

Apollo AL1206 ("Panda") Installation Manual



The information contained in this installation manual is the exclusive property of Solarpaint Ltd, a subsidiary of Apollo Power Ltd ("Apollo"). No part of this manual may be reproduced, transmitted, transcribed, stored in a retrieval system or translated into any language or computer language in any form or by any means, electronic, mechanical, magnetic, optical, manual, or otherwise, without the prior written permission of Apollo.

Contents

Introduction	3
Disclaimer	3
Safety	4
Storage, unpacking, and pre-installation information	5
Disposal	5
Site module layout.....	6
Electrical connections and information	8
Mechanical installation	11
Maintenance.....	19
Troubleshooting	20
Module operational environmental conditions	20
ANNEX A – AL1206 position and adherence areas on steel deck	21
ANNEX B – AL1206 removal from steel deck adherence	24

Introduction

Apollo's proprietary technology: flexible, lightweight, 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 enable 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 AL1206 (Panda) applications for:

- structures with corrugated steel deck
- structures with PVC waterproofing membrane cover
- structures with Bitumen waterproofing membrane cover
- any structure that complies with the mechanical and electrical instructions in this document

Apollo AL1206 (Panda) may be installed on, or attached to, a wide variety of Non-combustible substrates. Depending on the installation type, the modules adhere to various substrates using recommended double-sided tape \ single-component adhesives.

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 to as Apollo. The information provided herein is provided "As Is". Apollo makes no representations or warranties concerning 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 outlined 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
- The minimum module bending diameter is 1000 mm, an attempt to overbend the module will damage the module and void the warranty
- Cable bending radius should be larger than 4 times the cable diameter
- Apollo AL1206 shall only be installed on Non-combustible surfaces

CAUTION ⚠

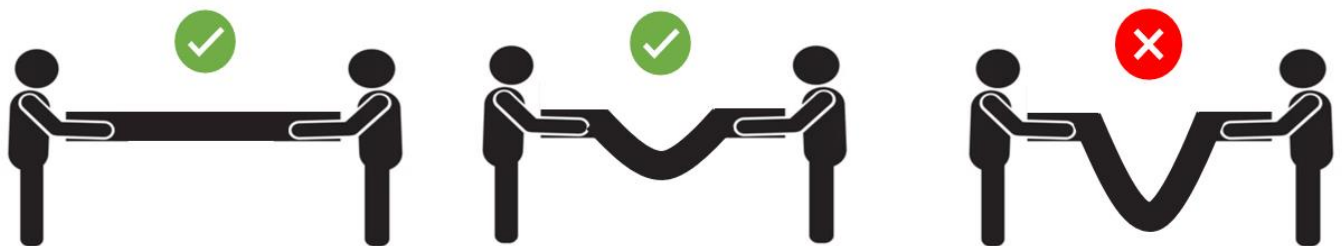
- Heavy objects must be kept off the module
- Do not stand on or step on the module
- Do not drop the module. Failure to comply may result in product damage, product failure, or injury
- Do not scratch the surface of the module. Scratches may decrease Module's power output
- Do not artificially concentrate 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 module are recyclable and do not contain toxic or environmentally harmful materials. Disposal instructions vary between different countries, please contact your local environmental administration for specific disposal information.

Site module layout

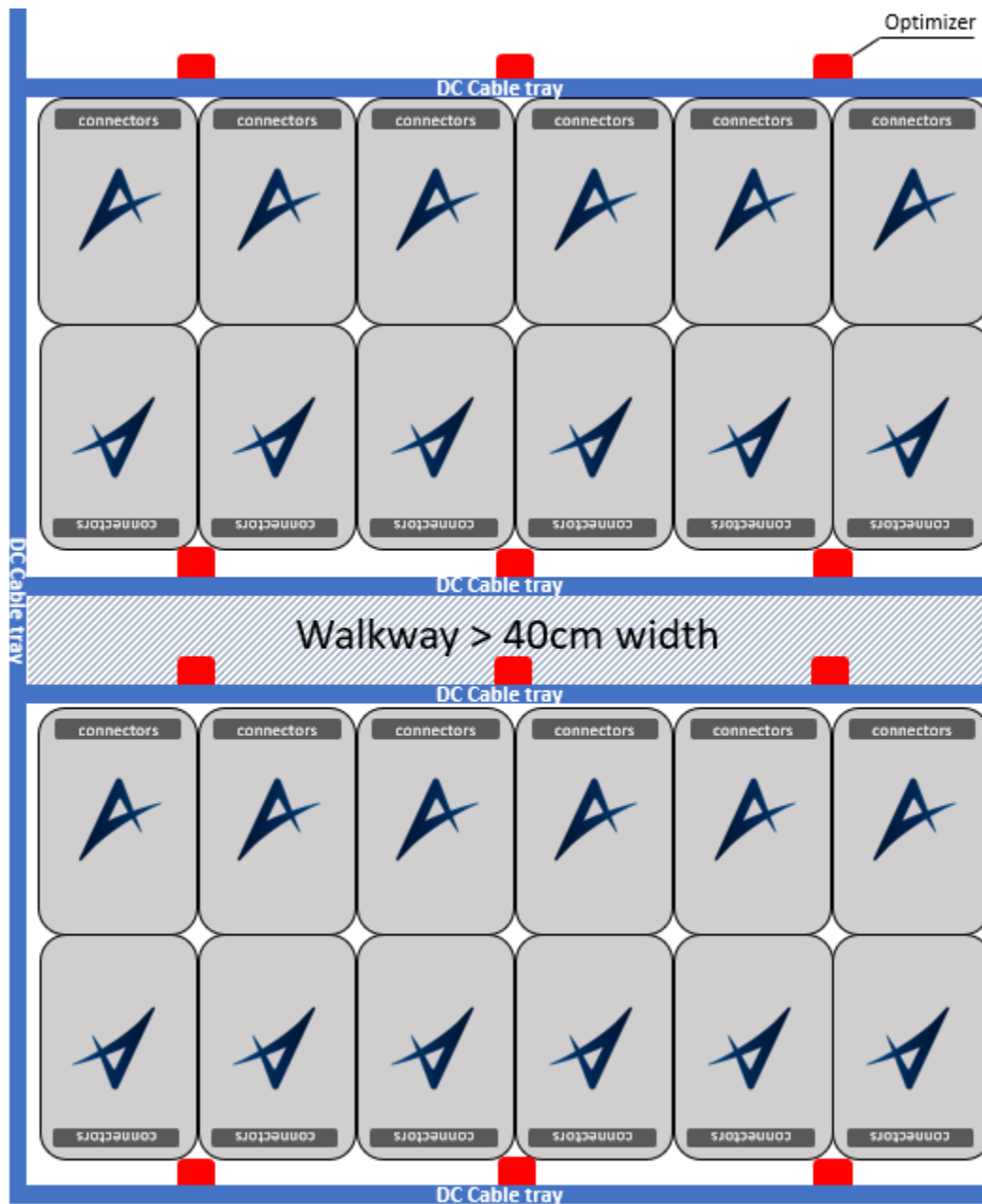
The layout information below refers to all methods of installation in this manual.

