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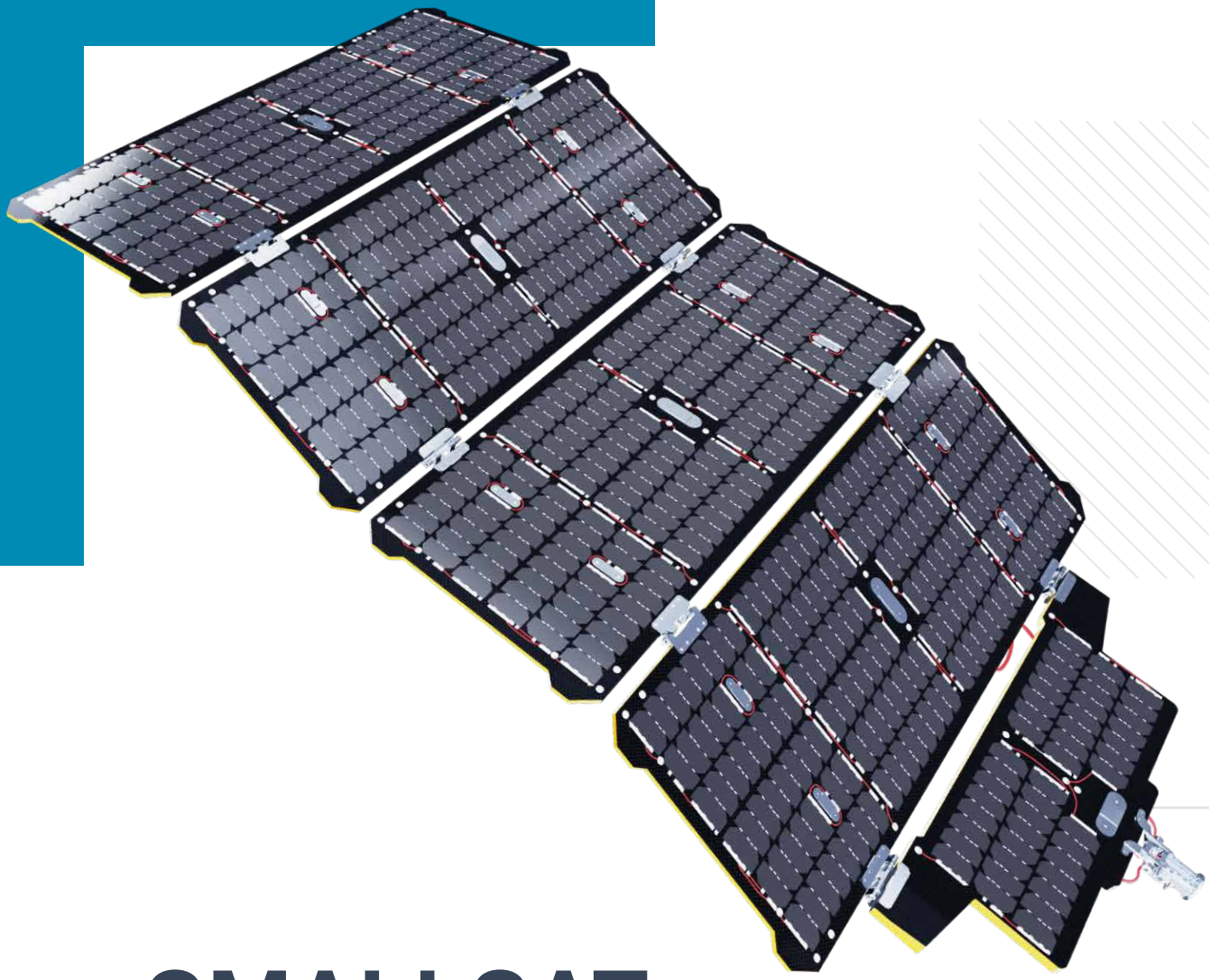


SMALLSAT POWER SOLUTIONS

High-quality solar panels and power subsystems for Small Satellites.

Products overview for Small Satellites

Deployable and body mounted customized and standard solar arrays, PCDU, SADA, MLI blankets and qualification services.

technology

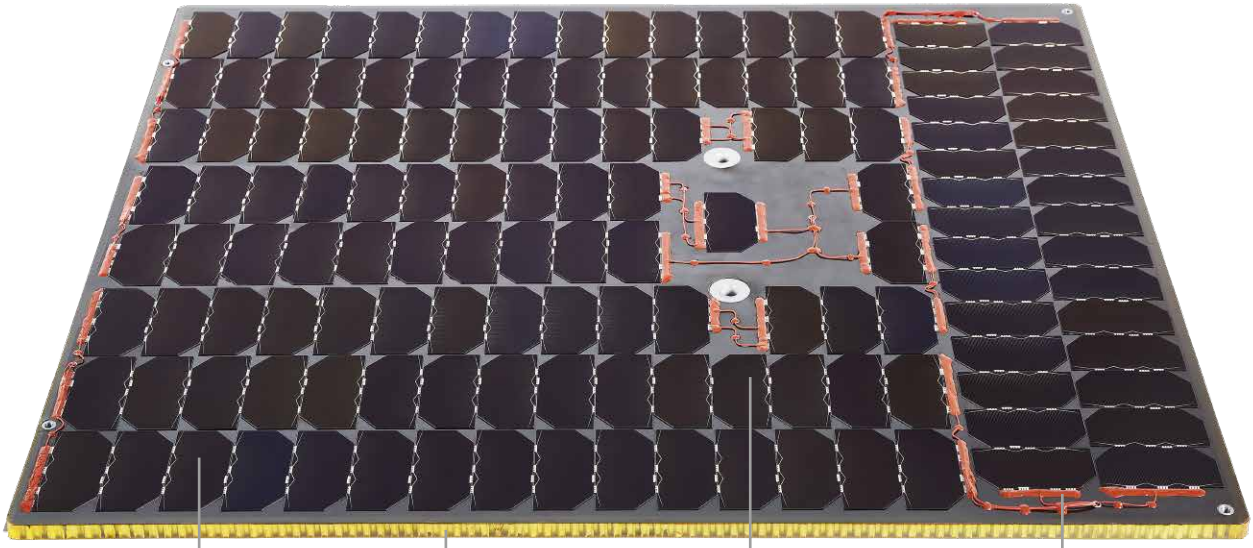
CONTENTS

Solar Panels for SmallSats

• Body mounted solutions

We have a wide experience manufacturing and developing body mounted solar array solutions for small satellites.

Our solar arrays are customized solutions in order to meet the power requirements from our client's missions and provide the maximum efficiency with the challenge of meeting the highest space industry standards.



