

Apollo PANDA AL1206 Installation Manual



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Introduction

Apollo's proprietary technology: flexible, light weight, durable and efficient solar modules designed to transform any surface under the sun into an electricity source.

Apollo's PV modules are specially designed for structures and buildings with limited load-bearing capacity. The Apollo ultralight and fully flexible technology enables the owner of those facilities to join the solar revolution without compromising on the solar system's efficiency, productivity, and durability.

The following manual focuses on the Apollo PANDA (AL1206) applications for:

- structures with corrugated steel deck
- any structure that complies with the mechanical and electrical instructions in this document

Apollo PANDA may be installed on, or attached to, a wide variety of substrates. Depending on the installation type, the modules can be:

- Adhered to various substrates using recommended double-sided tape \ single-component adhesives
- Attached to the substrate with drilled screws thru designated areas in the module periphery
- laminated to FR4 sheet

Note that the installation kit provided by Apollo contains the PV module only. Required installation materials mentioned in this manual (adhesives, screws, etc.) shall be provided by the installer.

Disclaimer

The product referenced in this manual was designed and manufactured by Solarpaint Ltd. a subsidiary of Apollo Power Ltd. ("**Apollo**"). In this manual, both companies will be referred as Apollo. The information provided herein is provided "As Is". Apollo makes no representations or warranties with respect to the content hereof and assumes no responsibility for any inaccuracies, errors, or omissions that may appear in this information. The installation, operation, use, and maintenance of photovoltaic (PV) products are beyond Apollo's control, Apollo does not accept any responsibility and expressly disclaims liability for loss, damage, or expense of any kind arising out of or in any way connected with such installation, operation, use or maintenance or compliance or non-compliance with the instructions set forth in this manual. No responsibility is assumed by Apollo for any infringement of patents or any other rights of third parties, which may result from the use of the PV product and/or this manual.

No license is granted by implication or otherwise under any patent or patent rights. The information in this manual is based on Apollo's knowledge and experience and is believed to be reliable, however, such information including (without limitations) product specification and suggestions do not constitute a warranty, expresses or implied. Apollo reserves the right to change the installation manual, the PV product, the electrical specifications, or the product information sheets without prior notice.

In the event of any inconsistency among different language versions of this document, the English version shall prevail. Please refer to our documents published on our website at: **www.Apollo-power.com**. these documents are updated regularly.

Safety

- The instructions related to safety and use indicated in this installation manual are intended for the prevention of unexpected danger, damage, or failure. Please notice the markings when indicated:
DANGER  **WARNING**  **CAUTION** 
- Non-compliance with the instructions may cause product damage, product failure, and/or serious injury or death and void the product warranty.

DANGER

- Do not contact electrically active parts of the panel, such as terminals, without appropriate safety gear. Contact may result in a lethal spark or electric shock
- Do not use or install if the module is broken or torn. Failure to comply may result in an electric shock
- Due to the risk of electrical shock, do not perform any work if the terminals of the PV module are wet
- Damaged modules must be treated by professional experts using safety protection equipment. Failure to comply may result in severe injury or death
- Do not approach the damaged or broken module unless you are an authorized or qualified expert. Failure to comply may result in severe injury or death
- Installation during rain, heavy wind, or snowy day may result in injury or death

WARNING

- Always wear protective gear, insulated gloves, and safety shoes
- Perform all work in dry conditions and use only dry tools
- Do not reconnect or repair the junction box cable. It may cause a spark or electric shock
- Do not bend the junction box's cable. While under stress, it may cause module damage
- Module bending radius is up to 650 mm, attempt to overbend the module will damage the module and void warranty
- Cable bending radius should be larger than 4 times the cable diameter

CAUTION

- Heavy objects must be kept off the module
- Do not stand on or step on the module
- Do not drop the module. Failure to comply may result in product damage, product failure, or injury
- Do not scratch the surface of the module. Scratches may decrease Module's power output
- Do not artificially concentrate sunlight on the solar module surface. Failure to comply may result in product damage or failure.
- Do not carry or handle the Module by the junction box of the module by the cable. Failure to comply may result in product damage

- Do not remove the labels attached to the module
- Upon module electrical connection, verify visually and audibly that all connectors are properly fastened. When reaching the correct position, an audible "click" sound should be heard
- Do not expose the PV module to excessive loads on the surface of the PV module or twist the module

Always use common sense to avoid injury. When in doubt, contact an Apollo Specialist for assistance at info@apollo-power.com

Storage, unpacking, and pre-installation information

- Modules should be stored in a dry and ventilated environment and avoid direct sunlight and moisture
- Do not stack more than 2 pallets in height. **CAUTION**  **Excessive stacking will result in product damage and loss of warranty.**
- In case the modules are stored in an uncontrolled environment, the storage time should be less than 1 month extra precautions should be taken to prevent connectors from being exposed to moisture or sunlight (using connector endcaps, covering the pallet and module packages with a material fit for the environmental conditions on site)
- Unpack module pallets carefully, **CAUTION**  be sure not to penetrate the package with any sharp object as it may damage the modules.
- Modules must always be unpacked and installed by two people.
- Installers must consider the maximum bend radius of the installed module which may not exceed it.



- Keep the modules packed in the original package until installation

Disposal

Apollo solar Modules are 85% recyclable and to be disposed per WEEE (Waste Electrical and Electronic Equipment) Directive 2012/19/EU. the modules do not contain environmentally \ human harming materials. Please contact us for any disposal information and quarries.

