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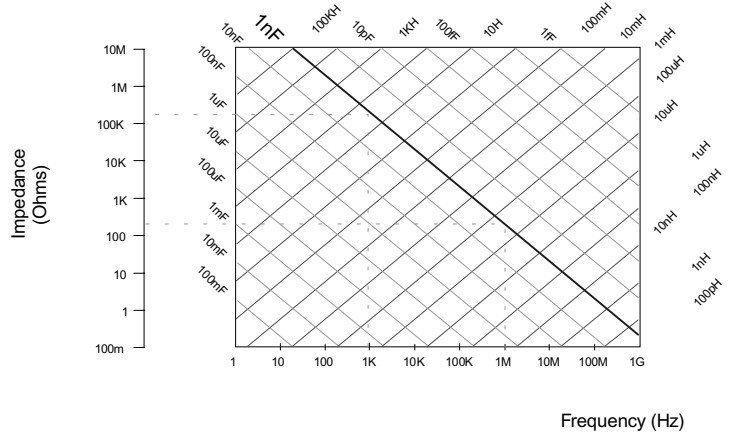
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IMPEDANCE MEASUREMENTS ... in brief

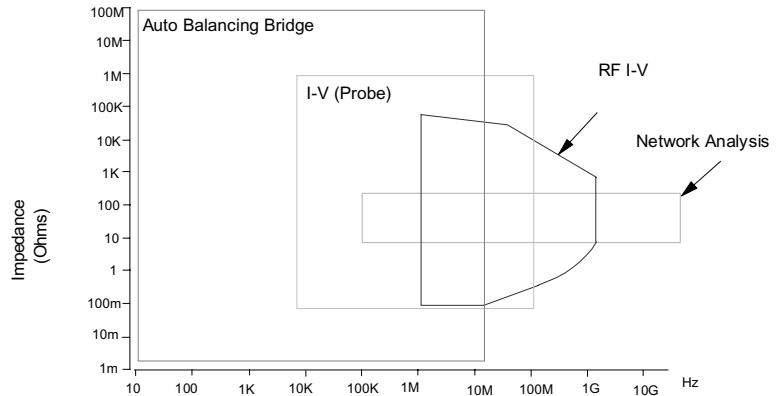
1. Know the DUT impedance

Reactance chart of various ideal capacitors and inductors helps approximating DUT impedance range vs frequency for choosing the proper instrument technique. For instance, a 1nF ideal capacitor exhibits an impedance of 160 KOhms @ 1KHz and only 160 Ohms @ 1MHz.



2. Choose adequate instrumentation

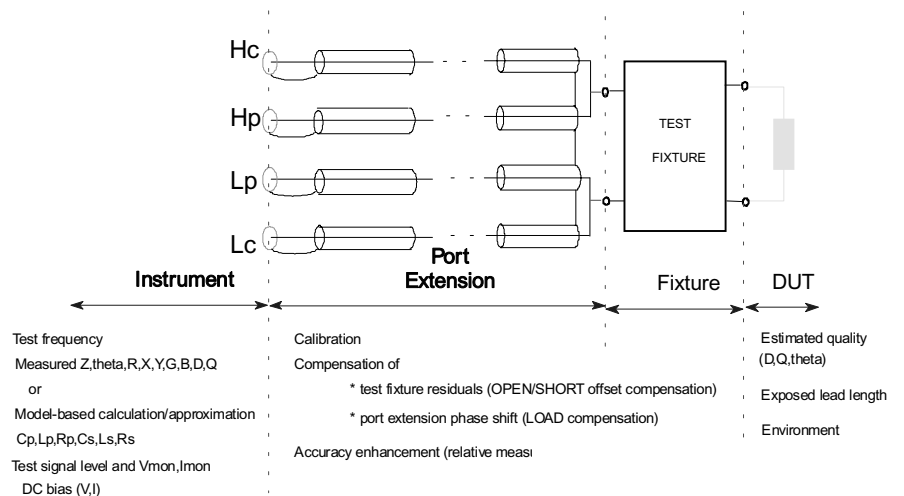
This chart shows that autobalancing bridge technique provides the widest impedance range. I-V probe is good for medium frequency range. Reflectometry or network analysis has narrowest impedance range, but allows very high frequency measurements. However, to be complete, this chart should be 3-dimensional showing accuracy as well. Don't forget it !



3. Set-up and measurement procedure

To test this 1nF capacitor up to 1MHz, with best accuracy, we will use an autobalancing bridge, with a 4 terminal pair port extension if required.

Here, measurement quality depends on the quality of the instrument, the port extension and the test fixturing. Indicated measurement result is then close to or identical to the real value. This figure summarizes the key points. For example, remember that Z and theta are measured while Cp,Lp,Cs,Ls,...are calculated. So, always start by evaluating Z and theta !



Measurement Methods and HP Products

Measurement Method	HP Products	Frequency range
Auto Balancing Bridge (Four-Terminal Pair)	HP 4263A LCR Meter HP 427xA LCR Meters HP 4284A Precision LCR Meter HP 4285A Precision LCR Meter HP 4192A LF Impedance Analyzer HP 4194A Impedance/Gain-Phase Analyzer	100Hz to 100 kHz spot 100Hz to 10MHz spot 20Hz to 1MHz spot 75KHz to 30MHz 5Hz to 13MHz 10Hz to 40MHz
Resonant (Q-Meter)	HP 4342A Q-Meter (Obsolete, FY94) HP 42851A Q Adapter (with HP 4285A)	22KHz to 70 MHz 75KHz to 30 MHz
I-V (Probe)	HP 41941A Impedance Probe (with HP 4194A) HP 4193A Vector Impedance Meter	10KHz to 100MHz 400KHz to 110MHz
RF I-V	HP 4286A RF LCR Meter HP 4291A Impedance/Material Analyzer	1 MHz to 1 GHz 1 MHz to 1.8 GHz
Network Analysis (Reflection Coefficient)	HP 4191A RF Impedance Analyzer (Obsoleted in 1995) HP 4195A Network/Spectrum Analyzer with HP 41951A Impedance Test Set HP 4396A Network/Spectrum Analyzer with HP 43961A Impedance Test Kit HP 8751A Network Analyzer HP 8752C/8753D RF Network Analyzers HP 8510B Network Analyzer HP 8719C/8720C Network Analyzers	1MHz to 1GHz 100 kHz to 500MHz 100 kHz to 1.8 GHz 5Hz to 500MHz 300KHz to 1.3GHz/6GHz 45 MHz to 100GHz 130MHz to 13.5GHz/20GHz

Cable Correction / Compensation by Product

4192A *4194A* *4263A* *4279A* *4278A* *4284A* *4285A* *4286A* *4291A*

Cable Correction / Electrical Length Compensation	✓	✓	✓	✓	✓	✓	✓	✓	✓
Open / Short Compensation	✓	✓	✓	✓	✓	✓	✓	✓	✓
Open / Short / Load Compensation			✓	✓	✓	✓	✓	✓	✓