

# Capacitive detection of liquid in micro-canals

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An on-line method to detect liquid and its dielectric properties in micro-canals.

The detection is performed using a capacitive measurement method.

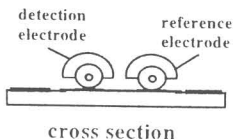
A low-cost electronic circuit enables the detection of capacitance changes as low as 50 aF.

## Basic principle

In this capacitive sensing system, one common electrode is directly placed under the two mono-mode 50 um step-index fibers.

The other electrodes of sensing capacitors  $C_1$  and  $C_{ref}$  are half circle of a metal pipe, which can fit just around the step-index fibers. The offset capacitor  $C_0$  is a shielded wire without any connection to the electrode.

The capacitance is affected by the dielectric between its electrodes.



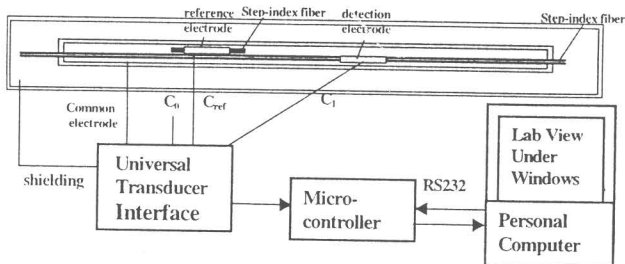
## Measurement set up

The system is comprised of the capacitive sensing element, one UTI chip, a microcontroller and a PC.

The UTI in mode 1 or 4 is used to measure three such capacitances with one common electrode,

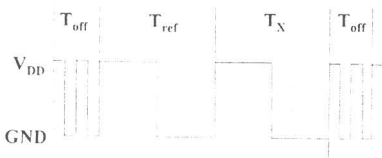
- one dielectric capacitor
- one reference capacitor
- one offset capacitor

One measurement cycle consists of three phases



Universal Transducer Interface (UTI):

$$T_X = KC_X + T_{off}$$



The program, LabView, in the PC will implement the calculation of the measurements based on the three-signal auto-calibration method.

These calculations are presented by

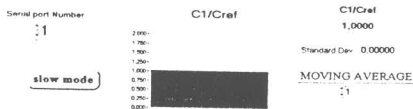
$$C_1 = C_{ref} (N_{C1} - N_{C0}) / (N_{Cref} - N_{C0})$$

Meanwhile, the results are displayed on a graphical display.

### Electronics 2000 Smart Sensor System

Capacitive detection of liquid in micro-canals with  
Universal Transducer Interface (UTI)

GRAPHICAL DISPLAY OF C1/Cref



Microcontroller:

- To measure the output signal of the UTI.
- To control the mode function of the UTI.
- To communicate with the PC.