

TEMPERATURE CONTROLLER FOR SOLAR PANEL INSTALLATIONS

C ←BUS

C ←RING

DPS 638 C3 Eng.



- **Temperature control for solar panel installations**
- **Communication systems:**
 - C- Bus for telemanagement
 - C-Ring for sharing data of common interest between local controllers
- **Power supply 230 V~; DIN rail mounting**

1. APPLICATION

DPS 638 temperature controller is designed for the automation of solar panel installations.

2. FUNCTIONS

The principal functions of DPS 638 are:

- Management of the thermal exchange between solar panels and storage tanks (max 3) according to the pre-set temperature differential and the desired exchange temperature in the main storage tank with:
 - control of pump in panels circuit;
 - automatic exchange between a maximum of three tanks.
- Control of integration circuit temperature by On-Off signals according to 24hour or 7day timed programs.
- Temperature control by modulating 3-wire control (e.g. minimum temperature solar panels, DHW distribution temperature).
- Three On-Off inputs for signalling status or alarm.
- Alarms for short or open circuit detectors and for malfunctioning of plant and components.
- C-Ring connection for local exchange of data with other controllers (integration priority, desired temperature boilers).
- C-Bus connection for exchange data with local PCs or remote telemanagement PC.

3. DETECTORS

No.	Description	Type	Sensing element	Range	Code	Data sheet	
1...3	Essential : Storage tank temp. detector	immersion or cable-type	SIH 010 SAF 010	NTC 10 kΩ NTC 10 kΩ	0...99 °C 0...99 °C	B1-2-3 B1-2-3	N 140 N 145
1	Panels temperature detector	immersion or cable-type	SIH 010 SHF 001	NTC 10 kΩ Pt 1 kΩ	0...99 °C 0...180 °C	B4 B7	N 140 N 145
1	Optional Integration temp. detector	immersion or cable-type	SIH 010 SAF 010	NTC 10 kΩ NTC 10 kΩ	0...99 °C 0...99 °C	B5 B5	N 140 N 145
1	Modulating control temp. detector		SIH 010	NTC 10 kΩ	0...99 °C	B6	N 140

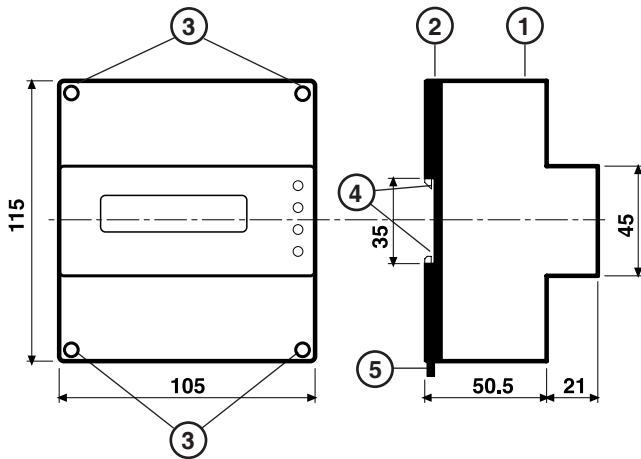
4. TECHNICAL DATA(default values in bold type)

• Electrical	
Power supply	230 V~ ± 10%
Frequency	50 ... 60 Hz
Consumption	5 VA
Protection	IP40
Radio disturbances	VDE0875/0871
Vibration test	with 2g (DIN 40 046)
Voltage-free output contacts:	
Maximum switched voltage	250 V~
Maximum switched current	5 (1) A
Construction standards	Italian Electrotech. Committee CEI
Data storage in memory	5 years
Software	Class A
• Mechanical	
Case	DIN 6E module
Mounting	on DIN 35 rail
Materials:	
Base	NYLON
Cover	ABS
Ambient temperature:	
Operating	0 ... 45°C
Storage	- 25 ... + 60°C
Ambient humidity	Class F DIN 40040
Dimensions	105 x 115 x 71.5
Weight	0.6 kg
• Programmes and periods	
24-hour programmes	1 ... 7
24-hour events	2 ... 6
7-day programmes	0 ... 2

• Measurement ranges	
Temperature of solar panels detector B4	0 ... 99 °C
detector B7	0...200 °C
Temperature of storage tanks (B1 - B2 - B3)	0 ... 99 °C
Integration temperature (B5)	0 ... 99 °C
Modulating control temperature (B6)	0 ... 99 °C
• Control setting ranges	
Control thermal exchange panels-storage tanks:	
Off differential	0 ... 5 ... 99 °C
On differential	0 ... 10 ... 99 °C
Exchange temperature storage tank 1	0 ... 60 ... 99 °C
Differential exchange storage tank 1	0 ... 5 ... 99 °C
Integration temperature	0 ... 50 ... 99 °C
On-Off integration differential	3 ... 5 ... 30 °C
Modulating control:	
Desired temperature	0 ... 50 ... 99 °C
Valve run time	30 ... 60 ... 3,600 s
Proportional Band	± 0.5 ... 10 ... 99 °C
Integral Time	0 ... 30 ... 1,275 s
• Setting ranges for alarms (setting by PC)	
Telemangement:	
Attempts to send alarms	1 ... 5 ... 255
Interval between alarm calls	2 ... 10 ... 255 min.
Alarms :	
Threshold diff. temp. integration (B5)	0 ... 5 ... 99 °C
Delay diff. temp. integration	2 ... 30 ... 255 min.
Threshold diff. temp. modulating control (B6)	0 ... 2 ... 30°C
Delay diff. temp. modulating control	2 ... 30 ... 255 min.

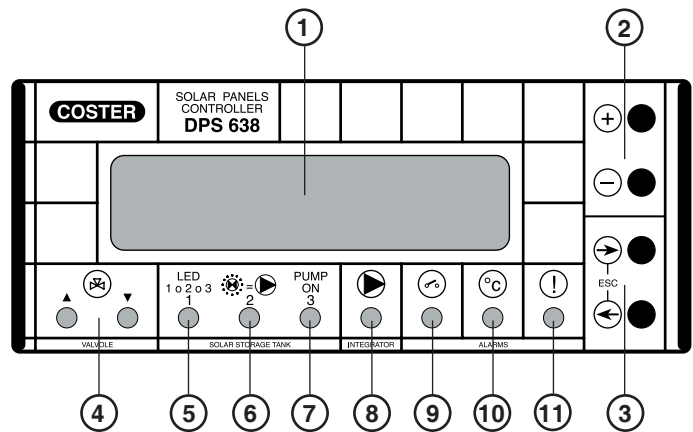
In the presence of electrical disturbances the output controls of the controller may change status but this will automatically return to normal.

5. OVERALL DIMENSIONS



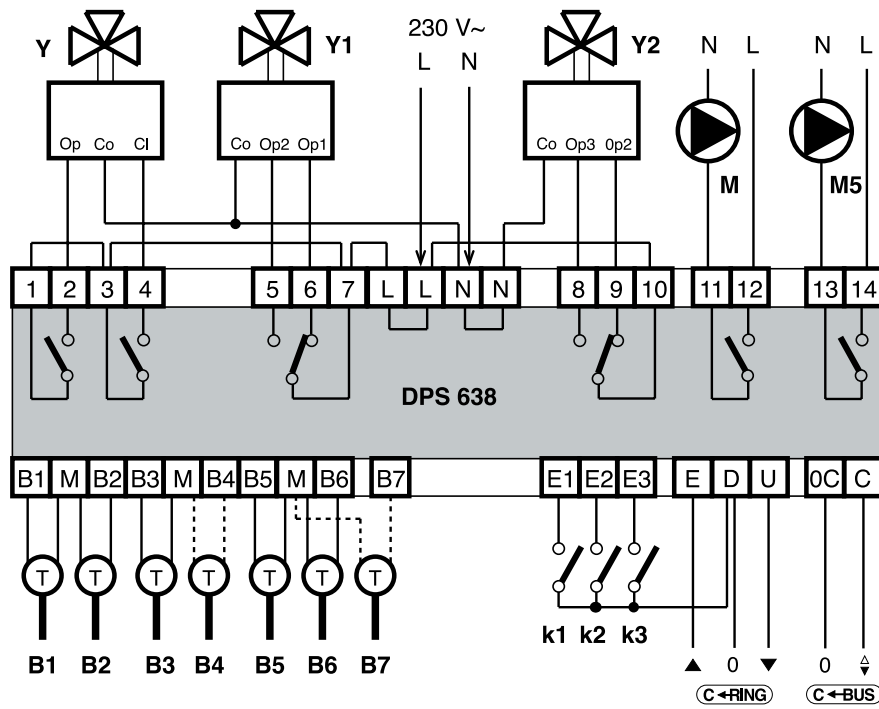
- 1 – Protective cover for electronic components
- 2 – Base with transformer, relay and terminal blocks
- 3 – Screws for securing base and cover
- 4 – DIN rail securing elements
- 5 – DIN rail release lever

6. FRONT PANEL



- 1 – Backlighted alphanumeric display
- 2 – + and – keys
- 3 – ← and → keys
- LEDs:
- 4 – Control valve modulating control
- 5 – Storage tank 1
- 6 – Storage tank 2
- 7 – Storage tank 3
- 8 – Integration circuit
- 9 – On-Off alarms
- 10 – Measurement alarms
- 11 – Controller fault alarm

7. WIRING DIAGRAM



- B1 – Solar storage tank 1 temp. detector (NTC 10 kΩ; 0...99 °C)
- B2 – Solar storage tank 2 temp. detector (NTC 10 kΩ; 0...99 °C)
- B3 – Solar storage tank 3 temp. detector (NTC 10 kΩ; 0...99 °C)
- B4 – Solar panels temp. detector (NTC 10 kΩ; 0...99 °C)
As alternative to B7
- B5 – DHW integration temp. detector
- B6 – Distribution DHW temp. detector
or minimum temp. solar panels
- B7 – Solar panel temp. detector (Pt 1kΩ; 0...200 °C)
As alternative to B4

- M – Panels pump
- M 5 – Integration pump
- Y – Control valve for DHW distribution
or minimum temp. solar panels
- Y1 – Changeover valve storage tanks 1 and 2-3
- Y2 – Changeover valve storage tanks 2 and 3
- k 1...3 – On-Off alarm switches

8. SITING OF CONTROLLER & DETECTORS

8.1 Controller

The controller must be sited in a dry space that meets the relevant ambient conditions shown under “Technical Data”. If placed in a space classified as “Hazardous” it must be installed in an electrical enclosure constructed according to the regulations in force for the degree of danger involved. It can be mounted on a DIN rail and housed in a standard DIN enclosure.

