



## MODEL 7200 Series

### KEY FEATURES

- Adjustable criteria for different process applications or models.
- Flexible algorithms programming editor for mono-crystalline and multi-crystalline silicon solar cells.
- Multiple interfaces to communicate with manufacturing equipment or information system.
- Various defects inspection capability for multilayer LED lighting design.
- Flexible design that can be easily integrated to your in-line printing system and sorting system.

## AUTOMATIC OPTICAL SOLAR CELL/WAFER INSPECTION SYSTEM MODEL 7200 SERIES

Among several factors for PV to achieve grid-parity, reliability of the PV modules plays an important role. Since the cell defects such as edge chips/ flakes, bumps of cell surface are known and proved to be the source of infant mortality of c-Si PV modules, the ways to detect those defects are very important for c-Si cell manufacturers.

Nevertheless, most of cell defects are inherited from wafers. Therefore, the defects inspection of cell and wafer are crucial to PV module's quality and reliability.

Due to the increasing of BIPV and rooftop applications, even the defects that do not directly link to reliability issues such as water mark and surface stain are detected and considered as fail or secondary grade of cells for the c-Si cell buyers.

Conventionally, those defects are visually inspected by operators. However, the inconsistent inspection results caused by human error make the fully automatic optical inspection (AOI) solution becomes an essential equipment for c-Si cell & wafer lines.

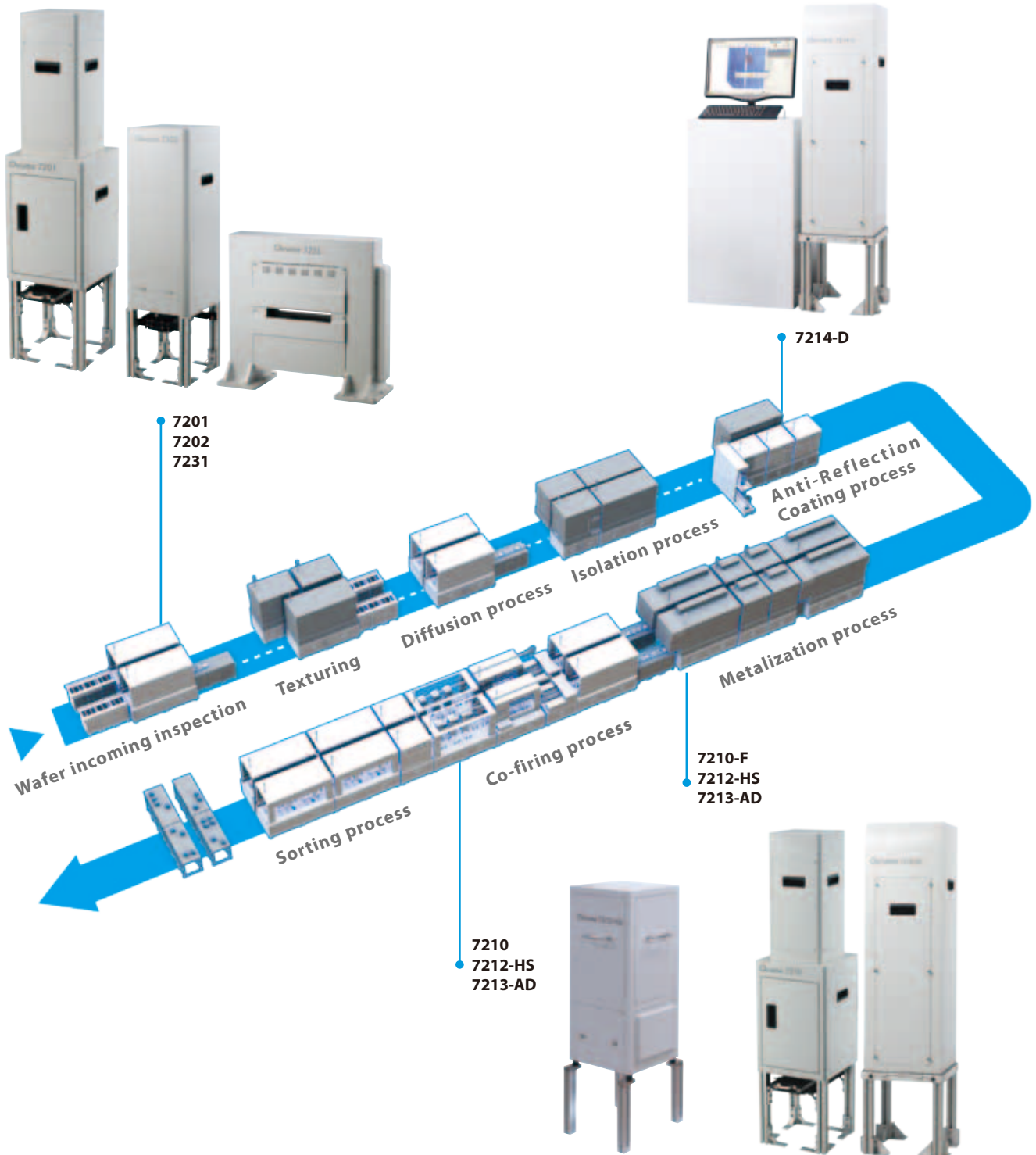
The Chroma 7200 Series AOI inspection systems are specially designed for detecting a wide variety of defects by observing the c-Si cells & wafers of all sizes and crystallizations. Based on the necessity of process, eight inspectors are available for sorting both incoming wafers and final cells.

