Semiconductor Reference Guide

Application Opportunities

How we can help?

Semiconductor manufacturing involves the design, fabrication, and assembly of semiconductors, which serve as the foundation for various electronic technologies. Companies operate specialized fabrication plants (fabs) equipped with state-of-the-art machinery and cleanroom environments to ensure the highest levels of precision and quality.

Semiconductor equipment is used to produce semiconductor chips, integrated circuits (ICs) that are formed on semiconductor wafers. These thin, flat discs are made of a semiconducting material that serves as the substrate. Often, the wafers are made of silicon, the second most abundant element in Earth's crust.

The semiconductor industry uses cleanrooms because silicon and other types of wafers are extremely sensitive to environmental contaminants. Within these cleanrooms, chip manufacturers use dicing machines, probing machines, polish and edge grinders, chemical mechanical planarization (CMP) and photolithography equipment, and sliced wafer demounting and cleaning machines.

Companies that make semiconductor manufacturing equipment are often not aware of the consequences of exposing their operators with the manual torque wrenches when assembling the equipment.

Majority of the Semiconductor companies are not aware of the high human error and musculoskeletal disorder which are both critical in their preventive maintenance process. Having first-time-right with the lowest turnaround time during preventive maintenance is why Atlas Copco is the trusted assembly solution provider for major semiconductor equipment manufacturing worldwide.

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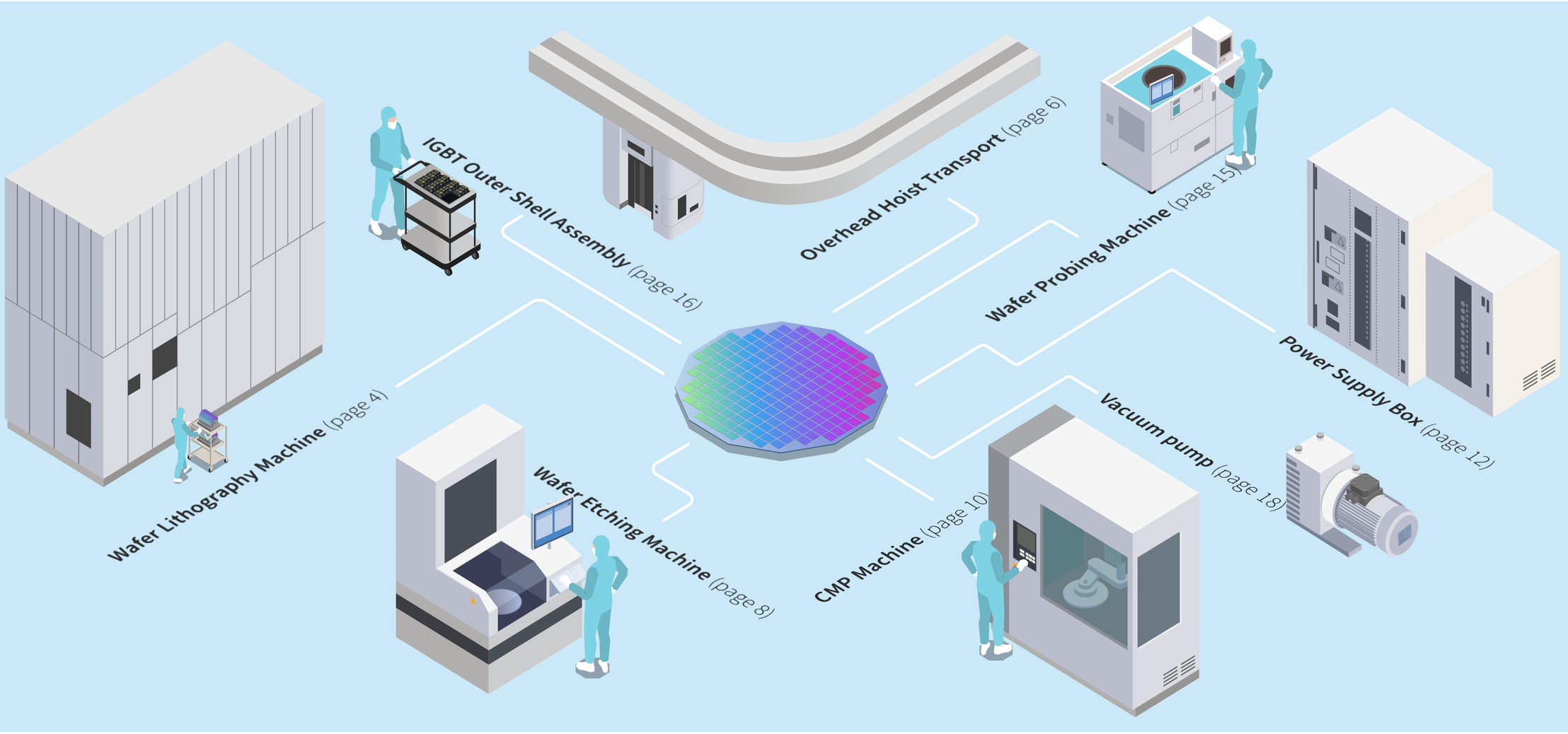
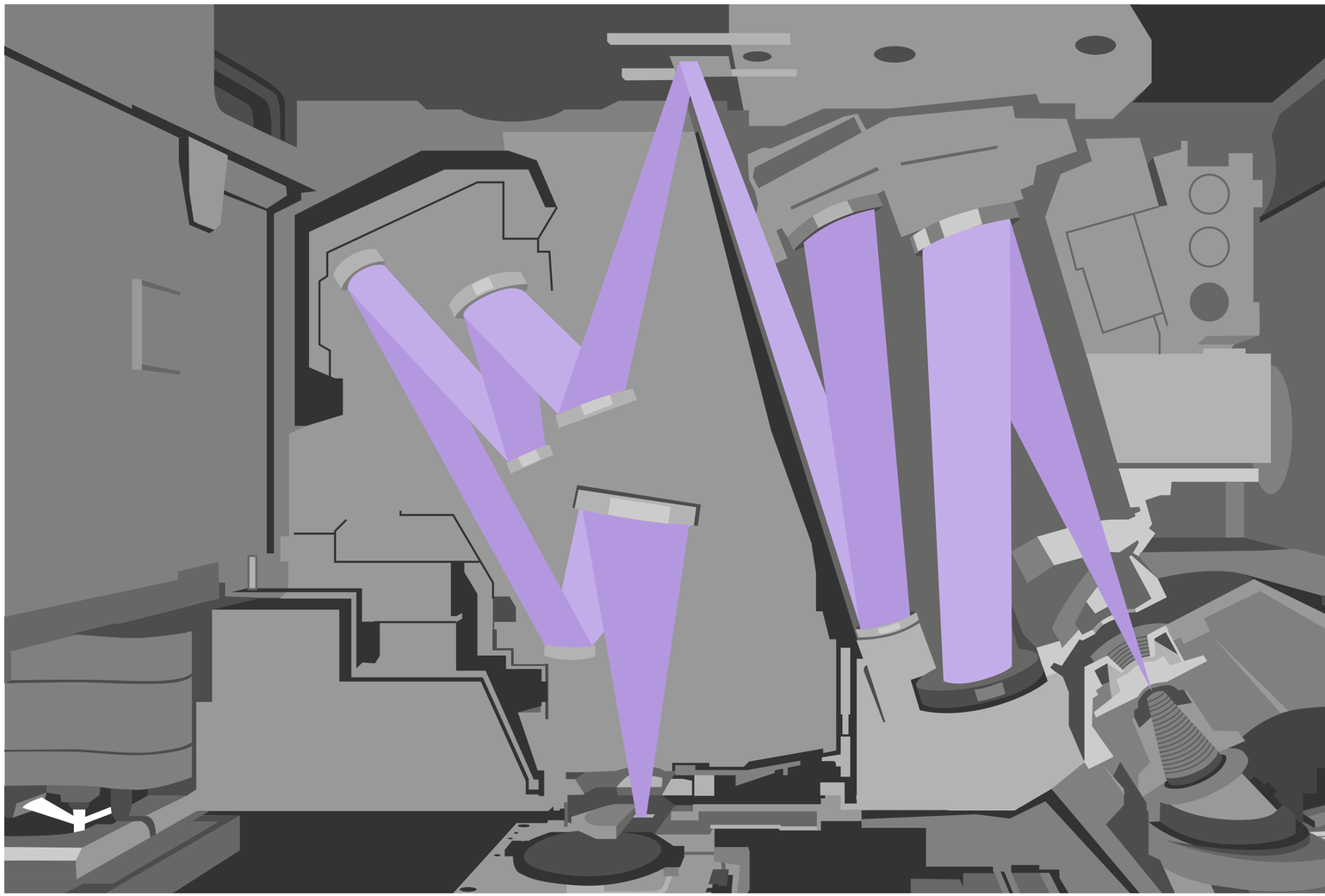


