QUALITY INSPECTION SUMMARY

CAT# 40-60-2B
Impedance Check Module
With Digital Display

We have made every effort to manufacture this instrument to the highest quality standards. All assemblies have been thoroughly tested and inspected at the factory as follows:

Product Inspection	_____ ☐
Initial QC Inspection/Calibration	_____ ☐
24 Hour Burn-In	_____ ☐
Final Performance Inspection	_____ ☐

Packaging Inspection Initials: _____ Date: _____

Items included with this catalog number are labeled and packaged separately in shipping carton.

Description	Quantity	Checked
40-60-2B Module	_____	☐
A710C Instruction Manual	_____	☐
*½ Amp 5x20mm Fuses	_____	☐
*1 Amp 5x20mm Fuses	_____	☐
Test Resistors/Gnd Pin (2/PK)	_____	☐
Calibration Test Cable	_____	☐

*Fuses are pre-installed at factory, as determined by shipping address.

DECLARATION OF CONFORMITY

We, FHC, Inc., 1201 Main Street, Bowdoin, Maine 04287 telephone number 207-666-8190, fax number 207-666-8292, declare under sole responsibility that the product:

Model # 40-60-2B Serial #

to which this declaration relates, is in conformity with the following standard:

EN60127-1, EN60320-1, EN60204-1

Following provisions of the Low Voltage (73/23/EEC) Directive.

The Technical Construction File is maintained at:

1201 Main Street
Bowdoin, ME 04287

DATE OF ISSUE: _____

PLACE OF ISSUE: Bowdoin, Maine USA

SIGNED: _____ Fred 2007.10.25 07:29:47 -04'00'

Frederick Haer

"Innovation through collaboration"

Providing Instrumentation and Apparatus for Cellular Research, Intraoperative Recording, and Microneurography; Micro-electrodes, Micropipettes, and Needles to the Neuroscience Community for 30 years.

40-60-2B- Impedance Check Module with Digital Display

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L005-18B

TABLE OF CONTENTS

1 Operational Manual

1.1 Features

- MEASURES FROM 1Kohm to 99.9Mohm IN TWO RANGES
- LOW MEASUREMENT CURRENT (10nA at 1000Hz)
- COMPLETE: NO OTHER INSTRUMENTATION IS REQUIRED
- EASY TO OPERATE; TUNED OSCILLATOR/FILTER MINIMIZES INTERFERENCE

1.2 Description

The new Impedance Check Module is designed to give the investigator valuable information about the tip of the microelectrode, the condition of the insulation, as well as recording characteristics as a function of depth.

Designed with a unique tuned oscillator/filter circuit and low frequency filters, this instrument can be used in most lab environments without shielding.

Impedance is shown on an easy to read LED display: two ranges covering from 1Kohm to 99.9Mohm are provided (other ranges can be specified on special orders).

The Impedance Check Module is line powered and is provided ready to use including cables and connectors.

1.3 Technical Summary

1.3.1 Specifications

Impedance: 3 digit red LED display

Measurement Ranges: 1-999 Kohm; 0.1-99.9 Mohm

Measurement Current: 10nA, peak-to-peak

Frequency: 1000Hz

Power Requirements: 115-230V (Switch Selectable) 50-60Hz. 1A Slo-Blo line fuse for 115V use or a 0.5A Fuse for 230V use.

Dimensions: 7" x 5 1/2" x 9" (18 x 14 x 23cm). 4 1/2 lbs. (2kg)

1.3.2 Controls/Connectors (include front panel drawing)

CONTROLS -- FRONT PANEL

Measure: Push button - depress to activate impedance measurement sequence

Range: 2-position toggle for selecting Mohm (1-99.9) or Kohm (1-999) impedance measurement range

Power: 2-position toggle switch for activating lines power.

Output: 5-pin Hex Socket (Amphenol 126-218) for electrode and reference connection. Mating Plug, (126-217) with 8" (20cm) cable terminated with miniature test clips included

Ground: Tip pin socket for ground connection (if required). Mating tip plug included.