Site module layout

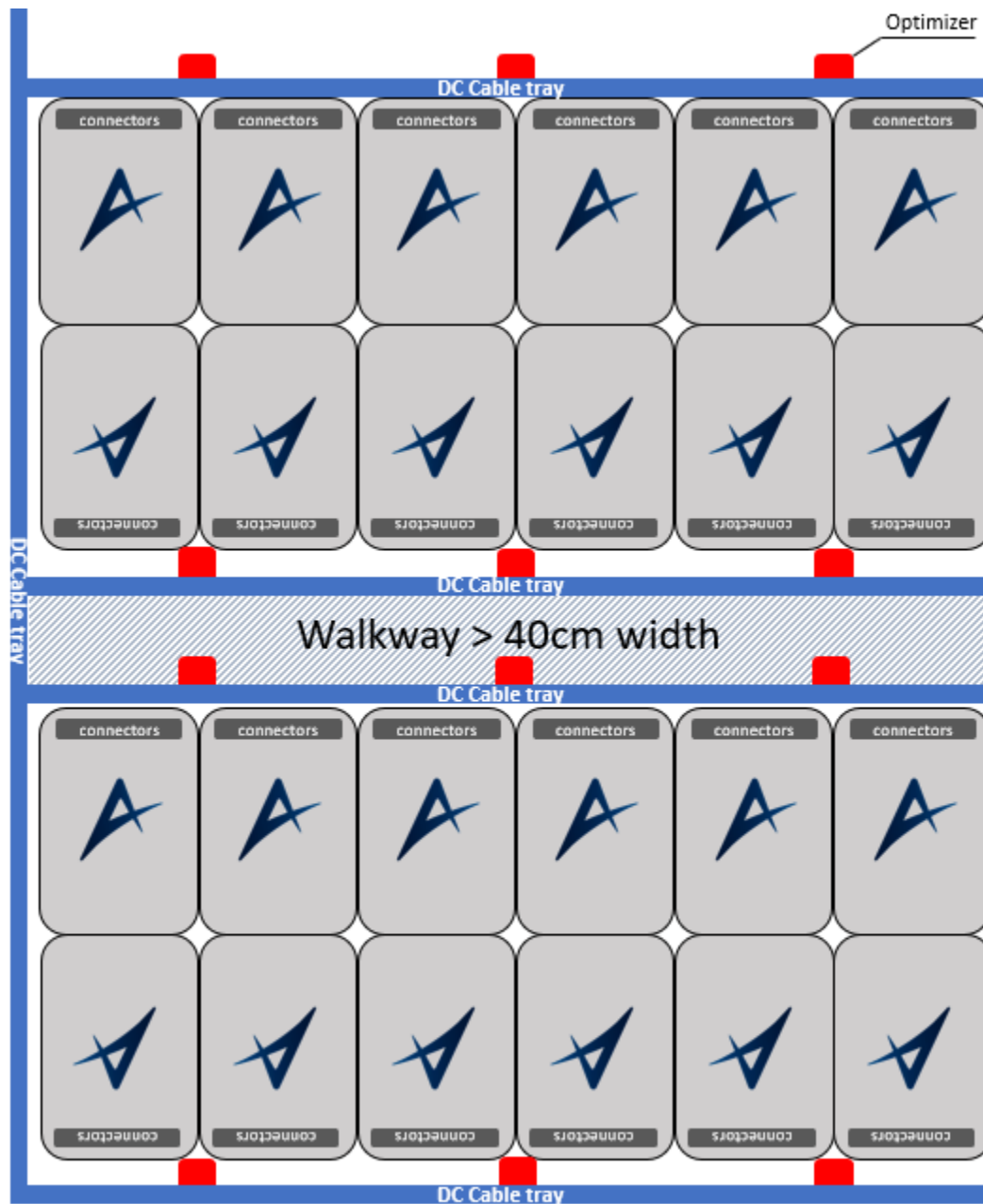
The layout information below refers to all methods of installation on this manual.

- Recommended string installation layout:



*distances between elements to be determined considering system position & shadings

- Recommended optimizer installation layout:



*distances between elements to be determined considering system position & shadings

- * Maintenance spacing specified above DO NOT include additional clearance for string cable tray. Add required spacing according to the specific site specifications.

Electrical connections and information

Module electrical ratings are measured under Standard Test Conditions (STC) of 1000 W/m² irradiance, with an AM1.5 spectrum, and a cell temperature of $(25 \pm 2)^{\circ}\text{C}$ in accordance with IEC 60904-3. Detailed electrical and mechanical characteristics of Apollo PV modules can be found herein and at www.Apollo-power.com. The main electrical characteristics at STC are also stated on each module label. Please refer to the datasheet or the product nameplate for the maximum system voltage.

Note that under certain conditions the module may produce more current or voltage than under its Standard Test Condition's rated power. As a result, the module short-circuits current under STC should be multiplied by 1.25, and a correction factor should be applied to the open-circuit voltage (see calculation below) when determining component ratings and capacities. Depending on your local regulations, an additional 1.25 multiplier for the short-circuit current (giving a total multiplier of 1.56) may be applicable when sizing conductors and fuses.

Open-circuit voltage can be calculated using the following formula:

$$\text{Correction factor } V_{oc} = 1 - \beta \times (25 - T)$$

Where:

T is the lowest expected ambient temperature at the system installation site

$\beta \left[\frac{\%}{^{\circ}\text{C}} \right]$ is the voltage temperature coefficient of the selected module (refer to the corresponding datasheet)

Note that Electrical calculations and design must be performed by certified personnel.

System adjustment calculations

Maximum No. of modules in parallel (n_p):

$$n_p < \left(\frac{\text{max series fuse}}{1.25 \cdot I_{sc}} \right) + 1$$

$$n_p < 3.38$$

Therefore max No' of modules in parallel is **3**.

Maximum No. of modules in series (n_s):

$$n_s = \frac{V_{sys}}{1.25 \cdot V_{oc}}$$

$$n_s = 25.1$$

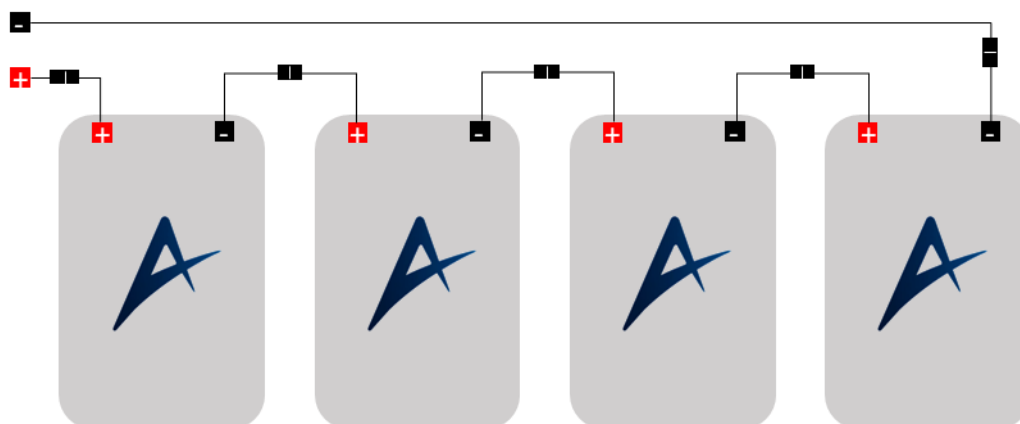
Therefore max No' of modules in series is **25**.

