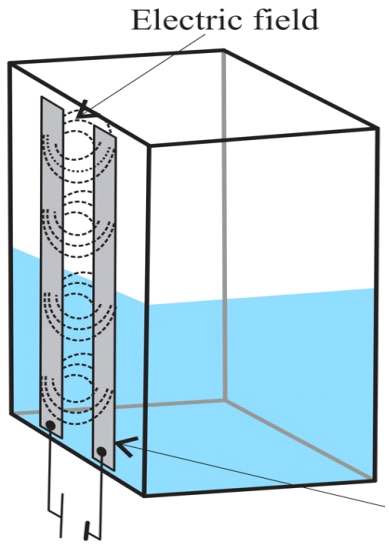
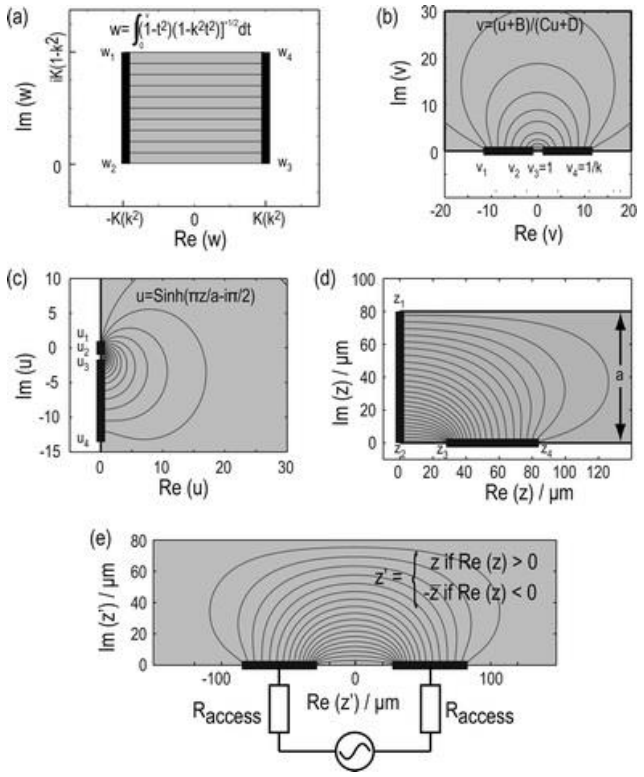
RF Probe

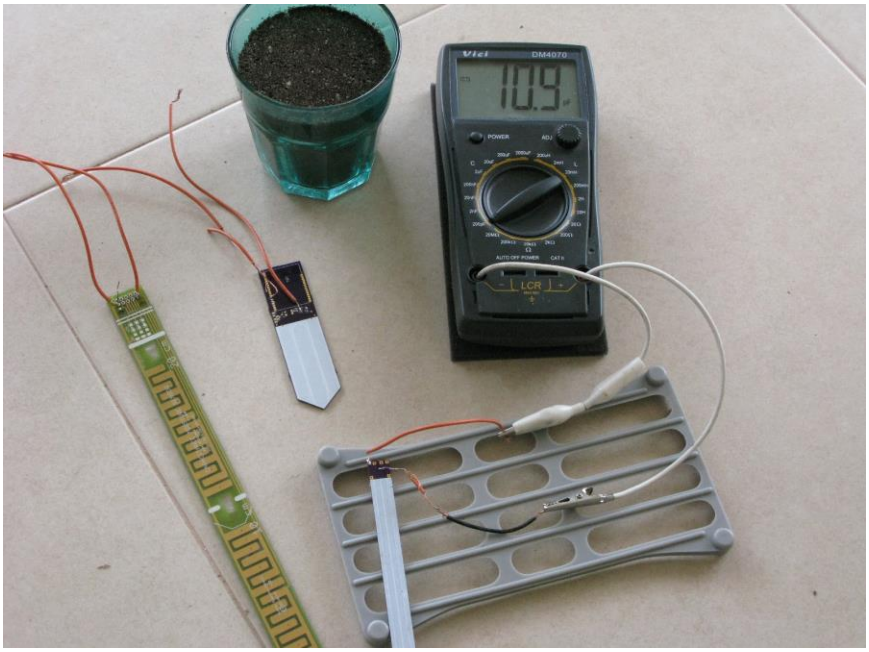
Developing of a capacitive sensor to measure surrounding water content. (dielectric variable of media or volumetric water content)

