AW AutomationWare

One step ahead on the future

brought to you by IKO

J–Actuators
T–Actuators

part of KIND Spa Group

AW **J-Actuators**
AutomationWare

Introducing the Robotics Joints: AW J-Actuators

AutomationWare is developing actuator for the next generation robotics.

Robotic joints are essential for imagining the next robotic configurations, whatever shape or application they will serve. **Robotic Joints** can define a new way of composing solutions on various levels that can also be integrated into basic arms configurations or stretched on Humanoid actuators systems.

J-Actuators are a series of **Robotic Joints** *modules to be the base of new innovative robotics configurations (17, 20, 25, 32, 40).* They could be applied with **several configurations** to allow any Robotic Integrator to assembly modular robotic solutions based on applications that could be **adapted precisely to the task** with any number of axes and is **freely scalable**, **modifiable**, **expandable** to be adapted to new task in the future.

Robotic Joint Platform
J-Actuators
J17 | J20 | J25 | J32 | J40~LP-HP~

J-Actuators series is optimized with high-level shapes and performances to obtain **consequential modularity**, designed to obtain maximum torque and precision performances with minimum dimensions and weights.

They **perform under high load conditions** thanks to the structural connection kits available in 3 versions, but not binding for any integrators.

They are **also available without servo motor board** to be used as **precise rotative actuators** *(T-Actuators)*.

5 sizes and a wide range of performances, to get the right combination according to application characteristics

J-Actuator **J25**, **J32** and **J40** are equipped with an **electromagnetic clutch brake** customized for the **best mechanical integration and with low power consumption**.

This brake lock the axis during an emergency situation or a power failure. This brake system **guarantees maximum safety** even in extreme operating conditions where the loads applied to the robotic joint can reach up to **800 Nm** in the **J40**.

A light weight pin-lock mechanical blocking system is embedded in the smaller **J17** and **J20**.

5
_ **Models**

. J40

. J32

. J25

. J20

. J17

AW J-Actuators
AutomationWare

Essential Elements

- **5 sizes** to reach up to **841 Nm** max torque

- Integrated **high efficiency harmonic reducer** available with different gear ratio

- **High Performance Torque** motor

- **Pin-Lock** or **Electromagnetic Clutch Brake system**

- **20 bit** magnetic absolute encoder *(single or double)*

- **EtherCAT Motor Control board** embedded

- **STO/SBC PLe Safety Functions**

- **Different Real Time Operation Modes** as: position sync, velocity sync and torque sync

- **ROS** *(Robot Operating System)* ready

- **Available in the Naked version** without external chassis

Safety

Sensing

Modularity

Scalability

Performance

Benefits

- Designed for **modular and scalable** robotic assembly

- **Customizable** on the customer requirements

- **Low power** consumption

- **High precision** movements

- **High torque performance**

- **Low weight**

EtherCAT
Motor Control board embedded

The **J-Actuators**, include an **EtherCAT board** for motor and brake control. **The robotics of the future must be easily integrated into modern industrial systems** that use deterministic fieldbuses and equipped with adequate safety in accordance with local regulations.

The board also has a **control platform** to adjust and **monitor the performance of the joint**, by modulating its performance according to the configuration of the robot and to **the working application. It could evaluate any protection systems for impacts with people or things**.

AW also includes an optional patented **accelerometric control device**, to observe the behaviour of the joint or the robotic arm in order to **prevent oscillations or vibrations of the system**, **caused by accidental impacts or potential load losses during the operation** of the robotic system.
(Available from June 2023)

In addition, for those who already use **R**obot **O**perating **S**ystem, widely used in robotic research, the joint can be controlled directly by **ROS**, thanks to the **RoboVu application™** which allows real-time connection of applications such as **Moveit** to the fieldbus **EtherCAT**.

Furthermore, the **J-Actuator**, can also be supplied in the *"Naked"* configuration.

It means that the robotic joint isn't supplied with the external Aluminum alloy chassis in order to be integrated directly by the customer accordingly to their specificic requirements like stringent environmental conditions.

The robotic joint contains a **high precision harmonic reducer with zero backlash**, which allows a great accuracy in term of positioning in combination with **high precision encoders** on both gearbox axes *(optional)*.

The reducer integration in the **J-Actuator** is customized to obtain a **great efficiency with very low friction** and it is integrated a high performance 48V torque motor.

Highlights

- Highest motion control performance

- **High speed fieldbus**
  https://www.ethercat.org/de/technology.html
  EtherCAT Interface *(DS402, up to 4kHz)*

- >10 **Certified Safety Functions** *(SIL3, Pl-e)* TUV

- 2 x Integrated **High Resolution Absolute Encoder**

- Various **sensor interfaces**

- Meets all relevant requirements *(EMC, Safety)*

- **Easy to use**
  https://www.synapticon.com/products/oblac
  commissioning and tuning tools

:::ROS
Attribution:
ROS is a trademark of Open Robotics.

EtherCAT®

AW J-Actuators
AutomationWare

Servo driver designed for J-Actuators

Whether you are planning to control one of more joints, this electronics is designed to perform the best on the market.

- Works with any type of **PMSM/BLDC** motor up to 48V and 60Arms

- **Model-predictive Field-oriented Control** for high efficiency, maximum bandwidth

- **Dual-loop control, gain-scheduling, high frequency control loops**

- EtherCAT interface with **high frequency** *(up to 4kHz),* **low latency**, **negligible jitter**

- Support for **2 position feedbacks** of any type

- **Motor Brake control** with power saving mode and special latching brake algorithm

- **STO/SBC SIL 3 Ple certified safety features**

DEFINING THE FUTURE FOR TRUE HUMAN-ROBOT COLLABORATION

The optional Safe Motion Module allows for SIL3 PL e level safe motion functions over FSoE *(FailSafe over EtherCAT).*

Implement your application according to ISO/TS 15066.

- STO – SAFE TORQUE OFF /
- SBC – SAFE BRAKE CONTROL
- SBT – SAFE BRAKE TEST*
- SS1 – SAFE STOP 1
- SS2 – SAFE STOP 2
- SLS – SAFELY LIMITED SPEED
- SLP – SAFELY LIMITED POSITION*
- SLT – SAFELY LIMITED TORQUE*
- SAFE VELOCITY PROCESS DATA
- SAFE POSITION PROCESS DATA
- SAFE TORQUE PROCESS DATA
- SAFE DIGITAL GPIO AND ANALOG INPUTS

*Functions must be implemented inside safety controller using safe process data.

