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About this Manual

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Introduction

This manual provides information about various aspects of the DLS-8235 VDSL2 Wireline Simulator, such as loop configurations, remote control, warranty, specifications, and contact information.

Read Chapter 2, "Getting Started," thoroughly before powering up the DLS-8235 VDSL2 Wireline Simulator.

Spirent Communications recommends using the DLS-8235 Control Software to configure and control the wireline simulator. If you decide to develop custom test software, see Chapter 5, "Remote Control," for common and device-specific command sets that can be sent to the DLS-8235 control module through the GPIB or RS-232 interfaces.

If you have any questions about the DLS-8235 VDSL2 Wireline Simulator, please contact your Spirent Communications sales representative or a support service specialist. Contact information is located at “How to Contact Us” on page 9.

References

Customers can view and download the following manual from the Spirent website:

• DLS-5500 Operating Manual (noise generation)

For more about the Spirent Support Services website, see “How to Contact Us” on page 9.

Specifications related to this Operating Manual are listed below:

• 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)

• 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)
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Chapter 1
Introduction

In this chapter...

• Spirent’s Involvement in Wireline Simulation . . . . 12
• About the DLS-8235 VDSL2 Wireline Simulator . . . . 12
• About the Test Setup . . . . 13
Spirent’s Involvement in Wireline Simulation

Thank you for choosing the Spirent Communications DLS-8235 VDSL2 Wireline Simulator.

During 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 active participation in all of the major standards bodies (ITU-T, DSL Forum, ETSI, and ANSI), Spirent Communications has helped drive the accuracy and quality of wireline simulators to new heights. In fact, the DLS-8235 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 standard bodies have identified several improvements to the conventional VDSL transceiver systems designed to better address higher data rates for short loops. Specifically, the newest VDSL2 technology features improved support for bandwidths up to 30 MHz.

About the DLS-8235 VDSL2 Wireline Simulator

The DLS-8235 VDSL2 Wireline Simulator is designed for performance testing in accordance with ETSI specifications. This simulator uses the TP100 cable model as per ETSI TS 101 270-1 and ensures complete testing coverage for multi-functional and rate-adaptive xDSL chipsets.

The DLS-8235 VDSL2 Wireline Simulator reproduces the AC and DC characteristics of twisted-pair copper telephony cable using passive circuitry (R, L, and 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-8235. Contact Spirent Communications for information about suitable noise impairment equipment for your testing needs.

The DLS-8235 VDSL2 Wireline Simulator consists of a single chassis.

There are two methods for controlling the DLS-8235 VDSL2 Wireline Simulator:

• you can use the DLS-8235 Control Software which ships with the DLS-8235 or
• you can write your own scripts to control the DLS-8235 via RS-232 or GPIB interfaces.

The DLS-8235 Control Software configures and controls the system remotely through either the GPIB (IEEE 488) or the RS-232 interface. The use of GPIB and RS-232 interfaces also allows for the easy integration of the DLS-8235 into a larger test system.
About the Test Setup

The DLS-8235 uses the ETSI TS 101 270-1 specification as the basis for emulating the TP100 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-8235 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-8235 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* illustrates an example of a typical test setup using the DLS-8235 VDSL2 Wireline Simulator. This test setup provides users with a comprehensive and accurate test bed for verifying that the Device Under Test (DUT) meets the testing requirements of the VDSL2 standards. Spirent AE solution users know that this functionality translates into robust performance, earlier product delivery, and greater market share.

*Figure 1-1.* Example of a VDSL2 Test System Setup

For more information on compatible Spirent Communications products, see “References” on page 8.
Loop

The DLS-8235 simulates a TP100 loop as illustrated in Figure 1-2. The loop has a continuous bandwidth of DC to 30 MHz.

Figure 1-2. DLS-8235 Loop Schematic

The TP100 cable model is based on the ETSI TS 101 270-1 document. See “References” on page 8.
Chapter 2
Getting Started

This chapter provides basic instructions on the setup of a DLS-8235 VDSL2 Wireline Simulator.

Note: Read this chapter thoroughly before powering up your DLS-8235.

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• Setup Overview . . . . 17
• Front Panel Components and Connections . . . . 18
• Back Panel Components and Connections . . . . 20
• Chassis Setup . . . . 24
Receiving and Unpacking the Unit

Each DLS-8235 chassis is shipped in a reinforced shipping container. Please keep this container in case you need to ship the wireline simulator to another location or for repair. You will need to ship the unit for the recommended yearly calibration.

The DLS-8235 system contains the following:

- One DLS-8235 chassis
- One power cord
- Two extra fuses
- One 9-to-25 pin adapter (RS-232)
- One RS-232C interconnection cable
- One GPIB interconnection cable
- One GPIB reverse-entry extender
- Two RJ-45 interconnect cables: 30 cm (1 foot) long, Spirent part number 7102040514
- One DLS-8235 Software CD
- One Operating Manual CD
- One 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. See Chapter 7, “Shipping the Unit,” for information.
Setup Overview

The following steps outline how to set up a DLS-8235 system. For details, see the sections referred to in the steps.

To set up the DLS-8235:

1. Install the DLS-8235 Control Software (see “Installing the Software” on page 29).
2. Connect the chassis to the control computer ("Control Computer Connection" on page 21).
3. Set up the equipment ("Chassis Setup" on page 24).
4. Connect the DLS-8235 to the Digital Subscriber Line Access Multiplexer (DSLAM) and CPE equipment ("Chassis Interconnections" on page 25).
5. Connect power to the chassis and switch it on ("Power Connection" on page 20).
6. Start the DLS-8235 software ("Starting the DLS-8235 Control Software" on page 29).
7. Select the Communication Settings tab.
8. Configure the appropriate GPIB or serial port settings.
9. Select the System Properties tab.
10. Select the loop type.
11. Adjust the wireline segment length.
12. If using a DLS-5500EV VDSL2 Noise Generation System, select the desired impairments using the software that comes with that system.
13. Begin testing.
Front Panel Components and Connections

Figure 2-1 shows the layout of the DLS-8235 front panel.

![Diagram of DLS-8235 Front Panel Components and Connections](image)

The DLS-8235 Front Panel components are:
1. Side A, RJ-45 connector: wireline Side A
2. Ext A, RJ-45 connector: not used
3. POWER LED: indicates the power status
4. REMOTE LED: indicates the remote status
5. Ext B, RJ-45 connector: not used
6. Side B, RJ-45 connector: wireline Side B

REMOTE and POWER Status LEDs

The DLS-8235 chassis has two LEDs that indicate the power and remote status. The POWER LED is green when the power is turned on. It is red when the chassis fails its self-test. It is yellow when 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 when 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 stays red until the error flags are cleared (see the command *ESR? in “Common Command Set” on page 58 for details). Chapter 5, “Remote Control,” has examples of how to read the ESR register, clear the error flags, and switch the REMOTE LED to green after error conditions are resolved.
Analog Device Connections

The maximum ratings for DLS-8235 connections are ±200 VDC, 125 mA, and +37 dBm. A 400 Hz signal at +36 dBm can be used as a howler signal (Section E.4.1 of the G.703 standard).

