

Annex to Solar Keymark Certificate						Licence Number		SKM 10086								
						Date issued		2019-10-01								
						Issued by		DQS Hellas								
Licence holder		PAPAEMMANOUEL S.A.				Country		Greece								
Brand (optional)						Web		www.papaemmanouel.gr								
Street, Number		1o Km Inofyta – St. Thomas, Inofyta Viotia				E-mail		exports@papaemmanouel.gr								
Postcode, City		32011, Viotia				Tel		+30 22620 31931								
Collector Type						Flat plate collector										
Collector name						Power output per collector Gb = 850 W/m <sup>2</sup> , Gd = 150 W/m <sup>2</sup> & u = 1.3 m/s $\vartheta_m - \vartheta_a$										
						0 K	10 K	30 K	50 K	70 K	89 K					
						mm	m <sup>2</sup>	mm	mm	m <sup>2</sup>	W	W	W	W	W	W
SOLO 1.50						87	1.50	1,485	1,013	1.39	1,097	1,040	919	791	654	519
SOLO 1.50H						87	1.50	1,485	1,013	1.39	1,097	1,040	919	791	654	519
SOLO 1.82						86	1.82	1,480	1,230	1.72	1,331	1,261	1,116	960	794	630
SOLO 1.82H						86	1.82	1,230	1,480	1.72	1,331	1,261	1,116	960	794	630
SOLO 2.00						86	2.00	1,980	1,010	1.86	1,462	1,386	1,226	1,055	872	692
SOLO 2.00H						86	2.00	1,010	1,980	1.86	1,462	1,386	1,226	1,055	872	692
SOLO 2.37						86	2.37	1,930	1,230	2.23	1,733	1,643	1,453	1,250	1,034	820
SOLO 2.37H						86	2.37	1,230	1,930	2.23	1,733	1,643	1,453	1,250	1,034	820
SOLO 2.72						87	2.73	2,162	1,264	2.56	1,996	1,892	1,673	1,440	1,191	945
SOLO 2.72H						87	2.73	2,162	1,264	2.56	1,996	1,892	1,673	1,440	1,191	945
Power output per m <sup>2</sup> gross area											731	693	613	527	436	346
Performance parameters test method		Quasi dynamic														
Performance parameters (related to A <sub>G</sub> )		$\eta_0, b$	a1	a2	a3	a4	a5	a6	a7	a8	Kd					
Units		-	W/(m <sup>2</sup> K)	W/(m <sup>2</sup> K <sup>2</sup> )	J/(m <sup>3</sup> K)	-	J/(m <sup>2</sup> K)	s/m	W/(m <sup>2</sup> K <sup>4</sup> )	W/(m <sup>2</sup> K <sup>4</sup> )	-					
Test results		0.739	3.73	0.007	0.000	0.00	0	0.000	0.00	0.0E+00	0.93					
Incidence angle modifier test method		Quasi dynamic - outdoor														
Incidence angle modifier		Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°					
Transversal		K <sub>GT, coll</sub>	1.00	0.99	0.98	0.95	0.89	0.80	0.65	0.40	0.00					
Longitudinal		K <sub>GL, coll</sub>	1.00	0.99	0.98	0.95	0.89	0.80	0.65	0.40	0.00					
Heat transfer medium for testing						Water-Glycole										
Flow rate for testing (per gross area, A <sub>G</sub> )						dm/dt	0.021	kg/(sm <sup>2</sup> )								
Maximum temperature difference during thermal performance test						( $\vartheta_m - \vartheta_a$ ) <sub>max</sub>	58.68	K								
Standard stagnation temperature (G = 1000 W/m <sup>2</sup> ; $\vartheta_a = 30$ °C)						$\vartheta_{stg}$	185.13	°C								
Maximum operating temperature						$\vartheta_{max, op}$	210	°C								
Maximum operating pressure						p <sub>max, op</sub>	1000	kPa								
Testing laboratory		NCSR Demokritos / Solar & other Energy System				www.solar.demokritos.gr										
Test report(s)		4251 DE1 4252 DQ1 4253 DE1				Dated		2/7/2019 1/8/2019 2/7/2019								
Comments of testing laboratory						Datasheet version: 6.0, 2018-10-30										
						N.C.S.R "DEMOKRITOS" SOLAR ENERGY LABORATORY Head: Dr Vassilis Belessiotis Tel: +210 6503915 - Fax: +210 6544523 153 10 Ag. Paraskevi - Attiki - Greece										
Central Offices: Kalavriton 4, 145 64 kifisia, Athens, Tel: +301 6233493-4, Fax: +301 6233495, http://www.dqshellas.gr, e-mail: ioannisalexou@dqshellas.gr																

