PRODUCT OVERVIEW

PLASMA COMPONENTS
ELECTRON BEAM GUNS
PROCESS CONTROL
Our components are now free to explore new horizons.

PROVEN COMPONENTS. EXCELLENT RESULTS. FOR YOU.

What are you looking for in a supplier of components and process solutions? Experience? Reliability? A proven track record?

VON ARDENNE equipment is used in over 50 countries. We have established an installed base of hundreds of coating systems worldwide, ranging from small tools to equipment for large-area coating applications.

Every day, our customers are facing the challenge of staying in a leading position. Why do they choose VON ARDENNE Process Solutions as their partner? Consider our keys to success:

- **Field Experience** – Our technical team is comprised of engineers who have been there, in the field, delivering results. Not only does this mean we know what it takes to get the job done, in many cases we have done it before.

- **Simulation & Modeling** – For new applications, we can guide the process design with extensive simulation and modeling capabilities. From mechanical stress, to thermal modeling, to magnetic field modeling, our team can simulate your process before we begin to ensure the highest chance of success.

- **Sampling Capability** – VON ARDENNE has over 20 machines that are suitable for sampling. From small cluster tools to large in-line systems, we can use demonstration runs to further assure you that your process will deliver the results you need once installed.

- **In-House Assembly & Quality Control** – VON ARDENNE builds all of our products in our facility in Germany. We conduct the most demanding quality and functional tests in the industry before shipping our products to you. We meet or exceed most of our competitor’s specifications for technical performance and reliability.

**Process Knowhow** – By combining our hardware and process control solutions, we can deliver the highest performing processes to the most demanding specifications. Whether you are looking for the best material properties, high rates, uniformity, utilization, or all of the above we can deliver a process that meets your requirements.

**Technology Knowhow** – Beyond the local coating processes, VON ARDENNE offers state-of-the-art machine control solutions. From optical inspection to automated process control, we are able to combine it all into one system to make your machine perform – to deliver a product as you need it, when you need it.

**Worldwide Competence Centers** – A truly global organization, VON ARDENNE’s subsidiaries can provide integration and startup support, service, and training. When you need it, help is always close at hand. VON ARDENNE is more than a component supplier, we are a solution provider. Let us put our experience to work for you.

**Mission** – Our mission is to create value by bringing our industry leading technology and process experience to our customers.

We want to achieve that by offering state-of-the-art hardware solutions with best-in-class performance specifications and reliability. Furthermore, we offer advanced process control hardware and software solutions to control processes of single sources or in complex layer stacks settings. It is our aim to deliver an excellent process result according to your specifications and timeline. And we are confident that we can offer you what you are looking for in a supplier.

VON ARDENNE has more than 40 years of experience in vacuum deposition and outstanding expertise in multiscale simulation to

- assure high target utilization, optimized process design and other technological requirements. VON ARDENNE plasma and magnetic field simulations are used to analyze and improve the decisive physical process responsible for the film growth.

**Optical Simulation**

**For Outstanding Film Properties**

**Ray Tracing and Thin Film Properties**

Optical simulations are widely used to achieve the most efficient design for VON ARDENNE equipment with flash-lamp based annealing and patterning technology. Furthermore, the parameters of thin films are optimized using simulation methods so that the overall optical properties meet the requirements.

**Finite Element Simulations**

**For Best Coating Results**

**Mechanical, Thermal, CFD, Multi-Physics**

FE simulations for the analysis and optimization of different physical processes in combination with many years of experience are essential prerequisites for VON ARDENNE coating systems to meet the high quality requirements of our customers.

**Simulation-Driven Product Development**

**Vacuum System Dynamics**

**For Complex Deposition Machines**

**MATLAB/SIMSCAPE**

The conceptual design of complex and dynamic vacuum systems is extremely demanding. VON ARDENNE has accepted this challenge and has developed a MATLAB/Simscap library to model and simulate vacuum dynamics either for single compartments or overall simulations for complex vacuum deposition machines.

**Component Design**

**Low Pressure Gas Flow**

**For Best Gas Distributions**

**DSMC – DIRECT SIMULATION MONTE CARLO**

The simulation of low-pressure gas distributions in process chambers requires special numerical methods and a highly computational effort. The DSMC method is applied already in the construction and design phase at VON ARDENNE in order to achieve the best gas distributions.

**Optical Simulation**

**For Outstanding Film Properties**

**Ray Tracing and Thin Film Properties**

Optical simulations are widely used to achieve the most efficient design for VON ARDENNE equipment with flash-lamp based annealing and patterning technology. Furthermore, the parameters of thin films are optimized using simulation methods so that the overall optical properties meet the requirements.

**Finite Element Simulations**

**For Best Coating Results**

**Mechanical, Thermal, CFD, Multi-Physics**

FE simulations for the analysis and optimization of different physical processes in combination with many years of experience are essential prerequisites for VON ARDENNE coating systems to meet the high quality requirements of our customers.

**Simulation-Driven Product Development**

**Vacuum System Dynamics**

**For Complex Deposition Machines**

**MATLAB/SIMSCAPE**

The conceptual design of complex and dynamic vacuum systems is extremely demanding. VON ARDENNE has accepted this challenge and has developed a MATLAB/Simscap library to model and simulate vacuum dynamics either for single compartments or overall simulations for complex vacuum deposition machines.

**Component Design**

**Low Pressure Gas Flow**

**For Best Gas Distributions**

**DSMC – DIRECT SIMULATION MONTE CARLO**

The simulation of low-pressure gas distributions in process chambers requires special numerical methods and a highly computational effort. The DSMC method is applied already in the construction and design phase at VON ARDENNE in order to achieve the best gas distributions.

**Optical Simulation**

**For Outstanding Film Properties**

**Ray Tracing and Thin Film Properties**

Optical simulations are widely used to achieve the most efficient design for VON ARDENNE equipment with flash-lamp based annealing and patterning technology. Furthermore, the parameters of thin films are optimized using simulation methods so that the overall optical properties meet the requirements.

**Finite Element Simulations**

**For Best Coating Results**

**Mechanical, Thermal, CFD, Multi-Physics**

FE simulations for the analysis and optimization of different physical processes in combination with many years of experience are essential prerequisites for VON ARDENNE coating systems to meet the high quality requirements of our customers.