8.2 Temperature detector for solar panels B4 or B7

This must be installed on the outlet pipe of the solar panels (upper part) and as near as possible to the panels themselves so that it can measure the temperature of the panels even when the solar circuit pump is idle.

8.3 Temperature detectors for storage tanks B1 – B2 – B3

Must be installed in the storage tank just above (5...10 cm) the internal heat exchanger or on the upper pipework coming from the external heat exchanger

8.4 Integration temperature detector B5

Must be installed in storage tank 1 just above (5...10 cm) the internal integration exchanger or on the upper pipework coming from the external integration exchanger.

8.5 Temperature detector for DHW distribution B6 (as alternative to minimum temp. solar panels)

Must be installed on DHW distribution on pipe at least 1 metre after mixing valve Y.

8.6 Minimum temperature detector for solar panels B6 (as alternative to DHW distribution temperature)

This must be installed between the solar panels and the mixing valve Y.

9. ELECTRICAL CONNECTIONS

Proceed as follows:

- Separate the base from the cover
- Mount the base on the DIN rail and check that it is firmly anchored by the securing elements (5.4).
- Carry out the wiring according to the diagram and in compliance with the relevant regulations and using:
 - 1.5 mm² cables for power supply and relay control outputs.
 - 1 mm² for the detectors.
 - 1 mm² for C-Bus and for C-Ring. For length limits see data sheets T 021 and T 022.
- Apply power (230 V~) and check its presence across terminals L and N.
- Remove power, replace cover on base/terminal block and secure it with the four screws supplied (5.3).

You are advised not to insert more than two cables in a single terminal of the controller and, if necessary, to use an external junction box.

10. COMMUNICATION

10.1 C-Ring for communication between controllers (for details see data sheet T 022)

DPS 638 controller can be “**Primary**” or “**Secondary**”.
 In the C-Ring the following signals are transmitted:

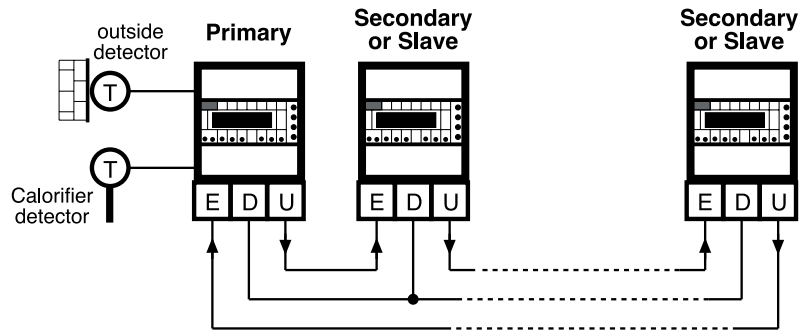
- permission to operate as **Slave** controllers.
- value of **flow temperature** requested by DHW/heating circuit controllers, used by “PRIMARY” controller for temperature regulation of boilers (if scheduled).
- modulating control of valves closure of heating circuits.

NO = connection to C-Ring not scheduled.
 PRIMARY = connected to C-Ring and is configured as “Primary”.
 SECONDARY = connected to C-Ring and is configured as “Secondary”.

21.5

CRing :
NO

10.2 C-Ring electrical connections

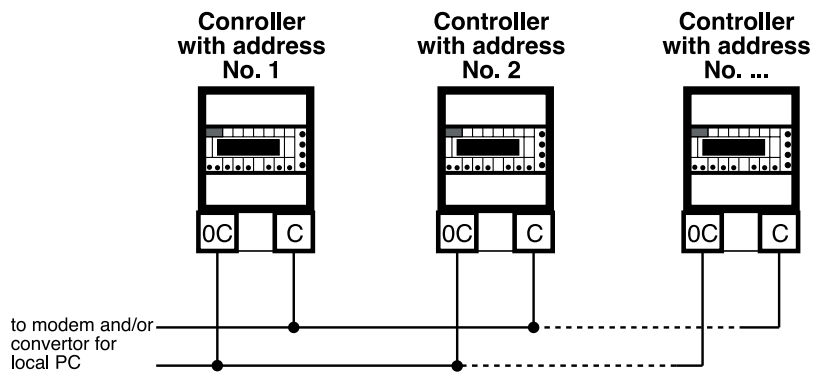


10.3 C-Bus communication for Telemangement (for details see data sheet T 021)

By means of C-Bus output DPS 638 can be telemanged: two-way communication of data via land lines with one or more local PCs and/or a central remote PC.
 From the PC or PCs you can see and adjust:

- data and values set on the display pages of the controller and the configurations dedicated exclusively to Telemangement. (see “Technical Data”).
- the operational status of the plant components (pumps, auxiliaries in general).
- receive the alarms originating in the plant.
- read the detector measurements (temperatures: outside, flow, boiler, etc).

10.4 C-Bus electrical connections



10.5 Telemangement address

21.4

Address : -
Group : -

Note:

Under Telemangement, in order for the controllers to be identified by the central PC and /or by the local PCs, they must each have a progressive address number.
 Additionally, the controllers can be assigned to groups of various categories.

*When Telemangement is not scheduled, leave the address in memory (-).
 To cancel the numbers, keep + and - keys pressed at the same time.*

10.6 Sending alarms

21.3

Send alarms : NO
PassWTeleman : NO

- **Send alarms :** NO = alarms are not transmitted.
YES = alarms are transmitted to central PC and indicated by the appearance of “ALARM” on the display.
- **PassWTeleman. :** NO = password not entered.
YES = password enabled.

10.7 Recording data

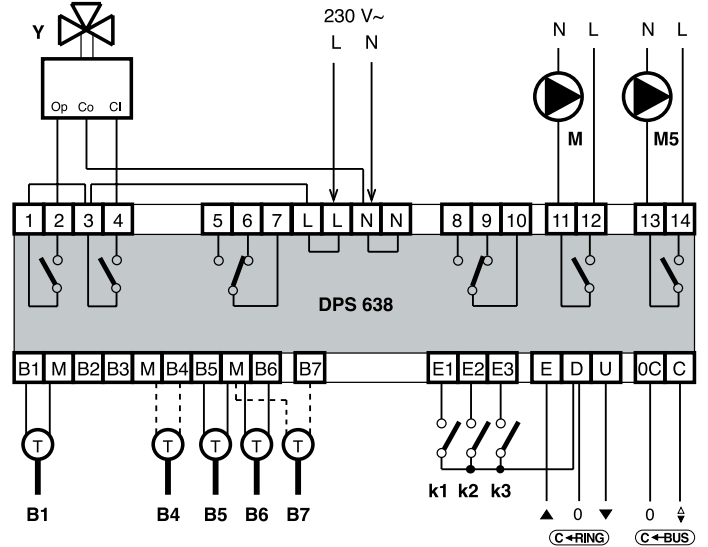
The controller memorises 32 sets of all the operational data of the plants controlled. The last recording brings about the cancellation of the oldest one. Recordings are made automatically at each change of mode, irrespective of whether this is brought about by the timed programming or by the intervention of the operator.

11.1 EXAMPLES OF PLANTS WITH ONE STORAGE TANK

Setting solar plants :

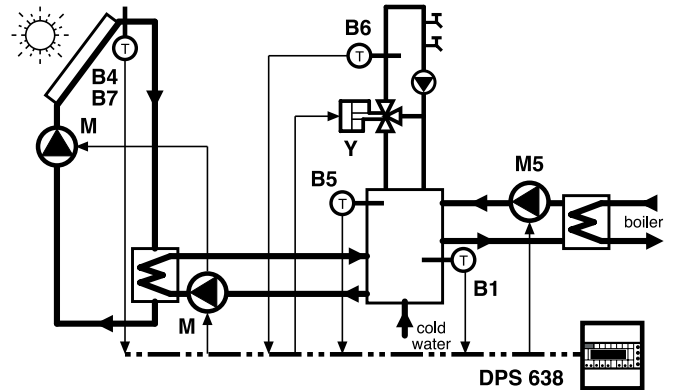
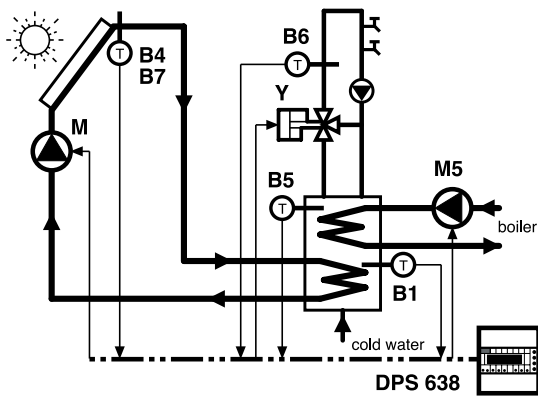
<p>21.1 Config detectors 1 - - 4 5 6 7</p>	<p>18.2 Integration temp Des:50c Act:xxc</p>
<p>20.1 Solar Different On : 5c Off: 3c</p>	<p>20.3 Integ Diff : 5c Priority :NO</p>

