To be filled in by issuer: The BYUK Package Manager or supply chain (subcontractor/ supplier)

BOUYGUES UK

UCLH PH4: PTS Form July 18

(PTS) PRODUCT TECHNICAL SPECIFICATION

Issuer : Package & Subcontractor :	KYOTEC Polska
Supplier used for the Submission:	ML SYSTEM S.A.
Description:	**PV Panels**

UCLH Phase 4 Proton Beam Therapy (P4PBT)

Reference: (As per "document numbering system & list of Authorized codes")

Project	Issuer	Area	Level	Type	Trade	Sequence N°	Rev.
P4PBT	KYO	ALL	06	PTS	3.01	020005	A

Material Description	**PV Panels**	**Intended location of use:**
Manufacturer name:	**ML SYSTEM S.A. FRONIUS**	
Model / Selection:	**FRONIUS SYMO 8.2-3-M & others components**	**EWS-450**
Name of issuer representative (please print):	**ML SYSTEM S.A.**	

To be filled by the supply chain (Sub Contractor or Supplier)

The materials of the PTS comply with:

[x] Subcontractor or Supplier Works Information [ ] Contractor Instruction (CI)

List below documents in compliance with this PTS.

The materials of the PTS do not comply with:

[ ] Subcontractor or Supplier Works Information [ ] Contractor Instruction (CI)

List below documents not in compliance with this PTS.

1) Subcontractor/ Supplier Works Information		1) Contractor Works Information		Alternative Proposal / Explanation of Equivalence
Reference	**Description**	**Reference**	**Description**	
1.1) Stage 4 Design Specifications		**1.1) Stage 4 Design Specifications**		
P4PBT-STW-ALL-SL-SPE-A31-105002 - Stage 4				
-External Envelope Specification Rev C; Chapter 2.1.15	Type EWS-450: Inclined Cladding to Roof at Level 6			
1.2) Stage 4 Other Design Documents		**1.2) Stage 4 Other Design Documents**		
1.3) Other Documents		**1.3) Other Documents**		
2) Contractor Instruction (CI)		**2) Contractor Instruction (CI)**		

Attachments:

[x] Data Sheet(s) with number of pages/ samples:	[ ] Test reports / Certificates (s)	[ ] Catalogue(s)	[ ] Manual	[x] Sample(s)	[x] Others
[x] pages: 6-11	[ ] pages	[ ] pages	[ ] pages	[x] pages: 2	[x] pages: 3-5; 12-14

To be filled by BYUK package Manager

The materials of the PTS comply with:

[x] Contractor Works Information [ ] Project Manager Instruction (PMI)

List below documents in compliance with this PTS.

The materials of the PTS do not comply with:

[ ] Contractor Works Information [ ] Project Manager Instruction (PMI)

List below documents not in compliance with this PTS.

Workflow Selection

TICK

1	2	3	4	5

1) Contractor Works Information		1) Contractor Works Information		Alternative Proposal / Explanation of Equivalence
Reference	**Description**	**Reference**	**Description**	
1.1) Stage 3 (former Stage D) Design Specifications		**1.1) Stage 3 (former Stage D) Design Specifications**		
a) (sample)	a) (sample)	a) (sample)		a) (sample)
1.2) Stage 3 (former Stage D)Other Design Documents		**1.2) Stage 3 (former Stage D) Other Design Documents**		
1.3) Other Documents		**1.3) Other Documents**		
2) Project Manager Instruction (PMI)		**2) Project Manager Instruction (PMI)**		

BOUYGUES UK

Sample Sign Off Sheet

UCLH

Ref.: P4PBT (Project) | KYO (Issuer) | ALL (Area) | SL (Level) | SSO (Type) | 3.01 (Trade) | 195501 (Sequence No.) | A (Rev)

Sample Title: *Photovoltaic module sample - EWS450*

Product Reference: **ML SYSTEM INCOTERMS 2010, EXW BLACKENING 190G**

Location: *EWS-450*

Issued by: (DM, E in C) Grzegorz Kołodziej

* Issue Date:	* Client Response Date:	Review Period (Working Days)
12.07.2018	26.07.2018	5 Days ☐ 10 Days ☐ 20 Days ☐ Other by Agreement ☐

