



Operating Manual

DLS 414E/415 E

ADSL2++ Wireline Simulator

Version 1
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1. INTRODUCTION

1.1 About Spirent's Involvement in Wireline Simulation

Thank you for choosing Spirent Communications.

Spirent Communications has been in the wireline simulation business for over 15 years and has designed many new simulators both to customers' specifications and to conform to an ever-growing range of standards.

Over years of ADSL interoperability and deployment, a need to improve performance and support new applications, services and deployment scenarios, with minimized replacement of existing equipment, has been seen by carriers worldwide. Echoing this, improvements, clarifications and changes to conventional ADSL technology have been reflected in different versions of ADSL standards, namely G.992.1 (G.dmt), G.992.3 (G.dmt.bis) and G.992.5 (ADSL2plus), which are also known as ADSL, ADSL2, ADSL2+ (and ADSL2++) respectively.

Specifically, the newest technology ADSL2++ features improved interoperability, enhanced rate and reach, as well as new functionality including diagnostics, seamless rate adaptation, power-down mode, channelized VoDSL, etc. ADSL2+ supports bandwidths up to 2.2 MHz, while ADSL2++ has been seen in a context that indicates useable DSL bandwidth up to 4.4 MHz.

This consequently developed a need for physical layer simulation systems (both wireline and noise impairment) that enable testing of ADSL2++ technology. Spirent Communications developed the first ADSL2++ test solutions, consisting of the DLS 414E/415E ADSL2++ Wireline Simulators and the DLS 5200R Reach Noise Generation System. There are 2 models in the DLS 414E/415E:

- 1) The DLS 414E European ADSL2++ Wireline Simulator (a PE 04 straight loop simulator that covers the frequency band of 0 to 4.5 MHz)
- 2) The DLS 415E European ADSL2++ Wireline Simulator (a PE 05 straight loop simulator that covers the frequency band of 0 to 4.5 MHz)

1.2 About DLS 414E/415E ADSL2++ Wireline Simulators

The DLS 414E/415E ADSL2++ Wireline Simulators (414E shown in Figure 1.1) reproduce 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 is properly simulated.

Both the DLS 414E and the DLS 415E chassis have the same physical front and rear panel. The only visual difference is the identifying sticker in the bottom right-hand corner of the front panel. Each model is a single chassis which provides two ports for external noise injection via the DLS 5200R Reach Noise Generation System for ADSL2++. The system offers an automatic relay refresh feature.



Figure 1.1 DLS 414E ADSL2++ Wireline Simulator

The DLS 415E European ADSL2++ Wireline Simulator simulates the loop shown in Figure 1.2 (with a 25 m granularity) and has a bandwidth of DC to 4.5 MHz.

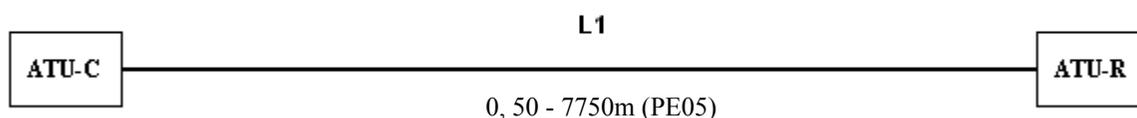


Figure 1.2 European ADSL2++ 0.5 mm PE Straight Loop

The DLS 414E European ADSL2++ Wireline Simulator simulates the loop shown in Figure 1.3 (with a 25 m granularity) and has a bandwidth of DC to 4.5 MHz.

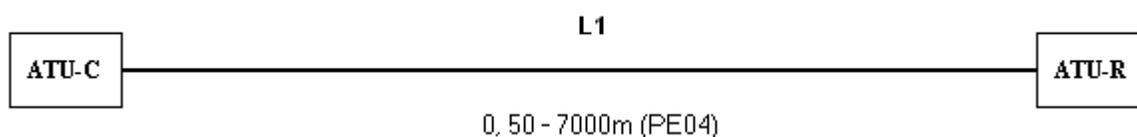


Figure 1.3 European ADSL2++ 0.4 mm PE Straight Loop

The DLS 414E/415E ADSL2++ Wireline Simulators and the DLS 5200R Reach Noise Generation System are an integrated system designed with the required wireline simulation and noise files to support ADSL2++ testing. The simulator's front panel interfaces can be connected to up to two noise sources and/or external test devices for easy integration into a larger test system. These simulators include an 'Extend' feature that allows insertion of a second low frequency simulator at the midpoint of the DLS 414E/415E at maximum reach.

The DLS 414E/415E Software configures and controls the DLS 414E/415E ADSL2++ Wireline Simulators remotely through the IEEE 488 or RS-232 interfaces. The software runs on any Windows™ 98/NT/2000 compatible computer. The IEEE 488 and RS-232 interfaces allow the easy integration of these wireline simulators into a larger test system. You can also control the DLS 414E/415E ADSL2++ Wireline Simulators with scripts using SCPI commands.

1.3 About the Test Setup

Globally, consensus is yet to be reached on the next generation ADSL standardization, ITU-T Draft Recommendation G.992.5 (ADSL2plus) being the working document.

Although 2.2 MHz is currently set as the upper limit of ADSL2+, the DLS 414E/415E covers the frequency band up to 4.5 MHz because the number of vendors and service providers who have started to investigate the so-called quadruple bandwidth technique has implied that 4.4 MHz might be the ultimate upper limit of the usable ADSL band. When the scenario of ADSL2+ to ADSL2+++ migration is seen, the band from 2.2 MHz to 4.4 MHz will be necessary.

The DLS 414E/415E allows full duplex signal transmission. It simulates all the characteristics (attenuation, group delay and characteristics impedance) of the European PE 0.4/0.5 mm straight loop that covers the North American ADSL2++ frequency spectrum. The attenuation (insertion loss), impedance and group delay is identical for both downstream and upstream signals.

Using this test set-up enables you to be certain that the device under test (DUT) will pass ITU-T certification testing. The DLS 414E/415E and DLS 5200R system offer a comprehensive and accurate test bed for

ADSL2++ testing. Spirent AE solution users know that this advantage translates into robust performance, earlier product delivery and greater market share. For more information on compatible Spirent Communications products, see the *About Related Documentation and Products* section of this chapter.

Figure 1.4 illustrates an example of a typical test setup using the DLS 414E/415E ADSL2++ Wireline Simulators.

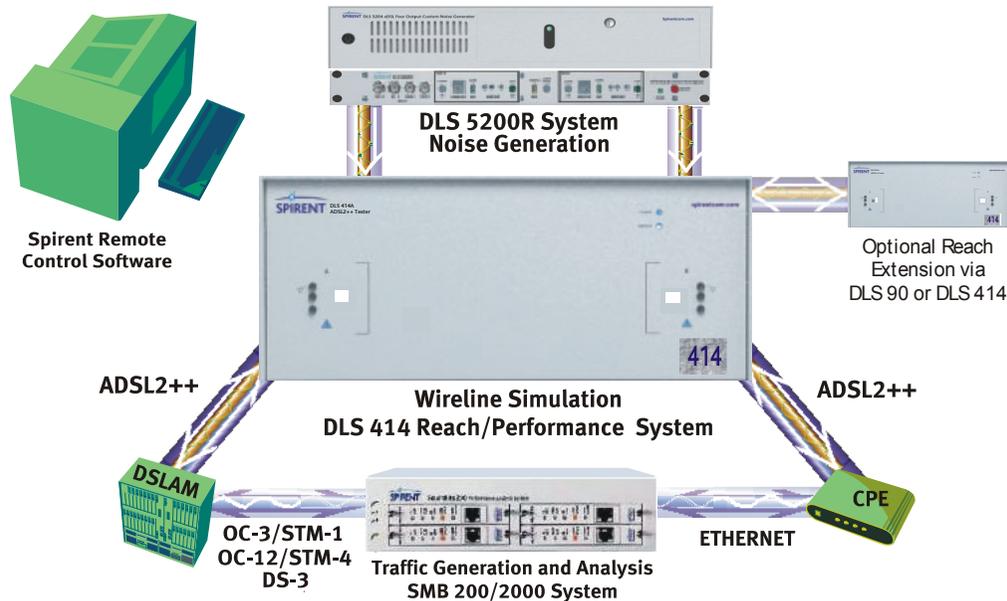


Figure 1.4 Example Test System Setup

1.4 About this Manual

You should read Chapter 2 "GETTING STARTED" thoroughly before powering up the DLS 414E/415E ADSL2++ Wireline Simulators. 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.

We recommend you use our DLS 414E/415E Software to configure and control the wireline simulator. However, we detail common and device specific command sets that can be sent to the wireline simulator's control module through the IEEE 488 or RS-232 interfaces, in Chapter 4 "REMOTE CONTROL".

If there are any questions after reading this manual, please contact your Spirent Communications sales representative or a member of the Customer Service team. Please find contact information in Chapter 6 "CUSTOMER SUPPORT" of this manual.

1.4.1 About Related Documentation and Products

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

<http://ae.spirentcom.com/extranet.htm>.

- DLS 5204 Operating Manual

For new customers, please contact Spirent Communications Customer Service about getting access to the site. Apply for a password at:

<http://ae.spirentcom.com/extranet.htm>.

2. GETTING STARTED

This chapter provides basic instructions on the setup of a DLS 414E/415E ADSL2++ Wireline Simulators.

2.1 Receiving and Unpacking the Unit

Each DLS 414E/415E chassis has been shipped in a reinforced shipping container. Please retain this container in case you need to ship the wireline simulator to another location or for repair. The DLS 414E/415E system contains the following:

- DLS 414E/415E chassis
- 1 power cord
- 2 extra fuses
- 1 9 to 25 pin adapter (RS-232)
- 1 RS-232C inter-connection cable
- 1 IEEE 488 inter-connection cable
- 1 IEEE reverser
- DLS 414E/415E Software
- 1 Operating Manual CD

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

2.2 Setup Overview

To test:

- 1) Connect the power cord to the DLS 414E/415E and switch the power on.
- 2) Connect a IEEE reverser to the IEEE 488 port on the back of the 414E/415E chassis.
- 3) Connect an IEEE inter-connection cable from the computer to the DLS 414E/415E. If you are using a serial port on a laptop computer (rather than the IEEE port), you may need to connect the 9 to 25 pin adapter to the computer serial port before connecting the RS-232 inter-connection cable.
Note: Only one DLS 414E/415E system should be connected to the control computer at a time.
- 4) If added reach is required, connect the additional wireline simulator to the appropriate RJ-45 connectors on the back panel of the DLS 414E/415E.
- 5) Connect your digital subscriber line access multiplexer (DSLAM) equipment to side A of the DLS 414E/415E.
- 6) Connect your customer premise equipment (CPE) equipment to side B of the DLS 414E/415E.
- 7) Start the DLS 414E/415E Software.
- 8) Adjust the line lengths for the test loop.
- 9) Select the desired impairments if a DLS 5200R Reach Noise Generation System is available.
- 10) Begin testing.

See the following sections for detailed information.

2.3 Cabling Requirements

Cabling, switches and other equipment are needed to connect the DSLAM, the loop simulator, the noise generator and the CPE. Cables should be kept as short as possible so minimum noise is coupled into the cables. Recommended cables are the CAT5 UTP. Since the length is typically short (e.g., 60 cm), this does not affect measurements.

Computer screen and power supplies radiate in ADSL2++ frequency bands. This noise may be generated by either internal or external power supplies. When the pick up noise levels are greater than -140 dBm /Hz, they will limit the ADSL2++ performance and influence the test results. These devices should be placed at a distance from the test setup or even switched off.

Ports NA and NB wiring as well as Side A and Side B interconnection wiring should be physically separated as crosstalk can occur between cabling. Configure the cables so that they are not touching and the cable connecting to the DSLAM and CPE are separated as much as possible (at least 6in/15 cm).

2.4 Front Panel Components and Connections

The DLS 414E/415E simulates a straight single gauge segment with variable length as per Figure 1.2 "European ADSL2++ 0.5 mm PE Straight Loop" for the DLS 415E, or Figure 1.3 "European ADSL2++ 0.4 mm PE Straight Loop" for the DLS 414E. Both the DLS 414E and the DLS 415E chassis have the same physical front and rear panel. The only visual difference is the identifying sticker in the bottom right-hand corner of the front panel. The connections on the front panel are used for connecting devices under test (DUT) and/or noise sources and reading the power and remote status. Figure 2.1 displays the key components of the front panel.

Note: Front panel states the connectors' input requirements of "+37dBm Max" (Referring to Section E.4.1 of G.test - A signal of +36dBm at 400Hz may be used as a howler signal) and of "+/-200VDC Max".

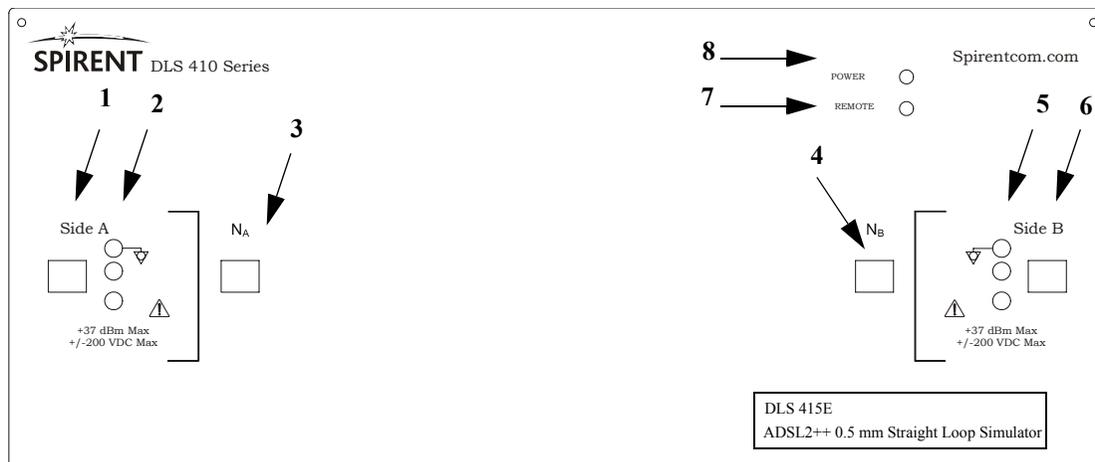


Figure 2.1 DLS 414E ADSL2++ Wireline Simulator Front Panel

DLS 414E/415E Front Panel Components

1. **Side A, RJ-45 connector:** used to connect a DUT
2. **Side A, balanced CF connector:** used to connect a DUT
3. **NA, RJ-45 connector:** used to connect a noise generator at Side A
4. **NB, RJ-45 connector:** used to connect a noise generator at Side B
5. **Side B, balanced CF connector:** used to connect a DUT
6. **Side B, RJ-45 connector:** used to connect a DUT
7. **Remote LED:** indicates the remote status
8. **Power LED:** indicates the power status

2.4.1 Reading Remote and Power Status

The DLS 414E/415E chassis has 2 LEDs which indicate the power and remote status.

The POWER LED turns green when the power is turned on. The power LED blinks red if it fails its self-test, or yellow if it detects an internal error.

The REMOTE LED is off after a power-up or a reset. When the unit receives the first remote message, the REMOTE LED turns green if the command is valid or turns red if an error is detected. An invalid command or an out-of-range value will cause an error. The REMOTE LED stays red until the error flags are cleared (see the command *ESR? for more details). When the REMOTE LED is red, the unit can still communicate as normal, but you should investigate why the error occurred. Chapter 4 "REMOTE CONTROL" shows examples on how to read the ESR register, clear the error flags and make the REMOTE LED green once error conditions have been resolved.

2.4.2 Injecting Noise in the System

You can inject externally-generated impairments using the RJ45 connectors to the NA and NB ports on the front the DLS 414E/415E chassis. An external noise impairment generator can be purchased which can inject noise differentially onto the wireline. See Section 2.4.4 for RJ-45 connector details.

The DLS 5200R Reach Noise Generation System can generate both user-defined and pre-packaged noise shapes from DC to 12 MHz. It provides convenient noise injection circuitry for any of the test loops. For more information on the DLS 5200R product, see the *DLS 5204 Operating Manual*.

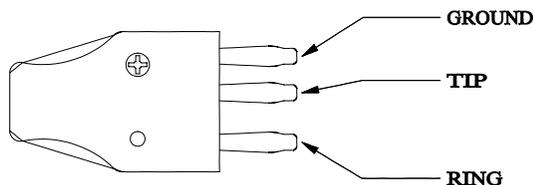
To enable/disable the external noise injection ports, use remote control commands or the control software. It is not necessary to disconnect the cables from NA and NB ports.

2.4.3 Connecting to Analog Devices with CF Connectors

In a typical setup the Telephone Exchange (Central Office) equipment would be connected to Side A and the customer site equipment to Side B of the DLS 414E/415E wireline simulator.

The CF connector is a balanced 3-pin (ring, tip, ground) connector. It is possible to use banana plugs instead of the CF connector, but note that the distance between the pins is not the 0.75" spacing used in North America.

