SIGNAL CONDITIONERS
BUYING GUIDE

WHAT DO THEY DO?

Signal conditioners transform raw signals from sensors or other sources into a form suitable for further processing. Since sensor outputs are often weak, noisy, non-linear, or incompatible with downstream equipment, signal conditioners amplify, filter, or convert these signals to ensure compatibility with receiving devices.

Common Functions of Signal Conditioners:

1. **Amplification:** Increases the strength of a weak signal, improving measurement resolution and signal-to-noise ratio. For example, a signal conditioner may boost a millivolt signal to a more usable range, such as 0 to 10 VDC.
2. **Attenuation:** Reduces the magnitude of a signal that is too strong to a safe, measurable level.
3. **Filtering:** Eliminates unwanted noise and interference by allowing specific frequencies to pass through while blocking others.
4. **Electrical Isolation:** Separates the input and output to prevent unwanted current flow and protect equipment from high-voltage spikes or ground loops.
5. **Linearization:** Adjusts a non-linear signal to establish a linear correlation between the signal and the value it represents.

Topics

6. **Excitation:** A voltage or current supplied to a sensor, such as RTDs or strain gauges, to enable its operation and generate an output signal.
7. **Signal Conversion:** Signal conditioners can convert signals from one form to another to ensure compatibility with receiving devices. For instance:
   - Converting an RTD's resistance into a voltage or current signal.
   - Converting a current signal (e.g., 0-20 mA) into a relay output.
   - Converting a wired signal into a wireless one and vice versa.
8. **Cold Junction Compensation (CJC):** Thermocouples produce voltage based on the temperature difference between their measurement (hot) and reference (cold) junctions. CJC corrects for the difference between the actual temperature of the reference junction and the 0°C reference used in thermocouple tables, ensuring accurate temperature measurement.
9. **Calibration:** Adjusting the zero and span of a sensor's output so the signal accurately reflects measured values.

APPLICATIONS

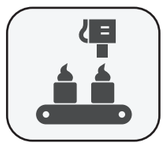
Signal conditioners are essential in a wide range of applications that require accurate and reliable sensor data. They convert and isolate raw sensor outputs, such as millivolt, frequency, or resistance signals, into standardized formats compatible with electronic control and monitoring systems. Typical examples include:

Monitoring and controlling temperature, pressure, flow rate, and level: Signal conditioners amplify, isolate, and linearize process signals to convert various sensor outputs (e.g., thermocouple, RTD, strain gauge) into standard input formats (e.g., 4-20 mA, 0-10V) required by PLCs and other control devices.

Ensuring signal integrity in noisy industrial environments: Since factories and plants often have significant electrical noise, filtering and isolation protect measurement signals from interference and ensure reliable operation.

Actuator control: Signal conditioners provide voltage/current conversion, amplification, isolation, filtering, and linearization to ensure compatibility, protection, and optimal performance of valves, motors, and other actuators.

Hazardous area applications: Specialized signal conditioners ensure safe operation by using intrinsic safety barriers or galvanic isolation to create a secure interface between sensors in a hazardous area and the control system.

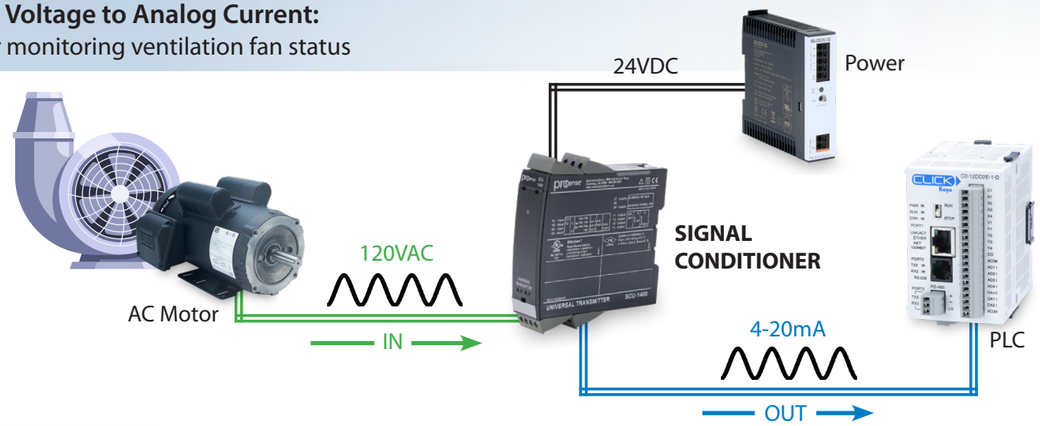


Food and beverage processing: Signal conditioners ensure accurate sensor data (conversion, isolation, filtering) in hygienic environments, enabling precise control and regulatory compliance for high-volume production.