**Simulation-Driven Product Development**

**Vacuum System Dynamics**

**For Complex Deposition Machines**

**MATLAB/SIMSCAPE**

The conceptual design of complex and dynamic vacuum systems is extremely demanding. VON ARDENNE has accepted this challenge and has developed a MATLAB/Simscap library to model and simulate vacuum dynamics either for single compartments or overall simulations for complex vacuum deposition machines.

**Component Design**

**Low Pressure Gas Flow**

**For Best Gas Distributions**

**DSMC – DIRECT SIMULATION MONTE CARLO**

The simulation of low-pressure gas distributions in process chambers requires special numerical methods and a highly computational effort. The DSMC method is applied already in the construction and design phase at VON ARDENNE in order to achieve the best gas distributions.
X-SERIES END BLOCKS

The X-Series End Blocks are drop-in end blocks for glass coating systems, such as the VON ARDENNE GC330H, GC254H, GC140H and PIA|nova. The X-Series is available for upgrades and retrofits, both for VON ARDENNE equipment and other coating systems if they fulfill certain parameters. It also covers a wide range of specifications.

The drive and media end blocks of the X-Series have a new design that ensures easy maintenance.

MECHANICAL INTERFACE

- Interface on vacuum side
- For the basic and advanced maintenance, the end block stays on the lid.
- The end block is designed as a wear cartridge.
- For advanced maintenance, the end block can be easily disassembled for replacing further parts (e.g. bearings, brush unit).

MEASUREMENTS

- VA blocking tube length + 238
- VA backing tube length + 238
- Max. current AC/DC: 350 A (60 kHz) / 400 A
- Max. power: 200 kW (DC/60 kHz AC)
- Max. target length: 4000 mm
- Helium leak rate: < 1x10^-6 mbar*l/s
- Rotation speed: 0 min^-1 to 60 min^-1
- Safe operation weight load: ≤ 500 kg horizontal mounting, ≤ 300 kg vertical mounting (500 kg on demand)

The dimensions and interfaces of the end block X-series are compatible to all common magnetrons in the field and are therefore suited for retrofits.

MODULAR SETUP

- All spare parts available separately
- Exchange of single parts for easy adaption of other components (e.g. minor adjustable magnet bars...)

EFFICIENT WEAR & SPARE PART CONCEPT

Due to the modular setup, the easy accessibility and the robust design, only a small number of wear parts are needed:
- Vacuum sealing cartridges
- Water sealing cartridge
- Wear part cartridge for media end block
Spare parts are mainly static seals and parts subjected to process technological loads and therefore show thermal and/or mechanical degradation.

For standard as well as for advanced services, the end block stays attached to the lid. Therefore, there is no need for additional end block maintenance areas near the production tools.

Only four parts must be replaced over the entire lifetime of an end block.

PROVEN X-SERIES TOOL KIT

- A small but comprehensive tool kit is available for fast and convenient service actions.
- Contains every tool (incl. standard tools e.g. screwdriver) for a standardized service -> no need for an additional basic tool kit
- Each tool kit equips two technicians for parallel work on media and drive end blocks
- One tool kit equips two technicians for parallel work on media and drive end blocks
- Verified duration for basic service per end block
  - ~ 30 minutes with one technician
- Verified duration for advanced service per end block
  - ~ 60 minutes with one technician

The X-Series End Blocks are drop-in end blocks for glass coating systems, such as the VON ARDENNE GC330H, GC254H, GC140H and PIA|nova. The X-Series is available for upgrades and retrofits, both for VON ARDENNE equipment and other coating systems if they fulfill certain parameters. It also covers a wide range of specifications.

The drive and media end blocks of the X-Series have a new design that ensures easy maintenance.

- Interface on vacuum side
- For the basic and advanced maintenance, the end block stays on the lid.
- The end block is designed as a wear cartridge.
- For advanced maintenance, the end block can be easily disassembled for replacing further parts (e.g. bearings, brush unit).

MEASUREMENTS

- VA blocking tube length + 238
- VA backing tube length + 238
- Max. current AC/DC: 350 A (60 kHz) / 400 A
- Max. power: 200 kW (DC/60 kHz AC)
- Max. target length: 4000 mm
- Helium leak rate: < 1x10^-6 mbar*l/s
- Rotation speed: 0 min^-1 to 60 min^-1
- Safe operation weight load: ≤ 500 kg horizontal mounting, ≤ 300 kg vertical mounting (500 kg on demand)

The dimensions and interfaces of the end block X-series are compatible to all common magnetrons in the field and are therefore suited for retrofits.
The Y-Series end blocks are used for applications where externally mounted end blocks are required. The basic concept is a single-sided design where all media connections and drive assemblies are installed in one end block. They are suited for roll-to-roll coating systems, such as the VON ARDENNE FOSA MX, but also for carrier-based coating systems such as the XEAnova or horizontal or vertical glass coating systems.

The Y-Series is also available for upgrades and retrofits, both for VON ARDENNE equipment and other coating systems. It also covers a wide range of specifications.

**EFFICIENT WEAR & SPARE PART CONCEPT**

Due to the modular setup, the easy accessibility and the robust design, only a small number of wear parts are needed:

- Water sealing cartridge for basic service
- Wear part cartridge for advanced service
- Carbon brush exchange can be done individually

Spare parts are mainly static seals and parts subjected to process technological loads and therefore show thermal and/or mechanical degradation.

For standard as well as for advanced services, the end block remains attached to the lid. Therefore, there is no need for additional end block maintenance areas near the production tools.

**CONDITION-BASED MAINTENANCE**

**Basic maintenance**
- < 15 minutes per end block
- Includes water and vacuum rotary sealings
- Typical maintenance cycle > 2 years

**Advanced maintenance**
- Includes all water rotary sealings
- Additionally, the wear part cartridge at the end block (incl. shaft, bearings, carbon brushes) can be replaced completely or individual parts separately (e.g. carbon brushes)
- Typical maintenance cycle > 5 years

**TECHNICAL DATA**

Subject to change without notice due to technical improvement.

