

Monoscopes & Test Cards by Brian Summers G8GQS

In the late 1940s and 1950s television broadcasting was expanding rapidly and there was a need for test signals and test cards. In addition to use in the studio, transmitters often radiated a test card. In the UK the test card 'C' was transmitted each weekday for the benefit of the radio industry and trade. The traditional solution was to place a physical card in front of a camera and use that as a picture source. This was not entirely a successful solution. There were the technical problems of camera alignment and card positioning and more importantly it tied up an expensive camera that was not then available for use and consumed its tube life.

The solution to these problems was a special cathode ray tube that became known as a Monoscope tube. This tube was similar in many respects to a conventional CRT except that instead of the normal phosphor coating inside the glass there was a metal target that had the desired pattern printed on it. The output was taken from a connection to this target via a button connector in the centre of what would have been the tube faceplate.



An early shape Monoscope tube by Cathodeon

Early tubes came in a variety of shapes and sizes, but in the UK & USA they soon settled down into a tube that was dimensionally similar to a standard 5 inch round tube of the sort often used in camera viewfinders of that period. The French tube type

TH.9500 from Thomson Houston had a long thin gun and a cylindrical body. A wide choice of standard patterns were available together with specials to order!



An RCA type 1699 Monoscope tube

the rack-mounting type for studio use. Simpler cameras were made for non-broadcast use in manufacturing and service shops.

The Monoscope cameras were made by Pye, RCA, Marconi and others. Marconi made a portable cased version for OB use as well as

The scanning requirements were quite modest and a standard deflection yoke could be used. The rest of the tube connections were much like a picture monitor except that the target was at 0 volts with the cathode at some 1200 volts negative, with the rest of the electrodes at appropriate negative voltages.

Operation

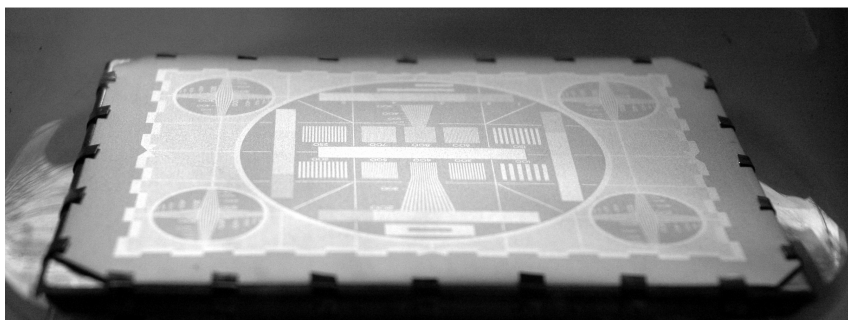
The Monoscope camera is a simple device, the principle controls are; gain, beam current and a black level adjustment. The beam current control being advanced to a point where the picture appears in conjunction with the gain control to set the output amplitude. To preserve tube life it was recommended that the beam current is no more than needed and the gain set for the correct level output consistent with the amount of noise present. The scan controls were adjusted so that the test card filled the picture correctly. Once the monoscope camera was up to temperature it was quite stable in operation, at least when they were new. Half a century or more of use/disuse has not helped them. The broadcast versions had connections for external drive pulses, line drive, field drive, mixed blanking and mixed syncs. For the rack mounting versions an external HT power supply was the norm.



Marconi BD665 Monoscope camera & power supply

Monoscope tube construction

Tubes are quite simple in construction. The glass envelope and gun assembly are similar to a 5 inch round C.R.T. (Kinescope). The target is an aluminium plate fixed inside the front of the tube by some metal spring clips and its output connection is a small metal "pip" in the centre of what would have been the faceplate. The target is printed with ordinary printers ink in the desired pattern. The tube is heated during



The Monoscope target as seen through the tube side

manufacture, this reduces the ink on the surface to practically pure carbon. The difference in the secondary emission ratio for the pattern or metal creates the output current, which is in the 0.3 to 0.7 μ amp range. The final

anode, which collects the secondary electrons from the target, is biased approximately 30 volts positive with respect to the target.

In a 1952 paper by R. D. Nixon a method was described; *employing light-sensitive fish glue as the printing medium, in conjunction with fine halftone screens, has been found to give superior results to direct or off-set printing with inks. The use of silver as a base material, instead of the more commonly employed aluminium, results in picture reproductions free from spurious signals.*

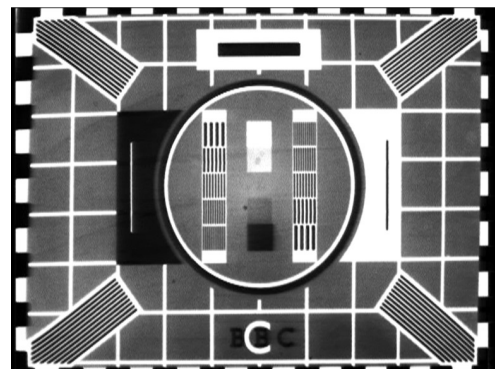
Safety Notice

You should be aware that all valve type equipments have an interesting selection of high voltages in them. **If you are not trained in safe working practices, you should NOT be working on this type of equipment.** Also note that the wiring practices of the 1950's are a long way short of today's standards. The use of a mains isolating transformer is recommended. You should not work alone!

