

Non-Contact Capacitance Gauging Instrument & Series 2800 Capacitive Probes



Description

The 4810 is a single channel instrument that provides an analog display of probe displacement on the front panel. The 4810 provides analog output via a BNC jack on the front panel for easy connection to oscilloscopes, spectrum analyzers or computer based A/D boards. The 4810, along with the 2800 series family of standard and custom probes, uses an advanced capacitive gauging technology to provide exceptional resolution, large operating ranges and large standoff distances. The large, easy-to-read front panel display makes the 4810 an ideal production tool for operations requiring visual verification of measurements.

Features

Sub nanometer resolution for ultra-precise measurements

Exceptional temperature stability for a wide variety of environmental measurement applications

Wide variety of precision capacitive sensors for measuring even the most difficult size and shape target

Standard analog outputs for easy connection to A/D boards

Large standoff distances allow safe gauging of delicate parts

Superior price/performance

Patented PhaseLock™ probe driver circuitry for improved accuracy on ungrounded targets and applications such as thickness

Selectable filters for maximum resolution: 10 Hz, 100 Hz, 1 kHz, 10 kHz

Probes are interchangeable with straightforward recalibration

Portable, lightweight

Applications

- Non-contact, non-destructive measurements
- Precision dimensional gauging
- X-Y positioning
- Real-time in-process measurements
- Slide and spindle runout
- In-process sheet thickness
- Vibration analysis
- Servo-loop positioning systems
- Wear measurements
- Precision alignment
- Ultra high vacuum measurements
- Ultra high stability
- Go/no go gauging

Laser calibration

High-precision individual unit calibration at factory using ADE-developed laser interferometry system. Calibration traceable to NIST. Performance graph included.

Options

Operating ranges

- Operating ranges can be user specified to optimize resolution for a specific application.
- Optional “driven target” mode significantly improves resolution.
- Optional Ultra High stability system for the most demanding long term measurements

Series 2800 probes

ADE Technologies has developed a new, lower cost family of high performance capacitive sensors providing a greater temperature stability and measurement linearity.

Measurement ranges from 20 microns to 2 millimeters are available in standard products. Custom probe configurations are available to meet unique applications requirements.

- ▲ Sub nanometer resolution for ultra-precise measurements
- ▲ Exceptional temperature stability
- ▲ Wide variety of precision capacitive sensors available
- ▲ Standard analog outputs for easy connection to A/D boards
- ▲ Large standoff distances allow safe gauging of delicate parts
- ▲ Superior price and performance
- ▲ Portable, lightweight



Performance

Measurement Range

± 10 microns to ± 1000 microns full scale, depending on probe selection.

Measurement resolutions

Typically better than 20 PPM of full scale range @ 1kHz. Resolutions of better than 1 PPM are attainable:

Typical Resolutions (RMS, nm)					
Sensor ø (mm)	Range ± μm	Bandwidth (Hz)	Resolutions (nm)	PPM	Optional Driven Target
5	30	10	0.05	0.83	N
5	30	1000	0.16	2.7	N
5	250	1000	7.0	14.0	N
5	250	1000	4.0	8.0	Y
1	30	1000	2.5	41.6	N
1	30	1000	1.2	20	Y
1	30	100	0.7	11.6	N
1	30	100	0.4	1.6	Y

Actual resolution depends on probe selection, bandwidth and operating range. Resolution improves with larger sensor area, reduced bandwidth and smaller range. Detailed specifications are provided with probe information

Linearity

Typically better than 0.025% over full scale range, depending on probe model and operating range Detailed

Stability

- Standard systems offer excellent stability. Typical stability is on the order of 100 PPM over 1 F or 200 PPM per PC.
- Optional high stability system: For the most demanding applications where stability over weeks and months is required to assure accuracy and productivity. Typical stabilities are on the order of 50 PPM over 6 months. Systems come with special stability testing, temperature and humidity correction coefficients.

Bandwidth

Standard 1 kHz
Jumper Selectable 10 Hz, 100 Hz, 10 kHz .

Inputs/Outputs

Probe inputs

Single, accepts Series 2800 probe family.

Analog Output

Standard ± 10 volts for full scale range

Optional ± 5 v, 0-10 v

Drive Synchronization

For multi-unit applications. Sensors may be driven in or out of phase.

Limits

User adjustable digital outputs for detecting overrange and measurement limits.

Adjustments/Indicators

Front panel adjustments

Calibration adjustment for scale factor.
Offset adjustment for zero setting. Limit settings.

Front panel LED indicators

Power, + limit, - limit

Physical Dimensions

18 cm- L x 11 cm-W x 4 cm-H
(7.0" x 4.25" x 1.5")

Weight

0.5 kg (1.1 lbs)

Operating Environment

Temperature

5° C to 50° C (41° F to 122° F)

Humidity

0 to 95% RH, non condensing

Power Requirements

90 - 240 VAC, Standard ADE Universal Low Noise Power Supply with IEC Connector included with Instrument

Probe Selection

Accepts Series 2800 and 2900 passive probes



Series 2800 Passive Probes



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Probe Selection Procedure

Steps **Guidance**

1 Identify Target Shape and Minimum Target Dimension by observing item to be measured and comparing with the guidance illustrations.