The electronic is compliant to the following standards
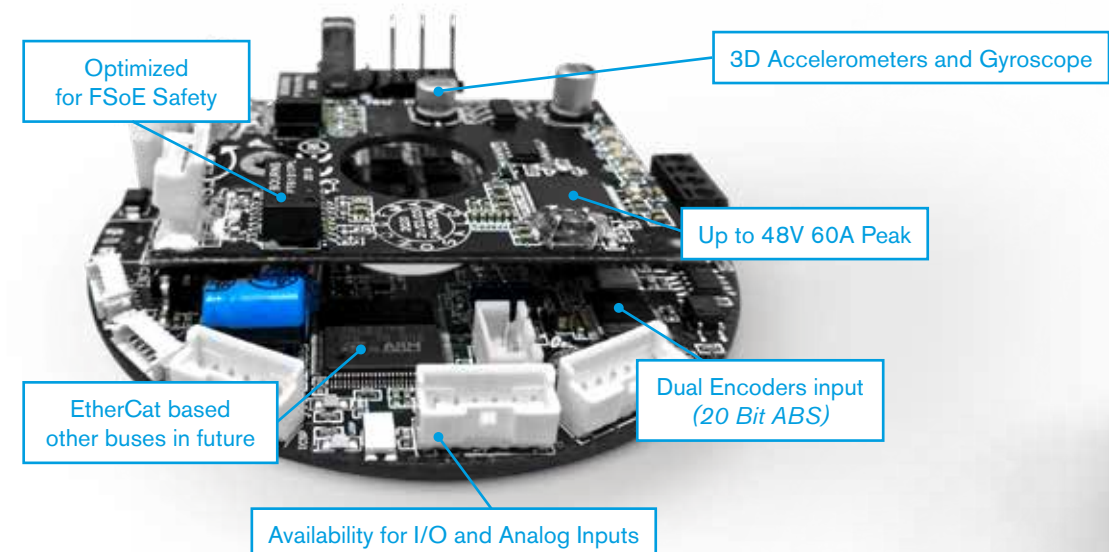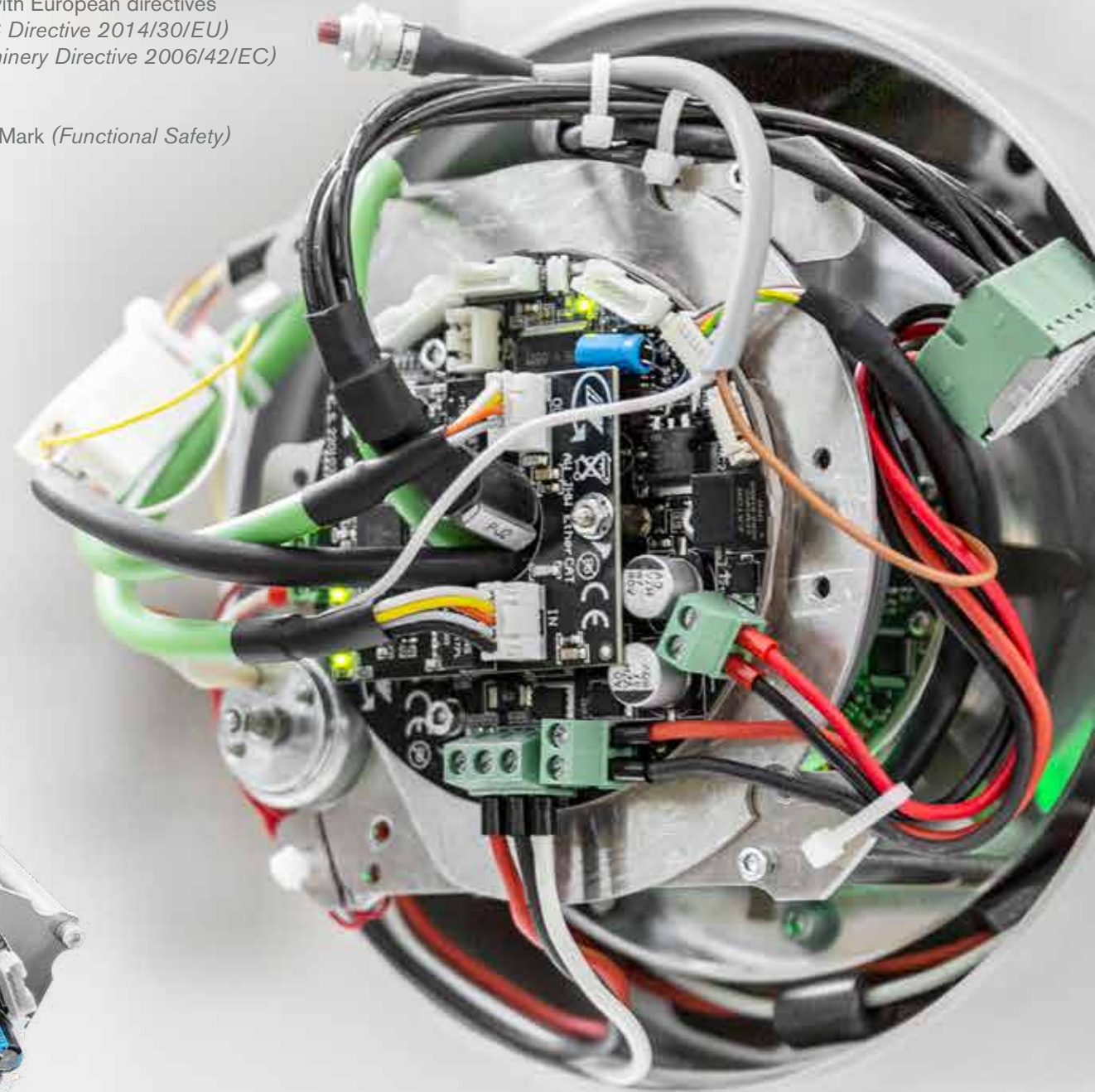CISPR 11 Class B *(EN 55011:2016)*

IEC 61000 – 4 – 6:2013
IEC 61000 – 4 – 3:2020
IEC 61000 – 4 – 2:2008
IEC 61000 – 4 – 8:2009
IEC 61800 – 5 – 1:2007
IEC 60204 – 1:2016
IEC 61800 – 5 – 2:2017
ISO 13849 – 1:2015
IEC 61508:2010 parts 1 – 7

Compliance with European directives
- **CE** *(EMC Directive 2014/30/EU)*
- **CE** *(Machinery Directive 2006/42/EC)*

Certificates
- TÜV Süd Mark *(Functional Safety)*

Optimized for FSoE Safety

3D Accelerometers and Gyroscope

Up to 48V 60A Peak

EtherCat based other buses in future

Dual Encoders input (20 Bit ABS)

Availability for I/O and Analog Inputs

AW J-Actuators
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AutomationWare
One step ahead on the future

Solutions for the factory of the future

Aluminium alloy Best Mechanical Technology

To offer best rigidity in combination with **AW robotics** links Kits

Brake System

To offer best reactions to emergency stops even with full load applied on the joints

Embedded Motor control Board

EtherCAT

Deterministic control and safety embedded and certified Safety Function

Fully ROS compatible

With **AW ROS** interface *(RoboVU)*

High Quality Gearbox

Modified to applied very low friction and very high precision

Torsional Stiffness

Measurement embedded *(2 x 20 bit Encoders)*

High Speed Torque Motor

To obtain max usable torque after the gearbox

Is possible to customize speed vs torque behaviour

RoboVu™

:::ROS
Attribution:
ROS is a trademark of Open Robotics.

EtherCAT®

AW **T-Actuators**
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Solutions
for the factory of the future
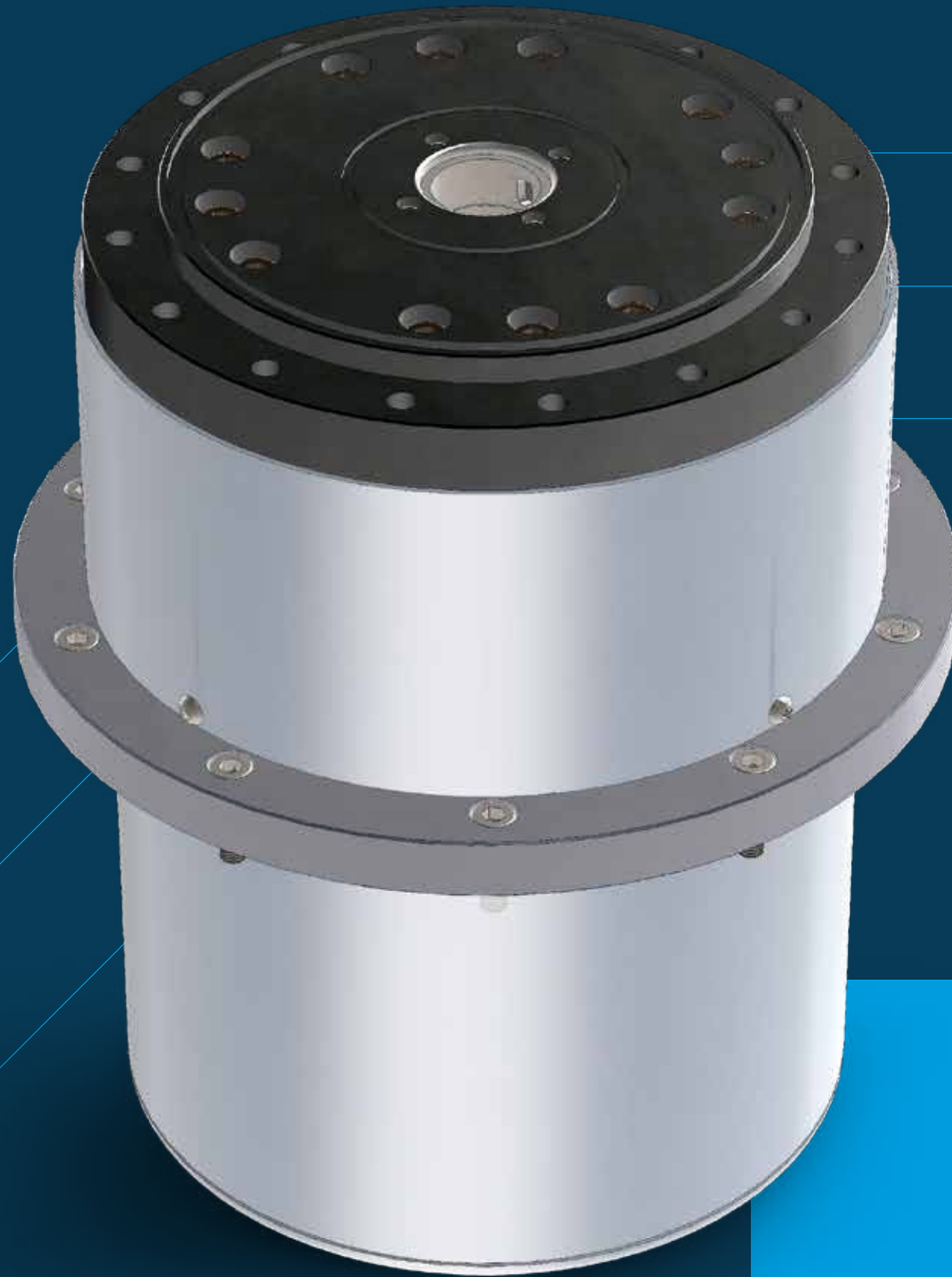
Encoder on single
or both gearbox axes

Brake System

Axial mounting

Aluminum alloy
best mechanical
technology

**High Load
Torque capability**

**High Speed
Torque Motor**

**High Quality
Harmonic gearbox**

RoboVu™

:::ROS
Attribution:
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Ether**CAT**®

AW J-Actuators
AutomationWare

AutomationWare robotic joints *"J-Actuator"* can be configured in a large variety of configurations, in order to be customized for different customer's application for the best performance.

