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YuMi®

Introducing the world's first truly collaborative dual-arm robot that will radically change assembly lines

PHIL CROWTHER – In recent years, progress in robotics has made it much easier to deploy robots on production lines: Installation has become quicker; programming and reprogramming have become simpler; and robots have become more versatile, enabling them to turn their hand to many more tasks than before. What was missing, though, was a collaborative robot – one that could work beside a human, unconstrained by safety barriers, and be easily taught its task. That has now changed. After years of research and development, ABB has unveiled YuMi®. YuMi is the first industrial robot that can truly be called collaborative and that complies with the safety standards enabling it to work hand-in-hand with humans on assembly lines. This groundbreaking robot ushers in a new era in manufacturing.

Title picture

YuMi represents a breakthrough in the field of collaborative robots.

1 YuMi features padded arms that stop immediately if there is any unexpected contact.



Few production arenas are changing as quickly as that of small-parts assembly. The electronics industry, in particular, has seen demand in this arena skyrocket past the supply of skilled labor. As conventional assembly methods diminish in value, manufacturers are finding it strategically and economically imperative to invest in new solutions.

ABB's market introduction of YuMi – a play on words that means “you” and “me” – is a groundbreaking solution for human-robot collaboration in the small-parts assembly environment.

First, safety

YuMi literally removes the barriers to collaboration by making protective fencing and cages a thing of the past. Its design is based on a revolutionary integration of motion control software, speed-limited hardware, reduced weight, a compact frame and 14-axis agility. The lightweight, padded, magnesium arms can stop the robot's motion in milliseconds if necessary – in the event of an unexpected collision, for instance → 1.

Like the human arm, YuMi has no pinch points, so there can be no crushing between two opposing surfaces as the arm flexes. The padded surfaces enclose the cabling and air connections, which eliminates snagging, reduces maintenance requirements and makes it easy to keep the robot clean and dust-free.

YuMi is safe around people and is the first industrial robot to be independently certified to such a high level of safety.

The combined effect of these features is the ensured safety of human coworkers on production lines and in fabrication cells.

Productivity

In addition to its inherent safety, YuMi is a highly efficient and proficient robot – two qualities that accelerate its return on investment. ABB designed YuMi to become productive very quickly as an all-in-one solution, with integrated arms, hands, torso, control technology and a parts-feeding system.

2 To teach YuMi its new task, the operator manually takes it through the required motions, which are recorded.



The future of robotics and automation depends on humans and robots working together – and nowhere is that more true than on the assembly lines around the world that build the electronics upon which society has come to depend.

In designing YuMi, ABB's global presence brought the benefit of an overview of manufacturing trends in 53 countries, many – such as those in north Asia – with high-growth forecasts for electronics. Foremost among these trends is the rapid merging of consumer, computer and communication devices (3C convergence). This has led consumers to expect constant innovation at affordable prices, further straining production processes. For manufacturers, the consumer market has changed the rules of production in ways that can be addressed effectively only by automation. Today's expectations of small-parts assembly involve higher product volumes, shorter product life cycles, shorter lead times and a growing trend to customize goods – particularly electronics – close to the final markets.

This new world of small parts assembly requires robots to be very flexible and easily trainable in new tasks. With YuMi, the operator simply has to activate a “record” program, manually guide YuMi through the desired movements and, while doing so, log waypoints and gripper actions on a paired tablet running the YuMi app. The app then turns those movements into the underlying code for the controller → 2. In this way, YuMi can learn new tasks in a matter of minutes. Best of all, no special operator training

is required. Known as lead-through programming, this is the future of robot programming, and is so easy anyone can use it.

For tasks too complicated for this lead-through approach, ABB's high-level RAPID programming language can be used to train the robot in a more traditional manner.

Set up and sit down

YuMi is easy to set up, too. At only 38 kg, it is very portable and mounting holes allow it to be simply and securely bolted to the work table → 3. The enclosed design means cables, electronics and hoses are inside the robot – this eliminates clutter and facilitates relocation. With such easy training and set-up, redeployment to another work area and task is quickly done.

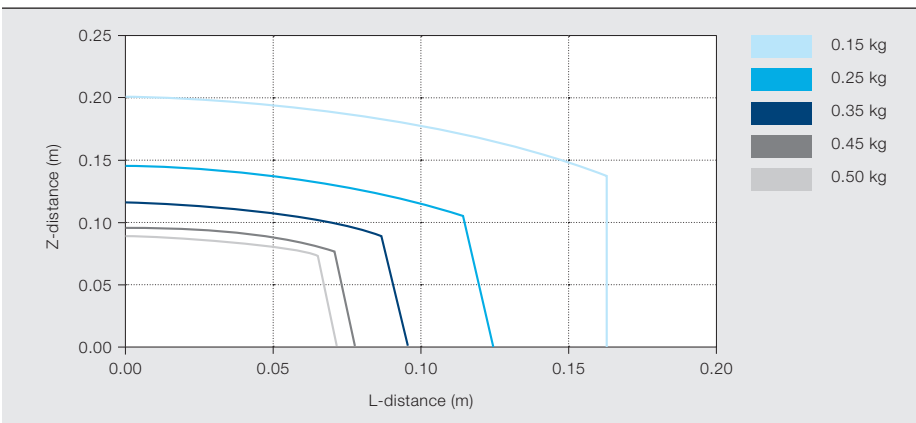
A gripping story

YuMi is compact – its torso is about the same size as a human's – but it has a long reach – about 70 cm above its mounting plane and about 30 cm below. Horizontally, it can reach about 55 cm. These distances depend on the weight being carried → 4. Its dual arms each feature seven axes of movement and endow the robot with great dexterity and pinpoint precision – YuMi can return to the

