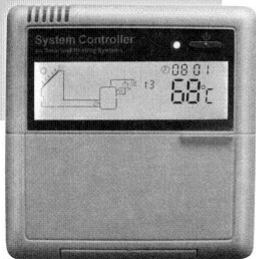


Instruction Manual

Science and Technology Create Perfection

Operation Instruction

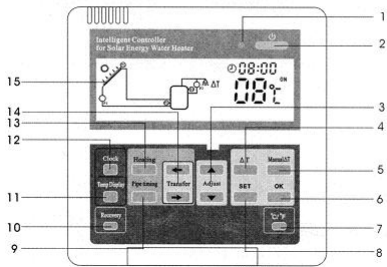
TK-SC6 Series
Intelligent
Controllers for Solar
Water Heater



2008.6

△Read the instruction carefully please before operation!

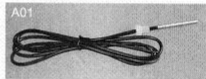
Display Panel Illustration



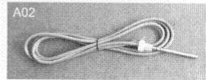
Pos.	Button on display panel	Button description
1	Green lamp	Power indication lamp
2	On/Off	Power "switch on/off" button
3	▲▼ adjust	Adjusting button
4	ΔT	To Set switch-on/off temperature difference of solar circulation
5	Manual ΔT	Manual commissioning to trigger temperature difference controlled solar circulation
6	OK	Activate /deactivate one function
7	°C / °F	Celsius / Fahrenheit transformation button
8	SET	
9	Pipe timing	To set time for hot water pipe circulation
10	Recovery	To recovery the display to factory set mode.
11	Temp. Display	Display temperature in different position one by one
12	Clock	Clock set
13	Heating	Electrical heating time set
14	"→" "←"	Transfer button
15	LCD display screen	

7. Components

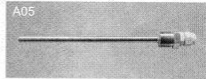
- Sensor for collector: high accuracy PT1000 sensor(A01)
Parameter: PT1000, Ø6X50mm



- Sensor for tank: high accuracy NTC 10K sensor (A02)
Parameter: NTC10K,B=3950, Ø6X50mm



- Thermowell of sensor: stainless thermowell (A05)
Parameter: 1/2" male thread, Ø6X200mm.



- Contactor unit of high power: TK601
When the power of electrical heater is over 1500W, we recommend strongly to install TK601 contactor unit in solar system to avoid damage of controller caused by high electrical current.
- Appearance dimension of power unit: 250mm x 185mm x 130mm
- Power supply range: 220V±10%
- Suitable power≤ 6000W
- Available ambient temperature: -10~50 °C
- Water proof grade: IP41



Contactor unit of high power

6. Technical Data

- Appearance of display see product itself (dimension: 120mm x120mm x18mm)
 - Appearance of controller: see product itself (dimension: 205mm x140m x 45mm)
 - Power supply: AC 230V ±10%
 - Power consumption: < 3W
 - Accuracy of temperature measuring: ± 2°C
 - Range of temperature measuring: 0 ~120 °C
 - Suitable power of pump: 2 pumps possible to be connected, power of each pump < 600W
 - Suitable power of valve: 1 valve possible to be connected, possible power < 600W
 - Suitable power of electrical booster ≤ 2000W.
 - Inputs: 4 sensors,
 - ✓ 1 Pt1000 sensor (≤50°C) for collector (silicon cable≤280°C).
 - ✓ 1 or 2 NTC10K, B3950 sensor (≤135°C) for tank, (PVC cable ≤105°C).
 - ✓ 1 NTC 10K, B3950 sensor (≤ 135°C) for hot water circuit pump, (PVC cable ≤105°C).
- Note: sensor for hot water circuit pump is optional.**
- Outputs: 4 relays, one for electrical booster, 2 for circulation pumps, 1 for valve.
 - Ambient temperature : -10°C ~ 50°C.
 - Water proof grade: IP40.
 - Socket :Choice by customer (Europe, American, Chinese or others, please note in order)

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1. Safety information

1.1 Installation and commissioning

- When laying cables, please ensure that no damage occurs to any of the constructional fire safety measures presented in the building.
- The controller must not be installed in rooms where easily inflammable gas mixtures are present or may occur.
- The permissible environmental conditions must not be exceeded at the site of installation.
- Before connecting the device, make sure that the energy supply matches the specifications of controller.
- All devices connected to the controller must conform to the technical specifications of the controller.
- All operations on an open regulator are only to be conducted cleared from the power supply. All safety regulations for working on the power supply are valid. Connecting and /or all operations that require opening the regulator (e.g. changing the fuse) are only to be conducted by specialists.

