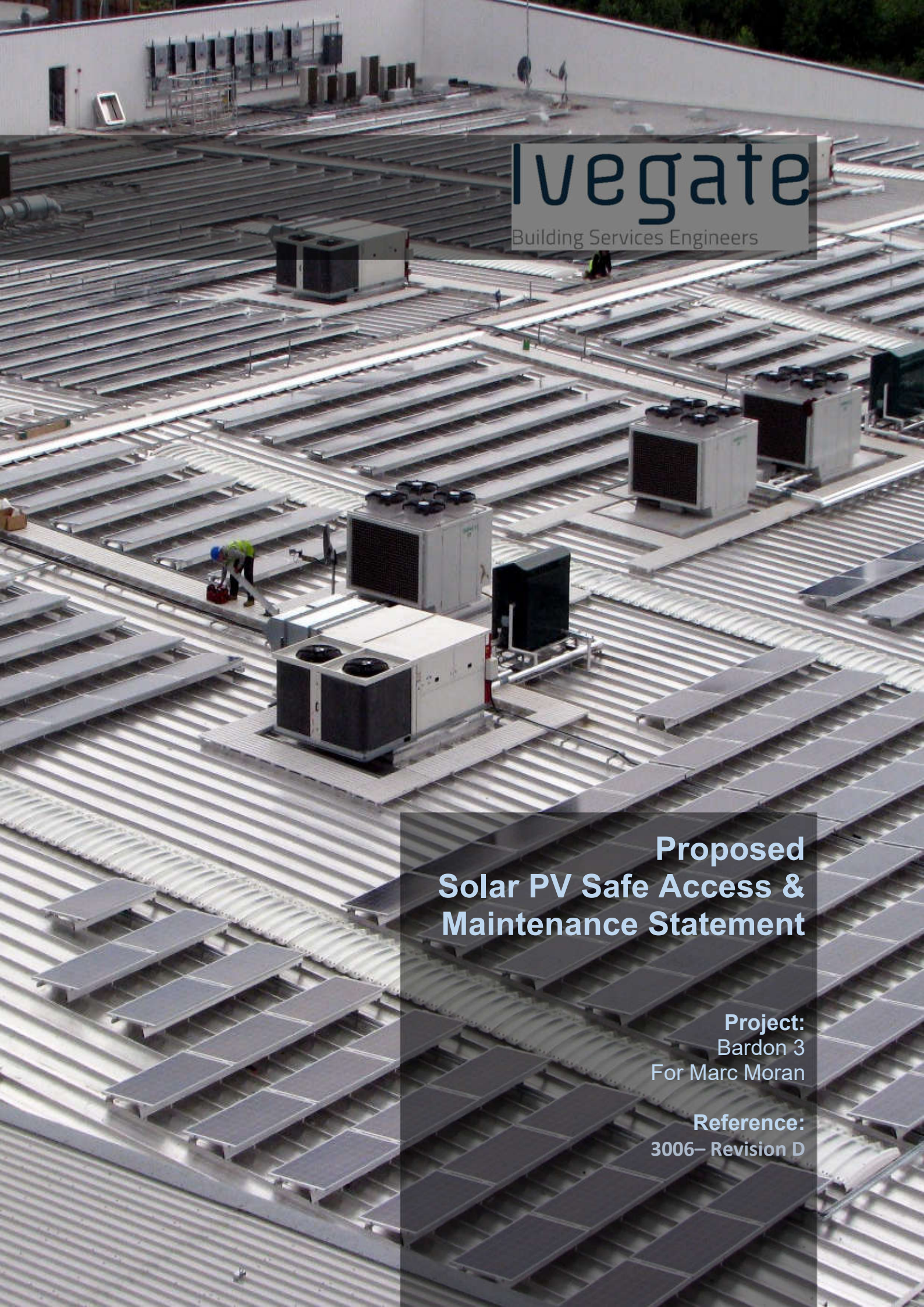




Ivegate

Building Services Engineers

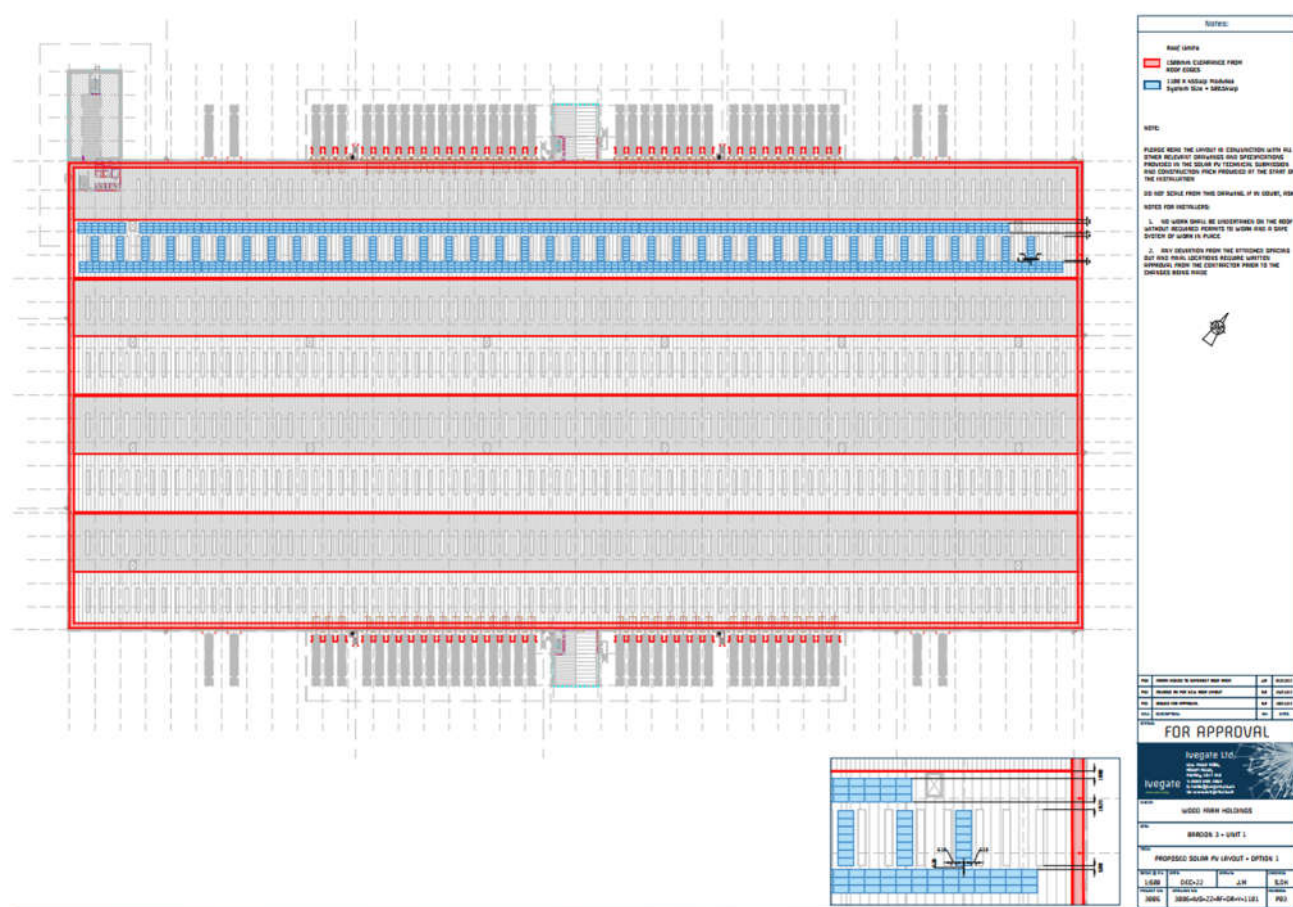
Proposed Solar PV Safe Access & Maintenance Statement

Project:
Bardon 3
For Marc Moran

Reference:
3006— Revision D

This document is intended to give the user an understanding of the proposed procedure for safe access to the solar PV system for the purposes of general maintenance and replacement of system parts (if required).

The solar PV system is located on the roof of the warehouse and is located below and between fragile rooflights as indicated in the plan below; (Plan below shows a typical install and is subject to final design). The Modules are from the JA 485/505W range. These modules are readily available in the UK and are a Tier 1 product.



