The Eddystone S.830/4 Revisited: Getting Over the Hump…

Introduction

In a recent article on my S.830/4, I described how re-capping and re-aligning this set had improved its performance considerably after slow deterioration over the past 5 years – I would have got around to it sooner but I have no shortage of alternate receivers at the VE7GUH shack to choose from if performance was an issue… (!). I mentioned in that article that I had used the alignment instructions per the manual, including those for the 100kHz IF stage. In summary, this comprises:

- With the AGC off, set up the 100kHz (2nd) IF, tuning to the actual crystal frequency in the set (adjusting T1 through T4, tuning for a peak). An output meter (and/or VTVM set on a low AC range coupled to the IF output of the set) is used to monitor the output;
- Align the BFO for both CW and USB/LSB (I have since repaired my VTVM, which had been acting-up during the earlier alignment process – due to faulty capacitors).

I took quite a bit of time doing this and was happy-enough with the result. However, after reading Graham Goslings excellent December, 2004 article[1], I thought I would use the spectrum analyser facility in my newly-acquired Agilent 8935 to check the response curves only to find it went down in frequency only as far as 400kHz, and then found that my homebrew wobbulator went down only to 350kHz – so I could not use either instrument for this purpose. After using the re-furbished S.830/4 for a week or so for some 'serious' listening, I started to notice a couple of annoyances: there seemed to be some irregularity in the response when the set was tuned to an AM broadcast station, with a sight double peak discernable, neither peak coinciding with the BFO null point that had been set on the CW position of the mode switch. I also noticed that the BFO drifted when set to the LSB position (it was ok on the USB setting), moving slowly higher in frequency as the set was used for several hours – to the point it could not be brought back to the correct offset for LSB reception after several days heavy use.

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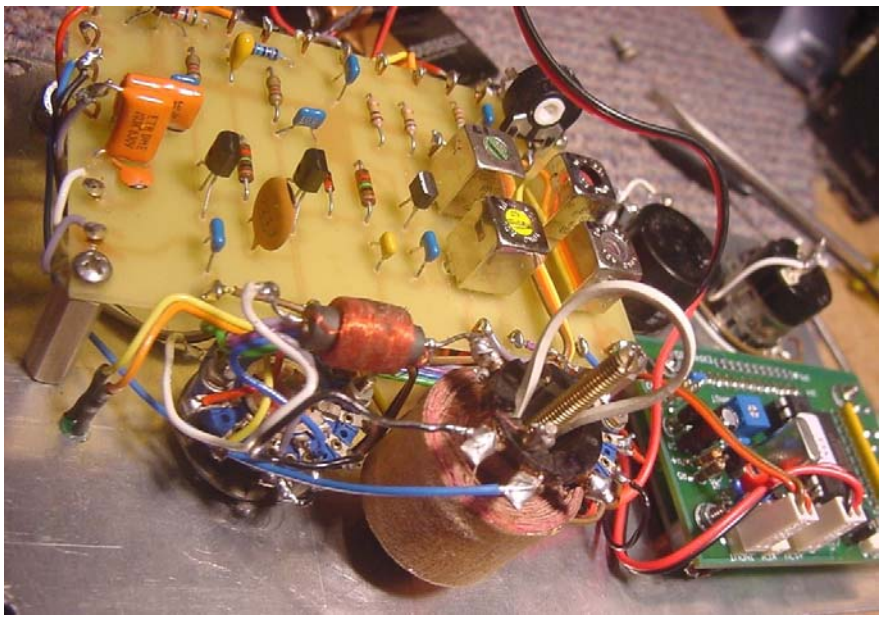
[1] *Serious TLC for the Jewel*, Graham Gosling, Lighthouse, Issue 88 p28, Dec 2004

