INSTRUCTION MANUAL

DLS100
Stimulus Isolator

Serial No._____

CAUTION: DS8000 must be powered off before DLS100 is attached.

CONTENTS

ABOUT THIS MANUAL

The following symbols are used in this guide:

This symbol indicates a CAUTION. Cautions warn against actions that can cause damage to equipment. Please read these carefully.

This symbol indicates a WARNING. Warnings alert you to actions that can cause personal injury or pose a physical threat. Please read these carefully.

NOTES and TIPS contain helpful information.

Fig. 1—DLS 100

INTRODUCTION

The **DLS100** is a biological linear stimulus isolator designed to operate exclusively with the **DS8000** 8-Channel Digital Stimulator. In addition to receiving signal information from the **DS8000**, the **DLS100** is also powered by the **DS8000**. Up to eight **DLS100** isolators may be connected to a single **DS8000**.

A high degree of signal precision is maintained by taking the signal information from the **DS8000** in digital form. The digital signal information is converted to analog by a Digital-to-Analog converter within the **DLS100**. Isolation is achieved through the use of optical isolation of the digital control signals and a DC-to-DC power converter. This power converter, which was developed by WPI specifically for the **DLS100**, eliminates the batteries usually employed in other stimulus isolators. The elimination of batteries allows the isolator to run indefinitely as long as it is connected with the **DS8000**.

Notes and Warnings

⚠ **WARNING! ELECTRIC SHOCK HAZARD! THE DLS100 IS CAPABLE OF PRODUCING HAZARDOUS VOLTAGES IN EXCESS OF 100 VOLTS. USE CARE NOT TO CREATE ELECTRICALLY EXPOSED OPEN CONNECTIONS TO THE DLS100 SO THAT YOU DON'T COME INTO CONTACT WITH THE OUTPUT VOLTAGE. IT IS UP TO THE USER TO ENSURE SAFE CONNECTIONS.**

🛈 **CAUTION**: **DS8000** MUST be powered off before attaching the **DLS100**.

General Notes

- If a monitoring device is connected to the **DLS100**, the "–" output of the **DLS100** must always be connected to the ground input of the monitoring device.

- In applications where a bio-amplifier and electrodes are used to monitor a stimulus response, a connection from the **DLS100** "–" output to the ground input of the bio-amplifier must be made.

- To obtain negative polarity outputs, do not exchange the **DLS100** output connections. Set the **DS8000** output for negative polarity. Always observe the grounding conditions specified above.

- For lowest noise and offset current, select the range that delivers the desired current with the amplitude from the **DS8000** set between 1–10V. Also, choose stimulation and reference electrodes with the lowest practical impedance.

- The **DLS100** should be located as close as practical to the experiment (the load). Shorter connecting wires ensures the highest possible frequency response.

- As a precaution, the **DLS100** is designed so that the lowest current range is automatically selected and the output switch is off during initial power up.

Parts List

After unpacking, verify that there is no visible damage to the instrument. Verify that all items are included:

(1) **DLS100**

(1) Instruction Manual

(1) Accessory kit, including

>(1) **2033** Black insulated miniature banana plug

>(1) **2034** Red insulated miniature banana plug

>(1) **3142** Mini banana adapter

>(1) **83016** DS8000 cable

>(1) **83017** 10KΩ Dummy load test resistor

>(1) **610023** Potentiometer adjustment tool

Unpacking

Upon receipt of this instrument, make a thorough inspection of the contents and check for possible damage. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed damage should be reported at once to the carrier and an inspection requested. Please read the section entitled "Claims and Returns" on page 15 of this manual. Please contact WPI Customer Service if any parts are missing at 941.371.1003 or customerservice@wpiinc.com.

Returns: Do not return any goods to WPI without obtaining prior approval (RMA # required) and instructions from WPI's Returns Department. Goods returned (unauthorized) by collect freight may be refused. If a return shipment is necessary, use the original container, if possible. If the original container is not available, use a suitable substitute that is rigid and of adequate size. Wrap the instrument in paper or plastic surrounded with at least 100mm (four inches) of shock absorbing material. For further details, please read the section entitled "Claims and Returns" on page 15 of this manual.

