TEKTRONIX 2465b OSCILLOSCOPES:

REPAIRING THE A5 CONTROL BOARD, SURFACE MOUNT VERSIONS SERIAL NUMBERS APPROX B050000 and UPWARDS.

(And the interesting case of logic IC equivalency of U2970)

H. Holden. OCT. 2013.

INTRODUCTION:

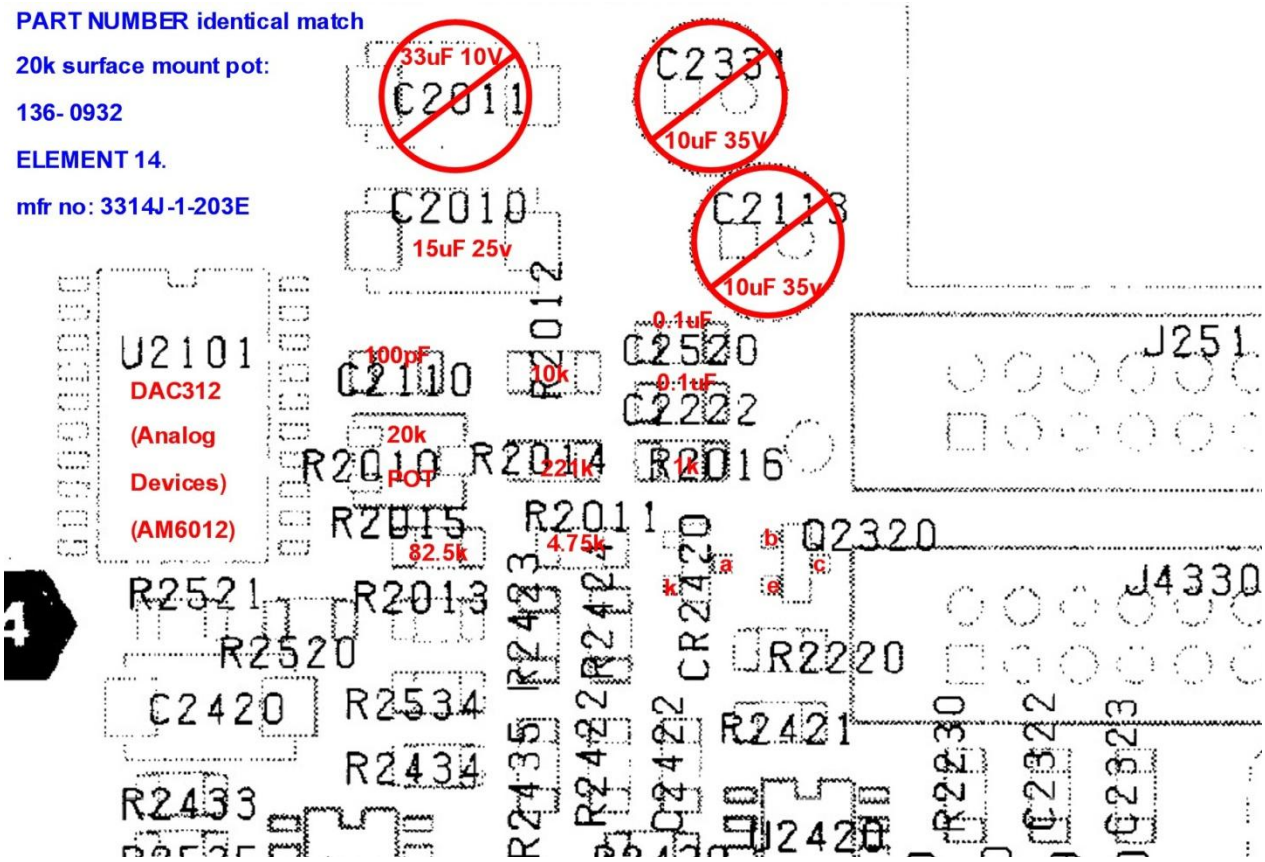
As noted in my previous article on the 2465b scope and nvRam memory options, unfortunately the late model 2465b developed failures related to leaking electrolytic capacitors on the A5 computer logic board. This is a widely known about problem for the 2465b.The A5 board also carries the on screen graphics (dot) generator, which in the early models was on a separate board.

