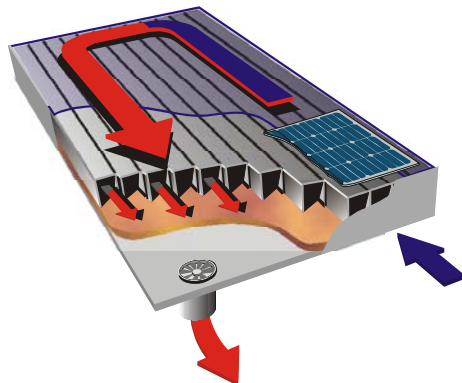
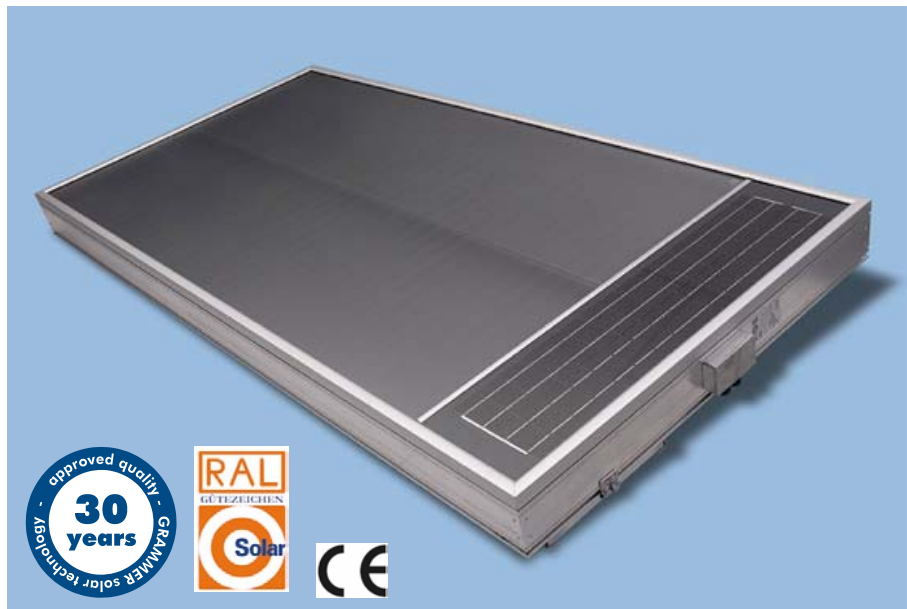




# TWINSOLAR - SLK

## TECHNICAL MANUAL

Installation information  
Technical information  
Operating and maintenance instructions



[www.twinsolar.com](http://www.twinsolar.com)

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GRAMMER Solar GmbH  
Oskar-von-Miller-Str. 8  
D-92224 Amberg  
Tel.: +49 – (0)9621/ 308 57-0  
Fax: +49 – (0)9621/ 308 57-10  
E-mail: [info@grammer-solar.de](mailto:info@grammer-solar.de)  
Internet: [www.grammer-solar.de](http://www.grammer-solar.de)

# 1 GRAMMER TWINSOLAR

## Heating and ventilation by means of solar energy

**GRAMMER TWINSOLAR** is a mains-independent air collector system for heating and ventilating by means of solar energy.

Because air is the heat transfer medium, TWINSOLAR is safe in operation and almost maintenance-free.

The photo-voltaic panel integrated in the collector ensures mains-independent operation of the system.

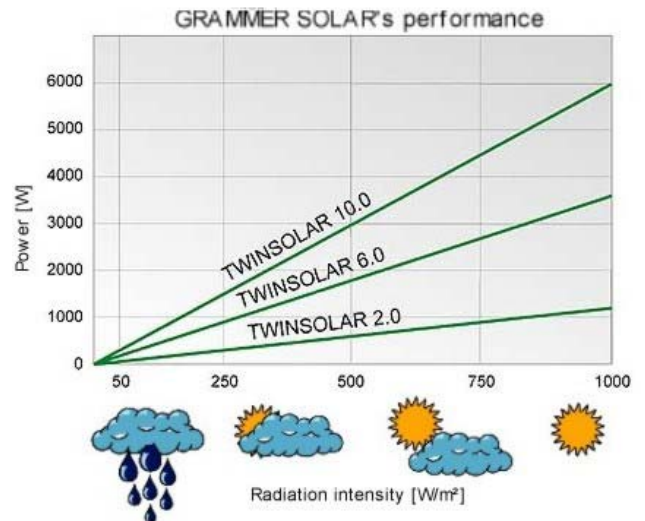
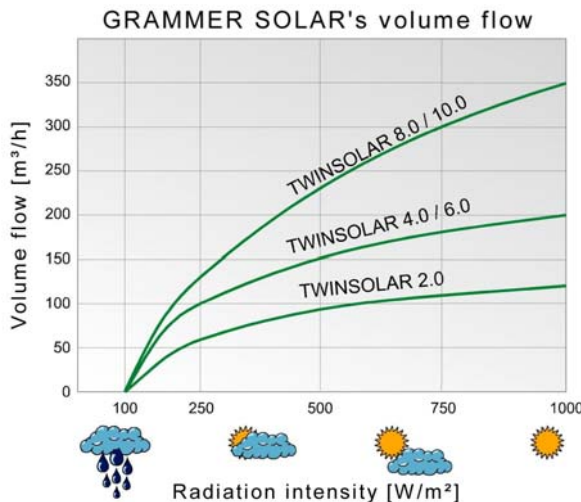
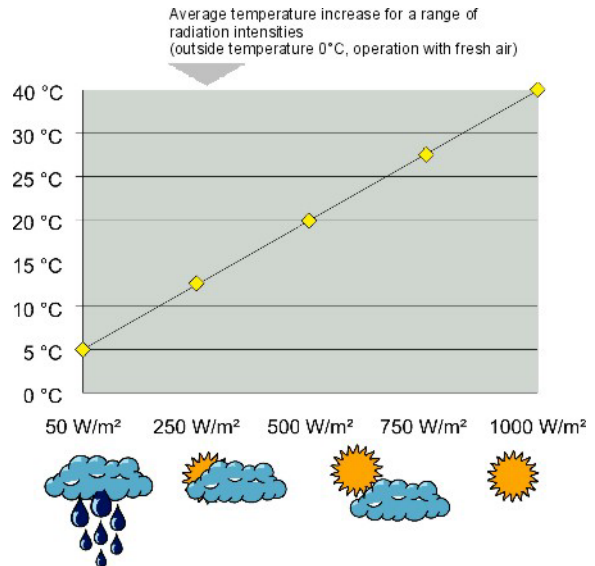
With TWINSOLAR you will receive tried-and-tested collector technology based on 30 years of experience in the production of air collectors.

## 1.1 What is the performance of a Grammer TWINSOLAR panel

Even when the radiation is low – i.e. when the sky is cloudy – GRAMMER TWINSOLAR starts working and moves fresh, warm air into the building.

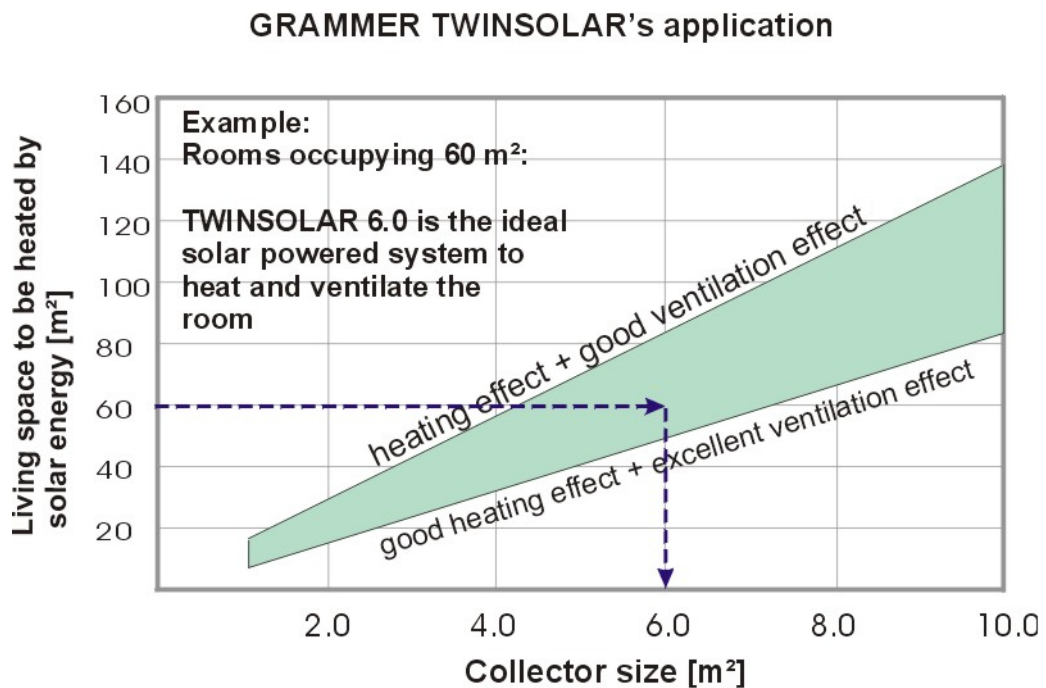
During maximum radiation the temperature increase can be up to 40 degrees with a power output of 700 W/m<sup>2</sup>. The maximum radiation intensity from the sun is – regardless of the time of year – 1000 Watt per m<sup>2</sup> collector surface.

This peak power is observed particularly during cold and clear winter days . 70 % of this received solar energy is transformed into thermal energy by TWINSOLAR and delivered to the building.



## Dimensioning – optimum collector size

The required size of TWINSOLAR system depends principally on the room area to be heated. For the dimensioning of the collector size, the diagram below will provide an indication.



Collector dimensioning – guidance value for a building with medium insulation standard  
**10 m<sup>2</sup> living area <-> 1 m<sup>2</sup> air collector**

### Notes:

- In the case of buildings with a good insulation standard or for installations in southern Europe 1 m<sup>2</sup> collector area can heat and ventilate a living area of up to 15 m<sup>2</sup>.
- The guidance values refer to an average room height of 2.5 m.
- For permanently used buildings (e.g. dwelling houses) the simulation program Luftkuss can carry out a dimensioning computation providing information about the energy saving achievable. A Luftkuss demo-version can be found under [www.grammer-solar.de](http://www.grammer-solar.de) in the download area.



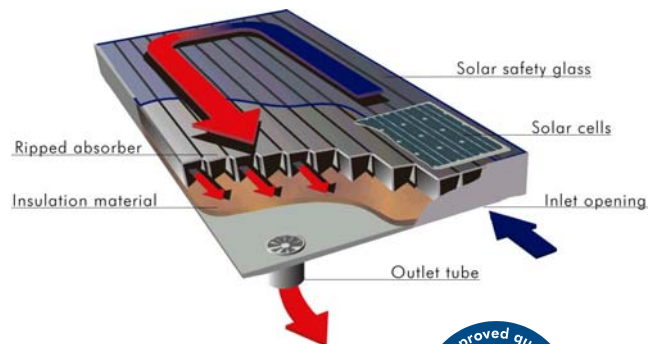
## 1.2 Grammer TWINSOLAR – pure solar energy ...

### Information / technical data

You will receive your Grammer TWINSOLAR system completely ready for use, and it is easily installed.

The PV modules integrated at the air inlet of one of the solar air collectors provide the electricity for the fan, the absorbers provided comfortable heat and the air channels convey the warmed fresh air to where it is needed.

An automatic control ensures that all components work harmoniously together even when you are away.



### Scope of delivery of the TWINSOLAR collector packages:

- Grammer high performance air collectors type SLK
- Collector-integrated solar module with connection socket at the collector
- Fan including the electronic maximum power unit
- TWINSOLAR Control (room thermostat for TWIN 2.0) solar control Collector-integrated air filter with change frame

### TWINSOLAR – certified quality !

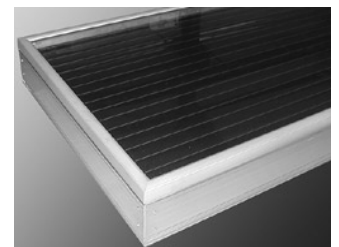
As part of the EU research project **IEA- Task 19** the Grammer air collector was measured in 1998 together with 6 further air collectors. In this test the Grammer air collector gave the best results.

Based on this, in collaboration with the **Fraunhofer Institut für solare Energiesysteme - ISE** (Fraunhofer Institute for solar energy systems) we have developed the solar air collector SLK for small installations.

