DLS–8234
Operating Manual

VDSL2 Wireline Simulator
Europe

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Contents

1. Introduction

1.1 About Spirent's Involvement in Wireline Simulation

Thank you for choosing the Spirent Communications DLS–8234 VDSL2 Wireline Simulator.

During the course of the past 15 years, Spirent Communications has been the industry leader in wireline simulation - providing both new and innovative solutions to the industry while also addressing individual customer requirements.

Through our active participation in all of the major standards bodies - ITU-T, DSL Forum, ETSI, ANSI - Spirent has helped drive the accuracy and quality of wireline simulators to new heights. In fact, the DLS–8234 represents a culmination of all of the research and development expertise gained to date - providing a platform with industry leading accuracy, repeatability and quality.

For VDSL2, the various standards bodies have identified several improvements to the conventional VDSL2 transceiver systems designed to better address higher data rates for short loops. Specifically, the newest VDSL2 technology features improved support for bandwidth up to 30 MHz.

1.2 About the DLS–8234 VDSL2 Wireline Simulator

The DLS–8234 VDSL2 Wireline Simulator is designed for performance testing in accordance with ETSI specifications. This simulator uses the PE04 cable model as per ETSI TS 101 388, and ensures complete testing coverage for multi-functional and rate-adaptive xDSL chipsets.

The DLS–8234 VDSL2 Wireline Simulator reproduces the AC and DC characteristics of twisted pair copper telephony cable using passive circuitry (R, L & C), which means that attenuation, complex impedance and velocity (propagation delay) of the wireline are accurately simulated. External noise impairments can be added to the DLS–8234. Contact Spirent for information about suitable noise impairment equipment for your testing needs.

The DLS–8234 VDSL2 Wireline Simulator consists of a single chassis. For rate-adaptive chipsets, the DLS–8234 can optionally connect to an external reach extension unit (for example, the DLS–414E) for full automode or rate-adaptive testing at reaches up to 10 750 meters.

There are two methods for controlling the DLS–8234 VDSL2 Wireline Simulator: you can use the DLS–8234 Control Application which ships with the DLS–8234, or you can take control of your testing and benefit from the flexibility of the DLS–1200 ScriptCenter Library tool to write custom, script-based software to operate your DLS test system.

The DLS–8234 Control Application configures and controls the system remotely through either the GPIB (IEEE 488) or RS-232 interface. Use of GPIB and RS-232 interfaces also allows for the easy integration of the DLS–8234 into a larger test system.

1.3 About The Test Setup

The DLS–8234 uses the ETSI TS 101 388 specification as the basis for emulating the PE04 wireline loop. It reproduces all the characteristics (attenuation, phase and impedance) of the simulated loops, and covers the European VDSL2 frequency spectrum. Attenuation (insertion loss) and phase are identical for both downstream and upstream signals.

The DLS–8234 allows full duplex signal transmission and covers the full frequency band from DC to 30 MHz, which allows for testing across all variations of DSL technologies.

Combined, the DLS–8234 VDSL2 Wireline Simulator and the DLS–5500EV VDSL2 Noise Generation System, form an integrated system with the required wireline simulation and noise files to support VDSL2 ETSI testing.

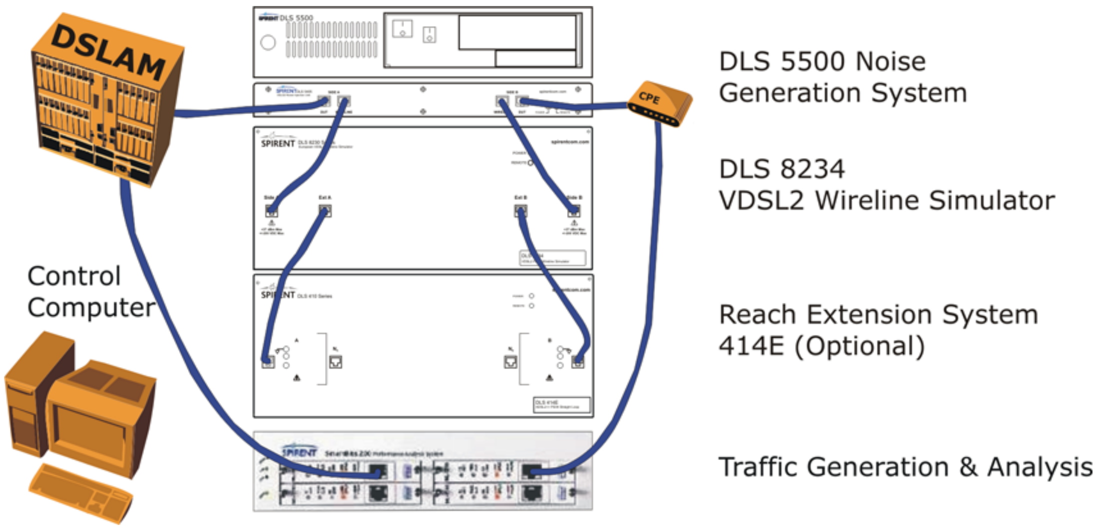


Figure 1-1 Example of a VDSL2 Test System Setup

Figure 1-1 illustrates an example of a typical test setup using the DLS–8234 VDSL2 Wireline Simulator.

This test set-up provides users with a comprehensive and accurate test bed for verifying that the Device Under Test (DUT) will meet the testing requirements of the VDSL2 standards.

Existing Spirent AE solution users know that this functionality translates into robust performance, earlier product delivery and greater market share.

For more information on compatible Spirent Communications products, see *1.4.1 "About Related Documentation and Products"*.

1.3.1 Loop

The DLS–8234 simulates a PE04 loop as illustrated in *Figure 1-2*.

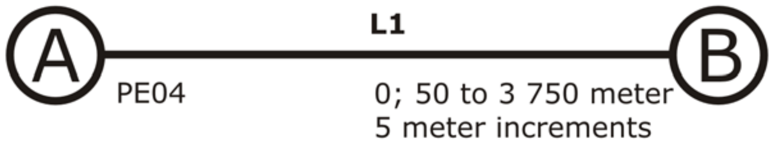


Figure 1-2 DLS–8234 loop schematic

NOTE

The loop has a continuous bandwidth of DC to 30 MHz.

NOTE

PE04 cable model as per document ETSI TS 101 388 - see *Chapter 6 "References"*.

1.4 About this Manual

We recommend you read *Chapter 2 "Getting Started"* thoroughly before powering up the DLS–8234 VDSL2 Wireline Simulator. The remainder of this manual provides information about the various aspects of the wireline simulator, such as loop configurations, remote control, warranty, specifications and contact information.

Spirent Communications also recommends that technicians and others use the DLS–8234 Control Application to configure and control the wireline simulator. If you decide to develop custom test software, see *Chapter 5 "Remote Control"* for details about common and device specific commands sets that can be sent to the DLS–8234 control module through the GPIB or RS-232 interfaces.

If you have any questions about the DLS–8234 VDSL2 Wireline Simulator, please contact your Spirent Communications sales representative or a support service specialist. You will find contact information in *Chapter 7 "Support Services"* of this manual.

1.4.1 About Related Documentation and Products

Existing customers can view and download the following manuals from the Spirent web site:

- DLS–5500 Operating Manual (noise generation)
- 410E Operating Manual (DLS–414E reach extension)

For more about the Spirent Support Services website, see *Chapter 7 "Support Services"*.

2. Getting Started

This chapter provides basic instructions on the setup of a DLS–8234 VDSL2 Wireline Simulator system.

2.1 Receiving and Unpacking the Unit

Each DLS–8234 chassis is shipped in a reinforced shipping container. Keep this container for shipping. You will need to ship the unit for the recommended yearly calibration. You may also need to ship the DLS–8234 to another location or for repair. The DLS–8234 system contains the following:

- DLS–8234 chassis
- 1 power cord
- 2 extra fuses
- 1 9 to 25 pin adapter (RS-232)
- 1 RS–232C inter-connection cable
- 1 GPIB inter-connection cable
- 1 GPIB reverse entry extender
- 2 RJ45 interconnect cables - 30 cm (1 foot) long, Spirent part number 7102040514
- 1 DLS–8234 Software CD
- 1 Operating Manual CD
- 1 diskette containing compensation settings specific to the shipped unit.

Check that you have received all the items on the list and report any discrepancies to Spirent Communications.

2.2 Setup Overview

The following steps outline how to set up a DLS–8234 system. For details, see the sections referred to in the steps.

To set up the DLS–8234:

Step 1: Install the DLS–8234 Control Application (see *Section 3.2 "Installing the Software"*)

Step 2: Connect the chassis to the control computer (*Section 2.4.2 "Control Computer Connection" on page 2-5*).

Step 3: Set up the equipment (*Section 2.5 "Chassis Set Up" on page 2-5*).

Step 4: If added wireline reach is required, connect an additional wireline simulator to DLS–8234 (*Section 2.5.5 "Extended Reach Set Up" on page 2-8*).

Step 5: Connect the DLS–8234 to the Digital Subscriber Line Access Multiplexer DSLAM and CPE equipment (*Section 2.5.3 "Chassis Interconnections" on page 2-7*).

Step 6: Connect power to the chassis and switch it on (*Section 2.4.1 "Power Connection" on page 2-4*).

Step 7: Start the DLS–8234 Software (see *Section 3.3 "Starting the DLS–8234 Control Application" on page 3-2*).

Step 8: Select the ***Communication Settings*** tab.

Step 9: Configure the appropriate GPIB or serial port settings.

Step 10: Select the ***System Properties*** tab.

Step 11: Select the loop type.

Step 12: Adjust the wireline segment length.

Step 13: If using a DLS–5500EV VDSL2 Noise Generation System, select the desired impairments using the software that comes with that system.

Step 14: Begin testing.

2.3 Front Panel Components and Connections

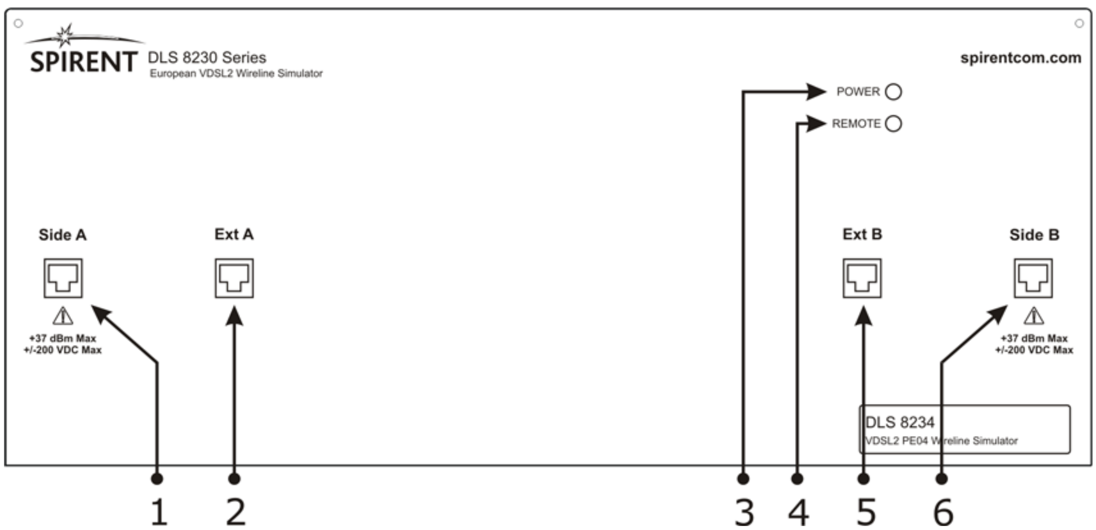


Figure 2-1 DLS–8234 VDSL2 Wireline Simulator Front Panel

DLS–8234 Front Panel Components

1) **Side A, RJ-45 connector**: wireline Side A
2) **Ext A, RJ-45 connector**: used to connect an extension unit
3) **Power LED**: indicates the power status
4) **Remote LED:** indicates the remote status
5) **Ext B, RJ-45 connector**: used to connect an extension unit
6) **Side B, RJ-45 connector**: wireline Side B

NOTE

The Remote and Power LEDs indicate the unit status, as described in *Section 2.3.1*.

2.3.1 Remote and Power Status LEDs

The DLS–8234 chassis has 2 LEDs which indicate the power and remote status.

The **POWER LED** is green when the power is turned on. It is red if the chassis fails its self-test. It is yellow if an internal error is detected.

The **REMOTE LED** is off after a power-up or a reset. After receiving a remote message, the REMOTE LED turns green for valid commands, or red if a command generates an error. Errors are usually caused by an invalid command or an out-of-range value. When an error is detected, the REMOTE LED will stay red until the error flags are cleared (see the command *ESR? in *Section 5.6 "Common Command Set"* for details). *Chapter 5* has examples of how to read the ESR register, clear the error flags and switch the REMOTE LED to green once error conditions have been resolved.

2.3.2 Analog Device Connections

NOTE

The maximum ratings for DLS–8234 connections are ±200 VDC, 125 mA and +37 dBm. A 400Hz signal at +36 dBm may be used as a howler signal (Section E.4.1 of G.test standard).

2.3.2.1 RJ-45 Connectors

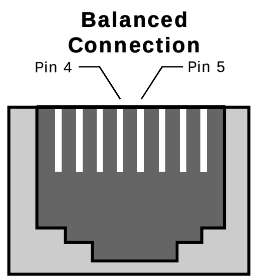


Figure 2-2 RJ-45 Female Connector

The RJ-45 connectors are balanced. The signal is carried by the two center pins. Pin 4 is *Tip*, pin 5 is *Ring* (*Figure 2-2*).

We recommend the following *maximum* lead lengths:

- 60 cm (2 feet) for signals with frequencies up to 4.5 MHz
- 30 cm (1 foot) for signals with frequencies up to 30 MHz.

It is possible to use longer leads with lower frequencies.

NOTE

RJ-11 male connectors will mate to the RJ-45 female receptacles on the front panel of the DLS–8234.

2.3.3 Reach Extension Connections

To extend the length of the wireline beyond its 3 750 meter capability, the DLS–8234 can directly connect to an external wireline simulator such as the DLS–414E.

The reach extension unit is connected to the Ext A and Ext B jacks on the front panel of the DLS–8234.

For details about the physical set up for a system with extended reach, see *Section 2.5.5 "Extended Reach Set Up" on page 2-8*.

For details about using the DLS–8234 Control Application to enable reach extension, see *Section 3.6.3 "Extended Reach" on page 3-8*.

2.4 Back Panel Components and Connections

The remote control connections, GPIB address DIP switch and power connector are located on the on the back panel. *Figure 2-3* shows the layout of the rear panel.

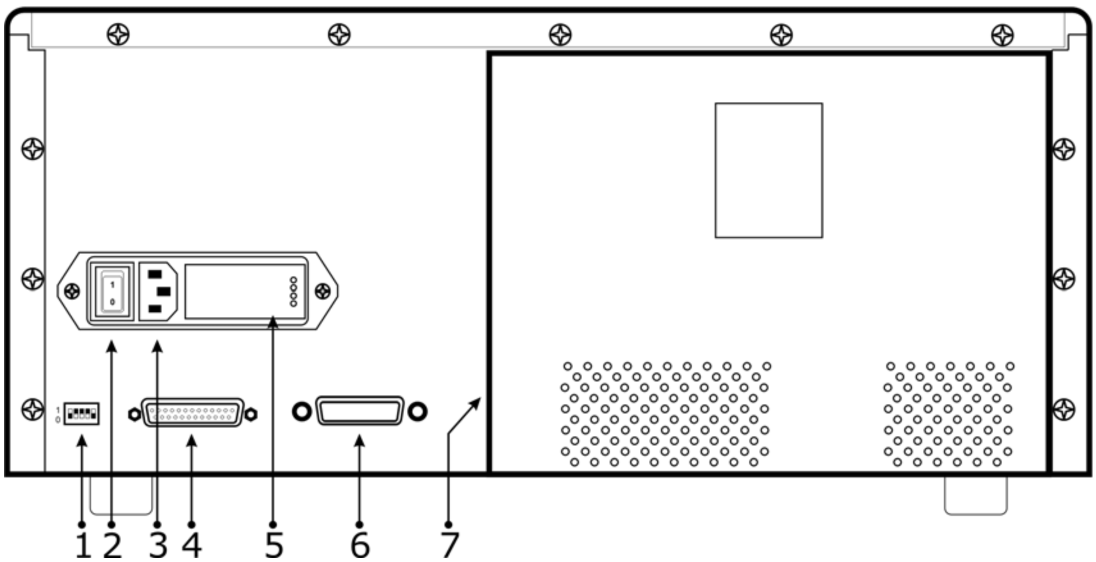


Figure 2-3 DLS–8234 VDSL2 Wireline Simulator Back Panel

DLS–8234 Back Panel Components

1) **IEEE 488 (GPIB) Address DIP Switch**: used to set the GPIB address.
2) **Power Switch**
3) **Power Input**: connect to an AC power source.
4) **RS–232 Connector**: connect to a computer for remote control*.
5) **Fuse Box**: containing two type “T” 2A/250V slow blow fuses.
6) **IEEE 488 (GPIB) Connector:** connect to a computer for remote control*.
7) **Power Supply**

* Use either the GPIB or RS-232 port for connecting to a control computer.

2.4.1 Power Connection

The DLS–8234 chassis is built with a 2-fuse configuration. Refer to *Chapter 11 "Safety"* for more details.

Connect one end of a modular AC line cord to the power input of the DLS–8234, and the other to an AC line supply, with a voltage between 100 and 240 VAC at 50 to 60 Hz. The DLS–8234 will work with any voltage and frequency in this range. Switch settings are not required.

When the DLS–8234 is powered off, the loop configuration persists. This allows you to use the DLS–8234 when un-powered although loop settings can not be changed.

When power is restored, loop settings continue to persist, although the loop is disrupted during power-up self-test. Do not cycle power while conducting a test.

NOTE

All chassis that form the wireline simulation system must be connected to the same circuit to avoid noise problems caused by ground loops. Spirent Communications recommends that the DLS–8234, DLS–5405, DLS–5500 and reach extension chassis (if used) are all plugged in to one power bar.

2.4.2 Control Computer Connection

The DLS–8234 Control Application runs on a PC computer, allowing you to select the simulated length of the wireline loop. You may instead develop custom control software to configure the unit.

You may use either GPIB or RS-232 to connect the control computer to the DLS–8234. One connector for each type of interface is located on the rear panel of the simulator.

Each simulator must have a separate connection to the control computer.

2.4.2.1 GPIB (IEEE-488) Port Connection

The GPIB portion of the control software supplied by Spirent Communications works only with a National™ GPIB interface card. If necessary, install the National™ GPIB interface card in the computer. Please refer to the "NATIONAL INSTRUMENTS GPIB CARD AND SOFTWARE INSTALLATION" for information on how to install the GPIB card.

Connect the control computer to the DLS–8234 chassis with a GPIB cable.

Set the GPIB address of the DLS–8234 chassis using the piano dip switch at the back of the chassis. Select an address between 1 and 31 that is unique to the GPIB bus. Address "0" is reserved for the GPIB controller (i.e the control computer).

To change the address, use the DIP switch on the back of the unit. The switches follow standard binary weighting.

As shown in *Figure 2-4*, the factory settings for the chassis is 14 (0+8+4+2+0).