The leaking *surface mount* electrolytic capacitors can cause fairly extreme damage to the PCB. However with patience and care it is possible to repair it as shown in this article. The damage often reaches geographically further on the PCB than a quick visual inspection would suggest. Some late model A5 PCB's did not use the surface mount Electrolytic capacitors, but through hole capacitors and were spared the damage as were the boards fitted with surface mount Tantalum capacitors.

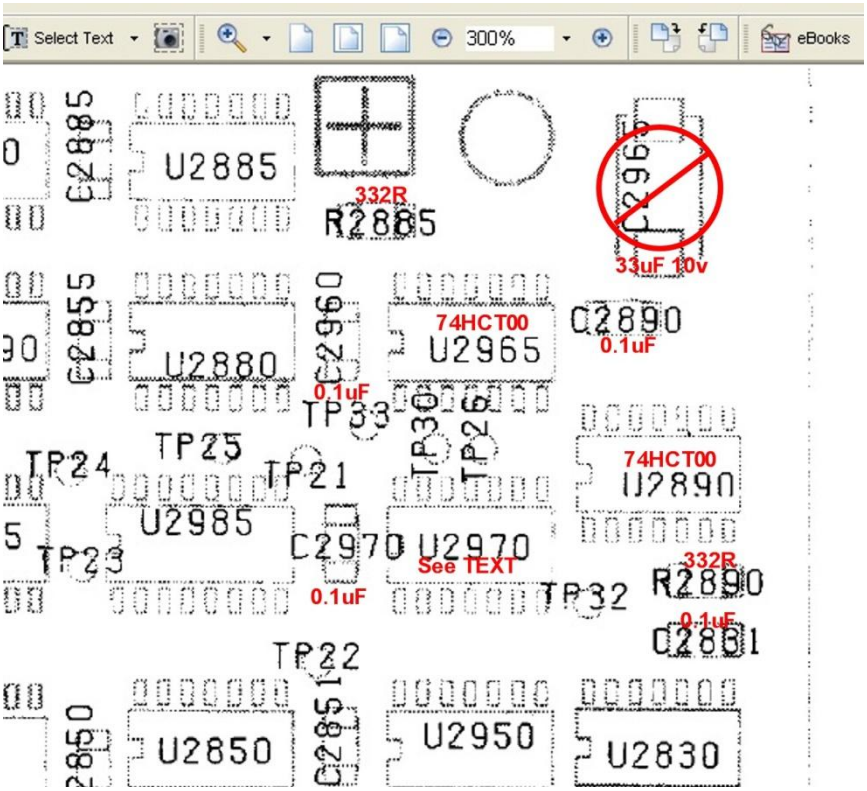
PCB IN THE REGION OF DAMAGE:

The following diagrams show the labelled components in the general area of the leaked electrolyte. In some case the zone could possibly extend further. The A5 board damage shown here is one of the worst cases I have seen, so the damaged area is probably a little larger than most.

