



# DLS100 Stimulus Isolator

*For use with DS8000 Digital Stimulator*



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## **INSTRUCTION MANUAL**

100505

**World Precision Instruments**





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**DECLARATION OF CONFORMITY**

We: World Precision Instruments, Inc.  
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 Sarasota, FL 34240-9258 USA

as the manufacturers of the apparatus listed, declare under sole responsibility that the product(s):

**Title: DLS100**

to which this declaration relates is/are in conformity with the following standards or other normative documents:

**Safety:** EN 61010-1:1993

**EMC:** EN 50081-1:1992  
 EN 50082-1:1992

and therefore conform(s) with the protection requirements of Council Directive 89/336/EEC relating to electromagnetic compatibility and Council Directive 73/23/EEC relating to safety requirements:

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## 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.

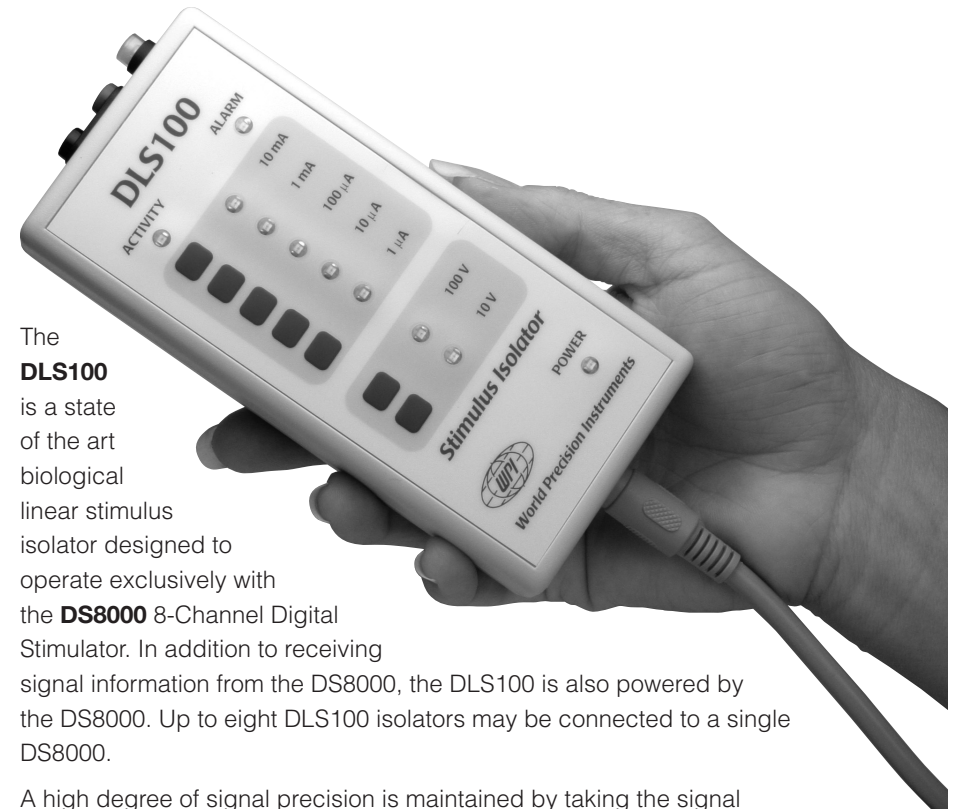
## Claims and Returns

- 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 10 days after receipt of shipment. Claims for lost shipments must be made within 30 days of invoice or other notification of shipment. Please save damaged or pilfered cartons until claim settles. 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.
- WPI cannot be held responsible for items damaged in shipment en route to us. Please enclose merchandise in its original shipping container to avoid damage from handling. We recommend that you insure merchandise when shipping. The customer is responsible for paying shipping expenses including adequate insurance on all items returned.
- Do not return any goods to WPI without obtaining prior approval and instructions (RMA#) from our returns department. Goods returned unauthorized or by collect freight may be refused. The RMA# must be clearly displayed on the outside of the box, or the package will not be accepted. Please contact the RMA department for a request form.
- Goods returned for repair must be reasonably clean and free of hazardous materials.
- A handling fee is charged for goods returned for exchange or credit. This fee may add up to 25% of the sale price depending on the condition of the item. Goods ordered in error are also subject to the handling fee.
- Equipment which was built as a special order cannot be returned.
- Always refer to the RMA# when contacting WPI to obtain a status of your returned item.
- For any other issues regarding a claim or return, please contact the RMA department.