FLAT

CYLINDRICAL

SPHERICAL

2 Calculate Maximum Sensor Diameter
 (Note: This dimension is less than the minimum target dimension because all of the "spreading" electric field needs to be on the target surface.)

$\text{Minimum Target Dimension} \times$ <hr style="width: 100%;"/>	\times	$\left\{ \begin{array}{l} 0.60 \text{ for Flat Target} \\ 0.25 \text{ for Cylindrical Target} \\ 0.20 \text{ for Spherical Target} \end{array} \right\}$	$=$	$\text{Maximum Sensor Diameter}$ <hr style="width: 100%;"/>
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3 Determine Optimum Sensor Size from step 2 answers
 For best overall performance select the **larger** sensor size option. However, smaller sensor sizes may be preferred if surface profile or flatness of a textured surface is being measured, or if measurements are being made near a target edge.

SENSORS

A

B

C

Target Surface

SENSOR OUTPUTS

Sensor 'A'

Sensor 'B'

Sensor 'C'

4 Select Probe Style
 Axial style is usually preferred, however other styles are available to facilitate target access. Refer to the probe diagrams on the preceding pages.

Axial

Lo-Profile

Right Angle

30° Axial

Correct Standoff

Incorrect Standoff

5 Determine Probe Ordering Information
 Use answers 2,3, and 4 above for probe and sensor size. Consult sensor drawings.

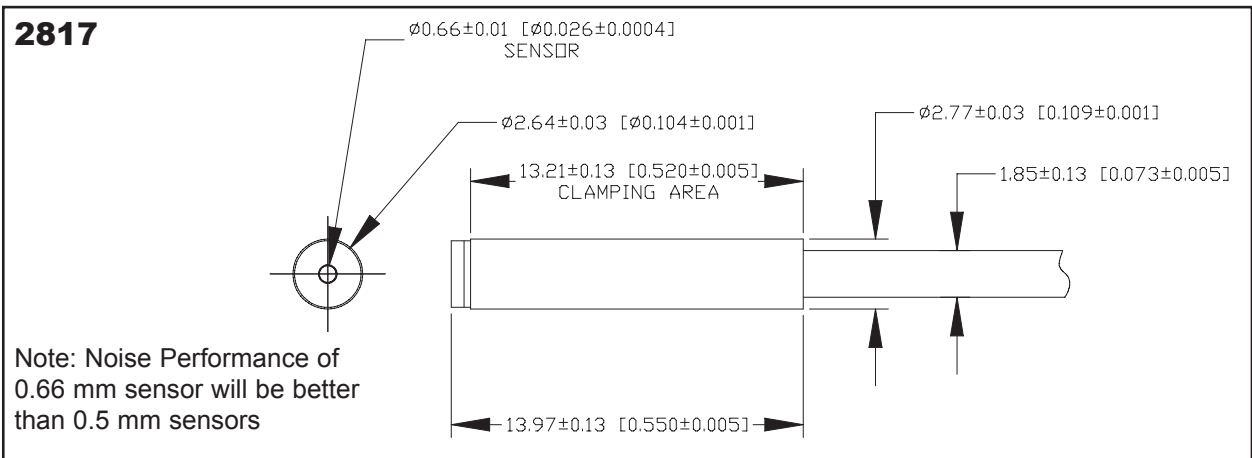
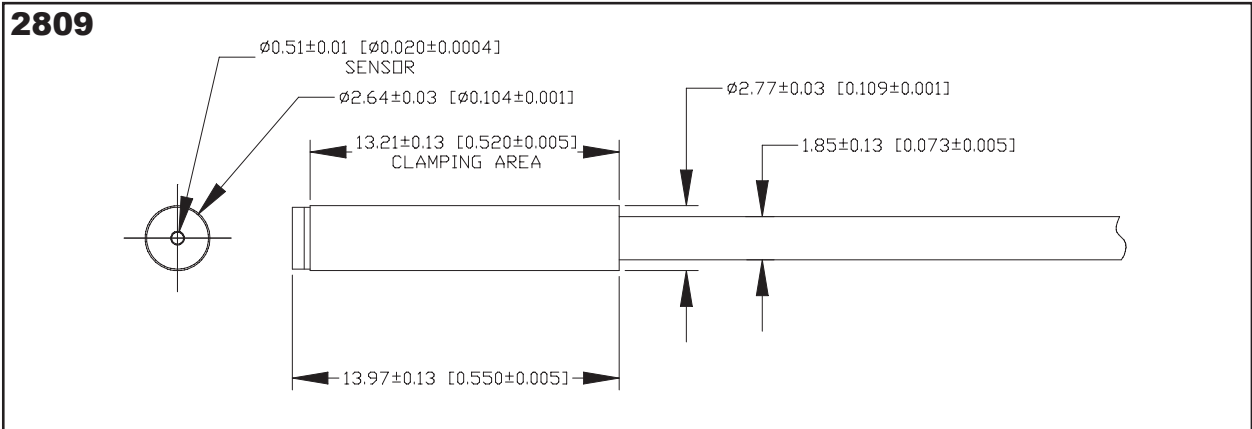
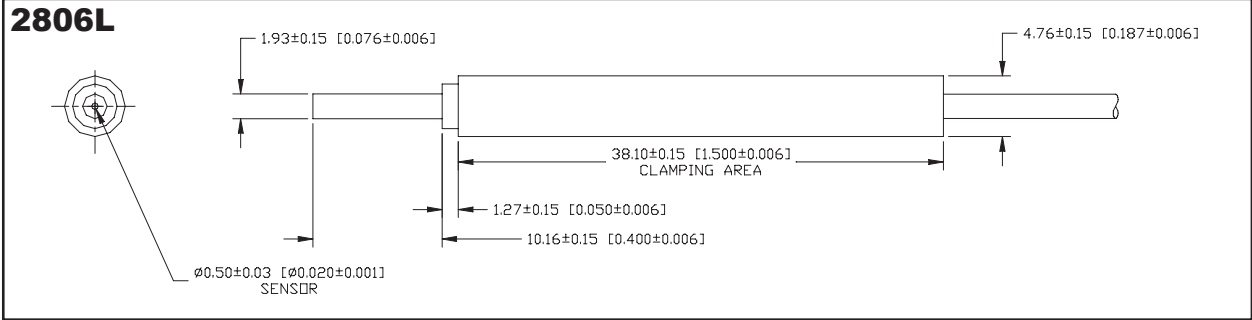
Refer to the following pages for the correct probe choice

