- **Mondragon Assembly Spain**
  Polígono Industrial Bainetxe, 5ª
  E-20550 Aretxabaleta (Spain)

- **Mondragon Assembly France**
  Parc d´Activités les Pradines
  1376, R.N 7 Route de Lyon
  84100Orange (France)

- **Mondragon Assembly Mexico**
  Carretera Estatal 431 Km. 2+200, Lote 45
  Parque Tecnológico Innovación
  76240 Querétaro (Mexico)

- **Mondragon Assembly Germany**
  Bodmaner Strasse 7
  D-78315 Stahringen (Germany)

- **Mondragon Assembly China**
  Mondragon Kunshan Indsutrial Park
  Wetside Huangpujiang Rd, Qiandang
  215341 Kunshan, Jiangsu, P.R.C (China)

- **Mondragon Assembly Brazil**
  Rodovia Anhanguera Km. 129 no. 5091, Bloco C
  Bairro Salto Grande - Americana · S.P. (Brazil)

- **Mondragon Assembly India**
  F-89/8, 1st&2nd Floor
  Okhla Industrial Area-Phase I
  110020 New Delhi (India)


HUMANITY AT WORK MONDRAGON

MONDRAGON ASSEMBLY

Solutions for Photovoltaic System

With us it´s possible

MONDRAGON ASSEMBLY

# INDEX

# Mondragon Corporation

Sales and production presence around the world in the industrial, financial, retail and knowledge sectors:

- Finance
- Industry
- Knowledge
- Retail

Mondragon is one of the leading Spanish business groups, integrated by autonomous and independent cooperatives with production subsidiaries and corporate offices in 41 countries and sales in more than 150.

**11.875**
IN TOTAL REVENUE (MILLION €)

**260**
BUSINESSES AND COOPERATIVES

**74.117**
EMPLOYEES

**15**
TECHNOLOGY CENTRES




# Mondragon Assembly

## About us

Mondragon Assembly is an international group specialising in the development of automation and assembly solutions. The parent company in Spain was created in 1977, one of the pioneers in the development of production and assembly technologies. The Group currently has six production plants in Spain, Mexico, France, Germany, China and Brazil, and a subsidiary in India. We also have a strategic network of commercial offices in leading world economies.

Thanks to the continuing success of our customers, we operate in numerous sectors: solar energy, automotive, domestic appliance components, cosmetics, medical devices and electronic components.

- Over 300 employees around the world
- Over 50M€ in sales
- 6 production plants around the world
- 40 years experience
- Innovative production technology




**WE ARE PART OF THE MONDRAGON CORPORATION, THE LARGEST COOPERATIVE GROUP IN THE WORLD. ESTABLISHED IN 1954, THIS CONSTANTLY EXPANDING GROUP INCLUDES OVER 260 COMPANIES EMPLOYING 75.000 PEOPLE.**

### QUALITY

All Mondragon Assembly products are manufactured using top quality materials and are subjected to stringent quality controls, ensuring the safety of the people that interact with our lines and the quality of all of our processes, in collaboration with companies and institutions that certify the quality of our products.

Certifications: ISO 9001, OSHAS, etc.

### OUR CUSTOMERS

Our innovative spirit, management excellence and closeness to the customer are the three values that have made Mondragon Assembly a benchmark group for customers worldwide.

### COMPANY SOCIAL RESPONSIBILITY

We are a socially responsible group committed to people and their environment. A group that makes a significant effort to develop new manufacturing applications and systems to reduce energy consumption, thereby increasing their efficiency and favouring sustainable development.

# Solar Energy

Mondragon Assembly is an internationally recognized producer of equipment for the manufacture of solar panels. We design and provide turnkey production lines and machinery for photovoltaic systems. We have been providing innovative manufacturing technology for more than fifteen years.

Mondragon Assembly provide their clients with solutions and services throughout the entire value chain:

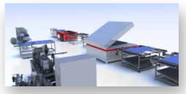
- Turnkey solutions with a capacity of between 15MW and 200MW per year
- Automatic and/or semi-automatic machinery: Tabber&Stringer + Layup, Interconnections, Cell Tester&Sorter, Laminators, Framing and machinery for Testing Photovoltaic Modules
- Design, specifications and sale of raw materials and consumables, development and certification of modules
- Training and know-how transfer
- Personalized solutions: Mondragon Assembly's engineering team offers their experience to help you develop your project

**Exclusive product development**

- Design and certification
  - ECO modules
  - Bifacial
  - BIPV
  - Desert tech
- Raw materials

MONDRAGON ASSEMBLY

Your technological partner



**Automatic production line**

- Tailored lines
- State-of-the-art technology
- Flexibility:
  - Product
  - Capacity
  - Automation level

100% GUARANTEE

100% SERVICE

100% SATISFACTION

**Long term partnership**

- Full installation and commissioning program
- Maintenance programs
- After sales service

KNOW HOW

**Full Know how transfer**

- Product and process engineering
- Full training program

# Solar Energy

## Turnkey Solar Manufacturing Line

**100-200MW**

The 100-200MW manufacturing line is a high capacity automatic solution for the assembly of photovoltaic modules.

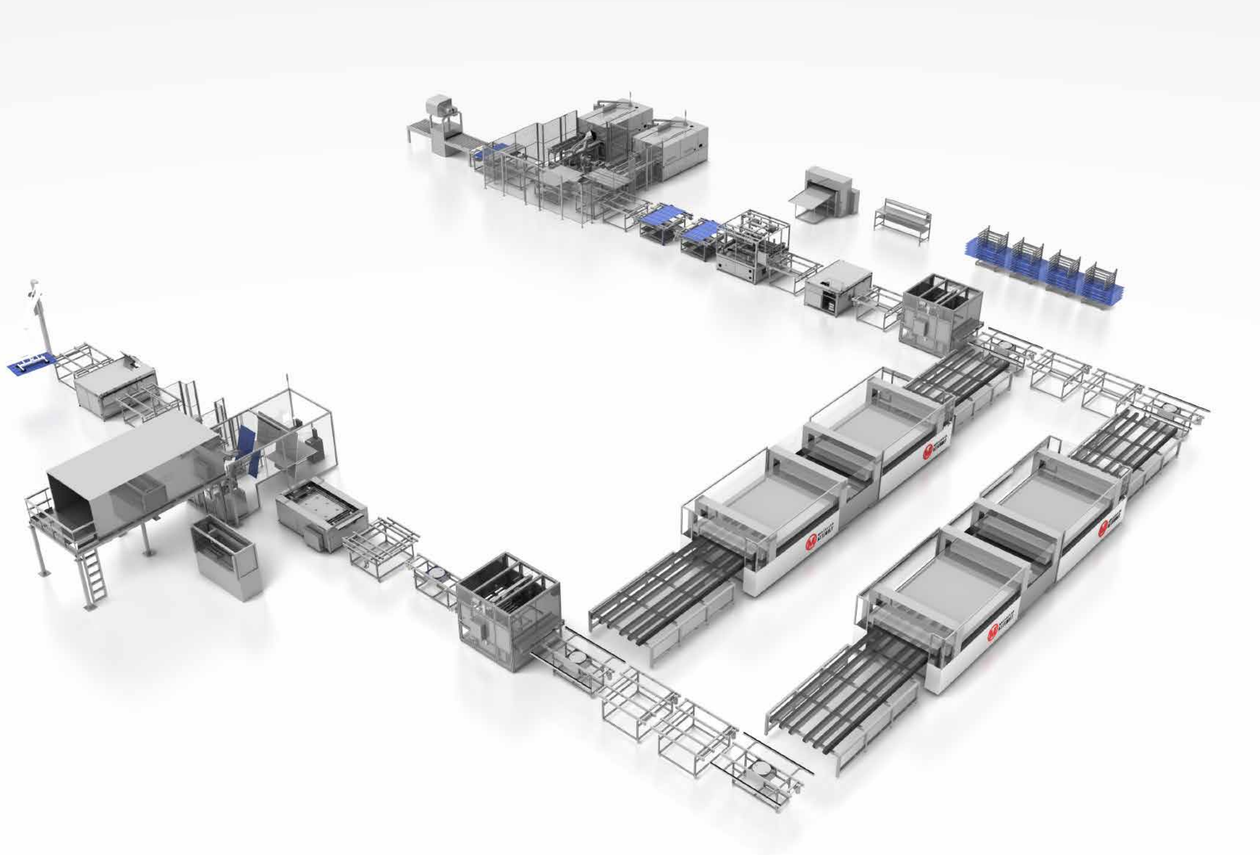
- State-of-the-art technology
- Fully automated industrial solution
- High quality, efficiency and capacity
- Quality control system: cells, strings, modules
- Rapid return on investment

