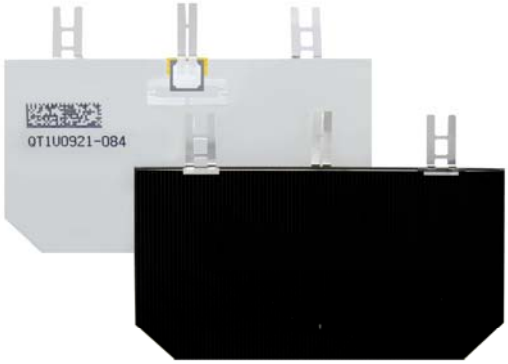
SPECTROLAB

A **BOEING** COMPANY

28.3% Ultra Triple Junction (UTJ) Solar Cells



Cells shown with interconnects, coverglass, and bypass diode

Features

- Small and large cell sizes offered for optimum packing factor and cost competitiveness
- All sizes qualified for LEO and GEO missions
- Discrete Si bypass diode protection
- Performance for cells <32 cm^2 is 28.3% efficiency (min. average @ max power, 28°C, AM0)
- Performance for cells >50 cm^2 is 27.7% efficiency (min. average @ max power, 28°C, AM0)
- Available as CIC assembly (Cell-Interconnect-Coverglass with diode) for ease of integration or delivered on completed solar panels (see Panel Data Sheet)

Product Description

Substrate	Germanium
Solar Cell Structure	$GaInP_2/GaAs/Ge$
Method	Metal Organic Vapor Phase Epitaxy
Device Design	Monolithic, two terminal triple junction. n/p $GaInP_2$, GaAs, and Ge solar cells interconnected with two tunnel junctions
Standard Sizes	26.62cm^2 and 59.65cm^2 are most cost effective and common standard sizes; other sizes available
Assembly Method	Welded
CIC Assembly	Coverglass thickness range from 3 mils to 30 mils with various coatings. Interconnects available with either out-of-plane or in-plane stress relief

Key Qualification Results

Low Earth Orbit (LEO)	66,060 cycles
Geostationary Orbit (GEO)	15,550 cycles
Multiple Interplanetary Missions: Mars, Jupiter, Asteroid	
ESD Survivability Tested to ISO Standard	

Heritage

- More than 2.6 million multi-junction cells delivered
- More than 820 kW of multi-junction arrays ***on orbit***
- Large area cell (59.65cm^2) delivered on solar panels for 25 satellites (LEO constellation)
- 1 MW annual capacity - cells and panels

Intellectual Property

This product is protected by Spectrolab's portfolio of patents including the following:

- 6,150,603
- 6,255,580
- 6,380,601
- 7,119,271
- 7,126,052

Specifications Subject to Change Without Notice

ISO9001:2000 REGISTERED

ENVIRONMENTAL MANAGEMENT SYSTEM CERTIFIED BY DNV ISO 14001

AS9100 REGISTERED

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28.3% Ultra Triple Junction (UTJ) Solar Cells

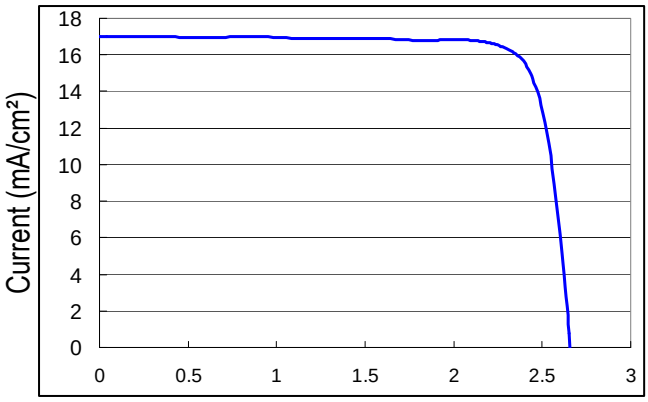
Typical Electrical Parameters

(AM0 (135.3 mW/cm²) 28°C, Bare Cell)

Parameters	*< 32 cm²*	*> 50 cm²*
Jsc	17.05 mA/cm²	17.05 mA/cm²
Jmp	16.30 mA/cm²	16.30 mA/cm²
Jload $_{min\ avg}$	16.40 mA/cm²	16.40 mA/cm²
Voc	2.660 V	2.660 V
Vmp	2.350 V	2.300 V
Vload	2.310 V	2.270 V
Cff	0.85	0.83
Effload	28.0%	27.5%
Effmp	28.3%	27.6%

Typical IV Characteristic

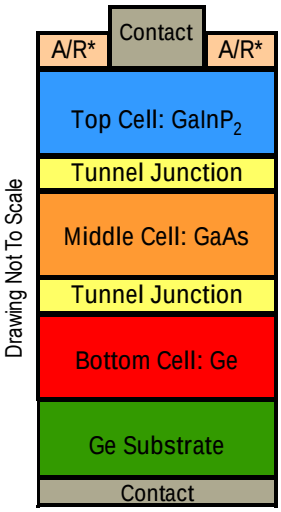
AM0 (135.3 mW/cm²) 28°C, Bare Cell



Radiation Degradation

(Fluence 1MeV Electrons/cm²)

Parameters	1x10^{14}	5x10^{14}	1x10^{15}
Imp/Imp$_0$	0.99	0.98	0.96
Vmp/Vmp$_0$	0.94	0.91	0.89
Pmp/Pmp$_0$	0.93	0.89	0.86



*A/R: Anti-Reflective Coating

Thermal Properties

Solar Absorptance= 0.92 (5 mil CMG/AR, 0.90 for bare cells)

Emittance (Normal)= 0.85 (Ceria Doped Microsheet)

Weight

84 mg/ cm² (Bare) @ 140 µm (5.5 mil) Ge wafer thickness

Temperature Coefficients *(15°C - 80°C)*

(Fluence 1MeV Electrons/cm²)

Parameters	BOL	5x10^{14}	1x10^{15}
Jmp (µA/cm²/°C)	1.2	5.3	6.9
Jsc (µA/cm²/°C)	5.3	6.5	6.9
Vmp (mV/°C)	-6.5	-6.7	-6.8
Voc (mV/°C)	-5.9	-6.3	-6.5

The information contained on this sheet is for reference only. Specifications subject to change without notice.
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