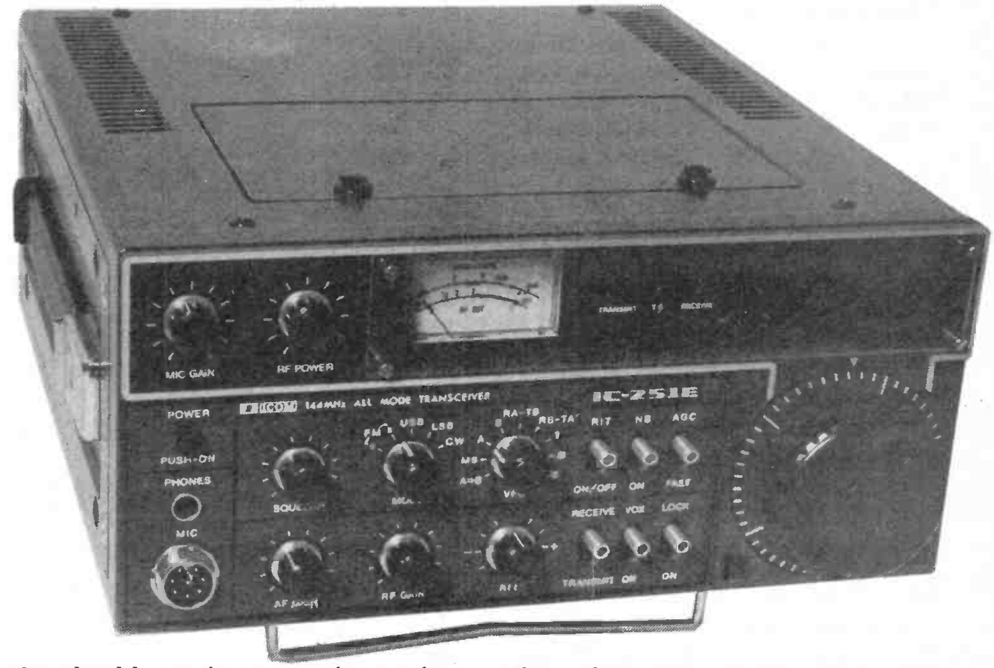
ment is made is normally stated. Noise figure is expressed in dBs of excess noise, but this parameter can also be expressed as noise temperature, which is the temperature at which the 50 ohm input termination would have to be taken to be equivalent to the noise within the receiver. Noise factor is a power ratio of receiver noise to basic 50 ohm resistor noise and is not in dB (note that many advertisements confuse noise factor with noise figure). A 3dB noise figure is the same as a noise factor of 2.

When you measure the SINAD ratio of an SSB or CW receiver, you are measuring the ratio of the carrier beat, plus noise within the passband of the selected filter, to the value of the noise with the carrier level subtracted. Some product detectors distort the carrier beat signal, and so unfortunately this distortion is measured both with the carrier and with the noise, so a rig having appreciable audible distortion will give inferior readings, since the ratio of signal plus noise and distortion, to noise plus distortion (SINAD ratio), is degraded. The selectivity must be measured accuately to estimate the true worth of the front end. If you measure a 12dB SINAD ratio with a rig having a selectivity of a few hundred Hz, you will get an apparent tremendous improvement in sensitivity as compared with a rig with a selectivity a few kHz wide. The 'noise floor' with a narrow bandwidth is obviously going to be lower than with a wide bandwidth, unless you rate the system noise per Hz of bandwidth. There is another caution here, in that to be strictly correct you should measure the *equivalent* 3dB bandwidth — taking into account the noise power outside this band width — and so the *actual* bandwidth for 3dB drop can be wider or narrower than the equivalent noise band width.

## Laboratory measurements

Starting with input sensitivity, we found it to be stunningly good on SSB, and indeed for a while we thought it was defeating the laws of physics. The 12dB SINAD rating was − 134.2dBm. But this represents an input PD of 0.045 V, which is only around 6dB higher than the noise we would expect from a perfect front end having an equivalent noise bandwidth of around 2.3kHz. How could we be seeing 12dB SINAD with a noise figure of 2dB? My colleague, Simon, G8UQX, took great trouble to avoid leakage and we checked and re-checked the accuracies of the Marconi generator on our Racal *9393* power meter, and could not find a problem. It was not until we measured the selectivity characteristics that we found the reason for our not inconsiderable bafflement, made all the more odd because the FM 12dB SINAD figure was virtually perfectly coinciding with what we would have expected from a 2dB noise figure front end, namely 0.1µV. The selectivity curve resembled 'the man with the pointed head', since the 3dB bandwidth was more like that of a CW filter, the 6dB bandwidth not far wrong for a teletype filter, and the 60dB bandwidth about right for a marginally wider than average SSB filter. If we calculate the noise back from the selectivity curve measured with our own measurement of SSB SINAD, we arrive at a figure, which although approximate, is in the 2dB ball park.




The RFIM measurements are extremely good, and indicate an approximate intercept point of 0dBm. The measurements were taken at three different levels, the 12dB SINAD point, and the inputs required to produce −120 and −87dBm third order products. We can see that there is a marginal contribution from the BF981 pre-amp at high levels, whereas the low level products are almost all caused by the mixer and first IF stage combination. What is particularly important is that the RFIM measurements from carriers spaced 25/50, 50/100 and 100/200kHz off frequency gave almost identical measurements, showing that Mutek's philosophy works out extremely well. We have the feeling that our own test equipment was in fact at its limit of performance here, and we are relieved to see the close-in intermod figures only very marginally worse than the further out ones, this meaning that our test equipment and Chris Bartrum's circuit are both good!

The FM selectivity was again stretching our equipment, possibly near its limit, for the 12.5kHz readings cannot be described as other than stunningly good. Of course, 25 and 50kHz selectivity were even better. Let's put this into perspective by saying that an FM station at 50kHz off carrier would have to be received at a level in excess of 1mV (say, 54dB over S9) to cause a significant deterioration to an extremely weak signal which was just readable on channel. This is, of course, assuming that the off-channel station was using a respectable rig!

## Other aspects

The S meter on SSB was the best that I have encountered for some while, averaging at around 5dB per S point between S4 and S9, although below S4 the steps were larger, and