

# SOLAR POWER GENERATION

Space

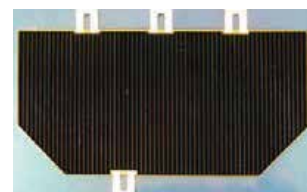
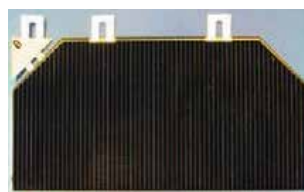
## SOLAR ARRAYS AND DEPLOYMENT MECHANISMS FOR SMALL SATELLITE APPLICATIONS

As a key player in Photovoltaic Assembly (PVA) design and lay-down, with a proven capability to supply state-of-the-art fixed solar array, we are a reliable worldwide partner for small solar generator systems. Thanks to its flexible approach to meeting the most challenging client needs, we are able to deliver solar arrays with an excellent cost/performance ratio.

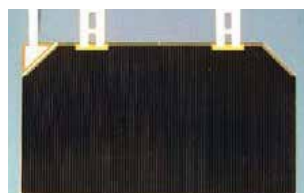
In order to fulfil LEO demanding environmental requirements, the company has developed and qualified a comprehensive set of technologies able to provide protection against ESD and atomic oxygen (ATOX) erosion phenomena.

Our presence in the photovoltaic sector has grown to include both electrical aspects of the solar array and the mechanical parts such as hinge systems, restrain and release mechanisms and substrate design and procurement.

In recent years the total lifetime and the operational requirements of small satellite businesses has become comparable with the bigger platforms ones.



Solar cell assemblies currently available. GaAs TJ28% cells. 8x4cm<sup>2</sup> with external or integral by pass diode.



Solar cell assemblies currently available. GaAs TJ 28% cell 7x4cm<sup>2</sup> with external by pass diode and 4x2cm<sup>2</sup>.



