



# **Temperature Control Accessory for Agilent 8453 UV-visible Spectrophotometer**



**Operator's Manual**



# Notices

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## In This Guide...

This handbook describes operation, installation, maintenance and repair, using GPIB commands, and service of the temperature control accessory.

### **Part 1 Installing and Maintaining Your Temperature Controller**

This part describes how you install, and maintain your temperature control unit, cell holder and optional external sensor (option #200).

#### **1 Description**

This chapter contains an overview of the temperature control accessory, including specifications.

#### **2 Installing Your Controller**

This chapter describes how to install your control unit, cell holder, external sensor and GPIB commands PROM.

#### **3 Simple Maintenance**

This chapter describes maintenance tasks you can do on your control unit and cell holder.

### **Part 2 Using Your Temperature Controller**

This part describes how you operate your temperature controller; that is the temperature control unit with the cell holder and external sensor (option #200). There is also a description of what you do in response to the messages that the control unit displays.

#### **4 Operating Your Control Unit**

This chapter describes how to prepare your control unit for operation.

#### **5 Display Summary**

This chapter contains a summary of the different control and read-out functions.

## **6 Using External Sensor**

This chapter describes how to get more accurate temperature monitoring of your sample.

## **7 Messages**

This chapter contains the messages that the control unit displays.

## **Part 3 Using GPIB Commands with the Temperature Controller**

This part is intended to provide information necessary to interface the temperature control unit to various computer systems, for option #305. It is written from a software interfacing point of view and assumes that the reader is knowledgeable in software interfacing concepts.

## **8 Communicating GPIB Commands**

This chapter contains information about controlling and communicating with the temperature control unit.

## **9 GPIB Commands**

This chapter contains information about controlling and communicating with the temperature control unit.

## **Part 4 Servicing the Temperature Controller**

This part is intended only for use by Agilent Technologies service personnel or other qualified engineers. It contains a description of the electronics, and information about the service, cables and connectors, and replacement parts of your temperature controller.

## **10 Electronics of the Temperature Control Accessory**

This chapter describes the GPIB commands for controlling the temperature control unit.

## **11 Cables and Connectors**

This chapter contains information about cables used with the temperature controller.

## **12 Troubleshooting**

This chapter contains troubleshooting instructions for trained personnel.

## **13 Identifying and Replacing Parts**

This chapter describes how to find parts information.

## **A Safety Information**

This chapter contains relevant safety information.



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# 1 Description

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The temperature control accessory consists of the control unit and temperature-controlled cell holder for the Agilent 8453 UV-visible spectrophotometer for sample temperature control. The digitally controlled unit uses thermoelectric heating and cooling (Peltier principle) over a 60 ° temperature range, 10 °C – 70 °C at 20 °C. The temperature control accessory gives a stable temperature for a wide range of applications, for example, enzyme kinetic rate determinations and equilibrium studies.

The Peltier temperature control accessory consists of four parts.

- temperature control unit
- temperature-controlled cell holder
- external sensor (optional)
- GPIB commands



## Temperature Control Unit

The control unit gives sample temperature control, sample stirring, and status and error indication. It controls the temperature of the cell holder and is operated manually through the keyboard interface or remotely through GPIB commands.

**NOTE**

The below temperature range describes the principle controller features of the temperature control unit. The cell holder device connected defines the applicable temperature settings

**Table 1** Control Unit Technical Specifications

Power supply	100–120 VAC, 50–60 Hz 220–240 VAC, 50–60 Hz
Temperature set range	-10 °C–120 °C *
Temperature set resolution	0.1
Temperature Display Range	-10 °C–120 °C †
Display resolution	0.1
Electromagnetic stirrer speed range	40–1000 rpm

\* or equivalent in K or °F

† or equivalent in K or °F

## Temperature-Controlled Cell Holder

The cell holder is a temperature-controlled cell holder for 1 cm sample cells (cuvettes) and flow cells.

**Table 2** Cell Holder Technical Specifications

Operating temperature range	10 °C–70 °C at 20 °C ambient temperature
Accessible temperature range	10 °C below ambient temperature
Temperature stability	50 °C above ambient temperature 10 °C–60 °C, ±0.1 K >60 °C, ±0.2 K
Temperature accuracy	0 °C–<20 °C, ±0.3 K 20 °C–40 °C, ±0.2 K >40 °C–60 °C, ±0.3 K
Temperature Reproducibility	0 °C–60 °C, ±0.1 K >60 °C, ±0.2 K
Typical Step Response	5.5 °C/min heating 3.0 °C/min cooling

## 1 Description

### External Sensor

## External Sensor

The external sensor is an optional temperature sensing probe. The temperature probe measures the actual temperature of your sample. It gives the possibility of more accurate temperature control, when used with the cell holder and control unit.

## GPIB Commands

The GPIB commands are available to remotely control the temperature control unit via a GPIB connection by means of GPIB commands.





## 2 Installing Your Controller

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## Choosing a Suitable Place

Check carefully before you begin that the place you choose to install your control unit meets the requirements shown in [Table 3](#).

**Table 3** Choosing a Suitable Place

Dimensions	325 × 105 × 285 mm (12.8 × 4.1 × 11.2 inches) (width × height × depth) Leave adequate space, at least 80 mm (3 inches), at rear for access to connectors.
Weight	5.5 kg (11.8 lb)
Environment	Operating temperature 0–55 °C (32–131°F)
Humidity	<95% (non-condensing)
Line power	100–120 VAC ±10% 220–240 VAC ±10%
Line frequency	48–66 Hz
Power consumption	90 VA maximum

**NOTE**

The Agilent 8453, the HP 8452A or HP 8451A spectrophotometers must be within 30 cm.

## Unpacking Your Controller

Inspect carton. If you find signs of external damage, contact your local Agilent Technologies office.

Open top of carton. Lift out accessory box. Check your accessories against the list below.

**Table 4** Controller Accessories

Description	Part Number	Check
Power cord	as ordered	...
Handbook	89090-90003	...
Hexagonal balldriver	8710-1900	...
<b>Primary fuses:</b>		
T0.5 Amp fuse	2110-0202	...
T1.0 Amp fuse	2110-0007	...
<b>Secondary fuses:</b>		
3.0 Amp fuse	2110-0003	...
0.5 Amp fuse	2110-0012	...
Tubing for heat exchanger	5041-2189	

## Unpacking the Controller Options

If you have ordered the options for use with the temperature controller:

Check the options against the list below.

**Table 5** Controller Options

Description	Option	Check
External Sensor	#200	...

## Setting Up Your Control Unit

Place control unit on bench, allowing adequate space at rear for access to connectors.

### WARNING

Ensure that line-power cord is disconnected before setting up your control unit.

---

### WARNUNG

Stellen Sie sicher, daß der Netzstecker gezogen ist, bevor Sie die Installationsprozedur durchführen.

---

### CUIDADO

Asegúrese de que el cable de red está desconectado antes de preparar su unidad de control.

---

### ATTENTION

Assurez vous d'avoir coupé le secteur avant de régler l'unité de contrile.

---

### ATTENZIONE

Assicurarsi che l'alimentazione elettrica sia scollegata prima di predisporre l'unità di controllo.

---

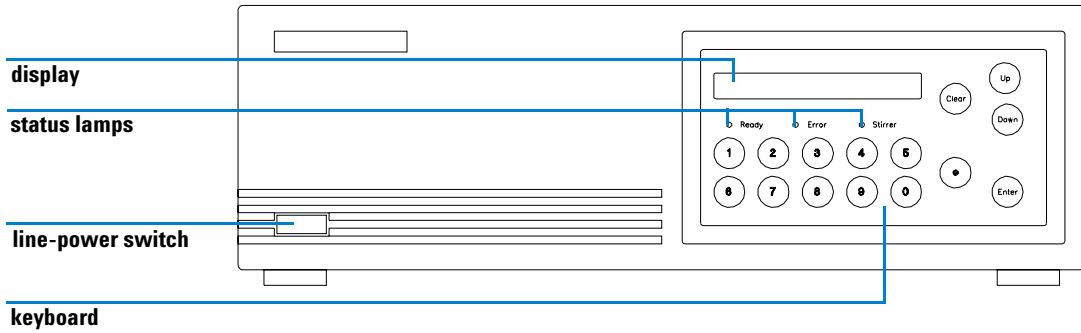
Each control unit is identified by a 10-digit serial number on a label attached to the rear panel.

The serial number of the control unit is:

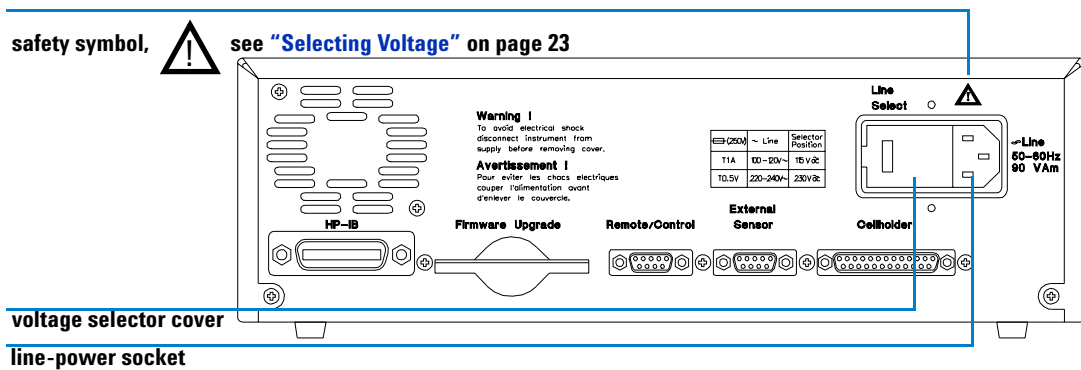
.....

**2 Installing Your Controller**  
**Setting Up Your Control Unit**

## Viewing the Control Unit



**Figure 1** Front View of the Control Unit



**Figure 2** Rear View of the Control Unit

## Selecting Voltage

The voltage selector is on the rear panel and is marked with the safety symbol,



. Check that the line-voltage selector is set to the correct line voltage for operation from your line-power supply, see [Figure 2](#) and [Table 6](#) for details.

**Table 6** Voltage Selection

Power Supply	Select
100 - 120 VAC	115Vac
220 - 240 VAC	230Vac

### WARNING

Ensure that the line-power cord is disconnected before changing the line-voltage setting.

### WARNUNG

Stellen Sie sicher, daß der Netzstecker gezogen ist, bevor die Netzspannungseinstellung geändert wird.

### CUIDADO

Asegúrese de que el cable de red está desconectado antes de cambiar la selección del voltaje de línea.

### ATTENTION

Assurez vous d'avoir déconnecté le câble secteur avant de changer le réglage du voltage.

### ATTENZIONE

Assicurarsi che l'alimentazione elettrica sia scollegata prima di spostare il selettore di voltaggio.

## 2 Installing Your Controller

### Setting Up Your Control Unit

To change the setting:

- 1 Insert the tip of a small screwdriver under the slot on selector cover and lift up the cover.
- 2 Turn the selector to the correct position, see [Figure 3](#). The two positions for each setting are identical.
- 3 Close the selector cover.

## Selecting Fuse

The line fuse (primary fuse) is behind the voltage selector cover. If you changed the line-voltage setting check that the correct fuse is installed for the voltage operation you selected.

### **WARNING**

Ensure that the line-power cord is disconnected before installing or replacing a fuse.

---

### **WARNUNG**

Stellen Sie sicher, daß der Netzstecker gezogen ist, bevor Sie eine Sicherung einlegen oder ersetzen.

---

### **CUIDADO**

Asegúrese de que el cable de red está desconectado antes de colocar o reemplazar un fusible.

---

### **ATTENTION**

Assurez vous d'avoir déconnecté le câble secteur avant d'installer ou de remplacer un fusible.

---

### **ATTENZIONE**

Assicurarsi che l'alimentazione elettrica sia scollegata prima di cambiare o inserire un fusibile.

---

See [Table 4](#) for the part numbers.



There are two line fuses located together, only one of which is used. To change a fuse:

- 1 Insert the tip of a small screwdriver under the slot on selector cover and lift up the cover to access the fuse.

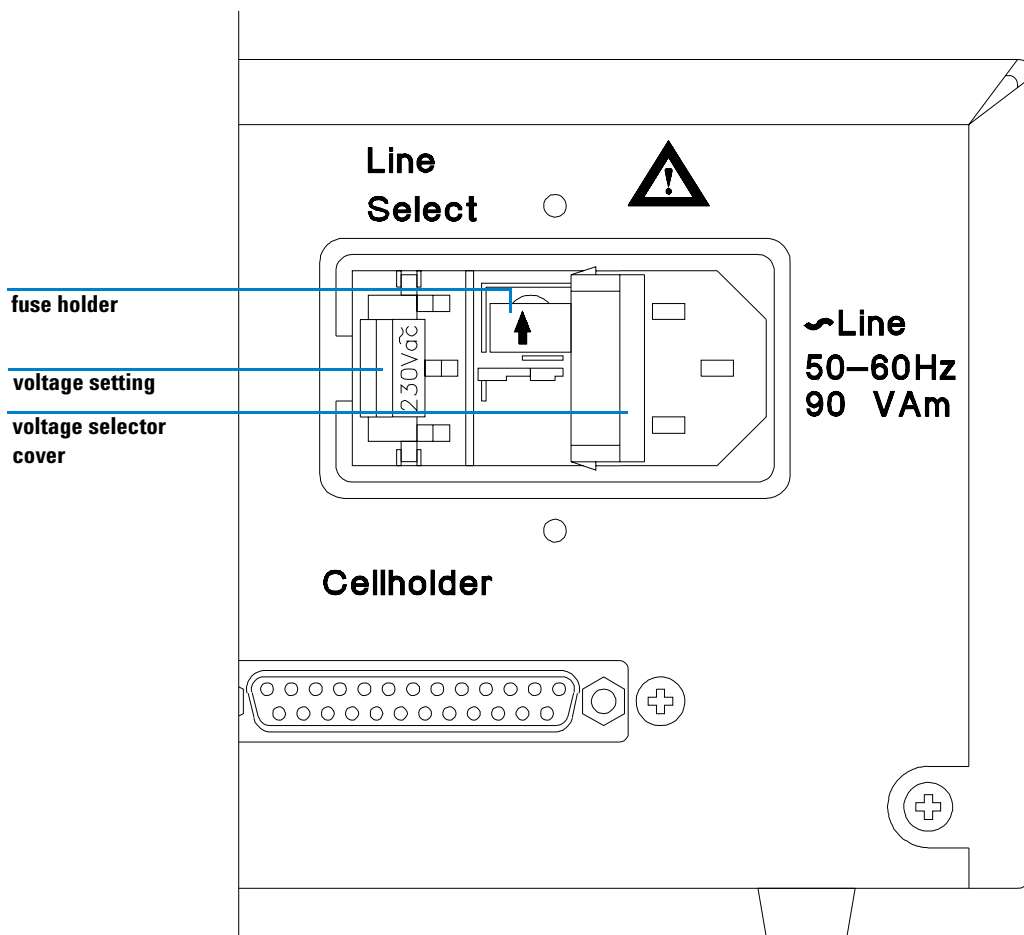


Figure 3 Details of Line-Power Socket

## 2 Installing Your Controller

### Setting Up Your Control Unit

- 2 Use a screwdriver or your finger to lift out the fuse holder.
- 3 Remove the fuse and replace with the correct one.
- 4 Replace the fuse holder.
- 5 Close the selector cover.

## Connecting Cables

Check that you have the correct power cable.

**Table 7** Control Unit Connection

From Control Unit Connector	To Connector:
Power socket	Line power

The cable connects to the rear panel of the control unit:

- 1 Push connector of power cord into line power socket.

### Remote Cable

You may want to monitor your control unit READY and ERROR status remotely.

You must use the details in [Table 26](#) on page 160 Remote Control Connector in [Chapter 12](#), “Troubleshooting” for making the correct type of cable.

### CAUTION

You must use a screened cable to prevent radio interference and to comply with the Radio Interference Requirements.

## Setting Up the Temperature-Controlled Cell Holder

Your diode-array spectrophotometer is supplied with the standard, single-cell holder installed in the sample compartment. You must remove this cell holder before you install the temperature-controlled cell holder.

If you used a different cell holder, for example the adjustable cell holder, variable path length cell holder or the multicell transport system, you must remove it before you install the temperature-controlled cell holder.

You may find it useful to refer to the relevant handbook for details about your cell holder before you remove it.

**Table 8** Handbooks for Cell Holders

Title	Agilent Technologies Part Number
Agilent 8453 UV-visible Spectroscopy System Installation Guide	G1115-90022
HP 8451A Diode Array Spectrophotometer Operator's Handbook	08451-90001
HP 8451A Diode Array Spectrophotometer Multicell Transport	89075-90003
HP 8452A Diode Array Spectrophotometer Handbook	08452-90001
Agilent 89075C Multicell Transport Operator's and Service Handbook	89075-90008

### NOTE

To avoid spillage of liquids into the sample compartment: remove cells and disconnect or remove flow cells from your cell holder before you remove the cell holder.

## Removing the Multicell Transport Cell Holder

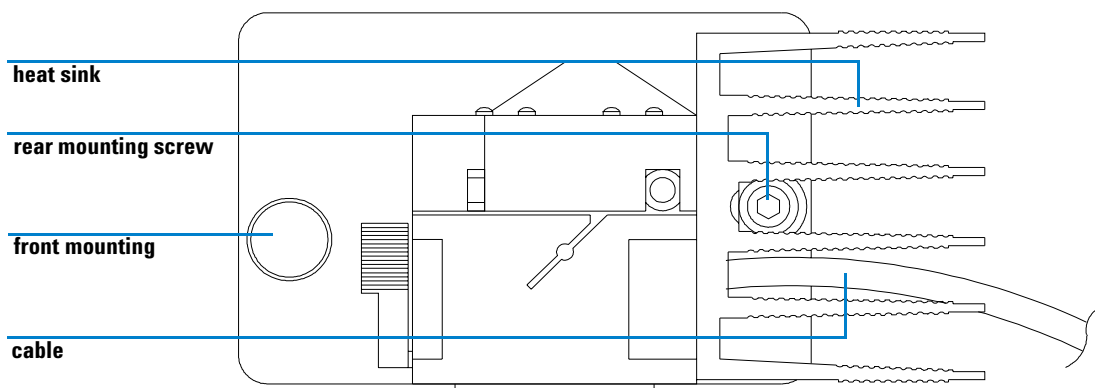
See your operating handbook for instructions about moving the transport.

- 1 Move the transport to position 6, this gives you access to the rear mounting screw.
- 2 Loosen the screw.
- 3 Move the transport to position 3, this gives you access to the front mounting screw.
- 4 Loosen the front mounting screw.
- 5 Lift the transport out of the sample compartment.
- 6 Disconnect the accessory interface cable.

## Removing other Cell Holders

- 1 Loosen the mounting screws.
- 2 Lift the cell holder out of the sample compartment.

