Digital Design Win Replication

Win designs faster by replicating proven solutions

Autonomous Mobile Robot Introduction

Doc Number: 25.01
Date : 2025 Feb 11th

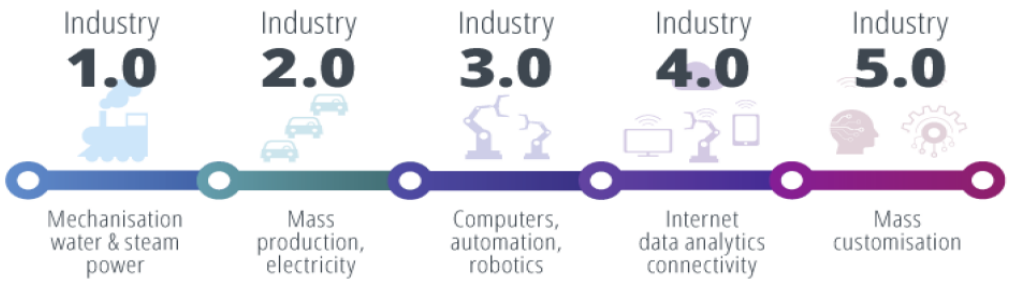
Autonomous Mobile Robot Market Overview

Updated: 11-February-2025

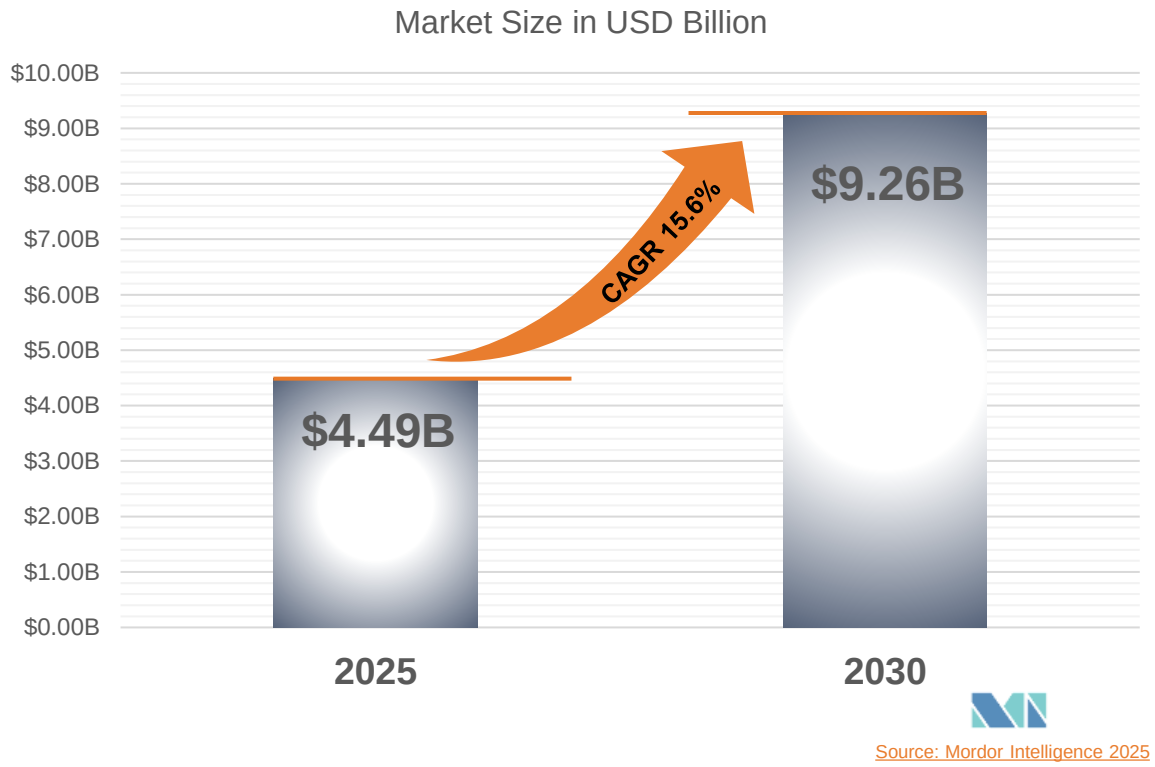
Factors driving AMR worldwide growth

- Advances in AI, Machine Learning (ML), Physical-AI
- Technological advancements in sensors and connectivity
- Performance of Embedded computing systems
- Increasing demand for automation
- Labor shortage and rising labor cost
- Safety

