Operating Manual

LR-*Cal* BK40-M & LR-*Cal* BK40-M-2I

Cryostatic Temperature Calibration Bath

WARNING

Hazardous voltage are present in this electrical equipment during operation.
Non-observance of the safety instruction can result in severe personal injury or property damage.
Only qualified personnel should work on or around this equipment after becoming familiar with all warnings, safety notices, and maintenance procedures contained herein.
Only qualified personnel or our personnel should work on this equipment for maintenance operation.
The successful and safe operation of this equipment is dependantdependent on proper handing, installation, operation and maintenance.

Electrical and electronic equipments with this symbol can notcannot be thrown away in public dump sites. According to the EU directive 2002/96/EC, the European users of electrical and electronic equipment have the opportunity to return to the distributor or manufacturer used equipment purchasing a new equipment. The illegal disposal of electrical and electronic equipments is punished by pecuniary administrative sanction.

SYMBOLS BEING USED IN THIS MANUAL OR ON THE INSTRUMENT

CAUTION: HOT SURFACE OR PART

CAUTION: REFER TO ACCOMPANING DOCUMENTS

CAUTIONS: RISK OF ELECTRIC SHOCK

EQUIPOTENTIALITY TERMINAL

CHARACTERISTICS AND/OR INSTRUCTIONS OF: **LR-*Cal* BK40-M-TR**

N.B:
In this manual: where not specified, the numbers in parentheses make reference to the annexed drawing.

INDEX

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1 - INTRODUCTION

1.1 - Purpose and summary of instructions

This manual contains the use and maintenance instructions valid for the following equipment:
Thermostatic bath **LR-*Cal* BK-40M** and derived models.

The instructions reported in this manual, for the above mentioned equipment, are those relevant to:

- Start-up preparation
- Operation description
- Using of the equipment
- Re-calibration procedure
- Preventive maintenance
- Typical faults and ways of their removal

Users must observe all the usual safety rules out in this manual for own security and to avoid equipment failure.

2 - SCOPE OF SUPPLY

2.1 - Name:

- Thermostatic bath **LR-*Cal* BK-40M**, complete of accessories, as listed (see paragraph 2.7).

2.2 - Technical data:

Environmental range: temperature +10÷+35°C, R.H. max. 90%

MODEL	RANGE *	RECOMMENDED LIQUID	STABILITY* 80°C	STABILITY* 0°C	STABILITY* -20°C	ORIZZ. UNIFORMITY* 0°C
BK40M ☞BK40M-TR	-40÷+70°C	Ethylenic glycol mixed with water (56%glycol+44%water)		±0,01	±0,007	±0,02
	-20÷+125°C	Silicon oil 47V20	±0,01	±0,02	±0,02	±0,02
	-40÷+125°C	Silicon oil 200C5	±0,03	±0,04	±0,03	±0,03

MODEL	RECOMMENDED LIQUID	MAX. COOLING GRADIENT*	MAX. HEATING GRADIENT*
BK40M ☞ BK40M-TR	Ethylenic glycol mixed with water (56%glycol+44%water)	0,3÷0,4°C/min.	2,5°C/min. (with cooling off)
	Silicon oil 47V20	0,8°C/min.	4°C/min. (with cooling off)
	Silicon oil 200C5	0,8°C/min.	4°C/min. (with cooling off)

- Resolution : 0,1-0,01°C
- Accuracy : ±0,015°C @0°C
- Switch test : 12Vcc.
- Power supply : 230V, 50Hz.
- Power : 2000VA
- Size : 450x450x1280 height
- Weight : 60 Kg (74Kg with package)
- Reading & regulation probe : PT100 DIN43760
- °C/°F/K readings.
- Input of an external PT100 or Thermocuoples J,K,N,E, R, S.
- RS232.
- Regulation of temperature with PID µcontroller
- Thermostat switch test facility included.
- Temperature ramps : minimum. 0,1°C/1'
- Structure in flanged iron plate with handle
- Tank dimension ø200 mm, 340 mm deep, capacity 10 L.
- Fiberglass superior protection cover.
- Security cover.
- Calibration zone dimension ø100mm, 330mm deep.
- Stainless steel mixer with electric motor power (100VA).
- 1400VA heating resistance.
- Refrigeration system with compressor and fan coil.
- Over temperature safety system thermostat.
- Frontal command panel.
- Recharge cooling group data : 280G of Freon R-404
- Electromagnetic compatibility : Emission EN50081-1
  Immunity EN50082-1

☞ The fluid level adapter slides directly into the test well of the **LR-*Cal* BK40-M-TR** bath is designed to calibrate glass thermometers

NOTE: **The data marked with * has been recorded at an ambient temperature of 20°C±3, power supply 230V±10%, with Pt100 ø4.5mm inserted in the block and with silicone oil 47V100 and 47V50, for a time of 30 minutes. The above-mentioned data keep valid for one year after the issuing of the calibrating certificate; afterwards it is necessary to carry out the oven re-calibration.**

µCONTROLLER DATA

- Display : 2 lines 20ch x linea (3,2x5,5) back lighting.
- µcontroller : 80C552
- A/D converter: Σ-Δ : 24 bits
- Memory : E2PROM per salvataggio parametri.
- Serial communication : RS 232 C

2.3 - Service (function)

The thermostatic bath **LR-*Cal* BK40-M** has been designed for:

- Calibration of indicators, recorders and regulators of temperature.
- Control of sensitive elements: thermocouple, bimetallic strips, RTD sensors.
- Control of thermostatic valve and bulb thermostats.

The thermostatic bath has been designed to reduce the EMC effect in accordance with the harmonised regulation for residential, commercial and light industry.

2.4 - Quantity

- 1piece

2.5 - Constructor

DRUCK & TEMPERATUR Leitenberger GmbH, Germany.

2.6 - N° of correspondent catalogue sheet

- BK40-M

2.7 - List of first equipment accessories

- Models **LR-*Cal* BK40-M**: base version
  LR-*Cal* BK40-M-2I: with double input for Tc and Pt 100
  ☞**...-TR**: version with fluid level adapter
- Standard equipment
  * Protection cover
  * Kit of clamp-screw adapter for bushes(only for version –2I)
  * Thermostat testing connection cables
  * Probe support and plier
  * Instruction manual.
  * Test report
- Accessories by request
  * Ethylenic glycol mixed with water (56%glycol+44%water).
  * 9 Kkg tank of Silicon oil 47V20.
  * 9 kKg tank of Silicon oil 200C5.

Certification: all the instruments are supplied with final testing, stability and accuracy certification traceable to SITACCREDIA standards.

3 - GENERAL RECOMMENDATIONS

➔**ATTENTION:**
The temperature adjuster has been configured in the factory with the parameters that are suitable to obtain performances that go will in the entire LR-*Cal* BK40-M field.
Modification of these parameters could cause malfunctioning or breakage of the equipment with consequent risk of damage to objects or injury to persons.

Notes about the filling of the calibrator:
Before filling the bath, be aware of fundamental things regarding the liquids that can be used:

3.1 - Liquids

The **LR-*Cal* BK40-M** bath is suitable in a field from temperature from -40 up to 125°C, different liquids can be put into the bath but not many can work on the entire calibrator field.
Before using the calibrator check the temperature field of the liquid to be used and always remain under the safety limits. The upper temperature limit is conditioned by vaporisation, smokiness, flammability and chemical deterioration of the liquid. The inferior temperature limit is conditioned by freezing of the liquid. The principal features of a liquid for constant-temperature baths are: the temperature field, viscosity, specific heat, thermal conductivity, the thermal expansion, the dielectric resistivity, life span, safety, etc.

3.1.1 - Recommended temperature field

The recommended temperature field of the principal liquids which can be used with the **LR-*Cal* BK40-M** is shown in the table. It depends principally on the equipment in which it is used. Normally the temperature field of a liquid is greater than the one shown in the table but out of these values some features of the liquid can jeopardise functioning inside the **LR-*Cal* BK40-M**.

LIQUID TYPES	RECOMMANDED USAGE FILED*	FUME BURNING POINT**	EQUIVALENT TEMPERATURE FOR 10cst VISCOSITY ***	FREEZING TEMPERATURE****
Water	10÷80°C	//	//	0°C
56% Glycol + 44% water	-40÷90 (70°C)	>110°C	20°C	-43°C
Silicon oil 200C5	-40÷125 (110°C)	136°C	5°C	-65°C
Silicon oil 47V20	-20÷125 °C(130°C)	230°C	60°C	-60°C

NOTES:
* The recommended temperature range is the most suitable for the bath, it is not the most suitable for the liquid. The value in brackets indicates the temperature above which it would be appropriate to use a fume extractor.
** temperature value on which steam triggers off in the presence of free flames
*** temperature value below which the thermostatic performance is no longer excellent. The viscosity value tends to decrease as temperature increases. The equivalent water value at 23°C is 1 cst.
****temperature value below which the liquid changes its state and solidifies.

3.1.2 - Viscosity

Viscosity is the property of fluids that indicates its resistance to mixing and it depends on the type of fluid and the temperature.
The more viscous the fluid, the more difficult the mixing of the fluid and consequently the distribution of a uniform temperature inside the bath.
Liquids with a viscosity higher than 10/20 centistokes do not allow good performance of the bath, therefore they should be avoided in the **LR-*Cal* BK40-M**. Oil viscosity is established at room temperature, the value for water at 20°C is 1 cst, for 47V20 oil it is 20 cst, for glycol it is 5cst and for 200C5 it is 5 cst.

Remember that viscosity, especially in oils, varies considerably when the temperature changes: this is the reason that characterises the use of oil in a well-defined field: normally the oils become more viscous when the temperature drops, creating problems in mixing and uniform distribution of the temperature.

3.1.3 - Thermal expansion

Thermal expansion indicates how liquid volume changes with variation of the temperature.
It is an important factor especially regarding oils, which increase in volume with increase in temperature.
Read the filling instructions and do not fill over the values indicated because thermal expansion could cause the liquid to escape from the bath.
Silicone oils increase by about 10% with respect to their initial volume with a temperature increase of 100°C.

3.1.4 - Life Span

The life span that you can expect depends on many conditions: evaporation, chemical deterioration, gelling, etc.
The life span of an oil becomes shorter because the higher the temperature the greater oxidation of the oil in contact with the air.
To increase the life span:

1. use the most suitable oil at high temperature for the shortest time possible
2. place a lid with holes on the bath to allow passage of the probes, in order to limit contact between the hot oil and air.

For example: a continuous use at 125°C, in open bath conditions, of the 200C5 silicon oil leads to deterioration in a few tens of hours; the viscosity of the oil increases considerably and at temperature below zero the 200C5 becomes doughy and mixing is impossible.

3.1.5 - Bath filling

Fill the calibrator with the suitable fluid depending on the field of calibration. The liquid we recommend is 200C5 silicone oil. Fill the liquid up to about 30mm under the top edge. Do not exceed the recommended quantity, as thermal expansion at the high temperatures could cause the liquid to escape from the upper opening.
Using 200C5, bath performances are optimal in the field from -20°C to 120°C, but with a fumes extractor device it can be used up to 125°C limiting the running time to the highest values in order to increase the life span, while at a low temperature the viscosity, even if high, allows good functioning of the BK40M.
If the liquid is often used at high temperatures, we suggest you realise a lid with holes that allow passage of the probes and place it on the bath.
Before replacing the liquid in the calibrator with a different one, it is recommended to clean the container with absorbent paper in order to prevent mixtures of different liquids that worsen the operating conditions and, most of all, cause the liquid to leak due to incompatibility of the maximum temperature.