## Viewing the Cell Holder



**Figure 4** Top View of Temperature-Controlled Cell Holder

## Installing the Temperature-Controlled Cell Holder

The cell holder is delivered with the cell-holder cover taped in position.

The cell holder is supplied with a long, hexagonal balldriver (part number 8710-1900) for tightening the rear mounting screw within the heat sink.

- 1 Remove the tape holding the cover in place. Take off the cover.
- 2 Place the temperature-controlled cell holder in the sample compartment so that the heat sink and cable are to the rear of the spectrophotometer.
- 3 Tighten the front mounting screw.
- 4 Tighten the rear mounting screw using the long, hexagonal balldriver.

## Connecting Cables

The cable connects to the rear panel of the control unit:

- 1 Push the 25 pin connector of the temperature-controlled cell holder cable into the cell holder connector.
- 2 Tighten the screws on the connector.

When removing cables hold the connector and do *not pull* on the cable.

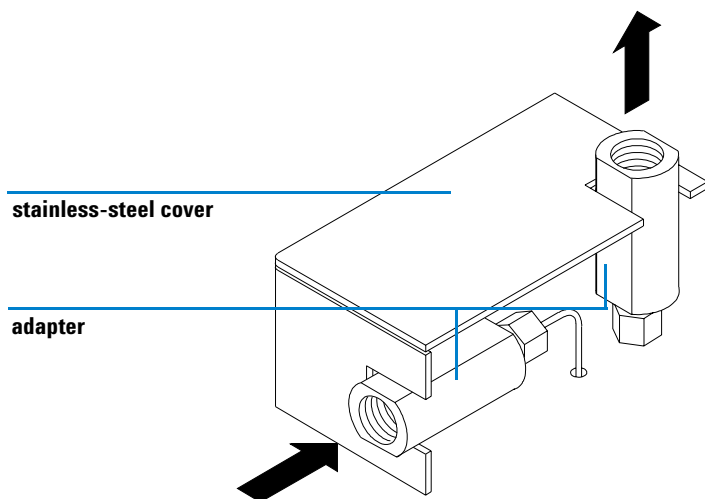
## Connecting Flow Cell and Heat Exchanger

The cell holder is delivered with protection plugs in the adapters of the heat exchanger. You must remove these before connecting your pump.

You connect your pump to the flow cell for using the heat exchanger. You set up your peristaltic pump according to the instructions in the *Sipper System for Agilent 8453 UV-visible Spectrophotometer Operator's Manual* (part number 89068-90006).

The direction of flow for your samples is from the sample container through the heat exchanger to the flow cell and out through the pump tubing to waste.

- 1 Connect the tubing supplied with the cell holder to the outlet of the heat exchanger.



**Figure 5** Heat Exchanger Connectors

- 2 Connect this tubing to the inlet (marked with ↓) of the flow cell.
- 3 Use the tubing supplied with your flow cell to connect to the inlet of the heat exchanger, and from the flow cell to your pump.

The 10 mm path-length, 160  $\mu$ l flow-cell recommended for use with the heat exchanger has a  $2 \times 8$  mm aperture (part number 5062-2476).

**CAUTION**

There may be residual liquid (propanol) in the tubing of the cell holder from cleaning before packing. You should rinse this out with a miscible solvent before use.

---

**ACHTUNG**

Es ist möglich, daß sich noch Restflüssigkeit (Propanol) von der Reinigung in der Wärmetauscherkapillare befindet. Deshalb sollte die Kapillare vor Gebrauch mit einem mischbaren Lösungsmittel gespült werden.

---

**PRECAUCION**

Puede haber liquido residual (Propanol) en los tubos del contenedor de la celda por haber sido limpiado antes de su empaquetado. Usted debe aclararlos con un solvente miscible antes de su uso.

---

**ATTENTION**

Il peut rester du propanol venant du nettoyage dans la tuyauterie du support de cellule. Rincer ce support avec un solvant miscible avant utilisation.

---

**PRECAUZIONE**

Può restare del solvente di lavaggio (propanolo) nel capillare della cella. Rimuoverlo eventualmente con un solvente miscibile prima dell'uso.

---

## Setting Up Your External Sensor

The cells recommended for use with your external sensor have part numbers 5062-2477 and 5061-3387.

### CAUTION

The temperature probe of the external sensor is glass-coated and is fragile.

---

### ACHTUNG

Der Temperatursensor des externen Sensors ist mit Glas überzogen und zerbrechlich.

---

### PRECAUCION

La sonda de temperatura del sensor externo está recubierta de vidrio, y es frágil.

---

### ATTENTION

La sonde de température du capteur externe est gainée de verre et est fragile.

---

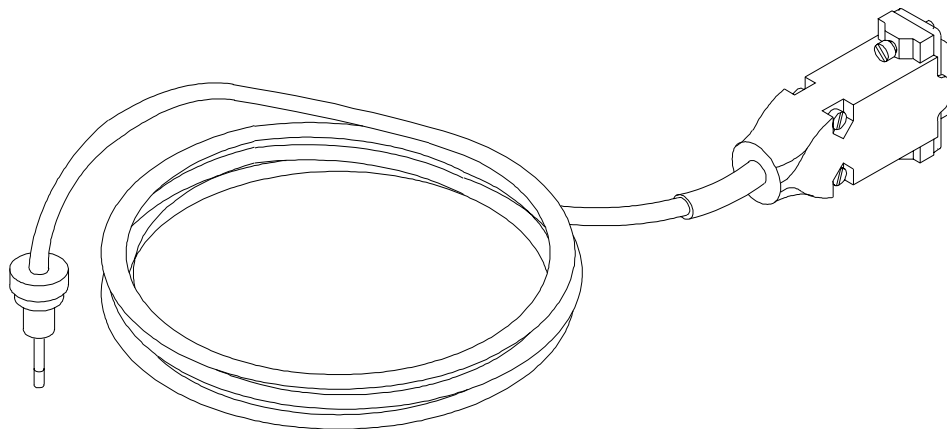
### PRECAUZIONE

La sonda termica del sensore esterno è rivestita di vetro e fragile.

---



## Viewing the External Sensor



**Figure 6** External Sensor for Temperature Control Unit

## Connecting Cables

The cable connects to the rear panel of the control unit:

- 1 Push the 9 pin connector on the cable of the external sensor into the external sensor connector on the control unit.

When removing the external sensor cable hold the connector and do not pull on the cable.

You insert the temperature probe into your sample in the cell holder during operation. See [Chapter 9](#), “GPIB Commands” for instructions about operation of the external sensor.

## **2 Installing Your Controller**

### **Setting Up Your External Sensor**



## 3 Simple Maintenance

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Cleaning Heat-Exchanger Tubing	49

Do only the maintenance specified in this section. Other maintenance or repairs must be done by Agilent Technologies trained personnel. Maintenance can be dangerous. Damage caused by maintenance is not covered by warranty.

Maintenance is divided into the following parts:

- Changing fuses.
- Replacing ferrule and fitting on heat exchanger.
- Cleaning cell (cuvette).
- Cleaning heat-exchanger tubing.

### WARNING

**Certain parts inside the control unit cabinet are at high voltage. Only touch the parts specified in the following procedure.**

### WARNUNG

**Bestimmte Teile innerhalb der Kontroll-Einheit stehen unter Netzspannung. Berühren Sie nur die Teile, von denen in der folgenden Prozedur die Rede ist.**

### CUIDADO

**Ciertas partes del interior del receptáculo de la unidad de control están a alta tensión. Toque solamente las partes especificadas en el siguiente procedimiento.**



**ATTENTION**

Certaines pièces de l'intérieur du boîtier de contrôle sont soumises à un haut voltage. Ne toucher que les pièces décrites dans la procédure suivante.

---

**ATTENZIONE**

Alcune parti all'interno dell'unità di controllo si trovano ad alta tensione. Toccare solo le parti specificate dalle istruzioni.

---

Replacement parts you may need depend on the maintenance task.

**Table 9** Replacement Parts

Description	Agilent Technologies Part Number
Cell holder	89090-62301
External sensor	89090-82100
Heat exchanger parts:	
Stainless steel cover	89090-0230
Adapter (KEL-F)	5021-1870

## Changing Fuse

**Table 10** Control Unit Problems

Symptom	Problem	Remedy
Not operating	Line fuse blown	Change mains fuse
Fan not operating, line fuse OK	Internal fuse blown	Change internal fuse

### Line (Primary) Fuse

If the line fuse blows you must change it. See “[Selecting Fuse](#)” on page 24 for instructions.

### Internal (Secondary) Fuse

#### Fan Not Operating

If the control unit does not operate, and you cannot hear the fan operating, and the line fuse has not blown you must change the internal fuse F863, see [Table 4](#) on page 19 for part number. The fuse is inside the control unit.

- 1 Turn off line power and disconnect line power cord.

**WARNING**

Ensure that line-power cord is disconnected before removing the top cover of the control unit.

**WARNUNG**

Stellen Sie sicher, daß der Netzstecker gezogen ist, bevor Sie die Abdeckung der Kontroll-Einheit entfernen.

### 3 Simple Maintenance

#### Changing Fuse

#### **CUIDADO**

Asegúrese de que el cable de red está desconectado antes de quitar la tapa superior de la unidad de control.

---

#### **ATTENTION**

Assurez vous d'avoir déconnecté le câble secteur avant d'enlever le capot supérieur du boîtier de contrôle.

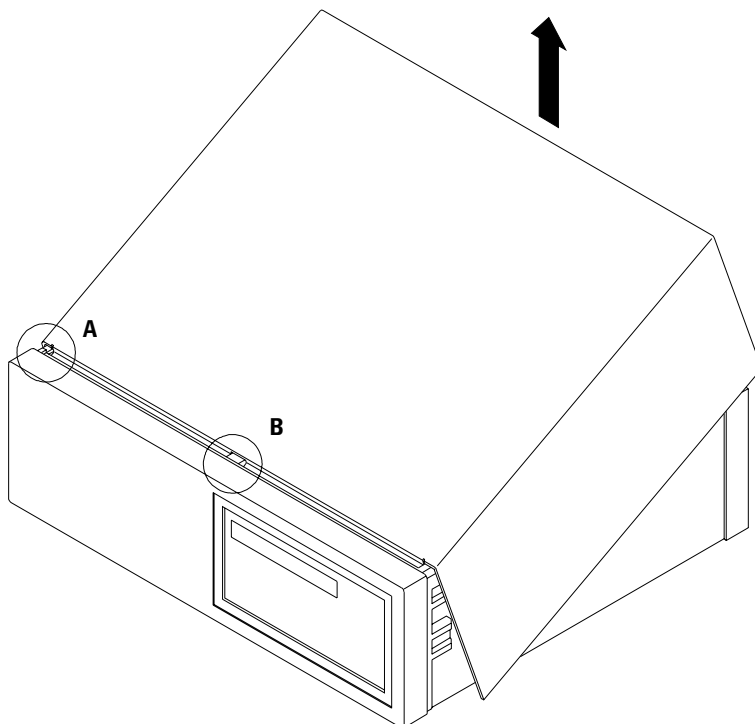
---

#### **ATTENZIONE**

Assicurarsi che l'alimentazione elettrica sia scollegata prima di rimuovere il coperchio dell'unità di controllo.

---

- 2 Remove control unit top cover by removing two screws at the rear, lifting up, and pulling backwards, see [Figure 7](#).

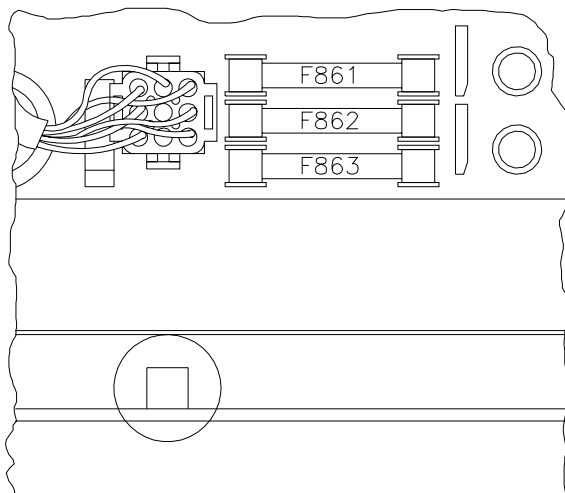


**Figure 7** Removing Control Unit Top Cover.

### 3 Simple Maintenance

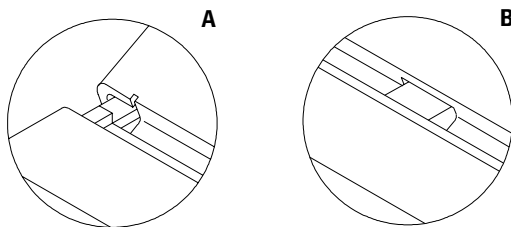
#### Changing Fuse

- 3 Remove the fuse F863, located at the front of the control unit in the middle, and replace with a new fuse.



**Figure 8** Internal Fuses of Control Unit

- 4 Place the cover on the control unit locating the top onto the front panel, see [Figure 9](#).



**Figure 9** Replacing Control Unit Top Cover

- 5 Replace and tighten screws at the rear.
- 6 Connect line power cord and turn on line power.



### **Fan Operating**

If one of the other internal fuses has blown an error message is displayed to indicate which one you must change. Follow the same procedure as above.

If the control unit does not operate, and you hear the fan operating, you must call Agilent Technologies for service.

## Leaking Fittings on Heat Exchanger

### NOTE

Check the temperature of the cell holder before disassembling the heat exchanger.

---

Turn off line power to control unit.

### WARNING

If the control unit has been in use, the sample, cell and heat sink may be hot. If so, wait for 5 to 10 minutes until the cell holder cools.

---

### WARNUNG

Die Probe, die Cuvette und der Kühlkörper können heiss sein, wenn die Kontroll-Einheit benutzt wurde. Warten Sie dann 5 - 10 Minuten, bis die Teile abgekühlt sind.

---

### CUIDADO

Si la unidad de control ha estado en uso, la muestra, celda o el difusor de calor pueden estar calientes. De ser así, espere entre 5 a 10 minutos hasta que el contenedor de la celda se enfrie.

---

### ATTENTION

Si le boîtier de contrôle a été utilisé; l'échantillon, la cellule et le bac peuvent être brûlants. Si ce devait être le cas, laissez refroidir l'ensemble 5 à 10 minutes.

---

### ATTENZIONE

Se l'unità di controllo è stata usata, campione, cella e dissipatore possono essere molto caldi. In questo caso, aspettare 5 - 10 minuti affinché si raffreddino.

---

## Stage 1: Disassembling Heat Exchanger

- 1 Remove stainless-steel cover of the heat exchanger by removing the screws.
- 2 Remove the KEL-F adapter to see the ferrule.

## Stage 2: Changing Ferrule on Fittings

A damaged ferrule can cause leaks by not sealing, and must be changed.

- 1 Remove the damaged ferrule.
- 2 Replace a new ferrule (see [Table 9](#) for part number).
- 3 Reassemble heat exchanger, “[Stage 4: Reassembling Heat Exchanger](#)”.

## Stage 3: Changing Fitting

A fitting with a damaged thread can cause leaks by not sealing, and must be changed.

### CAUTION

Take care not to damage the stainless steel tubing.

---

### ACHTUNG

Achten Sie darauf, daß die Kapillare nicht beschädigt werden.

---

### PRECAUCION

Tenga cuidado de no dañar los tubos de acero inoxidable.

---

### ATTENTION

Prendre garde à ne pas endommager le tube d'acier inoxydable.

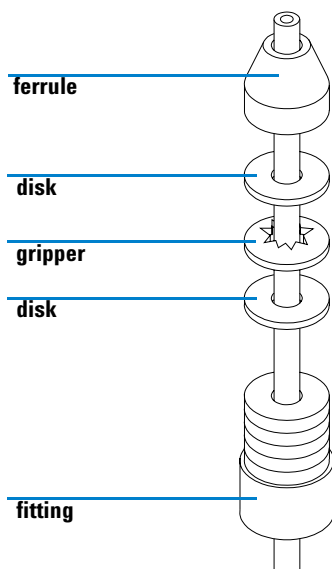
---

### 3 Simple Maintenance

#### Leaking Fittings on Heat Exchanger

#### PRECAUZIONE

Fare attenzione a non danneggiare il capillare di acciaio.



**Figure 10** Fittings for Connection to Heat Exchanger

- 1 Remove the ferrule and disk above the gripper.
- 2 Cut gripper and remove the disk above the fitting.
- 3 Remove the damaged fitting.
- 4 Replace a new fitting (see [Table 9](#) for part number).
- 5 Replace new disks, gripper, and ferrule.
- 6 Reassemble heat exchanger, “[Stage 4: Reassembling Heat Exchanger](#)”.

## Stage 4: Reassembling Heat Exchanger

- 1 Replace the adapter on the ferrule and fitting (see [Table 9](#) for part number) taking care to choose the smaller internal diameter thread.
- 2 Press the adapter firmly on the capillary so that the top of the ferrule is close to the adapter.
- 3 Tighten the adapter until you feel some resistance.
- 4 Ensure that the flat surfaces of the adapter are aligned as in [Figure 5](#) on page 30.
- 5 Using your fingers tighten the fitting one half a turn more. Use pliers only if you have difficulty holding the fitting with your fingers.
- 6 Replace stainless-steel cover of the heat exchanger by replacing and tightening the screws.
- 7 Turn on control unit.

## Cleaning Cells

When?: as necessary.

### NOTE

Check the temperature of the cell holder before removing flow cells or cuvettes.

---

## Removing Cell

### WARNING

If the control unit has been in use, the sample, cell and heat sink may be hot. If so, wait for 5 to 10 minutes until the cell holder cools.

---

### WARNUNG

Die Probe, die Cuvette und der Kühlkörper können heiss sein, wenn die Kontroll-Einheit benutzt wurde. Warten Sie dann 5 - 10 Minuten, bis die Teile abgekühlt sind.

---

### CUIDADO

Si la unidad de control ha estado en uso, la muestra, celda o el difusor de calor pueden estar calientes. De ser así, espere entre 5 a 10 minutos hasta que el contenedor de la celda se enfrie.

---

### ATTENTION

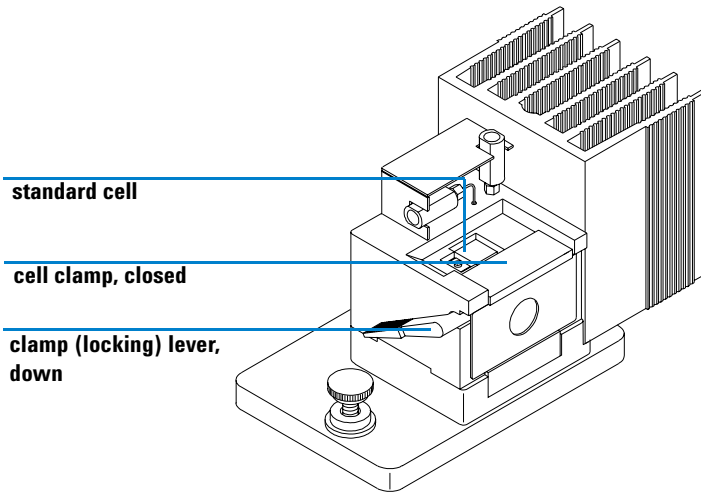
Si le boîtier de contrôle a été utilisé; l'échantillon, la cellule et le bac peuvent être brûlants. Si ce devait être le cas, laissez refroidir l'ensemble 5 à 10 minutes.

