



Annex to Solar Keymark Certificate

Licence holder		Licence Number		SKM9999/1
		Date issued		2022-07-27
		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
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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 θ _m - θ _a					
					0 K	10 K	30 K	50 K	70 K	84 K
					W	W	W	W	W	W
FMAX_150	1.50	1,480	1,010	86	1,143	1,087	963	822	665	548
FMAX_150H	1.50	1,010	1,480	86	1,143	1,087	963	822	665	548
FMAX_1.82	1.82	1,480	1,230	86	1,387	1,319	1,168	997	807	664
FMAX_1.82_H	1.82	1,230	1,480	86	1,387	1,319	1,168	997	807	664
FMAX_2.00	2.00	1,980	1,010	86	1,524	1,449	1,284	1,096	886	730
FMAX_2.00H	2.00	1,010	1,980	86	1,524	1,449	1,284	1,096	886	730
FMAX_2.37	2.37	1,930	1,230	86	1,806	1,718	1,521	1,299	1,050	865
FMAX_2.37H	2.37	1,230	1,930	86	1,806	1,718	1,521	1,299	1,050	865
FMAX_2.72	2.72	2,160	1,260	86	2,073	2 (13.01)	1,746	1,491	1,205	993
FMAX_2.72H	2.72	1,260	2,160	86	2,073	1,971	1,746	1,491	1,205	993
Power output per m ² gross area					762	725	642	548	443	365

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	0.771	3.59	0.014	0.000	0.00	10,827	0.000	0.00	0.0E+00	0.92

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	1.00	0.99	0.96	0.90	0.78	0.52	0.00
Longitudinal	K _{θL, coll}	1.00	1.00	1.00	0.99	0.96	0.90	0.78	0.52	0.00

Heat transfer medium for testing	Water									
Flow rate for testing (per gross area, A _G)	dm/dt	0.022		kg/(sm ²)						
Maximum temperature difference during thermal performance test	(θ _m -θ _a) _{max}	53.7		K						
Standard stagnation temperature (G = 1000 W/m ² ; θ _a = 30 °C)	θ _{stg}	190.5		°C						
Maximum operating temperature	θ _{max, op}	200		°C						
Maximum operating pressure	p _{max, op}	1000		kPa						

Testing laboratory	NCSR Demokritos / Solar & other Energy System	www.solar.demokritos.gr								
Test report(s)	4195DE2 4196DE2 4197DQ3	Dated		16/11/16 16/11/16 02/06/17						

Comments of testing laboratory	Ver. 6.2 (13.01.2022)
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Supplementary Information						Issued		2022-07-27	

Gross Thermal Yield in kWh/collector at mean fluid temperature ϑ_m													
Collector name	Standard Locations ϑ_m	Athens			Davos			Stockholm			Würzburg		
		25°C	50°C	75°C	25°C	50°C	75°C	25°C	50°C	75°C	25°C	50°C	75°C
FMAX_150		1,848	1,320	859	1,405	970	605	1,034	675	405	1,125	731	431
FMAX_150H		1,848	1,320	859	1,405	970	605	1,034	675	405	1,125	731	431
FMAX_1.82		2,243	1,601	1,042	1,705	1,177	734	1,254	819	491	1,365	886	523
FMAX_1.82_H		2,243	1,601	1,042	1,705	1,177	734	1,254	819	491	1,365	886	523
FMAX_2.00		2,464	1,759	1,145	1,874	1,293	806	1,379	900	540	1,500	974	575
FMAX_2.00H		2,464	1,759	1,145	1,874	1,293	806	1,379	900	540	1,500	974	575
FMAX_2.37		2,920	2,085	1,357	2,221	1,532	955	1,634	1,066	639	1,778	1,154	682
FMAX_2.37H		2,920	2,085	1,357	2,221	1,532	955	1,634	1,066	639	1,778	1,154	682
FMAX_2.72		3,352	2,393	1,558	2,549	1,759	1,097	1,875	1,223	734	2,040	1,325	782
FMAX_2.72H		3,352	2,393	1,558	2,549	1,759	1,097	1,875	1,223	734	2,040	1,325	782
Gross Thermal Yield per m ² gross area		1,232	880	573	937	647	403	689	450	270	750	487	288
Annual efficiency, η_a		70%	50%	32%	57%	40%	25%	59%	39%	23%	60%	39%	23%
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. 6.2 (13.01.2022). 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	3000		Pa
Hail resistance using steel ball (maximum drop height)	2		m
Additional collector attribute(s)			
Using external power source(s) for normal operation	No	Active or passive measure(s) for self-protection	No
Co-generating thermal and electrical power	No	Facade collector(s)	No

Energy Labelling Information		Additional Informative Technical Data	
	Reference Area, A _{sol} (m ²)	Hydraulic Designation Code	Aperture Area, A _a (m ²)
FMAX_150	1.50	9-V-1234S-A:7.2,1380-C:20.6,1080-D	1.38
FMAX_150H	1.50	14-V-1234S-A:7.2,908-C:20.6,1560-D	1.38
FMAX_1.82	1.82	11-V-1234S-A:7.2,1378-C:20.6,1300-D	1.72
FMAX_1.82_H	1.82	14-V-1234S-A:7.2,1128-C:20.6,1560-D	1.72
FMAX_2.00	2.00	9-V-1234S-A:7.2,1878-C:20.6,1080-D	1.86
FMAX_2.00H	2.00	18-V-1234S-A:7.2,908-C:20.6,2060-D	1.86
FMAX_2.37	2.37	11-V-1234S-A:7.2,1828-C:20.6,1300-D	2.23
FMAX_2.37H	2.37	18-V-1234S-A:7.2,1128-C:20.6,2010-D	2.23
FMAX_2.72	2.72	11-V-1234S-A:7.2,2060-C:20.6,1320-D	2.57
FMAX_2.72H	2.72	18-V-1234S-A:7.2,1158-C:20.6,2240-D	2.57
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})	60%	Zero-loss efficiency (η_0)	0.76
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)	3.59
		Second-order coefficient (a_2)	0.014
		Incidence angle modifier IAM (50°)	0.96
		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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