Notes regarding positioning of the probes:

To obtain the best result, follow the advises:

- Immerse the probe in the drive-pipes or directly in the liquid in case of probes oversized
- Immerse the probe in the liquid to have a dept equivalent to at least 15 times the diameter of the probe.
- Don't immerse the probe up to the bottom of the bath
- The best calibration area is: 4÷5cm far from the bottom and from the top of the liquid (fig. 1).
- In the case of calibration of two probes or more, it's advisable to immerse the probes at the same dept (reference to fig. 2)
- Always verify the range of the probes to be calibrated before using, the maximum temperature of the probes should be higher than the temperature of the liquid otherwise the probe could break or explode(especially in case of glass thermometers)

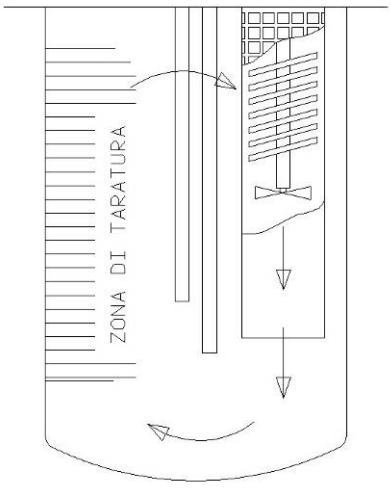


Fig.1

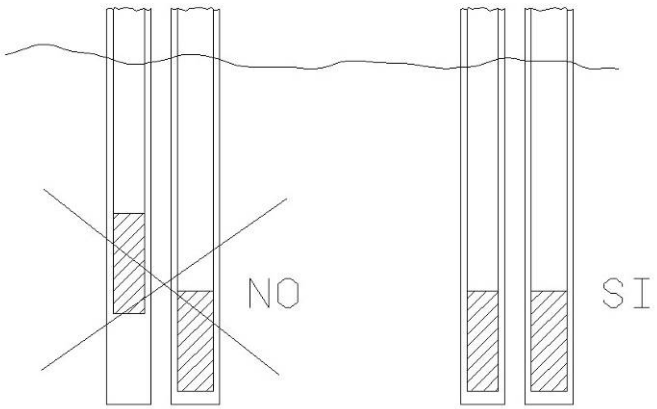
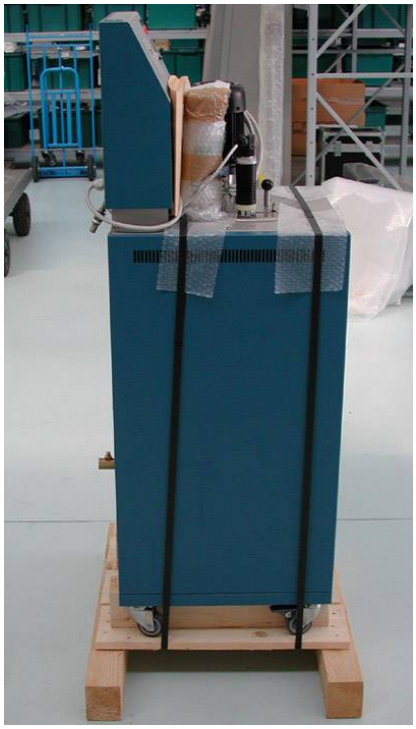


Fig.2

4 - SAFETY INSTRUCTIONS

4.1 - Opening of the packaging and movement of the bath

1) Cut the straps that fastens the carton to the pallet.
2) Remove the sealing tape of the carton.
3) Take off the carton
4) Cut the straps that block the equipment to the pallet
5) Take out the equipment; pay attention.
6) Keep the whole packaging in case of any returns.
7) Read the instruction manual for the other operations before use.
8) Keep the **LR-*Cal* BK40-M** Off in vertical position in case it travelled horizontally

4.2 - Operation for safety maintenance

It is absolutely forbidden to operate with the bath before have it filled with the right quantity of calibration liquid (reference to par. 5)

ATTENTION:

- Carry out the maintenance and repair operation only with the equipment at ambient temperature and disconnected from the electric power.
- Pay attention during the handling. Move the bath only if empty and disconnected from main power.
- For calibration use the recommended liquid: ethylene glycol mixed with water (56% glycol + 44% water) or silicon oil (reference to par. 5).

- The over flow pipe and the drain pipe should be to temperature elevated
- NEVER discharge the liquid at high temperature.
- During the use, the work plane may overheat.

4.3 - Safety systems

The bath is equipped with the following devices to protect operation from hazard:

- Magnetic-thermic master switch (1): it protects the bath against possible short circuits.
- Max. temperature safety thermostat (9) with alarm lamp (11): to disconnect the heating system at 130°C.
- Minimum level check (15) with alarm lamp (12): to disconnect the heating system when the level of the liquid is low – the lamp (12) switch on.
- Trickle drain (26): it drains the exceeding liquid in the operation tank.
- Protection cover: to avoid any contact to the inside liquid.

- Ground conductor and external equipotentiality terminal.

Suggest:

- Don’t put anything on the work plane.
- Don’t put fuel objet on the bath.
- Do not use any fuel liquids near the bath.
- Use only the recommended liquids.

..... use common sense any time

5 - PREPARATION FOR OPERATION

5.1 - Installation

5.1.1 - Positioning the calibrator

Remove the calibrator from the box board and place it in laboratory 30cm far from the wall to permit the recovery of the liquid from the rear drains (25-26) and to allow the circulation of the air inside the equipment. Do not put anything in front of the bath.
For the positioning of the calibrator make reference to paragraph 4
Before start the calibration read with attention the instruction manual, specially the paragraph 3: - General recommendation -.

Do not connect any voltage higher to 5V to the input 19-20-21

Do not absolutely switch ON the LR-*Cal* BK40-M in case it has been transported horizontally. Wait on at least two days in order to let the oil inside the refrigeration device go back into the compressor again letting the capillary tube free.

****DANGER**: The calibrator is suitable for operating at high temperatures with the consequent danger of fire. Keep it away from any type of inflammable materials and don't use calibration liquids different from that suggested.

5.1.2 - electric supply

- Make sure of the perfect grounding of the equipment and use the external ground bolt.
- Supply with 230V, 50Hz + ground, using the 16A plug connected to the bath.

➔ ATTENTION:
The bath must be connected to a switchboard with socket protected by magnetothemic switch or fuses.

5.1.3 - Hydraulic connection & filling

- Make sure that the drain cock (25) is closed.
- Connect the overflow drain (26) with a tank.
- Fill the liquid up to about 30mm under the top edge: rising in temperature the silicon oil increase its volume.

Notes about the filling of the calibrator:
Before replacing the liquid inside the calibrator with another type, it is recommended to clean always the container using a paper or absorbing cloth in order to prevent mixtures of different liquids which worsen the operating conditions and which may provoke above all liquid leaks due to the maximum temperature incompatibility.

Use with water:
The use of the water is not recommended, since the cooling coil fitted in the tank reaches such low temperature (approximately -40°C) that the water freezes around the coil, thus creating significant problems related to the fluid mixing and temperature stability, so as to be even required to stop the bath agitator with its subsequent breakage.
In the event that it is necessary to use water, only use the bath for temperature values up to a maximum of 70-80 °C.
At high temperatures (above 60 °C), water evaporation causes falls in the level, which should be compensated by some other liquid.

Use with Silicone Oil:
Fill the calibrator vessel with about 10 litres of Silicone Oil; do not exceed the recommended amount, since thermal expansion at high temperatures may cause the liquid to leak from the overflow pipe (26).
At high temperatures, silicone oils emit eye-irritating fumes; therefore, it is not recommended to exceed maximum temperatures.

Use with glycol
Fill the calibrator vessel with about 10 litres of glycol mixture; do not exceed the recommended amount, since thermal expansion at high temperatures may cause the liquid to leak from the upper opening.
At high temperatures, glycol emit eye-irritating fumes; therefore, it is not recommended to exceed maximum temperatures.
Its use is not recommended at high temperature (over 70÷80°C), since evaporation of water contained in the mixture varies mixing percentages, thus altering its features and consequently the bath performance

6 - OPERATION PROCEDURE

6.1 - Operation description

The thermostat **LR-*Cal* BK-40M** consist of a stainless steel insulated tank with a drain cock (25) on the bottom; on the upper side it has an opening for the introduction of the probes to be controlled. The liquid is kept mixed by a suitable mixer (16); eventual pouring-off of the liquid is conveyed into the over-flow pipe (26).
The PT100 probe (18) is placed directly in the liquid.
The probe signal is sent to the microprocessor card; the microprocessor displayed the temperature and enables the static relay (7). The static relay controls the heating resistor (17) inside in the bath.
For use under ambient temperature or even 40°C insert manually the cooling group (22).

6.2 - Description of command panel

6.2.1 - Main switch

The main switch (1) supplies electrical power to the bench. For the operation, the switch must be on.
The switch is an automatic magnetothermal 16A model.

6.2.2 - Cooling switch

The cooling switch (2) activates the compressor unit.

6.2.3 - Segnaling lamps

Heating lamp (10): it indicates the operation of the heating system.
Mx. Temp lamp (11): it indicates the activation of the maximum temperature thermostat (9).
Min. Level lamp (12): it indicates the activation of the minimum level sensor (15).

6.2.4 - Thermoregulator

The thermoregulator (6) is a PID microprocessor, which can be set from -50 to 125°C.

- UPPER DISPLAY: shows the measured value inside the bath.
- LOWER DISPLAY: shows the input set point value; indication of external probe; configuration parameter (this state is defined as "normal display mode").
- ▲▼ keys: increase or decrease the value showed on the display; if you keep pressed the key, the speed rises.
- **F** key: access to the function menu and change the parameter; pressed with the key ▲ it let you enter in the set up menu.
- **E** key: confirmation of the value.

6.2.5 - Mixer group

The mixer motor is compound from:

- 100VA motor
- Heating resistance incoloy made of 1400W.
- Optional: fluid level adapter

6.2.6 - Safety thermostat

The thermostatic bath is supplied with max. temperature safety thermostat (9) that disconnect the heating system; the thermostat intervenes on heating resistance and switch on the Max. temperature lamp (11).
In case the thermostat intervenes:

- Waiting the cooling of bath: the temperature must decrease at least 15÷20°C respect to maximum set point (until 110°C).
- Push the button on the safety thermostat (9) on the rear of the bath. The BK40 working if the temperature inside is lower then the differential of the thermostat.
- If problem persist: disconnect the electrical cable and proceeding to repair of eventual faults (reference to paragraph 4); therefore switch on the bath and insert the thermostat.
- Consulting chapter 9 – typical faults – for any problems on the thermostat.

N.B.: the thermostat mounted on standard ovens has been calibrated in factory to intervene at 130°C ±10°C.

6.2.7- Safety level

The bath is fitted with a minimum level sensor (15): in the event that the level of the liquid contained in the tank decreases by leaving uncovered a part of the heating resistance, the sensor will stop the operation of the heating system; the alarm is indicated by the minimum level lamp (12).
In order to restore the level, manually fill the tank with the calibration liquid; the Min. Level lamp (12) goes off and the heating system restarts.

6.2.8 - Bath

The bath is stainless steel made, the dimensions are: ø200x340mm
Inside the bath there are:

- Cooling coil cupper made.
- Over flow drain and discharge tube.
- Probe holder device

6.2.9 - Temperature sensor

The temperature sensor (18*)* used for the reading and thermoregulation is a PT100Ω probe; the probe is inserted directly into the calibration liquid.

6.2.10 - Cooling group

The cooling group (22)is composed of: compressor filled up with 280g of R404A, air compressor and evaporator coil

6.3 - Start-up instructions

ATTENTION:

- The bath can only be used correctly if the user has a good knowledge of its basics.
- Before starting with the calibration following the installation procedures (paragraph 5); read the instruction on paragraph 3 & 4.

In order to calibrate the probe it is possible to follow two ways: calibration with internal indicator (8), or calibration with external reference.

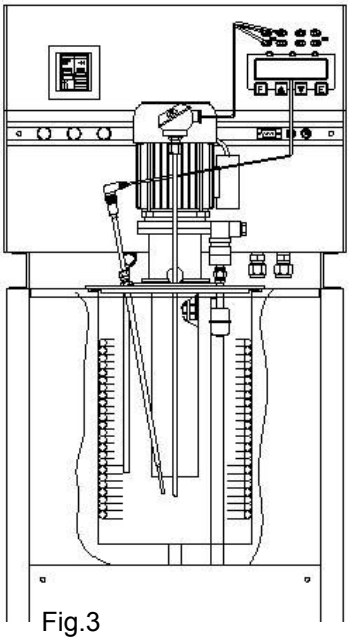


Fig.3

Calibration with the internal indicator (6):
Make reference to the temperature value of the display (6) (figure 3)
It is opportune to refer the value to the test report to compensate the error of the display.

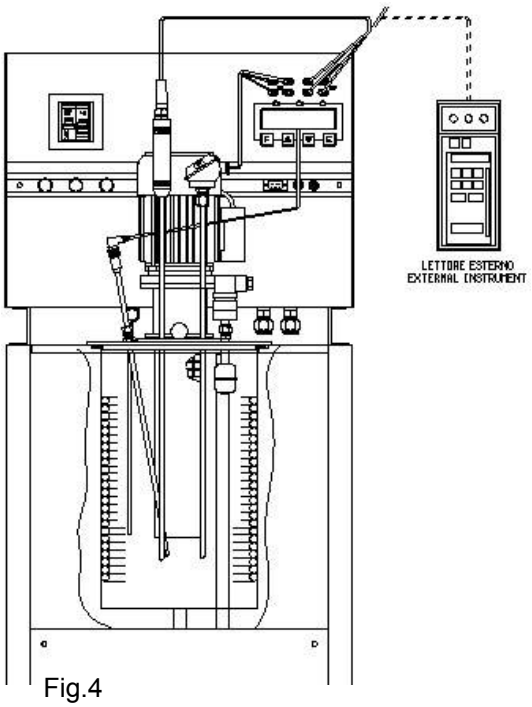


Fig.4

Calibration with external reference and reading on the calibrator display:
The reference temperature value is given by the external reference introduced in the tank and directly connected to BK40M (figure 4); the temperature can be read on the second line of the display (for the configuration of the sensor, see the paragraph 10.1). When possible, it is advisable to place two probes at the same level and as closest as possible (reference figure 1-3).

