

Master Contract No.: \_\_\_\_\_

# Technical Specification

For

## AM050E MBB PV Cell Soldering Stringer

(The information herein is totally confidential and shall not be disclosed to any third party)

Supplier: (Signed and sealed)

Customer: (Signed and sealed)

Representative:

Representative:

Date:

Date:

(Faxed copies are valid )

## 1 Product overview

AM050E MBB PV Cell Soldering Stringer is a fully automatic machine used to solder the mono-Si or poly-Si cells into a string. It can work with 156-230mm (3BB-15BB) cells, or 156-230mm (full, half-cut, 1/3-cut or 1/4-cut) cells after upgrade. With the use of PLC, servo, SCARA robot, industrial image processor system and other advanced automation technology, the entire process from cell feed to string outlet is fully automated.

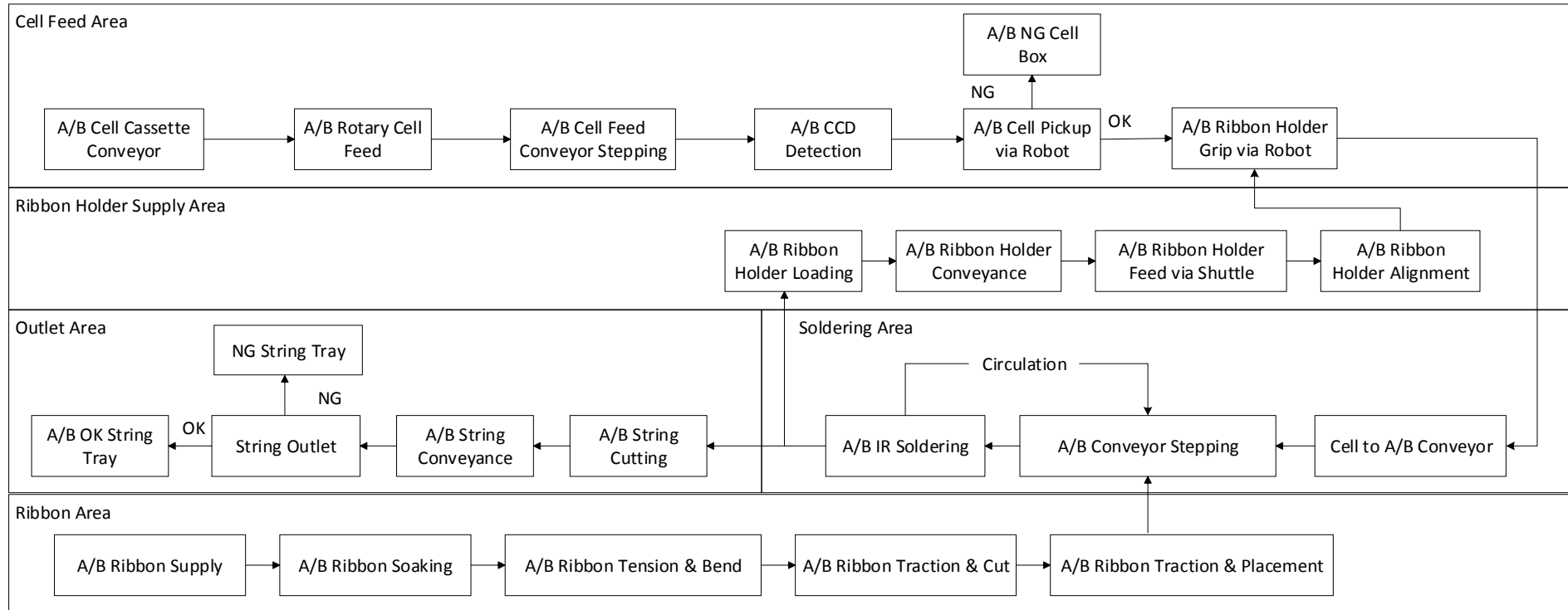
## 2 Product Info

### 2.1 Appearance

The appearance of AM050E MBB PV Cell Soldering Stringer:



## 2.2 Process flowchart



Production Process

### 3 Function

#### 3.1 Cell feeding

Each set of cell cassette loading unit consists of two conveyors (top and bottom), which are mainly responsible for conveying full cell cassette to cell pickup position and discharging the empty cell cassette.

