C330
Temperature Controller

Table of Contents

1   Introduction

THE C300 is designed for control of remotely located heating elements and circulation pumps, for example the LQ300 calibration bath series from ASL.

THE C300 can provide the most stable, accurate and reliable temperature control only if the heating element and the Pt-100 sensor are located at its optimum position.

THE C300 has a temperature range from -90° C to +300° C.
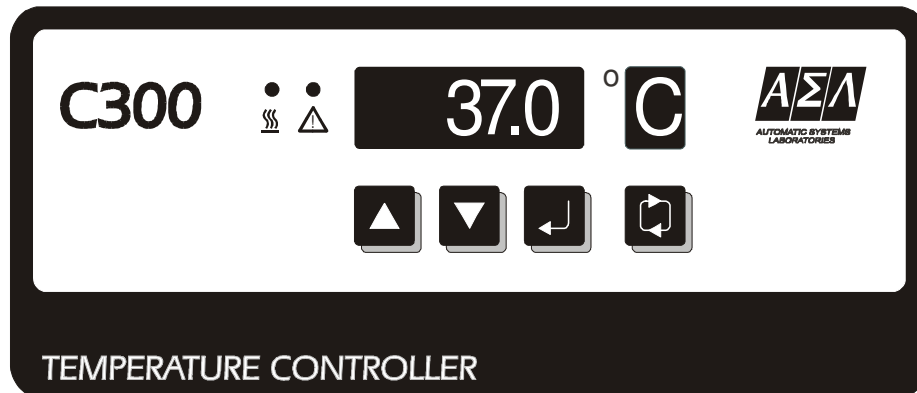
2   Safety system

Since the C300 is intended for continuous unattended operation it is equipped with inputs for external alarm signals including sensor detecting low liquid level or pump stop excess temperature in the bath protection temperature sensor break down or short-circuit. In case of an alarm signal, a relay will open, stopping the pump and the heating power. This will also trigger a visual- and an audio alarm.

The C300 is electrically protected with fuses. The safety system is designed according to "Safety requirements for electric equipment, control and laboratory use (EN 61010-1)", which assumes that two separate faults do not occur simultaneously.

It is therefore important that the value for excess temperature protection is set correctly otherwise a fault is introduced rendering no protection against any other fault (See section 6.8).

WARNING FIRE HAZARD
Operating the bath with flammable fluids at temperatures above their respective flash point constitutes a fire hazard. Fluids with flash points below the ambient temperature are particularly hazardous.

NOTE
Do not set the excess temperature alarm higher than 5°C below the flash point of the liquid being used. See section 3.

3   Recommended fluids

LIQUID	Minimum Temperatures	Maximum Temperatures	Flash point temperature	Max. Cut out Temperatures
LIQ-L (Ethanol)	-80°C	-14°C	+11°C	+6°C
Water	+2°C	+90°C	Not Applicable	+90°C
LIQ-M (Glycol fluid)	+90°C	+150°C	+237°C	+180°C
LIQ-M (Silicone oil)	+150°C	+250°C	+280°C	+250°C
LIQ-VH (Silicone oil)	+90°C	+300°C	+315°C	+300°C

