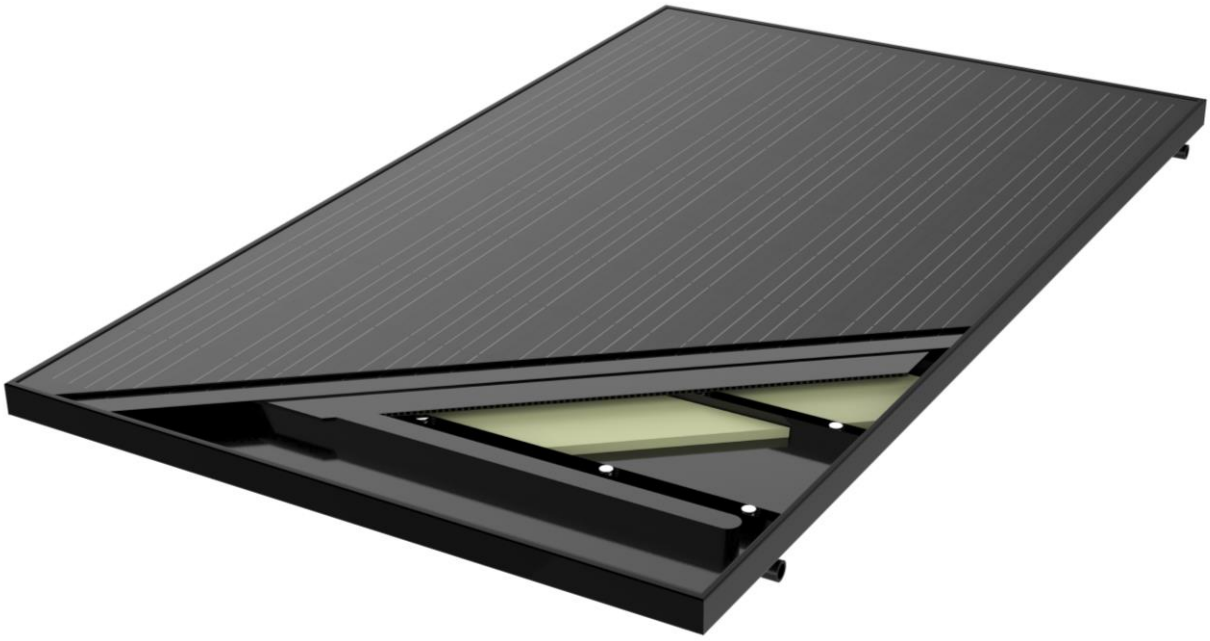
DUALSUN PROFESSIONALS

EN

Installation, operation and maintenance instructions

DualSun XXXM-60-3BBP



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DualSun online library

Head office
2 rue Marc Donadille
13013 Marseille - France

Manufacturing site
Rue du Champ de Foire
01640 Jujurieux – France

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1 Introduction

1.1 DualSun product list

Material	Name
Spring non-insulated hybrid panel	DualSun XXXM – 60 – 3BBPN
Spring insulated hybrid panel	DualSun XXXM – 60 – 3BBPI
Inter-Panel link - Pressurised system	DN15 - Spring link
Inter-Panel link - Pool system	DN26 - Spring link
Kit with temperature probe – installation memo – commissioning report – hydraulic fitting disassembly tool	Essential Kit DualSun
DN15 inlet/outlet hydraulic fittings kit Pressurised system	DN15 – Spring inlet/outlet fittings kit M3/4'''
DN26 inlet/outlet hydraulic fittings kit Pressurised system	DN26 – Spring inlet/outlet fittings kit M1''
Inlet/outlet hydraulic fittings kit Pool system	DN26 – compression Spring input/output fitting kit – Dext 32/40 mm

1.2 Symbols used in this document

Important remark

Security note

Risk of electric shock

Risk of falling

Risk of falling objects

High temperature risk

Information, advice, recommendation, etc.

Mandatory use of the safety harness during any height intervention

Use of protective goggles

Mandatory use of safety shoes

Mandatory use of gloves

Mandatory use of helmet

Switching off the electrical circuit upstream and downstream of the inverter

String: single circuit of modules mounted in series, either at the electrical level (PV photovoltaic) or at the hydraulic level (thermal).

1.3 General safety instructions

Please read this installation manual thoroughly and in detail in order to be able to fully exploit the functionality of the product. DualSun disclaims all liability for defects and damages resulting from failure to comply with the installation instructions (improper use, incorrect installation, handling error, etc...).

- It is important to follow these instructions for the safety of people. Improper assembly may cause serious injury. The end user must keep these safety instructions.


- For installations on roofs, it is necessary to respect the safety standards of the persons, relating to roof work and sealing of roofs and relating to scaffolding work with safety net by mounting the respective devices before starting the work. Refer to the recommendation published by the national risk prevention organization.




- The use of gloves is mandatory when handling the panels to avoid any risk of injury or burns.
- Installation, control, commissioning, maintenance and troubleshooting of the system must only be carried out by qualified personnel.
- The correct operation of the installation is guaranteed only if the installation and assembly have been made in the rules of art.
- Installation should not be used if there are signs of damage.


- Unplug all connecting cables from the power supply before intervening on the installation.


- All electrical work must be carried out according to local directives.

- The entire solar installation must be mounted and operated in accordance with the recognised technical rules.
- For the thermal part of the installation, we recommend the heat transfer fluid Tyfocor L; if you use another brand of glycol, it must contain anti-corrosion agents and be subject to validation by DualSun.

1.4 General standards to be respected

To ensure safe, ecological and economical operation, all applicable regional and national standards, rules and directives must be met, particularly those mentioned below:

- EN 12975 1 and 2: General requirements and method of controlling solar thermal collectors.
- EN 12976 1 and 2: General requirements and method of controlling prefabricated solar thermal installations.
- IEC/EN 61215 1 and 2 Edition 1: qualification of design and approval of crystalline silicon photovoltaic (PV) modules for terrestrial application
- IEC/EN 61730 1 and 2 Edition 2: qualification for the operating safety of photovoltaic modules (PV) – part 1: requirements for construction and part 2: requirements for testing.

The installation and safety instructions must be met.

Comply with the regulations on the prevention of occupational accidents prescribed by professional associations, in particular those relating to roof work.

The entire solar installation must be mounted and operated in accordance with the recognised technical rules.

All electrical work must be carried out according to local directives.

2 General description

2.1 Operating principle of the Spring Panel

DualSun Spring is a new generation hybrid solar panel that provides both electricity (photovoltaic) and hot (thermal) water for housing.

Protected by several patents, the Spring Panel produces 2.5 times more energy than a photovoltaic panel of the same surface. This innovative technology allows a space saving and total integration into the roof, for a competitive energy cost.

Our technology is derived from a double observation on photovoltaic panels:

- they produce much more heat (80%) than electricity (20%) when they are exposed to the Sun,
- their performance decreases when their temperature rises.

The Spring panel uses the heat emitted by the photovoltaic cells to heat the domestic water, thus improving the efficiency by cooling photovoltaic cells (potential gain from 5% to 15% by suitable cooling).

With a vertically integrated design of photovoltaic and thermal components in a single panel (protected by 3 patent families), the Spring panel is specifically designed for an optimized industrial manufacturing, making it more efficient, more aesthetic and cheaper than competitors.

With the same shape as a conventional photovoltaic panel, the Spring offers:

- harmonious design and total integration into the roof,
- a real space saving thanks to a more efficient solar panel per m²,
- a simple and safe installation.

2.2 Principle diagram of a Spring module

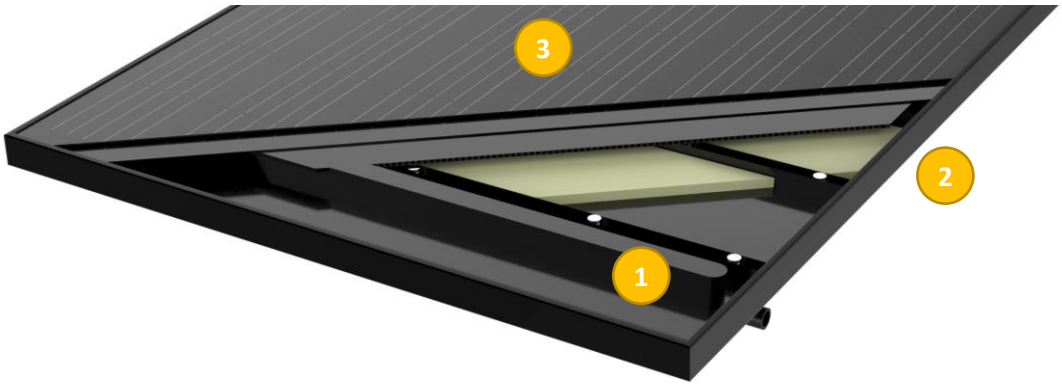


Figure 1 : Exploded view of the DualSun Spring Panel

1. Heat exchanger: completely integrated in the Panel, it allows an excellent heat transfer between the photovoltaic front and the water circulation.
2. Low thickness (35 mm frame): standard dimensions of a conventional photovoltaic panel (60 cells of 6 inches)
3. Solar photovoltaic cells: monocrystalline, high efficiency, they are cooled by water circulation.

2.3 Technical specifications

2.3.1 Physical characteristics

Please consult the datasheet in our online library.

2.3.2 Photovoltaic characteristics

Please consult the datasheet in our online library.

2.3.3 Thermal characteristics

THERMAL CHARACTERISTICS		
Sensor surface	1.635 m²	
Liquid volume	5 L	
Maximum operating pressure	1,5 bar	
Hydraulic input/output	15mm or 26mm fitting	
	Non-insulated	Insulated
Stagnation temperature	70 °c	75,6 °c
Optical efficiency a_0	58,9% *	58,2% *
Coefficient a_1	16 W/K/m² *	10,8 W/K/m² *
Coefficient a_2	0 W/(M², K²) *	

* The coefficients a_0, a_1 and a_2 are derived from the ISO 9806:2017 certification tests for the non-glazed solar collectors carried out by KIWA for a wind speed u = 1 m/s: $a_0 = n_0 - c_6*u'$; $a_1 = c_1 + c_3*u'$; $u' = u - 3$.

2.3.4 Thermal output vs. flow rate behaviour

- For domestic hot water (DHW) applications, the recommended nominal flow rate is 32 L/h/panel.
- For applications towards a thermal discharge, the recommended nominal flow rate is 100 L/h/panel. For example, towards a swimming pool or geothermal probes.
- For direct pool heating applications, the recommended nominal flow rate is 200 L/h/panel.

The curves below are given as an indication.

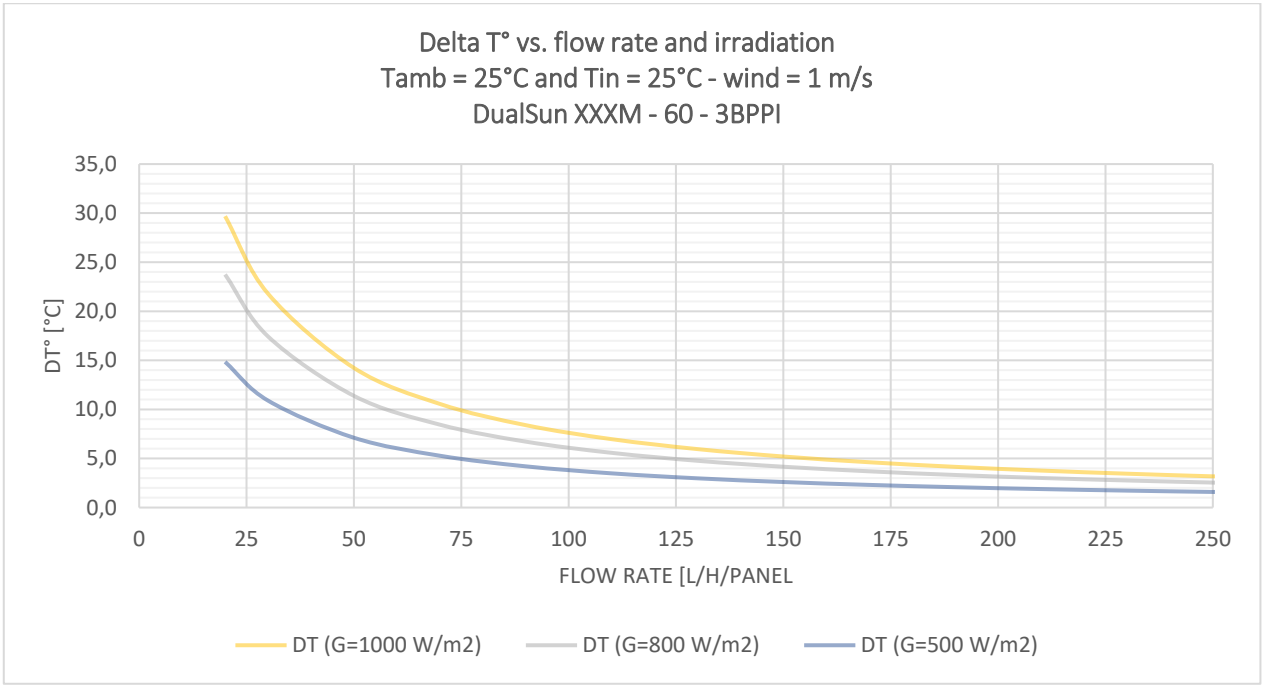


Figure 2 : Delta T = ƒ (Q) curves for DUALSUN Spring XXXM – 60 – 3BBPI – insulated version

