TELEVISION

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SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

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CRT Tester and Reactivator

Also:

TWO-TERMINAL STABILISERS

AUTOMATIC GREY-SCALE CORRECTION

SERVICING THE DECCA MS1700/MS2001/MS2401

CRT Tester and Reactivator

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DURING the course of television servicing, low-emission c.r.t.s are sometimes encountered. The symptoms are that the picture lacks brilliance and on advancing the brightness control the darker areas of the picture increase to the same maximum level as the brightest parts, giving a "silvery" picture.

One of the causes of low emission is cathode poisoning, caused by impurities on the surface of the cathode. The device described in this article will give a reading of emission from the cathode and, if necessary, clean the impurities from it. It also checks for leakage between the heater, cathode, grid and the first anode of the tube.

The process can also be applied to colour c.r.t.s, though care must be taken not to overdo the treatment. A selector switch is used so that it is possible to check and compare the emission of the red, green and blue guns.

Measurement of Emission

Fig. 1. shows a simplified circuit from which the instrument was developed. Current flows to h.t. through the c.r.t. and R1, giving half-scale deflection on the meter. At the same time current flows through R2, also giving half-scale deflection. The two currents add and providing the c.r.t. is good the meter will read approximately full scale.

The Treatments

The device performs in two ways. For reactivation it is necessary to increase the temperature of the cathode. This is done simply by increasing the heater voltage and current so that the impurities "boil off".

The other process involves the application of short pulses of high voltage between the grid and cathode. Fig. 2 shows the basic circuit for processing the cathode. When the relay contacts are in the rest position capacitor C1 charges via R3 to 300V. When the relay is operated, +300V is applied to the tube's control grid and current flows, limited by R3. This system ensures that only a short pulse of current can flow.

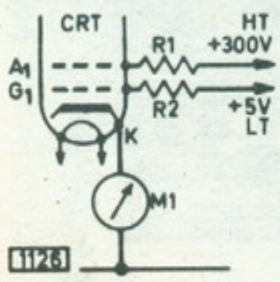
The relay is switched on and off about once every two seconds by a multivibrator—see the main circuit diagram, Fig. 4.

Leakage Circuit

Interelectrode short-circuits or leakage may also be encountered. A facility for checking this is therefore included. The basic circuit is shown in Fig. 3 and uses a neon lamp as the leakage indicator. Small mains neons are fairly cheap and robust and it was decided to use this method rather than become involved in extra meter switching at high voltages.

With the switch in position 2 the circuit is from the c.r.t. cathode, through S3b, through the neon lamp and associated resistor (normally included inside the neon casing) to the +300V line. As the heater circuit is at zero volts, any leakage between heater and cathode will result in the neon lamp glowing.

Switch position 3 checks for leakage between the cathode and grid connections. Notice that the h.t. is



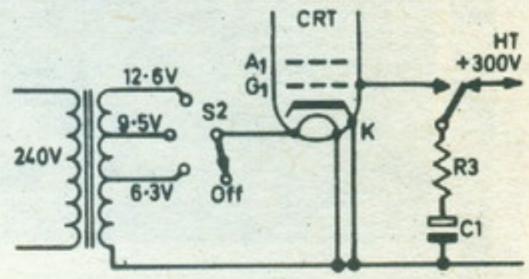


Fig. 1 (left): Basic circuit for emission measurement.

Fig. 2 (right): Circuit used for reactivation and processing.

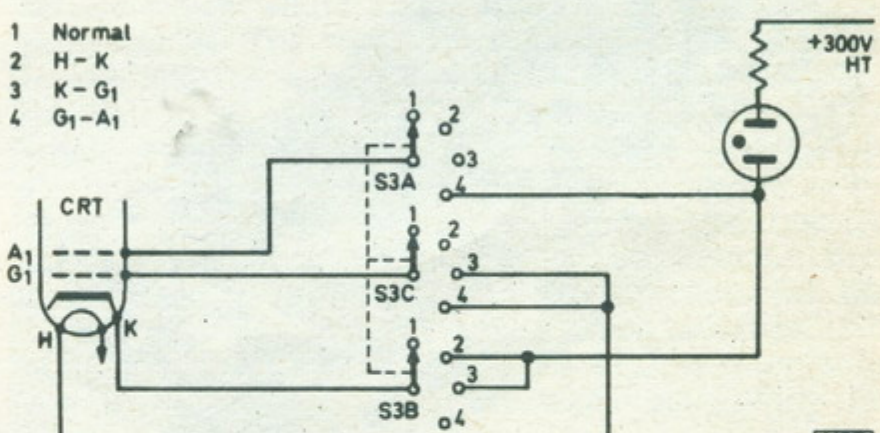


Fig. 3: A neon lamp is used to indicate inter-electrode leakage.

