OPERATING AND REFERENCE MANUAL

DLS 200HE

HDSL Wireline Simulator

Consultronics

Revision 13 (December 22, 1997)

Table of Contents

Section 1 INTRODUCTION

1.1 ABOUT THIS MANUAL

The DLS 200HE Operating Manual can be used to learn about the unit for the first time, or can be used as a look up reference book. It is suggested that you carefully read the introduction sections of this manual before powering on your unit. Failure to do this could cause damage to your DLS 200HE. You will find that this manual is divided into sections as listed in the table of contents.

If you have any questions not covered by this manual, we encourage you to contact your Consultronics sales representative or contact our customer service department at the location shown in the "Service" section of this manual. If you have any suggestions as to how this manual could be improved, please feel free to write to us at the same address.

Thank you for your business and for choosing Consultronics.

1.2 RECEIVING AND UNPACKING THE UNIT

The DLS 200HE has been shipped to you in a reinforced cardboard shipping container. It is suggested that you retain this carton for any future shipments.

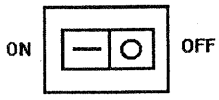
Inside the shipping carton is a packing list (a packing slip may be attached to the outside of the box, which is for the shipping company only, please refer to the packing list). Please check that you have received all items as per the packing list and report any discrepancies as soon as possible. Please also note that some options are installed within the chassis of the main unit and can only be checked by powering on the unit which is covered in the following section.

1.3 POWERING THE UNIT

The DLS 200HE has been supplied with a universal power supply which will operate on 90 to 260V AC, (a nominal 100 to 240 Volts ±10%) at 50 to 60 Hz. There is no selection needed for different voltages. The DLS runs on an internal IBM-PC/MS DOS platform and requires that the supplied disk be inserted into the disk drive in order to operate. MS-DOS Version 3.3 is installed in the unit and supplied together with the DLS program disk. Since the unit will not operate without this disk, it is suggested that you create a back-up copy before operating the DLS 200HE. See "CREATING A BACKUP" for details. Use the back-up copy to run the DLS 200HE.

INSERTING A DISKETTE

Slide the diskette into the disk drive and gently push it into the slot. The disk can only be inserted one way (i.e. the direction of the arrow), so if it does not go in smoothly, try turning the diskette over and re-inserting.



Once the diskette is in and locked, the unit may be powered by moving the rear panel mounted power switch to the ON position. Immediately the disk drive light will come on and then turn off, the display will then be lit. Note that it takes about 30 seconds before the information on the screen becomes legible. During this time the CPU is checking its memory and configuration, and the necessary screen drivers are loaded to configure the EL display.

After the above time has elapsed the message in Fig. 1.1 will be displayed. The DLS is now ready to be used.

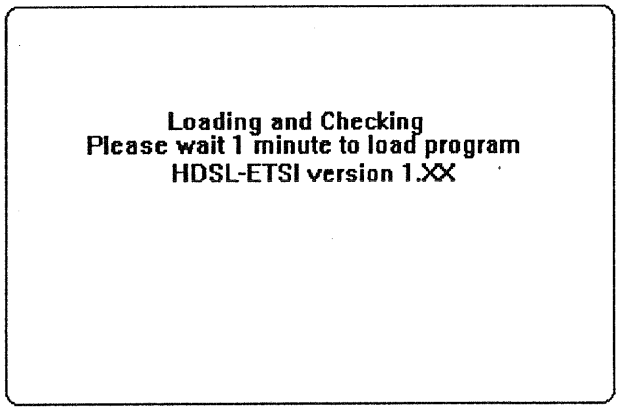


Fig. 1.1 Power Up Message for the DLS 200HE

CREATING A BACKUP

(1) On the Main Menu, select Quit and press Enter. This will terminate the DLS operation and transfer the DLS control to DOS, and the DOS prompt A:\ will appear on the screen.

(2) Check that the DLS program disk is in the disk drive and perform the following key sequence: Num Lock - 2 - Enter. This will type the number 2 at the DOS prompt and will run the disk backup program.

(3) After a few seconds, the DLS will prompt you for the SOURCE disk, which is the same disk already in the drive. Simply press Enter and the DLS will start loading the files into its memory.

(4) After the files are downloaded, the DLS will prompt you again for the DESTINATION disk. Follow the instruction in INSERTING DISKETTE, insert a blank 3 1/2" diskette into the floppy drive and press Enter. The DLS will copy the files from its memory to the floppy. If the disk is not formatted the DLS will format the disk before copying the files.

(5) Once copying is finished the unit will ask if you want to copy another one. If an external keyboard is available, type Y for yes if you want to copy another disk, and N if you want to end the session. If the session is ended, perform Num Lock - 1 - Enter on the DOS prompt to run the program. If a keyboard is not available, power down the DLS and power it up again, the DLS will reset and the program will run.

Since the DLS comes with only one set of diskettes, it is very important to perform a backup.

Section 2 BACKGROUND INFORMATION

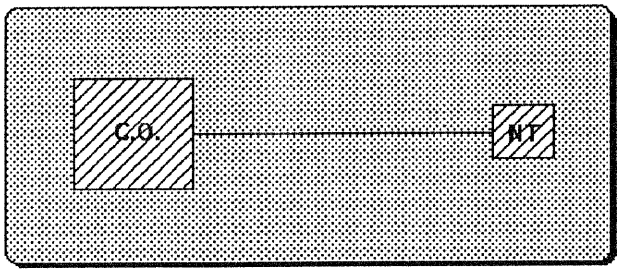
2.1 ISDN SERVICES

The Integrated Services Digital Network (ISDN) emerged in the late 1970's as a means of integrating different information streams, and re-implementing the analog network at that time into a digital transmission scheme. This development was a result of the demand from corporate users. The ISDN concept materialized when the CCITT (The International Telephone and Telegraph Consultative Committee) employed the concept and started developing a set of standards for a universal Integrated Services Digital Network.

ISDN has a very broad specification which includes Primary Rate (1.544 Mbps composed of 23 x 64 kbit/sec. B channels plus 1 x 64 kbit/sec. D channel in N. America, or 2.048 Mbps composed of 30 B channels plus 1 D channel in Europe), Basic Rate (2 x 64 kbit/sec. B channels plus 1 x 16 kbit/sec. D channel), and Broadband (video / data / voice in various configurations). Primary Rate is meant for users needing higher speed communications, and is often transmitted using a specification known as HDSL). Basic Rate requires a 144 kbit/sec.* connection for its three channels, and is meant for most end users. Broadband can achieve transfer rates of 150 Mbit/sec, and is meant to integrate with the broadband capability of fibre optics. The distribution of the ISDN signals is complex, as they are being carried by the existing network. For the purposes of this manual, we will concentrate on the distribution of ISDN signals at the basic and HDSL rates from the central office to the end user site.

* Depending on the interface, the total bit rate is different. For the U interface, the total is 160 kbps and for the S or T interface, it is 192 kbps.

2.2 THE ISDN U INTERFACE



ISDN signals at basic rate are sent to and from the central office, via single pair twisted copper wire known as the U-Interface. These bi-directional 160 kbps signals are coded as either a 2B1Q signal, or a 4B3T signal depending on the administration. Primary rate signals are sent using an encoding scheme known as High Rate Digital Subscriber Loop or HDSL. In Europe, there are two standards for doing this. One encodes the signals onto 3 pairs of wires, each carrying bidirectional data at 772 kbps. The other uses only 2 pairs of wires, but the signal rate is correspondingly higher. Soon there is expected to be a third rate The signal is terminated at the customer premises via a Network Terminator (NT).

The DLS 200HE simulates the physical parameters of the U interface in order to stress test U interface transmission products at basic or HDSL rates.

2.3 ETSI SPECIFICATIONS

ETSI documents specify the physical characteristics of the single pair Basic Rate ISDN as well as 3 pair, 2 pair and 1 pair HDSL rate U-Interfaces, and the transmission devices to be used to send data over these interfaces. In particular, the documents specify the physical cable and the testing procedures for devices which connect to the U-Interface.

2.4 THE DLS 200HE

The DLS 200HE simulates the characteristics of the physical cabling and interfering signals of the U-interface. It consists of wireline modules which can simulate various lengths of cable (user selectable), together with an impairment module, and appropriate software. The impairment module can introduce impairments such as white noise, shaped noise, and impulse noise. Also there is a matrix card which allows the cable type and configuration to be changed. (i.e. bridged taps to be added or subtracted, etc.). This manual describes the DLS 200HE with software for testing Basic Rate and HDSL rate transmission devices. It also mentions the previous DLS 200E which tests Basic Rate ISDN transmission devices.

The various hardware parts of the unit are described below:

Wireline Modules	Two wire simulation of cable selectable in 50 m steps of various lengths.
Mixed Gauge Wireline Modules	Simulates different gauges of wireline on a single card.
Impairment Module	Injects white noise, ETSI shaped noises, FTZ shaped noise, longitudinal noise, discrete impulses of noise and low frequency tones onto the simulated 2-wire path.
Matrix Card	Sets up the connection path between wireline modules. Allows the DLS 200 to simulate two wire circuits. It also allows wire gauges to be selectable and for bridged taps to be added.
Measurement Card	Used in self test and attenuation measurement modes to measure levels within the DLS.

DESCRIPTION

The DLS 200HE is a stand alone ISDN U-Interface Simulator. It features a large EL graphic screen, a PC compatible CPU running MS-DOS, open architecture (accepts various modules), and easy-to-operate front panel controls. An external keyboard can be connected, and the unit can be controlled via the IEEE-488 (GPIB) interface *.

* The IEEE-488 interface is electrically the same as the IEC 625 interface in Europe.

Fig. 2.1 Front View

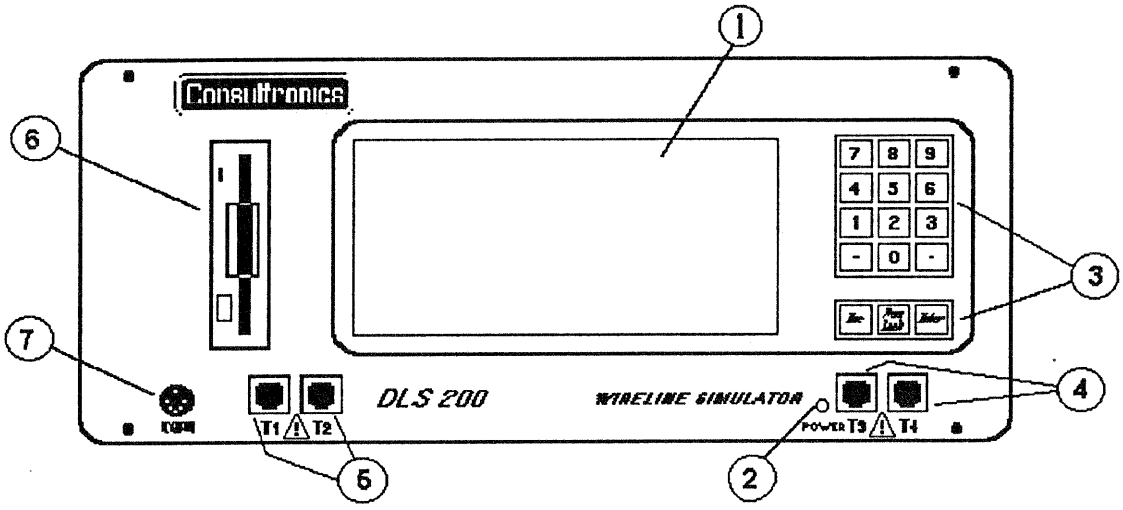
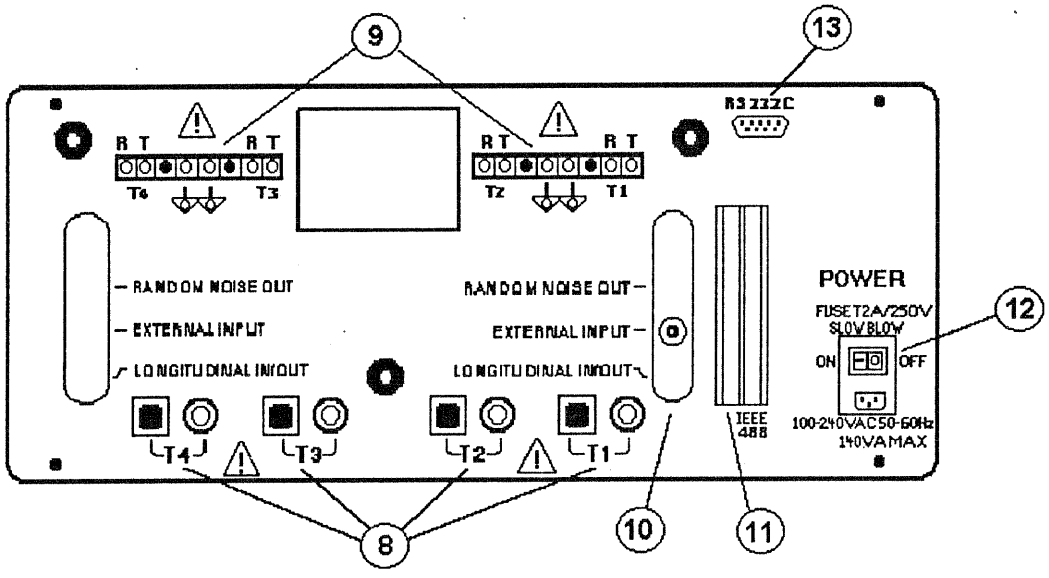


Fig. 2.2 Rear View



1. DLS 200 DISPLAY
2. POWER-ON LIGHT
3. KEYPAD / CONTROLS
4. RJ45 CONNECTOR FOR T3 and T4
5. J45 CONNECTOR FOR T1 and T2
6. 3 1/2" DISK DRIVE
7. EXTERNAL KEYBOARD CONNECTOR
8. RJ11 & 310 CONNECTORS FOR T1 TO T4
9. CONNECTIONS FOR T1 TO T4
10. EXTERNAL IMPAIRMENT INPUTS
11. IEEE 488 INTERFACE (REMOTE CONTROL)
12. POWER SWITCH AND AC MAINS
13. RS-232C / V.24 SERIAL PORT INTERFACE

There are provisions for connection to the equipments to be tested on the front and back panels of the DLS 200HE. Both front and back panels have RJ45 connectors. The 2-wire circuits come out of the RJ45 connectors on pins 4 and 5 at T3 and T4 respectively. Connecting to T3 and T4 at the front is the same as connecting to T3, T4 at the back panel.

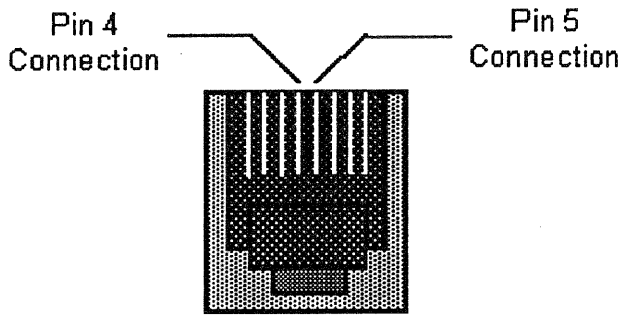


Fig. 2.3 RJ45(2 wire) Connector Pinout Diagram

2.5 CONFIGURATION

DLS 200HE Multigauge Cards (0.4, 0.5, 0.6, 0.8mm PE type cable or 0.4, 0.32, 0.63mm PVC type cable)

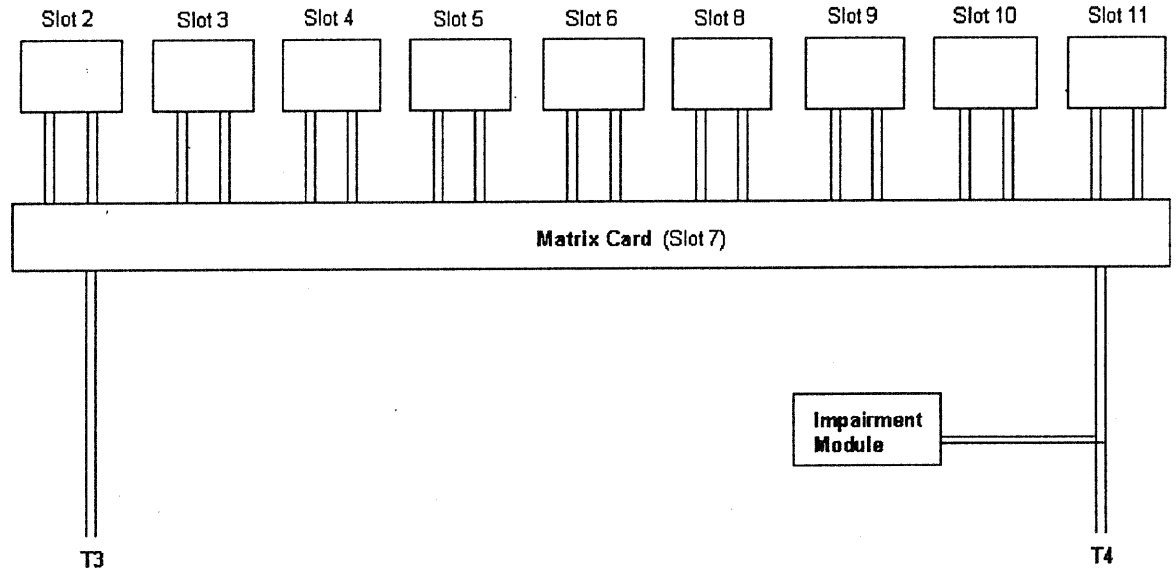


Fig. 2.4 DLS 200HE Wireline Card Configuration

The DLS 200HE Configuration

The DLS 200HE wireline cable uses passive components such as capacitors, resistors and inductors. This allows for bi-directional re-creation of the actual characteristics of twisted copper pair wire. In order to select different lengths of cable, the DLS 200HE switches in sections of fixed lengths of cable using relays. These sections and relays are contained on the wireline cards.

The DLS 200HE allows for different connection paths to be simulated. These paths could be a straight 2-wire path or 2-wire path with attached bridged taps. These paths could be of a single gauge of wire, or of mixed gauges. The path that is established through the DLS 200HE is set by the Matrix Card. It contains a number of relays which can route a signal through a particular

card. The Matrix card also determines the order of modules through which the signal passes, and the location of bridged taps.

The impairment card in the DLS 200HE injects different types of noises: simulated shaped noise, longitudinal noise, powerline noise and impulse noise onto the wireline path. Each simulated impairment can be enabled or disabled by the user and the parameters of the impairments (such as level) can also be varied. Metallic (differential mode) impairments are injected at T4, which is usually the NT end. Since all non-symmetrical loops can be reversed, noise can be injected at the LT by plugging in to T4 and the NT into T3. Longitudinal mode signals are injected in the centre of the loop, in accordance with the ETSI recommendations.

2.6 INSTALLATION OF IEEE 488 BUS

As an option, the DLS 200HE may be controlled over the IEEE 488 bus by installing an interface card. Installation of the card should be simple and is the first step. If you have ordered this option with your unit originally, then the card will come already installed. The IEEE address is set to 12 as the default. If you need to install the card or change the address, proceed as follows:

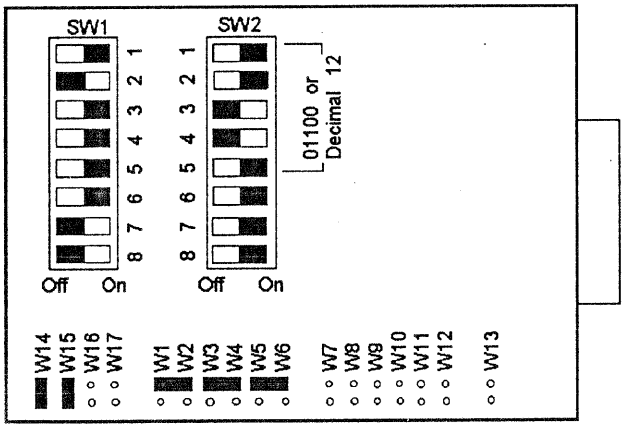
(1) Remove the top cover of the unit using a hex screw driver.

(2) Set the switches and jumpers on the card on the diagram below. This sets the card to an IEEE address of 12, prevents the 1444A from asserting IFC or REN, and enables open collector operation of the drivers. To change the address, set switches SW2-1 to SW2-5 using binary numbering. Position 5 is the most significant bit and position 1 is the least significant bit.

(3) Remove card blank covering IEEE slot (refer to item 11 in Section 2.4).

(4) Insert the card into the short IBM PC type slot of the DLS 200HE. Secure the card in place at the end tab by using the screw provided at the back of the DLS 200HE.

(5) Replace the cover of the DLS 200HE.



a.) Take out W13 shunt (used for grounding).

b.) SW2-8 is on (disables IFC and REN line from being asserted by the Ziatech card).

c.) SW2-7 is on (enables open collector operation of the interface drivers).

Fig. 2.5 IEEE 488 Interface Card Setup

2.7 SOFTWARE SUPPLIED

The software "customises" the DLS 200HE for use at basic rate or HDSL rate.

Two diskettes are supplied. One is labelled:

DLS 200HE HDSL-ETSI
CONTROL SOFTWARE
VERSION 2.xx

and is used for testing any of the 3 types of HDSL rates.

The other is labelled:

DLS 200HE BASIC RATE
CONTROL SOFTWARE
VERSION 2.xx

and is used for testing Basic Rate ISDN.

This second diskette is also used for testing FTZ loops at basic rate. In this case some appropriate hardware changes from the standard unit need to be done, too. Normally, testing using the FTZ loops is done for transmission devices using 4B3T data encoding, and Basic Rate loops are used for devices using 2B1Q encoding.

Note that in the above examples, the version number is given as 2.xx. This is the latest version number and comes with new DLS 200HE units. Older version of the DLS 200HE have a slightly smaller display which needs a different display driver. New versions of these diskettes carry a version number of 1.xx.

Section 3 OPERATION OF THE HDSL-ETSI PROGRAM

In order to operate the DLS 200HE, at the HDSL rate, insert the diskette labeled HDSL-ETSI, and switch on as outlined in section 1.3. The screen then displays the current configuration. Pressing the Esc key will display the menu shown in Fig. 3.1 below:

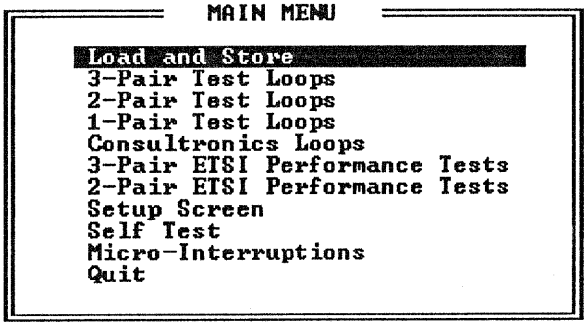


Fig. 3.1 DLS 200HE Main Menu Display

Main Menu
Presented on the main menu of the DLS 200HE upon power-up are a number of selections. To choose one of the selections, use the up and down arrows on the numeric keypad of the DLS 200HE, which is located to the right of the graphic display. Once the desired function is highlighted, press the Enter key to make that selection.

Load and Store
This selection is used to store and recall user created configurations. By pressing Enter when the cursor is on this selection, a sub-menu will appear showing the selection of the ETSI loop file to be recalled or written to. By pressing the PgUp key the file will be recalled, by pushing PgDn, the configuration will be stored. Note that there is a specific location for storing configurations for which a file name has not yet been created, this location is labelled "Save New File Here".

3-Pair Test Loops
This selection contains 8 ETSI loops with the 3-Pair configuration.

2-Pair Test Loops
This selection contains 8 ETSI loops with the 2-Pair configuration.

1-Pair Test Loops
This selection contains 8 ETSI loops with the 1-Pair configuration.

Consultronics Test Loops
This selection will place the DLS 200HE into 8 possible two wire configurations. The user can then set the distances of various wirelines.

3-Pair ETSI Performance Tests
Performs shaped noise, impulse noise, and common mode insertion tests on selected 3-Pair

loops in the DLS.

2-Pair ETSI Performance Tests
Performs shaped noise, impulse noise, and common mode insertion tests on selected 2-Pair loops in the DLS.

Set Up Screen
Used for setting the impairment units, screen saver activation time, and remote power.

Self Test
Performs attenuation measurement on 3-Pair and 2-Pair loops.

Micro Interruptions
Used with the micro interruptions card at the back of the unit for a separate test.
NOTE: Disconnect the wirelines when doing this test!

Quit
Used to exit the main menu and go to a DOS prompt.

3.1 DETAILED OPERATION

3.1.1 Saving and Loading Configurations

During the set-up of any configuration pressing Esc and moving the cursor to the Load and Store position and pressing Enter, allows you to enter the Load and Store menu. The menu can be used for saving the current edited configuration or loading new configurations from disk.

Shown on the menu are functions of the keys and list of configurations. The following explains each of their functions:

Recalling Configurations:
Use the Up / Down arrows to highlight the configuration to be loaded and then press PgUp. The disk drive LED will come on for a moment as the DLS 200HE loads the selected configuration from disk. After a few seconds, the selected configuration will be displayed.

Storing Configurations:
Edited configurations can be saved on disk as new configurations. To save an edited configuration, use the Up / Down arrows keys to get to the bottom of the list and highlight "Save New File Here". Press PgDn and a line on the bottom of the screen will come up prompting for the new configuration's name. Use the Up/Down arrows to change characters, Left/Right arrows to move to adjacent spaces (or type in the name if an XT compatible keyboard is available). Press Enter when finished to accept the name. The configuration will be saved and listed on the menu.

Edited configuration can also be saved under one of the listed configurations. To do this simply highlight the configuration desired and press PgDn. A line will come up displaying the selected configuration name to be saved under. If no change is required, simply press Enter and the new configuration will overwrite the old one.

Anytime during saving a configuration, pressing Esc will cancel the operation.

Deleting Configurations:
To remove a configuration from memory simply highlight the configuration to be deleted. Press the Del key and the DLS will come up with a message asking for confirmation. Press Del again to confirm deletion and the configuration will be removed from the disk. Press Esc to cancel deletion.

Resetting The DLS 200HE:
This key will reset all memory that keeps a track of the wireline lengths and impairment levels to default values. The user will be prompted to confirm that he/she wishes to reset the memory of the DLS 200HE to its default values. At this point the user can abort the procedure by pressing Esc. .

Exit The Load and Store Menu:
Press Esc will exit the menu and return the operation back to bus editing.

Note: If a keyboard is available, it is always helpful to use it to load and save configurations, this will greatly speed up the process.

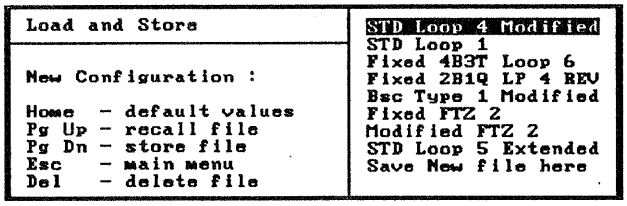


Fig. 3.2 Saving and Loading Configurations

3.1.2 Selecting One of the 8 Standard ETSI Test Loops

The DLS 200HE simulates the electrical characteristics of the wire loops as described by ETSI. When the unit is first powered-up, it automatically displays the last loop loaded or saved. With the Up/Down arrows, move the cursor to the Variable Test Loops section and press Enter. A Loop Menu will come up listing all the test loops. Select the loop with the Up/Down arrows and again press Enter. The selected loop is displayed. If you are already in another menu, press Esc to return to the main menu, then select the Variable Test Loops. The previously selected test loop will be displayed. See Fig. 3.3.

