Operating and
Reference Manual

DLS 90

ADSL Wireline Simulator

Revision 5
January 1, 2000

TABLE OF CONTENTS

1. INTRODUCTION

1.1 About this Manual

The DLS 90 Operating Manual can be used to learn about the unit for the first time, or can be used as a look up reference book. We suggest that you carefully read the introduction sections of this manual before powering on your unit.

If you still have questions after reading this manual, please contact your DLS TestWorks sales representative or our customer service department at the location shown in section 4, "Warranty" of this manual. If you have any suggestions as to how this manual could be improved, please write to us at the same address.

Thank you for your business and for choosing DLS TestWorks.

1.2 Receiving and Unpacking the Unit

The DLS 90 has been shipped to you in a reinforced cardboard shipping container. We recommend that you retain this carton for any future shipments.

Please check that you have received all the 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.

The DLS 90 supports many AC voltages found in various parts of the world. We have already selected the voltage appropriate to your country according to the information we had. But errors do occur... so read section 2.1 "Powering on the DLS 90" before switching on the DLS 90.

1.3 DLS 90 Overview

The DLS 90 simulates a 2 wire length of cable up to frequencies of 1.5 MHz and provides usable simulation up to 2 MHz. The user can easily change the length of the simulated cable by using the front panel of the DLS 90 or via a computer. It is meant to be used in laboratories and production lines to simulate "real life" wireline situations on bench top.

The DLS 90 can be ordered with 6.35 kft or 9.35 kft in 24 or 26 AWG, and 0.4mm PE line to 3 km.

Introduction

The devices under test are connected to the DLS 90 using either the RJ-45 connectors or the terminal block, located at the front or at the back. All the connectors on each side are connected in parallel.

The unit can be controlled via the IEEE 488 and the RS-232 serial interfaces. One simple command is all that is needed to set the channel length, but other IEEE 488.2 and SCPI commands are also supported.

The main component of the DLS 90 is the mother board, which holds

- The simulation circuitry
- The microprocessor and all the control logic
- The power supply
- Analog connectors (RJ-45 and terminal block)
- Digital Interfaces (RS-232 and IEEE 488)

The mother board has a front panel board attached which holds the display and the keys.

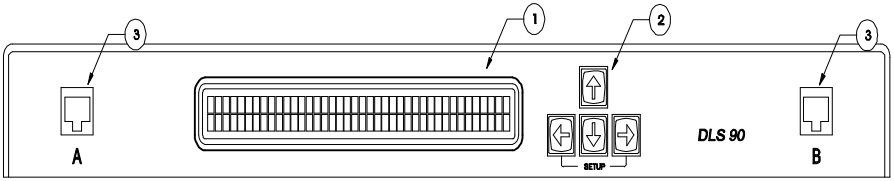


Figure 1-1 - The DLS 90 Front Panel

1. Liquid crystal display (LCD).
2. Menu control / setup keys.
3. RJ-45 modular connector for device under test, one on each end of the wireline (internally connected to items 9, 10 and 11).

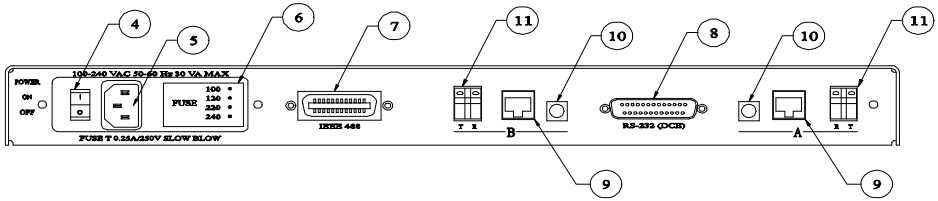


Figure 1-2 - The DLS 90 Back Panel

4. Power switch.
5. AC power input plug.
6. Power voltage selector and fuse case.
7. IEEE 488 interface connector for remote control.
8. RS-232 serial interface connector for remote control.
9. Modular connector for device under test (int. connected to items 3,10 & 11).
10. Modular connector for injection of impairments (internally connected to items 3, 9 and 11).
11. Terminal strip for connection to device under test (internally connected to items 3, 9 and 10).

2. OPERATION

2.1 Powering On the DLS 90

Before switching on the DLS 90, verify that the line voltage selection shown at the back of the unit corresponds to the local line voltage. If it is different, then do the following:

- Remove the power cord
- Open the fuse box cover in the power module at the back using a small flat screwdriver
- Pull the voltage selector card
- Turn the plastic knob until you have selected your local power voltage
- Put everything back together
- Check that the white dot is now beside your local line voltage.

The DLS 90 can is using a two fuse configuration.

To operate the DLS 90, connect the unit to the power source, and turn on the unit.

One convenient feature of the DLS 90 is that the last configuration used is kept latched into the relays, allowing the unit to be used even when the power is turned off. As an option, the wireline length may be restored or reset to zero.

