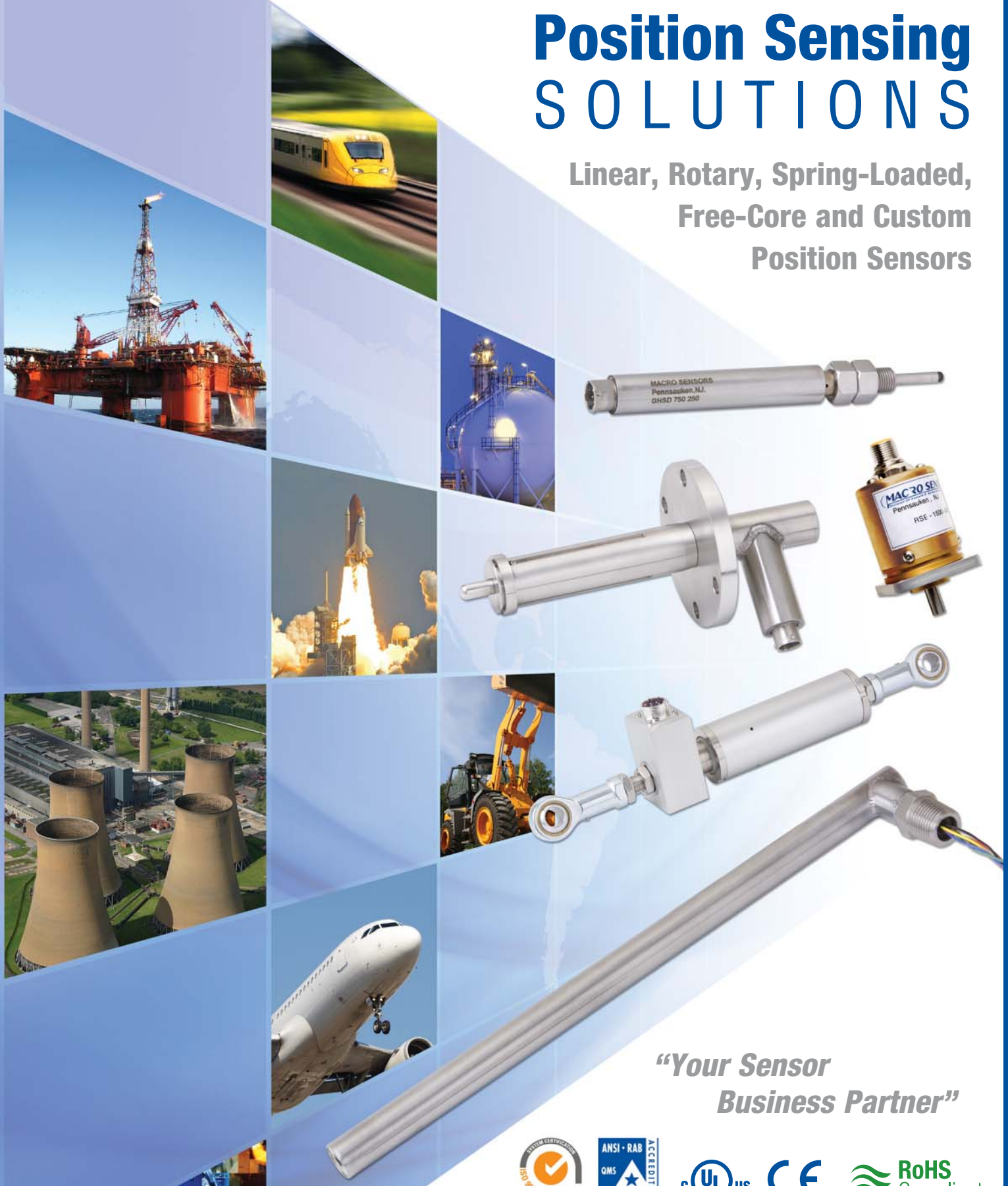
Position Sensing
SOLUTIONS

Linear, Rotary, Spring-Loaded, Free-Core and Custom Position Sensors



"Your Sensor Business Partner"

RoHS Compliant

MACRO SENSORS™
Division Of Howard A. Schaevitz Technologies, Inc.

Macro Sensors Company History

Macro Sensors is "***your sensor business partner...***," solving position measurement problems as an extension of the customer's engineering resource. Macro Sensors designs and manufactures highly accurate, extremely rugged position sensors utilized in industrial and aerospace applications worldwide.