**More than 25 years of experience** in the production of air-base solar collectors

### Characteristics of TWINSOLAR SLK

- stable and long lived aluminium frame housing (sea water resistant!)
- 4 mm hail-proof single pane safety glass
- long-life aluminium ribbed absorber
- high quality mono-crystalline or poly-crystalline solar module
- integrated air filters prevent contamination of the collector
- nominal power approx. 700 Watt / m<sup>2</sup> - theoretical efficiency > 80%
- 10 year warranty for the collector housing – minimum service life 25 years
- **GRAMMER air collectors are grant supported!** (application forms on the Internet[UC1])





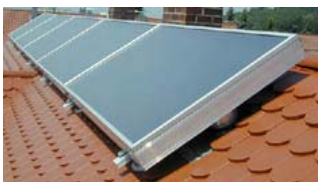
## Technical data for TWINSOLAR SLK

	TWINSOLAR 2.0	TWINSOLAR 4.0	TWINSOLAR 6.0	TWINSOLAR 8.0	TWINSOLAR 10.0	TWINSOLAR 4.5	TWINSOLAR 8.5	TWINSOLAR 12.5
Gross collector area [m <sup>2</sup> ]	2.0	4.0	6.0	8.0	10.0	4.55	8.55	12.55
Collector field dimensions LxW [m]	2.0 x 1.0	4.0 x 1	6.0 x 1	8.0 x 1	10.0 x 1	2.25 x 2.1	4.25 x 2.1	6.25 x 2.1
Thermal power peak [W]	1.200	2.400	3.600	4.800	6.000	2.700	5.100	7.500
Suitable for heated dwelling house area [m <sup>2</sup> ]	15-30	40-50	60-80	80-100	100-120	40-60	80-100	120-150
Electr. power PV module [W]	26	54	54	108	108	54	108	108
Nominal rating fan [W]	18	50	50	100	100	50	100	100
Collector housing	aluminium	aluminium	aluminium	aluminium	aluminium	aluminium	aluminium	aluminium
Collector weight [kg]	45	90	135	180	225	110	200	290
Fan type - arrangement Papst – ebm high performance fans	6224N axial integrated in collector	G1G 120 radial external	G1G 120 radial external	G1G 140 radial external	G1G 140 radial external	G1G 120 radial external	G1G 140 radial external	G1G 140 radial external
Maximum air volume delivered, free-blowing [m <sup>3</sup> /h]	120	200	200	350	350	200	350	350
Max. external pressure [Pa]	30	80	80	130	130	80	130	130
Diameter of air outlet [mm]	125	160	160	160	160	160	160	160
Differential temperature control	Thermostat	✓	✓	✓	✓	✓	✓	✓
Solar controller TWINSOLAR Control with room sensor (type Pt 1000)	-	✓	✓	✓	✓	✓	✓	✓

A data sheet with precise information on the SLK collector as well as information on the testing institute are found in the appendix.

### 1.3 Accessory packages

#### 1.3.1 Collector installation packages



##### Mounting on inclined roofs

- + stainless steel roof hooks for tiled roofs
- + aluminium installation rails, attachment brackets and screws
- + roof lead-through made from lead sheet, sealing profile and tube connection piece



##### Mounting on flat roofs

- + 45° mounting frame made from aluminium angle sections



##### Mounting on walls

- + aluminium angle sections (drilled + attachment material)
- + insulated wall lead-through

## 1.3.2 External accessories

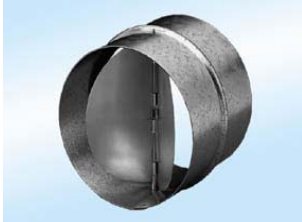
### Muffler



+ for the reduction of fan noise or to prevent noise from being transmitted between two technically connected rooms.

Recommended accessory from TWINSOLAR 4.0

### Non-return valve



+ prevents air circulation from the room via the tube system into the collector

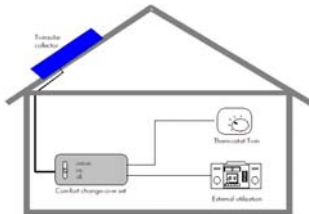
Recommended accessory !

### Fresh air disc valve



+ designer air outlet made from galvanised steel plate, painted white

### Comfort change-over kit



+ external utilisation of the collector-integrated PV module (Twin 2.0 – 10.0)

+ scope of delivery: Changeover switch, 5 m cable UV-resistant 3x1.5 mm<sup>2</sup>

### Summer ventilation kit



+ summer use of the collector-integrated PV modules for air extraction

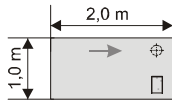
+ scope of delivery: Direct current fan (12 Volt, 5 Watt) with wall lead-through, muffler and thermostatic fresh air disc valve



# 1.4 Planning information for TWINSOLAR

## 1.4.1 Collector arrangement

### Standard arrangement variants



**TWIN-SOLAR 2.0**  
dimensions:  
2.000 x 1.006 x 135 mm (2.0 m<sup>2</sup>)



**TWIN-TOPSOLAR 4.0**  
dimensions:  
4.000 x 1.006 x 135 mm (4.0 m<sup>2</sup>)



**TWIN-TOPSOLAR 6.0**  
dimensions:  
6.000 x 1.006 x 135 mm (6.0 m<sup>2</sup>)



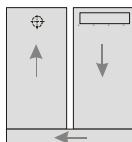
**TWIN-TOPSOLAR 8.0**  
dimensions:  
8.000 x 1.006 x 135 mm (8.0 m<sup>2</sup>)



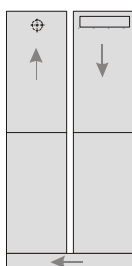
**TWIN-TOPSOLAR 10.0**  
dimensions:  
10.000 x 1.006 x 135 mm (10.0 m<sup>2</sup>)



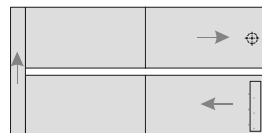
### Alternative arrangement variants



**TWIN-TOPSOLAR 4.5**  
dimensions:  
2.12 x 2.25 x 135 mm (4.55m<sup>2</sup>)



**TWIN-TOPSOLAR 8.5**  
dimensions:  
2.12 x 4.25 x 135 mm (8.55m<sup>2</sup>)



**TWIN-TOPSOLAR 12.5**  
dimensions:  
2.12 x 6.25 x 135 mm (12.55m<sup>2</sup>)



#### Deflection collector:

The alternative arrangement variants are realised using a deflection collector at the end of two parallel collector lines.

The deflection collector has a gross collector area of 0.5 m<sup>2</sup> and is constructed in a similar way to an SLK collector

Dimensions 2.12 x 0.25 m

#### Notes:

- All collector systems can be installed in a mirror arrangement or turned.
- Precise CAD collector diagrams may be found on page 32 in this handbook



### 1.4.2 Circulating air version option

As standard, TWINSOLAR is provided for so-called "fresh-air operation". This means that fresh outside air is sucked in via an air filter integrated into the collector.

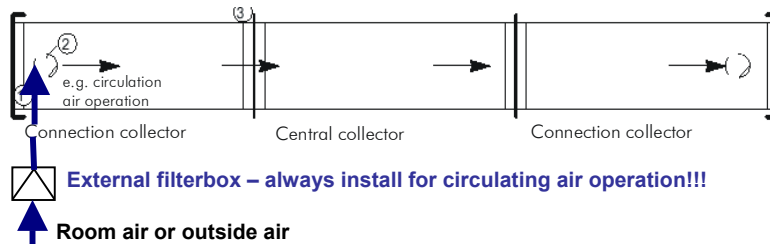


#### Optional circulating air operation

As an alternative to the fresh-air operation, the collector can also be fed with room air from the building or with fresh air via an external filter box.

This can be sensible in the case of the following applications:

- 1) Pure heating operation, no ventilation necessary. Room air from the building is warmed in the collector can then returned to the room.
- 2) Comfortable filter replacement in the loft. Instead of the more difficult filter replacement on top of the roof, in the case of an external filter box, the filter maintenance can e.g. be carried out easily in the loft.



### 1.4.3 Air distribution system – planning information



- Use spiral tubes made from galvanised steel plate of dimensions 125 mm and 160 mm
- Plastic tubes should not be used (evaporation, odour problems)
- Between the collector and the room a non-return valve must always be installed in the tube.
- With TWINSOLAR 2.0 the fan is integrated in the collector. From TWINSOLAR 4.0 an external radial fan is delivered with the collector package.
- In the fresh air tube mufflers are to be built-in downstream of the fan (from TWN 4.0).
- If two neighbouring rooms are connected by the ventilation system, telephone mufflers are to be installed between them.
- All tubes carrying warm air are to be insulated.
- Tubes carrying cold air through warm rooms are to be insulated – prevention of condensation!
- Keep the tube connection short in order to limit pressure drops and heat loss !
- Observe the permissible pressure losses (table chapter 1.2 "Technical data")

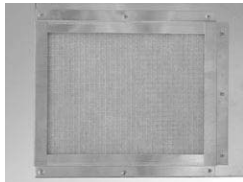
## Air ducting for TWINSOLAR 2.0

The fans are only designed for short tube connections.

The tube length of vertical tubes (see diagram) is limited.

With TWINSOLAR 2.0 the fan is integrated in the collector and insulated against noise transmission. Normally an additional muffler is not required.

### Collector details



**Fig. 1: Filter on the back of the collector.**

Pull out to the side from the collector side



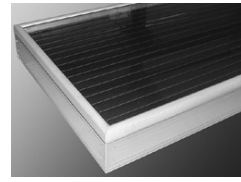
**Fig. 2: Air outlet**

On the back of the collector  
For TWIN 2.0 DN 125 mm  
From TWIN 4.0 DN 160 mm



**Fig. 3: Photo-voltaic module**

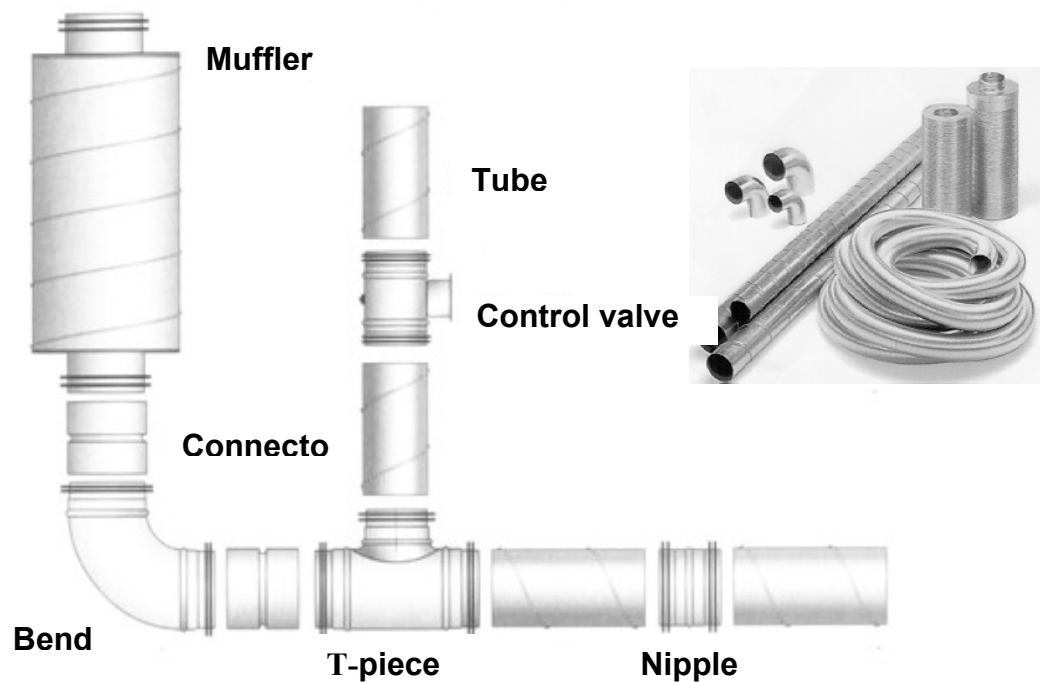
The photo-voltaic module is located at the glazing level of the collector or in the area of the (cooler) air inlet of the collector



**Fig. 4: Glass cover**

The glass cover consists of hail-resistant single pane safety glass

### Overview of tubes and fittings:



You will be able to obtain suitable ventilation accessories from our local partners. The partner list can be found on the Internet at [www.grammer-solar.de](http://www.grammer-solar.de)

## 1.5 Installation information – maintenance information

### 1.5.1 Important information

- PV modules of the TWINSOLAR collector must always be mounted at a location which is never shaded. Even minor shading of the solar modules will result in a massive loss in performance.
- The **air filter** must be **replaced** at least once or twice a year
- Do not install the air intake (filter collector) close to a chimney or exhaust air duct
- Adequate space is to be provided to allow the air filter to be pulled out of the collector from the narrow side
- Mount the fans (external from TWINSOLAR 4.0) with insulation against transmission of vibrations
- Provide a muffler downstream of the fan (see diagram below)
- The location of the PV cell should preferably be at the lowest point, in order to reduce heating of the solar module during standstill.
- All electrical installation work is to be carried out by an electrician in accordance with the VDE guidelines.
- All the screw connections on the collector mounting packages are to be checked annually for tightness and, if necessary, tightened up.