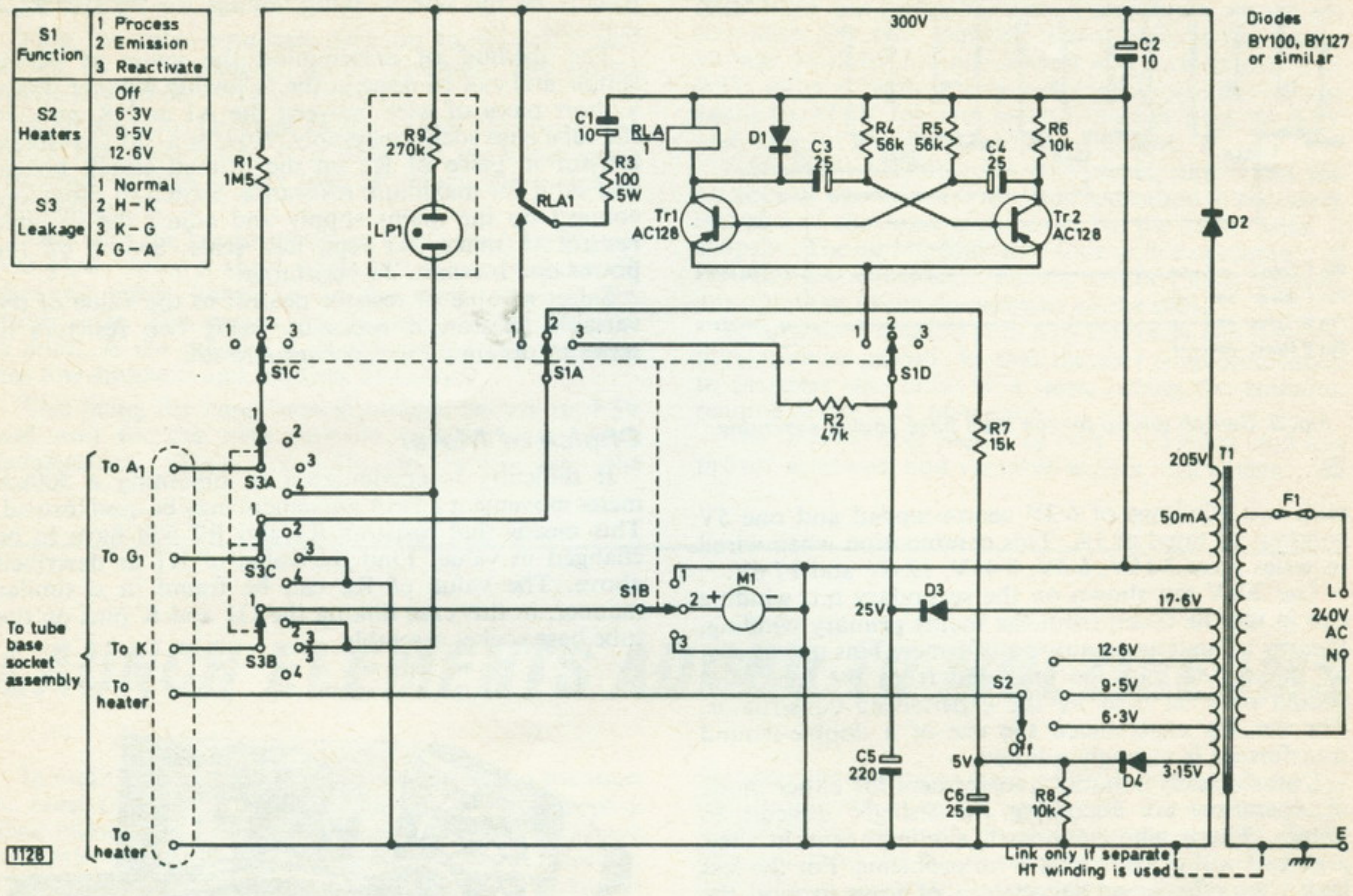


Fig. 4: Circuit diagram of the meter unit. Transformer T1 may be an auto-transformer—see text.

