BAUDER

Bauder Bio Solar Technical Report

Project: Hoxton Hotel High Holborn

Project Reference: B120624

11 April 2017

Prepared for: Hoare Lea

Prepared by: Bauder Ltd.

Technical Report

1. Project information

Project name	Hoxton Hotel High Holborn
Client	Hoare Lea
Contact	Mr Jeremy Holgate
Bauder ATM	Mr Hayden Davies

2. Property information

Building/Areas	Green Roof Area		
Address	203 High Holborn, London	*Postcode*:	WC1V 7BD

3. System configuration

Rated Power DC	8.64 kWp
Bauder System	BAUDER Bio Solar
Bauder Fixing Method	Ballasted*2
*Type of Module (power class)*1*	JA Solar (270Wp*3)
Module quantity	32 units
Bauder Mounts	32 units
Bauder Bio Solar Rails	70.4 lm (Number of mounts x 2.2m).
Type of Inverter	Fronius Symo 8.2-3-M
Inverter amount	1 units
DC Cable length	Ca. m (Confirmed when design finalized)
Cable tray system	M (Confirmed when design finalized)
DC Isolator	2 units

4. Yield studies

Global radiation at Site Location	975.8 kWh/m²		
Module Tilt / Angle	15°	*Module Azimuth*	72° SW & 108° SE
Roof Pitch	1°		
*Yield Forecast Specific Annual Yield *4*	760 kWh/kWp/a		
MCS Yield Forecast Specific Annual Yield	817.5 kWh/kWp/a		
*Forecast for generated energy in the first year *4*	6.56 MWh		
*CO2 savings per year *5*	3.470 tonnes/a		

*1 *Module type or power class can differ – dependant on the order time and availability*

*2 *Using Bauder biodiverse green roof – See Bauder Q37 green roof specification for further information.*

*3 *In accordance to STC (Standard Test Conditions): 1.000 W/m², (25 ± 2)°C, AM 1,5 according to EN 60904-3*

*4 *Simulation model subject to detailed system specification including inverter concept, shading analysis, cable losses etc. MCS figure shown is based on the closest geographical location provided on MCS irradiance datasheets. Yield forecast is based on PVsyst computer generated site specific output.*

*5 *According to: CO_2-emmission factor 529 g/kWh for the electrical mix in United Kingdom in 2012.*

Technical Report

5. Result

This result is based on the basic information provided and is only meant to show a preliminary design.

Full AutoCAD roof drawings are required to undertake a precise engineering design.

The exact method of roof attachment should be decided under consultation with Bauder Limited.

For a more detailed layout, further information is necessary – please contact us for details.

Created	D.Mitchell	*Checked*	T.Raftery
Date	2017/04/11	*Date*	2017/04/11

Evaluation basis

Document	**Description**	**Input date**
Drawing	10475-C-01-08-Z06-01 Model (1)	2017-04-11
Drawing	10475-C-01-08-Z06-01	2017-04-11
Drawing	DN-1520565-08-JH-20170330-Roof solar PV study	2017-04-11

Software used	AUTOCAD LT Version 2012, Weather Data Meteonorm Version 7.1.3, Program PVSYST Version 6.34,

6. Attachments

1. Layout	B120624PV - 20170405
2. Structural Analysis	Bio Solar Windload Calc - Hoxton Holburn Hotel - 20170411
3. Data Sheets	BAUDER Bio Solar
	Panel Datasheet
	Inverter Datasheet

This report was prepared by MW Photovoltaik Engineering GmbH on behalf of Bauder Limited.

MW Photovoltaik Engineering GmbH
Frohanuer Straße 3
D-13467 Berlin
Internet: www.solar-mw.com

MW Photovoltaik Engineering GmbH

contec

Kautschuk-Abdichtungen · Dachbegrünungen · Energiesysteme

Determination of Windload and Snowload on Flat Roof according Eurocode 1

EN 1991-1-4:2005 + A1:2010 + AC:2010
BS NA EN 1991-1-4 (2010)
EN 1991-1-3:2005
BS NA EN 1991-1-3 (2003)

Tender number:	Hoxton Hotel - High Holborn 203			Edited by:	D.Mitchell		
Order number:	B120624			Date:	11.04.17		
Object:	Engineer	Mitchell		County:			
	Street:	203 High Holborn		Borough:			
	Town / PC	London		District:			
Building position:							
	Altidude above sea level		A	26	m		
	Distance from shoreline			60	km		
	Distance inside town terrain			20	km		
	Basic wind velocity (figure A)		$v_{b,map}$	21.5	m/s		
	Snow load zone (figure B)			4			

This calculation sheet is only applicable when orography is not significant
(refer to NA to BS EN 1991-1-4:2005+A1:2010 Figure NA.2).
It should not be applied for buildings situated on top of hills and ridges or on slopes.

	East-West					
Building dimensions	x	Length	d	16.8	m	
		Width	b	15.7	m	
		Height	h	36	m	
		Pitch angle	α	1	°	

Roghness category	0	Sea				
	I + II	Country Terrain				
	III + IV	Town Terrain		x		
Windpressure	**reference mean velocity pressure**		q_{b0}	0.3	kN/m²	
	Peak velocity pressure		$q_{p(z)}$	0.921	kN/m²	
Roof Type		Sharp eaves				
		Parapet, hight	h_p	0.4	m	
		Curved eaves, radius	r		m	
		Mansard eaves, angle	α		°	
		horizontale length	l		m	
		effective hight	z_e	36.4	m	

Characteristic ground snow load	s_k	0.60	kN/m²	

Key

Outline of Panel =

Outline of Drainage Board =

Reprenstation of Mount Rail =

Wind suction areas (Structural analysis)

- Corner area F
- Edge area G
- Inner area H

This Layout is based on the given information. For a more detailed engineering, more information about the roof and nearby objects are necessary.