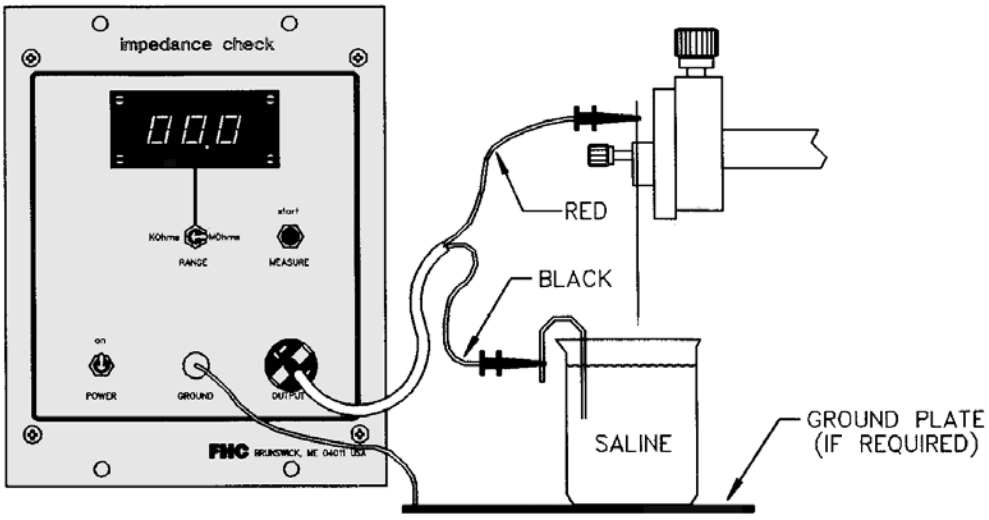
CONTROLS REAR PANEL

Line: Voltage selector/Fuse Holder

1.4 Illustrative Procedure

Equipment Required:

- Small beaker (50ml) filled with saline
- Positioner with .1mm resolution
- Metal wire (silver, stainless steel, or tungsten) for reference electrode
- Metal plate for ground plane (optional)
- Coarse manipulator to position microelectrode



1. Set up the impedance check module and equipment as shown; a grounded metal plate may be required if a calibrated resistor shows a repeatability variation of more than 2%. Connect the microelectrode (red) and reference electrode (black) wires as shown. Activate Power.

   NOTE 1: Make the connection to the microelectrode when the tip is out of solution so that induced currents do not pass through the tip in solution and damage the insulation at the tip.

2. Position the tip of the microelectrode just above the solution; advance the tip into the saline a fixed amount (we recommend 1mm).

3. Set the RANGE switch to Mohm and depress the MEASURE pushbutton. The display will count up and stop when the impedance value is measured. If the value exceeds 99.9Mohms, the counters will re-zero. Check the connections. If the value is less than 1Mohm. Set the RANGE switch to Kohm (the counters will zero) and again depress the MEASURE pushbutton. The impedance value in Kohm will be displayed.

   NOTE 2: The measurement current of 10nA is shut off once the counters are set (even though the value will continue to be displayed).

4. Advance the electrode to a depth equal to the approximate experimental recording depth and repeat the impedance measurement. It is also advisable to double the depth and make a third measurement.

   NOTE 3: Metal electrode impedance is a function of depth because of the shunt capacitance to ground generated by the metallic rod as it goes deeper into the solution. This effect is minimized by thicker insulation but a 30-50% drop in impedance value when going from 1 to 10mm is typical for a metal microelectrode. A sharp dramatic drop in impedance value indicates a break in the insulation and the electrode should be discarded or reinsulated.