EN 61010 demands that the operating temperature must be at least 25°C below the flash point of the liquid used.
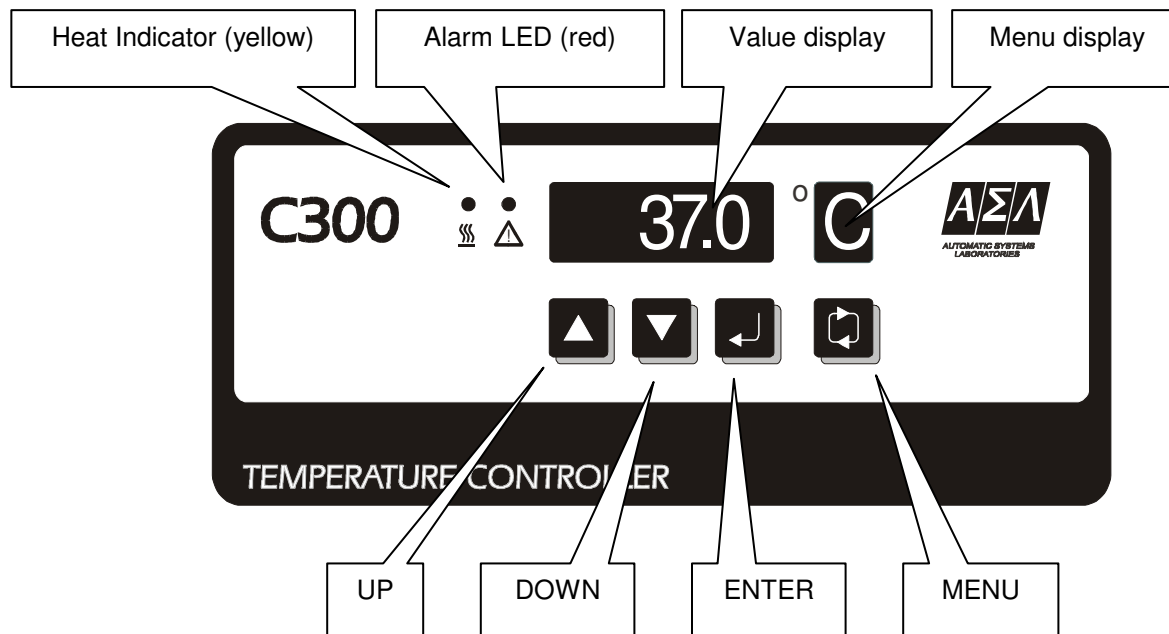
NOTE
ASL recommends that liquids with a flash point below the ambient temperature is stored and handled refrigerated.
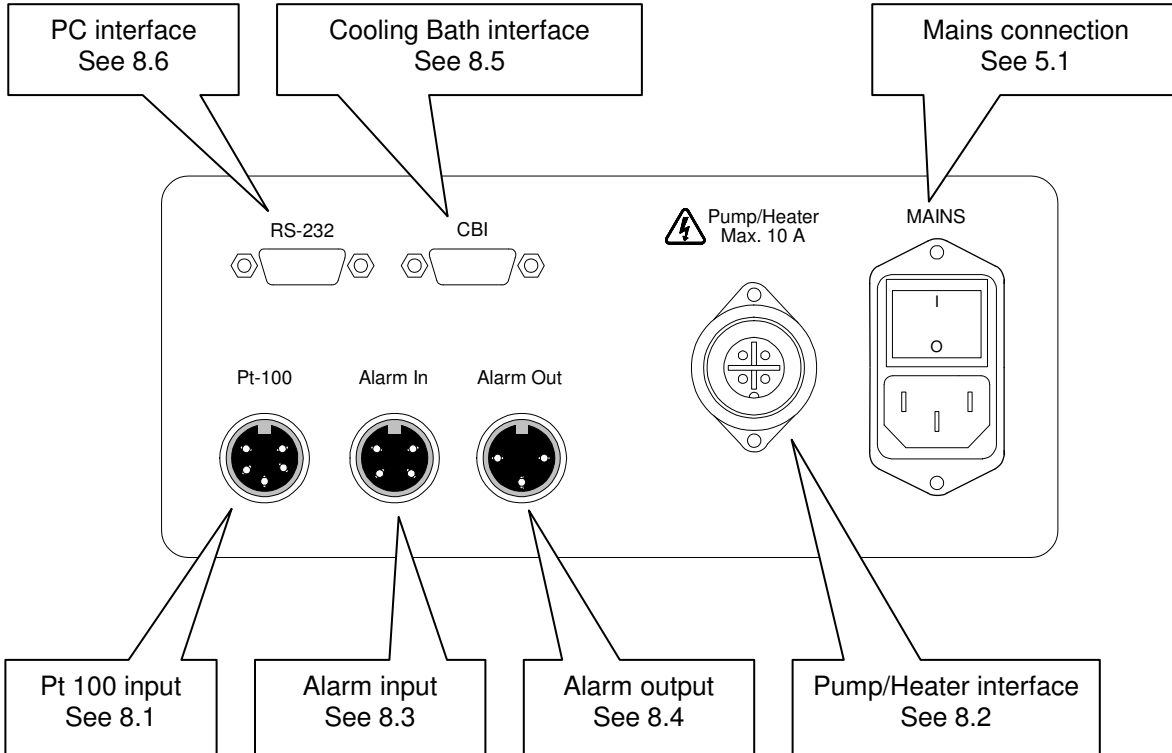
NOTE
The volume of bath oils will increase due to thermal expansion when the bath temperature rises. Avoid overflow by opening the overflow valve on the bath (if fitted).