General Information	
Total power DC	8.64 kWp
BAUDER System type	Bauder SOLAR
Module type	JA Solar (270wp)
Module amount	32 Units
Azimuth	72 Degrees SW & 108 Degrees SE

BAUDER Ltd.
70 Landseer Road
Ipswich, IP3 0DH
Tel.:+44 (0)1473 257671 Fax:+44 (0)1743 230761 Internet: www.bauder.co.uk

	Date	Name
Drawn	05.04.2017	Guy Whiteing
Changed		
Checked		

Drawing No.: B120624PV - 20170405

File Name: B120624PV - 20170405.dwg

Scale:

Client: Hoare Lea

Project: Hoxton Hotels WC1V 7BD

Drawing Title: PV Layout Plan
PV Design Layout

Planning Period:

Format: A

Sheet

BAUDER

BIOSOLAR

BAUDER BioSOLAR
Integrated Photovoltaic Green Roof

The construction and development of buildings in today's market is calling for rooftop solutions that include a duality of technologies for environmental advantage; a biodiverse green roof coupled with ecological and SUDS enhancement and a solar photovoltaic array. Bauder embraces this cohesive stance with our BioSOLAR solution designed to meet planning and BREEAM requirements.

Bauder BioSOLAR is an integrated mounting solution for photovoltaic renewable energy with a green roof where the substrate and vegetation provide the ballasted installation mechanism which removes the need for penetrating the waterproofing to secure the mounting units to the roof.

A key element of the BioSOLAR system is that the front edge of the PV panel is set at around 300mm above the level of the substrate which allows liberal growing room for the extensive vegetation without blocking light to the polycrystalline solar cells which would otherwise reduce the output and efficiency of the panels. This height setting also enables light and moisture to reach beneath the panel to support the plants below.

Improved Solar Panel Efficiency

A combined green roof with PV delivers advantages to the building as the cooling effect of the vegetation and water held within the green roof system preserves the ambient temperature around the photovoltaic array. Studies in Germany have shown that PVs work most efficiently with an ambient temperature of around 24°C and that when an array is combined with a green roof, the panels are expected to achieve around a 6% higher output.

Varied Habitats for Flora and Fauna

The mixture of sunny, shaded and sheltered areas together with a variable depth of FLL compliant extensive substrate gives a matrix of different habitats which allow a broader range of plant species to thrive, and small invertebrates to seek refuge from strong wind and rain. The broad mix of flowering vegetation provides a rich foraging environment for bees and insects.

Key Features

- Maximises solar output and allows entire roof to qualify as biodiverse green roof.
- No roof penetrations as the green roof substrate acts as ballast, ensuring that the waterproofing guarantee remains uncompromised.
- Quick and simple installation process.
- Cost competitive compared with a mechanically fixed alternative.
- Raised modules allow light and moisture under the panels so reduces the unproductive area.
- System can be retrofitted on many roofs without structural modification to the building.
- Single point responsibility for the waterproofing, green roof and PV installation.
- Increased module space between substrate and panels reduced risk of panel damage during green roof maintenance.

PHOTOVOLTAIC GREEN ROOF CONSTRUCTION

Mounted photovoltaic panel prior to the installation of the ballasting green roof and vegetation.

Service

Bauder is renowned for its green roofs and our BioSOLAR system is an extension to this provision and as such you receive the service that accompanies all our project commitment, delivery and management.

We will work with you through the entire process from consultation and initial site survey, design the PV array and green roof construction with appropriate Bauder waterproofing, suitable substrate depths and vegetation, create a specification package for every element of the roof including detail design and wind uplift calculations, monitor the installation and handover to the client with full guarantee.

Quality of Installation

Our approved contractors, engineers and installers are the only people fully trained and certified to install our rooftop solutions as excellent workmanship is crucial to the guarantee that accompanies all works on the Bauder roof.

BAUDER

UNITED KINGDOM
Bauder Limited
70 Landseer Road, Ipswich, Suffolk IP3 0DH, England
T: +44 (0)1473 257671 **E:** info@bauder.co.uk
bauder.co.uk

IRELAND
Bauder Limited
O'Duffy Centre, Cross Lane, Carrickmacross, Co. Monaghan, Ireland
T: +353 (0)42 9692 333 **E:** info@bauder.ie
bauder.ie

JA SOLAR

JAP6

60/255-275/4BB

MULTICRYSTALLINE SILICON MODULE

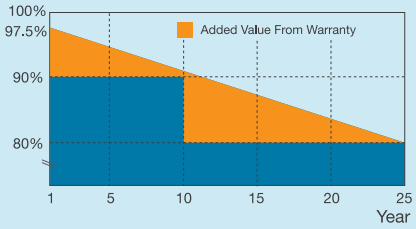
JA Solar Holdings Co., Ltd.

JA Solar Holdings Co., Ltd. is a world-leading manufacturer of high-performance photovoltaic products that convert sunlight into electricity for residential, commercial, and utility-scale power generation. The company was founded on May 18, 2005, and was publicly listed on NASDAQ on February 7, 2007. JA Solar is one of the world's largest producers of solar cells and modules. Its standard and high-efficiency product offerings are among the most powerful and cost-effective in the industry.

Add: NO.36, Jiang Chang San Road, Zhabei, Shanghai 200436, China
Tel: +86 21 6095 5888 / +86 21 6095 5999
Fax: +86 21 6095 5858 / +86 21 6095 5959
Email: sales@jasolar.com market@jasolar.com

Superior Warranty

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



Key Features

- JA 4BB design module reduce cell series resistance and stress between cell interconnectors improves module reliability and module conversion efficiency
- High output, 16.51% highest conversion efficiency
- Designed for IEC DC 1000V applications
- Anti-reflective and anti-soiling surface reduces power loss from dirt and dust
- Outstanding performance in low-light irradiance environments
- Excellent mechanical load resistance: Certified to withstand high wind loads (2400Pa) and snow loads (5400Pa)
- High salt and ammonia resistance certified by TÜV NORD

Reliable Quality

- Positive power tolerance: 0~+5W
- 100% EL double-inspection ensures modules are defects free
- Modules binned by current to improve system performance
- Potential Induced Degradation (PID) Resistant