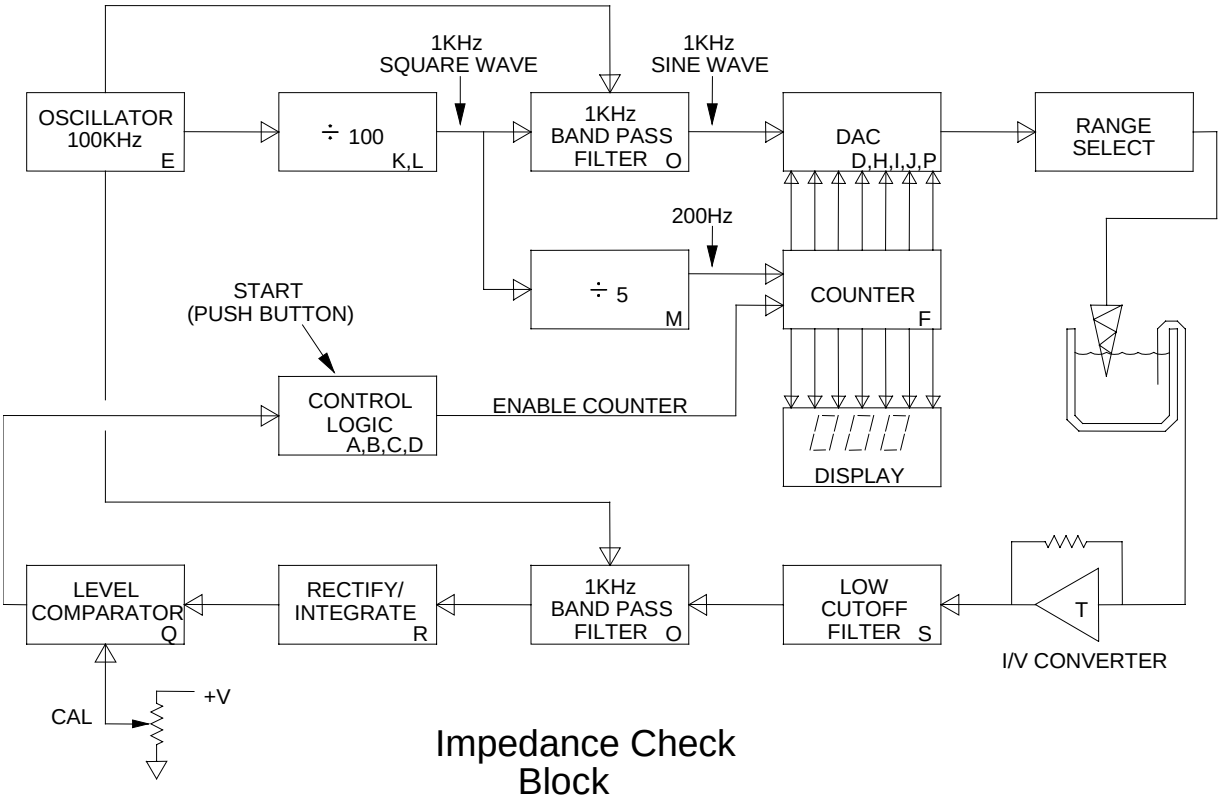
5. Back the electrode out at the solution before disconnecting the clips (see Note 1).

1.5 DESCRIPTION

"Start" - resets a counter and enables it to count up at a rate of 200Hz. The output of the counter drives a 3 digit display and a digital-to-analog converter configured as an attenuator of a 1 volt peak-to-peak 1KHz sine wave. The output of this DAC is, therefore, a sinusoidal waveform whose amplitude increases linearly with time starting at the push of the front panel switch. The output has a low impedance (constant voltage) and may be scaled to either of two impedance ranges (999 Kohm max or 99.9 Mohm max).

This output passes through the electrode impedance through the bath to a reference electrode, which is connected to a current-to-voltage (I-V) converter. The output of this stage (proportional in amplitude to the current passing through the electrode) is filtered to extract the 1KHz signal, rectified and compared with a voltage scaled to represent a current of 10nA (peak-to-peak) passing through the electrode. When this threshold current is reached, the display is latched and current to the electrode is turned off. The display reads the voltage required to pass the 10nA (i.e. the impedance of the electrode).

Letters in the blocks in the diagram below refer to the integrated circuits related to the titled functions. Please refer to Section 3.5 for a complete schematic diagram.



Impedance Check Block

2 Reference Manual

2.1 Reference Information

2.1.1 Packaging

FHC modules are packaged in metal cases which consist of standard size front panels (panel A= 2.75” x 7”; C= 5.5” x 7”; D= 8.25” x 7”) mounted on extruded side rails. Flat side panels slide into slots in the rails and are held in place when the back panel is secured into the rails. Please refer to Figure 2.1.1a.

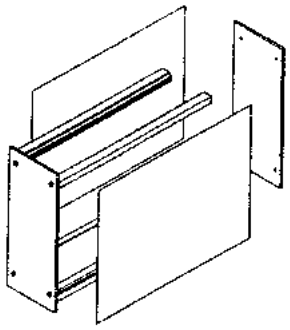


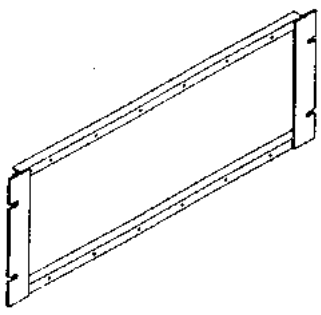
Fig 2.1.1a

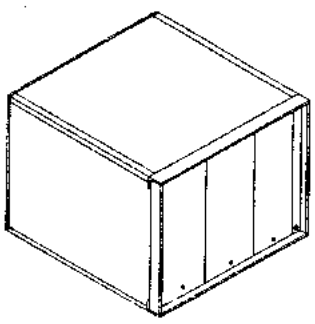
2.1.2 Mounting

All electronic modules are completely encased and can be used without further mounting or hardware. However, it may be suitable to group modules and we have made provision for several configurations.

