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INSTRUCTION MANUAL

A365

Stimulus Isolator

Serial No. _____

www.wpiinc.com

083016



WARNING! High voltages produced can produce dangerous electrical shock. This device is not approved for clinical applications. Do not turn on power while you are holding bare high voltage wires or connectors.

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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 A365 Stimulus Isolator

INTRODUCTION

The A365 is a specialized stimulus isolator for use in neuroscience and muscle studies. Battery operated and electrically isolated from ground, its quiet internal control circuitry minimizes artifacts and has very low leakage specifications. Stimulus isolation is needed to assure the precise localization of stimulus current and to prevent current flow from the stimulation site to ground. Two models are available: **A365D** is powered by sixteen 9-volt alkaline transistor batteries; **A365R** is powered by 16 rechargeable NiMH (nickel metal hydride) 9-volt cells (**A362** battery charger required). 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 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.

Because current threshold is the most quantitatively reproducible parameter for stimulation of nerve and muscle, all WPI stimulus isolators are designed to supply constant current. 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 **A365D** can generate a voltage of 135V or more across its output terminals. 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 sound, signifying 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 (see the Quick Instrument Test, below).



WARNING! High voltages produced can produce dangerous electrical shock. This device is not approved for clinical applications. Do not turn on power while you are holding bare high voltage wires or connectors.



WARNING! THIS DEVICE IS NOT INTENDED FOR HUMAN USE.

Parts List

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

(1) A365 Stimulus Isolator

(1) Instruction Manual

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 19 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 19 of this manual.

INSTRUMENT DESCRIPTION

Controls

INPUT: An external command voltage level of approximately 5 volts (TTL) applied to this connector enables current flow from the OUTPUT. Do not apply a continuous DC input voltage greater than 9 volts.

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

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”). A low frequency tone indicates the batteries need replacement or recharging.

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 positive. The polarity lamps will toggle from red to black in the bipolar mode as they are being switched.

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

% 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. For ranges below 5% (05.0), it is recommended to use fixed 0.1% test resistors and a digital meter to set and check the required current values.

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, the output terminals are disconnected from the circuitry.

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

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

Audible Alarms

Audio on — This is a high frequency tone to indicate stimulation is present.

High tone with Audio off — compliance alarm, this indicates that the A365 cannot supply enough voltage to drive the requested “dialed-up” current through the test

subject. This is usually an indication of a broken cable, electrode disconnection or a misplaced electrode. Warning, the maximum high voltage is present on the banana connectors.

Low tone — Battery low alarm; batteries require replacement or recharging. This alarm turns on when the high voltage stack reaches 90 volts and depending on the experiment's current requirements the A365 may only supply power for a short duration (less than half an hour at 10 mA with NiMH). This is at the 6.0 volt threshold of the NiMH battery and rapid voltage decay in the battery cell occurs after this point. NiMH batteries that have decayed below 5.5V (82.5V in A365) may not be further rechargeable and require replacement. Disposable alkaline batteries may be discharged longer (two hours at 10 mA) to 5.0 volts or less (75 volts on A365), however this not recommended as the cessation of the stimulation is not predictable.

OPERATING INSTRUCTIONS

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 **DS8000**, **A300**, **A310** pulse generators or equivalent generator will be an appropriate source of command and trigger sync pulses for oscilloscope viewing of bioelectric responses.

Electrode connections

Connect an appropriate pair of stimulating electrodes from the experimental site to the red and black OUTPUT terminals, respectively. Any conductive wire (including carbon wire) may be affixed to the terminals by either a banana plug (4 mm) or by means of holding a bare wire on the plastic nut.

Keep the output switch in the OFF position to avoid accidental stimulation.

During the powering of any electronic circuit either up or down, the output may be unstable due to internal oscillations or circuits powering at different times.

Turn the output switch to OFF. Turn POWER to ON. Select Biphasic Off (*i.e.*, unipolar current) and toggle the 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; normally this is left in the OFF position. 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 or powering up or down the unit. 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 (see Electrode Exhauster) if the Electrode Exhauster is enabled.

Check the accuracy of the setting on the % of Range dial by connecting a milliamp meter 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.