4   Overview of controls

4.1   Front panel

4.2   Rear Panel

| PC interface See 8.6 | | Cooling Bath interface See 8.5 | | | Mains connection See 5.1 |

RS-232   CBI   ⚠ Pump/Heater Max. 10 A   MAINS

Pt-100   Alarm In   Alarm Out

| Pt 100 input See 8.1 | Alarm input See 8.3 | Alarm output See 8.4 | Pump/Heater interface See 8.2 |

5   Installation

5.1   Connection of the unit

⚠ WARNING
Do not connect the supply voltage until the specifications on the rear panel label have been checked and are correct.

Care should be taken not to limit access to the supply ON/OFF switch.

- Place the pump and heating unit in the bath.

- Connect the power cable from the pump/heater unit, the alarm cable and the Pt-100 sensor to the controller.

- Connect the controller to the mains.

- Position the controller away from fumes and vapours.

- The display angle may be adjusted by unfolding the front legs.

5.2   Filling

- Fill the bath with a suitable fluid. For details refer to the instruction manual for the bath.

6   Operation

6.1   Preparations

Adjust the temperature protection device located on the pump unit. It must not be set higher than 5°C below the flash point of the liquid being used (See section 3).

The excess temperature protection is independent of the control circuit.

If the temperature in the bath has reached the safety temperature, a complete shut down of the heater and pump will occur and the display will show

$$AL - E$$
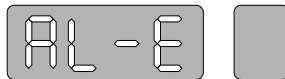
6.2   Start Up

Switch on the controller by pressing the supply button at the back of the unit ON.
After a display test the unit will display the current software version (for example 2.2) and the pump will start.

The controller indicates the actual temperature in the bath and if the value is below the Set temperature the heating element will be switched on - indicated by $\underset{\approx}{SSS}$.

6.3   Setting operation parameters

The controller is operated using the four keys

▲   increase the display value,

▼   decrease the display value,

↵   confirms the selection

⟳   menu/toggle.

Toggling ⟳ give access to the following menu items in the menu display

S   set temperature

H   high temperature alarm

L   low temperature alarm
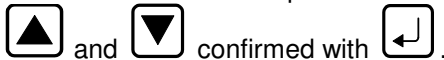
   correction factor

   proportional band

   option/communication

Change of operating temperature, temperature alarms, correction factor and proportional band may be carried out when the respective item is flashing in the menu display. The value may be altered by use of ▲ and ▼ confirmed with ↵.

6.4   Setting the operating temperature

Press 🔲 until '**S**' (= **Set temperature**) starts flashing in the menu display.

Alter the Set temperature value indicated in the value display using ▲ and ▼. If the key is held depressed the value will be altered slowly. After a while the alteration will speed up.

Press ↵ to confirm the new Set temperature value. The '**S**' will stop flashing indicating the new value has been saved.

By pressing ↵ again the unit will return to indicate actual temperature or if 🔲 is pressed the next menu point will be displayed.
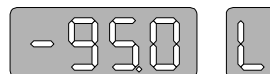
☞   NOTE
        If the Set temperature value is below the low temperature alarm or above the high
        temperature alarm, you will automatically be prompted to enter a new value for
        the alarm setting.

The display automatically returns to indicate the actual temperature after approximately 20 seconds. If the value hasn't been confirmed by then - the old value will be used.