Note: On special request, probes can be custom designed to suit specific customer needs. Consult the factory.



0.5 - 0.66 mm Diameter Sensors

Compatible with 4810, 4800, 4805



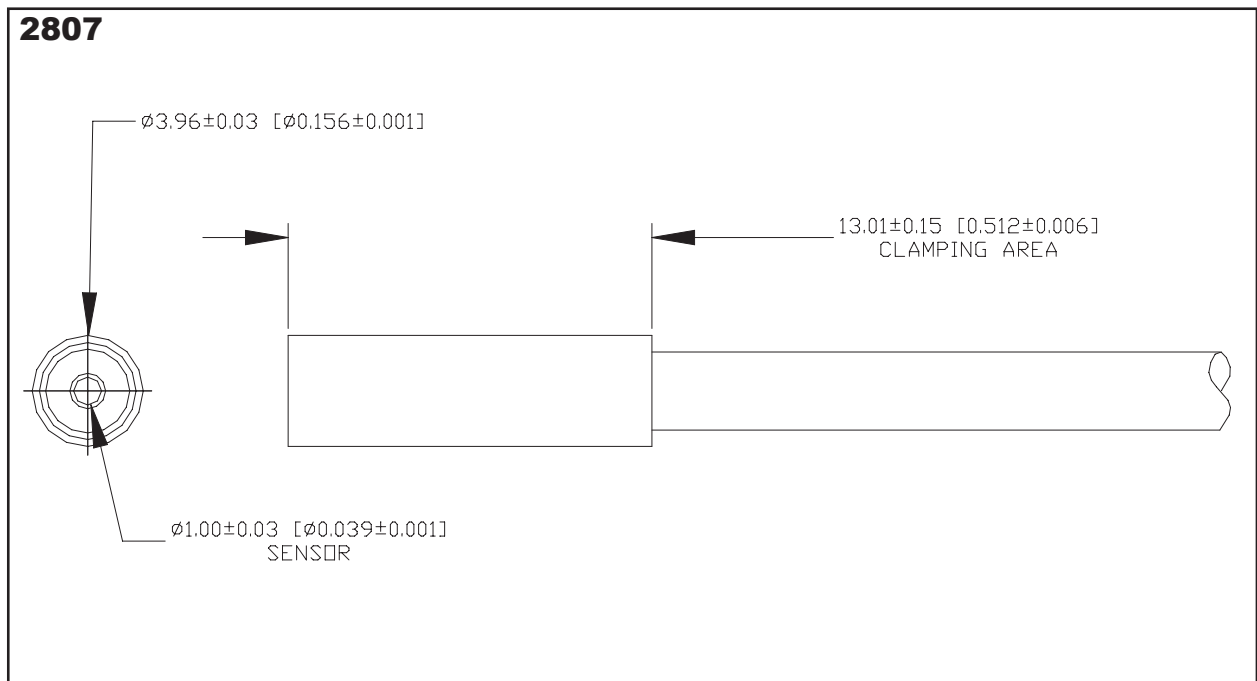
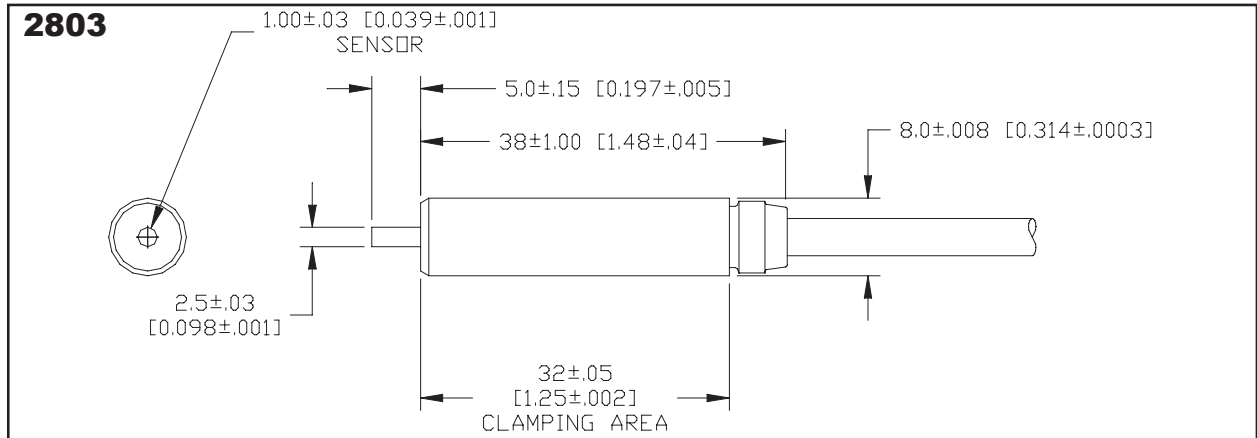
Performance Specification 0.5 mm Diameter Sensor