INSTRUMENT DESCRIPTION

Instrument Description

Front Control Panel

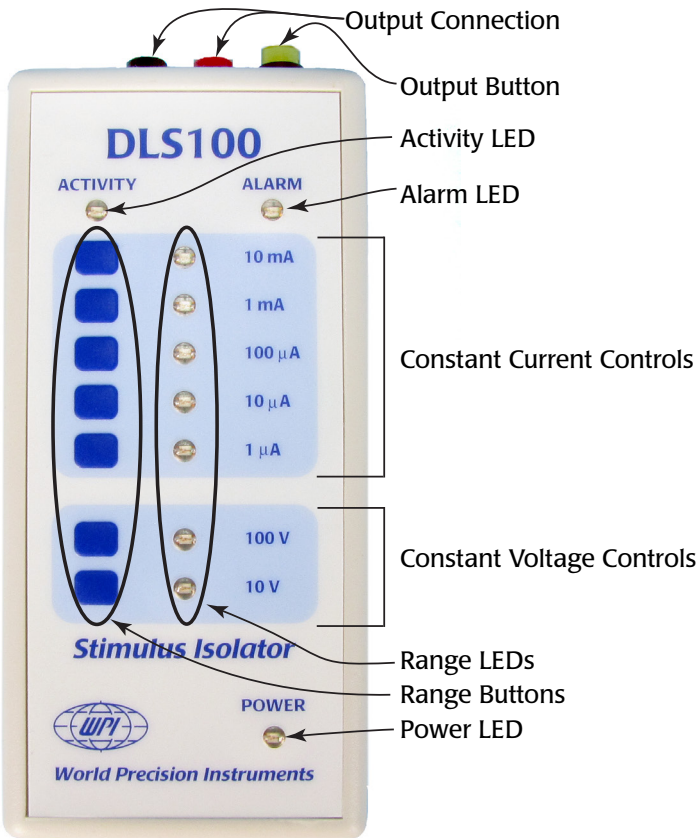The DLS100 control panel is shown **Fig. 2.**

Fig. 2—DLS100 front panel

Range Buttons and Range LEDs–Select the operating range by pressing one of the range buttons. They are marked according to the full-scale current or voltage available. The adjacent Range LED indicator illuminates to indicate the selected range. The full-scale value of the selected current or voltage output range is delivered when the signal level from the DS8000 is 10V. The polarity of the output current or voltage

corresponds directly to the polarity of the output signal from the DS8000.

Power LED–The Power LED indicator illuminates when the **DLS100** is connected to a **DS8000** and the **DS8000** is powered on.

Activity LED–The Activity LED indicator illuminates whenever a digital signal is received from the **DS8000**.

Alarm LED– The Alarm LED indicator illuminates whenever the **DLS100** is in constant current mode and unable to deliver the requested current. If the audible alarm is enabled, an alarm sounds simultaneously. For more information, see "Troubleshooting" on page 11.
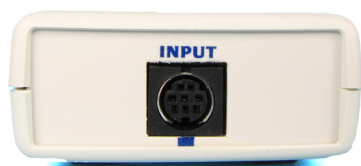
Bottom End Panel

Fig. 3—Bottom end panel of the DLS100

Input Connector–The input connector on the bottom end panel accepts the **DLS100** interface cable (WPI # **83016)**, which may be connected to any of the 9-pin output connectors on the back of the **DS8000**.

Top End Panel

Fig. 4—Top end panel of the DLS100

Output Connectors–The output connectors are "miniature banana" jacks on the top end panel **(Fig. 4)**. Mating miniature banana plugs are included in the accessory kit (WPI #**2033**, **2034**) The red "+" connector must always be connected to the stimulation electrode. The black "–" connector must be connected to the reference electrode and to the ground connection of the monitoring system.

On/Off Push button switch–This output button controls an output relay which connects/disconnects the signal from the output terminal. The button illuminates when the output is connected to the red terminal.
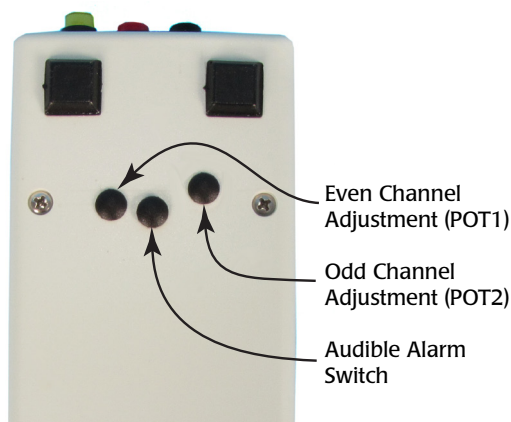
Back Panel

Fig. 5—Back panel of the DLS100

Three small black plugs cover access holes for DC adjustment offsets and an audible alarm enable switch.

Setup
Connecting to DS8000

⚠ **CAUTION**: **DS8000** MUST be powered off before attaching the **DLS100**.