★ Components list

Resistors

R1	1.5MΩ ½W	R4	56kΩ	R7	15kΩ
R2	47kΩ	R5	56kΩ	R8	10kΩ
R3	100Ω 5W	R6	10kΩ	R9	270kΩ

All ¼W unless specified

Capacitors

C1	10µF 450V	C3	25µF 25V	C5	220µF 25V
C2	10µF 450V	C4	25µF 25V	C6	25µF 25V

Switches

S1 4 pole 3 way S2, S3, S4 3 pole 4 way

Semiconductors

Tr1, Tr2 AC128 D1—D4 BY 100, BY127 etc.

Miscellaneous

LP1 Min. panel neon; M1 500µA; RLA 2p c/o heavy duty, 700Ω coil; T1 see text; monochrome and colour tube base sockets; metal boxes; knobs; materials for pcb.

now applied via the neon lamp to the cathode, the grid being taken to chassis. The reason for this is that if the tube cathode is warm, current will flow due to the normal emission of the tube. So we have to reverse bias the grid/cathode diode.

Position 4 on the switch checks for grid to anode leakage, operating in the same way as position 2. In switch position 1 the tube electrodes are connected to the Function switch.

Construction

All the smaller components except the relay are mounted on the printed circuit board shown in Fig. 6. The switch S4 is mounted in the tube base socket assembly. Most of the components with the exception of the meter were found in the junk box and in fact the project was attempted for this reason. Even the stainless steel box used was an offcut from a central heating boiler flue!

In the multivibrator circuit a miniature relay was used which had a coil resistance of 700 Ω and operated at 20V for positive action. Any relay used in this circuit must have break-before-make contacts and insulation suitable for the voltages involved.

The transistors specified are both AC128 but the type is not critical. Several others, for instance the AC169, should function just as well. The mains plug should be fitted with a 3A fuse.

Mains Transformer

Although in the main circuit diagram the mains transformer is shown as a double wound (isolating) transformer, the prototype used a filament transformer

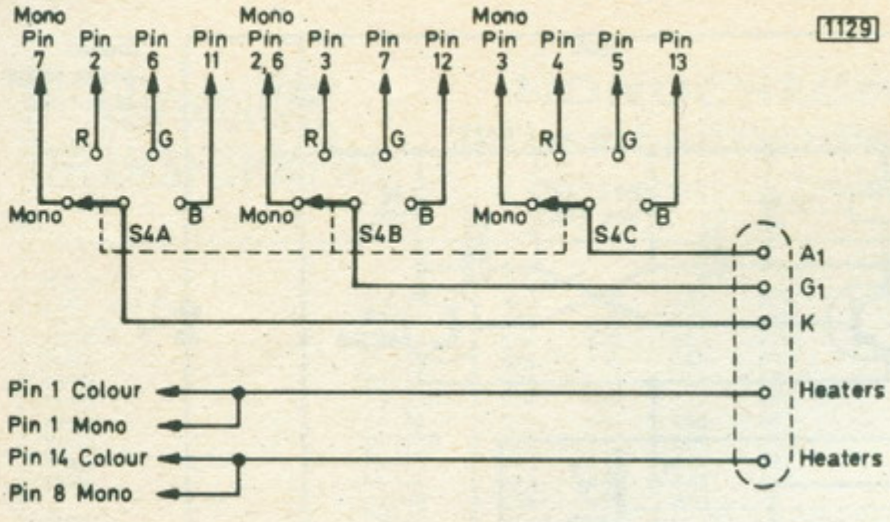


Fig. 5: Switch wiring for the tube base socket assembly.

with two windings of 6·3V centre-tapped and one 5V winding all rated at 1A. This combination when wired in series gives 3·15V, 6·3V, 9·45V, 12·6V and 17·6V.