Wafer Lithography Machine

Lithography is the most critical technology for manufacturing chips. It is a process by using light to print tiny patterns on silicon which is a fundamental step in mass producing microchips.

Meanwhile, manufacturing a lithography machine is extremely essential for the semiconductor manufacturing process. These machines are specifically designed to produce semiconductor wafers, whichserve as the foundation for integrated circuits and electronic devices.

Assembling the machines with the right tool and solution plays a vital role in Semiconductor manufacturing. This will facilitate the efficient production of highest quality of semiconductor wafers from the very beginning.



CHALLENGES

Consequences of using manual torque wrenches

- Manual torque wrenches causing serious quality issues
- Serious quality issues like over-torque, missing screws and floating screws
- Unpreventable human-errors are hard to analyze
- Zero data collection
- Extremely high turnaround downtime
- Health and safety issue with non-ergonomic manual wrenches

Wafer Lithography Machine

SOLUTIONS

To have a complete Atlas Copco Smart Tightening Workstation on a stationary table

Products

- MTF6000 controller for lower torque tightening in the chuck of the machine
- ETD M for lower torque ranges from 2cNm to 250cNm
- ILG – Industrial Location Guidance with torque arm to prevent ergonomic issue
- AC Node 21.5 Value Pro – A high-resolution display that supports digitalization and Industry 4.0 in assembly line

Software

- SQS3 – A graphical user interface/operator guidance for error-proofing
- ToolsNet8 – Real-time process monitoring and traceability software for data collection

Alternative options:

- ICB (controller-free) for battery tools ranges 1.5Nm–20 Nm
- ETD SR straight tools are ideal for handheld applications for torque range from 1.5 to 16 Nm
- Power Focus 8000 controller
- STB tools for pistol and right angle for multiple fasteners

VALUES

Quality

- Improve health and safety of the operators
- Quality management can be accomplished to maintain a desired level of excellence
- Keep your future factory sustainable

Error-proofing

- Minimizing rework and downtime, higher profitability
- Flexible production in assigning the right task at the right place and time

Data collection

- Expert data analysis tools like ToolsNet8
- Know the health of all systems
- Easy access to asset information
- Production optimization of maximizing production from a given facility with the available equipment

Overhead Hoist Transport (OHT)

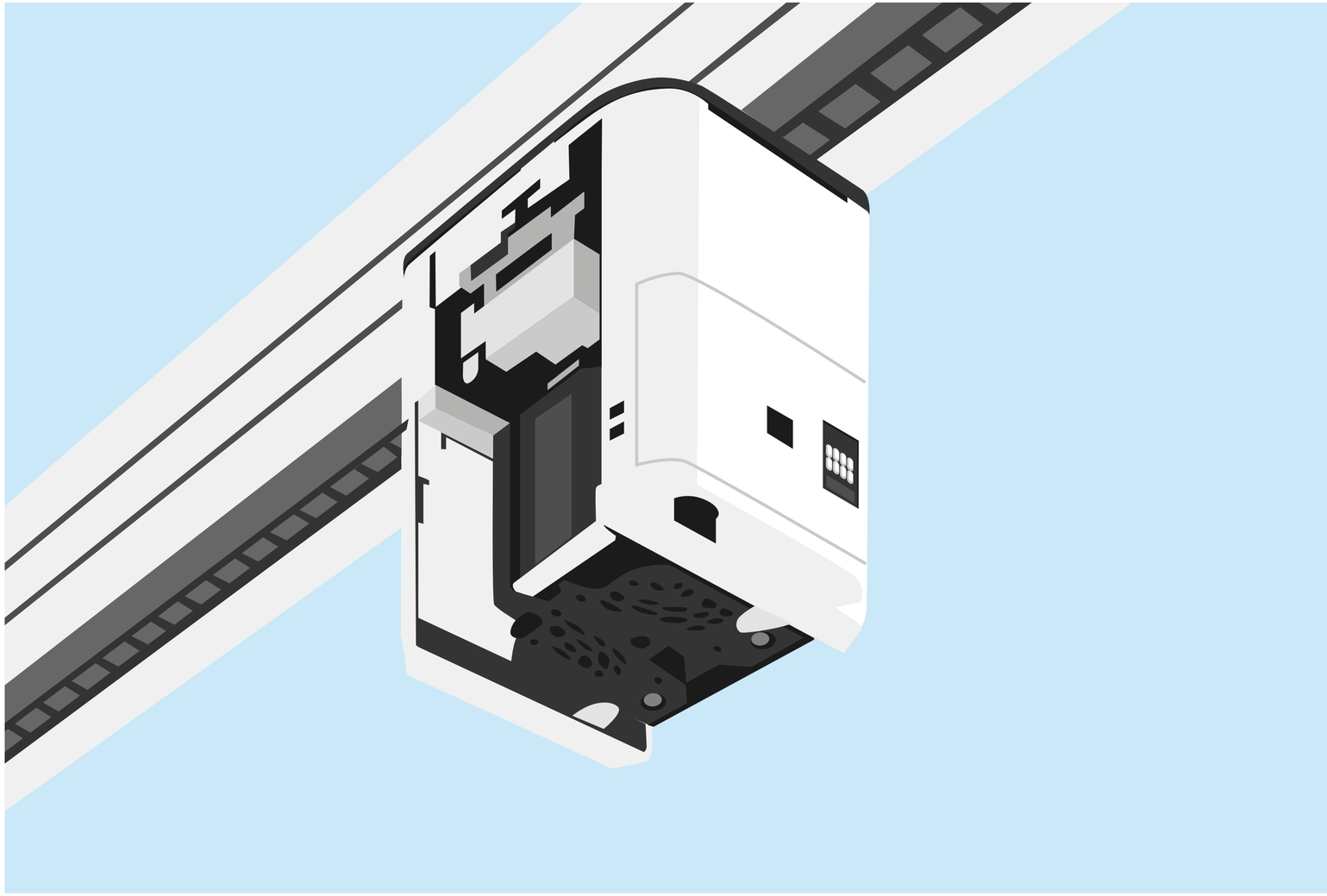
The Overhead Hoist Transport application plays a crucial role in semiconductor manufacturing. It is specifically designed to transport delicate semiconductor material safely and efficiently within the manufacturing facility. A high capacity transport system that does not interfere with ground-based facilities and equipment.