RJ-45 Connectors

The RJ-45 connectors are balanced. The signal is carried by the two center pins. Pin 4 is Tip, and pin 5 is Ring (Figure 2.2).

![Balanced Connection](image)

Figure 2.2.  RJ-45 Female Connector

Spirent Communications recommends 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-8235.
Back Panel Components and Connections

The remote control connections, GPIB address DIP switch, and power connector are located on the back panel. Figure 2-3 shows the layout of the DLS-8235 rear panel.

![Figure 2-3. DLS-8235 VDSL2 Wireline Simulator Back Panel](image)

The DLS-8235 Back Panel components are:

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\(^1\)
5. Fuse Box: containing two type “T” 2A/250V slow blow fuses
6. IEEE 488 (GPIB) Connector: connect to a computer for remote control\(^1\)
7. Power Supply

Power Connection

The DLS-8235 chassis is built with a two-fuse configuration. Refer to Chapter 9, “Safety,” for more details.

Connect one end of a modular AC line cord to the power input of the DLS-8235 and the other end to an AC line supply with a voltage between 100 and 240 VAC at 50 to 60 Hz. The DLS-8235 works with any voltage and frequency in this range. Switch settings are not required.

\(^1\) Use either the GPIB or RS-232 port for connecting to a control computer.
When the DLS-8235 is powered off, the loop configuration persists, allowing you to use
the DLS-8235 when unpowered although loop settings cannot 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-8235, DLS-5405, and DLS-5500 are all plugged into one
power bar.

### Control Computer Connection

The DLS-8235 Control Software runs on any Microsoft Windows® based PC and allows
you to control the length of the simulated wireline loop. You may instead develop your
own software to configure the unit.

You may use either GPIB or RS-232 interface to connect the control computer to the
DLS-8235. 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.

### GPIB (IEEE 488) Port Connection

The GPIB portion of the control software supplied by Spirent Communications works
only with a National Instruments™ GPIB interface card. If necessary, install the National
Instruments GPIB interface card in the computer. Refer to National Instruments
documentation for information on how to install the GPIB card.

Connect the control computer to the DLS-8235 chassis with a GPIB cable.

Set the GPIB address of the DLS-8235 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. 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 setting for the chassis is 15 (0+8+4+2+1).

![Figure 2-4. Default Address Switch Settings for the DLS-8235](image)
Configuring the GPIB Interface

For a list of supported GPIB drivers, see the DLS-8235 Software Release Notes.

**Note:** The DLS-8235 software uses GPIB card 0. For more information, refer to National Instruments device-specific documentation and online help.

The easiest way to verify that the GPIB board is configured properly is to open the Measurement & Automation Explorer (Figure 2-5) that is installed with the National Instruments software.

![National Instruments Measurement & Automation Explorer](image)

**Figure 2-5.** National Instruments Measurement & Automation Explorer

To configure the GPIB board:

1. Open the Measurement & Automation Explorer by selecting **Start > Programs > National Instruments > Measurement and Automation**.
2. Right-click on the GPIB interface and set the default parameters as follows:
   - disable automatic serial polling
   - disable high-speed data transfers
   - enable the system controller
   - enable “Assert REN when SC”
   - enable “Send EOI at end of write”
• set I/O time-out to be at least 10 s. If the time-out is less than the typical time, the command takes to complete, then the function returns while the command is still executing.

For more information, refer to National Instruments device-specific documentation and online help.

**Serial Port (RS-232) Connection**

Connect the DLS-8235 chassis to the control computer using an RS-232 serial cable. Use the provided 9-to-25 pin adapter, if needed.

**Note:** The DLS-8235 Software can be set to connect to serial port COM1 to COM9. Make sure there is no conflict with other serial devices.
Chassis Setup

The following subsections explain how to set up the components in a DLS-8235 system, including noise injection.

Reducing Noise and Crosstalk

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. Because 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 pickup levels exceed -140 dBm/Hz, they limit VDSL2/VDSL1/ADSL2++/ADSL2+/ADSL2/ADSL and SHDSL performance and influence the test results. Noise-generating devices should be placed away from the test setup or switched off.

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

Chassis Arrangement

Arrange the DLS-8235 system as shown in Figure 2-6. This arrangement keeps cable lengths as short as possible.

Figure 2-6. Chassis Setup
To set up a DLS-8235 system:

1. Place the DLS-8235 chassis on the bench.
2. Place the DLS-5405 VDSL2 Noise Injector chassis on top of the DLS-8235.
3. Follow the procedure in “Chassis Interconnections” below.

**Note:** Rack-mounting chassis is highly recommended due to the combined weight of the chassis involved in a complete wireline simulation system (DLS-8235, DLS-5500, and DLS-5405).

**Chassis Interconnections**

Interconnect the DLS-8235 system chassis as shown in Figure 2-6. Connections to the DUT are made via the noise injector.

**To interconnect the component chassis of the DLS-8235 system:**

1. Interconnect the DLS-8235 chassis and the DLS-5405 VDSL2 Noise Injector chassis with the 30 cm (1 foot) RJ-45 cables (provided in the DLS-8235 accessory package):
   - b. Connect Side B of the DLS-8235 chassis to Side B of the DLS-5405 chassis.

   **Note:** If you are not using a noise injector, connect the CO equipment to Side A of the DLS-8235 and connect the CPE equipment to Side B of the DLS-8235.

2. 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.

**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 “Chassis Interconnections” 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.
Chapter 3
DLS-8235 Software

The DLS-8235 ships with the DLS-8235 Control Software. This software runs on a Microsoft Windows based PC and provides an easy-to-use graphical user interface (GUI) for controlling the DLS-8235 via RS-232 or GPIB interfaces.

Each instance of the software controls a single DLS-8235 system. To control multiple DLS-8235 systems, you can use multiple software sessions.

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

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- DLS-8235 Control Software Tabs . . . . 30
- Configuring the DLS-8235 . . . . 30
- DLS-8235 Control and Information Tools . . . . 35
Computer Hardware and Software Requirements

The following hardware and software are required:

- A computer running the Microsoft Windows operating system.
  - National Instruments GPIB controller card
  - GPIB cable
  – OR –
  - Serial port
  - RS-232 serial cable

The DLS-8235 Software Release Notes provide a list of supported Microsoft Windows operating systems.
Installing the Software

To install the software:

1. Insert the DLS-8235 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.

2. Follow the on-screen installation wizard instructions.
   You are given the option to install the DLS Terminal after the DLS-8235 software has been installed. Spirent Communications recommends 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-8235 Software](image)

Starting the DLS-8235 Control Software

To access the main window:

Select **Program Files > Spirent Communications > DLS 8235 > DLS 8235** from the **Start** menu.
DLS-8235 Control Software Tabs

The DLS-8235 Control Software window includes these tabs:

- The **System Properties** tab is selected by default. Use it to configure loop properties and monitor commands sent to the DLS-8235. The **Loop Drawing** area graphically displays the simulated loop. See “Configuring the Loop Mode” on page 32 and “Configuring the DLS-8235 Loop Lengths” on page 33.

- The **System Compensation** tab is used to compensate the DLS-8235 using the test setup explained in Appendix A, “Measurements.” See Chapter 4, “System Compensation.”

