Smart Sensors with IO-Link

Enabling Smart Machines for The Connected Enterprise
Visibility from Plant Floor to Front Office

The Connected Enterprise is reshaping industrial automation by converging information technology (IT) and operations technology (OT) into a single, unified architecture. Enabled by integrated control and information and enhanced by the Internet of Things (IoT), the Connected Enterprise allows us to gather and analyze data, transforming it into actionable information. Our Integrated Architecture® helps manufacturers create intelligent equipment that provides access to that information and enables agile reaction to changing market demands. And Allen-Bradley smart sensors and I/O – based on IO-Link technology – are the foundation of integrated control and information, providing seamless visibility of field data through your Integrated Architecture control system.

Enabling The Connected Enterprise with Integrated Control and Information

Enterprise Optimization
Information Aggregation and Analytics
Converged, Secure Network Infrastructure
Multi-disciplined Control
Intelligent Assets

Business Management
Production Management
Operations
Engineering
Maintenance

What is IO-Link?

IO-Link is a worldwide open-standard peer-to-peer serial communication protocol (IEC 61131-9) that allows sensors and actuators to easily integrate into The Connected Enterprise. Through IO-Link you can access all sensor configuration parameters, process data and diagnostics. You can go beyond detecting products on your machine – now you can MONITOR your machine’s health as it runs. Plus, IO-Link simplifies setup and commissioning while offering enhanced flexibility for your current – and future – processes.
By combining simple implementation with powerful data and diagnostics, smart sensors with IO–Link can optimize your machines today – and prepare them for the future – to increase your uptime and productivity.

**Faster Time to Market**
- Program sensors and the controller in the same software environment (Studio 5000® software)
- Intuitive programming simplifies initial setup and helps eliminate logic errors
- Seamless integration with the Rockwell Automation Integrated Architecture

**Lower Total Cost of Ownership**
- No incremental cost for IO-Link enabled sensors
- No wiring changes
- Scalable solution – enable IO-Link functionality as needed
- Fully-configurable sensors reduce your device inventory and streamline SKUs by 50%

**Improved Asset Utilization**
- Easy access to actionable, contextualized data that can help you maximize Overall Equipment Effectiveness (OEE) and Mean Time Between Failures (MTBF)
- Real-time diagnostics including timestamp functionality optimize preventive maintenance and troubleshooting, reducing issue resolution time by up to 90%
- Multiple profiles facilitate flexible manufacturing by reducing changeover time for each sensor from minutes to seconds

**Enterprise Risk Management**
- Automatic Device Configuration (ADC) capabilities reduce errors upon sensor replacement
- Restrict configuration changes to authorized personnel only
- Ensure BOM compliance

Smart Sensors. Smart Machines. Smart Manufacturing.
Our Integrated Smart Sensor Solution

A truly connected enterprise has real-time control and information available across platforms and devices within the organization. When it comes to linking end point devices on the plant floor to The Connected Enterprise, our Integrated Architecture leverages smart sensors and I/O to deliver information, advanced functionality and flexibility, increasing efficiency machine- and plant-wide.

When using the full Rockwell Automation solution including Studio 5000 Logix Designer™ software, you get Premier Integration – an enhanced level of integration plus features and functionality not available with competitive offerings, such as:

- Simplified sensor configuration through Add-On Profiles (AOP)
- Controller saves sensor configuration automatically for device replacement conditions (ADC)
- Automatically formatted and named sensor tags

Allen-Bradley IO-Link Enabled Products

**IO-Link Masters**
- Enable connection of up to eight devices (IO-Link enabled or standard I/O)
- POINT I/O™ master for in-cabinet (IP20)
- ArmorBlock™ version for on-machine (IP67) applications
- Timestamp functionality in ArmorBlock model provides visibility to sensor data for better quality metrics

**Photoelectric Sensors**
- Notifies system when lens is dirty
- Parameter changes supported through controller during line/tool changes for flexible manufacturing (e.g. set points)
- Indication of sensor signal strength for monitoring machine wear and tear
- Locking options are available to lock local settings when operating in IO-Link mode, and therefore any user changes will not change the settings of the sensor.
**Timestamp Example**