The DLS 414E/415E wireline simulator provides bi-directional wireline simulation.



A CF plug looks like the diagram at the left. There are 3 prongs spaced unevenly, as shown. You can use banana plugs if the correctly spaced CF connector is not available.

Note that all 3-pin CF connectors on each side are balanced and connected in parallel.

WARNING: The maximum input to the DLS 414E/415E should not exceed +/-200 V between Tip and Ring and 125 mA. Exceeding these limits could damage the unit.

2.4.4 Connecting to Analog Devices with RJ-45 Connectors

In a typical setup the Telephone Exchange (Central Office) equipment would be connected to side A and the customer site equipment to side B of the DLS 414E/415E wireline simulator. The pinout of the RJ-45 female connector is shown in Figure 2.2.

In some cases, twisting of the Bantam connectors has introduced unwanted noise in testing. An RJ-45 connection resolves this problem.

Wiring

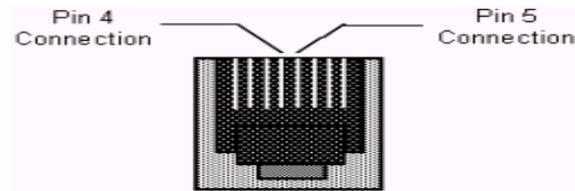


Figure 2.2 RJ-45 Female Connector

In Figure 2.2 "RJ-45 Female Connector", Pins 4 (Tip) and 5 (Ring) of the RJ-45 connectors, the center 2 pins, carry the signal.

Note: RJ-11 male connectors can also mate to RJ-45 female receptacles.

These connections are balanced. We recommend that these leads be shorter than 60 cm if you are using frequencies up to 4.5 MHz. It is possible to use longer leads as the frequency decreases.

WARNING: The maximum input to the DLS 414E/415E should not exceed +/-200 V between Tip and Ring and 125 mA. Exceeding these limits could damage the unit.

2.5 Back Panel Components and Connections

The connections on the rear panel are used for remote control (computer with DLS 414E/415E Software), extended reach and power. Figure 2.3 displays the key components of the rear panel.

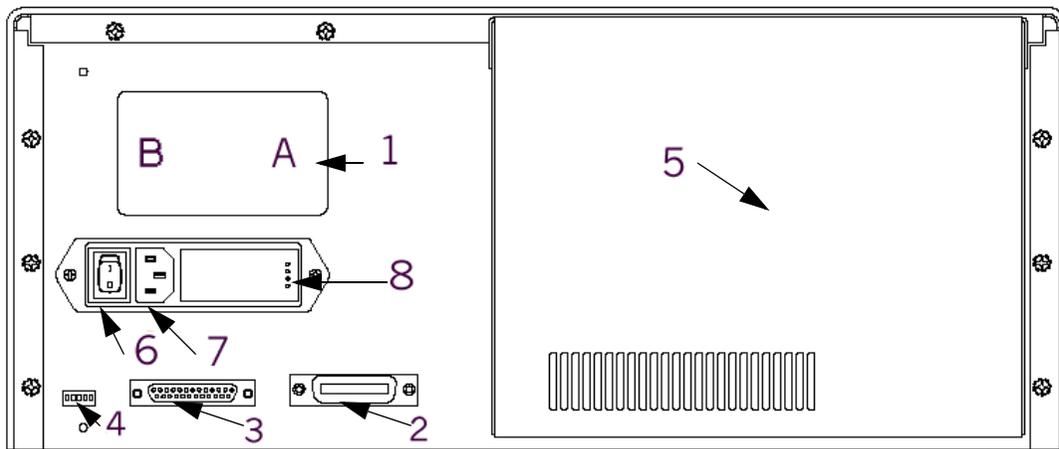


Figure 2.3 DLS 414E/415E ADSL2++ Wireline Simulator Back Panel

DLS 414E/415E Back Panel Components

- 1) **RJ-45 Reach Extension Connectors:** for connecting an additional wireline simulator
- 2) **IEEE 488 Connector:** for connection to a computer for remote control.
- 3) **RS-232 (DCE) Serial Connector:** for connection to a computer for remote control
- 4) **IEEE 488 Address DIP Switch:** used to set a unique address for the unit
- 5) **Power Supply**
- 6) **Power Switch:** for turning power to the unit on or off
- 7) **Power Input:** for connecting to an AC power source
- 8) **Fuse Box:** for fuse replacement when required

2.5.5 Connecting to Power

The DLS 414E/415E chassis is built with a 2-fuse configuration. Please refer to Chapter 10 "SAFETY" for more details.

Connect the power input which can be found at the back of the DLS 414E/415E chassis to an AC line, voltage between 90 and 240 V_{RMS} +/-10% and a frequency of 50 to 60 Hz. The DLS 414E/415E can work with any voltage and frequency in this range, switch settings are not required.

The DLS 414E/415E ADSL2++ Wireline Simulators always powers-up in an "idle" state. When powered off, the DLS 414E/415E remains latched to the previously selected loop settings, allowing the unit to be used when power is turned off.

2.5.6 Connecting Another Simulator

The maximum length of the DLS 415E is 7750 m and the maximum length of the DLS 414E is 7000 m. If you wish to extend the length of line simulation, a reach extension port consisting of 2 RJ-45 connectors is available at the back of the DLS 414E/415E. The RJ-45 connection labelled A should be connected to side A of the additional simulator. The RJ-45 connection labelled B should be connected to side B of the additional simulator.

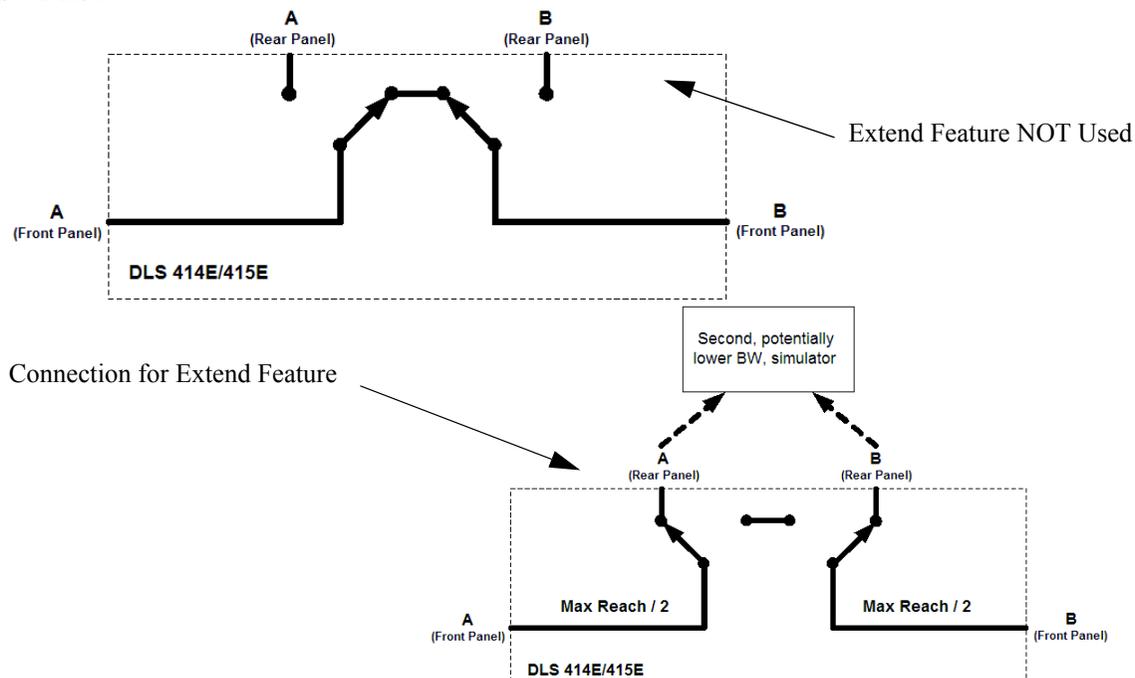


Figure 2.4 Extend Feature Connections

When using this extended reach set-up, the 'Extended Reach' option must be turned on in the DLS 414E/415E Software or via an automated script. The extended reach option may only be turned on when the DLS 414E/415E is set to its maximum length in the software or when the coarse value is set at or above a minimum level from a script. Once the Extend function is enabled, all distances larger than the maximum reach are controlled from the low frequency simulator (the DLS 414E remains at 7000 meters and the DLS 415E remains at 7750 meters).

At this length, the insertion loss for frequencies above 1.1 MHz is very high, making this portion of the DLS 414E/415E bandwidth (1.1Mz -4.4 MHz) un-usable. Therefore, the extended reach unit could be a DLS 90 or DLS 400XX unit, which operates in the range of DC-1.1 MHz.

2.5.7 Connecting to a Windows Computer (for Remote Control)

You configure the DLS 414E/415E ADSL2++ Wireline Simulators remotely via a computer connected to either an IEEE 488 or an RS-232 interface on the rear panel of the simulator. There are two options available to control the DLS 414E/415E, one being Spirent Communications's DLS 414E/415E Software, or the second being custom software / scripting using command sets.

The DLS 414E/415E Software allows you to select the simulated length of the wireline loops. If you are developing custom control software, refer to Chapter 4 "REMOTE CONTROL" which discusses the accepted commands to configure the unit.

2.5.7.1 Connecting the Computer via the IEEE 488 Port (GPIB)

The IEEE 488 portion of the control software supplied by Spirent Communications only works with a National™ IEEE 488 interface card. If necessary, install the National™ IEEE 488 interface card in the computer. Please refer to the "NATIONAL INSTRUMENTS GPIB CARD AND SOFTWARE INSTALLATION" for information on how to install the NI card.

Connect one end of an IEEE 488 cable to the IEEE 488 connector located on the back panel of the DLS 414E/415E. Connect the other end of the IEEE 488 cable to the IEEE 488 interface card in the computer.

No two units on the same IEEE bus can have the same IEEE 488 address. In association with the system, the DLS 414E/415E ADSL2++ Wireline Simulators can use any valid IEEE 488 address (from 0 to 30). You can change the address by using the DIP switch on the back of the unit. For more information see Section 4.1 "IEEE 488 Interface".

The weighting is as follows:

Table 2-1: Dip Switch Weightings

Dip Switch	Weighting
AD5	16
AD4	8
AD3	4
AD2	2
AD1	1

The following figure shows the default switch setting which is set to address 14 (i.e. 0+8+4+2++0=14):



2.5.7.2 Connecting the Computer via the Serial Port (RS-232)

Connect one end of an RS-232 serial cable to the RS-232 connector located on the back panel of the DLS 414E/415E chassis and the other end to a serial COM port connector on the computer.

If using a laptop computer, you may need to connect the 9 to 25 pin adapter to the computer serial port and then connect the RS-232 cable.

The DLS 414E/415E Software can be set to connect to serial port COM1 to COM9. Make sure there is no conflict with other serial devices.

3. CONTROL SOFTWARE

3.1 About the Software

The DLS 414E and the DLS 415E each have their own version of software. However, their functionality is virtually identical. Differences between the DLS 414E and DLS 415E software are relatively minor, and are discussed where relevant.

If you connect the computer to the simulator via the IEEE 488 (GPIB) port, ensure you install the National Instruments GPIB - PC II/IIA or PCMCIA card and its associated software in your computer. Please note that the DLS 414E/415E Software uses GPIB card 0. For more information please refer to National Instruments device-specific documentation and on-line help.

3.1.1 GPIB Settings

If you connect the computer to the simulator via the IEEE 488 (GPIB) port, ensure you install the National Instruments GPIB - PC II/IIA or PCMCIA card and its associated software in your computer. Here is a list of steps you should follow to ensure your GPIB set-up is correct.

1) Board level configuration

Make sure the GPIB board is configured properly. The easiest way to do this is to open the Measurement & Automation Explorer that is installed with the National Instruments software. To open the Measurement & Automation Explorer explorer go to Start--> Programs--> National Instruments--> Measurement and Automation..

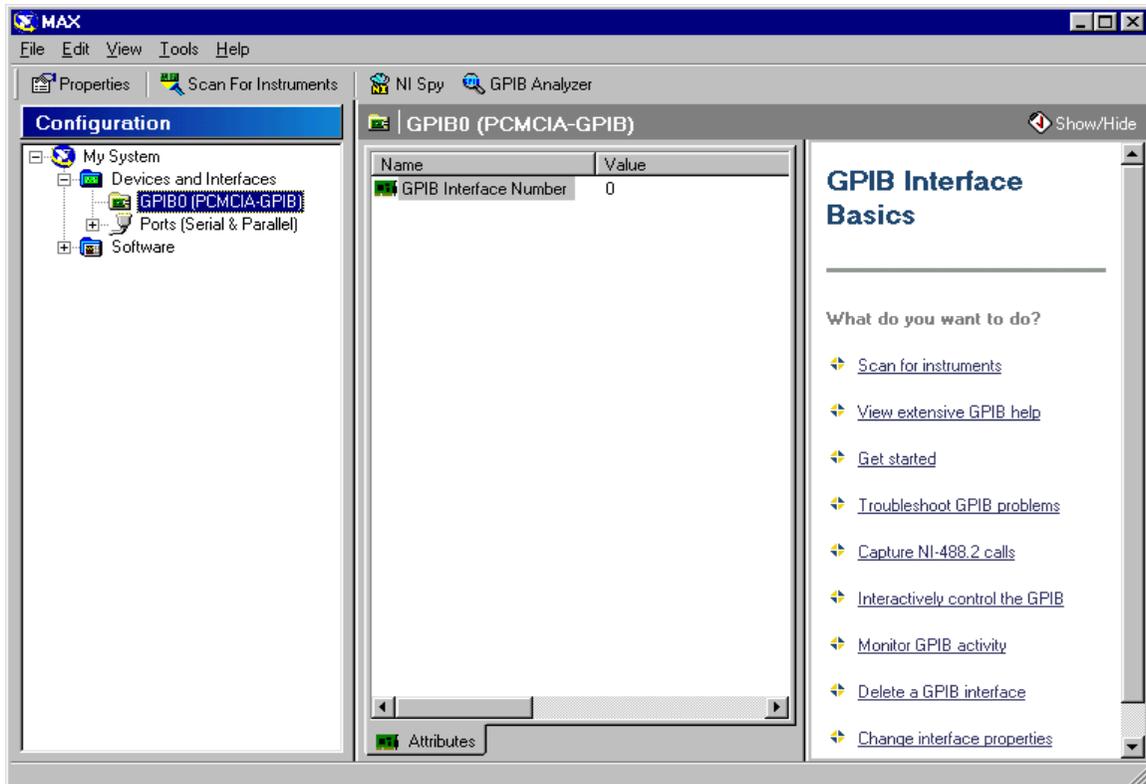


Figure 3.1 Measurement and Automation Explorer

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

- 1) disable automatic serial polling
- 2) disable high speed data transfer
- 3) enable system controller
- 4) enable "Assert REN when SC"
- 5) enable "Send EOI at end of write"
- 6) 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.

3.1.1 Computer Hardware and Software Requirements

You require the following to configure and control a simulator through either the serial port or IEEE 488 interface:

- If using the DLS 414E/415E Software (provided with the unit):
 - a computer running a version of the Windows® based operating system.
 - National Instruments GPIB-PCII/GPIB-PCMCIA, and
 - IEEE 488 cable
- OR
- Serial port, and
 - RS-232 serial cable.

The DLS 414E/415E Software provided by Spirent Communications allows the control of the DLS 414E/415E units either through an RS-232 or IEEE 488 interface. Please see the release notes of the DLS 414E/415E Software for a list of the current versions of Windows supported.

- Control of the simulator may also be done through writing custom software to send commands over the RS-232 or IEEE 488 port. See Chapter 4 "REMOTE CONTROL" for details about accepted commands.

3.2 Installing the Software

Insert the DLS 414E/415E Software Installation CD in the computer CD drive. The Setup Wizard is displayed if the CD autorun is enabled (in Windows). If the Setup Wizard does not appear, click the **Start** button, click **Run** and type <drive>:\setup. For example, if the CD-ROM is the E drive, type E:\setup. Once the Installation Wizard starts, simply follow the instructions on the Wizard's series of dialog boxes. You are given the option to install the DLS Terminal after the DLS 414E/415E Software has been installed. It is recommended that you install the DLS terminal by choosing the 'Install DLS Terminal' check box pictured below.

