

SOLINK

Your Energy Supply System for Heat Pumps



Product Description

- ▶ Combined solar-air heat exchanger with a PV-module
- ▶ Entirely independent heat supply for brine heat pumps
- ▶ Direct source of electricity for heat pumps
- ▶ Can produce all required electricity for heat and home throughout the year

Use • Application

Alongside geothermal probes/ground heat exchangers and ambient air evaporators, SOLINK provides a third, innovative type of heat source for heat pumps. SOLINK can be used not only in single-family and multiple-family dwellings but also in office and commercial buildings. SOLINK is particularly well suited for:

- ▶ Fulfilling percentage minimums or quotas of renewable energy requirements
- ▶ Implementing a highly efficient heating system without ground works

Furthermore SOLINK can be used to renew old heat pump systems:

- ▶ SOLINK can serve as regenerative support for earth probes rendered too small in conjunction with newly installed heat pumps.

Advantages • Benefits

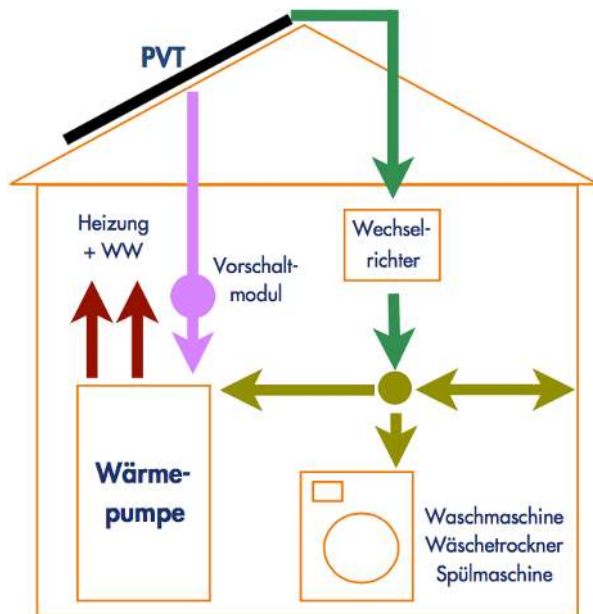
- ▶ Highly efficient, environmentally friendly system
- ▶ Heat and electricity solution with *one* roof system
- ▶ Thanks to its space-saving design, SOLINK does not require much roof space and is a great alternative to energy roofs (PV + heat)
- ▶ Silent in operation
- ▶ Better economic efficiency than air heat pumps
- ▶ Equal or even lower investment costs than ground source heat pumps

Content

1	CONNECTION TO A HEAT PUMP	2
1.1	Suitable Heat Pumps	2
1.2	Brine Temperature Limit	2
1.3	Defrost and Snow Melting	2
1.4	SOLINK-controller	3
1.5	Cooling of Buildings	3
2	DIMENSIONS	3
2.1	Collector Area	3
2.2	Collector Fields	3
2.3	Orientation	4
2.4	Simulation	4
2.5	Hydraulic Design	4
3	MOUNTING ACCESSORIES	4
3.1	Connection Accessories	4
3.2	Pipe System	4
3.3	Collector Mounting System	5
4	COLLECTOR AND MOUNT DIMENSIONS	5
4.1	Collector Dimensions	5
4.2	Field and Connector Dimensions	6
5	TECHINICAL DATA	7
6	CERTIFICATION, FUNDING	7
6.1	TNO Test	7
6.2	BAFA-Funding (Germany)	7
6.3	EPC-Certificate (Netherlands)	7
6.4	Patent	7

1 Connection to a Heat Pump

SOLINK-collectors can be connected to brine heat pumps in place of ground heat exchangers.



1.1 Suitable Heat Pumps

SOLINK-collectors are intended for use with select standard brine heat pumps.

To attain the best efficiency, i.e. to reduce the use of additional electric heating, the minimum permitted brine inlet temperature should be as low as possible and should correspond with the lowest air temperature in the region where SOLINK will be used:

At least: $< -10^{\circ}\text{C}$, preferably: $\leq -15^{\circ}\text{C}$.

