Revision: 001
Date: 15/04/19
Issued by: JS

envirolec
smart energy solutions

8.96 kWp Solar PV Installation

University of Hertfordshire, Mosquito Way, Hatfield, AL10 9BL

Technical Submission Document

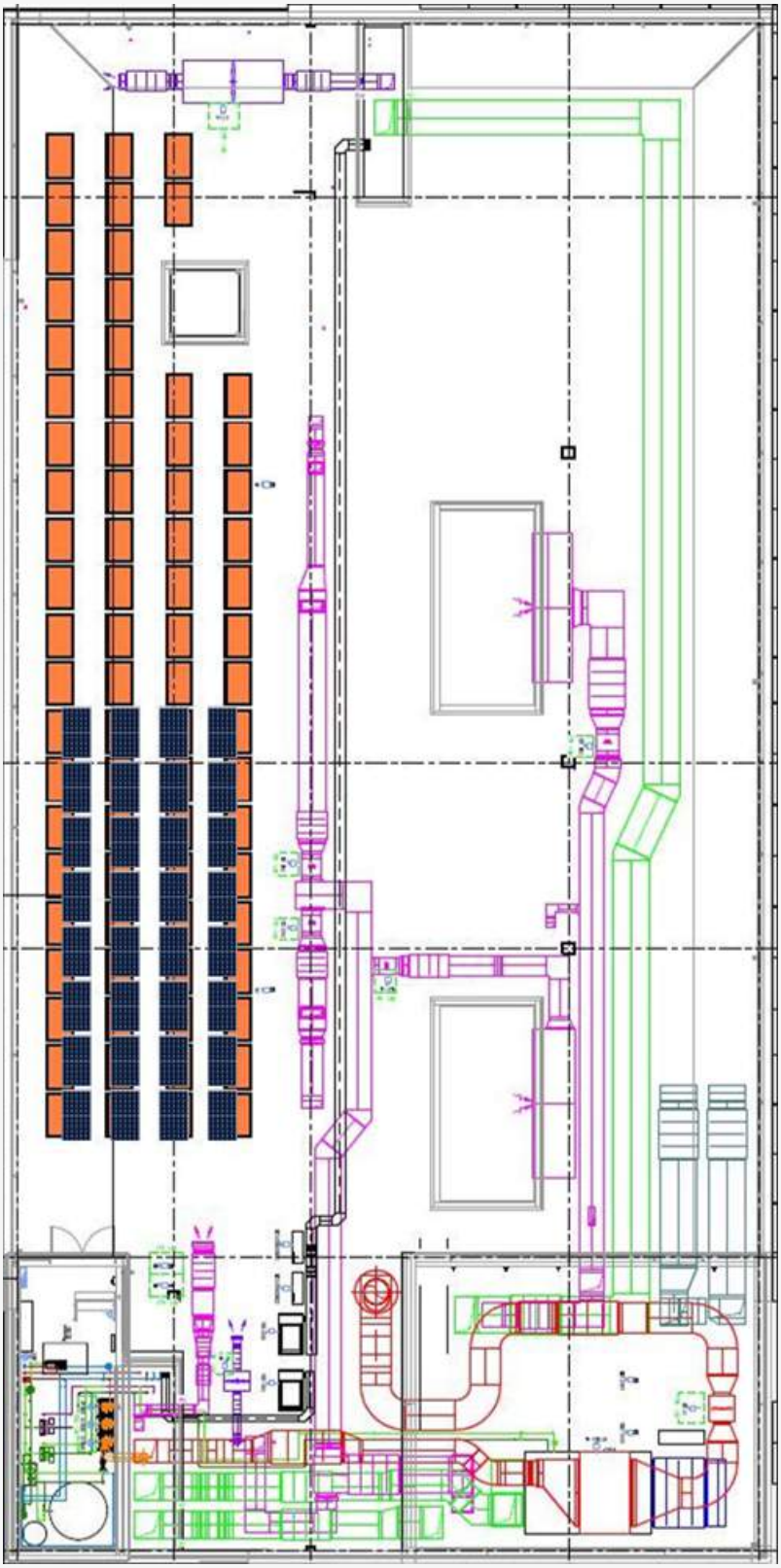
June 2019

Contents

Section 1

System Layout Drawing

Disposition - Google Maps [Roof_1]



Section 2

System Design

Project Overview

PV System

Grid-connected PV System

Climate Data	LUTON AIRPORT, GBR (2000 - 2009)	
PV Generator Output	8.96	kWp
PV Generator Surface	52.3	m²
Number of PV Modules	32	
Number of Inverters	1	

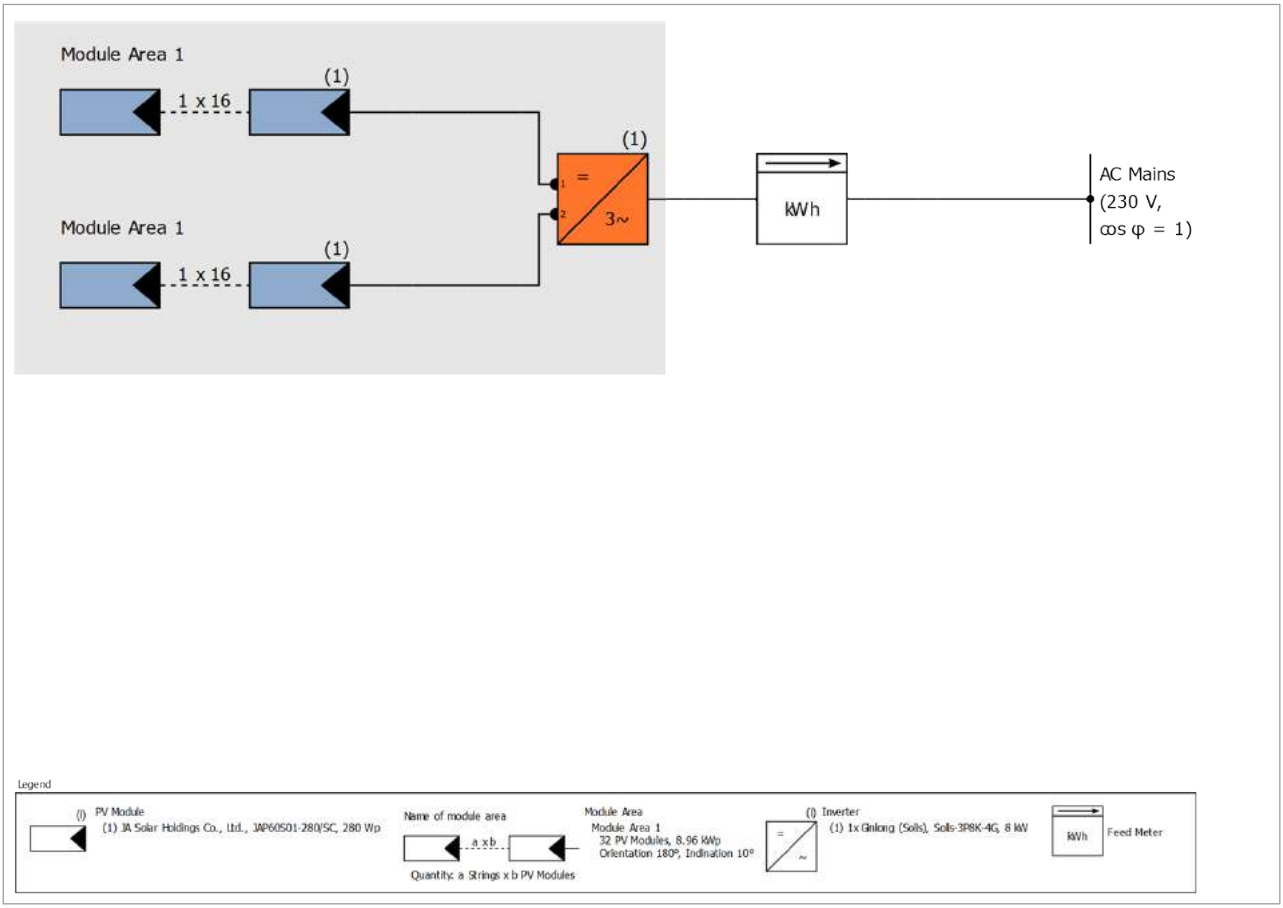


Figure: Schematic diagram

The yield

The yield

PV Generator Energy (AC grid)	8,418	kWh
Grid Feed-in	8,418	kWh
Down-regulation at Feed-in Point	0	kWh
Own Power Consumption	0.0	%
Solar Fraction	0.0	%
Spec. Annual Yield	939.49	kWh/kWp
Performance Ratio (PR)	89.6	%
CO_2 Emissions avoided	5,051	kg / year

Financial Analysis

Your Gain

Total investment costs	13,440.00	£
Return on Assets	4.18	%
Amortization Period	14.6	Years
Electricity Production Costs	0.08	£/kWh
Energy Balance/Feed-in Concept	Full Feed-in	

The results have been calculated with a mathematical model calculation from Valentin Software GmbH (PV*SOL algorithms). The actual yields from the solar power system may differ as a result of weather variations, the efficiency of the modules and inverter, and other factors.

Set-up of the System

Overview

System Data

Type of System	Grid-connected PV System
Start of Operation	03/06/2019

Climate Data

Location	LUTON AIRPORT, GBR (2000 - 2009)
Resolution of the data	1 h
Simulation model used:	
- Diffuse Irradiation onto Horizontal Plane	Hofmann
- Irradiance onto tilted surface	Hay & Davies

Module Areas

1. Module Area - Module Area 1

PV Generator, 1. Module Area - Module Area 1

Name	Module Area 1
PV Modules	32 x JAP60S01-280/SC
Manufacturer	JA Solar Holdings Co., Ltd.
Inclination	10 °
Orientation	South 180 °
Installation Type	Mounted - Roof
PV Generator Surface	52.3 m²

Inverter configuration

Configuration 1

Module Area	Module Area 1
Inverter 1	
Manufacturer	Ginlong (Solis)
Model	Solis-3P8K-4G
Quantity	1
Sizing Factor	112 %
Configuration	MPP 1: 1 x 16
	MPP 2: 1 x 16

