



JinkoSolar Co., Ltd

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Approver: Shawn Wan

Date: 2025-08-18

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Date: 2025-08-12

Editor: Feng Wu

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EL test Judgment standard

Version	Effective date	Reasons of amended	Compiled Date	Audited Date	Approved Date
02	2023.06.08	Modified the black edge/shadow standard description	Xu Huilin 2023.05.20	DejianZhang 2023.05.23	Fengbing Song 2023.06.06
03	2023.11.15	Redefining Cross Marks.	Yuan Rong 2023.10.22	DejianZhang 2023.11.03	Fengbing Song 2023.11.14
04	2025.01.24	The file title has been changed from "MBB Half Piece Component EL Test Judgment Standard" to "Half Piece Component EL Test Judgment Standard", clearly defining and strictly enforcing the double glass module cross hidden cracking standard	Dorothy 2025.01.17	Dejian Zhang 2025.01.17	Shawn Wan 2025.01.23
05	2025.08.18	Revise the standard description for line marks, black lines, scratches, and belt marks; Clearly define the scope of application	Feng Wu 2025.08.12	Dejian Zhang 2025.08.12	Shawn Wan 2025.08.18

Applicable scope:Jinkosolar Component Division: Shangrao Base, Haining base, Yuhuan base,Feidong base, American base, Vietnam base. OEM

Review Department	Review Department	Assessor	Review Department	Assessor	Review Department	Assessor
	Quality Management Department	Wan Xiang	Pre Sales Technical Service Department	Tian Yuan		
	Module Quality Management Department	Peng Xianping	Module Technology Development Department	Che Pengkui		
	Module Quality Management Department	Huang Ling	Supplier Quality Management Department	Yin Chuiwen		
	Component Process Platform	Zhou Tao				

1 Purpose

This document is used to normalize, describe and definite the EL defect types to provide working yardstick and judgement standard for EL test.

2 Applicable scope

For products with wafer spacing in Jinko, only applicable for EL testing before leaving the factory.

3 Definition

3.1 Critical Defect: Defects may cause injury to the human body, or cause violation of laws and regulations.

3.2 Major Defect: Defects may have effect on the basic performance, practicality and operating of the product.

3.3 Minor Defect: defects have no effect on the basic performance, practicality and operating of the product.

3.4 The letters represent the meaning

q: Quantity of defects per cell	Gv: Gray value of single defect
A: Defective area of single cell	HC: Total quantity of half cells in single module
S: Area of single cell	TA: Total defective area of single half cell
Sp: Span / length of single defect on the cell	Q: Quantity of defective cells per module
L: The length of the entire battery	Gd: Gray difference of cells
Ld: Diagonal length of cell	

Note:

3.4.1 For Sp, the black edge defect is calculated along the edge direction of the battery; for Ld, the black corner defect is calculated along the diagonal direction.

3.4.2 Black spot /Black lump defects are judged according to the minimum gray value of single defect, and GV >60% is not included in TA.

3.4.3 Similar span defects for half cell modules and the defects of raw materials shall be calculated of two half cells combined into one full cell.

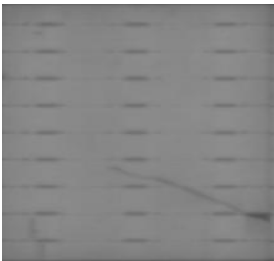
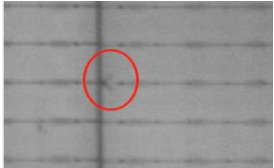
4 Management responsibility

4.1 Quality Control Department: Responsible for the revision, formulation and maintenance of the document.

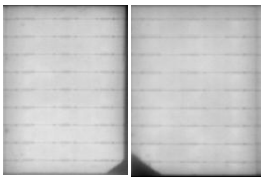
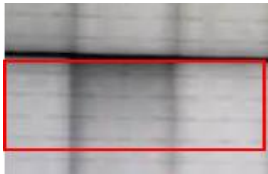
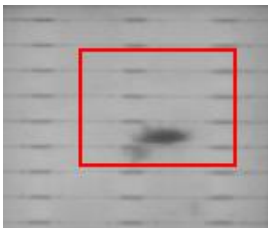
4.2 Other departments: Check and judge the EL test of modules by referring to this file standard.