1.2 Brine Temperature Limit

Collector output temperatures must be adjusted so as not to exceed the maximum inlet temperature of the heat pump. This can be arranged either by using a mixing valve or by using a Consolar ice store, which will also increase system efficiency.

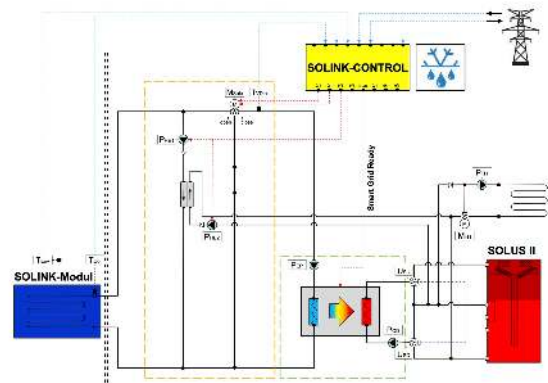
Consolar Support will provide assistance in choosing an appropriate mixing valve for power and flow, or determining the number of ice stores to be connected in parallel.

1.3 Defrost and Snow Melting

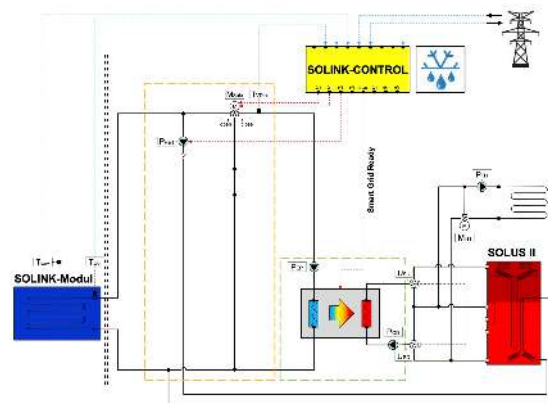
Thanks to its design, frosting on the front side of SOLINK-collectors is reduced even in low temperatures. This in turn reduces PV yield losses. Frosting on the back side of the heat exchanger is generally uncritical. Nevertheless, a hydraulic and control system is recommended to attain the best efficiency. With this system, the unit can be defrosted if necessary. The same function can also be used to trigger

snow melting, if there is any snow on the front side of the module. This further increases electricity yield in the winter, especially compared to standard PV-modules.

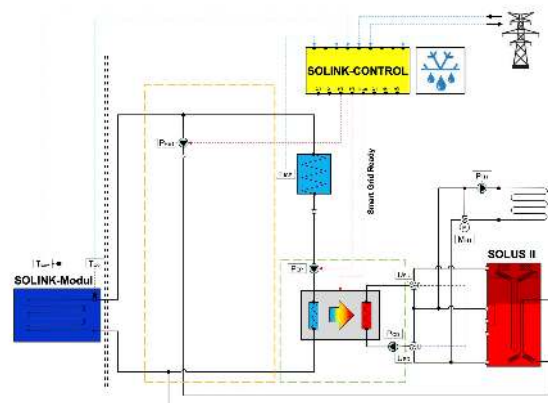
Possible hydraulics for this function are illustrated below:



Brine temperature limit via mixer, defrosting via external heat exchanger store - brine, manual switch over for activating the snow melting function



As above, but defrosting via internal heat exchanger store



Brine temperature limit and bridging periods of low ambient temperatures via ice stores, defrosting via heat exchanger store.

1.4 SOLINK-controller

The control logic for defrosting and snow melting will be provided with the SOLINK-controller (available in 2018). The heat pump can still be operated by its standard controller in conjunction with the SOLINK-controller.

Additional functions of the SOLINK-controller are:

- Control of a mixing valve to limit the collector flow temperature
- Ice store loading function (alternative)
- Energy management to maximize the share of self-produced electricity used for heating

1.5 Cooling of Buildings

SOLINK heat pump systems can be used for active cooling of buildings. Cooling is accomplished primarily via air, i.e. by means of a cooling heat exchanger integrated in the ventilation system, or, for buildings without active ventilation, using a convention cooler. Heat produced while cooling is fed into the heat storage tank (combustore, domestic hot water, heating buffer) and then released through a heat exchanger (used for defrosting in the winter) to the SOLINK-collectors and surroundings. Because heat losses are stored, additional use of the heat pump for DHW is not necessary. When outdoor temperatures are low, stored heat losses can also be emitted during the night.