6.5   High alarm/Low alarm

To protect samples it is possible to set high and low temperature alarms. This feature must not be confused with the independent excess temperature protection. The default values for the high and low

temperature alarm is 305.0°C and -95.0°C respectively and they are displayed by toggling 🔲.

Use ▲, ▼ and ↵ to change and store new values for the temperature alarms. The temperature high alarm cannot be set lower than 2°C above the Set temperature and the low alarm cannot be set higher than 2°C below the Set temperature. The alarms are not enabled until the actual bath temperature has reached the Set temperature.

6.6   Correction factor

The correction factor serves to compensate for the temperature difference that may occur between the sensor for regulation and a defined measuring point in the bath. This difference in temperature is closely related to the physical properties of the system (volume, type of fluid and insulation of the tank) and is also dependent on the Set temperature and ambient temperature. It is possible to get coherence between the displayed temperature and the calibration temperature by storing a correction factor at specific conditions.

Toggle ⟳ until the display indicates a flashing 'c'.

    0.00   c

Use ▲, ▼ and ↵ to change and store the correction factor.

Allow time for the system to stabilize with the new correction factor before any further adjustment (important).

☞   NOTE
A dot in the menu display indicates a correction factor different from zero when the controller returns to indicate the actual temperature.

The value will be saved when the unit is turned off. If the correction value is different from zero when the controller is turned on, the value will be displayed for approx. 20 seconds allowing the user to change or accept the current value.

6.7   Proportional band

In a controller such as the C300 the heater output is proportional to the deviation from the set temperature over a limited range around the set temperature. This temperature range is called the proportional band.
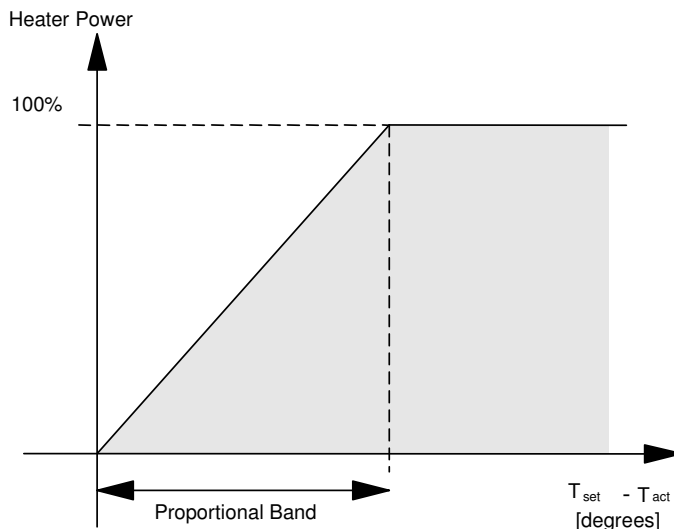
The width of the proportional band may be set to discrete values in degrees with a 0.1° resolution. Press ⟳ until '**P**' starts flashing in the menu display.

```
    0.5   P
```

Use △, ▽ and ↵ to change and store new values for the proportional band.

Changing the proportional band enables the user to fine-tune the controller to the thermal properties of the bath. A higher value will decrease the amplification in the control loop at the expense of a slower reacting system. If the band is too wide the temperature will tend to deviate excessively from the Set temperature due to varying external conditions. This is because the power output changes very little with temperature and the controller cannot respond very well to changing conditions or noise in the system. If the proportional band is too narrow (low value) the system will start oscillating, because the controller overreacts to temperature variations.

The optimal proportional bandwidth depends on several factors including system heat transfer characteristics, Set temperature and heater/sensor positioning. Thus the proportional bandwidth may require adjustment for best bath stability when any of these conditions change.

With water as liquid, set temperature above 40°C and use of KB-calibration baths the recommended setting is 0.6 to 0.8.

In the temperature range from -20°C to $+40^{o}$C it may be advantageous to decrease the value to 0.4 to 0.5 due to the increased efficiency of the cooling unit.

The values above is calculated using a 400 W heating element. If the heating capacity is increased the proportional band should be increased with the same amount.