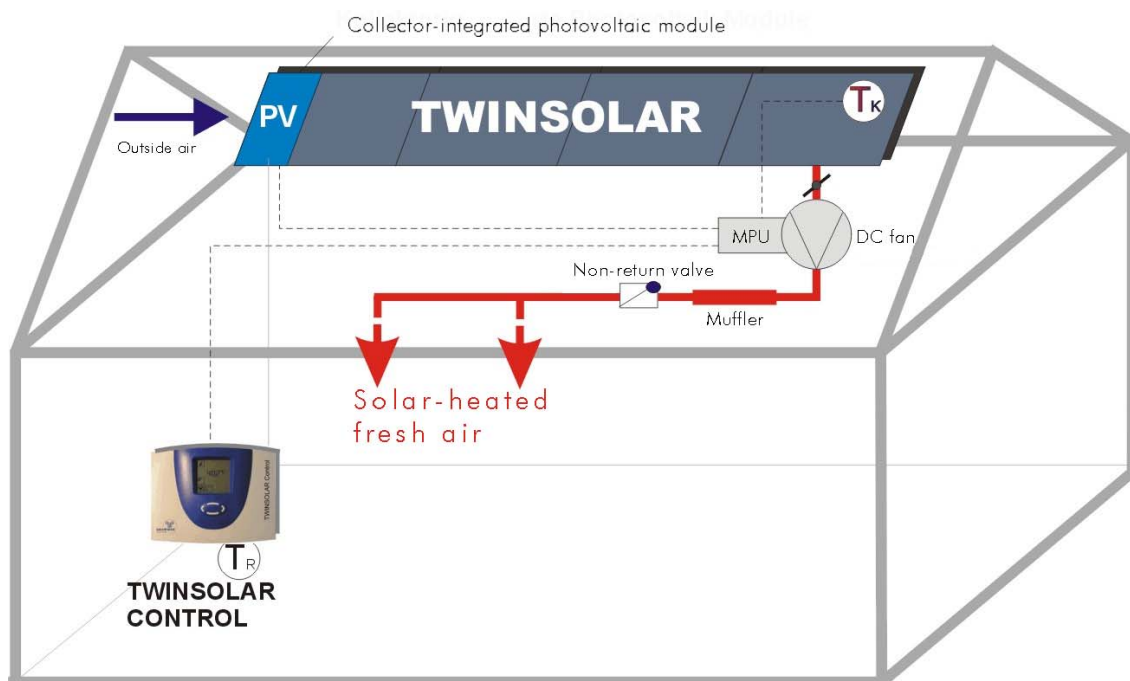
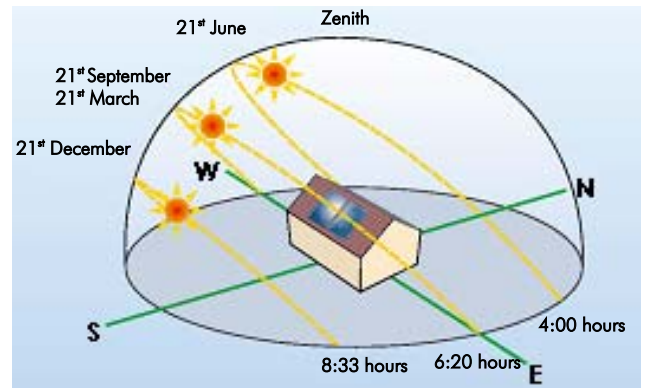


Fig. 1: TWINSOLAR system with external fan (from TWIN 4.0) and a simple solar ventilation system

## 1.5.2 Collector alignment

For optimum performance, the collector should always be directed to the south, although deviations from the southerly direction of up to 45° only result in a minor reduction in the energy gain.

Because a warm air collector system is mainly used to provide energy during the winter, spring and autumn, and during these times the solar angle is relatively low, the collector should ideally be mounted onto frames at a 45° to 60° angle from the horizontal.



In areas where high snowfalls are to be expected, wall-mounting is recommended!

## 1.5.3 Fan

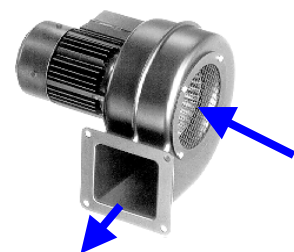
- **Commissioning:** Only when the air-duct system is connected!
- **Vibration insulation from the duct system:** flexible connection tubes (contained in the scope of delivery) are to be mounted on the inlet side and the pressure side. See fig. 3
- **Vibration insulation from the building:** Install a hard foam support between the fan support and the sub-structure as well as rubber washers on the screws!
- **Noise from the air flow:** Always install a muffler downstream of the fans!
- **Fan installation:** Always on the suction side!
- **Never insulate fans:** Danger of overheating!
- **Fans are not weather-proof or water-proof!**
- With **TWINSOLAR 2.0** the fan is integrated in the collector (ready for operation).



**Fig. 2: Direct current fan G1G**  
(installed externally downstream of the collector)  
Standard fan from TWINSOLAR 4.0



**Fig. 3: Flexible duct connections**  
(part of the delivery)



**Fig. 4: Direction of air flow**  
Observe intake and outlet direction

## 1.6. Control

For the maximum utilisation of solar energy, the operator should note the following:

- The solar control automatically controls the operation of the TWINSOLAR systems as a function of radiation or collector temperature and room temperature.
- The desired maximum room temperature is to be set 2 to 3 °C higher at the solar controller than that set for the conventional heating system. (Preferential setting for solar energy)



**Fig. 1: TWINSOLAR 2.0 room thermostat TEM 73 A**  
For limiting the maximum temperature from TWINSOLAR 2.0 (included in the delivery)

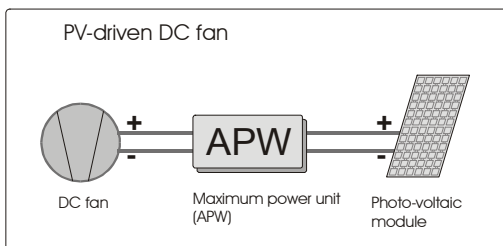


**New from 11-2005**

**Fig. 2: TWINSOLAR 4.0 – 12.5 TWINSOLAR Control**  
PV-operated differential temperature controller (included in the delivery)

### Maximum power unit “APW”

By means of a maximum power unit provided with the TWINSOLAR systems, the characteristics of fan and solar module are matched to each other. This ensures for varying radiation situations maximum gain by the system.



**Fig. 3: PV system with maximum power unit (APW)**

**Functional principle of APW:** The maximum power unit keeps the input voltage of the connected PV module constant. This means that the fan speed is automatically matched to the radiation received. This ensures a constant temperature difference between room and supplied air without the need to keep switching the fan on and off. By means of the current limitation, a soft start-up of the fan is achieved.



**Fig. 4: TWINSOLAR fan with integrated APW**

From TWINSOLAR 4.0 the electronic maximum power unit (APW) conforming to the picture on the left is integrated into the connection box of the G1G fan.

### Warranty:

Never attempt to interfere with the collector technology or electronics yourself, because otherwise the warranty will become void.  
Should the collector develop a fault during the warranty period, we will repair it or deliver a replacement.



## 1.6.1 TWINSOLAR 2.0 control

On the TWINSOLAR 2.0 collector, on the narrow side of the collector next to the photo-voltaic module a connection box is to be found (see fig. 2). This fulfils the following functions:

- Switch for the operating modes On – Off – External
- Connection terminals for the room thermostat
- Connection terminals for the comfort change-over kit (accessory)

### State at delivery

The fan is switched on and off either by means of the switch in the connection box or by means of an external room thermostat.

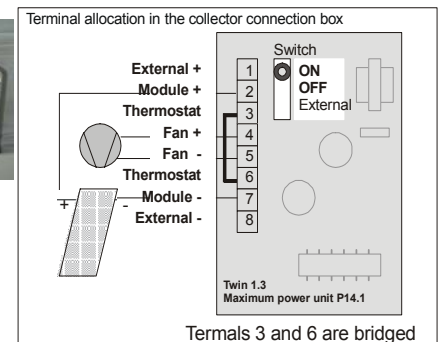
The connection of the room thermostat as well as the connection of external consumer for the summer utilisation of the PV module is shown below.



Fig. 1: TWINSOLAR 2.0



Fig. 2: Connection box and terminal allocation

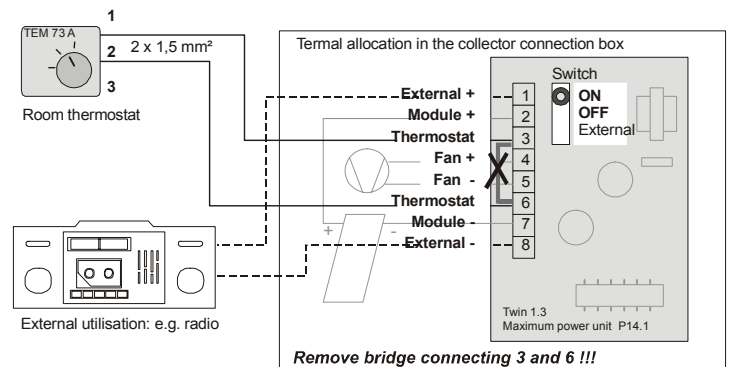


### Connection of the room thermostat

The room thermostat switches the fan off when the set room temperature is reached.

Room thermostat type: TEM 73 A

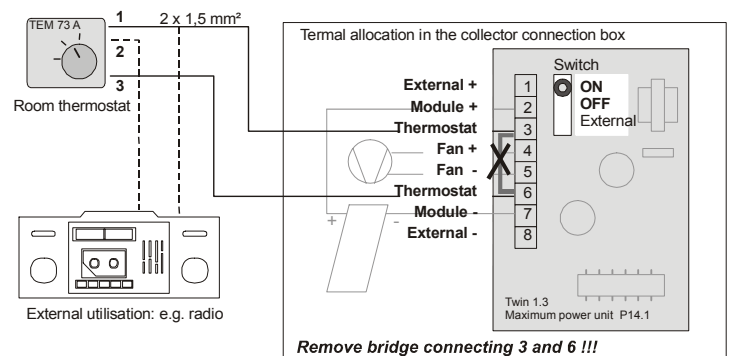
Terminals 1 and 3 of the room thermostat are to be connected to terminal 3 and 6 in the collector connection box! Minimum cable cross section  $2 \times 1.5 \text{ mm}^2$  UV-resistant for outdoor use.



### Automatic change-over for external utilisation

When the collector has reached the temperature set at the room thermostat the fan in the collector is switched off.

The module voltage will then be present at terminals 1 and 2 and can be utilised for other external applications (e.g. garden pump, radio...)



### Performance data for solar module TWINSOLAR 2.0

- Nominal voltage: 12 Volt
- No-load voltage: 21.4 Volt
- Nominal rating:  $12 \text{ W}_p$

## 1.6.2 Control TWINSOLAR 4.0 to 12.5

### NEW: TWINSOLAR Control (standard accessory from TWINSOLAR 4.0)

#### FUNCTION:

TWINSOLAR Control (Fig.2) controls and monitors the operation of TWINSOLAR systems.

The simple control compares the room and collector temperatures and switches the fan on or off depending on the temperature (differential temperature control). Once the desired room temperature has been reached the system will switch off.



Fig. 3: 2 TWINSOLAR Control

#### Manual operation

##### (Manual operation without temperature control !)

With the left-hand button the "manual operation" menu (hand symbol) can be activated or terminated.

By means of the right-hand button the fan (only when the PV module supplies sufficient power!) can be started up manually.

#### Important information:

During installation and commissioning please observe the information in the "Installation and operating instructions" for the controller.

The scope of delivery contains a "Quick info" about the controller in 5 languages. This "Quick info" in the appropriate language should be inserted in the slot provided for this on the back of the controller.

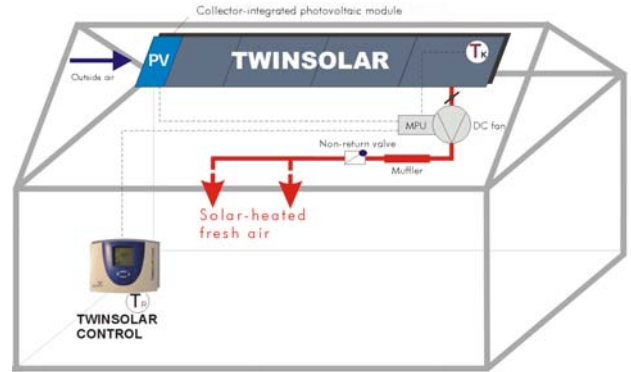



Fig. 1: Function diagram - TWINSOLAR 4.0 - 12.5

#### DISPLAY MEASURED VALUES – information menu



In the information menu the following measured values can be displayed by means of the "up" and "down" buttons:

- **Current collector temperature**
- **Min. and max collector temperature (resetable)**
- **Storage temperature = room temperature**
- **Min. and max room temperature (resetable)**
- **Hours of operation (resetable)**

The movable ventilator pictogram  is shown when the system is operating!

If received radiation is too low the display will be switched off!

#### SETTING – programming

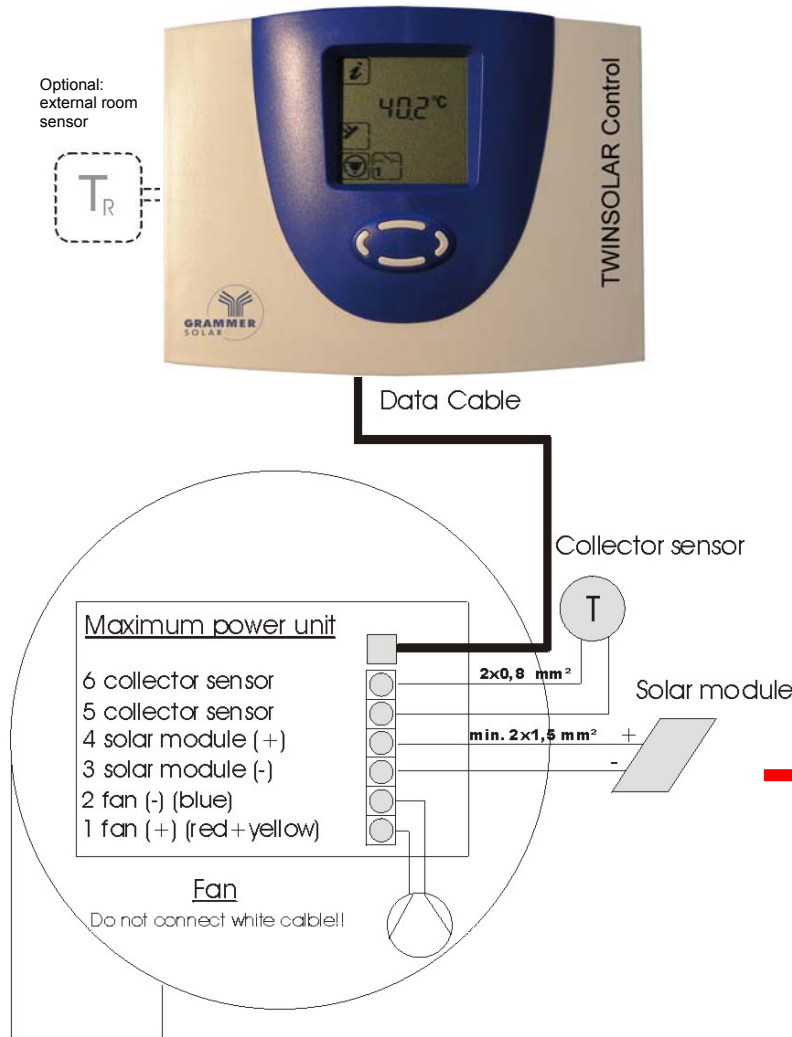
With the left-hand button the "programming" menu can be activated or terminated.