- Expected *CAGR* (2025 – 2030) 15,6% market growth



Autonomous Mobile Robot Market Size

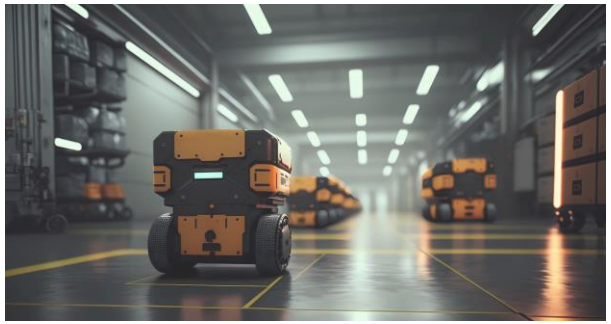


Source: Mordor Intelligence 2025

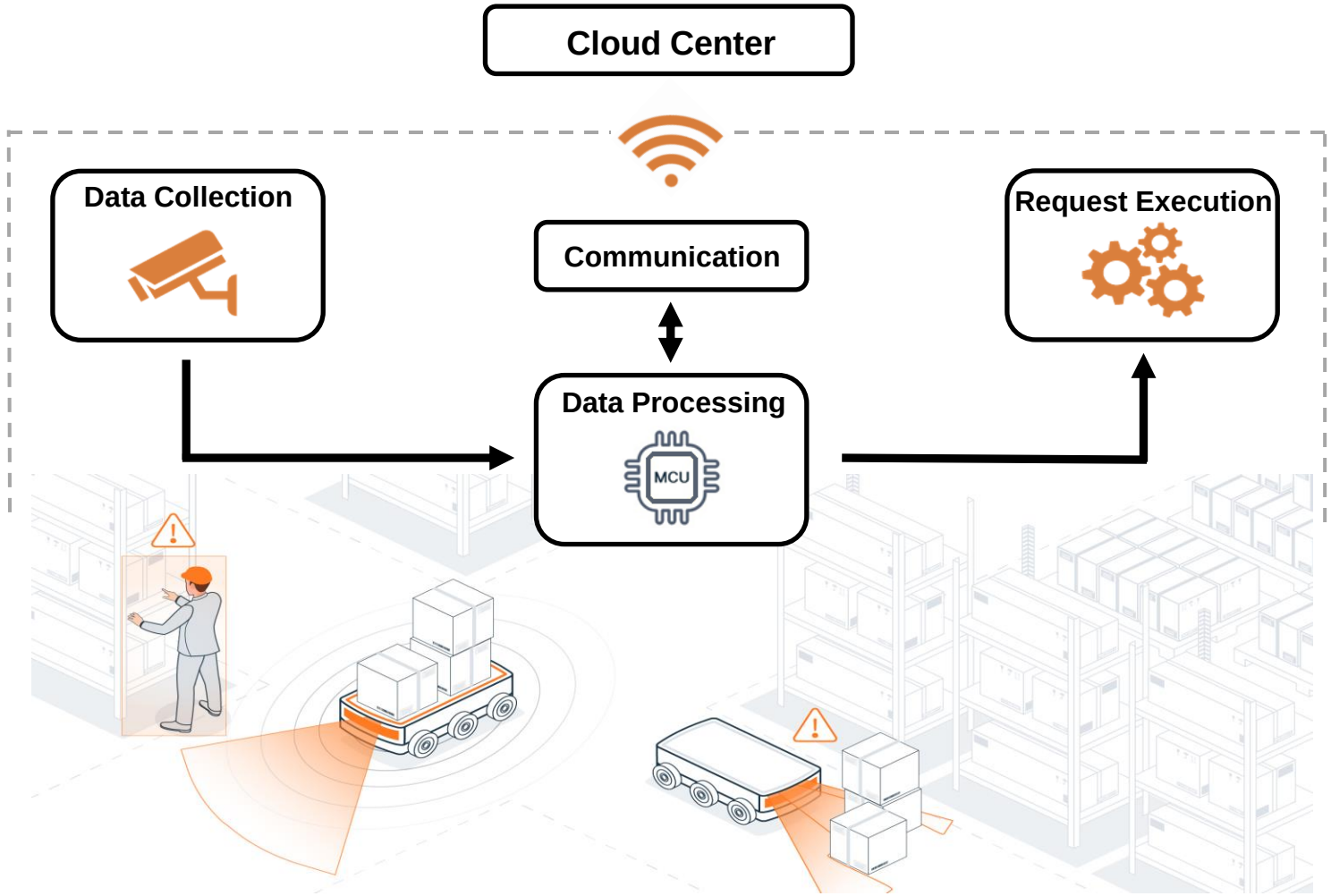
What is Autonomous Mobile Robot

Autonomous Mobile Robots (AMR)

are robots that navigate and operate in dynamic environments without fixed paths.
They use sensors and onboard computers to perceive surroundings and make real-time decisions to avoid obstacles and reach destinations efficiently.
These systems require minimal human interaction, allowing for greater automation and efficiency.



System level diagram for AMR



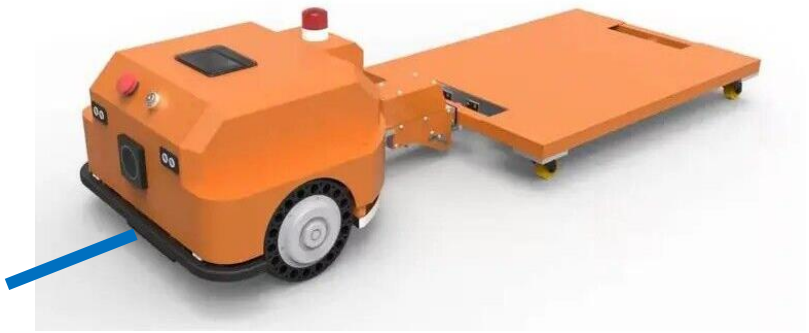
Autonomous Mobile Robot Market Overview

Updated: 11-February-2025

Industrial Robots

Global CAGR:
13.4%
(2024 – 2029)

Mordor Intelligence



AGV
Automatic Guided Vehicles

Autonomous Mobile Robot Market Overview

Updated: 11-February-2025

AMR
Autonomous Mobile Robots

Global CAGR:
19%
(2023 – 2030)

GRAND VIEW RESEARCH

Cobot
Collaborative Robot

Global CAGR:
32%
(2023 – 2030)

GRAND VIEW RESEARCH

Autonomous Mobile Robot Market Overview

Updated: 11-February-2025

AMM
Autonomous Mobile Manipulators

ADR
Autonomous Delivery Robots

Global CAGR:
30.3%
(2021 – 2030)