- 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 ± 2) °C per 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 and datasheet for the maximum system voltage rating, performance data and temperature coefficients.

The AL1206 module is safety Class 2 rated per IEC 61730-1

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-circuit 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. Maximum operating altitude:

Please consult Apollo power technical support department for more information on the use of modules in special climates, such as an altitude greater than 2000 m.

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

β [$\frac{\%}{^\circ\text{C}}$] 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.

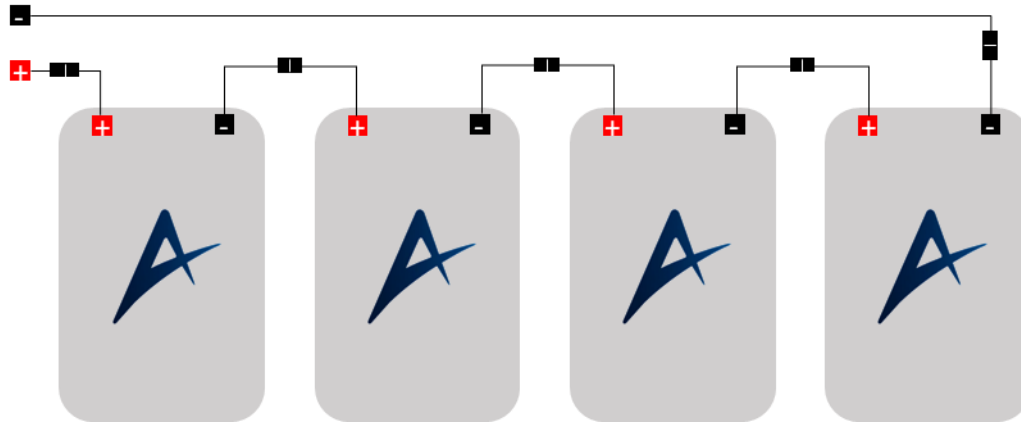
Wiring and connections

1. General information

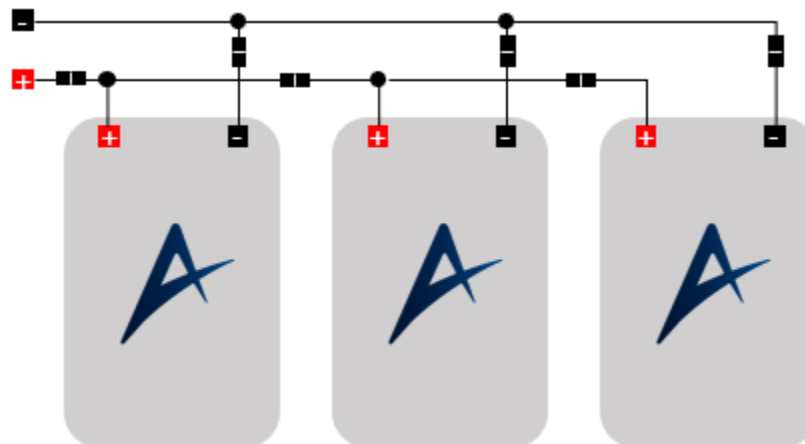
- The AL1206 module is wired with PV grade 4[mm²] cables with corresponding 1500V rated MC4-EVO2 connectors.
- DC string extensions and field wiring using IEC 62930 PV grade, UV and temperature resistant, flame retardant 6[mm²] wire, or larger diameter.
- Each module contains 3 units of 25A bypass diodes located inside the Junction box