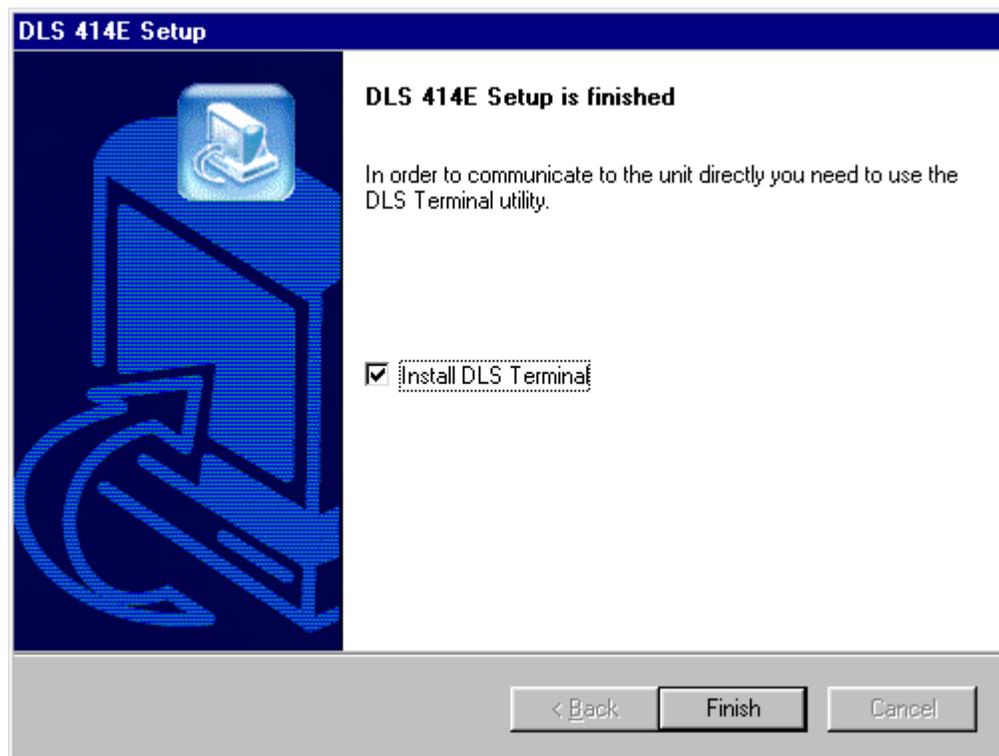


Figure 3.2 Final Screen for Installing the DLS 414E Software

3.2.2 Starting the Software

You can find the program executable file in the default installation folder.

For the DLS 415E this is:

C:/Program Files/Spirent Communications/DLS 415E/DLS 415E.exe.

For the DLS 414E this is:

C:/Program Files/Spirent Communications/DLS 414E/DLS 414E.exe.

Right-mouse click on the file name to create a short-cut to your desktop.

To access the main window:

From the **Start** menu, select Program Files>Spirent Communications> DLS 414E/415E> DLS 414E/415E or double-click the icon on your desktop. The **DLS 414E/415E** software window appears.

3.2.3 Accessing the Control Window (s)

The DLS 414E/415E control window has a tab for setting system properties and a tab for setting the communication interface. The DLS 414E/415E Software also has a tab for setting system compensation.

The control window also displays a **Loop Drawing** area and a **Command Logs** area. The **Loop Drawing** area graphically displays the simulated loop. The **Command Logs** area lists the controls commands being sent from the control computer to the wireline simulator.

The System Properties tab appears active in the DLS 414E/415E by default. At any time you can access system properties by clicking the tab title.

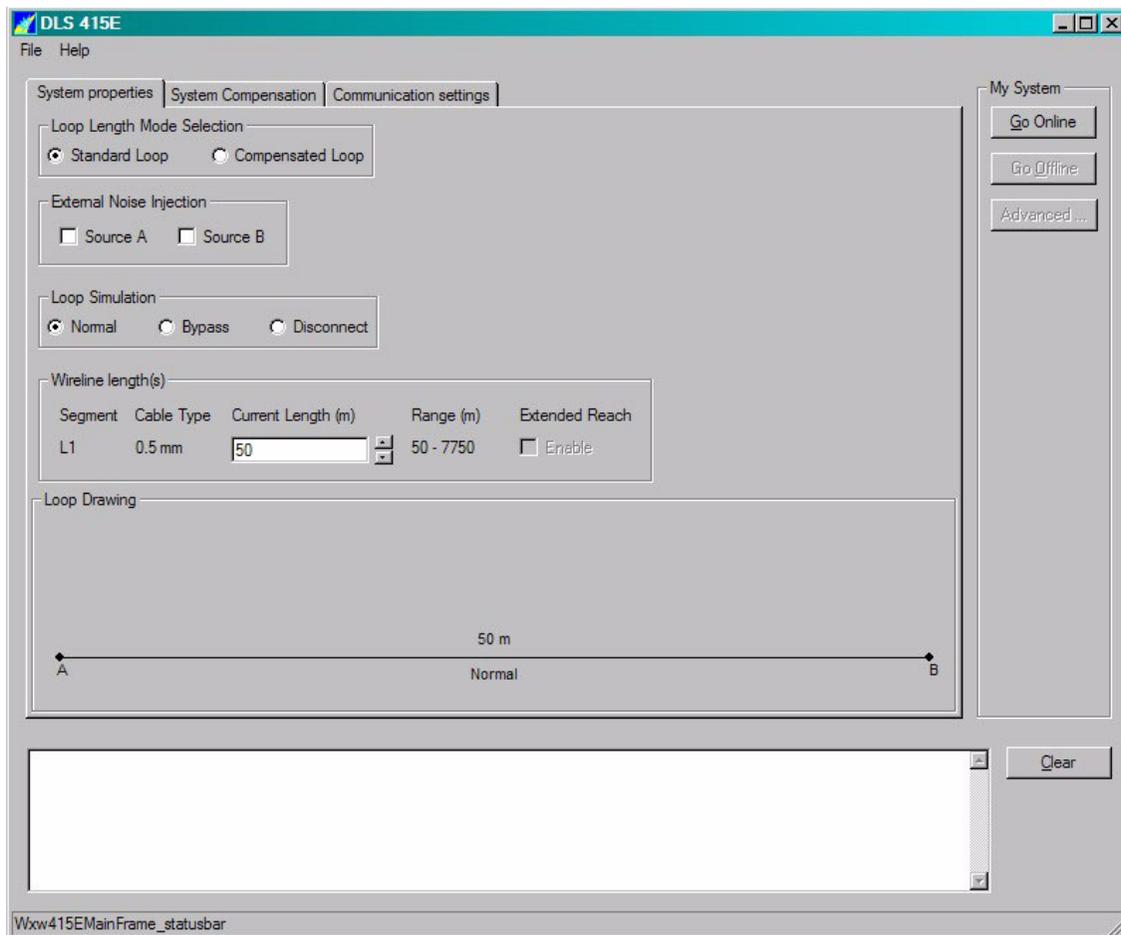


Figure 3.3 DLS 415E Control Software - System Properties Tab

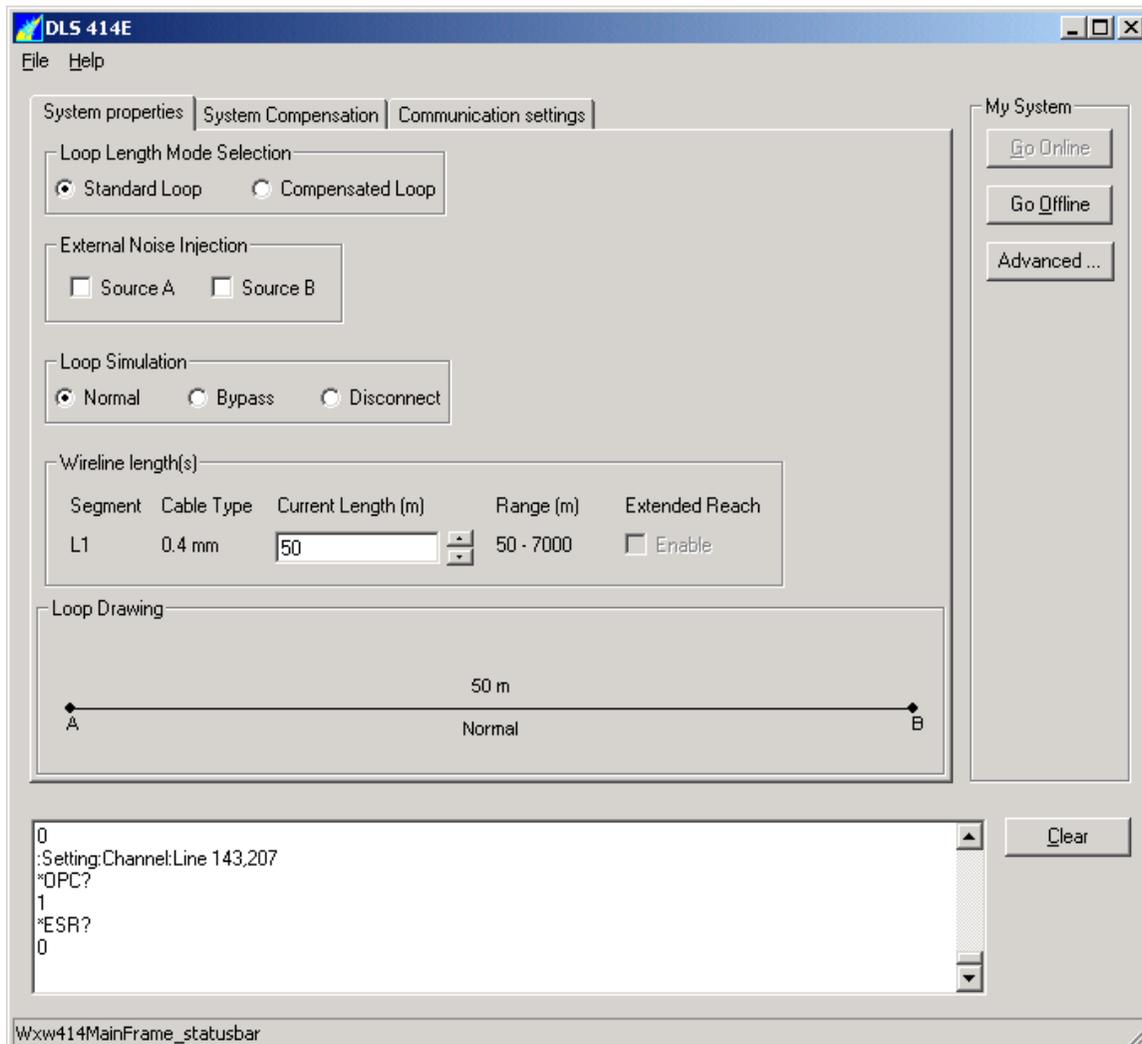


Figure 3.4 DLS 414E Control Software - System Properties Tab

To access the communications interface settings:

In the **DLS 414E/415E** window, click the Communication Settings tab. The **DLS 414E/415E** window appears with the Communication Interface Tab active. (The title bar is specific to the unit but the window contents are the same for both models).

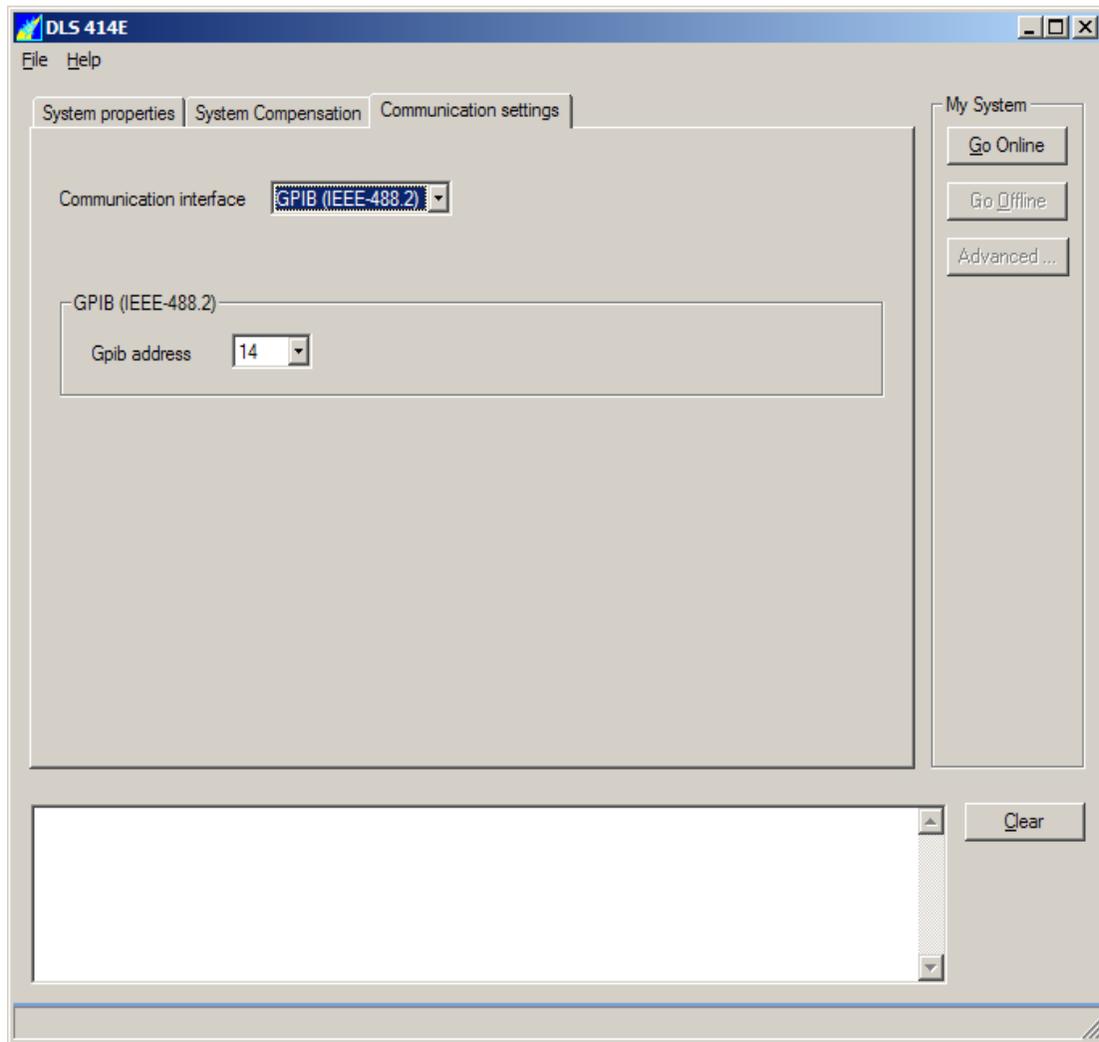


Figure 3.5 DLS 414E Control Software - Communication Settings Tab

To access the system compensation settings:

In the **DLS 414E/415E** window, click the System Compensation tab. The **DLS 414E/415E** window appears with the System Compensation Tab active. (The title bar is specific to the unit but the window contents are the same for both models).

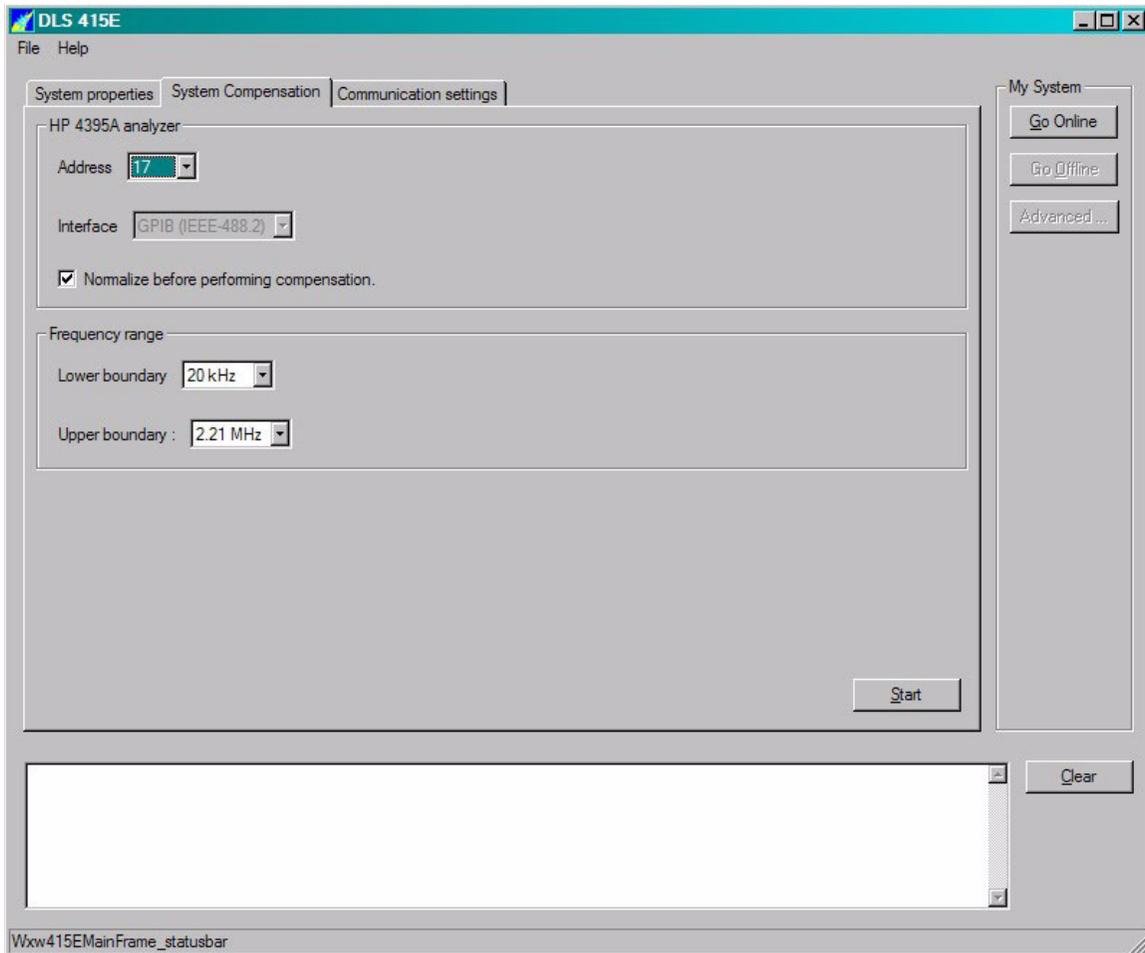


Figure 3.6 DLS 415E Control Software - System Compensation Tab

3.2.4 Accessing the Advanced Settings

For additional information required for troubleshooting or resetting the unit, in the DLS 414E/415E window click the **Advanced** button. The **Advanced** dialog box appears. (The title bar is specific to the unit but the window contents are the same for both models).