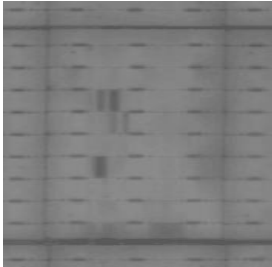
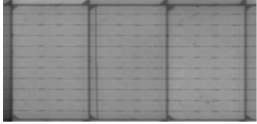
5 File content

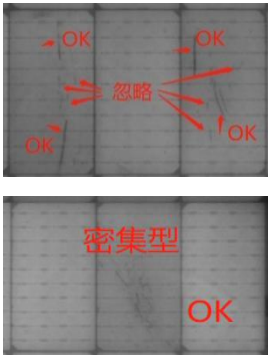
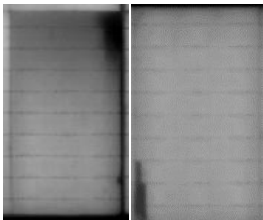
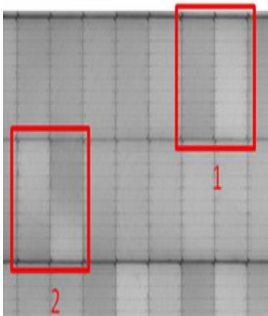
5.1 Inspection standard

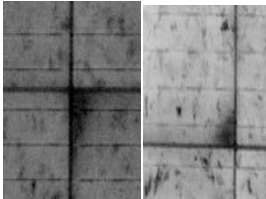
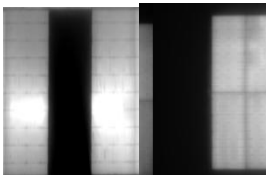
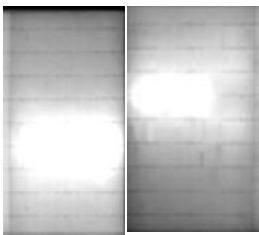
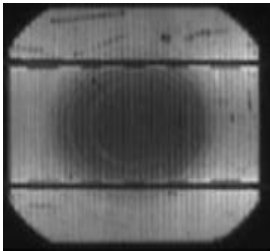
Serial number	Types	Defect grade	Description	Images	Judgement standard	
					Pre-EL	Post-EL
1	Linear Micro-crack	MA	Gray-black striated defect		The determination requirements of vertical/parallel/inclined crack location refer to the diagram of 5.2.6(3), the cracks that satisfy the position requirement are judged as follow: 1、$Sp \leq 1/3 L$, $q \leq 1$ per half cell, Module type 60pcs $Q \leq 1$pcs HC, 72pcs $Q \leq 2$pcs HC 2、Crack with inactive area not allowed.	1、$Sp \leq 5\text{mm}$ allowed; 2、$Sp > 5\text{mm}$, A single half slice $q \leq 3$; The number of pieces $Q \leq 6\%$ HC (calculated by the total number of half cells).
2	Cross micro-crack	MA	Gray black X/Y/V-shaped hidden crack defect	 	Crack with inactive area and cross crack are not allowed.	Single glass component: 1. $Sp \leq 5\text{mm}$ is ignored; 2. $5\text{mm} < Sp \leq 1/15L$, $q \leq 3$, Number of slices $Q \leq 6\%$ HC; Explanation: Crossings are calculated using longer lines; If a single $Sp \leq 5\text{mm}$ is not counted, the other one will be judged as a single hidden crack. Double glass components: 1. Long hidden crack length $Sp \leq 5\text{mm}$, $q \leq 3$ locations/piece, $Q \leq 10$ pieces; 2. $5\text{mm} \leq$ longer hidden crack

