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Instruments, Inc.



A365D & A365R

Constant current bipolar stimulus isolators

INSTRUCTION MANUAL

Serial No. _____



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DECLARATION OF CONFORMITY

We: World Precision Instruments, Inc.
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as the manufacturers of the apparatus listed, declare under sole responsibility that the product(s):

Title: A365D (containing dry batteries)

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

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We: World Precision Instruments, Inc.
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as the manufacturers of the apparatus listed, declare under sole responsibility that the product(s):

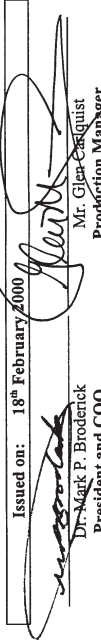
Title: A365R (containing rechargeable batteries)

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

Safety: EN 61010-1:1993 (IEC 1010-1:1990)
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.

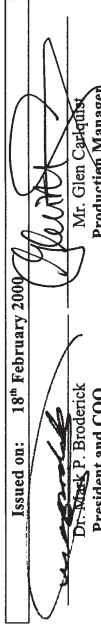
Issued on: 18th February 2000


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WARNING: High voltage can produce dangerous electrical shock. Do not turn on power while you are holding bare high voltage wires or connectors.

Stimulus isolation is needed to assure the precise localization of stimulus current and to prevent current flow from the stimulation site to ground. Models A365 D and R are stimulus isolation units, battery operated and electrically isolated from ground. A365D is powered by sixteen 9-volt alkaline transistor batteries. Model A365R is powered by 16 NiCad 9-volt rechargeable cells. These instruments can pulse repetitively at rates and durations controlled by front panel controls and/or be optically pulsed or gated for time durations of a few microseconds to DC, by any WPI pulse generator, standard pulse generator, D to A or interface unit which can provide an adequate output voltage equal to or greater than the threshold command levels specified below.

Specifications

Output Waveform	Current pulses or DC
Output Polarity	Unipolar or electronically switched bipolar
Output Current Ranges	0.1, 1.0 and 10 milliamperes
Current Amplitude Error	0.5 % of full scale, max.
Current Resolution	0.1% of full scale
Output Load Voltage Range	> 100 volts
External Command Volts	+2.2 V. min., 18 V (DC continuous) max.
Current Rise Time + Delay	2 µs, typ. (100 Ω load)
Current Fall Time + Delay	10 µs, typ. (100 Ω load)
Impedance to ground	10 ¹² Ω shunted by < 15 pF
Opto Coupler Max. Volts	2500 VAC, input to output
Power	
Model A365D	16 alkaline 9V batteries
Model A365R	Rechargeable NiCad stack (Requires A362 battery charger)

Introduction

All WPI stimulus isolators are designed to supply constant current because current threshold (not voltage) is the most quantitatively reproducible parameter for stimulation of nerve and muscle. Model A365 dispenses current reproducibly from its Output terminals; the amplitude being determined by the selected current RANGE and the setting of the % of Range dial. Current amplitude is “constant”, that is, load resistance independent, provided that the $I \times R$ (load) product does not exceed the available battery supply voltage. An audible alarm (the compliance alarm) will sound if $I \times R$ reaches this limit. Model A365 D can generate a voltage of 140 volts or more across its OUTPUT terminals. Thus, the user can be sure that the amplitude of the current will be as dialed as long as the voltage drop across the load (stimulus electrode path) does not reach the magnitude of the supply voltage. The compliance alarm would then be heard. The user would then know that (a) too much current was dialed for a given load or (b) inter-electrode resistance was too high or the electrode circuit path was open (this is illustrated by the Quick Instrument Test below).

Controls

INPUT: An external command voltage level of approx. 5 volts applied to this connector enables current flow from the OUTPUT. **Do not apply a continuous DC input voltage greater than 18 volts.**

DC/TEST: Current can be manually generated by toggling this switch. MOM (momentary) position allows push-release operation. ON provides a sustained DC.

AUDIO: When the AUDIO switch is on, an audible tone will sound whenever a stimulus current is being generated. A higher pitched audible signal will also sound, independent of the AUDIO switch, if the OUTPUT voltage amplitude approaches that of the battery power stack (the “compliance alarm”).

MODE: When this switch is set on Bipolar, every pulse applied to the input will cause the polarity of the output current to reverse. Thus, any sequence of pulses applied results in alternating plus and minus current pulses at the Output terminals. In the Off position, pulse polarity will be as indicated by the red Polarity lamps above the red and black Output terminals.