2.2 Connecting the DLS 90

The side A of the simulated wireline can be accessed from any of the RJ-45 connectors labelled "A" at the front or at the back of the DLS 90, or from the terminal blocks at the back of the DLS 90. The user can also inject impairments to side A of the wireline by using the "noise" RJ-45 connector on the back of the DLS 90.

Side B of the simulated wireline can be accessed from any of the RJ-45 and terminal blocks labelled "B" as explained above.

Note that all the RJ-45 connectors and terminal blocks on each side are connected in parallel, any combination of connectors can be used. For optimum performance at high frequencies, the recommended connectors to use are Side A at the front and side B at the rear.

The DLS 90 provides a fully bi-directional wireline simulation.

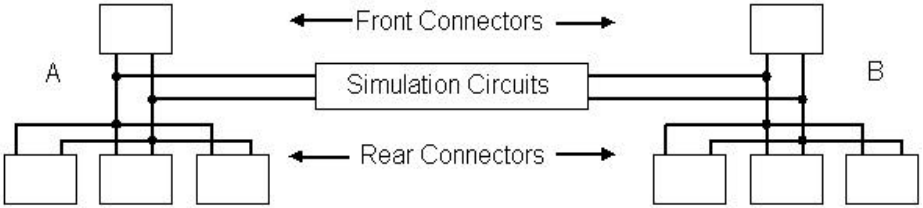


Figure 2-1 - DLS 90 internal connecting paths

2.3 Changing the Cable Length

The unit can be controlled via the 4 arrow keys on the front panel. The left and right arrow keys select the digit to be set and the up and down keys select the value of that digit. When reaching the maximum or the minimum, the value stops changing. The display will show the current length of the simulated cable, the type of wireline, and the maximum length shown on the right bottom section of the screen.

The resolution of the cable length is 50 ft (for AWG units) and 50m (for 0.4mm PE). The DLS 90 sets the cable length after 1 second of keyboard inactivity.

2.4 Configuring the DLS 90

Pressing both the Left and Right arrow keys at the same time gets into the unit setup menus, where some of the operational characteristics of the unit can be changed.

The user can move among the different fields using the Left and Right arrows. The Up and Down arrows will change the setting of the selected feature. On any of the setting screens, pressing both Left and Right arrow keys at the same time returns to the main screen.

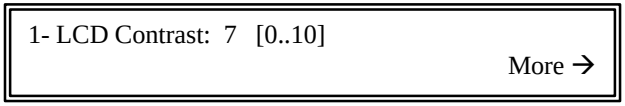


Figure 2-2 - LCD Contrast

To change the contrast of the display use the following steps:

- From the main screen, press both the left and right arrows simultaneously.
- Use the up and down arrows to select the desired contrast.
- Press the left and right arrows simultaneously to return to the main screen.

The contrast value is saved in non-volatile RAM, and will be restored on power up. The default contrast is 7.

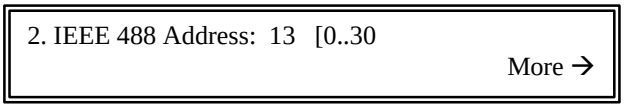


Figure 2-3 - IEEE 488 Address

To change the IEEE 488 address of the DLS 90 use the following steps:

- From the main screen, press both the left and right arrows simultaneously.
- Press the right arrow once to get to the IEEE 488 Address screen.
- Use the up and down arrows to select the desired address.
- Press the left and right arrows simultaneously to return to the main screen.

The address is saved in non-volatile RAM, and will be restored on power up. The default is 13. See section 3.1 for more details.

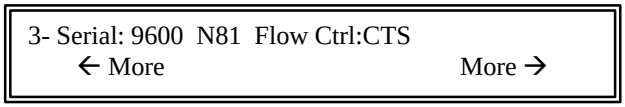


Figure 2-4 - RS-232 Interface

To change the serial interface baud rate, data format or flow control, use the following steps:

- Press both the left and right arrows simultaneously
- Press the right arrow until you get to the RS-232 Serial interface protocol screen
- Use the up and down arrows to select the desired baud rate.
- Press the right arrow key
- Use the up and down arrows to select the desired data format.
- Press the right arrow key
- Use the up and down arrows to select the desired flow control method.
- Press the left and right arrows simultaneously to return to the main screen.

The parameters are saved in non-volatile RAM, and will be restored on power up. The defaults are 9600, N81 and CTS. See section 3.2 for more details.

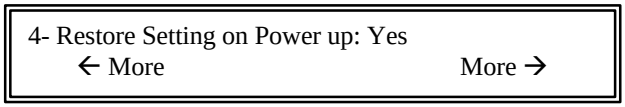


Figure 2-5 - Restore on Power up

On power up, the DLS 90 can restore the length of the wireline that was used when the power was turned off, or it can set the length to 0. To change the setting use the following steps:

- From the main screen, press both the left and right arrows simultaneously.
- Press the right arrow until you get to the Restore Setting screen.
- Use the up and down arrows to select the desired setting.
- Press the left and right arrows simultaneously to return to the main screen.