2. Series connection

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

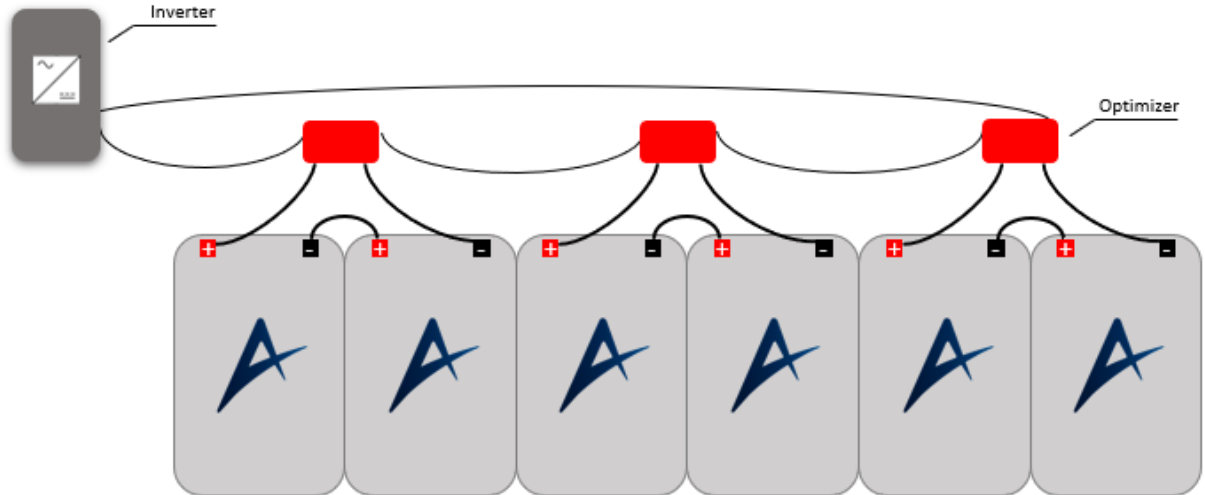


3. Parallel connection

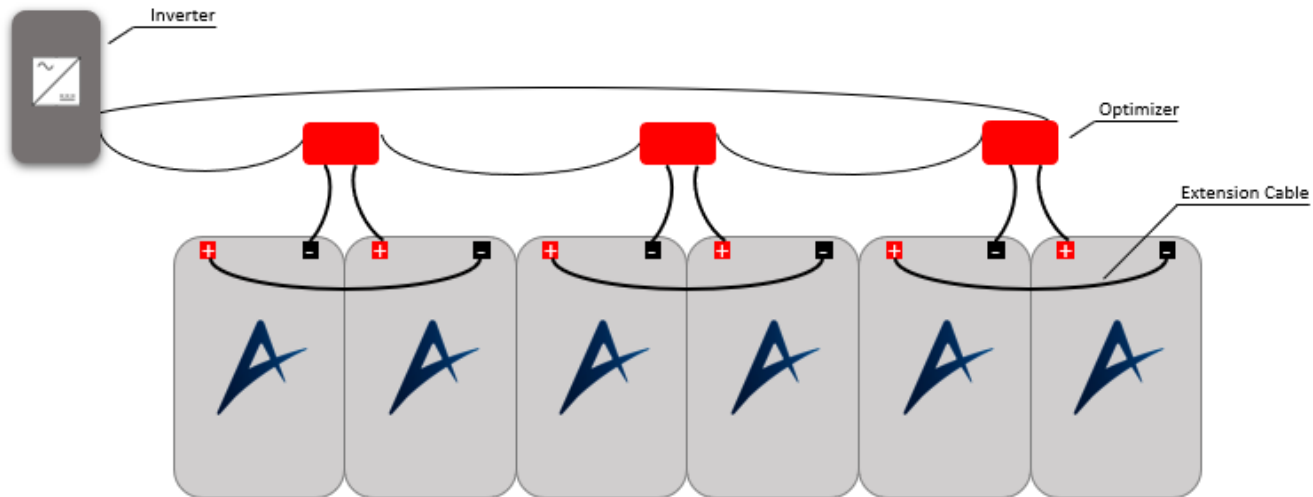


4. Optimizer string connection

- Configuration A



- Configuration B



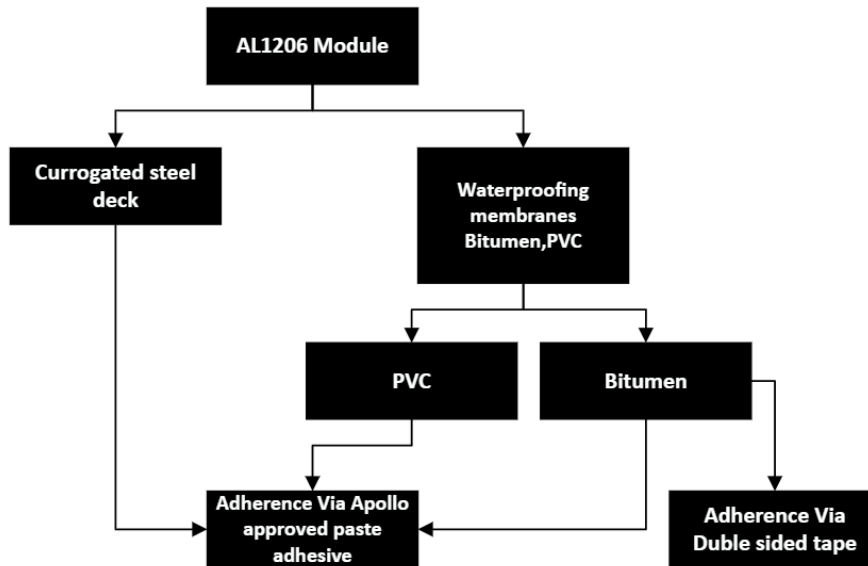
5. Rapid shutdown\ Micro-inverter connection

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. General

a. Module – Substrate interface diagram



b. General design information

- AL1206 modules were tested for 2400pa static load and 1000pa dynamic loads per IEC 61215.
- All installations must be approved by building engineering authorities, considering the environmental conditions, and predicted wind uplift, and subjected to local rules and regulations.
- Approved adhesives were tested to a minimum safety factor of 2.5 times the Approved static load. Adherence conditions and limitations vary per installation site. Please consult with Apollo technical support for any inquiries.
- The module is in compliance with this standard only when the module is mounted in the manner specified by the mounting instructions. A module with exposed conductive parts is in compliance with this standard only when it is electrically grounded in accordance with the manufacturer's instructions and the requirements of the National Electrical Code, ANSI/NFPA 70 (2014-2017).

