

# RF MODULATORS FOR VINTAGE 405 LINE TELEVISION.

A SYSTEM OF CONTROLS TO REPLICATE THE RADIO SIGNALS ORIGINATING FROM THE ALEXANDRA PALACE TV STATION.

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## INTRODUCTION:

1) While effort has been made to create a suitable 405 line video signal for vintage English televisions, using 625 to 405 line standards converters, it appears that the RF modulators used with these could sometimes be improved. One area of particular note is that the 405 line video signal feeding the RF modulators is, in many cases, AC coupled to the modulator circuitry and no thought has been given to the signal's DC axis and the residual carrier level. The result of this is that sync tip or peak white compression is a common problem. In other words the issue is a little more complex than just feeding audio and 405 line video into some "modulator box" and expecting a good result.

2) The ratio of the levels of the RF carrier for the sound and video channels is important. This is why for this modulator application it is important to have TWO RF modulators, one for the vision channel and one for the sound channel. This is so the sound carrier can be mixed (combined) with the vision carrier exactly 6dB down in level. Rather than a type of modulator where the sound carrier is generated by heterodyne with the vision carrier at the frequency difference between the sound and vision carriers. Many RF modulators which are ex-video machine parts were made this way and are not ideal for this particular application, though it hasn't stopped people from trying to use them. In addition, since the typical video signal that a modern video modulator is "expecting to see" in a 625 line system is such that sync increases the RF carrier level and white reduces it, then if there is an active sync tip clamping circuit in the particular modulator, it will malfunction with reversed video modulation.

3) After combining the RF carriers for vision and sound from two separate modulators, then amplification, metering and level control is ideally required. Also control and metering of the system's inputs is needed to prevent carrier over modulation.

4) The RF modulators themselves should also be crystal controlled. RF modulators based on L/C circuits for their oscillators drift and it is better the frequency is stable. It is easy to modify a modulator for crystal control as shown in this article.

There are other issues relating to modulators, but the above are the main ones as they relate to vintage 405 line TV. This article remarks on modulator systems mainly and not

the various types of standards converters. However, personally, I prefer the Dinosaur converter to any other type due to its high performance and excellent design, construction and serviceability.

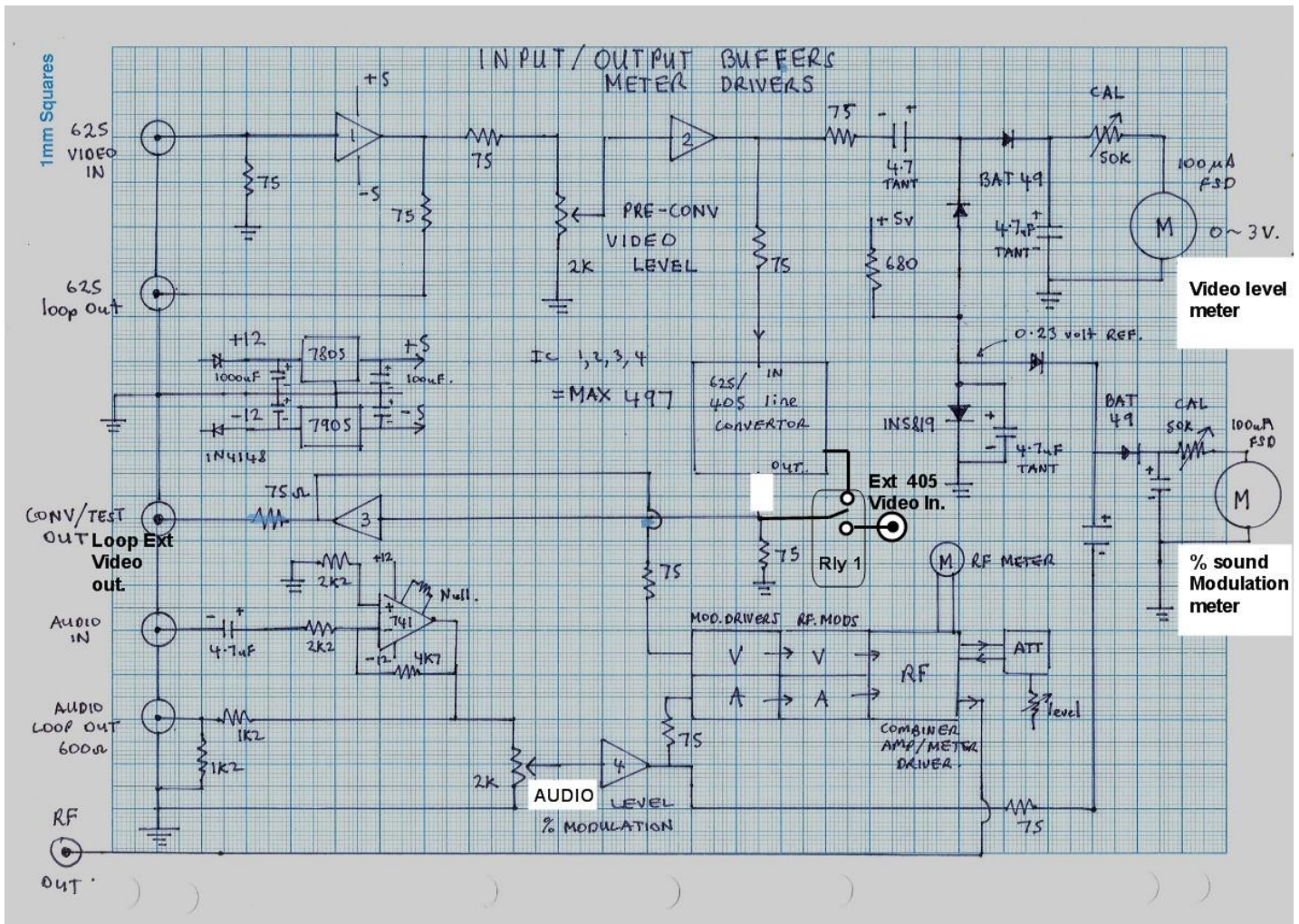
The modulator controls & systems presented here are built into the same enclosure as the Dinosaur converter pcb's. While this might seem excessive to some, this circuitry and no less, was what I found was required to do the job of generating the RF signals properly to replicate those of the Alexandra Palace transmitter.