High quality solar cells
Multi junction assembly with 30% efficiency class

Space qualified substrates
Customized substrate with different configurations

Laydown design
Design of the most efficient configuration to provide the maximum power

ATOX protection
Soldered or welded connections protected by an ultra-low outgassing polymer

A long heritage of more than 300 satellites flying with our technology and working with the top worldwide companies of the aerospace industry, support our experience supplying high-quality solar array solutions.

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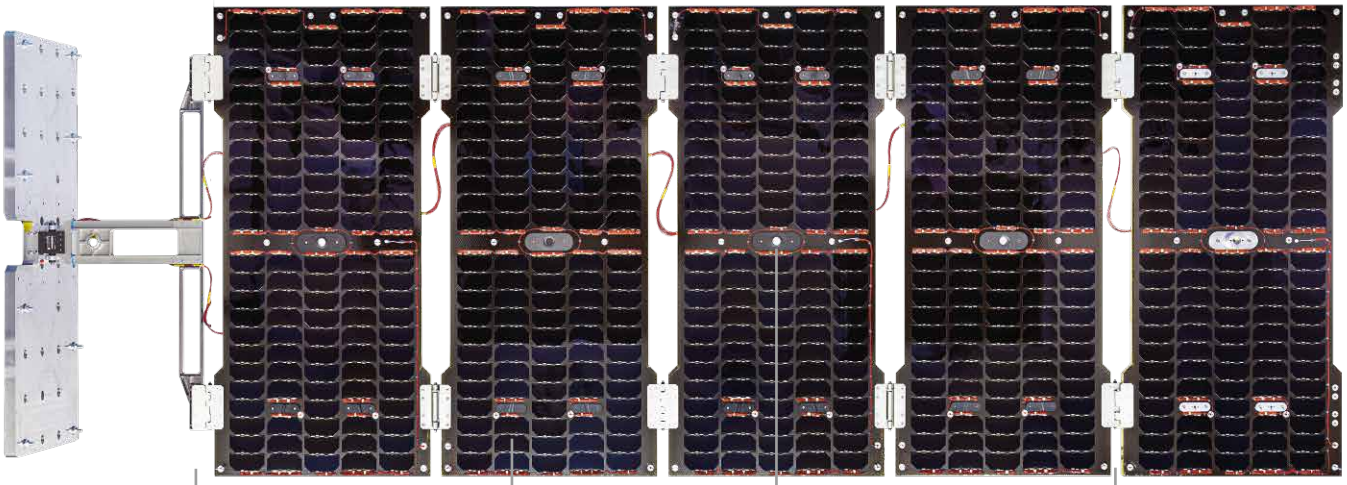
• Deployable solutions

When more power is required, we design and manufacture different deployable configurations providing a complete solution to our customers, including mechanical parts, EEE components and integrating deployment systems and sensors.

Our deployable solar panels also guarantee the highest levels of reliability thanks to a complete test and qualification campaign carried out before delivering the manufactured hardware to our customers.



Yoke design
Customized yoke design and mechanical parts

Snubbers integration
Improvement of the stiffness of the solar array in stowed position

Deployment mechanisms
HDRM integration in deployable configurations

Hinges design
Customized hinges and latching systems design with different deployable angles

Key features

- Customized laydown design according to mission requirements
- High and low temperature resistant materials
- TRL9 solar cells up to 30% efficiency
- Body mounted and deployable configurations under request
- Qualification and test campaign under request

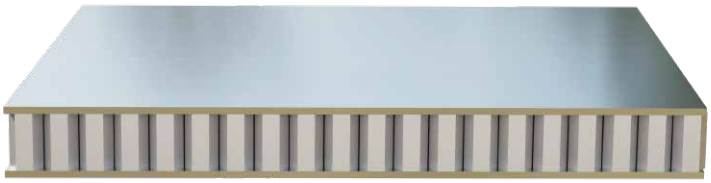
All components and processes are qualified for space environment

Solar Panel Substrates

• Materials and technologies

Our solar arrays are manufactured on different substrates in order to provide the most efficient solution in terms of mass, strength and thermal efficiency.

CFRP skins with honeycomb core
Carbon fiber reinforced polymers skins with aluminium honeycomb core



Aluminium skins with honeycomb core
Sandwich-structured aluminium honeycomb with aluminium skins

Monolithic CFRP substrate
Reinforced composite to ensure more flexibility

PCB polyimide based substrate
High resistance to temperature gradients film with a high dielectric strength

500+

Manufactured substrates

TECHNOLOGY READINESS LEVEL ** TRL9 **

100+

Satellites flying with our sub-strates

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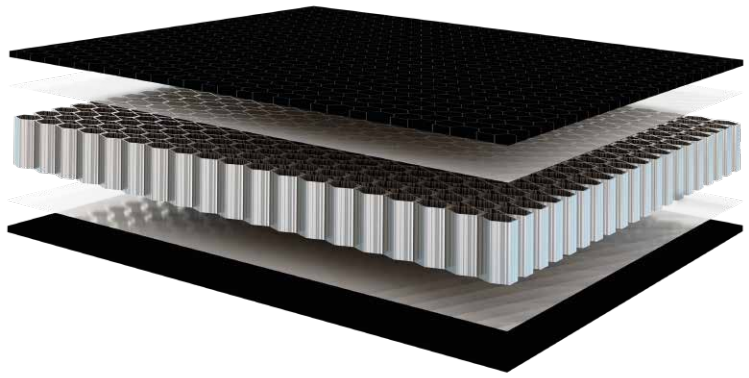
• SmallSat substrates

The main component in which composite materials are used in DHV Technology's production chain is substrates for solar panels.

A substrate is defined as any support with a structural component on which the PVA (PhotoVoltaics Assembly) is placed. In general, sandwich substrates (in 90% of cases) or monolithic carbon substrates are used.

Therefore, the most common solutions used in DHV substrates are as follows.

CFRP SKINS WITH HONEYCOMB CORE



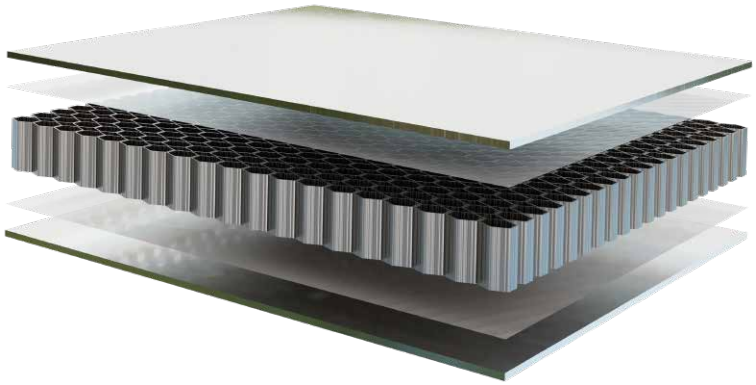
Carbon fiber prepreg facesheet
Film adhesive
Aluminium honeycomb core
Film adhesive
Carbon fiber prepreg facesheet

+

Hot-Bonded and/or Cold-Bonded inserts

Honeycomb substrates with CFRP (Carbon fiber reinforced polymer) skins provide the highest stiffness/mass ratio for our solar array solutions.