The setting is saved in non-volatile RAM, and will be restored on power up. The default is yes.

```
5- Checksum:1A2B3C  Version:05  RAM:OK
← More
```

Figure 2-6 - System Status

The last screen shows the checksum of the EPROM, the version of the firmware and the non-volatile RAM state. No change can be done in that screen.

3. REMOTE CONTROL

The DLS 90 can be remote-controlled via the IEEE 488 (also known as the GPIB bus) and RS-232 (serial) interface, allowing the integration of the DLS 90 into a larger test system.

The DLS 90 remote control is designed with several standards in mind:

- The GPIB physical interface follows IEEE 488.1. The functions implemented are outlined in 3.1 "IEEE 488 Interface".
- The Common Commands follow IEEE 488.2.
- The Device Dependent Commands (see Section 3.7) are based upon the Standard Commands for Programmable Interfaces (SCPI). However, we had to create some device dependant commands since there was no pre-defined SCPI command that could apply to the DLS 90.
- The serial port physical interface follows the EIA RS-232 standard.

The IEEE 488 and the serial interfaces are always enabled, and can be used alternatively. The DLS 90 directs its output to the last interface it received data from. Both interfaces use the same command set and produce the same results.

Section 3.1 and 3.2 describe the functions specific to one particular interface, the remainder of section 3 describes the commands that are common to both interfaces.

3.1 IEEE 488 Interface

3.1.1 IEEE 488.1 Interface functions supported

The IEEE 488.1 Interface functions supported by the DLS 90 are as follows:

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

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

3.1.2 IEEE 488 Address

The IEEE 488 address of the DLS 90 can be set from 0 to 30. The address can be changed by using the front panel (see section 2.4) or remotely (see section 3.7.2).

3.1.3 The SRQ Line

The SRQ line, as defined by the IEEE 488.1 standard, is raised when the DLS 90 is requesting service. Here are some examples of services that could raise SRQ:

- A message is available in the output buffer
- An error occurred
- All pending operations are completed
- The power was just turned on

In order to use the SRQ line, all relevant enable bits must be set, for example:

The SRQ line can be raised automatically when there is a message available by enabling the MAV bit in the Status Byte Register with *SRE 16.

The SRQ line can be raised automatically when there is an error by enabling the ESB bit in the Status Byte Register with *SRE 32 and by enabling the error bits in the Standard Event Status Register with *ESE 60 (32+16+8+4).

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

We recommend that you set the DLS 90 to raise the SRQ line when there is a message available and when there is an error. The control program should follow those steps:

- Set all the relevant enable bits (only done once)
- Send the message
- Wait for SRQ if using the IEEE 488 interface
- Read the Status Byte
- If MAV is set then read the response
- If ESB is set then read the Standard Event Status Register and take all the relevant actions

For example, to get the identification message with the IEEE 488 interface, do the following:

- 1. transmit "*SRE 48" →enable MAV and ESB (needed only once)
- 2. transmit "*ESE 60" →enable all the error flags (needed only once)
- 3. transmit "*IDN?" →query the identification message
- 4. wait for SRQ to be raised
- 5. read the status byte →use the IEEE 488.1 command, not *STB?
- 6. if MAV is set read the response
- 7. if ESB is set do the following →check if an error was detected
- 8. transmit "*ESR?" →query the Event Status Register
- 9. wait for SRQ to be raised
- 10.if MAV is set read the response and take all the relevant action according to the error type received

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

3.1.4 Message Terminators

Messages to the DLS 90 must be terminated with either a Line Feed character (ASCII <LF>, decimal 10, hex 0A), an IEEE 488.1 EOI signal or both. Messages from the DLS 90 are always terminated with a Line Feed character and the IEEE 488.1 EOI signal.

3.2 RS-232 Serial Interface

The DLS 90 uses a female DB-25 connector, and is configured as a DCE device.

To use the serial interface, simply connect your computer to the DLS 90 and set both the computer and DLS 90 to the same protocol: baud rate, data format and flow control. Do NOT use a null modem. The following sections give more details on the various protocols.

The RS-232 serial interface can be set from the front panel (see section 2.4) or remotely (see sections 3.7.3 to 3.7.5) with either the serial or the IEEE 488 interfaces.

3.2.1 Baud Rate

The DLS 90 supports the following baud rates:

300, 600, 1200, 2400, 4800, 9600, 19 200 and 38 400 bits per second.

The default is 9600 bps.

3.2.2 Data Format

The DLS 90 can use any of the following combinations of parity, character size, and number of stop bits:

E71, O71, E72, O72, N72, E81, O81, N81 and N82

Where:

E = even parity
O = odd parity
N = no parity
the second digit is the character size
the third digit is the number of stop bits

The default value is N81.

3.2.3 Flow Control

Flow control allows the receivers to stop and to restart the data transmission in order to prevent data loss.