D. 001 – Roof level Solar PV system – Bardon 3

It is recommended the engineer carrying out servicing of the PV arrays or the personnel carrying out visual inspections on the system familiarises themselves with this document to understand the location of equipment and how to safely access all areas of the system.

ACCESSING THE LOCATION OF THE SOLAR PV ARRAYS

Access to the roof will be via the built in access hatch ways indicated in red below. Internal locations for the roof access hatches have not yet been confirmed, but it is assumed the main point of access as time will be from the internal plant deck via a CAT ladder installed by the main contractor.



D. 003 – Roof access hatch locations for high level roof – Bardon 3

ACCESS ONTO THE ROOF

At this stage we anticipate there would be a mansafe system installed 2 meters in from the perimeter of the building as noted by the red perimeter line in the above layout. Min. 500mm clearances have been left around all rooflights to allow for access up and down slopes where required for future maintenance.

Alternatively, the advancement of new technology has made the use of Drones an ideal inspection tool for visual inspections of PV arrays which should be considered as an alternative to accessing the roof, this can be carried out by a trained operator (correctly insured for commercial use of a drone) and operators can be safely at ground level whilst the visual inspections are carried out. This is also an ideal way to gather evidence for completion of a maintenance report evidencing an inspection of modules.

After an initial inspection of the site location, there are no immediate concerns for flying a drone in the area, so this could be an ideal option for this project.

GENERAL MAINEANCE OF THE SOLAR PV SYSTEM

It is worth noting that a solar PV system in general is considered "low maintenance" due to the fact there are no mechanical parts on the solar panels and when elevated further than 5 degrees (this system is elevated at 6 degrees avg.) are considered self-cleaning when it rains.

For the avoidance of doubt, this document should be read in conjunction with the operation & maintenance manual issued at project completion and the included user manuals provided within it.

Ivegate would recommend that an annual service is carried out, in addition to monthly or quarterly visual checks of the system. Whilst considered 'low maintenance', its important this is carried out to ensure the system remains in good working order and to prolong its service lifetime.

Failure to maintain the system according to the recommended maintenance schedule may invalidate Ivegate's warranty. Currently, there is no maintenance package in place for the solar PV system on this project.

The maintenance of the system should only be carried out by suitably qualified or trained personnel. Ivegate can accept no liability for maintenance undertaken by others. the client is free to consider other O&M companies suitably qualified to carry out maintenance on solar PV systems should they wish.

The following provides an outline of the checks/works required on each visit. For further information and substantiation; please refer to the operation & maintenance manual included which will be provided on project completion.

- Quarterly or Monthly Visual Checks

To ensure the system is in good working order; the following visual checks should be carried out on a monthly, or at least quarterly period.

- Visual check of the inverter to ensure there are no error prompts and that the system is generating
- Check of the generation meter to check the generation yield is meeting the estimated projections
- Visual check of the panels to ensure there is no build up or dirt or soiling on the modules or any visible damage to panels.
- Visual check over the system cabling, to ensure there is no physical damage to cables or connections.
- Production of a visual checklist for the PV system to retain on file as proof of visual checks completed.

If there is any damage or errors present during these checks; please contact us. Repairs can be carried out during our defects/installation warranty period. After this period, we can advise on costs associated with the required repairs or the best way to proceed. Alternatively, if a maintenance package is sought for this project, they will also be able to assist where required.

- Annual Maintenance of the solar PV system

To maintain good working order of the PV system and ensure the lifespan of the arrays; the following tasks should be completed during an annual maintenance visit; This list is not exhaustive and some/all tasks may be required depending on the current state & age of the PV system;

- Annual cleaning to keep efficiencies maximised, especially where bird soiling or atmospheric pollution has degraded the surface of the panel
- Checking of module clamps Torque settings to ensure clamps are tightened as per manufacturers recommendations and have not become loose.
- Visual inspection of all panels
- Photovoltaic module string tests
- Inverter system checks
- Junction box, isolator, distribution board and cabling inspection

- Meter check
- Labelling/schematic check
- Energy production analysis
- Voltage and current check
- production of maintenance report

Following the annual maintenance of the system; the engineer should produce an on-site report detailing works carried out, and details of any faults (if any) that may be found during the maintenance works that weren't able to be resolved whilst on site.

