Warner Instruments
Dual-Channel Bipolar Temperature Controller
Model CL-200

Warner Instruments
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CE

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The **CL-200** Dual-Channel Bipolar Temperature Controller from Warner Instruments is a versatile and user-friendly thermal control device. This dual-channel automatic temperature controller is capable of accurately maintaining two Peltier devices between -6°C and 65°C. The unit will also maintain a resistive heater from ambient to 65°C.

While specifically designed for use with Warner's Heating/Cooling Platforms and In-Line Solution Heater/Coolers, this instrument can be easily adapted for use with custom-built equipment according to the requirements of the user. When coupled with the **SC-20** Dual In-line Solution Heater/Cooler, the **CL-200** provides efficient control of perfusion solution temperatures.

The unit is simple to use with a single control for temperature adjustment. Total automatic control is provided in *automatic mode*, while manual control is available in *manual mode*. A *loop-speed selector* is used to optimize the response of the system to accommodate thermal delay characteristics intrinsic to the setup.

Features of the **CL-200** include

- ✓ Quiet operation suitable for use in sensitive electrophysiology applications
- ✓ Automatic and manual modes
- ✓ Single control temperature adjustment
- ✓ Freeze alert
- ✓ Built-in protection for Peltier devices
- ✓ Selectable loop speed optimizes system speed and stability
- ✓ Simultaneous monitoring of system temperature and a separate point of interest
- ✓ Heat Loss compensation mode
- ✓ Open thermistor fault protection
- ✓ External inputs for computer control
- ✓ Compatible with all Warner Peltier-driven Heater/Cooler devices

THIS EQUIPMENT IS NOT DESIGNED NOR INTENDED FOR USE ON HUMAN SUBJECTS

NOMENCLATURE

Text conventions

This manual refers to instrument controls at two functional levels; specific controls and settings of these controls. To increase readability, we employ the following text conventions. Since our goal is to provide clarity rather than complexity, we welcome any feedback you may wish to provide.

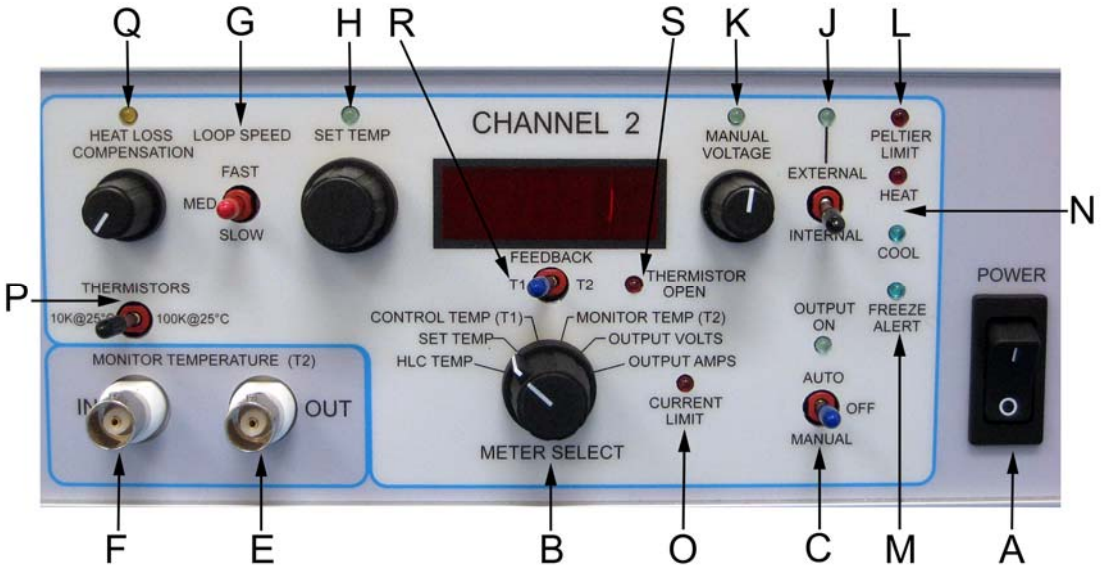
- Warner Instrument product model numbers are presented using **bold type**.
- References to controls are specified using SMALL CAPS.
- References to control settings are specified using *italic type*.
- Special comments and warnings are presented in highlighted text.