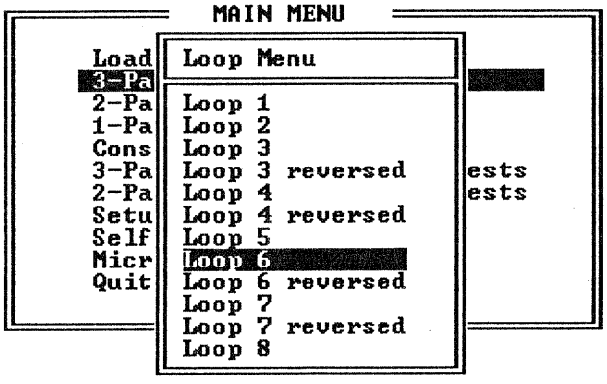


Fig. 3.3 ETSI Loop Menu

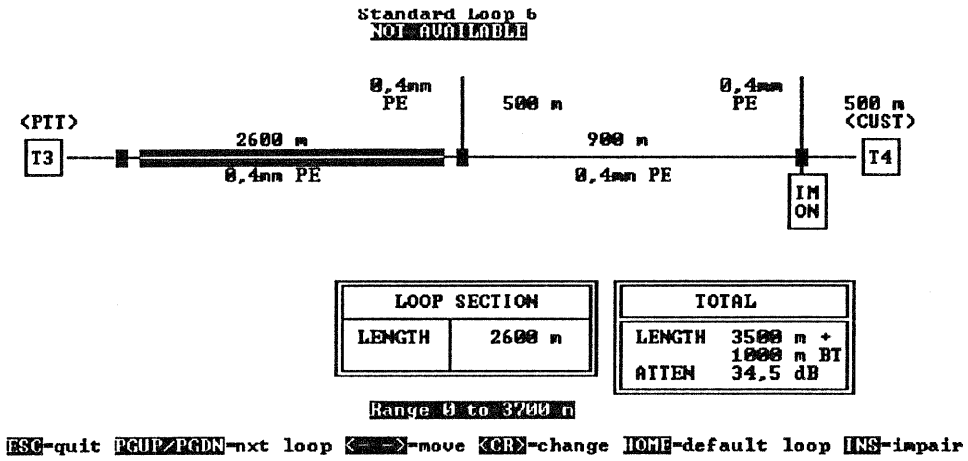


Fig. 3.4 Loop 6 of the 8 Standard Test Loops

The DLS 200HE is now displaying a schematic representation of its standard loop. Normally the PTT end of the loop is connected to T3. The NT, or customer end, is connected to T4 on the front or back of the DLS 200HE. The horizontal and vertical lines represent simulated wirelines and the box marked IM represents the impairments module.

A cursor is displayed on the first section of the wireline. Pressing the right and left arrow keys will move the cursor to the next section of wireline. The length of the wireline is shown in a box below the diagram. To change any value, move the cursor to the section to be changed and press Enter. The cursor will jump to the box below the diagram, and you will be able to use the Up/ Down arrow to change the value. Once the desired value is selected push the return key to enter the value and return the cursor to the diagram.

To select another loop, press the PgUp / PgDn buttons. The DLS 200HE will automatically select the next loop. A total of 12 loops are provided by the DLS, these are the 8 standard ones plus reversed loops 3, 4, 6, and 7. Except loop 1 which is less than 10 Ω, all loops can be changed to fit the user's requirements.

Bridged taps are sections of wire that connect to, but are not part of the regular signal path of a two wire circuit. They are normally caused by the inadvertent connection of twisted pair to the circuit. On the DLS 200HE, bridged taps are displayed as vertical lines. If these sections are set to zero length, it is the same as having no bridged taps at that point.

When a loop is first selected, impairments settings remain as previously set. Do not assume that because a new loop is called up, all the impairments have been turned off. Note that the word ON in the IM box means that one or more impairments are active. To add impairments to the simulated loop, see section 5.

3.1.3 Selecting 3-Pair, 2-Pair and 1-pair Loops

The DLS 200HE simulates ETSI specified 3-Pair, 2-Pair and 1-pair loops. The loops can be selected by using the PgUp/PgDn keys or the user can go back to the loop selection menu by pressing Esc, selecting another loop and then pressing Enter.

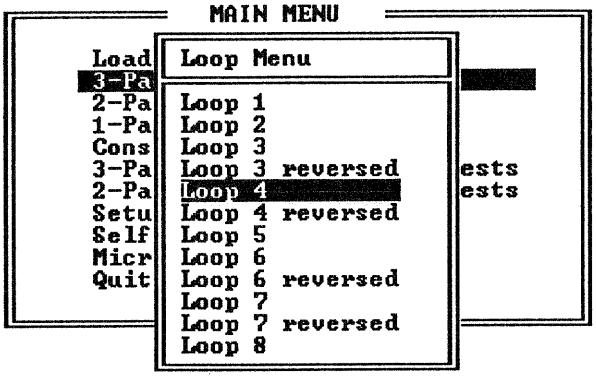


Fig. 3.5 3-Pair ETSI Loop Menu

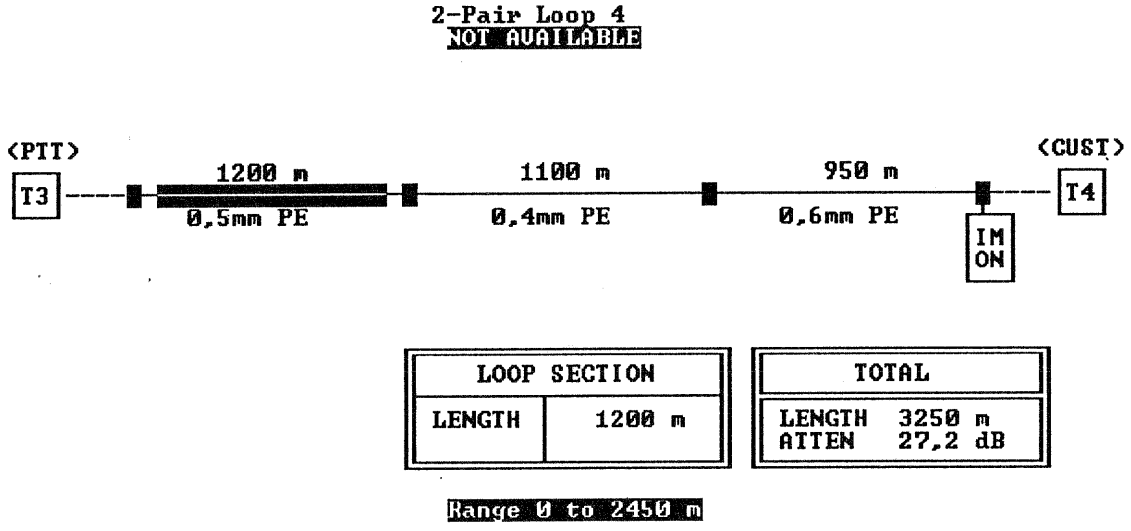


Fig. 3.6 Loop 4 of the ETSI 2-Pair Loop

3.1.4 Selecting a Consultronics Configuration

To select a basic two wire configuration, go to the main menu and move the cursor to the section Consultronics Loops and press Enter. A 2-wire configuration will be displayed which has several different gauges of cable connected together. The length of any section of this loop can be changed to build custom configurations. To change a length, follow the procedure outlined in the section for the standaed test loops. Figure 3.7 shows a basic two wire configuration.

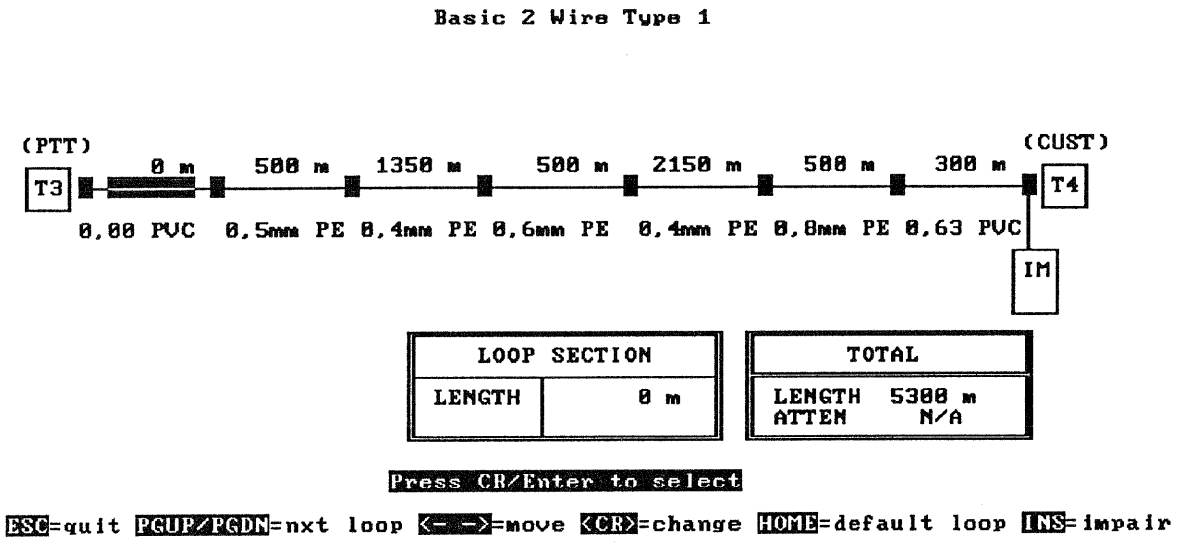


Fig. 3.7 A Basic Two Wire Configuration

To store a 2-wire configuration, see the section on Saving and Loading Configurations.

3.1.5 Performance Test

ETSI specifies a number of performance tests for users to do when measuring their equipment. The DLS 200HE allows the user to perform ETSI Shaped Noise, Impulse Noise, and Common Mode Insertion tests on Standard ETSI loops. The user can perform tests specified by ETSI or customize their own.

To run the Performance Tests, go to the main menu and select Performance Tests; press Enter and the test menu will appear. Select the one to be run and press Enter, a second test menu will be displayed.

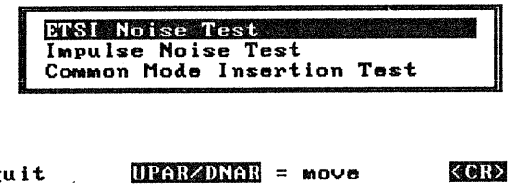


Fig. 3.8 Performance Test menu

ETSI Shaped Noise Test
12 standard tests are available for the user, with 3 additional tests for the user to customize. Each test specifies the loop to be tested with the noise level used. For tests l and m, all the loops listed in tests a to k are tested, with the one having the largest BER (Bit Error Rate) located.

To perform a test simply highlight the test and press Enter. To customize a test, move the cursor bar down to the last 3 items on the list, choose the one to be replaced and press the Ins key;

the user will be prompted to select the loop and the noise level. The test is then configured.

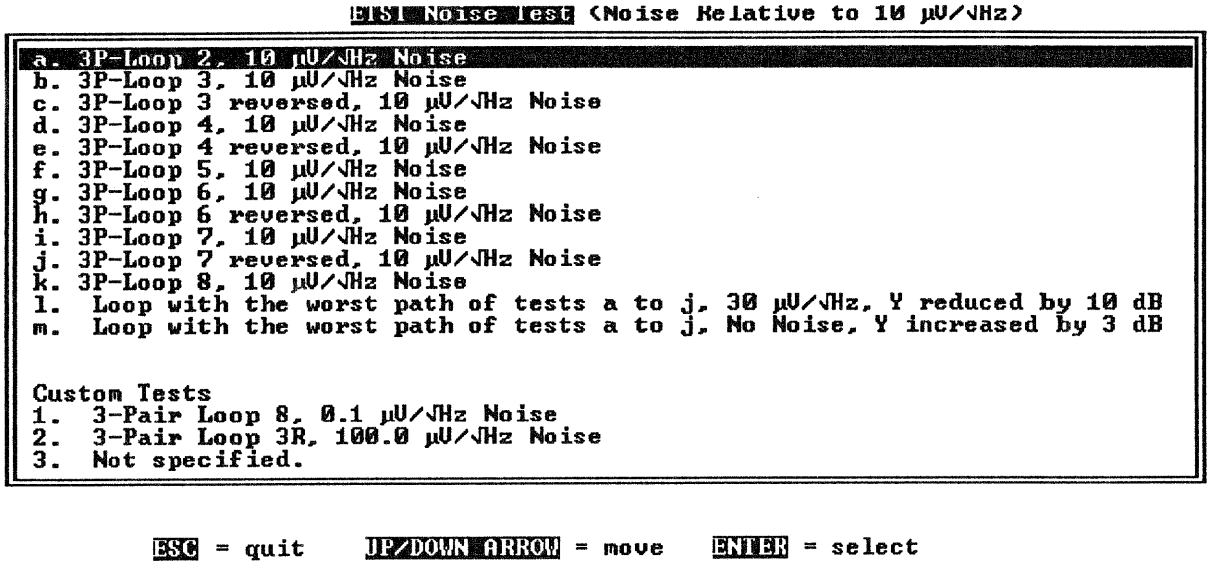


Fig. 3.9 ETSI, 3-Pair Shaped Noise Test menu

Impulse Noise Test

The Impulse Noise test has 3 standard tests available. Loop 2 is tested with cook pulse at 10 pulses per second for 3-Pair and 2-Pair Loops at 0, -6, and -12 dB. To customize tests the user can follow the same procedure as in ETSI-HDSL Shaped Noise, the user will be prompted for the loop, pulse rate and noise level. The test is run by pressing Enter on the selected test.

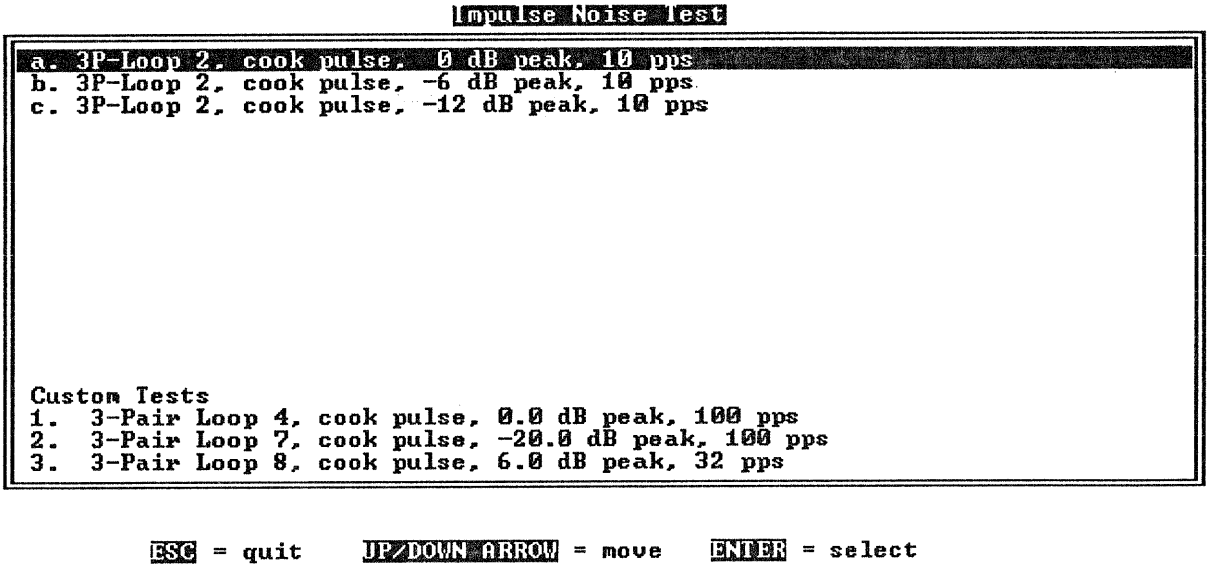


Fig. 3.10 Impulse Noise test menu

Common Mode Insertion Test

Specified by ETSI, the test uses loop 8 and couples in 15 Vrms of 50 Hz triangular wave from the Impairment Card. Standard loop 8 is the only loop with the common mode insertion circuit, therefore other loops cannot be customized for this test. When customizing, the signal is fixed and the user needs to enter only the noise level.

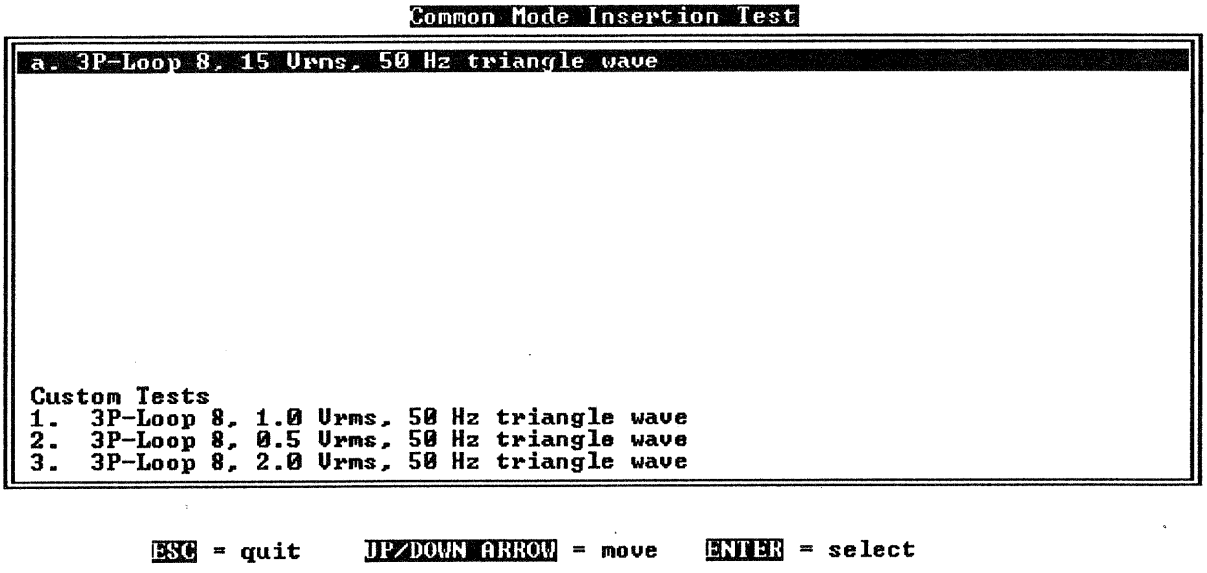


Fig. 3.11 Common Mode Insertion test menu

3.1.6 Micro-Interruption

For testing HDSL systems, ETSI specifies a micro-interrupt test. The micro-interruption hardware is on a card which may be installed in the DLS 200HE, in one of the 2 PC compatible slots. The software needed to run the card is contained within the DLS 200HE software, versions 1.70 and later.

It should be noted that version 1.70 software may not be completely compatible with some earlier versions of DLS 200HE units with revision 0 impairments cards. Subsequent versions of the software will overcome this. For now, if you have one of the earlier, incompatible, units, you should continue to use old software when running the DLS 200HE, and the version 1.70 software for running micro-interruption.

It is important to realize that the micro-interruption test and wireline (performance) testing are done at different times using different set-ups. PLEASE BE SURE TO DISCONNECT THE LOOP AND DEVICES-UNDER-TEST FROM CONNECTORS T3 AND T4 ON THE DLS 200HE WHEN RUNNING THE MICRO-INTERRUPTION TEST. Failure to do so will not damage the DLS 200HE, but incorrect results may occur. The reverse is not necessary: the micro-interruption card has been designed to carry a "straight through" path when not running the micro-interruption test. Below in figure 3.12, is a schematic representing the micro-interruption test circuit.

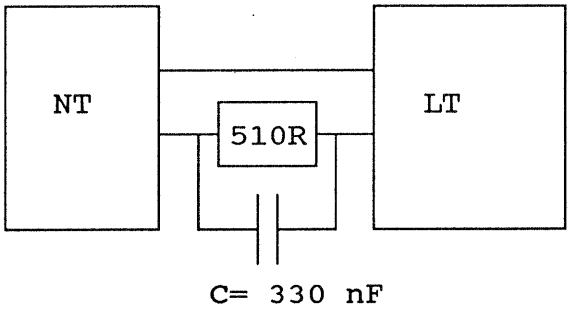


Fig. 3.12 Micro-Interruption Test Circuit

3.1.6.1 Connecting to the Micro-Interruption Card

If the micro-interruption card is not yet installed inside the DLS 200HE, refer to the micro-interruption card installation instruction. The micro-interruption card has two 8-way jacks on the back panel. This allows the use of 4-way, 6-way, or 8-way plugs. The centre 2 pins of each jack are used, and the others are not connected. The top jack is marked LT and the bottom jack is marked NT. The user must ensure that the "LT" jack is connected to the telephone exchange circuits, and the "NT" jack is connected to the user site equipment being tested. Figure 3.13 shows a micro-interruption card.

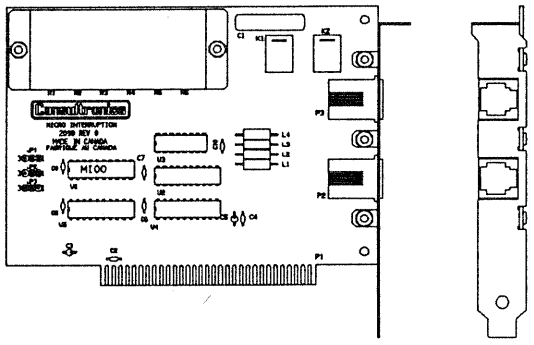


Fig. 3.13 Full View Of Micro-Interruption Card

3.1.6.2 Operation

Fig 3.14 shows the definition of the terms used by the Consultronics software.

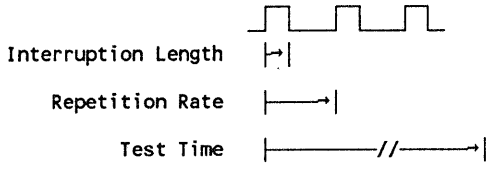


Fig. 3.14 Timing Diagram

The figure below shows how the user interface would be displayed.

MICRO-INTERRUPTIONS

TEST TIME	60 min
REPETITION RATE	1 sec
INTERRUPTION LENGTH	100 ms
START TEST	STOPPED

PLEASE DISCONNECT T3 & T4

Press CR/Enter to select

ESC = quit UP/DOWN ARROW = move (-> ENTER) = select

Fig. 3.15 Micro-Interruption Options

Test Time:
The "TEST_TIME" sets the time limit of the test. The range is from 0 to 60 minutes in 1 minute steps. A value of zero will set the test to run indefinitely.

Repetition Rate:
The "REPETITION RATE" sets the time between each interruption of the line. The range is from 1 to 120 seconds in 1 second steps.

Interruption Length:
This length sets the length of time of each interruption. The range is from 10 to 100 milliseconds in 1 ms steps.

Start Test:
The "Start Test" option starts the micro-interruption test until a key is pressed or the correct IEEE 488 device dependent command to stop the micro-interruption test has been received. See page 76 for details.

3.2 GENERAL OPERATION

3.2.1 Moving The Cursor

Operating the DLS 200HE can be accomplished through the keypad.

Left / Right arrow keys	highlight different sections of the wireline path. When a section is highlighted, it's corresponding setting is also displayed on the menu.
Up / Down arrow keys	when a section is selected, it's settings are displayed. These keys allow the operator to highlight the settings and make changes.
PgUp / PgDn keys	PgDn & PgUp allow you to scroll through the 8 standard test loops.
Enter / ESC keys	Enter changes or selects a setting, and Esc exits a menu when changes are done.
Home key	Resets a selected loop to its default settings.
Ins key	Displays the Impairments Menu and allows the user to configure the impairments.

To exit the DLS 200HE program and get into DOS, press Esc, and then move the cursor to the location marked QUIT, the program will terminate and operation will be returned to DOS. If an XT compatible keyboard is connected, extra functions of the DLS 200HE can be accessed since the instrument is a full featured PC.

Screen Saver

The DLS 200HE is designed with a screen saver to extend the life of the display. Screen blanking time can be varied by the user.

To change the screen blanking delay press Enter while the cursor is located on Set Up Screen. A menu will be displayed allowing the screen saver delay and the units used in displaying impairments to be changed. Highlight SCREENSAVE DELAY and press Enter, another menu will be shown. On this menu a value of 0 to 60 minutes can be entered; enter the time desired from the numeric keys and press Enter. Screen blanking will occur after the DLS is left idle for the preset time. After the screensaver takes effect a cursor will scroll across the screen. Any key pressed afterward will return the display to its setup screen.

After the screen saver delay time is entered, the user can return to the setup screen by pressing Esc.

The screensaver can be deactivated by entering zero delay time.

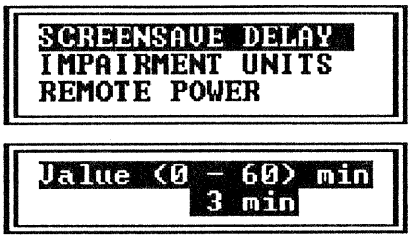


Fig 3.16 Screen Save Delay

Impairment Units

The DLS 200HE allows internal or external impairments to be injected into the bus to simulate real life conditions. When the Shaped Noise impairment is used (see Section 5.1), the levels can be displayed in volts or dBm, depending on the user's preference. The unit is changed through the Set Up Screen menu, following the similar method in setting up the screen saver. On the Set Up Screen menu, highlight IMPAIRMENT UNITS and press Enter, another menu will be shown. Select the unit desired and press Enter. The selected unit will be used for displaying impairments. Press Esc to return to the previous menu.

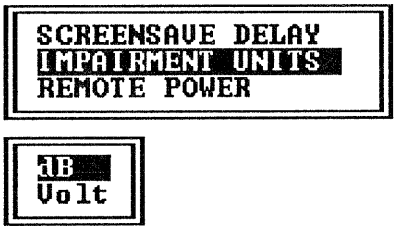


Fig 3.17 Impairments Units

Remote Power

The DLS 200HE can use two different methods of switching between loops. One is optimized for when the equipment under test supplies DC loop voltage and current. The other is best when there is no loop current flow. The user should select accordingly.

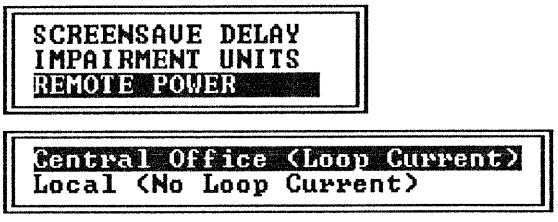


Fig. 3.18 Remote Power

3.2.2 Self Test

The DLS 200HE can perform self diagnostics to check the attenuation of its internal standard loops or loops selected by the user, the attenuation measured are indicated and pass/fail of the test is reported.

To perform a self check first access the main menu, highlight Self Test with the Up/Down arrows and press Enter. The Self Test menu will appear. Two tests can be performed: the Internal Test checks for the attenuation of each of the Standard Test Loops and the Line Attenuation Test checks the attenuation of the selected loop.

Internal Test:
To run the Internal Test, highlight the test and press Enter. Each of the loops will be polled and checked against the attenuation limits, a pass/fail indication will be shown for each loop.