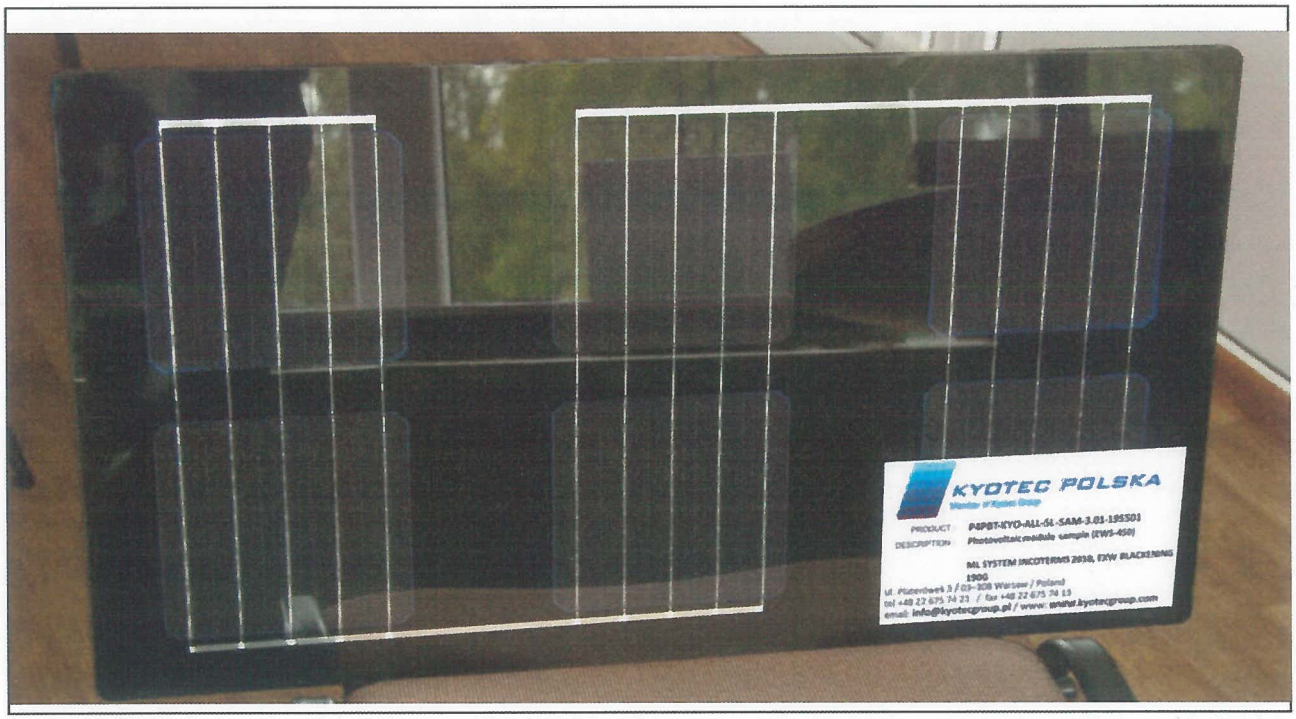
* to strike out if not applicable

Details: PV cell module.

Used for: Photovoltaic module sample - EWS450

Attachments:

Photos:



Approvers' Comments:

Architect: No comment.

Client:

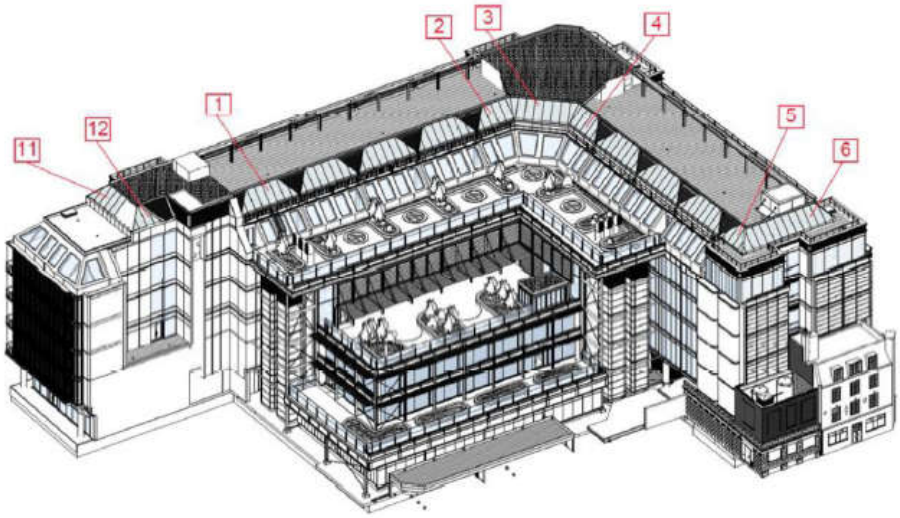
Approved by:	Name (PRINT):	Date:	YES	NO	Signature
Architect	ROB McGILL	24/7/18	✓		
Client					

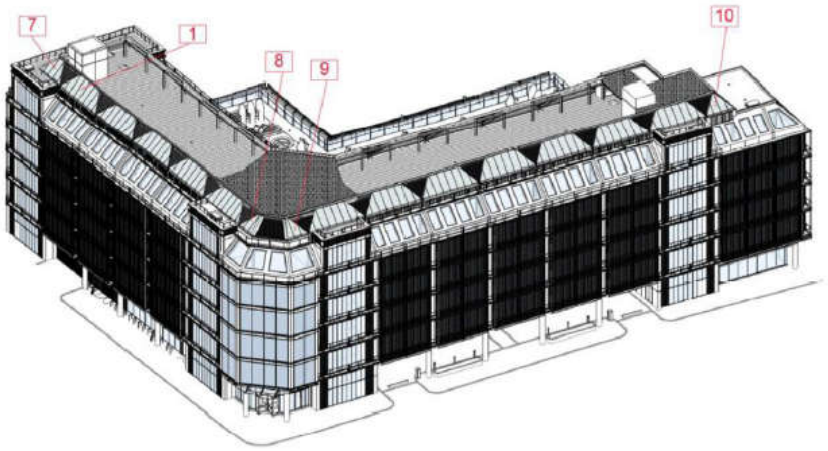
Note: Please make sure this form is returned to the Project Document Controller.

ENERGY YIELDS

ASSUMPTIONS ACCEPTED FOR THE CALCULATION OF ANNUAL ENERGY YIELDS

- total installation power 28 000 W
- location – London
- photovoltaic integrated with the building
- tilt angle 45^0
- arrangement of individual types:
  - Southwest: 6300 W
  - Southeast: 6200 W
  - South: 1400 W
  - Northwest: 8700 W
  - Northeast: 5400 W