The preventive maintenance of an OHT requires the highest precision and accuracy which means having the right tool for the right task while minimizing human-error.

CHALLENGES

The cost of an OHT is extremely high thus using manual torque wrenches for maintenance is not ideal

- Zero data collection
- Extremely high downtime for each preventive maintenance stop
- Serious quality issues like over-torque, missing screws and floating screws
- Unpreventable human-errors are hard to analyze
- Health and safety issue with non-ergonomic manual wrenches



Overhead Hoist Transport (OHT)

SOLUTIONS

To have a complete Atlas Copco Smart Tightening Workstation on a stationary table

Products

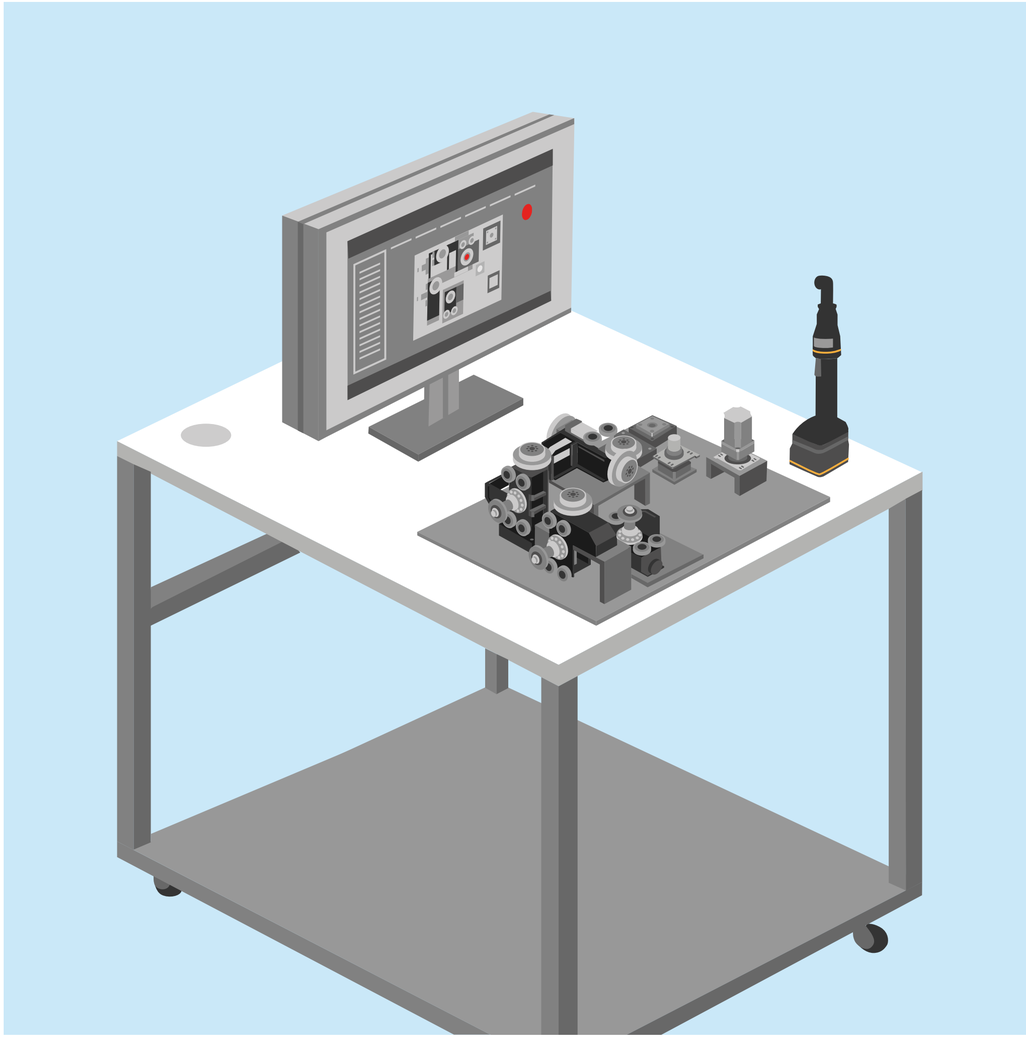
- ICB (controller-free) for battery tools ranges 1.5Nm–20Nm
- AC Node 21.5 Value Pro – A high-resolution display that supports digitalization and Industry 4.0 in assembly line

Software

- SQS3 – A graphical user interface/operator guidance for error-proofing
- ToolsNet8 – Real-time process monitoring and traceability software for data collection

Alternative options:

- Tensor SL compact screwdriver with excellent power to weight ratio for torque range from 0.3 to 10 Nm
- Power Focus 8000



VALUES

Quality

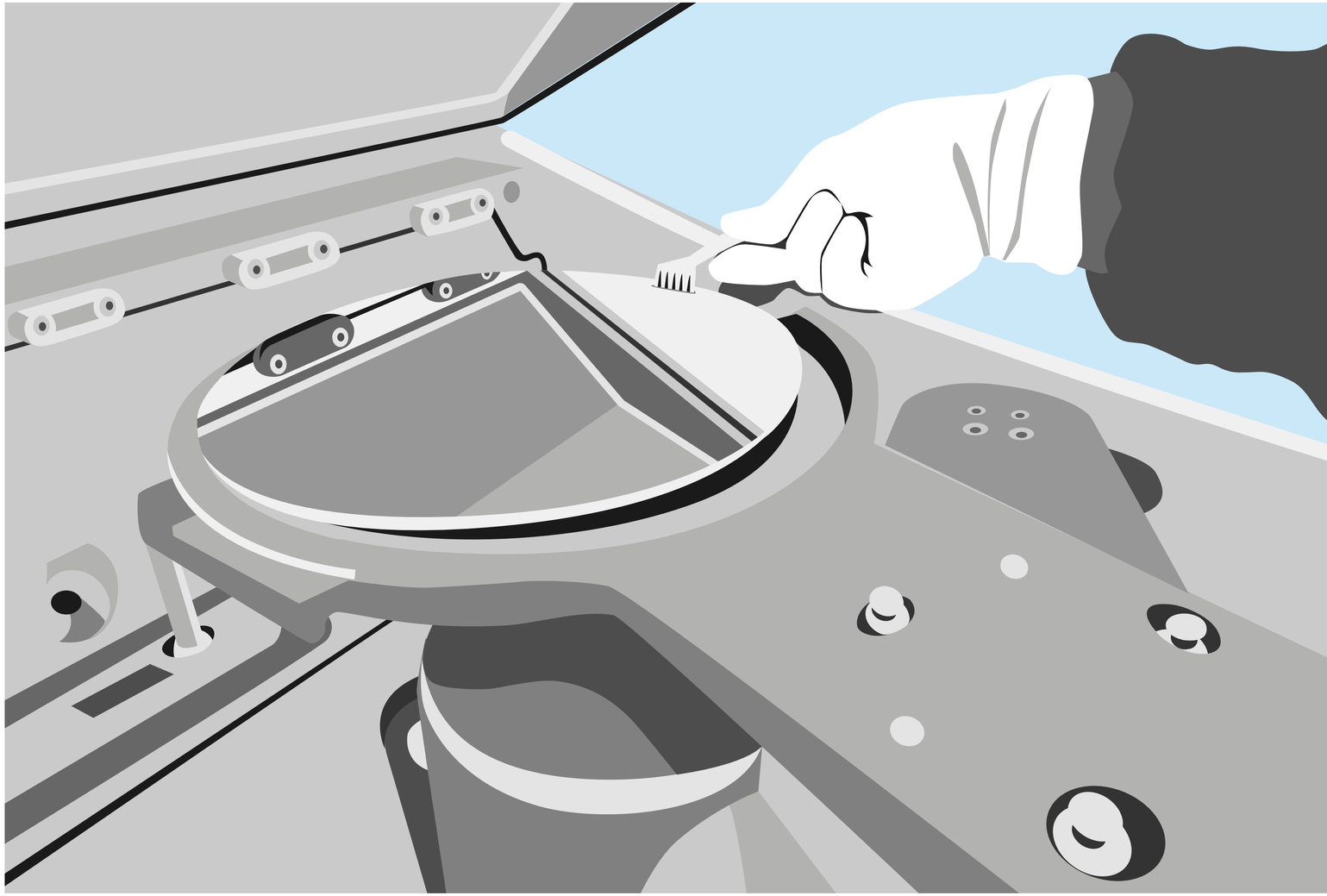
- Quality management can be accomplished to maintain a desired level of excellence
- No extra floor space needed with controller-free ICB tool
- Production optimization of maximizing production from a given facility with the available equipment
- Error-proofing with SQS3 software with operator guidance

