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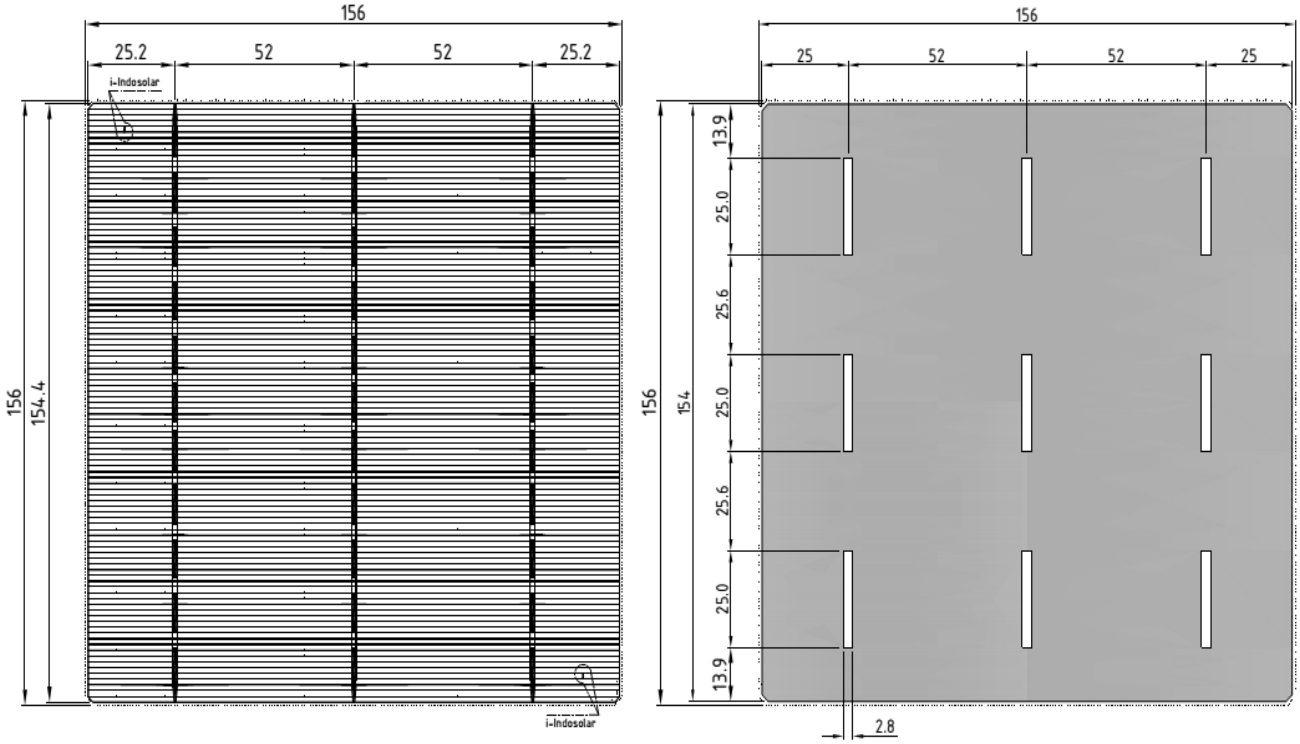
1.0: GEOMETRY

	Parameter	Specification
a.	Length and width of cell	156 ±0.5mm
b.	Diagonal length of cell	218±0.5mm
c.	Bevel edge width	0.5 - 2mm
d.	Thickness of cell (including paste on back/front of cell)	240±20µm
e.	Homogeneity of cell thickness (complete cell): Total Thickness Variation (TTV)	40 µm

1.1: CELL LAYOUT (FRONT & BACK PADS DESIGN AND SPACING IS SUBJECT TO CHANGE)



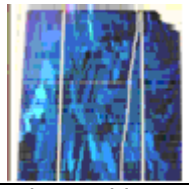
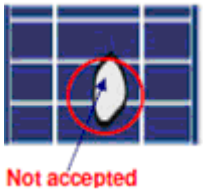
2.0: FRONT SURFACE

