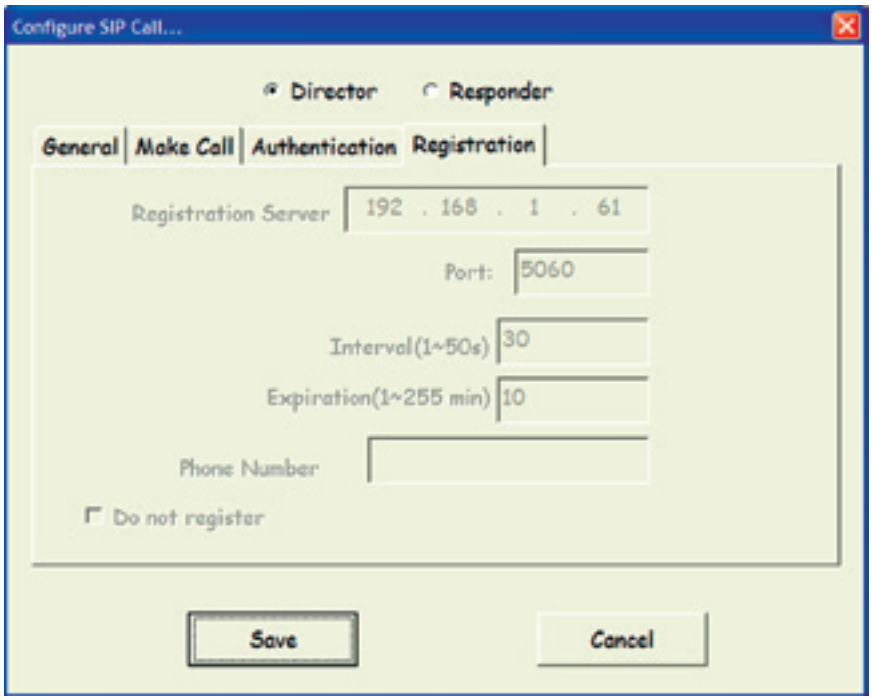


Figure 136e

SIP Monitor *(Ethernet only)*

Purpose and Function

The 960B can monitor and decode SIP protocol messages. SIP monitor can auto-detect or manually specify IP addresses of SIP calls. SIP monitor provides analysis of call setup messages in real-time.

Description

To configure the SIP Monitor simply enter the target IP address (see figure 137).

Figure 137

RTP Monitor *(Ethernet only)*

Purpose and Function

Passively Monitor & Troubleshoot SIP, H.323, NCS, or MGCP VoIP calls from the 10/100 interface. Qualify Voice Quality on Turn-up. Select Auto Discovery or Specify up to 128 addresses to Monitor (256 Simultaneous RTP streams). Analyze RTP for Echo and Audio Levels (G.711 & G.729).

Interface	Range	Accuracy
Ethernet	0 to 511 ms	±one packet

Description Emulates Jitter Buffer filters to assess delays impacts on Audio Quality. Assess Two-way RTP Packet Impairments Half Duplex (Hub/Switch) or Full Duplex (Tap) Monitor points. To configure the RTP monitor first set target IP address, buffer size and pakket timeout (see figure 138).

(continued on next page)

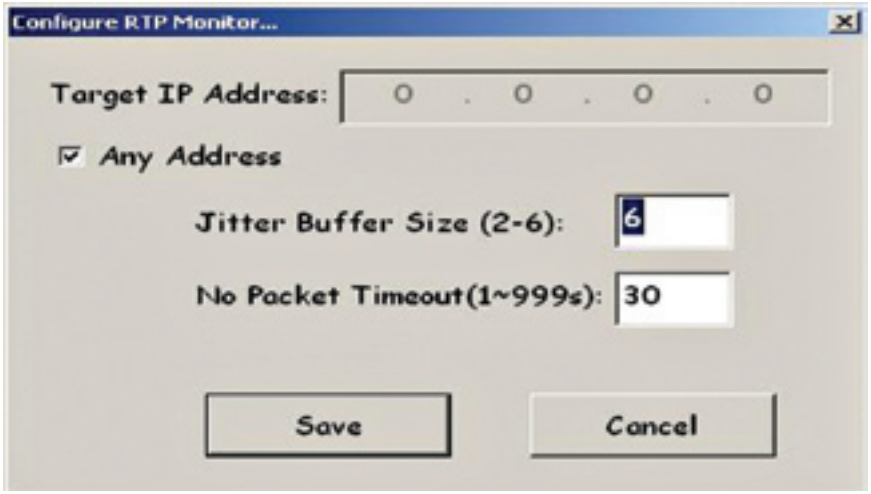


Figure 138

RTP Monitor *(continued)*

Next select the VF Test Type; Dual spectrum Analyzer, INMD or One-Way Delay. Even though the "Configure" buttons are not greyed-out no configuration is required for the VF Test selection (see figure 139).