Both the computer program and the DLS 90 must be set with the same flow control selection. Note that some communication programs may only support some of the 5 flow control options that the DLS 90 has, and in some cases, the terminology may differ.

3.2.3.1 "None" Flow Control

In most cases, there is no need for flow control because of the simplicity of the DLS 90. The "None" flow control selection can be a valid choice if only one command at a time is sent with some delay between them.

3.2.3.2 CTS Flow Control

When CTS flow control is selected, the DLS 90 lowers the CTS and the DSR lines when it cannot accept data, and raises them when it can accept new characters.

This protocol controls the data flow in only one direction; from the computer to the DLS 90.

3.2.3.3 RTS/CTS Flow Control

When RTS/CTS flow control is selected, the DLS 90 stops transmitting data when the RTS line is low, and restarts when the RTS line is high. The DLS 90 lowers the CTS and the DSR lines when it cannot accept data, and raise them when it can.

This protocols controls the data flow in both directions. Note that the RTS line is not the usual "Request To Send" as defined by the RS-232 standard.

3.2.3.4 XOn/XOff Flow Control

When XOn/XOff flow control is selected, the DLS 90 stops transmitting data when it receives the XOff character (decimal 19, hex 13, ^S), and restarts when it receives the XOn character (decimal 17, hex 11, ASCII ^Q). The DLS 90 will send XOff when it cannot accept data and will send XOn when it can.

This protocol controls the data flow in both directions.

3.2.3.5 "All" Flow Control

When "All" flow control is selected, the DLS 90 uses both the RTS/CTS and the XOn/XOff flow control.

This protocol controls the data flow in both directions.

3.2.4 Message Terminators

Any message sent to the DLS 90 through the serial interface MUST be terminated with the line feed character (decimal 10, hex 0A, LF). To ensure that no characters were left in the receive buffer of the DLS 90 from an old, incomplete command, you can send the line feed character by itself before sending new commands. Messages from the DLS 90 are always terminated with a Line Feed character.

3.3 Data formats

The DLS 90 adheres to the IEEE 488.2 principle of Forgiving Listening and Precise Talking.

The DLS 90 can accept data in the <NRf> format, which means that numbers can be made of a combination of digits, signs, decimal point, exponent, multiplier, unit and spaces. For example, any of the following are valid representation for 9000 feet: 9kft, 9.0 kft, 9000, 9E3 ft, +9000. If a unit is appended to a number, it must be valid in the current context. Note that the period separates the decimal part of a number.

Within this framework, the data formats supported by the DLS 90 are:

Listening:	a) <NRf> Decimal Numeric Program Data
Talking:	a) <NR1> Numeric Response Data - Integer b) Arbitrary ASCII Response Data

<NRf> is the Flexible Numeric Representation (just about any number representation) defined in the IEEE.2 standard, <NR1> is an implicit point representation of a numeric value (an integer number). Arbitrary ASCII Response Data is a generic character string without any delimiting characters. It is usually used to send data in response to a query, such as with the *IDN? command (see section 3.6, "IEEE 488.2 Common Command Set").

3.4 Command Syntax

The DLS 90 adheres to the IEEE 488.2 format for command syntax. As with the Data Format, the principle is forgiving listening and precise talking.

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

Common commands are preceded by *. Device Dependent commands are preceded by a colon, with a colon separating each level of the command. Commands may be either in upper or lower case. Multiple commands may be concatenated by separating each command by semi-colons.

The following are some examples:

***RST**
***RST; *WAI;: SET:CHANNEL:LENGTH 9kft**
***ESE 45; *SRE 16**

IEEE 488 messages to the DLS 90 may be terminated with either a Line Feed character (ASCII <LF>, decimal 10, hex 0A), an IEEE 488 EOI signal or both. RS-232 messages must be terminated with a line feed character. Messages from the DLS 90 are always terminated with a Line Feed character, and also with the EOI signal if using the IEEE 488 interface.

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

: SET: CHANNEL: LENGTH 9.0 kft
: SET: CHAN: LEN 9.0 kft
: SET: chan: LENGTH 9.0 kft

Queries of the system follow the same format as the commands, except that the data normally associated with a command is replaced by a question mark "?". Following receipt of such a command, the DLS 90 will place the appropriate response on the output queue, where it can be read by the controller.

Examples are:

***IDN?**
***ESE?;*SRE?**
: SET: CHAN: LEN?

When a command does not begin with a colon, the DLS 90 assumes that the command is at the same level as the previous command. For example, to set the serial interface, one does need to specify `: SYStem: COMMunicate: SERial' each time, such as in:

: SYStem: COMMunicate: SERial: BAUD 9600;PACE CTS
FORMAT N81

This shorter form is valid because BAUD, PACE and FORMAT are at the same level.