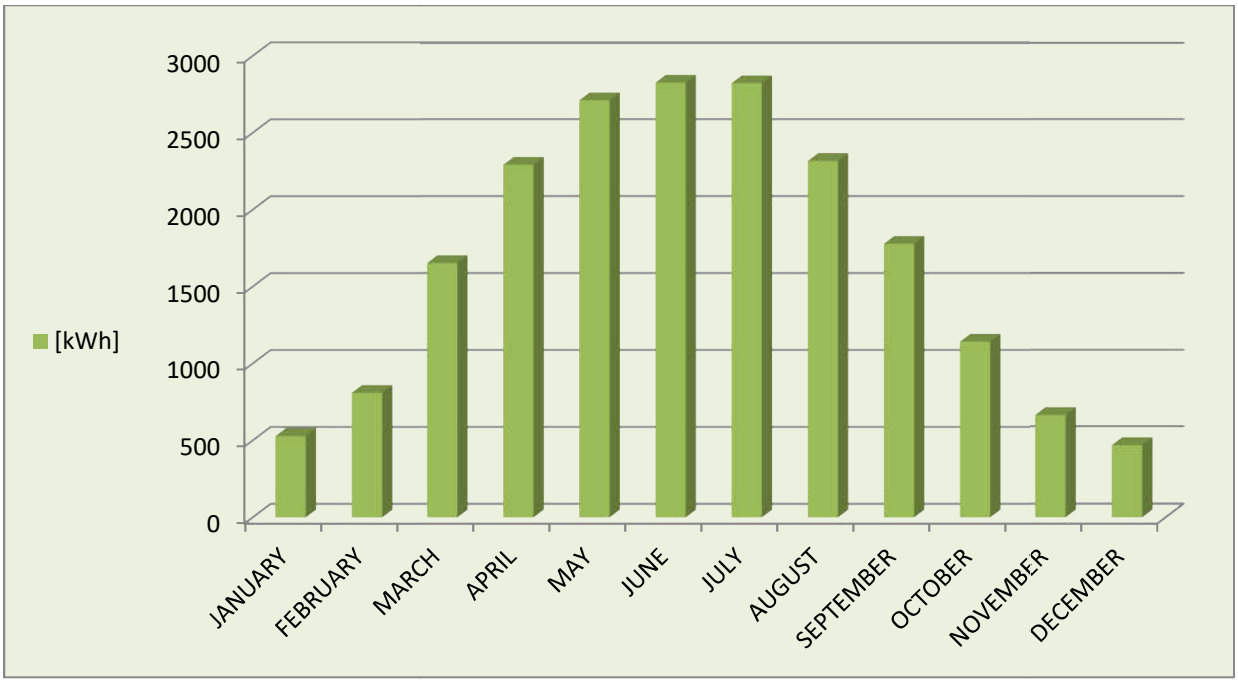




The table below presents estimated profits for individual months.

Month	E_m
JANUARY	530,20
FEBRUARY	812,00
MARCH	1655,00
APRIL	2293,00
MAY	2713,00
JUNE	2827,00
JULY	2824,00
AUGUST	2318,00
SEPTEMBER	1780,00
OCTOBER	1143,90
NOVEMBER	662,30
DECEMBER	467,80
ANNUAL YIELD	20026,20

E_m - average monthly energy yield [kWh]



Estimated calculations were made in the PVGIS program and are shaped at **20 MWh.**

It should be taken, that the reported profits are estimates and may differ from the actual ones.

/ Perfect Welding / Solar Energy / Perfect Charging

FRONIUS SYMO

Maximum flexibility for the applications of tomorrow

SnapINverter technology

Integrated data communication

Dynamic Peak Manager

Smart Grid Ready

SuperFlex Design

Zero feed-in

With 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)

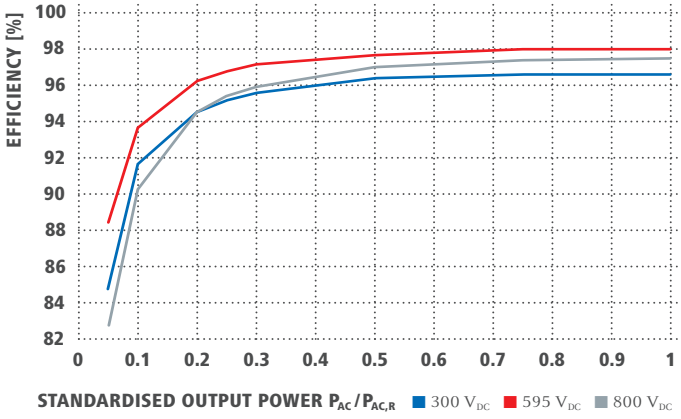
INPUT DATA	SYMO 3.0-3-S	SYMO 3.7-3-S	SYMO 4.5-3-S	SYMO 3.0-3-M	SYMO 3.7-3-M	SYMO 4.5-3-M
Number MPP trackers	1			2		
Max. input current ($I_{dc\ max\ 1}$ / $Idc\ max\ 2$ [1])	16.0 A			16.0 A / 16.0 A		
Max. array short circuit current (MPP_1 / MPP_2 [1])	24.0 A			24.0 A / 24.0 A		
DC input voltage range ($U_{dc\ min}$ - $U_{dc\ max}$)	150 - 1000 V					
Feed-in start voltage ($U_{dc\ start}$)	200 V					
Usable MPP voltage range	150 - 800 V					
Number of DC connections	3			2+2		
Max. PV generator output ($P_{dc\ max}$)	6.0 kW_{peak}	7.4 kW_{peak}	9.0 kW_{peak}	6.0 kW_{peak}	7.4 kW_{peak}	9.0 kW_{peak}

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 ($\cos \phi_{ac,r}$)	0.70 - 1 ind. / cap.			0.85 - 1 ind. / cap.		