- B1 – Storage tank temp. detector (NTC 10 kΩ; 0...99 °C)
- B4 – Solar panels temp. detector (NTC 10 kΩ; 0...99 °C)
As alternative to B7
- B5 – Integration temp. detector
- B6 – Distribution DHW temp. detector
or minimum temp. solar panels.
- B7 – Solar panel temp. detector (Pt 1kΩ; 0...200 °C)
As alternative to B4
- M – Solar circuit pump
- M5 – Integration circuit pump
- Y – DHW distribution control valve
or minimum temp. solar panels
- k 1...3 – On-Off alarm switches
- ΔOn – Solar plant switching on differential
- ΔOff – Solar plant switching off differential



Thermal exchange between solar panels and storage tank:
 • Pump M: On (11-12 closed) with $B4 - B1 \geq \Delta On$
 Off (11-12 open) with : $B4 - B1 \leq \Delta Off$

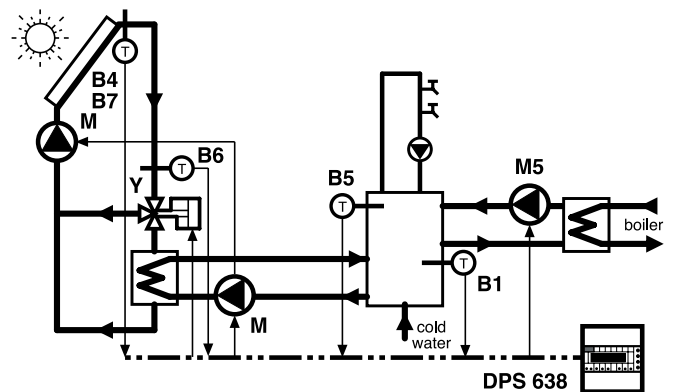
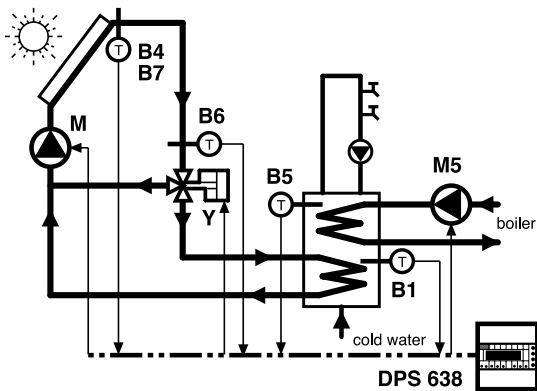
Plants with modulating control of DHW distribution temperature



Setting temperature control distribution of DHW :

<p>21.2 Control DHW Y:</p>	<p>18.4 T DHW Des:50c Act:50c</p>	<p>20.4 DHW Run time : 60s</p>	<p>20.5 DHW Proport Band:20c</p>	<p>20.6 DHW Integral T 30s</p>
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Plants with modulating control of minimum temperature solar panels



Setting control minimum temperature solar panels :

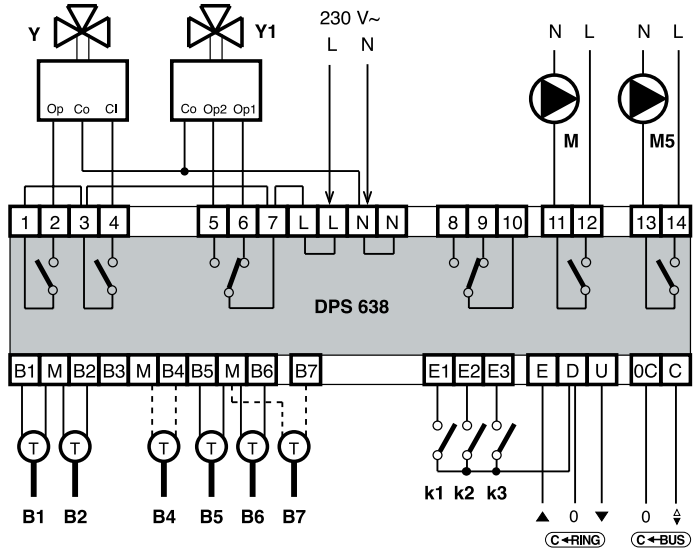
<p>21.2 Control Y: SOLAR PANELS</p>	<p>18.4 T Solar panels Des:60c Act:50c</p>	<p>20.4 Solar panels Run Time :120s</p>	<p>20.5 Solar panels Propor.Band : 5c</p>	<p>20.6 DHW Integral T. 600s</p>
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11.2 EXAMPLES OF PLANTS WITH TWO STORAGE TANKS & ONE DIVERTING VALVE

Setting solar plant:

21.1 Config detectors 1 2 - 4 5 6 7	18.5 Storage 1 T :xxc Des Switch T:60c	18.2 Integration temp Des:50c Act:xxc
20.1 Solar Different. On : 5c Off: 3c	20.2 Switch Different Storage 1 : 5c	20.3 Integ Diff : 5c Priority :NO

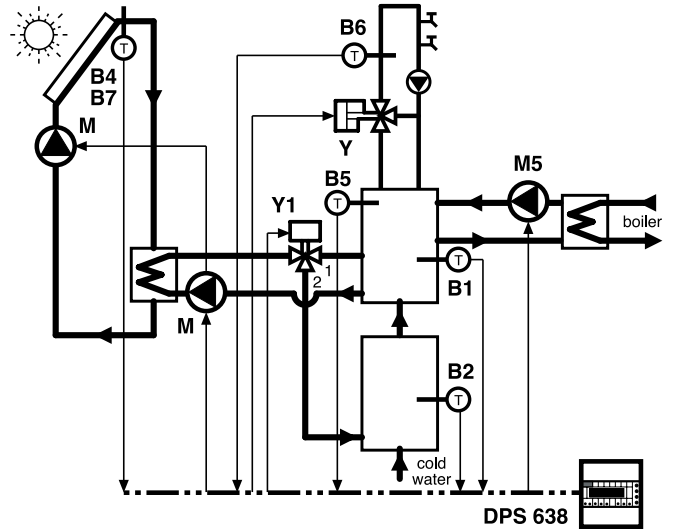
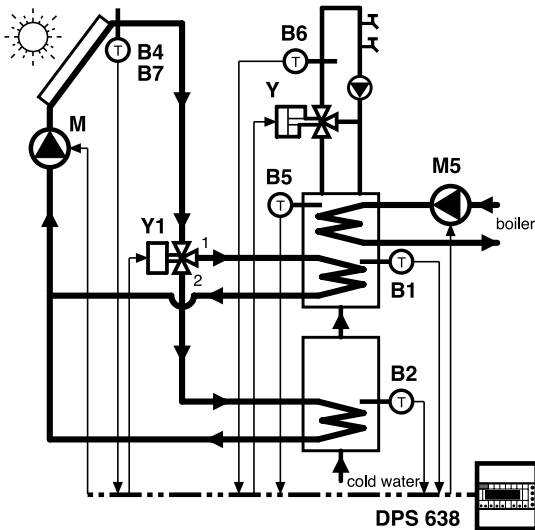
- B 1-2 – Storage tanks temp. detectors (NTC 10 kΩ; 0...99 °C)
- B4 – Solar panels temp. detector (NTC 10 kΩ; 0...99 °C)
As alternative to B7
- B5 – DHW integration temp. detector
- B6 – Distribution DHW temp. detector
or minimum temp. solar panels.
- B7 – Solar panel temp. detector (Pt 1kΩ; 0...200 °C)
As alternative to B4
- M – Solar circuit pump
- M5 – Integration circuit pump
- Y – DHW distribution control valve
or minimum temp. solar panels
- Y1 – Valve for switching storage tanks 1 and 2
- k 1...3 – On-Off alarm switches
- ΔOn – Solar plant switching on differential
- ΔOff – Solar plant switching off differential
- Tex – Storage tank 1 exchange temperature
- ΔTex – Storage tank 1 exchange differential



Thermal exchange between solar panels and storage tanks:

- Pump M: On (11-12 closed) with : $B4 - B1 \geq \Delta On$ or $B4 - B2 \geq \Delta On$
Off (11-12 open) with : $B4 - B1 \leq \Delta Off$ and $B4 - B2 \leq \Delta Off$
- Valve Y1: Opens storage tank 1 (7-6 closed ; 7-5 open) Off : $B4 - B1 \geq \Delta On$ and $B1 \leq Tex - \Delta Tex$
or
 $B4 - B1 \geq \Delta Off$ and $B4 - B2 \leq \Delta Off$
Opens storage tanks 2 (7-6 open ; 7-5 closed) with: $B4 - B1 \leq \Delta Off$ or $B1 \geq Tex$

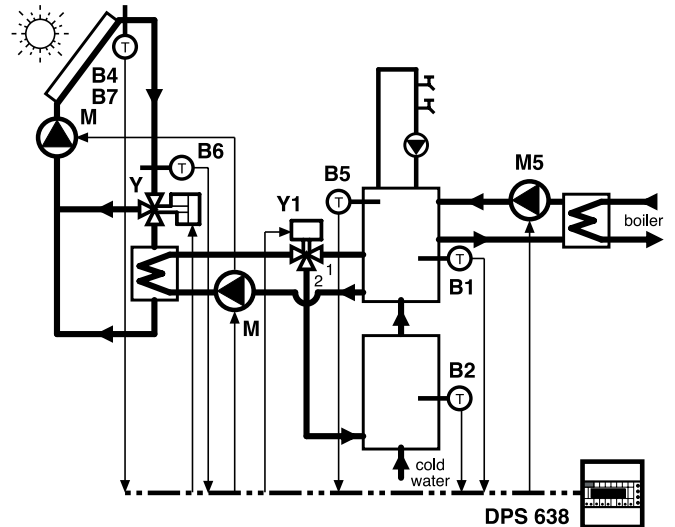
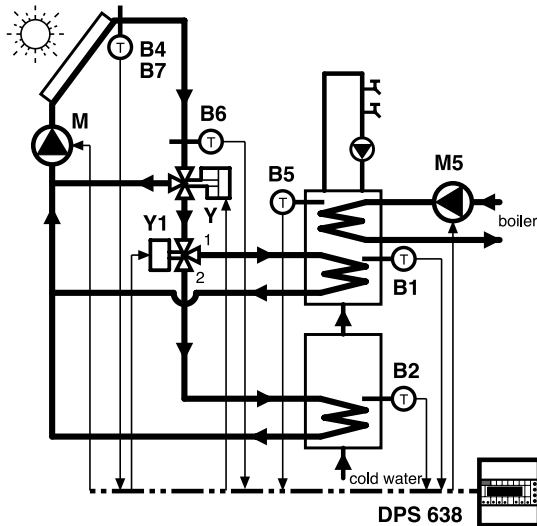
Plants with modulating control of DHW distribution temperature