The first series of **J-Actuator** is made up of 5 different models in terms of size and torque performance.

Each of these sizes can be customized on the application according to the desired speeds, torques and power consumption.

The 2D drawings could be found and downloaded from AutomationWare website.

MAIN SPECIFICATIONS

Key Feature	J17	J20	J25	J32	J40-LP	J40-HP
Ratio available	51-81-101-121	51-81-101-121-161	51-81-101-121-161	51-81-101-121-161	81-101-121-161	81-101-121-161
Rated motor speed [rpm]	3000	2000	1500	1500	1500	1200
Max motor speed [rpm]	5000	3200	2500	2500	2500	2200
Power	219	251	326	470	470	570
Rated Torque [Nm]	35 to 51*	44 to 64*	72 to 140*	140 to 281*	235 to 467*	320 to 586*
Peak Torque [Nm]	44 to70*	73/120*	127 to 229*	281 to 484*	675 to 841*	675 to 841*
Permissible dynamic tilting moment [Nm]	105	159	219	493	722	722
Permissible axial load [N]	1889	2651	3958	6937	7863	7863
Permissible radial load [N]	1266	1777	2652	4648	5268	5268
Encoder on motor axis or on both gearbox axes	Absolute 20 bit + 16 bit multiturn	Absolute 20 bit + 16 bit multiturn	Absolute 20 bit + 16 bit multiturn	Absolute 20 bit + 16 bit multiturn	Absolute 20 bit + 16 bit multiturn	Absolute 20 bit + 16 bit multiturn
Brake system	Pin-lock	Pin-lock	Clutch	Clutch	Clutch	Clutch
Weight [kg]	3,8**	4,1**	8,5**	14,2**	17**	17**
Hollow shaft diameter [mm]	14**	15**	20**	24**	24**	24**
Voltage [V]	48	48	48	48	48	48
Fieldbus	EtherCAT - CiA 402	EtherCAT - CiA 402	EtherCAT - CiA 402	EtherCAT - CiA 402	EtherCAT - CiA 402	EtherCAT - CiA 402
Motor control board Safety Function	STO/SBC according to SIL 3, Pl e	STO/SBC according to SIL 3, Pl e	STO/SBC according to SIL 3, Pl e	STO/SBC according to SIL 3, Pl e	STO/SBC according to SIL 3, Pl e	STO/SBC according to SIL 3, Pl e
Work Condition [°C]	0-45	0-45	0-45	0-45	0-45	0-45
Humidity	Max 90% non condensing	Max 90% non condensing	Max 90% non condensing	Max 90% non condensing	Max 90% non condensing	Max 90% non condensing

*depending from gear ratio — **referred to complete version with encoders on both gearbox axes and with external aluminum alloy chassis
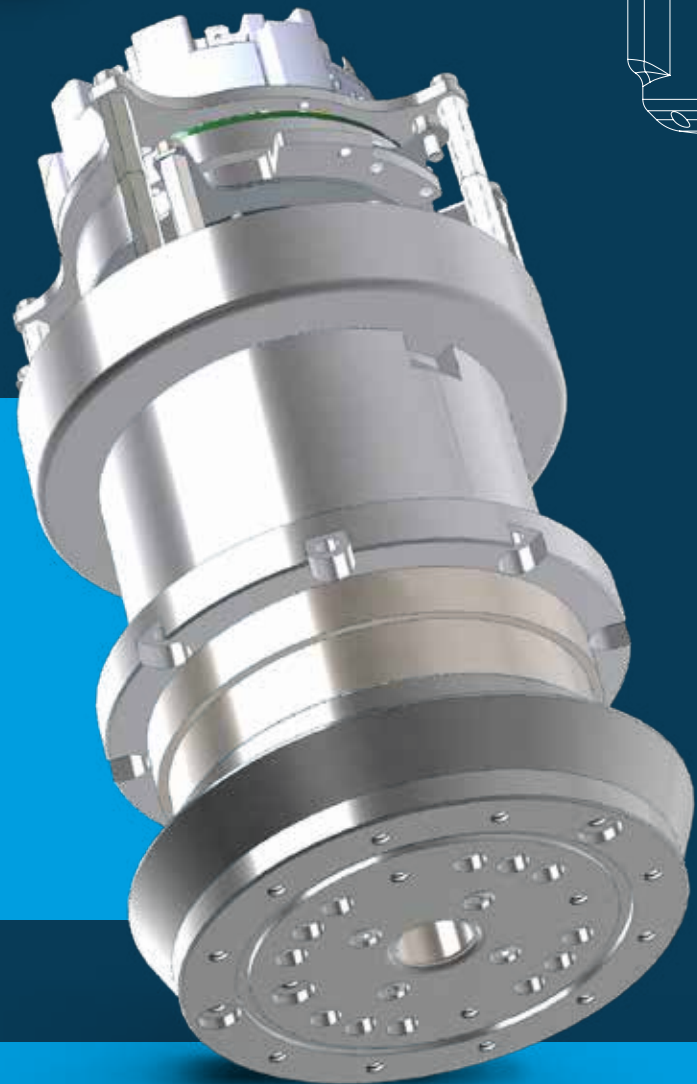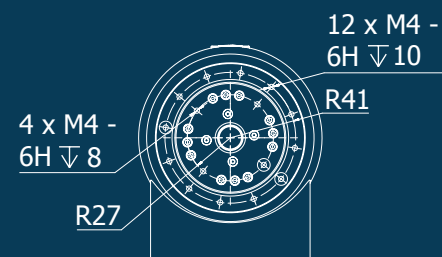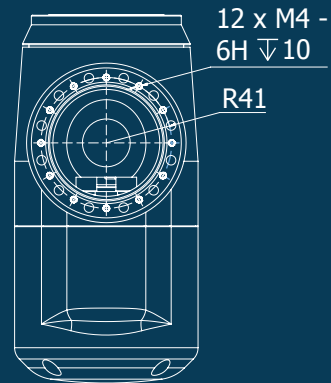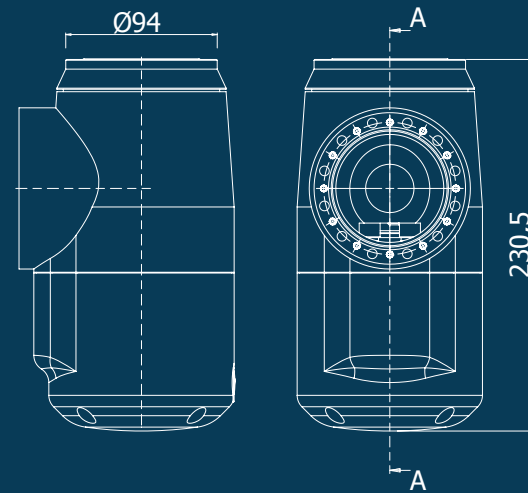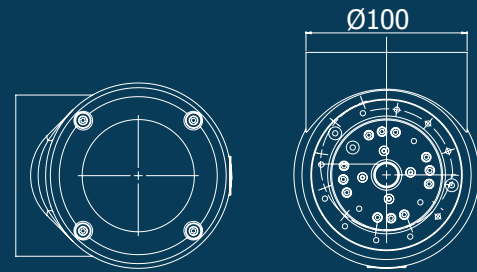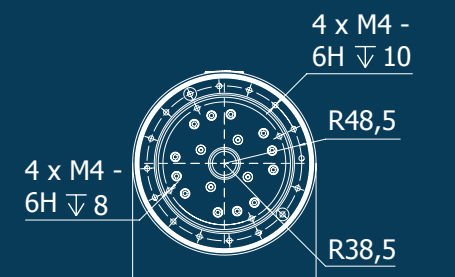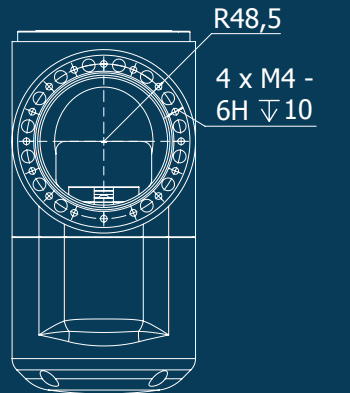

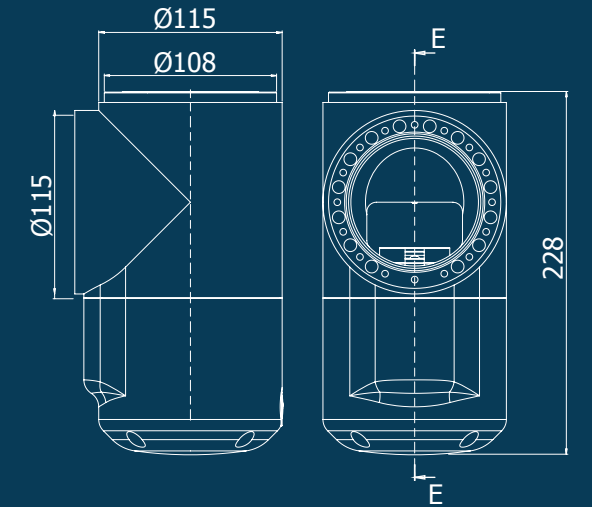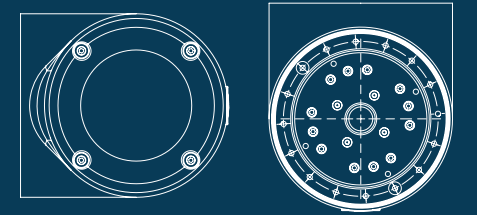# AW T-Actuators
AutomationWare

AutomationWare robotic joints *"T-Actuator"* can be configured in a large variety of configurations, in order to be customized for different customer's application for the best performance.