After the cell cassette reaches the cell pickup position, the cell pickup device will grab the cells and load them onto the cell conveyor.

Each set of cell pickup assembly consists of a cell raise electric cylinder and a cell pickup and transfer mechanism (with suction cups), as well as an air knife to ensure that only one cell is picked up from cell cassette each time.

If there is no cassette on the conveyor, the machine will automatically stop and raise the alarm.

#### 3.2 Cell feeding conveyor

Cell feed unit consists of two conveyors. The vacuum suction below the conveyor can hold the cells in place during conveyance to prevent cell sliding. The conveyor driven by a servo motor can send the cells to the CCD work station in an accurate way.

#### 3.3 Flux system

Each line of the machine (i.e. A and B line) has a set of flux soaking tray. After going through the heated flux soaking tray, the surface of the ribbon will be coated with flux.

The flux in the soaking tray is refilled by the 8L flux tank located in the cabinet. The level meter installed in the flux tank will raise an alarm when the flux level is below the lower limit, reminding the operator to add flux.

The flux tank and all the pipes and nozzles are made with anti-corrosive materials.

#### 3.4 Image processor inspection

High precision industrial cameras are used to examine the cells for any defect.

#### 3.5 SCARA robot

High-accuracy four-axis robots are used to do these:

- Grab NG cells and place them into the NG cell box.
- Grab OK cells and place them onto the conveyor. During this process, fine adjustment will be performed based on the CCD detection result so as to ensure the busbar of cell aligns with the ribbon.

The use of robot offers these advantages:

- Precise positioning: positioning precision is up to 0.01mm, which can significantly reduce soldering offset, and ensure the accuracy of the cell spacing and string straightness.

- High efficiency: fast movement contributes to high efficiency.
- Intelligent positioning: suitable for different types of cells.
- Stable and reliable: minimal maintenance is required.

### **3.6 Ribbon feed**

Ribbon feed assembly consists of 12 sets of ribbon supply motor and ribbon guide wheel set, which can be upgraded to 15 sets at most. Each ribbon supply unit can be enabled and disabled via HMI operation to fit the soldering of 3BB to 15BB cells.

The ribbon spool driven by a stepping motor directly can wind or unwind the ribbon smoothly and steadily without vibration or distortion.

The ribbon supply motor can drive a ribbon spool up to 15kg and it can work with spools made by different suppliers.

When the ribbon spool is empty, the sensor outputs a signal, and the machine will raise an alarm and then stop, prompting to replace ribbon spool. The auxiliary fixture for ribbon supply unit can help the operator change the ribbon spool quickly within 5 minutes.

### **3.7 Ribbon stretching, bending and cutting**

The ribbon processing system can be used to stretch, flatten (bend, optional) and cut the ribbon. The stretching amount can be set on HMI, and the bending depth and position can be adjusted manually.

The precision-machined guide posts ensure that all ribbons are parallel to each other with correct spacing gap.

The standard stretching, flattening (bending, optional) and cutting units are suitable for 2-5BB cells; for 3-15BB cells, the switchover of guide tool is required.

### **3.8 Ribbon Traction**

The ribbon traction mechanism consists of two traction arms (inner and outer), which can work alternately to draw ribbons out and place them directly on the busbar of cell.

The servo motor and linear module used for traction arms can offer positioning accuracy of 0.01mm.

### **3.9 Assembly Conveyor in Soldering Area**

Made of Teflon, the assembly conveyor belt can resist high temperature and prevent tin adhesion.