ALUMINIUM SKINS WITH HONEYCOMB CORE



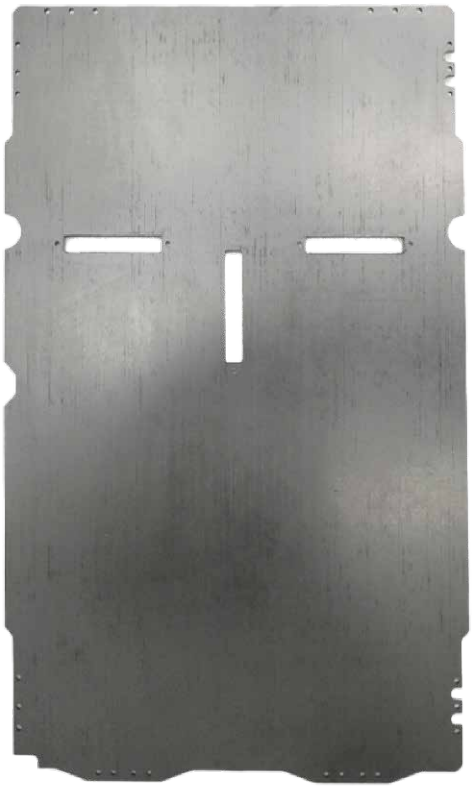
Aluminium sheet
Film adhesive
Aluminium honeycomb core
Film adhesive
Aluminium sheet

+

Hot-Bonded and/or Cold-Bonded inserts

Honeycomb substrates with aluminum skins provide high stiffness/mass ratio with additional radiation shielding based on our customer's needs.

MONOLITHIC CFRP SUBSTRATE



At DHV, we offer monolithic substrates as one of our manufacturing options.

These substrates are made from a single material layer, either carbon fiber, providing superior thermal and electrical conductivity, along with enhanced structural integrity.

They are particularly well-suited for applications where thermal management and a simplified manufacturing process are priorities.

One of the main characteristics of monolithic CFRP substrates is their highest stiffness/mass ratio when low available envelope.

Key features

All our substrates are customizable to modify certain features to align with different mission and platform requirements.

- Structure customizations: Dimensions, geometry, cut-outs, skins, cores, insulation layers, etc
- Reinforcement customizations: Doublers, structural reinforcements, inserts, etc
- Honeycomb core structures
- CFRP (Carbon fiber reinforced polymer) and aluminium skins
- ATOX protection under request
- Low outgassing properties

All components and processes are qualified for space environment

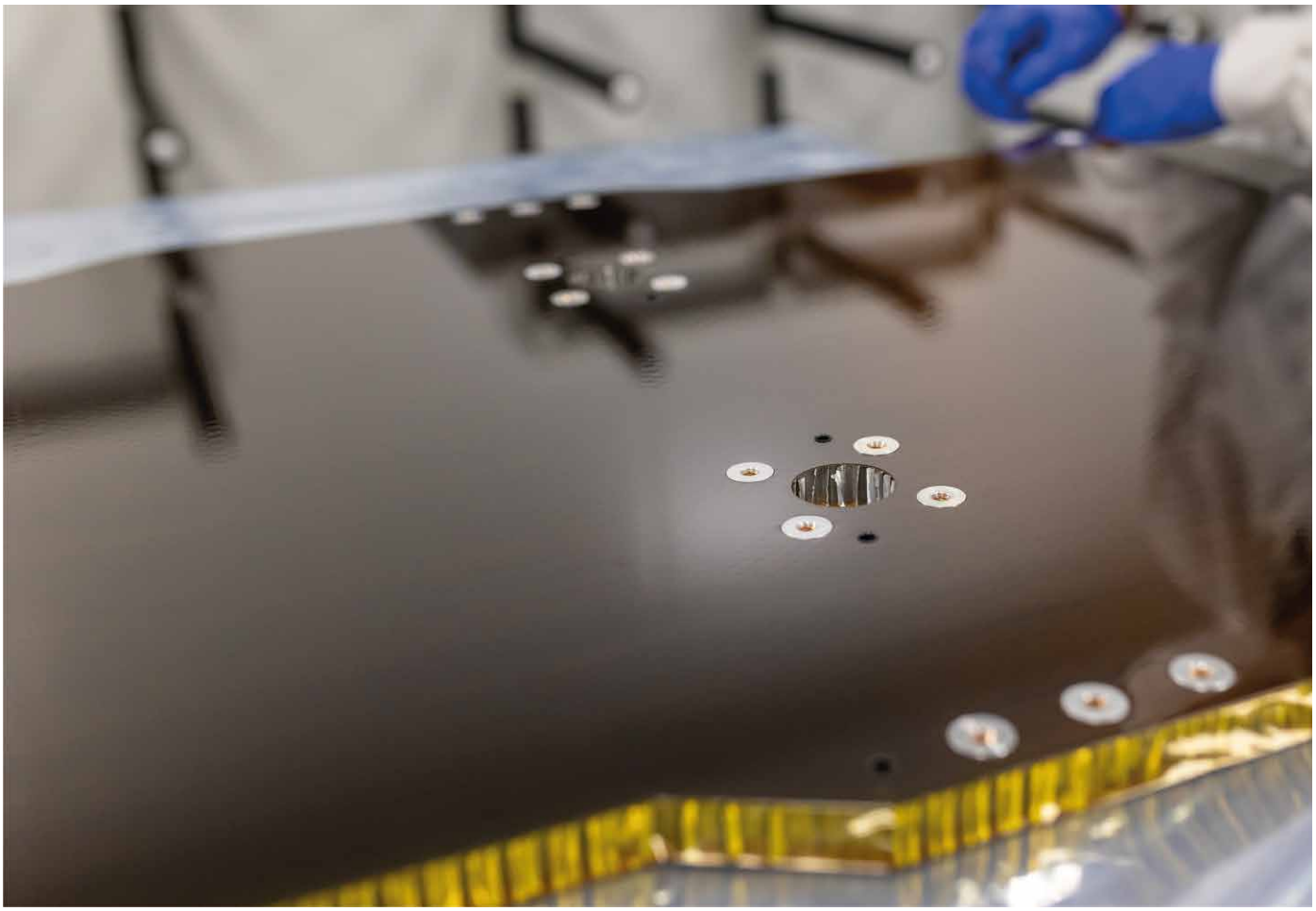
• Insulation tape

At DHV Technology, we offer our customers the option to add insulation tapes to solar panel solutions for their projects.

Kapton (polyimide film) is the most common solution that we offer due to its expectional thermal stability and electrical insulation characteristics.