3.5 Status Reporting

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

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

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

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

3.5.1 Status Byte Register (STB)

The bits of this register are mapped as follows:

bit 4: MAV (Message Available Bit)

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

bit 5: ESB (Event Status Bit)

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

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

MSS is raised when either MAV or ESB are raised and enabled. When the status of MSS changes, the whole Status Byte Register is copied into the Status Byte of the GPIB controller, where bit 6 is called RQS. When RQS goes high so does the SRQ line, and in response to an IEEE 488.1 Serial Poll command, both are cleared.

RQS and SRQ are defined by the IEEE 488.1 standard and are hardware related. MSS summarises all the status bits of the DLS 90, as defined by the IEEE 488.2 standard.

bits 7, 3, 2, 1,and 0 are not used by the DLS 90.

3.5.2 Event Status Register (ESR)

The Event Status Register monitors events within the system and reports on those enabled. It records transitory events as well. The DLS 90 implements only the IEEE 488.2 Standard Event Status Register (ESR). It is defined as:

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

bit 1 Request Control. The DLS 90 does not have the ability to control the IEEE bus, and so this bit is always 0.

bit 2 Query Error. There was an attempt to read an empty output queue or there was an output queue overflow. (Maximum output queue capacity is 50 bytes).

bit 3 Device Dependent Error. At this time there are no device dependent errors in the DLS 90, so this bit is always 0.

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

bit 5 Command Error. Either a syntax error (order of command words) or a semantic error (spelling of command words) has occurred. A GET (Group Execute Trigger) or *TRG command will also set this bit.

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

bit 7 Power on. This bit is set when the DLS 90 is turned on. Sending *ESR? clears the bit and stays cleared until the power is turned on again.

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

3.6 Common Command Set

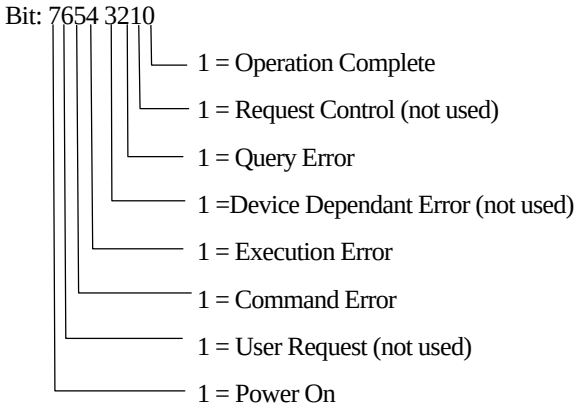
As specified in the IEEE 488.2 standard, a number of common commands are required to set up and control of standard functions of remote controlled devices. These common commands are as follow:

***CLS** **Clear Status Command**

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

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

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



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

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

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

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

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

***ESR?** **Event Status Register Query**

Type: Status command
Function: An integer value between 0 and 255 representing the value of the Event Status Register (ESR) is placed in the output queue. Once the value is placed in the

output queue, the register is cleared. The possible values are described in the *ESE command section.

***IDN?** **Identification Query**

Type: System command
Function: Returns the ID of the unit. Upon receiving this command the DLS 90 will put into the output queue the following string:

DLSTESTWORKS LTD, DLS 90 <Gauge>-<MaxLen unit>, <SN>, <Ver>

where:

<Gauge>	is the gauge installed in the unit
<MaxLen Unit>	is the maximum length supported by the DLS 90, followed by the unit of the length
<SN>	is the serial number of the unit
<Ver>	is the revision level of the control firmware (always 2 digits)

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

Type: Synchronisation command
Function: Indicates to the controller when the current operation is complete. This command will cause the DLS 90 to set bit 0 in the Event Status Register (ESR) when all pending operations are completed. The bit is read with the *ESR? command, which also clear the bit. Communication can proceed as normal after this command, but be prepared to receive SRQ at any time. See section "DLS 90 Synchronisation" for more details.

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

Type: Synchronisation command
Function: Indicates when the current operation is complete. This will cause the DLS 90 to put an ASCII 1 (decimal 49, hex 31) in the output queue when the current operation is complete. Communication can proceed as normal after this command, but be prepared to receive the "1" at any time. See the section 3.8 for more details.

***PSC <NRf>** **Power-on Status Clear**

Type: Status and event command

Function: Indicates if the unit should clear the Service Request Enable Register and the Standard Event Status Register at power-on. If 1 then all the enable registers are cleared at power-on, if 0 then all the enable registers are restored from the non-volatile RAM at power-on. The factory default is 1 (clear all the enable registers). Any change to the "Power-on Status" is saved in non-volatile RAM, and is always restored on power up.

***PSC?** **Power-on Status Clear Query**

Type: Status and event command

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

***RST** **Reset**

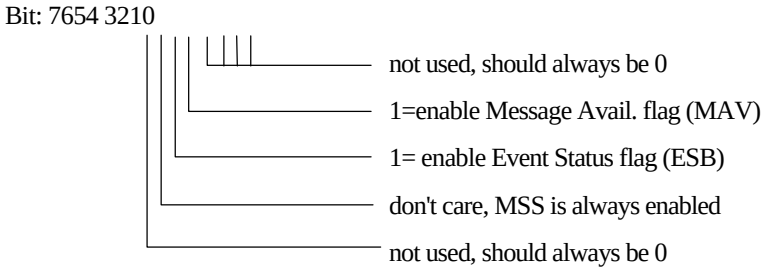
Type: Internal command

Function: IEEE 488.2 level 3 reset. This command will set the length of the DLS 90 to 0 kft (or 0 km), and cancel any pending *OPC operation. It will not affect the output buffer or other system settings of the unit.