- The **Communications Settings** tab is used to configure the physical interface between the control computer and the DLS-8235. See “Configuring the Simulator Connection” on page 30.

Configuring the DLS-8235

Before using the DLS-8235 Control Software, you must configure the connection to the DLS-8235 chassis. See “Configuring the Simulator Connection” for details.

Besides the normal simulation mode, the loop can be in bypass or disconnect mode. See “Configuring the Loop Mode” on page 32 for details.

Use compensated settings (“Configuring the DLS-8235 Loop Lengths” on page 33) to increase the accuracy of the wireline simulation.

For instructions on how to create a compensation file, see Chapter 4, “System Compensation.”

Configuring the Simulator Connection

The procedures in this subsection assume that you have the DLS-8235 Control Software running.

To configure the connection:

1. Select the **Communication Settings** tab *(Figure 3-2 on page 31).*
Figure 3-2. DLS-8235 Control Software - Communication Settings Tab

2 Select the type of connection used from the Communication Interface drop-down list. The choices are GPIB (IEEE-488) or Serial (RS-232).

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-8235. For instructions on setting the chassis GPIB address, see “GPIB (IEEE 488) Port Connection” on page 21. The default address is 15.

   b For a serial port, select the port from the Serial Port drop-down list to which the DLS-8235 chassis is connected. Your choices are 1-9. The default COM port is 1.

4 Click the Go OnLine button to connect the DLS-8235 Control Software to the DLS-8235. The current wireline settings will be sent to the unit. Click the Go OffLine button to disconnect the DLS-8235 Control Software from the wireline simulator.

Note: The DLS-8235 continues to simulate the loop with the last settings it received before going offline. The DLS-8235 also simulates the loop when turned off. When powered up, the previous settings remain active after the power-up self-test.
Configuring the Loop Mode

The loop mode determines whether length settings are internally adjusted using default or compensated settings. To use Compensated settings, you need to first run the built-in compensation function, which measures the response of the unit and creates a file containing the adjusted settings. You can then select Compensated mode and select this file. Using Compensated mode minimizes the Mean Absolute Error (MAE) for loop attenuation. The Default option selects factory default compensation settings for the DLS-8235. If the Default option is selected, no further configuration is required. You can now make loop length settings. See “Configuring the DLS-8235 Loop Lengths” on page 33 for details.

1. Select the System Properties tab.
2. Select the Default or Compensated option.

If the Compensated option is selected, the Browse button appears (Figure 3-3), 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.

![Figure 3-3. Browse Button Appears Only When Compensated Mode is Selected](image)

If using Compensated mode:

1. Click the Browse button. The Choosing A Compensation File dialog box appears.
2. Browse to and select the compensation file you wish to use.
3. 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 Chapter 4, “System Compensation,” for details.
Configuring the DLS-8235 Loop Lengths

Figure 3-4 shows the System Properties tab.

![Figure 3-4](image)

The following procedures assume that you have the DLS-8235 Control Software running.

To set the length of the DLS-8235:

1. Select the System Properties tab.
2. Click the Go Online button. The control software translates subsequent settings into commands and sends them to the DLS-8235.
3. Select Normal from the Loop Simulation radio buttons (see “Configuring the Loop Mode” on page 32).
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.

Notes:
- You cannot set the length of the loop to zero. For a zero-length wireline, set the Loop Simulation field to Bypass.
- If you enter a length that is not a multiple of the increment (i.e., 5 meters), the DLS-8235 Control Software rounds it to the nearest increment. The spin controls always change the length of a segment by the correct increment.
Loop Simulation Options

Bypass

*Bypass* connects the Side A jack directly to the Side B jack. To make the simulated wireline zero-length, select the *Bypass* option.

Disconnect

*Disconnect* makes the simulator an open circuit between Side A and Side B.

View Feet

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 entered in meters. To the right of this field, the selected length is displayed in feet when the *Show Feet* option is selected.

![Figure 3-5. Viewing Wireline Length in Feet and Meters](image)
DLS-8235 Control and Information Tools

Advanced Settings and Information

The Advanced Dialog property sheet (Figure 3-6) gives more information about the DLS-8235 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.

Figure 3-6. DLS-8235 Advanced Dialog Property Sheet

The property sheet provides a list of internal cards 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”.

**DLS Terminal**

You can communicate directly with the DLS-8235 chassis using DLS Terminal (Figure 3-7). This separate application sends the commands you type directly to the chassis and displays the chassis responses.

![DLS Terminal Window](image)

**Figure 3-7.** DLS Terminal Window

The DLS Terminal application can be installed when you install the DLS-8235 Control Software or you can install it manually. The installation program is located in the DLS Terminal directory of the DLS-8235 software CD.
To use DLS Terminal:

1. Start DLS Terminal by selecting Start > Program Files > Spirent Communications > DLS Terminal > DLS Terminal. The DLS Terminal window will appear.
2. Select the Communication interface for the chassis. Choices are GPIB (IEEE-488.2) or Serial (RS-232).
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 want to connect to.
4. Click the Attach button. DLS Terminal will connect to the DLS-8235.
5. Type commands and queries in the command line. Responses are displayed in the response pane. See Chapter 5, “Remote Control,” for an explanation of DLS-8235 commands.
Chapter 4
System Compensation

In this chapter...

• System Compensation Function . . . . 40
• Error Measurements . . . . 41
• Running a System Compensation Test . . . . 42
• Compensation Results . . . . 46
System Compensation Function

The system compensation function automates the measurement and calculation of compensated loop settings for the DLS-8235. This process produces a compensation file specific to each individual DLS-8235 system.

The general algorithm for a single loop is:

1. Measure the loop attenuation for selected frequency range.
2. Adjust the loop setting so that the Mean Absolute Error (MAE) between the measured attenuation and theoretical attenuation is minimized.
3. Save these adjusted loop settings.

The compensated loop length settings are stored in a .csv file and can be loaded by the DLS-8235 Control Software 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-8235 is shipped with each unit.
Error Measurements

Mean Error (ME) 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 is calculated as:

\[ \text{ME}_{\text{loop X}} = \frac{1}{N} \sum_{i \in \{A_{Ti} \leq A_{maxdB}\}} (A_{Ri} - A_{Ti}) \]

where:

\[ A_{max} = \text{See Table 4-1} \]

\[ A_{Ri} = \text{Attenuation sample, in dB, of the measured loop X} \]

\[ A_{Ti} = \text{Attenuation sample, in dB, of the theoretical loop X} \]

\[ N = \text{The number of points necessary to measure the attenuation in increments of 50 kHz, taking into account only those points for which } A_{Ti} \leq A_{max} \text{ dB} \]

Table 4-1. Amax Settings for Various Frequency Ranges

<table>
<thead>
<tr>
<th>Amax (dB)</th>
<th>Frequency Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>50 kHz - 7.5 MHz</td>
</tr>
<tr>
<td>80</td>
<td>7.55 MHz to 15 MHz</td>
</tr>
<tr>
<td>70</td>
<td>15.05 MHz - 30 MHz</td>
</tr>
</tbody>
</table>

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 101 270-1.