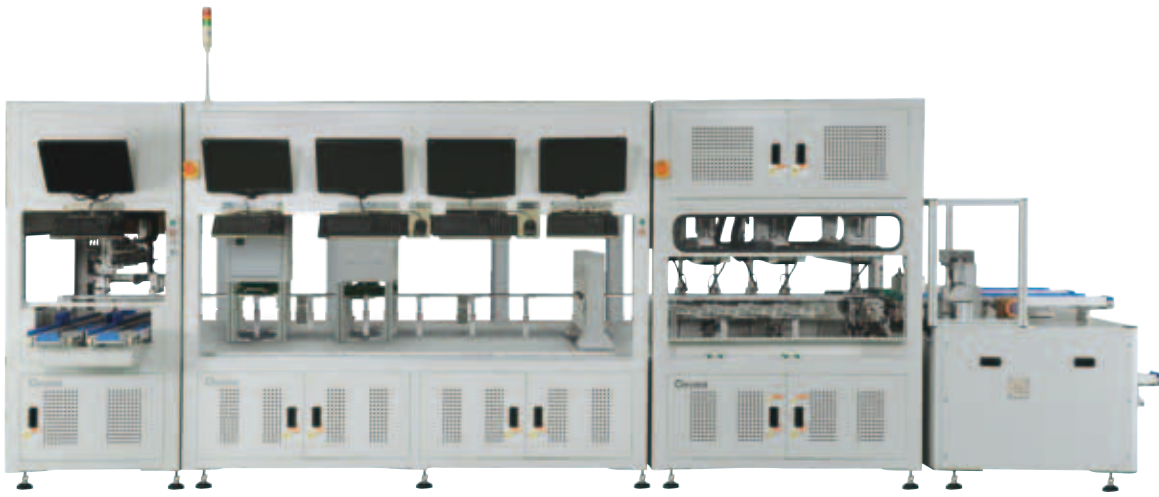


**Chroma**

## SOLAR CELL & WAFER PRODUCTION LINE:

	7201	7202	7210	7210-F	7212-HS	7231	7213-AD	7214-D
Sawmark						✓		
Geometry(Length, angle, area...etc)	✓							
Surface stain(Particle, water mark, finger print...etc)	✓	✓	✓	✓	✓		✓	✓
Printing defect (Fat, interruptions, nodes...etc)			✓	✓	✓		✓	
Color defect (Coloring, variation, spot...etc)			✓					✓





Sorter



Unload

### 3710-HS WAFER INSPECTION SYSTEM

- Good for 5 inches and 6 inches wafer
- High throughput and low breakage rate 0.1%
- 2D geometry inspection
- Surface inspection
- Micro crack inspection
- Saw mark Inspection
- Resistivity/ thickness tester
- Lifetime tester
- Easy trouble shooting
- Loader : coin stack
- Unload : coin stack / cassette

### SOLAR WAFER GEOMETRY AND SURFACE INSPECTOR MODEL 7201

The Chroma 7201 is able to measure the wafer's length, width, diagonal, orthogonal and chamfered size and angle as well as to detect the surface stains. The user friendly software and GUI equipped with versatile parameter settings and results are capable of providing defect display and storage functions for further analysis or potential MES/CIM integration.