	Parameter	Specification
a.	Width of bus bars	1.4 ±0.1mm
b.	Distance of outer bus bars w.r.t central bus bar (center-to-center)	52 ±0.2mm
c.	Length of Front bus bar	154.4 ±1mm
d.	No. of bus bar	3 Nos.
e.	Material of bus bars and fingers	Ag
f.	Texturing of cell	Acidic
g.	Front surface coating	Silicon Nitride (blue color), Anti reflection coating
h.	Edge Isolation	Chemical

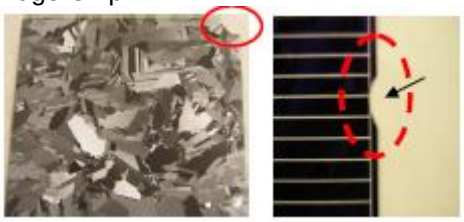
3.0: BACK SURFACE

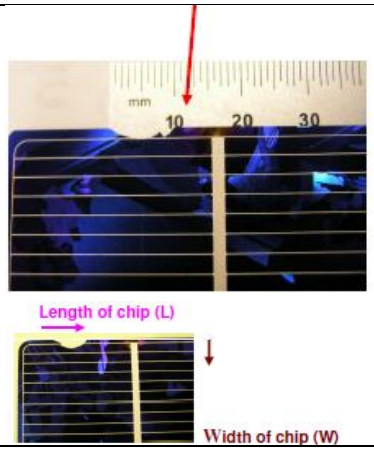
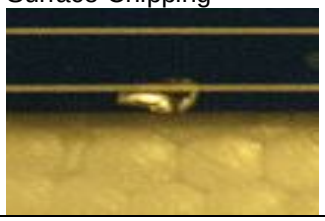
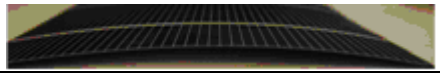
	Parameter	Specification
a.	Width of bus bars	2.8±0.2mm
b.	Distance of outer bus bars w.r.t central bus bar (center-to-center)	52 ±0.2mm
c.	Length of single pad of back bus bar (Three pads per bus bar)	25±1mm
d.	No. of bus bars	3 Nos.
e.	Material of bus bars	Ag
f.	Material of the surrounding parts of the back surface of the cell	Al

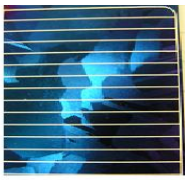
4.0(A): MECHANICAL DEFECTS (IS 2500 (Part I):2000, General Inspection II, AQL 0.65)

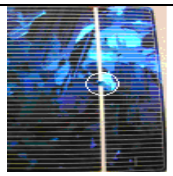
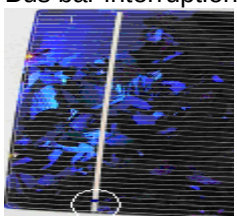
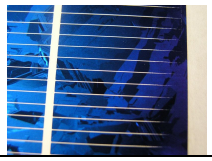
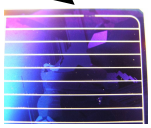
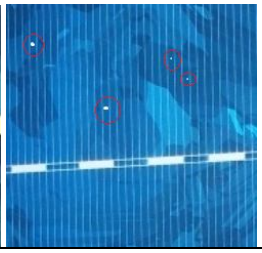
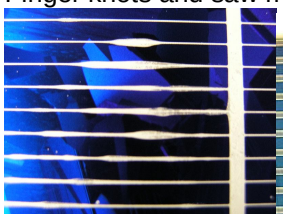
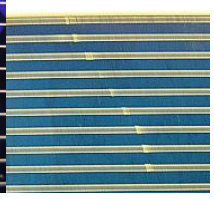
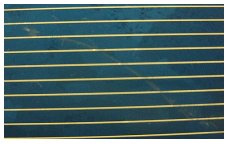
	Parameter	Tolerance
a.	Any visible cracks/broken cell 	No defects allowed (transmit damage is not covered)
b.	V-shape chip 	V-shaped chip of any size not permissible
c.	Visible hole in silicon 	Any visible hole in silicon is not Permissible.