Comprehensive Certificates

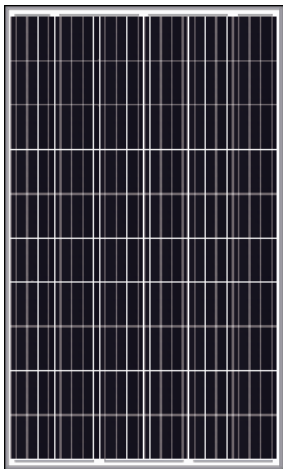
- IEC 61215, IEC 61730, UL1703, CEC Listed, MCS and CE
- ISO 9001: 2008: Quality management systems
- ISO 14001: 2004: Environmental management systems
- BS OHSAS 18001: 2007: Occupational health and safety management systems
- Environmental policy: The first solar company in China to complete Intertek's carbon footprint evaluation program and receive green leaf mark verification for our products

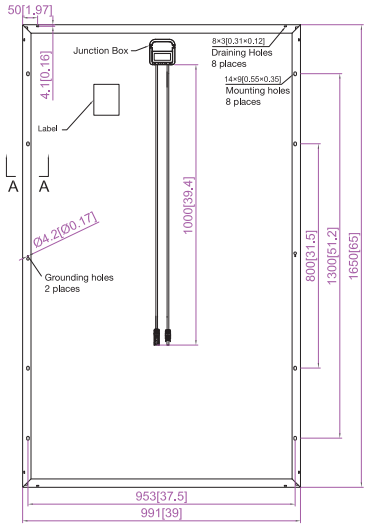
Specifications subject to technical changes and tests. JA Solar reserves the right of final interpretation.

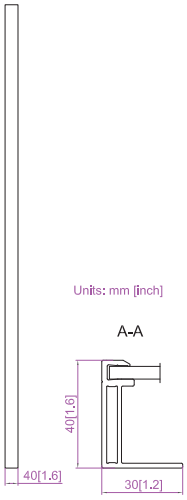
JAP6 60/255-275/4BB

JA SOLAR

Engineering Drawings







MECHANICAL PARAMETERS

Cell (mm)	Poly 156x156
Weight (kg)	18.2 (approx)
Dimensions (L×W×H) (mm)	1650×991×40
Cable Cross Section Size (mm^2)	4
No. of Cells and Connections	60 (6×10)
Junction Box	IP67, 3 diodes
Connector	MC4 Compatible
Packaging Configuration	26 Per Pallet

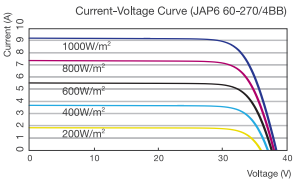
WORKING CONDITIONS

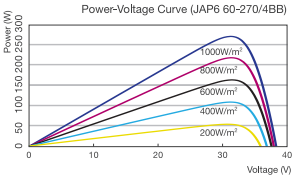
Maximum System Voltage	DC 1000V (IEC)
Operating Temperature	-40℃~+85℃
Maximum Series Fuse	15A
Maximum Static Load, Front (e.g., snow and wind) Maximum Static Load, Back (e.g., wind)	5400Pa (112 lb/ft^2) 2400Pa (50 lb/ft^2)
NOCT	45±2℃
Application Class	Class A

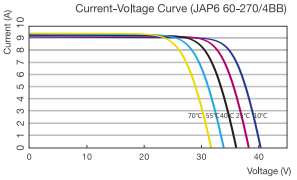
ELECTRICAL PARAMETERS

TYPE	JAP6 60-255/4BB	JAP6 60-260/4BB	JAP6 60-265/4BB	JAP6 60-270/4BB	JAP6 60-275/4BB
Rated Maximum Power at STC (W)	255	260	265	270	275
Open Circuit Voltage (Voc/V)	37.61	37.84	38.05	38.27	38.48
Maximum Power Voltage (Vmp/V)	30.59	30.81	31.02	31.23	31.44
Short Circuit Current (Isc/A)	8.90	9.04	9.08	9.15	9.26
Maximum Power Current (Imp/A)	8.34	8.44	8.54	8.65	8.75
Module Efficiency [%]	15.59	15.90	16.21	16.51	16.82
Power Tolerance (W)	-0~+5W				
Temperature Coefficient of Isc (αIsc)	+0.058%/℃				
Temperature Coefficient of Voc (βVoc)	-0.330%/℃				
Temperature Coefficient of Pmax (γPmp)	-0.410%/℃				
STC	Irradiance 1000W/m^2, Cell Temperature 25℃, Air Mass 1.5				

I-V CURVE







NOCT

TYPE	JAP6 60-255/4BB	JAP6 60-260/4BB	JAP6 60-265/4BB	JAP6 60-270/4BB	JAP6 60-275/4BB
Max Power (Pmax) [W]	185.13	188.76	192.39	196.02	199.65
Open Circuit Voltage (Voc) [V]	34.52	34.68	34.92	35.23	35.54
Max Power Voltage (Vmp) [V]	27.93	28.15	28.37	28.57	28.76
Short Circuit Current (Isc) [A]	7.04	7.08	7.11	7.15	7.21
Max Power Current (Imp) [A]	6.63	6.71	6.78	6.86	6.93
Condition	Under Normal Operating Cell Temperature, Irradiance of 800 W/m^2, spectrum AM 1.5, ambient temperature 20℃, wind speed 1 m/s				

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.

/ Perfect Welding / Solar Energy / Perfect Charging

SHIFTING THE LIMITS

FRONIUS SYMO

/ Maximum flexibility for the applications of tomorrow.

/ SnapINverter technology

/ Integrated data communication

/ SuperFlex Design

/ Dynamic Peak Manager

/ Smart Grid Ready

/ Boasting power categories ranging from 3.0 to 20.0 kW, the transformerless Fronius Symo is the three-phase inverter for systems of every size. Owing to the SuperFlex Design, the Fronius Symo is the perfect answer to irregularly shaped or multi-oriented roofs. The standard interface to the internet via WLAN or Ethernet and the ease of integration of third-party components make the Fronius Symo one of the most communicative inverters on the market. Furthermore, the meter interface permits dynamic feed-in management and a clear visualisation of the consumption overview.