<table>
<thead>
<tr>
<th>Conv</th>
<th>Sensor</th>
<th>Event Description</th>
<th>Date</th>
<th>Hr</th>
<th>Min</th>
<th>Sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conv 1</td>
<td>Sensor 1</td>
<td>Low Margin (lens dirty)</td>
<td>7/21/16</td>
<td>03</td>
<td>27</td>
<td>12</td>
</tr>
<tr>
<td>Conv 1</td>
<td>Sensor 1</td>
<td>Good Margin (lens clean)</td>
<td>7/21/16</td>
<td>04</td>
<td>05</td>
<td>35</td>
</tr>
<tr>
<td>Conv 1</td>
<td>Sensor 2</td>
<td>Temperature Overrun</td>
<td>7/22/16</td>
<td>11</td>
<td>55</td>
<td>22</td>
</tr>
<tr>
<td>Conv 2</td>
<td>Sensor 3</td>
<td>Disconnected</td>
<td>7/23/16</td>
<td>12</td>
<td>12</td>
<td>27</td>
</tr>
<tr>
<td>Conv 2</td>
<td>Sensor 3</td>
<td>Reconnected</td>
<td>7/23/16</td>
<td>12</td>
<td>14</td>
<td>55</td>
</tr>
<tr>
<td>Conv 1</td>
<td>Sensor 2</td>
<td>Parameter Change</td>
<td>7/24/16</td>
<td>10</td>
<td>53</td>
<td>39</td>
</tr>
</tbody>
</table>

**Multiple profiles can be set up and stored to support flexible manufacturing**

- Make sensor parameter changes in seconds (e.g. for different package sizes)
- Eliminate manual teach errors during changeovers
- Consistent parameter values sent to sensor for line changes
- Personnel no longer need to remember multiple sensor teach processes

**Proximity Sensors**

- Margin status helps optimize sensor installation for best performance
- Monitor the distance to detected targets (detect machine wear and tear)
- Immediate indication of damaged sensing element
- Application-specific names help the user quickly locate the sensor on the machine.

**Pressure and Temperature Sensors**

- Actual Pressure and Temperature values available at the controller
- Change set points via controller when process changes are needed
- Use controller to adjust parameters and use local display for current values
- Configure sensor data units (i.e. PSI or bar for pressure sensors)

**Automatic Device Configuration (ADC)**

Replacing IO-Link sensors or masters is easy. Simply remove the old Allen-Bradley IO-Link component and connect the new one – the controller will automatically send the configuration to the new device.

**Timestamp data (CIP Sync) pinpoints sensor events and input data for real-time monitoring of:**

- Sensor/cable damage or replacement
- Sensor parameter changes
- Target presence or absence
- Lens dirty/clean
How Does **IO-Link** Work?

Smart sensors featuring embedded IO-Link act the same as the standard I/O sensors you’re already using until connected to a master. But by interfacing these sensors with an IO-Link master, you can access all the advanced data and configuration capabilities IO-Link has to offer. This means you have the flexibility to install smart sensors as standard I/O today and activate IO-Link functionality later – whenever and wherever you want it – without having to install costly new wiring or sensors.

![Diagram of IO-Link connection](image)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>L+</td>
<td>24V</td>
</tr>
<tr>
<td>2</td>
<td>out</td>
<td>Depends on Sensor</td>
</tr>
<tr>
<td>3</td>
<td>L-</td>
<td>Ground</td>
</tr>
<tr>
<td>4</td>
<td>C/Q</td>
<td>Communication/ Switching Signal</td>
</tr>
</tbody>
</table>

Applying **IO-Link**

This example illustrates how IO-Link can change how you perceive and maintain your machine. Instead of using sensors to count/detect product, they can also provide valuable machine health information to prevent downtime while improving process efficiency.

Note: This example highlights only a few key functions and not all of those offered by IO-Link and the enabled sensors.