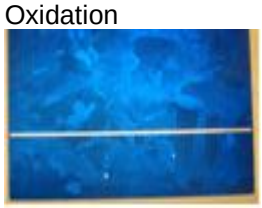
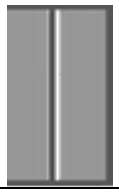
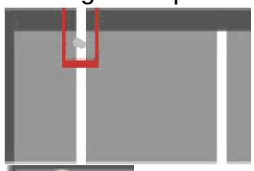
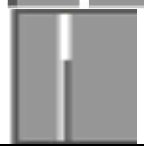
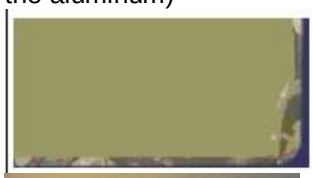
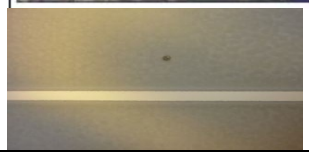
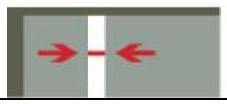
4.0(B): MECHANICAL DEFECTS (IS 2500 (Part I):2000,General Inspection II,AQL 1.5)

	Parameter	Tolerance
a.	Edge Chip: 	No chipping touching bus bar. L = 2.0 mm, W = 0.5 mm Location : 2 mm away from bus bar Chipping touching grid line not acceptable
b.	Edge Chip.	If distance between 2 chips is less than 1 mm it will be considered as a single chip and total length of chip should be 5 mm or less.

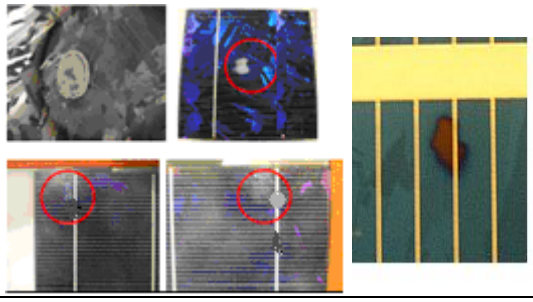
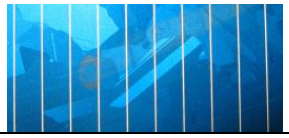
		
c.	Chip (triangle-shaped) 	Max. Chip size acceptable : One Length : 2 mm (excluding chamfer) Chipping touching grid line not acceptable
d.	Surface Chipping 	Surface Chipping. L ≤ 4.0 mm, W ≤ 0.5 mm Location : 5 mm away from Bus Bar
e.	Bow 	≤1.5 mm

4.1: FRONT SURFACE DEFECTS, (IS 2500 (Part I):2000, General Inspection II, AQL 2.5)		
a.	Front Print Shift (Front print pattern not centered on wafer.) 	≤0.5mm
b.	Rotated finger layout (Disorientation relative to reference edge or wafer corner) 	±0.25º
c.	Bus bar interruptions (on surface)	No interruption in bus bar

		
d.	Bus bar interruption close to end 	No interruption
e.	Finger Interruption 	Adjacent interruption with a length ≤3 mm, max. 04Nos/cell
f.	Finger Break 	Finger break with 3 mm, 5 fingers. Max. 02Nos./Cell
g.	Front Ag print (Excess Silver Paste: Silver of any size on the wafer that is not part of the pattern)  	Silver stains on front side < 2 mm^2 .Max. 02Nos./cell Pin hole mark with dia >1mm not allowed Pin hole mark with dia <1mm 03 Max. Nos./cell
h.	Finger knots and saw marks  	Finger knots/finger widening each with L≤ 0.5 mm and W≤ 0.2mm. Saw mark L≤ 1.5 mm, W ≤ 0.3 mm.
i.	Scratches on front surface 	≤ 5mm