- Mounting position: horizontal and vertical
- Max. current AC/DC: 350 A (60 kHz) / 400 A
- Max. power: 200 kW (DC/60 kHz AC)
- Max. target length: 4000 mm
- Helium leak rate: < 1x10^-6 mbar*l/s
- Rotation speed: 0 min^-1 to 60 min^-1
- Safe operation weight load: ≤ 500 kg horizontal mounting
  ≤ 300 kg vertical mounting (500 kg on demand)

The Y-Series end blocks are suited for retrofits on all common coating systems in the field using side-mounted end blocks as their dimensions and interfaces are compatible.
VON ARDENNE magnet bars are state of the art in technology. We have installed more than 2000 magnet bars in all fields of coating application. In the development of our magnet bars, we focus on target erosion, layer uniformity, process stability and application depending field strengths. They are available in a wide range of strengths and lengths and are inspected in our in-house facilities for quality control.

### FEATURES

- Optimum layer uniformity
- High target utilization
- Uniform layer properties over the full substrate width
- Optimal setting for your technology regarding
  - uniformity
  - sputter rate
  - process voltage
  - energy impact on substrate
- Reduced process voltage
- Maximum process power limit only limited by target material or banding
- Optimum solutions and support of process requirements

### BENEFITS

- Excellent magnetic field uniformity
- Optimized race track return design and different end caps
- Variation of sputter angle between ± 15° and ± 60°
- Available with inverted magnet arrangement
- Optimized cooling concept
- Technological experience
- Use with any end blocks

### TECHNICAL DATA

Subject to change without notice due to technical improvement.

<table>
<thead>
<tr>
<th></th>
<th>RVA 30</th>
<th>RVA 50</th>
<th>RVA 70</th>
<th>RVA 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. magnetic-field flux density at target surface (Ω 152 mm)</td>
<td>30 mT</td>
<td>50 mT</td>
<td>70 mT</td>
<td>100 mT</td>
</tr>
<tr>
<td>Target utilization</td>
<td>&gt; 80 % with dog bone targets</td>
<td>&gt; 85 % with straight targets</td>
<td>&gt; 85 % with straight targets</td>
<td>&gt; 85 % with straight targets</td>
</tr>
<tr>
<td>Application</td>
<td>Architectural glass, web coating/display, AR</td>
<td>Architectural glass, photovoltaics, web coating/display, AR, special applications</td>
<td>Architectural glass, photovoltaics, web coating/display, AR, special applications</td>
<td>ITO, photovoltaics, web coating/display, special applications</td>
</tr>
<tr>
<td>Length</td>
<td>Up to 4000 mm</td>
<td>Up to 4000 mm</td>
<td>Up to 4000 mm</td>
<td>Up to 4000 mm</td>
</tr>
<tr>
<td>Typical target materials</td>
<td>Sn, Zn, ZnSn, Si, TiO₂,…</td>
<td>Sn, Zn, ZnSn, Si, TiO₂, Cu, Al, Ag, In,…</td>
<td>CuGa, AZO, ZnTe, Si, metals,…</td>
<td>ITO</td>
</tr>
<tr>
<td>Magnetic field uniformity</td>
<td>≤ ± 1.25 %</td>
<td>≤ ± 1.25 %</td>
<td>≤ ± 1.25 %</td>
<td>≤ ± 1.25 %</td>
</tr>
<tr>
<td>Resulting layer uniformity</td>
<td>≤ ± 0.5 %</td>
<td>≤ ± 0.5 %</td>
<td>≤ ± 0.5 %</td>
<td>≤ ± 0.5 %</td>
</tr>
</tbody>
</table>

BEST QUALITY CONTROL ON THE MARKET

- In-house quality control of magnets - only magnets meeting very demanding specifications are used for assembly of magnetic systems
- Our magnetic systems are assembled by skilled workers.
- High sensitivity magnetic measurement during assembly [11 sensor simultaneous measurement for fast and complete 20 magnetic field scan]
- Re-assembly of magnetic systems if needed, until uniformity spec is fulfilled

APPLICATION EXAMPLE RVA 30: resulting layer uniformities large area coating

2D magnetic field measurement for magnet bars with 11 sensors to ensure excellent magnetic field uniformity

3D magnetic field simulation of magnet bar RVA 50

COMPONENTS FOR ROTATABLE MAGNETRONS

- TiO₂
- Thickness Deviation from Average
- 95 nm TiO₂ layer without gas trimming; thickness deviation ± 0.35%
- 95 nm TiO₂ layer without gas trimming; thickness deviation ± 0.9%

Automated inhouse QC of magnets
We offer state-of-the-art planar magnetrons for high-end technology applications. Our components are developed and manufactured 100 percent by VON ARDENNE.

Our planar magnetrons have been industry-proven in depositing blocker and absorber layers for high-end triple Low-E coatings on glass coating systems but also in PV coating systems, in roll-to-roll web coaters and coating systems for display and other special applications.

We have sold more than 350 planar magnetrons for a wide range of different applications. They are available for retrofits and as adaptation for new coating lines. Furthermore, we can provide them as complete process lids with and without direct pumping.

Hot target clamping available (e.g., for ITO) process evaluations for NiCr, Cr, Ag and others.

The product family consists of three different types of magnetrons: the Standard WSM, the High-Utilization Planar Magnetron WSM-HU and the Planar XT.

**FEATURES**

<table>
<thead>
<tr>
<th>STANDARD WSM BODY</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common planar type in last years</td>
<td>Stable operation</td>
</tr>
<tr>
<td>Simple target design</td>
<td>Good layer uniformity</td>
</tr>
<tr>
<td>Target utilization ≈ 35 % to 40 % (e.g., 4500 kWh for 30 mm Ag)</td>
<td>Coating uniformity of &lt; ± 1.0 %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HIGH-UTILIZATION PLANAR HU-WSM BODY</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target lifetime 6000 kWh for 30 mm Ag</td>
<td>Longer target lifetime</td>
</tr>
<tr>
<td>Target utilization ≈ 35 % to 40 %</td>
<td>Higher target utilization</td>
</tr>
<tr>
<td>Coating uniformity of &lt; ± 1.0 % with targets close to end of lifetime &lt; ± 1.5 %</td>
<td>Stable performance over whole target life time</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PLANAR XT BODY</th>
<th>BENEFITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target lifetime potentially &gt; 7000 kWh for Ag</td>
<td>High-performance in layer uniformity over whole target life time</td>
</tr>
<tr>
<td>Target utilization &gt; 40 %</td>
<td>Long target life time</td>
</tr>
<tr>
<td>Coating uniformity for planar cathodes down to &lt; ± 0.5 %</td>
<td>Highest target utilization</td>
</tr>
<tr>
<td>Simple target design</td>
<td>Simple and easy to manufacture target designs</td>
</tr>
</tbody>
</table>

**ALL**

| Sealed cooling channel | Magnets are not exposed to water, no water seals are broken during target exchange. |

**BEST QUALITY CONTROL ON THE MARKET**

- In house quality control of magnets - only magnets meeting our demanding specifications are used for assembly of magnetic systems
- Our magnetic systems are assembled by skilled workers.

