

1 Crystal, chemical and material properties					
Property	Specification	Control frequency	Measuring Methodes	References	
Crystal Growing methode	CZ	-	-	-	
Crystal Structure	Mono-crystalline	-	-	-	
Crystal Orientation	$\langle 1-0-0 \rangle \pm 3^\circ$	-	-	-	
Conductivity Type	N-type	Each block	-	-	
Dopant	Phosphorus	-	-	-	
Oxygen Concentration ¹	$\leq 9,0 \times 10^{17}$ atoms/cm ³ [≤ 18 ppma]	Each ingot - center value, seed and tail	FTIR	(new) ASTM F121 - 83	
Carbon Concentration ²	$\leq 5,0 \times 10^{16}$ atoms/cm ³ [$\leq 1,0$ ppma]	Each ingot - center value, seed and tail	FTIR	ASTM F1391-93a	

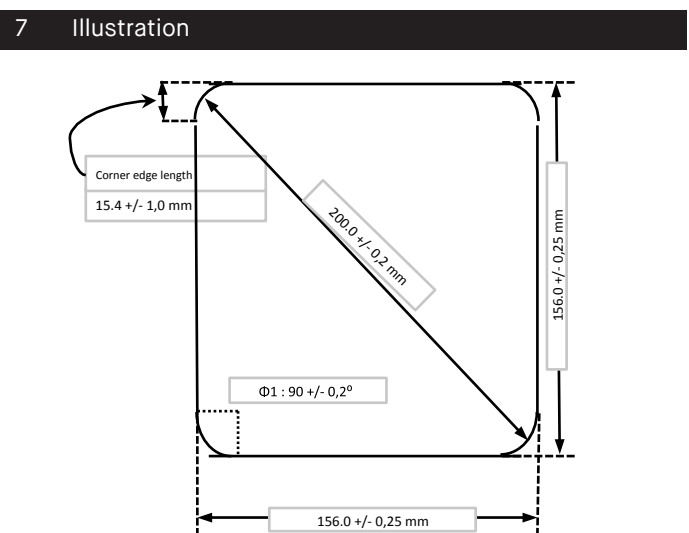
2 Electrical and Chemical properties					
Property	Specification	Control frequency	Measuring Methodes	References	
Specific Resistivity ³	1,0 - 6,0 Ohmcm	Each ingot - center value, seed and tail	4-point probe	ASTM F84	
Bulk Lifetime ⁴	$\geq 1000 \mu\text{s}$	Each ingot - center value, seed and tail	Sinton	Transient	
Defects ⁵	No slip lines	Each ingot - seed and tail	Visual	-	

3 Geometry					
Property	Specification	Control frequency	Measuring Methodes	References	
Wafer Shape	Pseudo square	-	-	-	
Wafer Size - flat to flat	156 mm \pm 0,25 mm	Continuous	Vision system	-	
Wafer Diameter	200 mm \pm 0,2 mm	Continuous	Vision system	-	
Corner edge length	15,4 mm \pm 1,0 mm	Continuous	Vision system	-	
Right Angel [ϕ 1]	$90^\circ \pm 0,2^\circ$	Continuous	Vision system	-	
Thickness	200 μm \pm 20/-10 μm	Continuous	Vision system	-	
TTV	$< 25 \mu\text{m}$	Continuous	Vision system	-	

4 Surface Properties					
Property	Specification	Control frequency	Measuring Methodes	References	
Wafer Slicing	Glycol Based Wafering	-	-	-	-
Wafer Cleaning	Water + Detergent	-	-	-	-
Wafer Surface	As cut - No stains exp. A) Water stains B) Stains from Si dust	Continuous	-	-	-

5 Apperance					
Property	Specification	Control frequency	Measuring Methodes	References	
Edge Defect	Length $\leq 0,3$ mm, Width $\leq 0,3$ mm	100% - Stacks of 100 pieces	Visual	-	-
Surface Chipping	Length $\leq 0,3$ mm, Width $\leq 0,3$ mm	Continous	Vision system	-	-
Saw Marks	Depth ≤ 15 μ m	Continous	Vision system	-	-
Crack and Pin Holes	No cracks w/ size > 1 mm. No Pin Holes	Continous	IR - Camera	-	-

6 Packaging	
Property	Specification
Packaging Method	EPS boxes packed in cardboard cartons and wooden pallet
Information on each EPS box	Product name, thickness, ingot lot, quantity, packaging date and inspector
Information on each pallet	Pallet number
Statistical quality criteria	AQL 1,0 - Inspection level II. AQL items are thickness, sawmarks, dimension and visual surface defects/Appearance



8 Explanations

- Oxygen is measured on 1,5 mm test wafer using FTIR (after Thermal donor removal)
- Measurement is done in center - Average of 5 measurements.
Note: Oxygen conc. is guaranteed to the customer specification at crystal growing inspection using test samples specifically prepared for oxygen analysis. Oxygen is not characterized on prime solar wafers.
- Carbon is measured on 1,5 mm test wafer using FTIR (after Thermal donor removal)
- Measurement is done in center - Average of 5 measurements.
Note: Carbon conc. is guaranteed to the customer specification at crystal growing inspection using test samples specifically prepared for carbon analysis. Carbon is not characterized on prime solar wafers.
- Specific resistivity is measured on 1,5 mm test wafer by using 4-point probe after thermal donor removal (single wafer annealing, 750°C, 120 sec cyclus, Ar-atmosphere)
Note: Resistivity is guaranteed to the customer specification at crystal growing inspection using test samples specifically prepared for resistivity analysis. Resistivity is not characterized on prime solar wafers.
- Bulk lifetime is measured on as cropped (i.e as squared) surface with Sinton BCT-0087 or BCT-210 equipment. Transient method is used for all values.
Specific Minority Carrier Density [cm^{-3}] is measured @ $1,4 \times 10^{15}$ (characteristic for n-type).
- Slip - lines is manually checked on as grown ingot before slabbing