Any other formatting should be apparent from context.

CONTROL DESCRIPTION

Front panel

A labeled image of the face panel for one channel of the **CL-200** is shown below. Operating components are identified by letters. Refer to this diagram as an aid in identification of the described components.



Power Switch (Item A)

Supplies power to the **CL-200**.

Meter Selector Switch and Meter (Item B)

THE SELECTOR SWITCH selects the parameter displayed on the associated METER. Included options are *HLC Temp, Set Temp*, *Control Temp (T1)*, *Monitor Temp (T2)*, *Output Volts,* and *Output Amps* and are described below.

Set Temp reports the adjustment from either the SET TEMPERATURE control (Item H) or the EXT TEMP SET BNC (Item Q). Displayed units are °C.

Control Temp reports the actual temperature of the feedback thermistor situated within the heater/cooler device being used. Displayed data is informative only and is in units of °C.

HLC Temp reports the heat loss compensated temperature of a "phantom" thermistor at the site of interest. Displayed data is informative only and is in units of °C.

Monitor Temp reports the temperature of the sensor thermistor which connects via the MONITOR TEMP IN BNC (Item F). This provides a convenient means to determine the temperature of any point of interest within your configuration. Displayed units are °C.

Output Volts reports the adjustment from either the MANUAL VOLTAGE control (Item K) or the EXT VOLT SET BNC (Item T). Displayed units are Volts.

Output Amps reports the current output command associated with either the MANUAL VOLTAGE control (Item K) or the EXT VOLT SET BNC (Item T). Displayed units are Amperes.

The METER also provides an indication that the main POWER is *on*.

Cooling Mode Switch (Item C)

Selects between *Automatic* or *Manual* operational modes, or center select for *off*.

Thermistor Recorder Outputs (Items E, V)

BNC connectors are provided to send thermistor readings to a data acquisition system or chart recorder.

MONITOR TEMP OUT (Item E) reports the temperature of the sensor thermistor which connects via the MONITOR TEMP IN BNC (Item F). Output is calibrated to 100 mV/°C.

CONTROL TEMP OUT (Item V, back panel) reports the actual temperature of the feedback thermistor situated within the heater/cooler device being used. Output is calibrated to 100 mV/°C.

Monitor Temp In BNC (Item F)

BNC for connecting a sensor thermistor used to sample the temperature at a point of interest. This input is designed for use with the **TA-29** cable assembly.

Loop Speed Switch (Item G)

This switch sets the feedback loop speed for the CONTROL TEMP THERMISTOR when the **CL-200** is used in *automatic mode*. Feedback options include *fast, medium,* and *slow*. Optimally set to *fast* for most applications but can be set to *medium* or *slow* for systems with longer thermal delay characteristics. For example, use the *medium* speed for use with the **SC-20** Bipolar In-Line Solution Heater.

Set Temperature Control (Item H)

This dial adjusts the set point of the *automatic* temperature control system. The associated GREEN LED is *on* when the INTERNAL/EXTERNAL SELECT CONTROL (Item J) is set to *internal*, and the COOLING MODE SWITCH (Item C) is set to *auto*. Set value can be read from the METER (Item B) in the *set temp* position.

External/Internal Select Control (Item J)

This switch selects between *internal* or *external* control inputs when the instrument is in *Manual* mode (Item C).

When the INTERNAL/EXTERNAL SELECT CONTROL is set to *internal*, and the COOLING MODE SWITCH (Item C) is set to *auto*, the SET TEMPERATURE CONTROL (Item H) will be active. Setting the COOLING MODE SWITCH (Item C) to *manual* disables the SET TEMPERATURE CONTROL (Item H) and activates the MANUAL VOLTAGE CONTROL (Item K).

Manual Voltage Control (Item K)

This dial is used to manually adjust the voltage output to the heater/cooler device. The associated GREEN LED is *on* when the INTERNAL/EXTERNAL SELECT CONTROL (Item J) is set to

internal, and the COOLING MODE SWITCH (Item C) is set to *manual*. Set value can be read from the METER (Item B) in the *output volts* position.

Peltier Limit LED (Item L)

This option functions only when the **CL-200** is used with an **SC-20** Dual In-line Solution Heater/Cooler. The RED LED is *lit* when the temperature of the Peltier device within the **SC-20** exceeds its operational limits. Activation of this circuit automatically sets the output voltage of the **CL-200** to *0 V*.