1.2 About this manual

This manual describes the installation, function and operation of a solar thermal controller. When installing the remaining components e.g. the solar collectors, pump assemblies and the storage unit, be sure to observe the appropriate installation instructions provided by each manufacturer. Installation, electrical connection, commissioning and maintenance of the device may only be performed by trained professional personnel. The professional personnel must be familiar with this manual and follow the instructions contained herein.

1.3 Liability waiver

The manufacturer cannot monitor the compliance with these instructions or the circumstances and methods used for installation, operation, utilization and maintenance of this controller. Improper installation can cause damages to material and persons. This is the reason why we do not take over responsibility and liability for losses, damages or cost that might arise due to improper installation, operation or wrong utilization and maintenance or that occurs in some connection with the aforementioned. The manufacturer preserves the right to put changes to product, technical data or installation and operation instructions without prior notice. As soon as it becomes evident that safe operation is no longer possible (e.g. visible damage). Please immediately take the device out of operation.

NOTE ensure that the device cannot be accidentally placed into operation.

1.4 Description of symbols

Safety instruction:

⚠ Safety instructions in the text are marked with a yellow warning triangle. They indicate measures which can lead to injury of persons or safety risks.

Operation steps: small triangle ▴ is used to indicate operation step.

NOTE contains important information for operation or function.

NTC 10K B=3950 resistance value

°C	0	10	20	30	40	50	60	70	80	90	100	110	120
Ω	33620	20174	12535	8037	5301	3588	2486	1759	1270	933	697	529	407

b.Cause of failures

Symptoms	Secondary symptoms	Possible cause	Procedure
Controller does not appear to function at all	Display shows nothing, no display illumination	Controller power supply is interrupted	Check the controller power cable and connection cable between controller and display.
The solar pump doesn't operate, despite the fact that switch-on conditions are satisfied	The pump symbol in the display blinks	Pump power supply is interrupted	Check the pump power cable
Pump doesn't operate	The pump symbol in the display doesn't blink, error message signal blinks on the display screen	Fault (short circuit or open circuit) in a temperature sensor	On the controller, request the current values from all connected temperature sensors, replace all defective sensors and /or cabling.
The solar pumps operated, despite the fact that the switch-on conditions are not satisfied.	The pump symbol in the display blinks.	The frost protection function is activated.	No problem, it is normal. If necessary to deactivate the corresponding functions.

C. Guarantee

The warranty expires within 12 months after the date of purchasing the controller.

5. Trouble Shooting

5.1 Trouble protection

When there is a break or short circuit between the connection of temperature sensors, controller switches off the corresponding functions and no more output signals are given, at the same time error indications are showed on the display.

5.2 Error messages indication

If control unit does not work correctly, please check following error messages and error rectification indication. "Warning" signal is displayed on screen.

Error messages and handling indication (LCD display warning signal blinks)

Error message	Meaning	Cause of error	Error rectification
T1 blinks	T1 sensor fault	Sensor wiring interrupted, not connected or short circuit	Check resistance value, replace sensor if necessary
T2 blinks	T2 sensor fault	Sensor wiring interrupted, not connected or short circuit	Check resistance value, replace sensor if necessary
T3 99°C blinks	T3 sensor fault	Sensor wiring interrupted, not connected or short circuit	Check resistance value, replace sensor if necessary
E0	Connection fault between display and controller	Connection cable is interrupted or short circuit	Check and replace if necessary

NOTE when the error of sensor appears, its corresponding function will be switched off automatically.

5.3 Error checking

The controller is quality product, conceived for years of continuous trouble-free operation. If a problem occurs, the cause of the problem very often lies not in the controller but in the peripheral components. The following description of some well-known problems should help the installer and operator to isolate the problem, so that the system can be placed back into operation as quickly as possible and to avoid unnecessary costs. Of course, not all possible problems can be listed here. However, most of the normal problems encountered with this controller can be found in the list below, only return the controller when you are absolutely sure that none of the problems listed below is responsible for the fault.

a. A potentially defective sensor can be checked using an ohmmeter. To do this, the sensor must be disconnected, its resistance measured, and the value compared with the figures in the table below, small deviation are acceptable, (note: remove the device from the mains supply before opening the case)

