

## Empower the Intelligent Edge & Create a Sustainable Industrial Future with ADI

Through superior innovation and a premier technology franchise, Analog Devices is increasing productivity on factory floors, enabling personalized output through flexible manufacturing, and raw material conservation through intelligent edge insights. As a co-creation partner of choice, ADI is charting the digital transformation journey, hand in hand with customers. Access new insights from edge devices, optimize control systems for efficiency, and collaborate safely with robots using scalable platform technology and software solutions from ADI. Leveraging our rich history of industrial domain expertise and a global team of problem solvers, ADI is helping to solve our customers' and society's toughest engineering problems.



# Digitizing the Factory Floor to Uncover New Insights



Drive productivity through improved operations

## Autonomous Mobile Robots (AMRs) for Material Handling



Material handling processes within the factory are becoming smarter and more flexible using AMRs. Leveraging ADI's MEMS sensing, intelligent processing, 3D time of flight (ToF) and machine learning technology, AMRs are safely and autonomously moving materials without the need for physical guides or markers.

## Increased Edge Sensing & Intelligent Processing



Smart manufacturing depends on unlocking new insights from devices deployed across the factory floor. This requires the use of more sensors and more types of sensing modalities. ADI's precision measurement and sensing technology is enabling a data revolution by continuously sensing, measuring, and interpreting the factory assets, enabling optimized monitoring and control of operations.

## Machine Health Monitoring to Increase Asset Utilization



Unplanned asset downtime is estimated to account for almost 24% of total manufacturing costs which reduces yield. Condition-based monitoring solutions from ADI, such as Voyager 3, are eliminating unplanned downtime and extending asset lifetime. ADI has end-to-end solutions for robust and reliable monitoring of a wide range of parameters to determine an asset's state of health, including ADI OtoSense™, an AI-based full turnkey hardware and software solution.

## Safe Working Environments for Humans



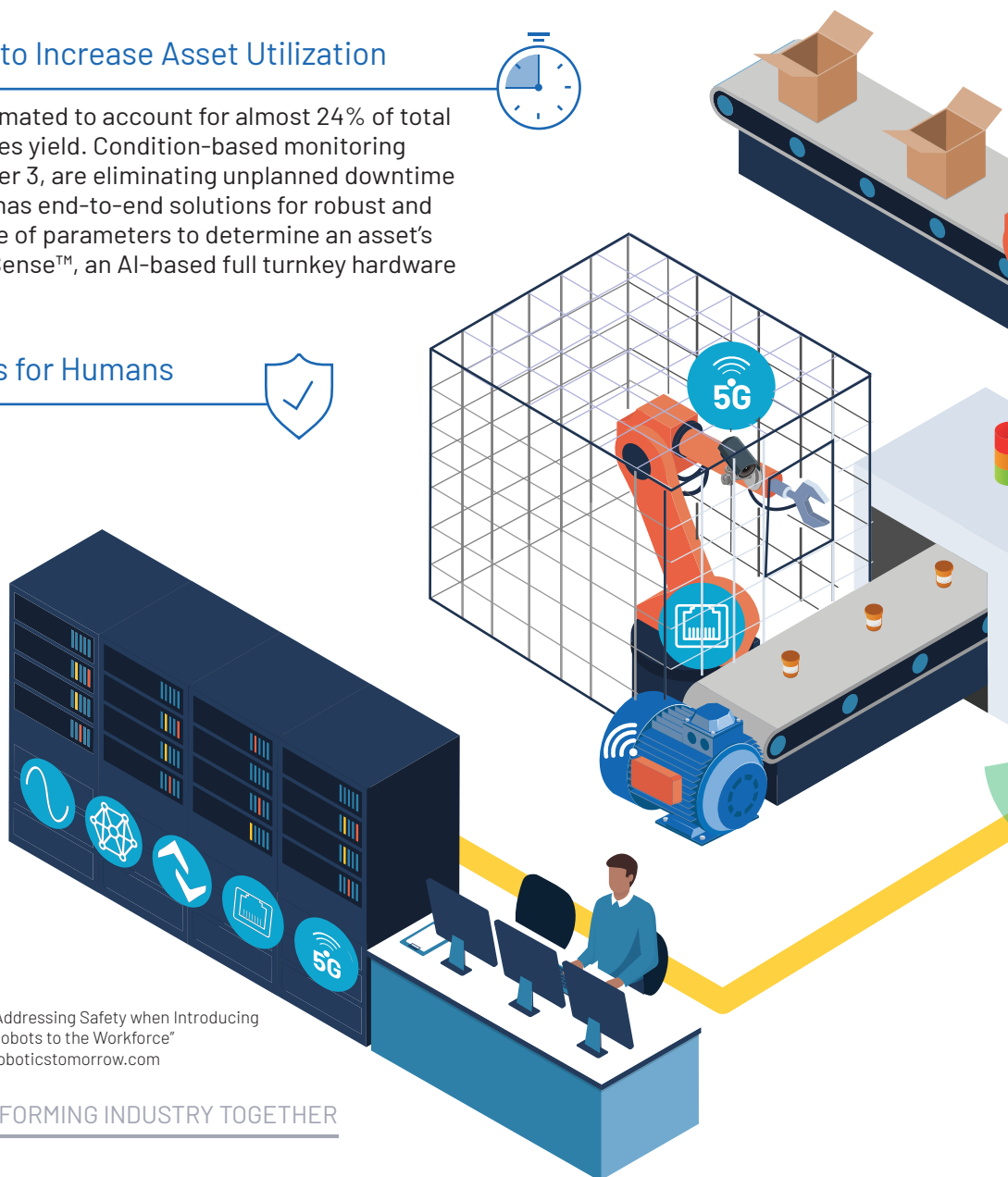
Collaborative robots (cobots) working along side humans increase productivity and drive consistency in output quality. Adopting innovative vision sensing technology and sophisticated algorithms, ADI is enabling more efficient operations and safer factory floors for humans. By removing the need for safety cages/curtains, factory floor space is optimized while system reconfiguration is simpler and quicker.