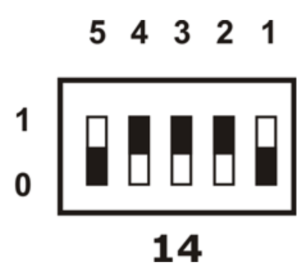


Figure 2-4 Default address switch settings for the DLS–8234

2.4.2.2 Serial Port (RS-232) Connection

Connect the DLS–8234 chassis to the control computer using an RS-232 serial cable. Use the provided 9 to 25 pin adapter if needed.

NOTE

The DLS–8234 Software can be set to connect to serial port COM1 to COM9. Make sure there is no conflict with other serial devices.

2.5 Chassis Set Up

The following sections explain how to set up the components in a DLS–8234 system, including reach extension and noise injection.

2.5.1 Reducing Noise and Cross-talk

Cabling, switches and other equipment are needed to connect the DSLAM, the loop simulator, the noise injector and the CPE. Cables should be kept as short as possible to reduce noise coupling. CAT5 UTP cables are recommended. Since the length is typically short (e.g., 30 cm/1 foot), this has a minimal effect on test measurements.

Computer screens, internal and external switching power supplies and other equipment radiate in xDSL frequency bands. When noise pick up levels exceed -140 dBm/Hz, they will limit VDSL2 performance and influence the test results. Noise-generating devices should be placed away from the test setup or switched off.

Ports Ext A and Ext B wiring as well as Side A and Side B interconnection wiring should be physically separated as crosstalk can occur between cables. Arrange the cables so that they are separated by at least 6 inches/15 cm (or further if possible).

2.5.2 Chassis Arrangement

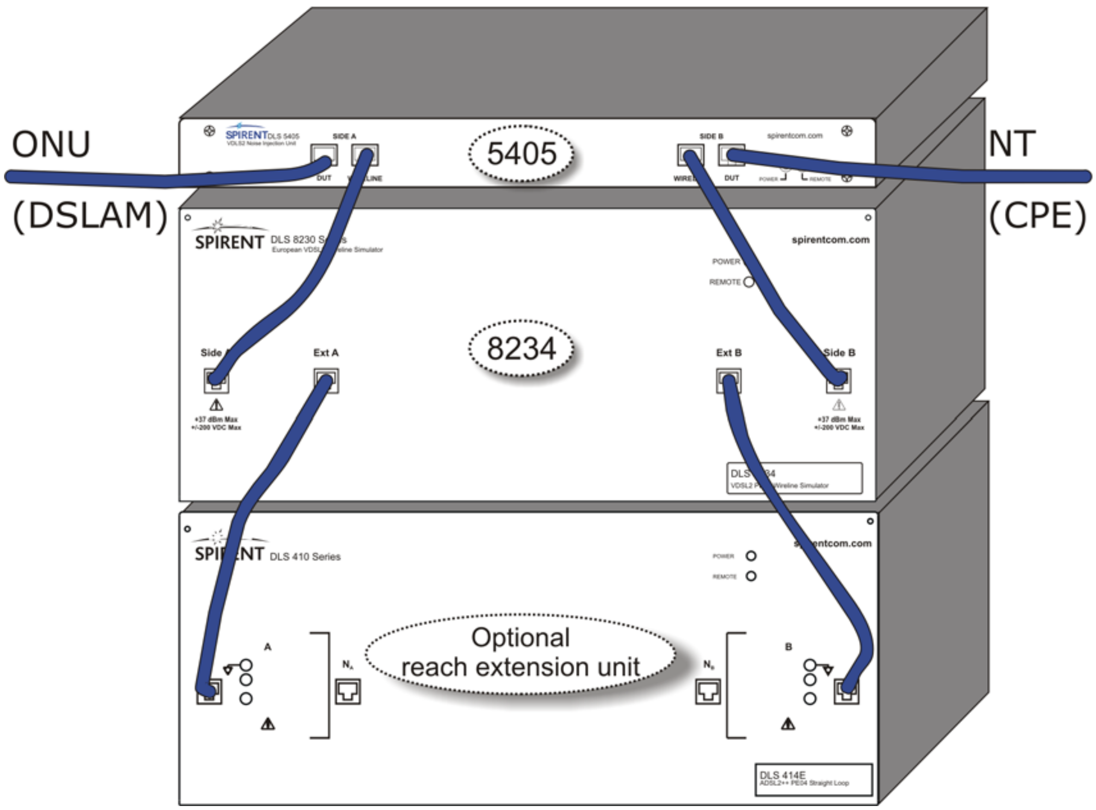


Figure 2-5 Chassis set up

Arrange the DLS–8234 system as shown in *Figure 2-5*. This arrangement keeps cable lengths as short as possible. Note that the reach extension unit is optional.

To set up a DLS–8234 system, follow these steps:

Step 1: If reach extension is included in the set up, follow the instructions in *Section 2.5.5 "Extended Reach Set Up" on page 2-8* before proceeding with this procedure.

Step 2: Place the DLS–8234 chassis on the bench, or on the reach extension unit if used.

Step 3: Place the DLS–5405 VDSL2 Noise Injector chassis on top of the DLS–8234.

Step 4: Follow the procedure in Section 2.5.3 "Chassis Interconnections".

NOTE

Rack-mounting chassis is highly recommended due to the combined weight of the chassis involved in a complete wireline simulation system (DLS–8234, DLS–5500, DLS–5405 and reach extension system).

2.5.3 Chassis Interconnections

Interconnect the DLS–8234 system chassis as shown in *Figure 2-5*. Connections to the DUT are made via the noise injector.

To interconnect the component chassis of the DLS–8234 system, follow these steps:

Step 1: If reach extension is used, interconnect the DLS–8234 chassis with the reach extension system. Connect Ext A to Side A of the external wireline simulator, and Ext B to Side B of the external wireline simulator.

Step 2: Interconnect the DLS–8234 chassis and the DLS–5405 VDSL2 Noise Injector chassis with the 30 cm (1-foot) RJ-45 cables (provided in the DLS–8234 accessory package):

a) Connect Side A of the DLS–8234 chassis to Side A of the DLS–5405 chassis.

b) Connect Side B of the DLS–8234 chassis to Side B of the DLS–5405 chassis.

Note: If you are not using a noise injector, connect CO equipment to Side A of the DLS–8234, and CPE equipment to Side B of the DLS–8234.

Step 3: Interconnect the DLS–5405 VDSL2 Noise Injector and the DUT with the RJ-45 cables (provided in the DLS–5405 accessory package):

a) Connect the CO equipment being tested to Side A of the DLS–5405.

b) Connect the CPE equipment being tested to Side B of the DLS–5405.

Note: Omit this step if you are not using a noise injector.

2.5.4 Injecting Noise Impairments

Adding noise impairment is an essential component of a realistically simulated wireline. Use the DLS–5500EV VDSL2 Noise Generation System for generating and injecting noise impairments. See *Section 2.5.4* for connection details.

The DLS–5500EV VDSL2 Noise Generation System can generate both user-defined and pre-packaged noise shapes from DC to 30 MHz. It provides convenient noise injection circuitry for the test loop. For more information on the DLS–5500EV system, see the *DLS–5500 Operating Manual*.

2.5.5 Extended Reach Set Up

Adding an extended reach system to the DLS–8234 is optional, and is required only if the PE04 straight segment must be extended beyond the 3 750 meter reach limit of the DLS–8234.

The DLS–414E is a suitable reach extension system for the DLS–8234.

If used, the extended reach system must be placed on the bench, with the DLS–8234 system on top of it (see *Figure 2-5 "Chassis set up"* on page 2-6).

To extend the length of the simulated wireline segment beyond its 3 750 meter capability, connect an external wireline simulator via the Ext A and Ext B ports on the front panel of the DLS–8234.

To set up reach extension, follow the instructions in the manual for your reach extension system.

NOTE

Rack-mounting chassis is highly recommended due to the combined weight of the chassis involved in a complete wireline simulation system (DLS–8234, DLS–5500, DLS–5405 and reach extension system).

3. DLS–8234 Software

The DLS–8234 ships with the DLS–8234 Control Application, a GUI which provides an easy method for controlling the DLS–8234. The DLS–8234 settings are controlled by sending commands to the DLS–8234 using either the RS-232 or GPIB interface.

This chapter explains how to use the control application. If you are developing custom software see *Chapter 5 "Remote Control"* for an explanation of the command set.

Each instance of the control application can address a single DLS–8234 chassis via the GPIB or RS-232 interface. To control multiple DLS–8234 units, use multiple sessions of the DLS–8234 software.

The DLS–8234 Control Application window has three tabs:

1) The *System Properties* tab is selected by default. Use it to configure loop properties, and monitor commands sent to the DLS–8234. The *Loop Drawing* area graphically displays the simulated loop. See *Section 3.5 "Configuring the Loop Mode" on page 3-5* and *Section 3.6 "Configuring the DLS–8234 Loop Lengths" on page 3-6*.
2) The *System Compensation* tab is used to compensate the DLS–8234 using the test setup explained in *Appendix A "Measurements"*. See *Section 4 "System Compensation" on page 4-1*.
3) The *Communications Settings* tab is used to configure the physical interface between the control computer and the DLS–8234. See *Section 3.4.1 "Configuring the Simulator Connection" on page 3-3*.

3.1 Computer Hardware and Software Requirements

The DLS–8234 is configured using a control computer.

If using the Spirent DLS–8234 software, you will need the following:

- A computer running the Microsoft Windows® 2000 or XP operating system.
  - National Instruments GPIB controller card
  - GPIB cable

  – OR –

  - Serial port
  - RS-232 serial cable

Review the DLS–8234 Software Release Notes for a list of supported Microsoft Windows operating systems.

3.2 Installing the Software

To install the software:

Step 1: Insert the DLS–8234 Software Installation CD in the computer CD drive. The installation wizard will start.

If the Setup Wizard does not appear automatically, click ***Start >> Run*** and type <drive>: \setup. For example, type “E:\setup”.

Step 2: Follow the on-screen installation wizard instructions.

NOTE

You will be given the option to install the DLS Terminal after the DLS–8234 software has been installed. We recommend that you install the DLS Terminal by selecting the ‘Install DLS Terminal’ check box (*Figure 3-1*).

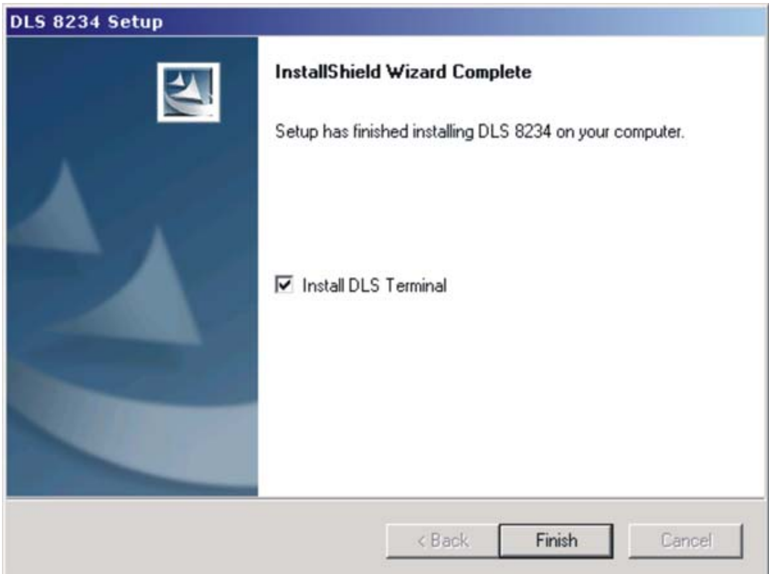


Figure 3-1 Final Screen for Installing the DLS–8234 Software

3.3 Starting the DLS–8234 Control Application

The program executable is located in the default installation folder:
C:/Program Files/Spirent Communications/DLS 8234/Dls8234.exe

To access the main window:

Step: Select ***Program Files >> Spirent Communications >> DLS 8234*** from the ***Start*** menu.

3.4 Configuring the DLS–8234

Before using the DLS–8234 Control Application, you must configure the connection to the DLS–8234 chassis. See *Section 3.4.1 "Configuring the Simulator Connection"* for details.

Besides the normal simulation mode, the loop can be in bypass, disconnect or exclude mode. See *Section 3.5 "Configuring the Loop Mode"* for details.

In normal mode, extended reach can be used to simulate wirelines longer than 3 750 meters. See *Section 3.6.3 "Extended Reach" on page 3-8* for details.

To increase the accuracy of the wireline simulation, use compensated settings (*Section 3.6 "Configuring the DLS–8234 Loop Lengths" on page 3-6*).

For instructions on how to create a compensation file, see *Section 4 "System Compensation"*.

3.4.1 Configuring the Simulator Connection

Each instance of the DLS–8234 Control Application can address a single DLS–8234 system via the GPIB or RS-232 interface. To control multiple DLS–8234 systems, use multiple DLS–8234 software sessions.

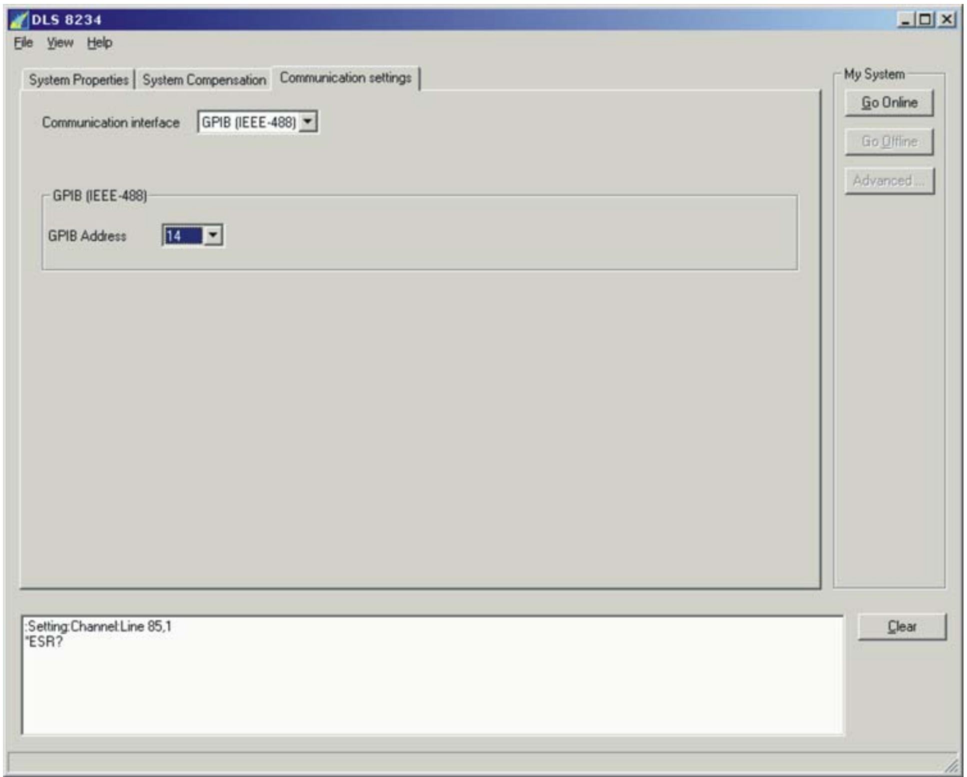


Figure 3-2 DLS–8234 Control Software - Communication Settings Tab

The following procedures assume that you have the DLS–8234 Control Application running.

3.4.1.1 Configuring the Connection

Step 1: Select the ***Communication Settings*** tab.

Step 2: Select the type of connection used from the ***Communication Interface*** drop-down list. Choices are GPIB (IEEE 488.2) or Serial (RS-232).

Step 3: Configure the connection, according to the type of interface selected in *Step 2*:

a) For a **GPIB** connection, select the GPIB address from the ***GPIB Address*** drop down list used by the DLS–8234. For instructions on setting the chassis GPIB address, see *Section 2.4.2.1 "GPIB (IEEE-488) Port Connection" on page 2-5*. The default address is 14.

b) For a **ComPort**, select the COM port from the ***Serial Port*** drop down list to which the DLS–8234 chassis is connected. Your choices are: 1-9. The default COM port is 1.

Step 4: Click the ***Go OnLine*** button to connect the DLS–8234 Control Application to the DLS–8234. The current wireline settings will be sent to the unit.

Click the ***Go OffLine*** button to disconnect the DLS–8234 Control Application from the wireline simulator.

NOTE

The DLS–8234 will continue to simulate the loop with the last settings it received before going offline. The DLS–8234 will also simulate the loop when turned off. When powered up, the previous settings will remain active after the power-up self-test.

3.4.1.2 Configuring the GPIB Interface

The DLS–8234 Control Application supports the National Instruments GPIB controller card. For a list of supported GPIB drivers, see the DLS–8234 software release notes.

If you connect the computer to the simulator via the GPIB port, ensure that the National Instruments GPIB controller card and its associated software are installed in the control computer.

NOTE

The DLS–8234 Software uses GPIB card 0. For more information please refer to National Instruments device-specific documentation and on-line help.

The easiest way to verify that the GPIB board is configured properly is to open the Measurement & Automation Explorer that is installed with the National Instruments software.

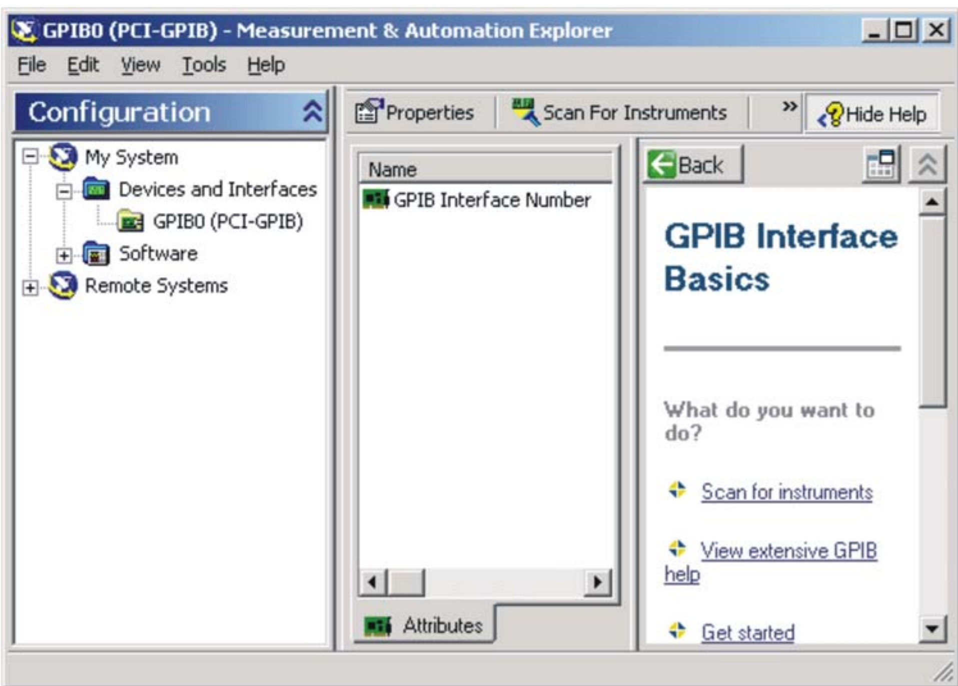


Figure 3-3 National Instruments Measurement and Automation Explorer

To configure the GPIB board:

Step 1: Open the Measurement & Automation Explorer: ***Start >> Programs >> National Instruments >> Measurement and Automation***.

