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OPERATING AND REFERENCE MANUAL

DLS 400E

Wireline Simulator

Consultronics



Revision 5 - July 3, 1997

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1. INTRODUCTION

Thank you for choosing Consultronics.

Consultronics has been in the wireline simulation business for over 20 years now. Since the days of the S2, Consultronics has designed many new units both to customers specifications and to conform to an ever-growing range of standards. By introducing the DLS 100 in 1985 we believe that we sold the world's first truly wideband wireline simulator to successfully simulate attenuation, characteristic impedance and delay.

1.1 About the DLS 400E Wireline Simulator

Delivering high-speed data, voice, and video to a subscribers' site over a single pair of wires requires a large bandwidth for transmission, coupled with complex algorithms of compression, error correction, and echo cancellation. The DLS 400E provides a perfect test bed for optimizing these algorithms. Due to the large bandwidth provided by the DLS 400E, it is suitable for testing ADSL, HDSL, T1 and ISDN (BRI & PRI) transmission products. The DLS 400E is equally suited for testing transmission schemes which use DMT, CAP, 2B1Q, and any other line codes.

The DLS 400E reproduces the A.C. and D.C. characteristics of twisted pair copper telephony cable using networks of passive discrete components (R, L & C). It can contain hundreds of segments of cable simulation which are matrixed together in various configurations and line lengths. Cable is simulated accurately up to 1.5 MHz and in some configurations up to 3.0 MHz. This makes it suitable for testing ADSL transmissions up to 7 Mbit/s. It allows the user to mix and match various gauges and lengths of wirelines in one or more chassis, in order to make up the loop of choice. It can be set to provide very many different configurations of these cables

In addition to the loop simulations, it is possible to add up to 2 wideband impairments generators, sometimes known as a "impairments cards" to the unit. This allows the user to add a wide variety of impairments to the signals at one end of the line, and test telecommunications transmission systems according to specifications recommended by both European (ETSI) and North American (ANSI) standards bodies.

Two DLS 400E chassis may be cascaded to simulate the longer loops required to perform 2.048 Mbit/s ADSL testing. See section 3.5, “DLS 400E 2.048 Mbit/s System” for more information.

The DLS 400E unit is controlled by software running on any Windows™ compatible computer. It includes both IEEE 488 and RS-232 interfaces for easy integration into a larger test system.

1.2 About this Manual

This manual contains a “QUICK START” section (see page 2) which lets experienced users get “up-and-running” quickly. First time users should read the “GETTING STARTED” section on page 3 thoroughly before powering up the DLS 400E. The remainder of the manual contains information about the software, remote control, warranty, specifications and performance.

If you have any questions after reading this manual, please contact your Consultronics sales representative or our Ottawa Customer Service department at the locations listed in section 15, "WARRANTY", of this manual.

If you have any suggestions as to how we can improve this manual or the DLS 400E, please use the registration form or contact the Ottawa division (see section 15, “WARRANTY”).

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2. QUICK START

This section is for experienced users. If you are using the DLS 400E for the first time, please read section 3, “GETTING STARTED”.

1) Connect the power cord to the DLS 400E and switch the power on.
2) Connect either an IEEE 488 or a RS-232 cable.
3) Connect your "Central Office" equipment to side A of the DLS 400E.
4) Connect your "Customer Site" equipment to side B of the DLS 400E.
5) Start the software by clicking on the DLS 400E icon.
6) Select the desired configuration and lengths.
7) Select the desired impairments.
8) Do your testing.

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3. GETTING STARTED

3.1 Receiving and Unpacking the Unit

The DLS 400E has been shipped to you in a reinforced shipping container. Retain this container for any future shipments.

Check that you have received all the items on the packing list and report any discrepancies as soon as possible.

Fill in the "Product Registration" card and send it back to the factory.

3.2 What You Need

To control the DLS 400E, you'll need the following:

1) DLS 400E Wireline Simulator
2) DLS 400E software package (or see section 3.4.4)
3) Windows™ compatible computer with either:

   National™ PCII or AT/TNT IEEE 488 Interface card
   IEEE 488 cable

OR

   Serial port: COM1, COM2, COM3 or COM4
   RS-232 serial cable

The software package provided by Consultronics will allow you to control the DLS 400E using the RS-232 or IEEE 488 interfaces. The software runs under Windows™ and lets you control up to two DLS 400E units. You may also control the DLS 400E simulator by writing your own software to send commands over the RS-232 or IEEE 488 port.

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3.3 DLS 400E Front Panel

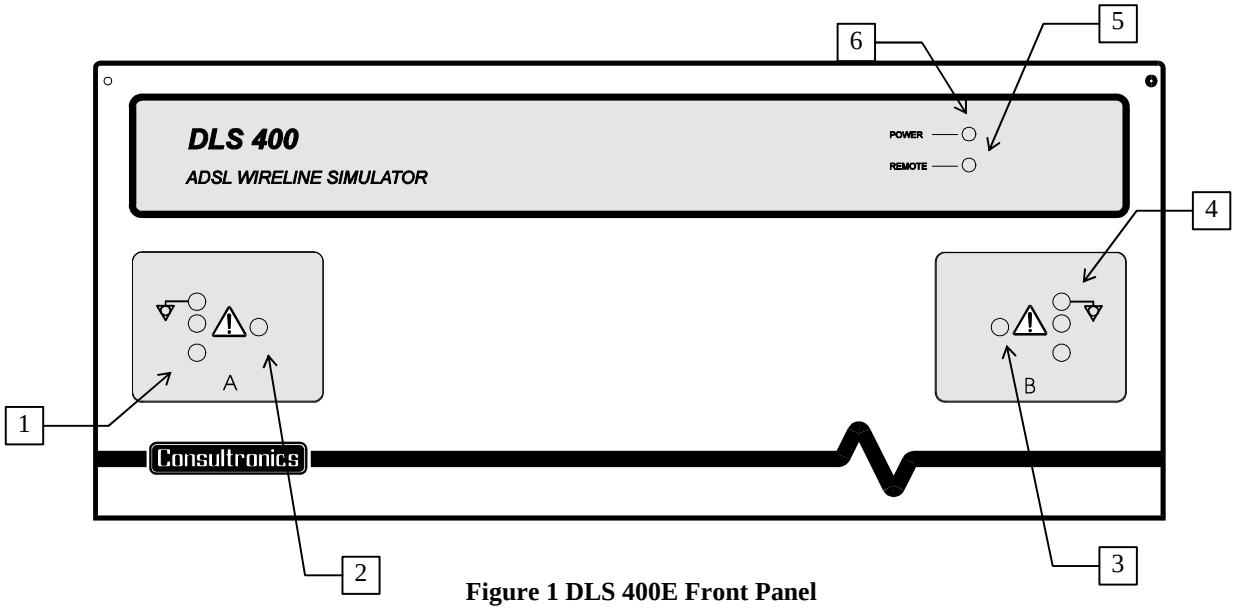


Figure 1 DLS 400E Front Panel

The input and output jacks of the simulator are located on the front panel and may also be found at the back of the DLS 400E. The “Power” and “Remote” LEDs are also located at the front.

1) Side A balanced CF connector
2) Side A bantam jack
3) Side B bantam jack
4) Side B balanced CF connector
5) Remote LED
6) Power LED

3.3.1 Analog connections

The bantam connector on the DLS 400E is a 3-wire (ring, tip, sleeve) balanced connector with a diameter of 0.173" (4.39 mm). The connector is also known under other names: miniature telephone connector, mini 310 connector, bantam telco jack, etc.

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 400E provides a bi-directional wireline simulation.

Normally, you would connect your Telephone Exchange (Central Office) equipment to side “B” of the DLS 400E, and connect your customer site equipment to side “A”. You can use either the Bantam or CF connectors on the front of the unit, or the connectors on the back. Note that all the Bantam jacks and 3-pin CF connectors on each side are balanced and connected in parallel.

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3.3.2 LEDs

The DLS 400E has 2 LEDs which indicate the power status and the remote status.

1) Power LED
2) Remote LED

The POWER LED turns green when the power is turned on. The power LED will turn blinking red if it fails its self-test, or yellow if it detects an internal error. See section 13.1 for more details about the "DLS 400E Self-Test".

The REMOTE LED is off after a power-up or a reset. When the DLS 400E receives the first remote message, the REMOTE LED will turn green if the command is valid or will turn red if an error is detected. The error may be, for example, an invalid command or an out-of-range value. The REMOTE LED will stay red until the error flags are cleared (see the command *ESR? in section 11.1.2 for more details). When the REMOTE LED is red, the DLS 400E can still communicate as normal, but the user should investigate why the error occurred. Sections 7.1.6 and 7.2.2 show examples of programs that will read the ESR register, clear the error flags and will make the REMOTE LED turn back to green.

3.4 DLS 400E Rear Panel

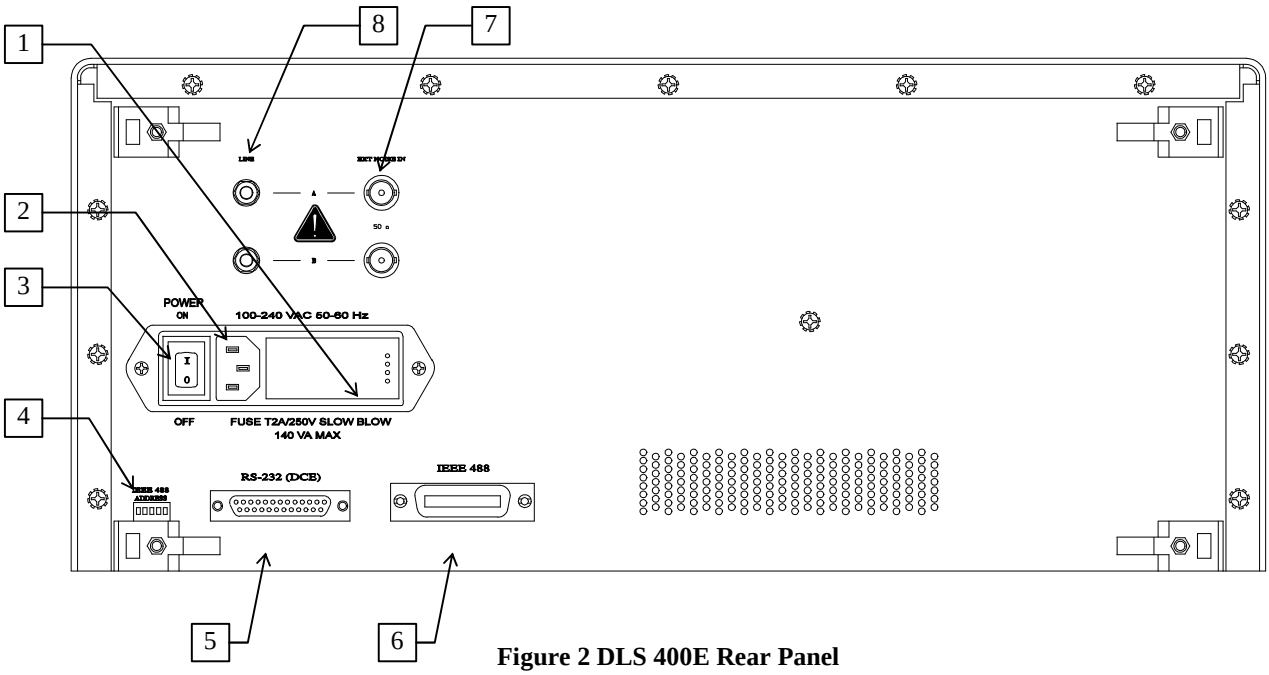


Figure 2 DLS 400E Rear Panel

The DLS 400E rear panel consist of the AC input module, digital connectors and analog connectors.

1) Fuses box
2) Power Input
3) Power On / Off Switch
4) IEEE 488 Address DIP switch
5) RS-232 (DCE) serial connector
6) IEEE 488 connector
7) External noise input A /B (BNC connector)
8) Side A/B line input / output (bantam jack)

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3.4.1 Connecting Power to the DLS 400E

The DLS 400E is built with a 2-fuse configuration,see section 12, “Fuses Configuration”.

Connect the power input on the back of the DLS 400E to an AC line voltage between 90 and 260 V_{RMS}, 50 to 60 Hz. The DLS 400E can work with any voltage and frequency in this range, so you don’t have to set any switches. The voltage selector on the rear panel has no effect.

The DLS 400E will always power-up in an “idle” state which means that it will not inject any impairments.

One convenient feature of the DLS 400E is that the last configuration used is kept latched into the relays, allowing the unit to be used even when the power is turned off.

3.4.2 Analog connections

The bantam connector on the DLS 400E is a 3-wire (ring, tip, sleeve) balanced connector with a diameter of 0.173" (4.39 mm). The connector for both sides is connected in parallel with the corresponding connector at the front of the unit.

3.4.3 External Noise Input

You can inject externally-generated impairments using the “EXT NOISE IN” BNC connector on the back of the DLS 400E. This 50 ohms input is NOT differential - the outside of the BNC connector is grounded.

The input signal should not exceed -30 dBm between 50 Hz and 1 kHz. The signal may be as high as -10 dBm between 1 kHz and 2 MHz. A 20 dB attenuator is inserted between the input and the differential output.

3.4.4 Remote Control

The DLS 400E works with either an IEEE 488 or an RS-232 interface. Consultronics provides control software that let you set the wireline inside the chassis to create a loop and to set the various impairments. If you are developing your own software, read section 7, “REMOTE CONTROL”, which explains the different commands to set the unit.

3.4.4.1 IEEE 488 Operation

The IEEE 488 portion of the control software supplied by Consultronics will only work with a National™ IEEE 488 interface card. If necessary, install the National™ IEEE 488 interface card in the computer. See section 4.2, “National™ IEEE 488 Interface card Settings”, for important information on configuring your card.

Connect one end of an IEEE 488 cable to the IEEE 488 connector located on the back panel of the DLS 400E. Connect the other end of the IEEE 488 cable to the IEEE 488 interface card in the computer.

3.4.4.2 Serial Port Operation

Connect one end of an RS-232 serial cable to the RS-232 connector located on the back panel of the DLS 400E and connect the other end to a serial port connector on the computer. The DLS 400E software works with COM1 to COM4. Make sure there is no conflict with your mouse. The two chassis configuration is not supported over the RS-232 port by the DLS 400E software package provided by Consultronics - you must use the IEEE 488 interface.

3.5 DLS 400E 2.048 Mbit/s System

The DLS 400E 2.048 Mbit/s system implements all the loops described in Annex “H” of ANSI T1.413. It consists of two chassis due to the very long length of some of the loops. The 1st chassis contains wirelines of gauges 0.32 mm,

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0.4 mm, 0.5 mm, 0.63 mm, and 0.9 mm. The 2nd chassis contains additional wirelines of 0.4 mm and 0.5 mm. The software shows exactly which type of wirelines are installed in which slots.

The 1st chassis is shipped from the factory with the IEEE 488 address set to 14. The 2nd chassis is shipped with the IEEE 488 address set to 15. See section 7.1.2 for more details on how to read or change the address.

The control software assumes the following analog and digital connections:

- Customer Site (ATU-R) equipment is connected to side A of the 1st Chassis.
- Side B of the 1st chassis is connected to side A of the 2nd chassis using the provided Bantam patch cord.
- Central Office or Exchange (ATU-C) equipment is connected to side B of the 2nd chassis.
- The IEEE 488 connectors of both chassis are connected to the connector of the National Instruments IEEE 488 card in your computer. The DLS 400E control software does not support the two chassis configuration over the serial port.

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4. DLS 400E SOFTWARE

4.1 Installation

DLS 400E control software is designed to run on any Windows™ compatible computer. You will need about 1 Mbytes of hard disk space. The software requires a National Instruments IEEE 488 card installed in your PC. Even though installation is required for the software, we advise you to make a backup copy of the original DLS 400E disk. When the installation is finished, keep the original and the backup in a safe place.

To install the DLS 400E software on a hard drive, insert the diskette into a 3½" floppy drive on your computer. From "File Manager" in Windows™ or otherwise, run "setup.exe". The setup program copies a number of files onto your \windows directory, and some into your \windows\system directory. It also copies 2 files into a DLS 400E directory. Usually this directory is C:\DLS400E, but you can choose exactly where you want these 2 files. When you have finished the installation, the software returns to "Program Manager", and you will see that now there is a new DLS 400E Icon.

If you look at the directory where the DLS program resides, you will see that there are 2 programs called DLS400E.EXE and DLS400E.CFG. The .CFG file saves the last setup so that if the computer is powered off and then on again, the DLS 400E will return to exactly the same configuration as before.

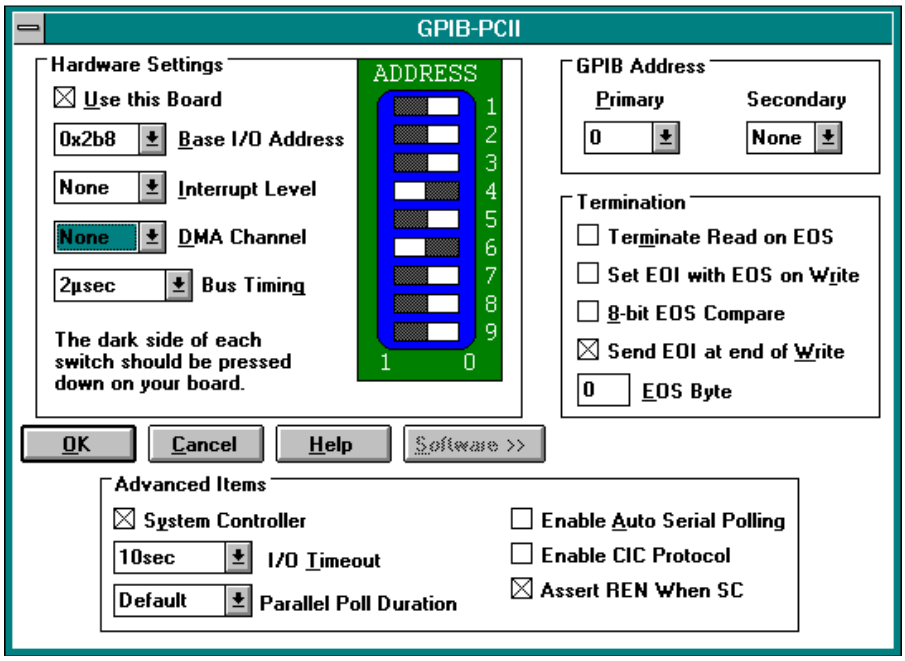
We tested the software using a GPIB-PCII card with NI-488.2 software version 2.6 (for Windows).

4.2 National™ IEEE 488 Interface card Settings

The DLS 400E software requires some settings to the National Instruments drivers. Run the GPIB settings program located in the Windows Control Panel and click on "Software" to show the entire configuration. You need to select:

- Assert REN when SC
- Bus Timing=2 microseconds
- Disable Auto Serial Polling.

Other settings, such as Base I/O address, depend on the configuration of your National Instruments IEEE 488 card.



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4.3 Communications Setup

You have to decide whether you want to communicate with the DLS 400E over the IEEE 488 or RS-232 bus, and connect the DLS 400E chassis to your PC. Connecting up the cables is described in section 3.4.4 and in section 3.5 for a 2 .048 Mbit/s system. If you want to use the RS-232 interface, the software will prompt you for which COM port to use - make sure to not select the one used by your mouse! If you want to use the IEEE interface, a National Instruments™ PC II or AT/TNT card must be installed in your computer. You may also run the software in "Offline" (demo) mode when the DLS 400E simulator is not connected or turned off.

When you run the software, the opening screen consists of 3 "buttons" that allow you to select RS-232 interface, IEEE 488 interface, or "Offline" mode. Select appropriately, and the main screen appears.

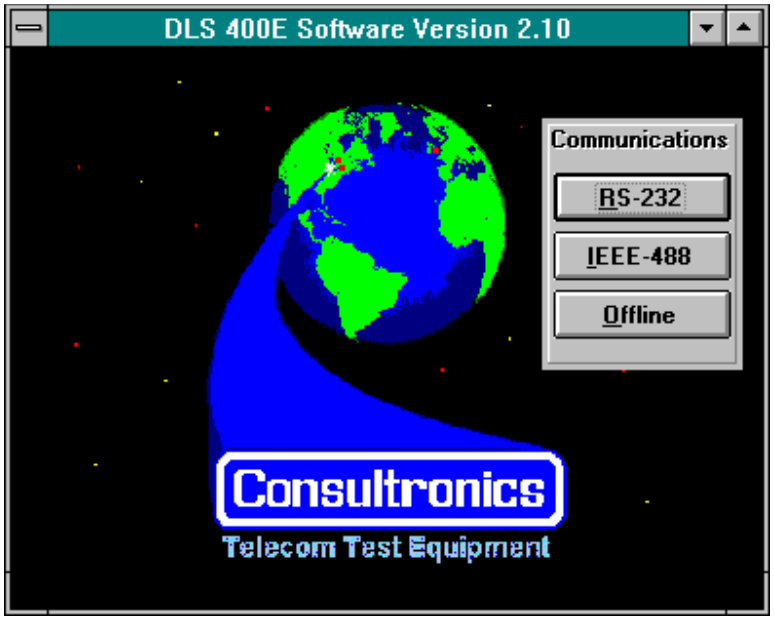


Figure 3 DLS 400E Opening Screen

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4.4 DLS 400E Main Screen

The main screen appears immediately after you have selected the interface as described above. The table lists all the slots within the unit, the wireline cards installed in those slots, the distance set on each wireline, and whether it is a normal (in line) section or a bridged tap.

