mtiinstruments

A worldwide leader in precision measurement solutions

Non-contact Capacitance
Position Measurement
with Nanometer Accuracy

ACCUMEASURE™ SERIES

Capacitance Measurement for Demanding Applications

Outstanding accuracy, stability and repeatability are the hallmarks of MTI Instruments' (MTII) non-contact capacitance systems.

The Accumeasure™ family of products is designed to address the needs of product developers, process engineers, researchers, designers and other who need precise. reliable, non-contact measurements. Fast response time and extremely high resolution amplifiers make them ideal for critical measurements of targets such as rotating spindles and shafts, disks, tires, precision X-Y stages and piezo electric elements.

Thousands of Accumeasure™ systems are installed worldwide and are considered the system of choice by major Corporations around the world. With over 40 years of product line history and application knowledge in virtually every industry, our systems provide the highest resolution and accuracy available on the market today.

Desktop Systems

Accumeasure™ 9000

The Accumeasure™ 9000 is a cost effective solution for single and dual channel applications such as thickness measurements and dual axis motion stages feedback control. The built-in universal AC power supply and summing amplifier reduce the need for additional system components. It features MTII's latest technology in capacitance amplifier design, resulting in the highest resolution and highest linearity available today.

The Accumeasure™ 9000 also features an offset adjustment along with a bargraph or digital display for easy probe positioning.

Modular Rack Systems

Accumeasure™ 500

The Accumeasure™ 500 is a compact modular rack system that can hold up to six measurement channels or summing amplifiers.

It has a built-in low-noise AC power supply for 85-265 VAC operation. Multiple Accumeasure™ 500 racks may be synchronized together for multichannel operation on a common surface to avoid inter-channel interference. These rack systems are cost effective for large multi-channel applications. An optional 12 Vdc version is also available for in-vehicle testing of displacement, vibration, run-out or thickness. The Accumeasure™ 500 also accepts MTII's "push/pull" capacitance amplifiers for use on conductive, semiconducting and rotating targets with poor or non-existent grounds.

The Accumeasure™ Advantages

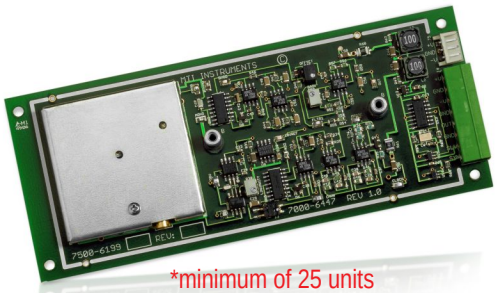
High stability designs for long-term monitoring and analysis

Modular design to accommodate expanding future needs

Standard Board Level (for OEM integration)

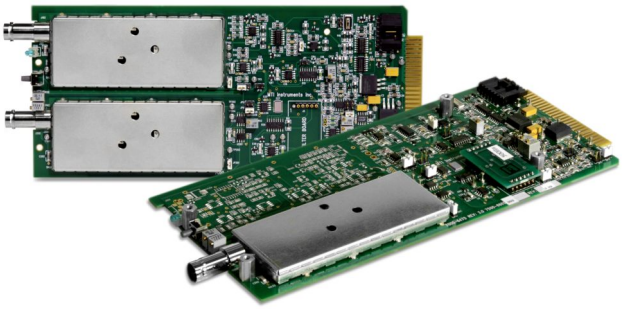
Accumeasure™ MicroCap

MTII offers cost-effective OEM amplifier solutions for high volume* applications that meet your exact requirements. Our experienced engineers will work together with you in reviewing all aspects of your application and tailor a cost-effective board level amplifier and probe solution.



*minimum of 25 units

Custom Board Level (for OEM integration)