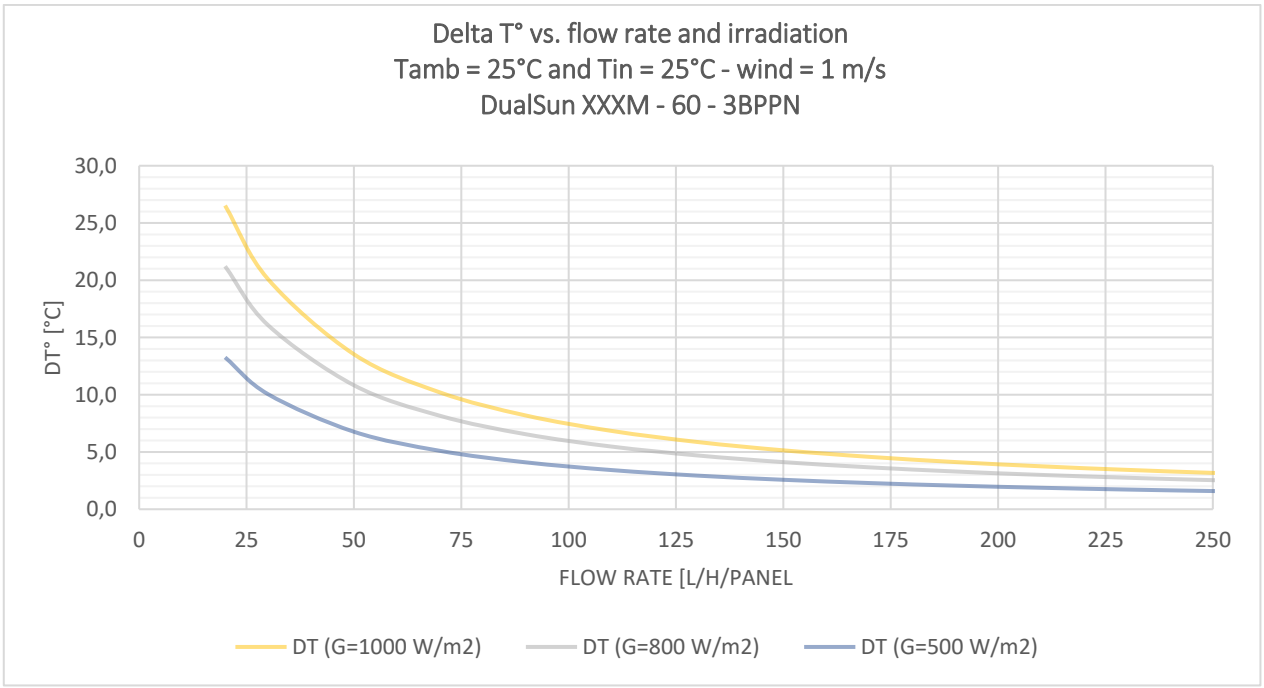
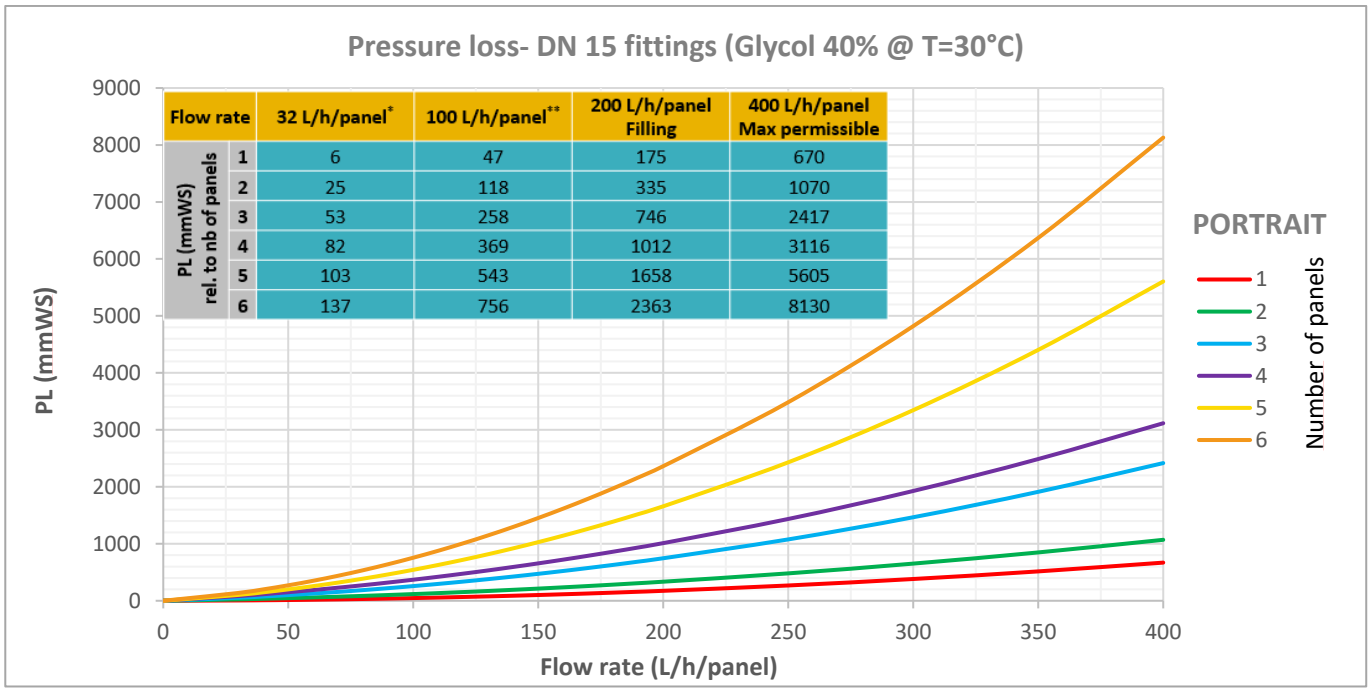


Figure 3 : Delta T = ƒ (Q) curves for DUALSUN Spring XXXM – 60 – 3BBPN – non-insulated version

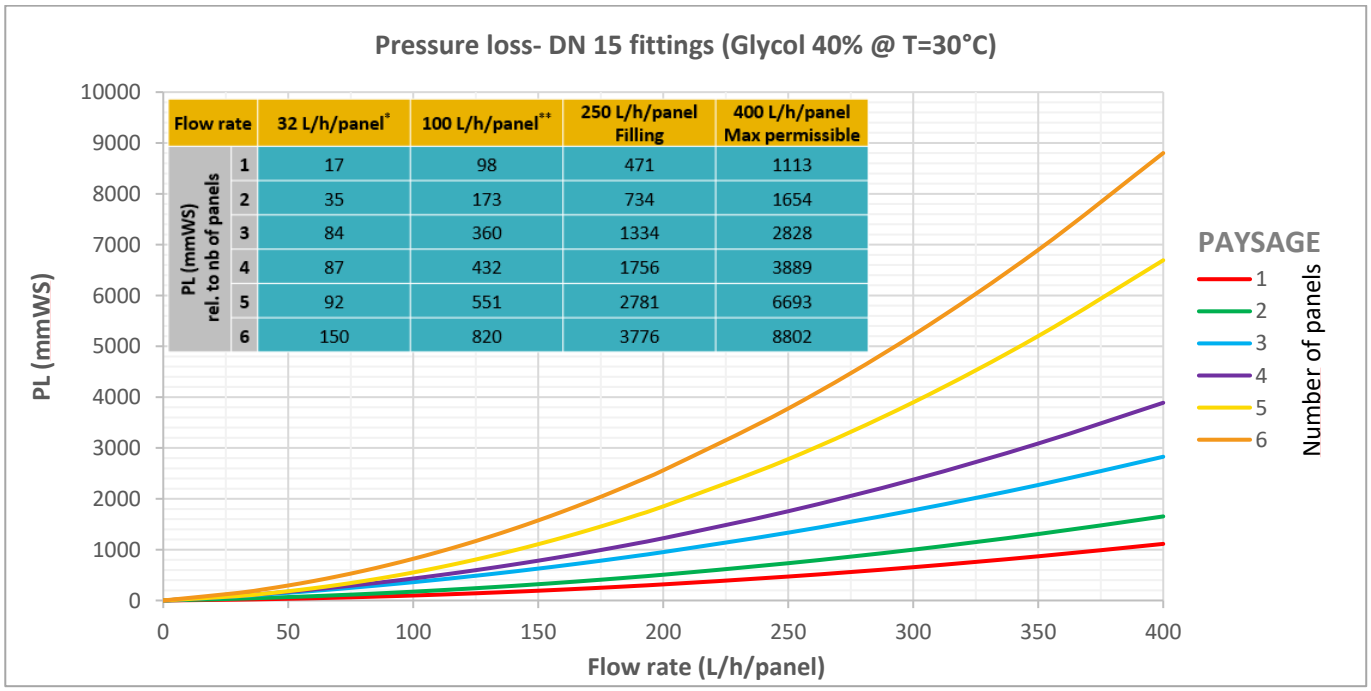
2.3.5 Pressure loss

The following values are derived from measurements with a glycol mixture (40%) and water (60%) at 30 °c.



Flow rate		32 L/h/panel*	100 L/h/panel**	200 L/h/panel Filling	400 L/h/panel Max permissible
PL (mmWS) rel. to nb of panels	1	6	47	175	670
	2	25	118	335	1070
	3	53	258	746	2417
	4	82	369	1012	3116
	5	103	543	1658	5605
	6	137	756	2363	8130

Figure 4 : Pressure loss curves for DUALSUN Spring XXXM – 60 – 3BBPI and 3BBPN panels in portrait with DN15 fittings



Flow rate		32 L/h/panel*	100 L/h/panel**	250 L/h/panel Filling	400 L/h/panel Max permissible
PL (mmWS) rel. to nb of panels	1	17	98	471	1113
	2	35	173	734	1654
	3	84	360	1334	2828
	4	87	432	1756	3889
	5	92	551	2781	6693
	6	150	820	3776	8802

Figure 5 : Pressure loss curves for DUALSUN Spring XXXM – 60 – 3BBPI and 3BBPN panels in landscape with DN15 fittings

* Recommended flow rate for DHW
** Recommended flow rate for thermal discharge

The following values are derived from measurements with water at 40°C

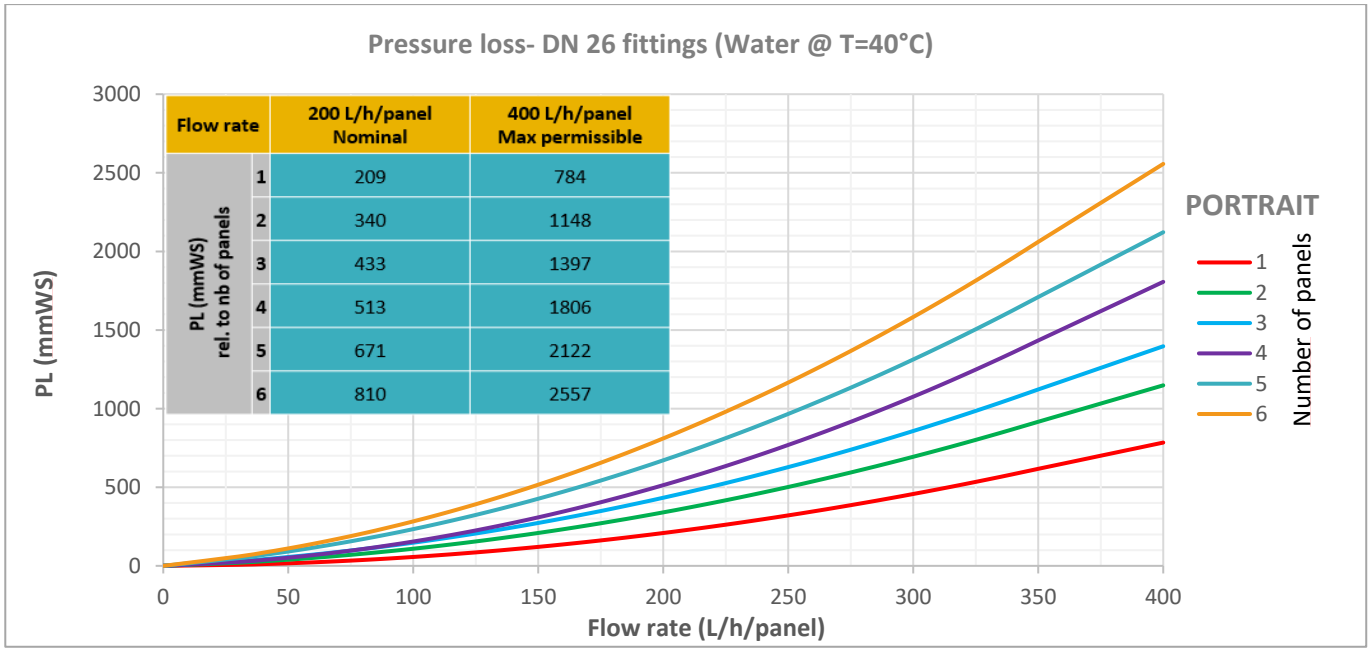


Figure 6 : Pressure loss curves for DUALSUN Spring XXXM – 60 – 3BBPN panels in portrait with DN26 fittings

2.3.6 Recommended flow rates

Nominal flow rates:

Application	DHW*	Thermal discharge**	Direct pool heating
Nominal flow rate (L/h/panel)	32	100	200

* DHW : Domestic hot water
** Thermal discharge: Pressurised system with thermal exchanger or geothermal probes coupling

Minimum filling flow rate:

- Panel in portrait mode: 200 L/h/panel
- Panel in landscape mode: 250 L/h/panel

Maximum permissible flow rate: 400 L/h/panel

The choice of the flow rate directly impacts the hydraulic pressure.

2.3.7 Maximum authorized pressures

It is imperative never to exceed the following pressures in the DualSun panels:

Maximum service pressure = 1,5 bar
Maximum filling pressure = 2 bar

The maximum filling pressure corresponds to the pressure allowable in the panels to purge correctly the air during hydraulic commissioning.
The temperature of the panels must be between 10 and 45°C during commissioning.
The pressure can be raised to 2 bar during a few minutes only.

At the end of the commissioning of the installation, the maximum service pressure to set is **1,5 bar**.

2.4 General recommendations

2.4.1 Handling

DualSun modules must be handled like any glass product. To avoid accidents, injuries, or damage to the module during work, the following precautions must always be followed:

- Do not walk on the modules.
- Do not drop anything on the modules.
- Protect modules from possible scratch on front and rear faces
- Do not exert any mechanical tension on the electrical connection.
- Always lift and transport the modules with both hands and never use the junction box as a carrying handle.