Calibration with external reference and reading on an external instrument:
The reference temperature value is given by the external reference introduced in the tank and connected to an external instrument. When possible, it is advisable to place two probes at the same level and as closest as possible (reference figure 1-3).

N.B: Reference to the paragraph 6.11.1 to reading the external probe.

Before any calibration follow the general recommendation (chapter 3):

- Starting the calibration only at ambient temperature: thermal shock can break the sensitive element of the probe and cause harm to operator.
- Put the probe to check into the tank: reference to chapter 3 (fig 1-2).
- Switch on the bath using the main switch (1); waiting for the end of autotest procedure.
- For set point under or near the ambient temperature insert the cooling group with the switch (2).
- Set the required temperature value on the display:

  ◊ Press the ▲ key to increase the set point value.
  ◊ Press the ▼ key to reduce the set point value.
  ◊ **Press the - E - key to confirm the input value.**

- Wait for the stabilisation of the bath before starting any calibration.

N.B: The display (6) shows the temperature of the bath and the set-point; when the temperature is reached and it's stable the display shows the symbol ÷.

- To working at different temperatures set the set point at the new value and wait for the stabilisation.
- The temperature indicated by display must not be considered as a reference temperature but only as a general indication of the temperature inside the tank.
  We suggest to insert a primary standard with SIT certificate in the tank; compare the measure with the values indicated by the standard.
  Don't ever use the primary standard: it's possible to calibrate the instrument to more significant points, comparing the displayed temperature with the temperature of the primary standard.

N.B: To modify the regulation parameter or to set the ramp, see the instructions of chapter 10.1 and 10.2

ATTENTION

- At the end of the calibration don't remove the probe from the bath and wait for stabilisation at ambient temperature. Always allow the calibrator to cool off with the probe still inserted in order to avoid thermal shock to the probe itself and harm to people or things.
- The minimum working temperature is depending to the ambient temperature (with ambient temperature at 20°C the bath cool down up to –40°C)

Cooling group

Insert manually the refrigeration system:

- To operate at low temperature
- To operate near the ambient temperatures
- To decrease from high temperature (100°C) to inferior temperatures.

Insert the compressor group for calibration temperature until 40÷50°C; for calibration at high temperature leave the compressor off.
When switching off manually the compressor, it's important to wait for some minutes before starting it up again, in order to allow the balance of the inside circuit pressure.
In case of frequented starts-up the safety ammeter relay prevents the compressor group from starting until the compressor head is cooled.

6.4 - Use of the functions

6.4.1 - Reading of external probes

It is possible to display one or two probes tied to the EXT and REF inputs.
The following probes can be connected:

1. THERMOCOUPLES TYPE J, K, R, S, N, E with automatic compensation of the terminal clamp temperature.
2. THERMAL RESISTANCE Pt 100 to 2, 3 or 4 wires.

- Connect the probe's wires to the clamps as it is indicated in the figures.
  - ◊ Thermocouple – connect the wires of probe to the clamps 2-4 to make attention to the polarity; connect the clamps 1-3 as indicated. Reference to Fig. 5-A
  - ◊ Pt100 to 4 wires – connect the clamps 1-2-3-4 as indicated in Fig. 5-B
  - ◊ Pt100 to 3 wires – connect the wires of probe to clamps 1-2-3; connect the clamps 3-4. Reference to Fig. 5-C
  - ◊ Pt100 to 2 wires – connect the wires of probe to clamps 2-4; connect the clamps 1-2 & 3-4. In case of two wires connections remembers to us shortest wires possible. Refer to Fig. 5-D

- In order to read the probes' temperature refer to the procedure explained in paragraph 10.1 till **SENSOR**.; the temperature will be displayed on the bottom of the display.
- In order to read in the '°F' way, refer to the procedure explained in paragraph 10.1 till **Units°C/°F/K**; the conversion of the new scale will be carried out at once.

NOTE: The calibrator always thermally adjusts with the control probe situated inside the block.

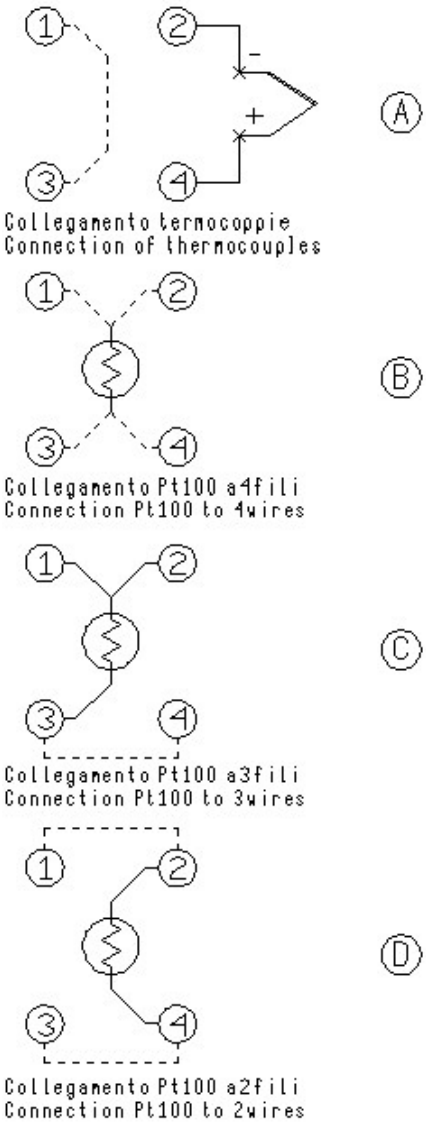


Fig. 5

6.4.2 - Switch test (SW ON - SW OFF)

You can test the operating point of the thermostats by the 'SWITCH TEST' function.

- Put the thermostat in the bath.
- Connect the terminals of the thermostat to the socket (19).
- Switch on the equipment.
- Set the test temperature upper to the operating temperature of the thermostat: the lamp (19.1) will come on when the thermostat electric contact works.
- The instrument store the switch test value. Follow the instruction and the flow chart chapter 10.1/10.2 up to SW ON - SW OFF to display the stored values.
- Push on together the ▲ & ▼ keys to reset the value of 'SW. ON - SW. OFF'.
- See chapter 10.1 & 10.2 for ramp generation.

6.4.3 - Serial communication

For PC control use the serial communication RS 232 (20) (references fig.6)
With RS232 you can read and/or change the operative parameters, for example: set point, external probe, slope rate etc..
Reference to communication protocol instruction (chapter 10.3).

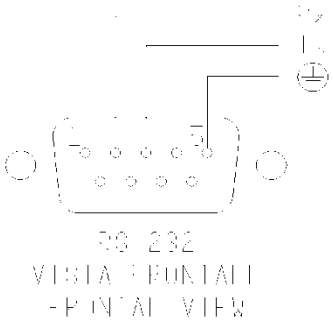


Fig.6

The external PC must be conform to the IEC950 standard.
ATTENTION: The RS232 cable has the wires 2 and 3 crossed together.

6.5 - Re-calibration procedure

To have instrument always efficient is opportune to re-calibrate it periodically.
Frequency of re-calibration is depending to the use of instrument; however we suggest to re-calibrate the calibrator every year.
To re-calibrate it is necessary to have a standard temperature instrument, the software 'CALIBRA' and follow the instructions of the software.

6.6 - Checks during operation

Periodically check the liquid level of the bath; fill-up the liquid to about 20mm under the top edge.
Periodically check the calibration liquid; change it if exhausted.

6.7 - Shut-down instructions

At the end of the calibration close the cover and set the ambient temperature in order to cool down the bath before switching off.
Don't move the bath until the liquid is cooled.
When switching off the compressor, it's important to wait for some minutes before starting it up again, in order to allow the balance of the inside circuit pressure.
In case of frequented starts-up the safety ammeter relay prevents the compressor group from starting.

AFTER EVERY USE AT HIGH TEMPERATURE REMEMBER TO SET UP THE AMBIENT TEMPERATURE. WHEN THE CALIBRATION LIQUID IS COLD SWITCH OFF THE BATH.

AFTER ANY EXTENDED USE AT A TEMPERATURE BELOW ZERO WITH SILICONE OIL, BRING THE SET POIN TO ABOUT 95-100°C LETTING THE CALIBRATOR WORK TILL THE WATER INSIDE OIL HAS COMPLETELY EVAPORATED.
USING THE CALIBRATOR AT A TEMPERATURE BELOW ZERO FOR A LONG TIME WITH HIGH ENVIRONMENTAL HUMIDITY NEEDS IT TAKES A LONG TIME TO EVAPORATE THE WHOLE WATER INSIDE OIL (more than one hour could be necessary)
AIR HUMIDITY WHEN THE OIL HAS A LOW TEMPERATURE CONDENSES ON OIL SURFACE IN THE SHAPE OF ICE CRYSTALS;
AT 95-100°C THE FORMATION OF FOAM MEANS THAT THE WATER INSIDE OIL HAS EVAPORATED

☞6.8 - Device for overflow (Versions LR-*Cal* BK40-M-TR & LR-*Cal* BK40-M-2I-TR)

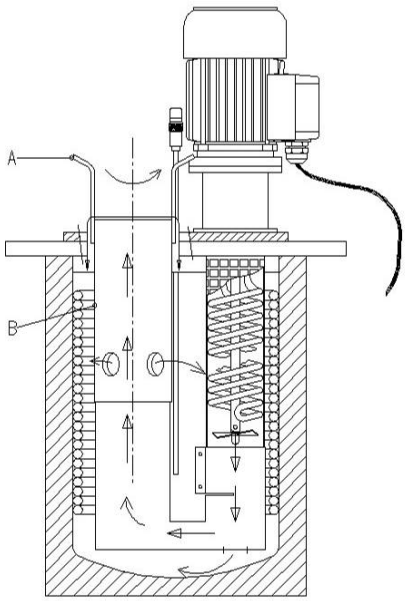
To use thermostatic baths with the overflow device follow the instructions of succession:

- Filling the bath tank up to around 20mm from the edge (do reference to as indicated formerly); to connect the exit of the over-flow pipe to a container.
- For the positioning of the probe or of the bulbs follow the general recommendations paragraph 3; if necessary use the adjustable bracket mounted on the piano of the instrument.
  NOTE: with this system the calibration zone is between the level of the liquid (point of overflow) and 5cm from the bottom tank.
- To regulate the liquid level inside the central tube (A) proceed as follows:
  - ◊ Lift the tube (A) completely: use the levers (B);
  - ◊ Revolve the tube of a pair of centimetres clockwise, then lower it: to this point the tube is unlocked.
  - ◊ Revolve the two levers (B) for regulate the level.
- During the operation the liquid must go up and overflow a little from the central tube (A); in this way it's possible obtain a correct heat-exchange.
- The liquid change his viscosity with temperature, so it will be necessary adjust the handles (B) every time that change the temperature: open almost completely the flow to low temperatures and close it to high temperatures.
- At the end of calibration lower and block the tube (A):
  - ◊ Revolve completely counterclockwise the tube and lift it of a pair of centimetres;
  - ◊ Revolve again of a pair of centimetres counterclockwise the lower the tube.

MODEL	RANGE *	RECOMANDED LIQUID	VERTICAL UNIFORMITY 0°C	VERTICAL UNIFORMITY 35°C	VERTICAL UNIFORMITY 80°C	HORIZONTAL UNIFORMITY 35 & 80°C **
☞BK40M-TR	-40÷+90 (70°C)	Ethylenic glycol mixed with water (56%glycol+44%water)	±0,015	±0,012	±0,006	±0,01
	-20÷+230 (130°C)	Silicon oil 47V20				

* The value in brackets is the temperature value above which an extractor hood should be used

** Horizontal uniformity 35 & 80°C: measured in 5 points, inclusive the centre, to the depth of 100 and 250mm; temperature of measure 35 and 80°C



7 - MAINTENANCE INSTRUCTIONS

7.1 - routine inspections instructions

- Make sure that the condenser of the cooling group is clean and that forced circulation of the air happens freely, otherwise the efficiency of the cooling group is reduced.
- To clean the condenser: disconnect the calibrator from the electric power and open the frontal greed. Blow with pressed air among the fins of the capacitor.
- Check periodically the level of the calibration liquid (reference to par. 6.13).
- Check periodically the calibration liquid; when it has busted to replace it.

For the retrieval of the exhausted liquid use petrol tank in plastics.
Don't disperse in the surrounding.
The excesses, the refusals and the containers must be eliminated according to the dispositions of the laws.

8 - MAINTENANCE SEQUENCE

- Unscrew the screws of the frontal and rear panel (ref. to pictures)
- Blow with the air gun on the condenser to remove the dirty.
- Reassemble the panel again with the 4 screws.

9 - TYPICAL FAULTS

Carry out the maintenance and repair operations with the equipment disconnect from the electric line.

