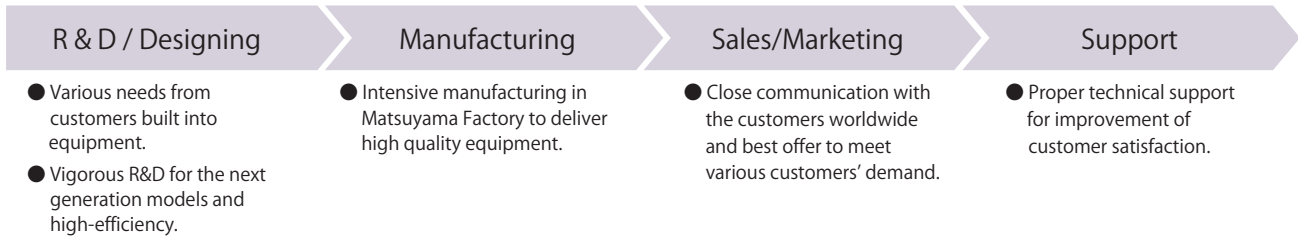


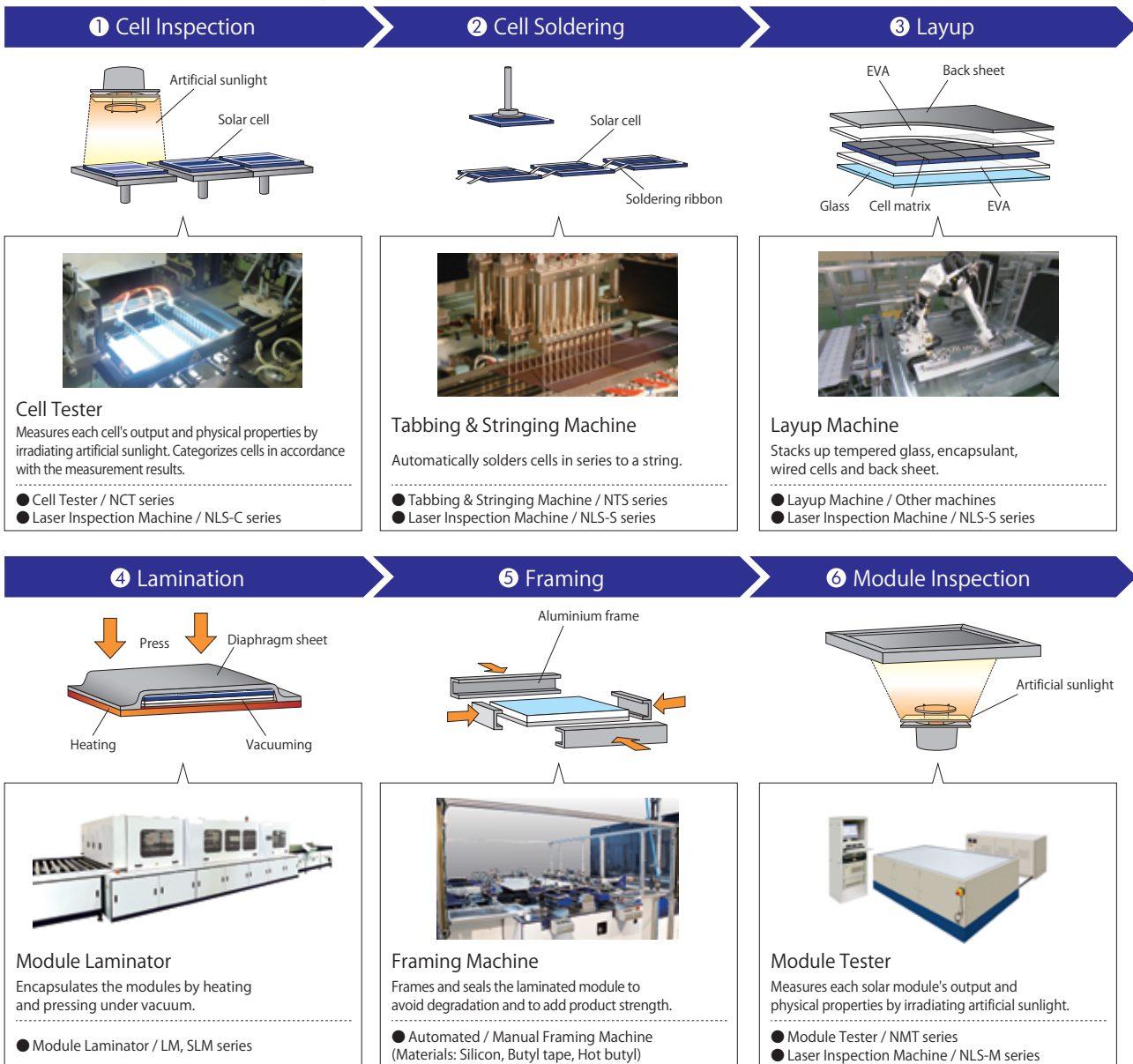
NPC offers the complete lineup for PV module assembly