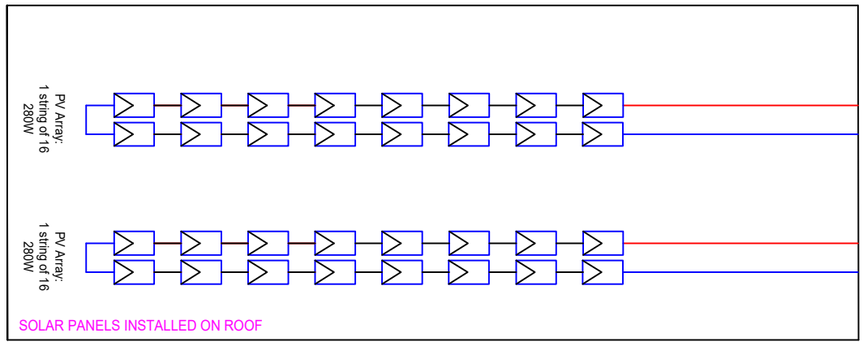
AC Mains

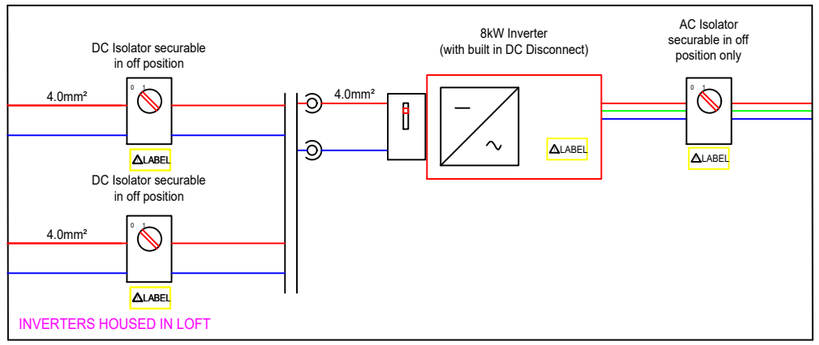
AC Mains

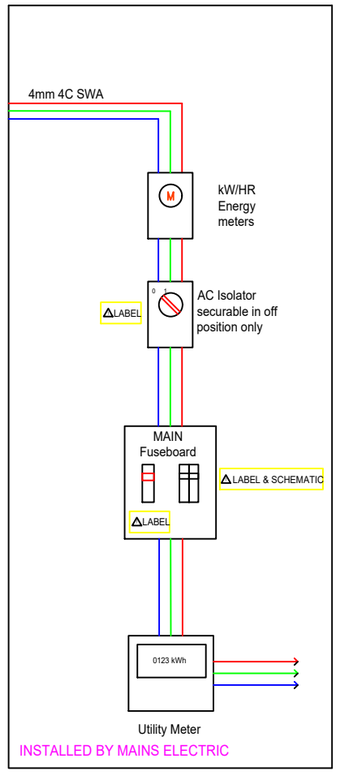
Number of Phases	3
Mains Voltage (1-phase)	230 V
Displacement Power Factor (cos phi)	+/- 1

Section 3

System PV Wiring Schematic Diagram







Disconnection and Shutdown

1. Turn off and padlock disconnector AC.
2. Turn off and padlock disconnector DC.
3. Turn off MCB in the comsumer unit.
4. Wait 5 minutes for residue power to dissipate before proceeding with any work.

Start Up

1. Turn on MCB in consumer unit.
2. Remove padlocks to disconnectors AC and DC
3. Turn on disconnector DC first then turn on AC
4. Refure to the inverter user guide to check the inverter is displaying that it is generating and working correctly.

Fault Finiding

1. Is there daylight , if no wait until there is.
2. Have the PV Panels been covered, if yes a competent person should remove them.
3. Follow shut down and start up procedures, if Inverter is still not generating contact an engineer.

Rev	Date	Description	Drawn
C	11/06/19	CONSTRUCTION ISSUE	GS

Issue status

CONSTRUCTION

Project

UNIVERSITY OH HERTFORDSHIRE

Title

SOLAR PV WIRING SCHEMATIC DIAGRAM

Scale	Designed By	Checked by	Date
NTS@A3	GS	JS	JUNE'19

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Envirolec SES Ltd
Unit 2, Hope Lane,
Green Lane
Eltham
SE9 3TP
E: gurpreet.singh@envirolec-ses.co.uk
T: 0208 090 0270

UHD	PV	501	C

Section 4

System Weight & Wind Load Calculations

PV Configurator

Powered by Renusol

Project report

6/5/2019

University of Hertfordshire, Hatfield AL10 9EU

Mosquito Way
AL10 9BL Hatfield
United Kingdom

Responsible

Darren Painter
Phone:
Email:darren.painter@renusol.com

Renusol Europe GmbH

Servicecenter Technik

Telefon: +49 221 788707-29
Telefax: +49 221 788707-98
E-Mail: support@renusol.com

Mehr Informationen funden sie unter: www.pv-konfigurator.de

Contents

Master data

Project Name	**University of Hertfordshire, Hatfield AL10 9EU**
Comment	**FS10-S**
Planning Responsible	**Darren Painter**
Amount Modules	**32**
System Size	**8.96 kWp**
Orientation [°]	**180**
Roofpitch [°]	**0**
Module Surface [m²]	**52**

Project Address

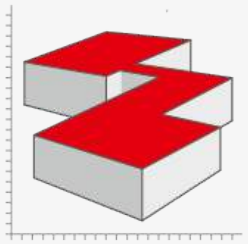
Name	
Street Address	**Mosquito Way**
Postal code	**AL10 9BL**
City	**Hatfield**
Phone	
Email	
Notes	
Country	**United Kingdom**
Latitude °	**51.76689**
Longitude °	**-0.24340**
Altitude [m]	**77**

Project Location

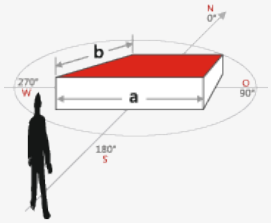
Roof [Roof_1]

Building height h [m]	**12.6**
Slope of roof [°]	**0**
Roofing	**Foil Roof**
Product Type:	**FS10S**
System alignment [°]	**180**
Parapet height [mm]:	**1100**
Parapet width [mm]:	**250**

Custom(Elev.)



System alignment [°]*



Snow load NA BS EN 1991-1-3:2003

Snow load [kN/m²]* (si=μi*sk)	**0.36**
Elevation altitude [m]:	**77**
Slope of roof [°]:	**0**
Snow load zone	**Area 3**

Wind load NA BS EN 1991-1-4:2005

Wind load [kN/m²]	**0.76**
Wind speed [m/s]	**22**
Building height h [m]*	**12.6**
Exposure Category	**4**
z-hdis	**12.6**
Distance to edge of City [km]	**1.21**
Distance to Ocean [km]	**59.44**

PV-Module [Roof_1]

Manufacturer:	**JA Solar PV Technology Co. Ltd.**
Name	**JA Solar Smart Modul 280W Cypress 5BB Mono AB**
Width [mm]:	**991**
Height [mm]:	**1650**
Thickness [mm]:	**40**
Framing:	**Aluminum**
Weight (kg)	**18.7**
Nominal Power [Watt]:	**280**
Module Type:	**Monocrystalline**
Installation:	**On Both Sides**
Frame color	**Schwarz**
Galvanic seperation required:	**No**

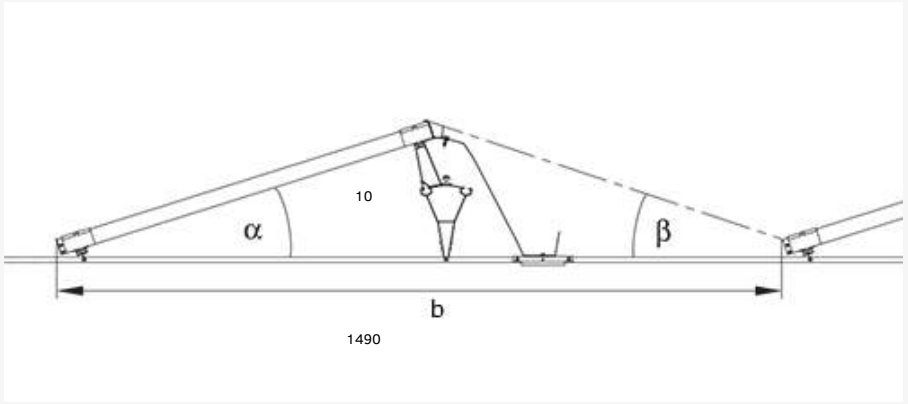
Clamps [Roof_1]

Mid Clamp:	**Middle clamp+**
End Clamp:	**End clamp+**

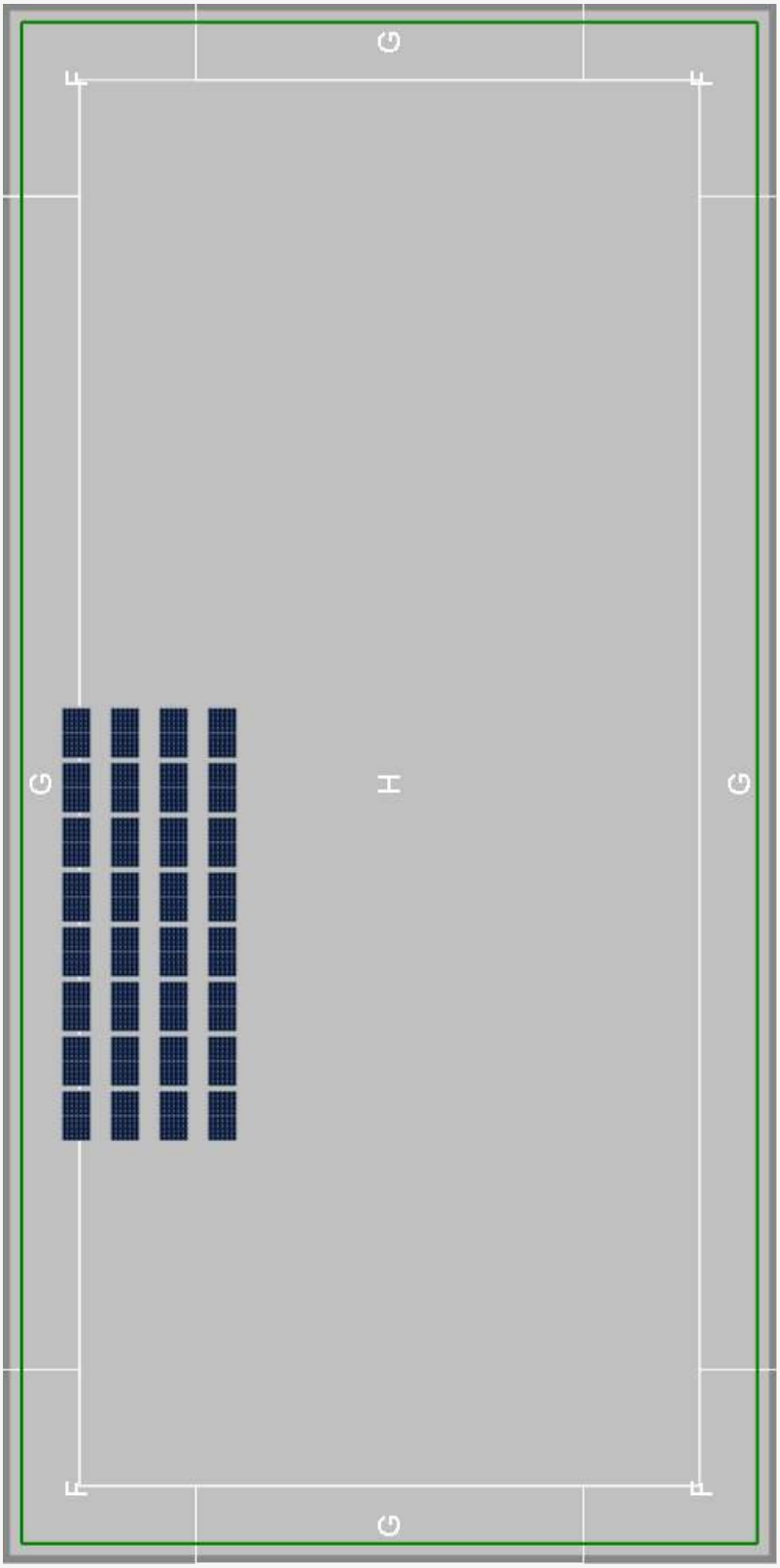
Note: Please check to see if the terminal points of the module conforms with the specifications of the manufacturer. If the access points do not match the specifications of the module manufacturer, it is recommended to contact the module manufacturer in conjunction to obtain a release planning. There is no guarantee that the proposed connection is released by the manufacturer.

