CONNECTING INDUSTRY 4.0

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NORCOMP



INDUSTRIAL ROBOTS

IMPOSE A VARIETY OF DEMANDS ON CONNECTORS

NorComp is a leader in the design, manufacturing, & marketing of interconnect solution products. Offering a wide range of premium, ruggedized, high reliability connectors for demanding applications in harsh environments.

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THE CHANGING ROLE OF INDUSTRIAL ROBOTS

Industrial robots are highly complex electro-mechanical machines that have been part of factory production lines since the early 1960s. Long a staple of automated production lines for operations such as welding, industrial robots are expanding their reach to more precise operations such as pick and place. This white paper discusses the new challenges faced by connector manufacturers in this new range of applications.Traditional applications for robots in a factory setting include:

Materials Handling

Material handling was an early application for industrial robots to help handle heavy items. They also can transfer parts from one piece of equipment to another. Benefits include a reduction in direct labor cost and the elimination of tedious and hazardous task traditionally performed by humans.

Welding

Arc welding robots became commonplace in the 1980s. Spot welding joins two contacting metal surfaces by directing a large current through the spot, which melts the metal and forms the weld. Robot welding improves worker safety by reducing the risk of burns or inhaling hazardous fumes.

Painting

Robotic painting is used in automotive production and elsewhere as it increases the quality and consistency of the product and reduces the need for rework.

Machine Tending

Robotic automation for machine tending is the process of loading and unloading raw materials into machinery for processing and overseeing the machine while it does a job.

Assembly

Robots routinely assemble products, eliminating tedious and tiresome tasks, increasing output, and reducing operational costs.

Picking, Packing & Palletizing

Most products are handled multiple times prior to final shipping. Robotic picking and packaging increases speed and accuracy along with lowering production costs.

Gluing, Adhesive Sealing & Spraying Materials

Sealer robots feature multiple configurations that enable the robot to apply adhesives to any type of product. The use of a robot improves speed of production, quality, and consistency.

Mechanical Cutting, Grinding, Deburring & Polishing

As robot dexterity starts to rival that of humans, they become able to carry out more complex mechanical operations. The medical device market provides many example such as the grinding and polishing or orthopedic knee and hip joints.

Other industrial operations performed by robots include inspection, waterjet cutting, and soldering.

NEWER AND EMERGING ROBOTIC APPLICATIONS RAISE THE BAR



Figure 1: The connectors for an industrial robot must withstand continuous motion in a harsh industrial environment. (source: NorComp)

Today, the Industrial Internet of Things (IIoT) is adding sensors, local processing power, and networking to many traditional industrial machines. These new features are driving the need for reduced size, weight, power consumption, and increased throughput. Space limitations in many applications are calling for connectors that can handle both power and data simultaneously.

The IoT trend towards adding electronic functions to industrial machines applies to industrial robots, too. End-of-arm (EOA) instruments move sophisticated electronics such as vision systems, with their cameras, microcontrollers (MCUs), and sensors, out to the end of the robot arm.

AI, ML, AND THE RISE OF COBOTS

Machine learning (ML) and artificial intelligence (AI) are making daily headlines, and industrial robots are also benefitting from these trends. ML and AI are extending robotic capabilities, allowing them to learn, improve, and make decisions without direction or guidance from humans.

Most industrial robots in use today are equipped with a multitude of advanced sensors that gather immense amounts of data. When integrated with advanced analytics and ML software, robots can interpret this data and use it to adapt to changes, alter mechanical motions, and better complete the task at hand. As industrial robots become smarter, they will be able to take on more complex tasks and execute them with an efficiency that exceeds human capabilities.

They will also be able to safely work alongside humans in the manufacturing environment. Collaborative robots (cobots) are designed to safely operate in close proximity or even in direct contact with humans. They utilize advanced technology, including force-limited joints and computer vision to detect the presence of humans in their environment. Cobots are often much smaller and lighter than traditional industrial robots, easily moveable, and trainable to perform specific tasks.

In another part of the factory, autonomous delivery robots are becoming standard features in highly-automated warehouses. These robots use a wide range of sensors to detect obstacles and navigate around them, and also to cease operation if a human operator is detected within a predefined operating area around the robot.