**Warning: This equipment is not designed or intended for use on humans.**

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

## INTRODUCTION



The **DLS100** is a state of the art 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. A high degree of isolation is achieved through the use of optical isolation of the digital control signals and a galvanically isolated 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 and the use of surface-mount component technology have resulted in a very compact device.

### Caution

***The DLS100 is capable of producing hazardous voltages of up to 100 Volts. Care must be exercised so that unintentional contact with the output is avoided.***

## OPERATION

Connection to the DS8000 is via a single cable that connects to one of the Channel Output connectors on the back of the DS8000. The DLS100 will reproduce the waveform that is programmed for the combined analog output of the channel to which it is connected. The digital signal information routed through a bank of optical isolators and then is converted to an analog signal by a Digital-to-Analog converter within the DLS100.

The DLS100 is a *linear* isolator, which means that the output current or voltage is controlled by the amplitude of the input signal. The DLS100 provides output in either *constant current* or *constant voltage* mode. In the constant current mode, the current delivered to the load (or preparation) is proportional to the amplitude of the output from the DS8000, scaled by the range setting on the DLS100 front panel, and independent of the electrical impedance of the subject.\* In the constant voltage mode, the voltage delivered to the load is proportional to the amplitude of the output from the DS8000, scaled by the range set on the DLS100 front panel, and independent of the electrical impedance of the subject.\*\*

Control of the DLS100 is performed mainly on the DS8000 control panel. Signal waveshape, amplitude, timing, and gating or triggering are all controlled by the DS8000. Controls on the DLS100 are limited to a set of range selector buttons and an output disconnect switch.

The DLS100 outputs the channels selected from the DS8000 CA menu (see the DS8000 manual section 5.11). In the DS8000 screen shown in Figure 1, only the stimulation running on channel 1 is selected to be output to the DLS100 that is physically mounted

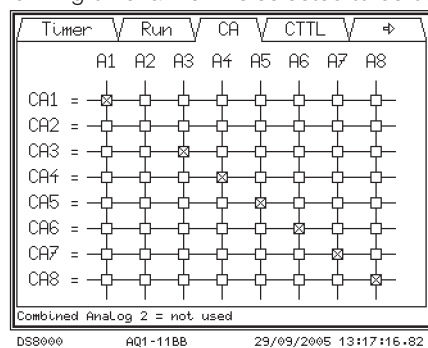


Fig. 1

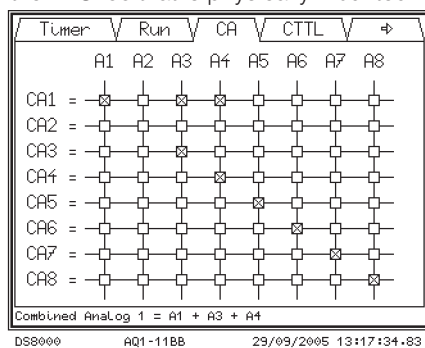


Fig. 2

\*As the term "constant current" implies, the current values maintained by the DLS100 in this mode are independent of changes in the impedance of the preparation.

\*\*Subject to the compliance limitations of the DLS100; see Important Notes section).

