


<b>Annex to Solar Keymark Certificate - Summary of EN ISO 9806:2013 Test Results</b>					<b>Licence Number</b>		<b>011-7S1890F</b>				
					<b>Date issued</b>		<b>2017-06-14</b>				
					<b>Issued by</b>		<b>DIN CERTCO</b>				
<b>Licence holder</b>	<b>TVP Solar SA</b>				<b>Country</b>	<b>Switzerland</b>					
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<b>Collector Type</b>					<b>Flat plate collector, glazed</b>						
<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 = 3 m/s ϑ <sub>m</sub> - ϑ <sub>a</sub>						
					0 K W	10 K W	30 K W	50 K W	70 K W	185 K W	
<b>MT- Power v4</b>	1.96	975	2 015	51	1 435	1 424	1 395	1 356	1 308	850	
<b>Power output per m<sup>2</sup> gross area</b>					732	727	712	692	668	434	
<b>Performance parameters test method</b>		<b>Quasi dynamic</b>									
<b>Performance parameters (related to A<sub>G</sub>)</b>		η <sub>0,b</sub>	c1	c2	c3	c4	c6	Kd			
<b>Units</b>		-	W/(m <sup>2</sup> K)	W/(m <sup>2</sup> K <sup>2</sup> )	J/(m <sup>3</sup> K)	-	s/m	-			
<b>Test results</b>		0.737	0.504	0.006	0.000	0.000	0.000	0.957			
<b>Incidence angle modifier test method</b>		<b>Quasi dynamic - outdoor</b>									
<b>Bi-directional incidence angle modifiers</b>		<b>No</b>									
<b>Incidence angle modifier</b>		Angle	10°	20°	30°	40°	50°	60°	70°	80°	90°
<b>Transversal</b>		K <sub>θT, coll</sub>	1.00	1.00	0.99	0.98	0.95	0.88	0.72	0.36	0.00
<b>Longitudinal</b>		K <sub>θL, coll</sub>	1.00	1.00	0.99	0.98	0.95	0.88	0.72	0.36	0.00
<b>Heat transfer medium for testing</b>					<b>Water</b>						
<b>Flow rate for testing (per gross area, A<sub>G</sub>)</b>					dm/dt	0.020	kg/(sm <sup>2</sup> )				
<b>Maximum temperature difference for thermal performance calculations</b>					(ϑ <sub>m</sub> -ϑ <sub>a</sub> ) <sub>max</sub>	185	K				
<b>Standard stagnation temperature (G = 1000 W/m<sup>2</sup>; ϑ<sub>a</sub> = 30 °C)</b>					ϑ <sub>stg</sub>	302	°C				
<b>Effective thermal capacity, incl. fluid (per gross area, A<sub>G</sub>)</b>					C/m <sup>2</sup>	15.32	kJ/(Km <sup>2</sup> )				
<b>Maximum operating temperature</b>					ϑ <sub>max, op</sub>	200	°C				
<b>Maximum operating pressure</b>					p <sub>max, op</sub>	160	kPa				
<b>Testing laboratory</b>	<b>TZS, ITW University Stuttgart</b>				<b>www.itw.uni-stuttgart.de</b>						
<b>Test report(s)</b>	16COL1343 16COL1343Q				<b>Dated</b>	24.05.2017 24.05.2017					
<b>Comments of testing laboratory</b>					Datasheet version: 5.01, 2016-03-01						
none					 <b>Forschungs- und Testzentrum für Solaranlagen</b> Institut für Thermodynamik und Wärmetechnik Universität Stuttgart Pfaffenwaldring 6, 70560 Stuttgart (Vaihingen)						
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<b>Annex to Solar Keymark Certificate</b> <b>Supplementary Information</b>	<b>Licence Number</b>	<b>011-7S1890F</b>
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Annual collector output in kWh/collector at mean fluid temperature $\vartheta_m$ , based on ISO 9806:2013 test results													
Collector name	Standard Locations $\vartheta_m$	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
MT- Power v4		2 417	2 275	2 087	2 164	1 996	1 796	1 539	1 399	1 240	1 652	1 508	1 338
Annual output per m <sup>2</sup> gross area		1 233	1 161	1 065	1 104	1 018	916	785	714	633	843	769	683
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. 5.01 (March 2016). A detailed description of the calculations is available at <a href="http://www.solarkeymark.org/scenocalc">www.solarkeymark.org/scenocalc</a>													

Additional Information		
Collector heat transfer medium	Water	
Hybrid Thermal and Photo Voltaic collector	No	
The collector is deemed to be suitable for roof integration	No	
The collector was tested successfully according to EN ISO 9806:2013 under the following conditions:		
Climate class (A, B or C)	A	--
Maximum tested positive load	3000	Pa
Maximum tested negative load	3000	Pa
Hail resistance using steel ball (maximum drop height)	0.6	m

Energy Labelling Information			
	Reference Area, $A_{sol}$ (m <sup>2</sup> )	Data required for CDR (EU) No 811/2013 - Reference Area $A_{sol}$	
MT- Power v4	1.96	Collector efficiency ( $\eta_{col}$ )	70 %
		<i>Remark: Collector efficiency (<math>\eta_{col}</math>) 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 <math>\eta_{col}</math> is based on reference area (<math>A_{sol}</math>) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2013.</i>	
		<b>Data required for CDR (EU) No 812/2013 - Reference Area <math>A_{sol}</math></b>	
		Zero-loss efficiency ( $\eta_0$ )	0.732 --
		First-order coefficient ( $a_1$ )	0.50 W/(m <sup>2</sup> K)
		Second-order coefficient ( $a_2$ )	0.006 W/(m <sup>2</sup> K <sup>2</sup> )
		Incidence angle modifier IAM (50°)	0.95 --
		<i>Remark: The data given in this section are related to collector reference area (<math>A_{sol}</math>) 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.</i>	