Range (um,mil)	Standoff (um,mil)	Linearity % Full Scale	Target Type (Ground, Driven)	Resolution By Filter Setting(nanometer, <i>microinch</i> , r.m.s)			
				10 Hz	100 Hz	1 kHz	10 kHz
± 5,0.25	10, 0.4	Consult Factory	Ground	0.05, 0.002	0.23, 0.009	0.77, 0.03	2.4, 0.10
			Driven	0.03, 0.001	0.12, 0.005	0.39, 0.015	1.29, 0.05
± 10,0.4	20, 0.8	Consult Factory	Ground	0.21, 0.009	1.3, 0.05	4.1, 0.16	12.9, 0.5
			Driven	0.10, 0.004	0.41, 0.017	1.45, 0.06	5.8, 0.24
± 25,1	50, 2	0.02%	Ground	1.23, 0.05	5.56, 0.22	19.5, 0.78	60.9, 2.4
			Driven	0.62, 0.025	3.6, 0.14	11.3, 0.45	32.5, 1.3
± 50,2	100, 4	0.05%	Ground	2.45, 0.05	11.0, 0.44	38.9, 1.55	121.0, 4.8
			Driven	1.22, 0.098	7.2, 0.28	22.3, 0.90	64.7, 2.6



1 mm Diameter Sensors

Compatible with 4810, 4800, 4805



Performance Specification 1 mm Diameter Sensor

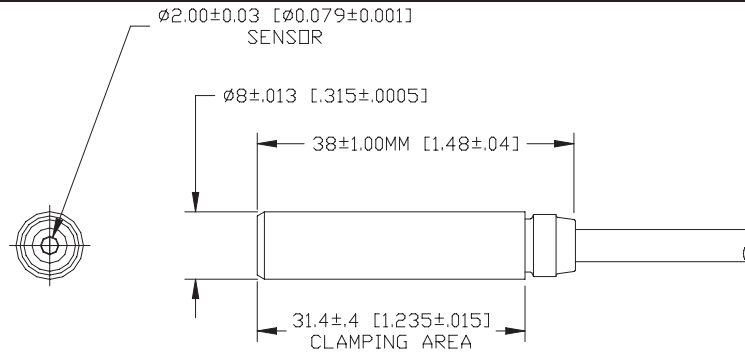
Range (um,mil)	Standoff (um,mil)	Linearity % Full Scale	Target Type (Ground, Driven)	Resolution By Filter Setting(nanometer, <i>microinch</i> , r.m.s)			
				10 Hz	100 Hz	1 kHz	10 kHz
± 10,0.4	20, 0.8	Consult Factory	Ground	0.1, 0.004	0.45, 0.018	1.5, 0.06	4.5, 0.18
			Driven	0.06, 0.002	0.23, 0.009	0.74, 0.03	2.3, 0.09
± 25,1	50, 2	0.12%	Ground	0.26, 0.01	1.2, 0.048	3.4, 0.16	12.0, 0.48
			Driven	0.15, 0.006	0.6, 0.024	2.0, 0.08	6.1, 0.25
± 50,2	100, 4	0.10%	Ground	1.08, 0.043	6.64, 0.27	20.9, 0.83	65.1, 2.6
			Driven	0.51, 0.02	2.1, 0.084	7.27, 0.29	29.4, 1.18
± 100,4	200, 8	0.02%	Ground	4.92, 0.2	22.2, 0.89	78.3, 3.1	244, 9.7
			Driven	2.46, 0.098	14.4, 0.58	45.0, 1.8	130, 5.2