The #40-10-1 Rack Mount Assembly will hold up to six 2.75” wide modules (Panel A) or three 5.5” wide modules (Panel C) or two 8.25” modules (Panel D), while occupying only 7” vertically on a standard 19” instrument rack. The #40-10-2 Three Module Cabinet hold three Panel A'' or one Panel A plus one Panel C module. The #40-10-4 Six Module Cabinet (not shown) is the same width as the Rack Mount Assembly.

Fig. 2.1.2 Rack Mount Assembly, Three Module Cabinet





2.1.3 Inspection

FHC modules are factory checked and calibrated but should be carefully inspected before activating power.

If any exterior damage to the shipping carton is noted, the instrument should be inspected for obvious physical damage.

2.1.4 Power Connections

The 40-60-2B is shipped set-up for 110-120V, 50-60Hz line voltage. Before operation at 220-240V, the power entry module on the rear panel must be reconfigured.

CAUTION: Failure to perform this procedure correctly may result in damage to, or improper operation of, the instrument.

The extra fuses required for changing the line voltage are packaged with the instrument.

For operation at 110-120 volts (For example, in North America):

1. Insert the voltage selector insert into the top socket within the recess above the power switch of the power module so that "115" legend is visible when the insert is installed. Press firmly into position.

2. Insert two (2) fuses, each marked 1A into the fuse drawer. (Discard the two fuses marked 500mA; they are intended for 230 volt operation).

3. Insert the fuse drawer into the power module. ("115" should appear in the fuse drawer window.)

4. Insert the power cord into the receptacle on the power module.

For operation at 220-240 volts (For example, in Australia or Europe):

1. Insert the voltage selector insert into the top socket within the recess above the power switch of the power module so that "230" legend is visible when the insert is installed. (The legend will be rotated 90 degrees). Press firmly into position.

2. Insert two (2) fuses, each marked 500mA into the fuse drawer. (Discard the two fuses marked 1A; they are intended for 115 volts operation).

3. Insert the fuse drawer into the power module. ("230" should appear in the fuse drawer window).

4. Insert the power cord into the receptacle on the power module.

2.1.5 Warranty

All FHC products are unconditionally guaranteed against defects in workmanship for one year from date of shipment as long as they have been exposed to normal and proper use. Even though the one year warranty may have expired, please contact our Service Department before attempting any repairs or alterations. Many of these repairs will still be performed at the factory at no charge to the customer.

2.1.6 Policies

1. TECHNICAL SUPPORT: It is our policy to provide our customers with the most comprehensive technical support in the industry. If any questions arise or problems occur, we encourage you to call or write and we promise to promptly and comprehensively respond to your requirements.

2. TRADE-UP POLICY: It is our policy to offer customers trade-up ability as new and/or expanded capabilities for their instruments are announced. In many cases, full credit will be given. In general, we will allow 100% credit for two years and depreciate 20% per year thereafter. Please contact our Marketing Department for information relating to your particular situation.

2.1.7 Service

Should service be required, please contact our Service Department for return instructions (207-666-8190). Carefully pack the instrument before returning. Save any packing retainers for future use.

Please include a note indicating:

1. The model number and purchase date of the instrument.
2. The person to contact if questions arise.
3. The "symptoms" indicating that repair is necessary.
4. A note indicating proper sterilization.

In order to safeguard our Repair Department personnel, we request that all returned equipment is sterilized by a method acceptable to the particular instrument, and that a note be included with the return indicating such.

If the instrument is not covered by the warranty, a quotation will be forwarded to the sender detailing the repairs necessary and charges, before repair is begun.

2.6 Functional Checkout

"Start" - resets a counter and enables it to count up at a rate of 200Hz. The output of the counter drives 1.) a 3 digit display and 2.) a DAC configured as an attenuator (of a 1KHz sine wave). The output of this DAC is, therefore, a sinusoidal waveform whose amplitude increases linearly with time starting at the push of the front panel switch. The output has a low impedance (constant voltage), and may be scaled to either of two impedance ranges (99.9KOhm max or 99.9MOhm max). This output passes through the electrode to the bath which is connected to an I-V converter. The output of this stage (proportional in amplitude to the current passing through the electrode) is filtered to extract the 1KHz signal, rectified and compared with a voltage scaled to represent a current of 10nA (peak-to-peak) passing through the electrode. When this threshold current is reached, the display is latched and current to the electrode is turned off. The display reads the voltage required to pass the 10nA (i.e. the impedance of the electrode).

