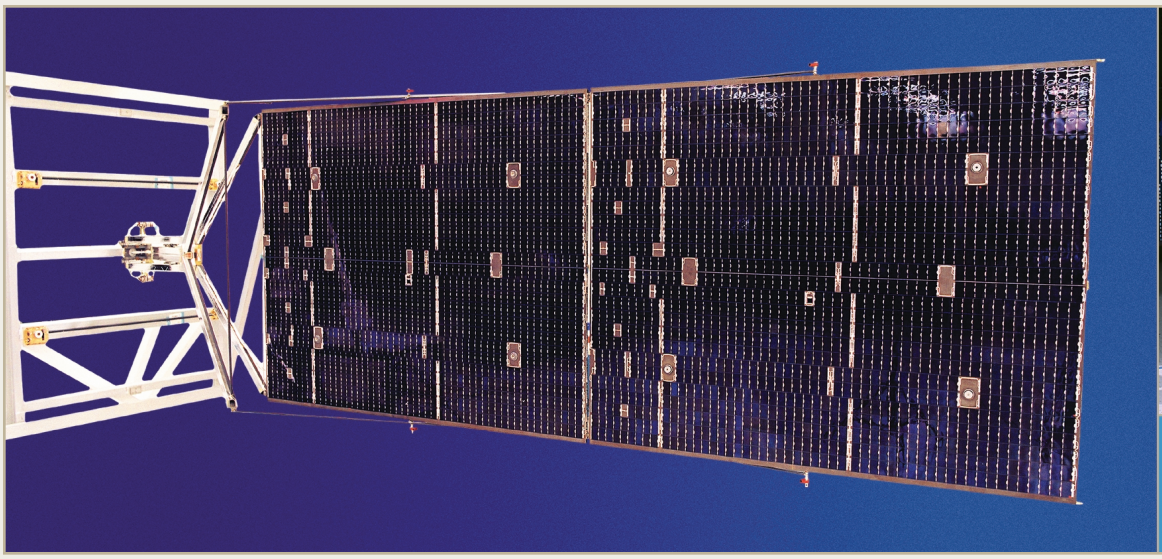
PUMA Solar Arrays

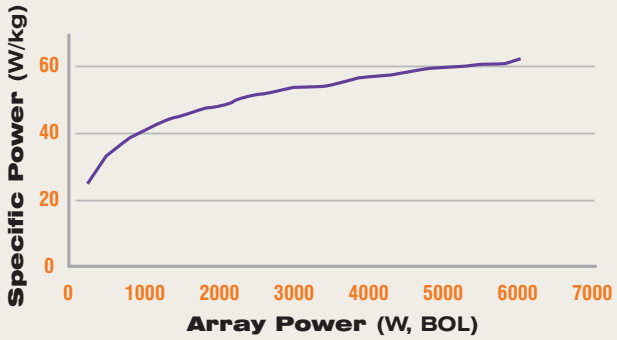
A Heritage-Technology Rigid Substrate Solar Array for Traditional Applications



Performance Features

- *GaInP/GaAs/Ge or Silicon Photovoltaics*
- *Carbon Fiber Structures*
- *Structural or Cable Synchronized Deployment with Non-Pyrotechnic Release*
- *Provides Stowed Power*
- *Long or Transverse Axis Deployment*
- *1/2 kW to 6 kW Power*
- *25 W/kg to 65 W/kg*
- *High Stiffness (0.3 Hz to 0.7 Hz)*
- *Mass Moment of Inertia (~300 kg-m^2)*

Specific Power Performance



Applications

Program	Orbit	Customer	Cell Technology
MSTI-3(4)	LEO	Spectrum Astro	GaAs/Ge
Indostar	GEO	CTA Space (Orbital)	Silicon
BSAT-2A	GEO	Orbital Sciences	Silicon
BSAT-2B	GEO	Orbital Sciences	Silicon
NSTARc	GEO	Orbital Sciences	TJ GaInP/GaAs/Ge
GPS-IIF	MEO	Boeing Space Systems	TJ GaInP/GaAs/Ge
Swift	LEO	Spectrum Astro	DJ GaInP/GaAs/Ge
Galaxy XII	GEO	Orbital Sciences	TJ GaInP/GaAs/Ge
BSAT-2C	GEO	Orbital Sciences	DJ GaInP/GaAs/Ge
PAS2	GEO	Orbital Sciences	TJ GaInP/GaAs/Ge
PAS3	GEO	Orbital Sciences	TJ GaInP/GaAs/Ge
Deep Space 1	Interplanetary	JPL/BMDO	DJ GaInP/GaAs/Ge