**COBOTS EXPECTED TO JUMP FROM 3% OF ROBOT SALES TO**

**34%**

**BY 2025**

"Addressing Safety when Introducing Cobots to the Workforce"  
roboticstomorrow.com



# Seamless Ethernet Connected Field Instruments with Ethernet-APL

Process plants, often an extension of the smart factory, are being modernized by adding high speed Ethernet to field instruments deployed in remote and intrinsically safe environments using the Ethernet-APL (advanced physical layer) standard. 10BASE-T1L technology from ADI is enabling access to new data, unlocking key insights to increase productivity and optimize raw material usage, while also reducing energy consumption and unplanned maintenance downtime.



## Flexibility Through Agile Manufacturing



Personalization is driving the need for flexibility in manufacturing systems, requiring fast reconfiguration to account for real-time changes in product mix, output volume, or process sequence. Production lines are becoming more adaptable by deploying ADI's Industrial Ethernet and software configurable I/O solutions, which enable direct IP addressability for real-time configurability and enhanced system utilization, respectively.

## Increased Connectivity to Access New Insights



The connected enterprise requires all devices deployed across the factory floor be connected to a central control system and on to the enterprise cloud. ADI's wired and wireless solutions are enabling new high bandwidth data streams to be captured reliably, control commands to be communicated in real time and production cells to become interconnected. Seamless connectivity to end node sensors/actuators from kbps to Gbps is resulting in substantial productivity improvements, while ADI's time sensitive networking (TSN) technology is enabling interoperability for the convergence of the IT and OT enterprise networks.

**SIMPLIFY YOUR  
SOLUTION  
DEVELOPMENT  
WITH ADI**

UNPLANNED ASSET  
DOWNTIME ACCOUNTS FOR

**~24%** OF TOTAL  
MANUFACTURING COSTS

"The Costs and Benefits of Advanced Maintenance in Manufacturing"  
U.S. Department of Commerce April 2018

# Engineering Intelligent Robots for Agile Manufacturing



Create safer working environments through improved sensing

## End Effector & End of Arm Tooling



Robotic end effector peripheral devices depend on ADI's precision sensing and measurement technology to enable more efficient execution of tasks. ADI's precise data acquisition systems enable superior force sensing for better overload protection and extremely robust systems. ADI's 60 GHz wireless latency free technology enables long term reliable and robust automated tool changing, without the burden of physical wired connector wear out, while ADI's 3D ToF vision sensing technology enables robots to become programmable sensor-orientated devices.