By having all business functions in-house, from R&D, manufacturing, sales and to customer support , NPC is able to continuously accumulate technical expertise and respond quickly to customers' requests.

【Every Business Function In-House】



【Covering the whole module assembly process】



NPC incorporated

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NPC offers optimized assembly lines for manufacturers of both crystalline silicon and thin-film modules.

NPC's products cover various types of modules for both crystalline silicon type and thin-film type (a-Si, CIS, CIGS, CdTe).

NPC is capable of supplying all types of equipment, from stand-alone machines to complete assembly lines.



Crystalline Silicon Module Assembly Line

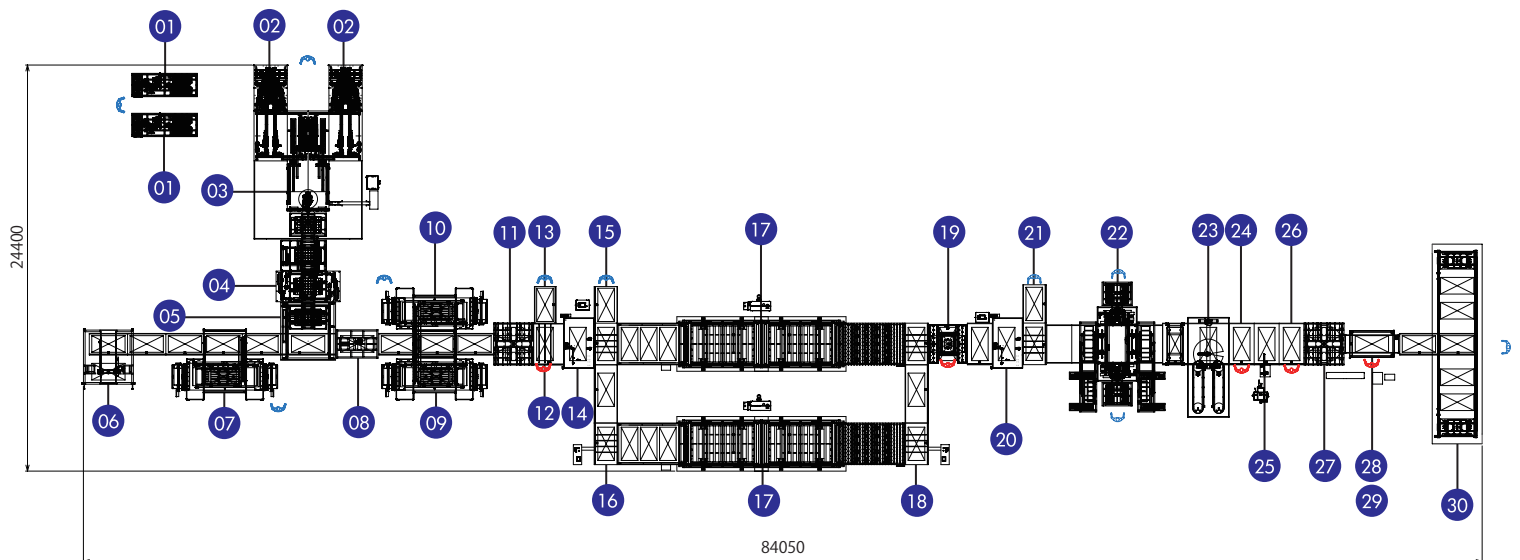
NPC offers total module assembly lines for crystalline silicon modules and engineering technologies. Our lineup covers all types of equipment necessary for module assembly, such as Cell Testers, Tabbing & Stringing Machines, Module Laminators, Module Testers, and other related equipment. Since 1994, we have been continuing R&D to meet various needs of our customers worldwide. Due to these efforts, we have achieved high throughput and uptime ratio, receiving high reputation.