GlobeNewswire by notified

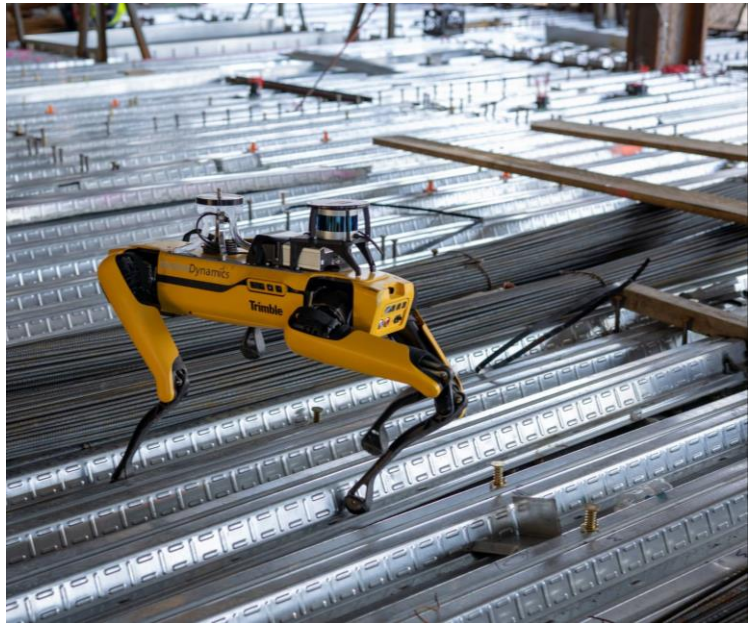
Autonomous Mobile Robot Market Overview

Updated: 11-February-2025

	EMEA	AMERICA	ASIA
 AMR Top 10*	KUKA Augsburg, Germany Continental The Future in Motion Germany ABB Zurich, Switzerland AGILOX Germany lowpad Netherland CEIT by ASSECO Slovenia CIMCORP Ulvila, Finland DS Austria SHERPA MOBILE ROBOTICS Haguenau, France lowpad Netherland	amazon robotics Westborough, MA Bastian SOLUTIONS (Toyota) Indianapolis, IN TERADYNE North Reading, MA INVIA ROBOTICS Westlake Village, CA LOCUS ROBOTICS Wilmington, MA ZEBRA (Fetch) San Jose, CA 6 RIVER SYSTEMS PART OF ocado GROUP Waltham, MA COBALT AI Fremont, CA GreyOrange Roswell, GA Rockwell Automation | CLEARPATH OTTO Canada	HIKROBOT Hangzhou, China CASUN China Quicktron Shanghai, China HAI ROBOTICS China Geek+ Beijing, China IPLUS MOBOT China Wellwit Robotics China OMRON Japan SEER China RICOH Japan
* Not fully data driven			
 ADR Autonomous Delivery Robot	STARSHIP Estonia	amazon Boston, MA REFRACTION AI Austin, TX kiwibot Berkeley, CA COCO Nashua, NH CARTKEN Oakland, CA nuro Mountain View, CA serve Redwood City, CA VAYU ROBOTICS Palo Alto, CA	ZMP Koishikawa, Tokyo
 Waiter Hospitality Security Robot		SEGWAY ROBOTICS Nashua, NH BEARROBOTICS Redwood City, CA Relay ROBOTICS Campbell, CA KNIGHTSCOPE Mountain View, CA RICHTECH ROBOTICS Las Vegas, NV	KEENON Shenzhen, China GAUSIUM Shanghai, China PUDU Shenzhen, China HD HYUNDAI ROBOTICS Korea CSJBot Suzhou, China SEQSENSE Tokyo, Japan ORIONSTAR Beijing, China