**COMPONENTS FOR PLANAR MAGNETRONS**

- Best quality control on the market
- High sensitivity magnetic measurement during assembly (3 sensor simultaneous measurement for fast and complete 2D magnetic field scan)
- Re-assembly of magnetic systems if needed, until uniformity spec is fulfilled

**TECHNICAL DATA**

Subject to change without notice due to technical improvement.

<table>
<thead>
<tr>
<th>WSM</th>
<th>HU-WSM</th>
<th>PLANAR XT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Target materials</strong></td>
<td>Ag, NiCr, Cr, Ti</td>
<td>Ag (limited by cooling and target design)</td>
</tr>
<tr>
<td><strong>Target life (kWh/m) for 30 mm Ag target</strong></td>
<td>&gt; 10 kJ/m</td>
<td>&gt; 15 kJ/m</td>
</tr>
<tr>
<td><strong>Target utilization for 30 mm clamped Ag target</strong></td>
<td>up to 30 %</td>
<td>&gt; 35 %</td>
</tr>
<tr>
<td><strong>Magnetic field strength at 30 mm Ag target thickness</strong></td>
<td>11 mT</td>
<td>15 mT</td>
</tr>
<tr>
<td><strong>Max. process power</strong></td>
<td>&gt; 16 kW/m</td>
<td>8 kW/m</td>
</tr>
<tr>
<td><strong>Proven magnetic field uniformity</strong></td>
<td>≤ ± 1.25 %</td>
<td>≤ ± 1.25 %</td>
</tr>
<tr>
<td><strong>Resulting layer uniformity, down to</strong></td>
<td>≤ ± 0.8 %</td>
<td>≤ ± 0.6 %</td>
</tr>
</tbody>
</table>

**APPLICATION EX. PLANAR XT:**

- Resulting layer uniformities large-area coating
- 2D magnetic field measurement for planar bodies with 3 sensors to ensure excellent magnetic field uniformity

**3D MAGNETIC FIELD SIMULATION HU WSM BODY**

- Automated inhouse QC of magnets
- 3D magnetic field simulation HU WSM body

**PLANAR XT BODY**

- Target lifetime potentially > 7000 kWh for Ag
- Target utilization > 40 %
- Coating uniformity for planar cathodes down to < ± 0.5 %
- Simple target design

**APPLICATION EX. PLANAR XT:**

- Resulting layer uniformities large-area coating
- 2D magnetic field measurement for planar bodies with 3 sensors to ensure excellent magnetic field uniformity

- Automated inhouse QC of magnets

**TECHNICAL DATA**

Subject to change without notice due to technical improvement.

<table>
<thead>
<tr>
<th>WSM</th>
<th>HU-WSM</th>
<th>PLANAR XT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Target materials</strong></td>
<td>Ag, NiCr, Cr, Ti</td>
<td>Ag (limited by cooling and target design)</td>
</tr>
<tr>
<td><strong>Target life (kWh/m) for 30 mm Ag target</strong></td>
<td>&gt; 10 kJ/m</td>
<td>&gt; 15 kJ/m</td>
</tr>
<tr>
<td><strong>Target utilization for 30 mm clamped Ag target</strong></td>
<td>up to 30 %</td>
<td>&gt; 35 %</td>
</tr>
<tr>
<td><strong>Magnetic field strength at 30 mm Ag target thickness</strong></td>
<td>11 mT</td>
<td>15 mT</td>
</tr>
<tr>
<td><strong>Max. process power</strong></td>
<td>&gt; 16 kW/m</td>
<td>8 kW/m</td>
</tr>
<tr>
<td><strong>Proven magnetic field uniformity</strong></td>
<td>≤ ± 1.25 %</td>
<td>≤ ± 1.25 %</td>
</tr>
<tr>
<td><strong>Resulting layer uniformity, down to</strong></td>
<td>≤ ± 0.8 %</td>
<td>≤ ± 0.6 %</td>
</tr>
</tbody>
</table>
VA PROCOS 2

VA PROCOS 2 is a modular process control system that is specially designed for the stabilization of reactive sputter processes in the critical transition mode.

It is suitable for process characterization by optical emission lines, cathode voltage, oxygen partial pressure, combinations thereof and/or further PLC signals.

Furthermore, it can be used for the stabilization of the plasma discharge and thus of the product properties by adjusting the supply of one or more reactive gases.

Since 1980, VON ARDENNE has been in a leading position in reactive sputtering processes. Furthermore, we have provided and optimized our process control system VA PROCOS for many years.

Our current VA PROCOS 2 controls the reactive sputtering of compound layers and reliably stabilizes the working points in the crucial transition region. Furthermore, the system controls one or more reactive gas inlets (e.g., oxynitrides).

