

0.1 EC Declaration of Conformity

We: **FHC Europe (TERMOBIT PROD srl)**

of:

**129 Barbu Vacarescu Str, Sector 2
Bucharest 020272
Romania**

declare that:

Equipment: **Temperature Regulation Systems**

Model: **Catalog No.s 40-90-8D, 40-90-5D-02, 40-90-3, 40-90-6, 40-90-2-XX**

Serial Number: _____

has been designed and manufactured to the following specifications:

IEC61326 Electrical Equipment for Measurement, Control, and Laboratory Uses

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications. The unit complies with all essential requirements of the Directives.

Signed by: _____ Date: _____

Name: Frederick Haer

Position: President , FHC

Done at: *FHC Inc., 1201 Main Street, Bowdoin, ME 04287 USA*

Phone: 1207-666-8190, Fax: 207-666-8292



E-mail: fhcinc@fh-co.com, Website: <http://www.fh-co.com>

QUALITY INSPECTION SUMMARY

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:

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

Packaging Inspection Initials: _____ Date: _____

Items included with any catalog number may be labeled and packaged separately in shipping carton.

Description	Quantity	Checked
Cat.#40-90-8D DC Temperature Controller Module		
Containing:		
Controller Module	_____	<input type="checkbox"/>
Junction Box	_____	<input type="checkbox"/>
Accessory Kit	_____	<input type="checkbox"/>
Specified Line Cord	_____	<input type="checkbox"/>
Cat.#40-90-2X Heating Pad	_____	<input type="checkbox"/>
Cat.#40-90-5D-02 Thermistor Probe	_____	<input type="checkbox"/>
Cat.#40-90-3 Heating Rod	_____	<input type="checkbox"/>
Cat.#40-90-6 Liquid Thermistor	_____	<input type="checkbox"/>



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

Temperature Regulation Systems

40-90-8D DC Temperature Controller
40-90-5D-02 Rectal Thermistor Probe
40-90-3 Liquid Immersion Heating Rod
40-90-6 Liquid Thermistor Insert
40-90-2-XX Heating Pads



FHC Headquarters
1201 Main Street,
Bowdoin, ME, 04287 USA
Fax: 207-666-8292
E-mail: fhcinc@fh-co.com
www.fh-co.com

24 hour technical service
+1-207-666-8190
1-800-326-2905(US & Can)

FHC Europe
(TERMOBIT PROD srl)
129 Barbu Vacarescu Str,
Sector 2
Bucharest 020272
Romania

L005-18B

TABLE OF CONTENTS

Manual A720E: Temperature Regulation Systems

- 40-90-8D DC Temperature Controller
- 40-90-5D-02 Rectal Thermistor Probe
- 40-90-3 Liquid Immersion Heating Rod
- 40-90-6 Liquid Thermistor Insert
- 40-90-2-XX Heating Pads

0 Declarations

- 0.1 Declaration Of Conformity
- 0.2 Conditions For Use
- 0.3 Symbols Used

1 Operational Manual

- 1.1 Features
- 1.2 Description
- 1.3 Operating Environment
- 1.4 Inventory
 - 1.4.1 Items Described In This Manual
 - 1.4.2 Additional Items Required For Operation
 - 1.4.3 Replacement Items
 - 1.4.4 Optional Accessories
 - 1.4.5 System Configurations
- 1.5 Concepts
 - 1.5.1 Terminology
 - 1.5.2 Design Description
- 1.6 Technical Summary
 - 1.6.1 Specifications
 - 1.6.2 Controls / Connectors
 - 1.6.3 Compatibilities
- 1.7 Illustrative Procedure

2 Reference Manual

- 2.1 Reference Information
 - 2.1.1 Packaging
 - 2.1.2 Mounting
 - 2.1.3 Inspection
 - 2.1.4 Power Connections
 - 2.1.5 Warranty
 - 2.1.6 Policies
 - 2.1.7 Service
- 2.2 Installation
- 2.3 Functional Checkout
 - 2.3.1 Calibration
- 2.4 Operational Information
- 2.5 Scheduled Maintenance

0.2 **CONDITIONS FOR USE**

Intended Use

The Temperature Regulation Systems are used to maintain constant temperatures of subjects or liquid.