# SOLAR POWER GENERATION

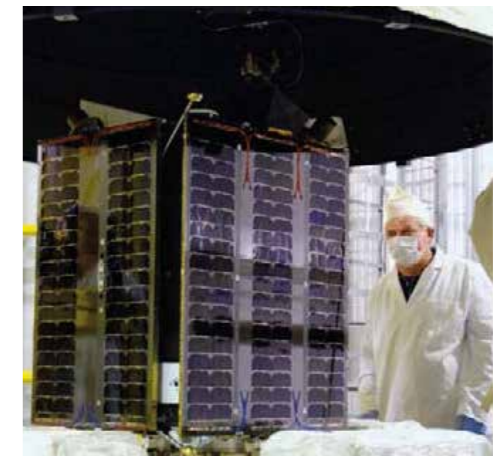
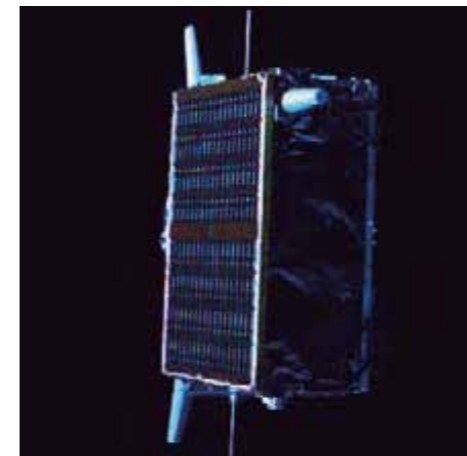
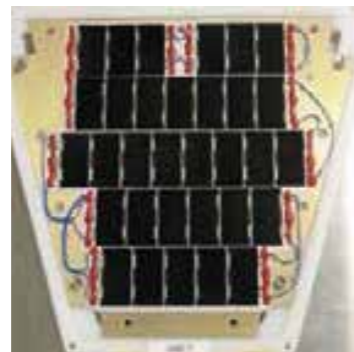
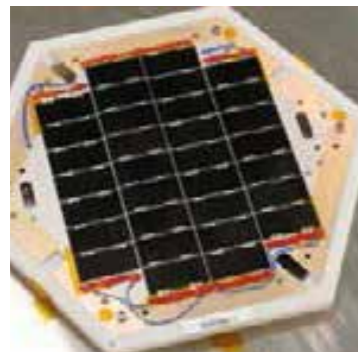
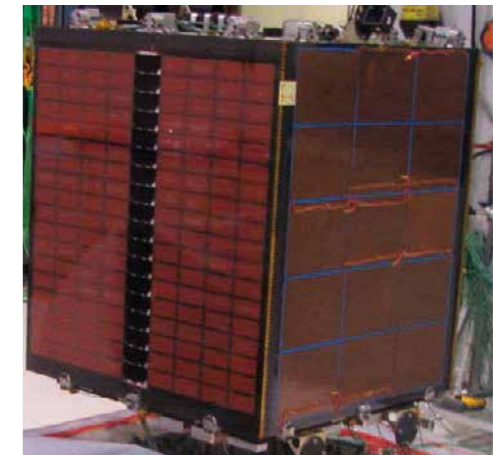
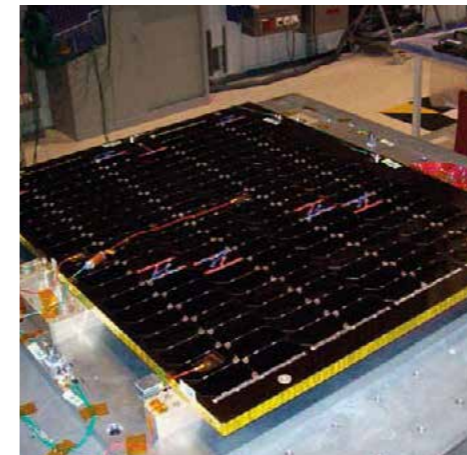
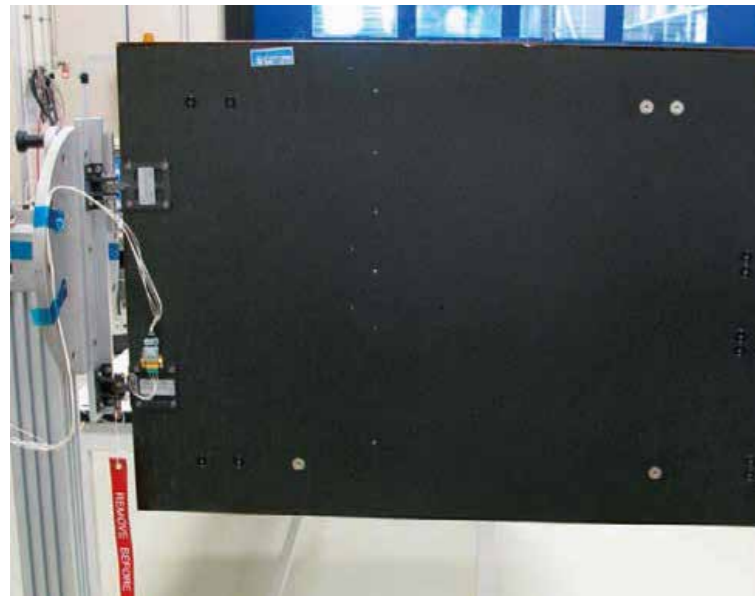
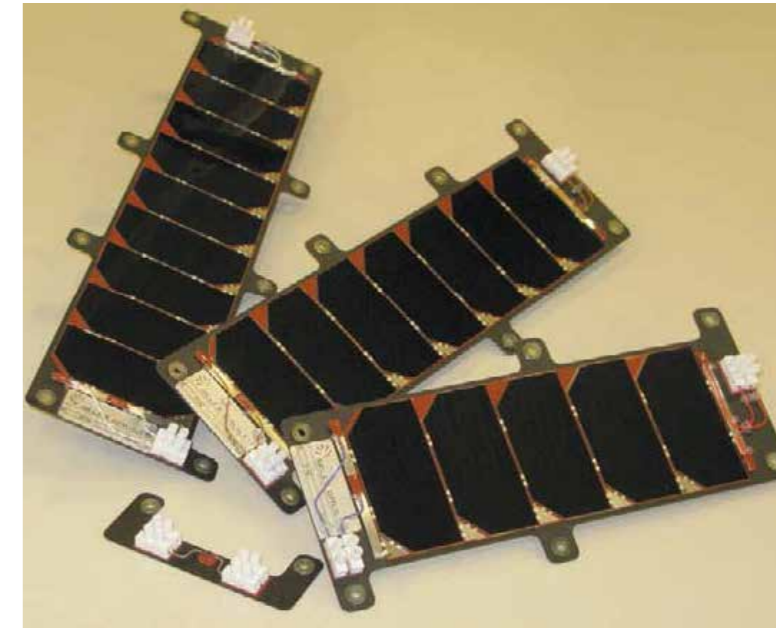
In order to provide turnkey solutions for this kind of solar generators, the company has developed and qualified a comprehensive set of state of the art technologies. The achievements obtained so far are not only limited to the electrical parts but also cover the other subsystems related issues like substrate design and various interface issues with spacecrafts and space environment either. Simple deployment systems (for single panel) and related mechanical parts are now included in our technical background.

