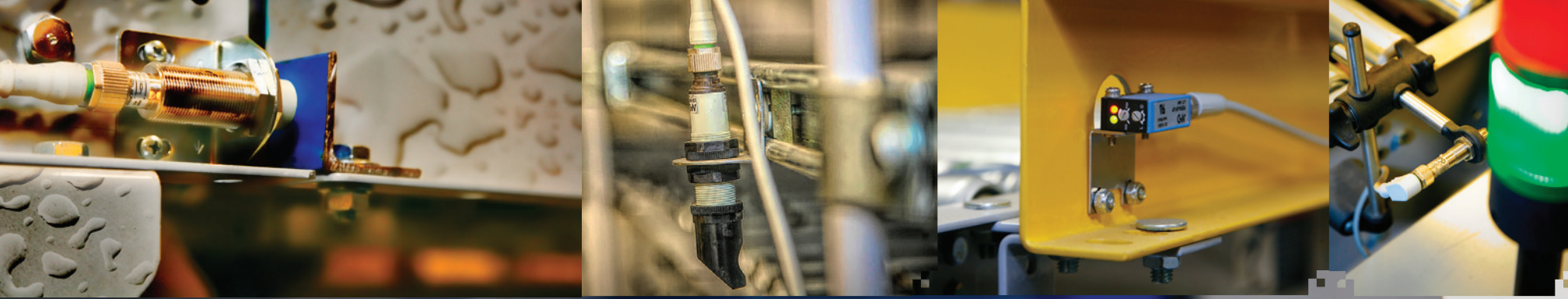

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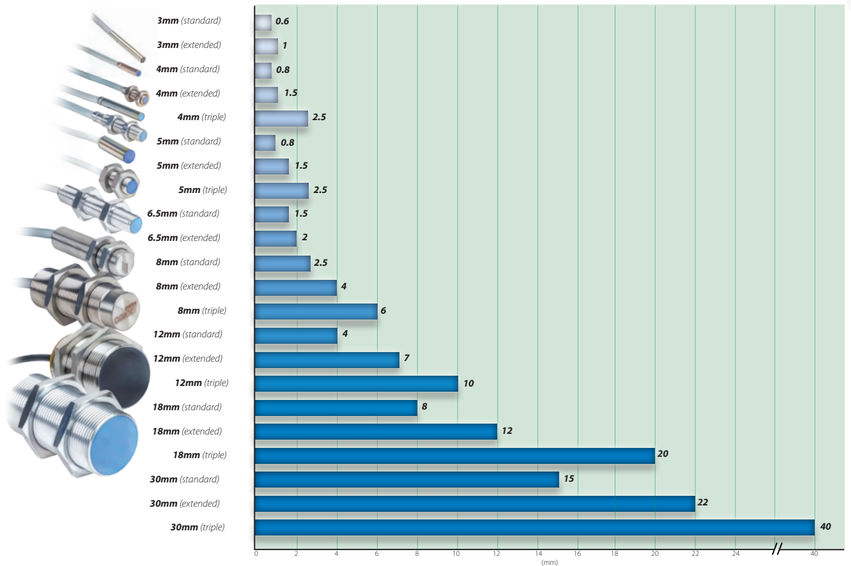
from AUTOMATIONDIRECT.com

Product Focus: Discrete Sensors

What is a Proximity Sensor?



Proximity sensors allow non-contact detection of objects, in particular the presence of parts and/or machine elements for the purpose of counting, indexing, verification, end-of-stroke or travel, determining orientation, and many other common automation tasks.

Selection Criteria

There are several types of proximity sensors. Some common selection criteria include sensing distance, size/shape, switching frequency, ingress rating, shielded vs unshielded, housing material, and connection type.