Line Attenuation Test:
To run the Line Attenuation Test, first select the loop to be tested from the main menu, then go to the test menu and highlight the test and press Enter. The attenuation result will be shown with the loop configuration. Any loop being selected or edited can be tested.

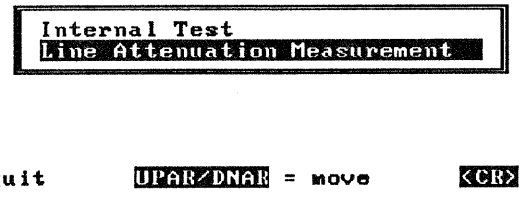


Fig. 3.19 Self Test Menu

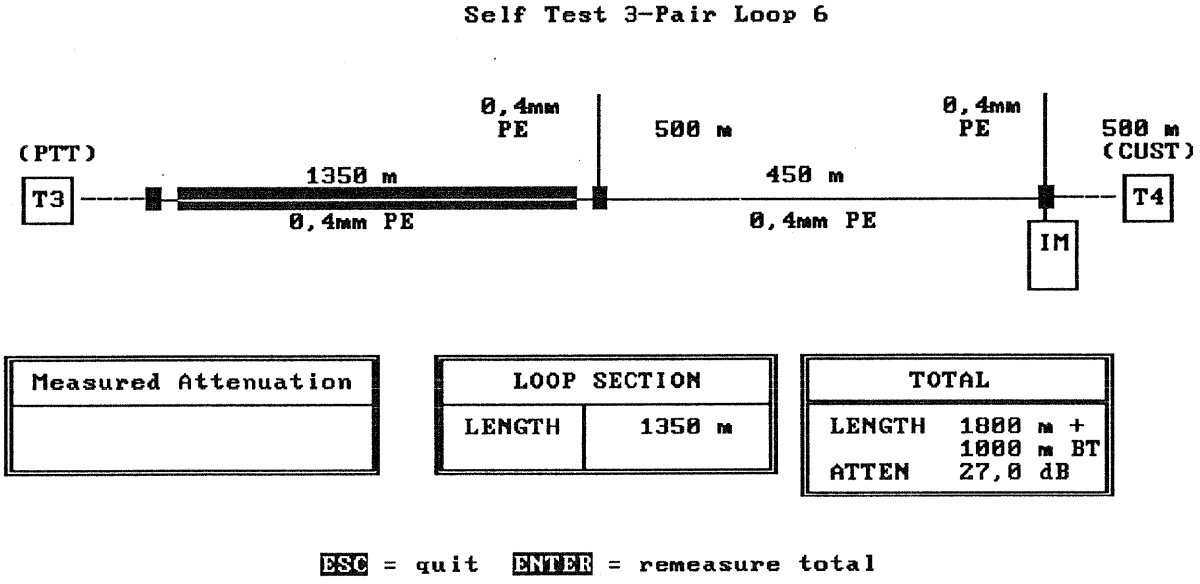


Fig. 3.20 Line Attenuation Test

Section 4 OPERATION OF THE BASIC RATE PROGRAM

In order to operate the DLS 200HE for basic rate, insert the basic rate software diskette and switch on the unit as outlined in section 1.3, Powering the Unit . The screen will then display the current configuration. Pressing the Esc key twice will display the menu shown below.

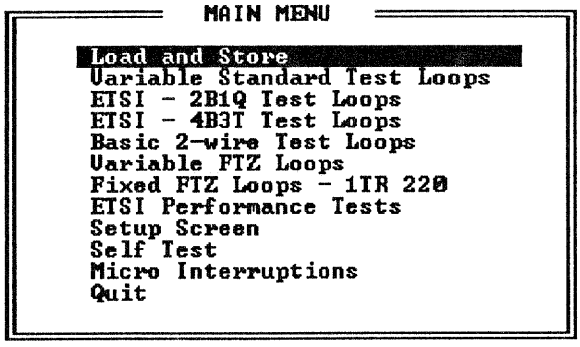


Fig. 4.1 DLS 200HE Main Menu Display

Main Menu
Presented on the main menu of the DLS 200HE upon power-up are a number of selections. To choose one of the selections, use the up and down arrows on the numeric keypad of the DLS 200HE, which is located to the right of the graphic display. Once the desired function is highlighted, press the Enter key to make that selection.

Load and Store
This selection is used to store and recall user created configurations. By pressing Enter when the cursor is on this selection, a sub-menu will appear showing the selection of the ETSI loop file to be recalled or written to. By pressing the PgUp key the file will be recalled, by pushing PgDn, the configuration will be stored. Note that there is a specific location for storing configurations for which a file name has not yet been created, this location is labelled "Save New File Here".

Variable Standard Test Loops
This selection will automatically load and the 8 standard test loops as defined by ETSI, the lengths can be varied by the user.

ETSI - 2B1Q Test Loops
This selection is similar to the 8 standard test loops except signal with the 2B1Q coding can be used.

ETSI - 4B3T Test Loops
This selection is similar to the 8 standard test loops except signal with the 4B3T coding can be used.

ETSI Performance Tests
Performs crosstalk, impulse noise, and common mode insertion tests on selected loops in the DLS.

Basic 2-Wire Test Loops
This selection will place the DLS 200HE into a two wire mode. The user can then set the distances and gauges of the various wirelines and bridged taps.

Fixed FTZ Loops - 1TR 220
This selection simulates the test loop of German Wirelines. It is available when the unit is fitted with German 0.4 mm and 0.6 mm cards instead of the ETSI Wireline cards. If the cards are not installed, this selection is for demonstration only.

Variable FTZ Loops
This selection allows the FTZ loops to be selected like the previous setting and the length to be varied by the user.

Set Up Screen
Used for setting the impairment units and the screensaver activation time.

Self Test
Performs attenuation measurement on the ETSI loops and the loop being configured.

Micro Interruptions
Used with the micro interruptions card at the back of the unit for a separate test.
NOTE: Disconnect the wirelines when doing this test!

Quit
Used to exit the main menu and go to a DOS prompt.

Note: For some selection, the message NOT AVAILABLE will appear on the top of the screen. In these cases, the unit is not fitted with the necessary hardware.

4.1 DETAILED OPERATION

4.1.1 Saving and Loading Configurations

During the set-up of any configuration pressing Esc and moving the cursor to the Load and Store position and pressing Enter, allows you to enter the Load and Store menu. The menu can be used for saving the current edited configuration or loading new configurations from disk.

Shown on the menu are functions of the keys and list of configurations. The following explains each of their functions:

Recalling Configurations:
Use the Up / Down arrows to highlight the configuration to be loaded and then press PgUp. The

disk drive LED will come on for a moment as the DLS 200HE loads the selected configuration from disk. After a few seconds, the selected configuration will be displayed.

Storing Configurations:
Edited configurations can be saved on disk as new configurations. To save an edited configuration, use the Up / Down arrows keys to get to the bottom of the list and highlight "Save New file here". Press PgDn and a line on the bottom of the screen will come up prompting for the new configuration's name. Use the Up/Down arrows to change characters, Left/Right arrows to move to adjacent spaces (or type in the name if an XT compatible keyboard is available). Press Enter when finished to accept the name. The configuration will be saved and listed on the menu.

Edited configuration can also be saved under one of the listed configurations. To do this simply highlight the configuration desired and press PgDn. A line will come up displaying the selected configuration name to be saved under. If no change is required, simply press Enter and the new configuration will overwrite the old one.

At anytime during saving a configuration, pressing Esc will cancel the operation.

Deleting Configurations:
To remove a configuration from memory simply highlight the configuration to be deleted. Press the Del key and the DLS will come up with a message asking for confirmation. Press Del again to confirm delete and the configuration will be removed from the disk. Press Esc will cancel deletion.

Resetting The DLS 200HE:
Press the Home key will display the message Press Home again to reset to power up values. Press Esc to abort. Press Home again will reset the unit to its default values.

Exit The Load and Store Menu:
Press Esc will exit the menu and return the operation back to bus editing.

Note: If a keyboard is available, it is always helpful to use it to load and save configurations, this will greatly speed up the process.

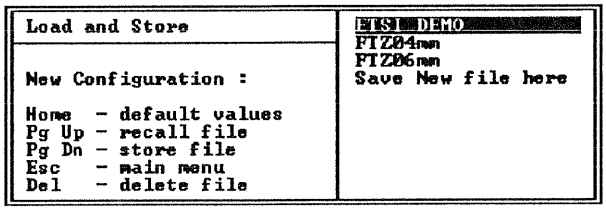


Fig. 4.2 Saving and Loading Configurations

4.1.2 Selecting One of the 8 Standard ETSI Test Loops

The DLS 200HE simulates the electrical characteristics of the wire loops as described by ETSI. When the unit is first powered-up, it automatically displays the last loop loaded or saved. With the Up/Down arrows, move the cursor to the Variable Test Loops section and press Enter, a Loop

Menu will come up listing all the test loops. Select the loop with the Up/Down arrows and again press Enter, the selected loop is displayed. If you are already in another menu, press Esc to return to the main menu, then select the Variable Test Loops. The previously selected test loop will be displayed. See Fig. 4.3.

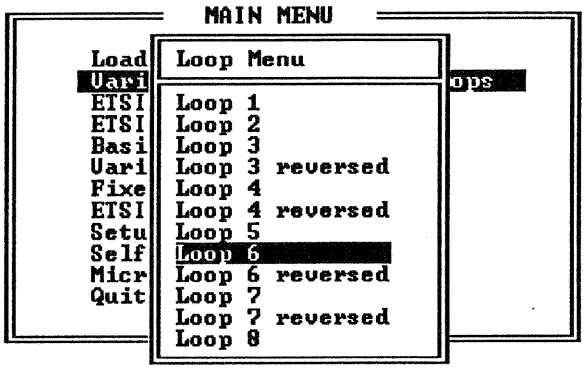


Fig. 4.3 ETSI Loop Menu

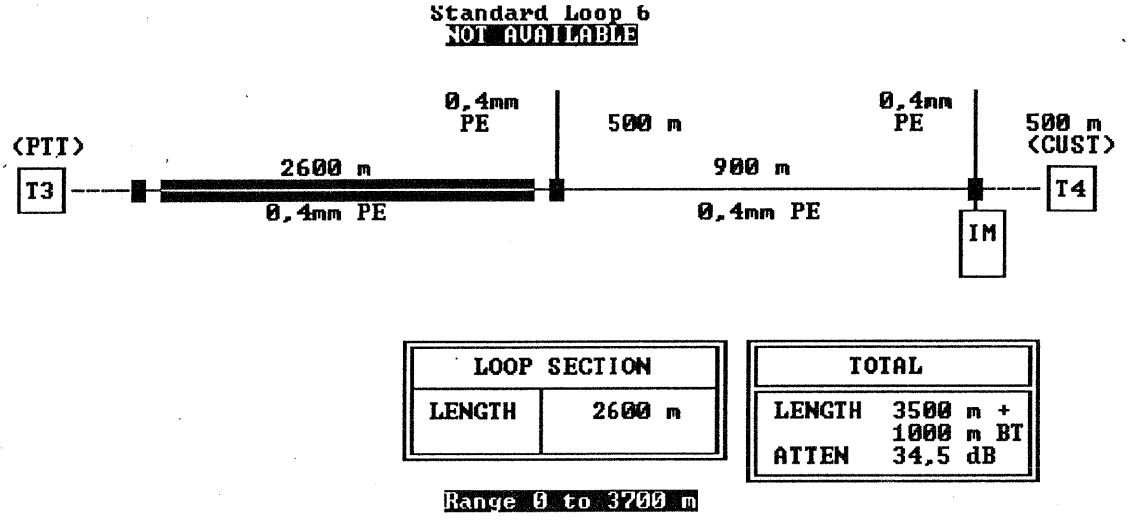


Fig. 4.4 Loop 6 of the 8 Standard Test Loops

The DLS 200HE is now displaying a schematic representation of its standard loop. Normally the PTT end of the loop is connected to T3. The NT, or customer end, is connected to T4 on the front or back of the DLS 200HE. The horizontal and verticle lines represent simulated wirelines and the box marked IM represents the impairments module.

A cursor is displayed on the first section of the wireline. Pressing the right and left arrow keys will move the cursor to the next section of wireline. The length of the wireline is shown in a box below the diagram. To change any value, move the cursor to the section to be changed and press Enter. The cursor will jump to the box below the diagram, and you will be able to use the UP/DOWN to change the value. Once the desired value is selected push the return key to enter

the value and return the cursor to the diagram.

To select another loop, press the PgUp / PgDn buttons. The DLS 200HE will automatically select the next loop. A total of 12 loops are provided by the DLS, these are the 8 standard ones plus reversed loops 3, 4, 6, and 7. Except for loop 1 which is less than 10 Ω, all loops can be changed to fit the user's requirements.

Bridged taps are sections of wire that connect to, but are not part of the regular signal path of a two wire circuit. They are normally caused by the inadvertent connection of twisted pair to the circuit. On the DLS 200HE, bridged taps are displayed as verticle lines. If these sections are set to zero length, it is the same as having no bridged taps at that point.

When a loop is first selected, impairments settings remain as previously set. Do not assume that because a new loop is called up, all the impairments have been turned off. Note that the word ON in the IM box means that one or more impairments are active. To add impairments to the simulated loop, see section 5, "Impairments".

NOTE 1 Units configured to simulate ETSI loops can also simulate the two 0.4mm FTZ Wirelines, but not the 0.6mm FTZ Wirelines. The DLS 200HE will still be able to display the FTZ Wirelines, but a NOT AVAILABLE indication will be shown on the top of the display to indicate to the user the loops are not installed.

To change from one unit to the other requires changing some wireline modules inside the DLS 200HE, the user can refer to Consultronics Ltd. for further information on modifying the DLS 200HE.

NOTE 2 Certain switching effects within the DLS 200HE increase the loop attenuation by about 0.8 dB. When Standard ETSI Test Loops are selected, the calculated lengths necessary for 36 dB attenuation are displayed, even though internally the lengths have been adjusted to compensate for the extra attenuation. When using the Variable Test Loops section, this extra attenuation will become more predominant as shorter lengths are selected.

4.1.3 Selecting the 2B1Q and 4B3T Fixed Loops

Besides the variable ETSI loops, the DLS 200HE simulates fixed loops for 2B1Q and 4B3T coding signals. For these loops, the line lengths are fixed and cannot be changed as in the variable loops. The loops are selected the same way, but to change to another loop the user cannot use the PgUp / PgDn keys. The user must go back to the loop selection menu by pressing Esc, select another loop, and press Enter. See Fig. 4.5.

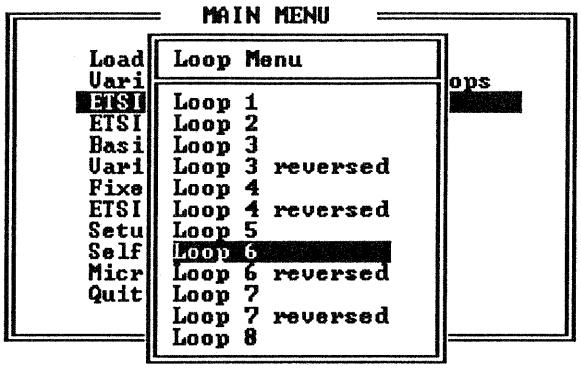


Fig. 4.5 ETSI Fixed Loop Menus

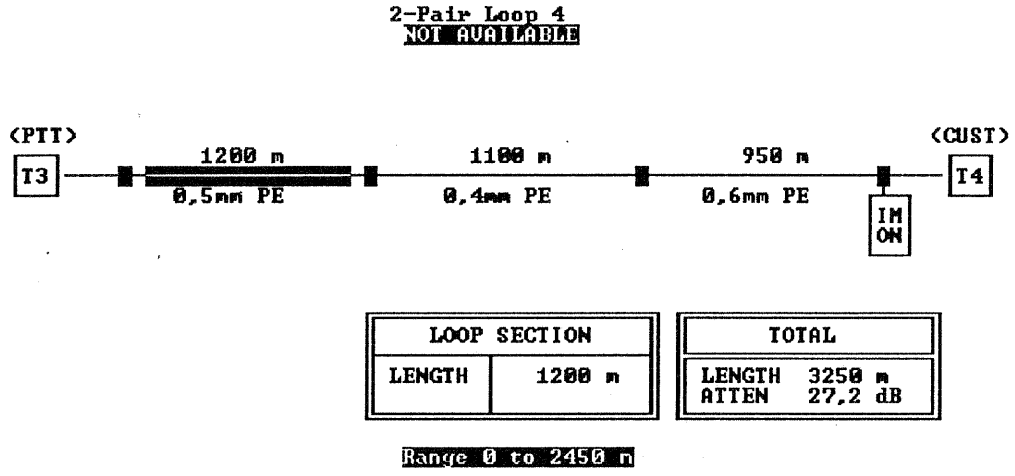


Fig. 4.6 Loop 4 of the ETSI 2B1Q Fixed Loop

4.1.4 Performance Test

ETSI specifies a number of performance tests for users to do when measuring their equipment. The DLS 200HE allows the user to perform ETSI Shaped Noise, Impulse Noise, and Common Mode Insertion tests on Standard ETSI loops. The user can perform tests specified by ETSI or customize their own. To perform these tests the Impairment Card has to be installed, the impairments used are the same as described in Section 5.

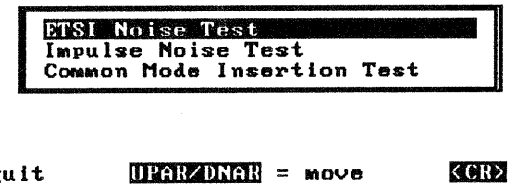


Fig. 4.7 Performance Test Menu

To run the Performance Tests, go to the main menu and select Performance Tests; press Enter and the test menu will appear. Select the one to be run and press Enter, a second test menu will be displayed.

NOTE: When exiting from the Performance Test, if longitudinal voltage has already been set, it will restore this voltage so do not attach any equipment sensitive to voltage at the outputs.

ETSI Shaped Noise Test

15 standard tests are available for the user, with 3 additional tests for the user to customize. Each test specifies the loop to be tested with the noise level used. For tests k, m, and o, all the loops listed in tests a to i, l, and n are tested, with the one having the largest BER (Bit Error Rate) located. For test p, the length is gradually increased in 200 m steps as the test is performed, up to the maximum loop length.

To perform a test simply highlight the test and press Enter. To customize a test, move the cursor bar down to last 3 items on the list, choose the one to be replaced and press the Ins key; the user will be prompted to select the loop and the noise level. The test is then configured.

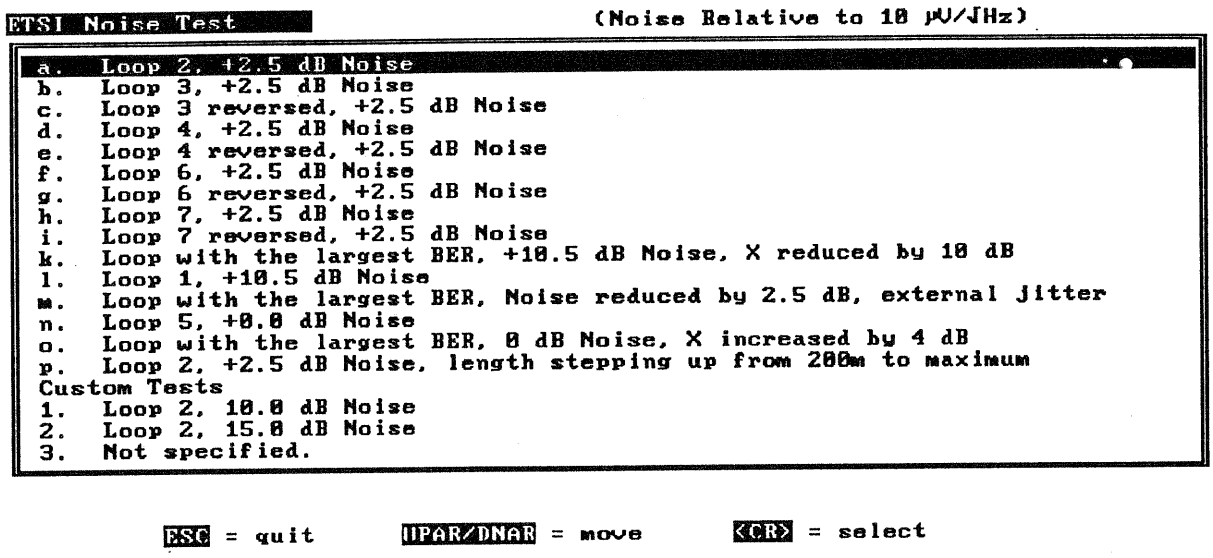


Fig. 4.8 ETSI Shaped Noise Test menu

Impulse Noise Test

The Impulse Noise test has one standard test available. Loop 2 is tested with the 50 μsec. bipolar pulse at 2 pulses per second. To customize tests the user can follow the same procedure as in Crosstalk, the user will be prompted for the loop, pulse rate and noise level. The test is run by pressing Enter on the selected test.

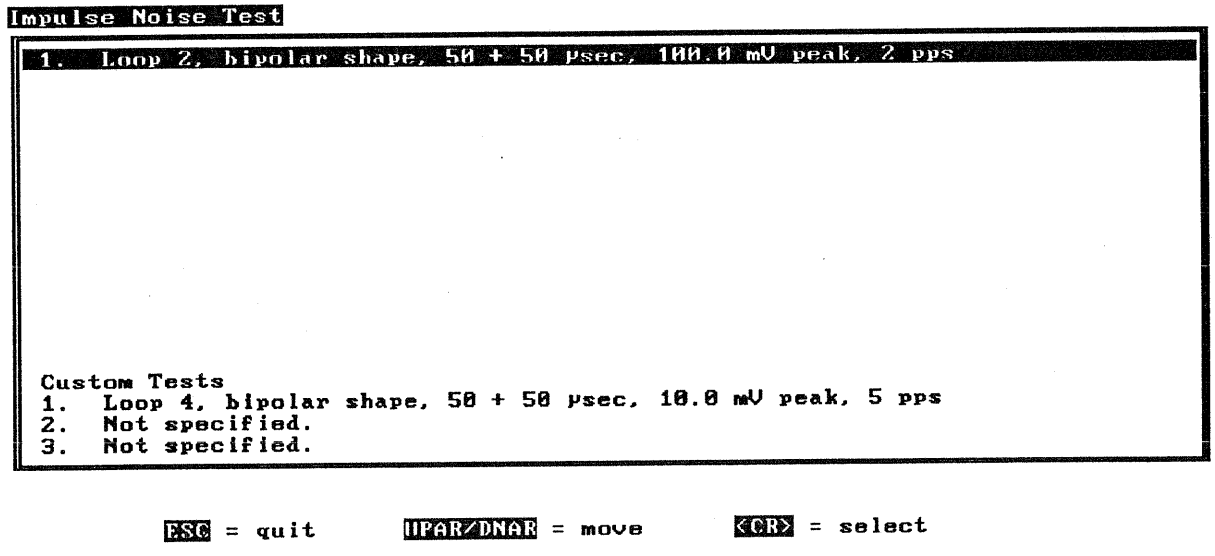


Fig. 4.9 Impulse Noise test menu

Common Mode Insertion Test

Specified by ETSI, the test uses loop 8 and couples in 15 Vrms of 50 Hz triangular wave from the Impairment Card. Standard loop 8 is the only loop with the common mode insertion circuit,

therefore other loops cannot be customized for this test. When customizing, the signal is fixed and the user needs to enter only the noise level.

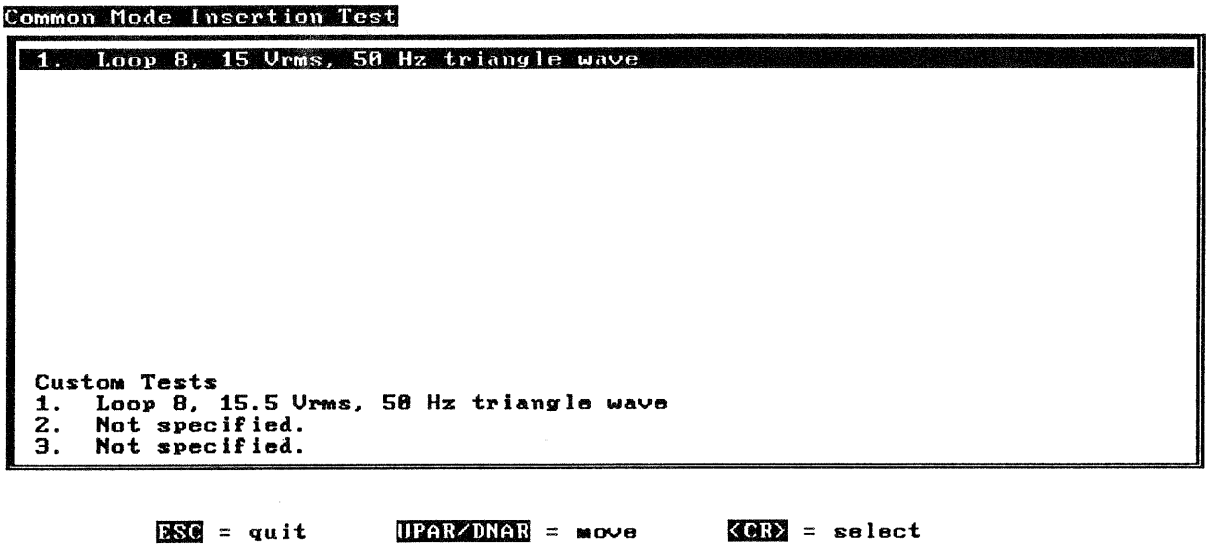


Fig. 4.10 Common Mode Insertion test menu

Custom Loop

To modify a custom loop:

- Move the cursor down to the Custom Tests section.
- Press the Insert key.
- Select using the Up/Down arrow key to select a loop with the Enter key.
- Enter an impairment level with the numeric key or with the UP/Down arrow key and press Enter to select.

To select a custom loop:

- Use the Up/Down arrow key to highlight a custom loop you want to select.
- Press enter to select the loop.

4.1.5 Selecting a Basic 2-wire Configuration

To select a basic two wire configuration, go to the main menu and move the cursor to the section Basic 2 Wire Test Loops and press Enter. A 2-wire configuration will be displayed which has length of 100 m of 0.4mm PVC line. Custom configurations can be built by moving the cursor to each section that need to be changed. To change a length, follow the same procedure as is outlined in the section for the standard test loops. Figure 4.11 shows a basic two wire configuration.

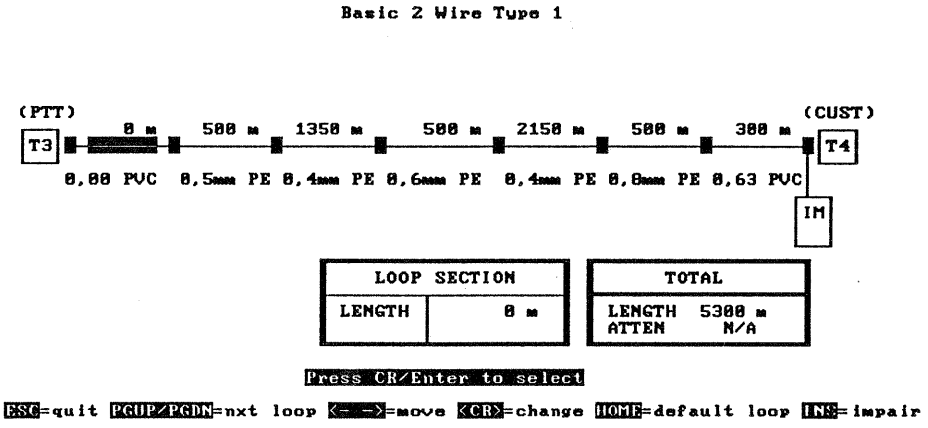


Figure 4.11 A Basic Two Wire Configuration

To store a 2-wire configuration, see the section on Saving and Loading Configurations.