Two examples of Dinosaur converters with modulators & controls:



## Buffering, level control & metering of the audio and video source material:

The diagram below shows how this is achieved using a video buffer IC the MAX497 which has a very low Z out so the output impedance can be set with series 75 ohm resistors. Each output can drive two 75R loads:



The incoming video signal is properly terminated in 75 Ohms, buffered and looped out from buffer 1. The pre-converter video level is then controlled by a front panel potentiometer. Buffer 2 drives the meter circuit and the 625-405 converter input. The meter circuit monitors the video level and due to the markings on the meter face, is calibrated to read what would be the “unterminated level” which is 2 volts peak to peak.

The signal out of the converter passes via buffer 3 to an output connector and also feeds the modulator driver circuit. Later buffer 3 had its input switched by an added

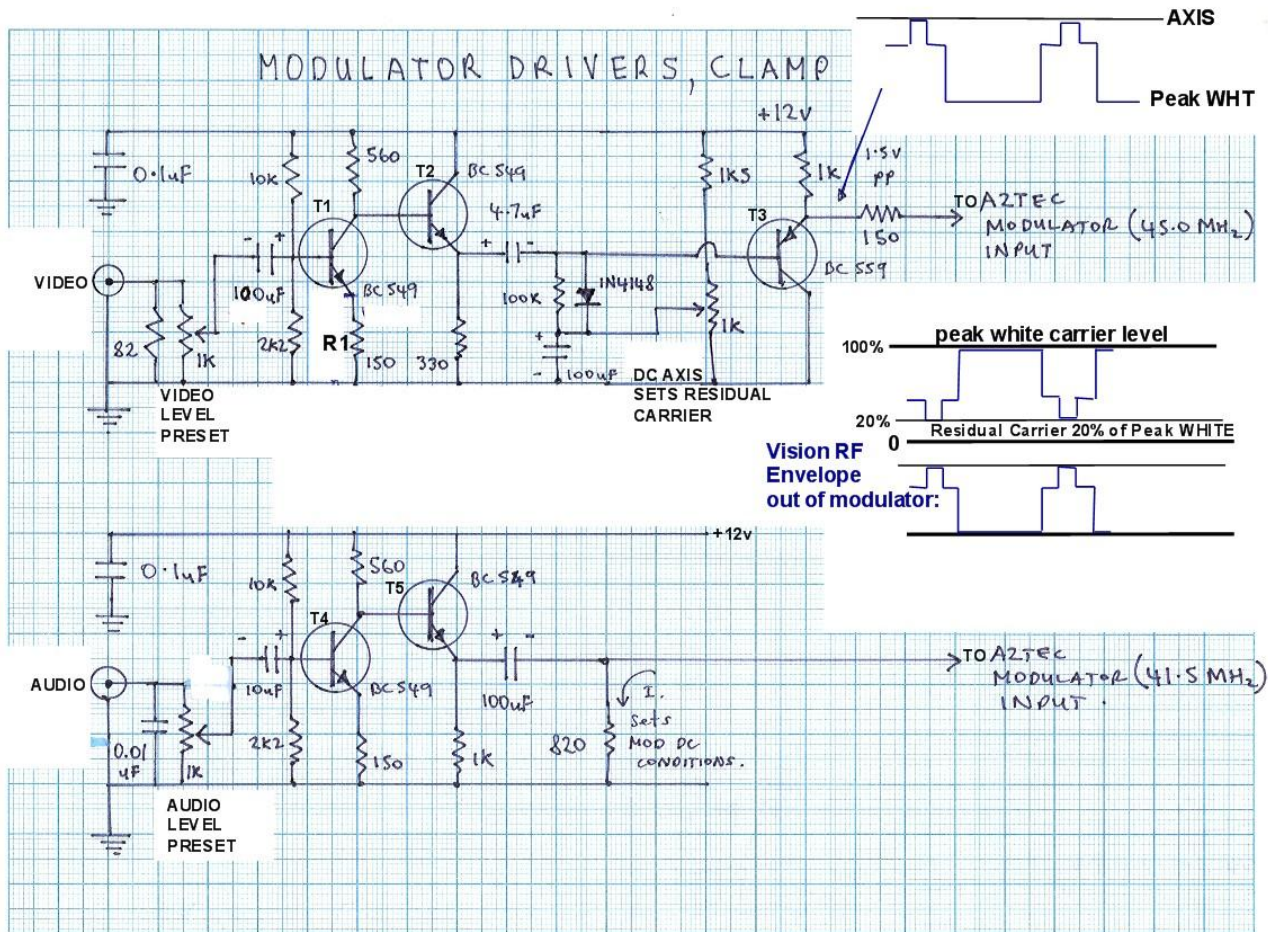


relay to an external connector so the video RF modulator could be driven from an external 405 line video source and not the converter.

The incoming line level audio is buffered by a 741 OP amp and looped out. The audio level is metered so that 100% modulation on the meter corresponds to that event at the sound RF modulator. The simple system above gets the audio and video signals controlled and ready to drive the RF modulator drivers.

### Modulator Drive & Clamp Circuits:

These are different for the audio and video.



The video signal from the previous diagram is now amplified and inverted by T1, buffered by T2 and sync tip clamped by the DC restorer diode in the base circuit of T3.

