Solar Thermal

Grant GSD1 Differential Solar Controller

Installation & User Instructions

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1 Introduction

1 Introduction

Dear Customer, Thank you for purchasing a Grant Solar Thermal System. This Installation manual must be read carefully before installing the Grant Solar Controller. We recommend that before installing the system that you attend a training course at our training centre.

The Grant GSD1 Mk2 Solar Controller is a digital differential controller for basic solar thermal systems using a single pump station. It is not intended for use with more complex solar thermal systems, e.g. those using two or more pump stations and/or two or more hot water storage vessels.

This controller is not intended to be used as part of a safety relevant thermal control circuit, or any other use, beyond the operation scope of the controller. Incorrect application of the controller could result in damage to the system, to property, or injury or death to either the users of the system or third parties. Grant Engineering UK Ltd shall not be liable for any injury or damage arising from the incorrect use of this controller.

For correct usage, refer to these installation and user instructions.

Installation of the Grant GSD1 Mk2 Solar Controller must be installed by a competent person in accordance with all current legislation, codes of practice and local by-laws relating to the installation of solar thermal systems.

The electrical installation must comply with the requirements of the Electricity at Work Regulations 1989 and BS7671:2008 – IEE Wiring Regulations 17th Edition (including all amendments).

All installation of Solar Thermal systems must comply with the relevant Building Regulations.

Pump type

The Grant GSD1 Mk2 controller is suitable for use with a 2-speed 230V 50Hz solar circulating pump, as fitted to the Grant Solar Thermal pump stations. For use with any other type of solar circulating pump please contact the Grant Technical Department for assistance.

! NOTE

The diagrams in these instructions show only the essential components in order to demonstrate the described functions. They are not intended as complete diagrams to be used for the design and installation of a system on site.

2 Technical Specifications

2.1 Technical Data

Ambient Temperature range	Operation Storage/transport	0 to 50°C -30 to 60°C
Degree of protection	To EN60529	IP40
Protection Class	To EN60730	II protected
Supply voltage		230V 50HZ
Power consumption		5 VA

2.2 Temperature Sensors

Temperature/resistance – Pt1000 Thermistor

Temp °C	Resist Ω	Temp °C	Resist Ω	Temp °C	Resist Ω
-50	803	20	1078	90	1347
-40	843	30	1117	100	1385
-30	882	40	1155	110	1422
-20	922	50	1194	120	1461
-10	961	60	1232	130	1492
0	1000	70	1270	140	1536
10	1039	80	1309	150	1573

2.3 Package Contents

The Grant GSD1 Mk2 Solar Controller kit comprises the following items:

1 x Wall mounting plate/wiring base

1 x GSD1 plug-in controller unit

2 x Pt1000 temperature sensors

1 x Installation and User Instructions

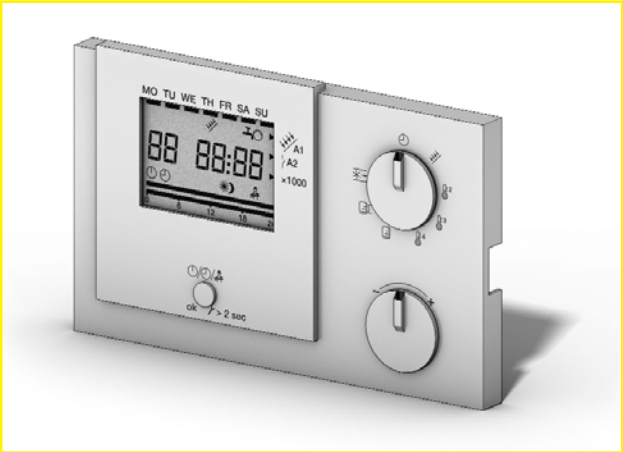


Figure 2-1: Controller unit

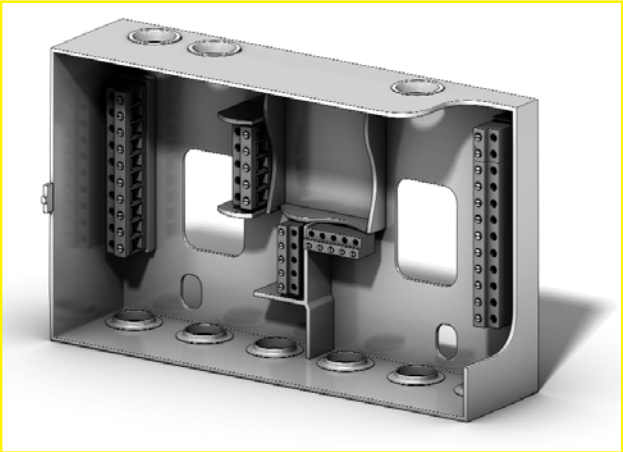


Figure 2-2: Wall plate/wiring base

3 Controls and Operation

3.1 Description

The Grant GSD1 Mk2 Solar Controller is a digital differential temperature controller. The purpose of a digital differential temperature controller is to efficiently operate the solar circulating pump when sufficient solar energy is available, whilst preventing unsafe high temperatures in the hot water storage cylinder. Refer to Section 4 for details of operation.

The controller has an easily accessible display mode and a password protected programming mode (in which the parameters for operation of the system can be set).

