Celera MOTION

A Novanta Company

Robot Joints

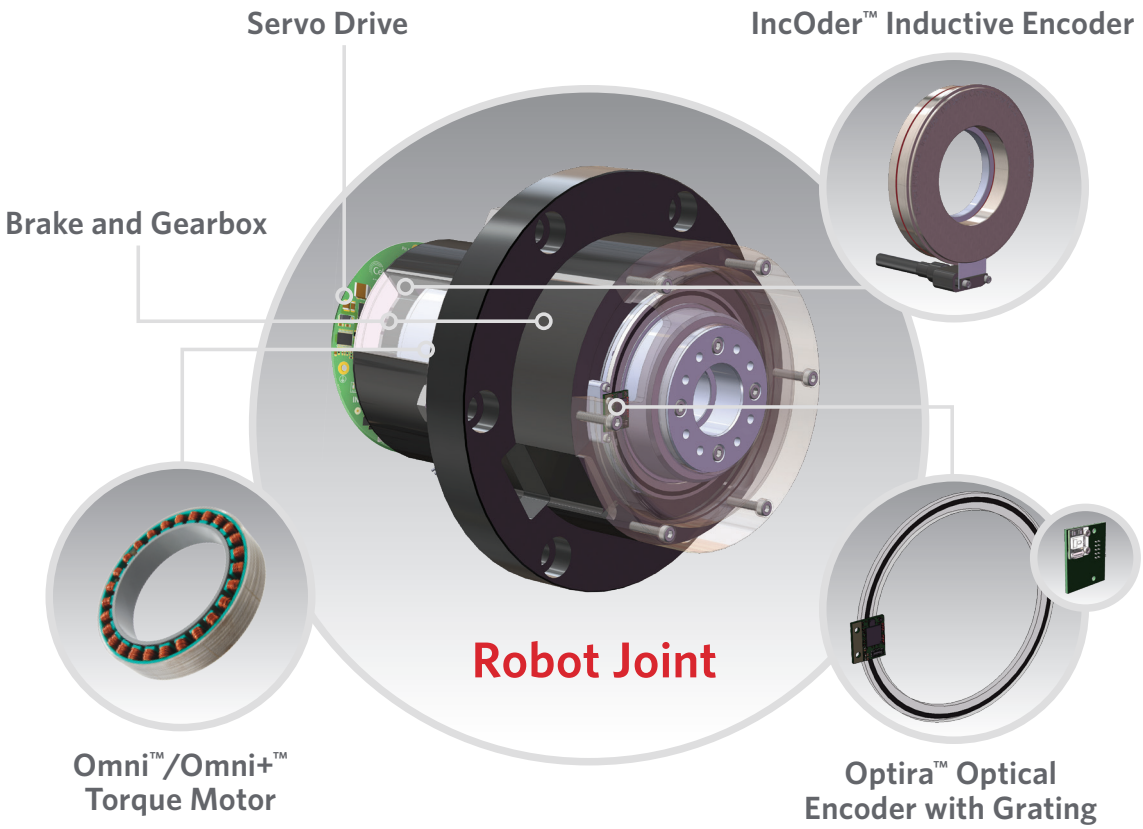
Bring the challenge.
We'll build the solution.

Accelerate Your Innovation

As robotic machines become more sophisticated and gain popularity in the industrial, commercial, and medical markets, they are called upon to perform more complex tasks.

New design trends are emerging that capitalize on smaller, more compact assemblies with high precision and reliability.

The integration of next generation control electronics and precision motion components directly inside the robotic joint is now a reality. Accelerate your innovations—reduce EMI issues, wiring complexity, and simplify the entire assembly.



Bring the challenge. Celera Motion will build the solution.

Robot Joint Design Guidelines

Technical Papers - Mechatronics

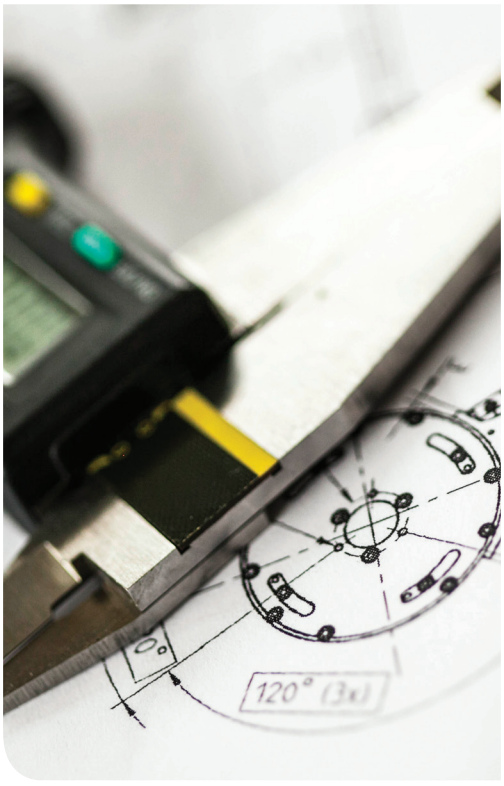
Purpose

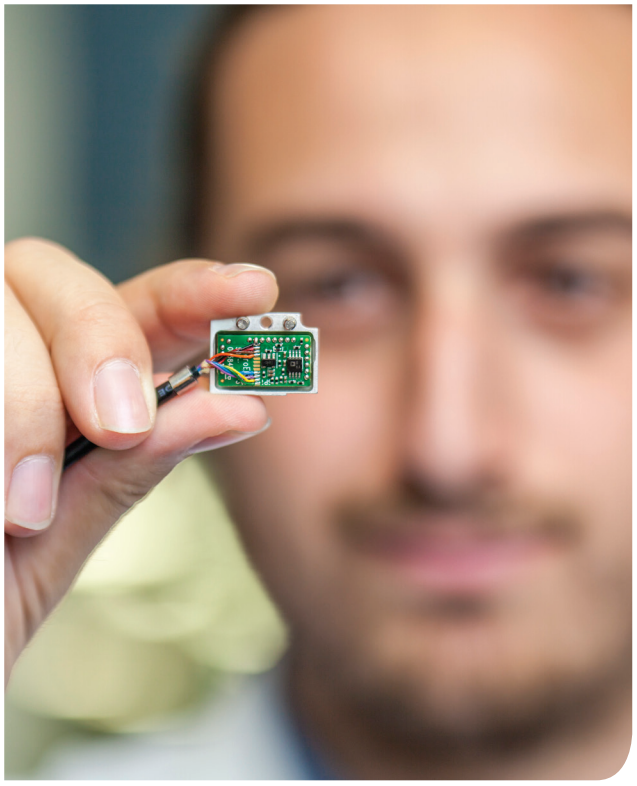
› The purpose of this technical paper is to provide an example of how to integrate all of the motion and sensing components into a low profile robot joint. It covers design options for the motor, encoder, brake, gear assembly, and servo drive.

Background

› As robotic and robotic assisted products proliferate the industrial, commercial, and medical markets, new design trends are emerging that capitalize on smaller and more compact assemblies with high precision and reliability.

To achieve this, one design solution is to develop an integrated robot joint that contains a direct drive frameless motor kit, high resolution encoder kit, precision zero backlash strain wave gear set, and an ultra miniature servo drive in one housing. This method of component integration results in a low weight and very low axial height, providing a very low profile compared to that of prepackaged motors, gearboxes, and encoders assembled together.





Integrated Robot Joint

Figure 1 below depicts an integrated robot joint. This design has capitalized on low axial height components, making the assembly very compact. The assembly also includes an encoder with high resolution and accuracy on the output, as well as a medium resolution encoder on the back of the motor.