- Capable of integrating into any wafer sorters
- Flexible algorithms editor for mono-crystalline, multi-crystalline and quasi-crystalline wafers, and works for both 5" and 6"
- Multiple interfaces to communicate with different equipment or manufacturing execution systems(MES)
- Ready for diamond-saw wafers inspection
- Self-monitoring and calibration system

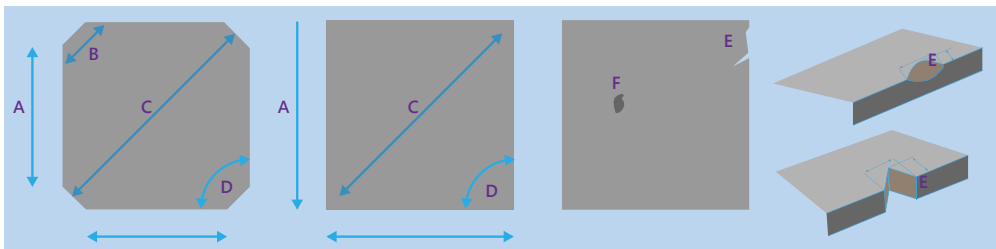
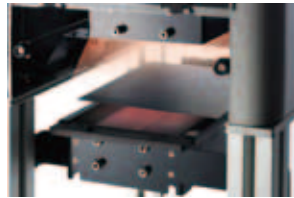


Illustration of 7201 inspection items

- |                   |               |                   |
|-------------------|---------------|-------------------|
| A: Side length    | C: Diagonal   | E: V-cut/chipping |
| B: Chamfer length | D: Orthogonal | F: Stain          |



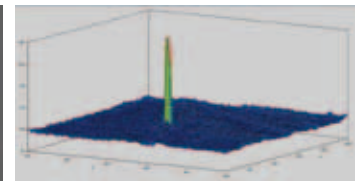
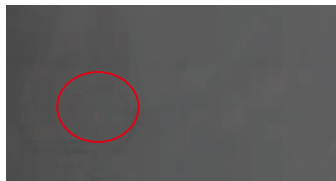
Examples of the grain-size inspection result on 7202

### SOLAR WAFER QUALITY INSPECTOR MODEL 7202

As to the design of 7202, a unique optical technique has been applied to ensure the result of grain-size calculation is highly repetitive. Since the classification of different grain-size could be quantified, the inspected wafers can be applied to the proper cell manufacturing lines to get the highest possible cell efficiency.

The pinhole defect which is known as the cause of  $\mu$ -crack or severe local shunting that may cause reliability issues to the PV module can also be detected by the 7202.

- Capable of integrating into any wafer sorters
- Flexible algorithms editor for mono-crystalline, multi-crystalline and quasi-crystalline wafers, and works for both 5" and 6"
- Multiple interfaces to communicate with different equipment or manufacturing execution systems(MES)
- Unique illumination design to ensure the repeatability of grain-size

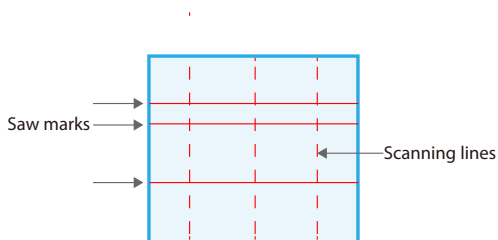


Analysis of pinhole defect

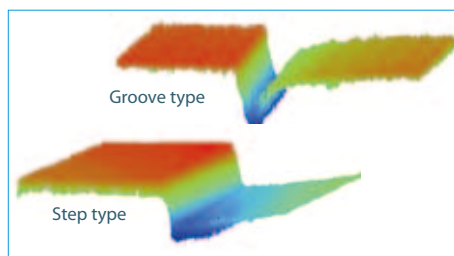
### SOLAR WAFER SAWMARK INSPECTOR MODEL 7231

Sawmarks happened during the wafering process because of the impurities or vibration of the wires. It happens sometimes near the edge and sometimes in the center. By complying with the British standard of EN 50513 2009, Chroma is able to provide the solution to sense the sawmarks in the center.