<table>
<thead>
<tr>
<th>Product</th>
<th>Function</th>
<th>Key IO-Link Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>45LMS – Laser Measurement Sensor</td>
<td>Monitors label roll diameter</td>
<td>Multiple Profiles</td>
</tr>
<tr>
<td>45CRM – Color Registration Mark Sensor</td>
<td>Detects label web registration marks</td>
<td></td>
</tr>
<tr>
<td>42JT – Photoelectric Sensor A</td>
<td>Detects product leaving the accumulator</td>
<td>Automatic Device Configuration (ADC)</td>
</tr>
<tr>
<td>42JT – Photoelectric Sensor B</td>
<td>Detects product for label placement</td>
<td></td>
</tr>
<tr>
<td>42EF – Photoelectric Sensor</td>
<td>Detects improperly placed label sleeves</td>
<td>Low Margin Alarm with Timestamp</td>
</tr>
<tr>
<td>871TM – Inductive Proximity Sensor</td>
<td>Monitors presence of the bottle cap</td>
<td>Sensor Health</td>
</tr>
<tr>
<td>How Performed</td>
<td>Application Specific Name</td>
<td>Tag Name in Controller (Automatically Generated)</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------</td>
<td>---------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Set up in controller to trigger on roll of film to indicate when a new roll</td>
<td>Zone2, LMS1,RollSize</td>
<td>My_1734_4IOL:1:Ch0.Distance</td>
</tr>
<tr>
<td>is needed. Since the trigger is timestamped, the controller will know when</td>
<td></td>
<td>My_1734_4IOL:1:Ch0_TRIGGERED1</td>
</tr>
<tr>
<td>the roll typically runs out and how long it takes the operator to replace.</td>
<td></td>
<td>My_1734_4IOL:1:Ch0_TRIGGERED2</td>
</tr>
<tr>
<td>Message instructions can configure the sensor to detect new packaging during</td>
<td>Zone3,CRM1,Register</td>
<td>My_1734_4IOL:1:Ch1_TRIGGERED</td>
</tr>
<tr>
<td>line changes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If a sensor is replaced with another compatible sensor, the controller will</td>
<td>Zone1,PE1,BottleDetect1</td>
<td>My_1734_4IOL:1:Ch2_TRIGGERED</td>
</tr>
<tr>
<td>send the “golden” configuration to the new sensor</td>
<td></td>
<td>My_1734_4IOL:1:Ch2_MARGIN_LOW_ALARM</td>
</tr>
<tr>
<td>Monitors sensor operating margin for diminishing performance due to a dirty</td>
<td>Zone1,PE2,BottleDetect2</td>
<td>My_1734_4IOL:1:Ch3_TRIGGERED</td>
</tr>
<tr>
<td>lens. If the lens becomes dirty it will send timestamped notification to the</td>
<td></td>
<td>My_1734_4IOL:1:Ch3_MARGIN_LOW_ALARM</td>
</tr>
<tr>
<td>controller that cleaning is recommended to assure target is detected. Also,</td>
<td>Zone2,PE2,LabelDetect</td>
<td></td>
</tr>
<tr>
<td>the increase in margin after cleaning is timestamped, so the controller will</td>
<td></td>
<td></td>
</tr>
<tr>
<td>know how long it took the operator to clean the sensor lens.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If sensor head is damaged, the controller receives a report that the sensor</td>
<td>Zone4, PX1,CapDetect</td>
<td>My_1734_4IOL:2:Ch1_TRIGGERED</td>
</tr>
<tr>
<td>has failed and IO data is compromised</td>
<td></td>
<td>My_1734_4IOL:2:Ch1_MARGIN_STATUS</td>
</tr>
</tbody>
</table>

45LMS – Laser Measurement Sensor
Monitors label roll diameter

42JT – Photoelectric Sensor A
Detects product leaving the accumulator

42JT – Photoelectric Sensor B
Detects product for label placement

42EF – Photoelectric Sensor
Detects improperly placed label sleeves

871TM – Inductive Proximity Sensor
Monitors presence of the bottle cap

Automatic Device Configuration (ADC)
If a sensor is replaced with another compatible sensor, the controller will send the “golden” configuration to the new sensor.
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