3 There is ready access to the interface panel (lower right), which provides a wide range of communications options.



4 YuMi: payload capacity



5 YuMi's main specifications. A repeatable accuracy of 0.02 mm is achieved.

IRB 14000 – 0.5/0.55	
Payload	0.5 kg per arm
Reach	559 mm
Accuracy	0.02 mm
Customer interface	Foot interface
Weight	38 kg
Mounting position	Table
Temperature	5 – 40 °C
IP protection	IP 30
Clean room/food grade	No

YuMi has a light-weight, yet rigid, magnesium skeleton covered with a floating plastic casing wrapped in soft padding that absorbs any unexpected impacts.

same point in space repeatedly with a 0.02 mm accuracy and a maximum velocity of 1,500 mm/s → 5. Contact force assembly between the arms is also possible. Its dual arms, of course, also allow multitasking.

YuMi has a standard tool-mounting interface. So that YuMi can be used to handle the great variety of parts that are seen in today's small-parts assembly environments, it can be supplied with integrated and highly flexible grippers, including servo grippers, single/dual suction cups and vision-enabled grippers → 6–7. This allows for customization so that the demands of most assembly tasks can be met. YuMi is ESD (electrostatic discharge) compliant, so it can handle even the most electrostatically sensitive components.

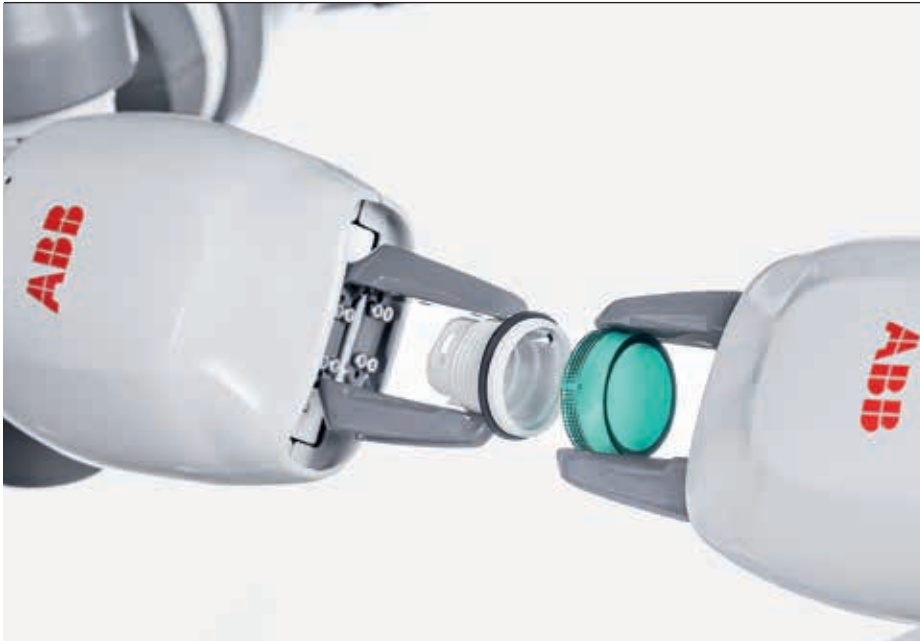
Stock feed

Small-parts assembly is about more than dexterity – supplying the parts for a given task effectively is also key to an efficient operation. To address this, ABB developed the sophisticated parts-feeding FlexFeeder™ system for parts delivery. The FlexFeeder stores a large number of parts, ranging from 3 mm to 30 mm in size, in a bin. Picking parts directly from the bin is a very complicated three-dimensional problem, so the FlexFeeder turns this into a much easier two-dimensional picking operation by placing parts from the bin onto a flat surface, where YuMi's integrated gripper cameras can easily locate the parts and pick them up.

Benefits

Manufacturers who employ YuMi will benefit from faster production, higher-quality

6 High accuracy, dexterity and ESD compliance enable YuMi to handle the most delicate and electrostatically sensitive components.



Like the human arm, YuMi has no pinch points, so there can be no crushing between two opposing surfaces as the arm flexes.

7 YuMi's grippers can deploy vision-enabled, single/dual suction cups and servo grippers.



products, lower waste, greater efficiency, increased flexibility and a high return on investment. While YuMi was specifically designed to meet the flexible and agile production needs of the consumer electronics industry, it can be applied equally effectively in any small-parts-assembly environment thanks to its dual arms, flexible grippers, universal parts feeding system, camera-based parts location, lead-through programming and state-of-the-art precision motion control.

YuMi benefits not only the manufacturer, but also the entire value chain: the worker, through a safer working environment and a higher quality of life; the environment, with less waste; and the consumer, with a better quality product.

Creating an automated future

With the introduction of YuMi, ABB is pushing the boundaries of robotic automation and fundamentally altering the types of industrial processes that can be automated with robots. YuMi is the result of years of research and development and heralds a new era of robotic coworkers that are able to safely work side-by-side with humans. While YuMi is specifically designed for small-parts assembly and has significant benefits in its own right, it is the first solution from ABB that is designed with a new era of human-robot collaboration in mind. The benefits of this type of collaboration are clearly not limited to a single industry – in fact, almost any industry stands to reap the benefits of collaborative robotic solutions.

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