Wobbulator Modifications

In the meantime, the fact that neither the Agilent or wobbulator worked at 100kHz was annoying me and I set about fixing that issue. I figured that the wobbulator was the easiest one to change (wonder why!). Conveniently I when I built the unit I had fitted a range switch with an extra position – originally to try to make it work at around 40MHz to align the bandpass filters in my RACAL RA-117, but found that I could not force it much beyond 30MHz and gave up (eventually using the Agilent for that purpose). So, I needed a coil that was suitable for around 100kHz. I checked-out the range of TOKO coils listed on the JAB website (http://www.jabdog.com/) and, although a couple of these may have been suitable, I thought I would first see what I could do from my junkbox and various boxes of RF and IF coils at the SPARC radio museum[2]. Given the varicap characteristics in the wobbulator I figured I needed something in the order of 8mH, but it would need to be tapped at 5% to 10% along its winding to provide feedback for the Hartley oscillator in the wobbulator. In the end, after around 5 hours experimentation, trying various coils, tapping them if they did not have taps, adding windings, chokes and even capacitors, and observing the frequency range and waveform on a 'scope, I settled on a rather large coil that had an adjustable iron dust slug. This coil had two separate sets of windings: one was in the 12mH range, tapped at 1mH. The other was in the 5mH range, tapped at 0.7mH. I ended up using the 5mH section, adding a 2.7mH ferrite-cored choke to the 'hot' end to bring its total inductance to around 8mH. This worked ok without any padding or trimming capacitors fitted, giving a tuning range of some 90kHz through 110kHz that could be tweaked with the dust slug. My main concern then was whether the varicap diode controlling the tuned circuit in the wobbulator's voltage controlled oscillator (VCO) could be made to swing the VCO sufficient to cover the receiver IF passband at this low frequency – this was later checked and found to be more than adequate. Having completed the experimentation and having confidence in my selection, I fitted the coil into the wobbulator. It was a rather neat fit, but I managed to squeeze it in (just) between the 'Range' and 'Counter' rotary switches (photo, above).



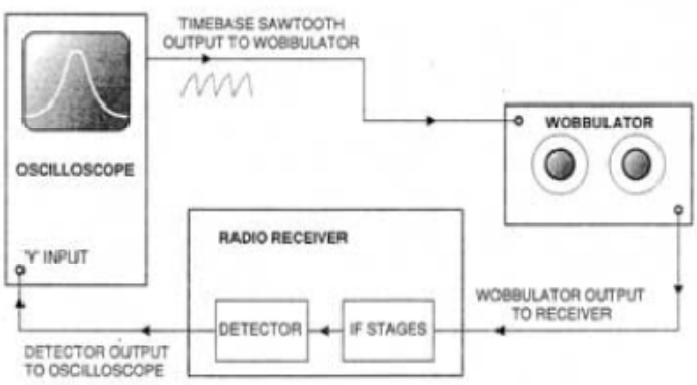
[2] Included 175kHz and 220kHz IF transformers, and RF coils and chokes of all shapes, sizes and vintages

The good news is that once the wobbulator was reassembled it was remarkably stable on the new range – holding frequency within +/20Hz or so of the nominal 100kHz centre frequency when left running for over an hour. Earlier modifications to the wobbulator had included fitting a 10-turn precision pot for the main tuning control and playing around with the resistor values in this section of the circuit to optimize both this and the fine tuning control. I also re-configured the sweep width input circuit to include the rotary switch on this control to completely remove the ramp signal if a steady frequency output is required – all this helps in controlling the wobbulator. Comparing the photo (above) with that on the first page will show that it is now working at 100kHz (albeit on the '40' range of the Range switch! – at least until I re-do the labels) – the only other change is the screw that has appeared near the 'Off' position of the 'Counter' rotary switch – this being the mounting screw for the new coil.

