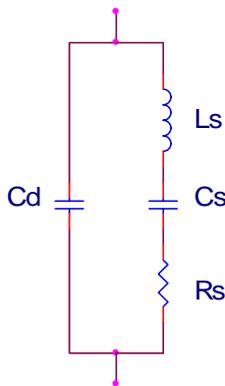# APPLICATION NOTE – AP050913

Equivalent Circuit of Ultrasonic Transducers

The equivalent circuit of piezoelectric ceramic ultrasonic transducer is similar as the well-known crystal, which is composed of a series branch of L_s, C_s and R_s and a parallel branch of C_d.

The values can be simply obtained from calculation of the impedance data.

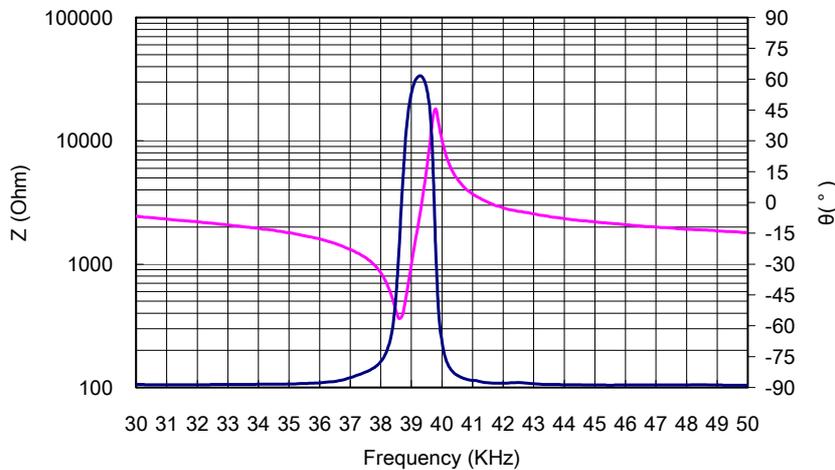Cd:Clamping Capacity, measured at the frequency far away from resonant frequency, which approximates to static capacity.

Ls:Equivalent Inductor = $1/(4\pi^2 f_s^2 C_s)$

Cs:Equivalent Capacity = $C_d * [(f_p^2/f_s^2)-1]$

Rs:Real part of the impedance at resonant frequency

A transducer of model 400ER250 has impedance characters shown as below.

f_s = 38.6 KHz
f_p = 39.8 KHz
Zf_s = 362 Ohm
f_s = -22.8°
Zf_p = 18200 Ohm
C_d = 2430 pF

Impedance (Z   ) at resonant frequency of 38.6 KHz is 362   (-22.8°).

C_s = 2430 * [(39.8²/38.6²)-1] = 153.4 pF

L_s = 1/[4 * 3.142 * 38600² * (153.4/1000000000000)] = 6.99 mH

R_s = 362 * cos (-22.8°) = 333.7 Ohm