“Results You Can Count On”

Reference Manual

Model 4901
Multi-Output Noise Simulators
v 1.0

As of Rev 1.25.4

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1.0 Introduction

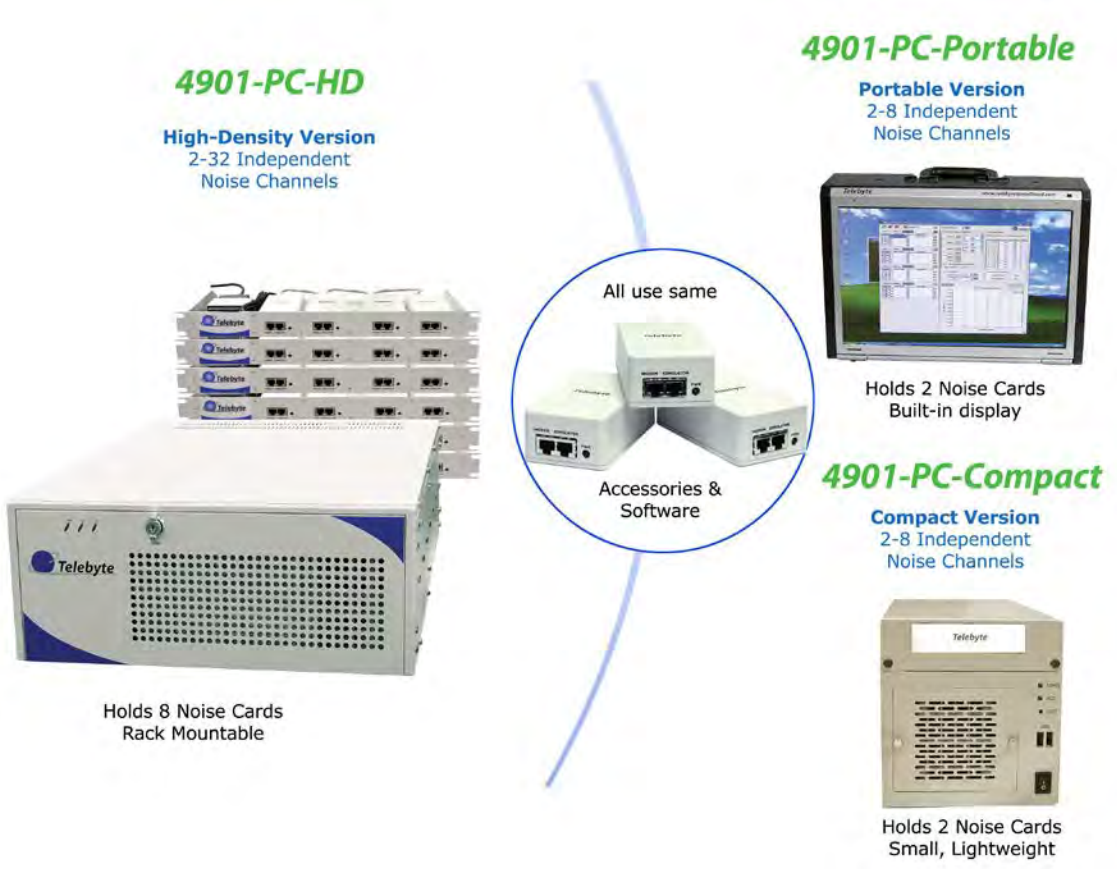
1.1 The Model 4901 Multi-Output Noise Simulator Versions

The 4901-PC-HD High-Density version provides **2 to 32 independent noise channels** in a 4U-high industrial PC. The modular system holds up to 8 (2 or 4-port) AWG cards and can be expanded by adding more AWG cards, noise injectors and other components as needed.

The 4901-PC-Compact version provides **2 to 8 independent noise channels** in a small form factor. The modular system holds up to 2 (2 or 4-port) AWG cards.

The 4901-PC-Portable version provides **2 to 8 independent noise channels** in a portable, handheld unit. The modular system includes a built-in display and holds up to 2 (2 or 4-port) AWG cards.

A user-friendly configuration software allows the user to select and build impairment models common to DSL network implementations. A wide variety of custom crosstalks (including ADSL2+ and VDSL2) as well as impulse noises (such as REIN, SHINE and PEIN) can be created. In addition, user-defined files in several formats (such as MATLAB and Excel) may be imported. Optional noise modules automatically setup standards-based testing for TR-114, TR-100, G.SHDSL and more.



1.2 Main Features

- Bandwidth 20 kHz to 30 MHz
- Crest Factor greater than 5
- High degree of accuracy
- Noise Floor less than -145 dBm/Hz (as measured at the output of the noise injector)
- Expandable, modular design. High-density version holds up to 8 AWG cards (2-Port and/or 4-Port) for a maximum of 32 Ports. Compact version holds up to 2 AWG cards (2-Port and/or 4-Port).
- Split output from 1 AWGx port to 2 noise injectors, expanding ports to total of 64 Ports
- Patented technology produces totally random "real-life" noise
- Inject crosstalk and impulse combined
- Independent control of each port
- Select from common crosstalk types such as SHDSL, ADSL, and VDSL
- Impulse noises such as REIN, SHINE and PEIN
- Specify NEXT, FEXT and number of disturbers
- Add in RFI and AWGN (at variable levels)
- Specify impedance, sampling rate and DUT location
- Optional Noise Modules setup and run all tests in standard automatically
- Design custom loops with Loop Configuration Editor
- Integrate with Telebyte WLS to control loop simulator
- Save custom noise files or entire configurations to repeat tests with ease and accuracy
- Import MATLAB (.mat) or Excel (.xls) noise files
- Remote control via RS-232, multiple Telnet sessions over Ethernet
- Adjust Amplitude of Crosstalk and Impulse noise
- Micro-Interruptions
- Optional component of Telebyte's solution for VDSL2 Vectored physical-layer testing

1.3 Specifications

4901-PC-HD & 4901-PC-Compact & 4901-PC-Portable Specifications	
Bandwidth	AWGN: 20 kHz to 30 MHz
Interference Profile Accuracy	≤ 0.5 dB mean absolute error (MAE) for all Power Spectral Densities of Crosstalks
AWGN Crest Factor	≥ 5
AWGN Gap	< 10%
Output Impedance	50Ω unbalanced
Dynamic Range	95dB (-90 dBm to +5 dBm)
Remote Commands	RS-232, TelNet
Included Software	Telebyte Multi-Output Noise Simulator Software
Power supply	AC 90 V to 264 V, 47 to 63 Hz
Operating Temperature Range	0 to 50 º C

4901-PC-HD Only Specifications	
Operating Relative Humidity	Maximum 80% for up to 31° C, decreasing linearly to 50% at 40°C
Mechanical Dimensions	4U-High Rack-Mountable Chassis DxWxH: 26.5 in x 16.94 in x 7 in (673.10 mm x 430.28 mm x 177.80 mm)
Weight	60 lbs (27.22 kg)
Connectors	Rear: 2 Serial, 2 USB, 2 LAN

4901-PC-Compact Only Specifications	
Operating Relative Humidity	10% - 90%
Mechanical Dimensions	DxWxH:15.75 in X 6.54 in X 6.91 in (400 mm x 166 mm x 175.5 mm)
Weight	17.5 lbs (7.94 kg) with 2, 4901-AWGx cards installed
Connectors	Front: 2 USB Rear: 1 Serial, 1 LAN

4901-PC-Portable Only Specifications	
Operating Relative Humidity	5% - 95% non-condensing
Mechanical Dimensions	DxWxH: 5.8 in X 16.75 in X 12.4 in (147.32 mm x 425.45 mm x 314.96 mm)
Weight	16 lbs (7.26 kg)
Connectors	2 USB 3.0 Ports, 4 USB 2.0 Ports, 1 RJ-45 LAN
Display	Integrated 17-in WUXGA+ (1920 x 1200) display connected to on-board Intel HD graphics. Removable, protective display cover.

Noise Injector Specifications	
Bandwidth	20 kHz to 30 MHz
Output Impedance	4kΩ Minimum (20 kHz to 30 MHz)
Input Impedance	50Ω unbalanced (100Ω unbalanced*)
Output Mode	Differential, balanced
Noise Floor	Below –145 dBm/Hz as measured at the output of the noise injector
Insertion Loss	13.0/35 dB ± 0.5 dB
Connectors	SMB Female Connector for 4901 Multi-Output Noise Simulator, RJ45 (2) Female Connectors for Loop Simulator (external cable provided) and for the modem.
Operating Temperature Range	0 to 50 º C
Operating Relative Humidity	Maximum 80% for up to 31° C, decreasing linearly to 50% at 40°C
Mechanical Dimensions	2.6" W x 1.4" H x 4.7" D
Power supply	AC 90 V to 264 V, 47 to 63 Hz, 10 W (supports 1-4 Noise Injectors)

Micro-Interruptions Specifications	
Micro Interruption Switches	Inclusion at either ATU-R/VTU-R or ATU-O/VTU-O ends
Duration	Programmable
Minimum Duration	1 msec
Duration Increments	1 msec
Duration Accuracy	+/- 0.5 msec
Periodicity	Programmable in increments of multiples of the Duration

*100Ω input used when the output from one port is split to two noise injectors. 100Ω and 50Ω are used when the output from two ports are combined in one noise injector.

2.0 Before You Begin

2.1 Noises Included with the 4901-NS Software

2.1.1 4901-NS Noise Generator Software

The Model 4901 ships with the Windows XP (or Windows 7) operating system and 4901-NS Noise Generator Software installed. The following lists the noises included with the 4901-NS software.

- Noise libraries are purchased separately.

2.1.1.1 Crosstalks

Standard	Bandplans/Protocols
ADSL, ADSL2, ADSL2+	G.992.3 Annex A, B, I, J, L, M G.992.4 Annex A, I G.992.5 Annex A, B, I, J, M
SHDSL	G.991.2 Annex A, B, F
HDSL	
ISDN	
T1	
VDSL2	G.993.2 Annex A (POTS) G.993.2 Annex A (ADL) G.993.2 Annex B7 (1-10), B8 (1-16)

2.1.1.2 Alien Crosstalks

Reference	Test System	Models
ETSI TS 101 388 §5.3.4.1.1	EC ADSL (POTS)	FA, FB, FC, FD
ETSI TS 101 388 §5.3.4.1.2	EC ADSL (ISDN)	FA, FB, FC, FD
ETSI TS 101 388 §5.3.4.1.3	FDD ADSL (POTS)	FA, FB, FC, FD
ETSI TS 101 388 §5.3.4.1.4	FDD ADSL (ISDN)	FA, FB, FC, FD
TR-100 Annex D.1	ADSL2 (TR-100 A.2)	FA, FB, FC, FD
TR-100 Annex D.1	ADSL2+ (TR-100 A.2)	FA, FB, FD, FD19
TR-100 Annex D.2	ADSL2+ (TR-100 A.3)	CAL=12, CAL=36, CAL=52
TR-100 Annex D.3	ADSL2+ (TR-100 B.3)	FA, FB, FD
G.991.2 §B.3.5.4.1.2	SHDSL	XA.#.A, XA.#.B, XA.#.C
WT-114 Appendix A	VDSL2	MD_EX, MD_CAB27, MD_CAB72

2.1.1.3 Other Crosstalk Features

- Select # Disturbers or Power Level
- Group Fields by North America or Europe
- Specify CO or CPE for DUT
- Fluctuating Crosstalk
- VDSL Power Back-Off
- Dynamic Noise Levels
- Variable AWGN
- RFI Tones (Sinusoidal, AM Modulation)
- Pre-Defined Spectra
    - ETSI A
    - ETSI B
    - EURO-K
- Batch conversion of user-defined Crosstalk files for easy import

2.1.1.4 Impulse Noise

- High Frequency
- Low Frequency
- Single Shot
- Custom Burst Pattern

2.1.1.5 Other

- Loop Editor
- Preconfigured Loops

2.1.2 Minimum Configuration

The Model 4901 ships with the 4901-AWG cards purchased and all necessary drivers installed.

- 4901-PC Telebyte Industrial Computer (high density, compact or portable version)
- 4901-NS Noise Generator Software (installed at factory)
- At least (1) 4901-AWG2A (2-Port AWG Card) or 4901-AWG4A (4-Port AWG Card).
- At least (1) 4901-D1-Micro Differential Mode Noise Injector.
- At least (1) 4901-PS Power supply for each set of (1-4) 4901-D1-Micro's.

2.2 Provided by Customer

- USB Keyboard
- USB Mouse
- Monitor and monitor cable (except portable version which includes a built-in monitor).

➢ **Monitor must be capable of displaying at a resolution of at least 1440 x 900**.

3.0 Connectors/Indicators/Switches

3.1 Product Views

3.1.1 4901-PC-HD

3.1.1.1 Front View

Figure 3-1: 4901-Front view, shown with cover open.

3.1.1.2 Rear View

Figure 3-2: 4901-Rear View showing four 4901-AWGx cards as well as serial, Ethernet, USB and monitor connectors.

- The number of 4901-AWGx Cards installed depends upon your configuration.

3.1.2 4901-PC-Compact

3.1.3 4901-PC-Portable

3.2 Making Connections

3.2.1 4901-D1-Micro Cables

3.2.1.1 4901-D1-Micro to WLS Using RJ-45 to RJ-45 Cable

- Using RJ-45 to RJ-45 cables, connect each 4901-D1-Micro RJ-45 connector marked **Simulator** to the desired channel on the Telebyte line card located in the 458-3SL (or 458-CC16) chassis.

- If desired, you may also connect the 4901-D1-Micro to a unit under test using the **Modem** RJ-45 connector.

Figure 3-3: 4901-D1-Micro to WLS Connections

3.2.2 4901-D1-Micro to 4901-AWG card

3.2.2.1 Using SMB-to-SMB Cables

3.2.2.1.1 One-to-One Mode

- Using SMB-to-SMB cable, connect Channel *x* (**C*x*)** on the 4901-AWGx card to the **50-ohm** connector on the 4901-D1-Micro, where *x* equals channel 0, 1, 2 or 3, depending on the 4901-AWG card configuration.

3.2.2.1.2 Two-to-One Mode

- Using SMB-to-SMB cables, connect Channel *x* (**C*x*)** on one 4901-AWG card to the **50-ohm** connector and Channel x (**C*x***) of another 4901-AWG card to the **100-ohm** connector on the same 4901-D1-Micro. *X* equals channel 0, 1, 2 or 3, depending on the 4901-AWG*x* card configuration. Because Crosstalk and impulse noises must be generated on separate 4901-AWG cards, this connection is commonly used to combine Crosstalk and impulse noise together.

3.2.2.2 Using 4901-YC Cable

The 4901-YC cable may be used to create a 1-to-2 (noise splitting) relationship that splits the noise from one 4901-AWG port to two 4901-D1-Micro noise injectors, providing the same (correlated) noise to each injector.

- When using a 4901-YC cable to connect one 4901-AWG*x* port to two 4901-D1-Micro's, the 100-ohm connector is used.

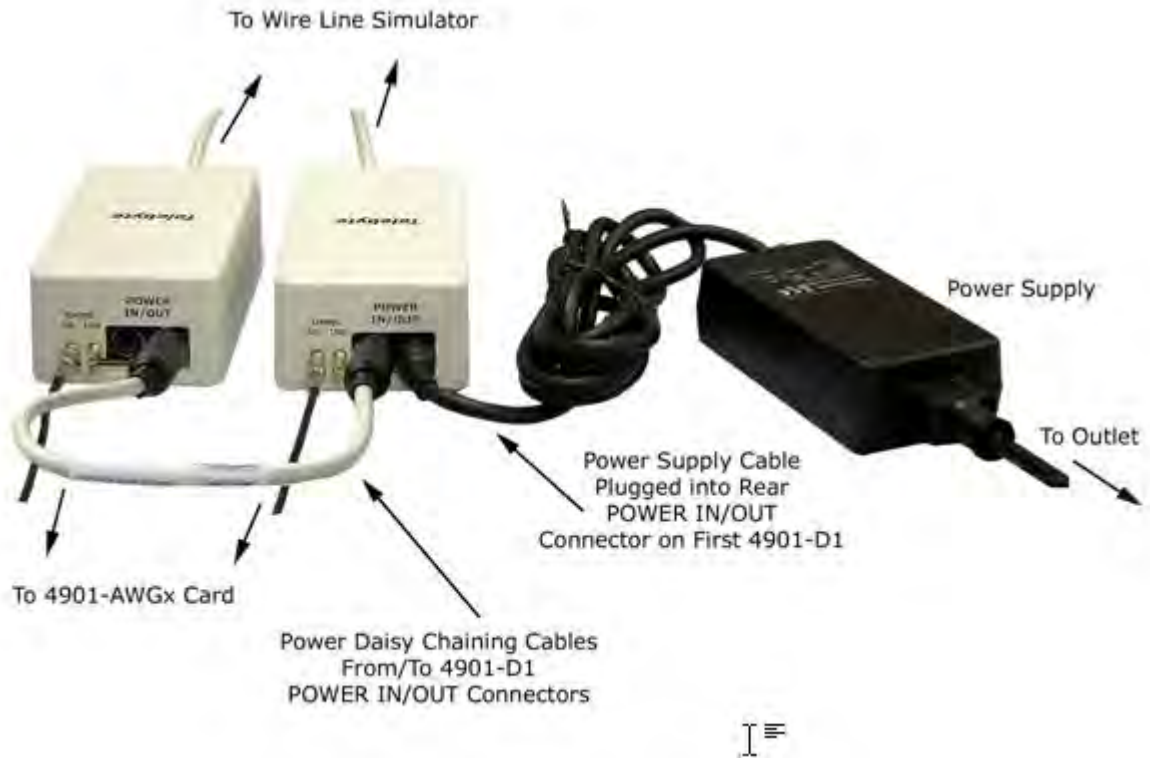
3.2.3 4901-D1-Micro Power Connections

- Plug the Power supply cable into the **POWER IN/OUT** connector on the closest 4901-D1-Micro.

- Use the connector closest to the Power supply.

- Daisy-Chain the remaining 4901-D1-Micro's by plugging one end of each Power Jumper cable into (1) 4901-D1-Micro and the other end into an adjacent 4901-D1-Micro. You may connect up to (4) 4901-D1-Micro's to each Power supply.

- Plug the Power supply into an outlet.



- The POWER IN/OUT connectors are used for connecting power going in OR out, allowing them to be used as needed for the desired configuration.

3.3 4901-RM-D1 Rack Mount Assembly and Connections (Optional)

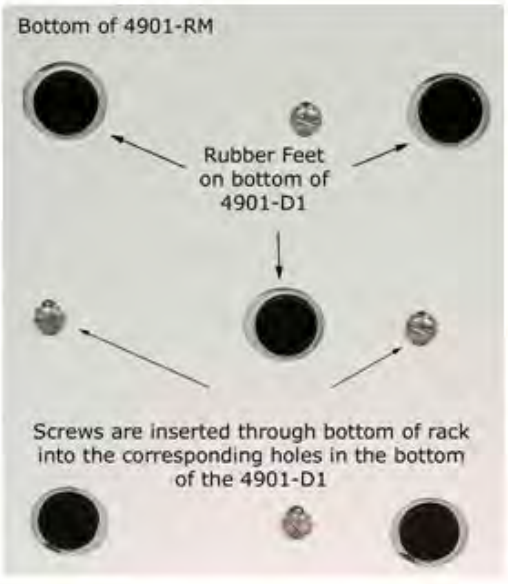
3.3.1 Overview

The 4901-RM-D1 Rack Mount allows up to four 4901-D1-Micro's to be mounted on a tray along with a Power supply. As many 4901-RM-D1's as desired may then be screwed into a 19" rack for dense test configurations. Each rack of 4901-D1-Micro's is connected to the Power supply by Power Jumper cables. The RJ-45 connectors on the 4901-D1-Micro's, marked **Simulator** and **Modem** fit into the cutouts in the front of the rack. Clips are available to mount on the front of the rack to assist in dressing RJ-45 to RJ-45 cables. Insert screws through the holes in the bottom of the rack and then into the bottom of the 4901-D1-Micro's.

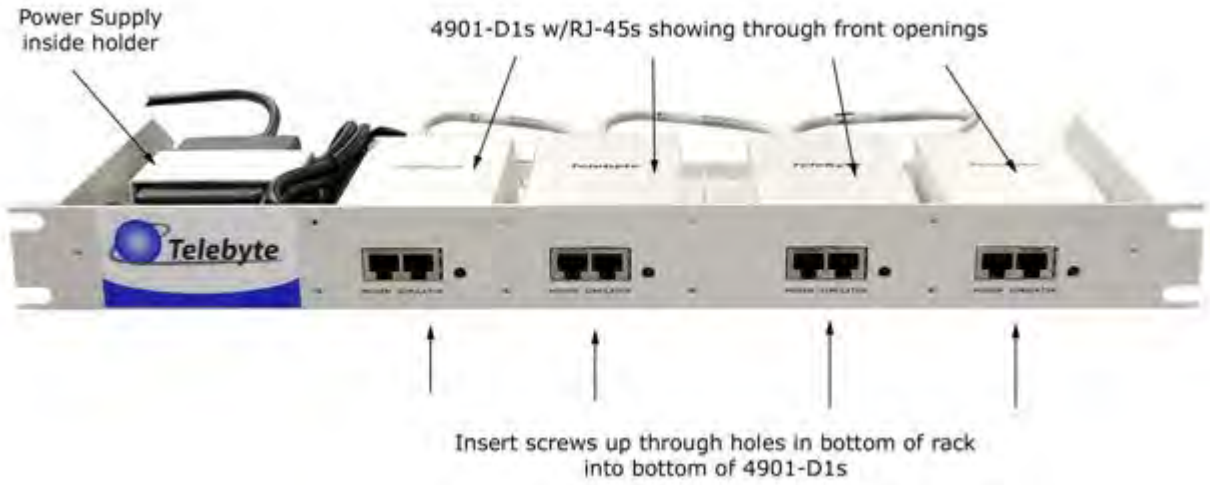
- A 4901-ISDN2, which does not require power, may be added to the 4901-RM-D1 rack along with two 4901-D1-Micro's. This configuration is used with the Same Pair/ISDN Line Sharing noise in the WT-114 noise library.

3.3.2 4901-RM-D1 Assembly

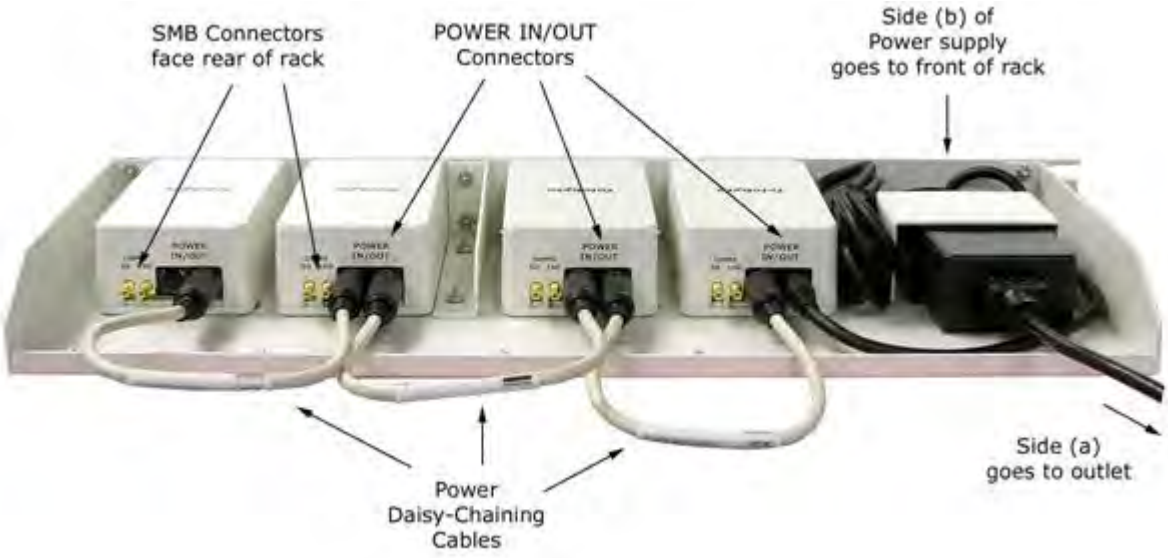
- Mount 4901-D1-Micro's
  - For each 4901-D1-Micro to be mounted, unscrew and remove the blank located behind the 4901-D1-Micro opening in the front of the rack.
  - Place the first 4901-D1-Micro, screw holes facing downward, onto the bottom of rack, in the space next to the Power supply. The RJ-45 connectors marked **Modem** and **Simulator** should face the opening in the front of the rack.
  - Ensure the 4 screw holes and rubber feet on the bottom of the 4901-D1-Micro are aligned with the holes in the bottom of the rack.



  - Screw the 4901-D1-Micro onto the bottom of the rack by inserting the 4 screws (included with the rack) up through the bottom of the rack, into the bottom of the 4901-D1-Micro.
  - Repeat this process for up to 3 more 4901-D1-Micro's.