Figure 1: Integrated Robot Joint

Figure 2 below reveals the major components in this integrated robot joint. It contains the following features:

- Precision low profile strain wave gearing with zero backlash
- Frameless brushless motor kit
- Medium resolution incremental optical encoder kit on the motor side
- High resolution incremental optical encoder kit with MMA near-absolute technology on the output side
- Front, center, and rear housing components
- A flanged output shaft for interfacing with nearby assemblies
- Precision bearings for the input shaft, gearing, and output shaft
- Axial through hole for simplified robot joint wiring

Figure 2: Cross Sectional View of Integrated Joint

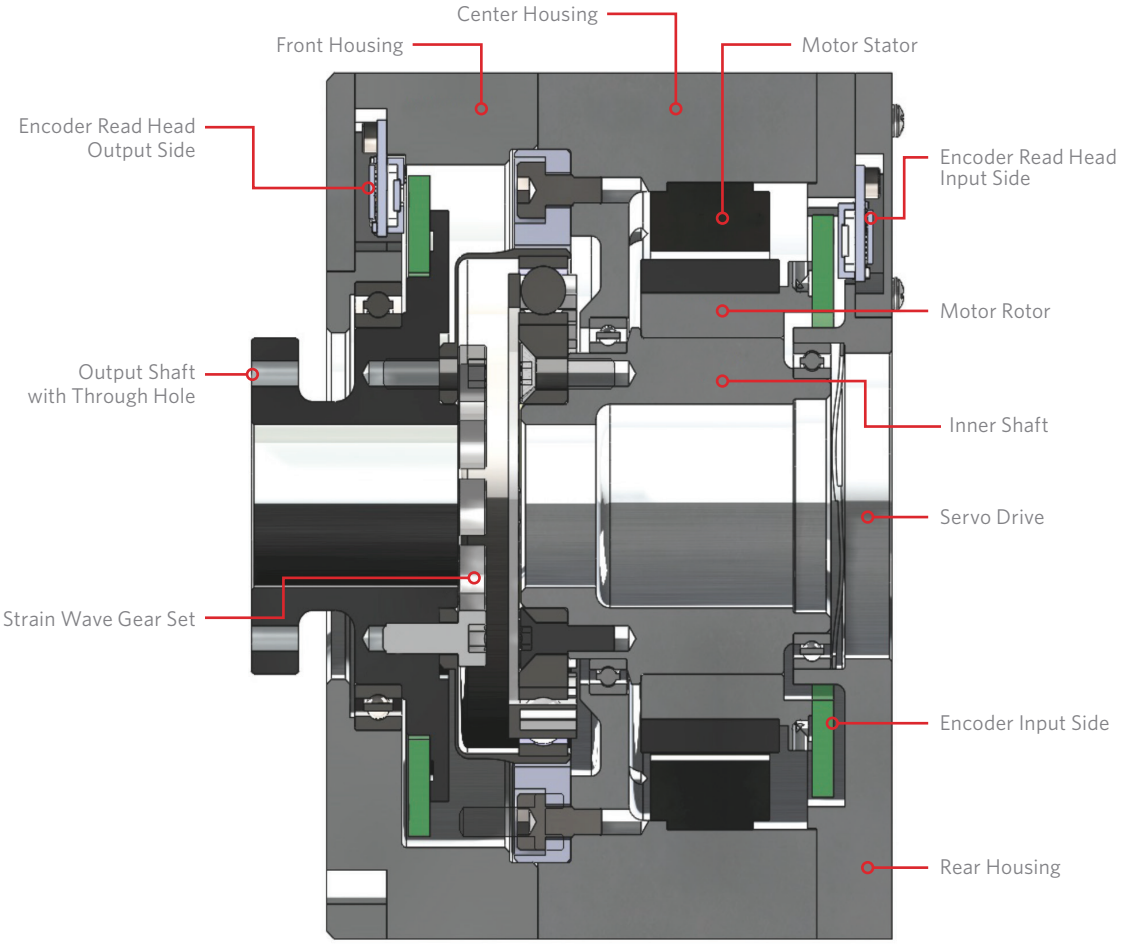


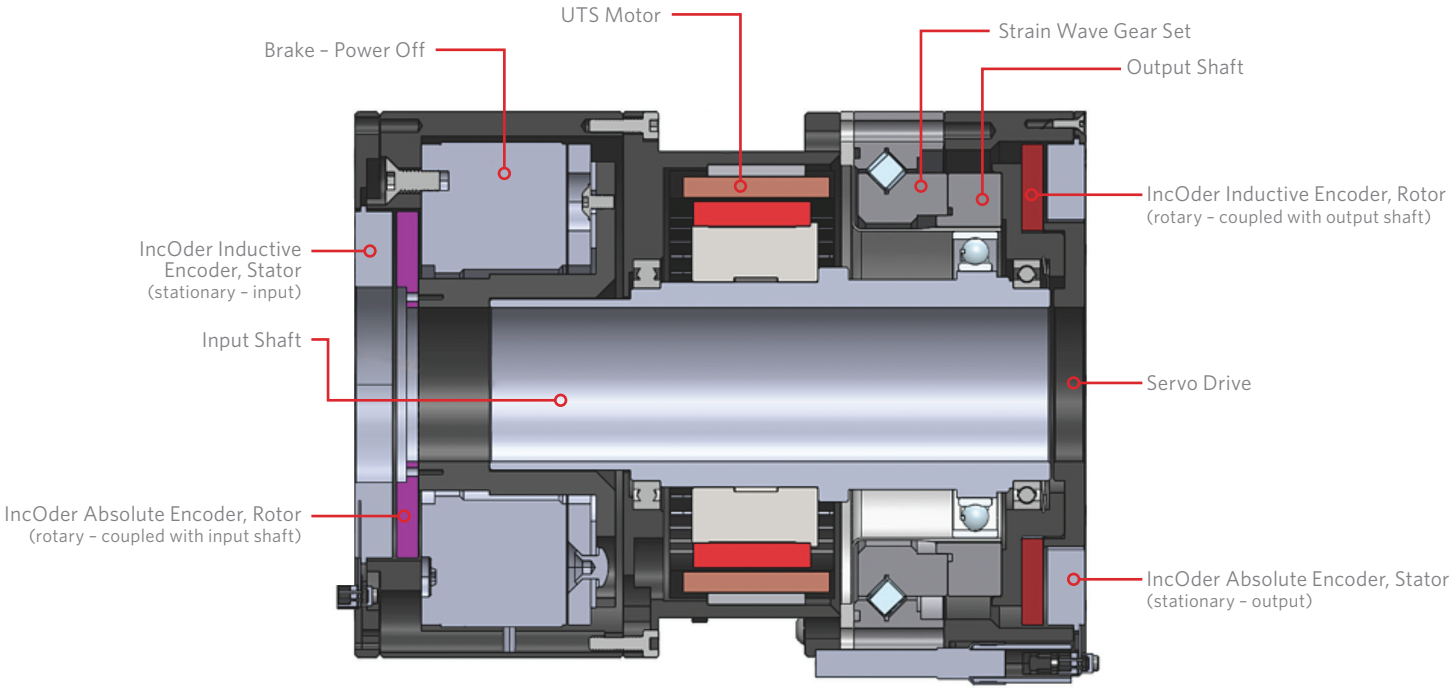
Figure 3 below shows an alternative approach using two absolute inductive encoders. In similar construction to the joint in Figure 2, there is an encoder on the motor side (input) and the output side after the gear. This assembly also includes an electromechanical brake for holding while power is off.

