USER-MANUAL

TV2000MKII,
TV4000MKII,
TV4000MKIIDC
TV17000

Tamson Instruments bv

Van 't Hoffstraat 12
2665 JL Bleiswijk, The Netherlands
T. 31 (0) 10 522 43 73
E-mail: sales@tamson.com
Website: www.tamson.com

VAT: NL 80 66 34 984 B01
Bank account no.:
NL28 INGB 0007 350 370
NL95 RABO 0160100046
Chamber of commerce 27 16 95 41

1 SAFETY AND WARNINGS

Make sure before installing or operating the equipment to read and understand all instructions and safety precautions listed in this manual. If there are any questions concerning the operation of the equipment or about the information given in this manual please contact your local dealer or our sales department first.

Performance of installation, operation, or maintenance other than those described in this manual may result in a hazardous situation and may void the manufacturer's warranty.

Never operate equipment that is not correctly installed. Unqualified personnel must not operate the equipment. Avoid damage to the equipment, or its accessories, caused by incorrect operation.

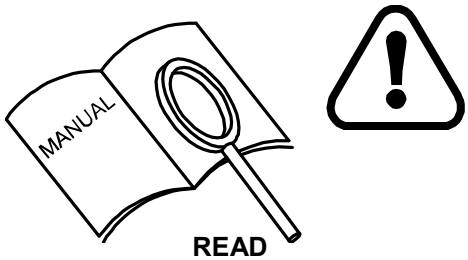
Important:
- When performing service, maintenance or moving the apparatus, always disconnect the apparatus at the main's socket,
- Proper skilled and trained personnel are only allowed to operate this equipment,
- Take notice of warning labels and never remove them,
- Refer service and repairs to qualified technician,
- If a problem persists, call your supplier or Tamson Instruments bv.

2 WARRANTY

Tamson Instruments bv. warrants that all their manufactured equipment is free from defects in material and workmanship, preventing the machine from normal operation. Tamson Instruments bv does not warranty that the equipment is fit for any other use than stated in this manual. The manufacturer can only be held responsible for the security, reliability and performance of the equipment, when operated in accordance with the operating instructions, extensions, adjustments, changes and/or if repair is performed by Tamson Instruments bv. or authorized persons only. This warranty is limited to one year from the date of invoicing. All equipment and materials are subject to standard production tolerances and variations.

3 PRECAUTIONS AND HAZARDS

Before attempting to operate the bath read all parts of this manual carefully to insure smooth operation and avoid damage to the equipment or its accessories.



READ CAREFULLY

If a malfunction occurs, consult section **"Fout! Verwijzingsbron niet gevonden.**", page**Fout! Bladwijzer niet gedefinieerd.** at the end of this manual. If problem persists, call your supplier or Tamson Instruments bv. Never operate the equipment if not correctly installed. The equipment must be operated only by qualified personnel. Avoid damage to the equipment or its accessories through incorrect operation.

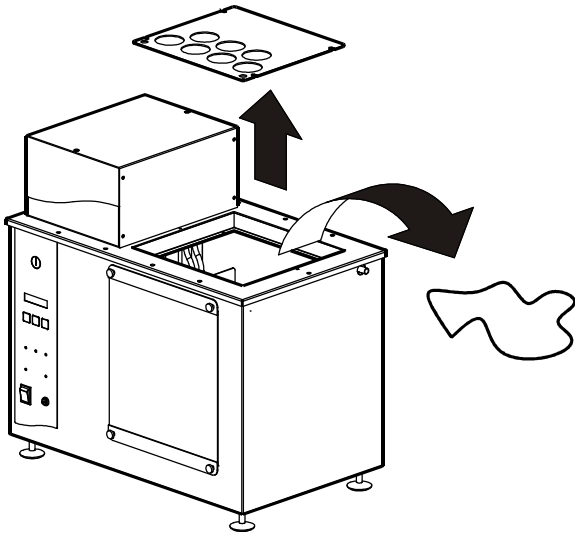
4 INSTALLATION

4.1 Important

Tamson Instruments bv is not responsible for any consequential damage or harm caused by using this bath. Repairs on the electrical system of the bath may only be carried out by well trained and authorized persons.

4.2 Unpacking

Before leaving the factory Tamson baths are adequately packed to prevent damage during normal transportation. Check the packing for external damage and make a note on the shipping documents if any damage is found. Always retain the cartons and packing material until the bath has been tested and found in good condition. (Transport companies generally will not honor a claim for damage if the respective packing material is not available for examination).



REMOVE ALL PACKAGE MATERIAL

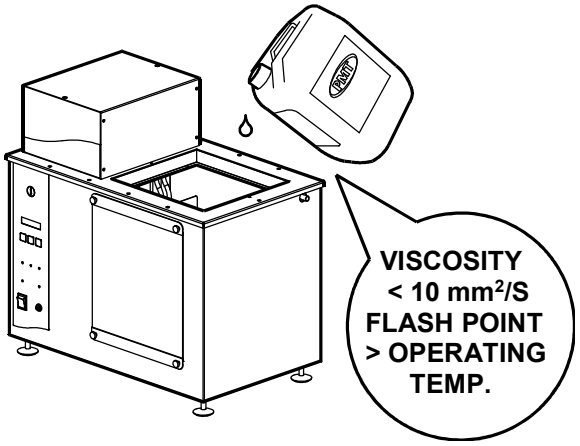
The shipment contains at least the bath as mentioned in the delivery checklist. Further the consignment might contain one or more viscometers, individually packed in small boxes with the calibration certificate included in the box, as well as ASTM thermometers, thermometer holders etc. Please see the packing list for details concerning total contents of consignment.

Before filling the bath remove any remaining packing material from its interior. The interior of the bath can be accessed by taking off the lid on the top of the bath.

4.3 Bath Liquid

The bath must be filled with a liquid suitable for the minimum operating temperature.

It is very important to select a liquid with a viscosity preferably less (e.g. 10 mm²/S) at the operating temperature and a flash point which is well above the operating temperature.



The use of other liquids is allowed as long as the viscosity of the fluid is low enough at the operating temperature. Following products can not be used as bath fluid:

- Distilled water,
- Aggressive fluids when in contact with stainless steel 304, 316, glass, brass, and silicon sealing.

The fluid flash point must be well above the maximum operating temperature.

4.4 Drainage of Bath Liquid

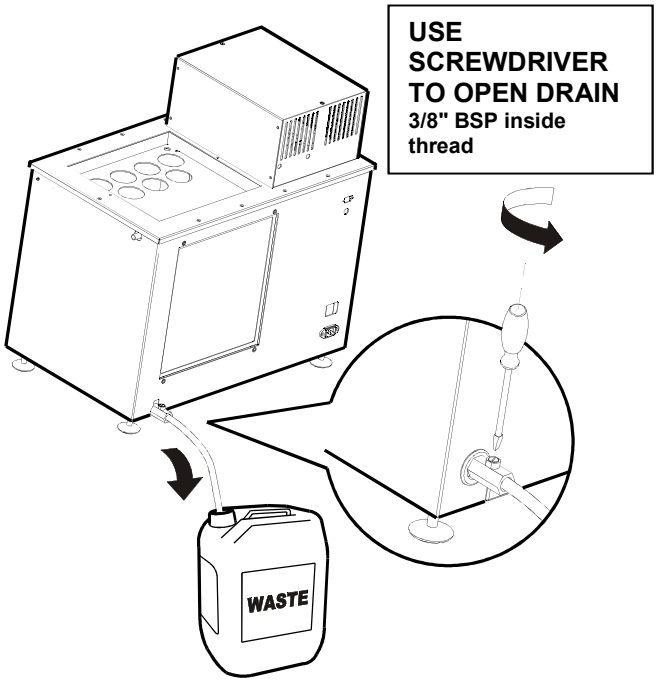
The bath can be emptied via the drain tap located at the backside of the apparatus. For safety reasons the tap can only be opened by using a screwdriver. The thread inside the tap is 3/8".

Take necessary precautions against fire hazard when removing flamable bath fluid.

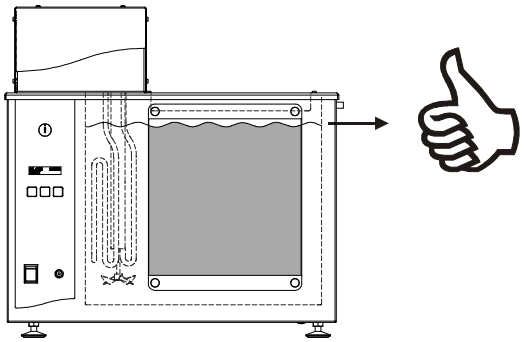
When removing bath fluid do not inhale toxic vapor. Always use appropriate ventilation.

Handle old bath fluid as toxic waste.

Cool down bath fluid to ambient before removing.



4.5 Fluid Level



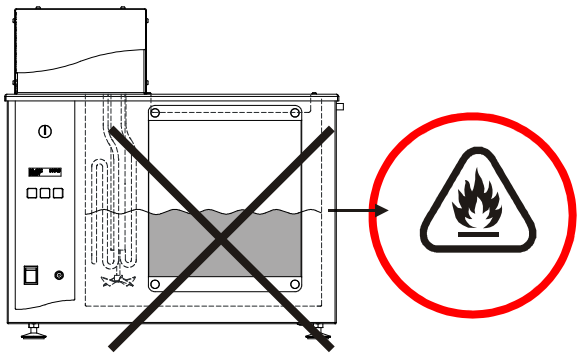
Do not operate the bath with low fluid level.