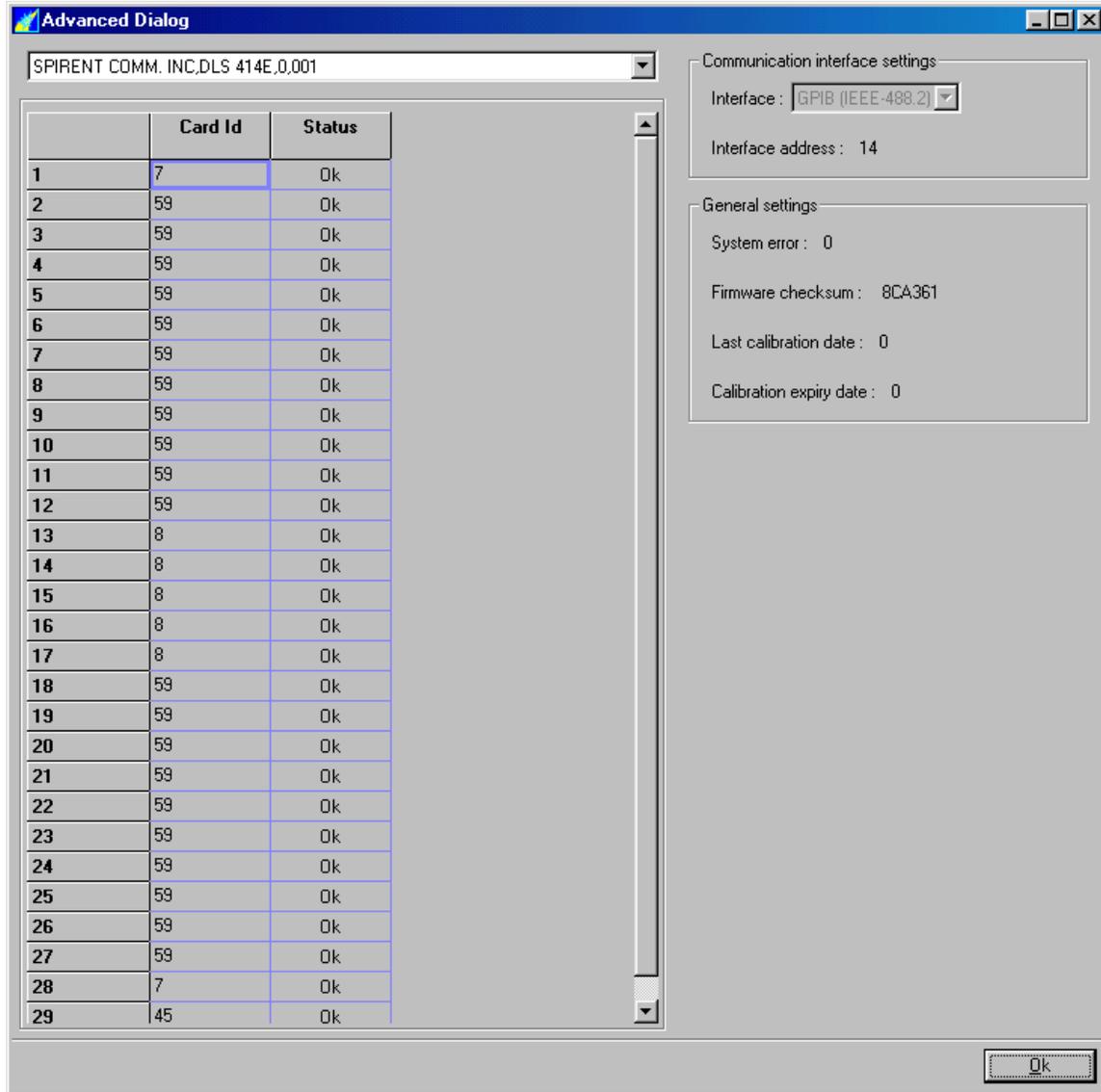


Figure 3.7 DLS 414E Advanced Dialog Box

3.2.5 Accessing the DLS Terminal Window

The DLS Terminal window is used to view the communication settings on the communication bus (serial or GPIB). It can be installed as a part of the DLS 414E/415E Software (see Chapter 3.2 "Installing the Software" for information on installing the DLS Terminal). To access the DLS Terminal Window, from the **Start** menu, select Program Files>Spirent Communications> DLS Terminal> DLS Terminal. The **DLS Terminal** window appears.

3.3 Configuring the DLS 414E/415E

3.3.1 Configuring the DLS 415E

You can vary the length of the simulated line segment from 0 (bypass) or 50 m to 7750 m in 25 m increments, as shown in Figure 3.8. The simulator configures dynamically as you change values in the software (see Section 3.3.7).

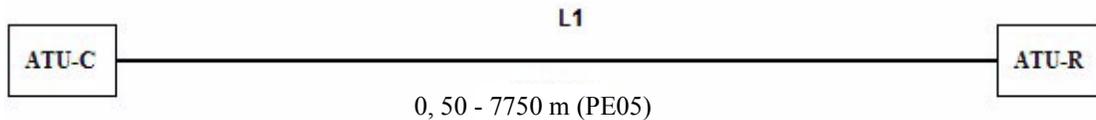


Figure 3.8 Wireline Segment Simulated by DLS 415E

3.3.2 Configuring the DLS 414E

You can vary the length of the simulated line segment from 0 (bypass), or 50 m to 7000 m in 25 m increments, as shown in Figure 3.9. The simulator configures dynamically as you change values in the software (see Section 3.3.7).

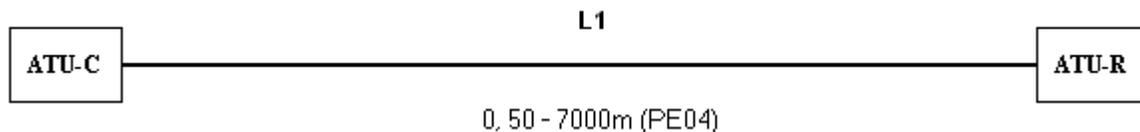


Figure 3.9 Wireline Segment Simulated by DLS 414E

3.3.3 Configuring for Extended Reach

The maximum length of the DLS 415E is 7750 m and the maximum length of the DLS 414E is 7000 m. If you wish to extend the length of line simulation, a reach extension port consisting of 2 RJ-45 connectors is available at the back of the DLS 414E/415E (see Section 2.5.6 "Connecting Another Simulator" for connection and extended reach simulator information). The extended reach option may only be turned on when the DLS 414E/415E is set to its maximum length in the software (see Section 3.3.7). Once the Extend function is enabled, all distances larger than the maximum reach are controlled from the low frequency simulator (the DLS 414E remains at 7000 meters and the DLS 415E remains at 7750 meters).

3.3.4 Identifying Simulator Connection

The software does not allow control of multiple DLS 414E/415E units via the IEEE 488 interface. In order to control multiple DLS 414E/415E units, multiple sessions of the DLS 414E/415E Software must be used. In the **DLS 414E/415E- Communication Interface** window, set the following fields as follows:

Communication Interface

Click the down-arrow and select the appropriate connection type between the desired chassis and the computer from the drop down list. Your choice affects the *GPIB Address/ComPort* field. Your choices are: GPIB (IEEE 488.2) or Serial (RS-232).

GPIB Address

If you selected IEEE 488 in the *Connection* field, click the down-arrow and select the appropriate IEEE 488 (GPIB port) address of the simulator you wish to configure from the drop down list. Your choices are: 1- 30. The default IEEE 488 address is 14.

OR

ComPort

If you selected Serial in the *Connection* field, click the down-arrow and select the appropriate serial port (RS-232 port) address of the simulator you wish to configure from the drop down list. Your choices are: 1- 9. The default RS-232 address is 1.

3.3.5 Connecting the Software to the Wireline Simulator

Press the **Go OnLine** button to connect the software interface to the wireline simulator. The current settings are sent to the unit.

Press the **Go OffLine** button to disconnect the software interface from the wireline simulator.

3.3.6 Controlling the DLS 414E/415E Noise Ports

The DLS 414E/415E allows two external noise sources to be injected via the chassis's front panel RJ-45 ports N_A and N_B . In the **DLS 414E/415E - System Properties** window, the following fields allow you to switch these ports ON or OFF.

(Noise) Source A

Check this check box to switch the N_A port ON and inject noise (if a noise source is connected). Clear this check box to switch the port OFF. The default setting is disabled.

(Noise) Source B

Check this check box to switch the N_B port ON and inject noise (if a noise source is connected). Clear this check box to switch the port OFF. The default setting is disabled.

3.3.7 Configuring the Loop Length Mode

In the **DLS 414E/415E - System Properties** window, the values you set in the following fields allow you to use a standard or compensated loop length.

Loop Simulation

Click the appropriate option button for the desired loop simulation. Your choices are:

- **Normal (default)** - Includes the unit in the circuit (with the line segment lengths set in the *Length* field).
- **Bypass** - Bypasses the unit in the test system (short circuit between A and B).
- **Disconnect** - Disconnects the unit from the test system (open circuit between A and B).

Loop Length Mode

Click the appropriate option button for the desired loop length mode. Your choices are:

- **Standard**- uses design standard coefficients.
- **Compensated Loop** - uses the compensation file to set the loop length. Using this mode enables the **Browse** button so you may select a previously loaded compensation file for this

particular unit. The compensation file may also be loaded using the **File/Load Compensation File** command. For example with the DLS 414E, use the file created by running the System Compensation Function (i.e.: DLS414E_SN#####_2003_12_05-11_45_15-Comp.csv). Files created by the System Compensation function contain a serial number, and are located in the C:/Program Files/Spirent Communications/DLS 414E/comp directory. You must choose a file with the same serial number as the unit you wish to control. See Chapter 3.3.9 "System Compensation" for more information.

Browse

This button is only available when *Compensated Loop* has been selected in the *Loop Length Mode* field. Click the button to open a standard Windows **Open** dialog box and navigate to and select the appropriate previously loaded compensation file for this unit.

3.3.8 Configuring the Length of the DLS 414E/415E Line Segment

3.3.8.1 DLS 415E

The DLS 415E configures the length of the line segment L1 in the **DLS 415E- System Properties** window. The values you set in the following fields are dynamically reflected in the loop diagram shown in the window.

Segment

Displays the line segment labelled L1.

Cable Type

Displays the cable type as 0.5 mm.

Current Length (m)

Click the up or down arrows to select the desired cable length in meters for L1 or type directly in the field. Your choices are:

L1 = 0 (Bypass), 50 to 7750 meters, increment = 25 meters

Note: You cannot set the length to zero in this field. You must set the *Loop Simulation* field to Bypass. This bypasses the unit thus simulating 0 meters.

Note: If you select 7750 meters the *Extended Reach* field becomes available.

Range (m)

Displays the minimum and maximum values of line length in meters.

Extended Reach

Check the check box to enable the connection to the additional wireline simulator. This check box is ONLY available when the *Current Length* field is set to 7750 meters.

3.3.8.2 DLS 414E

The DLS 414E configures the length of the line segment L1 in the **DLS 414E- System Properties** window. The values you set in the following fields are dynamically reflected in the loop diagram shown in the window.

Segment

Displays the line segment labelled L1.

Cable Type

Displays the cable type as 0.4 mm.

Current Length (m)

Click the up or down arrows to select the desired cable length in meters for L1 or type directly in the field. Your choices are:

L1 = 0 (Bypass), 50 to 7000 meters, increment = 25 meters

Note: You cannot set the length to zero in this field. You must set the *Loop Simulation* field to Bypass. This bypasses the unit thus simulating 0 m.

Note: If you select 7000 meters the *Extended Reach* field becomes available.

Range (m)

Displays the minimum and maximum values of line length in meters.

Extended Reach

Check the check box to enable the connection to the additional wireline simulator. This check box is ONLY available when the *Current Length* field is set to 7000 meters.

3.3.9 System Compensation

The system compensation function automates the measurement and calculation of compensated loop setting for all loops on the DLS 414E/415E. The general algorithm for a single loop is:

- 1) Measure attenuation of loop for selected frequency range.
- 2) Adjust loop setting so that the mean error 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 accessed by the program in order to make compensated loop settings. The .csv files can also be used by scripts in order to set compensated length settings. The system compensation function also reports the mean error and mean absolute error for all loops.

3.3.9.3 Mean Error Measurements

The mean error for loop attenuation is measured over the range[f1,f2], where frequency f1 is the lower bound frequency and is selected in the program to be either 20 kHz or 120 kHz. The frequency f2 is the upper bound frequency which is selected in the program to be either 1.11 MHz, 2.21 MHz or 4.42 MHz. Choose f1 and f2 to correspond with the frequency range for which the DLS 414E is to be used. Selecting a smaller frequency range decreases the amount of time needed to run a system compensation test.

One measurement is taken every 10 kHz. If loop attenuation is higher than specified (too much attenuation), the mean attenuation error shall be represented by a positive value in dB. If loop attenuation is lower than specified (too little attenuation), the mean attenuation error shall be represented by a negative value in dB. Mean error of the loop simulator can be calculated as:

$$\text{ME}_{\text{loop X}} = \frac{1}{N} \sum_{i \in \{A_{Ti} \leq 90\text{dB}\}} (A_{Ri} - A_{Ti})$$

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

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

N is determined by the number of points necessary to measure the attenuation in steps of 10 kHz.

3.3.9.4 Mean Absolute Error Measurements

MAE is reported for all loops. MAE is calculated as follows:

$$\text{MAE}_{\text{loop X}} = \frac{1}{N} \sum_{i \in \{A_{Ti} \leq 90\text{dB}\}} |A_{Ri} - A_{Ti}|$$

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

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

N is determined by the number of points necessary to measure the attenuation in steps of 10 kHz.