| 100 - 200 MW PRODUCTION LINE | |
|---|---|
| Installed Power | 400 - 800 kW |
| Power Consumption | 200 - 400 kW |
| Air Consumption | 5.000 - 10000L/Min. |
| Required Area (L x W) | 1750 - 3000 |
| Operators | 20 - 35 |
| Modules/hour | 60 - 120 |

### Advantages

- Fully automated Tabber and Stringer
- Automatic interconnection
- Fully integrated lines
- Advanced lamination process
- Complete quality control system for cells, strings and modules
- Balanced production
- Full MES system





# Solar Energy

## Turnkey Solar Manufacturing Line

**50MW**

The 50MW manufacturing line is a high capacity automatic solution for the assembly of photovoltaic panels.

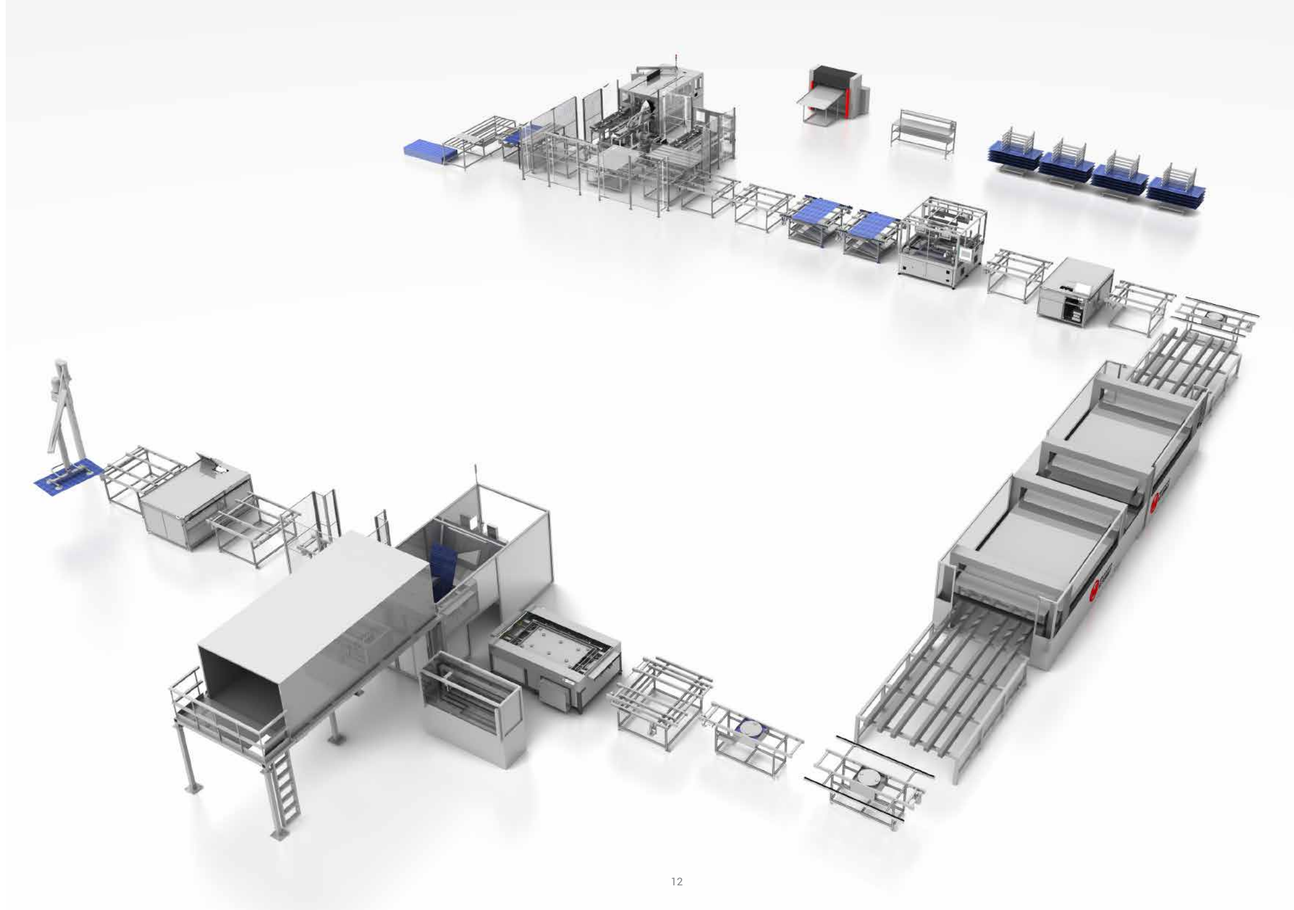
- State-of-the-art technology
- Fully automated industrial solution
- High quality and efficiency
- Modular production and automation capacity
- Quality control system: cells, strings, modules

### Advantages

- Fully automated Tabber and Stringer
- Automatic lay-up
- Fully integrated lines
- Complete quality control system for cells, strings and modules

| 50 MW PRODUCTION LINE | |
|---|---|
| Installed Power | 200 kW |
| Power Consumption | 100 kW |
| Air Consumption | 3000L/Min. |
| Required Area (L x W) | 1250 |
| Operators | 15 - 18 |
| Modules/hour | 30 |





# Solar Energy

## Turnkey Solar Manufacturing Line

### 30MW

The 30MW manufacturing line is a semi-automatic medium-capacity solution for the assembly of high quality photovoltaic panels.