When the fluid level is too low, bath fluid will vaporize leading to toxic and flamable fumes.

Flamable fumes can lead to fire

Flamable fumes can be ignited bij the not submersed part of the heating element.

The level indicator(optional) will start to blink (blue light) when the fluid level is too low.

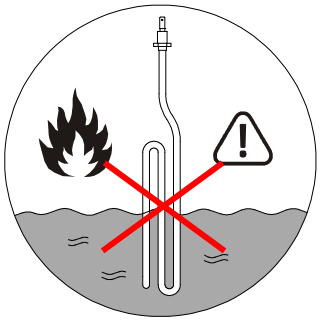


When the bath has been installed it must be filled with an appropriate liquid. When working with water the bath should be filled to 1 cm below the lid. For oil the bath should be filled to not more than 5 cm below the lid. Depending on the operating temperature the liquid level in the bath should be observed and excessive fluid should be removed.

The liquid level should be maintained between 1 and 3 cm below the lid during normal operation.

The heating element will be damaged when not fully submerged in the bath fluid. A lower level than 5 cm below the lid may damage the heaters. A high bath level can cause overflow and will might also damage the bath insulation.

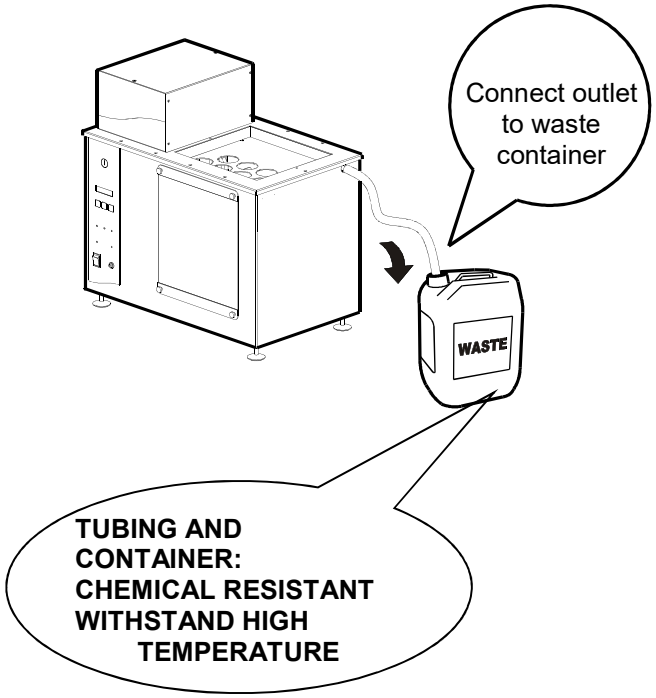
Low fluid level
- **Can cause fire when heater get's partially exposed**
- **Will damage the heater**



4.6 Maximum Level

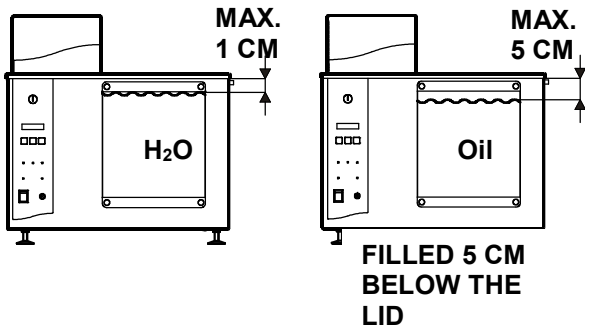
If the fluid level is too high, it will leave the bath via the overflow outlet (10mm outside diameter pipe). Prevent fluid from the overflow outlet entering the backside of the TV7000. For this reason the overflow outlet must be connected to a waste container.

When the bath is working at high temperatures, tubing and waste container must be chemical resistant and able to withstand high temperatures (>150°C / 302°F).



When the bath has been installed it must be filled with an appropriate liquid. When working with water the bath should be filled to 1 cm below the lid. For oil the bath should be filled to not more than 5 cm below the lid. Depending on the operating temperature the liquid level in the bath should be observed and excessive fluid should be removed.

The liquid level should be maintained between 1 and 3 cm below the lid during normal operation.
A lower level than 5 cm below the lid may damage the heaters. A high bath level can cause overflow and might also damage the bath insulation.



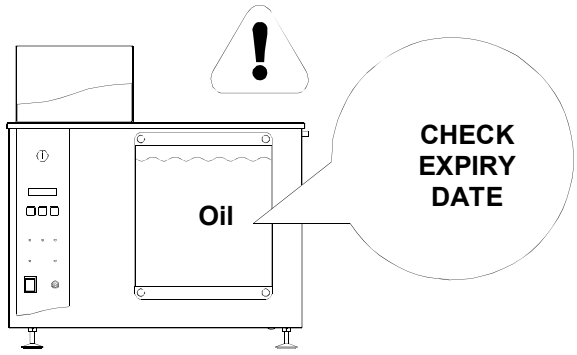
4.7 Bath Fluids and use

We recommend the use of the following liquids for the respective ranges:

Recommended bath fluids		
Range	Ordering code	Description
Ambient to 80°C/176°F	N.A.	Clean tap water (preferably de-carbonized) **Do not use DISTILLED. Filtered water by reversed osmoses can be used without problem.**
80..150°C / 176..302°F	00T0220 (20 ltrs)	Tamson mineral oil 150. Transparent, 4 mm^2/S @ 80°C/176°F; 3 mm^2/S @ 150°C/302°F; F.P. 200°C/392°F.
20..150°C / 176..302°F	08T0001 (20 ltrs)	Silicon oil 200-10, transparent. 10 mm^2/S @ 25°C/77°F; 2 mm^2/S @ 150°C/301°F. F.P. 315°C/599°F. When not polluted lifetime is unrestricted.
150..230°C / 302..446°F	00T0238 (20 ltrs)	Silicon oil 550, transparent. 150 mm^2/S @ 50°C/122°F; 6 mm^2/S @ 150°C/302°F. F.P. 315°C/599°F. Lifetime at 200°C/392°F is 1year, at 250°C/482°F 1200hrs (when not polluted)

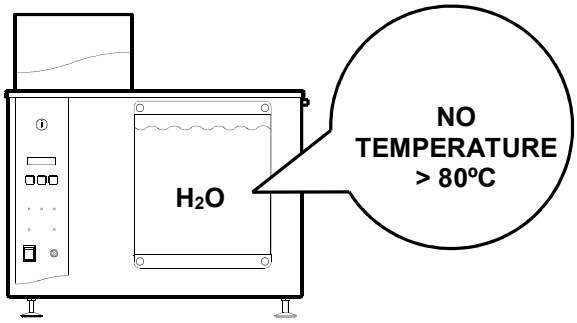
The oil used has a limited lifetime.

The type brand and operating temperature mainly determines lifetime. Spilling of sample may also reduce lifetime and in some cases can start chemical reactions. Silicon oil has the tendency to form gel, for this reason silicon oil has to be replaced as soon as visible changes like string forming are noticed. Within a few hours silicon oil can transform itself into solid gel, which is very difficult to remove. When not totally cleaned, very small pieces of left over gel will catalyse new oil to form gel!

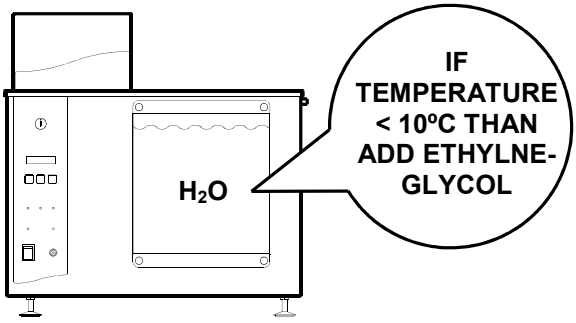


Do not use distilled water. This will cause corrosion and wear of stirrer bearings.

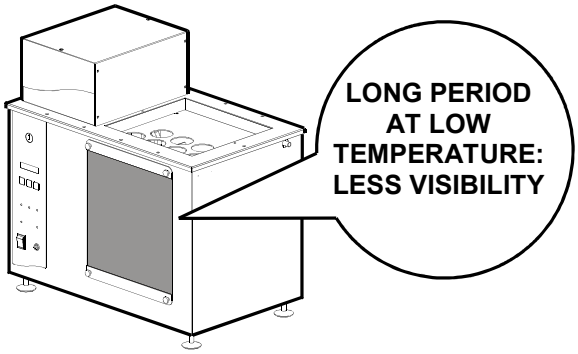
Only use water as a bath fluid below 80°C/175°F. Working for a longer period with water at temperatures above 80°C will damage the stirrer bearings.



When working at temperatures below 10°C / 50°F ethylene-glycol should be added to the water. For example, in the volume proportion of 50 / 50%.

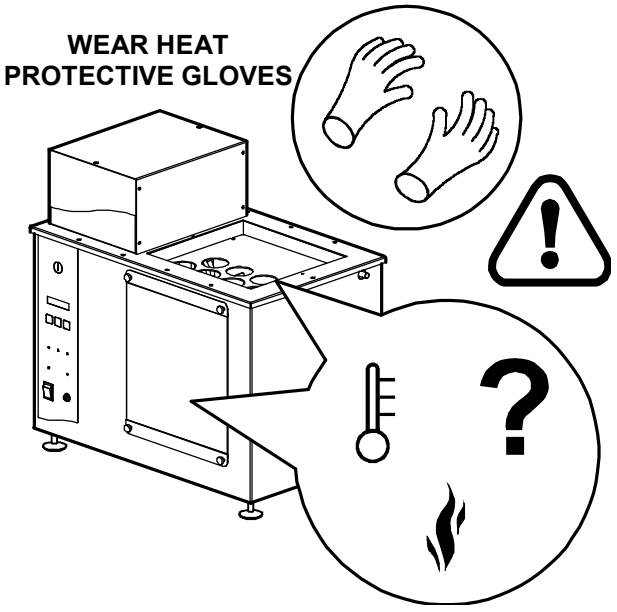


Using the bath for long periods at low temperatures will cause condensation on the glass window.