Sensing Distance

Proximity sensors come in three basic sensing distances: standard, extended, and triple distance, but the size of the sensor body and the shielding type also greatly impact the sensing distance. In many applications, it might not be possible to mount a sensor close to the sensed object. In those cases, longer sensing distances are needed. For instance, longer sensing distances may eliminate the need to buy more expensive high-temperature sensors. If a sensor is placed too close to a hot temperature source, the sensor will require more maintenance, or fail more quickly. Mounting the sensor further from the detection area may reduce heating of the sensor, which may extend the life of the sensor.

Size and Shape

Proximity sensors are available in a vast assortment sizes and shapes, from tiny 3 or 4mm barrels to 30mm cylindrical and in many rectangular form factors. Most inductive, capacitive, and magnetic sensors are single piece designs while some ultrasonic proxes are a two-piece "through-beam" design.

Switching frequency

The internal circuitry of a proximity sensor always has a switching frequency; this can loosely be interpreted to mean how often the sensor is checking the target area for an object. If you need to detect moving objects at very high speed, you may have to pay attention to the switching frequency – most sensors are fast enough for routine operations.

Output type

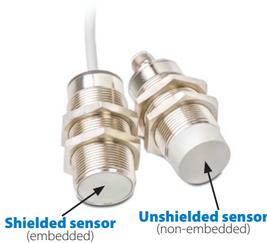
The type of output required must be determined (i.e., NPN, PNP, or analog). Most PLC I/O products will accept either NPN or PNP output. If connecting to a solid state relay, a PNP output is needed. The need for analog output is determined by the application. Sensors with analog outputs produce an output signal approximately proportional to the target distance.

Do you need 2, 3, or 4-wire discrete outputs? This may be dictated by the device to which the sensor will be connected, or it may be a personal preference. Some simple guidelines to use are:

2-wire
- Will work with sinking or sourcing devices
- Only 2 wires to terminate
- Higher leakage current

3-wire
- Most popular variety – familiar to most users
- Must select between NPN and PNP outputs

4-wire
- Allows configurability in one device.
- May have both NPN/PNP selection or NO/NC selection
- Allows the user to stock one part for numerous applications



Shielded vs unshielded

Shielded and unshielded sensors are also referred to as embeddable and non-embeddable. Unshielded sensors allow longer sensing distances but the sensor face must protrude from the mounting substrate. Shielded sensors can be flush mounted.

Environmental ratings

All proximity sensors provide excellent protection from environmental factors such as moisture and debris. Ingress Protection (IP) ratings are established by the IEC, and define the protection offered by electrical devices and their enclosures. It is similar to the NEMA rating system. IP ratings of IP65 or higher are very common for proximity sensors. Harsh duty models are also available and can have ratings as high as IP69K. IP69K is often required in the food and beverage industry where the sensors must withstand "washdown" cleaning procedures, often with harsh chemicals.

Connection types

Proximity sensors are usually offered with either an attached "axial" cable or a quick-disconnect (Q/D) termination. Both connection types offer a high degree of ingress protection, typically IP65 or higher.

Axial cables

Axial cables are typically 6 feet (2m) in length and are molded into the body of the sensor at the attachment point, exiting axially (inline with the sensor body). They are typically the less expensive option. The cable can be cut to length, but may not be long enough to reach all the way to the machine controller. Field junction boxes may be required, and numerous sensor signals are often combined into multiconductor cables at such junction points. Lastly, an axial cable exiting from the end of the sensor body may not fit (physically) in all applications.

Quick-disconnects (Q/D)

Sensors with quick-disconnects require the use of a separate cable to complete the installation. These cables typically include industry-standard M8, M12, or micro-AC (for some AC powered sensors) style connections on one end and offer a pigtail (flying leads) on the other end for completing the connection. These quick-disconnects offer several advantages: it's very easy to replace a damaged sensor without any rewiring, and the cables are available in longer lengths with axial or 90-degree connections at the sensor. Field-wirable quick disconnect connectors are also available for constructing custom cables. Extremely small sensors may have a short axial cable with the quick-disconnect a few inches from the sensor body.

Use multiport junction blocks to multiplex sensor signals and simplify wiring.