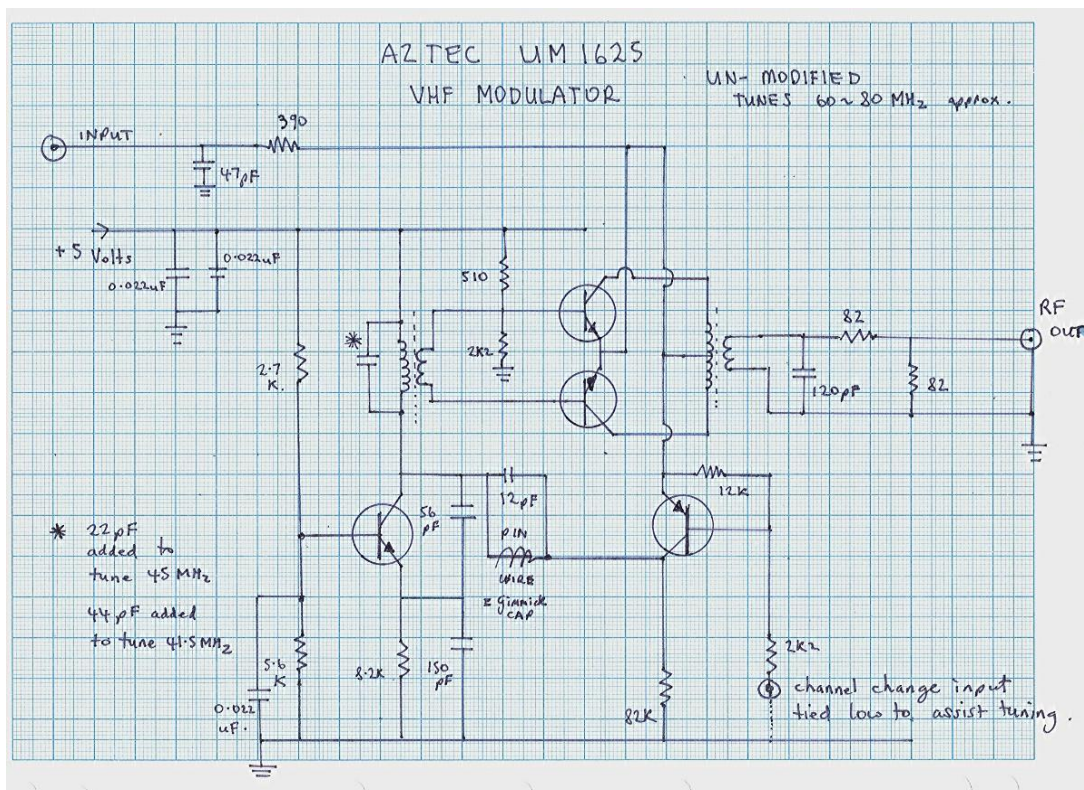
The video level preset pot in the diagram above is set so that with a standard 1V level video signal there is an inverted (positive going sync) signal of 1.5Vpp presented to the modulator. This value suits the Aztec modulator used. The DC axis control sets the DC position of the sync tips so that the residual carrier is about 20 to 25% of the value that it is at peak white.

When a standard line level 1000Hz audio signal is fed to the unit and the front panel audio level control (feeding buffer number 4 of the previous diagram) is set at about 30% rotation, then the audio meter is then calibrated to read 30%. The audio signal level is increased to read 100% on the meter and the audio preset level pot in the diagram above is set so the audio RF carrier is 100% modulated. This way 100% modulation on the meter corresponds with 100% modulation of the audio carrier. In practice, without an audio compressor circuit in the audio chain, it is best to keep the audio modulation at about 30% to 40%, due to the wide dynamic range and variable volume level of the source audio material (A good audio compressor IC is the NE571N and I use this with pantry AM radio transmitters in conjunction with a soft peak clipper circuit to prevent carrier over-modulation).

Depending on the performance of the 625 405 converter used, the resistor R1 in the emitter of T1 can be bypassed with a series R-C circuit (for example a 300pF and a 100R) provide some HF boost in the 3MHz area. This allows for a little loss from the standard converter's output LPF.

