Glass Electrode Meter

2700

INSTRUCTION MANUAL

FOR

Glass Electrode R/C Meter

MODEL 2700

Serial #_____

Date_____

A-M Systems
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U.S.A.
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360-683-3525

http://www.a-msystems.com

Version 8.0
May 2025

Contents

Each R/C Electrode Meter is delivered complete with:

One 3 Foot BNC Input Cable
One 3 Foot Banana GND cable
Rack Mount Hardware
Power Supply Cord
Power Supply

NOTE

This instrument is not intended for clinical measurements using human subjects. A-M Systems does not assume responsibility for injury or damage due to the misuse of this instrument.

General Description

Instrument Features

The Model 2700 R/C Electrode Meter is designed to measure resistance and capacitance of glass microelectrodes. Resistance and capacitance are important indicators of electrode recording and stimulating properties. The Model 2700 uses a low level, 1 kHz signal to measure resistance and capacitance in order not to affect the recording properties of the electrode. The resulting values are displayed on a digital meter.

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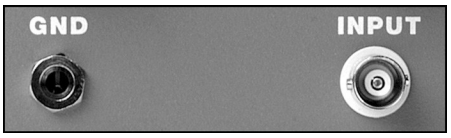
Controls and Connectors

INPUT:



This BNC connector is used to connect an electrode to the meter. The driven shield of the BNC is not grounded; but, rather it is driven with a voltage equal to the measurement signal to minimize cable capacitance. The center conductor of the BNC should be connected to the electrode to be measured. WARNING: The driven shield should not be connected to anything, except the front panel BNC input connector.

GND:

This connector provides a ground or reference point for measuring electrode resistance.

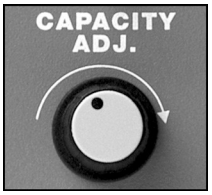
OUTPUT:

This BNC connector provides an output waveform of the voltage across the electrode. The impedance of the electrode can be calculated from the peak value of this waveform by the following equation or by reading the value from the chart on page 6.

$$Z_{electrode} = \frac{Vout_{peak}}{1 - Vout_{peak}} * R_{range}$$

where

Range switch	R_{range}
0.2MΩ	50k
2MΩ	500k
20MΩ	5M
100MΩ	25M
400MΩ	100M
1000MΩ	200M



CAPACITY ADJ.:

This knob is used to adjust an active feedback circuit to compensate and measure up to 200 pF of total capacitance from the electrode and input cable. The capacitance compensation can be accurately monitored in the experimental setup by connecting the OUTPUT connector to an oscilloscope. The CAPACITY ADJ. knob should be adjusted to obtain the sharpest corners possible on the square-wave. Clockwise rotation of this control increases the capacity compensation. If the knob is turned too far clockwise the warning "**over compensated**" will be displayed on the meter.

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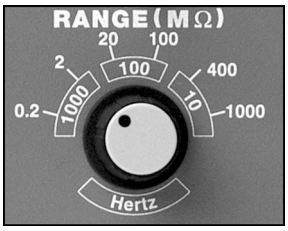
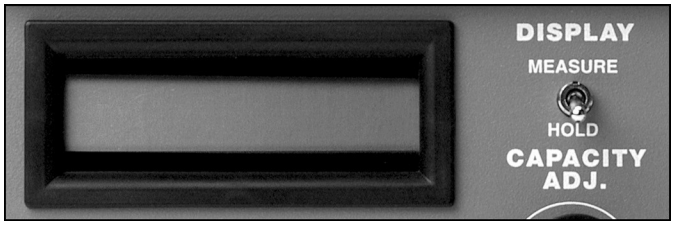
RANGE:



This knob controls the range of resistance to be measured and the frequency at which it is measured. If the knob's position is below the electrode's resistance, the warning "**Increase Range**" will be displayed on the meter. If the knob's position is above the electrode's resistance the warning "**Decrease Range**" will be displayed on the meter.

DISPLAY

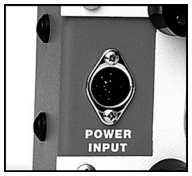


This switch controls both the test signal and the meter display. When the switch is in the MEASURE position, there will be a continuous application of the test signal to the electrode being measured. While the switch is in the HOLD position, the last measurement will be displayed, and the test signal will be turned off.

POWER

This switch turns the *R/C Electrode Meter* **ON** or **OFF**.

Rear Panel POWER INPUT



This jack connects the DC power source to the *Model 2700*. The DC supply contains +15V, -15V, and +5V.