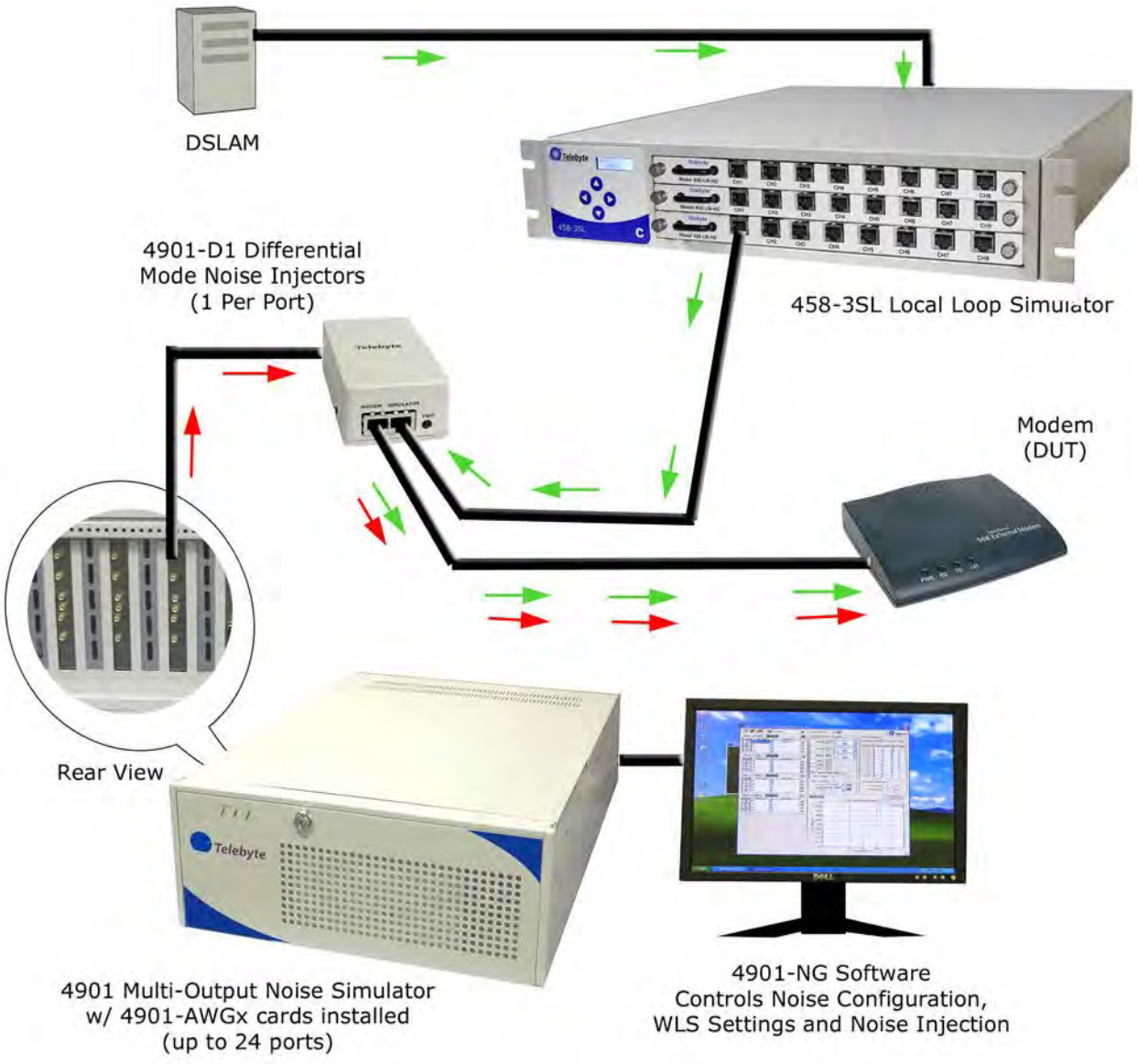
- Mount Power Supply
  - Loosen the screws that fasten the Power supply holder.
  - Place the Power supply into the Power supply holder. The Power supply has two cables – (a) goes to the electrical outlet (b) goes to the 4901-D1-Micro **POWER IN/OUT** connector. Make sure the Power supply is positioned so that side (b) faces the rear of the rack.
  - Tighten the screws on the holder to secure the Power supply.
  - Dress side (b) of the Power supply and stow it between the Power supply holder and the adjacent 4901-D1-Micro.
- Connecting the Power Supply
  - Plug side (b) of the Power supply cable into the **POWER IN/OUT** connector on the adjacent 4901-D1-Micro. Use the connector closest to the Power supply.
  - Daisy-Chain the remaining 4901-D1-Micro's by plugging one end of each Power Jumper cable into the **POWER IN/OUT** connector of two adjacent 4901-D1-Micro's.
- Plug the Power supply into an outlet.



4.0 Test Configuration Diagrams

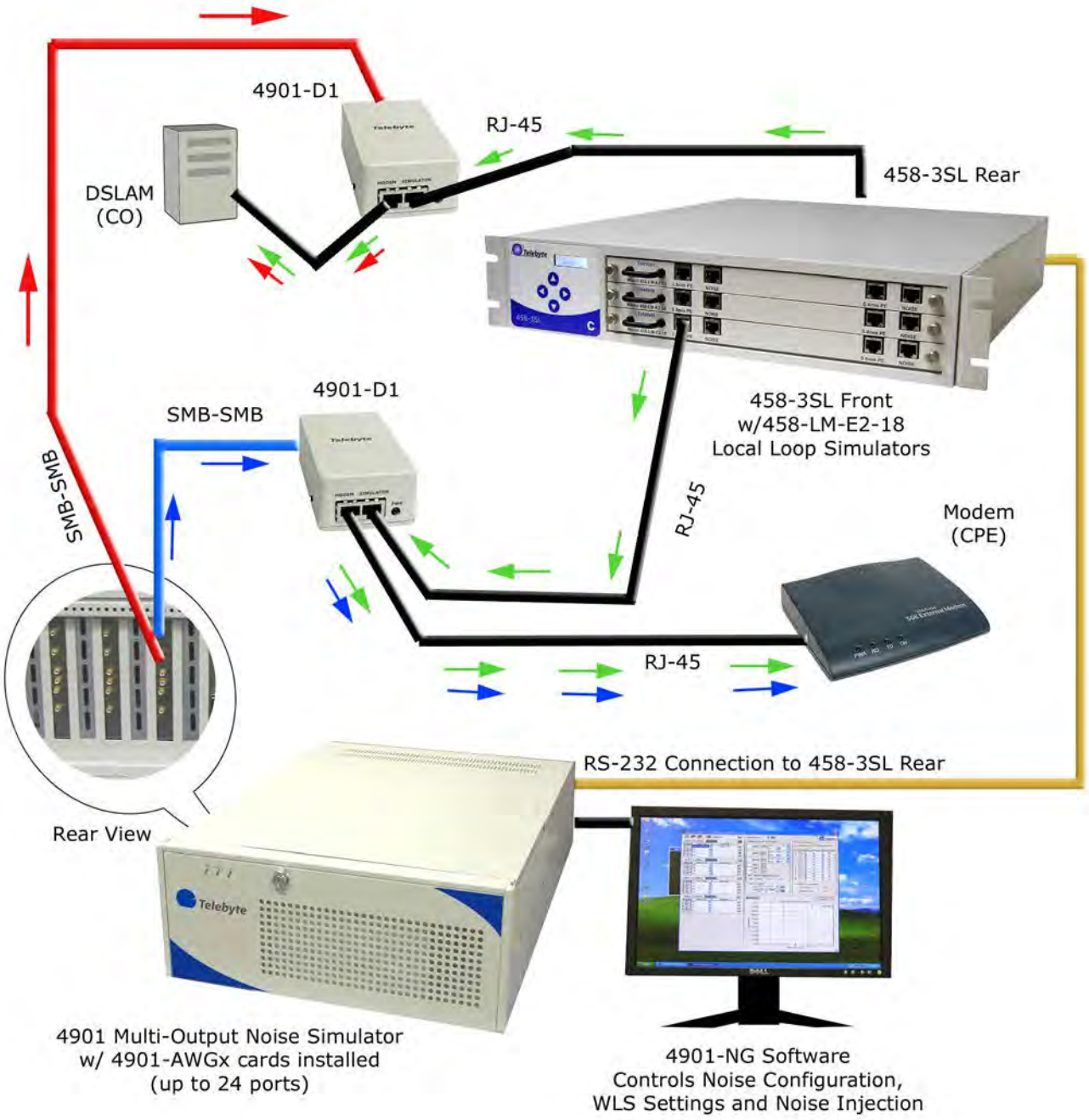
The following diagrams show examples of various test configurations using the Model 4901 hardware and software as well as the Model 458-3SLx (3-Slot Chassis) with different line modules installed. The Model 4901 is not limited to these examples - they are provided as a guide for making connections as well as illustrating ways the system can be expanded. Please note, the units under test on the CO and CPE sides are not Telebyte equipment.

4.1 Crosstalk on CO or CPE Side (1 card)



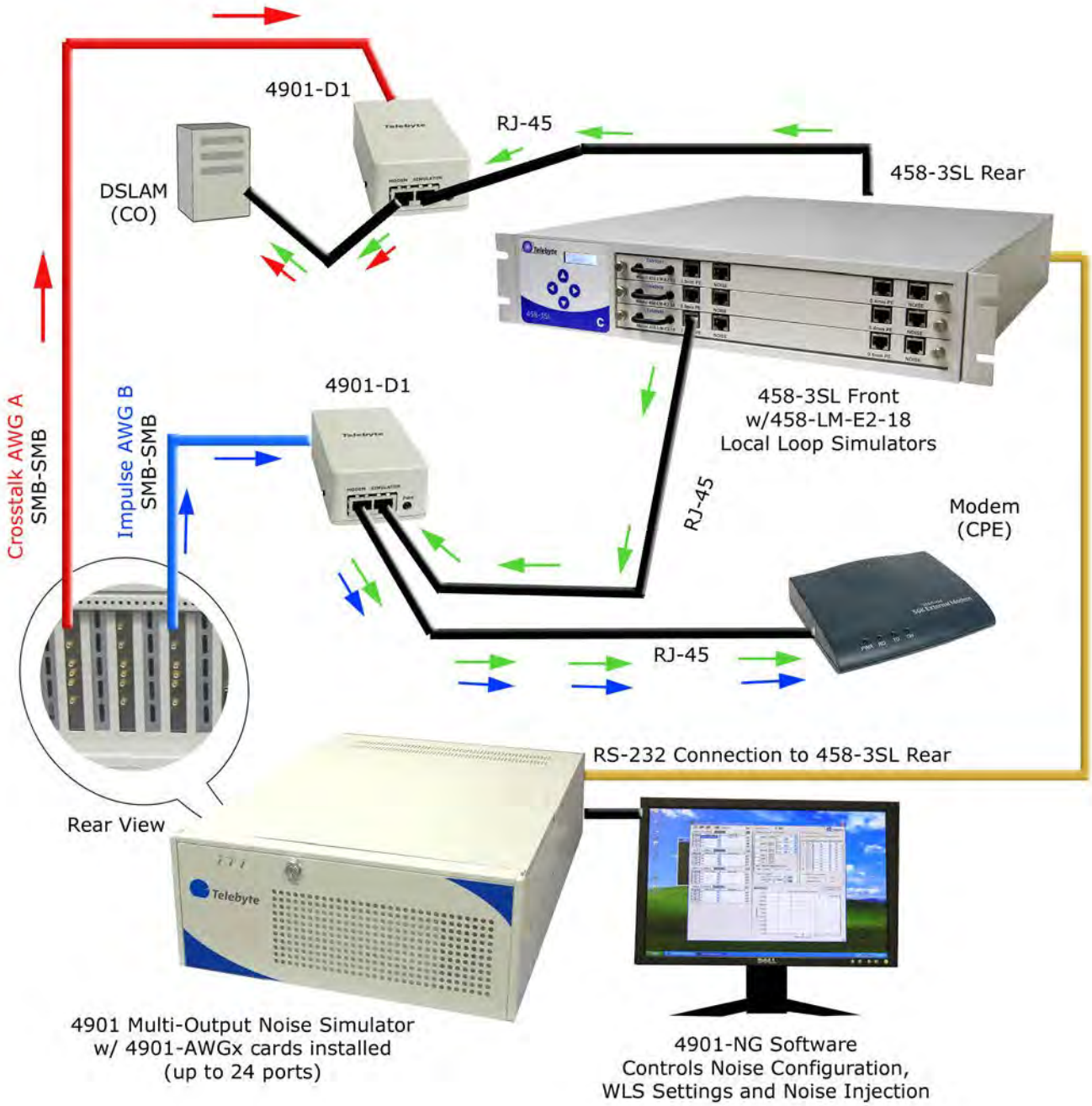
Summary: The Model 4901-PC injects noise using the 4901-D1-Micro noise injector. The injector combines the data from the local loop simulator and the 4901-PC and injects it into the unit under test on the CPE side. To inject noise on the far end, switch the unit under test from the CPE to the CO side and change the channel settings to CO.

4.2 Crosstalk on CO and CPE (1 card)



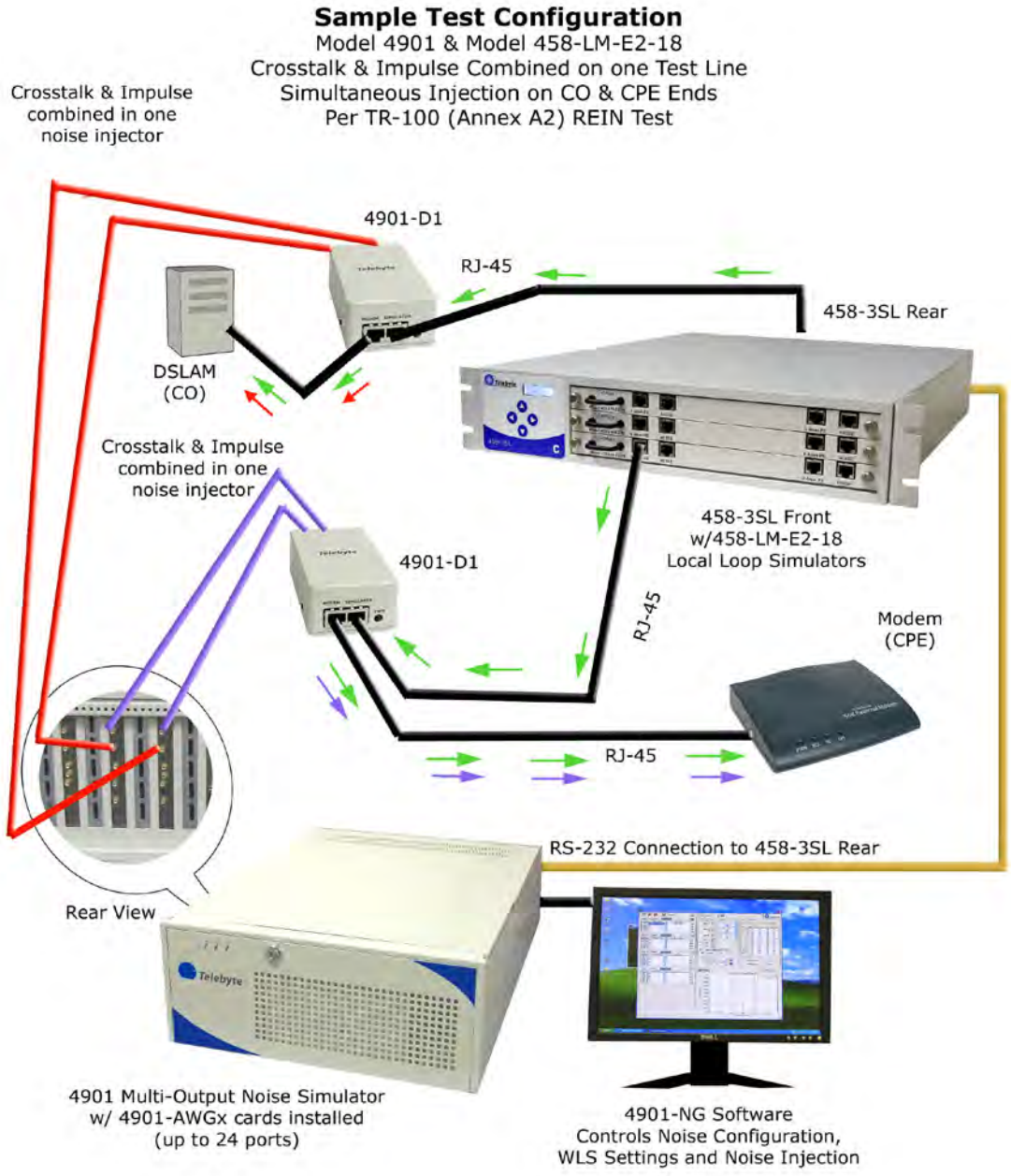
Summary: In this example, each port on one 4901-AWG card is connected to its own 4901-D1-Micro. Each injector combines the signal from the local loop simulator and the 4901-AWG card and injects it into the unit under test on both the CO and CPE side simultaneously.

4.3 Crosstalk on CPE/ Impulse on CO (2 cards)



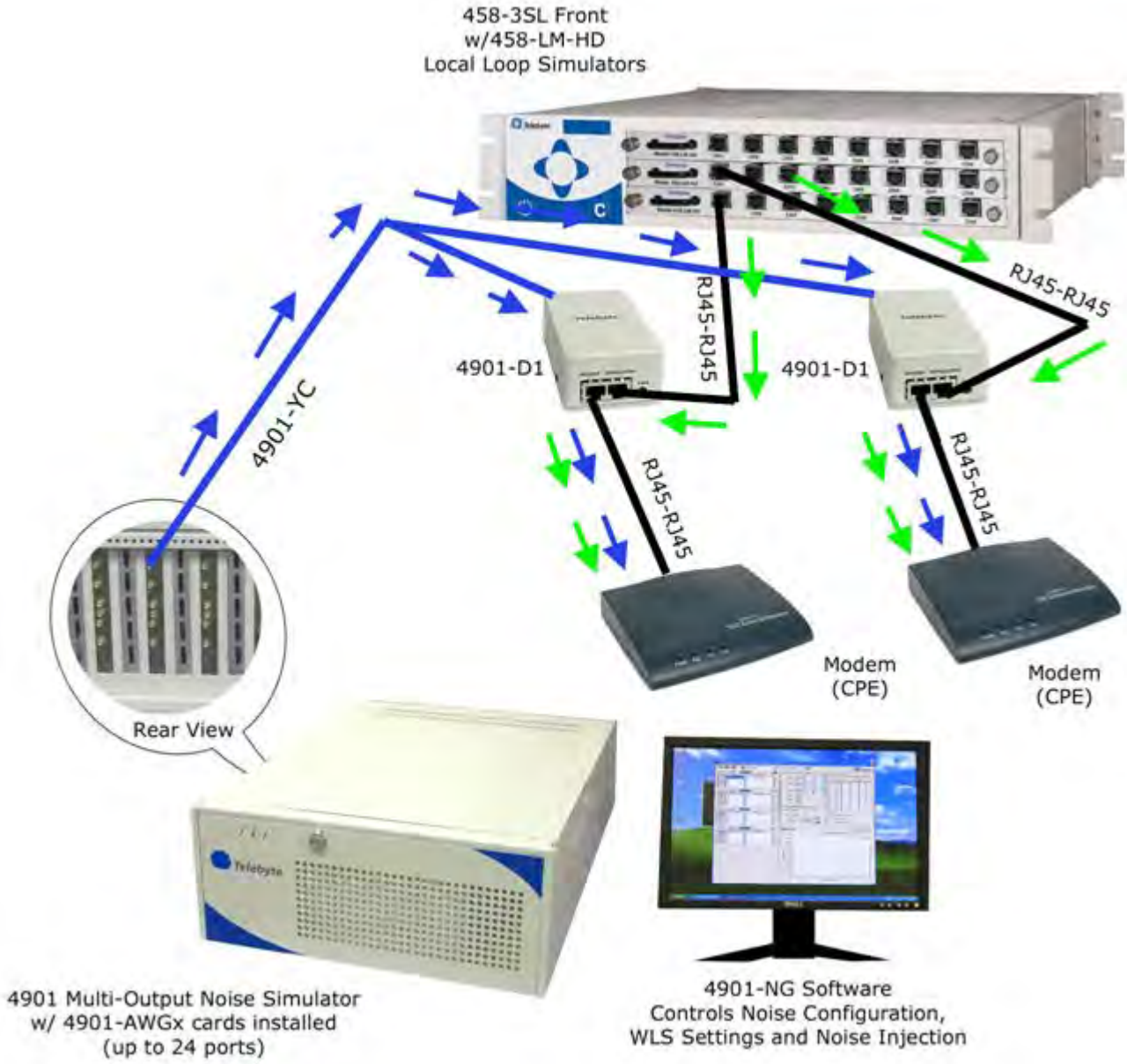
Summary: In this example, AWGN and impulse noise are generated on separate 4901-AWG-4 cards (A & B). Channel 1 on card A is connected to its own 4901-D1-Micro noise injector, while Channel 5 on card B is connected to its own 4901-D1-Micro. Each injector combines the signal from the local loop simulator and the 4901-AWG card and injects it into the unit under test on both the CO and CPE sides of the loop simultaneously.

4.4 Combine Crosstalk and Impulse on CO and CPE (2 cards)



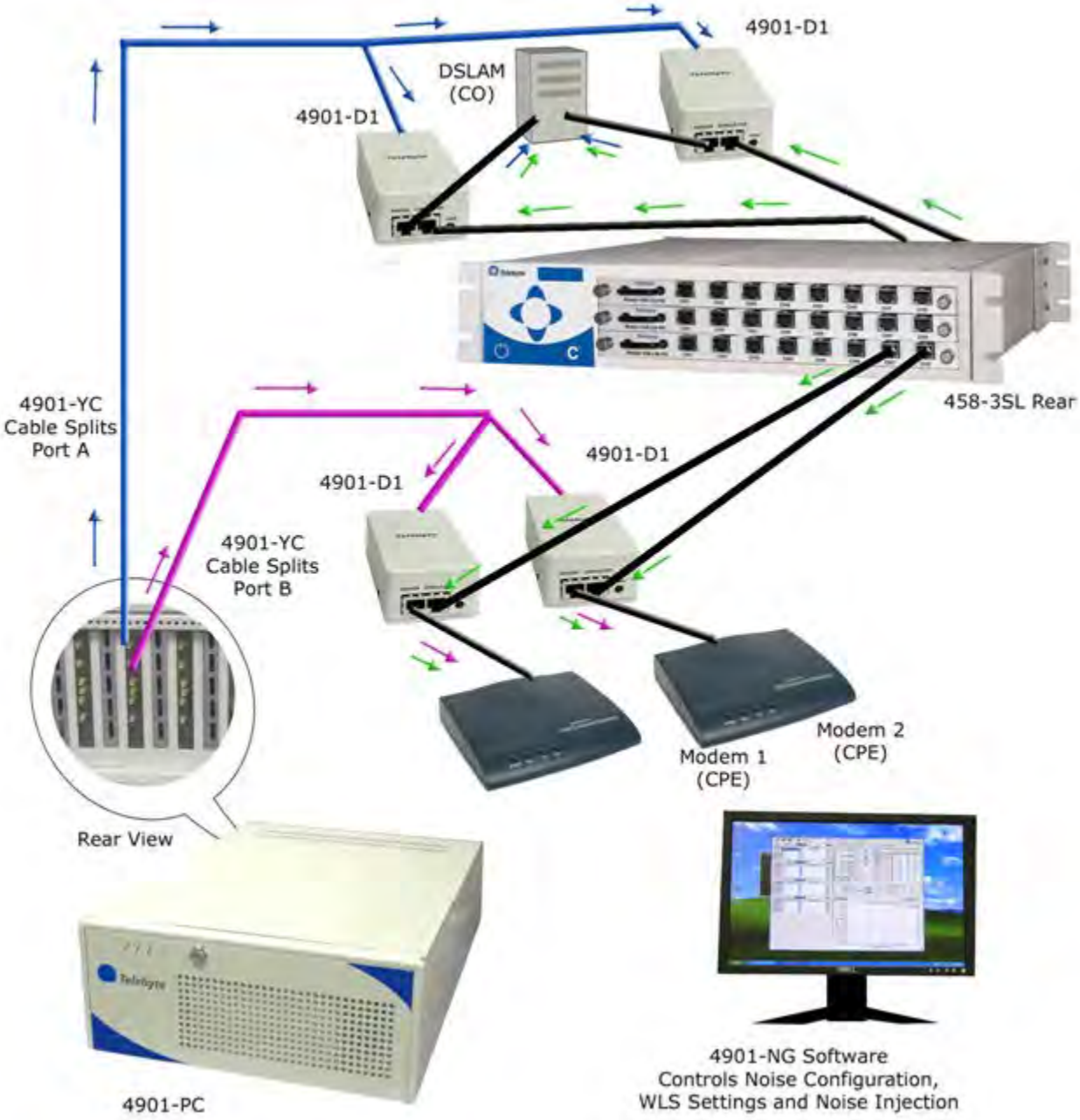
Summary: In this example, Crosstalk and impulse noise are generated on separate 4901-AWG-4 cards and combined in the noise injector. Each injector also combines the signal from the corresponding local loop simulator and injects it into the unit under test on both the CO and CPE side simultaneously. The sharing is created by connecting the SMB-to-SMB cables of the shared channels to both the 50-ohm and 100-ohm connectors in the rear of the same injector. This is repeated for the other side of the loop.