For the complete process of DualSun modules unconditioning and handling, see the DualSun file No. XX-04.

2.4.2 Transportation

In order not to damage the modules during transport, the following instructions must be followed:

- Transport stacked modules vertically, with a separator that supports the frame level of each module.
- Do not remove the original packaging until the time of installation.
- Do not apply mechanical pressure to the modules (for example, do not attach the modules using a strap, or place any objects on the surface of the modules).

2.4.3 Storage

When storing, to avoid accidents or damaging the modules, the following instructions must be followed:

- Store the modules vertically.
- Do not store the modules on the edges, in a corner, or on an irregular surface.
- Do not place any objects on the surface of the modules.
- When choosing a suitable storage location, make sure that:
    - the location is dry and cool,
    - No object can fall on the module and thus damage it.

If a DualSun module is damaged or broken, it is necessary to replace it. Never install a damaged module.

2.5 Technical considerations

Throughout the year, the system is exposed to external weather and natural conditions (Sun, wind, rain, hail, snow, thunderstorms, dead leaves, dust, bird droppings, etc.) that influence the performance and lifespan of the modules. To extend the life of the modules and to ensure that the installation is functioning properly, important factors and adjustment parameters are to be considered:

2.5.1 Static requirements on the roof

The Solar Installer must ensure that the roof structure can carry the additional weight of the hybrid system.

2.5.2 Tilt angle

The optimal mounting position of DualSun solar panels results in a 90° incidence angle of sun rays relative to the surface of the panels (i.e. Perpendicular to the panels). To maximize the productivity of the installation, panels should be positioned at the optimum orientation and tilt angle. Those angles depend on the geographical location of the installation and can be calculated by a qualified system designer. All panels in a string should, wherever possible, have the same orientation and tilt angles to ensure the system does not underperform due to mismatched outputs.

2.5.3 Wind and snow load

The module has been tested up to a pressure of **5400 Pa** in negative pressure (snow) and **2400 Pa** in positive pressure or negative (wind) without damage. It meets the requirements of the standard IEC/EN 61215 for wind speeds up to 130 km/h.

130 km/h

2.5.4 System location

The overall output of the photovoltaic system in series is always limited by the module delivering the lowest power. Different factors can influence the performance of a module (faults, shading, different orientations) and impact the entire system.

Therefore, it is necessary to study the implantation to avoid a shading effect on the modules in series.

In addition, all panels must be mounted with the same orientation. It is advisable to align all modules to the South, to achieve optimum performance.

DualSun suggests installing the modules in areas where temperatures range from-20 °c to + 50 °c, which corresponds to the minimum and maximum monthly average temperatures, in compliance with IEC 60364-5-51. The extreme operating temperatures of the modules are included between -40 °C and + 85 °C.

In areas with high snow conditions and exposed to strong winds, the assembly of the modules must be carried out in such a way as to ensure sufficient nominal resistance and in accordance with local regulations.

Some operating environments are not recommended for DualSun modules, and **are excluded from the DualSun limited warranty**:

- No panel should be mounted on a site where it can be exposed to direct contact with saltwater, salt mist, acid rain, active chemical vapours or any other aggressive environment.
- DualSun modules must not be installed near flammable liquids, gases, hazardous materials or any type of vehicle.
- The maximum altitude the PV module is designed for ≤ 2000m

2.5.5 Types of mounting

The fastening of the modules must be secured by at least 4 points and spread according to the areas specified in the diagram shown in chapter 0.

2.5.5.1 Integrated assembly

This assembly guarantees the retention of the original functionality of the roof. Special attention should be paid to the insulation as well as to the protection against rain and humidity. To achieve this level of sealing, the module must be mounted on a special frame that can route rainwater and withstand the wind and snow loads occurring in the geographical area of the installation.

2.5.5.2 Over the roof assembly

The modules can be mounted on a frame designed to support the photovoltaic panels. This framework must be able to withstand the wind and snow loads occurring in the geographical area of the installation. When fastening and connecting the system to the building, it is necessary to avoid damage or destruction of the roof covering in order to maintain optimum resistance against rain and moisture.

Figure 7 : installation on K2 overlay system

The instructions given in the installation guide for the mounting system must be followed for proper installation.

2.5.6 Fire/explosion protection

Do not install the DualSun modules in the vicinity of highly flammable gases, vapours, or dust (e.g., next to a gas station or containers). The national and local fire prevention standards and regulations must be respected during installation. For installations located on a roof, the modules must be mounted on a fire-resistant roofing cover adapted to the application.

The DualSun modules have a class C fire resistance according to IEC/EN 61730-2.

3 Assembly and installation

The installation of DualSun panels must be managed and carried out by trained and qualified personnel. The system must be assembled and operated according to the instructions provided, to comply with the local and national health and safety, and risk prevention regulations.

When assembling and operating the system, no unauthorized person shall be located on or around the roof of the facility.

3.1 Installing DualSun modules

The DualSun panels can be installed both in portrait and landscape orientation.

DualSun does not provide the mounting system for fastening the modules on the roof: please refer to the installation instructions of the chosen mounting system, to install the modules whether for an integrated or for a superimposed installation, in landscape or portrait.

The list of mounting systems compatible with DualSun modules is available in the "Mounting systems compatibility" document *on our website dedicated to professionals*

Even when the solar radiation is low, the photovoltaic part of the system produces direct current (DC). This DC current circulates from the module towards the inverter, do not manipulate the module or the connections without protections.

The modules are class II qualified in compliance with IEC/EN 61215-2 and IEC/EN 61730-1 standards. These standards concern PV modules for use on buildings, or on ground structures.

Artificially concentrated solar radiation should not be directed to the module.

The frame thickness and the dimensions of the Spring panel are identical to photovoltaic panels. It adapts easily to photovoltaic mounting systems; however, it is necessary to ensure the positioning of the hoses in relation to the mounting system frame and to the roof covering surface.

The mounting system must have a flat surface for mounting the panel and must not cause twisting or stress on the panel, even in case of thermal expansion.
We also remind that the sealing is not ensured by the panels but by the roof covering system and that the evacuation of the water must be foreseen.
It is necessary to provide a space between the frame of the panels and the structure or the floor to avoid damage to the cables and hydraulic fittings.

The panel mounting systems must be installed only on buildings that have been formally validated for structural integrity, and which have been considered capable of supporting the additional weight of the panels and mounting systems, by a certified building specialist or engineer.

The supplier of the mounting system must take into account the galvanic corrosion which may appear between the aluminium frame of the panels and the mounting system or the grounding parts if they are made of different metals.

The module is only certified when its original frame is completely intact. Do not remove or modify the module frame in any way. Drilling additional mounting holes is likely to damage the module and reduce the strength of the frame, and thus is not allowed.

The use of flanges and fasteners with additional grounding bolts or grounding connectors shall be in accordance with this safety and installation instruction manual and according to the conditions in section 4.3.

The modules can be installed according to the following methods:

1. **Frame holes:** attach the module to the structure using the factory-made mounting holes. It is recommended to use four M8x16 mm stainless steel screws with bolts, washers and lock washers for each module. The maximum tightening torque of the bolts is 24 N.m.

2. **Callipers or clamps:** the brackets can be mounted on the longitudinal (longest side) or lateral (shortest side) side of the module. The areas allocated to these clamps are specified in chapter 3.2 below. Installers must ensure that the resistance of the clamps is sufficient given the maximum pressure to which the module can be exposed. The clamps are not supplied by DualSun.

It is important to make sure that the clamping brackets do not distort the top of the aluminium frame of the DualSun panel, this may weaken or even break the glass.

The tightening torque of the clamps must not exceed 24 N. m.

The compatibility of the mounting system with the modules must be assessed before any installation, especially when the system does not use brackets or clamps.

3.2 Mechanical installation

3.2.1 Positioning areas of mounting system rails

The hybrid DualSun Spring modules have the particularity of integrating a heat exchanger on the back of a photovoltaic panel whose physical characteristics correspond to photovoltaic panels on the current market, 35 mm frame thickness in particular.

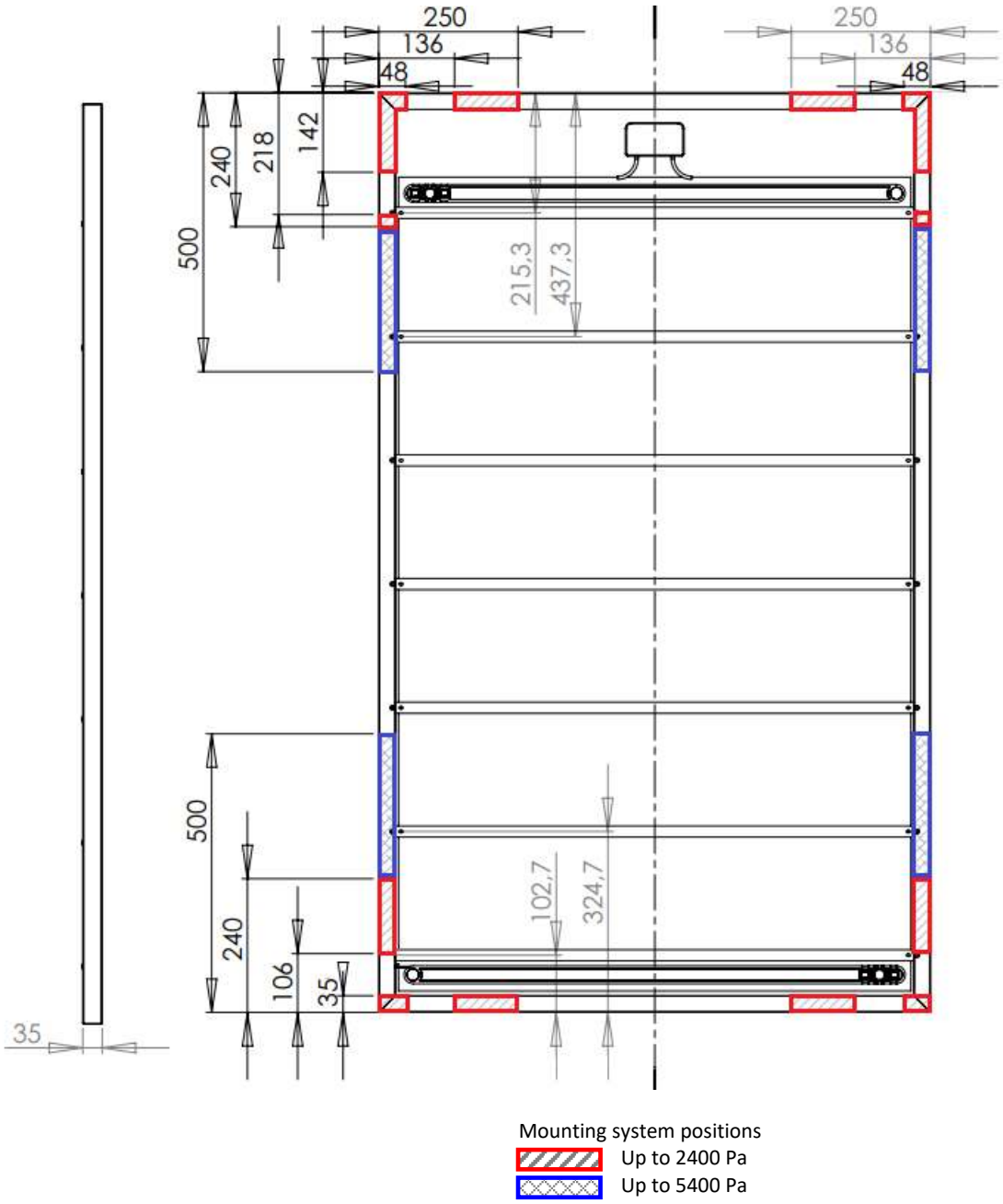


Figure 8 : Possible positions of the clamps to fasten DualSun XXXM-60-3BBP panels

Care must be taken not to overlay the rails of the mounting system with the hydraulic connections, the areas of which are delimited in the above plan.

3.2.2 Raising the panels relative to the roof surface

It is necessary to ensure that the size of the hydraulic connections corresponds to the distance allocated by the laying system, between the surface of the roof and the lower edge of the module frame, which will be in contact with the mounting system.

Depending on the hydraulic nominal flow, two types of fittings have been designed. Their size at the rear of the module is shown below.

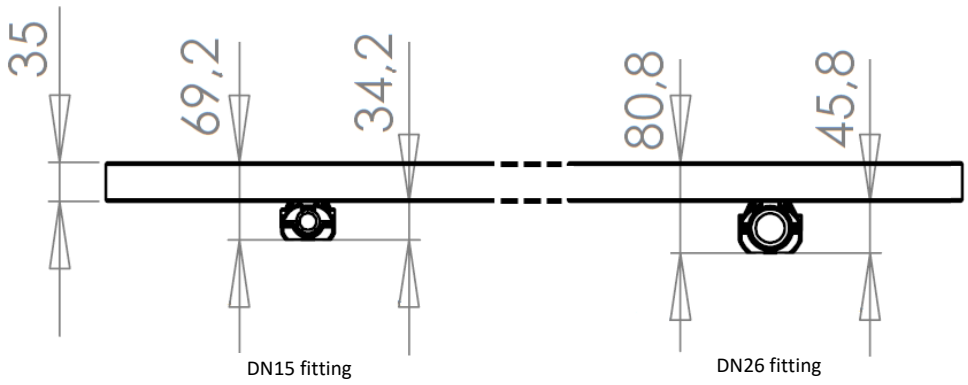


Figure 9 : Overall dimensions of hydraulic connections on the rear panel

The bulk of the hydraulic fittings on the rear side of the DualSun Spring panels is to be considered carefully to avoid contact of the fittings with the surface of the roof cover.

Tie the interpanel links to the modules or to the rails of the mounting system in order to avoid them to lay on the roof cover.