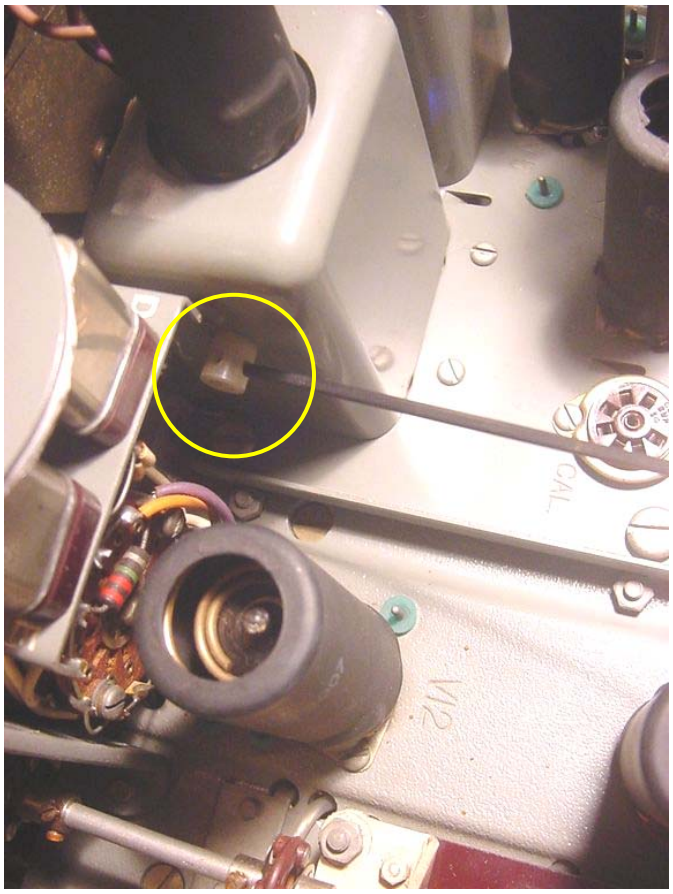
Checking the 100kHz IF

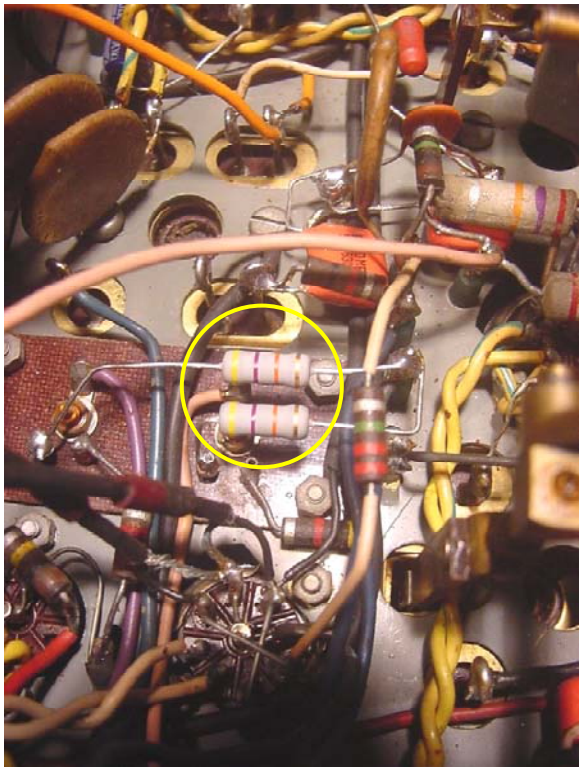
Armed with my new piece of 100kHz test gear, I cracked-open the S.830/4 again and heaved it onto the workbench. Coupling the wobbulator into the circuit is a doddle:

- Connect the 'scope Y-input to the switch end of the AF coupling capacitor to the AF gain control (C112 in the S.830/4 variant);
- Connect the 'scope ramp output to the wobbulator ramp input (this controls the VCO in the wobbulator in sync with the 'scope sweep); and
- Connect the wobbulator output in turn to the grid of the 2nd (100kHz) IF valve, the grid of the 1st (100kHz) IF valve, and finally to the grid of the 1st mixer (the stator of the relevant section of the main tuning gang is a convenient location for this - but it means temporarily removing the cover – not a big deal though).