4.5 Split Noise to CPE (1 or more cards)



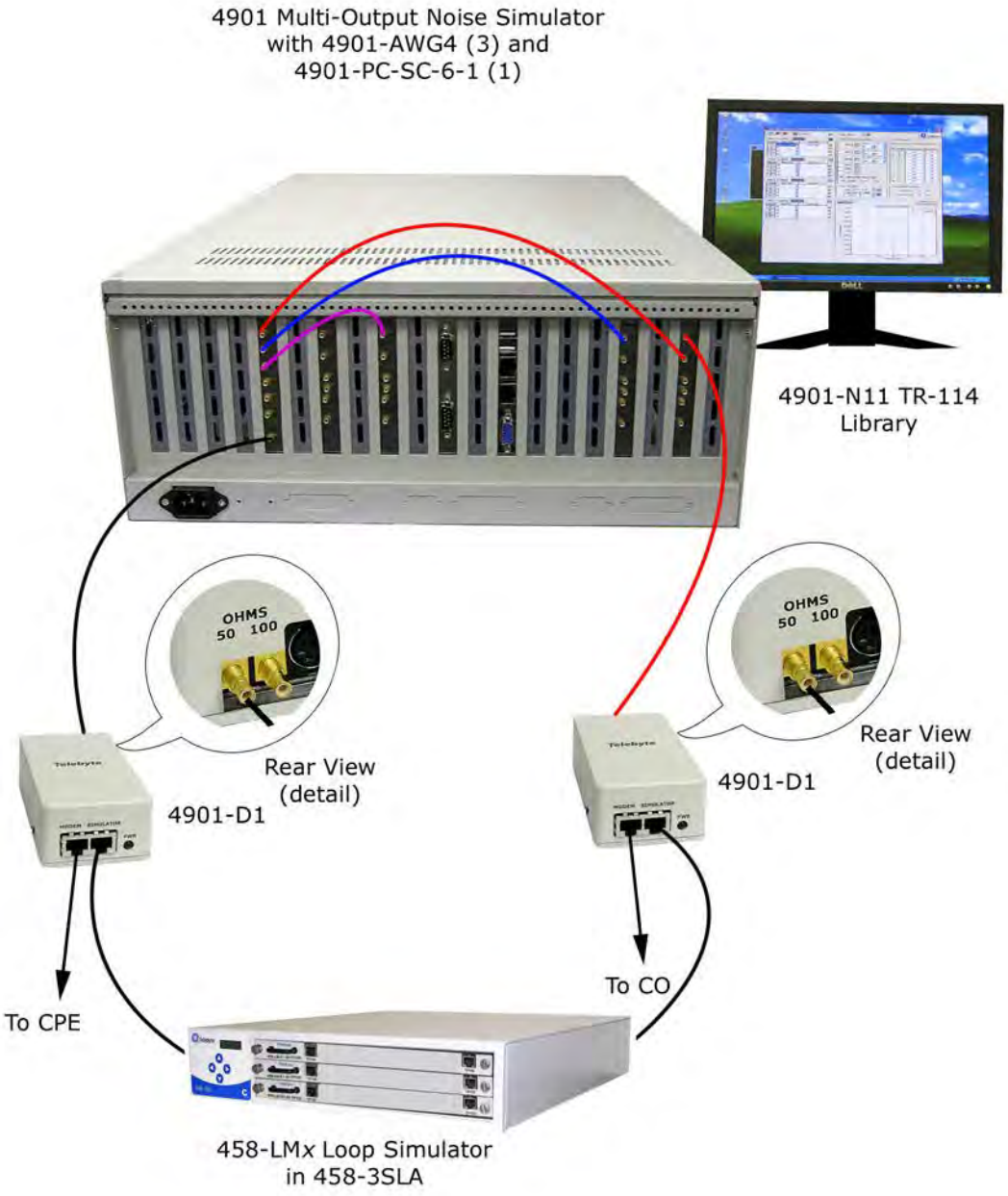
Summary: In this example, the noise from one 4901-AWG4 port is split between two 4901-D1-Micro Differential Mode Noise Injectors by a 4901-YC cable. Each noise injector combines the signal from one channel on a local loop simulator with the noise from the 4901-AWG port. The combined signal is then sent to the connected unit under test. This provides simultaneous noise injection on the near end of the loop to two units under test. A total of 48 units could be tested in this way with sufficient Telebyte equipment. Please note only one designation of CO or CPE per port is possible, therefore noise split from the same port is not used for simultaneous noise injection on the CO and CPE side.

4.6 Split Noise to CO & CPE (1 or more cards)



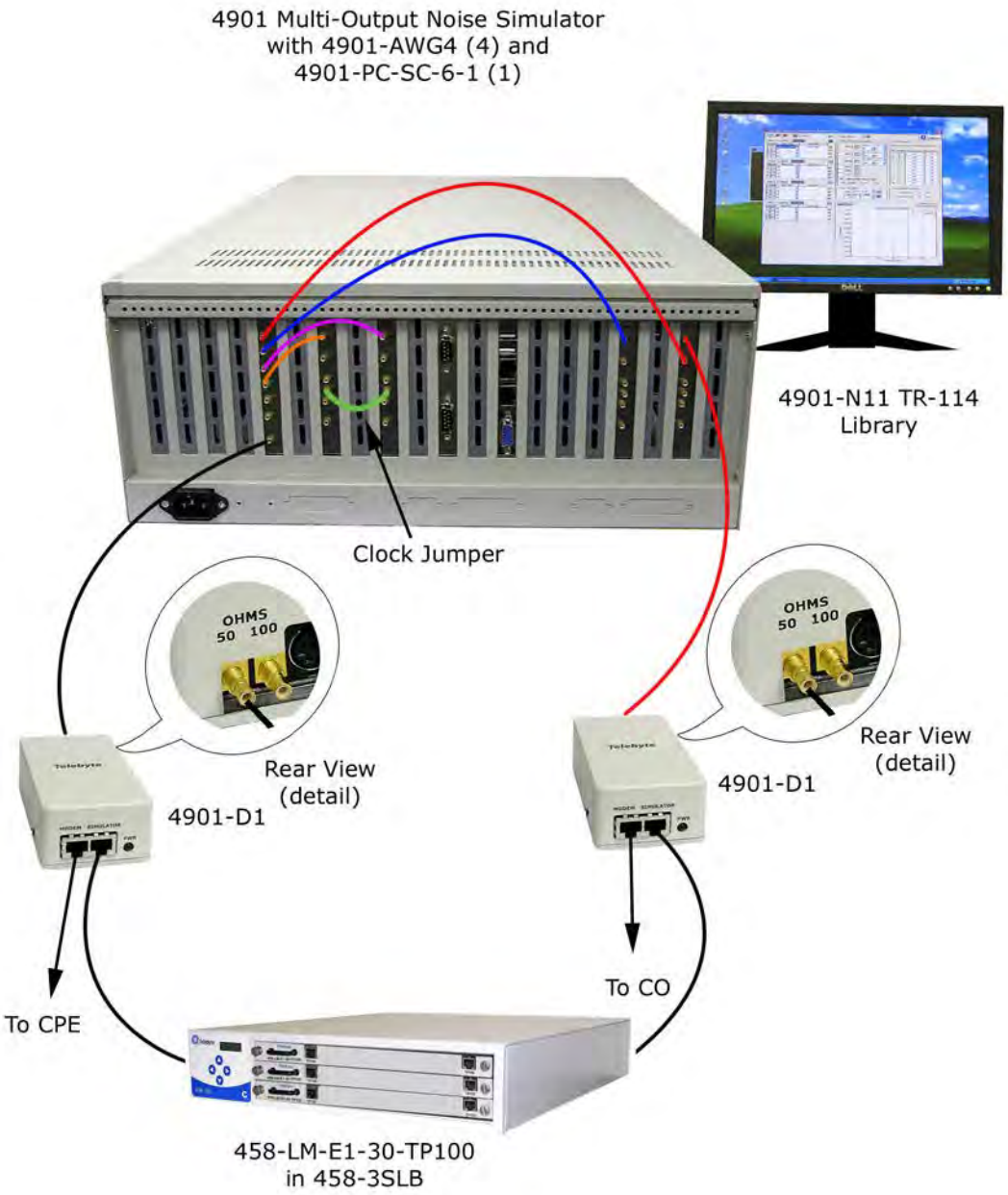
Summary: In this example, the noise from port A is split and sent to two 4901-D1-Micro noise injectors on the CPE side. The noise from port B is split and sent to two 4901-D1-Micro noise injectors on the CO side. The noise and loop signals are mixed by the noise injectors and then sent to each unit under test. When the noise from a port is split by the 4901-YC cable, both noises are the same. However, because the noise from port A is different from the noise from port B, simultaneous injection of uncorrelated noise on both ends of the loop is possible. Note that this configuration requires only 4 noise injectors and 2 noise ports.

4.7 Combined Noise Threat: REIN



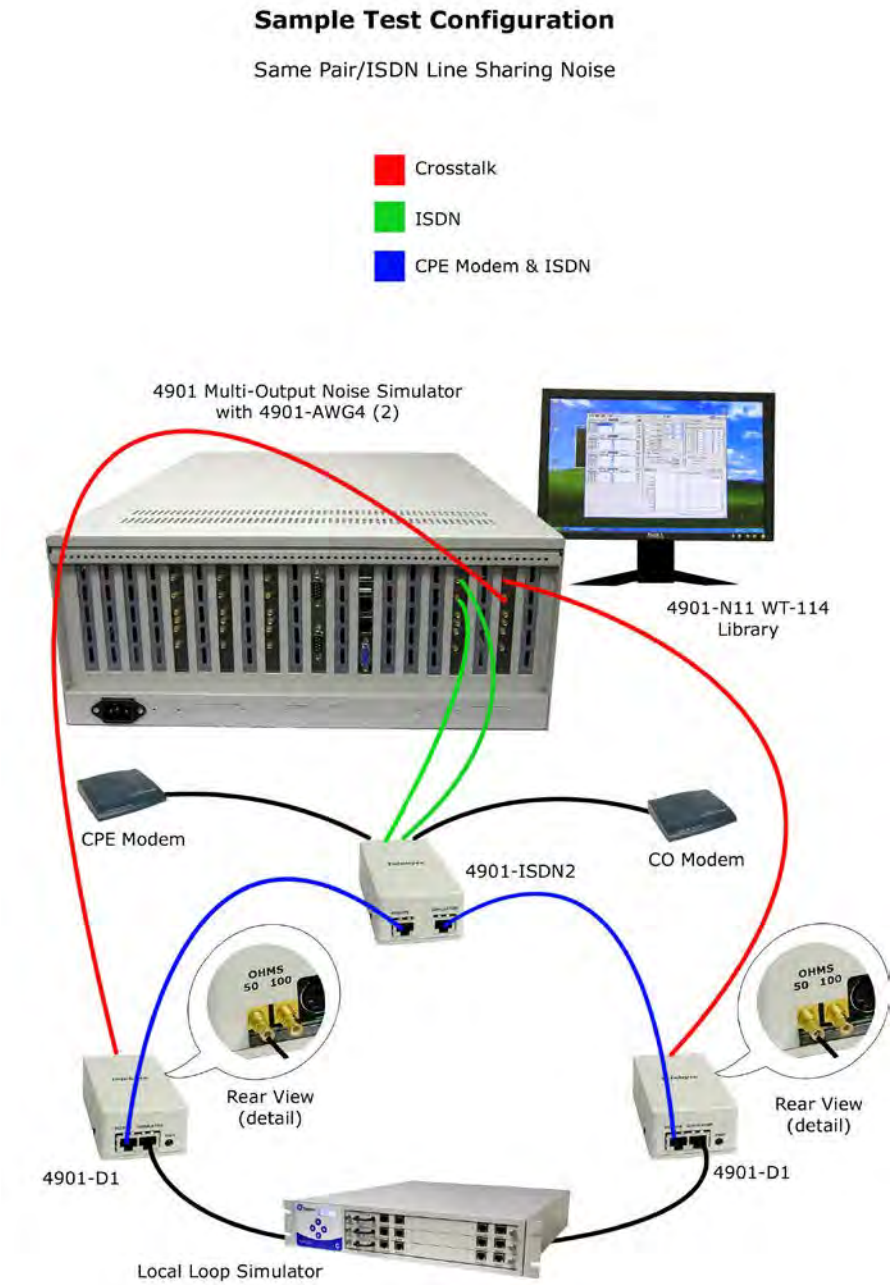
Summary: Telebyte's TR-114 solution provides all the software and hardware necessary to generate the noises required for the Combined Noise Threat: REIN test. The diagram shown above depicts the hardware and connections used to accomplish this (2 or 4 port 4901-AWG cards may be used). The 4901-N11 TR-114 Noise Library will automatically select and configure the test.

4.8 Combined Noise Threat w/Fluctuating RFI



Summary: Telebyte's TR-114 solution provides all the software and hardware necessary to generate the Crosstalk, fluctuating Crosstalk, PEIN and fluctuating RFI noises required for the Combined Noise Threat with Fluctuating RFI test. The diagram shown above depicts the hardware and connections used to accomplish this (2 or 4-port AWG cards may be used). The 4901-N11 TR-114 Noise Library will automatically select and configure the test.

4.9 Same Pair/ISDN Line Sharing Noise



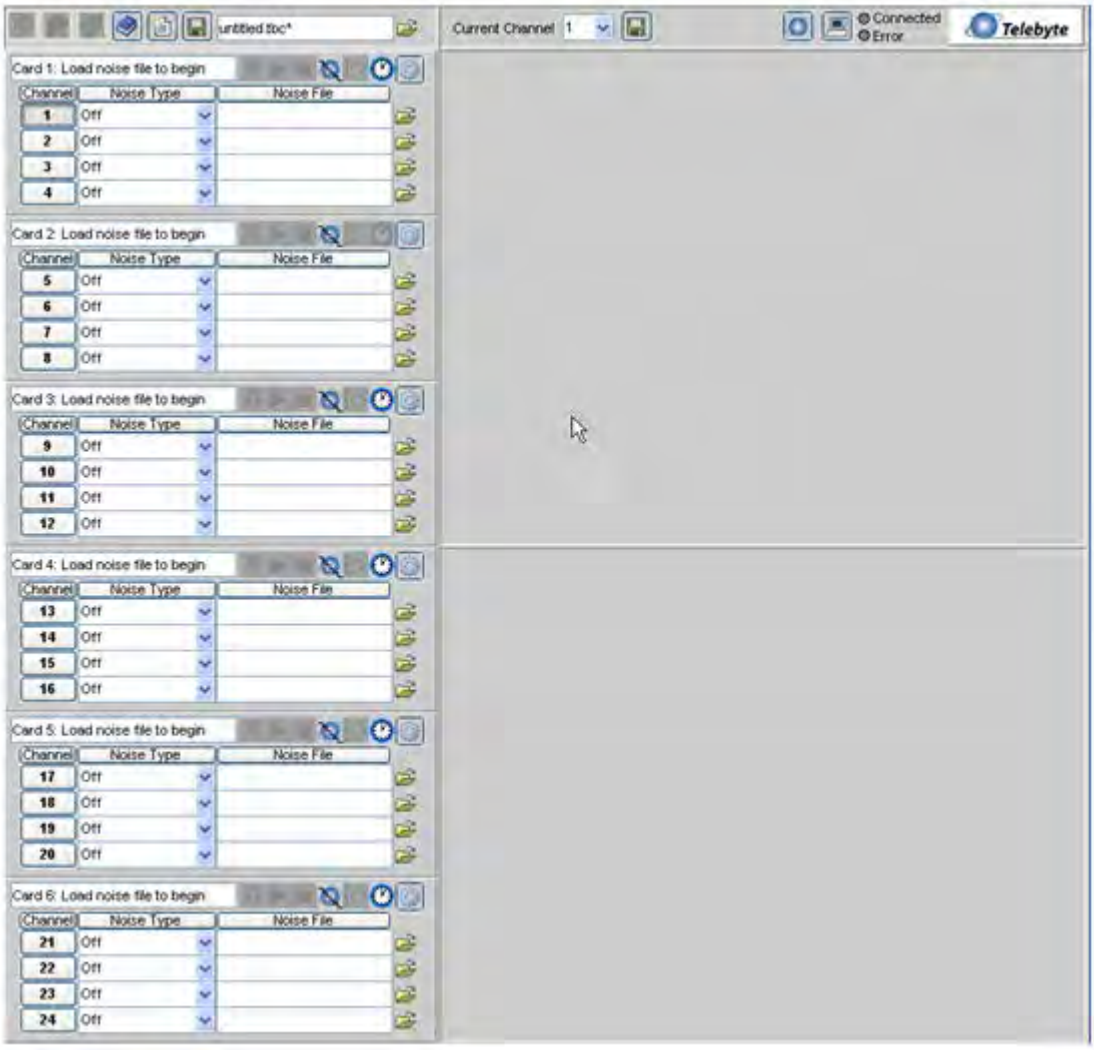
Summary: Tests that include Same Pair/ISDN Line Sharing require a 4901-PC, the 4901-NS basic software, 4901-N11 TR-114 library, and two 4901-AWG2(or 4) cards. The ISDN outputs from one AWG card are combined with modem signals in the 4901-ISDN2 Dual Output ISDN Noise Injector (with internal 50-to-150-ohm Matching Impedance Transformer). At the same time, Crosstalk from the other AWG card is added in via connection to two 4901-D1-Micro Differential Mode noise injectors. The 4901-N11 library automatically sets up and controls the entire test. When a Telebyte chassis and loop simulator are used, the PE04 portion of the test is also controlled by the 4901-N11 library.

5.0 Using the 4901-NS Software

5.1 Launching the 4901-NS Noise Generator Application Software

- For the remainder of this manual, the 4901-NS Noise Generator Application software is referred to as the 4901-NS software.

- Click the desktop icon created during installation. A splash screen is shown during program initialization and then the Main screen appears.



The Main screen appears as shown above when the program launches. The number of card sections displayed depends upon the number of 4901-AWGx cards installed.

5.2 Elements of the Main Screen

The following provides a brief orientation to the Main screen. More detail is provided in subsequent sections. You should familiarize yourself with this section before continuing with the remainder of the manual.

5.2.1 Menu Bar

5.2.1.1 Noise Control Icons – Menu Bar

 Load Noise On All Cards

 Play Noise On All Cards

 Stop Noise On All Cards

 Access Noise Libraries & Modules

5.2.1.2 Saving Files and Configurations – Menu Bar

 Create New Noise Configuration Profile

 Save Noise Configuration Profile (all current settings for all cards)

Configuration File Name Text Box/Open Configuration File

Select/Display Current Channel  Save Current Noise File on Current Channel

5.2.1.3 Remote Control Configuration – Menu Bar

 Set connection for Telebyte WLS

Displays Connection Status

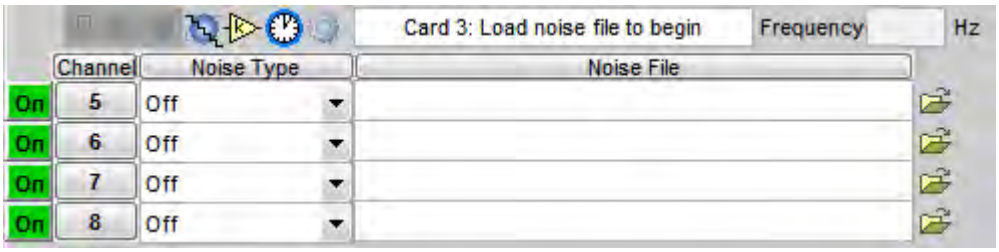
 Button to access Remote Control Configuration dialogue box

5.2.1.4 License Information – Menu Bar

View/Change License information

5.2.2 Noise Type Selections

Up to six **4901-AWG Noise Card Menus** display, depending on the number of 4901-AWG cards installed. The following graphic shows a representation of a four-port AWG card.



Change Card Configuration icon (in the upper-right corner of the Noise Type Selection section) is used to change the current 4901-AWG*x* card configuration. This icon is disabled when a noise type is selected for any channel on the card.

Several icons display on the top of each card and apply to all the channels on that card.

Load Noise

Play Noise

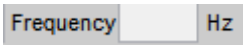
Stop Noise

Loop Length Iteration (applied to all channels on the card)

Adjust Amplitude (apply to one or all channels on a card)

Set Playback Timer/Replay Timer

Turn channel off or on (when using 4901-AWGxA cards only)



Displays the current frequency for the entire card and allows the user to change the frequency.

Displays the current Period for the entire card and allows the user to change the period.

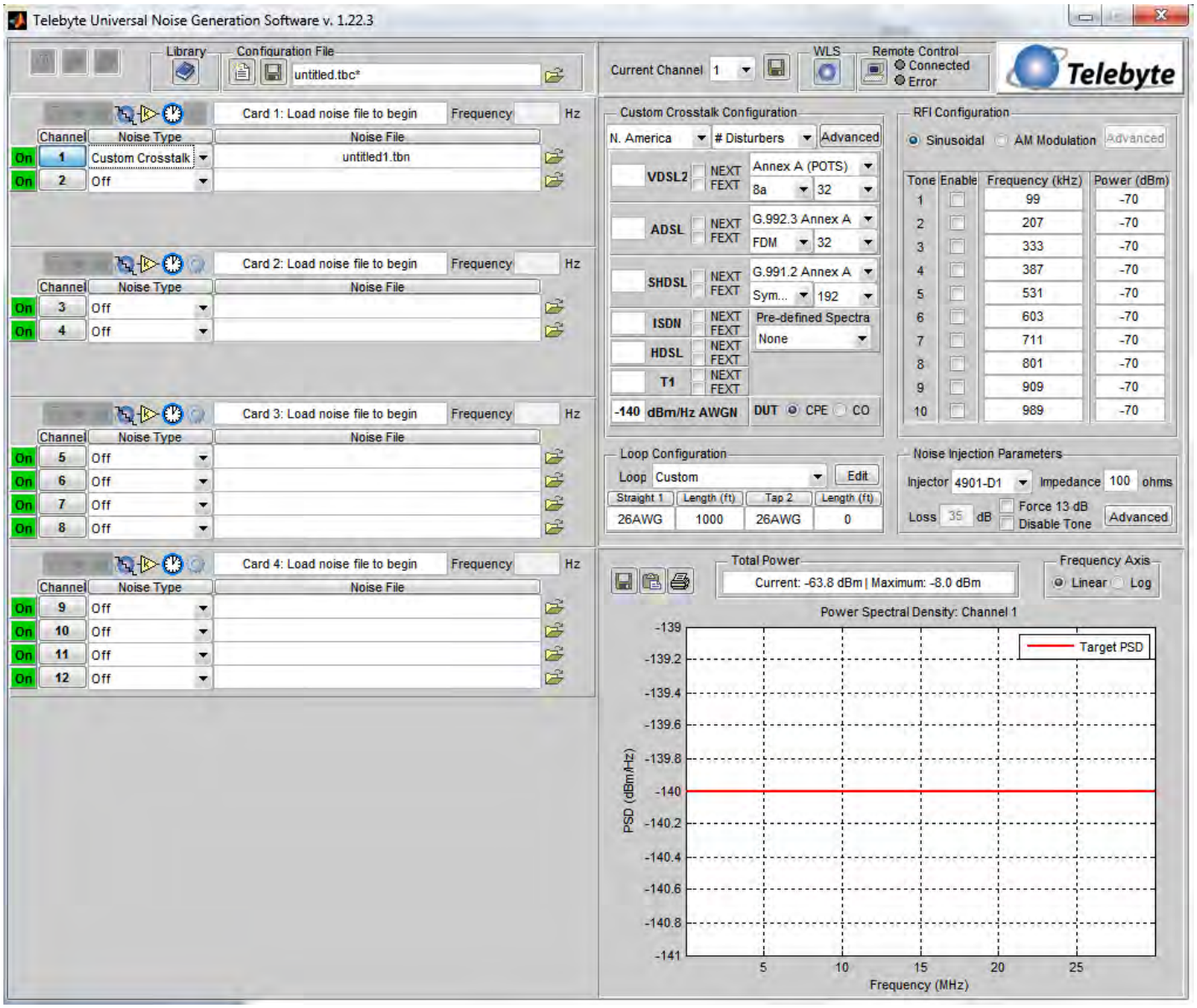
➢ Either a Frequency or Period field is shown, depending on how the card is configured.