* Safety factor 1.25 given in norm, can be higher.

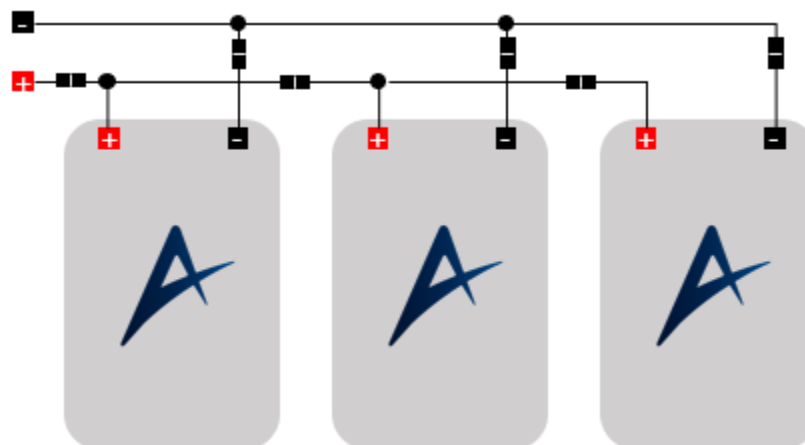
Wiring and connections

1. Series connection

NOTE: Modules with different characteristics must not be connected in series

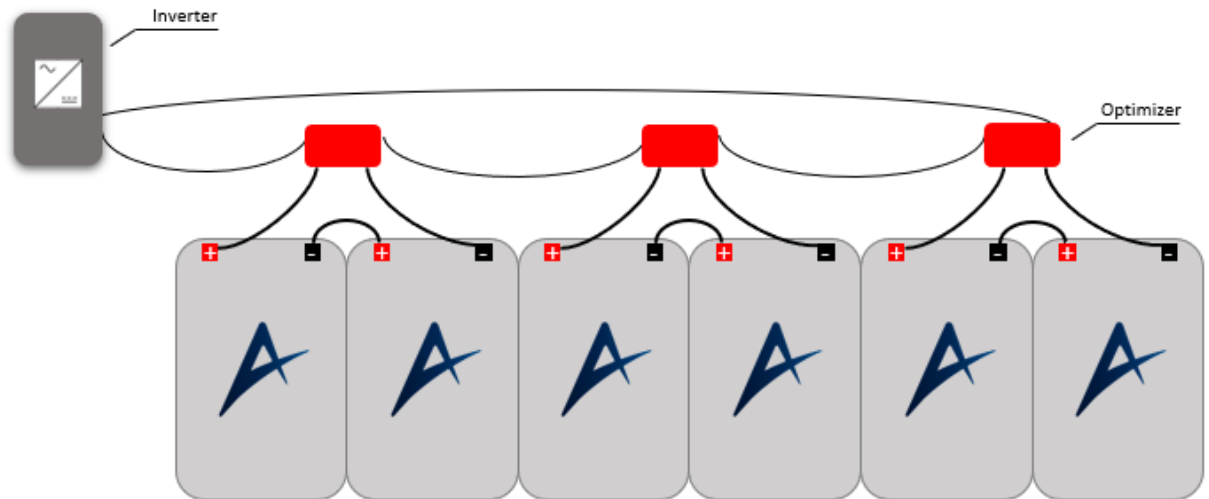


2. Parallel connection

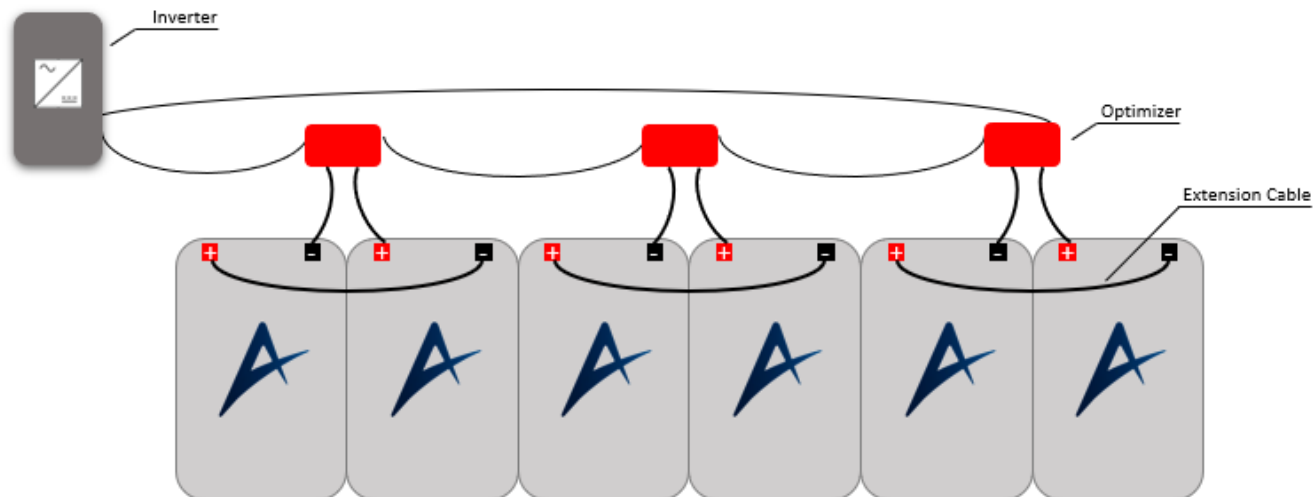


3. Optimizer string connection

- Configuration A



- Configuration B



4. Rapid shutdown\ Micro-inverter connection

Apollo PV modules may be connected directly to rapid shutdown devices, and micro-inverters. Please refer to the device technical design guide for specific connection instructions

