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2. Product Description

Xcell X2

Cells:	Fabricate TBD 78 x 156 mm, 105 x 210 mm, 125 x 125 mm, 156 x 156 mm 2/3 Busbar, standard Busbar spacing Maximum cell bow 5mm
Strings:	Max. String Length: 2.0 meters Min 2 mm gap between cells
Flux:	Loctite X33-08i or Kester 920-CXF
Ribbon: 15-	Without other notice tooling ready for 2,0 mm x 0,13 mm (Coating 20 microns).

Xcell String to Glass Lay-up System

Max. Glass Size:	Min. 300 mm X 900 mm - Max. 1000 mm x 2000 mm
Max. Glass Weight:	180 kg total weight on conveyor length, 3 glass panels of 60 kg
Conveyor Height:	38" min, 40 1/2 " max

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4. Machine Description / Xcell X2

Your benefits of this machine at a glance:

- Compact footprint of nearly 11m^2
- High throughput of 1200 cells/hr
- Only one cell pick and place step prior to preheating
- Cell pre-heating with temperature control, reducing thermal stress during soldering
- Close Loop Induction Soldering – With graphical temperature feedback
- Proven AccuTrack™ string transport system (nearly maintenance free).
- Graphical touch screen user interface for easy operators assistance
- Z-bend capability which can be turned on or off based on product recipe
- Total control of ribbon by holding both ends until control is transferred to the ribbon / cell hold down.
- Ribbon straightness (camber) is no longer critical to the alignment on the front of the cell due to better ribbon control. This is a significant benefit because ribbon camber has been historically difficult for the ribbon suppliers to control.
- Fully programmable control of ribbon length, position, and tension with no tooling change required for any of these parameters.
- Capable of up to 3 ribbons with no change to concept, motions, or cycle time.
- Compatible with traditional front contact cells as standard offering.
- Optional String to glass lay up with improved string placement accuracy available.
- Gull wing doors providing safety and increased machine access without sacrificing convenience.
- Komax global service and support.
- Extended Warranty plans and Service Agreements available.

Basic machine

A SCARA robot will separate and un-stack the solar cells from input pallets. At the height of the vertical axis the solar cell is imaged by a camera to determine Busbar location. After this imaging is complete the robot transports the solar cells through both the upper and lower flux stations. The robot then moves the solar cell into the focus of a second camera for the presence of chips and missing regions. If the cell is determined to be a good cell, it is then directly placed onto one of two AccuTrack™ walking beams. The cell will be placed in a reject tray if it is determined to be bad via inspections. Both AccuTrack™ walking beams contain heated sections to assist with the soldering operation and reduce the thermal stress on the solar cells.

Ribbon is introduced to the string on both walking beams using our **patent pending** ribbon handling device. This unit prepares and introduces ribbon into the string between each cell maintaining control of both ends of the ribbon to ensure the highest possible level of ribbon straightness and alignment.

The soldering station utilizes a proven **patent pending** one coil per Busbar induction solder head system developed by Komax Solar Inc.. The system is preset to solder 3 busbar cells up to 156 mm square or pseudo square. It has the capability to produce 2 busbar cells 156 mm square, and 3 busbar cells from 125 mm to 156 mm square. The solder head design also allows the capability to produce 2 or 3 busbar 156 mm and 210 mm half cells.

Light weight non-metallic ceramic hold-down pins are incorporated in the induction solder head to hold the ribbon in place during the solder reflow process. Non contact temperature feedback is incorporated in the induction solder head to insure proper monitoring of the temperature during the solder reflow process.

The soldering cycle will consist of lowering the solder head, energizing the induction coil, holding for cool-down, and lifting the solder head. Once the solder head is up and away from the cell, the string will index.

The closed loop system will allow more control over various aspects of the soldering cycle including ramp-up time, set-point temperature, soak time (time at set-point), and cool down delta.

(Note: Extending any of these times however may result in a net increase in the soldering cycle resulting in a reduction in throughput).