Freeze Alert LED (Item M)

This option functions only when the **CL-200** is used with an **SC-20** Dual In-line Solution Heater/Cooler. The BLUE LED is *lit* when the Peltier device within the **SC-20** approaches 0°C. Activation of this circuit is informative only and will not alter any instrument setting.

Heat / Cool LED's (Item N)

RED and BLUE LED'S indicate *heating* or *cooling* power applied to the Peltier device.

Current Limit LED (Item O)

This indicator light informs the user that the channel has reached the maximum current output of 5 Amperes. This indicator is informative only, and will not alter the function or settings of the device.

Thermistor Impedance Selector Switch (Item P)

This switch can be set to indicate the type of thermistor in use with the peripheral device. The thermistor impedance for Warner Instruments equipment is 10kΩ @ 25˚C, while the thermistor impedance for Harvard equipment is 100kΩ @ 25˚C.

Heat Loss Compensation Dial (Item Q)

This dial can be used in *auto* mode as an adjustment for the temperature gradient between T1 and T2. This circuit utilizes the change in power output to adjust for the heat lost from the system and maintain a stable temperature at the preparation.

Feedback Thermistor Selector Switch (Item R)

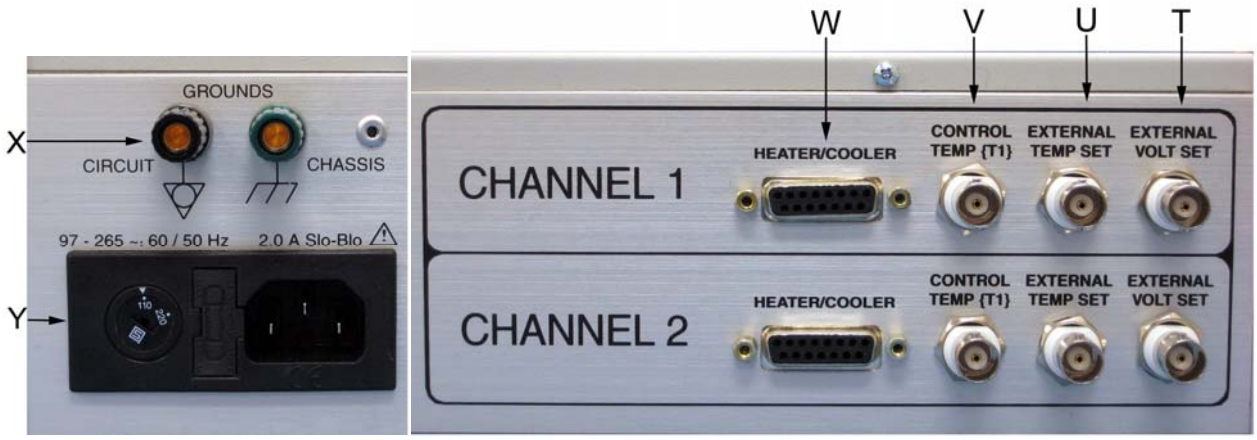
This switch can be set to select the thermistor that will be used as the control point for the feedback regulation of set temperature.

Thermistor Open LED (Item S)

This LED indicator will signify an open thermistor circuit (broken thermistor wire).

Rear panel

A schematic of the rear panel of the **CL-200** is shown below. Important components are identified by letter (T-Y). Refer to this diagram as an aid in identification of the described components.



External Volts Set (Item T)

Input BNC for the application of a specified voltage to be applied to the heater/cooler being controlled. Input functions only when the INTERNAL/EXTERNAL SELECT CONTROL (Item J) is set to *external*, and the COOLING MODE SWITCH (Item C) is set to *manual*. Units are 1 V/V input. This input can be used for computer control purposes.

External Temp Set (Item U)

Input BNC for adjusting the SET TEMPERATURE of the **CL-200**. Input functions only when the INTERNAL/EXTERNAL SELECT CONTROL (Item J) is set to *external*, and the COOLING MODE SWITCH (Item C) is set to *auto*. Units are 100 mV/°C. This input can be used for computer control purposes.

Heater/Cooler input (Item W)

This is the connection port for Warner Heater/Cooler devices such as the **SC-20** Dual In-line Heater/Cooler and **QE-1HC** Heating/Cooling Platform.