---

### ATTENZIONE

Se l'unità di controllo è stata usata, campione, cella e dissipatore possono essere molto caldi. In questo caso, aspettare 5 - 10 minuti affinché si raffreddino.

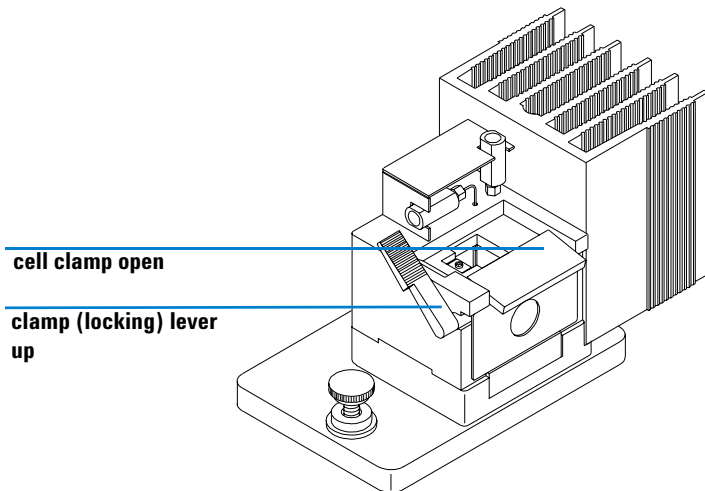
---



**Figure 11** Temperature-Controlled Cell Holder with Cell

- 1 Raise the clamp lever and lift out the cell.
- 2 Wash the cell.
- 3 Wipe the optical surfaces with lint-free cloth.

## Replacing Cell



**Figure 12** Temperature-Controlled Cell Holder without Cell

- 1 Replace the cell, ensuring that the optical surfaces are towards the light path.
- 2 Lower the clamp lever.
- 3 Turn on line power to control unit.

**NOTE**

Avoid spillage of liquids in the sample compartment.

After a spillage clean the surfaces of the cell holder to prevent liquid entering the base of the holder.



## Cleaning Heat-Exchanger Tubing

When?: as necessary.

With the flow cell connected to the heat-exchanger tubing and the pump:

- 1 Turn off the Peltier element.
- 2 Place the inlet tubing into clean solvent and the outlet in a waste container.
- 3 Pump solvent through the heat-exchanger tubing and flow cell for a few minutes.

### NOTE

Tubing is supplied with your temperature control accessory. See [Table 4](#) on page 19 for the part number and “[Connecting Flow Cell and Heat Exchanger](#)” on page 30 for connecting the tubing.

---

**3 Simple Maintenance**  
Cleaning Heat-Exchanger Tubing



## 4 Operating Your Control Unit

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This chapter starts with describing how to prepare your control unit for operation and gives you the instructions for checking operation. The second part gives details about each of the functions available in the temperature control unit.



## Before you Start

If your temperature control unit is not set up or if the cell holder is not installed see [“Installing Your Controller”](#) on page 17.

### CAUTION

There may be residual liquid (propanol) in the tubing of the cell holder from cleaning before packing. You should rinse this out with a miscible solvent before use.

---

### ACHTUNG

Es ist möglich, daß sich noch Restflüssigkeit (Propanol) von der Reinigung in der Wärmetauscherkapillare befindet. Deshalb sollte die Kapillare vor Gebrauch mit einem mischbaren Lösungsmittel gespült werden.

---

### PRECAUCION

Puede haber liquido residual (Propanol) en los tubos del contenedor de la celda por haber sido limpiado antes de su empaquetado. Usted debe aclararlos con un solvente miscible antes de su uso.

---

### ATTENTION

Il peut rester du propanol venant du nettoyage dans la tuyauterie du support de cellule. Rincer ce support avec un solvant miscible avant utilisation.

---

### PRECAUZIONE

Può restare del solvente di lavaggio (propanolo) nel capillare della cella. Rimuoverlo eventualmente con un solvente miscibile prima dell'uso.

---

## Turning on Line Power

Ensure that the cell holder is connected to the control unit. If not refer to [Chapter 2](#), “Setting Up the Temperature-Controlled Cell Holder”.

To turn on line power, press line power switch on front panel. Your control unit does a series of self-tests. The Ready lamp may be on or off depending on the ambient temperature. The control unit displays:

**Cell Temp xx.xC**

### NOTE

Where **xx.xC** is the actual temperature of the cell holder.

If this is the first time you have used the control unit and if your control unit displays:

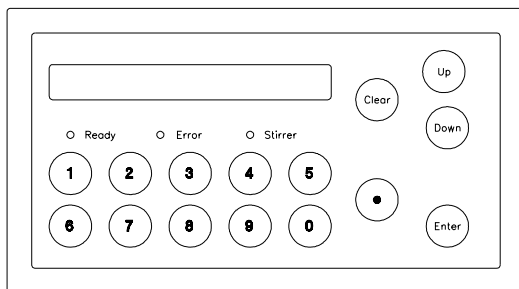
**No Cell Holder!**

Turn off line power, connect the cell holder and turn on again. If you have already used the control unit the display depends on previous settings.

If your control unit displays anything else or the Error lamp is on, refer to “[Troubleshooting](#)” on page 147 in your handbook.

## Checking Operation

You use the keys on the keyboard to change and set the display.



**Figure 13** Control Unit Keyboard

Starting with the display:

**Cell Temp xx.xC**

Where the actual temperature displayed is the actual temperature of the cell holder.

1 Press DOWN to display:

**Set Temp 25.0C**

2 Press ENTER 3 7 ENTER to set temperature to 37°C.

The Ready lamp turns off or remains off to indicate warming before the set temperature of 37°C is reached. When the cell temperature reaches 37°C the Ready lamp turns on.

## Turning off Line Power

To turn off line power, press line power switch on front panel. When you turn off line power all settings are stored.

## Using Functions

This section describes the different functions in your control unit and gives instructions about each key on the keyboard you press to use the functions of your control unit. There are two sets of functions:

- ✓ Main functions.
- ✓ System functions.

You select system functions from the main functions.

### Selecting Functions

To select a function press UP and DOWN keys to change the display:

<b>Cell</b>	<b>Temp</b>	<b>25.0C</b>	read-out function only.	
<b>Set</b>	<b>Temp</b>	<b>25.0C</b>		
<b>Ext</b>	<b>Temp</b>	<b>25.0C</b>	read-out function only.	
<b>System Functions</b>			→	<b>Remote</b> <b>OFF</b>
<b>Brightness</b>		<b>1</b>		<b>GPIB Address</b>
<b>Units</b>		<b>C</b>		<b>Self-test</b>
<b>Peltier</b>		<b>ON</b>		<b>Main Functions</b>
<b>Speed</b>		<b>500rpm</b>		
<b>Stirrer</b>		<b>ON</b>		

#### NOTE

Press CLEAR with any function displayed to display: **Cell Temp xx.xC**

If the cell holder and external sensor are connected the displays may show:

<b>Cell</b>	<b>Temp</b>	<b>High!</b>	or	<b>Cell</b>	<b>Temp</b>	<b>Low!</b>
<b>Ext</b>	<b>Temp</b>	<b>High!</b>	or	<b>Ext</b>	<b>Temp</b>	<b>Low!</b>



These messages appear when the temperature for the cell holder is outside of range -10°C to 100°C and the temperature is outside the range for this external sensor.

If the cell holder or external sensor are not connected the displays for the cell temperature and external temperature are:

<b>No</b>	<b>Ext</b>	<b>Sensor!</b>
<b>No</b>	<b>Cell</b>	<b>Holder!</b>

If there is no GPIB software installed the display for the GPIB address is:

<b>No</b>	<b>GPIB</b>	<b>Software</b>
-----------	-------------	-----------------

## Setting Functions

### NOTE

**Cell Temp** and **Ext Temp** are read-out functions only and cannot be set.

To change the function value:

**1** Select the function and press **ENTER** .

The function value blinks and can be changed.

**2** Press numerical keys or **UP** or **DOWN** key to change the value for temperature, brightness and speed.

**3** Press **UP** and **DOWN** keys to change the value for units, and to turn stirrer and Peltier element on and off.

### NOTE

To clear the current value press **CLEAR** .

**4** Press **ENTER** .

## **Resetting Functions**

To reset the function to the previous value:

- 1** Press CLEAR .
- 2** Press ENTER .

## Setting Temperature

To change temperatures for the set temperature:

- 1 Select the set temperature function and press ENTER .
- 2 Set the function value using the UP or DOWN keys or the numerical keys and the decimal key.
- 3 Press ENTER to set the value.

### Example for Setting Temperature

Select the set temperature function and press ENTER .

**Table 11** Key Sequence

Press:	Displays:		
3	Set	Temp	3
6	Set	Temp	36
.	Set	Temp	36.
5	Set	Temp	36.5

Press ENTER to set the value.

If the Ready lamp was on it turns off. If the Ready lamp was off it remains off.

#### NOTE

To correct a wrong number press CLEAR to reset to the previous function value.

## Example for Correcting a Wrong Set Temperature

Select the set temperature function and press ENTER .

To set 35.5°C but pressing the wrong keys.

**Table 12** Key Sequence

<b>Press:</b>	<b>Displays:</b>		
3	<b>Set</b>	<b>Temp</b>	<b>3</b>
6	<b>Set</b>	<b>Temp</b>	<b>36</b>
Clear	<b>Set</b>	<b>Temp</b>	<b>25</b> reset to previous value.
3	<b>Set</b>	<b>Temp</b>	<b>3</b>
5	<b>Set</b>	<b>Temp</b>	<b>35</b>
.	<b>Set</b>	<b>Temp</b>	<b>35.</b>
5	<b>Set</b>	<b>Temp</b>	<b>35.5</b>

Press ENTER to set the value.

Pressing (.) fixes the 3 digits before the decimal point and allows you to change the number after the decimal point with the UP and DOWN keys.

**NOTE**

For temperatures less than 0°C use F or K units. Set temperature in °F or K and change units.

Pressing UP and DOWN keys changes the set temperature by ±0.1.

## Changing Brightness

You may change the brightness of the display from least bright (value 1) through to most bright (value 6).

To change brightness:

- 1** Select the brightness function and press **ENTER** .
- 2** Set the function value using the **UP** or **DOWN** keys or the numerical keys:
  - a Press **UP** or **DOWN** to display **1, 2, 3, 4, 5** or **6**.
  - b Press a number key, for example **4** .
- 3** Press **ENTER** to set the value.

Pressing **UP** and **DOWN** keys changes the brightness value by  $\pm 1$ .

## Changing Units

Units available are:

- ✓ C, Celcius
- ✓ K, Kelvin
- ✓ F, Fahrenheit

Celcius (centigrade) is the default temperature scale and is used internally. To convert to different temperature scales the control unit uses the Celcius temperature and the following equations:

$$K = C + 273.2$$

$$F = \frac{9}{5}C + 32$$

To change units:

- 1 Select the units function and press ENTER .
- 2 Set the function value using the UP or DOWN keys.

The temperature displayed is the equivalent value in K or °F.

Pressing UP and DOWN keys changes the set temperature by ±0.1. You may notice a difference when changing from Fahrenheit to Celcius after using the UP and DOWN keys for setting the temperature. This is due to rounding up or down.

**Table 13** Fahrenheit Examples

To Set:	Press	
14°F	1	4
32°F	3	2
98.6°F	8	9 . 6

**Table 14** Kelvin Examples

<b>To Set:</b>	<b>Press</b>		
<b>270 K</b>	2	7	0
<b>296 K</b>	2	9	6

## Turning off Peltier Element

You may turn off the Peltier element and keep all other function values.

- 1 Select the Peltier function and press **ENTER** .
- 2 Set the function value to **ON** or **OFF** using the **UP** or **DOWN** keys.

### NOTE

When the Peltier element is off the **Ready** lamp is off.

---

## Selecting Stirring

To stir your sample:

- 1 Place a magnetic stirrer bar (part number 9301-1161) in your sample.
- 2 Select stirrer and speed functions and press **ENTER** .
- 3 Press **UP** or **DOWN** to turn the stirrer on and off.
- 4 Press number keys, for example **2 5 0** to change the speed to 250 rpm. \*
- 5 Press **ENTER** to set the value.

When the stirrer function is on the **Stirrer** lamp is on.

Pressing **UP** and **DOWN** keys changes the stirrer speed value by  $\pm 1$ .



## Setting System Functions

The system functions are remote mode, GPIB address and self-test.

To set the system functions:

- 1 Select the system functions and press ENTER .
- 2 Use the UP or DOWN keys to display

```

Remote                OFF
GPIB Address          or  No GPIB Software
Self-test
Main Functions
    
```

To reset to the main functions:

- 3 Select the main function and press ENTER to display **System Functions** in the main menu.

## Setting Remote Mode

“[Remote Mode](#)” on page 88 describes fully how to use the temperature controller in remote mode.

### NOTE

If the remote mode is set it is no longer possible to enter parameters from the keyboard. It is still possible to use the UP, DOWN, and CLEAR keys to display set points. You may also use the ENTER key in remote mode to change the display for system and main functions and to reset remote to off. If you try to use the other keys or the ENTER key, except in the above way, a warning is displayed for 10 seconds.

You set the remote mode either through the GPIB with the command REM ON or through the remote keyboard function. “[REM – Remote](#)” on page 109 describes setting remote mode with the GPIB command.

## 4 Operating Your Control Unit

### Setting System Functions

- 1 Select the system functions and press **ENTER** .
- 2 Use the **UP** or **DOWN** keys to display **Remote OFF** and press **ENTER** .
- 3 Set the function value to **ON** using the **UP** or **DOWN** keys.

To reset remote mode either use the GPIB command **REM OFF** or the remote keyboard function.

- 1 Use the **UP** or **DOWN** keys to display **Remote ON** and press **ENTER** .
- 2 Set the function value to **OFF** using the **UP** or **DOWN** keys.

#### NOTE

You may set the remote mode through the keyboard or the GPIB command and reset using the GPIB command. However, if you set the remote mode through the GPIB and reset through the keyboard an error message is generated: **ERR 147**.

## Changing GPIB Address

You can only set the GPIB address if you have installed option #305.

To change GPIB address:

- 1 Select the system functions and press **ENTER** .
- 2 Use the **UP** or **DOWN** keys to display **GPIB Address** and press **ENTER** .
- 3 Press **UP** or **DOWN** or number keys to change the GPIB address, for example **1 5** to change the GPIB address to 15.
- 4 Press **ENTER** to set the value.

You may set the GPIB address in the range 1 through 31.

## Starting Self-Test Manually

In case you observe unusual operation of your instrument or receive an error message, you may start the self-test manually:

### CAUTION

When executing the self-test you will receive the following message on your display: **WARNING 2** prompting you to remove your sample cell from the cell holder, because temperatures are not kept stable during self-test.

1. Press **CLEAR** to reset.
  2. Press **ENTER** to continue the self-test.
- 

To start the self-test:

- 1 Select the system functions and press **ENTER** .
- 2 Use the **UP** or **DOWN** keys to display<newline>

**Self-test** and press **ENTER** .

The self-test includes all diagnostic functions and you may receive all error messages, described in the service handbook.

## Hints for Operation

- ✓ The performance of your temperature control accessory is affected by the temperature of the heat sink, especially when cooling. For best performance, keep the air path to and from the heat sink clear of obstructions:
  - 1 Remove the dust cover from the sample compartment of your Agilent 8452A spectrophotometer.
  - 2 When using the Agilent 89068C automated sipper and sampler leave the door of the mounting cover open.
- ✓ When you use a set temperature below ambient and the ambient temperature changes by more than 10°C overnight (for example, air conditioning is switched off) switch off power or Peltier element. This avoids an overload of the Peltier element and prevents the display of the message **OVERLOAD**.

### NOTE

10°C under ambient is a valid temperature at any time to -10°C.

- ✓ When using a range of temperatures change from low to high temperatures and not from high to low.
- ✓ For rapid temperature changes, cooling and heating, near the set temperature the control unit supplies more power to the cell holder than the heat sink can dissipate. This may cause the control unit to display the message **OVERLOAD** when cooling from high temperature (40°C - 60°C) to temperatures below ambient. To avoid this overload use one or two intermediate temperature changes to reach the desired temperature.
- ✓ Your temperature-controlled cell holder is designed to operate at 10°C below ambient temperature, however, it may operate at lower temperatures. For best performance, use small temperature changes, for example, 1° to 5°, when setting temperatures below ambient.

- ✓ When cooling below ambient condensation may appear on the cell. Use the cover for the cell to prevent condensation causing dilution of your sample.
- ✓ Do not heat liquids above their boiling points in the temperature-controlled cell holder.
- ✓ Take care when heating a cuvette with its stopper in or with the temperature probe in. If the cuvette is tightly stoppered, an increase in pressure may damage the cuvette.

**4** **Operating Your Control Unit**  
Hints for Operation



## 5 Display Summary

You display the different control and read-out functions using the UP and DOWN keys.



## Normal Mode

UP and DOWN Move between functions, for example

<b>Cell</b>	<b>Temp</b>	<b>25.0C</b>	DOWN →	<b>Cell</b>	<b>Temp</b>	<b>25.0C.</b>
<b>Cell</b>	<b>Temp</b>	<b>25.0C</b>	UP →	<b>Stirrer</b>		<b>ON.</b>

CLEAR	Displays <b>Cell Temp</b> and original value of function, and clears previous entry.
ENTER	With continuous display; changes to edit mode.

## Edit Mode

**Blinking number** A blinking number in the display prompts you to press a button, (e.g. 3 ) to enter a numerical entry.

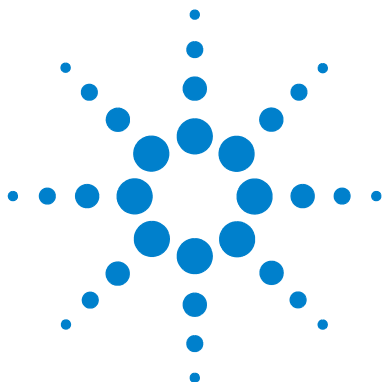
**Blinking character** A blinking character in the display prompts you to press a button, (e.g. UP ) to change an entry.

**UP and DOWN** Move between function values, for example

<b>Stirrer</b>	<b>ON</b>	UP and DOWN →	
<b>Stirrer</b>	<b>OFF</b>		
<b>Brightness</b>	<b>1</b>	UP →	<b>Brightness</b> <b>2</b>

ENTER	With blinking display; enters value of parameter or function currently displayed. Press CLEAR to restore value of parameter or function.
CLEAR	Displays original value of parameter or function, clears previous entry.
0 to 9	Displays number 0 to 9 in numeric entry field.
.	Displays decimal point (.) in numeric entry field.





## 6 Using External Sensor

The external sensor gives more accurate temperature monitoring of your sample, when used with the cell holder and control unit.