The controller has different parameters by which the control of the system can be adapted. The majority of these parameters are factory set and do not need to be adjusted. Only a small number of parameters need to be set by the installer as part of commissioning the controller/system.

Refer to Section 7.3 for details of all the controller parameters and guidance on those that have to be set by the installer.

3.2 Operating Modes

The controller has THREE different operating modes, as follows:

Off

In this setting the pump switch contact (A1) is permanently open and the system circulating pump is OFF – irrespective of differential Temperature sensing

Auto

In this setting the controller works in normal operating mode based on the parameter settings and differential temperature

Service

This setting allows normal operation of the controller to be overridden for commissioning or servicing work

Note: After 30 minutes the controller will automatically switch back to the **Auto** mode

To switch between these three operating modes briefly press the pushbutton (located below the display on the controller). Refer to section 3.3 for details.

3.3 Controller Features

The controller has the following features for setting the parameters and monitoring operation of the system:

a) A backlit display screen

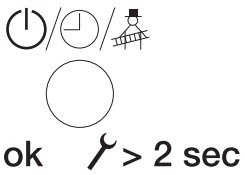
b) A display selector switch

c) A pushbutton for selecting the operating mode

d) An adjustment dial

3.4 Pushbutton

The pushbutton has several functions, as follows:



a) To change the operating mode of the controller. Press the push button briefly to switch between **Off – Auto – Service**

b) To access the programming mode. Press and hold the push button for 2 seconds.

c) To exit the programming mode. Press and hold the push button for 2 seconds.

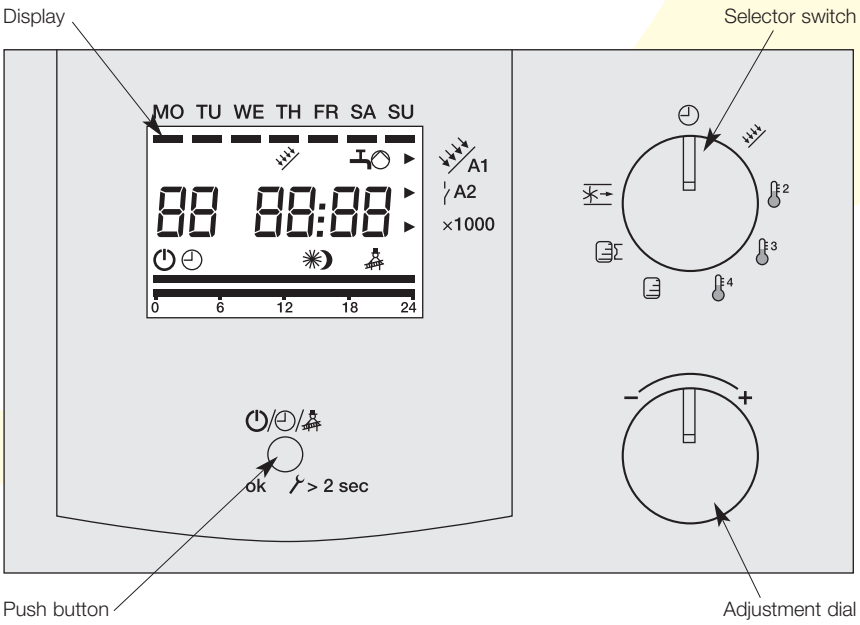
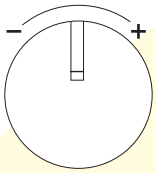


Figure 3-1: Controller features

3 Controls and Operation

3.5 Adjustment Dial

This is used to change the value of a parameter when in the programming mode. Turn the dial to select the required value of the parameter concerned. Turning the dial to the right (clockwise) increases the value and to the left (anticlockwise) decreases the value. Press the pushbutton to set and apply that value.



To the left decreases value

To the right increases value

3.6 Display Selector Switch

Setting the pointer of the selector switch to corresponding symbol allows the required value to be shown on the controller display, as follows:

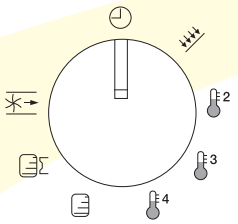


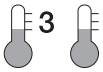
Figure 3-2: Display selector switch

Display Selector Switch Symbols

Display of the time in 24-hour format.

Display of collector temperature (in °C) – Input E1.

Display of the storage cylinder temperature (in °C) – Input E2.



No values displayed – these inputs are not used.

Display of the energy collected during the current day (in kWh).

Display of the total energy collected (in kWh).

Display of pump speed (%) – not used.

3.7 Display

Depending on the position of the Display Selector Switch, the corresponding information is shown on the display.

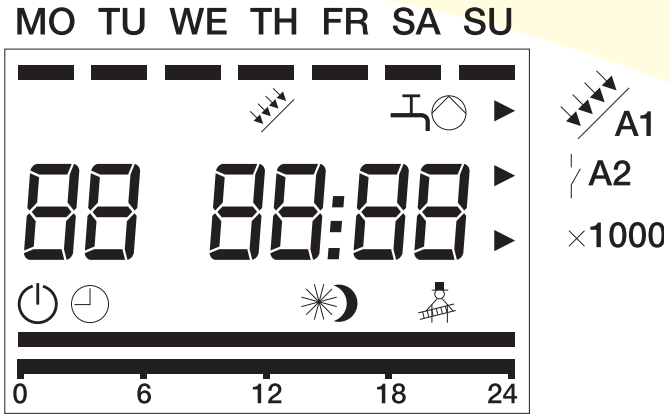


Figure 3-3: Controller display

MO TU WE TH FR SA SU	
MO	(Monday)
TU	(Tuesday)
WE	(Wednesday)
TH	(Thursday)
FR	(Friday)
SA	(Saturday)
SU	(Sunday)

Figure 3-4: Day of the week indication

In addition, the following system status information is also displayed:

Flashing collector indicates the system is in stagnation. The storage cylinder has reached the required temperature. No further heat can be transferred. The solar fluid in the collector evaporates in a controlled way.