In order to reduce the stress inside the cells caused by the temperature variation, there are several heating plates under the conveyor to preheat cells before soldering. The temperature of these plates can be set on HMI.

Driven by a servo motor, this conveyor can achieve a positioning accuracy of 0.01mm.

By using an exhaust fan to create negative pressure, the holes on the conveyor belt and heating plates can hold the cells firmly in place, preventing the offset of cell or ribbon.

The conveyor is one-side supported, easy for maintenance and replacement of belt.

### **3.10 Soldering**

The method of infrared soldering is used to heat both sides of cells at the same time and then solder the cells and the ribbons together.

The IR soldering station is controlled by a high-speed soldering controller. The soldering temperature is detected by an imported high temperature sensor. The soldering parameter can be set on HMI.

The soldering cycle is guaranteed via the use of preheated solder base. The heating of an entire piece of cell can prevent pseudo soldering or crack of cell caused by partial heating.

The soldering station is driven by a cylinder to move up and down. The soldering height is adjustable. There is no need to lift the solder station during normal work, ensuring high quality of soldering.

The service life of an infrared lamp is about 3000 hours. In normal use, it can work for about 3-5 months.

The temperature of heating plate under the conveyor in soldering position can be adjusted to fit the soldering process for different types of cells, ensuring soldering quality.

### **3.11 Outlet**

The outlet area is composed of 2 conveyor belts, 2 lower string pickup arms, 2 upper string pickup arms, 2 string traverse arms, 2 OK string tray support frames and 2 NG string tray support frames.

After the string is forwarded to the outlet area, the string pickup arms and the string traverse arm will function to send the string to one side of the machine for inspection; if the string is OK, it will be placed on the unloading conveyor; if it is NG, it will be put in the NG string tray.

The outlet area can be set to Manual (Inspection) mode or Automatic mode. Under the Manual mode, the string will be rotated automatically for easy manual inspection.

### **3.12 PV cell laser cutting machine (Optional)**

Laser cutting machine is optional.

### **3.13 Inline Optical String Inspection (Optional)**

This module is optional. Please refer to its technical specification.

### **3.14 Inline EL Inspection (Optional)**

This module is optional. Please refer to its technical specification.

#### 4 Specifications

Item		Specifications		Description
		Traditional cells	MBB cells	
Basic Information	Uptime	≥95%		(1 - unscheduled downtime/24H), unscheduled downtime refers to the time when the equipment malfunctions or is shut down unexpectedly.
	Speed	18X - 220mm cells: Half-cut ≥ 6600 strips/hour 220mm cells:		The capacity depends on the solder process. If the required solder time is too long, it may affect the production capacity.
	Cell Cracks	156mm to 171mm cells: Poly-Si ≤0.2%; Mono-Si ≤0.2%; 171mm to 230mm cells: Poly-Si ≤0.2%; Mono-Si ≤0.2%;		Popular Grade A cell, thickness ≥170μm Cell crack ratio = (cracked cells + micro-cracked cells)/total number of soldered cells × 100%
	Defect Detection	CCD		
	Flux Coating Method	Soak of ribbon		
	Soldering Method	IR soldering		
	Temp Control Accuracy	±7.5°C		The upper/lower temp limits can be set on HMI; an alarm will be raised when the temp is out of the limit.
Cell	Size	156~230mm crystalline silicon cell and its half-cut, 1/3-cut or 1/4-cut strips		Depending on the cell process.
	No. of Busbar	3BB-15BB		Tooling switchover is required for cells with different busbar number.
	Busbar distance	Busbar spacing ≥13 mm Outmost busbar to cell edge >5mm		
	Solder pad to cell edge distance	The top/bottom solder pad to cell edge >5.5mm		
	Cell Thickness	170μm~200μm		

