The secret radar valve the EF50 Part 2

By Graham Dicker

In this second part of the secret radar valve I look at TV, Radar, and some of the more interesting characteristics and applications of the EF50, including operation on low plate volts.

The UK TV receiver

In 1936 EMI designed a TV receiver using a TRF design on 45 MHz which outperformed everything on the market at the time, The EMI receiver was able to receive TV signals at a distance of up to 10km from the test transmitter.

Early Cossor TV set

In 1937 PYE took the idea of the EMI designed TRF receiver one stage further, and instead of making an entire variable frequency receiver on TRF principals, decided to make a straight through IF strip at carrier frequency, quite sensible as there was only one TV station on air in Britain. Dual conversion superhets with a fixed IF frequency had been in use for over 10 years by this stage, and were well known. The clever thing was to ensure adequate bandwidth, the receiver had no converter stage but the IF ran at 45 MHz, and with the EF50, with good performance. The advantage was each receiver could be built in a stable and repeatable manner fixed tuned to the BBC at 45 MHz. This reduced manufacturing costs and the number of user controls. This receiver had such sensitivity that the range of BBC reception went to 50km. This provided a great marketing edge for PYE as they were able to

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provide TV reception to all customers outside of the 10km range that other companies could not service.

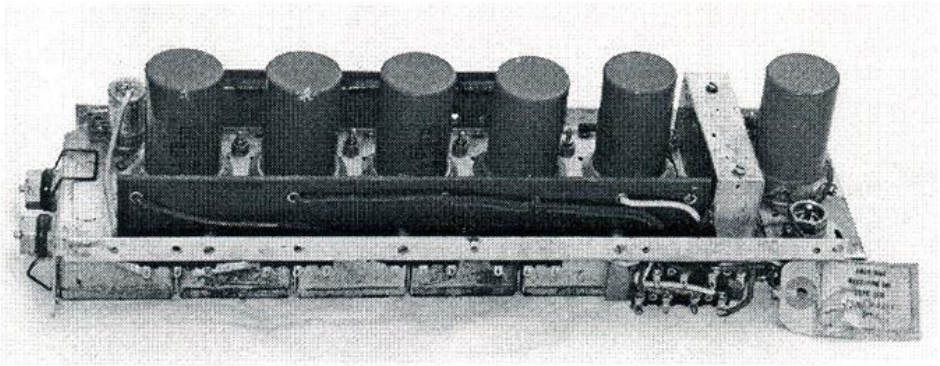
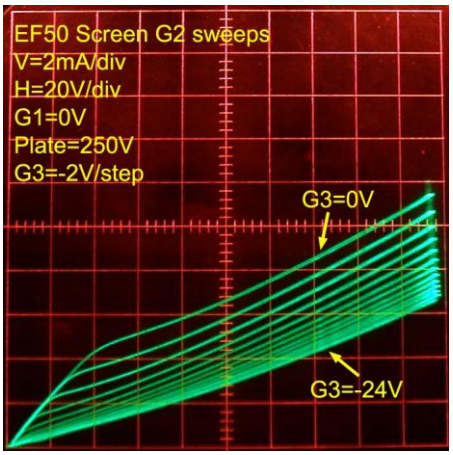
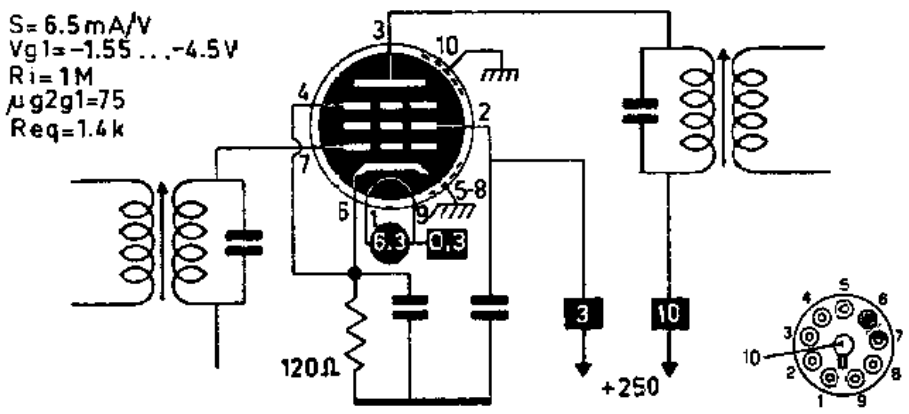


Figure 5: Receiver Unit Type 153 (the Pye 45MHz IF strip).

One of the secrets of the PYE design was the use of AGC, applied to the screen grid not the control grid. PYE engineers during the development stage of the EF50 worked out that the transfer function of the screen grid was an almost perfect straight line. This provided an excellent method to provide ACG control to all 5 if amplifier stages.



Screen transfer curves of EF50



Typical EF50 IF circuit

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The secret Radar receiver

the UK airborne radar group acquired one of the EMI receivers and used it for many vhf experiments. At the time radar was being developed at 6 MHz and antenna size for radar and direction finding experiments were leading towards VHF.

By 1939 Radar development was well underway and the British Government had based all of their research work on the EMI receiver, at that stage EMI did not have the manufacturing capacity to provide the number of receivers needed. Purely by accident the research team discovered the superior PYE TV receiver, further it was off the shelf, available in large numbers, and further outperformed the EMI one. This turned out to be very fortuitous at the time for both the Government and PYE. The PYE receiver was simply used as a fixed IF for the RADAR receivers, and as such almost 60% of TV production at PYE were sold to the Government.

The fast exit from Holland

With the outbreak of war it was realised that the supply of EF50 valves would dry up and Mullard did not have the capability of manufacturing the special glass base with sealed-in pins. Consequently, just before Germany invaded Holland, a truck came from Holland with one million of these glass bases, and some 200,000 finished EF50 valves. Later, huge numbers of the valves were manufactured by Sylvania in the USA.