Step 2: Right-click on the GPIB interface and set the default parameters as follows:

- disable automatic serial polling
- disable high speed data transfer
- enable system controller
- enable “Assert REN when SC”
- enable “Send EOI at end of write”
- I/O timeout set to be at least 10s. If the timeout is less than the typical time the command takes to complete then the function returns while the command is still executing

For more information please refer to National Instruments device-specific documentation and on-line help.

3.5 Configuring the Loop Mode

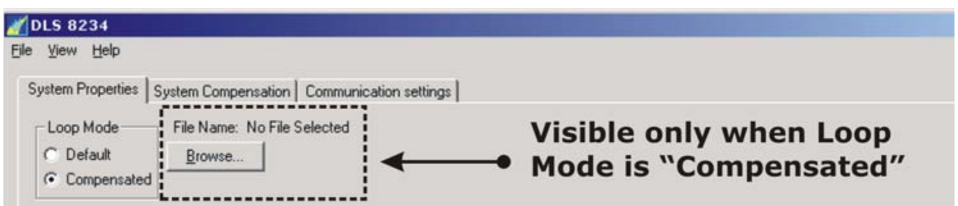


Figure 3-4 The Browse button appears only when Compensated mode is selected

The loop mode determines whether length settings are internally adjusted using default or compensated settings. Compensated settings are calibrated for a specific unit. The control application will only load a compensation file which was created for the unit attached to the control computer. Using compensated mode will minimize the Mean Absolute Error (MAE) for loop attenuation.

Step 1: Select the ***System Properties*** tab.

Step 2: Select the ***Default*** or ***Compensated*** option.

The ***Default*** option selects factory default compensation settings for the DLS–8234.

If the ***Default*** option is selected, no further configuration is required. You can now make loop length settings. See *Section 3.6 "Configuring the DLS–8234 Loop Lengths"* for details.

The ***Compensated*** option selects compensation settings that are specific to the DLS–8234 chassis you are controlling. This produces a more accurate simulation of the wireline.

If the ***Compensated*** option is selected, the ***Browse*** button appears (*Figure 3-4*), along with the name of the currently loaded compensation file (initially “No File Selected”). Compensated files are specific to a chassis. The software verifies that the serial number in the compensation file matches the serial number of the chassis.

If using Compensated mode:

Step 3: Click the ***Browse*** button. The *Choosing A Compensation File* dialogue box appears.

Step 4: Browse to and select the compensation file you wish to use.

Step 5: Click the ***Open*** button. The compensation file loads, and its name appears above the Browse button.

NOTE

You must use a file with the same serial number as the unit you wish to control. See *Section 4 "System Compensation" on page 4-1* for details.

3.6 Configuring the DLS–8234 Loop Lengths

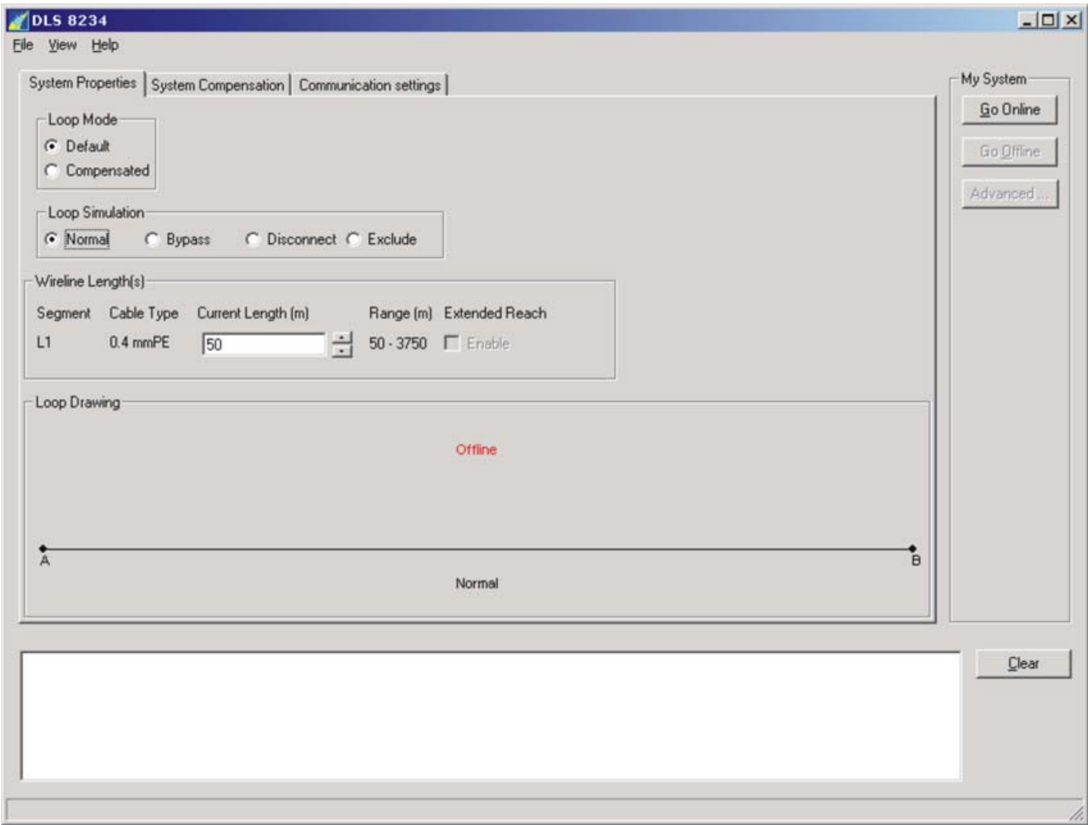


Figure 3-5 DLS–8234 Control Software - System Properties Tab

The following procedures assume that you have the DLS–8234 Control Application running.

The type of loop chosen in *Step 4* below will affect the availability of the *extended reach* function.

To set the length of the DLS–8234:

Step 1: Select the ***System Properties*** tab.

Step 2: Click the ***Go Online*** button. The control application translates subsequent settings into commands and sends them to the DLS–8234.

Step 3: Select ***Normal*** from the ***Loop Simulation*** radio buttons (see *Section 3.5 "Configuring the Loop Mode" on page 3-5*).

Step 4: Set the length of the wireline. You can either type a number in the ***Current Length (m)*** field, or click the spin controls next to the field.

NOTE

You cannot set the length the loop to zero. For a zero-length wireline, set the *Loop Simulation* field to ***Bypass***.

NOTE

If you enter a length that is not a multiple of the increment (i.e. 5 meters), the DLS–8234 Control Application will round it to the nearest increment. The spin controls will always change the length of a segment by the correct increment.

3.6.1 Loop Simulation Options

3.6.1.1 Bypass

Bypass connects the Side A jack directly to the Side B jack.

To make the simulated wireline zero-length, select the ***Bypass*** option.

3.6.1.2 Disconnect

Disconnect connects the wireline, making the simulator an open circuit.

3.6.1.3 Exclude

Exclude connects the Side A jack directly to the Ext A jack, and the Side B jack directly to the Ext B jack.

3.6.2 View Feet

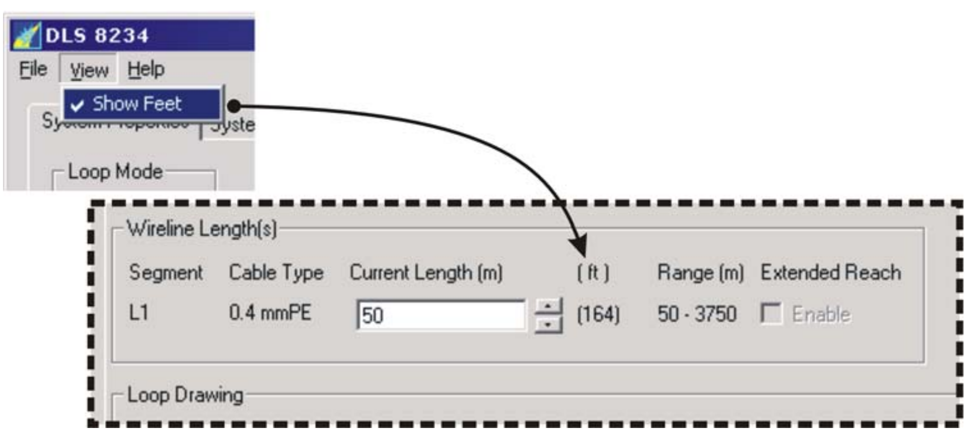


Figure 3-6 Viewing wireline length in feet and meters

You can view the wireline length in feet as well as meters by selecting the ***View >> Show Feet*** option.

The ***Current Length (m)*** field is still entered in meters. To the right of this field, the selected length is displayed in feet when the ***Show Feet*** option is selected.

3.6.3 Extended Reach

Extended reach allows you to extend the length of the wireline beyond the usual 3 750 meter maximum.

Extended reach can be engaged when the wireline length is set to between 3 705 and 3 750 meters. The external reach extension loop is inserted in the middle of the DLS–8234 wireline.

The rate adaptation functionality of VDSL2 can be tested by switching extended reach in or out of the wireline.

Use a DLS–414E as a reach extension system. As with real cable, extended reach increases the attenuation for frequencies above 4.5 MHz to a level that makes some VDSL2 modes inoperable. When using extended reach, the bandwidth of the wireline becomes DC - 4.5 MHz.

To enable extended reach:

Step 1: Select a loop length of between 3 705 and 3 750 meters. The ***Enable*** check box can now be selected.

Step 2: Select the ***Enable*** check box under ***Extended Reach***.

3.7 DLS–8234 Control and Information Tools

3.7.1 Advanced Settings and Information

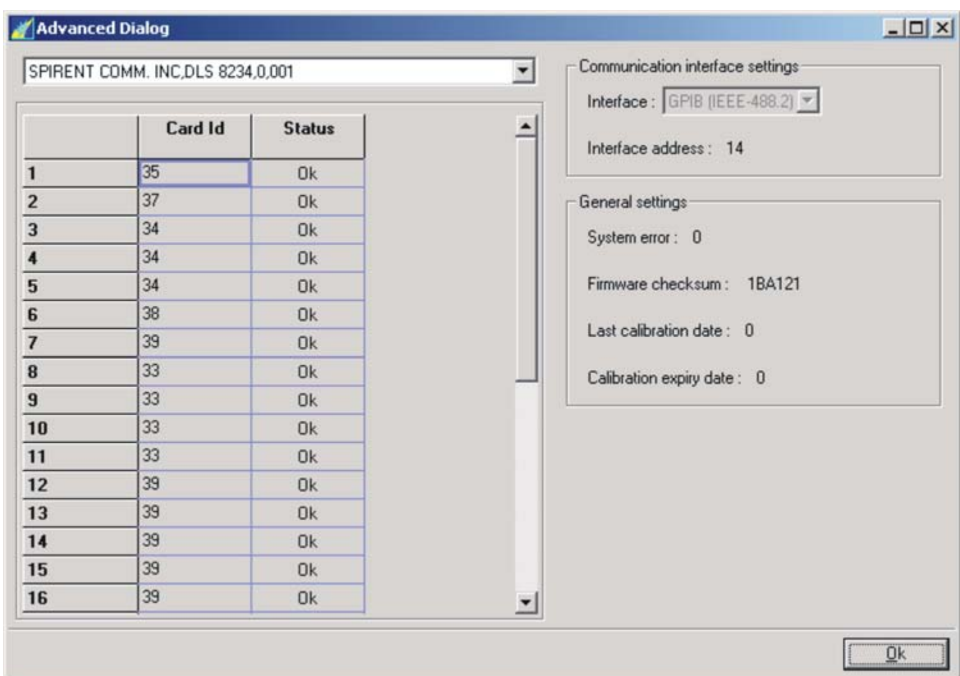


Figure 3-7 DLS–8234 Advanced Dialog property sheet

The *Advanced Dialog* property sheet gives more information about the DLS–8234, mainly to facilitate troubleshooting.

To open the *Advanced* dialog box, click the ***Advanced*** button at the right of the main application window.

NOTE

The advanced dialog property sheet can only be opened in "Online" mode.

A list of internal cards is listed along with the status of each card. All cards should indicate an **Ok** status.

NOTE

If any of the internal cards shows a status other than **Ok**, then there is a hardware fault. Contact your Spirent representative for assistance.

The **Communications Interface Settings** area displays information about the system's interface settings.

Interface

Displays the current interface type between the unit and the control computer. The field can display: GPIB (IEEE 488.2) or Serial.

Interface Address

Displays the GPIB address or COM port number.

The **General Settings** area displays information about the system.

System Error

Displays the results of the system self-check. "1" indicates an error; "0" indicates no error.

Firmware Checksum

Displays the firmware revision.

Last Calibration Date

Displays the date of the last calibration. When shipped this value is "0".

Calibration Expiry Date

Displays the due date for the next calibration. When shipped this value is "0".

3.7.2 DLS Terminal

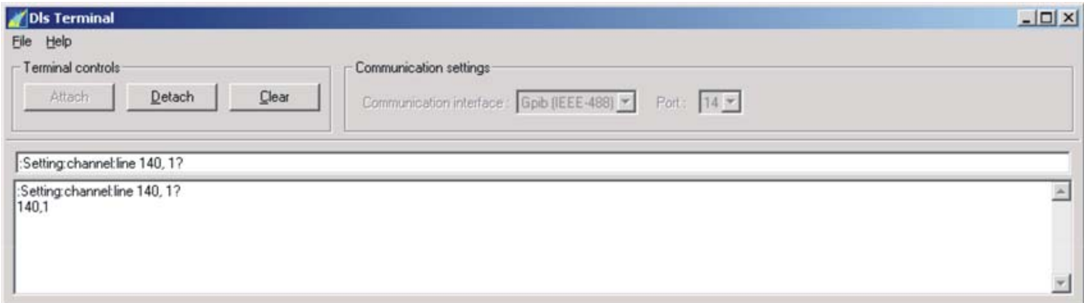


Figure 3-8 DLS Terminal Window

You can communicate directly with the DLS–8234 chassis using *DLS Terminal*. This is a separate application that sends the commands you type directly to the chassis, and displays the responses received from the chassis.

The DLS Terminal application can be installed when you install the DLS–8234 Control Application, or you can install it manually. The installation program is located in the ***DLS Terminal*** directory of the DLS–8234 software CD.

To use DLS Terminal:

Step 1: Start DLS Terminal by selecting ***Start >> Program Files >> Spirent Communications >> DLS Terminal >> DLS Terminal***. The *DLS Terminal* window will appear.

Step 2: Select the ***Communication interface*** for the chassis. Choices are **GPIB (IEEE-488.2)** or **Serial (RS-232)**.

Step 3: Select a ***Port*** for the communication interface from the drop-down list.

If **GPIB (IEEE-488.2)** was chosen for *Step 2*, select the GPIB address of the chassis you want to connect to.

If **Serial (RS-232)** was chosen for *Step 2*, select the COM port attached to the chassis you wan to connect to.

Step 4: Click the ***Attach*** button. DLS Terminal will connect to the DLS–8234.

Step 5: Type commands and queries in the command line. Responses will be displayed in the response pane. See *Chapter 5* for an explanation of DLS–8234 commands.

4. System Compensation

The system compensation function automates the measurement and calculation of compensated loop settings for the DLS–8234. This process produces a compensation file specific to each individual DLS–8234 system.

The general algorithm for a single loop is:

Step 1: Measure the loop attenuation for selected frequency range.

Step 2: Adjust the loop setting so that the Mean Absolute Error (MAE) between the measured attenuation and theoretical attenuation is minimized.

Step 3: Save these adjusted loop settings.

The compensated loop length settings are stored in a .csv file, and can be loaded by the DLS–8234 Control Application to make compensated loop settings. The .csv files can also be used in custom software for the same purpose. The system compensation function reports the mean error and mean absolute error for the loop.

A disk with the factory compensation data for the DLS–8234 is shipped with each unit.

4.1 Error Measurements

4.1.1 Mean Error Measurements

The mean error for loop attenuation is measured over a range of 50 kHz to 30 MHz. One measurement is taken every 50 kHz. If loop attenuation is higher than specified (too much attenuation), the mean attenuation error is represented by a positive value in dB. If loop attenuation is lower than specified (too little attenuation), the mean attenuation error is represented by a negative value in dB. Mean error of the loop simulator can be calculated as:

$$\mathrm{ME}_{\mathrm{loop\ X}} = \frac{1}{N} \sum_{i \in \{A_{Ti} \le Amax\mathrm{dB}\}} (A_{Ri} - A_{Ti})$$

Amax - see *Table 4-1*

A_{Ri} = Attenuation sample, in dB, of the measured loop X

A_{Ti} = Attenuation sample, in dB, of the theoretical loop X

N is the number of points necessary to measure the attenuation in increments of 50 kHz and taking into account only those points for which A_{Ti} <= AmaxdB.

Table 4-1 Amax settings for various frequency ranges

Amax (dB)	Frequency Range
90	50 kHz - 7.5 MHz
80	7.55 MHz to 15 MHz
70	15.05 MHz - 30 MHz

4.1.2 Mean Absolute Error Measurements

The theoretical MAE values are calculated from the RLCG parameters using two-port ABCD modelling methodology as specified in ETSI TS 101 388.

MAE is calculated as follows:

$$\mathrm{MAE}_{\text{loop X}} = \frac{1}{N} \sum_{i \in \{A_{Ti} \le Amax\mathrm{dB}\}} |A_{Ri} - A_{Ti}|$$

Amax - see *Table 4-1* in *Section 4.1* above.

A_{Ri} = Attenuation sample, in dB, of the measured loop X

A_{Ti} = Attenuation sample, in dB, of the theoretical loop X

N is the number of points necessary to measure the attenuation in increments of 50 kHz and taking into account only those points for which A_{Ti} <= AmaxdB.

4.2 Running a System Compensation Test

Periodic system compensation is highly recommended to maintain accuracy of the DLS–8234.

Figure 4-1 illustrates the compensation test set up.

4.2.1 Equipment and Connections

The following equipment is required to measure compensation values:

- One Agilent 4395A Spectrum/Network Analyzer
- Two Spirent 50 Ω to 100 Ω balun transformers (preferred, available as an optional accessory, part number DLS-8A14) or two North Hills 0301BB wideband transformers wired as shown in *Figure 4-2* on page 3.

Use the set-up shown in *Figure 4-1* when performing compensation tests. Balun transformer connection details are shown in *Figure 4-2*.

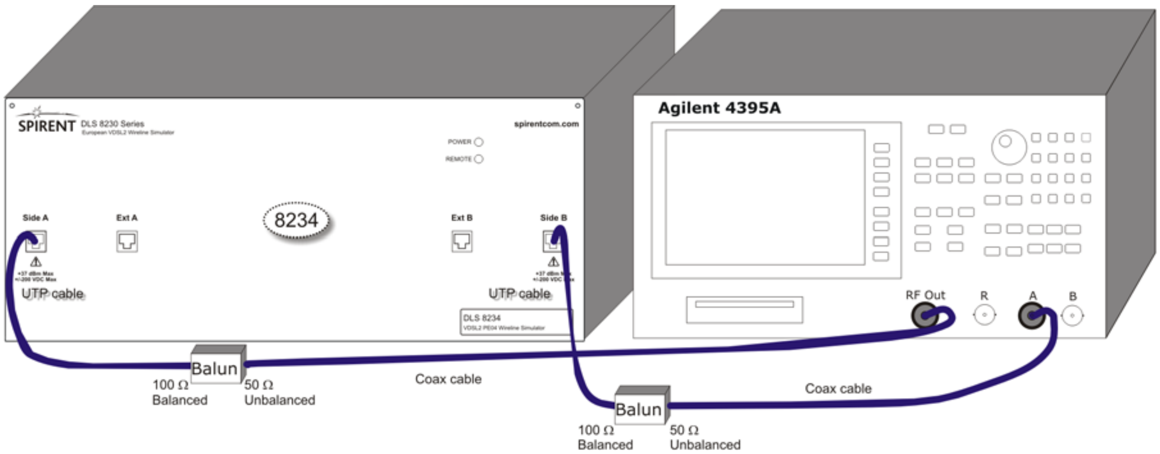


Figure 4-1 Equipment set-up for compensation test

The Agilent 4395A normalization process requires that the DLS–8234 is bypassed at one stage of the measurement procedure, as described in *Section 4.2.2 "Running a Compensation Test with the Control Application" on page 4-4*.

