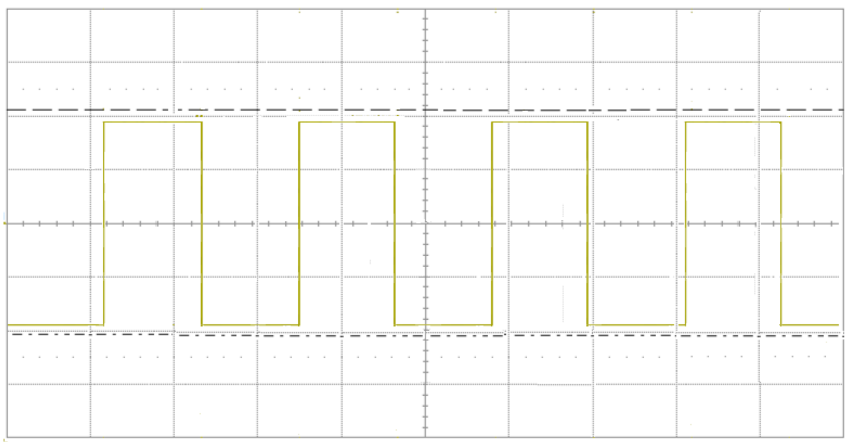
Inductive Measurements with a TEGAM Model 1750

The TEGAM Model 1750 micro-ohmmeter is the fastest and most accurate micro-ohmmeter available. It uses a 4-wire Kelvin measurement with thermal offset compensation and a multi-sampled SAR converter for high speed and accuracy. Unfortunately, the high speed operation is not compatible with many measurements that are inductive. The purpose of this Application Note is to describe a way of compensating the 1750's measurement circuit to be able to measure inductive test samples.

The 1750 has several different measurements modes. The most accurate is the delayed mode that alternates the polarity of a precision current source. The current source is designed to stabilize very quickly with a resistive test sample (Graph 1). An inductive load changes the phase margin of the current source to the point where it will oscillate. This condition may be first detected by noticing an unstable reading or the inability of the 1750 to properly auto-range. The condition can be confirmed by measuring across the test sample with an oscilloscope (Graph 2). Note that the black clips on the 1750 are grounded.



Graph 1 - 1750's test signal in a non-inductive measurement (5 mV/div)

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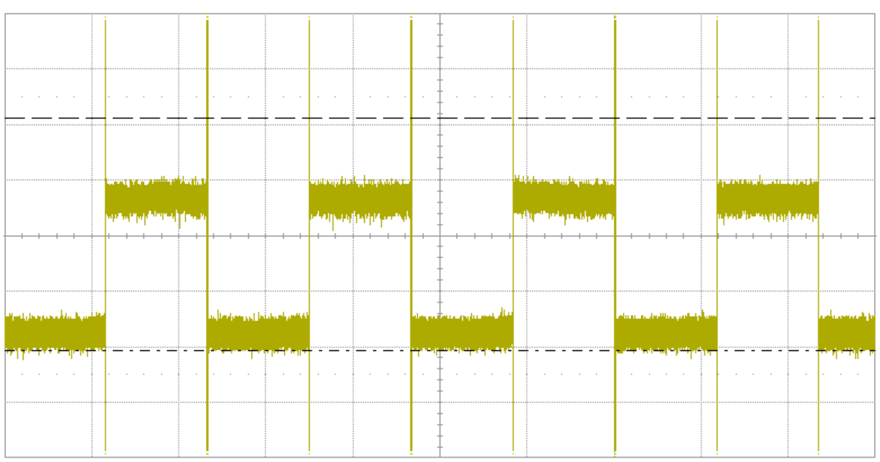


Graph 2 - 1750's test signal in an inductive measurement (5 mV/div)

To correct the phase margin of the current source and stop the oscillation, a capacitor can be connected across the test sample and the measurement delay time set to 250 ms. The voltage the 1750 applies to the test sample is less than 2V, therefore a capacitor rated higher than 20V will be acceptable. One additional consideration is how leakage current of the selected capacitor affects the measurement. The typical $R_{leakage}$ value of ceramic or even electrolytic capacitors are sufficiently high that their influence is undetectable by the 1750. In general: $R_{leakage}$ should be $R_{measured}/10,000$.