Thin-Film Module Assembly Line

NPC offers total module assembly lines for thin-film modules (a-Si, CIS, CIGS, CdTe). Our lineup covers all types of equipment necessary for module assembly, such as equipment for bussing, lead wiring, glass/EVA/back sheet feeding, lamination and module inspection. Lamination for double-glass modules is also available with NPC technologies. We can also provide appropriate technologies for the bussing process such as taping and soldering with various conductive materials to meet customers' needs.

Crystalline Silicon Module Assembly Line (75 - 80MW)

: Resident Operator : Operator for material exchange



- | | | |
|--|--|--|
| 01 High-speed Cell Tester | 11 Module 90-degree Rotating Table | 21 Rejected Module Discharge Conveyor |
| 02 Double-head Tabbing & Stringing Machine | 12 Ribbon Pick-up Station | 22 Automated Dispenser / Framing Machine |
| 03 Automated Layup Machine | 13 Module Repair Conveyor | 23 Automated J-Box Attachment Machine |
| 04 Automated Bussing Machine | 14 Module Laser Inspection Machine (before lamination) | 24 J-Box Wiring Station |
| 05 Matrix Transfer | 15 Rejected Module Discharge Conveyor | 25 Potting Machine |
| 06 Automated Cover Glass Feeding Machine | 16 Distribution Conveyor | 26 J-Box Cover Install Station |
| 07 Automated EVA Sheet Feeding Machine 1 | 17 2-Step Module Laminator | 27 Module 90-degree Rotating Table |
| 08 20 Steps Module Buffer | 18 Merge Conveyor | 28 Hi-Pot Tester |
| 09 Automated EVA Sheet Feeding Machine 2 | 19 Trimming Machine | 29 Module Tester |
| 10 Automated Back Sheet Feeding Machine | 20 Module Laser Inspection Machine (after lamination) | 30 Module Sorting Machine |

Cell Tester / NCT series

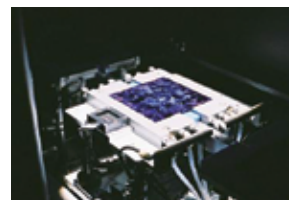
- I-V measurement and automatic sorting of cells into categories
- Class AAA
- Capable of handling high-efficiency cells with efficiency above 22% and back-contact cells
- High productivity by high-speed cell transfer and high-accuracy measurement technology
- Integrating laser inspection unit available as an option



