

1	Crystal, chemical and material properties				
	Property	Specification	Control frequency	Measuring Method	References
	Crystal Growing method	CZ	-	-	-
	Crystal Structure	Mono-crystalline	-	-	-
	Crystal Orientation	<1-0-0> +/- 3°	-	-	-
	Conductivity Type	N-type	Each block	-	-
	Dopant	Phosphorus	-	-	-
	Oxygen Concentration ¹	≤ 9,0 x 10 ¹⁷ atoms/cm ³ [≤ 18 ppma]	Each mother ingot - center value, seed and tail	FTIR	(new) ASTM F121 - 83
	Carbon Concentration ²	≤ 5,0 x 10 ¹⁶ atoms/cm ³ [≤ 1,0 ppma]	Each mother ingot - center value, seed and tail	FTIR	ASTM F1391-93a

2	Electrical and Chemical properties				
	Property	Specification	Control frequency	Measuring Method	References
	Specific Resistivity ³	1,0 - 6,0 Ohmcm	Each mother ingot - center value, seed and tail	4-point probe	ASTM F84
	Bulk Lifetime ⁴	≥ 1000 μs	Each mother ingot - surface value, seed and tail	Sinton	Transient
	Defects ⁵	No slip lines	Each mother ingot - seed and tail	Visual	-

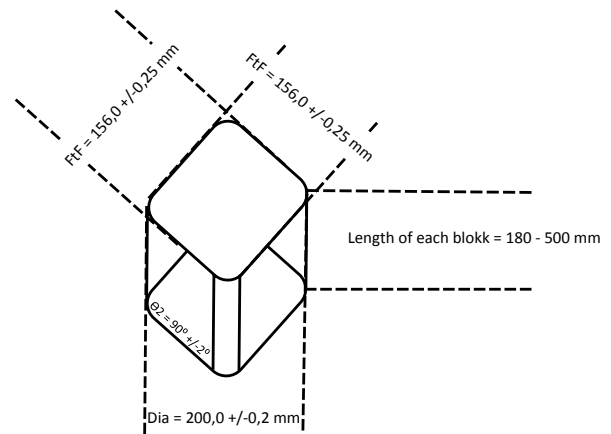
3	Geometry				
	Property	Specification	Control frequency	Measuring Method	References
	Ingot overall shape	Pseudo square	100% - All blocks	Visual	-
	Ingot Diagonal	200 mm +/- 0,2 mm	100% - All blocks	Caliper and Vision system	Intego ORION
	Ingot Dimensions	156 mm +/- 0,25 mm	100% - All blocks	Caliper and Vision system	Intego ORION
	Corner length	15,4 mm +/- 1,0 mm	100% - All blocks	Caliper and Vision system	Intego ORION
	Angle between sides [φ1]	90° +/- 0,2°	100% - All blocks	Caliper and- Vision system	Intego ORION
	Perpendicularity	90° +/- 0,2°	100% - All blocks	Caliper and Vision system	Intego ORION
	Block length	180 - 500 mm usable length	100% - All blocks	Caliper and Vision system	Intego ORION

4 Surface Properties				
Property	Specification	Control frequency	Measuring Method	References
Ingot surface	As polished block	100% - All blocks	Visual	0

5 Apperance				
Property	Specification	Control frequency	Measuring Method	References
Edge Defect	Length $\leq 0,3$ mm, Width $\leq 0,3$ mm	100% - All blocks	Vision system	Intego ORION
Surface Chipping	Length $\leq 0,3$ mm, Width $\leq 0,3$ mm	100% - All blocks	Vision system	Intego ORION
Crack	No cracks w/ size > 1 mm	100% - All blocks	Vision system	Intego ORION

6 Packaging	
Property	Specification
Traceability	All lot is identified with a lot number.
Documantation	C of A pr block/lot. Oi, C, Res, Lifetime, line defects/slip, Rz
Packaging method	Wood material outside and inside with stable support
Labelling on wooden box	Lot number, specification and shipment number
Labelling /marking on ingot	Lot number and specification

7 Illustration



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 (singlewafer 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
- All chip length will be withdrawn from the total length and not included in the accepted length.