Racking Parameter [Roof_1]

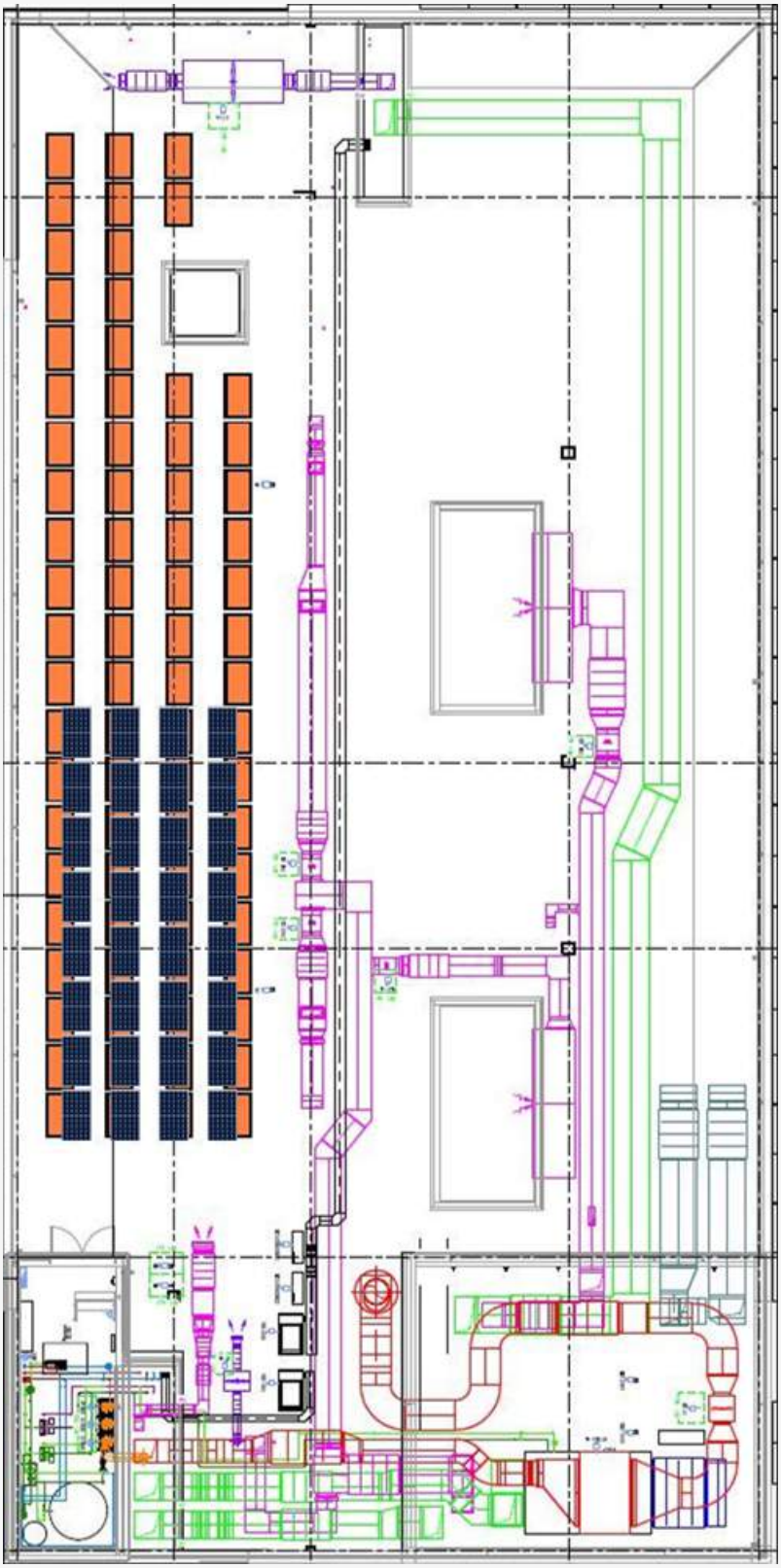
Bracket tilt α [°]:	**10**
Elevation rack depth on the roof b [mm]:	**1490**
Maximum height of rack incl. Module [mm]:	
Friction Constant μ	**0.5**
The default set-friction coefficient is 0.5 and checked by the installer / buyer (wet and dry test). If a lower friction coefficient is determined, it is mandatory to enter the value here, for the surcharge calculation! A higher value can be set to the maximum limit of 0.7 if it has been determined.	
Stone weight [kg]	**1**
Distance to roof edge [mm]:	**600**



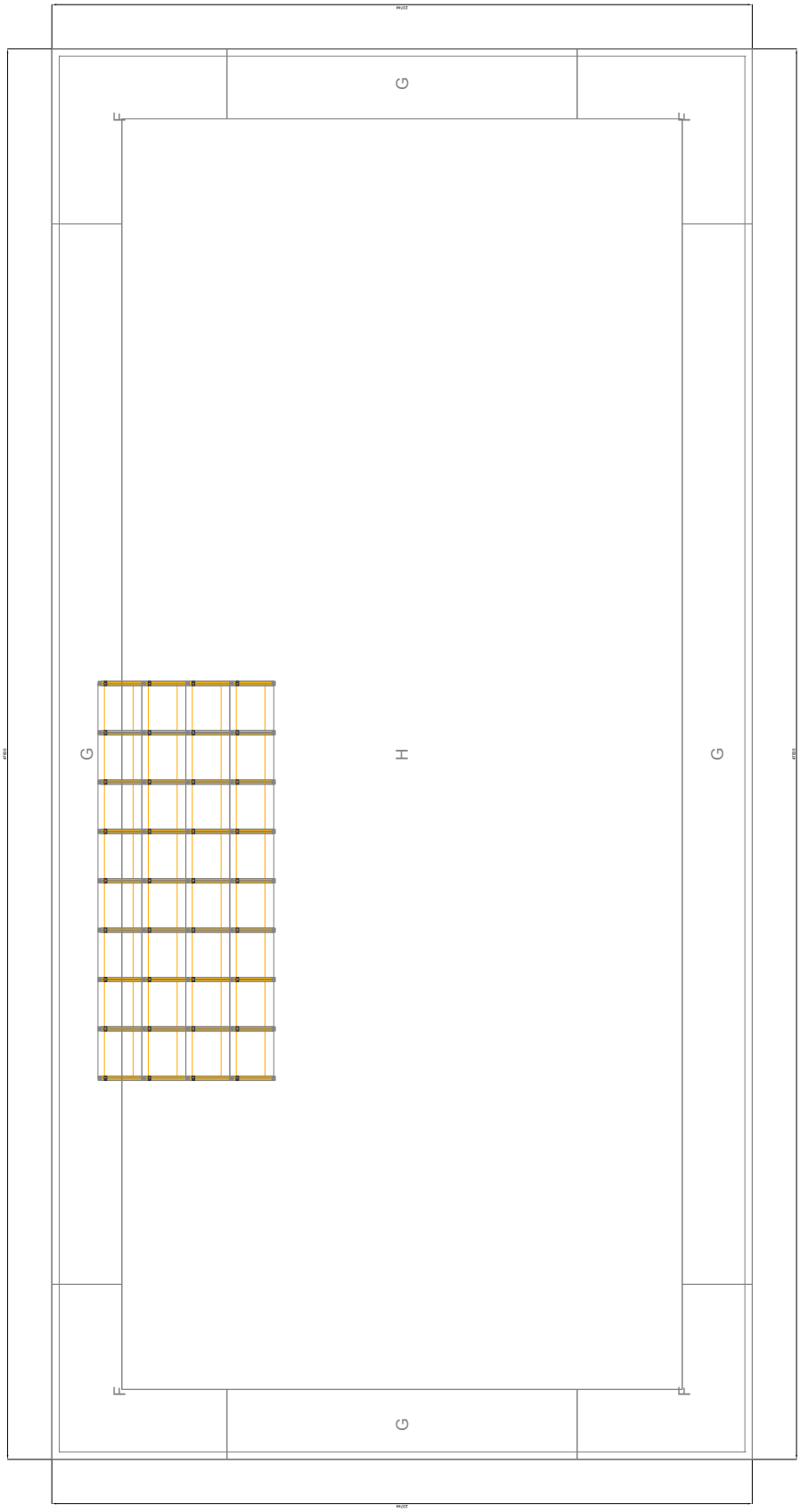
Position [Roof_1]



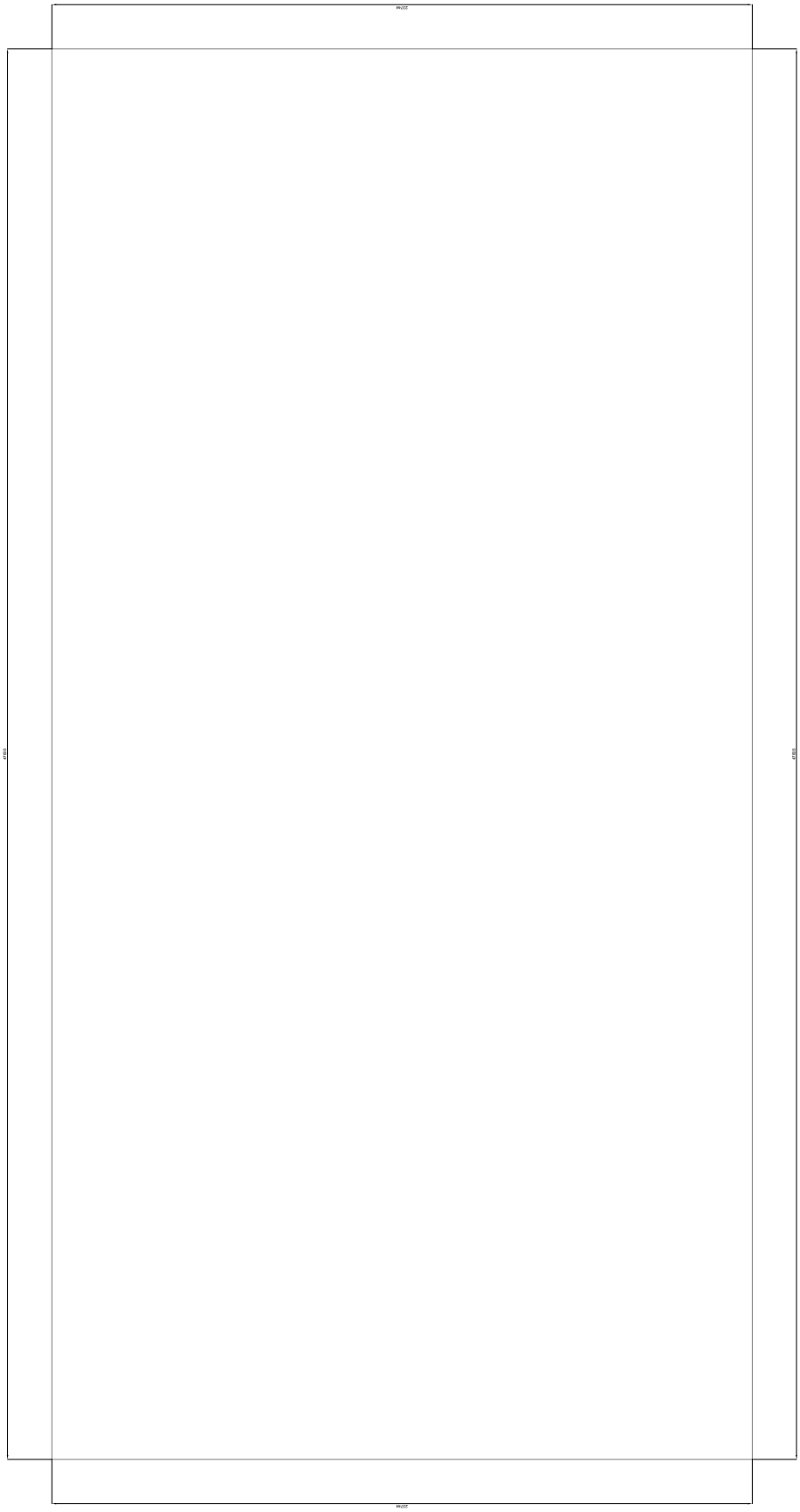
Disposition - Google Maps [Roof_1]