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

Type: Status command

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



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

Note that if both MAV and ESB are disabled, then the bits MSS and RQS and the line SRQ are never going to be raised (see section 3.5.1 for more details).

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

***SRE?** **Service Request Enable Query**

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

***STB? Status Byte Query**

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

Note that bit 6 is MSS, which does not necessarily have the same value as RQS (see section 3.5.1 for more details).

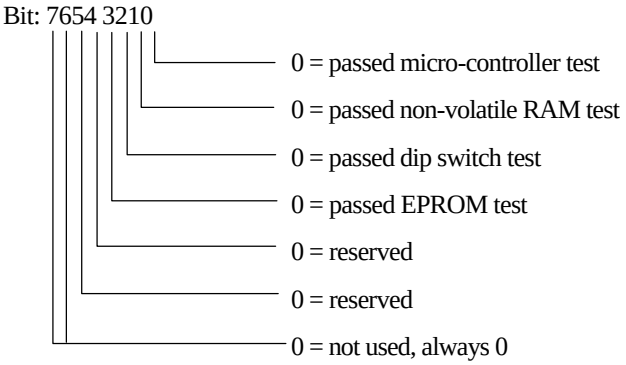
***TRG** **Trigger**

Type: Trigger command
Function: Trigger operation of the device. Since the DLS 90 has no functions that can be triggered this command has no effect on the operation of the unit.

***TST?** **Self-Test Query**

Type: Internal command

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



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

***WAI** **Wait to continue**

Type: Synchronisation command

Function: Used to delay execution of commands. The DLS 90 will ensure that all commands received before "*WAI" are completed before processing any new commands. This means that all further communication with the DLS 90 will be frozen until all pending operations are completed. See section "DLS 90 Synchronisation" for more details.

3.7 Device Dependent Command Set

As recommended by the SCPI consortium and to stay consistent with the more sophisticated DLS TestWorks simulators, the DLS 90 uses the following tree structure:

```
:SETting
        :CHANnel
                :LENgth <NRf>
:SYSTem
        :COMMunicate
                :GPIB
                        :ADDRess <0..30>
                :SERial
                        :BAUD 300 | 600 | 1200 | 2400 | 4800 | 9600 | 19200 | 38400
                        :FORMat E71 | O71 | E72 | O72 | N72 | E81 | O81 | N81 | N82
                        :PACE NONE | CTS | RTS/CTS | XON/XOFF | ALL
```

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

The DLS 90 will round any number to the nearest number permitted by the resolution of the parameter.

Sections 3.3 and 3.4 give more information on the data format and the command syntax.

3.7.1 :SETting:CHANnel:LENgth <NRf>

Set the length of the simulated wireline channel, where <NRf> is the length ranging from 0 to the maximum length (the maximum value depends on the DLS 90 model). For example, to set the length of the simulated wireline (for AWG units) to 8.5 kft, send:

:SET:CHAN:LEN 8.5 kft

To set the length of the wireline (for 0.4mm PE) to 3 km, send:

:SET:CHAN:LEN 3.0 km

The units of the length are optional, but they must match your DLS 90 model units.

To query the length currently simulated by the DLS 90 send:

:SET:CHAN:LEN?

The command will return an integer number ranging from 0 to the maximum length followed by the units. For example, if the length of the wireline is 8.5 kft, the return message will be:

8500 FT

3.7.2 :SYStem:COMMunicate:GPIB:ADDRess <NRf>

Set the address of the IEEE 488.1 interface, where <NRf> is the address ranging from 0 to 30. For example, to set the address to 13, send:

:SYS:COMM:GPIB:ADDR 13

Note that the new address must be used immediately for any further IEEE 488 communication.

To query the current address send:

:SYS:COMM:GPIB:ADDR?

The command will return an integer number ranging from 0 to 30. For example, if the address is 13, the return message will be:

13

3.7.3 :SYStem:COMMunicate:SERial:BAUD <NRf>

For example, to set the baud rate to 9600 bit per second, send:

:SYS:COMM:SER:BAUD 9600 bps

The units are optional, but they must be "bps" if used.

Note that the new baud rate must be used immediately for any further serial communication.

To query the current baud rate send:

:SYS:COMM:SER:BAUD?