Microstimulation

Microstimulation is considered to be stimulation currents of less than 500 μA passing through electrodes and tissues. Currents in excess of 1 mA have been known to damage tungsten metal electrodes by burning the tip of the electrode. Tungsten and other metal electrodes are made by an electro-etching process that leaves the electrode behaving as a capacitor (AC) rather than a conductor (DC).

This etching action results in the formation of an electrolytic interface between the metal surface and the electrolyte. The capacitive value of this electrode can be characterized as $0.2 \text{ pF}/\mu\text{m}^2$ at 1 KHz. This form of stimulation is best suited to neuroscience applications.

Normal Stimulation

For larger currents in excess of 1 mA that may be required for muscular stimulation, larger surface electrodes are to be used to distribute the larger currents. The use of silver-chloride surfaces (0.1 mm^2 or larger) may be necessary.

Biphasic Currents (bipolar)

To produce a biphasic pulse pair, the user must provide a double pulse from a pulse generator (such as WPI's **DS8000** or **A310 Accupulser**) with an inter-pulse time interval of 1 microsecond or more.

Electrolysis

Electrolysis or the emission of gases at the electrode tips are caused by a voltage greater than 2 or more volts passing in an electrolyte solution. This effect can be minimized by increasing the conductance of the electrodes to the tissue or by lowering the voltage below the emission threshold.

To effect electrical stimulation, current must flow across a metal-electrode/fluid-electrolyte interface. At a high current density, this can result in undesirable electro-chemical 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 a larger 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.

Viewing the current pulses

To view pulses of current on an oscilloscope it is first necessary to convert the current pulses to voltage pulses (see "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 Hz (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*). The stimulation voltage may be monitored by a very high-impedance, high-voltage-input amplifier / recorder, however the extra "load" and cable capacitance of the monitor needs to be taken into account. The input impedance of the recorder should be greater than 10¹⁰ ohms and the input voltage requirements of the amplifier is ± 150 volts. Please note that the isolation may be compromised.

Monitoring Current on a Data Acquisition system (Lab-Trax 4/16)

The Lab-Trax 4/16 has a voltage input limit of 10 volts and it has a 1M ohm impedance. The isolator output is converted from a maximum range of 200 volts to a usable range for the DataTrax4/16. One application would be to place a 475K ohm resistor in series with a 25K resistor. This resistor set is placed across the black and red connectors and the monitored signal is across the 25K ohm resistor. Larger resistor pairs may be chosen to reduce the loading effects on the measured voltages. This circuit passes 400 microamps and measures 0-10V across the 25K resistor. The Lab-Trax 4/16 measures the voltage and is adjusted by a 20 \times conversion factor. The 500K total R does draw current and this does effect the total voltage and current of the circuit and should be noted in the log.

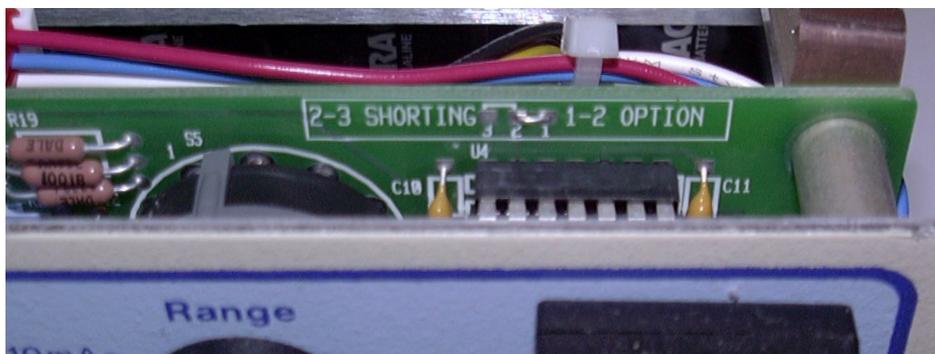


Fig. 2 Location of jumpers for the electrode exhauster circuit (shown disabled).

Monitoring Voltage on a Data Acquisition system (Lab-Trax 4/16)

To monitor the outputs as a current meter on the data acquisition system, use a shunt R resistor in series with the current flow along one of the electrodes (red connector).