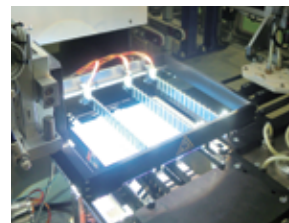
High-speed Cell Tester



R&D Cell Tester



Testing table for back-contact cells



Sunlight simulation

Specifications

Cell size	5 inch cell (125×125mm), 6 inch cell (156×156mm)
Busbar type	Both 2 and 3 busbars (3 busbars for 6 inch cells only)
Cell type	Mono-crystalline cells, poly-crystalline cells, and back-contact cells
Category	Max. 24 physical, 64 virtual categories
Light source	Xenon continuous lamp AM1.5G, Class A (IEC60904-9 Ed.2.0)
Data acquisition	Bipolar power supply + PCI bus high channel count board
Test range	Voltage: +/- 20V, Current: +/- 10A (20A)
Parameters	Full I-V curve, Isc, Voc, Imp, Vpm, Pmax, FF, Efficiency, Rs, Rsh, Iv, Vi, dark I-V curve, and reverse current
Operation	PLC + Touch screen + PC
Throughput*	Single-head type: 1,200 cells/hour High-speed type: 1,600 cells/hour

Options

- Spec. to handle 4 / 5 busbar cells, dot busbar cells, cut cells, back-contact cells
- Crack inspection (cell laser inspection unit)
- Bar-code Reader
- Laser Marking
- Interleaf Paper Feeder

Others

- R&D Cell Tester
Best suited for research and development
Compact size and low cost
- Double-head Cell Tester
Throughput: 2,400 cells/hour (twice of single-head type)
Reduction of footprint

*Subject to change depending on various conditions



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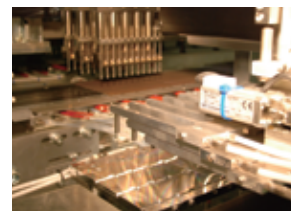
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Tabbing & Stringing Machine / NTS series

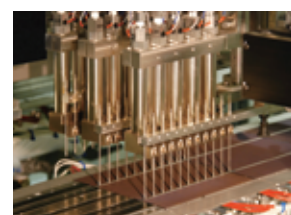
- Automated machine that produces strings by wiring cells with ribbons
- Applicable for various kinds of cells such as mono-crystalline cells, poly-crystalline cells, and 2 / 3 busbar cells
- Quick adjustment for cell size and busbar type by unitization of each part of the machine
- Can handle 4 / 5 busbar cells, cut-cells, Light Harvesting Strings (LHS), and conductive paste (CP) as an option
- Can be combined with automated layup machine for line production



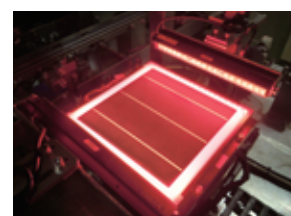
Double-head Tabbing & Stringing Machine



Ribbon transfer



Soldering



Alignment

Specifications

Cell size	5 inch cell (125×125mm), 6 inch cell (156×156mm)
Busbar	Both 2 and 3 busbars (3 busbars for 6 inch cells only)
Camera inspection	Alignment by cell dimensions or busbar dimensions, chip inspection, cell direction inspection
Flux application	Simultaneous application for both sides of the cell with contactless spray nozzles
Soldering	Hot air with heater table, IR lamp ^{*1}
String transfer	Transferred by 7 stainless steel belts with string flip-over
Operation	PLC + Touch screen
Throughput ^{*2}	Single-head type: 600 cells / hour Single-head High-speed type: 800 cells / hour Single-head High-speed type: 1,200 cells / hour Double-head type: 1,200 cells / hour Double-head High-speed type: 1,600 cells / hour

^{*1} Only single-head high-speed type (1,200 cells / hour)

^{*2} Subject to change depending on various conditions

Options

- For 4 / 5 busbar cells
- For cut-cells
- For conductive paste (CP)
- Stacking string trays
- For LHS (Light Harvesting Strings)
- For LRF (Light Redirecting Film)
- Crack inspection (string laser inspection unit)
- Combined unit with Automated Layup Machine