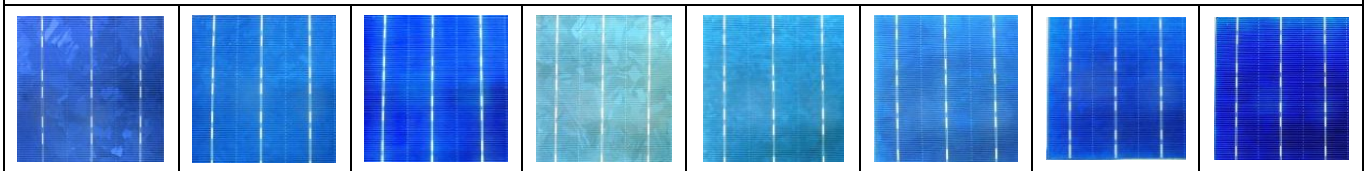
j.	Oxidation 	Not acceptable
4.2: BACK SURFACE DEFECTS (IS 2500 (Part I):2000, General Inspection II, AQL 2.5)		
a.	Back bus bar print misalignment  	No misalignment
b.	Missing silver paste on back bus bar  	Missing Al paste: 2 mm^2, 5Nos/Cell Missing Ag paste due to overlap of Al W ≤ 2mm, L ≤ 5mm
c.	Aluminum bead (Beads, bubbles, or folds in the aluminum)  	With normal eye inspection bubbles, raised surface, beads, protrusion, folds on the aluminum with size ≤0.5mm
d.	Back bus bar print defects (broken bus bar) 	No broken bus bar
e.	Missing paste on bus bar	No missing paste
f.	Scratches on Al surface	≤ 15mm
g.	Belt Mark	No belt Mark

4.3: STAINS (IS 2500 (Part I):2000,General Inspection II,AQL 2.5)

a.	Front surface stains 	Brown/ slurry off white/ finger prints, Light roller marks, Light smudges, White/ silver spots, Smeared/ Distorted Pattern. SiNx flakes - ≤ 2mm^2,Max. 02Nos./cell
b.	Water Marks 	No water mark
c.	Edge side paste at bus bar	No edge paste at bus bar

4.4: SiNx COLOR (IS 2500 (Part I):2000, General Inspection II, AQL 2.5)

a. SiNx Color Variation



LA (84-90nm)	MA (81-87nm)	HA (78-84nm)	BB (88-94nm)	LB (84-90nm)	MB (81-87nm)	HB (78-84nm)	DB (74-80nm)

No color variation within master carton (one color class cells in a master carton). Uniform color as seen by normal eyes.

5.0 : ELECTRICAL CHARACTERISTICS

	Parameter	Specification
a.	Temperature coefficients - TK V_{oc} - TK I_{sc} - TK P_{MPP}	 -0.3152 ±0.0068%/˚K 0.0477 ±0.0039%/˚K -0.3850 ±0.0084%/˚K
b.	Reverse current (Irev I)	1.5 Amp at -10V
c.	Reverse current at (Irev II)	3.5 Amp at -12V
d.	Rshunt	≥30 Ω

6.0: POWER MEASUREMENT CONDITION

	Parameter	Specification
a.	Power measurement (under STC conditions)	The power (Pmpp) of each cell is measured by class AAA flasher
b.	Calibration of the flasher	Cell testers are calibrated using Golden cells calibrated from ISE, Germany. Calibration cells are made periodically and ensured for precise & repeatable measurement.
c.	Classification of cells	The cell with the average **P_{mpp}** value measured under STC conditions defines the power class of the batch. Test method according to IEC-60904-1

