AN 5—Data Processing for the Floating Electrode Configuration

Both the LT-451 and LTF-631 dielectric cure monitors use the floating electrode configuration of Figure AN 5-1 for sensor measurements.

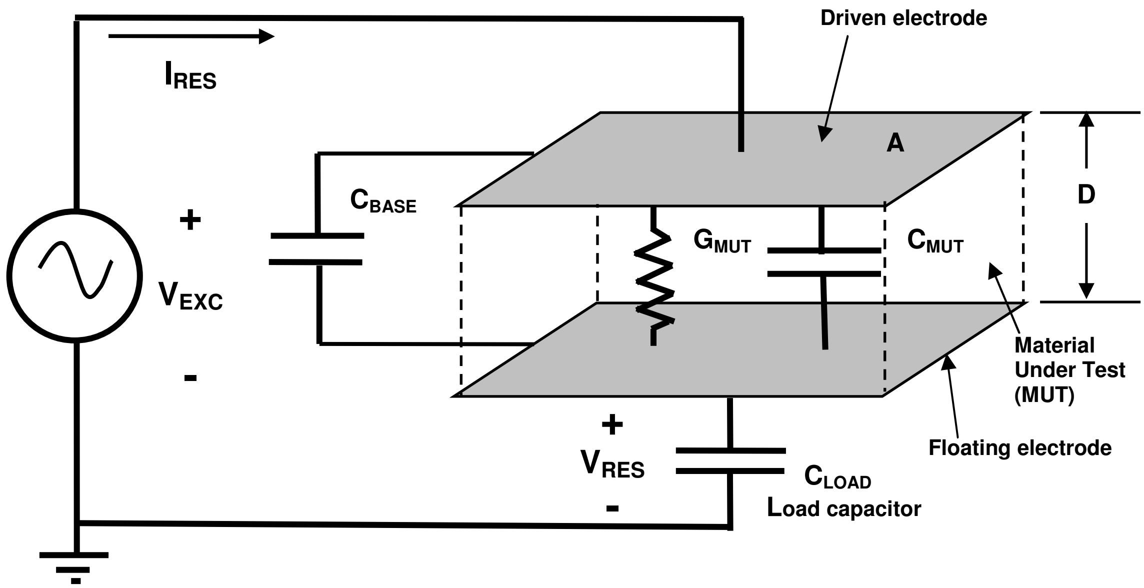

Figure AN 5-1
Electrical model of Material Under Test
(Floating electrode configuration)

Calculating dielectric properties from raw measurements consists of the following steps:

1. Measure the gain (dB) and phase θ (deg) of electrodes with Material Under Test.

2. Calculate the total conductance (G_{TOT}) and capacitance (C_{TOT}) between the electrodes. For mid-conductivity mode, floating electrode configuration:

Given: Gain (dB), phase θ (deg), C_{LOAD} (farad), f (Hz)

Then: $|V_{RES}/V_{EXC}| = 10^{\text{Gain}/20}$

$A = \cos(-\theta) / |V_{RES}/V_{EXC}|$
$B = \sin(-\theta) / |V_{RES}/V_{EXC}|$

$G_{TOT}\ (\text{ohm}^{-1}) = (2\pi f * C_{LOAD} * B) / ((A-1)^2 + B^2))$
$C_{TOT}\ (\text{farads}) = (C_{LOAD} * (A-1)) / ((A-1)^2 + B^2))$

3. Subtract the base capacitance.

   Given: C_{BASE} (farad) = Capacitance of sensor substrate plus cable capacitance

   Then: $C_{MUT} = C_{TOT} - C_{BASE}$
   $G_{MUT} = G_{TOT}$

   Where: C_{MUT} = Capacitance of Material Under Test
   G_{MUT} = Conductance of Mateial Under Test

4. Calculate relative permittivity (ε') and loss factor (ε") using the geometric term A/D.

   Given: A/D ratio (cm)

   Then: $\varepsilon' = (C_{MUT}) / (\varepsilon_0 * A/D)$
   $\varepsilon'' = (G_{MUT}) / (\varepsilon_0 * 2\pi f * A/D)$

   Where: $\varepsilon_0 = 8.86$ E-14 farad/cm

5. Calculate conductivity and ion viscosity.

   $\sigma = \varepsilon'' * \varepsilon_0 * 2\pi f$ = conductivity (ohm^{-1}-cm^{-1})
   $\rho = 1/\sigma$ = ion viscosity (ohm-cm)