(e.g. Water, Tset > 40°C, 1200 W heating power $\Rightarrow$ P = 1.8 to 2.4)

Temperature

Set temperature

Proportional band too narrow   Time
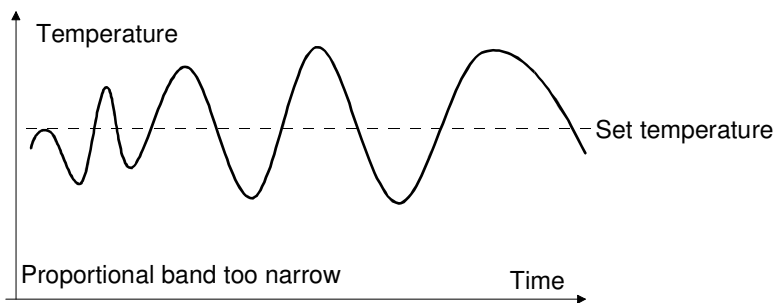
The default setting is 0.5. The value will be saved when the unit is turned off.

The optimum proportional bandwidth setting may be determined by monitoring the stability with a high-resolution thermometer. Narrow the proportional bandwidth to the point at which the process temperature begins to oscillate and then increase the bandwidth from this point.

The integral time of the controller is factory set to approximately 100 seconds and cannot be changed by the user.

☞   NOTE
Optimum stability is achieved by:

- The calibration bath must be exposed to constant temperature ($\pm\,2°C$)
- Liquid type and amount must be correct
- The calibration bath temperature must be stable for at least 1 hour prior to use
- Always use a calibrated reference instrument e.g. ASL F250 precision thermometer.

6.8   Option

To enable the communication (see section 8.6) the (**o**)ption point on the menu must be '**on**'. Scroll

through the menu using the [⟳] until '**o**' starts flashing on the menu display. Press the [▲] to enable

the communication and press the [↵] to confirm. The communication can be disabled by pressing [▼]

and then confirmed by the [↵]. The default setting is '**oFF**'.

oFF   [o]   Communication disabled.

on   [o]   Communication enabled.
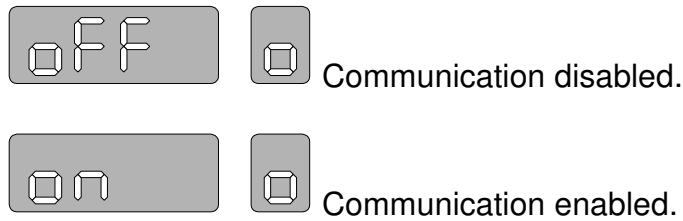
6.9   Excess temperature protection

Adjust the temperature protection device located on the pump unit. It must not be set higher than 5°C below the flash point of the liquid being used. (See section 3).

The excess temperature protection is independent of the control circuit.

6.10   Default Values (minimum/maximum values)

☞   NOTE

Pressing [↵] and the [⟳] simultaneously while switching the unit on will restore the default values.

Temperature

Set temperature

Proportional band too wide   Time
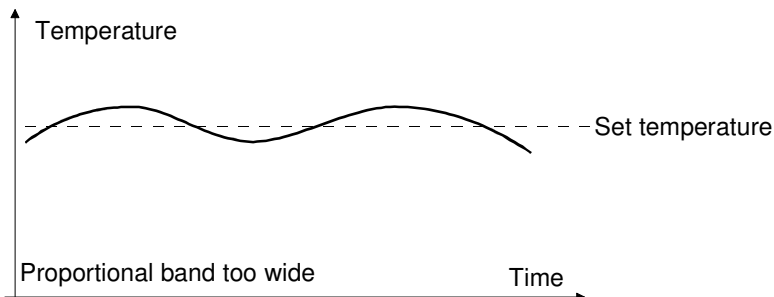
	Min. value	Max. value	Default value
Set temperature	-90.0	300.0	5.0
Alarm High	T_{set} +2.0	305.0	305.0

Alarm Low	-95.0	T_{set} -2.0	-95.0
Correction	-5.00	5.00	0.00
Proportional band	0.00	10.00	0.5
Option	Off	On	Off

6.11   Heat Indicator

The heat indicator $\underset{\smile\smile\smile}{555}$ is lit when the heating element is on.