With the equipment set up as described above (figure, base of previous page) and the set having been warmed-up (I would recommend at least an hour), it was time to start the checks. The set was already aligned to its internal IF crystal frequency (99.978kHz), so I did not need to tweak T3 and T4 again – the 'scope traces using the wobbulator on the grids if the two IF amplifier stages confirmed this. However, when I coupled the wobbulator to the grid of the 1st mixer I was in for a surprise – well sort of – conforming my suspicion of an irregular IF response on the wider settings of the selectivity control. The response looked fine on the crystal, CW and even the SSB setting, but a distinct and asymmetrical double hump appeared when rotating the control towards the widest AM setting. Graham Gosling makes the point that the setting of T2 is critical to obtain the correct passband shape, with C88 (crystal phasing) being adjusted for the best crystal response. He is absolutely correct: a slight re-adjustment of T2 and C88 (the latter being tweaked using a 'Tommy bar' – actually a 1/16" Allan key – circled yellow in photo, above, right) made a world of difference! – check out the before and after photos at the end of this article. After this experience, I would definitely recommend that a wobbulator (or similar) instrument is used to check alignment of an S.830/4.





BFO Repairs

While I was 'under the bonnet' of the S.830/4 again, I checked the BFO components providing the adjustable bias in the LSB and USB mode settings. Sure enough, one of the large 'wood dowel' type 1 Watt resistors (47kohm) – the one in the LSB circuit – was

found to drift high as it was warmed up with a hair-dryer. I changed these resistors for metal-film 1 Watt types (photo, base of previous page) in both the USB and LSB circuits. Problem solved – I now had the full range of adjustment back and no drifting on LSB.

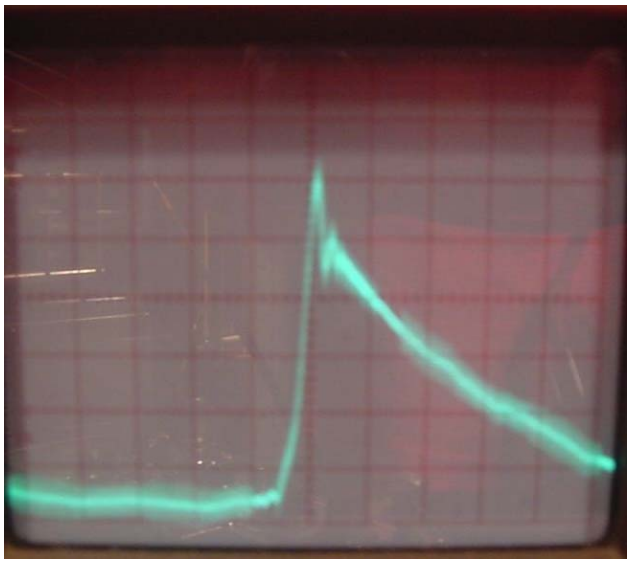
Conclusion

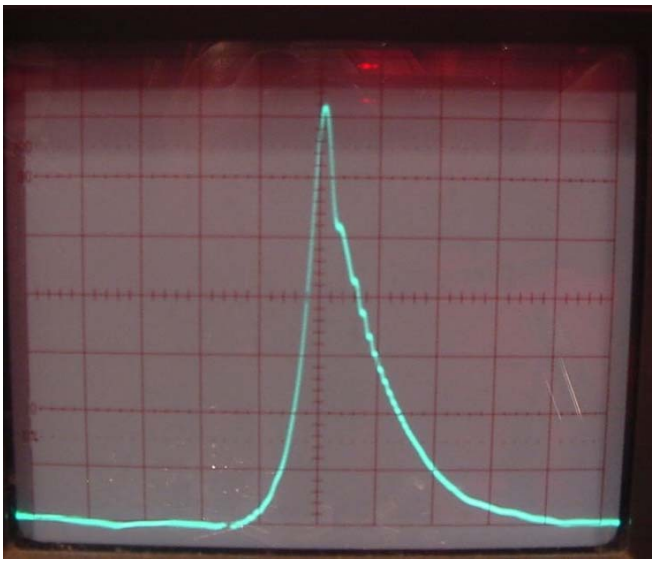
Well, I am really glad I had the conviction to follow-through with the wobbulator modifications and to check-out the 2nd IF response curves with it in the S.830/4. Listening tests since doing this work have shown a complete cure for my niggles has been effected. The set is a now a real pleasure to use – so much so, I have pulled it out of my shack and installed it on one of my operating tables so I can use it much more frequently – actually sitting alongside my S.680/2 – should make for some interesting comparisons…