"T-Actuator" is a special configuration of the naked **T-Actuator** that **include a special mounting flange to mount it in vertically position**, especially made for using it as rotary table.

T-Actuator is a very **high torque density actuator** and thanks to the aim of this product, to **reduce the geometrical dimensions** and give to the customer the possibility to control it with its desired servo drive, it doesn't include the motor control board as a standard.

T-Actuator that could be also equipped with a second encoder on the **load side of the harmonic reducer**, to **perform the stiffness control** or for redundancy reason.
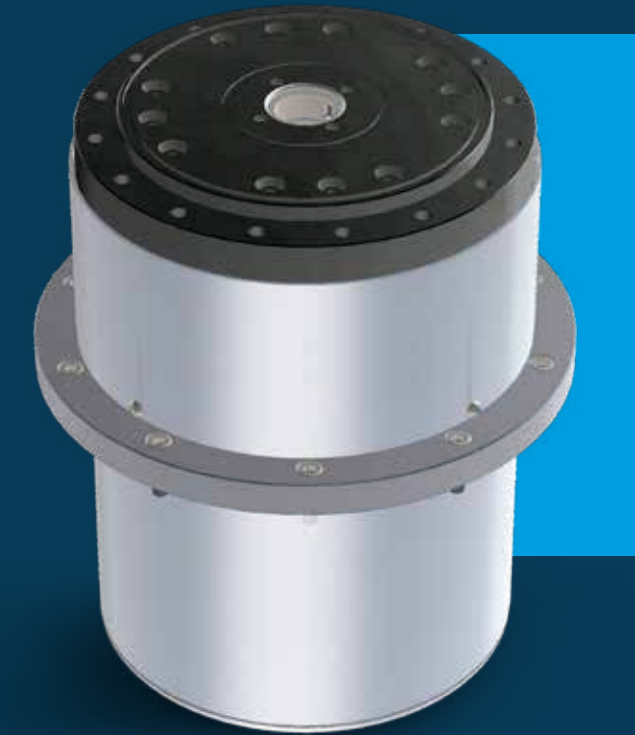
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Brake system	Pin-lock	Pin-lock	Clutch	Clutch	Clutch	Clutch
Weight [kg]	3,3**	3,5**	7,8**	13,5**	16,5**	16,5**
Hollow shaft diameter [mm]	14**	15**	20**	24**	24**	24**
Voltage [V]	48	48	48	48	48	48
Work Condition [°C]	0-45	0-45	0-45	0-45	0-45	0-45
Humidity	Max 90% non condensing	Max 90% non condensing	Max 90% non condensing	Max 90% non condensing	Max 90% non condensing	Max 90% non condensing

*depending from gear ratio — **referred to complete version with encoders on both gearbox axes and with external aluminum alloy chassis

AW **J-Actuators**
AutomationWare

Robotic joint
J17

Robotic joint
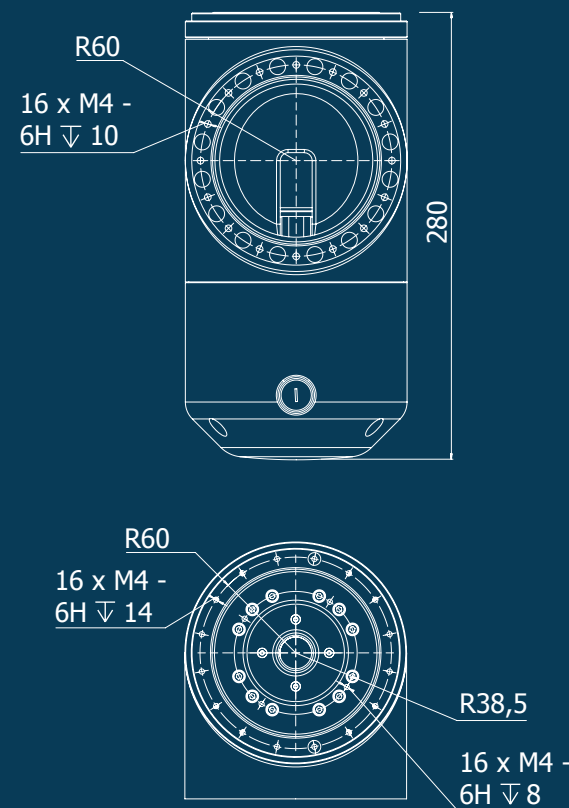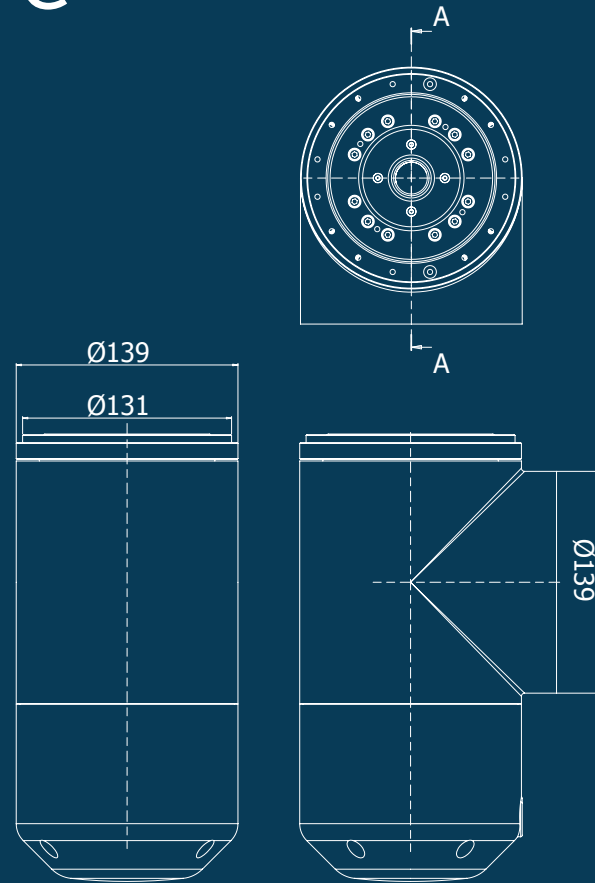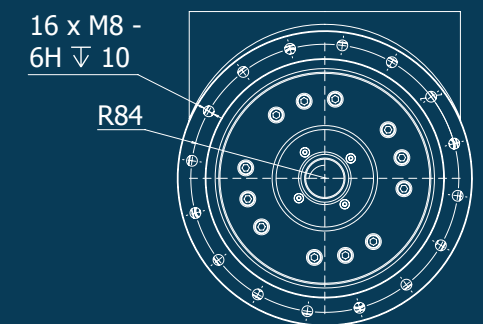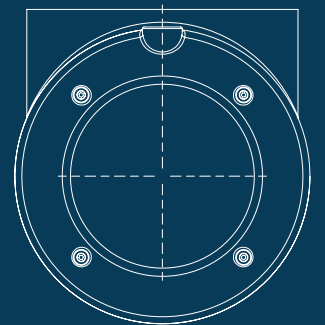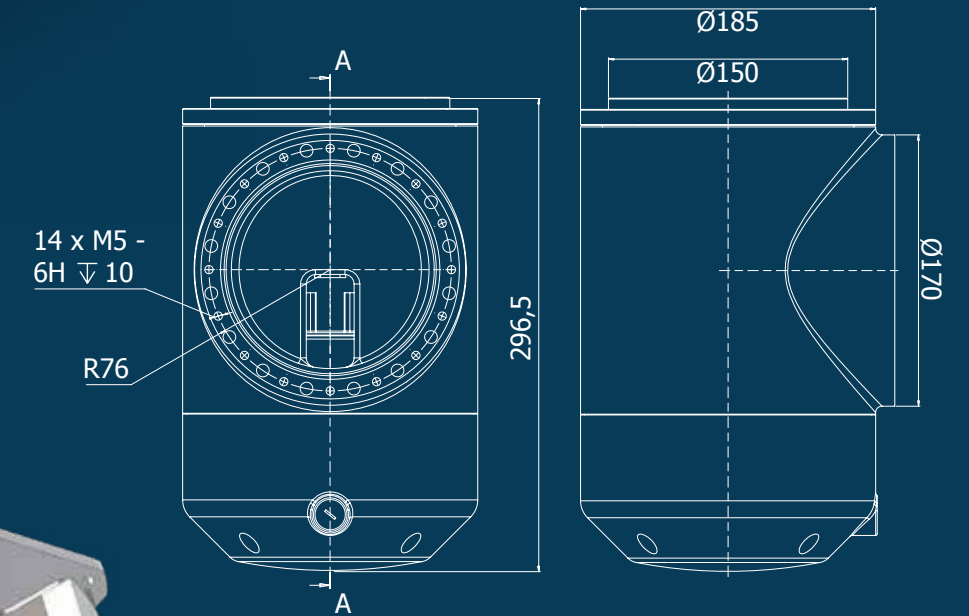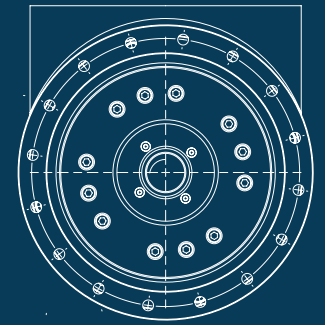### J20