System configurations of the Consolar ice stores also allow intermediate storage and a buffer of the cooling function.

The necessary control technology for the cooling of buildings is currently being finalized in coordination with heat pump manufacturers.

2 Dimensions

2.1 Collector Area

In order for the system to reach an annual SPF of 4.3, approx. 14 modules are required for 10,000 kWh of annual heating needs (approx. 7,500 kWh for heat and 2,500 kWh for DHW). These dimensions pertain to Würzburg and account for the PV-electricity used directly by the heat pump.

As a general rule:

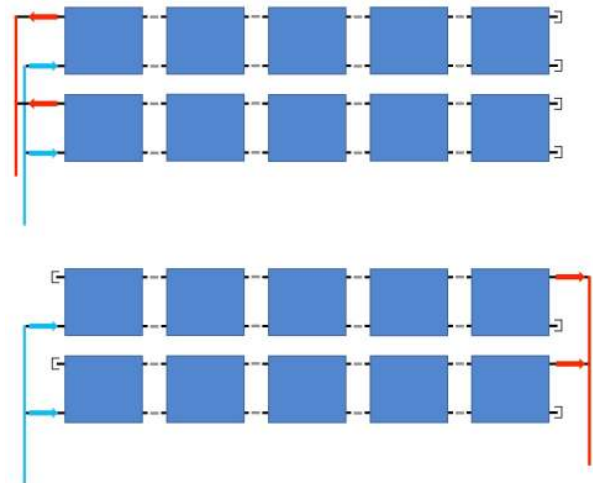
Module area [m²] = 4 x heat pump's heat output [kW]

2.2 Collector Fields

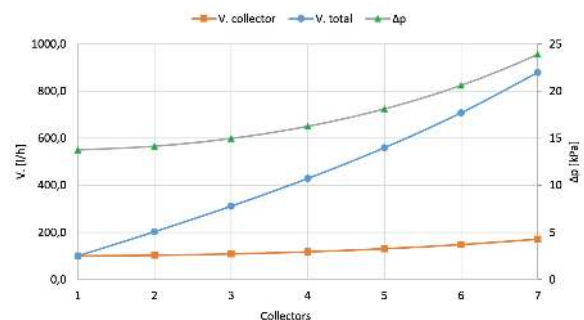
Because the SOLINK-collectors utilize integrated manifolds with flexible connectors, they can be directly connected to one another.

Maximum number of linked modules in one row:

- Connection on a single side: 5
- Connection as per Tichelmann: 7 (alternating connection)



The following graphic illustrates the flow distribution in the collectors and the pressure loss in the case of a *single side* connection. Do not connect 6 or more collectors with single side connections due to unbalanced flow.



Pressure loss in the collector fields for various field sizes is shown in the following table. These values can be approximately assumed for both configurations (equilateral and Tichelmann).

Number of collectors	Field flow	Loss of pressure
1	100 l/h	14 kPa
2	200 l/h	15 kPa
3	300 l/h	15 kPa
4	400 l/h	16 kPa
5	500 l/h	16 kPa
6	600 l/h	17 kPa
7	700 l/h	18 kPa

Fields with varying orientations, for example East-West, are connected parallel and always flow at the same time (no switching between fields).

2.3 Orientation

Ideally, SOLINK-collectors should be installed with a southern orientation and an angle between 30° - 60°. In snowy regions, lower angles should not be used, so as to ensure that the snow melting function works. Deviations from a southern orientation will reduce the PV-electricity production and the solar power used directly by the heat pump. This also reduces the annual SPF, even though the electrical energy consumed by the heat pump is largely independent of the collectors' orientation.