- Capable of integrating into any wafer sorters
- Flexible algorithms editor for mono-crystalline, multi-crystalline and quasi-crystalline wafers, and works for both 5" and 6"
- Multiple interfaces to communicate with different equipment or manufacturing execution systems(MES)
- Comply with the British standard of EN 50513 2009 to measure different wafer properties



Sawmark inspection methodology



Different sawmark types

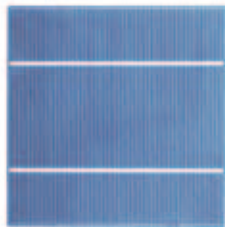
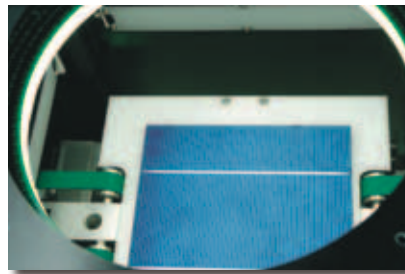
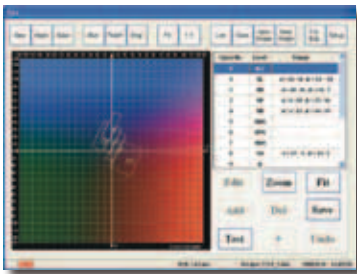


**SOLAR CELL QUALITY CLASSIFIER  
MODEL 7210**

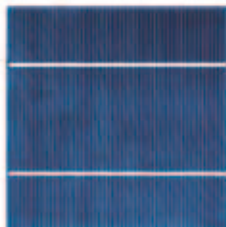
The Chroma 7210 has built two functions which are color sorting and printing inspection in one structure. With the compact "2 in 1" design, it not only optimizes the floor space but also maximizes the performance. As the "metallization" technology goes further in PV industry, the finger width has become narrower. Experts believe that practical finger width through "screen printing" technology would be narrower than 40 μm in the near future, and Chroma's 7210 is able to provide 33 μm/pixel\* solution for Photovoltaic technology innovators.

The Chroma c-Si cell coloring theory was designed to provide high repetitive color classification for c-Si PV cells. The CIE 1931 Lab color space and up to 60x60 grids for entire cell surface allow Chroma to provide numeric color severities down to 3600 blocks throughout the cell under test. Using the color information of each block and the customized algorithm, the user may determine the represented color for non-uniform color cells such as poly-crystalline cells or the cells have uneven anti-reflection coating thickness.

\*Note1: When working with Chroma 3730 Series



Light Blue



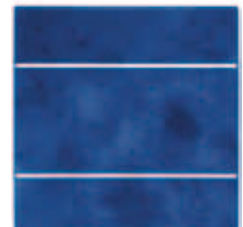
Blue



Dark Blue



Purple

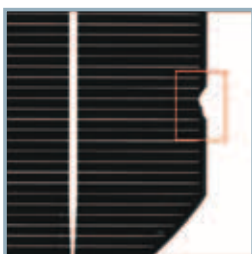
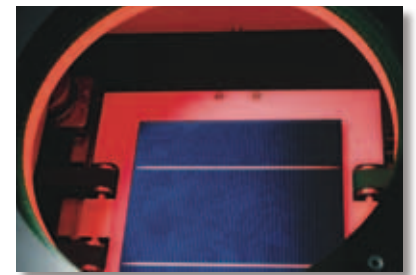


Mix Color

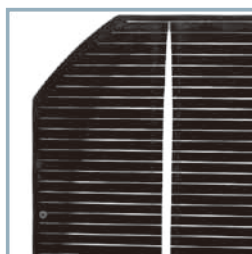
The defects caused by front-side (sunny side) printing process of c-Si PV cells may impact the performance, reliability or appearance. Therefore, a reliable and repetitive inspection of defects such as losing Ag paste on busbars, gridline interruptions, printing shift or rotation, water mark etc., has to be performed to ensure the quality before shipment. The Chroma 7210 solar cell quality classifier has equipped with a high resolution camera and superior software algorithm to recognize the unwanted defects on the front-side of c-Si PV cells.