For reference, we have included a blank form in appendix. A which can be used by the service engineer to highlight his findings and indicates the relevant checks required on the system.

CLEANING OF MODULES, REPLACEMENT OR TEMPORARY REMOVAL OF PARTS AND ACCESS TO PANELS IN THE MIDDLE OF AN ARRAY.

The following has been provided as a guide on the proposed method of access to the solar PV system for the purposes of carrying out the above tasks. Roof works should always be carried out by a minimum of 2 people at all times.

Cleaning of modules

For the purposes of cleaning the panels, we re-commend that this project takes advantage of new, safer technology in using robots to clean the panels between rooflights, omitting the need to access modules down the side next to roof lights.

The robot is fixed with a soap dispenser and hose attachment and comes complete with a caterpillar type tyre that grips well to the modules, (see picture example below), the robot would be controlled from a remote panel by the qualified/trained engineer, who can safely operate the robot within a safe zone on the roof.

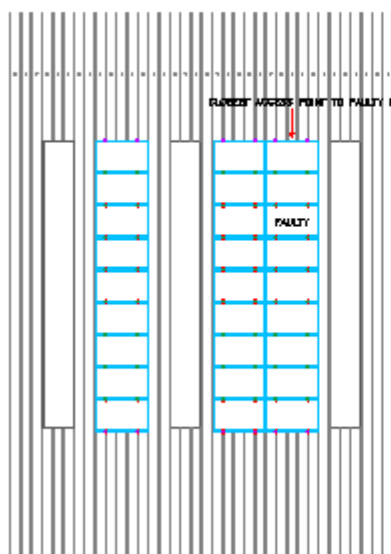


D. 003 – Cleaning of modules by Robot example

Access / Replacement of specific modules

In the event of having to replace a faulty module, panels can be removed, one by one from any position to reach the affected panel meaning there will be sufficient space to allow safe working.

ACCESSING A FAULTY/SOILED PANEL ONCE INSTALLED

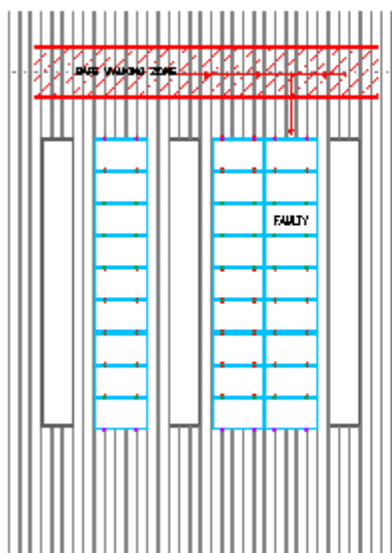


NOTE: BEFORE PROCEEDING WITH ANY WORKS ON PV PANELS. THE AFFECTED STRING SHOULD BE SAFELY ISOLATED AT THE NEAREST AVAILABLE POINT. (IN THIS CASE, BACK AT THE INVERTER).

THE PRINCIPLE OF ACCESSING A FAULTY OR SOILED MODULE IS THE SAME METHOD USED DURING THE INSTALLATION PROCESS. AT NO POINT ARE PANELS ACCESSED BETWEEN GAPS EITHER SIDE OF THE ROOF LIGHT.

IN CASE OF ACCESS DUE TO A FAULTY PANEL, OR IN NEED OF CLEANING PURPOSES. A QUALIFIED ENGINEER SHALL ACCESS THE PANEL FROM THE NEAREST POINT ON THE AFFECTED ROW.

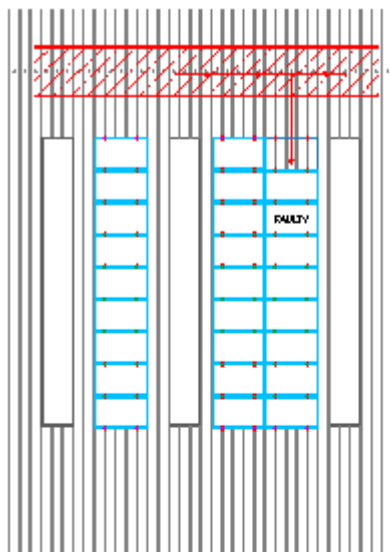
IN THE EXAMPLE PROVIDED TO THE LEFT, THE NEAREST ACCESS POINT IS HIGHLIGHTED BY THE RED ARROW.



