SECTION II
INITIAL CHECKS

2.1 INTRODUCTION

The following procedure is provided to facilitate initial performance checking of the Model 362 Scanning Potentiostat. In general, this procedure should be performed after inspecting the instrument for obvious shipping damage (any noted to be reported to the carrier and to EG&G PARC). The basic intent of these checks is simply to determine that the instrument in good working order, not to demonstrate that it meets specifications. Each instrument receives a painstaking checkout before leaving the factory, and, ordinarily, if no shipping damage has occurred, it will perform within the limits of the stated specifications. Before proceeding, check to see if there are any addenda to this manual that affect the Initial Checks. Addenda are generally located inside the back cover. If any problems are encountered in carrying out these checks, contact the factory or the proper factory representative for aid.

2.2 REQUIRED EQUIPMENT

(1) Model 362 to be checked and cell cable supplied with instrument.

(2) One 10 kΩ 0.1% resistor (supplied with unit).

(3) One 1 μF capacitor (supplied with unit).

(4) Voltmeter suitable for monitoring the POTENTIAL MONITOR and CURRENT MONITOR outputs.

(5) Special adapter for connecting to Cell Cable pin jack. This adapter may be provided fully assembled, or may have to be assembled from parts provided with the unit, as follows.

(a) Locate the alligator clip and probe (Figure II-1A).

(b) Insert the probe in the clip. Then press onto a hard surface to seat the probe securely as shown in Figure II-B. The finished adapter should appear as shown in Figure II-1C.

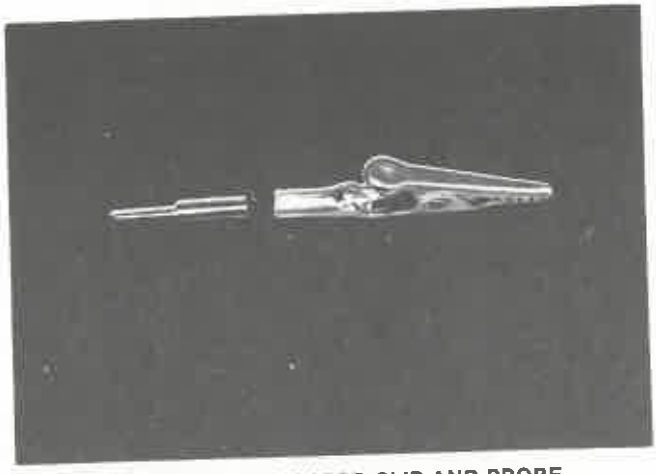


Figure II-1a. ALLIGATOR CLIP AND PROBE

Figure II-1b. INSTALLING PROBE

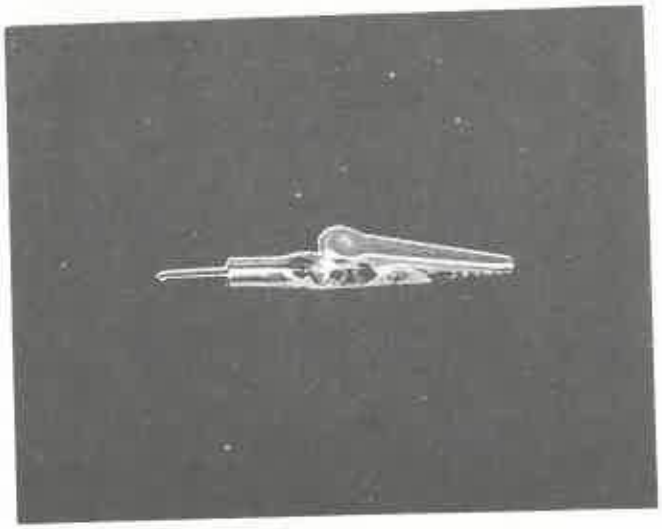


Figure II-1c. ASSEMBLED ADAPTER

Figure II-1 ASSEMBLY OF PIN JACK ADAPTER

2.3 PROCEDURE

2.3A SETUP

(1) Plug in the power cord but do NOT turn on the instrument.

(2) Connect the cell cable to the front-panel CELL connector.

(3) Connect the alligator clips at the other end of the cell cable to the 10 kΩ resistor. The green wire connects to one end of the resistor. The red wire connects to the other end. Using the special adapter, this end should additionally be connected to the cable pin jack (white cable lead). The black wire is not used. Take care that the alligator clip at the end of the black wire doesn't short to any of the other circuit elements. Figure II-2 shows the required connections.