Installation-Plan [Roof_1]



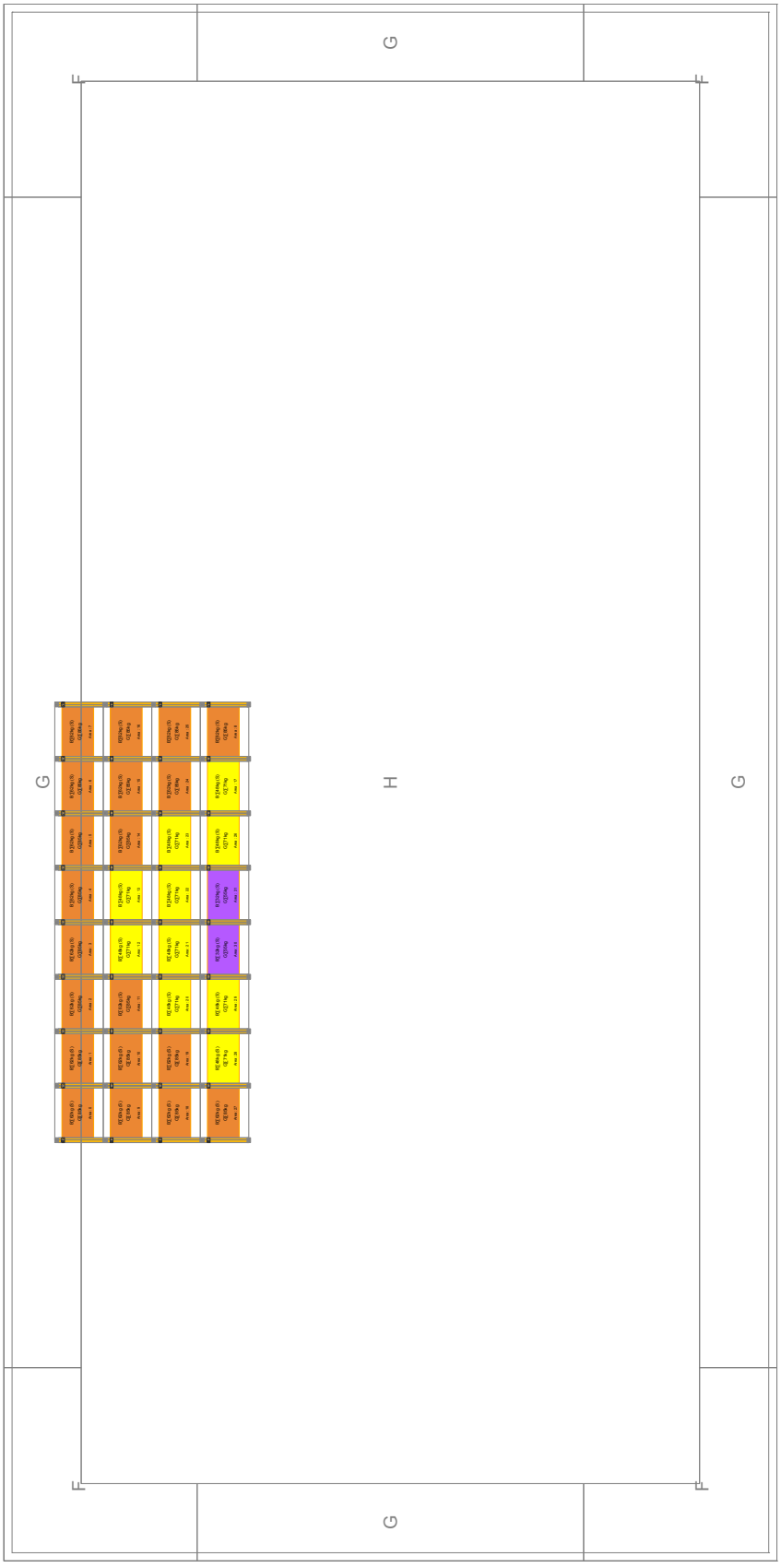
Roof coordinates [Roof_1]



Roof coordinates [Roof_1]

Coordinate 0	X:	**0**	Y:	**0**	Z:	**10**
Coordinate 1	X:	**47.835**	Y:	**0**	Z:	**10**
Coordinate 2	X:	**47.835**	Y:	**23.744**	Z:	**10**
Coordinate 3	X:	**0**	Y:	**23.744**	Z:	**10**

Static information: Ballasting [Roof_1]



Static - Important parameters and output values [Roof_1]

Factor of Safety for Uplift	**1.35**
Factor of Safety for Sliding	**1.35**
Load factor applied to Dead Load	**0.9**
Weight per ballast block [kg]	**1.00**
System surface area [m²]	**79.626**
Roof area [m²]	**1135.794**
Total ballast weight [kg]	**1784.00**
Weight Module/Rack [kg]	**756.70**
Total System weight [kg]	**2540.70**
Surface load on system area [kg/m²]	**31.91**
Surface load on roof [kg/m²]	**2.24**

Resulting surface stresses Basics

Roofpitch α [°]	α	= 0 °
Snow load	Q_s	= 0.36 kN/m²
Wind load	Q_w	= 0.76 kN/m²
Self-weight	G_m	= 0.15 kN/m²
Safeness factor stat., max.	γ_{G+}	= 1.35
Safeness factor stat., min.	γ_{G-}	= 0.9
Safeness factor dyn., max.	γ_{Q+}	= 1.5
Safeness factor dyn., min.	γ_{Q-}	= 0.9
Combined coefficient Wind	ψ_w	= 0.6
Combined coefficient Snow	ψ_s	= 0.5
$G_{upright}$	$= G_m \cdot \cos(\alpha)$	= 0.15
$G_{parallel}$	$= G_m \cdot \sin(\alpha)$	= 0
$Q_{s,upright}$	$= Q_s \cdot \cos^2(\alpha)$	= 0.36
$Q_{s,parallel}$	$= Q_s \cdot \sin(\alpha) \cdot \cos(\alpha)$	= 0
LC 1 (Sd,1)	$Q_1 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (Q_s + \psi_w \cdot Q_{w,d})$	
LC 2 (Sd,2)	$Q_2 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (\psi_s \cdot Q_s + Q_{w,d})$	
LC 3 (Sd,3)	$Q_3 = \gamma_{G-} \cdot G_m + \gamma_{Q+} \cdot Q_{w,sog}$	
LC 5 (Sd,5)	$Q_5 = G_m + 2.3 \cdot Q_s$	

Resulting surface stresses [Roof_1]

Area F

Affected area:	**1 sqf**
Cpe Suction:	**-2**
Max. Suction [kN/m²]:	**2.145**
Cpe Pressure:	**0**
Max. Pressure [kN/m²]:	**0.743**

	LC 1 (Sd,1)	LC 2 (Sd,2)	LC 3 (Sd,3)
upright [kN/m²]:	**0.743**	**0.473**	**-2.145**
parallel [kN/m²]:	**0**	**0**	**0**
Combined [kN/m²]:	**0.743**	**0.473**	**2.145**
Resulting angle°:	**0**	**0**	**180**

Area G

Affected area:	**8.026 sqf**
Cpe Suction:	**-0.9**
Max. Suction [kN/m²]:	**0.891**
Cpe Pressure:	**0**
Max. Pressure [kN/m²]:	**0.743**

	LC 1 (Sd,1)	LC 2 (Sd,2)	LC 3 (Sd,3)
upright [kN/m²]:	**0.743**	**0.473**	**-0.891**
parallel [kN/m²]:	**0**	**0**	**0**
Combined [kN/m²]:	**0.743**	**0.473**	**0.891**
Resulting angle°:	**0**	**0**	**180**

Area H

Affected area:	**10 sqf**
Cpe Suction:	**-0.7**
Max. Suction [kN/m²]:	**0.663**
Cpe Pressure:	**0**
Max. Pressure [kN/m²]:	**0.743**

	LC 1 (Sd,1)	LC 2 (Sd,2)	LC 3 (Sd,3)
upright [kN/m²]:	**0.743**	**0.473**	**-0.663**
parallel [kN/m²]:	**0**	**0**	**0**
Combined [kN/m²]:	**0.743**	**0.473**	**0.663**
Resulting angle°:	**0**	**0**	**180**

Module load determination, basics

Module wind load, example by Nr.32

Roofpitch α [°]	α
Pitch range regarded, lower limit	α_{start}
Pitch range regarded, upper limit	α_{end}
Coefficient at pitch lower limit	$C_{pe,0}$
Coefficient at pitch upper limit	$C_{pe,1}$
Coefficient interpolation formula	$c_{pe} = C_{pe,0} + (\alpha - \alpha_{start}) \cdot (C_{pe,1} - C_{pe,0}) / (\alpha_{end} - \alpha_{start})$
Load case 1	$Q_1 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (Q_s + \psi_w \cdot Q_{w,d})$
Load case 2	$Q_2 = \gamma_{G+} \cdot G_m + \gamma_{Q+} \cdot (\psi_s \cdot Q_s + Q_{w,d})$
Load case 3	$Q_3 = \gamma_{G-} \cdot G_m + \gamma_{Q+} \cdot Q_{w,sog}$
Load case 4	$Q_4 = G_m + Q_s + \psi_w \cdot Q_{w,d}$
Load case 5	$Q_5 = G_m + 2.3 \cdot Q_s$
Permanent loads factor, upper	$\gamma_{G+} = 1.35$
Permanent loads factor, lower	$\gamma_{G-} = 0.9$
Varying loads factor, upper	$\gamma_{Q+} = 1.5$
Varying loads factor, lower	$\gamma_{Q-} = 0$
Wind coefficient	$\psi_w = 0.6$
Snow coefficient	$\psi_s = 0.5$

