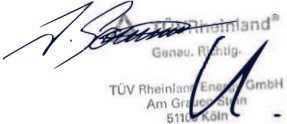


<b>Annex to Solar Keymark Certificate</b>					Licence Number		011-7S2983 R							
					Date issued		2021-05-18							
					Issued by		TÜV Rheinland Energy GmbH							
Licence holder		IES (Asia) Limited			Country		China							
Brand (optional)					Web		http://www.ies-group.com							
Street, Number		3 Dai Hei Street			E-mail		info@ies-group.com.hk							
Postcode, City		Tai Po Industrial Estate, Tai Po, N.T., HK			Tel		+852 2992 0830							
Collector Type					Evacuated tubular collector									
<b>Collector name</b>					<b>Gross area (A<sub>G</sub>)</b> m <sup>2</sup>	<b>Gross length</b> mm	<b>Gross width</b> mm	<b>Gross height</b> mm	<b>Power output per collector</b>					
									G <sub>b</sub> = 850 W/m <sup>2</sup> , G <sub>d</sub> = 150 W/m <sup>2</sup> & u = 1.3 m/s θ <sub>m</sub> - θ <sub>a</sub>					
									0 K	10 K	30 K	50 K	70 K	110 K
									W	W	W	W	W	W
FKA-VP-10					1.74	2 000	870	150	678	653	605	556	508	410
FKA-VP-15					2.52	2 000	1 260	150	982	946	876	806	735	594
FKA-VP-20					3.30	2 000	1 650	150	1 285	1 239	1 147	1 055	963	778
FKA-VP-25					4.08	2 000	2 040	150	1 589	1 532	1 418	1 304	1 190	962
FKA-VP-30					4.86	2 000	2 430	150	1 893	1 825	1 689	1 554	1 418	1 146
Power output per m <sup>2</sup> gross area									390	376	348	320	292	236
Performance parameters test method					Steady state - outdoor									
Performance parameters (related to A <sub>G</sub> )					η <sub>0, b</sub>	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					0.379	1.40	0.000	0.000	0.00	33 612	0.000	0.00	0.0E+00	1.19
Incidence angle modifier test method					Quasi dynamic - outdoor									
Incidence angle modifier					Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°
Transversal					K <sub>θT, coll</sub>	1.02	1.08	1.19	1.37	1.52	1.58	1.50	1.20	0.00
Longitudinal					K <sub>θL, coll</sub>	1.00	1.00	0.99	0.98	0.96	0.94	0.88	0.44	0.00
Heat transfer medium for testing					Water									
Flow rate for testing (per gross area, A <sub>G</sub> )					dm/dt		0.015					kg/(sm <sup>2</sup> )		
Maximum temperature difference during thermal performance test					(θ <sub>m</sub> -θ <sub>a</sub> ) <sub>max</sub>		80					K		
Standard stagnation temperature (G = 1000 W/m <sup>2</sup> ; θ <sub>a</sub> = 30 °C)					θ <sub>stg</sub>		227					°C		
Maximum operating temperature					θ <sub>max op</sub>		120					°C		
Maximum operating pressure					p <sub>max, op</sub>		600					kPa		
Testing laboratory					TÜV Rheinland Energy GmbH			www.tuv.com/solar						
Test report(s)					154019941_EN_P_Sunrain_10_Report_Gao 154019941_EN_Sunrain_30_Report_Gao			Dated		04.12.2013 04.12.2013				
Comments of testing laboratory					Datasheet version: 6.1, 2019-07-11									
The performance figures were converted to gross area:														
	Area [m <sup>2</sup> ]	dm/dt [kg/(sm <sup>2</sup> )]	a5 [J/(m <sup>2</sup> K)]	h <sub>0, hem</sub> [ ]	h <sub>0, b</sub> [ ]	a1 [W/(m <sup>2</sup> K)]	a2 [W/(m <sup>2</sup> K <sup>2</sup> )]	Kd [ ]						
Initial values based on aperture area	0.92	0.028	6357	0.733	-	2.643	0	0						
New values based on gross area	1.74	0.015	3361	0.388	0.378	1.397	0.000	1.185						
 TÜV Rheinland Energy GmbH Am Gröden 5116 Köln														
<b>DIN CERTCO • Alboinstraße 56 • 12103 Berlin, Germany</b> Tel: +49 30 7562-1131 • Fax: +49 30 7562-1141 • E-Mail: info@dincertco.de • www.dincertco.de														

Annex to Solar Keymark Certificate							Licence Number		011-7S2983 R						
Supplementary Information							Issued		2021-05-18						
Annual collector output in kWh/collector at mean fluid temperature $\vartheta_m$															
	Standard Locations	Athens			Davos			Stockholm			Würzburg				
Collector name	$\vartheta_m$	25°C	50°C	75°C	25°C	50°C	75°C	25°C	50°C	75°C	25°C	50°C	75°C		
FKA-VP-10		1 361	1 128	927	1 100	902	737	813	644	508	879	696	548		
FKA-VP-15		1 972	1 634	1 342	1 593	1 307	1 068	1 177	933	736	1 274	1 008	794		
FKA-VP-20		2 582	2 139	1 757	2 087	1 711	1 398	1 542	1 221	964	1 668	1 320	1 040		
FKA-VP-25		3 192	2 645	2 173	2 580	2 116	1 729	1 906	1 510	1 191	2 062	1 632	1 286		
FKA-VP-30		3 802	3 150	2 588	3 073	2 520	2 059	2 271	1 799	1 419	2 456	1 944	1 531		
Annual output per m <sup>2</sup> gross area		782	648	533	632	519	424	467	370	292	505	400	315		
Annual efficiency, $\eta_a$		44%	37%	30%	39%	32%	26%	40%	32%	25%	41%	32%	25%		
Fixed or tracking collector		Fixed (slope = latitude - 15°; rounded to nearest 5°)													
Annual irradiation on collector plane		1765 kWh/m <sup>2</sup>			1630 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. 6.1 (July 2019). A detailed description of the calculations is available at <a href="http://www.estif.org/solarkeymarknew/">http://www.estif.org/solarkeymarknew/</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		$H_x$ (MJ/m <sup>2</sup> ) >		600					
Maximum tested positive load										2250		Pa			
Maximum tested negative load										--		Pa			
Hail resistance using steel ball (maximum drop height)										--		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"/> Façade collector(s)										
<b>Energy Labelling Information</b>							<b>Additional Informative Technical Data</b>								
	Reference Area, $A_{sol}$ (m <sup>2</sup> )						Hydraulic Designation Code			Aperture Area, $A_a$ (m <sup>2</sup> )					
FKA-VP-10	1.74						1-H-12S-C:X			0.92					
FKA-VP-15	2.52						1-H-12S-C:X			1.38					
FKA-VP-20	3.30						1-H-12S-C:X			1.84					
FKA-VP-25	4.08						1-H-12S-C:X			2.31					
FKA-VP-30	4.86						1-H-12S-C:X			2.77					
Data required for CDR (EU) No 811/2013 - Reference Area $A_{sol}$							Data required for CDR (EU) No 812/2013 - Reference Area $A_{sol}$								
Collector efficiency ( $\eta_{col}$ )							33%								
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 ( $A_{sol}$ ) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2017.							Zero-loss efficiency ( $\eta_0$ )			0.39				--	
							First-order coefficient ( $a_1$ )			1.40				W/(m <sup>2</sup> K)	
							Second-order coefficient ( $a_2$ )			0.000				W/(m <sup>2</sup> K <sup>2</sup> )	
							Incidence angle modifier IAM (50°)			1.32				--	
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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