TECHNICAL DATA FRONIUS SYMO (3.0-3-S, 3.7-3-S, 4.5-3-S, 3.0-3-M, 3.7-3-M, 4.5-3-M)

INPUT DATA	SYMO 3.0-3-S	SYMO 3.7-3-S	SYMO 4.5-3-S	SYMO 3.0-3-M	SYMO 3.7-3-M	SYMO 4.5-3-M
Max. input current ($I_{dc\ max\ 1}$ / $I_{dc\ max\ 2}$ [1])	16.0 A / 16.0 A					
Max. array short circuit current (MPP_1/MPP_2 [1])	24.0 A / 24.0 A					
Min. input voltage ($U_{dc\ min}$)	150 V					
Feed-in start voltage ($U_{dc\ start}$)	200 V					
Nominal input voltage ($U_{dc,r}$)	595 V					
Max. input voltage ($U_{dc\ max}$)	1,000 V					
MPP voltage range ($U_{mpp\ min}$ – $U_{mpp\ max}$)	200 - 800 V	250 - 800 V	300 - 800 V	150 - 800 V		
Number MPP trackers	1			2		
Number of DC connections	3			2+2		

OUTPUT DATA	SYMO 3.0-3-S	SYMO 3.7-3-S	SYMO 4.5-3-S	SYMO 3.0-3-M	SYMO 3.7-3-M	SYMO 4.5-3-M
AC nominal output ($P_{ac,r}$)	3,000 W	3,700 W	4,500 W	3,000 W	3,700 W	4,500 W
Max. output power	3,000 VA	3,700 VA	4,500 VA	3,000 VA	3,700 VA	4,500 VA
AC output current ($I_{ac\ nom}$)	4.3 A	5.3 A	6.5 A	4.3 A	5.3 A	6.5 A
Grid connection (voltage range)	3-NPE 400 V / 230 V or 3-NPE 380 V / 220 V (+20 % / -30 %)					
Frequency (Frequency range)	50 Hz / 60 Hz (45 - 65 Hz)					
Total harmonic distortion	< 3 %					
Power factor (cos $\varphi_{ac,r}$)	0.70 - 1 ind. / cap.			0.85 - 1 ind. / cap.		

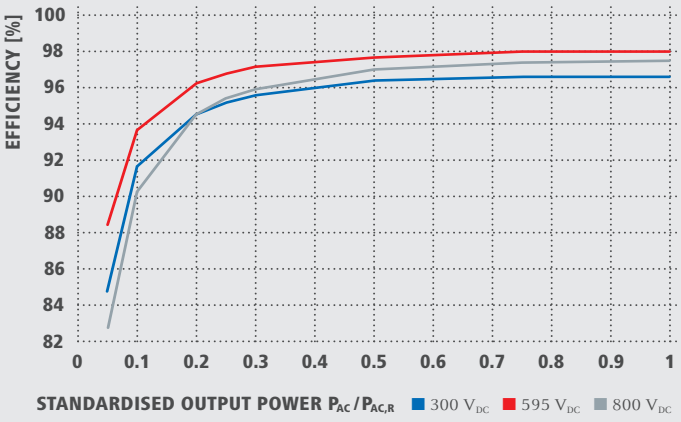
GENERAL DATA	SYMO 3.0-3-S	SYMO 3.7-3-S	SYMO 4.5-3-S	SYMO 3.0-3-M	SYMO 3.7-3-M	SYMO 4.5-3-M
Dimensions (height x width x depth)	645 x 431 x 204 mm					
Weight	16.0 kg			19.9 kg		
Degree of protection	IP 65					
Protection class	1					
Overvoltage category (DC / AC) [2]	2 / 3					
Night time consumption	< 1 W					
Inverter design	Transformerless					
Cooling	Regulated air cooling					
Installation	Indoor and outdoor installation					
Ambient temperature range	-25 - +60 °C					
Permitted humidity	0 - 100 %					
Max. altitude	2,000 m / 3,400 m (unrestricted / restricted voltage range)					
DC connection technology	3x DC+ and 3x DC- screw terminals 2.5 - 16 mm²			4x DC+ and 4x DC- screw terminals 2.5 - 16mm² [3]		
AC connection technology	5-pole AC screw terminals 2.5 - 16 mm²			5-pole AC screw terminals 2.5 - 16mm² [3]		
Certificates and compliance with standards	ÖVE / ÖNORM E 8001-4-712, DIN V VDE 0126-1-1/A1, VDE AR N 4105, IEC 62109-1/-2, IEC 62116, IEC 61727, AS 3100, AS 4777-2, AS 4777-3, CER 06-190, G83/2, UNE 206007-1, SI 4777 [1], CEI 0-21 [1], NRS 097					

[1] This applies to Fronius Symo 3.0-3-M, 3.7-3-M and 4.5-3-M.

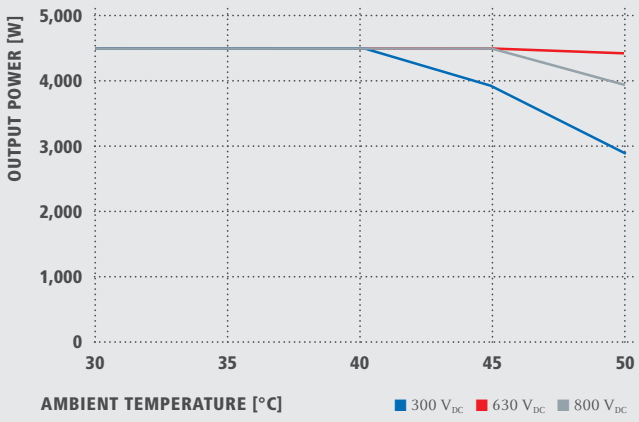
[2] According to IEC 62109-1.