Multiport junction blocks

Cables with quick disconnects on both ends (patch cables) can be used with multi-port junction blocks to multiplex numerous sensor signals back to the machine controller.

Cable Options

Q/D cables in PVC and PUR jackets meet the environmental requirements of most applications. Axial cables typically come with a PVC jacket. PVC is a general purpose insulation while PUR provides excellent oxidation, oil and ozone resistance. PUR is beneficial if the cable is exposed to oils or placed in direct sunlight.

Types of proximity sensors

Inductive

Inductive proximity sensors detect the presence of metallic objects at close range (up to about 1.5 inches typically). Ferrous metals allow the greatest distances to the sensor; other metals may reduce detection range. Low-cost, reliable sensors are available in an array of shapes and sizes for a wide range of applications.

Magnetic

Magnetic proximity sensors are used for non-contact object detection beyond the normal limits of inductive sensors. Used with a separate damping magnet, they offer very long sensing ranges in a small package and can detect magnets through walls of non-ferrous metal, stainless steel, aluminum, plastic or wood.

Capacitive

Capacitive sensors detect both metal and non-metal objects and can sense through insulating materials such as wood or plastic. They are often used to detect fill levels of liquids, pellets, and powders through container walls. Capacitive sensors are available in cylindrical or rectangular shapes, with sensing distances typically up to 40mm.

Ultrasonic

The principle of ultrasonic sensors is based on the emission of a sound impulse and the measurement of the time elapsing of the return echo signal reflected by the detected object. The ultrasonic beam is well reflected by almost all materials (metal, wood, plastic, glass, liquid, etc.) and is not affected by colored, transparent, or shiny objects. This allows the user to standardize on one sensor for many materials without any extra setup or sensing concerns.

Through-beam pair sensors are often the most accurate and reliable sensor configurations, but can also be more costly when compared to traditional diffuse or retro-reflective sensors. Ultrasonic sensors (rectangular) are ideal for detecting objects in applications where the use of other types of proximity sensors or photoeyes do not work, such as:

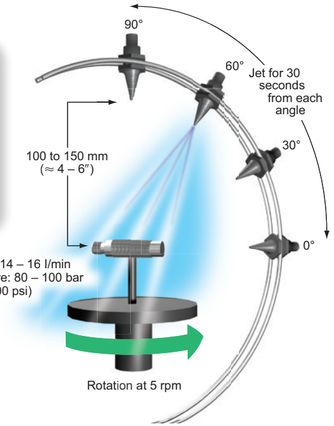
- Level measurement: for tanks containing solid or liquid
- Diameter or loop detection: for materials such as paper, sheet iron, etc.
- Transparent object detection: for plastic or glass bottles, plastic filters, etc.

IP69K-rated Proximity Sensors

All AutomationDirect Food and Beverage products are tested in accordance with the IP69K standard, according to DIN 40050 part 9. The goal of this test was to duplicate pressure cleaning conditions on a plant floor. In the test fixture, the sensors were exposed to a 1500 psi spray of water at a temperature of 176 °F. The duration of each cleaning cycle was 30 seconds. The test was performed at specified angles using a spray nozzle located at a distance of 4" from the switch. The sensors withstood test conditions and were still operable, providing 100% of sensing range.

Thermal endurance

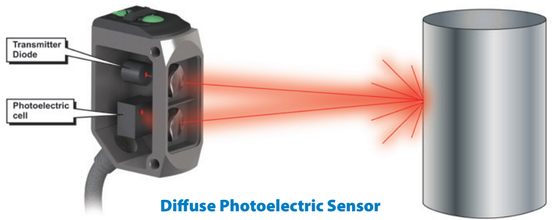
In pressure cleaning (washdown) environments, proximity and photo sensors can be exposed to extreme temperature conditions. A thermal shock test was performed on these proximity sensors by cycling the temperature to ensure their consistent high reliability. All IP69K-rated proximity sensors can withstand temperatures up to 100°C (212°F).