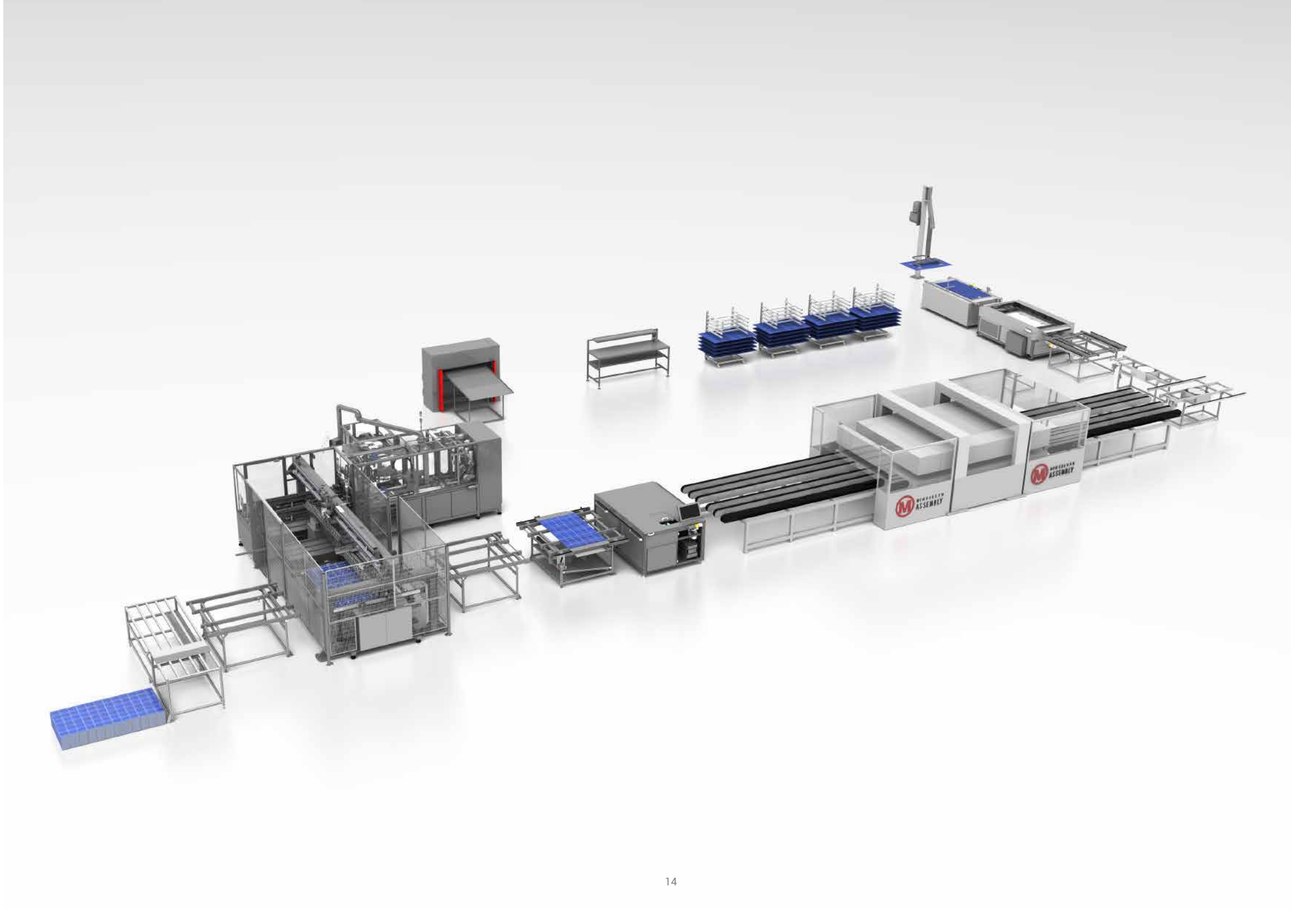
- Medium production capacity
- High quality and efficiency
- Production capacity and modular automation
- Fully automated critical processes
- Flexibility to manufacture different types of modules

### Advantages

- Fully automated Tabber and Stringer
- Automatic lay-up
- Fully integrated lines
- Complete quality control system for cells, strings and modules

| 30 MW PRODUCTION LINE | |
|---|---|
| Installed Power | 150 kW |
| Power Consumption | 75 kW |
| Air Consumption | 2500L/Min. |
| Required Area (L x W) | 500 |
| Operators | 10 - 12 |
| Modules/hour | 20 |





# Solar Energy

## Turnkey Solar Manufacturing Line

### 15MW

The 15MW manufacturing line is a semi-automatic solution to assemble high quality solar panels.

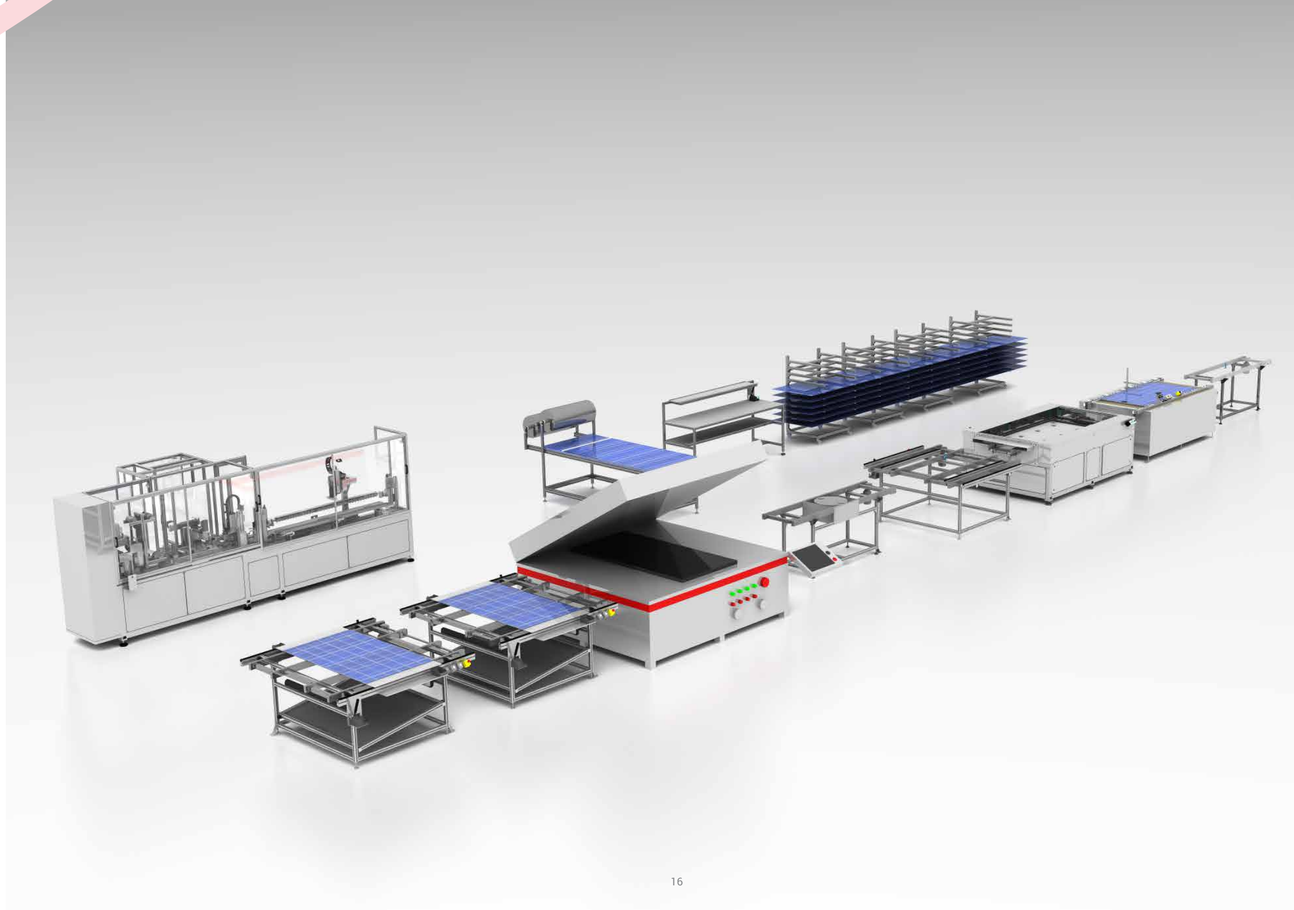
- Cost effective investment
- Production capacity and modular automation
- Fully automated critical processes
- Flexibility to manufacture different types of modules

