MANUAL TV4000LT TV7000LT

Safety and Warnings

You must 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 manufacturers 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 line cord of the apparatus,
- 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 B.V.

Warranty

Tamson Instruments B.V. warrants that all their manufactured equipment is free from defects in material and workmanship which could prevent the machine from performing normal operation. Tamson Instruments B.V. 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 B.V. 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.

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EC declaration of conformity thermostatic bath TV4000LT and TV7000LT

- Manufacturer: Tamson Instruments B.V. van 't Hoffstraat 12 2665 JL Bleiswijk The Netherlands
- Product: Thermostatic bath
- Model: TV7000LT TV4000LT

The products to which this statement relates, is manufactured and dully carried out in compliance with the provisions of Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility.

The products are in conformity with the following specification:

EN 50081-1 : 1992 EN 50082-2 : 1995 EN 61000-3-2 : 1995 EN 61000-3-2 : 1995

June 2005, Tamson Instruments bv, The Netherlands

Ing. R.C. van Hall Director

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. If a malfunction occurs, consult section "Trouble Shooting", page 16 at the end of this manual. If a problem persists, call your supplier or Tamson Instruments b.v. Never operate the equipment if not correctly installed. The equipment must be operated by qualified personnel only. Avoid damage to the equipment or its accessories through incorrect operation.



- Use temperature and chemical resistant protection material when operating the bath, **Connect overflow waste container, see** "

- Preventing overflow" page 11. Use chemical and temperature resistant materials,



- Prevent dangerous fumes or vapours and use appropriate ventilation. Methanol vapours can cause explosion hazard,



- Prevent occurence of dangerous fumes or vapours by appropriate use and ventilation. Methanol vapours can toxic,
- Do not move apparatus when filled,



- Do not place apparatus and waste container in walking area when operating,



- Use appropriate bath liquid.

Installation Important

Tamson Instruments b.v. 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.

Unpacking, connecting and installation.

To avoid damage during transport all Tamson baths are carefully packed for shipment. Check the packaging 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 honour a claim for damages if the packaging is not available for examination. The shipment contains at least the TV4000LT or TV7000LT bath. The consignment may contain other parts, individually packed in small boxes. Please see packing list for details concerning total contents of consignment.

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

Wait before switching on

After transport the bath may only be switched on after 8hours. Due to the transport the oil in the cooling circuitry has to leak back to the compressors. For this reason the bath can't be switched on directly as mechanical damage may occur

Remove packing material

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. 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 of less than 10 cSt at the operating temperature and a flash point which is well above the operating temperature.

Tilting

Before unpacking inspect the tilt watch located on the outside of the packing. When the tilt watch indicates a red colour contact Tamson instruments and the forwarder before continuing with unpacking.

Ventilation

The bath has to be placed in a well ventilated area. Air circulation has to be enabled by 15 .. 20 cm of free space at all sides.



Leaking

Inside the bath on the cold parts condensate and ice can build. When the apparatus is switched off this leak onto the floor. Do not place the apparatus on a floor which can be damaged by this leakage. The amount of condensate water is limited to a few ml/hr



Water may leak out of apparatus

Air flow

Air must pass the apparatus freely. The transports the heat from inside the apparatus to the environment. When airflow is blocked the apparatus will perform outside its specifications and it will cause mechanical damage.

vacuum cleaner. Do NOT remove dust with compressed air

Dust

Do not place the bath in a dusty environment. Dust will block the condenser unit inside the apparatus which will lead to severe mechanical damage.

Bath liquids

The best bath liquid to be used is methanol, enabling proper circulation at very low temperatures.

Regularly check the apparatus and condenser unit for dust. Remove dust with a

Methanol however is extremely flammable and can cause fire hazard. Take all necessary precautions to reduce fire hazard.

Methanol is toxic and can cause health risks. Use appropriate ventilation and other precautions to prevent inhaling toxic vapours.

When using methanol all vapours must be removed by using appropriate air ventilation.

If ventilation is insufficient the risk of explosion hazards can occur! Your local supplier of methanol will be able to hand over all chemical details and safety precautions related to the use of methanol. These precautions must be followed when operating the bath. See "Safety and Warnings" page 2





Extreme HAZARD

Do not use methanol at temperatures above $40^{\circ}C$. The methanol will vaporise and cause toxic and flammable vapours. Explosion hazard can build up in or around the bath

When working at temperatures above $40^{\circ}C$, oil or water can be used as an alternative.