Mechanical installation

1. Adherence:

a) Adhesion planning and Applicable substrates

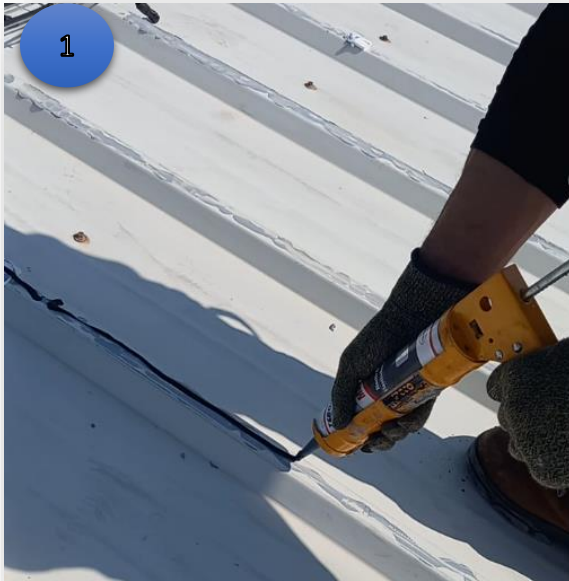
- Painted \ coated corrugated metal sheets, preferably PVDF-coated surfaces.
- Maximum surface Temp: 70[°C]
- **CAUTION** ⚠ during operation, the module temperature may reach up to 70[°C], **Do Not attach the module to a substrate that may be affected by the module temperature**
- **Always install the module at a slight inclination in order to allow water drainage and avoid**
- The module's correct position and adhesion areas are detailed in Annex A
- **WARNING** ⚠ installing PANDA modules in under rain \ windy conditions is forbidden and may void warranty.

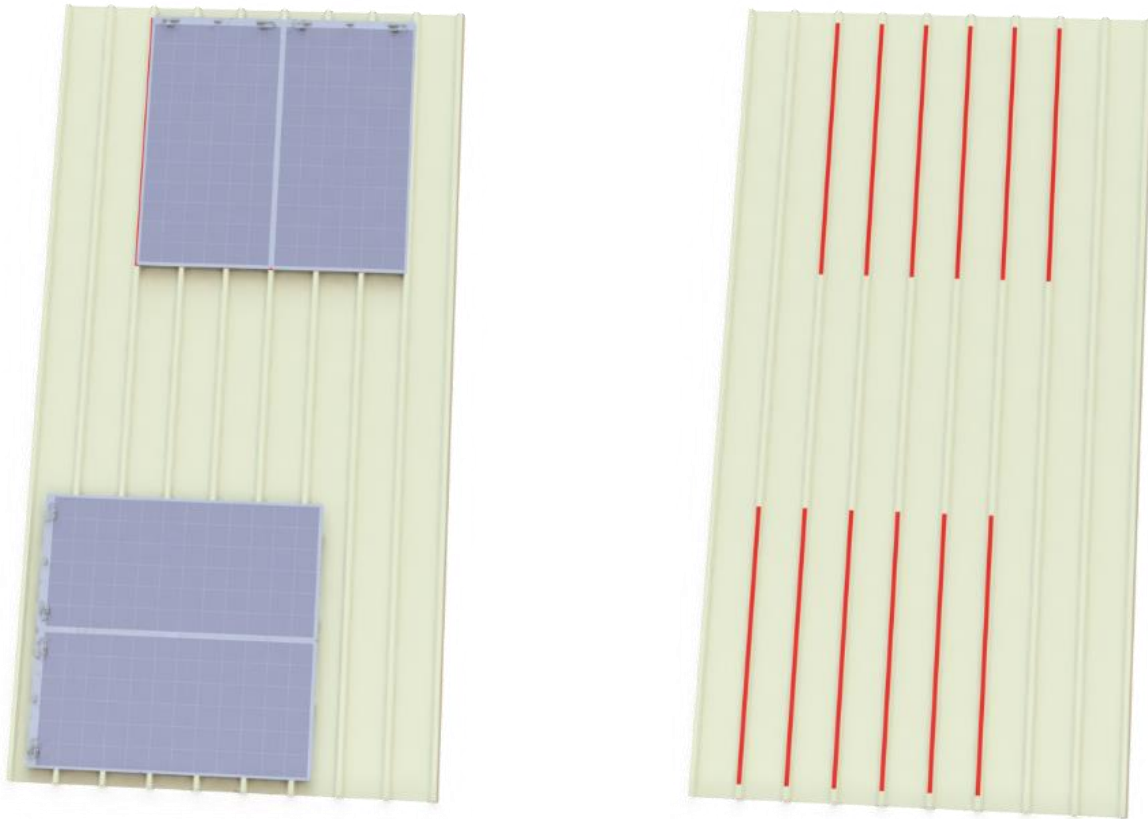
b) Surface Preparation

- 1) Substrate must be cleared of debris and sharp objects \ edges.
- 2) Ensure the surface is uniform and does not contain any loose paint or protective laminates.
- 3) Use water and detergent \ IPA to clean the substrate and model's back sheet adhesion surfaces.
- 4) **DO NOT** use solvents \ cleaning agents that may damage the substrate coating, make sure to remove any detergent residue.
- 5) Use a microfiber cloth or designated wipes.
- 6) Ensure the substrate and module substrate are fully dry before applying the adhesive.

c) Module application

- 1) Apply a continuous 3 to 4-mm diameter adhesive line along the top of the substrate trapezoidal deck in the designated area (NOTE: applying a larger thickness of glue line may cause under-curing and result in poor adherence)
- 2) If protruding screws are present, adhere to an EPDM foam layer on top of the screw. Apply the adhesive layer on top of the EPDM strip (see further details in Annex A)
- 3) Position the panel in the designated location and push **GENTLY** against the roof using your hand or a **soft** roller tool.
- 4) All the tops underneath the panels should adhere





Example: Horizontal and vertical installation on trapezoidal steel deck

d) Adhesive type and definition:

- Single component, silane-modified polymer
- Implementation in "paste" form
- Service temperature of -40 to+90 [°C]
- Hardness: 45-55 [Shore A]
- Tensile strength: 2.5 -3 [N/mm²]
- UV resistant
- Application temperature: 5 to 35 [°C]

e) Apollo-approved adhesives for painted steel deck:

Adhesive Manufacturer	Saudal	Teroson	Merbenit	FIX	FIX
Adhesive Name	Soudaseal 250XF	MS939	HM21	Expert FAST & EXTREME	Expert Transparent
Colors	Black, White	Black, White, Gray	White	White	Transparent
Datasheet					

f) Apollo-approved adhesive for polycarbonate corrugated sheet ("Suntuf"):

Adhesive Manufacturer	Saudal
Adhesive Name	Silirub PC
Colors	Transparent
Datasheet	

g) Adhesive quantities

A quantity of 220ml is required for adherence of each module.

h) Removal

Please refer to Annex B for module removal instructions.