2. Adherence:

a) Adhesion planning and Applicable substrates

- Painted \ coated corrugated metal sheets, preferably PVDF-coated surfaces.
- PVC and bitumen waterproofing membranes.
- 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 (up to 5 degrees) to allow water drainage and avoid soiling.**
- The module's correct position and adhesion areas are detailed in Annex A.
- **WARNING** installing PANDA modules under rain \ windy conditions is forbidden and may void the warranty.

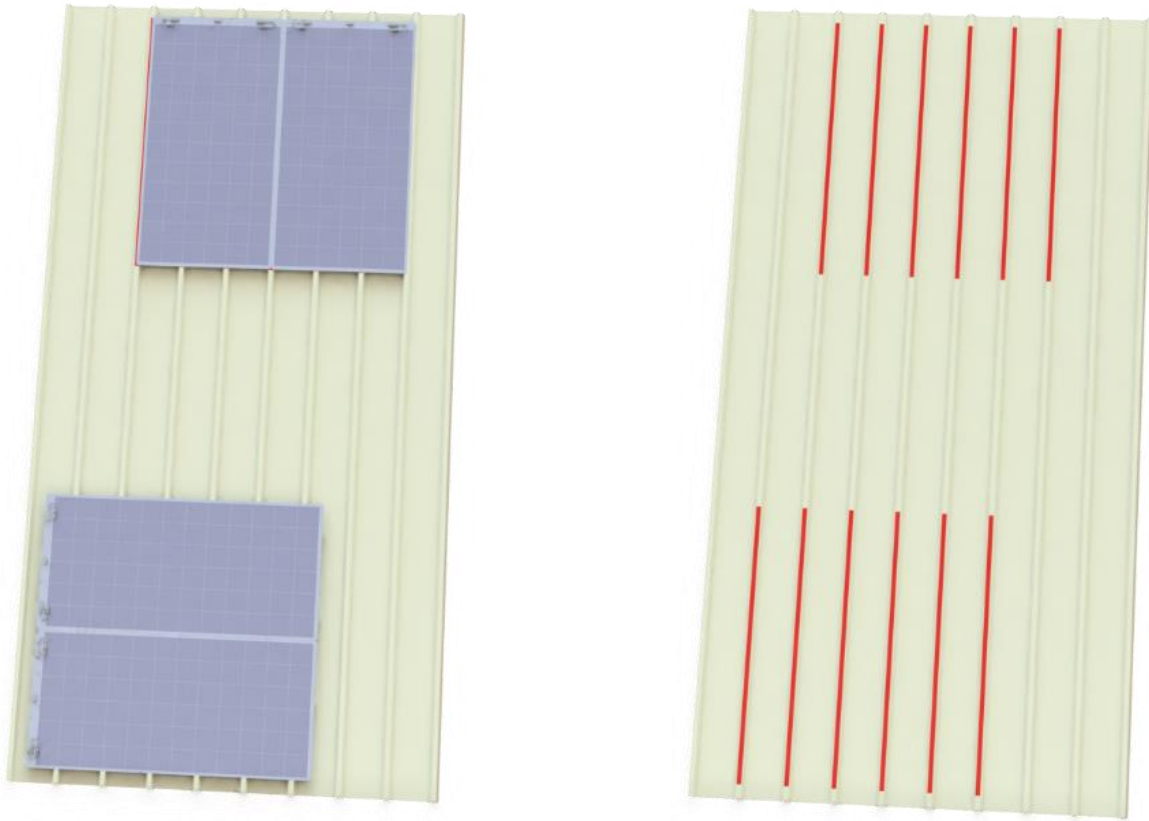
b) Surface Preparation

- 1) The 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.
- 7) **(For PVC installations)** Grid mark the designated location on the roof.
- 8) **(For Bitumen installations)** Grid mark the designated location on the roof. If the bitumen membrane contains loose aggregates, use flame and spazzle to form even, aggregate-free lines on the bitumen surface along the planned adhesion lines.

c) Module application on corrugated sheets

- 1) Apply a continuous 3 to 4-mm diameter adhesive line along the top of the substrate trapezoidal deck in the designated area, (preferably on a "zigzag" pattern, see pictures below) (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.

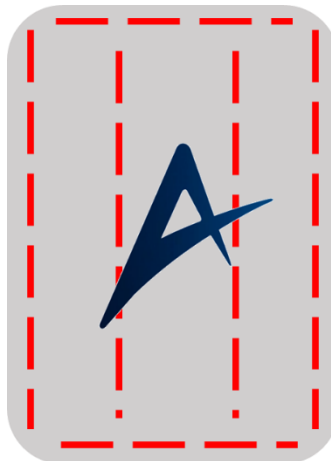




Example: Horizontal and vertical installation on trapezoidal steel deck

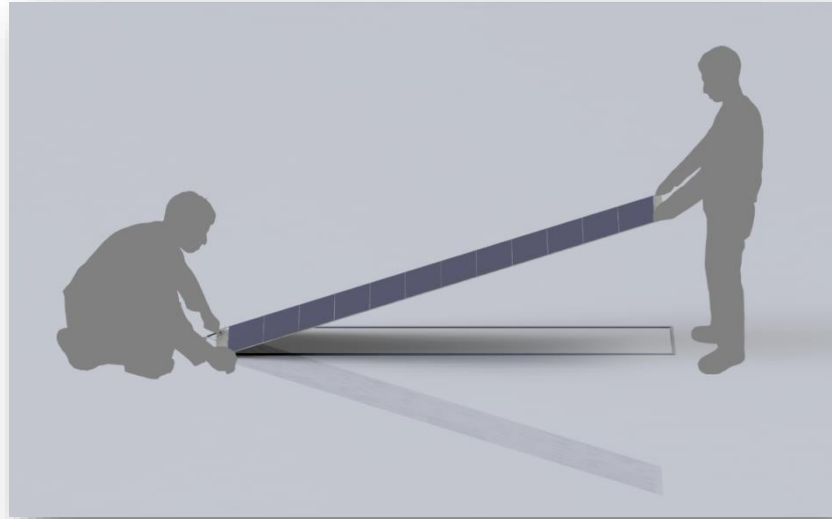
d) Module application on PVC waterproofing membranes