Power Entry Module (Item Y)

Comprised of the line cord attachment point, line voltage selector and fuse buss. Power entry is selectable between *115 VAC*, *60 Hz* or *230 VAC*, *50 Hz*. The replaceable fuse is 0.4 amp slow-blow for 230 V applications, or 0.8 amp "slow-blow" for 115 V applications.

Ground Terminals (Item X)

Provides separate connections for *chassis* and *circuit ground*. Banana jacks are bridged when shipped from the factory.

SETUP

The **CL-200** has been designed primarily to drive Warner's expanding line of Peltier-driven heating and cooling devices. However, the instrument is also capable of supplying power to Warner's line of resistive heaters (Series 20 heater platforms, in-line solution heaters, etc.). The instrument will auto-detect when a resistive-only heating device has been attached and will disable cooling commands.

Warner Peltier Driven Systems

The set up for the **CL-200** is straightforward when used with a Peltier driven heater/cooler. First connect the cable from the heater/cooler into the 15-pin D-connector on the back of the **CL-200**. Then connect the **TA-29** thermistor (supplied with the heater/cooler) to the MONITOR TEMP IN BNC (Item F).

If using the **SC-20** in-line solution heater/cooler, set the **CL-200** loop speed to *medium*. If using a different device, then set the loop speed to the setting specified in that devices user's manual, or initially set the loop speed to *fast* and adjust as necessary to achieve stable performance.

If using external control inputs, make connections from your *command output* (e.g., analog out on the A/D board or a power supply) to either the EXT TEMP SET (Item U) or EXT VOLT SET (Item T) BNC's on the rear panel.

Operating With Other Equipment

The **CL-200** can be used to power other Warner equipment such as the **SH-27B** and **SF-28** inline solution heaters. In addition, the controller can be used as an independent device to power third-party equipment so long as the following considerations are met.

Warner Resistive Heating Systems

Use of the **CL-200** to power Warner resistive heaters is permitted if used in conjunction with the **AC-100** adapter cable. When the **CL-200** is connected to a resistive device, all command inputs (auto and manual modes for both internal and external commands) are functional with the exception that cooling commands are not executed.

Third-party Equipment

The **CL-200** heater controller will work with many other heating devices if used in conjunction with the **AC-100** adapter cable. To obtain maximum heating power, the resistance of the third-party heating element should be between 8-12 Ω. However, any element that works at a maximum of 15 V and 2.4 A will also work with the **CL-200**.

Thermistor Considerations

The **CL-200** heater controller is designed to accommodate Unical thermistors from Thermometrics (Edison, New Jersey). This family of thermistors can be interchanged without recalibration of the instrument. The nominal resistance of a Unical thermistor is 10.0 kΩ at 25°C. Other thermistors may be used with the **CL-200** if the nominal resistance is also 10.0 kΩ at 25°C.

OPERATION

The main use of a heater/cooler control device such as the **CL-200** is to maintain a constant bath temperature with minimum deviation from a set temperature. This is usually achieved by using a thermally controlled chamber/platform or in-line solution heater, or a combination of both.

NOTE: Refer to the front and rear panel schematics on pages 6-9 for orientation of the **CL-200** controls.

AUTOMATIC MODE

In *Automatic Mode*, the **CL-200** maintains the temperature of the connected heater/cooler at the value set by the user.

Operation is straightforward. Connect your heater/cooler device and sensor thermistor as described on page 10. Set the **CL-200** to *internal commands* by setting the INTERNAL/EXTERNAL SELECT control (Item J) to *internal*. Place the **CL-200** into *auto mode* by switching the COOLING MODE SWITCH (Item C) to *auto*. Switch the METER (Item B) to *Set Temp* and adjust to the desired set-point using the SET TEMPERATURE control (Item H).

Alternatively, the **CL-200** can be commanded using external inputs. Set the **CL-200** to *external commands* by setting the INTERNAL/EXTERNAL SELECT control (Item J) to *external*. In this mode the **CL-200** will accept external temperature settings from the EXT TEMP SET BNC (Item U) on the instrument rear panel. This input is calibrated to 100 mV/°C.

