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IMPROVE YOUR HEATH-10-103

Add 10 more calibrated sweep speeds to it.

When Heathkit offered the I0-103 oscilloscope kit with its 10 MHz bandwidth and triggered sweep at a price I could just argue myself into, I found some precious pennies and quickly sent them off before I could change my mind. The resulting instrument with its calibrated vertical attenuator and triggering which proved to be positive beyond the useful response of the vertical amplifier was very satisfactory for my experimenting. The only disappointment was in the limited choice of calibrated horizontal sweep speeds. Seven sweeps in decade steps covered 100 ms/div to 0.1μ/div. Those of you who are familiar with industrial oscilloscopes will appreciate the restriction this forces on the operator.

Let me illustrate the problem. The horizontal sweep is set at 100 μs/div. and ¾ of a pulse is displayed. In order to see the complete pulse you must change the sweep speed and the nearest slower speed is 1 ms/div. In addition to the complete pulse you will also see 6½ more pulses of the pulse train as well. The resolution has been lost. You could use the variable sweep control but then the calibration would be useless for any accurate time measurements. What is needed is a calibrated sweep of 200 μs/div. A similar situation arises when three pulses are displayed at 100 μs/div. and you want to get maximum detail of one pulse. You need a sweep speed of 50 μs/div but you only have a sweep speed of 10 μs/div which would display only 3/10 of the pulse.

Adding ten more calibrated sweep speeds may sound like a formidable undertaking but really all you need is one more 10 KΩ 1% resistor and a two pole three position switch!

Basic Design

Let us look at the basic sweep circuit in Fig. 1 (the designations are Heathkit's). It is a PNP transistor using a basic characteristic

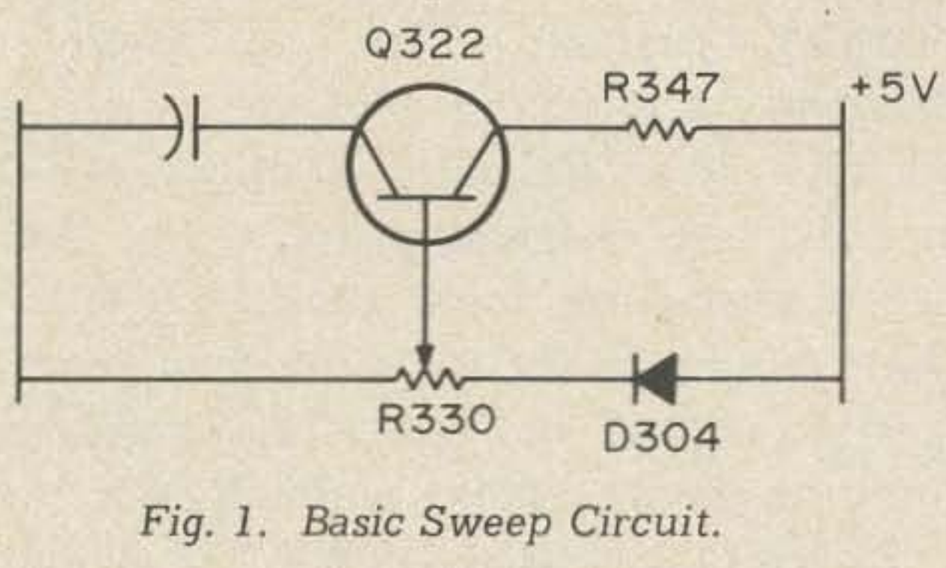

Fig. 1. Basic Sweep Circuit.

of a transistor. The collector current is nearly equal to and controlled by the emitter current. The voltage on the base of the transistor is held constant by the bias resistor R330. This will cause Q322 to conduct until the voltage across R347 is equal to the voltage across the bias resistor from its wiper tap to the cathode of D304