POLARITY SELECT: A polarity reversing push button switch sets the red or black OUTPUT terminal to be plus. A red lamp lights above the Output terminal selected to be positive.

RANGE: 0.1, 1 or 10 milliamperes can be selected as a maximum current.

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.*

Charging the Ni-Cd battery stack, Model A365R

To recharge the battery stack of an A365R, a companion charger, model A362 is designed to charge 365's batteries rapidly and safely. The charger cable plug inserts into the charging receptacle on the rear panel of the A365R isolator. Connect the charger's power cord to the power line. The POWER switch on A365R must be OFF to enable charger operation. The A365 battery stack will usually recharge overnight from a completely discharged state. Disconnect the battery charging cable from the A365 R while the instrument is in use. This avoids the possibility that power line noise will be introduced via the charger cable.

TO PRESERVE BATTERY LIFE, TURN POWER SWITCH OFF WHEN INSTRUMENT IS NOT IN USE.

Changing the batteries

Model A365D requires 16 nine-volt transistor batteries. Alkaline batteries are recommended. Depending on load current usage, the battery stack in model A365D will operate satisfactorily for two or three months or more. Replace batteries when required or annually.

Model **A365R** requires 16 Nickel-Cadmium 9-volt batteries. General Electric (U.S.A.) type TRB-SD1 or equivalent is recommended. **Alkaline batteries in model A365D cannot be replaced with Ni-Cd rechargeable batteries as model A365D is not equipped for charging.**

Turn POWER switch to OFF. Remove 4 screws on the bottom surface of the instrument case. Gently remove the entire internal instrument assembly from the outer case by sliding the front panel forward. Unscrew and remove padded cover plate over battery assembly. Firmly, but without wrenching excessively, remove all batteries. Insert new batteries with firm but moderate force. Match with care the male and female connectors on the battery tops to the mating connectors on the battery printed circuit board. Do not use excessive force. When all batteries have been installed, reattach the battery cover plate and test the instrument by repeating the "Quick Instrument Tests" outlined above. Nickel-Cadmium rechargeable batteries may require an initial charge depending on their condition when purchased. Reinsert the instrument assembly into the outer case and secure the bottom screws.

% OF RANGE: This variable ten turn digital indicator control sets the exact current amplitude as a percentage of the selected maximum current selected by the Range switch.

OUTPUT: Current output terminals. Output voltage depends on load resistance. An audible warning sounds when the maximum load voltage occurs. When the Output switch is Off, Output terminals are disconnected.

POWER ON/OFF: Switch connects battery power to the isolator.

Turn power switch off when instrument is not in use to avoid battery drain.

Quick Instrument Test

Switch Output to OFF, Range to 1 mA, Output to Off, Biphasic to Off and AUDIO to ON. Turn POWER switch to ON. A Battery Status lamp and one red lamp above one of the Output terminals should be lit. When DC/Test switch is toggled to MOM, an audible tone should be heard (an externally applied +5 volt command applied to the Input connector will have the same effect). Sound will cease when TEST is OFF. Turn Audio Off. Push Polarity Select button and confirm that red lamps above the red and black terminals switch back and forth when the button is pushed. Switch Output to On. A high pitched tone should sound. This is the "compliance" limit alarm which sounds when the full battery supply voltage is across the output terminal pair, for example, when the output leads are open-circuited and a trigger signal of 5 volts is applied to the input. Turn Output to Off. The instrument is operational.

Operation

Operation of the A365 is controlled by applying an external voltage command to the Input or by manually operating the DC/Test switch. Any source such as WPI's A300, A310 pulse generators or equivalent generator will be an appropriate source of command and trigger sync pulses for oscilloscope viewing of bioelectric responses.

Connect an appropriate pair of stimulating electrodes from the experimental site to the red and black OUTPUT terminals respectively. Keep the Output switch in the OFF position to avoid accidental stimulation. Turn POWER to ON. Select Biphasic Off (*i.e.*, unipolar current) and toggle Polarity Select. A red indicator lamp lights over the output electrode terminal which will be positive (usually, the negative electrode stimulates).