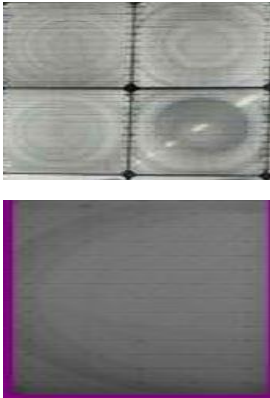
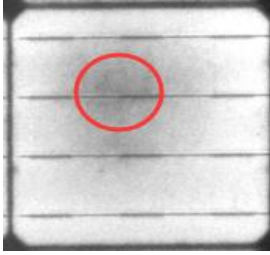
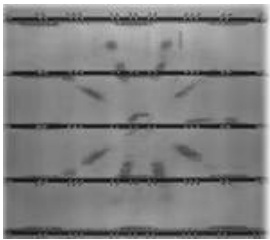
						length $S_p \leq 1/15L$, $q \leq 3$ locations/piece, single component ≤ 2 pieces
3	Branch like shape	MA	Gray-black striated defect		not allowed.	not allowed.

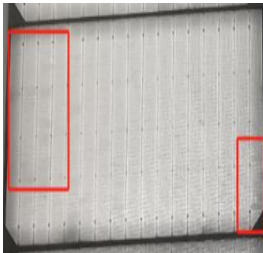
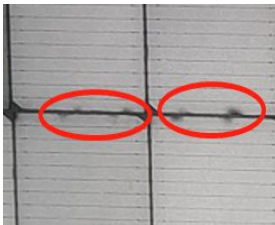
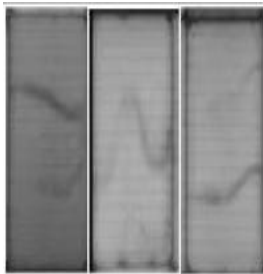
Serial number	Types	Defect grade	Description	Images	Judgement standard	
					Pre-EL	Post-EL
4	Inactive	MA	Dark area with obvious boundary on the cell		Not allowed.	1、No obvious separated of the chips from the cell 2、 $q \leq 1$, $TA \leq 2\%$ S, $Q \leq 3\%$ HC.
5	False Soldering	MA	Symmetrical dark area spread along the direction of busbar		1、 $TA \leq 10\%$ S, $Q \leq 5\%$ HC, allowed. 2、 $TA > 10\%$ S, Not allowed.	1、 $A < 2\%$, allowed. 2、 $TA \leq 10\%$ S, $Q \leq 5\%$ HC, allowed. 3、 $TA > 10\%$ S, Not allowed.
6	Black spot	MA	Obvious boundary nebulous gray-black and dark area in the cell		$G_v \leq 20\%$ 的： $TA \leq 2\%$ allowed; $2\% < TA \leq 5\%$, $Q \leq 10\%$ HC; $TA \geq 5\%$, Not allowed; $20\% < G_v \leq 60\%$ 的： $TA \leq 4\%$ allowed; $4\% < TA \leq 10\%$, $Q \leq 15\%$ HC; $TA > 10\%$, Not allowed; $G_v > 60\%$, allowed.	$G_v \leq 20\%$ 的： $TA \leq 2\%$ allowed; $2\% < TA \leq 5\%$, $Q \leq 10\%$ HC; $TA \geq 5\%$, Not allowed; $20\% < G_v \leq 60\%$ 的： $TA \leq 4\%$ allowed; $4\% < TA \leq 10\%$, $Q \leq 15\%$ HC; $TA > 10\%$, Not allowed; $G_v > 60\%$, allowed.

