FORUM

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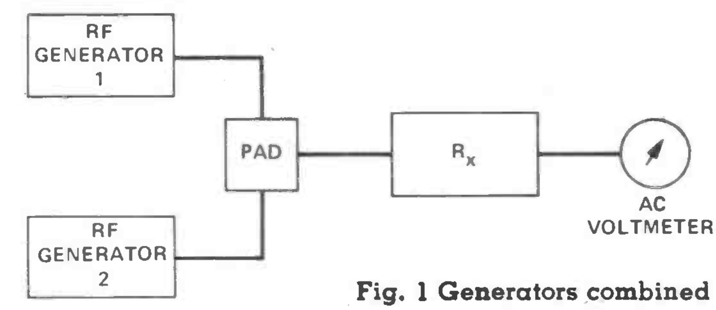

Fig. 1 Generators combined by pad

as the bandwidth used affects the results, this has to be quoted. The narrower the bandwidth the better the dynamic range in general, which is why most manufacturers quote the figure with a 500Hz CW bandwidth!

The effect of injecting the two signals at the same time is to generate within the receiver a number of distortion products. These will be 2fl — f2, and 2f2 - f1. For instance, if we were using 14.200MHz and 14.250MHz as our signals, then we will expect to find distortion products at 14.150MHz and 14.300MHz. (see **Fig. 2.**)

For the above reason, this is called a Two-Tone Dynamic Range test. There is a single tone test as well, but this measures what is normally termed as blocking.

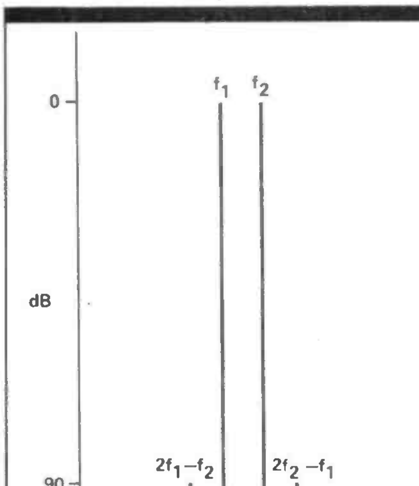

Fig. 2 Distortion arising from 2-tone input

To carry out the Two-Tone test, one of the two input signals only is applied to the receiver and the injection level measured which gives a signal 3dB above the noise floor of the receiver (using an AC millivoltmeter coupled to the audio output of the receiver). This is our reference level and we will assume that it is 0.3uV.

The other generator is then switched on, and the output of each increased at equal levels while listening at the frequency of one of the expected distortion products. When the level of the distortion product reaches 3dB above the noise floor, the generator output level is noted, taking into account the loss through the combining pad. Let's assume that it was 10mV.

What we now have are two figures, the ratio of which gives us the dynamic range of the receiver, ie. we have measured how much signal needs to be injected to give rise to unwanted distortion products, at the same level as a minimum detectable wanted signal. These two figures are normally expressed as a dB ratio, and in the case above this would be 90dB — a good result.

What about 70dB?

I say a good result, so what is a bad result? Difficult to say, but you should expect any half decent rig to manage at least 80dB, even then it will have problems on 40 metres after dark. 100dB is bordering on the excellent, and would be unlikely to suffer from any problems, unless an extremely large antenna array is attached to it.

If you consider the actual figures, it might mean more than the dB equivalents. In our example, the dynamic range was 90dB. If the dynamic range had been 74dB (doesn't sound a drastic amount less does it?) the figure would have been only 1.6mV, and if 96dB then 20mV. It doesn't need much imagination to see the effects of these differences.

The single tone test referred to above measures blocking, or how well the receiver can cope with a very strong signal on an adjacent channel. It can be measured using the same equipment, by setting one of the generators to provide a signal of around S7 on the receiver, then increasing the output of the other until the wanted signal is reduced in strength by 1dB. This measures the onset of blocking — you could expect a very good receiver to show a figure of over 120dB for this, and a poor one less than 100dB with 110dB as an average.

Improving results

Most modern receivers take great care in the design to achieve a high dynamic range figure. The distribution of gain in the RF and IF stages can have a terrific effect on the figure, which is why many receivers go straight into a high level double balanced mixer, or, if they do use RF amplification, high voltage devices are employed to reduce the IMD products. Single conversion designs are often favoured because there is only one mixer to generate IMD products, although good results can be achieved with multiple conversion, as witness the TS930 and similar rigs.

If your receiver is not in this category, is there anything you can do to improve things? One of the ways to reduce strong out of band signals, without affecting the wanted signal strengths is to use a high selectivity preselector unit. This needs to be a passive unit without gain, as if extra gain is added, this may compound the problem in-band although it reduces the signals out-of-band.

The way round this, and one which can be used alone with the receiver, is a switched attenuator. These are often seen on modern rigs, with steps of 10, 20 and 30dB of attenuation. It might seem strange to improve copy by reducing both the wanted and unwanted signals, but of