Please compare the following characteristics of the flexible hoses of the interpanel links with the allowable height:

	DN15	DN26
D_{int}/D_{ext} (mm)	15/21	26/32
Bending radius – R_b (mm)	88	140

Table 1 : Dimensions and bending radius of the DN15 and DN26 interpanel hydraulic links

3.2.3 Possible connection configurations with hydraulic links

In order to facilitate their routing in a maximum of configurations, the DualSun hydraulic links have been developed to allow connection in portrait or landscape mode. It is thus possible to adapt the hydraulic links according to the desired layout and also to bypass obstacles between the panels and the roof.

3.2.3.1 Panel mounted in portrait / Hydraulic links in portrait

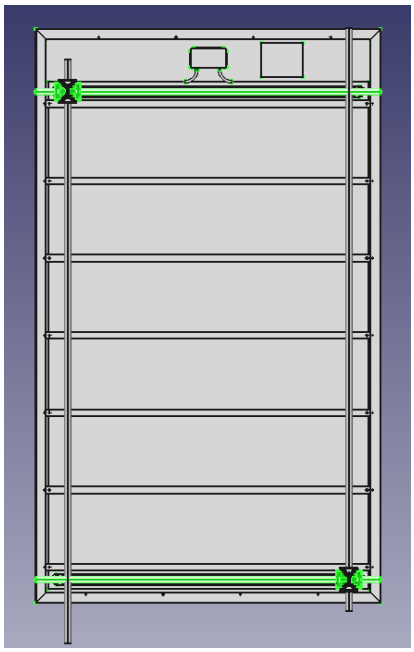


Figure 10 : Mounting configuration 1
Panel in portrait / Hydraulic link in portrait

3.2.3.2 Panel mounted in portrait / Hydraulic links in landscape

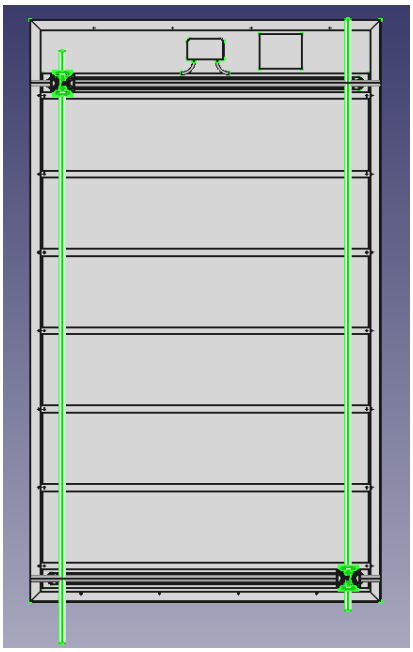


Figure 11 : Mounting configuration 2
Panel in portrait / Hydraulic link in landscape

3.2.3.3 Panel mounted in landscape / Hydraulic links in landscape

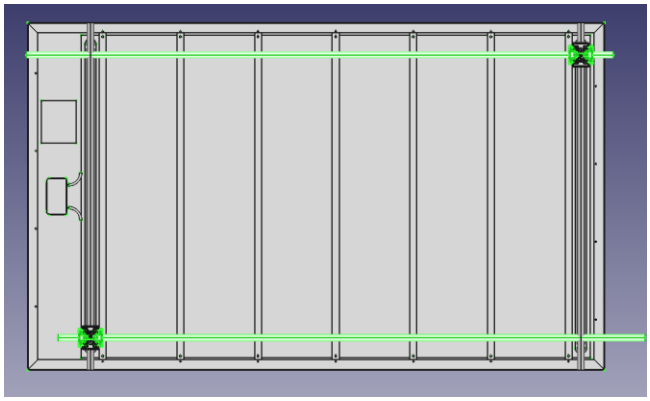


Figure 12 : Mounting configuration 3
Panel in landscape / Hydraulic link in landscape

3.2.3.4 Panel mounted in landscape / Hydraulic links in portrait

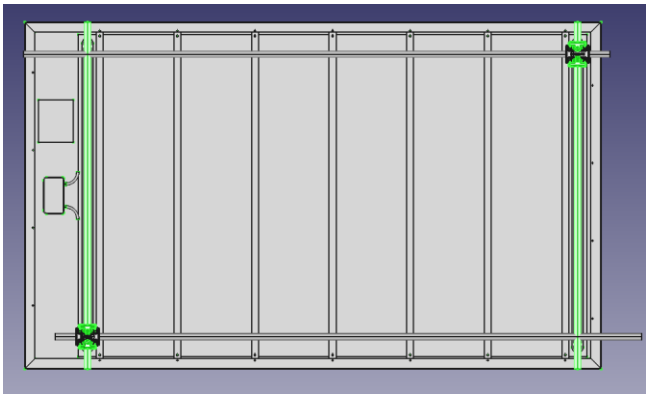


Figure 13 : Mounting configuration 4
Panel in landscape / Hydraulic link in portrait

Thus, the hydraulic connections can be oriented so as to avoid the rails of the mounting system or to adapt to the type of roof, in particular on trapezoidal sheet metal.

3.2.4 Trapezoidal sheet metal roofing

In the case of a trapezoidal sheet metal roof, the hydraulic connections can be positioned in a corrugation recess to limit the height of the modules.
The flexible hoses can either run perpendicular to the corrugations if the installation system raises the modules higher than the hose diameters, see Table 1, or run in the corrugation recess in the opposite case.

A detailed layout plan is then mandatory to ensure that the hydraulic connections do not interfere with the roof covering.

a. Checking the panel raising and positioning of the hydraulic links

DN15 fitting

See the characteristics of the DN15 hydraulic hose in table 1.
The minimum elevation of the module with regard to the corrugation crest is 22 mm.
In this case, the edge of the hydraulic fitting can be placed 34 mm to the edge of the corrugation crest.

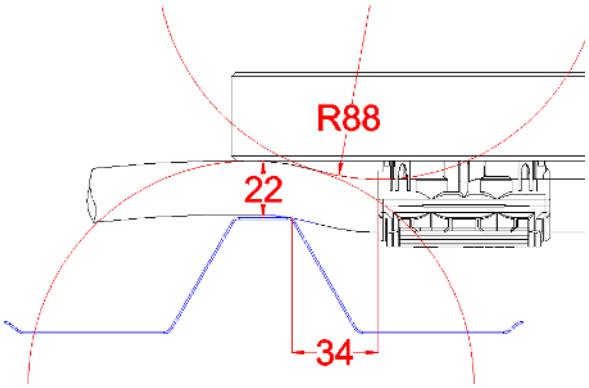


Figure 14 : DN15hydraulic link routing through corrugation crest

DN26 fitting

See the characteristics of the DN26 hydraulic hose in table 1.
The minimum elevation of the module with regard to the corrugation crest is 36 mm.
In this case, the edge of the hydraulic fitting can be placed 60 mm to the edge of the corrugation crest.

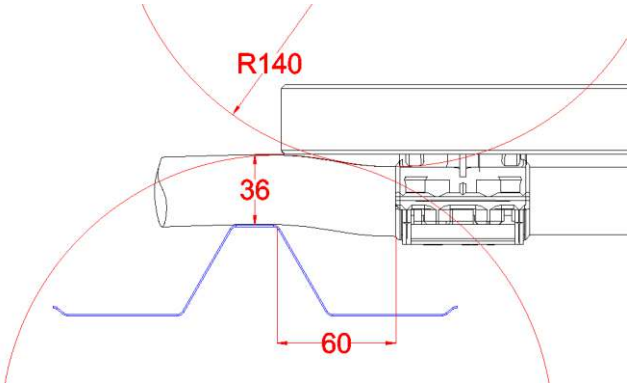


Figure 15 : DN26 hydraulic link routing through corrugation crest

b. Checking the roof layout

The positioning of the first module depends on the corrugation crest routing detailed above. Then check that each DualSun fitting is correctly positioned in the corrugation recess, according to the width of the inter-panel clamps, respecting the minimum distances for the routing of the hydraulic links through the corrugation crests.

Portrait layout

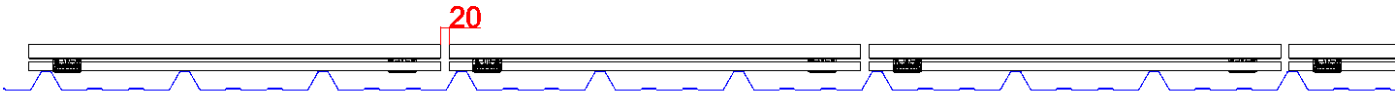


Figure 16 : Portrait layout

Landscape layout

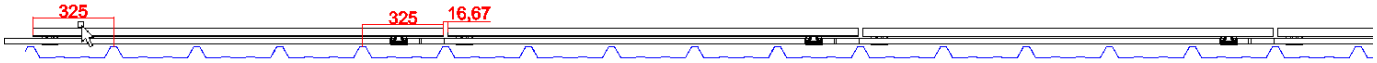


Figure 17 : Landscape layout

Sheet metal roof with 333 mm corrugation length : Select an inter-panel distance of 16.67 mm if possible and place the end of the module 325 mm from the centre of the corrugation crest. The position of the modules will thus be identical in relation to the corrugation crests over the entire layout.

c. Checking the routing of the hydraulic links

Routing perpendicular to the corrugations – Configurations 3.2.3.1 and 3.2.3.3

The previous points allow to check the routing of the hoses perpendicular to the corrugations according to the characteristics of the DN15 or DN26 hoses, to the height of elevation of the modules and to the positioning of the hydraulic links in relation to the corrugations.

Routing parallel to the corrugations – Configurations 3.2.3.2 and 3.2.3.4

Routing through rails may occur according to the mounting system. In this case it is possible to run the hydraulic links beneath or from the side of the rails.

It is necessary to ensure that :

- The height between the rails and the roof surface is greater than the external diameter of the flexible hoses, see table 1 above.
- The bending radius of the flexible hose is greater than the minimum bending radius to avoid the rails, see table 1 above.
- The rails are at a sufficient distance from the hydraulic fittings to comply with the minimum bending radii of the flexible hoses within the permissible fixing areas, see 3.2.1.

Rails avoidance in portrait:

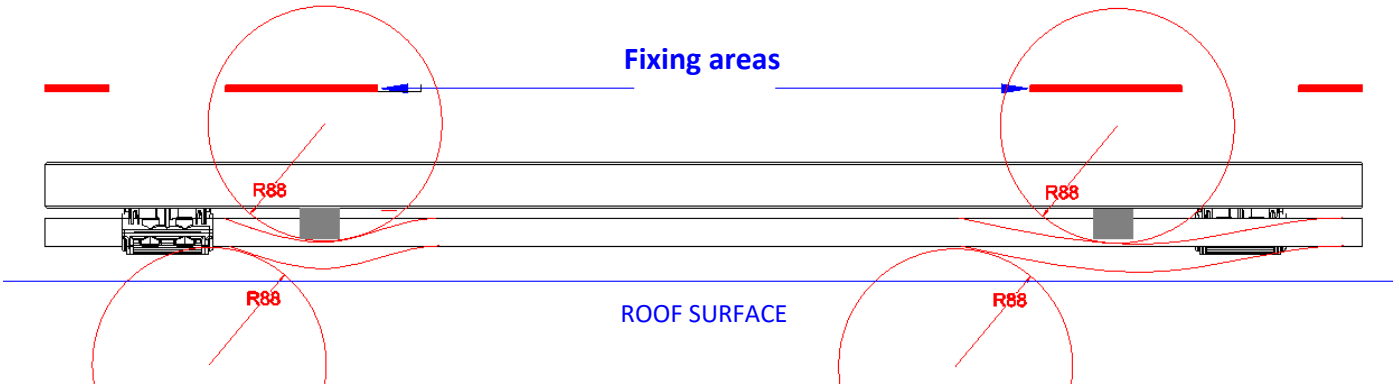


Figure 18 : Rails avoidance in portrait with DN15 hydraulic links

Rails avoidance in landscape:

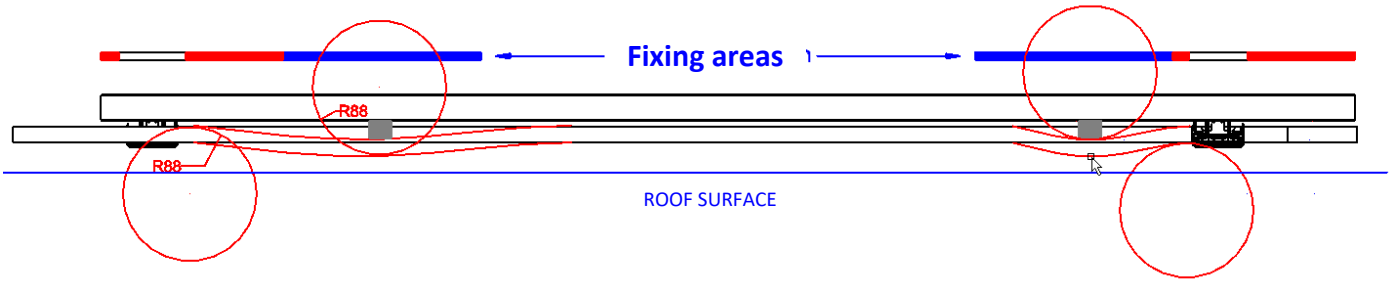


Figure 19 : Rails avoidance in portrait with DN26 hydraulic links

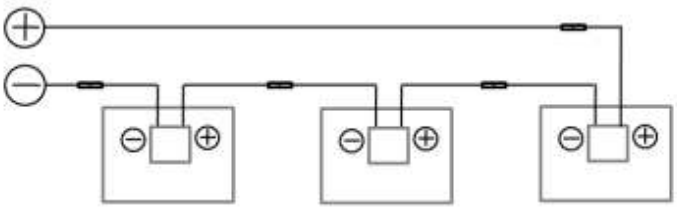
4 Electrical installation

The nominal electrical parameters Icc, Vco and Pmax of the modules are determined under standard test conditions STC (standard testing condition): illumination of 1000 W/m² with a spectrum of 1.5 AM and a cell temperature of 25°C. These values may vary from +/-3%.

