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Writing speed relationships and stored writing speed versus view time are discussed in this article on the new 7633 Storage Oscilloscope.

7 Using your oscilloscope probe

Part I of a two-part article discusses passive voltage probes. Knowing your probe's characteristics and how they affect the signals under test will help you make more meaningful measurements.

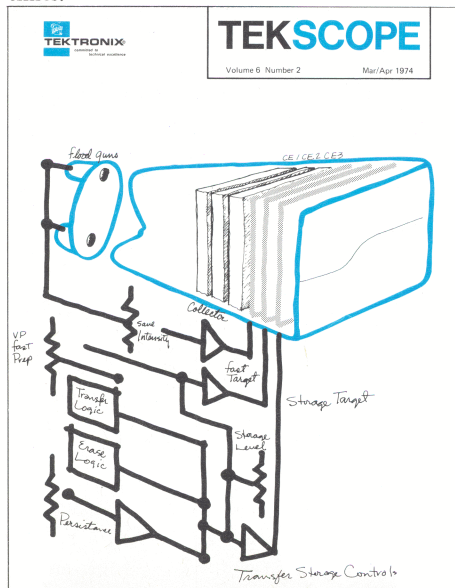
12 Triggering the oscilloscope from logic signals

A new low-cost instrument permits triggering your oscilloscope from any logic word up to four bits, and more by cascading instruments.

16 Servicing the TELEQUIPMENT D67 oscilloscope

Comprehensive trigger adjustment and sweep calibration procedures are included in this article on the low-cost D67 Oscilloscope.

Cover: New target designs and new operating modes yield direct-view storage writing speeds in excess of 1000 cm/ μ s. Transfer storage techniques produce fast writing speeds with relatively long viewing times.



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TEKSCOPE

Volume 6, Number 2

Mar/Apr 1974

Measuring pulse signals

Let's consider what happens to a typical pulse signal source (Figure 2(a)) when we apply a probe. If the generator had a t_r of 0, the output t_{r1} would be limited by the integration network of R_s and C_s and would be equal to $2.2 R_s C_s$, or 8.8 ns. If a typical passive probe, such as the P6053B (10X, 9.5 pF, 10 M Ω) is used to measure this signal, the probes' input capacitance and resistance are added to the circuit (Figure 2(b)). Since R_p is $\gg R_s$, R_p may be disregarded. Using the risetime formula, $2.2 R_s (C_s + C_p)$, the circuit risetime, t_{r2} becomes 13 ns. The loading effect of the P6053B to this signal source is the percentage change in risetime:

$$\frac{t_{r2} - t_{r1}}{t_{r1}} \times 100 = \frac{13 \text{ ns} - 8.8 \text{ ns}}{8.8 \text{ ns}} = 48\%$$

The percentage change that results from adding a passive probe to this pulse source is directly related to the capacitance added. The calculation to determine the amount of change in risetime would be:

$$\frac{C_p}{C_s} \times 100 = \frac{9.5 \text{ pF}}{20 \text{ pF}} = 48\%$$

This is a valid approach if the probe resistance, R_p , is large when compared to the source resistance.

Now let's see what happens if we use a probe such as the P6048 (10X, 1 pF, 1 k Ω) to measure this same signal source. In this instance R_p is not ten times greater than R_s and must be considered. R_p and R_s form a dc divider, reducing the amplitude and modifying the source impedance. Using Thevenin's theorem a new generator source voltage and a new source resistance (Figure 2(c)) is calculated resulting in: $t_{r3} = 2.2 R_{S1} (C_s + C_p) = 7.7 \text{ ns}$. Note that in relating this risetime to the risetime of Figure 2(a), our original circuit, the P6048 caused a change from 8.8 ns to 7.7 ns. The percentage of change is less than that caused by the P6053B.

$$\text{Percent change} = \frac{7.7 \text{ ns} - 8.8 \text{ ns}}{8.8 \text{ ns}} \times 100 = -12\%$$

It is interesting to note that rather than degrading the signal by slowing the risetime, the probe modified the source resistance and decreased the risetime making it faster than it should be. But take a look at the output amplitude; it has been decreased to 83.3% of the value without the probe, due to the voltage divider formed by R_p and R_s . In the first example, there was no change in the signal source amplitude when the probe was applied.

And so we see that the choice of probe depends to a large extent on which signal parameter we desire to measure. Low capacitance is desirable when measuring risetime, but high resistance is more important when measuring amplitude. Choosing a low impedance test point is desirable for both risetime and amplitude measurements.

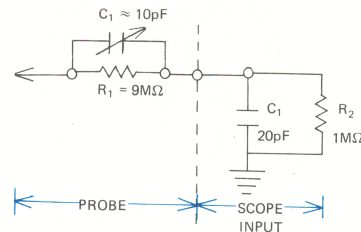


Fig. 1. Typical 10X attenuator and scope input.

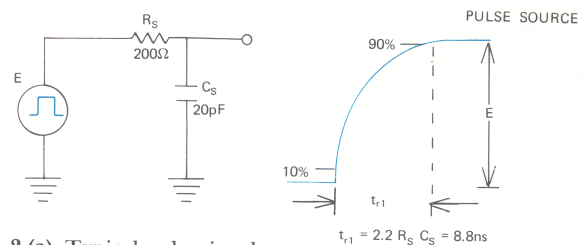


Fig. 2 (a). Typical pulse signal source.