- 1) Apply a thin layer of adhesive (3-4mm height) along the surface of the roof while keeping a minimum distance from the module edges (see Example below). The adhesive should be applied in segmented lines.
- 2) Apply two middle adherence lines (Note: To allow the adhesive to cure properly, do not form a "closed" shape)



Example No.1: Adherence of one AL1206 module on a flat surface

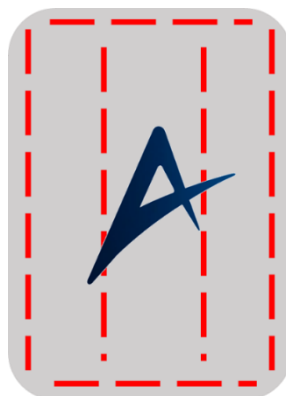
- 3) Using 2 workers, hold the module from both short edges. Attach one edge while the opposite edge is lifted.



- 4) Advance slowly to the opposite side **whilst pressing gently** on the adherence lines until reaching the opposite side.

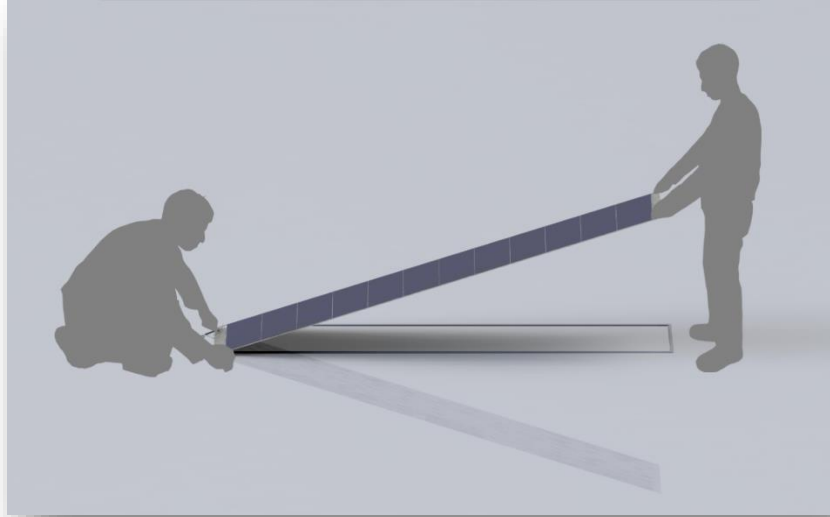
e) Module application on Bitumen waterproofing membranes

- f) **For paste adhesive:** Apply a layer of adhesive (6-8mm height) along the prepared surface while keeping a minimum distance from the module edges (see Example below). The adhesive should be applied in segmented lines to allow proper curing of the adhesive.
- g) Apply two middle adherence lines (Note: To allow the adhesive to cure properly, do not form a "closed" shape).



Example No.1: Adherence of one AL1206 module on a flat surface

- h) **For Double sided tape adhesive:** remove the protective film from the adhesive.
- i) Using 2 workers, hold the module from both short edges. Attach one edge while the opposite edge is lifted.



- j) Advance slowly to the opposite side **whilst pressing gently** on the adherence lines until reaching the opposite side.

k) Adhesive types and definitions

1) Corrugated metal sheets

- 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]

2) Corrugated polycarbonate ("Suntuf")

- Single component, Polysiloxane based
- Implementation in "paste" form
- Service temperature of -40 to+100 [°C]
- Hardness: 15-25 [Shore A]
- Tensile strength: <1.5 [N/mm²]
- UV resistant
- Application temperature: 5 to 35 [°C]

3) PVC waterproofing membranes




- Single component, silane-modified polymer
- Implementation in "paste" form
- Service temperature of -40 to+90 [°C]




- Hardness: 52-57 [Shore A]
- Tensile strength: 2.5 -3 [N/mm²]
- UV resistant
- Application temperature: 5 to 35 [°C]

4) Bitumen waterproofing membranes


- Single component, SPUR polymer
- Implementation in "paste" form
- Service temperature of -35 to+90 [°C]
- Hardness: 52-57 [Shore A]
- Tensile strength: 2.5 -3 [N/mm²]
- UV resistant
- Application temperature: 5 to 35 [°C]

1) Apollo-approved adhesives for painted steel deck:

Adhesive Manufacturer	Soudal	Teroson	Merbenit
Adhesive Name	Soudaseal 250XF	MS939	HM21
Colors	Black, White	Black, White, Gray	White
Datasheet			

Adhesive Manufacturer	FIX	FIX	Innotec
Adhesive Name	Expert FAST & EXTREME	Expert Transparent	Adheseal
Colors	White	Transparent	Black, white, gray
Datasheet			


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

Adhesive Manufacturer	Saudal
Adhesive Name	Silirub PC
Colors	Transparent
Datasheet	

n) Apollo-approved adhesive for PVC waterproofing membranes

Adhesive Manufacturer	Innotec
Adhesive Name	Adheseal
Colors	Black,white, gray
Datasheet	

o) Apollo-approved adhesive for Bitumen waterproofing membranes

Adhesive Manufacturer	Innotec
Adhesive Name	Versabond
Colors	Black
Datasheet	

p) Adhesive quantities

- For steel deck, PVC, and Polycarbonate: A quantity of 220ml is required for adherence of each module.
- For Bitumen: A quantity of 400ml is required for adherence of each module.

q) Removal

Please refer to Annex B for module removal instructions.