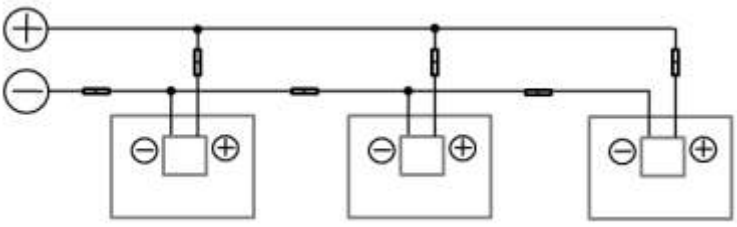
Under normal conditions, a photovoltaic module is likely to be exposed to conditions that produce more current and/or voltage than standard test conditions values. Therefore, ***the maximum rated values of Icc and Vco on the module should be multiplied by 1.25 when determining the nominal voltage of the components****, the nominal current of the conductors, the size of the fuses, and the size of the control devices connected to the PV output.*

4.1 Electrical connection

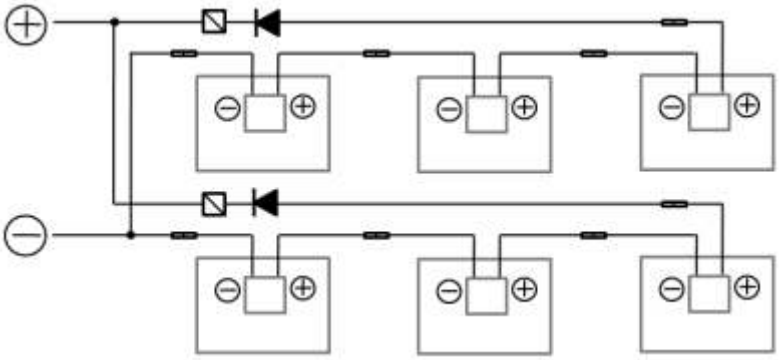
Serial wiring



Parallel wiring



Serial/parallel wiring



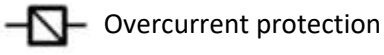


Figure 20 : Electrical wiring configurations

4.1.1 Serial wiring

To connect modules in series, the maximum number of connectable modules is to be determined. For this, it is necessary to determine the maximum tension of the string. This is calculated by summing the open circuit voltage (Vco) of each module when the ambient temperature is at its minimum value. Apply the temperature coefficient to determine the *Vco* value at the temperature considered.

The maximum open circuit voltage of the string must never exceed the maximum system voltage. See module datasheet.

For modules installed in series, only modules with the same nominal currents will be used.

To determine the number of maximum modules that can be connected in series:

$$N = \frac{Maximum\ system\ voltage}{1{,}15\ .Vco}$$

where:

- *N = maximum number of modules in series*
- *Vco = open circuit voltage* of each module, when the ambient temperature is at its minimum value (refer to the product datasheet in chapter 2.3.2)

If additional PV modules are to be installed in a string with the DualSun modules, their power and current must be equal to those of the DualSun panels within the tolerances of the manufacturers.

4.1.2 Parallel wiring

For DualSun modules connected in parallel, protection against the corresponding overcurrent must be used. For this purpose, a DC voltage fuse must be used to prevent reverse current. Refer to the inverse maximum current value of the product datasheet to determine the value of the protection. In addition, the operating conditions and design rules of the inverter manufacturer must be met.

Refer to the inverter instructions

For modules connected in parallel, only modules with the same nominal voltages will be used.

The electrical installation must be carried out by qualified personnel in accordance with current safety standards and IEC/EN 61730.

Refer to the grid operator requirements when installing the system.

The installation must be equipped with a circuit breaker to isolate at the same time all the cables that are not grounded by a minimum spacing of 3 mm at the contact level.

4.2 Electrical fittings, cables and diodes

The DualSun solar modules are supplied with cables, connectors, and a pre-equipped junction box. Before installation, check that the plugs and connections are not damaged.

Connect the positive plug of a module to the negative plug of the next module; see identification of the polarity of the MC4 connectors below:

Figure 21 : MC4 connectors

To connect the modules, special solar cables with a minimum diameter of 4 mm2 and the appropriate connectors must be used. These cables must be UV-and wear-resistant. Avoid leaving the cables exposed to the elements or place them in a protective sheath. **Observe a minimum bending radius of 40 mm**.

When connecting the connectors, it is important to ensure that they are connected in a watertight manner (minimum IP67).

When handling these cables, it is necessary to ensure that the tools used are dry.
All modules are supplied with pre-installed bypass diodes to minimize the hot spots and power losses of the modules in the case of shading (partial).

Never connect or disconnect a live circuit.

Never open the junction box.

DualSun module junction box contains bypass diodes which are in parallel connection with the cell strands. If heat spot occurs locally, the diode will come into operation to stop the main current from flowing through the heat spot cells in order to restrain module overheating and performance loss. However, the bypass diode is not the overcurrent protection device.

If the diode is suspected to get out of order, the installer or system maintenance supplier shall contact DualSun.

The diode type is 20SQ045 (for SUNTER, rated current is 15A, peak reverse voltage is 45V).

The replacement of the bypass diodes shall be done by qualified personnel only.

The maximum rating of a fuse connected in series with a cell string is typically 15A, but the actual module specific rating can be found on the product label and in the product datasheet.

Diodes that are used as blocking diodes must have a:

- Rated Average Forward Current [IF(AV)] above the maximum system current at the highest module operating temperature.
- Rated Repetitive Peak Reverse Voltage [VRRM] above the maximum system voltage at the lowest module operating temperature.

4.3 Grounding and lightning protection

The evaluation and design of the grounding system and lightning protection of PV installations must be carried out by trained and qualified personnel. Refer imperatively to applicable local regulations to meet all specific requirements.

The DualSun modules must be grounded. The grounding can be carried out through the holes made for this purpose in the framework of each module. These holes are used to attach the grounding cable and connect it to the equipotential link.

It is necessary to ensure that the grounding is carried out with the appropriate connections (stainless steel), to avoid anodizing or oxidation of the module frame at the level of the drilling intended for grounding*. The grounding device must be in good contact with the aluminium frame of the module.*

To obtain the optimum output power, DualSun recommends that the negative poles of the DC circuit of the module group be grounded.

The frame of the DualSun panels comes with two earthed holes at each corner of the frame.

Avoid direct contacts between aluminium and copper by using an intermediate metal such as stainless steel or tin.

4.4 Indirect lightning strike

The installation must also be protected from indirect lightning strikes. Indeed, the drivers of the system can become inductive if a lightning strike erupts in the vicinity of the installation. To prevent this phenomenon, the electrical cable loops must be avoided and the surface between the cables must be as small as possible, as can be seen in the graph below:

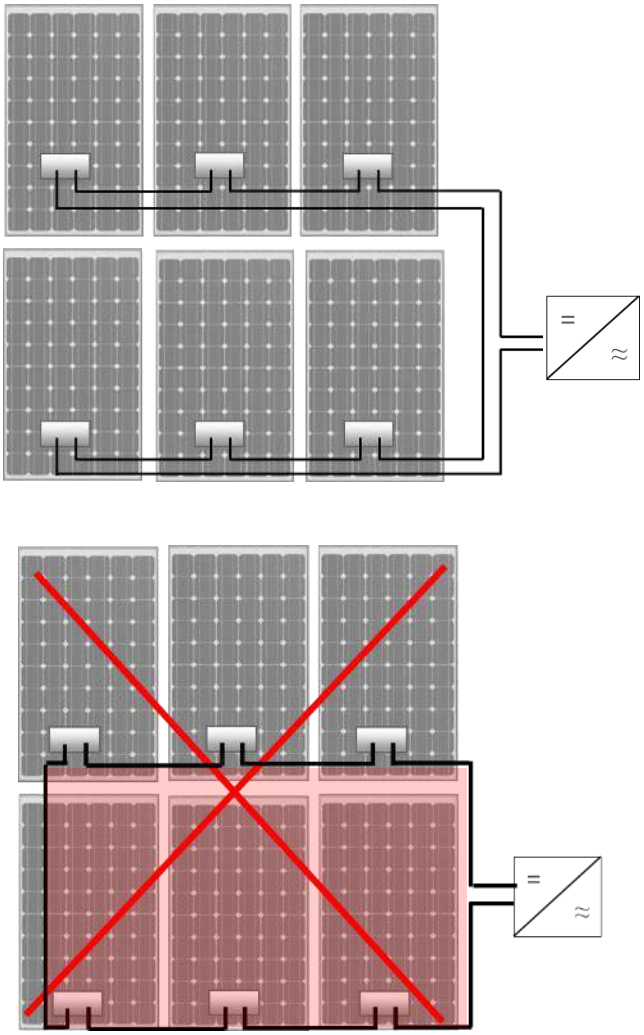


Figure 22 : Simplified diagrams showing two examples of good and poor grounding of a PV field

5 Hydraulic installation

5.1 Hydraulic connection of the panels

Two levels of hydraulic connection are to be considered:

- Inter-panel link
- Connection between the groups of panels and the transfer circuit

5.1.1 Inter-Panel hydraulic link

a. DualQuicfit fittings

To connect the Spring panels to each other, DualSun has developed the DualQuickfit quick fittings. They are mounted on flexible lines and conditioned as rings. These flexible lines are preassembled according to the roof layout of the installation, in portrait or landscape.

A flexible line consists of a flexible hose DN15 or DN26, depending on the nominal flow required, and portrait or landscape DualQuickfit quick fittings.

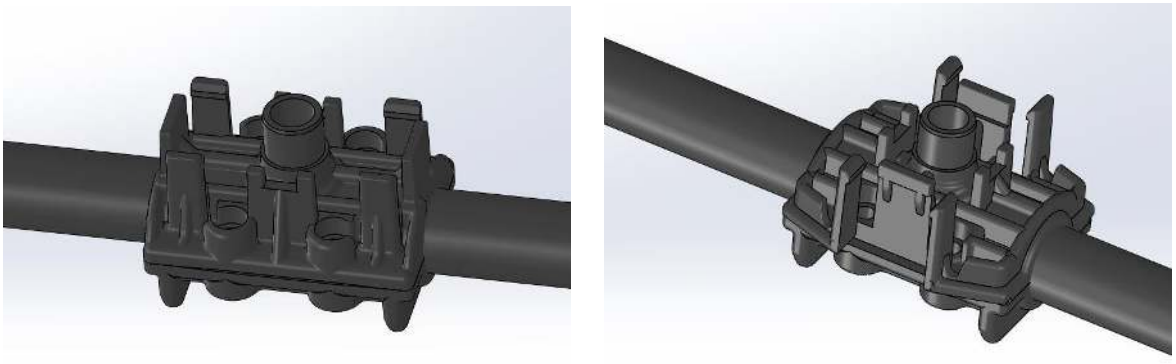


Figure 23 : DualQuickfit hydraulic fittings for portrait (left) or landscape (right) roof layout

b. Inlet/outlet fittings

Pressurised system

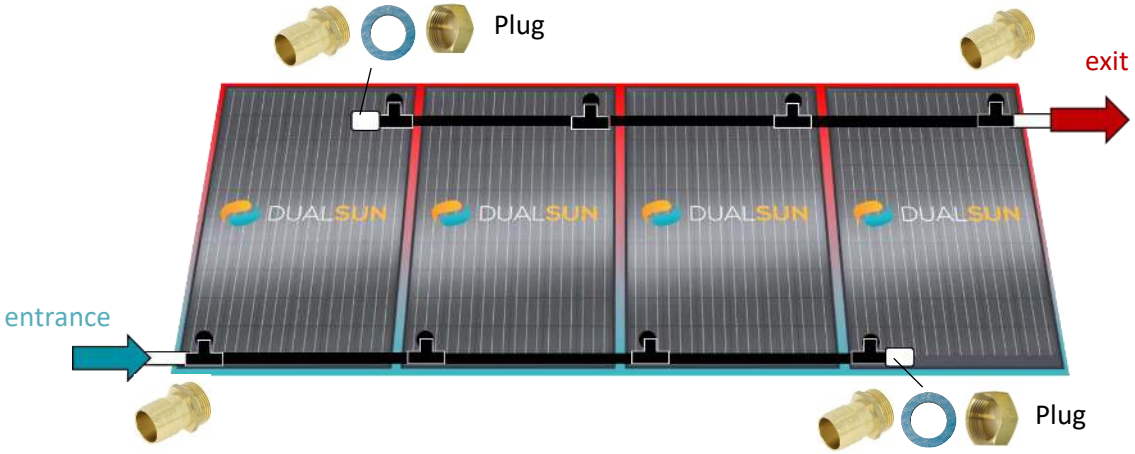
A kit made with brass fittings allows the connection between the group of panels and the transfer circuit. The fittings are M3/4" for DN15 inter-panel links or M1'' for DN26 inter-panel links.
This kit includes, for a line of panels, 4 barbed fittings, 4 hose clamps, 4 high-temperature fibre O-seals and 2 screw plugs.

These fittings are installed at the entry / exit of each panel line.

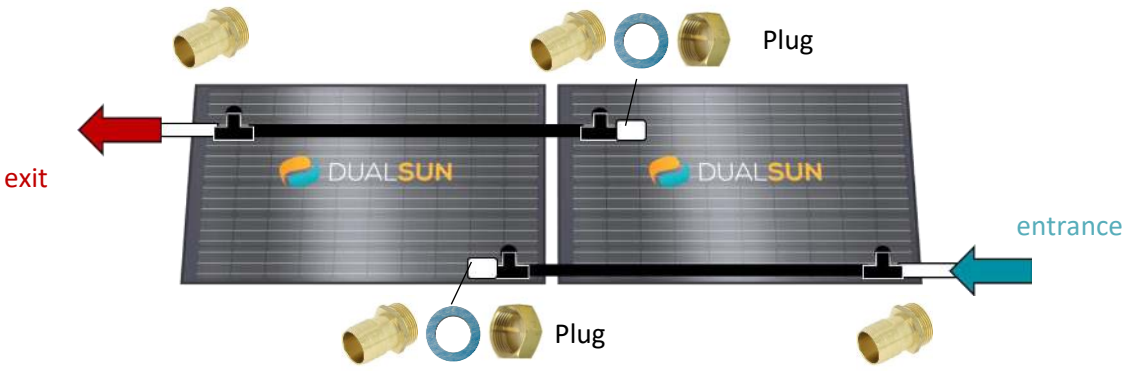
Place the clamp on the hose, insert the barbed fitting into the hose, tighten firmly.