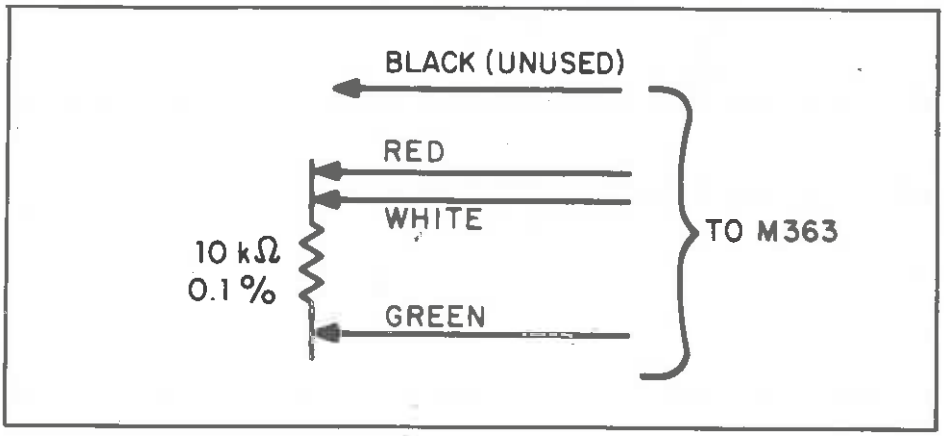


Figure II-2. CELL CABLE CONNECTIONS FOR INITITAL CHECKS

2.3B CONTROL E CHECKS

(1) Set the Model 362 controls as follows.

CELL: OFF
INITIAL POTENTIAL: +1.000
MODE: CONTROL E *(out)*
METER: E *(in)*
CURRENT RANGE: 1 mA *(in)*
$E_{INITIAL}$: $E_{INITIAL}$ *(out)*
POWER: ON *(switch illuminated)*
IR COMPENSATION: OFF

(2) Press in the CELL pushbutton (connects control amplifier output to the red lead of the cell cable).

(3) Note the panel meter indication. It should be positive at 20% of full scale. Full-scale meter sensitivity with the meter pushbutton in the *E* selected position is 5±V. the 20% of full-scale deflection indicates that the potential at the working-electrode end of the external resistor is +1 V with respect to the reference-electrode end of the resistor.

(4) Gradually increase the applied voltage by means of the INITIAL POTENTIAL control. The meter indication will track the control setting, reaching full scale with a setting of +5.000 V.

(5) Set the INITIAL POTENTIAL controls back to 1.000 V. The meter indication will return to 20% of full scale.

(6) If an external voltmeter is available, connect it to the POTENTIAL MONITOR output. The indicated potential should be −1 ±5 mV. NOTE: For this tolerance to hold, the accuracy of the external meter must be ±0.1% or better.

(7) Press the 100 µA Current Range pushbutton.

(8) Release the METER pushbutton so that the meter will indicate the "cell" current. The meter indication should be positive full scale. With the 100 µA current range selected, a full-scale meter indication corresponds to a current of 100 µA through the 10 kΩ dummy cell resistor.

(9) Press the 10 µA Current Range pushbutton. The CURRENT OVERLOAD lamp will extinguish and the meter indication will return to full scale.

(11) If an external voltmeter is available, connect it to the CURRENT MONITOR Output. The indicated voltage should be +1 V ±4 mV indicating a current of one full-scale current range, that is, +100 µA. (For this tolerance to hold, the accuracy of the external meter must be ±0.1% or better.)

2.3C CONTROL I CHECKS

(1) Press the MODE pushbutton, that is, transfer to the CONTROL I mode.

(2) Note the panel-meter indication. It should be positive full scale, indicating that the current is being controlled at 100 µA (Initial Potential/Current setting of 1.000 x Current Range of 100 µA = 100 µA).

(3) Press the METER pushbutton, that is, transfer the meter to the "E" display mode. The panel-meter indication should now be +20% of full scale, indicating that 100 µA dropped across the 10 kΩ dummy cell is 1 V (full-scale "E" meter range is ±5 V).

(4) Set the INITIAL POTENTIAL control to 2.000. The panel meter indication will increase to +40% of full scale, indicating that the drop across the dummy cell resistance is now 2 V.