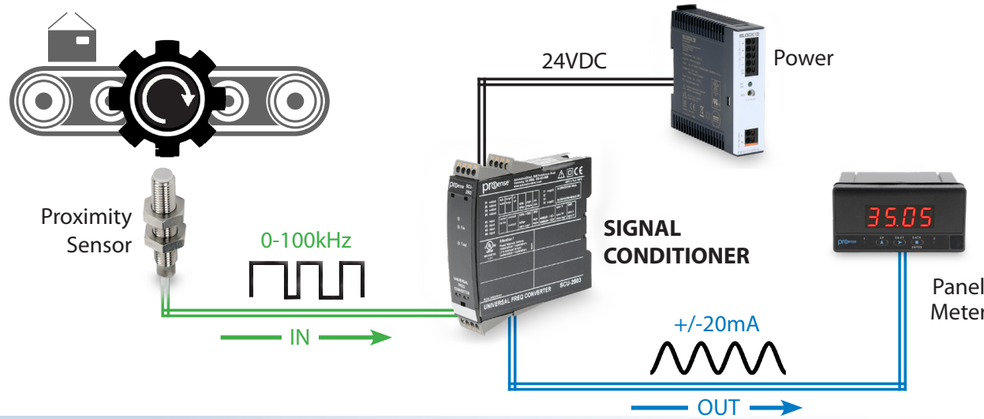
Weighing systems: Signal conditioners amplify and linearize load cell outputs to ensure accurate weight measurements for industrial and commercial scale applications.

SIGNAL CONVERSION EXAMPLES:

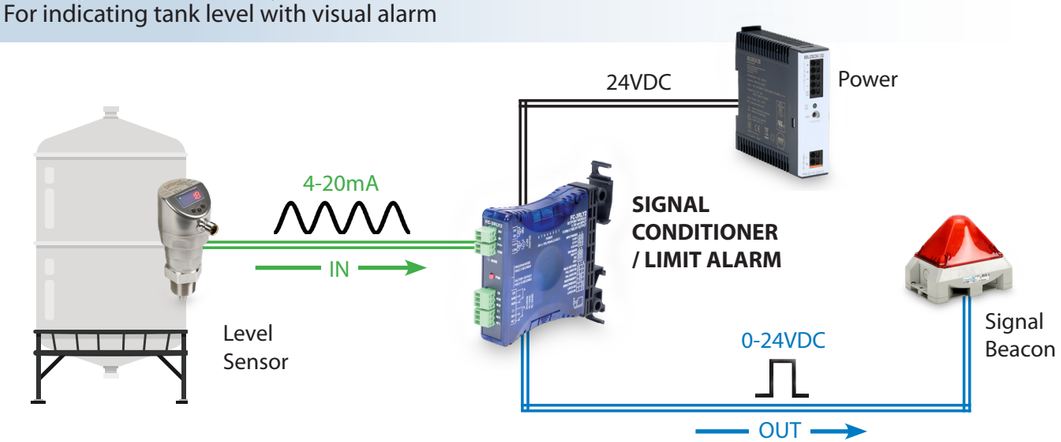
1. AC Voltage to Analog Current:
For monitoring ventilation fan status



2. Frequency to Analog Current:
For measuring/displaying conveyor belt speed



3. Analog Current to Relay (limit alarm):
For indicating tank level with visual alarm



POINT-TO-POINT WIRELESS I/O

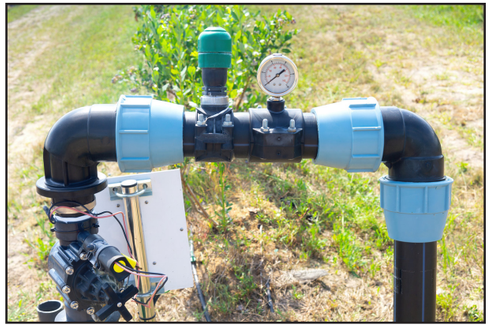
Another type of signal conversion that is very beneficial with automated systems is point-to-point wireless I/O technology. These devices are ideal for remote monitoring and control in areas where traditional wiring is impractical, costly, or impossible—such as across long distances, over obstacles, or between moving parts.