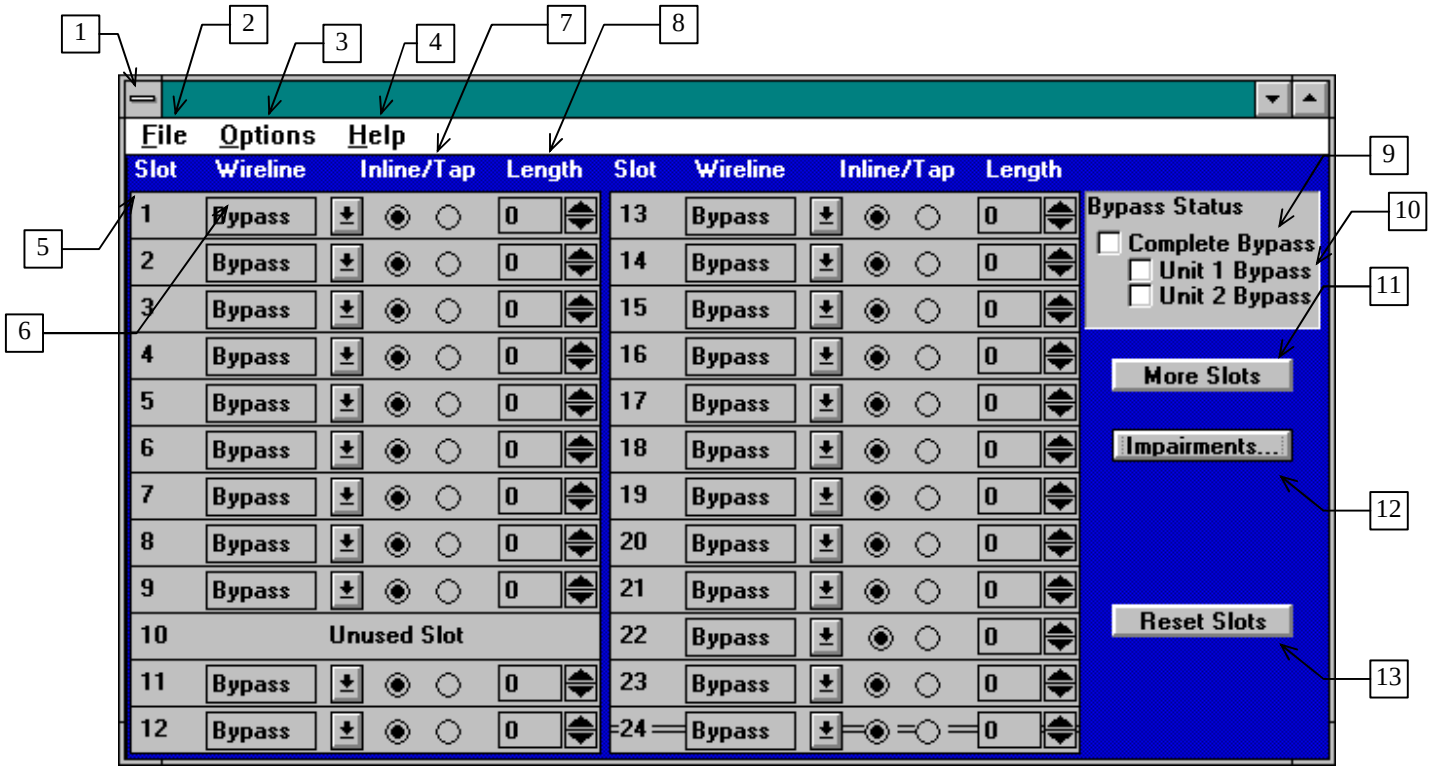


Figure 4 DLS 400E Main Screen

ID	Name	Description
1	Control box	Click on this box to pop up the control menu to move, size or close the window.
2	File	Pull-down menu to load and save user defined tests. Also enable the loading of more than 50 standard impairments files.
3	Option	System configuration settings such as number of chassis and impairments cards.
4	Help	Displays the title and version number of the DLS 400E control software.
5	Slot	The DLS 400E consists of 23 slots where a variety of wireline cards may be installed.

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ID	Name	Description
6	Wireline	Wireline type: bypass, 0.32 mm, 0.4 mm, 0.5 mm, 0.63 or 0.9 mm. In demo mode, the type is selectable but when attached to a DLS 400E simulator, the software will automatically poll the unit and will display the current configuration.
7	In-line/ Bridge Tap	Each wireline may be set either in-line or acting as a bridged tap.
8	Length	Length of the wireline in that particular slot.
9	Complete System Bypass	When using two chassis, clicking on this check box will bypass both units.
10	Unit 1 Bypass Unit 2 Bypass	Provides individual chassis bypass.
11	More Slots	Provides second chassis control. The slots will be numbered from 25 to 48 for the second chassis.
12	Impairments...	Click on the Impairments button in this box to change impairments setting.
13	Reset Slots	Resets all slots to zero length.

Using the mouse you can click on the appropriate fields to set up the configuration desired. See section 5 for more details on how to build loops.

You can also move around and select the wireline configuration using a keyboard if necessary. This is quite easy but takes a little longer. The <TAB> key is used to move from one field to the next. <SHIFT> and <TAB> together reverse the move order. As you tab through, you set up all the wireline types and lengths first, followed by the In-line / Bridged Tap selection followed by the Bypass and Impairments buttons, before returning to the wireline types and lengths again.

To set the wireline type field (when in demo mode), use the up and down arrow keys.

To change the wireline length field, type the distance and press <ENTER>.

To select In-line or bridged tap, use the left and right arrow keys.

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4.5 DLS 400E Unit Configuration

When running the software for the first time, configure the software to match your system. Click on “Options” to pull down the menu and select “Unit Configuration”.

First set the “DLS 400E System Type” to the number of chassis to be controlled by the software and the appropriate IEEE 488 addresses. Then click on the location of any installed impairments card for unit 1 and unit 2, if applicable. Click on “OK” to return to the main panel. If the DLS 400E chassis is connected the software will verify for the system configuration. If an IEEE address is incorrect or if an impairments card is not present, a message of error will be displayed. Go back into the “Unit Configuration” setup screen and do the appropriate changes.

If your system consist of 2 chassis, only one impairments card per chassis may be enabled and they need to be in a different slot. For example, if unit 1 contains an impairments card in slot A, another impairments card may only be enabled in slot B of unit 2.

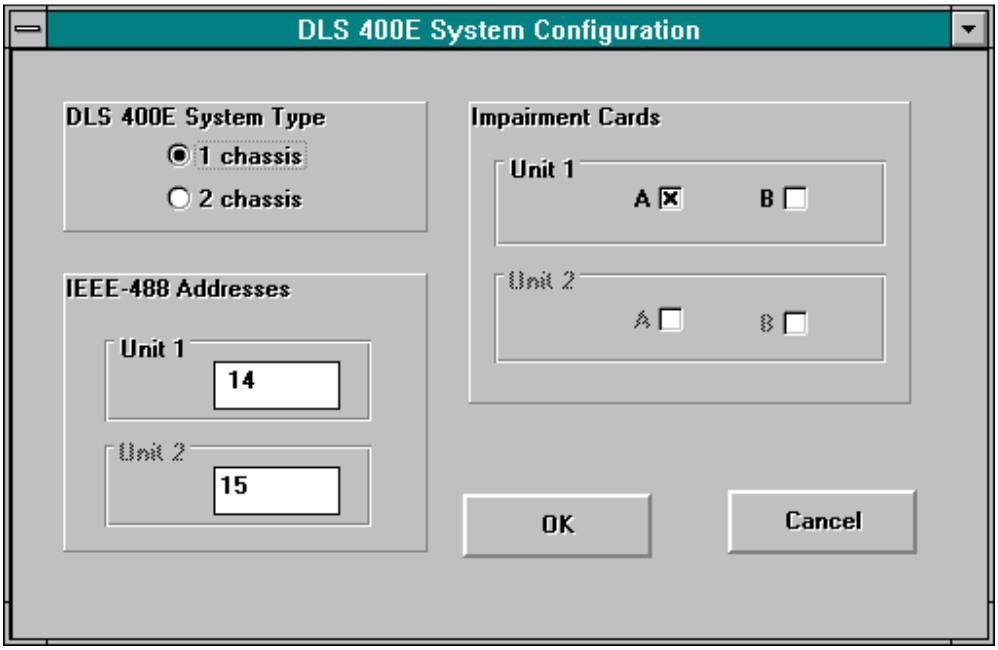


Figure 5 DLS 400E System Configuration

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4.6 Impairments Control Panel

The impairments control panel enables you to inject differential and longitudinal impairments on the simulated loop.

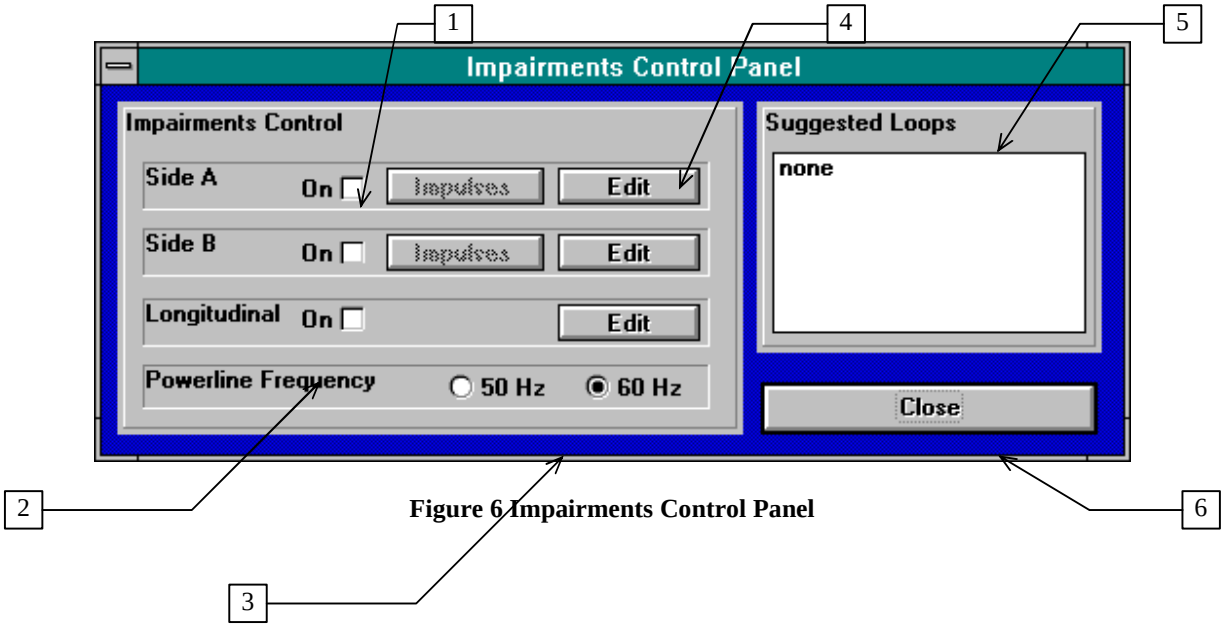


Figure 6 Impairments Control Panel

ID	Name	Description
1	Side A On Side B On	To switch the differential impairments ON, click on the ON check box to put an “x” in the box. To switch it OFF, click again on the ON check box.
2	Longitudinal On	To switch the longitudinal impairments ON, click on the ON check box to put an “x” in the box. To switch it OFF, click again on the ON check box.
3	Powerline Frequency	The powerline frequency (50 or 60 Hz) setting affects the frequency of the metallic noise generator and of the longitudinal noise generator
4	Edit	Select to edit the various impairments types and levels.
5	Suggested Loop	Depending on which standard combination has been loaded, a list of “Suggested Loops” will be displayed on the side. These loops are mainly used when doing ANSI loop testing.
6	Close	Returns to the Main Control Panel.

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4.7 Editing Differential Impairments Parameters

The Impairments Editing Panel shows ONLY the parameters of the selected combination. To see all available parameters, load “All Impairments Combinations” from the Standard combinations.

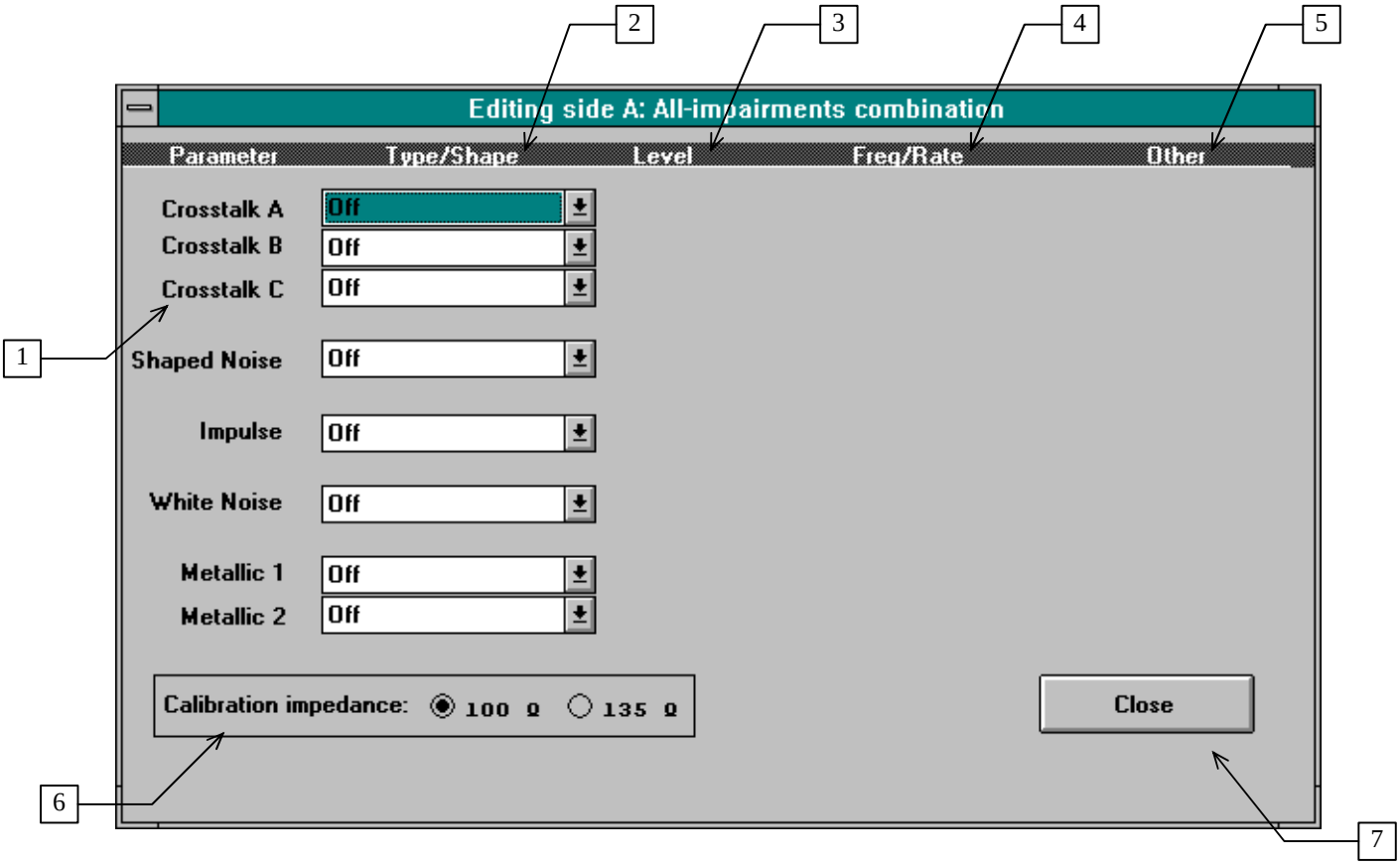


Figure 7 All-impairments combination

ID	Name	Description
1	Parameter	The noise simulator consists of the following impairments generator: ♦ crosstalk noise generators (total of three) ♦ shaped noise ♦ impulse ♦ white noise ♦ metallic powerline harmonic ♦ longitudinal triangular voltage
2	Type/Shape	Selects the type of the chosen parameter.
3	Level	Sets the level of the parameter. Units are shown beside the level and are selectable in some cases.
4	Freq/Rate	For impulses, shows the selected repetition rate. For impairment combinations other than ALL the rate is shown as PC CTL, which means that the rate is preset and cannot be changed. See the impulse section 6.2.6 for more details.
5	Other	Shows the absolute level of the selected T1.601 Power Related Metallic noise tone

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ID	Name	Description
		levels.
6	Calibration Impedance	Shows the impedance used to calculate dBm power levels. Note that when this value is changed the absolute power of the signal being injected onto the line is not changed, but rather its dBm reading is.
7	Close	Returns to the Main Control Panel.

There are 2 types of fields in the editor, drop down lists and text fields.

Drop down lists are identified by the down arrow at the far right of the field. Clicking on this arrow causes the list choices to drop down. You can then click on the choice you want. If you are using the keyboard without the mouse, hold the ALT key, and while you are holding it, press the down arrow.

In text fields, type the value for the parameter described by the field and press Enter. The parameter will change when you go to another field or after a preset interval of approximately 1 second.

When you have finished editing, you can click on the Close button to go back to the Impairments Control panel.

4.8 Editing Longitudinal Voltage Impairment

This screen allows you to set the longitudinal voltage and the location of the exchange (central office). The longitudinal voltage will be injected on the customer site for the ANSI impairments combination. Otherwise it will be injected on both sides. See section 6.2.7.2, “Longitudinal Noise” for more details.

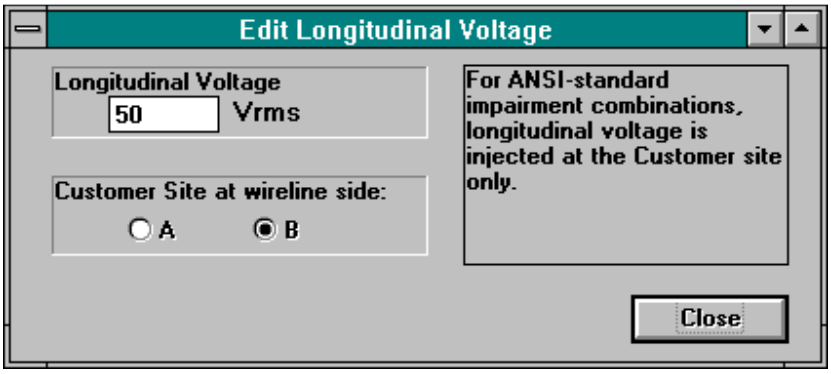


Figure 8 Edit Longitudinal Voltage

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4.9 Loading Impairments from Standards

The easiest way to generate impairments is to use the preset values available from the Load menu. With these you can be assured that you are using the proper values as called for in the appropriate specification. You can also vary the levels of any component of those impairments using the impairments editor.

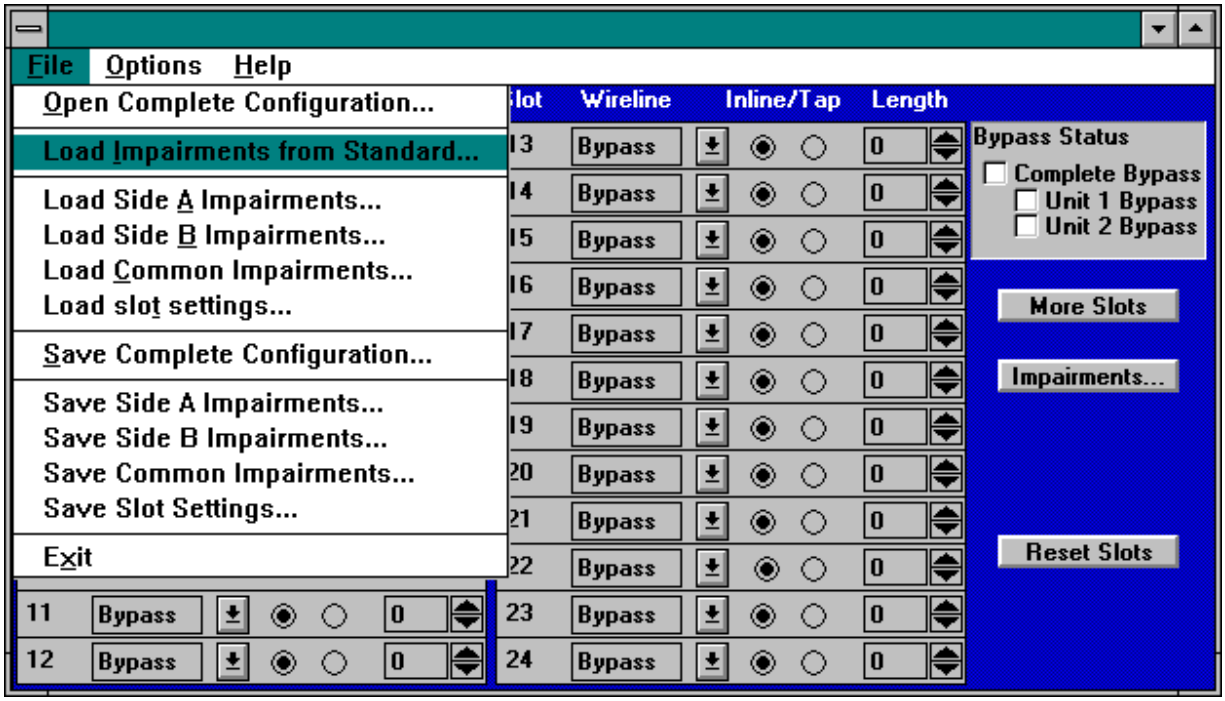


Figure 9 Load Impairments Sub-Menu

Start by selecting the “Load Impairments from Standard” from the Load sub-menu.

This will bring you to the “Load Impairments Combination from Standards” Panel. The panel offers over 50 combination of impairments which set the DLS 400E impairments parameters according to a variety of North American and European standards. The first one “All impairments combinations” enables you to edit every impairment, while the other combinations offers a limited set of impairments as defined in the following standards:

- ANSI ADSL T1.413
- ANSI HDSL Technical Recommendation
- ANSI Basic Rate T1.601
- 2.048 Mbit/s ADSL T1.413 Annex H
- ETSI HDSL RTR/TM 3036
- ETSI Basic ETR 80
- FTZ Basic 1TR220

Use the arrows to scroll through the various standard combinations or click on the scroll bar. To choose a combination, position the highlight bar on the desired combination and click on “Load”.