Others

- Compact-type Tabbing & Stringing Machine
The same throughput ability with Single-head Tabbing & Stringing Machine
Downsized 45cm (L), 40cm (W) compared with Single-head
- Tabbing & Stringing Machine for Conductive Film
Reduced cell stresses by low temperature processing: ideal for thinner cells
High stability by low contact resistance
Easy maintenance by non-usage of flux
- IH Tabbing & Stringing Machine
Temperature adjustment by measuring the ribbon surface temperature with pyrometer
- Back-contact Cell Tabbing & Stringing Machine
Able to design machines that meet your requirements



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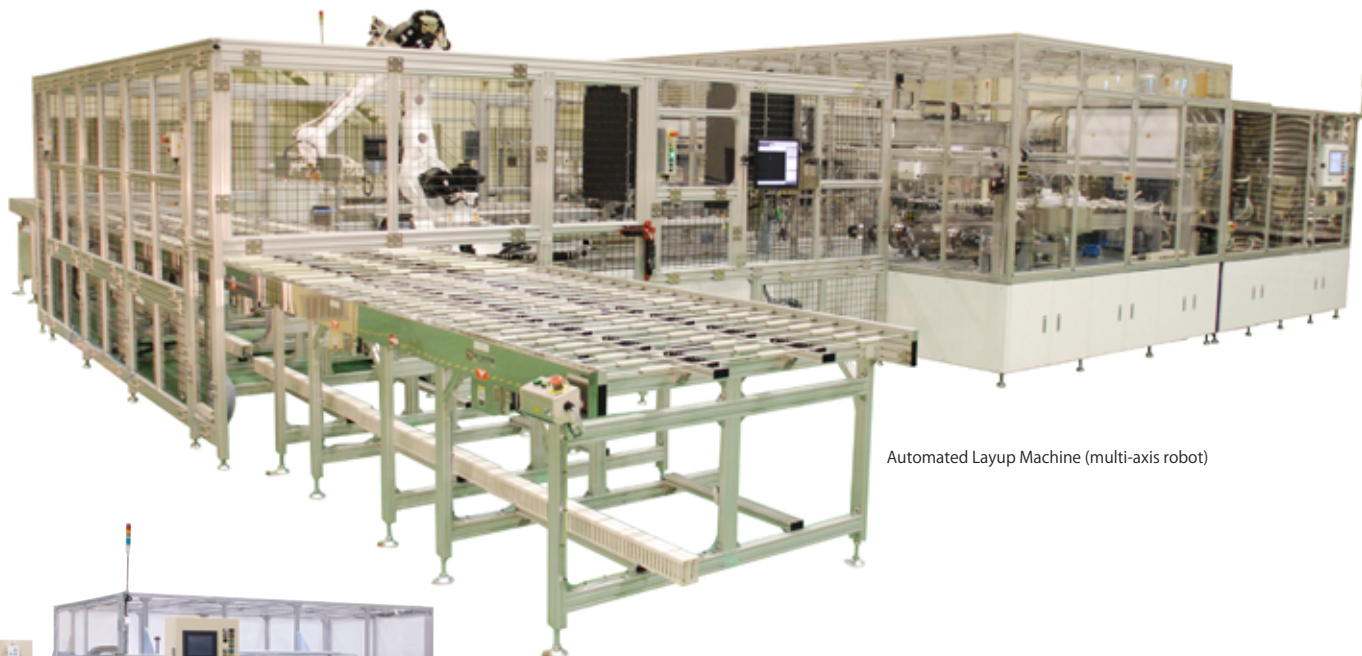
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Layup Machine / Other machines

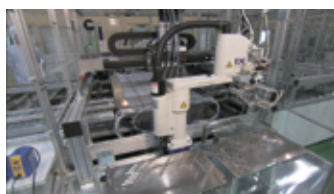
- Automated matrix formation of soldered strings
- Minimum cell breakage using non-contact string alignment
- Flexible machine configuration (automated/semi-automated) for various factory layouts
- Various inspection methods (camera inspection, laser inspection, EL inspection, etc.)