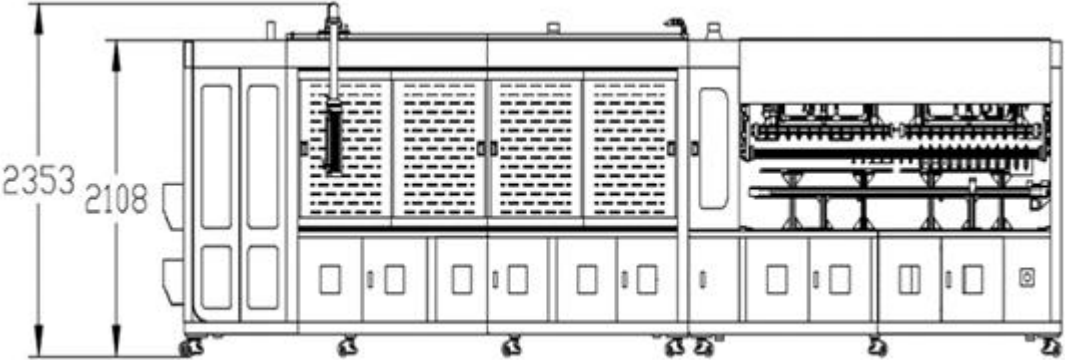
Item	Specifications	Description
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		Traditional cells	MBB cells	
Cell String	Max String Length	1200mm		If upgraded, the length of string can be up to 2500mm.
	Head/Tail Extra Ribbon	The length of extra ribbon for the first and last string can be set separately.		
	String Straightness Deviation	±0.5mm		
	Peel Strength	The peel strength is no less than 1N/mm*busbar width.	Face-side ≥0.5N (∅0.4mm ribbon; up to one point <0.5N is allowed for each busbar on face side); Back-side: ≥1N (∅0.4mm ribbon)	Popular Grade A cell
	Cell Positioning	Based on the busbar of cell		/
	Cell Defects	Chipped corner, chipped edge, crack, screen screw/offset, 90°/180° screen rotation, etc.; defect level (like crack depth);		Can be defined on HMI
	Ribbon Offset	≤±0.3mm		Check if the centerline of ribbon coincides with the centerline of solder pad.
	Cell Spacing	Negative spacing: -1mm to -0.5mm Small spacing: 0.6mm to 1mm Normal spacing: adjustable within 1.5mm to 6mm		
	Ribbon Flattening	/	Thickness of flattened circular ribbon: 0.12~0.15mm for 0.29mm ribbon, length ≥4.8mm-6mm	Applicable when +0.5/-0.5mm spacing is selected
	Cell Spacing Accuracy	±0.3mm		Depending on the cell cut depth and the screen print accuracy.
	Start Point of Soldering	Depending on the actual need		/
	String Unloading	Offline or sent to the layup machine		/
Max Capacity of Cassette	360 strips		/	

Item	Specifications	Description
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		Traditional cells	MBB cells	
Cell String	Optical String Inspection	Consistent soldering for each string and meet the visual requirements.		Optional
	EL String Inspection	Soldering defects, like pseudo soldering, micro-crack.		Optional
	Bad Soldered String	≤2%	≤2%	Popular Grade A cell, including pseudo soldering, over soldering, offset etc.
	Module Rework Ratio (Before Lamination)	≤12%	≤15%	/
Ribbon	Ribbon Specification	Traditional flat ribbon: Width: 0.8 to 3.0mm; Thickness: 0.18 to 0.32mm	Circular ribbon: Ø0.29 to Ø0.45mm, tolerance ≤±0.01 Yield strength: 70~80MPa; Tensile strength: ≥150MPa Elongation: ≥25%	Appearance: Free of any copper exposure, solder beads, dark spots, scratches, tin dross beyond the allowable tolerance, etc.; the surface of coating shall have bright metallic color and the winding of ribbon shall be smooth and even.
	Leaded or lead-free	Suitable for both		
	Ribbon Parameters	Average thickness of tin coating: ≥0.018±0.005mm Purity of copper substrate: ≥99.97% Elongation: ≥20% Tensile strength: ≥150MPa Yield strength: ≤70MPa		The thinnest place of tin coating ≥0.006mm
	Ribbon Spool	Inner diameter 16mm or 20mm, outer diameter ≤180mm, width ≤160mm	Inner diameter 16mm or 20mm, outer diameter ≤160mm, width ≤180mm	
Power Supply and Air Supply	Power Supply	Three-phase 380V, 50Hz Three-phase five-wire (L1/L2/L3/N/PE), wire size 4×16mm <sup>2</sup> +1×10mm <sup>2</sup>		
	Power	Average power: 35 kW; Peak power: 40 kW		
	Air Supply	Pressure: 0.6-0.8Mpa Air consumption: ≥2000L/min Two Ø16mm air inlet hoses working at the same time		Two Ø16mm air inlet hoses must work at the same time to ensure stable pressure of machine.