Open Noise File on Related Channel (must match current card configuration of Impulse or Crosstalk)

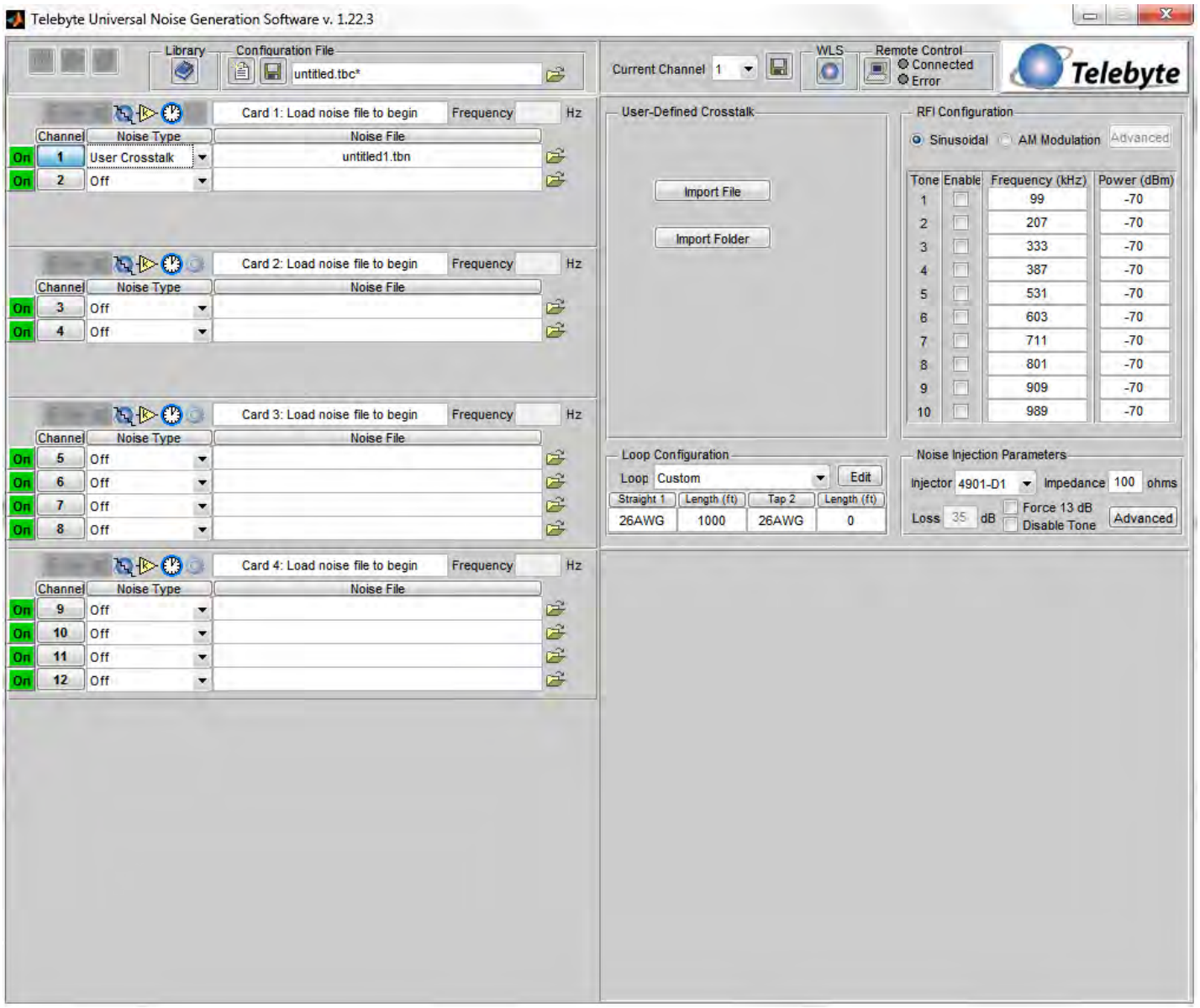
5.2.3 Noise Configuration Section

The right side of the Main screen changes when the Noise Type is changed. There are several screens that may appear in this area depending on whether the 4901-AWGx is configured for Crosstalk or Impulse mode and the settings within those modes. The following graphics depict the default screens that appear with the selection of each Noise Type.

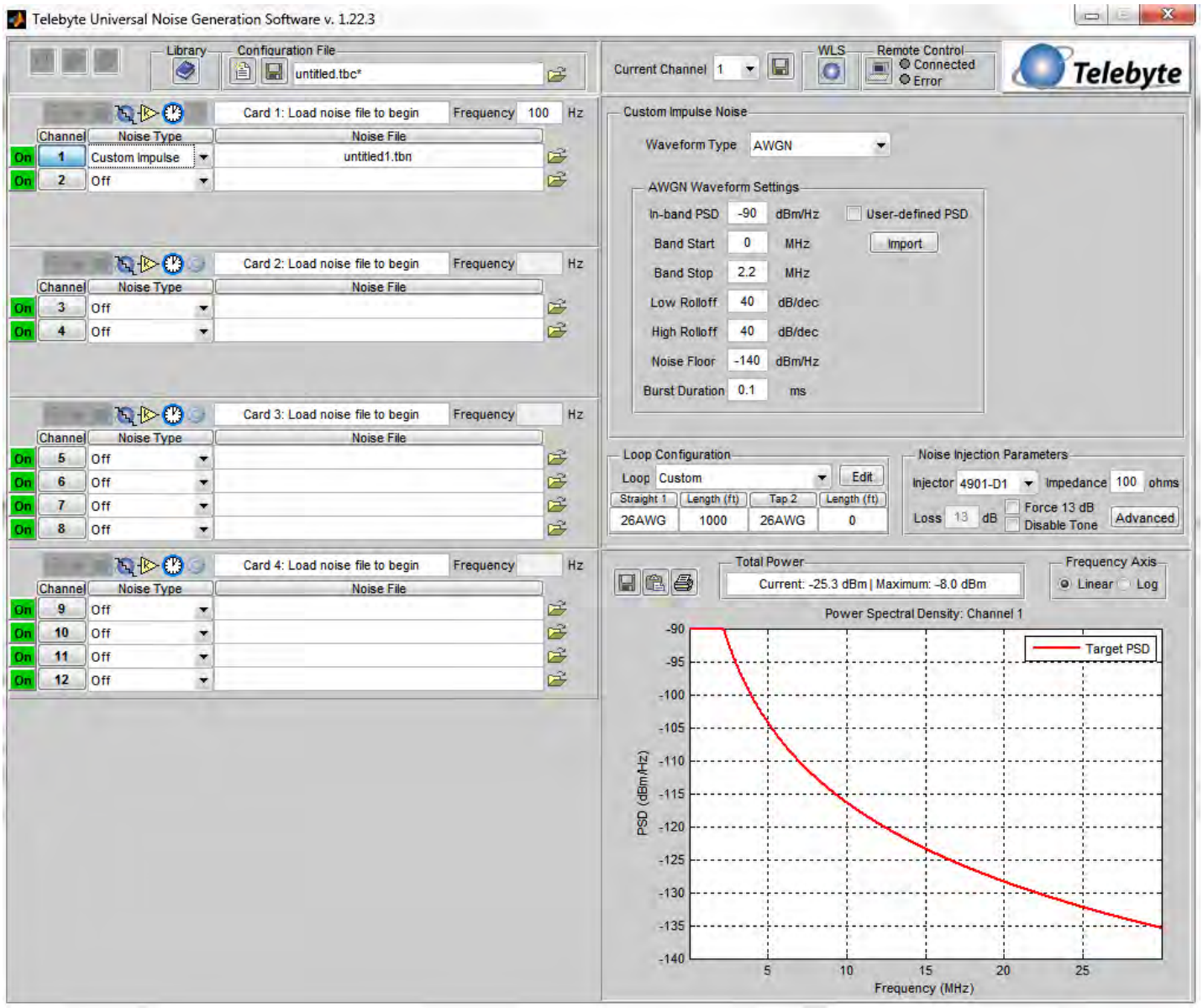
5.2.3.1 Noise Type Custom Crosstalk – Default Screen



5.2.3.2 Noise Type User Crosstalk – Default Screen



5.2.3.3 Noise Type Custom Impulse – Default Screen



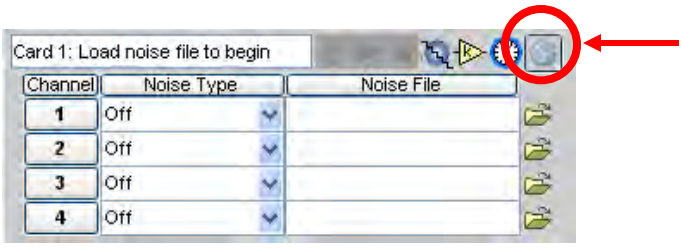
5.3 Quick Start

The following instructions provide a brief overview of the common steps followed when operating the Model 4901 via the 4901-NS interface. Please refer to the sections that follow for more detailed information.

Instructions:	Refer to:
1) **Configure 4901-AWGx card to work in either Crosstalk or Impulse mode** before selecting a Noise Type.	Configure 4901-AWGx Card Mode
2) Navigate to the applicable Noise Type section and **select the Noise Type** for the corresponding channel. a) For Crosstalk, select either Custom or User (imported) Crosstalk. b) For impulse, select Custom Impulse. User (imported) Impulse is available from within Custom Impulse.	Noise Configuration Section
3) If desired, **connect to a Telebyte Wire Line Simulator (WLS)** using the WLS Communication Settings icon. This will read the WLS slot:channel combinations available and populate the dropdown in the Loop Configuration section.	WLS Control
4) **Configure the Crosstalk or Impulse noise** using fields that appear on the right side of the screen.	Screen Sections by Noise Type
5) **Save the noise.**	Control Noises
6) **Load, then play or stop the noise.**	Control Noises
7) Access Noise Modules/Libraries via the  icon.	Noise Libraries

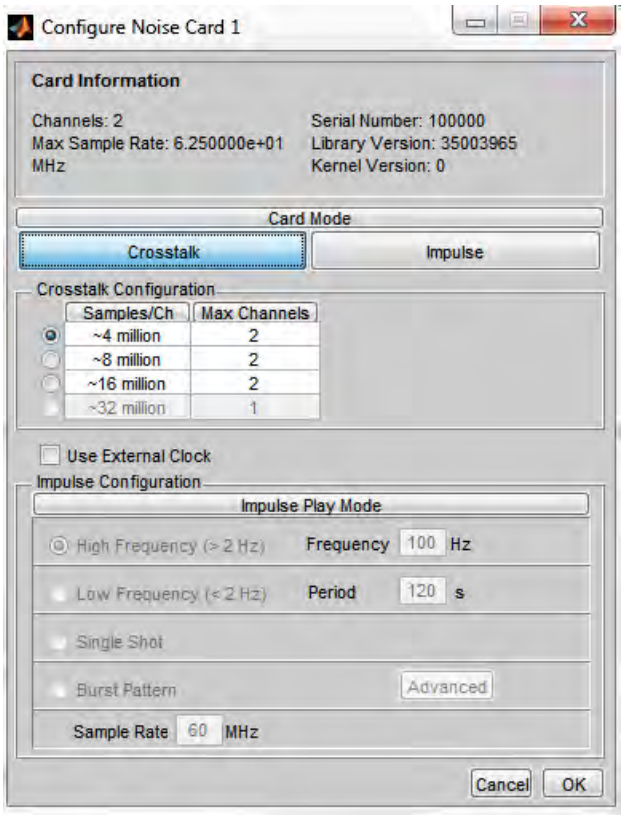
5.4 Configure 4901-AWGx Card Mode

The first step when creating a noise is to configure the 4901-AWG card to be used for Crosstalk or Impulse. If no Noise Type is selected for any of the channels on a given 4901-AWGx card, the Configure icon is visible and allows you to configure the card for Crosstalk or Impulse mode.



- Select either Crosstalk or Impulse by clicking the applicable button in the Card Mode section.

5.4.1 Crosstalk Mode

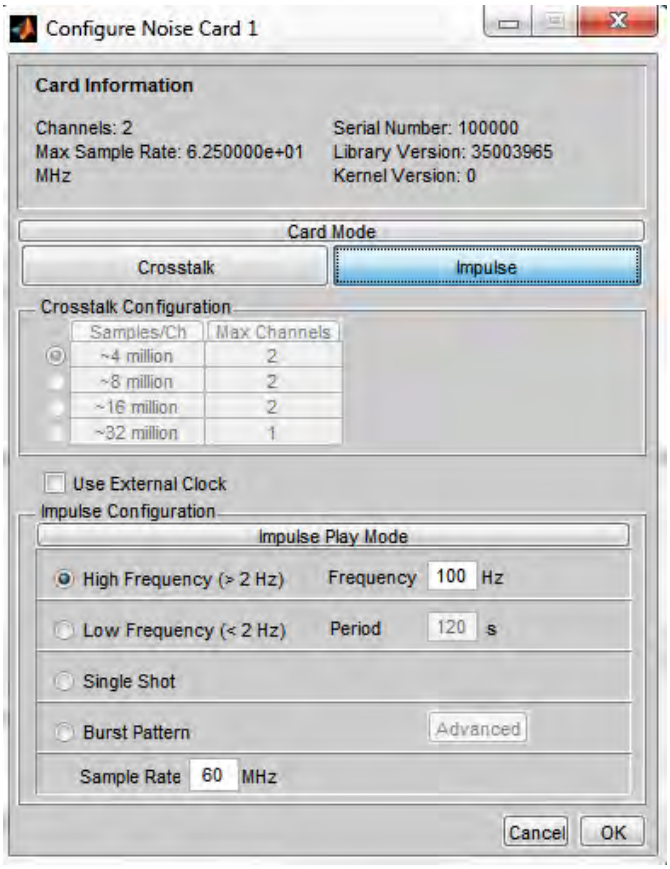


- For Crosstalk mode, select 4, 8, 16 or 32 million samples per channel. The maximum number of channels available in relation to the samples-per-channel value is dependent on amount of memory on the AWG card.

  - **This selection represents the number of samples generated before the same selection is repeated.**

5.4.2 Impulse Play Mode

- Maximum and minimum pulse duration and bandwidth frequency is 139 milliseconds and 10 microseconds at 60 MS/s at 30 MHz bandwidth.



- **High Frequency**

  The Frequency field value represents the frequency at which the impulse noise is being repeated. Enter the Frequency value (default is 100 Hz, maximum allowed is 1 kHz)

- **Low Frequency**

  Enter the Period value (default is 120 s).

- **Single Shot**

- **Burst Pattern**

- Refer to the Custom Impulse Mode section later in this document for instructions.

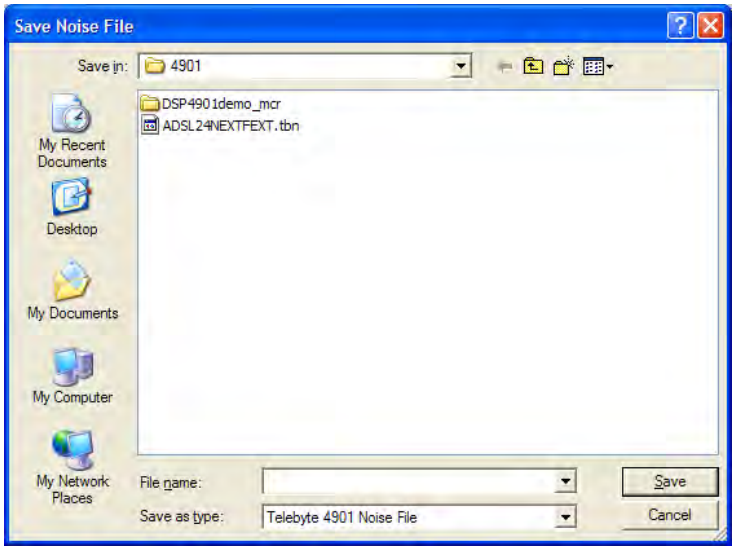
5.5 Control Noises

Noises may be loaded, played, or stopped for one card or all cards. ***A noise must be saved before it can be loaded***. Saving a noise automatically imports it and makes it available to be loaded.

5.5.1 Save Current Noise

- To save the current noise, click the **Save Current Noise File on Current Channel** icon. The channel displayed in the **Current Channel** field will be the noise saved. The following icons appear along the Menu bar for this purpose:

Select/Display Current Channel  Save Current Noise File on Current Channel



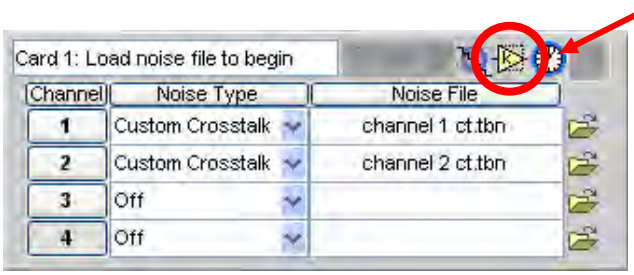
- Enter the name of the noise and click Save. The noise file is automatically saved and imported on the current channel and shown in the **Noise File** field. The PSD graphic displays the Estimated PSD (noise to be generated) and Target PSD data (true theoretical value). In addition, the Load Noise icon is activated in the Noise Type Selection section for the current channel.

5.5.2 Load/Play/Stop Noise

- All noises on a card may be loaded when either the  Load Noise or  Load Noise On All Cards icon is highlighted.
- All noises on a card may be played with either the  Play Noise or  Play Noise On All Cards icon is highlighted.
- All noises on a card may be stopped with either the  Stop Noise or  Stop Noise On All Cards icon is highlighted.

5.5.3 Change Noise Amplitude

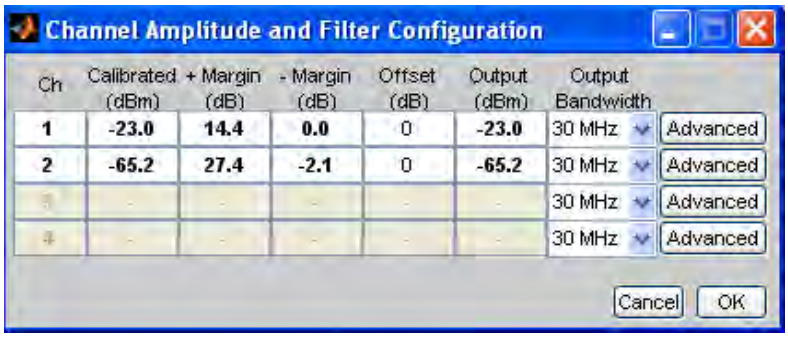
The Change Noise Amplitude feature is used to offset the current Crosstalk output for one or more channels. The initial menu is used to enter one offset value, while an advanced Dynamic Noise Level menu facilitates the setup of multiple offsets that change at specified time intervals. To access Change Noise Amplitude, click the Change Noise Amplitude icon.



- A Noise Type of Custom Crosstalk must be selected on at least one channel for the icon to activate. Dynamic Noise Level settings must be configured before saving a noise file.

5.5.3.1 Change Noise Amplitude and Filter Configuration – Initial Menu

The initial menu displayed when the Change Noise Amplitude and Filter Configuration window is opened allows the user to enter one offset value for each channel on the 4901-AWGx card. A noise must be loaded on the channel of interest before the Output value is displayed.



Calibrated(dBm): The default total power (0 dB offset).

+Margin/-Margin: The largest positive and negative values allowed in the Offset(dB) field.

Output(dBm): The total Power value allowed before a warning is shown.

Offset(dB): Positive and negative values entered in this field change the Output(dBm) value by the amounts entered (for the related channel).

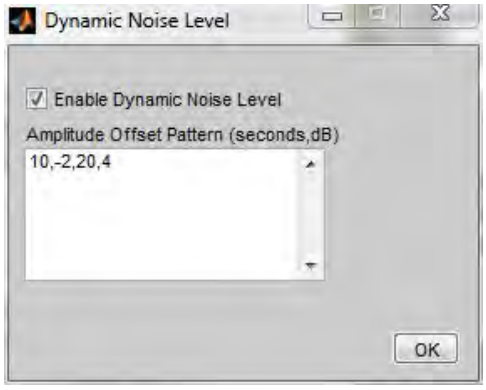
Output Bandwidth: Select 30 MHz, 10 MHz, 2 MHz or 200 kHz output bandwidth for the selected channel. The default is 30 MHz.

Advanced: See *Dynamic Noise Level (Advanced)* later in this text.

- Click OK to apply the settings.

5.5.3.2 Dynamic Noise Level (Advanced)

- Click the Advanced button in the Change Noise Amplitude window that corresponds to the channel you wish to work with.



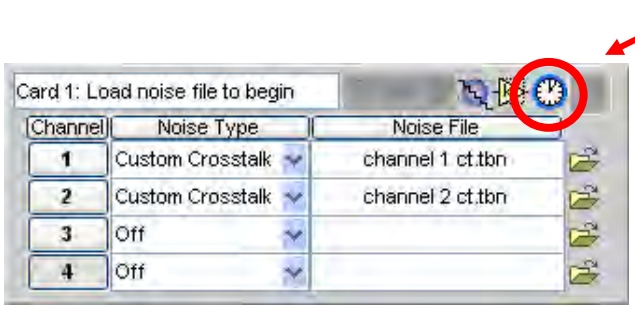
- Click the Enable Dynamic Noise Level box to enable this feature for the current channel.

- Enter the desired pattern in the Amplitude Offset Pattern text box. The pattern must consist of a pair of values for each noise level adjustment. The first indicates the time in seconds (from the start of noise play) and the second indicates the offset in dB to be applied at that time. The resolution is 100 ms and 0.1 dB and there is no limit to the number of transitions. There can be no more than a 29dB difference between the smallest and largest offsets.

- Click OK to apply the settings.

5.5.4 Set Noise Playback and Replay Time

- To set the noise playback and replay time for a given card, click the Noise Playback icon.



- The Playback Timer dialogue window appears.

- Enter the length of time you want the card to play the noise in the Playback Timer section in the **Hrs**, **Min**, and **Sec** fields. This is the "play duration." Click Enable. When the card is played, the length of time will count down to the right of the word "Playing" in the card menu area.

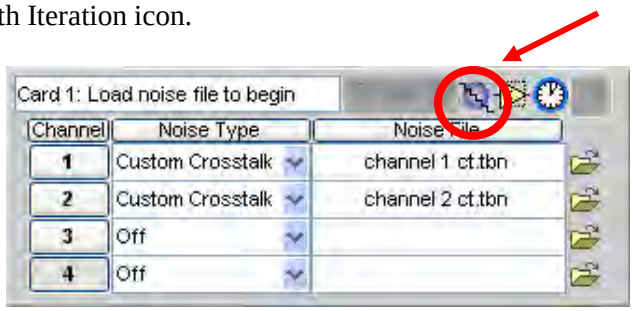
- To set the length of time you want to expire before the "play duration" repeats, enter values in the **Hrs**, **Min**, and **Sec** fields of the Replay Timer section. For example, if the Playback Timer (play duration) is one second and the Replay Timer is four seconds, playback will cycle continuously at one second on and then three seconds off. Click Enable. When the card is played, the length of time will count down to the right of the word "Waiting" in the card menu area.

- Press Enter and close the dialogue window to submit the settings and continue.

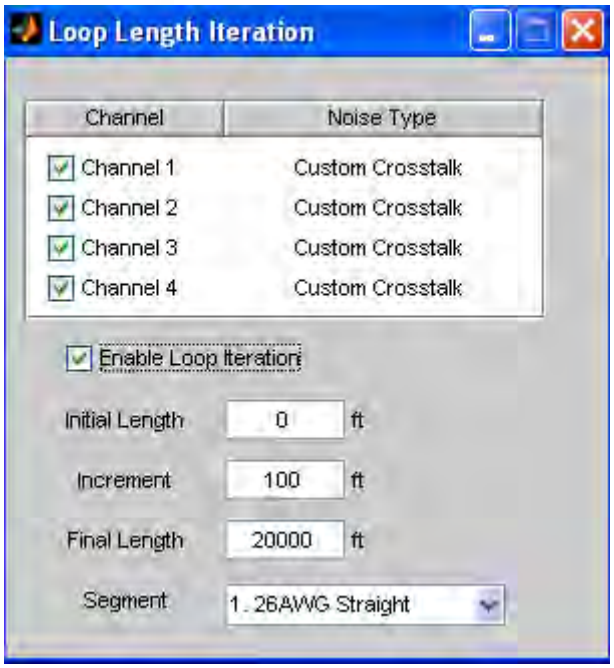
➢ Please note the setting for the Playback Timer is saved with the configuration file. It is not used in conjunction with the Loop Length Iteration function.

5.5.5 Loop Length Iteration

The Loop Length Iteration function allows the user to automatically step through incremented line lengths for all channels on an AWG card. The start length, increment and final length are configured for all channels on the AWG card. To use this function, click the Loop Length Iteration icon.



The Loop Length Iteration dialogue box is shown.



- Enter the Initial Length, Increment and Final length for all channels on the card.
- Click Enable Loop Iteration and press Enter. When the card is played, the iteration is advanced by clicking the Loop Length Iteration icon repeatedly.

➢ The wire type is saved with the noise file and the loop iteration information is stored in the configuration file. The loop iteration settings function independently of the wire type, i.e., whatever loop is in the noise file will iterate through those lengths.

➢ This function is not used with the Playback Timer function.

➢ This setting overrides the length setting in the Loop Configuration panel.