With the "Up" and "Down" buttons the following values to be set can be called:

- **max (max. room temperature) approx. 23°C**
- **dT max. (switching on difference) 6 K**
- **dT max. (switching on difference) 3 K**

The modified values are to be confirmed and saved by pressing the right-hand button.

## Connection diagram TWINSOLAR CONTROL



### Important information:

- Connection of solar module – observe POLARITY See Fig 1 and 2
- Do not locate the TWINSOLAR Control close to heat sources or in direct sunlight
- If no data cable is connected or if the TWINSOLAR Control is disconnected the fan will run purely depending on the radiation received (without temperature control)
- Please also observe the following chapters in this handbook:
 

Fan	<u>Chapter 1.6</u>
Checking list – fault correction	<u>Chapter 1.7</u>

### Options:

Optionally, instead of the integrated sensor an external room sensor can be connected to the controller. For change of settings see controller handbook

If desired, the controller can be delivered with an additional switch contract (floating) for solar operation.

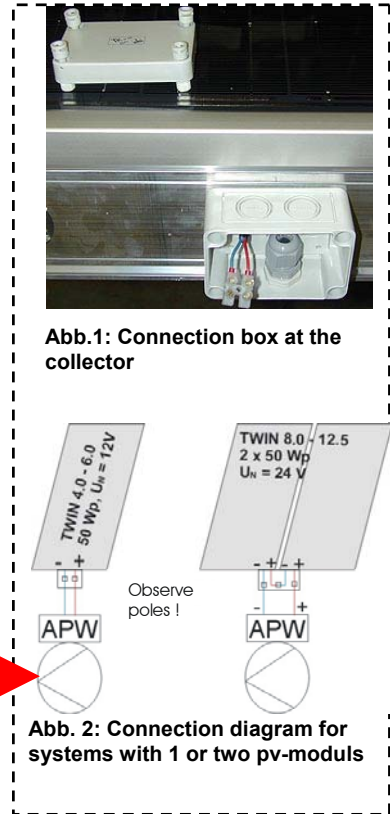


Abb. 1: Connection box at the collector

Abb. 2: Connection diagram for systems with 1 or two pv-modules

Fig. 3: Fan kit in the TWINSOLAR collector package



## 1.6.3 TWINSOLAR – Comfort change-over kit

### Optional accessory TWINSOLAR 2.0 – 12.0

#### FUNCTION:

The comfort change-over kit enables external use of the collector-integrated PV modules. In addition to the change-over facility available as standard at the collector, the comfort change-over kit can be used to switch between fan operation and alternative external utilisation (e.g. radio, lamps etc.) from the room.

#### OPERATING INFORMATION:

**External:** The current from the PV modules can be utilised externally

**Off:** The PV modules are switched off completely  
– the installation does not operate at all

**On:** The PV modules are switched to power the fan – ventilation function

#### Switch diagram for TWINSOLAR 2.0

Switch setting to external

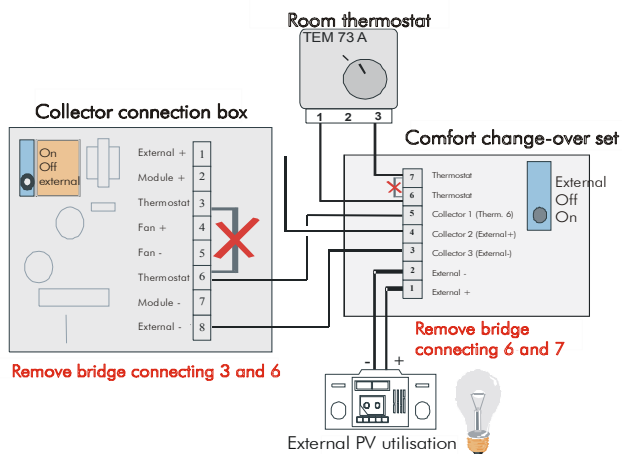


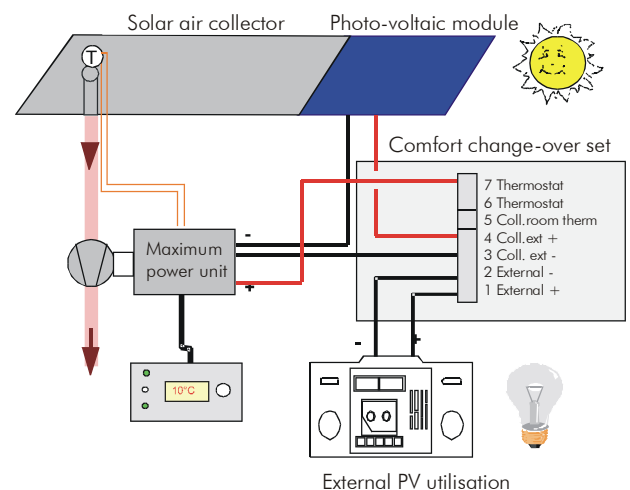
Fig. 1: Change-over kit with cable



Fig. 2: Change-over switch

#### Switch diagram for TWINSOLAR 4.0 and 10.0

Switch setting to external



## 1.6.4 Temperature measurement - room operating device - room thermostat

From TWINSOLAR 4.0: A room sensor (type PT1000) is integrated in the TWINSOLAR Control (Fig. 1). Alternatively, an external room sensor can be connected to the room device. (see page 16)

For TWINSOLAR 2.0 the room temperature is measured by a room thermostat.



Abb.1 TWINSOLAR Control

When arranging the room operating device or room thermostat please observe:

- Avoid direct irradiation by the sun
- Avoid the influence of extraneous heat sources
- Do not locate close to the supply air elements

The correct function of the temperature sensor can be checked by means of the temperature resistance table using a resistance meter:

Temperature in °C	Resistance in Ohm	Temperature in °C	Resistance in Ohm
-30	882	60	1232
-20	921	70	1271
-10	960	80	1309
0	1000	90	1347
10	1039	100	1385
20	1077	120	1461
30	1116		
40	1155		
50	1194		

## 1.6.5 Operation with summer ventilation kit / wall ventilation

During the summer, the collector-integrated PV modules can be used in combination with a fan for the wall installation (summer ventilation kit) for the ventilation of individual rooms.

### Technical data for wall ventilation:

Type: P 4212,  
 Nominal voltage: 12 Volt (7 – 14.5 Volt),  
 Power rating: 4.3 Watt  
 Max air flow: approx. 80 m³/h



### Electrical connection

- TWINSOLAR 2.0 – Please observe "External utilisation" connection in [chapter 1.6.1](#).
- TWINSOLAR 4.0 – 10.0 - Please observe "External utilisation" connection in [chapter 1.6.4](#). In this case a comfort change-over kit is necessary for operation. For TWINSOLAR 10.0 (24 Volt PV voltage) an additional choke has to be installed.



## 1.7 CHECKING LIST – FAULT CORRECTION

Fault	Possible cause – fault correction
Fan does not run	Photovoltaic module is shaded. Slight shading, large effect! Irradiation too weak.
	Electronic maximum power unit. Check contact at the connection terminals – if necessary, tighten
	Correct polarity at the solar module and fan
	Check the solar module connection cable to the electronic maximum power unit / fan
	Module connection box at the collector. Check contact at the connection terminals – if necessary, tighten
	Check the data cable between the fan and TWINSOLAR Control solar controller.
	Note: If the data cable or the solar controller is disconnected the fan will run depending on the received radiation (without temperature control) only
	Check that the ventilation tubes have an adequate free cross-section  <b>TWINSOLAR 2.0</b> For operation with the comfort change-over kit, external must be set in the collector connection box  Check the terminal allocation at the thermostat, observe bridges when operating without thermostat
The installation does not run in automatic operation	Check the connection with the sensor and whether it has been placed at a sensible location. See <a href="#">chapter 1.6.5</a>
	Check the setting of the differential temperature – might be too large
	Check the maximum temperature setting – if the value is set too low no heating operation will be possible
	Solar module is too hot. With an in-roof installed TWINSOLAR system in summer an operating status is possible, whereby the solar modules become very hot and the system can only be restarted with difficulty after standstill.
The system runs continuously and without control	Switch to ON in the operating menu – Set to automatic operation
	The data cable for the TWINSOLAR installations is not inserted or there is difficulty making contact
The fan runs too noisily	Provide muffler
	Install the fan with vibration insulation
	The supply air valves are throttled too much – whistling noises
	Check the mechanical stops at the motor
Varying temperature display	If long sensor cables are laid along power cables, interferences can occur. Correction: Choose screened cables or a different cable path
	In the case of TWINSOLAR systems at a very low levels of received radiation, temperature variations at the room device are possible
Power too low	Check filter for contamination. <b>Replace the filter at least 1 or 2 times per year !!!</b>
	Duct system is blocked. Check that the ventilation tubes have an adequate free cross-section
	Check the system for shading. Even minor shading of the photovoltaics will lead to strong losses in power.

## 1.8 Collector installation

### 1.8.1 Mounting on inclined roofs

For mounting on an inclined roof, individual collectors (e.g. TWINSOLAR 2.0) or several collector elements are connected by means of roof hooks or supports to the rafters or to the roof structure.

The roof structure experiences an additional load from the weight of the collectors. Whether or not a static calculation is required must be decided case by case. The collectors have a static weight of approx. 22. kg/m<sup>2</sup>.



### Mounting on inclined roofs – scope of delivery of the standard package

#### Example: Mounting package for inclined roofs 4.0 - SLK

for collector mounting on roof tiles consisting of:

- 8 off roof hooks for roof tiles
- 16 off wood screws M 8 x 100 + washers
- 4 off aluminium mounting rails of 1.15 m length + screws
- 4 off Z installation brackets + screws
- 4 off attachment clamps + screws
- 1 off lead sheet with rain-proof flange collar DN 180/160
- 1 off tube connection piece DN 160 mm, length 450 mm to connect to the roof lead-through

**In areas of high snowfall more installation rails and roof hooks than in the standard package are to be provided! Information and prices available on request.**

### Installation steps – short overview

1. Measure/determine the collector field on the roof (for collector diagrams see appendix)
2. Measure the location of the roof lead-through (consider location of rafters!) Install the roof lead-through – cut a hole in the roof boarding and fit the lead sheet so that it is rain-proof.
3. Install the roof hooks. Screw the roof hooks to the rafters. If necessary match heights by the means of inserted wood boards.
4. Install the mounting rails to the roof hooks.
5. Lay the collector sensor cable / PV connection cable and prepare connection.
6. Glue on the sealing profile to the collector connections
7. Mount the collectors.
8. Connect the collectors by means of the quick-action clamps.
9. For the collector sensor cable (+ PV connection cable for TWINSOLAR) stick the sealing profile onto one side of the collector connection.
10. Finally, check all the screws for secure attachment. This has to be repeated annually!

## Installation steps – comprehensive description

**1<sup>st</sup> step – measure the roof (CAD collector diagrams from page 32)**

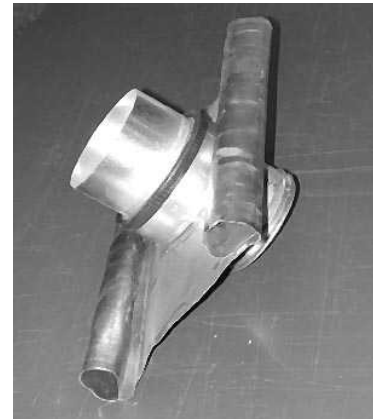
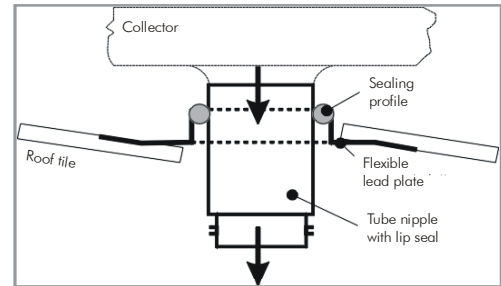
### **2<sup>nd</sup> step – roof lead-through and collector connection**

The roof lead-through for the collector installation consist of a lead sheet with a flange collar with sealing profile as well as a tube connection piece (125 or 160 mm).

The lead sheet is flexible and can be moulded to a wide range of tile shapes.

Grammer air-base collectors are equipped with a round tube connection on the back of the collector. The sliding joint included with the roof lead-through is pushed over the connection tube. The sliding joint must be protected against sliding off of the collector connection. This can, for example, be done by means of holding brackets.

In the case of insulated roofs, the tube must be glued to the roof insulation film.



### **3<sup>rd</sup> step – mount roof hooks**

The roof hooks are to be attached close to rafters and screwed to it tightly.