**Now that the signals are prepared and controlled and metered, it is time to look at the modulator units:**

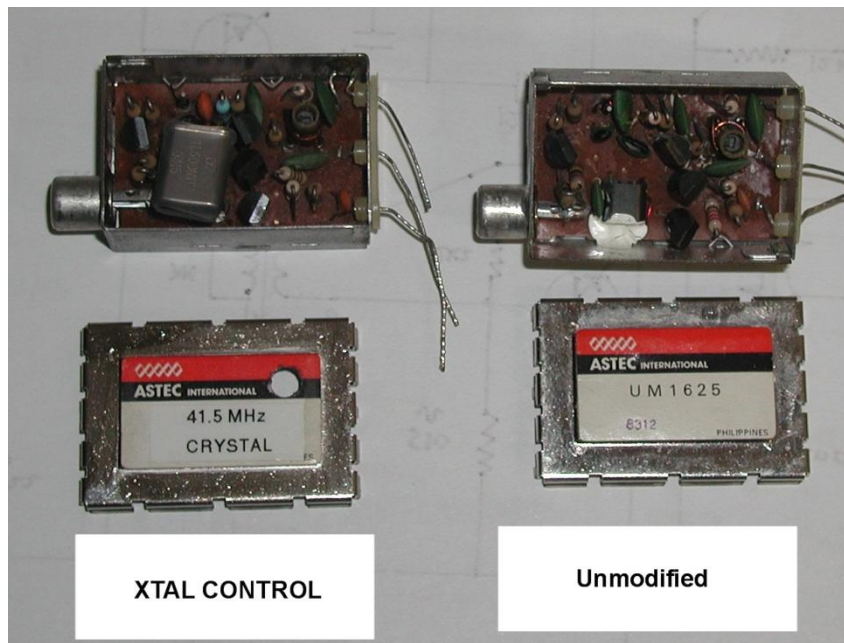
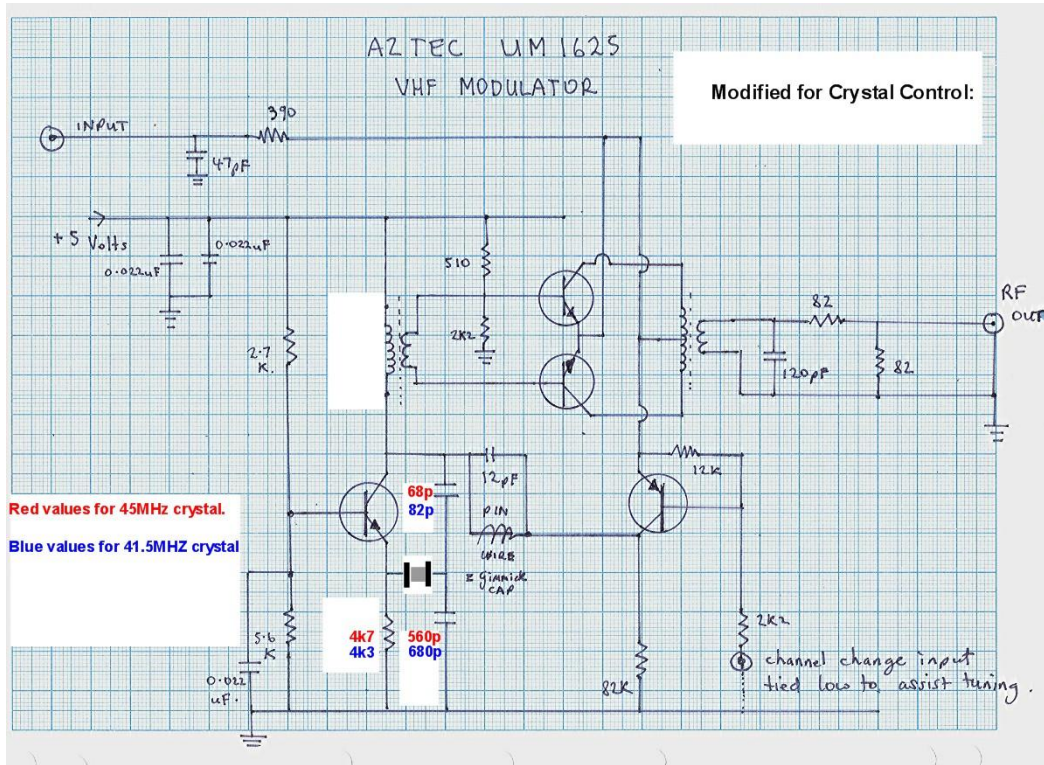
The circuit below is for the simple Aztec UM1625 VHF modulator (un-modified):