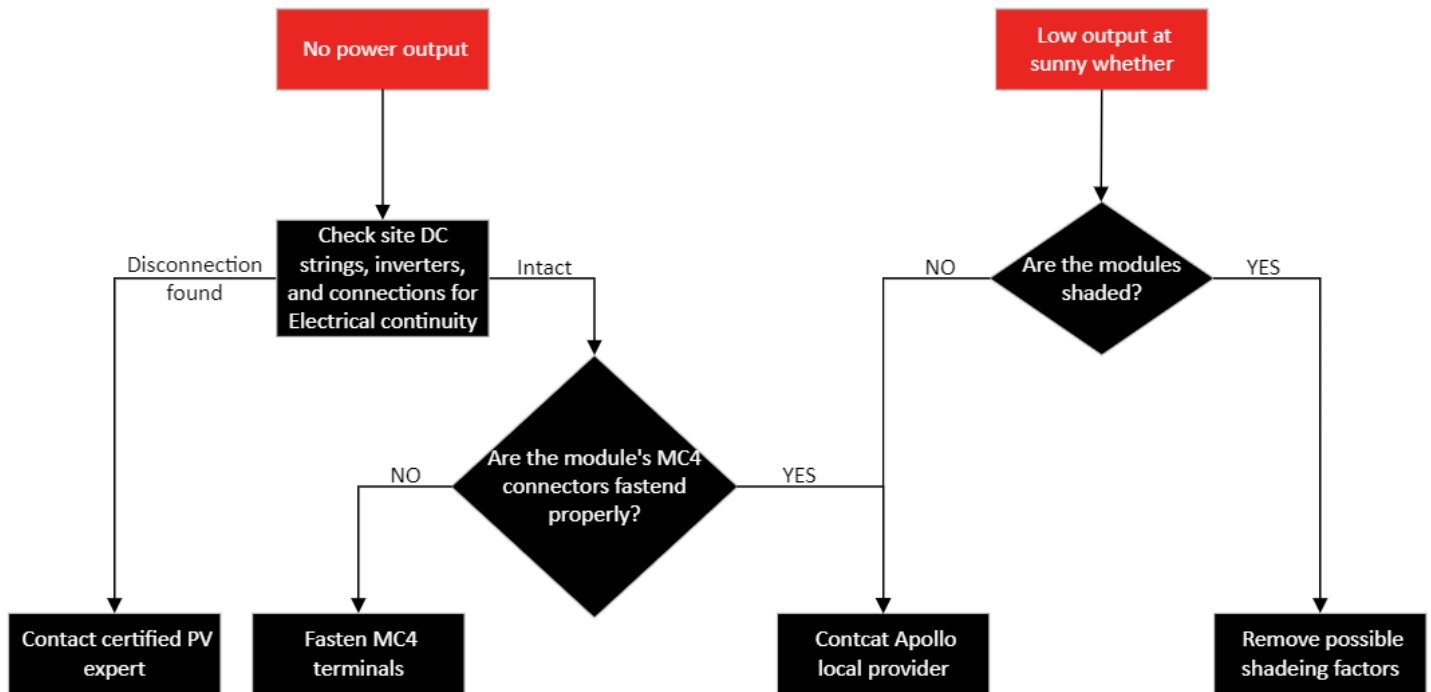
3. Note for substrate and fire testing

- IEC 61215, IEC 61730, and UL 61730 testing of AL1206 modules was only performed on a non-combustible corrugated steel deck substrate at up to 5 degrees tilt angle.
- Resistance to external fire sources was only evaluated per EN 13501-5:2016.

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%

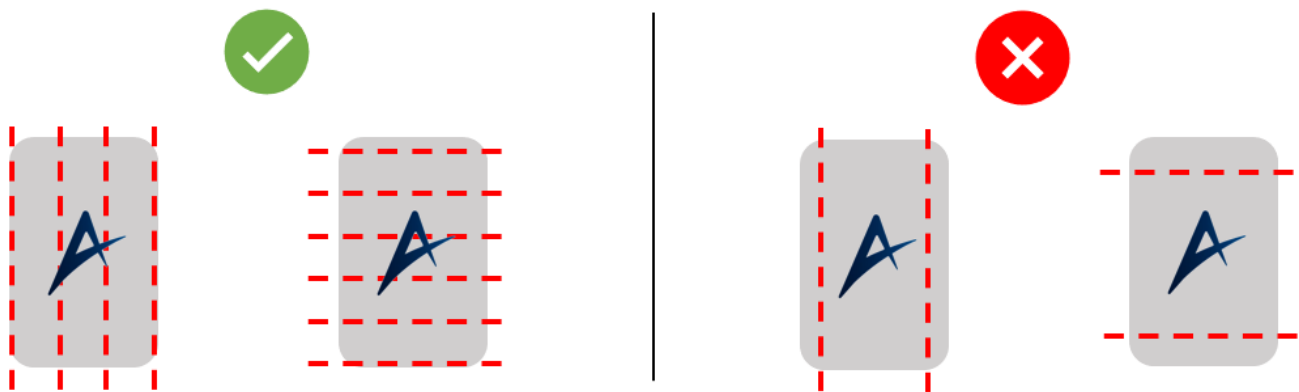
* Any PV module power is seriously degraded due to shading, when placed or installed avoid possible shadings (full or partial) from trees, poles, and other obstacles around.