MAE is calculated as follows:

\[ \text{MAE}_{\text{loop X}} = \frac{1}{N} \sum_{i \in \{A_{Ti} \leq A_{maxdB}\}} |A_{Ri} - A_{Ti}| \]
Running a System Compensation Test

Periodic system compensation is highly recommended to maintain accuracy of the DLS-8235.

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 43.

The setup shown in Figure 4-1 is used when performing compensation tests. Balun transformer connection details are shown in Figure 4-2 on page 43.

where:

\[
\begin{align*}
A_{\text{max}} & = \text{See Table 4-1 on page 41} \\
A_{R\text{i}} & = \text{Attenuation sample, in dB, of the measured loop X} \\
A_{T\text{i}} & = \text{Attenuation sample, in dB, of the theoretical loop X} \\
N & = \text{The number of points necessary to measure the attenuation in increments of 50 kHz, taking into account only those points for which } A_{T\text{i}} \leq A_{\text{max}} \text{ dB}
\end{align*}
\]
The Agilent 4395A normalization process requires that the DLS-8235 is bypassed at one stage of the measurement procedure as described in “Running a Compensation Test with the Control Software” on page 44. To bypass the DLS-8235, use the configuration illustrated in Figure 4-3.
Running a Compensation Test with the Control Software

First, set up the DLS-8235 as shown in Figure 4-1 on page 42.

Start the compensation procedure as follows:

1. Ensure that the Agilent 4395A analyzer is connected to the control computer with a GPIB cable.
2. Select the System Compensation tab (Figure 4-4) in the DLS-8235 Control Software.
3. Ensure you are in Offline mode. If you are in Online mode, click the Go Offline button.
4. Select the GPIB address of the Agilent 4395A analyzer in the Address drop-down box.
5. Click the Start button.

Note: The DLS-8235 software must be Offline to run compensation.
6. A dialog 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 on page 45). Bypass the DLS-8235 by connecting pins 3 and 4 of one transformer to pins 3 and 4 on the other
transformer, as shown in *Figure 4-3 on page 43*. When you have bypassed the DLS-8235, click the **OK** button. Normalization of the analyzer takes a few seconds.

![Network Analyzer Calibration Instructions](image)

**Figure 4-5.** Network Analyzer Calibration Instructions

7 When the Agilent 4395A normalization is complete, a dialog box tells you to make appropriate connections for compensation measurements (*Figure 4-6*). Use *Figure 4-1 on page 42* as a reference. When the connections have been made, click the **OK** button. The compensation process begins.

![Preparing Loop Compensation Instructions](image)

**Figure 4-6.** Preparing Loop Compensation Instructions

During compensation, the execution log is displayed. The compensation dialog reports the progress of the compensation as well as the MAE and ME for the loop.
Compensation Results

Compensation results are saved to a file in the C:/Program Files/Spirent Communications/DLS 8235/cust directory. The file is named as follows:

DLS8235_nnnnnnnn_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 is not run to completion, the file has “Incomplete” at the end of its name. Incomplete files cannot be used by the DLS-8235 software for compensation.
Chapter 5
Remote Control

In this chapter...

• Remote Control Overview . . . . . . 48
• GPIB Interface . . . . . . 49
• RS-232 Serial Interface . . . . . 51
• Data Formats . . . . . . 53
• Command Syntax . . . . . . 54
• Device-Dependent Command Set . . . . . 55
• Common Command Set . . . . . 58
• Status Reporting . . . . . . 62
• Synchronizing to Commands . . . . . 65
Remote Control Overview

The DLS-8235 is controlled via the GPIB (IEEE 488) or the RS-232 (serial) interface, allowing the integration of the DLS-8235 into a larger test system.

The DLS-8235 remote control design is based on the following standards:

- The GPIB physical interface follows IEEE 488. The functions implemented are outlined in “GPIB Interface” on page 49.
- The serial port physical interface (see “RS-232 Serial Interface” on page 51) follows the EIA RS-232 standard.
- The Device-Dependent commands (see “Device-Dependent Command Set” on page 55) are based upon the Standard Commands for Programmable Interfaces (SCPI).
- The Common commands (see “Common Command Set” on page 58) follow IEEE 488.2.

The GPIB and the serial interfaces are always enabled; either can be used. The DLS-8235 directs its output to the last interface from which it received data. Both interfaces use the same command set and produce the same results.
GPIB Interface

This section explains the GPIB (IEEE 488) interface. Refer to “RS-232 Serial Interface” on page 51 for information specific to the RS-232 interface.

Supported GPIB Interface Functions

The GPIB Interface functions supported by the DLS-8235 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 functions are the minimum required to implement the IEEE 488.2 standard.

GPIB Address

Each device on the GPIB bus must have a unique address. The DLS-8235 chassis can use any GPIB addresses between 1 and 31.

The factory setting for the DLS-8235 is address 15.

Service Request (SRQ) Line

The SRQ line, as defined by the IEEE 488 standard, is raised when the DLS-8235 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:** All enable registers are cleared upon power up.

Spirent Communications recommends that you configure the DLS-8235 to raise the SRQ line when there is a message available and when there is an error.

**Example Using the GPIB Interface**

To send and receive messages with error checking:

1. Set error bits (required only once).
2. Send the message.
3. Wait for SRQ.
4. Read the Status Byte.
5. If MAV (bit 4) is set, then read the response.
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, follow the steps listed in **Table 5-1**.

**Table 5-1. Setting the ID Message with GPIB**

<table>
<thead>
<tr>
<th>Action</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Transmit &quot;*SRE 48&quot;&quot;</td>
<td>Enable MAV and ESB (needed only once)</td>
</tr>
<tr>
<td>2 Transmit &quot;*ESE 60&quot;</td>
<td>Enable all the error bits (needed only once)</td>
</tr>
<tr>
<td>3 Transmit &quot;*IDN?&quot;&quot;</td>
<td>Query the identification message</td>
</tr>
<tr>
<td>4 Wait for SRQ to be raised</td>
<td></td>
</tr>
<tr>
<td>5 Read the status byte</td>
<td>Use the IEEE 488.2 serial poll command, not *STB?</td>
</tr>
<tr>
<td>6 If MAV (bit 4) is set, read the response</td>
<td></td>
</tr>
</tbody>
</table>
RS-232 Serial Interface

This section contains information specific to the RS-232 interface. Refer to "GPIB Interface" on page 49 for information specific to the IEEE 488 interface.

The system uses a female DB-25 connector, which 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-8235 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. This manual uses 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-8235 cannot use the parallel port of a computer (the female connector).

The system stops transmitting data when the RTS line is low; it restarts when the RTS line is high. The DLS-8235 lowers the CTS and the DSR lines when it cannot accept data; it raises the CTS and DSR lines when it can accept data.

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-8235.