5 FURTHER SAFETY PRECAUTIONS

When operating at high temperatures the lid (of the bath) top plate and the window section of the bath become very hot. Always use heat protective gloves. Care must be taken when placing or re-moving material from the bath.

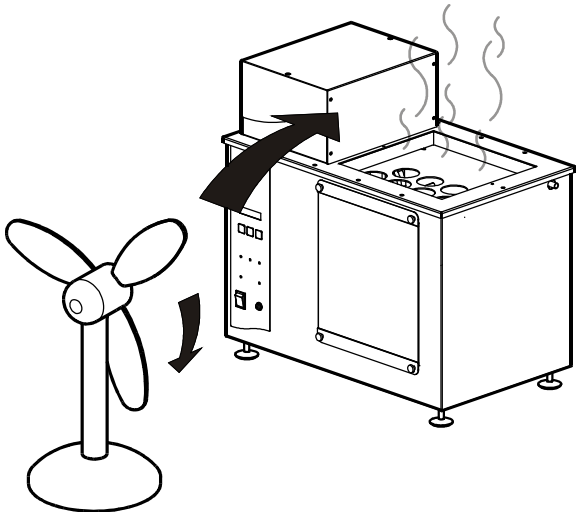


Pay attention when removing hot fluid:

Use heat protective clothing and wear safety glasses.

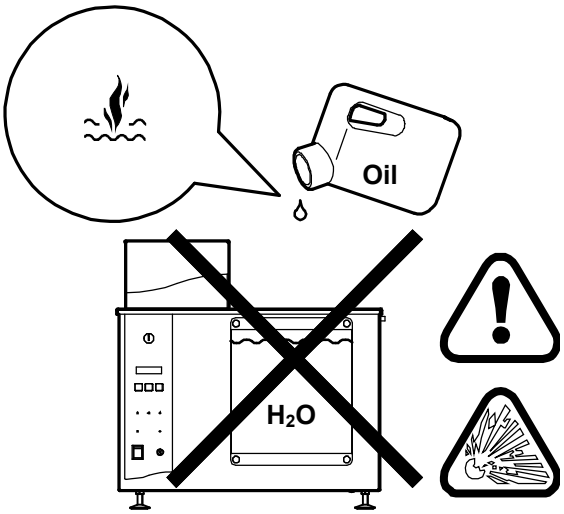
Use proper ventilation
Heated bath fluids can cause toxic fumes.

Remove fumes from hot oil or bath medium. Use fume cabinet or proper air ventilation.

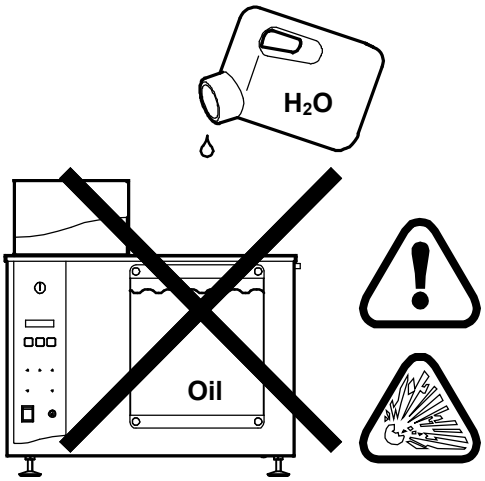


When changing the bath fluid from water to oil for operating at temperatures above 80°C, completely remove all the water from the bath. Small drops of water may result in hazardous situations while reheating the bath with oil.

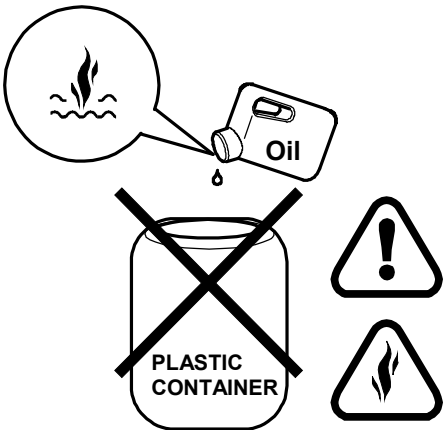
Water and oil must at all times be kept separate within the bath. Never mix oil and water in or around the bath.



Do not spill water in hot oil.



Never empty hot oil into a plastic container.

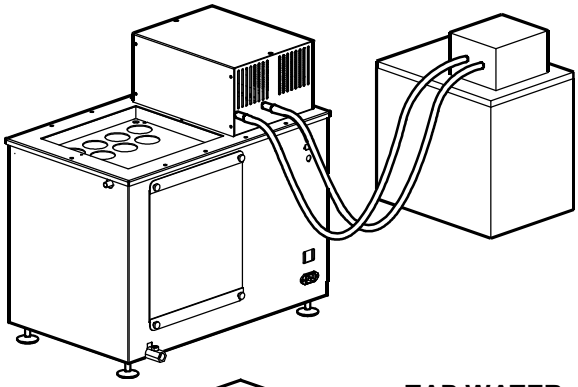


5.1 Cooling

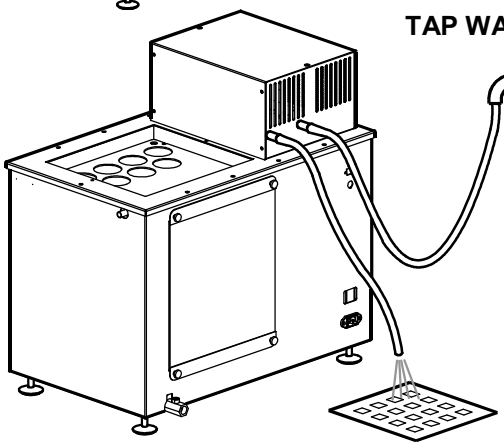
The bath is provided with an integral cooling coil. Because of the friction-heat generated by the stirrer mechanism the bath will heat-up slowly. The lowest operating temperature at which the bath can be controlled depends on the fluid used and the ambient temperature. When operating at lower temperatures it will be necessary to pass cooling liquid from a cooling circulator (TLC10-3 or TLC15-5) or tap water through the cooling coil. As an example to operate at 40°C / 104°F with an ambient temperature of 21°C / 70 °F and a cooling water temperature of approx. 16°C / 60.8°F an amount of 100 to 200 ml/min. is sufficient for a stable control of the bath temperature.

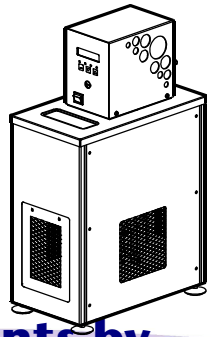
Sufficient cooling power is applied when the indicated power exceeds 8% on the display. The bath will than be able to realise stable temperature control.

COOLING CIRCULATOR:
TLC10 or TLC15



TAP WATER



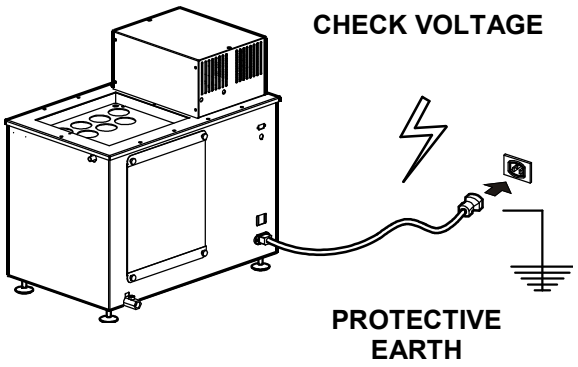


Cooling circulator
TLC10-3

5.2 Connecting

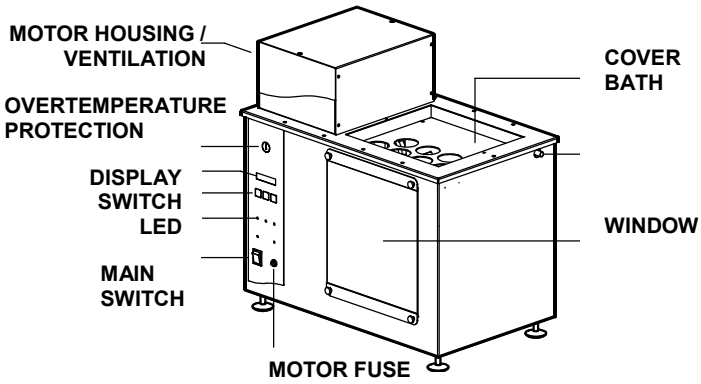
Before plugging the bath into mains socket, make sure the voltage of the bath corresponds to the local voltage.

Use a mains supply that is well earthed, clean of interference and suitable for the acquired electrical load of the bath.



6 GENERAL

The TV-series is intended for temperature control of applications requiring a high degree of stability over a broad temperature range. The robust construction including advanced safety features give the bath a range of wide application.



The heat input is controlled by a microprocessor system. A special optimized electronic temperature measurement circuit ensures an extremely high degree of accuracy and reproducibility of operation conditions.

The baths feature a standard RS232C interface for communication with a computer. Please download our free communication software "Tamcom" from the website.