Using the **DS8000** interface cable (WPI #**83016**) supplied with the unit, connect the Input port on the bottom end of the **DLS100** to the Output connector on the rear panel of the **DS8000** that corresponding with the channel from which stimulation signals are desired.

Connecting the Output

The **DLS100** accessory kit includes several connectors that provide options for connecting to the output. The **2033** and **2034** color-coded, single-pole, mini banana connectors or the **3142** double-pole, mini banana connectors are used to connect output wires. The optional **501670** dual mini-banana to BNC adaptor can be used to convert the mini banana sockets on the **DLS100** output into a standard female BNC connector.

NOTE: When making a connection with coaxial cable (WPI #**2851**, BNC, 5-ft long), use the **501670** Dual Mini-Banana-to-BNC adapter. See "Optional Accessories" on page 10.

OPERATING INSTRUCTIONS

The **DLS100** connects with the **DS8000** using a single cable that connects to any of the channel output connectors on the back of the **DS8000**. The **DLS100** reproduces the waveform that is programmed on the **DS8000**. The **DLS100** sources its signals from the combined analog matrix on the **DS8000**.

DLS100 Output

The **DLS100** is a continually variable (linear) isolator, which means that the output current or voltage is proportional to the amplitude of the input signal. The DLS100 can provide output in either constant current or constant voltage mode.

- Constant current–In this setting, the **DLS100** will vary its voltage continuously to maintain a fixed level of current to the preparation. In the event that more than 100V is required to generate the desired current, a non-compliance alarm will sound (if it's enabled) to alert you that the experimental current requirements are not met.

- Constant voltage–The output voltage of the **DLS100** tracks to the digital signal from the **DS8000**.

DLS Control

The **DS8000** control panel is the primary control center of the **DLS100**. Signal waveshape, amplitude, timing and gating or triggering are all controlled from the **DS8000**. Controls on the **DLS100** are limited to a set of amplitude range selector buttons and an output disconnect switch.

The **DS8000** combined analog (CA) matrix assignment screen (**Fig. 6**) shows A1-A8 across the top and CA1-CA8 down the left side. A1-A8 represent the eight "virtual channels" of signals available in the **DS8000**. CA1-CA8 correspond with the **DLS100** output connectors which are labeled 1-8 on the back of the **DS8000**. A **DLS100** can receive any combination of the virtual channels as assigned in the CA matrix by checking the assignment check boxes. If multiple signals are assigned to a single **DS8000** channel, they will be summed algebraically.
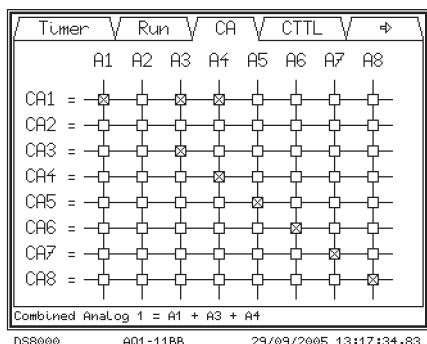
*Fig. 6—The combined analog matrix assignment screen shown left is configured to send **DS8000** signals from virtual channels A1, A3 and A4 to the **DLS100** that is connected to channel 1. Channels 3-8 are configured with a one-to-one correspondence, and channel 2 receives no signal.*

Quick Functional Check

To demonstrate the **DLS100** and **DS8000** are working as desired, complete the following exercise.

> ⊘ **CAUTION**: **DS8000** MUST be powered off before attaching the DLS100.

1. Connect the DLS100 to any channel on the **DS8000**.

2. Connect the 10KΩ "Dummy Load," included in the Accessory Kit, to the **DLS100** output.

3. Connect an oscilloscope to the dummy load resistor.

   NOTE: The ground lead of the oscilloscope probe MUST connect to the "–" output of the **DLS100**.

4. Turn power on to the **DS8000**. The Power LED and the 1μA range indicator on the **DLS100** illuminate.

5. Press the 1mA range key. The 1mA indicator illuminates.

6. Refer to the **DS8000** manual to set up the selected channel of the **DS8000** for a continuous uni-polar pulse, 1ms width, 5ms period, and 1V amplitude.

7. Set the **DS8000** output to on. The Activity LED on the **DLS100** illuminates, indicating that a signal is being received. The oscilloscope should not show any signal on the load yet, because the Output switch on the top panel is not yet on.

8. Press the On/Off (yellow) switch once. The switch button illuminates and a 1V positive pulse should be observed on the oscilloscope.