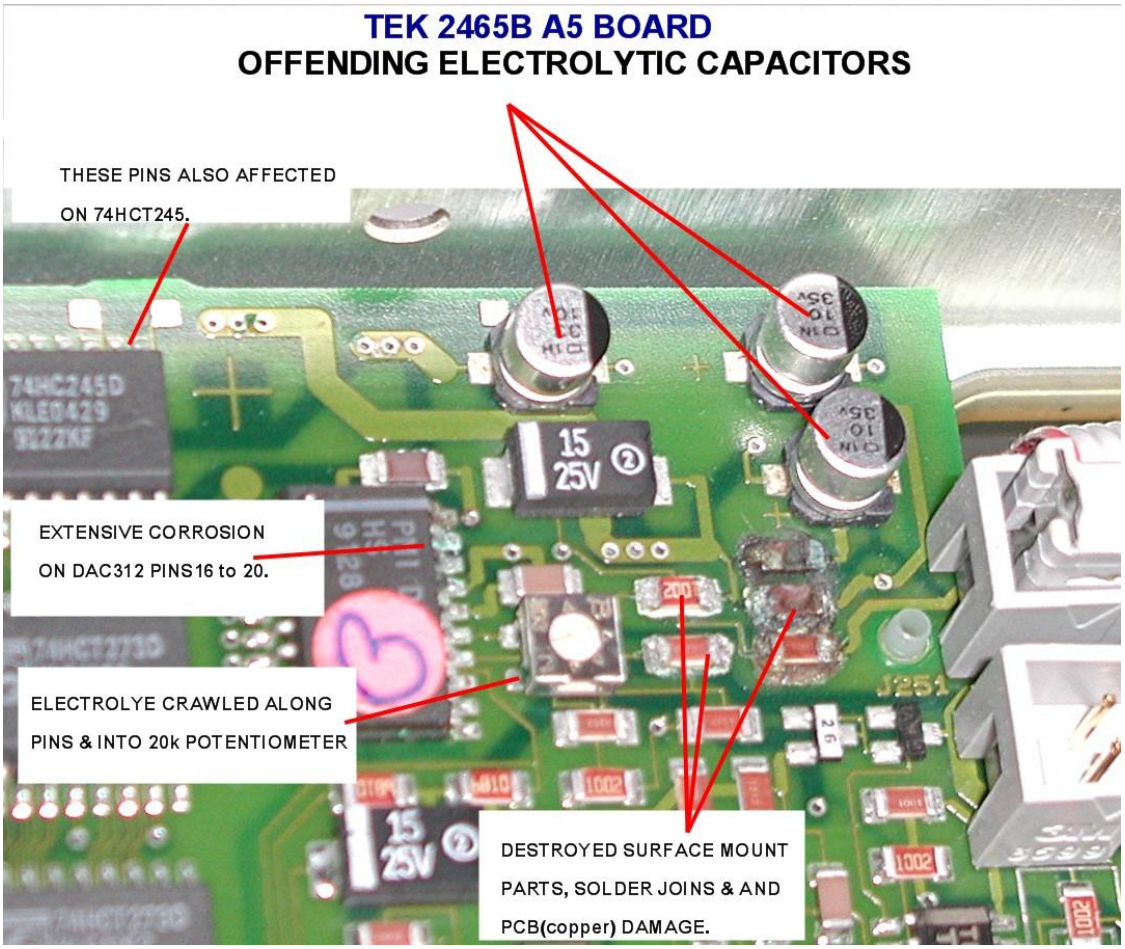
The first area on the upper left hand side sustains the greatest insult as there are three surface mount Electrolytics in that area which leak. On the upper right of the A5 pcb there is only one, so the damage is less extensive:



The left hand side of the board is laid out as follows:



The following photo shows the PCB with corrosion damage:



The leaked electrolyte “bubbles & boils” and is electrolysed by the applied voltage around the region of the two 0.1uF bypass capacitors, so the chemical activity of it is greater in that region and the copper pads and tracks in this region can be dissolved. Other damage includes the surface mount resistors going open circuit because the conductive film in them is corroded away. The fine copper tracks can be corroded through, especially where they join a component’s pad. On this particular A5 board the fine track leading to the DAC’s pin 18 U2101(one of its outputs) was open. This caused no visible scope beam and the *add* Led to be lit.

One clue that the electrolyte has been in contact with a component is that the solder joint loses its shine and goes grey & powdery looking. Fluffy white-grey fine crystalline material or whiskers project from the surfaces of the IC pins & solder joints too.

To repair this sort of damage and make a long lasting repair all of the components which have been in contact with the electrolyte must be removed and preferably replaced in most cases. The board then cleaned and inspected under high magnification for damage.

To remove the surface mount parts such as resistors and capacitors can be done with a twin prong soldering iron tip, however two separate soldering irons, holding one in each hand works just as well. For the IC's the pin rows are flooded with solder and a U shaped tool/tip is used. The size required for the 14 pin IC's came with the Antex soldering iron I bought for this job. I could not find a suitable one for the 20 pin DAC IC (U2101), so I made one using a standard soldering iron tip and a bent piece of brass plate riveted to the standard tip with a width that matched the IC pins.

One problem is that badly corroded solder won't melt and the greyish oxide like material it has turned into is a thermal insulator. So it is necessary to scrape through the corrosion on the IC pins (and the edges of the surface mount parts) and apply fresh solder, to then be able to get enough thermal coupling to be able to heat the pins enough for the de-soldering process. (For this surface mount work, no solder sucker is required however the solder sucker is required to remove a dead DS1225). Once the