Autonomous Mobile Robot Market Overview

Updated: 11-February-2025

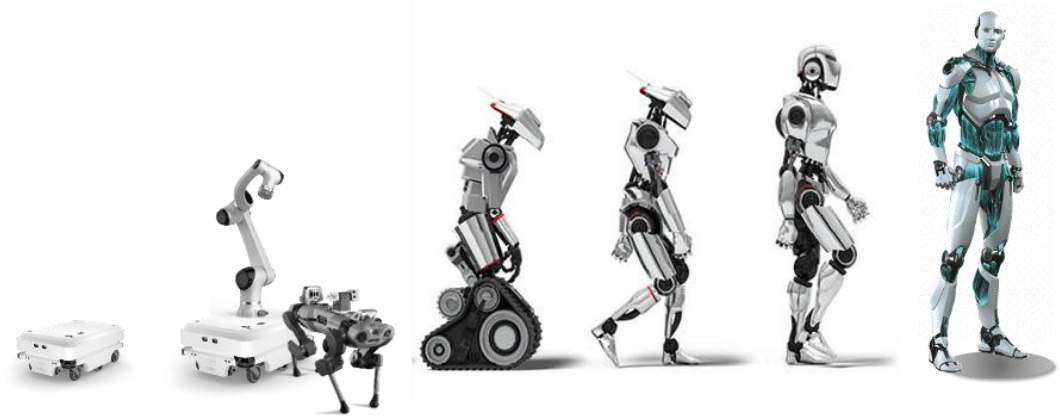


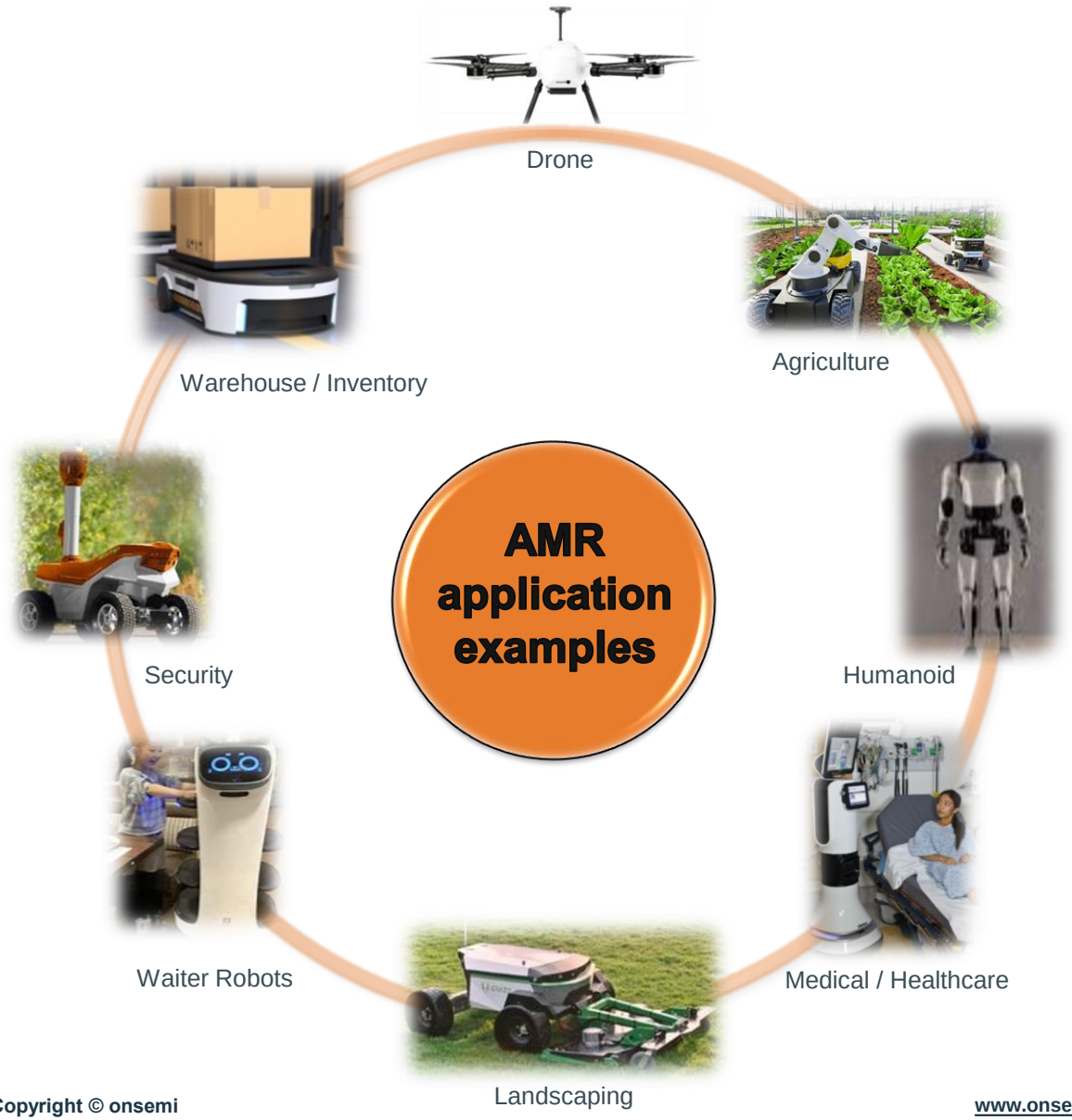
Autonomous Mobile Robot Market Overview

Updated: 11-February-2025

Design Trends of Autonomous Mobile Robot

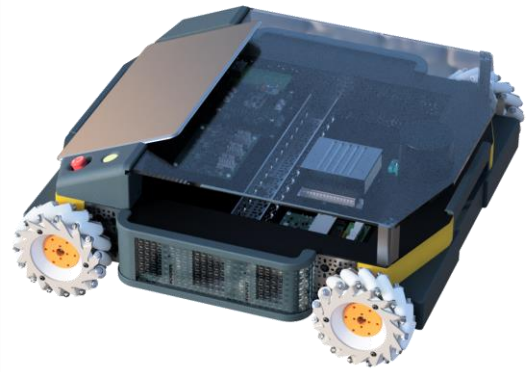
- **Enhanced Sensor Integration**
  - Safe in none-controlled spaces using advanced sensors like LiDAR, ultrasonic, and cameras to improve navigation and obstacle detection.
  - Challenging lighting conditions.
- **AI and Machine Learning**
  - AI and machine learning algorithms help AMRs learn from their environment, optimize routes, and improve performance over time.
- **Energy Efficiency**
  - New designs focus on reducing power consumption and improving battery life, making AMRs more sustainable and cost-effective.
- **Short-Wave infrared**
  - Expanding your view (400 – 2100nm wavelength)
- **Depth Sensing**
  - Direct time-of-flight (dToF) – SiPM sensor
  - Indirect time-of-flight (iToF) – depth sensor

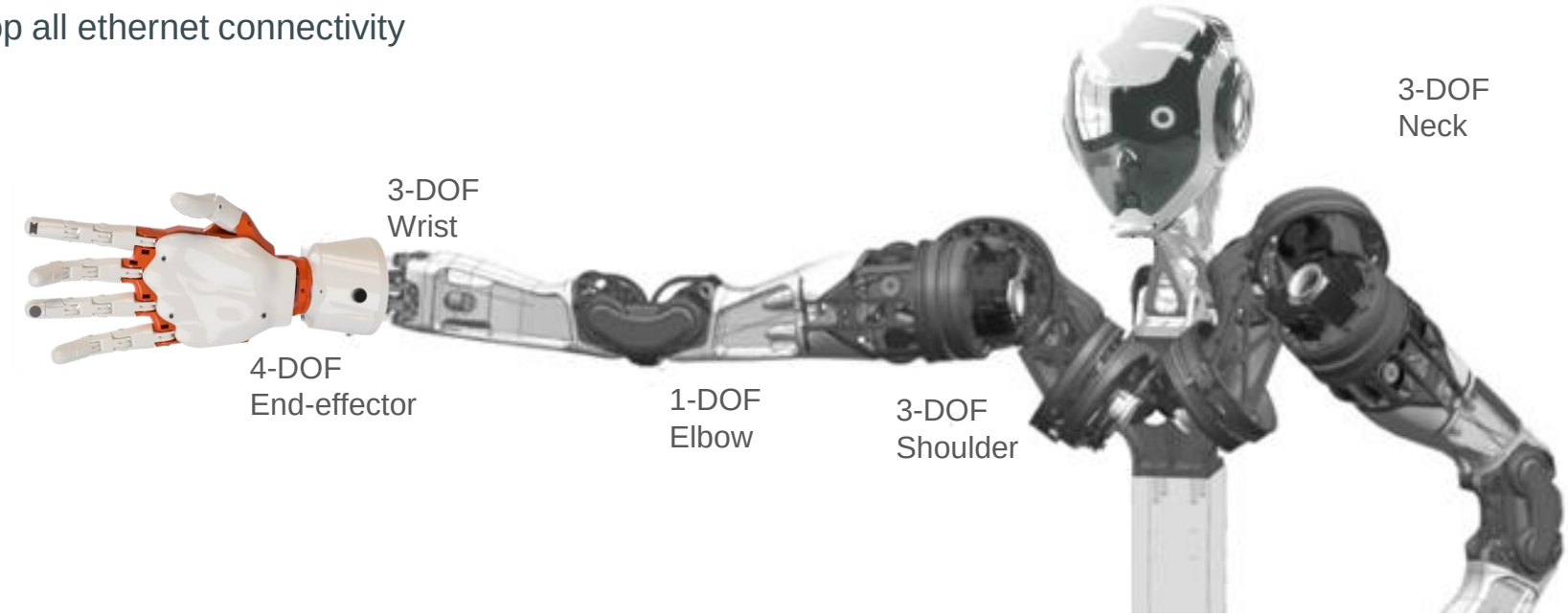




Focused Products for Autonomous Mobile Robots

- ✓ **NCV7192** Pressure / Force interface for Wheatstone bridge
- ✓ **NCV75215** Ultrasonic interface high-sensitivity, low-noise operation allows detection from 0.25 m up to 4.5 m for a standard 75 mm pole.
- ✓ **Hyperlux** Families ultra-low power **(LP)** and high dynamic range rolling shutter **(LH)**, small optical global shutter image sensors **(SG)**, and iToF **(IG)** for depth sensing **AF0130, AF0131**
- ✓ **NCS32100** Inductive positioning + 50 arcsec position accuracy.
- ✓ **NCV76124** rain and light detection interface
- ✓ **NCD83591** 3-phase BLDC Gate Driver
- ✓ **NTMFSOD9N04XM** 40V, T10, 0.9mΩ N-Channel MOSFETs
- ✓ **NCN26010 10BASE-T1S** Controller for multi-drop all ethernet connectivity over SPE (Single Pair Ethernet).