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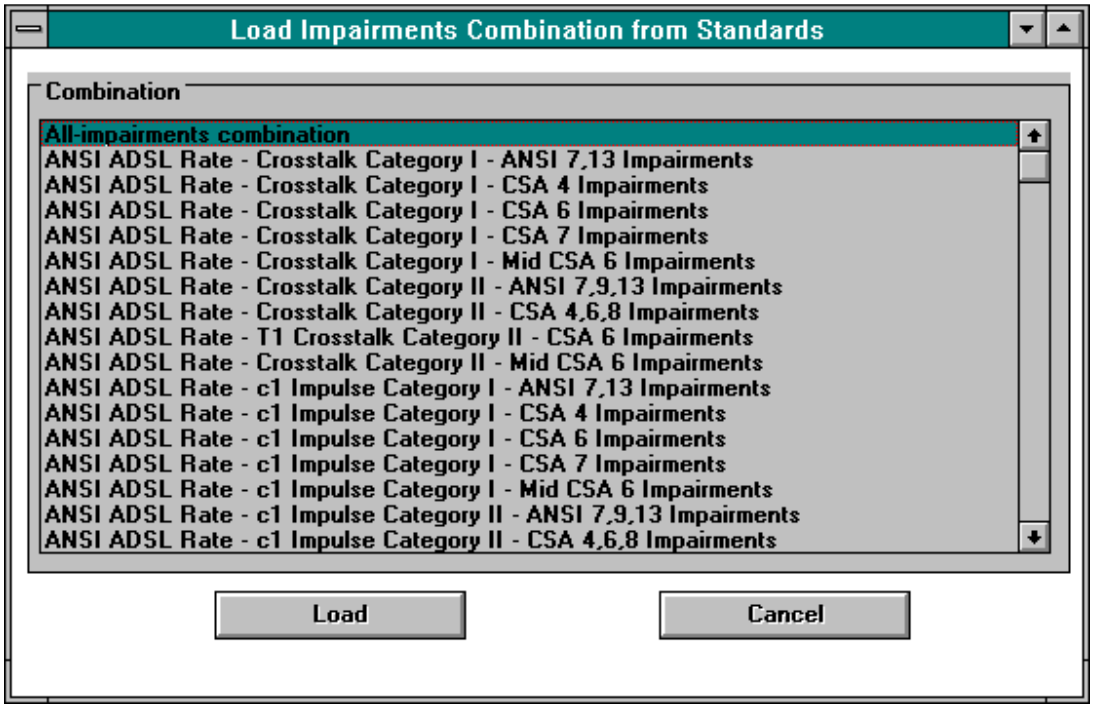


Figure 10 Load Impairments from Standard

4.10 File Save/Load for User-defined Wireline and Impairments Settings

The DLS 400E software allows five methods of storing and recalling information from disk:

- Complete test settings
- Loop settings
- Side A impairments settings
- Side B impairments settings
- Common mode (longitudinal) impairments settings

4.10.1 Saving/Loading Complete Test Settings

After setting impairments and the loop configuration, you can save the entire settings of the DLS 400E system on disk by clicking on the “File” menu and selecting “Save Complete Configuration...”.

To recall the file, select “Load Complete Configuration...”.

4.10.2 Saving/Loading Loop Settings

To save the loop settings, click on “File” menu and select “Save Slots Settings...”. This will only save the settings for every wireline slot in the chassis (i.e. in-line/bridge tap configuration and length).

To recall only the loop settings, click on “File” menu and select “Load Slots Settings...”.

4.10.3 Saving/Loading Side Specific Impairments Settings

After setting the various impairments, you can save them to disk by clicking on the “File” menu and selecting “Save Side A Impairments...” or “Save Side B Impairments...”.

To recall user-defined impairments from disk click on the “File” menu and select “Load Side A Impairments...” or “Load Side B Impairments...”.

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4.10.4 Saving/Loading Common Mode Impairments Settings

The longitudinal impairments settings are saved by clicking on the “File” menu and by selecting “Save Common Impairments...”.

The longitudinal impairments settings are retrieved by selecting “Load Common Impairments...”.

4.11 Triggering Impulses

In some cases where the impairments combination calls for impulses, the button labeled “Impulses”' on the Impairments Control panel will become active. Several impairments combinations defined by the ADSL testing standards call for 15 impulses to be applied upon channel establishment (i.e. after carriers have been detected on both side) at a rate slower than 1 per second. In these cases, you will see the “Impulses” button in the “Control” box. When you click on this button, a box appears, with buttons to Start impulse generation and to Cancel it and return to the Main Control Pane. When you press the Start button, impulse generation starts. A total of 15 impulses will be generated at interval of 1.1 seconds. Once started, a button appears, to let you stop impulse generation and will show you the progress of the test.

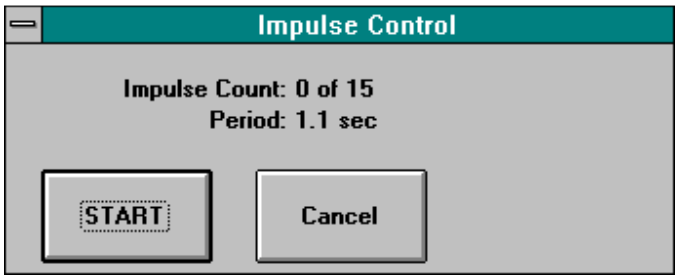


Figure 11 Impulse Control

When you edit combinations that use this software control of impulses, you will see the words “PC Ctrl”, indicating that the impulse rate is under PC Control. For other combinations that call for impulses, the rate appears in the editing screen.

Remember, the appearance of these buttons depends on the selected combination. Therefore, if the selected combination does not include any impulses, the Impulse button will be disabled.

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5. Configuring the Simulated Line

Internally, the chassis has 23 positions, known as "slots", in which wireline cards (sometimes called modules) can be inserted. Wireline cards inserted in these slots are connected together in series. Bypass cards, effectively of zero length, must be put in all slots which do not have wireline cards to carry the signal through from connector A to connector B.

Each DLS 400E metric gauge wireline card can simulate up to 500 m (approx. 1500 ft) of cable and has a length which is variable in 50 m steps. You can set any card to be a bridged tap instead of a through connection, if desired. The bridged tap can also take up any length from 0 to 500 m in 50 m steps.

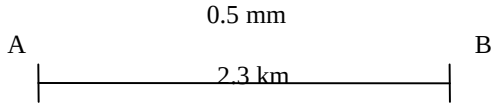
Consultronics also provides North American wireline cards (24AWG, 26AWG) for the DLS 400E. The N. A. wireline card can simulate up to 1500 ft of cable and has a length which is variable in 100 ft steps. The bridged tap can take up any length from 0 to 1500 ft in 100 ft steps.

The card cannot be part 'bridged tap' and part 'straight through' at the same time. Slot 10 has a special configuration and cannot be used for the wireline simulation . A bypass card must be inserted in this slot in order to keep continuity through the unit.

The wireline cards are automatically detected in the DLS 400E chassis when the power is turned ON, so any DLS 400E compatible card combination (in any order) can be used with a custom unit.

To simulate standard test loops for transport class 2M-3, DLS 400E consisting of a 2 chassis (2-Mbyte system) should be used. This system includes all necessary cards needed to simulate the standard ADSL loops. Those cards are located in factory default slots.

Often you will want to simulate just one gauge of cable to a specific length. Suppose this is 2.3 km of 0.5 mm line. You would use 5 slots of 0.5 mm cable, and the overall line would look like this:



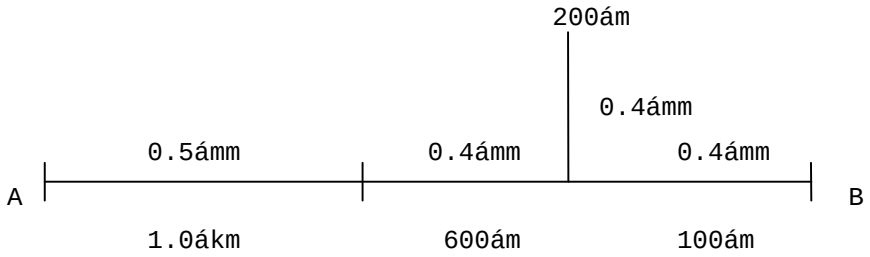
Typically 0.5 mm wireline cards are in slots 11 through 16. There are many ways to configure these for a 2.3 km length, but a simple way is to make slots 11 through 14 each 500 m, and make slot 15 300 m. Every other slot is either a bypass card or is set to 0 length. If you imagine all the cards end to end in the unit, they could then look something like this:

```
Slot No.     1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Gauge(mm)   .9 .9 .9 .9 .9 .9 .9 .9.63 BP .5 .5 .5 .5 .5 .5 .4 .4 .4 .4 .4 .4 .4 .32
          A                                                                        B
Length(km) |0  0  0  0  0  0  0  0  0     .5 .5 .5 .5 .3  0  0  0  0  0  0  0  0  0|
Norm or BT  N  N  N  N  N  N  N  N  N     N  N  N  N  N  N  N  N  N  N  N  N  N  N
```

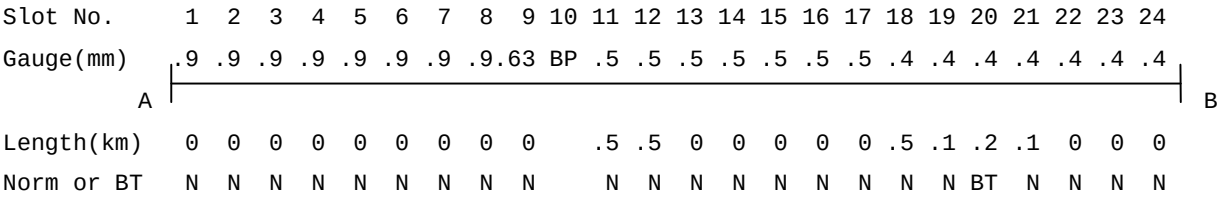
Looking at a more complicated configuration, you may want to set up a line that uses 1 km of 0.5 mm line followed by 0.6 km of 0.4 mm line, with a 200 m long bridged tap of 0.4 mm line, 100 m from the customer site end.

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This is the overall diagram:



and it could be made up like this:



5.1 ADSL Test Loops

Annex ‘H’ of the ANSI T1.413-1995 document describes all aspects of the ADSL system based on data rates at multiples of 2.048 Mbit/sec, for transport class 2M-3. To test the performance of the ADSL system incorporating the bearer channel capabilities outlined in clause ‘H2’ of the ANSI document, the test loops specified in Fig. ‘H3’ shall be used .

There are eight test loops with one adjustable section (marked ‘X’). Each of those 8 loops has 4 variations of the nominal length of the ‘X’ section. Those 4 variations of each loop can be divided into 2 configurations, and each of these configurations has 2 variations (one specified for noise model ‘A’ and another for noise model ‘B’) - total 32 test loops, which are shown in tables ‘H5’ to ‘H8’ of the ANSI document in annex ‘H’.

Both configurations are presented in the table below :

Transport class 2M-3 configuration	Simplex downstream rate (kbit/s)	Duplex rates (kbit/s)
1	2048	160 * 16 (C) (including analog POTS)
2	2048	16 (C) (including analog POTS)

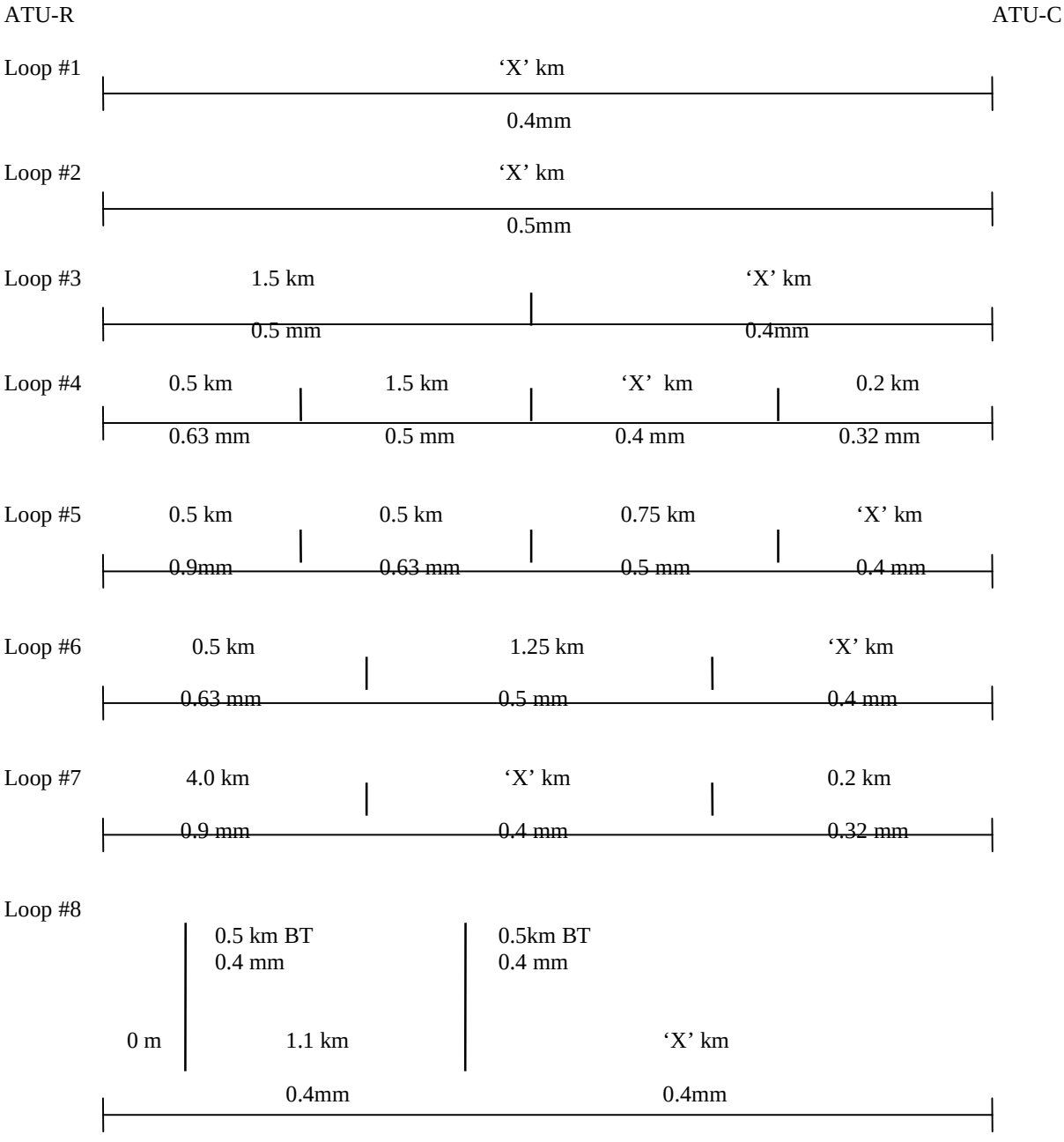
* This rate was designed to accommodate ISDN-BRA (2B + D + overhead)

Loop configurations 1 and 2 specified with noise model ‘A’ have much longer nominal value of adjustable length (therefore much higher insertion loss) than configurations 1 and 2 used for noise model ‘B’.

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5.1.1 ADSL Test Loop configurations

The test loops set for transport class 2M-3 configuration 1 or 2 operation with noise model A or B are shown below:



Nominal values of 'X' for 4 different configurations (as described in the ANSI document) are shown in the tables below:

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2M-3 Configuration 1 (noise model A)

Loop #	Nominal value of adjustable length 'X' (km)	Loop insertion loss at 300kHz (dB)
1	3.45	49.0
2	4.55	49.0
3	2.30	49.0
4	1.80	49.0
5	2.40	49.0
6	2.25	49.0
7	1.35	49.0
8	1.50	49.0

2M-3 Configuration 2 (noise model A)

Loop #	Nominal value of adjustable length 'X' (km)	Loop insertion loss at 300kHz (dB)
1	3.60	51.0
2	4.80	51.0
3	2.50	51.0
4	2.00	51.0
5	2.55	51.0
6	2.40	51.0
7	1.55	51.0
8	2.10	51.0

2M-3 Configuration 1 (noise model B)

Loop #	Nominal value of adjustable length 'X' (km)	Loop insertion loss at 300kHz (dB)
1	2.45	35.0
2	3.20	34.0
3	1.30	35.0
4	0.80	35.0
5	1.40	35.0
6	1.25	35.0
7	0.40	35.0
8	1.00	35.0

2M-3 Configuration 2 (noise model B)

Loop #	Nominal value of adjustable length 'X' (km)	Loop insertion loss at 300kHz (dB)
1	2.55	36
2	3.40	36
3	1.40	36
4	0.90	36
5	1.50	36
6	1.35	36
7	0.50	36
8	1.10	36

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5.1.2 ADSL Test Loops settings

All 32 test loop settings are stored on the files in the DLS 400E directory (folder) 'Loops'. The file name represents the specific loop configuration. For example, the file name **'Lp2c2ma.d4l'** contains the settings (nominal length) of the **test loop 2** for the 2M-3 **configuration 2** and noise **model 'A'** (as described in table H.6 of the Annex H). The file name **'Lp5c1mb.d4l'** represent the settings of the ADSL (2M-3) **test loop 5** , **configuration 1** for noise **model 'B'** (table H.7 of the Annex H).

After the desired file is retrieved , any available slot settings can be altered and a new configuration can be saved on disk. It is strongly recommended that the altered loop settings be saved in a different directory in a file with a different name to avoid overwriting the original test loop configurations. Simply select 'Save Slot Settings' and follow the screen information to save the loop settings to the new file. The standard test loop can be retrieved as shown below in Figure 12 and Figure 13.

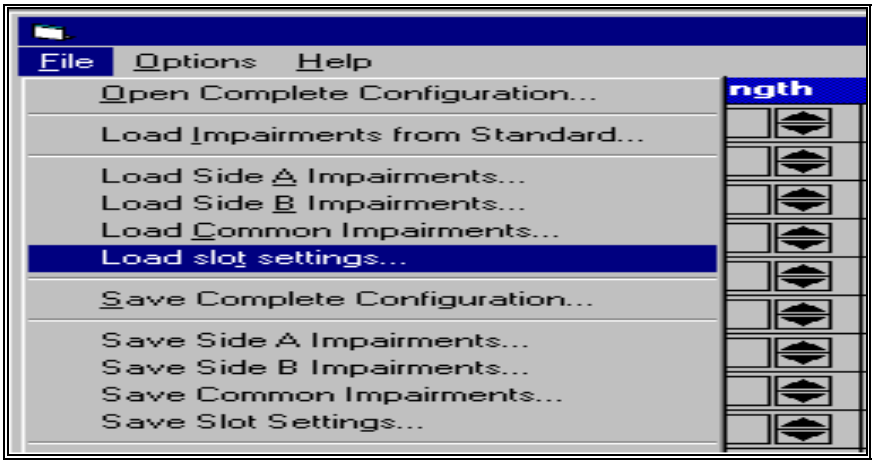


Figure 12 Load&save menu

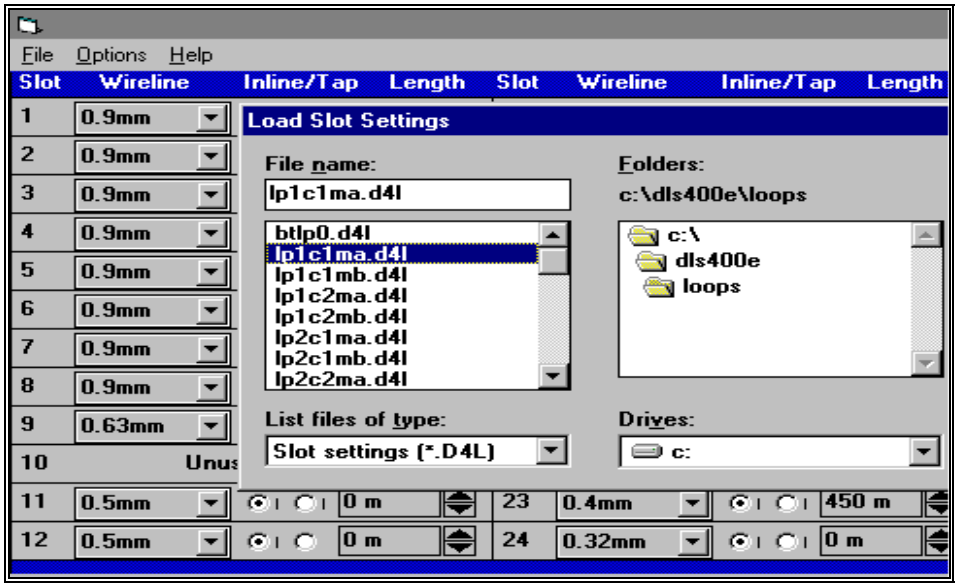


Figure 13 File selection menu

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5.1.3 The ADSL test loop characteristic attenuation

The following graphs show the measured attenuation some of the Consultronics ADSL test loops (used for transport class 2M-3, 2.048Mbit/s environment) :