The Chroma 7210 can be used right after the front-side process to retire cells with major defects. This allows best use of the capacity for the processes like I-V testing and sorting which are known as the bottlenecks of c-Si cell line.

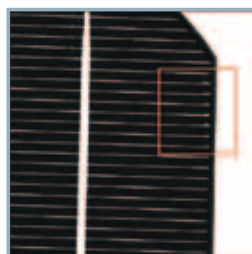
The 7210 can be integrated into in-line or off-line sorter for final inspection prior to shipping.



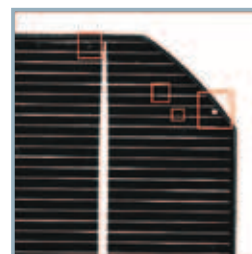
Chipping



Discoloration



Finger Width



Stains

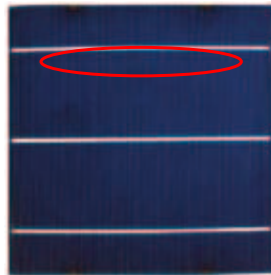
## SOLAR CELL FRONT-SIDE PRINTING AND SURFACE DEFECT INSPECTOR (HIGH-SPEED) MODEL 7212-HS

The Chroma 7212-HS is a line scan AOI inspector that can provide superior defect inspection for PV cells. As the fine grid printing process goes even faster than before, a reliable printing quality inspector is required to reduce the cost during PV cells metallization. The Chroma 7212-HS is able to provide 14µm/pixel resolution that can stop even the finest finger interruptions during the metallization process, and also feed back to the operator for instant response to improve the production yield rate.

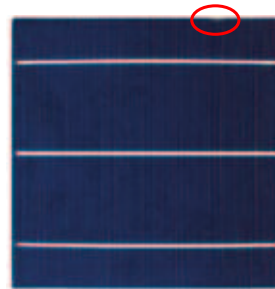
The Chroma 7212-HS can also use 20µm/pixel resolution to make the final quality judgment on the PV cell sorting process. The optical design in Chroma 7212-HS is even better. It can provide superior inspections for defects like stains and finger prints, which have been hurdles in other PV AOI products.



- Integrated with screen printing lines and cell sorting lines from any manufacturers
- Flexible and intuitive SW user interface
- Resolution down to 14µm/pixel
- Superior stain defects detection



Stain detection examples(1)

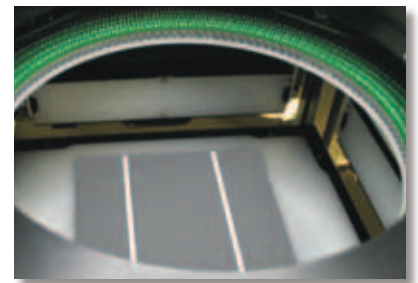


Stain detection examples(2)

## SOLAR CELL BACKSIDE PRINTING AND SURFACE INSPECTOR MODEL 7213-AD

The defects caused by back-side printing process of c-Si PV cells may also impact the performance and reliability. Among all the back-side printing defects, bumps caused by improper printing may cause high cell breakage rate during lamination in c-Si module process. The Chroma 7213-AD c-Si cell back-side printing inspector uses unique lighting technique to detect common back-side printing defects and most demanding bumps.

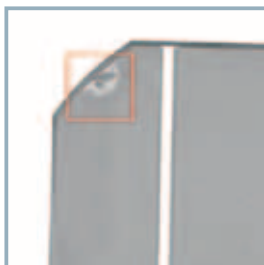
Same as Chroma 7212-HD, Chroma 7213-AD can be used after back-side process to retire cells with major defects. It can also be integrated into in-line or off-line sorter for final inspection prior to shipment.