Macro Sensors traces its origins directly to Herman Schaevitz who founded Schaevitz Engineering in 1945. Mr. Schaevitz is widely recognized as the pioneer developer of LVDT technology. He transformed the LVDT from a hand-made laboratory device to the mission critical position sensor it is today and built Schaevitz Engineering into a successful enterprise with the LVDT as the core product. Following Mr. Schaevitz' retirement, he was succeeded as CEO by his son, Howard, who presided over a decade of extraordinary corporate growth and product expansion.

Macro Sensors Corporate Headquarters - Pennsauken, NJ USA

After the sale of Schaevitz Engineering to a larger firm, Howard and several members of the Schaevitz "brain trust" formed Macro Sensors, a division of Howard A. Schaevitz Technologies, to design, manufacture and market position sensors and related products. Macro Sensors' personnel bring a level of knowledge and experience unrivaled in the position sensor industry with more than 500 years of cumulative design and manufacturing know-how. The organization continues to flourish in the manner established by its predecessors, fueled by an expanded product line and customer driven design-for-application engineering.

In 2005, American Sensor Technologies (AST), a state-of-the-art manufacturer of Krystal Bond™ Technology MEMS pressure sensors, acquired Macro Sensors, thereby creating a single source offering customers both pressure and position sensing expertise at the highest level.

Howard A. Schaevitz
Chairman of the Board

American Sensor Technologies (AST)

AST was founded in 1997 by a professional management team with knowledge and experience in the MEMS-based sensor industry, along with the drive to manufacture products in the U.S. Their relationship provides AST both unique and complementary talents in development engineering, marketing and business administration. Collectively, the founders bring over 80 years of industry experience to AST, assuring the company's ability to manage fast-paced business growth while sustaining the frequent introductions of new technologies and products.

Common applications of AST's sensor products are industrial OEM, fluid power, hydraulic systems, fuel cells, medical gases, HVAC/R, water management, oil & gas exploration and off-road vehicles. By utilizing AST's exclusive portfolio of sensor technologies including the proprietary Krystal Bond™ Technology, the specialized needs of key niche markets can be supported. Many of AST's products offer UL/cUL, CSA and CE approvals in hazardous environments.

AST Corporate Headquarters - Mt. Olive, NJ USA

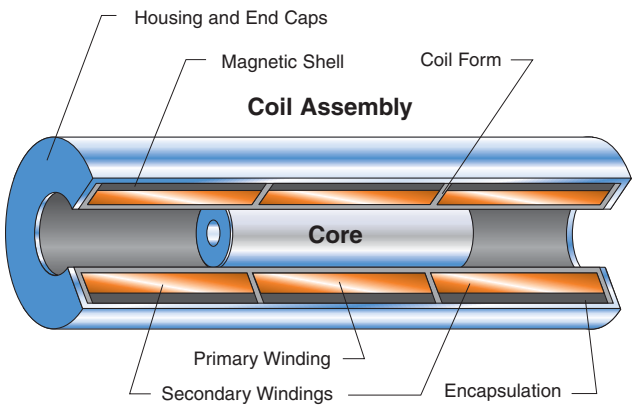
"quality products made in the USA"

What is an LVDT?

The letters LVDT are an acronym for Linear Variable Differential Transformer, an electromechanical transducer that converts the rectilinear motion of an object to which it is coupled mechanically to a corresponding electrical signal.

Structure of a typical LVDT

The figure below shows the components of a typical LVDT. The internal structure consists of a primary winding centered between a pair of secondary windings symmetrically spaced about the primary. The coils are wound on a coil form, surrounded by a magnetic shield, and secured in a cylindrical housing. This coil assembly is usually the stationary element of the position sensor.



The moving element of an LVDT is a separate tubular armature of magnetically permeable material called the core. The core is free to move axially within the coil's bore, and is mechanically coupled to the object whose position is being measured. The bore is large enough to provide radial clearance between the core and coil with no physical contact.

In operation, the LVDT's primary winding is energized by alternating current of appropriate amplitude and frequency, known as the primary excitation. The LVDT's electrical output signal, which varies with the axial position of the core, is the secondary winding differential AC voltage. Usually this AC output voltage is converted a high level DC voltage or current that is more convenient to use.

Why use an LVDT?

LVDTs have significant features and benefits which derive from its fundamental physical principles of operation and the materials and techniques used in its construction.