Warnings

The Temperature Regulation Systems components should not be disassembled beyond their major assemblies. Any disassembly beyond this may affect function and calibration. If repair is required please contact FHC at (207) 666-8190 for evaluation and to secure a return authorization number if necessary.

In animal applications, a blanket or similar insulating material should be placed between the heating pad and support plate. Additionally the rectal thermistor probe should be taped in place once inserted. In liquid heating applications, care should be taken to keep the instrumentation and cabling in a dry place.

Storage Precautions

Store at normal room temperatures between -34°C (-29°F) and 57°C (135°F). Do not expose to temperatures below -39°C (-29°F) or greater than 70°C (158°F), or a relative humidity of less than 10% or more than 100%, including condensation, or an atmospheric pressure less than 500hPa or greater than 1060hPa for long-term storage.

Sterilization

The Rectal Thermistor Probe can be sterilized by dipping the tip into a sterilizing agent previous to use. No other sterilization methods are recommended.

Handling

While a high degree of durability has been designed into the Temperature Regulation Systems components, care should be taken not to drop them. Place all cables and leads where they will not be inadvertently pulled or tangled.

0.3 **SYMBOLS USED**

None used

1 OPERATIONAL MANUAL

1.1 FEATURES

- 25° - 45°C Heating Range, 40 Watt capacity
- Proportional DC voltage does not generate electrical noise, no switching transient
- Thermistor probes and heating elements available for all lab applications
- Analog output of heater output for chart recording or other biological recording devices
- Compatible with other probes (ex. YSI 400) through factory modification
- Desktop or rack mountable

1.2 DESCRIPTION

The DC Temperature Regulation Systems are designed to maintain a constant temperature of a subject or liquid without introduction of electrical interference. The proportional DC power supply slowly varies its output to the heating element based on the resistance of the monitoring thermistor. Electrical noise and switching transients common in AC-based devices is eliminated.

The DC Temperature Controller (40-90-8D) is powered through an internal power supply (country specific line cord ordered separately). It has an easy-to-read three digit LED display on the front panel indicating the subject or liquid temperature in tenths of a degree Celsius. Failing thermistors or similar electrically "open" situations are indicated by a red LED on the front panel labeled "OPEN"

A junction box is provided with the Controller, which connects to the module via a 2.5m shielded cable (extension cable available); thermistors and heating elements plug into this box.

The 40-90-5D-02 Rectal Thermistor Probe is small enough (.062"/1.6mm diameter) to maintain the body temperature of a range of mammals (mouse, rat, cat etc.). Heating pads (40-90-2-XX) are available in sizes suitable for any application.

The 40-90-3 Liquid Immersion Heating Rod and 40-90-6 Liquid Thermistor Insert can heat up to 1L of liquid and maintain a constant temperature to serve as a water bath or warmed perfusate.

FHC thermistors utilize 5000Ohm resistance. The DC Temperature Controller can be factory configured for 2252Ohm thermistors, e.g. YSI 400 series, and factory-modified for other heating elements (contact FHC Technical Support for more information).

An analog output provides a voltage related to the measured temperature (100mV/°C) for use with biofeedback recording systems. (ex. Chart recorders etc.)

The DC Temperature Controller contains an internal power supply that can be user-configured for 50 or 60Hz. Country specific line cords are ordered separately. The module is compact and can be placed as a stand-alone unit on a desktop, or mounted in a standard 19" instrument rack with our SAF rack frame.

1.3 OPERATING ENVIRONMENT

The Temperature Regulation System components have been designed to operate in a typical laboratory setup. They should be placed on a flat surface that is level and free from contaminants and vibration.

1.4 INVENTORY

1.4.1 ITEMS DESCRIBED IN THIS MANUAL

The following items are included under the following catalog numbers:



1 ea. Temperature Control Module

- **40-90-8D** DC Temperature Controller

Includes: DC Temperature Controller Module

Junction Box

Line Cord

Accessory Kit

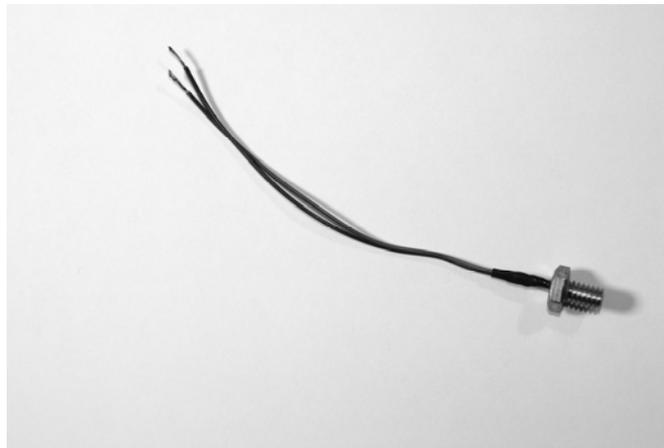
Includes:

Rubber feet (use optional)

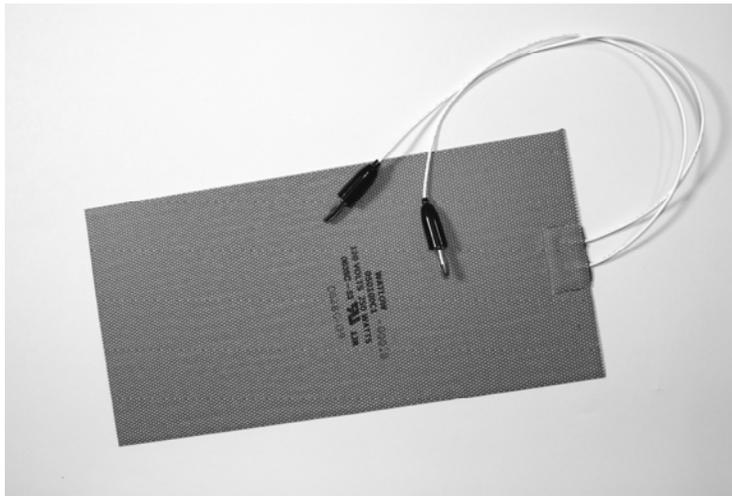
1 ea. Thermistor from the following:



- **40-90-5D-02** Rectal Thermistor Probe



- **40-90-6** Liquid Thermistor Insert



1 ea. Heating Element from the following:

- **40-90-2-02** 25X25cm Heating Pad
- **40-90-2-05** 10X12.5cm Heating Pad
- **40-90-2-06** 6.5X9.5cm Heating Pad
- **40-90-2-07** 5X12.5cm Heating Pad
- **40-90-3** Liquid Immersion Heating Rod

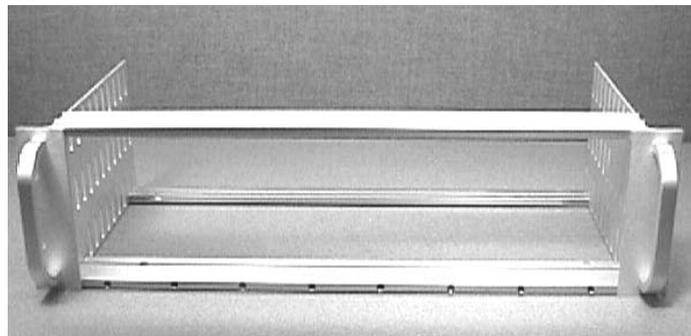
1.4.2 ADDITIONAL ITEMS REQUIRED FOR OPERATION

None Required

1.4.3 REPLACEMENT ITEMS

Thermistors and Heating elements may be ordered separately.

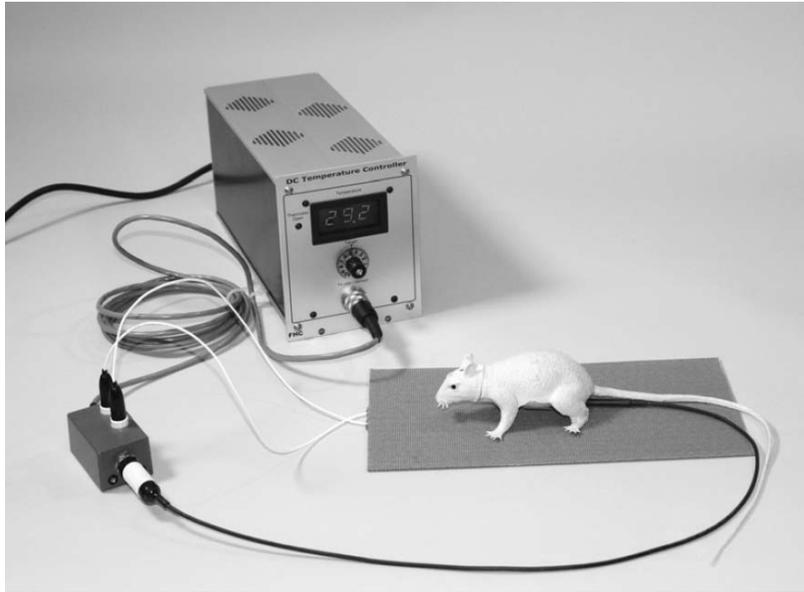
1.4.4 OPTIONAL ACCESSORIES *The following accessories are available:*