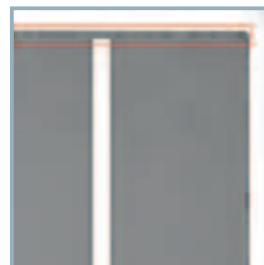
Bump



Busbar Defect



Stain



Alignment Shift

## SOLAR CELL ANTI-REFLECTION COATING INSPECTOR MODEL 7214-D

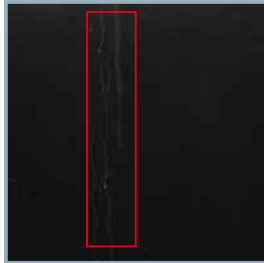
The Chroma 7214-D is the inspector for anti-reflection coating process. With 4M mono CCD and Chroma's experience in RGB illumination design, it can assure that each defined defect can be identified through the customized setup. The Chroma 7214-D can be used right after anti-reflection coating process to ensure that only cells with acceptable color uniformity will go down to the metallization process and the fail cells will be sent out for re-work.

The 7214-D anti-reflection inspector can be applied in discovering (1) Color differences, (2) Brownish stains, (3) Stripe shape watermarks, (4) Particles, (5) Belt marks, (6) Acid marks, (7) Stacking cells and (8) Chippings.

With flexible and hierarchy software design, the customer can set up the criteria to inspect the unique defect that is generated by different PECVD machines.



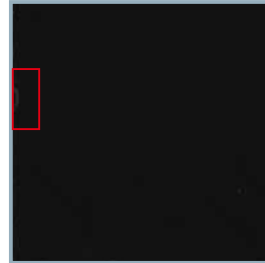
Stain



Watermark stripe shape



Particles



Acid mark

### SPECIFICATIONS

Model	7201	7202	7231
Description	Solar wafer geometry & surface inspector	Solar wafer quality inspector	Solar wafer sawmark inspector
Wafer size	5' or 6' wafers, for mono c-Si, multi c-Si and quasi mono c-Si		
Detection limit	80 $\mu$ m	80 $\mu$ m	5 $\mu$ m
Speed	NA*3	350mm/s	350mm/s
Inspection items	Length, Width, Diagonal, Chamfer length, Pinhole, Stain, Chipping, Grain-size, Sawmark, backside		
UPH*2	3000~3600		
Interface	TCP/IP		
Options	Option: IO,RS-232 RAID, UPS, MES,		

Model	7210 / 7210-F	7212-HS/C8	7212-HS/M12
Camera	25M mono CCD	8K linescan	12K linescan
Resolution	33 $\mu$ m/pixel	20 $\mu$ m/pixel	14 $\mu$ m/pixel
Speed	NA	350mm/s	500mm/s
Light Source	RGB LED strobe lighting	Line Source	
Application	Frontside defect and color inspection	Frontside defect inspection	
Lens	Low distortion lens		
Dimension	320mm x 324mm x 1032mm	340mm x 380mm x 760mm	
Weight	60 kg	70 kg	
Accessory	External keyboard, mouse, PC, monitor		
Interface	Ethernet, Option : IO, RS-232		

Model	7213-AD	7214-D
Camera	4M mono CCD	4M mono CCD
Resolution	90 $\mu$ m/pixel	90 $\mu$ m/pixel
Speed	NA	NA
Light Source	LED strobe lighting	WRGB LED strobe lighting
Application	Backside defect inspection	Anti-reflection coating inspection
Lens	Low distortion lens	
Dimension	320mm x 324mm x 1032mm	
Weight	60 kg	
Accessory	External keyboard, mouse, PC, monitor	
Interface	Ethernet, Option : IO, RS-232	

All specifications are subject to change without notice. Please visit our website for the most up-to-date specifications.

\*Note1 : When work with Chroma 3730

\*Note2 : When work with Chroma 3710-HS

\*Note3 : On-fly inspection on demand, maximum speed is 250mm/s

### ORDERING INFORMATION

**7210** : Solar cell Quality Classifier

**7213-AD** : Solar Cell Backside Printing & Surface Inspector (Diffuser type)

**7214-D** : Anti-reflection Coating Inspector

**7201** : Solar wafer geometry and surface inspector

**7202** : Solar wafer quality inspector

**7231** : Solar wafer sawmark inspector

**7212-HS** : Solar Cell Front-Side Printing and Surface Defect Inspector (High-Speed)



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