(5) Release the METER pushbutton, that is, transfer the meter back to the *I* display mode. The panel meter indication will exceed positive full scale. With 2 V applied, the current is two times the selected current range (100 µA) and right on the edge of triggering a current overload indication. Try increasing the applied potential to 2.500. The CURRENT OVERLOAD lamp should light with 2.5 times overload established. Return the Initial Potential control to +2.000.

(6) Press the 1 mA Current Range pushbutton, causing the controlled current to increase from 200 µA to 2 mA (current range is multiplied by the Initial Potential setting). The panel meter indication will still exceed positive full scale (1 mA).

(7) If an external voltmeter is available, connect it to the CURRENT MONITOR output. The voltage there should be +2 V, verifying the 2 mA "cell" current.

(8) Press the 10 mA pushbutton. The CONTROL AMPLIFIER OVERLOAD lamp will light, indicating that the control amplifier has reached its compliance limit. One hundred volts would be required to force 10 mA through the 10 kΩ resistor, and the compliance of the Model 362 Control Amplifier is limited to ±30 V.

(9) Press the 100 µA pushbutton, and set the INITIAL POTENTIAL control to +1.000, thereby restoring normal full-scale CONTROL I operation.

(10) Release the MODE pushbutton, transferring to the CONTROL E mode. Then release the CELL pushbutton, disconnecting the output of the power amplifier from the dummy cell resistor.

2.3D CONTROL E, LINEAR SCAN CHECKS

Note: the remaining checks make frequent reference to a set of latching pushbutton controls that select one parameter or option when they are *in* and another when they are *released*. In the text that follows, the words *press* or *release* followed by the name of the required function will preceed references to these buttons. *Press* implies *press in and latch*. *Release* implies *unlatch*. The instruction *release CONSTANT I*, for example, means *invoke the CONSTANT I MODE BY unlatching the switch labeled LINEAR SCAN and CONSTANT I*.

(1) With the 10 kΩ load resistor still connected as shown in Figure II-2, set the following controls as indicated:

CELL: OFF
AC: ON
INITIAL POTENTIAL: +5.000
FINAL POTENTIAL: -5.000
SCAN RATE: 500 mV/SEC
MODE: CONTROL E
METER: E
$E_{INITIAL}$ (*released*)
MULTIPLE (*in*)
LINEAR SCAN (*released*)
CURRENT RANGE: 1 mA
IR COMPENSATION: OFF

(2) Switch the CELL control ON. The panel meter will indicate +5 V, corresponding to the INITIAL POTENTIAL setting.

(3) Press RUN. This switches the instrument from its static modes to its scanning modes. In this case, RUN invokes the CONTROL E LINEAR SCAN mode, and the voltage across the dummy load, as well as the the voltage indicated by the panel meter, will change at a constant rate from +5 V to -5 V in about 20 s and return to +5 V in another 20 s. Since MULTIPLE scanning is enabled, the cycle will repeat until it is interrupted.

(4) Release $E_{initial}$. The instrument will return to static CONTROL E operation; its output level and panel meter indication will return to +5 V, the INITIAL POTENTIAL. Release SINGLE and release STOP AT E_I. This prepares the instrument for a single scan, beginning at the INITIAL POTENTIAL, continuing to the FINAL POTENTIAL, and then returning to the INITIAL POTENTIAL again before halting. Press RUN. The panel meter needle will swing smoothly, tracking the changing output voltage, which will ramp from +5 V to -5 V, return to +5 V, and then halt.

(5) Release $E_{INITIAL}$. The instrument's panel meter indication will remain at +5 V. Press STOP AT E_F. Press RUN. The panel meter indication will swing from +5 V to -5 V and then stop. Release $E_{INITIAL}$. The panel meter indication will return to +5 V.

(6) Press RUN, allow the panel meter indication to ramp toward -5 V, and press HOLD. Scanning will halt, and the panel meter will indicate a DC level. Release HOLD. The meter indication will continue toward -5 V. Press REVERSE and release it. The panel meter indication will change direction, return to +5 V, and then stop.

2.3E CONTROL I, LINEAR SCAN CHECKS

(1) With the 10 kΩ load resistor still connected as shown in Figure II-2, set the following controls as indicated:

CELL: OFF
AC: ON
INITIAL POTENTIAL: +1.000
FINAL POTENTIAL: -1.000
CURRENT RANGE: 1 mA
SCAN RATE: 500 mV/SEC
MODE: CONTROL I
METER: I
$E_{INITIAL}$ *(released)*
MULTIPLE *(in)*
LINEAR SCAN *(released)*
IR COMPENSATION: OFF

(2) Set the CELL control to ON and press RUN. The panel meter's needle will swing smoothly from +1 (on the CURRENT range) to -1.0 in about four seconds and then return to +1.0.

