Bauder Bio Solar Technical Report

Project: Red Lion Street

Project Reference: B170816

14 December 2017

Prepared for: Orms Designers & Architects

Prepared by: Bauder Ltd.

Technical Report

1. Project information

Project name	Red Lion Street 20
Client	Orms Designers & Architects Ltd
Contact	Ms Rosie Bard
Bauder ATM	Mr Mike Jones

2. Property information

Building/Areas	7th Floor Roof Area		
Address	20 Red Lion Street, London	*Postcode*:	WC1R 4PJ

3. System configuration

Rated Power DC	5.58 kWp
Bauder System	BAUDER Bio Solar
Bauder Fixing Method	Ballasted*2
*Type of Module (power class)*1*	Aleo S19 (310Wp*3)
Module quantity	18 units
Bauder Mounts	18 units
Bauder Bio Solar Rails	39.8 lm (Number of mounts x 2.2m).
Type of Inverter	Fronius Symo 4.5-3-M
Inverter amount	1 units
DC Cable length	Ca. m (Confirmed when design finalized)
Cable tray system	M (Confirmed when design finalized)
DC Isolator	1 units

4. Yield studies

Global radiation at Site Location	975.5 kWh/m²		
Module Tilt / Angle	15°	*Module Azimuth*	11° SE
Roof Pitch	1°		
*Yield Forecast Specific Annual Yield *4*	896 kWh/kWp/a		
MCS Yield Forecast Specific Annual Yield	922 kWh/kWp/a		
*Forecast for generated energy in the first year *4*	5.00 MWh		
*CO2 savings per year *5*	2.645 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	2017/12/14	*Date*	2017/12/14

Evaluation basis

Document	**Description**	**Input date**
Drawing	2077_X_AM(XX)GA_01_XX_ctownsend - Floor Plan - 07 - Proposed - General Arrangement - Roof	2017-07-03
Drawing	Red Lion Street - Google Earth	2017-07-03
Drawing	Roof plan 2077	2017-07-03

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

6. Attachments

1. Layout	B170816PV - 20171214
2. Structural Analysis	Provided upon request.
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

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

N

Open plant area below (6th floor)

Ladder access to the roof

Electrical tray

Mansafe system to the perimeter of the roof

Electrical riser

Refrigerant pipework (on the floor surface - approx. 80mm)

Extract WC

Riser for refrigerant pipework and WC extract

Existing Flue

PVs on top of sedum green roof

Bauder flex warm roof system on lift overrun 20-50-30/185

Lift Overrun

Riser

Smoke extract

SVP

AOV

1450

1350

09002

08001

09001

09003

24-26

22

20

4000

5133

1709

4548

4100 3215 3657 3657 3657 3657 3665

SANDLAND STREET

General Information

Total power DC	5.58 kWp
BAUDER System type	Bauder Bio Solar
Module type	Aleo S19 (310wp)
Module amount	18 Units
Azimuth	11 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	03.07.17	Darren Mitchell
Changed	14.12.17	Darren Mitchell
Checked		

Scale:

Client: Orms Designers & Architects Ltd

Project:

Red Lion Street
London, WC1R 4JP

Drawing No.: B170816PV - 20171214

Drawing Title: PV Layout Plan
PV Design Layout

Format: A

Planning Period:

Sheet

File Name: B170816PV - 20171214.dwg

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

More Power.
Endless possibilities.

S19 HE

300-310 W

QUALITY SIGNED AND SEALED

Up to 18.9%	25 year Product Guarantee	98% of nominal power guaranteed
efficiency	optional available	the first two years

PID FREE
PID tested with excellent results under the harshest conditions

12 YEARS PRODUCT GUARANTEE UPGRADEABLE TO 25 YEARS AS A PREMIUM OPTION

25 YEARS LINEAR PERFORMANCE WARRANTY

CRAFTED WITH PASSION

CONSTANTLY HIGH CELL QUALITY
through strict quality examinations by highresolution electroluminescence and infraredmeasurements

Made in Germany

aleo solar module S19 HE

ELECTRICAL DATA (STC)			S19_300	S19_305	S19_310
Rated power	P_{MPP}	[W]	300	305	310
Rated voltage	U_{MPP}	[V]	31.2	31.4	31.7
Rated current	I_{MPP}	[A]	9.63	9.72	9.80
Open-circuit voltage	U_{OC}	[V]	39.4	39.6	39.7
Short-circuit current	I_{SC}	[A]	9.97	10.06	10.12
Efficiency	n	[%]	18.3	18.6	18.9