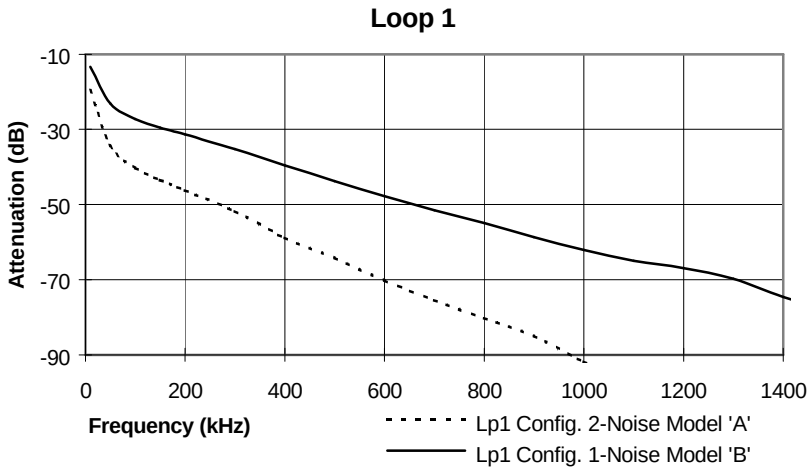


Figure 14 Loop-1 Attenuation graph

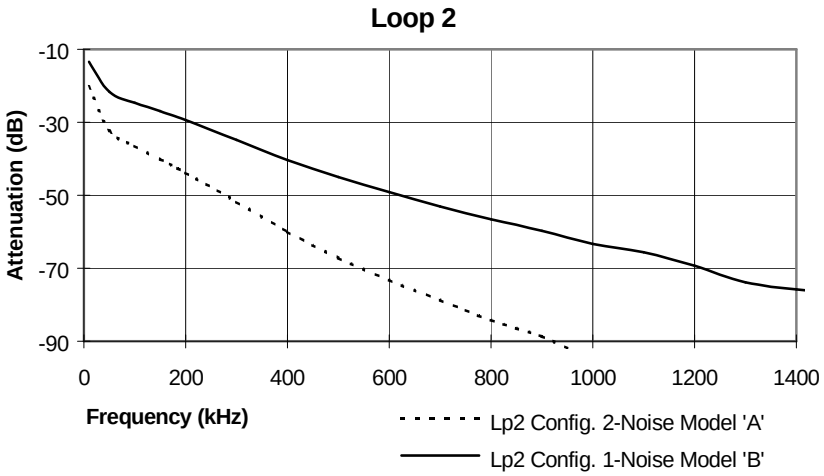


Figure 15 Loop-2 Attenuation graph

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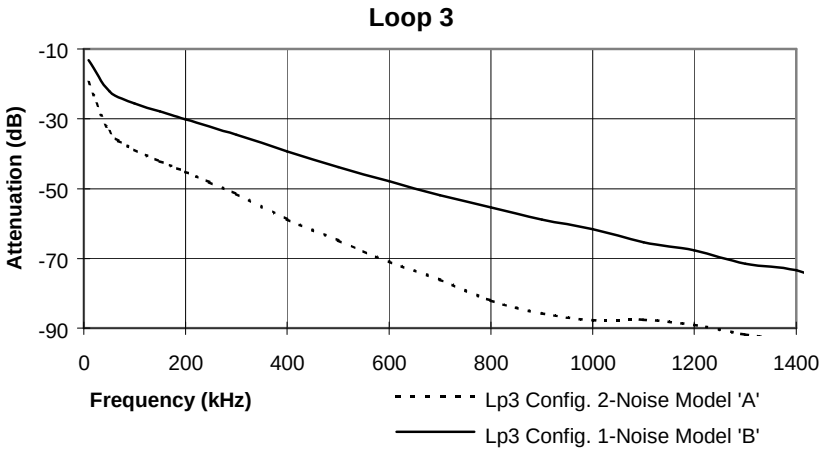


Figure 16 Loop-3 Attenuation graph

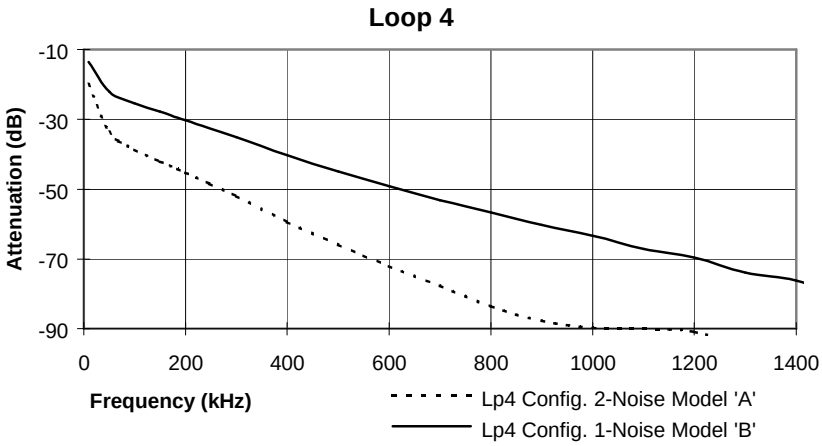


Figure 17 Loop-4 Attenuation graph

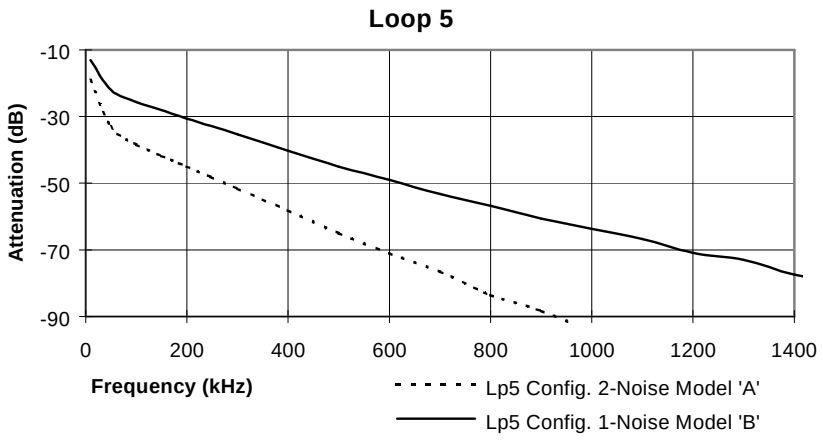


Figure 18 Loop-5 Attenuation graph

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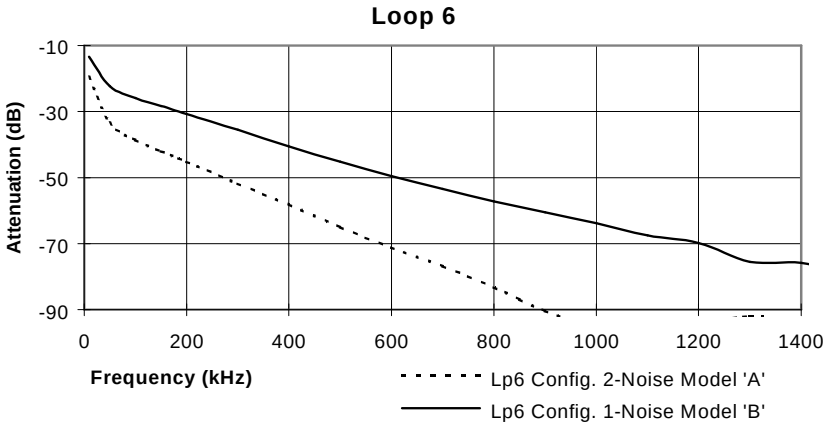


Figure 19 Loop-6 Attenuation graph

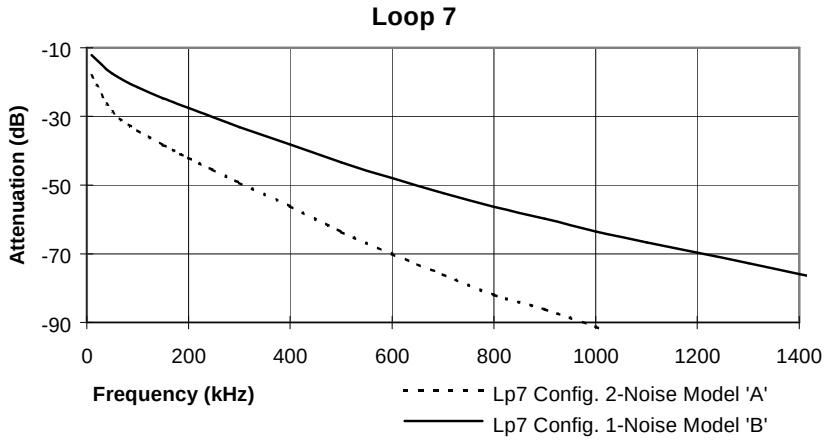


Figure 20 Loop-7 Attenuation graph

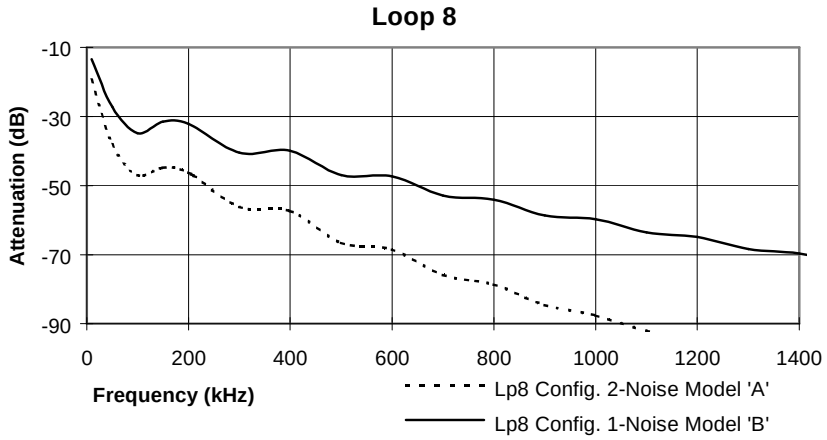
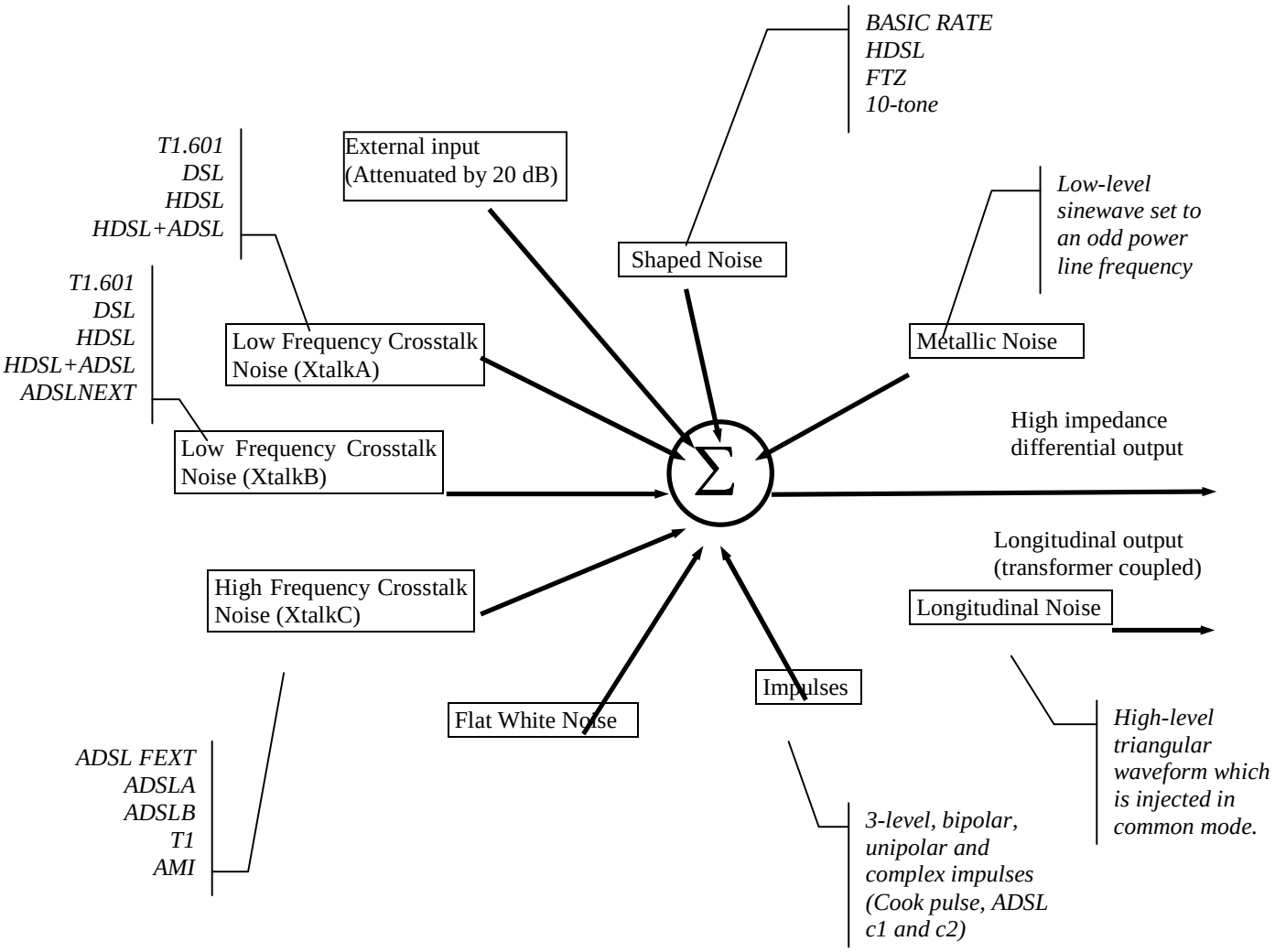


Figure 21 Loop-8 Attenuation graph

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6. ADSL NOISE GENERATOR DESCRIPTION

The ADSL noise card contains several generators that can simulate various impairments. The following block diagram shows these generators:



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6.1 Standards Implementation

Most impairments generated are specified by ANSI's T1E1.4 committee setting standards for ISDN Basic Rate, HDSL and ADSL rate testing of transmission devices. Some of the impairments are specified by the ETSI committee TM3 RG12 that sets standards for the same set of transmission device tests in Europe. When grouped by the relevant standards, the impairments are as follows:

6.1.1 Basic Rate Testing, ANSI T1.601 standard

Impairment	Description
Longitudinal Noise	Up to 60 volts common mode injection on the customer equipment side (normally on side A), 60 Hz (option 50 Hz).
Power related Metallic Noise	Odd harmonics of the fundamental up to 6th odd harmonic (660 Hz).
Crosstalk Noise (NEXT)	Spectrum and level as specified by ANSI for basic rate DSL 2B1Q transmission.

6.1.2 HDSL Rate Testing, ANSI Technical Report on HDSL

Impairment	Description
Crosstalk Noise (NEXT)	Spectrum and level as specified by ANSI for HDSL rate 2B1Q transmission.
Power related Metallic Noise	Odd harmonics of the fundamental up to 6th odd harmonic (660 Hz).

6.1.3 ADSL Rate Testing, ANSI T1.413

Impairment	Description
Impulse Noise	Both c1 and c2 types of impulses, as specified.
Crosstalk Noise	Five different types of crosstalk noise, which can be injected over varying levels and in combination. There are 3 different and independent crosstalk generators. The output level of each one is variable. They can be mixed together to form a wide variety of crosstalk combinations.

6.1.4 ETSI ISDN Basic Rate Testing, ETR80

Impairment	Description
Shaped Noise	Multiple tones at 160 Hz and harmonics up to 300 kHz, amplitude and phase related as specified.
Impulse Test	A bipolar pulse, of selectable pulse width, rate and level.
Longitudinal Noise	Common mode at 50 Hz (60 Hz option) at up to 20 Volts.

6.1.5 HDSL Rate Testing, ETSI RTR/TM 3036

Impairment	Description
Shaped Noise	Multiple tones at 320 Hz and harmonics up to 1.5 MHz, amplitude and phase related as specified.
Impulse Test	The Cook pulse, of selectable rate and level.
Longitudinal Noise	Common mode at 50 Hz (60 Hz option) at up to 20 Volts.

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6.1.6 European 2.048 Mbit/s ADSL rate testing, ANSI T1.413 Annex H

Impairment	Description
Impulse Noise	Both c1 and c2 types of impulses, as specified.
Crosstalk Tests 1 and 2	Also known as Model A and Model B crosstalk tests.
Maximum stress linearity test	White noise at -140 dBm/Hz from 1 kHz to 1.5 MHz

6.2 Individual Impairments

A list of all the individual impairments that can be generated is given below. You can use them in one of the preset combination mentioned above. Alternatively you can set them by loading the "All Impairments Combinations" from the standard combinations. Then you can set one or all of the possible impairments at varying levels, and in any combination. This very powerful mix of impairments can be used to provide a rich variety of test conditions.

Name	Type	Level Range	Description		
T1.601	Crosstalk	-75 to -30 dBm	For spectrum, see Figure 22 T1.601 NEXT		
DSL NEXT	Crosstalk	-75 to -30 dBm	For spectrum, see Figure 23 DSL NEXT		
HDSL NEXT	Crosstalk	-75 to -30 dBm	For spectrum, see Figure 24 HDSL NEXT		
HDSL+ADSL	Crosstalk	-75 to -30 dBm	For spectrum, see Figure 26 ADSL + HDSL NEXT		
ADSL NEXT	Crosstalk	-75 to -30 dBm	For spectrum, see Figure 25 ADSL NEXT		
ADSL FEXT	Crosstalk	-85 to -35 dBm	For spectrum, see Figure 27 ADSL FEXT		
ADSL A	Crosstalk	-85 to -35 dBm	For spectrum, see Figure 28 Noise Model A		
ADSL B	Crosstalk	-85 to -35 dBm	For spectrum, see Figure 29 Noise Model B		
T1	Crosstalk	-85 to -35 dBm	For spectrum, see Figure 30 T1 NEXT		
2.048Mbit/s AMI	Crosstalk	-85 to -35 dBm	For spectrum, see Figure 31 2.048 Mbit/s AMI		
ETSI BASIC	Shaped	3.2 to 100 µV/ Hz	ETSI Basic Rate Shaped Noise.		
ETSI HDSL	Shaped	3.2 to 100 µV/ Hz	ETSI HDSL Rate Shaped Noise.		
FTZ 1TR 220	Shaped	3.2 to 100 µV/ Hz	Basic Rate Shaped Noise to FTZ specs.		
Metallic 1		Offset ±10 dB	Any odd harmonic up to 660 Hz or 550 Hz.		
Metallic 2		Offset ±10 dB	Any odd harmonic up to 660 Hz or 550 Hz.		
Longitudinal	Common mode	0-60 V (60 Hz) 0-50 V (50 Hz)	A triangle wave common-mode		
White Noise		-140 to -90 dBm/Hz	Flat white noise.		
Cook Pulse	Impulse	-20 to +6 dB	Description	Rate	Width
			Used for HDSL rate testing. See Figure 34.	0-100 pps or single shot	n/a
ADSL #1	Impulse	0-100 mV	Used for ADSL rate testing. See Figure 32.	0-100 pps or single shot	n/a

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Name	Type	Level Range	Description		
ADSL #2	Impulse	0-100 mV	Used for ADSL rate testing. See Figure 33.	0-100 pps or single shot	n/a
Bipolar	Impulse	0-100 mV		0-100 pps or single shot	20-120 µs
3-Level	Impulse	0-100 mV		0-100 pps or single shot	20-120 µs
Unipolar+/-	Impulse	0-100 mV		0-100 pps or single shot	20-120 µs

NOTES

1) Level ranges in dBm are on a 100 Ohm dBm scale. They are measures of the total power in the bandwidth DC to 1.5 MHz with the exception of 2.048 Mbit/s AMI which goes up to 2.1 MHz.

2) Metallic noise is specified in T1.601 using a special load and 135 Ohm dBm scale. The levels are relative to the reference levels of the odd harmonics which are:

Frequency [Hz]	Level [dBm]
60	-47
180	-49
300	-59
420	-65
540	-70
660	-74

3) Cook pulse levels are relative to the reference level of 318 mV p-p, when using a 135 Ohm scale.

6.2.1 Output Stage

The noise generator can be completely disconnected from the output jacks by a relay even if impairments are still being generated inside the unit. This also removes the very slight loading effect (approximately 4 kohms) of the impairments card.

6.2.2 Crosstalk Generators A and B

The impairments card contains two independent low frequency crosstalk generators able to produce a variety of shaped white noises up to 600 kHz. Generator B can generate one extra type of noise, ADSL NEXT. Otherwise they are the same.