Productivity

- Reduced time on product installation
- Faster and more accurate tightening
- Minimize rework leads to higher ROI

Wafer Etching Machine

Semiconductor manufacturers produce more ultra flat wafers to meet the increasing consumer demand for slimmer electronic devices. For this reason, they have developed different wafer thinning techniques to achieve the desired flatness. The etching process is widely used in microfabrication. It involves the elimination of unwanted substances from the surface of the wafer by removing one or more layers. Servicing these machines is an extremely critical process because each chamber has to be perfectly sealed (vacuum state). These gases have to be handled carefully to avoid health, safety or environmental issues. There might be multiple chambers in one machine to be serviced.



CHALLENGES

Consequences of using manual torque wrenches

- Serious quality issues like gas leakage over bad tightening
- Lowest quality of tightening like over-torque, missing screws and floating screws
- Unpreventable human-errors are hard to analyze
- Zero data collection
- Extremely high turnaround downtime
- Health and safety issue with non-ergonomic manual wrenches

Wafer Etching Machine

SOLUTIONS

To have a moveable cart with a complete Atlas Copco Smart Tightening Workstation for service personnel to move around in their large facility

Products

- ICB (controller-free) for battery tools ranges 1.5Nm–20Nm
- AC Node 21.5 Value Pro – A high-resolution display that supports digitalization and Industry 4.0 in assembly line
- Socket selector – Error-proofing

Software

- SQS3 – A graphical user interface/operator guidance for error-proofing
- ToolsNet8 – Real-time process monitoring and traceability software for data collection

VALUES

Having a moveable cart will reduce unnecessary movement of transporting the chambers when performing preventive maintenance. At the same time, reducing human motion which is more than required to perform the process to achieve highest efficiency level

Quality

- No extra floor space needed with controller-free ICB tool
- Reduce risk of having gas leakage – safety critical
- Faster and more accurate tightening
- Production optimization of maximizing production from a given facility with the available equipment
- Know the health of all systems
- Keep your future factory sustainable

Productivity

- Reduced time required for preventive maintenance
- Faster and more accurate tightening
- Minimize rework leads to higher ROI
- Easy access to asset information via ToolsNet8 software
- Expert data analysis tools via ToolsNet8 software

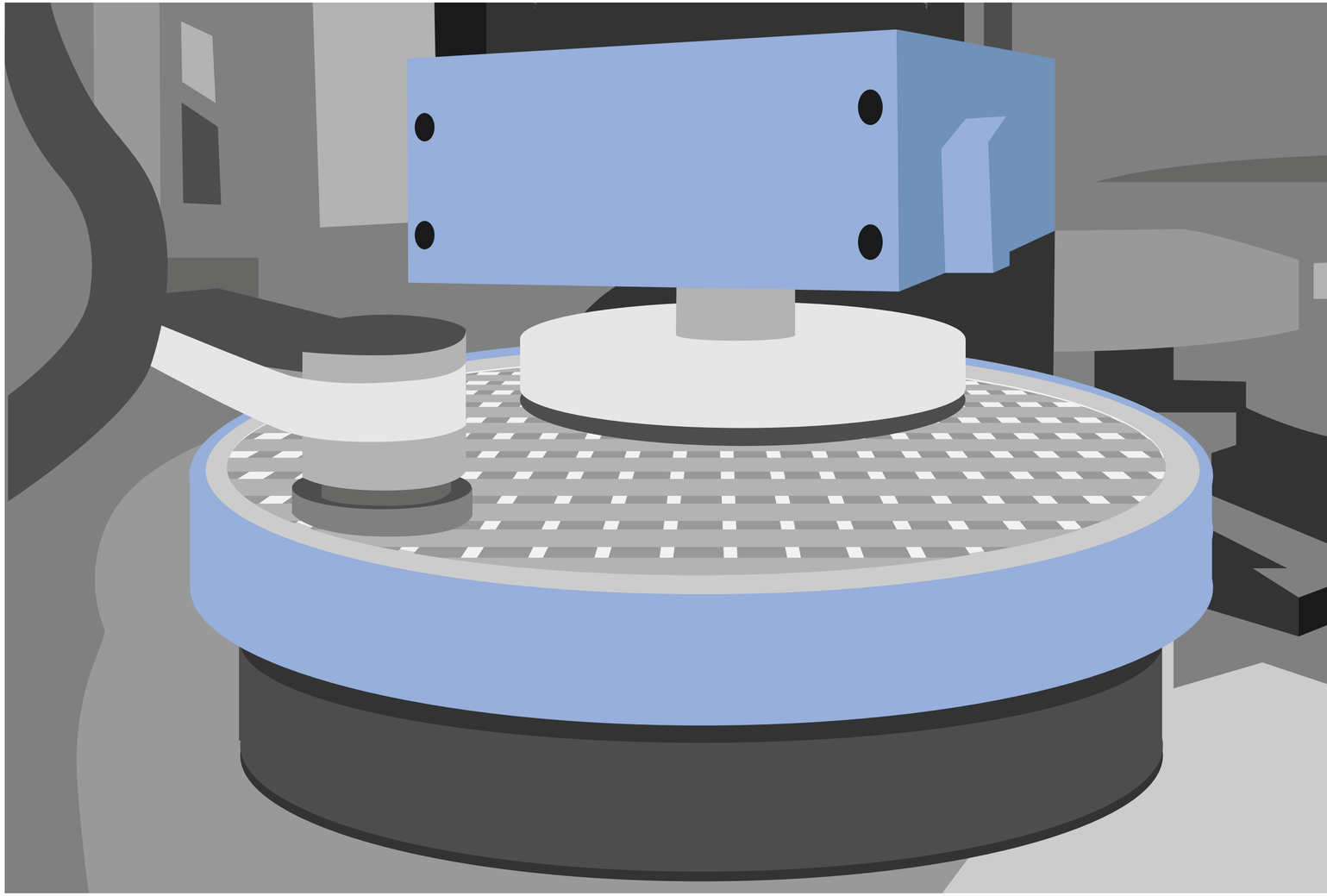
CMP Machine

Chemical mechanical planarization (CMP), often called chemical mechanical polishing, is a procedure to level thin layers. It is a critical step that is used multiple times in the semiconductor manufacturing process at each layer of the wafer to remove excess materials and create a smooth surface. This is done through the interaction of a pad and slurry on a polishing tool. To produce uniform wafers with the highest quality surfaces, highest maintenance level is needed

CHALLENGES

Critical yet high tightening numbers in one of the machine chambers but customers are using manual torque wrenches. Real case scenario, 108 fasteners to tighten during preventive maintenance process.