To bypass the DLS–8234, use the configuration illustrated in *Figure 3-8*.

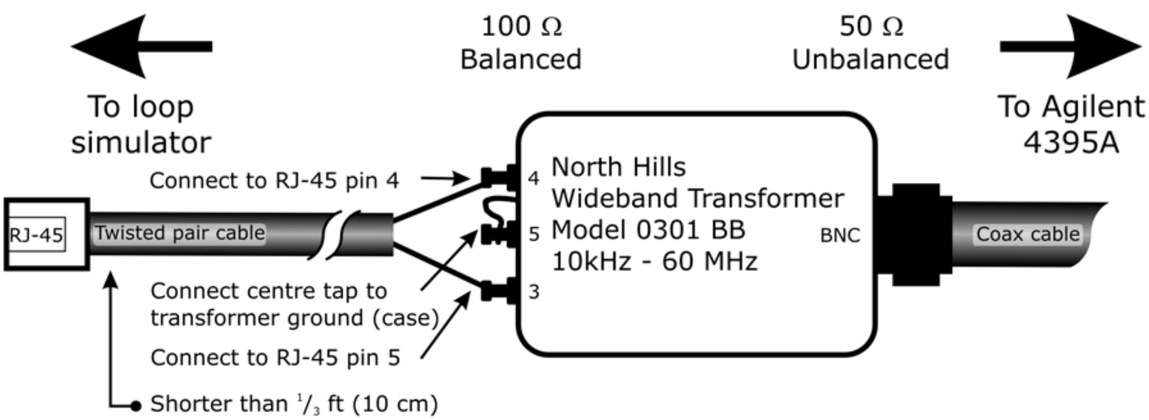


Figure 4-2 North Hills 50/100 ohm transformer, Model 0301 BB

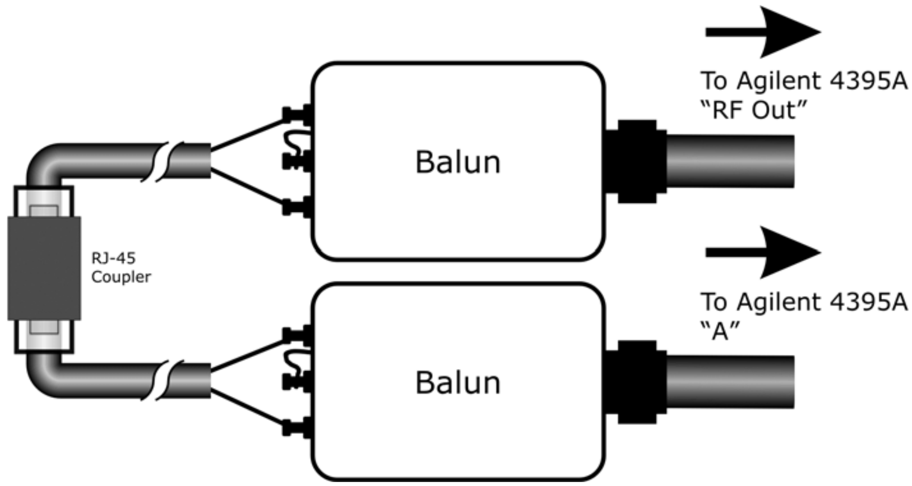


Figure 4-3 Bypass set-up for normalization

4.2.2 Running a Compensation Test with the Control Application

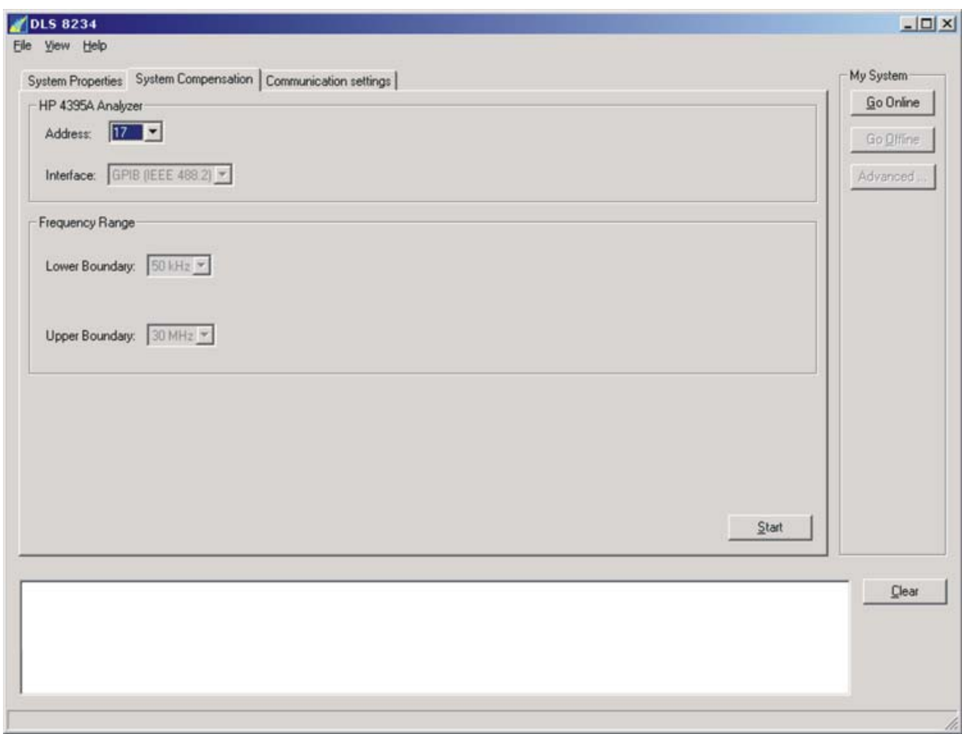


Figure 4-4 DLS–8234 Control Software - System Compensation Tab

After first setting up the DLS–8234 as shown in *Figure 3-6*, start the compensation procedure as follows:

Step 1: Ensure that the Agilent 4395A analyser is connected to the control computer with a GPIB cable.

Step 2: Select the ***System Compensation*** tab in the DLS–8234 Control Application.

Step 3: Ensure you are in “Offline” mode. If you are in “Online” mode, click the ***Go Offline*** button.

Step 4: Select the GPIB address of the Agilent 4395A analyzer in the ***Address*** drop-down box.

Step 5: Click the ***Start*** button.

NOTE

The DLS–8234 software must be **Offline** to run compensation.

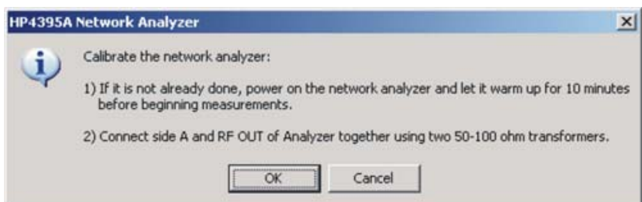


Figure 4-5 Network analyzer calibration instructions

Step 6: A dialogue box tells you to connect the 100 Ω sides of the baluns together so that the 4395A can run its normalization procedure (*Figure 4-5*). Bypass the DLS–8234 by connecting pins 3 and 4 of one transformer to pins 3 and 4 on the other transformer, as shown in *Figure 4-3*. When you have bypassed the DLS–8234, click the ***OK*** button. Normalization of the analyzer takes a few seconds.

Figure 4-6 Preparing loop compensation instructions

Step 7: When the Agilent 4395A normalization is complete, a dialogue box tells you to make appropriate connections for compensation measurements (*Figure 4-6*). Use *Figure 3-6* and *Figure 3-7* as a reference. When the connections have been made, click the ***OK*** button. The compensation process begins.

Step 8: Use the system compensation tab to set compensation parameters and start compensation measurements.

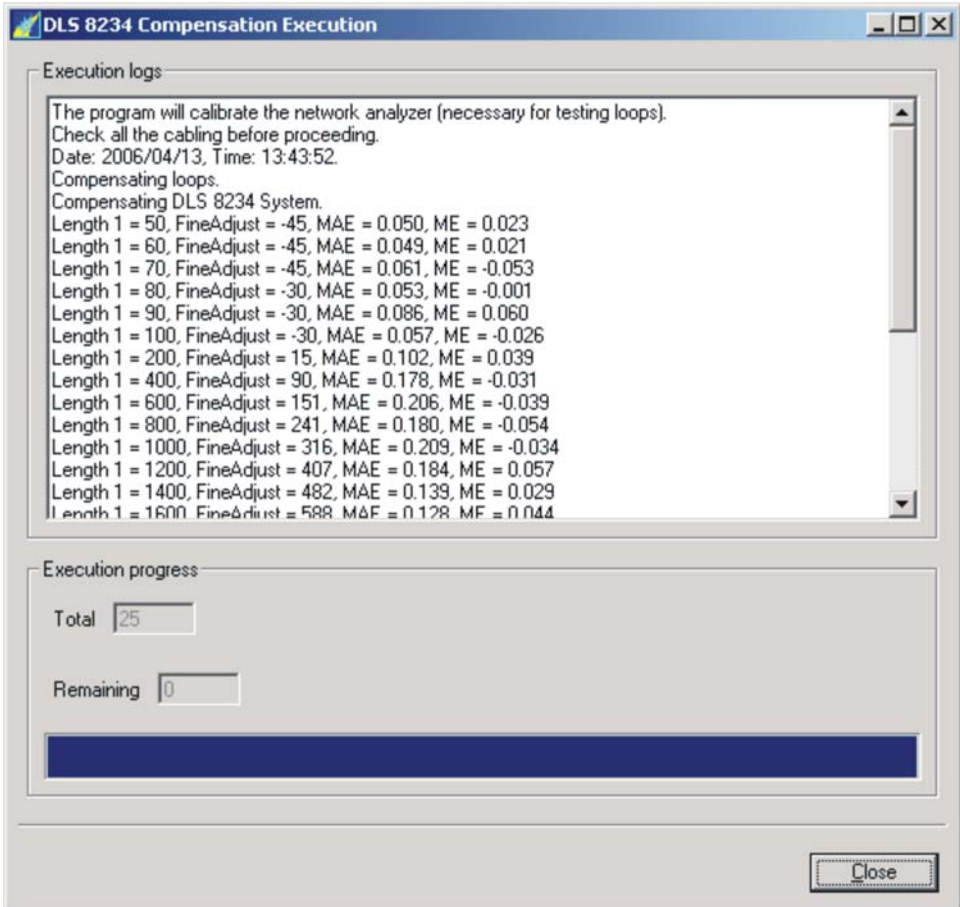


Figure 4-7 Compensation Execution Dialog Box

During compensation, the execution log will be displayed (*Figure 4-7*).

The compensation dialog will report the progress of the compensation, as well as the Mean Absolute Error (MAE) and Mean Error (ME) for the loop.

4.3 Compensation Results

Compensation results are saved to a file in the ***C:/Program Files/ Spirent Communications/DLS 8234/cust*** directory. The file is named as follows:

`DLS8234_nnnnnnn_YYYY_MM_DD-HH_QQ_SS-Cust.csv`

where:

nnnnnnn	is the serial number of the chassis
YYYY	is the year the test was started
MM	is the month the test was started
DD	is the day the test was started
HH	is the hour the test was started
QQ	is the minute the test was started
SS	is the second the test was started

NOTE

If the test was not run to completion, the file name will have "Incomplete" at the end of the file name. Incomplete files **cannot** be used by the DLS–8234 software for compensation.

5. Remote Control

The DLS–8234 is controlled via the GPIB (IEEE-488) or the RS-232 (serial) interface, allowing the integration of the DLS–8234 into a larger test system.

The DLS–8234 remote control is designed with several standards in mind:

- The GPIB physical interface follows IEEE 488.2. The functions implemented are outlined in the GPIB Interface section.
- The serial port physical interface follows the EIA RS-232 standard.
- The Common Commands follow IEEE 488.2.
- The Device Dependent Commands (see *Section 5.5 "Device Dependent Command Set" on page 5-6*) are based upon the Standard Commands for Programmable Interfaces (SCPI).

The GPIB and the serial interfaces are always enabled and either can be used. The DLS–8234 directs its output to the last interface from which it received data. Both interfaces use the same command set and produce the same results.

5.1 GPIB Interface

This section explains the GPIB (IEEE-488) interface. *Section 5.2 "RS-232 Serial Interface" on page 5-3* contains the information specific to the RS-232 interface.

5.1.1 Supported GPIB Control Units

The DLS–8234 installation directory does contain some libraries to communicate with the GPIB, and these libraries are specific to the Instruments GPIB controller, however you may choose to use other communication libraries.

5.1.2 Supported GPIB Interface Functions

The GPIB Interface functions supported by the DLS–8234 are as follows:

SH1	Source handshake - full capability
AH1	Acceptor handshake - full capability
T5	Basic talker - serial poll, untalk on MLA
L3	Basic listener - unlisten on MTA
SR1	Service request - full
DC1	Device clear - full
C4	Respond to SRQ
E1	Open Collector drivers
RL1	Remote Local - full

These represent the minimum required to implement the IEEE-488.2 standard.

5.1.3 GPIB Address

Each device on the GPIB bus must have a unique address. The DLS–8234 chassis can use any GPIB addresses between 1 and 31.

The factory setting for the DLS–8234 is Address 14.

5.1.4 Service Request (SRQ) Line

The SRQ line, as defined by the IEEE 488.2 standard, is raised when the DLS–8234 is requesting service. Here are some examples of services that could raise SRQ:

- a message is available in the output buffer
- an error has occurred
- all pending operations have been completed
- the power has been turned on

In order to use the SRQ line, the relevant enable bits must be set.

For example:

- the SRQ line can be raised automatically when there is a message available by enabling the MAV bit (bit 4) in the Status Byte Register with the command *SRE 16.
- the SRQ line can be raised automatically when there is an error by enabling the ESB bit (bit 5) in the Status Byte Register with *SRE 32 and by enabling the error bits in the Standard Event Status Register with *ESE 60 (bit 2, 3, 4 and 5).

NOTE

The Factory default is to clear all enable registers on power up. See *PSC, *ESE and *SRE commands for more details.

We recommend that you set the DLS–8234 to raise the SRQ line when there is a message available and when there is an error.

5.1.5 Example using the GPIB Interface

To send and receive messages with error checking:

Step 1: Set error bits (required only once)

Step 2: Send the message

Step 3: Wait for SRQ

Step 4: Read the Status Byte

Step 5: If MAV (bit 4) is set, then read the response

Step 6: If ESB (bit 5) is set, then read the Standard Event Status Register and take all the relevant actions.

For example, to get the identification message with the GPIB interface, do the following:

Table 5-1 Setting the ID message with GPIB

Action	Comment
transmit “*SRE 48”	enable MAV and ESB (needed only once)
transmit “*ESE 60”	enable all the error bits (needed only once)
transmit “*IDN?”	query the identification message
wait for SRQ to be raised	

Table 5-1 Setting the ID message with GPIB

read the status byte	use the IEEE 488.2 serial poll command, not *STB?
if MAV (bit 4) is set, read the response	
if ESB (bit 5) is set, do the following:	check if an error was detected
transmit “*ESR?”	query the Event Status Register
wait for SRQ to be raised	
if MAV (bit 4) is set, read the response and take all relevant action according to the error type received	

5.2 RS-232 Serial Interface

This section contains information specific to the RS-232 interface. *Section 5.1 "GPIB Interface" on page 5-1* contains the information specific to the IEEE 488 interface.

The system uses a female DB-25 connector, and is configured as a DCE device. It can be connected directly to your PC serial port.

Do **not** use a null modem with a computer that has a standard COM port configured as a DTE.

To use the RS-232 interface, connect the control computer to the DLS–8234 and configure the COM port as follows:

- **9600 bps baud rate**
- **No parity**
- **8 data bits per character**
- **1 stop bit**
- **CTS hardware flow control**

The RS-232 standard is equivalent to the European V.24/V.28 standards. In this manual we use the term RS-232 to refer to both of these standards. Generally, the computer literature uses the words “serial”, “COM1” and “COM2” to refer to the RS-232 interface. Note that the DLS–8234 cannot use the parallel port of a computer (the female connector).

The system stops transmitting data when the RTS line is low, and restarts when the RTS line is high. The DLS–8234 lowers the CTS and the DSR lines when it cannot accept data, and raises them when it can.

NOTE

The RTS line is not used. Leave the RTS line set and use only the CTS line.

Most serial port communication programs can be used to control the DLS–8234.

To use HyperTerminal:

Step 1: Select ***Start >> Programs >> Accessories >> HyperTerminal >> hypertrm.exe***. The program will start.

Step 2: Enter a name (for example; “DLS–8234”.)

Step 3: Select the port (for example; “Direct to COM1”).

Step 4: Enter the port settings: 9600, 8, none, 1 and hardware.

Step 5: Select ***File >> Properties >> Settings >> ASCII Setup***

Step 6: Enable “Send line ends with line feeds” and “Echo typed characters locally”

Step 7: Click **OK** twice. You should now be able to send and receive commands to and from the system.

5.2.1 Example using the RS-232 Interface

To send and receive messages with error checking follow these steps:

Step 1: Set error bits (required only once)

Step 2: Send the message

Step 3: Read the answer until you receive LF (decimal 10, hex 0A)

Step 4: Check if an error occurred with the command *ESR?

For example, to get the identification message with the RS-232 interface, do the following:

Table 5-2 Setting the ID message with RS-232

Action	Comment
transmit “*ESE 60”	enable all the error bits (needed only once)
transmit “*IDN?”	query the identification message
read the reply	the messages are always terminated with LF
transmit “*ESR?”	check if an error occurred
read the reply	if not 0, an error occurred, see Event Status Register (ESR) Section for a description of the error(s)

5.3 Data formats

This Section applies to both the GPIB and RS-232 interfaces.

The DLS–8234 adheres to the IEEE 488.2 principle of Forgiving Listening and Precise Talking.

The data formats supported by the DLS–8234 are:

Talking: a) <NR1> Numeric Response Data - Integer
b) Arbitrary ASCII Response Data

<NR1> is an implicit point representation of an integer (i.e. fixed format).

Arbitrary ASCII Response Data is a generic character string without any delimiting characters. It is usually used to send data in response to a query, such as with the *IDN? command.

Listening: <NRf> Decimal Numeric Program Data

<NRf> is the Flexible Numeric Representation defined in the IEEE.2 standard which can represent just about any number. For example, any of the following is a valid representation for -85.0 dBm: -85dbm,-85.0 dbm, -85, -85.0, -8.5e2. If a unit (i.e. dB, pps, mv, etc.) is appended to a number, that unit must be valid and not abbreviated. Note that the period separates the decimal part of a number.