Area G

Wind load	$Q_w = 0.76$
Wind pressure	$Q_{w,d} = 0.76 \cdot 0 = 0$
LC 1 (Sd,1)	$Q_1 = 1.35 \cdot 0.15 + 1.5 \cdot (0.36 + 0.6 \cdot 0) = 0.742$
LC 1 (Sd,1), force	0.745 kN
LC 3 (Sd,3)	$Q_3 = 0.9 \cdot 0.15 + 1.5 \cdot -0.684 = -0.891$ kN/m²
LC 3 (Sd,3), force	-0.894 kN

Area H

Wind load	$Q_w = 0.76$
Wind pressure	$Q_{w,d} = 0.76 \cdot 0 = 0$
LC 1 (Sd,1)	$Q_1 = 1.35 \cdot 0.15 + 1.5 \cdot (0.36 + 0.6 \cdot 0) = 0.742$
LC 1 (Sd,1), force	0.469 kN
LC 3 (Sd,3)	$Q_3 = 0.9 \cdot 0.15 + 1.5 \cdot -0.532 = -0.663$ kN/m²
LC 3 (Sd,3), force	-0.419 kN

Material list [Roof_1]

Part number	Description	Matchcode	Pck	Total Nr.	Total weight (kg)	Length (mm)	Total length (mm)
420081	End clamp+	420081	1	**16**	1.0	--	--
420082	Middle clamp+	420082	1	**56**	3.5	--	--
500400	Base rail FS10-S 1389 mm	500400	1	**36**	36.7	--	--
500404	Base rail connector	500404	1	**45**	3.6	--	--
500411	Roof protection pad 110x95x20mm alu coated	500411	1	**77**	10.3	--	--
500420	Eave support	500420	1	**36**	1.7	--	--
500421	Ridge support 10°	500421	1	**36**	12.3	--	--
500430	Streamliner FS10-S	500430	1	**32**	87.4	--	--
900229	Self Drilling Screw 4,8x19 A2	900229	1	**100**	0.5	--	--
900314	Socket bolt 6 x 110 mm	900314	1	**144**	1.3	--	--
					158.28		--

PV Configurator

Powered by Renusol

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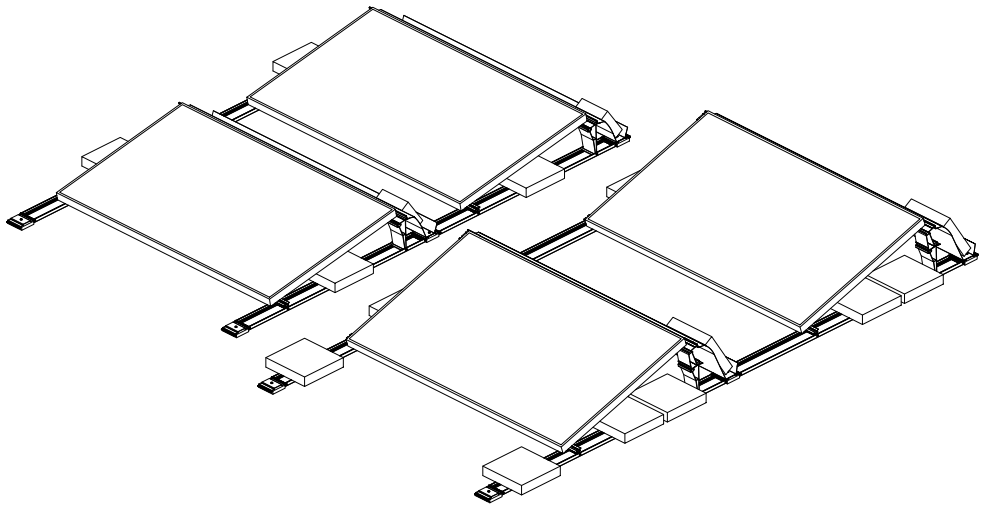
51063 Köln
Telefon:+49 221 788707-0
Telefax: +49 221 788707-99
E-Mail: support@renusol.com

Section 5

System Mounting Solution Data Sheet
System Mounting Solution Warranty Document

Renusol
A RBI SOLAR | GIBRALTAR INDUSTRIES COMPANY



System datasheet
FS10-S / FS18-S

General

System	Ballasted PV-mounting system
Compontents	Ground rails, rail connector, building protection mat, low post, high post, wind deflector, clamps
System warranty	10 years
Application area	Flat roof on industrial, agricultural and residential buildings
Roof covering	Bitumen, concrete, foil, gravel
Roof slope	max. 3° without additional measures

System properties

System orientation	South
Module tilt	10° / 18°
System weight approx.	2.2 kg/m² (FS10-S) / 2.3 kg/m² (FS18-S) plus ballast (project specific)
Weight PV-module included approx.:	9.3 kg/m² (FS10-S) / 8.1 kg/m² (FS18-S) plus ballast (project specific)
Friction coefficient	μ =0,5 is to be determined and ensured upon installation surface.
Material	Aluminum, stainless steel , strip-galvanized steel metal sheet, rubber granulate
Minimum edge distance	0,6 m
Shading angle	12° to 17.5°

PV-Modules

Type	Suitable for standard 60 cell panels. Approval for panel corner clamping is to be obtained.
Module width	10°: 950-1,050 mm / 18°: 975-1,010 mm
Orientation	Horizontal/Landscape

Certifications

Wind loads	Determined in wind tunnel tests by Ruscheweyh Consult GmbH

Services

Layout and ballast plan	Provided by Renusol

System	Ground rail #	Inter-row spacing approx. [mm]	Shading angle
FS10-S	500400	1,490	17,5°
FS10-S	500401	1,740	12,0°
FS18-S	500402	1,840	17,5°
FS18-S	500403	2,090	14,5°

Warranty Conditions of Renusol Europe GmbH
(As at 3 March 2017)

Renusol Europe GmbH, Piccoloministraße 2, 51063 Cologne, Germany ("**Renusol**") sells the products ("**Goods**") listed in **Annex A**. *Renusol* provides a warranty ("**Warranty**") to the Purchaser ("**Customer**") in accordance with the provisions of these warranty conditions.

1. Scope of Application of the Warranty

1.1 The *Warranty* applies only to *Goods* that the *Customer* has purchased directly from *Renusol*. If the *Customer* has purchased the *Goods* from a third party, any claims shall be asserted only against such third party.

1.2 The *Warranty* only applies if *Renusol* has declared vis-à-vis the Customer that this *Warranty* is to apply (esp. by letter, email or fax). A verbal undertaking does not suffice.

1.3 The *Customer's* claims for defects in accordance with clauses 7 and 8 of *Renusol's* General Terms and Conditions of Business ("**T&Cs**") in the version applicable to the *Customer* and the respective purchase shall apply in addition to the rights of the *Customer* under this *Warranty* and shall not be affected by the rights granted to the *Customer* under this *Warranty*.

2. Warranty Period

2.1 The *Warranty* shall commence at the time at which the risk passes to the *Customer* pursuant to clause 6 of the *T&Cs*.

2.2 The warranty period in relation to the *Goods* is set out in **Annex A**.

2.3 If *Renusol* provides goods or services to the Customer under this *Warranty* (repair or replacement of the Goods pursuant to clause 4.3), this shall not affect the length of the warranty period.

3. Making Claims under the Warranty

3.1 If the *Goods* are defective, the *Customer* shall immediately notify *Renusol*, in text form (esp. by letter, fax, email) and enclosing a copy of the warranty certificate, no later than within two weeks from detection of the defect; the notice of defect is deemed to have been submitted in time if it was sent within the prescribed time limit. If the *Customer* fails to notify *Renusol* of any defect within the prescribed time limit, any claims against *Renusol* under this *Warranty* are excluded.

3.2 The damage report must be submitted in text form (esp. by letter, fax, email) and include a description of all the circumstances of which the *Customer* is aware and which are relevant in order to determine the cause of defect; this description needs to be worded so as to be understood by a *Renusol* technician. This includes, in particular, the nature and location of the installation of the *Goods*, any modifications, repairs or other alterations or work carried out by the *Customer* or *third parties* in relation to the *Goods* as well as a description of the cause of the defect and any consequences. If the above details are not included, claims against *Renusol* under this *Warranty* are excluded. This does not apply if the *Customer* cannot be reasonably expected or is unable to provide these details as part of the damage report. In this case the *Customer* must provide the details without delay as soon as he is able to or as soon it can reasonably be expected of him.

3.3 At the request of *Renusol* the *Customer* shall send the Goods, at the *Customer's* cost and risk, to an address in Germany specified by *Renusol*, provided this can reasonably be expected of the *Customer*. *Renusol* will reimburse the *Customer* for the costs incurred in this regard if the defect is covered by the *Warranty* or if the *Customer*, through no fault of his own, has failed to realise that the defect is not covered by the *Warranty*. The costs for returning Goods that have been repaired or replaced under the Warranty are borne by *Renusol* "ex works".

3.4 In derogation from clause 3.4, the assertion of claims for defects within the statutory warranty period does not entail any costs for the *Customer*; any costs incurred by the *Customer* are borne by *Renusol* (section 439(2) German Civil Code ["*Bürgerliches Gesetzbuch*", "BGB"]). As a consequence, within the warranty period the *Customer* has to bear return and/or shipment costs under the Warranty only if, following a check of the notice of defect, it transpires that *Renusol* is not responsible for the defect asserted by the *Customer* and the

Customer is responsible for the unjustified notice of defect, and in particular if the *Customer* could have realised that *Renusol* was not responsible for the defect claimed.

3.5 *Renusol* shall acquire ownership in the *Goods* returned by the *Customer* provided they are not repaired and returned to the *Customer*.

3.6 For any items that are additionally sent to *Renusol* by the Customer and that do not form part of the Goods, *Renusol* shall be liable in accordance with clauses 7 and 8 of the *T&Cs* and the statutory provisions.

3.7 If the *Customer* had already firmly connected the Goods to a facility and in particular to a building so that, pursuant to sections 93, 94 BGB, the *Goods* have become an integral component of the facility, the *Customer* may request that the *Goods* be checked by way of an on-site assessment; clauses 3.3 and 3.4 shall apply mutatis mutandis with regard to any costs incurred in this regard.

4. Scope of the Warranty

4.1 A defect for purposes of this *Warranty* shall only include defects in the *Goods'* material, which limit their suitability for normal or intended use in accordance with the contract concluded with the *Customer*.

4.2 If the defect reported by the *Customer* is covered by this Warranty, *Renusol* will repair the *Goods* affected by the defect or replace them by supplying new *Goods*. *Renusol* will bear the costs thereof except for the costs for installing or removing the *Goods* at the *Customer's* premises; the *Customer* shall bear these costs himself. *Renusol* shall make the decision whether to repair or replace the *Goods* at its reasonable discretion (section 315 BGB). *Renusol* shall be free to exchange the *Goods*, where required, also for completely overhauled *Goods*.