REQUIREMENTS FOR ROBOTIC CONNECTORS

The industrial robotics environment is particularly challenging for connectors. Industrial robots can subject connectors to mechanical, chemical, or electrical stresses. Here are some examples:

Temperature Extremes. Excessive temperature or temperature cycling can cause thermal stress brought on by differences in the coefficients of thermal expansion (CTE) of different materials. Temperature extremes also affect a connector's mechanical components and cause leaks or cracks in rubber seals and plastics.

Shock & Vibration are common in the industrial environment. They can cause mechanical stress in connectors, which results in solder joint cracks, loosening of screws and other fasteners, and metal fatigue. Connectors on industrial equipment are continuously subject to these mechanical stresses.

Explosion Risk is a concern in oil & gas, wood processing, and other operations where flammable gases, vapor, or dust are everyday occurrences. In such conditions, a spark caused by the making or breaking of a contact – by unplugging a connector, for example - may have catastrophic results.

Rough Handling. Many industrial connectors, especially those on portable equipment, are connected and disconnected multiple times in a day, often hurriedly, which increases the risk of wear and tear on the connector. Connectors being dropped or dragged along hard surfaces can damage internal components and can affect the integrity of power or data signals.

Corrosion caused by exposure to chemicals is an everyday occurrence in industrial environments. The most common combination is high relative humidity coupled with salt fog, which can wreak havoc with electronic components, but common industrial chemicals can also cause corrosion.

In factories, robotic connectors are exposed to many of these environmental hazards, plus a few more. Repetitive motion is one obvious source of stress.

EOA installations allow robots to perform delicate operations such as fault detection or pick-and-place, but they require

extremely small, lightweight connectors that can withstand robotic motion and still survive the industrial environment.

As robotic work cells are becoming capable of multiple operations, robotic connectors must be easy to disconnect to swap out different tools or perform maintenance. In addition to the connectors that route signals and power around the robot, there is often a human-machine interface (HMI) that uses a wand, tablet, touchscreen, or similar device. The HMI also requires ruggedized industrial connectors for standard interface protocols such as USB or Ethernet. As automation increases and applications add internet connectivity, there is more pressure than ever before to develop reliable and robust interconnected production and motion control systems.