[3] 16 mm² without wire end ferrules. Further information regarding the availability of the inverters in your country can be found at **www.fronius.com.**

FRONIUS SYMO 4.5-3-S EFFICIENCY CURVE



FRONIUS SYMO 4.5-3-S TEMPERATURE DERATING



TECHNICAL DATA FRONIUS SYMO (3.0-3-S, 3.7-3-S, 4.5-3-S, 3.0-3-M, 3.7-3-M, 4.5-3-M)

EFFICIENCY	SYMO 3.0-3-S	SYMO 3.7-3-S	SYMO 4.5-3-S	SYMO 3.0-3-M	SYMO 3.7-3-M	SYMO 4.5-3-M
Max. efficiency	98.0 %					
European efficiency (ηEU)	96.2 %	96.7 %	97.0 %	96.5 %	96.9 %	97.2 %
η at 5 % Pac.r [1]	80.3 / 83.6 / 79.1 %	83.4 / 86.4 / 80.6 %	84.8 / 88.5 / 82.8 %	79.8 / 85.1 / 80.8 %	81.6 / 87.8 / 82.8 %	83.4 / 90.3 / 85.0 %
η at 10 % Pac.r [1]	87.8 / 91.0 / 86.2 %	90.1 / 92.5 / 88.7 %	91.7 / 93.7 / 90.3 %	86.5 / 91.6 / 87.7 %	87.9 / 93.6 / 90.5 %	89.2 / 94.1 / 91.2 %
η at 20 % Pac.r [1]	92.6 / 95.0 / 92.6 %	93.7 / 95.7 / 93.6 %	94.6 / 96.3 / 94.5 %	90.8 / 95.3 / 93.0 %	91.9 / 96.0 / 94.1 %	92.8 / 96.5 / 95.1 %
η at 25 % Pac.r [1]	93.4 / 95.6 / 93.8 %	94.5 / 96.4 / 94.7 %	95.2 / 96.8 / 95.4 %	91.9 / 96.0 / 94.2 %	92.9 / 96.6 / 95.2 %	93.5 / 97.0 / 95.8 %
η at 30 % Pac. [1]	94.0 / 96.3 / 94.5 %	95.0 / 96.7 / 95.4 %	95.6 / 97.2 / 95.9 %	92.8 / 96.5 / 95.1 %	93.5 / 97.0 / 95.8 %	94.2 / 97.3 / 96.3 %
η at 50 % Pac.r [1]	95.2 / 97.3 / 96.3 %	96.9 / 97.6 / 96.7 %	96.4 / 97.7 / 97.0 %	94.3 / 97.5 / 96.5 %	94.6 / 97.7 / 96.8 %	94.9 / 97.8 / 97.2 %
η at 75 % Pac.r [1]	95.6 / 97.7 / 97.0 %	96.2 / 97.8 / 97.3 %	96.6 / 98.0 / 97.4 %	94.9 / 97.8 / 97.2 %	95.0 / 97.9 / 97.4 %	95.1 / 98.0 / 97.5 %
η at 100 % Pac.r [1]	95.6 / 97.9 / 97.3 %	96.2 / 98.0 / 97.5 %	96.6 / 98.0 / 97.5 %	95.0 / 98.0 / 97.4 %	95.1 / 98.0 / 97.5 %	95.0 / 98.0 / 97.6 %
MPP adaptation efficiency	> 99.9 %					

[1] And at $U_{mpp\ min}$ / $U_{dc.r}$ / $U_{mpp\ max}$

PROTECTIVE DEVICES	SYMO 3.0-3-S	SYMO 3.7-3-S	SYMO 4.5-3-S	SYMO 3.0-3-M	SYMO 3.7-3-M	SYMO 4.5-3-M
DC insulation measurement	Yes					
Overload behaviour	Operating point shift. power limitation					
DC disconnector	Yes					
Reverse polarity protection	Yes					

INTERFACES	SYMO 3.0-3-S	SYMO 3.7-3-S	SYMO 4.5-3-S	SYMO 3.0-3-M	SYMO 3.7-3-M	SYMO 4.5-3-M
WLAN / Ethernet LAN	Fronius Solar.web, Modbus TCP SunSpec, Fronius Solar API (JSON)					
6 inputs and 4 digital in/out	Interface to ripple control receiver					
USB (A socket) [2]	Datalogging, inverter update via USB flash drive					
2x RS422 (RJ45 socket) [2]	Fronius Solar Net					
Signalling output [2]	Energy management (potential-free relay output)					
Datalogger and Webserver	Included					
External input [2]	S0-Meter Interface / Input for overvoltage protection					
RS485	Modbus RTU SunSpec or meter connection					

[2] Also available in the light version.

TECHNICAL DATA FRONIUS SYMO (5.0-3-M, 6.0-3-M, 7.0-3-M, 8.2-3-M)

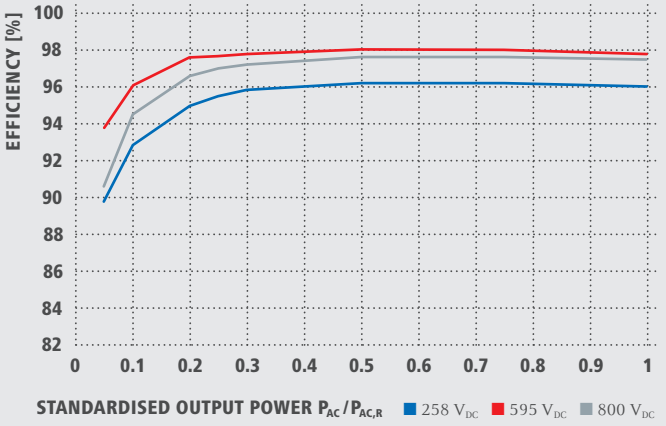
INPUT DATA	SYMO 5.0-3-M	SYMO 6.0-3-M	SYMO 7.0-3-M	SYMO 8.2-3-M
Max. input current ($I_{dc\ max\ 1}$ / $I_{dc\ max\ 2}$)	16.0 A / 16.0 A			
Max. array short circuit current (MPP_1/MPP_2)	24.0 A / 24.0 A			
Min. input voltage ($U_{dc\ min}$)	150 V			
Feed-in start voltage ($U_{dc\ start}$)	200 V			
Nominal input voltage ($U_{dc,r}$)	595 V			
Max. input voltage ($U_{dc\ max}$)	1,000 V			
MPP voltage range ($U_{mpp\ min}$ – $U_{mpp\ max}$)	163 - 800 V	195 - 800 V	228 - 800 V	267 - 800 V
Number MPP trackers	2			
Number of DC connections	2 + 2			

