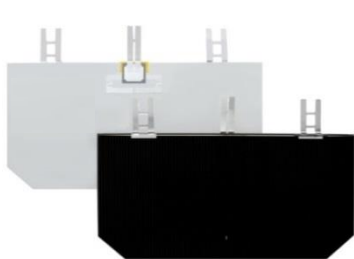


## 28.3% Ultra Triple Junction (UTJ)



2 Per (26.6 cm<sup>2</sup>)



LEONE (59.6 cm<sup>2</sup>)

### High Efficiency Space Photovoltaics

#### Product 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<sup>2</sup> is 28.4% efficiency (minimum average @ max power, 28°C, AM0)
- Performance for cells >32 cm<sup>2</sup> is 27.9% efficiency (minimum 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 (please refer to Panel Data Sheet)

#### Space Heritage

- Sustained quality without a single anomaly throughout six decades of space flight heritage
- Highest competitive EOL dollar per Watt solutions
- More than 4 million multi-junction cells **delivered**
- More than 2 MW of multi-junction arrays **on orbit**
- Large area LEONE cell (59.6 cm<sup>2</sup>) delivered on solar panels for over 37 satellites (LEO constellation)
- 1 MW annual capacity - cells and panels
- On orbit performance for multi-junction solar cells validated to +1% of ground test results on average

#### Qualification

Key Qualification Results	
Low Earth Orbit (LEO)	> 75,000 cycles
Geostationary Orbit (GEO)	> 15,550 cycles
Interplanetary Missions	Mars, Jupiter, Asteroid
Testing	ESD Survivability Tested to ISO Standards
Qualification	Fully Qualified for all Mission Types

#### Product Description

Substrate	Germanium
Solar Cell Structure	GaInP <sub>2</sub> /InGaAs/Ge
Method	Metal Organic Vapor Phase Epitaxy
Device Design	Monolithic, two terminal triple junction. n/p GaInP <sub>2</sub> , InGaAs, and Ge solar cells interconnected with two tunnel junctions
Standard Sizes	26.6 cm <sup>2</sup> and 59.6 cm <sup>2</sup> 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

## Ultra Triple Junction (UTJ)

### Typical Electrical Parameters

(AM0 (135.3 mW/cm<sup>2</sup>) 28°C, Bare Cell)

Parameters	< 32 cm <sup>2</sup>	> 50 cm <sup>2</sup>
Jsc	17.14 mA/cm <sup>2</sup>	17.22 mA/cm <sup>2</sup>
Jmp	16.38 mA/cm <sup>2</sup>	16.46 mA/cm <sup>2</sup>
Jload <sub>min avg</sub>	16.48 mA/cm <sup>2</sup>	16.56 mA/cm <sup>2</sup>
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	28.1%	27.8%
Effmp	28.4%	27.9%

### Radiation Degradation

(Fluence 1MeV Electrons/cm<sup>2</sup>)

Parameters	1x10 <sup>14</sup>	5x10 <sup>14</sup>	1x10 <sup>15</sup>
Imp/Imp <sub>0</sub>	0.99	0.98	0.96
Vmp/Vmp <sub>0</sub>	0.94	0.91	0.89
Pmp/Pmp <sub>0</sub>	0.93	0.89	0.86

### Thermal Properties

Solar Absorptance	0.92 (5 mil CMG-AR, 0.90 for bare cells)
Emittance (Normal)	0.85 (Ceria Doped Microsheet)

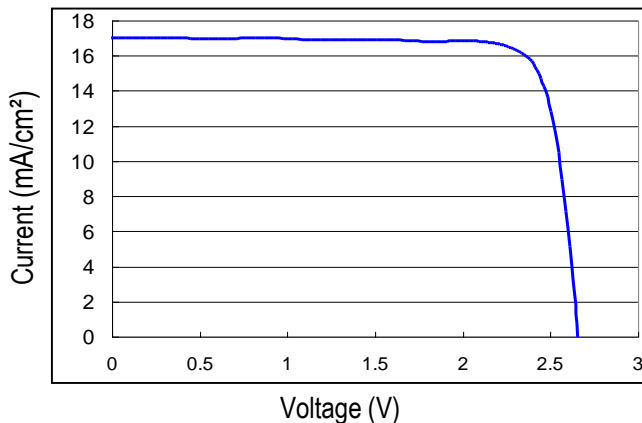
### Temperature Coefficients (15°C - 80°C)

(Fluence 1MeV Electrons/cm<sup>2</sup>)

Parameters	BOL	5x10 <sup>14</sup>	1x10 <sup>15</sup>
Jmp (μA/cm <sup>2</sup> /°C)	1.2	5.3	6.9
Jsc (μA/cm <sup>2</sup> /°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

### Typical IV Characteristic

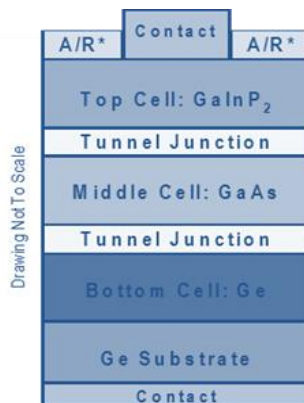
AM0 (135.3 mW/cm<sup>2</sup>) 28°C, Bare Cell



### Weight

84 mg/cm<sup>2</sup> (Bare) @ 140 μm (5.5 mil) Ge wafer thickness

### Solar Cell Structure



\*A/R: Anti-Reflective Coating

### 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

### Regulatory

Spectrolab's products are fully qualified and are ISO9001 and AS9100 certified