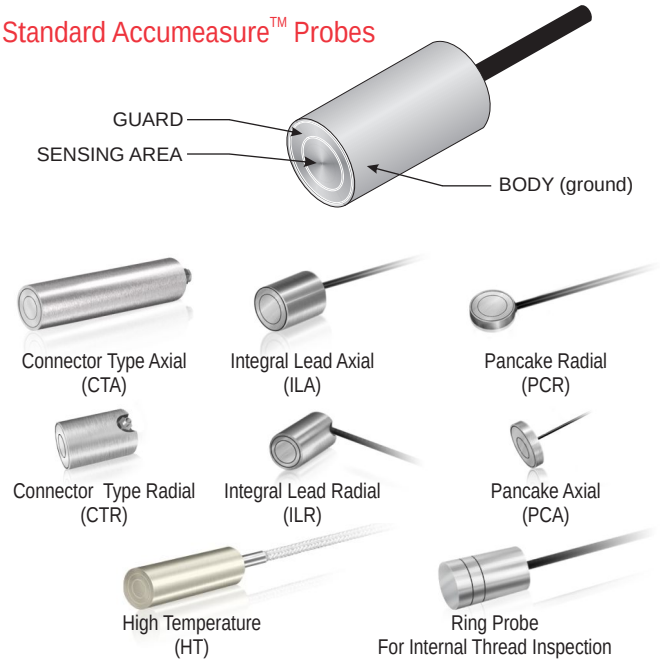


Accumeasure™ AS-562 and AS-563

MTII also provides customized boards available for large multi-channel applications. For more information about these products, contact any of our experienced engineers for details on different configurations available.

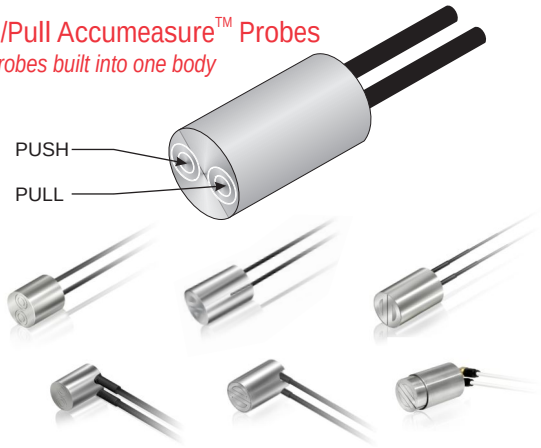
Accumeasure™ Probes

Standard Accumeasure™ Probes



Push/Pull Accumeasure™ Probes

Two Probes built into one body



Consult our probe brochures for complete specifications and sizes.

MTII also designs custom probes tailored to your measurement requirements

The Accumeasure™ Advantages

Custom, low-cost OEM solutions

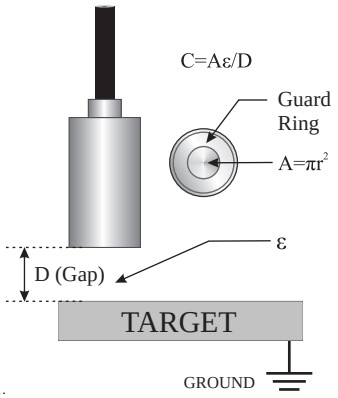
Passive probes for operation in high-temperature and harsh environments

Capacitance Measurement Principles

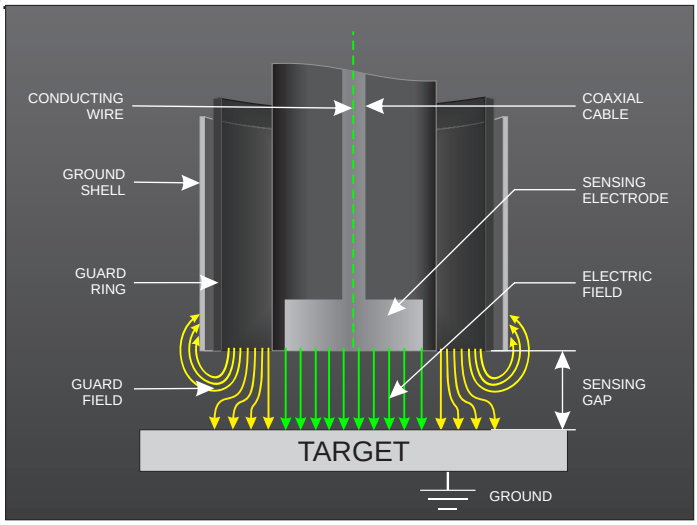
Accumeasure™ System measurement technology is based on the principle of parallel plate capacitor measurement. The electrical capacitance formed between an Accumeasure™ probe and a target surface varies as a function of the distance (gap) between these two surfaces. *see Figure 1*

Capacitance based measurement probes have long been employed as a means of non-contact measurement of electrically conductive materials. In a typical system, MTII's capacitance probe acts as one of the plates and the grounded target the other plate. MTII's amplifier converts the gap's capacitance into a output voltage proportional to the gap. Capacitive measurements are very stable rivaling interferometer accuracy. The Capacitance is not adversely affected by temperature, humidity and pressure.

