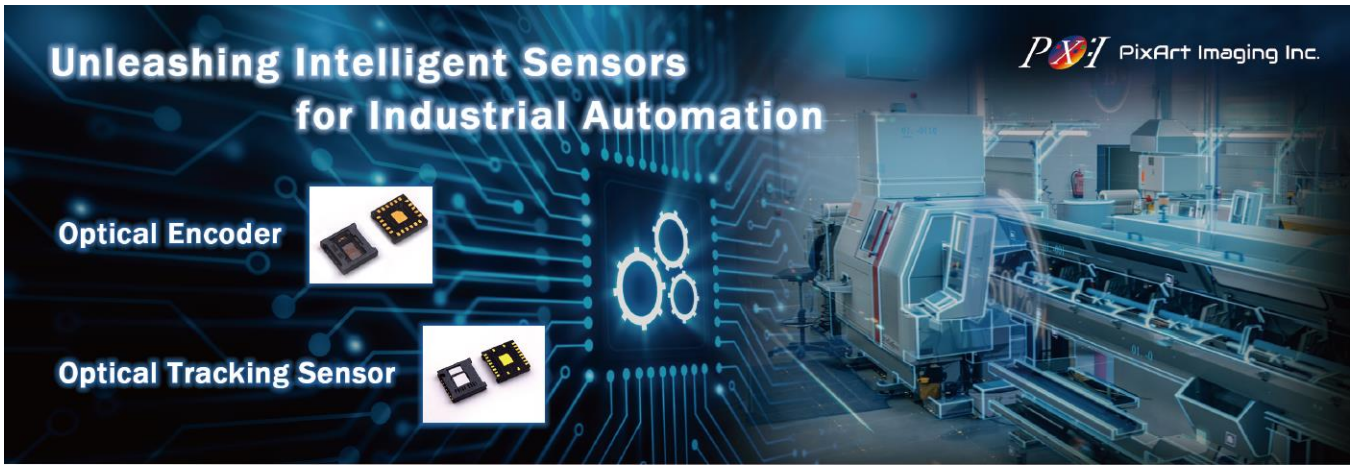
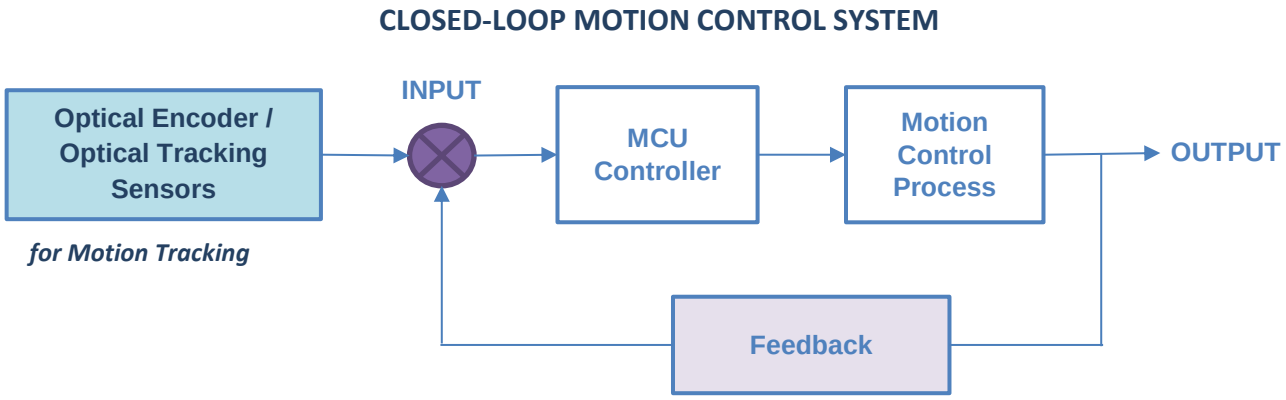
PixArt Unleashes the Intelligent Sensing for the Industrial Automation

The shifting of the industrial revolution to Industry 4.0 is rapidly making smart automation essential in manufacturing technologies and industrial practices. Automation transformation incorporates sensor-embedded smart machines that analyze and process data with fast interconnectivity without the need of human intervention. PixArt, with its leading sensing technologies, is furnishing traditional industrial machines with sensors, adding the intelligence facets to the shift of smart machines. The newly launched sensors in the Optical Tracking Sensor and Optical Encoder product series unleash intelligent sensing into the motion control of manufacturing machines and production equipment to empower industrial automation.