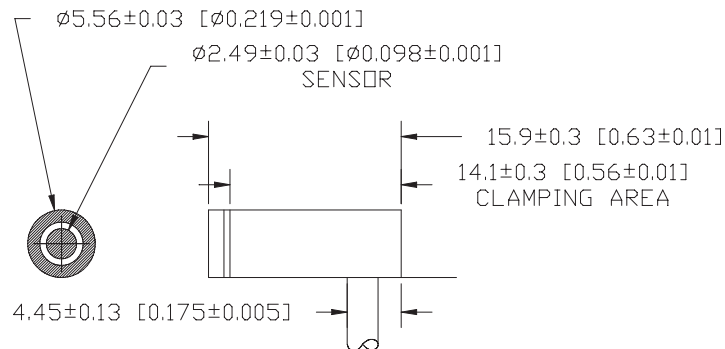
2-3 mm Diameter Sensors

Compatible with 4810, 4800, 4805

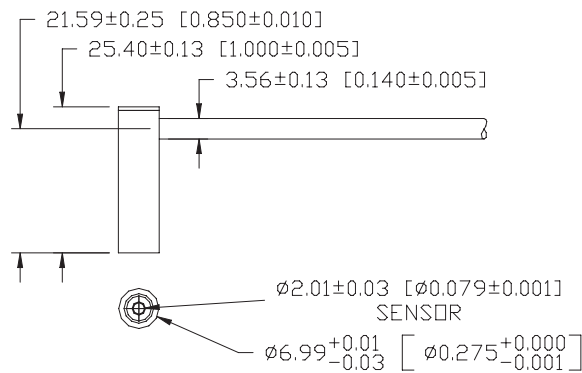
2804



2812



2815



Performance Specification 2 mm Diameter Sensor

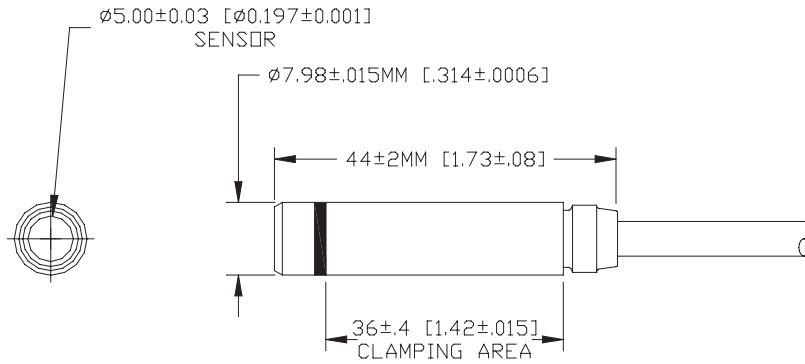
Range (<i>um, mil</i>)	Standoff (<i>um, mil</i>)	Linearity % Full Scale	Target Type (Ground, Driven)	Resolution By Filter Setting (nanometer, <i>microinch</i> , r.m.s)			
				10 Hz	100 Hz	1 kHz	10 kHz
± 25,1	50, 2	0.12%	Ground	0.094, 0.004	0.37, 0.015	1.18, 0.047	3.7, 0.15
			Driven	0.068, 0.003	0.22, 0.009	0.70, 0.028	2.1, 0.084
± 50,2	100, 4	0.05%	Ground	0.51, 0.021	2.3, 0.09	7.5, 0.3	23, 0.92
			Driven	0.30, 0.012	1.17, 0.047	3.77, 0.15	11.8, 0.47
± 100,4	200, 8	0.02%	Ground	1.06, 0.042	4.79, 0.19	15.6, 0.62	47.8, 1.91
			Driven	0.61, 0.024	2.43, 0.097	7.8, 0.31	24.6, 0.98
± 250,10	500, 20	0.10%	Ground	12.2, 0.49	55.3, 2.2	195, 7.8	606, 24.2
			Driven	6.1, 0.24	35.8, 1.4	111, 4.5	324, 13.0



5 mm Diameter Sensors

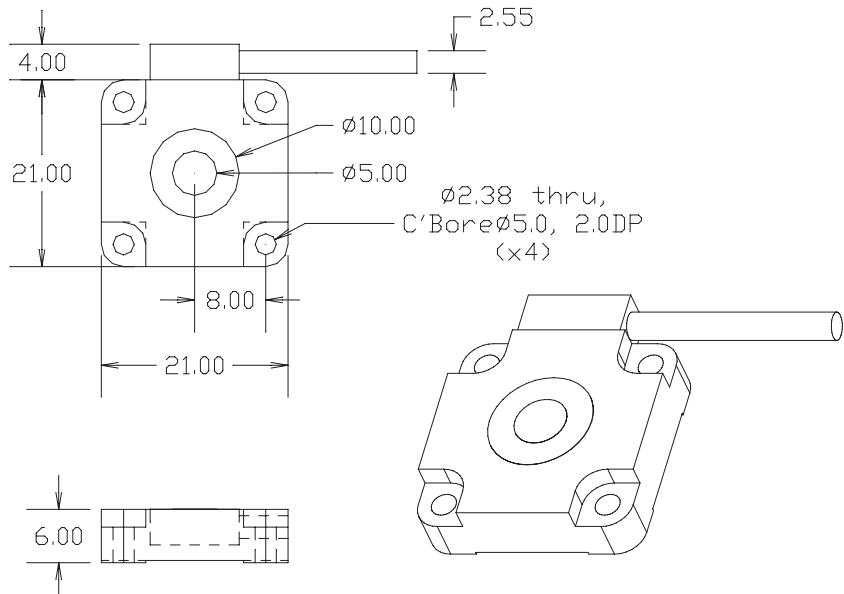
Compatible with 4810, 4800, 4805

2805, 2805V



Note: 2805 V is Vacuum Compatible

2820, 2820V, 2820HS, 2820HSV



Notes:

The 2820 Series are made of Alumina Ceramic.