WHY POINT-TO-POINT WIRELESS I/O?

1. **Cost Savings:**
   The most significant saving comes from eliminating the need to purchase, install, and maintain extensive cabling, conduits, and terminal blocks. This also reduces labor costs associated with wiring and trenching.
2. **Fast Deployment:**
   Wireless transceivers can be installed and configured quickly, making them ideal for temporary setups or time-sensitive projects.
3. **Flexible Installation:**
   Works well in remote, rugged, or hazardous environments where running cables may be unsafe or impractical.
4. **Reliable Signal Transmission:**
   Modern transceivers offer strong, interference-resistant communication with error-checking protocols for dependable signal integrity.
5. **Minimal Infrastructure:**
   Operates independently without requiring complex networks or Internet connectivity, making it suitable for isolated sites.
6. **Mobility:**
   Ideal for mobile or rotating equipment (e.g., cranes, trailers, turntables) where cabling would wear out or restrict movement.

Ideal for connecting to remote installations

HOW'S IT USED?

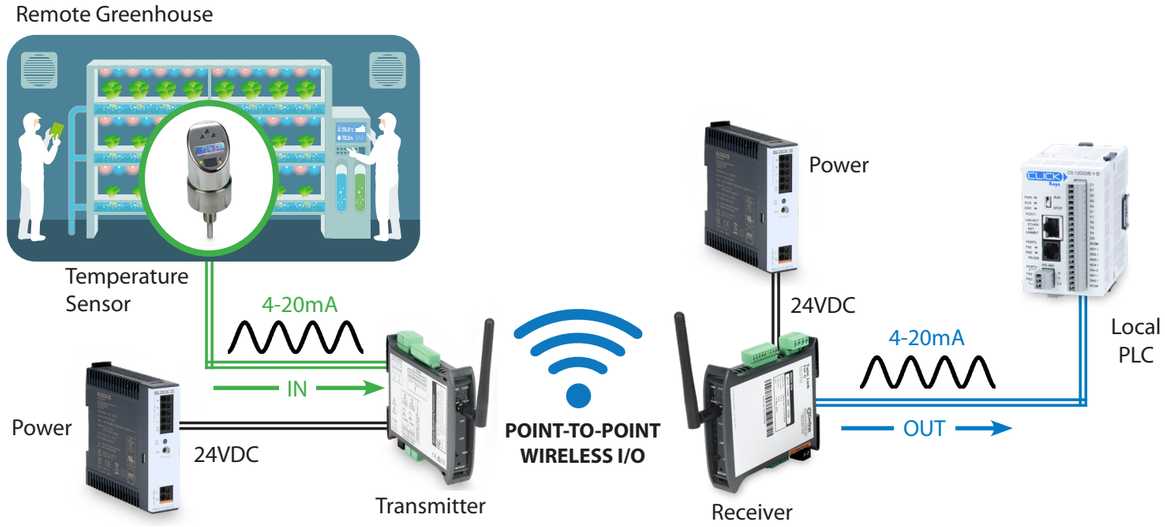


- **Remote Tank Monitoring:**
  Send high-level alarms or control signals from a remote tank to a central control room without running cable.
- **Pump Control in Fields:**
  Wirelessly start or stop irrigation pumps based on remote sensors, avoiding long trench runs through farmland.
- **Mobile Crane Monitoring:**
  Transmit limit switch or stop signals from moving cranes to a fixed control point without cable wear issues.
- **Gate/Barrier Control:**
  Control and monitor remote gates or barriers from a central location without hardwiring.
- **Bridge Sensor Monitoring:**
  Send vibration or water level data from bridge-mounted sensors to a nearby station without disrupting the structure.