- Serious quality issues like gas leakage over bad tightening
- Lowest quality of tightening like over-torque, missing screws and floating screws
- Unpreventable human-errors are hard to analyze
- Zero data collection
- Extremely low productivity – Hard production stop of 2 hours each time
- High audit risks – health, safety and environment



CMP Machine

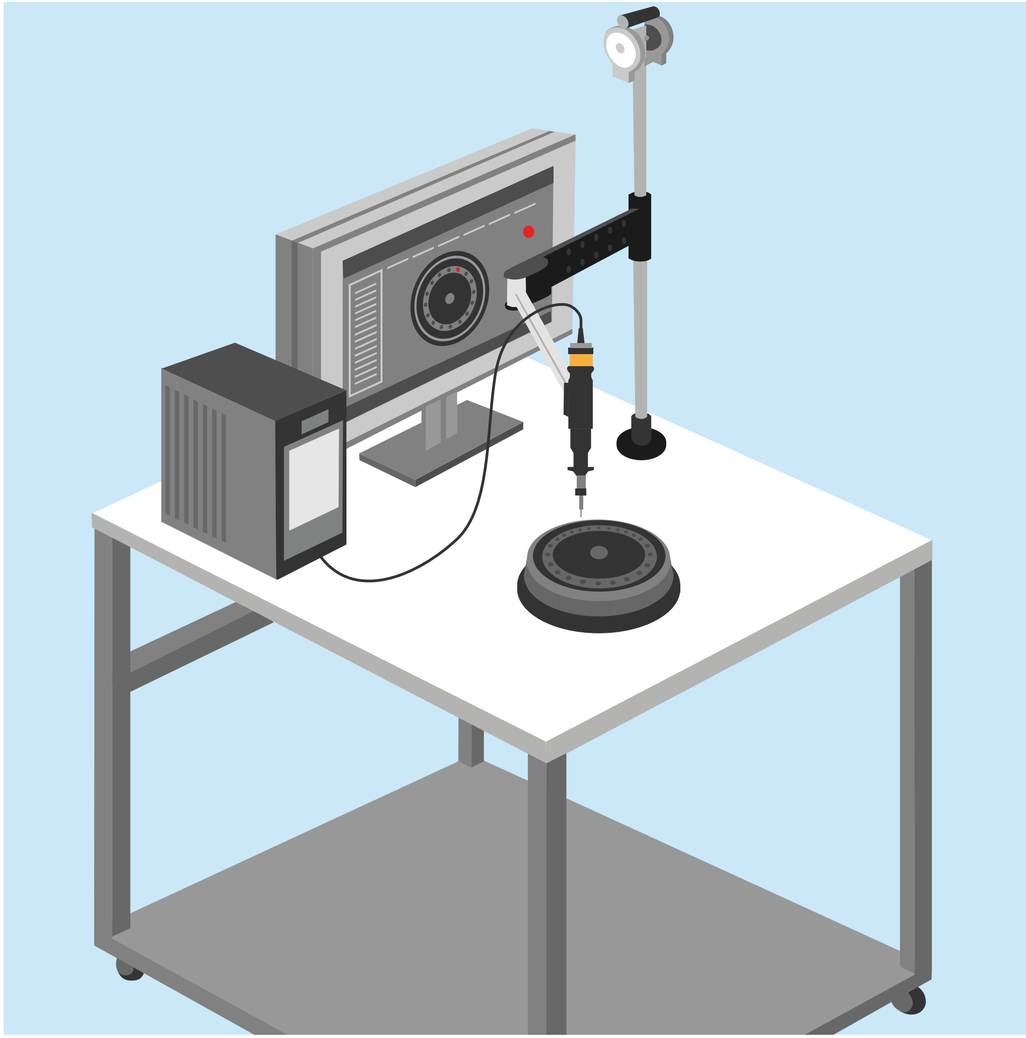
SOLUTIONS

Products

- Tensor SL compact screwdriver with excellent power to weight ratio for torque range from 0.3 to 10 Nm
- Power Focus 8000
- AC Node 21.5 Value Pro – A high-resolution display that supports digitalization and Industry 4.0 in assembly line
- Torque arm for a better ergonomic process having to tighten many screws at one time

Software

- SQS3 – A graphical user interface for operator guidance
- ToolsNet8 – Real-time process monitoring and traceability software for data collection



VALUES

Tremendous improvement on health issue of the operators by using ergonomic tools.
A complete solution from Atlas Copco

Quality

- Quality management can be accomplished to maintain a desired level of excellence
- Production optimization of maximizing production from a given facility with the available equipment
- Error-proofing with SQS3 software with operator guidance
- Keep your future factory sustainable

Productivity

- Reduced time on product installation
- Faster and more accurate tightening
- Minimize rework leads to higher ROI
- Minimize downtime, higher profitability

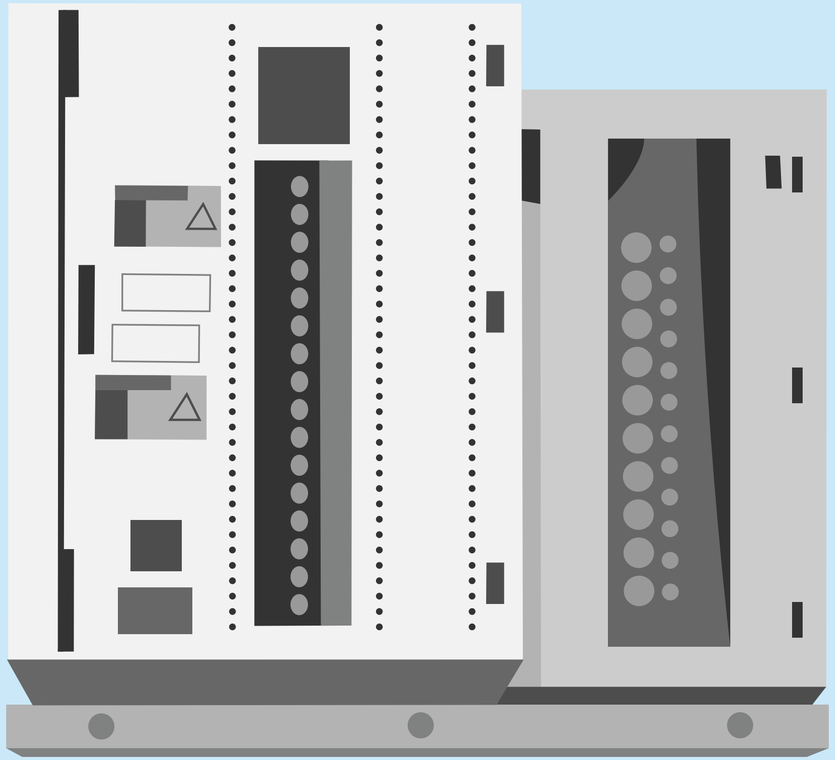
Power Supply Box

A power supply box is integrated into most of the Semicon manufacturing machines such as etching machines, chemical vapor deposition machines, UV thermal processing machines and many more. These machines are critical to have the highest torque accuracy with zero to minimal rework because it is not ideal to locate any error in tightening. The power box manufacturers tend to have first time right for their machine assembly and they need to have traceability for all their tightening.

CHALLENGES

Customer having high downtime up to half a day to detect leakage issue in a power box as they do not know where to begin

- Requested for data and traceability in every tightening
- Highest torque accuracy is needed
- Manual torque wrenches causing serious quality issues
- Unpreventable human-error- missing screws, over torque, floating screws
- Issues occurred are hard to analyze with zero traceability
- Extremely low productivity with lowest safety level with manual tools
- High audit risks – health, safety and environment
- Requested for battery tools - easy access and zero cables limiting movement



Power Supply Box

SOLUTIONS

Products

- ICB (controller-free) for battery tools ranges 1.5Nm–20Nm

Software

- SQS3 – A graphical user interface/operator guidance for error-proofing
- ToolsNet8 – Real-time process monitoring and traceability software for data collection

VALUES

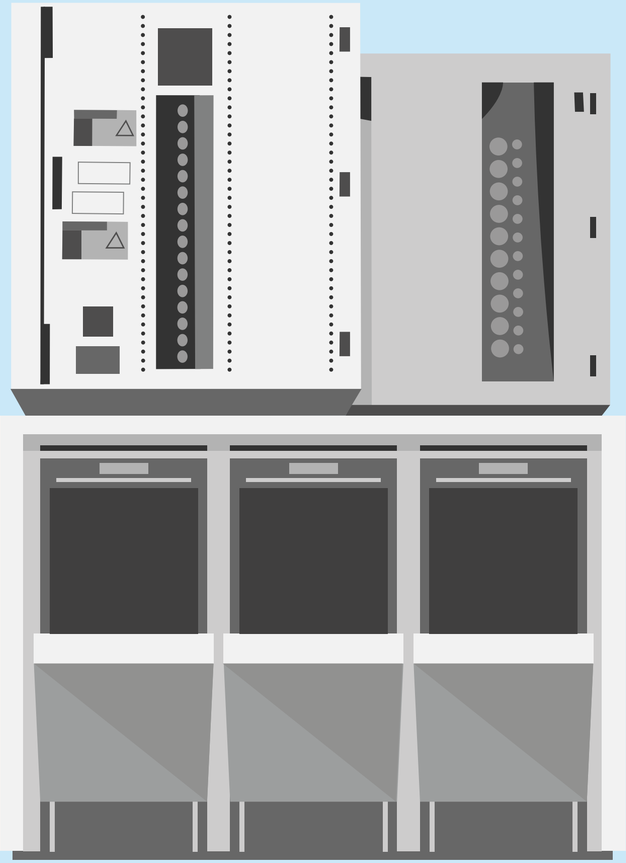
By transforming customer to battery tools for higher efficiency while minimizing operator movement complication with cable tools while having highest quality of tightening

Quality

- No extra floor space needed with controller-free ICB battery tool
- Error-proofing with SQS3 software for operator guidance
- Keep your future factory sustainable
- Improve health issue from using non-ergonomic manual wrenches
- Quality management can be accomplished to maintain a desired level of excellence

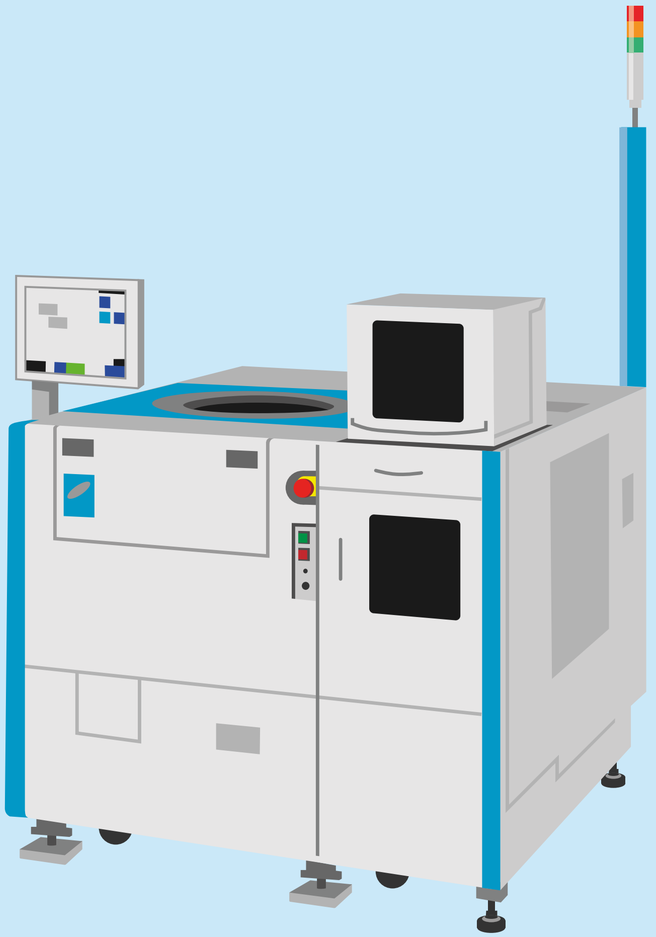
Productivity

- Minimize downtime, higher profitability
- Production optimization of maximizing production from a given facility with the available equipment



Wafer Probing Machine

Wafer probers are machines which are required for electrically testing the wafers of individual chips. The prober therefore undertakes the fully automatic loading and handling of the wafer while ensuring the best positioning accuracy. The assembly of a wafer prober needs to be in the highest precision for testing ultra-thin wafers to ensure maximum productivity of the high Semiconductor production throughput tightening.



CHALLENGES

Wafer prober has micrometer precision positioning control which is crucial for an exact determination of the temperature when testing each chip. Most of the available wafer probers in the market are fully automatic with high probing speed. Thus, operator using manual torque wrenches for assembly and preventive maintenance is not ideal.

- Unable to upkeep the right temperature for chip probing/ testing if there is a bad tightening on the machine-leakage
- Serious quality issues like over-torque, missing screws and floating screws
- Unpreventable human-errors are hard to analyze
- Zero data collection
- Health and safety issue with non-ergonomic manual wrenches

Wafer Probing Machine

SOLUTIONS

To have a complete Atlas Copco Smart Tightening Workstation on a cart as the machine to assemble/maintain is huge and heavy to move around

Products

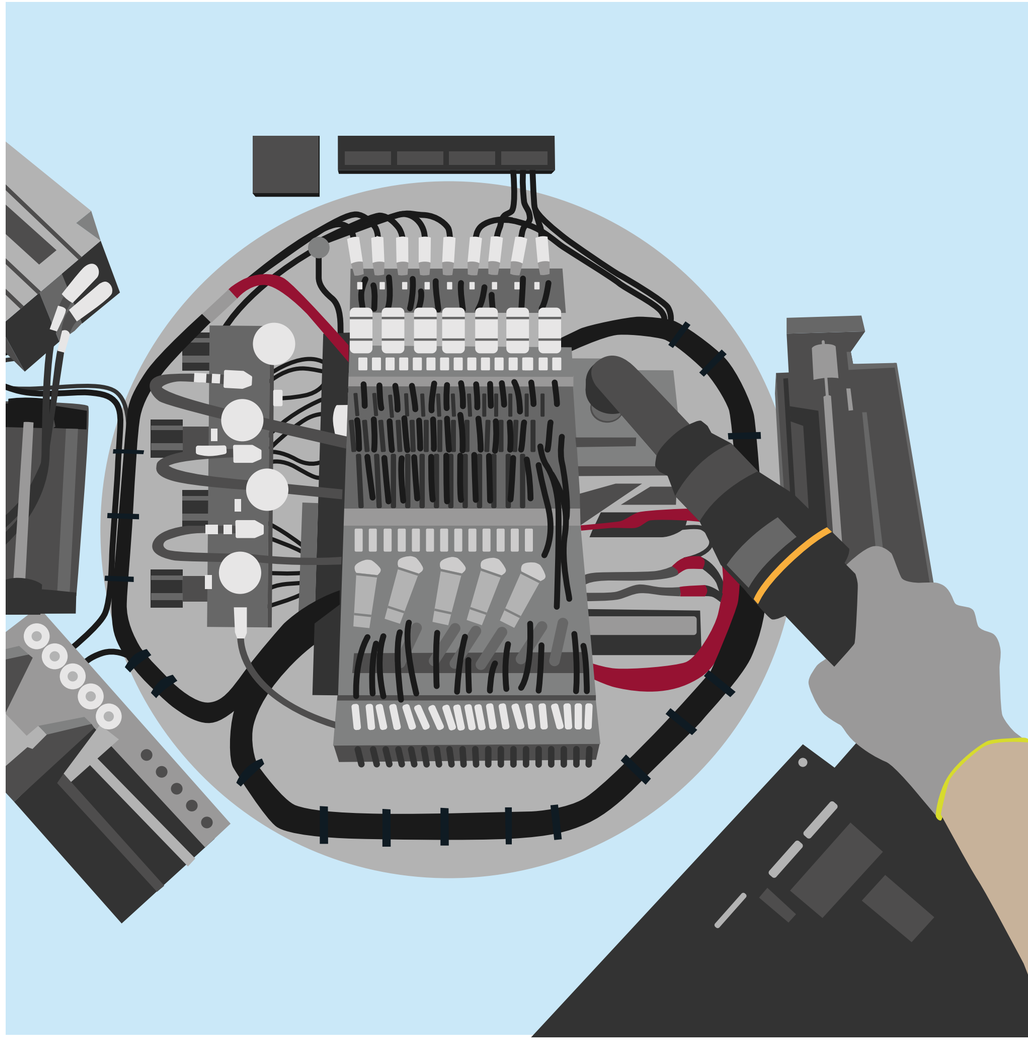
- ICB (controller-free) for battery tools ranges 1.5Nm–20Nm
- AC Node 21.5 Value Pro – A high-resolution display that supports digitalization and Industry 4.0 in assembly line

Software

- SQS3 – A graphical user interface/operator guidance for error-proofing
- ToolsNet8 – Real-time process monitoring and traceability software for data collection

For a different range of torque, there are other options in the product range such as:

- Tensor SL compact screwdriver with excellent power to weight ratio for torque range from 0.3 to 10 Nm
- Power Focus 8000



VALUES

Productivity

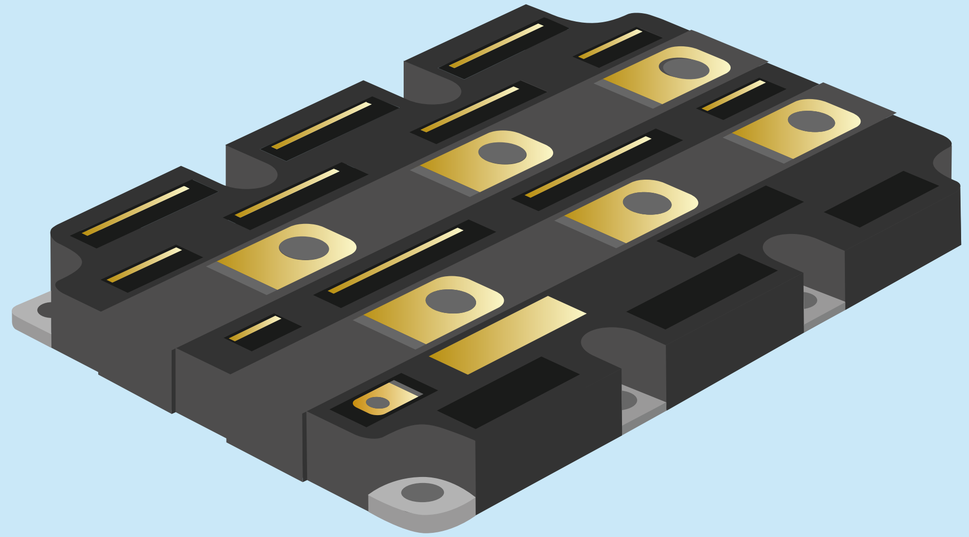
- There is no need to send to external source for pre-ventive maintenance for the lowest turnaround time
- Easy access to smart tools within reach as it will all be placed on a cart with error-proofing solutions and data collection
- Reduced time on product installation
- Faster and more accurate tightening
- Minimize rework leads to higher ROI

Quality

- Quality management can be accomplished to maintain a desired level of excellence
- No extra floor space needed with controller-free ICB tool
- Production optimization of maximizing production from a given facility with the available equipment
- Error-proofing with SQS3 software with operator guidance

Semiconductor Device – IGBT Outer Shell Assembly

An insulated-gate bipolar transistor (IGBT) is a three-terminal power semiconductor device primarily forming an electronic switch. IGBTs are widely used as switching devices in the inverter circuit (for DC-to-AC conversion) to drive small to large motors. IGBTs for inverter applications are used in home appliances such as air conditioners and refrigerators, industrial motors, and automotive main motor controllers to improve their efficiency.



CHALLENGES

Customers are using various brands of tools to assemble up to 5 screws on one application. The screws have different range in terms of sizes and torques at one station. There were more than 5 different tools being used at the same time and very often operators will use the wrong tool as they do not have any error-proofing in place.

- Wrong torque causes slip screws and high warping issue on every work piece
- Serious quality issues like over-torque, missing screws and floating screws
- Unpreventable human-errors are hard to analyze
- Zero data collection

Semiconductor Device – IGBT Outer Shell Assembly

SOLUTIONS

To replace a high mix of tools from various of brands with just one Atlas Copco tool per station

Products

- ETF SL – The smallest and lightest fixtured tool with torque ranges from 0.3–10 Nm
- Power Focus 8000

Software

- SQS3 – A graphical user interface/operator guidance for error-proofing
- ToolsNet8 – Real-time process monitoring and traceability software for data collection