A 5Ω resistor will drop 50mV at 10mA. The data conversion factor is $200\times= 10\text{mA}$
 A 50Ω resistor will drop 500mV at 10mA. The data conversion factor is $20\times= 10\text{mA}$
 A 500Ω resistor will drop 5V at 10mA. The data conversion factor is $2\times= 10\text{mA}$

The use of the above resistors will limit the maximum voltage that the A365 can deliver, and the current will be reduced by a proportional amount.

Constant Voltage Operation

A365 can be used as a precise voltage source by placing a precision “dummy” resistor load across the output terminals. Precision resistors (such as the 100 Ω , 1000 Ω and 10,000 Ω resistors in WPI’s optional Dummy Load Resistor Kit #DRL) 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 A365D and A365R can be used as low noise sources of accurate voltage pulses or DC. To maintain less than 1% error, avoid shunting the output dummy resistor with a load resistance less than 100 times the dummy resistance value.

Instrument Case Grounding (Earthing)

The instrument case has not been connected to any part of the internal circuit of A365. To make a connection to the case, a spade lug and wire can be inserted

under the head of any screw on the underside of the instrument case. This is useful in reducing noise in a Faraday cage environment.

Electrode Exhauster

The A365 is equipped with an electrode exhauster circuit. When enabled, this circuit will place a low resistance shunt across the output connections when the isolator is not stimulating (no TTL). This removes the excess charge on the cables and stimulation electrodes faster than allowing that voltage to decay through the tissue. This excess voltage is decayed in microseconds rather than a much slower decay in milliseconds. The value of this low resistance is approximately 5 to 15 ohms. To enable the electrode exhauster, open the A365 and locate jumper pads 1, 2 and 3 behind the current range potentiometer on the right side of the forward printed circuit board. As indicated by the printing on the board, if the soldered wire is between pads 2 and 3 (shorting), then the electrode exhauster is enabled; if the wire is between pads 1 and 2, then the electrode exhauster option is disabled. The A365 is factory shipped with this feature disabled. This can be tested with a voltmeter/ohmmeter. Turn the A365 power on, Output switch to ON. Leave the DC/Test switch to the center OFF position and do not move it. Check that the voltage across the banana connectors is zero (0.0) volts (to protect the ohmmeter), then check with an ohmmeter; the resistance should be below 20 ohms.

Low Battery Indication

A low-pitched tone (the battery alarm) will sound when the A365 is powered on. This is an indication that the batteries require replacement or recharging. This alarm turns on when the high voltage stack reaches 90 volts and, depending on the experiment's current requirements, the A365 may only supply power for a short duration (less than half an hour at 10 mA with NiMH). This is at the 6-volt threshold of the NiMH battery and rapid voltage decay in the battery cell occurs after this point. NiMH batteries that have decayed below 5.5V (82.5V in A365) may not be further rechargeable and require replacement. Disposable alkaline batteries may be discharged longer (2 hours at 10mA) to the 5.0 volt or below level (75 volts on A365), however this not recommended as the cessation of stimulation is not predictable.

MAINTENANCE

Charging the NiMH Battery Stack (A365R)

To recharge the battery stack of an A365R, a companion charger, model **A362**, is designed to charge the A365'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.

Full Charge or Partial Charge

The A365R battery stack will usually recharge overnight (16 hours) from a completely discharged state. Do not exceed 20 hours on NiMH batteries as overheating recharge-able batteries will lessen their overall recharge life cycles. For less than a full discharge, less time is required to obtain a full charge.

Disconnect the battery charging cable from the A365R while the instrument is in use. This avoids the possibility that power line noise will be introduced via the charger cable (as well as a loss of isolation). The charging rate on either the high voltage side (A=129.5V) or the low voltage side (B= 8.00 V) is 5.00 mA. The A362 and A365R can be placed on an multi-hour electronic AC timer to provide the correct time of the charge without loss of battery charge due to battery leakage back into the charger when the A362 is disconnected from the mains.

The A362 Charger

The A362 Charger has two high-voltage charging circuits built into it, and is used on a number of isolators and may use the A or B charging circuit in a manner different than described here. Both sides of the A362 provide 175 volts and are internally regulated to provide the correct voltage charge at 5.00 mA to the stack of batteries. The charger should not be attached to the isolator while in use. The two outer "D" shaped connectors are GND and the two inner circular pins are the separate positive outputs.