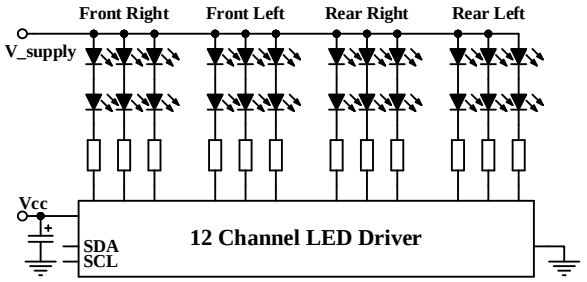




7 Sub-Systems of AMR:

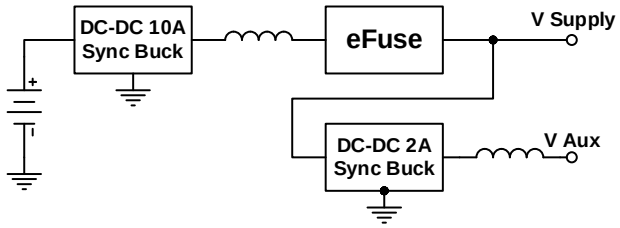
1. Motor Drive
2. Power Distribution
3. Sensor Fusion
4. Wired Communication
5. LED Lighting
6. Li-ion Battery Charging
7. Processor