Ø100

Ø94

230,5

A

A

12 x M4 - 6H ⤓ 10

R41

12 x M4 - 6H ⤓ 10

R41

4 x M4 - 6H ⤓ 8

R27

Ø115

Ø108

Ø115

228

E

E

R48,5

4 x M4 - 6H ⤓ 10

4 x M4 - 6H ⤓ 10

R48,5

4 x M4 - 6H ⤓ 8

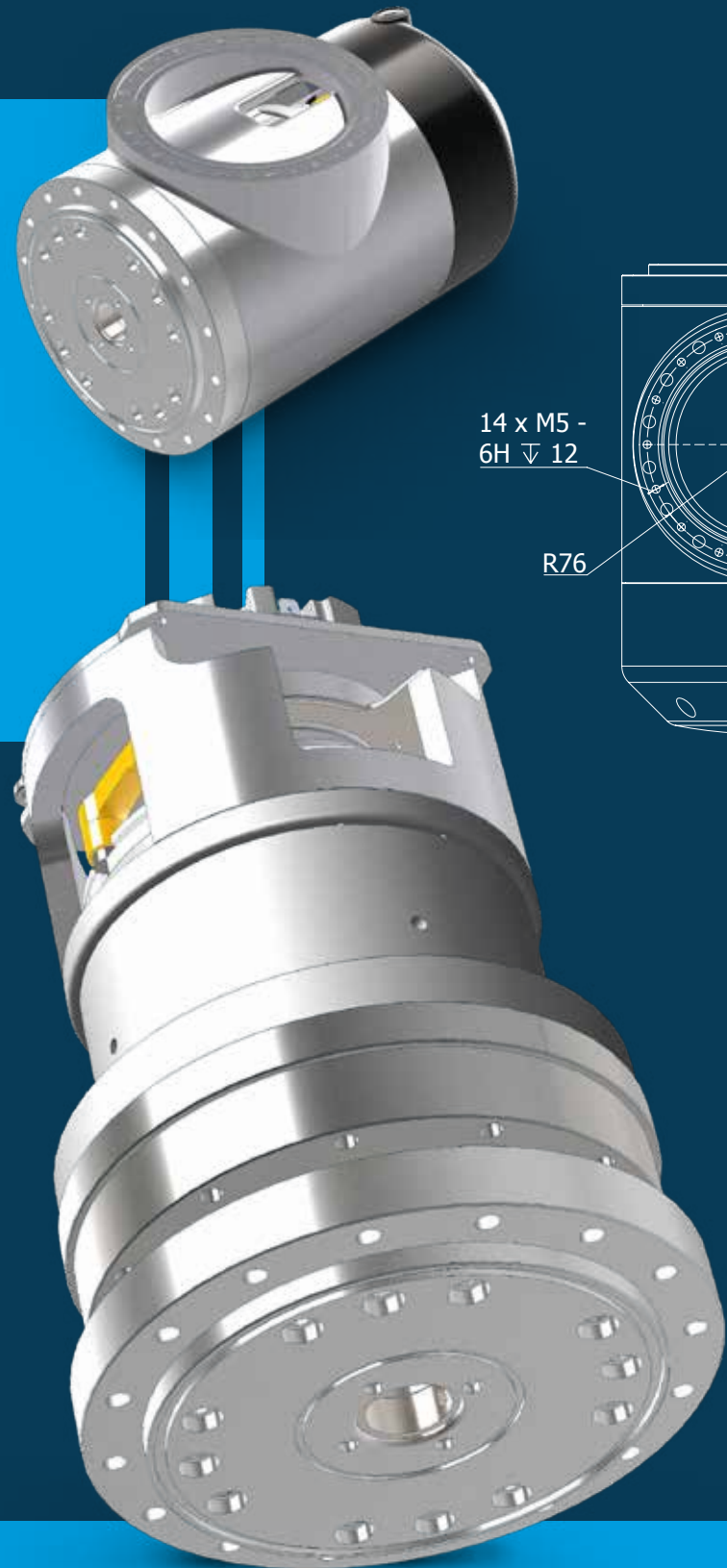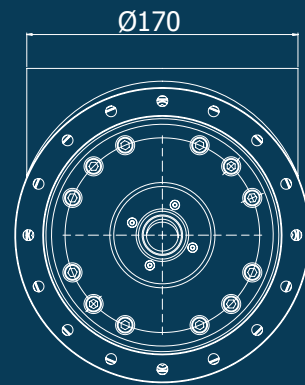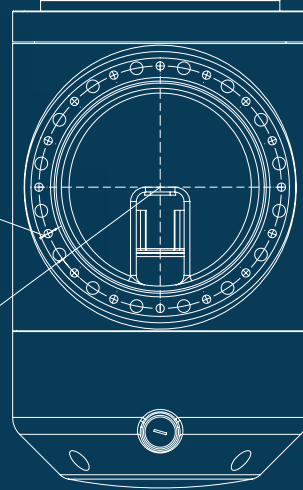R38,5

AW J-Actuators
AutomationWare

Robotic joint
J25

Ø139
Ø131

Ø139

A

A

R60

16 x M4 - 6H ▽ 10

280

R60

16 x M4 - 6H ▽ 14

R38,5

16 x M4 - 6H ▽ 8

Robotic joint
J32

Ø185
Ø150

A

14 x M5 - 6H ▽ 10

R76

296,5

Ø170

A

16 x M8 - 6H ▽ 10

R84

AW J-Actuators
AutomationWare

Robotic joint
J40

Ø170

Ø185

Ø150

A A

14 x M5 - 6H ▽ 12

R76
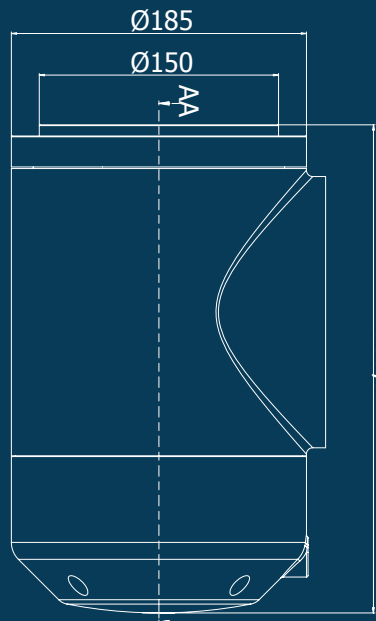
305.9
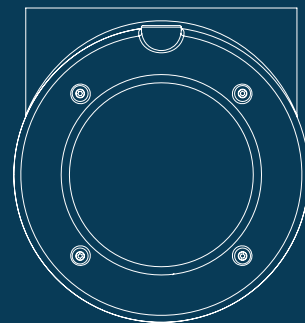
R84

16 x M8 - 6H ▽ 16

On the picture **AW-Combo** the first 16 Axis mobile robot on the market, based on **J-actuators** technology.

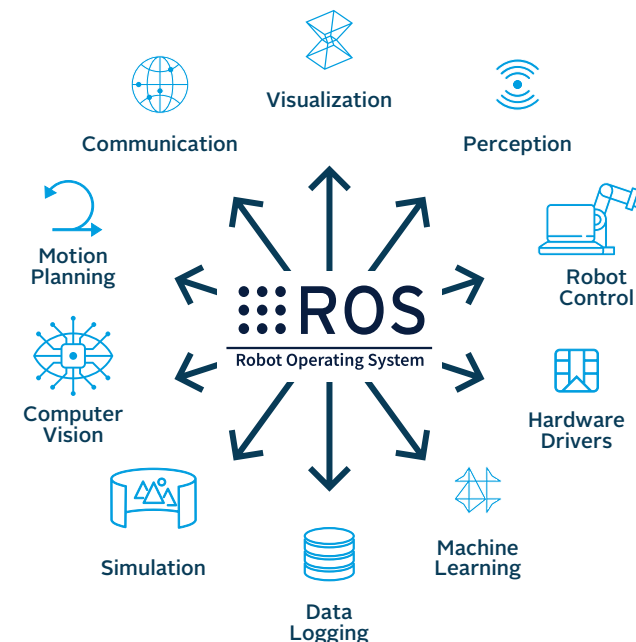# AW J-Actuators
AutomationWare

Focus on
Software & Control

Visualization

Communication   Perception

Motion
Planning   **ROS**
          Robot Operating System   Robot
                    Control

Computer   Hardware
Vision   Drivers

Simulation   Machine
                    Learning

          Data
          Logging

AutomationWare
Developing the Next
Generation Robotics

RoboVu™

ROS

The robot can be managed by proprietary systems that allow, after appropriate programming, to define the **operating kinematics by controlling the single joints** on the **EtherCAT fieldbus**.

