



10Hz to 3/5/10/20/30MHz

6630 Impedance Analyzer

Equivalent circuit analysis

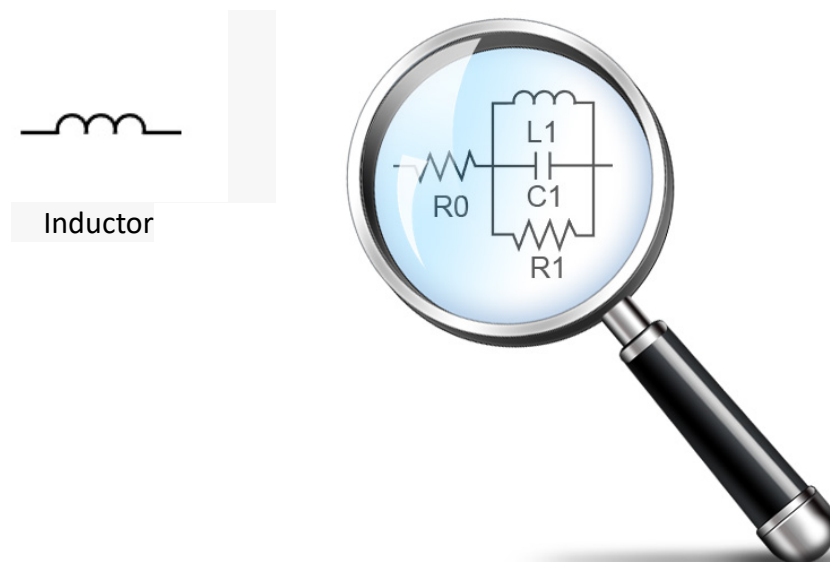


Applications include resistors, capacitors, inductors, oscillators, sensors, delay lines, wave filters and resonators.

Microtest 6630 Impedance Analyzer – Equivalent Circuit Analysis

Great Technical Breakthrough – RLC Model Analysis

For parameters that are required when measuring an element; we will no longer determine them by using only one single characteristic! In fact, for an element, it often comes along with a parameter that will affect other electrical characteristics, requiring consideration. For instance, an inductor is typically wound by copper wires and the impedance of copper wires, the capacitance formed between windings, and the equivalent impedance in parallel connection with the inductor, etc., it will cause unpredictable impacts in different frequencies.



Due to the series impedance (R_0), the parallel impedance (R_1) between wire heads and the stray capacitance (C_1) produced by the windings, the inductor has then become such a structure of this model.

● Why should we build model analysis?

Situation 1.) Frequently-asked questions by customers revealed that the same material may come up with a different result in product application due probably to a different manufacturer or a different lot number. This generally leads to different electrical characteristics, caused by slight difference in the manufacturing process, even though the materials are the same and the number of windings is the same.

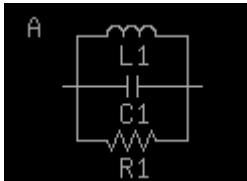
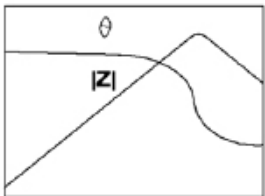
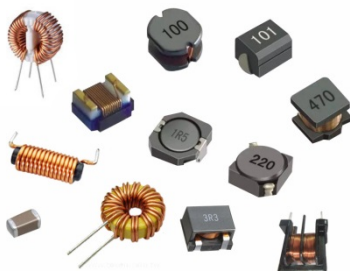
A: When the above occurs, an ordinary LCR meter may not quickly determine the characteristic differences of the product. This needs to be analyzed by using only an impedance analyzer. However, with Microtest 6630, not only can we identify the difference with the frequency-band scanning, we can also perform the model analysis, which makes it easy for us to understand which parameter that has caused an impact to the characteristics.