7.0 : EFFICIENCY CLASS DISTRIBUTION

Part No.	Efficiency (%)	P_m (Wp)	V_{mp} (V)	I_{mp} (A)	V_{oc} (V)	I_{sc} (A)	Current (A) at 0.5 V
I6MU1840ZZ	18.40	4.478	0.535	8.370	0.632	9.014	8.659
I6MU1830ZZ	18.30	4.453	0.534	8.339	0.631	8.982	8.626
I6MU1820ZZ	18.20	4.429	0.533	8.279	0.631	8.950	8.555
I6MU1810ZZ	18.10	4.405	0.532	8.280	0.630	8.918	8.544
I6MU1800ZZ	18.00	4.380	0.527	8.311	0.630	8.887	8.411
I6MU1790ZZ	17.90	4.356	0.526	8.281	0.629	8.856	8.378
I6MU1780ZZ	17.80	4.332	0.525	8.251	0.629	8.825	8.345
I6MU1770ZZ	17.70	4.307	0.524	8.219	0.628	8.794	8.312
I6MU1760ZZ	17.60	4.283	0.523	8.189	0.627	8.763	8.279
I6MU1750ZZ	17.50	4.259	0.522	8.159	0.626	8.732	8.246
I6MU1740ZZ	17.40	4.234	0.521	8.127	0.625	8.702	8.213
I6MU1730ZZ	17.30	4.210	0.520	8.096	0.624	8.670	8.180
I6MU1720ZZ	17.20	4.186	0.519	8.066	0.623	8.638	8.146
I6MU1710ZZ	17.10	4.161	0.518	8.033	0.622	8.606	8.111
I6MU1700ZZ	17.00	4.137	0.516	8.017	0.621	8.574	8.075
I6MU1690ZZ	16.90	4.113	0.515	7.986	0.620	8.542	8.037
I6MU1680ZZ	16.80	4.088	0.514	7.953	0.619	8.512	7.999

Note: 1.All data are at Standard Testing Condition i.e. Irradiance 1000 W/m^2 with AM1.5 spectrum, Cell temperature 25°C. Test method according to IEC-60904-1
Measurement accuracy for Pmpp within ± 0.5% rel. with Indosolar sister cell traceable to ISE Fraunhofer

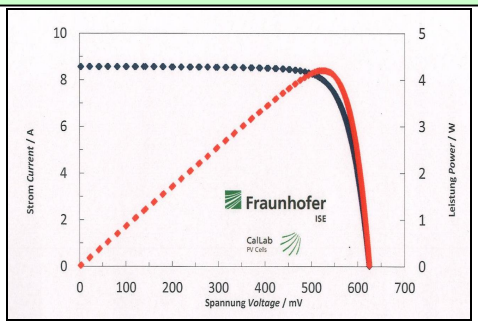
2. Specifications subject to change without prior notice as processes keep on improving. Indosolar reserves the rights of final interpretation and revision of this data sheet.
3. "ZZ'' stands for color as described in 4.4.

8.0: INTENSITY DEPENDENCE

Intensity w/m2	*Imp	*Vmp
1000	1.00	1.000
800	0.80	0.988
600	0.60	0.977
400	0.40	0.955
200	0.20	0.932

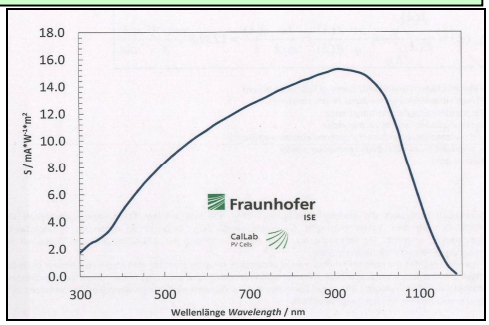
Ratio of Voc (Isc) at reduced intensity to Voc (Isc) at 1000w/m2

9.0: I-V CHARACTERISTICS



Reference data are calibrated against Fraunhofer ISE

10.0: SPECTRAL RESPONSE



Spectral Response

11.0: SOLDERING PEEL STRENGTH

The soldering peel strength is ≥ 1.5N measured on front and back bus bar at 180° using Indosolar regular flux and ribbon at 350±50°c

* Peel strength can vary with different types of flux, ribbon and tabbing process parameters.