55-11-0 SAF Rack Frame for Stand-Alone Modules

1.4.5 SYSTEM CONFIGURATIONS

As an animal temperature regulation system



As a bath temperature regulation device



1.5 CONCEPTS

1.5.1 TERMINOLOGY

Thermistor: A thermistor is a device whose resistance changes in proportion to its temperature. It is used to measure the temperature of an animal subject or of bath medium.

1.5.2 **DESIGN DESCRIPTION**

The DC Temperature Controller (Cat. #40-90-8D) generates a DC voltage that is proportional to the difference between the temperature set by a front panel potentiometer and the temperature sensed by a thermistor. Using this DC voltage to drive a heating element results in a closed-loop system for regulating temperature about the set-point established by the front panel control. Using a proportional DC voltage for the heater eliminates the noise-producing spikes associated with temperature controllers that switch the heater off and on to regulate temperature.

1.6 **TECHNICAL SUMMARY**

1.6.1 **SPECIFICATIONS**

DC Temperature Controller:

Output Voltage: 0-35V DC (Ripple<25mV peak to peak) **Output Current:** 0-1A
Temperature Range: 25°C - 45°C **Temperature Display:** 3 Digit LED indicating temperature in degrees and .1degrees C **Temperature Accuracy:** .2°C **Thermistor**

Resistance Required:

Standard Configuration: 5000Ohms at 25°C

Heater Element Resistance Required: 35 Ohms minimum

Power Requirements: 100-240 VAC, 50-60Hz

Dimensions:

Height: 13cm (5.22")

Width: 10cm (4.20")

Length: 25cm (9.75")

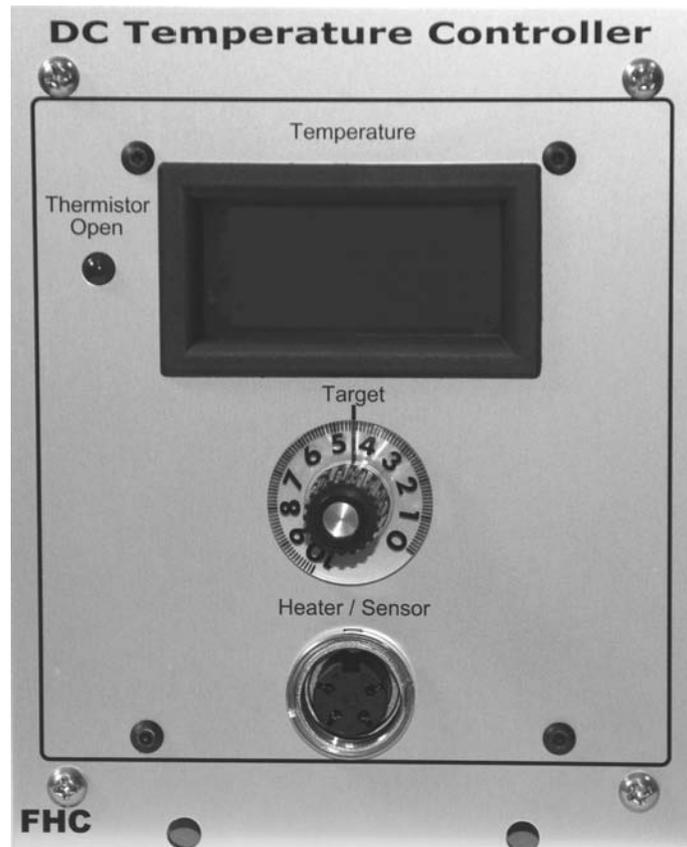
Weight: 1.48 Kg (3.26 lbs)

Mounting Options:

Tabletop, 4 rubber feet prevent sliding.