ENGINEER TO WALK ALONG THE SAFEST POINT OF THE ROOF WHEN ACCESSING THE PANELS. ON A TRAPEZOIDAL SHEET, THE LIP OF THE SHEETS ARE CONNECTED BY A JOINTING SCREW WHICH PROVIDES A SEAL BETWEEN THE TWO SHEETS. THESE SCREWS ARE USUALLY OVERLAIN ON A PURLIN TO THE UNDERSIDE OF THE ROOF AND IS CONSIDERED THE STRONGEST POINTS OF THE ROOF PROFILE.

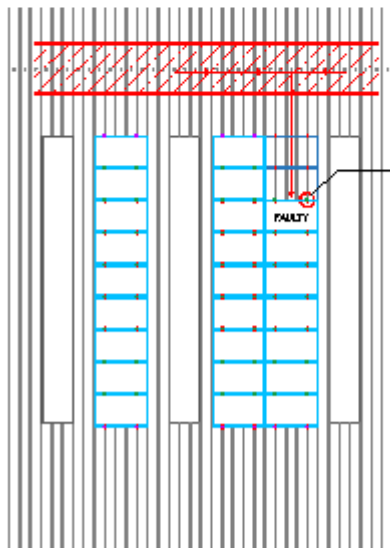
THE EXAMPLE DRAWING SHOWS A HATCHED RED ZONE WHERE THE ENGINEER IS TO WALK ALONG WHEN ACCESSING THE PANELS. AGAIN, THIS WILL BE FROM THE NEAREST AVAILABLE POINT. (NOTE: EXISTING MAN-SAFE LINES TO BE USED WHEN PRESENT, ENGINEERS NOT TO WALK BETWEEN THE GAPS ON EITHER SIDE OF THE PANELS TO GAIN ACCESS).

ONCE ARRIVING AT THE CLOSEST ROW OF PANELS, THE ENGINEER SHALL PROCEED TO REMOVE THE END PANEL TO THAT ROW.



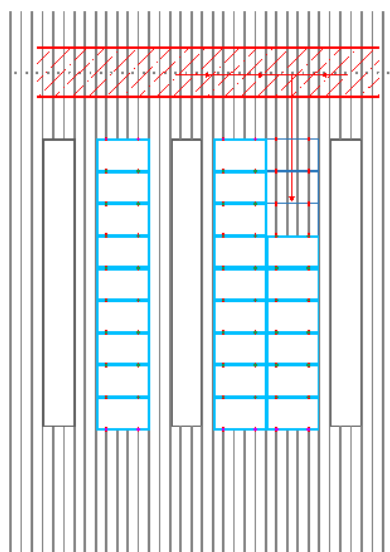
ENGINEER SHALL LOOSEN THE END CLAMPS TO THE FIRST PANEL, AND REMOVE THE PANEL FROM THAT ROW AND TEMPORARILY DISCONNECT THE DC STRINGS (PANELS WILL BE PLACED IN THE RED HATCHED ZONE TEMPORARILY, AWAY FROM ROOF LIGHTS).

THE ENGINEER WILL CONTINUE IN THIS MANNER UNTIL REACHING THE FAULTY/SOILED MODULE.



MID CLAMPS TO BE REMOVED WHEN ACCESSING EACH PANEL (AS INDICATED BY THE CIRCLE).

MID CLAMPS.



ONCE REACHING THE AFFECTED PANEL. THIS CAN BE REPLACED IF NECESSARY.

ONCE WORKS HAVE BEEN CARRIED OUT, THE ENGINEER SHALL CAREFULLY PLACE THE PANELS BACK INTO THEIR ORIGINAL POSITION AND RE-CONNECT THE STRINGS BEFORE TIGHTENING THE CLAMPS AS REQUIRED.

