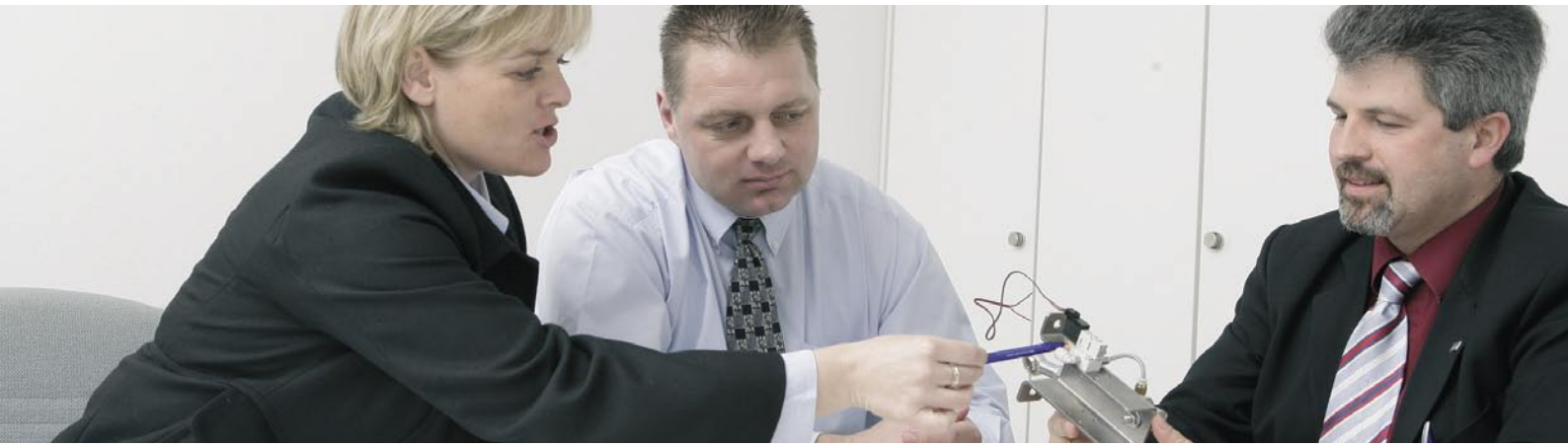
SMC - Experts in the Industry

SMC - Experts in the Photovoltaic Industry

1959-2009 50 years

SMC

Front cover: With over 20 years combined experience, SMC Experts find the perfect customer solution - SMC helping its customers to be superior to their competitors.



SMC - Experts in the Photovoltaic Industry

Expert (noun) - a person who is very knowledgeable about or skilful in a particular area (Oxford English Dictionary)

At SMC we recognise that an ability to fully understand the requirements and issues of any manufacturing process is the key to our and your continued success.

That's the reason why we have developed specialist teams - experts - dedicated to all the major manufacturing industries throughout the world.

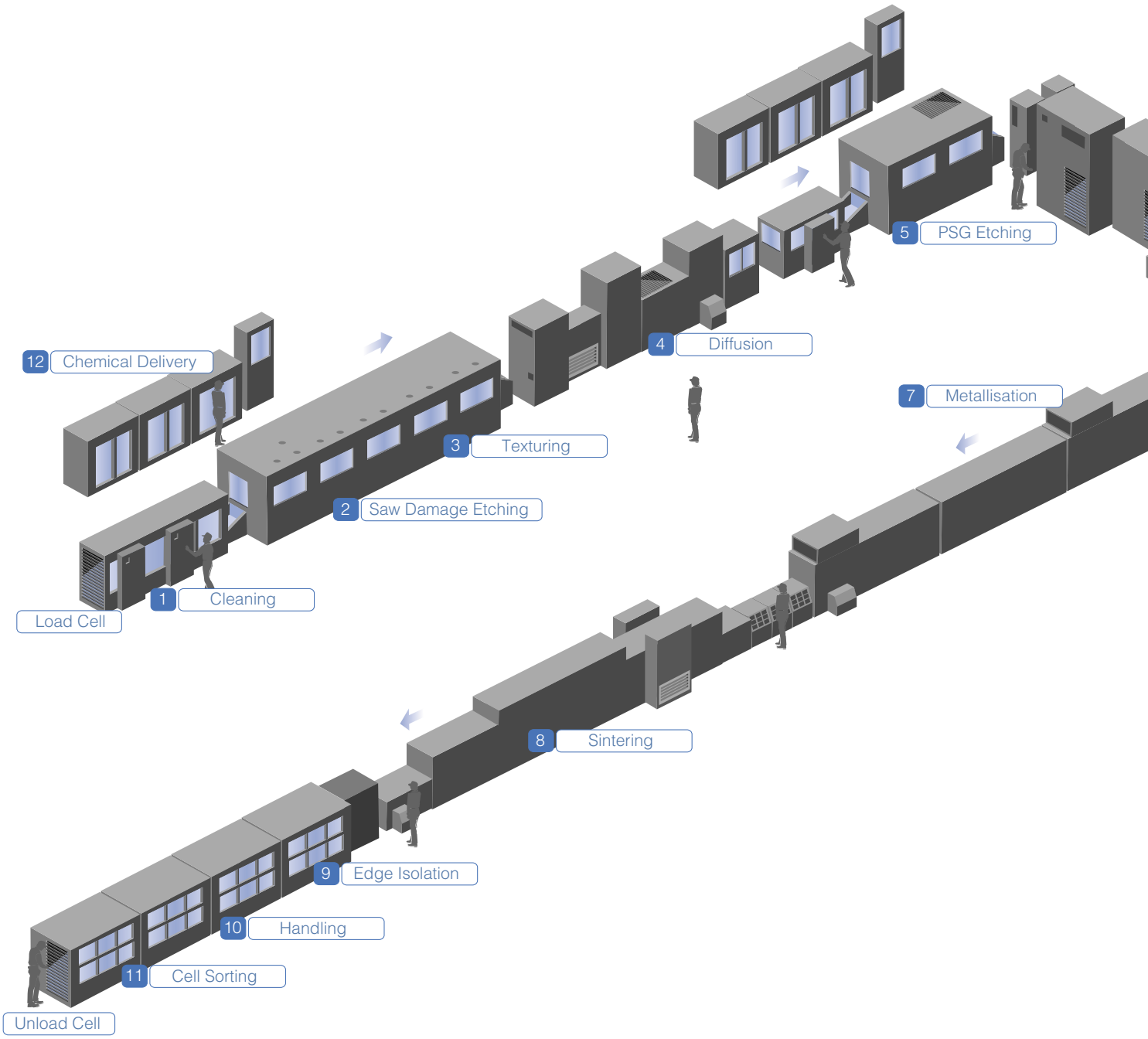
In the Photovoltaic Industry our experts know the stringent requirements that need to be met and all have extensive knowledge of both your production process and your business needs.

