

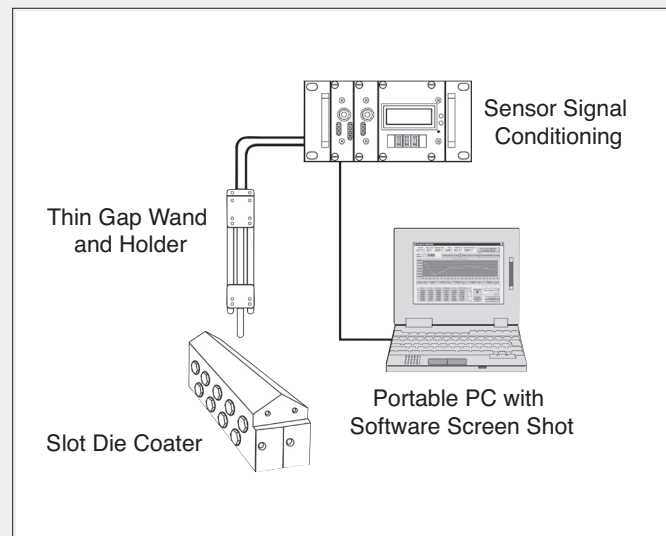


# SLOT DIE COATER GAP SENSOR SYSTEMS

Next Generation Slot Die Coater Gap Measurement Systems

For the past 25+ years Capacitec has been working closely with leading global manufacturers of labels, tapes and films to develop a system to precisely measure slot die coater gaps. The system offers dramatic improvements over traditional gap measurement methods achieving coater gap uniformity better than 10 microinches (0.25 microns) across the full length of the coater die. This non-contact capacitive gap measurement solution includes sensor wands, special wand holders, and signal conditioning electronics and software.

Over the past several years Capacitec has also made significant improvements with much thinner sensors down to 0.0053" (0.135mm), higher temperature sensors (up to 240°C and up to 300°C for several seconds), new line of electronics and upgrades in the BargrafX display software.



System Overview

### Applications

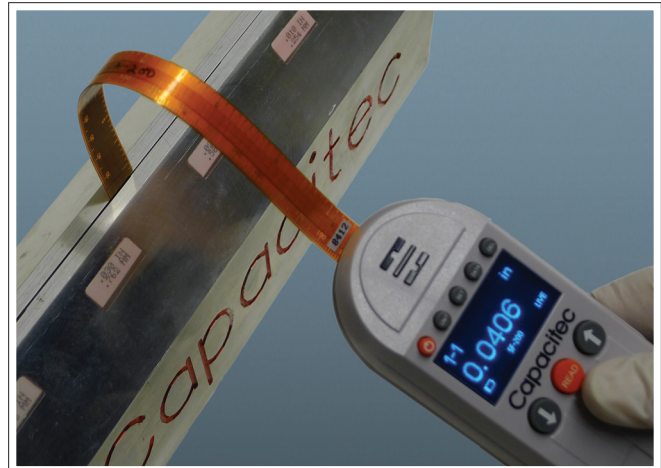
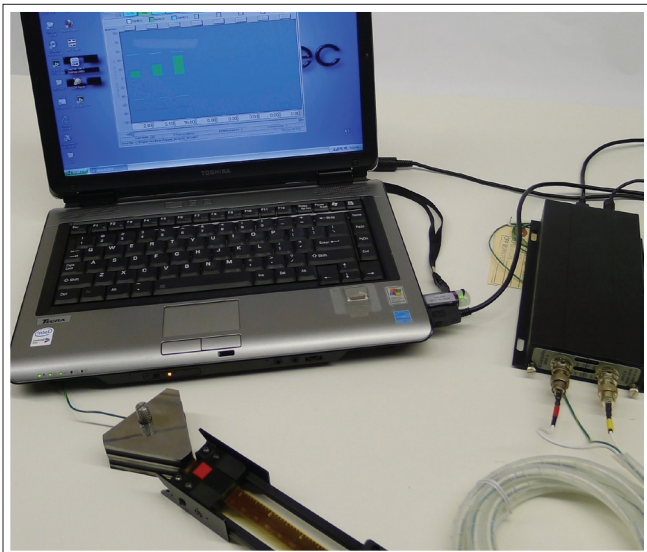
- Adhesive coating onto labels
- Chemical coatings onto films and tapes
- Manufacture of plastic tapes
- Adhesives on structural wallboard
- Lithium-Ion batteries
- Medical diagnostic media
- Photovoltaic solar panels
- Hot Melt Extrusion

## Benefits & Overview

- Significant time saving from the use of mechanical methods such as feeler gauges
- Excellent coater gap uniformity better than 10 microinches (0.25 microns) across the full length of the coater die
- Reduced scrap and enhanced quality of end products
- Excellent Return on Investment

### Lab System Overview

- New Capteura® 220 series amplifiers in a compact 2 channel enclosure or a Model 208 multi-channel rack
- A flexible dual capacitive sensor for position-compensated measurement
- Easy insertion into very thin gaps down to 0.006" (0.153 mm)
- Custom wand fixture positions sensors parallel to coater die for enhanced accuracy
- Bargrafx® software displays gap data along the length of the coater die
- Maintains slot die gap uniformity to 10 microinches (0.25 microns) across 3 meter dies



### Production System Overview

- Gapman® Gen3 fully portable slot die coater gap measurement system for production
- Flexible dual capacitive sensor for position-compensated measurement
- Custom wand holder positions sensors parallel to coater die for enhanced accuracy
- Gap results shown on LED display or can be sent to computer via USB or Bluetooth



## Instrumentation & Software

### Instrumentation

The dual sensor wands are combined with matching Capacitec Capteura® series instrumentation packages that consists of an electronic rack or compact enclosure, signal conditioning amplifiers, power supply and cables. The Capteura® series amplifiers and racks were designed to offer the best signal to noise ratio and wide band width response options in a simple modular package. When coupled with Capacitec sensor wands the electronics produce a linear output voltage of 0-10.000VDC proportional to the gap. Amplifiers come standard with 4KHz, -3dB frequency response.