Figure 3: Integrated Robot Joint with Brake

Figure 4 below reveals the major components in this integrated robot joint. It contains the following features:

- Precision low profile strain wave gearing with zero backlash
- Frameless, slotless, zero cogging brushless motor kit (see definition below)
- Medium resolution absolute inductive encoder kit on the motor side
- High resolution absolute inductive encoder kit on the output side
- Front, center, and rear housing components
- A flanged output shaft for interfacing with nearby assemblies
- Precision bearings for the input shaft, gearing, and output shaft
- Electromagnetic brake
- Axial through hole for simplified robot joint wiring

Figure 4: Integrated Robot Joint



Precision Gearing

Robot joints have varying reflective loads and inertia based on position. Using a gear reduction increases output torque, mitigates the servo tuning implications of a large change in inertia with position, and allows for the use of smaller motors which consume less power and increase efficiency.

One problem that arises from using traditional gear reducers is backlash. Although a higher gear ratio solves some torque and inertia challenges, the resulting backlash will cause positioning errors and potential tuning issues. There are two commonly available types of gearing with zero backlash: strain wave gears and cycloidal drives. These two solutions utilize a unique mechanical design that keeps sub-components in contact at all times. Recent improvements in design and packaging have produced very low profile gearing sets compared to previous offerings from the supply base.

Figure 5 below is an example of a low profile strain wave gear set. Cycloidal gear suppliers offer similar products.

Figure 5: Strain Wave Gear Set

Frameless Brushless Motor Kit

The assemblies in Figures 1 through 4 above use frameless brushless motor kits, also known as torque motor kits. These kits consist of an electromagnetic stator and a permanent magnet rotor operating as a traditional, synchronous motor via a three phase servo motor drive.

A quickly emerging design trend is to use a motor kit inside the integrated robot joint in order to drive a high ratio gear set. Direct drive motor kits have higher pole counts that improve torque output and large through holes to optimize mechanical packaging. These kits are shaped like a ring, and satisfy high torque requirements all while conforming to low profile constraints.

Robot joint output is generally slow. For example, 20 rpm would be a fast robot joint move. After a typical gear ratio of 150:1, the input speed (motor rotating speed) is 3,000 rpm. This is not considerably high for an electric motor as long as the proper impedance is selected to match the available voltage.

Figure 6 below is an example of an Agility™ slotless, low profile, large through hole, frameless motor kit.

Slotless motors eliminate cogging torque and make the fine motion of the robot predictable and smooth. They also have low magnetic core losses which enables achievement of high rotational speeds, and large through holes making them attractive for robot joint applications.

For more details on slotless motor kits, reference technical paper 'Comparison of Slotless and Slotted Motors' at www.celeramotion.com.

Because proper choice and sizing of a frameless motor kit is critical to your entire robotic joint design, Celera Motion offers online tools and performance prediction software to allow for fast and accurate component selection that will help fulfill your design requirements.

Figure 6: Agility Motor Kit

Encoders for the Input and Output

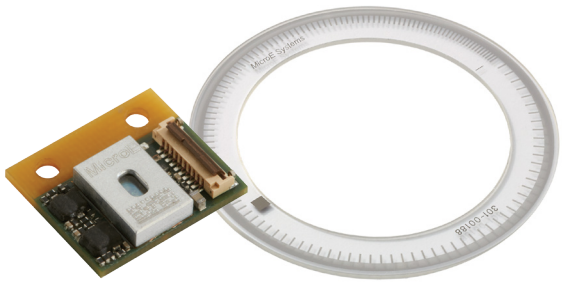
Encoder: Input (Motor) Side of Joint

The motion profile benefits from medium resolution encoder feedback, for example, 100,000 to 250,000 counts/revolution, creating smooth velocity trajectories. If the motor drive is controlling torque only, then lower values of resolution are sufficient, however, velocity and position control greatly improve with higher resolution in this range.

The integrated robot joint in Figure 1 uses an optical encoder kit capable of more than 200,000 counts/revolution with installed accuracy of 20-50 arc-seconds. It is a low profile, diffraction based, interpolated encoder that uses a glass grating. Optical encoders typically have higher accuracy, measured in arc-seconds, compared to other lower performance encoder technologies like magnetic and capacitive encoders, measured in arc-minutes. While high accuracy on the input may not appear to be as critical, it can impact performance. For example, if the control system is differentiating position to create a velocity signal, inaccuracy in the position information will create a velocity ripple.

To the right in Figure 7 is an example of a Celera Motion Optira™ Series configured as a medium resolution, low profile, optical encoder kit consisting of a read head and glass grating. This kit uses PurePrecision™ technology, and is capable of resolution of 250,000-500,000 counts/revolution with accuracy in the 20-50 arc-seconds range. This is approximately 2 to 5 times more accurate than magnetic encoders or resolvers, while offering medium resolutions and allowing for higher motor speeds of the input shaft.

Figure 7: Optira Read Head and Glass Grating Scale



The integrated robot joint in Figure 4 uses an inductive absolute encoder kit capable of up to 21 bits (2.1 M counts/rev) of resolution with an accuracy of +/- 65 arc-seconds.

The IncOder inductive encoder series contains a rotor and stator two part assembly. Electrical signals inductively couple between both parts to provide positon information. All versions have a large through hole and can easily be integrated with other robot joint mechanical parts. The absolute output is available in BiSS-C or SSI protocol.

Figure 8: IncOder Inductive Encoder

Encoder: Output Side of Joint

Motion controllers or robot controllers contain algorithms for trajectory control and coordination of multiple robot joints. These algorithms depend on high resolution feedback at each joint, for example, resolutions greater than one million counts/revolution.

The output encoder is one of the most important components of the integrated robot joint. The performance and accuracy of the robot greatly depends on the absolute accuracy of each joint. In some cases, the robot controller may depend on the output encoder to compensate for stiffness and deflection of all the joints working together and changes in environmental conditions such as temperature.

The Optira™ Series encoder can also be configured as a high resolution, high accuracy, read head with the same grating. It uses Celera Motion PurePrecision™ optical technology. In rotary form, these encoders are capable of < +/- 2 arc-seconds of accuracy and resolutions in the tens of millions of counts/revolution. Interpolation for a digital output is built into this small package and there is an option for 1 volt pp sine/cosine output for interpolation in the host controller.

The inductive encoder approach using IncOder technology offers high precision absolute feedback that covers a wide temperature range and is industrially rugged in shock and vibration environments. The option selected included a BiSS-C serial communications interface for absolute position feedback.

To learn more about using dual encoders to sense torque and stiffness variations in a robot joint, reference technical paper 'Mechanical Design Challenges for Collaborative Robots' at www.celeramotion.com.

Motor Control Electronics Integration

Robot joints with integrated motor control electronics provide great advantages in terms of ease of use, reducing wiring costs, and EMI. However, this environment is also the most demanding for electronics as they have to withstand high temperatures, vibrations, and dust or heavy magnetic fields.

Finding the right motor controller is not always easy. Most off-the-shelf controllers available in the market were designed for industrial applications. The purpose of this type of servo drive is to cover as many feedback types and communication busses as possible, allowing them to apply to most applications, but this has drawbacks, especially for integrated robot joints.

1. General purpose architectures making use of DSP and FPGAs, increase the heat generated by the electronics.
2. Servo drives designed for industrial machines, where trajectories are planned in advance, do not prioritize communications latency.
3. A small industrial servo drive is still much bigger than what is required when integrating inside a robot joint. Weight can drastically increase compared to servo drives for motor integration.

Figure 9: Integrated Robot Joint with Everest Series Servo Drive

Everest Series servo drives for integrated motors are designed and manufactured with the latest technology in order to achieve the lowest standby power dissipation, as well as optimized DSP technology for high positioning accuracy. This is the solution shown in Figure 9 where the off-the-shelf servo drive has been integrated inside the robot joint.

Most robots implement safety functions based on torque feedback from the robot joint. By monitoring the torque applied by the robot joint, the force that the robot arm could apply to a patient or user around the machine is controlled so that it should not harm anyone.