Soldered strings are indexed out of the machine on the patented AccuTrack™ transfer device.

Optical Alignment with Cell Inspection:

Vision inspection and optical alignment of crystalline cells is done simultaneously during the movement between the cell load pallet and placement on the walking beam by the SCARA robot.

The SCARA robot will pick the solar cell from the top of the stack inside the input pallet. As a function of the vertical axis movement the solar cell will be brought into the focus of a camera. This camera will image the solar cell capturing edge and busbar location data. This data is then transmitted back to the SCARA robot for a precise, accurate alignment and orientation. The robot then transports the solar cells through both the upper and lower flux stations. After fluxing a second camera inspects the solar cells for chips and 0.5 x 0.5 mm missing regions. Solar cells failing inspection will be placed into a reject bin by the SCARA robot Solar cells which pass inspection are placed directly on one of two AccuTrack™ walking beams for incorporation into a string.

Second Flux tank:

This includes the addition of a second flux tank for independent pressure control of upper and lower flux nozzles.

Controlled heating prior to soldering:

A fully heated walking beam with a wide center chuck width (27mm) will provide heating of the solar cell up to 220°C. The first two parts of the walking beam are a preheat zone followed by a heated zone. The presence of these two zones which are offered as a standard allow the cells to undergo a gradual temperature change which reduces cell cracking while still providing the heat required for flux activation.

Third Ribbon Capability:

The capability to produce 156 mm product with three busbars is designed into the machine, and includes the following components.

- 3rd ribbon hold down bar with pins.
- 1 additional ribbon feed and shear unit.
- One additional ribbon spool dereeler.
- 1 additional flux head for bottom and 1 additional flux head for top dispensing.

Controlled cooling after soldering:

Expanded thermal control is accomplished by the addition of heaters to three sections of the AccuTrack™ after the soldering head. This feature which is offered as a standard allows the cells to undergo a gradual temperature change which reduces cell cracking over the entire length of the walking beam.

Fume Extraction:

A self contained fume extractor mounted to the machine frame is offered as a standard feature. Air/fumes will be pulled from the soldering area and ducted to the filtration unit. Filtered air will be returned to the room.

Servo Controlled Flipper:

The addition of a servo controlled flipper to each walking beam provides the ability to take the strings produced (sunny side up) by the Xcell X2stringer and inverts them to a (sunny side down) position. The use of the servo controlled flipper also provides a string buffer. Strings can be transported off by a servo controlled flipping unit by either our standard basic off loader or Xcell String to Glass Lay-up.

Xcell String to Glass Lay-up System (not included in this quote):

The Xcell direct string to glass Lay-up system is designed to work with one Xcell X2 combined Tabber/Stringer machine. The Lay-up system is comprised of the following major sub-assemblies:

* Glass transport conveyor
* Multi-axis robotic string handling
* Machine vision string inspection and alignment
* One, string rework tray position
* Two, string buffer tray positions
* End tab cutting

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Glass with EVA is loaded or indexed onto the input end conveyor. On demand, the glass with EVA is transported into the lay-up work area. The servo controlled flipper unit picks strings from the AccuTrack sunny side up and rotates them to a sunny side down orientation. This flipper also serves to provide a full one string buffer, which helps maintain stringer machine uptime. The multi-axis robot picks the strings sunny side down from stringer flipper unit.

The strings are then transported through an inline vision tunnel. Back-lit images are taken of each cell in the string. The images are analyzed for two main purposes. First, a cell quality inspection is done to check for cell damage which includes edge chips and missing regions in the cell. Second, image data is used to determine exact location and length so that proper position /alignment adjustment can be made.

After vision inspection, strings are placed in the appropriate location on the glass or deposited in the buffer/ rework trays. The lay-up system can/will rotate strings 180 degrees for proper polarity orientation when required. If a broken/ chipped cell in the string is detected, the string is placed into the rework tray. When end tab cutting is required, this operation is performed after vision inspection and prior to string placement on the glass. Upon completion of populating the module with strings at the string lay-up position, the glass is conveyed out of the system. The output conveyor section is long enough to accommodate a manual bussing and final visual pre lamination inspection by an operator.