APPLICATION EXAMPLES:

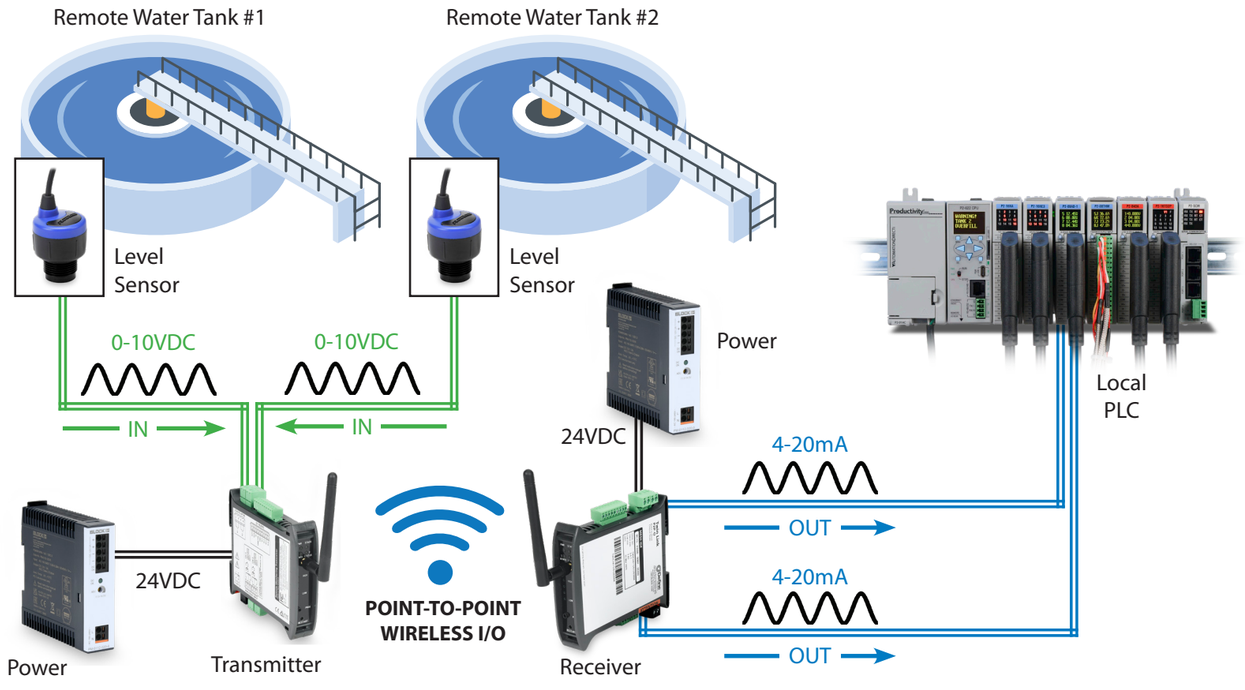
1. Smart Agriculture:

Wireless sensor networks for monitoring soil conditions, weather patterns, and irrigation systems.



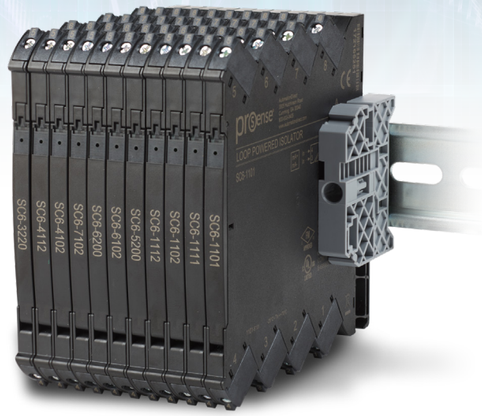
2. Water and Wastewater Management:

Monitoring tank levels, flow rates, and water quality in multiple remote locations.



THINGS TO CONSIDER

Signal conditioners come in all types, with numerous capabilities, functions, form factors, etc. Here are some advantages and basic considerations to know when using signal conditioning devices.



Advantages:

- **Clean Data:** Reduce noise, filter frequencies, and eliminate interference for reliable data.
- **Accurate Measurement:** Amplify weak signals and linearize outputs for improved accuracy.
- **Adaptable Signals:** Tailor sensor signals for flexible data acquisition and control.
- **Device Protection:** Electrically isolate devices against overvoltage, surges, and ground loops for reliability.
- **Optimal Sensor Operation:** Ensure sensors function within their ideal range for peak performance.
- **Simplified Processing:** Well-conditioned signals streamline analysis and control.
- **Reliable Transmission:** Amplify signals for robust long-distance transfer with minimal loss.
- **Advanced Capabilities:** Digital processing, communication interfaces, and built-in diagnostics.
- **Flexibility:** A wide variety of signal conditioners, tailored to different sensor types and application requirements, enables versatile system design.

