



Annex to Solar Keymark Certificate		Licence Number	SKM 10126.1
		Date issued	2021-09-30
		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	Gross area (A _G) m ²	Gross length mm	Gross width mm	Gross height mm	Power output per collector G _b = 850 W/m ² , G _d = 150 W/m ² & u = 1.3 m/s $\vartheta_m - \vartheta_a$					
					0 K	10 K	30 K	50 K	70 K	91 K
					W	W	W	W	W	W
ASL-1.50m ²	1.50	1,480	1,011	86	1,158	1,097	960	802	624	412
ASL-1.82m ²	1.82	1,480	1,230	86	1,405	1,331	1,165	973	757	500
ASL-2.00m ²	2.00	1,980	1,010	86	1,544	1,463	1,280	1,069	832	549
ASL-2.37m ²	2.39	1,935	1,234	86	1,846	1,748	1,529	1,278	994	656
ASL-2.72m ²	2.74	2,164	1,266	86	2,116	2,004	1,753	1,465	1,140	752
Power output per m ² gross area					772	732	640	535	416	274

Performance parameters test method	Steady state - outdoor									
Performance parameters (related to A _G)	η_0, b	a1	a2	a3	a4	a5	a6	a7	a8	Kd
Units	-	W/(m ² K)	W/(m ² K ²)	J/(m ³ K)	-	J/(m ² K)	s/m	W/(m ² K ⁴)	W/(m ² K ⁴)	-
Test results	0.784	3.90	0.017	0.000	0.00	10,800	0.000	0.00	0.0E+00	0.90

Incidence angle modifier test method	Steady state - outdoor									
Incidence angle modifier	Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°
Transversal	K _{θT, coll}	1.00	1.00	0.99	0.97	0.93	0.85	0.71	0.46	0.00
Longitudinal	K _{θL, coll}	1.00	1.00	0.99	0.97	0.93	0.85	0.71	0.46	0.00

Heat transfer medium for testing	Water	
Flow rate for testing (per gross area, A _G)	dm/dt	0.021 kg/(sm ²)
Maximum temperature difference during thermal performance test	($\vartheta_m - \vartheta_a$) _{max}	61.3 K
Standard stagnation temperature (G = 1000 W/m ² ; $\vartheta_a = 30^\circ\text{C}$)	ϑ_{stg}	187 °C
Maximum operating temperature	$\vartheta_{max, op}$	180 °C
Maximum operating pressure	p _{max, op}	kPa

Testing laboratory	NCSR Demokritos / Solar & other Energy System	www.solar.demokritos.gr
Test report(s)	4308 DE2 4309 DE1 4310 DQ2	Dated 23/09/21 03/08/21 23/09/21

Comments of testing laboratory: Datasheet version: 6.1, 2019-09-26

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Supplementary Information		Issued		2021-09-30											
Annual collector output in kWh/collector at mean fluid temperature ϑ_m															
Standard Locations		Athens		Davos		Stockholm		Würzburg							
Collector name	ϑ_m	25°C	50°C	75°C	25°C	50°C	75°C	25°C	50°C	75°C	25°C	50°C	75°C		
ASL-1.50m ²		1,836	1,266	777	1,373	909	528	1,014	635	357	1,104	685	379		
ASL-1.82m ²		2,227	1,536	943	1,666	1,103	640	1,230	771	434	1,340	832	460		
ASL-2.00m ²		2,448	1,688	1,036	1,831	1,212	704	1,352	847	476	1,472	914	506		
ASL-2.37m ²		2,925	2,018	1,238	2,188	1,449	841	1,616	1,012	569	1,759	1,092	604		
ASL-2.72m ²		3,353	2,313	1,419	2,509	1,661	964	1,852	1,160	653	2,017	1,252	693		
Annual output per m ² gross area		1,224	844	518	916	606	352	676	423	238	736	457	253		
Annual efficiency, η_a		69%	48%	29%	56%	37%	22%	58%	36%	20%	59%	37%	20%		
Fixed or tracking collector	Fixed (slope = latitude - 15°; rounded to nearest 5°)														
Annual irradiation on collector plane		1765 kWh/m ²			1630 kWh/m ²			1166 kWh/m ²			1244 kWh/m ²				
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 ϑ_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. 6.1 (September 2019). A detailed description of the calculations is available at http://www.estif.org/solarkeymarknew/															
Additional Information															
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 ²) >	1000			ϑ_a (°C) >			20			H _x (MJ/m ²) >			600		
Maximum tested positive load	3000											Pa			
Maximum tested negative load	2000											Pa			
Hail resistance using steel ball (maximum drop height)	1.8											m			
Additional collector attribute(s)															
<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"/> Façade collector(s)														
Energy Labelling Information						Additional Informative Technical Data									
	Reference Area, A _{sol} (m ²)					Hydraulic Designation Code				Aperture Area, A _a (m ²)					
ASL-1.50m ²	1.50					10-VH-1234S-A:7.2,1380-				1.39					
ASL-1.82m ²	1.82					12-VH-1234S-A:7.2,1380-				1.72					
ASL-2.00m ²	2.00					12-VH-1234S-A:7.2,1880-				1.87					
ASL-2.37m ²	2.39					14-VH-1234S-A:7.2,1830-				2.24					
ASL-2.72m ²	2.74					12-VH-1234S-A:7.2,2060-				2.55					
Data required for CDR (EU) No 811/2013 - Reference Area						Data required for CDR (EU) No 812/2013 - Reference Area A_{sol}									
Collector efficiency (η_{col})	59%					Zero-loss efficiency (η_0)				0.77				--	
Remark: Collector efficiency (η_{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 ² , expressed in % and rounded to the nearest integer. Deviating from the regulation η_{col} is based on reference area (A _{sol}) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2017.						First-order coefficient (a ₁)				3.90				W/(m ² K)	
						Second-order coefficient (a ₂)				0.017				W/(m ² K ²)	
						Incidence angle modifier IAM (50°)				0.94				--	
						Remark: The data given in this section are related to collector reference area (A _{sol}) 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.									
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