12.0: PID TEST

PID free at 60°C,85%RH, 96Hrs at 1000V according to IEC 62804

13.0: PROCESS RECOMMENDATION

Solder Joint-Copper ribbons coated with 10-15 µm 62%Sn/36%Pb/2%Ag Cell per by pass diode-Max. 20/24 cells for 60/72 cells module

14.0: CELL'S GRADING AND CLASSIFICATION

Cells are classified based on mainly two parameters,

- Power/Efficiency with positive tolerance
- Optical appearance

Cells are classified as I6MUXXXXZZ where

"I" stands for Indosolar

"6" stands for 6" cells

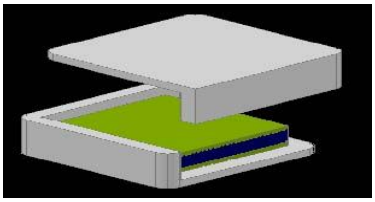
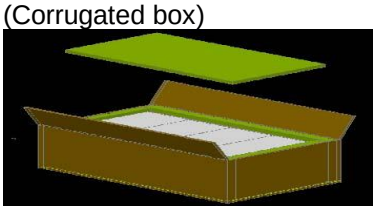
"MU" stands for multi-crystalline

"XXXX" stands for efficiency class, for example 1780 stands for 17.80% efficiency

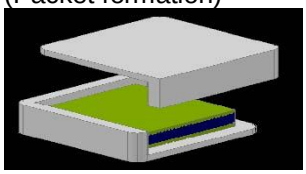
"ZZ" stands for optical/SiN color class, for example: HA/LA/MA/NA/HB/LB/MB/NB/DB/BB

Example: I6MU1700MA, I→ stands Indosolar, 6MU→6" Multicrystalline, 1780→17.80% efficiency, MA→Blue color.

15.0: PACKING

I).	Parameter (1x100x4)	Specification
a.	Cell packaging unit (Styrofoam box) 	Dimensions: Length: 19.5 cm ± 1.0 cm Width: 19.5 cm ± 1.0 cm Height: 9 cm ± 1.0 cm Additional requirements: Contents: 100 cells Material: polystyrene Cells are protected against damage. Labeling: Product code, Date/Lot, Serial number, Quantity, Average efficiency, Average power, * Average Isc & Voc (* optional)
b.	Secondary packaging (Corrugated box) 	Dimensions: Length: 40 cm ± 1.0 cm Width: 24 cm ± 1.0 cm Height: 25 cm ± 1.0 cm Additional requirements: Contents: 4 cell packaging units Material: cardboard Labeling: manufacturer, size of cell, power class, type, product name, number of cells.
c.	 Transport Packaging	Dimensions: Length: 126 cm ± 1.0 cm Width: 83 cm ± 1.0 cm Height: 112 cm ± 1.0 cm Additional requirements: Material: wood or weatherproof material Maximum 4 stacks Labeling: manufacturer, power classes, product name, colour, size of cells, number of cells, packing list

II). Packing (1x100x5)

	Parameter	Specification
a.	Cell packaging unit (Packet formation) 	Dimensions: Length: 18 cm ± 1.0 cm Width: 18 cm ± 1.0 cm Height: 7.5 cm ± 0.1 cm Additional requirements: Contents: 100 cells Material: polystyrene Cells are protected against damage. Labeling: Product code, Date/Lot, Serial number, Quantity, Average efficiency, Average power, * Average Isc & Voc (* optional)
b.	Secondary packaging (Corrugated box)  	Dimensions: Length: 42 cm ± 1.0 cm Width: 23 cm ± 1.0 cm Height: 23 cm ± 1.0 cm Additional requirements: Contents: 5 cell packets packaging units Material: cardboard Labeling: manufacturer, size of cell, power class, type, product name, number of cells.
c.	Transport packaging 	Dimensions: Length: 127 cm ± 1.0 cm Width: 85.5 cm ± 1.0 cm Height: 110 cm ± 1.0 cm Additional requirements: Material: wood or weatherproof material Maximum 4 stacks Labeling: manufacturer, power classes, product name, colour, size of cells, number of cells, packing list