4.1.6 Selecting the FTZ Loops

Units installed with the FTZ cards can simulate electrical characteristics of four FTZ loop configurations. To select the FTZ loop, go to the main menu and move the cursor to the section Fixed FTZ Loops - 1TR 220 and press Enter, an FTZ Loop Menu will come up listing four selections. Select the loop with the Up/Down arrows and again press Enter, the selected loop will be displayed as in Fig. 4.12. On this menu the lengths of the FTZ loops are fixed and cannot be changed. To change the lengths of the FTZ loops, see next section on Variable FTZ loops.

To select another loop, exit the selected loop and return to the FTZ Loop Menu by pressing Esc. Follow the same procedure as before, select the loop desired by the Up/Down arrows and Enter keys.

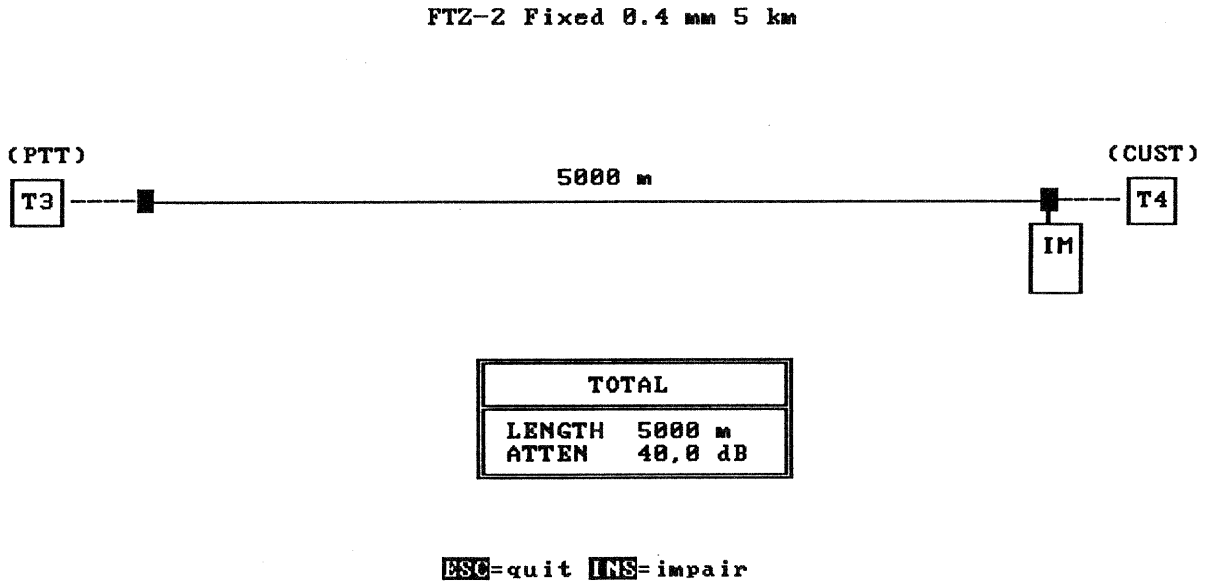


Fig. 4.12 FTZ Loop Menu

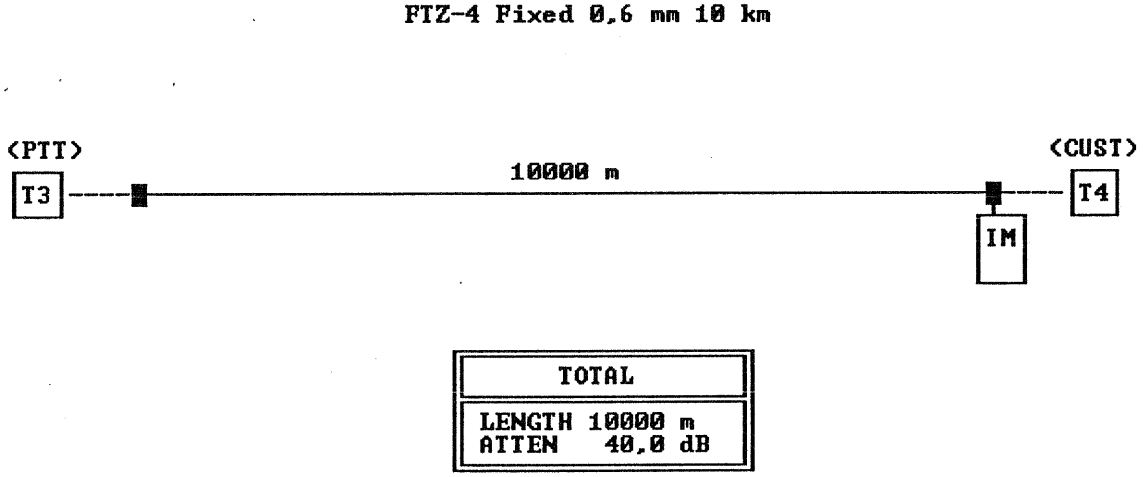


Fig. 4.13 0.6mm FTZ Loop

Note: Units configured to simulate FTZ loops will not be able to simulate ETSI Wirelines. A NOT AVAILABLE indication will be shown on the top of the main menu to indicate to the user the loops are not installed.

To change from one unit to the other requires changing some wireline modules inside the DLS 200HE, the user can refer to Consultronics Ltd. for further information on modifying the DLS 200.

4.1.7 Configuring the Variable FTZ Loops

The Variable FTZ Loops allow custom configurations to be built, just as in the Variable Standard Test Loops. Selecting the loops is similar to the fixed FTZ Loops (see previous section), which is done by first selecting Variable FTZ Loops on the main menu and then press Enter. Follow the same procedures in the fixed FTZ loops, the desired loop will be displayed (Fig. 4.14).

Custom configuration can be built on these loops by changing the lengths. The length of the wireline is shown in a box below the diagram. To change any value, move the cursor to the section to be changed and press Enter. The cursor will jump to the box below the diagram, and you will be able to use the Up/Down arrow to change the value. Once the desired value is selected push the return key to enter the value and return the cursor to the diagram.
The variable FTZ loops come with two options. Units installed with five 0.6mm wireline cards allow a simulated length beyond 10 km; with only four 0.6mm wireline installed, the wireline length will not go beyond 10 km and attenuation will be limited to below 40 dB.

On these loops, the user can also use the PgUp / PgDn keys to select the next FTZ loop.
To store the edited configuration, see Section 4.1.1 - Load and Store.

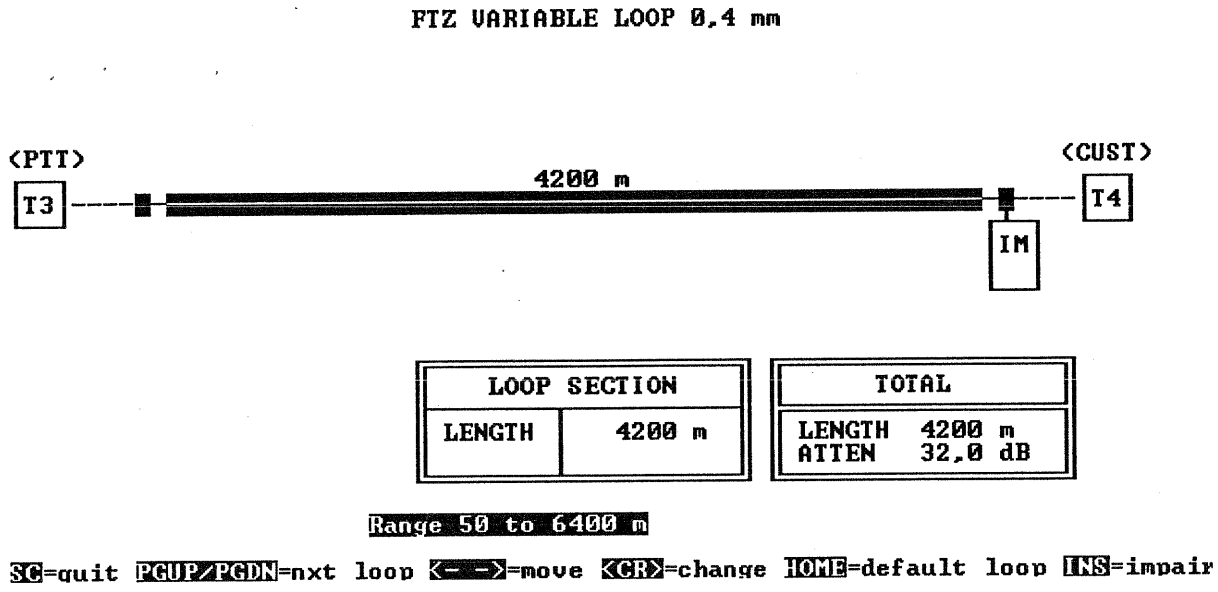


Fig. 4.14 Configuring the 0.4mm FTZ Loop

4.2 GENERAL OPERATION

4.2.1 Moving The Cursor

Operating the DLS 200HE can be accomplished through the keypad.

Left / Right arrow keys	highlight different sections of the wireline path. When a section is highlighted, it's corresponding setting is also displayed on the menu.
Up / Down arrow keys	when a section is selected, it's settings are displayed. These keys allow the operator to highlight the settings and make changes.
PgUp / PgDn keys	PgDn & PgUp allow you to scroll through the 8 standard test loops.
Enter / ESC keys	Enter changes or selects a setting, and Esc exits a menu when changes are done.
Home key	Resets a selected loop to its default settings.
Ins key	Displays the Impairments Menu and allows the user to configure the impairments.

To exit the DLS 200HE program and get into DOS, press Esc, and then move the cursor to the location marked QUIT. The program will terminate and operation will be returned to DOS. If an XT compatible keyboard is connected, extra functions of the DLS 200HE can be accessed since the instrument is a full featured PC.

Screen Saver

The DLS 200HE is designed with a screen saver to extend the life of the display. Screen blanking time can be varied by the user.

To change the screen blanking delay press Enter while the cursor is located on Set Up Screen. A menu will be displayed allowing the screen saver delay and the units used in displaying impairments to be changed. Highlight SCREENSAVE DELAY and press Enter, another menu will be shown. On this menu a value of 0 to 60 minutes can be entered; enter the time desired from the numeric keys and press Enter. Screen blanking will occur after the DLS is left idle for the preset time. After the screensaver takes effect a cursor will scroll across the screen. Any key pressed afterward will return the display to its setup screen.

After the screen saver delay time is entered, the user can return to the setup screen by pressing Esc.

The screensaver can be deactivated by entering zero delay time.

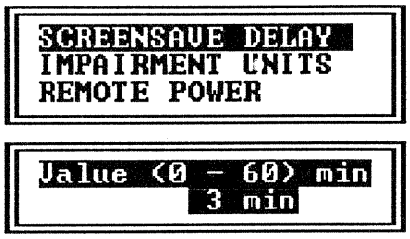


Fig. 4.15 Screen Save Delay

Impairment Units

The DLS 200HE allows internal or external impairments to be injected into the bus to simulate real life conditions. When a Crosstalk or Shaped Noise impairment is used (see Section 5.1), the level can be displayed in volts or dBm, depending on the user's preference. The unit is changed through the Set Up Screen menu, following the similar method in setting up the screen saver. On the Set Up Screen menu, highlight IMPAIRMENT UNITS and press Enter, another menu will be shown. Select the unit desired and press Enter, the selected unit will be used for displaying impairments. Press Esc to return to the previous menu.

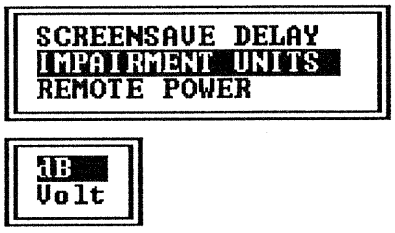


Fig. 4.16 Impairments Units

Remote Power

The DLS 200HE can use two different methods of switching between loops. One is optimized for when the equipment under test supplies DC loop voltage and current. The other is best when there is no loop current flow. The user should select accordingly.

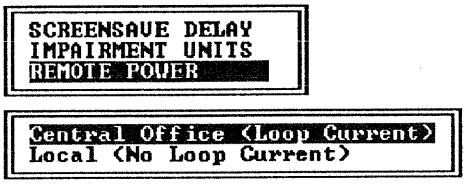


Fig. 4.17 Remote Power

4.2.2 Self Test

The DLS 200HE can perform self diagnostics to check the attenuation of its internal standard loops or loops selected by the user, the attenuation measured are indicated and pass/fail of the

test is reported.

To perform a self check first access the main menu, highlight Self Test with the Up/Down arrows and press Enter, the Self Test menu will appear. Two tests can be performed: the Internal Test checks for the attenuation of each of the Standard Test Loops and the Line Attenuation Test checks the attenuation of the selected loop.

Internal Test:
To run the Internal Test, highlight the test and press Enter. Each of the loops will be polled and checked against the attenuation limits, a pass/fail indication will be shown for each loop.

Line Attenuation Test:
To run the Line Attenuation Test, first select the loop to be tested from the main menu, then go to the test menu and highlight the test and press Enter. The attenuation result will be shown with the loop configuration. Any loop being selected or edited can be tested.

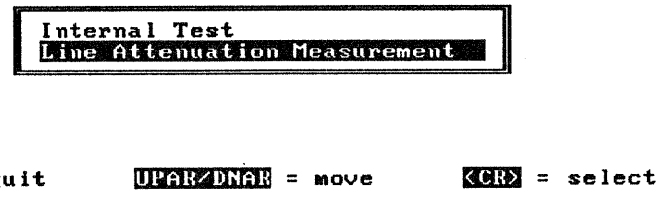


Fig. 4.18 Self Test Menu

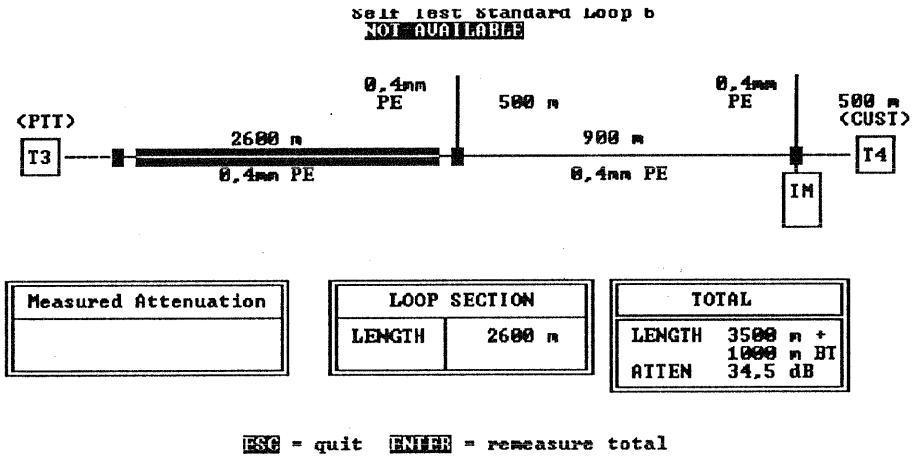


Fig. 4.19 Line Attenuation Test

Section 5 IMPAIRMENTS

An impairments card can inject metallic (differential mode) impairments onto the wireline path at T4. It can also inject common mode impairments in the middle of the wireline path for loop 8. The current version, called an HE impairments card, provides impairments for both Basic Rate and HDSL rates, as specified in ETSI documents ETR 080 and DTR/TM 3017 respectively. The previous version of impairment card provided Basic Rate impairments only. In addition to the impairments specified in the above documents, either card can also provide some single frequency and dual frequency impairments at low frequencies. The ETSI impairments card can also provide a North American "NEXT" spectrum.

Note that the impairments are injected only onto terminal T4, even when the loop is reversed. The transceiver that you want to test in the presence of noise should be at T4.

There are three types of software used to control DLS 200HE's, and as mentioned above, two types of impairment cards. These must be used in the right combinations. Even though 2 **types** of impairments cards exist, only one impairment card can go in a DLS 200HE or DLS 200E.:

To test HDSL equipment, you need an HE impairments card and the software diskette called "DLS 200HE Software, HDSL-ETSI"

To test Basic Rate, if you have an HE Impairments module use the diskette called "DLS 200E Software, Basic Rate" , or if you have the original ETSI impairments card, use the "DLS 200 (ETSI) Software" diskette.

A simple way to tell if the equipment has a ETSI impairments card or an HE impairments card is to look at the back of the DLS 200HE. If there is one BNC connector coming out of the noise card slot at the back, it is an HE card. If there are 3 then it is an ETSI card.

This diagram shows part of the normal front panel display. The presence of an impairments

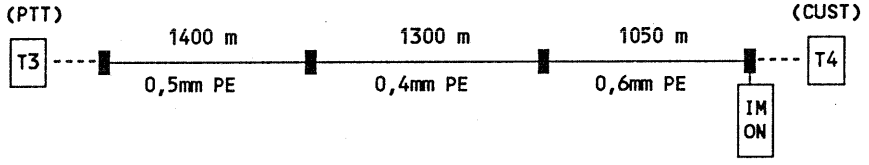


Fig 5.1 Active Impairments Box

card is shown by the box marked IM at T4. The line ON underneath indicates that one or more impairments are active. If all impairments are turned off, the ON is removed, and the impairments card is disconnected from the line by a relay.
To set or modify impairments, press the INS key while displaying any loop. A menu will be revealed indicating the impairments the user can inject.

The DLS 200HE can inject these groups of impairments:

(A) Shaped Noise
(B) Impulse Noise
(D) Powerline Noise
(E) Longitudinal Noise
(F) (On the original impairments card only) NEXT

On this menu, use the Left/Right arrow keys to move between columns, and the Up/Down arrows to move between rows and to change settings.

First Column from the left:
The left column indicates that this screen concerns impairments, and has a space underneath.

Second Column From the Left:
This column indicates if an impairment is on or not active.

Third Column:
Shows the groups of impairments currently available.

Fourth Column:
The far right column shows the type, value(s), and attributes of impairments currently selected.

Set Or Change An Impairment:

(1) Use the arrow keys to go to the third column and select the correct group of impairments. Press Enter or use the Right arrow to go to the fourth column.

(3) Then use the Up/Down arrow keys if necessary to select the correct type, level, or attribute to be set. Press Enter. This either toggles the field to be changed, or highlights a portion of the field.

(a) If it toggles the field, keep on pressing Enter to get to the correct selection. When the selection is correct, use the arrow keys to continue.

(b) If it highlights a portion of the field, you can change the field, either by using the Up/Down arrow keys, or by pressing NUMLOCK and typing in a value. When the field is correct, press Enter to confirm the value. The highlight reverts back to cover the whole field. Use the arrow keys to continue.

After you have finished changing one impairment, press the Left arrow to go back to the third column. When all editing is done, press Esc to exit from the menu.

Only one impairment card can fit inside a DLS 200HE. Section 5.1 describes the HE Impairments card. Section 5.2 describes the older ETSI Impairments card, which generates basic rate impairments only. Section 5.3 outlines the differences between the 2 types. of cards.

5.1 USING THE HE IMPAIRMENTS CARD

Shaped (ETSI/FTZ) Noises

The diagram below shows the impairments menu. This particular setting shows that from the "Shaped" group of impairments, impairment type ETSI-HDSL has been selected at reference level. As shown, the level of this impairment can be changed in dB's. If preferred, the display can show, and be changed, in $\mu v/\sqrt{Hz}$ rather than dB. This is selected from the, setup screen of the main menu as described elsewhere. Reference level is 10 $\mu v/\sqrt{Hz}$.

Impairments			
	ON	SHAPED NOISE ==>	TYPE ETSI-HDSL
	OFF	IMPULSE NOISE	REF LEVEL + 0.0 dB
	OFF	POWERLINE NOISE	

OUT OF RANGE TURNS OFF SETTING
Ref -40.0 to Ref +20.0 dB

Fig. 5.2 Shaped Noise Impairments Menu

The "OFF" in the second column next to Impulse Noise and Powerline Noise indicates that no impairments from either of these two groups are active. The two other types of noise in the ETSI/FTZ noise group are called FTZ 1TR200 and ETSI Shaped. Note that "ETSI Shaped" noise is the BASIC RATE noise up to 300 kHz. The HDSL type of shaped noise has been called ETSI-HDSL. There is more on this, with diagrams, in section 10.2 .

Impulse Noise

The next diagram shows that cook pulse has been selected from the "IMPULSE NOISE" group of impairments. The level selected is 318 mV, which is the 0 dB level for cook pulses, and the rate is 10 pulses per second. In order to get the level in mV rather than dB, the user has selected the units of display to be volts rather than dB's.

Impairments			
	ON	SHAPED NOISE	RATE 10 pps
	ON	IMPULSE NOISE ==>	LEVEL 318.0 mV
COOK PULSE	OFF	POWERLINE NOISE	TYPE: COOK PULSE

OUT OF RANGE TURNS OFF SETTING
Range 32.0 to 634.0 mV

Fig. 5.3 Impulse Impairments Menu

Notice that the "ON" in the second column indicates that one of the ETSI/FTZ group of noises has also been set.

Other types of impulses available from the Impulse Noise group are Three Level, Bipolar, UniPolar + and UniPolar-. Their shapes are:

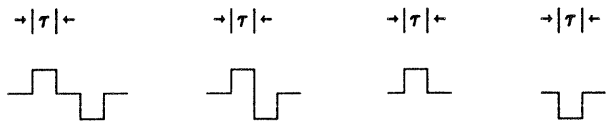


Fig 5.4 Impulse Shapes

Each positive or negative going pulse width τ can be set anywhere from 20 to 255 μsec in 1 μsec steps. In the case of the 3-level shape, this time is also the length of the zero time in the middle.

The repetition rate, level and width of these pulses can all be changed if required.

The next diagram shows common mode (longitudinal) voltage of 15 V rms at 50 Hz is being applied. This diagram comes up only for loop 8. Otherwise, longitudinal voltage is not available.

Impairments			
	ON	SHAPED NOISE	LEVEL 15.0 Vrms
	ON	IMPULSE NOISE	FREQUENCY 50 Hz
	OFF	POWERLINE NOISE	
	ON	COMMON MODE NOISE ==>	

OUT OF RANGE TURNS OFF SETTING
Range 0.0 to 20.0 Vrms

Fig 5.5 Common Mode Impairments Menu

Here, too, one can see that as well as the Common Mode Noise, an Impulse and an ETSI/FTZ noise is also being applied to the loop.

The Powerline Noise group is not specified by ETSI. This group enables low level SINGLE frequency tone or dual frequency tones (called ANSI) to be generated. As shown in the diagram below, a single sine wave at 980 Hz is being applied to the loop. No other impairments are present. The level can be set from -40.0 to -100.0 dBm. Entering a value of 0 or any other value entered beyond the above limits turns off the impairment.

Impairments			
	OFF	SHAPED NOISE	TYPE SINGLE
	OFF	IMPULSE NOISE	LEVEL -60.0 dBm
	ON	POWERLINE NOISE ==>	FREQUENCY 980 Hz
	OFF	COMMON MODE NOISE	

OUT OF RANGE TURNS OFF SETTING
Range 50 to 20000 Hz

Fig 5.6 Powerline Noise Impairments Menu

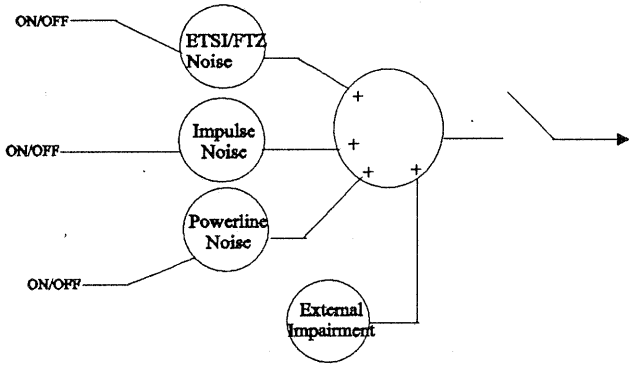
When ANSI is selected, two harmonically related sinewaves are generated. The level can be set from 9 to -15 dB relative to the ANSI specified levels in 0.1 dB steps.

Input of an External Impairment

Each HE impairment card has a BNC connector at the back. This can be used to inject an externally generated noise onto the line. The BNC connector provides a 50 Ohm impedance to ground. Signals input here are conditioned and applied in a balanced manner to the loop. The levels are arranged so that a -40 dBm signal relative to 50 Ohms applied to the connector is impressed on the loop, balanced, at -40 dBm relative to 135 Ohms. The frequency range is 0.1 to 1500 kHz, and the maximum level is approximately -20 dBm. If you have a 75 Ohm source rather than a 50 Ohm source, you need to apply approximately 0.18 dB higher level to get the same output, so to get -40 dBm at the loop, you need -39.82 dBm from a 75 Ohm generator.

Enabling/Disabling External Impairment

In order to inject an externally generated signal onto a line, one of the internal impairment types must be turned on. Turning on one of the impairment types, closes a relay inside the DLS 200. This relay connects the output of the impairment card to the simulated line. It is only once this relay is closed, that the external impairment can be applied to the line:



Note: If you wish to test with only external impairment, the best option is to turn on Powerline Noise at a low level, as this will have the least effect on your tests. For example, Powerline Noise set at -15.0 dB is so minute that it will probably not have an effect on modems.

5.2 USING THE ETSI IMPAIRMENTS CARD

ETSI and FTZ Specification for Impulse Noise Spectrum

Shaped according to ETSI and FTZ recommendations, the level can be set from 0.1 to 100.0 μV/$\sqrt{}$Hz. Or, if you have chosen a dB scale, from -15 to +9 relative to reference level. Reference level is 10 μV/$\sqrt{}$Hz at 100 kHz. Entering a value of 0 μV/$\sqrt{}$Hz or any other value outside the limits turns off the impairment.

ON	ETSI / FTZ NOISE ==>	TYPE ETSI Shaped
OFF	IMPULSE NOISE	REF LEVEL +10.0 dB
OFF	CROSSTALK NOISE	
OFF	POWERLINE NOISE	
OFF	EXTERNAL	

Fig. 5.7 Shaped Noise Impairments Menu

Impulse Noise

The rate sets the pulse-per-second rate from 0 to 100 pps. Single shot appears when the rate is set to 0 pps. Press Enter on Single shot will cause the selected pulse to be sent. The level can be set from 0.1 to 100.0 mV peak. Entering a value of 0 or any other out of range value turns off the impulses.

OFF	ETSI / FTZ NOISE	RATE 20 pps
ON	IMPULSE NOISE ==>	LEVEL 20.0 mV
OFF	CROSSTALK NOISE	SHAPE 3-LEVEL
OFF	POWERLINE NOISE	TIME τ 20 μsec
OFF	EXTERNAL	

Fig 5.8 Impulse Noise Impairments Menu

The shape can be any of these four:

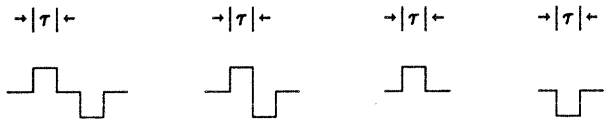


Fig. 5.9 Impulse Shapes

Each positive or negative going pulse width τ can be set anywhere from 20 to 120 μsec in 2 μsec steps. In the case of the 3-level shape, this time is also the length of the zero time in the middle.