The baths standard features include an integrated cooling coil enabling for rapid reduction of its temperature or alternatively enabling control around or slightly below ambient temperature.

6.1 Construction

The TAMSON baths are constructed entirely from corrosion-resistant materials such as stainless steel brass and teflon.

A thick layer of rock wool between the inner bath and outer casing ensure effective insulation. It improves temperature stability and lowers the casing temperature when the instrument is used at high bath temperatures.

The central microprocessor within the control module manages and controls, the functions for temperature measuring regulation, program storage, safety control and error coding.

6.2 Temperature control and setting

The bath temperature is regulated using a PT100 temperature probe which is connected to a microprocessor module. The advanced electronic control system continually computes the energy input required for optimal temperature accuracy and stability. The controller will activate the heaters partially or in full, taking into account the difference between actual bath temperature and set point.

The required temperature is set by three membrane switches on the front panel. Read-out is on LCD. An absolute temperature offset is provided with a resolution of 0.01°C (0.001°C for the TV4000MKIIDC) and a specific offset of 0.005°C is available from the menu. This

finetuning can be carried out at any time during operation of the bath.

6.3 RS232C Control

A RS232C, bi-directional communication interface (300 to 38400 Baud) is integrated as standard, and offers the possibility of computerised control.

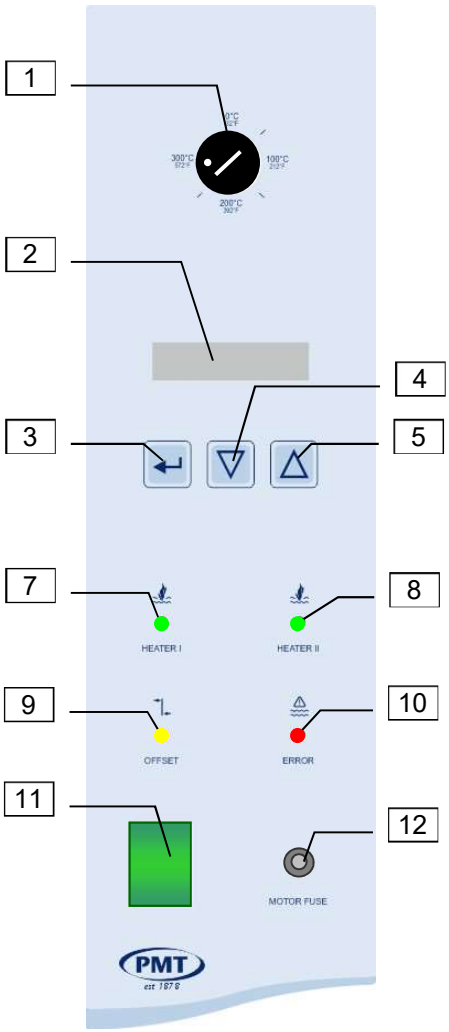
6.4 Safety systems

A number of precautions is provided to ensure a safe around the clock working of the bath. These features protect the equipment, the bath fluid temperature and the workplace. A mechanical over-temperature protection thermostat (1) will automatically switch-off the entire bath when its maximum value is exceeded. This maximum temperature can be manually adjusted from 50°C up to 270°C.

A thermal protection of the stirrer mechanism (13) will switch-off the motor in case of malfunction. Both thermostat and motor-fuse can easily be accessed. A large number of integral electronic safety checks will cause the bath to shut-down in case of electronic or electrical error (11). Any kind of activated safety system will be attended with an acoustic and visible alarm. On the front display operating faults or component failures, are reported as numbered 'errors'. In this way there is a continual check of the proper functioning of the bath.

6.5 Front panel layout

Item	Description	Function
1	Thermostat	Over-temperature protection
2	Display	Shows bath parameters
3	Switch	Menu
4	Switch	Down
5	Switch	Up
7	LED	Heater I
8	LED	Heater II
9	LED	Offset entered
10	LED	System - Error
11	Switch	Mains switch
12	Fuse	Protects stirrer motor

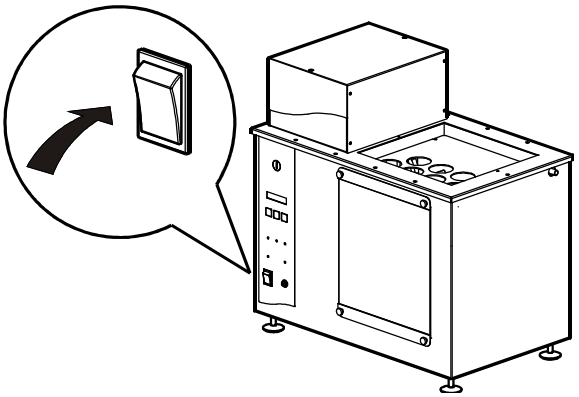


7 OPERATING THE BATH

When the bath is ready for use it can be switched on by pressing the mains switch. The bath will initialise and calibrate itself.

7.1 Overview menu items

- Set point
- Offset (press: <-5.00 .. +5.00°C resolution 0.01°C)
- Max Power (press: low, med, hi, max)
- Boost heater (press on / off)
- Time const. (press: fast, medium slow, precise)
- PID parameter :
  PID set 1,
  PID set 2,
  PID set 3,
  PID set 4, for use with RS232
  Each PID set offers settings for
  - Proportional band value
  (Pb=1/P where P is proportional value)
  - Integral value
  - Differential value
- Backlight (LCD)
- Temp units
- Baudrate
- SP Offset
- Restart



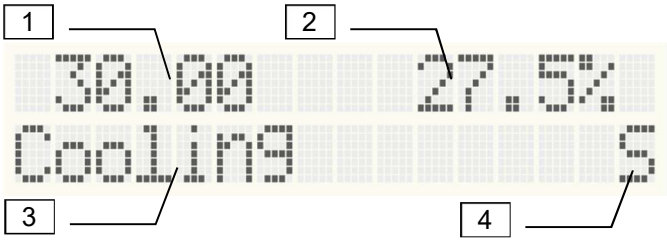
7.2 Safety thermostat

When the bath temperature becomes higher than the set point temperature of the safety thermostat. The heating electronics and controller are switched-off. The red LED on the display will light. When the temperature of the bath has been lowered with approximately 20°K, the thermostat re-sets itself automatically, however to continue normal operation the bath has to be switched off and on again.

When switching-off wait 5 seconds before switching on again.

7.3 Display

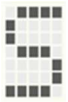
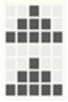
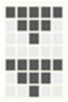
[1] Temperature readout
[2] Applied percentage of power
[3] Operating mode
[4] Indicator, alarm high, alarm low, control stable



Ad 1: When the controller starts or is restarted, the displayed value increases to a stable readout appears after a few seconds.
Ad 2: The controller calculates every second the amount of power which should be applied for stable control. The value is displayed with a resolution of 0.1% and ranges from 0% to 99.9%.

Ad 3:	Boost	Bath is heating to set point using boost heater
	Heating	Bath is heating to set point, boost heater is off
	Cooling	Bath is cooling down to set point
	Tuning Ratio	Bath is tuning for power needed at set point, first step
	Tuning SA	Bath is tuning, second step
	PID SP=25.00	Bath is controlling, set point is 25.00°C (example)

Ad 4:

- Bath control is stable 
- Alarm high, press button to reset* 
- Alarm low, press button to reset* 

* Optional item

7.4 Quick Start

To start operating the bath in a quick way do the following:

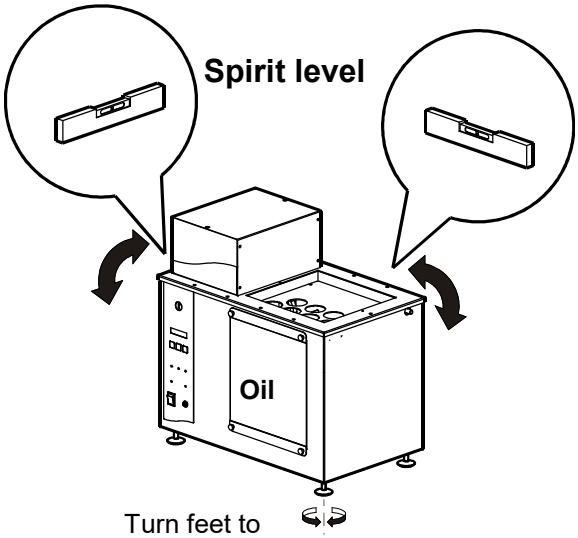
Fill the bath with liquid as indicated, place the power plug, connect to mains socket, switch-on the bath, using the mains switch, select appropriate set point.

PID settings
All measuring results have been acquired using following PID settings:

Pb	:=	25
I	:=	16
D	:=	0

Under different settings its possible to achieve even better values by trimming the PID settings.

Place the bath spirit level. The 4 supporting feet can be turned in and outwards for exact adjustment.



Turn feet to adjust bath spirit level

8 Menu items

The menu items can be operated using the three front panel button. Use the left button to select the item, than change the parameter using the "up" and "down" key. By pressing the menu button the changes are activated immediately. When the value is altered but the button is not pressed the value will be accepted and stored after approximately 5 seconds, and the menu will returns back to normal operating mode.

Menu item "Set point"
This item will set the bath temperature. It can be set in steps of 0.01°C.

Menu item "Offset"
The temperature displayed can be increased or decreased with an offset ranging from +5.00 down to -5.00 in steps of 0.01°C.

The offset will synchronise the bath temperature readout with an independent separate thermometer.