▶ A1 Switch A1 is closed and the solar pump is operating depending on the collector and cylinder temperatures (when the controller is set to **Auto** operating mode).
OR
Switch A1 is closed and the solar pump is operating due to the controller being overridden (when the controller is set to **Service** operating mode).

▶ A2 Switch A2 is closed – due to controller override (when the controller is set to Service operating mode).

×1000 Displayed value x1000.

The controller is switched **Off**.

The controller is in **Auto** mode.

Pump kick function: Day function.

Pump kick function: Night function.

The controller is in **Service** mode.

With controller in **Auto** mode: Analogue display of the collector temperature from 0°C to 120°C. With controller in programming mode: A flashing display indicates that the parameter displayed can be adjusted (using the adjustment dial).

3.8 Time of day

With the controller in either the Auto or Service mode, the current time is displayed in 24-hour format. The time displayed can be altered by adjusted Parameter P01 in the Programming mode.

3.9 Day of the week

With the controller in either the Auto or Service mode, the current day of the week is displayed as a bar below the inscription for the corresponding day of the week. Refer to Figure 4-1. The day of the week displayed can be altered by adjusted Parameter P02 in the Programming mode.

4 Operating Functions

4.1 Differential temperature

The Solar circulating pump is activated by the controller when the temperature difference between the solar collector(s) and the solar part of the hot water storage cylinder exceeds the 'switch-on' temperature difference value (P20) of 6°C (6K).

When the temperature difference between the collector(s) and the storage cylinder falls to 'switch-off' value (P21) of 3°C (3K) the controller will stop the solar circulating pump.

This 'switch-on' temperature difference and 'switch-off' temperature difference parameters are factory set and **should not be adjusted** unless advised to do so by the Grant Technical Department.

4.2 Collector temperature

Provided that the 'switch-on' temperature difference is exceeded (see 4.1 – Differential temperature), the collector temperature has to exceed the collector minimum 'switch-on' temperature (P30) of 20°C for the solar controller to start the solar circulating pump.

When the collector falls below the collector minimum 'switch-off' temperature (P31) of 15°C the solar controller will stop the solar circulating pump.

The minimum 'switch-on' temperature (P30) must always be higher than the minimum 'switch-off' temperature (P31) by a difference of 5°C (5K). These temperature parameters are factory set and **should not be adjusted** unless advised to do so by the Grant Technical Department.

4.3 Storage cylinder temperature

The maximum storage cylinder 'switch-on' temperature (P62), for the solar part of the hot water cylinder, is the maximum temperature up to which the solar circulating pump is switched on by the controller.

When the maximum storage cylinder charging temperature (P60) is reached, the solar circulating pump is switched off by the controller.

! NOTE

To meet the requirements of Approved Document G - Part G3, a tempering valve must be fitted to the hot water outlet of the cylinder.

4.4 Collector switch-off

When the maximum collector 'switch-off' temperature (P34) is exceeded, the solar controller stops the solar circulating pump. As the heat is no longer transferred away from the collector(s), a controlled vaporisation of the solar fluid takes place within the collector(s). The solar circulating pump cannot be switched back on until the temperature in the collector falls below the maximum collector switch-on temperature (P35).

The switch-on temperature parameter is factory set and **should not be adjusted** unless advised to do so by the Grant Technical Department.

4.5 Collector cooling

! NOTE

This function is not used with Grant Solar Thermal Systems.

The collector cooling function of the solar controller delays the vaporisation of the solar fluid in the collectors. Shortly before reaching the maximum temperature of the collector, the controller starts the solar pump to cool the solar fluid using the heat losses in the system pipework and hot water storage cylinder.

In order for the collector cooling function to operate, the maximum collector 'switch-off' temperature (P34) must be set higher than the 'switch-on' temperature of the collector cooling function (P32).

The working range of the collector cooling function is set by Parameter P32 (Collector cooling 'switch-on' temperature) and Parameter P33 (Collector cooling 'switch-off 'temperature). These temperature parameters are factory set and **should not be adjusted** unless advised to do so by the Grant Technical Department.

The solar circulating pump is switched off by the solar controller when the temperature in the solar part of the storage cylinder reaches the maximum storage cylinder charging temperature (P60).