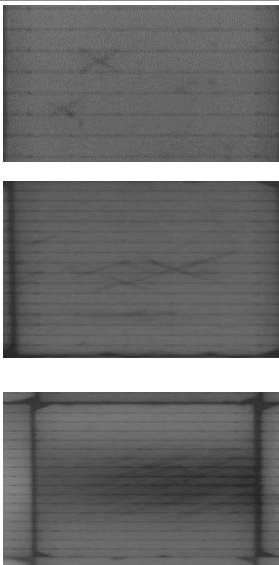
Serial number	Types	Defect grade	Description	Images	Judgement standard	
					Pre-EL	Post-EL
7	Finger Interruption	MA	gray-black line or gray-black area spread along the direction of fine grid	 	N-type SMBB: 1、$TA \leq 5\%S$ allowed; 2、$5\% < TA \leq 20\%$, $Q \leq 20\%HC$; 3、$TA > 20\%$ Not allowed; 4、The discontinuous area formed by lines with gray value difference $Gd \leq 20\%$ and the width $\leq 5mm$ is not included in the area of the finger interruption P-type MBB: 1、$TA \leq 2\%S$ Allowed; 2、$2\% < TA \leq 10\%$, $Q \leq 20\%HC$; 3、$TA > 10\%$ Not allowed; 4、Area which is constructed by gray line do not belong to finger interrupt area.	N-type SMBB: 1、$TA \leq 5\%S$ Allowed; 2、$5\% < TA \leq 25\%$, $Q \leq 20\%HC$; 3、$TA > 25\%$ Not allowed; 4、The discontinuous area formed by lines with gray value difference $Gd \leq 25\%$ and the width $\leq 5mm$ is not included in the area of the finger interruption P-type MBB: 1、$TA \leq 2\%S$ Allowed; 2、$2\% < TA \leq 15\%$, $Q \leq 25\%HC$; 3、$TA > 15\%$ Not allowed ; 4、Area which is constructed by gray line do not belong to finger interrupt area.
8	Stria / black line	MA	Gray black lines caused by non cell surface damage	 	1、Penetrating stria/black line is not allowed; 2、Non-penetrating stria/black line, $Q \leq 5\%$;equal or more is not allowed.	1、Penetrating stria/black line is not allowed; 2、Non-penetrating stria/black line, $Q \leq 5\%$;equal or more is not allowed.

Serial number	Types	Defect grade	Description	Images	Judgement standard	
					Pre-EL	Post-EL
9	scratches	MA	Gray black lines caused by surface damage to battery cells		Non-intensive scratches scratches 1、$Sp \leq \text{distance of main bars}$, allowed; 2、distance between main bars $\leq Sp \leq 1/3L$, $q \leq 3$, $Q \leq 10\%HC$; 3、$Sp > 1/3L$, $q \leq 1$, $Q \leq 2\%HC$; Intensive scratches and scratches $A < 1/2S$, $Q \leq 3\%HC$.	Non-intensive scratches scratches 1、$Sp \leq \text{distance of main bars}$, allowed; 2、distance between main bars $\leq Sp \leq 1/3L$, $q \leq 3$, $Q \leq 10\%HC$; 3、$Sp > 1/3L$, $q \leq 1$, $Q \leq 2\%HC$; Intensive scratches and scratches $A < 1/2S$, $Q \leq 3\%HC$.
10	Black edging shadow	MA	Strip-like gray shadow area along edge of cell		1、Length or width $\leq 1/15L$, allowed; 2、Length and width $> 1/15L$, not allowed.	1、Length or width $\leq 1/15L$, allowed; 2、Length and width $> 1/15L$, not allowed.
11	Different brightness	MA	There is a phenomenon that the difference of light and dark between cells and or in a single cell		1、$Gd < 25\%$, allowed; 2、$25\% \leq Gd \leq 30\%$, $Q \leq 5\%HC$ 3、$Gd > 30\%$, Not allowed.	1、$Gd < 30\%$, allowed; 2、$30\% \leq Gd \leq 35\%$, $Q \leq 5\%HC$; 3、$Gd > 35\%$ Not allowed

Serial number	Types	Defect grade	Description	Images	Judgement standard	
					Pre-EL	Post-EL
12	Black corner	MA	Black triangle area appears on the four corners of cell		1、 $Sp \leq 1/20 Ld$, allowed; 2、 $Sp > 1/15 Ld$, Not allowed; 3、 $1/20 < Sp \leq 1/15 Ld$, $Q \leq 10\% HC$;	1、 $Sp \leq 1/20 Ld$, allowed; 2、 $Sp > 1/15 Ld$, Not allowed; 3、 $1/20 < Sp \leq 1/15 Ld$, $Q \leq 10\% HC$;
13	Short Circuit	CR	Cell or cell string is deep black		Not allowed	Not allowed
14	Bright cell	MA	Some area of the cell is more brighter, and busbar is misty.		Not allowed	Not allowed
15	Black core	MA	Gray and dark area with obvious circular outline on the center of cell		Not allowed	Not allowed