Automated Layup Machine (multi-axis robot)



Automated Sheet Feeding Machine (EVA/back sheet)



Automated bussing machine



Soldering

Specifications (NLU-100×200-R)

Max. matrix size	Standard: 1,000×2,000mm with 6 inch cell: max. 12 cells × 6 lines
String inspection	6-item inspection and alignment at the same time by LED light and camera (Existence of the ribbons/cell gap/cell edge chips/crack inspection/string straightness/string length/alignment)
String transfer	Vacuum and transfer the string by the multi-axis robot
String ribbon cut	Cut the head and end ribbons of the string automatically
Matrix formation / Bussing	1) String is transferred directly onto the Glass/EVA one by one => Bussing on Glass/EVA or 2) String is transferred onto the matrix template => Bussing on template => Matrix after bussing is transferred onto Glass/EVA
Operation	PLC + Touch screen

Options

- Crack inspection (string laser inspection unit / string EL inspection unit)
- String buffer
- Automated flux applicator (apply to the head and end ribbons of the string)
- Automated tape applicator for string connections
- Automated bussing machine

Other machines

- Semi-automated Layup Machine
- Automated Glass Feeding Machine
- Automated EVA/Back Sheet Feeding Machine (roll/cut sheet)
- In-line 20 Steps Buffer (first-in/last-out, first-in/first-out)
- EL Inspection Machine
- Module Laser Inspection Machine



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Module Laminator / LM, SLM series

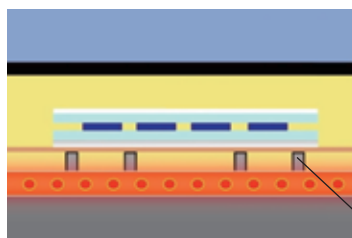
- Encapsulation (lamination) by applying pressure under heated vacuum condition
- More than 1,200 machines delivered throughout the world
- Available for both crystalline and thin-film modules
- High quality lamination with temperature uniformity of $\pm 2^{\circ}\text{C}$
- Various lineup not only for production line but also for R&D



SLM series



LM series (for R&D)



Supporting device pin

Specifications

		LM series (for R&D)	LM series	SLM series	SLM 2-Step series
Usable heating platen size	(W)	200 - 500mm	1,100 - 1,700mm	1,800 - 2,400mm	2,200 - 2,400mm
	(L)	200 - 500mm	1,600 - 2,550mm	3,400 - 4,600mm	3,600 - 4,600mm
Heating system		Cartridge heaters			
Temperature control		Control zones: 1 PID control Temperature uniformity: $\pm 3^{\circ}\text{C}$	Control zones: 3 - 12 PID control Temperature uniformity: $\pm 2^{\circ}\text{C}$	Control zones: 16 PID control Temperature uniformity: $\pm 2^{\circ}\text{C}$	
Press system		Diaphragm press			Diaphragm press 1st step: vacuuming/press 2nd step: main press
Press control		Single step press	3 step press		
Operation		Desktop: analog operation Stand-alone: PLC + touch screen	PLC + touch screen/Max. 32 recipes can be registered	PLC + touch screen/Max. 32 recipes can be registered /Data logging function	
Upper release sheet (auto driving/cleaning function)		—	—	Standard	Standard
Load/unload conveyor		—	Option	Automated	Automated

Options

【All machines】

•Pre-heating conveyor •Hot air press •Pressing at 2 atmospheric pressures •Dry vacuum pump

【SLM 2-Step series】

- Vacuum mechanical press for 2nd step (1st step: vacuuming/press, 2nd step: main press)
Uniform pressing prevents edge pinch of double-glass modules such as BIPV modules, thin-film modules, etc.
- Cooling press for 2nd step (1st step: vacuuming/main press, 2nd step: cooling press)
Cools modules uniformly and shortens the cooling time compared with natural cooling

Others

- 3-Step Module Laminator
Reduces cycle time by separating lamination process into vacuuming, press, and cooling press