## SPECIFICATIONS

### Current Source Mode

Full-scale* Current	10 mA, 1 mA, 100 $\mu$ A, 10 $\mu$ A, 1 $\mu$ A, bipolar
Compliance Voltage	$\pm$ 100 volts
Output Impedance	Greater than 100 Megohms
Zero-signal Leakage	Less than 0.01% of full-scale range setting ( $\leq$ 10 mV @ 100 V / 10,000 ohms, 10 mA scale = $\leq$ 1 $\mu$ A leakage)
Linearity	Better than 0.05% of full-scale range setting
Bandwidth	Range and load dependant: 20 kHz with 10K load and 100 $\mu$ A or above range.**

### Voltage Source Mode

Full-scale* Voltage	$\pm$ 100 volts
Maximum Current	10 mA
Output Impedance	Less than 1 ohm
Zero-signal Offset	Less than 1 mv
Linearity	Better than 0.05% of full-scale range setting
Bandwidth	50 kHz

### ISOLATION

Resistance	Greater than 1000 Megohms
Capacitance	Less than 50 pF, from output terminals to DS8000 and earth ground

### POWER REQUIREMENTS

+12 volts and +5 volts, supplied by DS8000

### DIMENSIONS

14 x 9 x 3.5 cm (5.5 x 3.5 x 1.5 in.)

### OUTPUT TERMINALS

Mini-banana jacks

### CONNECTING CABLE

183 cm (6 ft)

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

\*\* High load impedances, stray capacitance, and the use of shielded cable on the output will reduce bandwidth and increase pulse rise and fall times.

## IMPORTANT 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 will deliver the desired current with the amplitude from the DS8000 set between 1 and 10 Volts. 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). Connecting wires from the DLS100 to the experiment should be as short as possible, which will ensure highest possible frequency response and lowest noise.

The DLS100 reproduces the waveform that is programmed for the combined analog of the channel to which it is connected. If unusual or unexpected waveforms are observed, check to see if the channel that to which the DLS100 is connected is programmed for a combination of other channels. See Section 5.8 of the DS8000 Instruction Manual.

## Alarm Indication

The ALARM indicator will illuminate and the beeper will sound (if sound is enabled) when the DLS100 attempts to output more voltage than is available from the power supply. This situation will occur when the product of the demanded current level and the load impedance exceeds 100 Volts. For example, if the load impedance is 25,000 Ohms, the maximum current that the DLS100 can deliver is 4.0 milliamperes ( $25000 \text{ Ohms} \times 0.004 \text{ Amperes} = 100 \text{ V}$ ). It is usually difficult to predict or measure the exact impedance value of an experimental setup, but if the ALARM indicator illuminates, the impedance or the demanded current needs to be reduced. Larger electrodes will reduce impedance, as will placing the reference electrode nearer to the stimulation electrode.

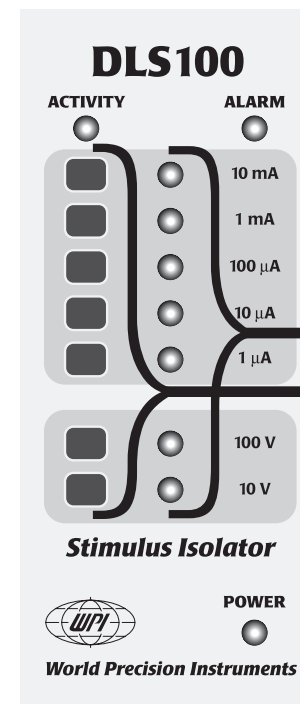
on the channel 1 connector. Note that channel 2 is not selected: this further reduces any interference that may be caused by the interaction of the adjacent channel in the DSL100 Stimulus Isolator. A DLS100 mounted on channel 6 would have the junction of A5-CA5 unselected. To insure minimum isolator leakage and to minimize interference, it is recommended to turn off any unused channels for that CA channel. Doing this can lower the leakage and noise.

In the DS8000 screen shown in Figure 2, the DLS100 physically mounted on channel 1 is being fed the signals from channel 1, channel 3 and channel 4.

## KEYS, CONTROLS, INDICATORS AND CONNECTORS

### Control Panel

The DLS100 Control panel is shown below. The operating range is selected by pressing one of the Range keys, which are marked according to the full-scale current or voltage that is available. The adjacent LED indicator will illuminate to indicate which range has been selected. The full-scale value of the selected current or voltage output range will be delivered when the signal level from the DS8000 is 10 Volts. The polarity of the output current or voltage corresponds directly to the polarity of the output signal from the DS8000.