Serial number	Types	Defect grade	Description	Images	Judgement standard	
					Pre-EL	Post-EL
16	concentric ring	MA	Complete or incomplete lines of concentric circles		N-type: 1、The gray value difference is less than 30% oxygen ring, allowed 2、The gray value difference exceeds 30% oxygen ring, allowing 10% of the number of half cells in the same photovoltaic module 3、Oxygen rings cause black core, according to the black core standard; P-type, Not allowed.	N-type: 1、The gray value difference is less than 30% oxygen ring, allowed 2、The gray value difference exceeds 30% oxygen ring, allowing 10% of the number of half cells in the same photovoltaic module 3、Oxygen rings cause black core, according to the black core standard; P-type, Not allowed.
17	Black lump cell	MA	Gray and dark area without obvious circular outline on the center of cell		$G_v \leq 25\%$, Not allowed; $25\% < G_v \leq 60\%$: $TA \leq 20\%$, $Q \leq 10\%$ HC; $G_v > 60\%$, allowed.	$G_v \leq 25\%$, Not allowed; $25\% < G_v \leq 60\%$: $TA \leq 20\%$, $Q \leq 10\%$ HC; $G_v > 60\%$, allowed.
18	sucker cup print	MA	Sucker cup prints caused by sucker cups during production		Not allowed.	Not allowed.

Serial number	Types	Defect grade	Description	Images	Judgement standard	
					Pre-EL	Post-EL
19	Belt mark	MA	Black line on the same direction of Battery fine grid direction; the small grayish-black ring between the main bars		N-type: The slight degree of belt printing does not exceed the limit shown in the diagram. P-type: Not allowed.	N-type: The slight degree of belt printing does not exceed the limit shown in the diagram P-type: Not allowed.
20	Fixture imprint	MA	gray-black fixture imprint on both sides of the battery		N-type: Not touching bus-bar line, allowed. P-type: /	N-type: Not touching bus-bar line, allowed. P-type: /
21	Finger Resistance EL gray	MI	watermark striated gray shaded area on the cell		N-type: Single cell $G_d \leq 30\%$, allowed; Single cell $G_d > 30\%$, not allowed; P-type: /	N-type: Single cell $G_d \leq 30\%$, allowed; Single cell $G_d > 30\%$, not allowed; P-type: /

Serial number	Types	Defect grade	Description	Images	Judgement standard	
					Pre-EL	Post-EL
22	Cross mark	MA	Mark line color is light, cross center no obvious black dot		Single point type: 1、$Sp \leq 5\text{mm}$ allowed; 2、$5\text{mm} < Sp \leq 30\text{mm}$, $q \leq 5$ per HC, The number of pieces $Q \leq 6\%HC$; 3、$Sp > 30\text{mm}$, Not allowed; Intensive: 1、$Gd < 30\%$, $Q \leq 7\%*HC$; 2、$30\% \leq Gd \leq 35\%$, $Q \leq 5\%*HC$; 3、$Gd > 35\%$, Not allowed.	Single point type: 1、$Sp \leq 5\text{mm}$ allowed; 2、$5\text{mm} < Sp \leq 30\text{mm}$, $q \leq 5$ per HC, The number of pieces $Q \leq 6\%HC$; 3、$Sp > 30\text{mm}$, Not allowed; Intensive: 1、$Gd < 30\%$, $Q \leq 7\%*HC$; 2、$30\% \leq Gd \leq 35\%$, $Q \leq 5\%*HC$; 3、$Gd > 35\%$, Not allowed.

5.2 Operation instruction

5.2.1 Penetrating Defect: a defect which run through the cell and connect two edges.

5.2.2 Gray value: in this document gray value refers to the value which is divided into 21 equal parts by 5% interval from 0% to 100% of RGB color system. 0% is black, 100% is white and the others are gray.

5.2.3 If the standard is a percentage and cannot be divided, round it to the nearest whole number (such as 1.6 pieces rounded to 2 pieces), but if the result is less than 1 piece, calculate it as 1 piece.