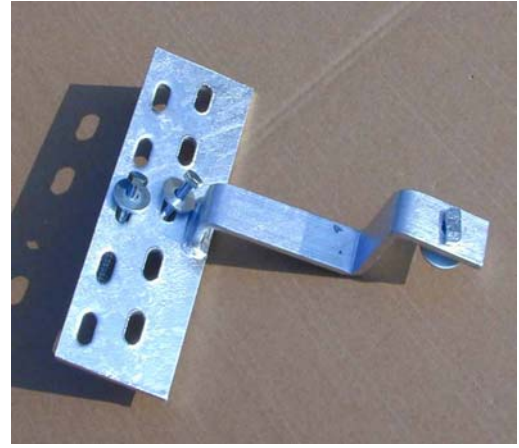
Roof hook for slate roof



Attachment of a roof hook for slate roofs



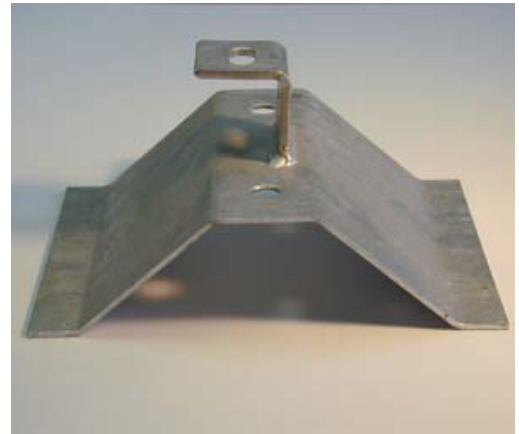
Tap a recess for the roof hook out of the tile



Roof hook for roof tiles including attachment screws



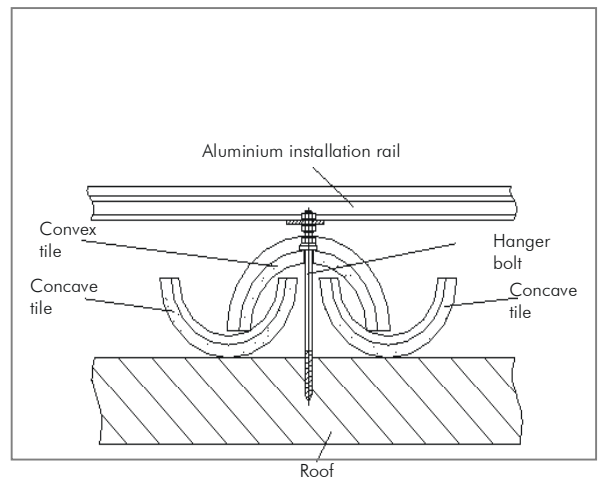
Attached roof hook with screwed-on cross rail



Corrugated Eternit roof hook



Installation to a standing seam metal roof



Convex/concave tiling

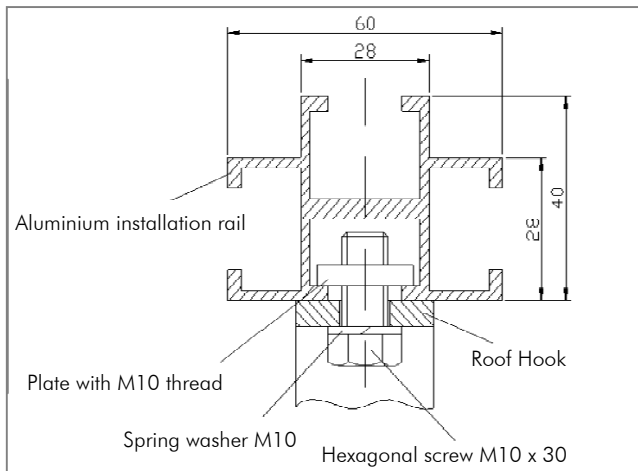
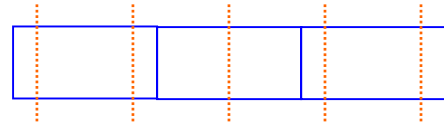


#### 4. step – fit the mounting rails to the roof hooks.



##### Aluminium mounting rails

- For each of the end collectors two installation rails are provided
- For each middle collector normally one mounting rail is adequate (except in regions with high snow fall!)
- For the collector with the integrated air filter sufficient space (min. 30 cm) must be provided on the narrow side to allow filter replacement



##### Aluminium mounting rails – screw attachment

Important for secure attachment!  
After inserting into the aluminium rail, the rectangular threaded plate must be turned by 90° until it locks in and then it must be tightened by means of the hexagonal screw.

Please also observe the safety information in chapter 1.9.2 on page 29 !

#### 5<sup>th</sup> step - lay the collector sensor cable / PV connection cable and prepare connection



##### Connection boxes

- To each end collector a sensor connection box is fitted. The sensor must be connected to the control via a 2-pole cable (min. 2 x 0.8 mm<sup>2</sup>).
- The PV connection box (only for TWINSOLAR collectors) is to be connected via a 2-pole cable (min 2x1.5 mm<sup>2</sup>) to the PV module on the fan
- Observe the location of the connection boxes! (You will find the dimensions in the collector mounting diagrams)
- Cable lead-through close to the roof lead-through



## 6<sup>th</sup> step - stick on the sealing profile to the collector connections



### Collector connection sealing surface

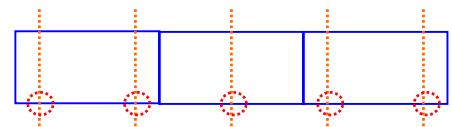
- For sealing the collector connection **before** mounting the collector a sealing strip is **to be stuck on**
- (Self-adhesive) rubber sealing strips are included in the scope of delivery
- Stick the sealing strips to only one of the two collectors to be connected!

## 7<sup>th</sup> step – collector mounting



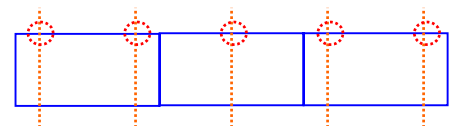
### Collector attachment I

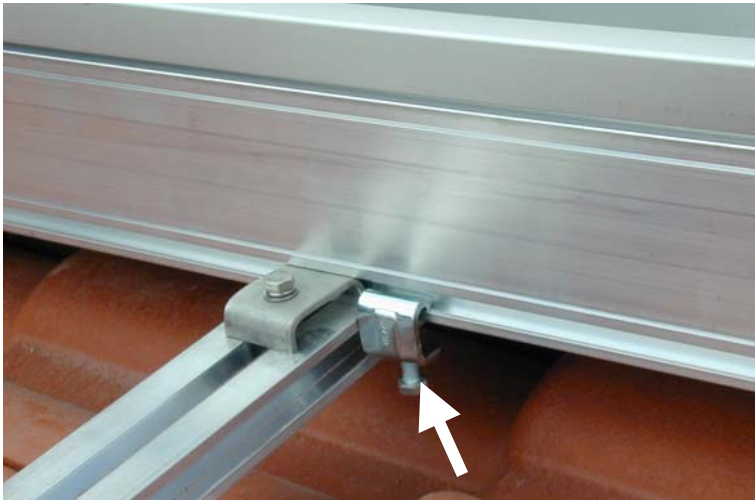
- On the back of the collector the collectors are fixed by means of Z-mounting brackets
- The Z-mounting brackets are to be aligned or attached to the pre-mounted aluminium mounting rails before mounting the collector.



### Collector attachment II

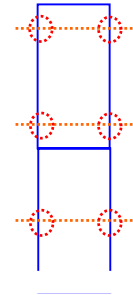
- The collectors are screwed onto the top surface by means of attachment clamps to the aluminium mounting rails





### Vertical mounting

- By means of the mounting clamps the collectors are screwed to the mounting rails
- Mounting aid to prevent sliding off



### 8<sup>th</sup> step – collector connection by means of quick-action clamps



### Collector connection

- The collectors are to be connected to each other by means of adjustable clamp locks
- Rubber sealing strips on the sealing surfaces!
- Pins in the collector connection assist in the collector alignment
- The clamp locks are to be adjusted in such a way that the collectors are firmly pressed together
- The clamp locks are to be secured by means of a spring lock



### Standard arrangement variant for mounting on inclined roofs

Usually air collectors are arranged as a long line of collectors



**Alternative arrangement variant – parallel mounting**



**Parallel mounting**

- Parallel collector lines are mounted at a distance of 110 mm



**Deflection collector**

- The deflection collector is connected by means of clamp locks to the collectors
- A rubber sealing strip is also to be stuck onto the sealing surfaces (description see step 6)
- In snow-rich regions the deflection collector must be supported by an additional mounting rail



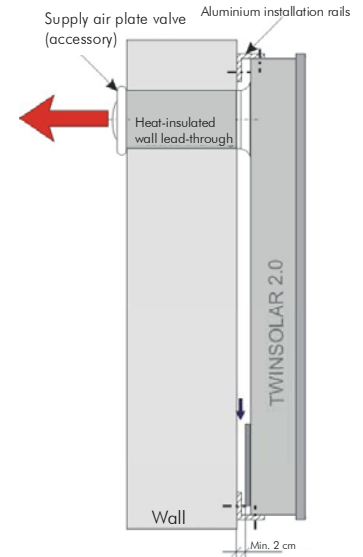
## 1.8.2 Wall mounting

### Example: Wall mounting package TWINSOLAR 2.0

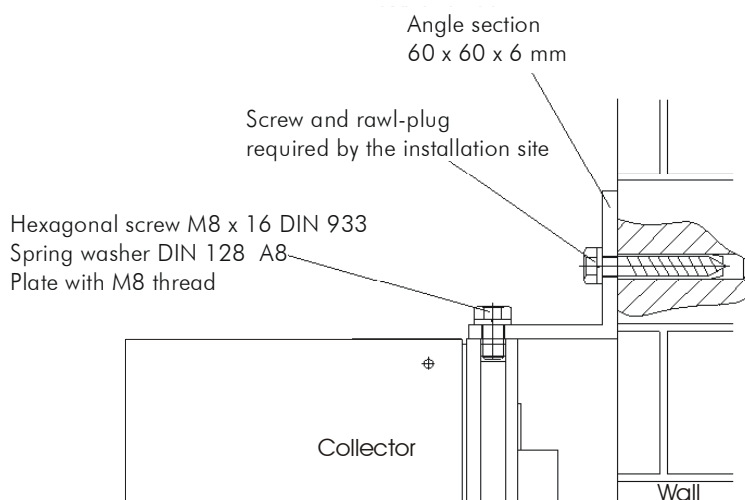
2 off aluminium angle sections 60 x 60 x 6 mm, with holes  
Length 2 m (depending on the collector)

1 off wall lead-through DN 125 mm, length 450 mm

1 pack of M8 screws for attaching the collector



- The collector is mounted to the wall by means of aluminium angle sections
- In the case of filter collectors, it must be ensured that adequate space for the filter change is available. Between the back of the filter or collector and the wall a distance of at least 2 cm must be maintained!
- The heat insulated wall lead-through must be shortened to match the wall thickness.
- The insulation of the wall lead-through is important for preventing condensation.
- All screw or dowel connections are to be made carefully. Safety in the wind!
- Please also observe the safety information in chapter 1.9.2 on page 29 !



### 1.8.3 Mounting on flat roofs

The mounting kit is suitable for:

- Frame mounting on top of flat roofs
- Frame mounting on the ground, e.g. in the garden
- Wall installation with 45° frame mounting

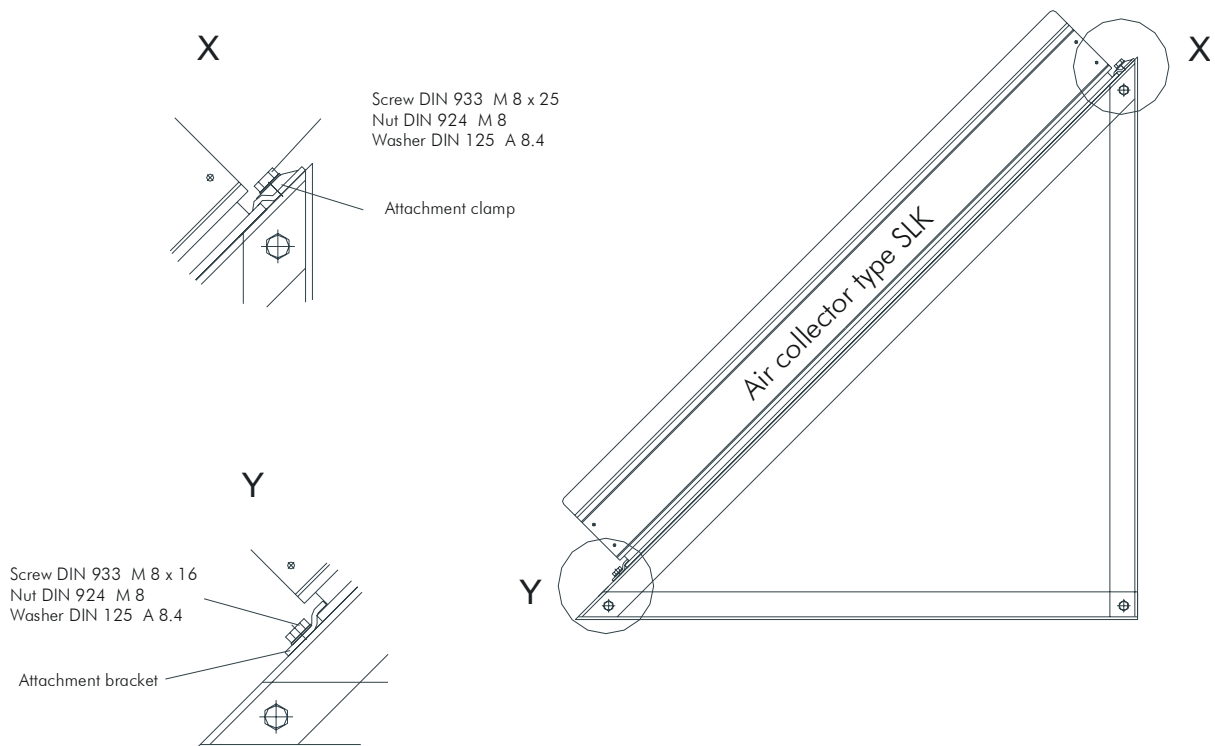


The mounting package for flat roofs contains:

- 2 off 45° support triangles per collector (for the central collector only one support triangle is required)
- 2 off attachment clamps per collector for standard collector systems
- 2 off Z-mounting brackets

#### Important information:

- The collectors are to be placed on top of the support triangles and are to be screwed on with the attachment clamps
- In the case of installation on top of flat roofs the system may need to be protected against wind loads (screw tight, weigh down, clamp down). Under favourable conditions the weight of the installation will be adequate. For this a wind load calculation has to be carried out
- All screw or dowel connections are to be made carefully. Safety in the wind!
- **Please also observe the safety information in chapter 1.9.2 on page 29 !**
- In the case of a membrane roof, Asozell tape should be glued underneath the contact-making sections.