You use the glass-coated temperature probe to measure the actual temperature of your sample. You may correct for any differences between the set temperature and the desired temperature for your sample.

### CAUTION

The temperature probe of external sensor is glass-coated and is fragile.

---

### ACHTUNG

Der Temperatursensor des externen Sensors ist mit Glas überzogen und zerbrechlich.

---

### PRECAUCION

La sonda de temperatura del sensor externo está recubierta de vidrio, y es frágil.

---

### ATTENTION

La sonde de température du capteur externe est gainée de verre et est fragile.

---

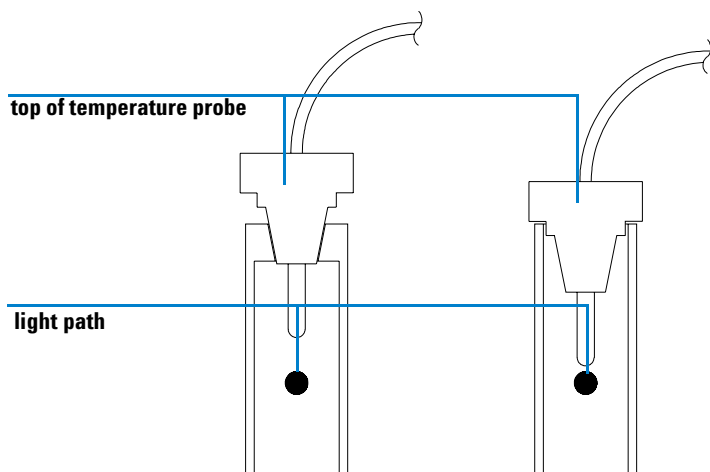
### PRECAUZIONE

IlLa sonda termica del sensore esterno è rivestita di vetro e fragile.

---



The temperature probe of the external sensor is designed to fit in the normal 10 mm path length cells (part number 5062-2477 for round-stoppered closure and part number 5061-3387 for square-covered closure). In this position it is above the spectrophotometer light beam, see [Figure 14](#).

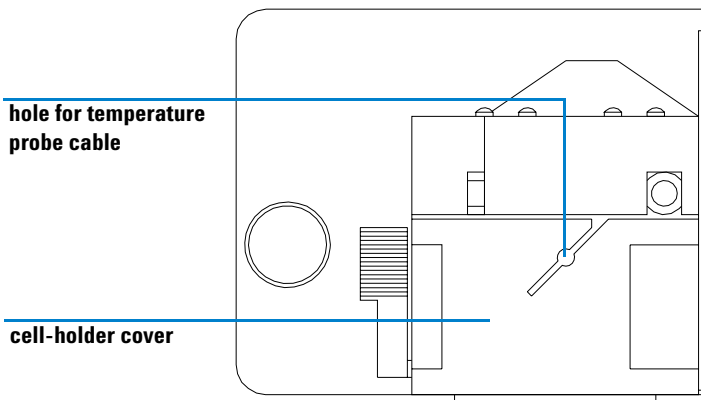


**Figure 14** External Sensor in Cuvette

To insert the temperature probe into your sample:

- 1 Place the sample, in the cell, into the cell holder.
- 2 Remove the cover from the temperature probe, by turning and pulling the cover and holding the top of the temperature probe. Do not pull on the cable to remove the cover.
- 3 Insert the temperature probe into the cell.

- 4 Place the cell-holder cover over the sample area.



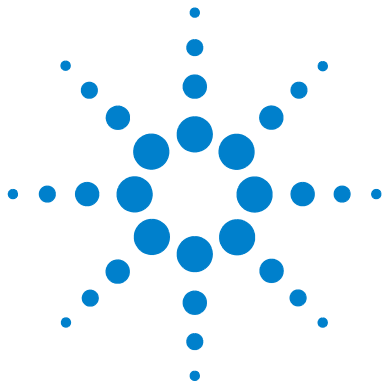
**Figure 15** Top View of Cell Holder and Cover

- 5 Set cell temperature, see “[Checking Operation](#)” on page 54.

**NOTE**

You may want to increase or decrease the value for set temperature to give the exact temperature for your sample as measured by the **Ext Temp** display.





## 7 Messages

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The control unit may display messages for your attention.

There are two types of messages:

- Requiring some action, for example, pressing a key.
- Requiring no action. The message is displayed for a short time only.



## Responding to Messages

### OVERLOAD!

Error lamp turns on.

You must change the setting. It is not possible to reach the set temperature, for example:

>10°C below ambient

Too large a temperature change.

A malfunction of the control unit has occurred.

- 1 Press **ENTER** to acknowledge the message.
- 2 Change the set temperature.
- 3 See [“Hints for Operation”](#) on page 68.

### WARNING 1

You tried to set the temperature in the range <70°C - 100°C. However, the higher operation temperature range for this cell holder is 70°C.

- 1 Press **CLEAR** to reset the temperature to 70°C.

This is the maximum recommended temperature for this cell holder. This will cause no increase in the degradation of the Peltier element and no change in specifications.

The control unit is in edit mode and you can change the temperature, see [“Setting Temperature”](#) on page 59.

- 2 Press **ENTER** to set the value.

**CAUTION**

Peltier life time is greatly reduced using this temperature (70°C).

There are no specifications for temperature accuracy at this temperature; at 60°C temperature accuracy is  $\pm 0.3^{\circ}\text{C}$ .

The accuracy of the temperature sensor above 70°C will drift with frequent switching from high and low temperatures.

---

**ACHTUNG**

\* Die Lebensdauer des Peltier verkürzt sich erheblich bei dieser Temperatur (70°C).

Die Temperaturgenauigkeit des Controllers ist für Temperaturen über 60°C nicht spezifiziert. Bei 60°C beträgt die Messgenauigkeit  $\pm 0.3^{\circ}\text{C}$ .

Die Genauigkeit des Temperatursensors kann bei häufigem Wechsel zwischen hohen (über 70°C) und niedrigen Temperaturen nachhaltig negativ beeinflusst werden.

---

**PRECAUCION**

El periodo de vida Peltier se reduce considerablemente usando esta temperatura (70°C).

No hay especificaciones referentes a la precisión de la temperatura a esta temperatura; a 60 C dicha precisión es de  $\pm 0.3^{\circ}\text{C}$ .

La precisión del sensor de temperatura puede derivar con el cambio de frecuencia de altas (por encima de 70°C) a bajas temperaturas.

---

**ATTENTION**

La durée de vie du système Peltier diminue de beaucoup avec cette température (70°C).

Il n'y a pas de spécifications de précision à cette température. A 60°C, la précision de température est  $\pm 0.3^{\circ}\text{C}$ .

La précision de la sonde de température peut dériver lors de passages fréquents d'une haute (au dessus de 70°C) à une basse température.

---

**PRECAUZIONE**

La durata del Peltier è fortemente ridotta lavorando a questa temperatura (70°C).

Non sono fornite specifiche di accuratezza per questa temperatura; a 60°C l'accuratezza è  $\pm 0.3^\circ\text{C}$ .

L'accuratezza del sensore di temperatura può variare con frequenti passaggi da alta (>70°C) a bassa temperatura.

---

**WARNING 2**

When executing the self-test you will receive this message on your display.

You should remove your sample cell from the cell holder, because temperatures are not kept stable during self-test.

- 1 Press CLEAR to reset.
- 2 Press ENTER to continue the self-test.



## Display Messages

### OUT OF RANGE

You may not enter a value that is not settable. Maximum temperature for this temperature-controlled cell holder is 100°C.

You cannot use your entered set temperature. It is not within the specifications. Highest temperature allowed is 100°C. Lowest temperature allowed is 0°C.

**OUT OF RANGE** is displayed for about 5 seconds. The control unit displays **Set Temp 100.0C** or **Set Temp 0.0C** depending on whether the entered value was too large or too small. The control unit is in edit mode and you can change the temperature, see [“Setting Temperature”](#) on page 59.

## Status Messages

For example: **ERR 110**. You can find a full description of the hardware problems associated with these messages in [“Error Messages” on page 152](#).

- ✓ External sensor broken
- ✓ Cable broken
- ✓ Short circuit
- ✓ Peltier defect

These error messages are for isolating problems and protecting the electronics of your control unit. If an error message is displayed, the Error lamp lights:

- 1 Press ENTER to clear message. The Error lamp stays on.
- 2 Start the self-test, see [“Starting Self-Test Manually” on page 67](#).

If error is displayed again call Agilent Technologies service and report the error number.

Error message for temperature too high and too low:  
**Cell Temp High!** and **Cell Temp Low!**.

These messages appear when the temperature is outside the range  $-10^{\circ}\text{C}$  to  $120^{\circ}\text{C}$ , for this control unit.

**Ext Temp High!** and **Ext Temp Low!**.

These messages appear when the temperature is outside the range for this sensor.

## Status Lamps

Three lamps are Ready, Error and Stirrer.

### Ready

Ready lamp is only on when set temperature is reached and the temperature is within the stability specifications, that is  $\pm 0.1$  K in the range 10°C to 60°C and  $\pm 0.2$  K  $> 60^\circ\text{C}$ .

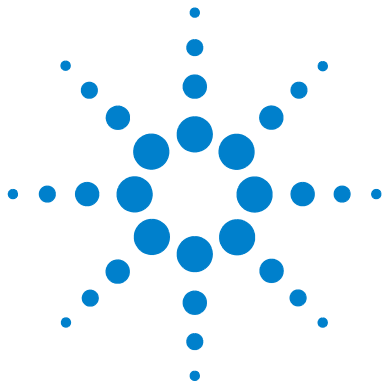
### Error

Error lamp is on if there is an internal error. For operating errors there will also be an error display, for example **OUT OF RANGE** for non-settable temperature.

### Stirrer

Stirrer lamp is only on when you select **Stirrer ON**.

**7** **Messages**  
Status Lamps



## 8 Communicating GPIB Commands

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## Communication Interface

The GPIB interface can be used to control and communicate with the temperature control unit.

You can use the GPIB commands from a Agilent UV-visible ChemStation (Windows series, Pascal series or DOS series) or a computer that has an GPIB interface and an operating system, for example MS-DOS. GPIB commands can be written in many different forms, for example, from the Agilent ChemStation (Windows series, Pascal series) as MACROS and from MS-DOS using the GPIB command library in BASIC, Pascal or C languages.

Communication to the temperature control unit is through a set of well defined ASCII instructions. Several of these instructions have various parameters that control or set up conditions within the temperature control unit.

Communication and control of the temperature control unit can be achieved by simple input and output in a high level language, for example, BASIC. The following example sets a new temperature and asks for Peltier status.

```
TEM 37;STA
```

The computer can use time efficiently to process multiple instructions because controlling the temperature control unit can be as simple as this example. There are 2 types of instructions from the computer:

- 1 Instructions to set a parameter, this expects no reply from the temperature control unit.

### NOTE

If you read the out-buffer after sending this type of instruction the out-buffer is empty and you read only <CR> <LF and EOI> in the computer.

- 2 Instructions to ask for a reply from the temperature control unit.  
Exceptions are TRA, EXT and TEM.

In addition the temperature control unit has the possibility to interrupt the computer through the service request (SRQ) line of the GPIB interface.

When the computer receives a SRQ it uses the serial poll capability to read the status byte of the temperature control unit. The SQR line can be activated automatically by the temperature control unit, see “[Service Request](#)” on page 90.

## Remote Mode

If the remote mode is set it is no longer possible to enter parameters from the keyboard. It is still possible to use the UP , DOWN , and CLEAR keys to display set points. You may also use the ENTER key in remote mode to change the display for system and main functions and to reset remote to off. If you try to use the other keys or the ENTER key, except in the above way, a warning is displayed for 10 seconds. You set the remote mode either through the GPIB with the command REM ON or through the keyboard function **Remote**, see “REM – Remote” on page 109.

- 1 Select the remote function and press ENTER .
- 2 Set the function value to **ON** using the UP or DOWN keys.

See also “Using Functions” on page 56.

To reset remote mode either use the GPIB command REM OFF or the keyboard function **Remote** .

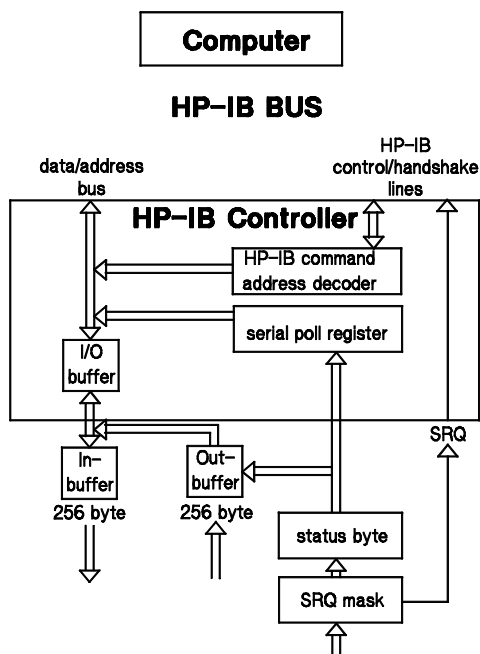
- 1 Select the remote function.
- 2 Set the function value to **OFF** using the UP or DOWN keys.

### NOTE

You may set the remote mode through the keyboard or the GPIB command and reset using the GPIB command. However, if you set the remote mode through the GPIB and reset through the keyboard an error message is generated: ERR 147.



## GPIB Control



**Figure 16** Temperature Control Unit GPIB Bus

Figure 16 shows the logical flow of communication. (It does not show hardware of the temperature control unit).

The GPIB controller of the temperature control unit controls data/address flow to and from the computer with the help of the control/handshake lines. Listener and talker commands and addresses are decoded in the GPIB command address decoder. ASCII instructions to the temperature control unit are sent through the I/O buffer into the in-buffer which is 256 byte of reserved space in main ram. ASCII replies from the temperature control unit are sent to the computer from the out-buffer, which is also 256 byte of reserved space in main RAM, through the I/O buffer.

The status byte contains the general information about the temperature control unit status, for example, ready, and error. The status byte can be sent to the computer in two different ways:

- ✓ Using the STA command from the computer. This transfers the contents of the status byte through the out-buffer via the I/O buffer to the computer, that is asking for a reply.
- ✓ Using serial poll capability. The status byte is transferred to the computer through the serial poll register.
- ✓ In addition the service request (SRQ) mask can be used to interrupt the computer through the SRQ line and control/handshake lines whenever the masked bits of the status byte change from 0 to 1 (Low to High).

## Service Request

SRQ mask regulates the sending of service requests to the computer. The temperature control unit actually interrupts the computer with the SRQ line of the GPIB bus.

Whenever there is a change in the condition in the temperature control unit, it updates the status byte. If any one bit 0 through 7 of the status byte (except SRQ bit itself) has a transition 0 to 1 and the corresponding bit in the SRQ mask is 1 (you can set the SRQ mask by sending the MSK instruction to the temperature control unit), the SRQ line of the GPIB bus is activated and causes an interrupt to the computer.

## Trigger Lines

The GPIB communication allows control of INTRIG (pin 4) and OUTTRIG (pin 9) lines of the remote control connector, J150.

If an INTRIG signal is received (transition 5 V to 0 V, H to L) the trigger bit in the status byte is set high, see “[STA – Status](#)” on page 113 and “[GPIB Control](#)” on page 89. This bit must always be set back by the computer using the TRA command.

## Device Clear

"Device clear" or "selected device clear" (that is only the device clear on the selected address) are commands provided by the GPIB command library. "Device clear" or "selected device clear" are also capable of controlling the temperature control unit by resetting the communication interface. These commands should be used to start up the temperature control unit.

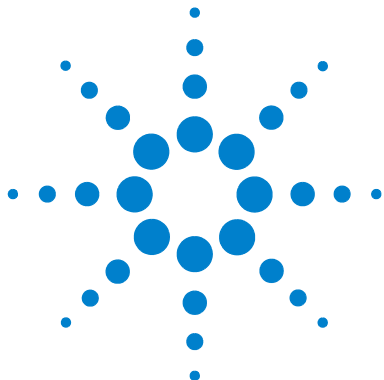
When the temperature control unit receives the "device clear" message or the "selected device clear" message (GPIB commands) it will clear the in-buffer and out-buffer. It also clears the status byte and the service request mask.

### NOTE

All stored errors are lost by resetting the communication interface.

---

**8 Communicating GPIB Commands**  
GPIB Control



## 9 GPIB Commands

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## Buffers

The in-buffer is full whenever a linefeed is received. In case of an overflow, that is no linefeed before the contents of the in-buffer exceeds 256 bytes, an error is generated and the in-buffer is cleared. When the in-buffer is full execution of the instruction(s) starts. After all the instructions in the in-buffer are processed, the in-buffer is again empty, and the temperature control unit is ready to receive new instructions. The ready for instruction bit of the status byte can be used to monitor the temperature control unit's ability to receive more instructions (only using serial poll, but not the *STA* command).

The out-buffer contains replies to the instructions sent by the computer, for example, status and parameter enquiries. The status of the buffer is represented by the ready reply bit of status byte (only using the serial poll to the computer). The buffer must be empty before another instruction can be executed successfully.

## Instruction Format

The IEEE Std 728-1982 Code and Format Conventions have been used for instructions.

The GPIB capability subset used by the HP 8452A diode-array spectrophotometer (see *Interfacing and Programming Guide* for the HP 8452A diode-array spectrophotometer for details) has been applied to the temperature control unit with the following exceptions:

- ✓ "Device Clear".
- ✓ "Selected Device Clear".
- ✓ No abort function.

See “[Device Clear](#)” on page 91 for more details.

The default GPIB address is 20.

## General Description

The instructions sent by the computer to the temperature control unit have the following format :

```
<instructions>[ ; <instructions>... ] [ ; ] <terminator>
```

- ✓ All the instructions are ASCII codes.
- ✓ Multiple instructions are separated by a semicolon (;).
- ✓ Certain instructions produce a reply from the temperature control unit. The computer must read the reply from the temperature control unit before sending a new instruction.
- ✓ Multiple instructions may be sent in an instruction string. However, for instructions which generate a reply from the temperature control unit only 1 is allowed and it must be the last in the instruction string.

For example,

```
PEL ON;STA
```

is an acceptable multiple instruction, but

```
STA;PEL ON
```

results in 140 OUTPUT FULL error when the instruction PEL is executed. If an error is found in executing an instruction, the remaining instruction string is discarded.

- ✓ Either <LF>, or <CR> <LF>, or <CR> <LF and EOI> must be the terminator for the instruction string. <CR> refers to the ASCII character for carriage return. <LF> refers to the ASCII character for linefeed. EOI is the end or identify line of the GPIB bus.
- ✓ Blanks and <CR> between instructions are ignored.
- ✓ All replies from the temperature control unit are terminated by <CR> <LF and EOI>. All replies are in ASCII code.