PT1000 resistance value

°C	0	10	20	30	40	50	60	70	80	90	100	110	120
Ω	1000	1039	1077	1116	1155	1194	1232	1270	1309	1347	1385	1422	1460

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2. Installation

2.1 Installation of display panel

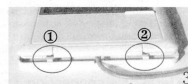
- Remove the back panel from display with screw in direction showed on picture 1
- Fix the back panel with screw on the wall, please note don't drill hole on controller, see picture 2
- Insert the upper case of display into the grooves ① ② of back panel, fasten them, see picture 3



Picture 1



Picture 2



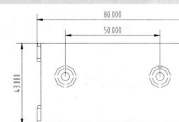
Picture 3

2.2 Installation of controller

NOTE Controller must only be installed in a place having an adequate level of protection.

2.2.1 Fixing the hang – panel of controller

- selecting a proper place
- putting hang-panel on wall and marking the position of hole (note the up/down side of panel) see picture 4
- drilling-hole and put the plastic expansion screw in it
- Screw hang-panel
- hanging the controller on this panel reliably



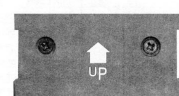
Picture 4

2.2.2 Connection of power

Remove the device from the mains supply before opening the case! All guidelines and regulations of the local electricity supplier must be observed.

- Open and close the cover of terminal panel

- Loosen the screw ① ② and remove the upper case in an upwards direction, see picture 5
- Close the cover : downwards close the cover
- fasten with screw ① ②.



Picture 5

2

• Preparation before connection

Power can only be switched on when the housing of controller is closed, an installer must make sure that the IP protection class of the controller is not damaged during installation.

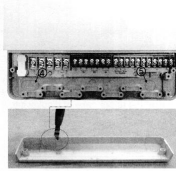
Depending on the type of installation, the cables may enter the device through the rear of the case ③ ④ or through the lower side of the case.

See picture 6

Cable comes from the rear ③ ④: remove the plastic flaps from the rear side of the case using an appropriate tool.

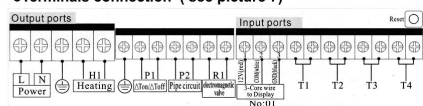
Cable comes from the below: cut the left and right plastic flaps using an appropriate tool (e.g. knife) and break them out of the case.

After connection the cable, please put the cable into groove and fix them by cable press plate.



Picture 6

• Terminals connection (see picture 7)



Abbreviation	Function
T1	Input port of collector temperature sensor T1
T2	Input port of tank temperature sensor T2, bottom
T3	Input port of tank temperature sensor T3, above
T4	Input port of hot water pipe temperature sensor, optional
No:01	Connection port for display panel
Power	Power input port
Heating	Output port of electrical heating H1
ΔT _{out} /ΔT _{in}	Output port of temperature difference circulation pump P1
Pipe circuit	Output port of hot water pipe circulation pump P2
electromagnetic valve	Used for the function of tank high temperature protection in system with tank, which has two heat exchangers inside.

Input ports 1. Inputs T1, T2 and T3 (T4 optional): are temperature sensors. 2. Inputs No:01 is 3-core wire connected with display.	Output ports 1. Outputs P1 and P2: electromagnetic relays max. switching current: 5A 2. Output H1: electromagnetic relay, max switching current 16A 3. Output R1: electromagnetic valve, max. switching current: 5A	Power connection 1. Please note the type of power supply required from the type label on the case of the device. 2. The protective conducting wire (earth wire) must also be connected
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3

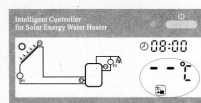
Activate /deactivate this function:

- Press "SET" button 3 times, the setting area of maximum temperature of tank blinks on display. Default setting is off. Display "—".
- Press "OK" button to activate this function.
- Press "▲"/"▼" button to adjust the maximum temperature of tank, (adjustable range: 50°C ~ 99°C). After 6 seconds controller confirms the set value automatically.

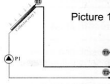
In the status of anti freezing function is in operation.

- Press "OK" button to cease this function, "—" appears on screen.

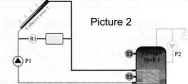
NOTE When the signal of high temperature protection (2) displays on screen, it indicates this function is activated.



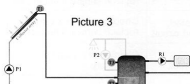
Application example: (three examples can be realized according to following three drawings)



Picture 1



Picture 2



Picture 3

4.11 "°C/°F" button

- Press "°C/°F" button to achieve display of temperature between Celsius and Fahrenheit.