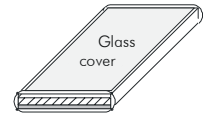




## 1.9 General maintenance information

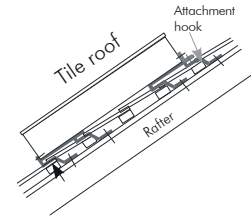
### 1.9.1 GRAMMER air-base collector

The GRAMMER air-base collector does not include any mechanically moving parts and is therefore maintenance free and intrinsically safe.



### 1.9.2 Checking the attachment of collectors and mounting frames

The collector system on the roof will be properly secured by the installation company. However, it is exposed to movements from wind and gales. A regular checking routine should ensure that all screw connections are tight, in particularly after heavy gales.



### 1.9.3 Cleaning

According to our experience the cleaning effect of strong rainfall is adequate. In areas with strong environmental contamination or when large amounts of pollen have been released or dry periods last a long time, it may be useful to clean the glass surface with tap water and a sponge or car washing brush.

### 1.9.4 Air filter

The collectors are protected by the intake air filter in the system of quality class EU 4 against internal contamination. The filters should be replaced after the period customarily used by the company or at the location as described in the general installation instructions, or every 6 months for collectors run on out-of-doors air or mixed air or, in the case of a pure circulating air system, every year before the beginning of the heating period (September)

For collector-integrated fresh air filters, the end cover is to be removed by loosening the screwed-on attachment clamps. The filter cartridge has to be pulled out, the old filter mat replaced by a new one and the newly filled filter cartridge has to be re-inserted and the end cover re-attached. The filter has to be removed from the filter frame by removing the clamp and then replaced. For the circulating air intake the filter in the filter box (e.g. within the roof space) has to be replaced.



### FILTER REPLACEMENT

#### 1 to 2 x annually

The filter collectors take in the air through the back of the collector

The filter cover is to be loosened via the clamp locks and removed

Then the filter can be pulled out and replaced

### 1.9.5 Air as heat transfer medium

Air does not experience phase changes (freezing or boiling) so all safety measures in this respect are not necessary.

However, it cannot be excluded that after a longer period of standstill occasionally condensation will form on the inside of the cover, depending on the air humidity and low outside temperatures. After the system has been restarted this condensation will disappear by itself



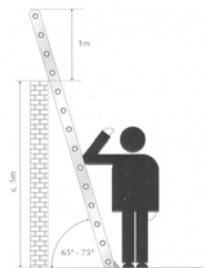
## 1.10 Safety information

### 1.10.1 Weather

Carry out the installation only when the weather is fair. Particularly for installations integrated into the roof, it should be observed that no precipitation is falling in order to prevent humidity from entering the building. If the wind freshens up, you should interrupt the installation in the interests of your own safety. Also remember that on very hot days with strong solar radiation, there is a risk of burns from hot metal parts. Under unfavourable conditions temperatures up to 150°C can occur (particularly at the absorber).

### 1.10.2 Ladders

Ladders should be leant at an angle of 65 – 75° to a secure support and they must reach at least 1 m above the highest point used to step off it. In addition, they should be secured against sliding, falling over, slipping off and sinking into the ground. Finally, ladders are only to be used to access points up to a height difference of 5 m.



### 1.10.3 Protection from falling objects

Traffic areas and workplaces below have to be protected against objects dropping, falling, sliding or rolling off. The areas where people are endangered are to be marked and blocked off.



### 1.10.4 Protection against falling

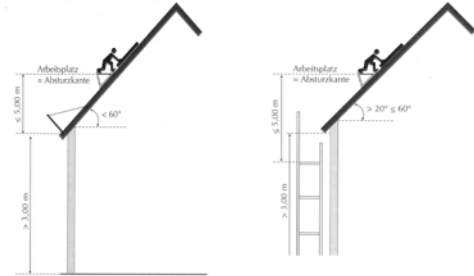
From a height of 3 m for work on an inclined roof of more than 20° to 60° protection against falling is required (VBG, 37, § 8).

One option is roof safety scaffolding. The vertical distance between workplace and safety installation may be no greater than 5 m. Alternatively, the top scaffolding support can also be designed as a safety platform.

For roof steeper than 45° inclination special workplaces must be created (e.g. roofer chairs, roof ladders, wooden safety structures)

A further option for fall protection for work on inclined roofs up to 60° are roof safety walls. They are also required from a fall height of 3 m and the vertical distance between workplace and safety installation may be no larger than 5 m. Safety walls must be at least 2 m higher than the workplaces to be protected by them.

If roof safety scaffolding or roof safety walls are inappropriate, safety harnesses can also be used as fall protection. The safety roof hook should be preferably attached above the user to load bearing components. Do not use ladder hooks!



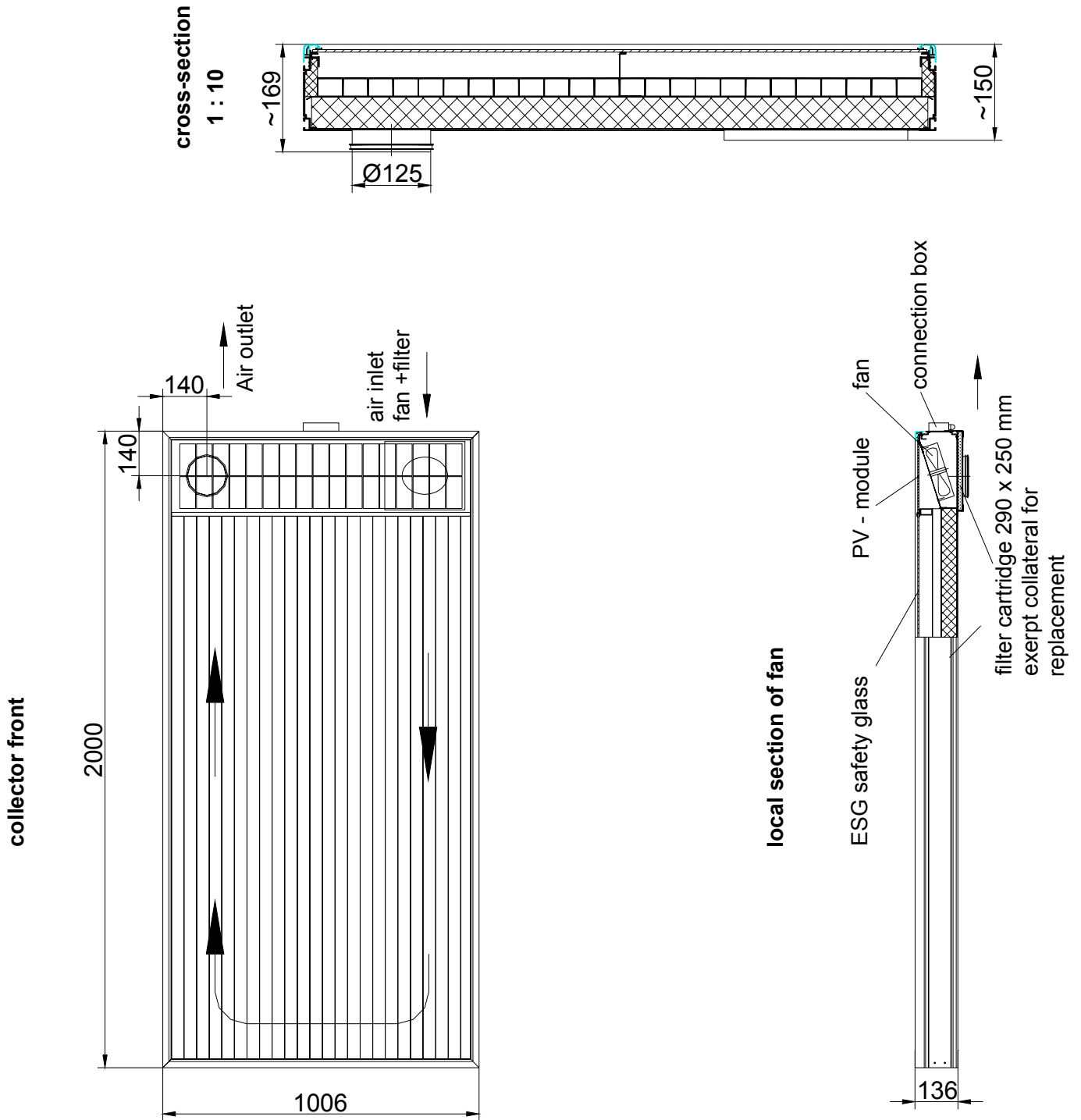
### 1.10.5 Rules of technology

The installations should correspond to the conditions on site, the local regulations and, not at least, to the rules of technology. In this context, the following are to be mentioned in particular:

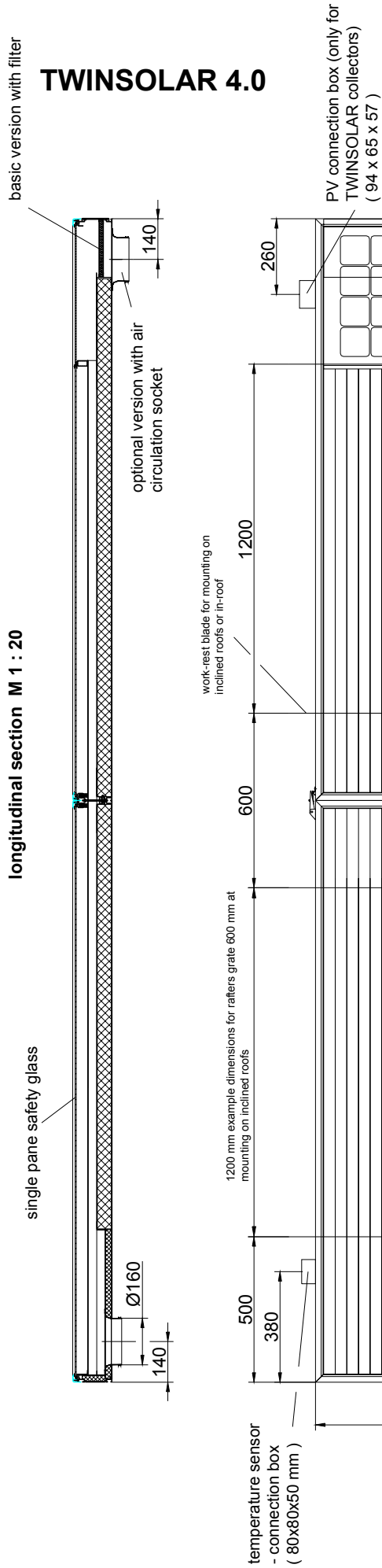
- **Mounting on roofs**
  - DIN 18338 Roofing,
  - DIN 18339 Plumbing
  - DIN 18451 Scaffolding
- **Connection of thermal solar installations**
  - DIN 4757
- **Electrical connection**
  - VDE 0100 Electrical equipment
  - VDE 0185 Lighting protection systems
  - VDE 0190 Main potential equalisation
  - DIN 18382 Electrical cables in buildings

The fan may only be started up when the air duct system is connected Under no circumstances place hands into the moving fan.