| 15 MW PRODUCTION LINE | |
|---|---|
| Installed Power | 80 kW |
| Power Consumption | 40 kW |
| Air Consumption | 1500L/Min. |
| Required Area (L x W) | 250 |
| Operators | 6 - 9 |
| Modules/hour | 10 |

### Advantages

- Fully automatic Tabber and Stringer and cell quality control system
- Fully integrated lines

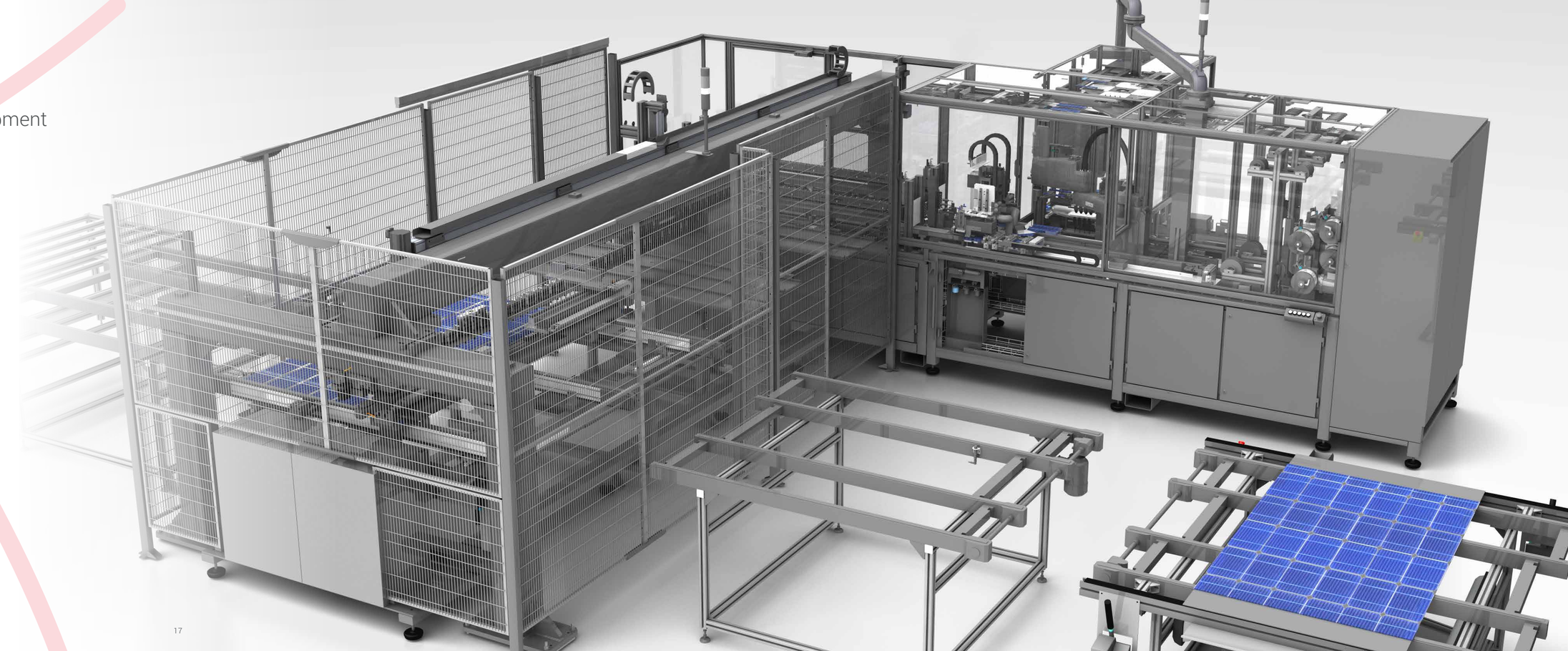




# Solar Energy

## Solar manufacturing equipment

### Tabber and Stringer



# Solar Energy

## Tabber and Stringer

### Tabber and Stringer GTS18

Easily configurable Tabber and Stringer with state-of-the-art technology. Capacity of 60MW/year.

#### Function

The main function of the Tabber and Stringer is to make cell strings, interconnection electrically the PV cells with ribbon by mean of contactless IR tech. Quality of both, cells and strings are checked during the process.

#### Description

Mondragon Assembly's Tabber and Stringer is ergonomic, simple, and has a high production capacity.

Thanks to our knowledge and experience in technological processes and solar equipment, our team offers modular designs with advanced functions, low cost and high performance.

The Tabber and Stringer has four main remarkable elements: Cell quality control using artificial vision, advanced control of the IR soldering process, servo-drives and up to 5 bus bar ribbon power systems.

#### Advantages

- Vision control systems to check the quality of the cells so that defective ones can be detected and regected
- Control of cell temperature to ensure good soldering
- Time control for correct self-diagnostics
- Unlimited number of process formulas, where the same model or module can assume different process parameters, depending on the materials used
- Flexibility for processing different cell models or sizes with a very short change time. We work with cut cells. Up to 1/2 of 6" cells




#### Main features

- Contactless IR soldering so that no stress is generated in the cell
- Flux dispensing onto the bus bar without contact with the cell
- Anti-camber systems to improve the ribbon's alignment
- Artificial vision

| Cell parameters | |
|---|---|
| Cell dimension range | 156 x 156 and cut cells ½ |
| Cell thickness range | 160 - 300 µm |
| Cell geometry | All |
| **Tabs** | |
| Number of tabs per cell | 2 - 3 - 4 - 5 |
| Tabs spacing (2 tabs) | Tab spacing: 2BB: 78 or 75; 3BB: 52; 4BB: 39; 5BB: 31,2mm |
| Tab soldering process | Continuous |
| **Strings** | |
| Number of cells (125 x 125mm) per string | 15 |
| Number of cells (156 x 156mm) per string | 12 |
| Max. string length | 1960mm |
| Distance between cells with string | 2,5 - 160mm (longer on request) |
| Max. number of paralist strings in assembly unit | 8 |
| Max. module size (L x W) | 2000 x 1100mm |
| Min. module size (L x W) | 1400 x 600mm |
| **Tabbing & Stringing** | |
| Cell aligning | Vision System |
| Tabbing & stringing process | One step |
| Flux application method | Automatic, contactless |
| Soldering process | IR |
| **Cell Transport System** | |
| Tabbing & stringing | Conveyor |
| **Loading&Unloading** | |
| Max. number of cells per casette (buffer) | 200 cells (5 cassettes per buffer) |
| Cell loading | Robot Epson |
| String unloading | Layup on glass |
| **Performance features** | |
| Max./nominal throughput | 1850/1800 cells/h |
| Average cell breakage ratio | <0,2 % (with certified cells) |
| **Air&Power supply** | |
| Compressed air pressure & flow | 5 bar 1200 Nl/min |
| Installed power | 70 kW (3Ph, 380 - 420 V, 50 - 60 Hz) |
| Power consumption during heating | Variable |
| Power consumption | 26 kWh |
| **Dimensions** | |
| Weight | 4200kg |
| L x W x H | 5,9 x 2 x 2,1m |
| **System Control & Software** | |
| Hardware | Omron PLC with touch panel |
| Software allowing remote diagnosis | Yes |
| Acquired data compatible with Acess Excel | Yes |