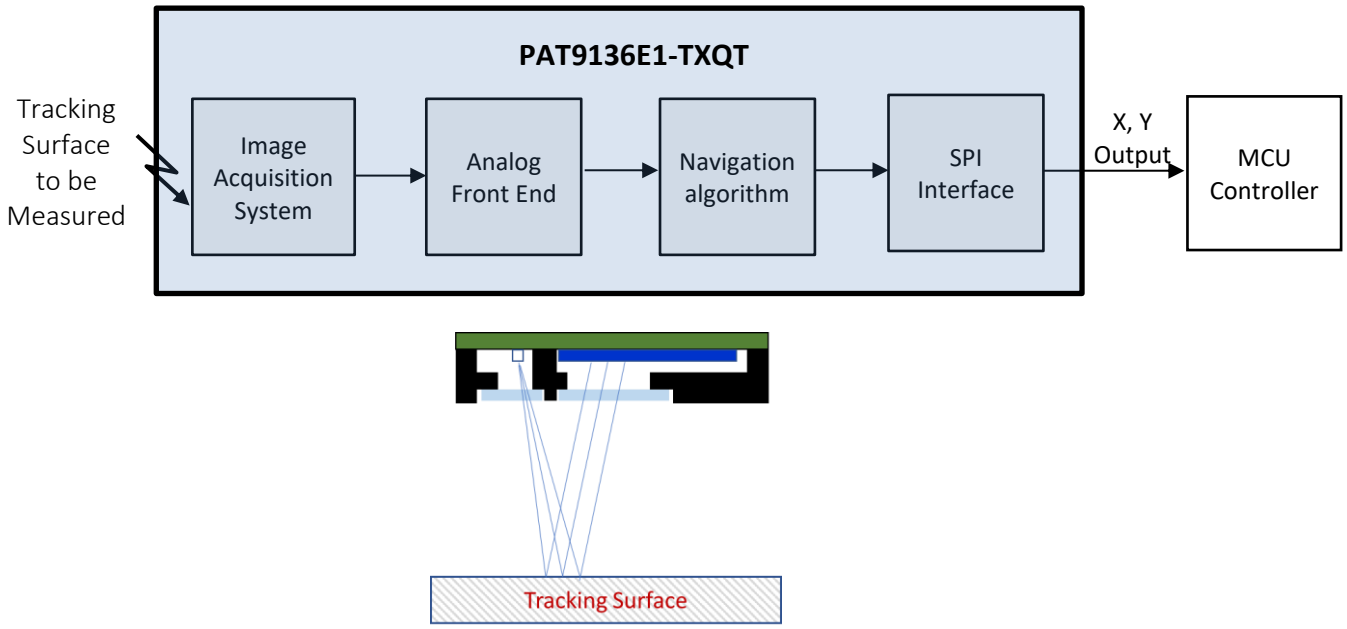
Various sensors take over human interaction for a fully automated system to detect the instant event or measure the desired data. Then they give feedback to the host controller to regulate the process output accordingly. The Optical Tracking Sensor and Optical Encoder are mutually comprehending in the closed-loop motion control systems, providing more accurate, precise, and reliable control. These sensors return the position or velocity of the motor, actuator, and moving surfaces to the motion controller as closed-loop feedback. Let's explore further how these sensors play a role in motion control.



THE NEW OPTICAL TRACKING SENSOR (OTS) – PAT9136E1-TXQT

The OTS is an advanced CMOS imaging sensor to track the movement of various types of surfaces directly. It computes the relative position displacement in X & Y. These output units are in counts per inch (cpi) correlated to the programmable resolution setting. They could have a maximum resolution of up to 20,000 cpi. The output is in serial data format, easily communicable with an MCU through an SPI interface.