---

Table 5-1. Setting the ID Message with GPIB (continued)

<table>
<thead>
<tr>
<th>Action</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. If ESB (bit 5) is set, do the following:</td>
<td>Check if an error was detected</td>
</tr>
<tr>
<td>• Transmit &quot;*ESR?&quot;</td>
<td>Query the Event Status Register</td>
</tr>
<tr>
<td>• Wait for SRQ to be raised</td>
<td></td>
</tr>
<tr>
<td>8. If MAV (bit 4) is set, read the response and take all relevant action according to the error type received</td>
<td></td>
</tr>
</tbody>
</table>
To use HyperTerminal:

1. Start HyperTerminal.
2. Enter a name (for example, “DLS-8235”).
3. Select the port (for example, “Direct to COM1”).
4. Enter the port settings: 9600, 8, none, 1, and hardware.
5. Select File > Properties > Settings > ASCII Setup.
6. Enable “Send line ends with line feeds” and “Echo typed characters locally.”
7. Click OK twice.
   You should now be able to send and receive commands to and from the system.

Example Using the RS-232 Interface

To send and receive messages with error checking:

1. Send the message.
2. Read the answer until you receive an LF (decimal 10, hex 0A).
3. Check if an error occurred with the *ESR? command.

For example, to get the identification message with the RS-232 interface, follow the steps in Table 5-2.

Table 5-2. Setting the ID Message with RS-232

<table>
<thead>
<tr>
<th>Action</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Transmit “*IDN?”</td>
<td>Query the identification message</td>
</tr>
<tr>
<td>2 Read the reply</td>
<td>The messages are always terminated with LF</td>
</tr>
<tr>
<td>3 Transmit “*ESR?”</td>
<td>Check if an error occurred</td>
</tr>
<tr>
<td>4 Read the reply</td>
<td>If not 0, an error occurred, see Event Status Register (ESR) Section for a description of the error(s)</td>
</tr>
</tbody>
</table>
Data Formats

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

The DLS-8235 adheres to the IEEE 488.2 principle of Forgiving Listening and Precise Talking. Table 5-3 lists the data formats supported by the DLS-8235.

Table 5-3. DLS-8235 Supported Data Formats

<table>
<thead>
<tr>
<th>Data Format</th>
<th>Description</th>
</tr>
</thead>
</table>
| Talking     | • <NR1> Numeric Response Data - Integer  
              <NR1> is an implicit point representation of an integer (i.e., fixed format).  

• Arbitrary ASCII Response Data  
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: -85 dbm, -85.0 dbm, -85, -85.0, -8.5e2. If a unit (for example, dB, pps, or mv) is appended to a number, that unit must be valid and not abbreviated. Note that the period separates the decimal part of a number. |

Message Terminators

Messages to the DLS-8235 must be terminated with either a Line Feed character (ASCII <LF>, decimal 10, hex 0A), an IEEE 488 EOI signal, or both. Messages from the DLS-8235 are always terminated with a Line Feed character and the IEEE 488 EOI signal.

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

The carriage return character, which is not a valid terminator, invalidates 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 is interpreted as a second command and is simply discarded by the DLS-8235.

For example:

PRINT #1, "SETTING:CHANNEL:STATE?"+CHR$(10); *Preferred solution*  
− or −  
PRINT #1, "SETTING:CHANNEL:STATE?; *Alternate solution*
Command Syntax

The DLS-8235 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 “Device-Dependent Command Set” on page 55, the format of the latter in “Common Command Set” on page 58. Each type can 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 asterisk character (*). Device-Dependent commands are preceded by the colon character (:). Each level of a command is separated by a colon.

Commands can be in either upper or lower case. Multiple commands can be concatenated by separating each command with semi-colons. The following are some examples of commands:

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

Messages sent to the DLS-8235 must be terminated with a Line Feed character (ASCII <LF>, decimal 10, hex 0A). Messages from the DLS-8235 are always terminated with a Line Feed character.

As defined in the SCPI specifications, a Device-Dependent command can 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-8235 places the appropriate response in the output queue, where the controller can read it.

Below are three examples of queries:

*IDN?
*ESE?; *SRE?
:SET:CHAN:STA?
Device-Dependent Command Set

The DLS-8235 and other Spirent equipment use the tree structure below, according to the SCPI consortium recommendations:

```
:SETting
   :CHANnel
       :STAte <Normal|Bypass|Disconnect>
       :LINe <N_Fine>,<N_Coarse>

:System
   :Reset
   :Error?
   :Calibration
       :date?
       :expiry?
```

Each section of the command can be sent in the full or the truncated form (indicated above in upper case). The command itself may be sent in uppercase or lowercase form. For more information, see “Data Formats” on page 53 and “Command Syntax” on page 54.

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 wireline cards during power-up, the POWER LED turns red.

System Check Commands

```
:SYSTEM:ERROR?
```

This read-only command 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”, there is no error. If the return string is “1”, at least one card in the system is of the wrong type for the DLS-8235 VDSL2 Wireline Simulator.

```
:SYSTEM:CALIBRATION:DATE?
```

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

```
:SYSTEM:CALIBRATION:EXPIRY?
```

This read-only command returns the date at which the unit should be next calibrated. The string is a maximum of 25 characters.
Chapter 5: Remote Control

Device-Dependent Command Set

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

Setting the channel state to Normal allows the reach settings made with the SETTING:CHANNEL:LINE command ("SETting:CHANnel:LINE <N_Fine>,<N_Coarse>") to change the length of the wireline.

Setting the channel state to Bypass bypasses all line simulator cards in the DLS-8235 chassis. The DLS-8235 behaves like a zero-length wireline.

Setting the channel state to Disconnect causes the DLS-8235 to behave like an open circuit.

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 “Common Command Set” on page 58 for more details on the *WAI and *OPC commands.

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

This command controls the length of the simulated wireline using the N_Fine and N_Coarse coefficients.

Table 5-4 provides a sample of N_Fine and N_Coarse values for various wireline lengths. This table is taken from the file Dls8235_Length_Coefficient.csv, which is used by the DLS-8235 Control Software. If the DLS-8235 Control Software was installed in the default location, the .csv file is located in the C:\Program Files\Spirent Communications\DLS-8235 directory.

Table 5-4. Example Reach Fine/Coarse Settings

<table>
<thead>
<tr>
<th>Reach (m) (Column 3)</th>
<th>N_Fine (Column 4)</th>
<th>N_Coarse (Column 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>42</td>
<td>1</td>
</tr>
<tr>
<td>75</td>
<td>120</td>
<td>2</td>
</tr>
<tr>
<td>100</td>
<td>90</td>
<td>4</td>
</tr>
<tr>
<td>500</td>
<td>35</td>
<td>32</td>
</tr>
<tr>
<td>1000</td>
<td>66</td>
<td>73</td>
</tr>
<tr>
<td>2000</td>
<td>114</td>
<td>171</td>
</tr>
<tr>
<td>3000</td>
<td>60</td>
<td>266</td>
</tr>
</tbody>
</table>
**Note:** Valid N_Fine values range between 1 and 144. Valid N_Coarse values range between 1 and 294.

**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 “Common Command Set” on page 58 for more details on the *WAI and *OPC commands.

Examples:

To set the length of the DLS-8235 to 100 meters, send:

```
:SET:CHAN:LINE 90, 4
```

To query the current setting, send:

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

This command returns the current N_Fine and N_Coarse settings. The returned message format is:

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

**:System:Reset**

This command causes the system to reset. For example:

```
:System:Reset
```
Common Command Set

As specified in the IEEE 488.2 standard, a number of common commands are required to set up and control the standard functions of remote-controlled devices.