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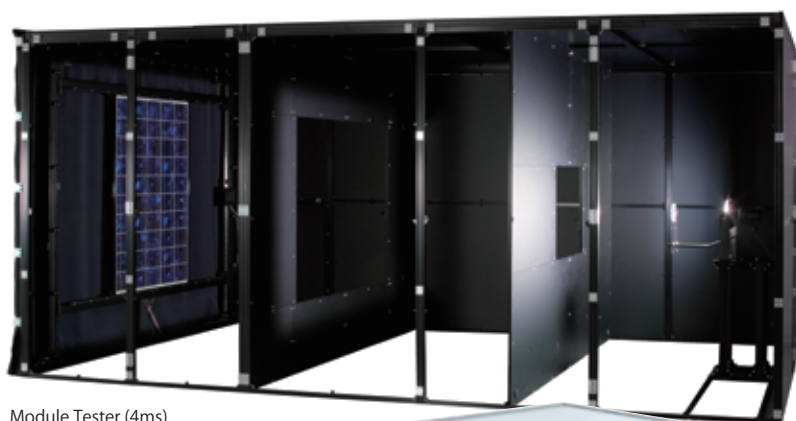
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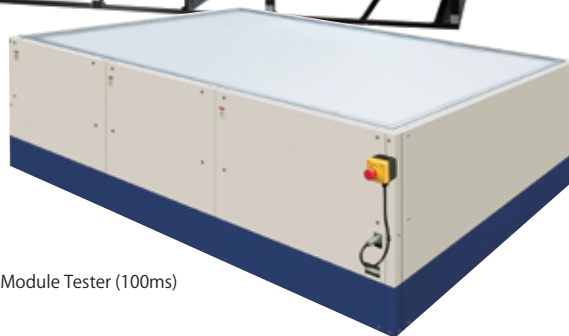
Module Tester / NMT series

- I-V curve and final output measurement for module
- Class AAA
- Simple design, easy maintenance, and low price
- Suitable for a variety of purposes from R&D to mass production (in-line type)
- 100ms pulse width available for high-efficiency module and thin-film module

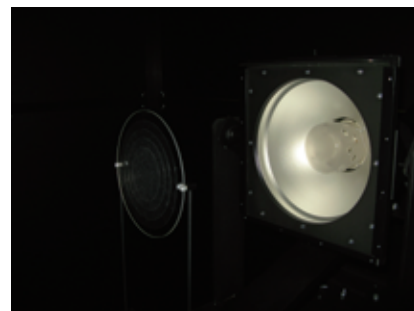
* Restrictions in accordance with module type



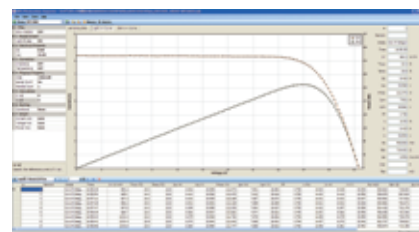
Module Tester (4ms)



Module Tester (100ms)



Light source (4ms)



Measurement software (100ms)

Specifications

	Module Tester (100ms)	Module Tester (4ms)
Irradiance area	1,000 × 1,960mm	1,600 × 2,000mm
Irradiance level	Initial value: 0.7 - 1.1 SUN Adjustable resolution: Less than 0.01 SUN	800 - 1,200W/m ²
Spectrum	AM1.5G Class A (IEC60904-9 Ed.2.0)	
Flashing time	20 - 90ms	4ms
Interval of irradiation	At cycle irradiation: 15sec.	
Irradiance non-uniformity (Within irradiance area)	Below +/- 2% Class A (IEC60904-9 Ed.2.0)	
Testing range	Voltage: 1 - 150V (1, 2.5, 5, 10, 20, 50, 100, 150V) Current: 5 - 50A (5, 10, 20, 50A)	
Measurement parameter	I-V Curve, I _{sc} , V _{oc} , I _{pm} , V _{pm} , P _{max} , FF, Efficiency, R _s , R _{sh}	
Temporal instability	STI (Short Term) : below 10ns Class A (IEC60904-9 Ed.2.0) LTI (Long Term) : below +/- 2% Class A (IEC60904-9 Ed.2.0)	STI (Short Term): Class A (IEC60904-9 Ed.2.0)
Lamp	Pulsed xenon lamp	Xenon lamp
Average lamp lifetime	Approximately 100,000 shots	Approximately 50,000 shots
Irradiation system	• Irradiate the module front surface from downward • Effective irradiation width is adjustable between 10 - 100ms in 1ms increment by setting pulse width	• Irradiate the module front surface vertically • Distance between light source and module: 5.2m