The Lay-up system will handle module (glass) sizes up to approximately 1.0 m wide by 2.0 m long.

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6. Machine Performance (Xcell X2 only)

The performance table shown below is based on one Xcell X2, Grade A cells and indicates a maximum and a minimum throughput with **leaded** ribbon. The stated average breakage rate is only achievable if soldering is not done edge to edge. The minimum edge to ribbon distance may vary by cell thickness and will be determined upon customer supplied product mix which is intended to be used on the Xcell at time of order placement. The performance warranty is only valid for products known at the date of order placement and products supplied by the customer to qualify the machine for factory acceptance. Future products can be added to this performance warranty after they have been qualified and evaluated by Komax technicians. Performance variations between Mono- or Polycrystalline cells are possible. Performance values using lead free ribbon are not shown in this table.

5 to 6 inch cell / 160 – 220 µm	1200 cells/ hour
Breakage Rate:	≤ 0.3% down to 160 µm Note: tested with QCell, 160 µm cells by all other cell manufactures must be validated first upon availability, prior to committing to any breakage rate. Ribbon softness has a significant impact on solder quality and breakage rate. Customers ribbon, flux and cell combination is part of the validation.
Machine uptime:	≥97% (Machine related only)
Noise level:	≤72% dB

System performance (String to Glass Lay-up System with one Xcell X2 stringer)

Average system throughput,	≥ 1200, based on a 10 cell string.
Machine uptime:	≥90% (as a system)
Noise level:	< 72 dB
Conveyor rated speed:	9-18 meters per minute
String placement accuracy:	+/- 0.3 mm - EVA is required to guarantee the string placement accuracy

7. Utilities

Electrical Power input	3 phase 208, 380, 400, or 420 input VAC 50 Amps (50/60) HZ *(A 3 phase transformer is provided to adapt the voltage to the customer's location)*
Electrical power consumption:	Xcell X2 – 21 kW String to Glass Lay-up – 21 kW
Air requirements	Recommended 6 to 10 bar (87 - 145 psi) Minimum 5 bar (72 psi)

8. General Environmental conditions

Temperature

- The temperature of the production site must be between 15° C and 35 ° C.

Moisture

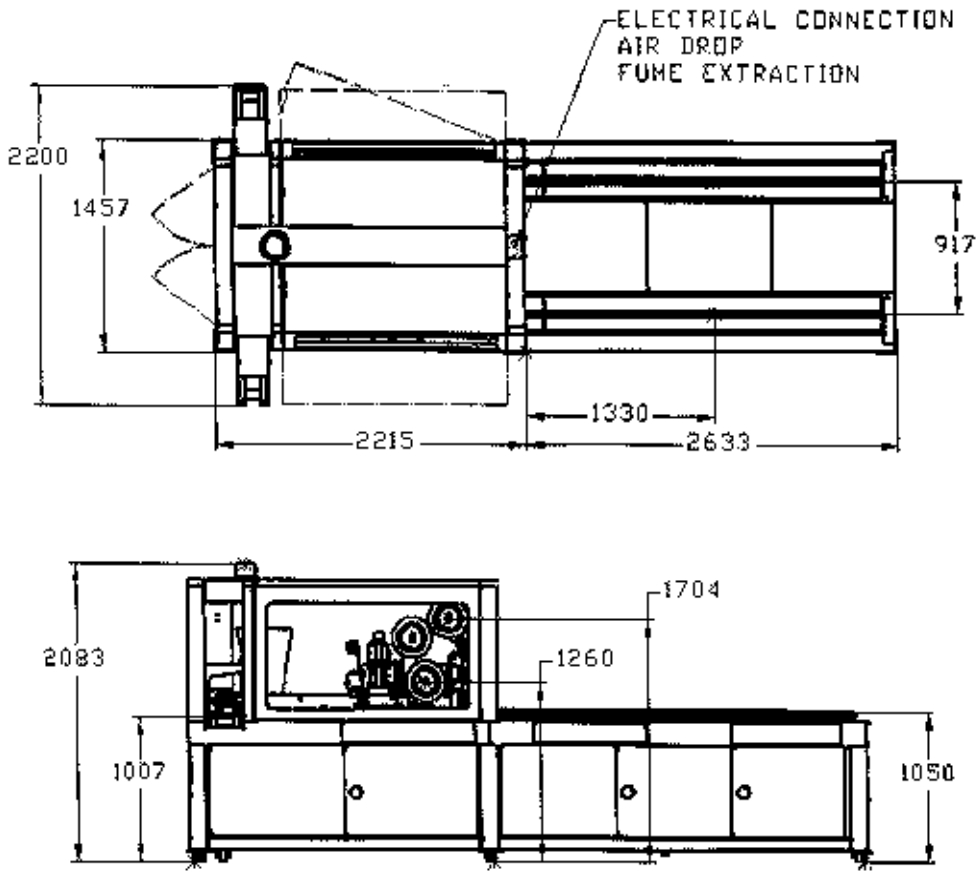
- The environment inside the production facility should have a relative humidity below 75%.