5.6 Screen Sections by Noise Type

5.6.1 Noise Type: Custom Crosstalk

5.6.1.1 Section: Custom Crosstalk Configuration

The Custom Crosstalk Configuration section is divided into two groups: North America and Europe. The field definitions in this section are grouped by "North America or Europe," "North America only," and "Europe only" to avoid redundancy. Before you begin, select the Region and Disturber/Power Level mode, as explained in the following text:

5.6.1.1.1 Set Region

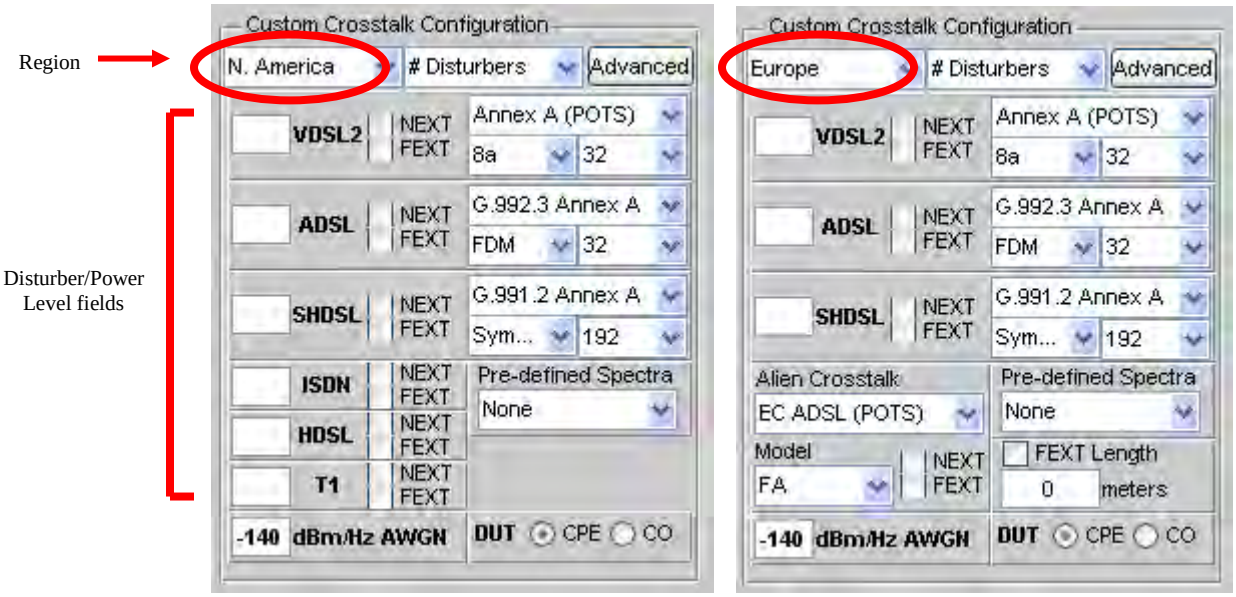
Select North America or Europe from the drop down to access the desired field group.

5.6.1.1.2 Set Disturber/Power Level Mode

Select the mode as either "# of Disturbers" or "Power Level." The associated value is entered in the blank field to the left of the DSL type (e.g., VDSL2, ADSL, SHDSL, etc.).

When "Power Level" is selected, the value in the Disturbers/Power Level field is interpreted as the power level (in dBm) of each Crosstalk component (NEXT and FEXT). For example, if NEXT and FEXT are both checked and -30 is entered, there will be -30 dBm of NEXT plus -30 dBm of FEXT for a total power of -27 dBm.

When "# Disturbers" is selected, the value in the Disturbers/Power Level field is interpreted as the number of disturbers.

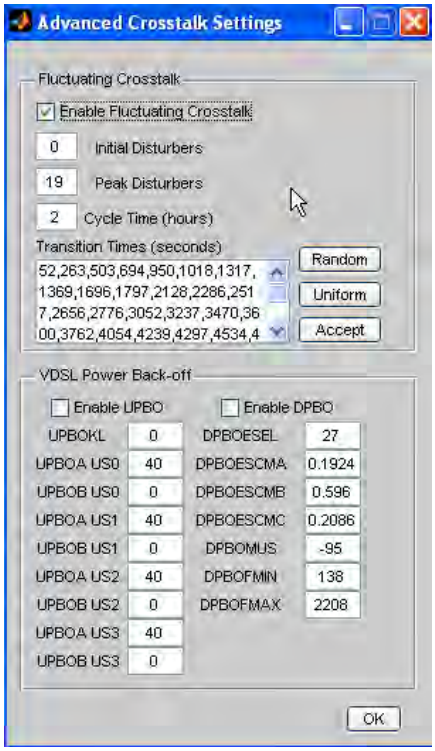


Select the Region and then the Disturber/Power Level mode.

5.6.1.2 Custom Crosstalk Configuration Fields

5.6.1.2.1 North America or Europe Group

Advanced Button: Used to configure Fluctuating Crosstalk and VDSL Power Back-Off settings.



Fluctuating Crosstalk starts at the initial number of disturbers, and increases the number of disturbers one-by-one until it reaches the peak number of disturbers, then decreases the number of disturbers one-by-one until it returns to the initial number of disturbers. The Cycle Time is the time it takes for the entire process to complete (it repeats indefinitely). The disturbers are turned on and off on pseudo-random intervals. The intervals can be chosen randomly, spread uniformly, or specified arbitrarily.

When Fluctuating Crosstalk is enabled for a Crosstalk channel, only one disturber type can be selected at a time. The RFI section, as well as several sections of the Custom Crosstalk interface, are not available when Fluctuating Crosstalk is enabled. The Disturbers field will be disabled and will automatically be set to the peak disturbers set in the Fluctuating Crosstalk interface, if NEXT and/or FEXT is selected for a disturber type. The PSD shown will correspond to the peak number of disturbers.

When the noise is played it is set to the initial disturber level. The amplitude will be adjusted automatically according to the schedule in the Fluctuating Crosstalk interface, adding a disturber at each of the minute intervals until it reaches the maximum, and then removing them one-by-one until back at the initial level, and then repeating the cycle indefinitely.

Fluctuating Crosstalk (for the current channel):

- Click Accept after changing values.
- Check the Enable Fluctuating Crosstalk box and click OK to continue. The main screen does not show the PSD until the noise is saved.

VDSL Power Back-Off (for the current channel):

- Check the Enable UPBO box to enable Upstream Power Back-Off per the values in the fields with the UPBO prefix.
- Check the Enable DPBO box to enable Downstream Power Back-Off per the values in the fields with the DPBO prefix.
- Click OK to continue. The main screen does not show the PSD until the noise is saved.

Disturbers (North America or Europe): Enter the number of disturbers for the corresponding standard (field to left of standard title). A value in this field is required when selecting NEXT or FEXT. In addition, disturbers to do not apply to selections in the Pre-defined Spectra dropdown.

NEXT/FEXT (North America or Europe): Check the applicable boxes for the corresponding standard. This checkbox allows the addition of NEXT and/or FEXT to the noise. A line length is required when selecting FEXT.

dBm/Hz AWGN (North America or Europe): To adjust the Additive White Gaussian Noise (AWGN) enter the desired level in the **dBm/Hz AWGN** field. The default value is -140.

DUT Location (North America or Europe): Select CPE or CO. This should correspond to the location of the 4901-D1-Micro noise injector (connected to the CPE or CO side of the test configuration).

VDSL2(1) Selections (North America or Europe)

Annex A (POTS), Annex A (ADL)
Annex B (B7-1 through B7-10)
Annex B (B8-1 through B8-16)
Annex C (ISDN)

Profile

8a, 8b, 8c, 8d, 12a, 12b, 17a, 30a

# of Tones in UO Band

32, 48, 64, 128

ADSL(2,2+) Selections (North America or Europe)

G.992.3 Annex A, B, I, J, L, M
G.992.4 Annex A, I
G.992.5 Annex A, B, I, J, M

Duplex Mode

Select either **EC** (echo-cancelled or overlapped) or **FDM** (frequency-division multiplexed or non-overlapped)

# of Upstream Tones

32, 36, 40, 44, 48, 52, 56, 60, 64, 128

SHDSL Selections (North America or Europe)

G.991.2 Annex A, Annex B, Annex F

Mask Type

Select either Symmetric or Asymmetric ISDN
For Annex F: 16-TCPAM, 32-TCPAM

Data Rate (KBPS)

Annex A Symmetric: 192, 256, 384, 768, 1544, 2408, 2304

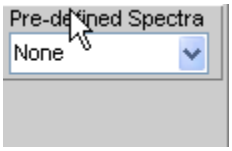
Annex A Asymmetric: 758, 1544

Annex B Symmetric: 384, 512, 768, 1024, 1280, 1536, 2408, 2304

Annex B Asymmetric: 2048, 2304

Annex F: User entry allowed, rounded to nearest allowable value

Pre-Defined Spectra Subsection (North America or Europe)



Select: ETSI A, ETSI B or Euro-K. Note that ETSI A does not include discrete RFI tones. These may be added by selecting all tones in the RFI Configuration section.

- Disturbers do not apply to these selections.

5.6.1.2.2 North America Group Only

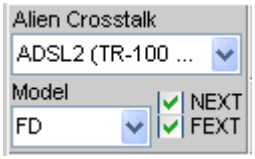
ISDN (North America)
No additional options specific to this protocol.

HDSL (North America)
No additional options specific to this protocol.

T1 (North America)
No additional options specific to this protocol.

5.6.1.2.3 Europe Group Only

Alien Crosstalk Subsection (Europe)



Alien Crosstalk: This subsection is used in place of the ISDN, HDSL, and T1 areas of the North America group. The selections represent noise from a combination of interferers that are different from the system under test. They are typically combined with "Self" Crosstalk which is from the system under test. Each of the ten different Alien Crosstalk designations have three or four separate Crosstalk models associated with them, and each are affected by the side of the loop selected. Each one designates the intended system under test. See *Combinations for Alien Crosstalk and Model fields* that follows for available selections.

- Changes made to this field will update the value in the **Model** field.

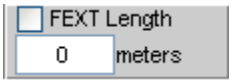
Model: The value in this field may be changed; however, that value will be overridden by selections made in the **Alien Crosstalk** field. For available selections, see *Combinations for Alien Crosstalk and Model fields* that follows.

Combinations for Alien Crosstalk and Model fields:

Reference	Test System	Models
ETSI TS 101 388 §5.3.4.1.1	EC ADSL (POTS)	FA, FB, FC, FD
ETSI TS 101 388 §5.3.4.1.2	EC ADSL (ISDN)	FA, FB, FC, FD
ETSI TS 101 388 §5.3.4.1.3	FDD ADSL (POTS)	FA, FB, FC, FD
ETSI TS 101 388 §5.3.4.1.4	FDD ADSL (ISDN)	FA, FB, FC, FD
TR-100 Annex D.1	ADSL2 (TR-100 A.2)	FA, FB, FC, FD
TR-100 Annex D.1	ADSL2+ (TR-100 A.2)	FA, FB, FD, FD19
TR-100 Annex D.2	ADSL2+ (TR-100 A.3)	CAL=12, CAL=36, CAL=52
TR-100 Annex D.3	ADSL2+ (TR-100 B.3)	FA, FB, FD
G.991.2 §B.3.5.4.1.2	SHDSL	XA.#.A, XA.#.B, XA.#.C
WT-114 Appendix A	VDSL2	MD_EX, MD_CAB27, MD_CAB72

NEXT/FEXT (Europe): Check one or both boxes to add NEXT and/or FEXT to the **Alien Crosstalk** and **Model** selected.

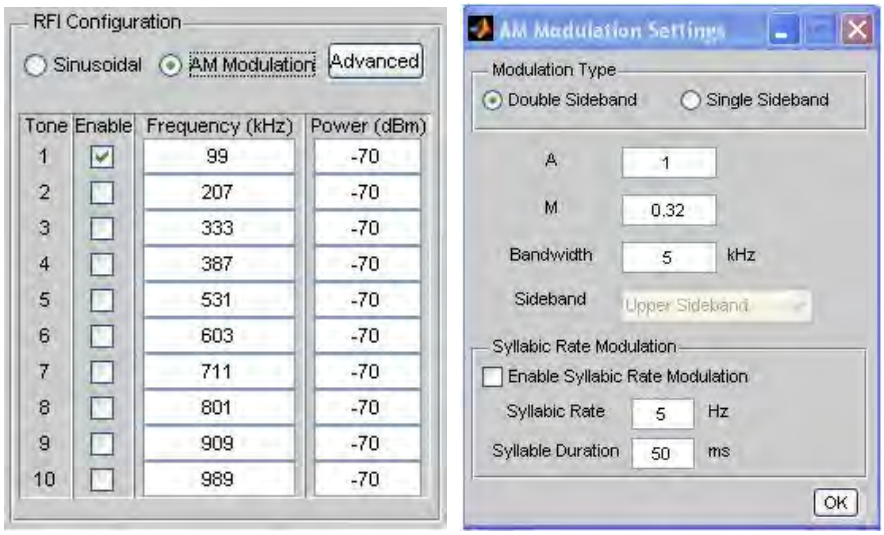
FEXT Length Subsection (Europe)



FEXT Length: When checked, this field forces all FEXT to be calculated at the length specified in the **meters** field. This feature does not apply unless FEXT is also checked in one of the following: VDSL2, ADSL, SHDSL or Alien Crosstalk.

Meters: When the **FEXT Length** field is checked the value in this field is used to calculate all FEXT.

5.6.1.3 Section: RFI Configuration



- Select Sinusoidal or AM Modulation

  Sinusoidal: Produces sinusoidal RFI interference
  AM Modulation: Produces AM-modulated white Gaussian noise
  Tone, Enable, Frequency, Power: Enable from 1 to 10 tones, selecting the desired Frequency(kHz) and Power(dBm) for each. The **Power dBm** field defaults to -70 and may be changed.

- **Advanced:** When the AM Modulation option is selected, the Advanced button is available to access the AM Modulation Settings screen.

5.6.1.3.1 AM Modulation Advanced Settings

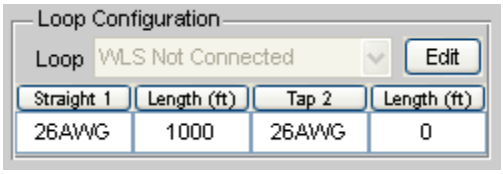
The default values in this screen correspond to ETSI TS 101 388.

Modulation Type
DSB (Double Sideband) or **SSB** (Single Sideband)

Modulation Depth (A/M)
A: Carrier Amplitude Constant (a value of 0 results in a suppressed carrier)
M: Modulation Amplitude Constant
Bandwidth: bandwidth of noise source and sideband(s) of AM signal in kHz
Sideband: When a SSB Modulation Type is selected, user may choose Upper Sideband or Lower Sideband option.

Syllabic Rate Modulation
Enable Syllabic Rate Modulation: check to enable simulation of the cadence of human speech in noise source
Syllabic Rate: number of syllables per second in Hz
Syllable Duration: duration of each syllable in ms

5.6.1.4 Section: Loop Configuration/Loop Editor



5.6.1.4.1 Loop Configuration Overview

The Loop Configuration section may be used in one of two ways:

- **Select a slot:channel combination** for a line module installed in a connected WLS. The length is available for change. In this mode, the Loop dropdown field is automatically populated with the slot:channel combinations that apply to the installed line modules.

- **Build a custom loop in the Loop Editor**. Click the Edit button to access this feature. A custom loop may contain multiple straight and bridged-tap segments of varying lengths and wire types. The Loop Attenuation is graphically represented as the loop is built. While many segments (both straight and bridged tap) may be created, only two may be displayed in the Loop Configuration area. The segments that appear are designated from within the Loop Editor. Refer to the Loop Editor fields later in this document.

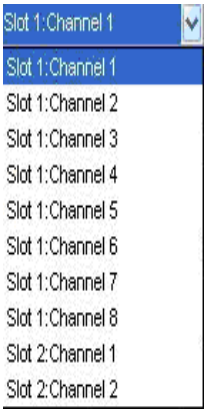
➢ If connected to a WLS, the Loop Editor may be accessed but used only to edit length.

➢ Match the slot:channel selected for the WLS with the slot:channel selected in the 4901-NS if you wish to see changes reflected in the WLS.

5.6.1.4.2 Loop Configuration Fields

5.6.1.4.2.1 Loop

- Select the desired slot:channel combination. The Length field is available for change. Only available when connected to a WLS. Here is an example of how this field should look when successfully connected:



5.6.1.4.2.2 Straight (x)

Represents the wire type of the selected slot:channel or straight segment (*x*) created in Loop Editor, where *x* represents the straight segment number.

5.6.1.4.2.3 Length (ft) or (m)

Displays the length and unit of measure related to the slot:channel combination or the custom segment. This value may be changed.

5.6.1.4.2.4 Tap (x)

Represents the wire type of the bridged tap segment (*x*) created in Loop Editor, where *x* represents the bridged tap segment number.

5.6.1.4.3 Loop Editor Fields

5.6.1.4.3.1 Accessing the Loop Editor

- Access the Loop Editor by clicking the Edit button in the Loop Configuration section. The Loop Editor screen is shown.

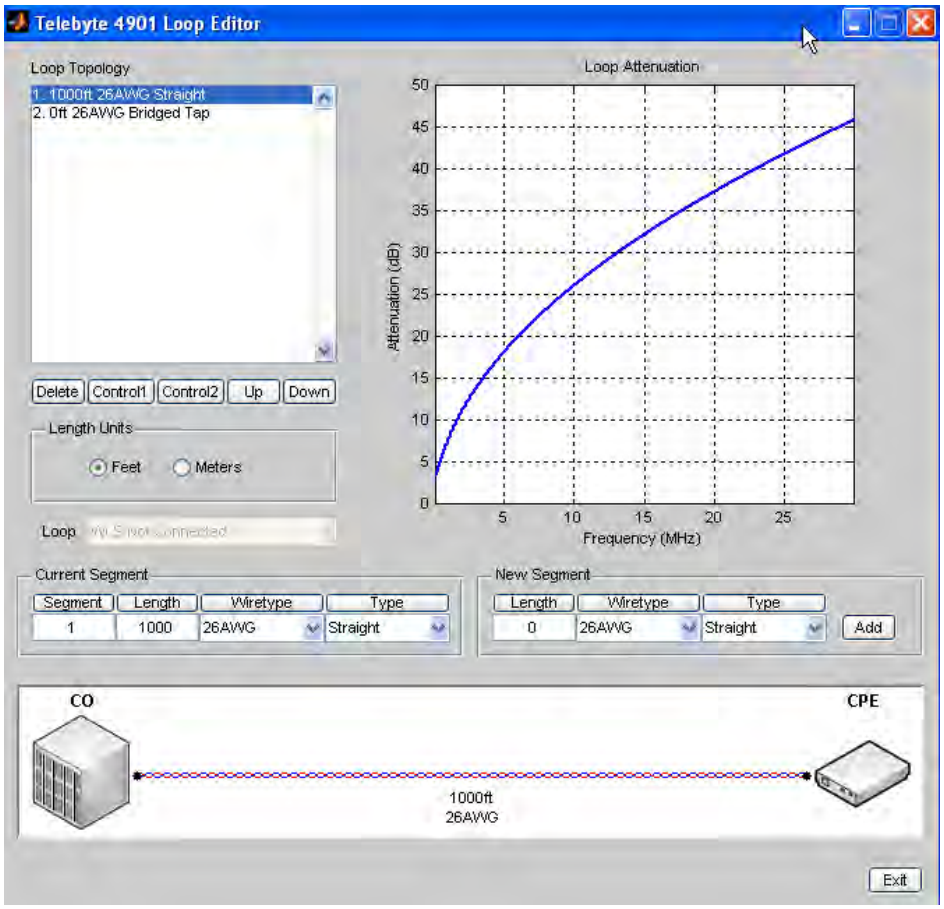
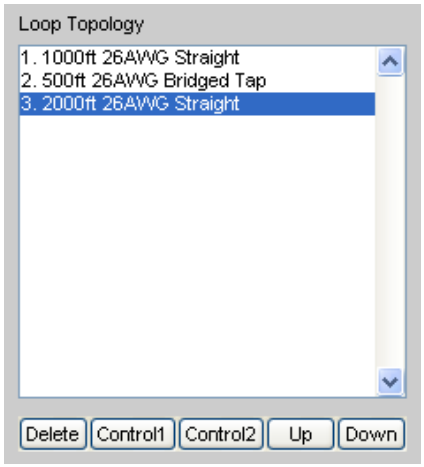


Figure 5-1: The Loop Editor screen is shown with the default values.

5.6.1.4.3.2 Loop Topology



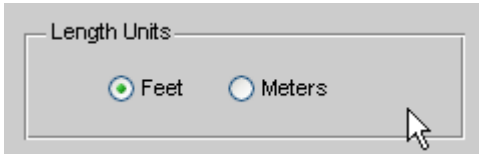
- Select a segment in this list before performing one of the following tasks.

Delete: delete the selected segment

Control (1,2): designate the selected segment to appear on the Main screen in the Loop Configuration section. Up to two segments may be designated for this purpose.

Up/Down: Move the selected segment up or down in the list.

5.6.1.4.3.3 Length Units

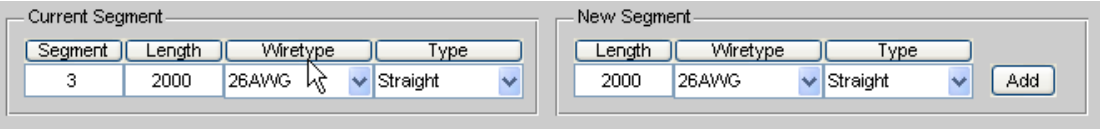


- Select the unit of measure for the Current (selected) segment or the New segment. Please note, the Length Unit settings are applied to all segments in the loop. A new segment is listed after the currently selected segment.

5.6.1.4.3.4 Loop

If connected to a WLS, this field displays the selected slot:channel combination.

5.6.1.4.3.5 Current/New Segment



The Current Segment area displays the values from the segment selected in the Loop Topology section. The Length, Wiretype and Type fields may be updated.

The New Segment area provides entry fields to add a new segment to the loop. The Length, Wiretype and Type fields are used. The defaults are Length (0), Wiretype (26AWG) and segment Type (straight).

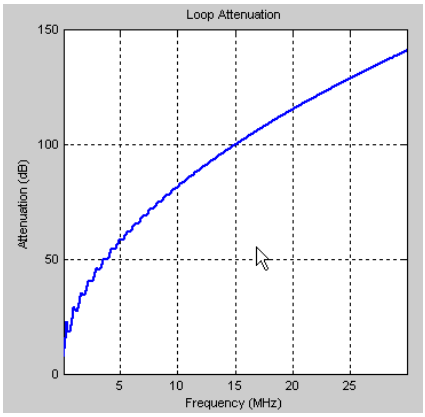
- Click Add to add the segment to the Loop Topology list.

Wire Types available:

0.40mm Paper
0.50mm Paper
0.65mm Paper
0.90mm Paper
0.32mm PE
0.40mm PE
0.50mm PE
0.65mm PE
0.90mm PE
24AWG
26 AWG
CAT5
DW10
FP
PE032
PE04 & (PE04 G.991.2)
PE05 & (PE05 G.991.2)
PE06 G.991.2
PE063
PE08 G.991.2
PE09
PVC032 G.991.2
PVC04 G.991.2
PVC063 G.991.2
TP100
TP150
TP100x
TP180x

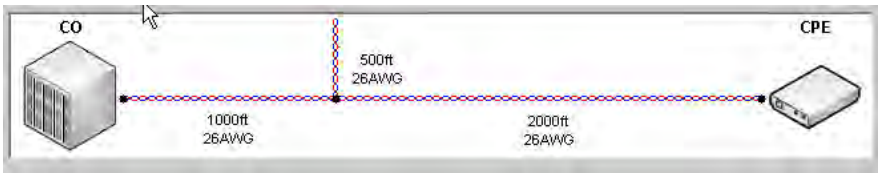
5.6.1.4.3.6 Loop Attenuation

A graphic display that updates as the custom loop is constructed.



5.6.1.4.3.7 Loop Diagram

A graphic display of the loop segments that updates as the loop is constructed.



- Click Exit to apply the loop information. Segments designated by the Control (1,2) buttons in the Loop Topology area appear in the Loop Configuration section. The controls in the Main screen allow you to control the length but not the wiretype or segment type.

5.6.1.5 Section: Noise Injection Parameters

5.6.1.5.1 Noise Injector

Custom: When custom calibration of insertion loss is desired, select Custom and enter a new value in the **Loss** field.

4901-D1-(Micro): Default. Select this value when using the 4901-D1-Micro. The **Loss** field value is automatically changed to 35 dB.

4801-D4: Select this value when using the 4801-D4. The **Loss** field value is automatically changed to 19 dB.

VxT-N48: Select this value when using the VxT-N48 48-Channel AWGN Noise Generator/Injector. The **Loss** field value is automatically changed to 13 dB.

5.6.1.5.2 Insertion Loss

This field is only available when the Noise Injector value is Custom. The insertion loss is specific to the **DUT Impedance**. For example, the 4901-D1-Micro Differential Mode Noise Injector has an insertion loss of 35 dB when injecting onto a 100-ohm line. However, the insertion loss of the same noise injector is about 1.3 dB less when injecting onto a 135-ohm line.

Maximum Power Settings: The maximum power value allowed is dependent on the loss for the noise injector. The maximum power with 0 dB of injection loss is approximately +5 dBm. Be certain to use the correct values when creating files for import as values that exceed the maximum allowed will produce a warning message and the user will not be able to continue.

Example:
The default loss for the 4901-D1-Micro injector is 13 dB.
The maximum power with 0 dB of injection loss is approximately +5 dBm.
Therefore, the maximum power with 13 dB loss on the noise injector is -8 dBm.

5.6.1.5.3 Advanced

- Click the Advanced button when configuring noise splitting or injection sharing. See Sharing or Splitting Noises for instructions on using this menu.