Example: single-family dwelling in Würzburg with 14 collectors:

Orientation	Elec. energy production PV	Elec. energy consumption Heating	Elec. energy used directly	Annual SPF
South, 40°	5,782 kWh	3,088 kWh	1,864 kWh	4.23
East, 40°	4,363 kWh	3,055 kWh	1,506 kWh	3.77
West, 40°	4,497 kWh	3,107 kWh	1,620 kWh	3.83
East-West, 15°	4,589 kWh	3,096 kWh	1,577 kWh	3.76
East-West, 30°	4,139 kWh	3,081 kWh	1,504 kWh	3.71

2.4 Simulation

The SOLINK-collector and SOLINK-system are modeled in TRNSYS. Illustration in Polysun is planned, however as of now, no validated simulations are possible.

2.5 Hydraulic Design

Recommended procedure: Design for the operating point with the lowest temperature, for monovalent systems generally - 15 °C.

1. Calculate the brine flow for the heat pump performance at - 15 °C with a cooling in the evaporator of $\Delta T = 4$ K.
2. Calculate the pressure loss for this flow and the temperature for pipes, bends, fixtures, collector field, evaporator and, if applicable, ice stores. The pressure loss for various collector fields as indicated in 2.2 can be converted for different flows:

$$p_1 = p_2 (V_1/V_2)^2$$
3. Enter the entire pressure loss in the circulation pump's characteristics.
4. If necessary, adjust the piping or pump selection

3 Mounting Accessories

3.1 Connection Accessories

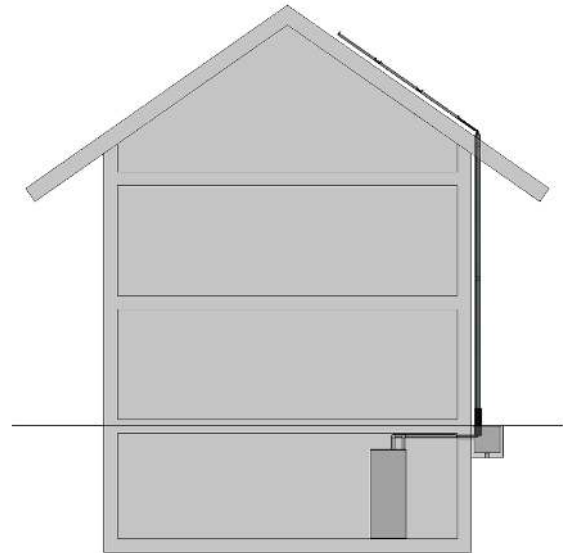
The following collector accessories are supplied:

- Connectors (2 pieces btw. 2 collectors)
- Reinforced hoses of varying lengths with connectors for connecting to the feed and return pipes

- End caps with and without air vents

3.2 Pipe System

The pipe connecting the SOLINK-collectors to the heat pump can be installed as an uninsulated plastic pipe on the outside of the house. The pipeline can be placed through a rainwater downpipe or a chimney pipe on the facade of the building and is hardly noticeable.



Plastic pipes and fittings must be UV stable. Possible options are PE pipes or PP-R pipes integrated with aluminium or a special fibre mix. PE pipes exhibit high thermal expansion (13.5 cm x 10 m and $\Delta T = 75$ K). This must be taken into consideration when routing the pipes: it requires the use of appropriate expansion joints. PE-100 pipes are suitable for SOLINK, which has a maximum operating pressure of 6 bar.

PP-R multi-layer pipes have a thermal expansion five times smaller than that of PE pipes. There are many connection solutions available with integrated internal and external metal threads for these pipes. The pipes are available with a black UV protective skin. The fittings however are not UV stable and must, for instance, be painted with protective paint.

The following table lists reference values for the necessary pipe diameter, depending on the heat pump performance, for ethylene glycol water 40/60. The correct dimensions however depend on the entire system (pipe length, number of bends, multiple arrays, with or without ice store).

Pipe diameter	Heat pump performance (0/35)
32 x 3.0 / 32 x 2.9	Up to 8 kW
40 x 3,7	Up to 15 kW
50 x 4,6	Up to 28 kW
63 x 5,8	Up to 50 kW

If pipes are run inside, it is necessary to use insulation (due to condensation). Sufficient dimensions are: At least 25 mm (Lambda value $\leq 0,034$ W/mK at 0 °C).