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Operating Instructions

Typical Set-Up Procedure

This is a generalized procedure for setting up the Model 2700 Glass Electrode R/C Meter for measuring electrode characteristics. Portions of this procedure may need to be modified for your specific application.

1. Use a beaker filled with physiological saline (or the solution in which the tissue will be bathed). The solution should have the same temperature and ionic strength as in which your experiments will be made.
2. Connect a ground wire (generally an Ag/AgCl reference electrode) from the GND connector on the front panel to the saline within the beaker.
3. Place the ground wire (Ag/AgCl reference electrode) 1-2 inches deep in the saline solution.
4. Connect the center conductor on the input cable to your electrode to be measured. WARNING: Do not connect the shield of the input cable to ground.
5. Connect the input cable's BNC connector to the instrument's INPUT connector.
6. Dip the glass microelectrode tip into the beaker of physiological saline solution. Note: immerse the micropipette to approximately the same depth as will be used during the experiment.
7. Set the instrument controls as follows:

POWER	**OFF**
DISPLAY	**HOLD**
CAPACITY ADJ.	**FULLY COUNTERCLOCKWISE**
RANGE	**Set to the maximum value you think the electrode resistance might be. For example if you think the electrode will have a resistance below 5 MΩ then set the range to 20 MΩ.**
OUTPUT	**This can be connected to an oscilloscope if you want to observe the test signal.**

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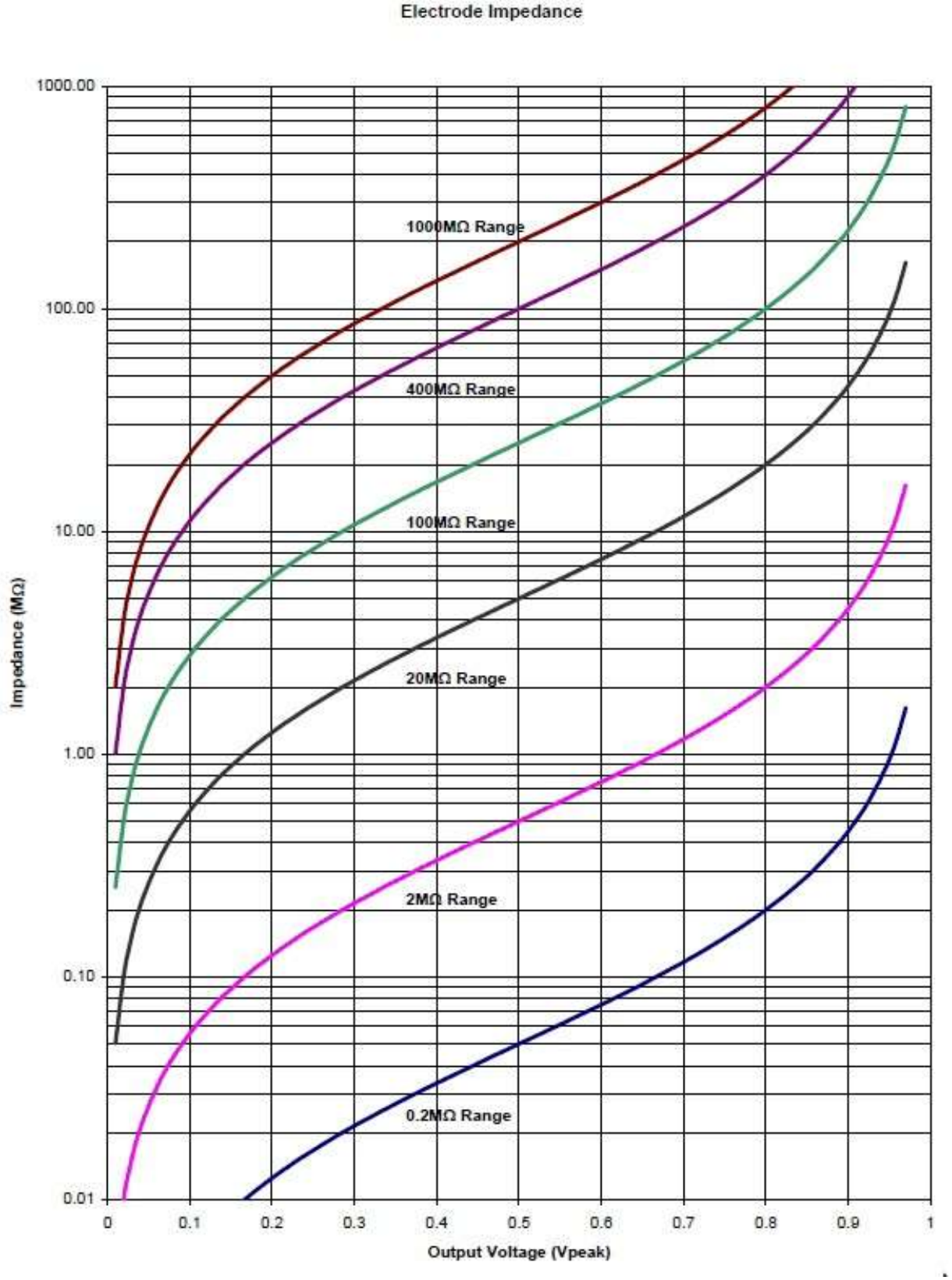
8. Turn the **POWER** switch to **ON** and allow the *Model 2700* to warm up for 1 minutes.
9. Now set the **DISPLAY** switch to **MEASURE**, and then read the value on the meter.
10. If the meter reads "**Increase Range**" or "**Decrease Range**" then turn the **RANGE** knob clockwise to increase the range and counterclockwise to decrease the range.
11. In most situations, the value displayed will be close to the actual resistance. But because the electrode and cable have capacitance, you should increase the **CAPACITY ADJ.** (rotate the knob clockwise), until the meter reads "**Over Compensated**". Finally, turn the knob a small amount counterclockwise until the display no longer reads "**Over Compensated**". The capacitance value displayed on the meter will be the actual capacitance of the electrode and cable. Note: using a resistor in place of the electrode will give the capacitance of the cable.