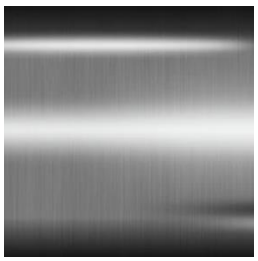
OPERATION PRINCIPLE OF OPTICAL TRACKING SENSOR



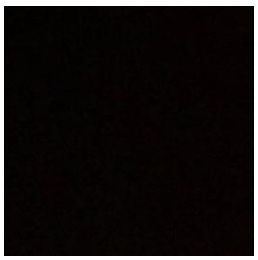
PixArt has innovated a new PAT9136E1-TXQT Optical Track Sensor for industrial applications. It has a wide working range of 5-50mm from the tracking surface to the sensor and can track at a maximum speed of 5m/s. Compared to other relative-position sensors, this OTS sensor with the latest imaging technology can provide higher accuracy in position tracking. When mounting at a fixed speed and height, the PAT9136E1-TXQT sensor can achieve a low <1% resolution output variation. Even with a varying speed or height (while other parameters remain fixed), the resolution variation can still be controlled at around 3%. These are the essential parameters to provide a flexible design for after-market use in the motion tracking system.

The OTS sensors can work on broad surface coverage, including metal and non-metal surfaces, with varying degrees of working height. These are some examples of working surfaces.

Aluminum



Glossy Stainless Steel



Black Painted Metal

ESD Mat

KEY FEATURES OF PAT9136E1-TXQT OPTICAL TRACKING CHIP

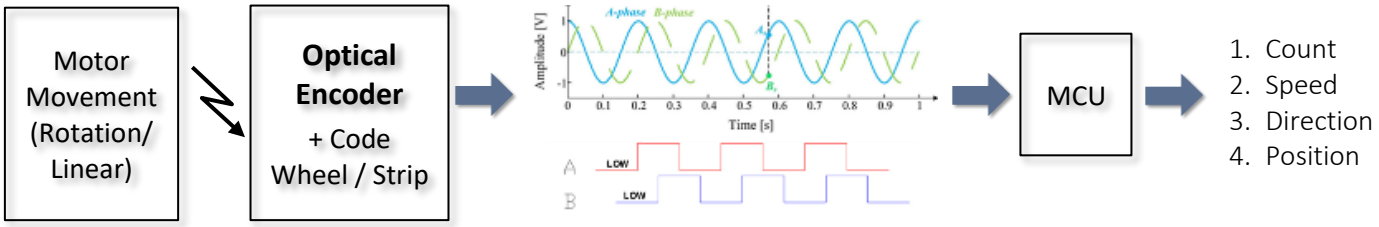
Supply Voltage	VDD: 1.8 – 2.1 V VDDIO: 1.8 – 3.3 V
Working Distance to Tracking Surface	5 – 50 mm
Tracking Speed (max.)	5 m/s
Tracking Acceleration	98 m/s^2
Resolution (max.)	20,000 counts/inch (cpi) or 7,874 counts/cm
Resolution Variation	<1% (at a fixed speed and height) ~3% (while varying either the speed or height and fix the other parameter)
Frame Rate	20,000 fps
Interface	4-Wire SPI @ 4MHz
Package & Dimension Size	16-pin LGA 6 x 6 x 1.35 mm^3

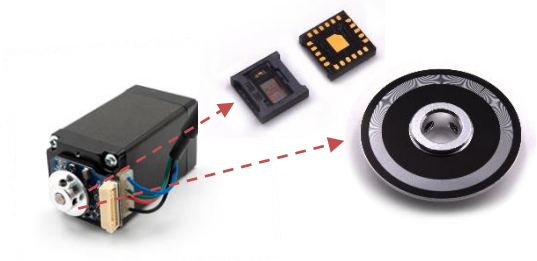
RELIABLE OPTICAL ENCODER SENSOR WITH HIGH ACCURACY - PAE6102E1-KG1

An optical encoder is commonly used in industrial motion control for its high accuracy, precision, and robustness over the motor's magnetic field interference. PixArt is newly launching the Reflective Incremental Optical Encoder product series to fulfill the call for enhanced positioning tracking.