Unlimited Mechanical Life and Friction Free Operation

Because there is normally no contact between the LVDT's core and coil structure, parts do not rub together or wear out. This means that an LVDT features unlimited mechanical life with no source of friction.

Infinite Resolution and Repeatability

Since an LVDT operates on electromagnetic coupling principles in a friction free structure, it can measure infinitesimally small changes in core position. This infinite capability is limited only by the noise and resolution of the LVDT signal conditioner.

Single Axis Sensitivity

An LVDT responds to motion of the core along the coil's axis, but is generally insensitive to cross axis motion of the core or to its radial position. Thus, an LVDT can usually function without adverse effect in applications involving misaligned or floating moving members, and in cases where the core doesn't travel in a precisely straight line.

Separable Coil And Core

Because the only interaction between an LVDT's core and coil is magnetic coupling, the coil assembly can be isolated from the core by inserting a non magnetic tube between the core and the bore. By doing so, a pressurized fluid can be contained within the tube, in which the core is free to move, while the coil assembly does not have to be pressurized.

Environmentally Robust

The materials and construction techniques used in assembling an LVDT result in a rugged, durable sensor that is robust to a variety of environmental conditions. Bonding of the windings is followed by epoxy encapsulation into the case, resulting in superior moisture and humidity resistance, as well as the capability to take substantial shock loads and high vibration levels in all axes. Both the case and core are made of corrosion resistant metals, with the case also acting as a supplemental magnetic shield. And for those applications where the sensor must withstand exposure to flammable or corrosive vapors and liquids or operate in pressurized fluid, the case and coil assembly can be hermetically sealed using a variety of welding processes.

Ordinary LVDTs operate over a very wide temperature range, and, if required, they can be produced to operate down to cryogenic temperatures, or at the elevated temperatures and radiation levels found in many nuclear reactors.

Absolute Output

An LVDT is an absolute output device, as opposed to an incremental output device. This means that in the event of loss of power, the position data being sent from the LVDT will not be lost. When the measuring system is restarted, the LVDT's output value will be the same as it was before the power failure occurred.

Energy

BENEFITS

- High temperatures to 250 °C
- High pressure to 20,000 PSI
- Radiation to 3 x 10^7 Rads

APPLICATIONS

- Power generation
- Hazardous locations
- Down-hole pipeline monitoring

Factory Automation

APPLICATIONS

- Product gaging
- Process control

BENEFITS

- Wide selection of measurement ranges
- Non-linearity to 0.1%
- Hermetically sealed
- µm (micro-inch) resolutions
- Analog I/O for PLC compatibility
- Absolute measurement
- Indicators / controllers

Aerospace / Military

BENEFITS

- COTS compatibility
- High temperatures to 250 °C
- Hermetically sealed

APPLICATIONS

- Control surface position
- Engine control feedback
- Thermal control
- Submarine hatch
- Pilot control inputs

Hydraulics / Pneumatics

BENEFITS

- Frictionless
- Unlimited cycle life
- Embedable
- Excellent stroke to length ratio

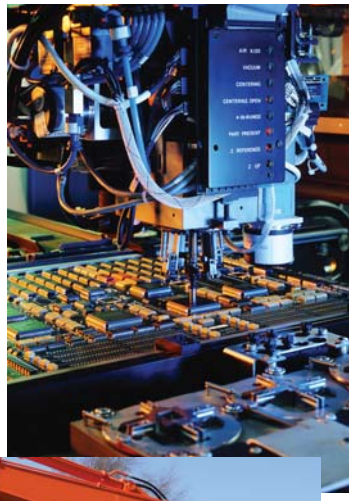
APPLICATIONS

- Spool valves
- Cylinders
- Booms
- Valve position
- Actuators

Industrial OEM

BENEFITS

- Cost effective solutions
- Supply chain support
- Integral or remote electronics
- Custom design solutions
- ISO 9001: 2000 certified