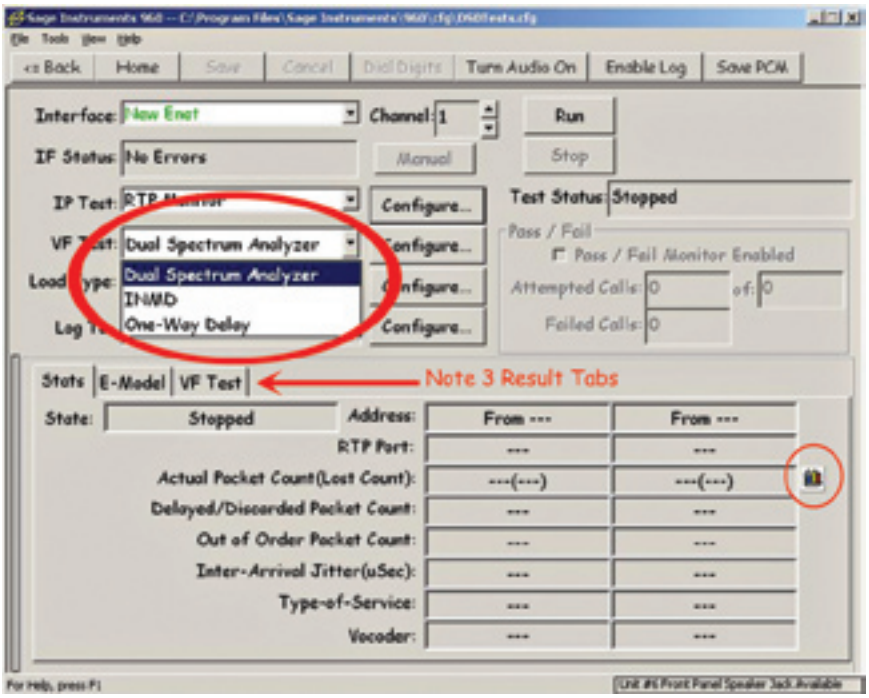


Figure 139

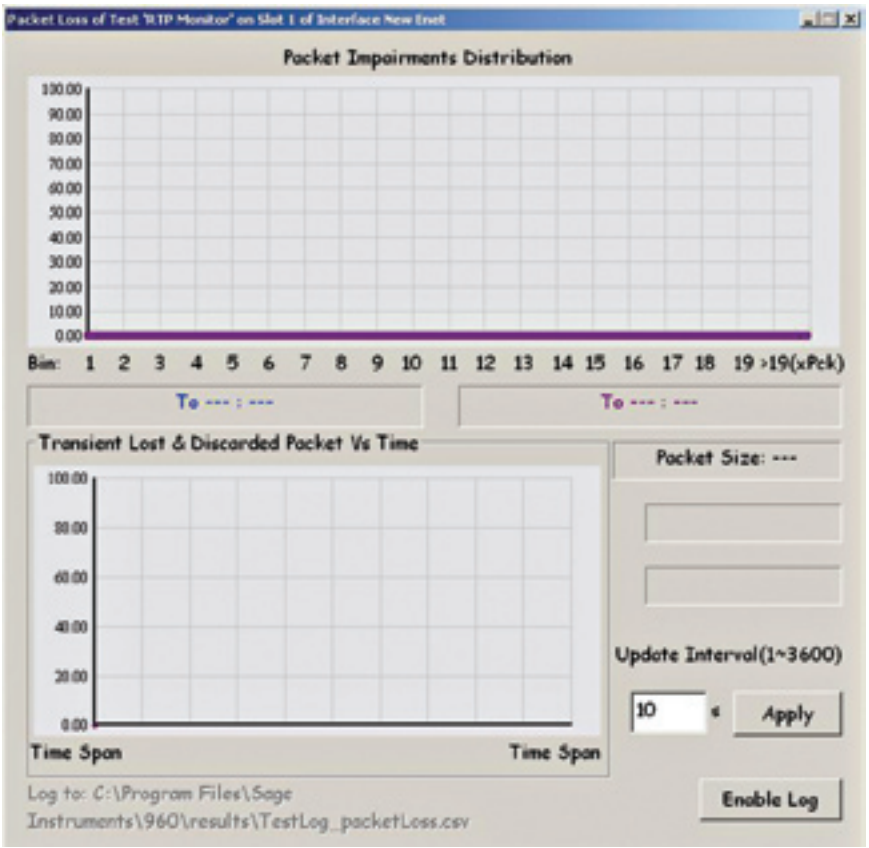


Figure 140

The results for the RTP Monitor tests are displayed in the three tabs labeled; Stats, E-Model and VF Test (see figures 141 through 143).

Figure 141 Stats results tab

Figure 142 E-Model results tab

Figure 143 VF Test results tab

In Figure 139 notice the small "Graph Icon", clicking on this link launches a dual real-time graphing window displaying Packet Imparments Distribution and Transient Lost and Discarded Packets Vs Time (see figure 140).

Echo PING Utility

The Echo Ping test is a packet utility service test that supports Internet Control Message Protocol (ICMP-RFC 792) PING requests. 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.

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. Outof-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.

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