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

3.3.9.5 Running A System Compensation Test

To access the System Compensation screen in the DLS 414E/415E Software, click the System Compensation tab:

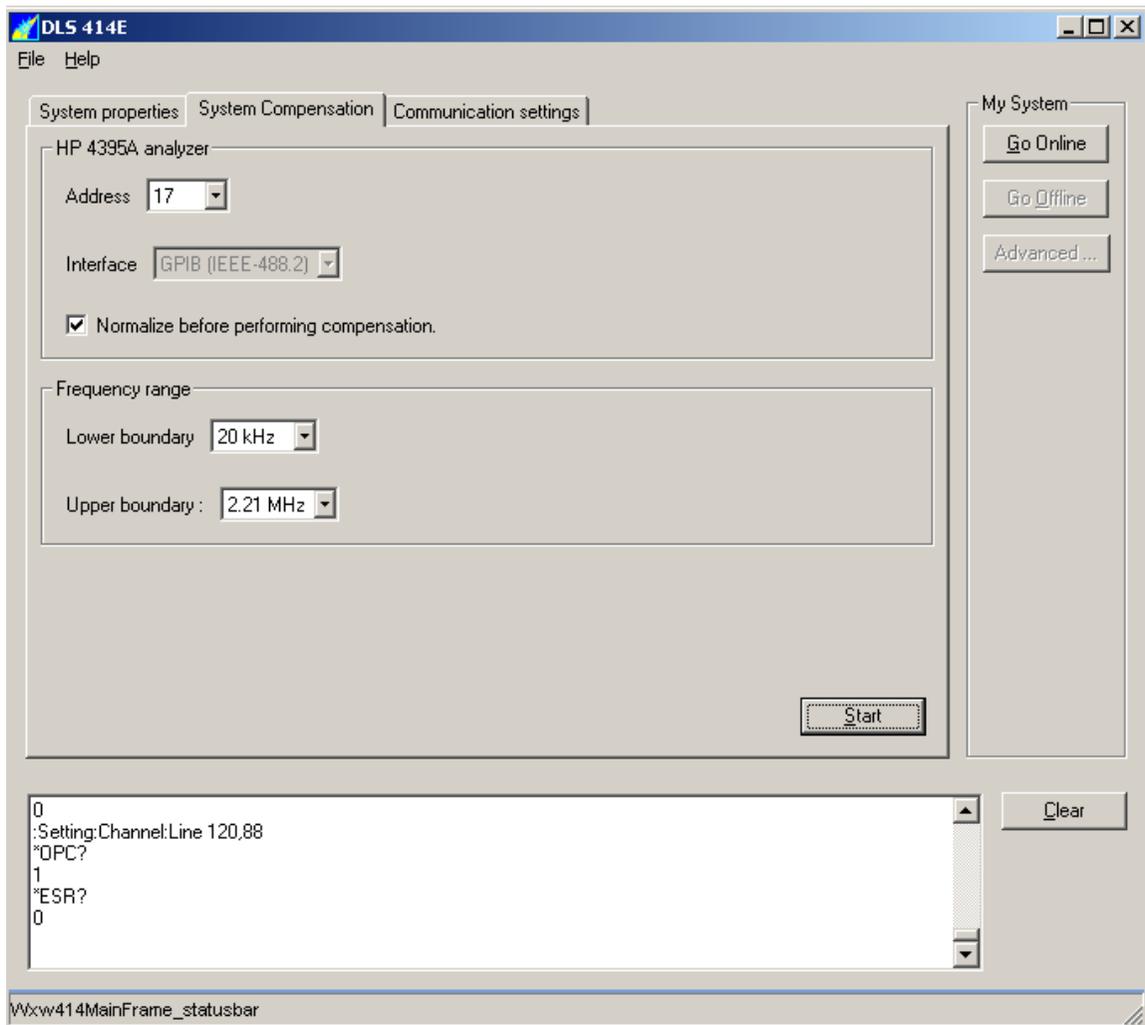


Figure 3.10 DLS 414E Control Software - System Compensation Tab

The system compensation tab allows you to set compensation parameters and start compensation measurements. Note that you must be online in order to make any settings on the system compensation screen. The procedure for measuring compensation values is as follows:

- 1) Ensure the following equipment is available:
 - Agilent 4395A Spectrum/Network Analyzer
 - 50 to 135 Ohm North Hills transformers, Model 0303LB (see Figure 3.11), quantity 2

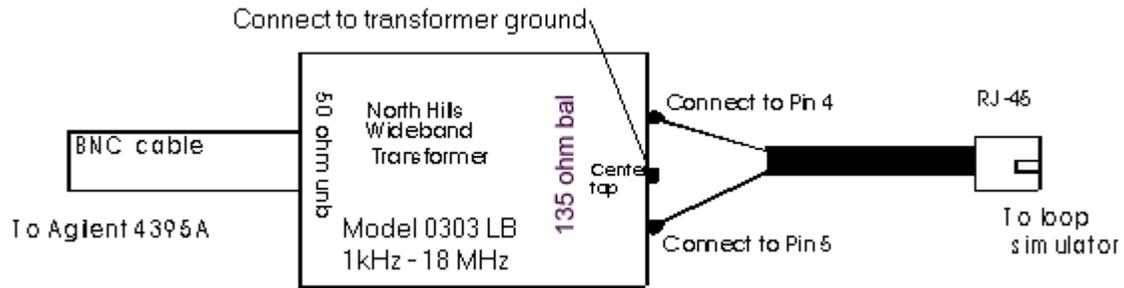


Figure 3.11 North Hills 50/135 ohm transformer, Model 0303 LB

- 2) Ensure you are in 'Offline' mode. If you are in 'Online' mode, choose 'Go Offline.'
- 3) From the HP4395A Analyzer Settings settings, choose the interface (GPIB or RS-232) and address of the analyzer.
- 4) Choose 'Normalize Before Performing Compensation'. Normalization of the Spectrum/Network analyzer should be done before every test.
- 5) Choose the frequency range over which you wish to make the measurements.
- 6) Select 'Start'.

Note that you must be in 'Offline' mode in order to run compensation.

If normalization has been selected, you are prompted to connect the 135 Ohm sides of the baluns together. Normalization of the analyzer takes a few minutes. Once the normalization is complete, you are prompted to make appropriate connections to do compensation measurements.

During compensation, the Compensation Execution dialog box appears:

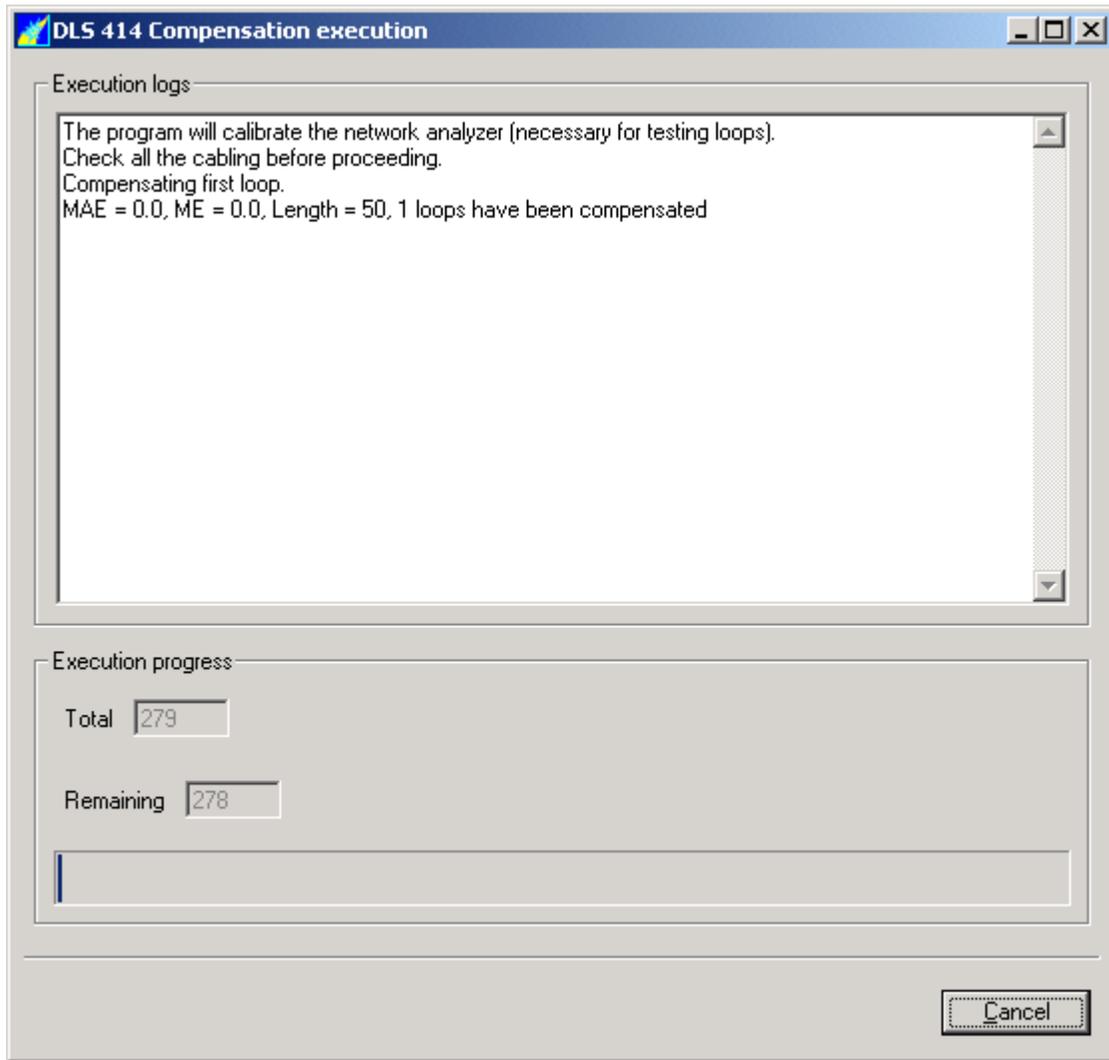


Figure 3.12 Compensation Execution Dialog Box

The compensation dialog reports the progress of the compensation, as well as the MAE and ME for each loop.

3.3.9.6 Compensation Results

Compensation results are saved the C:/Program Files/Spirent Communications/DLS 414E/comp directory. There are 2 files

- 1) The DLS 414E software-compatible file. This file can be selected as the compensation file in the DLS 414E program. The file is named as follows:

DLS414E_XXXXX_YYYY_MM_DD-HH_QQ_SS-Comp.csv.

where

XXXXX = serial number of the unit

YYYY= year the test was started

MM= month the test was started

DD = date the test was started

HH = hour the test was started

QQ= minute the test was started

SS= second the test was started

Note that 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 program for compensation information.

- 2) The Compensation Report file. This file is for the your information only, and cannot be used by the software to make compensated length settings. It contains MAE and ME values for all loops. The file is named as follows:

DLS414E_XXXXX_YYYY_MM_DD-HH_QQ_SS-CompReport.csv.

where

XXXXX = serial number of the unit

YYYY= year the test was started

MM= month the test was started

DD = date the test was started

HH = hour the test was started

QQ= minute the test was started

SS= second the test was started

3.3.10 Accessing Advanced Information About the Unit

The **Advanced** dialog box gives more information about the unit, mainly for the purpose of troubleshooting. To open the **Advanced** dialog box, in the **DLS 414E/415E** window click the **Advanced** button. The advanced dialog box can only be opened in 'Online' mode.

The **Wireline Card** area displays information about the wireline cards in the unit.

Slot #

Displays the wireline slot number.

Card ID

Displays wireline card ID number in each slot.

Status

Provides status for card.

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:
The IEEE 488 or Serial.

Interface Address

Displays the interface address.

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

System Error

Displays the results of the system self-check. A "0" indicates no error, and a "1" indicates an error.

Firmware Checksum

Displays a number that indicates the firmware revision.

Last Calibration Date

Displays the date of the last calibration. When shipped this value is set to '0' by default. For information on setting the Calibration Date value, please see

Section 4.5.1.4 ":System:Calibration:date <date>" .

Calibration Due Date

Displays the due date for the next calibration.

3.3.11 Using The DLS Terminal Window

The DLS Terminal window is a useful tool that is included with the DLS 414E/415E Software. This window allows you to send commands and receive responses directly from the unit. To open the DLS Terminal window, choose Start-->Programs--> Spirent Communication--> DLS Terminal-->DLS Terminal.

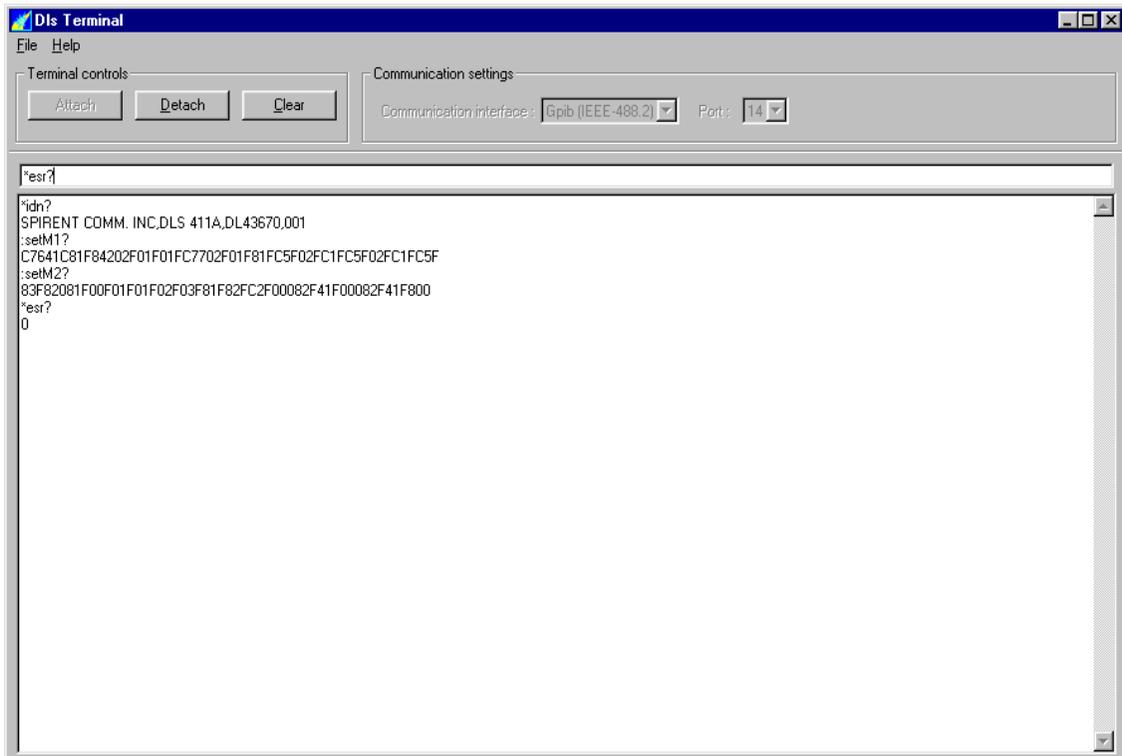


Figure 3.13 DLS Terminal Window

To connect to a unit, choose the communication interface for the unit, and hit the 'Attach' button. Commands and queries can be typed in the terminal window, and the response is displayed on the screen.

One terminal window can be connected to one unit at a time.

4. REMOTE CONTROL

The DLS 414E/415E is controlled via the IEEE 488 (also known as the GPIB bus), or the RS-232 (serial) interface, allowing the integration of the DLS 414E/415E into a larger test system.

The DLS 414E/415E remote control is designed with several standards in mind:

- The GPIB physical interface follows IEEE 488.1. The functions implemented are outlined in the IEEE 488 Interface section.
- The Common Commands follow IEEE 488.2.
- The Device Dependent Commands (see Section 4.5 "DEVICE DEPENDENT COMMAND SET") are based upon the Standard Commands for Programmable Interfaces (SCPI).
- The serial port physical interface follows the EIA RS-232 standard.

The IEEE 488 and the serial interfaces are always enabled and either can be used. The DLS 414E/415E directs its output to the last interface from which it received data. Both interfaces use the same command set and produce the same results.

4.1 IEEE 488 Interface

This section contains information specific to the IEEE 488 interface. Section 4.2 "RS-232 Serial Interface" contains the information specific to the RS-232 interface.

4.1.1 IEEE 488.1 Interface Functions Supported

The IEEE 488.1 Interface functions supported by the DLS 414E/415E 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.

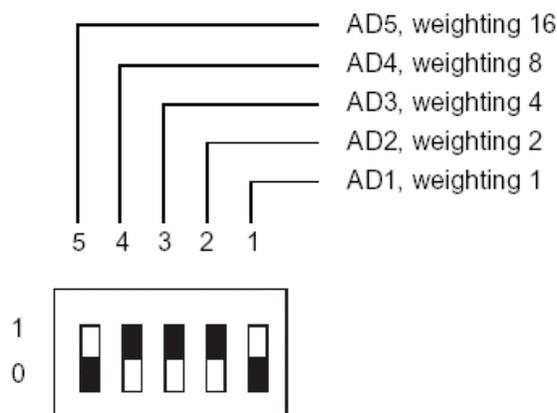
Note that the IEEE 488 interface is also known as the GPIB and the HP-IB interface.

4.1.2 IEEE 488 Address

The DLS 414E/415E can use any valid IEEE 488 address (from 1 to 31). The factory settings are:

- Address 14 for the DLS 414E/415E

The address can be changed by using the DIP switch on the back of the unit. The weighting is as follows:



Address 14

4.1.3 The Service Request (SRQ) Line

The SRQ line, as defined by the IEEE 488.1 standard, is raised when the DLS 414E/415E is requesting service. Here are some examples of services that could raise SRQ:

- a message is available in the output buffer
- an error occurred
- all pending operations are completed
- the power was just turned on

In order to use the SRQ line, all 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 414E/415E to raise the SRQ line when there is a message available and when there is an error.

4.1.4 Message Terminators

Messages to the DLS 414E/415E must be terminated with either a Line Feed character (ASCII <LF>, decimal 10, hex 0A), an IEEE 488.1 EOI signal, or both. Messages from the DLS 414E/415E are always terminated with a Line Feed character and the IEEE 488.1 EOI signal.

Note that 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 IEEE 488 port. Another solution is to append a semi-colon at the end of the command itself (inside the quotes), so that the carriage return can be interpreted as a second command, and be simply discarded by the DLS 414E/415E.