4.12 Protection function

• Memory protection when power is failure

In case power failure occurs, controller keeps the parameter settings unchanged.

• Screen protection

When no any press on button for 30 minutes, screen protection is activated, and then LED light lamp is switched-off. Through press any button to light LED lamp again.

• System comeback

When mistakes or problems occur in system, press "OK" button, which is on display panel, to recover system to factory set.

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range: 2°C~10°C), after 6 seconds, controller confirms the setting automatically.

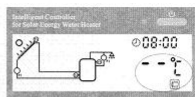
► In the status of setting frost protection temperature, press "OK" button to cease this function, "—" appears on screen.



When the signal of frost protection displays on screen, it indicates frost protection function is activated.

NOTE

this function is allowed to be used in the solar system, which doesn't use anti-freezing heat transfer liquid, in the area where only few days in whole year the ambient temperature may be closed to the freezing temperature. But for a safety system and in the area where anti-freezing must be considered, we suggest using proper anti-freezing liquid to resolve freezing problem.



4.9 tank high temperature protection (1)

In order to avoid the high temperature of tank, controller will check the temperature of top part of tank (T3), when T3 rises to 80°C, this function is activated, and solar pump is ceased. When temperature of top part of tank (T3) drops less than 70°C, this function is deactivated automatically.

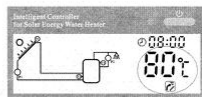
► Press "SET" button 4 times, temperature setting area blinks 88.8°C; default setting is 80°C.

► Press "▲▼" button to adjust the maximum temperature of high temperature protection function of tank, (adjustable range: 10°C~95°C), after 6 seconds, controller confirms the setting automatically.

► In the status of setting temperature of high temperature protection function, press "OK" button to cease this function, "—" appears on screen.



When the signal of high temperature protection (1) displays on screen, it indicates this function is activated.



4.10 tank high temperature protection (2)

this function and " tank high temperature protection (1) function can be activated at the same time.

Functional description:

In order to use this function it is necessary to install an extra electromagnetic valve or a pump (R1) on the inlet pipe. In order to avoid the high temperature of tank, controller will check the temperature of top part of tank (T3), if this temperature (T3) is higher than the preset switching-on temperature of this function, then the electromagnetic valve or pump (R1) will be triggered. When this temperature (T3) drops 5°C below the switching-on temperature of this function, the electromagnetic valve or pump (R1) will be closed automatically.

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3. Commissioning



Connect the sensors, pumps to the controller before you connect the power supply! After switching on power to the controller, firstly controller will ask to set "clock"

3.1 Time set

After power is switched on, "00:00" displays on LCD screen.

► Press "Clock" button, hour selection area "00" blinks on display screen.

► Press "▲▼" button to adjust hour of clock

► Press "Clock" button again, the minute selection area "00" blinks

► Press "▲▼" button to adjust minute of clock

After 6 seconds controller confirms the setting automatically, the current time is displayed on the screen.

3.2 Manual operation

When operating the device first time, or when testing the function, the outputs of controller can be operated manually. To do like the following steps:

● Temperature difference controlled pump operated manually

► Press "Manual ΔT" button, temperature difference controlled solar circulation pump is triggered immediately, the relevant signal is lighted.

► Press "Manual ΔT" button again to shut off this output immediately, or program switches off the pump in 10 minutes automatically.

● Hot water pipe circulation pump operated manually

► In the status that power is on, press "On/Off" button, the hot water pipe circulation pump is triggered immediately. The relevant signal is lighted.

► Press "On/Off" button again to shut-off this operation, or program stops pump in 3 minutes automatically.

● Heating operated manually

► Press "Heating" button for 6 seconds, the auxiliary electricity heating or gas, oil boiler is triggered.

► Press "Heating" button again to shut off this output immediately.

3.3 Temperature query

► Press "Temp. Display" button to check different temperature value of collector (T1), tank (bottom T2), tank (above T3) and hot water pipe circulation (T4) one by one. Temperature of bottom tank (T3) is displayed automatically when no more operation within 6 seconds.

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Reset: This button is on the terminal connection panel, when system program is out of working, press "Reset" to recover the program of system to the factory settings.