We understand the important issues such as the fast and safe handling of cells, the need for a uniform deposition layer and other specific technical requirements unique to the Photovoltaic Industry.

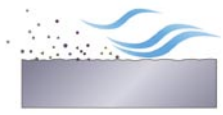
Our experts recognise that maximum operator health and safety is vital and with energy costs increasing at an alarming rate, even the smallest saving can have a real impact on the bottom line as well as the environment.

Photovoltaic Industry

c-Si Cell Manufacturing



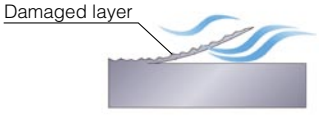
1 Cleaning



Removes particles from the surface of the Si-substrate.

A Handling P.10
E Temperature Control P.13
B Control P.12
F Chemical Products P.14
C Transfer P.12

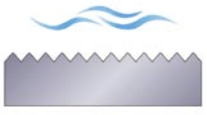
2 Saw Damage Etching



Removes any scratches from the surface of the Si-Substrate and then smooths it out.

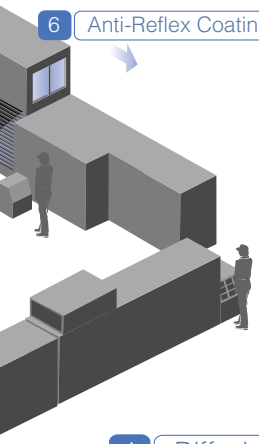
A Handling P.10
E Temperature Control P.13
B Control P.12
F Chemical Products P.14
C Transfer P.12

3 Texturing



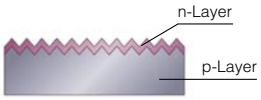
Forms a micro rough surface.

A Handling P.10
E Temperature Control P.13
B Control P.12
F Chemical Products P.14
C Transfer P.12



6 Anti-Reflex Coating

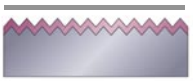
4 Diffusion



Implementation of pn-junction with gas under high temperature.

A Handling ▶P.10
B Control ▶P.12
C Transfer ▶P.12
D High Vacuum ▶P.13

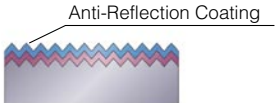
5 PSG Etching



Removal of Phosphore-Silicat glass from Diffusion process.

A Handling ▶P.10
B Control ▶P.12
C Transfer ▶P.12
E Temperature Control ▶P.13
F Chemical Products ▶P.14

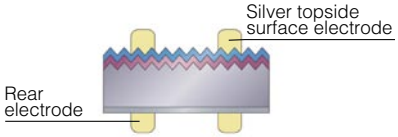
6 Anti-Reflex Coating



Deposition of Anti-Reflex coating.

A Handling ▶P.10
B Control ▶P.12
C Transfer ▶P.12

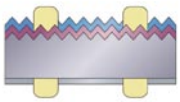
7 Metallisation



Screen printing forms electrodes on the surface on both the front and the back.

A Handling ▶P.10
B Control ▶P.12
C Transfer ▶P.12

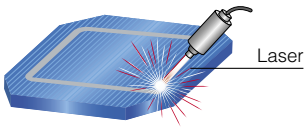
8 Sintering



The silver electrode penetrates the anti-reflective coating and connects to the pn-Layer.

A Handling ▶P.10
B Control ▶P.12
C Transfer ▶P.12
E Temperature Control ▶P.13

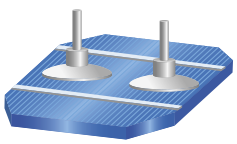
9 Edge Isolation



To prevent a short circuit a groove is cut using a Laser.

A Handling ▶P.10
B Control ▶P.12
C Transfer ▶P.12

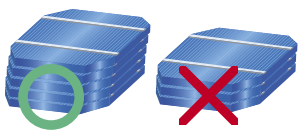
10 Handling



A handling system is used to transport the cell.

