

## Suniva® ARTisun® Series 156.17X.3 -- 18X.3 Monocrystalline Photovoltaic Cells

### Reduced Module Loss and Increased Cell Performance

Suniva's ARTisun® Series 3bus monocrystalline cells are in an elite performance category that few manufacturers ever achieve: consistently offering efficiencies of 17.4% to 18.2%, with increases in product performance at both the cell and module level.

Increased performance at the cell level allows our customers to achieve more power with the same or fewer modules. Additionally, ARTisun® Series 3bus cells provide efficiency gains at the string-to-string level and via the interconnect ribbon between cells, producing more power and a more effective path for energy flow and performance. Customers can expect to achieve .2% - .3% increases in efficiency at the cell level, with the potential to reduce series resistance loss in the module by up to 1.21%. Customers will also see power gains at the module level, as higher-efficiency solar cells allow for more effective balancing of energy across the entire module.

### ARTisun® Series 3bus



### Intersection of High Efficiency and Low Cost

At Suniva®, our vision has always been the intersection of high efficiency and low cost, to deliver leading-edge monocrystalline solar cell performance while dramatically cutting the cost of the PV value chain. Our team leads the industry in PV technology and manufacturing, and we will continue to lead the industry with high-quality cells and cost-effective processes.

### Value of Leading Scientists and Manufacturers

Suniva's world-class manufacturing experts work with the best materials, from silicon to pastes, emitters to anti-reflection coating to cell contacts. More importantly, our Suniva® scientists have spent their careers understanding what it takes to extract the maximum performance from each part of the cell and deliver superior power. Our collaborative development approach, utilization patents and proprietary processes make Suniva® a sought-after cell provider to the world's most demanding customers.

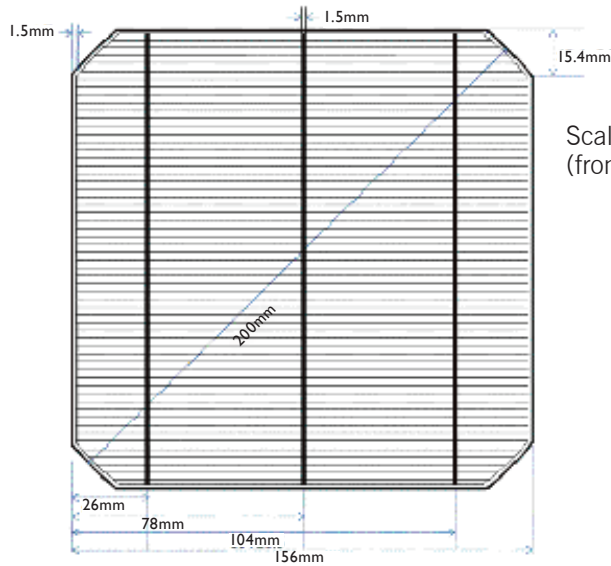
### Long-term Commitment to Quality

Suniva's state-of-the-art microcrack detection and uncompromising commitment to process control drives our reputation for superior quality, cell accuracy and product performance. Suniva® ARTisun® Series 3bus cell benefits include:

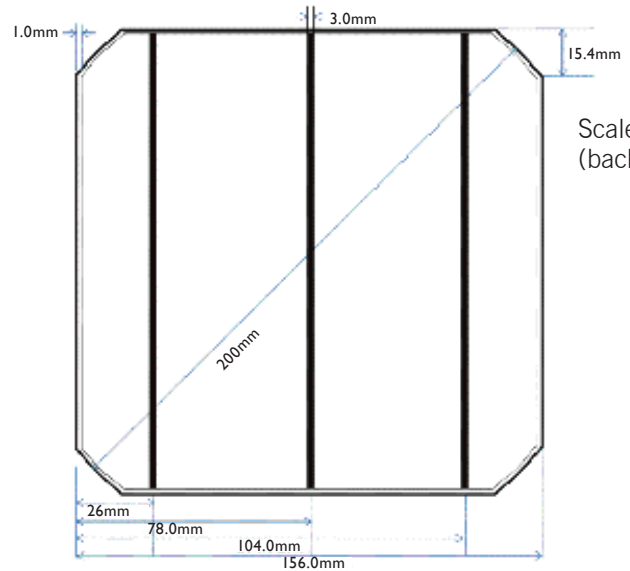
- Lower series resistance within modules
  - Minimizes power loss after stringing
- More power
  - Further reduces balance-of-system costs per watt
- Excellent low-light level performance
  - Offers broader geographical and climate application
- Quality visual and electrical characterization
  - Provides maximum performance reliability
- Consistent appearance of mono wafer
  - Provides visual appeal of module



## Reference Dimensions: ARTisun® Series 156.17X.3 -- 18X.3 Monocrystalline Photovoltaic Cells



Scaled drawing  
(front of wafer)



Scaled drawing  
(back of wafer)

Average Cell  
Bow Amount:  $\leq 1.5$  mm

## Typical Cell Electrical Properties<sup>1</sup>

Model	ARTisun® 156-17.7	ARTisun® 156-17.8	ARTisun® 156-17.9	ARTisun® 156-18.0	ARTisun® 156-18.1
Efficiency Eff (%)	17.65-17.75	17.75-17.85	17.85-17.95	17.95-18.05	18.05-18.15
Power $P_{pm}$ (W)	4.22-4.24	4.24-4.27	4.27-4.29	4.29-4.31	4.31-4.34
Max. Power Current $I_{pm}$ (A)	8.07	8.10	8.13	8.16	8.19
Short Circuit Current $I_{sc}$ (A)	8.63	8.66	8.69	8.72	8.74
Max Power Voltage $V_{pm}$ (V)	0.524	0.525	0.526	0.527	0.528
Open Circuit Voltage $V_{oc}$ (V)	0.621	0.622	0.622	0.623	0.623

<sup>1</sup> All electrical parameters valid under Standard Testing Conditions (STC): Intensity - 1000 W/m<sup>2</sup>; Spectrum - AM1.5 Global; Temperature - 25 °C

## Cell Temperature Coefficients

Parameter	Value
Voltage $\beta(V_{oc})$	- 2.2mV/°C
Current $\alpha(I_{sc})$	+2.9mA/°C
Power $\gamma(P_{max})$	- 0.46%/°C

## Wafer and Cell Specifications & Geometry

Parameter	Value
Crystal Growth Technique	Czochralski
Crystal Type	Monocrystalline
Crystal Orientation	<100>
Dopant Species	Boron, P Type
Wafer Shape	Pseudo-square
Wafer Size	156.0 $\pm$ 0.5mm cut from 200 diameter $\pm$ 0.5 mm
Wafer Area	239 cm <sup>2</sup>
Wafer Thickness	200 $\pm$ 20 microns
Cell Configuration	Front and Rear screen print; Aluminum Back Surface Field (BSF)
Cell Visual Appearance	Uniform dark blue (Silicon Nitride AR coating with fine pyramidal texture)