NORMAL OPERATING PARAMETERS

Measured at collector sensor E1

P30=20°C Min collector Switch-on temp

P31= 15°C Min collector Switch-off temp

P20=6°C (K) Switch-on temp diff (ΔT on)

P21=3°C (K) Switch-off temp diff (ΔT off)

COLLECTOR COOLING PARAMETERS

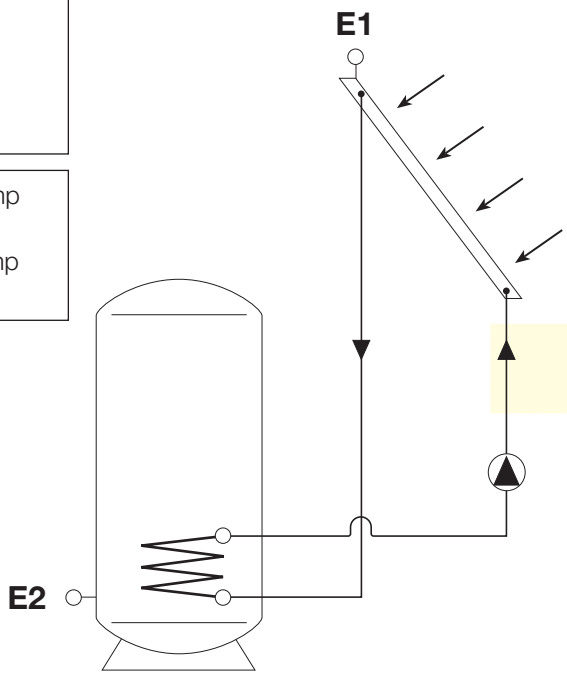
Measured at collector sensor E1

P32=115°C Switch-on temp

P33=110°C Switch-off temp

P34=120°C Max collector switch-off temp

P35=105°C Max collector switch-on temp



Measured at cylinder sensor E2

P60=60°C Max cylinder charging temp

P62=55°C Max cylinder switch-on temp

Measured at cylinder sensor E2

P61=90°C Max storage cylinder temp

Figure 4-1: System operating parameters

4 Operating Functions

4.6 Pump kick function

This function is **not used** with Grant Solar Thermal systems and is factory set to OFF (Parameter P76 is set to 0) and **should not be adjusted** unless advised to do so by the Grant Technical Department.

When set to operate (i.e. when Parameter P76 in not set to 0), the solar pump will automatically operate for a short period (the 'pump kick interval' – P76) at regular time intervals (the 'pump kick break' period – P75). As a result, if the sensor was in shade (and thus cooler than the rest of the collector), the resulting flow over the sensor will enable it to detect the actual temperature of the fluid in the collector.

If the temperature increase of the sensor is less than 0.5K then the solar circulating pump is switched off again. After a further pump kick break period (P75) the process is repeated.

If, during the pump kick interval (when the solar circulating pump is running), a temperature increase of 0.5K is measured by the sensor the next pump kick break is skipped (i.e. the solar pump continues to run).

This process is repeated until either:

a) The 'switch-on' conditions for the normal operation of the solar thermal system are met, or

b) A temperature increase is no longer measured by the sensor.

In order to optimise the power consumption of the solar circulating pump used to provide this function, a time frame is set within which the a solar output is expected. This time frame is defined by setting a 'switch-on' time (P05) and a 'switch-off' time (P06). The factory set values for these two parameters are 7.00 (P05) and 22.00 (P06).

4.7 Heat quantity calculation (Calorimetry)

The controller will measure the amount of heat energy collected based on the value of the flowrate (in litres/min) manually entered as Parameter P82. For this function of the controller to operate Parameter P80 must be set to 0. Refer to Section 7.3 – parameter settings.

The measurement of heat energy collected is based on:

a) The temperature of the hot flow – using the collector sensor (E1);

b) The temperature in the hot water store – using the storage cylinder sensor (E2);

c) The type of heat transfer fluid – Parameter P85 (pre-set to 0 for Propylene Glycol);

d) The solar fluid concentration – Parameter P84 (pre-set to 40%);

e) The solar fluid flowrate (in litres/min) – Parameter P80 (actual flowrate set on pump station).

Depending on the setting of the Display Selector switch, either the Daily heat output or Total (cumulative) heat output can be displayed, based on the above parameters. Refer to Section 3.6.

IMPORTANT

Important. All the above parameters must be correctly set in order for the controller to measure and display the amount of heat collected.

5 Installation

IMPORTANT

Ensure the electrical supply to the solar thermal system has been isolated before fitting and connecting the GSD1 solar controller.

5.1 Mounting wall plate/ wiring base

Separate the controller from the wall plate/wiring base by gently prising the two grips (one at each side of the controller) away from the controller using a small screwdriver. Refer to Figure 5-1. Carefully pull the controller unit out from the wall plate wiring base.

Insert screwdriver blade and twist

Carefully prise controller out from wiring base

Figure 5-1: Removal of controller

Position the wiring base in the required location on a wall. Using the wiring base as a template, mark and drill four holes in the wall. Note: Only use the wiring base to mark the hole positions and NOT as a drilling jig. Fix the wiring base to the wall using suitable wall plugs and screws (not provided).

5.2 Electrical connection

The inside of the wiring base is divided into three sections – refer to Figure 5-2. All 230V mains electrical connections are situated in the left hand section and all the connections for the temperature sensors are situated in the right hand section.