Rack mountable with SAF Rack Frame (Cat. #55-11-0 Available separately)

1.6.2 **CONTROLS/CONNECTORS**



Display - DC Temperature Controller Front Panel:

Temperature: 3 digit LED display of the temperature read from the thermistor to .1°C

Open: Red LED display warning of an open thermistor circuit

Controls - DC Temperature Controller Front Panel:

Target: Graduated dial for setting the target subject/liquid temperature. See section 2.4 for setting/temperature chart

Connections - DC Temperature Controller Front Panel:

Heater/Sensor: 4 conductor socket for connecting the thermistor/heating element junction box



Controls - DC Temperature Controller Back Panel:

0|I: Rocker switch used to activate power.

Connections - DC Temperature Controller Back Panel:

Line Voltage: Voltage selector for 115 or 230V line voltage **Fuse:** Holder for 2 Slo-Blo fuses **Power:** 6-ft. (2m) line cord with 3-pronged plug **Analog Output:** Male BNC connector providing proportional voltage of thermistor's temperature measurement (100mV/°C)

1.6.3 COMPATIBILITIES

The DC Temperature Controller comes factory calibrated to work with thermistors of 5000Ohms at 25°C and heating elements of 35 Ohms minimum. We are happy to recalibrate or modify it for use with other thermistors or elements. (Contact FHC Technical Support for details)

1.7 ILLUSTRATIVE PROCEDURE

Temperature regulation in animal applications:

1. Position animal in stereotaxic.
2. Slide the Heating Pad between the animal and a suitable insulating material. Direct contact between the Heating Pad and stereotaxic support plate is not advised.
3. Insert Rectal Thermistor Probe into the animal and tape in place.
4. Connect the Junction Box to the controller
5. Plug the Rectal Thermistor Probe and Heating Pad leads into the Junction Box.
6. Adjust controller to the desired target temperature using the Target knob. (ex. "6" for 37°C)

Temperature regulation in liquid applications

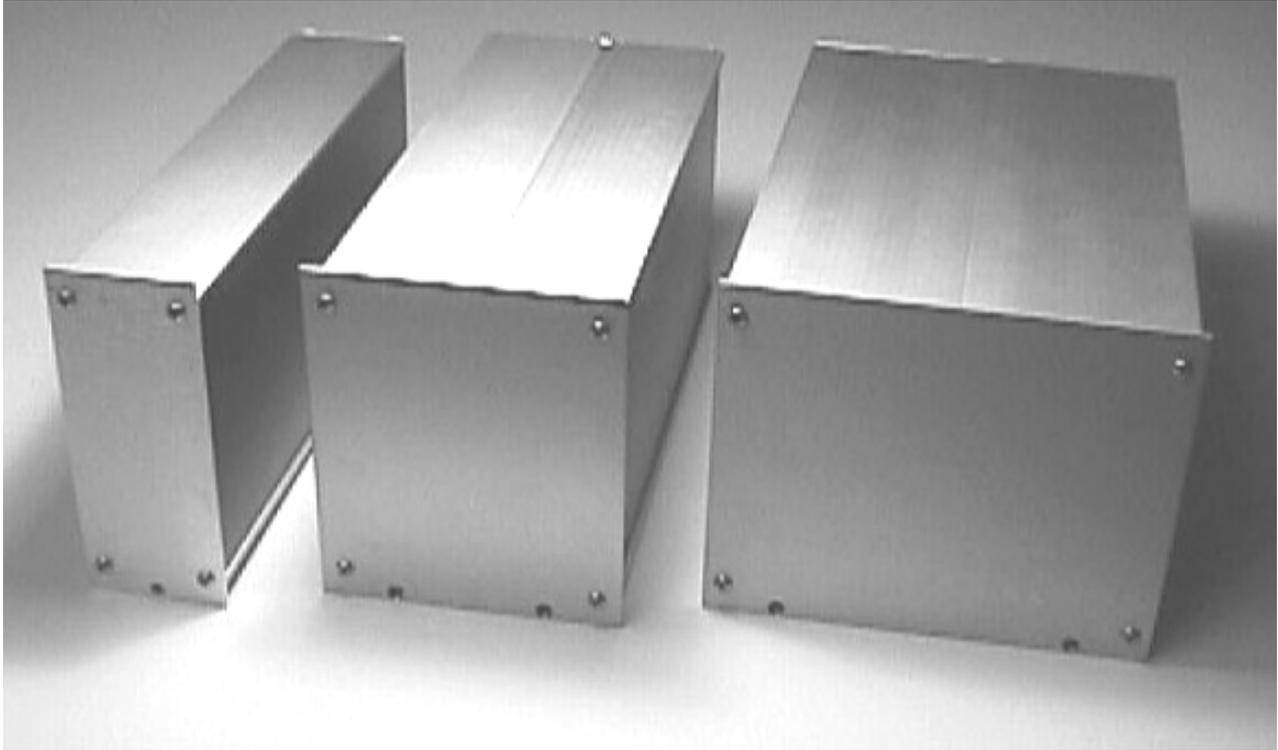
1. Thread the Liquid Thermistor Insert and Liquid Immersion Heating Rod into the bath sidewalls so that they will be completely immersed.
2. Fill the bath with water and cover. It is recommended that the bath water circulate.
3. Connect the Junction Box to the controller
4. Adjust controller to the desired target temperature using the Target knob (ex. "6" for 37°C)