Above: the refurbished S.830/4 sitting side-by-side with my restored S.680/2 - although similar technology is used in both sets, they are almost two decades apart in age - quite a difference in style, topology and performance (and 'when new' cost!). Not too surprisingly, the S.840/4 wins hands-down in the frequency accuracy, resettability and stability departments and, of course, there are no images on the higher bands due to the dual-conversion design

Before and After IF Responses

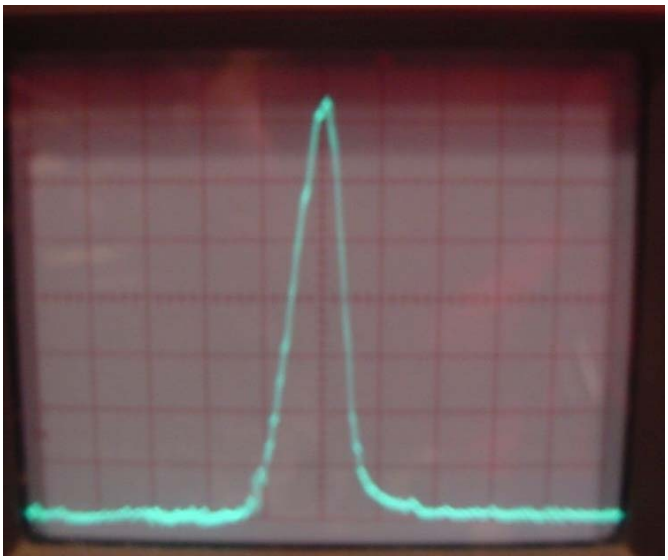
The following three pages illustrate the before and after adjustment of T2 and C88 using the wobbulator to provide a visual indication of the 2nd IF shape factor. The horizontal divisions are each approximately 1kHz in width. I did not bother to accurately calibrate the vertical axis, but I estimated that one division is around 3db.