Figure 1



Where:
C=Capacitance
ε= Dielectric constant of the gap medium, typically air
D= Gap distance between the probe and grounded target
A= Probe sensing area



To maintain a highly linear response it is important to establish a uniform electric field in the gap. To accomplish this MTII uses a "guarded" probe approach. All of MTII's capacitance probes are designed with sufficient guards to protect the sensing area under normal operating conditions. However, the flexibility of MTII's Accumeasure amplifier series allows the system measurement range to be increased up to 10 times. Contact MTII's Applications Engineers for assistance when extending the range of the capacitive probes. In addition to improving linearity and accuracy, the guard is also used to reduce noise and external influences. Each capacitance probe is driven by a low noise coaxial cable.

The Accumeasure™ System measures the electrical impedance of the capacitance between a sensing electrode in the probe and a ground-referenced target. The magnitude of the impedance (Z_c) is proportional to the reciprocal of the capacitance value as defined by the equation:

$$Z_C = \frac{1}{\omega C}$$ *where:* ω is proportional to the frequency at which the capacitance measurement is performed. $\omega = 2\pi f$ (f=16kHz)

Substituting the equation for capacitance into the impedance equation shows that the impedance is directly proportional to the gap value D, as shown in the following equation: $$Z_C = \frac{D}{\omega \varepsilon A}$$ So, D is proportional to C, and the Accumeasure™ probe amplifier produces a DC voltage that is linearly proportional to the probe gap impedance (Z_c). Any vibration variation shows up as an AC voltage proportional to the amplitude of the vibration. The amplifier electronic circuitry eliminates the effects of both the probe cable capacitance and the stray capacitance at the edge of the probe sensing area that could cause non-linearity of the gap and vibration measurements.

Accuracy is a function of linearity, resolution, temperature stability and drift, with linearity being the majority contributor. Fortunately, the linear response of MTII's capacitive sensors is very repeatable. Calibration reports provide data that can be used to correct for the non-linearity of a system using inexpensive computers and correction software.

The Accumeasure™ Advantages

Superior linearity for sub-nanometer resolution and accuracy

Extended system ranges for added measurement flexibility

MTII Capacitance Amplifier Specifications

FEATURES	Accumeasure™ 9000	Accumeasure™ 500	Accumeasure™ MicroCap
Number of Channels	up to 2	up to 6	1
[1]Measurement Range	0 to 12.5mm (0 to 0.5 in.)		
[2]Resolution *(% of Full Scale)* RMS	0.00167%		
[3]Accuracy *(% of Full Scale)*	± 0.02%		
Frequency Response	Standard Filter Modules Available (10Hz, 100Hz, 200Hz, 500Hz, 1kHz, 2kHz or 5kHz)		Component Selectable
Temperature Stability	± 0.01% FSR/ °C		
Analog Output 0-10 Vdc	BNC[4]	BNC[4]	Euro Screw Terminals
Output Impedance	50 Ω		
Power Requirements	85 to 265 Vac	85 to 265 Vac	± 15 Vdc
	47 to 440 Hz	47 to 440 Hz	
		Optional 12 Vdc	
Summing Amplifier	Standard in dual channel units	Plug in board	N/A
Operating Temperature	4 to 38°C (40 to 100°F)		
Dimensions	240x160x50mm (9.5x6.3x2.0in.)	175x140x340mm (6.88x5.5x13.4in)	150x60 x13mm (5.9x2.4x0.5 in.)
Weight	2.3 kg (5 lbs)	4.6 kg (10.2 lbs)	0.11 kg (0.25 lbs)

[1] Measurement range is determined by probe selected and amplifier gain (Range Extension)

[2] Equivalent to 1mV/10,000mVpp@500Hz, 1x range extension, 2.4m cable. Resolution RMS: (0.000423 x bandwidth in Hz + 1.2) x 0.00002 x FSR in Mils or Microns

[3] Assumes 1x range extension, 2.4m cable, 254 µm probe

[4] The analog output can be configured for ± 5Vdc with front-panel offset adjustment

Calibration and Fixturing

FIGURE 1
FS-2

The FS-2 is an adjustable fixture to support and position probes over the target being measured. The system consists of a probe clamp, 2 positioning arms, ON/OFF magnetic base, c-clamp base and a micrometer with a 7mm (0.28") travel. The probe clamp holds probes up to 25.4mm (1.0") in diameter with a reach of approximately 152mm (6").

FIGURE 2
KD-CH-IIID calibrator

The KD-CH-IIID™ is a precision fixture that secures a non-contact displacement sensor and accurately varies the position of a target relative to the sensor. It provides an excellent means of obtaining calibration data at the user's facility.