The command will return the baud rate as an integer number. For example, if the baud rate is 9600 bps, the return message will be:

9600

3.7.4 :SYStem:COMMunicate:SERial:FORMat <format>

Set the receiver and transmitter data format of the serial interface, where <format> is any of the following choices:

E71 | O71 | E72 | O72 | N72 | E81 | O81 | N81 | N82

Where:

E = even parity
O = odd parity
N = no parity

the second digit is the character size

the third digit is the number of stop bits

For example, to set the data format to no parity, 8 bit per character, 1 stop bit, send:

:SYS:COMM:SER:FORMAT N81

Note that the new data format must be used immediately for any further serial communication.

To query the current data format send:

: SYS:COMM:SER:FORMAT?

The command will return the data format as a 3 character string. For example, if the data format is no parity, 8 bit per character, 1 stop bit, the returned message will be:

N81

In order to simplify the setting of the serial interface, we have slightly modified the command set as specified by the SCPI standard. The SCPI standard requires separate settings for parity, character size, and number of stop bits. The DLS 90 combines the three settings.

3.7.5 :SYStem:COMMunicate:SERial:PACE <pace>

Set the receiver and transmitter pace method (flow control) of the serial interface, where <pace> is any of the following choices:

NONE | CTS | RTS/CTS | XON/XOFF | ALL

For example, to set the pace method to RTS/CTS, send:

:SYS:COMM:SER:PACE RTS/CTS

Note that the new pacing must be used immediately for any further serial communication.

To query the current pacing method send:

:SYS:COMM:SER:PACE?

The command will return the pacing method as a string. For example, if the pacing method is RTS/CTS, the returned message will be:

RTS/CTS

To simplify the setting of the serial interface, we used a slightly modified SCPI command set. The SCPI standard requires separate settings for the RTS/CTS flow control and XOn/XOff pacing, and differentiates between the receive and the transmit sides. The command set of the DLS 90 combines the ":RTS" and the "XON" settings into one ":PACE" command.

Note that the SCPI standard assumes a DTE configuration, whereas the DLS 90 is configured as a DCE port (thus not requiring a Null Modem).

3.7.6 DLS 90 Synchronization

The program controlling the DLS 90 can use three different commands to synchronize with the DLS 90: *OPC, *OPC? and *WAI. Following are the main differences:

	Set Operation Complete bit when Done	Return "1" when operation complete	Raise SRQ when operation complete	Block comm. with the DLS 90	Required Enable Bit(s)
*OPC	Yes	No	Yes (1)	No	Operation Complete, ESB
*OPC?	No	Yes	Yes (2)	No	MAV
*WAI	No	No	No	Yes	none

(1) if "Operation Complete" and ESB are enabled

(2) if MAV is enabled

The main difference between OPC and WAI is that WAI will block any further communication with the DLS 90 until all pending operations are completed. The main difference between *OPC and *OPC? is that *OPC set the "Operation Complete" bit, and *OPC? will return an

ASCII "1" when all pending operations are completed. Make sure that all the required enable bits are set.

When using *OPC or *OPC?, the program controlling the DLS 90 can determine when the operation is completed by waiting for SRQ, or by reading the status byte with the serial poll or with *STB? (if corresponding bits are enabled).

If the program uses the *OPC? command and then sends more queries, the program must be ready to receive the "1" concatenated to other responses at any time.

When using *WAI, the communication time out should be set long enough to avoid losing data (the DLS 90 needs approximately 200 ms to set a length).

4. References

The following references give more information on the IEEE 488 interface:

- ANSI/IEEE 488.1-1987, IEEE Standard Digital Interface for Programmable Instrumentation (The Institute of Electrical and Electronics Engineers, Inc. 345 East 47th Street, New York, NY 10017-2394, USA)

- IEEE 488.2-1992, IEEE Standard Codes, Formats, Protocols, and Common Commands (The Institute of Electrical and Electronics Engineers, Inc. 345 East 47th Street, New York, NY 10017-2394, USA)

- SCPI Standard Commands for Programmable Instruments, available from some interface controller manufacturers
  (SCPI Consortium, 8380 Hercules Drive, Suite P. S., La Mesa CA 1942 Phone: (619) 697-8790, Fax: (619) 697-5955.)

5. WARRANTY

DLS TestWorks 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 DLS TestWorks service centre prior to the expiration of the warranty period for the purpose of allowing DLS TestWorks to inspect and repair the equipment.

If inspection by DLS TestWorks 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 DLS TestWorks.

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

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

DLS TestWorks
169 Colonnade Road
Nepean, Ontario, Canada
K2E 7J4
Telephone: (613) 225-6087
Fax: (613) 225-6315
Toll Free: 1-800-465-1796
e-mail: sales@dlstestworks.com

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

Or your local DLS TestWorks representative

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

In no event (including, but not limited to the negligence of DLS TestWorks, its agents or employees) shall DLS TestWorks 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 DLS TestWorks whatsoever in connection with the equipment shall terminate.

6. SHIPPING THE DLS 90

To prepare the DLS 90 for shipment, turn the power off and disconnect all cables, including the power cable, and pack the simulator in the original carton. Do not place any cables or accessories directly against the front panel as this may scratch the surface of the display. We suggest that you mark all shipments with labels indicating that the contents are fragile.

