horizontal output stage will greatly increase the losses in the LOPT's primary circuit. That is, they lower the Q.

We chose the principle of `ring' testing as the basis for this instrument because it's easy to implement with relatively simple circuitry and common components, and produces predictable results with no need for calibration.

`Ring' testing gets its name from the fact that when a fast pulse is applied to the primary winding of the LOPT, the total inductance and capacitance in the circuit will produce an electrical `ring' - a decaying AC voltage which can have a duration of a dozen or more cycles before it reaches a low value. It's the electrical equivalent of tapping an empty glass; in each case, an energy impulse generates damped oscillations.

Waveform `A' in Fig.1 shows the HOT collector voltage waveform in a typical fault-free TV (a General Electric TC63L1 in this case), in response to a pulse from this tester. However if the losses in the horizontal output circuit are increased, the amplitude of the `ringing' waveform will decay much more quickly. Waveform `B' shows the effect of a shorted rectifier diode on one LOPT secondary winding of the same TV, but note that a shorted LOPT winding or several other faults would have a similar effect.

A collector-emitter short in the HOT or a shorted tuning capacitor will result in no ringing at all, indicating a really major fault.

So to do an initial check of a horizontal output stage, with this tester, you first make sure the TV or monitor is de-energised(!). Then you simply switch the tester on, connect the ground lead to the chassis and the `HOT Collector' lead to the horizontal output transistor's collector. One LED will illuminate for each `ring' cycle above about 15% of the initial pulse value, and in general if four or more LEDs are glowing, the horizontal output stage is OK.

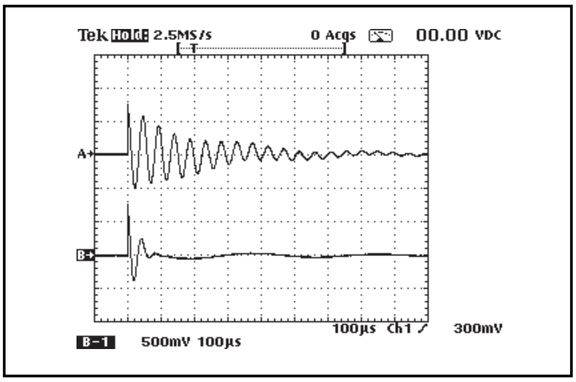

Fig.1: Ringing waveforms from 'good' (top) and 'shorted winding' line output transformers, in response to the tester's pulse.

We'll talk more about using the tester later, after the circuit description. For the moment though, it's worth mentioning that because the tester uses a low-voltage testing pulse, it is suitable for testing LOPTs `in circuit' - i.e., without having to disconnect the yoke or other connections.

Circuit description

At first glance the circuit in Fig.2 might look a bit complicated, but it really consists of three quite simple sections. These are the low frequency pulse generator, the ring amplitude comparator and the LED bar-graph display. We'll now look at these in turn.

1. The low frequency pulse generator: Voltage comparator IC1a is set up as a low frequency oscillator, whose output on pin 7 is normally pulled up to essentially the positive supply rail by R6 and R7. Due to the time constants produced by C2, R4 and R5/D1, pin 7 pulses down to ground potential for about 2ms every 100ms, and it's during these low-going 2ms pulses that each ring test occurs.

When IC1 pin 7 drops low, Q1 is driven into saturation by its base current flowing in R7, and its collector voltage jumps to the +6V supply, which makes two things happen. First, C6 in collaboration with R16 sends a positive pulse of about 5us duration to the reset pins of four-bit shift registers IC2a and IC2b, which drives all their outputs to a low state - switching off all the LEDs, in readiness for a new ring test.

At the same time, about 20mA flows through R8, driving D2 into a low impedance state and dropping about 650mV across it. The voltage step across D2 is coupled via C3 to the test leads and the LOPT primary winding, causing this circuit to `ring' a bit below its natural resonant frequency due to the presence of C3 (which functions as the resonating capacitor when testing an LOPT on its own).

2. The ring amplitude comparator: The `ringing' waveform is coupled by C4 to the inverting input of comparator IC1b, which is DC biased to about +490mV by the junction of R11 and R12. D3 is constantly forward-biased by about 1mA flowing through R10, and its entire voltage drop of about 600mV is applied to IC1b's non-inverting input as a reference voltage, via R13. R14 produces a small amount of positive feedback around IC1b, ensuring that its output switches cleanly between its low and high voltage levels.

The result of all this is that an inverted and squared-up version of the ringing waveform appears at the output of IC1b,

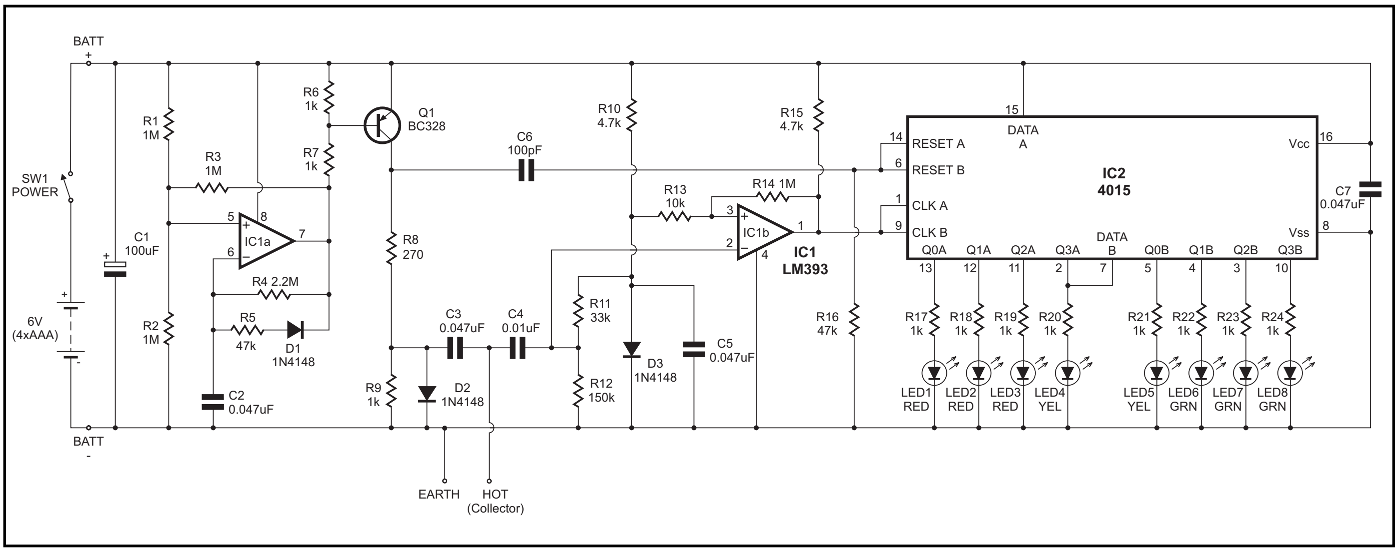

Fig.2: The circuit is simple, but elegant. IC2 shows clearly how many rings are supported by the inductor under test.