Summary

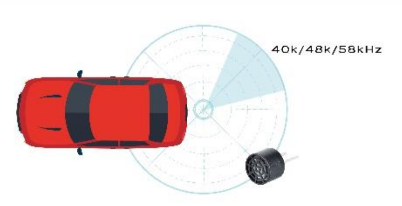
- Ultrasonic is a mechanical wave, a special sound wave with a frequency above 20kHz.
- This sound wave has physical properties, such as refraction, reflection, and interference.
- Applied to ultrasonic ranging sensors, the transmitter can be used to send out sound wave, and the time difference between sender and receiver can be used to calculate the distance.
- Divided into destructive and non-destructive.

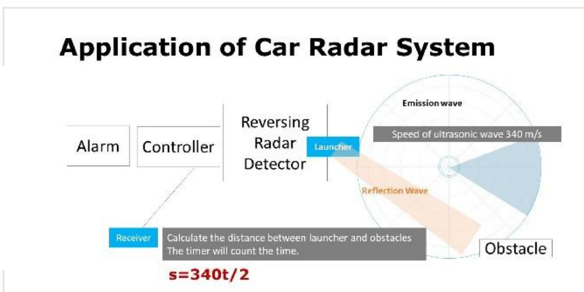
Youtube

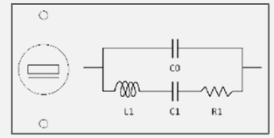
▼Application of Car Radar System

Use an ultrasonic transmitter to emit sound wave in a certain direction. (Launch and start timing)

Sound signal transmit through air, and when obstacles are encountered on the way, they are reflected and send back to the receiver. (Stop timing as soon as the response is received)







Most piezoelectric component connect to a circuit.

We could use the equivalent circuit model to simulate the vibration characteristic.

The catachrestic of impedance change by the frequency.

C0 Static Capacitor

R1 dynamic impedance- Resistor

L1 dynamic impedance-Inductor

C1 dynamic impedance-Capacitor

We can use the complex symbol of AC circuit to evaluate the resonance impedance characteristic of piezoelectric component.

Impedance in the circuit: Z = U / I

Admittance in the circuit: Y = I / U

Measuring admittance of component = Measuring Impedance

Evaluate the matching impedance between the component and the circuit.

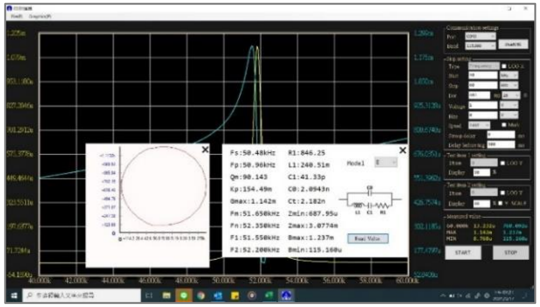
When the piezoelectric component is static.

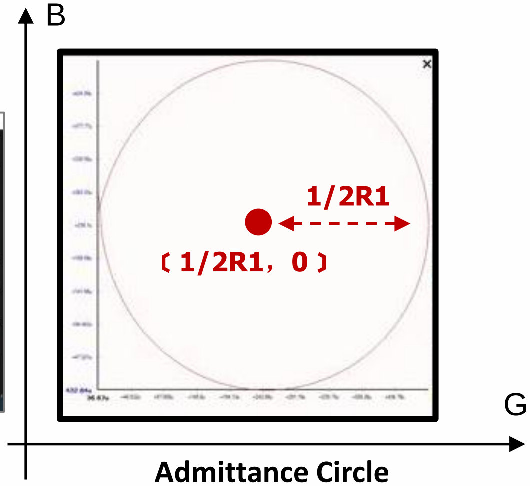
We ignore the loss and consider it as a static capacitor C0.

When the component is vibrating and radiating energy.

The dynamic impedance and static capacitor will have reflection.

It's more intuitive to analyze impedance of piezoelectric component by using admittance circle drawing





Admittance Circle

▼Y – Admittance of whole circuit

Static admittance Y0 Dynamic admittanceY1

▼ Y0 parallel branch
(Compose by material insulation resistance R0 and static capacitor C0)

▼ Y1 Series branch
(Compose by dynamic impedance R1, capacitor C1, and inductor L1)

Calculated by following formula,

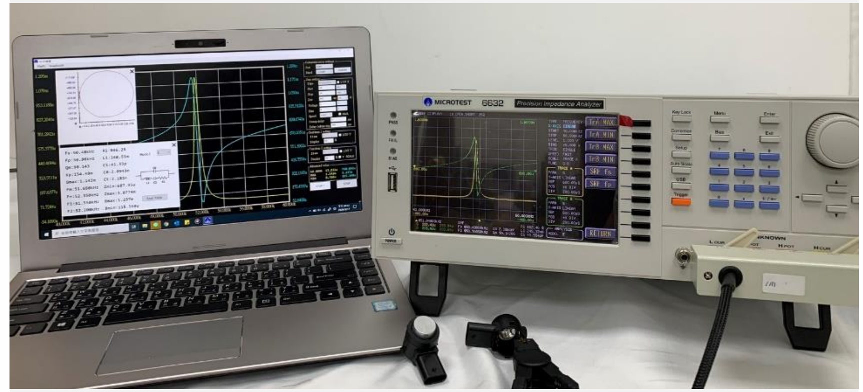
$Y=Y0+Y1$

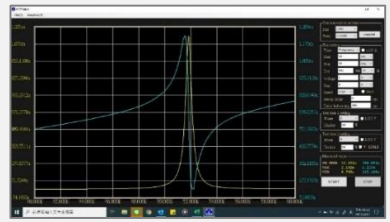
$Y0 = 1/R0+1/(j2\pi fC0)$

$Y1 = 1/\{R1+j2\pi f L1+1/(j2\pi fC1)\}$

Conclusion: Y and dynamic Y1 will change by the frequency.

In the past, Agilent 4294A was used to analyze piezoelectric component. Now 6632 Impedance Analyzer is a better option.





- Fs/FP Resonance Frequency Curve
- Key parameters(Fs/Fp/Cs/D)
- Admittance circle graphical analysis
- Important parameters on admittance circle coordinate