# CERTIFICATION BODY HEADER

## field available for logo etc.

<b>Annex to Solar Keymark Certificate Supplementary Information</b>							<b>Licence Number</b>			<b>SKM 10086</b>				
							<b>Issued</b>			<b>2019-10-01</b>				
<b>Annual collector output in kWh/collector at mean fluid temperature <math>\vartheta_m</math></b>														
<b>Standard Locations</b>		<b>Athens</b>			<b>Davos</b>			<b>Stockholm</b>			<b>Würzburg</b>			
<b>Collector name</b>	<b><math>\vartheta_m</math></b>	<b>25°C</b>	<b>50°C</b>	<b>75°C</b>	<b>25°C</b>	<b>50°C</b>	<b>75°C</b>	<b>25°C</b>	<b>50°C</b>	<b>75°C</b>	<b>25°C</b>	<b>50°C</b>	<b>75°C</b>	
SOLO 1.50		1,728	1,215	799	1,299	895	575	956	621	383	1,043	671	407	
SOLO 1.50H		1,728	1,215	799	1,299	895	575	956	621	383	1,043	671	407	
SOLO 1.82		2,097	1,474	970	1,576	1,085	698	1,160	753	464	1,265	814	493	
SOLO 1.82H		2,097	1,474	970	1,576	1,085	698	1,160	753	464	1,265	814	493	
SOLO 2.00		2,304	1,620	1,065	1,731	1,193	767	1,275	827	510	1,391	894	542	
SOLO 2.00H		2,304	1,620	1,065	1,731	1,193	767	1,275	827	510	1,391	894	542	
SOLO 2.37		2,731	1,919	1,262	2,052	1,413	909	1,511	981	605	1,648	1,059	642	
SOLO 2.37H		2,731	1,919	1,262	2,052	1,413	909	1,511	981	605	1,648	1,059	642	
SOLO 2.72		3,145	2,211	1,454	2,363	1,628	1,047	1,741	1,129	696	1,898	1,220	740	
SOLO 2.72H		3,145	2,211	1,454	2,363	1,628	1,047	1,741	1,129	696	1,898	1,220	740	
Annual output per m <sup>2</sup> gross area		1,152	810	533	866	596	384	638	414	255	695	447	271	
Fixed or tracking collector		Fixed (slope = latitude - 15°; rounded to nearest 5°)												
Annual irradiation on collector plane		1765 kWh/m <sup>2</sup>			1714 kWh/m <sup>2</sup>			1166 kWh/m <sup>2</sup>			1244 kWh/m <sup>2</sup>			
Mean annual ambient air temperature		18.5°C			3.2°C			7.5°C			9.0°C			
Collector orientation or tracking mode		South, 25°			South, 30°			South, 45°			South, 35°			
The collector is operated at constant temperature $\vartheta_m$ (mean of in- and outlet temperatures). The calculation of the annual collector performance is performed with the official Solar Keymark spreadsheet tool Scenocalc Ver. 6.0 (October 2018). A detailed description of the calculations is available at <a href="http://www.solarkeymark.org/scenocalc">www.solarkeymark.org/scenocalc</a>														
<b>Additional Information</b>														
Collector heat transfer medium										Water-Glycole				
The collector is deemed to be suitable for roof integration										No				
The collector was tested successfully under the following conditions:														
Climate class (A+, A, B or C)										A		--		
G (W/m <sup>2</sup> ) >		1000		$\vartheta_a$ (°C) >		20		H <sub>x</sub> (MJ/m <sup>2</sup> ) >		600				
Maximum tested positive load										3000		Pa		
Maximum tested negative load										3000		Pa		
Hail resistance using steel ball (maximum drop height)										2		m		
<b>Additional collector attribute(s)</b>														
<input type="checkbox"/> Using external power source(s) for normal operation				<input type="checkbox"/> Active or passive measure(s) for self-protection										
<input type="checkbox"/> Co-generating thermal and electrical power				<input type="checkbox"/> Wind and/or infrared sensitive collector(s) (WISC)										
<input type="checkbox"/> Façade collector(s)														
<b>Energy Labelling Information</b>														
		Reference Area, A <sub>sol</sub> (m <sup>2</sup> )			Hydraulic Designation Code									
SOLO 1.50		1.50			{F}-{O}-{CL}-{A:Ø,L}-{C:Ø,L}-{D}									
SOLO 1.50H		1.50			{F}-{O}-{CL}-{A:Ø,L}-{C:Ø,L}-{D}									
SOLO 1.82		1.82												
SOLO 1.82H		1.82												
SOLO 2.00		2.00												
SOLO 2.00H		2.00												
SOLO 2.37		2.37												
SOLO 2.37H		2.37												
<b>Data required for CDR (EU) No 811/2013 - Reference Area</b>						<b>Data required for CDR (EU) No 812/2013 - Reference Area A<sub>sol</sub></b>								
Collector efficiency ( $\eta_{col}$ )						57%		Zero-loss efficiency ( $\eta_0$ )		0.73		--		
Remark: Collector efficiency ( $\eta_{col}$ ) is defined in CDR (EU) No 811/2013 as collector efficiency of the solar collector at a temperature difference between the solar collector and the surrounding air of 40 K and a global solar irradiance of 1000 W/m <sup>2</sup> , expressed in % and rounded to the nearest integer. Deviating from the regulation $\eta_{col}$ is based on reference area (A <sub>sol</sub> ) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2017.						First-order coefficient (a <sub>1</sub> )		3.73		W/(m <sup>2</sup> K)				
						Second-order coefficient (a <sub>2</sub> )		0.007		W/(m <sup>2</sup> K <sup>2</sup> )				
						Incidence angle modifier IAM (50°)		0.90		--				
						Remark: The data given in this section are related to collector reference area (A <sub>sol</sub> ) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806. Consistent data sets for either aperture or gross area can be used in calculations like in the regulation 811 and 812 and simulation programs.								
<b>Central Offices: Kalavriton 4, 145 64 kifisia, Athens, Tel: +301 6233493-4 , Fax: +301 6233495, <a href="http://www.dqshellas.gr">http://www.dqshellas.gr</a>, e-mail: ioannisalexioi@dqshellas.gr</b>														