5.3.1 Message Terminators

Messages to the DLS–8234 must be terminated with either a Line Feed character (ASCII <LF>, decimal 10, hex 0A), an IEEE 488.2 EOI signal, or both. Messages from the DLS–8234 are always terminated with a Line Feed character and the IEEE 488.2 EOI signal.

Some languages, such as BASIC, may automatically append a carriage return and a line feed at the end of messages.

The carriage return character is not a valid terminator, and will invalidate the last command.

To avoid this problem, you can append a semi-colon after a string (after the quotes) when printing to the GPIB port.

Another solution is to append a semi-colon to the end of the command itself (inside the quotes). The carriage return will be interpreted as a second command, and be simply discarded by the DLS–8234.

For example:

`PRINT #1, “:SETTING:CHANNEL:STATE?”+CHR$(10);` *Preferred solution*

– **or** –

`PRINT #1, “:SETTING:CHANNEL:STATE?;”` *Alternate solution*

5.4 Command Syntax

The DLS–8234 adheres to the IEEE 488.2 format for command syntax. As with the Data Format, the principle is Forgiving Listening and Precise Talking.

Commands may take one of two forms: either a *Device Dependent* Command or a *Common Command*. The format of the former is detailed in *Section 5.5 "Device Dependent Command Set"*, the format of the latter in *Section 5.6 "Common Command Set"*. Each type may be preceded by one or more spaces, and each must have one or more spaces between its mnemonic and the data associated with it.

Common commands are preceded by the character “*” (asterisk). Device Dependent commands are preceded by the character “:” (colon). Each level of a command is separated by a colon.

Commands can be in either upper or lower case. Multiple commands may be concatenated by separating each command with semi-colons.

The following are some examples:

```
*RST
*RST;*IDN;:SETTING:CHANNEL:STATE Normal
*ESE 45; *SRE 16
```

Messages sent to the DLS–8234 must be terminated with a Line Feed character (ASCII <LF>, decimal 10, hex 0A). Messages from the DLS–8234 are always terminated with a Line Feed character.

As defined in the SCPI specifications, a Device Dependent Command may be sent in its short form or long form, in upper or lower case. The following commands are therefore identical in operation:

```
:SETTING:CHANNEL:STATE Normal
:SET:CHAN:STA Normal
```

Note that the parameters cannot be shortened.

Queries to the system follow the same format as the commands, except that the data normally associated with a command is replaced by a question mark “?”. Following receipt of such a command, the DLS–8234 will place the appropriate response in the output queue, where the controller can read it.

Examples:

```
*IDN?
*ESE?;*SRE?
:SET:CHAN:STA?
```

5.5 Device Dependent Command Set

The DLS–8234 use the tree structure below, following the SCPI consortium recommendations, and other Spirent equipment:

```
:SETting
      :CHANnel
         :STAte <Normal|Bypass|Disconnect|Exclude>
         :LINe <N_Fine>,<N_Coarse>
         :Extend <On|Off>
:System
      :Reset
      :Error?
      :Calibration
         :date?
         :expiry?
```

Each section of the command may be sent in the full or the truncated form (indicated above in upper case). The command itself may be sent in upper or lower case form.

For more information see *Section 5.3 "Data formats"* and *Section 5.4 "Command Syntax"*.

Settings for all of these commands are stored in non-volatile RAM. When the unit is powered up, their values are restored to the same state as before the unit was powered down.

When shipped, the default settings are: **normal**, **length = 50**.

If an error is detected on the line cards during power-up, the power LED will be red.

5.5.1 System Check Commands

5.5.1.1 :System:Error?

This command is read-only and returns the overall status of the unit. The status is generated during boot up, and is also indicated by the Power LED.

If the return string is “0”, it means that there is no error. If the return string is “1”, it means that at least one card in the system is of the wrong type for the DLS–8234 VDSL2 Wireline Simulator.

5.5.1.2 :System:Calibration:date?

This command is read-only and returns the last date the unit was calibrated. The string is a maximum of 25 characters.

5.5.1.3 :System:Calibration:expiry?

This command is read-only and returns the date at which the unit should be next calibrated. The string is a maximum of 25 characters.

5.5.1.4 :SETting:CHANel:State<Normal|Bypass|Disconnect|Exclude>

Setting the channel state to ***Normal*** will allow reach settings made with the SETTING:CHANNEL:LINE command (*Section 5.5.1.5*) to change the length of the wireline.

Setting the channel state to ***Bypass*** will by-pass all line simulator cards in the DLS–8234 chassis. The DLS–8234 will behave like a zero-length wireline.

Setting the channel state to ***Disconnect*** will cause the DLS–8234 to behave like an open circuit.

Setting the channel state to ***Exclude*** connects Side A directly to Ext A, and Side B directly to Ext B.

For example, to set the state to bypass, send:

```
:SET:CHAN:STATE Bypass
```

WARNING

Do not interrupt the execution of this command. Use the *WAI or the *OPC command to ensure that this command is complete before issuing a subsequent command. See *Chapter 5.6 "Common Command Set"* for more details on the *WAI or *OPC command.

5.5.1.5 :SETting:CHANnel:LINe <N_Fine>,<N_Coarse>

The DLS–8234 Control Application uses the ***Dls8234_Length_Coefficient.csv*** file to determine the default (uncompensated) N_Fine and N_Coarse settings for the desired reach. If the DLS–8234 Control Application was installed in the default location, the .csv file is located in the C:\Program Files\Spirent Communications\DLS–8234 directory. *Table 5-3* provides a sample of N_Fine and N_Coarse values for various wireline lengths.

Compensated settings are obtained by using the compensated .csv file to determine N_Fine and N_Coarse settings.

The compensated .csv file is similar to the default .csv file, but there is header information included at the top of the file. This header information includes details such as the chassis serial number, and time and date that the compensation file was generated. When writing a script, it is up to you to verify that the compensation file matches the chassis you are controlling.

N_Fine and N_Coarse settings begin the line after “Segment Info”.

NOTE

Valid N_Fine values range between 0 and 279.
Valid N_Coarse values range between 1 and 265.

NOTE

See *Section 4.3 "Compensation Results" on page 4-7* for information about generating compensated reach settings.

Table 5-3 Some Reach Fine/Coarse Settings

Reach (m) (Column 3)	N_Fine (Column 4)	N_Coarse (Column 5)
50	85	1
75	226	2
100	150	4
500	75	31
1000	150	64
2000	75	131
3000	226	197

To determine the correct N-values, search for the reach in the third column of the .csv file. The fourth column contains N_Fine, the fifth column N_Coarse.

WARNING

Do not interrupt the execution of this command. Use the *WAI or the *OPC command to ensure that this command is complete before issuing a subsequent command. See *Chapter 5.6 "Common Command Set"* for more details on the *WAI or *OPC command.

Examples:

To set the length of the DLS–8234 to 100 meters, send:

```
:SET:CHAN:LINE 150, 4
```

To query the current setting, send:

```
:SET:CHAN:LINE?
```

The command will return the current N_Fine and N_Coarse settings. The returned message format is:

```
<N_Fine>,<N_Coarse>
```

5.5.2 :System:Reset

This command causes the system to reset.

Example:

```
:System:Reset
```

5.6 Common Command Set

A common command set, specified by the IEEE 488.2 standard, is used to set up and control the DLS–8234.

Some commands apply to the GPIB interface only. These are listed separately.

5.6.1 Serial and GPIB Interface Types

***CLS Clear Status Command**

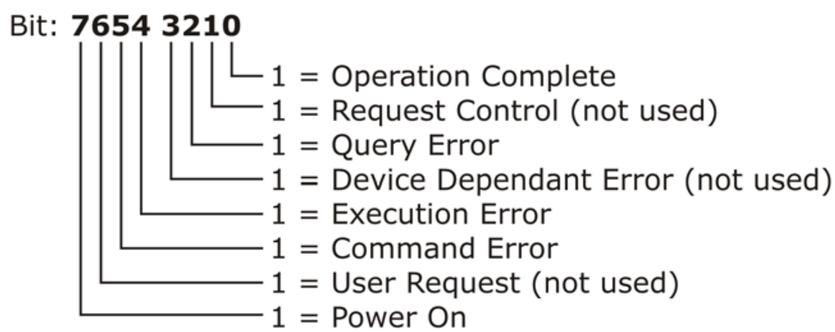
Type: Status command

Function: Clears the Event Status Register (ESR). Clearing the Event Status Register will also clear ESB, the bit 5 of the Status Byte Register (STB). It has no effect on the output queue (bit 4 of the STB).

***ESE <NRf> Event Status Enable**

Type: Status command

Function: Sets the Event Status Enable Register (ESER) using an integer value from 0 to 255, representing a sum of the bits in the following bit map:



Bits 7 to 0 have values of 128, 64, 32, 16, 8, 4, 2 and 1, respectively. For example, if bits 3 and 5 are set then the integer value is 40 (8+32).

The ESER masks which bits will be enabled in the Event Status Register (ESR).

On power-on, the register is cleared.

***ESR? Event Status Register Query**

Type: Status command

Function: An integer value between 0 and 255 representing the value of the Event Status Register (ESR) is placed in the output queue. Once the value is placed in the output queue, the register is cleared. The command will turn the REMOTE LED green if the LED was red. The possible values are described in the *ESE command section.

***IDN? Identification Query**

Type: System command

Function: Returns the ID of the unit. Upon receiving this command, the DLS–8234 will put the following string into the output queue:

```
SPIRENT COMM INC,<unit ID>,<SN>,<Ver>
```

where: <unit ID> is “DLS 8234”, <SN> is the serial number of the unit (i.e.: #######), <Ver> is the revision level of the control firmware (always 3 digits)

***RST Reset**

Type: Internal command

Function: IEEE 488.2 level 3 reset. This command cancel any pending *OPC operation. It will not affect the output buffer or other system settings of the unit. Note that this is NOT equivalent to the power-up reset and the IEEE 488.2 “Device Clear”.

5.6.2 GPIB Interface Only

***ESE?** **Event Status Enable Query**

Type: Status command

Function: An integer value between 0 and 255 representing the value of the Event Status Enable Register (ESER) is placed in the output queue. The possible values are described in the *ESE command section.

***OPC** **Operation Complete**

Type: Synchronization command

Function: Indicates to the controller when the current operation is complete. This command will cause the DLS–8234 to set bit 0 in the Event Status Register (ESR) when all pending operations are completed. The bit is read with the *ESR? command, which also clear the bit. Communication can proceed as normal after this command, but be prepared to receive SRQ at any time.

NOTE

The *OPC and *OPC? commands work with the GPIB interface only. If you are using an RS-232 interface, use a delay instead.

***OPC?** **Operation Complete Query**

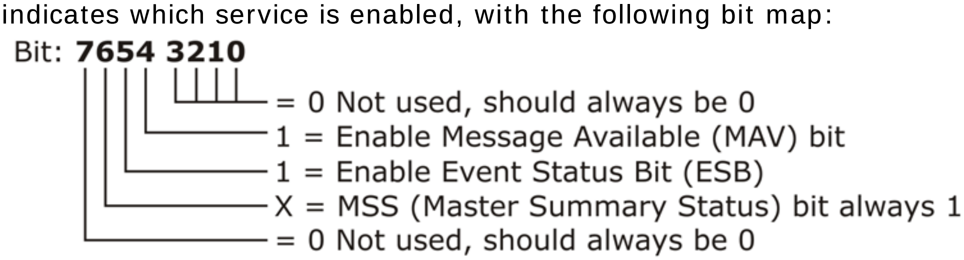
Type: Synchronization command

Function: Indicates when the current operation is complete. This will cause the DLS–8234 to put an ASCII 1 (decimal 49, hex 31) in the output queue when the current operation is complete. Communication can proceed as normal after this command, but be prepared to receive the “1” at any time.

***SRE <NRf>** **Service Request Enable**

Type: Status command

Function: Sets the Service Request Enable Register (SRER). An integer value indicates which service is enabled, with the following bit map:



Bits 7 to 0 have values of 128, 64, 32, 16, 8, 4, 2 and 1, respectively. For example, if bits 4 and 5 are set then the integer value is 48 (16+32).

Note that if both MAV and ESB are disabled, then the bits MSS and RQS and the line SRQ are never going to be raised.

On power-on, this register is cleared.

***SRE? Service Request Enable Query**

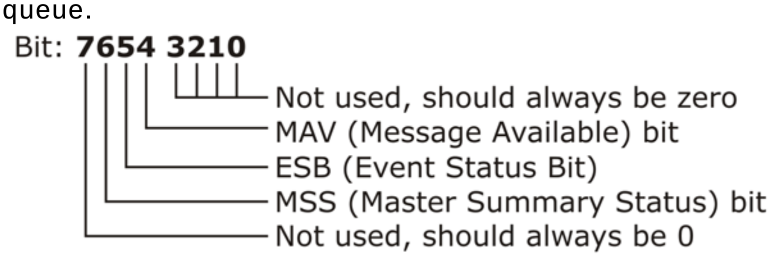
Type: Status command

Function: An integer value representing the value of the Service Request Enable Register is placed in the output queue. The possible values are listed in the *SRE command section.

***STB? Status Byte Query**

Type: Status command

Function: The value of the Status Byte Register is put into the output queue. Contrary to the "*ESR?" command, this register is not cleared by reading it. The register will be zero only when all its related structures are cleared, namely the Event Status Register (ESR) and the output queue.



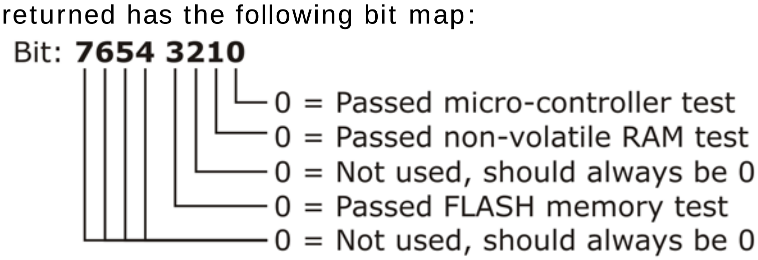
Bits 7 to 0 have values of 128, 64, 32, 16, 8, 4, 2 and 1, respectively. For example, if bits 3 and 5 are set then the integer value is 40 (8+32).

Note that bit 6 is MSS, which does not necessarily have the same value as RQS.

***TST? Self-Test Query**

Type: Internal command

Function: Returns the results of the self-test done at power up. The number returned has the following bit map:



Bits 7 to 0 have values of 128, 64, 32, 16, 8, 4, 2 and 1, respectively. For example, if bits 0 and 1 are set then the integer value is 3 (1+2).

***WAI Wait to continue**

Type: Synchronization command

Function: Used to delay execution of commands. The DLS–8234 will ensure that all commands received before "*WAI" are completed before processing any new commands. This means that all further communication with the DLS–8234 will be frozen until all pending operations are completed.

5.7 Status Reporting

The status reporting registers apply to the GPIB interface only.

There are two registers that record and report the system status, the Status Byte Register (STB), and the Event Status Register (ESR).

For both registers there are three basic commands: one to read the register, one to set the enabling bits, and one to read the enabling bits.

Table 5-4 Byte Register Commands

	Status Byte Register	Event Status Register
Read Register	*STB?	*ESR?
Set Enabling Bits	*SRE <NRf>	*ESE <NRf>
Read Enabling Bits	*SRE?	*ESE?

Where <NRf> is the new value of the register.

5.7.1 Status Byte Register (STB)

The bits of this register are mapped as follows:

bit 4: MAV (Message Available Bit)

Indicates that the Output Queue is not empty. If MAV goes high and is enabled then MSS goes high.

bit 5: ESB (Event Status Bit)

It indicates that at least one bit of the Event Status Register is non zero and enabled. If ESB goes high and is enabled then MSS goes high.

bit 6: MSS/RQS (Master Summary Status/Request Service)

MSS is raised when either MAV or ESB are raised and enabled. When the status of MSS changes, the whole Status Byte Register is copied into the Status Byte of the GPIB controller, where bit 6 is called RQS. When RQS goes high so does the SRQ line, and in response to an IEEE 488.2 Serial Poll command, both are cleared. RQS and SRQ are defined by the IEEE 488.2 standard and are hardware related. MSS summarizes all the status bits of the DLS–8234, as defined by the IEEE 488.2 standard.

bits 7, 3, 2, 1,and 0

These bits are not used by the DLS–8234.

5.7.2 Event Status Register (ESR)

The Event Status Register monitors events within the system and reports on those enabled. It records transitory events as well. The DLS–8234 implements only the IEEE 488.2 Standard Event Status Register (ESR). It is defined as:

bit 0 Operation Complete. This bit is set in response to the *OPC command when the current operation is complete.

bit 1 Request Control. The DLS–8234 does not have the ability to control the IEEE bus, and so this bit is always 0.

bit 2 Query Error. There was an attempt to read an empty output queue or there was an output queue overflow. (maximum output queue capacity is 75 bytes).

bit 3 Device Dependent Error. Not used, so this bit is always 0.

bit 4 Execution Error. The data associated with a command was out of range.

bit 5 Command Error. Either a syntax error (order of command words) or a semantic error (spelling of command words) has occurred.

bit 6 User Request. Indicates that the user has activated a Device Defined control through the front panel. Not used, so this bit is always 0.

bit 7 Power on. This bit is set when the DLS–8234 is turn on. Sending *ESR? clears the bit and stays clear until the power is turned on again.

The setting of the Event Status Register can be read with the Event Status Register query command (*ESR?). This will put the value of the register in the output queue, AND will clear the register.

5.8 Synchronizing to Commands

Some commands, notably the :Setting:Channel:State command and the :SETting:CHANnel:LINe <N_Fine>,<N_Coarse> command, must complete before the chassis receives the next command. The synchronization method depends on which interface is used.

5.8.1 GPIB Synchronization

The program controlling the DLS–8234 can use three different commands to synchronize with the DLS–8234: *OPC, *OPC? and *WAI. The main differences are:

Table 5-5 Synchronization Commands

	Set Operation Complete bit when Done	Return “1” when operation complete	Raise SRQ when operation complete	Block comm. with the DLS–8234	Required Enable Bit(s)
***OPC**	Yes	No	Yes[1]	No	Operation Complete, ESB
***OPC?**	No	Yes	Yes[2]	No	MAV
***WAI**	No	No	No	Yes	none

1. if “Operation Complete” and ESB are enabled
2. if MAV is enabled

The main difference between OPC and WAI is that WAI will block any further communication with the DLS–8234 until all pending operations are completed.

The main difference between *OPC and *OPC? is that *OPC sets the “Operation Complete” bit, and *OPC? will return an ASCII “1” when all pending operations are completed.

Make sure that all the required enable bits are set.

When using *OPC or *OPC?, the program controlling the DLS–8234 can determine when the operation is completed by waiting for SRQ, or by reading the status byte with the serial poll or with *STB? (if corresponding bits are enabled).

If the program uses the *OPC? command and then sends more queries, the program must be ready to receive the “1” concatenated to other responses at any time. When using *WAI, the communication time out should be set long enough to avoid losing data (the DLS–8234 needs approximately 2 seconds to set a line segment length).

5.8.2 RS-232 Synchronization

When the DLS–8234 is connected with an RS-232 interface, the *OPC and *OPC? commands are not available (as they are with the GPIB interface).

Insert a delay following commands sent to the DLS–8234 when using the RS-232 interface to ensure they have completed before sending the next command.