Restoration

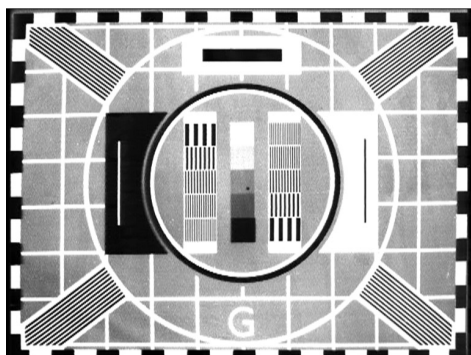
I start with a good clean up, IPA Isopropyl Alcohol, is a useful solvent in a well ventilated area. Cotton buds and baby wipes are handy too. This is a good point to take detailed photos for later reference. Small parts like knobs, valve cans can be removed for cleaning. Put right any mechanical damage.

The valves themselves can be removed for cleaning. Do take great care NOT to rub the valve makings off! If this should happen write the number back at once with a fine felt tip pen. Valves are fairly reliable but check the getter is not white and the pins are not covered in corrosion. I do not habitually test valves in a valve tester, if there is a suspect substitution is a quicker than a test. It is quite OK to use equivalents indeed there may well be equivalents in it as received. Substitution by a near equivalent needs to be done on a case by case basis, examining the published valve parameters.



A BBC test card C

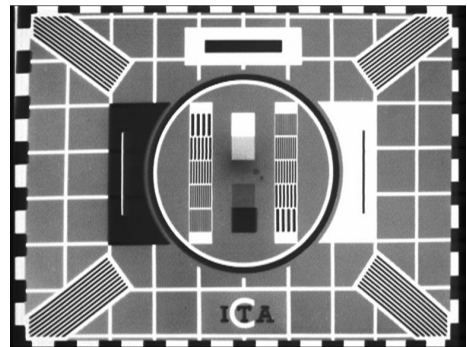
Monoscopes cameras tend to be well made with quality components and the valve bases give little trouble. Only in extreme cases will they need cleaning. Use the IPA and an old valve wriggled in the socket to clean. Other plugs and sockets clean as needed. Most old connectors can be sourced with perseverance. Avoid at all costs the temptation to change the connectors. Do not solder to the pins, if a temporary connection is needed, a wire with a Hellerman sleeve is good, or a single socket/pins salvaged from an old plug can be used with better reliability. The correct plug/socket will be found in due course.



Test card G

A unit of this age will have all the problems you might expect with leaky capacitors and resistors high in value! The place to start is with the main electrolytic capacitors. These were quality items and with careful reforming they can be nearly as good as new. Depending on the circuit it may be necessary to disconnect one connection so that the leakage current can be monitored. I am very reluctant to replace these electrolytics as they are very visual and a 99% success rate can be achieved with reforming. Small paper coupling

capacitors are a different story, most will be leaky to some extent and, with a few exceptions, will need to be replaced. It depends where they are in the circuit. Grid coupling capacitors are critical and no leakage is permitted. At the other extreme a leaky capacitor decoupling a cathode resistor, of say 5K ohms, its leakage has no real effect, providing of course it is still a capacitor! Resistors are the next for examination. There were two main types, wirewound and carbon composition. The wirewound ones, often the green enamelled power types, have a habit of going open circuit and will need replacing; they don't often drift in value so it's a go no-go for these. The carbon composition resistors do tend to go high in value, but as most of them were 20% tolerance when new some considerable change in value is permissible. I have found the higher value ones to be more likely to be well out of tolerance. Again it is a case of assessing the effect of any changes. Wound components, transformers, chokes and coils are more of a worry especially if they have been damp. Make sure they are well dried out before applying power.



An ITV test card C

Results

I have a number of monoscope tubes, three of them work to some extent. I have a nice test card C tube with ITV as a logo. It has good emission but it has some intermittent connection in the tube base. I have reflowed the pins with no improvement and I am reluctant to remove the base in case the intermittency is at the glass pinch. Its picture is good except for some spots that may be due to some contamination fallen on the target. Like camera tubes these should always be target upwards. There is also some unexplained shading in the central area. It is thought that this might be Helium gas poisoning. This comes about as the helium in the atmosphere sees the glass tube walls as an easy porous route to the attractive vacuum within! I also have a BBC test card C, but worryingly the getter is going white, and a test card G tube. All of them display the central shading or darkening with some dirt spots. The pictures shown are untouched screen grabs of the Monoscope camera's output. Once warmed up the Monoscope camera is quite stable in operation.

References:-

- "Television Engineering", Amos & Birkinshaw. Vol.1 page 79.
- "The Monoscope", R.G. Dixon, IEE Television convention 1952 paper No. 1293
- "Principals of TV engineering", Fink, Mcgraw-hill 1940, pages 116-7 & 494

<http://www.tvcameramuseum.org/pdfs/cathodeon/cathodeon%20monicon.pdf>
http://www.earlytelevision.org/experimental_rca_monoscope.html
<http://lampes-et-tubes.info/ct/ct041.php?l=e>

Practical television March 1951 reports that the BBC ordered 8 monoscope cameras from Marconi.