A Handling ▶P.10
B Control ▶P.12
C Transfer ▶P.12
D High Vacuum ▶P.13

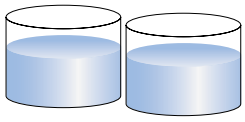
11 Cell Sorting



To measure and sort cells by performance.

A Handling ▶P.10
B Control ▶P.12
C Transfer ▶P.12
E Temperature Control ▶P.13

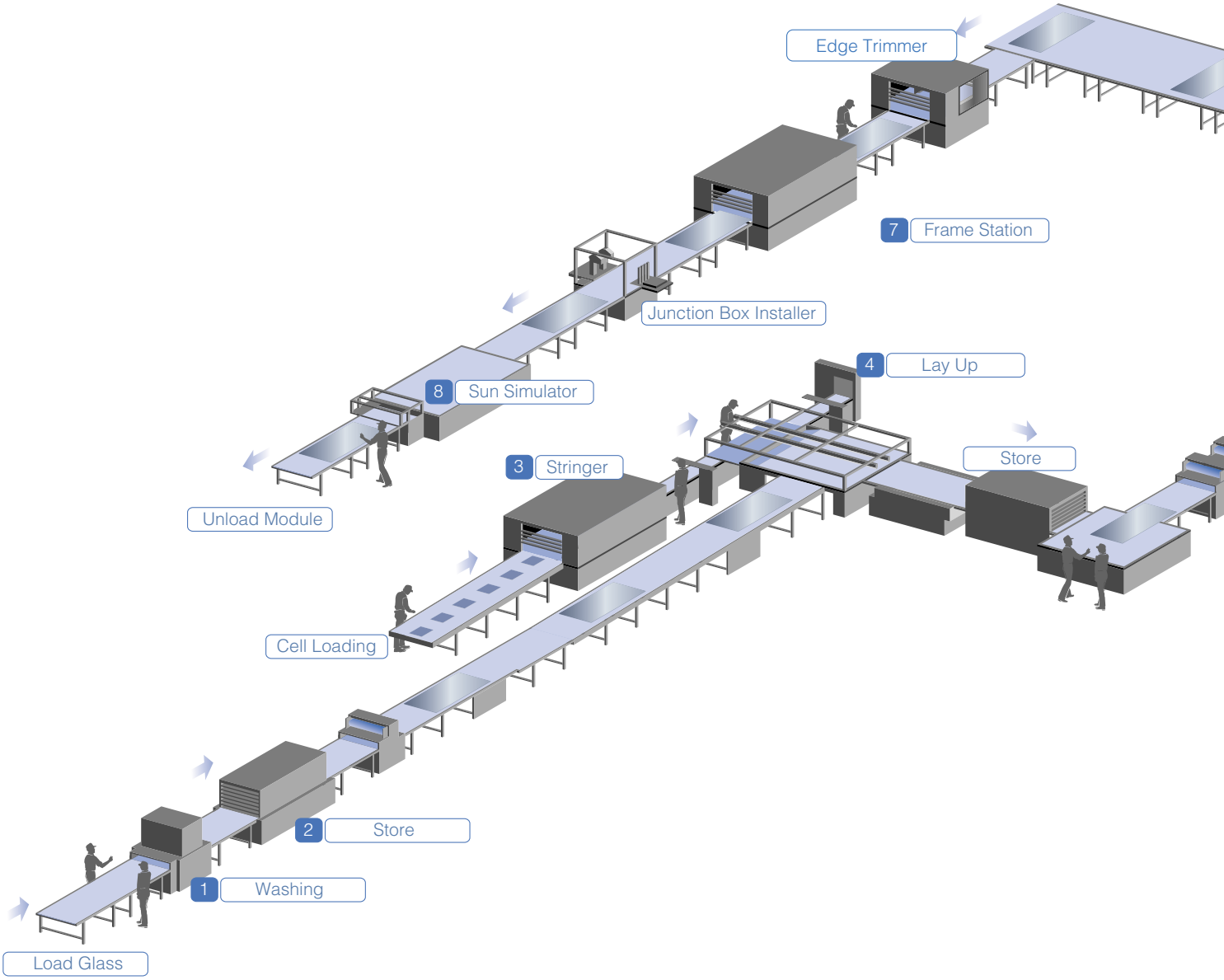
12 Chemical Delivery



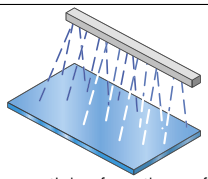
Chemicals are stored in tanks and delivered to the wet benches.

A Handling ▶P.10
B Control ▶P.12
C Transfer ▶P.12
D High Vacuum ▶P.13
E Temperature Control ▶P.13
F Chemical Products ▶P.14
G Static Control ▶P.14

Module Manufacturing



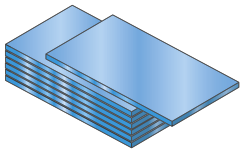
1 Washing



Removes particles from the surface of the glass.

- A Handling ▶P.10
- B Control ▶P.12
- C Transfer ▶P.12
- E Temperature Control ▶P.13
- F Chemical Products ▶P.14

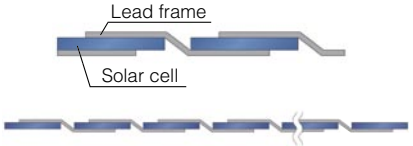
2 Storage



Clean glass store.