Setting control DHW distribution temperature:

21.2 Control DHW Y:	18.4 T DHW Des:50c Act:50c	20.4 DHW Run time : 60s	20.5 DHW ProportBand :20c	20.6 DHW Integral T 30s
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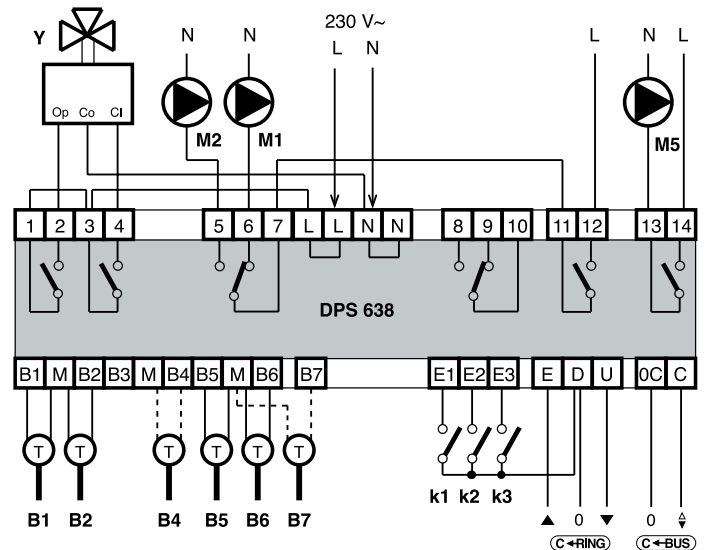
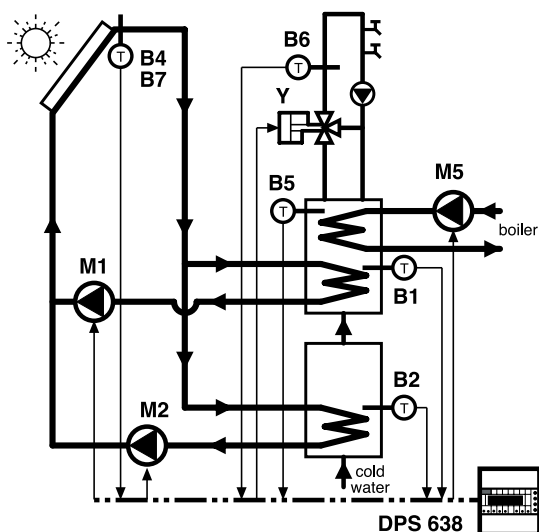
Plants with modulating control of minimum temperature solar panels



Setting control minimum temperature solar panels:

21.2 Control Y: SOLAR PANELS	18.4 T Solar panels Des:60c Act:50c	20.4 Solar panels Run time :120s	20.5 Solar panels Proport Band: 5c	20.6 Solar panels Integral T 600s
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11.3 EXAMPLES OF PLANTS WITH TWO STORAGE TANKS & TWO PUMPS



Setting solar plant :

21.1 Config Detectors 1 2 - 4 5 6 7	18.5 Storage 1 T :xxc Des switch T:60c	18.2 Integration temp Des:50c Act:xxc
20.1 Solar Different On : 5c Off : 3c	20.2 Switch Different Storage 1 : 5c	20.3 Integ Diff : 5c Priority : NO

- B 1-2 – Storage tanks temp. detectors (NTC 10 kΩ; 0...99 °C)
- B4 – Solar panels temp. detector (NTC 10 kΩ; 0...99 °C)
As alternative to B7
- B5 – DHW integration temp. detector
- B6 – DHW distribution temp. detector
- B7 – Solar panel temp. detector (Pt 1kΩ; 0...200 °C)
As alternative to B4
- M1 – Storage tank 1 pump
- M2 – Storage tank 2 pump
- M5 – Integration circuit pump
- Y – DHW temperature control valve
- k 1...3 – On-Off alarm switches
- ΔOn – Solar plant switching on differential
- ΔOff – Solar plant switching off differential
- Tex – Storage tank 1 exchange temperature
- ΔTex – Storage tank 1 exchange differential

Thermal exchange between solar panels and storage tanks:

• Pump M1On and M2 Off (11–12 closed; 7-6 closed; 7-5 open)) with :

$$B4 - B1 \geq \Delta On \text{ and } B1 \leq Tex - \Delta Tex$$

or

$$B4 - B1 \geq \Delta Off \text{ and } B4 - B2 \leq \Delta Off$$

$$B4 - B1 \leq \Delta Off \text{ or } B1 \geq Tex$$

• Pump M1Off and M2 On (11-12 closed; 7-6 open; 7-5 closed) with :

• Pump M1 and M2 Off (11-12 On) with : $B4 - B1 \leq \Delta Off$ and $B4 - B2 \leq \Delta Off$

Setting control temperature DHW distribution:

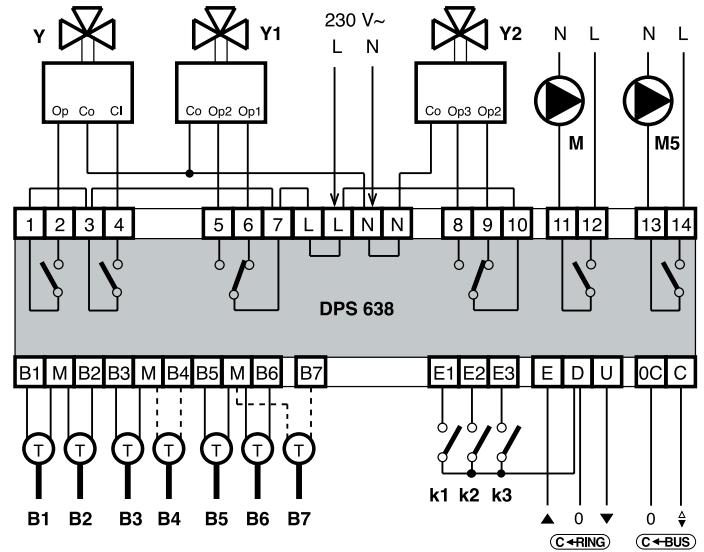
21.2 Control DHW Y:	18.4 T DHW Des:50c Act:50c	20.4 DHW Run time : 60s	20.5 DHW Proport Band:20c	20.6 DHW Integral T 30s
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11.4 EXAMPLES OF PLANTS WITH THREE STORAGE TANKS AND THREE PUMPS

Setting solar plant:

21.1 Config detectors 1 2 3 4 5 6 7	18.5 Storage 1 T : xxc Des switch T:60c	18.2 Integration temp Des:50c Act:xxc
20.1 Solar Different On : 5c Off: 3c	20.2 Switch Different Storage 1 : 5c	20.3 Integ Diff : 5c Priority : NO

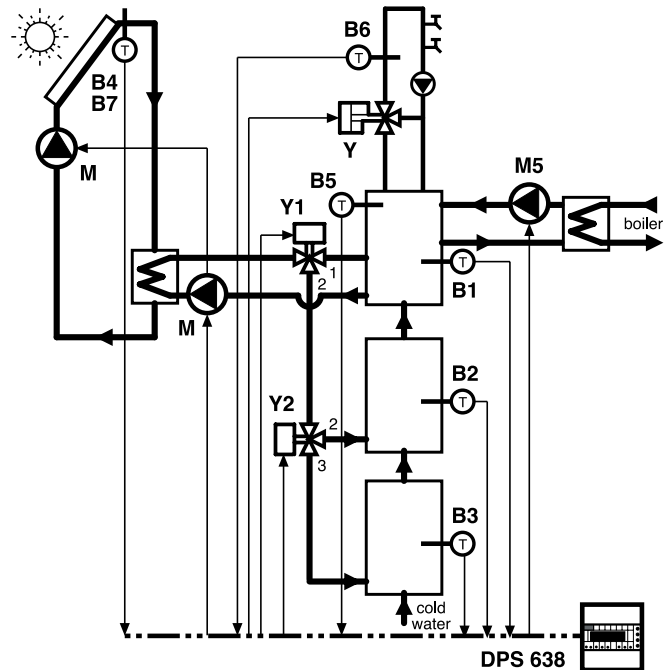
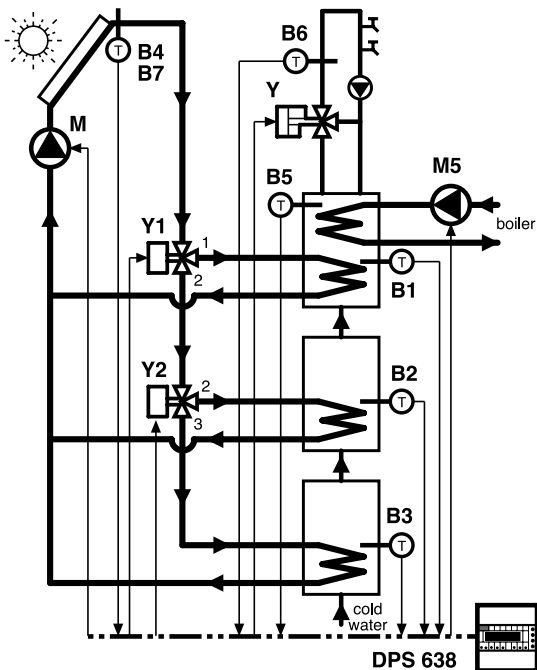
- B 1-2-3 – Storage tanks temp. detector (NTC 10 kΩ; 0...99 °C)
- B4 – Solar panels temp. detector (NTC 10 kΩ; 0...99 °C)
As alternative to B7
- B5 – DHW integration temp. detector
- B6 – Distribution DHW temp. detector
or minimum temp. solar panels.
- B7 – Solar panel temp. detector (Pt 1kΩ; 0...200 °C)
As alternative to B4
- M – Solar circuit pump
- M5 – Integration circuit pump
- Y – DHW distribution control valve
or minimum temp. solar panels
- Y1 – Valve for switching storage tanks 1 and 2
- Y2 – Valve for switching storage tanks 2 and 3
- k 1...3 – On-Off alarm switches
- ΔOn – Solar plant switching on differential
- ΔOff – Solar plant switching off differential
- Tex – Storage tank 1 exchange temperature
- ΔTex – Storage tank 1 exchange differential