The main characteristics of Kapton are detailed below:

- **Thermally stable:** Withstands extreme temperatures
- **Strong:** Exhibits excellent mechanical strength
- **Lightweight:** Helps reducing overall satellite weight
- **Insulating:** Provides outstanding electrical insulation
- **Chemically resistant:** Durable against radiation and harsh environmental conditions
- **Flexible:** Easy to integrate into all designs
- **Low outgassing:** Minimizes contamination in sensitive environments



Standard Solutions

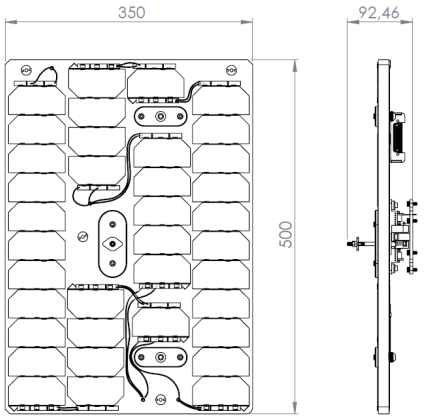
• COTS Solar Arrays

Our portfolio of commercial off-the-shelf solar arrays for **Smallsats** are ready-to-market qualified solutions available for our customers to avoid the engineering related costs and reducing project timeline.

DHV standard solutions range from solar panels with over 40W of power to our largest standard solution, which is capable of delivering over 1260W. Our portfolio includes multiple models, offering both deployable and body-mounted solutions.

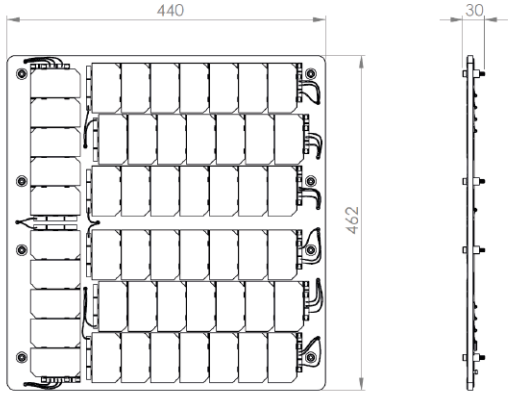
Based on the specific needs and requirements of each mission, we tailor our approach to provide the most efficient and reliable solar array solution for our customers.

DSA-042W



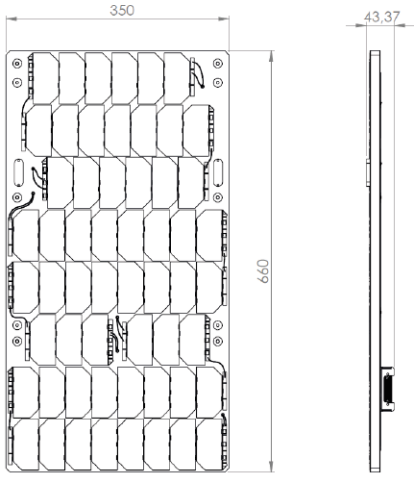
Total Power (BOL): **> 42W** (16s2p + 5s1p)
Panel type: **Simple Deployable Wing**

BMSA-050W



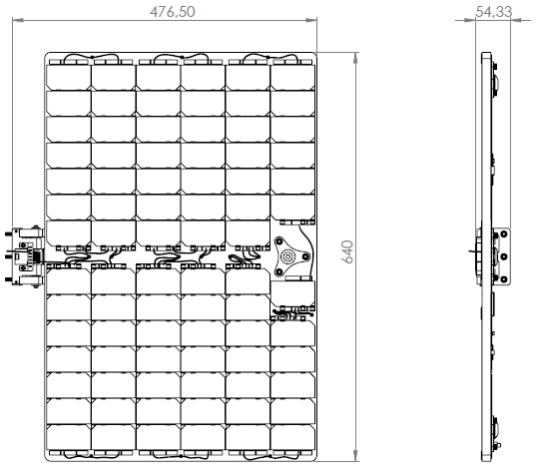
Total Power (BOL): **> 50W** (7s6p + 5s2p)
Panel type: **Body Mounted**

BMSA-066W



Total Power (BOL): **> 66W** (17s3p + 7s1p)
Panel type: **Body Mounted**

DSA-079W



Total Power (BOL): **> 79W** (7s11p + 5s1p)
Panel type: **Simple Deployable Wing**

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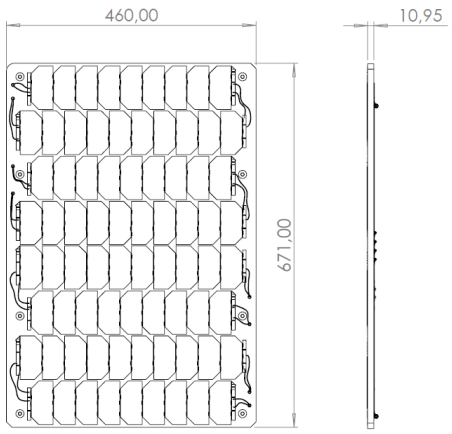
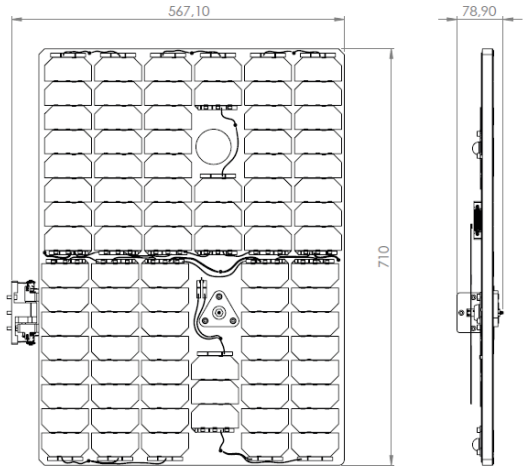
BMSA-087W



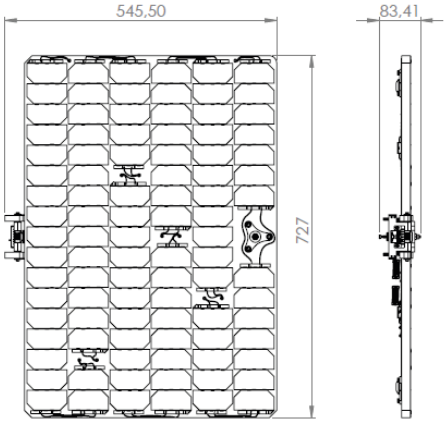
Total Power (BOL): **> 87W** (19s4p)
Panel type: **Body Mounted**