Reference levels of noise, with dBm based on 100 ohms, are

Type	Level [dBm]
T1.601	-45.0
10-disturber DSL NEXT	-56.1
10-disturber HDSL NEXT	-47.6
10-disturber ADSL NEXT	-49.9
10-disturber HDSL+ADSL	-45.6

The difference in levels due to different numbers of interferers are:

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Number of disturbers	Level difference [dB]
24	+2.3
20	+1.8
10	0.0
4	-2.4
1	-5.0

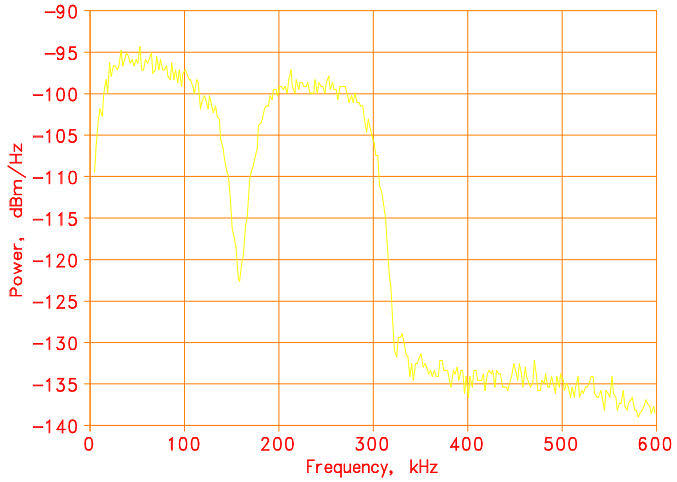


Figure 22 T1.601 NEXT

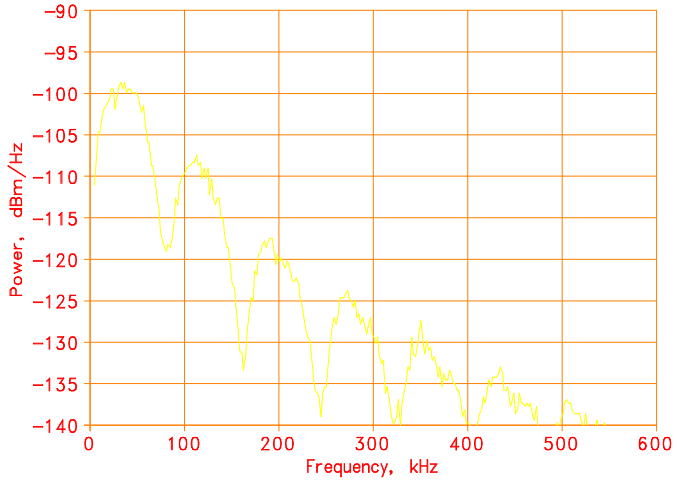


Figure 23 DSL NEXT

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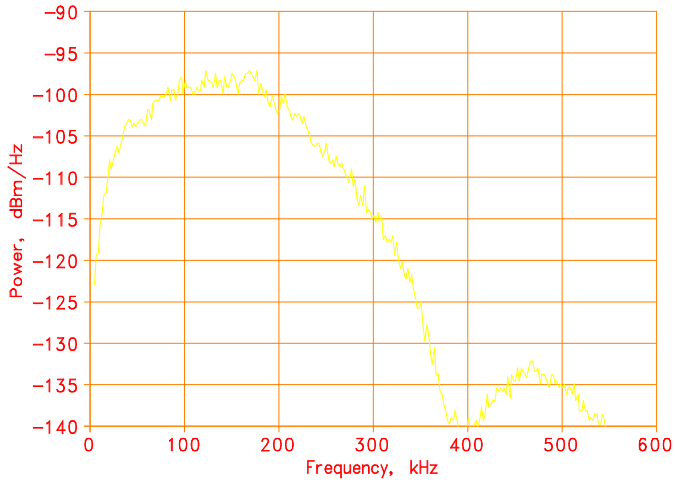


Figure 24 HDSL NEXT

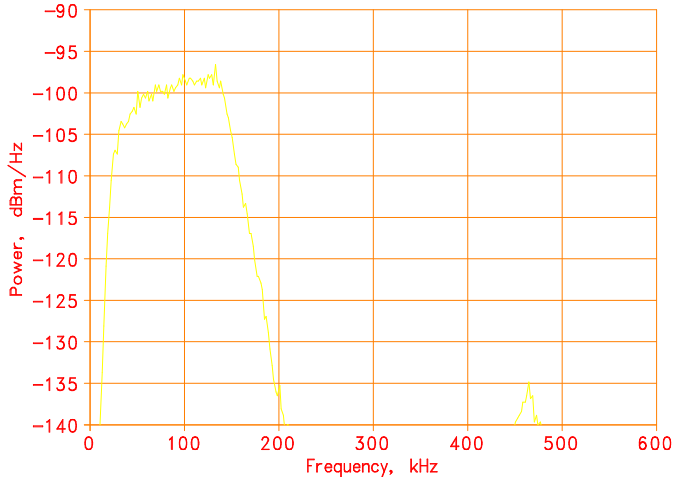


Figure 25 ADSL NEXT

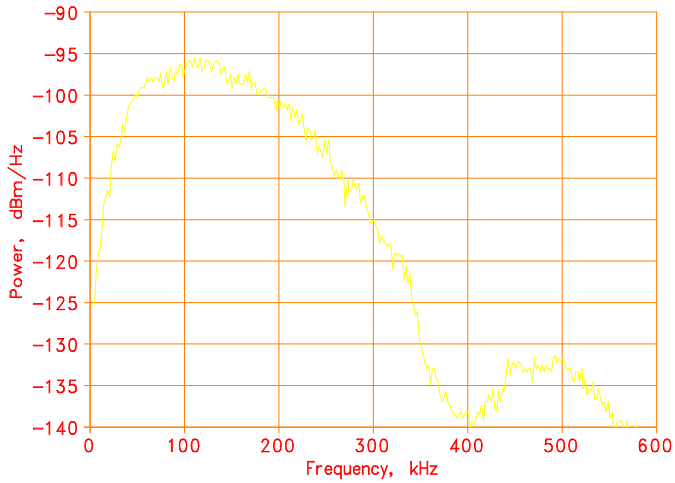


Figure 26 ADSL + HDSL NEXT

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6.2.3 Crosstalk Generator C

The (high frequency) crosstalk generator C produces noise with frequency components up to 2 MHz. Reference levels of noise, with dBm based on 100 ohms, are

Type	Level [dB]
10-disturber ADSL FEXT	-69.6
ADSLA	-49.4
ADSLB	-43.0
T1 NEXT	-47.8
2.048Mbit/s AMI	-46.0

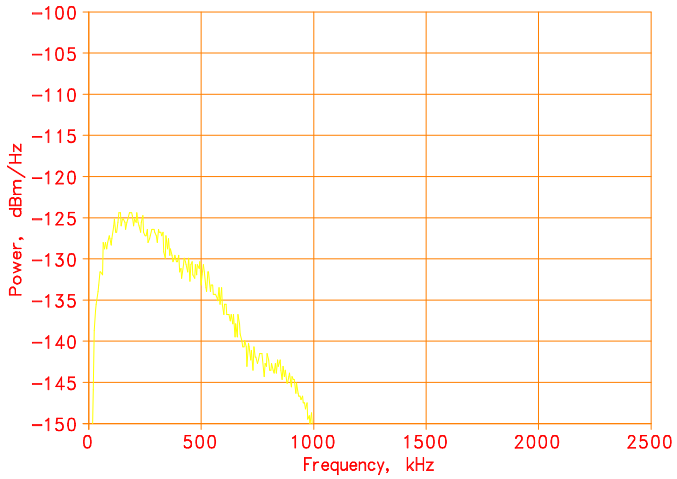


Figure 27 ADSL FEXT

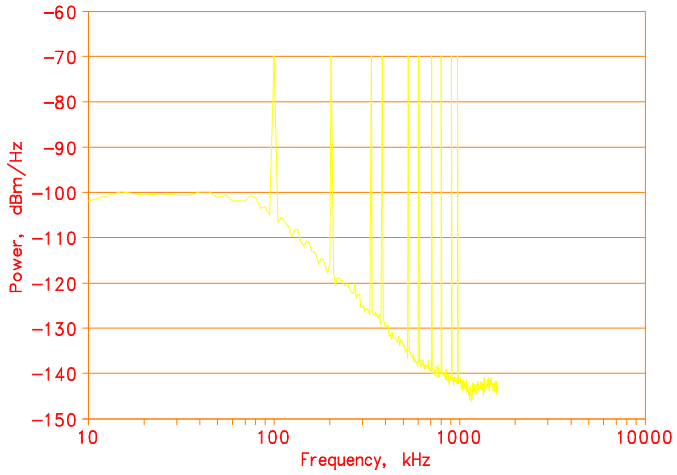


Figure 28 Noise Model A

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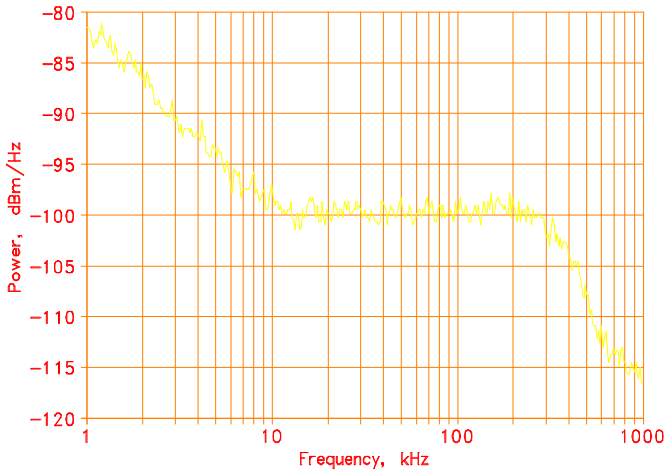


Figure 29 Noise Model B

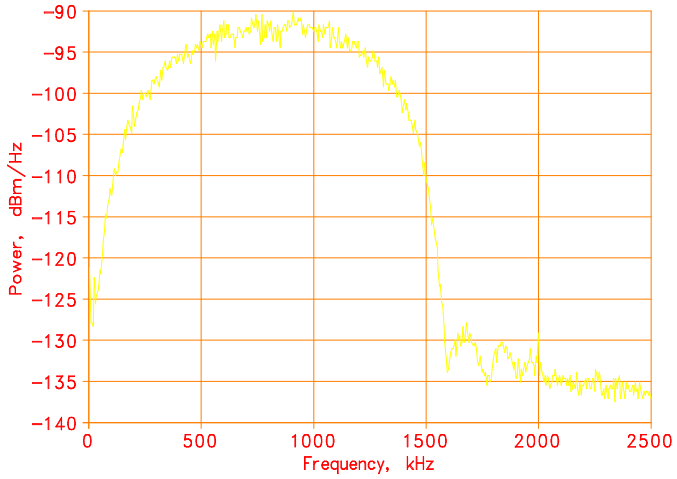


Figure 30 T1 NEXT

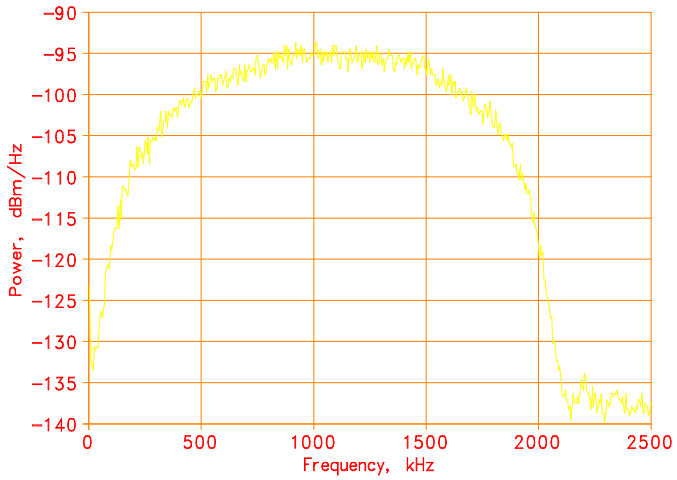


Figure 31 2.048 Mbit/s AMI

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6.2.4 Shaped Noise Generator

The shaped noise generator is a RAM-based generator which produces a variety of discrete tones:

- ETSI Basic Rate ETR 80
- ETSI HDSL Rate RTR/TM 3036
- FTZ 1TR.220 recommendations

It is also used to generate the 10 tones which are needed for ADSL Model A noise.

6.2.5 Flat White Noise Generator

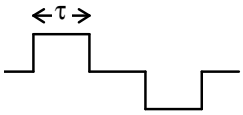
The flat noise generator injects a flat white noise signal, with a -3 dB point located above 1.5 MHz.

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6.2.6 Impulse Generator

Seven different types of impulse may be selected. They are: 3-level, bipolar, unipolar+, unipolar-, cook, ADSL c1, ADSL c2.

Four of them (3-level/bipolar/unipolar+/unipolar-) consist only of either 2 or 3 different levels. These type of impulses are calibrated in mV peak. The pulse width "τ" is only enabled when one of these type is selected and may be varied from 20 to 120 micro-seconds. The impulse width is defined as the duration of every transition in an impulse.



The other three types, Cook, ADSL c1 & c2, are complex waveforms as shown in the diagrams below. Impulse rate can also be a single, "triggered" impulse or varied from 0 to 100 per second.

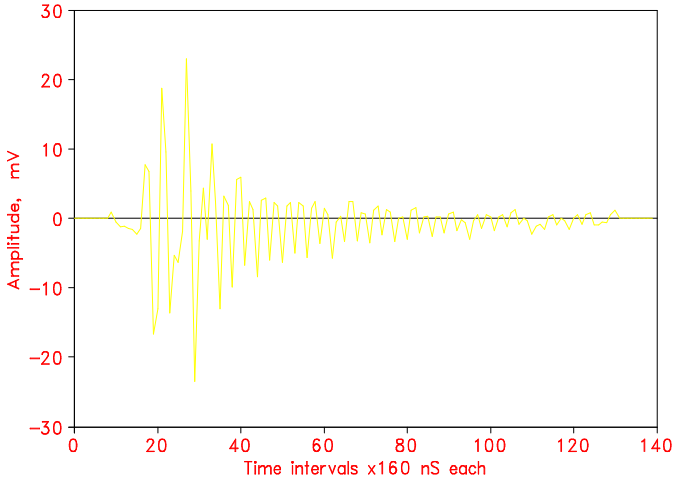


Figure 32 ADSL c1 Impulse

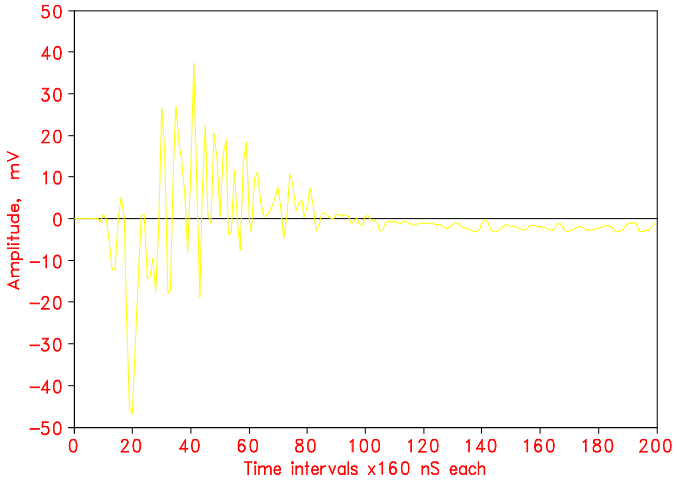


Figure 33 ADSL c2 Impulse

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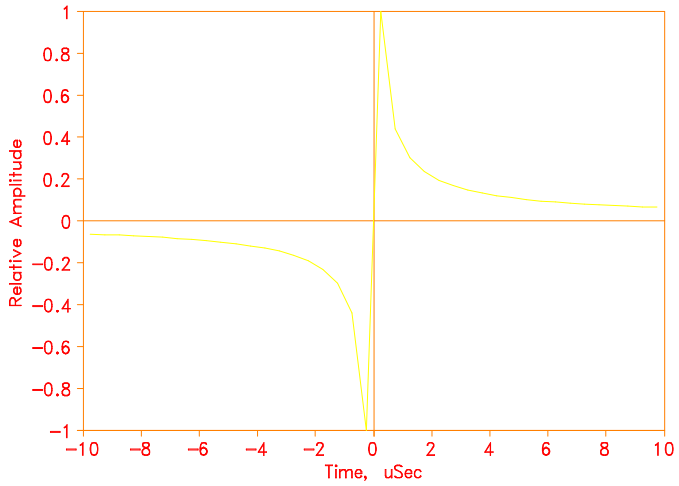


Figure 34 Cook Impulse

6.2.7 Powerline Related Impairments

Two types of impairments due to the interference from AC power lines are generated by the ADSL noise generator. One of them is called “metallic” and the other one “longitudinal”.

The reference powerline frequency used in both cases can be selected as 50 or 60 Hz.

6.2.7.1 Metallic Noise

Powerline metallic noise is a pair of low-level sine waves which are injected in differential mode. The frequency of the sinewaves can be set to any odd harmonic, from the fundamental up to the 6th odd harmonic (550 or 660 Hz). The ADSL noise generator contains two generators that can be set independently. The generator will automatically disable the second tone generator if both frequencies are set equal. The relative levels of the harmonics are always the same. The levels of both tones taken together can be varied up to ±10 dB relative to the ANSI T1.601 reference levels.

The ANSI T1.601 reference levels are shown in the following table:

Frequency [Hz]	Level [dBm]
60/50	-47
180/150	-49
300/250	-59
420/350	-65
540/450	-70
660/550	-74

6.2.7.2 Longitudinal Noise

Longitudinal noise is a triangular waveform which is injected in common mode on the wireline using a transformer. Associated with the longitudinal noise, some longitudinal loads should also be used. The ETSI ETR80 standard requires that both pairs of loads (located on both sides of the transformer) are set any time the longitudinal voltage is generated. Otherwise only ONE pair is installed.

When one load is installed, it should be at the CO side, where no longitudinal voltage will appear. The level of longitudinal noise which appears at the customer site end of the line is 0 to 50 V_{RMS} in 1V steps when the powerline frequency is 50 Hz, and 0 to 60 V when the powerline frequency is 60 Hz.

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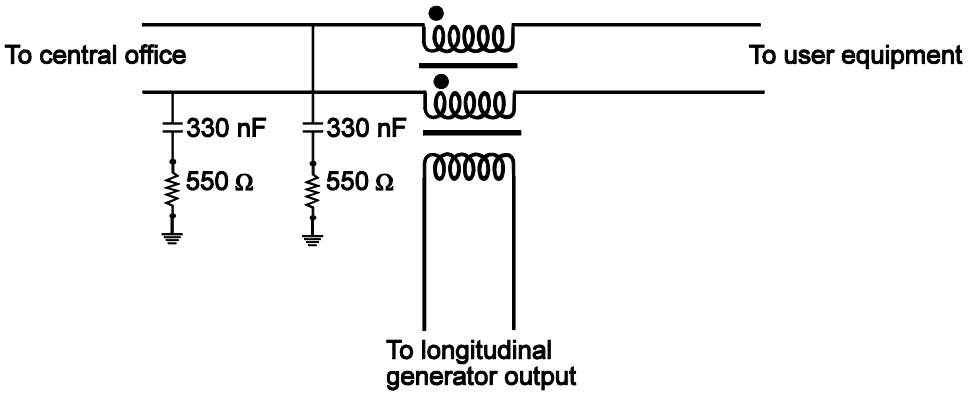


Figure 35 ANSI Longitudinal Load Configuration

If both pair of loads are set, then equal and opposite-phase voltages appear at both ends of the line. They are half the voltage that would appear at one end of the line if only one pair of loads are in place. The longitudinal noise appears on both sides and the level may be set between 0 and 25 V_{RMS} in 1V steps.

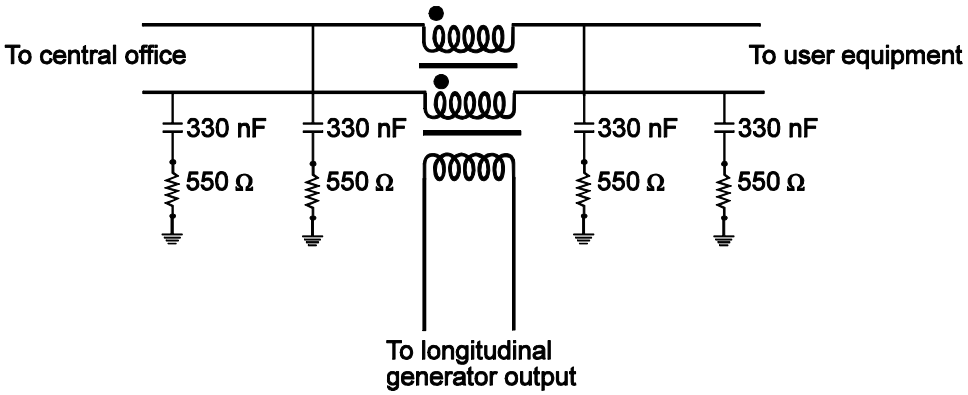


Figure 36 ETSI Longitudinal Load Configuration

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7. REMOTE CONTROL

The DLS 400E is controlled via the IEEE 488 (also known as the GPIB bus), or the RS-232 (serial) interface, allowing the integration of the DLS 400E into a larger test system. Sections 7 through 11 will provides you complete details on how to control the DLS 400E. These sections may be skipped if you are only using the software provided by Consultronics.

The DLS 400E remote control is designed with several standards in mind:

- The GPIB physical interface follows IEEE 488.1. The functions implemented are outlined in Section 7.1, “IEEE 488 Interface”.
- The Common Commands (see section 11)follow IEEE 488.2.
- The Device Dependent Commands (see section 7.5) are based upon the Standard Commands for Programmable Interfaces (SCPI). However, we had to create some device dependent commands since none of the pre-defined SCPI commands apply to the DLS 400E.
- 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 400E directs its output to the last interface from which it received data. Both interfaces use the same command set and produce the same results.

Section 7.1 and 7.2 describe features specific to one particular interface, and the rest of this section describes the commands that are common to both interfaces.

7.1 IEEE 488 Interface

This section contains information specific to the IEEE 488 interface. Section 7.2 contains the information specific to the RS-232 interface.

7.1.1 IEEE 488.1 Interface functions supported

The IEEE 488.1 Interface functions supported by the DLS 400E 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 at the GPIB and the HP-IB interfaces.

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7.1.2 IEEE 488 Address

The DLS 400E 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. The weighting is as follow:

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):



7.1.3 The Service Request (SRQ) Line

The SRQ line, as defined by the IEEE 488.1 standard, is raised when the DLS 400E 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 in section 11.

We recommend that you set the DLS 400E to raise the SRQ line when there is a message available and when there is an error.

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7.1.4 Resetting the DLS 400E

To reset the DLS 400E, use the "Device Clear" command as defined in the IEEE 488.1 standard. This has the same effect as the power-up reset.

Shunt JP2 on the controller card determines whether the "Interface Clear" line resets the whole unit or just the IEEE 488 interface. The factory default is to set JP2 in the IFC position (pin 1 and 2) which resets only the interface when IFC is received.

The only tool you need to change the shunt of position is a Phillips screwdriver. Ensure that the cover, card retainer and card stabilizer hardware is kept separate to ensure that they are re-installed in the correct location. This procedure should be read entirely before beginning.

1) Turn off the DLS 400E and remove the power cord.
2) Remove the 11 screws and washers from the rear of the unit. This allows the top cover to be removed.
3) Remove the card retainer (item 5) and the 5 card stabilizers (item 4) (see Figure 37).
4) Remove the control card from slot 25.