A plug at the end of each flexible link is to be installed with a fibre O-seal as specified below.

Simplified diagram of a 4-panel line in portrait:



Simplified diagram of a 2-panel line in landscape:



A kit made with compression fittings allows the connection between the group of panels and the transfer circuit.
This kit includes, for a line of panels, 2 D32/40 mm compression fittings and 2 D32 mm compression plugs.

When the flexible inter-panel links are equipped with the inlet/outlet connections, they are then easily connected to the Panel manifolds, without tools, as shown below.

When connecting the inter-pane lines, it is preferable to start with the entry or cold line (bottom of the panel). This then facilitates the electrical and hydraulic connection by lifting the top of the panel.

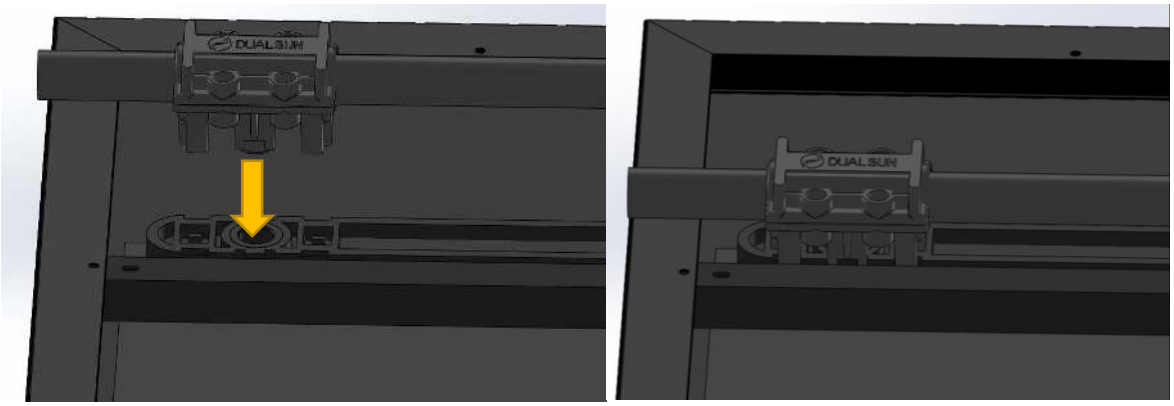


Figure 24 : Plugging of the DualQuickfit hydraulic fittings into the Spring Panel collector

Make sure to insert the DualQuickfit connector as straight as possible into the Spring Panel collector.

On tilted roofs, it is advisable to prepare the inter-panel links according to the roof layout before starting the installation on the roof.

To ensure proper filling of the panels during commissioning, **no more than 6 panels shall be placed in line either in portrait or landscape**.

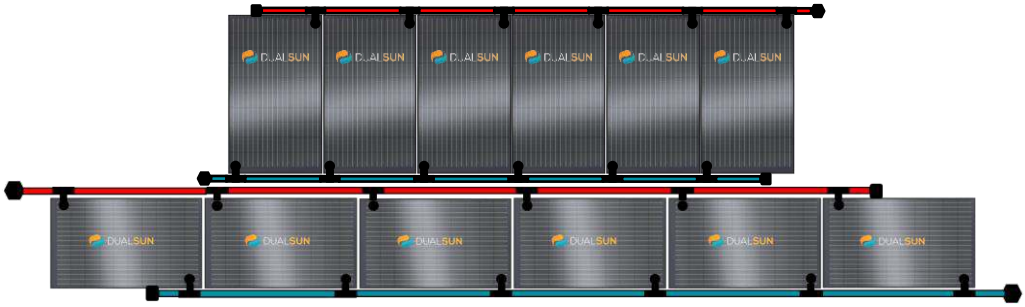


Figure 25 : Maximum number of modules in line

5.1.2 Hydraulic balancing of panel fields

In case of panel fields, the panel strings can be connected in parallel.

Ensure the proper hydraulic balancing of each string of panels

a. Homogeneous strings – Pressurised system

Hydraulic balancing using the Tichelmann loop principle can be adopted when the panel strings are identical, with the same number of panels laid in the same direction. The inlet and outlet hydraulic lines must be of the same length.

The installation of stop valves is necessary to purge string by string during filling for commissioning

To limit heat loss, it is preferable to extend the cold inlet lines.

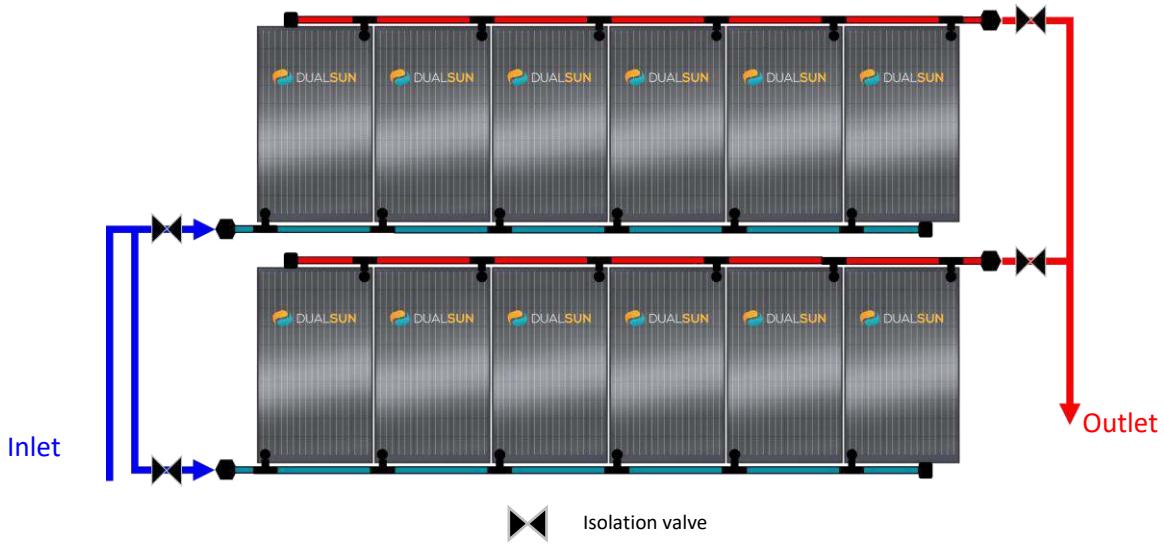


Figure 26 : Hydraulic balancing – Pressurised system
Panels in portrait – DN15 Hydraulic links in portrait – cf. 3.2.3.1

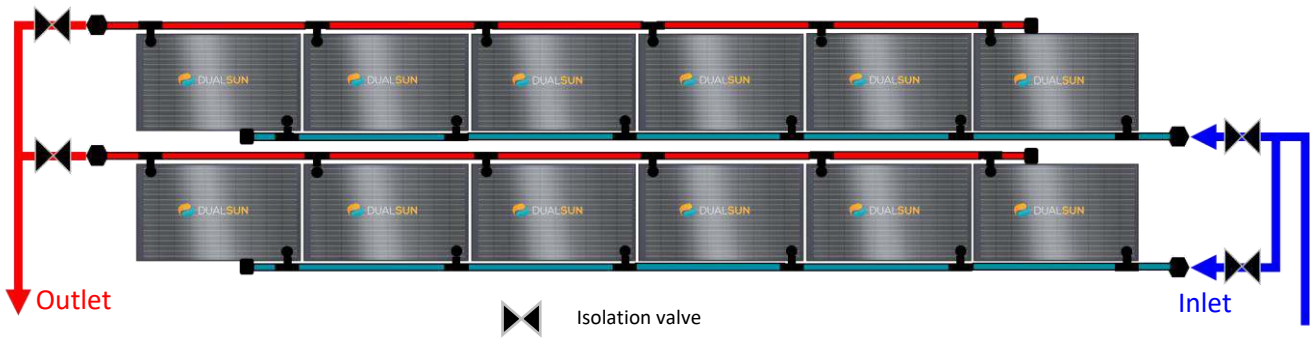


Figure 27 : Hydraulic balancing – Pressurised system
Panels in landscape – DN15 Hydraulic links in landscape – cf. 3.2.3.3

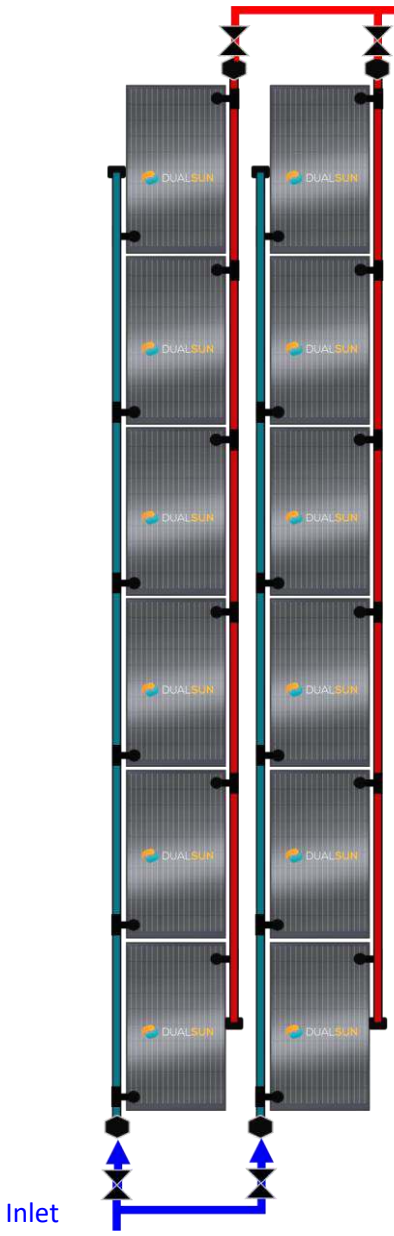


Figure 28 : Hydraulic balancing – Pressurised system
Panels in portrait – DN15 Hydraulic links in landscape – cf.3.2.3.2

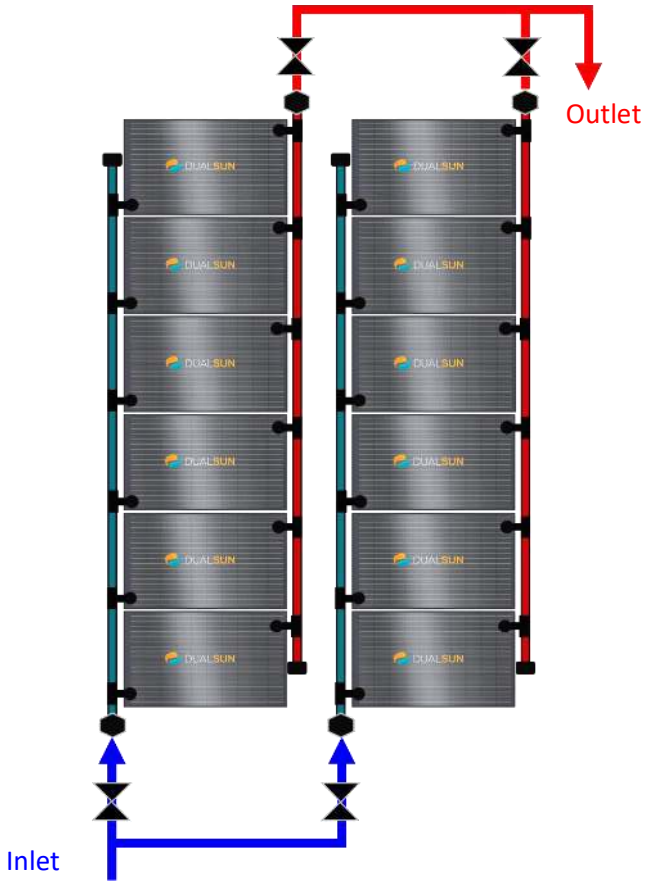


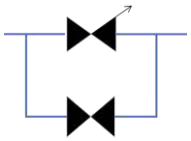
Figure 29 : Hydraulic balancing – Pressurised system
Panels in landscape – DN15 Hydraulic links in portrait – cf. 3.2.3.4


Isolation valve

b. Inhomogeneous strings – Pressurised system

Where Tichelmann hydraulic loop balancing is not feasible or the panel strings are not homogeneous, different number of panels per string and/or panels laid in different directions (portrait / landscape), the installation of balancing valves is recommended. The sizing of the balancing valves depends on the number of panels per string and the recommended nominal flow rate, see chapter **Erreur ! Source du renvoi introuvable.**.

Provide for the installation of bypass / isolation valves in parallel with automatic balancing valves for commissioning filling (higher flow rate). With manual balancing valves, fully open the balancing valves when filling for commissioning.