Li-ion Battery Charging

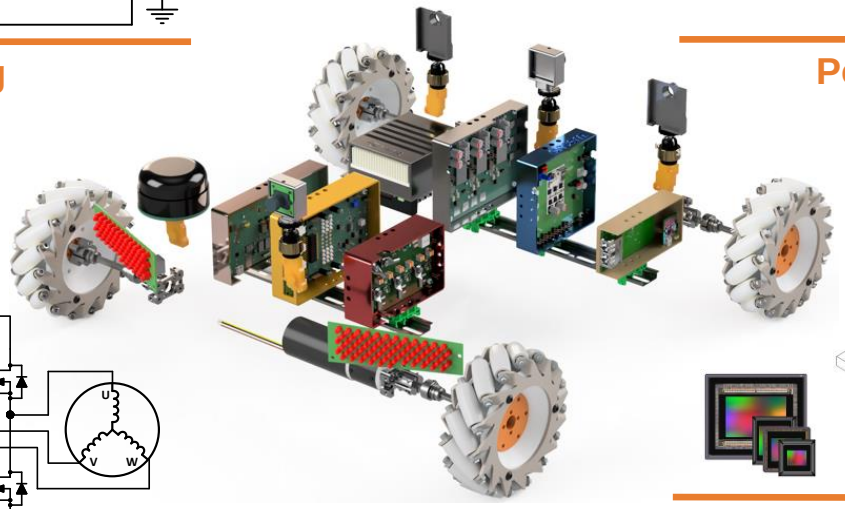


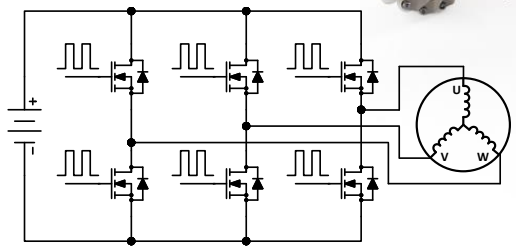
LED Lighting

Processor

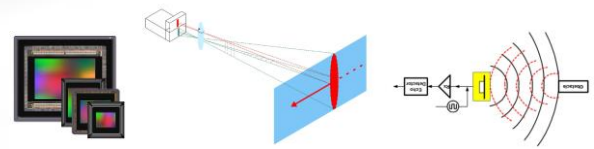


Power Distribution





Motor Drive



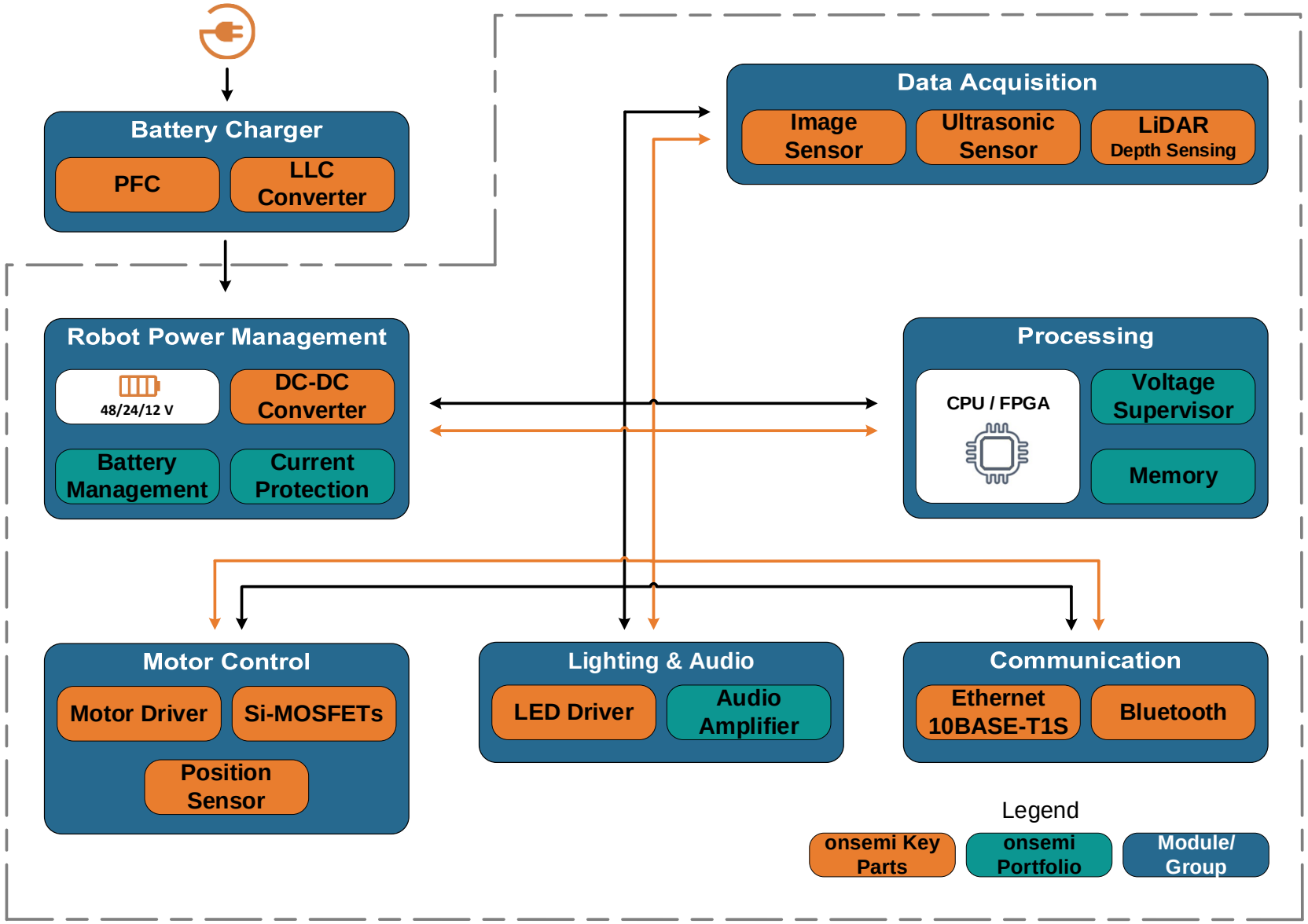
Sensor Fusion

Wired Communication

Interactive slide

Generic Block Diagram of Autonomous Mobile Robot

Updated: 11-February-2025



Interactive slide

System Solution for Easy Integration

Sub-System – Sensor Fusion

Updated: 11-February-2025

Getting started with onsemi solution

- Read System Solution Guide (SSG) for Smart & Mobile Robotics & dDWR Machine Vision presentation
- Review Block Diagram in the presentation and Interactive Block Diagram on web page for **onsemi** portfolio
- Distributors can request Customer Specific Block Diagrams by contacting **onsemi** sales
- Use Application notes and collateral listed in the SSG
- Utilize Product Recommendation Tools + to select parts
- Order evaluation boards for selected sensor
- Order the Demo 3 base board
- Install comprehesive Development Software DevWareX
- Request technical support from **onsemi** community forums
- Register to MyON
- Call Your Local Sales for NDA document agreement and access to Image Sensor Portal. (How to get an access to datasheets)

onsemi product value proposition

Image Sensors:

- **Global shutter** performance at its best
- PYTHON family for the **highest frame rate**
- XGS family for the **best image quality**
- Hyperlux SG family for the most **cost-efficient solution**
- **Many resolutions** available, serving all application requirements

Depth Sensing (SiPM):

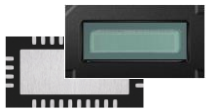
- **RDM-Series -** Highest 905nm Photon Detection Efficiency for LiDAR. Standard and fast outputs**.**
- **C-Series -** Highest sensitivity in visible range
  Standard and fast outputs
  Lowest noise
  High photon detection efficiency at 420nm
  Robust micro leadframe package

Ultrasonic Distance Measurement: detection 0.25m – 4.5m

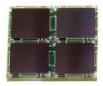
SSG Machine Vision

Image Sensor

SiPM RDM-Series



SiPM C-Series



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System Solution for Easy Integration

Sub-System - Motor Drive

Updated: 11-February-2025

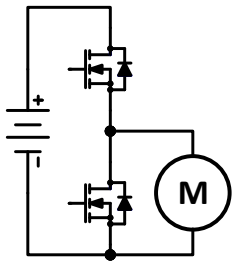
Getting started with onsemi solution

- Read System Solution Guide (SSG) for Smart & Mobile Robotics
- Review Block Diagram in the presentation and Interactive Block Diagrams on web page
- Distributors can request Customer Specific Block Diagrams by contacting **onsemi** sales
- Use Application notes and collateral listed in the SSG
- Utilize Simulation and Product Recommendation Tools + (for easy selection of components)
- Elite Power Simulator PLECS based simulation tool that accelerates time-to-market
- Get access to Coil Design Tool & watch Video Training for easy design of Rotor/Stator PWB
- Use Evaluation Boards and request support from onsemi community forums

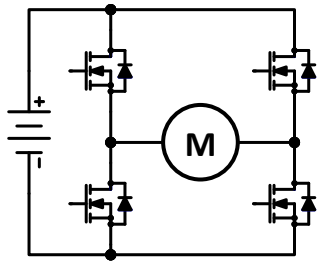
Value Proposition of onsemi's components

- Integrated 1, 2, and 3-phase **BLDC Motor Drivers**. System voltages 5V to 1200V
- **PowerTrench® T6, T8, T10 Mosfets** technology delivers industry leading 20 -150V, $R_{DS(ON)}$ from 0.4mΩ,
- **SiC Mosfets** – Blocking Voltage BV_{DSS} 650V – 1700V, $R_{DS(on)}$ 12mΩ – 160mΩ
- **IGBTs** – $V_{(BR)CES}$ 360V – 1200V, Ic_{Max} 5A – 240A
- Large portfolio of **Gate Drivers** to support any type of transistors
- **High accuracy, reliability, low cost** of rotary sensor NCS32100.
  High speed up to 60,000 RPM
  (reduced accuracy > 6,000rpm)