## Detailed Description

```
instructions = [ccc [Parameter[,Parameter]]]
```

- ✓ Instruction code consists of a header, ccc, of three alpha characters (upper or lower case) followed by a space, and no, one, or several optional parameters.
- ✓ [ ] indicate this is optional, do not enter the brackets as part of the command.
- ✓ [ | ] and [ | | ] indicate these are optional choices.
- ✓ Multiple parameters within an instruction are delimited by a comma (,).
- ✓ All instruction parameters are ASCII digits (ddd), or characters (ccc), and for temperature parameters dash (-) for minus, plus sign (+) for plus and fullstop (.) for the decimal point.



If an instruction with a temperature as parameter is sent all digits following the first digit after the decimal point will be ignored, for example, if 25.76 is sent from the computer, 25.7 is read by the temperature control unit. However, in replies for temperature values from the temperature control unit, two number after the decimal point are sent, for example, ddd.dd.

## CSM – Agilent ChemStation Mode

### Parameter

[on | off]

If no parameter is sent with the instruction CSM a reply from the temperature control unit is generated.

### Output

[0|1] <CR> <LF and EOI>''

### Description

This mode is especially used for low level communication because a computer like the Agilent ChemStation (Pascal series) cannot use strings which come back as a reply from the GPIB controller. Therefore only numbers are used in the Agilent ChemStation mode.

This instruction changes the reply format for the GPIB interface CSM ON and sets the interface in the temperature control unit in a low level (primitive) mode. In this mode all reply strings from the temperature control unit start with a number. For the commands PEL, REM, SEU, STR, and TRG the reply is no longer a string but only 0 or 1 (in ASCII).

The meaning of this number for the different commands is as follows:

0 =	PELTIER OFF
	REMOTE OFF
	C (Centigrade)
	STIRRER OFF
	OUTTRIG LOW
1 =	PELTIER ON
	REMOTE ON

```
K (Kelvin)  
STIRRER ON  
OUTTRIG HIGH
```

```
2 = F (Fahrenheit)
```

### Reply Description

The CSM instruction without any parameters is to read the current mode of the interface. The meaning of the replied number is:

```
0 = normal mode  
1 = Agilent ChemStation mode
```

## ERR – Error

### Parameter

None

### Reply

ddd ccccccccccccccccc <CR> <LF and EOI>

### Reply Description

The temperature control unit keeps track of 3 types of error that can occur:

- 1 Hardware
- 2 Instruction
- 3 Operation

From each type of error the temperature control unit saves the last error. If more than one type of error was present when the temperature control unit receives the ERR instruction, the temperature control unit will report one error at a time. Multiple errors are reported in the above order. After an error reply has been sent to the computer this particular error is cleared in the temperature control unit. The error bit of the status byte is reset immediately after receiving the ERR instruction and is set again if there were more errors. This has the effect of generating multiple SRQ if an interrupt mask that included the appropriate error bits was active (see the MSK instruction, [page 106](#)).

#### 1 Hardware Errors

After the temperature control unit detects a hardware or device error the number is written in the EEPROM, the number code is displayed on the front panel, and the Error LED turns on.

In case of an error, the following ASCII strings are replied to the computer after an error command has been sent.

110 V\_30\_SUPPLY  
111 V\_15\_SUPPLY  
112 CURRENT\_SOURCE  
113 MUX\_DEMUX  
114 GAIN\_AMPL  
115 POW\_AMP\_0  
116 POW\_AMP\_1  
117 AMP0\_OR\_H  
118 AMP1\_OR\_H  
119 H\_BRI0\_COL  
120 H\_BRI1\_COL  
121 H\_BRI0\_HEA  
122 H\_BRI1\_HEA  
123 DISPLAY  
124 MEMORY  
125 ROM  
130 EXT\_SENS  
131 INT\_SENS0  
132 INT\_SENS1  
133 CELL\_HOLH0  
134 CELL\_HOLH1  
135 COMMUNICATION

**2 Instruction Errors**

140 OUTPUT\_FULL

141 COMMAND

142 PARA\_SYNTAX

143 PARA\_NUMBER

144 PARA\_RANGE

145 OUTPUT

146 INPUT

147 REM\_CHANGE

**Error Description**

140 OUTPUT\_FULL

The temperature control unit has received a second instruction before the previous reply has been read.

141 COMMAND

The syntax of the most recent instruction is wrong.

142 PARA\_SYNTAX

The temperature control unit has detected an error in the syntax of the parameters that accompanied the most recent instruction.

143 PARA\_NUMBER

The temperature control unit has detected an error in the number of the parameters that accompanied the most recent instruction.

144 PARA\_RANGE

The temperature control unit has detected an error in the value (syntax or size) of a parameter that accompanied the most recent instruction. If the value is out of range, the previous value is kept.

145 OUTPUT

The temperature control unit received a new GPIB command before all the data from the out-buffer could be transferred, for example, a clear is sent before the output buffer is empty.

146 INPUT

The temperature control unit received a new GPIB command before all incoming data could be read, especially before <LF and EOI> are received.

147 REM\_CHANGE

The temperature control unit's remote state was released by a user from the keyboard. This error occurs only if the remote state was entered by an GPIB command.

**3 Operation Errors**

150 OVERLOAD

151 H\_TEMP\_EXT

152 L\_TEMP\_EXT

153 H\_TEMP\_SENS0

154 L\_TEMP\_SENS0

155 H\_TEMP\_SENS1

156 L\_TEMP\_SENS1

These operation errors are similar to the messages given by the temperature control unit as display messages without the numbers. For more details see [Chapter 8](#), “Communicating GPIB Commands”.

## EXT – External Temperature

### Parameter

[C | K | F]

### Reply

<tem> [C | K | F] <CR> <LF and EOI>''

### Description

This instruction always generates a reply. The temperature units are either the previously set units or in the units given as a parameter for this instruction. Using this instruction with a parameter has no effect on the set unit in the temperature control unit.

### Reply Description

The EXT instruction without parameters returns a value with the current temperature unit (for instruction see “SEU – Select Unit” on page 111). The value returned represents the temperature of the external sensor in the selected unit.

The format of the reply is:

tem = [-][dd]d.dd

If the measured temperature is out of the temperature control units specified limits, the reply will be the highest or lowest possible value (-999.99 | 999.99) regardless of the selected units.

### NOTE

The out of limits result could be caused by a defective sensor. See also “Messages” on page 77.



## IDY – Identify

### Parameter

None

### Reply

AGILENT89090A,REV x <CR> <LF and EOI>

### Description

This instruction is used to retrieve a string that identifies the temperature control unit and the current revision of firmware installed.

## MSK – Service Request Mask

### Parameter

ddd

ddd specifies the decimal value in the range 0 to 256 which corresponds to the bit pattern to set the SRQ mask.

### Reply

ddd <CR> <LF and END>''

### Description

A non-zero value as a parameter configures the temperature control unit so that service requests are sent to the computer, if any one or more bit in the status byte has a transition 0 to 1 and the corresponding bit in the SRQ mask is 1.

A service request (SRQ) remains in effect until the temperature control unit receives a serial poll or "device clear" command. This means that the computer has to evaluate the complete status byte.

For example, assume that the computer has set up the mask such that a service request is generated when the set temperature is reached and when an error occurred (that is, MSK 34). If the computer only reacts on the ready bit and does not evaluate the complete status byte the error message is not read.

### Reply Description

The MSK instruction without parameters is used to read the current mask.

After power on or "device clear" command the mask is always zero.

The following numbers are the decimal values corresponding to the bits in the mask. If combinations of bits are enabled intermediate numbers are obtained.

Condition	Decimal Value
TRIGGER	1
READY	2
REPLY READY	4
READY FOR INSTRUCTION	16
ERROR	32
SERVICE REQUEST	64
POWER ON	128

**NOTE**

The computer should always evaluate the status byte after receiving a service request from the temperature control unit to determine the reason for the interrupt before performing any action.

## PEL – Peltier

### Parameter

[on | off]

### Reply

[on | off] <CR> <LF and EOI>

### Description

This instruction is used to switch the Peltier element on or off. The PEL instruction without any parameters reads the current state of the Peltier element.

### Reply Description

See “[CSM – Agilent ChemStation Mode](#)” on page 98 for interpreting the reply when using the CSM command.

## REM – Remote

### Parameter

[ on | off ]

### Reply

[ on | off ] <CR> <LF and EOI>

### Description

This instruction is used to switch remote mode on and off. With REM ON the temperature control unit is set in a remote mode. In this remote state the keyboard is disabled for all inputs (only the UP , DOWN , and CLEAR keys are accepted). The ENTER key is only accepted within the remote function context, that is to change the display for system and main functions and to reset remote to off. However, the function **REMOTE ON**, which is selected, can be used to reset to **REMOTE OFF** instead of using the REM OFF command, (see also “Remote Mode” on page 88).

### Reply Description

The REM instruction without parameters returns a string which represents the current state of the temperature control unit:

```
on = remote mode
off = normal mode
```

See “CSM – Agilent ChemStation Mode” on page 98 for interpreting the reply when using the CSM command.

## SET – Set Cell Temperature

### Parameter

[ tem ][ C | K | F ]

### Reply

tem [ C | K | F ] <CR> <LF and EOI>

### Description

The SET instruction with a temperature (tem) as a parameter instructs the temperature control unit to set a new cell temperature. The second parameter represents the unit. If there is no specified unit the temperature control unit takes the current units as default. If the value is out of the specified limits a 144 PARA\_RANGE error is generated and the cell temperature is kept at the previous value.

The format for tem is :

tem = [-][ddd][.][d]

### NOTE

With the temperature-controlled cell holder the operating temperature range is 10°C - 70°C at 20°C ambient temperature. A higher temperature results in greatly reduced lifetime of the Peltier element. **WARNING 1** (see “Messages” on page 77) is not issued when the SET command is used.

### Reply Description

The SET instruction without a tem parameter is used to read the current set cell temperature. The value returned represents the temperature in the selected units. Without any unit parameter the returned value is in the current instrument unit (for instruction see “SEU – Select Unit” on page 111).

The format of the reply is:

tem = [-][dd]d.dd

## SEU – Select Unit

### Parameter

[ C | K | F ]

### Reply

[ c ] <CR> <LF and END>

### Description

This instruction defines the default temperature units of the temperature control unit. SEU without any parameters generates a response with the current unit.

### Reply Description

See “[CSM – Agilent ChemStation Mode](#)” on page 98 for interpreting the reply when using the CSM command.

## SPE – Speed

### Parameter

[ dddd ]

### Reply

dddd <CR> <LF and EOI>

### Description

This instruction is used to set a new stirrer speed. If the new speed is out of the specified limits (40 -1000 rpm) a 144 PARA\_RANGE error is generated and the speed is kept at the previous value.

### Reply Description

The SPE instruction without parameters returns the current speed setting in rpm.



## STA – Status

### Parameter

None

### Reply

ddd <CR> <LF and EOI>

### Description

This instruction is used to read the status byte from the temperature control unit. Faster replies can be achieved on the GPIB via the serial poll capability, see “GPIB Control” on page 89, or after SRQ, see “Service Request” on page 90. In any case, the meaning of the status byte returned is identical and as follows:

The following numbers are the decimal values corresponding to the bits in the status byte.

Condition	Decimal Value
TRIGGER	1
READY	2
REPLY READY	4
READY FOR INSTRUCTION	16
ERROR	32
SERVICE REQUEST	64
POWER ON	128

TRIGGER

is set whenever there is a 1 to 0 transition of the trigger input line, INTRIG, pin 4 on the remote control connector. A trigger acknowledge (TRA) instruction clears this bit.

READY

is set to 1 whenever the cell temperature reaches the set temperature. This bit is 0 whenever the cell temperature is out of the limits or has not reached the set temperature. It is like the Ready LED on the front panel of the temperature control unit.

REPLY READY

is set to 1 whenever there are data in the temperature control unit out-buffer ready to be read by the computer. Reading the data will clear this bit.

READY FOR INSTRUCTION

is set to 1 whenever the temperature control unit is in a state to allow new instructions to be received. This bit is cleared immediately after any instruction is received and becomes set again after the temperature control unit has dealt with the instruction. For the STA instruction, this bit is always 0 because STA is an instruction itself and therefore resets this bit to 0. The serial poll does not disturb the device function (being an interface command as opposed to an temperature control unit instruction) and therefore only the received status in response to the serial poll command is meaningful.

ERROR

is set to 1 whenever the temperature control unit detects an error condition. This bit is cleared by reading the error with the ERR instruction.

SERVICE REQUEST

is set to 1 whenever the temperature control unit that is included in the current SRQ mask makes a 0 to 1 transition (see the “[MSK – Service Request Mask](#)” on page 106 instruction). This bit is cleared whenever the current interface status is read with GPIB serial poll or device clear command. For the STA instruction, this bit is always 0.

POWER ON

is set to 1 when the temperature control unit restarts itself after a software or hardware failure. If the temperature control unit is turned on by the power switch the bit is always reset to 0.

## STR – Stirrer

### Parameter

[on | off]

### Reply

[on | off] <CR> <LF and EOI>

### Description

This instruction is used to switch the stirrer on or off. The STR instruction without any parameters is used to read the current state of the stirrer.

### Reply Description

See “[CSM – Agilent ChemStation Mode](#)” on page 98 for interpreting the reply when using the CSM command.

## TEM – Cell Temperature

### Parameter

[ C | K | F ]

### Reply

<tem> [ C | K | F ] <CR> <LF and EOI>

### Description

This instruction always generates a reply. The temperature units are either the previously set units or in the units given as a parameter for this instruction. Using this instruction with a parameter has no effect on the set unit in the temperature control unit.

### Reply Description

The TEM instruction without parameters returns a value in the current units (see “SEU – Select Unit” on page 111 instruction).

The value returned represents the temperature of the cell sensor in the selected unit. The format of the reply is:

tem = [-][dd]d.dd

If the measured temperature is out of the temperature control unit’s specified limits, the reply will be the highest or lowest possible value (-999.99 | 999.99) regardless of the selected units.

### NOTE

The out of limits result could be caused by a defective sensor.

## TRA – Trigger Acknowledge

**Parameter**

None

**Reply**

None

**Description**

This instruction is used by the computer to acknowledge the receipt (via status byte) of a trigger input line (remote control connector pin 4) condition from the temperature control unit from an external device. The TRA instruction clears the TRIGGER bit in the temperature control unit status byte.

## TRG – Trigger Out

### Parameter

[ high | low ]

### Reply

[ high | low ] <CR> <LF and EOI>

### Description

This instruction is used to set the trigger output, OUTTRIG, line to high or low. The TRG instruction without any parameters echoes back current trigger line setting. (Remote control connector pin 9).

Using the command TRG HIGH sets:

OUTTRIG line (pin 9) to high (H) (+5 V).

Using the command TRG LOW sets:

OUTTRIG line (pin 9) to low (L) (0 V).

### Reply Description

See “CSM – Agilent ChemStation Mode” on page 98 for interpreting the reply when using the CSM command.

## TST – Test

### Parameter

[eep]

### Reply

<num> <num> ...<CR> <LF and EOI>

### Description

eep = EEPROM.

<num> = a number.

This instruction runs a temperature control unit self-test which takes 10 seconds. During this time the GPIB is not available.

With parameter eep the temperature control unit returns the EEPROM settings. This can be used to obtain a quick overview of the temperature control unit without using all the commands to get a reading from the different functions.

### NOTE

**WARNING 2** (see “Messages” on page 77) is not issued when the TST command is used.

The meanings of the 17 numbers are as follows:

- 1 set\_temperature [-][dd]d.dd
- 2 free
- 3 free
- 4 stirrer speed [dd]dd
- 5 free
- 6 free
- 7 free
- 8 free
- 9 over\_temperature\_counter [dddd]d
- 10 free
- 11 gpib\_address [d]d (1 -31)
- 12 error\_code ddd

## 9 GPIB Commands

### TST – Test

```
13 store_counter [dddd]d
14 selected unit d (0 = C)
                   (1 = K)
                   (2 = F)

15 Peltier d       (0 = Peltier off)
                   (1 = Peltier on)
16 stirrer d       (0 = stirrer off)
                   (1 = stirrer on)
17 brightness d    (1 - 6)
```

#### NOTE

Over\_temperature\_counter records the amount of time, in 10 minute parts, that the Peltier element is used above 70°C.

Store\_counter is the record of write cycles to the EEPROM.

---





## 10 Electronics of the Temperature Control Accessory

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Microcontroller and Peripherals	127
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Power Amplifier	132
Sensor Electronic	134

This chapter describes the electronics system of the temperature control accessory. It is kept to block diagram level to give you an overview of the function of the instrument and to help you troubleshoot defective items.

The electronic hardware is divided into the following subassemblies:

- Temperature controller board,
- Inner cabinet assembly, containing line filter and transformer,
- Line-power switch,
- Front panel assembly, containing keyboard,
- Display assembly,
- Single cell temperature station (cell holder), containing Peltier element, magnetic stirrer and internal temperature sensor,
- External sensor,
- Cell holder cable,
- Fan assembly.

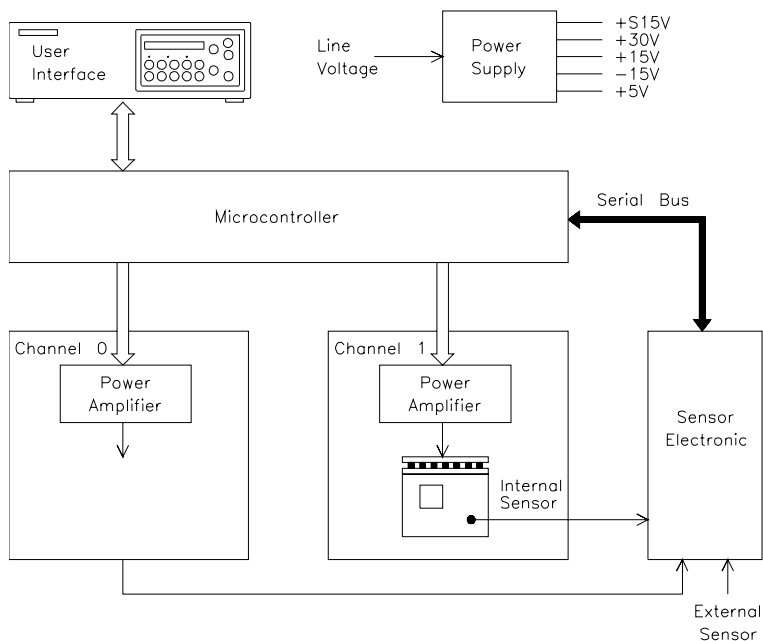
For more information on part numbers and how to replace parts, see [Chapter 13](#), “Identifying and Replacing Parts”.



## Electronics Overview

The electronics system of the temperature controller consists mainly of one printed circuit board.

The HPC46003 one chip microcontroller is the heart of the Agilent 89090A temperature controller. It receives data from the keyboard of the user interface and supports the display.



**Figure 17** Electronics Overview

Electronic circuits for two separate channels (channel 0 and channel 1 in [Figure 17](#)) are supplied. With the Agilent 89090 single cell temperature station (cell holder), only channel 1 is used. The electronics for a second channel (channel 0) is built in for future use.