Advice regarding the installation of temperature sensors:

Only original factory equipped PT1000 temperature sensors are approved for use with the collector. It is equipped with 1.5meter silicon cable and suitable for all weather conditions, the temperature sensor and cable are temperature resistant up to 280°C, not necessary to distinguish the positive and negative polarity of the sensor connection.

Only original factory equipped NTC10K, B=3950 temperature sensors are approved for use with tank and pipe, it is equipped with 1.5meter PVC cable, and they are temperature resistant up to 105°C, not necessary to distinguish the positive and negative polarity of the sensor connection. All sensor cables carry low voltage, and to avoid inductive effects, must not be laid close to 230 volt or 400-volt cables (minimum separation of 100mm)

If external inductive effects are existed, e.g. from heavy current cables, overhead train cables, transformer substations, radio and television devices, amateur radio stations, microwave devices etc, then the cables to the sensors must be adequately shielded.

Sensor cables may be extended to a maximum length of ca. 100 meter, when cable's length is up to 50m, and then 0.75mm² cable should be used. When cable's length is up to 100m, and then 1.5mm² cable should be used.

NOTE PT1000 and NTC10K, B=3950 are different kind of temperature sensor, it may exist measuring error between these two at the same ambient temperature, but it doesn't effect the operation of system.

4.7 Temperature-controlled hot water circuit pump

NOTE T4 sensor isn't included in the standard delivered product; user needs to have a extra temperature sensor T4 when he wants to have this function.

Functional description:

Solar system can provide temperature-controlled hot water circulation function, this function needs an extra hot water circulation pump (P2) and a sensor (T4), which is positioned on the return pipe of hot water. When the temperature signal of sensor T4 is less than the preset turning on temperature, the hot water circulation pump (P2) is triggered and works till the temperature exceeds the turning off temperature.

If the preset turning-on temperature of this function is 40°C, then when T4 is less than 40°C, for example it is 39°C, this circulation pump is triggered and it is ceased until T4 temperature reaches 45°C.

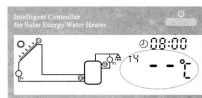
Activate/deactivate this function:

► Press "SET" button 2 times, the hot water circulation temperature setting area blinks, default setting is "OFF" mode, "—" displays.

► Press "OK" button to activate this function.

► Press "▲▼" button to adjust the temperature of circulation pump, (adjustable range: 20°C~50°C), after 6 seconds, controller confirms the setting automatically.

► In the status of setting the temperature for circulation pump, press "OK" button to deactivate this function, "—" displays.



NOTE

● Temperature-controlled hot water circulation function is priority to trigger than time-controlled hot water circulation function.

● If the temperature-controlled hot water circulation function is triggered, then time-controlled hot water circulation function is ceased automatically.

● If the temperature-controlled hot water circulation function is ceased, then time-controlled hot water circulation function is triggered automatically.

● The position of the sensor T4 should be minimum 1.5m far from tank, so that avoid the measuring error.

4.8 Anti freezing protection of collector

NOTE this function is only useful in the system which doesn't use anti-freezing liquid.

Functional description:

In Winter when the temperature of collector is below the preset start temperature (2~10°C) of anti-freezing protection, solar circuit pump is triggered. While the anti-freezing protection function works, if the tank temperature is less than 10°C, electrical booster will be triggered immediately and is switched off until water up to 20°C or when frost protection function is deactivated. When temperature of collector is 5°C higher than preset start temperature of frost protection, controller stops solar circuit pump and exits the program. This function is used in the system which uses water as heat transfer medium to avoid freezing problem.

Activate/deactivate this function:

► Press "SET" button 1 time, the frost protection setting area blinks; default setting is off, display "—".

► Press "OK" button to activate this function.

► Press "▲▼" button to adjust the switch-on temperature of frost protection, (adjustable

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!!! when heating signal displays on screen, it means this function is in operation.

NOTE

- Preset switch-off time of timing heating should be later than the switch-on time of timing heating
For example: if you set the switch-on time of timing heating is 17:00 and set switch-off time is 06:00, then heating in this time section is ineffective; the right setting is like following: This setting should be divided into two time sections, the first time section is from 17:00 to 23:59, then second time section is from 00:00 to 06:00.
- The set switch-on time of heating should be later than the current clock's time, otherwise the setting can not effect in this day. If you set the switch-on time is earlier than the current clock's time, then the heating will be effective in next day.
For example: if the current clock's time is 8:00 am and you set the switch-on time of heating is 7:00, switch-off time is 9:00, then heating in current day is ineffective, time heating function will start from next day.