The selectable LOOP SPEED control (Item G) is used to adjust the speed of the feedback loop in the heater/cooler-thermistor system, which controls the rate of change of the **CL-200** output voltage. Non-Warner heater systems with feedback thermistors can be used in *automatic mode* provided they are compatible with the **CL-200** requirements.

LOOP SPEED is normally set to *fast* to provide the shortest cycle time between the application of power to the heater element and the sensing of temperature at the thermistor. For heater/cooler-thermistor systems with long response times, such as with Warner's **SC-20** in-line solution heater/cooler, the *fast* setting will cause the temperature to overshoot the target resulting in system oscillation. For this condition, try *medium* or *slow* settings to find a more optimal feedback rate.

Heat Loss Compensation

An additional control sets the amount of HEAT LOSS COMPENSATION. This allows the **CL-200** to control the temperature at a location downstream from the heater or cooler, where there is heat transferred to the environment. By setting the amount of correction for the heat loss, the Control Thermistor can control the temperature as if there were a "phantom" thermistor at the location of interest. Changes in the Temperature Setting or the thermal load will be corrected, and be reflected in the "Compensated Set Temperature" as displayed on the front-panel meter. Meanwhile, the temperature at the point of interest will be maintained.

The amount of Heat Loss Compensation needed will vary with each setup. With the HEAT LOSS COMPENSATION control set fully off (counterclockwise), the set-temperature is maintained at the control thermistor. Heat loss (or gain in the case of cooling) at the location of the experiment will cause a temperature closer to ambient than is desired for that set-temperature. Adjusting the set-temperature further from the ambient temperature will correct for this loss, but any change in

conditions will cause a new error. If the temperature is instead changed using the HEAT LOSS COMPENSATION control, then changes in perfusion rate or input fluid temperature will be compensated. Changes in ambient temperature or set-temperature will also be compensated.

With the METER SELECT switch set to "*Set Temp*", the desired temperature is displayed on the panel meter. Changing the meter select switch to "*Compensated Set Temp*" shows the temperature at the heating device needed to heat the point of interest to the "*Set Temp*" temperature. Adding heat-loss compensation is similar to moving the control thermistor away from the heating or cooling source. This slows the forward loop speed in the feedback system, reducing the stability of the overall system. This makes it desirable to keep the heat path as short as possible. If the perfusion path is too long or the chamber losses to the atmosphere are too great, then the compensation will not be stable. The time needed to stabilize this temperature will be longer than the time to stabilize at a temperature without the compensation. Also, if changes in conditions occur quickly, then the system will need time to make the corrections.

Feedback Thermistor Selection

A FEEDBACK THERMISTOR switch allows the user to select which thermistor is used for the control loop. Choosing *T1* (control thermistor) sets the peripheral's internal thermistor to control the feedback loop. Selecting *T2* (monitor thermistor) allows feedback control at the location of the monitor thermistor, as selected by the user. Note that when T2 is selected as the feedback thermistor, the HEAT-LOSS COMPENSATION function is disabled.

The standard CONTROL THERMISTOR is the sensor located in the heating/cooling device. This sensor is placed at the optimal point to control the temperature of the heating/cooling device. The MONITOR THERMISTOR is the peripheral thermistor that can be used to monitor the temperature at another location in the experimental configuration. This thermistor monitors the temperature at the selected point in the experiment and is more accurate but is less stable in the control loop because of the delay between heating (or cooling) and sensing.

To protect the experiment if the monitor thermistor is removed, the limit of the increase in temperature between the control and monitor thermistors in the feedback loop is 8˚C. This lowers the probability of overheating the experiment to the point of damage. There is no protection from overcooling caused by a misplaced monitor thermistor.

A switch above the T2 INPUT CONNECTOR provides selection of the thermistor impedance for both the control thermistor (T1) and the monitor thermistor (T2) for that channel. The thermistor impedance for Warner Instruments equipment is 10kΩ @ 25˚C, while the thermistor impedance for Harvard equipment is 100kΩ @ 25˚C.

An indicator on the front panel indicates an open-thermistor fault of the selected feedback thermistor. Normally, if a thermistor becomes open, as in a broken wire, the controller sees this as a lower temperature. The controller will then increase the output power to try to raise the temperature. This can cause overheating of the experiment if the fault is not noticed. In the **CL-200**, the selected feedback thermistor is monitored for an open condition. If an open fault is detected, the output power is shut off, preventing overheating. A red LED indicates the presence of an open thermistor.