For example:

```
PRINT #1, ":SETTING:CHANNEL:STATE?"+CHR$(10);      Preferred solution
or
PRINT #1, ":SETTING:CHANNEL:STATE?;"              Other solution
```

4.1.5 Example using the IEEE 488 Interface

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

- set all relevant enable bits (only done once)
- send the message
- wait for SRQ
- read the Status Byte
- if MAV (bit 4) is set, then read the response
- 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 IEEE 488 interface, do the following:

Table 4-1:Setting the ID message with IEEE 488

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	
read the status byte	use the IEEE 488.1 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	

4.2 RS-232 Serial Interface

This section contains information specific to the RS-232 interface. Section 4.1 "IEEE 488 Interface" 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, simply connect your computer to the host system and set the computer to **9600 bps baud rate, no parity, 8 data bits per character, 1 stop bit and 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 two standards. Generally, the computer literature will use the words “serial”, “COM1” and “COM2” to refer to the RS-232 interface. Note that the DLS 414E/415E 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 414E/415E lowers the CTS and the DSR lines when it cannot accept data, and raises them when it can. Note that the RTS line is not the usual “Request To Send” as defined by the RS-232 standard. If desired, the user can leave the RTS line set, and use only the CTS line.

Most serial port communication programs can be used to control the DLS 414E/415E.

To use HyperTerminal:

1. Select “Start” >> “Programs” >> “Accessories” >> “HyperTerminal” >> “hypertrm.exe”. The program starts.
2. Enter a name (for example; “DLS 414”).
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.

4.2.1 Message Terminators

Messages sent to the DLS 414E/415E through the serial interface **MUST** be terminated with the line feed character (decimal 10, hex 0A, LF). To ensure that no characters are left in the receive buffer of the DLS 414E/415E from a previous incomplete command, you can send the line feed character by itself before sending new commands.

Messages from the DLS 414E/415E are always terminated with a Line Feed character.

Note that 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 IEEE 488 port. Another solution is to append a semi-colon at the end of the command itself (inside the quotes), so that the carriage return can be interpreted as a second command, and be simply discarded by the DLS 414E/415E.

For example:

<code>PRINT #1, “:SETTING:CHANNEL:STATE?”+CHR\$(10);</code>	<i>Preferred solution</i>
or	
<code>PRINT #1, “SETTING:CHANNEL:STATE?;”</code>	<i>Other solution</i>

4.2.2 Example using the RS-232 Interface

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

- set error bits

- send the message
- read the answer until you receive LF (decimal 10, hex 0A)
- 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 4-2: 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 answer	the messages are always terminated with LF
transmit "*ESR?	check if an error occurred
read the answer	if not 0, error occurred, see Event Status Register (ESR) Section for a description of the error(s)

4.3 Data formats

This Section applies to both the IEEE 488 and RS-232 interfaces.

The DLS 414E/415E adheres to the IEEE 488.2 principle of Forgiving Listening and Precise Talking.

The data formats supported by the DLS 414E/415E are:

- Talking:**
- <NR1> Numeric Response Data - Integer
 - 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.

4.4 Command Syntax

The DLS 414E/415E 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 4.5, the format of the latter in Section 4.6. 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 “*”. A colon precedes Device Dependent commands and a colon separates each level of the command. Commands may be either in upper or lower case. Multiple commands may be concatenated by separating each command by semi-colons.

The following are some examples:

*RST

*RST;*WAI;;SETTING:CHANNEL:STATE Normal

*ESE 45; *SRE 16

Messages to the DLS 414E/415E must be terminated with a Line Feed character (ASCII <LF>, decimal 10, hex 0A). Messages from the DLS 414E/415E 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 of 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 414E/415E will place the appropriate response in the output queue, where the controller can read it.

Examples are:

*IDN?

*ESE?;*SRE?

:SET:CHAN:STA?

4.5 DEVICE DEPENDENT COMMAND SET

The DLS 414E/415E is comprised of one chassis. As recommended by the SCPI consortium and following other Spirent AE simulators and noise generators and to simplify programming, the DLS 414E/415E uses the following tree structures:

DLS 414E/415E

```
:SETting
  :CHANnel
    :STATe <Normal|Bypass|Disconnect>
    :LINE <N_Fine><N_Coarse>
    :Extend <On|Off>
:SourceA
  :Noise <On|Off>
:SourceB
  :Noise <On|Off>
:System
  :Reset
  :Error?
  :Calibration
    :date?
    :expiry?
    :date <date>
    :expiry <expiry>
  :SlotID?
  :SlotID <SlotNumber>?
```

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

The DLS 414E/415E will round any number to the nearest number permitted by the resolution of the parameter.

Sections 4.3 and 4.4 give more information on the data format and the 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**, **line** at <0,0>, **extend** at off and the **noise injection** of both sides is off.

If an error is detected on the line cards during the power up sequence, the device-dependent commands are unavailable for use.

The following sections describe the command settings in more detail.

4.5.1 System Check Commands

4.5.1.1 :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 this model of simulator.

4.5.1.2 :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.

4.5.1.3 :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.

4.5.1.4 :System:Calibration:date <date>

This command enters the value of the last calibration date. When shipped from the factory, this value is set to '0' by default. For new units, the purchase date of the unit should be entered.

4.5.1.5 :System:Calibration:expiry <date>

This command enters the value of the calibration expiry date. When shipped from the factory, this value is set to '0' by default. For new units, one year from the purchase date of the unit should be entered.

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

Setting the channel state to Bypass will by-pass all line simulator cards in the DLS 414E/415E chassis.

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

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

You should take care not to interrupt the completion of this command. Using the *WAI or the *OPC command can ensure that this command is complete before issuing a subsequent command. See Chapter 4.6 "Common Command Set" for more details on the *WAI or *OPC command.

4.5.2 :SETting:CHANnel:LINE <N_Fine>,<N_Coarse>

You should take care not to interrupt the completion of this command. Using the *WAI or the *OPC command can ensure that this command is complete before issuing a subsequent command. See Chapter 4.6 "Common Command Set" for more details on the *WAI or *OPC command.

The DLS 414E/415E Software installs the file Dls415E_Standard_Length_Setting.csv in the C:\Program Files\Spirent Communications\DLS 415E directory and the file Dls414E_Standard_Length_Setting.csv in the C:\Program Files\Spirent Communications\DLS 414E directory. These files contain the N_Fine and N_Coarse coefficients that correspond to a particular length settings. i.e., for the DLS 415E:

Table 4-3: Reach Fine/Course Settings

Reach (m)	N_Fine		N_Coarse	
	414E	415E	414E	415E
50	97	60	0	0
75	195	120	0	1
100	21	45	1	2
125	118	85	1	3
300	82	75	2	4

Note: DLS 414E users may use compensated length settings by using the compensation result file stored in the C:\Program Files\Spirent Communications\DLS 414E\comp directory. See Chapter 3.3.9.6 "Compensation Results" for more information.

When scripting, parse to find the desired length under the 'reach' column. Then use the N_Fine and N_Coarse in that row.

For example, to set the length of the 414E line segment L1 to 100 meters, send:

```
SET:CHAN:LINE 21, 1
```

For example, to query the current setting, send:

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

The command will return the current length. For example the returned message format will be:

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

4.5.3 :SETting:CHANnel:Extend <ON|OFF>

When you require extended reach, you connect another wireline simulator to the rear RJ-45 connectors on the back panel of the unit (see Section 2.5.6 "Connecting Another Simulator"). Then set the N_Fine and N_Coarse for the maximum distance (7750 m for DLS 415E or 7000 m for DLS 414E) before you can turn the Extend feature on. If the unit is not set for its maximum length setting, the extend setting is ignored.

For DLS 414E, the option is acceptable only when N_Coarse is greater than 201.

For DLS 415E, the option is acceptable only when N_Coarse is greater than 273.

Once the Extend function is enabled, all distances larger than the maximum reach are controlled from the low frequency simulator (the DLS 414E remains at 7000 meters and the DLS 415E remains at 7750 meters).

For example, to turn the extend feature on, send:

```
SET:CHAN:Extend ON
```

Users should take care not to interrupt the completion of this command. Using the *WAI or the *OPC command can ensure that this command is complete before issuing a subsequent command. See Chapter 4.6 "Common Command Set" for more details on the *WAI or *OPC command.

4.5.4 :SourceA:Noise <ON|OFF>

The unit has two switched ports N_A and N_B that can be connected to a noise generation system. Setting the Source A to ON connects the noise source (connected to the port labelled N_A) in parallel with the DLS 414E/415E line simulator cards. Setting Source A to OFF disconnects the NA port.

For example, to switch the NA port ON, send:

```
:SourceA:Noise ON
```

Users should take care not to interrupt the completion of this command. Using the *WAI or the *OPC command can ensure that this command is complete before issuing a subsequent command. See Chapter 4.6 "Common Command Set" for more details on the *WAI or *OPC command.

4.5.5 :SourceB:Noise <ON|OFF>

The unit has two switched ports N_A and N_B that can be connected to a noise generation system. Setting the Source B to ON connects the noise source (connected to the port labelled N_B) in parallel with the DLS 414E/415E line simulator cards. Setting Source B to OFF disconnects the NB port.

For example, to switch the NB port ON, send:

```
:SourceB:Noise ON
```

Users should take care not to interrupt the completion of this command. Using the *WAI or the *OPC command can ensure that this command is complete before issuing a subsequent command. See Chapter 4.6 "Common Command Set" for more details on the *WAI or *OPC command.

4.5.6 :System:Reset

This command causes the system to reset in the same manner as the power-down, power-up.

For example, to reset the unit, send:

```
:System:Reset
```

4.6 Common Command Set

As specified in the IEEE 488.2 standard, a number of common commands are required to set up and control of the standard functions of remote-controlled devices. They can be used with both the IEEE 488 and the RS-232 interfaces. These common commands are as follows:

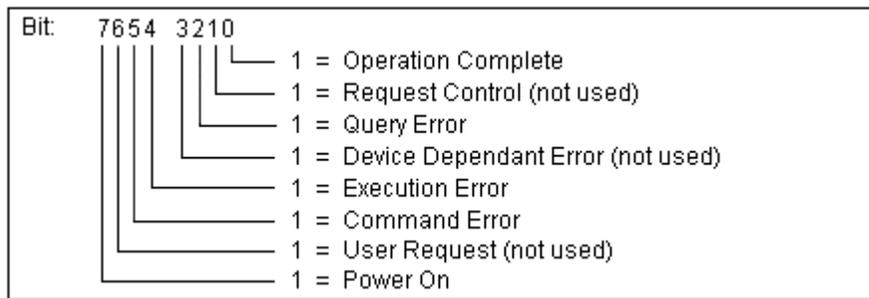
*CLS	Clear Status Command
Type:	Status command

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.

***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.

***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 414E/415E will put the following string into the output queue:

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

where:<unit ID> is DLS 414E/415E,<SN> is the serial number of the unit (i.e.: DL41XXX), <Ver> is the revision level of the control firmware (always 3 digits)

***OPC Operation Complete**

Type: Synchronization command

Function: Indicates to the controller when the current operation is complete. This command will cause the DLS 414E/415E 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.

***OPC? Operation Complete Query**

Type: Synchronization command

Function: Indicates when the current operation is complete. This will cause the DLS 414E/415E 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.

***RST Reset**

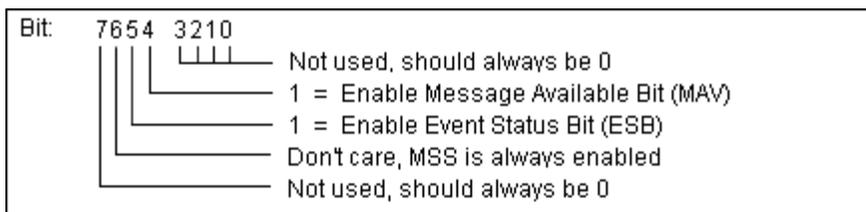
Type: Internal command

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 “Device Clear”.

***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

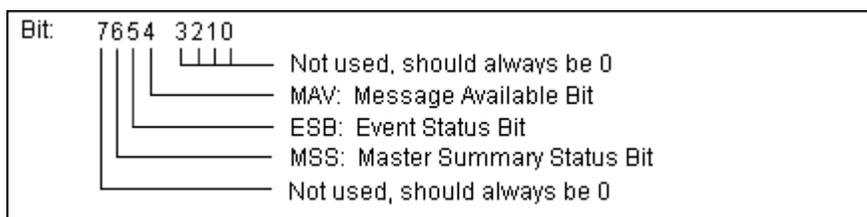
Function: An integer value representing the value of the Service Request Enable Register is placed in the output queue. The possible values are listed in the *SRE command section.

***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?**

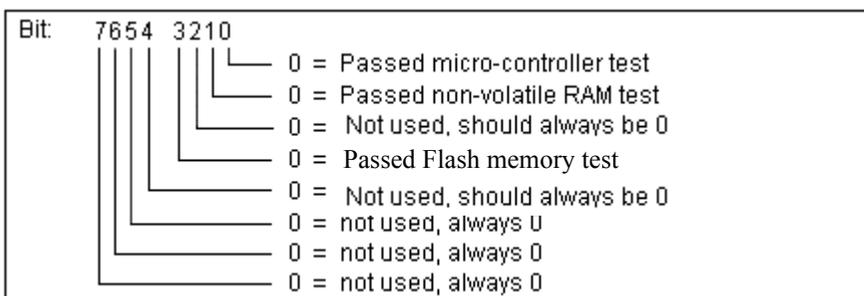
Self-Test Query

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 414E/415E will ensure that all commands received before “*WAI” are completed before processing any new commands. This means that all further communication with the DLS 414E/415E will be frozen until all pending operations are completed.

4.7 Status Reporting

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 4-4: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.

4.7.1 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 488.1 Serial Poll command, both are cleared.

RQS and SRQ are defined by the IEEE 488.1 standard and are hardware related. MSS summarizes all the status bits of the DLS 414A/E, as defined by the IEEE 488.2 standard.

bits 7, 3, 2, 1, and 0

These bits are not used by the DLS 414E/415E.

4.7.2 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 414E/415E 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 414E/415E 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 414E/415E 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.

4.8 DLS 414E/415E Synchronization

The program controlling the DLS 414E/415E can use three different commands to synchronize with the DLS 414E/415E: *OPC, *OPC? and *WAI. Following are the main differences:

Table 4-5: Synchronization Commands

	Set Operation Complete bit when Done	Return “1” when operation complete	Raise SRQ when operation complete	Block comm. with the DLS 414E/415E	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 414E/415E 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 414E/415E 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 414E/415E needs approximately 2 seconds to set a line segment length).

5. 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 Draft Recommendation G.992.1 (G.dmt) (International Telecommunication Union, Place des Nations, CH1211 Geneva 20, Switzerland)
- ITU-T Recommendation G.992.3 (G.dmt.biz) (International Telecommunication Union, Place des Nations, CH1211 Geneva 20, Switzerland)
- 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 101 388 European Asymmetric Digital Subscriber Line (ADSL) Transceivers (European Telecommunications Standards Institute, 650 Routes des Lucioles, F-0 6921 Sophia Antipolis Cedex, France)

6. CUSTOMER SUPPORT

6.1 Customer Service Contact Information

For all North American customers, please direct any questions or concerns regarding the operation of a purchased unit, to the Spirent Communications Customer Service team by one of the following methods:

Direct Line: 613-592-7301

Toll free at: 800-SPIRENT

Fax at: 613-592-0522

E-mail at: ae.service@spirentcom.com.

All other customers should check the **ae.spirentcom.com** web site for the contact information of the nearest Customer Service center or contact the main Spirent Communications service center for assistance (contact information is listed above).

For product information and updates, please visit the Spirent Communications web site at:

<http://ae.spirentcom.com>

For product manuals, software updates and more information, please visit the customer extranet at:

<http://ae.spirentcom.com/extranet.htm>.

Passwords for the extranet can be requested at:

<http://ae.spirentcom.com/extranet.htm>.

6.2 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

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 firm ware 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 firm ware 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. Spirent Communications sends out an e-mail reminder when the next calibration is due. 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 Spirent Communications Customer Service for more information on these programs, or visit us on the web at **ae.spirentcom.com**.

7. 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 international customers, please contact your local Spirent Communications sales representative or check the **ae.spirentcom.com** web site for the contact information of the nearest service center.

In North America, if warranty service becomes necessary, the customer must contact Spirent Communications to obtain a return authorization number and shipping instructions:

Spirent Communications
750 Palladium Drive
Ottawa, Ontario, Canada
K2V 1C7
Customer Service Direct Line: 613-592-7301
Fax: 613-592-0522
Toll Free: 1-800-465-1796
ae.service@spirentcom.com

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. 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.

The RMA number is mandatory and must be obtained from a Spirent Communications Customer Service center before shipping the unit (see Section 6 "CUSTOMER SUPPORT" for details on how to contact the nearest Spirent Communications Customer Service center).