AT NO POINT SHOULD THE ENGINEER BE TEMPORARILY STORING OR WALKING NEAR ANY ROOF LIGHTS THROUGHOUT ANY WORKS INVOLVING PV PANELS.

ONCE STRINGS AND PANELS ARE RE-CONNECTED, THE ENGINEER CAN CARRY OUT THE RELEVANT CHECKS TO ENSURE THE SYSTEM IS WORKING CORRECTLY.

All works on the roof are to be strictly carried out in accordance with site specific risk assessments & method statements (RAMS) and any relevant permits to work please note the following statements that are also included in the risk assessment register with the main contractors O&M literature.

1. The client is strongly advised not to adapt the system in any way. If there is a need to adapt or re-locate any of the equipment in any way, the client is advised to contact the installer to ensure any required movement or modification can be approved before undertaking any works.
2. It should be noted that any changes or adaptations to the system without prior authorization from the installer would invalidate the warranty provided on the system.
3. For any further information or clarification, the client is advised to refer to the operation and maintenance manuals provided at hand over.

For any further information or clarifications, please don't hesitate to contact Ivegate who will be happy to assist in any way they can.

APPENDIX A

SOLAR PV INSPECTION REPORT TEMPLATE

APPENDIX B

SOLAR PV MODULE DATASHEET

DEEP BLUE 3.0

Mono

505W MBB Half-cell Module
JAM66S30 480-505/MR Series

Introduction

Assembled with 11BB PERC cells, the half-cell configuration of the modules offers the advantages of higher power output, better temperature-dependent performance, reduced shading effect on the energy generation, lower risk of hot spot, as well as enhanced tolerance for mechanical loading.



Higher output power



Lower LCOE



Less shading and lower resistive loss

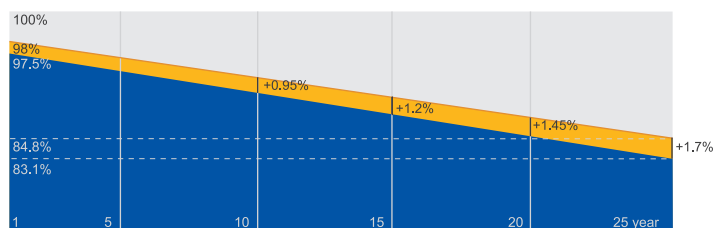


Better mechanical loading tolerance

Superior Warranty

- 12-year product warranty
- 25-year linear power output warranty

0.55% Annual Degradation
Over 25 years



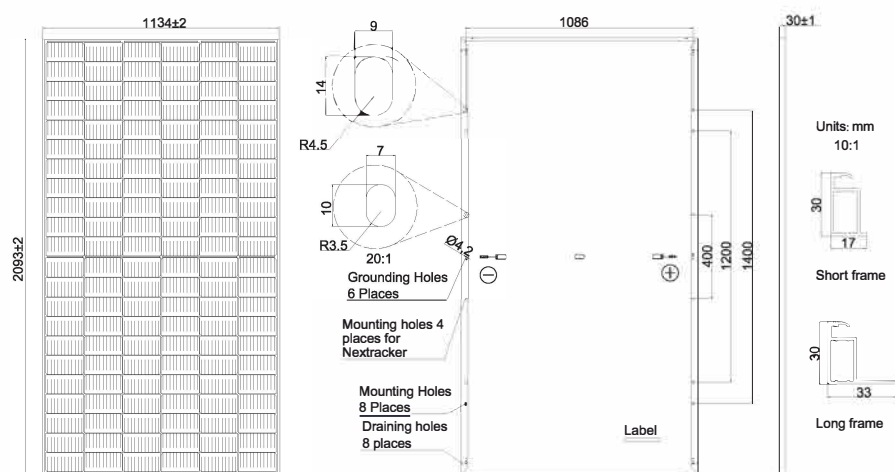
■ New linear power warranty ■ Standard module linear power warranty

Comprehensive Certificates

- IEC 61215, IEC 61730, UL 61215, UL 61730
- ISO 9001: 2015 Quality management systems
- ISO 14001: 2015 Environmental management systems
- ISO 45001: 2018 Occupational health and safety management systems
- IEC 62941:2019 Terrestrial photovoltaic (PV) modules - Quality system for PV module manufacturing



