

**CPV solar panel based on GaAs - type die and optical concentrator****ET - CPV - 125****Company profile**

ELCERAM a.s. is a Czech manufacturing company whose products include white ceramic substrates of Aluminum oxide ( $Al_2O_3$ ) for electro industries, printed ceramic substrates for microelectronics, fixed and variable resistors, networks, heating elements, temperature sensors. A wide variety of substrates, resistive, conductive and overcoat materials are available to tailor solutions. The quality of the products is assured by certification according to ISO/TS 16949 and ISO 9001.

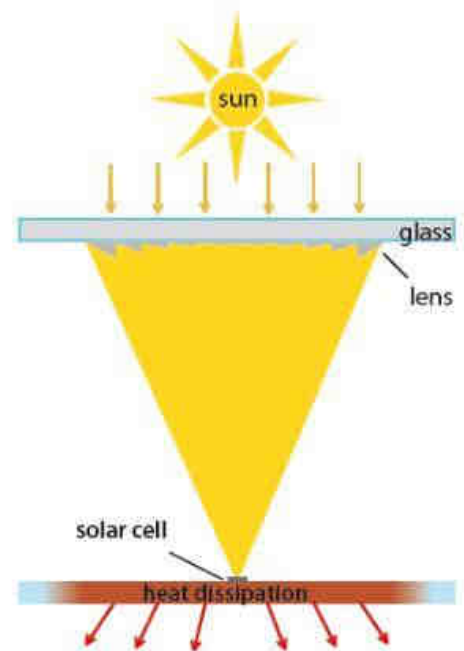
For the years 2008 – 2011 gained ELCERAM a.s., together with the company TTS s.r.o., financial support from the Ministry of Industry and Trade of the Czech Republic for development of the CPV Photovoltaic solar panels based on GaAs - type die and optical concentrator, focusing the sun irradiation on the die. This type of panels is suitable for regions with high sunlight irradiation throughout the whole year.

**CPV - Concentrated photovoltaic technology**

CPV solar technology is based on concentration of solar irradiation on the high efficiency multi - junction solar cell by means of an optic concentrator, e.g. Fresnel lens. Therefore only a small amount of the semiconductor material is needed in comparison to conventional silicon technology.

The base principle is shown in the picture on the right hand side. The sun's rays are focused by lens on the solar cell ELC 38 where the sun energy is converted to electrical energy with 38 % efficiency. The factor of focusing is about 300 suns. The optical system position must be at anytime to the sun, therefore the tracker system is used.

The high solar cell efficiency and solar tracking are the reasons of the high efficiency of solar system. As this technology exhibits small dependence of efficiency on temperature it is an ideal solution for the subtropical and tropical climatic belts where the efficiency of conventional (e.g. Si) solar panels is significantly lower because of their overheating.



## The solar panel technology

Both ELCERAM and TTS have built experimental measuring workplaces (see the picture on the right) where the solar panels are installed and tested. It enables to optimize the size of solar lens and solar die and other technical solutions as well. On the workplace there is also the pyrheliometer installed – it is very important device for the sun normal direct irradiance (NDI) measurement.

The solar panel is made of the Fresnel lens array plate and heat sink plate on which the high efficiency solar cells are mounted. ELCERAM and TTS companies are the owners of custom design of the solar die and Fresnel lens arrays as well.

The solar die, provided by Azur Space GmbH, is encapsulated by ELCERAM technology. The solar cell (encapsulated solar die) is made of the ceramics substrate, thick film conductive paths and contacts. It also contains integrated bypass diode.



The Fresnel lens array is manufactured by SOG (Silicon on Glass) technology which ensures its low cost and long lifetime. The solar cells with the Fresnel lenses are optimized for maximal power and efficiency.