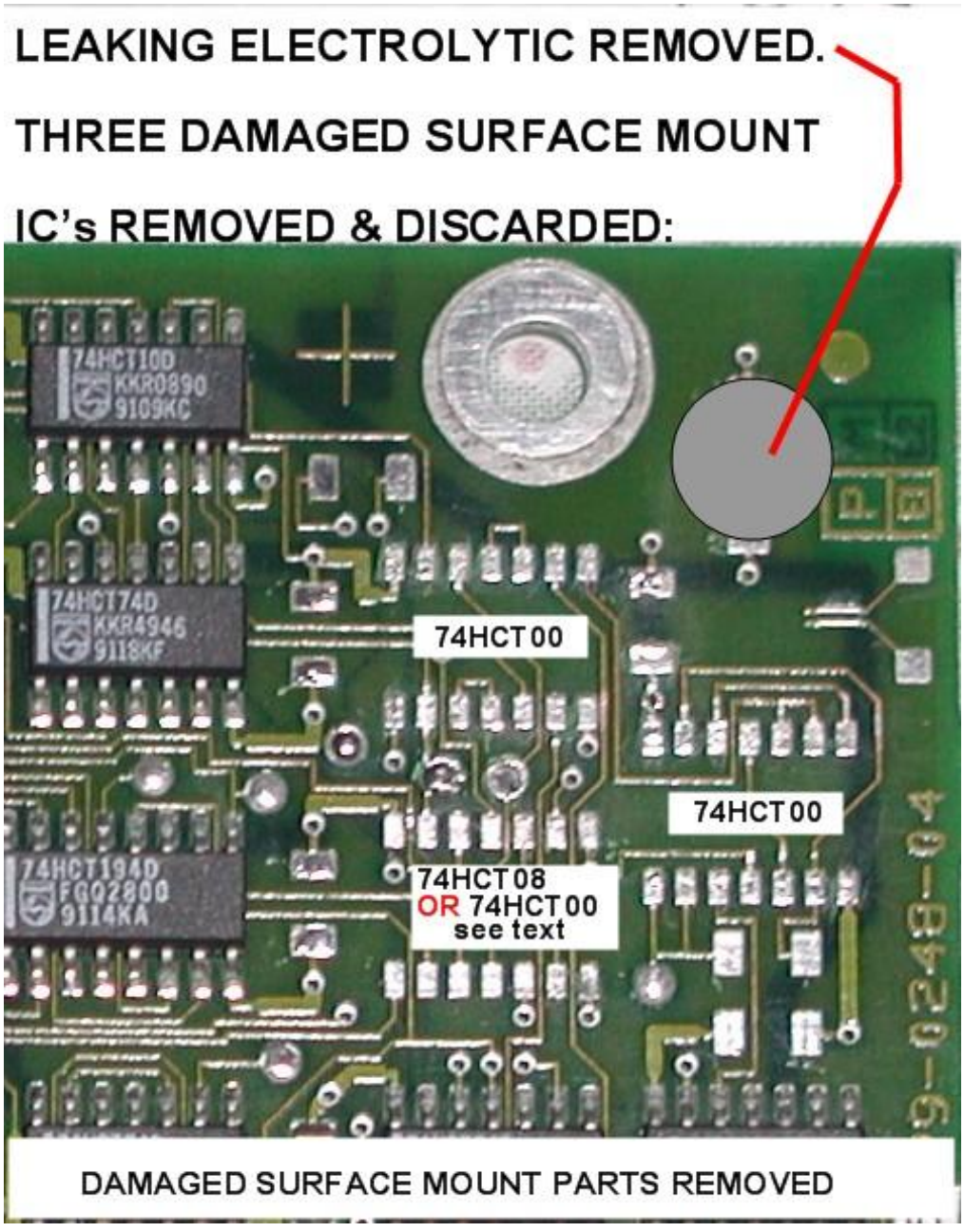
components are removed the component pads are cleaned and fresh solder applied, then this is removed with solder wick, prior to replacing the surface mount parts with new ones.

The replacement 1206 sized resistors I chose were standard values, for example the 221K was replaced with a 220k, the 82.5k with an 82k and the 4.75k with a 4.7k, the small differences being eliminated when the 20k adjustment pot is set. On the other side of the PCB the 332 Ohm resistors are replaced with 330R resistors. Transistor Q2320 and diode CR2420 and the 74HCT245 IC were removed, so the pads and tracks under them could be cleaned, and since these were only mildly corroded, their pins were cleaned and they were re-fitted, but all the other surface mount parts in the damage field were replaced with new ones.

When these de-soldering tools are applied to the IC, it is important that the IC pins are heated simultaneously before any lateral pressure is applied to loosen the IC body from the PCB, or the pads where the IC pins connect may be damaged.

