

# KUKA



## COBOTS IN CLEANROOMS

The new dimension of automated  
semiconductor production



Facts & Figures

\$433,000,000,000

was the global sales volume for semiconductors in 2020. That's a significant increase over the previous year – despite coronavirus-related shutdowns and geopolitical tensions. The industry association SEMI predicts that growth will continue in 2021. A new record high is expected in 2022. The reason: the pandemic is accelerating digitalization.



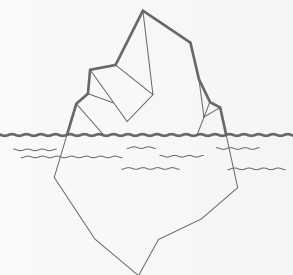
35 particles

> 0.5 µm – equivalent to 0.0005 mm – per 1 m³ of air is the upper limit for ISO Class 3 cleanrooms, as required in semiconductor production.

By comparison:



1 m³ of city air (30 km/h speed limit) contains up to 500,000 particles > 0.5 µm



while even at the North Pole 1 m³ of air contains up to 10,000 particles of this size.

(source: [www.iab-reinraumprodukte.de](http://www.iab-reinraumprodukte.de))



360°

The KMR iiwa CR stands for unlimited mobility in cleanrooms. Its omnidirectional wheel concept enables autonomous motion in any direction – even from a standing start. The mobile cobot navigates skillfully even in the narrowest aisles, delivers its load safely to its destination, and reduces cycle times considerably.

1,000

or more steps may be necessary to produce a silicon wafer in the largely-automated fabrication process. Depending on the component, a period of around three months sometimes elapses before the wafer leaves the production line, which operates 24/7/365.

Dear Readers,

The Fourth Industrial Revolution is in full swing. And at the heart of it all: KUKA, with many years of comprehensive expertise in automation and robotics. This is especially important in semiconductor production.

Tight cycle times, top quality, repeatability, ultra-low particle generation and significant cost reductions are the requirements for intelligent automation in cleanrooms. To meet these requirements, innovative products and individual concepts are needed – for the construction of new plants as well as for the conversion of existing production facilities. Sensitive and mobile cobots can revolutionize these demanding production environments. They enable humans and machines to interact and pave the way for a new kind of cleanroom automation.

KUKA offers a comprehensive portfolio for the electronics industry – from hardware and software to turnkey solutions, system control and service – all from a single source, worldwide.

Victor Hugo once said: “The future has many names: For the weak, it means the unattainable. For the fearful, it means the unknown. For the courageous, it means opportunity.” KUKA has always focused on opportunities and would be pleased to do so together with you. Let’s talk about it.

Sincerely,

Ralf Ziegler

Ralf Ziegler



Experienced robotics expert: Ralf Ziegler, Business Development Manager Electronics at KUKA, has been supporting customers from the electronics industry for many years.



# Industrie 4.0 – Digitalization with a turbo-boost

**Industrie 4.0 is revolutionizing the world of work. The semiconductor industry in particular, with its extremely demanding and often very small-scale processes, is leading the way here. Sensitive, autonomous and mobile cobots have the potential to introduce a new dimension of automation to the cleanrooms of the semiconductor industry.**

The crisis year 2020 also hit the electronics industry hard. “The industry has nevertheless fared somewhat better than some others in the manufacturing sector,” notes Dr. Gunther Kegel, President of the German Electrical and Electronic Manufacturers’ Association. The reason lies in the trend toward a more climate-friendly, all-electric society. This goes hand in hand with full-scale electrification, digitalization and automation of the energy, industry, buildings and mobility sectors.

Unlike other industries that were hampered by the coronavirus crisis, the semiconductor sector was even able to record growth in the crisis year 2020. The industry is already very optimistic again for 2021, expecting growth rates of up to 8.4 percent. The industry association SEMI anticipates that the digitalization trend accelerated by COVID-19 will lead to record demand for semiconductors and record investment in manufacturing facilities. For manufacturers, this means that they have to equip themselves and their production operations for the future – not least with new robotic applications. For such a demanding industry with such high automation requirements, the challenge is anything but trivial.

Looking at the investments in the semiconductor industry, it quickly becomes clear what expectations the industry has for the future and its growth prospects. Sums in the double-digit billions are earmarked for chip factories, and just a single machine for the exposure of silicon wafers can cost as much as 150 million US dollars. “Expectations of the reliability and efficiency of such smart factories are accordingly high,” reports Heinz Arnold, journalist and editor-at-large of the trade magazines Markt & Technik and smarterworld.

At the center of the semiconductor industry’s automation requirements are questions of quality, cycle times, particle generation and cost reduction. The use of new sensitive, collaborative robotics may be a key to these issues.

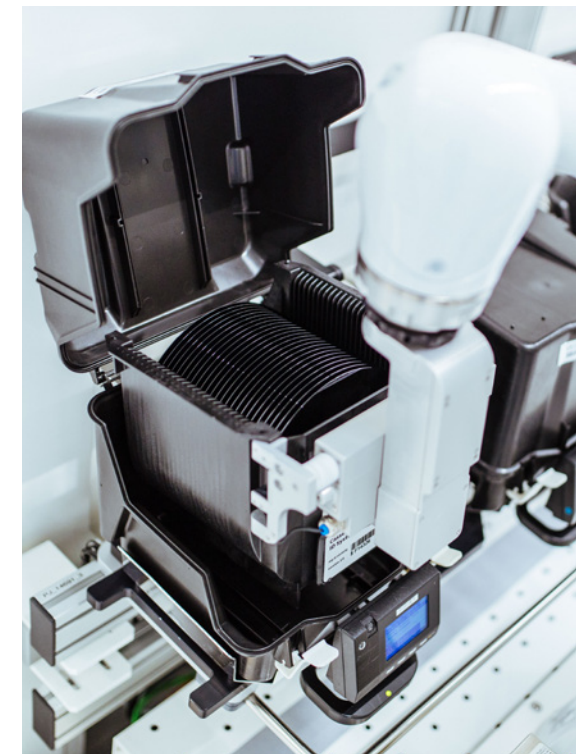
Cobots enable safe handling of the sensitive wafers. They work extremely reliably. Cleanroom robots assure minimal particle generation and share a workspace with humans without any problems. This opens the way to solutions for automation in cleanrooms that offer many interesting advantages, especially for customers in semiconductor fabrication.

“In wafer production, it is crucial to have a controlled material flow without congestion, and this over many hundreds of individual process steps, some of which take months and rely on a meticulously protected cleanroom environment.” The material handling systems and control of the equipment and processes therefore also play a decisive role in the success of such mega-factories. “Automation and the use of robots are then the key to process reliability,” says Arnold.

Infineon Technologies Austria AG in the Austrian city of Villach is already deploying cobots in semiconductor production. “Given the extremely sensitive production conditions for our wafers, we have to think very carefully about which material handling technology we should use here,” explains Martin Moser, Team Leader for Automation in the AMHS (Automated Material Handling Systems) division. “Since various mobile units and also a number of people are always moving about in wafer fabrication, automation can only involve robots that are extremely compact and sensitive and designed for safe interaction between humans and machines. And all this without any protective fencing.” In other words, cobots.



In the cleanroom, humans and machines work "hand in hand" in many ways. A mobile cobot can be an alternative to costly and technically complex Overhead Transport Systems (OHT)



The cobot safely and reliably handles recurring tasks in the handling of sensitive wafers



# KUKA Cobots –

## Entering new dimensions of semiconductor production with cobots

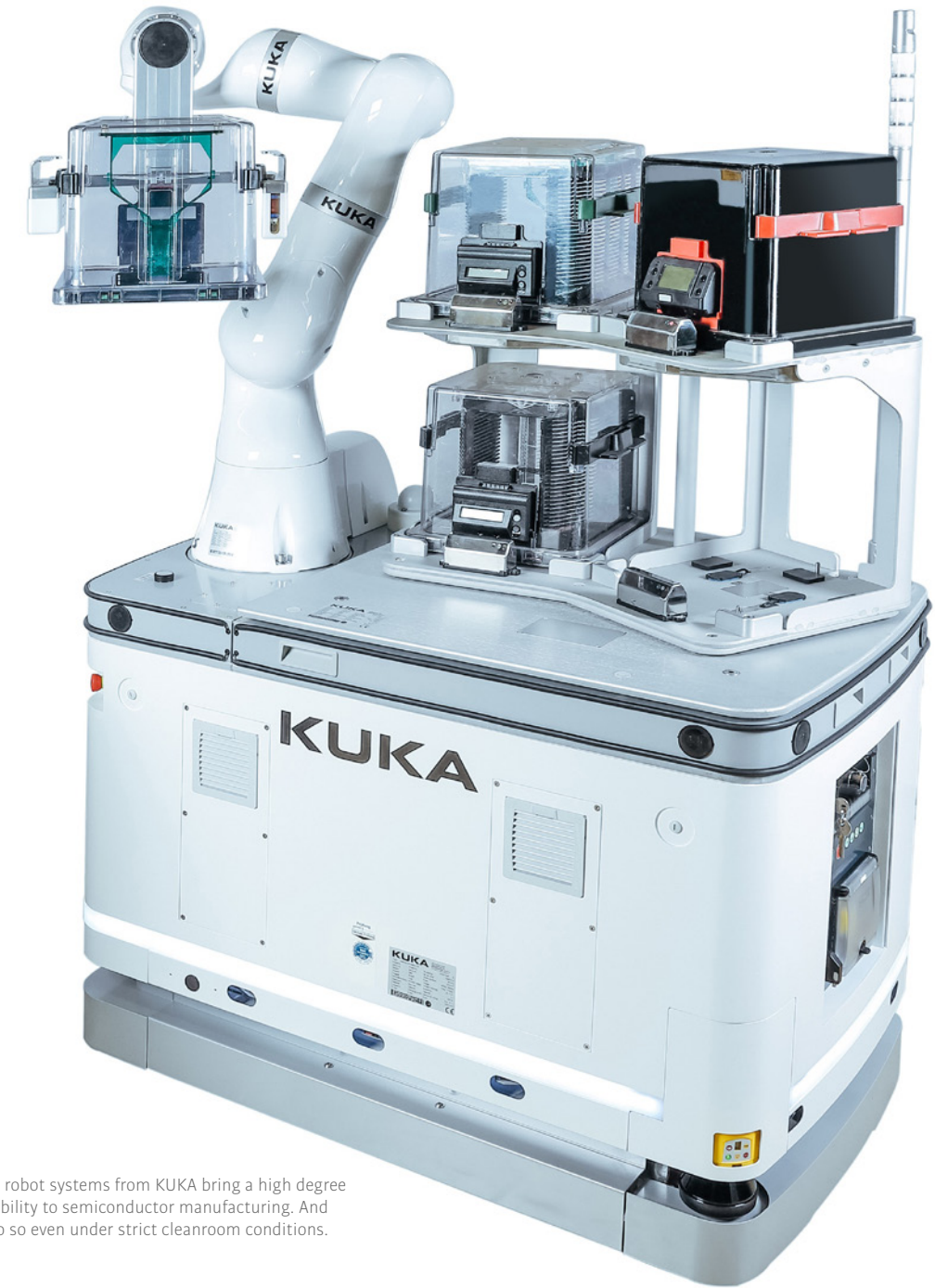
Autonomous navigation, sensitive collaboration with human operators and precise handling of valuable components: robots provide consistently high quality and optimum output. As highly-flexible production assistants, mobile cobots take cleanroom manufacturing to a new level.