Thermal exchange between solar panels and storage tanks:

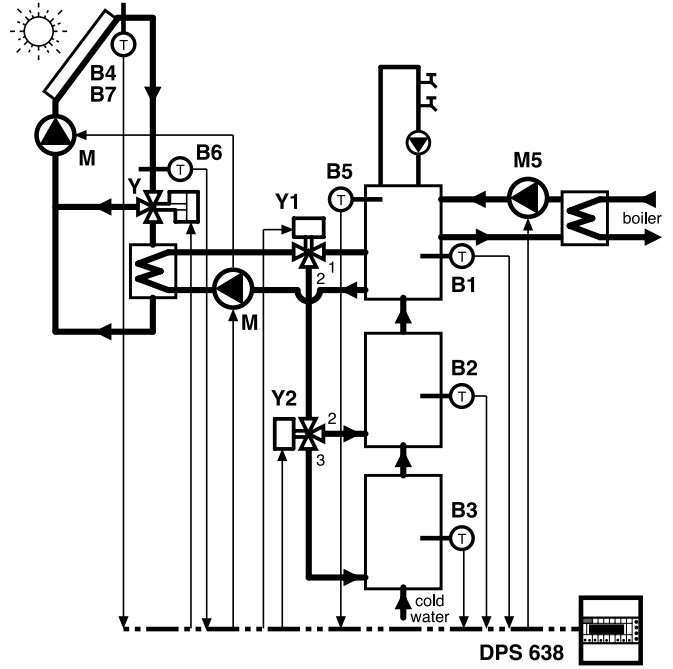
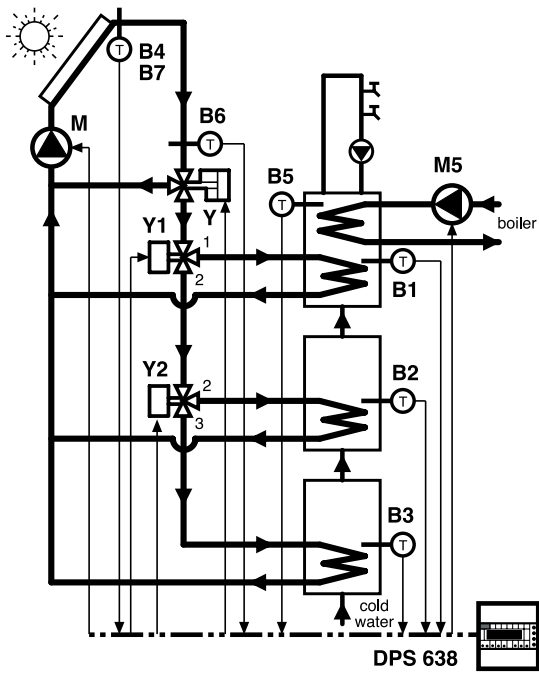
- Pump M : On (11-12 closed) with : $B4 - B1 \geq \Delta On$ or $B4 - B2 \geq \Delta On$ or $B4 - B3 \geq \Delta On$
Off (11-12 open) with : $B4 - B1 \leq \Delta Off$ and $B4 - B2 \leq \Delta Off$ and $B4 - B3 \leq \Delta Off$
- Valve Y1 : Opens storage tank 1 (7-6 closed ; 7-5 open) with : $B4 - B1 \geq \Delta On$ and $B1 \leq Tex - \Delta Tsc$
or
 $B4 - B1 \geq \Delta Off$ and $B4 - B2 \leq \Delta Off$ and $B4 - B3 \leq \Delta Off$
- Valve Y2 : Opens storage tanks 2 and 3 (7-6 open ; 7-5 closed) with : $B4 - B1 \leq \Delta Off$ or $B1 \geq Tex$
Opens storage tank 2 (10-9 closed ; 10-8 open) with : $B4 - B2 \geq \Delta On$
Opens storage tank 3 (10-9 open ; 10-8 closed) with : $B4 - B3 \geq \Delta On$ and $B4 - B2 \leq \Delta Off$

Plants with modulating control of DHW distribution temperature



21.2 Control Y : DHW	18.4 T DHW Des:50c Act:50c	20.4 DHW Run time : 60s	20.5 DHW Proport Band:20c	20.6 DHW Integral T 30s
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Plants with modulating control of minimum temperature solar panels



Setting control minimum temperature solar panels:

21.2	18.4	20.4	20.5	20.6
Control Y: SOLAR PANELS	T Solar panels Des:60c Act:50c	Solar panels Run time :120s	Solar panels Proport Band :5c	Solar panels Integral T 600s

11.5 EXAMPLES OF PLANTS WITH THREE STORAGE TANKS AND THREE PUMPS

Setting solar plant:

21.1 Config detectors 1 2 3 4 5 6 7	18.5 Storage 1 T : xxc Des switch T : 60c	18.2 Integration temp Des: 50c Act: xxc
20.1 Solar Different On : 5c Off: 3c	20.2 Switch Different Storage 1 : 5c	20.3 Integ Diff : 5c Priority : NO

- B 1-2-3 – Storage tanks temp. detector (NTC 10 kΩ; 0...99 °C)
- B4 – Solar panels temp. detector (NTC 10 kΩ; 0...99 °C)
As alternative to B4
- B5 – DHW integration temp. detector
- B6 – Distribution DHW temp. detector
- B7 – Solar panel temp. detector (Pt 1kΩ; 0...200 °C)
As alternative to B4
- M1 – Storage tank 1 pump
- M2 – Storage tank 2 pump
- M3 – Storage tank 3 pump
- M5 – Integration circuit pump
- Y – DHW temperature control valve
- k 1...3 – On-Off alarm switches
- ΔOn – Solar plant switching on differential
- ΔOff – Solar plant switching off differential
- Tex – Storage tank 1 exchange temperature
- ΔTex – Storage tank 1 exchange differential

Thermal exchange between solar panels and storage tanks:

• Pumps M1 On, M2 and M3 Off (11-12 closed; 7-6 closed) with :

$$B4 - B1 \geq \Delta On \text{ and } B1 \leq Tex - \Delta Tex$$

or

$$B4 - B1 \geq \Delta Off \text{ and } B4 - B2 \leq \Delta Off \text{ and } B4 - B3 \leq \Delta Off$$

or

$$B4 - B2 \geq \Delta On \text{ and } B4 - B1 \leq \Delta Off$$

or

$$B4 - B2 \geq \Delta On \text{ and } B1 \geq Tex$$

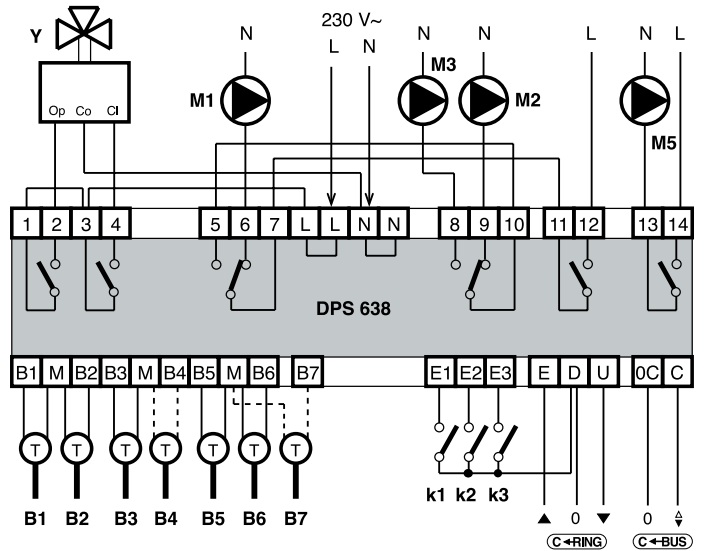
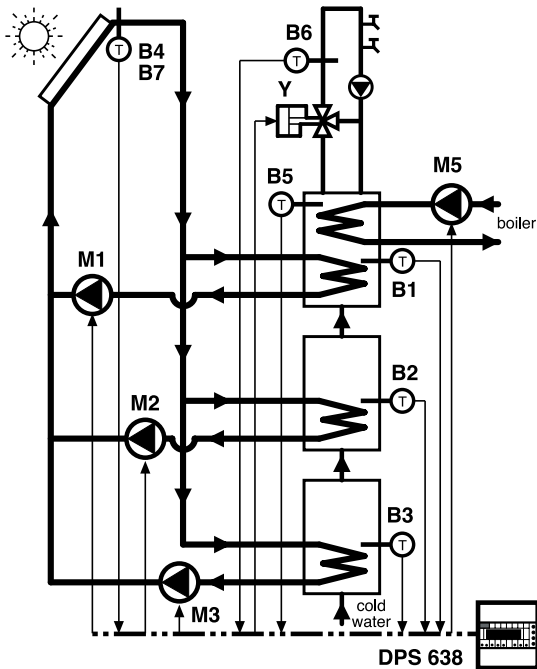
or

$$B4 - B3 \geq \Delta On \text{ and } B4 - B2 \leq \Delta Off$$

• Pumps M2 On, M1 and M3 Off (11-12 closed; 7-5 closed; 10-9 closed) with :