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

Serial and GPIB Interface Types

*CLS Clear Status Command

Type: Status command

Function: Clears the Event Status Register (ESR). Clearing the ESR also clears ESB, bit 5 of the Status Byte Register (STB). It does not affect 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 bitmap:

<table>
<thead>
<tr>
<th>Bit</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Operation Complete</td>
<td>1</td>
<td>Request Control (not used)</td>
<td>1</td>
<td>Query Error</td>
<td>1</td>
<td>Device Dependent Error (not used)</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>Command Error</td>
<td>1</td>
<td>User Request (not used)</td>
<td>1</td>
<td>Power On</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 are enabled in the Event Status Register (ESR).

On power-on, the ESER 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 turns 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-8235 puts the following string into the output queue:

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

where:

- `<unit ID>` is “DLS-8235”
- `<SN>` is the serial number of the unit (i.e., #######)
- `<Ver>` is the revision level of the control firmware (always three digits)

**RST**  
*Reset*

**Type:** Internal command

**Function:** IEEE 488.2 level 3 reset. This command cancels any pending *OPC operation. It does 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 “Device Clear.”
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 causes the DLS-8235 to set bit 0 in the ESR when all pending operations have been completed. This bit is read with the *ESR? command, which also clears it. Communication can proceed as normal after this command, but be prepared to receive an SRQ at any time.

Note that 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 command causes the DLS-8235 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 bitmap:

<table>
<thead>
<tr>
<th>Bit</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 MSS and RQS bits and the SRQ line are never going to be raised.

On power-on, the SRER 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. This register is zero only when all its related structures are cleared, namely the ESR and the output queue.

<table>
<thead>
<tr>
<th>Bit</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Message Available (MAV) bit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Event Status Bit (ESB)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Master Summary Status (MSS) bit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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, which is represented by bit 6 in the status byte returned in response to a serial poll.
Chapter 5: Remote Control
Status Reporting

**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 bitmap:

<table>
<thead>
<tr>
<th>Bit</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Passed microcontroller test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Passed nonvolatile RAM test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Not used and should always be 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Passed Flash memory test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Not used and should always be 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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-8235 ensures that all commands received before “*WAI” are completed before processing any new commands. Thus all further communication with the DLS-8235 are frozen until all pending operations are completed.

---

**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). Both registers have three basic commands (**Table 5-5**): one to read the register, one to set the enabling bits, and one to read the enabling bits.

**Table 5-5.** Byte Register Commands

<table>
<thead>
<tr>
<th>Read Register</th>
<th>Status Byte Register</th>
<th>Event Status Register</th>
</tr>
</thead>
<tbody>
<tr>
<td>*STB?</td>
<td></td>
<td>*ESR?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set Enabling Bits</th>
<th>Status Byte Register</th>
<th>Event Status Register</th>
</tr>
</thead>
<tbody>
<tr>
<td>*SRE &lt;NRf&gt;</td>
<td></td>
<td>*ESE &lt;NRf&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Read Enabling Bits</th>
<th>Status Byte Register</th>
<th>Event Status Register</th>
</tr>
</thead>
<tbody>
<tr>
<td>*SRE?</td>
<td></td>
<td>*ESE?</td>
</tr>
</tbody>
</table>

1  
<NRf> is the new value of the register.
Status Byte Register (STB)

The bits of this register are mapped as indicated in Table 5-6.

**Table 5-6. STB Bit Descriptions**

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit 4: MAV (Message Available Bit)</td>
<td>Indicates that the Output Queue is not empty. If MAV goes high and is enabled, then MSS goes high.</td>
</tr>
<tr>
<td>Bit 5: ESB (Event Status Bit)</td>
<td>Indicates that at least one bit of the Event Status Register (ESR) is non-zero and enabled. If ESB goes high and is enabled, then MSS goes high.</td>
</tr>
<tr>
<td>Bit 6: MSS/RQS (Master Summary Status/Request Service)</td>
<td>MSS is raised when either MAV or ESB is raised and enabled. When the status of MSS changes, the entire STB 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. In response to an IEEE 488 Serial Poll command, this Status Byte is returned, then RQS and SRQ are cleared. RQS and SRQ are defined by the IEEE 488 standard and are hardware related. MSS summarizes all the status bits of the DLS-8235, as defined by the IEEE 488.2 standard.</td>
</tr>
<tr>
<td>Bits 7, 3, 2, 1, and 0</td>
<td>These bits are not used by the DLS-8235.</td>
</tr>
</tbody>
</table>

Event Status Register (ESR)

The ESR monitors events within the system and reports on those enabled. It records transitory events as well. The DLS-8235 implements only the IEEE 488.2 ESR. Table 5-7 defines the ESR bits.

**Table 5-7. ESR Bit Descriptions**

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit 0</td>
<td>Operation Complete. This bit is set in response to the *OPC command when the current operation is complete.</td>
</tr>
<tr>
<td>Bit 1</td>
<td>Request Control. Because the DLS-8235 does not have the ability to control the IEEE bus, this bit is always 0.</td>
</tr>
<tr>
<td>Bit 2</td>
<td>Query Error. There was an attempt to read an empty output queue or there was an output queue overflow (the maximum output queue capacity is 75 bytes).</td>
</tr>
</tbody>
</table>
The setting of the ESR can be read with the ESR query command (*ESR?), which puts the value of the register in the output queue AND clears the register.

**Table 5-7. ESR Bit Descriptions (continued)**

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit 3</td>
<td>Device-Dependent Error. Not used, so this bit is always 0.</td>
</tr>
<tr>
<td>Bit 4</td>
<td>Execution Error. The data associated with a command was out of range.</td>
</tr>
<tr>
<td>Bit 5</td>
<td>Command Error. Either a syntax error (order of command words) or a semantic error (spelling of command words) has occurred.</td>
</tr>
<tr>
<td>Bit 6</td>
<td>User Request. Indicates that the user has activated a Device-Defined control through the front panel. Not used, so this bit is always 0.</td>
</tr>
<tr>
<td>Bit 7</td>
<td>Power on. This bit is set when the DLS-8235 is turn on. Sending *ESR? clears the bit and stays clear until the power is turned on again.</td>
</tr>
</tbody>
</table>

The setting of the ESR can be read with the ESR query command (*ESR?), which puts the value of the register in the output queue AND clears the register.
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.

GPIB Synchronization

The program controlling the DLS-8235 can use three different commands to synchronize with the DLS-8235: *OPC, *OPC?, and *WAI. Table 5-8 lists the main differences.

### Table 5-8. Synchronization Commands

<table>
<thead>
<tr>
<th></th>
<th>Set Operation Complete Bit when Done</th>
<th>Return “1” when Operation Complete</th>
<th>Raise SRQ when Operation Complete</th>
<th>Block Communication with the DLS-8235</th>
<th>Required Enable Bit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>*OPC</td>
<td>Yes</td>
<td>No</td>
<td>Yes(^1)</td>
<td>No</td>
<td>Operation Complete, ESB</td>
</tr>
<tr>
<td>*OPC?</td>
<td>No</td>
<td>Yes</td>
<td>Yes(^2)</td>
<td>No</td>
<td>MAV</td>
</tr>
<tr>
<td>*WAI</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>none</td>
</tr>
</tbody>
</table>

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

The main difference between *OPC and *WAI is that *WAI blocks any further communication with the DLS-8235 until all pending operations are completed.