Application Benefits

- *Low-Risk Heritage Technology*
- *Simple, Easily Adaptable Spacecraft Interfaces*
- *Low Non-Recurring Engineering*
- *Flight Heritage Components and Processes*
- *11-16 Month Delivery Time*
- *Streamlined Spacecraft Integration*

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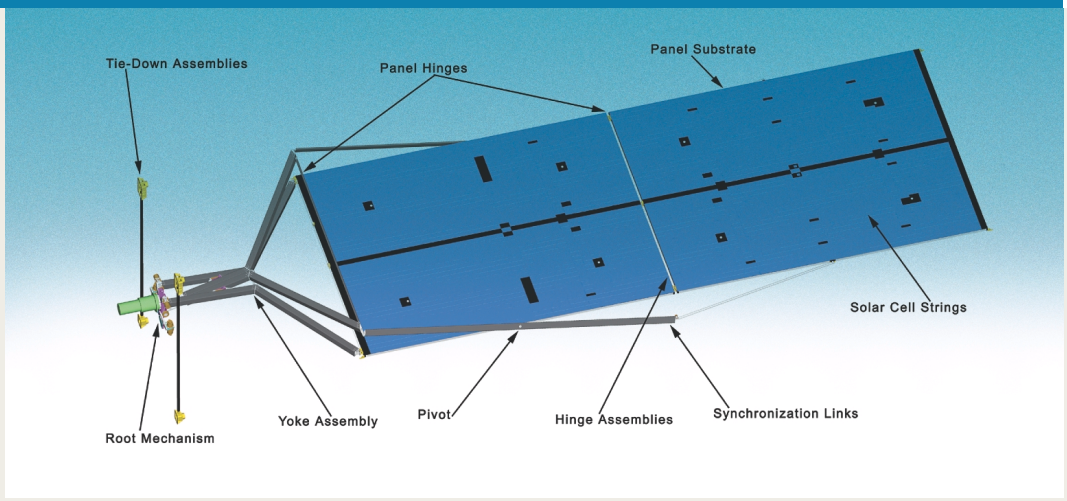
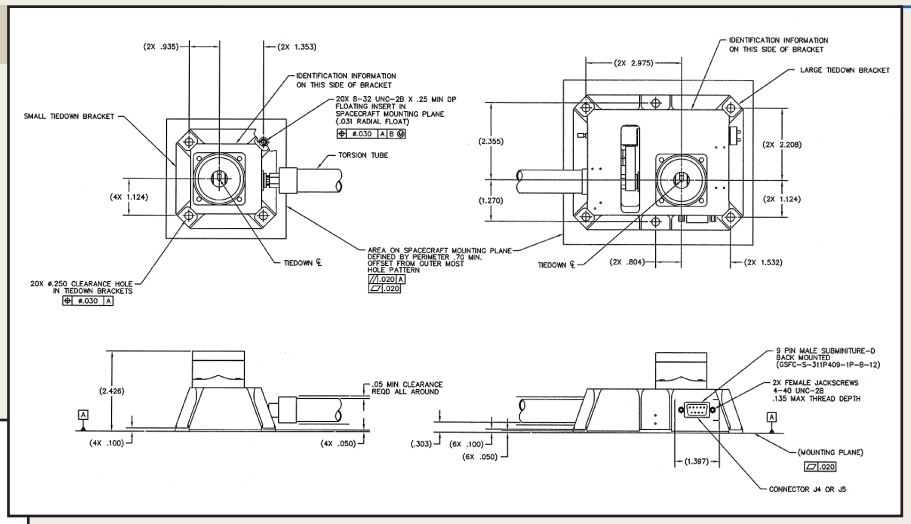