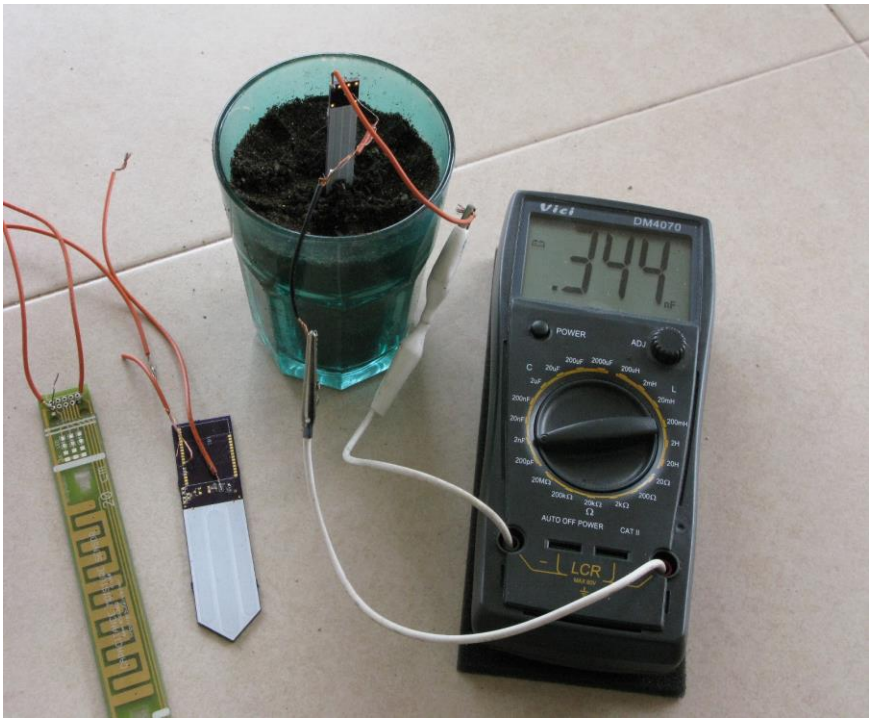


Coplanar PCB strips act as a capacitor at high frequencies and generate a surrounding field.



I have measured capacity of capacitive sensor probe 10pF free air, 344pF semi wet and 1000pF wet media.





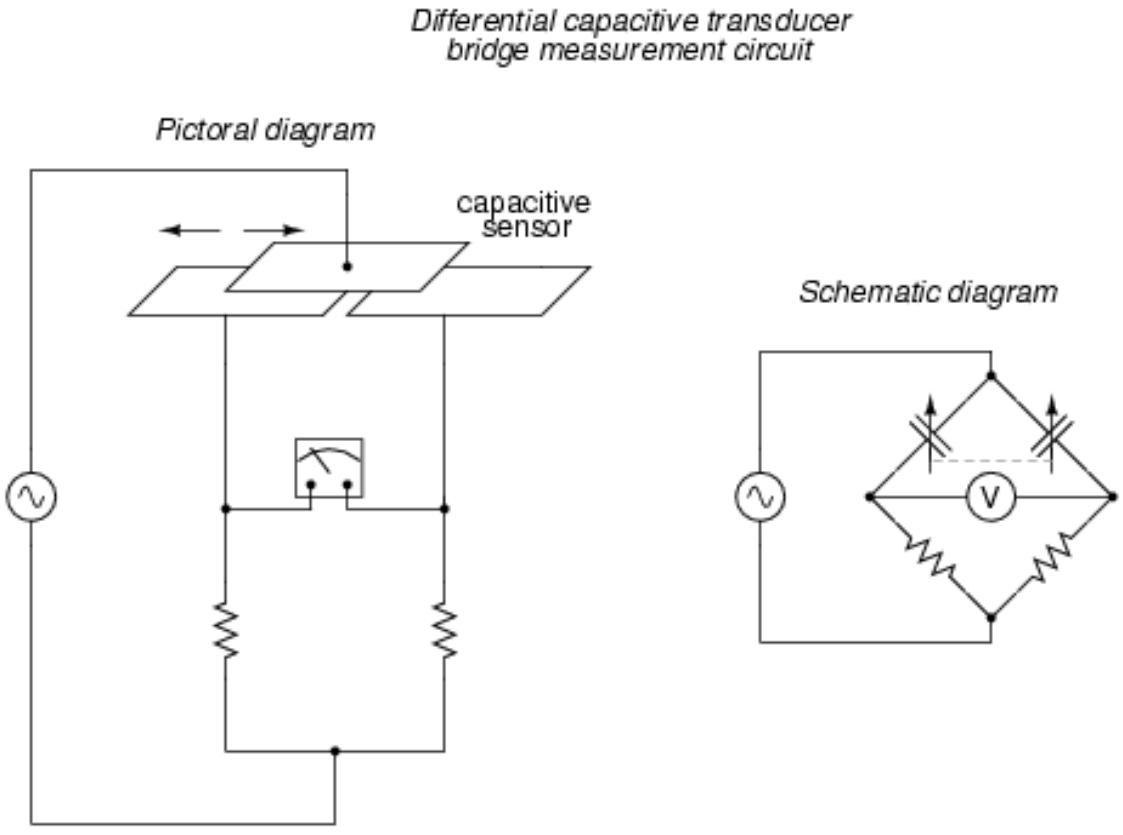
So we have a variable "unknown" capacitor that needs to be measured to get a proportional value DC out.