The robotic joints can also be controlled for environments based on **ROS** or **ROS2** thanks to our **RoboVu software connector** which allows the **ROS** kinematics to control our joints with real time performance starting from kinematics generated with **URDF** files.

EtherCAT®

Kinematics
& Control

- URDF File describing geometry and dynamics of the mechanical system

- User Interface   **ROS**

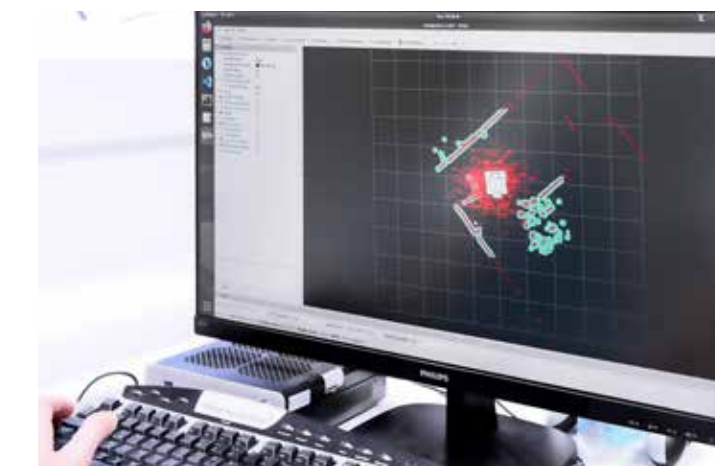- Motion Planning   **MoveIt**

- Virtualization and Simulation of project   **GAZEBO**

- Link to real virtual hardware   **ROS** CONTROL

The key element is to customize the best fit robotic configuration for the specific applications and **manage and control** it a simply way with **RoboVu**.

This possibility allows customer who use **J-Actuators** to free themselves from predefined commercial systems with fixed shapes, geometries and payload.

Furthermore, the **EtherCAT fieldbus** allows, thanks to the use of **RoboVu**, a **real time control** of the robot or of the **J-Actuators**, ideal for obtaining a combination of movement and/or cognitive performance.

AW J-Actuators
AutomationWare

Focus on
Software & Control

AutomationWare developed a software architecture based on ROS or ROS2 to manage their robotic arms (AWTube) and robotic joints (J-Actuator).

Motion Planning functionalities are implemented in ROS using the framework MoveIt which offers several planning solutions allowing the users to select the best one to fit their requirements.

Motion planning algorithms available on MoveIt fit the URDF model derived from the CAD project.

Using Gazebo it is possible to reproduce a robotic cell and testing it in a virtual environment.

This can be very useful during the initial stages of a project to do an accurate feasibility study of the application taking any countermeasure in a preventive way.

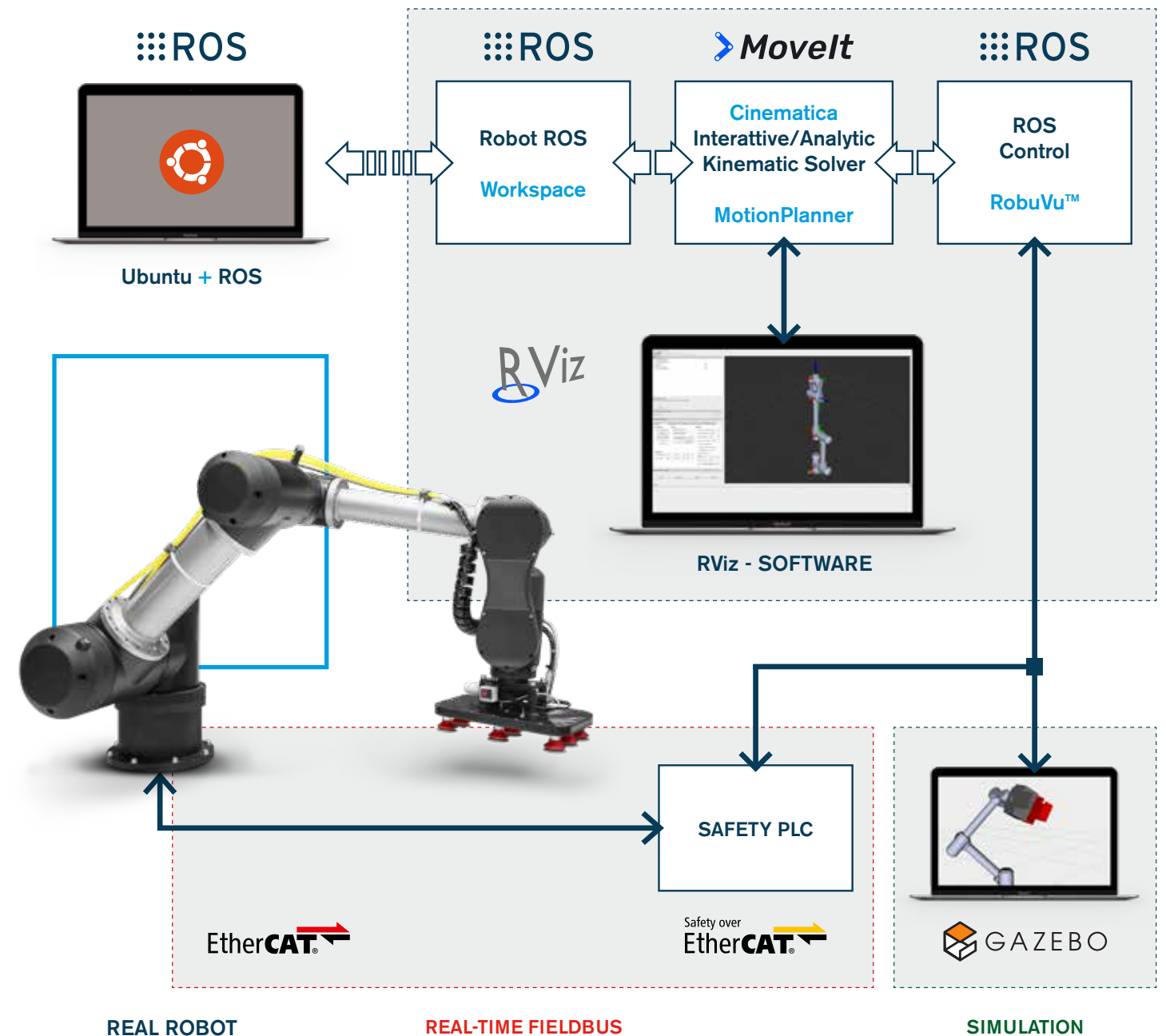Safety is implementend outside ROS, using proper commercial devices (SAFETY PLC).

Soon it will be possible to manage J-Actuators and AWTube arms using Fail Safe Over EtherCAT (FSOE) to separately exchange «non fail safe» data from the «fail safe» ones.