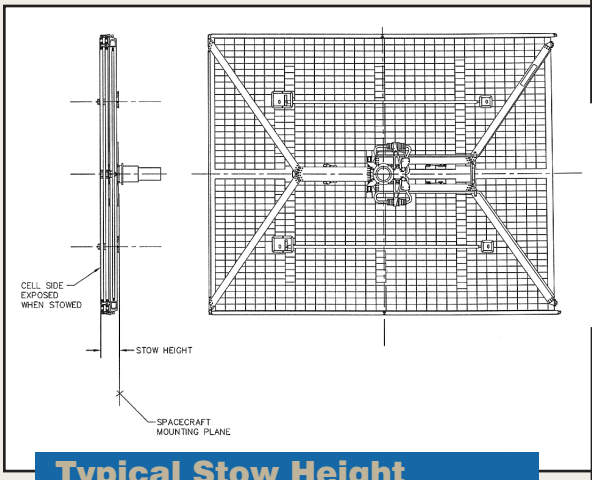
Typical Interfaces



Launch Restraint Assembly • Two Locations per Wing

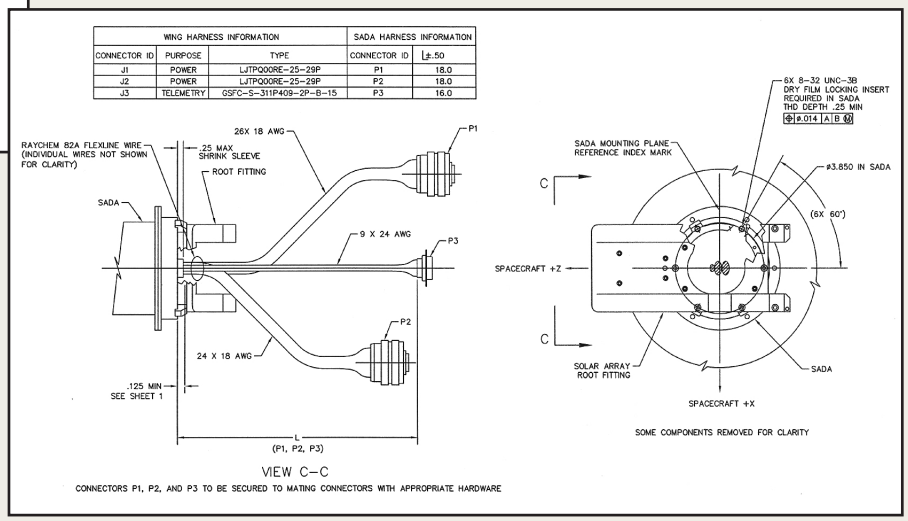
Wing Plan and Side Views

Outline Dimensions are Application Specific



Typical Stow Height

Configuration	Max Dimension (Inches)
1 Panel	3.60
2 Panels	4.90
3 Panels	6.20
4 Panels	7.20