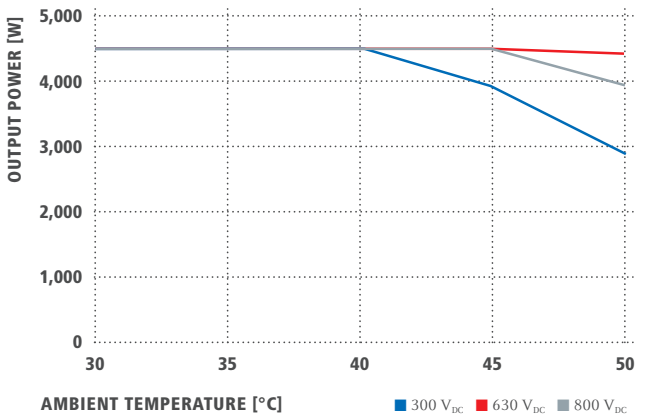
GENERAL DATA	SYMO 3.0-3-S	SYMO 3.7-3-S	SYMO 4.5-3-S	SYMO 3.0-3-M	SYMO 3.7-3-M	SYMO 4.5-3-M
Dimensions (height x width x depth)	645 x 431 x 204 mm					
Weight	16.0 kg			19.9 kg		
Degree of protection	IP 65					
Protection class	1					
Overvoltage category (DC / AC) [2]	2 / 3					
Night time consumption	< 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 mm^2			4x DC+ and 4x DC- screw terminals 2.5 - 16mm^2 [3]		
AC connection technology	5-pole AC screw terminals 2.5 - 16 mm^2			5-pole AC screw terminals 2.5 - 16mm^2 [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 mm^2 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 %
MPP adaptation efficiency	> 99.9 %					

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) [1]	Datalogging, inverter update via USB flash drive					
2x RS422 (RJ45 socket) [1]	Fronius Solar Net					
Signalling output [1]	Energy management (potential-free relay output)					
Datalogger and Webserver	Included					
External input [1]	S0-Meter Interface / Input for overvoltage protection					
RS485	Modbus RTU SunSpec or meter connection					

[1] 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)

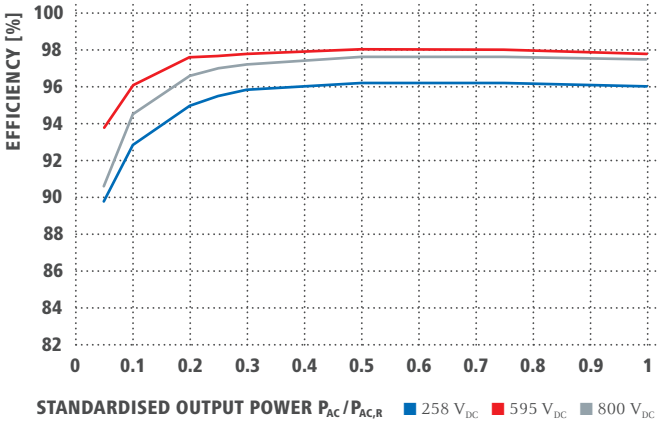
INPUT DATA	SYMO 5.0-3-M	SYMO 6.0-3-M	SYMO 7.0-3-M	SYMO 8.2-3-M
Number MPP trackers	2			
Max. input current ($I_{dc\ max\ 1}$ / $I_{dc\ max\ 2}$)	16.0 A / 16.0 A			
Max. array short circuit current (MPP_1/MPP_2)	24.0 A / 24.0 A			
DC input voltage range ($U_{dc\ min}$ - $U_{dc\ max}$)	150 - 1000 V			
Feed-in start voltage ($U_{dc\ start}$)	200 V			
Usable MPP voltage range	150 - 800 V			
Number of DC connections	2+2			
Max. PV generator output ($P_{dc\ max}$)	10.0 kW_{peak}	12.0 kW_{peak}	14.0 kW_{peak}	16.4 kW_{peak}

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 $\phi_{ac,r}$)	0.85 - 1 ind. / cap.			