The most common implementation consists of using a motor controller that can read torque sensors and feed the information back to the master controller through the real-time, deterministic EtherCAT bus. On Figure 10, a series of safety mechanisms were implemented using an Everest NET plug-in servo drive and a custom built interface board:

1. Motor controller torque input is fed back to the master controller over the EtherCAT bus.
2. The system includes dual BSS-C encoders and digital halls for redundancy. If there is a mismatch between the encoders, the servo drive notifies the master controller.
3. The motor controller includes Safe Torque Off functionality, which disables the power stage when activated.

Figure 10: Collaborative Robot Axis Joint with Integrated Safe Electronics

Power Density

When designing robotic axis joints, the main limiting factors that mechanical and electronics engineers experience include the complexity of finding components with enough power density, the right form factor, and low heat dissipation. The use of new, non-silicon based transistors with state-of-the-art gate driver technology allows change to the Everest Series to provide power densities up to 0.21 W/mm3. This high power density enables the integration of motor controllers on the end of arm effectors for surgical robots or humanoid robot wrists and fingers. Size alone is not the only factor when designing integrated robot joints. In order to integrate a motor controller inside a robot joint, heat must be properly managed. Flexible architecture allows for high performance and low heat dissipation with standby power consumption down to 2.5 W.

Mechanical Housing and Output Shaft Components

The general form factor of a robot joint is driven by overall robot operational requirements. In Figure 2 and Figure 4 above, the housing consists of three sections. There are two shafts: one internal for the motor and input encoder, and one external for the gear output and output encoder. All parts are precise in nature, following guidelines of the bearing, encoder, and motor suppliers.

Housing design must consider the following:

1. Relative precision of the housing must match the bearing, motor, and encoder requirements.
2. High resolution encoders require very tight axial and radial runout specifications. Any runout will reduce absolute accuracy. It is common to use ABEC 7 or better bearings.
3. Material selection should accomplish both mechanical accuracy and account for temperature fluctuations.
4. In the case of a robot joint, weight is important, therefore minimizing the number of parts is advised.

Conclusion

› In this technical paper, the most compact, lowest profile robot joint is designed with a combination of low profile gearing, optical incremental or inductive absolute encoders, direct drive frameless motor kit, brake, and integrated drive control electronics. This design path contains the fewest number of components and offers the highest torque output in the smallest axial length. While the final external packaging will vary by application, the internal components of the integrated assembly shown above are common, and the overall strategy can benefit all segments of the robotics market.

Each robot joint has a set of conditions that include voltage and current inputs, torque and speed requirements, and temperature limits on the inside and outside of the assembly. It is important to consider electrical, thermal, and mechanical integration of all components, as well as manufacturability of the complete assembly.

NANO

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MicroE
Encoders

ChipEncoder™ Series

SMT Encoders for High Performance, High Volume Designs

ChipEncoder models feature built-in interpolation and mount directly on your printed circuit board, providing significant space and cost savings through design integration.

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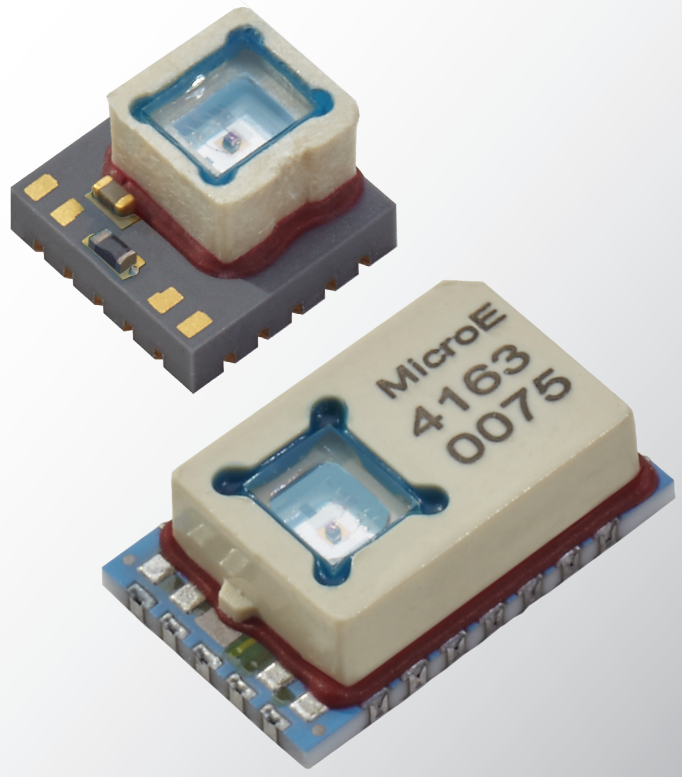

CE Actual Size

6 x 6 mm

CE300 Actual Size

7 x 11 mm

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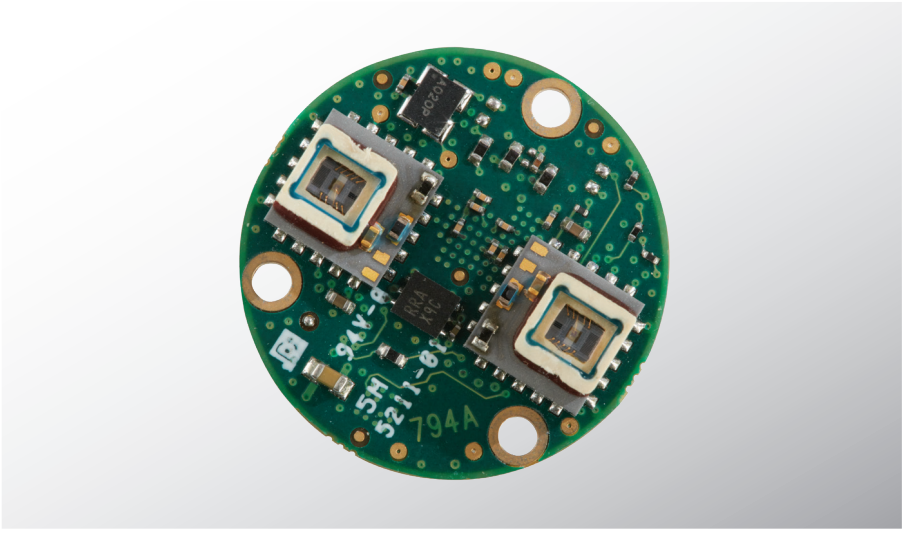
ChipEncoder™ Series Encoders

SMT Encoders for High Performance, High Volume Designs



Small, Low Cost, High Resolution.

The CE300 and CE ChipEncoders are modular SMT kit encoder systems that combine small size with high resolution making high performance digital closed-loop motion control possible and affordable for your high volume product designs.

The optical, non-contact system consists of either a linear or rotary glass scale and a BGA packaged sensor head that you integrate into your own PCB design. Based on a 40 µm pitch diffractive scale, the system's integral interpolation electronics can deliver up to 1 µm linear resolution at high speed. The total cost of the ChipEncoder is low because it is integrated into your PC board for minimal systems parts count and automated pick and place manufacturing.