SADA Mechanical and Electrical • Separate Power and Signal Interfaces

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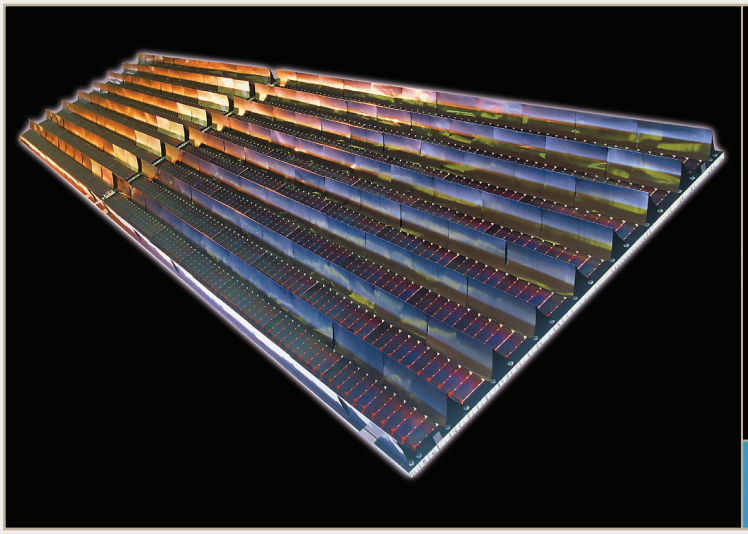
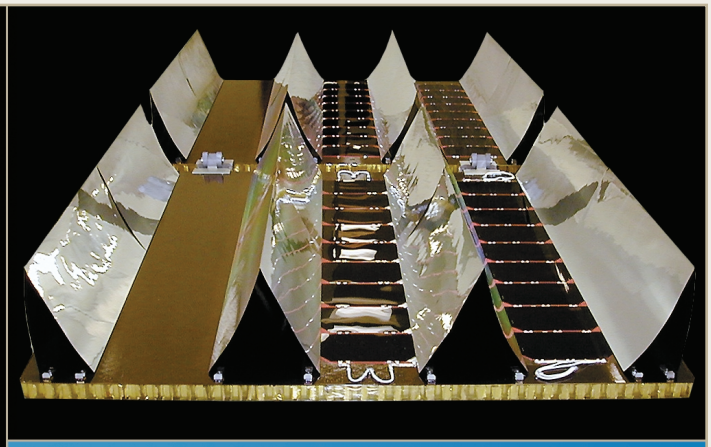
CellSaver

Solar Concentrator Technology

A Cost-Effective Advanced Array Technology to Maximize Delivered Value





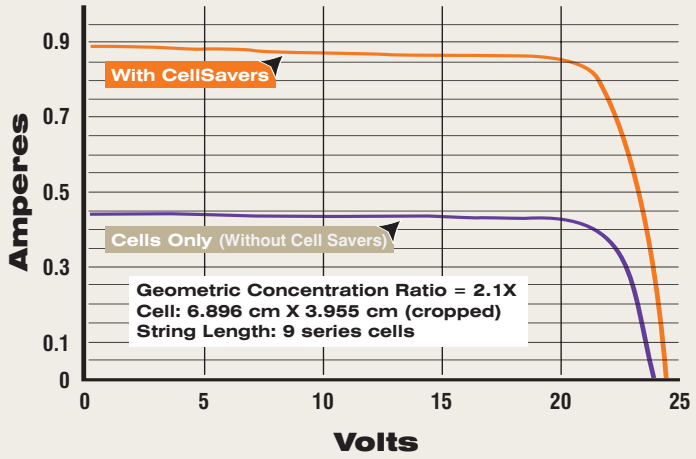
Performance Features

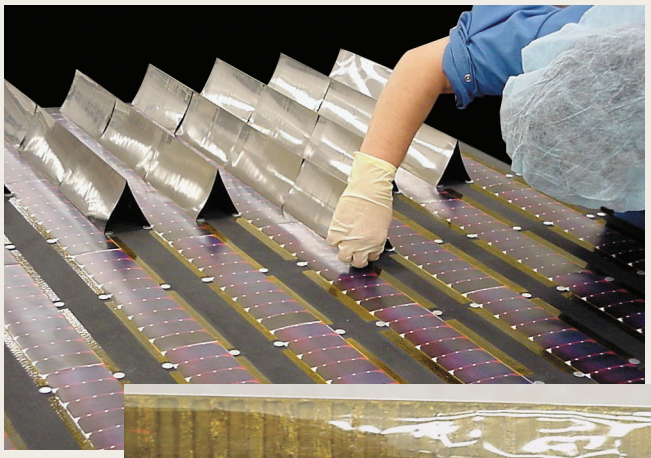
- *~2X Reflective On-Panel Concentrator*
- *One-piece All-metal Construction Redundantly Grounded to Panel*
- *Low Temperature Operation (75°C in GEO)*
- *Wide Solar Acceptance Angle ($\alpha \pm 12°$, $\beta \pm 24°$)*
- *Array Mass Reduction (~2%)*
- *Standard Large Area 3J Cells, Laydown and Interconnects*
- *Retrofits onto Existing Qualified Platforms*