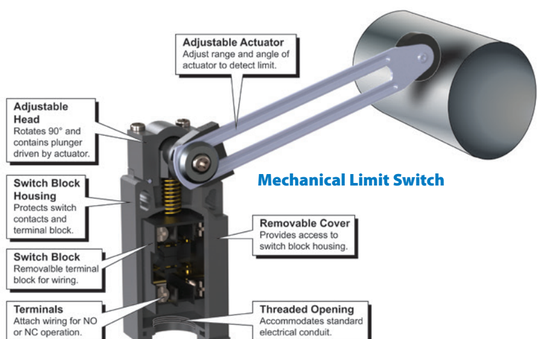
FDA certified Materials

Food & Beverage sensors are manufactured from materials capable of withstanding solutions used during equipment cleaning. These materials are all approved by the FDA for use in food production environments:

- 316L (V4A) stainless steel
- PMMA (acrylic) • PEEK (Polyether Ether Ketone)
- PPS (Techtron)
- Third Party chemical testing companies such as ECOLAB and Johnson Diversey have tested these products with common cleaning agents, such as P3-clint KF and P3-topax 52, to assure continued operation.



Diffuse Photoelectric Sensor



Mechanical Limit Switch

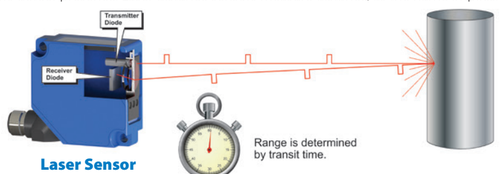
Beyond Proximity Sensors: Use Light, Touch, or Laser for Reliable and Accurate Position Sensing

Limit switches, photoelectric switches and laser sensors all provide position sensing, but there are many options and technologies to consider when specifying the use of these presence sensors in automated machines. There is much overlap in functionality of these sensors, and there are also some selection considerations as each device has its advantages and disadvantages.

Mechanical limit switches are used in industrial automation systems to detect presence or position. Physical contact with the switch actuator, usually adjustable, activates these electromechanically- operated devices.

Photoelectric sensors, also called photo eyes, detect object presence or distance using light. These sensors use a light source from an emitter and a receiver that detects changes in light intensity reflected or interrupted by the target object. With no physical contract required, photo eyes can detect objects at extremely close range or out to a meter or more, depending on the specific photo eye technology employed.

Laser sensors operate like photoelectric sensors but with a much more focused light source to detect presence or measure distance, depending on the configuration. Laser photoelectric sensors detect presence. Laser distance sensors measure distance, as the name implies.



Laser Sensor

The Tried and True Limit Switch

Limit switch actuators are available in many forms, including an adjustable arm or a plunger, mechanically linked to an electrical switch block inside the housing.

Most limit switch's use linkages and movement of the sensed object to operate the switch contacts. Heavy-duty contacts are common in limit switches, enabling switching of higher currents than other presence and position sensing devices.

Limit switches must touch an object to detect it, which limits sensing distance to the travel distance of the switch's rotary lever arm or plunger-type actuator. However, this short sensing range provides reliable detection of an object regardless of its color, shape or size. Care must be taken to ensure the object touching and activating the actuator roller or plunger does not damage it.

When looking at presence sensors' repeatability, or repeat accuracy, it is important to understand when it's needed because many sensors don't excel in this area. For applications where a high degree of repeatability is needed, precision touch limit switches are available with an accuracy of 5 microns or less.

A very common application for a limit switch is detecting the closed position of a conveyor lift gate.

Diffuse, Retroreflective and Through-Beam Photoelectric Sensors

The typical light source used in the emitter, or sender, of a photoelectric sensor is visible red or infrared. The light is reflected or interrupted by the object, and then collected by a receiver where the intensity is measured. These emitter and receiver elements can be installed in the same housing or in different housings.

Diffuse and retroreflective configurations are available with the emitter and receiver integrated together. Diffuse sensing bounces emitted light directly off an object and back to the receiver in the same housing. Retroreflective sensors bounce light off a fixed reflector and objects are detected when they break the beam.