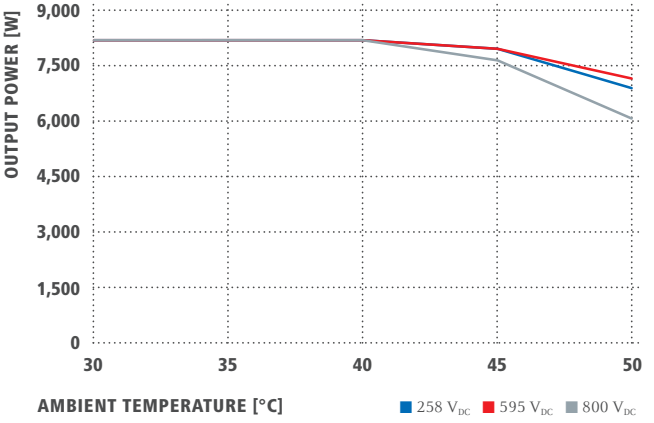
GENERAL DATA	SYMO 5.0-3-M	SYMO 6.0-3-M	SYMO 7.0-3-M	SYMO 8.2-3-M
Dimensions (height x width x depth)	645 x 431 x 204 mm			
Weight	19.9 kg		21.9 kg	
Degree of protection	IP 65			
Protection class	1			
Overvoltage category (DC / AC) [1]	2 / 3			
Night time consumption	< 1 W			
Inverter design	Transformerless			
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 - 16mm^2 [2]			
AC connection technology	5-pole AC Screw terminals 2.5 - 16mm^2 [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 mm^2 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 %
MPP adaptation efficiency	> 99.9 %			

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) [1]	Datalogging, inverter update via USB flash drive			
2x RS422 (RJ45 socket) [1]	Fronius Solar Net			
Signalling output [1]	Energy management (potential-free relay output)			
Datalogger and Webserver	Included			
External input [1]	S0-Meter Interface / Input for overvoltage protection			
RS485	Modbus RTU SunSpec or meter connection			

[1] 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
Number MPP trackers	2				
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		
DC input voltage range ($U_{dc\ min}$ - $U_{dc\ max}$)	200 - 1000 V				
Feed-in start voltage ($U_{dc\ start}$)	200 V				
Usable MPP voltage range	200 - 800 V				
Number of DC connections	3+3				
Max. PV generator output ($P_{dc\ max}$)	15.0 kW_{peak}	18.8 kW_{peak}	22.5 kW_{peak}	26.3 kW_{peak}	30.0 kW_{peak}

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 $\phi_{ac,r}$)	0 - 1 ind. / cap.				

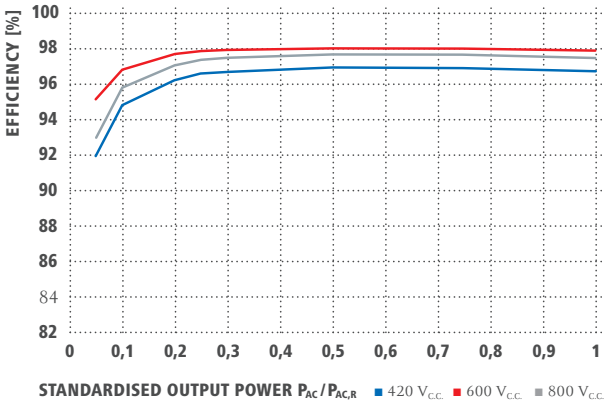
GENERAL DATA	SYMO 10.0-3-M	SYMO 12.5-3-M	SYMO 15.0-3-M	SYMO 17.5-3-M	SYMO 20.0-3-M
Dimensions (height x width x depth)	725 x 510 x 225 mm				
Weight	34.8 kg		43.4 kg		
Degree of protection	IP 66				
Protection class	1				
Overvoltage category (DC / AC) [2]	2 / 3				
Night time consumption	< 1 W				
Inverter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