2. Screw-mounted installation:

a) Applicable substrates

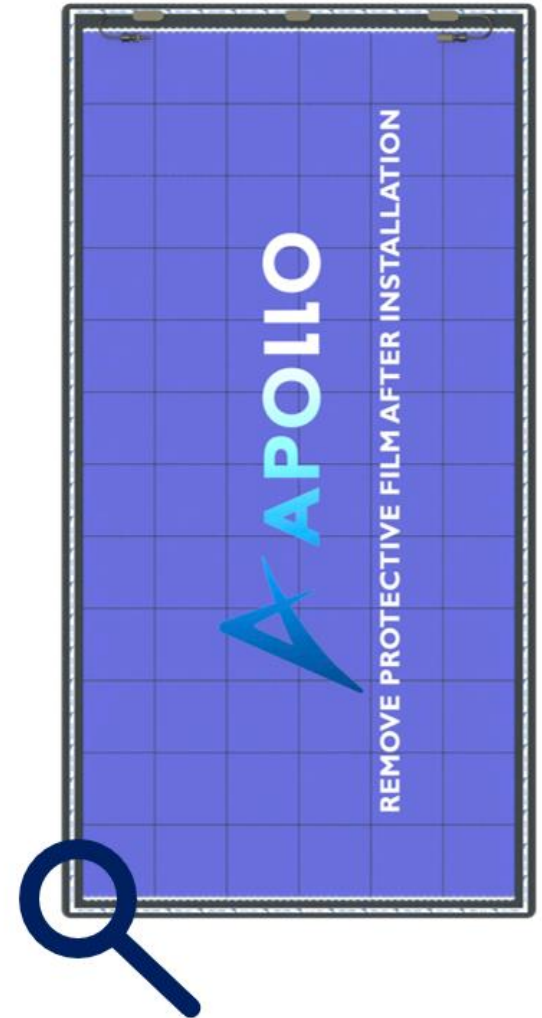
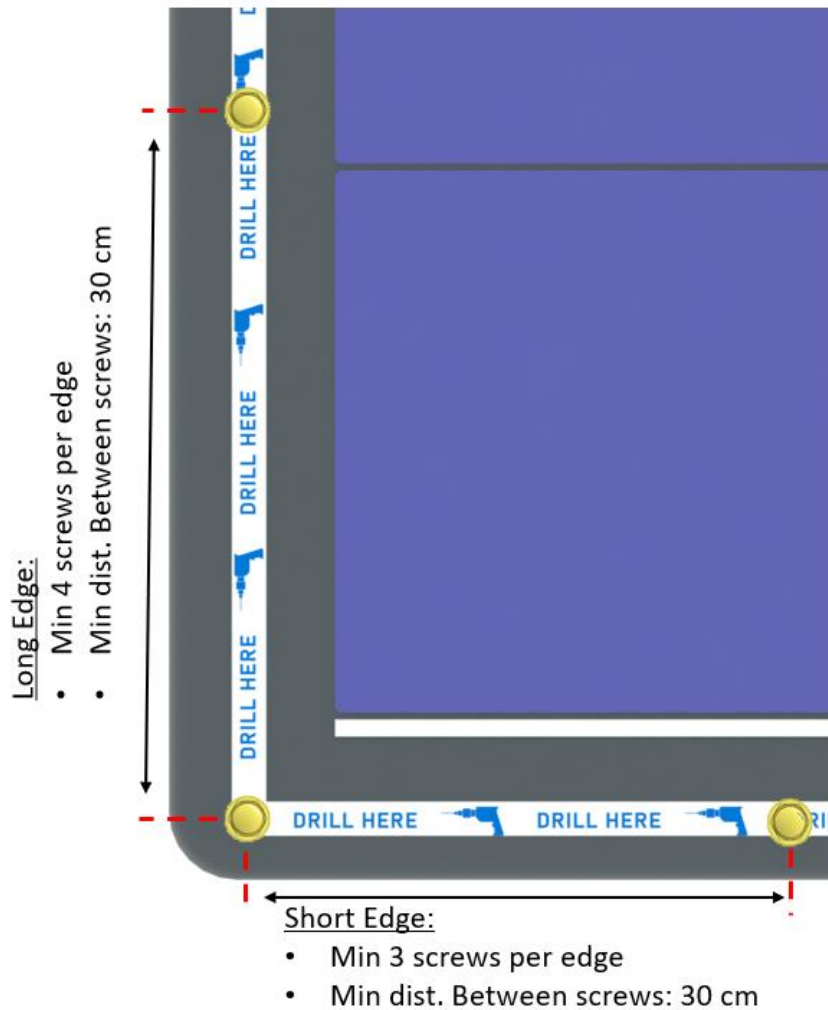
- Substrate must be cleared of sharp objects \ edges
- Any Hard surface (E.g. Corrugated metal sheets, wood, and steel frames)
- Maximum surface Temp: 70[°C]
- CAUTION: during operation, the module temperature may reach up to 70[°C], Do Not attach the module to a substrate that may be affected by the module temperature

b) Surface Preparation

- Use water and detergent \ IPA to clean the substrate and model's back sheet adhesion surfaces. DO NOT use solvents \ cleaning agents that may damage the substrate coating
- Use a microfiber cloth or designated wipes.
- Make sure the substrate is fully dry before initiating the installation process