> **TECHNICAL NOTE**: The amplitude is 1V because the **DS8000** is sending a 1V signal to the **DLS100**, and the 1mA full scale range is selected. Since a 10V signal is required to produce a full scale output, a 1V signal produces 10% of full scale, or 100μA output. From Ohm's Law, (E = I×R), 100μA through a 10KΩ load produces 1V.

9. Set the amplitude of the pulse from the **DS8000** to 10V. The pulse observed on the oscilloscope should be 10V, also.

10. Press the 100μA range switch on the **DLS100**. The pulse amplitude on the oscilloscope should drop to 1V.

11. Set the pulse amplitude on the **DS8000** to –10V. The output of the **DLS100** should now be –1V.

You may try other signal waveforms, such as a sine wave. Or, you can program different waveforms on other **DS8000** channels and move the interface cable to these other channels, one at a time, to see the **DLS100** output change according to which channel it is connected.

Adjusting the DC Offset

The **DLS100** DC offset must be adjusted for both the even and odd channels. Adjust the even channels first, because they are subject to the adjustment of the odd channels. This calibration involves two potentiometers. POT1 is for even channels on the **DS8000**, and POT2 is for odd channels.

> ⓘ **CAUTION**: **DS8000** MUST be powered off before attaching the **DLS100**.

1. Connect the **DLS100** to the **DS8000** channel 2 output (9-pin connection).

2. Power on the **DS8000**.

3. On the **DS8000**, program channel 2 in DC mode for 0.00V amplitude. Select both the Run and Output check boxes on the **DS8000** panel.

4. Plug the 10KΩ dummy test resistor (WPI #**83017**) into the Output (red and black mini-banana connectors) to the top of the **DLS100**.

5. Set the **DLS100** to the current range you intend to use by pressing the desired Range button. The 1mA range is sufficient. The 10mA range may also be used, but it is much more difficult to adjust to zero.

6. Press the On/Off button to turn the **DLS100** output on. Allow the unit to warm up for 30 minutes before adjustment continues.

7. Turn the **DLS100** face down and remove the two black plugs covering POT1 and POT2 (**Fig. 7**).

Even Channel Adjustment (POT1)

Odd Channel Adjustment (POT2)

Audible Alarm Switch

Fig. 7—POT1 and POT2 are located on the underside of the DLS100 and are covered by small black plugs

8. Use a high quality digital volt meter with a scale greater than 20MΩ. Set the meter in the millivolt scale and monitor the output voltage at the top of the load resistor.

9. Using the provided adjustment tool (WPI #**610023**), carefully adjust POT1 until the meter reads 0.00mV ±1mV.

10. Turn off the **DS8000** and connect the **DLS100** to the **DS8000** channel 1 output (9-pin connection).

11. Power on the **DS8000** and bring up the channel 1 menu. Verify that channel 1 is set to Run and the Output is on. The output must be set to 0.00 amplitude.

12. With a digital volt meter set in the millivolt scale, monitor the output voltage of the load resistor.

13. Using the provided adjustment tool (WPI #**610023**), carefully adjust POT2 until the meter reads 0.00mV ±1mV.

14. Repeat this procedure for both channels to achieve the best zero balance.

15. Reinstall the two, small, black plugs.

Disabling Audible Alarm

If desired, the audible alarm may be disabled. The switch is accessible through a small hole on the back of the unit (**Fig. 7**).

1. Three black plugs are located on the back panel of the **DLS100**. Remove the center black plug covering the audible alarm switch.

2. Use a #1 or #0 Phillips screwdriver to rotate the switch counter-clockwise to disable the audible alarm.

OPTIONAL ACCESSORIES

Table 1: Accessories

Part Number	Description
2851	BNC, 5-ft long
501670	Dual Mini-Banana-to-BNC
83016	Replacement DS8000-to-DLS100 Cable
610023	Potentiometer adjustment tool
503301	Cable, mini-DIN extension, 10'

TROUBLESHOOTING

Issue	Possible Cause	Solution
DLS has no power	Poor cable connection	Check connections between the **DS8000** and the **DLS100**. If necessary, reseat the cable in the socket.
	Bent pin on 9-pin connector on the **DLS100** cable	Examine the 9-pin connector. Carefully straighten any bent pins. If any pin is missing, replace the cable (WPI #**83016**).
	Yellow **DLS100** On/Off switch is set to off	Press the yellow button on the **DLS100**
No signal output (activity light off)	Green output switch on the **DS8000** is set to off	Set the output switch to on
	DS8000 software "Run" check box is not selected for the appropriate channel	On the **DS8000** screen, verify that the Run and Output check boxes are selected for the channel your **DLS100** is connected with
	The appropriate channel check box is not selected in the matrix assignment screen on the **DS8000**	Check the matrix assignment screen and verify that the correct check boxes are selected for the channel you are using. See "DLS Control" on page 7.
	Yellow **DLS100** On/Off switch is set to off	Press the yellow button on the **DLS100**
Non-compliance alarm sounding	Open output circuit	Check the integrity of all the connections in your preparation
	DC offset is greater than 20mV	Adjust the DC offset. See "Adjusting the DC Offset" on page 7.