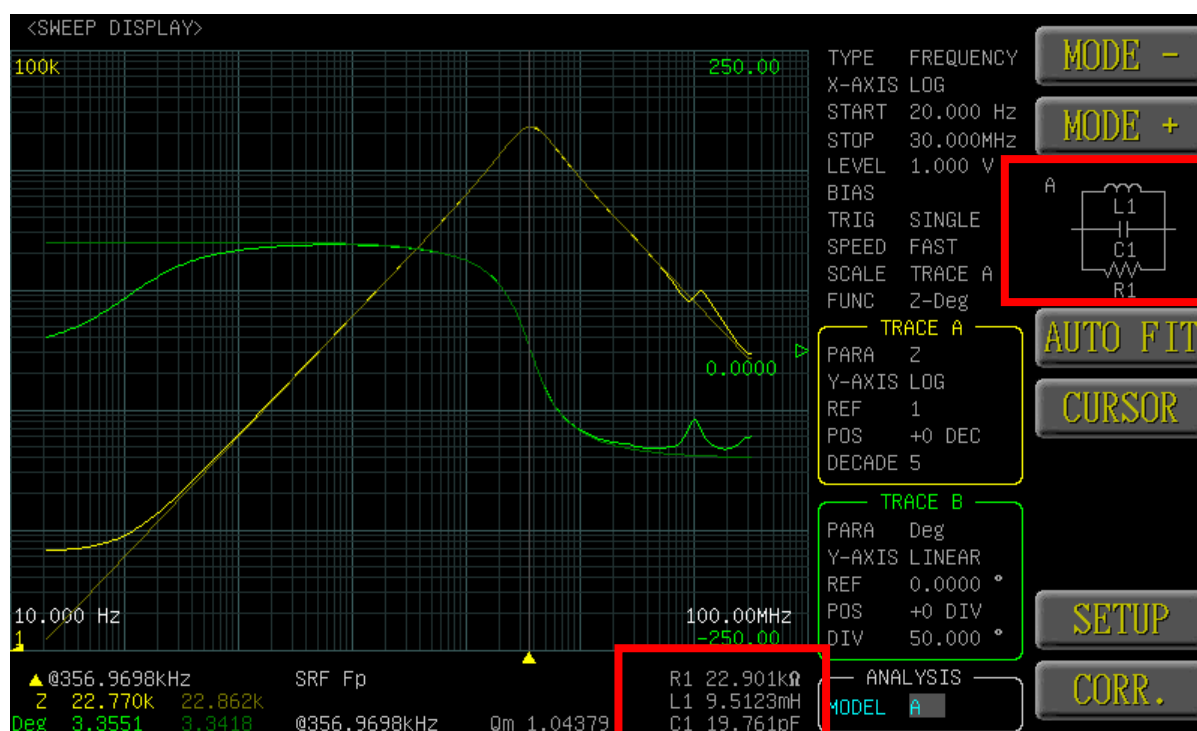
Situation 2.) For a transformer product, what is the difference when the core winding wire is different?

A: In product application, with the same inductance, it often ends up with other different parameters, e.g., wire impedance or the quality factor, etc., due to a different winding density or a different winding tension. These factors may lead to different results under the different frequency or the different testing condition.

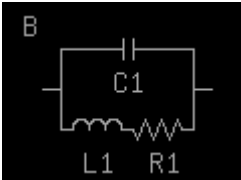
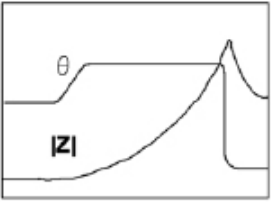
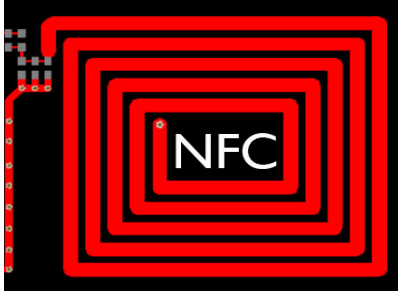
To clearly define the characteristics in certain frequencies, it is normally impossible for the low-frequency RLC meters to meet the measuring requirements. Only by using a network analyzer, we can get a more detailed result. With the Microtest 6630 impedance analyzer, not only can we measure an element characteristic up to 30MHz, we can also calculate with the measuring parameters it yields and estimate the effect at each frequency band after combination. In analyzing a model element, if the above is not taken into consideration, it may turn out to be an unpredictable result in real application. The equivalent circuit analysis is intended to build a model for the DUT with the impedance that is affected differently due to different frequencies.

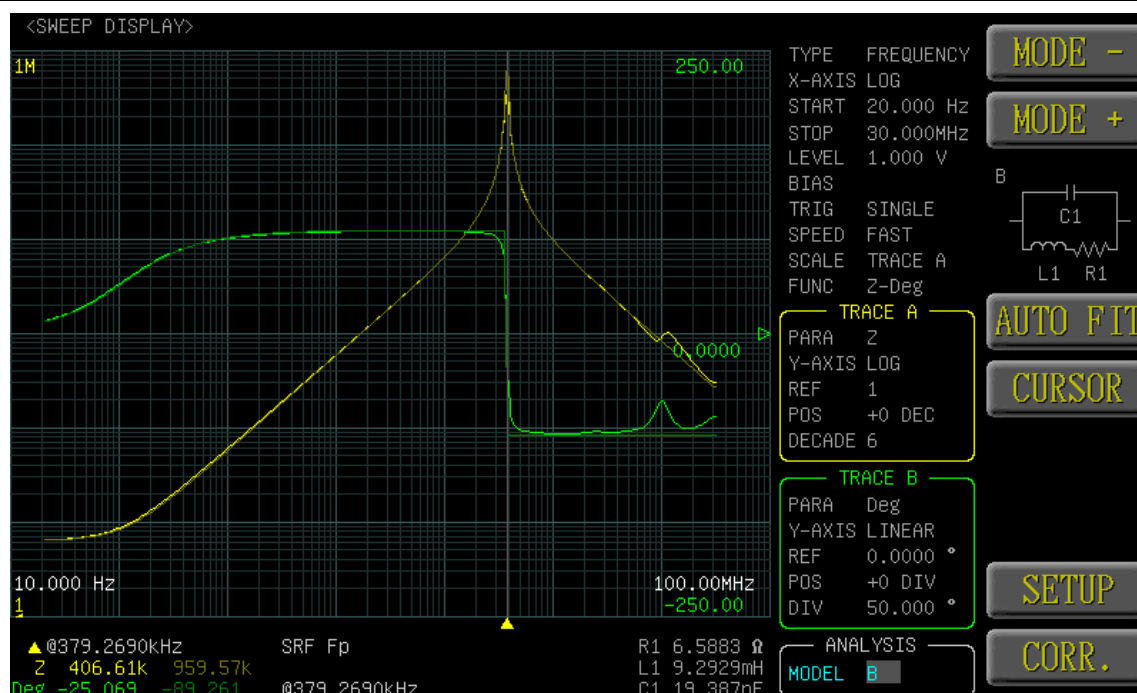
● Seven different RLC models of the 6630 impedance analyzer