DSA-095W



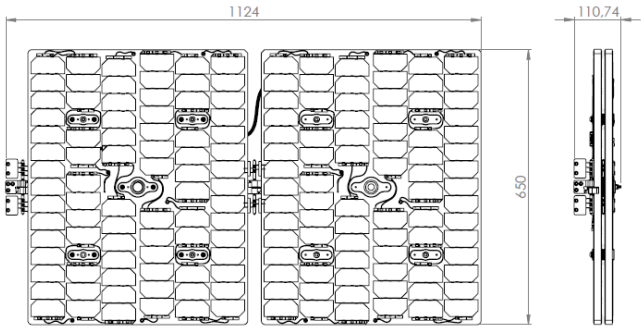
Total Power (BOL): **> 95W** (8s11p)
Panel type: **Simple Deployable Wing**

DSA-108W



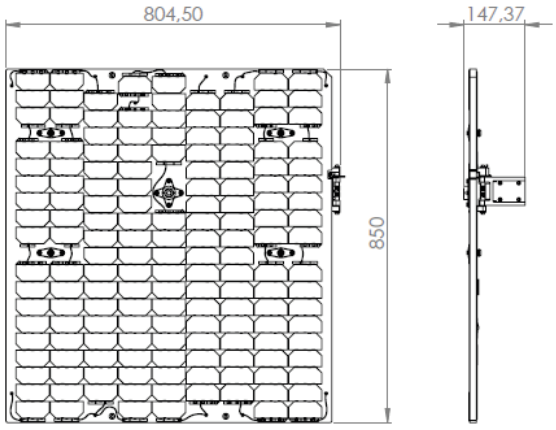
Total Power (BOL): **> 108W** (19s5p)
Panel type: **Simple Deployable Wing**

DSA-183W



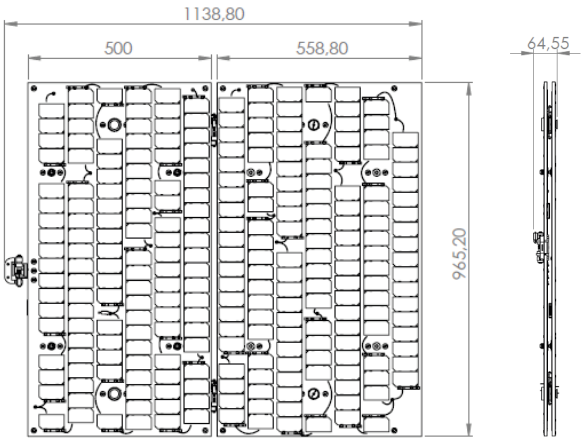
Total Power (BOL): **> 183W** (20s8p)
Panel type: **Double Deployable Wing**

DSA-185W



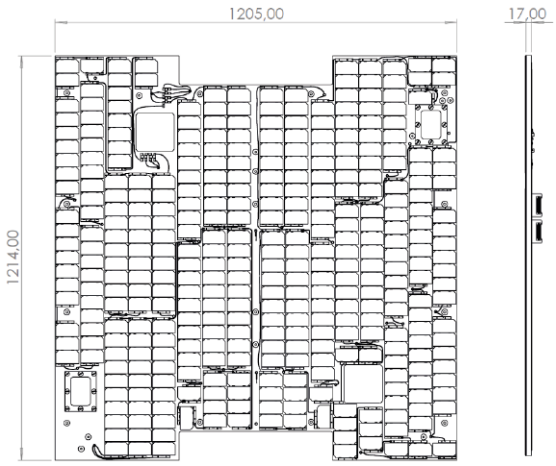
Total Power (BOL): **> 185W** (18s9p)
Panel type: **Simple Deployable Wing**

DSA-255W



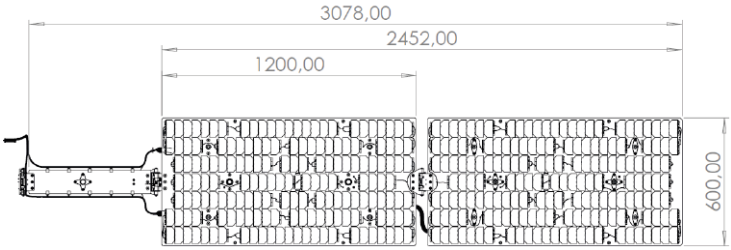
Total Power (BOL): **> 255W** (17s15p)
Panel type: **Double Deployable Wing**

BMSA-355W



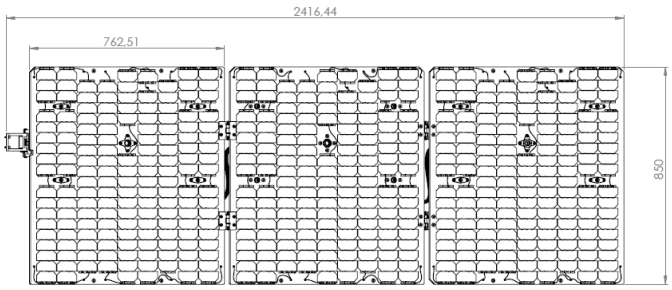
Total Power (BOL): **> 355W** (10s18p+10s19p)
Panel type: **Body Mounted**

DSA-373W



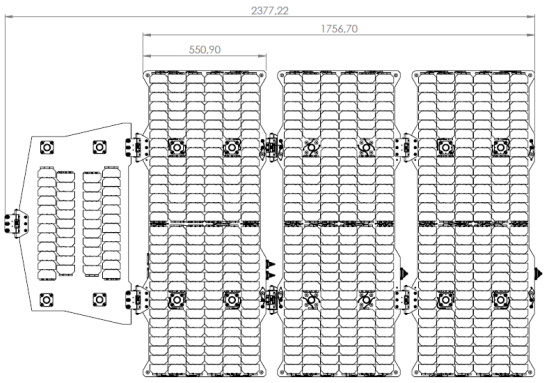
Total Power (BOL): **> 373W** (11s30p)
Panel type: **Double Deployable Wing**

DSA-555W



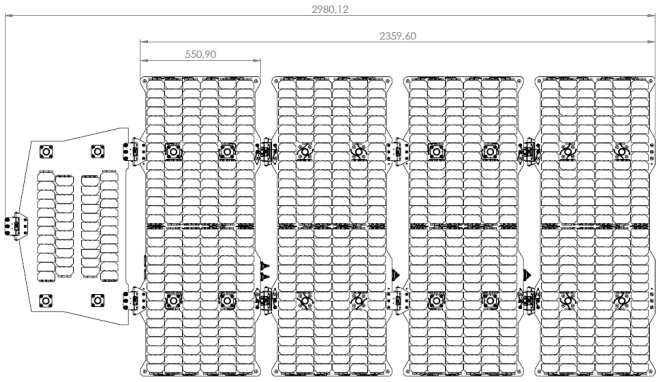
Total Power (BOL): **> 555W** (18s27p)
Panel type: **Triple Deployable Wing**