• Pumps M3 On, M1 and M2 Off (1-12 closed; 7-5 closed; 10-8 closed) with :

• Pumps M1, M2 and M3 Off (11-12 open) with : $B4 - B1 \leq \Delta Off$ and $B4 - B2 \leq \Delta Off$ and $B4 - B3 \leq \Delta Off$



Setting control temperature distribution DHW:

21.2 Control Y: DHW	18.4 T DHW Des: 50c Act: 50c	20.4 DHW Run time : 60s	20.5 DHW Proport Band: 20c	20.6 DHW Integral T 30s
---------------------------	------------------------------------	-------------------------------	----------------------------------	-------------------------------

12. OPERATION

DPS 638 is a microprocessor-based digital controller for:

- Control of thermal exchange panels-storage tanks with On-Off control of solar circuit pump and automatic switching of three (max.) storage tanks by control of diverting valves.
- Control at fixed point of integration temperature with On-Off control.
- Control of temperature at fixed point with three-wire modulating control (e.g. minimum temp. solar panels, DHW distribution temperature).

21.1

Config detectors
1 - - 4 - - -

It is essential to configure the controller according to the detectors connected.

12.1 On-Off control of thermal exchange between solar panels and storage tanks

With three storage tanks (detectors B4, B1, B2 and B3)

20.1

Solar Diffent
On : 5c Off: 3c

18.5

Storage 1 T : xxc
Des switch T: 60c

20.2

Switch Different
Storage 1 : 5c

The controller compares the difference between the panels temperature B4 and the temperatures of storage tank B1, storage tank B2 and storage tank B3, with the differentials Solar ΔOn and ΔOff :

- Pump M :
switches on when : $B4 - B1 \geq \Delta On$ or $B4 - B2 \geq \Delta On$ or $B4 - B3 \geq \Delta On$
switches off when : $B4 - B1 \leq \Delta Off$ and $B4 - B2 \leq \Delta Off$ and $B4 - B3 \leq \Delta Off$
- Valve Y1 :
opens Storage 1 when : $B4 - B1 \geq \Delta On$ and $B1 \leq Tex - \Delta Tex$
or
 $B4 - B1 \geq \Delta Off$ and $B4 - B2 \leq \Delta Off$ and $B4 - B3 \leq \Delta Off$
opens Storage 2 and 3 when : $B4 - B1 \leq \Delta Off$ or $B1 \geq Tex$
- Valve Y2 :
opens Storage 2 when : $B4 - B2 \geq \Delta On$
opens Storage 3 when : $B4 - B3 \geq \Delta On$ and $B4 - B2 \leq \Delta Off$

With two storage tanks (detectors B4, B1 and B2)

The controller compares the difference between the panels temperature B4 and the temperatures of storage tank B1 and storage tank B2 with the differentials Solar ΔOn and ΔOff :

- Pump M :
switches on when : $B4 - B1 \geq \Delta On$ or $B4 - B2 \geq \Delta On$
switches off when : $B4 - B1 \leq \Delta Off$ and $B4 - B2 \leq \Delta Off$
- Valve Y1 :
opens Storage 1 when : $B4 - B1 \geq \Delta On$ and $B1 \leq Tex - \Delta Tex$
or
 $B4 - B1 \geq \Delta Off$ and $B4 - B2 \leq \Delta Off$
opens Storage 2 when : $B4 - B1 \leq \Delta Off$ or $B1 \geq Tex$

With one storage tank (detectors B4 and B1)

The controller compares the difference between the panels B4 temperature and the storage tank B1 temperature with the differentials Solar ΔOn e ΔOff :

- Pump M :
switches on when : $B4 - B1 \geq \Delta On$ and $B1 \leq Tex - \Delta Tex$
switches off when : $B4 - B1 \leq \Delta Off$ or $B1 \geq Tex$

- Legend :
- **B1** = storage tank 1 temperature
 - **B2** = storage tank 2 temperature
 - **B3** = storage tank 3 temperature
 - **B4** = solar panels temperature
 - ΔOn = solar On differential
 - ΔOff = solar Off differential
 - **Tex** = storage tank 1 exchange temperature
 - ΔTex = storage tank 1 exchange temp. differential

The plants with two or three storage tanks can be constructed without diverting valves, and using a circulation pump for each tank (see EXAMPLES PLANTS 11.3 and 11.5)

12.2 On-Off control integration circuit (detector B5)

It is possible to program the operation of the integration circuit according to the consumer requirements:

- 7 DAY 1-2 = timed operation with 7 day program 1 or 2.
- 24 HOUR 1...7 = timed operation with one of seven 24 hour programs.
- ALWAYS ON = continuous operation with desired temperature.
- ALWAYS OFF = always off.

The current operating mode (-On - Off) depends on the program set.

The controller compares the desired integration temperature with the value measured by detector B5 according to the differential set:

- When $B5 \leq T_i - \Delta$:
 - Pump M5 = On ;
- When $B5 \geq T_i$:
 - Pump M5 = Off ;

When DPS 638 is connected in C-Ring with other controllers, the Priority function is enabled and the pump M5 is switched on, sends in C-Ring the differential between the desired and actual integration temperature (B5). The controllers in C-Ring, with the Anticondensing function enabled, reduce their own desired flow temperature by 4°C for each C° of differential in order to give precedence to the DPS 638 integration circuit.

18.3
 Integration : ON
 24 HOUR : 1

18.2
 Integration temp
 Des : 50c Act : 50c

20.3
 Integ Diff : 5c
 Priority : NO

12.3 Three-wire modulating control (detector B6)

This can be used for:

- Control of minimum temperature of the solar panels so as to exploit better the thermal exchange with the storage tanks (valve Y and detector B6 installed on the panels circuit).
- or
- Control of temperature of DHW distribution (valve Y and detector B6 installed on the DHW distribution circuit).
- or
- Control of the temperature of a generic plant not in relation to the solar panels installation.

The controller compares the value measured by detector B6 with desired temp. and produces the command Y according to the difference measured

18.4
 T. DHW
 Des : 50c Act : 50c

and the PI parameters set:

20.4
 DHW
 Run time : 60s

20.5
 DHW
 Propert Band : 10c

20.6
 DHW
 Integral T : 30s

12.4 Antibacteria function

Prevents the formation of bacterial colonies in the DHW circuit by bringing the Integration circuit to a high temperature for a certain period of time.

20.8
 Antibacteria
 Temp : 70c for 090m

- NO : function not enabled.
- STORAGE ONLY : function enabled only for storage tank; DHW control continues to maintain the distribution circuit at low temperature.
- STORAGE + DISTRIB. : function enabled both for storage tank and for distribution circuit: the DHW control valve is completely opened.

The function is enabled at the time and on the days of the week (1 or 2) set

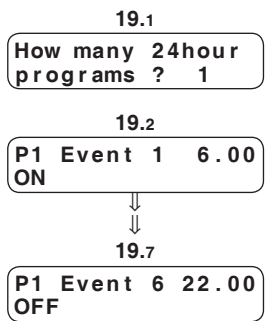
20.9
 Antibacteria
 02.00 MONandTHU

20.7
 Antibacteria
 NO

13. PROGRAMS & PERIODS WITH DATES

*The timed programs can be used only for control of the **integration circuit**.*

13.1 24 hour programs



Set the number of 24 hour programs (1... 7) you wish to use in order to eliminate unnecessary display pages.

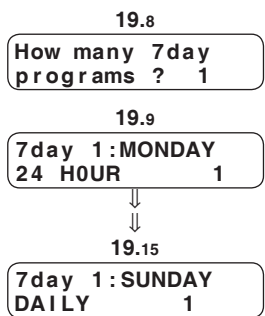
In each 24 hour programs you can set a maximum of six event start times (**Ev1...Ev6**) assigning to each one of the following modes:

- ON : control with desired integration temperature set in
- OFF : plant off

18.2
Integration temp
Des: 50c

*The times of each start event must be entered in increasing order.
Unused times must be excluded by pressing + and - keys at the same time.
You must not leave unused times(---) between programmed times.*

13.2 7day programs

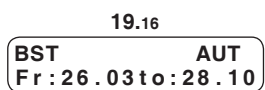


Set the number of 7 day programs (0...2) to be used so as to eliminate unused display pages.

In each 7day program you can assign to each day of the week one of the programs:

- 24 HOUR 1 ...7; - ON ; - OFF.

13.3 British Summer Time (BST)



The controller changes the time automatically according to BST period.

- BST :
 - MAN = Changes the time at the dates set.
 - AUT = Changes the time automatically:
 - at 02.00 on the last Sunday in March the clock is put forward an hour;
 - at 02.00 on the last Sunday in October the clock is put back an hour.
- Fr - - - - to - - - - = day and month of start and end of BST (only if MAN).

To cancel the period keep pressed + and - keys at the same time.

14. COMPLEMENTARY FUNCTIONS

14.1 Access key number

21.9

Choice keynumber
- - - -

Choice and enabling of access key number which prevents the use of + and – keys and consequently any modification of the data. Enter the number (1900...1999) using + and – keys.
To cancel the key number press + and – at the same time until the dashes re-appear.