At the cessation of WW2, companies who produced RADAR sets such as Cossor turned their hand to TV test gear and specialised in producing oscilloscopes. With large quantities of post WW2 war surplus to build them with, it is not surprising to find them full of EF50's.

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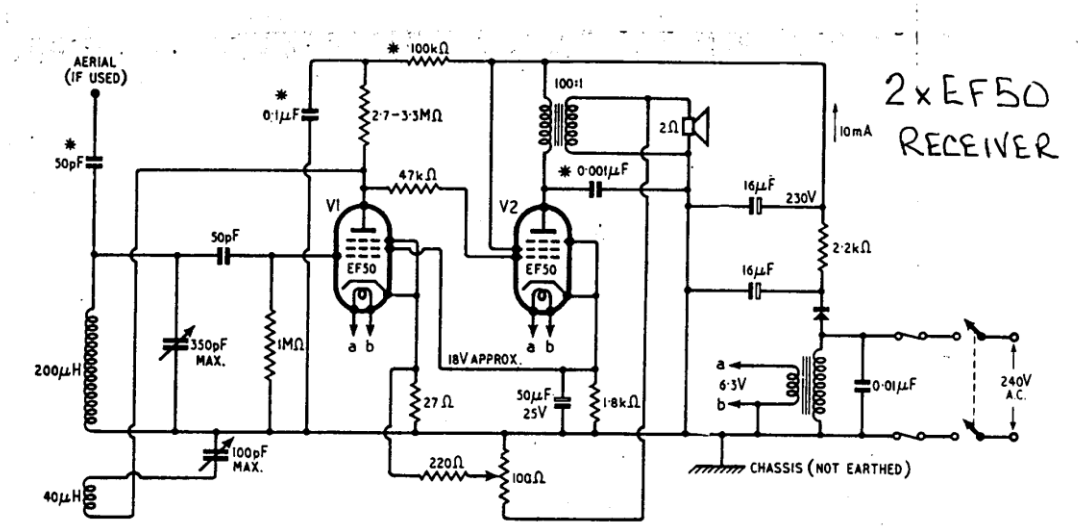
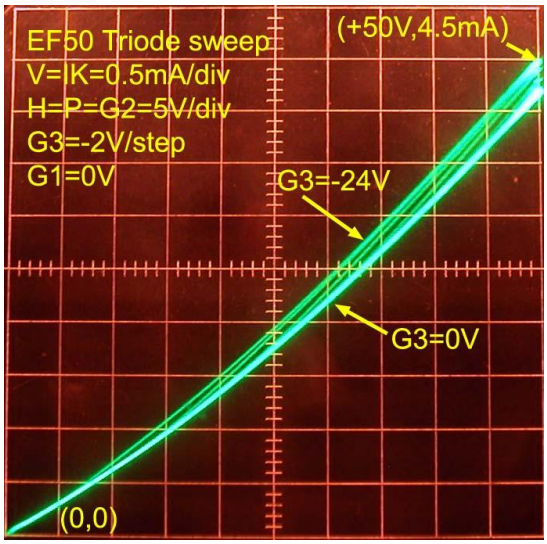
Innards of an Early Cossor CRO note the EF50's



*Circuit diagram of the receiver. Resistors can be ½W and capacitors 350V d.c. working. The 0·01-μF capacitor across the mains input must be capable of continuous operation at 250V a.c. Components marked thus * may be omitted for "local" reception. The cathode resistor for V_2 must be adjusted to fix the h.t. current at 10 mA.*

In post WW2 days radio manufacturers had boom times producing domestic receivers, and while many imported and high end sets of the day were super hets, there was also a market position for low cost mantle sets. This is an example of a late 1940's regenerative receiver based on the EF50's one as the regenerative detector the other as an audio output valve. The rectified mains supply however is another matter. This receiver is quite clever in design to minimise the parts count. Firstly the detector is direct coupled to the audio output valve grid, the output valve cathode provides a negative DC feedback path by way driving the screen grid of the detector valve. The gain control is by way of negative speaker feedback being applied to the cathode of the detector by way of the audio gain control. The detector valve running with anode starvation. This circuit is one of those that is EF50 specific probably without any substitution. Part of the reason it does work can be attributed to the exceptional low anode supply voltage characteristics of the EF50. A transfer curve shown below in triode mode with a 50 Volt plate voltage.



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During the 60's and 70's I managed to build a lot of guitar amplifiers as a teen. This helped to pay for my own projects and interest in audio. In those days a vibrato/tremolo circuit usually used an LDR and a phase shift oscillator to modulate the audio. LDR's and complex circuits to drive neon lamps or light globes were unnecessarily complex, and as LDR's back then were more costly than valves to purchase from Newton Maclaren, Philips or Mac's Hi-Fi , I managed to use the circuit below which simply used a screen driven EF50, these again were in plentiful supply from Robbie's for the obligatory Bob a piece. Used sockets from memory were about the same price. Today however the 9 pin EF50 bases are getting a little harder to find.

Oddly enough I still use this circuit in high quality guitar amps due to the superior sonic qualities. In low cost units the LDR/LED combination using a solid state oscillator is the norm, and cheaper to fabricate.

This circuit has been in my amplifier collection folder for many years, and still comes out for a build once or twice a year !!!!!! The noise figure of the EF50 in audio is fantastic and the sonic quality better than an EF86 (it's later replacement) In the circuit below the EF50 output can be used to directly drive the grid of a SE output stage or a phase splitter with a push pull amp. The preamp below has buckets of good low noise gain. My favourite output valve for this preamp is the 12E1, which will provide around 17 watts RMS single ended output.