5.2.4 If there is an EL test defect outside the scope defined in the document, it shall be immediately reported to the on-site quality/process staff for re-determination. If the re-determination is still an external defect, the quality/process opinion shall be the main judgment for such defect;

5.2.5 Gray level judgement: the gray level judgement shall be judged through the visual inspection first. If the visual inspection cannot be confirmed, then takes the following methods:

(1) Intercept the original image (fig.1) from the center of two bus-bars of cell, and the paste the image on the gray scale to make gray level recognition;

(2) Approximate gray level is compared firstly when read gray value, and the image is placed in corresponding gray level region, the result is subject to the gray level which is the most difficult to recognize (fig.2);

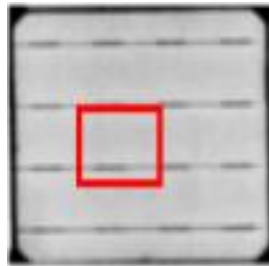


fig.1

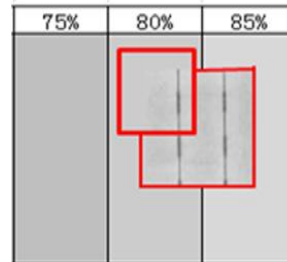
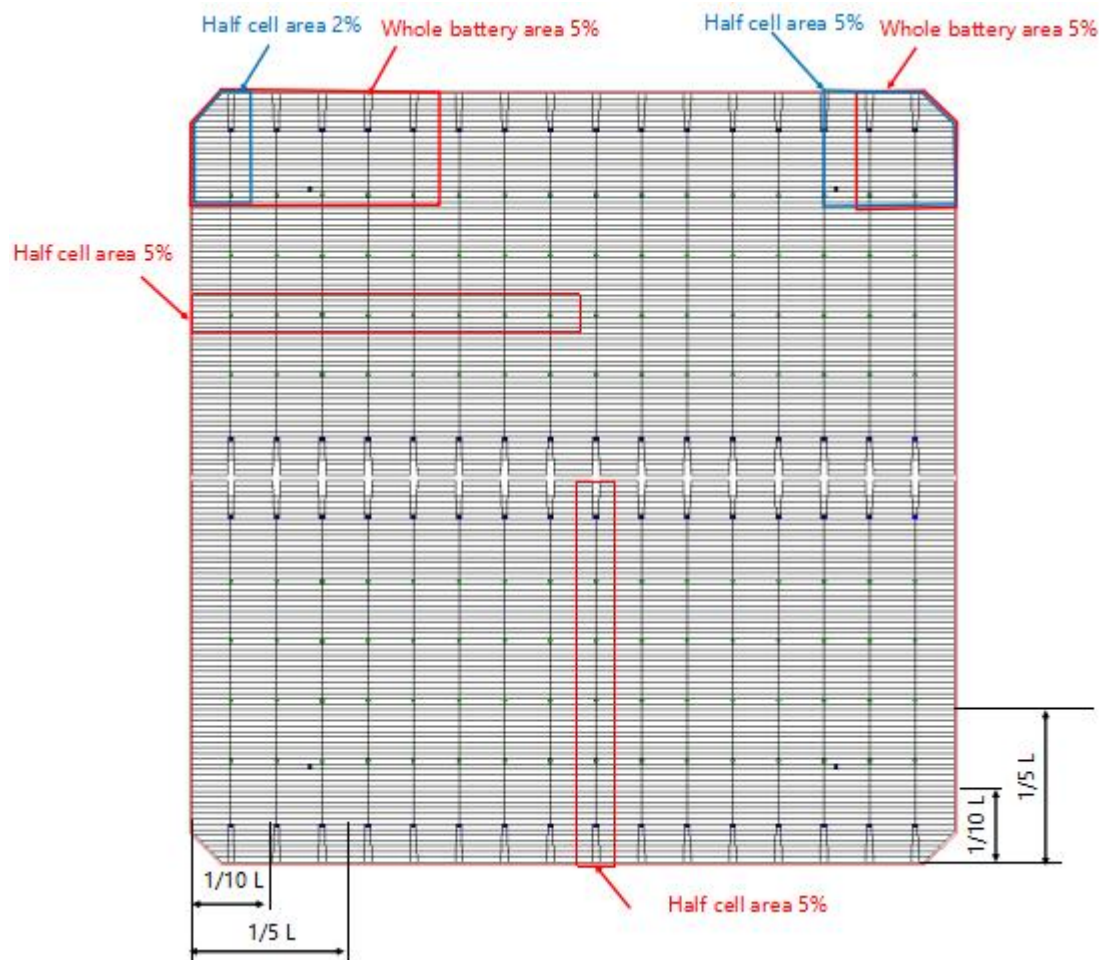