4.6 Time controlled hot water pipe circulation

Functional description:

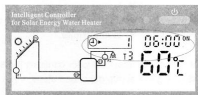
Solar system can provide time-controlled hot water pipe circulation function; through this function can realize to get hot water immediately when man opens the tap. This function needs an extra circulation pump (P2), and this pump can be triggered automatically within the preset time section. Within the preset time section pump (P2) operates for three minutes, and then stops for 15 minutes, after then it triggers again for 3 minutes, stops for 15 minutes, same process continues so. Three time sections can be set within one day.

Setup steps:

- ▶ Press "Pipe timing" button, timing setting area blinks, to set the start time of circulation.
- ▶ Press "▲▼" button to adjust hour.
- ▶ Press "←→" transfer button to minute area.
- ▶ Press "▲▼" button to adjust minute.
- ▶ Press "Pipe timing" button again to set the end time of circulation.
- ▶ Press "▲▼" button to adjust hour.
- ▶ Press "←→" transfer button to minute area.
- ▶ Press "▲▼" button to adjust minute.
- After 6 seconds, controller confirms setting automatically.
- Doing like above steps. Within one day, three time sections can be set (1-3 displays on screen to indicate the preset time section).
- If you want to shut off one timing circulation, then you can set the turning on time and turning off time same value (for example, deactivate the function in the second time section, then you can set turning on time is 10:00, and then set turning-off time is 10:00 also).
- Controller has memory function, setting is remembered, it needn't to set everyday. Everyday when the preset time is coming, water circuit pump is triggered automatically.
- Pressing "Pipe timing" button can check the setting.

Manual operation: At the status that controller is in operation, hot water circuit pump can be triggered immediately by pressing "On/Off" button, pipe circulation signal displays. If the time of this operation is happened at the preset time section, it works as normal situation, namely works for 3 minutes, then stops for 15 minutes, same process continues within the time section. If the time of this operation is not within the preset time section, it works for 3 minutes, and then it stops automatically, no more restart.

At the status that hot water circuit pump is in operation, press "Pipe timing" again to stop pump immediately.



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4. Device setup

4.1 Clock set

- ▶ Press "Clock" button, the hour selection area "00" blinks on display screen.
 - ▶ Press "▲▼" button to adjust hour of clock.
 - ▶ Press "Clock" button again, the minute selection area "00" blinks.
 - ▶ Press "▲▼" button to adjust minute of clock.
- After 6 seconds controller confirms the setting automatically, the current time is displayed on the screen.

4.2 On/Off button operation

- After power is switched-on, as default set controller is in open status, it displays water temperature of tank and clock time, all functional buttons are ready for setting operational parameters.
- ▶ Press "On/Off" button, 3 minutes water circulation function becomes into affect (hot water pipe circulation pump), circulation signal is indicated on screen, 3 minutes later program stops water circulation pump automatically.
 - ▶ Press "On/Off" button for 3 seconds, controller is closed, only tank temperature and time are displayed on screen. In the status that controller is closed, press this button again, controller reopened.

4.3 System description

4.3.1 1 collector array – 1 storage tank – 1 pump (1 sensor on tank)

Description:

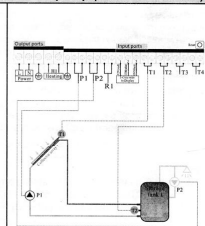
The solar circuit pump (P1) is triggered immediately when the switch-on temperature difference between the collector array (T1) and the storage tank (T2) is reached. When the temperature difference between the collector array (T1) and storage tank (T2) drops below the switch-off temperature difference, then the solar circuit pump (P1) is ceased.

T1: Temperature sensor for collector
T2: Temperature sensor in the bottom part of tank (for controlling temperature difference circulation and auxiliary heating).

P1: Temperature difference solar circuit pump
P2: Hot water circuit pump

NOTE

- H1 is port for connecting with auxiliary electrical heating booster.
- T4 is temperature sensor positioned on the pipe of user side.



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4.3.2 1 collector array – 1 storage tank – 1 pump (2 sensors on tank)

Description:

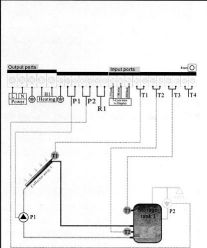
The solar circuit pump (P1) is triggered when the switch-on temperature difference between the collector array (T1) and the storage tank (T2) is reached, when the temperature difference between the collector array (T1) and storage tank (T2) drops below the switch-off temperature difference, then the solar circuit pump (P1) is ceased.