9. SPECIFICATIONS

9.1 Wireline Simulator Specifications

Technology	Cable simulation using passive circuits
Type of Wire	FOR DLS 415E: Twisted pair PE05 (as per ETSI TS 101 388) FOR DLS 414E: Twisted pair PE04 (as per ETSI TS 101 388)
Number of Conductors	single pair
Standard	ITU-T Draft Recommendation G.992.5 (ADSL2plus)
Simulated Loops	FOR DLS 415E: Straight loop: a straight single gauge segment, with variable length from 0, 50 to 7750 m based upon granularity of 25 m. FOR DLS 414E: Straight loop: a straight single gauge segment, with variable length from 0, 50 - 7000 m based upon granularity of 25 m.
Bandwidth	DC to 4.5 MHz continuous frequency response
Attenuation	20kHz - 4.5 MHz: +/- (1db + 4% attenuation)
Accuracy	Max. MAE \leq 0.5dB for attenuation up to 90 dB after compensation
Impedance	\pm 5% typical
Group Delay	\pm 5% typical
DC Resistance of the loop	\pm 10% typical
Background Noise	\leq 150 dBm/Hz typical
DC Rating	\pm 200 V between tip and ring, tip and ground, ring and ground and 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	+10°C to +40°C (50°F to 104°F)
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")

IEEE 488 Remote Control

RS-232 Remote Control

System

- DLS 414E/415E chassis
- DLS 414E/415E Software
- DLS 414E/415E Operating Manual CD
- Power cord
- 2 fuses
- 1 9 to 25 pin adapter (RS-232)
- 1 RS-232C inter-connection cable
- 1 IEEE 488 inter-connection cable
- 1 IEEE reverser

Associated Products

- National Instruments IEEE 488 card (for the controlling PC)
- DLS 5200R Reach Noise Generation System for ADSL2+ (external)

9.2 Operating Conditions

In order for the unit to operate correctly and safely, it must be adequately ventilated. The DLS 414E/415E 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.

10. SAFETY

10.1 Information

10.1.1 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”.

10.1.2 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.

10.1.3 Power Supply Requirements

The unit can operate from any single phase AC power source that supplies between 100V and 240V ($\pm 10\%$) 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 casing or panels.

10.1.4 Fuses

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

10.1.5 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.

10.1.6 Operating Environment

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

10.1.7 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.

10.2 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 AE assumes no liability for the customer's failure to comply with any of these requirements.

10.2.1 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 input to the unit should not exceed +37 dBm, and should not exceed +/- 200 Vdc and 125 mA.

10.2.2 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 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.
- Operating the equipment in the presence of flammable gases or fumes is extremely hazardous.
- Do not perform any operating or maintenance procedure that is not described in the Operating Manual.

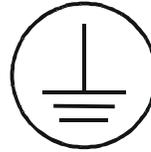
- Some of the equipment's capacitors may be charged even when the equipment is not connected the power source.

10.3 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 Measurement of the DLS 414E/415E

Data for the characteristics of the cables were obtained from the ITU-T G.992.5 Draft Recommendations. Data for this type of cable are specified in terms of resistance, inductance, capacitance and conductance per meter of length of line as it varies with frequency.

When measuring the insertion loss of a balanced line or line simulator throughout the ADSL2++ frequency domain, the following method is recommended:

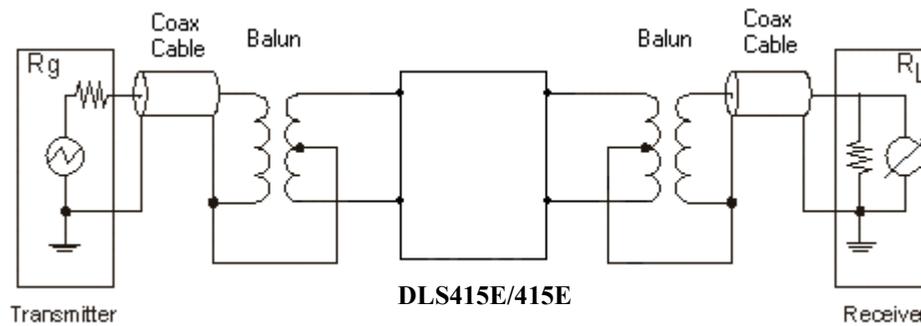


Figure A1.1 DLS 414E/415E Electrical Characteristics Measurements.

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

For the DLS 414E/415E, use 50 to 135 Ohm baluns. Measurement termination is 135 Ohm if used in ETSI loops or 100 Ohm if used in interoperability tests (e.g. TR-048).

WARNING: The use of unbalanced signals through the DLS 414E/415E will usually give incorrect measurements.

Note: The above method and diagram apply only to the DLS 414E/415E and not to other wireline simulators.

Figure A1.2 "Test Setup with Noise Injection" shows an example of one of the test setup options:

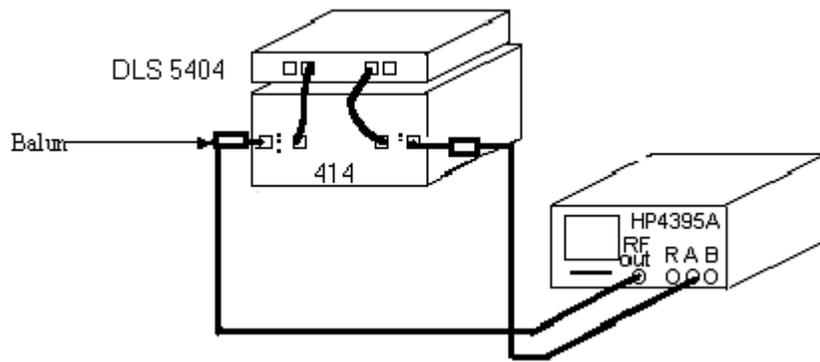


Figure A1.2 Test Setup with Noise Injection

The DLS 414E is connected to the DLS 5200R by two cables of the same type each labelled 7102040526, provided as an accessory within the DLS 5200R package.

A.2 Common Errors

There are three common errors:

- 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, or 1/1000000 of the input power is present on the output. It is very easy for transformers - or even wires - placed close to each other to couple together far more than this. Take care to keep inputs and outputs separate.
- 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 bad mismatch at the end of the line, and leads to very peculiar response curves.
- Ground injected directly onto 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”.

Appendix B TEST RESULTS

B.1 DLS 415E Results

The following graphs are a sampling of DLS 415E test results.

Insertion loss 1 km Measured on DLS 415 E vs Theoretical

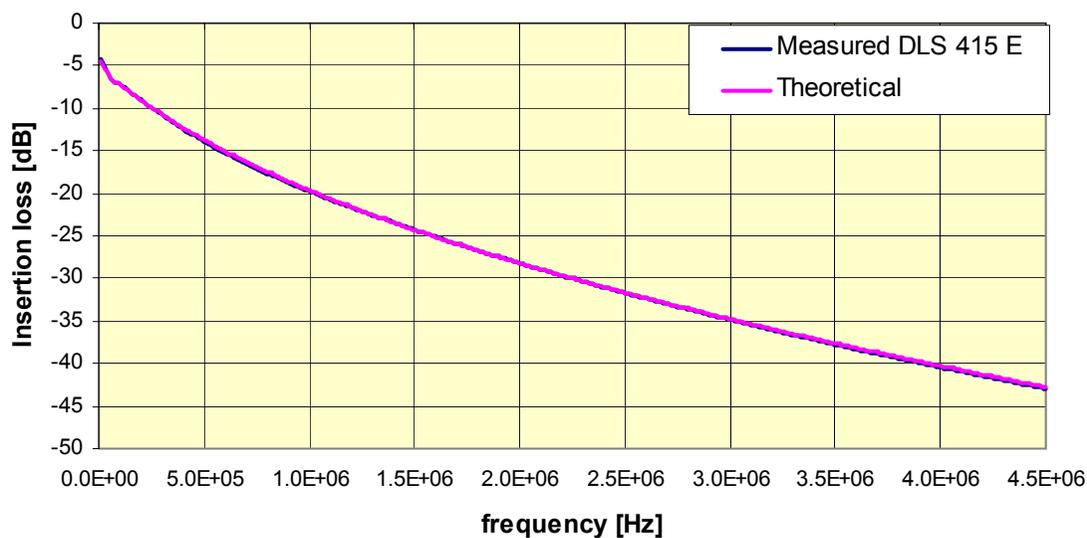


Figure B.1 Insertion loss 1km

Insertion loss 2 km Measured on DLS 415 E vs Theoretical

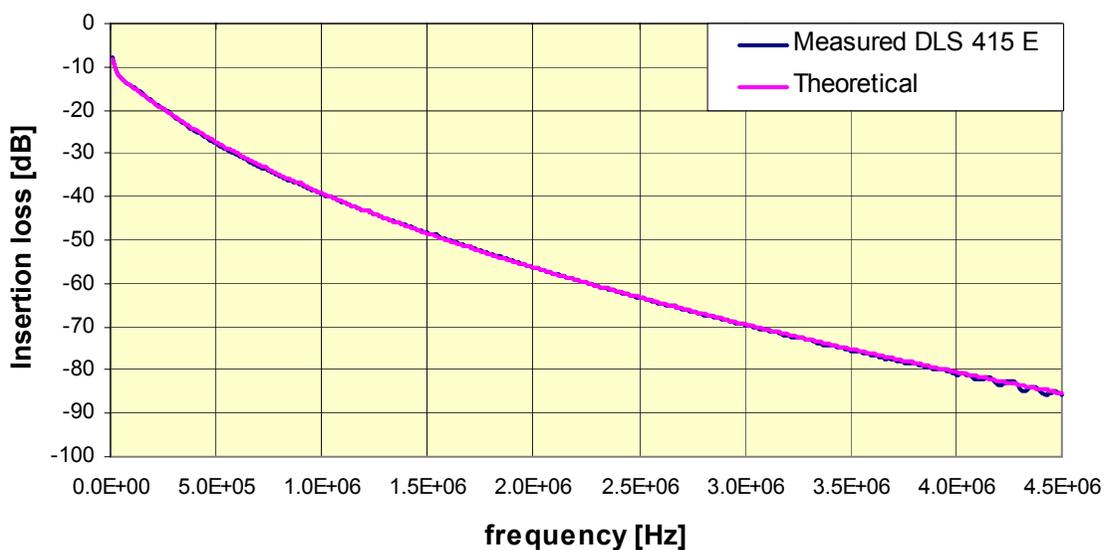


Figure B1.1 Insertion loss 2 km

Insertion loss 3 km Measured on DLS 415 E vs Theoretical

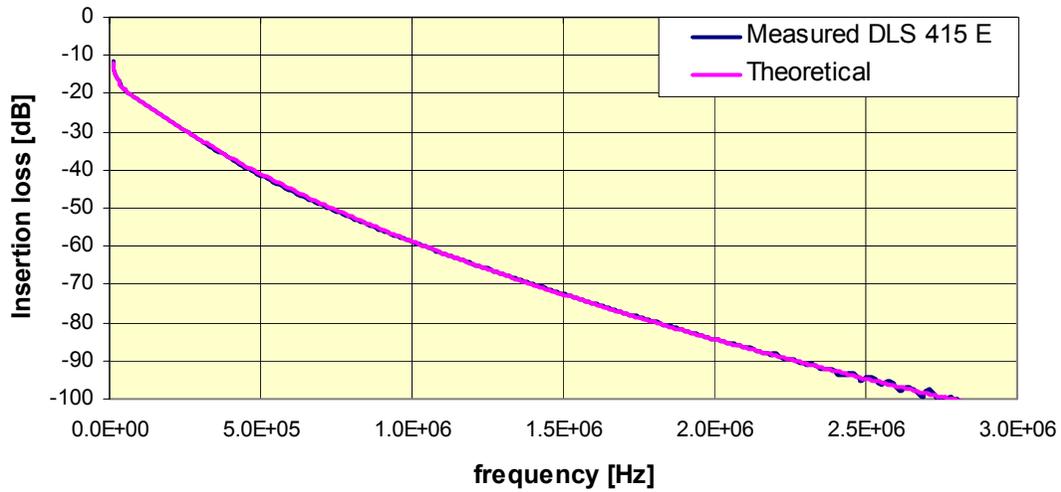


Figure B1.2 Insertion loss 3 km

Insertion loss 4 km Measured on DLS 415 E vs Theoretical

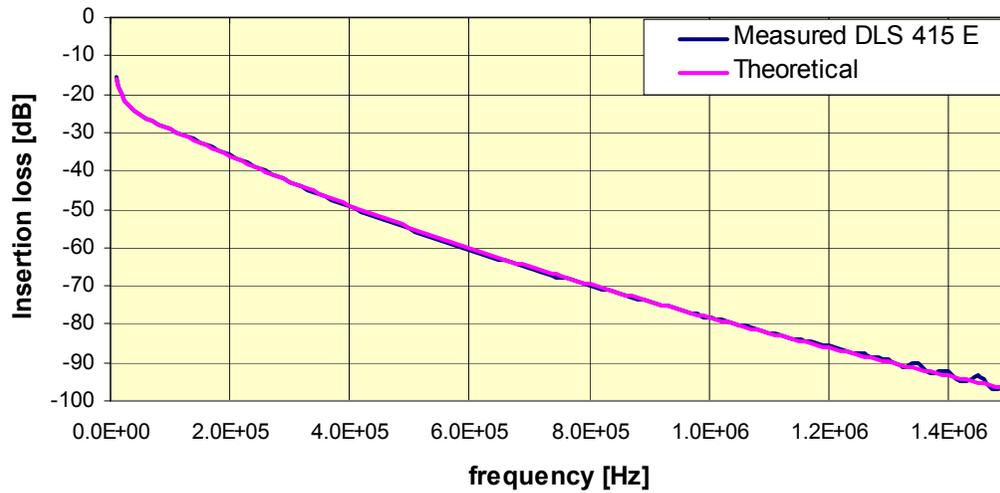


Figure B1.3 Insertion loss 4 km

Insertion loss 5 km Measured on DLS 415 E vs Theoretical

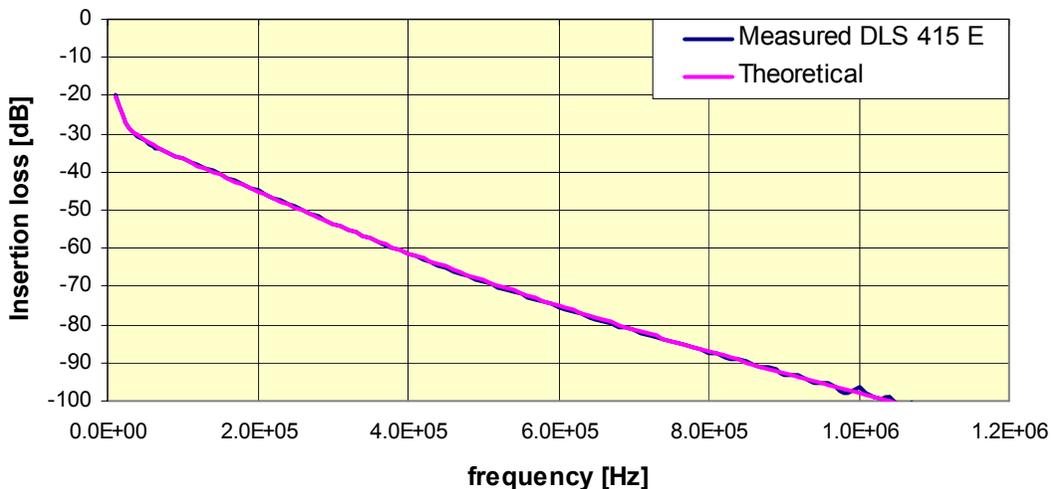


Figure B1.4 Insertion loss 5 km

Group delay 1 km Measured on DLS 415 E vs Theoretical

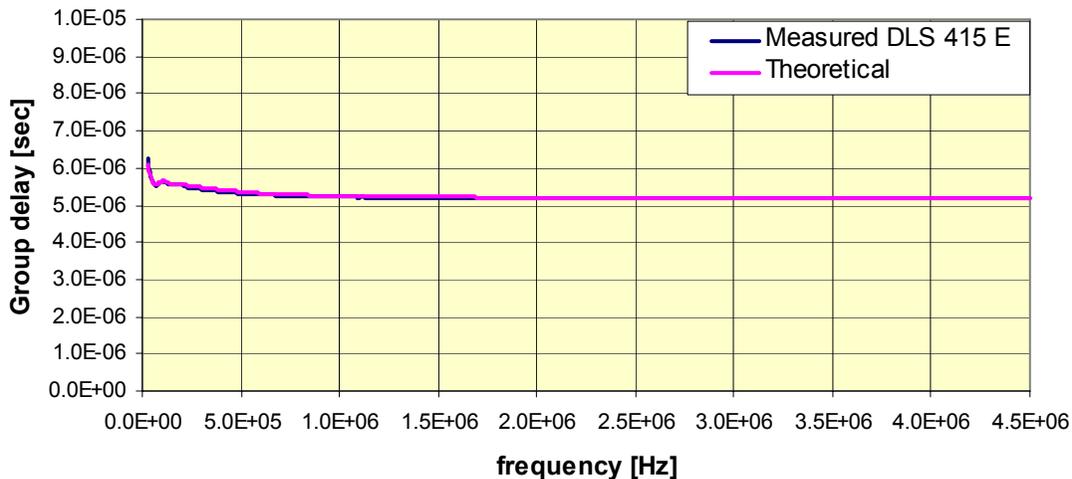


Figure B1.5 Group delay 1 km

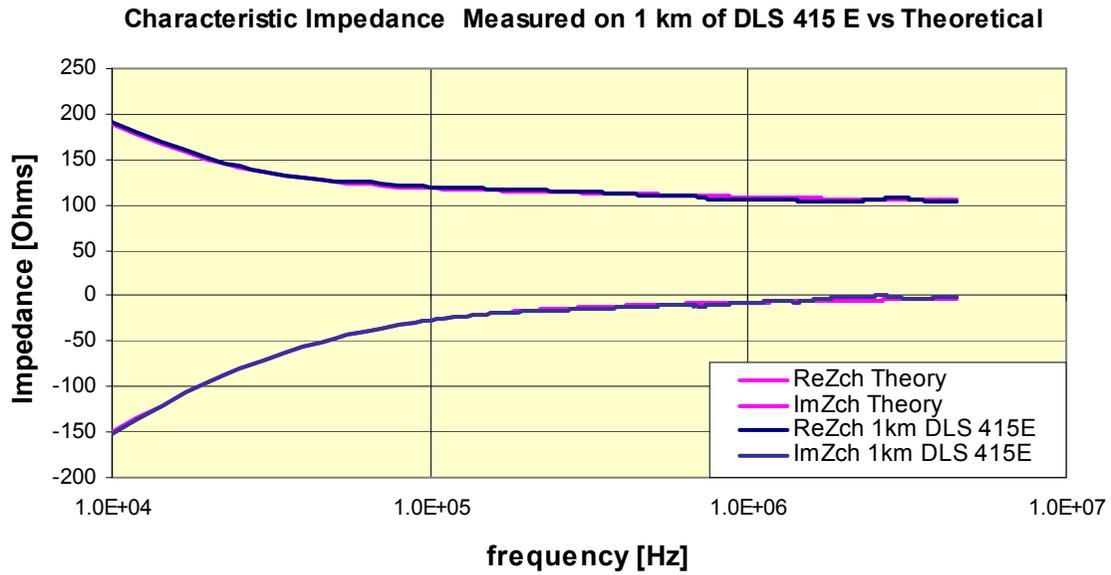


Figure B1.6 Characteristic Impedance 1 km

B.2 DLS 414E Results

The following graphs are a sampling of DLS 414E test results.