4.3 *Renusol* is entitled to commission third parties to fulfil any rights under the Warranty. The *Customer* does not have any claim for *Renusol* to fulfil any rights under the Warranty.

4.4 Should it transpire that the defect reported by the *Customer* is not covered by this *Warranty*, *Renusol* reserves the right to charge the *Customer* for the cost of checking and, where relevant, transporting the *Goods*. This does not apply if the *Customer* has failed to recognise, through no fault of his own, that the defect is not covered by the *Warranty*. *Renusol* is entitled, in relation to any deliverables under the Warranty that are not owed, to charge a flat rate of 20 % of the sale price of the *Goods* reported by the *Customer* to be defective. The Customer shall be entitled to prove that *Renusol* has, in fact, not incurred any costs or significantly lower costs.

4.5 No claims other than those under clause 4.2 – in particular claims for a reduction of the purchase price, claims for withdrawal or damages claims – shall arise on the basis of this Warranty.

5. Exclusion of the Warranty

5.1 The following defects are excluded from this *Warranty*:

- all defects that are not based on a defect in the *Goods'* material (clause 4.1),
- all defects of *Goods* in relation to which a manufacturing or serial number attached by *Renusol* has been removed or rendered illegible,
- all defects that have arisen from non-intended use of the *Goods* by the Customer or a third party, i.e. where the Customer or third party has failed to use the *Goods* for the purpose that was contractually intended or typical,
- all defects that have arisen in disregard of or as a result of a breach of installation, operating, repair or other instruction manuals pertaining to the *Goods* that may have been provided by *Renusol*,
- all defects that have arisen from the installation or maintenance of the *Goods* if the installation or maintenance was not carried out by a suitable and professional specialist firm,
- all defects that have arisen due to external influences on the *Goods* after they have been delivered to the *Customer*, in particular due to changes, modifications, extensions, repairs, maintenance work, use of the *Goods* with non-original parts belonging to the *Customer* or third parties, improper transport or packaging of the *Goods*, vandalism, damage caused by animals, riots, civil unrest (civil war, demonstrations), war, earthquakes, floods, overvoltage, fire, explosion or lightning strike, and
- all defects caused to *Goods* of *Renusol* that are not included in any of the product groups listed in **Annex A**.

5.2 In addition to clause 5.1., defects of the respective *Goods* that have arisen due to a failure to use the *Goods* in accordance with the standard terms and conditions of use as set out in **Annex B** are excluded from the Warranty.

6. Final Provisions

6.1 This *Warranty* and all claims related hereto shall be subject to substantive German law only, to the exclusion of the UN Convention on Contracts for the International Sale of Goods and any conflict of law provisions; this shall not affect article 3(3) and (4) Rome I.

6.2 Insofar as translations of these warranty conditions into languages other than German are produced, only the German version shall be legally binding.

6.3 If the *Customer* is a merchant, a legal person under public law or a special fund under public law, the exclusive place of jurisdiction for all disputes arising directly or indirectly under this contractual relationship anywhere in the world shall be Cologne, Germany. The same applies even if the *Customer* does not have any general place of jurisdiction in Germany or if his place of residence or habitual abode is not known at the time these legal proceedings are brought. *Renusol* is entitled to assert claims against the *Customer* at its general place of jurisdiction.

6.4 Any amendments or supplements to the Warranty as well as all declarations and notifications related to the Warranty must be made in text form (esp. by letter, fax, email). This shall also apply to the repeal of this requirement for text form.

6.5 If any provision of this Warranty is or becomes invalid or unenforceable, in whole or in part, this shall not affect the remainder of the provisions. Statutory provisions shall apply in place of the invalid provision. This shall apply accordingly in relation to any omissions in these provisions that the parties had not foreseen.

A n n e x A

These warranty conditions shall apply to the following *Goods* with the respective warranty period as set out in clause 2.2:

- FS 10 – warranty period: ten years
- FS 10-S – warranty period: ten years
- FS 18-S – warranty period: ten years
- FS 10-EW – warranty period: ten years
- ConSole/CS+ – warranty period: ten years
- InterSole – warranty period: ten years
- VarioSole/VS+ – warranty period: ten years
- MetaSole/MS+/MS+P – warranty period: ten years
- IntraSole – warranty period: ten years
- TS+ – warranty period: ten years

A n n e x B

In accordance with clause 5.2, *Goods* in the ConSole and CS+ product group shall be subject to the following standard terms and conditions of use:

- the *Goods* shall only be used subject to a sufficient structural basis, in particular installation on a load bearing device that is sufficiently strong to carry the weight of the *Goods* as well as any additional weather-related loads such as water, wind, leaves or snow,
- surface friction coefficient no less than 0.6,
- wind speeds of no more than 130 km/h, and
- ambient temperatures of no less than -30 °C and no more than 50 °C.

In accordance with clause 5.2, *Goods* in the InterSole, VarioSole, MetaSole and IntraSole product groups shall be subject to the following standard terms and conditions of use:

- the *Goods* shall only be used subject to a sufficient structural basis, in particular installation on a load bearing device that is sufficiently strong to carry the weight of the *Goods* as well as any additional weather-related loads such as water, wind, leaves or snow,
- wind speeds of no more than 115 km/h, and
- ambient temperatures of no less than -30 °C and no more than 50 °C.

In accordance with clause 5.2, *Goods* in the FS10, FS10-S, FS18-S and FS10-EW product groups shall be subject to the following standard terms and conditions of use:

- the *Goods* shall only be used subject to a sufficient structural basis, in particular installation on a load bearing device that is sufficiently strong to carry the weight of the *Goods* as well as any additional weather-related loads such as water, wind, leaves or snow,
- surface friction coefficient no less than 0.5,
- dynamic wind pressure of no more than q_k=1.0 kN/m², and
- ambient temperatures of no less than -30 °C and no more than 50 °C.

Section 6

System Solar Panel Data Sheet
System Solar Panel Warranty Document

Harvest the Sunshine

Poly

280W Module

JAP60S01 260-280/SC Series

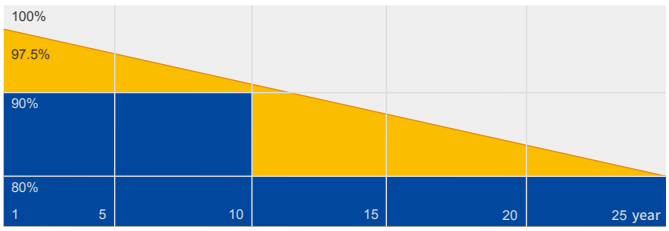
Introduction

This time-tested legacy module series has been proven to be one of the powerful and most reliable products offered by JA Solar and the most popular choice by PV system installers and customers around world.

- 5BB — 5 busbar solar cell design
- Low cost
- PID — Anti-PID
- Highly reliable due to strict quality control

Superior Warranty

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



JA Linear Power Warranty Industry Warranty

Comprehensive Certificates

- IEC 61215, IEC 61730, UL 1703, IEC TS 62804, IEC 61701, IEC 62716, IEC 60068-2-68
- ISO 9001: 2015 Quality management systems
- ISO 14001: 2015 Environmental management systems
- OHSAS 18001: 2007 Occupational health and safety management systems
- IEC TS 62941: 2016 Terrestrial photovoltaic (PV) modules – Guidelines for increased confidence in PV module design qualification and type approval

JA SOLAR

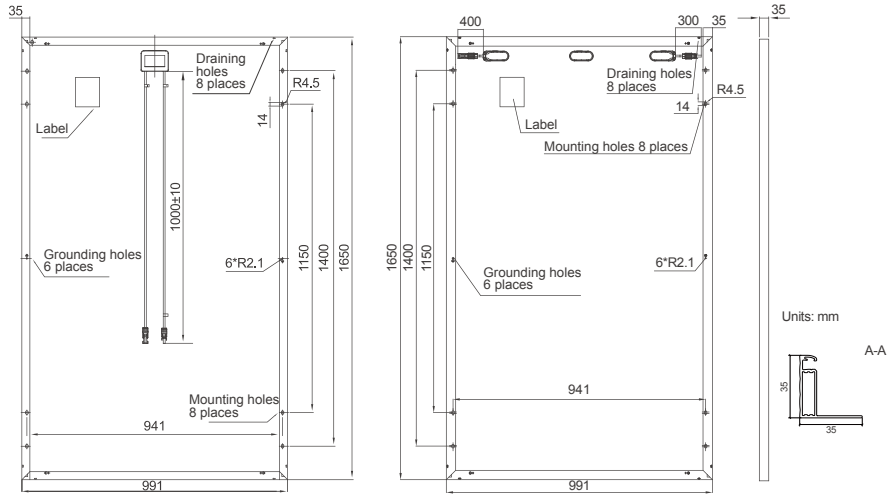
www.jasolar.com

Specificantions subject to technical changes and tests.
JA Solar reserves the right of final interpretation.

JA SOLAR

JAP60S01 260-280/SC Series

MECHANICAL DIAGRAMS



Integrated junction box

Split junction box

Remark: customized frame color and cable length available upon request

SPECIFICATIONS

Cell	Poly
Weight	18.2kg±3%
Dimensions	1650mm×991mm×35mm
Cable Cross Section Size	4mm²
No. of cells	60(6x10)
Junction Box	IP67, 3 diodes
Connector	MC4 Compatible(1000V) QC 4.10-35(1500V)
Packaging Configuration	30 Per Pallet

ELECTRICAL PARAMETERS AT STC

TYPE	JAP60S01 -260/SC	JAP60S01 -265/SC	JAP60S01 -270/SC	JAP60S01 -275/SC	JAP60S01 -280/SC
Rated Maximum Power(Pmax) [W]	260	265	270	275	280
Open Circuit Voltage(Voc) [V]	37.74	37.95	38.17	38.38	38.65
Maximum Power Voltage(Vmp) [V]	30.71	30.92	31.13	31.34	31.61
Short Circuit Current(Isc) [A]	9.04	9.11	9.18	9.29	9.37
Maximum Power Current(Imp) [A]	8.47	8.57	8.67	8.77	8.86
Module Efficiency [%]	15.9	16.2	16.5	16.8	17.1
Power Tolerance	0~+5W				
Temperature Coefficient of Isc(α_Isc)	+0.058%/℃				
Temperature Coefficient of Voc(β_Voc)	-0.330%/℃				
Temperature Coefficient of Pmax(γ_Pmp)	-0.400%/℃				
STC	Irradiance 1000W/m², 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

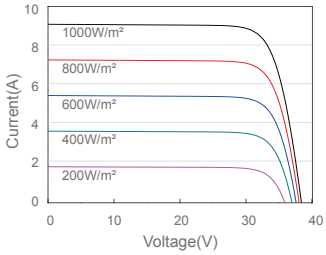
TYPE	JAP60S01 -260/SC	JAP60S01 -265/SC	JAP60S01 -270/SC	JAP60S01 -275/SC	JAP60S01 -280/SC
Rated Max Power(Pmax) [W]	192	196	200	204	207
Open Circuit Voltage(Voc) [V]	35.70	35.94	36.25	36.56	36.85
Max Power Voltage(Vmp) [V]	28.87	29.09	29.29	29.48	29.69
Short Circuit Current(Isc) [A]	7.20	7.23	7.27	7.33	7.40
Max Power Current(Imp) [A]	6.66	6.74	6.82	6.90	6.98
NOCT	Irradiance 800W/m², ambient temperature 20°C, wind speed 1m/s, AM1.5G				