To prevent condensation, a complete, unbroken and airtight insulation of the solar pipes is necessary. The air

surrounding the insulated pipelines must be able to circulate freely. Do not mount pipe clips directly to the pipes. Use insulated pipe clips.

The use of permeable plastic pipes must be permitted by the heat pump (generally the case for ground source heat pumps).

Consolar can provide assistance with the assembly of the pipe system.

3.3 Collector Mounting System

SOLINK-collectors can be mounted on many common PV mounting frames. The supplied clamps are used to screw

the modules onto horizontal mounting frames. See the illustration on the following page. The clamps work with M8 or M10 bolts.

Some mounting profiles appropriate for parallel roof installations are:

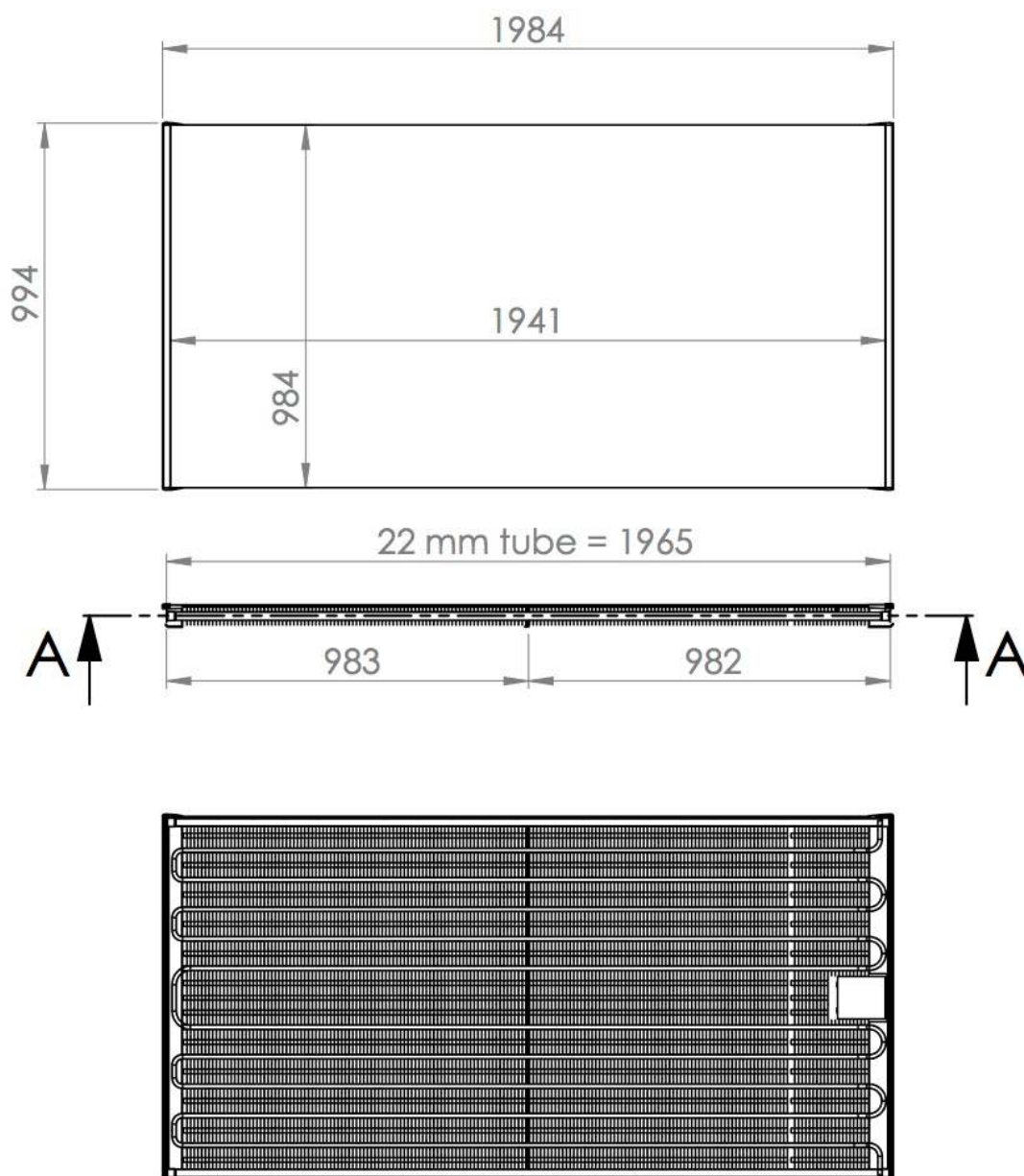
Schletter Mounting Profile SoloLight, Solo05 and Solo- Plus
Some mounting frames appropriate for achieving elevation on flat roofs are:

Schletter Flat Roof Supports Light U Series 07 or Flex Console combined with mounting systems (see above).
Static layout will be completed by the supplier of the mounting system.

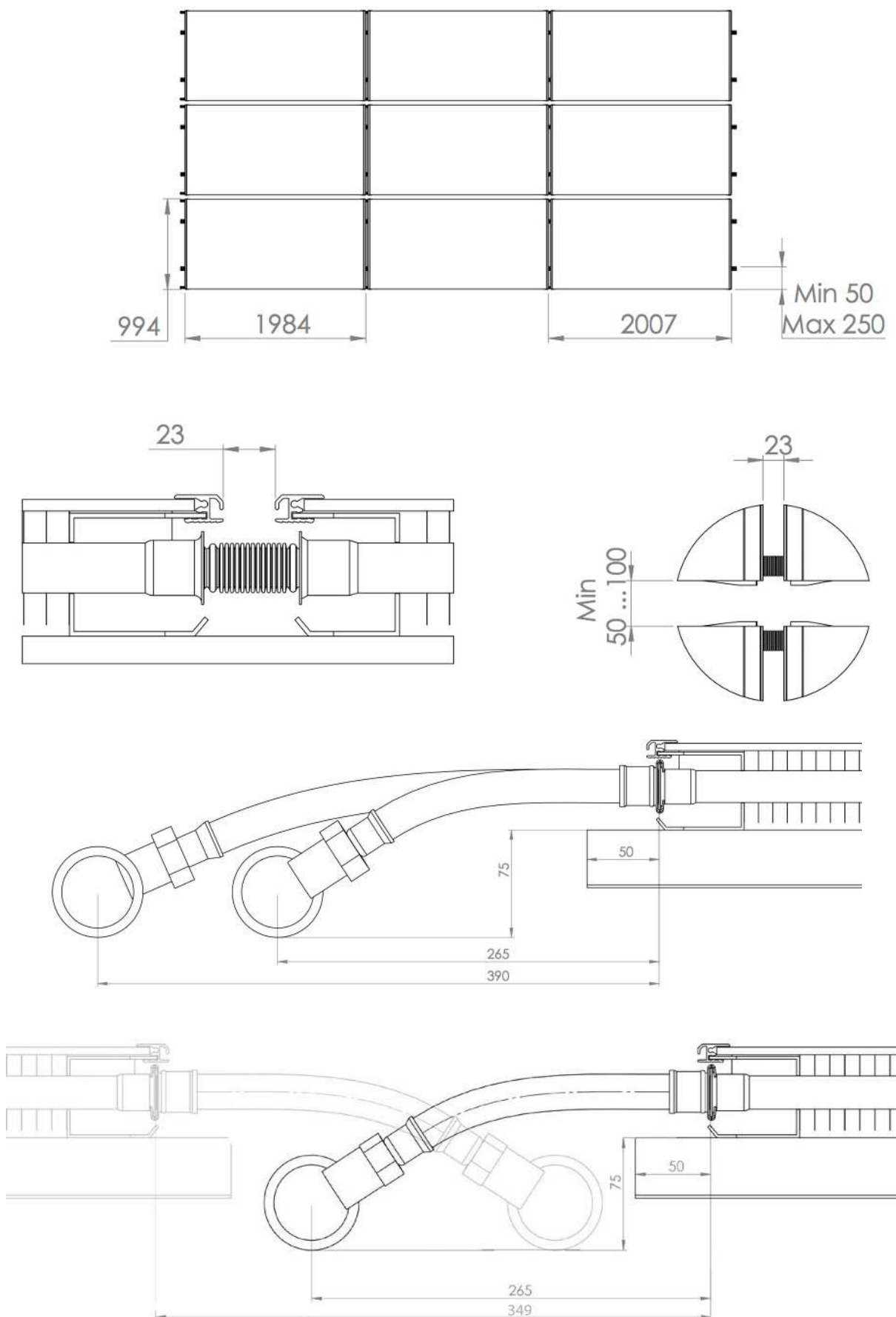
Consolar offers a mounting system for parallel roof installations.