Options

• In-line (load/unload conveyor) • Hi-pot, insulation test devices (wet/dry) • Label printer



NPC incorporated

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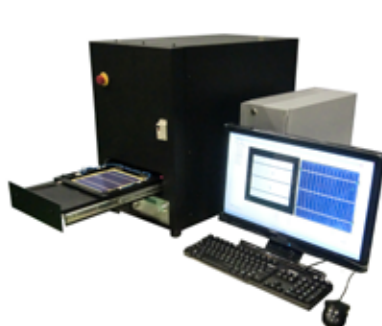
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Laser Inspection Machine / NLS series

- Automated detection of cracks, chips, etc. in cells by irradiating laser beam (patented inspection method*1)
- Available for cells/strings/modules
- Applicable in various fields
- Automated detection of cracks, cutting man-power for visual detection and preventing misjudgments by human error
- Stress reduction on cells/strings/modules during inspection
- Integratable into Cell Testers or Tabbing & Stringing Machines*2



Cell Laser Inspection Machine

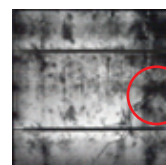


String Laser Inspection Machine

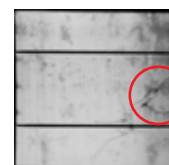


Module Laser Inspection Machine

Comparison of inspection images



EL inspection



Laser inspection

Clearly visualizes cracks only

Specifications

	NLS-C series (for cells)	NLS-S series (for strings)	NLS-M series (for modules)
Cell type	Crystalline cells (including back-contact cells)		
Cell size	5 inch cell (125×125mm), 6 inch cell (156×156mm), cut-cell		
Inspection objects	Crystalline cells	Crystalline strings	Crystalline modules*3
Inspection items	Micro cracks, through cracks, chips, and pinholes		
Inspection time (transfer time is not included)	Approx. 1 sec./cell*4	Approx. 10 sec./10-cell string (Approx. 1 sec./cell)	Standard: approx. 50 sec./module*5

Lineup

Manual inspection	○	○	○
Automated inspection	○	○	○
Integration into other machines	○	○	○ (Built into production lines)

Fields of utilization and expected outcome

R&D, certification authority	Suitable for random inspections or R&D		
Cell manufacturer	Can be applied to pre-shipment inspection of cells		
Module manufacturer	<ul style="list-style-type: none"> • Can be integrated into Cell Testers • Raise the yield of the products at production process by rejecting defective cells 	<ul style="list-style-type: none"> • Can be integrated into Tabbing & Stringing Machines or Layup Machines • Raise the yield of the products by rejecting defective strings in upstream process 	<ul style="list-style-type: none"> • Capable of discharging defective modules from production line by inspecting modules before/after lamination • Can objectively sort modules by existence, size, shape, number, etc. of detected cracks.
System manufacturer	—	—	Suitable for acceptance inspections or inspections before installation of modules

*1 Japanese registered number: 5015341, Korean registered number: 1214884, Taiwanese registered number: 1394967 *2 Depending on machine specifications *3 Modules before/after lamination, modules with bypass diodes and modules with J-box and frames *4 In case of throughput 1,200 cells/hour. Subject to change according to cell type, recipe, materials, and operators *5 In case of 10 cells × 6 lines. Transfer time is not included



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