Water, water-glycol, mineral or silicone oil also are liquids applicable to use in this bath.

Do not use distilled water. Distilled water can cause corrosion to the stainless steel inner bath and its parts. Filtered water from reversed osmoses apparatus can be used without problem.

General

The TV4000LT and TV7000LT apparatus basically consists of a combination of a cooling system and microprocessor controlled heating element. The design ensures a high degree of accuracy and reproducibility of temperature control.

Construction

The TAMSON baths are constructed from corrosion and chemical resistant materials like stainless steel and Teflon. The bath is effectively insulated against heat loss by a layer of Armaflex[®] rubber between the inner tank and outer casing and the use of two multilayer thermo-pane windows.

Circulator

A circulator is built-in to guarantee an uniform temperature distribution within the bath (see "Technical specifications" page 24)

Temperature control and setting

The bath temperature is regulated using a PT-100 temperature probe Class-A connected to a microprocessor module. The advanced electronic control system continually computes the energy input required for optimal temperature accuracy and stability. Temperature read-out is on a LCD display. The actual set point is computed within the controller with an accuracy of 0.001°C. For further details about accuracy and range see "Technical specifications" page 24.

The heat removal(cooling) is automatically selected from the set-point temperature setting.

Automatic selection of heat removal



The set-point temperature in the selected range than can be set on the controller with it's blue front, see "Menu item "Setpoint"" page 16.

To obtain an energy friendly control of the temperature the cooling has been split in four stages:

- 1 Heating only, no cooling,
- 2 Limited capacity cooling (single compressor and bypass short),
- 3 Limited capacity cooling (single compressor and bypass long),
- 4 Half cooling capacity (single compressor),
- 5 Full capacity cooling (two compressors).

As the set point temperature is controlled by heating against the heat removal, it is obvious that by limiting the cooling capacity this way of control is more energy friendly than conventional systems. If full heat removal capacity is used at 0 °C over 2 kW (TV4000LT, 3 kW TV7000LT) of heating should be applied, instead of the current 300 watt.

Bath fluid level

The minimum fluid level is just above the baffle plate. When fluid level is lower than the baffle plate circulation will be insufficient causing instability and non homogeneousness of the fluid temperature .

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



Caution:

When using Methanol one must be worn that the fluid shrinks dramatically when cooled down. If the bath is filled at these low temperatures up to it's maximum level the bath will overflow when heating up.

Preventing overflow



When using Methanol as a bath fluid overflow problems can occur. The methanol shrinks at low temperatures. If the bath is filled to the maximum level at these low temperatures, the bath will overflow when heated up. For this reason there's an overflow outlet placed on top on the right hand side of the TV7000LT. When a hose is connected to this overflow drain, the expanded methanol can flow back into the connected waste container or jerry can. See "Safety and Warnings" page 2 and pay attention to following:

- Use chemical resistant materials (hose and container (jerry can),
- Use appropriate indication on jerry can,
- When working at higher temperatures use temperature resistant materials,
- Prevent fumes from escaping,
- Do not place the container in the walking area but storage space next to the apparatus.

Operating the TV4000LT / TV7000LT system

Prepare for operation

If the bath has been properly filled the appropriate range can be selected as indicated in chapter







Use well grounded mains. Before plugging the TV4000LT / TV7000LT into mains socket, make sure the voltage of the bath corresponds to the local voltage. See also Installation page 10

The front panel layout shows the turn-push button:

| Next / increase: | Turn right | \bigcirc |
|----------------------|------------|--------------------|
| Previous / decrease: | Turn left | $\langle \rangle$ |
| Select: | Press | |

Overview menu items

- Setpoint
- Offset (press: <-5.00 .. +5.00 ℃ resolution 0.01 ℃)
- Max Power (press: low 25, med, hi, max)
- Boost heater (press on / off)
- Time const (press: fast, medium slow, precise)
- Stirrer
- Low alarm
- High alarm
- PID parameter (PID set 1, PID set 2. PID set 3, PID set 4)
 - Proportional band (Pb=1/P where P is proportional value) Integral
 - differential
- Backlight
- Temp units
- Baudrate
- Restart



- 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 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

Window heating

The TV4000LT and TV7000LT have heated windows to prevent build up of condensate. The heating is thermostat driven and kept around $30 \,^{\circ}$ C. If heating is off and the innerbath cooled down, the outside window also will drop in temperature forming a cold surface. This surface quickly will be covered with condensate blocking the visibility.