Electrical values measured under standard test conditions (STC): 1000 W/m²; 25°C; AM 1.5

ELECTRICAL DATA (NOCT)			S19_300	S19_305	S19_310
Power	P_{MPP}	[W]	220	224	228
Voltage	U_{MPP}	[V]	28.5	28.5	28.6
Current	I_{MPP}	[A]	7.72	7.86	7.93
Open-circuit voltage	U_{OC}	[V]	36.3	36.4	36.4
Short-circuit current	I_{SC}	[A]	8.07	8.15	8.23
Efficiency	n	[%]	16.7	17.0	17.3

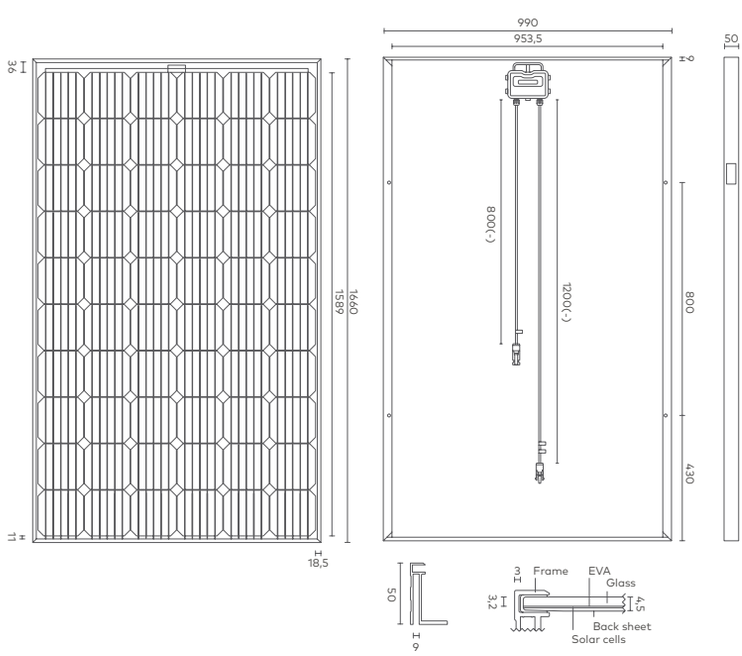
Electrical values measured under nominal operating conditions of cells: 800 W/m²; 20°C; AM 1.5; wind 1 m/s
NOCT: 48°C (nominal operating cell temperature)

TEMPERATURE COEFFICIENTS			
Temperature coefficient I_{SC}	a (I_{SC})	[%/K]	+0.05
Temperature coefficient U_{OC}	ß (U_{OC})	[%/K]	-0.29
Temperature coefficient P_{MPP}	Y (P_{MPP})	[%/K]	-0.40

BASIC DATA JUNCTION BOX		
Length x width x height	[mm]	148 x 123 x 27
IP class		IP67
Cable length	[mm]	1200 (+), 800 (-)
Connectors		MC4
Bypass diodes		3

Measurement tolerance of P_{MPP} under STC -3/+3% | Accuracy of other electrical values -10/+10%
Efficiency relating to gross module area

DIMENSIONS [MM]



BASIC MODULE DATA		
Length x width x height	[mm]	1660 x 990 x 50
Weight	[kg]	20
Number of cells		60
Cell size	[mm]	156.75 x 156.75
Cell material		Monocrystalline Si
Number of bus bars		3 / 4 / 5
Front sheet		Solar glass (TSG)
Back sheet		Polymer sheet, white
Frame material		Al alloy, silver

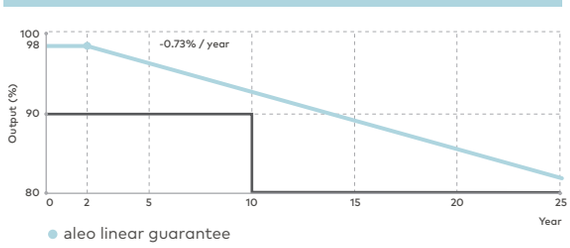
CERTIFICATIONS AND WARRANTY	
Product Guarantee	12 years, optional 25 years
Power Guarantee	25 years – Linear
Fire Resistance	Class C
Protection Against Electric Shock	II
Certifications	§ IEC 61215, IEC 61730-1/-2
	§ IEC 62716 – Ammonia Resistance
	§ IEC 61701 – Salt mist Resistance
	§ IEC 62804 – PID Resistance
	§ MCS 010; MCS 005

LOADS			
Max. module pressure load		[Pa]	5400*
Max. module suction load		[Pa]	5400*
Max. system voltage		[V_{DC}]	1000
Reverse current load	I_R	[A]	20

Mechanical load acc. to IEC/EN 61215
* Please observe the mounting conditions in the installation manual

ADDITIONAL ELECTRICAL DATA		
Reduction of STC efficiency from 1000 W/m² to 200 W/m²	[%] rel.	< 2
Classification range (positive classification)	[W]	0/+4.99

PERFORMANCE GUARANTEE



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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.		