Powerline Noise

Two types of powerline noise are available: SINGLE and ANSI.

When SINGLE is selected, a single sinewave is generated. The level can be set from -40.0 to -100.0 dBm. Entering a value of 0 or any other value entered beyond the above limits will cause the impairment to be turned off. The tone frequency can be set from 0 to 1 kHz.

When ANSI is selected, two harmonically related sinewaves are generated. The level can be set from 9 to -15 dB relative to the ANSI specified levels in 0.1 dB steps.

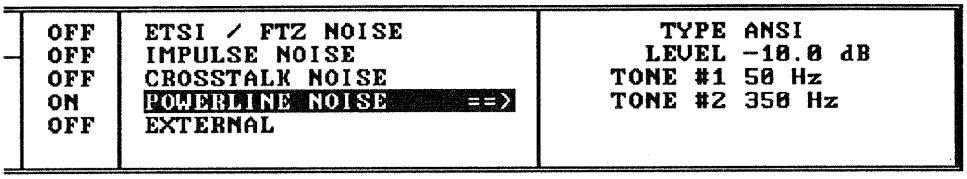


Fig 5.10 Powerline Noise Impairments Menu

Crosstalk Noise

There are 3 types of noise under this heading:

(1) ANSI FULL BW is crosstalk noise as to ANSI specification T1.601, up to 500 kHz.
(2) ANSI 320 kHz is crosstalk noise as to ANSI specification T1.601, up to 320 kHz.
(3) FLAT is white noise from 100 kHz to 500 kHz.

For the ANSI noises, the level can be set relative to ANSI level. This is defined as -44.2 dBm in a bandwidth up to 320 kHz. The white noise level can be set from 0.1 to 100 $\mu v/\sqrt{Hz}$. If you have set up for dBm instead of volts, the range is -71.3 to -131.0 dBm/Hz. Entering a value of 0 or a value beyond the above limits will turn off the impairment.

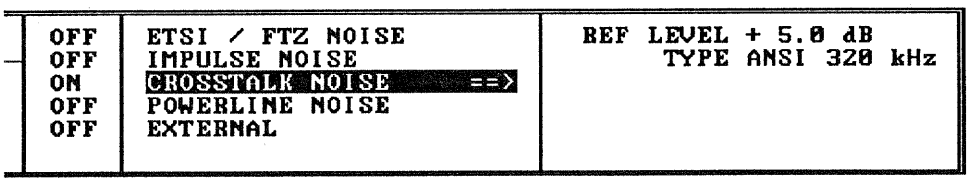


Fig. 5.11 Crosstalk Noise Impairments Menu

External Impairment

When External Input is set to External Signal, the analog signal can be applied. External Filtered Crosstalk Noise is intended for those who want to use the crosstalk noise signal from BNC 1 (the top BNC) on the back of the DLS 200HE, filter it into external circuits as required, and re-inject the signal into BNC 2 (the middle BNC), at the back of the DLS 200HE. On the External Hit Trigger setting, an impulse generator can be connected. When in External Off, no impairments will be taken from the BNC connectors.

been increased to 20000 Hz from 2000 Hz.

The older ETSI impairments card provides Crosstalk Noise and also allows the user more choices for externally generating and modifying noise via 3 BNC connectors.

It can be distinguished from the HE impairments card at the back of the DLS 200HE by the three BNC connectors. The HE impairments card has only one BNC connector.

5.4 BACKGROUND INFORMATION ON IMPAIRMENTS

(1) Most impairments are injected on the line in metallic (differential) mode. All impairments except for the special Longitudinal (common) mode are applied between the two wires carrying the signals under test.

(2) Metallic noise is injected onto the simulated line from a high impedance source of 4.05 kOhms. Sometimes this is called a current source . It means that the generator has very little effect on signals travelling on the simulated wireline. It also means that if you measure the level of the signals coming from the DLS 200HE impairments card, the level you measure depends on the impedance of the load that you use.

(3) The circuit for injecting differential mode impairments is shown here:

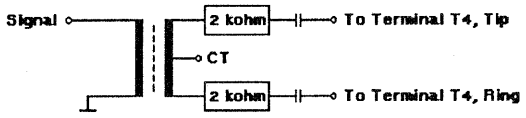


Fig. 5.13 Differential Mode Injection

(4) When setting up the system, many people want to completely disconnect an impairments generator from the loop. This is done automatically with a relay when all impairments from that generator are switched off. You can check this on the screen of the DLS 200HE. Look at the box containing the letters IM. If the word ON is present below the IM then the generator is still connected to the simulated line. When the word ON disappears, a relay has disconnected the generator.

(5) Several different types of units of level are used (dBm, dBm/Hz, Volts, etc.) There is a short appendix at the back of this manual about why we have to do this, and how to translate from one system of units to another. Wherever possible, we indicate in the paragraphs below, the levels recommended by standards bodies for testing purposes. Also in the main menu there is an item, "Setup Screen" which gives the user a choice of units. This may help you to pick units that you want to see.

(6) There are two types of Powerline Noise.

(a) Single tone is fairly self evident, and is injected at a specific power level in dBm.

(b) ANSI, or Dual Tone consists of two harmonically related sine waves. They are any two frequencies from the fundamental and odd harmonics up to the 11th of either

External Input and Output of Impairments:
Each impairment card has 3 BNC connectors at the back, that are used for connection to external equipment. They function like this:

(1) **Longitudinal Noise In/Out**
The bottom BNC connector is for longitudinal impairments. If longitudinal impairments are set, the triangular, 50 or 60 Hz waveform is present on this connector. Alternatively, you can put in a waveform on this connector, and it is impressed on the line in longitudinal (Common) mode.

(2) **Random Noise Out**
The middle BNC connector is an output from the Impairments Card. The signal there is Random Noise. Normally when you use this connector, Random Noise is set to White Noise which is flat from 100 Hz to 500 kHz. You can externally filter this signal, and inject it back into the top BNC connector.

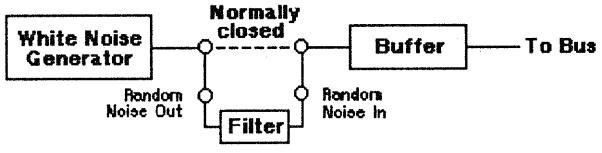


Fig. 5.12 White Noise Filter Setup

(3) **Random Noise In**
The top BNC connector allows external impairments to be injected. This signal can be one of the following:

Analog Signal that the card buffers and injects onto the simulated wireline. The signal should be in the range 100 Hz to 300 kHz, with maximum level 7.5 V peak to peak. Signal used for triggering an impulse. The impulse signal has to be 5 V CMOS compatible, and is initiated by the falling edge. The maximum rate is 2000 per second.

When external impairments are injected, the input has to be internally enabled by the DLS's external setting. The setting is located on the bottom of the menu's middle column, it can be changed from EXTERNAL HIT TRIGGER to External Signal, EXTERNAL FILTERED CROSSTALK NOISE, or switched off. EXTERNAL SIGNAL is selected when the analog signal is injected, and EXTERNAL HIT TRIGGER is selected when an impulse is applied. Edit the External setting just like the other impairments and ensure the impairment source is connected to the back to enable the input.

5.3 DIFFERENCES BETWEEN IMPAIRMENTS CARDS

The HE impairments card has an extra shaped noise according to ETSI specifications for HDSL. We call this extra noise ETSI-HDSL shaped noise. There is an extra impulse noise in the HE noise card called Cook Pulse. Also the range of the pulse width of the regular impulses has been increased from 20 -120 to 20 -255 uSec. The Single Tones frequency that can be generated has

50 Hz or 60 Hz. The two harmonically related sine waves are produced at different levels. Relative to the 5th harmonic, these are the levels:

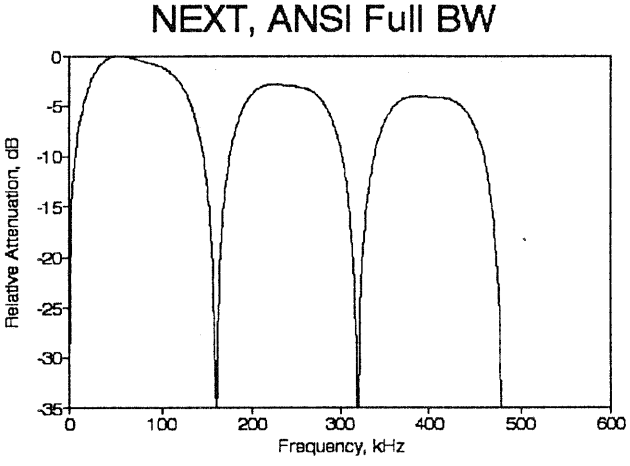
Harmonic	1st	3rd	5th	7th	9th	11th
Frequency, Hz	50	150	250	350	450	550
Relative level, dB	+12	+10	0	-6	-11	-15

ANSI specified level for the 5th harmonic is -59 dBm. The Impairments card takes the two tones and combines them at the correct relative levels. Then, as a pair, the overall level of the dual tone signal can be varied by the user over the range +15 to -9 dB relative to the ANSI specified level.

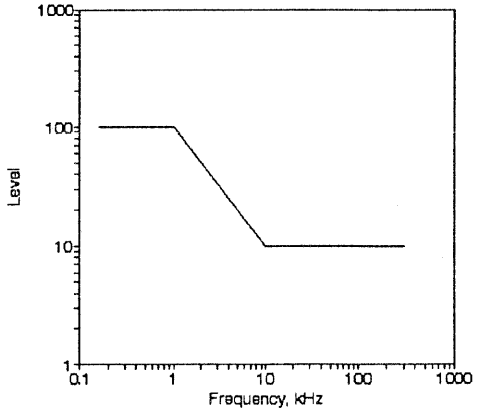
(7) The crosstalk noise generator (ETSI Card only) uses a pseudo random signal with a bandwidth up to 600 kHz and a Gaussian level distribution. It has a peak to average ratio of 5. The spectrums are filtered versions of this noise.

a) Flat is white noise in the bandwidth 100 Hz up to 500 kHz.

b) ANSI FULL BW is crosstalk noise as to ANSI specification T1.601, up to 500 kHz. The specification calls for a total power of -44.2 dBm in a bandwidth of 320 kHz when measured using the load specified by T1.601. This level is our calibrated Reference Level. You can select a few dB up and down relative to this level. For instance, if you select Relative -2.2 dB, the level is -46.4 dBm in a 320 kHz bandwidth.



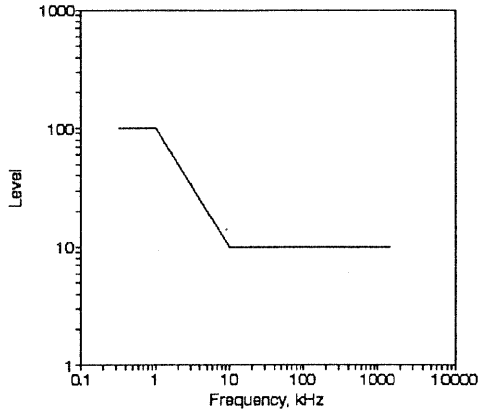
(8) ETSI Shaped Noise. This is how we refer to the basic rate impairment specified by ETSI in ETR 080. It is a repetitive waveform, with a period of 1/160 second, and has a spectrum from 160 Hz to 300 kHz. It is made up of a discrete number of spectral lines of 160 Hz and harmonics, with amplitude and phase also specified. The amplitude of the spectrum is shown here on the right.



(9) FTZ Shaped Noise. This is similar to the ETSI basic rate noise. The spectrum extends to

500 kHz, and the low frequency emphasis is from 1.5 kHz to 15 kHz, but the waveform is similar.

(10) ETSI-HDSL Shaped Noise. (HE impairments card only). This is how we refer to the HDSL rate "shaped noise" specified by ETSI in DTR/TM 3017. So far there have been several variations of these specifications, but at the meeting in England in June 94, we came up with a proposal that has been accepted.



The specified spectrum is given on the right.

It is a repetitive waveform, with a period of 1/320 second, and has a spectrum from 320 Hz to 1.5 MHz. It is made up of a discrete number of spectral lines of 320 Hz and harmonics, with amplitude and phase of each harmonic also specified.

Just a note of caution when measuring the amplitude of this waveform. The waveform consists of a large number of spectral lines. If you use a very narrow band filter of less than 320 Hz, and pick an unlucky frequency, it is possible to miss the spectral lines completely! If you use a not so narrow band filter, say 500 Hz, you may pick up either one or two of the spectral lines. This will give wildly variable results. In our test department, we use a balanced, 3 kHz filter, set it to a frequency of 100 kHz, and measure using a total load resistance of 67.5 Ohms. This gives us good, repeatable results.

(11) Cook Pulse (HE Impairments card only).

This is a sharp bipolar signal with equal positive and negative excursions. It is normally applied at a rate of 10 per second, and is designed to test immunity to impulsive impairments.

Section 6 IEEE COMMANDS AND OPERATION

6.1 INTRODUCTION

As an option the DLS 200HE can have IEEE 488 Control. This allows it be controlled by a computer and to be integrated into a larger test system. The DLS 200HE IEEE 488 control is designed with several standards in mind.

A) The physical interface follows IEEE 488.1, implementing the functions outlined in section 6.2.1, "IEEE 488.1 Interface Functions Supported".

B) The command structure follows IEEE 488.2 with one small exception, the Listening functions are not universally forgiving. The restrictions on the data formats are outlined in section 6.2.2, "Data Formats".

C) The Device Dependent Commands in section 6.3 have been designed with the Standard Commands for Programmable Interfaces (SCPI) in mind. However, since there are no SCPI commands that apply to the DLS 200HE, all the device dependent commands are unique to it.

The Self Test and Performance Tests are not implemented for the IEEE 488 portion of the DLS 200HE. The DLS 200HE unit will be able to accept IEEE 488 commands once the program has been loaded. Do not send commands through to the bus as the program is being loaded .Any command that the DLS 200HE does not recognize or is of the wrong format will set bit 4 (Execution Error) of the Standard Event Status Register described in section 6.5.2.

6.2 GENERAL

6.2.1 IEEE 488.1 Interface functions supported

The IEEE 488.1 Interface functions supported by the DLS 200HE are:

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

These represent the minimum required to implement the 488.2 standard.

6.2.2 Data formats

The DLS 200HE adheres to the IEEE 488.2 principle of Forgiving Listening and Precise Talking with one exception. The device listening format used in the DLS 200HE (Decimal Numeric Program Data-<NRf>) does not support exponential representation of numeric data. Any other representation using signs, optional leading digits, decimal points, and optional trailing digits is acceptable.

Within that framework the data formats supported by the DLS 200HE are:

Listening: a) <NRf> Decimal Numeric Program Data

Talking: a) <NR2> Numeric Response Data - Fixed Point
b) Arbitrary ASCII Response Data

<NRf> and <NR2> are simply generic integer representation formats. 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. In the case of the DLS 200HE it is used with the *IDN command.

6.2.3 Command Formats

The DLS 200HE adheres to the IEEE 488.2 format for command syntax. As with the Data Format the principle is forgiving listening and precise talking.

A) Commands

Commands may take one of two forms, either a Common Command or a Device Dependent Command. The format of each is detailed in subsequent sections. Each type may be preceded by a white space, and each will have a white space between its mnemonic and the data associated with it.

Device Dependent commands are preceded by a colon, with a colon separating each level of the command.

Common commands are preceded by an *. Several examples are shown below.

```
*RST
:SET:CHANNEL:LOOP1
*ESE 45
```

Messages TO the DLS 200HE may be terminated with either a Line Feed character (ASCII dec 10), an IEEE EOI signal or both. Messages FROM the DLS 200HE are always terminated with both.

Since all the commands for the DLS 200HE have only one piece of data, there is no Data Separator specified. (normally a comma).

Commands may be either in Upper or Lower case.

B) Queries

Queries of the system follow the same format as the commands, except that the data normally associated with the command is replaced with a question mark ?. Following receipt of such a command the DLS 200HE will place the appropriate response in the Output queue where it can be read by the controller.

Examples are: *IDN?
:SET:CHAN:LOOP1?

6.2.4 Buffer Size

The maximum length of message that can be sent to the DLS 200HE without overflow is 1024 bytes.

6.2.5 Addressing

The address of the DLS 200HE is set using the DIP switches on the Ziatech Interface card. See section 2.6. Please refer to the manual that accompanies the card for complete directions on address selection.

6.2.6 IEEE 488.2 Common Commands

As specified in the IEEE 488.2 specification there are a number of common commands required of devices to simplify the set up and control of standard functions of remote controlled devices. These common commands are described below.

*IDN? Identification Query (System command)
Returns the ID of the unit

Upon receiving this command the DLS 200HE will put into the output queue the following string

CONSULTRONICS LTD, yy..yy, 0, VERSION x.xx

where:
yy..yy is the type of unit. The four possibilities are:
DLS 200E ETSI for an ETSI configuration
DLS 200E FTZ-4 for a 4 card FTZ configuration
DLS 200E FTZ-5 for a 5 card FTZ
DLS 200E DEMO for a computer or misc configuration
x.xx is the version number of the software.

The DLS 200HE does not support the unit serial number reporting part of the *IDN function.

*RST Reset (Internal command)
IEEE 488.2 level three reset

This command will set the DLS 200HE to loop 1. It will set all impairment settings to default levels and it will not affect the output buffer or other system settings.

*TST? Self-Test Query (Internal command)

Performs a self test and returns the results.

The DLS 200HE always returns an integer 0 to the output queue as it does not have any self test capabilities under IEEE 488 control.

*OPC Operation Complete (Synchronization command)
Indicates to the controller when the current operation is complete.

The DLS 200HE does not support this command.

*OPC? Operation Complete Query (Synchronization command)
Indicates when the current operation is complete.

The DLS 200HE does not support this command.

*WAI Wait to continue (Synchronization command)
Used to delay execution of commands

As all the commands in the DLS 200HE operate serially this command will have no effect in the unit.

*DDT Define Trigger (Trigger Command)

In the DLS 200HE a trigger command (see below) may optionally be used to trigger impulse hits from the impairment card. This command will define a hit when the trigger command is sent over the bus. The data associated with the command is either TER4, or NONE (to turn off the capability). There is also a query form of the command.

i.e. *DDT TER4

*TRG Trigger (Trigger Command)
Trigger operation of the device

If a trigger has been enabled by the DDT command, sending the *TRG command will inject one impulse hit onto the simulated line. A separate *TRG command is required for each impulse hit, unless a repetition rate greater than zero has been programmed, in which case the impulses will be generated automatically. (See section 6.3 Device Dependant Commands for more details).

*CLS Clear Status Command (Status)

Clears the Event Status Register (ESR), and therefore also b5 of the Status Byte Register (STB). It has no effect on the output queue (b4 of the STB).

*SRE Service Request Enable (Status)

Sets the Service Request Enable Register (SRER) using an integer value, representing a sum of the bit by bit mapping of the register. Since the DLS 200HE uses only b4 (message available) and b5 (Event Status) the valid values for this command are:

0 - no bits enabled
16 - b4 enabled
32 - b5 enabled
48 - b4 and b5 enabled.

*SRE? Service Request Enable Query (Status)

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 previous command.

*STB? Status Byte Query (Status)

The value of the Status Byte (with b6 = MSS) is put into the output queue. This byte is only cleared by clearing the related enabling structures, namely the Event Status Register (ESR) and/or the output queue.

*ESE Event Status Enable (Status)

Sets the Event Status Enable Register (ESER) using an integer value from 0 to 255, representing a sum of the bit by bit mapping of the register. ie/ b0=1, b1=2, b2=4, b3=8, etc. The ESER masks which bits will be enabled in the Event Status Register (ESR)

*ESE? Event Status Enable Query (Status)

An integer value between 0 and 255 representing the value of the Event Status Enable Register (ESER) is placed in the output queue.

*ESR? Event Status Register (Status)

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 queue, this register is cleared.

6.3 DEVICE DEPENDENT COMMANDS FOR THE BASIC RATE

The device dependant commands of the DLS 200HE fall onto one of two categories. There are those that set the wireline simulation circuits, and those that set the impairments. These are described in separate sections below.

The commands assume a good working knowledge of the DLS 200HE. For further details consult the Manual Operation section of the instructions.

6.3.1 Wireline Settings

The wireline commands can be used to set either standard loops or to modify the settings of standard loops. The command hierarchy is to select a SET command, select a CHANNEL, then select a LOOP.

There are certain loops where each individual segment may be changed. These are:

a) Variable Standard Loops
b) Basic Loops
c) Variable FTZ Loops.

If desired, further data can be added to the command to change the setting of a particular segment of the loop. Note that the remaining loops (2B1Q, 4B3T, Standard FTZ) by definition cannot be changed and so do not have an individual segment command.

The segment numbering is taken from the DLS 200HE diagrams and works from left to right including bridged taps. More details of setting segments is included in the sections dealing with each type of loop.

2B1Q Loops

These are the standard ETSI loops. They do not have variable sections. The commands for these loops are:

:SET:CHANnel:	2B1Q_LP1	(ETSI 2B1Q Loop 1)
	2B1Q_LP2	
	2B1Q_LP3	
	2B1Q_LP3R	(Reversed ETSI 2B1Q Loop 3)
	2B1Q_LP4	
	2B1Q_LP4R	
	2B1Q_LP5	
	2B1Q_LP6	
	2B1Q_LP6R	
	2B1Q_LP7	
	2B1Q_LP7R	
	2B1Q_LP8	

4B3T Loops

These are the standard ETSI loops with the attenuation modified for the 4B3T modulation scheme. They do not have variable sections. The commands for these loops are:

: SET : CHANnel :	4B3T_LP1	(ETSI 4B3T Loop 1)
	4B3T_LP2	
	4B3T_LP3	
	4B3T_LP3R	(Reversed ETSI 4B3T Loop 3)
	4B3T_LP4	
	4B3T_LP4R	
	4B3T_LP5	
	4B3T_LP6	
	4B3T_LP6R	
	4B3T_LP7	
	4B3T_LP7R	
	4B3T_LP8	

Standard FTZ Loops

These loops are those specified by the FTZ. Because they have been designated standard they do not have variable sections. (A set of these loops with variable sections have been included below). The commands for the standard loops are:

: SET : CHANnel :	STDFTZ1	(Standard FTZ 0.4mm 4.2km)
	STDFTZ2	(Standard FTZ 0.4mm 5km)
	STDFTZ3	(Standard FTZ 0.6mm 8km)
	STDFTZ4	(Standard FTZ 0.6mm 10km)

Standard Variable Loops

These are the Standard 2B1Q loops with variable sections. They are included in case the user wishes to vary one or more of the sections. The commands for the loops themselves are:

: SET : CHANnel :	LOOP1	(Variable Standard Loop 1)
	LOOP2	
	LOOP3	
	LOOP3R	(Variable Reversed Standard Loop 3)
	LOOP4	
	LOOP4R	
	LOOP5	
	LOOP6	
	LOOP6R	
	LOOP7	
	LOOP7R	
	LOOP8	

Standard Variable Loops Segment Lengths:

Shown are the maximum possible lengths for each loop. The lengths can be adjusted in 50 m steps between zero metres and the maximum shown.

: SET : CHANnel : LOOP1 N/A
LOOP2 s1 <4900>
LOOP3 s1 <2400>, s2 <2450>, s3 <2100>, s4 < 2400>
LOOP3R s1 <2400>, s2 <2100>, s3 <2450>, s4 <2400>
LOOP4 s1 <2450>, s2 <4900>, s3 <2100>
LOOP4R s1 <2100>, s2 <4900>, s3 <2450>
LOOP5 s1 <100>*, s2 <14450>, s3 <100>*
LOOP6 s1 <3700>, s2 <500>*, s3 <2400>, s4 <500>*
LOOP6R s1 <500>*, s2 <2400>, s3 <500>*, s4 <3700>
LOOP7 s1 <50>*, s2 <4900>, s3 <2450>, s4 <300>*
LOOP7R s1 <300>*, s2 <2450>, s3 <4900>, s4<50>*
LOOP8 s1 <2400>, s2 <2400>

eg. ":set:channel:loop2 s1 4450"

Variable FTZ Loops

These loops are the same as the standard FTZ loops but the segments can be varied. In that sense they are similar to the standard variable loops described above. The commands for the regular loops are:

: SET : CHANnel : VARFTZ1 (Variable FTZ 0.4mm 4.2km)
VARFTZ2 (Variable FTZ 0.4mm 5km)
VARFTZ3 (Variable FTZ 0.6mm 8km)
VARFTZ4 (Variable FTZ 0.6mm 10km)

The setting of a segment involves selecting the segment with an identifier and choosing the setting of the segment. The minimum and maximum lengths that can be set for each loop is shown below.

: SET : CHANnel : VARFTZ1 s1 <50 to 6400>
VARFTZ2 s1 <50 to 6400>
VARFTZ3 s1 <50 to 10000> w/ 4 FTZ cards
VARFTZ3 s1 <50 to 12350> w/ 5 FTZ cards
VARFTZ4 s1 <50 to 10000> w/ 4 FTZ cards
VARFTZ4 s1 <50 to 12350> w/ 5 FTZ cards

eg. ":set:channel:varftz1 s1 4350"

Basic Loops

These are generic loops that have been put together by Consultronics. They allow the user to use Standard sections in different combinations. Each has a Loop command and a segment command associated with it. The Loop commands are:

: SET : CHANnel :	BAS_LP1	(Basic Loop Type 1)
	BAS_LP1R	(Basic Loop Type 1 Reversed)
	BAS_LP2	
	BAS_LP2R	
	BAS_LP3	
	BAS_LP3R	
	BAS_LP4	
	BAS_LP4R	
	BAS_LP5	
	BAS_LP5R	
	BAS_LP6	
	BAS_LP6R	
	BAS_LP7	
	BAS_LP7R	
	BAS_LP8	
	BAS_LP8R	

The setting of a segment involves selecting the segment with an identifier and choosing the setting of the segment. The identifiers may be used in any combination. The range of each is from zero to the maximum shown below. The one exception is the setting of the short sections at the ends of some lines. These are identified below by an asterisk and have a limit as follows:

Basic Loops of type 1,2,3,4 can have their section set in this fashion:

Leftmost side (section 1)		Rightmost side (section 7)	
0		0	can be set in
100	right most side	50	every case
300	must be 0 or 50	100	left most side
		300	must be 0

Basic loops of type 5,6,7,8

Leftmost side	Rightmost side
0	N/A
100	
300	

Note that Reverse Basic Loops have the same restrictions but the sides (left and right) are reversed.