Benefits

- Integrates with other components on your PC board for lowest total system cost; designed for low cost automated PC board assembly
- High resolution with on-board interpolation and digital output improves motion system accuracy and stability
- High speed capability enhances motion system performance
- Non-contact design for high reliability
- Small size enables ultra-miniature, low cost motion control

Specifications	
Dimensions:	6.1 x 6.1 x 3.9 mm (CE) 11.0 x 7.0 x 3.1 mm (CE300)
Interfaces:	A-quad-B digital
Resolution:	10 µm or 1 µm (linear) 3,300 CPR – 327,680 CPR (rotary)
Accuracy Class:	± 1 µm (linear glass) ± 2 arc-seconds (rotary)
Input Voltage:	5 VDC± 0.5
Supply Current:	30 mA, unterminated outputs
Max Speed:	14 m/s
Index:	40 µm Window
Outputs:	A-quad-B, Index
Operating Environment:	Atmospheric
Scale Pitch:	40 µm
Repeatability: (Hysteresis)	1 ± 1 LSB
Weight:	0.37 g (CE300), 0.25 g (CE)
Grating Compatibility:	Linear and Rotary (glass only)

Specifications subject to change.

RoHS
CE

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MicroE
Encoders

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MicroE
Encoders

Optira™ Series Encoders

Miniature Precision Encoders for the World's Smallest Spaces

By combining the patented PurePrecision™ optical encoder technology from MicroE with state-of-the-art electronics and signal processing, the Optira Series delivers unprecedented performance in an incredibly small and lightweight package.

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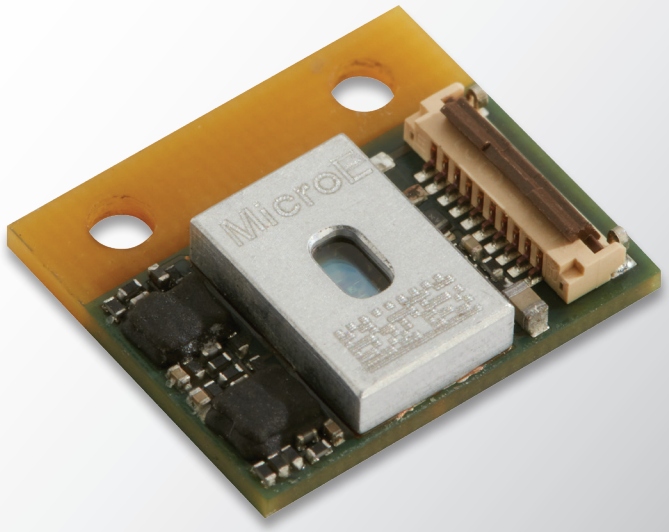

Actual Size

11.4 x 13 mm

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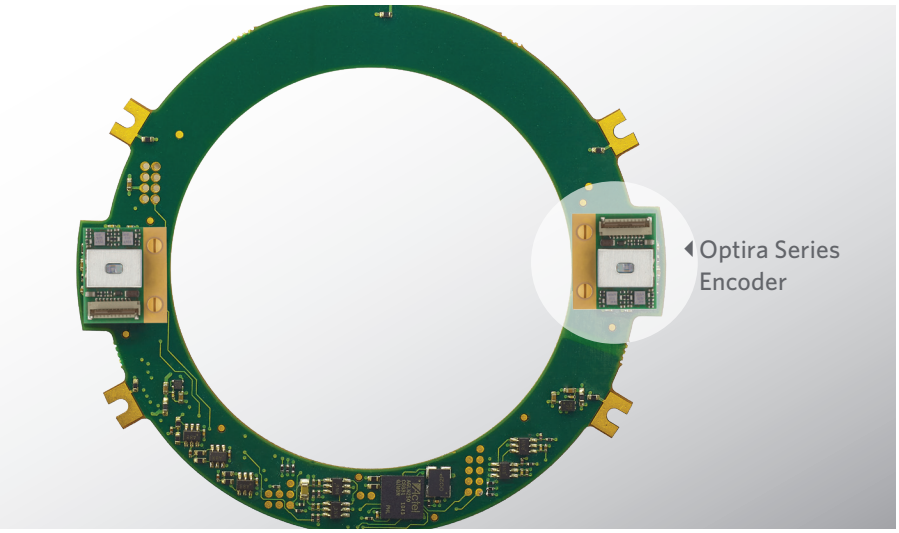
Optira™ Series Encoders

Miniature Precision Encoders for the World's Smallest Spaces



Smaller and Smarter.

Optira is the only encoder in its size class that offers up to 5 nm resolution with all interpolation, AGC, and signal processing performed in the sensor head. No additional PCBs, adapters, or dongles are required for operation.

Patented PurePrecision™ optical technology and industry-leading alignment tolerances from our MicroE encoders make Optira's miniature sensor head extremely easy to install. Optira's two mounting options, industry standard analog and digital incremental encoder outputs, and standard FFC connector provide the durability and flexibility needed by designers of miniature precision motion control systems.

Optira is engineered to deliver industry-leading low power consumption. A 3.3 VDC version is offered, making it ideal for battery-powered precision instruments.

Compatibility with our wide range of linear and rotary gratings and scales enables a miniature installation footprint.

Benefits

- Miniature footprint; interpolation and signal processing in sensor head
- Mechanical and PCB-mount options
- Easy installation
- Simple and flexible cabling/connectivity
- Durable mechanical and electrical design
- Multiple linear and rotary grating/scale options
- Alignment/Status LED in sensor head
- Optional connector board for index calibration and connector flexibility

Specifications	
Dimensions:	11.4 x 13.0 x 3.7 mm
Interfaces:	A-quad-B digital or 1 Vpp Sin/Cos analog
Resolution: (Interpolation in Sensor Head)	5 µm – 5 nm (linear) 2,000 CPR – 75M CPR (rotary)
Accuracy Class:	+/- 1 µm (linear glass) +/- 5 µm (linear metal tape) +/- 2 arc-seconds (rotary)
Input Voltage:	3.3 VDC or 5 VDC
Supply Current:	130 mA with 120Ω across A, B, I 100 mA with 120Ω across Sin/Cos, IW
Max Speed:	4 m/s
Index:	IW for analog and 5 µm digital LSB for 2.5 µm digital and above
Outputs:	Sin/Cos or A-quad-B, Index, Alarm
Status LED:	Yes
Operating Environment:	Atmospheric (standard) Vacuum version available
Scale Pitch:	20 µm
Repeatability: (Hysteresis)	≤ 1 LSB
Typical Sub-Divisional Error (SDE):	< 100 nm RMS
Weight:	< 1.5 g
Grating Compatibility:	Linear and Rotary

Specifications subject to change.