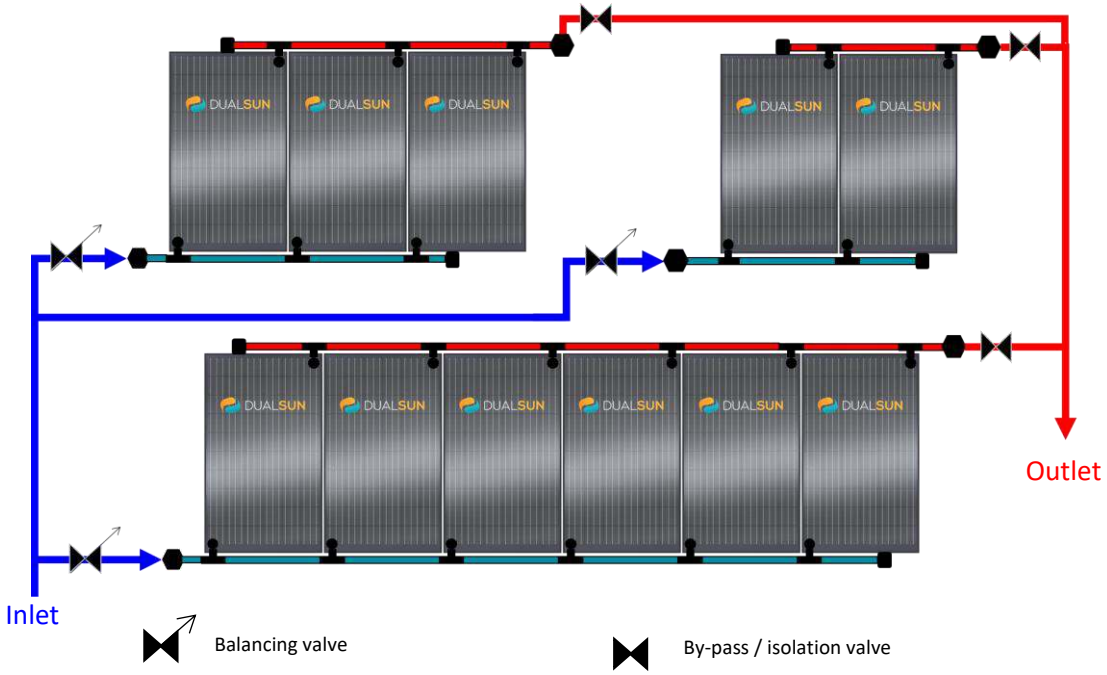


Figure 30 : Hydraulic balancing with balancing valves – Pressurised system
Panels in portrait – DN15 Hydraulic links in portrait – cf. 3.2.3.1

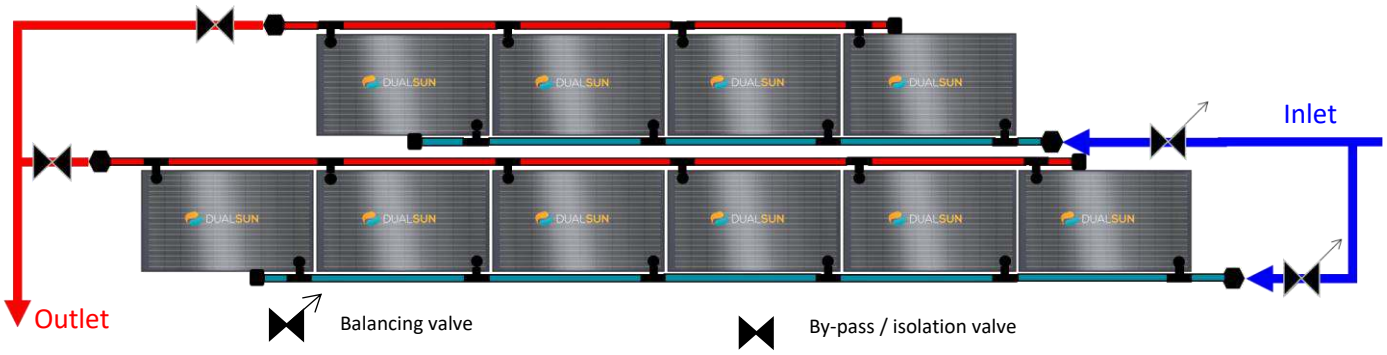


Figure 31 : Hydraulic balancing with balancing valves – Pressurised system
Panels in landscape – DN15 Hydraulic links in landscape – cf. 3.2.3.3

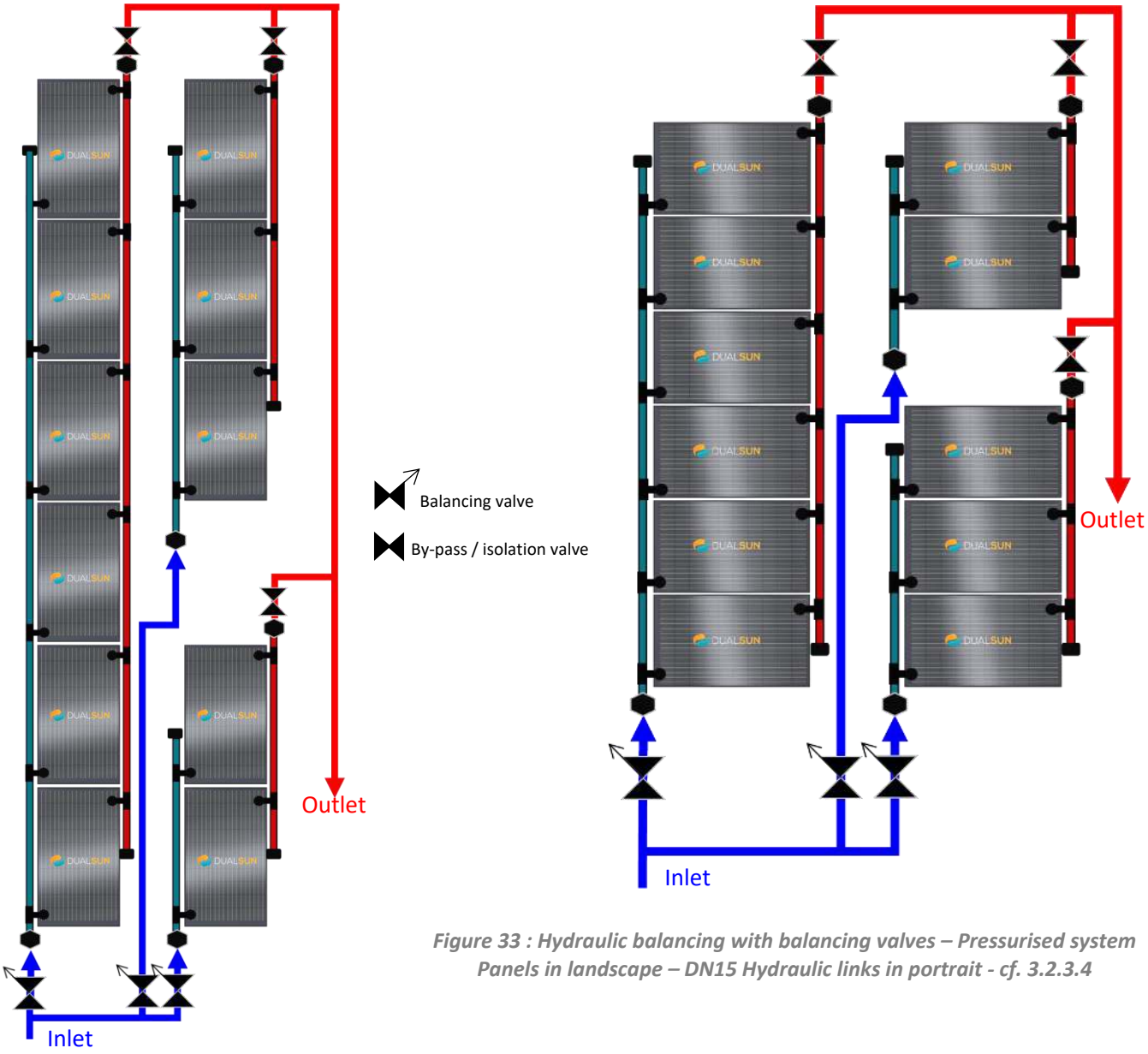


Figure 33 : Hydraulic balancing with balancing valves – Pressurised system
Panels in landscape – DN15 Hydraulic links in portrait - cf. 3.2.3.4

Figure 32 : Hydraulic balancing with balancing valves – Pressurised system
Panels in portrait – DN15 Hydraulic links in landscape – cf.3.2.3.2

c. Homogeneous strings – Direct pool heating system (wintering draining)

Hydraulic balancing using the Tichelmann loop principle can be adopted when the panel strings are identical with the same number of panels laid in the same direction. The inlet and outlet lines must be of the same length.

The installation of stop valves is recommended to purge string by string during filling, commissioning and possible maintenance operations.
Panels only in portrait to enable water draining.

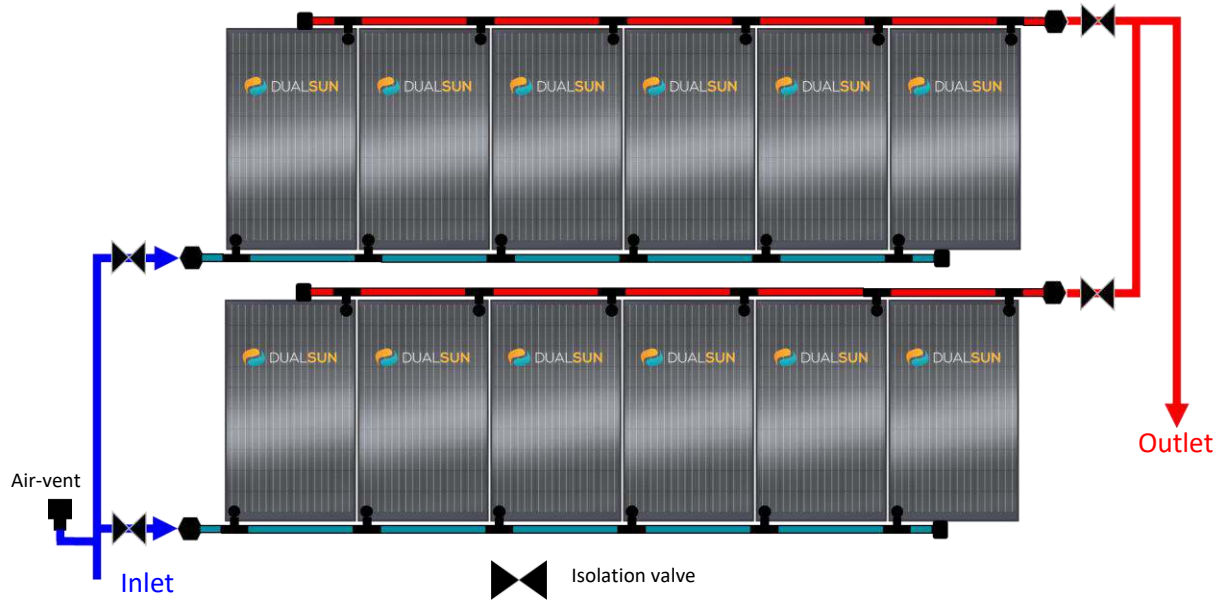


Figure 34 : Hydraulic balancing – Direct pool heating system
Panels in portrait – DN26 Hydraulic links in portrait – cf. 3.2.3.1

d. Inhomogeneous strings – Direct pool heating system (wintering draining)

Where Tichelmann hydraulic loop balancing is not feasible or the panel strings are not homogeneous, different number of panels per string and/or panels laid in different directions (portrait / landscape), the installation of balancing valves is recommended. The sizing of the balancing valves depends on the number of panels per string and the recommended nominal flow rate, see chapter **Erreur ! Source du renvoi introuvable.**. With PVC pressure pipes, it is necessary to install a stop valve and a float flowmeter vertically. The flow adjustment depends on the number of panels per string, see **Erreur ! Source du renvoi introuvable.**.

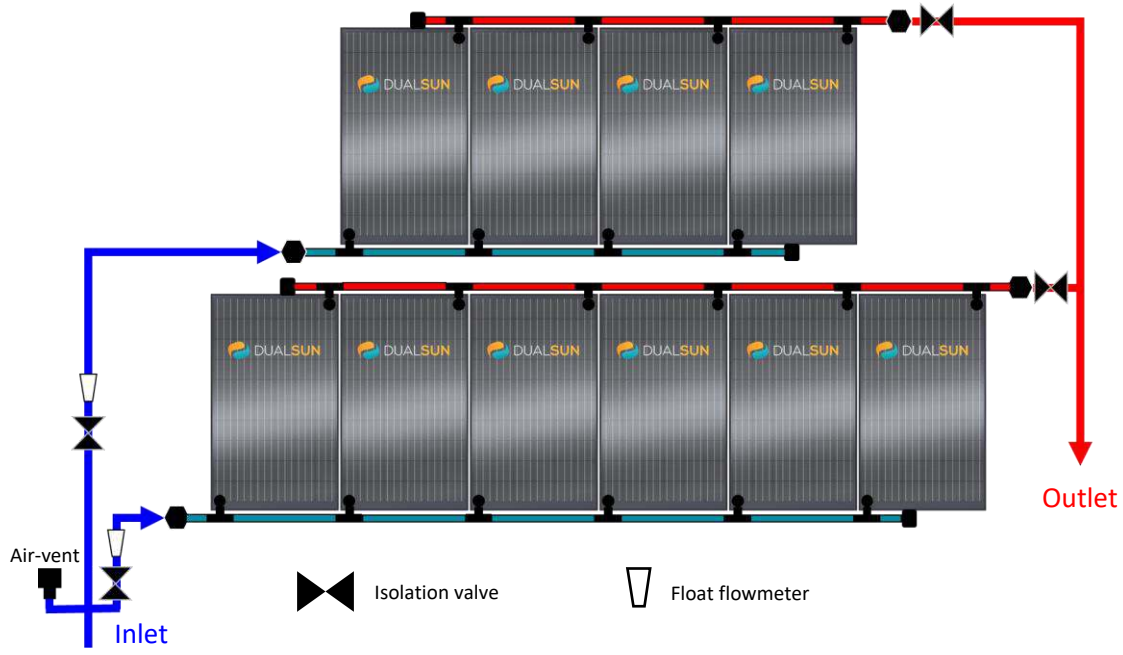


Figure 35 : Hydraulic balancing – Direct pool heating system
Panels in portrait – DN26 Hydraulic links in portrait – cf. 3.2.3.1

5.1.3 Connecting the panel field to the transfer circuit

The transfer circuit pipes carry the heat transfer fluid between the sensor field and the elements of the solar circuit in the technical room.

Once the inter-panel links are installed on the panels as shown above, the transfer lines are to be connected to the M3/4'' male connections for the DN15 links, or M1'' connections for the DN26 links, see chapter 5.1.1.b
The sealing of the fittings is ensured by a high-temperature fibre O-seal (in addition to the usual sealing products such as oakum, filetix, etc.).