This instrumentation when used for coater gap measurements can be calibrated to 0 – 0.010” (254 microns) = 10VDC. This shows one millivolt output for each microinch (0.0254 microns) measured, offering excellent resolution in measuring gap uniformity of 10 microinches.



Capteura® 208 Series modular 8-channel design versus legacy 4008 8-channel system



Capteura® Model 200-ENC dual channel enclosure with 220-S amplifier card

### Bargraf® Software

The Capacitec BarGraf® software was developed under National Instruments' LabView™ program and operates under Windows™ XP, Windows 7 & 8

The BarGraf® software has the following features and functions:

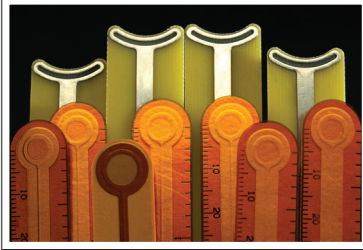
- A real-time Calibration module which takes analog output voltage and turns it into linear engineering units
- Reduces cost by allowing two amplifiers, normally dedicated to only one dual sensor gap wand, to be used on several sets of wands without additional cost
- A general equations editor can combine channels for subsequent arithmetical relations such as sum, gap thickness, deviation, etc.
- The BarGraf® Equation Editor allows these linear equations or arithmetical equations to be assigned to 9 display bars for a general bargraph user interface
- A Limits module that allows the assigned bargraph display to reflect upper critical, upper warning, lower critical, lower warning and other displays for quick user recognition (see screen shots)
- The data files are in a .txt format

Bar graph screen shot

Screen shot showing multiple value display

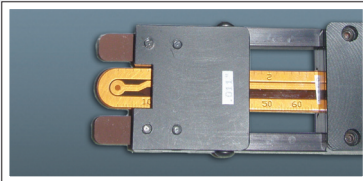
Point	Vols	Known	Predicted	Error	% Rel. Error
1.0000	0.6788	0.5000	0.5206	0.0206	0.4119
2.0000	1.3379	1.0000	0.9771	-0.0229	-0.4579
3.0000	1.9954	1.5000	1.4889	-0.0111	-0.2229
4.0000	2.6544	2.0000	2.0047	0.0047	0.0946
5.0000	3.3135	2.5000	2.9321	0.0021	0.0410
6.0000	3.4115	3.0000	3.0089	0.0089	0.1772

## Non Contact Wands and Holders



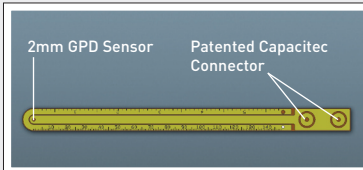
Standard Thin Gap Wand

Two capacitive non-contact displacement sensors are mounted on either side of the sensor wand to create an "electronic feeler gauge". Sensor size and wand thickness is dependent upon the range and gap size being measured. Typical wand thickness for Kapton® wands is 0.009" (0.23mm) to 0.040" (1.0mm) with a gap range of 0.009" (0.23mm) to 0.10" (2.5mm). Composite wand thickness is from 0.035" (0.90mm) to 0.20" (5.0mm) for gap ranges of 0.040" (1.0mm) and above. Best accuracy ( $\pm 0.1\%$ FS) is attained by selecting the wand to "fill" the measured gap to within 0.006" (152 microns) below the targeted slot gap resulting in a total range of 0.010" (250 microns).



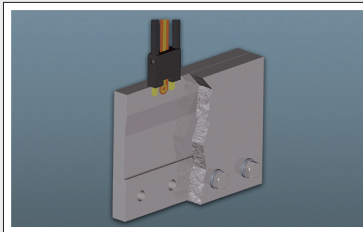
Very Thin GPD-2SW-A-150 Gap Wand

New very thin: Model GPD-2SW-A-150 capacitive gap wand measures gaps down to 0.0053 (135 microns) expanding the range of sensors used in the slot die coater system using Capacitec new 208-SW-ENC electronic amplifier. This is available in a stand-alone 2 channel black aluminum extrusion.



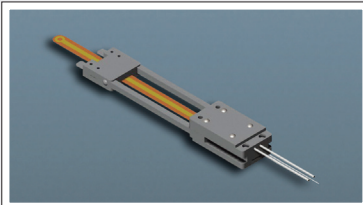
240C High Temp Wand

New non-contact capacitive gap measurement GPD sensor wand that measures extruder lip gaps at operation temperatures up to 240°C. It functions the same as standard dual sensor wands except it opens up new possibilities for use in considerably hotter extrusion and coating die processes. This gap tool can operate short term (up to several seconds per insertion) at up to 300°C. This will shorten life expectancy at up to 300°C.



Wand Holder show inside a slot die gap taking measurements

Measurement accuracy is enhanced with the use of wand fixtures to secure the sensor wand in a parallel position relative to the two halves of the coater die. The two positioning tabs on each side of the wand tip (see top section) further prevent the wand from twisting or rocking out of position. The easy to grip fixture allows ease of use in measuring the coater die gap along the full three to six foot (1 to 2 meter) length. Standard cables are available to connect the sensor wand and fixture to the signal conditioning electronics.



Custom Wand Holder with adjustable insertion length and slot guides

Custom wand holders offer adjustable insertion length to measure across the same slot die at different depths. The Slot Guides allow the gap sensors to be positioned in parallel with the die lips enhancing accuracy.

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