Access keynumber
- - - -

When the key number is enabled, if you press + or – keys there will appear on the display the request to enter the key number.

Only after having entered the correct number is it possible to use the + and – keys.

If for 15 minutes no key is pressed the key number is automatically re-enabled.

14.2 Name of plant site

21.10

Site Name
- - - - - - - -

Entering name of plant site. This appears on first page of display.

Each dash can be replaced, using + and – keys, by a letter of the alphabet (A ... Z) or by a number (0...9). The → keys serves to position the cursor

14.3 Display of measurements

18.7

Panels
Temperature : xxc

The controller displays all the measurements monitored by the detectors and the data which serves to understand the operational status of the plant:

- *Solar panels* temperature measured by detector **B4**.

18.5

Storage 1 T: xxc
Des switch T: 60c

- *Actual*/temperature measured by detector **B1**.
- *Desired storage tank 1 exchange* temperature.

18.2

Integration temp
Des: 50c Act: xxc

- *Desired integration* temperature.
- *Actual*/temperature measured by detector **B5**.

18.4

T DHW
Des: 50c Act: xxc

- *DHW or solar panels or ----- desired* temperature.
- *Actual*/temperature measured by detector **B6**.

18.6

Storage 2 T: xxc
Storage 3 T: xxc

- *Actual storage tanks* temperature measured by detectors **B2** and **B3**.

15. ALARMS

The alarms processed by the controller are of three types:

- alarms for malfunctioning of the controller (LED 6.11) and of the plants controlled (LED 6.10)
- alarms for short or open circuits to the detectors connected (LED 6.10)
- alarms from external switches (LED 6.9)

The alarm status is indicated by the LEDs on the front panel of the controller and by the word ALARM appearing on the display when the alarm is transmitted to the PC and identified, on the configuration page, by the letter "A" alternating with the number of the alarm concerned.

With C-Bus the alarms can be sent to a local PC and/or to the central telemanagement PC.

15.1 Functional alarms

The functional alarms are triggered when there are prolonged differences between actual and desired values.

These alarms do not affect the normal operation of the controller.

21.6

Functional Alarms
- - 8

Factory setting: all disabled except the internal clock alarm (8).

Using + and - keys enable the alarms of interest by replacing the dashes with numbers.

When the number flashes = alarm triggered.

The limit values and delay times for sending alarms can be modified only from the PC.

Type of alarm and causes:

- 5** = difference integration temperature (only if B5 connected)
 - enabled with pump M5 in operation
 - triggered when actual temperature below that desired.
- 6** = difference temperature *DHW or Panels or -----* (only if B6 connected)
 - triggered when actual temperature below that desired.
- 8** = internal clock - *cannot be disabled.*
 - triggered when clock assumes meaningless values.

15.2 Detector alarms

The detector alarms are triggered in the event of **short** or **open** detector circuits.

The presence of the alarm is indicated after one minute.

21.7

Detector alarms
- - - - -

Factory setting: all disabled.

Using + and - keys enable alarms of interest by replacing dashes with numbers.

Type of alarm and effect:

- 1** = storage tank 1 detector (B1).
Pump M (11-12) idle.
- 2** = storage tank 2 detector (B2).
Tank 2 not used
- 3** = storage tank 3 detector (B3).
Tank 3 not used
- 4** = panels detector (B4).
Pump M (11-12) idle
- 5** = integration detector (B5).
Pump M5 (13-14) idle
- 6** = DHW or panels or ----- detector (B5).
Valve Y (1-2; 3-4) open
- 7** = panels detector (B7)
Pump M (11-12) idle
- 8** = C-Ring: open electric circuit or fault in one of controllers in ring.

15.3 Alarms or status of external switches (K)

Alarms triggered by closure of voltage-free switches **k1**, **k2** and **k3** for plant components (pumps, burners, etc).

21.8

K alarms
- - -

The presence of the alarm is signalled after about 60 seconds.

Factory setting: all disabled.

Using + and - keys enable alarms of interest by replacing dashes with numbers.
If not used as alarms they can be used to signal status.

16. TESTING AT COMMISSIONING

Testing to be carried out when installation has been completed and electric wiring and configuration carried out and tested.

16.1 Testing C-Ring

21.5

CRing:
PRIMARY
CRing:
SECONDARY

The C-Ring testing page appears only if it is configured in

Ensure that all the other controllers connected in C-Ring are:

22.1

CRing: ??

– correctly powered at mains voltage (230 V~).

– Slave controllers or configured as SECONDARIES in

CRing:
SECONDARY

– selected on testing page

CRing: ??

The PRIMARY controller sends via C-Ring a signal every 10 seconds. On all the displays appears “??”. If the connection is satisfactory the word “YES” replaces “??” on all the displays. If on one or more displays “YES” does not appear this means that there is a break in the connection between the last controller with “YES” and the first with “??”.

Examples of testing a C-Ring with four controllers:

- Cont.1 "YES" – Cont.2 "YES" – Cont.3 "YES" – Cont.4 "YES" : *Connection OK*
- Cont.1 "??" – Cont.2 "YES" – Cont.3 "YES" – Cont.4 "YES" : *Break between 4 & 1*
- Cont.1 "??" – Cont.2 "YES" – Cont.3 "??" – Cont.4 "??" : *Break between 2 & 3*
- Cont.1 "??" – Cont.2 "??" – Cont.3 "??" – Cont.4 "??" : *Break between 1 & 2*

16.2 Testing outputs

22.2

Output : VALVE Y
Status : CLOSED

Using + and – keys choose:

• output to be tested:

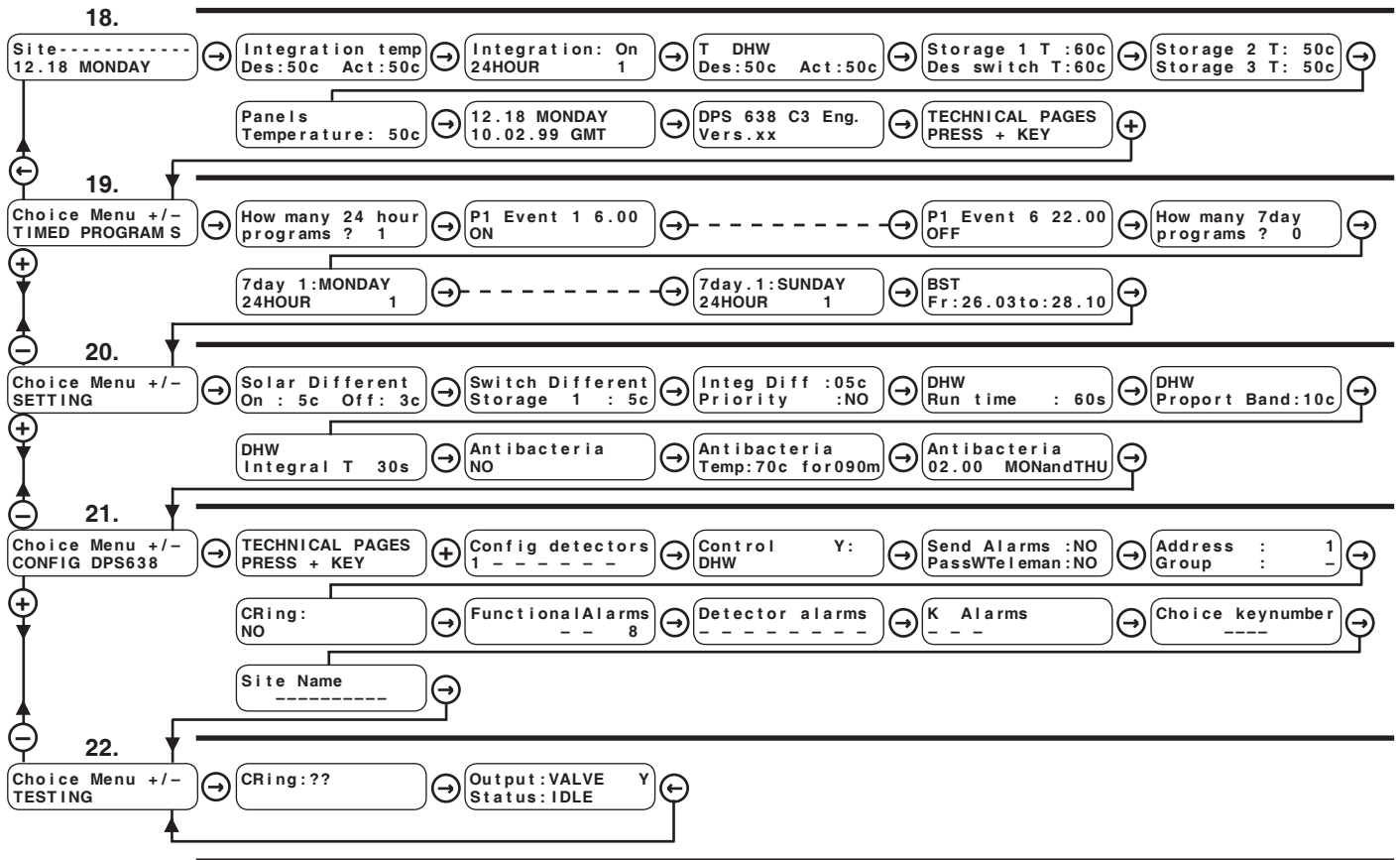
- VALVE Y ;
- INTEGRAT. ;
- STORAGES ;

•status :

- with VALVE : IDLE ;
CLOSES;
OPENS
- with INTEGRAT.: ON = switch 13-14 closed;
OFF = switch 13-14 open.
- with STORAGES: ON 1 = switch : 11-12 closed, 7-6 closed, 10-9 closed.
ON 2 = switch : 11-12 closed, 7-5 closed, 10-9 closed.
ON 3 = switch : 11-12 closed, 7-5 closed, 10-8 closed.
OFF = switch : 11-12 closed, 7-6 closed, 10-9 closed.