A through-beam photoelectric sensor uses a configuration where the emitter and receiver are in different housings and detect presence when the beam is broken. Through-beam sensors provide the longest operating distances since the emitter shines light directly at the receiver.

Photoelectric sensors detect object presence or distance in a wide range of industrial applications, and typically contain all required optics and electronics in a single unit.

Both short-range CMOS, and this long-range, time-of-flight Wenglor photoelectric laser sensor, are often used in material handling applications.

Laser Sensor Operating Principles

Laser sensors use highly focused laser light to detect objects or measure distances, and can return a measured value regardless of ambient light, or the object's material, color or brightness. Laser sensors are available in diffuse, background suppression and retroreflective styles for object/position sensing, or with CMOS or transit time technologies for accurate distance measuring.

The diffuse, background suppression and retroreflective styles work similarly to their non-laser, photo-eye counterparts. The light source is reflected by or interrupted by the target object, and the built-in detector drives the output signal.

For distance measuring at short ranges, high-precision laser sensors measure down to 8 micrometers resolution using CMOS technology; long-range models use time-of-flight (measuring transit time of the reflected light) to measure distances up to 100 meters.

Applications for Touch, Light and Laser

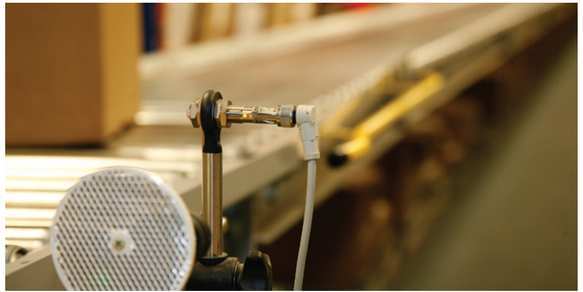
There is much overlap in the application of limit switches, photoelectric sensors and laser sensors, so carefully check the device's specifications; how it will fit into an application; and how it will be used. Limit switches are just one of the many solutions to use in automated applications, but they are a simple and rugged choice for presence sensing, providing reliable detection of many components or parts.

Both photoelectric and laser sensors have a sensing range from close to far. Adjustable light intensity and sensing thresholds help tune this range. This wide and adjustable detection makes the photo eye a popular choice for presence detection, and it has an excellent sensing range-to-size ratio. As the sensing distance increases or a more accurate or a smaller spot size is needed, laser becomes a popular choice.

Mechanical limit switches have moving parts that can wear out, so the speed of actuation must also be limited, making them unsuitable for high-speed applications. The electronics in both photoelectric and laser sensors enable fast switching operation. With operation speeds from 25 Hz on the low end to thousands of times per second, high-speed applications are possible, and the number of actuations is not a concern.

Photo eyes are probably the best general-purpose position sensor. They have a longer sensing range than proximity sensors, and they are available in a wide range of configurations and housing sizes to fit many applications.

Lasers are best for precise measurement of distance, or object detection in dynamic lighting conditions. Close, far, dusty or clean—they work well in most environments. They also work well for small part detection, much better than other technologies.



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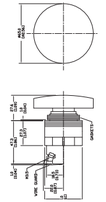

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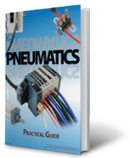

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- Productivity1000® micro-modular PLCs
- Productivity2000® micro-modular PLCs
- Productivity3000® modular PLCs
- Do-more® BRX®, H2 and T1H series PLCs
- CLICK® micro brick PLCs
- Numerous I/O expansion modules available including discrete, analog, temperature and high-speed (depending on model)
- Think & Do® PC control software
- *Direct*LOGIC® components still available for maintaining legacy systems.