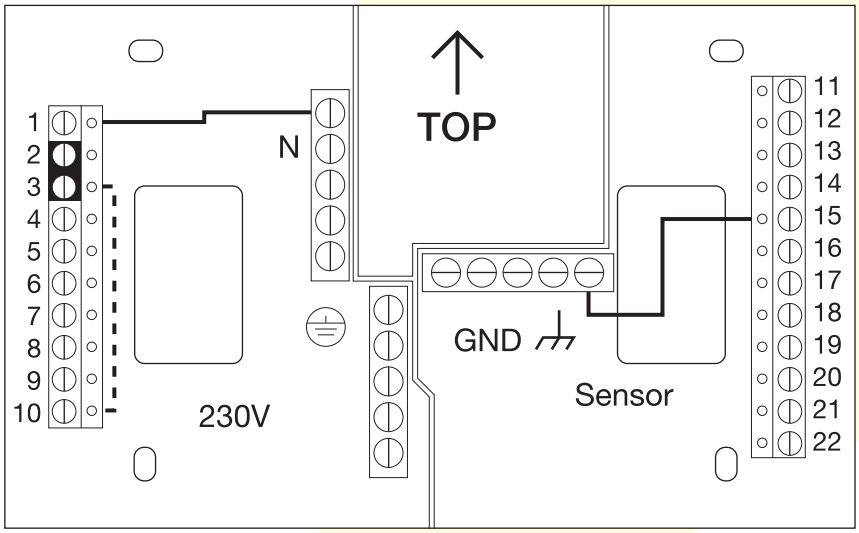


Figure 5-2: Wiring base terminals

5 Installation

Make the electrical connections to the wiring base as follows:

a) Fit a link wire (minimum cross section 1.5mm²) between Terminal 1 on the left hand (Live) terminal bar and the Neutral (N) terminal block.

b) Fit a link wire between Terminal 15 on the Right hand (sensor) terminal block and the Ground (GND) terminal block.

c) Connect the 230V mains power supply.
Live to Terminal 2.
Neutral to Neutral terminal block (N).
Earth to Earth terminal block.

d) Connect the 230V output to the solar pump.
Live to Terminal 5.
Neutral to Neutral terminal block.
Earth to Earth terminal block.

e) Connect the Collector sensor.
One wire to Terminal 16.
One wire to Ground terminal block (GND).
There is no polarity for sensor connections.

f) Connect the Cylinder sensor.
One wire to Terminal 17.
One wire to Ground terminal block (GND).
There is no polarity for sensor connections.

NOTE

The broken line shown between terminals 3 and 10 in Figure 5-2 indicates an internal connection. NO wire link should be fitted between these two terminals.

Refer to Figure 5-3 for a full connection diagram for the solar thermal system, including wiring of the hot water storage cylinder thermostats and high temperature motorised (or solenoid) valve on the solar thermal input to the cylinder. Figure 5-4 shows the cabling arrangement for this system.