The 205V tap shown on the secondary h.t. winding can in fact be taken from the mains primary winding, thereby using it as an autotransformer. This means that all the wiring must be insulated from the case, and should only be used by the experienced constructor. For the less experienced the use of a double-wound transformer is strongly advised.

Unfortunately suitable transformers for either mode of operation are becoming increasingly difficult to obtain. Those who have such a component in their junk box will of course have no problems. For the less lucky, we offer some suggestions of ways around the problem.

With either mode of operation, if no 5V winding is available, a further 6·3V may be used instead, with a resulting slight increase in the 25V rail. Three separate 6·3V centre-tapped heater transformers could then be used, with the tapped primary of one supplying the 205V for the h.t. rail.

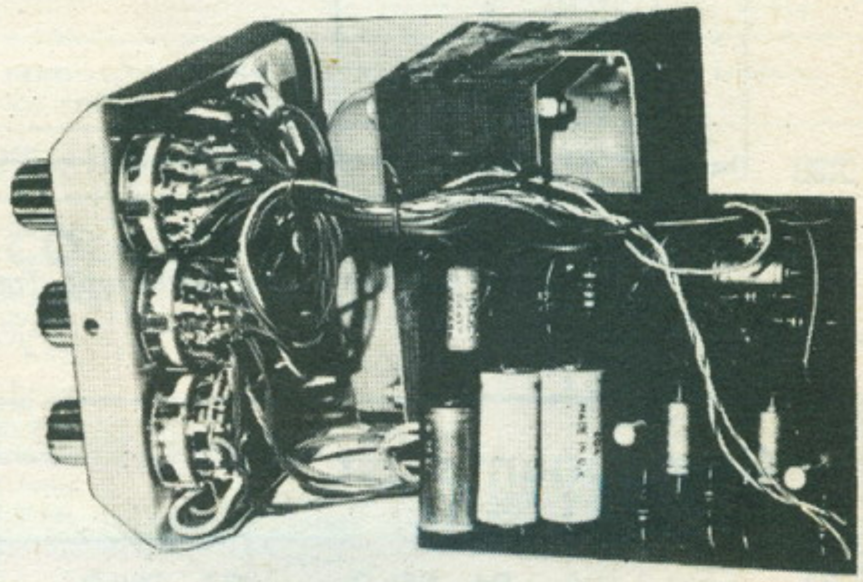
For the fully isolated mode, a transformer with an h.t. secondary winding higher than 205V can be used providing the value of R1 is increased to compensate for the rise in the 300V rail. The limiting factor will usually be the safe working voltage for S1 and RLA contacts.

The method of determining the value of R1 is simple and can be done in the following manner. Place a short piece of wire between the A1 and K pins on the tube base socket assembly. Now fit a 2M Ω variable resistor in place of R1 on the printed circuit board, and set it for maximum resistance. Switch to Emission, connect up the mains supply and adjust the variable resistor to make M1 read half scale. Switch off the power and measure the resistance.

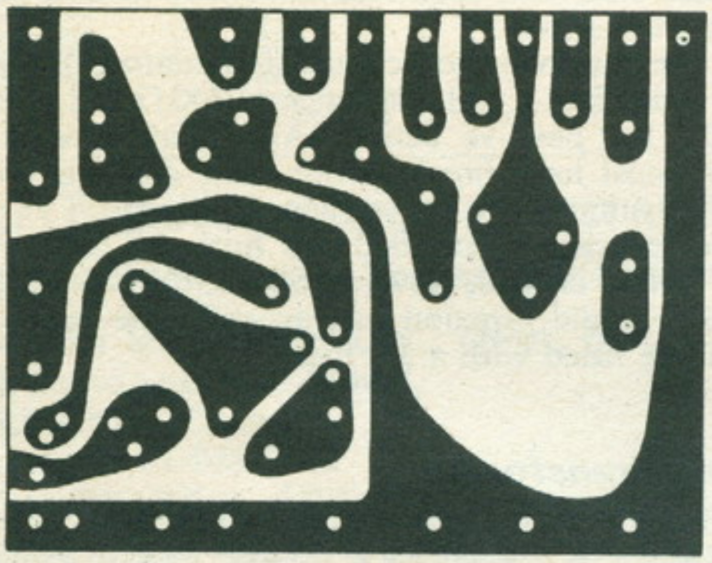
Select a value of resistor nearest to the value of the variable resistor, if necessary using two resistors in series to obtain a more accurate result.