OUTPUT DATA	SYMO 5.0-3-M	SYMO 6.0-3-M	SYMO 7.0-3-M	SYMO 8.2-3-M
AC nominal output ($P_{ac,r}$)	5,000 W	6,000 W	7,000 W	8,200 W
Max. output power	5,000 VA	6,000 VA	7,000 VA	8,200 VA
AC output current ($I_{ac\ nom}$)	7.2 A	8.7 A	10.1 A	11.8 A
Grid connection (voltage range)	3-NPE 400 V / 230 V or 3-NPE 380 V / 220 V (+20 % / -30 %)			
Frequency (Frequency range)	50 Hz / 60 Hz (45 - 65 Hz)			
Total harmonic distortion	< 3 %			
Power factor (cos $\varphi_{ac,r}$)	0.85 - 1 ind. / cap.			

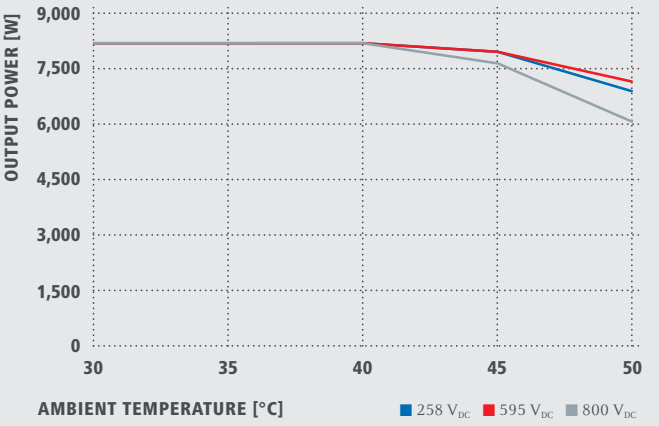
GENERAL DATA	SYMO 5.0-3-M	SYMO 6.0-3-M	SYMO 7.0-3-M	SYMO 8.2-3-M
Dimensions (height x width x depth)	645 x 431 x 204 mm			
Weight	19.9 kg		21.9 kg	
Degree of protection	IP 65			
Protection class	1			
Overvoltage category (DC / AC) [1]	2 / 3			
Night time consumption	< 1 W			
Inverter design	Transformerless			
Cooling	Regulated air cooling			
Installation	Indoor and outdoor installation			
Ambient temperature range	-25 - +60 °C			
Permitted humidity	0 - 100 %			
Max. altitude	2,000 m / 3,400 m (unrestricted / restricted voltage range)			
DC connection technology	4x DC+ and 4x DC- Screw terminals 2.5 - 16mm² [2]			
AC connection technology	5-pole AC Screw terminals 2.5 - 16mm² [2]			
Certificates and compliance with standards	ÖVE / ÖNORM E 8001-4-712, DIN V VDE 0126-1-1/A1, VDE AR N 4105, IEC 62109-1/-2, IEC 62116, IEC 61727, AS 3100, AS 4777-2, AS 4777-3, CER 06-190, G83/2, UNE 206007-1, SI 4777, CEI 0-21, NRS 097			

[1] According to IEC 62109-1.
[2] 16 mm² without wire end ferrules.
Further information regarding the availability of the inverters in your country can be found at **www.fronius.com**.

FRONIUS SYMO 8.2-3-M EFFICIENCY CURVE



FRONIUS SYMO 8.2-3-M TEMPERATURE DERATING



TECHNICAL DATA FRONIUS SYMO (5.0-3-M, 6.0-3-M, 7.0-3-M, 8.2-3-M)

EFFICIENCY	SYMO 5.0-3-M	SYMO 6.0-3-M	SYMO 7.0-3-M	SYMO 8.2-3-M
Max. efficiency	98.0 %			
European efficiency (ηEU)	97.3 %	97.5 %	97.6 %	97.7 %
η at 5 % Pac,r [1]	84.9 / 91.2 / 85.9 %	87.8 / 92.6 / 87.8 %	88.7 / 93.1 / 89.0 %	89.8 / 93.8 / 90.6 %
η at 10 % Pac,r [1]	89.9 / 94.6 / 91.7 %	91.3 / 95.6 / 93.0 %	92.0 / 95.9 / 94.7 %	92.8 / 96.1 / 94.5 %
η at 20 % Pac,r [1]	93.2 / 96.7 / 95.4 %	94.1 / 97.1 / 95.9 %	94.5 / 97.3 / 96.3 %	95.0 / 97.6 / 96.6 %
η at 25 % Pac,r [1]	93.9 / 97.2 / 96.0 %	94.7 / 97.5 / 96.5 %	95.1 / 97.6 / 96.7 %	95.5 / 97.7 / 97.0 %
η at 30 % Pac, [1]	94.5 / 97.4 / 96.5 %	95.1 / 97.7 / 96.8 %	95.4 / 97.7 / 97.0 %	95.8 / 97.8 / 97.2 %
η at 50 % Pac,r [1]	95.2 / 97.9 / 97.3 %	95.7 / 98.0 / 97.5 %	95.9 / 98.0 / 97.5 %	96.2 / 98.0 / 97.6 %
η at 75 % Pac,r [1]	95.3 / 98.0 / 97.5 %	95.7 / 98.0 / 97.6 %	95.9 / 98.0 / 97.6 %	96.2 / 98.0 / 97.6 %
η at 100 % Pac,r [1]	95.2 / 98.0 / 97.6 %	95.7 / 97.9 / 97.6 %	95.8 / 97.9 / 97.5 %	96.0 / 97.8 / 97.5 %
MPP adaptation efficiency	> 99.9 %			