Accessories - Options

Product #	Product Description	Model Name
7500-3580	Standard Cable for CTA and CTR Probes 2.4 meters (8 feet) length	Microdot-M to BNC-M Cable
7500-6027-05	**90 Ω Low Noise Extension Cable** 1.2 meters (4 feet) length	BNC-M to BNC-M Extension Cable
7500-6027	2.4meters (8 feet) length	BNC-M to BNC-M Extension Cable
7500-6027-12	3.6 meters (12 feet) length*	BNC-M to BNC-M Extension Cable
2100-2104	BNC Coupler BNC Adapter to join two Extension Cables	BNC-F to BNC-F Adapter
8000-4186	FS-2 Fixture Stand	FS-2 Fixture Stand *(FIGURE 1)*
8000-4174	Probe Calibrator	KD-CHIIID *(FIGURE 2)*
8000-6282	BNC-BNC Bulkhead Feed Thru	BNC-F to BNC-F Bulkhead Feed Thru

xxx-M: Male type connector
xxx-F: Female type connector

* Max cable length of 15 meters (50 feet)
Cables longer than 2.4 meters (8 feet) will decrease linearity proportionally.

Looking for Direct Digital Output?

Click here to visit our
Digital Capacitance Webpage

Tips for Quick Ordering Process

Desktop Systems

1 Select Model

Accumeasure 9000 Models	Description	Product #
AS-9000/1	1-Channel with bargraph display	8000-4257
AS-9000/2	2-Channel with bargraph display	8000-4261
AS-9000/1D	1-Channel with digital display	8000-6556
AS-9000/2D	2-Channel with digital display	8000-6557

2 Select Filter

Filters	Product #
10 Hz	7500-5047
50 Hz	7500-5065
100 Hz	7500-5045
200 Hz	7500-6083
500 Hz	7500-5056
1 kHz	7500-5048
2 kHz	7500-5049
5 kHz	7500-5050
660 Hz Bessel filter for high speed transient measurements	7500-6105

MTII Probe Models Structure

ASP- ## -xxx/#

- MTII Probe
- 0.5, 1, 2, 5, 10, 20, 50, 100, 200, 500
- CTA, CTR, ILR, ILA, PCR, PCA, ILA/HT
- Default=1X *See Standard Probe Brochure for Max.*

3 Select From Standard Probes

Standard Probes	
Refer to Standard Probe Brochure for Product #	

4 Select Range Extension *Default=1X see brochure for max. range*

Modular Rack Systems

1 Select Model

Accumeasure 500 Models	Description *Up to 6-channel Amplifier Modules/Summing Amplifier*	Product #
AS-500-RH	Standard Power - 6 individual BNC 0-10 VDC output jacks, one BNC rack synchronization jack and one BNC + 9 VDC CMOS logic signal @16.38 kHz jack	8000-4305-001
AS-500-RH-DC	DC Power - all specifications of AS-500-RH with -supplied polarized DC power cable, requires 12VDC power supply (not included)	8000-4305-002

2 Select Module/s

Amplifier Modules	*Each Module Occupies 1 slot on AS-500*	Product #
AS-563-PA	Plug-In Amplifier Module for Grounded Targets with Front panel offset and gain adjustments, compatible with MTI Standard probes (refer to standard probe brochure)	8000-4304-001
AS-562-PA	Push-Pull Plug-in Amplifier Module - for Ungrounded Targets, with Front panel offset and gain adjustments, compatible with MTI Push/Pull probes (refer to Push/Pull probe brochure)	8000-4303-001
AS-541-SA	Summing Amplifier - Provides 2 analog summations or differences of any selectable channels within the AS-500 rack. Compatible with AS-562 or 563 boards.	8000-4302-001

3 Select Filter

Filters	Product #
10 Hz	7500-5047
50 Hz	7500-5065
100 Hz	7500-5045
200 Hz	7500-6083
500 Hz	7500-5056
1 kHz	7500-5048
2 kHz	7500-5049
5 kHz	7500-5050
660 Hz Bessel filter for high speed transient measurements	7500-6105

4 Select From Any Probes

Standard Probes	Refer to Standard Probe Brochure for Product #	5 Select Range Extension *Default=1X see brochure for max. range*
Push/Pull Probes	Refer to Push/Pull Probe Brochure for Product #	Select Range Extension *up to 5X*

Standard and Custom (OEM) Boards

MicroCap, AS-562 and AS-563	Contact MTII

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