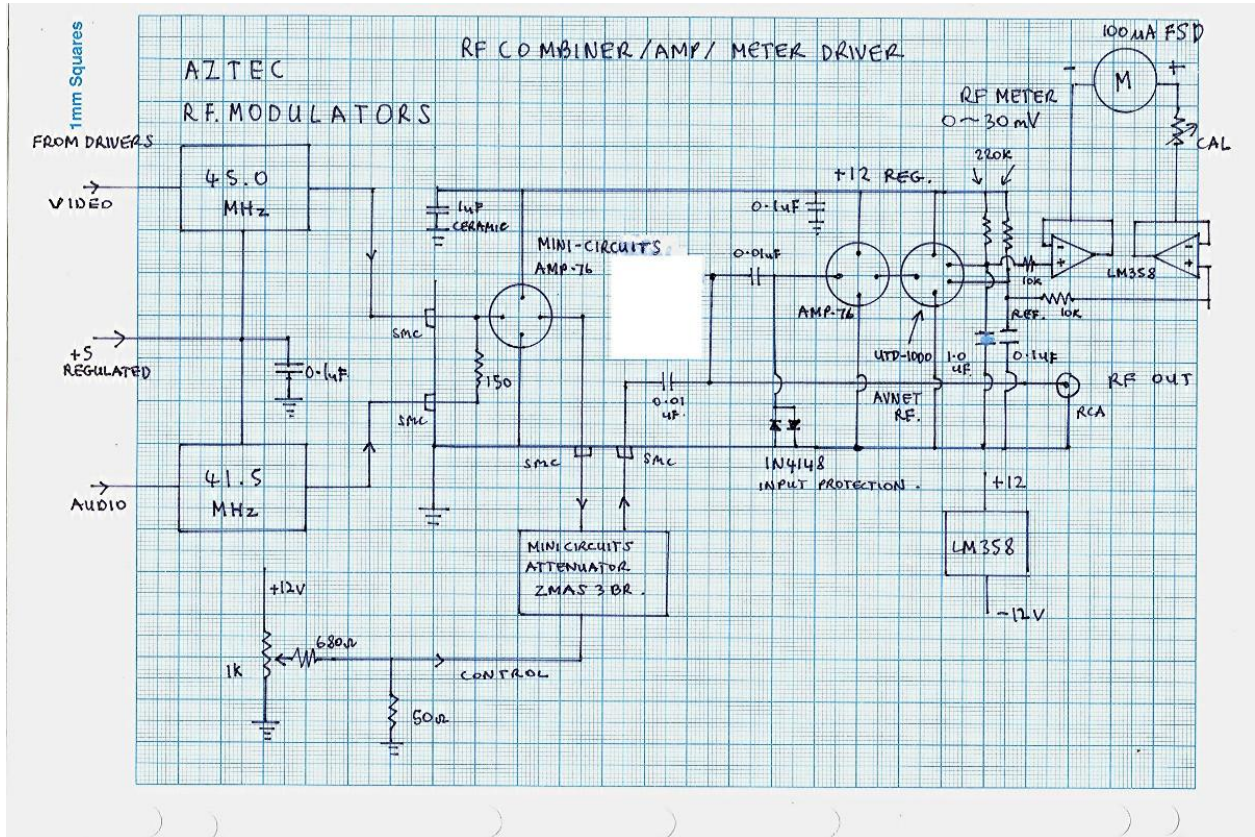


The UM1625 modulator can readily perform the task with additional capacitors to get the units tuned down to 41.5 and 45MHz. As can be seen with this design the emitter current of the modulator transistors is programmed by an external resistor on the input.

For crystal control using series resonant crystals the following changes are made:



The outputs of the two modulators need to be combined. A simple way to do this is with resistive mixing at the input of an amplifier. I have made a number of broad band amplifiers before, but the pre-made ones from Mini Circuits are very handy:

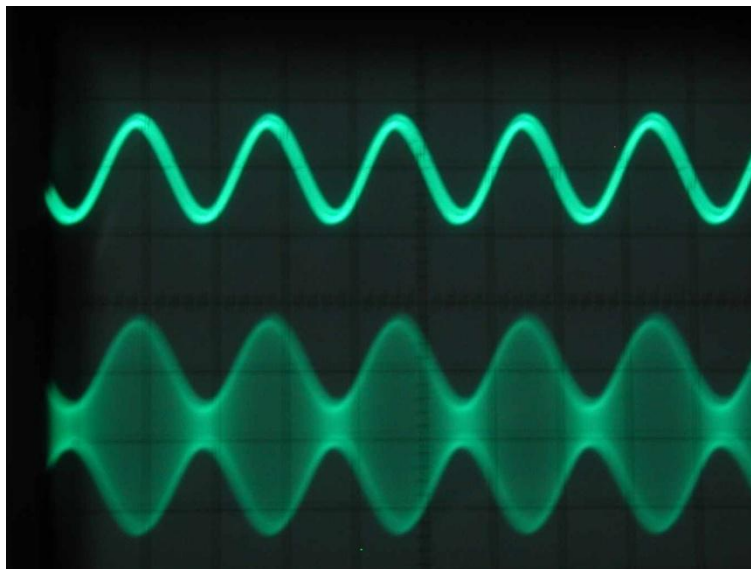
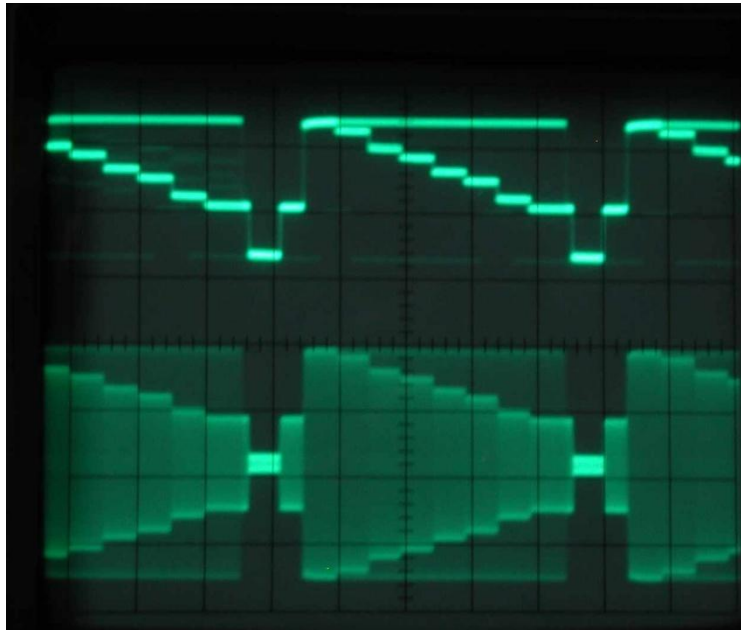