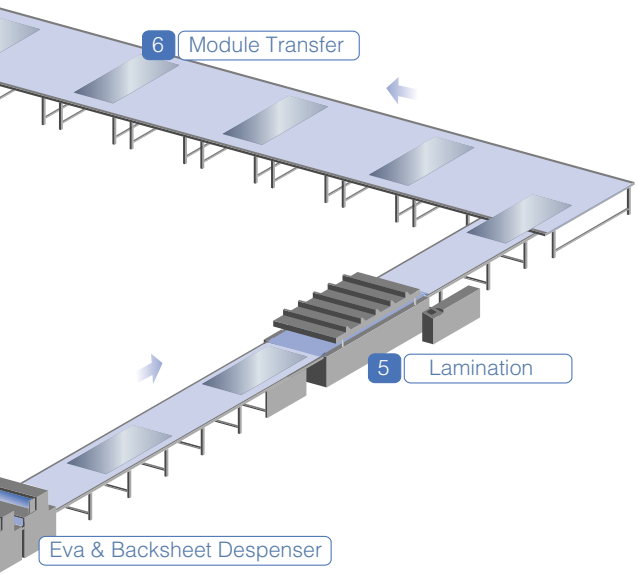
- A Handling ▶P.10
- B Control ▶P.12
- C Transfer ▶P.12

3 Stringer

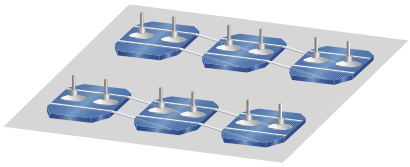


Electrical ribbons are soldering to cells and wired in series.

- A Handling ▶P.10
- B Control ▶P.12
- C Transfer ▶P.12
- E Temperature Control ▶P.13



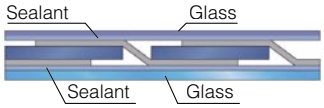
4 Lay Up



Cells are layed-up on the glass.

- A Handling ▶P.10
- B Control ▶P.12
- C Transfer ▶P.12
- G Static Control ▶P.14

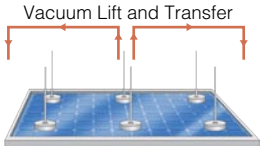
5 Lamination



Under vaccum cells, glass and a foil is encapsulated.

- A Handling ▶P.10
- B Control ▶P.12
- C Transfer ▶P.12
- G Static Control ▶P.14

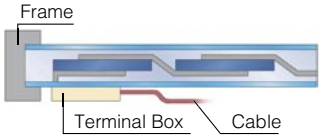
6 Module Transfer



The module is transfered to the next part of the process.

- A Handling ▶P.10
- B Control ▶P.12
- C Transfer ▶P.12

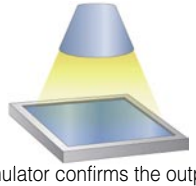
7 Frame Station



An aluminum frame is formed around the panel and a junction box is installed.