Equivalent Circuit	Frequency Diagram	Applicable Component - Inductor
<p>A</p>  <p>Three elements</p>		



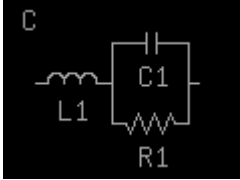
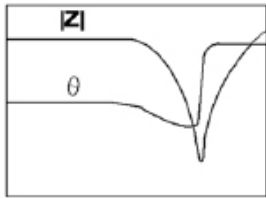

↑ Model A is suitable for measuring and analyzing inductors. (The solid line shows the real measurement while the dotted line is obtained from calculation with the 6630 analyzer. When the solid line and the dotted line are close or the same, it means that the situation fits this model.) The parameters such as, R1, L1 and C1 will show at the bottom of the diagram. In addition, for the values of R1, L1, and C1, you can input values by yourselves to adjust the waveforms of the entire frequency characteristics. Modifying a particular parameter will lead to a different distribution of entire frequencies and Z values, which in turn are displayed with electrical characteristics.

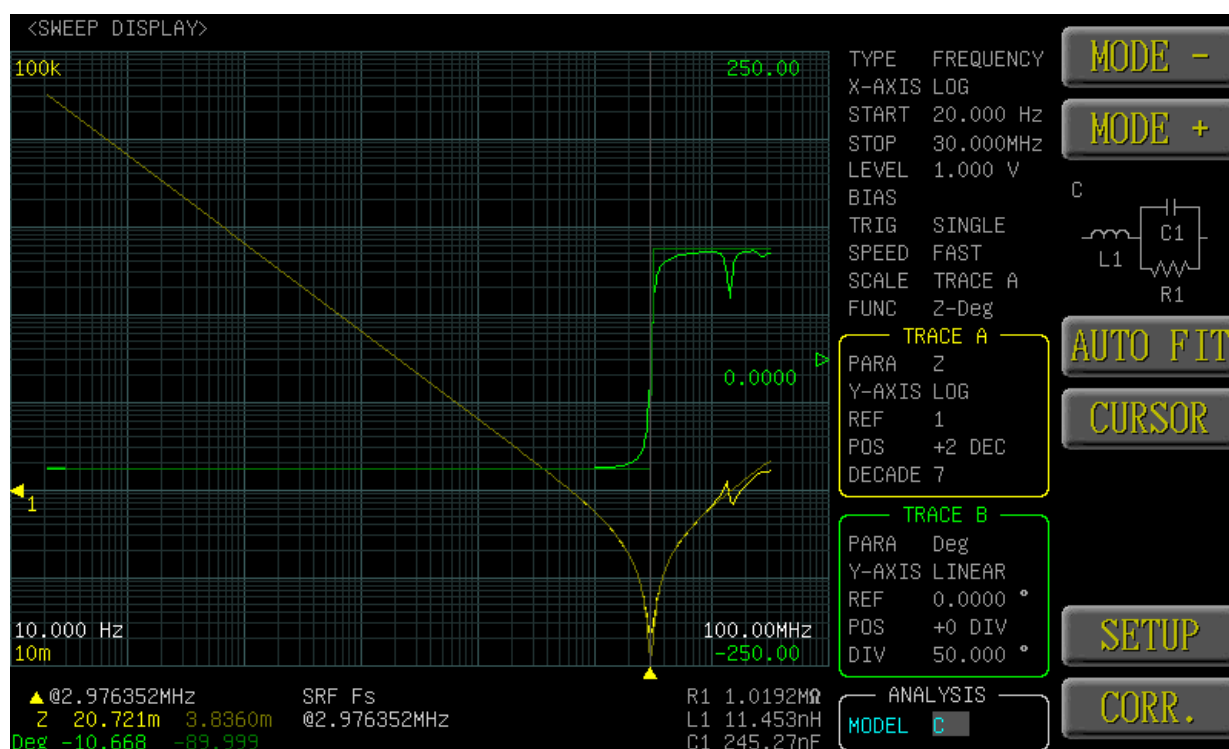
	Equivalent Circuit	Frequency Diagram	Applicable Component – NFC (mobile phone wireless charging)
B	 <p>Three elements</p>		