Floor

- It is advisable that the floor be coated with a sealant to prevent the production of dust.
- Floor type, hole depth: smooth, level concrete to set the robot base onto; must be deep enough to allow lag bolt holes at least 168 mm deep without cracking.
- Load requirements: 2000 Kg/Square meter

  (String to Glass Lay-up System weigh:. 1825 kg; Each Xcell X2 stringer weight: 3500kg)

Xcell X2 footprint



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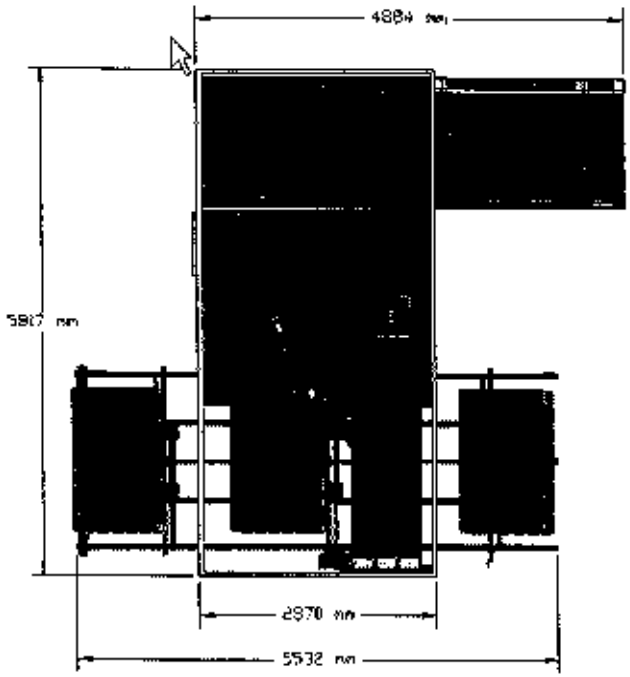
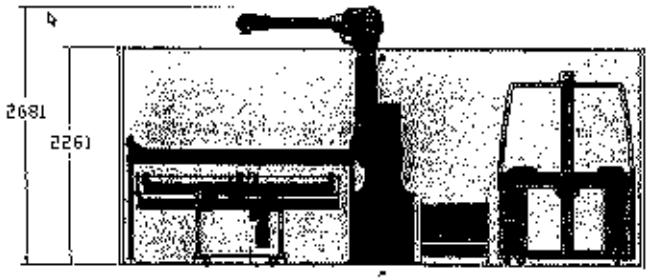
THE WAY TO MAKE IT

Sting to Glass Lay up footprint





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