The following guidelines suggest the delay to insert between set-type commands and the next command:

- Wait 100 ms after sending a :Setting:Channel:State command.
- Wait 2 000 ms after sending a :SETting:CHANnel:LINe <N_Fine>,<N_Coarse> command.

6. References

- IEEE 488.1-1987, IEEE Standard Digital Interface for Programmable Instrumentation (The Institute of Electrical and Electronics Engineers, Inc. 345 East 47th Street, New York, NY 10017-2394, USA)
- IEEE 488.2-1992, IEEE Standard Codes, Formats, Protocols, and Common Commands (The Institute of Electrical and Electronics Engineers, Inc. 345 East 47th Street, New York, NY 10017-2394, USA)
- SCPI Standard Commands for Programmable Instruments, available from some interface controller manufacturers (SCPI Consortium, 8380 Hercules Drive, Suite P.S., La Mesa, CA 91942, Phone: (619) 697-8790, Fax: (619) 697-5955)
- ITU-T Recommendation G.992.5 (ADSL2plus) (International Telecommunication Union, Place des Nations, CH1211 Geneva 20, Switzerland)
- ANSI T1.417 Spectrum Alignment for Loop Transmission Systems (American National Standards Institute, 11 West 42nd Street, New York, NY 10036, USA)
- ETSI TS 101 270-1 V2.0.1 (2003-05)
- ETSI TS 101 388 V1.3.1 (2002-03)

7. Support Services

7.1 Support Services Contact Information

If you have any questions or concerns regarding the operation of a purchased unit, you can contact Spirent Communications through the Customer Service Center (CSC) website at:

http://support.spirentcom.com

You can also reach the Spirent Communications Support Service department by telephone, fax or email:

Toll Free:	(800) SPIRENT (774-7368) - North America only
Telephone:	+1 (613) 592-7301
Fax:	+1 (613) 592-0522
Email:	ae.service@spirentcom.com

The most recently published user manuals, application notes, software and firmware updates are available on the CSC website.

7.2 Protecting Your Investment

Spirent Communications is committed to providing the highest quality products and customer support possible. An annual calibration is required to ensure that your unit is operating properly.

Spirent Communications is pleased to offer two cost effective optional service programs. Each of these programs is designed to improve the ease and efficiency of servicing Spirent Communications test equipment.

Extended Warranty

The Spirent Communications Extended Warranty gives two years in addition to the original Standard manufacturer's warranty (typically 1 year). Under the warranty agreement, Spirent Communications repairs any covered product that needs service during the warranty period. At the time of repair, any required firmware and/or software upgrades are installed free of charge and if required as part of the repair, the unit receives a complete calibration. Spirent Communications also provides return shipment of any unit covered under warranty at Spirent Communications's cost.

The Extended Warranty gives:

- Extension of the original one-year limited warranty by two years (giving a total warranty coverage of three years).
- Required firmware and software upgrades installed free at time of repair.
- If required because of a repair, free calibration due to repair during the coverage period.
- Prepaid, return shipment of repaired products worldwide.

Spirent Communications' Extended Warranty can be purchased at any time up until the expiration of the original one-year manufacturer's warranty.

Three-Year Calibration Agreement

Spirent Communications' three-year calibration agreement gives the opportunity to invest in a yearly calibration for three years at a significant cost saving, ensuring optimum product performance.

Specific Spirent Communications products are shipped with a National Institute of Standards and Technology (N.I.S.T.) traceable calibration that expires one year from the original ship date. With ISO-9000 and other manufacturer specific metrology requirements, timely calibrations become critical to your operations. A report containing all calibration data is shipped with the product.

The Spirent Communications's three-year calibration agreement gives:

- Three yearly N.I.S.T traceable calibrations (one per year).
- Notification from Spirent Communications when calibration is due.
- Calibration data report.
- Prepaid return shipment of calibrated unit worldwide.
- The Spirent Communications' three-year calibration agreement may be purchased at any time.

Please contact the Spirent Communications Support Services Department for more information on these programs, or visit us on the web at **support.spirentcom.com**

8. Warranty

Spirent Communications warrants all equipment bearing its nameplate to be free from defects in workmanship and materials, during normal use and service, for a period of twelve (12) months from the date of shipment.

In the event that a defect in any such equipment arises within the warranty period, it shall be the responsibility of the customer to return the equipment by prepaid transportation to a Spirent Communications service centre prior to the expiration of the warranty period for the purpose of allowing Spirent Communications to inspect and repair the equipment.

If inspection by Spirent Communications discloses a defect in workmanship or material it shall, at its option, repair or replace the equipment without cost to the customer and return it to the customer by the least expensive mode of transportation, the cost of which shall be prepaid by Spirent Communications.

In no event shall this warranty apply to equipment which has been modified without the written authorization of Spirent Communications, or which has been subjected to abuse, neglect, accident or improper application. If inspection by Spirent Communications discloses that the repairs required are not covered under this warranty, the regular repair charges shall apply to any repairs made to the equipment.

For information about how to contact Spirent Communications about a warranty issue, see *Section 7.1 "Support Services Contact Information" on page 7-1*.

This warranty constitutes the only warranty applicable to the equipment sold by Spirent Communications, and no other warranty or condition, statutory or otherwise, expressed or implied, shall be imposed upon Spirent Communications nor shall any representation made by any person, including a representation by a representative or agent of Spirent Communications, be effective to extend the warranty coverage provided herein.

In no event (including, but not limited to the negligence of Spirent Communications, its agents or employees) shall Spirent Communications be liable for special consequential damages or damages arising from the loss of use of the equipment, and on the expiration of the warranty period all liability of Spirent Communications whatsoever in connection with the equipment shall terminate.

8.1 Comprehensive Three-Month Replacement Plan

In the case where any warranty issue is discovered within 90 days from the date of shipment from the factory, you will be covered by the Comprehensive Three-Month Replacement Plan.

Spirent communications will ship a new unit to you in advance of receiving the defective unit, and will cover the cost of shipping of the replacement unit.

Be sure to ask specifically for advance replacement of the unit. This is to ensure that import/export customs clearance is processed correctly. This plan is not appropriate in situations where your inventory system requires that you maintain the serial number of the originally purchased equipment.

To take advantage of this plan, contact Spirent Communications (as described in *Chapter 7 "Support Services"*). You will receive an Return Material Authorization (RMA) number from Spirent Communications. Return the unit to Spirent Communications as instructed by the Support Services Department.

This comprehensive replacement plan covers new units only. Refurbished and demo units are excluded from this plan.

You are responsible for the cost of shipping the returned unit. Returned units will not be accepted without an RMA number.

9. Shipping The Unit

To prepare the unit for shipment, turn the power off, disconnect all cables (including the power cable) and pack the simulators in their original cartons. Do not place any cables or accessories directly against the front panel as this may scratch the surface of the unit. It is highly recommended that all shipments are marked with labels indicating that the contents are fragile.

If sending a unit back to the factory, ensure that the Return Material Authorization (RMA) number given by the Spirent Communications Support Services department is shown on the outside.

The RMA number is mandatory and must be obtained from a Spirent Communications Customer Service Center before shipping the unit (see Section 7 "Support Services" for details on how to contact the nearest Spirent Communications Customer Service Center).

10. Specifications

10.1 VDSL2 Wireline Simulator Specifications

Technology	Cable simulation using passive circuits.
Type of Wire	PE04 twisted pair .
Number of Conductors	Two (single pair).
Standard	ETSI TS 101 388
Simulated Loop	PE04 Loop (0; 50 to 3 750 meters in 5 meter increments). Can be extended with an external wireline simulator.
Bandwidth	DC to 30 MHz continuous frequency response.
Attenuation	Smooth from 0 to -90dB over the DC to 30MHz bandwidth.
Attenuation Accuracy	Max. MAE ≤0.5dB after compensation as per table:

Amax (dB)	Frequency Range
90	50 kHz - 7.5 MHz
80	7.55 MHz to 15 MHz
70	15.05 MHz - 30 MHz

DC Resistance	typically better than ± 10%
Impedance	typically better than ± 10%
Group Delay	typically better than ± 5%
Noise Floor	≤ -150 dBm/Hz typical
DC Rating	± 200 V between tip and ring or tip/ring and ground. The maximum current is 125 mA (150 mA peak).
Power Supply	140 VA max: 100-240 VAC (50-60 Hz)
Fuses	Type ‘T’ 2A/250V Slow Blow (2 required, 5mm x 20mm)

Environmental:

Operating Temperature	+10ºC to +40ºC (50ºF to 104ºF)
Storage Temperature	-20° C to +70° C (-4° F to 158° F)
Humidity	90% (non-condensing) max.

Mechanical

Weight per Chassis	28 kg. (61 lbs) max.
Dimensions per Chassis	194 mm x 452 mm x 494 mm (H x W x D) (7.6" x 17.8" x 19.4")

GPIB (IEEE-488) Remote Control

RS-232 Remote Control

System

- DLS–8234 chassis
- 1 power cord
- 2 extra fuses
- 1 9 to 25 pin adapter (RS-232)
- 1 RS–232C inter-connection cable
- 1 GPIB inter-connection cable
- 1 GPIB reverse entry extender
- 2 RJ45 interconnect cables - 30 cm (1 foot) long, Spirent part number 7102040514
- 1 DLS–8234 Software CD
- 1 Operating Manual CD
- 1 diskette containing compensation settings specific to the shipped unit.

Associated Products

- National Instruments GPIB card (for the controlling PC)
- DLS–5500EV VDSL2 Noise Generation System (external)
- DLS–414E (for reach extension)
- DLS–5405 VDSL2 Noise Injector

10.2 Operating Conditions

In order for the unit to operate correctly and safely, it must be adequately ventilated. The DLS–8234 simulator contains ventilation holes for cooling. Do not install the equipment in any location where the ventilation is blocked. For optimum performance, the equipment must be operated in a location that provides at least 10 mm of clearance from the ventilation holes. Blocking the air circulation around the equipment may cause the equipment to overheat, compromising its reliability.

11. Safety

11.1 Information

11.1.1 Protective Grounding (Earthing)

This unit consists of an exposed metal chassis that must connect directly to a ground (earth) via a protective grounding conductor in the power cord. The symbol used to indicate a protective grounding conductor terminal in the equipment is shown in this section under “symbols”.

11.1.2 Before Operating the Unit

- Inspect the equipment for any signs of damage, and read this manual thoroughly.
- Become familiar with all safety symbols and instructions in this manual to ensure that the equipment is used and maintained safely.

WARNING

To avoid risk of injury or death, ALWAYS observe the following precautions before operating the unit:

- Use only a power supply cord with a protective grounding terminal.
- Connect the power supply cord only to a power outlet equipped with a protective earth contact. Never connect to an extension cord that is not equipped with this feature.
- Do not wilfully interrupt the protective earth connection.
- The protective conductor terminal must be attached to the mains supply earth.

CAUTION

When lifting or moving the unit, be careful not to apply any pressure to the plastic grid which is located on the bottom of the chassis, toward the front right corner. Lift the chassis by gripping it on both sides at the bottom, ensuring not to touch the plastic grid.

11.1.3 Power Supply Requirements

The unit can operate from any single phase AC power source that supplies between 100V and 240V (±10%) at a frequency range of 50 Hz to 60 Hz.

WARNING

To avoid electrical shock, do not operate the equipment if it shows any sign of damage to any portion of its exterior surface, such as the outer casting or panels.

11.1.4 Fuses

The fuse type used is specified in the specifications chapter of this manual.

11.1.5 Connections to a Power Supply

In accordance with international safety standards, the unit uses a three-wire power supply cord. When connected to an appropriate AC power receptacle, this cord grounds the equipment chassis.

11.1.6 Operating Environment

To prevent potential fire or shock hazard, do not expose the equipment to any source of excessive moisture.

11.1.7 Class of Equipment

The simulator consists of an exposed metal chassis that is connected directly to earth via the power supply cord. In accordance with HARMONIZED EUROPEAN STANDARD EN 61010-1:1993, it is classified as Safety Class I equipment.

WARNING

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

11.2 Instructions

The following safety instructions must be observed whenever the unit is operated, serviced or repaired. Failing to comply with any of these instructions or with any precaution or warning contained in the Operating Manual is in direct violation of the standards of design, manufacture and intended use of the equipment.

Spirent assumes no liability for the customer’s failure to comply with any of these requirements.

11.2.1 Before Operating the Unit

- Inspect the equipment for any signs of damage, and read the Operating Manual thoroughly.
- Install the equipment as specified in the relevant section of this manual.
- Ensure that the equipment and any devices or cords connected to it are properly grounded.

WARNING

The maximum signal between Tip and Ring must not exceed ±200 V. The maximum current is 125 mA. Exceeding these limits could damage the unit.

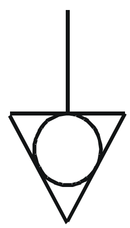
11.2.2 Operating the Unit

- Do not operate the equipment when its covers or panels have been removed.
- Do not interrupt the protective grounding connection. Any such action can lead to a potential shock hazard that could result in serious personal injury.
- Do not operate equipment if an interruption to the protective grounding is suspected. Ensure that the instrument remains inoperative.
- Use only the type of fuse specified.
- Do not use repaired fuses and avoid any situation that could short circuit the fuse.

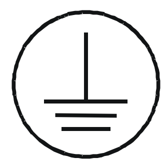
- Unless absolutely necessary, do not attempt to adjust or perform any maintenance or repair procedure when the equipment is opened and connected to a power source at the same time. Any such procedure should only be performed by a qualified service professional.
- Do not attempt any adjustment, maintenance or repair procedure to the equipment if first aid is not accessible.
- Disconnect the power supply cord from the equipment before adding or removing any components.
- Do not operate the equipment in the presence of flammable gases or fumes.
- Do not perform any operating or maintenance procedure that is not described in the Operating Manual.
- Some of the equipment's capacitors may be charged even when the equipment is not connected the power source.

11.3 Symbols

When any of these symbols appear on the unit, this is their meaning:



EQUIPOTENTIALITY–FUNCTIONAL EARTH TERMINAL



PROTECTIVE GROUNDING CONDUCTOR TERMINAL

CAUTION - REFER TO ACCOMPANYING DOCUMENTS

Appendix A: Measurements

A.1 DLS–8234 Measurements

Data for the characteristics of the cables were obtained from the ETSI TS 101 388 document. Data for this type of cable are specified in terms of resistance, inductance, capacitance and conductance per meter or foot of wireline as it varies with frequency.

When measuring the insertion loss of a balanced line or line simulator throughout the VDSL2 frequency domain, the following method is recommended:

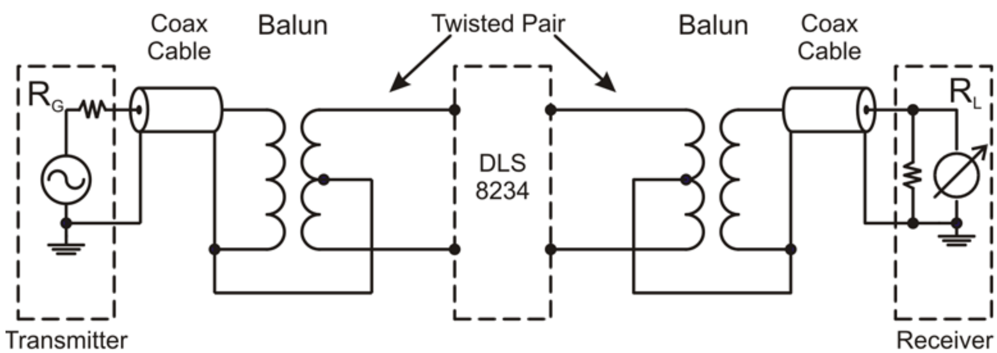


Figure A-1 DLS–8234 Electrical Characteristics Measurements

Transformers and cables introduce attenuation and phase errors. For accurate measurements, first perform calibration (normalization) by eliminating the simulator with a direct connection.

We recommend that you use two Spirent 50 Ω to 100 Ω balun transformers (available as an optional accessory, part number DLS-8A14). It is also possible to use two North Hills 0301BB wideband transformers wired as shown in *Figure 4-2 on page 4-3*

WARNING

Applying unbalanced signals to the DLS–8234 will usually result in incorrect measurements.

NOTE

The above method and schematic apply only to the DLS–8234 VDSL2 Wireline Simulator.

Figure A-2 "Test Setup" shows an example of one test setup option.

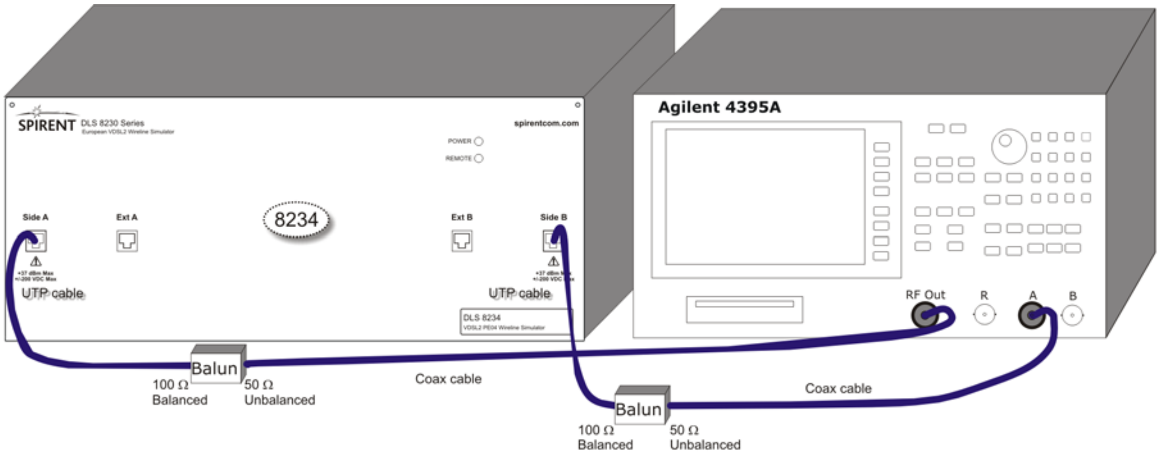


Figure A-2 Test Setup

A.2 Common Errors

Four errors are commonly encountered when making test measurements:

1) **Coupling between input and output via the two transformers**. When trying to measure attenuations of 60 dB or so, approximately 1/1000 of the input voltage (1/1000000 of the input power) is present on the output. It is quite likely that transformers - or even wires - placed close to each other will couple together far more than this. Take care to keep inputs and outputs well separated.
2) The use of a **high impedance measuring device with no load** from tip to ring at the receive end. This results in reflections due to a mismatch at the end of the line, resulting in very peculiar response curves.
3) **Ground injected directly to the tip or ring** of the wireline simulator. This almost always leads to a very noisy spectrum, with high background noise levels and often harmonically related spectrum “spikes”.
4) **Ground loops** may occur if the network analyzer and the wireline simulator are not plugged in to the same wall socket. To avoid this problem, plug all components in the wireline simulation system and the network analyzer into the same power bar.

Appendix B: Sample Test Results

The following graphs show theoretical vs measured electrical characteristics in graphical format for several DLS–8234 test results:

- Insertion loose
- Group delay
- Input impedance

Calculated and measured values for all parameters have been performed with 100 Ω terminations.