Programmable Controllers

CPU and I/O Comparison	AutomationDirect CLICK	AutomationDirect Do-more! (BRX)	AutomationDirect Productivity2000	vs.	Allen-Bradley CompactLogix
Base (if required)	N/A N/A	N/A N/A	$70.00 P2-04B		N/A N/A
Power Supply	$39.50 C0-01AC	N/A N/A	$70.00 P2-01AC		$406.40 1769-PA4
CPU	$141.00 C0-10ARE-D (Ethernet built in)	$489.00 BX-DM1E-36DR3 (Ethernet built in)	$258.00 P2-550 (Ethernet built in)		$6,080.00 1768-L45 (Serial port only)
16 AC Inputs	$40.50 C0-08NA (8-point AC Input)*	$60.00 BX-16NA	$107.00 P2-16NA		$242.51 1769-IA16
16 24VDC Inputs	$45.50 C0-16ND3	$0.00 Included with CPU	$70.00 P2-16ND3		$216.00 1769-IQ16
8 Relay Outputs	$40.50 C0-08TR	$0.00 Included with CPU	$51.00 P2-08TRS		$261.60 1769-OW8I
8 Analog Input Channels (mA)	$90.00 x 2 (2) C0-04AD-1	$187.00 BX-08AD-1	$202.00 P2-08AD-1		$698.40 1769-IF8
Total System Price	$426.00	$556.00	$828.00		$7,904.91

*C0-08NA used in conjunction with eight AC inputs on CPU gives the 16 points needed

Distributed I/O with Modbus® TCP, EtherNet/IP, Modbus RTU, DeviceNet® and Profibus® support

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- *DURA*PULSE® variable frequency AC drives up to 300hp
- WEG CFW300 AC drives up to 5hp
- IronHorse® DC drives up to 3hp
- Cost-effective GS series VFDs up to 10hp
- Drive accessories
- Soft starters up to 480A

AC and DC Drives

- Free PLC programming software (download)
- System configuration
- Free motion control software (download)
- OPC server software
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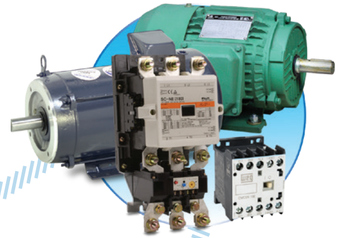
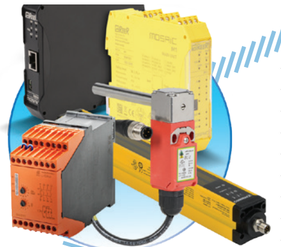


- IronHorse® general purpose AC motors up to 300hp
- Stainless steel AC motors
- DC motors up to 2hp
- Marathon® inverter duty AC motors up to 100hp
- Compressor duty AC motors up to 5hp
- Motor controls and contactors up to 300hp

Motors and Motor Controls

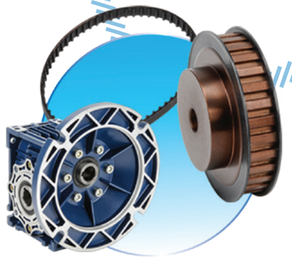
- Temperature controllers
- Digital panel meters
- Temperature sensors and transmitters
- Pressure sensors and gauges
- Level sensors and controllers
- Flow sensors
- Signal conditioners
- Pipeline valves
- Current to pneumatic (I/P) transducers
- Timer relays, counters and tachometers

Process



Safety

- Reer MOSAIC safety controllers
- IDEM® and Dold® safety relays
- Magnetic safety switches
- Magnetic coded safety switches
- RFID coded safety switches
- Light curtains
- Safety relays
- Trapped key interlocks
- Safety mats and edges



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- Helical gearboxes
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- Shaft mount gearboxes
- Timing belts and pulleys
- Couplings and bushings
- Shafting and shaft supports
- igus polymer bearings

Danny in SAN ANTONIO, TX wrote:

"Excellent service, large selection of parts, and quick to get what I need. Been using you since you started out as PLC Direct. Quality is better on some items, but you have always taken care of me if there was an issue on anything. Please keep up what you are doing so well.Look forward to many more years doing business with you."

Chris in ORRICK, MO wrote:

"Automation Direct is my Go-To supplier. They have what I need and ship quickly.!"