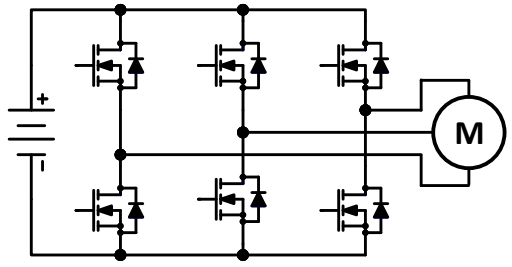
Half-bridge

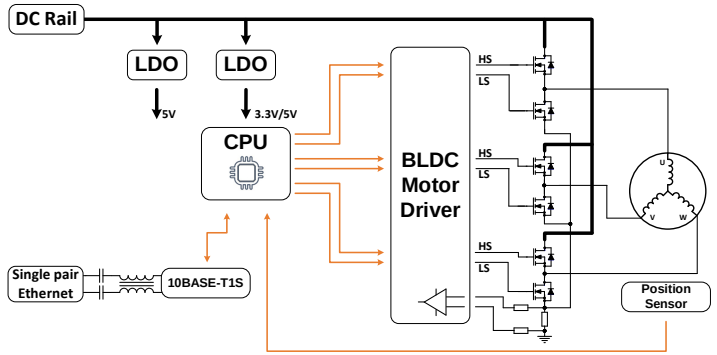


Full-bridge



Three-phase bridge





Interactive slide

System Solution for Easy Integration

Sub-System – Power Distribution

Updated: 11-February-2025

Getting started with onsemi solution

- Read System Solution Guide (SSG) for Smart & Mobile Robotics
- Review Block Diagram in the presentation and Interactive Block Diagrams on web page
- Distributors can request Customer Specific Block Diagrams by contacting **onsemi** sales
- Design you power supply with the WebDesigner+ tool
- Use Application notes and collateral listed in the SSG
- Utilize Product Recommendation Tools+ (for easy selection of components)
- Elite Power Simulator PLECS based simulation tool that accelerates time-to-market
- Use Evaluation Boards and request support from onsemi community forums

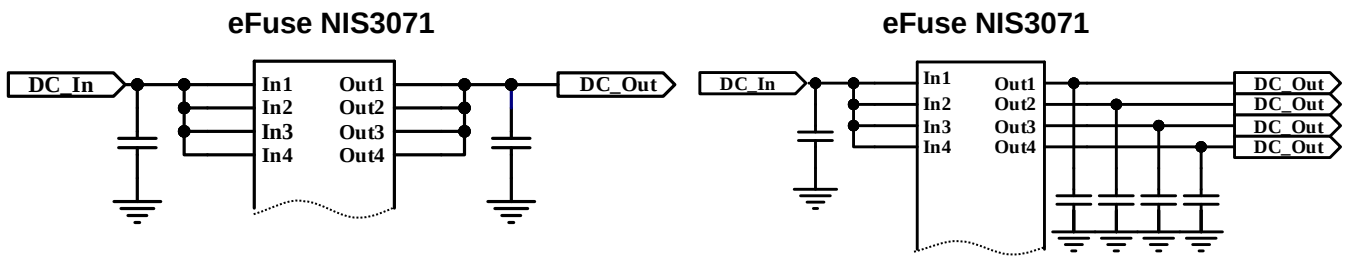
Value Proposition of onsemi's components

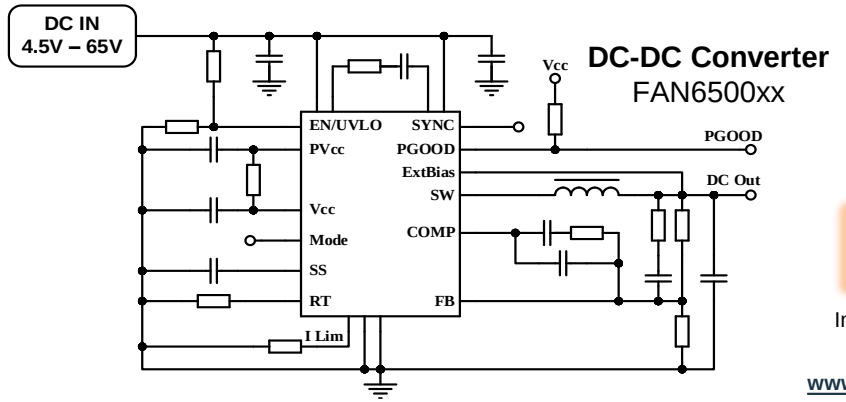
DC-DC Converters:

- Input **voltage up to 65 V**
- Output **current up to 10A**
- **High Efficiency up to 97%**

Current Protection:

- Wide operating input **voltage range up to 60V**
- 4 independent and **configurable channels** in a compact 5x6mm package (NIS3071)
- **2.5A continuous current** operation for each channel (NIS3071), configurable to 10A (4 channels in parallel)
- $R_{DS(on)}$ **50mΩ – 200mΩ**





Interactive slide

System Solution for Easy Integration

Sub-System – Wired Communication

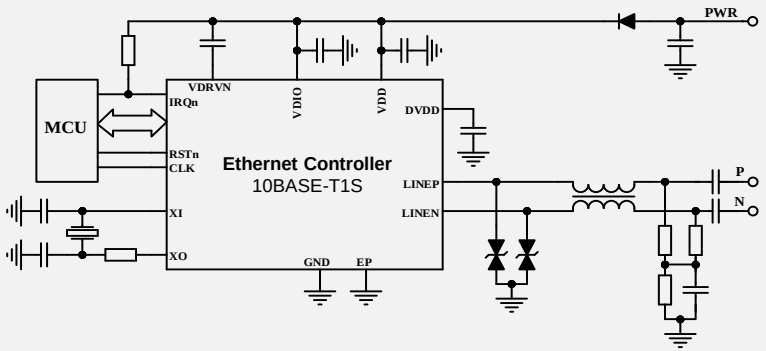
Updated: 11-February-2025

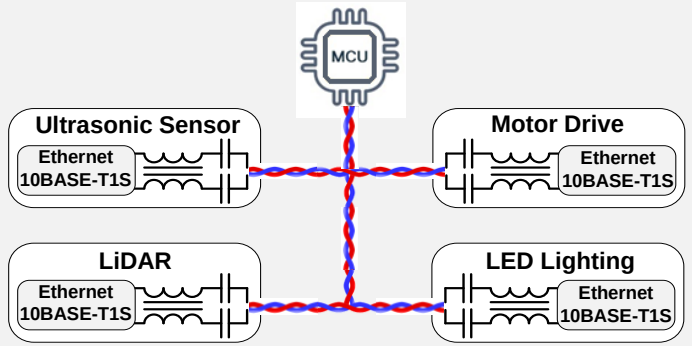
Getting started with onsemi solution

- Read System Solution Guide (SSG) for Smart & Mobile Robotics
- Review Block Diagram in the presentation and Interactive Block Diagrams on web page
- Distributors can request Customer Specific Block Diagrams by contacting **onsemi** sales
- Use Application notes and collateral listed in the SSG
- Utilize Product Recommendation Tools + (for easy selection of components)
- Request support from onsemi community forums