5.6.1.5.4 Line Impedance

Line Impedance: Enter either **100** ohms or **135** ohms**.** The default when selecting a value of 4901-D1-Micro for Noise Injector is 100 ohms.

The value in this field represents the characteristic impedance of the DUT. This feature adjusts the power level of Crosstalk in cases where a selected disturber (standard or technology) uses a terminating impedance that is different than the technology under test. For example, if **DUT Impedance** is set to 100 ohms, SHDSL Crosstalk is calibrated with 1.3 dB less power because SHDSL uses a different terminating impedance. 135 ohms is used with SHDSL.

5.6.1.5.5 Advanced Menu: Injector Sharing

The Advanced Menu is used to configure Injector Sharing (the combining of noises on one injector). Each 4901-AWG may be configured for Crosstalk **or** impulse. Some configurations require the simultaneous loading of impulse and Crosstalk into one 4901-D1-Micro injector (i.e., a combined noise is loaded on one shared injector). This is accomplished by using two straight, SMB-to-SMB cables, each of which is connected to either the 50-ohm and 100-ohm connectors in the same 4901-D1-Micro injector. The Advanced menu, found in the Noise Injection Parameters section, is used to configure which 4901-AWG ports are sharing the same 4901-D1-Micro noise injector.

How to Configure Injector Sharing

- Configure each card for impulse or Crosstalk, as needed.
- Configure all noises on all channels without saving the noises or configuration.
- Click the Advanced button in the Noise Injection Parameters section.
- Using the Advanced Menu
    - Select the two channels (ports) to be shared by selecting “Shared” in the Injector Mode dropdown next to each channel in the pair.
    - Select the same Label column value for both channels in the pair.
    - Be certain to specify whether the channel is associated with the 50-ohm or 100-ohm connector so it matches your actual, physical setup. Do this for both channels in the shared pair.
- After making selections, close the Advanced menu.
- Save all noise files.
- The noises are now ready to be loaded.

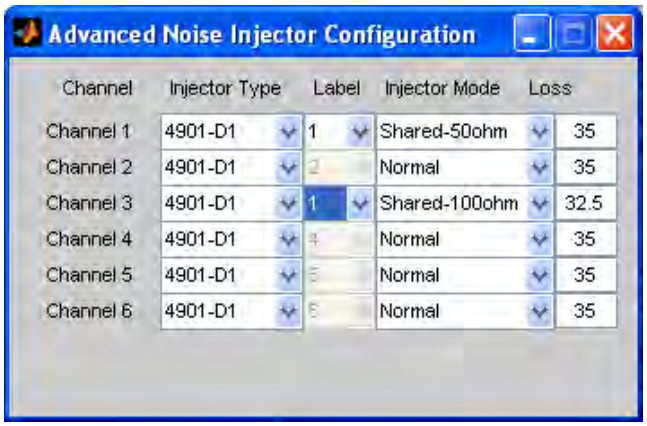
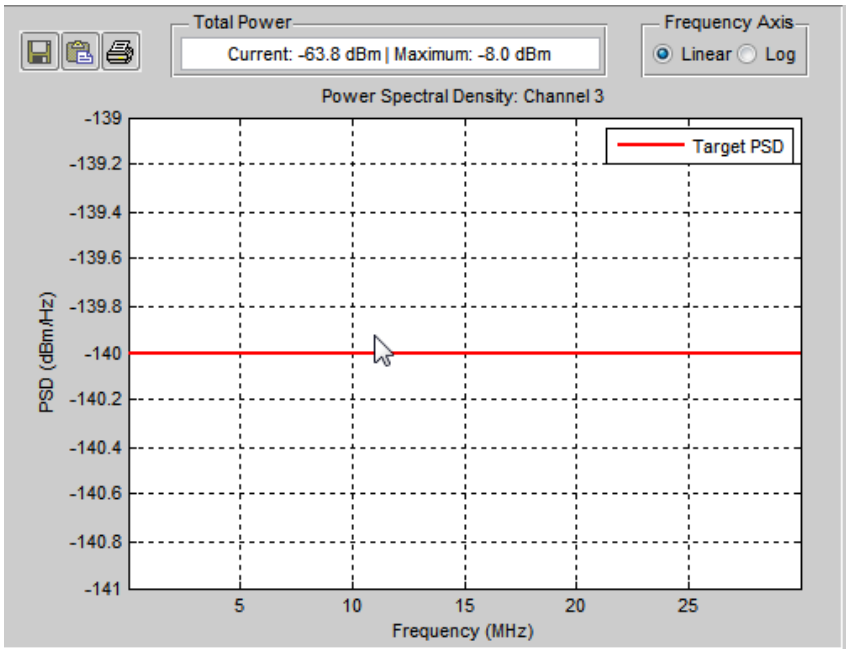


Figure 5-2 Setting injector sharing in the Advanced Menu

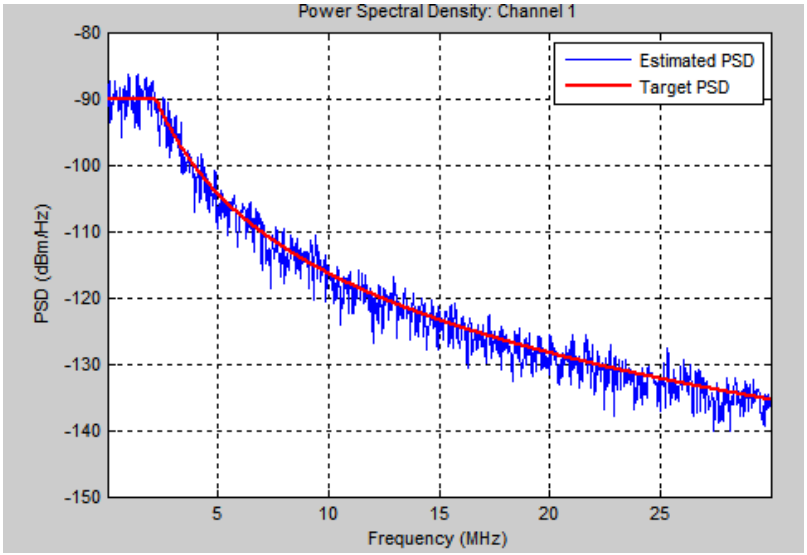
In the example above, channel 1 is connected to the 50-ohm connector and Channel 3 is connected to the 100-ohm connector of the same noise injector. When using the optional Noise Modules/Libraries, the Advanced menu is not required.

- When using the optional noise libraries, all settings are assigned by the software.

5.6.1.6 Section: PSD graphic



A PSD graphic displays the total power for the current noise and the results of the current Custom Crosstalk configuration, for the current card and channel, in the lower-right corner of the Main screen. The current plot may be copied, printed or saved in various formats. In addition, the mouse may be used to zoom in and out of the graph. This area also displays the Estimated PSD (noise to be generated) versus the Target PSD data (true theoretical value) after a noise is saved as shown in the graphic that follows.



5.6.1.6.1 Save/Copy/Print

Save the plot to an image or data file. The choices are Windows Bitmap, Jpeg, MATLAB data file, Excel Spreadsheet or CSV file. (Excel must be installed on the Model 4901 to successfully save in an Excel format. If Excel is not installed the file will be saved in a CSV format instead.)

- Plots saved to data files cannot be imported as a user-defined Crosstalk or impulse file. A noise file must be saved using the Save Noise icon at the top of the main screen.

Copy plot to clipboard and paste into documents. This data cannot be imported back into the 4901-NS.

Print plot.

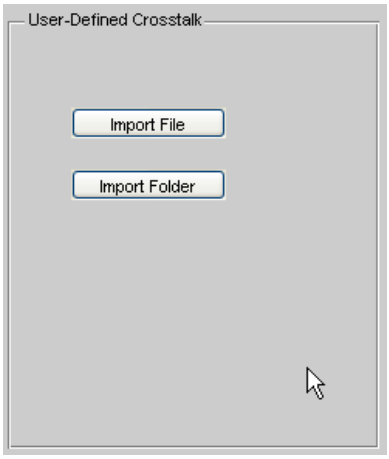
5.6.1.6.2 View Options

Frequency Axis: Select Log or Linear to switch the frequency axis between linear and logarithmic scaling. This is very convenient for viewing low-frequency Crosstalks.

Zoom Options: To zoom in or out of the graph, move the mouse over the graph area. The cursor changes to a + sign indicating zoom mode. Click the mouse to zoom in or drag the mouse to select an area to zoom into. To zoom out shift-click or, right-click while the cursor is in zoom mode to bring up a Zoom menu. From the zoom menu you can select Zoom Out, Reset to Original View or bring up the Zoom Options menu. This provides options for Unconstrained, Horizontal and Vertical zoom.

5.6.2 Noise Type: User Crosstalk

5.6.2.1 Section: User-Defined Crosstalk



- Click on Import Data to import a user-defined noise file in MATLab, CSV, XTK.DAT or Excel format.

- To convert a group of files to a .tbn format, click Import Folder. This function automatically finds all user-defined crosstalk data files (e.g., .mat, .xls, .csv, .xtk.dat) in the selected folder and converts them to .tbn noise files.

5.6.2.1.1 Format for User-Defined Crosstalk Files

User Crosstalk

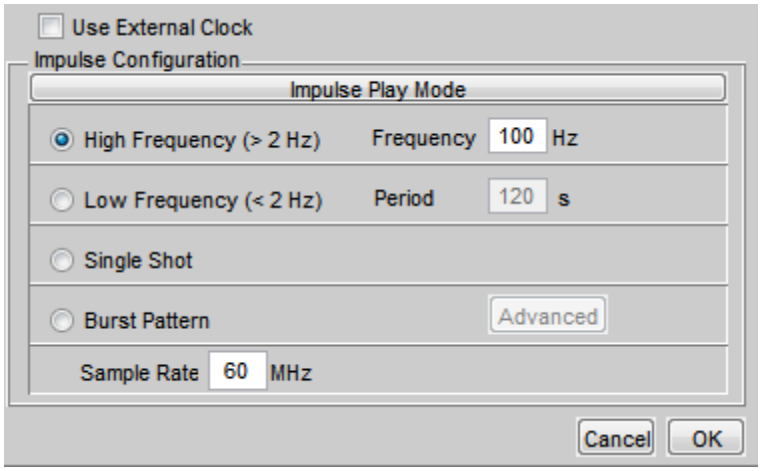
a. .mat – array PSD with target PSD data in dBm/Hz and array f with corresponding frequency points in Hz

b. .xls/.csv – frequency in Hz in column 1 and target PSD in dBm/Hz in column 2

5.6.3 Noise Type: Custom Impulse

- To access Custom Impulse, click the  icon in the upper-right corner of the Noise Card Menu.

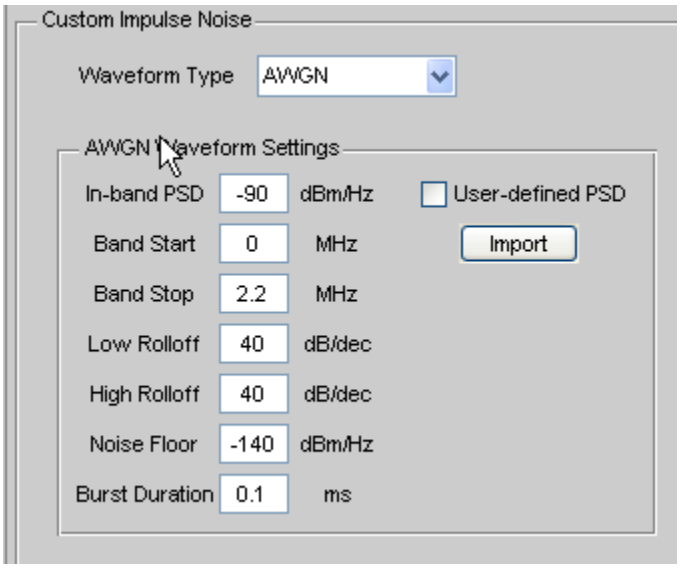
There are four Custom Impulse Play Modes (High Frequency, Low Frequency, Single Shot and Burst Pattern). In addition, there are five Waveform Types (AWGN, Chirp, User Defined, Micro-Interruption, and G.SHDSL) and finally, an Advanced Burst Pattern feature.



The Impulse Play Mode is selected when configuring an AWGx card.
In the example above, High Frequency is selected.

5.6.3.1 Wave Form Types

5.6.3.1.1 Custom Impulse - AWGN



In-band PSD: The value of the output PSD between Band Start and Bandwidth [dBm/Hz]

Band Start (Stop): The lowest/highest frequency over which the In-Band PSD extends [MHz]

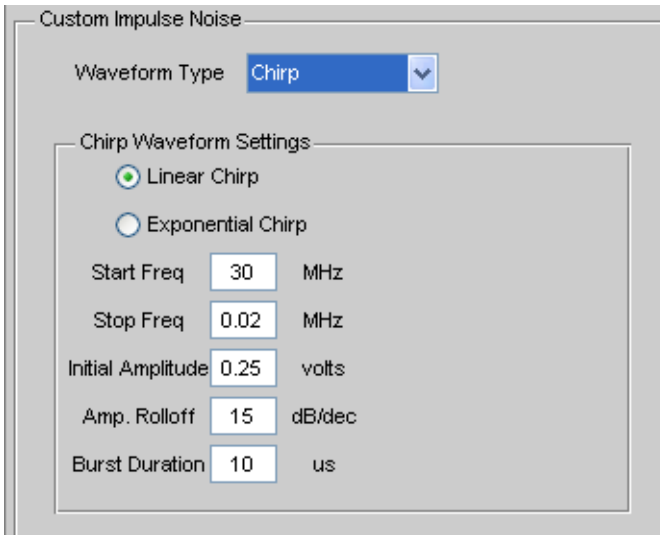
Low (High) Rolloff: Low Rolloff is the rolloff below Band Start; High Rolloff is the rolloff above Bandwidth

Noise Floor: The minimum value of the output PSD [dBm/Hz]

Burst Duration: The length of time the REIN burst is active per cycle [ms]

User-Defined PSD: This checkbox appears when the Waveform Type is AWGN. If the Waveform Type is AWGN and User-Defined PSD is selected, the noise is made from PSD data in the imported file.

5.6.3.1.2 Custom Impulse - Chirp



Linear Chirp: The chirp frequency varies linearly with time

Exponential Chirp: The chirp frequency varies logarithmically with time

Start Freq: The initial frequency of the chirp [MHz]

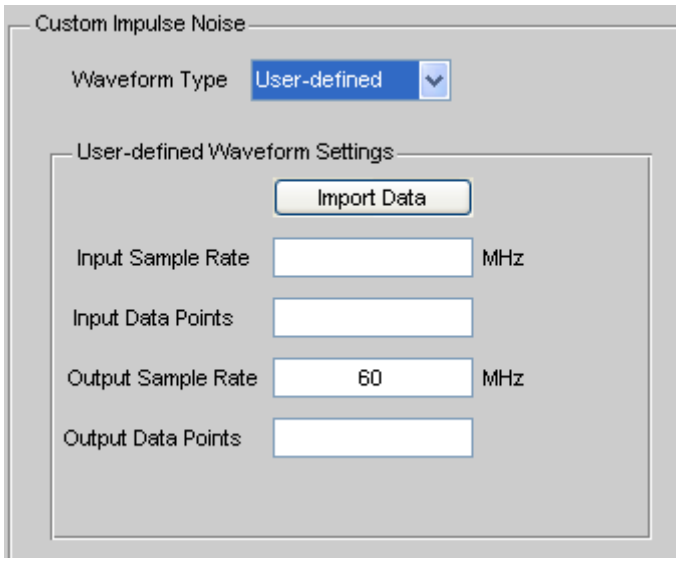
Stop Freq: The final frequency of the chirp [MHz]

Initial Amplitude: The amplitude of the waveform at t=0 [volts]

Amp. Rolloff: The rate of amplitude decay with respect to the starting frequency [dB/dec]

Burst Duration: The duration of the chirp [µs]

5.6.3.1.3 Custom Impulse - User Defined



Input Sample Rate: The sample rate supplied in the user file; indicated the rate at which the data was sampled.

Input Data Points: Count of the number of samples read from the file.

Output Sample Rate: Defaults to the value in the card configuration. The user-supplied data is re-sampled at the output sample rate.

Output Data Points: The number of samples in the re-sampled output waveform.
Click Import Data to import the file.

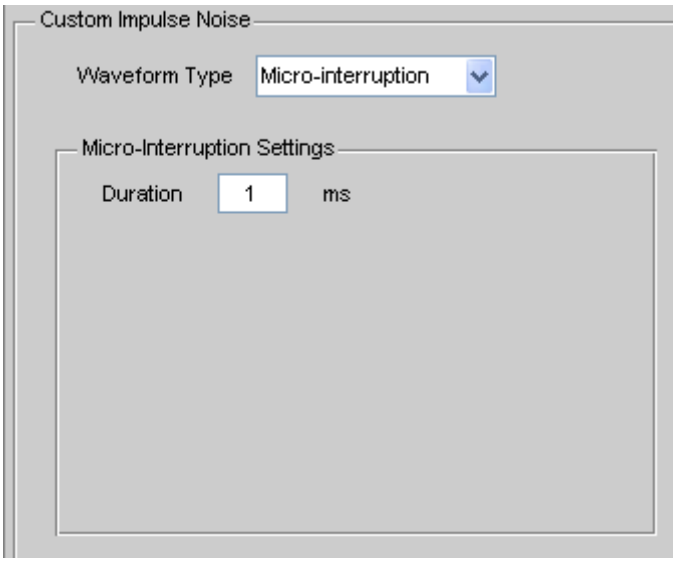
5.6.3.1.3.1 Format for User-Defined Impulse Files

User Impulse

a. .mat – array y with waveform sample data in volts and variable fs equal to the sample rate in MHz

b. .xls/.csv – waveform sample data in volts on column 1 and sample rate in MHz in column 2, row 1

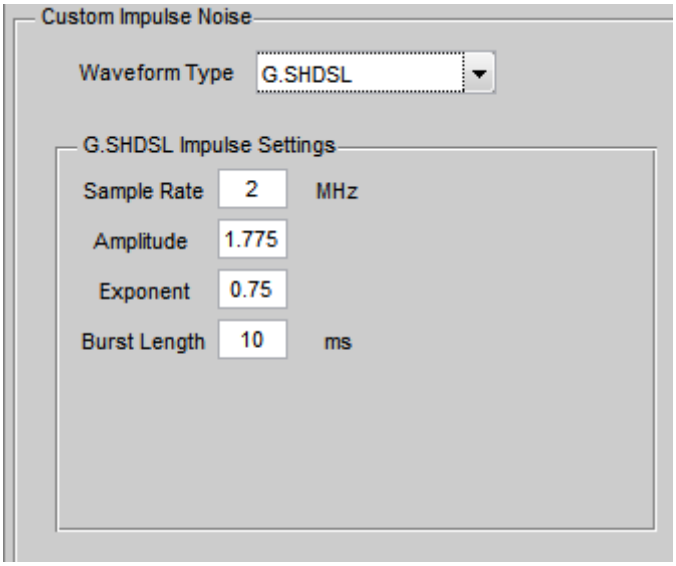
5.6.3.1.4 Custom Impulse – Micro-Interruption



The Micro-interruption feature is used to program repeating micro-interruptions at any fixed frequency and duration, or as a single replay. There is an upper frequency limit of 15 Hz; therefore, the High Frequency set in Impulse Play Mode should not exceed 15 Hz. One setting is available to specify the duration of the interruption in milliseconds. This has a minimum value of 1 ms and a maximum value of 250 ms for the duration. The maximum duration is also limited by the frequency, i.e., the duration cannot be longer than the card period.

- Select High Frequency. *Do not enter a value greater than 15Hz in the Frequency field or an error is shown.*
- Select a Waveform Type of Micro-Interruption.
- Enter the duration in ms. The minimum value allowed is 1 and the maximum is 250. The duration cannot be longer than the value in the Period field.

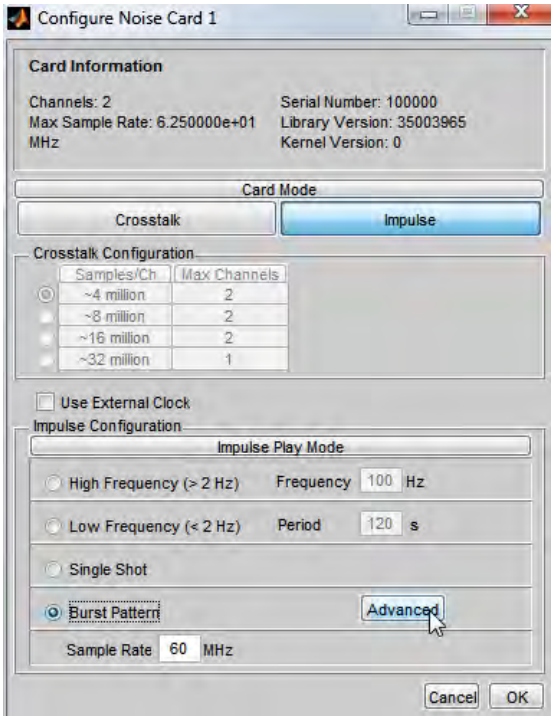
5.6.3.1.5 Custom Impulse – G.SHDSL



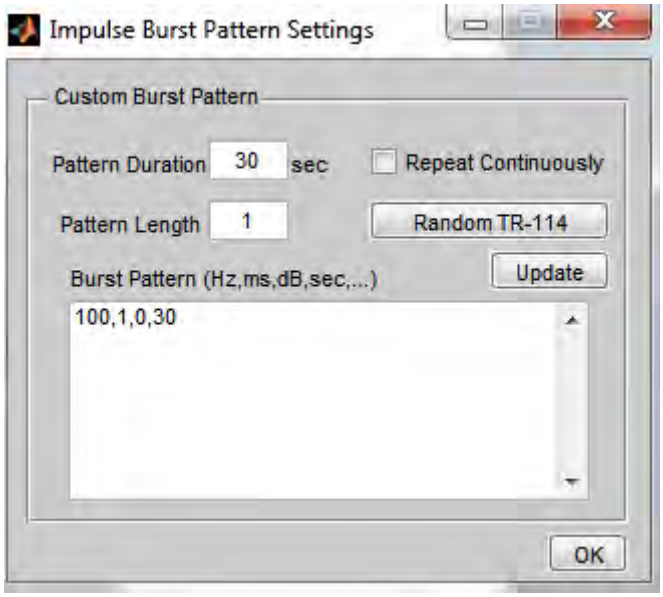
5.6.3.2 Advanced Burst Pattern

Burst Pattern mode allows the user to manually configure one or more impulse bursts, represented by four comma-separated values: frequency level in Hz, burst duration in milliseconds, dB offset and pattern length. Users are free to manually enter as many of these patterns as desired or automatically generate a series of random burst patterns. Patterns work together with settings in the Waveform Type screen.

- Select Burst Pattern in the Configure Noise Card panel.



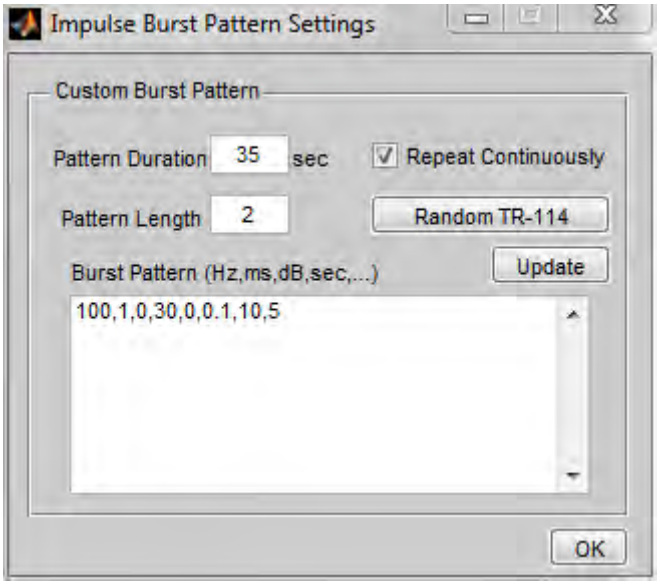
- Click the Advanced button. The Impulse Burst Pattern Settings window is shown.



- **Pattern Duration:** displays the length in time for all patterns defined to complete once.
- **Pattern Length:** displays the number of individual patterns defined.
- **Burst Pattern (Hz,ms,dB,sec):** used to enter a custom set of parameters to establish a Burst Pattern. A minimum of values must be entered.
- **Update** (button): when clicked, updates the Pattern Duration and Pattern Length fields based on user entry in the Burst Pattern field.
- **Repeat Continuously:** when checked, constantly repeats all patterns defined until manually stopped by the user or the timer feature.
- **Random TR-114** (button): when clicked, fills the Burst Pattern field with a series of randomly selected parameters.