DSA-676W



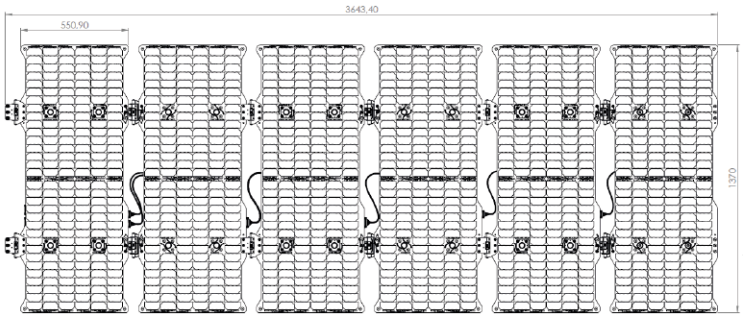
Total Power (BOL): **> 676W** (23s26p)
Panel type: **Quadruple Deployable Wing**

DSA-889W



Total Power (BOL): **> 889W** (23s34p)
Panel type: **Quintuple Deployable Wing**

DSA-1268W



Total Power (BOL): **> 1268W** (23s48p)
Panel type: **Sextuple Deployable Wing**

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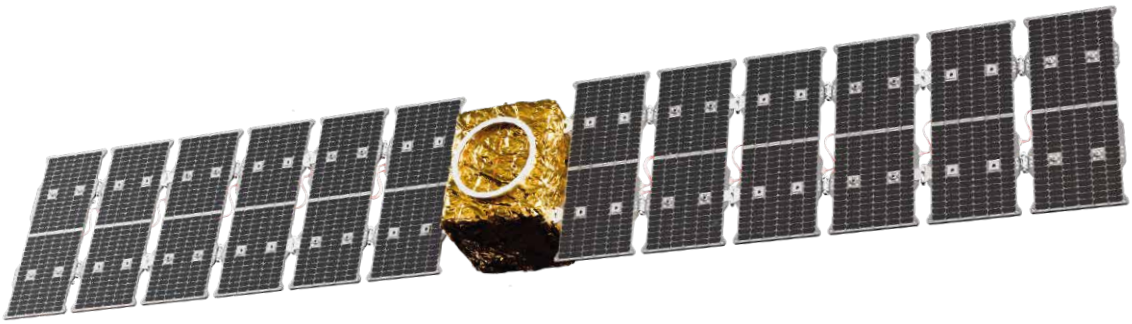
Technical features

This section details the general conditions used to calculate the total power output for the standard models presented in previous pages.

Additionally, this power output is associated with general loss factors that are always applied to the panels for SmallSat solutions. Furthermore, depending on the final mission, some additional electrical losses may also be considered.



GENERAL CONDITIONS	LOSS FACTORS
■ 1AU mean Solar Flux (1367 W/m²) ■ AM0 solar spectrum ■ 28ºC ■ BOL	■ Blocking diode: 0,8V ■ Current cell mismatch: 2,12% ■ Calibration error: 3% ■ Pointing error: 0,14%

Key features

- Standard solutions without NRE costs
- Reduced costs and lead time
- Qualified solutions TRL8 ~ TRL9
- CFRP substrates with honeycomb core
- HDRM integration
- ATOX protection
- Loss factors considered
- General conditions applied for the power output

Download our full COTS brochure

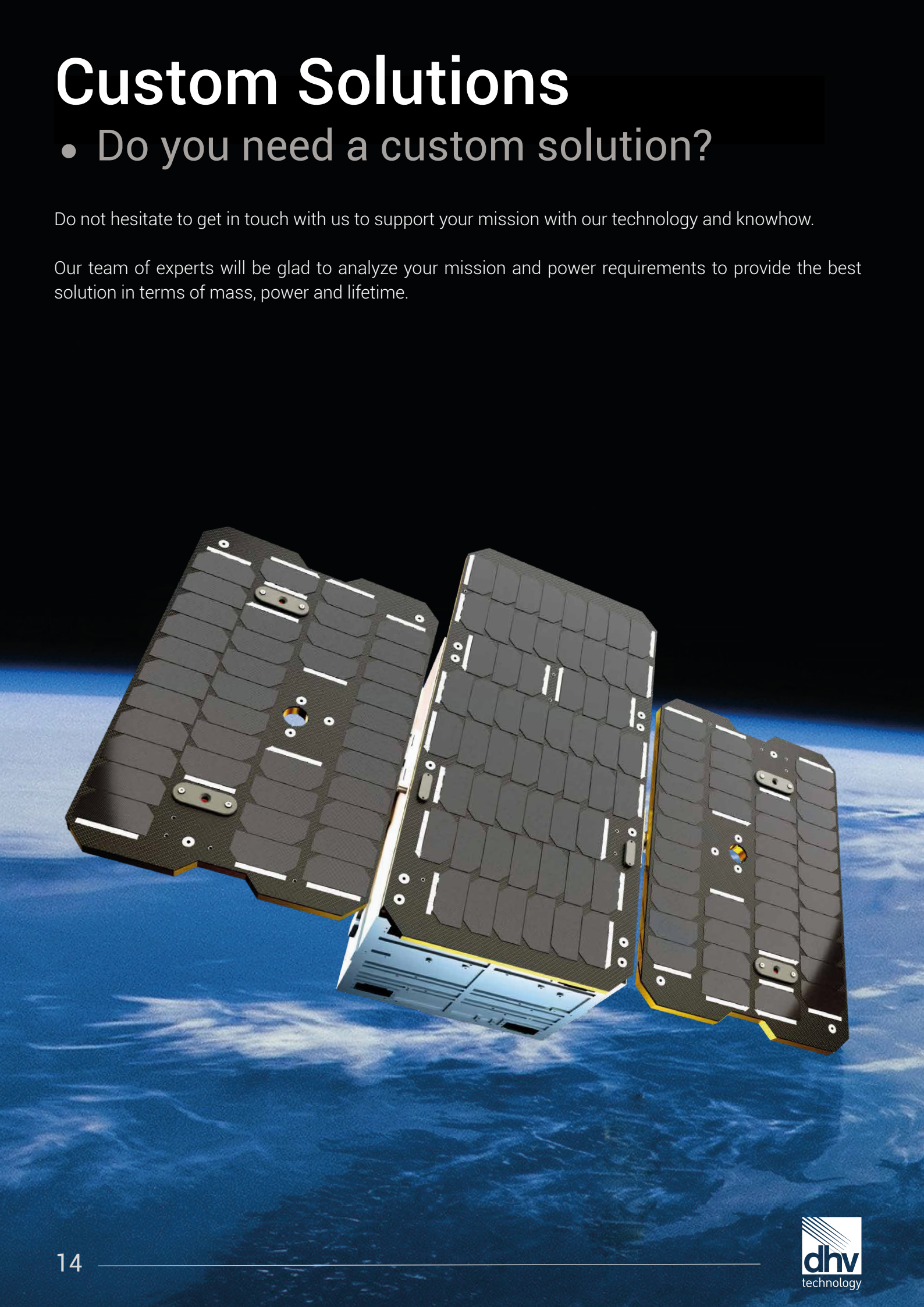
All components and processes are qualified for space environment