ANNEX A – AL1206 position and adherence areas on steel deck

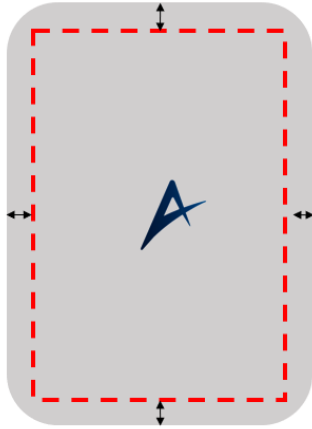
1) General principals

- a) The module shall adhere at a minimum of 3 adherence lines if the lines are parallel to the long edge and a minimum of 4 adherence lines if the lines are parallel to the short edge.
- b) The maximum distance from the last adherence 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 adherence lines (close to the module edges) must be cleared of EPDM and adhere the module directly to the substrate.

2) Reference examples

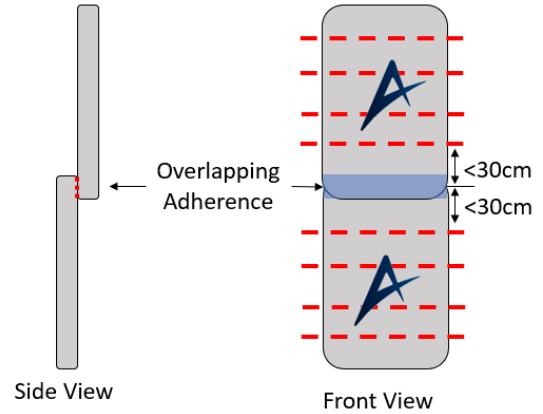


Adhesion Parallel to the **long** edge - Minimum 4 Adhesion lines.
 Adhesion Parallel to the **short** edge - Minimum 6 Adhesion lines



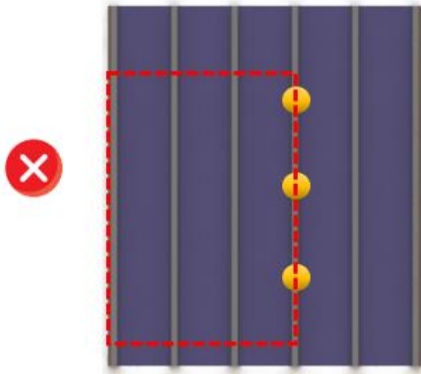
Maximum distance from the last adhesion line to the module edge is 15 cm

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

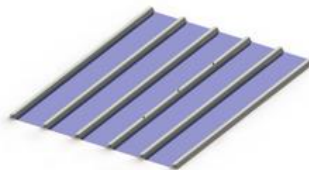
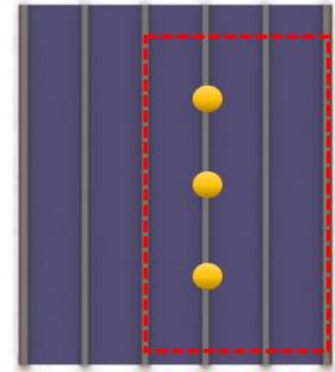




Trapezoidal steel roof (PBR metal sheet) with protruding screws

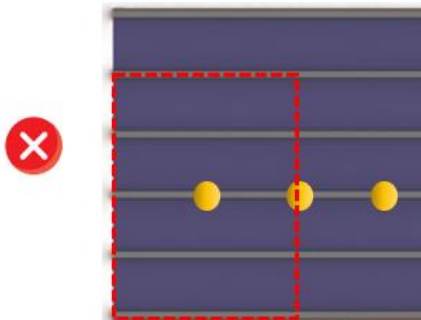
Panel position



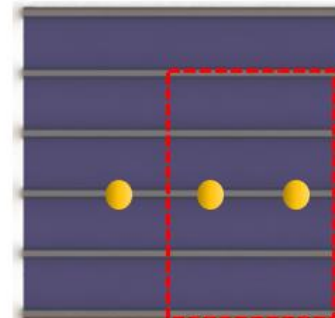
Vertical installation
up to **1** screw lines allowed under each panel.

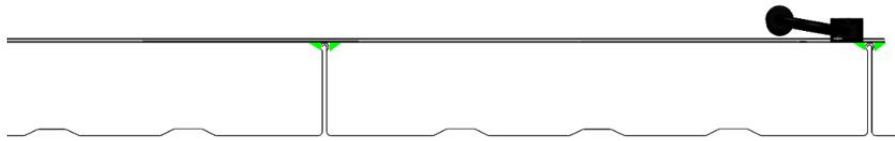
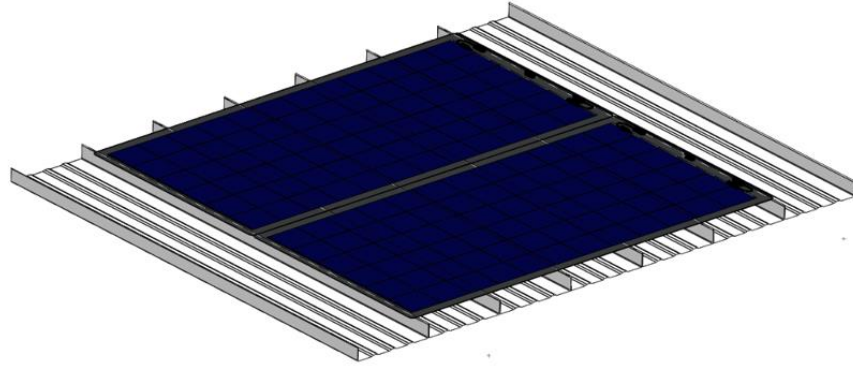