N°	FAULT DESCRIPTION	FAULTY COMPONENT OR FUNCTION	METHOD FOR REMOVAL
1	The heating signal lamp (10) remains always on, but the bath temperature doesn't rise.	- The heating resistor (18) is cut off. - The mixer motor is broken.	- Replace the resistor. - Replace the mixer motor.
2	The control panel is working normally but doesn't rise in temperature.	The supply card (3) is broken.	Replace the supply card (3).
3	The main switch (1) opens automatically and doesn't switch on again.	- Short circuit on the resistor (17). - Short circuit on the cooling group (22) or on his fan. - Short circuit on the supply card (5)	- Replace the resistor. - Replace the damaged part. - Replace the supply card.
4	The temperature shown on the display is different from the actual temperature of the bath.	- The PT100 RTD (18) is damaged. - The regulator card (6) is damaged.	- Replace the RTD (18). - Replace the regulation card.
5	The display shows "MEMORY FAIL"	The memory lost the data for electrical troubles	Replace the thermoregulation card (6) and/or re-calibrate the BK40M
6	The display shows "Internal sensor fail"	Short circuit on the PT100 RTD (18).	- Replace the PT100 RTD and re-calibrate the BK40-M
7	The appliance keeps on heating without interrupting. The lamp (10) remains on, (the led on the control card is off).	Short circuit on the static relay (7).	Replace the static relay.
8	Differences of temperature inside the bath higher then 1°C	- The rotor screwed on the driving shaft has unscrewed - Calibration liquid unemployed. - The conveyor tube is dirty. - Calibration liquid under the minimum level.	- Replace the rotor (to disassemble the mixer group); ensure of the right rotation of the motor. - Replace the calibration liquid - Cleaning the conveyor tube. - Fill-up the liquid inside the basin.
9	The safety thermostat (9) doesn't intervene at the set temperature and the alarm lamp (11) doesn't light.	Safety thermostat is faulty.	Replace safety thermostat
10	The thermostat (9) remains always on, the alarm lamp (11) is on and the temperature is inferior at the set point	Safety thermostat faulty.	To check the calibration of the thermostat.

N°	FAULT DESCRIPTION	FAULTY COMPONENT OR FUNCTION	METHOD FOR REMOVAL
11	The mixer motor (16) turn slowly or anti-clockwise,	- The motor is faulty. - The condenser on the motor is faulty.	- Replace the motor. - Replace the condenser.
12	The mixer motor is not working.	- The motor is faulty. - The condenser is faulty.	- Check the motor terminals voltage and replace the motor or condenser if necessary.
13	The mixer motor is working but the liquid isn't mixed.	The rotor screwed on the driving shaft has unscrewed and has fallen on the bottom of the tank.	Disassemble the resistor and mixer set and assembles the rotor again, after having checked that the motor turn clock-wise.
14	Mixer motor is noisy	The motor bearing has an excessive clearance.	Replace bearings or the complete motor.
15	Driving shaft is noisy inside the tank.	The shaft has twisted and the rotor knocks against the resistor.	Replace the motor
16	The cooling compressor switches off while the condenser fan is working.	The thermal relay inside the compressor has intervened.	Wait that the compressor cools and start up. If the compressor doesn't start, replace the thermal relay. If the faulty goes on, check the compressor.
17	The cooling group stop though the temperature has not reached the temperature set on the safety thermostat.	The thermostat is faulty or the cooling switch is damaged.	Replace the thermostat or the cooling switch.
18	The cooling group is working but the temperature doesn't fall.	The cooling circuit is run down or faulty.	Recharge the cooling group with R-404a. Bring the appliance to overhauled.
19	The compressor group is working regularly, but the temperature doesn't reach the set value.	The calibrator liquid is freezing on the evaporation coil placed in the bath, preventing so the thermal exchange.	Add ethylene glycol for lowering the solidification point or change completely the liquid

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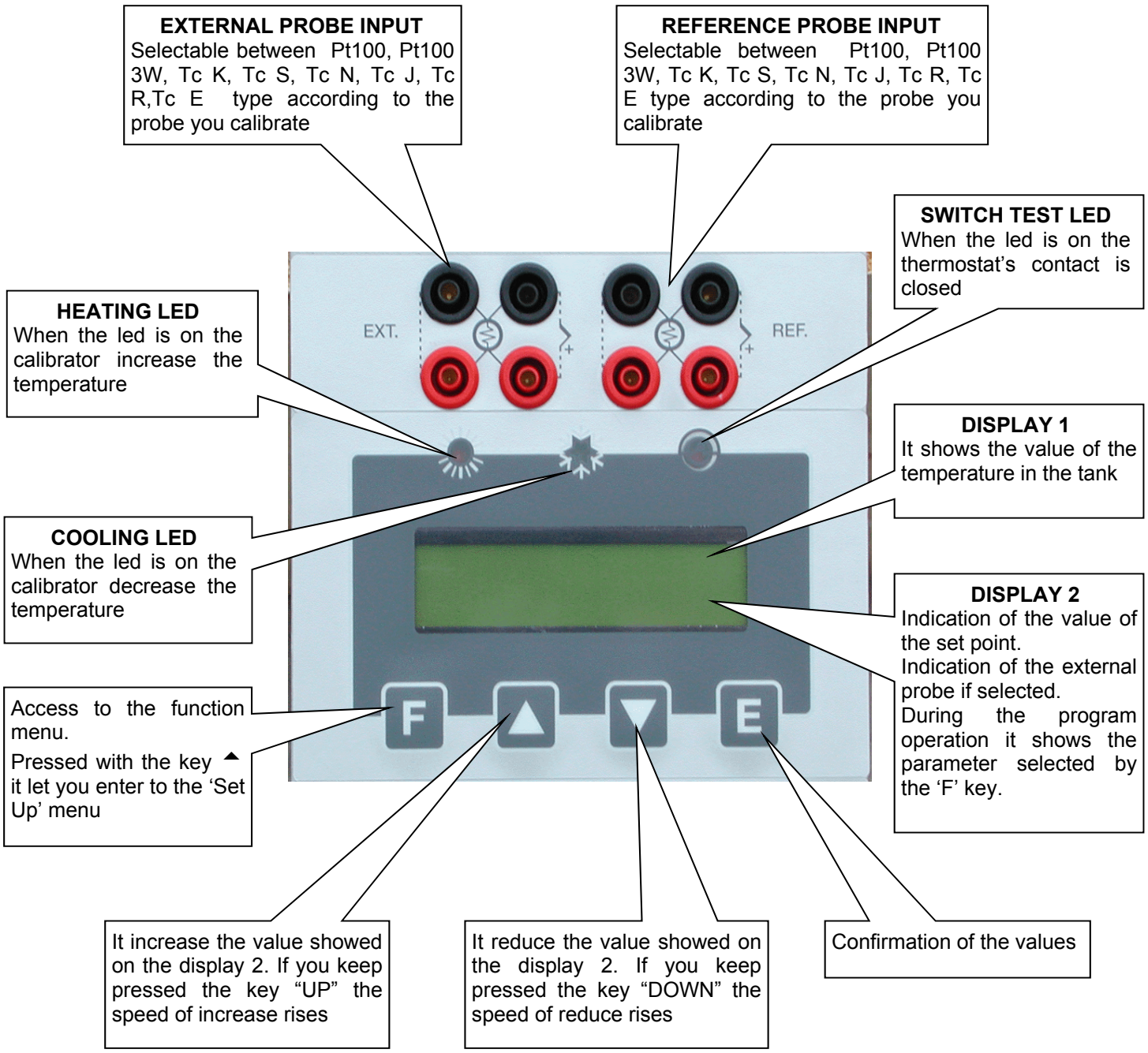
!

9.1 - Emergencies and alarms

Alarm description	Action	Method for removal	Alarm indication
Max. temperature alarm.	In case of failure of the thermoregulation system, the temperature of the liquid contained in the tank may reach high values to activate the safety thermostat (9), which will stop the heating system.	Check the cause of the failure; wait for the temperature in the tank to decrease at least by 20 °C (up to nearly 110 °C or less), then reset it by pressing the thermostat resetting button (9) situated on the back of the equipment. The operation of the equipment will start, if the temperature of the bath is below the differential value of the safety thermostat. If the cause of the intervention persists, switch off the equipment and disconnect it from the electric mains; wait for the liquid to be cold and check the cause of the failure – see the previous chapter.	The lamp (11) show to operator the high temperature alarm.
Alarm of minimum level of the liquid contained in the tank.	In the absence of the calibration liquid in the working tank, the minimum level sensor (15) activates the alarm relay, which will stop the heating system.	Manually fill the tank with the proper calibration liquid until the minimum level lamp is off (12). By restoring the liquid, the heating system will automatically restart.	The alarm is signalled to the operator by the switching-on of the alarm lamp (12).
Safety on the refrigeration unit.	In case of overtemperature of the compressor head due to a thermal or amperometric overload, the thermal and/or amperometric safety relay is activated.	* The activation of relays may occur on machines with dirty condenser and high ambient temperature. Remove the dust from the fins of the condenser placed behind the front grid; dirt causes the gas to go back into the compressor head at higher temperature. Wait for the cooling of the head before restarting it. * Check the operation of the fan of the compressor unit.	There is no visualization; the refrigeration unit does not start.

10 - APPENDICES

10.1 - Thermoregulator frontal panel



DESCRIPTION OF REGULATOR'S MENU
The calibrator has three menu levels(see item10.2):
at the first level there are the functions for the continuous usage,
at the second level there are more specific functions for the regulation of the calibrator,
at the third level there are the typical functions for each calibrator and the calibration procedures.

1st MENU LEVEL
PRESS THE **F** KEY TO STEP THROUGH THE MENU

- **SP**
  SET POINT: temperature set which the oven has to reach following technical specifications, press the ▲ or ▼ key to adjust the set point and press **E** key to accept new the new value.

- **SP2**
  SET POINT2: temperature set which the oven reaches with the set gradient and the ongoing launched ramp procedure, press the ▲ or ▼ key to adjust the set point and press **E** key to accept new the new value.

- **GRAD**
  GRADIENT: set point variation speed during the change from one temperature value to the SP2 value, press the ▲ or ▼ key to adjust the set point and press **E** key to accept new the new value.
  The set gradient must be negative for descent ramps.
  NOTE: gradient values to be set must be lower than the ones stated in the technical data, at point 2.2 (cooling grad. max.: -7°C/min.; heating grad. max. 18°C/min).

- **RAMP**
  Ramp procedure enabling/disabling.
  Select ON or OFF by the ▲ or ▼ key and press **E** key to accept; the oven will reach the set SP2 temperature with the set gradient, starting from the same temperature as the one with which the ramp has been confirmed. The starting temperature does not depend on the Set Point temperature.
  If a negative ramp is set put the gradient is left positive and/or the SP2 is higher than the current temperature, the little over will not accept the ramp start and an alarm will begin running.
  When the ramp is on, the display will show the word "**Ramp:.....**" followed by the Set Point value on the second line of the text. The Set Point value will reach the speed related to the set gradient.
  When the block temperature reaches the SP2 set temperature, the oven will produce an alarm and the ramp procedure will be automatically set off; the SP2 value will be considered as the new set point value and the oven will be steadily set at that temperature.
  During the ramp process, the derivative parameter will not be considered.

  RAMP PROCEDURE EFFECTIVE EXAMPLE
  Let's say that the set temperature is the ambient one and that it is necessary to reach 400°C with a gradient of 2°C/min.
  - Press the **F** key and set **SP2** to 400°C using the ▲ or ▼ keys. Press the **E** key to accept.
  - Press the **F** key and set **GRAD** to 1°C/min using the ▲ or ▼ keys. Press the **E** key to accept.
  - Press the **F** key and set **RAMP** to **ON** using the ▲ or ▼ keys. Press the **E** key to accept.
    After pressing the E key to confirm the ramp start, the oven temperature will ascend with the set slope. Of course, there will be some oscillations at the beginning since the ramp slope will not be suitable but they will stop in a short time and then the oven temperature will follow the ramp's set point.

- **RIS. 0.1/0.01**
  Display reading resolution; Press the ▲ or ▼ key to select 0,1 or 0,01 and press **E** key to accept.

- **SW. ON**
  Switch on; displays the temperature at which the thermostat connected to the terminals "SWITCH TEST" is closed.

- **SW. OFF**
  Switch off; it displays the temperature at which the thermostat connected to the terminals "SWITCH TEST" is open. The value is reset each time the power supply fails or by pressing the two "▲ ▼" keys at the same time. The value is updated every time that the contact closing is detected.

- **SENSOR (OFF/EXT/REF/EXT+REF)**
  This parameter allows enabling the reading of sensors on the auxiliary inputs:
  OFF no input is enable to read the sensors' value.
  EXT the four terminals of the input EXT are enabled to read the sensor tied to them, whose value is indicated at the bottom of the Display.
  REF the four terminals of the input REF are enabled to read the sensor tied to them, whose value is indicated at the bottom of the Display.
  EXT+REF the eight terminals of inputs 1 and 2 are enabled to read the sensors tied to them, whose value is indicated at the bottom of the Display.