Sam Y in AYLETT, VA wrote:

"Great company to buy from, this is my second purchase and my motor arrived very quickly. Great product and will definitely buy from again!!"

Relays & Timers

- Electro-mechanical relays
- Solid state relays
- Relay sockets and accessories
- Timer relays
- Counters
- Tachometers
- Motor control relays
- Force guided relays

Tools

- Wera screwdrivers and torque tools
- Wera wrenches, ratchets and sockets
- Knipex® pliers, stripping and crimping tools
- Cable tie tools
- Hole cutting tools
- RUKO grinders and burrs
- SapiSelco® wire ties

Servo Systems	AutomationDirect Price/Part Number	vs.	Allen-Bradley Price/Part Number
Digital Servo Drive	$483.00 SVA-2040		$1,418.00 2098-DSD-005
100W Servo Motor with connectorized Leads	$322.00 SVL-201		$643.65 TLY-A130T-HK62AA
Breakout Board Kit for CN1 Control Interface	$80.00 ZL-SVC-CBL50 + ZL-RTB50		$316.05 2090-U3BK-D4401
10' Motor Feedback Cable	$51.00 SVC-EFL-010		$96.68 2090-CFBM6DF-CBAA03
10' Motor Power Cable	$30.50 SVC-PFL-010		$109.00 2090-CPBM6DF-16AA03
Configuration Software	FREE SV-PRO*		$85.02 2098-UWCPRG

*SureServo Pro software is FREE when downloaded and is also available for $9.00 on a CD

Complete 1-axis 100W System $966.50 $2,668.40

All prices are U.S. list prices. AutomationDirect prices as of 12/19/2018.
The Allen-Bradley 100W system consists of part numbers shown in table above with prices from www.wernerelectric.com, www.todaycomponents.com 11/21/2018.

Bruce in LAYFAYETTE, CA wrote:

"I recently bought 3 isolation transformers from Automation Direct. The specifications were equivalent to transformers from other industrial suppliers and the quality appears to also be equivalent. The pricing, as with other products from Automation Direct, was considerably better, not to mention free delivery. Also, their website is excellent in terms of ease of use, clarity, disclosure and quantity and quality of information provided."

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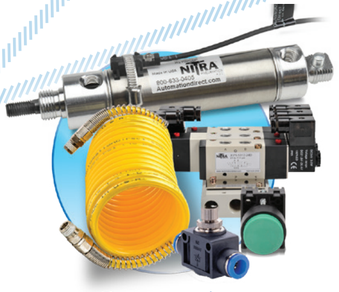
- Pressure sensors and gauges
- Temperature sensors, switches, transmitters and thermometers
- Liquid level sensors
- Flow sensors
- Ultrasonic sensors
- Fork sensors

Pushbuttons, Switches and Lights

- KILLARK® hazardous location control stations
- IDEM emergency stops
- Fuji®, Schmersal and Eaton metal/ plastic 22 and 30mm pilot devices
- IP69K-rated selector switches, pilot devices and pushbuttons from Schmersal
- WERMA audible devices and visual signals
- WERMA and Patlite stacklights
- IP69K-rated Patlite stacklights
- Foot switches
- IP69K-rated selector switches, pilot devices and pushbuttons from Schmersal

Communications

- Industrial managed and unmanaged Ethernet switches
- Modbus gateways
- Network adapters/ converters
- Ethernet cables
- VPN routers and cloud services for secure remote access
- Power over Ethernet (PoE) switches



Pneumatics

- Tubing, hose and fittings in a wide variety of configurations
- Air cylinders and position switches
- Solenoid valves
- Modular solenoid valves (Ethernet or hardwired)
- Air preparation and air relief valves
- Pushbutton valves
- Total Air Prep (TAP) all-in-one units
- Rotary actuators and grippers
- Pressure switches, transmitters, and transducers