# Solar Energy

## Tabber and Stringer

### Tabber and Stringer TS1400

Very flexible Tabber and Stringer, can make standard modules or special modules using cut cells. User-friendly with a medium-high production capacity of >40MW/year.

#### Function

The main function of the Tabber and Stringer is to make cell strings, interconnection electrically the PV cells with ribbon by mean of contactless IR tech. Quality of both, cells and strings are checked during the process.

#### Description

Mondragon Assembly's Tabber and Stringer is easy to operate, precise and reliable. By just changing a few parameters, we can immediately change the string.

Thanks to our knowledge and experience in technological processes and solar equipment, our team offers modular designs with advanced functions, low cost and high performance.

The Tabber and Stringer has four main remarkable elements: Cell quality control using artificial vision, advanced control of the IR soldering process, servo-drives and up to 5 bus bar ribbon power systems.

#### Advantages

- Vision control systems to check the quality of the cells so that defective ones can be detected and regected
- Control of cell temperature to ensure good soldering
- Time control for correct self-diagnostics
- Unlimited number of process formulas, where the same model or module can assume different process parameters, depending on the materials used
- Flexibility for processing different cell models or sizes with a very short change time. We work with cut cells. Up to 1/2 of 6" cells



#### Main features

- Contactless IR soldering so that no stress is generated in the cell
- Flux dispensing onto the bus bar without contact with the cell
- Anti-camber systems to improve the ribbon's alignment
- Artificial vision

| Cell Parameters | |
|---|---|
| Cell dimension range | Cut cells of 6": ⅛"; ¼", ⅙". Other to be studied |
| Cell thickness range | 160 - 300 µm |
| Cell geometry | All |
| **Tabs** | |
| Number of tabs per cell | 2 - 3 - 4 - 5 |
| Tabs spacing (2 tabs) | Tab spacing: 2BB: 78 or 75; 3BB: 52; 4BB: 39; 5BB: 31,2 (Minimum 25mm) |
| Tab soldering process | Continuous |
| **Strings** | |
| Number of cells (125 x 125mm) per string | 15 |
| Number of cells (156 x 156mm) per string | 12 |
| Max. string length | 1960mm |
| Distance between cells with string | 2,5 - 160mm (longer on request) |
| Max. number of paralist strings in assembly unit | 8 |
| Max. module size (L x W) | 2000 x 1100mm |
| Min. module size (L x W) | 1400 x 600mm |
| **Tabbing & Stringing** | |
| Cell aligning | Vision system |
| Tabbing & stringing process | One step |
| Flux application method | Automatic, contactless |
| Soldering process | IR |
| **Cell Transport System** | |
| Tabbing & stringing | Walking Beam |
| **Loading&Unloading** | |
| Max. number of cells per casette (buffer) | 200 cells (5 cassettes por buffer) |
| Cell loading | Adept S800 Scara Robot |
| String unloading | Layup on glass |
| **Performance features** | |
| Max./nominal throughput | 1400/1300 cells/h |
| Average cell breakage ratio | <0,2 % (with certified cells) |
| **Air&Power supply** | |
| Compressed air pressure & flow | 5 bar 750 Nl/min |
| Installed power | 31 kW (3Ph, 380 - 420 V, 50 - 60 Hz) |
| Power consumption during heating | 12 kWh |
| Power consumption | 6 kWh |
| **Dimensions** | |
| Weight | 4000kg |
| L x W x H | 6,5 x 3,2 x 2,1m |
| **System Control & Software** | |
| Hardware | Beckhoff PLC with touch panel |
| Software allowing remote diagnosis | Yes |
| Acquired data compatible with Acess Excel | Yes |

# Solar Energy

## Tabber and Stringer

### Tabber and Stringer TS700

User-friendly and competitive Tabber and Stringer with a production capacity of >25 MW/year.

#### Function

The main function of the Tabber and Stringer is to make cell strings, interconnection electrically the PV cells with ribbon by mean of contactless IR tech. Quality of both, cells and strings are checked during the process.

#### Description

Mondragon Assembly's Tabber&Stringer is user-friendly, but precise and reliable at the same time.

Thanks to our knowledge and experience in technological processes and solar equipment, our team offers modular designs with advanced functions, low cost and high performance.

The Tabber and Stringer has four main remarkable elements: Cell quality control using artificial vision, advanced control of the IR soldering process, servo-drives and up to 5 bus bar ribbon power systems.

#### Advantages

- Vision control systems to check the quality of the cells so that defective ones can be detected and regected
- Control of cell temperature to ensure good soldering
- Time control for correct self-diagnostics
- Unlimited number of process formulas, where the same model or module can assume different process parameters, depending on the materials used
- Flexibility for processing different cell models or sizes with a very short change time. We work with cut cells. Up to 1/2 of 6" cells



#### Main features

- Contactless IR soldering so that no stress is generated in the cell
- Flux dispensing onto the bus bar without contact with the cell
- Anti-camber systems to improve the ribbon's alignment
- Artificial vision

| Cell Parameters | |
|---|---|
| Cell dimension range | Cut cells of 6": ½"; ¼", ⅛". Other to be studied |
| Cell thickness range | 160 - 300 µm |
| Cell geometry | All |
| **Tabs** | |
| Number of tabs per cell | 2 - 3 - 4 - 5 |
| Tabs spacing (2 tabs) | Tab spacing: 2BB: 78 or 75; 3BB: 52; 4BB: 39; 5BB: 31,2 (Minimum 25mm) |
| Tab soldering process | Continuous |
| **Strings** | |
| Number of cells (125 x 125mm) per string | 15 |
| Number of cells (156 x 156mm) per string | 12 |
| Max. string length | 1960mm |
| Distance between cells with string | 2,5 - 160mm (longer on request) |
| Max. number of paralist strings in assembly unit | 8 |
| Max. module size (L x W) | 2000 x 1100mm |
| Min. module size (L x W) | 1400x600mm |
| **Tabbing & Stringing** | |
| Cell aligning | Vision system |
| Tabbing & stringing process | One step |
| Flux application method | Automatic, contactless |
| Soldering process | IR |
| **Cell Transport System** | |
| Tabbing & stringing | Walking Beam |
| **Loading&Unloading** | |
| Max. number of cells per casette (buffer) | 200 cells (5 cassettes per buffer) |
| Cell loading | Adept S800 Scara Robot |
| String unloading | Layup on glass |
| **Performance features** | |
| Max./nominal throughput | 700/650 cells/h |
| Average cell breakage ratio | <0,2 % (with certified cells) |
| **Air&Power supply** | |
| Compressed air pressure & flow | 5 bar 750 Nl/min |
| Installed power | 20 kW (3Ph, 380 - 420 V, 50 - 60 Hz) |
| Power consumption during heating | 8 kWh |
| Power consumption | 6 kWh |
| **Dimensions** | |
| Weight | 3500kg |
| L x W x H | 6,5 x 3,2 x 2,1m |
| **System Control & Software** | |
| Hardware | Beckhoff PLC with touch panel |
| Software allowing remote diagnosis | Yes |
| Acquired data compatible with Acess Excel | Yes |

# Solar Energy

## Tabber and Stringer

### Tabber and Stringer TS600LT

User-friendly and competitive  Tabber and Stringer with a production capacity of >20 MW/year.