The segment commands and lengths for the basic loops are:

Basic 2 Wire Type 1
s1 <300>*, s2 <2450>, s3 <2400>, s4 <2100>, s5 <2400>, s6<14450>, s7 <300>*
Basic 2 Wire Type 2
s1 <300>*, s2 <2400>, s3 <2450>, s4 <2100>, s5 <2400>, s6 <14450>, s7 <300>*
Basic 2 Wire Type 3
s1 <300>*, s2 <2450>, s3 <2400>, s4 <2400>, s5 <2100>, s6 <14450>, s7 <300>*
Basic 2 Wire Type 4
s1 <300>*, s2 <2400>, s3 <2450>, s4 <2400>, s5 <2100>, s6 <14450>, s7<300>*
Basic 2 Wire Type 5
s1 <300>*, s2 <2450>, s3 <2400>, s4<14450>, s5<2400>, s6<2100>, s7<0>*
Basic 2 Wire Type 6
s1 <300>*, s2 <2400>, s3 <2450>, s4 <14450>, s5 <2400>, s6 <2100>, s7 <0>*
Basic 2 Wire Type 7
s1 <300>*, s2<2450>, s3 <2400>, s4 <14450>, s5 <2100>, s6 <2350>, s7 <0>*
Basic 2 Wire Type 8
s1 <300>*, s2 <2400>, s3<2450>, s4 <14450>, s5 <2100>, s6 <2400>, s7 <0>*

eg. ":set:channel:bas_lp1 s1 300, s2 2300, s3 2200"

* NOTE Any section marked with an asterisk (*) can only be toggled between "0" and the specified value.

6.3.2 Wireline Queries

The set length of the simulator can be queried over the IEEE bus as well. The user has the option to query the:

a) Loop that has been set.
b) The settings of all segments in a loop.
c) The setting of an individual segment in a loop.

Examples are:

a) :SET:CHANNEL?
b) :SET:CHANNEL:LOOP2?
:SET:CHANNEL:VARFTZ3?
c) :SET:CHANNEL:LOOP2 S1?
:SET:CHANNEL:BAS_LP6R S5?

Note that the queries in B) will not return the actual set values of a segment, but rather THE STANDARD VALUES for that segment.

A query of a specific loop will return the STANDARD lengths for that loop whereas the query of the loop that is set will return the ACTUAL lengths for that loop. Unless a segment has been changed the Loop Query and the Standard Loop Query will return the same results. A table is shown below that summarizes the setting of segments for each of the different types of loops in the DLS 200HE.

	Basic	Standard	2B1Q	4B3T	FTZ	VFTZ
Query all results	X	X	X	X	X	X
Query sections	X	X	N/A	N/A	N/A	X
Query set loop	X	X	X	X	X	X
Set section	X	X	N/A	N/A	N/A	X

Table for Querying Loops and Setting sections

6.3.3 Impairments Commands

The format of the Impairments commands are listed below. Note that while they follow a format similar to the wireline cards the actual commands are different.

:SOURce:TER4: PWRFreq (freq)
:SOURce:TER4: IMPUlse (type), (rate), (level), (width), (units)
:SOURce:TER4: TONE (freq1), (freq2), (level)
:SOURce:TER4: LONGitudinal (level)
:SOURce:TER4: SHPNoise (type), (level), (units)

The limits for each parameter are as follows:

PWRFREQ

:SOURce:TER4:PWRFreq <freq>
<freq>: (50¦60) Hz

eg. :source:ter4:pwrfreq 60

NOTE: The setting affects longitudinal frequency and ansi tones

IMPULSE

:SOURce:TER4:IMPUlse <type>, <rate>, <level>, <width>
<type>: (TRILVL¦BIPOL¦UNIPOLNEG¦UNIPOLPOS)
<rate>: (0 to 100) pps
<level>: (0.0 to 100.0 or OFF) mV
<width>: (20 to 255) (20 sec is the default pulse width) µsec

eg. :source:ter4:impulse trilvl, 100, 60, 255

COOK

To set the cook pulse in dB

:SOURce:TER4:IMPUlse <type>, <rate>, <level>, <units>
<type> : (cook)
<rate> : (0 to 100) pps
<level> : (-20.0 to 6.0 or OFF) dB
<units> : DB

To set the cook pulse in mV

:SOURce:TER4:IMPUlse <type>, <rate>, <level>, <units>
<type> : (cook)
<rate> : (0 to 100) pps
<level> : (32.0 to 634 or OFF) mV
<units> : MV

eg. :source :ter4: impulse cook, 100, 6, db
eg. :source :ter4: impulse cook, 100, 634, mv

TONE (ANSI)

:SOURce:TER4:TONE <freq1>, <freq2>, <level>
<freq1>: (OFF¦50¦150¦250¦350¦450¦550)* Hz
<freq2>: (OFF¦50¦150¦250¦350¦450¦550)* Hz
<level>: (-15 to 9.0 of OFF) dB

eg. :source:ter4:tone 60, 60, -10

*NOTE: Based on the pwrfreq setting of 50 Hz the step of the tones should be as shown. If it is based on 60 Hz then the allowed values are: (OFF¦60¦180¦300¦420¦540¦660)

TONE (SINGLE)

:SOURce:TER4:TONE <freq1>, <freq2>, <level>
<freq1>: (50 to 20000) Hz
<freq2>: 0*
<level>: (-40.0 to -100.0 or OFF) dBm

eg. :source :ter4:tone 555, 0, -80

*NOTE: The second frequency must be of value zero to have the parser recognize that single tones are desired.

LONGITUDINAL

:SOURce:TER4:LONGitudinal <level>
<level> : (0.0 to 20.0 or OFF)* Vrms

eg. :source:ter4:longitudinal 10.5

*NOTE: The frequency of the triangular longitudinal voltage is set from the power frequency portion. The longitudinal level can only be incremented by 0.5 steps. Longitudinal noise can only be set and queried from loop 8. Any other loops will have the longitudinal noise turned off even if it was already set in loop 8.

SHPNOISE

To set the ETSI, FTZ, or HDSL noise in dB
:SOURce:TER4:SHPNoise <type>, <level>, <units>
<type> : (ETSI¦FTZ¦HDSL)
<level> : (-40.0 to 20.0 or OFF) dB
<units> : DB

To set the ETSI, FTZ, or HDSL noise in $\mu V/\sqrt{Hz}$
:SOURce:TER4:SHPNoise <type>, <level>, <units>
<type> : (ETSI¦FTZ¦HDSL)
<level> : (0.1 to 100.0 or OFF) $\mu V/\sqrt{Hz}$
<units> : UV

eg. :source:ter4:shpnoise etsi, 5.0, db for ETSI type noise in dBs
eg. :source:ter4:shpnoise ftz, 5.0, uv for FTZ type noise in $\mu V/\sqrt{Hz}$

6.3.3.1 Default settings

There are times when it may be desirable to set the impairments card to default values. This can be done with the following command:

:SOURce:TER4:DEFAult

This command sets the impairments card to its default startup settings. Essentially, it shuts off all impairments. Alternatively, individual impairments can be shut off by typing OFF for any of the levels or by typing an out-of-range value for any of the levels. Another method of shutting down the level for each individual impairment is by inputting NONE or OFF as the data with no other values in the command.

:SOURce:TER4:IMPUlse off
:SOURce:TER4:TONE off
:SOURce:TER4:SHPNoise off
:SOURce:TER4:LONGitudinal off

NOTE: Pwrfreq cannot be turned off. It must have a value of 50 or 60 Hz.

6.3.3.2 Queries

The format for querying the settings of all impairments commands is:

: SOURce : TER4?

This command will respond with a long string displaying all the settings of the impairments card. Individual settings may be queried by using the following commands:

: SOURce: TER4: PWRFreq?
IMPUlse?
TONE?
SHPNoise?
LONGitudinal?

6.4 DEVICE DEPENDENT COMMANDS FOR THE DLS 200HE PROGRAM

6.4.1 Wireline Settings

The wireline commands can be used to set either standard loops or to modify the settings of standard loops. The command hierarchy is to select a SET command, select a CHANNEL, then select a LOOP.

There are certain loops where each individual segment may be changed. These are:

a) 3-Pair Loops
b) 2-Pair Loops
c) Consultronics Loops

If desired, further data can be added to the command to change the setting of a particular segment of the loop. The segment numbering is taken from the DLS 200HE diagrams and works from left to right including bridged taps. More details of setting segments is included in the sections dealing with each type of loop.

3-Pair Variable Loops Segment Lengths:

Shown are the maximum possible lengths for each loop. The lengths can be adjusted in 50 m steps between zero metre and the maximum shown.

```
:SET:CHANnel:3P_LOOP1   N/A
             3P_LOOP2   s1 <4900>
             3P_LOOP3   s1 <2400>, s2 <2450>,  s3 <2100>, s4 <2400>
             3P_LOOP3R  s1 <2400>, s2 <2100>,  s3 <2450>, s4 <2400>
             3P_LOOP4   s1 <2450>, s2 <4900>,  s3 <2100>
             3P_LOOP4R  s1 <2100>, s2 <4900>,  s3 <2450>
             3P_LOOP5   s1 <100>*, s2 <14450>,s3 <100>*
             3P_LOOP6   s1 <3700>, s2 <500>*,  s3 <2400>, s4 <500>*
             3P_LOOP6r  s1 <500>*, s2 <2400>,  s3 <500>*, s4 <3700>
             3P_LOOP7   s1 <50>*,  s2 <4900>,  s3 <2450>,  s4 <300>*
             3P_LOOP7R  s1 <300>*, s2 <2450>,  s3 <4900>, s4 <50>*
             3P_LOOP8   s1 <2400>, s2 <2400>
```

eg. ":set:channel:3p_loop2 s1 4700"

* NOTE: Any section marked with an asterisk (*) can only be toggled between "0" and the specified value

2-Pair Variable Loops Segment Lengths:

Shown are the maximum possible lengths for each loop. The lengths can be adjusted in 50 m steps between zero metre and the maximum shown.

```
:SET:CHANnel:2P_LOOP1   N/A
             2P_LOOP2   s1 <4900>
             2P_LOOP3   s1 <2400>, s2 <2450>, s3 <2100>, s4 <2400>
             2P_LOOP3R  s1 <2400>, s2 <2100>, s3 <2450>, s4 <2400>
             2P_LOOP4   s1 <2450>, s2 <4900>, s3 <2100>
             2P_LOOP4R  s1 <2100>, s2 <4900>, s3 <2450>
             2P_LOOP5   s1 <100>*, s2 <14450>,s3 <100>*
             2P_LOOP6   s1 <3700>, s2 <500>*, s3 <2400>, s4 <500>*
             2P_LOOP6r  s1 <500>*, s2 <2400>, s3 <500>*, s4 <3700>
             2P_LOOP7   s1 <50>*,  s2 <4900>, s3 <2450>, s4<300>*
             2P_LOOP7R  s1 <300>*, s2 <2450>, s3 <4900>, s4<50>*
             2P_LOOP8   s1 <2400>, s2 <2400>
```

eg. ":set:channel:2p_loop3 s1 2350, s2 2400"

* NOTE: Any section marked with an asterisk (*) can only be toggled between "0" and the maximum shown.

Basic Loops

These are generic loops that have been put together by Consultronics. They allow the user to use Standard sections in different combinations. Each has a Loop command and a segment associated with it. The Loop commands are:

:SET:CHANnel:	BAS_LP1	(Basic Loop Type 1)
	BAS_LP1r	(Basic Loop Type 1 Reversed)
	BAS_LP2	
	BAS_LP2R	
	BAS_LP3	
	BAS_LP3R	
	BAS_LP4	
	BAS_LP4R	
	BAS_LP5	
	BAS_LP5R	
	BAS_LP6	
	BAS_LP6R	
	BAS_LP7	
	BAS_LP7R	
	BAS_LP8	
	BAS_LP8R	

The setting of a segment involves selecting the segment with an identifier and choosing the setting of the segment. The identifiers may be used in any combination. The range of each is from zero to the maximum shown below. The one exception is the setting of the short sections at the ends of some lines. These are identified below by an asterisk and have a limit as follows:

Basic Loops of type 1,2,3,4 can have their section set in this fashion:

Leftmost side (section 1)		Rightmost side (section 7)	
0		0	can be set in
100	right most side	50	every case
300	must be 0 or 50	100	leftmost side
		300	must be 0

Basic loops of type 5,6,7,8 can have their section set like this:

Leftmost side	Rightmost side
0	N/A
100	
300	

Note: Reverse Basic Loops have the same restrictions but the sides (left and right) are reversed.

The segment commands and lengths for the basic loops are:

Basic 2 Wire Type 1
s1<300>*,s2<2450>,s3<2400>,s4<2100>,s5<2400>,s6<14450>,s7<300>*
Basic 2 Wire Type 2
s1<300>*,s2<2400>,s3<2450>,s4<2100>,s5<2400>,s6<14450>,s7<300>*
Basic 2 Wire Type 3
s1<300>*,s2<2450>,s3<2400>,s4<2400>,s5<2100>,s6<14450>,s7<300>*
Basic 2 Wire Type 4
s1<300>*s2<2400>,s3<2450>,s4<2400>,s5<2100>,s6<14450>,s7<300>*
Basic 2 Wire Type 5
s1<300>*,s2<2450>,s3<2400>,s4<14450>,s5<2400>,s6<2100>,s7<0>*
Basic 2 Wire Type 6
s1<300>*,s2<2400>,s3<2450>,s4<14450>,s5<2440>,s6<2350>,s7<0>*
Basic 2 Wire Type 7
s1<300>*,s2<2450>,s3<2400>,s4<14450>,s5<2100>,s6<2350>,s7<0>*
Basic 2 Wire Type 8
s1<300>*,s2<2400>,s3<2450>,s4<14450>,s5<2100>,s6<2400>,s7<0>*

eg. ":set:channel: bas_lp1 s2 2250, s3 2350"

6.4.2 Wireline Queries

The set length of the simulator can be queried over the IEEE bus as well. The user has the option to query the:

a) Loop that has been set.
b) The standard settings for all segments in a loop.
c) The setting of an individual segment in a loop.

Examples are:

a) :SET:CHANNEL?
b) :SET:CHANNEL:3P_LOOP2?
:SET:CHANNEL:2P_LOOP4?
c) :SET:CHANNEL:3P_LOOP3 S1?
:SET:CHANNEL:BAS_LP6R S5?

The queries in B) will not return the actual set values of a segment, but rather THE STANDARD VALUES for that segment.

A query of a specific loop will return the STANDARD lengths for that loop. A query using ": SET : CHANNEL?", will return the ACTUAL lengths for that loop. Unless a segment has been changed, the Loop Query and the Standard Loop Query will return the same results. A table is shown below that summarizes the setting of segments for each of the different types of loops in the DLS 200HE program.

	Basic	3-Pair	2-Pair
Query all results	X	X	X
Query sections	X	X	X
Query set loop	X	X	X
Set section	X	X	X

6.4.3 Impairments Commands

The format of the Impairments commands are listed below. Note that while they follow a format similar to the wireline cards the actual commands are different.

:SOURce:TER4: PWRFreq (freq)
:SOURce:TER4: IMPUlse (type), (rate), (level), (width), (units)
:SOURce:TER4: TONE (freq1), (freq2), (level)
:SOURce:TER4: LONGitudinal (level)
:SOURce:TER4: SHPNoise (type), (level), (units)

The limits for each parameter are as follows:

PWRFREQ

:SOURce:TER4:PWRFreq <freq>
<freq>: (50¦60) Hz

eg. :source:ter4:pwrfreq 60

Note: The setting affects longitudinal frequency and ansi tones

IMPULSE

:SOURce:TER4:IMPUlse <type>, <rate>, <level>, <width>
<type>: (TRILVL¦BIPOL¦UNIPOLNEG¦UNIPOLPOS)
<rate>: (0 to 100) pps
<level>: (0.0 to 100.0 or OFF) mV
<width>: (20 to 255) (20 sec is the default pulse width) μsec

eg. :source:ter4:impulse trilvl, 100, 60, 255

COOK

To set the cook pulse in dB

:SOURce:TER4:IMPUlse <type>, <rate>, <level>, <units>
<type> : (cook)
<rate> : (0 to 100) pps
<level> : (-20.0 to 6.0 or OFF) dB
<units> : DB

To set the cook pulse in mV

:SOURce:TER4:IMPUlse <type>, <rate>, <level>, <units>
<type> : (cook)
<rate> : (0 to 100) pps
<level> : (32.0 to 634 or OFF) mV
<units> : MV

eg. :source :ter4: impulse cook, 100, 6, db
eg. :source :ter4: impulse cook, 100, 634, mv

TONE (ANSI)

:SOURce:TER4:TONE <freq1>, <freq2>, <level>
<freq1>: (OFF¦50¦150¦250¦350¦450¦550)* Hz
<freq2>: (OFF¦50¦150¦250¦350¦450¦550)* Hz
<level>: (-15 to 9.0 of OFF) dB

eg. :source:ter4:tone 60, 60, -10

*NOTE: Based on the pwrfreq setting of 50 Hz the step of the tones should be as shown. If it is based on 60 Hz then the allowed values are: (OFF¦60¦180¦300¦420¦540¦660)

TONE (SINGLE)

:SOURce:TER4:TONE <freq1>, <freq2>, <level>
<freq1>: (50 to 20000) Hz
<freq2>: 0*
<level>: (-40.0 to -100.0 or OFF) dBm

eg. :source :ter4:tone 555, 0, -80

*NOTE: The second frequency must be of value zero to have the parser recognize that single tones are desired.

LONGITUDINAL

:SOURce:TER4:LONGitudinal <level>
<level> : (0.0 to 20.0 or OFF)* Vrms

eg. :source:ter4:longitudinal 10.5

*NOTE: The frequency of the triangular longitudinal voltage is set from the power frequency portion. The longitudinal level can only be incremented by 0.5 steps. Longitudinal noise can only be set and queried from loop 8. Any other loops will have the longitudinal noise turned off even if it was already set in loop 8.

SHPNOISE

To set the ETSI, FTZ, or HDSL noise in dB
:SOURce:TER4:SHPNoise <type>, <level>, <units>
<type> : (ETSI¦FTZ¦HDSL)
<level> : (-40.0 to 20.0 or OFF) dB
<units> : DB

To set the ETSI, FTZ, or HDSL noise in
:SOURce:TER4:SHPNoise <type>, <level>, <units>
<type> : (ETSI¦FTZ¦HDSL)
<level> : (0.1 to 100.0 or OFF) $\mu V/\sqrt{Hz}$
<units> : UV

eg. :source:ter4:shpnoise etsi, 5.0, db for ETSI type noise in dBs
eg. :source:ter4:shpnoise ftz, 5.0, uv for FTZ type noise in $\mu V/\sqrt{Hz}$

6.4.3.1 Default settings

There are times when it may be desirable to set the impairments card to default values. This can be done with the following command:

:SOURce:TER4:DEFAult

This command sets the impairments card to its default startup settings. Essentially, it shuts off all impairments. Alternatively, individual impairments can be shut off by typing OFF for any of the

levels or by typing an out-of-range value for any of the levels. Another method of shutting down the level for each individual impairment is by inputting NONE or OFF as the data with no other values in the command.

:SOURce:TER4:IMPUlse off
:SOURce:TER4:TONE off
:SOURce:TER4:SHPNoise off
:SOURce:TER4:LONGitudinal off

NOTE: Pwrfreq cannot be turned off. It must have a value of 50 or 60 Hz.

6.4.3.2 Queries

The format for querying the settings of all impairments commands is:

:SOURce:TER4?

This command will respond with a long string displaying all the settings of the impairments card. Individual settings may be queried by using the following commands:

eg. : SOURce : TER4 : PWRFreq?
IMPUlse?
TONE?
SHPNoise?
LONGitudinal?

6.4.4 ETSI Impairment Card Commands

The format of the Impairment commands are listed below. Note that while they follow a format similar to the wireline cards the actual commands are different.

:SOURce :TER4 :PWRfreq (freq)
:SOURce :TER4 :IMPUlse (type), (rate), (level), (width)
:SOURce :TER4 :XTALk (type), (level)
:SOURce :TER4 :TONE (freq1), (freq2), (level)
:SOURce :TER4 :EXTErnal (type), (level)
:SOURce :TER4 :LONGitudinal (level)
:SOURce :TER4 :SHPNoise (type), (level), (units)

The limits for each parameter are as follows:

PWRFREQ

: SOURce : TER4 : PWRFreq <freq>
<freq> : (50 ¦ 60) Hz

eg. : source : ter4 : pwrfreq 60

Note: This setting affects longitudinal frequency and ansi tones

IMPULSE

: SOURce : TER4 : IMPUlse <type>, <rate>, <level>, <width>
<type> : (TRILVL ¦ BIPOL ¦ UNIPOLNEG ¦ UNIPOLPOS)
<rate> : (0 to 100) pps
<level> : (0.0 to 100.0 or OFF) mV
<width> : (20 to 120) (20 sec is the default pulse width) $\mu V/\sqrt{Hz}$

eg. : source : ter4 : impulse trilvl, 100, 60, 20

XTALK

: SOURce : TER4 : XTALk <type>, <level>
<type>, <level> : (flat), (-71.3 to -131.3 or OFF) in dBs
<type>, <level> : (flat), (0.0 to 100.0 or OFF) in $\mu V/\sqrt{Hz}$
<type>, <level> : (ansifull), (-15.0 to 20.0 or OFF) dB
<type>, <level> : (ansi320), (-15.0 to 20.0 or OFF) dB

NOTE: For crosstalk type FLAT, positive or negative values for the level will determine if it is in dBs or $\mu V/\sqrt{Hz}$.

eg. : source : ter4 : xtalk flat, -80.3 (in dB)
: source : ter4 : xtalk flat, 50.0 (in $\mu V/\sqrt{Hz}$.)

TONE (ANSI)

: SOURce : TER4 : TONE <freq1>, <freq2>, <level>
<freq1> : (OFF ¦ 50 ¦ 150 ¦ 250 ¦ 350 ¦ 450 ¦ 550)* Hz
<freq2> : (OFF ¦ 50 ¦ 150 ¦ 250 ¦ 350 ¦ 450 ¦ 550)* Hz
<level> : (-15.0 to 9.0 or OFF) dB

eg. : source : ter4 : tone 60, 60, -10

*NOTE: Based on the pwrfreq setting of 50 Hz the step of the tones should be as shown. If it is based on 60 Hz then the allowed values are: (OFF ¦ 60 ¦ 180 ¦ 300 ¦ 420 ¦ 540 ¦ 660)

TONE (SINGLE)

: SOURce : TER4 : TONE <freq1>, <freq2>, <level>
<freq1> : (50 to 1000) Hz
<freq2> : 0*
<level> : (-40.0 to -100.0 or OFF) dBm

eg. : source : ter4 : tone 555, 0, -80

*NOTE: The second frequency must be of value zero to have the parser recognize that single tones are desired.

EXTERNAL

: SOURce : TER4 : EXTErnal <type>, <level>
<type> : (NONE ¦ TRIGGER ¦ SIGNAL ¦ XTALK)
<level> : (0.0 to 60.0 or OFF)* dB

eg. : source : ter4 : external signal 50

*NOTE: Only the level need to be inputted for EXTERNAL SIGNAL

LONGITUDINAL

: SOURce : TER4 : LONGitudinal <level>
<level> : (0.0 to 20.0 or OFF) * Vrms

eg. : source : ter4 : longitudinal 10.5

*NOTE: The frequency of the triangular longitudinal voltage is set from the power frequency portion. The longitudinal level can only be incremented by 0.5 steps and the card can accept external injection of the longitudinal noise at any time. Longitudinal noise can only be set and queried from loop 8. Any other loops will have the longitudinal noise turned off even if it was already set in loop 8.

SHPNOISE

To set the ETSI or FTZ noise in dBs

: SOURce : TER4 : SHPNoise <type>, <level>, <units>
<type> : (ETSI ¦ FTZ)
<level> : (-40.0 to 20.0 or OFF) dB
<units> : DB

To set the ETSI or FTZ noise in $\mu V/\sqrt{Hz}$
: SOURce : TER4 : SHPNoise <type>, <level>, <units>
<type> : (ETSI ¦ FTZ)
<level> : (0.1 to 100.0 or OFF) $\mu V/\sqrt{Hz}$
<units> : UV

eg. : source : ter4 : shpnoise etsi, 5.0, db for ETSI type noise in dBs
: source : ter4 : shpnoise ftz, 5.0, μv for FTZ type noise in $\mu V/\sqrt{Hz}$..

6.4.4.1 Default settings

There are times when it may be desirable to set the impairment card to default values. This can be done with the following command:

:SOURce : TER4 : DEFAult

This command sets the impairment card to its default startup settings. Essentially, it shuts off all impairments. Alternatively individual impairments can be shut off by typing OFF for any of the

levels or by typing an out-of-range value for any of the levels. Another method of shutting down the level for each individual impairment is by inputting NONE or OFF as the data with no other values in the command.

:SOURce : TER4 : EXTErnal none
:SOURce : TER4 : XTALk off
:SOURce : TER4 : IMPUlse off
:SOURce : TER4 : TONE none
:SOURce : TER4 : SHPNoise off
:SOURce : TER4 : LONGitudinal off

NOTE: Pwrfreq cannot be turned off. It must have a value of 50 or 60 Hz

6.4.4.2 Queries

The format for querying the settings of all impairment commands is:

: SOURce : TER4?

This command will respond with a long string displaying all the settings of the impairments card. Individual settings may be queried by using the following commands:

: SOURce : TER4 : PWRFreq?
EXTErnal?
XTALk?
IMPUlse?
TONE?
SHPNoise?
LONGitudinal?

6.4.5 Screen Saver

*NOTE: The programs: ETSI version 2.30 or above, Basic Rate version 1.00 or above, and HE version 1.10 or above will have the ability to change the screen saver from the IEEE 488 bus.

6.4.5.1 Setting the delay

To set the screen save blanking delay, the format is:

: DISPlay : CLEArdelay <numeric>
<numeric> : (0 to 60)

6.4.5.2 Queries

The format for querying the screen save blanking delay is:

: DISPlay : CLEArdelay?

6.4.6 Remote Power

6.4.6.1 Selecting the Remote Power

Depending on whether the equipment at the user site is powered from the exchange or locally, the format is:

: SET : WCURrent : STATe : <option>
<option> : (EXCHange ¦ LOCAl)

e.g. : set : wcurrent : state : exchange

This command sets the unit to respond as if the user site is powered from the exchange.

6.4.6.2 Queries

The format for querying the type of power the equipment at the user site is set up for is:

: SET : WCURrent : STATe?

6.4.7 Micro-Interruption

6.4.7.1 IEEE 488 Micro-Interruption Commands

To set the micro-interruption test time, the command is:

: INTErruption : TEST_time <value>
<value> 0-60
eg. ":interruption : test_time 0"

To set the repetition rate, the command is:

: INTErruption : RATE <value>
<value> 1-120
eg. ": interruption : rate 5"

To set the interruption length, the command is:

: INTErruption : LENGth <value>
<value> 10-100
eg. ": interruption : length 10"

To run or halt the micro-Interruption process, the command is:

: INTErruption : STATe <option>
<option> (start¦stop)
eg. ": interruption : state start"
eg. ": interruption : state stop"

When the DLS 200HE is already running and the user has sent the IEEE 488 command to run again, then the unit will restart the testing.

6.4.7.2 Queries

To query the test time setting from the IEEE, the command is:

: INTErruption : TEST_time?

eg. ": interruption : test_time 0"

To query the repetition rate setting from the IEEE, the command is:

: INTErruption RATE?

eg. ": interruption : rate 5"

To query the interruption length setting from the IEEE, the command is:

: INTErruption : LENGth?

eg. ": interruption : length 10"

To query the state of the micro-Interruption process from the IEEE, the command is:

: INTErruption : STATe?

eg. ": interruption : state start"

6.4.8 General

Some points to note about the Device Dependent Commands:

The command may be sent in upper or lower case form.