Window heating can be switched on or off separately from the TV-LT system. When the window heating is on, the green lamp of the switch will light.

Backside apparatus

On the top - backside of the bath following can be indicated:



Safety thermostat

When the bath temperature becomes higher than the set point temperature of the safety thermostat (Indicated "1", see drawing), 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. If the compressors are running wait for about 5 minutes to switch the bath back on again.

Quick start

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

- Fill the bath with fluid as indicated in Bath fluid level, page 11,
- Place the power plug,
- Switch the bath on 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.

Menu items

Use the turn-pus button to select a menu item and select the item by pressing the button. After pressing a sign appears next to the value indicating the value can now be changed. Pressing the button again activates the value immediately. When the value is altered but the button is not pressed the value will be accepted and stored after 5 seconds automatically. The menu returns back to normal operating mode.

Menu item "Setpoint"

Select the set point temperature. Resolution is $0.01 \,^{\circ}C$ +/- the system accuracy. The set point range and system accuracy both are described under "Technical specifications" page 24

There bath can be cooled down more rapidly by entering the minimum setpoint of -40. Both compressors are than switched on and the systems cools down fastest. When the bath has reached a temperature just below the desired SP, set the new SP. For example if the bath is running at 40 °C and the operator wants to lower the temperature to 5 °C. Set the SP to -40 °C. When the unit has reached 4 °C set the new SP to 5 °C. The unit will than heat and get stabilised around 5 °C.

Care must be taken when using water as there is a risk of freezing.

The reason for following this procedure is technical and is caused by the way the cooling capacity is adapted over the temperature span of the bath.

If the unit does not get stable have a look at the PID parameters. These settings are explained in the manual. Standard values are 25, 16 0. If the unit fluctuates too much try to increase the P to 50 or 100 and the I to 50.

To get stable temperature control with small variations is a secure procedure and may take effort to realise.

Menu item "Offset"

The temperature displayed can be increased or decreased with an offset ranging from +5.00 down to -5.00 $^{\circ}$ C in steps of 0.01 $^{\circ}$ C. This way the temperature reading on the display can be synchronised with an independent separate thermometer.

If there remains an offset try to increase the I to 25 or 50. The offset is due to the PID setting and depends on the applied power percentage. An offset of $0.1 \,^{\circ}$ C can be adjusted with the offset value available in the menu or when increasing the PIDs' integrator value to 25 or 50.

Menu item "Max Power"

| (press: low 25, me | ed, 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"

Stirrer 0 .. 100% (step 6%). Inactive

Menu item "Low alarm"

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

Menu item "High alarm"

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

Menu item "PID parameter"

| PID set 1 | | |
|-----------|---|--|
| PID set 2 | - | deactivated |
| PID set 3 | - | deactivated |
| PID set 4 | - | Activated when communication via RS232 |
| | | |

Each set offers independant PID settings for:

Proportional band Integrating differentiating

Default settings

Pb* := 25

I := 16

D := 0

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

If there remains an offset in the temperature readout try to increase the I to 25 or 50. The offset is due to the PID setting and depends on the applied power percentage. An offset of 0.1 °C can be adjusted with the offset value available in the menu or when increasing the PIDs' integrator value to 25 or 50.

Menu item "Backlight"

On Off Standard value: On

Menu item "Temp units"

℃ ℉ Standard value: ℃

Menu item "Baudrate"

9600 19200 38400 Standard value: 9600

Menu item "Restart"

Restarts system and activates tuning

PID configuration

The two graphs below show the influence of the integral setting. The graph on top has a setting of 200 for the integral parameter. The bottom graph has a setting of 16. The value of 200 causes less stable control.



Manual tuning

The temperature control of the bath is based on a digital PID system. When using different fluids in the bath each with their own heat capacity, the use of external cooling and external connected processes(circulation), or working at different set point temperatures requires new settings of the PID parameters. These parameters have to be optimised after changes to the system when optimal and accurate temperature control of the bath liquid is required.