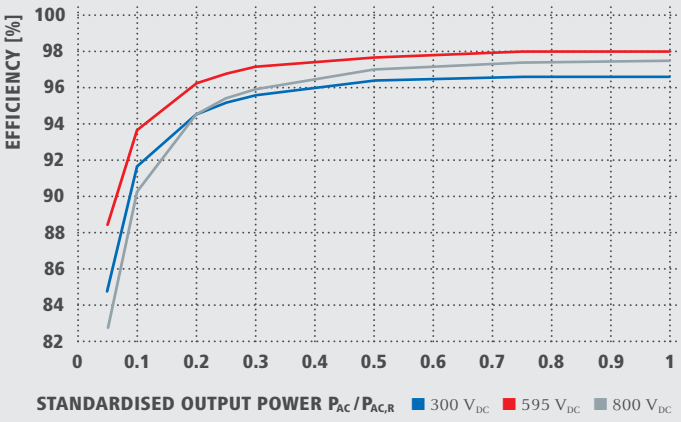
GENERAL DATA	SYMO 3.0-3-S	SYMO 3.7-3-S	SYMO 4.5-3-S	SYMO 3.0-3-M	SYMO 3.7-3-M	SYMO 4.5-3-M
Dimensions (height x width x depth)	645 x 431 x 204 mm					
Weight	16.0 kg			19.9 kg		
Degree of protection	IP 65					
Protection class	1					
Overvoltage category (DC / AC) [2]	2 / 3					
Night time consumption	< 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.

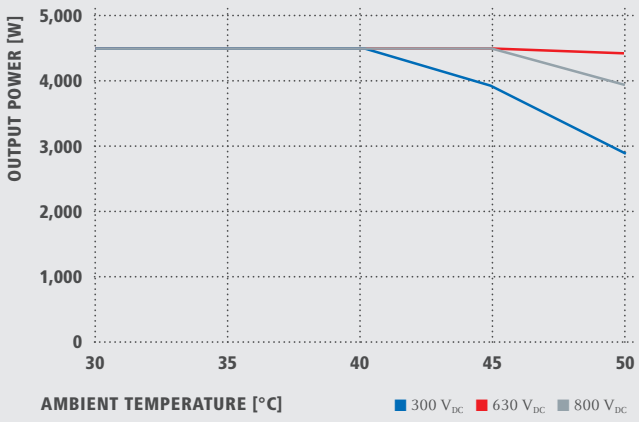
[2] According to IEC 62109-1.

[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)

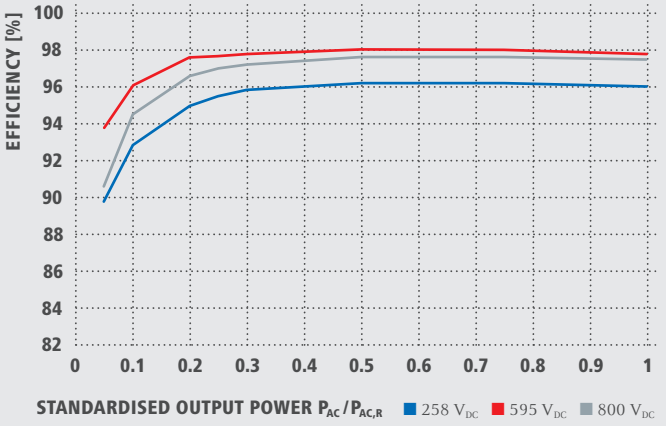
INPUT DATA	SYMO 5.0-3-M	SYMO 6.0-3-M	SYMO 7.0-3-M	SYMO 8.2-3-M
Max. input current ($I_{dc\ max\ 1}$ / $I_{dc\ max\ 2}$)	16.0 A / 16.0 A			
Max. array short circuit current (MPP_1/MPP_2)	24.0 A / 24.0 A			
Min. input voltage ($U_{dc\ min}$)	150 V			
Feed-in start voltage ($U_{dc\ start}$)	200 V			
Nominal 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.			