The main difference between *OPC and *OPC? is that *OPC sets the “Operation Complete” bit, and *OPC? returns 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-8235 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-8235 needs approximately two seconds to set a line segment length).
RS-232 Synchronization

When the DLS-8235 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-8235 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.
Chapter 6
Customer Support

To obtain technical support, refer to “How to Contact Us” on page 9.

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- Extended Warranty . . . . 68
- Three-Year Calibration Agreement . . . . 69
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

Spirent Communications' Extended Warranty gives two years in addition to the original one-year manufacturer’s warranty. 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 (1) year manufacturer's warranty.
Three-Year Calibration Agreement

Specific Spirent Communications products are shipped with a National Institute of Standards and Technology (NIST) traceable calibration that expires one year from the original ship date.

The Spirent Communications three-year calibration agreement gives the opportunity to invest in a yearly calibration for three (3) years at a significant cost saving, ensuring optimum product performance.

Spirent Communications sends out an email reminder when the next calibration is due. A report containing all calibration data is shipped with the product.

The Spirent Communications three-year calibration agreement provides:

• Three (3) annual NIST 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 Spirent Communications Customer Service for more information on these programs or visit us on the web at http://support.spirentcom.com.
Chapter 7
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 Customer Service department is shown on the outside.

**Note:** The RMA number is mandatory and must be obtained from a Spirent Communications Customer Service center before shipping the unit (see “How to Contact Us” on page 9 for details on how to contact the nearest Spirent Communications Customer Service center).
Chapter 8

Specifications

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• Associated Products . . . . 76
• Operating Conditions . . . . 76
### VDSL2 Wireline Simulator Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technology</strong></td>
<td>Cable simulation using passive circuits</td>
</tr>
<tr>
<td><strong>Type of Wire</strong></td>
<td>TP100 twisted pair</td>
</tr>
<tr>
<td><strong>Number of Conductors</strong></td>
<td>Two (single pair)</td>
</tr>
<tr>
<td><strong>Standard</strong></td>
<td>ETSI TS 101 270-1</td>
</tr>
<tr>
<td><strong>Simulated Loop</strong></td>
<td>TP100 Loop (0; 50 to 3,000 meters in 5 meter increments)</td>
</tr>
<tr>
<td><strong>Bandwidth</strong></td>
<td>DC to 30 MHz continuous frequency response</td>
</tr>
<tr>
<td><strong>Attenuation</strong></td>
<td>Smooth from 0 to -90 dB over the DC to 30 MHz bandwidth</td>
</tr>
<tr>
<td><strong>Attenuation Accuracy</strong></td>
<td>Max. MAE ≤ 0.5 dB after compensation as per table:</td>
</tr>
<tr>
<td></td>
<td><strong>Amax (dB)</strong></td>
</tr>
<tr>
<td></td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>70</td>
</tr>
<tr>
<td><strong>DC Resistance</strong></td>
<td>Typically better than ± 10%</td>
</tr>
<tr>
<td><strong>Impedance</strong></td>
<td>Typically better than ± 10%</td>
</tr>
<tr>
<td><strong>Group Delay</strong></td>
<td>Typically better than ± 5%</td>
</tr>
<tr>
<td><strong>Noise Floor</strong></td>
<td>≤ -150 dBm/Hz typical</td>
</tr>
<tr>
<td><strong>DC Rating</strong></td>
<td>± 200 V between tip and ring or tip/ring and ground. The maximum current is 125 mA (150 mA peak).</td>
</tr>
<tr>
<td><strong>Power Supply</strong></td>
<td>140 VA max: 100-240 VAC (50-60 Hz)</td>
</tr>
<tr>
<td><strong>Fuses</strong></td>
<td>Type ‘T’ 2A/250V Slow Blow (2 required, 5 mm x 20 mm)</td>
</tr>
</tbody>
</table>
Environmental Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Temperature</td>
<td>+10°C to +40°C (50°F to 104°F)</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-20°C to +70°C (-4° F to 158°F)</td>
</tr>
<tr>
<td>Humidity</td>
<td>90% (non-condensing) max.</td>
</tr>
</tbody>
</table>

Mechanical Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight per Chassis</td>
<td>28 kg. (61 lbs) max.</td>
</tr>
<tr>
<td>Dimensions per Chassis</td>
<td>194 mm x 452 mm x 494 mm (H x W x D) (7.6&quot; x 17.8&quot; x 19.4&quot;)</td>
</tr>
</tbody>
</table>

Remote Control

Two interfaces are supported:

- GPIB (IEEE 488)
- RS-232
Carton Contents

- One DLS-8235 chassis
- One power cord
- Two extra fuses
- One 9-to-25 pin adapter (RS-232)
- One RS–232C interconnection cable
- One GPIB interconnection cable
- One GPIB reverse entry extender
- Two RJ-45 interconnect cables: 30 cm (1 foot) long, Spirent part number 7102040514
- One DLS-8235 Software CD
- One Operating Manual CD
- One 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-5405 VDSL2 Noise Injector

Operating Conditions

In order for the unit to operate correctly and safely, it must be adequately ventilated. The DLS-8235 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.
Chapter 9
Safety

In this chapter...

• Information . . . . 78
• Instructions . . . . 80
• Symbols . . . . 81
Information

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.”

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.

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.

Fuses

The fuse type used is specified in Chapter 8, “Specifications.”
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.

Operating Environment

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

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.
Chapter 9: Safety

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

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.

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 to the power source.

Symbols

Below are the meanings of symbols that may appear on the unit.

![Symbol Diagram]

- EQUIPOTENTIALITY–FUNCTIONAL EARTH TERMINAL
- PROTECTIVE GROUNDING CONDUCTOR TERMINAL
- CAUTION - REFER TO ACCOMPANYING DOCUMENTS
Appendix A

Measurements

In this appendix...

• DLS-8235 Measurements . . . . 84
• Common Errors . . . . 85
DLS-8235 Measurements

Data for the characteristics of the simulated cable was obtained from the ETSI TS 101 270-1 document. Data for this type of cable is 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/VDSL1/ADSL2++/ADSL2+/ADSL2/ADSL and SHDSL frequency domain, the method shown in Figure A-1 is recommended.

![Figure A-1. DLS-8235 Electrical Characteristics Measurements](image)

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

Spirent Communications recommends 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 43.

**Warning:** Applying unbalanced signals to the DLS-8235 usually results in incorrect measurements.

**Note:** The above method and schematic apply only to the DLS-8235 VDSL2 Wireline Simulator.
Figure A-2 shows an example of one test setup option.

**Figure A-2. Test Setup**

### 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 condition 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 graphs in this appendix show theoretical versus measured electrical characteristics in graphical format for several DLS-8235 test results. Calculated and measured values for all parameters have been performed with 100 Ω terminations.

In this appendix...