RoHS
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MicroE
Encoders

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INDUCTIVE ABSOLUTE

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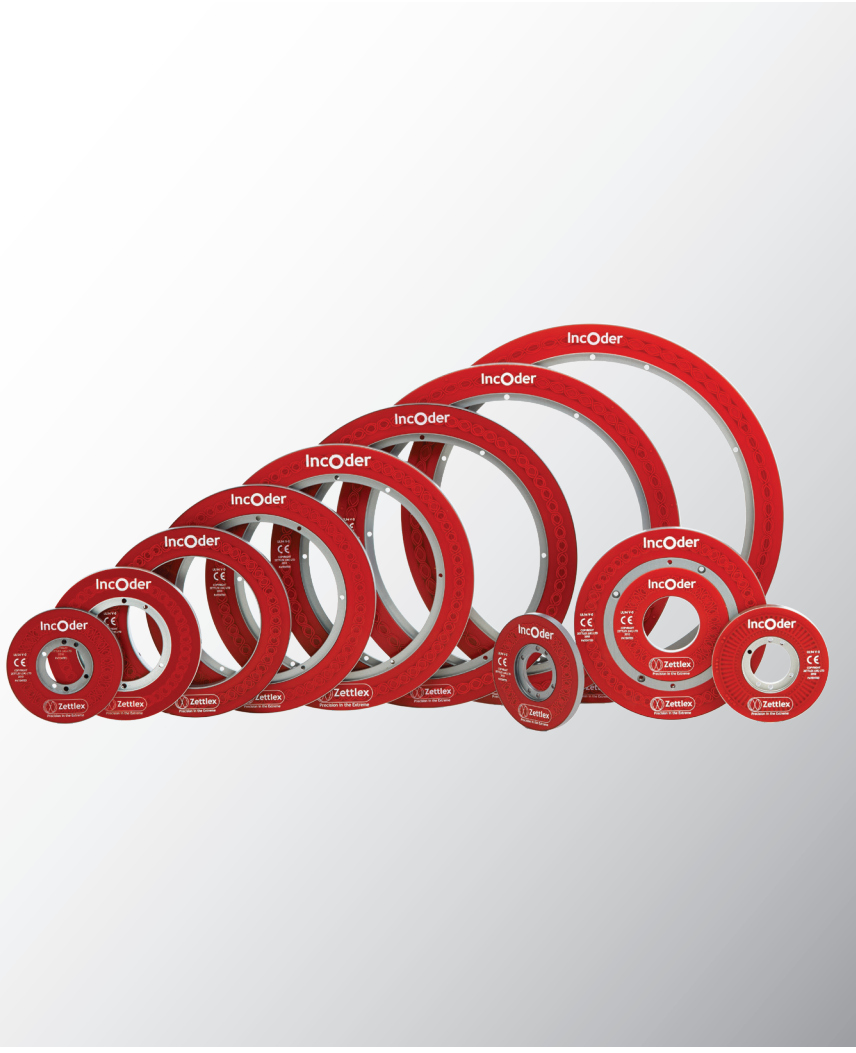
Zettlex
Inductive Encoders

IncOder™ Series Encoders

Precision in the Extreme

Using an inductive technique, the non-contact IncOder Series is easy-to-install and enables precise and reliable absolute angle measurement, even in harsh environments.



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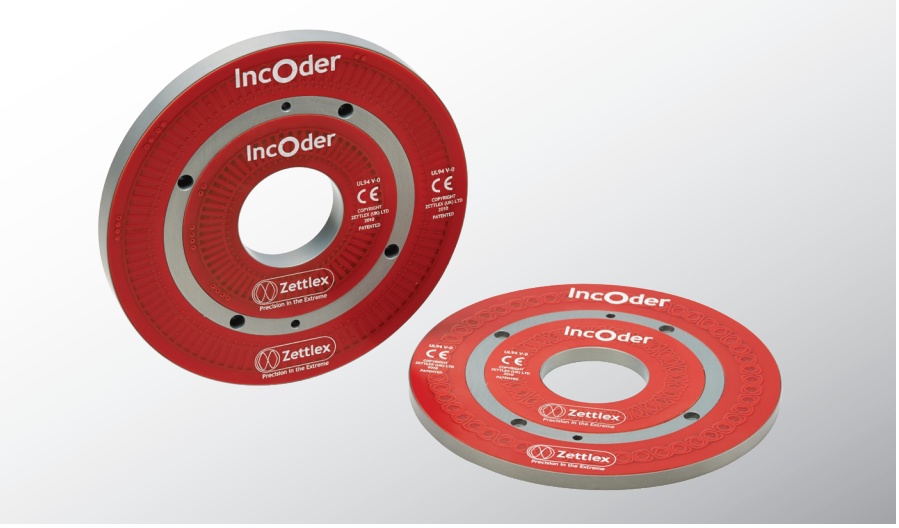
IncOder™ Series Encoders

Precision in the Extreme



Robust and Easy to Install.

Designed for easy integration into OEM assemblies, the low-profile IncOder Series is offered in a wide range of diameters with a large through hole for convenient routing of cables, optics, and other system elements.

The stator contains all of the electronics to receive power and output a signal, and the output signal shows the position of the rotor relative to the stator. Absolute feedback is a standard option, so no instrument motion is required at power up to determine position.

IncOder's integrate easily along side Omni™ and Agility™ direct drive motors, and can be direct mounted without special couplings or high toleranced mounting features.

IncOder's have a solid track record in demanding applications such as industrial machinery, medical devices, robot joints, gimbals, actuators, as well as camera and antenna positioning.

All models are compatible with a wide range of controllers and drives.

Benefits

- Non-contact technology for high reliability in extreme environments - where potentiometers, capacitive devices and other encoder types may prove unreliable
- Large through hole for convenient routing of cables, optics, plumbing and other system elements
- Easy integration into system design; Precisely machined mounting components or couplings not required
- Configurable with a variety of communication interfaces: Synchronous Serial, Asynchronous Serial, Serial Peripheral, Analog (sin/cos) Voltage, A/B/Z, BiSS-C
- Multiple connection options available
- Customizations and extended range options available

Specifications	Units	Mini Models	Midi Models	Maxi Models
Size (stated as outside diameter):	mm	37, 58	75, 90, 100, 125, 150, 175, 200, 225, 250, 300	325, 379, 429, 595
Resolution Options:	bits	up to 17	up to 22	up to 22
Standard Mechanical Formats:	number	4	9	1
Voltage Options:	VDC	5, 12, 24	5, 12, 24	5, 12, 24

Actual product attributes are model and configuration specific. Standard and custom models are available within the representative ranges described above. Specifications subject to change.

RoHS
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Zettlex
Inductive Encoders

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SLOTLESS

Celera MOTION
A Novanta Company

Applimotion
Motors & Actuators

Agility™ Series Motors

Zero Cogging Direct Drive Motors for Exceptionally Smooth Motion

Designed with ZeroCog™ slotless motor technology from Applimotion, the Agility Series enables OEMs to achieve extremely smooth and highly accurate motion profiles using flexible and easy-to-integrate motor components.

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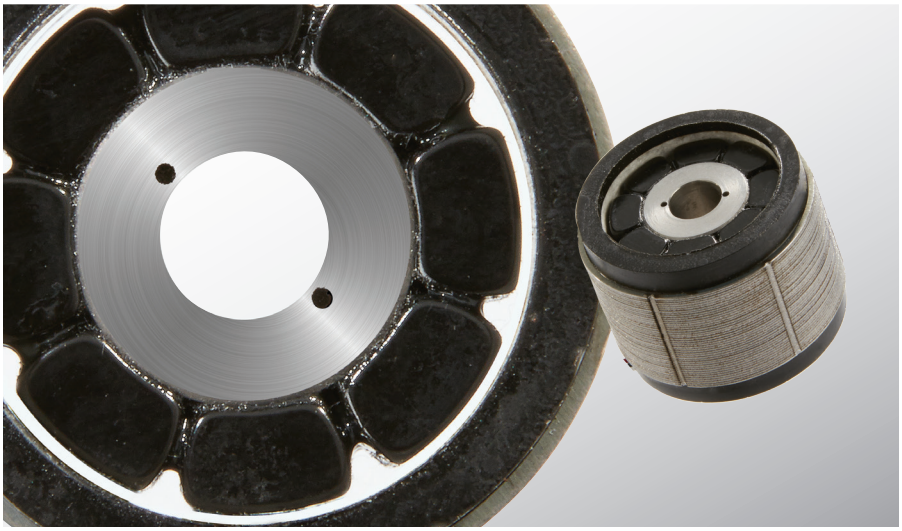
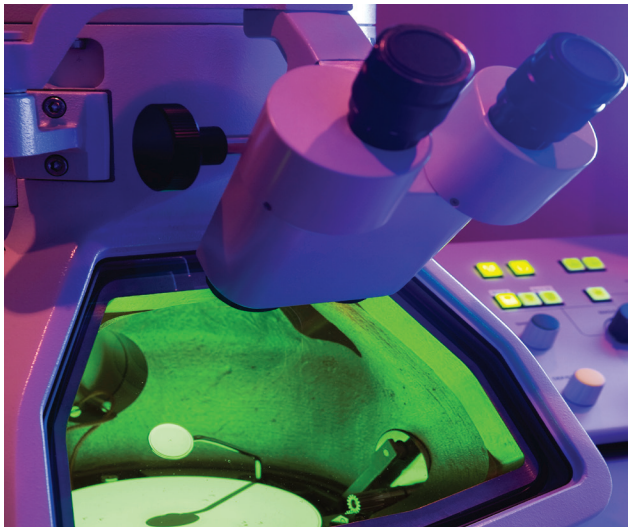
Agility™ Series Motors

Zero Cogging Direct Drive Motors for Exceptionally Smooth Motion





Smooth and Accurate.