NOTE: If you have a problem/issue with that falls outside the definitions of this troubleshooting section, contact the WPI Technical Support team at 941.371.1003 or technicalsupport@wpiinc.com.

SPECIFICATIONS

The **DLS100** conforms to the following specifications:

Current Source Mode

Full-scale* Current	10mA, 1mA, 100µA, 10µA, 1µA, bipolar
Compliance Voltage	± 100V
Output Impedance	Greater than 100MΩ
Linearity	Better than 0.05% of full-scale range setting
A/C Noise Floor	Range Value
	10mA ≥1µA
	1mA ≥0.5µA
	100µA ≥0.3µA
	10µA ≥0.3µA
	1µA ≥0.3µA

Voltage Source Mode

Full-scale* Voltage	± 100V
Maximum Current	10mA
Output Impedance	Less than 1Ω
Linearity	Better than 0.05% of full-scale range setting
A/C Noise Floor	Range Value
	100V ≥20mV
	10V ≥10mV

Isolation

Resistance	Greater than 1000MΩ
Capacitance	Less than 0.01µF, from output terminals to DS8000 and earth ground
Dimensions	14 x 9 x 3.5 cm (5.5 x 3.5 x 1.5 in.)
Output Terminal	Mini-banana jacks
Connecting Cable	183cm (6')

* A 10V signal from the **DS8000** produces a full-scale output from the **DLS100**.

INDEX

WARRANTY

WPI (World Precision Instruments, Inc.) warrants to the original purchaser that this equipment, including its components and parts, shall be free from defects in material and workmanship for a period of one year* from the date of receipt. WPI's obligation under this warranty shall be limited to repair or replacement, at WPI's option, of the equipment or defective components or parts upon receipt thereof f.o.b. WPI, Sarasota, Florida U.S.A. Return of a repaired instrument shall be f.o.b. Sarasota.

The above warranty is contingent upon normal usage and does not cover products which have been modified without WPI's approval or which have been subjected to unusual physical or electrical stress or on which the original identification marks have been removed or altered. The above warranty will not apply if adjustment, repair or parts replacement is required because of accident, neglect, misuse, failure of electric power, air conditioning, humidity control, or causes other than normal and ordinary usage.

To the extent that any of its equipment is furnished by a manufacturer other than WPI, the foregoing warranty shall be applicable only to the extent of the warranty furnished by such other manufacturer. This warranty will not apply to appearance terms, such as knobs, handles, dials or the like.

WPI makes no warranty of any kind, express or implied or statutory, including without limitation any warranties of merchantability and/or fitness for a particular purpose. WPI shall not be liable for any damages, whether direct, indirect, special or consequential arising from a failure of this product to operate in the manner desired by the user. WPI shall not be liable for any damage to data or property that may be caused directly or indirectly by use of this product.

Claims and Returns

Inspect all shipments upon receipt. Missing cartons or obvious damage to cartons should be noted on the delivery receipt before signing. Concealed loss or damage should be reported at once to the carrier and an inspection requested. All claims for shortage or damage must be made within ten (10) days after receipt of shipment. Claims for lost shipments must be made within thirty (30) days of receipt of invoice or other notification of shipment. Please save damaged or pilfered cartons until claim is settled. In some instances, photographic documentation may be required. Some items are time-sensitive; WPI assumes no extended warranty or any liability for use beyond the date specified on the container

Do not return any goods to us without obtaining prior approval and instructions from our Returns Department. Goods returned (unauthorized) by collect freight may be refused. Goods accepted for restocking will be exchanged or credited to your WPI account. Goods returned which were ordered by customers in error are subject to a 25% restocking charge. Equipment which was built as a special order cannot be returned.

Repairs

Contact our Customer Service Department for assistance in the repair of apparatus. Do not return goods until instructions have been received. Returned items must be securely packed to prevent further damage in transit. The Customer is responsible for paying shipping expenses, including adequate insurance on all items returned for repairs. Identification of the item(s) by model number, name, as well as complete description of the difficulties experienced should be written on the repair purchase order and on a tag attached to the item.

Electrodes, batteries and other consumable parts are warranted for 30 days only from the date on which the customer receives these items.