B.1 100 Meters

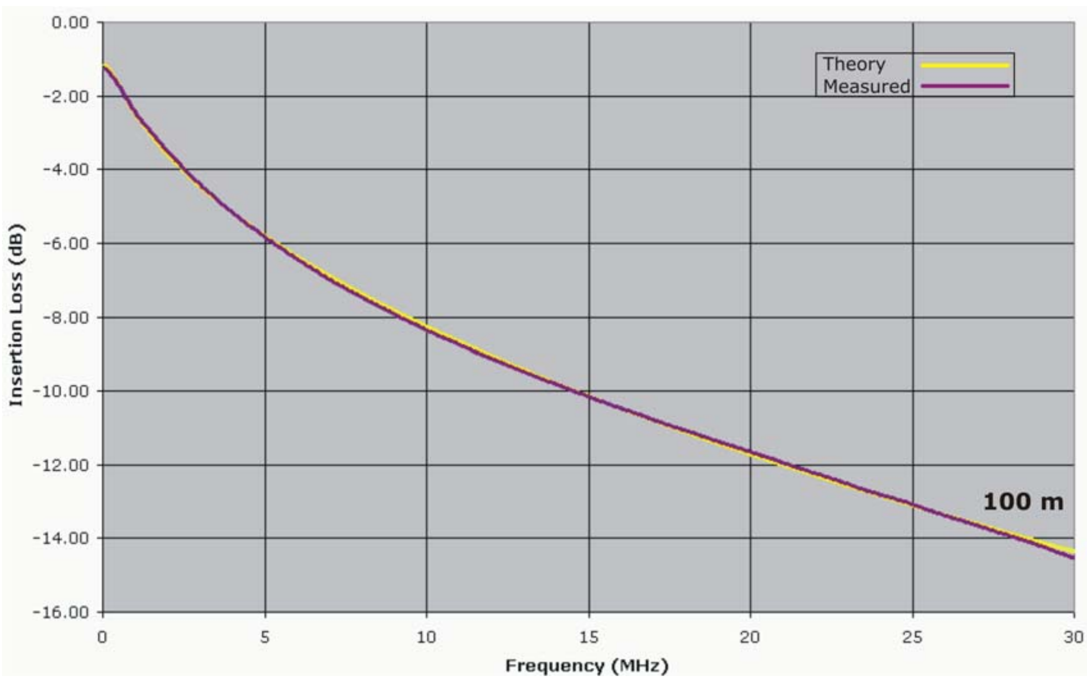


Figure B-1 Insertion loss at 100m

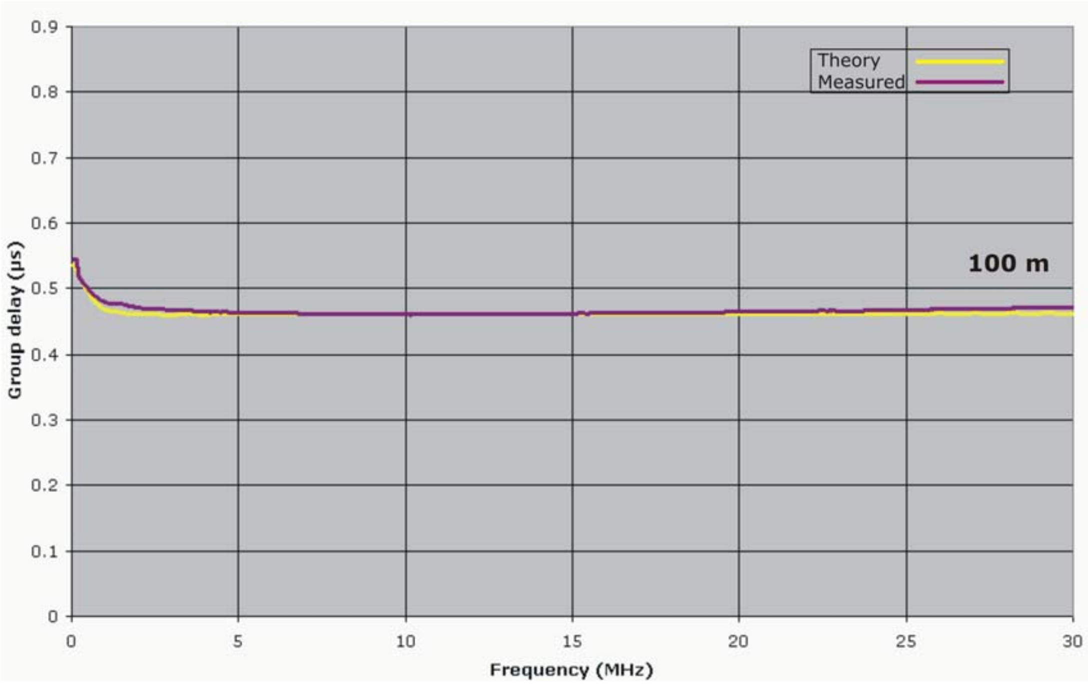


Figure B-2 Group delay at 100m

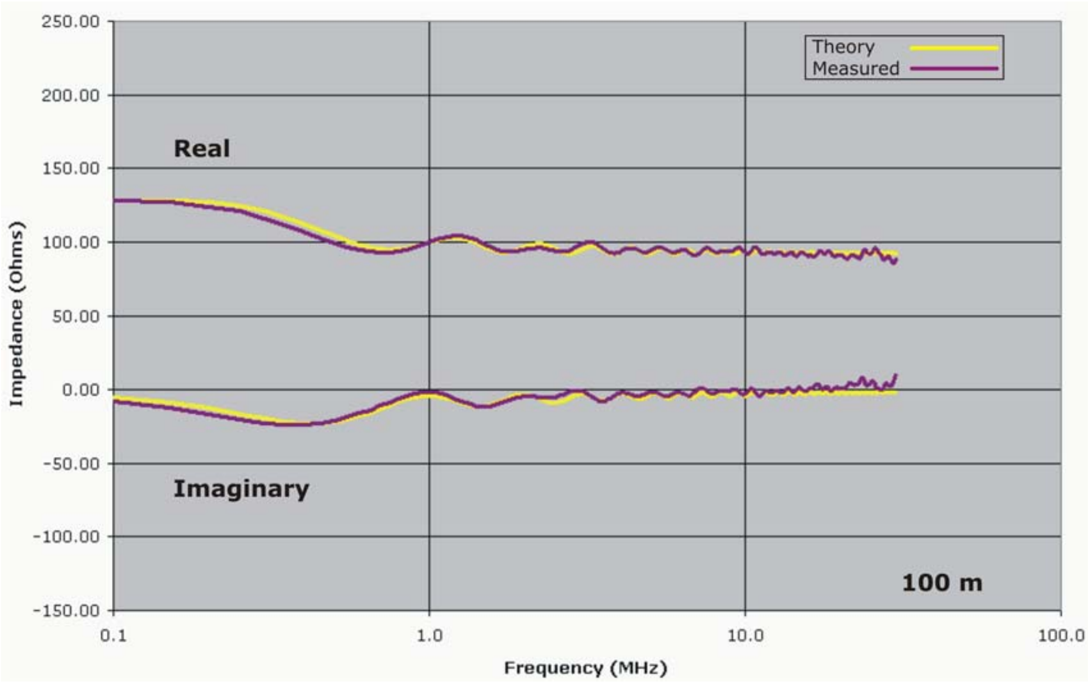


Figure B-3 Impedance at 100m

B.2 500 Meters

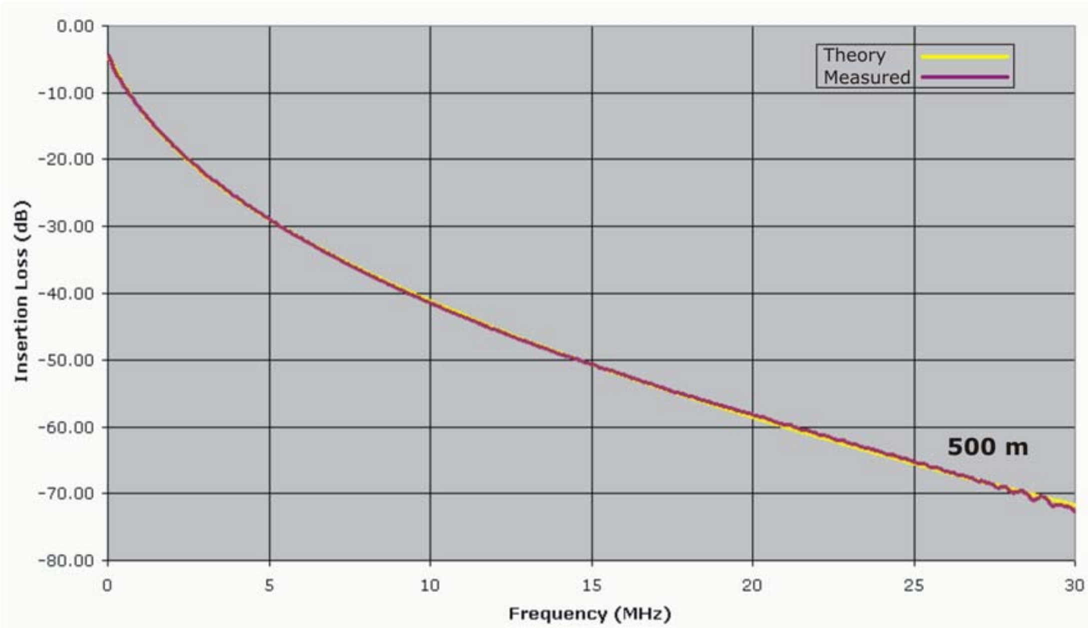


Figure B-4 Insertion loss at 500m

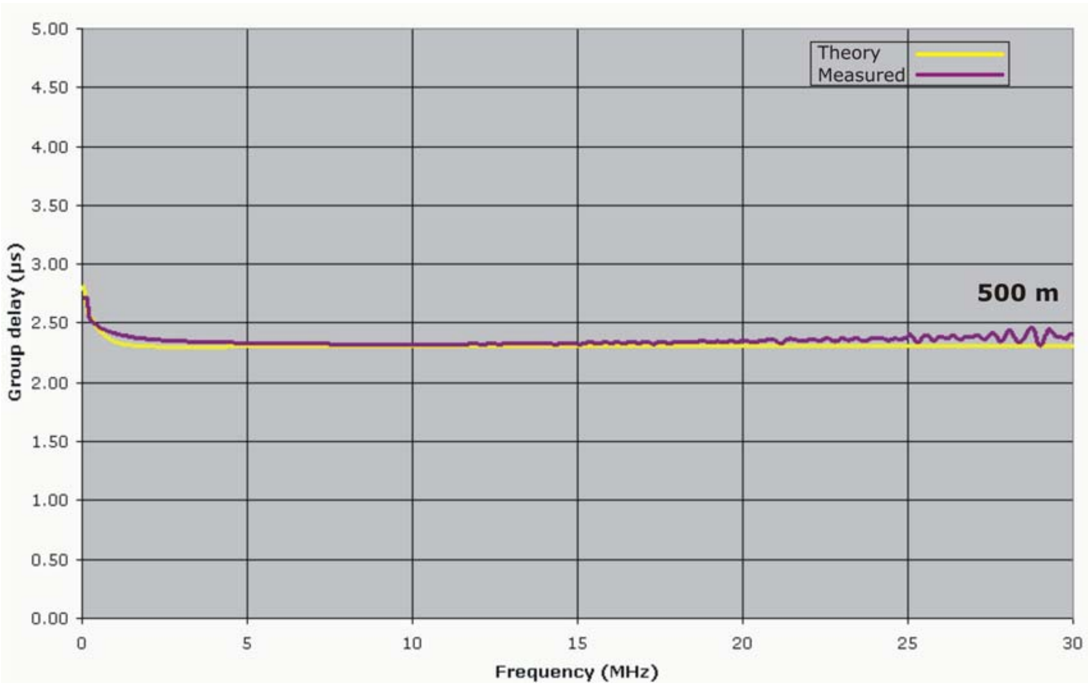


Figure B-5 Group delay at 500m

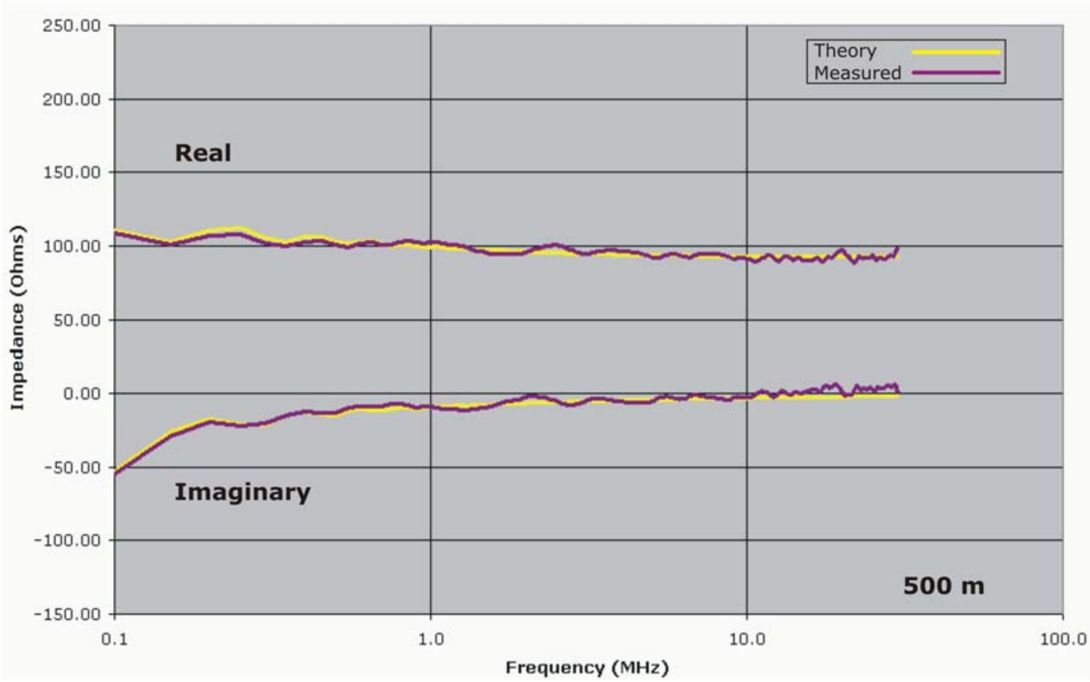


Figure B-6 Impedance at 500m

B.3 1000 Meters

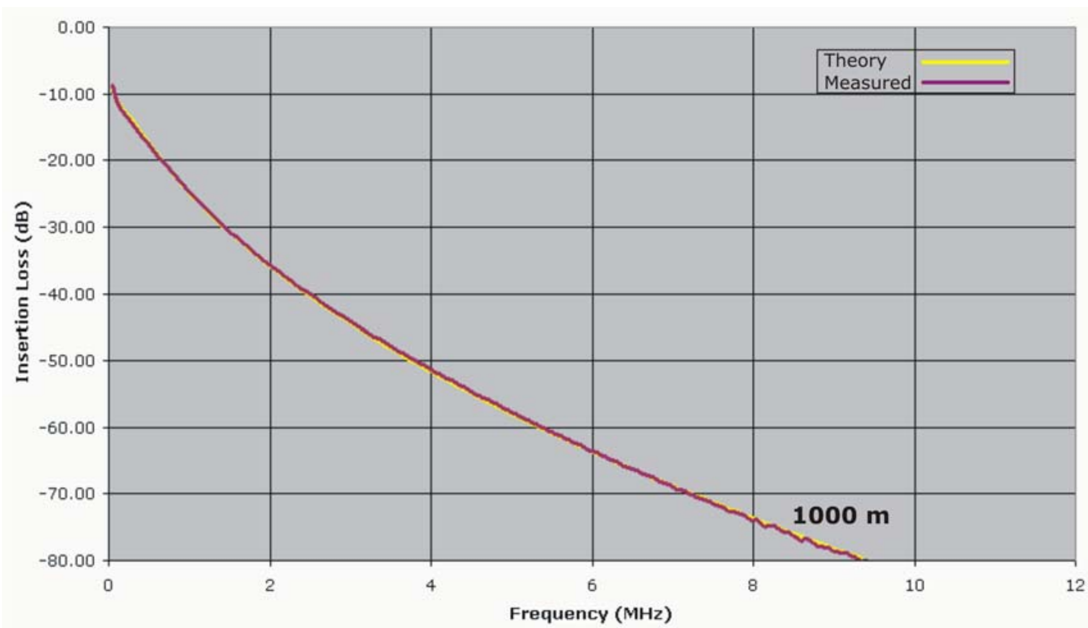


Figure B-7 Insertion loss at 1000m

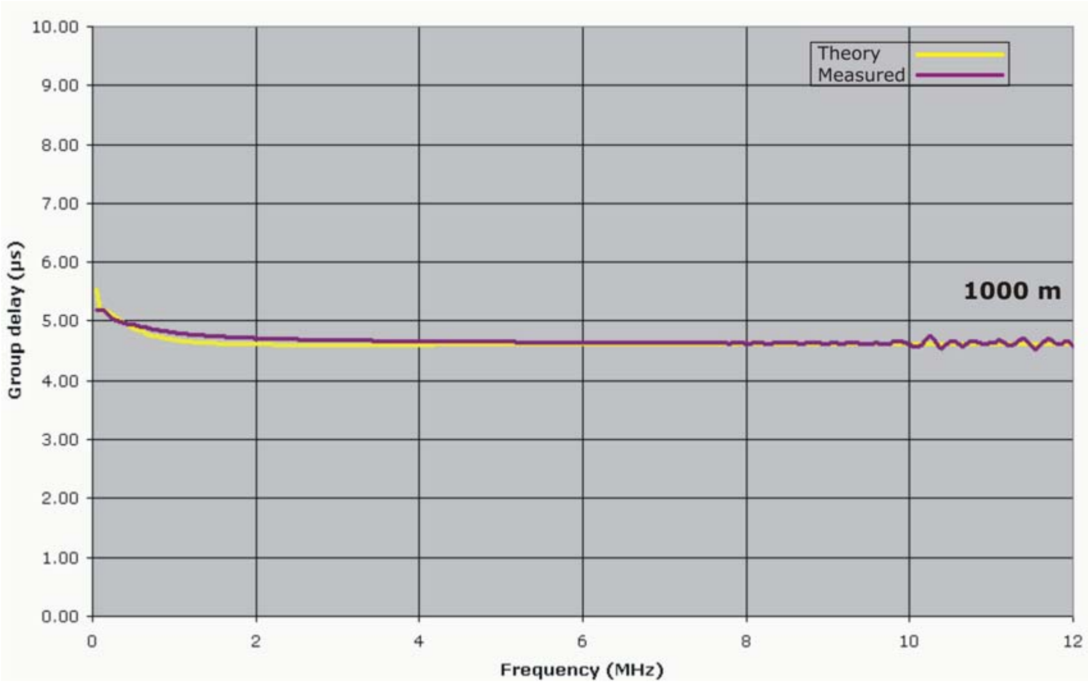


Figure B-8 Group delay at 1000m

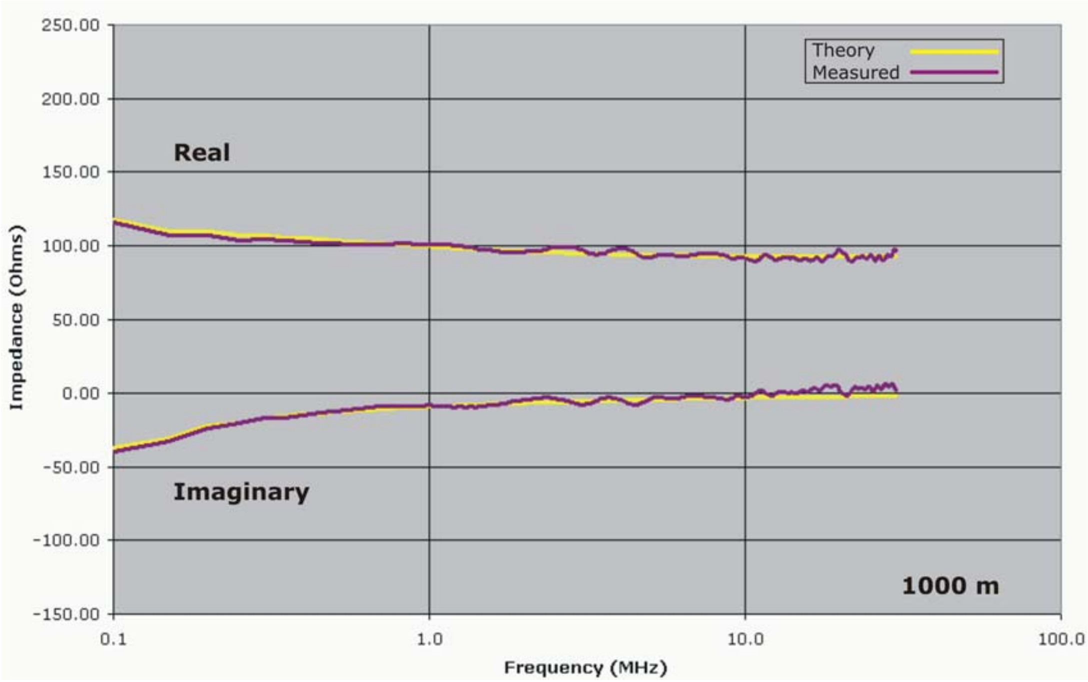


Figure B-9 Impedance at 1000m

B.4 2000 Meters

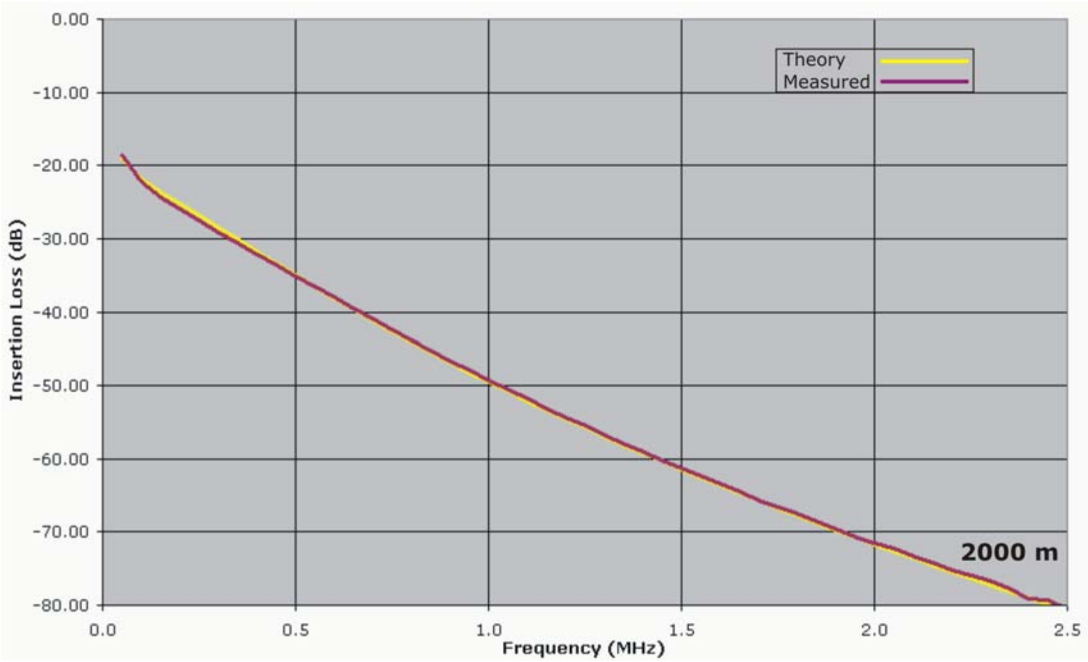


Figure B-10 Insertion loss at 2000m

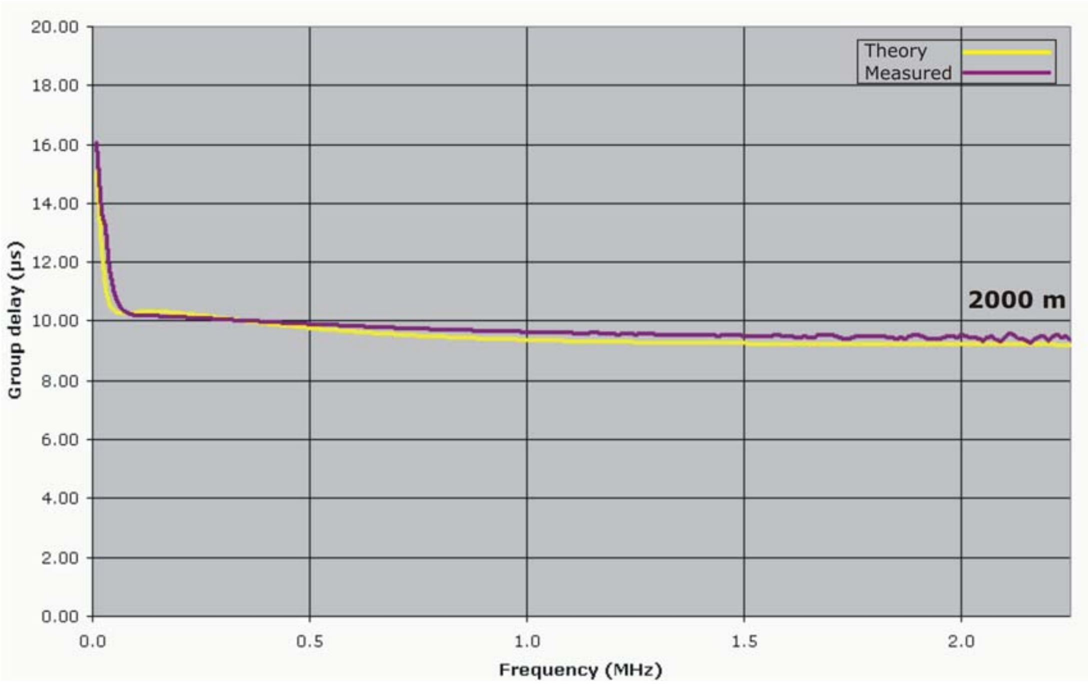


Figure B-11 Group delay at 2000m

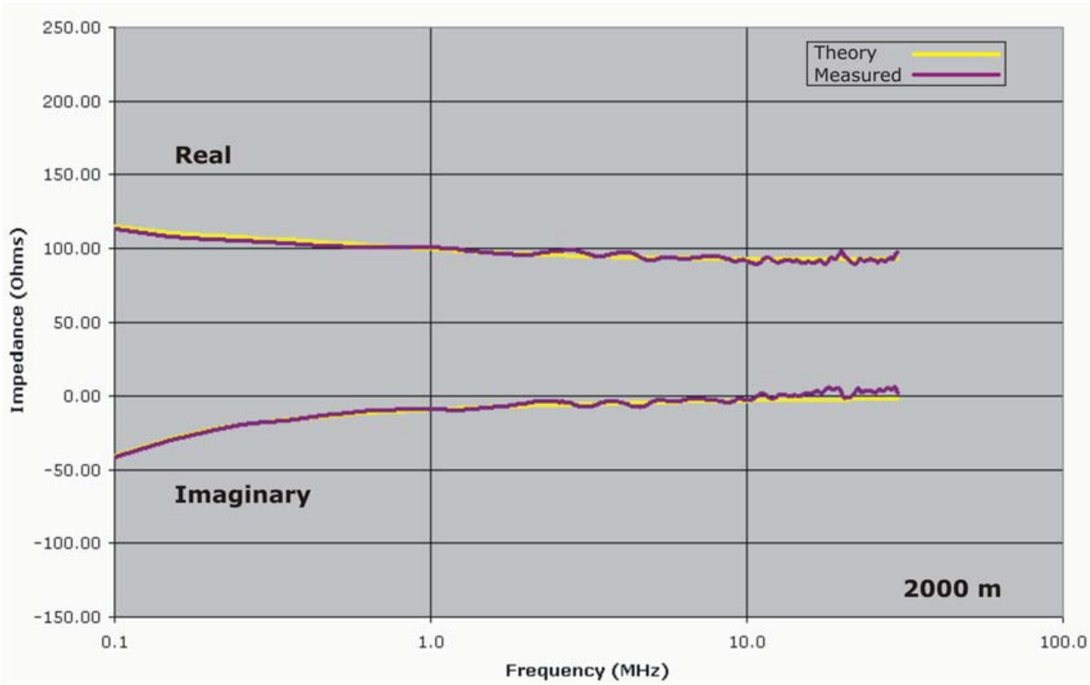


Figure B-12 Impedance at 2000m

B.5 3000 Meters

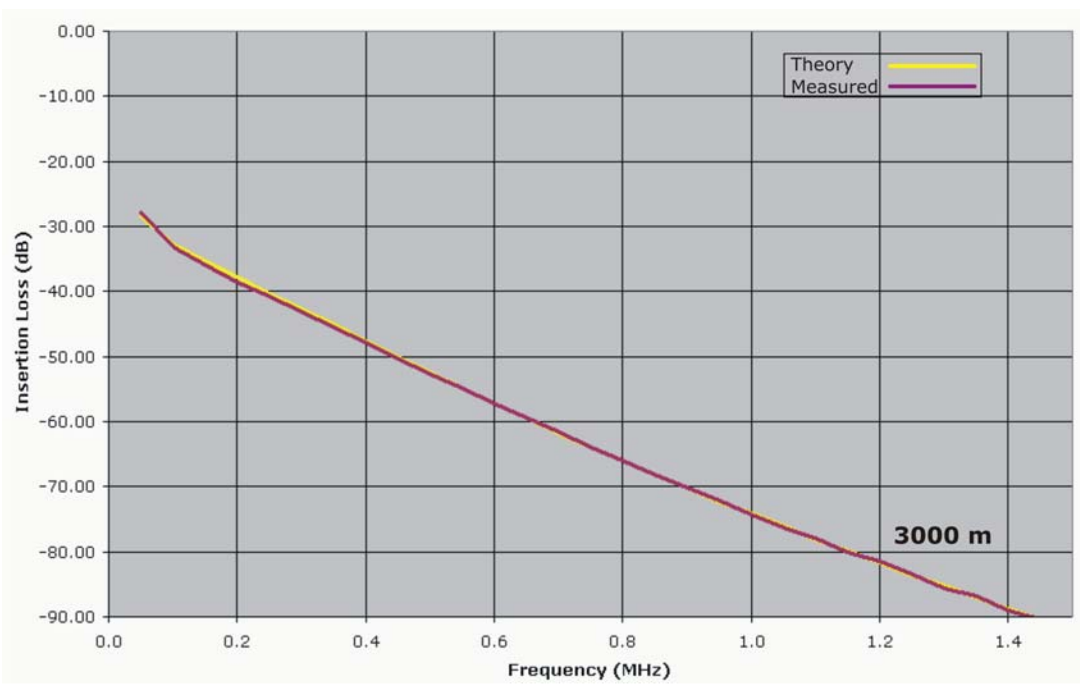


Figure B-13 Insertion loss at 3000m

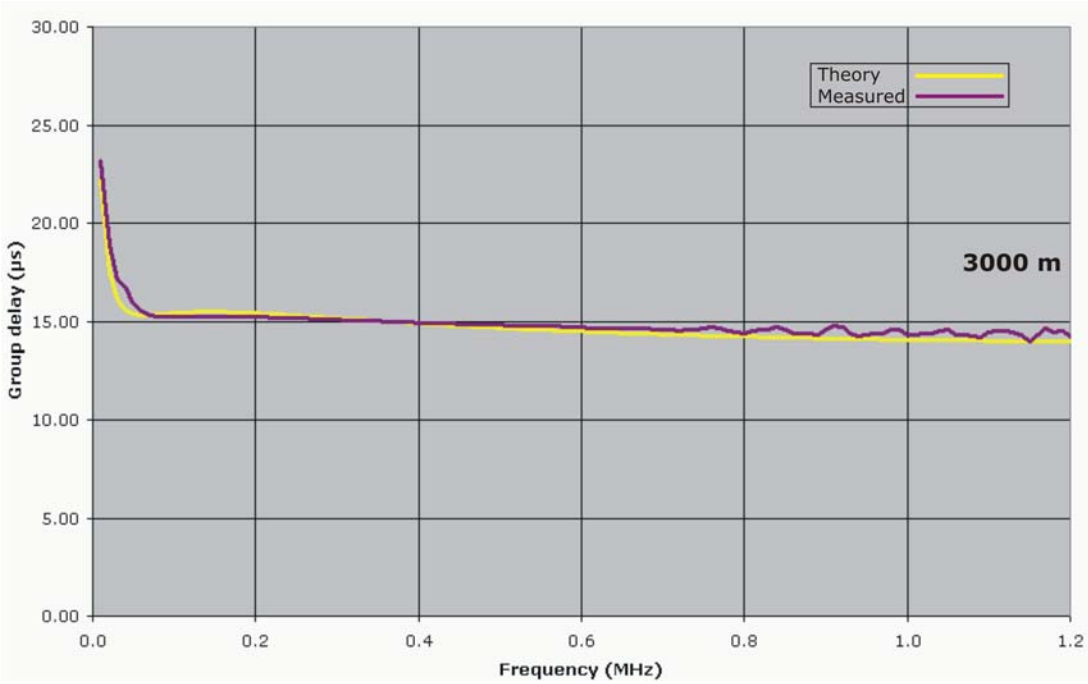


Figure B-14 Group delay at 3000m

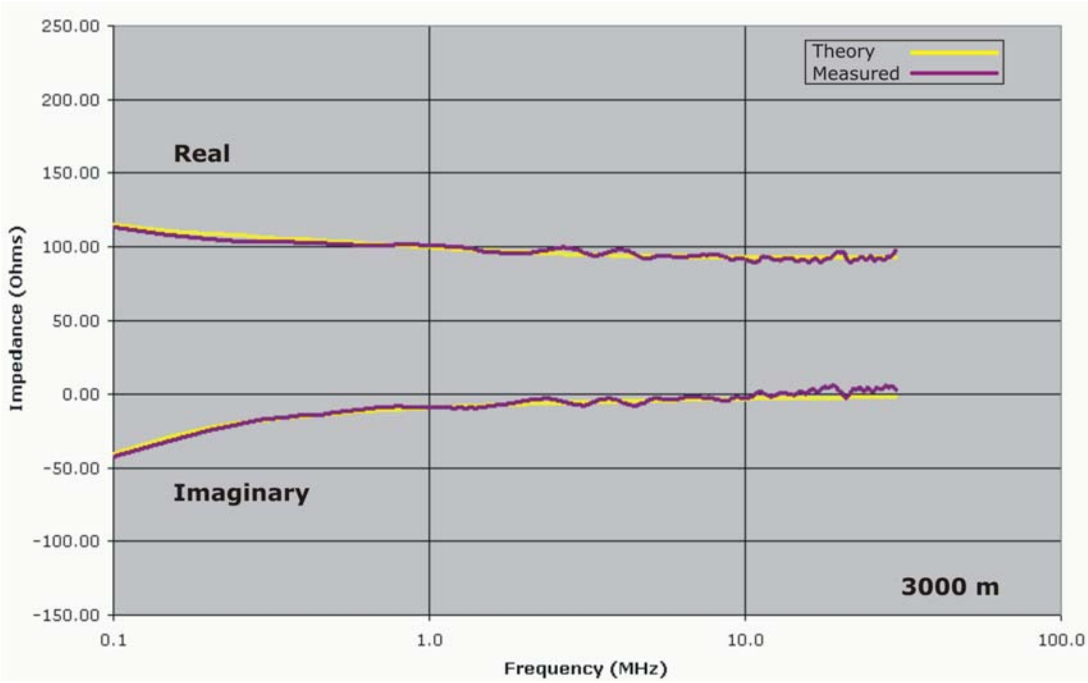


Figure B-15 Impedance at 3000m