Tuning of the bath results in:

- Stable temperature control of the bath,
- No over- or undershoot of the temperature set point,
- Quick response to deviations from the set point caused by external disturbances.

| rannig ban be dene adternatioally of mandally. | | | | |
|--|--|---------|--|--|
| Parameter | Description | Display | | |
| Proportional band | The bandwidth in display-units over which the output power is proportional between minimum and maximum | Prop | | |
| Integration time | Determines the time taken by the controller to remove steady state error signals | Integ | | |
| Derivative time | Determines the time taken by the controller to react on error signals. | Diff | | |

Tuning can be done automatically or manually.

Table 1 Parameters influencing the temperature control

Drain bath fluid

The TV7000LT can be emptied via the drain tap located at the backside of the apparatus. For safety reasons the tap can only be opened when using a screwdriver. The thread inside the tap is 5/8".



Maintenance

Keep the apparatus free from dust. Regularly check the cooling openings and remove dust with vacuum cleaner. If necessary remove cover and clean internally. Use appropriate protection when cleaning, dust can be very unhealthy.

Trouble Shooting

The motor, compressor and lamps are dead.

Check the main voltage and all electrical connections, including switches.

Check fuse in wall socket of mains supply.

Check the safety thermostat. See "Safety thermostat" page 15

Motor is not running, lamps and electronics operate (the motor turns freely by hand).

Motor overloaded. The motor protection may trip because of mechanical overload. Reset the fuse by pushing button on rear side of the motor housing.

The motor capacitor is defective. Replace motor capacitor inside the system.

Malfunctioning wiring. Check wiring.

Compressor makes "clicking" noise

Bath has been switched on and off to quickly. Wait approximately 10 minutes before switching on again. The clicking noise is a temperature fuse inside the compressor preventing it from overheating.

Clean the condenser unit and make free from dust. Air must pass the inside of the unit freely.

Compressor will not start

When the machine has been switched off the pressure in the cooling circuit can rise to a high level. For this reason the apparatus has to settle the pressure of the cooling liquid for a few minutes before it can be restarted.

When this problem occurs more often it will indicate that dust is blocking the condenser circuit. Clean the inside of the TV4000LT / TV7000LT and remove all dust from the condenser unit and fan with a vacuum cleaner. Do not use pressurised air remove dust. The flying dust particles can damage the fan bearings, are very unhealthy when breathed in and can lead to severe eye problems.

Temperature not stable

- Restart system (option from menu, see Menu item "Restart" page 18)

Temperature control TV4000L T-bath Methanol [SP-40 PID=25-200-0.xis]

- Place top lid on the bath.
- Check PID settings When PID settings are incorrect the system can start to be unstable.



Pb*=25 I=16 D=0

- *Pb= proportional band. Proportional value P is found to be 100/Pb)
- System connected to RS232. PID settings "4" are used. Change settings with Tamcom to Pb=25, I=16, D=0.
- Check maisn supply for stable power. Graph below shows heavy disturbance due to fluctuations in mains supply. Temperature accuracy is heavily disturbed by voltage fluctuations due Temperature control TV40001 Thath Methanol resources and the second stable power. (SP-40 PID=25-200-



Bath temperature does not drop

- Check set point setting (option from menu, see Menu item "Setpoint" page 16)
- Restart system (option from menu, see Menu item "Restart" page 18)

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gh setting of I=200.

Faulty temperature reading / temperature offset

The temperature read out on the display does not correspond to the temperature measured.

- When the controller starts or is restarted, the displayed value increases to a stable readout appears after a few seconds.
- PT100 is defective
- PT100 has aged.
- Check offset in menu

Condensate building up on window

- Fuse window heating defective. Check fuse inside the system. Replace when defective
- Measure shortcut caused by condensate in heating elements.

Unit is leaking water

Inside the bath on the cold parts condensate and ice can build. When the apparatus is switched off this leak onto the floor. Do not place the apparatus on a floor which can be damaged by this leakage. The amount of condesate water is limited to a few ml/hr

It takes long to reach the new bath temperature

There is a possibility to cool down rapidly by entering the minimum setpoint of -40. Both compressors are switched on and the systems cools down fastest. When the compressor reached a temperature just 1 degree below the desired SP, set the new SP. For example if the bath is running at 40'C and the operator wants to lower the temperature to 5°C. Set the SP to -40°C. When the unit has reached 4°C set the new SP to 5°C. The unit wil heat and stabelise around 5°C.

When using water as bath medium care must be taken to prevent freezing.

If the unit does not get stable have a look at the PID parameters. These settings are explained in the manual. Standard values are 25, 16 0. If the unit fluctuates too much try to increase the P to 50 or 100 and the I to 50.