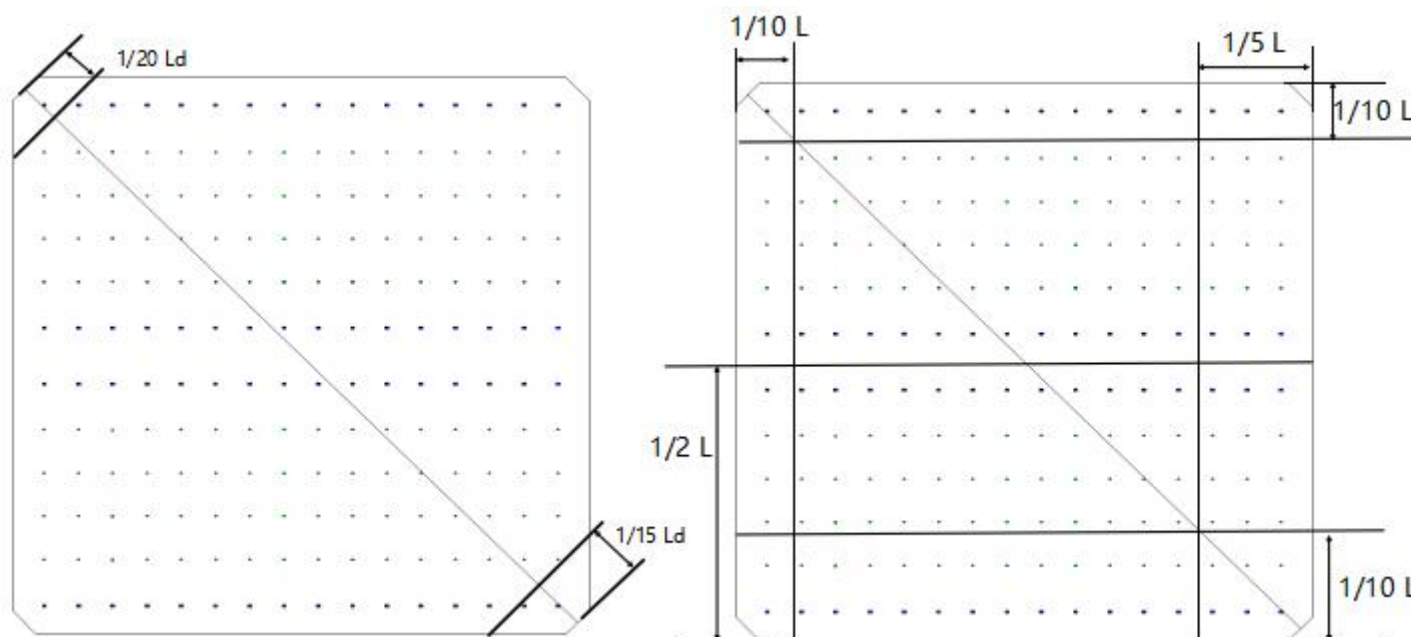
fig.2

5.2.6 Area/proportion diagram

(1)Regional schematic diagram:

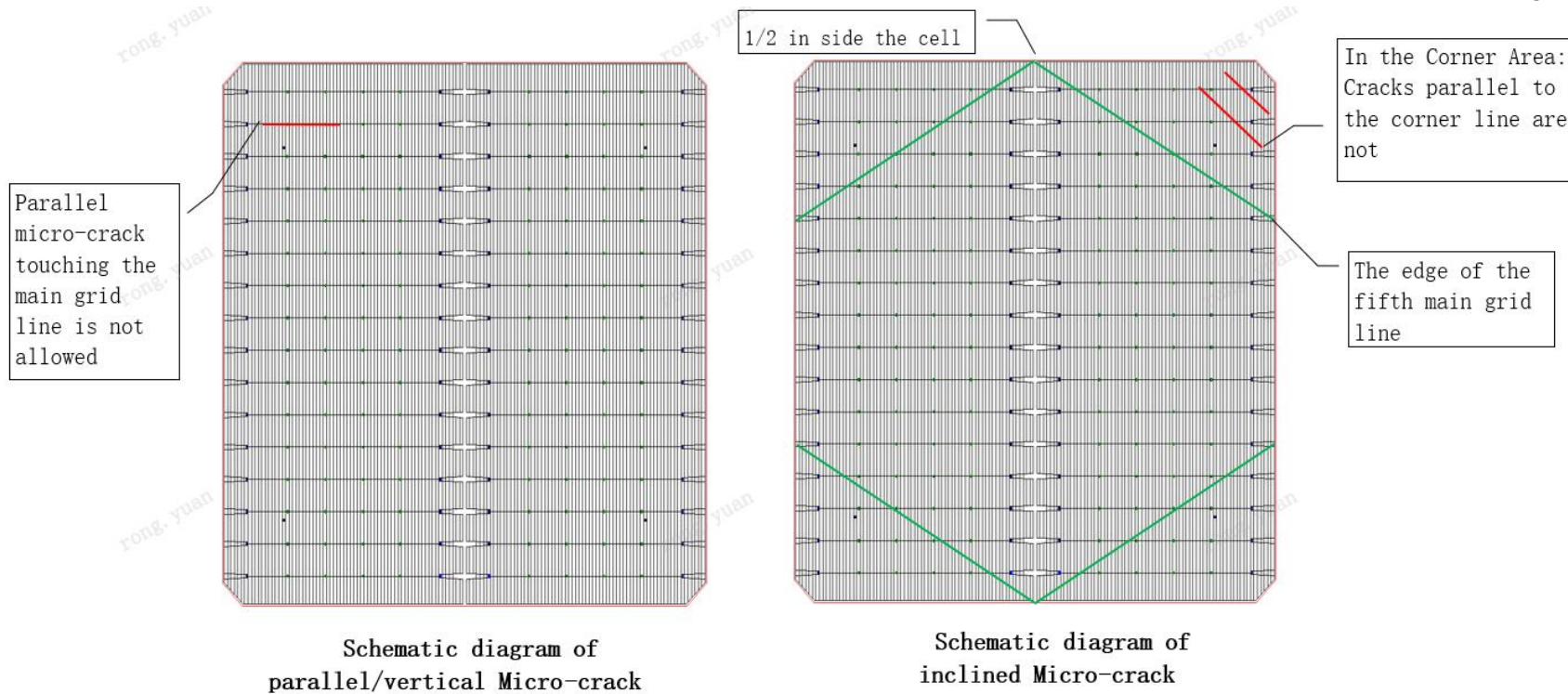


(2)Length diagram:



(3) Pre -EL schematic diagram of the location of micro crack

Corner Area: the outer area formed by the edge of the fifth main grid line and the 1/2 length of the cell edge:



(4) reference table

Percent	60P/M	72P/M	60HP/M	66HP/M	72HP/M	78HP/M
5%	3pcs	4pcs	6pcs	7pcs	7pcs	8pcs
6%	4pcs	4pcs	7pcs	8pcs	9pcs	9pcs
10%	6pcs	7pcs	12pcs	13pcs	14pcs	16pcs
15%	9pcs	11pcs	18pcs	20pcs	22pcs	23pcs
25%	15pcs	18pcs	30pcs	33pcs	36pcs	39pcs

6 Release and execution

6.1 Jinkosolar Quality Management System module Quality Department is responsible for formulating, updating and organizing

the implementation of this system, and the Vice President of Quality Management System is responsible for approving this system.

6.2 Jinkosolar Quality Management System module Quality Department has the right to the final interpretation of this system.

7 Attachments

7.1 《Gray scale》JKM-QM-0044TN-a*

8 The attachment

None