Constantly on   The controller is heating with full power.

Flashing   The temperature is at the Set temperature and the controller will keep it there.

Constantly off   No heating, the actual bath temperature is above the Set temperature.

7   Alarms and Errors

7.1   Safety system

If the safety system is triggered

- The red alarm LED will flash

- The external alarm output will be activated

- The display will indicate the type of fault

- The audible alarm will sound

- The pump and heating element are switched off

The safety circuit turns the unit into a stable, safe condition.

The alarm may be activated by:

$\boxed{AL-H}$ $\square$ *- Bath temperature higher than high alarm temperature.*

$\boxed{AL-L}$ $\square$ *- Bath temperature lower than low alarm temperature.*

$\boxed{SEnS}$ $\square$ *- The Pt-100 sensor short-circuited or disconnected.*
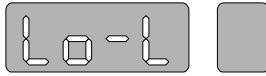
$\boxed{Lo-L}$ ☐ *- Liquid sensor (if fitted) indicating lack of liquid.*
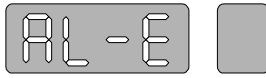
$\boxed{AL-E}$ ☐   *- Bath temperature higher than excess temperature setting.*

The pump motor is fitted with a temperature safety cutout, which switches the motor off when it is overheated.

7.2   Switch off the alarm

After the cause of the fault has been eliminated the controller may be started again by turning the unit off

and then on. It might be necessary to press ⏎ and ⟳ simultaneously while the unit is switched on to recall the default values.

7.3   Error
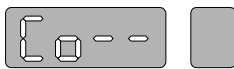
$\boxed{Co--}$ ☐   *- Communication error (RS-232).*

After the alarm message has been displayed for approx. 20 seconds, the controller will return to display the actual temperature. Secondary alarms will not activate the external alarm output.

8   Interface

8.1   Pt 100 input

The C300 is set up to use a 100Ω platinum RTD sensor (Pt 100).

The 4-wire connection makes the measurement insensible to cable length and contact resistance.

(5) I-   (1) I+

(4) V-   (2) V+

Pt-100 sensor
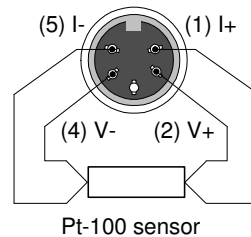
8.2   Pump/Heater interface

The combined current of pump and heater must not exceed 10 amperes.

Pin	Description
1	Pump (Live)
2	Heater (Live)
3	Common (Neutral)
⏚	Protective Earth

(1)   ⏚

(2)   (3)
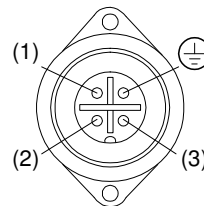
8.3   Alarm input

The alarm contact is closed during normal conditions.

For connection of the optional level switch please contact ASL.

Excess
Temperature
Protection

(4)   (1)

(3)   (2)

Optional
Level Switch
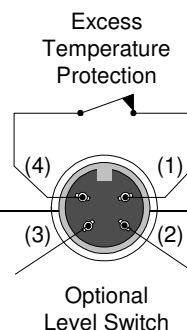
8.4   Alarm output

The controller is equipped with a 3-pole DIN socket on
the rear panel for connection of an external alarm circuit.

CONDITION	1 – 2	2 – 3
Normal	Closed	Open
Alarm	Open	Closed
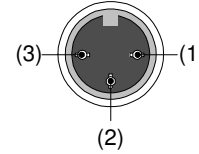
External alarm

Specification:

DESCRIPTION	C300
Maximum Switching Power	20 W
Maximum Switching Voltage	24 V
Maximum Switching Current	1 A

8.5   Cooling Bath Interface (CBI)

C300 is equipped with an interface for control of ASL cooling baths. Further details may be found in the
respective instruction manual for the bath. The main purpose of this interaction between bath and
controller is to obtain better temperature stability and eliminate unnecessary energy waste by
automatically terminating cooling power when not required.