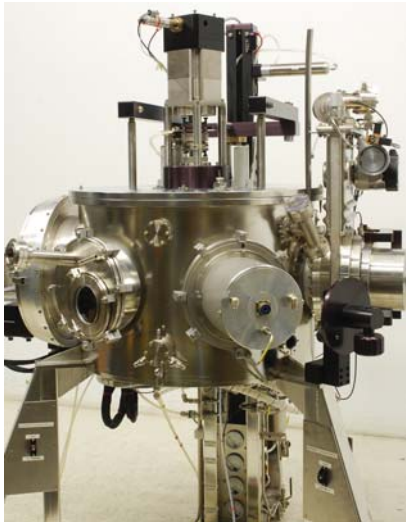
APPLICATIONS

- Electro-mechanical systems
- High volume product

Civil Engineering / R&D

APPLICATIONS

- Structural monitoring
- Test equipment



BENEFITS

- Wide range of products
- High vacuum operation
- Submersible
- Extensive selection of indicators and controllers

Subsea / Marine

BENEFITS

- High pressure to 20,000 PSI
- Inconel / Monel construction
- 316L stainless steel construction
- Long term reliability
- 20+ years survivability

APPLICATIONS

- Control valves
- ROV and exploration
- Pipeline monitoring
- Off-shore drilling and platforms

Transportation

APPLICATIONS

- Railroad
- Agricultural equipment
- Road paving equipment
- Off-road construction equipment

BENEFITS

- Unlimited cycle life
- Hermetically sealed (IP-69K)
- High shock to 1000 g
- Vibration to 20 g (RMS)

Our Free-Core AC powered LVDT's are available in a wide varitey of sizes, measuring ranges and packages. Their robust construction allows them to be used for general purpose, harsh environments or hazardous locations.

PR Series

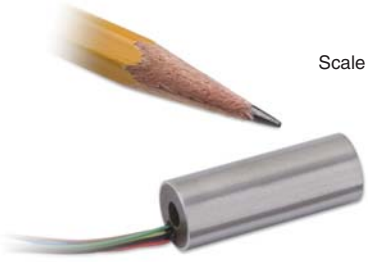
The PR Series of AC LVDTs features excellent linearity and high sensitivity and is a reliable and cost effective solution for many position measurements. Available in either 0.750 inch or 0.812 inch diameters, these units are nominally interchangeable with legacy units from other manufacturers.

Scale approx. 1:2

- **Available in standard 0.750 inch [19 mm] or 0.812 inch [20.6 mm] diameter**
- **Ranges of ±0.05 inches to ±10 inches [±1.25 mm to ±250 mm]**
- **0.031 [0.8 mm] or 0.062 [1.6 mm] radial core to bore clearance**
- **±0.25% maximum linearity error**

CD Series

The CD Series of AC LVDTs features a compact package design for applications with size constraints. The low mass core also makes them well suited for dynamic applications.

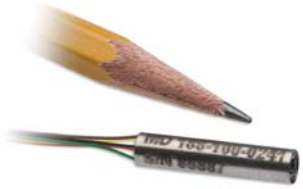


Scale approx. 1:1

- **Miniature 0.375 inch [9.5 mm] body diameter**
- **Low core mass**
- **Ranges of ±0.025 inches to ±2 inches [±0.63 mm to ±50 mm]**
- **±0.25% maximum linearity error**

MD Series

The MD Series of sub-miniature AC LVDTs are designed to operate over millions of cycles without wear or degradation of signal quality in tight spaces. Ultra-low-mass cores allow them to be used for high response dynamic measurements.



Scale approx. 1:1

- **Miniature 0.188 inch [4.8 mm] body diameter**
- **Low core mass**
- **Ranges of ±0.020 inches to ±0.100 inches [±0.50 mm to ±2.5 mm]**
- **±0.5% maximum linearity error**

HSA Series

The HSA Series AC LVDTs feature a welded stainless steel connector with glass sealed pins and are designed for use in harsh environments.

Scale approx. 1:2

- Available in standard 0.750 inch [19 mm] diameter
- Hermetically sealed against hostile environments
- Ranges of ±0.05 inches to ±10 inches [±1.25 mm to ±250 mm]
- ±0.25% maximum linearity error
- Mating plug for connector included

HSAR Series

The HSAR Series offers all the benefits of the HSA with the additional advantage of a radial connector for reduced installed length. Ranges of ±1 inch and above are rated to 300°F [150°C].

Scale approx. 1:2

- Available in standard 0.750 inch [19 mm] diameter
- Hermetically sealed against hostile environments
- Ranges of ±0.05 inches to ±10 inches [±1.25 mm to ±250 mm]
- ±0.25% maximum linearity error
- Through-bore design
- Mating plug for connector included

SQ Series

The SQ Series of AC LVDTs has been developed for use in extremely harsh environments. They are epoxy encapsulated in heavy duty aluminum housings and are double shielded to enhance their immunity to noise and external magnetic fields.