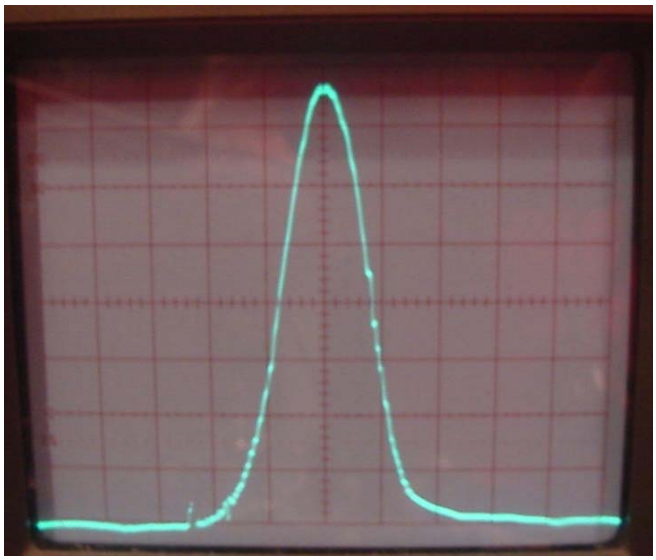


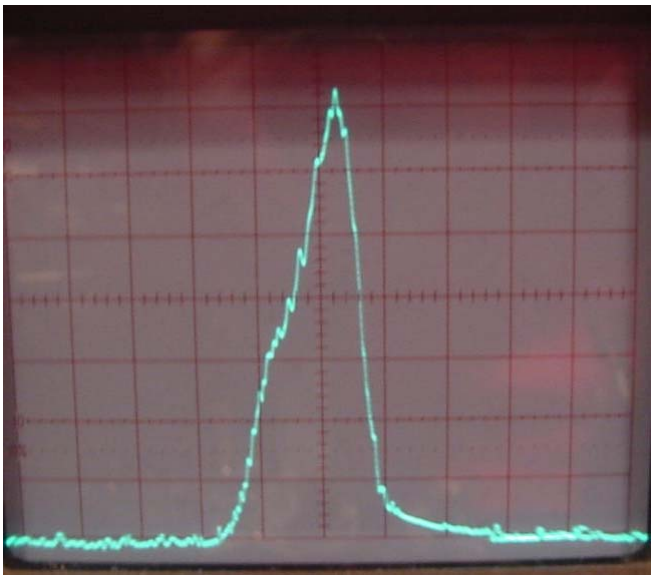


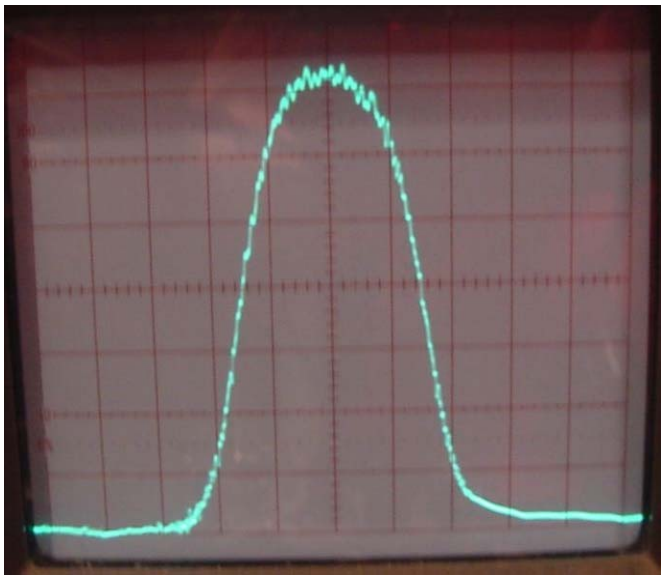
Above, left: crystal setting before adjustment – note the pronounced 'ringing' and very asymmetric shape. Above, right: crystal setting after adjustment – now much sharper, with a very distinct peak and a bandwidth of around 200Hz at -6dB, coupled with less ringing and less asymmetry

Below, left: CW setting before adjustment – not bad, but a little too sharp. Below, right – CW setting after adjustment – slightly wider (around 1.3kHz at -6dB) and nice steep, symmetrical skirts