OPERATING CONDITIONS

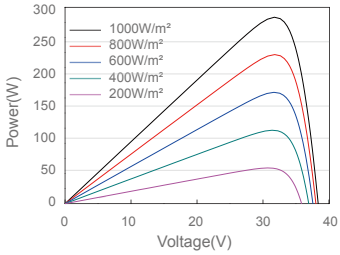
Maximum System Voltage	1000V/1500V DC(IEC)
Operating Temperature	-40°C~+85°C
Maximum Series Fuse	20A
Maximum Static Load,Front	5400Pa
Maximum Static Load,Back	2400Pa
NOCT	45±2°C
Application Class	Class A

CHARACTERISTICS

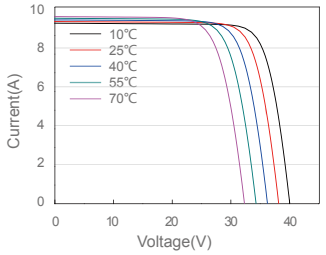
Current-Voltage Curve JAP60S01-270/SC



Power-Voltage Curve JAP60S01-270/SC



Current-Voltage Curve JAP60S01-270/SC



Limited Warranty

for PV Modules

JA SOLAR

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JA Solar 08.2016

JA SOLAR

JA Solar Holdings Co., Ltd., and on behalf of ALL its DIRECTLY AND indirectly owned and controlled subsidiary, INCLUDING BUT NOT LIMITED TO Shanghai JA Solar Technology Co., Ltd.-(hereinafter jointly referred to as "JA Solar") warrants its Photovoltaic Solar modules' (MODULES) performance starting from the date of sale to the first customer installing (for their own use) the modules ("Customer") or starting at the latest 6 months after modules dispatch from the JA Solar factory, whichever occurs earlier (the "Warranty Commencement Date").

1. Limited Product Warranty – Twelve Year Repair or Replacement

JA Solar warrants that the MODULES together with the factory-assembled DC connectors and cables are free from any defects in materials and workmanship under normal application, usage, installation and service conditions for a period of one hundred and forty-four (144) months from the Warranty Commencement Date. If MODULES become malfunctioning or non-operative due to defects in material or workmanship during the one hundred and forty-four (144)-month period from the Warranty Commencement Date, as verified by an independent testing agency that will be selected and confirmed mutually by JA Solar and Customer in advance, JA Solar will, at its sole option, either repair or replace the malfunctioning or inoperative MODULES. MODULES' repair or replacement remedy shall be the sole and exclusive remedy provided under this Limited Product Warranty and shall not extend beyond the period set forth herein. This Limited Product Warranty does not warranty a specific power output at or during any time frame, which shall be exclusively covered under Section 2 of this Warranty hereinafter
("Limited Peak Power Warranty")

2. Limited Peak Power Warranty– Limited Remedy

JA Solar warrants that for a period of twenty-five years starting from the Warranty Commencement Date, loss of power output against the minimum "Peak Power at STC" as specified on the label of the modules (hereinafter "Nominal Power") when measured at Standard Test Conditions (STC) for the Product(s) shall not exceed:

(1) For Mono Products: 3 % for the first year from the Warranty Commencement Date, and 0.65% per year thereafter from the 2nd to the 25th year of the warranty period: with a power output standing at 81.4% of the Nominal Power at the end of the 25-year warranty period;

(2) For Poly Products: 2.5 % for the first year from the Warranty Commencement Date, and, 0.7% per year thereafter from the 2nd to the 25th year of the warranty period: with a power output standing at 80.7% of the Nominal Power at the end of the 25-year warranty period.

Within the period of twenty-five (25)-year warranty period from the Warranty Commencement Date, should any qualified Module sold by JA Solar exhibit a loss of power output exceed the aforementioned warranted values, provided that any such declared loss in power has been verified by JA Solar, at its sole discretion is due to MODULES' defects in materials or workmanship attributable to JA Solar's own causes and further confirmed by an independent testing agency (if so requested by a customer) (which is to be selected and confirmed mutually by JA Solar and Customer in advance), JA Solar will, at its sole option and discretion, either (1) make up such loss in power by providing to customer(s) additional MODULES; or (2) repair or replace the defective MODULES including free shipping to the location as set out in the original sales contract entered between JA Solar and the customer.

The remedies set forth herein are the sole and exclusive remedies JA Solar is bound to provide under the Limited Peak Power Warranty.

CAVEAT:

The shipping charges for any allegedly defected MODULES shall be borne by the customers making such claims in advance. Should the independent testing agency confirm that such filed defected are to be covered under this Warranty by JA Solar, the shipping charges advanced by the customers may be reimbursed by JA Solar against the original proof of expenditure.

3. Exclusions and Limitations

(a) Warranty claims from any customers, in any event, shall be filed in writing to JA Solar or its authorized distributors within the applicable warranty period and not beyond the last day of the applicable period of time as stated above.

(b) The Limited Product Warranty and Limited Peak Power Warranty shall not apply to MODULES which have been subject to:

- Misuse, abuse, neglect, vandalism or accident;
- Repair or modifications that do not strictly follow the manufacturer's instructions;

Non-observance of JA Solar's maintenance instructions;

- Power failure, electrical spikes or surges, lightening, flood, fire, accidental breakage or other events outside JA Solar's control.
- Alteration, improper installation or application which is not compliant with JA Solar standard installation manual.

(c) The Limited Product Warranty and Limited Peak Power Warranty do not cover any costs associated with installation, removal or re-installation of the MODULES and (except as explicitly set forth in the last paragraph of the Section 5) customs clearance or any other costs for return of the MODULES.

(d) Warranty claims will not be honored if the type or serial number of JA Solar MODULES have been altered, removed or made illegible without written authorization from JA Solar.

4. Limitation of Warranty Scope

This Warranty as set forth herein is expressly in lieu of and excludes all other express or implied warranties, including but not limited to warranties of merchantability and of fitness for particular purpose, use, or application, and all other obligations or liabilities on the part of JA Solar, unless such other obligations or liabilities are expressly agreed to in writing signed and approved by JA Solar. JA Solar shall have no responsibility or liability whatsoever for damage or injury to persons or property, or for other loss or injury resulting from any cause whatsoever arising out of or related to the MODULES, including, without limitation, any defects in the MODULES or from use or installation.

Under no circumstances shall JA Solar be liable for incidental, consequential or special damages, howsoever caused. Loss of use, loss of profits, loss of production, and loss of revenues. The aforementioned alleged losses by customers are specifically and without limitation excluded from responsibilities of JA Solar. JA Solar's aggregate liability, if any, in damages or otherwise, shall not exceed the invoice value as paid by the Customer, for the single unit of MODULES.

5. Obtaining Warranty Performance

If the Customer has a justified claim covered by this Warranty, an immediate written notification shall be directly made to JA Solar by means of registered letter to the address of JA Solar listed hereunder, or, sending a notification via e-mail to the e-mail account of JA Solar listed hereunder. Together with the notification, the Customer should enclose the evidence of the claim with the corresponding serial number of the MODULES and the date on which the MODULES have been purchased. An invoice with clear indication of the purchase date, purchase price, module type, stamp or signature of JA Solar or its distributors should also be submitted as part of the preliminary evidence.

If the MODULES will be returned to JA Solar for inspection, repair or replacement by JA Solar, JA Solar shall provide the Customer with a Return Merchandise Authorization (RMA). However, JA Solar wil not accept a return of any MODULES without such RMA. In connection with both the Limited Product Warranty and Limited Peak Power Warranty, JA Solar may reimburse customer for reasonable, customary and documented transportation charges by sea freight for both the return of the MODULES and reshipment of any repair or replacement MODULES, only if such cost reimbursement is authorized by JA Solar's Customer Service Department in advance.

6. Transferability

This warranty is extended to the original end-user purchaser, and is also transferable to any subsequent owner of the location or holder of the product when MODULES remain at their original installed location upon satisfactory proof of succession or assignment.

7. Severability

If a section, provision or clause of this Warranty, or the application thereof to any person or circumstance, is held invalid, void or unenforceable, such shall not affect and thus shall leave all other sections, provisions, clauses or applications under this Warranty severable, and therefore validly binding.

8. Dispute Resolution

In case of any dispute in terms of warranty-claims, a first-class international testing institute, such as PI Berlin, TÜV SUD or Intertek , UL, shall be entrusted by both parties upon mutual consents in order to provide third party verification and comments. All fees and expenses shall be borne by the party that demanded such verification procedure, unless otherwise agreed.

Further dispute over the claim shall be submitted to dispute resolution as stipulated in the main sales contract to which this Warranty is a part of and subject to the applicable jurisdiction agreed by the parties in the sales contract.

9. Various

The repair or replacement of the MODULES or the supply of additional MODULES does not lead to a new commencement of warranty terms, nor shall the original terms of this Warranty be extended. Any replaced MODULES shall become the property of JA Solar.

JA Solar shall at its own options to deliver another type of MODULES (different in size, color, shape, or power), either a new brand or the original one, in case that JA Solar has discontinued producing the module in question at the time of the claim.

10. Force Majeure

JA Solar shall not be responsible or liable to the Customer whatsoever or any third-party arising out of any non-performance or delay in performance of any terms and conditions of the sales, including this Warranty, due to causes of natural disasters such as fire, flood, blizzard, hurricane, thunder, acts of God, changes of public policies, terrorism, war, riots, strikes, unavailability of suitable and sufficient labor or materials and other events which are out of control of JA Solar.

REMARK:

"Peak Power" is the power in watt peak that MODULES generates in its maximum power point under STC condition. 'STC' are as follows:

(a) Light spectrum of AM 1.5

(b) Irradiance at 1,000W/m2

(c) Cell temperature of 25 degree Centigrade at right angle irradiation

The measurements are carried out in accordance with IEC61215 as tested at the junction box terminals per the calibration and testing standards of JA Solar valid at the date of manufacture of the MODULES. JA Solar's calibration standards shall be in compliance with the standards applied by international institutions accredited for this purpose.