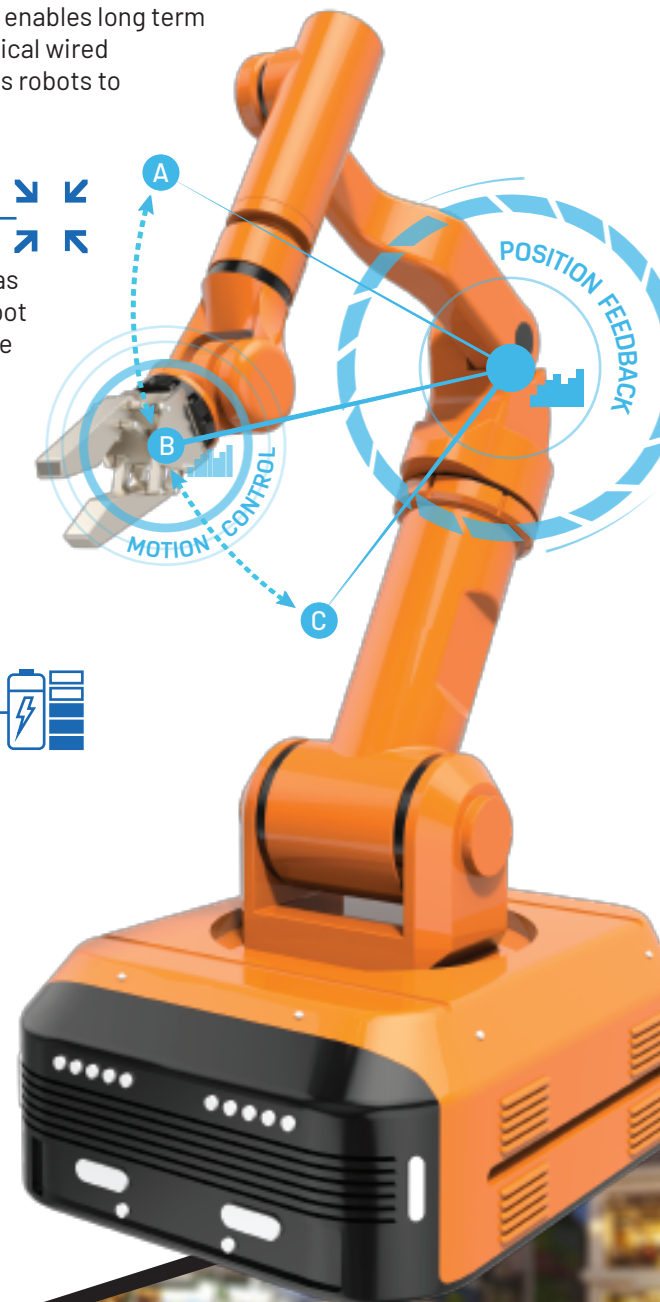
## Teach Pendant & Human Machine Interfaces

ADI's leading low power, small form factor signal conditioning and processing technology enables the extension of battery lifetime as well as the design of lightweight ergonomically optimized handheld wireless robot controllers. Embrace next-generation interfacing with ADI's leading voice and vision-based control systems.



ADI's solutions are engineered to support interoperability and come complete with supporting ROS software drivers for simple, fast integration within existing systems.

ROS



## Robot Power System

From battery-powered mobile robots to large line-powered fixed robots, power efficiency is critical. ADI's extensive portfolio of power solutions range from nanoamps to megawatts and provides efficient, low noise power conversion capability to optimize performance while minimizing heat dissipation and energy consumption. ADI's battery management systems enable more efficient battery management, reducing battery weight and extending operating time between charge cycles.



## Robot Controller Interfaces



As robots get smarter with increased multi-axis functionality and performance, they require advanced real-time network communication solutions. ADI's low latency, low power Industrial Ethernet technology, wireless transceivers, robust isolated and nonisolated industrial interface solutions (RS-485) provide best-in-class connectivity for controlling a complete robot system.