Choice of Meter

If difficulty is encountered in obtaining a 500μA meter movement a 1mA movement may be used instead. This means that resistors R1 and R2 will have to be changed in value. Find the value of R1 as described above. The value of R2 can be found in a similar manner, in this case linking the G1 and K pins on the tube base socket assembly.



Interior view of the completed meter unit.



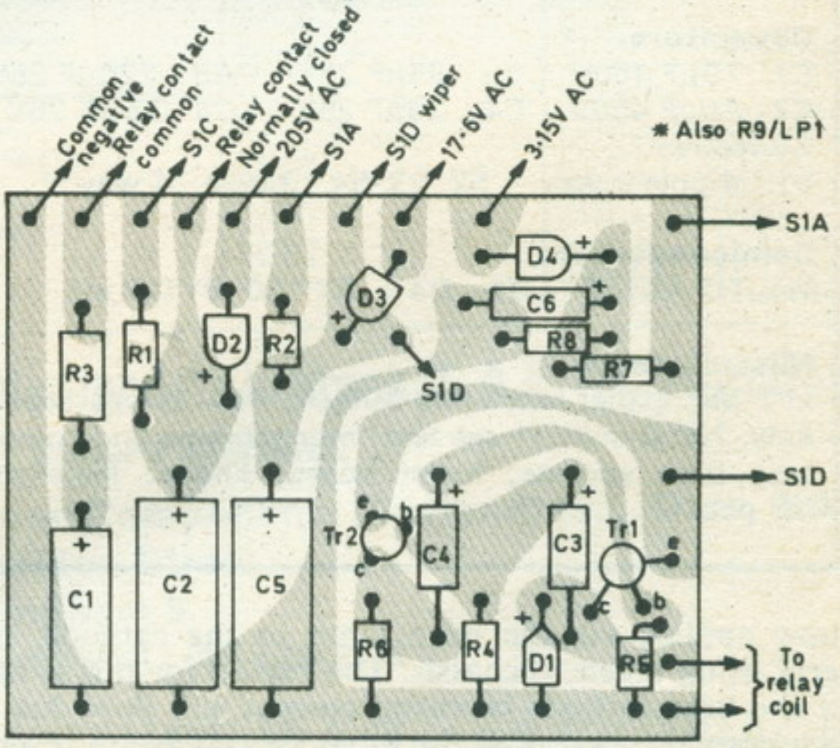


Fig. 6: Printed board layout and component location, both shown half-scale.

Operation

Plug the tube base assembly on to the c.r.t. and switch S1 to Emission, S3 to Normal. The heater switch should be in the off position.

Now turn the Leakage switch slowly clockwise and watch the neon lamp. If it does not glow the inter-electrode leakage is very low, so return the switch to Normal again.

Next turn the heater switch to 6·3V: the tube heaters will glow. After a short while the meter reading will rise and settle, hopefully, in the green area of the meter scale. This means that the emission of the tube is good. If the reading is in the red section the tube has low emission and requires processing.

This being the case, turn the heater switch to 9·5V and wait for the tube cathode to reach the higher temperature. Move the Function switch into the Reactivate position and allow the tube to remain in this state for two minutes. Then increase the heater voltage to 12·6V for one second **only,** and return it to 9·5V. After a further thirty seconds increase the voltage again to 12·6V for one second. Switch back to 9·5V and turn the Function switch to Process.

Now listen for the relay to operate, and count the number of operations. No visual indication is necessary because of the loud click given by the relay when it snaps in. The author finds that four or five operations of the relay are sufficient, the exact number being dependant upon the original condition of the tube.

Return the Function switch to Emission and note the improvement gained. At first the user is recommended to progress one pulse at a time, noting the emission reading of the c.r.t. after each.

The finished unit measures only $5 \times 5 \times 6$in. and has proved a reliable and valuable service instrument. ■