2nd MENU LEVEL

PRESS THE **F** + ▲ KEYS AT THE SAME TIME TO ACCES THE SECONDARY MENU.
PRESS THE **F** KEY TO STEP THROUGH THE MENU.
PRESS THE "**F** + ▲ KEYS AT THE SAME TIME OR WAIT FOR ABOUT 20 SECONDS TO COME BACK THE PRIMARY MENU

- **P.B.**
  Value of the Proportional Band expressed in percentage of the value of the end of the scale. Proportional band means the length of time in the measure field within which there is the variation of the regulation probe exit alarm and therefore the adjustment of the heating element power.

- **T.I.**
  Integral Time value expressed in seconds. The integrating action cancel the error between the chosen set point and the temperature reached only by the proportional action. Integral time means the length of time necessary to the integrative action to double up the proportional action

- **T.D.**
  Derivative Time expressed in seconds. When there is a step variation of temperatures, the derivative action induces an greater initial adjustment, so that the oven will have a greater power than it usual has due to the proportional and integral action only. Since the error keeps existing, the derivative action reduces the impact giving the integrative action the task of reducing the error.

- **EXT SENSOR TYPE: J, R, S, N, K, E, Pt100, Pt100 3wires**
  This parameter allows selecting the kind of sensor read by the display and connected to the four Ext. terminals.(item 6.4.1)

- **Units °C/°F/K**
  This parameter allows selecting the temperature measuring unit. By selecting "**°C**" all temperatures will be expressed in Celsius degrees; by selecting "**°F**" all temperatures will be expressed in Fahrenheit degrees.

- **Def. Par. ON/OFF**
  Default Parameter; this function allows choosing to set the thermoregulator with the P.B., T.I., T.D. parameters either as a default or as a customisable adjustment. By selecting the "**OFF**" parameter and confirming by the "**E**" key it is possible to modify the adjustment parameters, which will keep operational even if the calibrator is turned off. By selecting the "**ON**" key (followed by the confirmation by pressing the "**E**" key) the adjustment values will be set on the default ones recorded by the manufacturer, and therefore not allowing to be changed. By turning the calibrator off the parameter will set on OFF but the default parameters will be kept recorded.

- **REF SENSOR TYPE: J, R, S, N, K, E, Pt100, Pt100 3wires**
  This parameter allows selecting the kind of sensor read on the display and connected to the four REF. Sensor terminals.(item 6.4.1)

- **KEY**
  This is the key to step the third menu level. Press ▲ or ▼ key to set the number recorded in the " **ACCESS KEY** parameters at the third menu level, and press "**F**" + ▲keys at the same time (*it is not necessary to confirm the choice by pressing the E key*) to step to the third menu level. The acceptable values are from 1 to 99: **the default set value is 2. If you lost the access key remember that it is possible to have the number by reading the register 13 (item 10.3)**

3rd MENU LEVEL

MENU THAT CAN BE SELECTED BY PRESSING THE "**F** + ▲" KEYS AT THE SAME TIME WHEN THE **KEY** PARAMETER IS REACHED AT THE SECOND LEVEL AND WHEN THE SET VALUE CORRESPONDS TO THE RECORDED ONE.
PRESS THE **F** KEY TO STEP THROUGH THE MENU.
PRESS THE "**F** + ▲ KEYS AT THE SAME TIME OR WAIT FOR ABOUT 20 SECONDS TO COME BACK THE PRIMARY MENU

- **ACCESS KEY**
  Access key; numerical value from 1 to 99 that enables passing to the third parameter level. **The default value is 2**

- **BAUD RATE**
  Data transmission speed from the computer. Values are from 2400 to 19200 **(default value is 9600).**

- **ADDRESS**
  Communication address. The value of this parameter is necessary to communicate from the computer to many instruments. The admitted values are from 1 to 32 and once the value is set by using the ▲ or ▼ keys it is necessary to confirm the choice by the **E** key

- **S/N**
  Equipment serial number. It is set by the manufacturer and cannot be changed by the user.

- **Board S/N**
  Serial number of the board. It is set by the manufacturer and cannot be changed by the user.

- **MAX. SET.**
  Maximum value of the Set Point. It is set by the manufacturer and cannot be changed by the user.

- **MIN. SET.**
  Minimum value of the Set Point. It is set by the manufacturer and cannot be changed by the user.

- **WAIT**
  initial waiting procedure. If the value "**0**" is set, when it is started up, the calibrator immediately run to the last set point value chosen after turning off. If the value "**1**" is set, when it is started up, the calibrator goes on the waiting position and the **SP** flash. It is necessary to press any key in order to move it from the waiting position and to choose the desired Set Point value. It is possible to set the WAIT value only by the serial communication.

- **REV. SOFTWARE**
  Internal software's release number.

- **SENSOR TYPE**
  It indicates the type of the internal probe.

- **STAB:**
- It indicates the swinging value of the temperature, which has been set to see on the Display the symbol of the oven ÷ steadiness. The symbol light on when the temperature is stable for over 6 minutes.

- **Cal_chnl**:
  Chooses the channel to be calibrated. It can assume three values: **INT, EXT, REF.** Press the ▲ or ▼ key to select **INT, EXT or REF** and press **E** key to accept

- **P1**:
  First Calibration point. Press the ▲ or ▼ key to set the value read with the standard thermometer and press **E** key to accept

- **P2**:
  Second Calibration point. Press the ▲ or ▼ key to set the value read with the standard thermometer and press **E** key to accept.

- **CAL: INT (Y/N):**
  This writing can have three different configurations.
  CAL: INT (Y/N) if **Cal_chnl** is set on **INT**
  CAL: EXT (Y/N) if **Cal_chnl** is set on **EXT**
  CAL: REF (Y/N) if **Cal_chnl** is set on **REF**
  Press the ▲ or ▼ key to set **Y**es or **N**ot and press **E** key to accept.

EXAMPLE OF RE-CALIBRATION

The appliance can have a complete or partial re-calibration yearly or when chosen by the user.
Calibration can be carried out using CALIBRA ED200 software or directly on the keyboard of the appliance. The calibration of the INTERNAL probe is done by adjusting the internal probe at two points of the range using a standard thermometer.
The calibration of the EXTERNAL and the REFERENCE inputs is done by adjusting the inputs of the controller at two points of the range using a mV/ohm standard generator.
The calibration is possible only by setting the temperature in °C.

CALIBRATION OF THE **INTERNAL PROBE**
The purpose of re-calibration is to correct the error between the temperature indicated and the value of a standard thermometer.
To calibrate the internal probe it is necessary to have a standard thermometer with precision greater than that of the appliance and then to follow the instructions:

1. Insert the standard thermometer probe in the temperature bath or in the most suitable hole of the calibrator.
2. Choose two calibration points depending on the appliance range or the field where one wishes to carry out calibration. For example the points 0 and 120°C are recommended for the QUARTZ.
3. Set the first calibration point and wait for the appliance to be stable (see symbol **÷)**
4. Enter the third menu level (see instructions) and select Cal_chnl= INT. Press E to confirm.
5. Press F to select P1, press the ▲ or ▼ key to set the value read with the standard thermometer and press **E** Key to accept**.** Confirmation is indicated by the symbol * which appears on the display after about 5 seconds.
6. Return to the first menu level and set the second set point. Then wait for the appliance to be stable (see symbol **÷).**
7. Enter the third menu level (see instructions) and select P2, press the ▲ or ▼ key to set the value read with the standard thermometer and press **E** Key to accept. Confirmation is indicated by the symbol * which appears on the display after about 5 seconds.
8. Select **CAL: INT** set **Y**es and confirm by pressing **E** key . Calibration begins. The procedure takes a few seconds, at the end of which there is a Beep.

CALIBRATION OF THE **EXT** + **REF** INPUTS with a signal calibrator

The purpose of the re-calibration is to correct the EXT and REF inputs error together.
To calibrate the two inputs, it is necessary to have a Pt100 calibrator and/or a thermocouples calibrator depending on what is to be calibrated.
Calibration of the EXT input automatically reproduces the same calibration on the REF input:

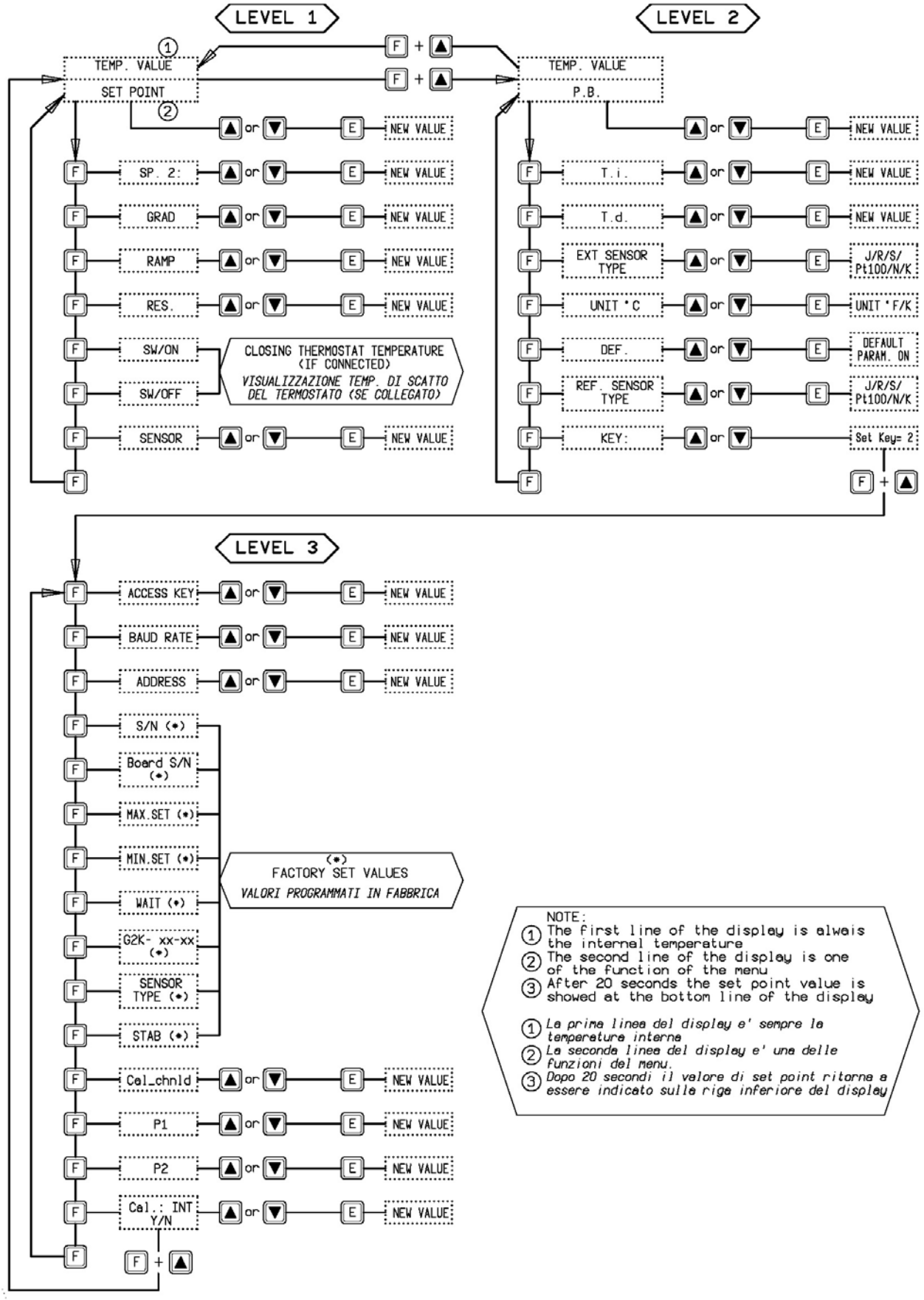
1. On the second menu level, select the type of EXT input to calibrate (Pt100, Tc K, Tc J, Tc N, TcR, Tc S, Tc E) following the instructions in the manual. Press E key to confirm.
2. Enter the third menu level (see instructions) and press the ▲ or ▼ key to set Cal_chnl= **EXT**. Press E to accept.
3. Choose two calibration points depending on the appliance range or the field where one wishes to carry out calibration. (For example 0 and 450°C for PT100, 200 and 800°C for the thermocouples).
4. Connect the signal generator to the EXT input, generating the first calibration value. See the instructions for the connection.
5. Select P1 and press the ▲ or ▼ key to set the first value (for example 0°C). Press E Key to confirm. Confirmation is indicated by the symbol * which appears on the display after about 5 seconds.
6. Generate the second calibration value with the signal generator. See the instructions for the connections.
7. Select P2 and press the ▲ or ▼ key to set the second value (for example 450°C). Press E Key to confirm. Confirmation is indicated by the symbol * which appears on the display after about 5 seconds.
8. Select **CAL: EXT** Set **Y**es and confirm pressing E Key. The procedure takes a few seconds. At the end there is a Beep.