Considerations:

- **Cost:** Signal conditioner introduce an additional cost that scales directly with their complexity and feature set.
- **Complexity:** More components can complicate troubleshooting and maintenance.
- **Accuracy:** Incorrect selection or calibration can introduce errors or distort signals.
- **Power Consumption:** Increased power consumption requires additional power management.
- **Latency:** Added signal processing can introduce minor delays, potentially impacting high-speed applications.
- **Footprint:** Conditioners add to physical space requirements (compact options available).
- **Maintenance:** Regular calibration may be crucial for sustained signal accuracy.

HOW TO CHOOSE

Choosing the right signal conditioner involves careful consideration of several factors related to your sensor, the environment, and your measurement or control system. Here's a step-by-step guide to help you make the best selection:

1. Understand Your Sensor and Its Output:

- **Sensor Type:** Specify the sensor type, as different sensors have unique output characteristics that require specific conditioning.
- **Output Signal:** Determine the sensor's electrical output signal, including its type (voltage, current, resistance, frequency) and operating range.
- **Signal Characteristics:** Identify key signal characteristics such as linearity (linear/non-linear), type (AC/DC), and frequency.
- **Excitation Requirements:** If the sensor requires external excitation (e.g., RTDs, strain gauges), detail the necessary voltage or current specifications.

2. Define Your Measurement System Requirements:

- **Receiving Device Input:** Signal type and range accepted by the receiving device (e.g., 0-10V, 4-20 mA, digital signals).
- **Desired Output:** Conditioned signal type and range for the receiving device interface.
- **Accuracy:** Required measurement accuracy influences linearity and precision.
- **Bandwidth/Frequency:** Necessary signal frequency range for accurate measurement.
- **Environment:** Operating environment (temperature, humidity, vibration, hazards) and required ratings.
- **Isolation:** Need for electrical isolation (sensor, conditioner, receiving device) for ground loops, protection, or safety.
- **Transmission Range:** Assess signal integrity over long distances. Consider point-to-point wireless I/O for spans with obstacles, extreme lengths, or moving equipment.

3. Determine the Necessary Functions:

Identify the necessary functions from the following, considering sensor output and measurement system requirements:

- Amplify weak signals
- Attenuate strong signals
- Filter unwanted noise
- Provide electrical isolation
- Linearize non-linear outputs
- Supply sensor excitation
- Convert signal types (e.g., resistance into voltage or wired into wireless)
- Perform Cold Junction Compensation (CJC)
- Enable calibration and offset adjustment
- Incorporate smart features such as digital processing, communication interfaces, or alarm functions

4. Consider Practical Factors:

- **Power:** Verify compatibility with the available power supply.
- **Mounting:** Select a suitable form factor for the installation (e.g., DIN rail or panel mount).
- **Connections:** Ensure compatible connectors for the sensor and receiving device; factor in potential adapter needs.
- **Usability:** Evaluate setup ease, considering fixed vs. programmable options and required tools/software.
- **Cost:** Balance the features and performance with your budget.

Selecting the right signal conditioner involves understanding the complete measurement chain, from sensor to receiving device, and choosing a conditioner that effectively bridges gaps and optimizes the signal for accurate and reliable data acquisition or control.

PRODUCT LINEUP

proSense® Automation Direct WAGO Define INSTRUMENTS

Accuracy begins with signal integrity

For systems that rely on precise measurements, safeguarding control signals from degradation and interference is vital. Even with the best equipment, signals can be degraded if the equipment is not properly installed or is not protected by signal conditioners/signal isolators. This selection of signal conditioners, transmitters, and optical isolators solve ground loop problems, isolate noise issues, convert signals to desired levels and types, and allow longer cable runs. Limit alarms take analog inputs and provide low-limit, high-limit, or other discrete outputs based on the input value.

SIGNAL CONDITIONERS

DC VOLTAGE / CURRENT/ POTENTIOMETER INPUT

STARTING AT $145.00

AutomationDirect FC series signal conditioners provide isolation and conversion for common analog signals, helping ensure clean, reliable data transmission in industrial systems.

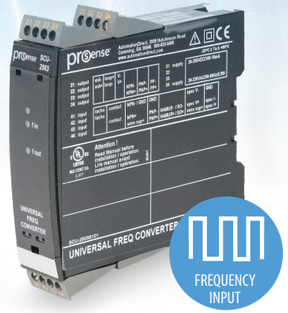
- Isolate and convert unipolar and bipolar voltage or current signals
- Slim-line housing with 35mm DIN rail mount for compact installation
- Supports long cable runs and eliminates ground loops

UNIVERSAL INPUT

STARTING AT $229.00

ProSense SCU series universal signal conditioners handle a wide range of sensor inputs, providing scaling, isolation, and signal conversion in one compact unit.