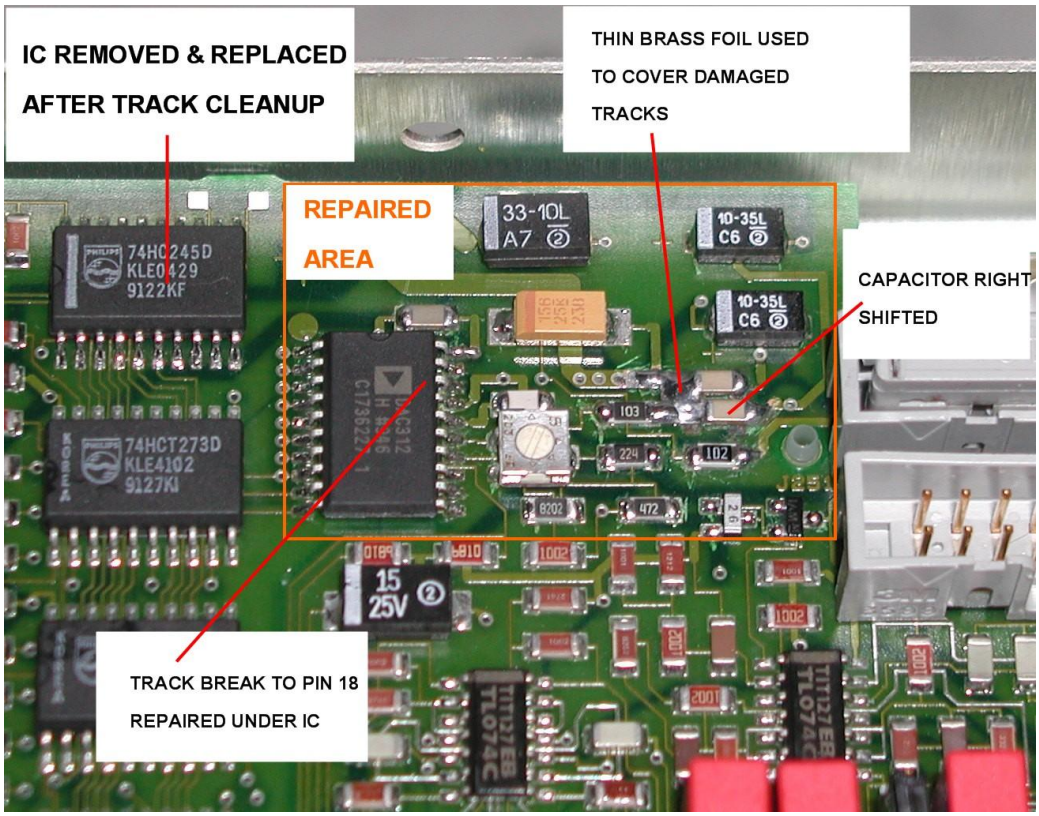
The following photos show the damaged components removed and the PCB cleaned up:

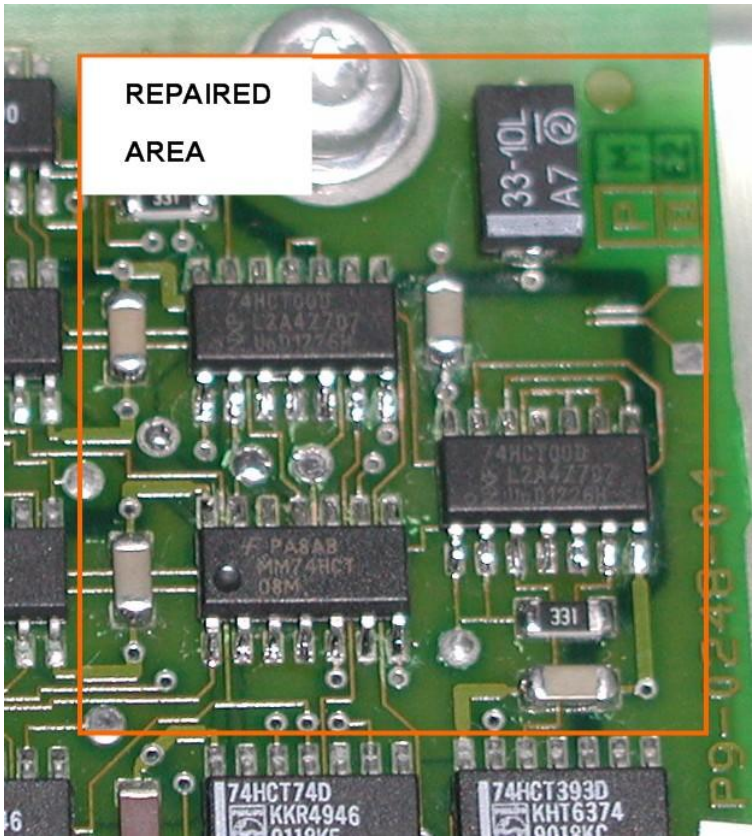
Any open circuit tracks need to be detected and repaired before the components are re-fitted. On this particular scope the track leading to pin 18 of the DAC IC (one of its outputs) was open circuit. There is a thin black line between the track leading to this pad and the pad, just visible in the photo above. Here the thin copper tract was eaten completely through. This was repaired with a small bridging wire. Fortunately none of the plated through holes in the region were damaged, despite the extensive corrosion elsewhere.