OPTICAL INTENSITY MEASURING SYSTEM MS601

Wavelength range 185 nm to 900 nm
Vacuum connection DN 40 ISO KF
Collimators approx. (1 x 1.7) m², e.g. (6 x 9) 6" wafers
Max. ambient temperature of fiber optic 300 °C

MF/DC VOLTAGE MEASURING UNIT SE04

Measurement range 2000 V
Peak input voltage 6000 V
Attenuation 1:1000
Output voltage 0 V to 10 V
Casing IP67

O₂-LAMBDA PROBE

ZrO₂ sensor length 250 mm (other lengths on request)
Vacuum connection DN 25 ISO KF
Analog gain 10x
Output voltage 0 V to 10 V
Casing IP67

VA PROCOS 2 BASE

Main controller for monitoring or process control application with 4 or 8 general purpose IO channels;
Profinet interface and Profibus as option (automatic baud rate detection)
10/100 MBit Ethernet connection, 4/8 x 16 Bit AD 4/8 x 16 Bit DA 4/8 x low pass with 500 Hz edge frequency variable digital fIR filter

VA PROCOS 2 EXTENDER

Unit to decentrally extend BASE with 4 or 8 general purpose IO channels
Profinet Interface, See VA PROCOS BASE

FEATURES

- PEM control, impedance control, Lambda control, balance/MBAL
- Higher sputtering rate
- Specialized processing for ARC event detection and handling
- Choice of working point
- Automatic on-line balancing
- Thermal stabilized photomultiplier for PEM
- Unified analog I/O port for all sensors and actors
- IP67, robust cases, EMI shielded
- Flexible configuration of hardware
- Designed for operation in an industrial environment

BENEFITS

- Stabilization of process, reduction of loss and longer campaign times
- Optimized layer and stoichiometry uniformity
- Stable measurements and control for low intensity plasma
- Increased productivity
- Less energy consumption (less power for same deposition rate)
- New applications (Stoichiometry, morphology)
- Process adapted and ready to use configuration

TECHNICAL DATA

Subject to change without notice due to technical improvement.

INPUT

<table>
<thead>
<tr>
<th>SENSORS</th>
<th>PHYSICAL QUANTITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical emission (photomultiplier)</td>
<td>Light intensity (single lambda)</td>
</tr>
<tr>
<td>Voltage / impedance of discharge</td>
<td>Voltage</td>
</tr>
<tr>
<td>Oxygen partial pressure (lambda sensor)</td>
<td>O₂ partial pressure</td>
</tr>
<tr>
<td>Additionally: Generic -10 V to +10 V PLC signals</td>
<td>Various</td>
</tr>
</tbody>
</table>

OUTPUT

<table>
<thead>
<tr>
<th>ACTORS</th>
<th>PHYSICAL QUANTITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass flow controllers</td>
<td>Reactive gas flow</td>
</tr>
<tr>
<td>— Single</td>
<td>Generic -10 V to +10 V</td>
</tr>
<tr>
<td>— 3 mm gas 3, 5 or more channels</td>
<td>Power/Voltage</td>
</tr>
</tbody>
</table>

APPLICATION EXAMPLES

HIGHER SPUTTERING RATE

MORE PRODUCTIVITY

NEW FILM PROPERTIES

NEW APPLICATIONS

REDUCED ARCING/NODULES

LONGER CAMPAIGN TIMES

INPUT

SENSOR

PHYSICAL QUANTITIES

ACTORS

PHYSICAL QUANTITIES

VA PROCOS 2 EXTENDER

Unit to decentrally extend BASE with 4 or 8 general purpose IO channels
Profinet Interface, See VA PROCOS BASE

VA PROCOS 2 SOFTWARE

Monitor (trending) and process control 5 ms
VON ARDENNE develops and manufactures electron beam systems which are used for melting, refining, evaporation or heat treatment. The first electron beam gun was developed in 1959 at the Manfred von Ardenne Research Institute. Our 60 years of experience are reflected in over 400 electron beam systems installed worldwide. Our current EH150V, EH300V and EH800V electron beam guns are the most powerful in the world.

We work on the continuous improvement of our key components at our development center for electron beam technologies. This is where we produce and test all our high-quality electron beam guns.

**ELECTRON BEAM GUNS**

The first electron beam gun was developed in 1959 at the Manfred von Ardenne Research Institute. Our current EH150V, EH300V and EH800V electron beam guns are used for melting, refining, evaporation or heat treatment. VON ARDENNE develops and manufactures electron beam systems.

**FEATURES**

- Power control by means of a patented VARIOCATHODE
- High degree of pressure decoupling
- Internal valve to separate EB gun from process chamber
- Quick and simple changing of cathode plug

**BENEFITS**

- Easy handling and maintenance
- High reliability
- High acceleration voltage up to 60 kV
- Magnetically self-focusing beam

**TECHNICAL DATA**

**ELECTRON BEAM CONTROL**

The beam guidance system is an electronic unit for controlling and monitoring the electron beam of an electron beam gun by means of electromagnetic lenses and deflection coils. It consists of an industrial PC, a beam guidance base unit, a control console and associated beam guidance software.

**VA BCOS** is MS Windows-based beam guidance software and performs the following tasks:

- Control of max. 4 electron beam guns
- Generation of deflection figures to realize the electron beam distribution required at the process location
- Generation of deflection sequences by means of the pre-installed figure library, or based on coordinate lists generated with customary software (e.g. MS Excel)
- Management of technological process sequences (recipes)
- Continuous beam deflection with simultaneous adaptation of form, position, size and dwell time of the individual deflection figures during operation, by means of operator control actions or a connection to the automatic process control
- Adaptation of the electron beam focusing within the electron beam gun and at the process location, including monitoring of the focusing state by evaluating the temperature increase of the cooling water in the electron beam gun
- Display and data recording of all process-relevant operating parameters such as power, power distribution and acceleration voltage
- Data transfer
- Interface for external access via internet connection

**FEATURES**

- Freely programmable time & power based beam scanning sequences
- Comprehensive scanning figure library
- Signal processor-based calculation of all dynamic functions
- Tracks: automatically moving scanning figures
- Online geometrical and dynamic correction of scanning sequences
- Synchronization of scanning sequences of multiple EB guns
- User permissions management
- Latest software technology and architecture
- Integration of various process control modules - VA BCOS / VA PROCESS MASTER / customer controllers

**BENEFITS**

- Reliable process control for certified products
- Flexible adaptation to VON ARDENNE or customer machines
- Controlled continuous beam scan despite digital figure coordinate definition
- Open customer interface
- Easy and flexible operator interaction as well as automatic process control
- Implementation on standard industrial hardware components