Examples of Use

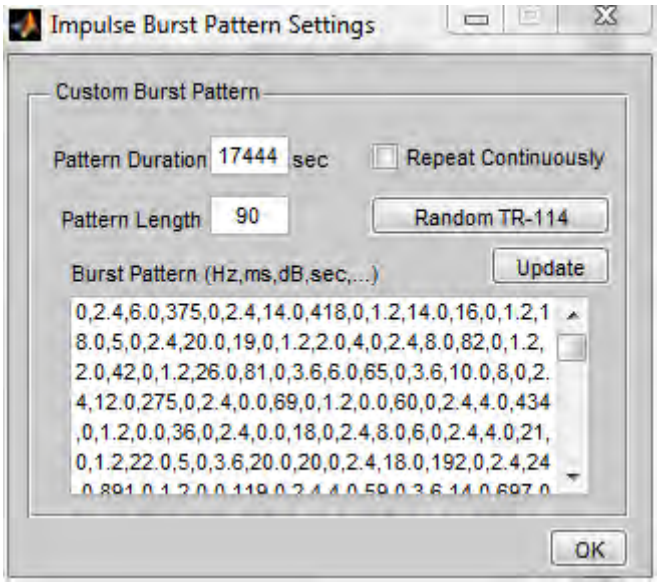
Two Patterns Repeated Continuously



The example above shows two patterns repeated continuously. The first pattern (100,1,0,30) is a 100Hz impulse with a 1ms burst duration and zero dB offset (relative to the noise to be defined). The pattern will last for 30 seconds.

The second pattern (0,0.1,10,5) has a frequency of zero which will create a single burst that occurs throughout the defined pattern. The second burst pattern will have a burst duration of 100µs, with a 10dB offset (relative to the noise to be defined). The pattern will last for 5 seconds. Note the **Repeat Continuously** option is enabled, therefore the pattern will constantly repeat from the start until the user manually stops it.

Randomly Generated Pattern



The example above shows the results when the Random TR-114 button is pressed.

6.0 Noise Splitting

Noise may be split from one 4901-AWG port and loaded on two 4901-D1-Micro injectors (i.e., the same noise is loaded on both injectors). This is accomplished through the use of the 4901-YC cable.

- Attach the stem end of the 4901-YC cable to the desired channel (port).
- Attach each end of the "Y branch" to its own 4901-D1-Micro noise injector, using the 100-ohm connector.

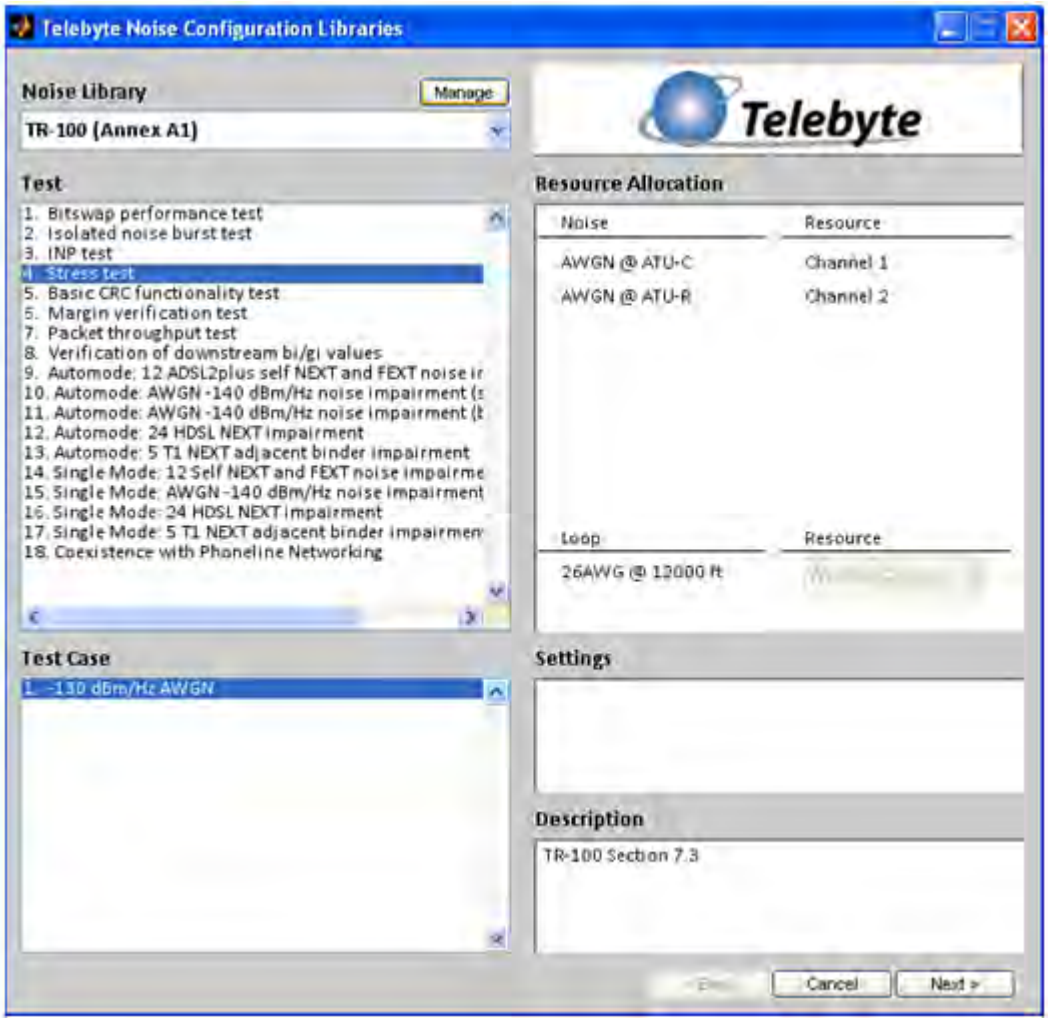
7.0 Combining Three or More Noises

The 4901-PC-SC-6-1 (6-to-1 Combiner Card) is required to combine more than three noises into one output. This optional hardware accessory allows a maximum of six inputs. The output is connected to a 4901-D1-Micro Differential Mode Noise Injector to inject noise on one end of a loop. Two are required for simultaneous injection on both ends of a loop. For more information on the maximum input levels allowed, please contact Telebyte support.

8.0 Noise Libraries

Optional Noise Libraries provide easy, methodical selection of test cases from several standards. Each library provides automatic configuration of every test case within the standard, simply by clicking on the desired test case.

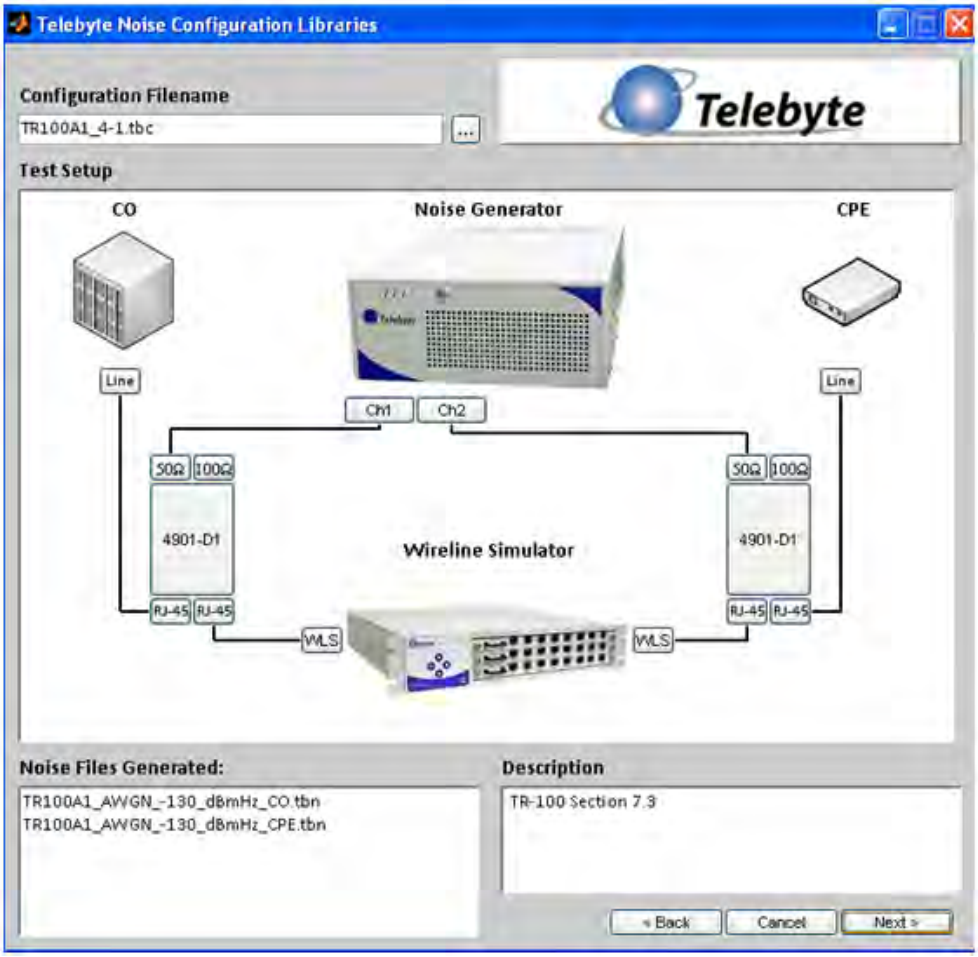
- To access Noise Libraries, click on the  icon in the Menu bar. The following screen shows the TR-100 (Annex 1) Library screen as an example.



- Select the Library and the desired Test and Test Case. The Configuration section shows the noise(s) and, where applicable, the loop(s) appropriate to the Test case. To the right of each noise, in the Resource column, the channel to be used for the resource is shown. In the same column, to the right of each loop to be used, the loop simulator slot and channels available are shown.

- Where applicable, the Settings section shows additional selections allowed. The Description field displays the applicable description from the standard.

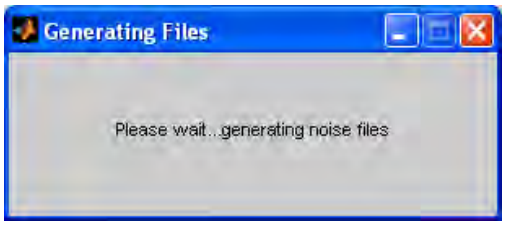
- Click Next.

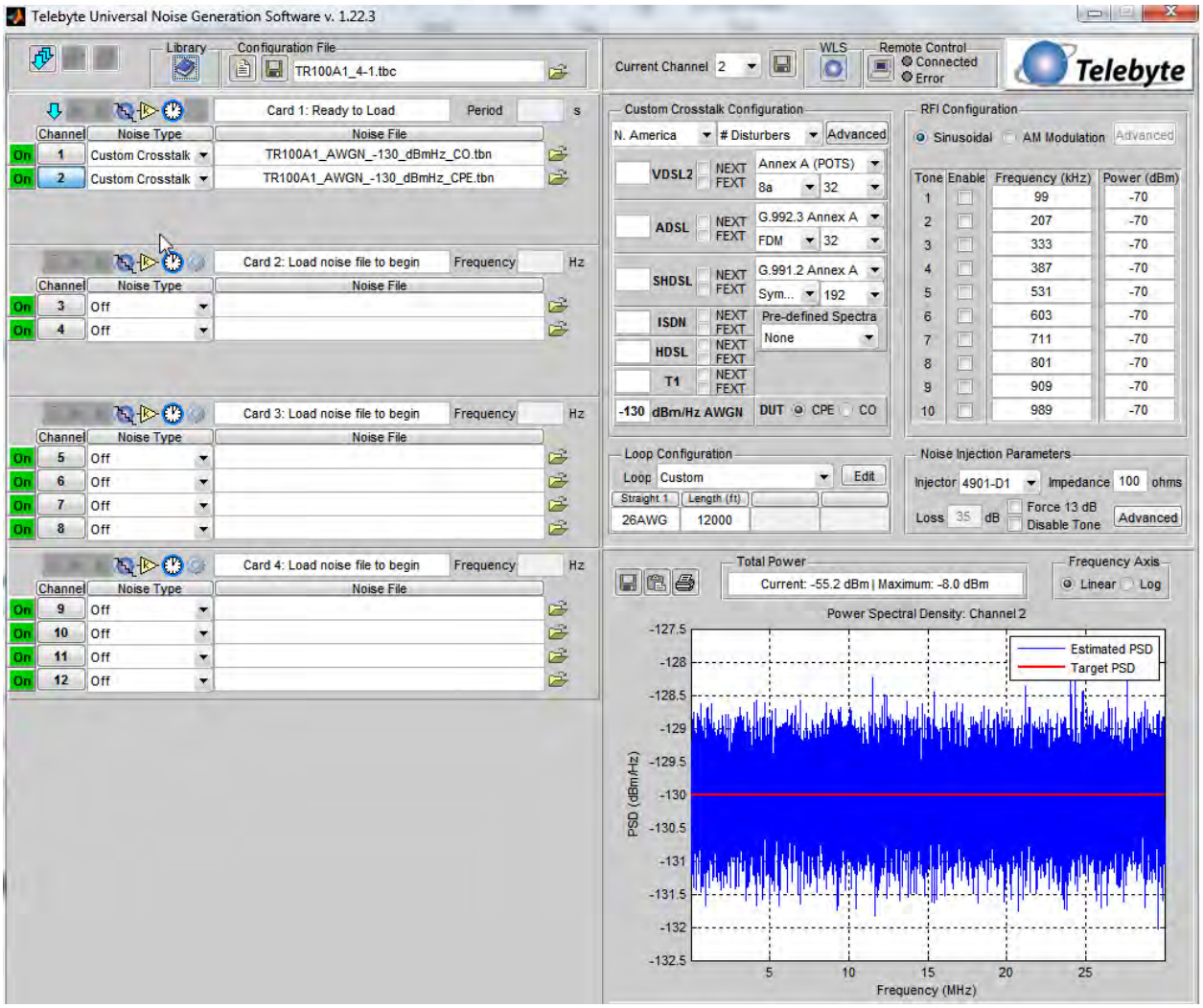


- The default filename for the entire configuration is shown. The first time a test case is run, the individual noises (*.tbn files) in the configuration are saved to the 4901-PC hard drive. The *.tbn files may be used in scripts or recalled through manual selections in the GUI at a later time.

- A diagram of the test setup provides the correct cabling for the current test case. It is very important to follow this diagram and to make certain the correct ohm connectors are used.

- Click Next to continue. A status window displays a message, indicating files are being generated.





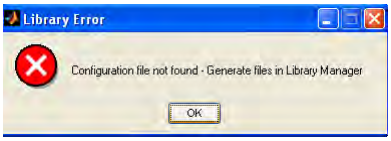
- The configuration file is automatically saved and loaded into the Main screen. All settings required are automatically selected for the user.

➢ The settings created in the Main screen may be further customized by changing line lengths, number of disturbers and more.

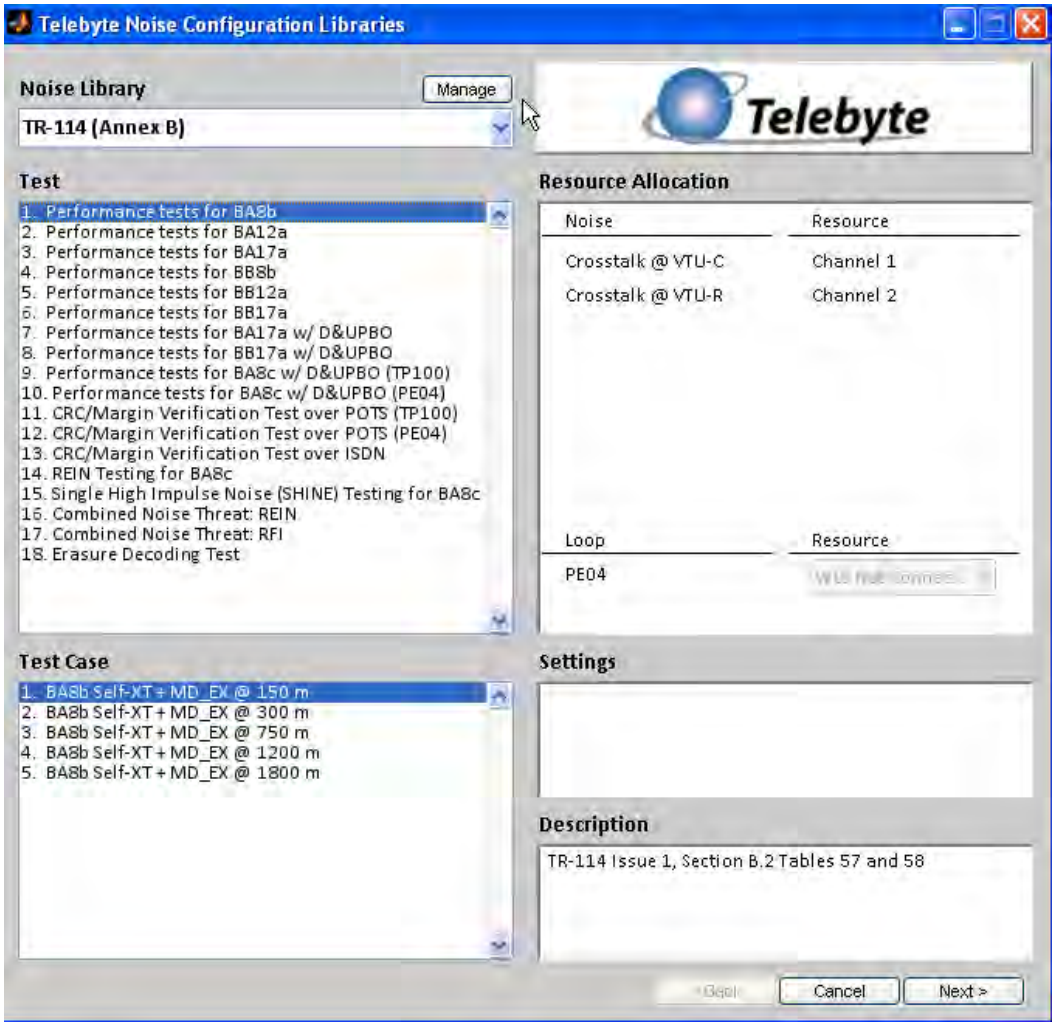
8.1 Library Manager

The library management feature allows the user to create all the noise and configuration files for a given library in one session or to generate specific files. This is usually done for the user prior to shipment. However, if a new version of the software is installed or the card configuration is changed, this may need to be performed by the user.

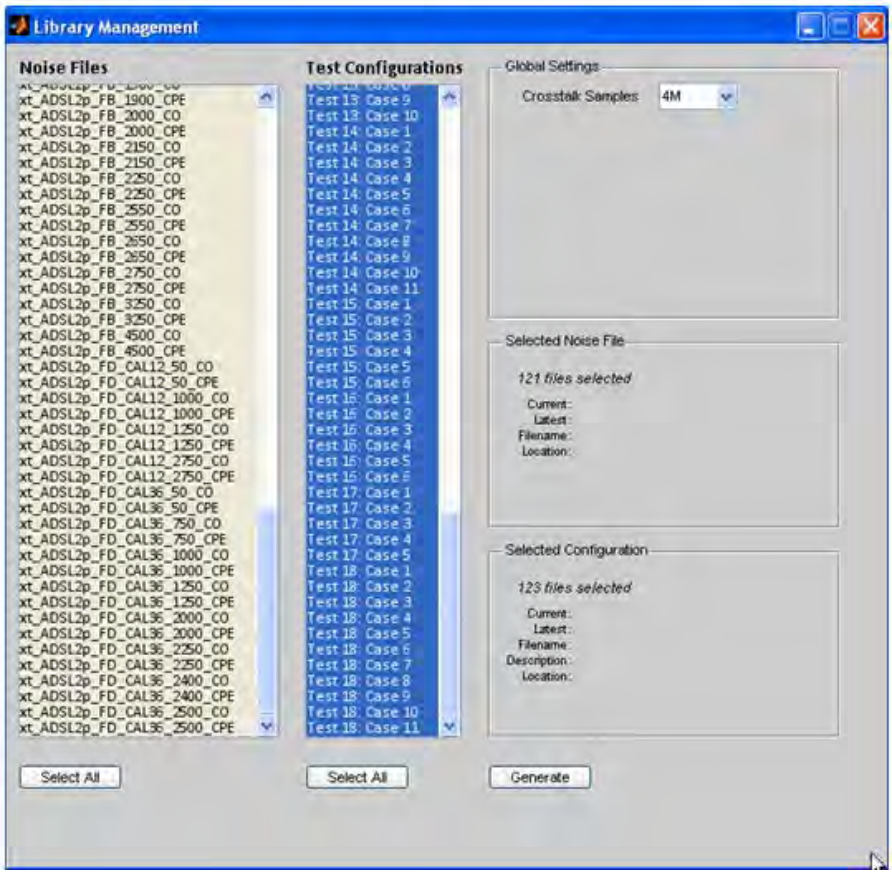
- If the following message is displayed, the files associated with the test you are attempting to run need to be generated:



- To access the Library Manager, click the Manage button, found at the top of the Library screen.

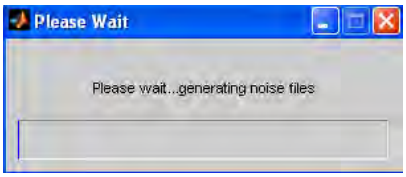


The Library Management screen highlights all Noise files and Test Configurations that require generation. Either accept the current selection(s) or click on specific files to highlight them. (Please note, highlighting a Test Configuration file does not automatically highlight associated Noise Files. Selections must be made from both columns for the specific files the user wishes to generate.)



- Select the number of Crosstalk samples for the selected files. (When regenerating files with a different number of samples, the new file will overwrite the older file.)

- Click Generate. A message is displayed indicating the files are generating.



8.2 Setting Loop Lengths with Noise Libraries

Where applicable, a connection to the WLS must be made prior to accessing a Noise Library for the settings to work correctly. Once in the Library options screen, the slot and channel for the loop may be configured. When noise files are generated from the Library, the length is set automatically on the WLS slot and channel selected. If the line module in the WLS does not support the length indicated in the Library file, it rounds to the nearest available length.

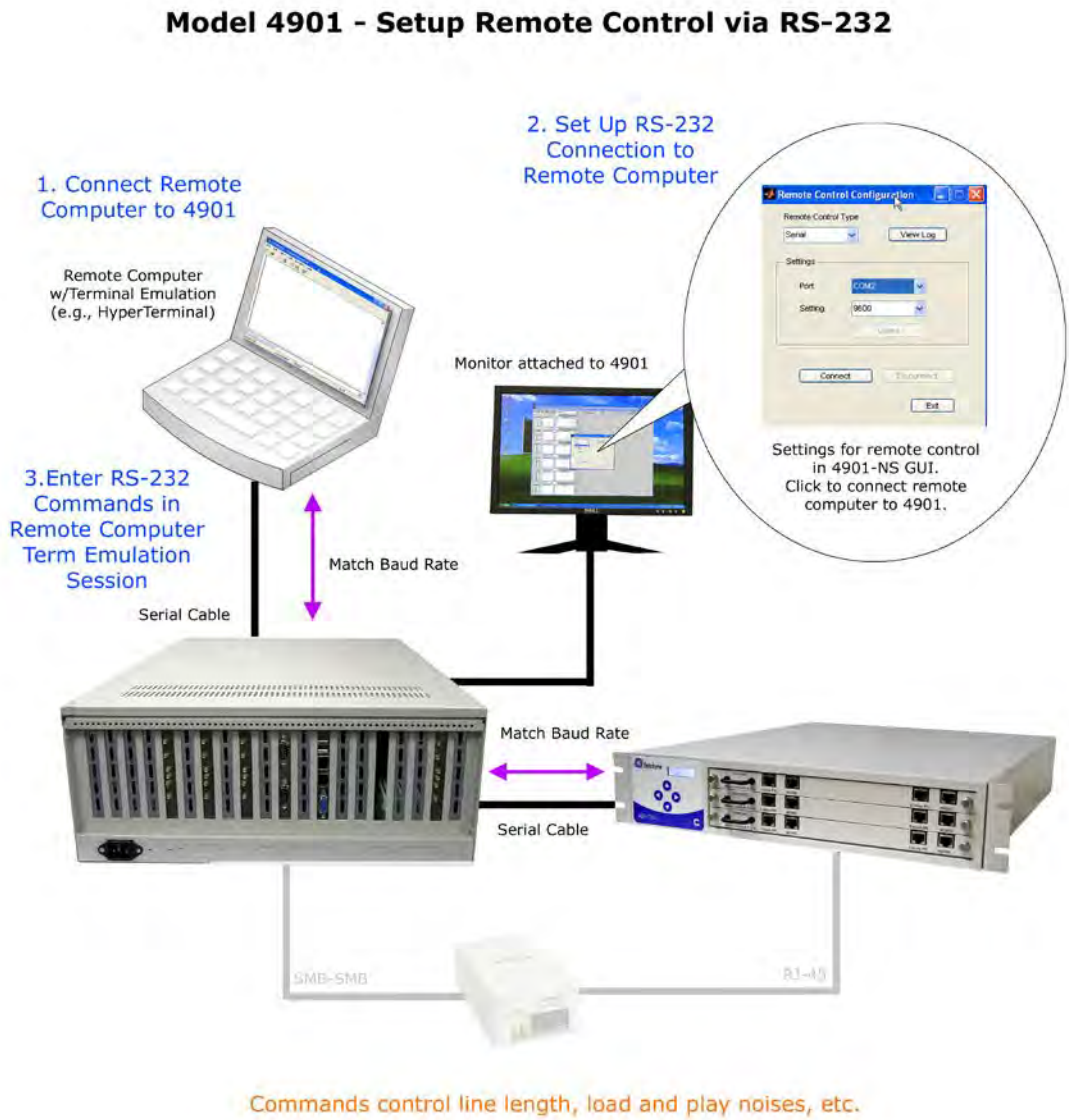
There are cases in the TR-100 Libraries where the ADSL2+ FEXT noises are length specific and the ADSL2 FEXT noises are calibrated to a specific length (when the test may call for testing over a number of different lengths). In these cases, the noises will generate correctly but the WLS must be set manually to the various lengths. This is due to the discrepancy between the length for which FEXT is calculated and the length to which the WLS is set.