Item		Specifications		Description
		Traditional cells	MBB cells	
Power Supply and Air Supply	Air Supply Requirements	Air pressure: 0.6 - 0.8MPa; Ø16mm air inlet hose; Compressed air quality: Max. solid particle: 15µm (Class 3); Min. pressure dew point: +3°C (Class 4); Max. oil vapor concentration: 5mg/m <sup>3</sup> (Class 4)		
	Ventilation	The 5 vents on the top of machine are Φ102mm. Connect these vents to the facility exhaust piping with Φ104mm ducts. The exhaust duct of the blower is Φ65mm. The duct is connected to the facility exhaust system via the fifth Φ102 vent. The overall exhaust flow rate is larger than 1000m <sup>3</sup> /h. Considering the high temperature of exhaust, it is recommended to use PVC pipe for exhaust duct.		
	Installation Floor	The floor for installation shall have a loading capacity of 600kg/m <sup>2</sup> at least and be flat without any vibration. The installation space (including the space for the operator to work) shall be no less than 8500(L)×3500(W)×2650(H)mm. Ambient temperature: 5 - 40°C Relative humidity: 5 - 70% (non-condensing)		
Dimensional Drawing	 <p>Weight: front part 6000KG, rear part 3000KG</p>			

## 5 Attached files

No.	Item	Qty	Remarks
1	Packing list	1	
2	Factory Inspection Report	1	
3	Operation Manual	1	
4	Service Repair Manual	1	
5	Maintenance Manual	1	

## 6 Main parts and components

Main parts and components are listed as follows:

No.	Name	Brand	Remarks
1	PLC	KEYENCE	
2	Servo	YASKAWA, INOVANCE	
3	Robot	STAUBLI, YASKAWA, DENSO	
4	CCD	DALSA	
5	Sensor	OMRON, PANASONIC	
6	Touch screen	ADVANTECH	
7	Terminals	WAGO, DEGSON	
8	Cable carrier	IGUS, MISUMI	
9	Bearing	NSK	
10	Linear screw module	THK, HIWIN, TBI, etc.	
11	Pneumatic parts	SMC, AirTAC, FESTO	
12	Mechanical parts	MISUMI, YIHEDA, etc.	
13	Motor	JSCC, Leadshine	

## **7 After-sales service**

### **7.1 After-sales service and training**

- The supplier will provide training in the operation and maintenance of the machine for free at the owner's site.
- During the installation and commissioning period, the supplier will send technicians to the site of the owner to offer free technical guidance.
- The after-sales service staff of supplier will provide 24-hour phone support.

### **7.2 Quality assurance**

- The supplier will offer a one-year warranty (excluding the consumable parts) after the installation, commissioning and acceptance of the machine.
- During the warranty period, if any issue occurs due to the quality of equipment, the supplier will replace or repair the parts free of charge.
- The supplier shall offer the best price for the technical services the owner requested after the expiration of the warranty period.