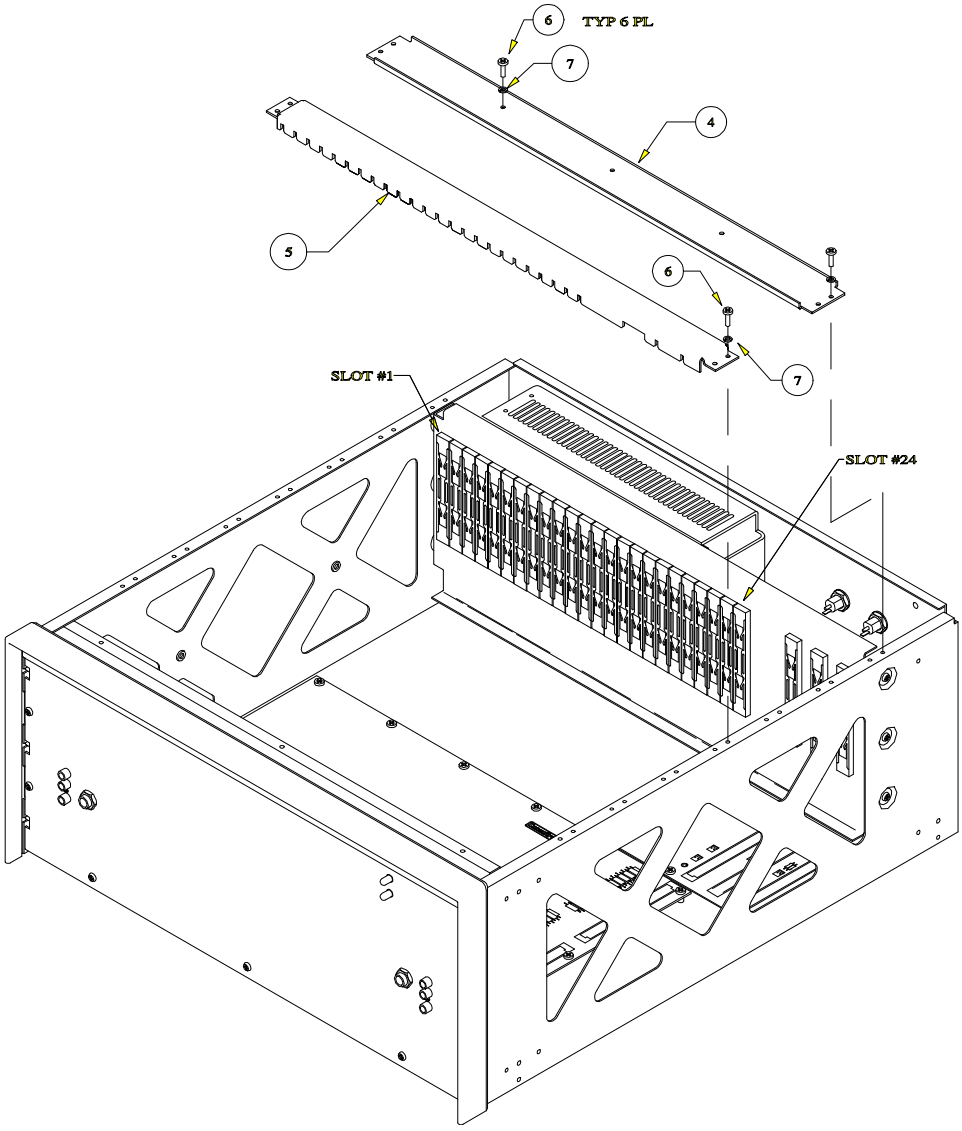


Figure 37 DLS 400E Chassis Assembly

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5) Locate JP2 using Figure 38 and installed the shunt in the desired location. Setting JP2 in the IFC position (pin 1 and 2) resets only the interface when IFC is received. In the “RESET” position (pin 2 and 3), IFC resets the entire unit.

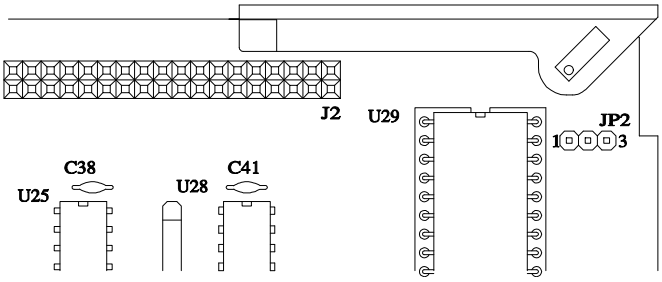


Figure 38 DLS 400E Controller IFC Strap Option

6) Re-install the controller and ensure a tight fit with the connectors on the motherboard.
7) At this time, plug the unit in and turn it on. Run the software that came with the unit and ensure the program can set the loops. Turn the unit off and proceed with the procedure.
8) Replace the card retainer (item 5) and the 5 card stabilizers (item 4).
9) Replace the top cover and re-install the 11 screws and washers at the back of the unit.
10) Plug the unit in and turn it on. Run the software that came with the unit and ensure the program can set the loops.

7.1.5 Message Terminators

Messages to the DLS 400E 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 400E 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 400E. For example:

PRINT #1, “:sourceB:output on”+CHR$(10); Preferred solution

or

PRINT #1, “:sourceB:output on;” Other solution

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7.1.6 Example using the IEEE 488 Interface

To enable the output stage, do the following:

- transmit ":SOURCEB:OUTPUT ON"
- check that the REMOTE LED is green

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:

- 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

If desired, all the enable registers can be restored on power up with the *PSC command.

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7.2 RS-232 Serial Interface

This section contains information specific to the RS-232 interface. Section 7.1 contains the information specific to the IEEE 488 interface.

The DLS 400E uses a female DB-25 connector, and is configured as a DCE device. It can therefore be connected directly to your PC serial port.

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 400E cannot use the parallel port of a computer (the female connector).

To use the RS-232 interface, simply connect your computer to the DLS 400E and set the computer to 9600 bps baud rate, no parity, 8 data bits per character, 1 stop bit and RTS/CTS hardware flow control.

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

The DLS 400E stops transmitting data when the RTS line is low, and restarts when the RTS line is high. The DLS 400E 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.

7.2.1 Message Terminators

Message sent to the DLS 400E 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 400E from a previous incomplete command, you can send the line feed character by itself before sending new commands.

Messages from the DLS 400E 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 400E. For example:

PRINT #1, “:sourceB:output on”+CHR$(10); Preferred solution

or

PRINT #1, “:sourceB:output on;” Other solution

7.2.2 Example using the RS-232 Interface

To enable the output stage, do the following:

- transmit “:sourceB:OUTPUT ON”
- check that the REMOTE LED is green

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

- set all relevant enable bits (only done once)
- 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:

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- 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, see section 11.1.2 for description of the error(s)

7.3 Data formats

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

The DLS 400E adheres to the IEEE 488.2 principle of Forgiving Listening and Precise Talking.

The data formats supported by the DLS 400E are:

DLS 400E Talking: a) <NR1> Numeric Response Data - Integer

b) Arbitrary ASCII Response Data

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

Arbitrary ASCII Response Data is a generic character string without any delimiting characters. It is usually used to send data in response to a query, such as with the *IDN? command (see section 11, "Common Command Set").

DLS 400E 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.

The DLS 400E can accept data in the <NRf> format, which means that numbers can be made of a combination of digits, signs, decimal point, exponent, multiplier, unit and spaces. 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.

7.4 Command Syntax

The DLS 400E adheres to the IEEE 488.2 format for command syntax. As with the Data Format, the principle is forgiving listening and precise talking.

Spaces are optional between keywords, except after the last one and the parameter(s).

Common commands are preceded by the character "*". Device Dependent commands are preceded by a colon, with a colon separating 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.

Commands may take one of two forms, either a Common Command or a Device Dependent Command. The format of each is detailed in the following sections:

- Section 8: summary commands for both the wirelines and impairments
- Section 9: wirelines commands details
- Section 10: impairments commands details
- Section 11: common commands details

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The following are some examples :

***RST**

***RST;*WAI;:sourceB:output off**

***ESE 45; *SRE 16**

IEEE 488 messages to the DLS 400E may be terminated with either a Line Feed character (ASCII <LF>, decimal 10, hex 0A), an IEEE 488 EOI signal or both. RS-232 messages must be terminated with a line feed character. Messages from the DLS 400E are always terminated with a Line Feed character, and also with the EOI signal if using the IEEE 488 interface.

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:

:sourceB:IMPULSE:RATE 100 PPS

:sourceB:IMPULSE:RATE 100

:sourceB:IMPULSE:RAT 100

:sourceB:IMP:RAT 100

:sourceB:impulse:rate 100

:sourceB:Impulse:Rate 100 pps

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 400E will place the appropriate response in the output queue, where it can be read by the controller.

Examples are:

***IDN?**

***ESE?;*SRE?**

:sourceB:IMPULSE:RATE?

When a command does not begin with a colon, the DLS 400E assumes that the command is at the same level as the previous command. For example, to set the impulse, one does NOT need to specify ":sourceB:IMPULSE" for each parameter but rather may send the following command:

:sourceB:IMPULSE:TYPE BIPOLAR;RATE 100;WIDTH 50

7.5 Device Dependent Command Set

As recommended by the SCPI consortium and to simplify programming of the various Consultronics simulators, the DLS 400E uses the following rules:

- Each section of the command may be sent in the full or the truncated form.
- The command itself may be sent in upper or lower case form.
- The DLS 400E will round any number to the nearest number permitted by the resolution of the parameter.

Sections 8, 9 and 10 give more information on the various command syntax to set the wirelines and impairments.

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8. Wirelines and Impairments Commands Summary

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 400E will round any number to the nearest number permitted by the resolution of the parameter.

Sections 7.3 and 7.4 give more information on the data format and the command syntax.

8.1 Wirelines Commands Summary

The following list show the various commands used to control the wirelines boards located inside the DLS 400E unit. It is recommended to the programmer to become familiar with the system architecture by reading section 5, "Configuring the Simulated Line".

The following list provides a summary of the wireline commands. The detailed command set is described in section 9.

:Setting :slot <*Slot Number*>, <*Length*>, <*Connection*>

:channel :bypass <*boolean*>

8.2 Impairments Commands Summary

When setting impairments, the DLS 400E command set uses the following general format:

:Source?:AAAA:BBBB CCCC DD

where	:Source?	specifies the ADSL noise card located inside the DLS 400E chassis. Use :source? for the impairments card located on side A and :SourceB for the one on side B.
	:AAAA	specifies the impairment generator (in one case two levels are required - i.e. for "pwrline")
	:BBBB	specifies the parameter
	CCCC	specifies a value
	DD	specifies the unit. When multiple units are allowed, the first one is optional and is indicated by square brackets (i.e. [dBm]). The second one are mandatory, if used. For example, if setting the impulse level in mV, the units are optional, but if the level is in dBm they are mandatory.

It is assumed that the programmer is familiar to some extent with the block diagram and description of the impairments card as given in section 0.

The following list provides a summary of the commands. The detailed command set is described in section 10.

:source? :output <*boolean*>

:xtalkA :type < *choice* >
:level <*numeric value*> [dBm]

:xtalkB :type < *choice* >
:level <*numeric value*> [dBm]

:xtalkC :type < *choice* >
:level<*numeric value*> [dBm]

:shaped :type < *choice* >
:level <*numeric value*> [uv/sqrt(Hz)]
:level <*numeric value*> dBm/Hz
:level <*numeric value*> dBm

:white :state < *choice* >

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```
            :white    :level <numeric value> [dBm/Hz]

            :impulse  :type < choice >
                      :width <numeric value> [us]
                      :level <numeric value> [mV]
                      :level <numeric value> dB
                      :rate <numeric value> [pps]
                      :trigger

            :pwrline  :freq <choice> [Hz]
                      :metallic  :harmonic1 < choice >
                                 :harmonic2 < choice >
                                 :offset <numeric value> [dB]
                     :longitudinal :level <numeric value> [Vrms]

            :load1 <boolean>
            :load2 <boolean>
            :quiet
:setting    :pwrline :longitudinal :state <boolean>
```


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9. Device Dependant Command Set Details for Wireline

9.1 Wireline Settings

This command is used to build a loop by setting the simulated length and loop connection of slot 1 through 24, with the exclusion of slot 10. Slot 10 has special functions and can not be used to build the loop. The loop connection selects whether the wireline is connected normally or as a bridged tap.

:setting:slot <*Slot Number*>, <*Length*>,<*Connection*>

where

<*Slot Number*>	Range: 1 trough 9, 11 through 24
<*Length*>	Range: 0 to 500 m in 50 m steps (metric types).
	0 to 1500 ft in 100 ft steps (AWG types)
<*Connection*>	Choices: TAP,INLINE

The units of the length are optional, but they must be "m" if present. For more details on the numeric format supported by the DLS 400E, see section 7.3.

The query of a slot of a DLS 400E chassis will return the length, connection type (inline or tap) and also the wireline type. This information is very useful to automatically determined the architecture of the simulator. The following table describes the various wireline type available:

Wireline Type
0.32 mm ADSL
0.4 mm ADSL
0.5 mm ADSL
0.63 mm ADSL
0.9 mm ADSL
24 AWG ADSL
26 AWG ADSL
Bypass Card
Empty Slot
ANSI Card
Unknown Card

The first five types are metric wirelines described in ANSI T1.413 Technical Recommendation Annex “H”. A “Bypass Card” type is returned for any other slot not occupied by a wireline.

The type “Empty Slot” is returned if no card (wireline or bypass) is installed in a particular slot.

The type “ANSI Card” is returned by the DLS 400E controller if an ANSI wireline card used in the DLS 400 chassis is installed.

The type “Unknown Card” is return if the controller firmware does not support a new type of wireline. Please contact the customer service department in Ottawa for details on how to upgrade the firmware (see section 15 for the phone number).

All slots must have a wireline card to ensure continuity of the signal throughout the simulator.

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Examples

To set the slot 5 to a length of 100 m inline, send:

:SET:SLOT 5,100 m,INLINE

To query the slot 5 settings send:

:SET:SLOT 5?

The command returns the slot settings and the wireline type. For example, if slot 5 contains a 0.5 mm wireline card length set to 500 m and set as tap, the returned message will be:

5,500 M,TAP, 0.5 mm ADSL

9.2 Loop Simulator Bypass

Sets the DLS 400E in bypass mode.

:setting:channel:bypass <*boolean*> Choices: NO,YES

For example, to bypass the DLS 400E, send:

:SET:CHAN:BYPASS YES

To query the current bypass status, send:

:SET:CHAN:BYPASS?

The command returns either "NO" or "YES".

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10. Device Dependant Command Set Details for Impairments

10.1 Output Stage

This command enables the complete disconnection of the generator from tip and ring even if any (or all) impairments may still be generated on the card. This command will also remove the loading effect of the output circuitry (typically around 4 kohms). To turn OFF all impairments without affecting the state of the output stage relay, use the "Quiet" command (see the command on page 57).

:source? :output <*boolean*> Choices: OFF, ON

10.2 Low Frequency Crosstalk Generators (XtalkA and XtalkB)

The ADSL noise generator contains two independent low frequency crosstalk generators able to produce a variety of shaped white noises up to about 600 kHz. Both generators are identical with the exception of XtalkB which is able to do an additional shaped noise (ADSL NEXT).

The following tables are shown as a reference to the programmer.

Reference Levels (100 ohms)	
Type	Level [dBm]
T1.601	-45.0
10-disturber DSL NEXT	-56.1
10-disturber HDSL NEXT	-47.6
10-disturber ADSL NEXT	-49.9
10-disturber HDSL+ADSL	-45.6

XtalkB Generator only!

Number of disturbers	Level difference [dB]
24	+2.3
20	+1.8
10	0.0
4	-2.4
1	-5.0

10.2.1 Xtalk Generator A - Type

:source? :xtalkA :type <*choice*> Choices: OFF
T1.601
DSLNEXT
HDSL
HDSL+ADSL

10.2.2 Xtalk Generator A - Level

:source? :xtalkA :level <*numeric value*> [dBm] Range: -75.0 to -30.0 dBm in 0.1 dB steps

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10.2.3 Xtalk Generator B - Type

:source? :xtalkB:type <*choice*> Choices: OFF
T1.601
DSLNEXT
HDSL
HDSL+ADSL
ADSLNEXT

10.2.4 Xtalk Generator B - Level

:source? :xtalkB :level <*numeric value*> [dBm] Range: -75.0 to -30.0 dBm in 0.1 dB steps

10.3 High Frequency Crosstalk Generator (XtalkC)

The high frequency crosstalk generator on the ADSL noise generator allows the addition of shaped noise with frequency components up to about 2 MHz. The following tables are shown as a reference to the programmer.

Reference Levels (100 ohms)	
Type	Level [dBm]
10-disturber ADSL FEXT	-69.6
ADSLA	-49.4
ADSLB	-43.0
10-disturber T1 NEXT	-47.8
2.048 Mbit/s AMI	-46.0

Number of disturbers	Level difference [dB]
24	+2.3
20	+1.8
10	0.0
4	-2.4
1	-5.0

10.3.1 Xtalk Generator C - Type

:source? :xtalkC:type <*choice*> Choices: OFF
ADSLA
ADSLB
T1
AMI

When selecting ADSLA in the high frequency crosstalk generator, make sure to select also the 10-tone type for the shaped noise generator, since ADSL Model A noise is made up of both Crosstalk noise and Shaped noise. The levels of shaped noise and ADSL model A noise that must be sent are different. The 10-tone noise must be set 36.2 dB less than the model A noise.

For example, to set model A noise to -55.4 dBm, you should send:

:sourceA:xtalkC :type ADSLA

:sourceA:xtalkC :level -55.4 dBm

:sourceA:shaped:type 10-tone

:sourceA:shaped:level -91.6 dBm

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10.3.2 Xtalk Generator C - Level

:source? :xtalkC :level <*numeric value*> [dBm] Range: -85.0 to -35.0 dBm in 0.1 dB steps

10.4 Shaped Noise Generator

The shaped noise generator is a RAM-based generator which is able to generate a variety of discrete tones. Make sure to set the level using the appropriate unit.

10.4.1 Shaped Noise Generator - Type

:source? :shaped :type <*choice*> Choices: OFF
BASIC_RATE
HDSL
FTZ
10-tone

10.4.2 Shaped Noise Generator - Level

Level value could be issued using any of the three units (µV/√Hz or dBm/Hz or dBm). Level is typically in µV/√Hz when type selected is either BASIC_RATE, HDSL or FTZ. Level is typically in dBm when the type selected is 10-tone and is usually set to -70.0 dBm. Note that the units are NOT optional when setting the level in dBm/Hz or in dBm.

:source? :shaped :level <*numeric value*> [uv/sqrt(Hz)] Range: 3.2 to 100.0 µV/√Hz in 0.1 µV/√Hz steps

OR

:source? :shaped :level <*numeric value*> dBm/Hz Range: -101.3 to -71.3 in 0.1 dBm/Hz steps

OR

:source? :shaped :level <*numeric value*> dBm Range: -110.0 to -50.0 dB in 0.1 dB steps

10.5 Flat White Noise Generator

The flat noise generator injects a flat white noise signal, with a 3-dB point located around 2 MHz.

10.5.1 Flat White Noise Generator - State

:source? :white :state <*boolean*> Choices: OFF, ON

10.5.2 Flat White Noise Generator - Level

:source? :white :level <*numeric value*> [dBm/Hz] Range: -140.0 to -90.0 dBm/Hz in steps of 0.1 dB

10.6 Impulses

Seven different type of impulses may be selected. Four of them (3-level/bipolar/unipolar+/-) consist only of either 2 or 3 different levels. These type of impulses are calibrated in mV peak, therefore the level should be sent using the mV as the unit of measurement. The pulse width ("τ") is only enabled when one of these types is selected. Beware that the unipolar+ and unipolar- may be of opposite polarity when viewed on an oscilloscope due to the inherent nature of a differential signal!

The other three types are complex waveforms (adsl-c1/c2, cook). The shape of ADSL-c1 and ADSL-c2 is assymetric and is calibrated in mV peak. The command to set the Cook pulse level should include dB units to the desired value.

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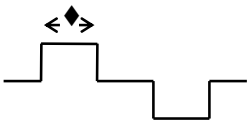
10.6.1 Impulses - Type

:source? :impulse :type <*choice*>

Choices: off
3-level
bipolar
unipolar+
unipolar-
cook
adsl-c1
adsl-c2

10.6.2 Impulses - Width

The impulse width is defined as the duration of every transition in an impulse.



:source? :impulse :width <*numeric value*> [us]

Range: 20 to 120 µs in 1 µs steps
Only apply for 3-level, bipolar and unipolar impulses

10.6.3 Impulses - Level

:source? :impulse :level <*numeric value*> [mV]

Range: 0.0 to 100.0 mV peak in 0.1 mV steps
This syntax must be used for all impulses type except the Cook pulse (see below).

OR

:source? :impulse :level <*numeric value*> dB

Range: -20.0 to +6.0 dB in 0.1 dB steps
This syntax must be used **ONLY** for the Cook impulse. Cook pulse levels are relative to a reference level of 318 mV (a value of -6.0 dB translates to 159 mV and -12.0 dB to 79 mV).

10.6.4 Impulses - Rate

:source? :impulse :rate <*numeric value*> [pps]

Range: 0 to 100 pulses per seconds in 1 pps steps

10.6.5 Impulses - Single Shot Trig

The single shot command would generate a single impulse as soon as the command is received and decoded by the ADSL noise generator, whether the rate is to zero or not.

:source? :impulse :trigger

Range: none

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10.7 Powerline Related Impairments

Two types of impairments due to the interference generated by the AC power linesare generated by the ADSL noise generator. One of them is called “metallic” and the other one “longitudinal”.

The reference powerline frequency used in both cases (i.e. 50 or 60 Hz) is set by the following command:

:source?: pwrline :freq <*choice*> [Hz] Choices: 50, 60 Hz

10.7.1 Metallic Noise

The powerline metallic noise is a low-level sinewave which is injected in differential mode. The frequency of the sinewave could be set to any odd harmonic, from the fundamental (50 or 60 Hz) up to the 6th odd harmonic (550 or 660 Hz). The ADSL noise card contains two generators that can be set independently of each other. The unit will automatically disable the second tone generator if both frequencies are set equal.

10.7.1.1 Tone Generator - Harmonic #1 Frequency

:source?: pwrline: metallic: harmonic1 <*choice*> Choices: 0 to 6

where 0 = off
1 = fundamental (50/60 Hz)
2 = 2nd odd harmonic (150/180 Hz)
3 = 3rd odd harmonic (250/300 Hz)
4 = 4th odd harmonic (350/420 Hz)
5 = 5th odd harmonic (450/540 Hz)
6 = 6th odd harmonic (550/660 Hz)

10.7.1.2 Tone Generator - Harmonic #2 Frequency

The second frequency will automatically be disabled if both frequencies are equal.

:source?: pwrline: metallic: harmonic2 <*choice*> Choices: 0 to 6

where 0 = off
1 = fundamental (50/60 Hz)
2 = 2nd odd harmonic (150/180 Hz)
3 = 3rd odd harmonic (250/300 Hz)
4 = 4th odd harmonic (350/420 Hz)
5 = 5th odd harmonic (450/540 Hz)
6 = 6th odd harmonic (550/660 Hz)

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10.7.1.3 Tone Generators - ANSI T1.601 Level Offset

The level of the sinewave is set using the following command. To turn off a tone entirely, use the tone frequency command. The ANSI T1.601 table is shown below as a quick reference to the programmer.

:source?: pwrline :metallic: offset <*numeric value*> [dB] Range: -10.0 to +10.0 dB in 0.1 dB steps

ANSI T1.601 Metallic Noise Levels	
Frequency [Hz]	Tone Power [dBm]
60	-47
180	-49
300	-59
420	-65
540	-70
660	-74

10.7.2 Longitudinal Noise

Longitudinal noise is a high-level triangular waveform which is injected in common mode on the wireline using a transformer. The frequency of the waveform (either 50 or 60 Hz) is determined by the powerline frequency command (see “Powerline Related Impairments”, section 10.7 on page 55). Note that the maximum level is slightly lower when the powerline frequency is set to 50 Hz due to transformer saturation.

When using the longitudinal noise, one or two longitudinal loads should be set. The ETSI standard requires that two loads (located on both side of the transformer) be inserted any time the longitudinal voltage is generated. Otherwise only ONE load should be set on the CO side. See section 10.7.2.2 for more details.

See section 6.2.7.2, on page 37, for more details on the longitudinal generator.

10.7.2.1 Longitudinal Noise Level

:source? :pwrline :longitudinal :level<*numeric value*> [Vrms] Range: 0 to 60 V_{RMS} in 1V steps when powerline frequency is 60 Hz.

Range: 0 to 50 V_{RMS} in 1V steps when powerline frequency is 50 Hz.

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10.7.2.2 Longitudinal Loads

Whenever the longitudinal noise is enabled, the appropriate longitudinal load(s) should also be set. The ETSI standard requires that both load (located on both side of the transformer) be inserted any time the longitudinal voltage is generated. Otherwise only ONE load should be inserted on the CO side. If the CO is connected on side A, then set Load1 ON and Load2 OFF.

:source? :load1 <*boolean*> Choices: OFF, ON

:source? :load2 <*boolean*> Choices: OFF, ON

Also associated with the longitudinal impairment is the command which sets the secondaries of the longitudinal transformer in or out of circuit. See section 10.7.2.3 for more details.

10.7.2.3 Longitudinal Transformer Insertion

This command controls whether the secondary windings of the longitudinal transformer are in or out of the loop. Putting the winding in the loop can effectively add several hundred feet to the loop, so unless longitudinal mode is actively required, the state should be OFF.

:setting:pwrline:longitudinal :state <*boolean*> Choices: OFF,ON

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10.8 Quiet

This command will turn off all impairments but will not affect the state of the output stage which connects the impairment to tip and ring:

:source?: Quiet Range: none

This command is equivalent to the following commands:

```
:source?  :pwrline :freq 60 Hz
                   :metallic  :harmonic1 0
                              :harmonic2 0
                              :offset 0.0 dB
                   :longitudinal :level 0 Vrms

          :impulse :type OFF
                   :width 50 us
                   :level 0.0 mV
                   :rate 0 pps

          :shaped  :type OFF
                   :level 3.2 uv/sqrt(Hz)

          :xtalkA  :type OFF
                   :level -75.0 dBm

          :xtalkB  :type OFF
                   :level -75.0 dBm

          :xtalkC  :type OFF
                   :level -85.0 dBm

          :white   :level -140.0 dBm/Hz
                   :state off

          :load1 off

          :load2 off
```

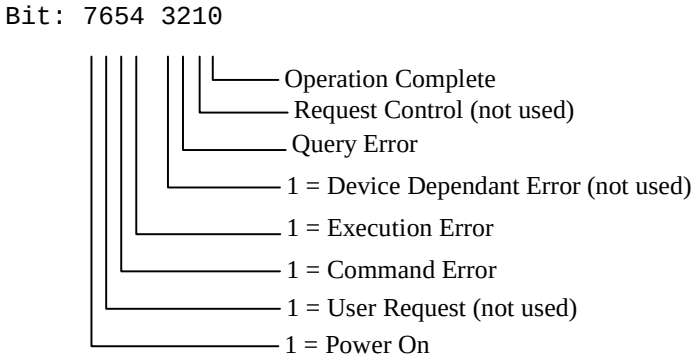

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11. Common Command Set

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:



Bit 7 to 0 have a respective value of 128, 64, 32, 16, 8, 4, 2 and 1. For example if bit 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). See section 11.1.2 for more detail.

On power-on, the register is cleared if the Power-on Status Clear bit is 1, or restored if the bit is 0 (see *PSC for more details).

*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, and in more detail in section 11.1.2.

*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, and in more detail in section 11.1.2.

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*IDN? Identification Query
Type: System command
Function: Returns the ID of the unit. Upon receiving this command the DLS 400E will put the following string into the output queue:

CONSULTRONICS LTD,DLS 400E,<SN>,<Ver>
where:
<SN> is the serial number of the unit
<Ver> is the revision level of the control firmware (always 2 digits)

*OPC Operation Complete
Type: Synchronization command
Function: Indicates to the controller when the current operation is complete. This command will cause the DLS 400E 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. See section 11.2, “DLS 400E Synchronization” for more details.

*OPC? Operation Complete Query
Type: Synchronization command
Function: Indicates when the current operation is complete. This will cause the DLS 400E 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. See the section 11.2, “DLS 400E Synchronization” for more details.

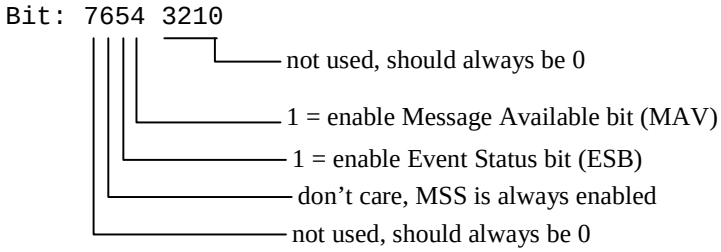
*PSC <NRf> Power-on Status Clear
Type: Status and event command
Function: Indicates if the unit should clear the Service Request Enable Register and the Standard Event Status Register at power-on. If 1 (or higher) then all the enable registers are cleared at power-on, if 0 then all the enable registers are restored from the non-volatile RAM at power-on. The factory default is 1 (clear all the enable registers). Any change to the “Power-on Status” is saved in non-volatile RAM, and is always restored on power up.

*PSC? Power-on Status Clear Query
Type: Status and even command
Function: Return the Power-on Status Clear value. If 1 then all the enable registers are cleared at power-on, if 0 then all the enable registers are restored from the non-volatile RAM at power-on. The factory default is 1 (clear all the enable registers).

*RST Reset
Type: Internal command
Function: IEEE 488.2 level 3 reset. This command will initialize the DLS 400E with the bypass loop, and 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”.

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*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:



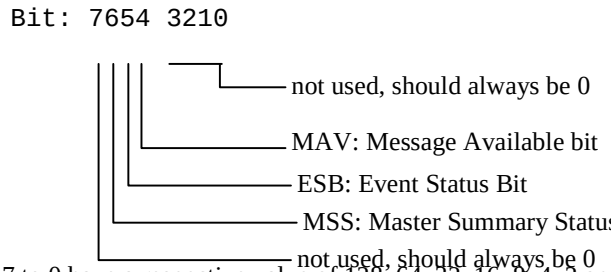
Bit 7 to 0 have a respective value of 128, 64, 32, 16, 8, 4, 2 and 1. For example if bit 4 and 5 are set then the integer value is 48 (16+32).

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 (see section 11.1.1 for more details).

On power-on, this register is cleared if the Power-on Status Clear bit is 1, or restored if the bit is 0 (see *PSC for more details).

*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.

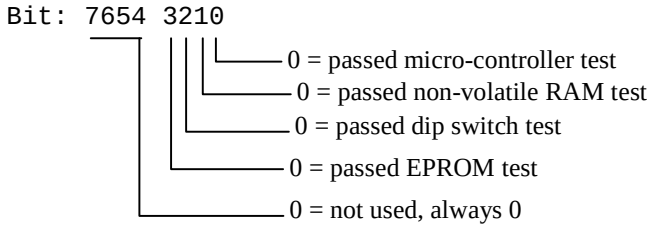


Bit 7 to 0 have a respective value of 128, 64, 32, 16, 8, 4, 2 and 1. For example if bit 4 and 5 are set then the integer value is 48 (16+32).

Note that bit 6 is MSS, which does not necessarily have the same value as RQS (see section 11.1.1 for more details).

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*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:



Bit 7 to 0 have a respective value of 128, 64, 32, 16, 8, 4, 2 and 1. For example if bit3 and 5 are set then the integer value is 40 (8+32).

*WAI Wait to continue
Type: Synchronization command
Function: Used to delay execution of commands. The DLS 400E will ensure that all commands received before "*WAI" are completed before processing any new commands. This means that all further communication with the DLS 400E will be frozen until all pending operations are completed. See section 11.2, "DLS 400E Synchronization" for more details.

11.1 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.

	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.

11.1.1 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.

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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 60, as defined by the IEEE 488.2 standard.

bits 7, 3, 2, 1, and 0: those bits are not used by the DLS 400E.

11.1.2 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 400E 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 400E 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. This error bit will be set for example if the longitudinal voltage is set above 50 V when the powerline frequency is set to 50 Hz.

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. A GET (Group Execute Trigger) command will also set this bit.

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 400E 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.

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11.2 DLS 400E Synchronization

The program controlling the DLS 400E can use three different commands to synchronize with the DLS 400E: *OPC, *OPC? and *WAI. Following are the main differences:

	Set Operation Complete bit when Done	Return "1" when operation complete	Raise SRQ when operation complete	Block comm. with the DLS 400E	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 400E 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 400E 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 400E needs approximately 2 seconds to set a loop).

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12. Fuses Configuration

1) In North America only one of the AC supply lines is live, and needs to be fused. However in some other countries both AC supply lines are live and both may need to be fused. The DLS 400E is shipped with the 2-fuse configuration.

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13. TROUBLE SHOOTING

13.1 DLS 400E Self-Test

When you switch on the power or issue a reset, the DLS 400E does a series of self-tests. If any of the self-tests fail, the DLS 400E will flash the POWER LED red, in which case you should call the factory.

Following is a short description of some of the self-tests the DLS 400E performs:

- Checks if the checksum of the EPROM is valid.
- Checks if the non-volatile RAM and its self-contained battery are functional. The battery has an expected life of over 10 years, and, if necessary, can be easily replaced.
- Checks if the micro-controller is functional.

13.2 Power/Remote LED

The Power LED is normally green on power-up while the Remote LED will be off. After receiving a correct message from either the RS-232 or IEEE 488 port, the Remote LED will turn green.

In some occasions, the Power and Remote LED may been acting differently.

1) The power LED flashes red:

   At power up, the DLS 400E performs a self-test. If this self-test fails, the power LED flashes red. If this happens, consult the factory.

2) The power LED is yellow:

   If the DLS 400E detects an internal error, it does a full system initialization and turns the power LED yellow. If this happens, consult the factory.

3) The remote LED is off:

   This is normal after a power-up and a reset.

4) The remote LED is red:

   The DLS 400E received an invalid command from the control computer. See sections 3.3.2 and 11 for more details.

13.3 Serial Communication Problems

1) Check that no device (such as a mouse) is connected to the same serial (COM) port as the DLS 400E.
2) Check the cabling.
3) Check that all cards in the DLS 400E chassis are firmly seated in their sockets. Using anti-static precautions, open the top panel and push firmly on all cards.

13.3.1 Serial Communication Problems - Customer Written Software

1) If the remote LED is red, you may have sent an invalid command. See sections 3.3.2 and 11 for more details.
2) Queries must be terminated with a question mark.

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13.4 IEEE 488 Communication Problems

1) Check that no device has the same IEEE 488 address as the DLS 400E.
2) Check that the National IEEE 488 interface card is configured correctly. See section 4.2 for more details.
3) Check that the IEEE 488 address of the DLS 400E corresponds to the address set in the program. See section 7.1.2 for more details.
4) Check the cabling.
5) Check that all cards in the DLS 400E chassis are firmly seated in their sockets. Using anti-static precautions, open the top panel and push firmly on all cards.

13.4.1 IEEE 488 Communication Problems - Customer Written Software

1) The DLS 400E does not raise SRQ after a query: You must enable all the relevant bits before using SRQ. For example, to raise SRQ when there is a message available (MAV) send the command "*SRE 16". See sections 7.1.3 and 11 for more details.
2) If the remote LED is red, you may have sent an invalid command. See sections 3.3.2 and 11 for more details.
3) Queries must be terminated with a question mark.

13.5 Display Character Problems

1) The Software makes use of the MicroSoft Line Draw fonts from windows, and these must be available. If they are not, you will find that lines, and other non standard characters do not come out correctly on the screen..
2) Check that the MS LineDraw (True Type) font is installed. To do this, click on the "Control Panel"in the Windows main program group. Then click on "Fonts" and check that this font is present. If it is not, then from this menu click on "Add". Using the browser go to the windows/system directory and find the font called MS LineDraw (True Type). Install this font.
3) It is also possible that the MS LineDraw font has been re-assigned to be some other font. To check on this you need to go to DOS and be in the C:\WINDOWS directory. Type EDIT WIN.INI. This allows you to edit the windows setup file (Be careful while editing this file, as it can cause windows to lock up). Go through the file until you find [FontSubstitutes]. Check if there is a line after this header that says something like: MS LineDraw = ????????, where ???????? is any file name. If there is, change it to MS Line Draw (TrueType)= LINEDRAW.FOT, save the file, and exit the EDIT screen. Restart windows and re-check the the DLS 400E software.

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14. REFERENCES

- ANSI T1.601-1991, ISDN Basic Access Interface for use on Metallic Loops for Application on the Network Side of the NT (American National Standards Institute, 11 West 42nd Street, New York, NY 10036, USA)
- ANSI Technical Report on High Bit Rate Digital Subscriber Lines (HDSL) - June 1992 (American National Standards Institute, 11 West 42nd Street, New York, NY 10036, USA)
- ANSI T1.413-1995, Asymmetric Digital Subscriber Line (ADSL) Metallic Interface (American National Standards Institute, 11 West 42nd Street, New York, NY 10036, USA)
- ETSI ETR-80, ISDN Basic Access Digital Transmission System on Metallic Local Lines (European Telecommunication Standards Institute Secretariat 06921 Sophi Antipolis, Cedex, France, Tel:+33 92 94 4200, Fax:+33 93 65 4716)
- ETSI RTR/TM 03036, High Bit Rate Digital Subscriber Line (HDSL) Transmission on Metallic Local Lines (European Telecommunication Standards Institute Secretariat 06921 Sophi Antipolis, Cedex, France, Tel:+33 92 94 4200, Fax:+33 93 65 4716)
- FTZ 1TR220, PCM Data Transmission at 64 kbps (FTZ, DBP Telekom, Postfach 100 003, D-64276, Darmstadt, Germany).
- 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)

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15. WARRANTY

Consultronics 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 Consultronics service center prior to the expiration of the warranty period for the purpose of allowing Consultronics to inspect and repair the equipment (see section 16 for shipping details). If inspection by Consultronics 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 Consultronics. In no event shall this warranty apply to equipment which has been modified without the written authorization of Consultronics, or which has been subjected to abuse, neglect, accident or improper application. If inspection by Consultronics discloses that the repairs required to be made on the equipment are not covered by this warranty, the regular repair charges shall apply to any repairs made to the equipment.

If warranty service becomes necessary, the customer **must** contact Consultronics to obtain a return authorization number and shipping instructions:

Consultronics Ltd. (Head Office)
160 Drumlin Circle
Concord, Ontario, Canada
L4K 3E5
Telephone: (905) 738-3741
In North America Only: 1-800-267-7235
Fax: (905) 738-3712

Consultronics (U.S.A.)
1304 Rockbridge Rd SW, Suite 4
Stone Mountain, GA 30087
Telephone: (770) 925-3558
In US Only. 1-800-227-3345
Fax: (770) 931-4798
Email: jwright@consultronics-usa.com

Consultronics Ltd (Ottawa)
169 Colonnade Road
Nepean, Ontario, Canada
K2E 7J4
Telephone: (613) 225-6087
In North America Only: 1-800-465-1796
Fax: (613) 225-6315
Email: ottservice@cslo.consultronics.on.ca

Consultronics (Europe)
Unit A
Omega Enterprise Park
Electron Way
Chandlers Ford
Hampshire, England
SO5 3SE
Telephone: 0703 270222
Fax: 0703 270333

Or your local Consultronics representative

This warranty constitutes the only warranty applicable to the equipment sold by Consultronics and no other warranty or condition, statutory or otherwise, express or implied shall be imposed upon Consultronics nor shall any representation made by any person including a representation by a representative or agent of Consultronics be effective to extend the warranty coverage provided herein. In no event (including, but not limited to the negligence of Consultronics, its agents or employees) shall Consultronics 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 Consultronics whatsoever in connection with the equipment shall terminate.

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16. SHIPPING THE DLS 400E

To prepare the DLS 400E for shipment, turn the power off and disconnect all cables, including the power cable, and pack the simulator in the original carton. Do not place any cables or accessories directly against the front panel as this may scratch the surface of the unit. We suggest that you mark all shipments with labels indicating that the contents are fragile.

If sending a unit back to the factory, ensure that the return authorization number given by our customer service department is shown on the outside.

The return authorization number is mandatory and must be obtained before shipping the unit. Please contact customer service in Ottawa (see section 15 for details on how to contact us).

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17. SPECIFICATIONS

The DLS 400E is a two wire cable simulator which can be equipped with up to two ADSL wideband noise cards. The user can select the length, line configuration, and set the various impairments using the IEEE 488 or the RS-232 interface. The command language is based on the Standard Commands for Programmable Interfaces (SCPI) standard.

17.1 Wireline Specifications

Technology:	Cable simulation using networks of discrete R, L & C components.
Cable simulated:	Balanced twisted copper pair.
Cable impedance:	Complex, varies over frequency with length and gauge.
# of conductors:	2
Types of cables:	0.32 mm, 0.4 mm, 0.5 mm 0.63 mm, and 0.9 mm cables as specified in ANSI T1.413, Annex "H".
	24 AWG and 26 AWG cables.
D.C. Rating:	up to 300 V_{DC}, between tip and ring, 100 mA.
Bandwidth:	D.C. to 1.5 MHz, smooth response up to 2 MHz.
Accuracy:	For the specified bandwidth; ±0.5 dB for all attenuations up to 20 dB, for attenuation from 20 to 70 dB the tolerance is within 5% of design to a maximum of 1.5 dB.

17.2 Impairments Specifications

The ADSL noise card simulates a variety of impairments which can be used to test according to the following standards:

- ANSI T1.601 ISDN Basic Access Interface
- ANSI Technical Report on HDSL
- ANSI ADSL T1.413
- ETSI ISDN ETR80
- ETSI RTR/TM03036 - HDSL

The ADSL noise card consists of eight discrete generation sections. The features associated with one generator operate independently of the others. However, the options within a section can only be activated one at a time. The eight sections are:

- White noise generator
- 2 x low frequency (20 to 600 kHz) NEXT shaped PSD generator
- 1 x high frequency (20 kHz to 2.0 MHz) NEXT shaped PSD generator
- Shaped noise generator
- Impulse generator
- Powerline related metallic noise
- Longitudinal noise

The output circuit is balanced with a minimum Thevenin impedance of 4000 ohms over the range 50 Hz to 2.0 MHz.

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17.2.1 White Noise Generator

Level: -90.0 to -140.0 dBm/Hz, variable in 0.1 dB steps

Form: Gaussian amplitude distribution to 5 sigma

Bandwidth: 50 Hz to 2.0 MHz

17.2.2 NEXT Generators A and B

Level: Levels are varied in 0.1 dB steps over a range from 10 dB below the 1 disturber level to 10 dB above the 49 disturber level. The absolute power associated with each will vary according to the NEXT PSD shape selected.

Power: The total power of each shape is accurate to within ±0.5 dBm

Accuracy: Each shape will track the reference shape to within ±1.0 dB, down to a level 30 dB below the peak. Each reference may deviate its null frequencies by ± 5.0%.

Shapes: The following shapes are available in Generators A and B:

ANSI T1.601 - 320 kHz bandwidth

ANSI T1.413 - DSL Next

ANSI T1.413 - HDSL Next

ANSI T1.413 - ADSL + HDSL Next

and Generator B also provides this shape:

ANSI T1.413 - ADSL Next

17.2.3 NEXT Generator C

Level: Levels are varied in 0.1 dB steps over a range from 10 dB below the 1 disturber level to 10 dB above the 49 disturber level. The absolute power associated with each will vary according to the NEXT PSD shape selected.

Power: The total power of each shape is accurate to within ±0.5 dBm

Accuracy: Each shape will track the reference shape to within ±1.0 dB, down to a level 30 dB below the peak. Each reference may deviate its' null frequencies by ±5.0%.

Shapes: The following shapes are available in the High Frequency NEXT Generator.

ANSI T1.413 - ADSL Fext

ANSI T1.413 - Annex "H" - noise model A *[1]

ANSI T1.413 - Annex "H" - noise model B

1.544 Mbit/s T1

2.048 Mbit/s AMI

*[1] The 10 discrete tones are being generated by the shaped noise generator. The Consultronics control software automatically enable both generators and set both levels.

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17.2.4 Shaped Noise Generator