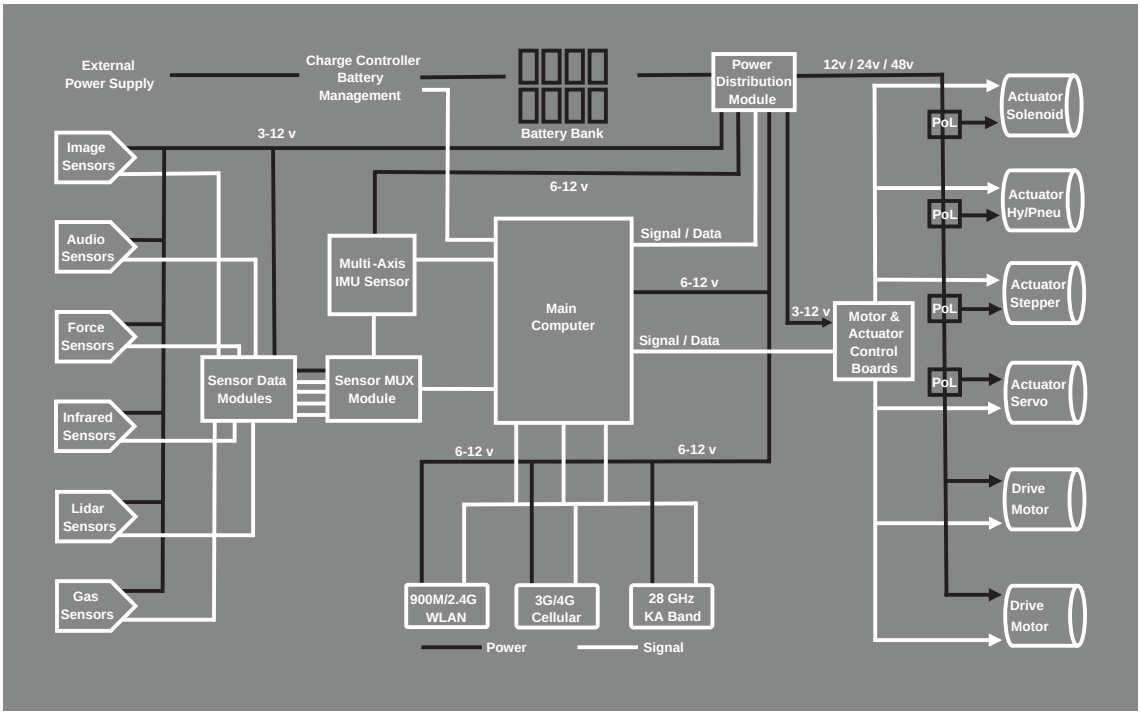


Figure 2: Some of the system blocks in an industrial robot design. (source: Norcomp)

Current-generation industrial robots often contain several computers, dozens of sensors, hydraulic pumps, multiple motors, and network connections. Figure 2 shows some of the typical interconnects in a robotic system. No single system contains all the functions shown, but there is clearly a diverse variety of sensors, signal conditioning modules, processing elements, power supplies, motor drivers, actuators, and more.

As applications proliferate and design cycles shorten, robotics system designers are architecting custom solutions from a wide range of standard modules.

Many suppliers now offer pre-made minicomputers, controllers, and modules for sensors, actuators, battery packs, motor drives and more. As ML and AI continue to spread in the factory environment, specialized modules will simplify the addition of edge AI functions. Figure 3 shows examples of some standard modules that provide wireless communications.

The use of premade hardware blocks allows design engineers to focus on the actual robotic tasks that need to be accomplished.



These modules are designed to be applicable to multiple robotic configurations so they use industry-standard connector interfaces.

The most common for industrial robots are Industrial Ethernet (4 pin D-Code M12), Gigabyte Ethernet (8 Pin X-Code M12), and legacy bus standards such as CAN/ PROFIBUS/FIELDBUS that use 5 pin M circular connectors with either A-Code or B-Code configurations.

This design methodology Is changing the market for connector suppliers. Once the designer has selected the modules for the application, the connector supplier provides the interconnects between the various modules, using appropriate wiring harnesses and mating connectors. The connectors must handle signal, data & power depending on application.

The new approach raises the demands on the supplier in this market. They must now develop expertise in wiring, wiring harness manufacturing, and subsystem assembly in addition to their knowledge of connector design.

NORCOMP CONNECTORS RECOMMENDED FOR INDUSTRIAL ROBOTICS



Figure 3: Norcomp connectors for industrial robot applications (Source: Norcomp)

NorComp has six different product lines for industrial robot applications, as shown in Figure 4. The Norcomp engineering team can also develop custom wiring harnesses that provide connectivity solutions for a wide range of robotic designs. Most of the connectors are designed for harsh environments and feature IP67 ratings.

VULCON™ Metric Circular Connectors have screw threads and conform to the DIN EN 61076 standard. These connectors offer a robust waterproof cable-to-panel or cable-to-PC board interface for demanding end-use applications.

QUIK-LOQ™ Circular Push-Pull Connector systems are rugged, sealed connectors ideal for high-reliability waterproof applications where quick connect / disconnect and environmental protection are required.

Micro-D Connectors are less than one-third the size of standard d-subs and are designed for space-constrained applications.