The optical encoder works in pairs with a code wheel or code strip. The code wheel or strip is the pattern generator so that the mechanical movement of the motor is translated into electrical signals for the MCU to decode into the data form in count, speed, direction, and position. Optical encoders are more accurate than other types of encoders, like magnetic encoders, because of the finer grating on the pairing code discs in detecting tiny changes in position.

OPERATION PRINCIPLE OF OPTICAL ENCODER CHIP





ELECTRICAL SIGNALS OUTPUT

- Sin or Cos alone
- Sin and Cos
- Index (homing)

The new PAE6102E1-KG1 product is designed with a high native analog resolution of 856CPR when it is paired with a 10.8mm radius optical code wheel. It supports both analog and digital output. The built-in interpolator, which outputs in digital form, enables resolution interpolation of 1x, 2x to 32x, with the highest interpolated digital resolution of 27,680CPR (0.013 degrees). The analog output also supports external interpolation to achieve a much higher resolution for motor-related applications.

The PAE6102E1-KG1 package design is aimed at a small form factor to enable more flexibility on the chip mounting position and allow a thinner form of the optical encoder module. PixArt uses its vast optomechanical design experience to house the Optical Encoder IC and IR-LED within a small 5.0 x 5.0 x 1.03mm^3 22-pin LGA package by mounting the Optical Encoder IC's photo-array sensing area and the IR-LED on the same side of the package for an optically optimized design. With the protective glass cover built-in on the LGA package and the unique index track design, the PAE6102E1-KG1 is capable of averting dust particles, which makes the encoder more robust and higher contamination immunity to dust particles.

KEY FEATURES OF PAE6102E1-KG1 REFLECTIVE INCREMENTAL OPTICAL ENCODER CHIP

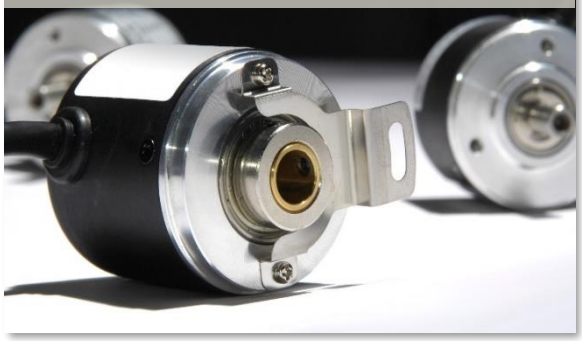
Supply Voltage	VDDA: 3.0 – 5.5 V VDDD: 3.0 – 5.5 V
Working Range	R_{OP}: 10.80mm (for 26mm code wheel) Code wheel gap: 0.60 – 1.20 mm Radial tolerance: ± 0.20 mm Tangential tolerance: ± 0.20 mm
Resolution	865 CPR (for 26mm code wheel)
Output Data	Differential AB in Analog/Digital with interpolation Differential Digital Index Z
Frequency	120 kHz
Digital Interpolation	2x, 4x, 8x, 16x and 32x
Index Gating Option	Ungated, 90, 180 and 360 °e
Max Output Frequency	Analog: 120 kHz Digital: 960 (32x) kHz
Package & Dimension Size	22-pin LGA 5.0 x 5.0 x 1.03 mm^3

OPTICAL ENCODER vs. OPTICAL TRACKING SENSOR

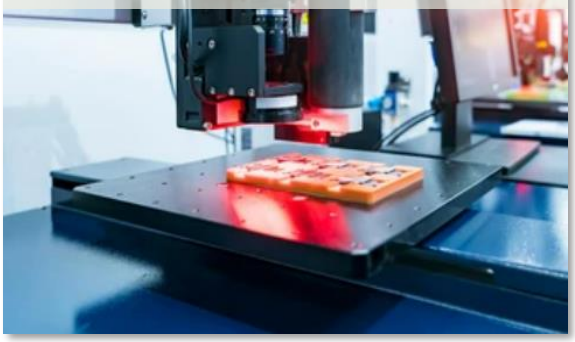
An optical encoder is commonly housed within the motor assembly to achieve reliable and high positioning accuracy. The optical encoder system design is part of the motor's design integration and manufacturing assembly. The optical encoder and code wheel are integrated into the motor during the motor assembly to form a closed-loop feedback system. The reporting output of the optical encoder is an absolute error under the excellent system design and well control of assembly on the optical encoder sensor position, rotation, and code wheel. Undoubtedly, an optical encoder can provide the highest accuracy in reporting the speed or position of the motor or linear stage as the superior position measurement.