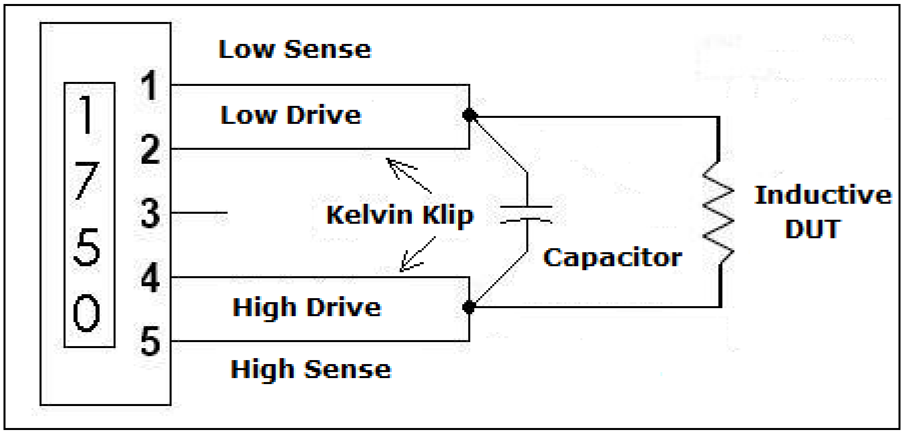
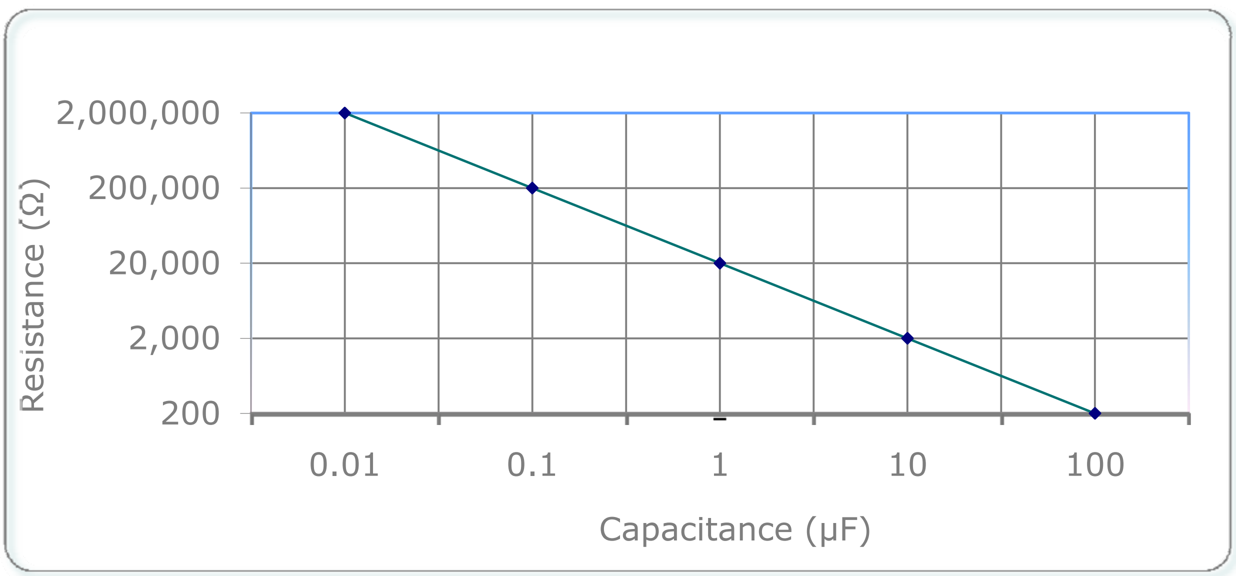


Figure 1 - 1750's setup for an inductive DUT.

The addition of the capacitor does impose some limitations on the measurement. As the capacitance increases, the maximum resistance that can be measured accurately decreases. This occurs because the test sample and the precision current source work together to discharge and recharge the capacitor every time the polarity of current source switches. This is not normally a problem because measurements with inductive properties typically have fairly low resistances. As a convenience, Graph 3 was produced to guide the selection of a capacitor. The graph shows the maximum recommended resistance when connected in parallel with different capacitor values.



Graph 3- Capacitance vs. Maximum Recommended Resistance