MECHANICAL DIAGRAMS



Remark: customized frame color and cable length available upon request

SPECIFICATIONS

Cell	Mono
Weight	25.2kg
Dimensions	2093±2mm×1134±2mm×30±1mm
Cable Cross Section Size	4mm ² (IEC) , 12 AWG(UL)
No. of cells	132(6×22)
Junction Box	IP68, 3 diodes
Connector	MC4-EVO2/QC 4.10-35
Cable Length (Including Connector)	Portrait: 200mm(+)/300mm(-); Landscape: 1200mm(+)/1200mm(-)
Packaging Configuration	36pcs/Pallet 792pcs/40HQ Container

ELECTRICAL PARAMETERS AT STC

TYPE	JAM66S30 -480/MR	JAM66S30 -485/MR	JAM66S30 -490/MR	JAM66S30 -495/MR	JAM66S30 -500/MR	JAM66S30 -505/MR
Rated Maximum Power(P _{max}) [W]	480	485	490	495	500	505
Open Circuit Voltage(V _{oc}) [V]	45.07	45.20	45.33	45.46	45.59	45.72
Maximum Power Voltage(V _{mp}) [V]	37.62	37.81	37.99	38.17	38.35	38.53
Short Circuit Current(I _{sc}) [A]	13.65	13.72	13.79	13.86	13.93	14.00
Maximum Power Current(I _{mp}) [A]	12.76	12.83	12.90	12.97	13.04	13.11
Module Efficiency [%]	20.2	20.4	20.6	20.9	21.1	21.3
Power Tolerance	0~+5W					
Temperature Coefficient of I _{sc} (α _{Isc})	+0.045%/°C					
Temperature Coefficient of V _{oc} (β _{Voc})	-0.275%/°C					
Temperature Coefficient of P _{max} (γ _{Pmp})	-0.350%/°C					
STC	Irradiance 1000W/m ² , cell temperature 25°C, AM1.5G					

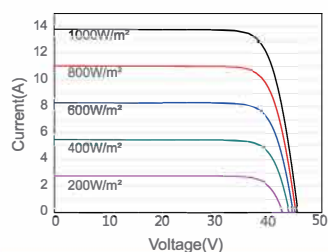
Remark: Electrical data in this catalog do not refer to a single module and they are not part of the offer. They only serve for comparison among different module types.

ELECTRICAL PARAMETERS AT NOCT

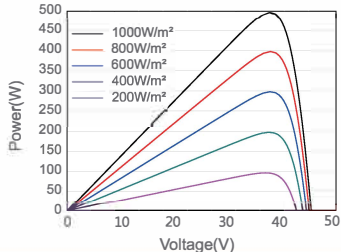
TYPE	JAM66S30 -480/MR	JAM66S30 -485/MR	JAM66S30 -490/MR	JAM66S30 -495/MR	JAM66S30 -500/MR	JAM66S30 -505/MR	OPERATING CONDITIONS	
Rated Max Power(Pmax) [W]	363	367	370	374	378	382	Maximum System Voltage	1000V/1500V DC
Open Circuit Voltage(Voc) [V]	42.15	42.30	42.43	42.58	42.72	42.86	Operating Temperature	-40℃~+85℃
Max Power Voltage(Vmp) [V]	35.54	35.67	35.76	35.84	35.93	36.02	Maximum Series Fuse Rating	25A
Short Circuit Current(Isc) [A]	10.99	11.06	11.13	11.20	11.27	11.34	Maximum Static Load,Front* Maximum Static Load,Back*	5400Pa(112lb/ft²) 2400Pa(50lb/ft²)
Max Power Current(Imp) [A]	10.21	10.28	10.36	10.44	10.52	10.60	NOCT	45±2℃
NOCT	Irradiance 800W/m², ambient temperature 20℃,wind speed 1m/s, AM1.5G						Safety Class	Class II
							Fire Performance	UL Type 1

CHARACTERISTICS

Current-Voltage Curve JAM66S30-495/MR



Power-Voltage Curve JAM66S30-495/MR



Current-Voltage Curve JAM66S30-495/MR