Value Proposition of onsemi's components

- 10BASE-T1S runs **2x to 3x faster** then CAN
- **Enhanced Noise Immunity Mode** – extends the noise immunity values well above the IEEE T1S standard.
- Supports **IEEE802.3 PLCA & CSMA/CD** Collision Detection
- **Collision Detection Masking** allows operation in noisy conditions
- Data Rate of **10 Mb/s**
- Replace various wired protocols: HART, FieldBus, CAN, RS485,RS232, FlexRay, etc.
- Uses lower cost unshielded single-pair cables (SPE)





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System Solution for Easy Integration

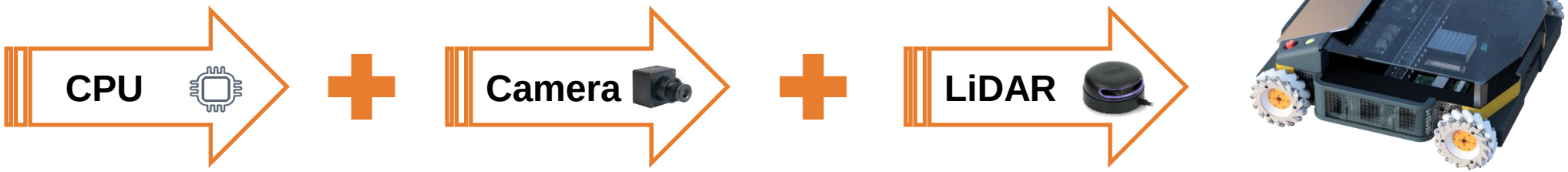
Typical CPU Sub - Systems

Updated: 11-February-2025

Getting started with onsemi solution

- Read System Solution Guide (SSG) for Smart & Mobile Robotics
- Review Block Diagram in the presentation and Interactive Block Diagrams on web page.
- Distributors can request Customer Specific Block Diagrams by contacting **onsemi** sales
- Use Application notes and collateral listed in the SSG
- Request support from onsemi community forums
- Review with Channel Partner to chose best option for CPU and other systems

Processor	NVIDIA D3 Jetson Orin 	AMD Kria KR260 	RENESAS RZ/V2H 	ADVANTECH NVIDIA® Jetson Orin™ NX 
Camera Using AR0234	D3 e-con Systems 	LEOPARD IMAGING 	LEOPARD IMAGING 	TechNexion 
Lidar	RPLIDAR A2M12 **DFR0445** 	NA  Slamtec RPLIDAR S2L	NA  Slamtec RPLIDAR S2L	DFROBOT  RPLIDAR A2M12



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Autonomous Mobile Robot – Other Relevant Products from onsemi

Updated: 11-February-2025

AC-DC Power Management

PFC
NCP1680
NCP1681
Controller
NCP4390
NCP13992
Gate Driver
NCP81075
NCP51560
NCD57540

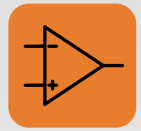
DC-DC Power Management

Converter
FAN65004B
FAN65005A
FAN65008B
FAN49103
NCP3237

MOSFETs

NTBLS0D8N08X
NTMFD1D1N02X
NTMFS0D7N04XL
NTMFWS1D5N08X
NTMFS1D1N04XM

eFuse / Audio Amp.



eFuse
NIS5420
NIS6452
NIS3071

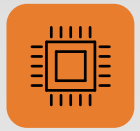
Audio Amplifier
NCS2211
NCS2632

Communication

Bluetooth
Secure Wireless
RSL15

Ethernet Controller
NCN26010
NCN26000
NCN7410

Memory



EEPROM
N24C008
CAV24C32
CAV24C64
CAV24C128
NV24C256

LED Drivers

NCV7685
CAT9532
CAT4004A
CAT4104
FAN5624

ESD Protection

NUP2115L
ESD7002
ESD8708
ESD7C
ESDONCAN1LT

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References for Easy Access

Updated: 11-February-2025

Marketing Documentation: Product Brochures, Blogs, Videos

- Autonomous Mobile Robots - **onsemi** solution
- Autonomous Mobile Robot Demo - Video
- Sensor Fusion: Steering Future AMRs - Video
- NCS32100 Inductive Rotary Encoder Demo - Video
- NCS32100 Industrial Rotary Position Sensor - Video
- Autonomous Mobile Robot and Cobot Arm Demonstration - Video
- Improving Accuracy with Inductive Position Sensor PCB Design Tools - Video
- Inductive Position Sensors for Industrial and Transportation Markets - Video
- How onsemi AMR Solutions Overcome Technical Design Challenges - Video

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Product Pages:

- Autonomouse Mobile Robot
- Image Sensors
- Silicon Photomultiplier (SiPM)
- Ultrasonic Sensor
- Inductive Sensing
- Bluetooth Low Energy
- AC DC Power Conversion
- DC DC Power Conversion
- Linear Regulators (LDO)
- Current protection (eFuse)
- MOSFETs
- LED Drivers
- Power Modules
- Memory
- Voltage Supervisors
- Audio Amplifiers
- ESD Protection Diodes
- Ethernet Controllers
- Wired Transceivers
- RF Transistors

Technical Documentation: Application Notes, Guides, PRT+

- Smart & Mobile Robotics - SSG
- Introduction to the Silicon Photomultipier - Application Note
- Inductive Sensor Design Principles - Application Note
- Test Bench for Ultrasonic Sensing ASSP - Application Note
- System Solution Guides – SSG General
- Product Recommendation Tools + – PRT+
- Web Designer+ Design Tools – Power Supplies
- Elite Power Simulator – Simulator
- Efficient Location Finding Systems – White Paper
- All Ethernet to the Edge: 10BASE-T1S – White Paper
- Design Considerations for AMRs – White Paper
- Interactive Block Diagram – Block Diagram

onsemi Community:

- https://community.onsemi.com

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appendix

Revision History

Revision Version #	Date of Revision	Changes
25.01	2025 February 11th	Original