(3) With the instrument still scanning, set the SCAN RATE to 50 mV/SEC. The scan rate, reflected in the deflections of panel meter, will slow to approximately 10% of the initial rate.

(4) Return the SCAN RATE to 500 mV/SEC. The scan rate will return to the initial rate.

(5) Press HOLD. The panel meter will indicate that scanning has stopped. Release HOLD. Scanning will continue.

(6) Press REVERSE momentarily. Scanning will reverse.

(8) Change the INITIAL POTENTIAL setting to +2.500 and the final potential to -2.500. (This can be done while the instrument is still scanning.) These changes establish an initial current at 2.5 times the CURRENT RANGE setting and a final current at -2.5 times the CURRENT RANGE. The CURRENT OVERLOAD lamp will light briefly as the magnitude of the current light exceeds approximately twice full scale (± 2 mA). The current ramp, however, continues in spite of the meter overload. When the magnitude of the current returns to within twice full-scale, the light goes out.

(9) Change the INITIAL POTENTIAL setting to +4.000 and the FINAL POTENTIAL setting to -4.000. This establishes an initial current at 4 times the CURRENT RANGE and a final current at -4 times the current range. The panel meter will cycle from +1.0 to -1.0 and the CURRENT OVERLOAD lamp will light when the current exceeds twice full-scale. The CONTROL AMPLIFIER OVERLOAD lamp will also light as the current approaches ±4 mA to indicate that CONTROL AMPLIFIER has lost loop control. In this case the CONTROL AMPLIFER's output voltage, which is limited to approximately ± 30 V, is not sufficient to push ±4 mA through the 10 kΩ dummy load.

(10) Switch the CELL control OFF.

2.3F CONTROL I, CONSTANT I SCANNING CHECKS

(1) With the CELL switched OFF, replace the 10 kΩ dummy cell with the 1 μF capacitor provided with the instrument. See Figure II-3. The check to follow confirms that the instrument can serve as a constant current source and charge and discharge a cell between selected potential limits. A capacitive load is necessary here because a resistive load would charge and discharge instantantly at a constant current, and instrument would simply. The voltage across a capacitor ramps smoothly in time if it is charged with a constant current.

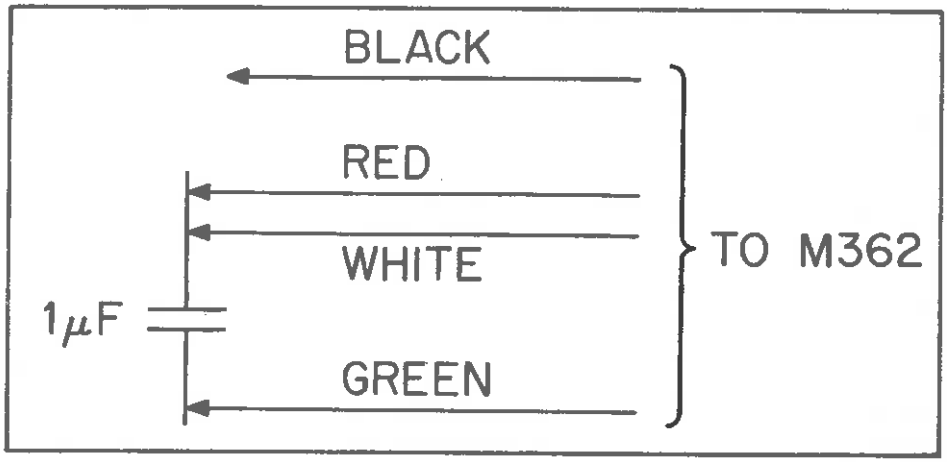


Figure II-3. DUMMY CELL CONNECTIONS FOR CONTROL I, CONSTANT I CHECKS

(2) Set the instrument's controls as follows:

CELL: OFF
AC: ON
INITIAL POTENTIAL: +5.000
FINAL POTENTIAL: -5.000
SCAN RATE: 100 % OF FULL SCALE
MODE: CONTROL I
METER: I
CURRENT RANGE: 1 μA
$E_{INITIAL}$ *(released)*
MULTIPLE *(in)*
CONSTANT I *(in)*
IR COMPENSATION: OFF

(3) Switch the CELL control ON. Press RUN. On the CURRENT scale, the panel meter's needle will deflect to the -1.0 position, remain there for a few moments, and then swing abruptly to the +1.0 positon. This cycle will repeat until until the scan is interrupted. The output indicated by the panel meter corresponds to the constant current output of the instrument, which changes polarity when the voltage across the cell (in this case, a capacitor) reaches the limits set by the INITIAL and FINAL POTENTIAL controls.