# TWINSOLAR 2.0



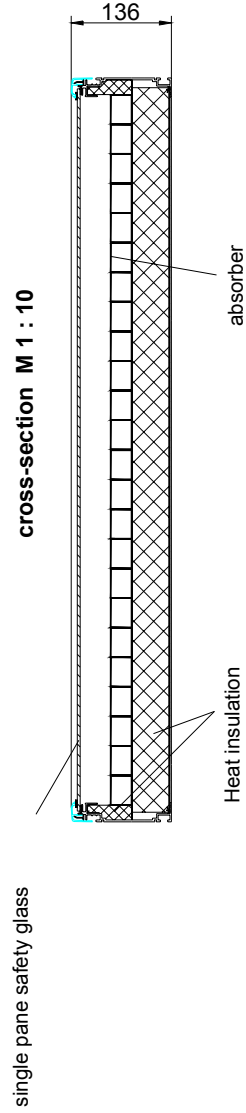
**longitudinal section M 1 : 20**



**TWINSOLAR 4.0**

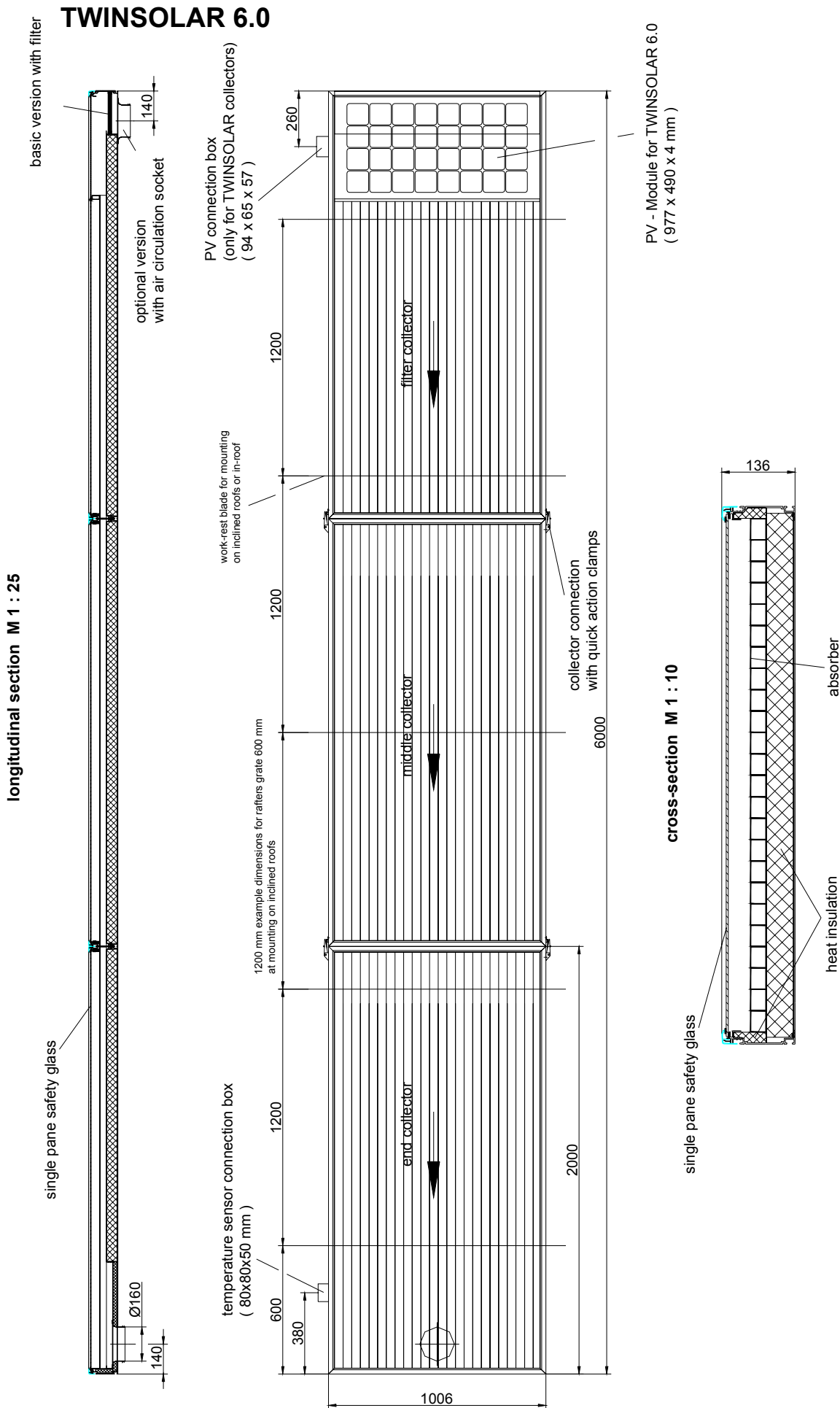
PV module for TWINSOLAR  
( 977 x 490 x 4 mm )

**cross-section M 1 : 10**



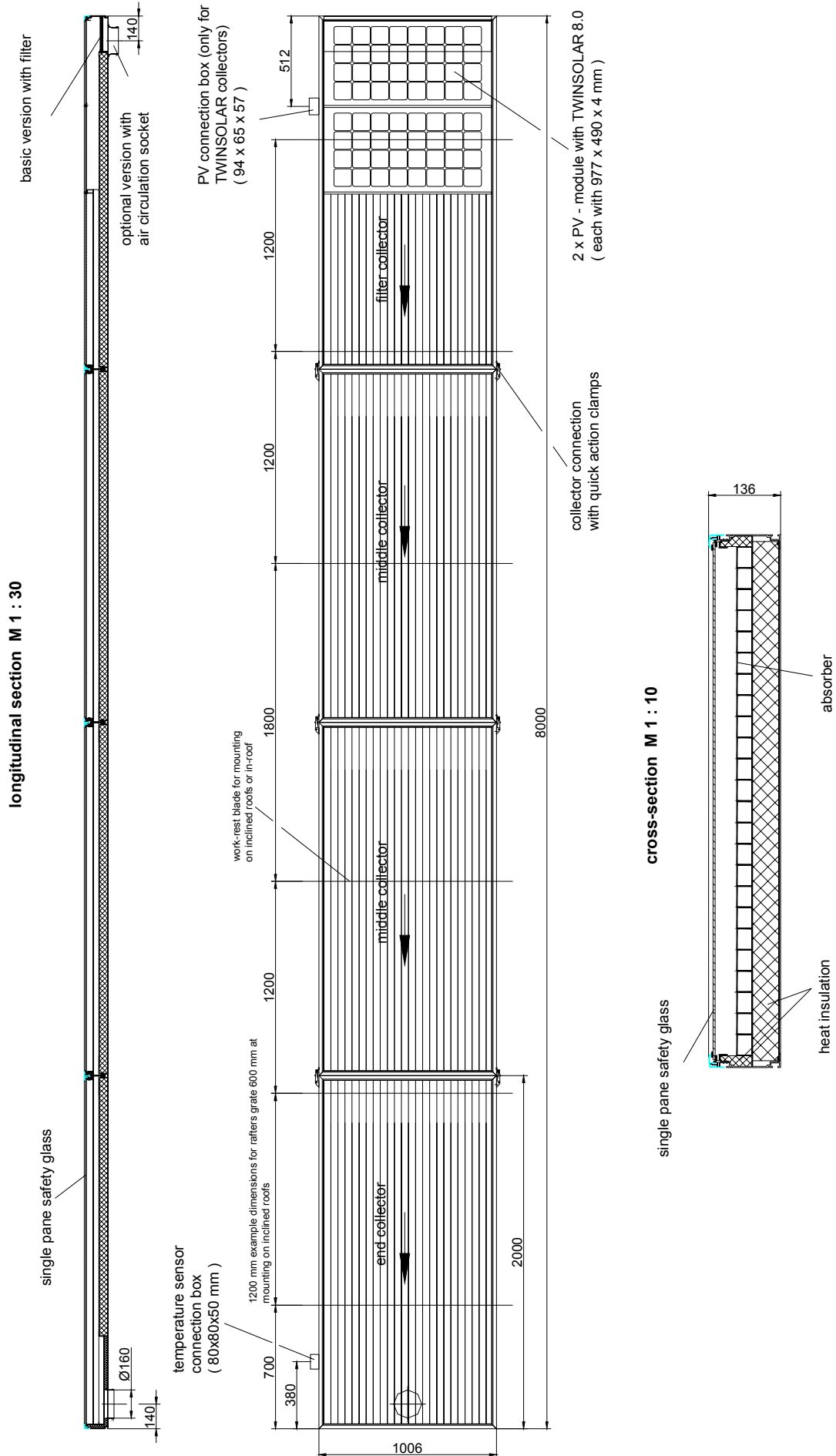
**TOPSOLAR 4.0**  
**TWINSOLAR 4.0 ( with PV module )**





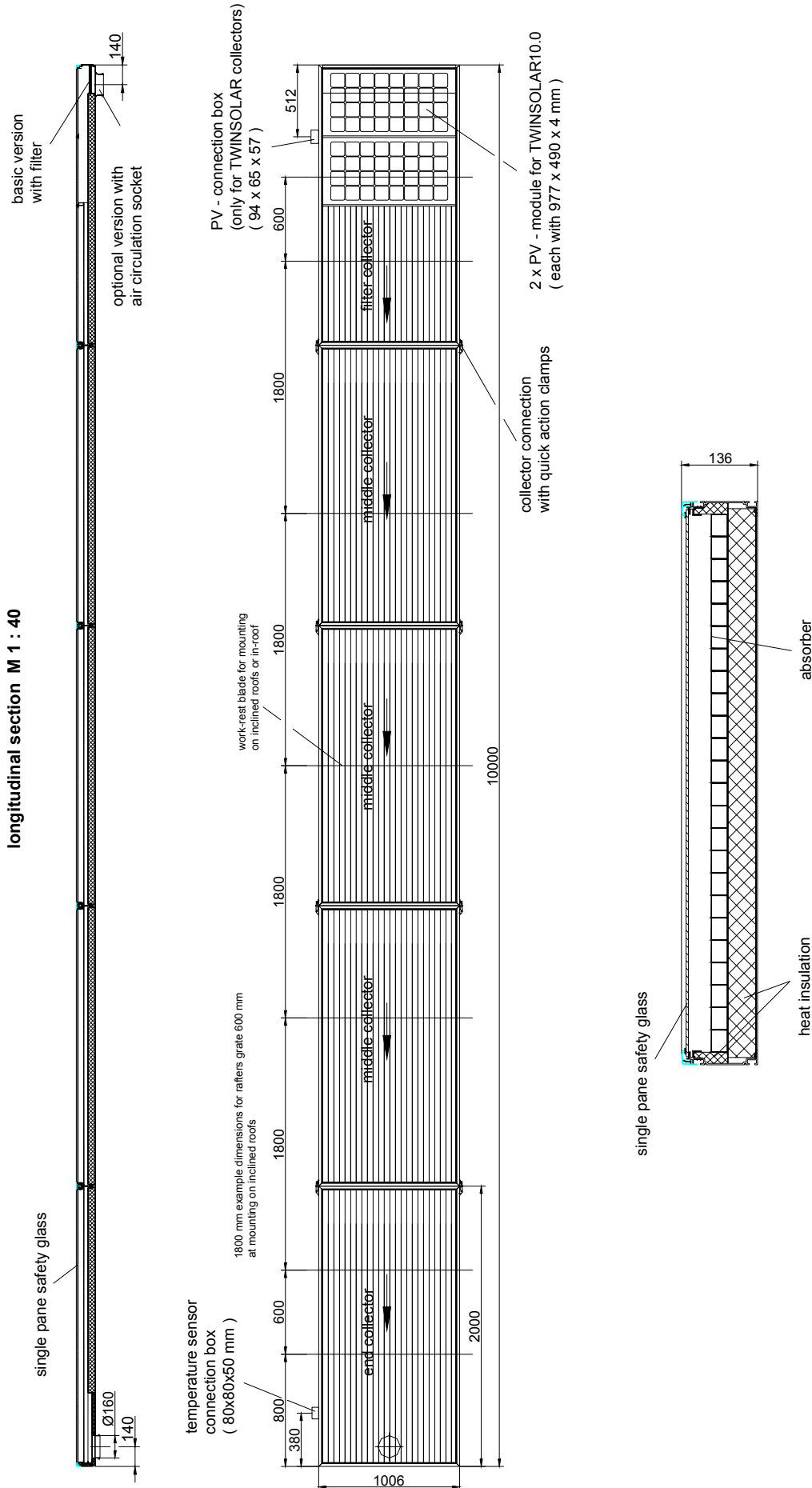
**TOPSOLAR 6.0**  
**TWINSOLAR 6.0 ( with PV - module )**

# TWINSOLAR 8.0



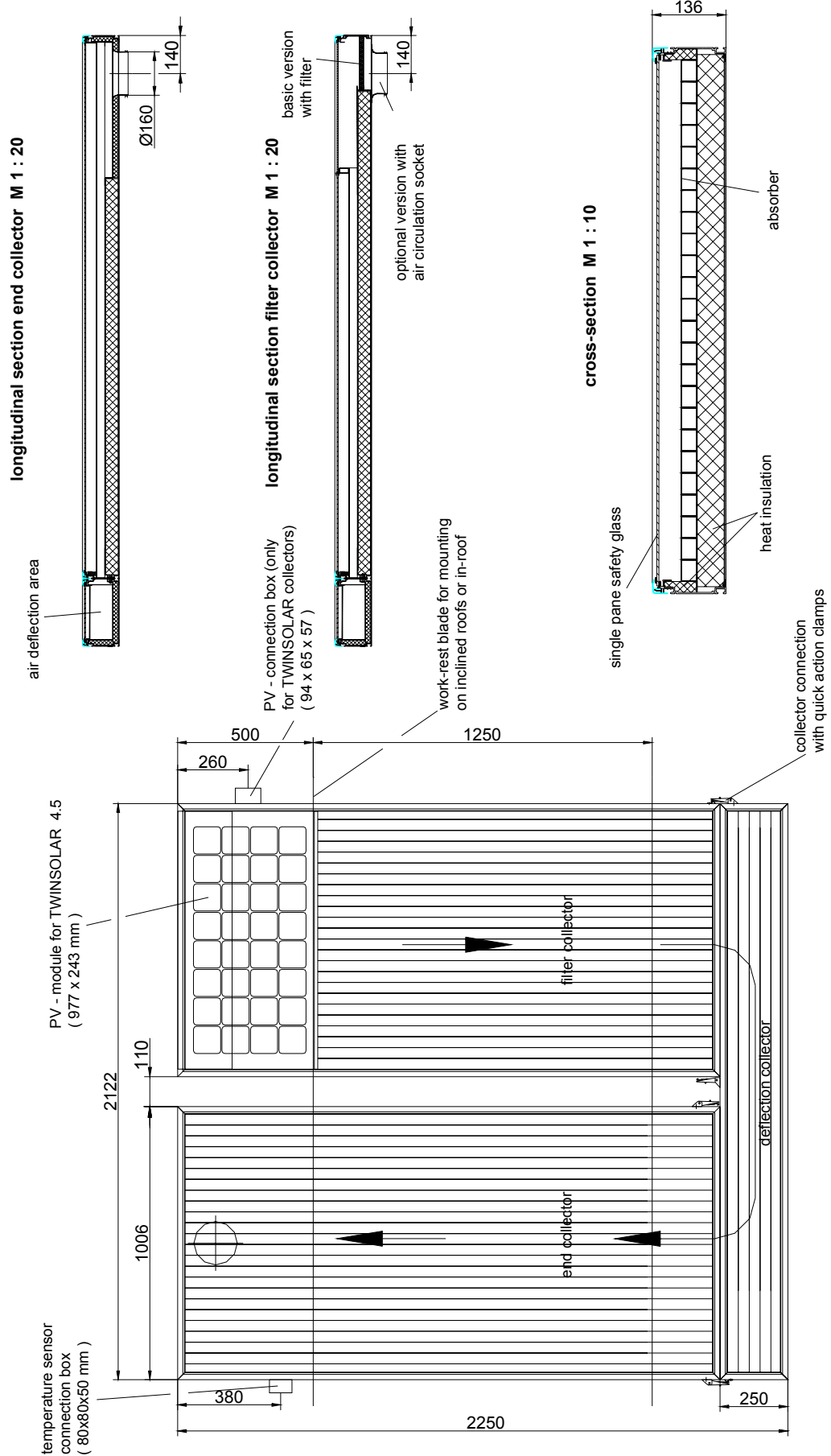
**TOPSOLAR 8.0**  
**TWINSOLAR 8.0 ( with PV - module )**