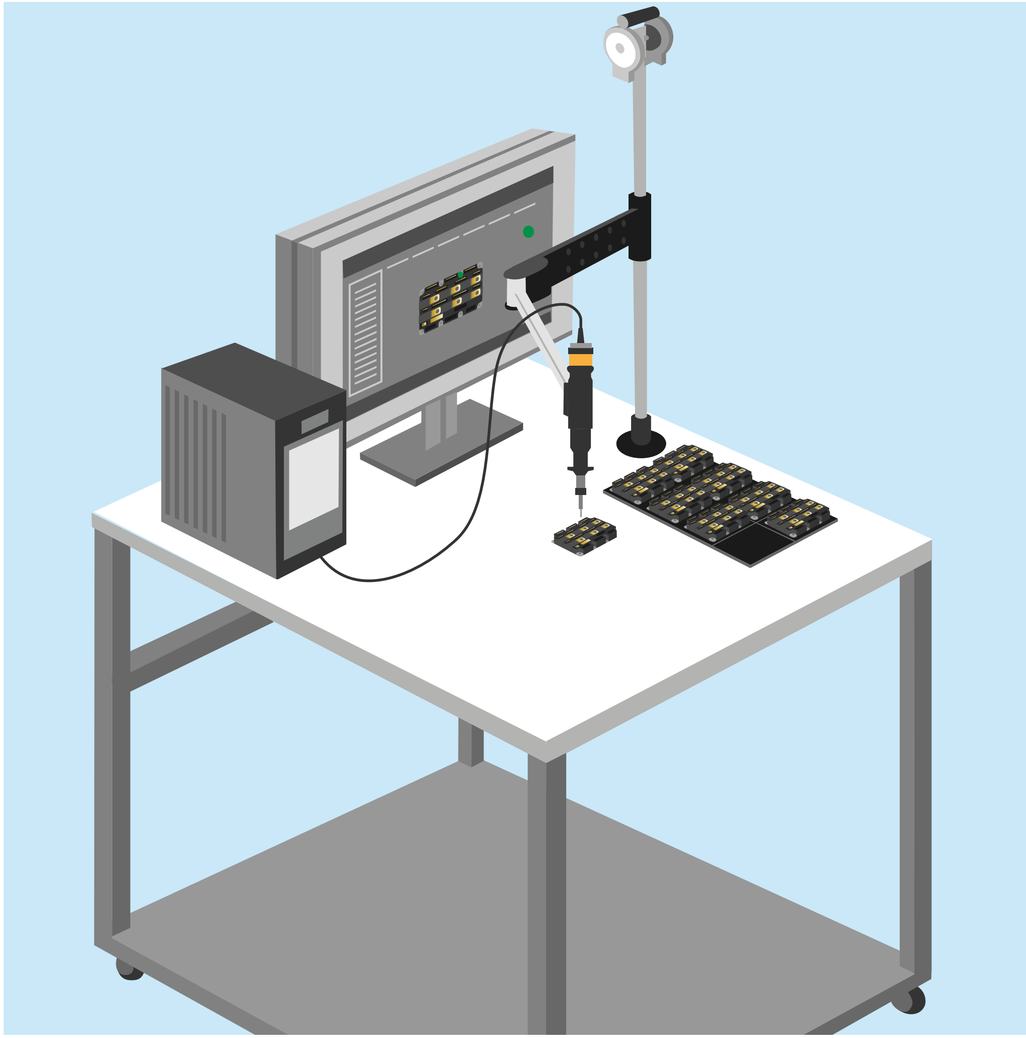
VALUES

Productivity

- 1 tool achieving up to 5 different torques with highest efficiency
- Reduced time on product assembly
- Faster and more accurate tightening
- Minimize rework, cost and tool management and maintenance lead to higher ROI

Quality

- SL tools improve torque accuracy of screw assembly (from +/– 12.5 % to +/– 5 %)
- SL tools provide a ”batch validation” function to reduce errors and improve product quality
- SL tools use advanced multi-step tightening strategies to reduce errors and improve product quality
- Quality management can be accomplished to maintain a desired level of excellence
- Error-proofing with SQS3 software with operator guidance



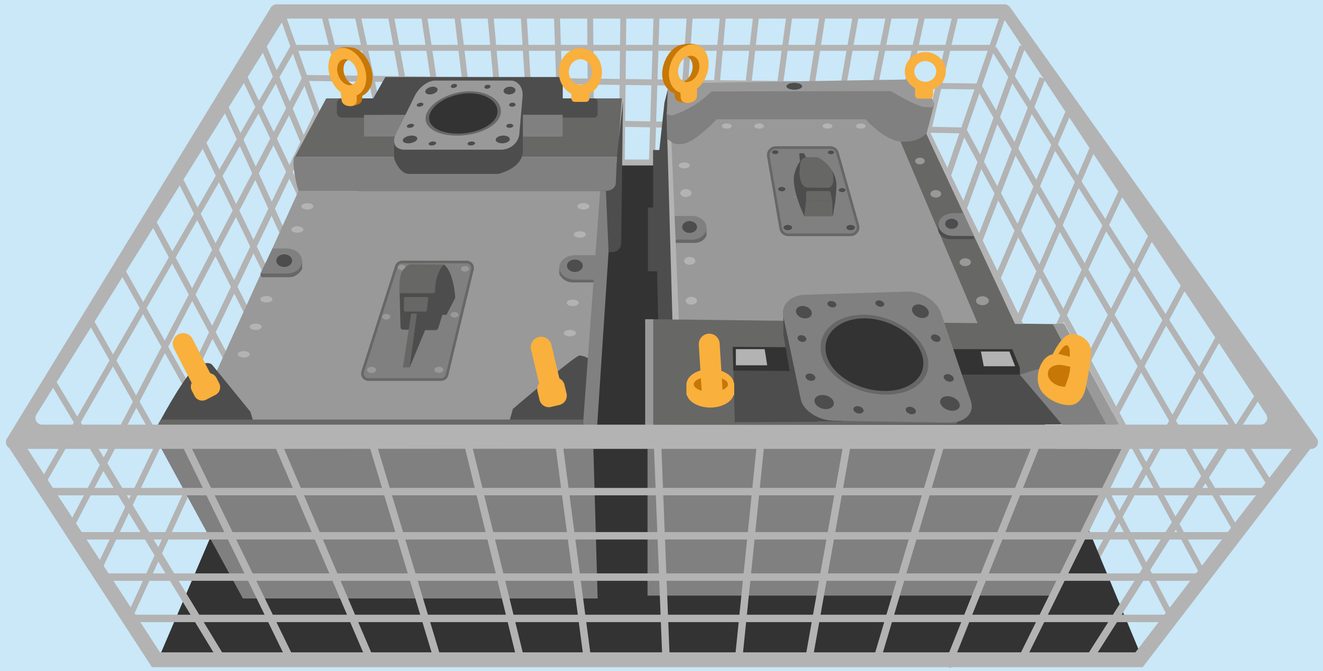
Vacuum pump for Semiconductor Industry – Stator-water Plate Assembly

Vacuum pumps are instrumental in the Semiconductor manufacturing process. It can be a vacuum system for EUV/DUV wafer lithography machines. In a Semiconductor production, air and gases are put into a chamber to react and form a film on the surface of a silicon wafer. The function of the pump is to provide reliable low pressure in the chamber to facilitate the forming of that film. Generally, their purpose is to clean and seal. In order to prevent contamination, various stages of critical assembly are in place such as the stator-water plate.

CHALLENGES

At least 2 operators are needed to operate the click wrench to install one application as it involves different torque and bolts. The bolts have different range in terms of sizes and torques on one piece of application. The exchange of ratchet wrenches manually will cause high human-error as they do not have any error-proofing in place.

- Wrong torque causes quality issues on every work piece
- Over-torque, under-torque, no sequence tightening, missing screws and floating screws
- Unpreventable human-errors are hard to analyze
- Zero data collection
- High workforce/headcount required for each assembly



Vacuum pump for Semiconductor Industry – Stator-water Plate Assembly

SOLUTIONS

To replace with an automatic tightening station with one Atlas Copco tool per station and can be operated with just one operator

Products

- ETD STR – A straight model protected against intrusion of dust and water to withstand the toughest environments with IP class 54. Torque ranges from 1Nm – 120Nm
- Power Focus 8000
- AX1-1.5 Floor-mounted robotic arm
- Industrial Location Guidance (ILG) with HMI

Software

- SQS3 – A graphical user interface/operator guidance for error-proofing
- ToolsNet8 – Real-time process monitoring and traceability software for data collection

VALUES

Productivity

- 1 tool with 1 operator with highest efficiency
- Reduced time on product assembly
- Faster and more accurate tightening
- Minimize rework, cost and tool management and maintenance lead to higher ROI

Quality

- STR tool has a built in gyroscope to detect operators influence on tightening
- STR tool has High cycle rate capability due to improve heat dissipation.
- Tools use advanced multi-step tightening strategies to reduce errors and improve product quality
- Quality management can be accomplished to maintain a desired level of excellence
- Error-proofing with SQS3 software and ILG with HMI with operator guidance