CALIBRATION OF THE **REF** INPUT with a with probe connected

This operation adapts the value indicated by the REF input to the value indicated by the probe connected to it, compensating its errors.
To carry out the calibration it is necessary to connect the probe to the REF terminals and to have a standard thermometer

1. Connect the probe to the **REF** input following the instructions in the manual.
2. Insert the probe in the suitable hole in the appliance.
3. Insert the standard thermometer in the appliance.
4. Set the first calibration point and wait for the appliance to be stable (see symbol **÷)**
5. Enter the third menu level (see instructions) and select Cal_chnl= **REF**. Press E key to accept.
6. Select P1 and press the ▲ or ▼ key to set the value read with the standard thermometer. Press E key to accept. Confirmation is indicated by the symbol * which appears on the display after about 5 seconds.
7. Return to the first menu level and set the second set point. Then wait for the appliance to be stable (see symbol **÷).**
8. Enter the third menu level (see instructions), select P2 and press the ▲ or ▼ key to set the value read with the standard thermometer. Press E Key to accept. Confirmation is indicated by the symbol * which appears on the display after about 5 seconds.
9. Select **CAL: REF** Set **Y**es and confirm pressing E Key. Calibration begins. The procedure takes a few seconds. At the end there is a Beep.

10.2 - Microprocessor regulator: control description



10.3 - Communication Protocol RS 232 C

General characteristics:

Baud Rate:	*9600*	Parity:	*No*
N. Bit:	*8*	Bit of stop:	1

The communication runs in half duplex way which means that is transmission and reception could not be contemporaneously present.
The regulator replies only after receiving command; it never replies itself.
The command and reply are ASCII character string, as detailed forward. The communication program will be able to convert ASCII to decimal to extract numeric values. The default address is 1.
Baud rate: 2400, 4800, 9600 e 19200 baud, the Default value is 9600; the other parameters are standard.

VARIABILES AVAILABLE IN READING

0	Set point
1	Ramp ON/OFF
2	Set point 2
3	Gradient
4	Resolution
5	Prop. Band
6	Integral time
7	Derivative time
8*	**Sensor input selection**
9	Title
10***	**Units (°C/°F/K)**
13	Access key
14	Baud rate
15	Address
16	Serial number
18	Mx. set point
19	Min. set point
21	Wait ON/OFF
22	Switch on temperature
23	Switch off temperature
24	Version
25**	**Ext. Sensor type**
26**	**Ref. Sensor type**
28	Stability range
29	Symbol of steadiness
100	Temperature
105	Ext. temperature
106	Ref. temperature

VARIABILES AVAILABLE IN WRITING

0	Set point
1	Ramp ON/OFF
2	Set point 2
3	Gradient
4	Resolution
5	Prop. band
6	Integral time
7	Derivative time
8*	**Sensor input selection**
9	Title
10***	**Units (°C/°F/K)**
13	Access key
15	Address
25**	**Ext. Sensor type**
26**	**Ref. Sensor. type**

*

8* Sensor input selection

1	Correspond to the INTERNAL probe
2	Correspond to the INTERNA+EXT probe
3	Correspond to the INTERNA+REF probe
4	Correspond to the INTERNA+EXT +REF probe

**

25/26 Ext. Sensor type/ Ref. Sensor type**

0	Correspond to the Pt 100 4 wires
1	Correspond to the N thermocouple
2	Correspond to the K thermocouple
3	Correspond to the J thermocouple
4	Correspond to the R thermocouple
5	Correspond to the S thermocouple
6	Correspond to the Pt100 3 wires
7	Correspond to the E thermocouple

***

10*Units (°C/°F)**

0	Correspond to the °C
1	Correspond to the °F
2	Correspond to Kelvin temperature

* the variable 8 is available only for the models SOLAR-2I-X; the value of the variable corresponds to the table.
** the variable 25/26 is available only for the models SOLAR-2I-X; the value of the variable corresponds to the table.
*** the value of the variable 10 corresponds to the table.

Each commands string are ASCII character succession.
First is $ character; the next must indicate the instrument address (default 1) and than is the command (4 characters).
Possibility:

RVAR	(data reading)
WVAR	(data writing)

The ultimate part of string is depending of a type command. The character (cr) concludes the sequence

DATA READING:

Example 1) reading of the Set Point (0 variable):
the command string is: **$1RVAR0_<cr>**

Each characters means:

$	beginning of message
1	instrument address
RVAR	reading command
0	number of the variable to read (see the table of the "VARIABILES" on the previous page)
_	space
<cr>	end of message

the response string is: ***1_110,0** (110,0 is only for example)
The character <cr> concludes the message.

Command to read the temperature of an external probe (index 25):

Example 2) reading of the EXT sensor (105 variable):

the command string is: **$1RVAR105_<cr>**
the response string is: ***1_123,4** (123,4 is only for example)
The character <cr> concludes the message.

The response does not include the measure unity, to read the unity read the variable 10:
the command string is: **$1RVAR10_<cr>**
the response string is: ***1_0 for °C**
the response string is: ***1_1 for °F**

DATA WRITING:

FLOAT VARIABLES

For writing you use the command WVAR.

Examples 1) writing of the Set point to 132,5°C

If the unity of measure of the temperature is already °C it is enough to write the SET POINT (see the table of the "VARIABILES" on the previous pages).

the command string is: **$1WVAR0_132,4<cr>**

Each characters means:

$	beginning of message
1	instrument address
WVAR	writing command
0	number of the variable to read (see the table of the "VARIABILES" on the previous pages)
_	space
132,4	numerical value of a data with the character **.** to separate the decimal part of the number
<cr>	end of message

At reception of the command, the answer of the instrument is:

*1<cr>

This string shows the recognition of the command.

If the unity of measure of the temperature is not °C You should write first the variable 10 UNITS to 0(see the table of the "VARIABILES" on the previous pages).

INTEGER VARIABLES

We have just shown the procedure for the writing of a float data.
The variables 1, 4, 8, 10, 25, 26 have two or more states (for example, the resolution by tenth or hundredth of °C) and to activate them it is necessary to assign to the variable number the number corresponding to that one which should be set, according to the table indicated below:

1	Ramp	ON = **1** OFF = **0**				
4	Resolution	0.1°C = **0**	0.01°C = **1**			
8	Sensor input selection	INT = **1**	INT+EXT = **2**	INT+REF = **3**	INT+EXT+REF = **4**	
10	Units	°C = **0**	°F = **1**	K=**2**		
25	Ext. Sensor type	**0** = Pt 100	**1** = Tc N	**2** = Tc K	**3** = Tc J	**4** = Tc R
		5 = Tc S	**6** = Pt 100 3 wires		7 = Tc E	
26	Ref. Sensor type	as for the variable 25				

Example 1: the variable 1 corresponds to the activation of the ramp. If you want to set it to ON in order to activate the ramp, you should assign the value 0, otherwise the value 1.

the command string is: **$1WVAR1_0<cr>**

Example 2: the variable 8 corresponds to the activation of the sensor reading which can be connected to the bushes of the external inputs. If you want to read the thermocouple K connected to the Ref. input, you should set the variable 26 to the number corresponding to the type of sensor which you want to read (2 for the thermocouple K) and then set the variable 8 to 3.
the command strings are: **$1WVAR26_2<cr>** **$1WVAR8_3<cr>**

Do likewise for the other variables.

Description of the functions

1st LEVEL FUNCTION

FUNCTIONS TO BE SELECTED BY PRESSING THE F KEY AND CONFIRMED BY KEY E

- **SP**
  SET POINT; reserved temperature which the bath reaches with the maximum gradient

- **SP2**
  SET POINT2; Reserved temperature which the bath reaches with selected gradient and with the launched ramp procedure

- **GRAD**
  GRADIENT; variation speed of the set point when passing from a temperature value to the SP2 value. The set gradient must be negative in falling ramps.
  N.B: the gradient values must be lower than the values indicated on technical date chapter 2 (max. cooling gradient : -0,3÷0,4°C/min.; max. heating gradient 2,5°C/min.)

- **RAMP ON-OFF**
  Ramp procedure switch-on/switch-off.
  By being in the ON position using the ▲ or ▼ keys and by confirming the datum by means of key "**E**", the bath will reach the temperature reserved with SP2 with the selected gradient starting from the temperature at which the ramp confirmation was received. The starting temperature does not depend on the Set Point temperature.
  If a negative ramp is set but the positive gradient and/or SP2 is higher than the current temperature, the bath will stop the ramp from starting by sounding a warning signal.
  When the ramp is activated, the message "**Ramp:.....**" will appear on the second line of the screen followed by the Set Point value which will translate at the speed dictated by the set gradient.
  When the temperature reaches the temperature set with SP 2 the bath will sound a warning signal and will automatically switch off the ramp procedure; the SP 2 value will be considered valid as the new set point and the oven will stabilise at that temperature.
  During the ramp phase, the shunt parameter is not taken into consideration.

EXAMPLE OF HOW THE RAMP PROCEDURE IS APPLIED
Let us suppose that ambient temperature exists and that we wish to increase this to 200°C with a gradient of 0.5°C/min.

- Push **F** and set **SP 2** at 200°C using keys ▲ or ▼ Push **E** to confirm the datum.
- Push **F** and set **GRAD** at 0.5°C/min using keys ▲ or ▼ . Push **E** to confirm the datum.
- Push **F** and set **RAMP** on **ON** using the keys ▲ or ▼ . Push **E** to confirm the datum.

Once key E has been pressed to confirm ramp start, the bath will raise with the indicated gradient. Logically, in the first part of the ramp oscillations will exist which are not compatible with the ramp's gradient, but if the Proportional Band and Integral Time parameters have been correctly loaded, the oven's temperature will follow the ramp set point temperature within a short time.

- **RIS. 0.1/0.01**
  Display reading resolution; the permitted values are 0.1°C and 0.01°C which can be selected using keys ▲ or ▼ .

- **SW.ON**
  Switch on; displays the contact switch-off temperature of a thermostat connected to the "SWITCH TEST" inlets. The value is reset every time power is cut. The parameter is updated every time a new contact is recorded following a contact switch-off.

- **SW.OFF**
  Switch off; displays the switch-on temperature of a thermostat connected to the "SWITCH TEST" inlets. The value is reset every time the power is cut. The value is updated every time a contact switch-off is recorded.

- **PT 100 INT/EXT**
  Parameter which makes it possible to select the temperature read on the display screen. By selecting "**INT**", the temperature read by the regulating probe will be appear on the screen and on the second line the set point value chosen; by selecting "**EXT**", on the first line of the display the regulating probe temperature will appear, while on the second line, the temperature read by a PT100 probe, connected to the rear "PT 100 Ext." tap, will be displayed. It is also possible to modify the set point value in the second case.
  To use this function read the chapter 6.3.1.

2nd LEVEL FUNCTIONS

FUNCTIONS SELECTED BY PRESSING KEYS "**F**" AND " ▲ " AT THE SAME TIME. ONCE THE SECOND LEVEL OF PARAMETERS HAS BEEN REACHED, FUNCTIONS ARE SELECTED BY PRESSING KEY "**F**" ONLY; TO RETURN TO THE FIRST LEVEL PUSH KEYS "**F**" AND " ▲ " AT THE SAME TIME AT ANY POINT, OR WAIT APPROXIMATELY 20 SECONDS.

- **P.B**
  Proportional Band value expressed as a percentage of the full scale. By proportional band we mean the interval in the measuring field within which a variation in the out-going signal of the regulating probe takes place and consequently regulation of the power of the heating element.

- **T.I.**
  Integral Time Value expressed in seconds. The integrating action reduces the error between the set point chosen and the temperature reached by means of only the proportional action to zero. By Integral Time we mean the time required for the integrating action to double the proportional action.

- **T.D.**
  Shunt Time Value expressed in seconds. When a temperature step variation takes place, the shunt action causes an extensive initial regulation in order to provide the oven with higher power than it would normally receive by a single proportional-integral action. When an error exists the shunt action reduces its action leaving it to the integrating action the job of reducing the error.

- **PT 100 INT/EXT**
  Parameter which makes it possible to select the temperature read on the display screen. By selecting "**INT**", the temperature read by the regulating probe will be appear on the screen and on the second line the set point value chosen; by selecting "**EXT**", on the first line of the display the regulating probe temperature will appear, while on the second line, the temperature read by a PT100 probe, connected to the rear "PT 100 Ext." tap, will be displayed. It is also possible to modify the set point value in the second case.
  To use this function read the chapter 6.3.1.

- **Units °C/°F**
  Parameter which makes it possible to select the temperature measuring unit. By selecting "**°C**", all the temperatures will be expressed in degrees Celsius; by selecting "**°**F" all the temperatures will be expressed in degrees Fahrenheit.