Check the result.

17. SEQUENCE OF DISPLAY PAGES (data and functions are those in memory at time of delivery)



← → Keys for scrolling the display pages and positioning the cursor █ on adjustable data on the pages.

The adjustable data, in the following descriptive list of display pages, are highlighted thus █

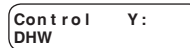
By pressing these keys at the same time, or in any event after 15 minutes, the first page appears



− +

Keys for : - adjusting the values indicated by the cursor █

– seeing the possibility of configuring a function, e.g.



or



– passing directly from one menu (series of pages) to another.

18. NORMAL USE				
Ref.	Display	Description	Notes	Sect.
18.1	Site----- 12.18 MONDAY	Name plant site Current time and day	Set in 21.10	.
18.2	Integration temp Des:50c Act:50c	Integration temperature desired by storage tank 1 in ON period	Appears only if in 21.1 B5 configured	12.2
18.3	Integration: ON 24 HOUR 1	Integration circuit current mode. Choice programme of integration plant: 7DAY 1-2 ; 24HOUR 1...7 ; ALWAYS ON; ALWAYS OFF.	Appears only if in 21.1 B5 configured - On; - Off: depends on program - Antib. :Antibacteria function running	12.2
18.4	T DHW Des:50c Act:50c	Desired DHW distribution temperature	Appears only if in 21.1 B6 configured If 21.2 is CONTROL Y: DHW	12.3
	T Solar Panels Des:50c Act:50c	Desired solar panels temperature	If 21.2 is CONTROL Y: SOLAR PANELS	
	T ----- Des:50c Act:50c	Desired temperature -----	If 21.2 is CONTROL Y: -----	
18.5	Storage 1 T:60c Des. switch T:60c Storage 1 T:60c	When B1 exceeds the exchange value it switches the solar to storage tank 2.	Appears only if in 21.1 B2 is configured. Appears if in 21.1 B2 is not configured.	12.1
18.6	Storage 2 T:50c Storage 3 T:50c	Temp. storage tanks 2 & 3 measured by B2 & B3.	2: appears only if in 21.1 B2 configured. 3: appears only if in 21.1 B3 configured.	14.3
18.7	Panels Temperature :50c	Temp. solar panels measured by B4.	.	14.3
18.8	12.18 MONDAY 10.02.99 GMT	Setting : Time, day of week and date Current time period: GMT or BST	According dates BST set in 19.16	
18.9	DPS 638 C3 Eng. Vers.xx	Identifying data of controller		

19. TIMED PROGRAMS				
Ref.	Display	Description	Notes	Sect.
19.1	How many 24 hour programs ? 1	Choice of number of 24 hour (1...7) and 7 day programs to use	Cancel unused display pages.	13.1
19.2	P1 Event 1 6.00 ON	Number of prog., number of event & start time of period programmed. Choice of mode to assign to period: ON ; OFF Further pages according figure in 19.1	Max. 6 periods. To cancel an unused period press + and - together - - - will appear Times must be in increasing order.. Do not leave - - - - between program times. Times set are winter ones.	13.1
19.7	P1 Event 6 22.00 OFF			
19.8	How many 7 day programs ? 0	Choice of number of 24 hour (1...7) and 7 day (0...2) programs to be used.	Cancel unused display pages.	13.2
19.9	7day 1:MONDAY 24HOUR 1	Choice program for each day of week: 24 HOUR 1...7 ; ON ; OFF. Further 7 pages if in 19.8 is 2	Appears only if in 19.8 number > 0.	13.2
19.15	7 Day 1:SUNDAY 24HOUR 1			
19.16	BST Fr:26.03to:28.10	Dates of start and end of BST.		13.3

20. SETTING				
Ref.	Display	Description	Notes	Sect.
20.1	Solar Different On : 5c Off: 3c	Differential between temp. panels B4 & any of temperatures of storage tanks B1, B2, B3 for: – Switching on solar circuit pump – Switching storage tanks.		12.1
20.2	Switch Different Storage 1 : 5c	Differential exchange temp. storage tank 1.	Appears only if in 21.1 B2 configured.	12.1
20.3	Integ Diff : 5c Priority : NO	Temp. differential for control integration DHW. Priority: : – YES ; – NO.	Appears only if in 21.1 B5 configured.	12.2
20.4	DHW Run time : 60s	Mode: DHW or solar panels or ----- Actuator run time in seconds.	Appears only if in 21.1 B6 configured. DHW if in 21.2 is DHW Solar panels if 21.2 is SOLAR PANELS ----- se 21.2 è -----	12.3
20.5	DHW Proport Band: 10c	Mode: DHW or solar panels or ----- Proportional Band	Appears only if in 21.1 B6 configured.. DHW if in 21.2 is DHW Solar panels if 21.2 is SOLAR PANELS ----- if 21.2 is -----	12.3
20.6	DHW Integral T 30s	Mode: DHW or solar panels or ----- Integral Time	Appears only if in 21.1 B6 configured.. DHW if in 21.2 is DHW Solar panels if 21.2 is SOLAR PANELS ----- if 21.2 is -----	12.3
20.7	Antibacteria NO	Choice use Antibacteria function:NO ; ONLY STORAGE; STORAGE + DISTRIB.	Appears only if in 21.1 B5 configured.. STORAG + DISTRIB.: appears only if 21.2 is SOLAR PANELS	12.4
20.8	Antibacteria Temp: 70c for 090m	Temp. & duration of Antibacteria function.	Does not appear 20.7 is NO.	12.4
20.9	Antibacteria 02.00 MONandTHU	Time & days of week (1 or 2) Antibacteria function operates:– MON; – TUE; – WED; – THU; – FRI; – SAT; – SUN; - - - ;	Does not appear if 20.7 is NO.	12.4
20.10	Solar pump Delay Off: 0min	Delay in switching off panels pump.	Useful when output Y is used to control minimum temp. of solar panels.	

21. CONFIGURATION DPS 638

Ref.	Display	Description	Notes	Sect.
21.1	Config detectors 1 - - 4 - - -	Configuration detectors connected (inputs B-M). - = detector not connected; Number = detector connected. Factory setting: B1 & B4 configured (cannot be disabled).	1 : Storage tank 1 detector B1 . 2 : Storage tank 2 detector B2 . 3 : Storage tank 3 detector B3 . 4 : Solar panels detector B4 (0...99 °C). As alternative to B7 5 : Integration detector B5 . 6 : Distribution circuit detector B6 . 7 : Solar panels detector B7 (0...200 °C). As alternative to B4	12.
21.2	Control Y: DHW	Use of control output Y: DHW = control of temp. of DHW distribution SOLAR PANELS = control of minimum temp. of solar panels. ----- = name of control.	Appears only if in 21.1 B6 is configured.	12.3
21.3	Send alarms : NO PassWTeleman : NO	Enabling alarms to send to Teleman. PC. Enabling telemanagement password.	Only if connected in C-Bus	10.6
21.4	Address : 1 Group : -	Telematic address of controller (1...239). Group to which controller belongs.	Only if connected in C-Bus	10.5
21.5	CRing: NO	NO : Not connected in C-Ring. PRIMARY : Connected as Primary. SECONDARY : Connected as Secondary.		10.1
21.6	Functional Alarms - - 8	Enabling of functional alarms. Factory setting: only 8 enabled (cannot be disabled).	5 : Integration time alarm B5 . 6 : Temp. ----- B6 alarm. 8 : Internal clock alarm.	15.1
21.7	Detector alarms - - - - -	Enabling alarms for short or open detector circuits. Factory setting: all disabled.	1 : Storage tank 1 detector B1 . 2 : Storage tank 2 detector B2 . 3 : Storage tank 3 detector B3 . 4 : Solar panels detector B4 (0...99 °C). As alternative to B7 . 5 : Integration detector B5 . 6 : Distribution circuit detector B6 . 7 : Solar panels detector B7 (0...200 °C). As alternative to B4 8 : C-Ring alarm.	15.2
21.8	K Alarms - - -	Enabling On-Off alarms. Factory setting: all disabled.	1 : Input E1, alarm with k1 closed. 2 : Input E2, alarm with k2 closed. 3 : Input E3, alarm with k3 closed.	15.3
21.9	Choice keynumber - - - -	Choice key number for preventing use – 1901 ... 1999	To cancel key number, press + and – keys together.	14.1
21.10	Site name - - - - -	Entering plant site name.	Use + and – to enter letters or numbers. Use ← and → to position cursor.	14.2

22. TESTING

Ref.	Display	Description	Notes	Sect.
22.1	CRing : ??	Page of testing C-Ring connections. ?? = C-Ring test in progress or test failed. YES = test positive.	Appears only if 21.5 is PRIMARY or SECONDARY.	16.1
22.2	Output : VALVE Y Status : IDLE	Choice outputs to be tested. Choice output status.	Choice output: VALVE Y ; INTEGRAT ; STORAGES. Choice status: With VALVE Y : IDLE ; CLOSES ; OPENS. With INTEGRAT : ON ; OFF. With STORAGES : ON 1 ; ON 2 ; ON 3 ; OFF.	16.2

Amendment to data sheet

Date	Revision No.	Page	Section	Amendment description
02.09.05 AM		2	6. FRONT PANEL	Change front panel diagram.
30.06.09 VM	01	various	various	Update value of Differenziale Solar different

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R.E.A. C.C.I.A.A. di Milano: 969861
C.F. e Num. di Iscr. al Registro Imprese di Milano: 00856030150
P.IVA IT 00542780986
Cap. Sociale € 4.864.000,00 int. vers.

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