↑Model B is suitable for measuring and analyzing NFC (Near Field Communication), a short-range high frequency wireless communication technology, e.g. the induction coil for wireless charging in a mobile phone. Due to the manufacturing process, the wiring density layout from the induction coil will affect the original capacitance. The size of the parallel equivalent capacitance in the coil is the key to determine whether the product can be successful in high frequency application. It can affect the receiving function/wireless charging of an antenna. With this element analysis, we can accurately determine the RLC value to ensure the quality of the induction coil. -- Continued next page --

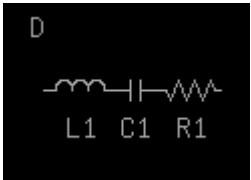
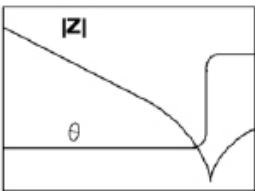
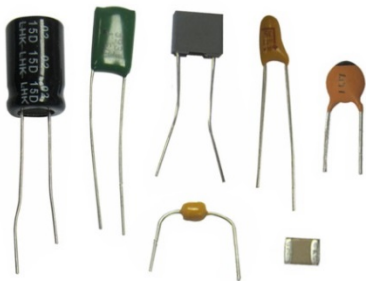
This model is suitable for the R&D stage. It allows us to verify earlier the wiring planning and the selection of material used. Also, at the production stage, it can quickly let us determine whether the stability meets the expectation, accelerating the R&D and completing the manufacturing process improvement.

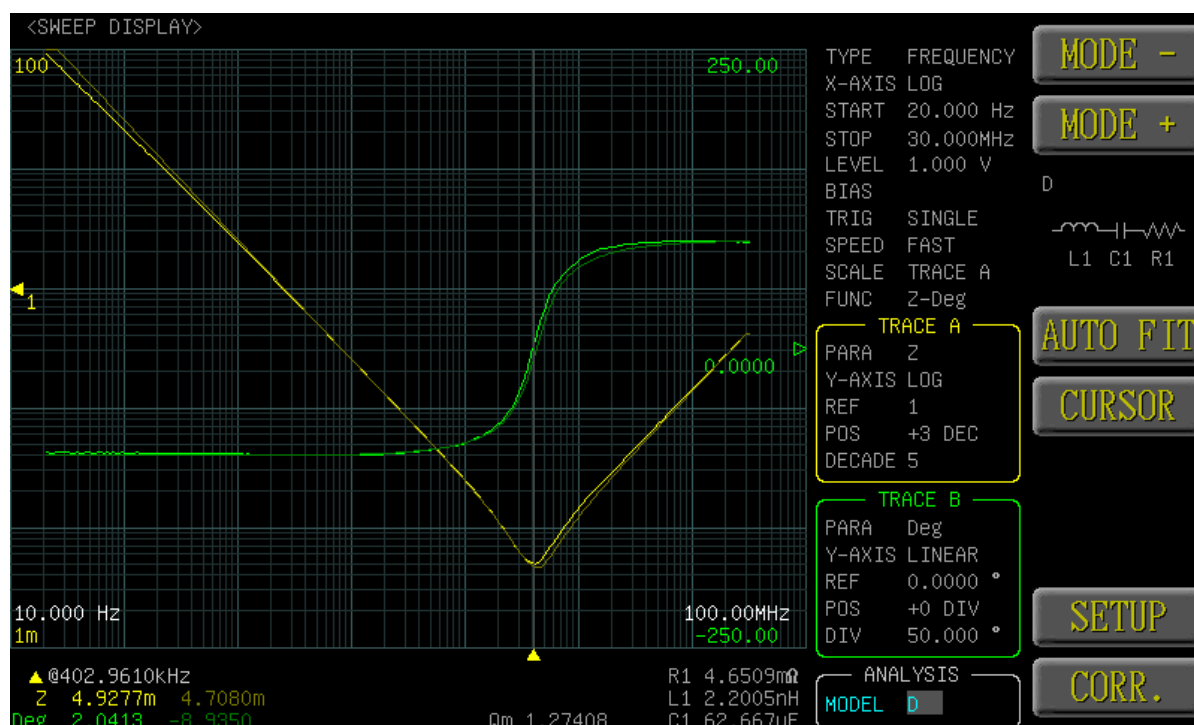
Equivalent Circuit	Frequency Diagram	Applicable Component – High-resistance resistors
<p>C</p>  <p>Three elements</p>		



↑Model C is suitable for measuring and analyzing the high-resistance resistors.