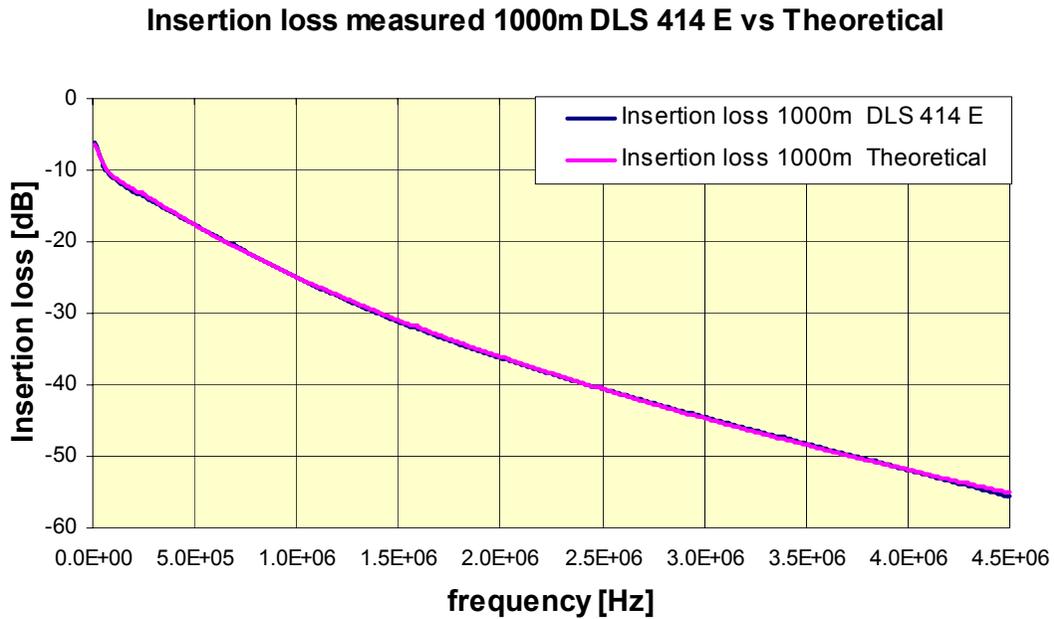


Figure B2.1 Insertion loss 1km

Insertion loss measured 2000m DLS 414 E vs Theoretical

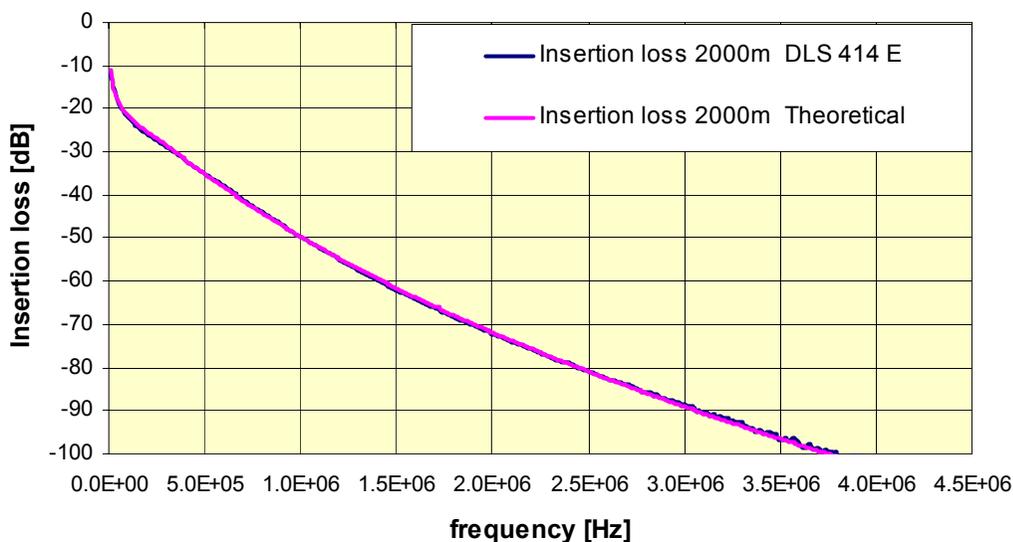


Figure B2.2 Insertion loss 2 km

Insertion loss measured 3000m DLS 414 E vs Theoretical

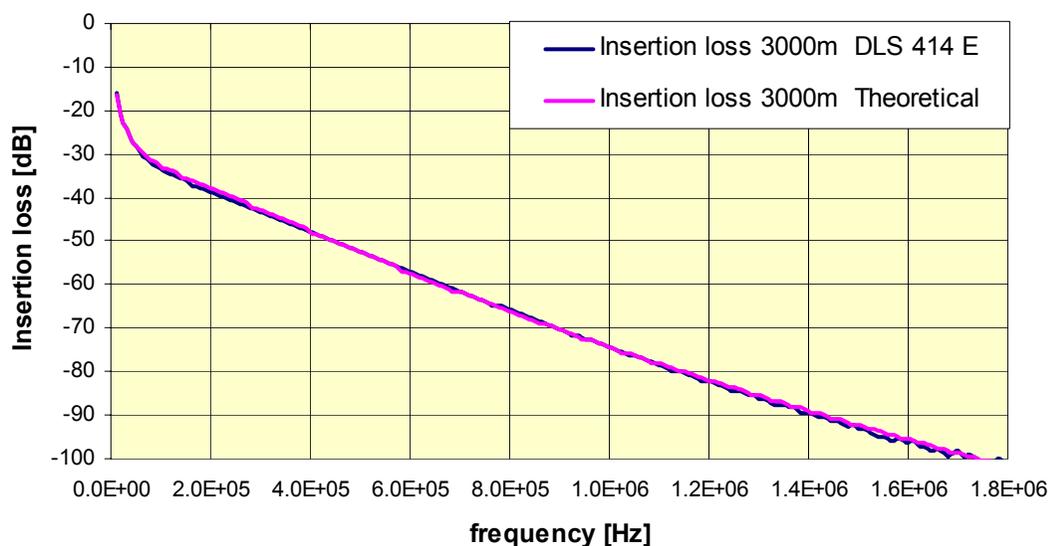


Figure B2.3 Insertion loss 3 km

Insertion loss measured 4000m DLS 414 E vs Theoretical

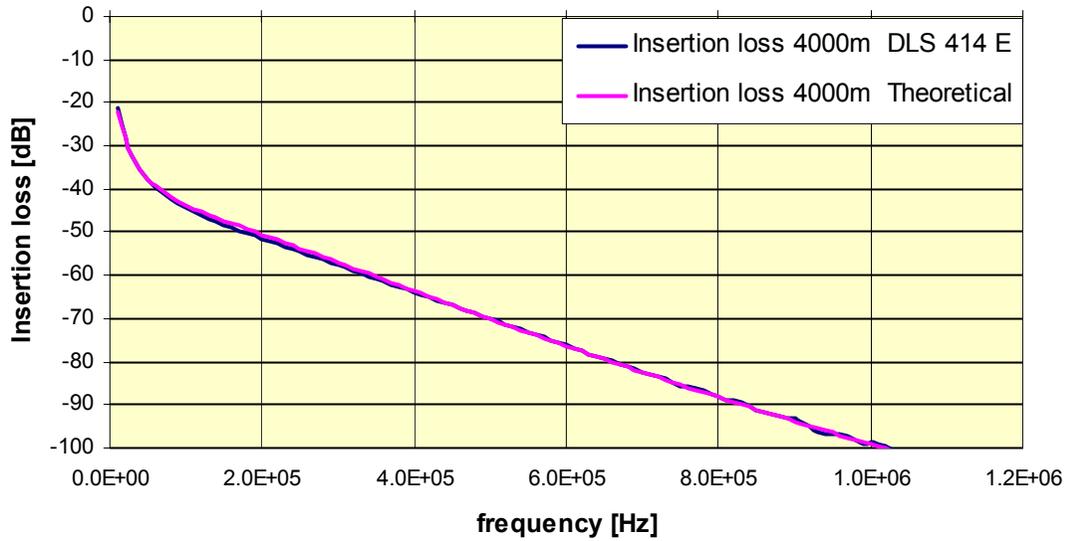


Figure B2.4 Insertion loss 4 km

Insertion loss measured 5000m DLS 414 E vs Theoretical



Figure B2.5 Insertion loss 5 km

Group delay 1000m measured DLS 414E vs Theoretical

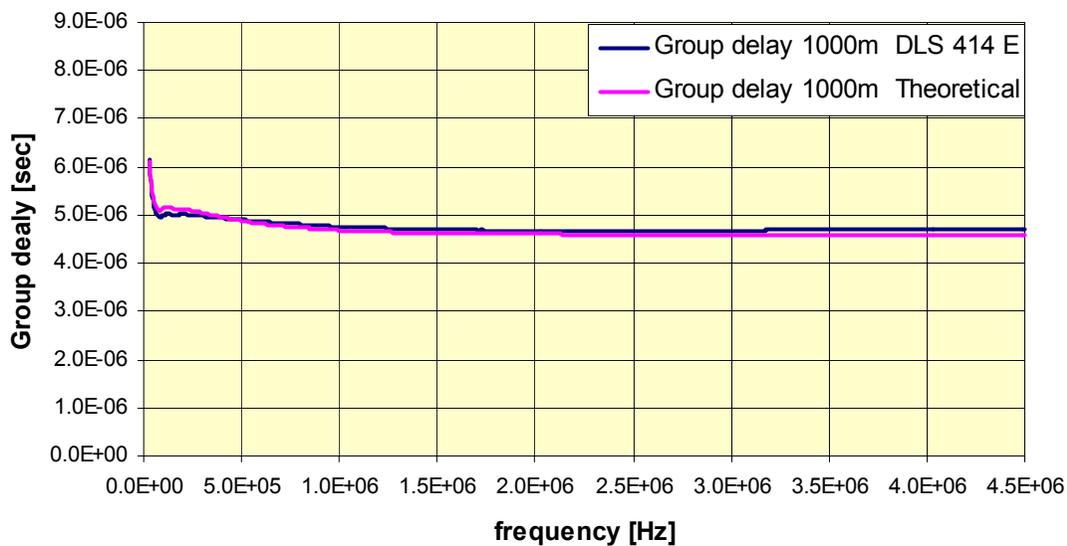


Figure B2.6 Group delay 1000m

Characteristic Impedance DLS 414 E vs Theoretical

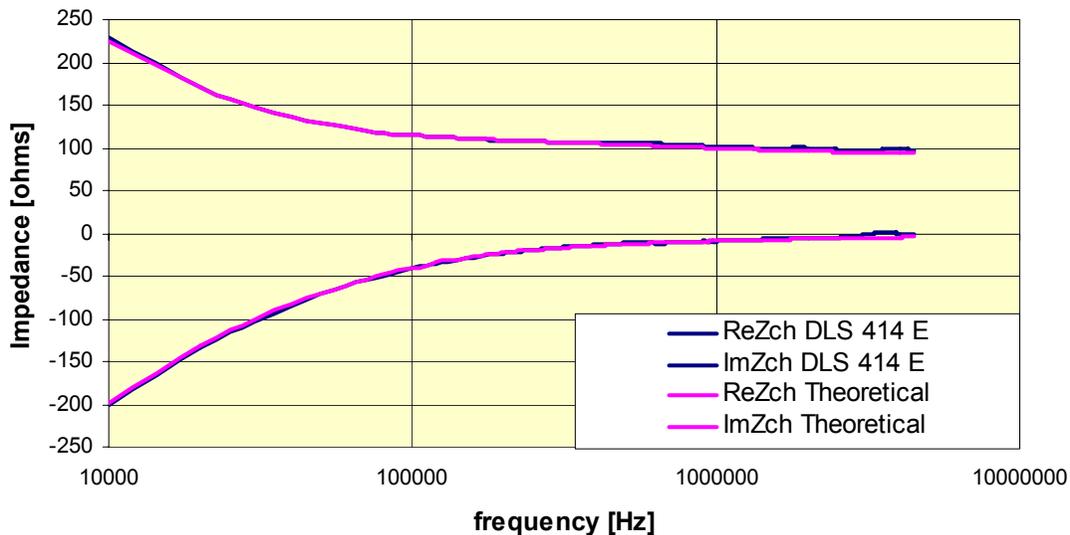


Figure B2.7 Characteristic Impedance Measured on 1km DLS 414 E vs Theoretical

Appendix C BACKGROUND NOISE MEASUREMENT CONSIDERATIONS

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 not connected) is illustrated in the graph below:

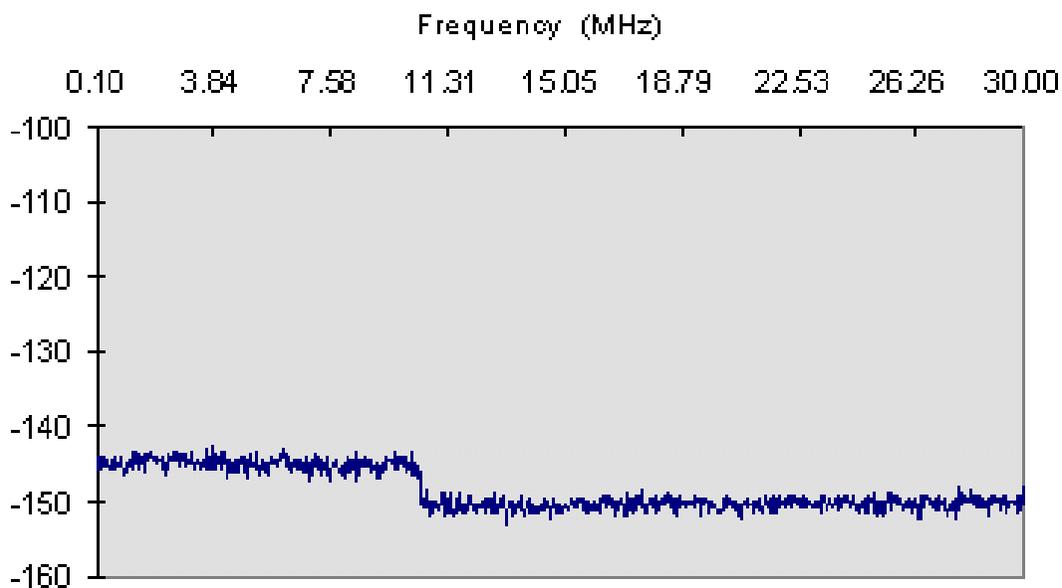


Figure C.1 HP 4395A Noise Floor

Figure C.1 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 noises 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.

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

