This manual should be used in conjunction with the Tronic Line data sheets. The information herein is for reference only. Final product selection should be based on the technical specifications provided on the most recent product data sheets. All technical specifications in this manual and on the data sheets are subject to change without notice. For further assistance, please contact the WIKA technical team.

1.0 Introduction

Pressure transmitters and transducers are electronic devices that measure pressure and produce an output signal that is both **linear** and **proportional** to the applied pressure.

> A **pressure transmitter** converts applied pressure to an amplified output signal such as 4-20 mA or 0-10 V.
> A **pressure transducer** converts applied pressure to an unamplified signal such as 2mV/V.

General purpose pressure sensors, transducers, and transmitters are usually referred to as pressure transducers. In this manual , the word transmitter is used to refer to both transmitters and transducers unless otherwise noted.

Typical WIKA Tronic Industrial Pressure Transmitter

Standard electrical connection: DIN 43650 cap with solderless screw terminals. Available options include 1/2" NPT female conduit, NEMA 4 flying leads with vented cable, 4 and 6 pin Mil Plug, and custom connectors.

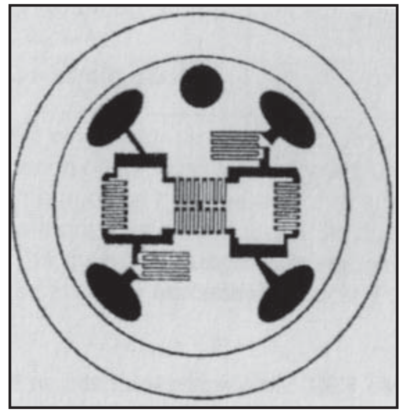
Body: 304 stainless steel. Contains circuit board for signal conditioning to produce 4-20 mA, 0-5 volt, or other high level output. The circuit board is potted in silicone gel for moisture and vibration protection.

Process connection: 316 stainless steel for corrosion resistance. 1/2 NPT male is the standard. The sensing element is located inside the process connection near the hex.

WIKA manufactures a broad range of transmitter models to meet a variety of applications and environments. These models can vary in the type of electrical connection, process connection, and electrical specifications.

1.1 The Pressure Sensor

WIKA pressure transmitters use a **strain gauge** as the primary sensing element. Strain gauge sensors feature small size, fast response, and high reliability. The strain gauge is a series of resistors arranged in a circuit called a **Wheatstone Bridge.** As the sensor is pressurized, the resistors are stretched and compressed by the pressure and their resistance changes in proportion to the amount of pressure applied.



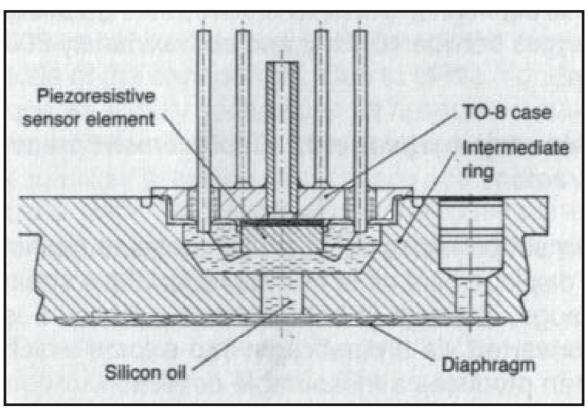
Wheatstone Bridge

Three types of strain gauge sensors are used in most WIKA pressure transmitters: **piezoresistive**, **thin film, and ceramic.**

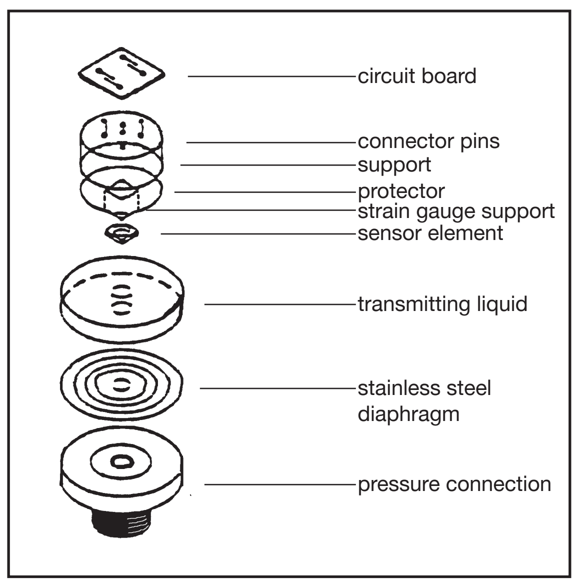
1.2 Piezoresistive Sensors

Low pressure applications to 300 psi use a diffused semiconductor **piezoresistive** strain gauge. This type of strain gauge is manufactured using integrated circuit technology. The Wheatstone Bridge is etched onto a single crystal silicon diaphragm. Since the silicon diaphragm cannot withstand corrosive media, it is isolated by a metal diaphragm. Pressure is transmitted to the silicon diaphragm by a transmitting liquid, usually a synthetic oil. Other fill fluids including halocarbon are available for special applications including paint and oxygen media.