Custom Solutions

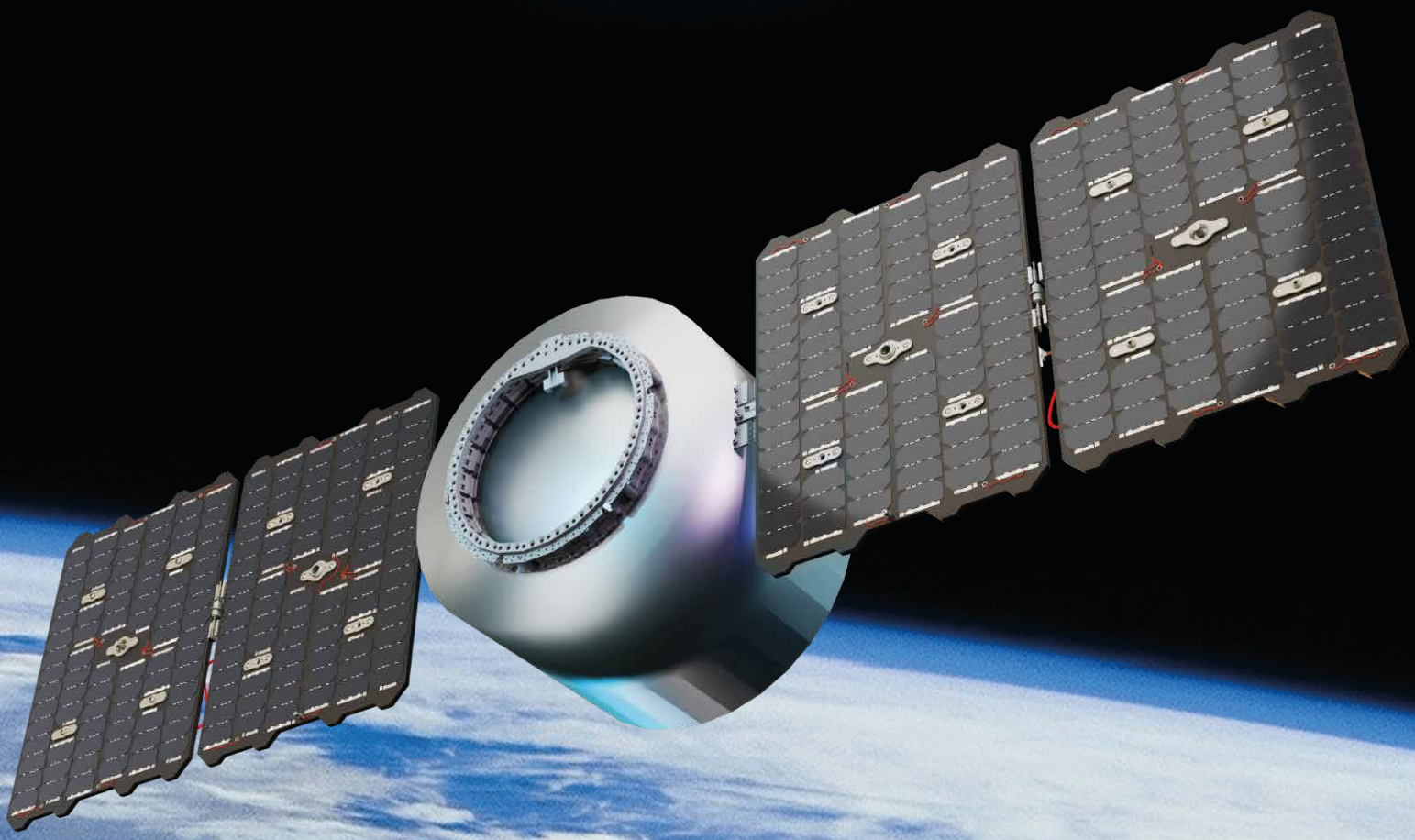
• Do you need a custom solution?

Do not hesitate to get in touch with us to support your mission with our technology and knowhow.

Our team of experts will be glad to analyze your mission and power requirements to provide the best solution in terms of mass, power and lifetime.



We are open to hearing from your project and mission requirements



More information

Power Conditioning Distribution Unit

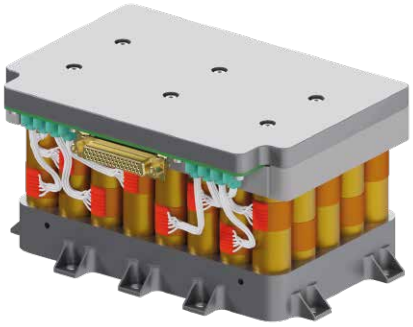
• PCDU - Power supply and storage

The Power Conditioning and Distribution System PCDU has been designed to be integrated into different SmallSats systems.

This PCDU is developed to provide an efficient power supply and control for any type of mission and it is composed by a power management module and a battery module.

The Power Module of the PCDU is the interface that manages the power of the solar panel inputs, the battery charge and the HDRM control for solar array deployment.

This module can work with up to 900W.



The Battery Module of the PCDU is responsible for energy storage and battery thermal control with a 482 Wh capacity.

* Images for commercial purposes only

Key features

- Maximum Power Point Tracking (MPPT)
- HDRM control for solar array deployment
- Li-ion cells with heaters
- 482 Wh capacity with integrated battery cells balancing
- Maximum 2 battery modules per PCDU ~ 964 Wh
- Power Module TRL8 Level
- Battery Module TRL8 Level

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Technical features

POWER MODULE

Power generation

- 8 BCR, **175W per BCR**
- Maximum input power: **1.4 KW**
- Solar arrays input voltage: **20V ~ 70V**
- BCR Efficiency at maximum load **> 90%**

Output buses

- Regulated 3.3V bus (10A max.)
- Regulated 5V bus (10A max.)
- Regulated 12V bus (10A max.)
- Unregulated battery bus (24A max.)
- 24 ~ 48 switched and selectable current limited (LCL) outputs
- 4 unswitched but current limited (LCL) outputs
- Efficiency at maximum load > 90%
- Other output voltages available under request

Power conditioning and distribution are redundant

BATTERY MODULE

Electrical parameters

- Battery cells configuration: **Li-ion 8S5P**
- Capacity [TYP]: **482 Wh**
- Capacity [MIN]: **460 Wh**
- I_{1C}: **16.25 A**
- MAX charge current: **8.1 A**
- MAX discharge current: **32 A**
- Voltage (fully charged): **33.6 V**
- Voltage (nominal): **28.8 V**
- Voltage (discharged): **24 V**

Battery management

- Li-ion cells with heater
- Battery cells protections: CID and PTC
- Capacity status and aging estimation
- Temperature control (embedded heaters)