b) Application

- 1) Position the module on the designated surface. make sure the screw lines are aligned and located above the desired substrate.
 - 2) Press gently against the substrate and apply screws on the marked area.
 - 3) CAUTION! – avoid excessive pressure on the module during the screw penetration process.
 - 4) Remove the protective film after installation.
 - 5) Screw location and quantity shall be determined by the installer according to the specific structure roof-bearing capability and specific site meteorological conditions.
 - 6) Reference design information: per each M6 screw, the PANDA module can bear a Maximum horizontal sheer force of [40 Kg] PER BOLT.
 - 7) NOTE: In order to avoid "wind flapping" effect, a minimum quantity of 4 screws on the module's long edge and 3 screws on the module's short edge of the module is essential.
 - 8) A minimum distance of 30 cm between screws is allowed.
 - 9) Use DIN or ANSI penetrating screws only.
 - 10) M4-M6 penetrating screws are recommended
- **NOTICE that application of screws outside the marked area will damage the module and void product warranty.**
 - **Unscrewed holes on the module surface will damage the module and the product warranty.**

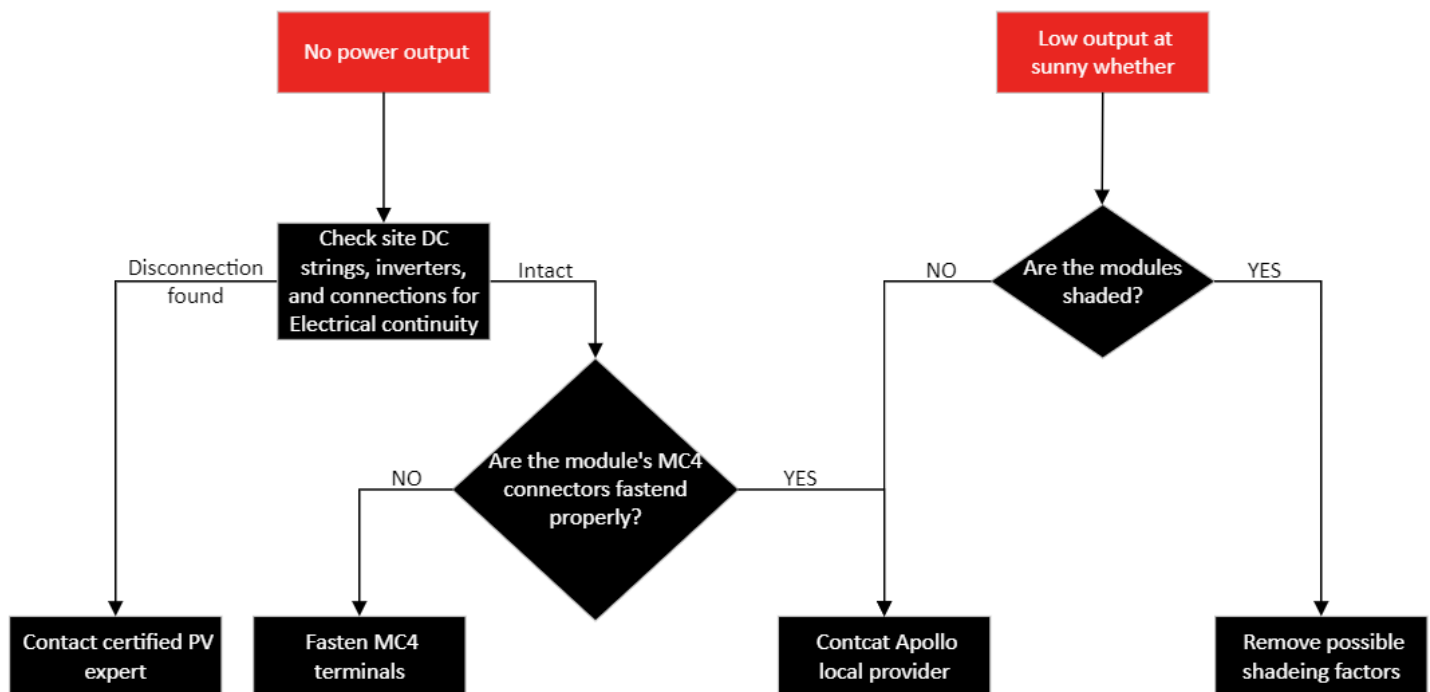


Maintenance

- **DANGER** ⚠️ Never perform any Maintenance activity under voltage. Always disconnect the system from the grid before maintenance activity.
- At least every 6 months, check the Apollo PANDA module surface for debris or dirt.
- Cleaning instructions and guidelines:
- Cleaning instructions and guidelines:
 - Verify there is no visible damage
 - use a soft brush or cloth. Never use chemicals when cleaning the module as this may affect the module warranty and energy output

- Never use abrasive material under any circumstances
- Avoid using excessive downforce when cleaning
- Never use power cleaners (jet pressure cleaners). Maximum recommended water pressure: 4 Mpa
- Water quality requirements:
 - PH: 5-7
 - Conductivity: 1500-3000 $\mu\text{c}/\text{cm}$
 - Hardness: 0-40 mg/L
 - TDS: ≤ 1000 mg/L
- Check all wiring to confirm no loose connections or insulation wear.
- Examine the module for signs of deterioration. Check all wiring for possible rodent damage, and weathering and ensure that all connections are tight and corrosion free
- Check the junction box. If you have any junction box problems, please contact Apollo

Troubleshooting



Module operational environmental conditions

Temperature	Relative Humidity
-40°C to +85°C	20% to 100%

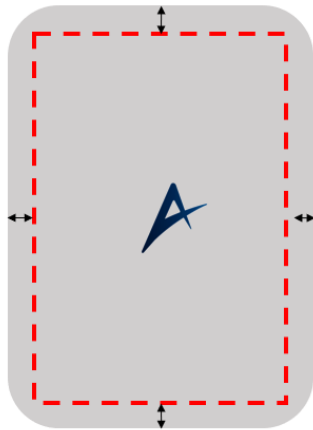
* Any PV module power is seriously degraded due to shading, when placed or installed avoid possible shading (full or partial) from trees, poles or any other obstacle around.