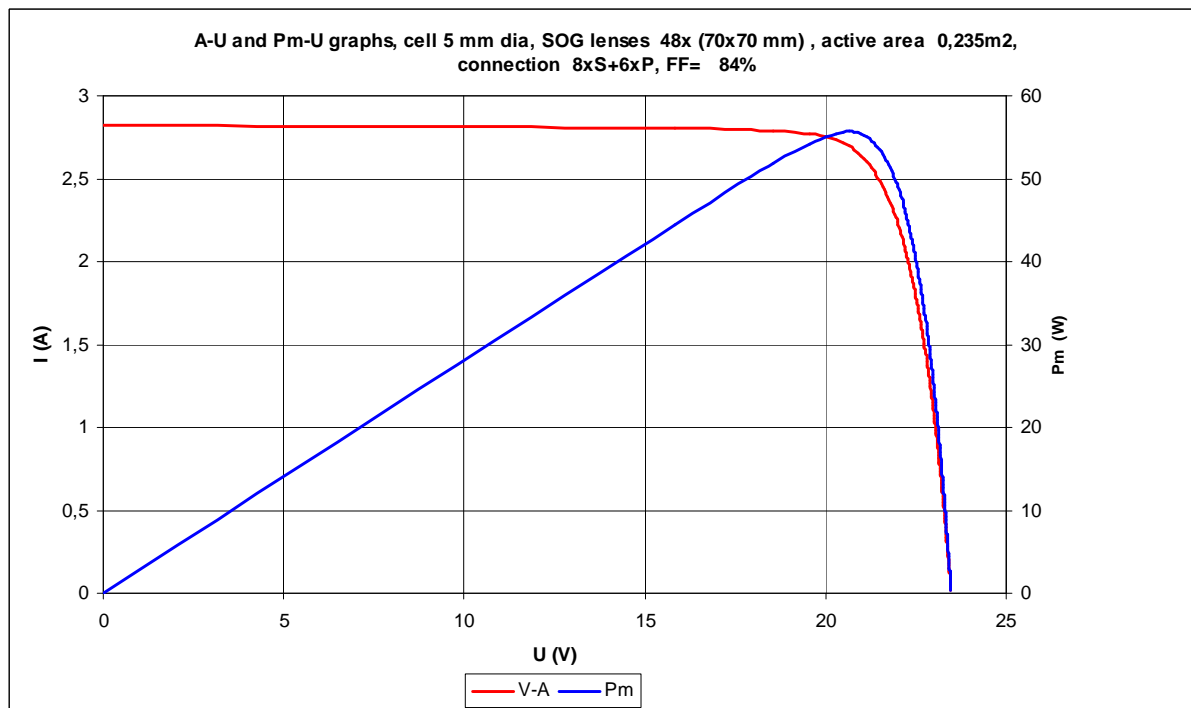
The solar panel is mounted on a two – axis tracking system that follows the sun at every moment of the whole day. It ensures that hot spot of the concentrated sunlight is focused on the centre of the cell. The wiring of cells is possible to vary by the change of the cells interconnections, to obtain convenient setting of the output DC voltage and current.

The table of the parameters of solar cell, panel and tracking system is shown below.

<b>Specifications of solar cell ELC 38 - 300</b>	
Base material	Al <sub>2</sub> O <sub>3</sub> - 96 %
Solar die	Multi - junction GaInP / GaAs / Ge, substrate Ge
Dimensions	24 x 24 x 1,35 mm
Temperature coefficient of efficiency	- 0,106 % / K
Encapsulation	Polymer
Qualification test	IEC 62108:2007 – Powered Thermal Cycling – Sections 10.6
<b>Specifications of solar panel ET - CPV - 125</b>	
Dimensions	922 x 600 x 170 mm
Number of cells	96
Active area	0,47 m <sup>2</sup>
Output power	125 W at DNI 850 W / m <sup>2</sup> AM1.5d
DC efficiency	29 %
Acceptance angle	+ - 1°
<b>Specifications of tracking system</b>	
Tracking type	Dual – axis
Tracking accuracy	0,1°
Power consumption	8 W

## Current – Voltage and Maximum Power - Voltage Characteristics

Measurements on panel in real conditions at solar irradiance DNI 785 W. The panel contains 48 SOG lens array, active area of the panel is 0,235 m<sup>2</sup>.



NDI (W/m <sup>2</sup> )	Voc (V)	Isc (A)	Vmp (V)	Imp (A)	Pmp (W)	Efficiency (%)	FF (%)
785	23,47	2,83	20,67	2,70	55,70	30	84

The maximum power corresponds to the power of 255 W / m<sup>2</sup> @ DNI 850 W.

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