FROM FACTORY FLOOR TO ON THE MOVE  
ANALOG DEVICES HAS THE SOLUTION FOR YOU

# Enabling Efficient Motion Control for Sustainable Production



## Facilitate flexible manufacturing through intelligent control

Motion control is the core building block of smart manufacturing, supporting agility and sustainability. The combination of ADI Trinamic's motion control expertise for low voltage DC and stepper motors with ADI's leading technologies for medium to high power AC drives and servos is enabling a new class of intelligent motion solutions.

### Energy Efficiency for Reduced Carbon Footprint



ADI's motor control designs utilize precision current sensing and isolated sigma delta technology for closed loop phase control and optimized power delivery. For lower voltage DC motors, CoolStep™ technology from ADI Trinamic drives the motor in a highly efficient manner by adapting the current to the actual load conditions, keeping the motor cool and reducing energy consumption by up to 75%.

### Precise Motion for High Quality Output



Repeatable and dependable motor rotation information is essential to control precise drives and deliver a high quality output. The challenge becomes high lifetime accuracy in a space constrained, high ambient temperature environment. ADI's high performance analog signal conditioning and AMR (anisotropic magnetoresistance) magnetic position sensing technology enable more precise system positioning while ADI Trinamic's synchronized drive, integrated encoder interfaces, and motion control technology leads the way for stepper motor control.

### Miniaturization for Ultra Compact Designs



Miniaturization of motor control solutions is key to enabling smaller lightweight and portable machines. Higher power density power modules from ADI, as well as small form factor isolation technology is a defining advantage in realizing this miniaturization requirement. ADI Trinamic's complete and compact cDrivers integrate not only the predriver and power stage, but also the dedicated motion controller in a single package.

### Smarter Motion Control for Increased Local Intelligence



From robust Industrial Ethernet connectivity solutions for real-time configurability to vision and precision sensing for optimized positioning, ADI technology enables flexible intelligent motion control designs. Together with intelligent sensors, software configurable I/O, and AI algorithms, intelligent actuators unleash an era of self-aware drives.

### Predictive Maintenance for Real-Time Motor Health Monitoring



Integrating condition monitoring provides real time feedback on motor conditions to eliminate unplanned downtime. Try the ADI OtoSense Smart Motor Sensor to highlight issues requiring inspection.

## INDUSTRY 4.0: Engineering a Sustainable Manufacturing Future with ADI



**40%** REDUCED MOTOR ENERGY CONSUMPTION IN FACTORY LINES USING ADI'S PRECISION SIGNAL CHAIN & POWER MANAGEMENT TECH

\*ADI Investor Day 2022

# INDUSTRIAL CONNECTIVITY

**ANALOG DEVICES**  
AHEAD OF WHAT'S POSSIBLE™

Trusted Industrial Connectivity Solutions for Factories of the Future

Unlock the power of the intelligent edge with ADI's scalable and robust connectivity solutions, offering low latency, deterministic, low power, and reliability. Bringing the best in wired and wireless technology together, accelerate the development of seamlessly connected automation equipment and industrial sensors with trusted solutions from Analog Devices.



## IO-LINK & DIGITAL I/O

- ▶ Simplified installation
- ▶ Automated parameter setting
- ▶ Enhanced diagnostics



## BLE

- ▶ Ultra low power solutions
- ▶ Leading-edge security
- ▶ Darwin family of microcontrollers



## 5G

- ▶ Best-in-class 5G radio technology
- ▶ Full signal-chain capabilities
- ▶ Ultra reliable low latency and low power



## ISOLATED RS-485

- ▶ 25 Mbps throughput
- ▶ Reinforced isolation
- ▶ Fully integrated with power



## 60 GHz

- ▶ Latency free wireless data link
- ▶ True wireline-like performance
- ▶ Protocol agnostic



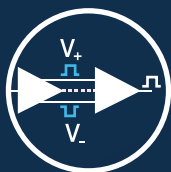
## WIRELESS SMART MESH

- ▶ Highly robust and reliable
- ▶ Ultra low power
- ▶ Scalable solutions



## ISOLATED USB

- ▶ Enhanced robustness
- ▶ Compact ease of use USB port isolators
- ▶ Auto speed detection features