2820V - Vacuum Compatible.

2820HS - High Stability Version.

2820HSV - High Stability, Vacuum Compatible

Performance Specification - 5 mm Diameter Sensor

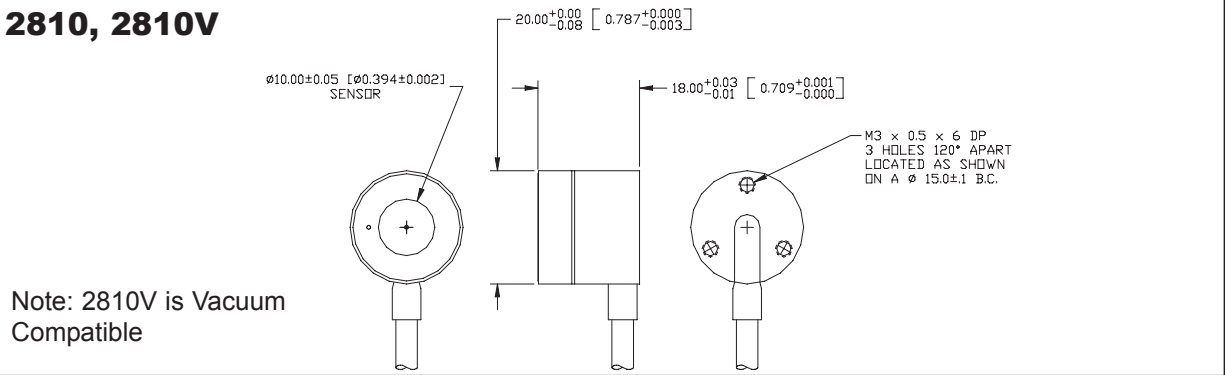
Range ($\mu\text{m}, \text{mil}$)	Standoff ($\mu\text{m}, \text{mil}$)	Linearity % Full Scale	Target Type (Ground, Driven)	Resolution By Filter Setting (nanometer, <i>microinch</i> , r.m.s)			
				10 Hz	100 Hz	1 kHz	10 kHz
$\pm 50, 2$	100, 4	0.05%	Ground	0.11, 0.004	0.15, 0.006	0.3, 0.12	1.6, 0.064
			Driven	0.11, 0.004	0.15, 0.006	0.3, 0.012	1.6, 0.064
$\pm 100, 4$	200, 8	0.02%	Ground	0.43, 0.017	0.75, 0.03	2.4, 0.95	7.5, 0.3
			Driven	0.22, 0.009	0.4, 0.03	1.2, 0.05	4.1, 0.17
$\pm 250, 10$	500, 20	0.04%	Ground	2.5, 0.1	11.3, 0.45	36.7, 1.46	112, 4.5
			Driven	1.46, 0.06	5.7, 0.23	18.4, 0.74	58.1, 2.3
$\pm 500, 20$	1000, 40	0.12%	Ground	5.2, 0.21	23.7, 0.95	77.1, 3.1	236, 9.4
			Driven	3.0, 0.12	12.1, 0.48	38.7, 1.5	121, 4.9