# TWINSOLAR 10.0



**TOPSOLAR 10.0**  
**TWINSOLAR 10.0 ( with PV - module )**

# TWINSOLAR 4.5

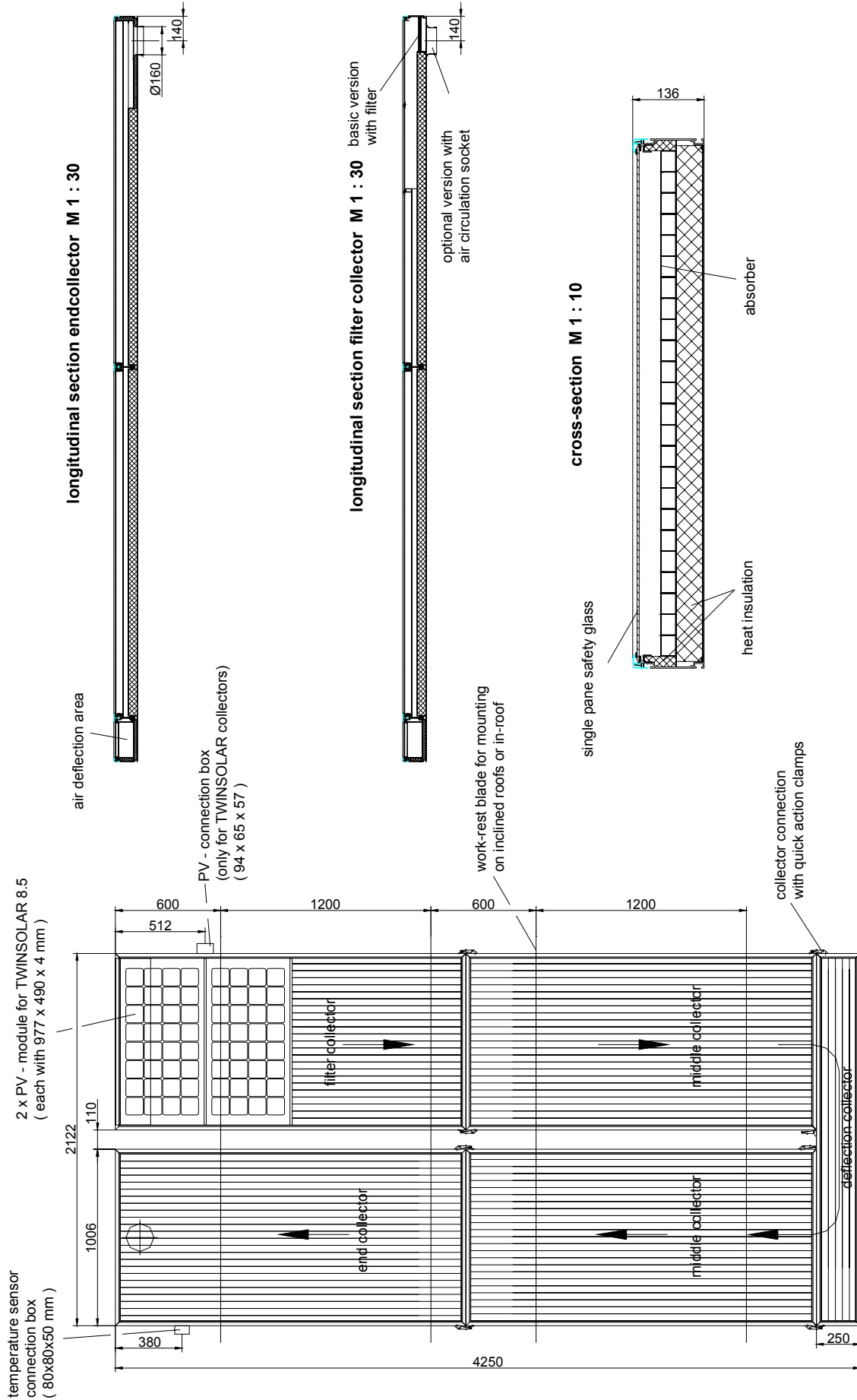


**TOPSOLAR 4.5**  
**TWINSOLAR 4.5 ( with PV - module )**





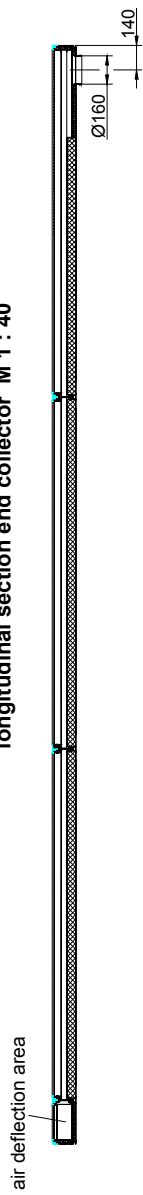
# TWINSOLAR 8.5 vertical



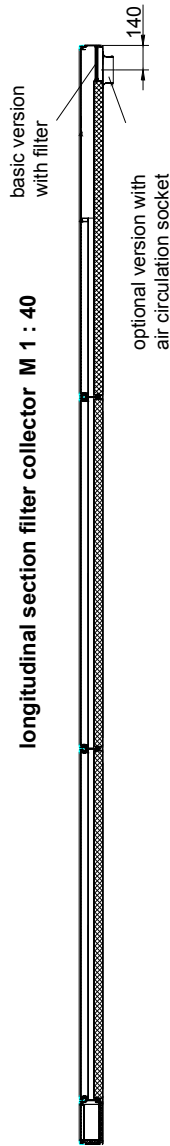
**TOPSOLAR 8.5**  
**TWINSOLAR 8.5 ( with PV - module )**

# TWINSOLAR 12.5

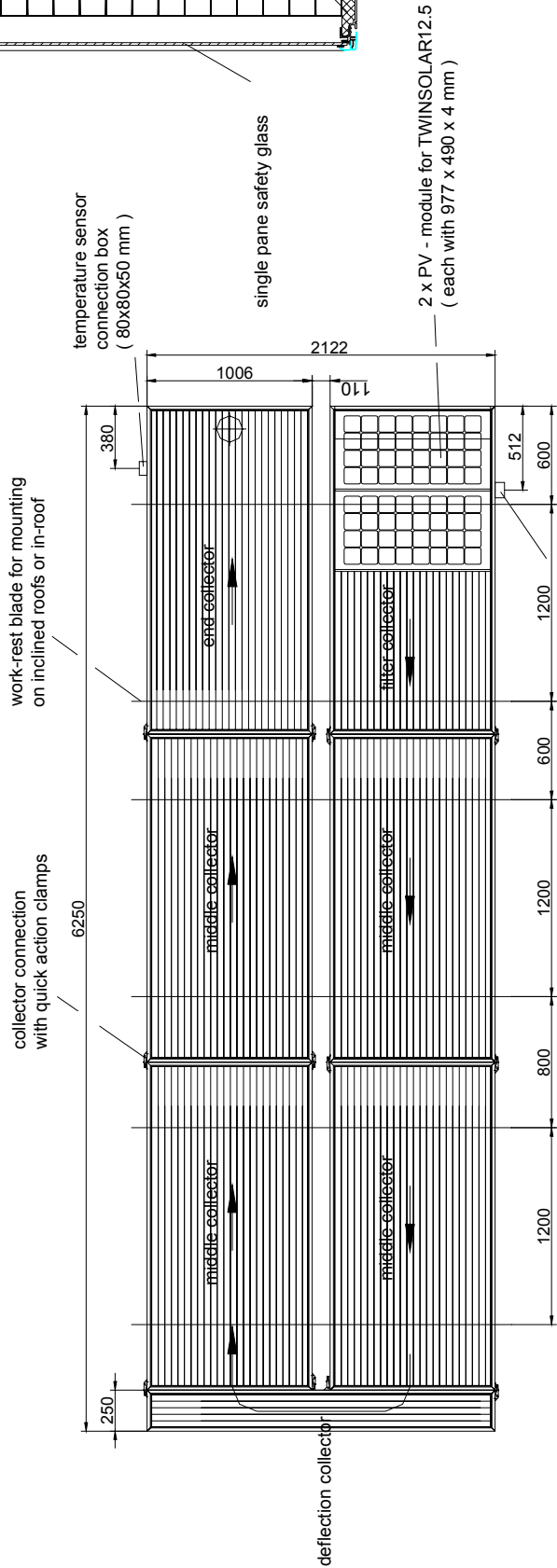
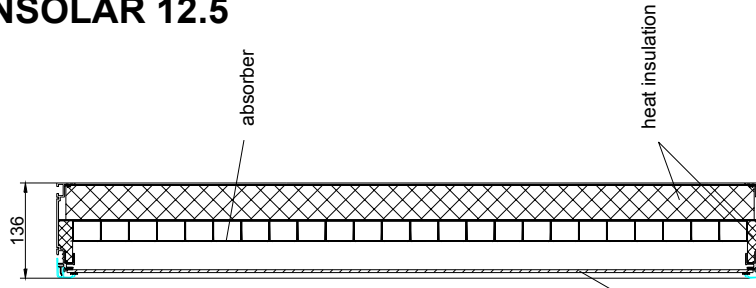
longitudinal section end collector M 1 : 40



longitudinal section filter collector M 1 : 40



cross-section M 1 : 10



TOPSOLAR 12.5  
TWINSOLAR 12.5 ( with PV - module )

Data sheet with manufacturer information on the collector			
Information about the type and the testing organisation			
Collector type / designation	<b>SLK – Solar air-base collector</b>		
Construction type	Air-base collector		
Manufacturer	GRAMMER Solar GmbH		
Testing organisation	ARSENAL RESEARCH A-Wien, ISE D-Freiburg		
Test according to STANDARD	There is currently no standard covering air-base collectors		
Test report	SLK200305_01 (ISE), IEA-TASK 19 SOLAR AIR SYSTEMS		
Performance characteristic values (all values with respect to the aperture area)			
Feature	Symbol	Unit	Typical values / examples (with respect to the aperture area)
Conversion factor for temperature difference ( $t_m - t_a$ ) = 0	$\eta_0$	-	0.834
Linear collector efficiency	$a_1$	W/(m <sup>2</sup> x K)	3.197
Squared collector efficiency	$a_2$	W/(m <sup>2</sup> x K)	0.034
Irradiation angle correction factor	$K_{\theta}(50^\circ)$	-	0.96
Pressure loss curve	$\Delta p = a_1 \times m + a_2 \times m^2$		
Recommended area for flow		m <sup>2</sup> /(h x m <sup>2</sup> )	30 to 60
Specific (area) heat capacity (full)	$c$	W/(m <sup>2</sup> x K)	
Housing			
Dimensions (L x W x H)		all mm	2000 x 1006 x 136
Material			aluminium
Total mass of the collector (full)		kg	45
Absorber			
Absorber material, material thickness Connecting technology to the tube register			aluminium, t = 0.6 mm no tube register
Material of heat transfer medium ducts			aluminium (absorber = air duct)
Heat transfer medium contents	$V_A$	l	55 l (air duct)
Transparent covering			
Material, thickness, possible coating			single pane safety glass, 4 mm, -
Heat insulation			
Type, material			insulation mats, mineral wool
Heat conductivity	$\lambda$	W/(m x K)	0.040
Thickness			50 mm (on the back) or 20 mm (on the sides)
Reference areas			
Gross area	$A_G$	m <sup>2</sup>	2.01
Aperture area	$A_a$	m <sup>2</sup>	1.86
Effective absorber area	$A_A$	m <sup>2</sup>	3.25
Limiting data for operation			
Temperature at standstill		°C	150°C
Permitted operating pressure		bar <sub>ü</sub>	operation at underpressure
Permitted heat transfer medium			air
Installation modes			
Types			on roof, in roof, separate installation, wall installation frame mounted or integrated