III). Packing (1x300x6)

	Parameter	Specification
a.	Cell packaging unit (Packet formation) 	Dimensions: Length: 19.0 cm ± 1.0 cm Width: 16.5 cm ± 1.0 cm Height: 19.5 cm ± 0.1 cm Additional requirements: Contents: 3x100 cells Material: polystyrene Cells are protected against damage. Labeling: Product code, Date/Lot, Quantity, Average efficiency, Average power, * Average Isc & Voc (* optional)
b.	Secondary packaging (Corrugated box) 	Dimensions: Length: 52.5 cm ± 1.0 cm Width: 42.5 cm ± 1.0 cm Height: 23.0 cm ± 1.0 cm Additional requirements: Contents: 6 cell packets packaging units Material: cardboard Labeling: manufacturer, size of cell, power class, type, product name, number of cells.
c.	Transport packaging 	Dimensions: Length: 110 cm ± 1.0 cm Width: 110 cm ± 1.0 cm Height: 110 cm ± 1.0 cm Additional requirements: Material: wood or weather proof material Maximum 4 stacks Labeling: Manufacturer name, Customer Name, Invoice detail, Pallet No., etc.

16.0: STORAGE CONDITIONS

Cells should be stored in the condition of good ventilation in humidity below 50% and temperature of ≤40°C. Solar cells are highly susceptible to the humidity. It is recommended to make panels using the cells within the three months of the storage period for best perfromance.

17.0: RECOMMENDED BOM FOR MODULES WITH INDOSOLAR CELLS

Sr. No.	Material	Supplier	Priority	Type	Specification for 3BB	Remark
1	Multi-crystalline Cells	Indosolar	√	Silicon	Poly crystalline Si, 156 x 156 (mm)	
2	Ribbon	LUVATA	√	Sn/Pb	Sn60Pb40/1.2 (width)*0.20 mm thick(4BB)	
		Gebaur &Griller				
3	String Connector	LUVATA	√	Sn/Pb	Sn60Pb40/5 x 0.3 (mm)	
		Gebaur &Griller				
4	Tempered Glass	Borosil		(AR coated tempered glass)	Thickness 3.2mm with 94 % transmittance	
		CSG	√			
		Xinyi				
5	EVA	STR	√	15580P	Fast cure, Model: 15580P	
		RENEWSYS				
6	Back sheet	Coveme	√	Dymat PYE	Model: dymat PYE 295 micron	
		Renesys				
7	Frame	Jiangyin East	√	6063-T5	Anodized Aluminum	
8	Fluxing Agent	Henkel	√	X3308i	No clean, Halide free, Liquid flux	
9	Soldering Material	Hybrid Metals	√	KESTOR	Model: KESTOR Solder wire	
10	Junction Box	Renhe Photovoltaic	√	IP65 rated	3 diodes, PPO(-25A/60V)	
		Sunter	√			
11	Cables	Renhe Photovoltaic			4 sq.mm,1200mm long	
		Sunter	√	PV1-F		
12	Connector	Renhe Photovoltaic		IP67 rated	MC4 compatiable	
		Sunter	√	PVZH 202		
13	Bypass Diode	Renhe Photovoltaic		PS4025	3Nos. In a series,	
		Sunter	√	25 SQ45,		
14	Adhesive for frame	Lohman		Duplocoll 57005F	double sided foam tape	
		Dow Corning	√	PV 804		
15	Adhesive for JB	Dow Corning	√	Solar PV804	Neutral sealent	

*The above BOM is recommended to get desired results but Indosolar will not take reponsibile for low Output.

√ = Preferred

INDOSOLAR
3C/1, Ecotech II, Udyog Vihar, Greater Noida, Uttar Pradesh, India 201 306
Phone : +91-(0)120-4762500, Fax : +91-(0)120-4762525, Website: www.indosolar.co.in