#### Function

The main function of the Tabber and Stringer is to make cell strings, interconnection electrically the PV cells with ribbon by mean of contactless IR tech. Quality of both, cells and strings are checked during the process.

#### Description

Mondragon Assembly's Tabber&Stringer is user-friendly, but precise and reliable at the same time.

Thanks to our knowledge and experience in technological processes and solar equipment, our team offers modular designs with advanced functions, low cost and high performance.

The Tabber and Stringer has four main remarkable elements: Cell quality control using artificial vision, advanced control of the IR soldering process, axles equipped with servo-drives and ribbon power systems of 2, 3, 4 and up to 5 bus bar.

#### Advantages

- Vision control systems to check the quality of the cells so that defective ones can be detected and regected
- Control of cell temperature to ensure good soldering
- Time control for correct self-diagnostics
- Unlimited number of process formulas, where the same model or module can assume different process parameters, depending on the materials used
- Flexibility for processing different cell models or sizes with a very short change time. We work with cut cells. Up to 1/2 of 6" cells



#### Main features

- Contactless IR soldering so that no stress is generated in the cell
- Flux dispensing onto the bus bar without contact with the cell
- Anti-camber systems to improve the ribbon's alignment
- Artificial vision

| Cell Parameters | |
|---|---|
| Cell dimension range | Cut cells of 6": ½", ¼", ⅛". Other to be studied |
| Cell thickness range | 160 - 300 µm |
| Cell geometry | All |
| **Tabs** | |
| Number of tabs per cell | 2 - 3 - 4 - 5 |
| Tabs spacing (2 tabs) | Tab spacing: 2BB: 78 or 75; 3BB: 52; 4BB: 39; 5BB: 31,2 (Minimum 25mm) |
| Tab soldering process | Continuous |
| **Strings** | |
| Number of cells (125 x 125mm) per string | 15 |
| Number of cells (156 x 156mm) per string | 12 |
| Max. string length | 1960mm |
| Distance between cells with string | 2,5 - 160mm (longer on request) |
| Max. number of paralist strings in assembly unit | 8 |
| Max. module size (L x W) | 2000 x 1100mm |
| Min. module size (L x W) | 1400 x 600mm |
| **Tabbing & Stringing** | |
| Cell aligning | Vision system |
| Tabbing & stringing process | One step |
| Flux application method | Automatic, contactless |
| Soldering process | IR |
| **Cell Transport System** | |
| Tabbing & stringing | Walking Beam |
| **Loading&Unloading** | |
| Max. number of cells per casette (buffer) | 200 cells (5 cassettes per buffer) |
| String unloading | Layup on glass |
| **Performance features** | |
| Max./nominal throughput | 600/540 cells/h |
| Average cell breakage ratio | <0,3 % (with certified cells) |
| **Air&Power supply** | |
| Compressed air pressure & flow | 5 bar 650 Nl/min |
| Installed power | 15kW (3 Ph, 380 - 420 V, 50 - 60 Hz) |
| Power consumption during heating | 7,2 kWh |
| Power consumption | 3,6 kWh |
| **Dimensions** | |
| Weight | 2500kg |
| L x W x H | 5,6 x 1,7 x 2,1 m |
| **System control &software** | |
| Hardware | Beckhoff PLC with touch panel |
| Software allowing remote diagnosis | Yes |
| Acquired data compatible with Acess Excel | Yes |

# Solar Energy

## Tabber and Stringer

### Tabber and Stringer + Layup

The layup manipulates and inspects the strings coming from the Tabber and Stringer using artificial vision and accurately positions them over the glass + EVA.

Mondragon Assembly's different layups adapt to the capacity of each Tabber and Stringer, from the compact machine with layup integrated into the customizable, to the GTS 18 with 6 axle robot, providing an extremely broad variety of options for our clients.

| Layup Cartesian Robot | |
|---|---|
| Max. panel length | 2000mm |
| Min. panel length | 1400mm |
| Max. panel width | 1100mm |
| Min. panel width | 600mm |
| Máx. panel/h | 40 (60 cells) |
| Camera pixel count | 5 Mpx (only with string check camera option) |
| Reworked strings | 2 positions |
| Máx. no - OK positions | 3, programmable |
| Ends cut range | 8 - 30 (only with cutting station option) |

| Layup Anthropomorphic Robot | |
|---|---|
| Max. panel length | 2000mm |
| Min. panel length | 1400mm |
| Max. panel width | 1100mm |
| Min. panel width | 600mm |
| Máx. panel/h | 60 (60 cells) |
| Camera pixel count | 5 Mpx (only with string check camera option) |
| Reworked strings | 2 positions |
| Máx. no - OK positions | 3, programmable |
| Ends cut range | 8 - 30 (only with cutting station option) |

# Solar Energy

## Interconnection

Mondragon Assembly has the most advanced interconnection system on the market.

### Advantages

Mondragon Assembly IC machine provides soldering with high accuracy and repeatability, by means of state-of-the-art vision cameras and induction soldering, which prevents human error as well as avoiding the formation of hot spots in the panel. Includes automatic feeding, forming and ribbon loading options. Enables a process without operators.

### Features

We offer systems adapted to different production capacities:

| | Model | | | |
|---|---|---|---|---|
| | **IC150** | **IC40** | **IC20** | **IC10** |
| For a production of | 150MW | 120MW | 60MW | 30MW |
| Maximum module size | 2000 x 1100mm | 2000 x 1100mm | 2000 x 1100mm | 2000 x 1100mm |
| Minimum module size | 1400 x 600mm | 1400 x 600mm | 1400 x 600mm | 1400 x 600mm |
| Soldering capacity | 66 points/min (2BB, 3BB, 4BB, 5BB, 6BB) | 36 points/min | 18 points/min | 9 points/min |
| Installed power (3 phases, 380 - 420 V, 50 - 60 Hz) | 55kW | 50 kW | 29 kW | 18 kW |
| Weight | 3400Kg | 3700kg | 3500kg | 3400kg |
| L x W × H (includes conveyor belts) | 2.9 X 3 x 2 x 2m | 3.0 x 3.2 x 2.0m | 3.0 x 3.2 x 2.0m | 2.9 x 3.2 x 2.0m |
| Computer software | Combined PLC and PC with touch panel | | | |
| Software | Allows remote diagnostics and data acquisition compatible with Access and Excel | | | |

| **Features** | |
|---|---|
| Location of soldering point | Ribbon and tab alignment check included using high-resolution camera |
| Flux metering system | Contactless with pressure tank |
| Soldering | Induction, without contact or adding material |
| | Prevents hot spots |
| | Durable permanent soldering. Avoids tool wear |
| Ribbon loading | Manual loading of ribbon on inspection table |
| | Artificial vision check of ribbon position before soldering |
| Ribbon retention | Constant pressure and non-conductive materials, which prevents short-circuits |
| Cooling Circuit | Water closed circuit with cooler |
| Process formulas | There are many possible combinations of parameters |
| | On the configuration panel, different soldering and geometry parameters |
| | can be adjusted and selected |
| Loading and unloading | Automatic, with conveyor belts |
| Change-over | Immediately by software used with the touch panel |
| Compressed air supply | 5 bar, 30 NL/min |

# Solar Energy

## Solar Laminator

### The laminator

Lamination is one of the most critical processes in the solar panel manufacturing line; it ensures the quality and durability of the photovoltaic module.