The unit will round any data of greater than needed precision to the required number of places.

*NOTE: When setting longitudinal and pwrfreq values standard loop 8 should be displayed in order to have the impairment settings displayed on the front panel. This is because the ETSI specifications require that only longitudinal voltage be permitted for loop 8. In any other loop, the tone display will be shown since dual tones is related to the power frequency.

6.5 STATUS REPORTING

While at first glance the Status reporting mechanisms of IEEE 488.2 may seem complicated, they are in fact very simple, and it is mostly the nomenclature that is a bit cryptic. There are two main structures that record and report status, the Status Byte Register (STB), and the Event Status Register (ESR). If the Event Status Register is non zero (ie. a defined and enabled event has occurred) this fact, at the users discretion, may be reflected in the Status Byte Register.

As well, each register has an enabling byte, which allows the user to control which events will activate the byte. There is a command to set this enabling byte, and one to read it. Thus, for each Register there are three commands, one to read the register, one to set the enabling byte, and one to read the enabling byte.

6.5.1 Status Byte Register (STB)

i) Status Byte Register STB

The bits of this register are mapped as follows:

bit 6 Master Summary Status

This bit is the Master Summary Status (MSS) when the STB is sent in response to a IEEE 488.2 Status Byte Query command (*STB?). It indicates that the device has at least one reason to request service.

or

This bit is the Request Service bit (RQS), when the STB is sent in response to a IEEE 488.1 Serial Poll command.

The only difference is that the MSS bit is not cleared by the *STB? command, whereas the RQS bit is cleared by the Serial poll command.

bit 5 Event Status Bit

It indicates that the Event Status Register is non zero. i.e. that an enabled event has occurred. Note that there are two levels of masking for event status bits. For an event to set RQS (b6 of the STB) and cause a service request the appropriate bit must be enabled by the Event Status Enable Register (ESER) and the Event Status Register bit must be enabled by the Service Request Enable Register (SRER).

bit 4 Message Available Bit

Indicates that the Output Queue is not empty.

bit 7,bit 3,bit 2,bit 1,and bit 0 are not used by the DLS 200HE.

ii) Service Request Enable Register (SRER)

The Service Request Enable Register is used to enable generation of SRQ (Service Request). The bits of the Status Byte Register represent events. If an event occurs and the corresponding Service Request Enable Register bit has been set, SRQ will occur. Since bit 4 and bit 5 are the only bits of the Status Byte Register that can be set there are only 4 values for the SRER, which

is set by the Service Request Enable command (*SRE). The values are:

0 no events will enable service request.
16 bit 4 (output queue not empty) will cause a service request.
32 bit 5 (Event Status Register non zero) will cause a service request.
64 bit 4 or bit 5 will cause a service request.

The setting of the Service Request Enable Register can be checked with the Service Request Enable Query command (*SRE?). This will put the value of the SRER in the output queue.

iii) General STB information

As outlined above, bit 6 (RQS) of the STB will go high when bit 4 or bit 5 have been enabled and the event they represent has occurred. RQS going high will always cause the SRQ line on the IEEE 488.1 interface to go high (i.e. they will be tied together). If this is not desired set *SRE = 0 and poll the system status with *STB?.

The IEEE 488.1 Serial Poll only clears bit 6 of the STB. To clear the whole byte read all pending data from the output queue (clear bit 4) and use the *CLS command to clear the Event Status Register (clear bit 5).

6.5.2 Event Status Register (ESR)

i) Event Status Register

The Event Status Register monitors events within the system and reports on those enabled. It records transitory events as well. The DLS 200HE implements only the IEEE 488.2 Standard Event Status Register (ESR). It is defined as:

bit 7 Power on. Since the ESR was last read the power to the unit has been turned off and back on again.

bit 6 User Request. Indicates that the user has activated a Device Defined control through the front panel. The DLS 200HE does not set this bit.

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, or *TRG) command inserted in a command line will also set this bit.

bit 4 Execution Error. The data associated with a command was out-of-range or does not exist.

bit 3 Device Dependent Error. At this time there are no device dependent errors in the DLS 200HE, 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.

bit 1 Request Control. The DLS 200HE does not have the ability to control the IEEE bus, and so this bit is always 0.

bit 0 Operation Complete. The DLS 200HE does not set this bit.

ii) Event Status Enable Register

The Event Status Enable Register (ESER) is used to set the ESB bit of the Status Bit Register. The bits of the Event Status Register represent events. If an event occurs and the corresponding Event Status Enable Register has been set, then the ESB bit will be set. The command used for this purpose is the Event Status Enable command (*ESE). The value used to set the register is an integer value from 0 to 255, representing a sum of the bit by bit mapping of the register. i.e. bit 0=1, bit 1=2, bit 2=4, bit 3=8 etc. The ESER masks which bits will be enabled in the Event Status Register (ESR).

Although not all the bits in the ESR are used by the DLS 200HE, for simplicity sake all of them can be enabled. When polled however, the non active bits (bit 7,bit 3,bit 1) will always return a value of 0.

The setting of the Event Status Enable Register can be checked with the Event Status Enable Query command (*ESE?). This will put the value of the ESER in the output queue.

iii) General ESR Information

The Event Status Register (ESR) is only cleared by reading the register (*ESR?) or by clearing it (*CLS).

For more information on Status reporting see section 6.2.6, "IEEE 488.2 Common Commands".

The following references provide detail information on the IEEE interface:

(1) ANSI/IEEE 488.1-1987 IEEE Standard Digital Interface for Programmable Instrumentation

(2) ANSI/IEEE 488.2-1987 IEEE Codes, Formats, Protocols, and Common Commands

(3) Standard Commands for Programmable Instruments (SCPI), available from some interface controller manufacturers.

Section 7 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 centre prior to the expiration of the warranty period for the purpose of allowing Consultronics to inspect and repair the equipment. 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.

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.

If warranty service becomes necessary, please phone or Fax Consultronics to get return authorization number and shipping instructions:

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K2E 7J4
Phone: (613) 225 6087 or
Toll Free 1 800 465 1796
Fax: (613) 225 6315

Consultronics (U.S.A. Office)
1304 Rockbridge Road SW, Suite 4
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Fax: (770) 931 4798

Consultronics (Europe Office)
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Omega Enterprise Park
Electron Way
Chandlers Ford
Hampshire, England
S053 4SE
Phone: 0703 270222
Fax: 0703 270333

or your local Consultronics representative

Section 8 SHIPPING THE DLS 200HE

If the instrument is to be shipped on a regular basis, a transit case is recommended.

To prepare the DLS for shipment, turn the power off and disconnect all cables including power cable.

Be sure to remove the program disk from the drive. Protect the disk with suitable packaging and put it together with the instrument.

If a transit case is not available, pack the instrument in the original carton. Do not place any cables or accessories directly against the front panel as this may scratch the surface of the display. It is suggested that you mark all shipments with labels indicating that the contents are fragile.

Section 9 SERVICING THE DLS 200HE

NOTE: POWER MUST BE OFF BEFORE CIRCUIT BOARDS MAY BE REMOVED OR REPLACED.

The DLS has been designed for ease of servicing. The unit is very modular in design and circuit functions are divided among different boards. Problems can be traced to each individual board, and defective boards can be quickly isolated. If a problem should occur, Consultronics should be notified of the problem. We will then recommend the action to be taken. In most cases, a replacement board will be dispatched to solve the problem.

To access the hardware:

1) Turn OFF the power of the DLS unit.

2) Using a hex and/or Phillips screw-driver remove the two screws on the right hand side of the unit and the two feet on the left hand side that hold the top cover in place. Remove the top cover and set aside.

3) Using a hex screw-driver remove the four (4) screws holding the front panel in place. Let the front panel swing down (be careful no to pull the front panel out as it may damage the cables connecting it to the unit).

4) Using a Phillips screw-driver, remove the screws holding the front and rear card guide in place. Remove the card guides and set aside. The rear card guide may be difficult to remove as it holds the cards in the unit securely. Be careful removing the rear card guide or it may damage the Filtran filter on one or more of the impairment cards.

For further instructions see the DLS Service Manual.

WARNING: The DLS contains electronic components which are protected against static damage while properly installed in the unit. Before touching any component or removing a circuit board insure that you and the environment are static free. By doing this, component damage can be avoided. To ship circuit boards use an anti-static plastic bag or wrap the board in aluminum foil.

Section 10 SPECIFICATIONS

10.1 LINE SIMULATION ACCURACY

Loop 1 loss is 0.1 to 0.15 dB. For loops 2 to 7 , the loss is within 1.0 dB of the values in the table shown below.

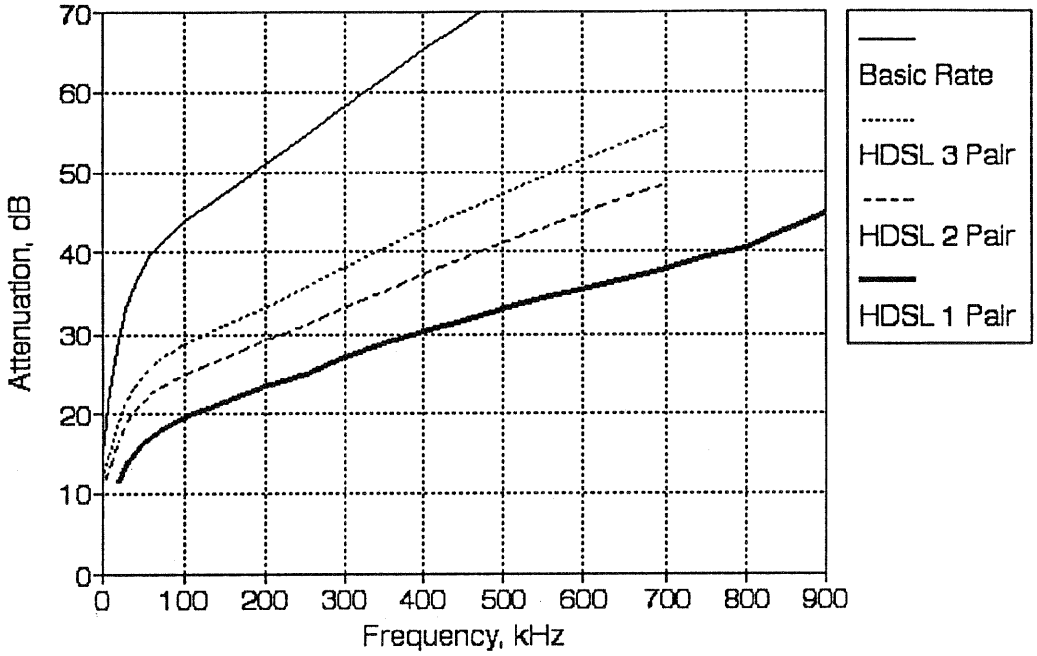
	Basic Rate (dB) at 40 kHz	3-Pair (dB) at 150 kHz	2-Pair (dB) at 150 kHz
Loop 2	35.7	31.0	27.0
Loop 3	36.0	31.2	27.3
Loop 4	35.8	31.1	27.2
Loop 5	33.6	28.8	25.6
Loop 6	34.5	27.0	24.0
Loop 7	36.5	31.2	27.4
Loop 8	35.1	30.7	27.1

At any frequency from 1 kHz to 200 kHz, the attenuation, characteristic impedance, and delay are all repeatable within 3%.

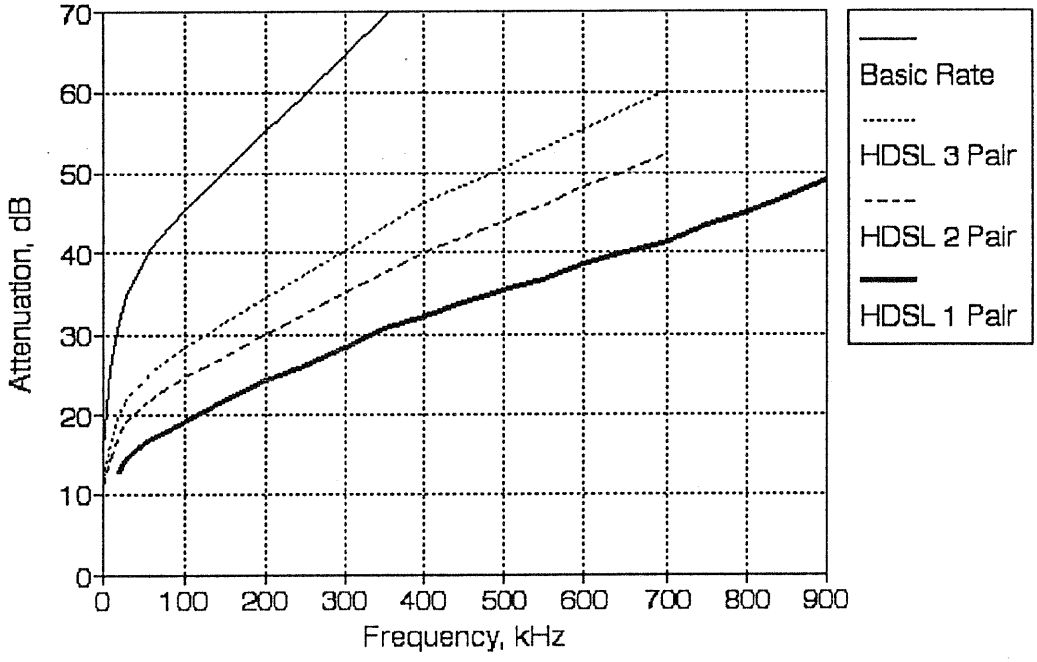
NOTE: For loop 8, the response is dependent on the longitudinal transformer, its insertion circuit and its insertion loss. Characteristics up to 150 kHz are similar to loop 2.

The following pages show measured responses of the loops:

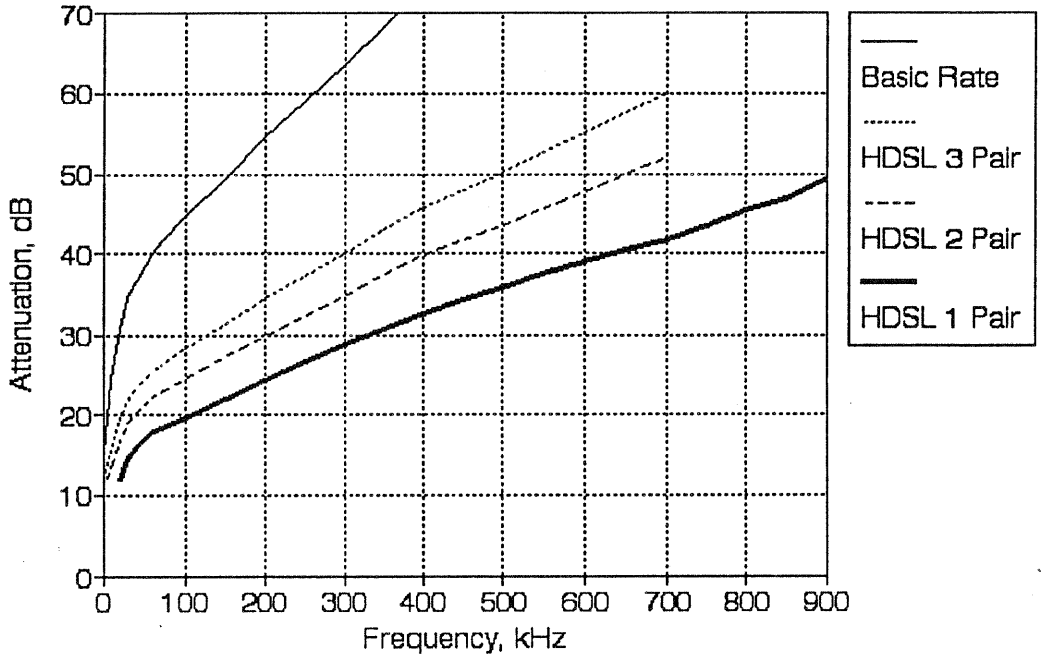
Loop 2


Attenuation, dB
70
60
50
40
30
20
10
0
0
100
200
300
400
500
600
700
800
900
Frequency, kHz
Basic Rate
HDSL 3 Pair
HDSL 2 Pair
HDSL 1 Pair

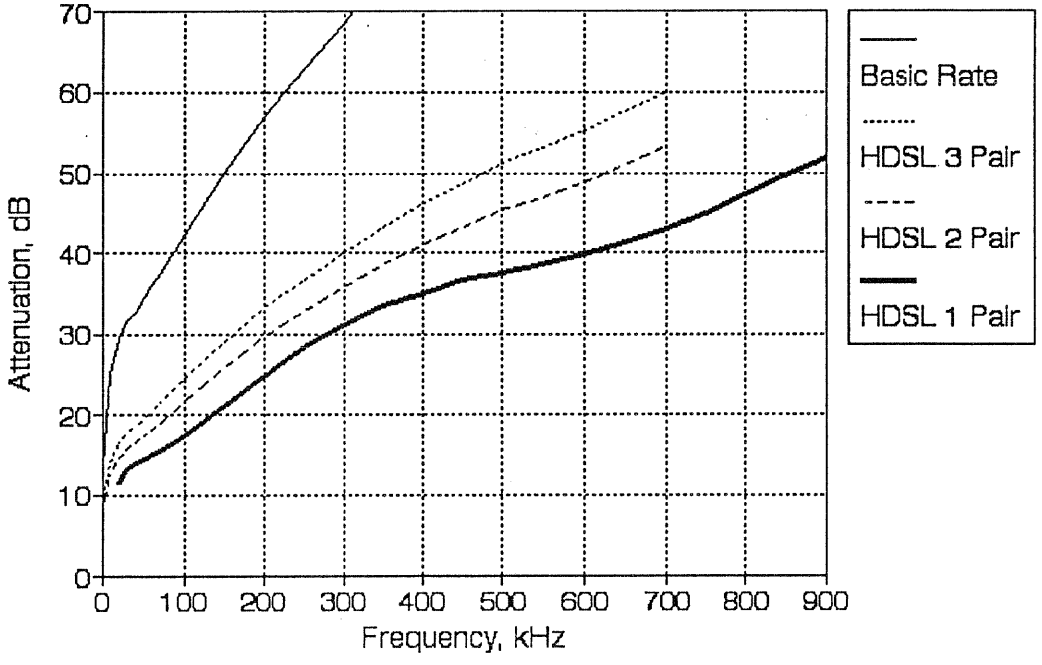
Loop 3


Attenuation, dB
70
60
50
40
30
20
10
0
0
100
200
300
400
500
600
700
800
900
Frequency, kHz
Basic Rate
HDSL 3 Pair
HDSL 2 Pair
HDSL 1 Pair

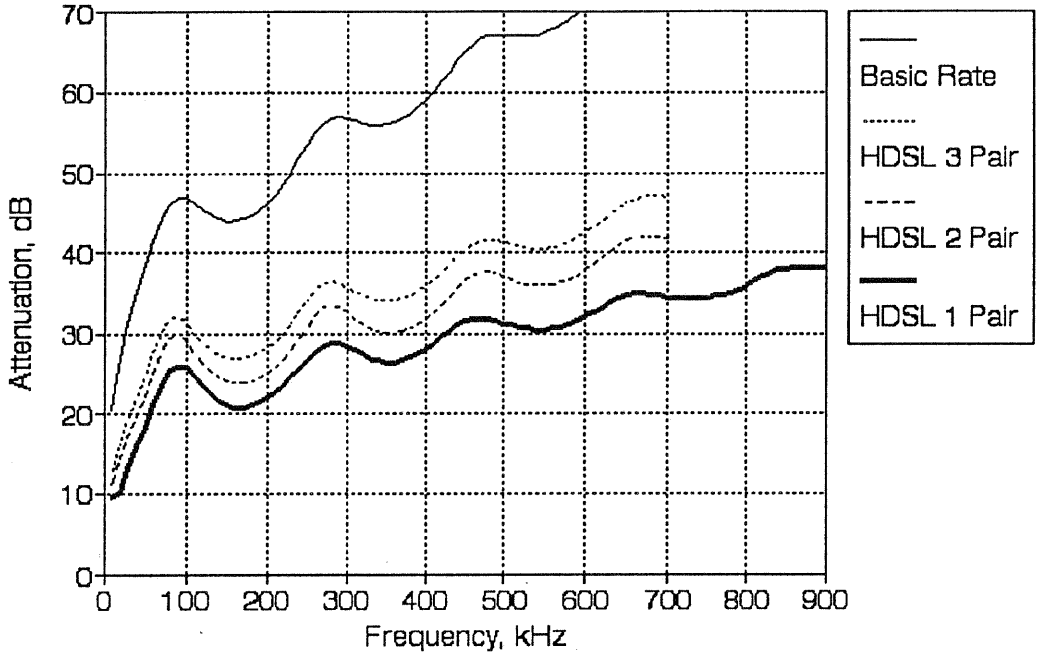
Loop 4


Attenuation, dB
70
60
50
40
30
20
10
0
0
100
200
300
400
500
600
700
800
900
Frequency, kHz
Basic Rate
HDSL 3 Pair
HDSL 2 Pair
HDSL 1 Pair

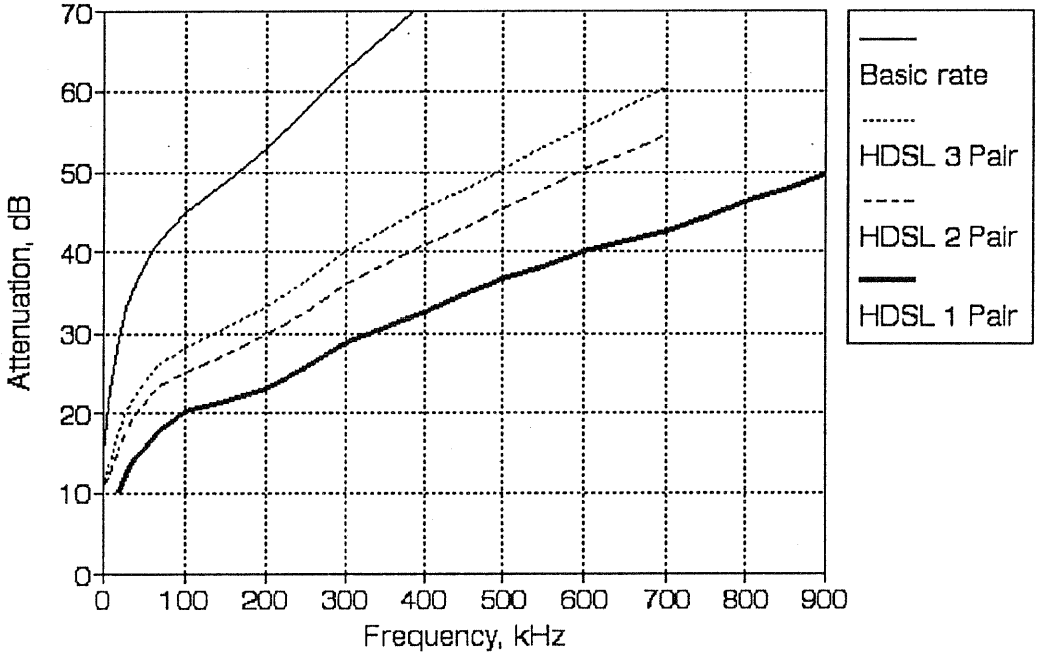
Loop 5

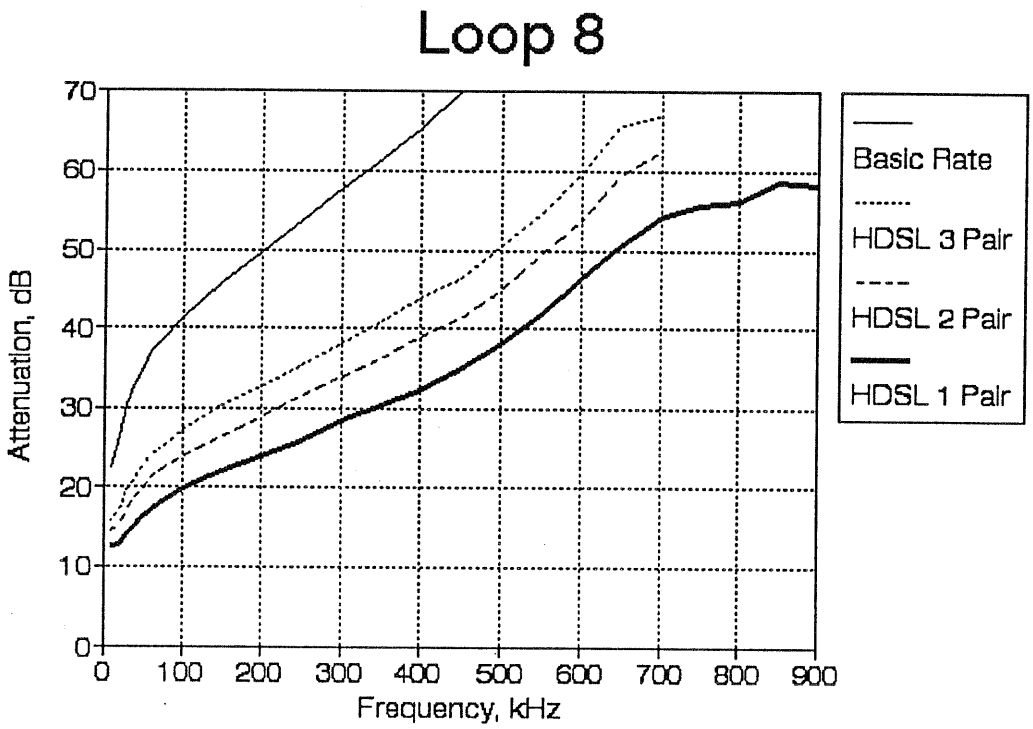

Attenuation, dB
70
60
50
40
30
20
10
0
0
100
200
300
400
500
600
700
800
900
Frequency, kHz
Basic Rate
HDSL 3 Pair
HDSL 2 Pair
HDSL 1 Pair