The internal sensor of channel 1 (a negative temperature coefficient (NTC) resistance sensor) reads the actual temperature and shows a proportional resistance to the sensor electronic. The current flowing through the sensor transfers the resistance to a proportional voltage. The analog to digital converter (ADC) of the sensor electronic forms a digital value and forwards it to the microcontroller. For temperature calibration of the Agilent 89090A temperature controller, internal calibration resistors are read by the sensor electronic at constant intervals.

The difference between sensor input and setpoint from the keyboard is fed into a digital control algorithm. The microcontroller calculates the necessary current to hold the temperature in the cell holder on the setpoint temperature.

An external sensor (NTC) can be used to measure the cell temperature or any other remote temperature.

## Power Supply

The line voltage connects to the line filter which contains the line fuse.

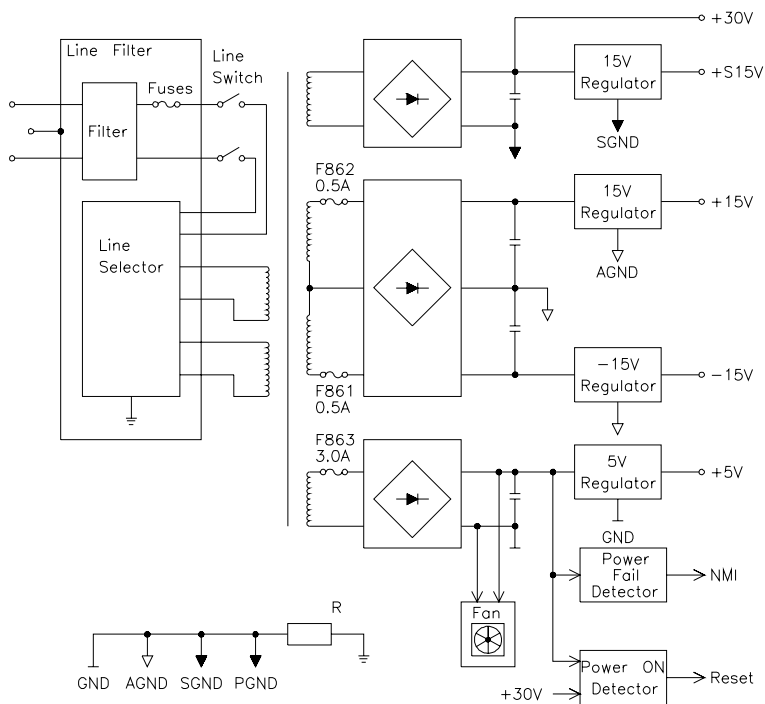


Figure 18 Power Supply

### Line Fuses

You access the line fuse (primary fuse) in the line filter from the rear of the instrument after removing the power cord.

- ✓ T1000 mA for 110 VAC operation (part number 2110-0007)
- ✓ T500 mA for 220 VAC operation (part number 2110-0202)

## Internal Fuses

The internal fuses (secondary fuses) are placed on the temperature controller board (TCB)

- ✓ F861 and F862: 0.5 A for the  $\pm 15$  V supply (part number 2110-0012)
- ✓ F863: 3.0 A for the +5 V supply (part number 2110-0003)

## Transformer, Regulation

The line voltage feeds through the line switch and line selector switch to the transformer which has three separate windings.

The unregulated +30 V supply is used to drive the Peltier elements through the power amplifiers and fan. All other voltage lines contain linear regulation circuits. +5 V is used for the digital electronics,  $\pm 15$  V is used for the analog section and +S15 V is used to drive the magnetic stirrer.

## Power Fail Detector

When the DC supply voltage of the +5 V regulator drops below 6.0 V, a non-maskable interrupt (NMI) is issued, the microcontroller backs up all valuable information and changes the brightness to level 1. After recovering from power fail the control unit restores the previous brightness level.

## Power On Detector

As soon as the unregulated +30 V line is higher than +20 V and the unregulated +5 V line is higher than 4.8 V, a reset is issued to the microcontroller so that it starts operation in a defined state.

## **GND, AGND, PGND, SGND, Shield**

Various ground lines are used for the electronics. Digital ground (GND) is used for all digital circuits, analog ground (AGND) for the analog circuits mainly in the sensor electronic, and power ground (PGND) is used for the power amplifiers and H-bridges. Stirrer ground (SGND) is an extra ground line which is used for the magnetic stirrer, because the coils of the magnetic stirrer induce spikes on the ground line. All ground lines are connected in the power supply.

## Microcontroller and Peripherals

The HPC46003 one chip microcontroller runs at 9.83 MHz. It provides various input/output lines, a 16 bit data/address bus, a serial bus, pulse width modulated outputs and interrupt control logic. An address decoder is needed to separate the addresses from the 16 bit data/address bus.

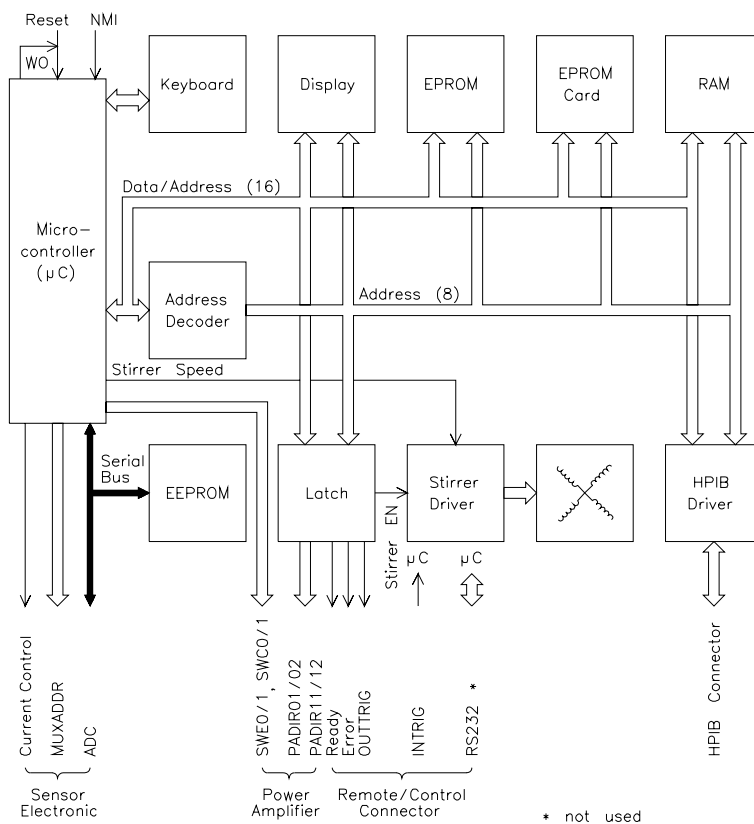


Figure 19 Microcontroller and Peripherals

The HPC46003 microcontroller supports the following hardware via address/data and address bus.

- ✓ Display
- ✓ PROM (32 Kbyte)
- ✓ PROM card (optional)
- ✓ RAM (64Kbyte)
- ✓ GPIB driver
- ✓ Latch

## **PROM Card**

The optional PROM card can be plugged in from the rear of the instrument. It provides easy upgrade possibility for firmware. It is automatically selected when plugged in (the normal PROM is disabled).

## **Latch, Remote Control Connector**

The ready line, error line and out-trigger (OUTTRIG) line (presently not used) lead to the remote/control connector. The in-trigger (INTRIG) signal and the RS-232 lines from the remote/control connector are connected directly to the microcontroller and are presently not used.

## **Lines to Power Amplifiers**

The power amplifier direction lines PADIR11 and PADIR12 are used to reverse the direction of current through the Peltier element of channel 1. (PADIR01 and PADIR02 are used for channel 0.)

The switch enable lines SWE0/1 and switch control lines SWC0/1 are directly controlled from the microcontroller. SWE1 is an enabled line for the power amplifiers of channel 1 (SWE0 is used for channel 0).



The SWC1 line carries a pulse width modulated signal for the power amplifier for channel 1 (SWC0 is used for channel 0). The pulse width of SWC1 or SWC0 is proportional to the current that is needed to maintain a stable temperature.

## Lines to Sensor Electronic

The current control line is needed for the temperature measurement in the sensor electronic (pulse width modulated signal). The multiplexer address (MUXADDR) lines supply the address to the two multiplexers of the sensor electronic. Data from the ADC of the sensor electronic is transferred to the microcontroller via the serial bus.

## EEPROM

In the EEPROM (electrically erasable PROM) all valuable data are stored in case of a power fail and while the instrument is turned off.

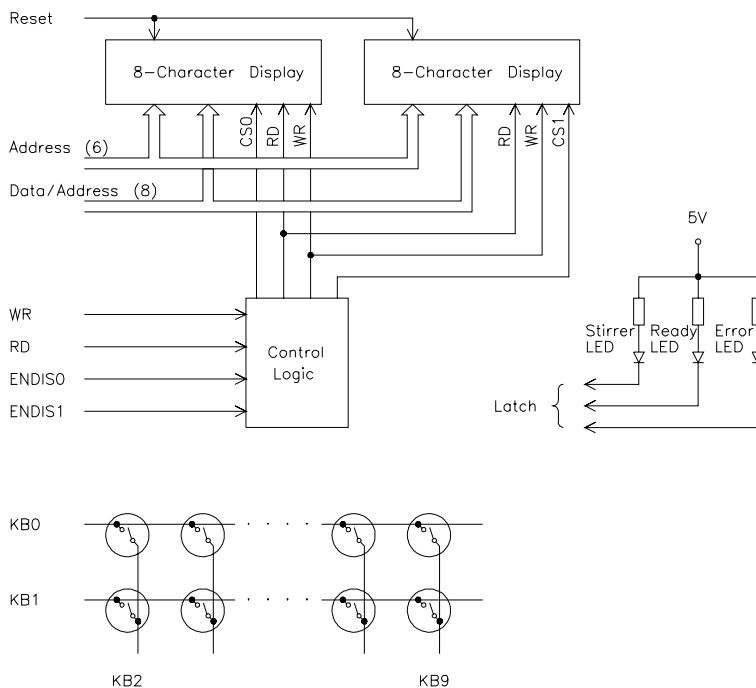
## Stirrer Driver, Stirrer

The stirrer is enabled by the stirrer enable (EN) line from the latch. Speed control is done by the stirrer speed line from the microcontroller (frequency proportional to stirrer speed).

## Reset, NMI

The reset and NMI (non-maskable interrupt) signals are provided from the power supply. An integrated watchdog circuit detects lockups of the microcontroller and causes a reset for the microcontroller. The watchdog (WO) line becomes active, if the watchdog circuit is not accessed in regular intervals by the firmware or if it is accessed too often (program running in loop).

## Keyboard Display Electronic



**Figure 20** Keyboard and Display Electronic

### Keyboard

KB0 and KB1 lines are driven from the microcontroller and KB2, KB3, ... to KB9 lines are sensed.

## LEDs

Stirrer LED, Ready LED and Error LED are driven from the microcontroller via the latch (see microcontroller and peripherals block diagram, [Figure 19](#) on page 127).

## Control Logic

The control logic enables one of the two 8-character displays, according to the lines chip select 0 and 1 (CS0 and CS1). Enable display 0 and 1, (ENDIS0 and ENDIS1) together with the read (RD) and write (WR) signals determine the state of the CS lines. (RD signal is used for self-test only).

## 8-Character Display

The eight digit,  $5 \times 7$  dot matrix alphanumeric display includes a ROM, where 128 ASCII characters are stored, and a RAM which can hold up to 16 user defined symbols. These and various control registers are addressed by the address lines. The data/address lines select ASCII characters from the ROM and are used to address the internal registers. Brightness of the display is controlled by the microcontroller. The reset line brings the internal logic back to a defined state.

## Power Amplifier

The power amplifier is used to drive the Peltier element and regulate the current through it.

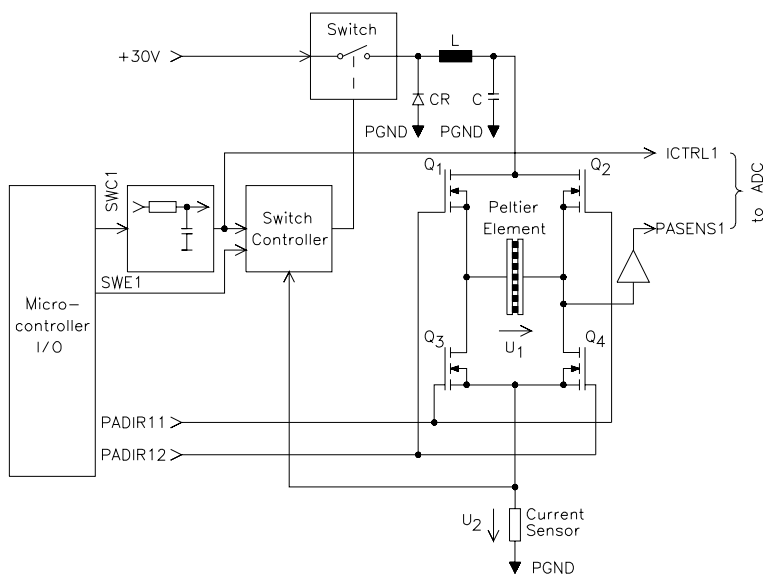


Figure 21 Power Amplifier

### Switch Controller, Current Sensor

The SWE1 line enables the power amplifier of channel 1 (SWE0 is used for channel 0). The low pass transforms the SWC1 signal (pulse width is proportional to the current that is needed to maintain a stable temperature) to an analog signal for the switch controller of channel 1 (SW0 is used for channel 0). The analog signal from SWC1 (current set point) is compared with the voltage  $U_2$  from the current sensor (actual). The result of the comparison is used to drive the current switch. An internal protection mechanism avoids destruction of the switch control circuit due to overcurrent.

The setpoint voltage on the internal control (ICTRL1) line is fed back to the ADC of the sensor electronic. This signal is used for diagnostic purposes of the power amplifier electronics (ICTRL0 is used for channel 0).

## Switch

Current regulation is done with the switching current supply, which contains the switch, L, CR and C.

## H-Bridge, Peltier Element

The MOS-FETS:  $Q_1$ ,  $Q_2$ ,  $Q_3$  and  $Q_4$  form an H-bridge to supply negative or positive current through the Peltier element. With the PADIR11 and PADIR12 lines, the current through the Peltier element can be reversed to either heat or cool the cell holder (PADIR01 and PADIR02 are used for channel 0).

The power amplifier (PASENS1) line delivers a voltage to the ADC of the sensor electronic. This signal is used for diagnostic purposes of the power amplifier and the H-bridge (PASENS0 is used for channel 0).

## Sensor Electronic

The sensor electronic is the interface between the internal or external sensor and the microcontroller.

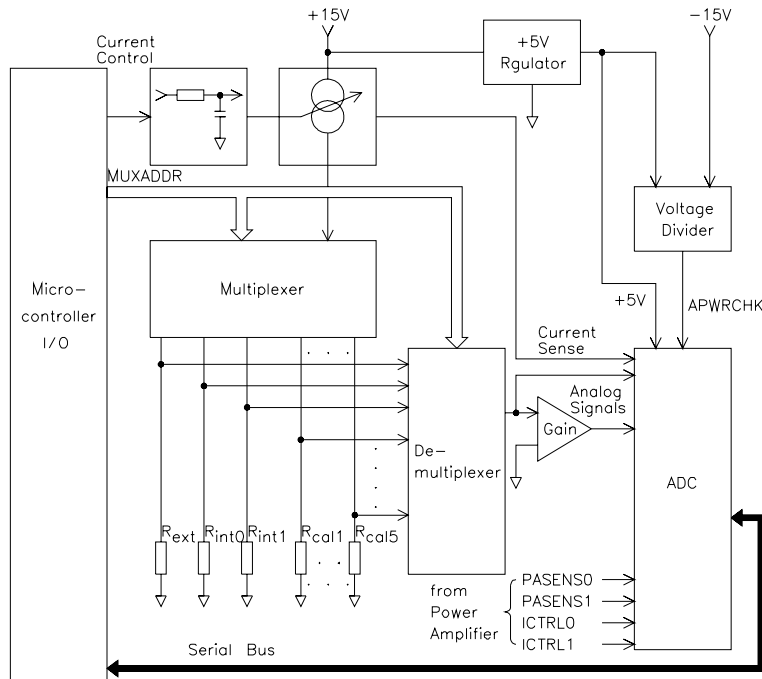


Figure 22 Sensor Electronic

## Current Source

The current control signal is a pulse width modulated signal (pulse width is proportional to the current). The low pass filter transforms the pulse width modulated signal to an analog signal which controls the constant current source.

The low pass filtered current control signal is led to the analog to digital converter (ADC) for diagnostic purposes.

## Multiplexer, Demultiplexer

With the help of the MUXADDR lines the constant current is directed through one of the sensor resistors (NTCs) or the calibration resistors.

The demultiplexer connects the resistor, which is selected by the multiplexer, to the gain amplifier. The voltage drop on the resistor is amplified with a fixed gain and forwarded to the analog to digital converter (ADC).

For temperatures smaller than 1 °C the processor uses the data from the analog to digital converter (ADC), which are measured on the second analog signal line that by-passes the gain amplifier.

$R_{ext}$  is the resistor of the external sensor,  $R_{int1}$  is the resistor of the temperature sensor in the Agilent 89090 single cell temperature station (cell holder).  $R_{int0}$  is presently not available.  $R_{cal1}$  through  $R_{cal5}$  are calibration resistors.

## Measuring Principle

Measuring the voltage drop over a calibration resistor and the temperature sensor with the same current, the resistance of the temperature sensor can be calculated as shown in the following example for the external temperature sensor  $R_{\text{ext}}$ :

$$U_{\text{ext}} = G \cdot I \cdot R_{\text{ext}} \quad (1)$$

$$U_{\text{caln}} = G \cdot I \cdot R_{\text{caln}} \quad (2)$$

$$\frac{U_{\text{ext}}}{U_{\text{caln}}} = \frac{G \cdot I \cdot R_{\text{ext}}}{G \cdot I \cdot R_{\text{caln}}} \quad (3)$$

$$\frac{U_{\text{ext}}}{U_{\text{caln}}} = \frac{R_{\text{ext}}}{R_{\text{caln}}} \quad (4)$$

Rearranging Equation 4 leads to:

$$R_{\text{ext}} = \frac{U_{\text{ext}}}{U_{\text{caln}}} R_{\text{caln}}$$

$U_{\text{ext}}$	Voltage drop on the temperature sensor.
$R_{\text{ext}}$	Resistance of sensor (NTC).
$G$	Gain.
$I$	Current.
$R_{\text{caln}}$	Resistance of calibration resistor, $R_{\text{cal1}}$ to $R_{\text{cal5}}$ .

Because of this measurement principle, the calculated  $R_{\text{ext}}$  is independent of drift in current and gain. Because  $R_{\text{ext}}$  is a known function of the temperature, the temperature of the sensor can be looked up on a table. To minimize errors and temperature drifts  $R_{\text{caln}}$  resistor with low tolerances and low temperature drift coefficients are used and  $U_{\text{ext}}$  and  $U_{\text{caln}}$  are kept in the same voltage range.