An optical encoder is a rotary & linear motor feedback device for high accuracy positioning across many industrial applications, such as industrial plotters, office printers, housed encoders, servo motors, X-Y tables, AGV, robotic arms, turnstiles, etc.

Housed Encoder in the Motor



Precision Positioning of X-Y Table



Accurate Positioning for Robotic Arm

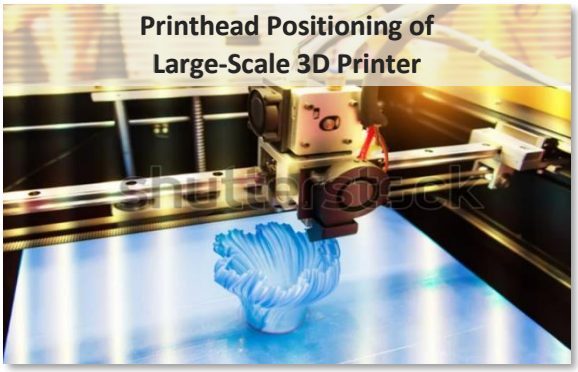
Movement Control in AGV

In industrial automation, the motor drives the movement to a medium. Measuring the motor movement is not directly measured on the intended moving medium. The moving medium may have slippage, friction, or other factors which could impact the overall motion system. For example, the motor is the motion source of the conveyor belt. In an ideal situation, the speed or position of the conveyor belt is directly equal to the measurement of the encoder housed in the motor. However, factors such as external technical errors, tension changes, and load variation may lead to the conveyor belt's slippage, causing the motion reported by the encoder to deviate from the actual movement of the conveyor belt. In advanced automation, all the measurable errors should be feedback into the system to realize a near-to-ideal case motion feedback system. The PAT9136E1-TXQT Optical Tracking Sensor (OTS) addresses the need to measure the movement of the medium directly.

By reference to the above example, the OTS is mounted to look directly at the moving surface of the conveyor belt to report the belt's movement in the form of 2-axis XY-displacement data. Feeding these data as offset compared to the optical encoder measurement is another valuable input to the closed-loop motion system. The OTS can also determine the magnitude of horizontal movement on the conveyor belt. In some cases, continuous incremental changes in horizontal direction might be an initial symptom of a catastrophic failure.

The OTS's capability to provide robust tracking on a wide selection of tracking surfaces/materials is vital to industrial automation. The OTS is a suitable candidate for post-installation setup after the commissioning of the motion control system in the manufacturing line assembly. As the OTS could handle all the motion computation by itself, no other imaging processing and motion computation algorithm is required. The OTS can be easily integrated into a motion control system by connecting the OTS to an MCU to read out the data to function as additional feedback to the existing motion control system.

Some examples shown below highly require the OTS feedback to regulate the motion control to achieve optimum performance and high-quality output in the transformation of smart automation.



COLLABORATING WITH PIXART AS YOUR PREFERRED DESIGN PARTNER

The selection of unique sensors is crucial in revamping the manual manufacturing facilities that rely on human involvement to draw a level for Industry 4.0. PixArt is the only company currently offering both Reflective Incremental Optical Encoder Chips for motor integration and Optical Tracking Sensor Chips for an add-on in the motion control feedback system. PixArt aims to provide a one-stop solution for our customers to help improve their motion control feedback system with less effort and speed up the design time. We are ticking the boxes of time, fidelity, quality, and cost to help customers close the gap between design concept, operational reliability, and practicality with the sensor fusion of Optical Encoder and OTS in industrial automation control.

For more information, please get in touch with your PixArt local sales or contact us at https://www.pixart.com.

Ordering Information for Related Products

Part Number	Description
PAT9136E1-TXQT	Optical Tracking Chip
PAE6102E1-KG1	Reflective Incremental Optical Encoder Chip

RoHS compliant