ANNEX A – AL1206 position and adherence areas on steel deck

1) General principals

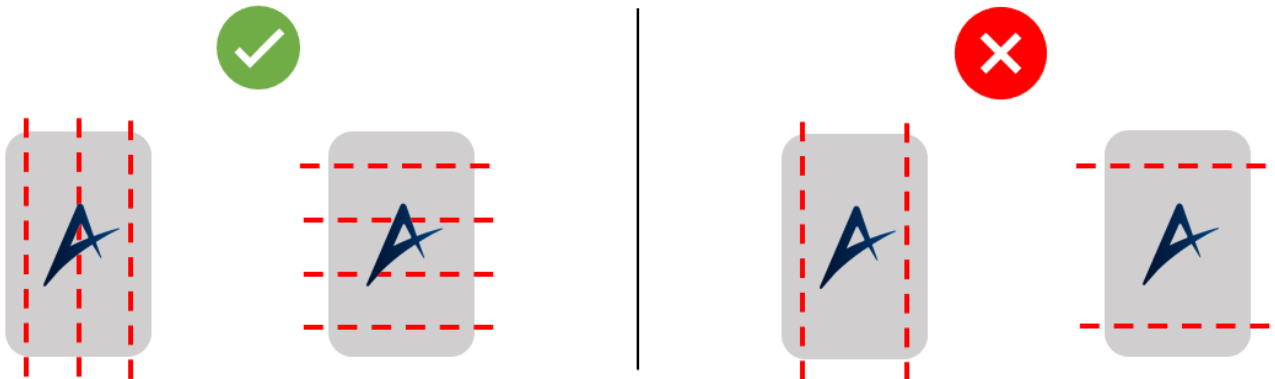
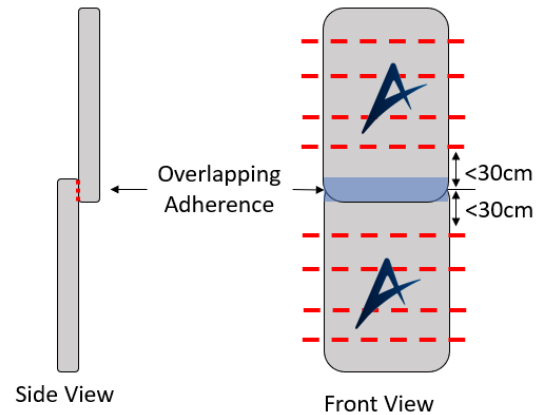
- a) The module shall adhere at a Minimum of 3 adhesion lines if the lines are parallel to the long edge and a Minimum of 4 adhesion lines if the lines are parallel to the short edge.
- b) The maximum distance from the last adhesion line to the module edge is 15 cm. exceptions can be made up to 40 cm from the edge by overlapping adhesion of 2 modules (see drawing below).
- c) When adhering to the steel deck with penetrating screws, apply EPDM strips above and along the screws as shown in the drawing below. Make sure to apply the adhesive over and under the EPDM strip. NOTE that the last 20cm of the adhesion lines (close to the module edges) must be cleared of EPDM and adhere the module directly to the substrate.

2) Reference examples



Maximum distance from the last adhesion line to the module edge is 15 cm

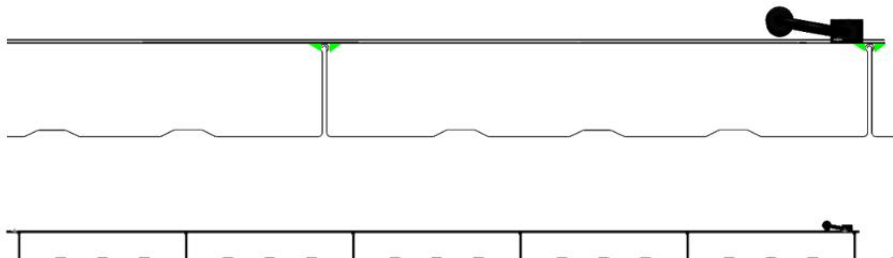
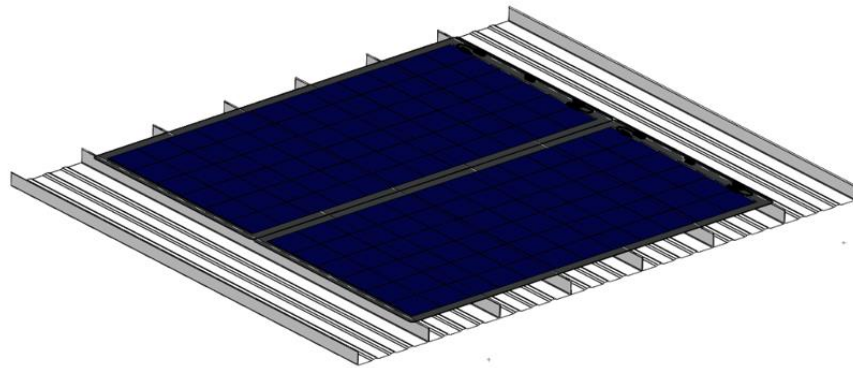
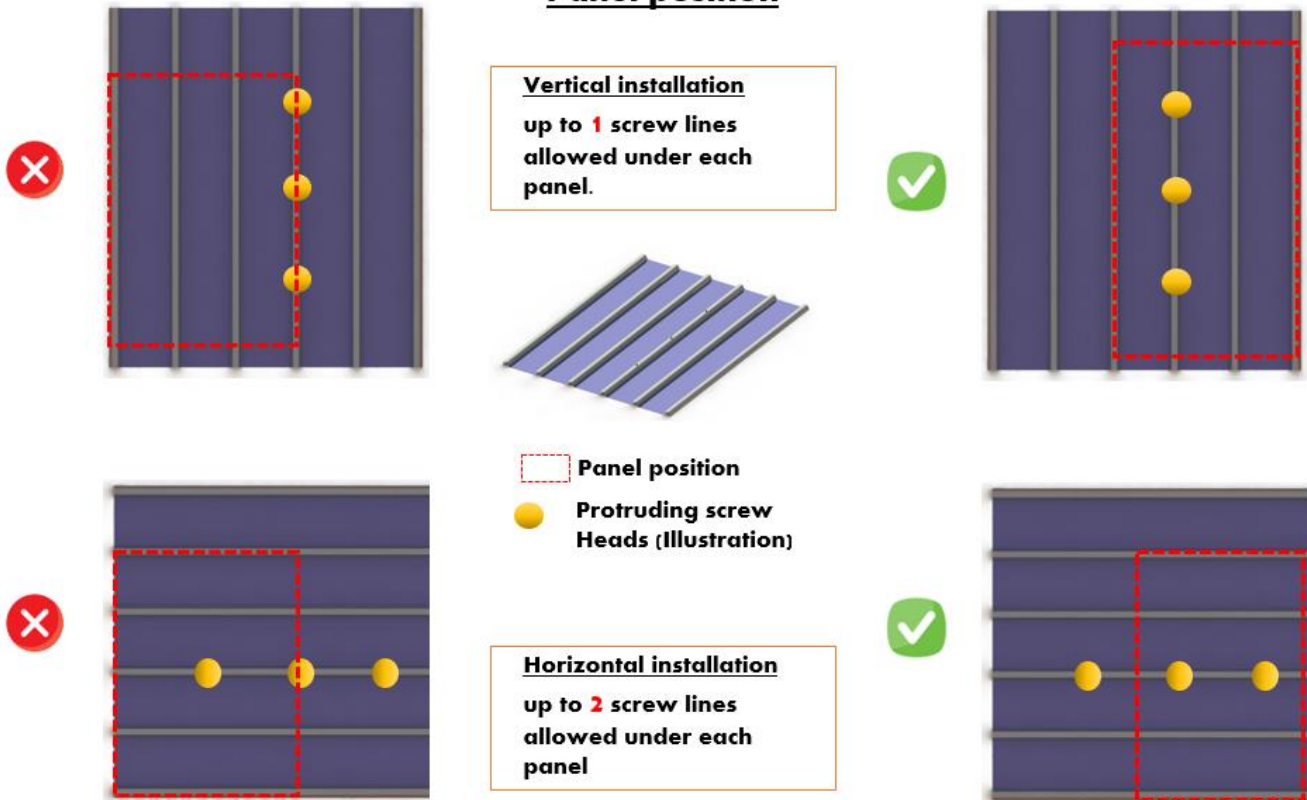
overlapping adhesion of 2 modules when adhesion lines are far from the edge (UP to 40 cm). The exception is valid only for the overlapped edge