Toggling the AUDIO switch ON will allow the user to hear the advent of the command pulse. Turn the % of Range knob to zero and Range switch to 1 mA. Switch the Output switch to On. This connects the electrodes to the current source. Arriving at an optimal stimulation current level is usually an empirical procedure in which the user increases the current gradually from sub-threshold values until a desired stimulus response is achieved. Always toggle the Output switch to OFF while connecting electrodes. When this switch is toggled to OFF, the output terminals are disconnected from the stimulus current source and the current source is short circuited internally.

The user may check the accuracy of the setting on the % of Range dial by connecting a milliammeter directly across the OUTPUT connectors and pushing the DC/TEST switch. The direction of current flow is determined by which OUTPUT connector has been designated as the anode, *i.e.*, RED + or BLACK + on the POLARITY switch. AUDIO monitoring of the pulses can be switched ON or OFF at the user's option.

Biphasic Currents

To effect electrical stimulation, current must flow across a metal-electrode/fluid-electrolyte interface. At high current density, this can result in undesirable electrochemical action at the metal-electrolyte interface as well as high voltage gradients. Effects may include metal-electrolyte polarization, plating and deplating, or electrolysis. These effects can be diminished by: (a) Using large electrode surface area so as to reduce current density and (b) biphasic (*i.e.*, zero net charge) stimulus current using brief pulses. A365's biphasic mode enables the user to alternate the polarity of successive current pulses so that the net DC current flow is zero. When using the biphasic mode note that the first command pulse will result in an output pulse opposite in polarity to that indicated by the polarity lamp prior to the pulse since the leading edge of each command pulse reverses the polarity of the output current. The user can confirm this by toggling the MOM (momentary) switch briefly in the Biphasic mode. Note that the polarity lamp will switch position. Therefore, if the polarity of the first pulse is of importance, the user can preset the polarity with the push button switch to the complementary state of that required. For example, if one wants the first pulse at the red output terminal to be negative, toggle the Polarity button so as to light the red lamp over the red terminal. With the receipt of the leading edge of the first command pulse, the lamp will switch to the black terminal. Thus the first current pulse would have a polarity of red negative. If a burst of pulses is used, the polarity at the end of the burst will depend on whether an odd or even number of pulses were emitted.

To produce a biphasic pulse pair, the user must provide a double pulse from a pulse generator (such as WPI's A310 Accupulser) with an inter-pulse spacing which is very short.

Viewing the current pulses

To view pulses of current on an oscilloscope it is first necessary to convert current pulses to voltage pulses (also see paragraph, "Voltage", below) by using a dummy electrode pair. Therefore connect a resistor of 1 K Ohm across the OUTPUT terminals. Connect the two OUTPUT terminals to the input of an oscilloscope. Oscilloscope settings: 200 mV per cm, vertical sensitivity, DC coupled and 1 millisecond per cm sweep speed. Set the frequency of a pulse generator to 200 Hertz (INTERVAL= 5 ms) and pulse WIDTH to 1 millisecond. Set the controls as follows: RANGE to 1 mA, AUDIO to OFF, POLARITY to RED +. Dial % of Range to maximum and turn the POWER switch to ON. When the oscilloscope is synchronized, 1 Volt pulses (5 cm on the scope) should be observed. Note the shape and speed of the rising and falling edges. They should be fast and smooth. The true speed of a current pulse generator can be best seen using low values of shunt resistance, as in the example above. As the load resistance increases to 10 K Ω and larger, the effect of shunt capacity will be to slow the rising and falling edges of the voltage waveform. It should be noted that in connecting the oscilloscope to view the A365 output, one output terminal usually will be connected to ground (thus, one cannot view or measure the output waveform without compromising A365's isolation from ground).

Voltage

A365 can be used as a precise voltage source by placing a precision "dummy" resistor load across the OUTPUT terminals. Precision resistors such as 100, 1000 and 10,000 Ohms when placed across the OUTPUT terminals convert the precision current levels to accurate voltage levels. For example 1 milliampere flowing through 1000 Ohms will produce 1 volt across the OUTPUT terminal pair. Thus, models A360D/R can be used as low noise sources of accurate voltage pulses or DC. To maintain less than 1% error the user must avoid shunting the OUTPUT dummy resistor with a load resistance less than 100 times the dummy resistance value. A dummy resistor load kit, model DRL, is available from WPI to allow users to conveniently create and view voltage waveforms.

Instrument Case

The instrument case has not been connected to any part of the internal circuit of A365. If the user wishes to make a connection to the case, a spade lug and wire can be inserted under the head of any screw head underneath the instrument case.