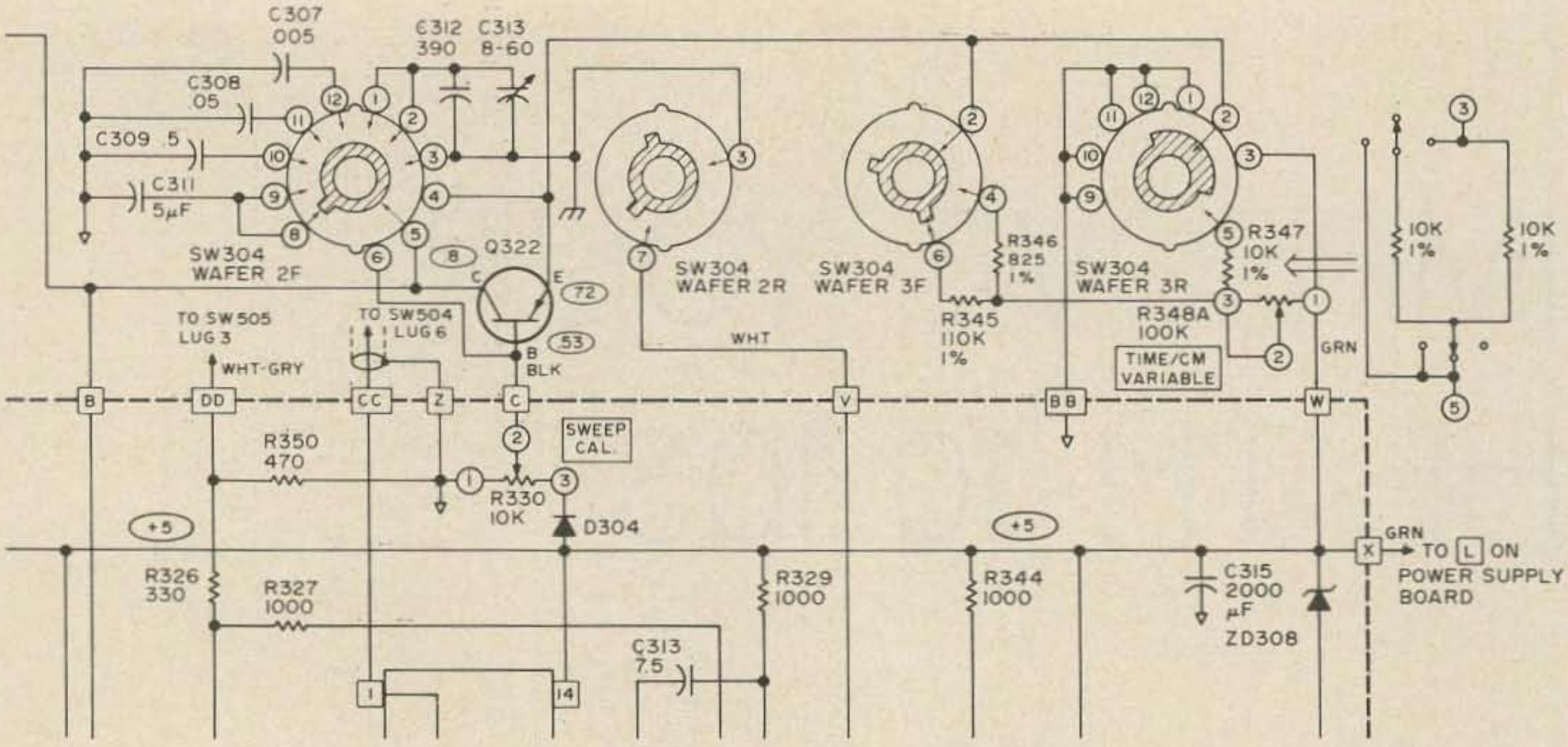

Fig. 3

(the diode mirrors the base-emitter voltage for temperature stability). By ohm's law, if this voltage is held constant and the resistance of R347 is held constant, then the emitter current must be constant. It follows then that the collector current will be constant as well and can be used to create a linear sweep voltage.

Let us look at the capacitor charging formula. I/C = change of volts/time. The change of volts/time is our linear sweep. The capacitance will stay constant so the charging current is the only parameter to change to give us a new sweep speed. Going back to our discussion of the basic sweep circuit we see that R347 controls the charging current. Thus to double the charging current and thus the sweep speed we must *halve* the value of R347. Similarly, to halve the charging current and thus the sweep speed we must double R347. With this knowledge we take our two pole three position switch and two 10 KΩ resistors and combine them to make a new R347.

Heathkit has used 10 KΩ for all but two of the sweep currents, changing decade ranges by changing the sweep capacitor. For the desired sweep speeds we will need an R347 of 5 KΩ 10 KΩ and 20 KΩ. The 5 KΩ can be fabricated by paralleling the 10 KΩ resistors, the 10 KΩ resistor is supplied, and 20 KΩ can be fabricated with two 10 KΩ resistors in series. This sounds like five precision resistors but a switch is necessary regardless so it can be used to make up the various values. Now only one more precision resistor must be acquired. The resistors and switch wired as in Fig. 2 will replace the original R347 in the sweep circuit.

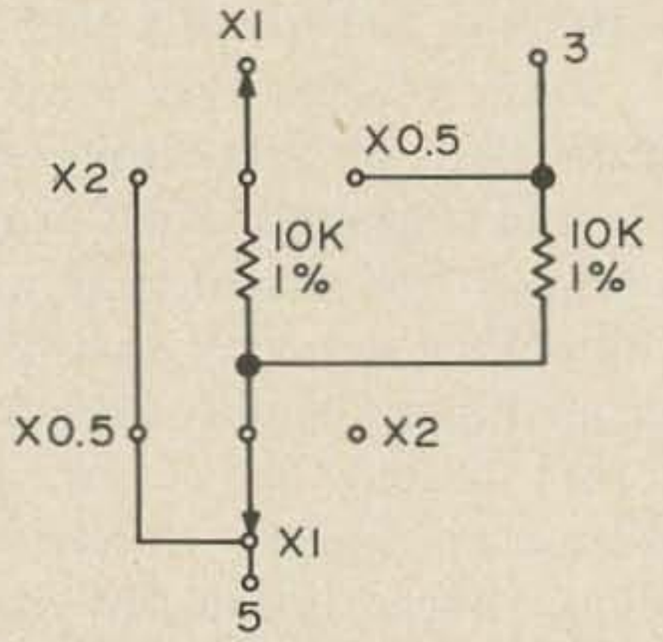

Fig. 2. Modified circuit to replace the R347 in the sweep circuit in Fig. 1.

In use the original decade selector chooses the correct capacitor for the desired decade, then the new switch will choose the multiplier which will give the sweep X1, X2, or X0.5.

When buying your switch be certain to get one small enough to fit in the available panel space beside the decade switch. As a small finishing touch, spend the few extra cents to buy the Heathkit H2 pointer knob and its insert. The result will be an I0-103 which appears at first glance to be unmodified but which holds the advantage of ten more calibrated sweep speeds.

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