In addition a special offset of 0.005°C can be set using the item "SP offset".

Menu item "Max Power"
(press: low, med, hi, max)
Limits the applied power by a maximum value:

Low	Maximum of 25% applied
Medium	Maximum of 50% applied
High	Maximum of 75% applied
Maximum	100% power is applied

Menu item "Boost heater"
A secondary heater is used to quickly heat up the bath. This menu item enables or disables the heater.
Standard value: On

Menu item "Time const."
Used to select time to tune. The option precise has to be used to reach maximum temperature accuracy. Options are:

- Fast	60 seconds
- Medium	120 seconds
- Slow	180 seconds
- Precise	240 seconds
Standard value:	Precise

*** Menu item "Stirrer"**
Optional: Stirrer 0 .. 100% (step 6%). Inactive

*** Menu item "Low alarm"**

Optional: min SP to max SP. resolution 0.1°C. No hardware connected, display function only.

"Menu item "High alarm"

Optional: min SP to max SP. resolution 0.1°C. No hardware connected, display function only.

* Optional

Menu item "PID parameter"

PID set 1	-	First set of parameters
PID set 2	-	Second set of parameters
PID set 3	-	Third set of parameters
PID set 4	-	Activated when communication via RS232

Each set offers individual PID settings for:
Proportional band value
Integrating value
Differentiating value

Default settings

Pb*	:=	25
I	:=	16
D	:=	0

*Pb= proportional band. Proportional value P is found to be 100/Pb.

Menu item "Backlight"

On
Off
Standard value: On

Menu item "Temp units"

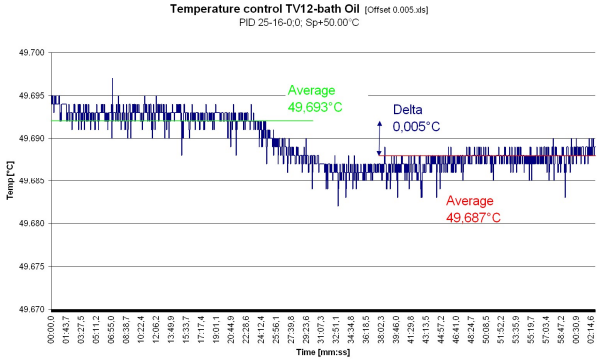
°C
°F
Standard value: °C

Menu item "Baudrate"

300
600
1200
2400
4800
9600
19200
38400
Standard value: 9600

Menu item "Offset 0.005"

This menu item offers an additional offset of 0.005°C. The value of 0.005°C is added to the selected SP value. The SP can be selected with 0.01°C accuracy.



Menu item "Restart"

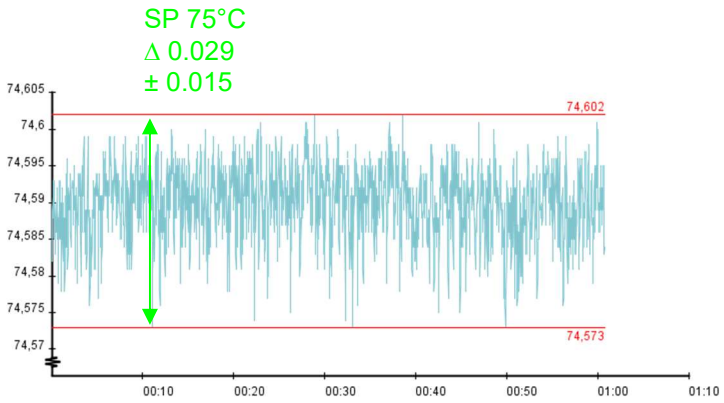
Restarts system and activates tuning

8.1 PID settings

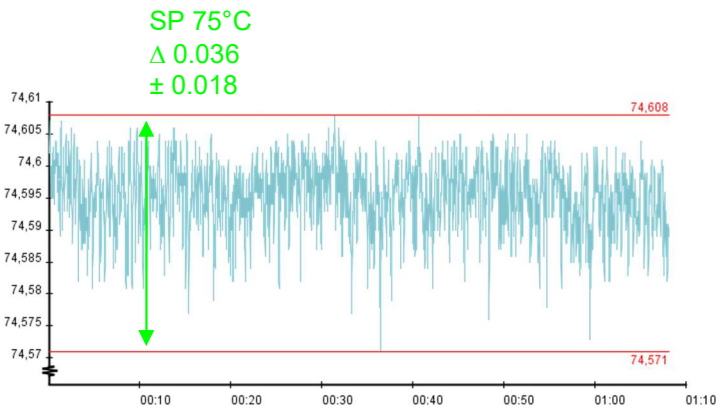
Default settings P = 2 .. 25
I = 0 .. 25
D = 0

Following shows influence on stability with different PID settings

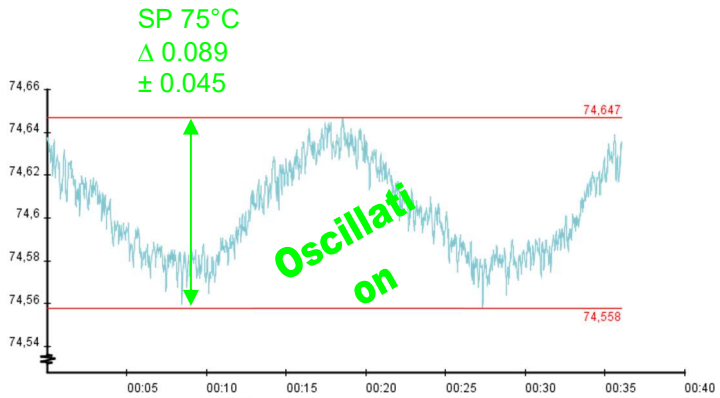
Temperature	:	75°C
Proportional band (Pb)	:	25
Integrator	:	16
Differentiator	:	0
Min/max	:	± 0.015



Temperature	:	75°C
Proportional band (Pb)	:	50
Integrator	:	25
Differentiator	:	0
Min/max	:	± 0.018°C