10 mm Diameter Sensors

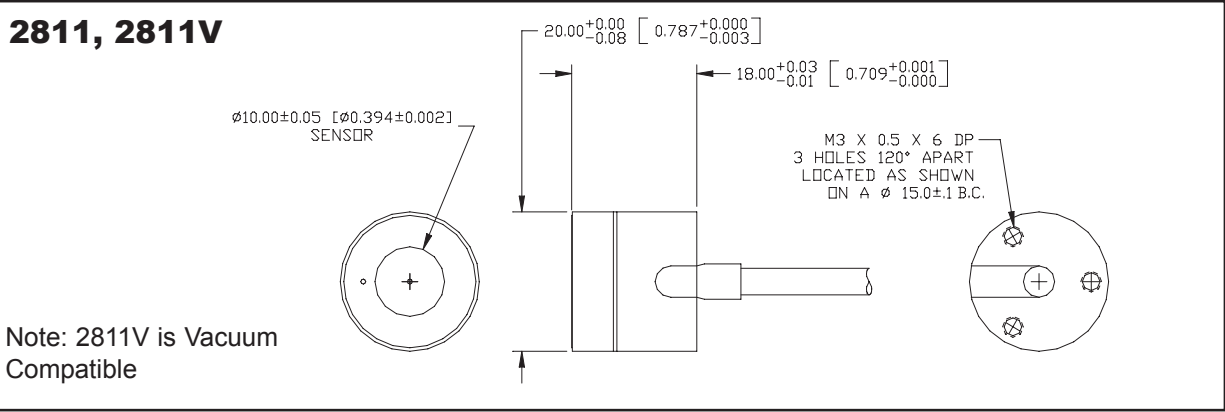
Compatible with 4810, 4800, 4805

2810, 2810V



Note: 2810V is Vacuum Compatible

2811, 2811V



Note: 2811V is Vacuum Compatible

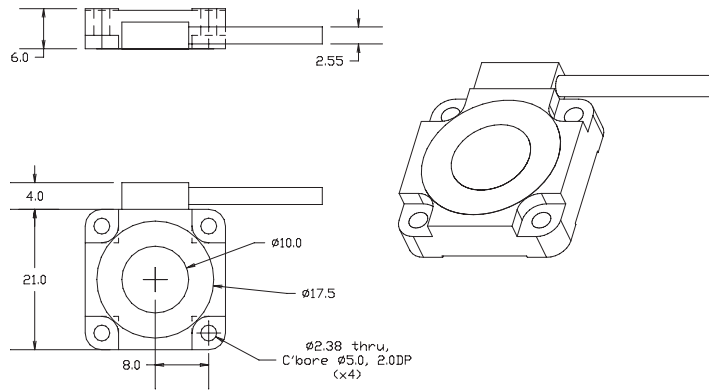
2821, 2821V, 2821HS, 2821HSV

Notes:
The 2821 Series are made of Alumina Ceramic.

2821V - Vacuum Compatible.

2821HS - High Stability Version.

2821HSV - High Stability, Vacuum Compatible



Performance Specification 10 mm Diameter Sensor

Range (<i>um, mil</i>)	Standoff (<i>um, mil</i>)	Linearity % Full Scale	Target Type (Ground, Driven)	Resolution By Filter Setting (nanometer, <i>microinch</i> , r.m.s)			
				10 Hz	100 Hz	1 kHz	10 kHz
± 250, 10	500, 20	0.04%	Ground	0.94, 0.038	1.6, 0.06	4.8, 0.19	15.9, 0.64
			Driven	0.56, 0.023	0.94, 0.038	2.5, 0.1	9.6, 0.39
± 500, 20	1000, 40	0.02%	Ground	1.9, 0.075	7.0, 0.28	22.8, 0.91	72, 2.9
			Driven	1.3, 0.05	4.3, 0.17	13.4, 0.54	40.4, 1.62
± 1000, 40	2000, 80	0.07%	Ground	10.1, 0.4	45.2, 1.8	147, 5.9	451, 18
			Driven	5.8, 0.23	23.0, 0.92	74, 3.0	232, 9.3
± 2000, 80	4000, 160	Consult Factory	Ground	21.1, 0.84	95, 3.8	309, 12.3	947, 37.9
			Driven	12.1, 0.49	48.3, 1.93	155, 6.2	487, 19.5



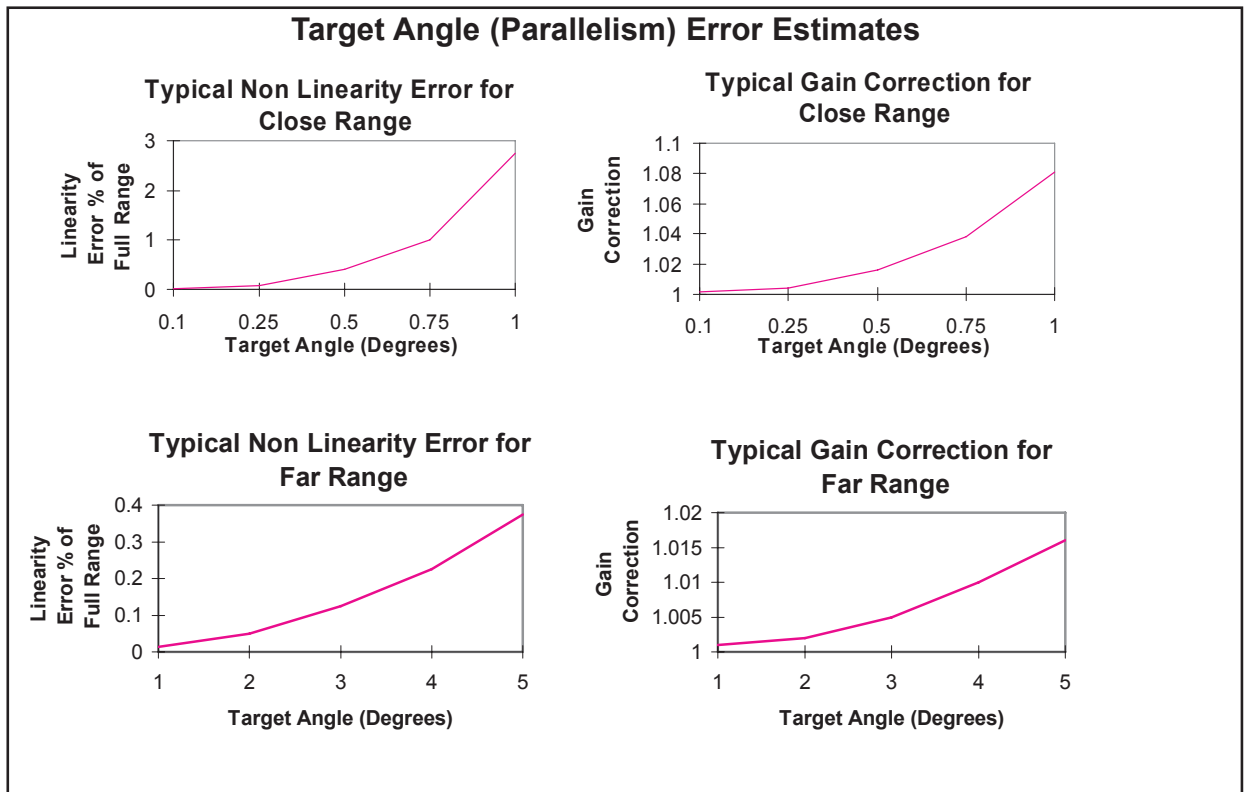
Probe Clamping - With the exception of the 2810 and 2811 and ceramic probes the probes should be held in the area indicated on the drawings. Use of a split ring or collet is recommended. Use of a set screw is not recommended as it may cause a deformation of the probe body which could effect calibration.