## MULTIPPOINT-LVDS

- ▶ Low power and ultra small footprint
- ▶ High temperature range
- ▶ Enhanced ESD protection



## INDUSTRIAL ETHERNET

- ▶ Lowest latency, lowest power Ethernet
- ▶ Complete communication platforms
- ▶ Scalable solutions

# ADI's Industrial Automation Key Technology & Solutions

**50+**  
YEARS

DOMAIN  
EXPERTISE

**10k+**  
ENGINEERS

DEDICATED TO SOLVING  
THE AUTOMATION CHALLENGES  
OF **TODAY & TOMORROW**

## Highest Performance Precision Analog



Choose ADI precision technology to precisely measure real-world signals to accurately control, monitor and interpret the diverse range of low and wide bandwidth signals found within automation equipment. ADI's high precision analog converter, linear, and signal conditioning portfolio offers products to match all performance, power, cost, and size needs.

## Industrial Sensing Technology



Discover ADI's leading-edge sensing technology, enabling and enhancing industrial systems for precise positioning, safer collaboration between humans and machines, and real time asset health monitoring. MEMS accelerometers provide accurate detection of acceleration, tilt, shock and vibration while ADI's 3D time of flight image sensing platforms enable high quality long range depth sensing.

## Intelligent Power Solutions



ADI's extensive portfolio of power management products provides small form factor, high efficiency solutions with reduced energy consumption, bringing low carbon footprint production to life. From nanoamps to megawatts, ADI's power products and design tools help our customers accelerate time-to-market while delivering best-in-class performance and reliability.

## Robust Isolation



ADI's digital isolators, isolated transceivers, isolated ADCs, and isolated gate drivers utilize the award winning *iCoupler*®, *isoPower*®, and *µModule*® BGA digital isolation technologies for robust, reliable and safe systems. Partner with ADI for trusted safety and data integrity in digital isolation technology solutions.

## Ultra Low Power, Secure Microcontrollers



Increase the intelligence and functionality of your end equipment with tailored resource-optimized processing solutions from ADI, ideal for edge node devices like field instruments, robotic equipment, and condition monitoring platforms.

# Featured Technology

## ADI TRINAMIC: Complete Low Voltage DC & Stepper Motion Control Solutions

From standalone applications to interconnected synchronized drives, ADI Trinamic products offer a variety of unique features to improve accuracy and smoothness of motor operation. CoolStep™ always drives motors at their optimum load-dependent current. StealthChop™ completely silences stepper motors by eliminating the noise caused by unsynchronized motor coil chopper operations. StallGuard™ removes the need for limit switches.

- ▶ Chip sets for precise motion control
- ▶ Board-level solutions for embedded motion control
- ▶ Single and multi-axis solutions including software stack



## 3D Time of Flight (ToF) Vision Solutions

Combining low noise, high resolution, and low latency, ADI's 3D ToF depth sensing technology is advancing the use of machine vision for object detection, dimensioning, and obstacle avoidance for AMRs and collaborative robot deployments. This technology enables the highest resolution systems designed for greatest range within harsh industrial environments.

- ▶ Turnkey systems to support rapid implementation of 3D ToF
- ▶ Highest resolution up to 1 megapixel
- ▶ Integrated depth sensing solution for accurate depth compute



## OtoSense™ Predictive Maintenance and Quality Control AI Solutions

ADI OtoSense predictive maintenance and Quality Control AI solutions turn sensing data into actionable insights to dramatically enhance productivity and efficiency. The ADI OtoSense Smart Motor Sensor (SMS) is an AI-based, full turnkey hardware and software solution for continuous monitoring of electric motors, combining best-in-class sensing technologies with leading-edge data analysis. Agnostic of motor type, OtoSense SMS detects anomalies and learns from interactions that enable forecasting of maintenance cycles and avoid unplanned downtime.



Decades of Experience Combined with Expert Knowledge Have made ADI a Co-Creation Partner of Choice for Industrial Automation, Pioneering the Digital Future.

With Platform Solutions and Cutting Edge Software,  
ADI Is Ahead of What's Possible.