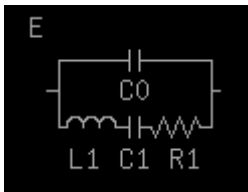
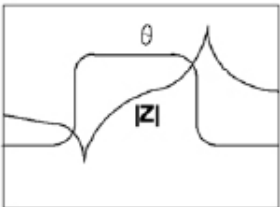

A resistor product may lead to the electrical characteristic difference due to the inductance in windings and the capacitance between two pins. This model can quickly analyze each parameter of wire-wound resistors/ chip resistors / bleeder resistors/insulated HV resistors in the equivalent circuit.

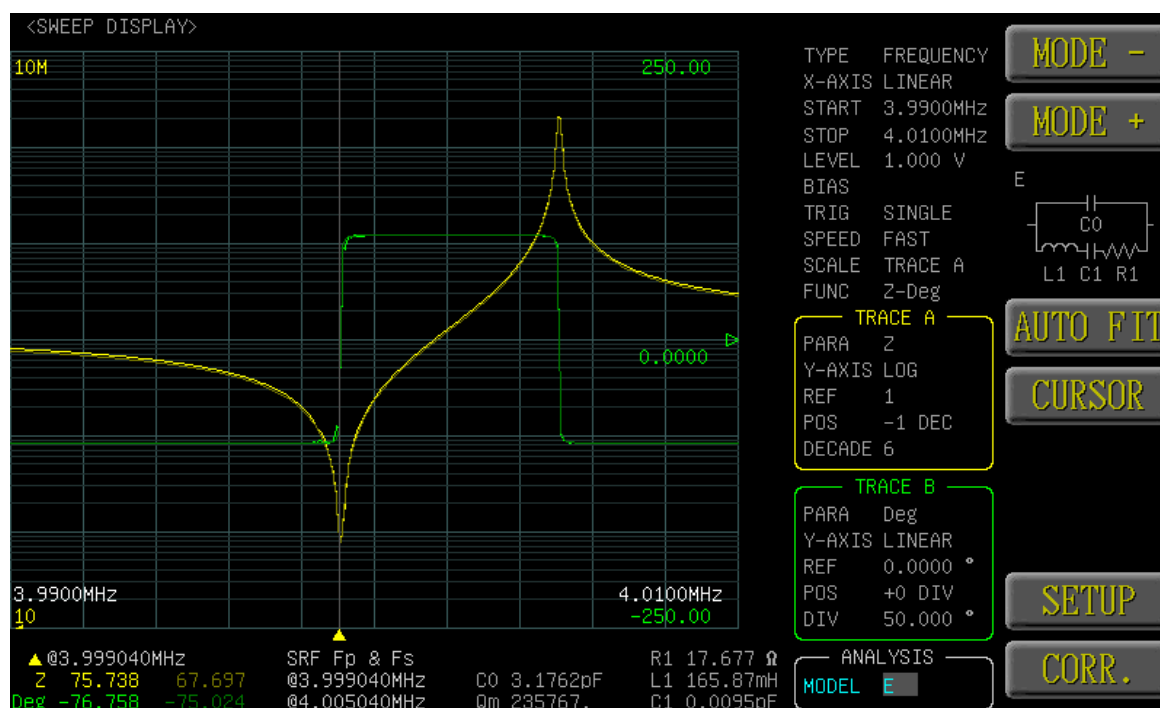
	Equivalent Circuit	Frequency Diagram	Applicable Component - Capacitor
D	 <p>Three elements</p>		



↑Model D is suitable for measuring and analyzing the capacitors.

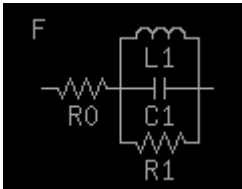
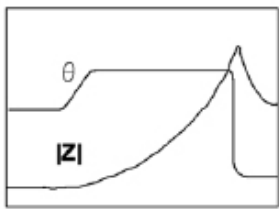

For electrolytic capacitors, plastic capacitors, box capacitors, tantalum capacitors, ceramic capacitors, laminating capacitors, etc., the inductance and the resistance on the lead will affect the characteristics at a different frequency band. This model can quickly analyze the series equivalent resistance and inductance of the capacitor.