Replace Batteries Annually

Rechargeable batteries should be replaced on an annual basis. If the A365R is placed in storage for over 90 days, the batteries should be removed and stored separately. Rechargeable batteries can and do leak KOH (potassium hydroxide), a caustic substance which can damage the internal circuitry of the instrument.

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

Changing the Batteries

Model A365D requires 16 nine-volt alkaline batteries. Depending on load current usage, the batteries will operate satisfactorily for two months or more. Replace batteries when required or annually. Model A365R requires 16 Nickel-Metal Hydride 9-volt batteries (7.2 volt); type IEC-6F22 or equivalent is recommended. Alkaline batteries in model A365D cannot be replaced with NiMH rechargeable batteries as model A365D is not equipped for charging. Do not use the higher voltage 9.6.V rechargeable cells in this instrument.

Procedure

Turn the POWER switch to OFF. Remove four screws on the bottom of the instrument case. Gently remove the entire internal instrument assembly from the outer case by sliding the front panel forward. Unscrew and the remove padded cover plate over the battery assembly. Remove this plate by lifting up and moving out the right side of the instrument. When removing the batteries work from the front row first on either side and firmly pull up, but without tilting the batteries excessively as not to damage the battery clips. Insert the new batteries with firm but moderate force to seat the battery in the clips. Match with care the male and female connectors on the battery tops to the mating connectors on the battery printed circuit board. When all batteries have been installed, reattach the battery cover plate and test the instrument by repeating the “Quick Instrument Tests” outlined above. Nickel-Metal Hydride rechargeable batteries may require an initial 16-hour charge, depending on their condition when purchased. Reinsert the instrument assembly into the outer case and secure the bottom screws. Take care to push the copper contacts down when inserting the case. Nickel-Metal Hydride rechargeable batteries will discharge by themselves on the shelf. If the A365 is to be stored for a length of time (up to 3 months), then test the unit and either recharge the batteries or replace them as necessary. For long term storage remove the batteries from the A365. Nickel-Metal Hydride rechargeable batteries should last approximately one to two years with proper care. The replacement batteries should be chosen from the same manufacturer (and the same manufacturing lot number, if possible) to ensure equal levels of drain.

Expected Battery Life

9V Alkaline main high voltage stack: 57 hours at 100% duty cycle 10 mA load; 428h @ 1 mA, 1200h @ 100 μ A.

7.2 V NiMH main high voltage stack: 14 hours at 100% duty cycle 10 mA load; 100h @ 1mA; 306h @ 100 μ A.

Typical duty cycles are 1 to 5% (At a full load of 10mA and at a 1% duty cycle the A365 can last approximately 1000hours on alkaline cells, on NiMH this duration is approxi-mately 260 hours, both are due to the 9V power circuit discharging first. Control circuit (powered by one 9V or 7.2V battery):

Power on and not stimulating: 1000 hours (9 V alkaline), 260 hours (7.2 V NiMH)

TROUBLESHOOTING

Quick Instrument Test

Switch Output to OFF, Range to 1 mA, DC/Test to OFF, Bipolar to OFF and AUDIO to ON. Turn POWER switch to ON. One red lamp above one of the output terminals should be lit. When the 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 the Polarity Select button and confirm that red lamps above the red and black terminals switch back and forth when the button is pushed. Switch the OUTPUT switch to ON then turn the DC/Test switch to ON or press the momentary switch again and a high-pitched tone should sound. Switch DC/Test 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 DC/TEST to Off. The instrument is operational.

Another quick instrument test for the battery charge level: With the power on and a digital voltmeter across the banana connectors, switch the output to ON and hold down the MOM key. With 9V alkaline batteries at a full charge, the voltmeter should read 135 V or more; less than 90 V indicates low batteries. With 8.4V NiMH batteries a full charge, the voltmeter should read 110 V or more; if less than 90V these should be charged (the low battery test alarm should sound).