[1] And at $U_{mpp\ min}$ / $U_{dc,r}$ / $U_{mpp\ max}$

PROTECTIVE DEVICES	SYMO 5.0-3-M	SYMO 6.0-3-M	SYMO 7.0-3-M	SYMO 8.2-3-M
DC insulation measurement	Yes			
Overload behaviour	Operating point shift. power limitation			
DC disconnector	Yes			
Reverse polarity protection	Yes			

INTERFACES	SYMO 5.0-3-M	SYMO 6.0-3-M	SYMO 7.0-3-M	SYMO 8.2-3-M
WLAN / Ethernet LAN	Fronius Solar.web, Modbus TCP SunSpec, Fronius Solar API (JSON)			
6 inputs and 4 digital in/out	Interface to ripple control receiver			
USB (A socket) [2]	Datalogging, inverter update via USB flash drive			
2x RS422 (RJ45 socket) [2]	Fronius Solar Net			
Signalling output [2]	Energy management (potential-free relay output)			
Datalogger and Webserver	Included			
External input [2]	S0-Meter Interface / Input for overvoltage protection			
RS485	Modbus RTU SunSpec or meter connection			

[2] Also available in the light version.

TECHNICAL DATA FRONIUS SYMO (10.0-3-M, 12.5-3-M, 15.0-3-M, 17.5-3-M, 20.0-3-M)

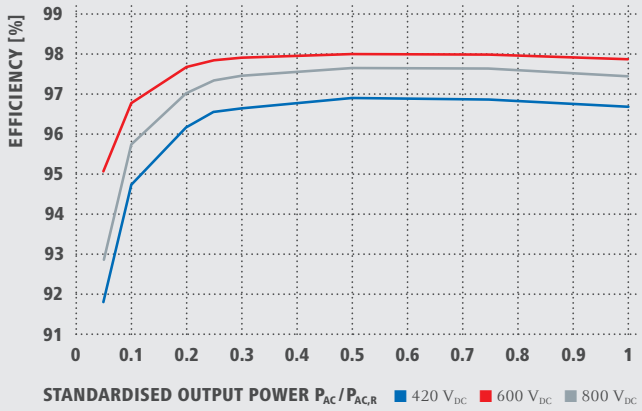
INPUT DATA	SYMO 10.0-3-M	SYMO 12.5-3-M	SYMO 15.0-3-M	SYMO 17.5-3-M	SYMO 20.0-3-M
Max. input current ($I_{dc\ max\ 1}$ / $I_{dc\ max\ 2}$)	27.0 A / 16.5 A [1]		33.0 A / 27.0 A		
Max. usable input current total ($I_{dc\ max\ 1}$ + $I_{dc\ max\ 2}$)	43.5 A		51.0 A		
Max. array short circuit current (MPP_1/MPP_2)	40.5 A / 24.8 A		49.5 A / 40.5 A		
Min. input voltage ($U_{dc\ min}$)	200 V				
Feed-in start voltage ($U_{dc\ start}$)	200 V				
Nominal input voltage ($U_{dc,r}$)	600 V				
Max. input voltage ($U_{dc\ max}$)	1,000 V				
MPP voltage range ($U_{mpp\ min}$ – $U_{mpp\ max}$)	270 - 800 V	320 - 800 V		370 - 800 V	420 - 800 V
Number MPP trackers	2				
Number of DC connections	3+3				

OUTPUT DATA	SYMO 10.0-3-M	SYMO 12.5-3-M	SYMO 15.0-3-M	SYMO 17.5-3-M	SYMO 20.0-3-M
AC nominal output ($P_{ac,r}$)	10,000 W	12,500 W	15,000 W	17,500 W	20,000 W
Max. output power	10,000 VA	12,500 VA	15,000 VA	17,500 VA	20,000 VA
AC output current ($I_{ac\ nom}$)	14.4 A	18.0 A	21.7 A	25.3 A	28.9 A
Grid connection (voltage range)	3-NPE 400 V / 230 V or 3-NPE 380 V / 220 V (+20 % / -30 %)				
Frequency (Frequency range)	50 Hz / 60 Hz (45 - 65 Hz)				
Total harmonic distortion	1.8 %	2.0 %	1.5 %	1.5 %	1.3 %
Power factor (cos $\varphi_{ac,r}$)	0 - 1 ind. / cap.				

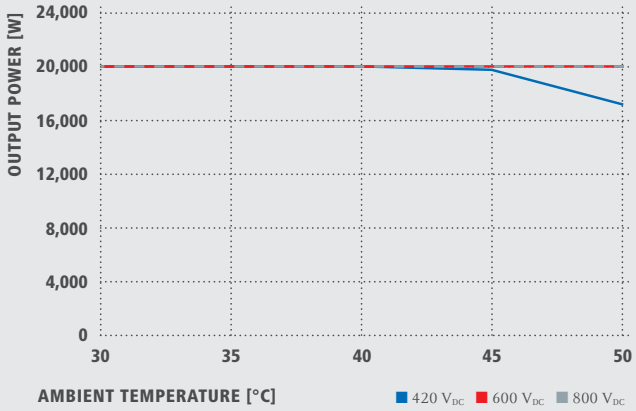
GENERAL DATA	SYMO 10.0-3-M	SYMO 12.5-3-M	SYMO 15.0-3-M	SYMO 17.5-3-M	SYMO 20.0-3-M
Dimensions (height x width x depth)	725 x 510 x 225 mm				
Weight	34.8 kg		43.4 kg		
Degree of protection	IP 66				
Protection class	1				
Overvoltage category (DC / AC) [2]	2 / 3				
Night time consumption	< 1 W				
Inverter design	Transformerless				
Cooling	Regulated air cooling				
Installation	Indoor and outdoor installation				
Ambient temperature range	-40 - +60 °C				
Permitted humidity	0 - 100 %				
Max. altitude	2,000 m / 3,400 m (unrestricted / restricted voltage range)				
DC connection technology	6x DC+ and 6x DC- screw terminals 2.5 - 16 mm^2				
AC connection technology	5-pole AC screw terminals 2.5 - 16 mm^2				
Certificates and compliance with standards	ÖVE / ÖNORM E 8001-4-712, DIN V VDE 0126-1-1/A1, VDE AR N 4105, IEC 62109-1/-2, IEC 62116, IEC 61727, AS 3100, AS 4777-2, AS 4777-3, CER 06-190, G83/2, UNE 206007-1, SI 4777, CEI 0-16, CEI 0-21, NRS 097				

[1] 14.0 A for voltages < 420 V
[2] According to IEC 62109-1. DIN rail for optional overvoltage protection (type 2) is included.
Further information regarding the availability of the inverters in your country can be found at **www.fronius.com**.