To ensure your products are top quality, Mondragon Assembly selects the best laminator for the production characteristics defined by the client, offering an optimised production line tailored to your needs.

### Function

Encapsulation of the module by applying the right pressure and temperature to laminate the various components. The crucial factors in the laminating process are the raw materials, temperature, vacuum and pressure.

### Description

The laminator consists of two chambers separated by a flexible diaphragm. The relevant materials are positioned on the glass of the photovoltaic module to be inserted into the laminator. Next, a vacuum is created in the chamber in order to remove the air from the front of the module, pressure and a previously-set temperature are applied, resulting in a compact laminate.

### Features

- Uniformity of temperature
- Machine productivity and availability above 95%, VDI 3423.
- Optimised processes to avoid breakages
- Fast changing of membranes
- Easy integration into a solar panel manufacturing line
- Control panel formula monitoring
- Remote diagnosis

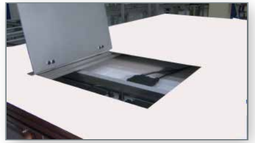

| Production Lines | Capacity |
|---|---|
| 15MW | 2 modules per batch |
| 30MW | 4 modules per batch |
| 60MW | 4 modules per batch |
| 120MW | 8 modules per batch |



# Solar Energy

## PV Module Testing

### EL Inspection



Mondragon Assembly provides systems for all types of applications, from manual laboratory systems to fully automatic online solutions, adapting the characteristics of these to each client's needs.

With their constant eagerness to improve the quality of their products, Mondragon Assembly has developed a new EL inspection system equipped with three high-definition cameras, enabling easy identification of defects that were previously invisible, such as micro cracks, dark areas, finger problems, and short-circuits as cells which may have errors are highlighted.

In the same station there is an option to add a "dark I-V" test.

### Sun Simulator

We select the best sun simulator for the production characteristics defined by the client, offering an optimised production line tailored to your needs.

This machine performs a simple and direct resistance in series assessment in accordance with IEC891 and measures UV light at any radiation level point in the module. This calculates the module's power, archiving the measurement on the machine's computer and printing the module's label with its barcode and measured power. The solar simulators provided by Mondragon Assembly are rated AAA to A+A+A+. The following types can be provided: table or robotic tunnel type, Cartesian or manual.

### HiPot Inspection

This equipment performs electrical isolation tests on the panel.

We comply with international standard IEC-61215 for design and approval certification.

It performs the following test types:

- Dielectric resistance
- Continuity and efficiency tests
- Insulation resistance


### IR Inspection

A thermographic image of the panel is acquired to locate hot spots and dark areas. Any electrical fault in the photovoltaic modules is shown.

# Solar Energy

## Framing

Mondragon Assembly has one of the best framing equipment. Correct framing of the laminates provides mechanical strength to the photovoltaic modules and facilitates their subsequent installation, making it more simple and timely.

### Function

Automatically frames the laminate, fixes the aluminium frame with tape or silicon.

### Advantages

Automises and guarantees the quality of a key process in solar panel manufacture.

### Features

- Automatic loading and unloading of the module
- Two independent perpendicular movements to insert the aluminium profiles around the laminate
- Adjustable for differently sized photovoltaic modules
- Vacuum attachment of the laminate and aluminium frame
- Compatible with: Corner block, crimping or screwing

| Specifications | |
|---|---|
| Closing direction | X - Y |
| Closing force | 195Kg per corner block |
| Module dimensions | Module length: Max. 2000 mm and Min.: 1400 mm |
| | Module width: Max. 1100 mm and Min.: 600 mm |
| | (Adjusted only for two module sizes and easily readjustable in +-5mm from those theorical diemntions) |
| Junction type | Corner block or screw between frames or screw between frames |
| | Silicone or tape between frames and glass |
| Frame width | Min. 35mm and Max. 55mm |
| Corner block size | Max. length 55mm |
| Closing drive | Pneumatic |
| Frame type | Aluminium rail with corner blocks |
| Aluminium rail loading | Manual |
| Laminate loading | Automatic with lifting conveyors |
| Safety | Light guards |
| Dimensions (L x W x H) | 2700 x 1700 x 1000 mm. |
| **Specifications** | |
| Corner block max length (mm) | 55mm |
| Corner-block max and minimum width (mm) | Min. 35mm and Max. 55mm |
| Corner block max insertion force (N) | 195Kg |



# Solar Energy

## Cell Tester and Sorter

The automatic Cell Tester and Sorter machine performs a function and quality test on the photovoltaic cells before commencing production of the modules, classifying them according to their electrical characteristics (current, voltage and/or power, etc.), avoiding defective cells in the production process.

Mondragon Assembly's Cell Tester and Sorter is equipped with an advanced artificial vision system and a (grade A+A+A+) state-of-the-art solar simulator, allowing precise measurement and checking of various electrical parameters:

- Electrical tests: Measurements of electrical parameters and the photovoltaic performance of each cell are obtained using a solar simulator
- Quality tests: Thanks to the artificial vision system, geometrical aspects such as surface quality, ruptures, cracks, etc., can be checked

| Features | |
|---|---|
| Tests included | Vision for geometry of cells and printing. (Ok/NOk ) |
| | Test I - V |
| | Solar simulator (battery classification) |
| | OPTIONAL: EL Vision test (Ok/Nok) |
| Production | 2400 cells per hour |
| Capacity of cells | 8 batteries of 200 cells for initial charge |
| Air pressure | 5 bars, 775 NL/min |
| Utilities | 3 phases, 380 - 420 V, 50 - 60Hz |
| Max. power | 18 kW |
| Average power | 10 kW |
| Dimensions (L x W x H) | 5050 x 2500 x 3200 mm |
| Weight | 3500 kg |
| Interface | Integrated PC with touch panel and illuminated coloured alarm signal |
| Control | Sun simulator PC and PLC control system combined with a Scara robotic computer. All connected by a local network |
| Warranty | 1 year |

### Function

Cells are sorted into batches of normally 4 or 8 classifications and rejects the cells below quality criteria, with the objective of matching cells with similar characteristics and optimising the yield of the production.

### Description

The cell stacks are manually loaded onto the machine. This equipment automatically controls and classifies the cells into 8 quality levels according to their characteristics. This process maximizes the overall production yield, reducing mismatching loses.