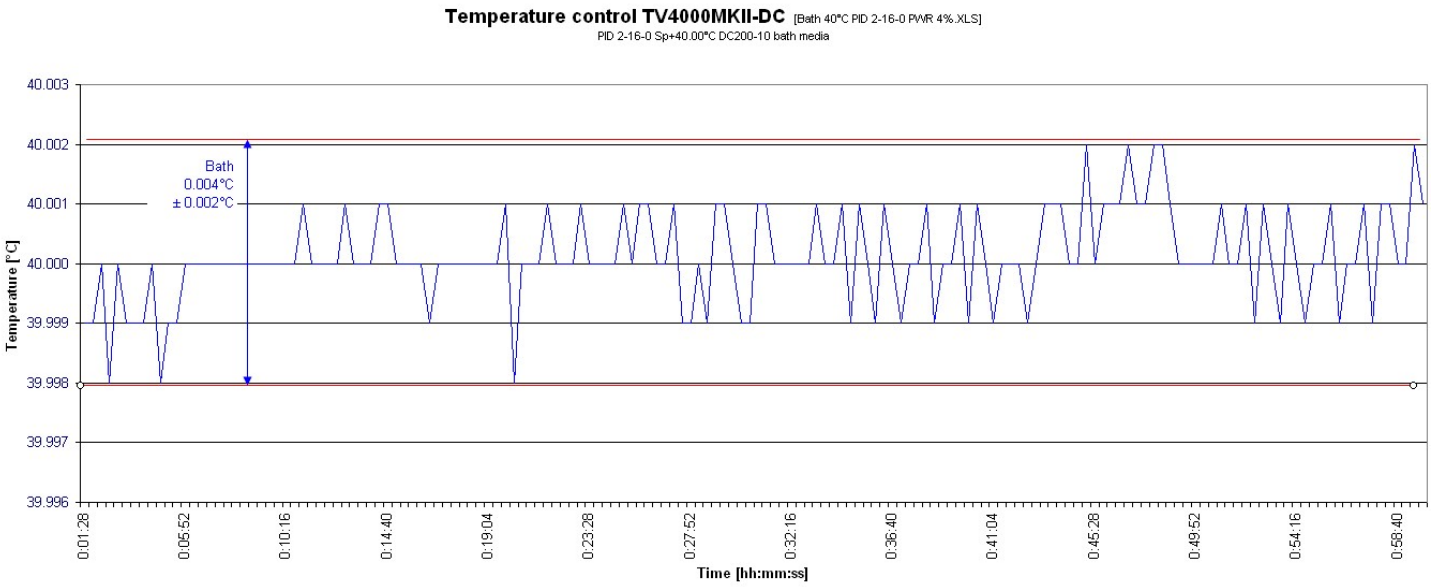


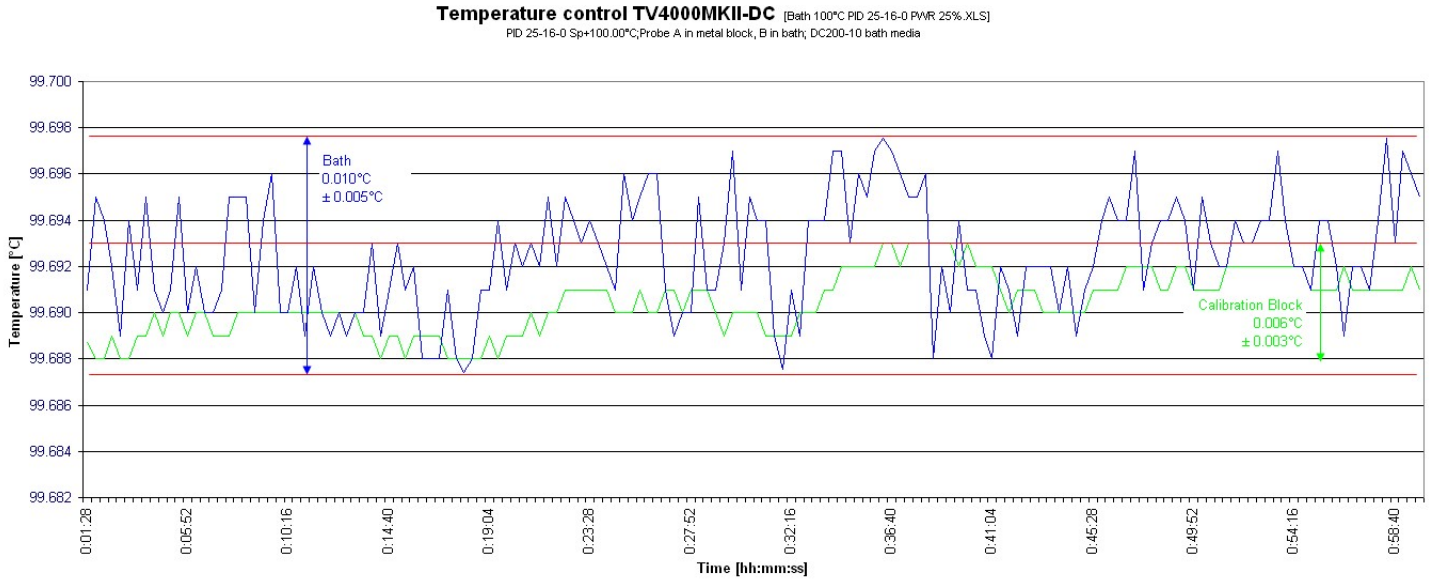
Temperature	:	75°C
Proportional band (Pb)	:	100
Integrator	:	25
Differentiator	:	0
Min/max	:	± 0.045°C

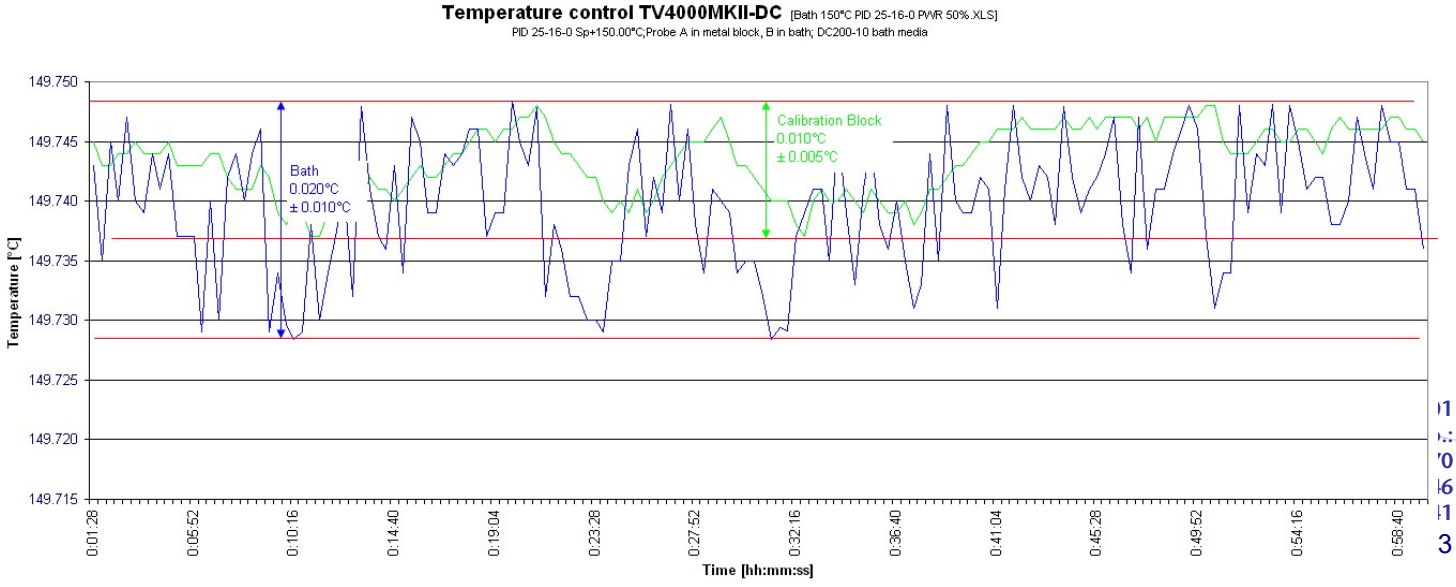


8.2 TV4000MKII DC stability

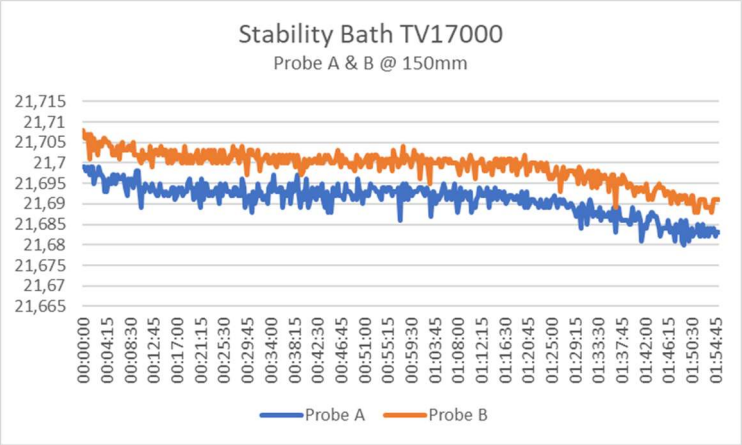
Bath temperature
Temperature measured in calibration block
Measurements have been performed with silicone oil <3 mm²/S @ set point temperature





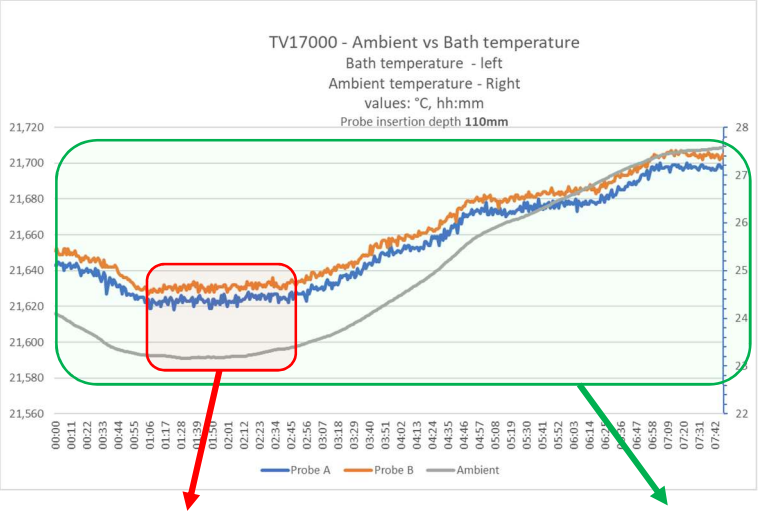


8.3 Stability TV17000



Stability bath Probe A & B @ 150mm	Probe A	Probe B	
Max	21,699	21,708	°C
Min	21,680	21,688	°C
Δ	**0,019**	**0,020**	°C
±	**0,010**	**0,010**	°C
stDev	**0,003848**	**0,003843**	°C
Duration	02:05		[hh:mm]

8.4 Influence ambient temperature TV17000

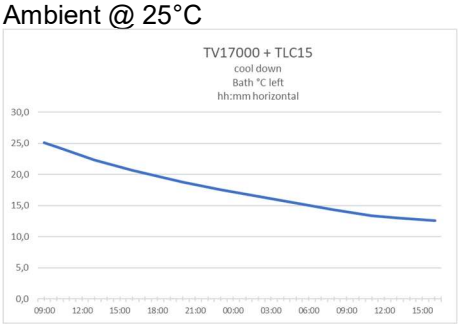


Stability when ambient Δ<0,2°C	Probe A	Probe B	Ambient	
Max	21,628	21,636	23,344	°C
Min	21,618	21,628	23,168	°C
Δ	**0,010**	**0,008**	0,176	°C
±	**0,005**	**0,004**	0,088	°C
stdev	0,002156	0,001664	0,0437	°C
Duration		01:28		[hh:mm]