- A Handling ▶P.10
- B Control ▶P.12
- C Transfer ▶P.12

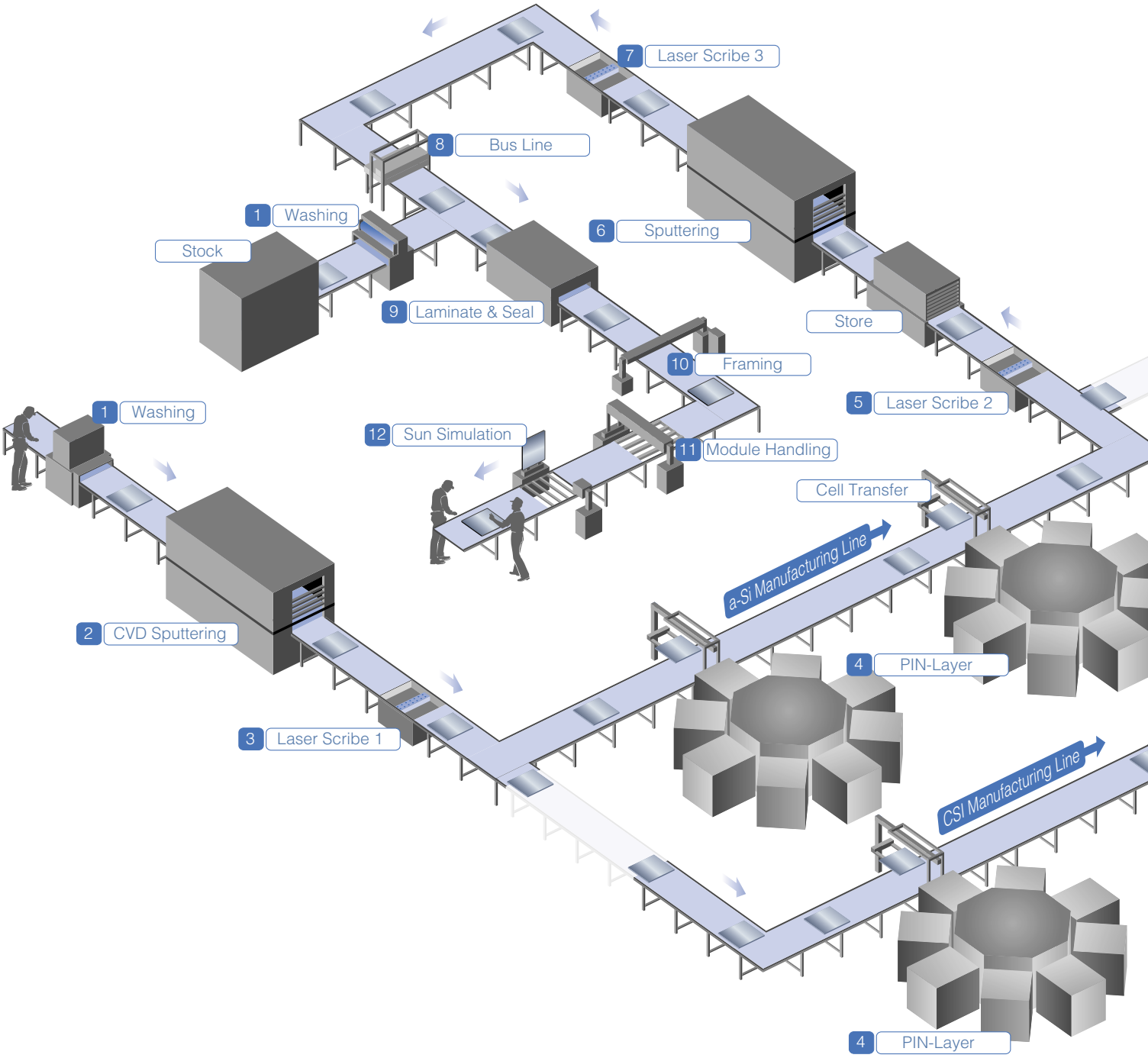
8 Sun Simulator



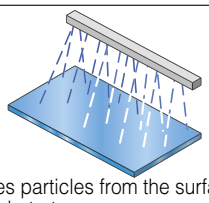
A sun simulator confirms the output performance and a final check for defects.

- A Handling ▶P.10
- B Control ▶P.12
- C Transfer ▶P.12

Thin Film Manufacturing



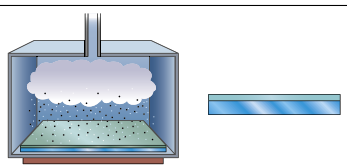
1 Washing



Removes particles from the surface of the glass-substrate.

- A Handling ▶P.10
- B Control ▶P.12
- C Transfer ▶P.12
- E Temperature Control ▶P.13
- F Chemical Products ▶P.14

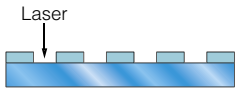
2 Layer CVD/Sputtering



The TCO-layer is deposited on the glass substrate.

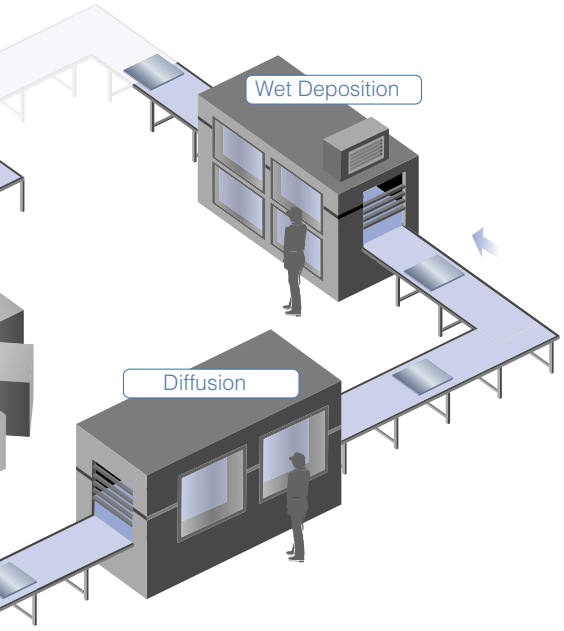
- A Handling ▶P.10
- B Control ▶P.12
- C Transfer ▶P.12
- D High Vacuum ▶P.13

3 Laser Scribe 1

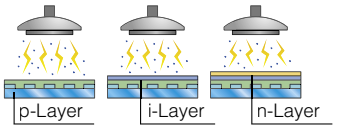


A laser is used to selectively scribe the TCO-Layer into individual cells.

- A Handling ▶P.10
- B Control ▶P.12
- C Transfer ▶P.12



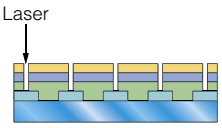
4 PIN-Layer Deposition



PIN-layer is deposited on the glass substrate.

A Handling ▶P.10
B Control ▶P.12
C Transfer ▶P.12
D High Vacuum ▶P.13

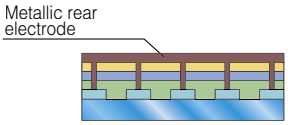
5 Laser Scribe 2



A laser is used to selectively scribe the PIN-layer into individual cells.

A Handling ▶P.10
B Control ▶P.12
C Transfer ▶P.12

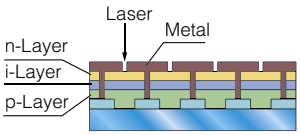
6 Layer-Deposition



A rear contact is deposited on the glass substrate.