    Once the electrode has been properly adjusted for capacitance, the resistance value displayed on the meter will be the actual resistance of the electrode.

    It is useful to view the test signal on an oscilloscope when using the **CAPACITY ADJ.** Exact measurement of resistance and capacitance occurs when the square wave signal at the **OUTPUT** connector is "squared up" and does not have high frequency oscillations on top of the signal.
12. Set the **DISPLAY** switch to **HOLD** to stop the test signal.



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Safety considerations

Removal of the cover will expose electronic components. Capacitors inside the instrument may still be electrically charged even when the instrument has been disconnected from all power sources.

Do not ground the shield of the input cable. The shield has a voltage applied to it; and, if it is tied to ground, it will cause the *Glass Electrode R/C Meter* to give erroneous results. The shield of the input connector should only be connected to the **INPUT** BNC connector.

Driven Shield and Ground Connections

Since the input is enclosed by a driven shield maintained at the same potential as the input connector, there is no electric field between the input connections and shield. Consequently, there is no capacitive shunting do to the cable. This shield is connected to the external connector of the BNC. Using a driven shield for electrode measurements has the advantage of not introducing any additional shunt capacitance nor a path for the leakage current to ground.

Problem Solving

If the *Model 2700* does not function properly, consult the following list of suggested solutions to the most common problems. If you need further assistance, please contact technical support at A-M Systems, Inc.

Problem	**Cause / Solution**
Values keep changing	Possibly, this is caused by too much noise in your setup. Observe the output on an oscilloscope. If the waveform is not a square wave and looks more like a sine wave on top of a square wave then you are getting too much power-line interference. Try turning off unnecessary equipment. Try to shield the *Model 2700*, glass microelectrode, ground electrode, and input cables from external noise.
The display reads over compensated even though the **CAPACITY ADJ.** is off.	This can be due to excess noise. The treatment is the same for “Values keep changing” see above.

Specifications

Input

Impedance	10^{13} Ω || 1pF
Capacitance	Adjustable to zero
Working range	± 5.0 V
Maximum range	± 10 V

Internal signal source

Frequency	1kHz Range < 1.99 MΩ 100 Hz Range 2-99 MΩ 10 Hz Range 100-1000MΩ
Amplitude	Variable current to assure that the potential across the electrode stays under 100mV.

Meter Output

Resistance	10kΩ - 1GΩ +/- 5% of RANGE
Capacitance	0-200pF +/- 5%

Output

External Signal Source

Voltage Output	± 5 V
Current Output	± 5 mA
Output Resistance	100 Ω

Power

+15 Vdc	50mA
- 15 Vdc	50mA
+ 5 Vdc	100mA

DC voltages are used in the METER, so it can be used inside a Faraday cage

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Warranty and Service

LIMITED WARRANTY

What does this warranty cover?