T1: Temperature sensor for collector
T2: Temperature sensor in the bottom part of tank (for temperature difference circulation)
T3: Temperature sensor in the top part of tank (for auxiliary heating).

P1: Temperature difference solar circuit pump
P2: Hot water circuit pump

NOTE

- H1 is port for connecting with auxiliary electrical heating booster.
- T4 is temperature sensor positioned on the pipe of user side.
- When the sensor T3 (in top part of tank) is damaged, controller will adopt the signal from sensor T2 (in bottom part of tank) to control the electrical heater.



4.4 Temperature difference controlling function

Functional description:

Solar circuit pump P1 is triggered by temperature difference, so long as the preset temperature difference between collector and tank is reached, solar pump is switched on.

For example: if we set the switch-on temperature difference is 8 °C, the switch-off temperature difference is 4°C. Then when the temperature in bottom part of tank is 20°C, the collector temperature must rise up to 28°C, pump is triggered, when collector temperature falls below 24°C, pump stops.

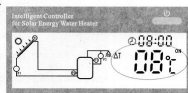
Important information: the switch-on temperature difference 8°C and the switch-off temperature 4°C are standard system setting according to many years' experiences. Only in special application cases it can be changed (e.g. far distance heat transferring), switch-on and switch-off temperature difference are important setting.

NOTE to avoid mistake the minimum difference between two temperature differences ($\Delta T_{on} - \Delta T_{off}$) is set as 2°C.

Setup steps:

- ▶ Press "ΔT" button, temperature setting area blinks.
- ▶ Press "▲▼" button to adjust switch-on temperature difference. (Adjustable range: (off+2°C) ~ 15°C, default valve is 8°C.)
- ▶ Press "ΔT" button again.
- ▶ Press "▲▼" button to adjust switch-off temperature difference. (Adjustable range: 0°C ~ (on- 2°C), default valve is 4°C.)

After 6 seconds, controller confirms the setting.



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4.5 Temperature controlled auxiliary heating during three time sections

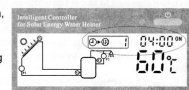
Functional description:

Solar system can be combined with electrical booster or gas, oil boiler, controller can achieve automatically temperature and time controlled heating. During the preset time sections electrical booster is triggered when the temperature (T3) of top part of tank is 6 °C below the preset temperature of electrical booster. When T3 exceeds or equals the preset temperature, electrical booster stops heating.

NOTE When it is outside of the preset time section, electrical booster doesn't work automatically even when the tank temperature reaches the start temperature of electrical heating.

Setup steps:

- ▶ Press "Heating" button, timing area blinks on display, you can set turning on time and temperature of electrical heating now,
- ▶ Press "▲▼" button to set hour,
- ▶ Press "←→" button to shift to minute setting,
- ▶ Press "▲▼" to set minute.
- ▶ Press "←→" again to shift to temperature area,
- ▶ Press "▲▼" to set turning off temperature of electrical heating.
- ▶ Press "Heating" button again, you can set turning off time of electrical heating.
- ▶ Press "▲▼" button to set hour.
- ▶ Press "←→" button to shift to minute setting.
- ▶ Press "▲▼" to set minute.



- 6 seconds later controller confirms the settings
- Doing like above described steps, three timing sections can be set. (1-3 displays on screen to indicate the preset time section)
- Default setting:
 - First heating time section: 4:00 turning on, 5:00 turning off
 - Second heating time section: electrical heater doesn't work, setting is 10:00 ~10:00
 - Third heating time section: 17:00 turning on, 22:00 turning off
- Default turning off temperature of electrical booster is 55°C.
- If you want to shut off heating in one time section, then you can set the turning on time and turning off time same value (for example, the second time section no this function, then you can set turning on time is 10:00, turning off time is 10:00 also).
- Controller has memory function, your setting is remembered, and you don't need to set everyday.
- Pressing "Heating" button can check the setting.

Manual operation:

Press this button for 3 seconds, when T3 < 50°C, electrical heater is triggered immediately, corresponding signal is lighted, when T3 ≥ 55°C, electrical heating is ceased. During the heating operation process press this button again to cease heating.

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