A Handling ▶P.10
B Control ▶P.12
C Transfer ▶P.12
D High Vacuum ▶P.13

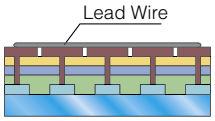
7 Laser Scribe 3



A laser is used to selectively scribe the rear contact-layer into individual cells.

A Handling ▶P.10
B Control ▶P.12
C Transfer ▶P.12

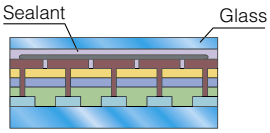
8 Bus Line Attachment



Assembly of the electrical bus line.

A Handling ▶P.10
B Control ▶P.12

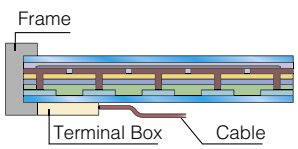
9 Lamination



Between a second glass subtrate on top the Thin film stack is encapsulated.

A Handling ▶P.10
B Control ▶P.12
C Transfer ▶P.12
G Static Control ▶P.14

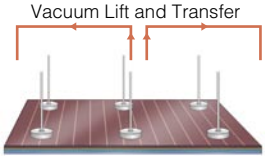
10 Framing



An aluminum frame is formed around the panel and a junction box is installed.

A Handling ▶P.10
B Control ▶P.12
C Transfer ▶P.12

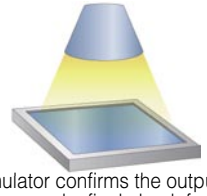
11 Module Handling



The module is transfered to the next process step.

A Handling ▶P.10
B Control ▶P.12
C Transfer ▶P.12

12 Sun Simulation



A sun simulator confirms the output performance and a final check for defects.

A Handling ▶P.10
B Control ▶P.12
C Transfer ▶P.12

A Handling

Electric Actuators

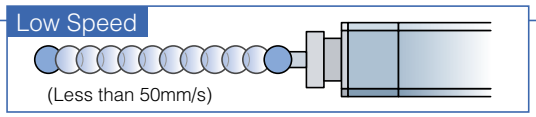
Having both the operational ability of an air cylinder and the speed controllability of an electric actuator. Integrated controller type.

- e-Rodless Electric Actuator ····· **Series E-MY**
- Electric Actuator (Guide Rod Type) ····· **Series LXP**

Low Speed & Low Friction

Low pressure, friction resistance and speed (less than 50mm/s) with reduced friction to meet the demands of reduced lurching that occurs during start up.

- Low Speed Cylinder ····· **Series C□X**
- Low Speed Rotary Actuators ····· **Series CRQ2X/MSQX**
- Low Friction Cylinder ····· **Series MQ**
- Smooth Cylinder ····· **Series C□Y**

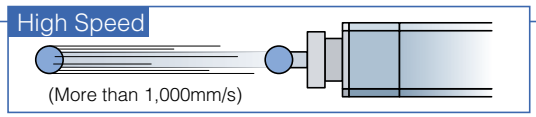


Low Speed

High Speed

High Speed Actuators (more than 1,000mm/s) with improved cycle time.

- High Power Cylinder ····· **Series RHC**
- High Speed Rodless Cylinder ····· **Series CY**

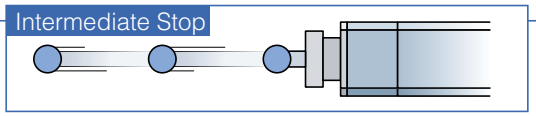


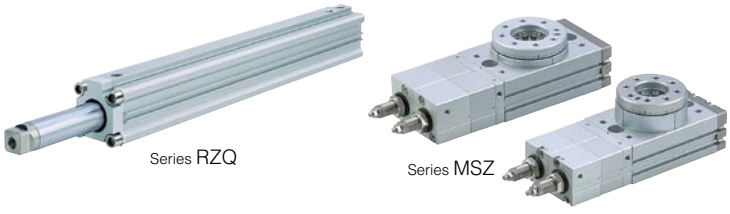
Low Speed RHC

Intermediate Stop

Actuators with an intermediate stop mechanism.

- 3 Position Cylinder ····· **Series RZQ**
- 3 Position Rotary Table ····· **Series MSZ**
- 4 Position Cylinder ····· **Series CXSJ**
- Cylinder ····· **Series CJ**

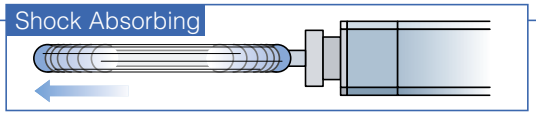




Shock Absorbing

In response to delicate workpieces transferred at high speed. Shock absorbing stroke end.

- Sine Cylinder ····· **Series RHC**
- Sine Rodless Cylinder ····· **Series REA/REB**
- Shock Absorber ····· **Series RB/RJ**



Series REA

Handling

Other application

Water Resistant

For use in areas where there is water spray.

- Hygienic Cylinder ..... **Series HY**
- Stainless Cylinders ..... **Series CJ• 5/CG• 5**

Series HY

Water Resistant

Guide Cylinders

- Slide Table ..... **Series MXS**
- Guide Cylinders ..... **Series MGP**

Series MXS

Series MGP

Directional Control Valves (IP65/67 Enclosures)

- 5 Port Solenoid Valve ..... **Series SV**
- 5 Port Solenoid Valve ..... **Series VQC**
- 5 Port Solenoid Valve ..... **Series SV/SYJ**
- 5 Port Solenoid Valve ..... **Series SQ**
- 5 Port Solenoid Valve ..... **Series VQZ**
- 5 Port Solenoid Valve ..... **Series VQ**
- 5 Port Solenoid Valve ..... **Series SY**
- 5 Port Solenoid Valve ..... **Series VV100**
- Serial Transmission System ..... **Series EX**

Series SV

Series VQC

To reduce the number of wires.