This type of sensor, also known a *piezoresistive strain gauge*, is found in most WIKA industrial, OEM, and special purpose transmitters up to a pressure range of 300 psi.



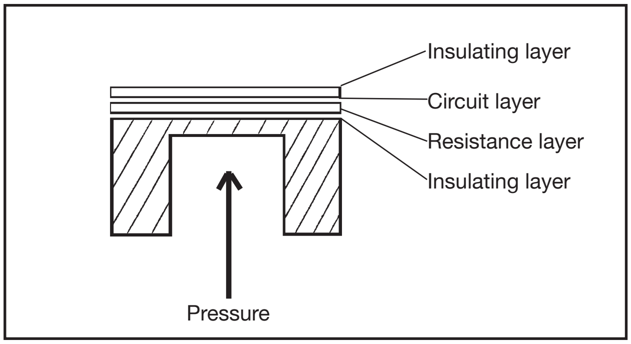
Piezoresistive sensor



Exploded view of a typical piezoresistive sensor assembly

1.3 Thin Film Sensors

Tronic pressure transmitters above 300 psi use a **Thin Film** strain gauge sensor. A Thin Film sensor has the Wheatstone Bridge deposited directly on a stainless steel diaphragm. This is applied to the diaphragm by a vacuum deposition process called sputtering. This sensor technology results in fewer components and higher reliability in high pressure applications when compared to many other sensor technologies.



Cross section of a Thin Film sensor

WIKA 7 mm Thin Film sensor

The thin film sensor is used in WIKA Tronic pressure transmitters with a range above 300 psi.

Product example:

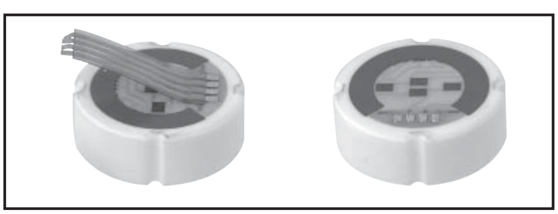
The WIKA **TTF-1** is the Thin Film sensor packaged in a 1/4" NPT male process connection and equipped with 6" color coded leads. The **low level output** is 2 millivolts per volt (**2mV/V**). Using the 0-25 bar range as an example, a circuit with a 10 volt supply will provide an output of 20 mV at 25 bar pressure. A 20 volt supply voltage (the maximum) will provide a 40 millivolt output at full pressure. The lowest available pressure range for this sensor is 0-10 bar (0-145 psi).

Model TTF-1

This sensor is designed for OEM engineers who want to provide their own regulated power supply and signal conditioning circuitry. Substantial cost savings for the user are possible when large quantities are required.

Ceramic Sensors

The WIKA monolithic ceramic thick film sensor is a one piece design. This provides high, long term stability. The ceramic substrate produces virtually no hysteresis. It is a low cost sensor with an unamplified mV per V signal for use in the automotive, pneumatics, and water industries. It is also used in the WIKA low cost PSD-10 pressure switches, DG-10 digital gauge, and MCT sensors.



WIKA monolithic ceramic sensors

Model DG-10

1.4 Other Sensor Types

Many different sensor technologies exist for pressure measurement. Many have specific advantages, depending upon the application.

Foil type strain gauges are inexpensive and flexible because they can be applied to many types of metal surfaces, including curved surfaces, by using adhesives. They are glued to the rear surface of the diaphragm. An additional plastic film is applied over the strain gauge for protection. Bonded strain gauges may show excessive temperature and stability effects because they use an adhesive to attach the foil to the metal diaphragm. Since the steel diaphragm and adhesive expand and contract at different rates with temperature changes, elaborate temperature compensation measures are required to minimize this error. The bonded foil may also "creep" (shift position on the diaphragm) when under load because the diaphragm and adhesive have different elastic properties.

Capacitive sensors use the change in distance between two metallic plates to measure pressure. They are very sensitive in low pressure and high vacuum applications. If made with ceramic diaphragms, this type of sensor can withstand very high overload pressures. However, ceramic diaphragms are brittle when compared to stainless steel, and many require a sealing gasket of Viton® or other material when installed in a stainless steel process connection.

Inductive sensors include types that use a change in magnetic resistance and LVDT (linear variable displacement transformer). These sensors require a relatively large displacement of the diaphragm and are typically used to measure static pressure. This technology has largely been replaced by other newer sensor technologies.

Microelectromechanical systems (MEMS) combines microelectronics with miniature mechanical systems such as valves or gears all on a single chip using nanotechnology for pressure measurement.

Vibrating elements (for example silicon resonance) use the change in vibration on the molecular level of different material elements caused by a change in applied pressure to measure the pressure.

Many other sensor technologies exist, including Hall effect, potentiometric, ionization, and quartz. Many are for highly specialized, nonindustrial applications.