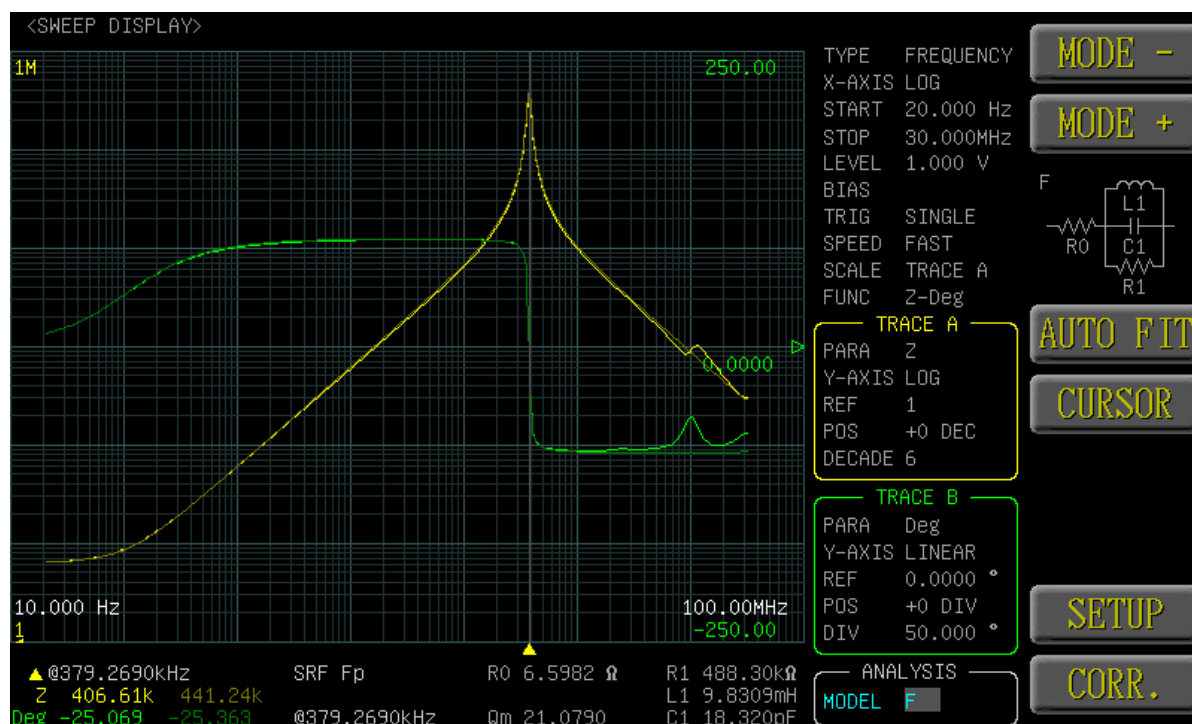
	Equivalent Circuit	Frequency Diagram	Applicable Component - Resonators, piezoelectric films, transducers
E	 <p>Four elements</p>		



↑ Model E is suitable for measuring and analyzing the resonators. The two-resonance frequency characteristic diagram presented above is suited for Model E.

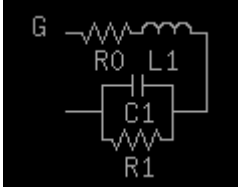
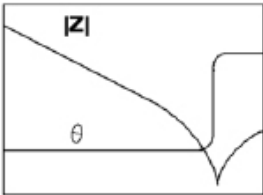
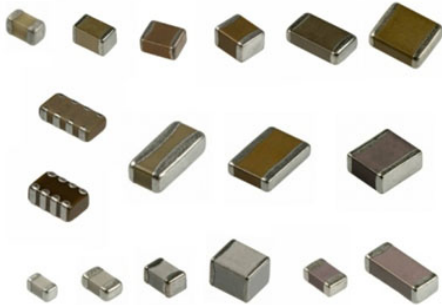
Unlike other elements, when analyzing an ordinary resonator, piezoelectric film or transducer, there may have more than one resonant frequency. For instance, to maximize the amplitude output of the piezoelectric material, we have to know exactly the range of the resonant frequency. As shown above, this model can clearly analyze the frequency between two resonant points.

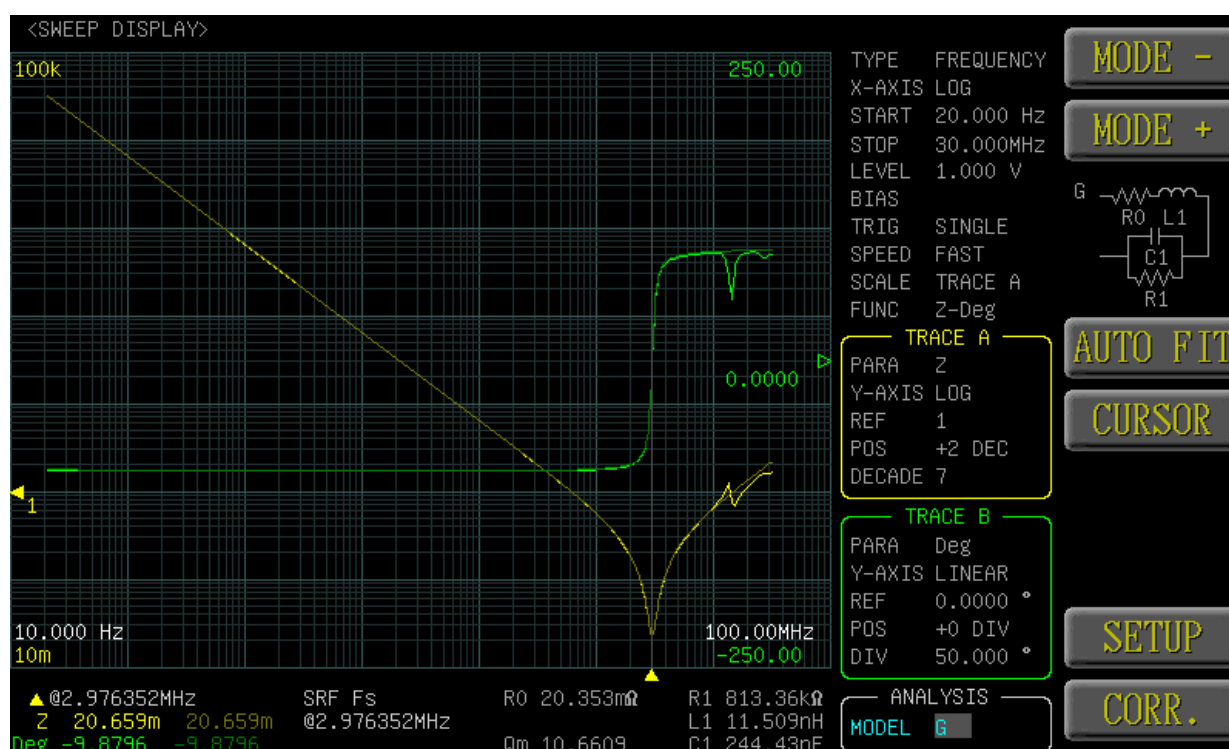
Equivalent Circuit	Frequency Diagram	Applicable Component - Inductor
<p>F</p>  <p>Four elements</p>		