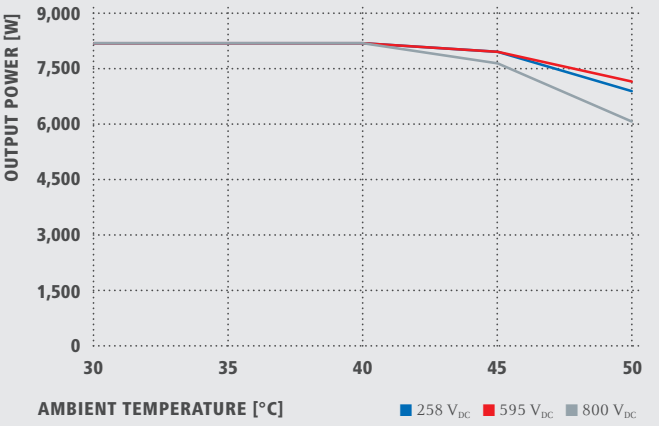
GENERAL DATA	SYMO 5.0-3-M	SYMO 6.0-3-M	SYMO 7.0-3-M	SYMO 8.2-3-M
Dimensions (height x width x depth)	645 x 431 x 204 mm			
Weight	19.9 kg		21.9 kg	
Degree of protection	IP 65			
Protection class	1			
Overvoltage category (DC / AC) [1]	2 / 3			
Night time consumption	< 1 W			
Inverter design	Transformerless			
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)

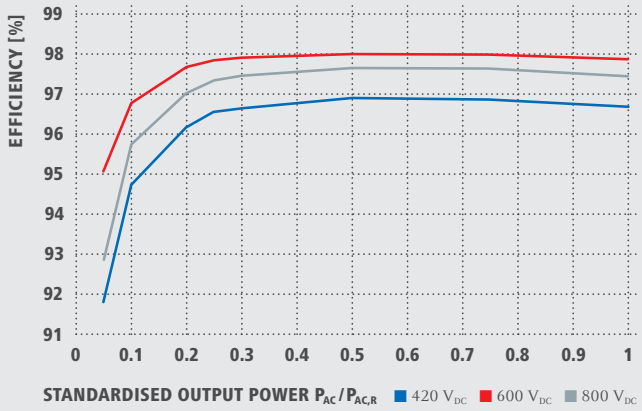
INPUT DATA	SYMO 10.0-3-M	SYMO 12.5-3-M	SYMO 15.0-3-M	SYMO 17.5-3-M	SYMO 20.0-3-M
Max. input current ($I_{dc\ max\ 1}$ / $I_{dc\ max\ 2}$)	27.0 A / 16.5 A [1]		33.0 A / 27.0 A		
Max. usable input current total ($I_{dc\ max\ 1}$ + $I_{dc\ max\ 2}$)	43.5 A		51.0 A		
Max. array short circuit current (MPP_1/MPP_2)	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.				

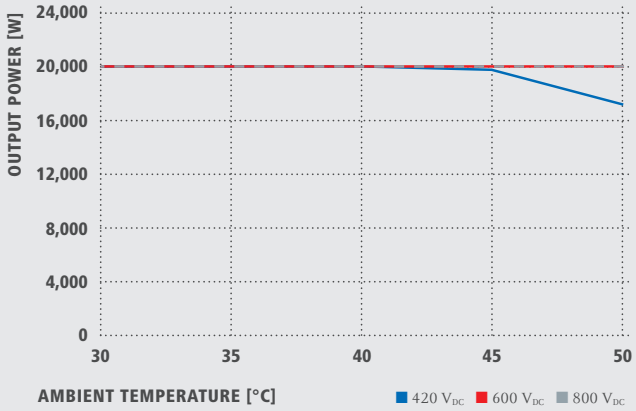
GENERAL DATA	SYMO 10.0-3-M	SYMO 12.5-3-M	SYMO 15.0-3-M	SYMO 17.5-3-M	SYMO 20.0-3-M
Dimensions (height x width x depth)	725 x 510 x 225 mm				
Weight	34.8 kg		43.4 kg		
Degree of protection	IP 66				
Protection class	1				
Overvoltage category (DC / AC) [2]	2 / 3				
Night time consumption	< 1 W				
Inverter 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
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Signalling output [2]	Energy management (potential-free relay output)				
Datalogger und Webserver	Included				
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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.

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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

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