8.6   PC interface

The C300 controller is equipped with an RS 232 C interface port for remote control of the unit. Using a PC
it is possible to log processed data and/or control and change parameters (Set temperatures, alarm points
etc.).

☞   NOTE
        To enable the communication the (**o**)ption value must be on (See section 6.8).

Cable

The unit must be connected to the PC with a "null-modem" cable

Communication parameters
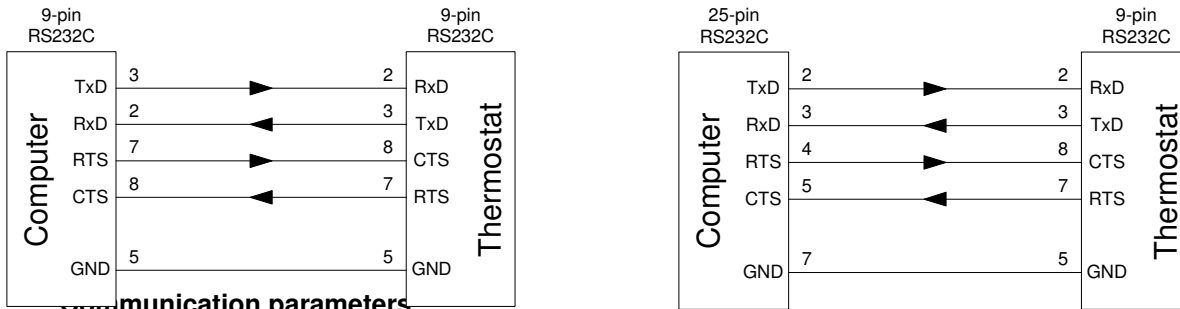
Set the communication port on the PC with following parameters

PARAMETER	VALUE
Baud-rate	9600
Data bits	8
Stop bits	1

Parity	No
Handshake	RTS/CTS

8.6.1   Commands

The following functions can be controlled via the RS232C-interface

Command	Description	Format
T	Return Actual Temperature	T↵
SET	Return Set Temperature	SET↵
SET=	Change Set Temperature	SET=<value>↵
ALH	Return High Alarm Temperature	ALH↵
ALH=	Change High Alarm Temperature	ALH=<value>
ALL	Return Low Alarm Temperature	ALL↵
ALL=	Change Low Alarm Temperature	ALL=<value>
COR	Return Correction Factor	COR↵
COR=	Change Correction Factor	COR=<value>↵
PRO	Return Proportional Band	PRO↵
PRO=	Change Proportional Band	PRO=<value>↵
VER	Return Current Software Version	VER
MDE	Operation Mode	MDE=<value>↵

All letters must be typed in upper case and the values must be within the allowed ranges (see 6.10). Decimal delimiter is '.' Every string is terminated with Carriage Return ↵.

Example

Command sent from PC   **SET=24.0↵**

String returned from unit   **SET=: 24.00 S↵**

☞   NOTE
          The letter normally displayed on the menu display will be added at the end of the returned string.

If the value is outside the allowed range, the following message will be returned:

?2: OUT OF RANGE↵

If a command is not on the list above or is miss-spelled, the unit will return:

?1: NO COMMAND↵

☞   NOTE
          Due to the extensive error checking, at least 10 seconds must pass between sent commands.

Modes of operation

The MDE command allows the user to bring the controller in the following modes:

Command	Description	Function	
MDE= S	STAND BY	HEATER, STIRRER & COOLING = OFF	Note 1
MDE= R	REMOTE ONLY	KEYBOARD LOCK	Note 2
MDE= N	NORMAL	NORMAL OPERATION	

Note 1 C300 will remain in stand-by mode unless the power is interrupted. Normal operation is resumed by sending MDE= N, alternatively recalling the default-values.

Note 2 Operation mode REMOTE ONLY will not remain if the power is interrupted.