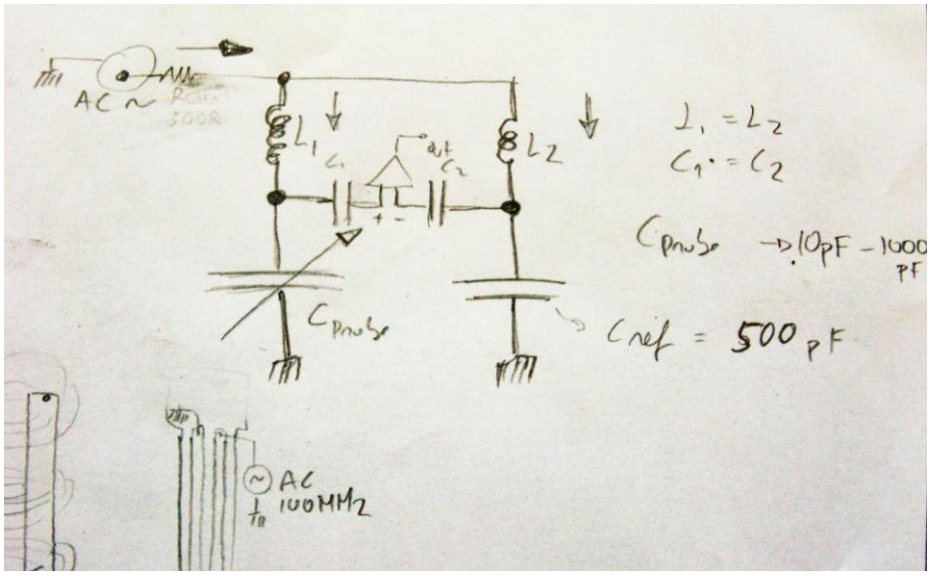
Chosen frequency is 100MHz, so I use LTC6905 (17MHz to 170MHz oscillator R set frequency) this is low power and able to go down to 2,7V.

Output specifics are 3Vpp rail to rail out square wave for a load of 500ohms. The resistor is going to be set for IC oscillate at 100MHz.

To measure sensors is best to use Wheatstone bridge (DC), in this case Schering Bridge (AC). 100MHz is RF so going to use a return loss bridge technic with AD8307 logarithmic instrumentational amplifier to get DC out from RF in.

The unknown capacitance in bridge will be the capacitance of probe. From 10pF to 1000pF range.





Wheatstone bridge with AC in from LTC6905 100MHz 3Vpp (datasheets says 3Vpp 500ohm load)

Instrumentational amplifier in middle is AD8307 WITH C1=C2 maybe 1nF

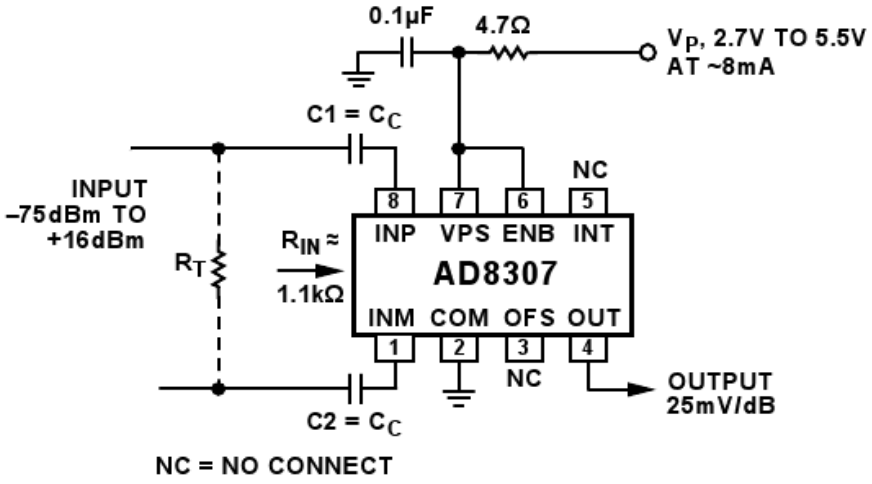
L1=L2 should be calculated to 100MHz operation.

C_{ref} can be 500pF because middle of 10pF to 1000pF

C probe variable from 10pF to 1000pF (the "unknown capacity")

Data from AD8307 instrumentational amplifier are:

Rin = 1,1Kohm output dc voltage 25mV per dB input



In power Out proportional DC voltage

-20dBm 1,6784V

-10dBm 1,9237V

-5 dBm 2,0574V

-1 dBm 2,1502V

0dBm 2,1808V

Using http://www.coretechgroup.com/dBm_Calculator.php to convert dbm to Volts peak.

EXAMPLE -5dBm equals to 1.124V peak under a 500ohm load

LTC6905 outputs 3Vpp at 500ohm load so equals to 3.521dBm under 500ohm load (recommended 500ohm load LTC6905)

I need some simulation and outputting proportional DC out from the capacitive probe 10pF to 1000pF

L1 L2 should be calculated to 100MHz frequency.

Simulation should show voltage on middle of bridge.

Task to optimize bridge. Minimal external components.

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