- Removable programming module simplifies setup and cloning
- Ideal for mixed-signal environments and broad application use
- Select models feature two individually configurable relay outputs for use as limit alarms
- Reduces hardware variety and simplifies inventory



FREQUENCY INPUT

STARTING AT $258.00

ProSense SCU series universal frequency transmitters are designed for high-speed sensing applications. They accept frequency inputs and deliver precise analog, relay, or frequency outputs.

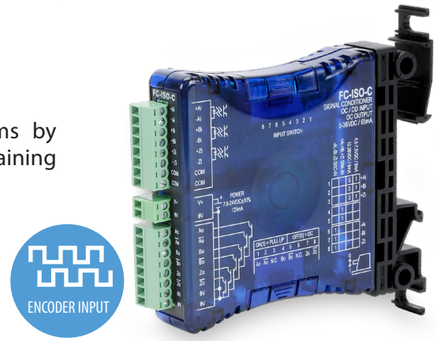
- Supports inputs up to 100 kHz from various frequency sensors
- Compatible with NPN, PNP, TTL, tachometer, and NAMUR sensors
- Optional square root output for flow applications
- Ideal for speed monitoring, flow, and RPM-based processes

HIGH SPEED OPTICAL ISOLATORS (ENCODER INPUT)

STARTING AT $157.00

AutomationDirect FC series optical isolators protect control systems by separating encoder signals from downstream equipment while maintaining high-speed performance.

- Interfaces between encoders and PLCs, drives, or controllers
- Provides high-speed, multi-channel isolation
- Reduces electrical noise and prevents signal distortion
- Converts between open collector or differential line driver output formats



HIGH DENSITY SIGNAL CONDITIONERS

STARTING AT $110.00

ProSense SC6 series high density signal conditioners offer a compact solution for space-limited applications. These low-cost conditioners are ideal for industrial automation and process control systems where accurate and reliable signal conditioning is essential and cost concerns are at the forefront.

- Only 6mm wide for maximum panel density
- Select models convert or isolate voltage, current, and bipolar signals; temperature models convert potentiometers, RTDs, and thermocouples
- Standard models in single channel, dual channel, and splitter versions; temperature models are single channel only
- In-rail bus or loop-powered for flexible installation
- FM approved for use in Class 1 Division 2 hazardous locations

POINT-TO-POINT WIRELESS I/O

PRICED AT $675.00

Define Instruments Twin Link series point-to-point wireless I/O devices ensure reliable signal transmission over long distances where cabling is difficult or costly.

- Sender/receiver pair combines signal transmission and control in ompact form factor
- Accepts a wide range of inputs (thermocouple, RTD, mA, frequency) and provides two isolated 4-20mA outputs for seamless integration
- 4 digital inputs, 2 digital outputs, and 2 relay outputs per node for advanced control, alarms, or pass through (transparent mode)
- Strong signal transmits up to 0.9 miles line-of-sight or 500 ft through walls
- Up to 15 repeaters may be used to improve the signal path and extend range
- Easy configuration via USB with the free Define ToolBox software

Part number DEFINE-TWIN-LINK includes a sender-receiver pair

LIMIT ALARMS

STARTING AT $141.00

AutomationDirect FC series limit alarms monitor analog inputs and trigger discrete outputs when signals exceed user-defined thresholds.

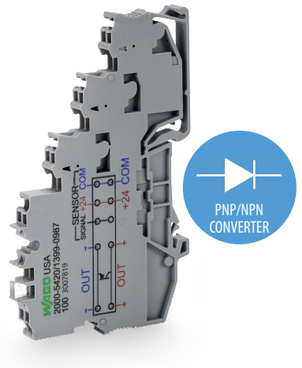
- Accepts voltage or current inputs
- DIP switch and button configuration for easy setup
- Multiple relay modes for flexible control
- Protects equipment by triggering alerts under fault conditions

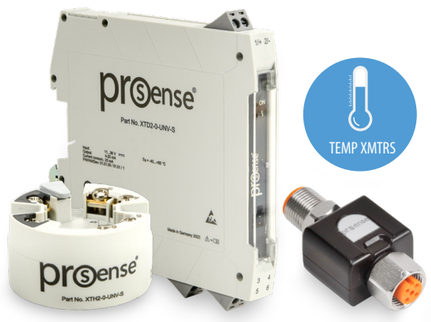
PNP/NPN CONVERTER

PRICED AT $51.00

The WAGO PNP/NPN converter adapts discrete signals between PNP and NPN logic types.