Ideally suited for scanning, pointing, measuring and cutting applications that require extremely smooth velocity control and highly accurate positioning, the Agility Series delivers best-in-class torque ripple and zero cogging.

Engineered with ZeroCog™ slotless motor technology from Applimotion, the effects of cogging torque, magnetic forces, flux harmonics and phase balance and alignment are minimized to counteract the causes of torque ripple. Agility magnetic designs and construction techniques can achieve less than 2% torque ripple.

The Agility Series is offered in a wide range of low-profile form factors with a large through hole for convenient routing of cables, optics, sensing technologies and other system elements.

Frameless direct drive kit construction, high torque density and low mass enables Agility to be tightly integrated into compact, lightweight precision assemblies.

All models are compatible with a wide range of controllers and drives.
Windings and form factors can be customized to meet application requirements.

Benefits

- Zero cogging and low torque ripple for extremely smooth velocity control and low vibration
- Slotless magnetic design and direct drive technology enable highly accurate position control
- High torque density in low-profile form factors enables small footprint
- Large through hole for convenient routing of cables, optics, sensing technologies and other system elements
- High mechanical stiffness and low rotor inertia for efficient control of highly dynamic axes
- Easy integration into system design
- Compatible with wide range of drives and controllers
- Custom windings and form factors available to meet application requirements

Specifications	Units	UTS-19	UTS-53	UTS-89	UTS-102	UTS-165	UTS-222	UTS-292
Continuous Torque:	Nm	0.041	0.114 -0.203	0.537 - 1.168	0.86	1.55	3.07	15.10
Peak Torque:	Nm	0.123	0.342 - .608	1.475 - 5.505	2.59	4.66	9.22	45.29
Diameter (Stator OD):	mm	19.0	52.83	89.0	192.0	165.0	222.0	292.0
Through Hole (Rotor ID):	mm	5.0	41.95	74.17	66.0	140.9	190.5	241.3
Stator Length:	mm	30.0	19.94 - 20.27	25.0.02 - 40.3	25.4	24.1	24.1	48.3
Pole Count:	#	6	12	12	28	48	64	32

Specific models listed and corresponding data are provided as a reference. Celera Motion offers additional sizes and custom configurations. Peak torque output is based on a 3:1 peak to continuous current ratio in the amplifier, and is based upon limited duty cycle. Specifications subject to change.

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Motors & Actuators

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TORQUE

Celera MOTION
A Novanta Company

Applimotion
Motors & Actuators

Omni™ Series Motors

Low-Profile Direct Drive Motors for the World's Machines and Robots

The Omni Series enables OEMs to design high performance, reliable, small and lightweight systems using flexible and easy-to-integrate rotary motor components.

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MEDICAL | INDUSTRIAL | SCIENTIFIC | MICROELECTRONICS

Accelerate Your Innovation.

Omni™ Series Motors

Low-Profile Direct Drive Motors for the World's Machines and Robots

Compact and Powerful.

Designed for easy integration into OEM assemblies, the Omni Series is offered in a wide range of low-profile form factors with a large through hole for convenient routing of cables, optics, and other system elements. Frameless direct drive kit construction enables easy integration into machinery, robot joints, rotary stages and actuators.

Built using state-of-the art magnetic designs, the Omni Series delivers high torque density, low cogging and low stator and rotor mass in a thermally efficient package. Direct drive technology provides high speeds and accelerations with good mechanical stiffness and zero backlash, reducing settling times and increasing system performance and throughput.

Three models of the Omni Series motors are available: ULT for low-mid range torque requirements; UTH for high torque requirements; and UTO for applications that require an outside rotating configuration. All models are compatible with a wide range of controllers and drives. Windings and form factors can be customized to meet application requirements.

Benefits

- High torque density in low-profile form factors enables small footprint
- Large through hole for convenient routing of cables, optics, plumbing and other system elements
- High mechanical stiffness and low rotor inertia for efficient control of highly dynamic axes
- Low cogging for accurate and smooth motion
- Easy integration into system design
- Compatible with wide range of drives and controllers
- Custom windings and form factors available to meet application requirements

Specifications	Units	ULT Models	UTH Models	UTO Models
Continuous Torque:	Nm	0.043 to 6.581	0.092 to 15.903	0.014 to 9.102
Peak Torque:	Nm	0.129 to 19.744	0.275 to 47.708	0.042 to 27.307
Diameter:	mm	45 to 165 (Stator OD)	22 to 533 (Stator OD)	20 to 200 (Rotor OD)
Through Hole:	mm	32 to 120 (Rotor ID)	13 to 432 (Rotor ID)	9 to 100 (Stator ID)
Maximum Speed:	rpm	up to 5,000	up to 5,000	up to 10,000

Product groups listed and corresponding data are provided as a reference. Actual motor attributes are model and configuration specific. Standard and custom models are available within each group. Peak torque output is based on a 3:1 peak to continuous current ratio in the amplifier, and is based on limited duty cycle. Specifications subject to change.

RoHS
CE

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MOTOR CONTROLLER

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Ingenia
Servo Drives

Everest Series Servo Drives

High Power Density, High Performance, Ready-to-Use Servo Drives

Decrease time-to-market with the Everest Series that delivers fast integration into robotic actuators.

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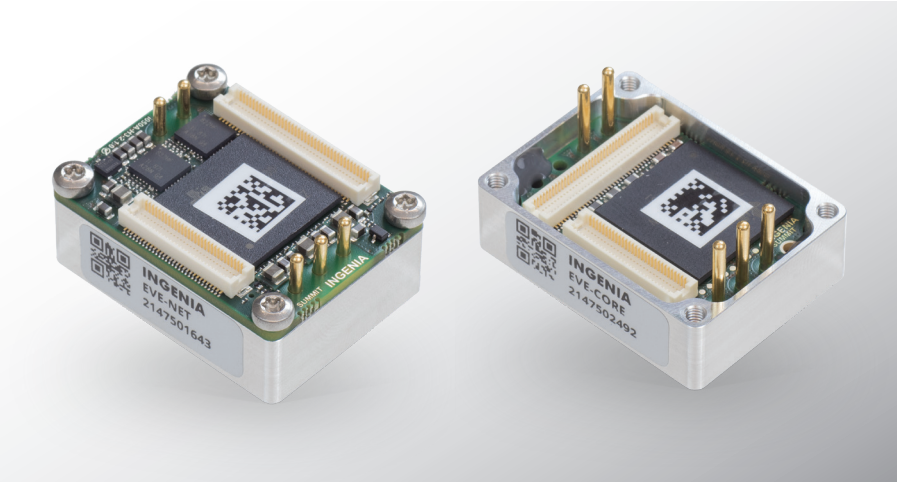
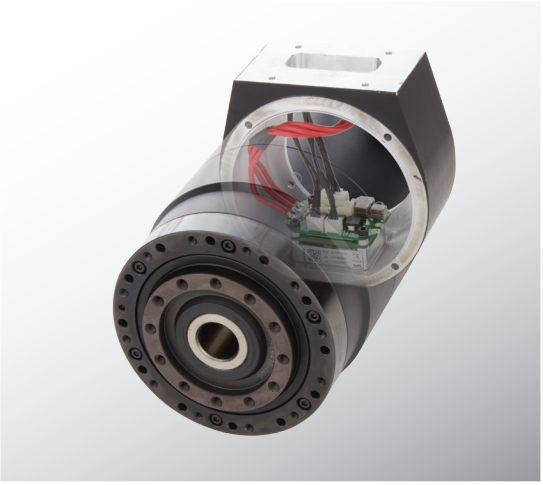
Accelerate Your Innovation.