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

7. SPECIFICATIONS

The DLS 90 is a two wire cable simulator. The user can select the simulated cable length using the keys on the front panel, or via one of the remote control interfaces (i.e IEEE488 or RS-232). For AWG gauges, the length can be varied from 0 to 6.35 kft in steps of 50 ft. With the extended wireline option, a maximum length of 9.35 kft can be achieved. The DLS 90 (0.4mm PE version) simulates up to 3 km of cable and the maximum length can be varied in steps of 50m.

7.1 Simulated Cable Type and Maximum Length

The DLS-90 simulates one gauge of cable which may be 26, 24 AWG or 0.4mm PE.The gauge must be specified at the time of order.The maximum length can be up to 9.35 kft for AWG units, and in 3.0 km for 0.4mm PE.

7.2 Frequency Response

From DC to 1.5 MHz.
Accuracy:

±0.5 dB up to 20 dB attenuation,
±1 dB from 21 dB up to 35 dB attenuation,
±2 dB up to 70 dB attenuation.

7.3 Delay

From 20 KHz to 1 MHz, ±10%

7.4 Characteristic Impedance

From 20 KHz to 999 KHz, ±5%
From 1 MHz to 1.5 MHz, ±10%

7.5 DC Characteristics

DC Resistance ± 5%
100 mA, 300 V maximum DC + peak AC between tip & ring

7.6 IEEE 488 Remote Control

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

a) Listener
b) Talker
c) Local Lockout
d) Serial Poll
e) Selective Device Reset
f) Bus Reset
g) Primary Addressing from 0 to 30

7.7 RS-232 Remote Control

The unit can be controlled via a RS-232 serial interface. The unit supports the following functions:

Baud Rate: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400

Data Format: E71, O71, E72, O72, N72, E81, O81, N81 and N82

Where:

E = even parity
O = odd parity
N = no parity

the second digit is the character size

the third digit is the number of stop bits

Flow Control: None, CTS, RTS/CTS, XOn/XOff, All

7.8 Connections

2 (one per terminal) 8 way RJ-45 connectors at the front and back.

Two 2 pole terminal strips and an extra set of RJ-45 connectors at the back.

All connectors are in parallel.

7.9 Options

(1) Rack mount kit
(2) IEEE 488 shielded cable

7.10 ELECTRICAL

7.10.1 AC Power

Rated Input Voltage: 100-240VAC(±10%).
Rated Frequency: 50-60Hz.
Rated Power consumption: 30VA max.
Line Fuses: Type "T" 0.25A/250V SLOW BLOW (2 required, 5mm x 20mm).

7.11 ENVIRONMENTAL

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

7.12 MECHANICAL

Weight: 4.5kg / 10 lbs.
Dimensions: 42mm x 429mm x 366mm (H x W x D).
1¾" x 17" x 15"(1U height.)

7.13 OPERATING CONDITIONS

In order for the unit to operate correctly and safely, it must be adequately ventilated. The DLS 90 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 ½" (10 mm) of clearance from the ventilation holes. Blocking the air circulation around the equipment may cause the equipment to overheat, compromising its reliability.

8. SAFETY

8.1 Information

8.1.1 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".

8.1.2 Before Operating the Unit

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

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

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

8.1.3 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.

8.1.4 Mains Fuse Type

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

8.1.5 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.

8.1.6 Operating Environment

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

8.1.7 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 .

8.2 INSTRUCTIONS

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

DLS TESTWORKS LTD. assumes no liability for the customers failure to comply with any of these requirements.

8.2.1 Before Operating the Unit

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

8.2.2 Operating the Unit

Do not operate the equipment when its covers or panels have been removed.
Do not interrupt the protective grounding connection. Any such action can lead to a potential shock hazard that could result in serious personal injury.
Do not operate equipment if an interruption to the protective grounding is suspected. Ensure that the instrument remains inoperative.
Use only the type of fuse specified.
Do not use repaired fuses and avoid any situation that could short circuit the fuse.
Unless absolutely necessary, do not attempt to adjust or perform any maintenance or repair procedure when the equipment is opened and connected to a power source at the same time.
Any such procedure should only be performed by qualified service professional.
Do not attempt any adjustment, maintenance or repair procedure to the equipment if first aid is not accessible.
Disconnect the power supply cord from the equipment before adding or removing any components.
Operating the equipment in the presence of flammable gases or fumes is extremely hazardous.
Do not perform any operating or maintenance procedure that is not described in the Operating and Reference Manual or the Sevice Manual.
Some of the equipment's capacitors may be charged even when the equipment is not connected the power source.

8.3 SYMBOLS

This symbol is on the unit and has the following meaning:

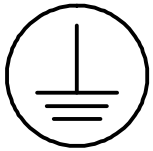


FIG. 7.1 "PROTECTIVE GROUNDING CONDUCTOR TERMINAL"

INDEX