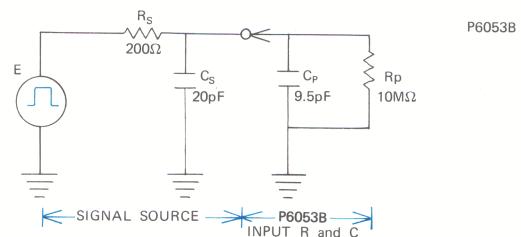


Fig. 2 (b). P6053B probe added to typical pulse source.

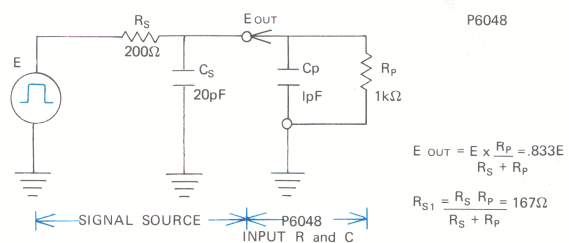


Fig. 2 (c). P6048 probe added to typical pulse source.

Setting B timing

You can use the same procedure for B timing as was used for A with the exception that R186 is the adjustment for the .2 ms timing and C219B for the .2 μ s timing. There is no adjustment for X5 on the B sweep. When timing is completed, turn off the scope and replace the wire link on TP153.

After replacing the link set A TIME/DIV to .1 ms and B TIME/DIV to 20 s. Depress the A intens by B DISPLAY push button and check for proper operation of the A intensified and B delayed modes of operation. This concludes the sweep calibration procedure.

The vertical section

Calibration of the vertical section is relatively easy and the manual procedure is adequate so we will not cover it here. However, there is one item of interest that should be mentioned. If CH 1 and CH 2 have unequal inputs and the SUM mode is selected, the sum of the two inputs will be seen on the crt. If the INVERT switch on CH 2 is depressed, then the difference of the two signals will be displayed, thus acting as a differential amplifier. Remember that in the SUM mode only CH 1 position control will position the trace.

Some service hints

There are two different versions of the D67. One has printed circuit boards that are soldered through to the outside; the other is soldered from the back side only.

If you are removing parts or doing any soldering on the latter version, it would be advisable to do so from the back of the board. This is the side with the circuit runs on it and the crt should probably be removed for accessibility. When soldering on these boards it is important to avoid applying excessive heat for long periods. Excessive heat will damage the runs and lift pads and eyelets away from connections.

The crt is removed by taking off the back panel (4 screws), unplugging the crt socket and removing the three mounting screws on the left hand side of the crt shield as viewed from the front of the scope. Disconnect the neck pins and the anode lead, and slide the crt and shield assembly toward the back until the crt clears the front panel. It can now be removed by pulling it to the left and forward.

A note of caution is in order when troubleshooting the unblanking circuit. This circuit is elevated to -1450 V and it is easy to short out several transistors when probing around with your test scope leads. Using an isolation capacitor of approximately .01 μ f, 3-5000 V rating at the tip of your test probe will limit the possibility of shorting.

Cleaning of the D67 should be done with compressed air and a soft brush. It is not recommended that you wash the instrument. 

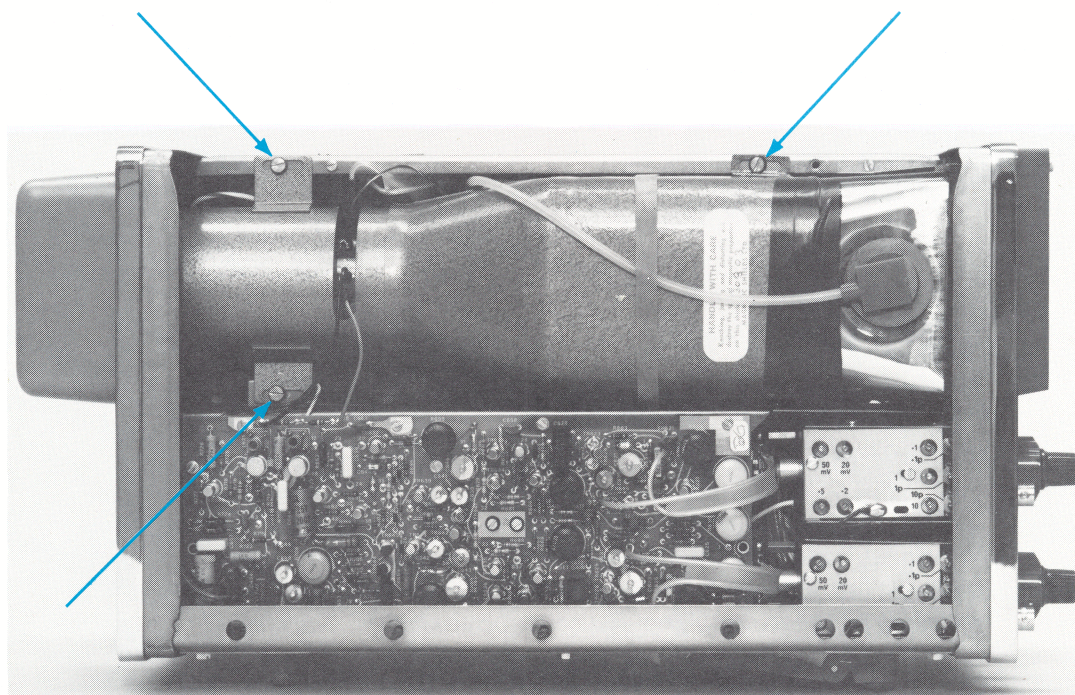


Fig. 5. Arrows indicate three mounting screws holding crt shield.