DAMAGED SURFACE MOUNT PARTS REMOVED

The following photos show the rebuilt pcb:

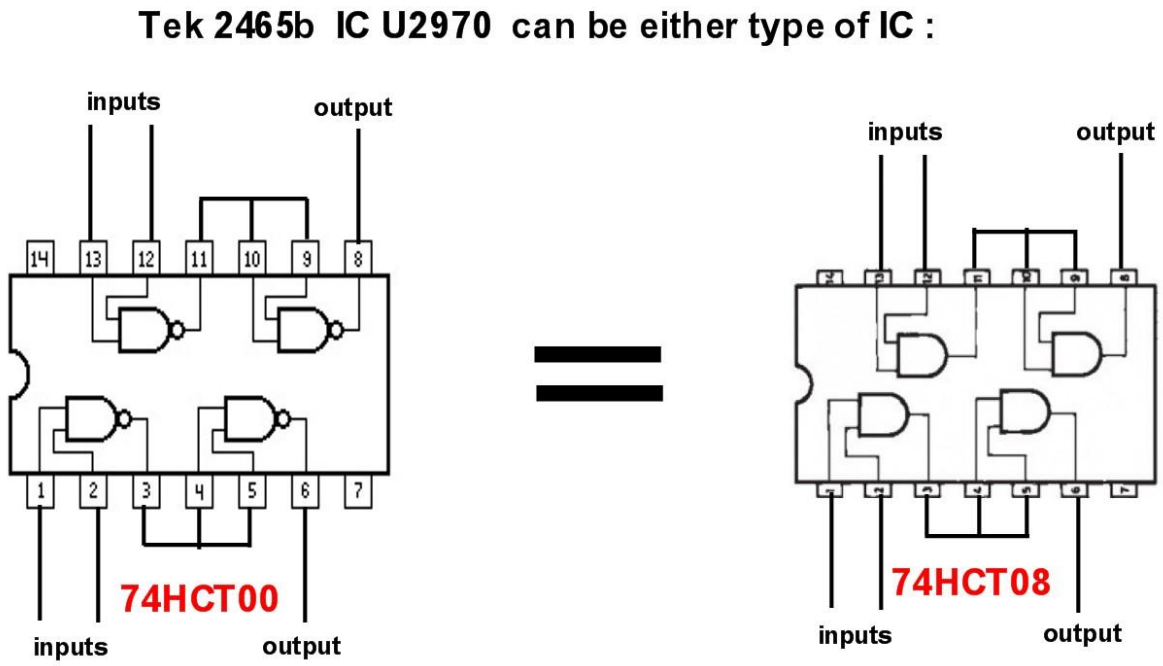




Obviously the electrolytic capacitors should not be replaced with the same type unless you want history to repeat itself. So Tantalum capacitors are used.

The interesting case of IC equivalency in a specific configuration:

One observation, comparing two A5 PCB's, is that there was a different type of IC on the same location on the PCB for U2970.The manual lists it to be a 74HCT00 which is a quad NAND gate. However one of the A5 boards in one of my 2465b scopes had a 74HCT08 (a quad AND gate) in that location. In addition the PCB's tracks on the two boards appeared to be identical. The reason for this became obvious on inspecting the DOT START GOVERNER circuit. In the case where the 74HCT00 is used, the functionality of the overall "gate pairs" is an AND because one is used as an inverter. In the case of a 74HCT08, with the wiring left as it is, no inversion occurs by the second AND gate of the pair, so the circuit is still AND in functionality. This interesting equivalency is shown below. The circuit is such you can use either type of IC with identical overall logic functionality and yet the same PCB and circuit:



****