The two RF carriers are mixed and the sound carrier level reduced by 6dB due to the 150 ohm resistor. The output of the AMP-76 then passes via a mini-circuits attenuator to control the output level and then out to the RF out connector. The RF is monitored by another AMP76 and a UTD1000 detector and measured on the meter as peak milli-volts RF out. This circuit is best built into a small metal housing with smc connectors:





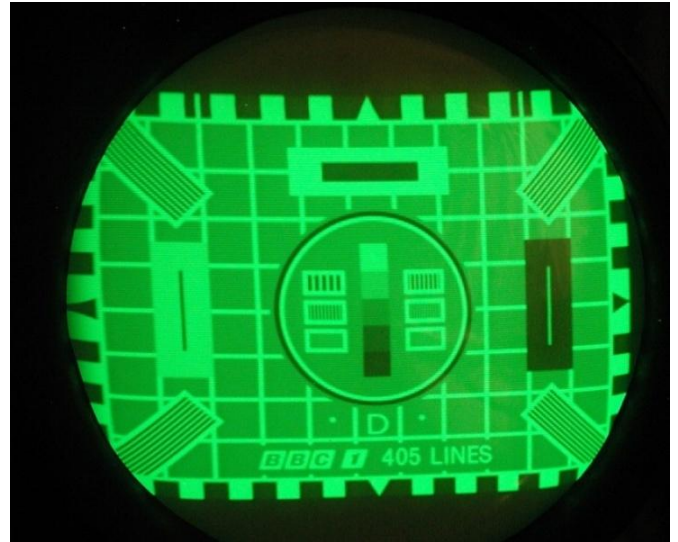
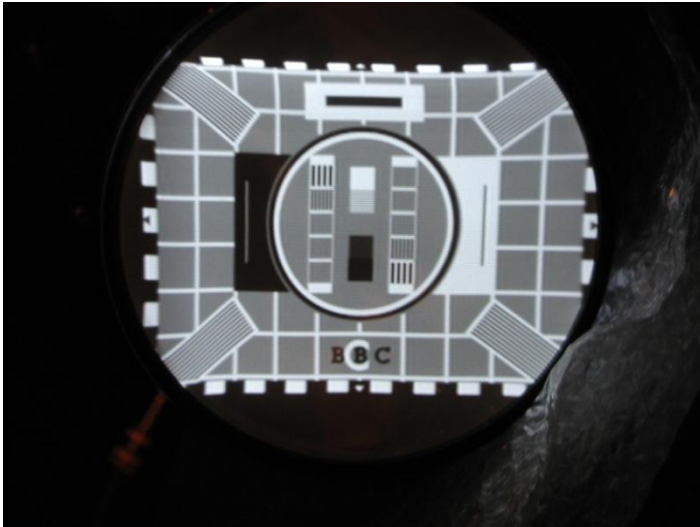
Below are some photos of a line of video signal and the resultant RF carrier from the modulator during the initial set up prior to final adjustment of the signal's DC axis. Also a photo of the modulated sound carrier (excuse the poor photo focus):



For multi-TV channel modulators it is better to use a PIC based system to program the various carrier frequencies. Still ideally the modulator outputs would be metered and level controlled.



With this crystal modulator arrangement and the Dinosaur converter it is possible to attain very good images on 405 line vintage TV sets and good audio too. The one below left is from the HMV904 (with a 5FP4 crt), on the right the Argus (VCR97 crt):



The one below is from a Bush TV22:

