

# APAS

Intelligent Systems  
for Human-Machine  
Collaboration



**BOSCH**

Invented for life

Welcome to the

# FLEXIBLE CONNECTED FACTORY

# 4

With digital transformation, industrial production is treading new ground. Agile and flexible manufacturing facilities will safeguard the future – which is exactly why we developed our automatic production assistants (APAS).

Geared to the needs of their users, the flexible assistants support their human colleagues with easy, monotonous or ergonomically challenging tasks. State-of-the-art technologies enable new forms of human-machine interaction.

Manufacturing individual products, even in small batch sizes, is one of our strengths. Together we will develop a tailor-made production concept, ensuring you can meet tomorrow's challenges. Depending on your requirements, the process modules can be combined with different platforms and flexibly adapted to your changing production needs. Put your work teams together just the way you need them, and make your production more efficient and competitive.

**Discover the possibilities of industry 4.0!**





Reinventing Collaboration:  
The APAS assistant

# FOCUS: HUMANS

## The Operator is top Priority

The more varied and complex modern production processes become, the more urgently it is needed: the human touch. Supported by the precision and stamina of our production assistants, human beings remain indispensable as problem-solvers and decision-makers. Accordingly, the human operator is the top consideration in the development of all our products.

Starting at the very development stages, we consistently orient our products on your employees' needs. Whether we do this through ergonomic workstation design, intuitive concepts for interaction and control, or by ensuring optimal interplay with their human "colleagues": our production assistants greatly reduce the daily workload, creating a unique user experience and attractive working conditions for your employees.

Reinventing Collaboration:  
The APAS assistant

# FOCUS: MACHINE

## The Robot as Essential Support

It is no coincidence that we called it APAS assistant: our robots assist your employees wherever they need it – for instance with work involving special safety considerations, simple and monotonous tasks or ergonomically challenging procedures.

The prerequisite: a direct and safe interplay of humans and machines. To make that happen, the APAS assistant works 100% contact-free with your employees. As soon as it senses impending contact with the operator, it instantly stops, then resumes its work where it left off as soon as the employee is no longer in its immediate vicinity. The result: a collision-free workspace in which humans and machines truly work with, and not simply beside one another. Together, the two boost productivity and efficiency – without ever compromising workplace safety.



# THE APAS ASSISTANT

With the APAS assistant we offer you a variable, intelligent robot system for the direct, safe and contact-free collaboration of man and machine.

## Your benefits:

- ▶ Unique robot kinematics with specially developed sensor skin
- ▶ Safe, contact-free collaboration without the need for a safety fence
- ▶ Intuitive control and interaction concepts for user-friendly operation
- ▶ Support with monotonous and simple tasks or ergonomically challenging movements
- ▶ Available as complete mobile system or as safe kinematics integrated into existing lines or manual workstations
- ▶ Development of individual projects while adhering to all relevant safety standards
- ▶ Variable functions at low investment costs
- ▶ Improved efficiency, quality and productivity





# The APAS assistant in Detail

## Sensor skin

The APAS assistant was the first assistance system to be certified for the interaction with human operators without the need for a safety fence. Its robot arm is equipped with a highly sensitive sensor skin that can sense when the operator approaches. If the distance is too small, the arm stops immediately – before there is any contact between operator and machine.

## Camera system

As a complete mobile system, the APAS assistant includes a 3D image processing system with integrated lighting, which enables the identification of objects and spatial referencing. Moreover, the assistant's ability to precisely grasp and position components simplifies parts feeding.

## Gripper

Thanks to its sensitive three-finger gripper, the robot can flexibly and reliably grasp and hold components and products. In the event of collision, the gripper fingers automatically retract, helping to avoid pinching and jamming. The APAS assistant can also be equipped with individual, proprietary grippers while adhering to all relevant safety standards.

## Technical Data

KINEMATICS	
Version	6
Power supply	230 VAC
Pick & Place cycle time	4s – 8s (standard) 3s – 5s (distance monitoring)
Interfaces	Ethernet, EtherCAT, E/A opto-decoupled
Range	911 mm
Track speed	0.5 m/s (standard) 2.3 m/s (distance monitoring)
Repetition precision	+/-0.03 mm (dependent on the image processing method)
Part weight	Depending on gripper, 7 kg on robot flange
Activation sensor	Contact-free (capacitive)
Automatic safety shut-off distance	< 50 mm
Certified by	Type-tested by Deutsche Berufsgenossenschaft
Distance monitoring	Enables extended safety area

## Operating surface

Employing a mobile touchpad, the APAS assistant can be intuitively operated without special expertise or programming skills.

## Distance monitoring

With optional distance monitoring, the APAS assistant can adjust its working speed in response to the presence or absence of employees. As long as no one is nearby, the kinematics system works at maximum speed; as soon as it senses someone enter its application-specific far range, it automatically reduces speed. If an employee advances further, the robot stops completely. When the person has left its close vicinity, it will start working again at reduced speed. Only when the application-specific far range has also been cleared will the robot accelerate to its maximum speed again.

## Connectivity

Standardized interfaces allow our assistance systems to communicate with one another, as well as with external machines and systems.

IMAGE PROCESSING SYSTEM	
Overview camera	2D monochrome
Positioning camera	3D, calibrated stereo cameras
Image area	250 mm x 250 mm
Integrated lighting	1 x Infrared, 1 x pattern projection

THREE-FINGER GRIPPER*	
Suitable for	Especially for round and cylindrical objects
Force regulation	Adjustable in the gripping direction: 40 – 120 N
Position regulation	0 – 130 mm opening radius
Positive locking	via interchangeable fittings or gripper adjustment

\*Customer-specific grippers can be applied according to application



APAS Process Modules

# APAS INSPECTOR

With the APAS inspector we offer you individual solutions for visual inspections and quality control – modular, reliable and ready-to-use at any time.

#### Your benefits:

- ▶ Compatible hardware and software modules
- ▶ Variable testing modules for needs-oriented adaptation to different testing tasks
- ▶ Robust 3D imaging for operation in rough production environments
- ▶ Dependable results and unparalleled precision
- ▶ Proven methods thanks to long-standing experience in image processing
- ▶ Application on mobile platform or integrated into existing lines
- ▶ Inspection modules previously used on a mobile platform can also be easily integrated into existing lines
- ▶ Variable functions, low investment costs

# The APAS inspector in Detail

## Testing modules

Employing variable testing modules, the APAS inspector can be used to test matt or glossy surfaces, as well as for completeness, micro-fracture or dimension testing. The interchangeable modules allow the assistant to quickly and easily switch tasks.

## 3D imaging

Thanks to our years of experience in image processing, our advanced 3D imaging methods deliver dependable, high-precision testing results, even in inclement production environments.

## Parts feeding

One or two independent parts carriers are manually or automatically loaded with components for testing, and transported to one or more photographing positions via the flexible planar stage.

## Technical Data

PARTS FEEDING*	
Version	1
Technology	Planar stage with planar traveler, optionally with second traveler
Speed	up to 0.5 m/s
Position resolution	up to 3 µm
Position reproducibility	up to 10 µm
Functions	Feed to testing position, image quilting and stitching, paths for scanning in line camera mode

## Operating surface

The APAS inspector is operated by means of a mobile touchpad, which can also depict the inspection results.

## Learning machine vision

Thanks to learning machine vision, even employees without specific know-how can continuously optimize and adjust the inspection parameters with the help of training images. The operator simply takes pictures of a given sample with the APAS inspector, and marks the “good” and “bad” areas of the item. The inspection system can be retrained with new images at any time. Apart from “good” and “bad”, further classes can be added, for instance for post-processing.

## Connectivity

Standardized interfaces allow our assistance systems to communicate with one another, as well as with external machines and systems.

TEST MODULE 1 (STANDARD**)	
Camera system	High-resolution, high-speed camera
Image area (with standard optics)	14 mm x 14 mm ... 140 mm x 140 mm
Resolution (with standard optics)	7 µm ... 70 µm / pixel
Lighting	4 High-power LED
Technology	2D and 3D data recording and assessment

\*further infeed modules available  
\*\*further inspection modules available





# As variable as your needs: **The APAS Platforms**

Mobile, as a fixed installation or integrated into your own projects, retrofitted or partly automated – our solutions can be easily adapted to the changing needs of your production facilities and employees.

No matter how you have designed your production lines – our production assistants can be seamlessly integrated into the overall concept.

Whether your employees use robot-integrated workstations, a mobile assistance system does the preliminary work for them, or three different production assistants are integrated into a production line – assemble your workteams flexibly according to your needs. Our modular solutions will adapt to your requirements.

Share your ideas with us. We can accompany you from the start, and help you get your production ready for industry 4.0.

**We look forward to hearing from you!**





# APAS CUSTOM

## Your partner for the flexible factory

Regardless what you might ask from the flexible factory – together we will develop your individual solution based on our automated production assistants.

As your reliable engineering partner, we will accompany you from the development of suitable modules to the implementation of entire production lines, including certification and hand-over. And along the way, we will never lose sight of what matters most: making your employees' work safer and easier.

“We chose the APAS assistant because there is no comparable system on the market.”

Ingo Burkhardt, Technology Manager, Rieber kitchentec GmbH

**Robert Bosch Manufacturing Solutions GmbH**

Bosch Connected Industry  
Postbox 30 02 20  
70442 Stuttgart  
Germany  
+49 711 811 - 0  
APAS@de.bosch.com

**bosch.com**  
**bosch-apas.com**

© Robert Bosch Manufacturing Solutions GmbH  
March 2017 | Printed in Germany

Bosch and the device mark are registered trademarks of Robert Bosch GmbH, Germany.  
This document is a schematic representation and not an operating manual. Occasional differences of the images to the operating manual are possible.  
Please refer to the operating manual with regard to the proper use of the system.