2 REFERENCE MANUAL

2.1 REFERENCE INFORMATION

2.1.1 **PACKAGING**

The stand-alone modules of the neuro/craft™ series instruments are packaged in metal cases, which consist of standard 5.25" high front panels. Front panel widths are specified as Type 2 modules (2.05" actual), Type 4 modules (4.15" actual), and Type 6 modules (6.25" actual) Front panels are mounted on extruded top and bottom panels. Flat side panels slide into slots in the extrusions, and are held in place when the back panel is secured into the extrusion. All modules are 9.75" in depth.



Type 2 Module

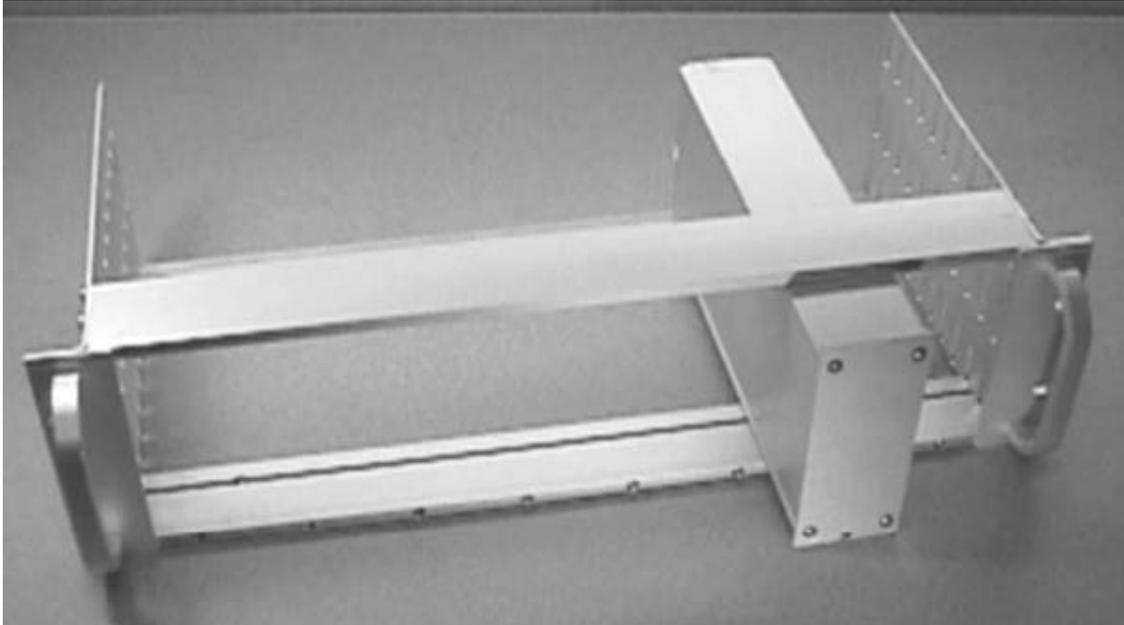
Type 4 Module

Type 6 Module

2.1.2 **MOUNTING**

All stand-alone modules are completely encased and can be used without further mounting or hardware. Provided rubber feet may be used to protect surfaces from scratching. However, it may be suitable to group modules, and we have made provision for several configurations. The SAF Rack Frame for Stand-Alone Modules (cat #55-11-0) will hold up to eight Type 2 modules, four Type 4 modules, or two Type 6 modules and 2 ea. Type 2 Dress Panels (cat #55-11-1 use optional), while occupying only 3 rack units (5.25") vertically on a standard 19" instrument rack. Several combinations are available for all of the neuroCraft series stand-alone modules. For example an SAF frame could accommodate 3-Type 2, 1-Type 4, and 1-

Type 6 within its 16" of horizontal rack space.



SAF Rack Frame For Stand-Alone Modules (Shown with a neuroCraft Type 2 Module)

Dress Panels for SAF (Ordered Separately):

- 55-11-1 Type 2 Dress Panel

2.1.3 ***INSPECTION***

FHC Modules are factory checked and calibrated but should be carefully inspected upon receipt, before using, or activating power. If any exterior damage to the shipping carton is noted, the instrument(s) should be inspected for obvious physical damage. The contents of each package should be physically checked against the inventory list (sec. 1.3) to determine shortages or errors in inventory.

2.1.4 ***POWER CONNECTIONS***

All of the stand-alone modules in the neuro/craft series are powered by an internal universal power supply that accepts inputs of 85-265VAC, 50-60Hz. An international pattern Line Cord (not shown) is ordered separately, and is specified by country per the catalog number. (See table below for catalog numbers.)

66-EL-LC-AUS Australia
66-EL-LC-CH China
66-EL-LC-DAN Denmark
66-EL-LC-EURO Europe
66-EL-LC-ISR Israel
66-EL-LC-ITA Italy

66-EL-LC-JA Japan
66-EL-LC-SAF South Africa
66-EL-LC-SWI Switzerland
66-EL-LC-UK United Kingdom
55-USA North America