 Panel position
 Protruding screw Heads (Illustration)



Horizontal installation
up to **2** screw lines allowed under each panel






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

ANNEX B – AL1206 removal from steel deck adherence

1. Safety:

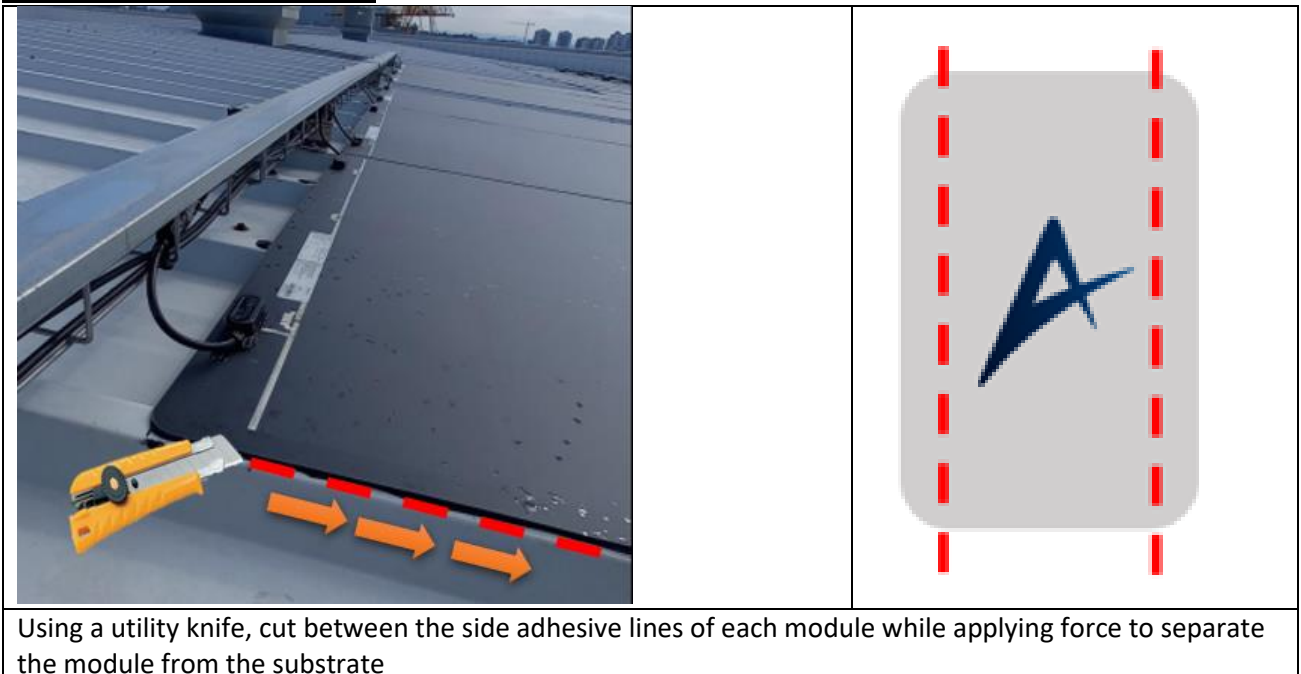
- Before module removal, Ensure the module is not connected to the grid.
- Follow all safety instructions warnings and limitations in the "safety" chapter of this document.
- DANGER**  the removal process causes permanent damage to the modules! Do not try to re-install or re-use removed modules in any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

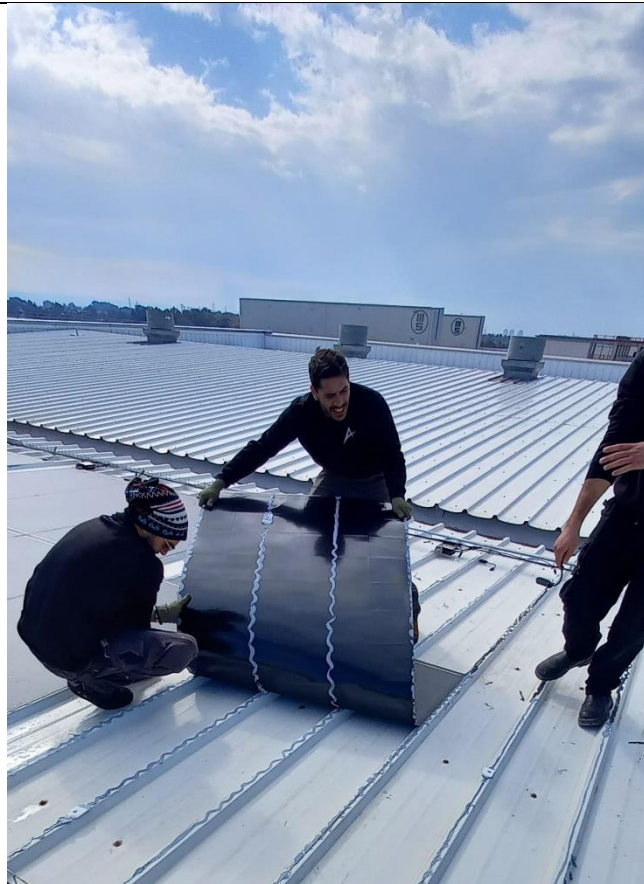
2. Required tools:

- Utility knife.
- Protective gloves.

3. Required personnel: minimum 2 workers.

4. Module removal procedure:





With 2 people: lift the top of the module and start peeling the module off. The most efficient peel is a 180-degree peel. You may use a utility knife to help separate the adhesive lives between the module and the roof.



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

5. **Disposal:**

Apollo solar module are recyclable and do not contain toxic or environmentally harmful materials. Disposal instructions vary between different countries, please contact your local environmental administration for specific disposal information.