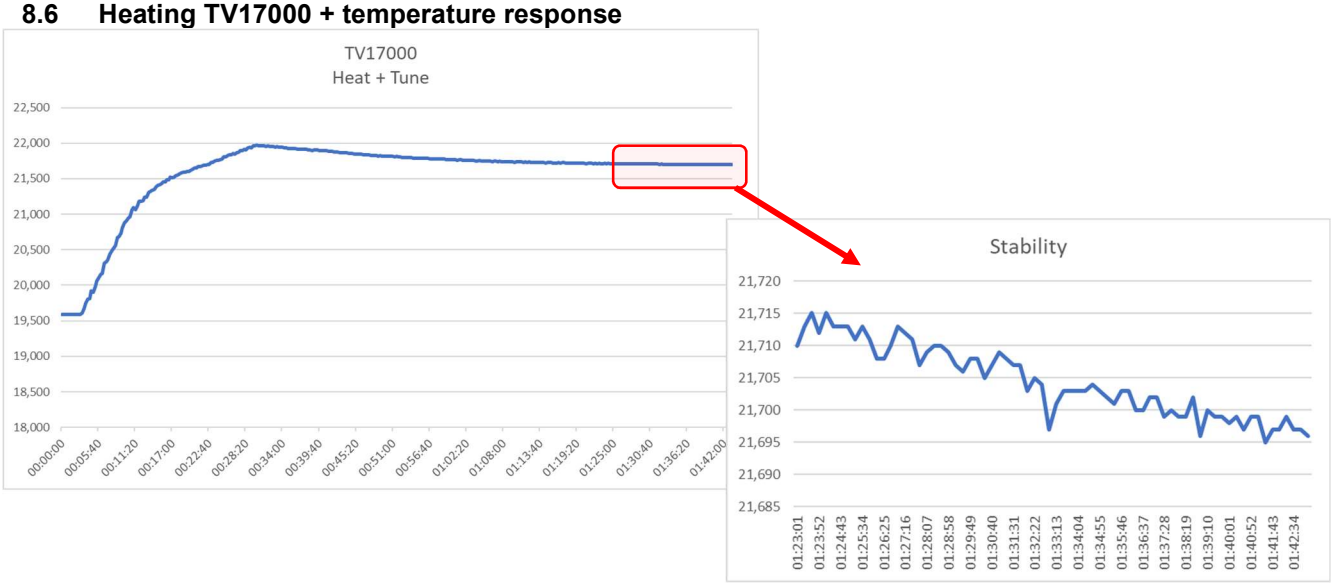
Stability over 7:42 hrs	Probe A	Probe B	Ambient	
Max	21,700	21,707	27,573	°C
Min	21,618	21,627	23,168	°C
Δ	0,082	0,080	4,405	°C
±	00:59	00:57	2,203	°C
stdev	00:38	00:37		°C
Duration		07:48		hh:mm

8.5 Cooldown TV17000 + TLC15 chiller

Ambient @ 25°C



8.6 Heating TV17000 + temperature response



8.7 Manual tuning

The parameters for the PID control can be changed manually.

The control of the PID parameters allow setting of the I and D values to zero. The bath will then function as a proportional system. The “P” parameter can than be varied to an optimal value by trial and error. A higher P will stabilize the system when I and D are off. The PID parameters can also be determined with the use of the Ziegler Nichols method described below.

Set the integral time “Ti” and the derivative Time “Td” to off.

Ignore the fact that the temperature may not settle precisely at the set point. If the temperature is stable, reduce the proportional band Pb so that the temperature just starts to oscillate. If the temperature is already oscillating, increase the proportional band until it begins oscillating. Allow enough time between each adjustment for the loop to stabilize. Make a note of the proportional band value “B” and the period of oscillation “T” Set the Pb, Ti and Td parameter values according to the calculations given in the table below:

Type of control	Proportional band	Integral time "**ti**"	Derivative Time "**td**"
Proportional only	2xB	Off	Off
P + I control	2,2xB	0,8xT	Off
P + I + D control	1,7xB	0,5xT	0,12xT

9 TROUBLE SHOOTING

9.1 Safety devices

The controller is equipped with a number of safety devices which switch off the bath to prevent excessive temperature rise or malfunction. The safety devices are divided in mechanical and electronic parts. The mechanical over-temperature safety thermostat is located near the mains switch and consists of an adjustable thermostat. The desired temperature at which the bath should be switched-off can be set by turning the knob with a screwdriver or a coin.

9.2 Over-temperature safety thermostat

When the thermostat is activated the entire bath is switched-off (with the exception of the controller) the red system error LED will light up. When the temperature of the bath has been lowered with approximately 20 degrees, the thermostat re-sets itself automatically, however to continue normal operation the bath has to be switched off and on again.

The thermostat can be adjusted as follows:
-Turn the thermostat fully clockwise.
-Heat the bath to its proper temperature. Be aware that the safety thermostat is now only functioning at 270 °C.
-Turn the thermostat gently counter clockwise, until you hear a “click”. Turn the knob approximately 20 to 30° higher (clockwise). Switch the bath Off and On again. The bath is ready to operate safely.

9.3 Error messages

There are two types of error messages:

- Fatal
- Non fatal

In case of a fatal error the bath will be switched-off. If a non fatal error exists the error will be repeated after approximately 3 minutes.

9.4 Application errors

Besides the electronic errors reported on the display there are also practical errors.

9.5 Bath temperature does not become stable

If the bath temperature does not stabilize after 45 minutes after set point has been reached the following points might cause this problem:
·The operating temperature is around or below 30°C. To stabilize the bath at a set-point temperature just above

the ambient temperature it is necessary to apply cooling water to the cooling coil or to increase or decrease the flow of cooling water through the cooling coil.

9.6 RS 232 C Interface

The bath is equipped with a RS 232 C interface which allows the communication with a computer.

Please see our separate manual "communication.PDF" and Tamsom software to use the bath remotely or use the software as data logger.

9.6.1 General settings

Baud rate can be selected using the menu option "Baud rate". Standard setting is 9600

Data setting parameters are fixed (can not be altered):
8 data bits
1 stop bit
parity none

9.6.2 Commands overview

Notation
commands are place between brackets "[ ]"
values are placed between "< >" signs
(Do not use these brackets when sending commands.)

[ST] returns whether bath is stable or not. State 1 = stable, 0 not stable. Limits are set with parameters StableLimitHigh and StableLimitLow defined by ASTM D445. So when PV is in the region of 100°C>PV<0°C StableLimitHigh is defined as 0.05. When the average PV deviation (calculated from a sliding window of 255 seconds) is smaller than StableLimitHigh, the ST command will return stable(1).

When PV is 0°<=PV<=100°C and the average PV (calculated from a sliding window of 255 seconds) is smaller than StableLimitLow, the ST command will return stable(1)

[RS] Restarts (same as power off-on)
[RA] Reads raw ADC value, returns 3 bytes binary data, LSB first. This returns the last raw ADC reading. Note that this is updated every 200mS, so reading at a faster rate may return duplicate values. Maximum reading is 0x7FFFFF. This command is used for factory calibration/test.
[CT] **<enter>** Returns the offset value.
[CT] **<value> <enter>** Sets the offset value.

[TC] Sets/displays time constant in seconds
[PL] Power limit in seconds.
[BH] Returns boost heater on/off state, 0 or 1
[BH<n>] sets boost heater state 0/1
[CS] Control state – returns state of control algorithm
bits 4..7 represent the main control stages, bits 0..3 are sub-states within each main state
$00 : control algorithm disabled – allows external PC to take control of heaters
$10 : startup hold-off started
$11 : startup holdoff in progress

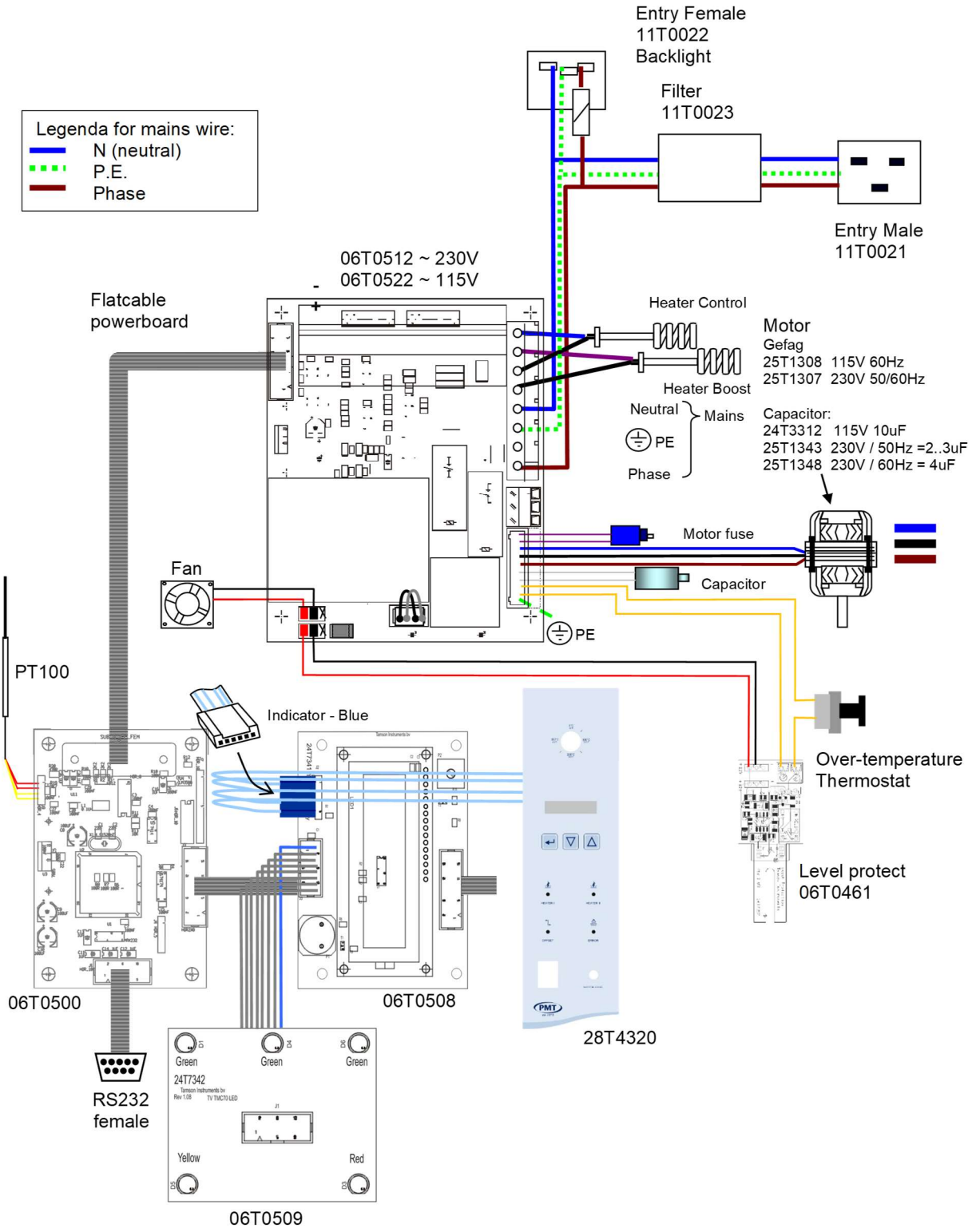
$12 : startup delay finished, decide to boost or cool
$20 : boosting
$30 : Waiting for cool-down
$40 : Start of ratio process
$41 : Ratio process in progress
$42 : waiting for PV<SP-tuneoffset after ratio
$50 : Start of successive approximation process