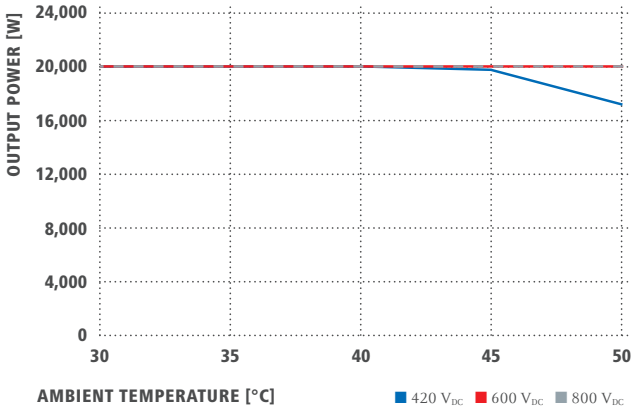
[2] According to IEC 62109-1. DIN rail for optional type 1 + 2 or type 2 surge protection device available.

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 %
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) [1]	Datalogging, inverter update via USB flash drive				
2x RS422 (RJ45-socket) [1]	Fronius Solar Net				
Signalling output [1]	Energy management (potential-free relay output)				
Datalogger and Webserver	Included				
External input [1]	S0-Meter Interface / Input for overvoltage protection				
RS485	Modbus RTU SunSpec or meter connection				

[1] Also available in the light version.
Further information and technical data can be found at **www.fronius.com.**

/ Perfect Welding / Solar Energy / Perfect Charging

THREE BUSINESS UNITS, ONE GOAL: TO SET THE STANDARD THROUGH TECHNOLOGICAL ADVANCEMENT.

What began in 1945 as a one-man operation now sets technological standards in the fields of welding technology, photovoltaics and battery charging. Today, the company has around 3,800 employees worldwide and 1,242 patents for product development show the innovative spirit within the company. Sustainable development means for us to implement environmentally relevant and social aspects equally with economic factors. Our goal has remained constant throughout: to be the innovation leader.

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

v08 Aug 2017 EN

Fronius India Private Limited
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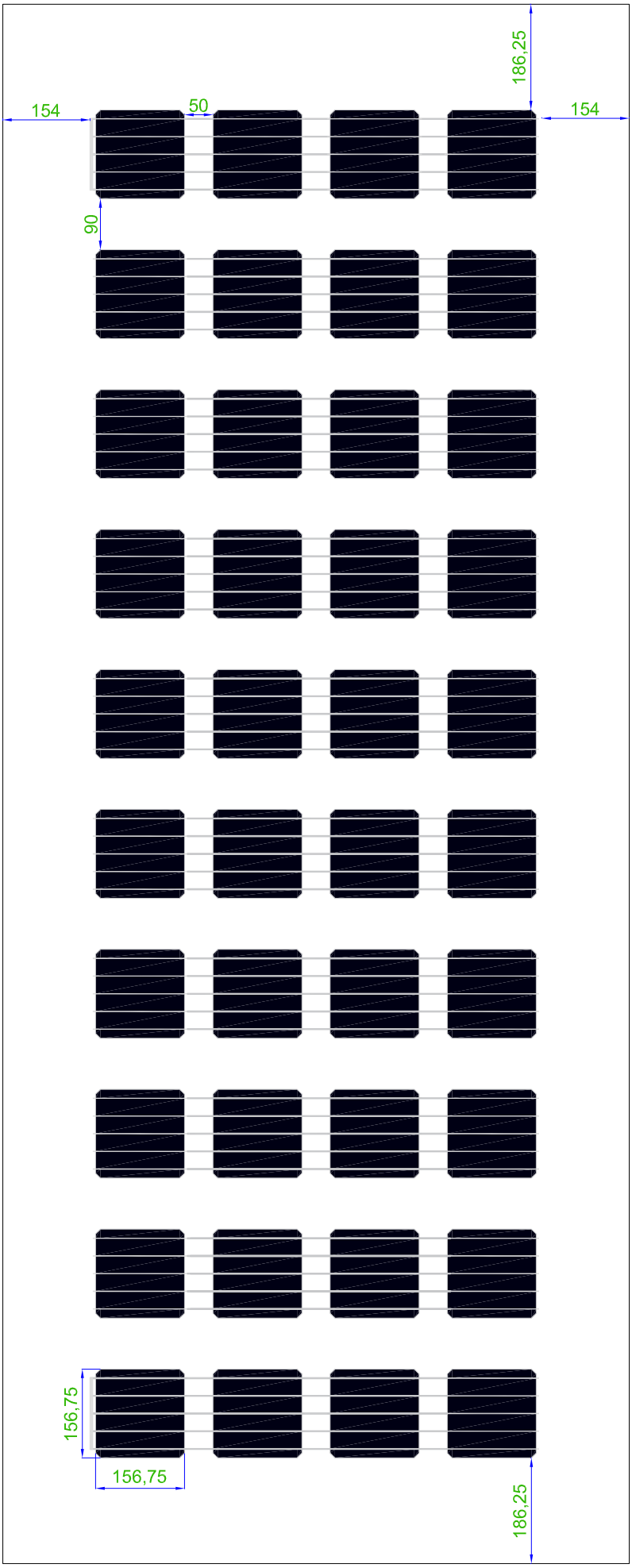
TYP 1