↑ Model F is suitable for measuring and analyzing the inductors.

This model analyzes the inductor elements by using four elements. Comparing with the three-element analysis, it can analyze more effectively and separately the series and parallel equivalent impedances, and display in this model the impacts that are likely to be produced.

Equivalent Circuit	Frequency Diagram	Applicable Component - SMD
<p>G</p>  <p>Four elements</p>		

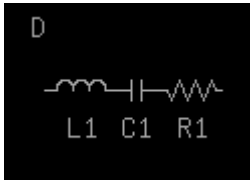
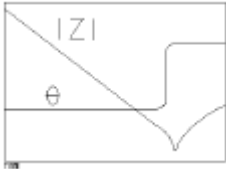
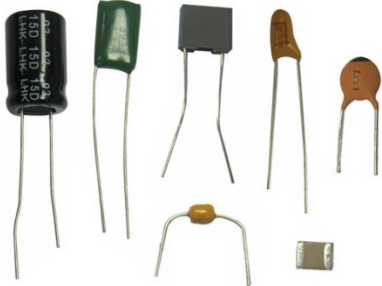
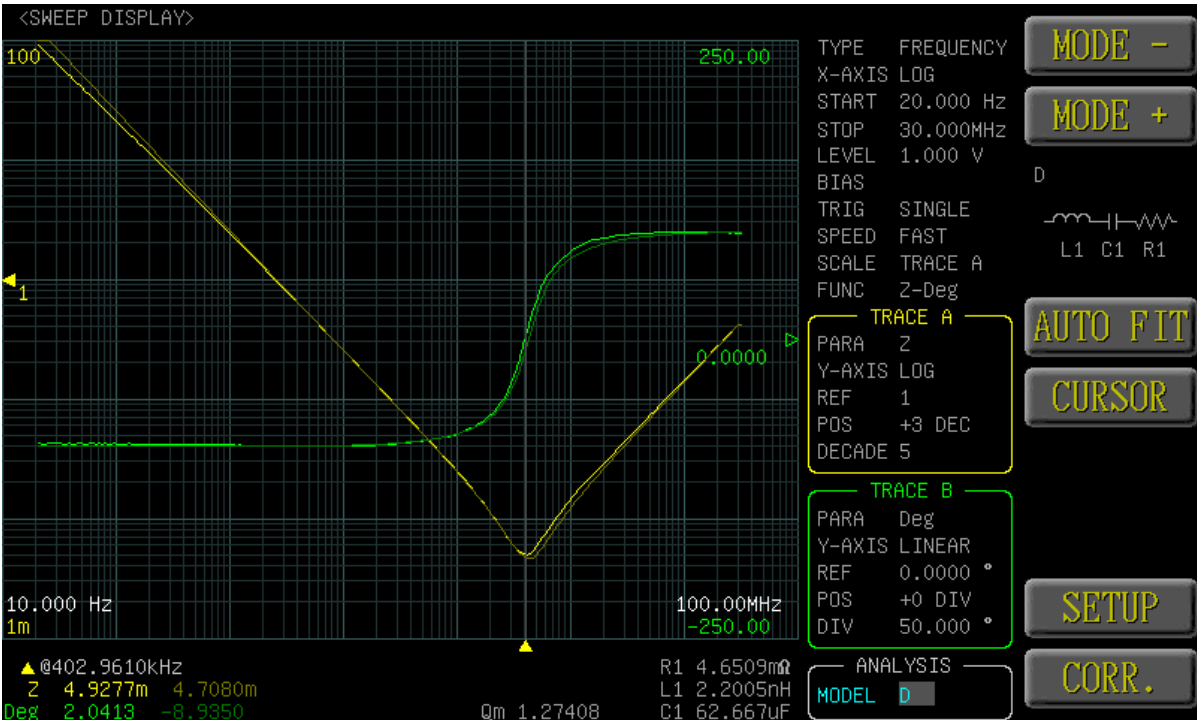


↑Model G is suitable for measuring and analyzing the capacitors.