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. Although 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**

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.

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 a return authorization number and instructions (207-666-8190). Please have the model and serial number on hand (Both are located on the back panel). Carefully pack the instrument before returning.

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

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.

2.2 **INSTALLATION**

1. Attach rubber feet to bottom corners of the DC Temperature Controller module if mounting on a desktop. If rack-mounting in the SAF Rack Frame, install the device and tighten the front panel thumbscrew before plugging in any cabling.
2. Plug the line cord into the power outlet on the back panel.
3. Attach the junction box connector into the socket on the front panel. Turn clockwise to tighten.

4. Plug the thermistor and heating element leads into the junction box.
5. Route cables so that they can't be inadvertently pulled or tangled.

2.3 **FUNCTIONAL CHECKOUT**

Equipment needed: Oscilloscope or voltmeter

1. Connect junction box to Temperature Control module. Plug heater into junction box jacks. Connect the decade resistance box ("R") to the thermistor jacks of the junction box. Connect the oscilloscope or the voltmeter across the heater; + to terminal number 4, - to terminal number 3 (see Dwg.40-90-8C(1/1)). If a liquid heating rod is used, it must be immersed in water; no such precaution is necessary with the heating pad.
2. Turn the Temperature Control Module on. Set the TEMPERATURE control to zero. Vary "R". When "R" is higher than approximately 5000 ohms, the heater voltage should rise to about 29-32 volts; lower values of "R" should cause this voltage to fall to near zero. When "R" is 5000 ohms, the Analog Output should measure approximately 0V.
3. Set the TEMPERATURE control to 10. When "R" is higher than approximately 2200 ohms, the heater voltage should rise to 29-32 volts; lower values of "R" should cause this voltage to fall to near zero.
4. Set "R" to 2100 ohms; display should read 46.0 degrees and the Analog Output should at 2.1V. Set "R" to 5000 ohms; display should read 25.0 degrees. Also, the Analog Output should measure approximately 0mV.
5. Disconnect the thermistor. The THERMISTOR OPEN LED should light and the heater voltage should fall to near zero.
6. Check the magnitude of noise on the output. With a 60-Ohm, load (e.g. a 40-90-2 heating pad), the maximum AC ripple should be 25mV peak-to-peak when the DC output is maximum ("R" greater than 5000 Ohms).