MANUAL MODE

In *manual mode*, the MANUAL VOLTAGE control (Item K) is used to set the output voltage to a fixed value. In *manual mode*, the SET TEMPERATURE control (Item H) is disabled, as is the feedback system of the **CL-200**.

Operation is again straightforward. Set the **CL-200** to accept *internal commands* by setting the INTERNAL/EXTERNAL SELECT control (Item J) to *internal*. Place the **CL-200** into *manual mode* by switching the COOLING MODE SWITCH (Item C) to *manual*. Switch the METER (Item B) to *Output Volts* and adjust to the desired set-point using the MANUAL VOLTAGE control (Item K).

Alternatively, the **CL-200** can be commanded using external inputs. Set the **CL-200** to *external commands* by setting the INTERNAL/EXTERNAL SELECT control (Item J) to *external*. In this mode the **CL-200** will accept external voltage commands at the EXT VOLT SET BNC (Item T) located on the instrument rear panel.

In this mode, the instrument operates as a 0-15 VDC power supply that can provide up to 2.4 A of current to a device. Use this mode with heater systems that will operate properly with a fixed voltage and lack of feedback thermistors.

The **CL-200** has a convenient feature for switching modes. In the **CL-200**, the control loop integrator is held at its last value when switching to *off*, allowing the integrator to resume when the Automatic mode is again selected.

When the **CL-200** is switched to *manual* mode, the integrator tracks the manual voltage. When the mode is set from *manual* to *off*, this value is held. Switching to automatic mode allows the control loop integrator to begin at the last voltage setting of the manual mode. This allows the user to set the integrator to any desired initial value for the automatic mode.

APPENDIX

Specifications

Maximum Output Voltage	±15 V Heat/Cool, 0 to 15 V Heat-Only
Maximum Output Current	5.0 Amperes DC per channel
Manual Voltage Range	0 to 15 VDC
Maximum Output Power	75 Watts @ 3Ω Load Each Channel
Power Requirements	100-130 or 200-260 VAC, 50/60 Hz, 80 VA
Power Fuse (5 x 20 mm)	0.8 A Slow-Blow for 100-130 VAC 0.4 A Slow-Blow for 200-260 VAC
Front Panel Input	External thermistor (BNC, calibrated to 10.0 kΩ at 25°C)
Recorder Outputs	Monitor Temp Out (BNC, 100 mV/°C) Control Temp Out (BNC, 100 mV/°C)
Rear Panel Inputs	External Temperature Set (BNC, 100 mV/°C) External Voltage Set (BNC) Heater/Cooler Device (15-pin D connector)
Temperature Range	Peltier: -6 ˚C to 65 ˚C Resistive: Ambient to 65 °C
Meter Display; Resolution	3 digit LED display of °C or V 0.1 ˚C / 0.01 Volt / 0.01 Ampere
Meter Readouts	Set temperature (°C) Control Temperature (°C) Monitor Temperature (°C) Output Voltage (V) Output Current (A) Heat Loss Compensation Temp (°C)
Enclosure	8.9 X 42.6 X 29.2 cm (W x H x D)
Weight	10 lb (4.54 Kg)
Operating conditions:	Ambient temperature: 0 to 40 °C Altitude: sea level to 2000 m Relative humidity: 0-95%

Equipment is intended to be operated in a controlled laboratory environment.

Accessories and replacement parts

Model number	Order number	Description
ACC-1	64-1427	Adapter cable for heater only components

Warranty and service

Warranty

The model **CL-200** is covered by our Warranty to be free from defects in materials and workmanship for a period of two years from the date of shipment. If a failure occurs within this time, we will either repair or replace the faulty component(s). This warranty does not cover instrument failure or damage caused by physical abuse or electrical stress (inputs exceeding specified limits).

In the event that instrument repairs are necessary, shipping charges to the factory are the customer's responsibility. Return charges will be paid by Warner Instruments, Inc.

Normal business hours are 8:30 AM to 5:30 PM (EST), Monday through Thursday and 8:30 AM to 5:00 PM on Friday. Our offices are located at 1125 Dixwell Avenue, Hamden, CT 06514, and we can be reached by phone at (800) 599-4203 or (203) 776-0664. Our fax number is (203) 776-1278. In addition, we can be reached by e-mail at support@warneronline.com or through our Web page at http://www.warneronline.com.