4 Collector and Mount Dimensions

4.1 Collector Dimensions



4.2 Field and Connector Dimensions



► NOTE:

Minimum bend radius of the reinforced hose: 80 mm. Minimum spacing between roof and collector: 80 mm

5 Technical Data

Dimensions	Unit	
Gross	mm	1984 x 994 x 58
Aperture	mm	1940 x 984
Weight	kg	32
Aperture area	m ²	1.91
Gross area	m ²	1.97
Material		
PV modules	-	Glass
Heat exchanger pipes	-	Copper
Heat exchanger fins	-	Aluminium
Coating	-	Cataphoresis

PV modules	Unit	
Manufacturer	-	Bisol (EU)
Model	-	Monocrystalline silicon
Rated output	W _p	340
Short-circuit current	A	9.45
Open-circuit voltage	V	48.0
Rated current	A	9.05
Rated voltage	V	37.6
Cell efficiency	%	19.4
Module efficiency elec.	%	17.5
Power output tolerance	W	0/+5 W
Max. reverse current	A	18
Max. System voltage	V	1000 (application class A)
Current temp. coeff.	%/K	0.046
Voltage temp. coeff.	%/K	- 0.30
Power temp. coeff.	%/K	- 0.39
NOCT	°C	44
Temperature range	°C	- 40 – + 95

All electrical data given for standard PV conditions. Improvements through module cooling by means of air heat exchanger and heat pump operation not considered.

Heat exchanger	Unit	
Meander pipe	mm	12 x 0,3
Manifold	mm	22 x 1,0
Content	l	3.4
Heat exchanger pipes	-	Copper
Heat exchanger fins	-	Aluminium
Thick fins	mm	0.18
Heat exchanger area	m ²	approx. 20
Connections	-	Double o-ring connection
Length adjustment	-	integrated header pipe
Max. Pressure	bar	6
Pressure drop water ethylene glycol 40 %, -15 °C	mbar	140
Spec. Flow	l/(m ² h)	approx. 50, depending on heat pump performance
Heat transfer coeff. air Air heat carrier b1 ¹⁾	W/(m ² K)	60, parallel roof installations, with regard to A = 1,94 m ²
Visual efficiency ¹⁾	%	25.3
Effective heat capacity ¹⁾	kJ/(m ² K)	177
Standstill temperature	°C	approx. 70 °C

- 1) TNO report 2017 R10903; values will be verified once again using a benchmark test.

6 Certification, Funding

6.1 TNO Test

The TNO Institute in Delft has tested the SOLINK-controller using the quasi-dynamic test method as described in EN 12975-2. In Amsterdam, a collector field with a size of 10 m² was tested over the course of several months in use with a heat pump.

6.2 BAFA-Funding (Germany)

SOLINK heat pump systems are listed at BAFA as eligible for innovation funding. For the innovation funding, a simulation results sheet that shows an annual SPF of at least 4.3 for the object in question must be submitted. The necessary simulation can be carried out by Consolar. Upon request, heat pumps that are eligible for innovation funding will be disclosed by Consolar.

6.3 EPC-Certificate (Netherlands)

In the Netherlands, there is an equivalent certificate issued by an independent institute for a SOLINK heat pump systems permit. Available for download at the Bureau Centrale Registratie Gelijkwaardigheidsverklaringen: <http://www.bcrq.nl/bcrg/uploads/bestanden/20170994GGRVWB.pdf>

6.4 Patent

The SOLINK-collector has been registered by Consolar and its cooperation partner Triple Solar as a worldwide patent under the nr. PCT/EP2017/069742.

► NOTE:

All information provided in this technical product information brochure is tentative and non-binding.

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