RF.AMX10.v.4.1 : DIY RF bias condenser microphone project

The RF.AMX mic project has very much been an experimental hobby project, with input from several expert contributors – notably from the GroupDIY forum.
My thanks to them all.

This latest revision (v.4.1) has seen an important change in how the project has been realised - although the actual physical differences consist merely of a couple of resistor changes.

In all previous issues, there has been an attempt to maximise oscillator output voltage swing - while minimising current drain. Moving further and further down that 'tunnel' rather tended to exclude other options…. My error there!

In fact, because a self biased FET is used as an infinite impedance detector (some notes on that below) there is no need to try and maximise oscillator output, which would probably still be the best option, should a conventional diode detector be used for demodulation.

The vast majority of the noise in the system comes from the oscillator, and appears to be largely proportional to the oscillator amplitude – as one might expect.

In this latest configuration, the oscillator amplitude and current has been significantly reduced, so that the whole system now draws only around 2.5mA of current. This seems to result in several advantages:

• The microphone background noise is reduced to around 12dB

• The crystal drive level is reduced to around 75uW

• The microphone sensitivity is reduced by around 6dB (to c. -23dB)
(It can still vary quite lot between different capsule types of course)

• The capsule only has around 2-3V of RF bias applied to it

As before, the project should still be regarded as experimental, so further ideas and comments are always welcome….

'rogs' 23.4.21

Infinite Impedance Detector.

These notes are a précis of pages 54 - 56 of this US Navy paper from 1967:

https://core.ac.uk/download/pdf/36705909.pdf

In a non-linear application, the FET may be used as an amplitude modulation detector - the 'Infinite Impedance Detector.'
Two advantages of this concept over a conventional diode detector are no loading of the previous stage, and the ability to detect a highly modulated signal without distortion.
A standard diode detector will not detect high level modulation without distortion. The blame for this failing rests upon the fact that the input impedance to the diode detector is of a different value for modulation frequency components than it is for direct current.
This factor is almost non-existent in an infinite impedance detector.
Also, the diode detector loads the previous stage, a typical input impedance being in the neighborhood of 5 to 25 KOhms.
The infinite impedance detector - as the name implies - has a theoretical infinite impedance. Practically, the impedance might be 1 to 10 Mohms, and for an FET will be determined by the gate leak resistor, if used.

A basic FET infinite impedance detector is shown below.
First consider operation without an input signal. Capacitor C1 will charge through the FET to a value almost, but not quite equal to, Vp of the FET. The FET will then be almost cutoff, differing from cutoff only due to the slight discharge of C1 through R1, and re-charging through the FET.
Now consider an unmodulated RF signal on the gate.
On the positive half cycle of the signal, the FET will be driven further into cutoff. Since it was already cutoff, no change occurs. On the negative half cycle, the FET comes out of cutoff since Vgs is now less than Vp. C1 will charge to a new level equal approximately to Vp plus the peak value of the signal.
With a modulated signal on the gate, C1 will again charge to the peak of the signal in the negative half cycle. However the values of C1 and R1 have been chosen such that for an audio signal, the time constant R1/C1 is small enough to allow the source voltage to follow the modulation.
Thus the source voltage will not follow the carrier, but will follow the modulation.