Series EX

Series EX

Fittings & Tubing (Stainless Products)

- SUS316 One-touch Fittings ..... **Series KQG**
- SUS316 Insert Fittings ..... **Series KFG**
- One-touch Fittings ..... **Series K□**
- S-Couplers / Stainless Type ..... **Series KKA**
- Antistatic One-touch Fittings ..... **Series KA**
- Antistatic Tubing ..... **Series TA**
- Miniature Fittings / Stainless Type ..... **Series M/MS**

Series KQG

Series KFG

Series KKA

Process Valves

- 2 Port Solenoid Valves ..... **Series VQ20/30**
- 2 Port Solenoid Valves ..... **Series VCA**

Series VQ

Series VCA

Clean Room Products

Products for use in clean rooms. Particle reducing products, assembled inside a clean room and shipped in double packaging.

- Clean Air Module ..... **Series LLB**
- Clean Series Actuators ..... **Series 10-/11/12-/13**
- Clean Speed Controller ..... **Series AS-FPQ/FPG**
- Clean Exhaust Cleaner ..... **Series AMP**
- Clean One-touch Fittings ..... **Series KPQ/KPG**
- Clean Air Filter ..... **Series SFD**
- Clean Gas Filter ..... **Series SF**
- Clean Regulator ..... **Series SRH**
- Precision Clean Regulator ..... **Series SRP**
- Clean Tubing ..... **Series TPH/TPS**

Series LLB

Series SFD

Series SRH

B Control

■Sensors

For monitoring the flow of fluids, such as air, water oil, Di water chemicals, etc. Can detect vacuum pressure of lift and transfer lines.

- Digital Pressure Switch (Integrated Sensor) ····· **Series ZSE/ISE**
- Digital Pressure Switch (Separate Sensor) ····· **Series PSE□**
- Digital Flow Switch ····· **Series PF**
- General Purpose Fluid Pressure Sensor ····· **Series PSE560**
- Digital Flow Sensor Air ····· **Series PF2A**
- Digital Flow Sensor Water ····· **Series PF2W**
- Digital Flow Sensor ····· **Series PFMV**

Integrated type
Series ISE80

Separte Sensor type
Series PSE

Series PF2A

Series PFM

■Flow Control Equipment

- Speed Controller ····· **Series AS**
- Speed Controller / Stainless ····· **Series ASG**

Series AS

Series ASG

■Pressure Control Equipment

- Regulator ····· **Series AR**
- Regulator Manifold ····· **Series ARM**
- Electro-Pneumatic Regulator ····· **Series ITV**

Series ARM

Series ITV

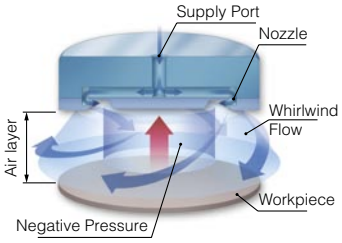
C Transfer

■Non-Contact Transfer

Non-contact conveyance is possible for uneven surfaces and/or with varying textures (Solar cells).

- Cyclone Pad (Made to Order)

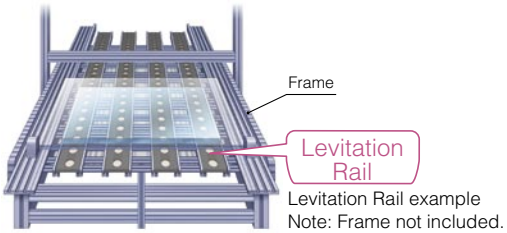
Operating Principle
Air enters from supply port and is blown out of the pad´s nozzle to generate a whirlwind flow inside the pad and leading to the cyclone effect (vacuum). Supply air is discharged to the atmosphere from between the pad and the workpiece. A layer of air is generated between the Cyclone Pad and the workpiece, resulting in the workpiece being lifted without contact.



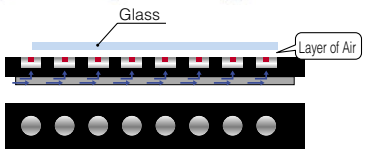
To prevent bending and vibration of thin workpieces.

- Levitation Rail (Made to Order)

Series XT661



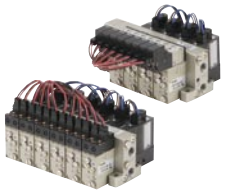
Levitation Rail example
Note: Frame not included.



■Low Vacuum

Products for vacuum lift and transfer.

- Vacuum Ejectors ····· **Series Z□**
- Air Suction Filters ····· **Series ZF**
- Vacuum Pads ····· **Series ZP**
- Peek Pads ····· **Series INO**



Series ZX

Series ZFC

Series ZP

D High Vacuum

For use in 10 - 6 Pa high vacuum applications.
Valves for high vacuum chamber vent, supply & isolation.

