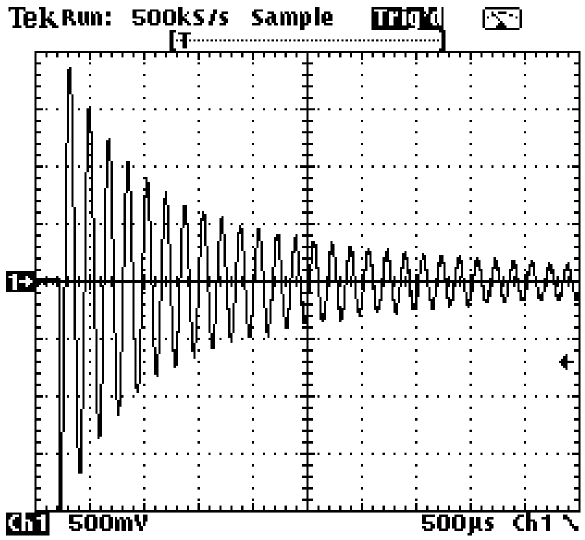
Bob's basic wide range ring tester

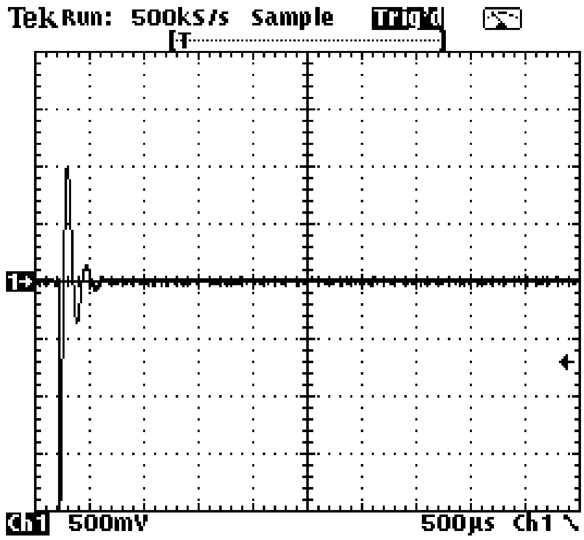
After I designed the “Blue2” microcontroller-based wide range ring tester which is being sold by **EVB in Portugal**, I wondered if a more basic version of it could be designed around common 4000 series CMOS ICs and through-hole components so that anyone with electronics skills could build it. This tester is the result.

It differs from the “Blue2” unit by being in a larger case and powered by a 9V alkaline battery. Power switching is by a push-on/push-off button, and there is no automatic turn-off or low battery warning.

Apart from that, it uses the same principle of discharging a low loss polypropylene capacitor charged to 2V into the inductor being tested, about 5 times per second. If the inductor or transformer winding is OK, the capacitor and inductor will form a resonant circuit which “rings” with a slowly decaying waveform of many cycles. It's the electrical equivalent of tapping an empty glass, which “rings” at a particular frequency. However if there are short-circuited turns present, this severely loads the resonant circuit and there are very few “rings”. Here are the relevant waveforms:



Good coil



Shorted turn

This tester uses the same front-end circuitry as the “Blue2” tester, which feeds the waveform into a high impedance JFET buffer then half of an LM393 dual comparator with hysteresis to generate square waves until the “ring” voltage has decayed to about 30mV peak-to-peak. A CD4518B dual decade counter is reset at the start of each measurement cycle and counts the square waves. The counter outputs in BCD format go to a pair of CD4511B latch/decoder/7-segment driver ICs. At the end of each measurement cycle, the displays are updated with the new counter numbers.

In the unusual situation of the counters getting to 99, a diode AND gate stops them from “overflowing” back to “00”, to prevent confusion.

The other half of the LM393 functions as an oscillator to set the timing for the measurement cycles.

Battery & power switch

This tester uses a 9V battery and I recommend installing an alkaline one such as an Energizer E522. The battery compartment of this case is not very well designed and it can be a battle to get the battery in and out. I've found that it's least difficult to insert the battery terminals-end first, and remove it last. You might need a small screwdriver at the non-terminals end to “encourage” it to come back out. Please replace the battery if the displays start getting dim.

Push the power button to turn the tester on, and push it again to turn it off. There is no automatic switch-off so if you're transporting it in a toolbox, make sure that nothing can bump the button.

Theory and using this tester

A lot of electronic equipment makes use of inductive components in the form of various kinds of transformers and chokes etc.

In circuitry like switch mode power supplies and LCD backlight inverters as well as older CRT line output (flyback) transformers and deflection yokes, high voltages are involved and there is always the risk that the insulation between wires in the windings of those components will break down.

These parts are usually hard to find and always expensive. When the symptoms of a fault point to an internal breakdown in a transformer or inductor, the technician needs to be pretty sure that the part is defective before looking for a replacement.

Testing inductive components

Inductive components generally fall into two categories. There are high frequency types which usually have ferrite cores and very low losses. They include switchmode power supply and monitor/TV LCD backlighting inverter transformers. This tester is designed to also test low frequency iron-cored transformers such as in valve (tube) amplifier output stages and mains power supplies. Normally the tester will be connected to the primary winding of a transformer being tested.

The tester only outputs a low voltage. In many cases it can be used to test inductive components while they are still in their circuit, as long as there are no faults in the circuit or resistive loads on any output windings. If in doubt, take the inductive component out of the circuit and test it.

Typical readings

I'm indebted to **Jestine Yong** for providing a lot of this usage information.

High frequency transformers

Most low loss ferrite-cored transformers in switching power supplies and inverters will produce readings above **50** up to **99** rings. If there are shorted turns, the reading will almost always drop below **10**. However if an entire secondary winding is short-circuited (very unusual), the tester can show a deceptive high reading, e.g. "**37**", so be aware of this possibility.

Many LCD Monitors and TVs will have more than one inverter transformer making it easy to compare a suspect transformer with a good one.

If you suspect that there is a partial short circuit in a transformer's primary winding, put a short circuit onto one of the secondary windings. For a good transformer, the reading will drop to about **50%** of the initial reading, e.g. from **99** down to **~50**. However on a transformer with a partially shorted primary, the same test will have less effect and the reading will not drop so much, e.g. dropping from an initial **37** down to **34**.

If you have a high voltage insulation tester, it might show up internal breakdowns between windings which this ring tester cannot see due to its low test voltage.

Low frequency transformers

50/60Hz mains and tube output transformer primary windings produce much lower readings than ferrite cored transformers. If possible, always compare the tester's readings on a suspect transformer with its readings on a known good transformer of the same kind.

Typical readings are around **15** to **30** for a good transformer primary winding without any interference from other components in the circuit. Shorted turns usually drop the reading to less than **10**, however a solid short circuit on a secondary winding can produce a reading similar to a good transformer, so keep this in mind.

Please try out the tester on as many transformers and inductors as you can, to get a "feel" for what are normal readings. There are so many different inductors and transformers that it's not possible to provide "hard and fast" readings for all of them.