Scale approx. 1:3

- Heavyduty industrial design
- Ranges of ±0.50 inches to ±10 inches [±12.5 mm to ±250 mm]
- Splashproof design to IEC IP64*
- 300°F (150°C) operating temperature

*within temperature rating

HLR Series

HLR Series AC LVDTs are UL listed for Class 1, Div 2, Groups A, B, C, and D, and Class 1, Zone 2, Group IIC hazardous locations.

Scale approx. 1:4

- Available in standard 0.750 inch [19 mm] diameter
- Stainless steel throughbore construction
- Ranges of ±1 inch to ±10 inches [±25 mm to ±250 mm]
- 1/2 inch conduit outlet for lead wires
- 300°F (150°C) operating temperature

Macro Sensors offers a wide variety of spring-loaded AC-powered LVDTs designed for precision dimensional gaging and other factory automation applications.

GHSA Series

These heavy duty units use sleeve bearings to provide good repeatability and extended service life in shop floor applications. Three different configurations are available: the GHSA, with an axial connector for close mounting; the GHSAR, with a radial connector for shorter installed length; and the GHSAR-A, an air extend/spring retract version with a radial connector.

Scale approx. 1:2

- **Available in standard 0.750 inch [19 mm] diameter**
- **Ranges of ±0.05 inches to ±2 inches [±1.25 mm to ±50 mm]**
- **Repeatability of 0.000025 inches or better**
- **Mating plug for connector included**

BBP/BBT Series

These AC LVDTs utilize linear ball bearings to provide exceptional repeatability and long service life. They are available in 0.315 inch [8 mm] diameter plain body and 0.375 inch [9.5 mm] diameter, either plain or threaded body.

Scale approx. 1:2

- **Ranges of ±0.04 inches to ±0.20 inches [±1 mm to ±5 mm]**
- **Repeatability of 0.000006 inches (0.15 im) or better**
- **Life exceeds 2 x 108 cycles**
- **Sealed to IEC IP65**
- **Also available in air extend/spring retract versions**

GSA Series

The GSA Series of short range spring loaded position sensors were developed for cost sensitive applications requiring LVDT reliability and performance.

Scale approx. 1:2

- **Ranges of ±0.10 inches to ±0.30 inches [±2.5 mm to ±7.5 mm]**
- **±0.5% maximum linearity error**
- **Economical 3/4 inch size**

LVC 2500 Series

The LVC 2500 is a rugged, compact, din rail mount, single-channel signal conditioner for AC LVDTs that operates on 10-30 V DC. Designed expressly for use in 24 V systems with PLCs, it offers the user a choice of three analog outputs.

Scale approx. 1:3

- 10-30 V DC operation
- Outputs of 0 to 10 V DC, 0 to ±10 V DC, or 4-20 mA
- DIN rail mounting
- Adjustable span and zero
- User selectable gain and excitation frequencies
- Synchronizable oscillator

Macro Sensors provides support electronics solutions for users, system integrators and OEMS. These include AC/DC operated single-channel and dual channel microprocessor-based controllers and indicators with digital readout and setpoint control for both AC and DC LVDT's.

DMC Series

The DMC Series is an accurate, high performance, programmable dual-channel controller.

- 115/230 V AC power line operation; 12/24 V DC (optional)
- 0-10 V DC single analog output; 4-20 mA (optional)
- RS232C serial communications
- Four independently programmable set points to control four 5 A Form A relays
- Supports all standard AC LVDTs (DMC-A2) or 24 V powered DC LVDTs (DMC-D2)
- PC-software configurable
- Scrolling prompts for easy meter setup

DMI Series

The DMI Series is an accurate, high performance, programmable single-channel indicator.

- 115/230 V AC power line operation
- Supports all standard AC LVDTs (DMI-A1) or 24 V powered DC LVDTs (DMI-D1)
- 12/24 V DC powered operation (optional)
- 0-10 V DC single analog output (optional)
- RS232C serial communications (optional)
- Four independently programmable set points to control four 5 A Form A relays (optional)

Macro Sensors pre-calibrated DC-powered LVDTs are designed for a wide range of industrial applications. Free-core and spring-loaded models are offered in a variety of mechanical configurations and include built-in electronics for the following standard I/O configurations:

- 24 V DC input, true 0-10 V DC output, 3-wire, single-ended electronics
- ±15 V DC input, 0 to ±10 V DC output
- 4-20 mA loop powered

HSD Series

The HSD Series of precalibrated DC LVDTs is designed for operation in hostile environments. The standard HSD includes an in-line, hermetically-sealed, stainless steel connector, while a radial version (HSDR) with a through-bore design allows easy cleaning and reduced installed length. A mating plug is also included.