2.3.1 **Calibration**

1. Mechanically align the calibrated knob on the front panel potentiometer shaft so that the full clockwise position lines up with "1" on the number 10. Tighten knob screw when finished.
Note: Trimpots T1 and T2 along with test points Tp1 and Tp2 are all located on the front panel circuit board (1057C1.00). Trimpots T3, T4, and T5 along with test points Tp3 and Tp4 are all located on the main circuit board (1148C1.00).
2. Connect a heating pad to the output and the decade resistance box (R) to the thermister input of the module. Set R to 5000 Ohms. Adjust T2 for a voltage of 3.4V at Test Point 2 (Tp2). Adjust T1 for a voltage of 3.3V at Test Point 1 (Tp1).
3. Set R to 2100 Ohms. Adjust T1 for a digital display reading of 46.0 degrees.
4. Set R to 5000 Ohms. Adjust T2 for a digital display reading of 25.0 degrees.

(Note: Steps 3 and 4 interact and should be repeated until both specified display readings are obtained.)

5. Set R to 5000 for a digital display reading of 25.0 degrees. Connect the Analog Output(BNC connector) of the Temperature Controller to channel 2 of the oscilloscope. Adjust T5 so that the measure voltage equals as close to 0V as possible.

(Note: It is possible to adjust T5 too far and still have the Analog output equal 0V. For example, the minimum value of the Analog output may be 4mV. Adjust T5 until the output reaches 4mV but don't adjust T5 any further. Likewise, the Analog output may already be at 4mV, so T5 should be adjusted to the exact point where the Analog output starts to increase.)

6. Set R to 2100 Ohms. Confirm that the digital display reads 46.0. Adjust T6 so that the Analog output equal 2.1V. Set R to 2184 Ohms. Confirm that the digital display reads 45.0 and the Analog output equals 2.0V.

7. Adjust R, the decade resistance box, for a digital display reading of 25 degrees (R = 5000 Ohms). Set the TEMPERATURE control knob to 0. Adjust T4 so that the heater output is 16V (CW to raise). Confirm that the Analog Output is equals 0mV.

8. Adjust R for a display reading of 45 degrees (R approximately equals 2184 Ohms). Set the TEMPERATURE control knob to 10. Adjust T3 so that the heater output is 16 volts(CW to lower).

2.4 OPERATIONAL INFORMATION

As An Animal Temperature Regulation System

1. Install the unit per the instructions in 2.2. Installation
2. After positioning in the stereotaxic, slide the Heating Pad under the animal, and place an insulating blanket between the pad and the support plate. Wrap the animal in the blanket to minimize heat loss.
3. Insert the Rectal Thermistor Probe into the animal, and tape in place.
4. The control module will not operate without the thermistor connected. If the thermistor is removed (or fails in an open condition), the THERMISTOR OPEN LED will light and the output will turn off.
5. The TARGET control knob sets the regulation point at approximately the following temperatures:

KNOB SETTING	TEMPERATURE, DEGREES C
0	25
2	29
4	33
6	37
8	41
10	45

6. Nominal resistance values for the 5000-Ohm thermistor are as follows:

TEMPERATURE, DEGREES C	RESISTANCE, OHMS
25	5000

30	4029
35	3266
40	2663
45	2184

As A Bath Temperature Regulation System

1. Install the unit per the instructions in 2.2. Installation
2. Thread the Immersion Heating Rod and Liquid Thermistor Insert into the bath sidewalls so that they will be completely immersed.
3. Fill the bath with water and cover. It is recommended that the bath water circulate.
4. The control module will not operate without the thermistor connected. If the thermistor is removed (or fails in an open condition), the THERMISTOR OPEN LED will light and the output will turn off.
5. The TARGET control knob sets the regulation point at approximately the following temperatures:

KNOB SETTING	TEMPERATURE, DEGREES C
0	25
2	29
4	33
6	37
8	41
10	45

6. Nominal resistance values for the 5000-Ohm thermistor are as follows:

TEMPERATURE, DEGREES C	RESISTANCE, OHMS
25	5000
30	4029
35	3266
40	2663
45	2184

2.5 SCHEDULED MAINTENANCE

A yearly performance of the Functional Checkout in section 2.3 should be performed to ensure function and calibration. If the unit fails any part of this functional test, contact the FHC Repair Department at (207)666-8190