Alarms

In case of an alarm one of the following messages will be continuously sent from unit:

!1: SENSORFAULT   Sensor unserviceable or disconnected

!2: HIGH ALARM   Actual temperature above High temperature alarm setting

!3: LOW ALARM   Actual temperature below Low temperature alarm setting

!4: EXCESS TEMP   Actual temperature above Excess temperature protection setting

!5: LOW LEVEL   Float switch activated

Testing

The communication interface may be tested with the terminal programs provided with the Microsoft Windows™ package Terminal on Windows 3.1x™ or HyperTerminal on Windows 95™, Windows 98™ and NT 4.0™.

9   Specification

9.1   General

DESCRIPTION	C300
Depth x Width x Height	190 x 205 x 105 mm
Weight	1,5 kg
Required power supply	230/50 V/Hz
Power consumption	maximum 2000 W
Ambient temperature	5 - 40°C
Ambient relative humidity	maximum 80%
Protection Class	IP 20

9.2   Operating parameters

DESCRIPTION	C300
Set temperature range	-90 to + 300°C
Temperature stability over 15 min.*	$<\pm$ 0.01°C
Resolution	0.1°C
Set temperature accuracy	$\pm$ 0.5°C
Control mode	PID
Heat capacity (@ 230 V)	Maximum 2000 W

* Conditions
Liquid: Water   Ambient temperature: 23°C ±2°

10   Cleaning and Maintenance

10.1   Cleaning

Make sure the Model C300 is turned off and unplug the mains supply cable.

Clean the outside of the instrument with a soft, clean cloth dampened with mild detergent.   Do not allow water to enter the instrument.

WARNING   Never use alcohol or thinners as these will damage the instrument.

Never use a hard or abrasive brush.

10.2   Preventive Maintenance

WARNING   Regular inspection of the mains supply cable is required to ensure that

the insulation is not damaged.

10.3   General safety Warning

WARNING   If the Model C300 is used in a manner not specified by ASL, then the

protection provided by the instrument may be impaired.

If the heating element on the pump-unit is covered with calcareous deposits, immerse the element in acetic acid (10%) and leave it in there for 6 to 12 hours.

10.4   Trouble-shooting

PROBLEM	POSSIBLE CAUSE	SOLUTION
The system will not run.	The controller is not connected to the mains or there is no voltage on the socket.	Connect the controller to the mains and/or check by using another electrical instrument that there is power on the socket.
The controller gives alarm when turned on.	The actual temperature in the bath is above or below the alarm settings on the controller. The liquid level is too low. The Pt-100 sensor or part of the control system may be damaged.	See section 5 Alarms and Errors. It may be necessary to restore the default values. (See section 6.10) Refill the bath. Contact ASL for information on service and repair.
The controller doesn't control the temperature.	The temperature setting is out of the operational range. Either the Set temperature is below the lowest possible temperature of the liquid or above the boiling point of the liquid being used.	Adjust the controller to a Set temperature within the operational range. If the above mentioned is not sufficient the control circuits of the heating element may be damaged. Contact ASL for information on service and repair.

11 Service and Warranty

C300 and accessories, (unless stated otherwise), are covered by a 12 month warranty for parts and labor, but not including costs incurred in returning it to the factory for repair, from the date of dispatch from Automatic Systems Laboratories.

11.1   Technical Support

For all technical support, repair, warranty and service inquiries please contact:

Isotech North America
154 Brentwood Drive, Unit 3
Colchester, VT 05446

Phone: 802-863-8050
Fax: 802-863-8125

sales@isotechna.com
www.isotechna.com

11.2   Returned Instruments

All returned goods should be sent carriage paid, insured and packed well, to the above address.

11.3   Documentation

The shipment should include:

11.3.1.1   Your goods return note, a delivery note or an export invoice stating clearly GOODS RETURNED FOR REPAIR.

11.3.1.2   Your Company / Establishment order or contract reference number.

11.3.1.3   The name of your purchasing and technical contact.

11.3.1.4   A brief fault report.

11.4   Repair Quotations

We shall be pleased to advise estimated repair costs upon receipt and initial inspection of returned goods.

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NOTES