Measuring the calibration resistors starts with the highest for  $R_{\text{caln}}$  (30 kOhm resistance = 0°C) and steps down until it finds the appropriate  $R_{\text{caln}}$  range compared with the actual value on  $R_{\text{ext}}$ .



## +5 V Regulator, Voltage Divider

The +5 V supply and reference voltage for the analog to digital converter (ADC) is derived from the +15 V line by the +5 V regulator.

The voltage divider forms the analog power check signal (APWRCHK) which is used for diagnostic purposes, that is, to check if the -15 V and +15 V lines are available.

## Analog to Digital Converter (ADC)

The analog to digital converter (ADC) includes a sample and hold circuit. From the 8 analog input channels which are provided, two are used to read the analog signal from the demultiplexer. The other 6 inputs are used for diagnostic purposes.

The current-sense line carries a signal which is proportional to the current of the current source that supplies the sensor electronic. This signal is used for diagnostic purposes, see [Chapter 12](#), “Troubleshooting” under the appropriate error messages.

The other 5 inputs (PASENS1, PASENS0, ICTRL1, ICTRL0 and APWRCHK) are used for diagnostic purposes during self-test. The diagnostic checks which are done with the help of these lines are described in [Chapter 12](#), “Troubleshooting”, see the appropriate error messages.

**10 Electronics of the Temperature Control Accessory**  
Sensor Electronic



# 11

## Cables and Connectors

Cables 140  
Connectors 142



## Cables

There are two cables used in or with the temperature controller.

- The front panel cable is used to connect the front panel with the temperature controller board. For pin assignment see [Table 23](#) on page 146 in this chapter (the connectors on both sides of the cable have the same pin assignment).
- The cell holder cable is part of the cell holder and connects to the rear of the Peltier temperature control unit.

**Table 15** Cell Holder Cable

Pin Temp. Contr.	Pin Cell Holder	Function
1	NC	PELTIER1A
2	NC	PELTIER1A
3	NC	PELTIER1B
4	1	+30 V
5	3	STIRRERA
6	5	STIRRERC
7	7	PELTIER2B
8	9	PELTIER2B
9	11	PELTIER2A
10	13	SCODE0*
11	15	Sensor Rint1
12	17	Sensor Rint2
13	19	GND
14	NC	PELTIER1A

SCODE0\* = Low and SCODE1 = High select the cell holder  
 (-) sign indicates negative true logic

**Table 15** Cell Holder Cable (continued)

Pin Temp. Contr.	Pin Cell Holder	Function
15	NC	PELTIER1B
16	NC	PELTIER1B
17	2	SGND
18	4	STIRRERB
19	6	STIRRERD
20	8	PELTIER2B
21	10	PELTIER2A
22	12	PELTIER2A
23	14	SCODE1 *
24	16	24AGND
25	18	25AGND * SCODE0

SCODE0\* = Low and SCODE1 = High select the cell holder  
(-) sign indicates negative true logic

## Connectors

The temperature controller has several different types of interfaces. They are used for power distribution and to communicate with internal and external devices. The connectors for the external devices are located on the rear of the temperature control unit.

The numbers of the PCB reference designators are:

Connector	Number
GPIB	J190
Fan	J790
PROM Card	J370
Remote Control	J150
External Sensor	J140
Cell Holder	J120
Power Supply	J840
Front Panel	J480

The following tables give the functions of each pin of the connectors on the panels of the temperature control unit.

**Table 16** GPIB Connector (J190)

Pin	Function	Pin	Function	Pin	Function
1	DI01	9	IFC	17	REN
2	DI02	10	SRQ	18	GND
3	DI03	11	ATN	19	GND
4	DI04	12	Housing	21	GND

**Table 16** GPIB Connector (J190) (continued)

Pin	Function	Pin	Function	Pin	Function
5	EOI	13	DI05	22	GND
6	DAV	14	DI06	23	GND
7	NRFD	15	DI07	24	GND
8	NDAC	16	DI08		

**Table 17** Fan Connector (J790)

Pin	Function
1	unregulated 5V
2	GND

**Table 18** PROM Card Connector (J370)

Pin	Function	Pin	Function	Pin	Function
5	Address 12	19	Address 1	39	Data/Address 7
6	+ 5 V	21	Address 0	41	PROM (-)
7	Address 7	23	Data/Address 0	43	Address 10
8	Address 15	25	Data/Address 1	45	RD (-)
9	Address 6	27	Data/Address 2	47	Address 11
10	GND	29	GND	49	Address 9
11	Address 5	30	GND	51	Address 8
12	GND	31	Data/Address 3	53	Address 13
13	Address 4	32	GND	55	Address 14
14	GND	33	Data/Address 4	58	Card Detect
15	Address 3	35	Data/Address 5	59	+5 V
17	Address 2	37	Data/Address 6	60	+5 V

(-) sign indicates negative true logic

## 11 Cables and Connectors

### Connectors

**Table 19** Remote Control Connector (J150)

Pin	Function
1	Ready (-)
2	RXD
3	TXD
4	INTRIG (-)
5	GND
6	Error (-)
7	RTS
8	CTS
9	OUTTRIG (-)

(-) sign indicates negative true logic

**Table 20** External Sensor Connector (J140)

Pin	Function
2	SCODE_EXT
4	GND
5	AGND
8	Sensor Rext

**Table 21** Cell Holder Connector (J120)

Pin	Function	Pin	Function
1	PELTIER1A	14	PELTIER1A
2	PELTIER1A	15	PELTIER1B
3	PELTIER1B	16	PELTIER1B

\* SCODE0 = Low and SCODE1 = High select the cell holder  
 (-) sign indicates negative true logic



**Table 21** Cell Holder Connector (J120) (continued)

Pin	Function	Pin	Function
4	+30 V	17	SGND
5	STIRRERA	18	STIRRERB
6	STIRRERC	19	STIRRERD
7	PELTIER2B	20	PELTIER2B
8	PELTIER2B	21	PELTIER2A
9	PELTIER2A	22	PELTIER2A
10	SCODE0*	23	SCODE1*
11	Sensor $R_{int1}$	24	24AGND
12	Sensor $R_{int2}$	25	25AGND
13	GND		

\* SCODE0 = Low and SCODE1 = High select the cell holder  
(-) sign indicates negative true logic

**Table 22** Power Supply Connector (J840)

Pin	Function
1,4	AC lines for S15 V supply (> 16 VAC)
3,6	AC lines for +5 V supply (> 6.5 VAC)
7,9	AC lines for $\pm 15$ V supply (> 14 VAC)
8	AGND (GND of $\pm 15$ V supply)

## 11 Cables and Connectors

### Connectors

**Table 23** Front Panel Connector (J480)

Pin	Function	Pin	Function	Pin	Function
1	KB0	13	Error LED	25	RD (-)
2	KB1	14	STIRRER LED	26	SGND
3	KB2	15	ENDIS0 (-)	27	Reset (-)
4	KB3	16	ENDIS1 (-)	28	+ 5 V
5	KB4	17	Data/Address 0	29	WR (-)
6	KB5	18	Data/Address 1	30	DGND
7	KB6	19	Data/Address 2	31	Address 0
8	KB7	20	Data/Address 3	32	Address 1
9	KB8	21	Data/Address 4	33	Address 2
10	KB9	22	Data/Address 5	34	Address 3
11	+5 V	23	Data/Address 6	35	Address 4
12	Ready LED	24	Data/Address 7	36	Address 5

(-) sign indicates negative true logic



## 12 Troubleshooting

General Description [148](#)

Basic Failures [150](#)

Error Messages [152](#)

This section describes troubleshooting of the temperature controller and is intended for the use by trained service personnel only. Troubleshooting is divided into three parts:

- 1 General description.
- 2 Basic failures.
- 3 Error messages.



## General Description

The Agilent 89090A temperature control accessory has sophisticated internal diagnostics which cover most of the errors that are possible in the system. These include plausibility checks on various analog lines (see Sensor Electronic, description of ADC) which lead to error messages to help isolate the defective parts.

### Diagnostic During Operation and Power-On

A number of diagnostic functions are automatically executed during normal operation and after turning on, see “[Error Messages](#)” on page 152 for more information. If a malfunction is detected, depending on where it originated, the power amplifier and/or the sensor electronic is automatically turned off.

#### NOTE

During normal operation and after turning on you will only receive errors 110 through 118.

### Starting Self-Test Manually

In case you observe unusual operation of your instrument or receive an error message, start the self-test manually:

- 1 Use the UP and DOWN keys to display **System Function** and press ENTER .
- 2 Select **Self-test** and press ENTER .

#### NOTE

When executing the self-test you will receive the following message on your display:

#### **WARNING 2**

prompting you to remove your sample cell from the cell holder, because temperatures are not kept stable during self-test. Press ENTER to continue the self-test or CLEAR to stop the self-test.

The self-test includes all diagnostic functions and you may receive all error messages, described in this handbook.

## Basic Failures

**No LED and No Fan On**

These symptoms may appear when there is a problem in the power supply.

**Action:**

- 1 Check line fuse.
- 2 Check fuse in +5 V line (F863).
- 3 Measure voltages on power supply connector (J840). If the correct voltage on one of the lines is not present, exchange the inner cabinet assembly.
- 4 Exchange temperature controller board.

**No Parameters Stored After Turning Off and On**

**Action:**

- 1 Exchange EEPROM.
- 2 Exchange temperature controller board.

**Display Not Functioning**

**Action:**

- 1 Check or exchange front panel cable.
- 2 Exchange display assembly.
- 3 Exchange temperature controller board.

**Display Partly Not Functioning**

**Action:**

- 1 Exchange display assembly.

**LEDs Not Functioning**

**Action:**

- 1 Check or exchange front panel cable.
- 2 Exchange front panel assembly.
- 3 Exchange temperature controller board.

**Keyboard Not  
Functioning**

**Action:**

If the whole keyboard or some keys do not function:

- 1 Check or exchange front panel cable.
- 2 Exchange temperature controller board.

If only one key does not function:

- 1 Exchange front panel assembly.

## Error Messages

The table on the next two pages gives an overview of the error messages. Some of the error messages turn off the sensor electronic and/or the power amplifier automatically for safety reasons. Some diagnostic checks are done automatically during turn on and/or operation whereas all diagnostic checks are done during self-test.

A detailed description of all error messages with possible causes and troubleshooting procedures are given on the following pages.

**Table 24** Overview of Error Messages

Error Message	Symptom	Automatic Turn Off	Error Checked during		
			Turn On	Operation	Self-test
<b>ERR 110</b>	Low counts measured on the APWRCHK line	sensor electronic, power amplifier	X	X	X
<b>ERR 111</b>	High counts measured on APWRCHK line	sensor electronic, power amplifier	X		X
<b>ERR 112</b>	Sensor electronic failure (current source)	sensor electronic, power amplifier	X	X	X
<b>ERR 113</b>	Sensor electronic failure (multiplexer or demultiplexer)	sensor electronic, power amplifier	X		X
<b>ERR 114</b>	Sensor electronic failure (gain amplifier)	sensor electronic, power amplifier	X		X
<b>ERR 115</b>	Power amplifier failure (channel 0)	power amplifier	X		X
<b>ERR 116</b>	Power amplifier failure (channel 1)	power amplifier	X	X	X



**Table 24** Overview of Error Messages (continued)

Error Message	Symptom	Automatic Turn Off	Error Checked during		
			Turn On	Operation	Self-test
<b>ERR 117</b>	Power amplifier or H-bridge failure (channel 0)	power amplifier	X	X	X
<b>ERR 118</b>	Power amplifier or H-bridge failure (channel 1)	power amplifier	X	X	X
<b>ERR 119</b>	H-bridge failure. Cooling does not function. (channel 0)				X
<b>ERR 120</b>	H-bridge failure. Cooling does not function. (channel 1)				X
<b>ERR 121</b>	H-bridge failure. Heating does not function. (channel 0)				X
<b>ERR 122</b>	H-bridge failure. Heating does not function. (channel 1)				X
<b>ERR 123</b>	Display failure				X
<b>ERR 124</b>	Memory failure				X
<b>ERR 125</b>	ROM failure				X
<b>ERR 130</b>	External sensor failed				X
<b>ERR 131</b>	Internal sensor failed (channel 0)				X
<b>ERR 132</b>	Internal sensor failed (channel 1)				X
<b>ERR 133</b>	Cell holder failure (Peltier of channel 0)				X
<b>ERR 134</b>	Cell holder failure (Peltier of channel 1)				X

**ERR 110** Low counts measured on the APWRCHK line.

The APWRCHK line is used to check the +15 V and –15 V lines from the power supply which supply the analog circuits. A missing +15 V or both, a missing +15 V line and a missing –15 V line or defective analog circuits produce this error message.

This error turns the power amplifiers and the sensor electronic off automatically.

**Checked:**

After turning on, during operation, during self-test.

**Action:**

- 1 Check fuses F861 and F862.
- 2 Measure voltages on power supply connector (J840). If all volages are not present, exchange the inner cabinet assembly.
- 3 Exchange temperature controller board.

**ERR 111** High counts measured on APWRCHK line.

The APWRCHK line is used to check the +15 V and –15 V lines from the power supply which supply the analog circuits. A missing –15 V line or defective analog circuits produce this error message (if +15 V are available).

This error turns the power amplifiers and the sensor electronic off automatically.

**Checked:**

After turning on, during self-test.

**Action:**

- 1 Check fuses F861 and F862.
- 2 Measure voltages on power supply connector (J840). If all volages are not present, exchange the inner cabinet assembly.
- 3 Exchange temperature controller board.

**ERR 112** Sensor electronic failure (current source).

The current-sense line carries a signal which is proportional to the current of the current source that supplies the sensor electronic. Comparing this value with the current setpoint, the microcontroller is able to detect malfunctions in the current source.

This error turns the power amplifiers and the sensor electronic off automatically.

**Checked:**

After turning on, during operation, during self-test.

**Action:**

- 1 Exchange temperature controller board.

**ERR 113** Sensor electronic failure (multiplexer or demultiplexer).

The current-sense line carries a signal which is proportional to the current of the current source that supplies the sensor electronic. Comparing the reading on the current-sense line with the readings from the internal calibration resistors, malfunctions of the multiplexer or demultiplexer are detected.

This error turns the power amplifiers and the sensor electronic off automatically.

**Checked:**

After turning on, during self-test.

**Action:**

- 1 Exchange temperature controller board.

**ERR 114** Sensor electronic failure (gain amplifier).

A comparison of the analog signal from the gain amplifier with the analog signal that by-passes the gain amplifier is used to detect a malfunction of the gain amplifier. This error turns the power amplifiers and the sensor electronic off automatically.

**Checked:**

After turning on, during self-test.

**Action:**

- 1 Exchange temperature controller board.

**ERR 115** or

**ERR 116** Power amplifier failure.

The ICTRL0 and ICTRL1 lines are used to check if the switch controller of the power amplifiers of both channels are provided with the correct analog signal to maintain or reach a set temperature. A wrong reading on ICTRL0 line produces **ERR 115** (power amplifier 0), whereas a wrong reading on ICTRL1 line produces **ERR 116** (power amplifier 1).

These errors turn the power amplifiers off automatically.

**Checked:**

After turning on, during self-test.

**Action:**

- 1 Exchange temperature controller board.

**ERR 117** or

**ERR 118** Power amplifier or H-bridge failure.

The PASENS0 and PASENS1 lines are checked for correct operation of the power amplifier of channel 0 and 1.

During self-test the H-bridge of channel 0 is shorted using the PADIR01 and PADIR02 lines. The processor checks the PASENS0 line for a correct voltage drop on  $Q_4$  and the current sensor. For the check of the PASENS1 line (channel 1), the PADIR11 and PADIR12 lines are used to shorten the H-bridge.

A wrong reading on PASENS0 line produces **ERR 117** (power amplifier 0), whereas a wrong reading on PASENS1 line produces **ERR 118** (power amplifier 1). These errors turn the power amplifiers off automatically.

**Checked:**

After turning on, during operation, during self-test.

**Action:**

- 1 Exchange temperature controller board.

**ERR 119** or

**ERR 120** H-bridge failure. Cooling does not function.

The microcontroller tries to cool the cell holder but it does not get an appropriate response when measuring the temperature of the cell holder. **ERR 119** relates to H-bridge of channel 0, whereas **ERR 120** relates to H-bridge of channel 1.

**Checked:**

During self-test.

**Action:**

- 1 Exchange temperature controller board.

**ERR 121** or

**ERR 122** H-bridge failure. Heating does not function.

The microcontroller tries to heat the cell holder but it does not get an appropriate response when measuring the temperature of the cell holder. **ERR 121** relates to H-bridge of channel 0, whereas **ERR 122** relates to H-bridge of channel 1.

**Checked:**

During self-test.

**Action:**

- 1 Exchange temperature controller board.

**ERR 123** Display failure.  
(The display can be also checked visually after turning on.)

**Checked:**

During self-test.

**Action:**

- 1 Exchange display assembly

**ERR 124** Memory failure.

**Checked:**

During self-test.

**Action:**

- 1 Exchange temperature controller board.

**ERR 125** ROM failure.

**Checked:**

During self-test.

**Action:**

- 1 Exchange temperature controller board.

**ERR 130** External sensor failed.

The current-sense line carries a signal which is proportional to the current of the current source that supplies the sensor electronic. Comparing the reading on the current-sense line with the readings from the external temperature sensor, malfunctions of the sensor are detected. The processor automatically determines if the external sensor is connected, using the SCODE\_EXT line of the external sensor connector (see [Chapter 11](#), “Cables and Connectors”, J140).

**Checked:**

During self-test.

**Action:**

- 1 Exchange external sensor or check resistance on plug of external sensor, for pin assignment see [Table 20](#) on page 144.

The following table gives the relationship between resistance of the external sensor and temperature:

**Table 25** Resistance of External Sensor

Temperature (Celsius)	Resistance (kOhm)
15	15.7
20	12.5
30	8.0
35	6.5

- 2 Exchange temperature controller board.

**ERR 131** or

**ERR 132** Internal sensor failed.

The current-sense line carries a signal which is proportional to the current of the current source that supplies the sensor electronic. Comparing the reading on the current-sense line with the readings from the internal temperature sensors of channel 0 and 1, malfunctions of the sensors are detected. The processor automatically determines if the cell holder is connected, using the SCODE0 and SCODE1 lines of the cell holder connector (see J120). **ERR 131** relates to internal sensor of channel 0 (presently not used), whereas **ERR 132** relates to internal sensor of channel 1 (cell holder).

**Checked:**

During self-test.

**Action:**

- 1 Exchange cell holder assembly or check resistance of internal sensor on plug of cell holder, for pin assignment see [Table 21](#) on page 144.

The following table gives the relationship between resistance of the internal sensor and temperature:

**Table 26** Resistance of Internal Sensor

Temperature (Celsius)	Resistance (kOhm)
15	15.7
20	12.5
30	8.0
35	6.5

- 2 Check cable of cell holder assembly (for pin configuration see [Chapter 11](#), “Cables and Connectors”).
- 3 Exchange temperature controller board.