Loop 6

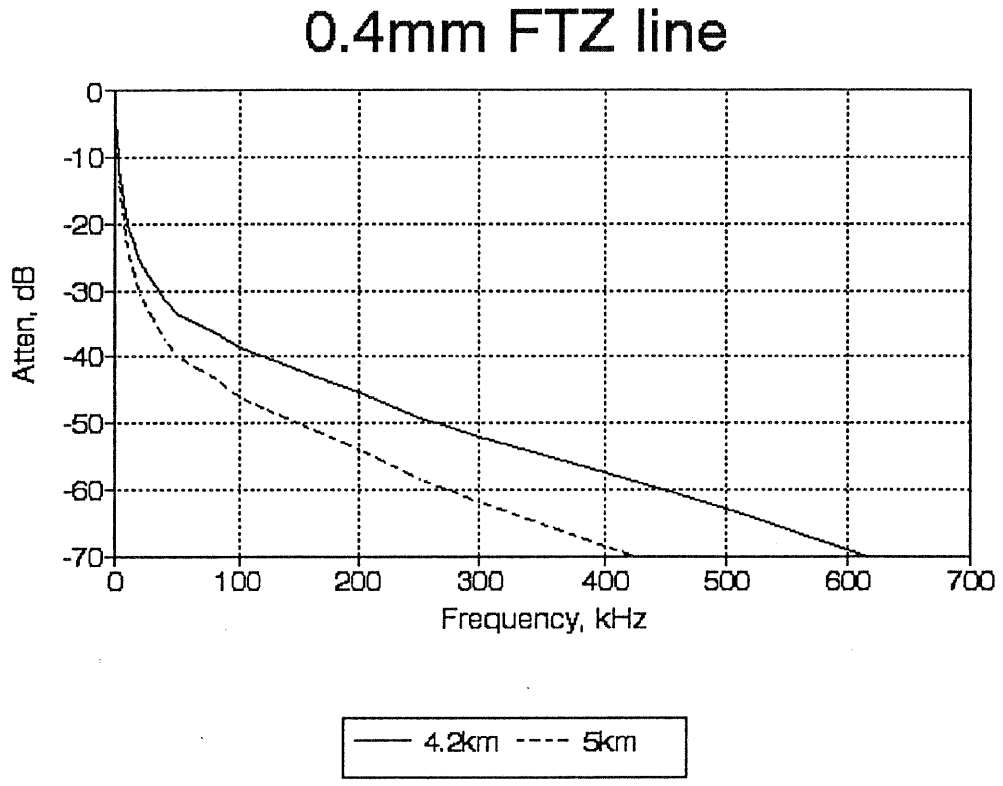

Attenuation, dB
70
60
50
40
30
20
10
0
0
100
200
300
400
500
600
700
800
900
Frequency, kHz
Basic Rate
HDSL 3 Pair
HDSL 2 Pair
HDSL 1 Pair

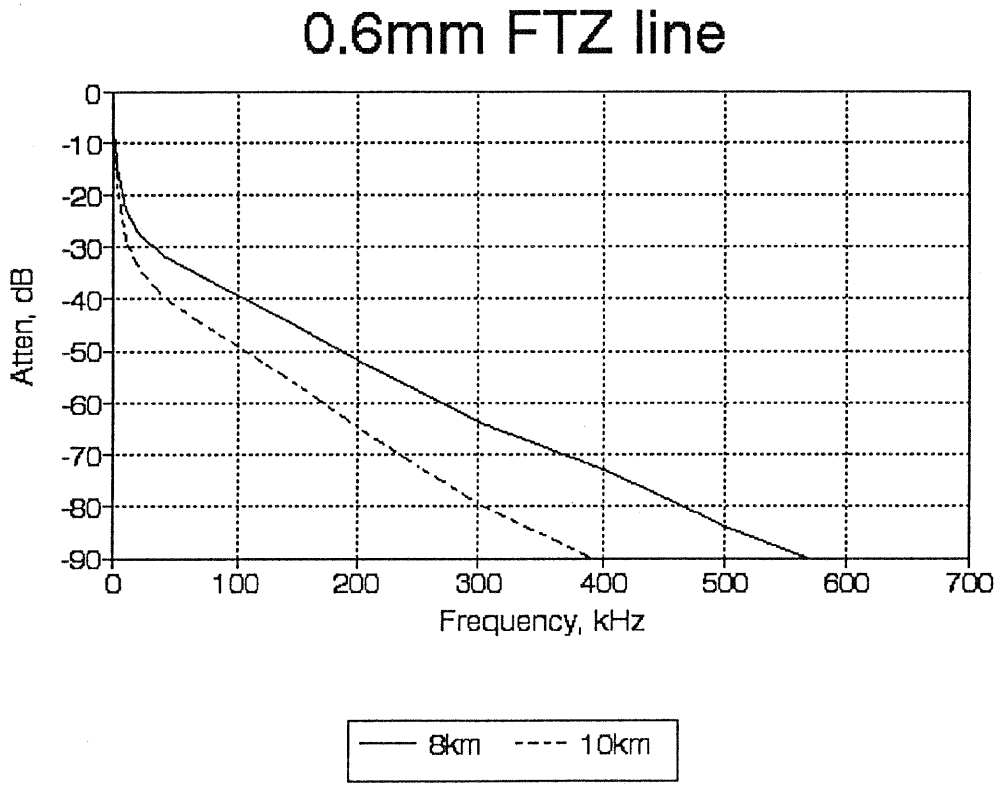
Loop 7


Attenuation, dB
70
60
50
40
30
20
10
0
0
100
200
300
400
500
600
700
800
900
Frequency, kHz
Basic rate
HDSL 3 Pair
HDSL 2 Pair
HDSL 1 Pair


Loop 8
Attenuation, dB
70
60
50
40
30
20
10
0
0
100
200
300
400
500
600
700
800
900
Frequency, kHz
Basic Rate
HDSL 3 Pair
HDSL 2 Pair
HDSL 1 Pair

The following are the responses of the FTZ loops:





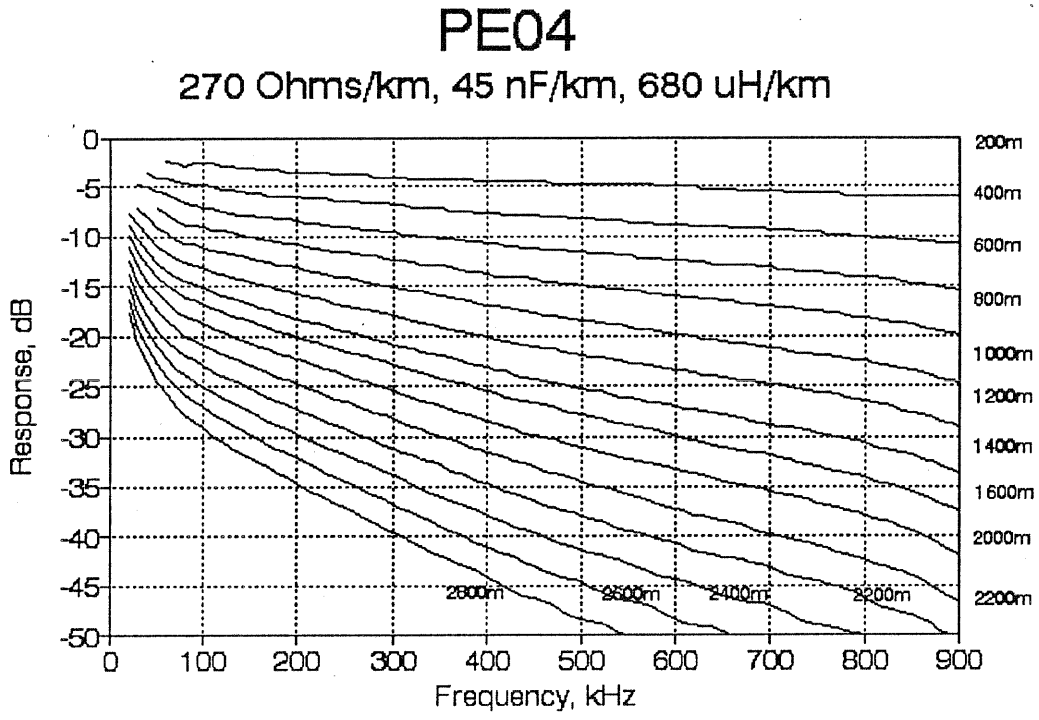
10.2 LENGTH OF SIMULATED LINE

The DLS 200HE contains the following types of wirelines.

Type 1 Qty 3 3600m of 0.8mm PE line
Type 2 Qty 1 3350m of 0.8mm PE line + 50m of 0.32mm PVC line
Type 3 Qty 1 2450m of 0.5mm PE line + 500m 0.4mm PE line
Type 4 Qty 1 2150m of 0.6mm PE line + 100m PVC line
Type 5 Qty 2 2350m of 0.4mm PE line
Type 6 Qty 1 100m of 0.4mm PVC line + 300m of 0.63mm PVC line + 1700m of 0.4mm PE

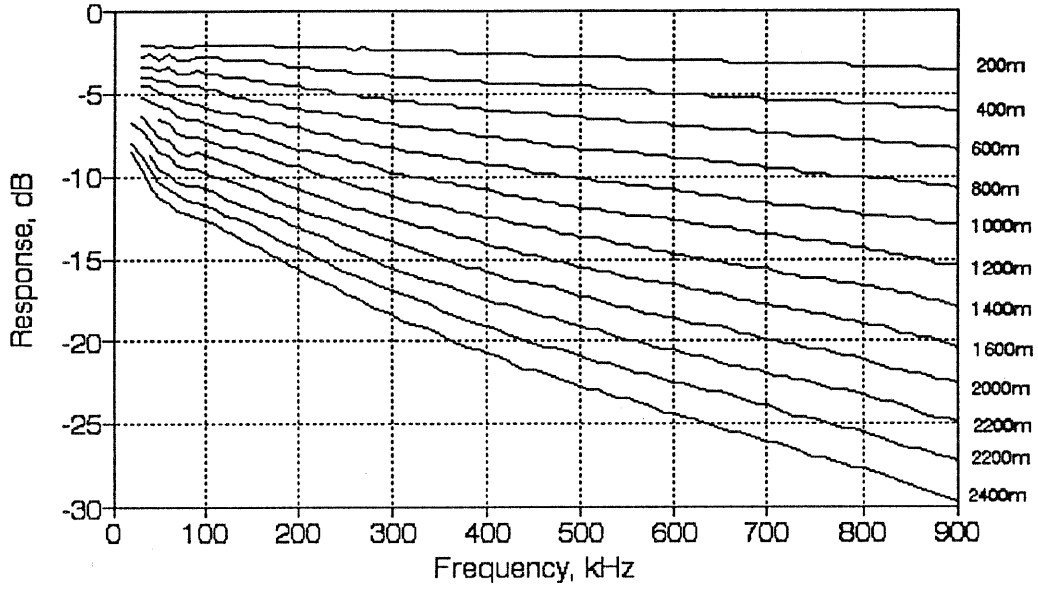
All PE line lengths are adjustable in 50m steps.

Here are measured response graphs of the DLS 200HE lines:



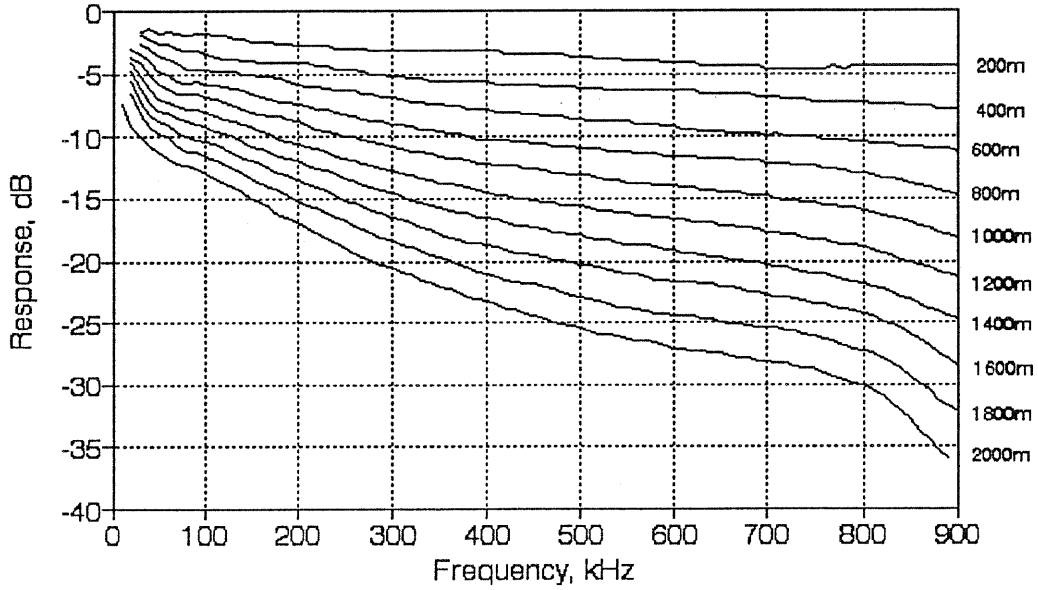
PE05

172 Ohms/km, 25 nF/km, 680 uH/km



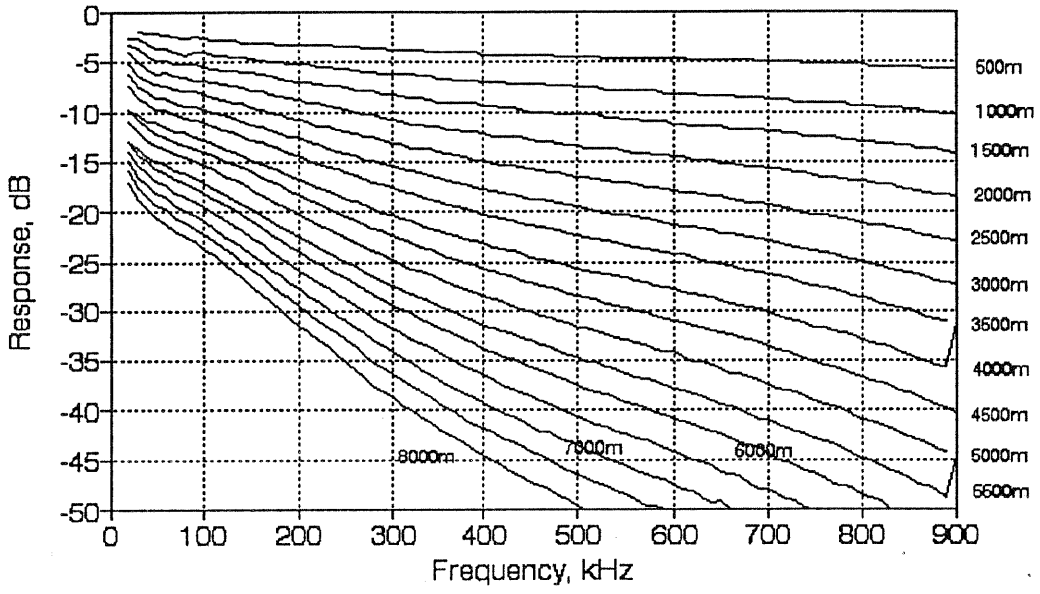
PE06

120 Ohms/km, 56 nF/km, 700 uH/km



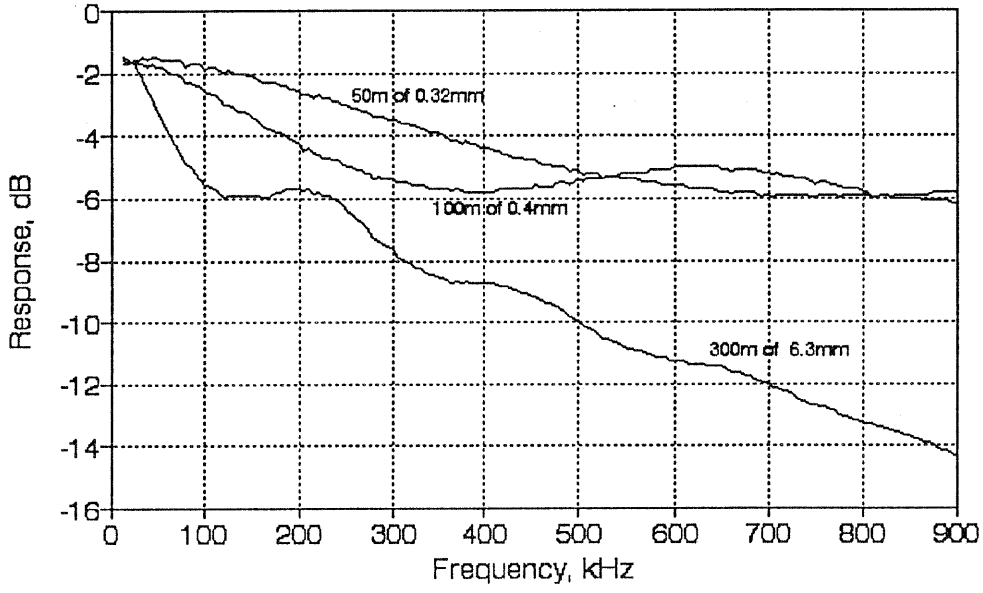
PE08

68 Ohms/km, 38 nF/km, 700 uH/km



PVC Simulations

0.32 mm, 0.4 mm, and 0.63 mm



HE IMPAIRMENT MODULE

(a) Impulse Noise

Level:	0.0 to 100.0 mV peak in 0.1 mV steps or off
Rate:	0 to 100 pps, or single shot.
Pulse Shapes:	3 - Level Bipolar pulse Positive and negative unipolar pulse
Pulse Width:	Variable from 20 to 255 μsec in 1 μsec steps. Accuracy 1 μsec.
Risetime:	2.5 μsec.

(b) Cook Pulse:

Level:	-20.0 to 6.0 dB in 0.1 dB steps or off
Rate:	0 to 100 pps
or	
Level:	32.0 mV to 634 mV in 1 mV steps or off
Rate:	0 to 100 pps

(c) Shaped Noise

Type: Shaped to either ETSI, FTZ 1TR220, or ETSI-HDSL specifications

Level: -40.0 to 20.0 dB relative to reference level or 0.1 to 100 $\mu V/\sqrt{Hz}$

Graphs of the ETSI Shaped Noise are shown in the next two pages.

(d) Powerline Noise

Type:	Dual tone as per ANSI T1.601/1991 LB rev., with tone frequency selectable in 50 or 60 Hz. Single tone with frequency from 50 to 20000 Hz variable in 1 Hz
Level:	(Dual Tone) -15.0 to 9.0 dB in 0.1 dB steps relative to ANSI reference levels (Single Tone) -40 to -100 dBm variable in 0.1 dBm steps.

(e) Longitudinal Noise

Type:	Triangular waveform
Level:	0 to 20 Vrms in 0.5 volt steps.
ETSI Reference Level:	15 V.
Frequency:	50 or 60 Hz.

(f) Externally Generated Spectrum:

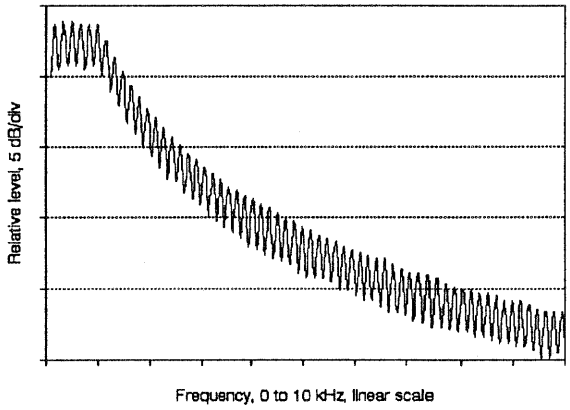
A single-ended, externally generated signal in the frequency range 100 Hz to 1.5 MHz. Total level should be less than 100 mV.

The ETSI Shaped Noise (Basic Rate) spectrum, measured on a DLS 200HE, is shown here:

This diagram shows the low frequency part of the spectrum. You can see the individual spectral lines spaced at 160 Hz, as well as the low frequency shaping.

Some of the spectrum analyzer settings were:

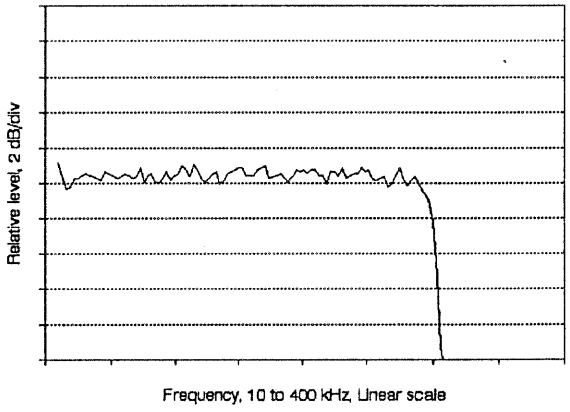
Real bandwidth: 3 kHz
Video bandwidth: 50 Hz



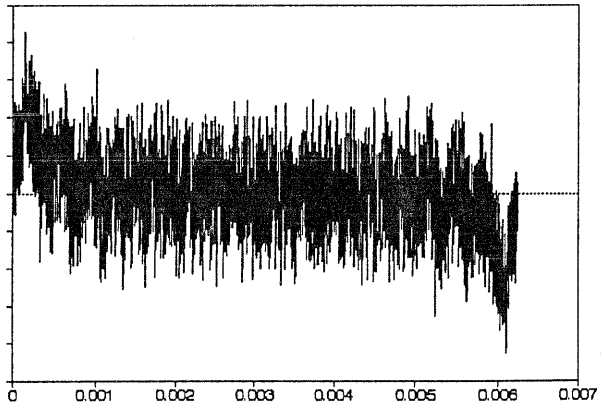
This diagram shows the major part of the spectrum up to 300 kHz.

Some of the spectrum analyzer settings were:

Real bandwidth: 3 kHz
Video bandwidth: 50 Hz



Shown here is the waveform that you can see on a (balanced) scope

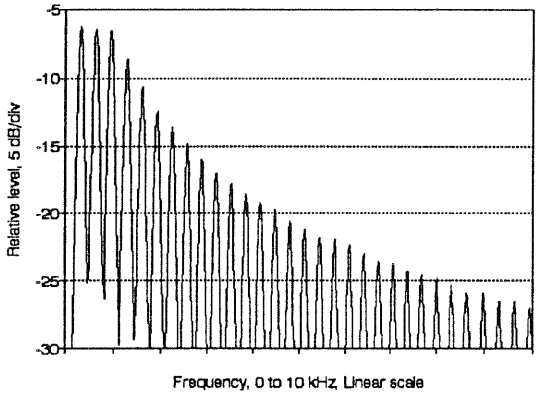


Note that the waveform for the FTZ noise is similar, and the spectrum can be measured in a similar way.

Measurements on a DLS 200HE shows these diagrams for the ETSI-HDSL shaped noise spectrum:

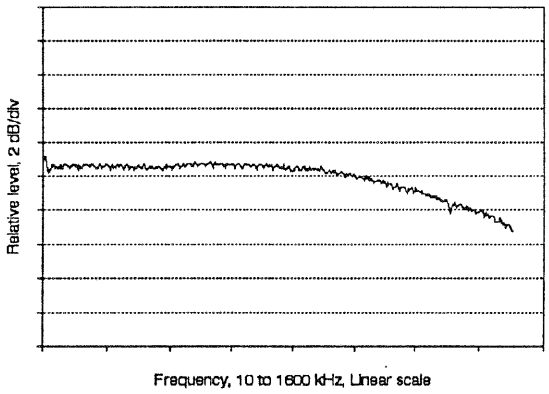
The diagram on the right shows the low frequency part of the spectrum, with the bandwidth of the spectrum analyzer set so that you can see the discrete spectral lines as well as the roll off of 20 dB from 1 kHz to 10 kHz.

The spectrum analyzer settings for this were:
Real Bandwidth: 100 Hz,
Video Bandwidth 150 Hz.

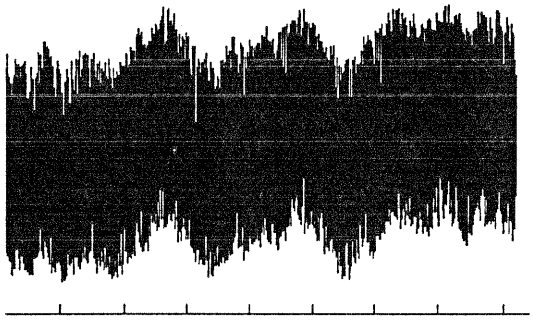


This diagram shows the main part of the spectrum. and shows how the spectrum is flat to 1 MHz before rolling off by 3 dB at 1.5 MHz.

Spectrum analyzer settings were:
RBW:3 kHz
VBW:50 Hz,



The time representation of the waveform is shown on the right. This shows just one cycle. It is very difficult to see on a scope unless you can synchronize the trigger to a 320 Hz source.



10.3 ELECTRICAL

10.3.1 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).

10.3.2 On Simulated Wireline

300 Volts maximum peak AC +DC voltage between:
Tip and Ring, or
Tip and Ground, or
Ring and Ground.

Maximum Current: 100 ma DC

10.4 ENVIRONMENTAL

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

10.5 MECHANICAL

Weight:	17 kg
Dimensions:	7" x 17.5" x 15" or 180mm x 445mm x 382mm (H x W x D).

10.6 OPERATING CONDITIONS

In order for the unit to operate correctly and safely, it must be adequately ventilated. The DLS 200HE 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.

Section 11 SAFETY

11.1 INFORMATION

11.1.1 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".

11.1.2 Before Operating the Unit

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

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

- Use only a power supply cord with a protective grounding terminal.
- Connect the power supply cord only to a power outlet equipped with a protective earth contact. Never connect to an extension cord that is not equipped with this feature.
- Do not willfully interrupt the protective earth connection.

11.1.3 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.

11.1.4 Mains Fuse Type

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

11.1.5 Connections to a Power Supply

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

11.1.6 Operating Environment

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

11.1.7 Class of Equipment

The 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 a Safety Class I equipment .

11.1.8 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.

11.1.9 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.

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

11.2 SYMBOLS

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

EQUIPOTENTIALITY-FUNCTIONAL EARTH TERMINAL

PROTECTIVE GROUNDING CONDUCTOR TERMINAL

CAUTION - REFER TO ACCOMPANYING DOCUMENTS

Section A APPENDIX

A.1 INTERPRETATION OF LEVEL UNITS

This section explains 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) $\mu V/\sqrt{Hz}$ - 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.

1) $\mu V/\sqrt{Hz}$ 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 $\mu V/\sqrt{Hz}$:

$$V * V = (\mu V/\sqrt{Hz}) * (\mu V/\sqrt{Hz}) * \text{Bandwidth}$$
$$= (10E\text{-}6) * (10E\text{-}6) * 3000$$
$$= 3.00E\text{-}7$$

$$P\ (load) = V * V / R \text{ watts}$$
$$= (3.00E\text{-}7) / 135 \text{ watts}$$
$$= 2.22E\text{-}9 \text{ watts}$$

$$P\ (ref) = 1E\text{-}3 \text{ watts}$$

$$dBm = 10*LOG\ [P(load)/P(ref)]\ dBm$$
$$= 10*LOG\ [(2.22E\text{-}9)/(1E\text{-}3)]\ dBm$$
$$= -56.5\ dBm$$

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

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. The following are loads that are assumed to be in place for Consultronics DLS 200HE Noise generators. (In all cases any wirelines in place are set to zero length).

For the ANSI FULL BW, the loading is one 135 Ω resistor and one complex impedance as described in the text.

For all other noises the loading is two 135 Ω resistors in parallel.

Notes:

A) To change a level in $\mu V/\sqrt{Hz}$ by a certain number of dB use the following formula: (Assume x is the amount to change the $\mu V/\sqrt{Hz}$ setting by, and the dB change required is -6 dB.)

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

Therefore the original setting in $\mu V/\sqrt{Hz}$ should be multiplied by 0.50 to give a change of -6 dB.

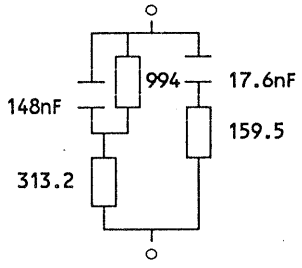
B) To change a level in dBm/Hz by a certain number of dB simply change the dBm/Hz setting by the required amount. An examination of the formula on the previous section will bear this out.

A.2 COMMONLY ASKED QUESTIONS & ANSWERS

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 W, 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) In general, we set the DLS 200HE to a loop length of 0, and provide a 67.5 Ω load at the terminal, T3 or T4 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:



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

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 asthe 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 200HE? (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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