Scale approx. 1:2

Available in standard 0.750 inch [19 mm] diameter

Precalibrated ranges of 0.10 inches to 20 inches or ±0.05 inches to ±10 inches [2.5 mm to 500 mm or ±1.25 mm to ±250 mm]

±0.25% maximum linearity error, ±0.1% optional

Operate in hostile environments

S Series

The S Series consists of general purpose, free- core DC LVDTs that utilize built-in electronics to provide the desirable features of an AC LVDT, while offering the convenience of DC input and pre-calibrated DC output.

Scale approx. 1:2

Available in standard 0.750 inch [19 mm] diameter

Precalibrated ranges of 0.10 inches to 20 inches or ±0.05 inches to ±10 inches [2.5 mm to 500 mm or ±1.25 mm to ±250 mm]

±0.25% maximum linearity error, ±0.1% optional

Economical, general purpose DC LVDTs

GHSD Series

The heavy duty GHSD includes an axial connector for close mounting. It is also available with a radial connector for shorter installed length (GHSDR) or in an air extend/spring retract version with a radial connector (GHSDR-A).

Scale approx. 1:2

Available in standard 0.750 inch [19 mm] diameter

Ranges of 0.10 inches to 4 inches or ±0.05 inches to ±2 inches [2.5 mm to 100 mm or ±1.25 mm to ±50 mm]

±0.1% or ±0.25% maximum linearity error

Low pressure air extend/spring retract version

LP Series

LP Series infinite life position sensors offer frictionless operation, enhanced stroke to length ratios, high resolution, excellent repeatability, and low hysteresis. They are particularly suited for use where installation space is limited. These rugged sensors are contructed of stainless steel, and are hermetically sealed against hostile environments to IEC standard IP-68.

Scale approx. 1:3

Potentiometer replacement; unlimited cycle life

Available in standard 0.750 inch [19 mm] diameter

Ranges of 4.0 inches to 40.0 inches [100 mm to 1000 mm]

±0.25% maximum linearity error, ±0.1% optional

Available with the following standard I/O configurations:

- **24 V DC input, true 0-10 V DC output, 3-wire, single-ended**
- **5 V DC input, 0.5 to 4.5 V DC output**
- **4-20 mA loop powered**

RSE 1500 Series

The Macro Sensors RSE 1500 series of contactless, fractional turn rotary position sensors provide an output proportional to shaft rotation with a true zero to 10 V DC output. RSE 1500 series rotary sensors are enclosed in a 1-1/2 inch diameter anodized aluminum shell, and have a 0.250 inch stainless steel shaft running in high performance ball bearings.

Scale approx. 1:1

0° to 30°, 60°, 90°, or 120° rotational ranges

Full 360° rotation contactless technology

Non-linearity less than ±0.1% of FRO

DC voltage absolute analog outputs

Environmentally sealed to IEC IP-66

Integral DC-in / DC-out electronics

Macro Sensors has a library of over 800 custom designs. Our engineering team will work closely with your company to offer the most cost-effective solution to your measurement challenges.

High Pressure

- Flange mount
- Spring loaded
- Up to 5000 psi

Monel / Inconel

- High pressure up to 5000 psi
- Submersible
- Subsea

High Temperature

- Up to 200 °C
- Ruggedized design
- Rod-eye end connections

Hazardous Locations

- Explosion-proof
- Weather-proof
- Wide range of operating temperatures

Remote Electronics

- Hostile environments
- UL approved
- High level outputs
  (0-10 V, 4-20 mA, 0.5 - 4.5 V, etc.)

Military / Aerospace

- Flight qualified
- High reliability
- COTS

In-Cylinder Mounting

- Frictionless
- High pressure hydraulics
- High stroke to length ratio

Some of our business partners are...


















7300 US Route 130 North, Bldg. 22
Pennsauken, NJ 08110-1541 USA
tel: 856-662-8000
fax: 856-317-1005
www.macrosensors.com
lvdts@macrosensors.com