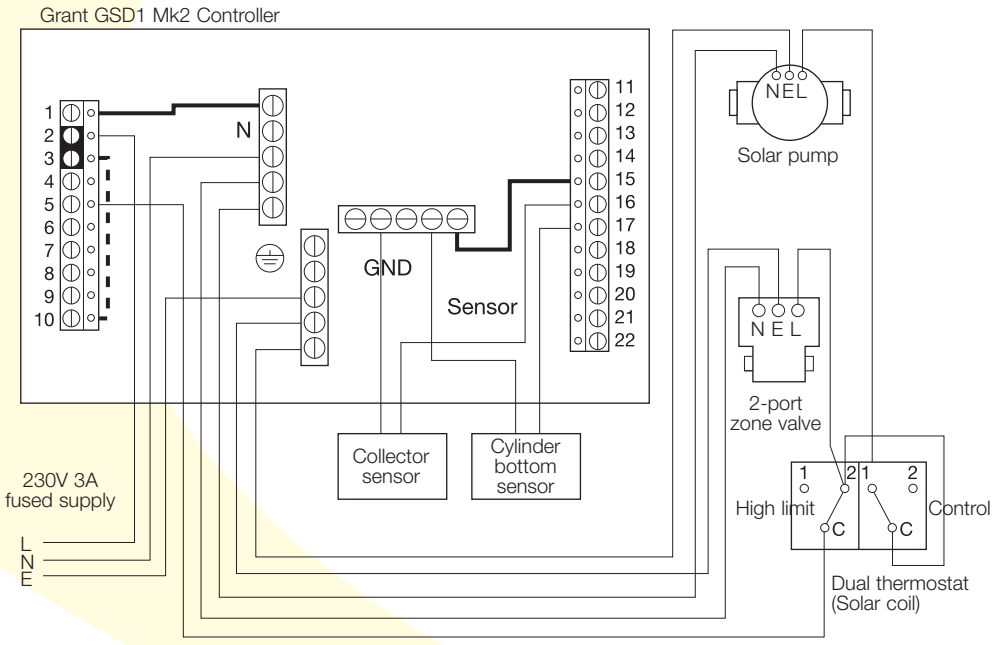


Figure 5-3: Solar thermal system wiring diagram

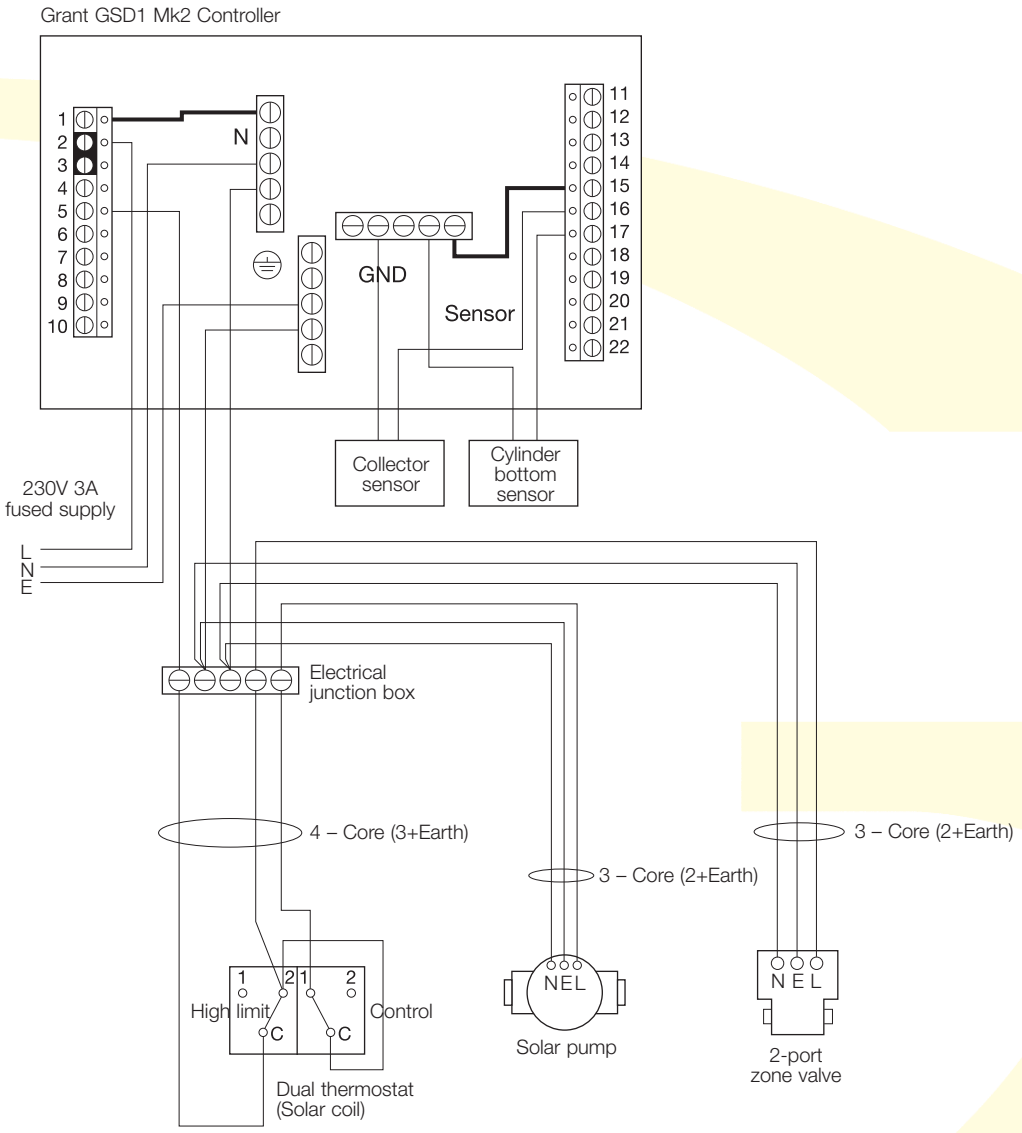


Figure 5-4: Cabling diagram for system controls

5.3 Fitting the controller

When the electrical connections to the wiring base are all completed, re-fit the controller. Carefully locate the controller into the wiring base and, applying an even force on each end of the controller, push fully into place until the two grips (one at either side of the controller) are correctly located.

If there is any resistance do not force the controller into the wiring base, but remove and check for any obstructions (e.g. wires, etc.) before attempting to re-fit. Ensure that the connecting pins on the back of the controller are all straight so that they can be located into the corresponding holes in the terminal blocks in the wiring base.

6 System

6.1 System operation

The Grant GSD1 solar controller automatically operates the system based on the following:

- The temperature difference between the collector (E1) and the solar part of the hot water storage cylinder (E2)
- The temperature of the collector (E1)
- The temperature of the solar part of the hot water storage cylinder (E2)

Refer to Section 4 for details of the operating functions.

IMPORTANT

Cylinder thermostat and temperature sensor positions may differ from those shown depending on the make and type of cylinder used.

6.2 System type

In order for the controller to function as described above, the controller is supplied with the 'system' parameter (P17) factory set to 1. This parameter must be checked during commissioning to ensure it is correct. It **should only be set to 1** unless advised to do so by the Grant Technical Department.