Bath temperature doesn't equal set point temperature

If there remains an offset try to increase the I to 25 or 50. The offset is due to the PID setting and depends on the applied power percentage. An offset of 0.1 ℃ can be adjusted with the offset value available from the menu or when increasing the PIDs' integrator value to 25 or 50. However an high I factor can lead to an oscillating temperature.

Technical specifications

| Item | Unit | TV4000LT | TV7000LT |
|----------------------------------|--------|------------------------|----------------|
| Temperature range | [°C] | -40 80 | -40 80 |
| Setting ± | [°C] | 0,01 | 0,01 |
| Stability* ± | [°C] | 0,02 | 0,02 |
| Uniformity* ± | [°C] | 0,02 | 0,02 |
| Temperature linearity full range | [°C] | 0,2 <i>°</i> C | 0,2 <i>°</i> C |
| Heating | [W] | 1000W + 200 | 1500W + 500 |
| Power | [W] | 2200 max | 3200 max |
| Heaters | | 2 | 2 |
| | | (single combi element) | |
| Bath volume | [L] | 40 | 70 |
| Opening | [mm] | 260 x 240 | 260 x 240 |
| Depth | [mm] | 600 | 600 |
| Length | [mm] | 50 | 50 |
| Width | [mm] | 68 | 68 |
| Height | [mm] | 145 | 145 |
| Weight | [kg] | 80 | 80 |
| Power | [Watt] | 3000 Max | 3500 Max |
| Voltage | [Volt] | 230-50HZ | 230-50HZ |
| Noise (1mtr, average) | [dB] | 61 | 61 |

* Absolute min/max value measured over 1hrs in methanol

Performance TV4000LT Cooldown



TV4000LT [Tv4000LT Cooldown]

Cooldown

Time [mm:ss.s]

Recovery temperature disturbance

Following graphs show temperature recovery at -20 $^{\circ}$ C and +20 $^{\circ}$ C of the TV4000LT system after a temperature disturbance.



Temperature dip and recovery TV4000LT

SP -20.00; PID 25-16-0; RC1.05; Methanol

Time [mm:ss.s]



Temperature dip and recovery TV4000LT

Stability at 29℃

Bath liquid used is methanol



Control TV4000LT-bath Methanol [+29 stability PID 25:16-0.xls] PID 25:16:0; Sp +29:00*C; Homogeinety ±0:018*C

Stability at +20 ℃

Bath liquid used is methanol



Tem perature control TV4000LT-bath Methanol [+20 stability PID 25-160.xls] PID 25:16.0; Sp +20.00°C; Homogenety ±0.017°C

Stability at 0℃

Bath liquid used is methanol



Tem perature control TV4000LT-bath Methanol p stability PID 26-16-0.xls] PID 26;16:0; Sp 0.00 °C; Homogenety ±0.011 °C

Stability at -10℃

Bath liquid used is methanol



Stability at -20 ℃

Bath liquid used is methanol



Tem perature control TV4000L T-bath Methanol [20 stability PID 25-16-0.xis] PID 25;16:0; Sp -20:00 °C; Homogenety ±0.026 °C

Stability at -30 ℃

Bath liquid used is methanol



Stability at -40 °C Bath liquid used is methanol



Stability tests TV7000LT

Cool down

Bath liquid used is methanol



Stability at 0°C

Bath liquid used is methanol

Temperature drift TV7000[Ref. TV7000_01.xls]



PID 2;240;40, SP=0 ℃, Homogeinety = ± 0.012 ℃

Stability at -10 ℃

Bath liquid used is methanol

Temperature drift TV7000_Ref. TV7000_02.sts]

PID 2;240;40, SP=-10.0°C, Homogeinety = ± 0.016°C



Stability at -20°

Bath liquid used is methanol



Tem perature drift TV7000LT [Feft. TV7000_06.xts] PID 2;240;40, SP=-20.0°C, Homogeinety = ± 0.012°C; TMC70

Stability at -30°

Bath liquid used is methanol



Stability at -40 ℃

Bath liquid used is methanol

Temperature drift TV7000[Ref. TV7000_03 xls]

PID 2;240;40, SP=-40.0°C, Homogeinety = ± 0.017°C



Settling time (at -10 ℃)

Bath liquid used is methanol



Bath liquid used is methanol

Tune and temperature-dip recovery TV7000LT [Ref. TV7000_07.Ms]