Everest Series Servo Drives

High Power Density, High Performance, Ready-to-Use Servo Drives





High Power Density and Compact Size.

The Everest Series is an ultra-compact, super smart, high-powered servo drive. It is the most versatile servo drive in its class. Built on a shielded body construction which provides best-in-class heat dissipation and ultra-low radiated emissions, packed with features for the most demanding applications. High-efficiency power stage reduces power losses and actuator temperature.

Its small size and rugged design enables it to be mounted virtually anywhere including robot joints, wearable robots, unmanned ground or aerial vehicles, as well as inside motors.

The Everest Series is not only a BLDC motor controller—it also features the most advanced transistor technology in the world. It delivers the highest power density and efficiency while keeping negligible EMI, providing linear amplifier performance.

Benefits

- Miniature size, great for robotic applications
- Dual (motor and load) loop support for unparalleled precision
- 16-bit high-resolution torque sensing
- Ultra-fast servo loops for smooth operation
- Ready-to-use connectors accelerate development time
- Highest power density smart servo drive, up to 60 A
- Wide voltage range for DC bus or battery operation, up to 72 V
- Low channel resistance for highest efficiency up to 99%

Specifications	XCR	NET	CORE
Continuous Current:	30 ARMS	30 ARMS	30 ARMS
Peak Current:	60 ARMS	60 ARMS	60 ARMS
Supply Voltage:	Up to 48 VDC*	Up to 48 VDC*	Up to 48 VDC*
Dimensions:	29 mm x 42 mm x 23 mm (includes mating connectors)	26 mm x 34.5 mm x 17 mm	26 mm x 34.5 mm x 17 mm
Weight:	38 g	24 g	16 g
Communications:	CANopen, EtherCAT	CANopen, EtherCAT	SPI
Feedback:	Digital Encoder, Digital Hall, BiSS-C, SSI	Digital Encoder, Digital Hall, BiSS-C, SSI	Digital Encoder, Digital Hall, BiSS-C, SSI
Motor Type:	Rotary Brushless, Rotary Brushed DC	Rotary Brushless, Rotary Brushed DC	Rotary Brushless, Rotary Brushed DC
Command Source:	Network Interface	Network Interface	Network Interface
Environment:	Industrial, High Temperature, Low Temperature	Industrial, High Temperature, Low Temperature	Industrial, High Temperature, Low Temperature

*Higher voltage available .

Specifications subject to change.

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Ingenia
Servo Drives

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Mechatronics

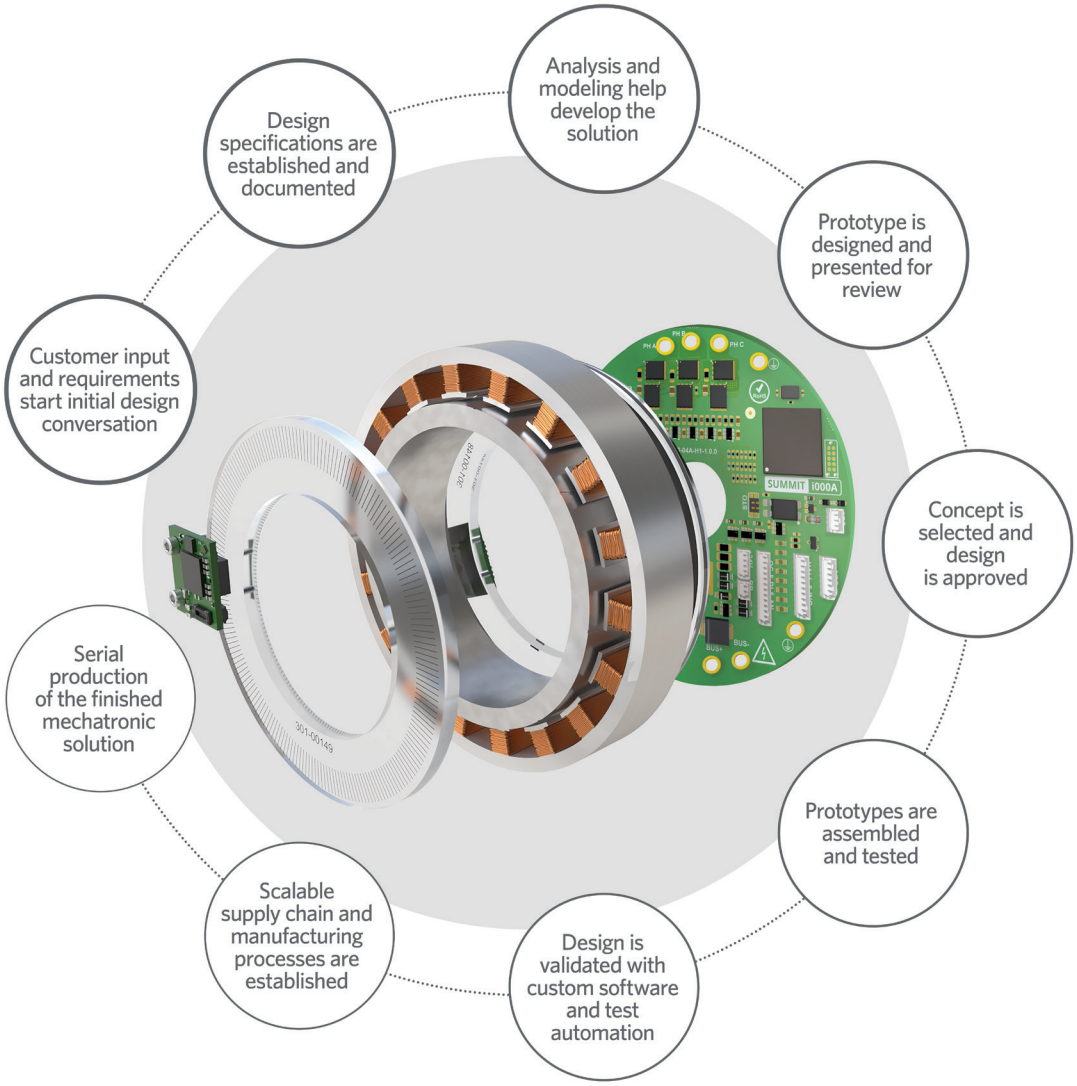
Delivering the Complete Solution

From concept through serial production - Celera Motion is your trusted partner for robot joint assemblies

We know that no two precision motion challenges are alike. Using miniature precision optical encoders, robust absolute inductive encoders, direct drive motors, and servo drives, we push the boundaries to deliver unparalleled results. We develop each robot joint solution with the latest technologies for your project's specific application requirements.

- Uniquely optimized form factors
- Low profiles with high torque
- Ease of installation
- Precise and dynamic performance
- Quality and reliability
- High efficiency

Engineering a solution is only the first step. Our team enables customers to gain a competitive edge with fast prototyping, domestic and off-shore manufacturing, and the delivery of high-quality efficient products. At Celera Motion, in-house serial production capabilities include in-depth experience with supply chain and logistics management, as well as ISO 9001 and ISO 13485 quality management systems.



Celera Motion enhances lives with a visionary approach

› Rely on us to deliver precision motion solutions that accelerate your innovations.
Experience unparalleled expertise, shaping the future of precision motion.

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