5.1.3.1 Selecting the hydraulic transfer lines material

a. Pressurised system

Three types of transfer lines can be used to connect the solar station to the inlet and outlet connections described above:

1. Copper pipes,
2. Stainless steel tubes,
3. Multilayer PEX-Al-PEX tubes.

DualSun suggest the use of multilayer pipes for hydraulic transfer lines. Indeed, due to the low temperatures and pressures in the solar circuit (<80°C and 6 bar max.) and the resistance to glycol at over 80°C, the multilayer is ideal for hybrid systems. The table below summarises the main advantages and disadvantages of the different types of compatible pipes:

	Copper pipe	Stainless steel tube	Multilayer tube
Technical constraints	> 150°C at 10 bar	150°C at 10 bar max.	95°C at 10 bar max.
Cost	High	Moderate	Low
Required level of competence	High	Moderate	Moderate
Specific equipment required	Torch	Tooling for collars	Crimping pliers
Main advantages	Thermal performances, operation range	Flexibility, all-in-one kits	Cost, easy and fast to install
Main disadvantages	High price and complexity of installation	Rings trap air, reliability of collars	Crimping pliers and accessories

Table summarising the advantages and disadvantages of compatible pipes

Multi-layer piping for the solar circuit offers real time and cost savings compared to other variants. Nevertheless, there are a few considerations to be taken into account:

- To avoid heat loss from the circuit, choose pre-insulated multilayer piping.
- The insulation on the multilayer is not suitable for outdoor use, so it is necessary to provide insulation for outdoor application (UV and weather resistant) for the parts of the circuit exposed to the elements.
- Include the temperature probe cable when laying the pipes, see **Erreur ! Source du renvoi introuvable.**.

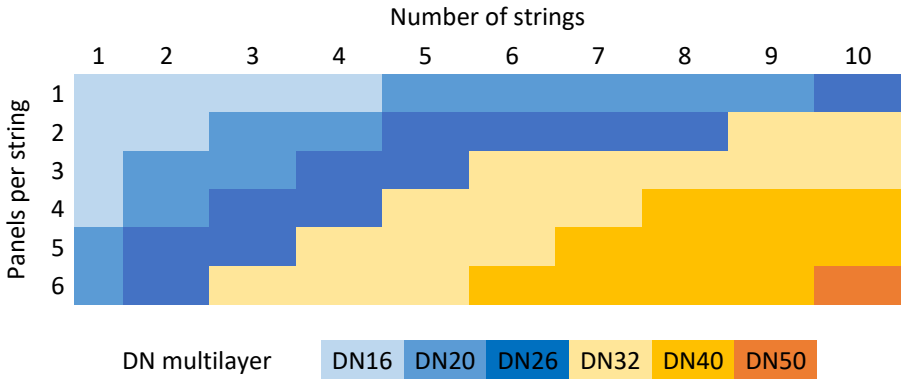
b. Direct pool heating system

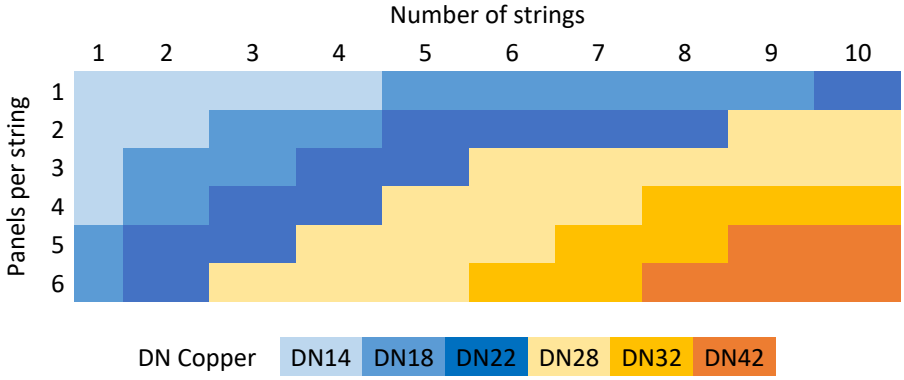
For direct pool heating systems, it is recommended to use PVC pressure pipes with anti-UV treatment. For aesthetic reasons, it is possible to paint the PVC pipes: in this case, use a good quality paint, anti-UV if possible.

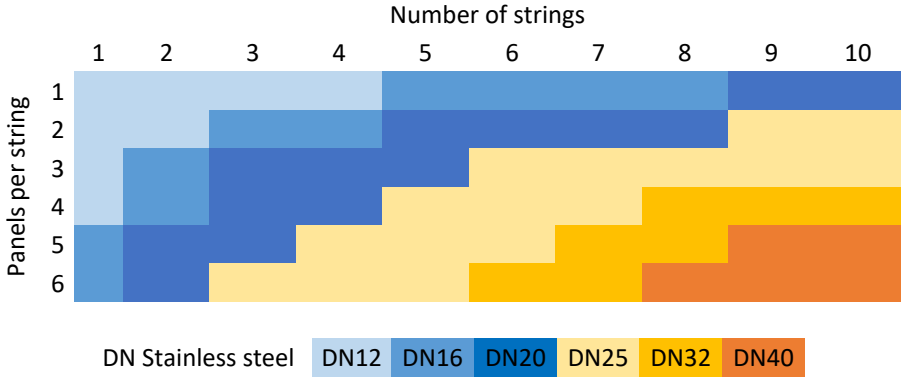
5.1.3.2 Selecting the hydraulic transfer lines diameter

The diameters shown in the following tables are indicative for standard installations. For more complex installations, the required diameter should be calculated according to the pressure losses of the solar field and the pipes.

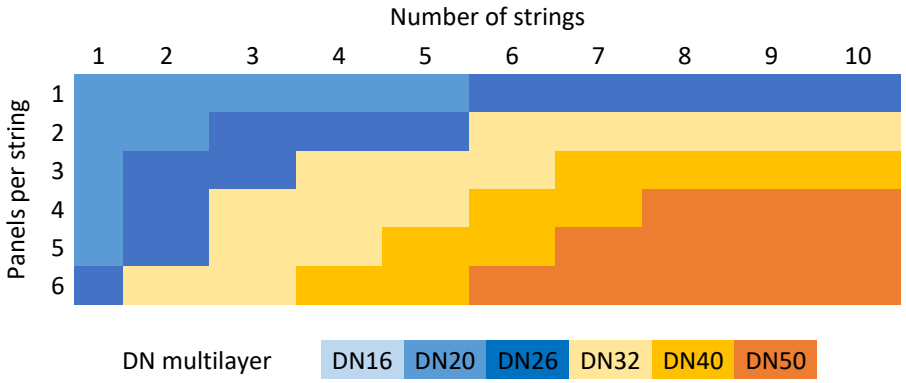
a. Pressurised system – DHW – Nominal flow rate = 32 L/h/panel

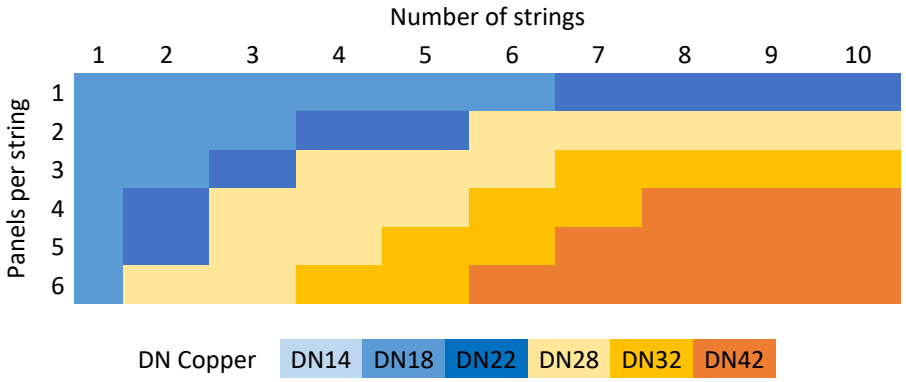


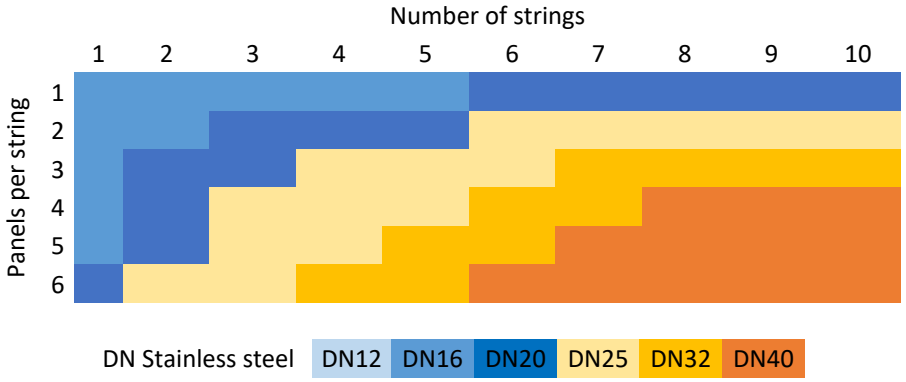




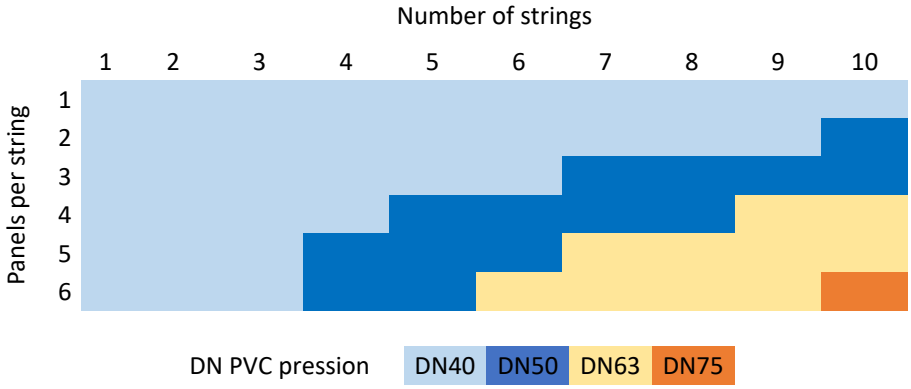
b. Pressurised system –Thermal discharge –Nominal flow rate = 100 L/h/panel







c. Direct pool heating system – Nominal flow rate = 200 L/h/panel



5.2 Panel temperature probe

It is important to include the installation of the panel temperature probe cable to the layout work of the transfer pipes. The panel temperature probe cable must be routed from the roof to the solar regulation box in the technical room.

To do this, use a cable with at least two conductors of diameter greater than 0.5 mm² (2G0, 5)

The DualSun temperature probe is a PT1000 4 mm probe, supplied into the DualSun essential kit.

It is placed at the outlet of the **last** Spring module of the thermal circuit.

The probe must then be connected to solar regulation box.

Refer to the instructions of the solar regulation used.

The probe is inserted into the recess on the last panel of the field. This allows a measurement as close as possible to the heat transfer fluid.

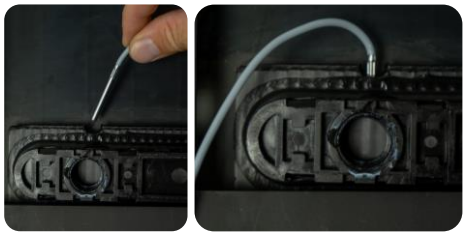


Figure 36 : Panel temperature probe

6 Cleaning the surface of the modules

The higher the level of contamination of the PV system surface, the less the cells are able to absorb the energy contained by the incident sunlight.

By tilting slightly, the panels relative to the horizontal, the rain and snow can clean the surface, and thus temporarily protect them from additional contamination. However, after a while, dust, leaves or bird droppings will salt the glass in front and thus reduce the output power.

In case of persistent soiling, the panels must be washed with cold water and a soft sponge.

Never use solvents or a pressure washer, and never scrape the surface of the panel. Cleaning operations must be carried out by qualified professionals.

7 Decommissioning the installation

Before any operation on the appliance/installation, the power supply and the injection must be switched off (e.g. via the appropriate fuse or a general switch) and to prevent any re-operation.

For any intervention involving disassembly of the regulations, make sure that the internal components are not likely to cause a static discharge.

7.1 Disassembling a module

If it proves necessary to disassemble a module, the following procedure must be followed:

- Drain the installation *(see DualSun instructions – Installation and commissioning of a pressurised system and Swimming pool system installation)*.
- Turn off the electrical circuit upstream and downstream of the inverter.
- Risk of electrocution. Refer to the inverter/micro-inverter manufacturer's manual for this. It may be necessary to use a particular disconnection tool. Disconnect the module from its support.
- Unplug the electrical connectors.
- Unplug the grounding module.
- Disconnect the quick fittings of the inter-panel links*, see chapter 7.2*.
- If this is the last module that is removed from the installation, the temperature probe must also be dismantled, see chapter 5.2.

7.2 Hydraulic disconnection

Once the installation has been drained, the DualQuickfit quick fittings are disassembled using a special clamp, supplied in the essential Kit.

Figure 37 : Disassembly of DuaQuickfit hydraulic fittings

7.3 Waste treatment

For the waste treatment of a used DualSun system, the applicable regional and national regulations must be met.

8 Responsibilities

DualSun	*installer*	*user*
DualSun products are produced in compliance with the requirements of the various applicable European directives.	Installation and first commissioning must be carried out in accordance with the rules of the art in conformity with: • the instructions in the installation manual, • the legislation and standards in force. The installer must inform the user of the need for regular maintenance.	The user must employ qualified professionals: • to carry out the installation and to carry out the first commissioning, • to carry out the regular maintenance of the installation. The user must keep the installation-related documents close to the system components.

8.1 Warranty conditions

See the document "DualSun – Contractual warranty" for DualSun products.

For the other components of the installation, see the warranty conditions of the different manufacturers.

8.2 Disclaimer

DualSun's liability cannot be incurred in the following cases:

- Failure to comply with the instructions contained in the notice concerning installation, use, operation and maintenance of the installation.
- Failure to comply with the safety rules set out in the recommendation published by the national risk prevention body