FRONIUS SYMO 20.0-3-M EFFICIENCY CURVE



FRONIUS SYMO 20.0-3-M TEMPERATURE DERATING



TECHNICAL DATA FRONIUS SYMO (10.0-3-M, 12.5-3-M, 15.0-3-M, 17.5-3-M, 20.0-3-M)

EFFICIENCY	SYMO 10.0-3-M	SYMO 12.5-3-M	SYMO 15.0-3-M	SYMO 17.5-3-M	SYMO 20.0-3-M
Max. efficiency	98.0 %		98.1 %		
European efficiency (ηEU)	97.4%	97.6 %	97.8 %	97.8 %	97.9 %
η at 5 % Pac.r [1]	87.9 / 92.5 / 89.2 %	88.7 / 93.1 / 90.1 %	91.2 / 94.8 / 92.3 %	91.6 / 95.0 / 92.7 %	91.9 / 95.2 / 93.0 %
η at 10 % Pac.r [1]	91.2 / 94.9 / 92.8 %	92.9 / 96.1 / 94.6 %	93.4 / 96.0 / 94.4 %	94.0 / 96.4 / 95.0 %	94.8 / 96.9 / 95.8 %
η at 20 % Pac.r [1]	94.6 / 97.1 / 96.1 %	95.4 / 97.3 / 96.6 %	95.9 / 97.4 / 96.7 %	96.1 / 97.6 / 96.9 %	96.3 / 97.8 / 97.1 %
η at 25 % Pac.r [1]	95.4 / 97.3 / 96.6 %	95.6 / 97.6 / 97.0 %	96.2 / 97.6 / 97.0 %	96.4 / 97.8 / 97.2 %	96.7 / 97.9 / 97.4 %
η at 30 % Pac.r [1]	95.6 / 97.5 / 96.9 %	95.9 / 97.7 / 97.2 %	96.5 / 97.8 / 97.3 %	96.6 / 97.9 / 97.4 %	96.8 / 98.0 / 97.6 %
η at 50 % Pac.r [1]	96.3 / 97.9 / 97.4 %	96.4 / 98.0 / 97.5 %	96.9 / 98.1 / 97.7 %	97.0 / 98.1 / 97.7 %	97.0 / 98.1 / 97.8 %
η at 75 % Pac.r [1]	96.5 / 98.0 / 97.6 %	96.5 / 98.0 / 97.6 %	97.0 / 98.1 / 97.8 %	97.0 / 98.1 / 97.8 %	97.0 / 98.1 / 97.7 %
η at 100 % Pac.r [1]	96.5 / 98.0 / 97.6 %	96.5 / 97.8 / 97.6 %	97.0 / 98.1 / 97.7 %	96.9 / 98.1 / 97.6 %	96.8 / 98.0 / 97.6 %
MPP adaptation efficiency	> 99.9 %				

PROTECTIVE DEVICES	SYMO 10.0-3-M	SYMO 12.5-3-M	SYMO 15.0-3-M	SYMO 17.5-3-M	SYMO 20.0-3-M
DC insulation measurement	Yes				
Overload behaviour	Operating point shift. power limitation				
DC disconnector	Yes				
Reverse polarity protection	Yes				

INTERFACES	SYMO 10.0-3-M	SYMO 12.5-3-M	SYMO 15.0-3-M	SYMO 17.5-3-M	SYMO 20.0-3-M
WLAN / Ethernet LAN	Fronius Solar.web, Modbus TCP SunSpec, Fronius Solar API (JSON)				
6 inputs and 4 digital inputs/outputs	Interface to ripple control receiver				
USB (A socket) [2]	Datalogging, inverter update via USB flash drive				
2x RS422 (RJ45-socket) [2]	Fronius Solar Net				
Signalling output [2]	Energy management (potential-free relay output)				
Datalogger und Webserver	Included				
External input [2]	S0-Meter Interface / Input for overvoltage protection				
RS485	Modbus RTU SunSpec or meter connection				

[1] And at $U_{mpp\ min}$ / $U_{dc.r}$ / $U_{mpp\ max}$ [2] Also available in the light version.

/ Perfect Welding / Solar Energy / Perfect Charging

WE HAVE THREE DIVISIONS AND ONE PASSION: SHIFTING THE LIMITS OF POSSIBILITY.

/ Whether welding technology, photovoltaics or battery charging technology – our goal is clearly defined: to be the innovation leader. With around 3,300 employees worldwide, we shift the limits of what's possible - our record of over 900 granted patents is testimony to this. While others progress step by step, we innovate in leaps and bounds. Just as we've always done. The responsible use of our resources forms the basis of our corporate policy.

Further information about all Fronius products and our global sales partners and representatives can be found at **www.fronius.com**

v05 May 2015 EN

Fronius India Private Limited
GAT no 312, Nanekarwadi
Chakan, Taluka - Khed District
Pune 410501
India
pv-sales-india@fronius.com
www.fronius.in

Fronius Australia Pty Ltd.
90-92 Lambeck Drive
Tullamarine VIC 3043
Australia
pv-sales-australia@fronius.com
www.fronius.com.au

Fronius UK Limited
Maidstone Road, Kingston
Milton Keynes, MK10 0BD
United Kingdom
pv-sales-uk@fronius.com
www.fronius.co.uk

Fronius International GmbH
Froniusplatz 1
4600 Wels
Austria
pv-sales@fronius.com
www.fronius.com

M,06,0092,EN v15 Aug 2015 as17