The integration of an advanced artificial vision system and a solar simulator provides solid automation, as well as a rapid return on investment and final product quality improvement.

### Advantages

- Improves cell sorting by efficiency
- Reduced overall production line downtime, because only good cells enter to the manufacture process
- Improves quality
- Rapid return on investment
- Small machine dimensions

# Solar Energy

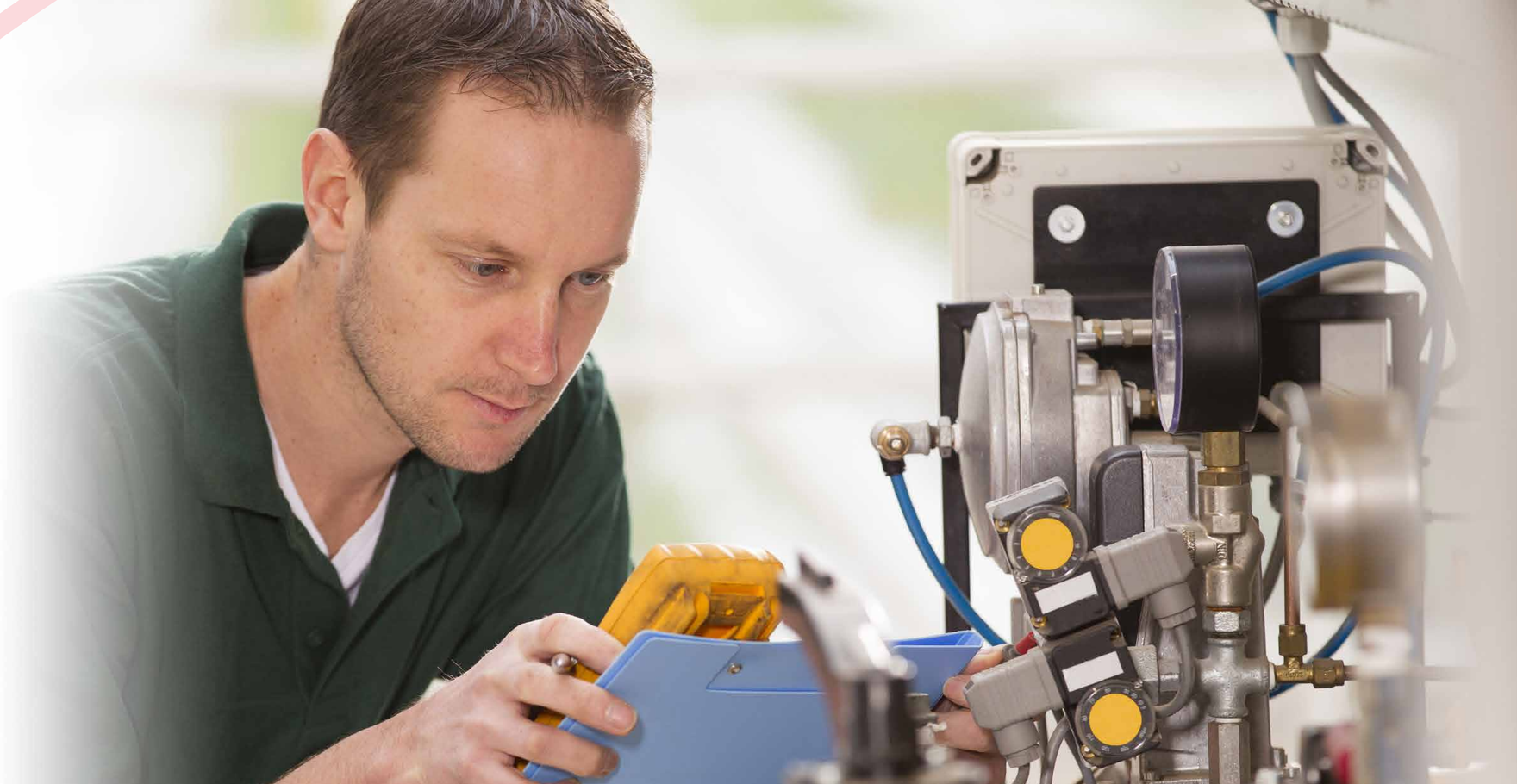
## Solar Services

Mondragon Assembly has an extensive worldwide partner network providing a fast and effective service. In recent years, we have substantially improved our technical support team, offering the best service to our customers, reducing down-time and guaranteeing the constant safety and functionality of our equipment.

Our technical support services include the following, amongst others:

- Over 50 technicians worldwide
- Remote diagnosis. Remote internet connection and diagnosis and solution for most incidents.
- Preventive maintenance programs. Qualified personnel visit to make machinery adjustments and give advice
- Supply of mechanical, electrical, etc., spares. Provision of supplies and raw materials when needed
- Emergency maintenance
- Facility status verification services
- Support and assistance during line commissioning
- Safety inspections and risk analysis
- Modernisation of facilities to revitalise and improve the productivity of older machinery
- Re-engineering of existing lines to improve their performance
- Simplification of the use and maintenance of older equipment by adding new controls
- Equipment and process optimisation
- EC certification for older machinery through modernisation and standard compliance adaptation
- Training programs





# Solar Energy

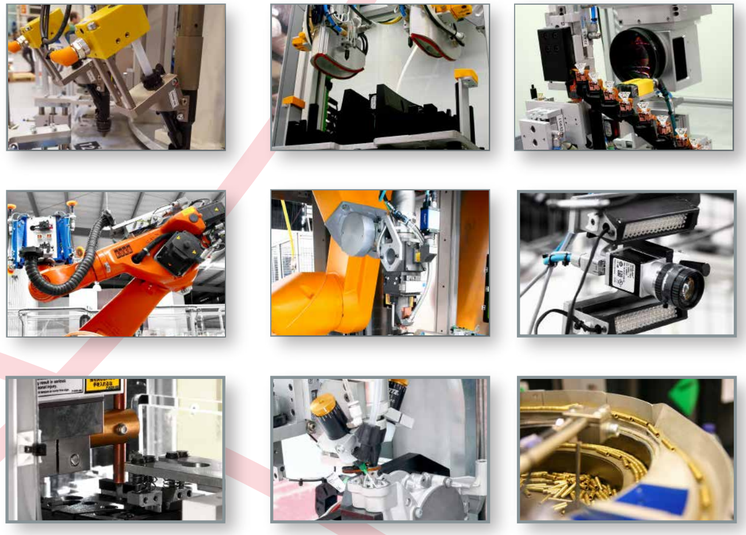
## Technologies

Mondragon Assembly integrates the most advanced technologies on the market into its solutions, pioneering the development of new automation applications.

We have a team of highly qualified and specialised engineers, with extensive product, process and technology experience. We offer automated solutions that best adapt to our customers' needs.

Mondragon Assembly's products include the following applied technologies: robotics, artificial vision systems, advanced linear motors, magnetic transfer systems, welding technology systems and collaborative robotics.

- Feeding technologies
- Handling systems
- Robotics
- Joining / forming technics
- Dispensing
- Marking and identification
- Transfers systems
- Vision systems
- Measurements and control
- Soldering and welding
- Product traceability systems
- Networks





# Solar Energy

## References

Cooperation with research centers:

# NOTES



# NOTES