- Terminal block design for easy installation
- Easy selection simplifies setup
- Ensures sensor/controller compatibility





TEMPERATURE TRANSMITTERS

STARTING AT $79.00

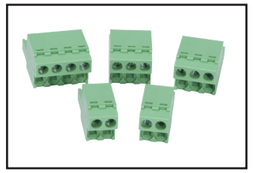
Temperature transmitters improve the accuracy and reliability of temperature measurements by converting low-level millivolt signals into robust, noise-resistant analog outputs.

For more information on temperature transmitters, please see our Temperature Sensors brochure

SIGNAL CONDITIONER ACCESSORIES

SPARE PARTS & ACCESSORIES

Spare parts and accessories for signal conditioners, isolators, and converters include replacement terminal blocks, configuration software, detachable programming/display module for select models, and more.



Terminal blocks, cables, and connectors

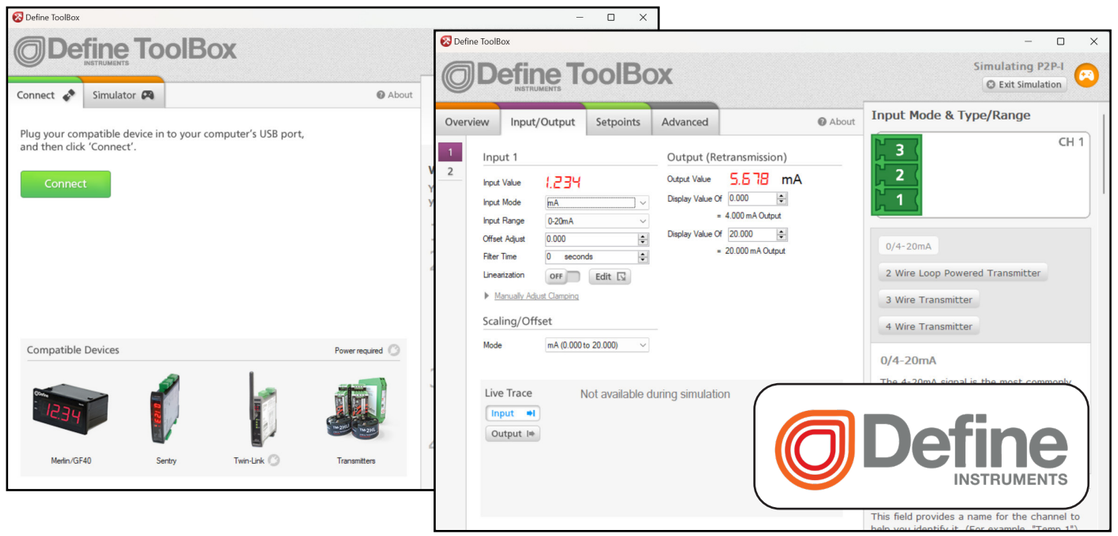
Probe and field mount housings

Digital displays

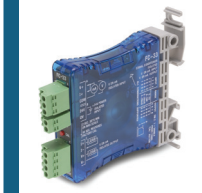
Programmable/ display module

Configuration software

- Select signal conditioners offer easy-to-use configuration software for quick setup and deployment.



SELECTION GUIDE

Features	Automation Direct FC Series	ProSense SCU Series	High Density Series	WAGO PNP/ NPN Converter	Define Instruments P2P I/O
					
Pre-configured or configured with buttons/switches on device	✓	---	✓	✓	---
Configured with software or display module	---	✓	---	---	✓
Universal configurable input	---	✓	---	---	✓
Relay output options for alarms or simple control	✓	✓	---	---	✓
Temperature specific inputs	✓	✓	✓	---	✓
Loop powered units	✓	---	✓	---	---
Frequency inputs and outputs	---	✓	---	---	✓
Encoder input	✓	---	---	---	---
Slim line for stackable, high-density installations	---	---	✓	✓	---
Hazardous location rated options	---	✓	✓	---	---
Starting at price	$145.00	$252.00	$121.00	$52.00	$675.00