Section 7

System Inverter Data Sheet
System Inverter Warranty Document

Three

6kW - 15kW

Solis Three PV Inverter

- Three phase output
- Precise MPPT algorithm
- Compact and light design, easy installation
- IP65 rated for outdoor installation
- RS485, WiFi/GPRS (optional) interface
- WiFi and monitoring app available
- Numerous protection functions
- 5 years standard warranty, 20 years optional upgrade

Model:

Solis-6K Solis-10K Solis-15K

Features:

- Fanless — Cooling Concept
- Ultra wide — Voltage Range
- WiFi/GPRS — Real time monitoring
- Available on the iPhone App Store / Available on the iPhone App Store
- IP65
- Weight — 29kg

Datasheet

Model	Solis-6K	Solis-10K	Solis-15K
Energy Source	PV		
Input Side(DC)			
Max. DC input power(kW)	6.9	11.5	16.5
Max. DC input voltage(V)	1000		
Start-up voltage(V)	250		
MPPT voltage range(V)	200-800		
Max. input current(A)	15A+15A	18A+18A	18A+18A
MPPT number/Max input strings number	2/2	2/4	2/4
Output Side (AC)			
Rated output power(kW)	6	10	15
Max. apparent output power(kVA)	6.6	11	15
Max. output power(kW)	6.6	11	15
Rated grid voltage(V)	400		
Grid voltage range(V)	313-470		
Rated grid frequency(Hz)	50/60		
Operation phase	Three		
Rated grid output current(A)	8.7	14.4	21.7
Max. output current(A)	10	16.7	25
Power Factor (at rated output power)	0.8…1…0.8		
THDi (at rated output power)	<3%		
DC injection current(mA)	<20		<50
Grid frequency range(Hz)	47–52 or 57–62		
Efficiency			
Max.efficiency	98.2%		98.3%
EU efficiency	97.3%		97.5%
MPPTefficiency	>99%	>99.5%	
Protection			
DC reverse-polarity protection	Yes		
Short circuit protection	Yes		
Output over current protection	Yes		
Output over voltage protection	Yes		
Insulation resistance monitoring	Yes		
Residual current detection	Yes		
Surge protection	Yes		
Islanding protection	Yes		
temperature protection	Yes		
Integrated DC switch	Optional		
General Data			
Dimensins(mm)	430W*613H*269D (mm)		
Weight(kg)	29		30
Topology	Transformerless		
Self consumption (night)	<1W(Night)		
Operating ambient temperature range	-25~60℃		
Ingress protection	IP65		
Noise emission{typical}	<30 dBA		
Cooling concept	Natural convection		
Max.operation altitude	4000m		
Designed lifetime	>20years		
Grid connection standard	EN50438, G59/3, AS4777, VDE0126-1-1, IEC61727		
Relative humidity	0~100%		
Safty/EMC standard	IEC62109-1/-2, AS3100, EN61000-6-1, EN61000-6-3,		
Features			
DC connection	MC-4mateable		
AC connection	Ip67rated plug		
Display	LCD,2×20 Z.		
Communication connections	4 pins RS485 connector		
Warranty	5 years standard (extend to 20 years)		

SOLIS INVERTER WARRANTY – 3 Phase 5 Year

Ginlong(Ningbo) Technologies Co., Ltd.

No. 57 Jintong Road, Binhai Industrial Park, Xiangshan, Ningbo, Zhejiang 315712, China
Tel: (+86) 574 6578 1806 Email: sales@ginlong.com

Solis Inverter are manufactured by Ginlong (Ningbo) Technologies Co., Ltd. (The Company) (referred to as Ginlong) provides the following Warranty to the purchaser (The Customer) of the Solis 3 Phase Inverter (The Goods). (The Customer is deemed to be the owner of the installed Goods at first sale.

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1. Warranty Terms

The Company warrants all Goods to be free from defects in material or workmanship under normal use and service for a period of 5 years from the date of sale to the Customer.

The Warranty covers the cost of unit repairs or replacement parts. The Goods must be returned to the Company for inspection.

The company may repair or replace faulty components at its discretion.

This warranty extends the Customer's statutory rights and cannot be construed so as to diminish such statutory rights.

2. Warranty Extension

The purchaser may apply for a warranty extension within 12 months of purchase by providing the serial number of the unit along with proof of purchase.

3. Warranty Limitations

The Warranty is valid only for Goods purchased either directly from the Company or from an authorized reseller of the company.

The Warranty is not transferable and applies to brand new Goods only.

Defective parts replaced under Warranty become the property of the Company.

The Warranty does not cover:

(a) Access, labour or transport costs;

(b) Consequential damages including but not limited to loss of revenue;

(c) Claims by third parties other than the Customer;

(d) Defects of installation. (Except where the installation is performed by the Company);

(e) Goods damaged as a consequence of incorrect installation. (Except where the installation is performed by the Company);

(f) Items ancillary to installation not supplied by the Company;

(g) Duties, import/export fees or costs and other general administrative costs;

(h) Damage to Goods caused by misuse, improper handling or unauthorized modification;

(i) Loss or damage occurring whilst in transit;

(j) Accidental or willful damage;

(k) Any Goods described in a quotation or delivery note as 'ex-display' or 'reconditioned'. (A separate Warranty extension may have been issued to cover such Goods.)

Labour, travel and delivery (to and from customer) will be charged if goods returned found to be not faulty following a warranty claim.

Covers all Three Phase inverters purchased after July 1st 2016 where warranty term changed to 5 year standard.

4. Warranty Claims Procedure

To make a warranty claim the following information needs to be provided:

- Completed RTM Inspection Form
- Product Model (ie. Solis 15kW) and Product Serial Number (ie. A1110011)
- Copy of the invoice for the inverter
- Copy of the installation report and MCS installation certificate

The authorised reseller will liaise with the Company regarding repair or replacement. The cost of unit repair or replacement will be borne by the Company provided the Warranty has been validated and the Warranty period has not expired.

Where repairs must be effected at the Company's headquarters, the Company will endeavor to minimize the down time for the Goods.

Karen Taylor

From: Jonny Springall <jonny.springall@envirolec-ses.co.uk>
Sent: 02 July 2019 10:31
To: Chris Wells
Cc: Paul Critcher; Toby Buckley; 6556 UOH : Delivery Team
Subject: RE: University of Herts Social Space PV Works
Attachments: Hillside Primary Collage.jpg; PHOTO-2019-04-10-17-28-21.jpg; Envirolec - SPV.pdf

Chris,

In response to comments on the technical submission document see below.

1. kg/CO2 = 5,051. kWh annum = 8,418kWh/ achieved on current design report; therefore the system is achieving the desired outputs required.
2. ENE-01 not included within documents received however cost uplift can be provided if relevant information is received.
3. G99 application will be included within the proposal (In order to make this application further information is required which can be sough at point of order).
4. Inverters ideally located within a top floor riser cupboard or a plant room. The inverter would require 300mm clearance to sides, 500mm to bottom to uphold warranties. The inverter itself measures 310W x 538H x 158D.
5. PV generation meter location by main DB board.
6. Ballast to be placed along the rear and beneath the panels as attached images.
7. Cables to be laid on big feet and tray as attached image to roof penetration (location and route to be advised). Containment within riser down to main DB by others. Schematic attached indicating electricians/Envirolec's works for clarity.

Please do not hesitate to contact me should you require any further information.

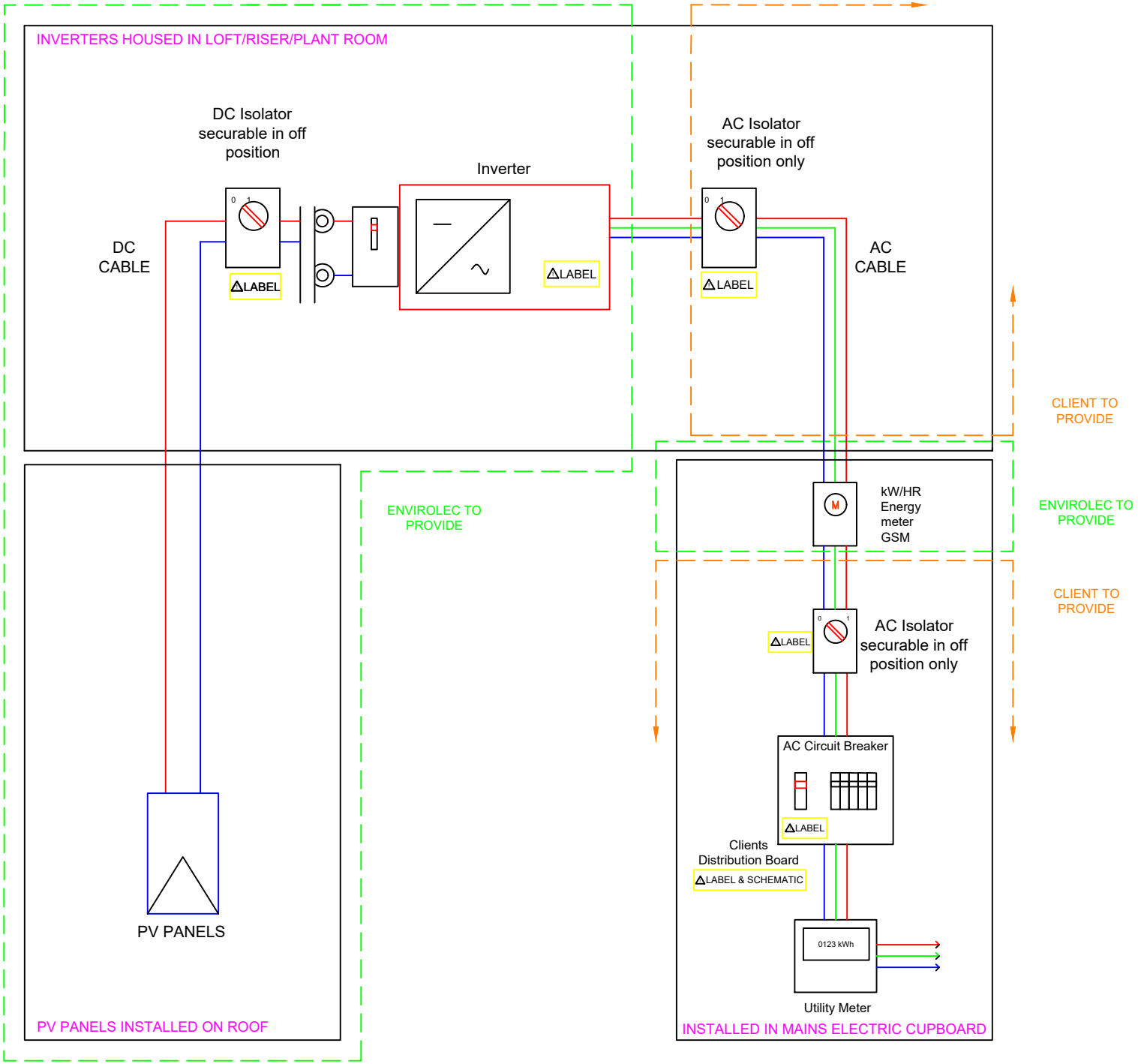
Kind Regards

Jonny Springall
Design Manager

envirolec
smart energy solutions

GREATER LONDON ENERGY EFFICIENCY AWARDS 2019 WINNER SOLAR PV INSTALLER & CONTRACTOR

Envirolec Smart Energy Solution Ltd
Unit 2,
Hope Lane,
Eltham,
London,
SE9 3TP



Rev Date Description Drawn

Issue status
INFORMATION

Project
ENVIROLEC
GENERAL DETAILS

Title
CLIENTS AC DETAIL
SOLAR PV

Scale	Designed By	Checked by	Date
NTS@A4	MB	JS	SEP'18

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SE9 3TP
molly.bratton@envirolec-ses.co.uk
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envirolec

smart energy solutions