AutomationWare
AW Software Architecture
for Robotic Systems Management

MOTION PLANNING - COLLISION AVOIDANCE - KINEMATICS SOLVING

:::ROS

Ubuntu + ROS

:::ROS
Robot ROS
Workspace

> MoveIt
Cinematica
Interattive/Analytic
Kinematic Solver

MotionPlanner

:::ROS
ROS
Control

RobuVu™

RViz

RViz - SOFTWARE

SAFETY PLC

EtherCAT

Safety over EtherCAT

GAZEBO

REAL ROBOT　　　**REAL-TIME FIELDBUS**　　　**SIMULATION**
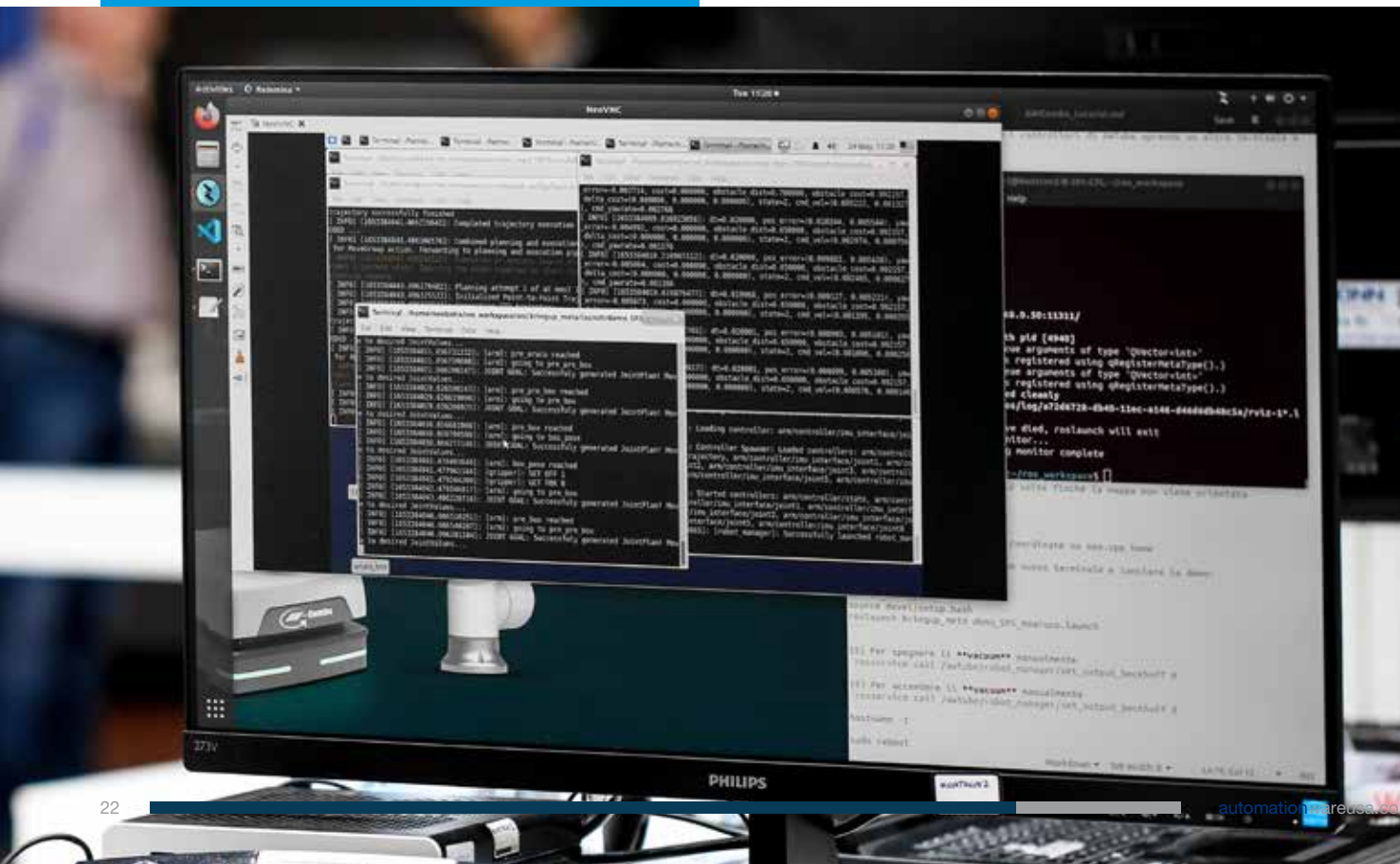
AW J-Actuators
AutomationWare

ROS
Repository on GitHub

AutomationWare published on **GitHub** a repository **Automationware/aw_robotics** which contains the **ROS packages** for each **J-Actuator** and **AWTube** available models with some related test nodes.

In this way, users can test virtually *(eg on **Rviz**)* and phisically *(using **RoboVu**)* each model of **J-Actuator** and **AWTube**.

The aims are the following ones:

- Allowing user to know **AW**'s products

- Promoting the use of **ROS** in industrial applications

- Encouraging the creation of **robotic ecosystems** to improve technology in robotics through the discussion between **companies, research institutes, universities and enthusiastics robotics users**.

TwinCAT

AutomationWare provides the user with a project prototype developed using the supplied **TwinCAT tool by Beckhoff** to command the robotic joint a **sequence of simple movements, in different modalities operating on EtherCAT fieldbus according to standard CiA402**

The project is available on **GitHub** at the following link: https://github.com/Automationware/aw_joint_twincat

| Mode of operation	Abbr.	Code
Profile position mode	pp	1
Profile velocity mode	pv	3
Torque profile mode	tq	4
Cyclic synchronous position mode	csp	8
Cyclic synchronous velocity mode	csv	9
Cyclic synchronous torque mode	cst	10
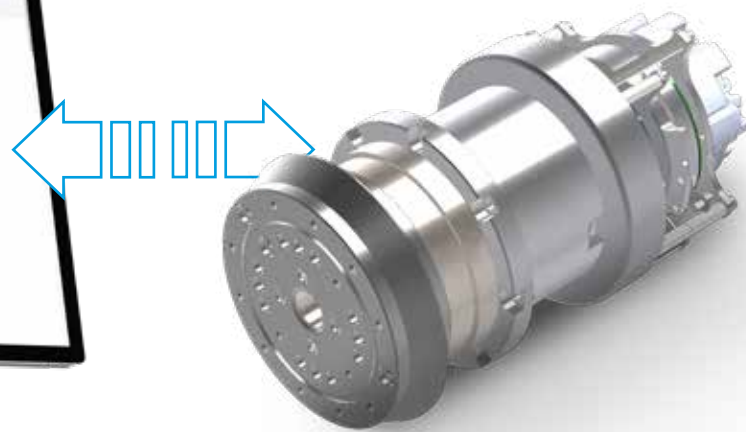
ROS

GitHub

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AW J-Actuators
AutomationWare

AW-Modular
Robotic Architecture
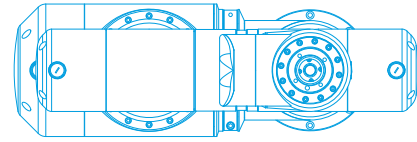
AutomationWare offers some predefined integration options to **facilitate** the construction of **your own robotic system**.

For this purpose, a series of links and coupling are proposed in order to define **robotic arm with 3-4-5-6 or 7 degree of freedom** but also to define configurations with double arms or more axes, to **overcome the limits of the actual commercial cobots** limitation in the complex applications.

The **modularity of AW robotic joint**, configurable with joints of various types, allows the **design of robotic arms or systems of all types**.

This helps especially to **deal with very complex application situations**, where the relationship between the execution speed and the applicable payload must be customized according to requirements.

AutomationWare could provide the **kit parts to assemble the complete robotic arm** like **links**, and **clamps** to connect the joints each other.

_ **Robot** Size L

_ **Robot** Size M

_ **Robot** Size S

Ø 63
110
205
225
310
500
1226
102
Ø 169
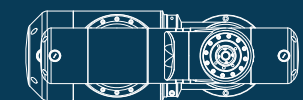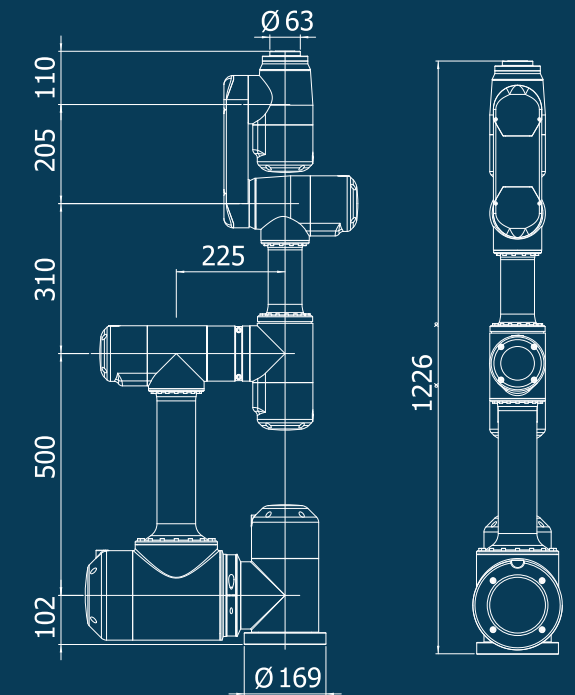
MAIN SPECIFICATIONS

Description	Data
Reach [mm]	800
Payload [kg]	8
Axes	6

J-ACTUATOR

Composition	Data
Joint 1	J25
Joint 2	J32
Joint 3	J25
Joint 4	J20
Joint 5	J17
Joint 6	J17

ASSEMBLY PARTS

Description	Data
Links kit	[1]
Clamp kit	[2]
Wirings kit	-
ISO Tool Flange	-

_ **Link** [1]

_ **Clamp** [2]