Target Angle: The angle of the probe face to the target is important for obtaining a quality measurement. The smaller the standoff and range, for a given probe size, the more critical the angle of the probe face to the target. Angular deviations result in increases in nonlinearity and in the signal gain (cosine error). The following charts illustrate typical increases in non linearity and gain for the 2800 series probes at the close and far ranges. "Close Range" corresponds to the smaller ranges found performance tables in the preceding pages and "Far Range" larger ranges.

increased output noise from the gaging system. For dual probe applications such as thickness measurements well grounded targets are desired but not required. Using a patented technology ADE can balance the currents of the 2 probes and drive them 180 degrees out of phase to make a quality measurement. Please discuss your requirements with your representative for this type of application.

Target Size - In general the size of the target should be at least 20% larger than the diameter of the outer guard ring of the probe.

Target Resistance - Target resistance of less than 100k Ohms will not cause measurement errors. However, a poorly grounded target will be more susceptible to noise pickup. It is acceptable to capacitively ground a target. Capacitance's of 1000 pf or higher work well.



Target Grounding - For proper operation a well grounded target is required for single probe applications and most multiple probe operations. The series 2800 probes have a built in ground line. A conductive path from the target to the clamp region or attachment point will provide adequate grounding. Grounding to earth or grounding to the equipment case are also acceptable. Note that ground loops or other grounding inadequacies can cause

Custom Calibration - Custom calibration is available and longer ranges are available. The result of a longer range is a decrease in resolution and linearity. Repeatability, however, remains excellent which makes extended ranges ideal for servo applications and the non linear response can be modeled with modern computer software. Consult your ADE representative for more information.



Resolution - Probe resolution is specified as the RMS value of the noise of the gages output signal. Peak to peak resolution will be about 3 to 6 times this value. Resolution is a function of the size of the sensor, the range, and filter bandwidth. The resolutions specified in the preceding page are measured at nominal standoff (mid point of the range). Resolution at the far end of the range will be about 1.5 times this value and at the near end of the range about 0.5 times this value.

Linearity - All capacitive gauges have small non linearities over their full scale range. A feature of ADE passive gauges is that this non linearity is highly repeatable.

Cable Fixtures - The cable of the 2800 series probes form an integral part of the probe. When routing the cable bends with a radius of less than 10 mm (3/8 in) should be avoided. Rolling bends with radii of less than 75 mm (3 in) should be avoided. Use of excessive force in holding the cables or other actions that can cause abrasion or excessive wear should be avoided. For maximum reliability the cables should be secured 25 mm to 75mm (1-3 inches) from the probe. Cables should not be clamped in areas where there is active flexing

Cable Length - The standard length of the cable on a 2800 series probe is 3 meters (approx. 10 ft). Alternative lengths are available. Because the cable forms a part of the overall capacitive structure of the probe changes in cable length will cause changes in resolution. Shorter

cables will yield better resolution and longer cables will yield worse resolution. Consult your ADE Representative for more information.

Vacuum Compatibility - Probes with a V designation are designed for Vacuum Compatibility. These probes are made with vacuum compatible materials to assure low/no outgassing. Standard Vacuum compatible probes come with 2 cables. The exterior cable connects the gauge electronics to a vacuum feed through connector. This cable is 2 meters long. The standard length of the probe cable inside the vacuum chamber is 1 meter but may be configured by the customer. The system requires a fully shielded, floating shield bulkhead connector. The preferred connector is a double ended BNC type but others can be provided.

Ultra High Stability - The standard 4810 offers excellent long term stability. For the most demanding applications where stability is measured in days and nanometers ADE Technologies offers a 4810 HS (High Stability) Gauge and probes with the HS marking. These systems undergo special long term testing to assure that any long term drift is constrained to acceptable parameters. ADE Technologies recommends you discuss your requirements with your representative if you have a requirement in this area.

Custom Probes: Custom probes are available consult your ADE Representative for more information.

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