DLS100
Stimulus Isolator

Serial No._____________________

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

**ABOUT THIS MANUAL** .................................................................................................................. 1  
**INTRODUCTION** .......................................................................................................................... 2  
  Notes and Warnings.......................................................................................................................... 2  
  General Notes .................................................................................................................................. 2  
  Parts List .......................................................................................................................................... 3  
  Unpacking ...................................................................................................................................... 3  
**INSTRUMENT DESCRIPTION** ........................................................................................................ 4  
  Instrument Description ..................................................................................................................... 4  
  Front Control Panel .......................................................................................................................... 4  
  Bottom End Panel ............................................................................................................................ 5  
  Top End Panel .................................................................................................................................. 5  
  Back Panel ....................................................................................................................................... 6  
  Setup ............................................................................................................................................... 6  
  Connecting to DS8000 ..................................................................................................................... 6  
  Connecting the Output ..................................................................................................................... 6  
**OPERATING INSTRUCTIONS** ....................................................................................................... 7  
  DLS100 Output ............................................................................................................................... 7  
  DLS Control ..................................................................................................................................... 7  
  Quick Functional Check .................................................................................................................... 8  
  Adjusting the DC Offset ................................................................................................................... 9  
  Disabling Audible Alarm .................................................................................................................. 10  
**OPTIONAL ACCESSORIES** .......................................................................................................... 11  
**TROUBLESHOOTING** .................................................................................................................. 11  
**SPECIFICATIONS** ......................................................................................................................... 12  
**INDEX** .......................................................................................................................................... 13  
**WARRANTY** .................................................................................................................................. 15  
  Claims and Returns .......................................................................................................................... 15  
  Repairs ............................................................................................................................................. 15t

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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.

![DLS100 Front Panel Diagram](image)

**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**

![Bottom end panel of the DLS100](image)

**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**

![Top end panel of the DLS100](image)

**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, \((E = I \times R)\), 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**).

![Fig. 7—POT1 and POT2 are located on the underside of the DLS100 and are covered by small black plugs](image)

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>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2851</td>
<td>BNC, 5-ft long</td>
</tr>
<tr>
<td>501670</td>
<td>Dual Mini-Banana-to-BNC</td>
</tr>
<tr>
<td>83016</td>
<td>Replacement DS8000-to-DLS100 Cable</td>
</tr>
<tr>
<td>610023</td>
<td>Potentiometer adjustment tool</td>
</tr>
<tr>
<td>503301</td>
<td>Cable, mini-DIN extension, 10’</td>
</tr>
</tbody>
</table>
# TROUBLESHOOTING

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

**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

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

### Voltage Source Mode

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

### Isolation

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance</td>
<td>Greater than 1000MΩ</td>
</tr>
<tr>
<td>Capacitance</td>
<td>Less than 0.01µF, from output terminals to DS8000 and earth ground</td>
</tr>
</tbody>
</table>

### 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

Symbols
2033 3
2034 3
3142 3
83016 3, 6
83017 3

A
accessories 10
alarm 10
audible alarm 5, 10

B
banana 5
banana sockets 6
batteries 2
bio-amplifier 2

C
cable 6
coaxial cable 6
combined analog matrix 7
connectors 6
control panel 4, 7

D
DC adjustment offsets 6
DC offset 9
Digital-to-Analog converter 2

F
functional check 8

I
input connector 5

M
matrix assignment screen 7
mini banana sockets 6

N
negative polarity outputs 2
noise 2

O
offset current 2
Ohm’s Law 8
optical isolation 2
output connectors 5

P
parts list 2

R
range buttons 4
returns 3

S
signal waveforms 8
sine wave 8
sockets 6
specifications 12

T
troubleshooting 11

U
unpacking 3

V
virtual channels 7
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.
USA
International Trade Center, 175 Sarasota Center Blvd., Sarasota FL 34240-9258
Tel: 941-371-1003 • Fax: 941-377-5428 • E-mail: sales@wpiinc.com

UK
1 Hunting Gate, Hitchin, Hertfordshire SG4 0TJ
Tel: 44 (0)1462 424700 • Fax: 44 (0)1462 424701 • E-mail: wpiuk@wpi-europe.com

Germany
Zossener Str. 55, 10961 Berlin
Tel: 030-6188845 • Fax: 030-6188670 • E-mail: wpide@wpi-europe.com

China & Hong Kong
WPI Shanghai Trading Co., Ltd.
Rm 29a, No8 Dongfang Rd., Pudong District, Shanghai, 200120 PR China
Tel: +86 21 6888 5517 • E-mail: chinasales@china.wpiinc.com

Brazil
Av. Conselheiro Nébias, 756 sala 2611, Santos-CEP: 11045-002, São Paulo Brazil •
Tel: (013) 406-29703 • E-mail: info@brazil.wpiinc.com

Internet
www.wpiinc.com • www.wpi-europe.com • www.wpiinc.cn