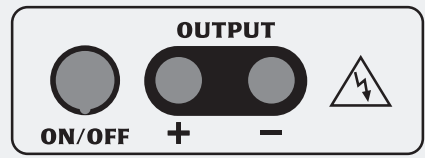
The POWER indicator will illuminate whenever the DLS100 is connected to a DS8000 and the DS8000 is in the power on state. The ACTIVITY indicator will illuminate whenever a signal is received from the DS8000.

The ALARM indicator will illuminate whenever a combination of load impedance and output current exists that demands more voltage from the DLS100 than it is capable of delivering. An audible beeper will also sound when the ALARM indicator is on, unless the beeper has been turned off.

## Input Connector

The input connector on the bottom end panel accepts the DLS100 Interface Cable, which can be connected to any of the output connectors on the DS8000.

## Output Connectors and Output ON/OFF Switch



The output connectors, which are “miniature banana” jacks, are on the top end panel, shown below. Mating miniature banana plugs are included in the accessory kit.

The red “+” connector must always be connected to the stimulation electrode,

and the black “-” connector must be connected to the common electrode and to the ground connection of the monitoring system. The “ON/OFF” pushbutton switch adjacent to the output connectors alternately connects or disconnects the output signal to the red(+) output terminal. The black(-) terminal remains connected to the DLS100 isolated circuit common. The switch illuminates when the output is connected

## Beeper ON/OFF Switch

The beeper may be switched off if the audible alarm is not desirable. The switch is accessible through a small hole in the base of the unit. The hole is covered with a black plastic plug. Remove the plug, then use a #1 or #0 Phillips screwdriver to actuate the switch. Turn it counter-clockwise to disable the beep.

## CONNECTION TO DS8000

Using the Interface Cable supplied with the unit, connect the DLS100 to the Output connector on the rear panel of the DS8000 corresponding to the channel from which stimulation signals are desired.

For a connection to coaxial cable (#2851, BNC, 5-ft long), use adapter #501670 Dual Mini-Banana-to-BNC.

Replacement DS8000-to-DLS100 Cable: #83016.

## QUICK FUNCTIONAL CHECK

Connect the DLS100 to any channel on the DS8000. Connect the 10K Ohm “Dummy Load”, included in the Accessory Kit, to the DLS100 output. Connect an oscilloscope to the dummy load resistor. **Important: the ground lead of the oscilloscope probe MUST connect to the “-” output of the DLS100.** Now turn power on to the DS8000. 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. The POWER indicator and the 1 $\mu$ A range indicator on the DLS100 should be on. Press the 1mA range key. The 1mA indicator should now be on.

Set up the selected channel of the DS8000 for a continuous uni-polar pulse, 1 millisecond width, 5 millisecond period, and 1 volt in amplitude. Set the output on. The ACTIVITY indicator on the DLS100 should be illuminated, 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. Press this switch once. The switch button will illuminate and a 1 Volt positive pulse should be observed on the oscilloscope.

Why is the amplitude 1 Volt? This is because the DS8000 is sending a 1 V signal to the DLS100, and the 1mA Full Scale range is selected. Since a 10 V signal is required to produce a full-scale output, a 1 volt signal will produce 10% of full scale, or 100 micro-ampere output. From Ohm’s Law, ( $E = I \times R$ ), 100  $\mu$ A through a 10K Ohm load will produce 1 V.

Now set the amplitude of the pulse from the DS8000 to 10 V. The pulse observed on the oscilloscope should now be 10 V also.

Press the 100 $\mu$ A range switch on the DLS100. The pulse amplitude on the oscilloscope should drop to 1 volt.

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

You may wish to try other signal waveforms, such as a sine wave. Or 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 to. **It is OK to plug and unplug the DLS100 Interface Cable while power is on the DS8000. The DLS will reset to the 10 $\mu$ A range, with the OUTPUT switch OFF, each time it is powered up, so you will need to re-select the range and press the OUTPUT switch each time the cable is re-connected.**