9.0 Remote Control

The Model 4901 may be remotely controlled via RS-232 or Telnet commands. Commands include the ability to load saved noises and configurations, as well as play and stop noise files. When a noise file is saved, the WLS settings are saved with it; therefore, those settings provide remote control of line lengths.

9.1 Remote Control via RS-232

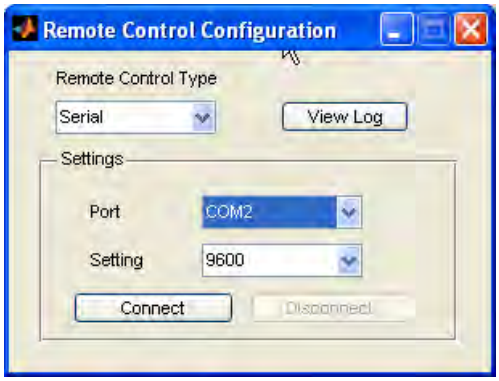
9.1.1 RS-232 Remote Control Connection Diagram



- This section pertains to connecting a remote computer to the 4901. A separate connection is required to connect the 4901 to a WLS.

9.1.2 Connect Remote Computer to 4901 via RS-232

- Connect the remote computer to the Model 4901 serial port.
- Click the  (Remote Control Settings) icon. The Remote Control Configuration dialogue box is shown.



- Select a **Remote Control Type** of Serial.
- Select the appropriate **Port** and **Setting** values for this connection.
- Click **Connect** to connect the remote computer to the Model 4901.

9.1.2.1 Launch Terminal Emulation Session on Remote Computer

Launch a terminal emulation program such as Hyper Terminal or Tera Term. The settings for this program should be appropriate for the COM port and baud rate of your remote computer. In addition, the Terminal setup should include settings for new-line transmit of "CR + LF." Local Echo can be checked to display the command being entered.

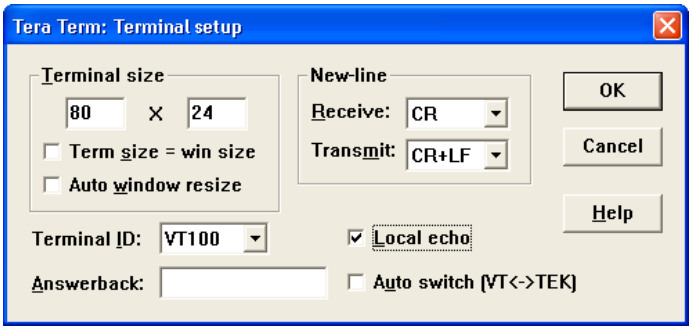


Figure 9-1: Sample terminal emulation screen settings.

- If communication problems arise, attempt to communicate from the terminal emulation program on the remote computer to a terminal emulation program on the Model 4901. Use this configuration to verify the cable is functioning correctly. In addition, confirm that COM and Baud settings are properly selected. When characters typed in the remote program appear on the Model 4901 emulation side, the connection is correct. Finally, make certain the correct firmware is installed on your WLS.

9.1.2.2 RS-232 Remote Commands

Command	Usage	Description	Examples
help	help	show valid commands	
configfiles?	configfiles?	returns list of .tbc configuration files in the noise directory	
configload	configload:<filename>	loads the indicated configuration file	configload:test.tbc
disable	disable:<channel #>	disable noise playback on channel	disable:1
enable	enable:<channel #>, enable:<channel #>?	enable or query noise channel enable	enable:1, enable:1?
forward	forward:<port>:<baud>:<string>	forward commands to WLS	forward:com2:9600:id?
library	Library:<library>:<Test #>:<Case #>	load library test case	library:tr114i2b:3:1
library:loop	library:loop:<channel #>	set WLS channel for library	library:loop:8
loadcard	loadcard:<card >	programs the indicated card #1-6 or all available cards	loadcard:1, loadcard:all
loopstep	loopstep:<channel>:<initial|step|final>:<length> loopstep:<card>:run	set loop steps calculate next loopstep	loopstep:1:initial:1000 loopstep:1:run
noisedir	noisedir, noisedir?	set or retrieve the noise directory path	noisedir:c:\temp
noisefiles?	noisefiles?	returns list of .tbn noise files in the noise directory	
noiseload	noiseload:<channel>:<filename>	loads the indicated noise file on the indicated channel	noiseload:1:test.tbn
offset	offset:<channel #>:<offset[dB]>	sets the amplitude offset on given channel	
playcard	playcard:<card>	initiates playback on the indicated card #1-6 or all available cards	playcard:1, playcard:all
status?	status?	returns the current status of all cards	
stopcard	stopcard:<card>	aborts playback on the indicated card #1-6 or all available cards	stopcard:1, stopcard:all
timer	timer:<card #>:<playback|replay>:enable:<off|on|0|1> timer:<card #>:<playback|replay>:<hrs>:<min>:<sec>	sets up the replay/playback timers	
version	version?	query the software version	

9.1.2.2.1 Example – RS-232 Commands to set up loop iteration

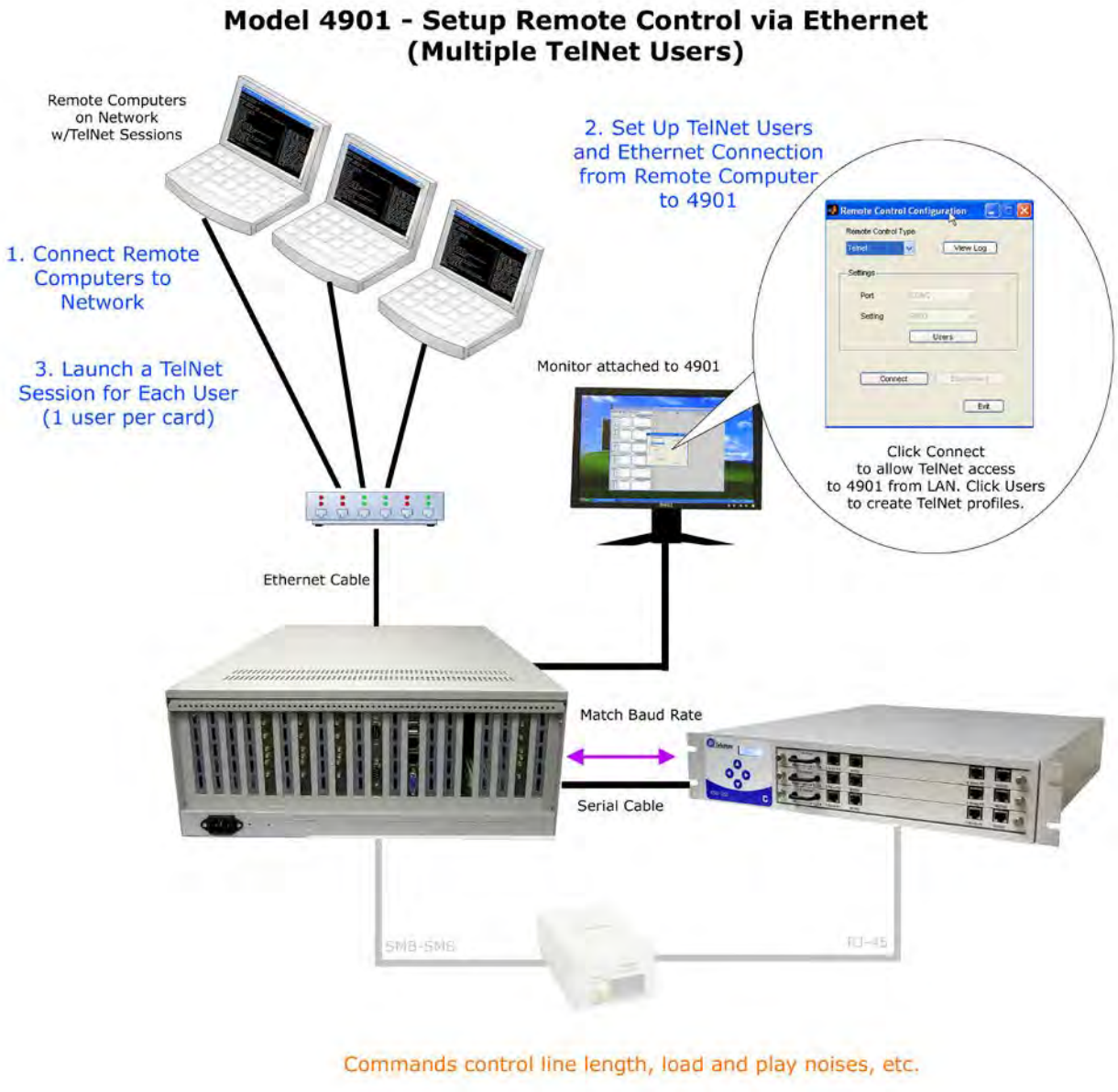
Load two saved custom Crosstalk files (they should contain a FEXT component) onto channel 1 and 2 on card 1. This will configure the loop step feature to use 1,000-ft steps from 1,000 ft to 10,000 ft.

noiseload:1:fext_channel1.tbn	load previously saved Crosstalk files with FEXT
noiseload:2:fext_channel2.tbn	the length saved in the file does not matter
loopstep:1:enable:on	set loop steps of 1000 from 1000 to 10000
loopstep:1:initial:1000	
loopstep:1:step:1000	
loopstep:1:final:10000	
cardload:1	load the AWG
playcard:1	play the AWG – this will recalculate noise at initial length
loopstep:1:run	each successive run command will stop the noise,
loopstep:1:run	recalculate at the next length, and resume noise generation
loopstep:1:run	

9.2 Remote Control via Multiple Telnet Sessions (over Ethernet)

Each 4901-AWG card installed in the Model 4901 may be assigned (reserved for) a different user and controlled using Telnet commands over an Ethernet connection.

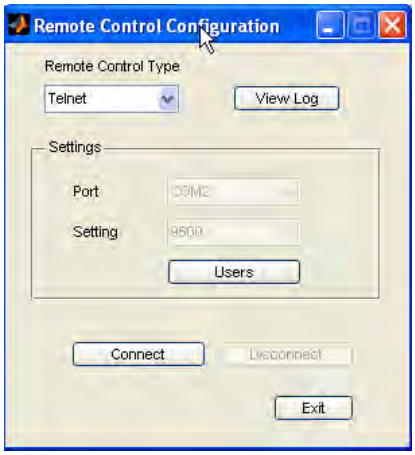
9.2.1 Remote Control via Ethernet Diagram



- This section pertains to connecting a remote computer to the 4901. A separate connection is required to connect the 4901 to a WLS.

9.2.2 Connect Remote Computers to 4901 via Ethernet

- Physically connect the Model 4901 and any remote computers to the network.
- Assign an IP address to the Model 4901.
- Click the  (Remote Control Settings) icon. The Remote Control Configuration dialogue box is shown.

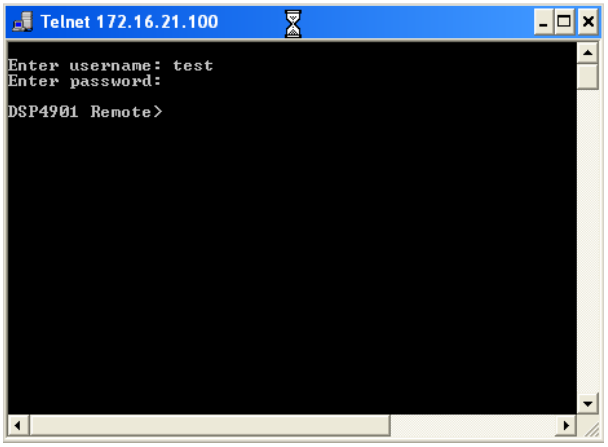


- Select a **Remote Control Type** of Telnet.
- Click **Connect** to open a connection from the Model 4901 to the network.

9.2.2.1 Start Remote Telnet Session

Use a remote computer on the network to initiate a Telnet session.

- From the remote computer, click Start/Run.
- Enter **telnet xxx.xx.xx.xxx** (where **xxx.xx.xx.xxx** represents the Model 4901's IP address on your network)
- Press Enter. The username and password prompts are shown.



- Enter **help** for a list of valid 4901 Telnet commands.

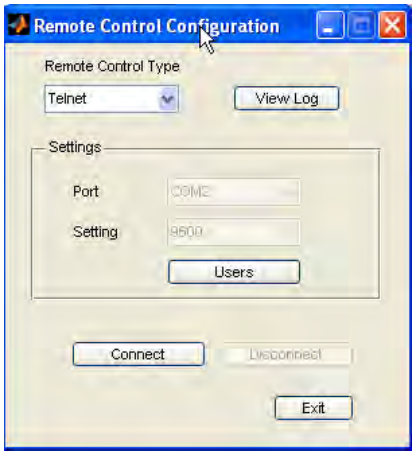
9.2.2.2 4901 Telnet Commands

COMMAND	DESCRIPTION
help	show valid commands
configload:<filename>	load .tbc configuration file
reserve:<card #>	reserve AWG card to remote user
release:<card #>	release AWG card
release:all	release all user AWG cards
show:cards	show reserved cards and users
show:configfiles	show available config files
show:files	show available noise files
show:status	show noise generator status
forward:<port>:<baud>:<string>	forward command to WLS
library:<library>:<test #>:<case #>	load library test case
library:loop:<channel #>	set WLS channel for library
loadcard:<card #>	load AWG card
loopstep:<card>:<parameter>:<value>	set loop step functionality
loopstep:<card #>:run	calculate next loop step
noiseclear:<channel #>	clear noise on channel
noiseclear:all	clear noise on all channels
noisedir:<pathname>	change noise file directory
noisedir?	query noise file directory
noiseload:<channel #>:<filename>	load noise file on channel
offset:<channel #>:<value>	change amplitude offset on channel
playcard:<card #>	initiate noise playback on card
stopcard:<card #>	stop noise playback on card
enable:<channel #>	enable noise playback on channel
disable:<channel #>	disable noise playback on channel
timer:<card #>:<timer>:enable:<value>	enable/disable noise card timer
timer:<card #>:<timer>:<hrs>:<min>:<sec>	set noise card timer
logout	logout
version?	query the software version

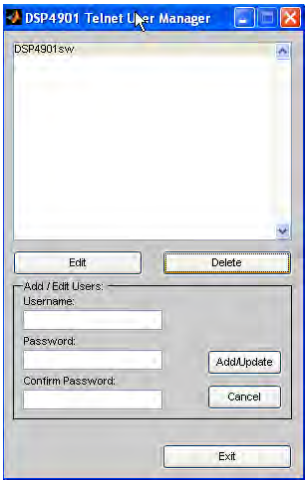
9.2.3 Telnet Profile Setup

Each 4901-AWG card may be assigned to a user by creating a user profile in the 4901-NS interface. User names and passwords are created, edited and deleted in the Telnet User Manager.

- Click the  (Remote Control Settings) icon. The Remote Control Configuration dialogue box is shown.



- Click Users. The DSP4901 Telnet User Manager dialogue box is shown.



- Add a user profile by completing the Username and Password fields. Click Add/Update.
- Edit a user profile by selecting the user profile and clicking Edit.
- Delete a user profile by selecting the user profile and clicking Delete.
- Click Exit.

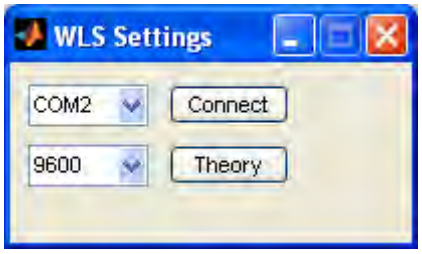
10.0 WLS Control

A Telebyte wire line simulator (WLS) can be controlled by the 4901-NS. Line lengths included in noise file settings are retained when the noise file is saved. The control module in the WLS communicates with the Model 4901 through a serial port connection. After making the necessary connections, the 4901-NS initiates communications with the WLS. The 4901-NS then reads the line modules installed in the WLS chassis and populates the appropriate fields with the slots, channels, line lengths and wire types found. The user then selects the desired slot:channel combination.

- This section pertains to connecting the Model 4901 to a WLS. To send remote commands to the 4901 from a remote computer via RS-232 or Ethernet, refer to *Remote Control*.

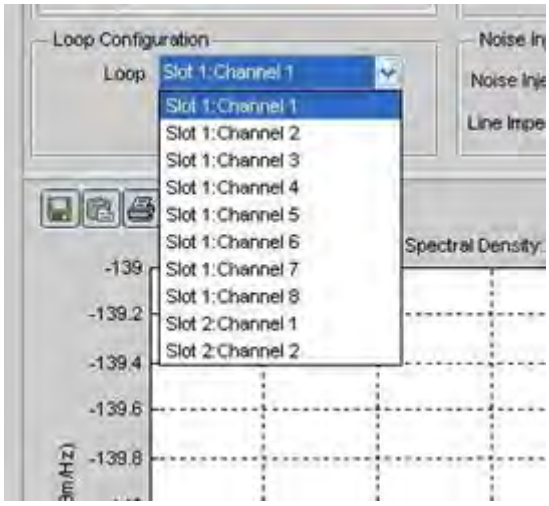
10.1.1 Step-by-Step Instructions

1. Connect the Model 4901and WLS with a serial cable.
2. Turn on the WLS.
3. Select the desired baud rate on the WLS using the Configuration button and Up/Down arrows on the WLS keypad (refer to WLS Control via Keypad).
4. Launch the Model 4901-NS.
5. Click the **WLS Settings** icon. The WLS Settings dialogue window is shown.
6. Select the **COM** port used on the 4901 for this communication and the desired **baud** rate (must match the WLS baud rate) and click **Connect**.



7. The 4901-NS reads the line modules installed and populates the Loop Configuration section of the interface.

8. Select the line length, slot and channel from the Loop Configuration section on the right side of the 4901-NS screen. (These selections are only available after a successful connection to the WLS.)



11.0 Installing/Moving 4901-AWG Cards in the 4901-PC

While the 4901-AWG card(s) ordered with your system are installed at the factory, you may wish to move them or you may purchase additional cards in the future. These instructions provide the steps to accomplish this.

- The driver required for 4901-AWGx cards is installed at the factory when you purchase the 4901-PC and does not need to be installed again. After installation, the Windows XP operating system will recognize the new card configuration.

- The serial numbers of AWG cards may have an effect upon certain test cases in the optional Noise Libraries.

11.1.1 Step-by-Step Instructions

➲ **To avoid damaging the 4901-AWGx card(s), ensure you are properly grounded when performing these steps! Standard ESD practices should be observed.**

- Remove the screws from around the top cover and carefully slide the cover off the top.

- Note the backplane contains sixteen PCI slots. It is recommended that you arrange the 4901-AWG noise cards in a configuration that provides optimum spacing for ventilation between cards.

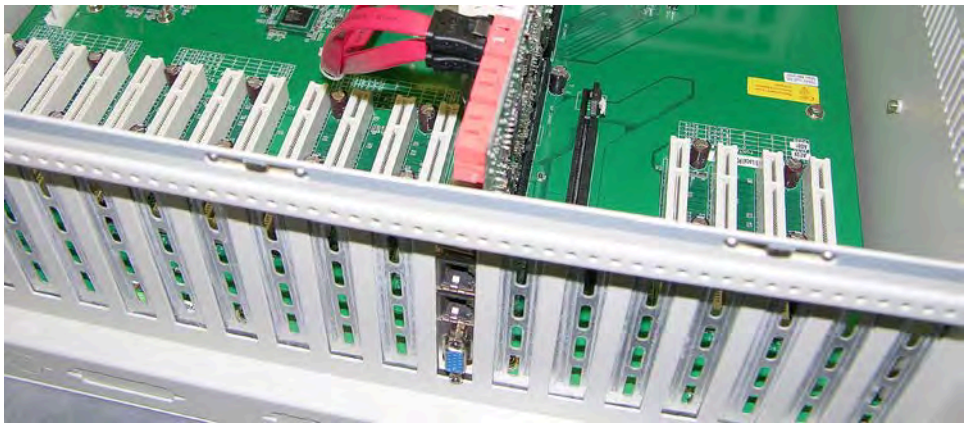
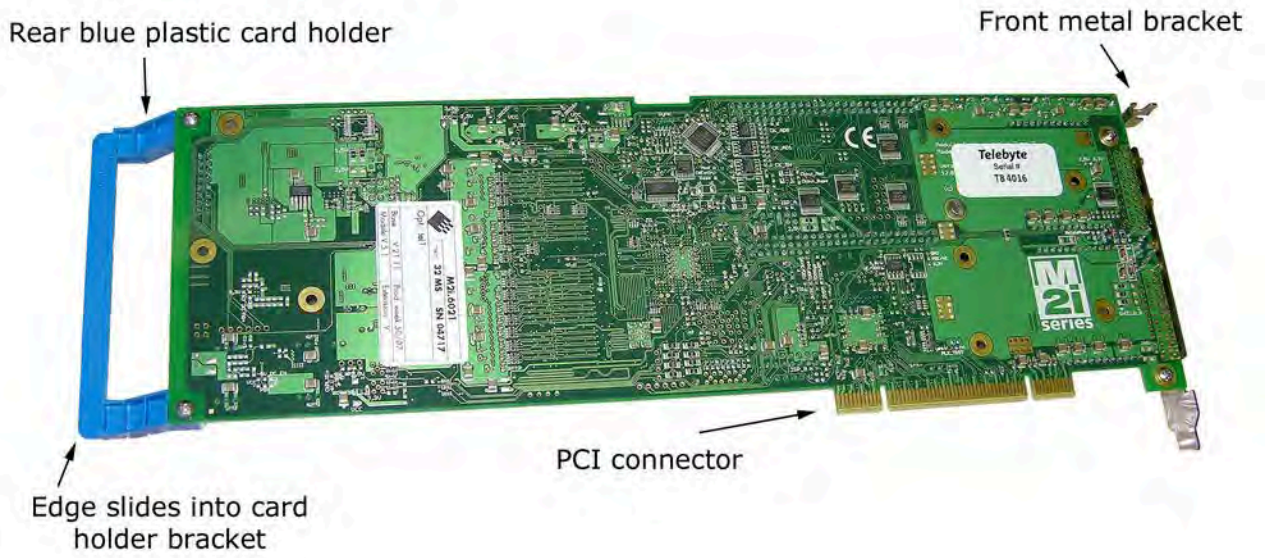
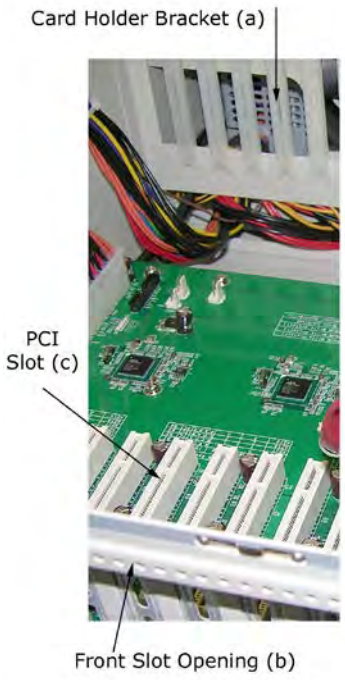


Figure 11-1: Interior view showing PCI slots

- Unscrew and remove the blank cover on the slot to be used. Retain the screw.
- Hold the 4901-AWG card by the front metal bracket and rear blue plastic card holder.



- Align the PCI connector with the PCI slot (c), then slide the raised edge on the 4901-AWG plastic card holder into the card holder bracket (a) while sliding the front metal bracket into the front slot opening (b).
- Gently push the 4901-AWG into the PCI slot (c).



- Using the screw from the blank cover, fasten the front metal bracket to the chassis.
- Replace the cover, placing the tabs in the front of the cover under the chassis front edge, and fasten with screws.

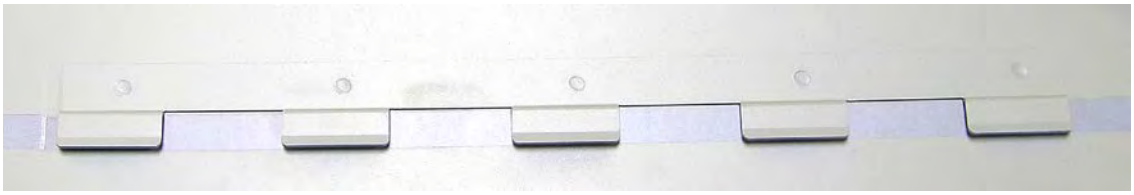


Figure 11-2: Tabs on bottom of front cover fit under front edge of chassis

- When the 4901-PC is powered up, the Windows XP operating system will recognize the new card and location. To confirm installation, launch the 4901-NS software. A menu for each card, with the correct number of channels will display immediately.

12.0 Technical Support

Technical support is available on the web by going to http://www.telebytebroadband.com/main/support_index.asp.