10 Spareparts

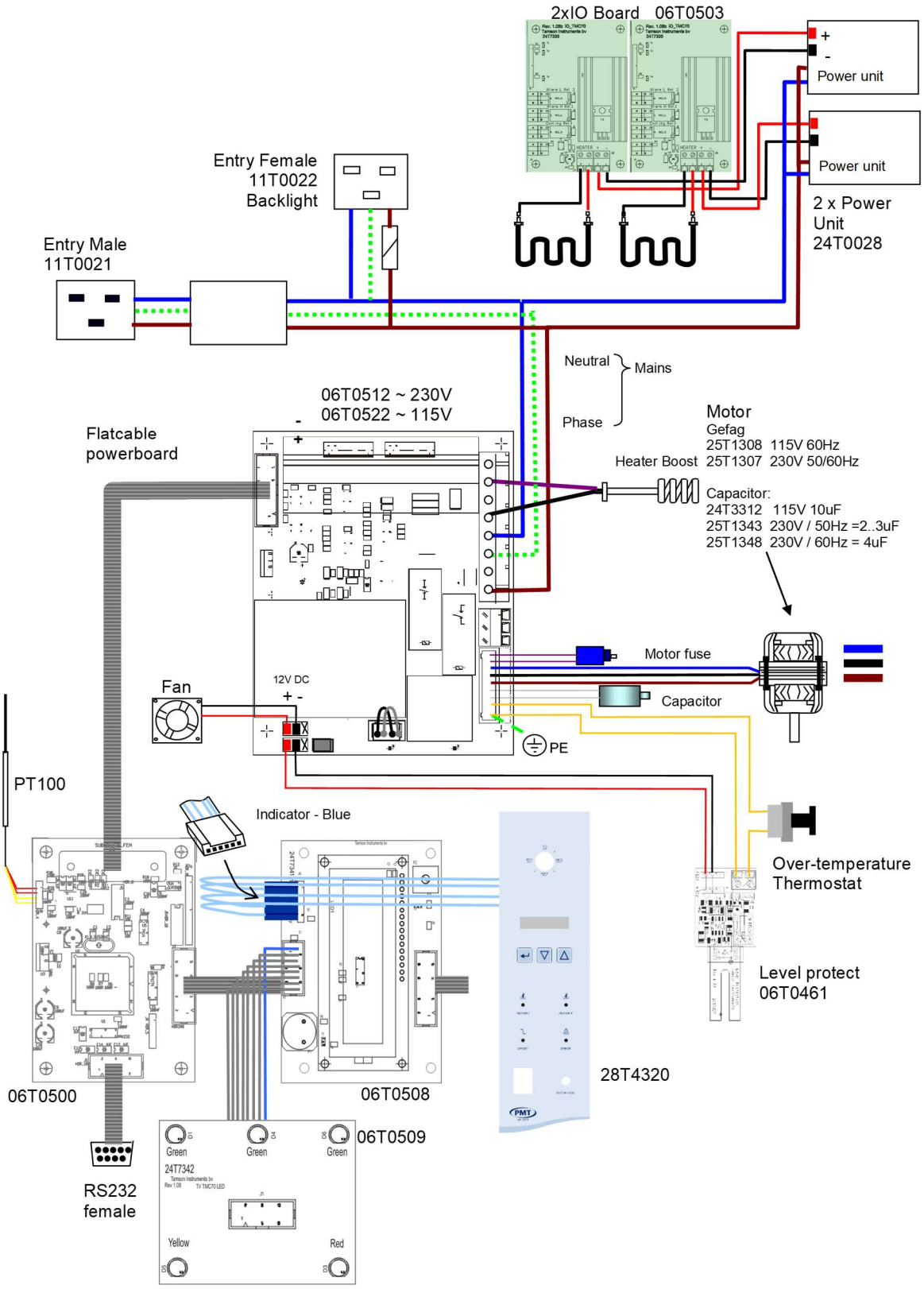
TV2000 / TV4000 / TV4000DC MKII / TV17000		
230V	115V	Description
04T0081	04T0181	Stirrer complete TV4000MKII / TV40000MKIIDC
04T0082	04T0182	Stirrer complete TV2000MKII
04T0081 + 04T2430	04T0181 + 04T2430	Stirrer complete TV17000
25T0202	25T0205	1400W Control Heater
25T0202	25T0202	1500W Boost Heater
25T1344		Capacitor 5.5uF
	24T3312	Capacitor 10uF
24T8080		Motorfuse 0.6 Ampère
	24T8083	Motorfuse 0.1 Ampère
24T8541		Mains switch
25T1242		Cooling fan
06T0512	n.a.	PCB Mains board with filter and relay 230V
n.a.	06T0522	PCB Mains board with filter and relay 115V
28T4026		PT100 sensor
06T0500		PCB – uP Controller
06T0508		PCB front panel with LCD and connector to keys
06T0509		PCB front panel TV MKII with LED's
28T4320		Frontfoil with membrane switches TV2000/TV4000
11T0023		Mains Filter
06T0461		PCB level protection
07T0085		Level Protection Complete
TV4000DC-MKII specific		
25T0351		Heater control (2*)
24T0028		Supply 600W 48V/DC
06T0503		Board IO

11 ADDENDUM: TECHNICAL REFERENCE

11.1 Technical Drawing TV2000-TV4000MKII



11.2 Diagram TV4000MKIIDC



11.3 EC Declaration

Following equipment is in complience with EMC Directive 2014/30/EU:

Product: Thermostatic bath
Model: TV2000-MKII, TV4000-MKII, TV4000-MKII DC, TV17000
Serial code: Effective from 08Txxx
Manufacturer: Tamson Instruments bv
van 't Hoffstraat 12
2665 JL Bleiswijk
The Netherlands

The products are in conformity with the following specifications:

Item	Reference	Description	Test result
a	**RoHS Directive**	2011/65EU	p
b	**EN61010-2-010**	Safety requirements for electrical equipment for measurement, control, and laboratory use. Particular requirements for laboratory equipment for the heating of material	
c	**Machine Directive 2006/42/EC**	Machinery Directive, of the European Parliament and of the Council of 17 May 2006/42/EC 2nd Edition June 2010	p
d	**EN 60204**	Machinery Directive and Safety requirements	p, p^i
e	**EN60950-1**	Low Voltage Directive	p
f	**EN61000-3-2**	Harmonics	p
g	**EN61000-3-3**	Flicker	p^3
h	**EN61000-4-2 +A1+A2**	ESD	p
i	**EN61000-4-3 +A1+A2**	Radiated immunity	p (anechoic room)
j	**EN61000-4-4**	Electrical Fast Transients	Minimum requirements pass
k	**EN61000-4-5+A1**	Surges	Minimum requirements pass
l	**EN61000-4-6+A1**	Conducted immunity	p
m	**EN61000-4-11 +A1**	Voltage dips and Voltage variations	p
n	**EN55016-2-1**	Conducted emission	p
o	**EN55016-2-3**	Radiated emission	p (anechoic room)

p = Pass
p^i = Individually tested
p^3 = Pass, condition of operating during Pst measurement: Operational with heating element 1400W. P_{st} and P_{lt} are not evaluated in accordance with A.5 of Annex A of EN 61000-3-3(1995) + A1(2001).

not applicable were:
Conducted discontinuous emissions (Clicks)
Radiated emission (OATS)
Magnetic field immunity
The equipment conforms with all the specifications and norms in this regard.
The equipment conforms without any further notice.

Entity responsible for marking this declaration :
Manufacturer, Tamson Instruments bv, van 't Hoffstraat 12, Bleiswijk The Netherlands,

Name	:		R.C. van Hall
Function	:		Director
Date	:		January, 2016
Version	:		1.04

12 DISCLAIMER

Information given herein is offered in good faith as accurate, but without guarantee. Conditions of use and suitability of the product for particular uses are beyond our control; all risks of use of the product are therefore assumed by the user.

We expressly disclaim all warranties of every kind and nature, including warranties of merchantability and fitness for a particular purpose in respect to the use or suitability of the product.

Nothing is intended as a recommendation for uses which infringe valid patents or as extending license under valid patents. Appropriate warnings and safe handling procedures should be provided to handlers and users. Alteration of this document is strictly prohibited. Except to the extent required by law, republication or retransmission of this document, in whole or in part, is not permitted. Tamson Instruments bv assume no responsibility for accuracy of information. Tamson Instruments neither represent nor warrant that the format, content or product formulas contained in this document comply with the laws of any other country except the Netherlands.