**ERR 133** or

**ERR 134** Cell holder failure (Peltier element).

Malfunctions on the Peltier element and the cell holder cable of channel 0 can be detected, using the ICTRL0 and the PASENS0 lines. (ICTRL1 and PASENS1 lines are used for channel 1.) The processor automatically determines if the cell holder is connected, using the SCODE0 and SCODE1 lines of the cell holder connector (see J120). **ERR 133** relates to Peltier element of channel 0 (presently not used), whereas **ERR 134** relates to Peltier element of channel 1 (cell holder).

**Checked:**

During self-test.



**Action:**

- 1 Check cable of cell holder assembly (for pin configuration see [Chapter 11](#), “Cables and Connectors”).
- 2 Exchange cell holder assembly.

Additions from GPIB commands section: ERR 135 COMMUNICATION . This error indicates that the temperature control unit has received an GPIB interrupt for which the interface was not masked. This indicates GPIB hardware or firmware error

- 1 Turn off the temperature controller.
- 2 Turn on again, if error continues turn off.
- 3 Exchange temperature controller board.

## **12 Troubleshooting**

### **Error Messages**



## 13 Identifying and Replacing Parts

Parts Identification 165  
Changing Parts 167

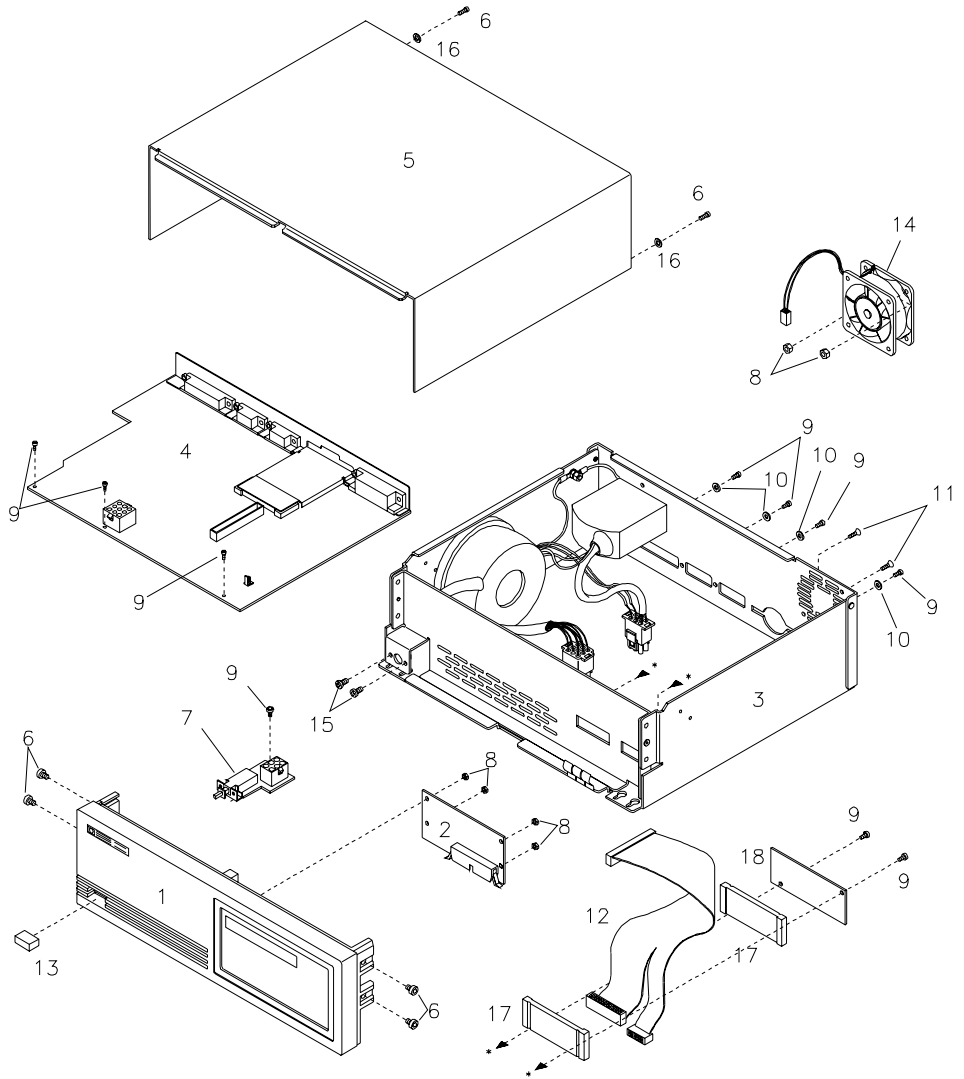
Use the section “[Parts Identification](#)” on page 165 to identify parts and find part numbers.

The section “[Changing Parts](#)” on page 167 gives some replacement procedures. Only those replacement procedures are given which require a specific knowledge. These are:

- Changing temperature controller board.
- Changing inner cabinet assembly.
- Changing cell holder cable.



## 13 Identifying and Replacing Parts



**Figure 23** Overall Diagram of the Temperature Control Unit

## Parts Identification

The parts in the following table are shown in “[Overall Diagram of the Temperature Control Unit](#)” on page 164. Assemblies shown do not contain any parts shown around them, for example, screws or lower level subassemblies.

**Table 27** Temperature Control Unit

Item	Description	Agilent Technologies Part Number
1	Front panel assembly	89090-60201
2	Display assembly	89090-66501
3	Inner cabinet assembly	
4	Temperature controller board	89090-69500
5	Top cover	
6	Screw M4, 6 mm long	0515-0898
7	Power switch assembly	
8	Nut M3	0535-0025
9	Screw M3, 6 mm long	0515-0886
10	Lock washer for M3	2190-0411
11	Screw M3, 8 mm long	0515-1430
12	Front panel cable	5062-2412
13	Pushbutton	5041-1203
14	Fan assembly	
15	Tapping screw M4, 20 mm long	
16	Lock washer for M4	2190-0409
17	Ferrite bar	9170-1392
18	Metal bar	

## 13 Identifying and Replacing Parts

### Parts Identification

**Table 27** Temperature Control Unit (continued)

<b>Item</b>	<b>Description</b>	<b>Agilent Technologies Part Number</b>
	Fuse T1000 mA	2110-0007
	Fuse T500 mA	2110-0202
	Fuse 500 mA	2110-0012
	Fuse 3.0 A	2110-0003

The parts in the following table are shown in figures in previous chapters in these handbooks:

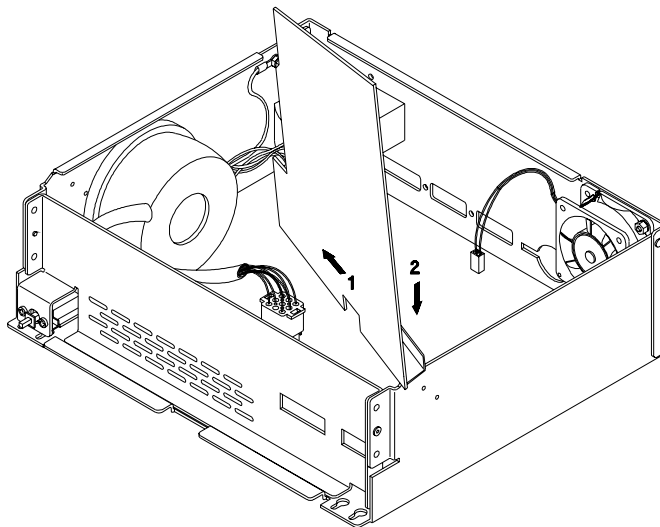
**Table 28** External Devices

<b>Description</b>	<b>Agilent Technologies Part Number</b>
External temperature sensor	89090-82100
Cell holder	
Cover, cell holder	89090-45203
Stainless-steel cover	
Lever	89054-40001
Cable, cell holder	89090-61601
Adapter, Cell Holder (KEL-F)	5021-1870
Stirring bar	9301-1161

## Changing Parts

### Changing Temperature Controller Board

- 1 To remove the top cover, refer to section "Changing Fuses" in *Installing and Maintaining Your Temperature Controller*.
- 2 Remove all eight screws that fix the temperature controller board to the ground plate and to the rear panel of the inner cabinet.
- 3 Remove the board, pulling it towards the front panel and lifting the front left corner up.
- 4 To replace the board, place it in the inner cabinet as shown in [Figure 24](#). Move it in the direction, indicated by arrow 1, and then move it in the direction indicated by arrow 2.

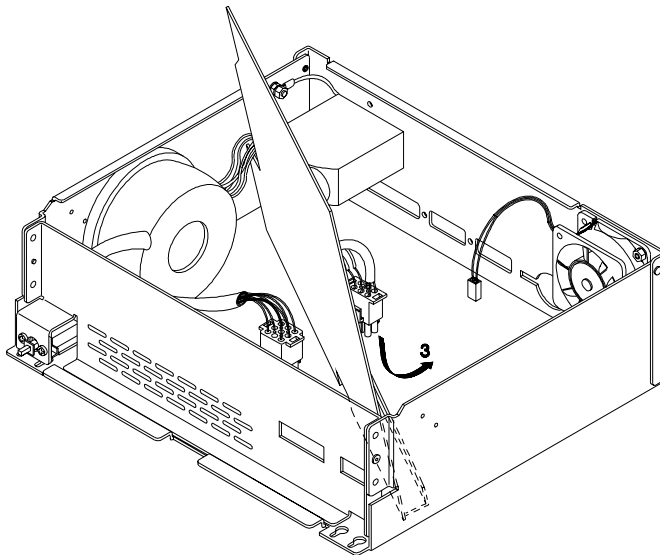


**Figure 24** Positioning Temperature Controller Board

## 13 Identifying and Replacing Parts

### Changing Parts

- 5 Move the board in the direction, indicated by arrow 3 in [Figure 25](#).



**Figure 25** Replacing Temperature Controller Board

- 6 Replace and tighten screws at rear panel and at ground plate.
- 7 To replace the top cover, refer to section [“Changing Fuse”](#) on page 37.

## Changing Inner Cabinet Assembly

The transformer and line-power socket are part of the inner cabinet assembly. To change the inner cabinet assembly you have to remove the following items:

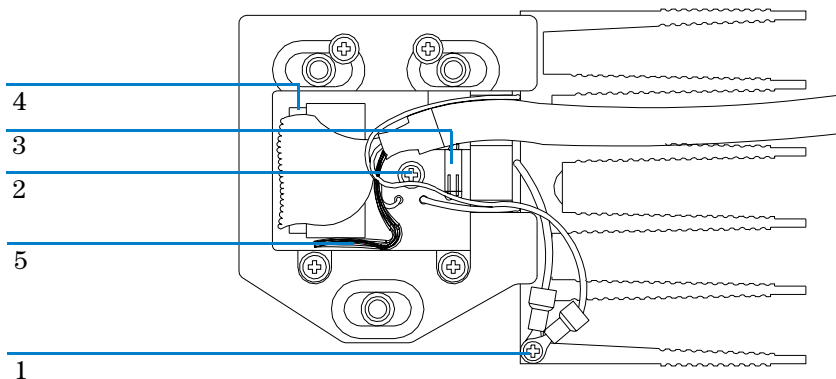
- ✓ Power switch
- ✓ Temperature controller board
- ✓ Fan assembly



## Changing Cell Holder Cable

Item numbers in the following procedure refer to [Figure 26](#) only.

- 1 Remove the three screws from underneath the ground plate of the cell holder and take the ground plate off.
- 2 Remove screws 1 and 2.



**Figure 26** Changing Cell Holder Cable

- 3 Remove connector 3.
- 4 Carefully lift printed-circuit board up at the side where connector 4 is located. It may be difficult to lift the board up because the magnetic stirrer underneath is sometimes fixed by the seal.
- 5 Remove connector 4 of the cell holder cable.
- 6 To replace the cell holder cable, put connector 4 in place.
- 7 Push printed-circuit board back into place and tighten screw 2.
- 8 Replace connector 3.
- 9 Fix the two cables on the heat sink with screw 1.
- 10 Place the spare wires 5 of the cell holder cable in the gap between connector and housing.
- 11 Replace the ground plate of the cell holder and tighten the three screws.

## **13 Identifying and Replacing Parts**

### **Changing Parts**



## **A** **Safety Information**

Safety Information [172](#)

Radio Interference [176](#)

Agilent Technologies on Internet [177](#)



## Safety Information

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

### General

This is a Safety Class I instrument (provided with terminal for protective earthing) and has been manufactured and tested according to international safety standards.

### Operation

Before applying power, comply with the installation section. Additionally the following must be observed.

Do not remove instrument covers when operating. Before the instrument is switched on, all protective earth terminals, extension cords, auto-transformers, and devices connected to it must be connected to a protective earth via a ground socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in serious personal injury. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any intended operation.

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, and so on) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

Some adjustments described in the manual, are made with power supplied to the instrument, and protective covers removed. Energy available at many points may, if contacted, result in personal injury.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible. When inevitable, this should be carried out by a skilled person who is aware of the hazard involved. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present. Do not replace components with power cable connected.





Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Do not install substitute parts or make any unauthorized modification to the instrument.

Capacitors inside the instrument may still be charged, even though the instrument has been disconnected from its source of supply. Dangerous voltages, capable of causing serious personal injury, are present in this instrument. Use extreme caution when handling, testing and adjusting.

## Safety Symbols

**Table 29** Safety Symbols used on Instruments and in Manuals

Symbol	Description
	The apparatus is marked with this symbol when the user should refer to the instruction manual in order to protect the apparatus against damage.
	Indicates dangerous voltages.
	Indicates a protected ground terminal.
	Eye damage may result from directly viewing light produced by deuterium lamps used in detectors and spectrophotometers. Always turn off the deuterium lamp before opening the lamp door on the instrument.

**WARNING**

The **WARNING** sign denotes a hazard. It calls attention to a procedure, practice or the like, which, if not correctly done or adhered to, could result in injury or loss of life. Do not proceed beyond a warning sign until the indicated conditions are fully understood and met.

---

**WARNUNG**

Das **WARNUNG** Zeichen weist auf eine Gefahr für den Menschen hin. Wenn die Anweisungen und Verfahrensweisen oder ähnliches nicht befolgt und korrekt ausgeführt werden, könnte das eine erhebliche Verletzungsgefahr oder Lebensgefahr zur Folge haben. Solange die neben dem Warnungzeichen angegebenen Anweisungen nicht vollständig verstanden und ausgeführt sind, sollten keine weiteren Schritte unternommen werden.

---

**CUIDADO**

El signo de **CUIDADO** denota un riesgo. Remite a un procedimiento o práctica que de no ser llevada a cabo correctamente, podría resultar en un daño o pérdida de vida. No continúe cuando exista un signo de cuidado hasta que las condiciones indicadas hayan sido completamente entendidas y satisfechas.

---

**ATTENTION**

Le signe **ATTENTION** dénote un risque. Il appelle une précaution quant à une procédure ou une pratique qui, si elle n'est pas correctement suivie, peut résulter en une blessure ou même en un risque pour la vie. S'assurer d'avoir rempli toutes les conditions indiquées avant de continuer.

---

**ATTENZIONE**

La scritta **ATTENZIONE** indica un pericolo. Essa richiama l'attenzione su una situazione che può portare a danni anche gravi per le persone. Non proseguire oltre tale indicazione senza aver ben compreso il rischio ed aver seguito le istruzioni per evitarlo.

---

**WAARSCHUWING**

Het teken **WAARSCHUWING** wijst op gevaar. Indien de aanwijzingen, procedures etc. niet opgevolgd en korrekt uitgevoerd worden, kan dat een aanzienlijk risico en zelfs levensgevaar met zich mee brengen. Zolang de naast het waarschuwingsteken aangegeven aanwijzingen niet volledig begrepen en opgevolgd zijn, dienen geen verdere stappen ondernomen te worden.

---

### CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice or the like, which, if not correctly done or adhered to, could result in damage to or destruction of part or all of the equipment. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.

---

### ACHTUNG

Das ACHTUNG-Zeichen weist auf eine mögliche Beschädigung der Geräte hin. Wenn Anweisungen und Verfahrensweisen oder ähnliches nicht befolgt und korrekt ausgeführt werden, könnte das eine Beschädigung oder Zerstörung eines Teils oder des gesamten Gerätes zur Folge haben. Solange die neben dem Achtungzeichen angegebenen Anweisungen nicht vollständig verstanden und ausgeführt sind, sollten keine weiteren Schritte unternommen werden.

---

### PRECAUCION

El signo de PRECAUCION denota un riesgo. Remite a un procedimiento o práctica que de no ser llevada a cabo correctamente podría resultar en un daño o destrucción parcial o total del equipo. No continúe cuando exista un signo de precaución hasta que las condiciones indicadas hayan sido completamente entendidas y satisfechas.

---

### AVERTISSEMENT

Le signe AVERTISSEMENT dénote un risque. Il appelle une précaution quant à une procédure ou une pratique qui, si elle n'est pas correctement suivie, peut résulter en un dommage ou même une destruction du matériel. S'assurer d'avoir rempli toutes les conditions indiquées avant de continuer.

---

### PRECAUZIONE

La scritta PRECAUZIONE indica un pericolo. Essa richiama l'attenzione su una situazione che può portare a danni anche permanenti allo strumento. Non proseguire oltre tale indicazione senza aver ben compreso il rischio ed aver seguito le istruzioni per evitarlo.

---

### VOORZICHTIG

Het teken VOORZICHTIG wijst op gevaar voor een mogelijke beschadiging van de instrumentatie. Het vraagt de aandacht voor een praktijk, werkwijze etc. welke, indien niet opgevolgd en korrekt uitgevoerd, kan leiden tot beschadiging of vernieling van de apparatuur of een deel ervan. Zolang de naast het teken voorzichtig aangegeven aanwijzingen niet volledig begrepen en opgevolgd zijn, dienen geen verdere stappen ondernomen te worden.

---

## Radio Interference

### Manufacturer's Declaration

This is to certify that this equipment is in accordance with the Radio Interference Requirements of Directive FTZ 1046/1984. The German Bundespost was notified that this equipment was put into circulation, the right to check the series for compliance with the requirements was granted.

#### Test and Measurement

If test and measurement equipment is operated with equipment unshielded cables and/or used for measurements on open set-ups, the user has to assure that under operating conditions the radio interference limits are still met within the premises.

### Herstellerbescheinigung

Hiermit wird bescheinigt dass dieses Gerät/System in Übereinstimmung mit den Bestimmungen von Postverfügung 1046/84 funkentstört ist. Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes/Systems angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

#### Test- und Messgeräte

Werden Mess- und Testgeräte mit ungeschirmten Kabeln und/oder in offenen Messaufbauten verwendet, so ist vom Betreiber sicherzustellen, dass die Funk-Entstörbestimmungen unter Betriebsbedingungen an seiner Grundstücksgrenze eingehalten werden.



## Agilent Technologies on Internet

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<http://www.agilent.com/chem>

**A Safety Information**  
Agilent Technologies on Internet

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## In This Book

This book provides information on how to install the Temperature Control Accessory for Agilent 8453 UV-visible Spectrophotometer on both a Cerity NDS Professional system (stand-alone) and client/server installation.

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