This section is used to generate a series of discrete tones. Its main application is to generate either the shaped noise called for in the ETSI Basic Rate, HDSL, FTZ Basic Rate recommendations or the 10 discrete tones described in the ANSI T1.413 Technical Recommendation Annex "H".

Noise:	Shaped to either ETSI ISDN, ETSI HDSL or FTZ 1TR 220
Level:	-40.0 to +20.0 dB relative to the published reference level
"10 Tone":	As per ANSI T1.413 Annex "H" *[1]
Level:	-20.0 to +20.0 dB relative to the published reference level.

*[1] The Consultronics control software automatically enable both generators and set both levels. Users must send appropriate commands to enable only the 10 discrete tones - see section 10.4 for more details.

17.2.5 Impulses

Types:	This generator produces 7 different impulses. 4 are standard multi-level (unipolar + & -, bipolar, 3-level) , 2 are complex as per ANSI T1.413 Annex"C", and one is the ETSI Cook pulse.
Timing:	The duration of the 4 multi-level impulses can be varied between 20 and 120 microseconds in 1 microsecond steps.
Levels:	Multi-level: 0.0 to 100.0 mV, 0.1 mV steps
	ANSI (c1 & c2): 0.0 to 100.0 mV, 0.1 mV steps.
	Cook: -20 to +6 dB (relative to the reference of 318 mV) in 0.1 dB steps

17.2.6 Powerline Related Metallic Noise

Type:	Dual tones as per ANSI T1.601
Level:	-15.0 to +9.0 dB relative to ANSI reference levels, 0.1 dB steps.

17.2.7 Longitudinal Noise

Type:	Triangular waveform
Frequency:	50 or 60 Hz
Level:	0-60 V_{RMS} at 60 Hz. 0-50 V_{RMS} at 50 Hz, 1 volt steps using internal balanced transformer.

17.2.8 Externally Generated Signals

In addition to the generators, this section conditions externally-generated signals, and applies them to the line.

Frequency:	50 Hz to 2.0 MHz
Input Level:	-30 dBm maximum for the frequency bandwidth from 50 Hz to 1 kHz
	-10 dBm maximum for the frequency bandwidth from 1 kHz to 2.0 MHz
Input Impedance:	50 ohm BNC
Output:	External signals are attenuated by 20 dB and summed with other noise signals and injected through the standard output circuit.

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17.3 Physical

Construction:	Main chassis plus plug-in wireline modules and impairment module.
Noise card slots:	2
Wireline modules:	23
Connectors:	Bantam jacks and 3-pin balanced CF.
Dimensions:	20.2" x 17.8" x 8.2" (51.1 cm x 45.1 cm x 20.6 cm) (LxWxH)
Net weight:	60.1 lbs (27.3 kg)
Gross weight:	79.3 lbs (36.0 kg)

17.4 General / Environmental

Background noise:	Background noise level (all impairments OFF/ output relay connected to tip and ring) is in the region of -145 dBm/Hz.
Power:	90 to 260 V_{RMS}, 50 or 60 Hz, automatic line voltage sensing.
Operating Temperature:	10 to 40 °C. Specifications to 20°C.
Relative humidity:	10 to 95% RH non-condensing.

17.5 IEEE 488 Remote Control

The unit can be controlled via an IEEE 488 interface. The unit supports the following functions:

1) Listener
2) Talker
3) Local Lockout
4) Serial Poll
5) Selective Device Reset
6) Bus Reset
7) Primary Addressing from 0 to 30

17.6 RS-232 Remote Control

The unit can be controlled via an RS-232 serial interface. The unit is configured with 9600 bps baud rate, no parity, 8 data bits per character, 1 stop bit and RTS/CTS hardware flow control.

17.7 Fuses

Dual-fuse configuration: Type “T” (5mm x 20 mm), 2 A, 250 V, Slow-blow.

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17.8 System Components

1) DLS 400E Control Software
2) Manual
3) 2 Bantam cables
4) RS-232 cable
5) Power cord
6) 2 fuses

17.9 Option

National IEEE 488 PCII card interface card for use inside a remote control computer.

17.10 Electrical

17.10.1 AC Power

Rated Input Voltage: 100-240VAC(±10%).
Rated Frequency: 50-60Hz.
Rated Power consumption:140VA max.
Line Fuses: Type "T" 2A/250V SLOW BLOW (2 required, 5mm x 20mm).

17.11 Environmental

Operating Temperature: +10°C to +40°C.
Storage Temperature: +10°C to +40°C.
Humidity: 90% (non-condensing) max.

17.12 Mechanical

Weight: 28 kg
Dimensions: 452mm x 494mm x 194mm (W x D x H).

17.13 Operating Conditions

In order for the unit to operate correctly and safely, it must be adequately ventilated. The DLS 400E 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.

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18. SAFETY

18.1 Information

18.1.1 Protective Grounding (Earthing)

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

18.1.2 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 with a protective earth contact. Never connect to an extension cord that is not equipped with this feature.
- Do not willfully interrupt the protective earth connection.

CAUTION: When **lifting or handling the unit** do not touch the **cooling fan** ,which is located on the bottom of the chassis towards the right-front corner. The unit may be lifted by utilizing the space beneath the chassis.

18.1.3 Supply Power Requirements

The unit can operate from any single phase AC power source that supplies between 100V and 240V (±10%) at a frequency range of 50 Hz to 60 Hz. For more information, see the specifications section of this manual.

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

18.1.4 Mains Fuse Type

The fuses type used is specified in the specifications section of this manual.

18.1.5 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.

18.1.6 Operating Environment

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

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18.1.7 Class of Equipment

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

18.2 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 and Reference Manual is in direct violation of the standards of design, manufacture and intended use of the equipment.

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

18.2.1 Before Operating the Unit

- Inspect the equipment for any signs of damage, and read the Operating and Reference 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.

CAUTION: When **lifting or handling the unit**, do not touch the **cooling fan** which is located on the bottom of the chassis, towards the right front corner. The unit may be lifted by utilizing the space beneath the chassis.

18.2.2 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 and Reference Manual or the Sevice Manual.
- Some of the equipment's capacitors may be charged even when the equipment is not connected the power source.

18.3 Symbols

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

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Figure 39: Equipotentiality-Functional Earth Terminal



Figure 40: Protective Grounding Conductor Terminal



Figure 41: Caution refer to accompanying documents

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19. APPENDIX 1: INTERPRETATION OF LEVEL UNITS

This appendix discusses the relation between the simulator setting and the real noise it represents.

In all cases the objective is to choose a setting that corresponds to the reading of a level meter connected to the equipment. Since we know that the noise SOURCE is unchanged, the reading will only change according to the bandwidth and the impedance of the meter (designated the Load Impedance).

In Impairment modules the units used in setting levels are designed to give a compromise between commonly used units and those that are unambiguous.

There are three forms of Units that are used.

1) μV/√Hz - Is independent of the Load Impedance and the bandwidth of the measuring device. It therefore requires the most manipulation to be translated into a meter reading.
2) dBm/Hz - Is independent of the bandwidth of the meter but not of the impedance. Therefore, when using a setting of x dBm/Hz the Load Impedance must be previously defined.
3) dBm - Is related to both Load Impedance and bandwidth. When using a setting of x dBm the Load Impedance and the bandwidth must both have been previously defined.

Following is a set of examples on how to convert a unit to dBm, the most common readout of level meters.

19.1 μV/√Hz to dBm

For this example we will assume that the load impedance is 135 Ω and the bandwidth is 3 KHz.

Assume that the setting is 10 μV/√Hz:

V * V = (μV/√Hz) * (μV/√Hz) * Bandwidth
= (10E-6) * (10E-6) * 3000
= 3.00E-7

P (load)= V * V / R watts
= (3.00E-7) / 135 watts
= 2.22E-9 watts

P (ref) = 1E-3 watts
dBm = 10*LOG [P(load)/P(ref)] dBm
= 10*LOG [(2.22E-9)/(1E-3)] dBm
= -56.5 dBm

19.2 dBm/Hz to dBm

Here we will assume that the bandwidth is 3000 Hz and the setting is -70 dBm/Hz.
dBm = dBm/Hz + 10*LOG (bandwidth) dBm
= -70.0 + 10*LOG (3000) dBm
= -70.0 + 34.8 dBm
= -35.2 dBm

Notes:

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A) To change a level in μV/√Hz by a certain number of dB use the following formula: (Assume x is the amount to change the μV/√Hz setting by, and the dB change required is -6 dB.)

x = 10** (y / 20)
= 10** (-6 / 20)
= 0.50

Therefore the original setting in μV/√Hz should be multiplied by 0.50 to give a change of -6 dB.

Note: To change a level in dBm/Hz by a certain number of dB simply change the dBm/Hz setting by the required amount. An examination of the formula on this section will bear this out.

19.3 LOADING

As can be seen from the above discussion the choice of loads plays a large part in the level that the meter will read. One of 3 loads are used when calibrating Consultronics Impairments (Noise) generators. In all cases any wirelines in place are set to zero length. They are 50 Ohms, 67.5 Ohms, and one 135 Ohm resistor in parallel with one complex impedance as described in Appendix 5.

These impairments are calibrated using a 50 Ohms load:

Crosstalk Noises

ADSL FEXT, ADSL NEXT, ADSL MODEL A, ADSL MODEL B, T1, E1 AMI, ADSL+HDSL

White Noise

Impulses

Complex Impulse A and B (used in ANSI ADSL testing)

These impairments are calibrated using a 67.5 Ohms load:

Crosstalk Noises
DSL, HDSL
Shaped Noises
ISDN (ETSI), HDSL (ETSI), FTZ

Impulses

3-LEVEL, COOK PULSE

and these are calibrated using a load of 135 Ohms in parallel with an ANSI Load. See appendix 5 for a description of the compex ANSI load.

Crosstalk Noises
T1.601
Dual Tones

Notes:

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Consultronics has consistently used 50 Ohms when calibrating ADSL Model A and Model B noises, recommended for testing systems operating in a 2048 kbps environment. We understand that this is a mis-interpretation of the spec on our part. This leads to DLS 400(E) and NSA 400 units generating 6 dB too much for these two impairments only.

You are advised that if you are following an ANSI or ETSI recommendation that calls for calibrated noises of -49.4 dBm of model A noise, or -43.0 dB of model B noise, you should set the DLS 400, DLS 400E or NSA 400 to -55.4 or -49.0 dBm respectively.

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20. APPENDIX 2: MEASUREMENTS

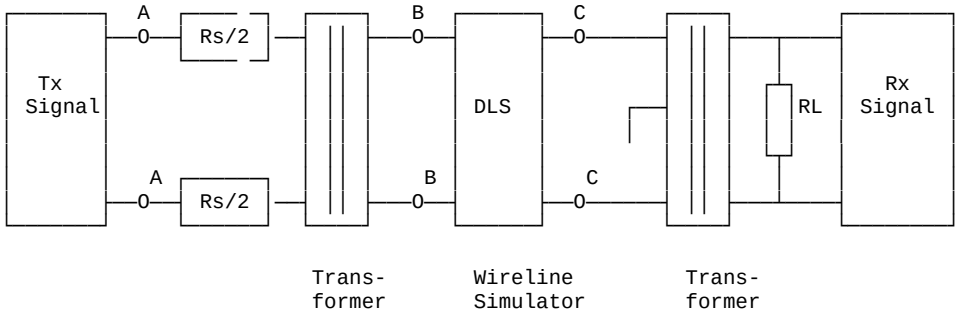
20.1 Measurement of Wireline Simulators

Data for the characteristics of North American AWG lines were obtained from Bell System Technical Reference PUB 62310. This provides information on the line's attenuation FOR AN INFINITELY LONG LINE. Data for other wirelines are generally specified in terms of resistance, impedance, capacitance and conductance per unit length of line as it varies with frequency. This is easily converted into characteristics of an infinitely long line.

When measuring the response of a simulated line, it is of finite length, may be made up of several different gauges of wire and is usually terminated in a real load. There are several common ways to measure the amplitude response of electronic systems. Refering to the figure these are:

1) The amplitude of the TRANSFER FUNCTION from BB to CC.
2) Some Engineers include the source resistors in the system and measure from AA to CC.
3) Yet others measure using method 2, subtract 6dB from the attenuation and quote the result. This is called the INSERTION LOSS of the system.

For wireline measurement, method 3, the insertion loss method is standard.



Attenuation of a wireline simulator is correct when used with balanced, metallic (differential mode) signals which are injected and received by transformers. See the figure above. The transformers may be included with the Transmit (Tx) Signal generator and Receive (Rx) Signal device. The centre tap of the receive transformer need not be grounded, but may be if no other point between the transformers is grounded.

THE USE OF UNBALANCED SIGNALS THROUGH THE DLS WILL USUALLY GIVE INCORRECT MEASUREMENTS.

20.2 Common Errors

a) 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.
b) 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.
c) 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'.

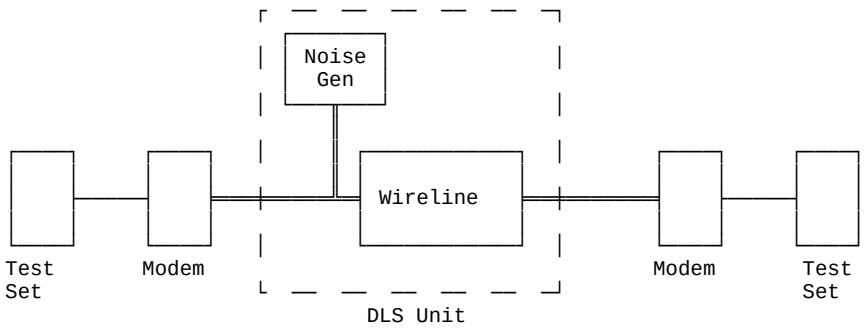
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21. APPENDIX 3: NOISE GENERATOR CONNECTIONS

The theory behind connecting up the impairments generator to the wireline is simple, but sometimes leads to confusion. When testing access equipment, the tests generally consist of:

1) A pair of modems, the equipment under test.
2) A wireline or wireline simulator, over which the modems communicate
3) One, or sometimes two, impairments (noise) generators, which impair the transmission conditions on the wireline, and make it more difficult for the modems to train up and communicate..
4) A pair of error rate testers (test sets), which send data to and receive data from the modems. These may also perform call set up and termination, and always have some method of determining the quality of the received data. In many cases they are Consultronics Lynx testers.

This is shown here, diagrammatically, assuming one noise generator is used:



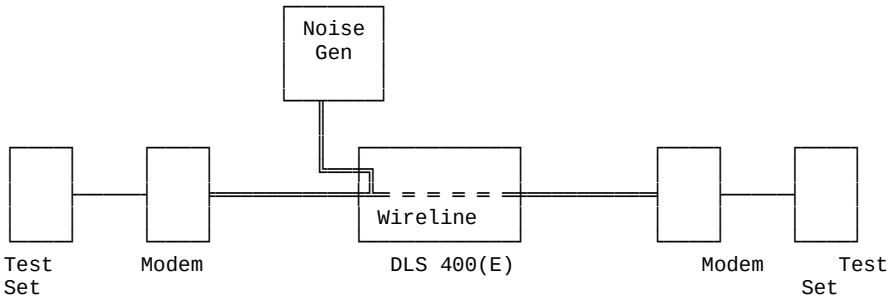
Simulators such as the Consultronics DLS 400(E), DLS 200 and DLS 100A can all contain both the wireline simulation and the noise generator, and is the equipment enclosed in the dotted lines. You do not have to worry about connecting wireline simulator and noise generator together because this is already done inside the unit. External to the unit, you must connect up the modems using a balanced interface. This balanced line is shown diagrammatically, both inside and outside the unit by the ═ lines. You just connect up using twisted pair wire—or better, screened twisted pair—from the modems to the DLS unit. It is best to keep the connecting wire short, since then it picks up less noise, and does not give unwanted reflections. Screened twisted pair is better because it picks up less noise, and there is less chance of unwanted crosstalk.

Note that when the noise generator is applied to the line it must not disturb the signals already on the line. Otherwise communication between the modems would be altered. For this reason, the noise generator has a high output impedance. Some people like to look at it as a current generator rather than a voltage generator. All present Consultronics generators have an output impedance of 4 kOhms or more.

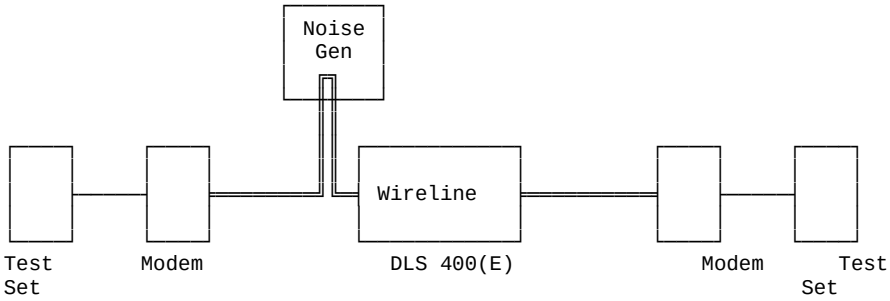
Depending on the simulator type, connectors on the DLS may be an RJ45 jack, a Siemens CF connector (which will also take banana plugs) a bantam jack, a terminal strip, or some combination of these. Note that the bantam jack goes under several names, such as mini-bantam, mini 310, bantam telco jack. For the DLS 400(E), there are bantam jacks front and back and CF connectors on the front. On side A of the unit, all 3 of these connectors are equivalent, and internally connected. You may connect to any or all of them. The same is true for side B. Of course, if you connect to two of them, this joins the two plugs electrically together.

Sometimes you may want to connect the noise generator from, say, an NSA 400 to a wireline simulator such as a DLS 400(E), if it is not equiped with its own impairments generator. This is easy. Connect the DLS 400(E), modems, and error rate testers together in the usual way. At the side of the DLS 400(E) where you want added impairments, plug in one end of your connecting wire to one of the spare connectors on the DLS 400(E). It is either a bantam jack or a CF connector. Plug the other end in to the NSA 400. The diagram shows the connections together with connections internal to the NSA.

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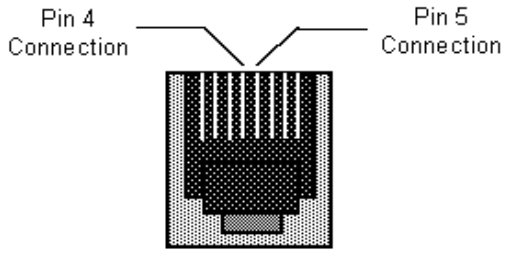


As an alternative, you could use the extra parallel connectors on the NSA to connect the line to the impairments generator like this:



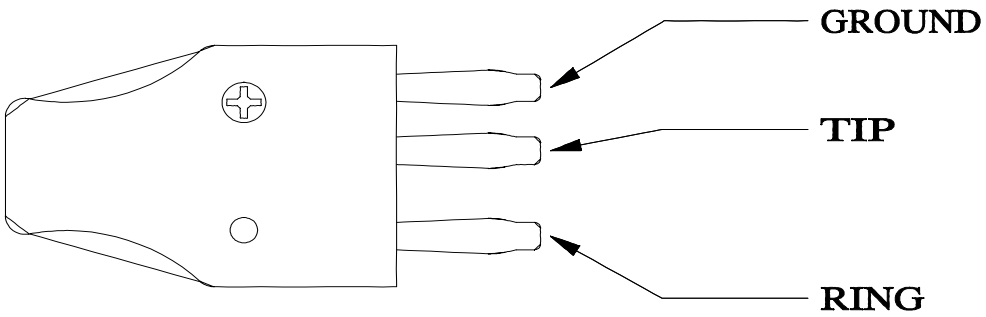
The diagram shows a DLS 400(E) as the wireline simulator, but it could equally well be a DLS 90, or any other Consultronics line simulator, or even real cable!

The various types of jacks and plugs refered to above are shown in the diagrams below.



For the RJ45 connectors, pins 4 and 5, the center 2 pins are the ones which carry the signal. If you wish, you can use an RJ11 plug.

A CF plug looks like the diagram below. There are 3 prongs spaced unevenly, as shown below:



You can use banana plugs if the correctly spaced CF connector is not available.

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The bantam plug looks like the diagram shown on the right. Its corresponding jack on the front of the DLS 400E, as seen on the front panel, is a hole, roughly 1.75” in diameter.



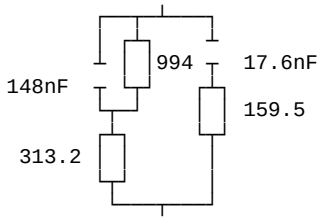
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APPENDIX 3: COMMONLY ASKED QUESTIONS

Q) How much will an impairments module affect the signals travelling along the wireline?
A) It depends on the loop, the frequency, and the impedance of the modems being tested. For frequencies above 100 kHz, and with a Receiver / Transmitter that provides 135 Ohms, connecting the impairments generator reduces the signal at the receiver by 0.14 dB.

Q) How can I disconnect the Impairments module completely from the simulated loop?
A) Turn off all impairments.

Q) What loads do you use to calibrate impairments.
A) For ISDN and HDSL specified noises, we generally set the DLS to a loop length of 0, and provide a 67.5 Ω load at the terminal where the generator is located. Then we measure the voltage. For two types of impairments specified by ANSI, (Crosstalk Noise type ANSI FULL BW, and Powerline Noise type ANSI) we use 135 Ω in parallel with the ANSI load specified shown below:



For ADSL impairments, which are specified on a 100 Ohm scale, we use a 50 Ohm resistor instead of the 67.5 Ohm resistor.

Q) How does wideband noise in dBm/Hz relate to total noise in dBm?
A) See Appendix 1.

Q) Does the loop selected affect the noise level output by the Impairments module?
A) Yes. Since impairments are injected from a 4.05 kΩ impedance, the power injected on to the loop depends heavily on that impedance. Different loops have different impedances.

Q) Why is the noise not at the calibrated level when injected on to a simulated line?
A) No real loop provides the same load as the one used for calibrating the module, with the possible exception of the ANSI special load, and one of the ANSI loops.

Q) Why do I have to use a balanced meter to measure noise levels from the DLS ? (What happens if I just use the meter that I already have?)
A) The Transmitter/Receivers under test provide a balanced load, so we should measure them the same way.
Most meters ground one connection. This upsets the simulation at the higher frequencies. Even if the meter is floating , it may be that capacitance to ground from one lead is more than the other, and this can lead to wrong answers.

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