Service notes

Please refer all questions regarding service to our Engineering Department.

A) If the instrument POWER light fails to light, check the fuse at the rear panel (located in the black POWER INPUT MODULE). If the fuse is found to be defective replace it with a 5x20 mm, 0.8 A, slow-blow fuse (0.4 A for facilities using 220-240 V line voltages). If the replacement fuse also fails, please call Warner Instruments for assistance.

B) Occasionally, a knob on the front panel will loosen after long use. These are "collet" style knobs and are tightened with a screw located under the knob cap. To gain access to the adjustment screw, pry the cap off with a thin bladed screwdriver or similar tool.

C) Should service be required, please contact the factory. The problem may often be corrected by our shipping a replacement part. Factory service, if required will be expedited to minimize the customer inconvenience.

D) Instruments are inspected immediately upon receipt and the customer is notified if the repair is not covered by the warranty. Repairs can often be completed in 1-2 days from our receipt of the instrument.

E) If factory service is required, please observe the following instructions:

   1) Package the instrument with at least 3 inches of cushioning on all sides. Use the original shipping carton if it is available.

   2) Insure the shipment for its full value.

   3) Include with the shipment an explanation of the problem experienced.

IMPORTANT for customers outside of the U.S.: Please contact us before return shipping any goods. We will provide instructions so that the shipment will not be delayed or subject to unnecessary expense in clearing U.S. Customs.

Certifications

Declaration of Conformity

CE MARKING (EMC)

Application of Council Directive: 89/336/EEC

Standards To Which Conformity Is Declared:	EN55022 Class A EN61000-3-2 EN61000-3-3 EN50082-1:1992 EN61000-4-2 EN61000-4-3 ENV50204 EN610000-4-4 EN610000-4-8 EN610000-4-11
Manufacturer's Name:	Warner Instruments, LLC
Manufacturer's Address:	1125 Dixwell Avenue Hamden, CT 06514 Tel: (203) 776-0664
Equipment Description:	Power Controller
Equipment Class:	ITE-Class A
Model Numbers:	CL-200

I the undersigned, hereby declare that the equipment specified above, conforms to the above Directive(s) and Standard(s).

Place: Hamden, Connecticut USA

Signature:

Full Name: Burton J. Warner

Position: President

Declaration of Conformity

CE MARKING (LVD)

Application of Council Directive: 73/23/EEC

Standards To Which Conformity Is Declared:	EN61010-1:1993
Manufacturer's Name:	Warner Instruments, LLC
Manufacturer's Address:	1125 Dixwell Avenue Hamden, CT 06514 Tel: (203) 776-0664
Equipment Description:	Power Controller Safety requirements for electrical equipment for measurement and laboratory use
Equipment Class:	Class I
Model Numbers:	CL-200

I the undersigned, hereby declare that the equipment specified above, conforms to the above Directive(s) and Standard(s).

Place: Hamden, Connecticut USA

Signature:

Full Name: Burton J. Warner

Position: President

WEEE/RoHS Compliance Statement

EU Directives WEEE and RoHS

To Our Valued Customers:

Harvard Apparatus is committed to being a good corporate citizen. As part of that commitment, we strive to maintain an environmentally conscious manufacturing operation. The European Union (EU) has enacted two Directives, the first on product recycling (Waste Electrical and Electronic Equipment, WEEE) and the second limiting the use of certain substances (Restriction on the use of Hazardous Substances, RoHS). Over time, these Directives will be implemented in the national laws of each EU Member State.

Once the final national regulations have been put into place, recycling will be offered for those Harvard Apparatus products which are within the scope of the WEEE Directive. Products falling under the scope of the WEEE Directive available for sale after August 13, 2005 will be identified with a "wheelie bin" symbol.

Two Categories of products covered by the WEEE Directive are currently exempt from the RoHS Directive – Category 8, medical devices (with the exception of implanted or infected products) and Category 9, monitoring and control instruments. Most of Harvard Apparatus' products fall into either Category 8 or 9 and are currently exempt from the RoHS Directive. Harvard Apparatus will continue to monitor the application of the RoHS Directive to its products and will comply with any changes as they apply.

- **Do Not Dispose Product with Municipal Waste.**
- **Special Collection/Disposal Required.**