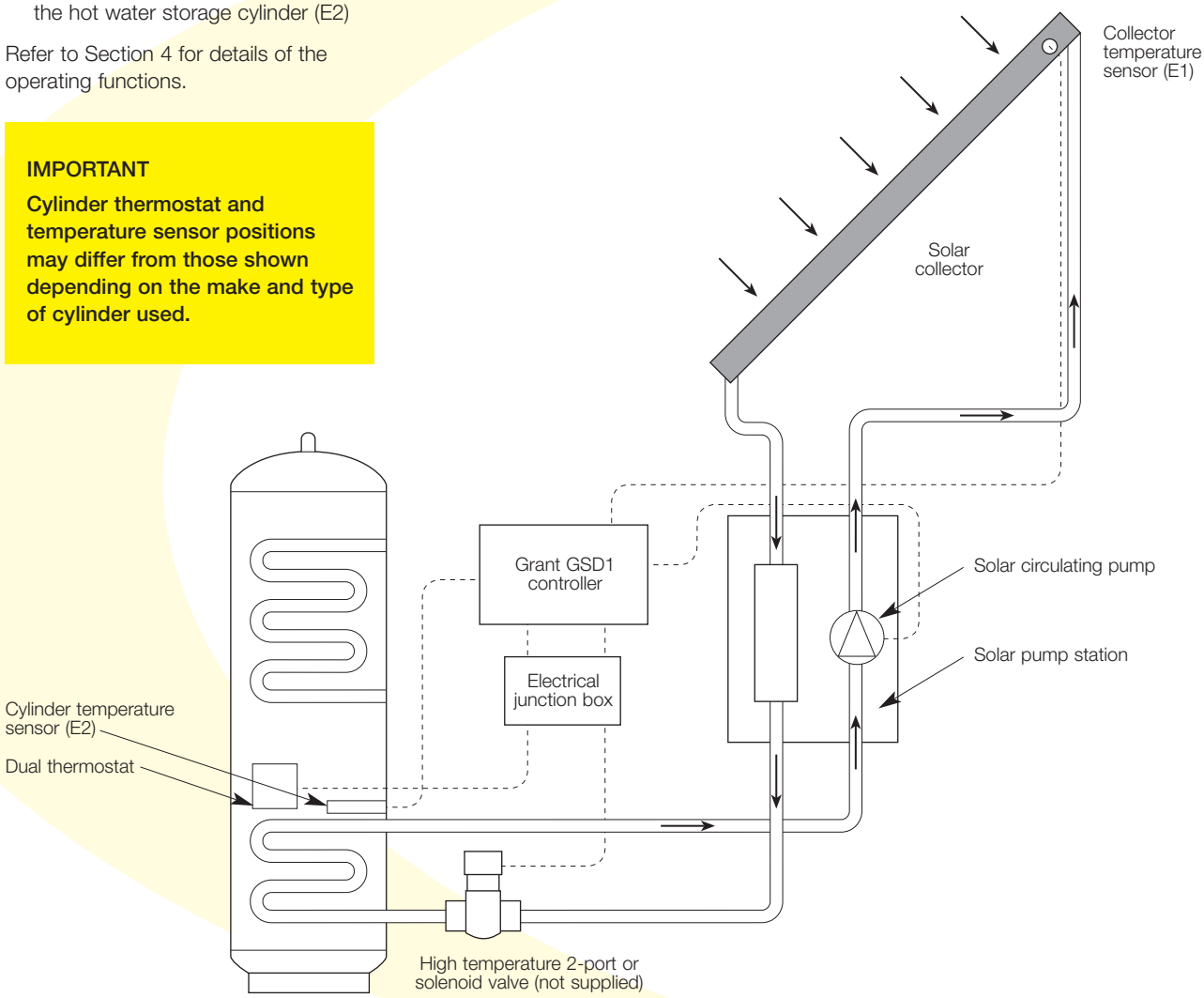


Figure 6-1: Schematic diagram of Grant solar thermal system

NOTE

Refer to Section 5 – Figures 5-3 and 5-4 for system electrical wiring diagram

7 Commissioning/Programming

7.1 Programming mode

The programming mode is accessed by pressing and holding the push button for at least 2 seconds.

By pressing the push button again and holding for at least 2 seconds, the controller exits the programming mode and returns to the previous mode – Off, Auto or Service.

If the controller is left in the programming mode for greater than 30 minutes it will automatically exit and return to the previous mode – Off, Auto or Service.

NOTE

The controller remains active in the selected operating mode even when in the programming mode!

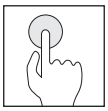
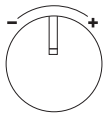
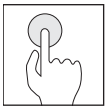
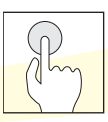
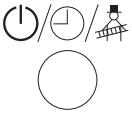
7.2 Setting the controller

After having installed the controller and made all electrical connections, switch on electrical supply.

The software status of the controller appears on the LCD display for 2 seconds, followed by the solar circulating pump type detected by the controller (Parameter P92).

The factory settings for the first start-up are as follows:
System 1 (Parameter 17)
Operating mode Off (see section 3.1)

To adjust the controller parameters use the following procedure

STEP 1	 (t>2 s)	Press push button and hold for at least 2 seconds to enter Programming mode.
STEP 2		Operate Adjustment dial to select parameter to be adjusted. Refer to Section 7.4 for table of all the controller parameters.
STEP 3		Press push button briefly to enter parameter adjustment mode – line will be flashing.
STEP 4		Adjust value of parameter as required using the Adjustment dial.
STEP 5		Press push button briefly to set Parameter value
STEP 6		Repeat steps 2 to 5 for all other parameters to be adjusted – refer to Section 7.3
STEP 7	 (t>2 s)	Press and hold push button for at least 2 seconds to exit programming mode
STEP 8		Press push button briefly to set operating mode to Auto for solar controller to operate

7 Commissioning/Programming

7.3 Parameters settings

ALL the following parameters **must** be adjusted and set by the installer prior to operating the system for the first time. Refer to Section 7.4 for a Table showing all parameter settings of the controller.