Applications Benefits

- *~25% Cost Savings at Array Level*
- *Low Risk Implementation*
- *Simple Self Deployment as Panels Open*
- *Utilize Standard ACS and Array Tracking*
- *Array-Level End-to-End Testing*
- *Maintains Heritage Qualification Basis*

CellSaver LAPSS Data with Advanced Triple Junction Cells





Stowed View

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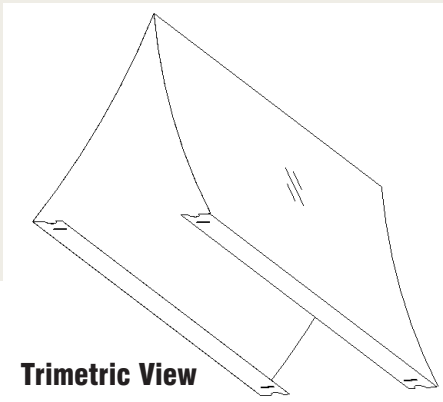
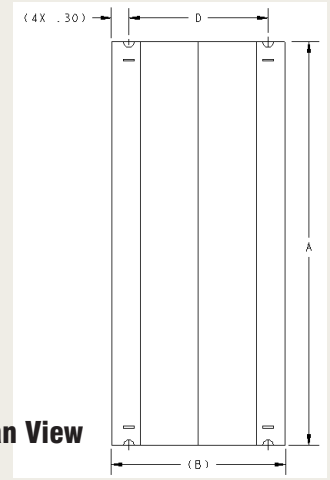
CellSaver
Solar Concentrator Technology

Typical Mechanical Interfaces

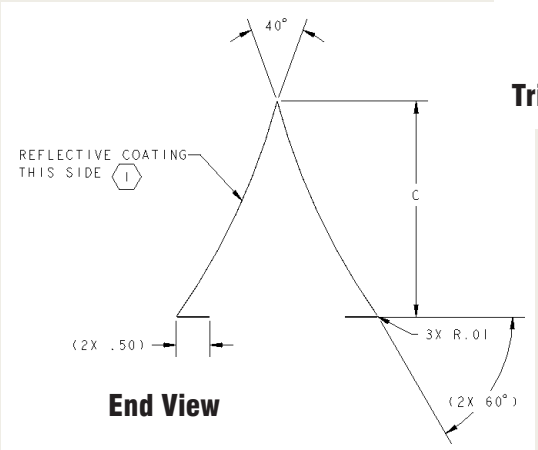
Typical Installed Fastening Tabs



Trimetric View



Plan View



End View

Interface Dimensions

Part No.	A	B	C	D
-1	6.942	3.000	3.200	2.400
-2	8.600	2.996	3.200	2.396
-3	9.260	2.996	3.200	2.396

Qualification

Test	Environment	Result
Electrical	AM0 LAPSS Test	Pass - >95% Efficiency
Off-Angle Performance	AM0 LAPSS Test	Cosine Fall-Off out to 12°(α) & 24°(β)
Random Vibration	52, 45 & 87 g-rms (x, y & z Respectively)	Pass - No shape or power impacts
GEO Thermal Cycles	-175°C to +120°C, 2,000 Cycles	Pass - < 1% Power Loss
LEO Thermal Vacuum Cycles	-115°C to +135°C, $1x10^{-5}$ Torr, 12 Cycles	Pass - No Measurable Power Loss
LEO Thermal Cycles	-100° C to +120° C, 80,000 Cycles	In Process - Pass Through 4000 Cycles
Long Term Stowage	11 mm Gap for 3 Years	In-Process - Pass Through 4 Months
Minimum Panel Gap	5 mm Gap for 1 Minute	Pass - No shape or power impacts
Deployment Cycles	50 Stow and Deploy Cycles	Pass - No shape or power impacts
Humidity	90% RH at 22°C, 60 Days	Pass - < 1% Power Loss
UV Radiation	10,000 Equivalent Sun Hours	In Process - Pass Through 1300 ESH
Electron Radiation	15 Year GEO Exposure	In Process - Pass Through 3 Years
Proton Radiation	15 Year GEO Exposure	In Process - Pass Through 3 Years

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