still allows you to achieve a proper transfer of power. Of course there will be a small power loss in the matching unit through losses in the inductors and capacitors, but in a decent unit these are small enough to forget about.

So far we have used the SWR reading to tell us about, and compensate for, mismatches between the TX and the feeder, so that the transmitter can deliver its maximum power into the load.

The 'aerial tuning' syndrome

It is at this point that the biggest stumbling block arises when using a matching unit. So many times you will hear stations announce that they have just tuned the antenna for a 1:1 SWR with the ATU, when they have in fact done nothing of the sort. What they have done is simply to adjust the matching unit so that the transmitter can see its correct load impedance — the SWR on the feeder from the output of the matching unit is still whatever it was in the first place!

Earlier on, we started with the assumption that we had a perfect lossless feeder system, which of course we don't have in practice. Now, the only way we can lose power is by dissipating some of the current in resistance in one form or another. We have already shown that it is possible by one means or another to get the full TX power into the feeder cable, but what happens along this cable which still has an SWR on it — does this mean we are losing lots of power?

Once there is a mismatch, we introduce standing waves along the cable, where the ratios of current and voltage vary at any point along the line, but repeating at half-wavelength intervals (electrical half-wavelengths). In fact, the average current and voltage is higher overall on a mismatched line than a matched one. The power meter will tell you this by reading a higher forward power on a mismatched line than it did for the same line when matched.

There isn't actually a higher forward power as such — what *is* happening is that the 'reflected power' shown on your SWR meter is again reflected by the AMU back towards the load but is now in phase with the forward current, and adds to the forward power reading — it's known as *conjugate matching* and is really what this article is all about, were we to be discussing mathematics. The result is that the higher voltage introduces some loss of power by dielectric heating, and the extra current a bit more by resistive losses in the conductor.

How much loss?

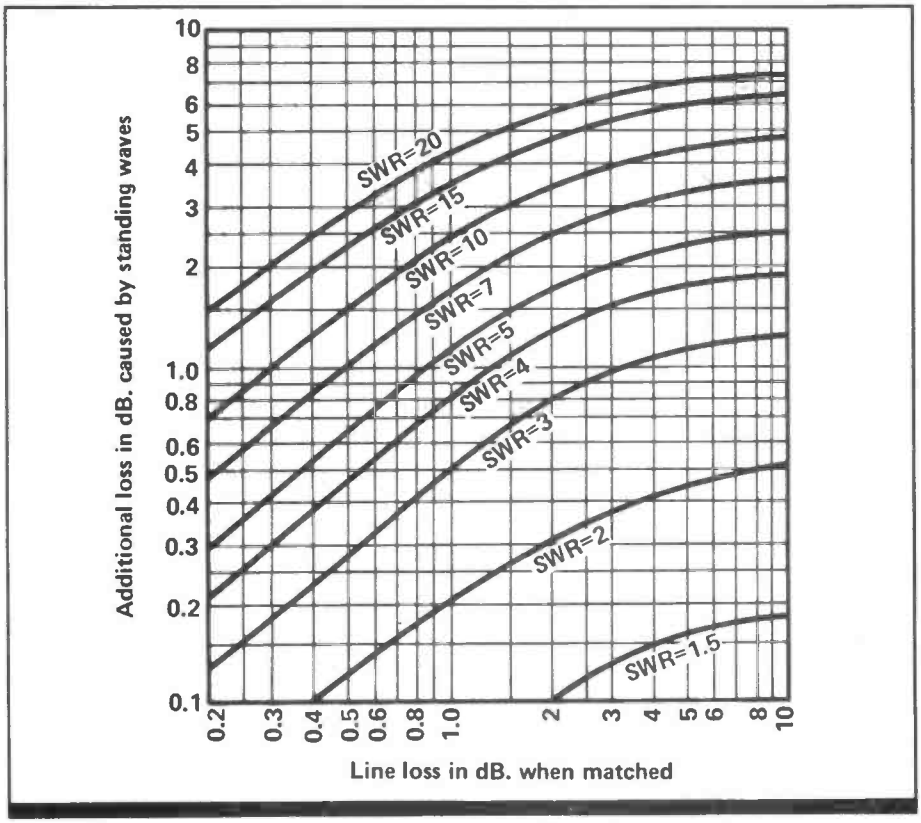
Contrary to popular belief, these losses are *small* in the normal system, and do not contribute much loss to the signal that is reaching the antenna. At HF, say 7MHz, a 100 metre length of typical 50 ohm coaxial cable will have an additional loss over that which will be there anyway when it is perfectly matched, of only 0.27dB at an SWR of 3:1! This is a 6.4% power loss, insignificant if you look at it in S-meter terms where one S point requires a 6dB increase in power.

As long as the transmitter is delivering its rated power into its correct load impedance, by whatever means, then all but that lost in the matching unit, and the fraction of dB in the feeder will get radiated by the aerial into space. If you insert an SWR bridge into the feeder, it will correctly tell you that we have a 3:1 SWR, and also that this represents 25% power loss — however this latter fact is irrelevant as a bald statement of fact. We know that the SWR is 1:1 at the *input* to the matching unit, because we already adjusted it to be so.

Therefore, if you believe the 'reflected power' reading, then 25 watts most be being absorbed by the matching unit, as it can't be going anywhere else — if it is being absorbed then it will be converted into heat so that the matching unit will get rather hot. Which of course it doesn't.

You should be able to deduce from all this that if you have a PA which is adjustable, or a suitable matching unit, then once you have compensated for the mismatch, and managed to get all your power going into the feeder, there is little point in trying to do anything about the SWR on the feeder itself. It will have next to no effect. Of course, with very long coaxial feeder runs, and at VHF/UHF, the mismatch loss in the feeder becomes much more important as it may be high enough to affect the signal. What we have been trying to say is that there is little point trying to achieve a low SWR for its own sake. Other factors may modify this decision but at HF it is probably a wasted effort.

With something like an 80 metre dipole, there is consequently no point at all in considering where in the band to adjust it for resonance as indicated by a 1:1 SWR. Providing you can compensate for the mismatch at the TX end, you should be radiating the same signal at 3.5 as at 3.8MHz, despite high SWR at one end and low at the other.



Finale

As a final note, if your transmitter loads happily into the feeder, you might be better off not being influenced by an SWR meter in the first place. It may even be telling you lies! Unless you are using a good quality instrument that is designed for exactly the same impedance cable as you are using it in, then you are unlikely to be getting an accurate reading anyway, although it may be correctly indicating that the ratio is low.

Most of the cheaper instruments on the market give varying readings depending on the frequency and the power level in use. They may even change reading as you watch them and give you the impression that your power is falling off. The writer has a selection of bridges — few of them agree on the ratio obtained.