---

### TECHNICAL DATA

<table>
<thead>
<tr>
<th></th>
<th>EH150V</th>
<th>EH300V</th>
<th>EH800V</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Max. beam power</strong></td>
<td>150 kW</td>
<td>300 kW</td>
<td>800 kW</td>
</tr>
<tr>
<td><strong>Beam power control range</strong></td>
<td>0 % to 20 %</td>
<td>0 % to 20 %</td>
<td>0 % to 20 %</td>
</tr>
<tr>
<td><strong>Max. acceleration voltage</strong></td>
<td>35 kV</td>
<td>45 kV</td>
<td>60 kV</td>
</tr>
<tr>
<td><strong>Average life time of cathodes at max. beam power</strong></td>
<td>100 h</td>
<td>200 h</td>
<td>200 h</td>
</tr>
<tr>
<td><strong>X-ray leakage</strong></td>
<td>&lt; 1 μSv/h</td>
<td>&lt; 1 μSv/h</td>
<td>&lt; 1 μSv/h</td>
</tr>
<tr>
<td><strong>Total cooling water consumption</strong></td>
<td>0.5 m³/h</td>
<td>0.5 m³/h</td>
<td>2.2 m³/h</td>
</tr>
<tr>
<td><strong>Compressed air supply (dry)</strong></td>
<td>0.5 MPa</td>
<td>0.5 MPa</td>
<td>0.5 MPa</td>
</tr>
<tr>
<td><strong>Height (with closed lid)</strong></td>
<td>980 mm</td>
<td>1070 mm</td>
<td>1400 mm</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>150 kg</td>
<td>190 kg</td>
<td>530 kg</td>
</tr>
<tr>
<td><strong>Max. maximum radius</strong></td>
<td>350 mm</td>
<td>350 mm</td>
<td>400 mm</td>
</tr>
<tr>
<td><strong>Max. height</strong></td>
<td>250 mm</td>
<td>250 mm</td>
<td>250 mm</td>
</tr>
<tr>
<td><strong>Max. cooling water inlet temperature</strong></td>
<td>± 20 %</td>
<td>± 20 %</td>
<td>± 20 %</td>
</tr>
<tr>
<td><strong>Max. cooling water outlet temperature</strong></td>
<td>± 40 °C</td>
<td>± 20 °C</td>
<td>± 20 °C</td>
</tr>
<tr>
<td><strong>Max. process pressure</strong></td>
<td>≈ 2 Pa</td>
<td>≈ 2 Pa</td>
<td>≈ 2 Pa</td>
</tr>
<tr>
<td><strong>Recommended size of vacuum pumps</strong></td>
<td>300 l/s</td>
<td>300 l/s</td>
<td>300 l/s</td>
</tr>
<tr>
<td><strong>Recommended size of vacuum pumps for both electron beam guns</strong></td>
<td>20 m³/h</td>
<td>20 m³/h</td>
<td>35 m³/h</td>
</tr>
<tr>
<td><strong>Recommended size of vacuum pumps for both electron beam guns</strong></td>
<td>DN 100</td>
<td>DN 100</td>
<td>DN 100</td>
</tr>
<tr>
<td><strong>Recommended size of vacuum pumps for both electron beam guns</strong></td>
<td>DN 160</td>
<td>DN 160</td>
<td>DN 160</td>
</tr>
<tr>
<td><strong>Recommended size of vacuum pumps for both electron beam guns</strong></td>
<td>DN 250</td>
<td>DN 250</td>
<td>DN 250</td>
</tr>
</tbody>
</table>

---

### FEATURES

- Power control by means of a patented VARIOCATHODE
- High degree of pressure decoupling
- Internal valve to separate EB gun from process chamber
- Quick and simple changing of cathode plug

### BENEFITS

- Easy handling and maintenance
- High reliability
- High acceleration voltage up to 60 kV
- Magnetically self-focusing beam

---

### TECHNICAL DATA

<table>
<thead>
<tr>
<th></th>
<th>EH150V</th>
<th>EH300V</th>
<th>EH800V</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Max. beam power</strong></td>
<td>150 kW</td>
<td>300 kW</td>
<td>800 kW</td>
</tr>
<tr>
<td><strong>Beam power control range</strong></td>
<td>0 % to 20 %</td>
<td>0 % to 20 %</td>
<td>0 % to 20 %</td>
</tr>
<tr>
<td><strong>Max. acceleration voltage</strong></td>
<td>35 kV</td>
<td>45 kV</td>
<td>60 kV</td>
</tr>
<tr>
<td><strong>Average life time of cathodes at max. beam power</strong></td>
<td>100 h</td>
<td>200 h</td>
<td>200 h</td>
</tr>
<tr>
<td><strong>X-ray leakage</strong></td>
<td>&lt; 1 μSv/h</td>
<td>&lt; 1 μSv/h</td>
<td>&lt; 1 μSv/h</td>
</tr>
<tr>
<td><strong>Total cooling water consumption</strong></td>
<td>0.5 m³/h</td>
<td>0.5 m³/h</td>
<td>2.2 m³/h</td>
</tr>
<tr>
<td><strong>Compressed air supply (dry)</strong></td>
<td>0.5 MPa</td>
<td>0.5 MPa</td>
<td>0.5 MPa</td>
</tr>
<tr>
<td><strong>Height (with closed lid)</strong></td>
<td>980 mm</td>
<td>1070 mm</td>
<td>1400 mm</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>150 kg</td>
<td>190 kg</td>
<td>530 kg</td>
</tr>
<tr>
<td><strong>Max. maximum radius</strong></td>
<td>350 mm</td>
<td>350 mm</td>
<td>400 mm</td>
</tr>
<tr>
<td><strong>Max. height</strong></td>
<td>250 mm</td>
<td>250 mm</td>
<td>250 mm</td>
</tr>
<tr>
<td><strong>Max. cooling water inlet temperature</strong></td>
<td>± 20 %</td>
<td>± 20 %</td>
<td>± 20 %</td>
</tr>
<tr>
<td><strong>Max. cooling water outlet temperature</strong></td>
<td>± 40 °C</td>
<td>± 20 °C</td>
<td>± 20 °C</td>
</tr>
<tr>
<td><strong>Max. process pressure</strong></td>
<td>≈ 2 Pa</td>
<td>≈ 2 Pa</td>
<td>≈ 2 Pa</td>
</tr>
<tr>
<td><strong>Recommended size of vacuum pumps</strong></td>
<td>300 l/s</td>
<td>300 l/s</td>
<td>300 l/s</td>
</tr>
<tr>
<td><strong>Recommended size of vacuum pumps for both electron beam guns</strong></td>
<td>20 m³/h</td>
<td>20 m³/h</td>
<td>35 m³/h</td>
</tr>
<tr>
<td><strong>Recommended size of vacuum pumps for both electron beam guns</strong></td>
<td>DN 100</td>
<td>DN 100</td>
<td>DN 100</td>
</tr>
<tr>
<td><strong>Recommended size of vacuum pumps for both electron beam guns</strong></td>
<td>DN 160</td>
<td>DN 160</td>
<td>DN 160</td>
</tr>
<tr>
<td><strong>Recommended size of vacuum pumps for both electron beam guns</strong></td>
<td>DN 250</td>
<td>DN 250</td>
<td>DN 250</td>
</tr>
</tbody>
</table>
The VON ARDENNE HCS (Hollow Cathode Source) is a device that produces a plasma below the electrode plate. The electrons are confined between the potential drops on the cathode's trench walls, increasing gas ionization and plasma density. The patented HCS is characterized by a hollow structure and an integrated anode. This design is scalable and easy to customize, making it suitable for pre-treatment and surface modification.