Power Products

- Acme Electric®, Hammond and Jefferson Electric® transformers
- Rhino® DC power supplies and converters
- Mersen surge protectors
- Roxburgh and Eaton line filters and surge protectors
- Roxburgh power outlets
- ACME Electric encapsulated transformers
- Edison® power distribution blocks
- Bryant® electrical plugs, connectors and receptacles, and other wiring devices
- AcuAMP® AC current transformers
- Socomec multifunction power meters
- Trumeter graphical panel meters

Water (Potable) Components

- Regulators
- Solenoid valves
- Hand valves
- Check valves
- Push-to-connect water fittings
- Lead-free brass fittings
- Tubing
- Hose
- Hose clamps

Circuit Protection

- Eaton UL 489 miniature circuit breakers
- Fuji UL 489 molded case circuit breakers
- Eaton UL1077 supplementary protectors
- Edison fuses, fuse holders and fuse blocks
- Socomec, Gladiator® and Bryant® disconnect switches
- Bryant UL 508 manual motor controllers

Terminal Blocks and Wiring

- Electrical hook-up wire / building wire
- Konnect-It® and DINnectors® terminal block systems
- Edison power distribution blocks
- Bryant power wiring devices
- Wire duct and tubing
- Wire end connectors cable glands, connectors and fittings
- ZIPport® connectors
- Multi-wire connectors
- Sensor cables
- General, latching, UV resistant, releasable, mounting head, identification, and metal-detectable cable ties

All of our cable is now available cut to your specified length so you can eliminate waste and purchase only what you need - **plus it's cut and shipped the same day!**

Types of cable we offer:

- Flexible portable cord
- Bulk data cable (RS232/ RS422/ RS485)
- Flexible control (tray) cable
- Variable frequency drive (VFD) Cable
- Instrumentation cable
- Continuous flexing control cable
- Continuous flexing motor supply cable
- Continuous flexing industrial Ethernet cable

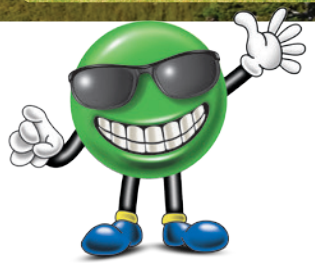
Enclosures	AutomationDirect Hubbell/Wiegmann Price/Part Number		Hoffman Price/Part Number	
NEMA 1 wall mount 24 x 24 x 08"	$191.00 N1C242408LP		$335.24 A-24N24BLP	
NEMA 12 wall mount 20 x 16 x 08"	$256.00 N12201608		$459.11 A-20160BLP	
NEMA 12 free-standing mount 60 x 60 x12"	$1,517.00 N12606012		$2,771.49 A-606012LP	
NEMA 4 wall mount 20 x 20 x 06"	$333.00 N4202006		$587.02 A-20H20ALP	
NEMA 4X wall mount 20 x 20 x 06"	$796.00 SSN4202006		$1,398.19 A-20H2006SSLP	
NEMA 4/12 wall mount 36 x 24 x 08"	$332.00 N4123624O8C		$587.80 C-SD36248	

*All prices are U.S. published prices. AutomationDirect prices as of 12/19/2018. Hoffman prices are taken from www.alliedelec.com 11/21/2018. Prices may vary by dealer. Many other part numbers are available from all vendors.

- Over 2,400 NEMA rated enclosures to choose from
- Stainless steel, carbon steel and aluminum enclosures from Hubbell-Wiegmann®
- Fiberglass and polycarbonate enclosures from Attabox
- Polycarbonate enclosures from Integra
- Thermoplastic ABS enclosures from AutomationDirect
- Custom cut-out enclosures
- Heating, cooling and climate control
- Lighting

Enclosures

- Honest up-front pricing (no gimmicks)
- Quick delivery - order today, it ships today
- FREE tech support - independently rated tops in service for 15 years
- FREE shipping on orders over $49



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As a privately-held efficiently run company, we take pride in serving our customers the way they want to be served - honestly and fairly. We do everything we can to accomplish this day in and day out.

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