• 100 Meters . . . . 88
• 500 Meters . . . . 91
• 1000 Meters . . . . 94
• 2000 Meters . . . . 97
• 3000 Meters . . . . 100
100 Meters

This section shows the following test results at 100 meters:

- Insertion loss (*Figure B-1*)
- Group delay (*Figure B-2 on page 89*)
- Impedance (*Figure B-3 on page 90*)

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**Figure B-1.** Insertion Loss at 100 Meters
Figure B-2. Group Delay at 100 Meters
Figure B-3. Impedance at 100 Meters
500 Meters

This section shows the following test results at 500 meters:

- Insertion loss (Figure B-4)
- Group delay (Figure B-5 on page 92)
- Impedance (Figure B-6 on page 93)

**Figure B-4.** Insertion Loss at 500 Meters
Figure B-5. Group Delay at 500 Meters
Figure B-6. Impedance at 500 Meters
1000 Meters

This section shows the following test results at 1000 meters:

- Insertion loss (Figure B-7)
- Group delay (Figure B-8 on page 95)
- Impedance (Figure B-9 on page 96)

**Figure B-7.** Insertion Loss at 1000 Meters
Figure B-8. Group Delay at 1000 Meters
Figure B-9. Impedance at 1000 Meters
2000 Meters

This section shows the following test results at 2000 meters:

- Insertion loss (Figure B-10)
- Group delay (Figure B-11 on page 98)
- Impedance (Figure B-12 on page 99)

![Graph showing insertion loss at 2000 meters]

Figure B-10. Insertion Loss at 2000 Meters
Figure B-11.  Group Delay at 2000 Meters
Figure B-12. Impedance at 2000 Meters
3000 Meters

This section shows the following test results at 3000 meters:

- Insertion loss (*Figure B-13*)
- Group delay (*Figure B-14 on page 101*)
- Impedance (*Figure B-15 on page 102*)

![Graph showing insertion loss at 3000 meters](Image)

*Figure B-13.* Insertion Loss at 3000 Meters
Figure B-14. Group Delay at 3000 Meters
Appendix B: Sample Test Results

3000 Meters

Figure B-15. Impedance at 3000 Meters
Appendix C

Background Noise Measurements

Background noise measurements for the 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 is not connected) is illustrated in Figure C-1.

![Figure C-1. HP 4395A Noise Floor](image)

*Figure C-1* demonstrates the Agilent 4395A spectrum/network analyzer’s noise floor over a bandwidth of 0-30 MHz. 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 noises with values close to the noise floor of the analyzer itself, results are inaccurate in that the analyzer’s noise adds to the noise of the device under test (DUT); the displayed result is worse than the real one.

In conclusion, the error introduced by the analyzer itself has to be taken into consideration when measuring noises with values close to -140 dBm/Hz.
Appendix D
ESD Requirements

Spirent Communications manufactures and sells products that require industry standard precautions to protect against damage from electrostatic discharge (ESD). This document explains the proper process for handling and storing electrostatic discharge sensitive (ESDS) devices, assemblies, and equipment.

The requirements presented in this document comply with the EIA Standard, ANSI/ESD S20.20-1999: Development of an Electrostatic Discharge Control Program, and apply to anyone who handles equipment that is sensitive to electrostatic discharge. Such equipment includes, but it not limited to:

- All electronic assemblies manufactured by Spirent Communications
- Discrete and integrated circuit semiconductors
- Hybrid microcircuits
- Thin film passive devices
- Memory modules

Caution: Failure to comply with the requirements explained in this document poses risks to the performance of ESDS devices, as well as to your investment in the equipment.

General Equipment Handling

Whenever you handle a piece of ESDS equipment, you must be properly grounded to avoid harming the equipment. Also, when transporting the equipment, it must be packaged properly. Follow the requirements below to help ensure equipment protection.

- Wrist straps must be worn by any person handling the equipment to provide normal grounding.
- The use of foot straps is encouraged to supplement normal grounding. If foot straps are used exclusively, two straps (one on each foot) should be used. Note that foot straps are only applicable in environments that use ESD flooring and/or floor mats.
- Hold ESDS equipment by the edges only; do not touch the electronic components or gold connectors.
- When transporting equipment between ESD protected work areas, the equipment must be contained in ESD protective packaging. Equipment that is received in ESD protective packaging must be opened either by a person who is properly grounded or at an ESD protected workstation.
• Any racks or carts used for the temporary storage or transport of ESDS equipment must be grounded either by drag chains or through direct connection to earth ground. Loose parts that are not protected by ESD-safe packaging must not be transported on carts.

Workstation Preparation

The ideal setup for working with ESDS equipment is a workstation designed specifically for that purpose. Figure D-1 illustrates an ESD protected workstation. Please follow the requirements listed below to prepare a proper ESD protected workstation.

• The ESD Ground must be the equipment earth ground. Equipment earth ground is the electrical ground (green) wire at the receptacles.

• An ESD protected workstation consists of a table or workbench with a static dissipative surface or mat that is connected to earth ground. A resistor in the grounding wire is optional, providing that surface resistance to ground is \( \leq 10^9 \) \( \Omega \).

• The workstation must provide for the connection of a wrist strap. The wrist strap must contain a current limiting resistor with a value from \( \geq 250K \) \( \Omega \) to \( \leq 10M \) \( \Omega \).

• ESD protective flooring or floor mats are required when floor-grounding devices (foot straps/footwear) are used or when it is necessary to move in between ESD protected workstations when handling ESDS equipment.

Figure D-1. ESD Protected Workstation

Note: The equipment needed for proper grounding is available in ESD service kits, such as the ESD Field Service Kit available from Spirent Communications (P/N 170-1800). Additional information on ESD can be found on the following website: http://www.esda.org/aboutesd.html
Appendix E

Fiber Optic Cleaning Guidelines

Spirent Communications manufactures and sells products that contain fiber optic components, including fiber optic transmitters and receivers. These components are extremely susceptible to contamination by particles of dirt or dust, which can obstruct the optic path and cause performance degradation. To ensure optimum product performance, it is important that all optics and connector ferrules be kept clean.

This document presents guidelines for maintaining clean fiber optic components. Spirent Communications recommends that these guidelines be followed very closely.

Caution: • Failure to comply with the guidelines explained in this document poses risks to the performance of fiber optic-based devices, as well as to your investment in the equipment.

• Whenever you handle a piece of equipment that contains fiber optic components, you must be properly grounded to avoid harming the equipment. See the Appendix in this document titled ESD Requirements for more details on electrostatic discharge (ESD).

Cleaning Guidelines

To ensure the cleanliness of fiber optic components, follow the guidelines below:

• Use fiber patch cords (or connectors if you terminate your own fiber) only from a reputable supplier. Low-quality components can cause many hard-to-diagnose problems during an installation.

• Dust caps are typically installed on fiber optic components to ensure factory-clean optical devices. These protective caps should not be removed until the moment of connecting the fiber cable to the device. Ensure that the fiber is properly terminated, polished, and free of any dust or dirt. Also make sure that the location of installation is as free of dust and dirt as possible.

• Should it be necessary to disconnect the fiber device, reinstall the protective dust caps.

• If you suspect that the optics have been contaminated, alternate between blasting with clean, dry, compressed air and flushing with methanol to remove particles of dirt.