The intelligent, connected production worlds of the semiconductor industry place the highest demands on automation systems. Mobile cobots can become a game changer here. They enable users to improve the productivity and cost-effectiveness of their systems and to manufacture individualized products in both very large and small quantities at affordable prices and in the highest quality.

For this purpose, mobile robot systems such as the KMR iiwa CR combine the sensitive lightweight robot LBR iiwa CR with a mobile, flexible platform. As a freely-scalable system, the cobot can track moving workpieces, move around them and link solitary production islands to form new, highly flexible production units. And this under stringent ISO Class 3 cleanroom conditions. The mobile systems are designed to execute their work and mechanical motions reliably in environments that have to be cleaner than an operating room – with ultra-low particle generation.

### 7 advantages of using mobile cobots in cleanrooms:

- ✓ Human operators are supported with monotonous, non-ergonomic tasks (which are always also a potential source of contamination) and can concentrate on important processing steps and their core competencies.
- ✓ The flow of materials is assured: 24/7/365. Thanks to its innovative navigation system, the KMR iiwa CR operates autonomously and is able, for example, to set down machined workpieces or independently fetch required parts.
- ✓ The cobot takes over machine loading duties in the cleanroom. The risk of damage when handling fragile workpieces such as wafers is reduced to a minimum.
- ✓ Through the combination of the KMR 200 mobile platform and the sensitive LBR iiwa CR, the mobile cobot moves omnidirectionally and shares the workspace with human colleagues.
- ✓ With 7 axes and a payload capacity of up to 14 kg, the mobile cobot is both powerful and flexible.
- ✓ The integrated fleet manager enables communication between the higher-level host system and all the mobile cobots. The best-positioned mobile cobot with a charged battery is automatically assigned the job.
- ✓ The industry-specific hardware interfaces facilitate communication between the mobile cobot and the machine that is being loaded.



Mobile robot systems from KUKA bring a high degree of flexibility to semiconductor manufacturing. And they do so even under strict cleanroom conditions.

The outstanding maneuverability shortens throughput times and reduces idle times in the manufacturing process. All in the interest of extensively optimized and plannable costs.

The fleet manager integrated into the software evaluates incoming transport orders with regard to vehicle availability, specified priorities and routes. The fleet manager software can scale from a single-cobot solution with one vehicle per production line to a multi-cobot solution where multiple vehicles per production line are used.

With KUKA, the software and the hardware both come from a single source, which ensures fast, flexible and bespoke integration of the system in both new and existing production facilities. For example, a mobile cobot can thus represent an alternative to costly and technically complex overhead transport (OHT) systems when retooling a fabrication plant. A worldwide service network assures production.

“When I saw the LBR iiwa CR for the first time,  
I was immediately and totally fascinated: I could have  
watched the soft, harmonious movements of the  
robot for hours.”

Lisa Ebner, Automation & Robotics Specialist, Infineon Technologies Austria AG

#### IMPRINT

**Publisher**

KUKA Deutschland GmbH | Zugspitzstraße 140 | 86165 Augsburg

**Overall responsibility**

Sebastian Schuster | Sebastian.Schuster@kuka.com

**Editor**

Marcus Schick | www.schick-kommunikation.de

**Design**

heiter&sonnig | www.heiterundsonnig.de

**Photographs**

Sebastian Grenzing and KUKA