- **Def.Par. ON/OFF**
  Default Parameter; with this function it is possible to choose whether you use the P.B., T.I., T.D. parameters loaded in the factory or whether you modify these yourselves. By selecting the "**OFF**" parameter and confirming with key "**E**", it is possible to modify the regulating parameters which will

remain operative even if the calibrator is switched off; by selecting "**ON**" instead (following by confirmation with key "**E**") the regulating values will place themselves on the default values memorised in the factory and which can no longer be modified. When the calibrator is switched off the parameter will return to "**OFF**" but the default parameters will be maintained.

- **KEY**
  Access key to the third programming level. By selecting the number memorised in the "ACCESS KEY" parameter in the third level with keys ▲ or ▼, and pressing keys "**F**" and ▲ together (*there is no need to confirm the value by pressing E*), access is given to the third level parameters concerning serial transmission and instrument configuration. Permitted values range from 1 to 99; the value loaded in the factory is 2.

3rd LEVEL FUNCTIONS

FUNCTIONS SELECTED BY PRESSING KEYS "**F**" AND "▲" TOGETHER WHEN YOU ARE IN THE SECOND LEVEL AT PARAMETER "***KEY***" AND WITH THE SET VALUE CORRESPONDING TO THE VALUE IN MEMORY. ONCE IN THE THIRD LEVEL OF PARAMETERS, THE FUNCTIONS ARE SELECTED BY PRESSING KEY "**F**" ONLY. TO RETURN TO THE FIRST LEVEL PRESS KEYS "**F**" AND "▲" TOGETHER AT ANY POINT, OR WAIT APPROXIMATELY 20 SECONDS.

- **ACCESS KEY**
  Access key; numeric value from 1 to 99 which makes it possible to pass to the third level of parameters. The factory value is 2.

- **BAUD RATE**
  Speed of data transmission from the computer. The values range from 300 to 19200 (default value 9600).

- **ADDRESS**
  Communication address. The value of this parameter is necessary for communication from computers with more than one instrument. The values permitted range from 1 to 32 and once they are loaded with keys ▲ or ▼ confirmation must be given with key **E**.

- **S/N**
  Serial number of the equipment. This is loaded in the factory and cannot be changed by the user.

- **MAX. SET.**
  Maximum value at which Set Point can be set. This is set in the factory and cannot be changed by the user.

- **MIN. SET.**
  Minimum value at which Set Point can be set. This is set in the factory and cannot be changed by the user.

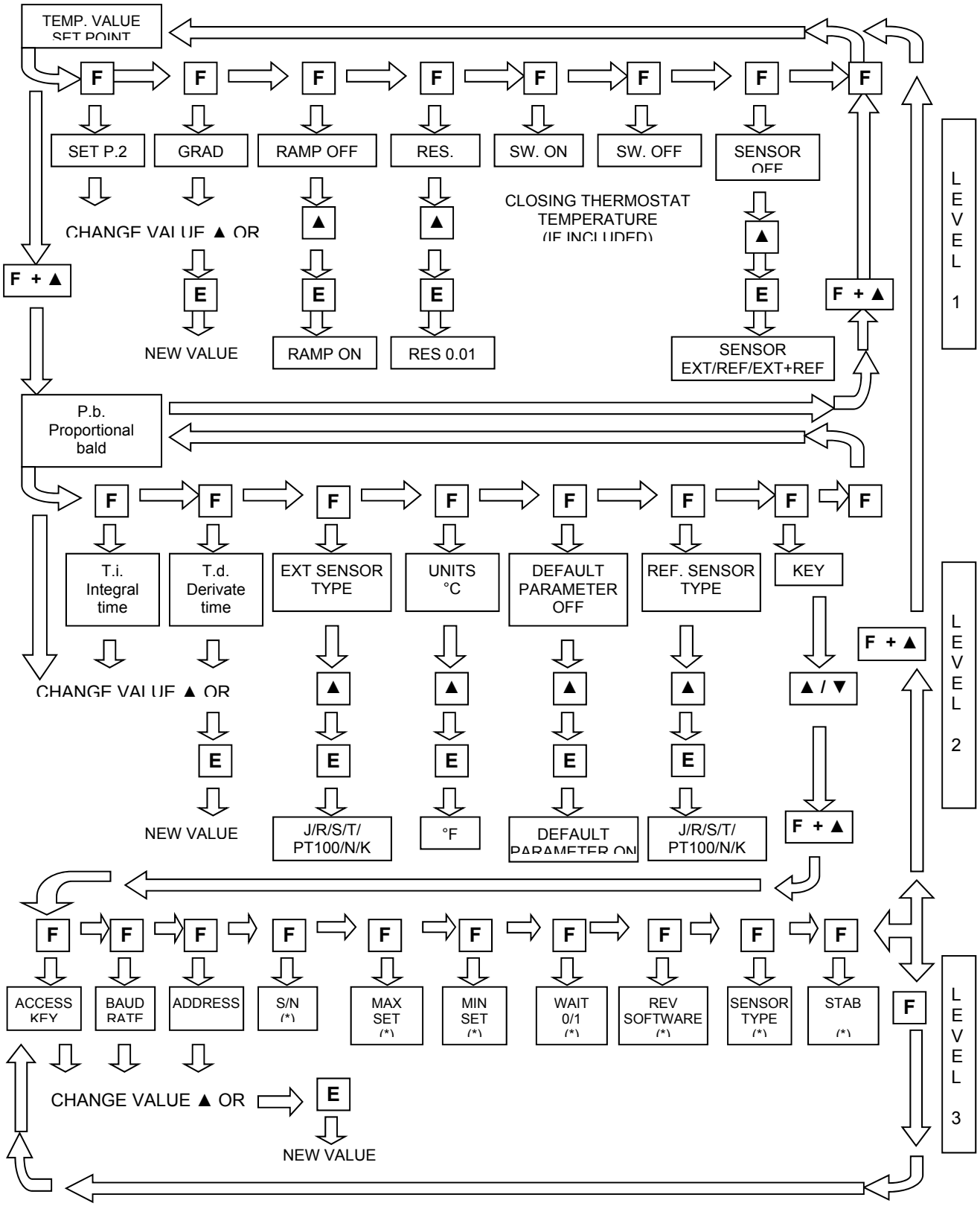
- **WAIT 0/1**
  Initial waiting procedure. When the bath has been switched on and after carrying out the general check, if "0" is selected, the calibrator immediately moves to the last set point value set before the equipment was switched off.
  If "1" is chosen, when it has been switched on and after carrying out the general check, the bath will place itself in the waiting position, and will flash the second line on the display screen. By pressing any key the waiting phase is ended and the desired parameter or value can be selected.

- **REV. SOFTWARE**
  N° of release of the internal software.

- **SENSOR TYPE**
  It indicates the type of the main sensor designed to adjust the temperature.

- **STAB:**
  It indicates the swinging value of the temperature, which has been set to see on the Display the symbol of the oven ÷ steadiness. The symbol light on when the temperature is stable for over 6 minutes.

10.2 - Microprocessor regulator: control description



(*) DEFAULTS VALUES, SET BY THE MANUFACTURER

Note: after 20 seconds the set poit value is showed at the bottom line of the display

10.3 - Communication protocol RS232/c

General characteristics:

Baud Rate: *9600* Parity: *No*
N. Bit: *8* Bit of stop: 1

The communication runs in half duplex way witch means that is transmission and reception could not be contemporaneously present.
The regulator replies only after receiving command; it never replies itself.
The command and reply are ASCII character string, as detailed forward. The communication program will be able to convert ASCII to decimal to extract numeric values. The default address is 1.
Baud rate: 2400, 4800, 9600 e 19200 baud, the Default value is 9600; the other parameters are standard.

VARIABILES AVAILABLE IN READING	
0	Set point
1	Ramp ON/OFF
2	Set point 2
3	Gradient
4	Resolution
5	Prop. Band
6	Integral time
7	Derivative time
8*	**Sensor input selection**
9	Title
10***	**Units (°C/°F)**
13	Access key
14	Baud rate
15	Address
16	Serial number
18	Mx. set point
19	Min. set point
21	Wait ON/OFF
22	Switch on temperature
23	Switch off temperature
24	Version
25**	**Ext. Sensor type**
26**	**Ref. Sensor type**
28	Stability range
29	Symbol of steadiness
100	Temperature
105	Ext. temperature
106	Ref. temperature

VARIABILES AVAILABLE IN WRITING	
0	Set point
1	Ramp ON/OFF
2	Set point 2
3	Gradient
4	Resolution
5	Prop. band
6	Integral time
7	Derivative time
8*	**Sensor input selection**
9	Title
10***	**Units (°C/°F)**
13	Access key
15	Address
25**	**Ext. Sensor type**
26**	**Ref. Sensor. type**

8* Sensor input selection	
1	Correspond to the INTERNAL probe
2	Correspond to the INTERNA+EXT probe
3	Correspond to the INTERNA+REF probe
4	Correspond to the INTERNA+EXT +REF probe

25/26 Ext. Sensor type/ Ref. Sensor type**	
0	Correspond to the Pt 100 4 wires
1	Correspond to the N thermocouple
2	Correspond to the K thermocouple
3	Correspond to the J thermocouple
4	Correspond to the R thermocouple
5	Correspond to the S thermocouple
6	Correspond to the Pt100 3 wires

10*Units (°C/°F)**	
0	Correspond to the °C
1	Correspond to the °F

Each commands string are ASCII character succession.
First is $ character; the next must indicate the instrument address (default 1) and than is the command (4 characters).
Possibility:

RVAR (data reading)
WVAR (data writing)

The ultimate part of string is depending of a type command. The character (cr) concludes the sequence

DATA READING:

Example 1) reading of the Set Point (0 variable):
the command string is: **$1RVAR0_<cr>**

Each characters means:

$	beginning of message
1	instrument address
RVAR	reading command
0	number of the variable to read (see the table of the "VARIABILES" on the previous page)
_	space
<cr>	end of message

the response string is: ***1_110,0** (110,0 is only for example)
The character <cr> concludes the message.

Command to read the temperature of an external probe (index 25):

Example 2) reading of the EXT sensor (105 variable):

the command string is: **$1RVAR105_<cr>**
the response string is: ***1_123,4** (123,4 is only for example)
The character <cr> concludes the message.

The response does not include the measure unity, to read the unity read the variable 10:
the command string is: **$1RVAR10_<cr>**
the response string is: ***1_0 for °C**
the response string is: ***1_1 for °F**

DATA WRITING:

FLOAT VARIABLES

For writing you use the command WVAR.

Examples 1) writing of the Set point to 132,5°C

If the unity of measure of the temperature is already °C it is enough to write the SET POINT (see the table of the "VARIABILES" on the previous pages).

the command string is: **$1WVAR0_132,4<cr>**

Each characters means:

$	beginning of message

1	instrument address
WVAR	writing command
0	number of the variable to read (see the table of the "VARIABILES" on the previous pages)
_	space
132,4	numerical value of a data with the character **.** to separate the decimal part of the number
<cr>	end of message

At reception of the command, the answer of the instrument is:

*1<cr>

This string shows the recognition of the command.

If the unity of measure of the temperature is not °C You should write first the variable 10 UNITS to 0(see the table of the "VARIABILES" on the previous pages).

INTEGER VARIABLES

We have just shown the procedure for the writing of a float data.
The variables 1, 4, 8, 10, 25, 26 have two or more states (for example, the resolution by tenth or hundredth of °C) and to activate them it is necessary to assign to the variable number the number corresponding to that one which should be set, according to the table indicated below:

1	Ramp	ON = **1** OFF = **0**				
4	Resolution	0.1°C = **0**	0.01°C = **1**			
8	Sensor input selection	INT = **1**	INT+EXT = **2**	INT+REF = **3**	INT+EXT+REF = **4**	
10	Units	°C = **0**	°F = **1**			
25	Ext. Sensor type	**0** = Pt 100	**1** = Tc N	**2** = Tc K	**3** = Tc J	**4** = Tc R
		5 = Tc S	**6** = Pt 100 3 wires			
26	Ref. Sensor type	as for the variable 25				

Example 1: the variable 1 corresponds to the activation of the ramp. If you want to set it to ON in order to activate the ramp, you should assign the value 0, otherwise the value 1.

the command string is: **$1WVAR1_0<cr>**

Example 2: the variable 8 corresponds to the activation of the sensor reading which can be connected to the bushes of the external inputs. If you want to read the thermocouple K connected to the Ref. input, you should set the variable 26 to the number corresponding to the type of sensor which you want to read (2 for the thermocouple K) and then set the variable 8 to 3.
the command strings are: **$1WVAR26_2<cr>** **$1WVAR8_3<cr>**

Do likewise for the other variables.