**Features:**
- Simple scalable design for robust behavior and easy customization
- Can compete with CCP and ICP in high density plasma processing and at lower costs compared to ICP
- RF and VHF processing
- Low generator power
- Low discharge voltage for gentle processing
- Maintenance free (recommended sealings exchange after 5 years)
- Broden process window:
  - RF and VHF amplitude stability
- RF amplitude is nearly constant over a broad pressure range
- A change in bias and RF amplitude by alternating RF power is less pronounced compared to conventional CCP CVD

**Benefits:**
- Simple and scalable design
- Highly energetic and strongly focussed beam
- Excellent etching uniformity
- Campaign time up to four weeks
- Easy customization

**Technical Data:**
Subject to change without notice due to technical improvement.

**Electrode HC design 2**

Cross section of plasma generation principle in a HCS structure

**HOLLOW CATHODE SOURCE**

**LION®**

The VON ARDENNE Linear Ion Source LION® is a component that is suitable for pre-treatment and surface modification. It helps remove hydrocarbons and works with argon and, if necessary, with additional oxygen. The ion beam of the LION® is strongly focused and highly energetic, making it an ideal device for inline coating systems that require physical etching. Due to its simple and robust design, the ion source is easily scalable.

**Features:**
- Simple and scalable design
- Highly energetic and strongly focussed beam
- Pre-treatment of different substrate materials

**Benefits:**
- Campaign time up to four weeks
- Excellent etching uniformity
- Easy customization

**Technical Data:**
Subject to change without notice due to technical improvement.

**LION®**

**LINEAR ION SOURCE**

The main applications for the LION® are large-area glass coating and metal strip coating. It is available as a remote mounted version with an adjustable incidence angle or as a flange mount version.
**TECHNICAL DATA**

**FEATURES**
- Capacitively coupled dynamic PECVD for moving substrates
- Continuous sheet by sheet, carrier by carrier or roll-to-roll processing
- Integrated sidegasing gas distribution system
- Integrated process gas extraction system
- Free operation modes: face-up, face-down and vertical
- Adjustable electrode distance to match process
- For plasma chemical etching, surface engineering and material deposition

**BENEFITS**
- Scalable high-throughput option for all state-of-the-art CCP CVD processes
- Dynamic deposition on various substrates
- Enables high layer homogeneities
- Permits large area deposition at RF and VHF
- Long campaign deposition runs for different set-ups and materials
- High durability
- Maintenance free (recommended sealings exchange after 5 years)
- No starting layer on substrate

**FEATURES**
- Inorganic (e.g. SiH4) and organic (e.g. C2H4, plastic monomers) precursors usable
- Integrated gas distribution system
- Continuous sheet by sheet, carrier by carrier or roll-to-roll processing
- Free operation modes: face-up (limited), face-down (limited) and vertical
- Adjustable wire distance to match process
- Integrated thermocouples
- Optional pyrometer for process control and surveillance

**TECHNICAL DATA**

**FEATURES**
- Inorganic (e.g. SiH4) and organic (e.g. C2H4, plastic monomers) precursors usable
- Integrated gas distribution system
- Continuous sheet by sheet, carrier by carrier or roll-to-roll processing
- Free operation modes: face-up (limited), face-down (limited) and vertical
- Adjustable wire distance to match process
- Integrated thermocouples
- Optional pyrometer for process control and surveillance

**BENEFITS**
- Divided source design with separated wire mounting for quick exchange and quick process restart – the uptake flange simply stays on the lid or door
- Wires can be energized in selectable form which can be used to prolong coater’s productive uptime
- No plasma process: No ion bombardment, no field accelerated electrons and therefore smooth and highly conformal layer deposition with low internal stress
- Inherently free of dust
- Deposition rate up to factor 10 higher than PECVD processes
- No RF equipment
- High gas utilization of 40 % to 80 % and very low parasitic deposition in pumps and ductwork

**TECHNICAL DATA**

**FEATURES**
- Deposition rate up to factor 10 higher than PECVD processes
- No plasma process: No ion bombardment, no field accelerated electrons and therefore smooth and highly conformal layer deposition with low internal stress
- Inherently free of dust
- Deposition rate up to factor 10 higher than PECVD processes
- No RF equipment
- High gas utilization of 40 % to 80 % and very low parasitic deposition in pumps and ductwork

**BENEFITS**
- Divided source design with separated wire mounting for quick exchange and quick process restart – the uptake flange simply stays on the lid or door
- Wires can be energized in selectable form which can be used to prolong coater’s productive uptime
- No plasma process: No ion bombardment, no field accelerated electrons and therefore smooth and highly conformal layer deposition with low internal stress
- Inherently free of dust
- Deposition rate up to factor 10 higher than PECVD processes
- No RF equipment
- High gas utilization of 40 % to 80 % and very low parasitic deposition in pumps and ductwork

**TECHNICAL DATA**

**FEATURES**
- Deposition rate up to factor 10 higher than PECVD processes
- No plasma process: No ion bombardment, no field accelerated electrons and therefore smooth and highly conformal layer deposition with low internal stress
- Inherently free of dust
- Deposition rate up to factor 10 higher than PECVD processes
- No RF equipment
- High gas utilization of 40 % to 80 % and very low parasitic deposition in pumps and ductwork