Detailed Test

Equipment required for testing: a set of precision resistors such as WPI's DRL, and a precision digital voltmeter that has been recently calibrated. Measure the exact resistance of the test resistors. Place a 1K 0.1% resistor across the output terminals and the test leads of the voltmeter. Set the range to 1 mA and range percentage to 50.0%. Turn the power switch on, audio on, polarity to positive. When the momentary switch is activated a tone will be heard and the DVM will read 0.50 volts ($1000 \text{ ohms} \times 0.0005 \text{ A} = 0.50 \text{ V}$). On the 100 μA scale the voltage will be 0.050 V and on the 10 mA scale the voltage will be 5.00 V.

Resistor	100 Ω	1000 Ω	10,000 Ω
10m A scale 50%	0.50 V +/- 0.0025 V	5.00 V +/- 0.025 V	50.0 V +/- 0.25 V
1m A scale 50%	0.05 V +/- 0.00025 V	0.50 V +/- 0.0025 V	5.00 V +/- 0.025 V
100 μA scale 50%	0.005 V +/- 0.000025 V	0.05 V +/- 0.00025 V	0.50 V +/- 0.0025 V

Audio tests: Toggle the audio switch to OFF while the momentary switch is ON and the tone will stop. With the momentary switch ON, remove the resistor pack and

the compliance alarm will sound, indicating a lack of controllable current. *Warning: A high voltage of 125V or more is present across the terminals.*

Battery Voltage Testing: To determine that a battery stack is fully charged and ready to use: Remove any loads from the output terminals, place the power switch in the on position, output to positive. Place a digital voltmeter test leads on the output terminals. Apply the momentary switch and note the output voltage.

Alkaline: An alkaline stack of batteries will measure in the 135 volt range ($9V \times 15$). Alkaline 9V batteries can be discharged to approximately 5.0V per battery or 80V per stack of 16. However, replacement should be indicated at the 90V point to ensure longevity during a procedure.

Rechargeable: A full charge of NiMH batteries will indicate a voltage range greater than 108V ($7.2V \times 15$). A low stack of rechargeable batteries for a NiMH stack will be less than 96V (6.0V per cell, requiring recharge). Recharging should begin when the voltage of the stack reaches 95V to ensure longevity during a procedure.

Calibration

There is no calibration for the A365D or A365R; any exacting current requirements should be verified by the user by using ohm's law and a set of precision resistors and a traceable voltmeter. The current set knob should display all zeros at the minimum counter-clockwise position, though this does not prevent the instrument from being externally calibrated.

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

This unit conforms to the following specifications:

Output Waveform.....	Current pulses or DC
Output Polarity.....	Unipolar or electronically switched bipolar
Output Current Ranges.....	0.1, 1.0 and 10mA
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., 9 V (DC continuous) max.
Current Rise Time + Delay	6 μ s, typical. (1000 Ω load)
Current Fall Time + Delay.....	10 μ s, typical. (1000 Ω load)
Impedance to ground.....	10^{12} Ω shunted by < 15 picofarads
Isolation Max. Volts.....	2500 VAC, input to output
Leakage	less than 9 nA at full scale 10 mA
Power	Model A365D: 16 alkaline 9V batteries Model A365R: Rechargeable NiMH (7.2 V only) (Requires A362 battery charger)

DECLARATION OF CONFORMITY



WORLD PRECISION INSTRUMENTS, INC.

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DECLARATION OF CONFORMITY

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

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:

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

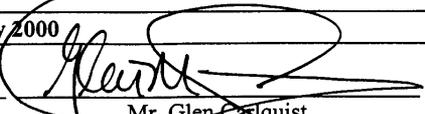
EMC: EN 50081-1:1992
EN 50082-1:1992

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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DECLARATION OF CONFORMITY

We: World Precision Instruments, Inc.
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 USA

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

Title: A365R (containing rechargeable batteries)

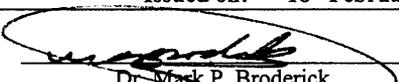
to which this declaration relates is/are in conformity with the following standards or other normative documents:

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

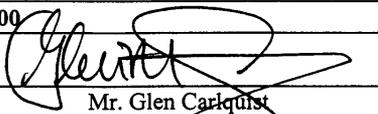
EMC: EN 50081-1:1992
 EN 50082-1:1992

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


 Dr. Mark P. Broderick
 President and COO

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 Production Manager

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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 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.*

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