AW J-Actuators
AutomationWare

Size M
Robot AW-Modular

205 90 20,5
475
235
525
116,5
1432
Ø 219
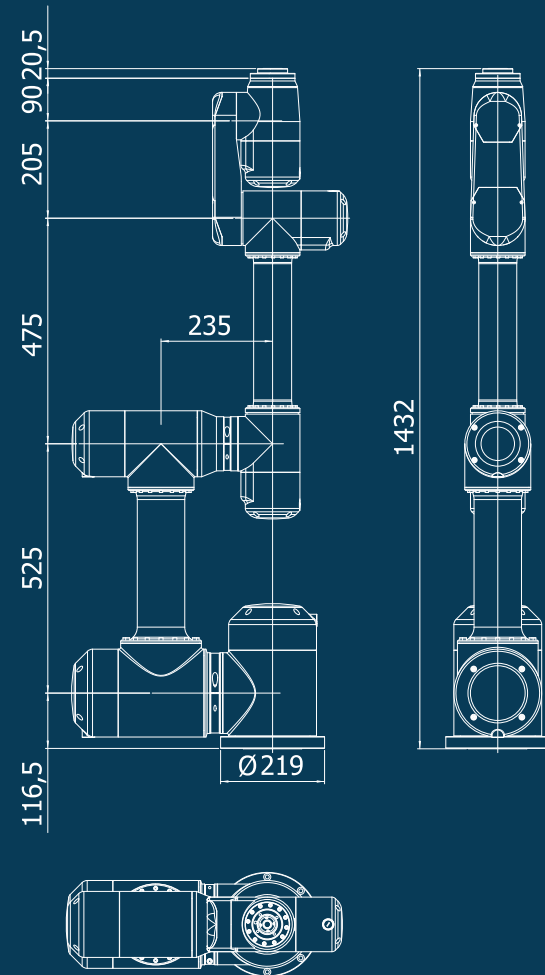
MAIN SPECIFICATIONS

Description	Data
Reach [mm]	1000
Payload [kg]	12
Axes	6

J-ACTUATOR

Composition	Data
Joint 1	J32
Joint 2	J32
Joint 3	J25
Joint 4	J20
Joint 5	J20
Joint 6	J17

ASSEMBLY PARTS

Description	Data
Links kit	[1]
Clamp kit	[2]
Wirings kit	-
ISO Tool Flange	-

_ Link [1]

_ Clamp [2]

Size L
Robot AW-Modular

Ø 63
108
250
675
245
725
117
Ø 219
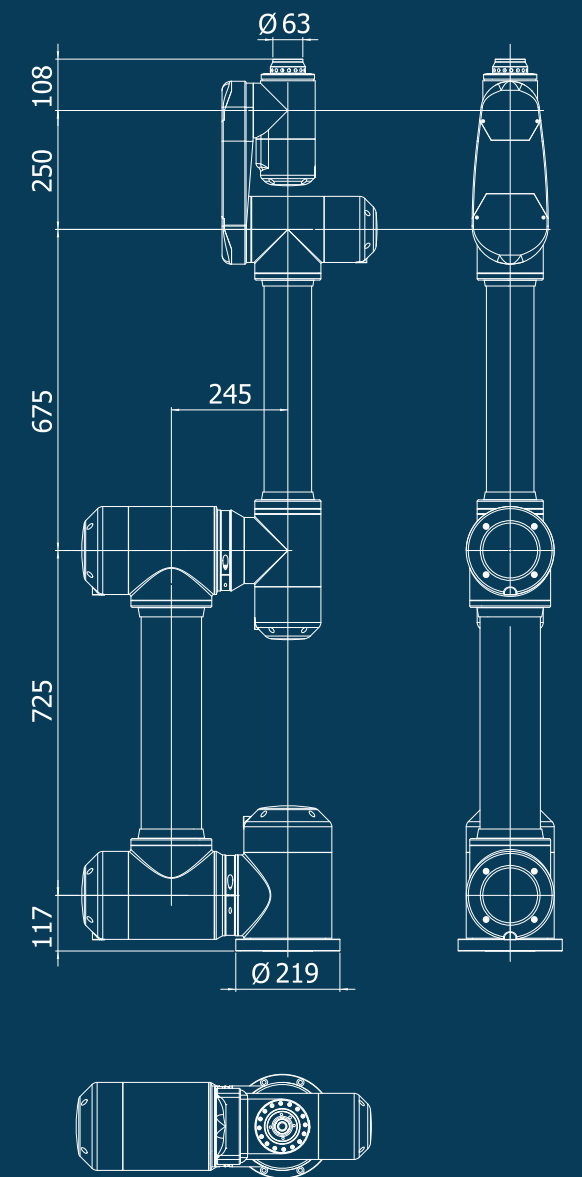
MAIN SPECIFICATIONS

Description	Data
Reach [mm]	1300
Payload [kg]	18
Axes	6

J-ACTUATOR

Composition	Data
Joint 1	J40-LP
Joint 2	J40-HP
Joint 3	J32
Joint 4	J25
Joint 5	J25
Joint 6	J20

ASSEMBLY PARTS

Description	Data
Links kit	[1]
Clamp kit	[2]
Wirings kit	-
ISO Tool Flange	-

_ Link [1]

_ Clamp [2]

Robotics Joints
Areas of Applications

Uniquely optimized form **factors, precise and dynamic performawnce, quality, reliability, and ease of installation** are the hallmarks of everything we design and build.

High torque and loads, absolute precision, sensors for detecting the torque applied by the system's loads, make this device unique for a series of application:

Medical Robotics

- Surgery Multiple Arms
- Joints for Prostheses or Exoskeletons
- Medical Scanner Arms *(X-Ray or TAC applications)*

Laboratory and Diagnostic

- Vials Handling
- Diagnostic Actuations Arms
- Analytical Robotics Arms
- Mobile Robotics Applications

AutomationWare
Headquarters in Venice - **Aw—Combo**

Applications

Space and Defence

- Space Arms
- Space Mobile Joints
- Solar Panel Orientation
- Robot for Explosive Ordnance Deactivation
- Antennas Orientation
- EW Radar Orientation
- Military Robotics Arms
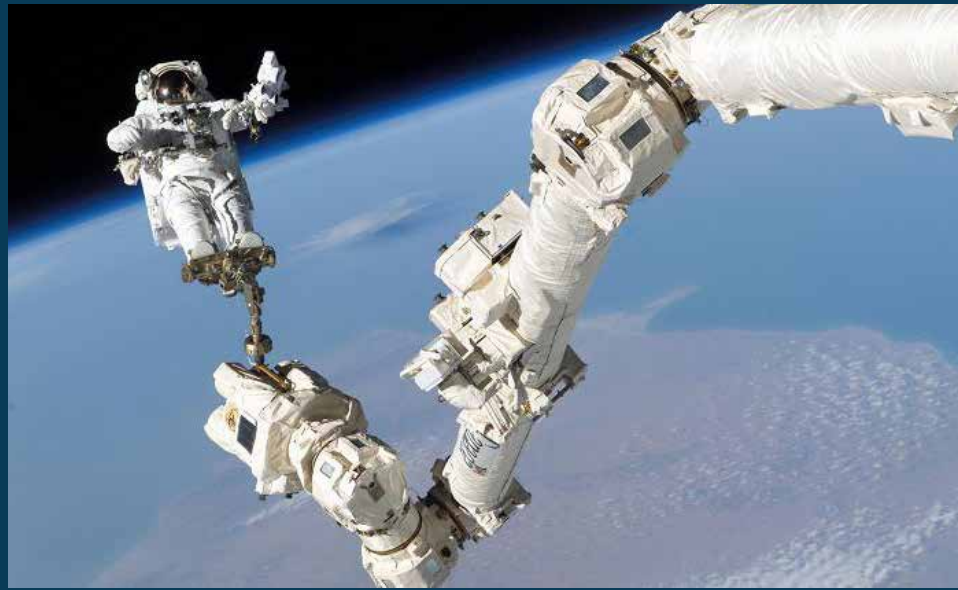
Industrial

- Robotics Arms
- Extension of Traditional Robots
- Grippers
- Arms for AMRs *(Pick and Place)*
- Hygienic or Clean Robotics for Food or Pharma
- Machinery Robotics Arms

Logistic

- Warehouse Robotics
- Arms for AGVs
- Grippers for Logistic
- Shuttle Picking Actuators

5 **J-Actuators models**

Joints　　　　**Arm**　　　　**AW−Combo**

AutomationWare
winner of the Maietti Award 2022
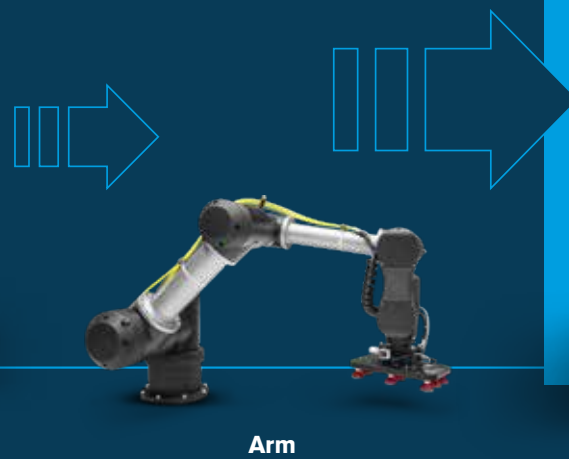
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smart production solutions
Award 2022
Roberto Maietti
Automationware

IKO

91 Walsh Dr,
Parsippany, NJ 07054

Telephone   862 895 6280
Email   ikoaw_usa@ikonet.co.jp

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