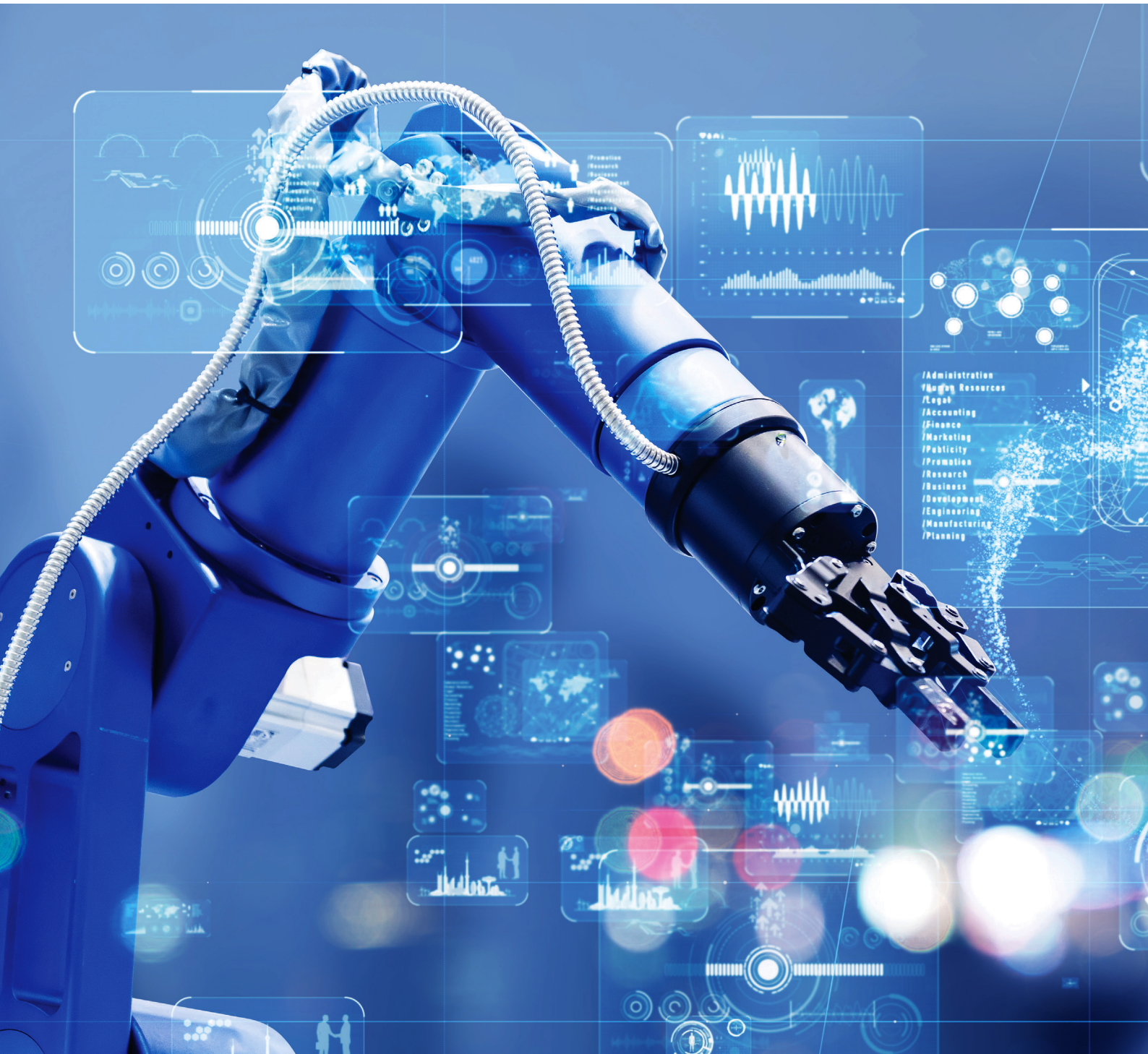
SEAL-D® Connectors are designed for applications that require protection from heavy spray or are exposed to short-term submersion. The IP67 rated waterproof d-sub connectors are sealed internally and maintain the same footprint as the standard d-sub product offering.

POWER-D & Combo-D mixed Contact D-sub Connectors are designed for industrial and robotics applications where both power & signal are required from a single connection. Power-D connectors can carry both signal (5 amp) and power (20 / 40 amp) contacts within the same connector body.

CONNECTING NEXT-GEN ROBOTS

The industrial robot market is a fast-changing one, with new applications appearing all the time. The increased diversity and compressed design cycles are leading to a reliance on standard hardware modules that are combined to meet a specific design objective.

To address this market, the team at Norcomp is building on its expertise in connector design and can design custom wiring harnesses to meet the needs of the industrial robot market.





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