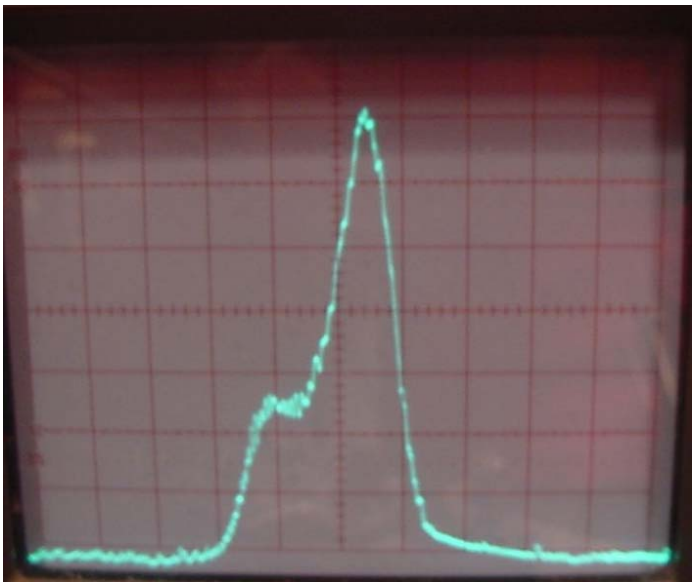


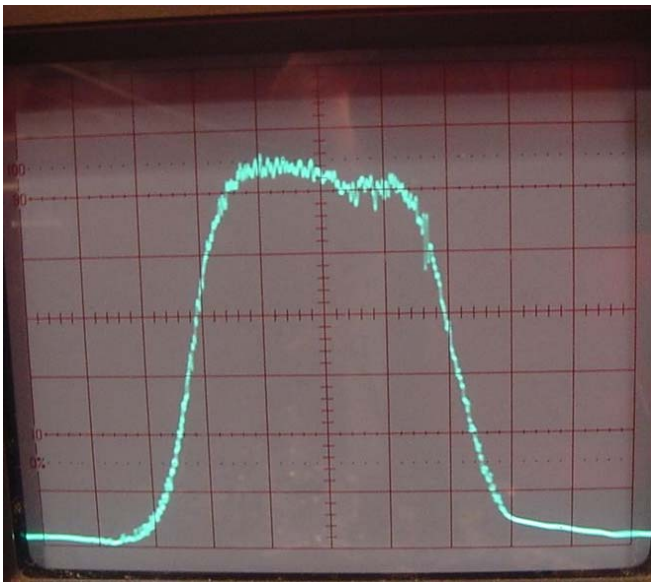


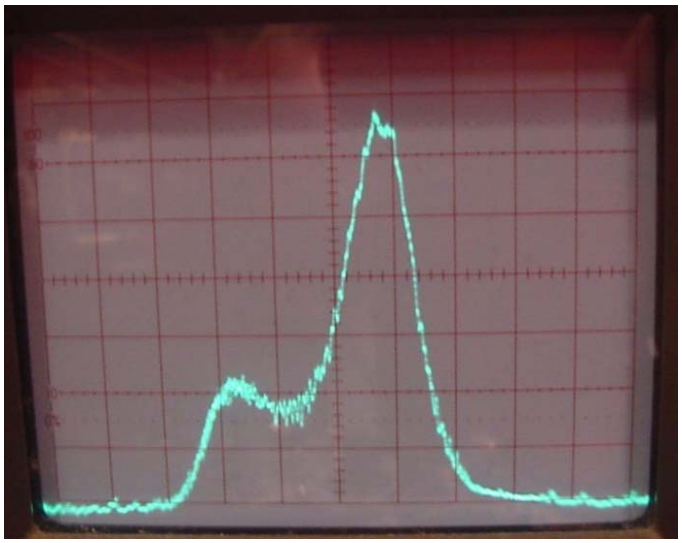


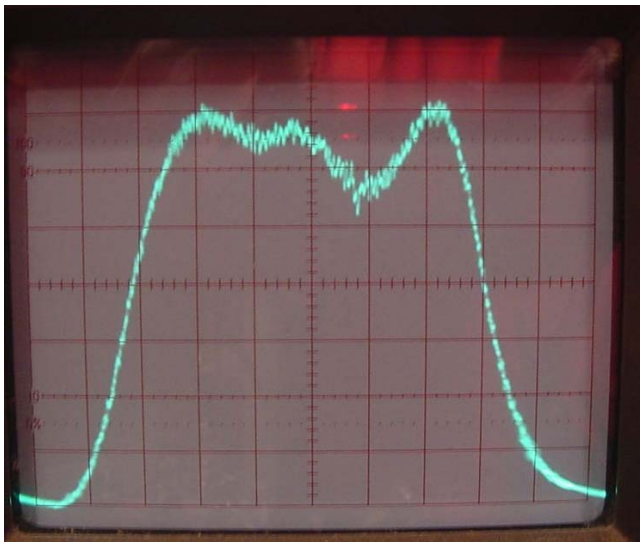
Above, left: SSB setting before adjustment – too sharp at the nose and some asymmetry creeping in (start of the hump forming on the low-frequency side). Above, right: SSB setting after adjustment – flatter top, around 2.4kHz width at -6dB, symmetrical and steep skirts

Below, left: Narrow-AM setting before adjustment - much too sharp and with a distinct step formed on the low-frequency side. Below, right: Narrow-AM setting after adjustment – much better – a wider overall response (4kHz width at -6dB) with a nice flat top and steep skirts









Above left: widest AM setting before adjustment – oh dear, what a camel back! (or cross-section through the Matterhorn?). Above, right: widest AM setting after adjustment – not perfect, but looks much better with a 6kHz bandwidth at -6dB (and better-sounding too)

Below left: sketch from Graham Gosling's Lighthouse (Issue 88) article illustrating the desired IF response curves (compare with the photos above). Below right: my co-author, Sid the cat, gets the hump (but only 'cos I won't let him play with the knobs) – this guy really knows his Eddystones – at least much better than your average moggie that is…