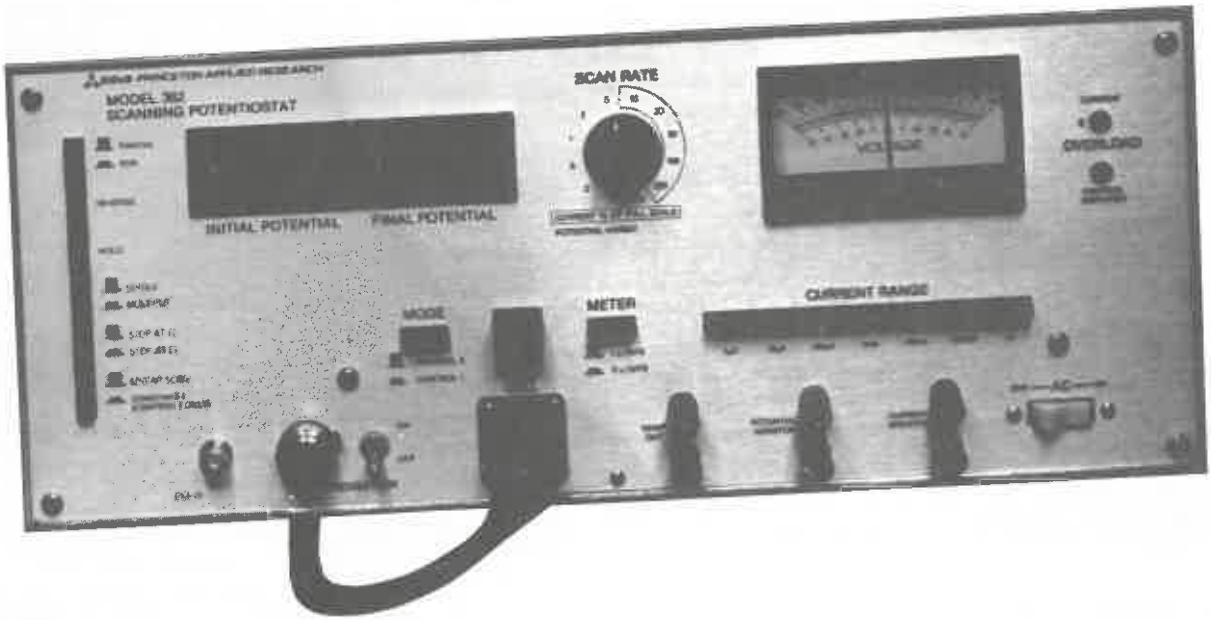
(4) Press the METER control to select the E position. With E selected, the needle will swing smoothly back and forth from +5 to -5, indicating that the voltage across the cell is ramping up and down within the limits established by the POTENTIAL controls.

(5) Switch the SCAN RATE to 200% OF FULL SCALE. The $\Delta v/\Delta t$, as shown by the panel meter, will double. Press HOLD. The panel meter reading will indicate a DC level on the cell. Release HOLD. Scanning will continue. Press REVERSE. Scanning will reverse.

(6) Switch the SCAN RATE back to 100% OF FULL SCALE. When the panel meter indicates approximately 0 V, select SINGLE by releasing the SINGLE button. Scanning will halt at either +5 or -5 V, depending upon the state of the STOP AT... control.

(7) Turn the CELL control OFF, press $E_{INITIAL}$ turn the AC control OFF, and disconnect the dummy cell from the cell cable.

This completes the initial checks. If the indicated results were obtained, the user can be reasonably sure that the instrument has arrived in good working order.


MODEL 362
SCANNING POTENTIOSTAT
SCAN RATE
INITIAL POTENTIAL
FINAL POTENTIAL
VOLTAGE
OVERLOAD
MODE
METER
CURRENT RANGE