**BENEFITS**
- Divided source design with separated wire mounting for quick exchange and quick process restart – the uptake flange simply stays on the lid or door
- Wires can be energized in selectable form which can be used to prolong coater’s productive uptime
- No plasma process: No ion bombardment, no field accelerated electrons and therefore smooth and highly conformal layer deposition with low internal stress
- Inherently free of dust
- Deposition rate up to factor 10 higher than PECVD processes
- No RF equipment
- High gas utilization of 40 % to 80 % and very low parasitic deposition in pumps and ductwork
The VON ARDENNE LOE is a component that thermally evaporates organic material in a closed crucible. The vapor is distributed through a heated pipe in the direction across the substrate and released to the substrate through a linear nozzle array. All parts that are in contact with the organic vapor – primarily crucible and nozzle pipe – are made of ceramics that are completely inert to the OLED materials. The crucible and nozzle pipe are heated to a temperature above the condensation point of the organic materials. The surfaces facing the substrate are shielded by directly cooled copper parts to minimize the thermal load on the OLED substrate. The system enables the inert loading and unloading of air-sensitive evaporation materials.

Source setup single and co-evaporation
Substrate width 300 mm to 1200 mm
Source-to-substrate distance 120 mm to 250 mm

The VON ARDENNE Online Trimming and Shimming Module is a web-based application that enables the quick optimization of the thickness uniformity (“% range”) of a single thin layer. After entering a measured thickness profile and the current trim gas settings, it proposes new trim gas settings that lead to improved uniformity. In the same manner, the magnet bar adjustment (“shimming”) for optimal settings can be calculated.

TRIMMING AND SHIMMING
Trimming means the adjustment of gas flows at each individual gas inlet segment of the magnetron in order to achieve the most uniform layer thickness at any position of the glass pane. This adjustment can be carried out while the coater is operating using the VON ARDENNE Ex-Situ Measuring System and visualization together with the Trimming & Shimming Module. Trimming adjustment is usually the first choice to improve the thickness uniformity. Shimming is the adjustment of the magnetic system of rotatable magnetrons in order to improve the thickness uniformity locally on the glass substrate.

TRIMMING AND SHIMMING
Trimming means the adjustment of gas flows at each individual gas inlet segment of the magnetron in order to achieve the most uniform layer thickness at any position of the glass pane. This adjustment can be carried out while the coater is operating using the VON ARDENNE Ex-Situ Measuring System and visualization together with the Trimming & Shimming Module. Trimming adjustment is usually the first choice to improve the thickness uniformity. Shimming is the adjustment of the magnetic system of rotatable magnetrons in order to improve the thickness uniformity locally on the glass substrate.

FEATURES
- Tuning of each layer to reach best uniformity
- Startup tuning of homogeneity after target change
- Pit-stop correction of long term deviation of thickness profile

BENEFITS
- Enables applications with strict uniformity requirements, like double or triple Low-E
- Increases product quality
- Reduces time needed
Process control in large-area coating is usually a non-automated task. It requires permanent monitoring of online measurements by human operators to detect deviations from a given reference spectrum. Such deviations result from different sources. Typically, the operator must decide which process parameters need to be adjusted. The operator’s experience is crucial to achieve fast and reproducible results.

The VA PROCESS MASTER is the tool for automated process setting and control for all layer systems. It follows a novel approach in process control and leads to best results without operator interaction. It also allows for a fully-automated drift compensation of the sputtering process and improves product quality. In a further step, this tool enables our customers to create complex recipes for attractive products. The tool also helps increase the productivity of a coating system, as it enables a faster adjustment to a new recipe.

Features:
- Analysis of inline measurement: Mean and uniformity values of thin layers
- Closed-loop control of:
  - Process power
  - Reactive gas feed
  - Magnet bar (shim settings)
- Subject judgement replaced by objective predictable behavior
- Permanent action
- Deviations held at zero instead of waiting for threshold violation
- No “Sawtooth” curves on startup
- Full overview
- Simultaneous control of all magnetrons
- Simultaneous mean-value (power) and balance control
- 24/7 operation
- Machine state survey
- Automated check of process values, e.g. voltage, pressure, voltage drift,
  - Configurable by recipe
  - Summarized „Production Ready“ flag
VON ARDENNE develops and manufactures industrial equipment for vacuum coatings on materials such as glass, wafers, metal strip and polymer films. These coatings give the surfaces new functional properties and can be between one nanometer and a few micrometers thin, depending on the application.

Our customers use these materials to make high-quality products such as architectural glass, displays for smartphones and touchscreens, solar modules and heat protection window film for automotive glass.

We supply our customers with technologically sophisticated vacuum coating systems, extensive expertise and global service. The key components are developed and manufactured by VON ARDENNE itself.

Systems and components made by VON ARDENNE make a valuable contribution to protecting the environment. They are vital for manufacturing products which help to use less energy or to generate energy from renewable resources.

WHO WE ARE & WHAT WE DO

VON ARDENNE GmbH (headquarters) | Am Hahnweg 8 | 01328 DRESDEN | GERMANY
Sales: +49 (0) 351 2637 189 | sales@vonardenne.biz
Service: +49 (0) 351 2637 9400 | support@vonardenne.biz

VON ARDENNE Vacuum Equipment (Shanghai) Co., Ltd. | +86 21 6173 0210 | sales-vave@vonardenne.biz; support-vave@vonardenne.biz

VON ARDENNE Malaysia Sdn. Bhd. | +60 4408 0080 | sales-vama@vonardenne.biz; support-vama@vonardenne.biz

VON ARDENNE Japan Co., Ltd. | +81 3 6435 1700 | sales-vajp@vonardenne.biz; support-vajp@vonardenne.biz

VON ARDENNE North America, Inc. | +1 419 386 2789 | sales-vana@vonardenne.biz; support-vana@vonardenne.biz

VON ARDENNE North America, Inc. | +1 480 726 5470 | sales-vavn@vonardenne.biz; support-vavn@vonardenne.biz

VON ARDENNE Vietnam Co., Ltd. | +60 124 23 7353 | sales-vavn@vonardenne.biz; support-vavn@vonardenne.biz

WORLDWIDE SALES AND SERVICE

Photos © VON ARDENNE GmbH