A-M Systems, LLC (hereinafter, "A-M Systems") warrants to the Purchaser that the Instruments manufactured by A-M Systems (hereinafter the "hardware"), and sold after January 1, 2020, is free from defects in workmanship or material under normal use and service for the lifetime of the hardware. Headstages manufactured by A-M Systems and sold after January 1, 2020, will be repaired under warranty only once per year. This warranty commences on the date of delivery of the hardware to the Purchaser. "Lifetime" is defined as the time all components in the instrument can still be purchased from mainstream, common, electronic component distributors such as Digi-Key Electronics, Newark, or Mouser Electronics.

For hardware sold prior to January 1, 2020, the warranty in effect at time of purchase applies, with the maximum warranty period of three (3) years for new purchases, and one (1) year for those that have been repaired by A-M Systems. For headstages manufactured by A-M Systems and sold prior to January 1, 2020, the maximum warranty period is one (1) year.

What are the obligations of A-M Systems under this warranty?

During the warranty period, A-M Systems agrees to repair or replace, at its sole option, without charge to the Purchaser, any defective component part of the hardware. To obtain warranty service, the Purchaser must return the hardware to A-M Systems or an authorized A-M Systems distributor in an adequate shipping container. Any postage, shipping and insurance charges incurred in shipping the hardware to A-M Systems must be prepaid by the Purchaser, and all risk for the hardware shall remain with Purchaser until A-M Systems takes receipt of the hardware. Upon receipt, A-M Systems will promptly repair or replace the defective unit and then return the hardware (or its replacement) to the Purchaser with postage, shipping, and insurance prepaid by the Purchaser. A-M Systems may use reconditioned or like-new parts or units at its sole option, when repairing any hardware. Repaired products shall carry the same amount of outstanding warranty as from original purchase. Any claim under the warranty must include a dated proof of purchase of the hardware covered by this warranty. In any event, A-M Systems liability for defective hardware is limited to repairing or replacing the hardware.

What is not covered by this warranty?

This warranty is contingent upon proper use and maintenance of the hardware by the Purchaser and does not cover batteries. Neglect, misuse whether intentional or otherwise, tampering with or altering the hardware, damage caused

by accident, damage caused by unusual physical, electrical, chemical, or electromechanical stress, damage caused by failure of electrical power, or damage caused during transportation are not covered by this warranty. Further, no guarantee is made regarding software compatibility with future updated operating systems. Products may not be returned to A-M Systems for service, whether under warranty or otherwise, which are contaminated by infectious agents, radioactive compounds or other materials constituting a health hazard to employees of A-M Systems

What are the limits of liability for A-M Systems under this warranty?

A-M Systems shall not be liable for loss of data, lost profits or savings, or any special, incidental, consequential, indirect or other similar damages, whether arising from breach of contract, negligence, or other legal action, even if the company or its agent has been advised of the possibility of such damages, or for any claim brought against you by another party.

THIS EQUIPMENT IS NOT INTENDED FOR CLINICAL MEASUREMENTS USING HUMAN SUBJECTS.

A-M SYSTEMS DOES NOT ASSUME RESPONSIBILITY FOR INJURY OR DAMAGE DUE TO MISUSE OF THIS EQUIPMENT.

Jurisdictions vary with regard to the enforceability of provisions excluding or limiting liability for incidental or consequential damages. Check the provision of your local jurisdiction to find out whether the above exclusion applies to you.

This warranty allocates risks of product failure between the Purchaser and A-M Systems. A-M Systems hardware pricing reflects this allocation of risk and the limitations of liability contained in this warranty. The agents, employees, distributors, and dealers of A-M Systems are not authorized to make modifications to this warranty, or additional warranties binding on the company. Accordingly, additional statements such as dealer advertising or presentations, whether oral or written, do not constitute warranties by A-M Systems and should not be relied upon. This warranty gives you specific legal rights. You may also have other rights which vary from one jurisdiction to another.

THE WARRANTY AND REMEDY PROVIDED ABOVE IS IN LIEU OF ALL OTHER WARRANTIES AND REMEDIES, WHETHER EXPRESS OR IMPLIED. A-M SYSTEMS DISCLAIMS THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR USE, WITHOUT LIMITATION.

Revision History

Rev	Date	Description
3	6/30/06	Initial Document Control release
4	4/28/10	DCR201200 Warranty and Company info
5	9/20/16	DCR 202471 Remove Calibration instructions.
6	1/18/19	DCR 202615. Review content, begin content rev control.
7	3/19/20	DCR 203316. Updated Warranty
8	5/1/2025	DCR 204239. Update Warranty