■ Vent

- Aluminum Angle Valves ····· **Series XL**
- Two stage Control Angle Valve ····· **Series XLD**
- Quick maintenance Angle Valve ····· **Series XLAQ**
- Stainless Sngle/Inline Valves ····· **Series XM/XY**
- Two stage Control Angle Valve ····· **Series XMD**

Series XL

Series XM

■ Gas Valve

- Smooth Vent Valve ····· **Series XVD**
- High Vacuum Straight Valve ····· **Series XSA**

■ Transfer

- Gate Valve
- Door Valve

■ Actuator

- Vacuum Rodless Cylinder ····· **Series CYV**
- Bellow Actuator ····· **Series XGL**

E Temperature Control

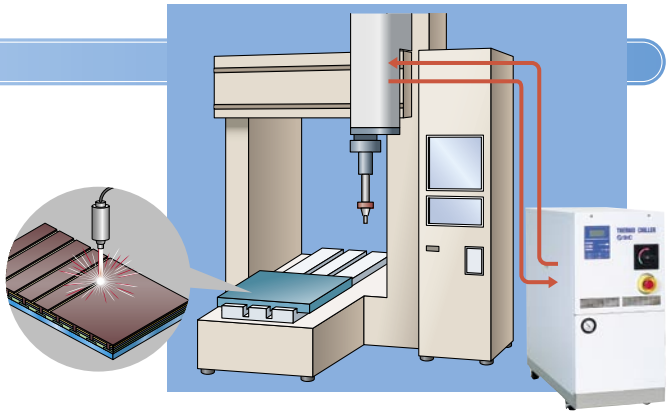
Constant temperature control of the heat source.

Chillers

- Thermo Cooler ····· **Series HRG/HRGC**
- Thermo Cooler ····· **Series HRZ/HRW**

Thermo Controllers

- Thermo Controller ····· **Series HEC**
- Thermostat Bath ····· **Series HEB**
- Chemical Thermo Controller ····· **Series HED**



Ex.) Temperature control of a laser oscillating device.

Series HRZ

Series HED

Series HEC

F Chemical Products

Chemicals & Di Water

High purity products for use with chemicals and Di water.

Process Valves

- Air Operated Chemical Valve ····· **Series LV**
- Needle Valve ····· **Series LVN**

Pressure Control Equipment

- Clean Regulator (Fluororesin Type) ····· **Series SRF/LVR**

Flow Sensors

- Digital Control Switch ····· **Series PF2D**

Pumps

- Process Pumps ····· **Series PAF**
- Process Pumps ····· **Series PB**

Fittings & Tubing

- Fluororesin Fittings ····· **Series LQ**
- Fluororesin Tubing ····· **Series TL**
- FEP Tubing ····· **Series TH**
- Flexible Fluororesin Tubing ····· **Series TD**

Series LVQ

Series SRF

Digital Switches

Sensors

Series PF2D

Series PAF

G Static Control

Antistatic Equipment

To prevent an electrical charge due to conductance and to reduce problems caused by the build-up of static electricity.

Actuators

- Antistatic Cylinder ····· **Series CM2-X1051**

Fittings & Tubing

- Antistatic One-touch Fittings ····· **Series KA**
- Antistatic Tubing ····· **Series TA**

Flow Control Equipment

- Antistatic Speed Controller ····· **Series AS-X260**

Vacuum Products

- Vacuum Pads ····· **Series ZP**

Series KA

Series TA

Ionizers

Corona effect used to neutralize ions and eliminate the build up of static electricity.

- Ionizer (Bar) ····· **Series IZS**
- Ionizer (Nozzle) ····· **Series IZN**

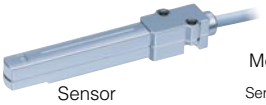
Series IZS

Series IZN

Measuring Instruments

Measures the electrical charge potential of the workpiece.

- Electrostatic Sensor/Monitor ····· **Series IZD/IZE**
- Handheld Electrostatic Meter ····· **Series IZH**



Sensor

Monitor

Series IZD/IZE

SMC and Advanced Pressure Technology (APTech)

In spring 2007, SMC Corporation Japan purchased Advanced Pressure Technology – better known as AP-Tech - from its directors.

Based in Napa, California, USA, AP-Tech was founded in the late 1980´s by Rene Zakhour. Rene´s objectives were to provide products with uncompromising quality, performance and reliability from a company offering exceptional service and technical support – almost identical values to those which SMC has based its successful approach to business.

From July 2008, our European customers can now purchase – through SMC Pneumatik GmbH – AP-Tech´s excellent range of high quality products made exclusively for both the PV and Semiconductor Industries.

These include a great range of High Purity Gas Regulators which are made, tested and packaged in ultra high clean room conditions, thereby ensuring excellent levels of quality (ISO 9001 standard).

If you´d like more information of AP-Tech products ask your local representative for more information today.

July 2008

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SMC Corporation South Africa (Pty) Ltd.
Unit 4, Midrand Central Business Park, 1019 Morkels Close, Midrand

Telephone: +27 10 900 1233
Technical: zatechnical@smcza.co.za
Sales: zasales@smcza.co.za
Orders: zaorders@smcza.co.za

Contact us for a free consultation on 010 900 1233 or zasales@smcza.co.za

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SMC CORPORATION Akihabara UDX 15F, 4-14-1, Sotokanda, Chiyoda-ku, Tokyo 101-0021, JAPAN Phone: 03-5207-8249 FAX: 03-5298-5362

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