Adhesion Parallel to the long edge - Minimum 3 Adhesion lines.
 Adhesion Parallel to the short edge - Minimum 4 Adhesion lines

Trapezoidal steel roof (PBR metal sheet) with protruding screws

Panel position



Example: positioning an array along a "standing seam" steel deck

ANNEX B – AL1206 removal from steel deck adherence

1. Safety:

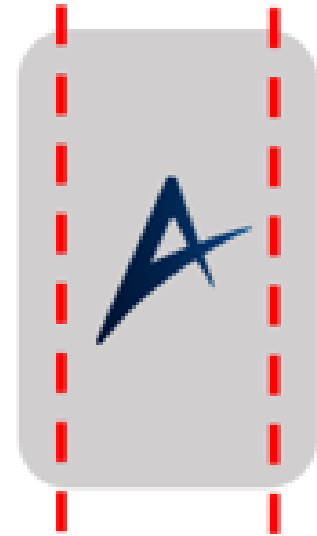
- a. **DANGER** ⚠ prior to module removal, Ensure the module is not connected to the grid.
- b. Follow all safety instructions warnings and limitations in "safety" chapter of this document.
- c. **DANGER** ⚠ the adherence removal process causes permanent damage to the modules!
Do not try to re-install or re-use removed modules in any case – this may cause electrocution and/or fire hazard.

2. Required tools:

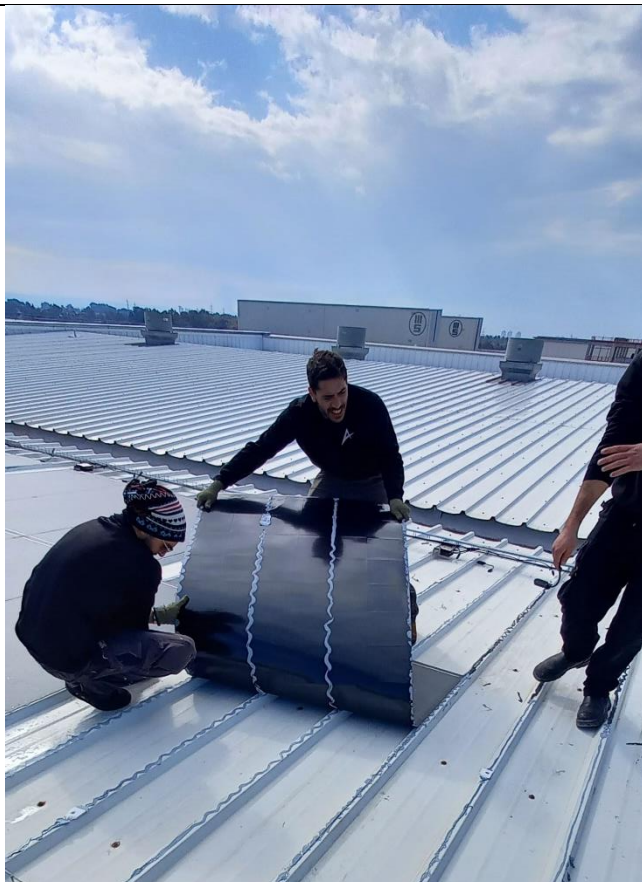
- a. Utility knife.
- b. Protective gloves.

3. Required personnel: minimum 2 workers.

4. Module removal procedure:



Using utility knife, CUT between the side adhesive lines of each module while applying force to separate the module from the substrate



With 2 workers: lift the top of the module and start peeling the module off. The most efficient peel is a 180 degree peel. You may use the utility knife to help remove the adhesion lines while peeling the module



Use utility knife or scraper to remove adhesive residue from the roof prior to installing new modules

5. **Disposal:**

Apollo solar Modules are 85% recyclable and to be disposed per WEEE (Waste Electrical and Electronic Equipment) Directive 2012/19/EU. the modules do not contain environmentally \ human harming materials. Please contact us for any disposal information and quarries.