Small solar arrays were initially devoted to the qualification of the GaAs on Ge single junction cell technology. Typical missions were ranging from altitudes between 400 and 1000km with polar orbits and installed power between 10W and 150W.

Meanwhile the technology progressed and the power requirement increased. This scenario imposes different solutions, derived from the "state of the art" design implemented on "big" solar array dedicated to commercial and captive markets.

The evolution of the small satellite solar generator technology can be summarized as follows: from single to multi junction thin GaAs based solar cells together with an improved joining technique, from Al alloy substrates to advanced composite structures, based on carbon fibre reinforced plastic (CFRP) skins and honeycomb (HC) Al core. With the aim to satisfy Customer needs for small satellites, the company has also developed small standard string blocks named SPVS™.

SPVS™ is a modular solar array whose building blocks can be combined to form cell strings of different length. SPVS™ has been optimized to be adapted to different structures and mechanical constraints, without losing a good balancing between performance and price. SPVS™ provides an alternative GaAs TJ cell based solar generator with respect to the traditional one integrated onto composite (Al or CFRP+Al) substrates.



# SOLAR POWER GENERATION

## TECHNICAL SPECIFICATION

### SOLAR CELL ASSEMBLY

#### Solar cell

- 28% and 30% efficiency class InGaP/GaAs/Ge MOCVD growth. Bypass protection against reverse bias: integral GaAs or external Si diode
- Silicon hi-eta BSFR, CZ <1-0-0>

#### Interconnection technology

- Parallel gap resistance welding
- Soldering
- Silver plated Invar interconnect
- Gold plated Invar interconnect
- Silver plated Molybdenum interconnect

#### Protection cover

- Ceria doped micro sheet type CMG and CMX
- Ceria doped micro sheet with ITO conductive coating

### PHOTOVOLTAIC ASSEMBLY

#### EEE parts

- Blocking diodes type 1N5811 up to JANS quality level, up screened for the extended T range
- Platinum thermistor and transducers for T monitoring
- Wire wound bleed resistors type RWR79 for substrate grounding

#### Wires and cables

- Gore type SPL and SPM and Raychem wires of different gauges (from 20 to 26), single and twisted, shielded for signal transfer

#### Bonding adhesives

- Wacker Chemie RTV adhesives for structural bonding and coverglassing
- Dow Corning transparent adhesive for coverglassing
- Nusil Technology adhesives for cable spot bonding and conductive bonding

### QUALIFICATION ENVIRONMENT

#### Low Earth Orbit

- Up to 60,000 extended temperature cycles covering +/- 110 °C
- ATOX erosion test up to 10E21 AO/cm<sup>2</sup> followed by a comprehensive material analysis
- ESD test at single solar cell assembly and coupon level covering specific mission requirements

#### Geostationary Orbit

- Up to 3,000 extended temperature cycles covering -175 °C to +140 °C
- ESD test at single solar cell assembly and coupon level covering specific mission requirements

#### Specific lifetime testing

- Long duration, high temperature test on bypass diode (alternate forward and reverse biasing)
- Long duration
- High temperature under illumination test on solar cell assemblies

#### Typical acceptance testing

- Resonance search from 5Hz to 2000Hz; 1 sweep, 2 oct/min; test level = 0.5g
- Sine from 5Hz to 100Hz; 2 sweep up and down; 2 oct/min; test level from 5Hz to 21Hz; 11 mm (0 peak); from 21Hz to 60Hz, 20g, from 60Hz to 100Hz 6g
- Random: from 20 to 2000 Hz; 20Hz 0.013 g<sup>2</sup>/Hz; from 50Hz to 8000Hz 0,08 g<sup>2</sup>/Hz; 2000Hz 0.013 g<sup>2</sup>/Hz; global RMS = 10 grms
- Shock tests
  - 100Hz (20g)
  - 1500Hz (2000g)
  - 10,000Hz (2000g)
- Thermal vacuum cycling (extreme operational temperatures +/- 10 °C)