PID 25;16;0, SP=-30.0°C; TMC70



RS232 Communication

Commands

When TMC70 selected via menu to communicate at Baudrate 4800 use following settings on PC:

4800 8 data bits 1 stop bit parity none

ST – returns wether 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 $100 \degree$ >PV<0 \degree 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 $0^{\circ} <= PV <= 100^{\circ}C$ 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
- \$51 : Sucessive approximation stabilisation delay
- \$52 : Successive approximation in progress
- \$53 : end of sucessuve approximation stage
- \$60 : Proportional mode (subject to change other values to be defined)

CS<**n**> Sets state of control algorithm

HP : Returns current heater power percentage

HP<nn> : sets heater percentage to <nn> - this command is only useful if control algorithm suspended with CS command.

AC : Returns 1 when a new temperature value is available, 0 if no new has been measured since the last PV or PVH command. Cleared by PV or PVH command. Used for external PC control synchronisation.

PV Returns Proces Value with unit, no decimals. 23C or 74F

PVF returns temp as follows :

Use PVF to return a decimal value with 7 decimal digits, e.g.

12.345342C, works for degrees Centigrade, and degrees Fahrenheid. Only first three are significant. When reading is in degree Fahrenheit character F indicates the unit i.e. 73.3961328F

Whentemperature is negative, minus sign appears i.e. -1.6955468F

PP, returns proportinal band value. Proportional band is 100/gain

PI, returns integrating value

PD, returns derivative value

Setting PID: Range: Pb = setting 1..999 I= 0..999 D=0..999

PP followed by value, or space and value, will set proportional band. I.E. PP25 will set Proportional band to 25.

PI followed by value, or space and value, will set integrating value. I.E. PI16 will set Integratin g value to 16.

PD followed by value , or space and value, will set integrating value. I.E. PD2 will set Derivative value to 2.

The TMC70 contains 4 independent PID sets. Each set can be enabled using the TMC70.EXE program and can have its own name i.e "water", "silicone oil" or "methanol". However when the command PP, PI, or PD is used to set a value, automatically set 4 is used. So PID set4 is reserved for RS232 operation and is activated when approached from RS232.

SP Set point temperature

SP, Set point temperature is returned i.e. 20.22 SP22.50 sets set point temperature to 20.50 °C When controller displays temperature in °F, SP20.50 sets the set point to 20.50 °F SP22.555 results in error code "10"

RS 232 Cable



Ordering code

| Item | voltage | ordering code |
|----------|-----------|---------------|
| TV4000LT | 230V/50Hz | 00T0460 |
| TV4000LT | 230V/60Hz | 00T0462 |
| TV4000LT | 115V/60Hz | 00T0465 |
| TV7000LT | 230V/50Hz | 00T0450 |
| TV7000LT | 230V/60Hz | 00T0452 |
| TV7000LT | 115V/60Hz | 00T0455 |

Spare parts list

| Voltage | | |
|--------------|------------|---|
| 230V(50/60hz | 115V(60hz) | Item |
|) | | |
| 04T0061 | 04T0062 | Stirrer complete TV4000LT |
| 04T0062 | 04T0162 | Stirrer complete TV7000LT |
| 24T8080 | 24T8090 | Motorfuse 0.6 Amp. |
| 24T3300 | | Capacitor 7uF |
| | 24T3330 | Capacitor 25uF |
| 25T0216 | 25T0215 | Heater 500W/1500W |
| 28 | Г4009 | Keypad foil |
| 28 | Г3904 | Indicator safety thermostat |
| 24 | T8545 | Mains switch |
| 24 | T8581 | Safety cut-out thermostat |
| 24 | T7580 | Knob safety thermostat |
| 27 | T3056 | Solid State Relay 16A |
| 28T4026 | | PT-100 sensor |
| 28T2052 | | Mains relais |
| 28T2057 | | Relais timer |
| 06 | T0500 | PCB micro controller TMC70 |
| 06T0502 | | PCB display TMC70 |
| 06T0505 | | PCB IO/cooler TMC70 |
| 06T0511 | | PCB power TMC70 |
| 24T7089 | | Wheel 80mm, no break |
| 24T7090 | | Wheel 80mm, with break |
| 10 | T2200 | Knob insert light-blue turn-push button |
| 10T2205 | | Knob light grey turn-push button |



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