Appendix C: Background Noise Measurements

Background noise measurements for the DLS–8234 VDSL2 Wireline Simulator are performed with a spectrum analyzer, in this case, an Agilent 4395A spectrum/network analyzer.

Input A is used in spectrum-noise mode and the results are displayed in power spectral density units, i.e. dBm/Hz.

The noise floor of the Agilent 4395A with an input attenuator of 0 dB and resolution BW=30 kHz (input A not connected) is illustrated in the graph below:

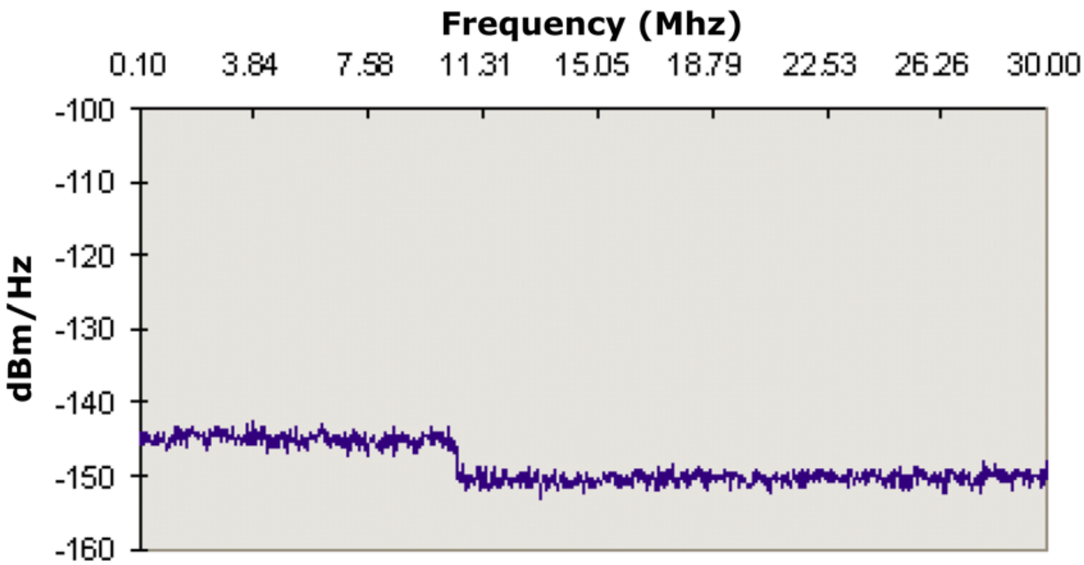


Figure C-1 HP 4395A Noise Floor

demonstrates the Agilent 4395A spectrum/network analyzer's Noise Floor over a Bandwidth of 0-30MHz. The graph shows that for frequencies up to 10 MHz, the noise floor is about -144 dBm/Hz; for frequencies in the range 10-30 MHz, the noise floor is about -151 dBm/Hz. Hence, when measuring noise with values close to the noise floor of the analyzer itself, results are inaccurate in the sense that the analyzer's noise adds to the noise of the device under test (DUT); the displayed result will be worse than the real one.

The error introduced by the analyzer itself has to be taken into considerations when measuring noise approaching -140 dBm/Hz.