Equipment required - 2 resistors of known resistance.
(Resistors with calibrated values are provided with equipment and are coded red and blue).

1. Set RANGE switch to Mohm. Connect the red (~20 Mohm) resistor directly between the red and black chip leads. Depress START pushbutton. Note displayed impedance measurement matches values given for the coded resistor.

2. Change RANGE switch to Kohms and repeat step 1 with the blue (~340 Kohm) resistor.

3 Technical Manual

3.0 General Documentation Information

It is our policy to provide comprehensive product documentation with our instruments. Section 3 of our instruction information includes not only technical descriptions and calibration procedures but parts lists, schematics and parts layouts. We also maintain a service record file on each product, information that is available to any instrument owner if in the future he should experience problems.

Section 3.4 includes our master parts list. The master parts list details the assemblies for the instrument and individual parts list for each assembly. These parts lists include our FHC part or assembly numbers, a general description of the part, and quantities.

Parts layouts are provided for all relevant assemblies. These layouts include component values and circuit numbers unique to the assembly. In those cases where the density of the assembly is too high a separate drawing with circuit numbers is included.

Complete schematics are also provided for each instrument. Schematics include all components of an instrument and as such, one schematic may include two or more assemblies, e.g. front panel and captive circuit board assemblies. Whenever possible assemblies are separated or designated on schematics. Schematics, in addition to listing component values include circuit numbers. Because circuit numbers are unique to each assembly, the same circuit number e.g C10 may be used twice on a schematic referring in one place to a 10 pF capacitor on a front panel switch and in another to a .47mF PCB mounted capacitor. However, functional considerations should remove any ambiguity.

Schematics are referenced by the instrument catalog number followed by a code which lists the total number of pages which constitute the complete instrument schematic i.e. 1/2, 2/2.

Assemblies are referenced by the assembly number followed by the number of pages code i.e. 1.2, 2.2. In those situations in which a printed circuit board is wired to another assembly, for example a front panel, the identifying interconnections, wire colors, etc. are included with the front panel assembly.

3.1 Specific Packaging Description

To open an FHC, Inc. module for service or inspection, set the instrument upright, remove the front and rear screws holding the top right rail as viewed from the front, and lift the rail upwards. This will release the top and side panels exposing the circuit boards and front and rear panel connections.

NOTE! Many modules that contain their own power supplies have circuit boards mounted on both side panels. As a result, it is important to use caution when moving the right panel to avoid damage to wiring.

Disassembly for service or calibration is not required on a routine basis.

3.3 Calibration Procedure

Equipment Required: Oscilloscope

1. Connect clip lead cable assembly to the OUTPUT connector. Set range to Mohms. Turn POWER on.

2. Adjust T1 so that the frequency of the TTL-level square wave at Test Point 1 is 100KHz.

3. Adjust T2 so that the peak-to-peak amplitude of the 1KHz sine wave at Test Point 2 is 1.0 volt.

4. Connect the red coded resistor provided with the instrument (20 Mohm) between the two clip leads. Repeatedly pushing the START pushbutton to initiate the measurement sequence; adjust T3 so that the front panel display indicates an impedance equal to the value listed for the red resistor.
   NOTE: If Catalog No. 40-60-2B-02 (10 Mohm range) has been ordered, a red-coded resistor rated at 4.42 Mohms has been provided for this calibration step.

5. Set RANGE to Kohms and connect the blue resistor (~340 Kohm) between the clip leads. Depress the START pushbutton and adjust T4 for correct impedance reading.

3.4 Master Parts List

Catalog #40-60-2B:

1180B1.00 Z-Check Front Panel Assembly	1ea.
1181B1.00 Z-Check Back Panel Assembly	1ea.
1066C1.09 +/- 5V Power Supply PCB	1ea.
1132B1.00 Three Digit Display	1ea.
1182B1.00 Z-Check PCB	1ea.
1183A1.00 Z-Check Test Cable Assy.	1ea.
4180B1.00 Z-Check Production Inspection	1ea.
7180A1.00 40-60-2B Packing List	1ea.

3.5 Schematics

Refer to the following Schematic drawings provided.

3.6 Parts Layouts

Refer to the following Parts Layout drawings provided.