10.4 - List of components

Reference number relevant to the drawings: 3D2444 - 0D2442

POS.	DESCRIPTION	CODE
1	Main Magnetothermic switch 16A	3ABBS951N
2	Cooling group switch	3ABBE22120X
3	10A input filter	3FMT50010F
4	Input varistor	3MRC20D391
5	Supply card	4ITC02099DS
6	Thermoregulation card & Display	4ED20048
7	25A static relay	3CGPRA4425D08
8	High temperature protection contactor	3ALL100M09N3A
9	Max. temperature safety thermostat	3IMTC542163/2
10	Heating signal lamp	3SGN2132220FL (230V- green lamp) 3SGN51F9VE (lampholder)
11	Max. Temperature lamp	3SGN2132220 (230V - lamp) 3SGN51F9RO (lampholder)
12	Min. Level lamp	3SGN213224 (24V - lamp) 3SGN51F9RO (lampholder)
13	230/24V Transformer for level	3ABBTM1524
14	Min. level protection relay	4CDCTV4824
15	Min. level sensor	6ELTLM21A130S
16	Mixer group - BK40M model	9DC894
16a	Mixer motor	3D1098
17	Heater element	3DC892
18	Pt100 probe	3DC346
19	Switch Test – plugs	3B&BPAN10A
19.1	Switch Test – signal lamp	3SGN-24.00
21	Plugs for External probe & Reference probe	4ED20011 (card) 3B&BPAN10A (plugs)
22	Cooling group - BT4412 model (A ventilator - B condenser - C compressor - D protection relay)	3IEFBT4412
23	5A filter for cooling group	3FMT823005F
24	Varistor for cooling group	3MRC20D391
25	Drain tank valve + connection F. tube 12-3/8”	5FFB1511C4 + 5FRG12-3/8
26	Over flow (ø16x1.5 tube)	5FFB6980C8 (Connection M.3/8)

10.5- Declaration of conformity and check report

The declaration of conformity CE is at the end of the manual, the test report is included with the calibrator

10.6 - Drawing and wiring diagram

The drawings are at the end of the manual

”Declaration of conformity”

DRUCK & TEMPERATUR Leitenberger GmbH
Bahnhofstr. 33, D-72138 Kirchentellinsfurt, GERMANY

Declares that the: **THERMOSTATIC BATH** **LR-*Cal* BK40-M & LR-*Cal* BK40-M-2I**

is conforms with the requirements of the following European directive:

- Machine’s directive 2006/42/CE.
- Low voltage directive 2006/95/CE.
- EMC directive 2004/108/CE.

and that it has been designed in accordance with the following harmonized regulation:

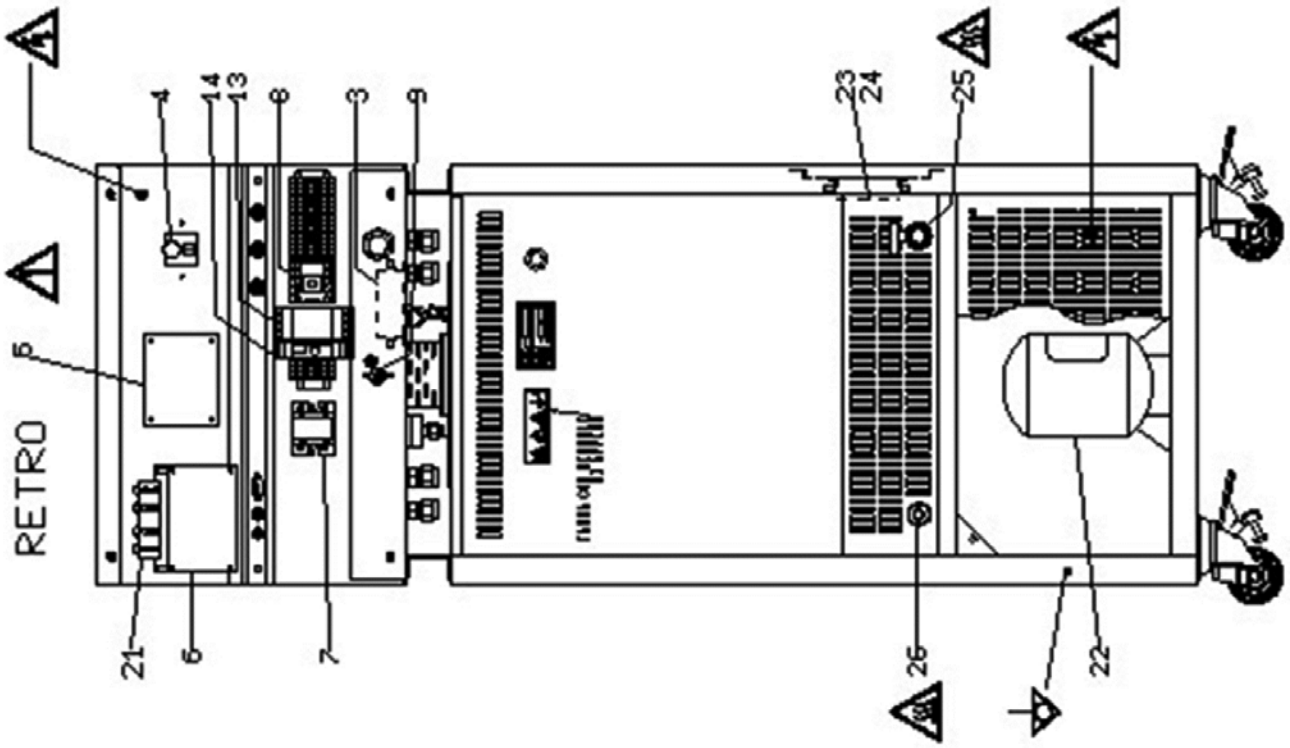
- EN 60204-1 Safety of the machinery and the machine’s electrical equipment.
- EN 61010-1 Safety rules for the electrical measuring and control equipment for laboratory use

The conformity with the above-mentioned requirements is certified by affixing the CE Mark on the product.

DRUCK & TEMPERATUR Leitenberger GmbH
D-72138 Kirchentellinsfurt / GERMANY

i.V.

(Gerd Broglie / Sales Director)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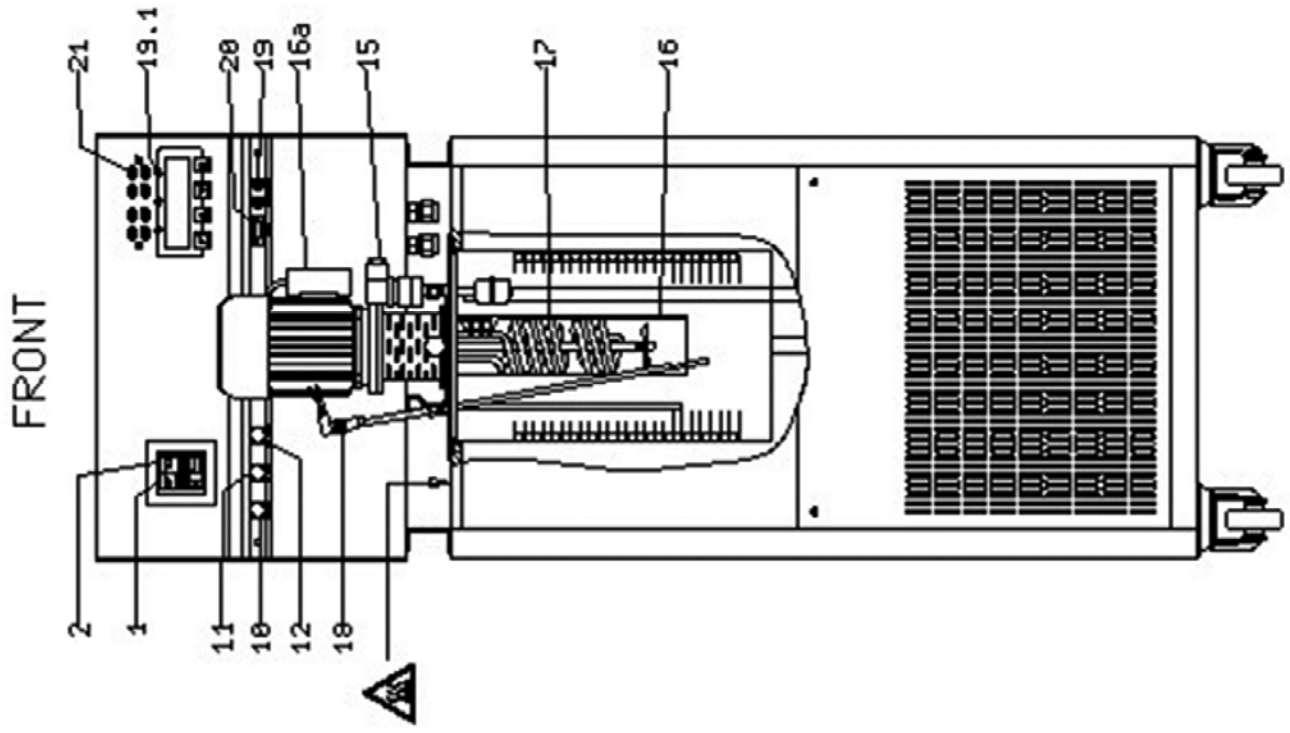
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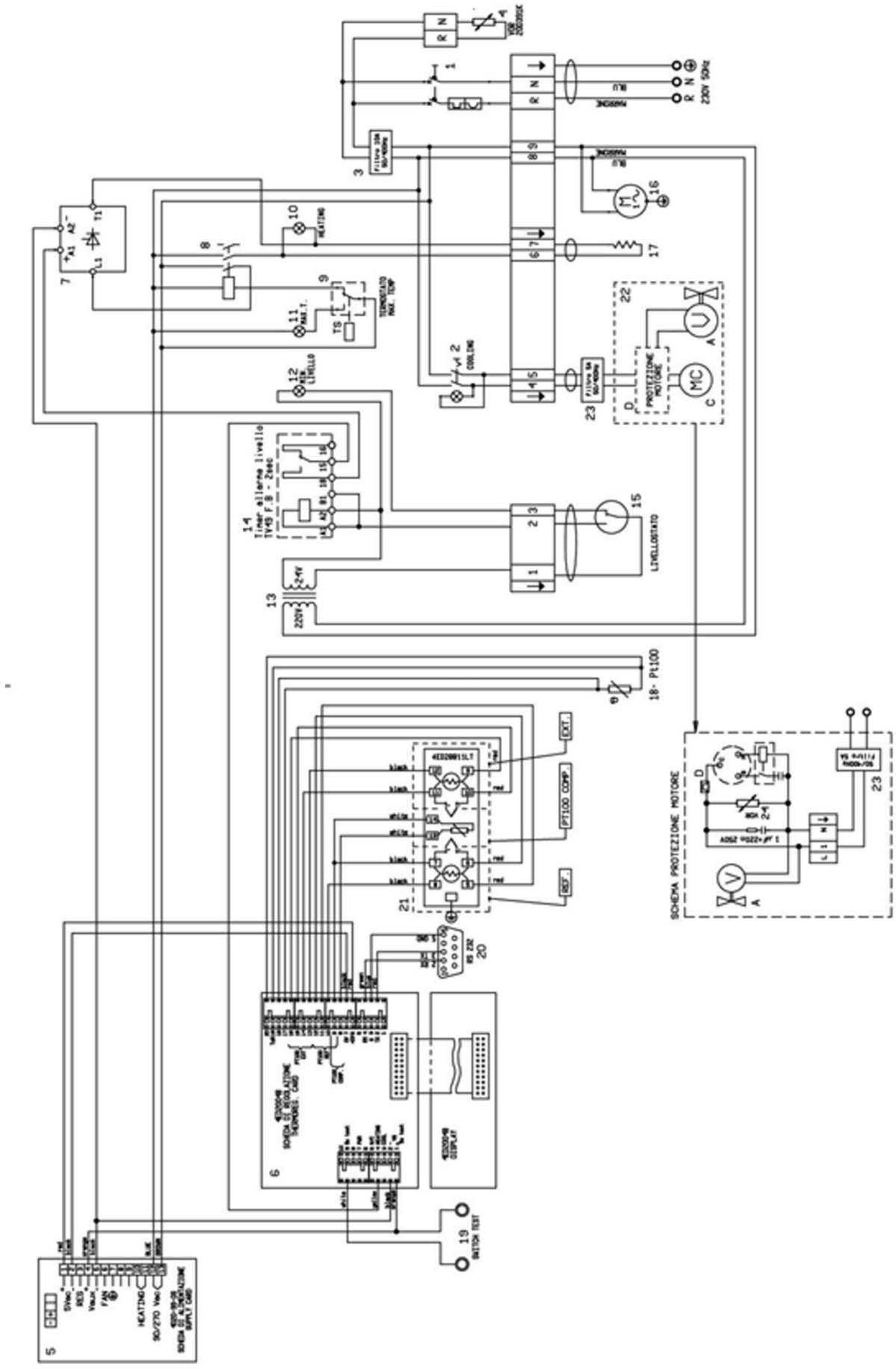
SCHEMA PROTEZIONE MOTORE
PT100 COMP
EXT.
REF.
LIVELLOSTATO
18- Pt100
RS 232
HEATING
230/270 Vac
BUTTON TEST