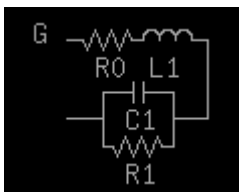
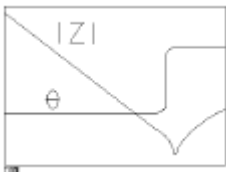

This model analyzes the capacitor elements by using four elements. Comparing with the three-element analysis, not only the original parallel equivalent resistance and inductance, it also adds the analysis of the parallel equivalent impedance, more suitable for analyzing the element with a smaller capacitance.

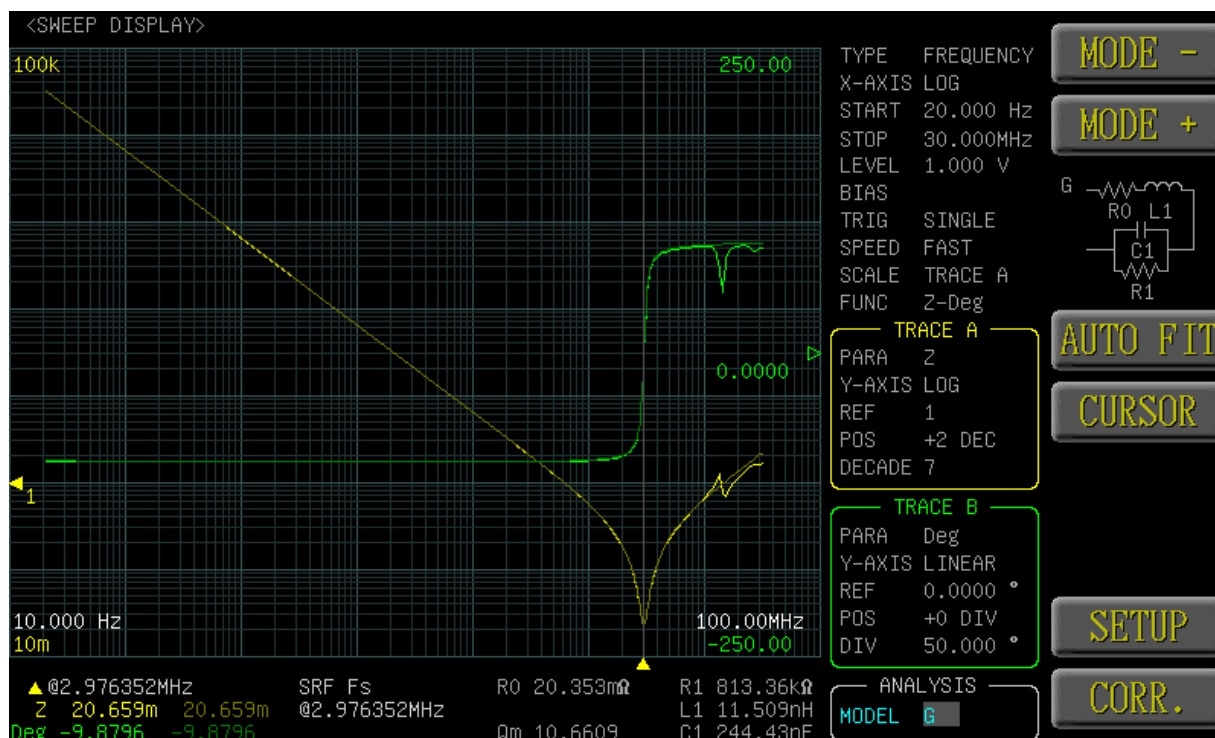
● **For Example:**

We may compare and analyze with Model D and Model G as follows:

Equivalent Circuit		Frequency Diagram	Applicable Component - Capacitor
D	 <p>Three elements</p>		
			

↑ Choose a right RLC model to analyze three/four elements value.

<p>G</p>	 <p>Four elements</p>		
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↑ Model G is the model that analyzes the capacitance measurement (four parameters: R0, L1, C1, and R1). The frequency diagram obtained from scanning is the same as Model D. The dotted line is obtained from calculating with the 6630 impedance analyzer, which is not similar to the diagram of solid line obtained from real measurements. Therefore, it is not appropriate to analyze by using the parameter of Model G.



Tip: Model D and Model G both analyze by using the measuring capacitor. Now, you should choose the diagram having overlapped dotted lines or close solid lines. Therefore, Model D is more suitable.