Step	Parameter	Setting required
1	P01	Set to the correct time of the day
2	P02	Set to correct day of the week
3	P15	Enter password to access further parameters
4	P62	Set to **55ºC** (before setting parameter P60) – this must be set **5ºC** lower than parameter P60
5	P60	Set to **60ºC**
6	P80	Set to **0** (before setting parameter P82)
7	P82	Set value of system flowrate (in litres/sec)
8	P90	Set to **0**
9	P92	Set to **0**
10	P93	Set to **0**

7.4 Solar controller parameters

P	Function	Setting Range Range	Units	Factory Settings	Installer Settings
00	Resets the factory settings	0/1		0	As required
01	**Time**	**0.00 – 24.00**		**10**	**To suit**
02	**Day of the week**	**MO – SU**		**MO**	**To suit**
03	Daily output (reset =1)	0/1		0	As required
04	Total output (reset = 1)	0/1		0	As required
05	Pump kick: switch-on time	0.00 – 24.00		7.00	
06	Pump kick: switch-off time	0.00 – 24.00		22.00	
15	**Password entry: access to the following parameters**	**0000 – 9999**			**0000**
16	Password (entry/change)	0000 – 9999		0000	As required
17	System	1 – 5		1	
20	Difference for output A1 “ON”	1 – 30	K	6	
21	Difference for output A1 “OFF”	0 – 29	K	3	
30	Minimum collector switch-on temperature	-20 – +90	°C	20	
31	Minimum collector switch-off temperature	-21 – +89	°C	15	
32	Collector cooling function: switch-on temperature	80 – 180	°C	115	
33	Collector cooling function: switch-off temperature	75 – 175	°C	110	
34	Maximum collector switch-off temperature	80 – 180	°C	120	
35	Maximum collector switch-on temperature	70 – 170	°C	105	
60	**Maximum storage cylinder charging temperature**	**5 – 95**	**°C**	**85**	**60**
61	Collector cooling function: Max. storage cylinder temperature	10 – 95	°C	90	
62	**Maximum storage cylinder switch-on temperature**	**4 – 94**	**°C**	**80**	**55**
75	Pump kick: break	10 – 60	min	30	
76	Pump kick: OFF (0)/kick interval	0/2 – 59	s	0	
77	Pump kick: measuring time for 0.5K increase	1 – 10	min	1	
80	**Calorimetry (ON = 1)**	**0/1**		**1**	**0**
82	**Volume flow for heat quantity calculation**	**0 – 100**	**l/min**	**0**	**To suit**
84	Glycol concentration	0 – 70	%	40	
85	Glycol type (Propylene = 0, Ethylene = 1)	0/1		0	
90	**Error messages Er62/Er63 (display inactive = 0/active = 1)**	**0/1**		**1**	**0**
92	**Pump type A1**	**0/1/2**			**0**
93	**Operating mode volume flow control (manual = 0/auto = 1)**	**0/1**		**1**	**0**
94	Number of revolutions, nominal value (MANUAL)	(5) 30 – 100	%	100	

NOTE

All parameters from Parameter 16 onwards can only be adjusted after entering the password – at Parameter 15.

IMPORTANT

ALL highlighted parameters MUST be checked and set as shown above during commissioning. Refer to Section 7.3.

8 Fault Finding

8.1 Error messages

Message	Cause	Explanation
Er 71	E1 delivers undefined values	The output (A1) to the solar pump is switched off. *The error message cannot be acknowledged, the display only shuts off after the error has been eliminated. In order to do this, interrupt the power supply to the controller for approx. 20 seconds.* Check the 'Temperature sensor' – see Section 8.2 Set to correct day of the week
Er 79	E2 delivers undefined values	
Er 64	No Circulation	Pump failed System airlocked *Check - rectify (see below)*
Er 81	EEPROM	All outputs are switched off. *Send the controller to manufacturer with a list of the system parameters that were set*

8.2 Checking for faults

Temperature sensor

Check the connections of the sensor at the controller (and at any junction boxes).

Check the condition of the sensor and sensor lead.

Check sensor is correctly located in collector or storage cylinder (as appropriate).

Check sensors are correct – i.e. collector sensor is in collector, cylinder sensor is in cylinder.

Check the resistance of the sensor against the temperature (refer to Section 2.2).

Danger: Isolate 230V electrical supply BEFORE removing controller unit from wiring base to check sensor connections

No Flow

Check flow meter in pump station to confirm flow rate.

Check solar circulating pump is running.

Check all valves on the solar primary system are fully open.

Flow too low

Check flow meter in pump station to confirm flow rate.

Check all valves on the solar primary system are **fully** open.

Select a higher solar pump speed.

No energy collection displayed

Check Parameters 80, 82, 84, 85, 92 and 93 are all correctly set.

Unable to adjust Parameter settings from P16 onwards

Enter either 4-digit default password (0000) or your amended password at Parameter 15.

GRANT ENGINEERING (UK) LTD
Hopton House, Hopton Industrial Estate, Devizes, Wiltshire. SN10 2EU
Telephone: 01380 736920 Fax: 01380 736991
Email: info@grantuk.com Website: www.grantuk.com