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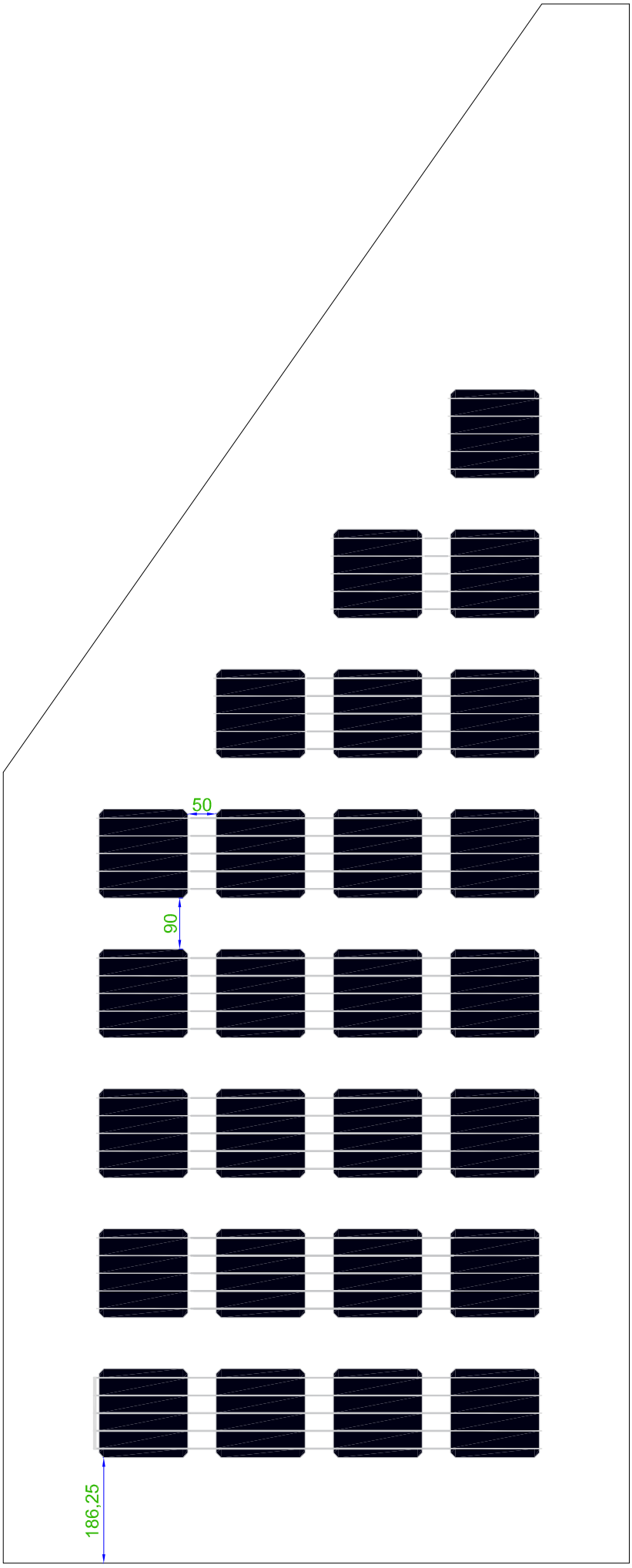

TYP 3