SPECIFICATIONS FOR BOTH MODULES

Mechanical interfaces
- Power Module: 12 x M5 screws
- Battery Module: 10 x M5 screws

Mass
- Power module: 3.4 Kg ~ 6 Kg
- Battery module: 3.2 Kg

Environmental and functional tests
- Vibration
  (NASA GEVS levels, other under request)
- Thermal cycling test
  (high vacuum, -30 to +65 °C)

Manufacturing
- PCB IPC Class III
- Assembled in clean room ISO 8 class

Envelopes
- Power Module:
  198x269x88 mm ~ 198x269x143 mm
- Battery Module:
  125x185x95 mm

Telemetry and control
- TC/TM via CAN Bus
- Transmission error detection codes
- TM voltages, currents, temperatures, SoC, status registers and flags errors

Inhibits
- Three redundant kill switches
- One redundant remove before flight and ground switch

- Technical support within 24h
- Customization available under request
- 3D CAD files
- Integration with solar arrays
- EGSE (optional)

Solar Array Drive Assembly

• SADA-M - For SmallSat platforms

SADA-M is the latest developed solution from DHV Technology in charge of rotating the solar arrays to keep them optimally oriented with respect to the sun and providing a path for power transfer from the arrays to the SmallSat bus.

This device has been designed taking into account the features of the most common standard and customized platforms in the market.

SADA-M can be also customizable in order to modify some of its features to match with different mission and platform requirements.

Datasheet download

Key features

- Space-flight grade components
- Designed to rotate up +/- 175 degrees
- Solar panel position feedback
- Gimbal for one-axis concept
- Electrical interfaces : D-SUB and Micro-D connectors
- Rotation speed of 1 deg/s
- Reduced mass < 2000 g
- CAN Bus communication protocol
- Forthcoming version including slip ring for 360º free rotation

dhv technology

Technical features

GENERAL PROPERTIES

Motion range:

• +/- 175 deg (twist capsule)

Rotation speed:

• 1 deg/s

Position accuracy:

• +/- 1 deg

Solar array inertia load capability:

• 1,0 Kg*m²

In-orbit duty:

• 30000 cycles
1 cycle = +175/-175/0 = 700 deg in total

Mass:

• < 2000 g

Envelope:

• Φ 150 x 150 mm

Power consumption:

• 5 W (nominal) / 10W (peak)

Input voltage:

• From 12V to 51V

Power and signal transfer:

• **Nº of power tracks:** 40 @ 2,5A / 120V
• **Nº of signal tracks:** 10 @ 0,5A

ENVIRONMENTAL PROPERTIES

Mission life:

• 5 years

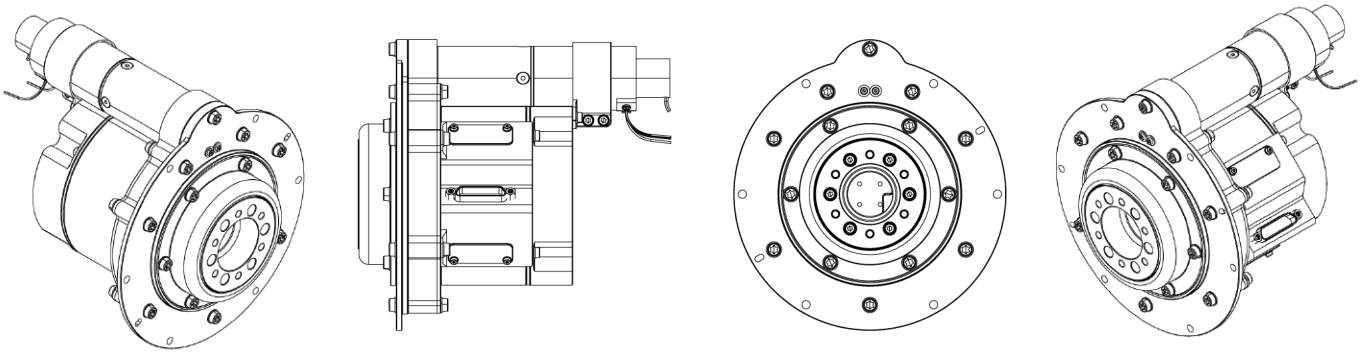
Orbit:

• LEO

Temperature ranges:

• **Operational range:** from -30ºC to +75ºC

• **Non-operational range:** from -50ºC to +85ºC



Multi-layer Insulation Blankets

• MLI Blankets - Thermal Insulation

We also manufacture and provide Multi-Layer Insulation (MLI) blankets for complex geometries, space instruments and satellites.

The MLI blanket is a thermal insulation conformed by multiple layers of optical and electrically conductive materials separated by a thin netting spacers.

MLI is a fundamental piece in the spacecraft thermal design and critical in preserving the spacecraft from the space extreme temperatures.

Our production process is adapted to our customers choosing advanced materials with an outstanding performance meeting the customer needs. All the manufacturing process are carried out in our facilities with a dedicated ISO Class 8 temperature and humidity controlled clean room.

Qualification & Testing

• Services

Before delivering the solar panels, we carry out a testing campaign to our manufactured solutions under request, in order to qualify them for the space environment.

These different tests could vary depending on the customer requirements and mission features, covering different fields such as:

- Random vibrations
- Sine vibrations
- Thermal vacuum cycling tests
- Acoustic tests
- Deployment tests
- Standard functional tests
- Sun simulator

ABOUT US

DHV Technology is a Spain based international company that designs and manufactures solar panels for space applications and other power subsystems for different platforms.

DHV Technology has been providing tailor-made solar arrays systems to different international companies at the same time the company has been developing different power subsystems implementing the most advanced technologies.

Our facilities, with a total of 3700 m², consist of:

- 1200 m² clean room
- 1000 m² offices
- 1500 m² warehouse and others

350+

Projects completed

4000+

Days in orbit

400+

Satellites flying with our solutions

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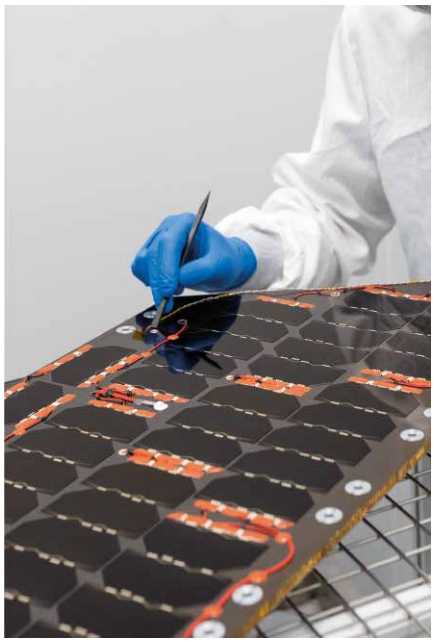

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