RF.AMX10

-- a DIY 'RF bias' condenser microphone project --

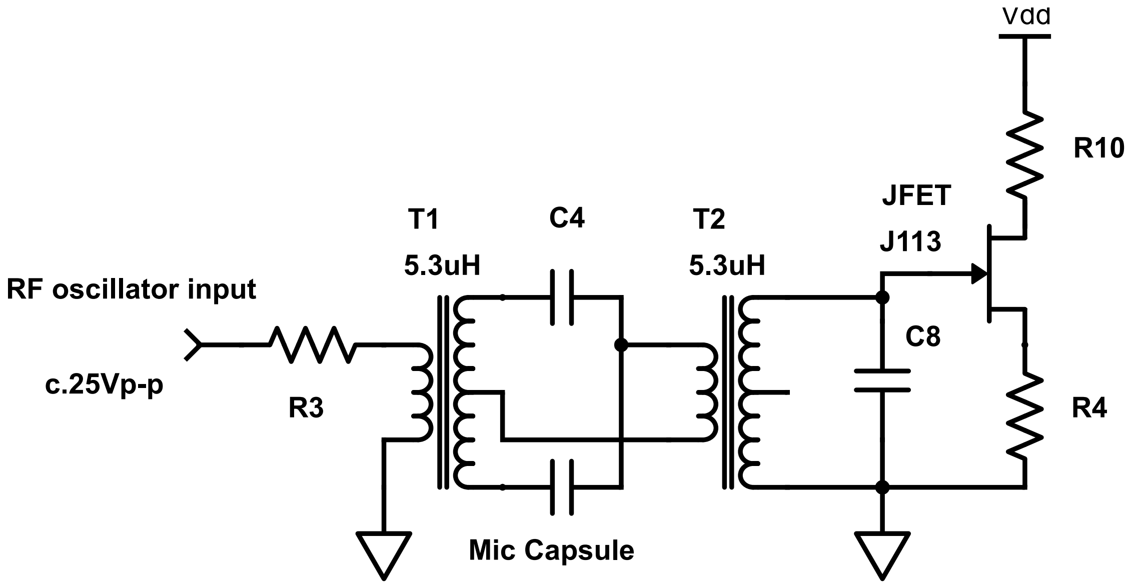
(You can find the main project website here: **www.amx.jp137.com**)

...Some further thoughts and 'tweaks'...

At the 'heart' of the RF.AMX10 microphone schematic....

(see this page: http://www.amx.jp137.com/index-scheme.html)

...is the inductor assembly, the essential parts of which are shown below:



(The component references correspond to the numbers on the main project schematic)

It can be useful to understand how the component values for the present version have been selected, and what changes might be advisable to obtain optimum performance when using alternative capsules...

The 'primary' winding of T1 has an impedance of around 800Ω at the specified inductor operating frequency of 7MHz. In this present version of the project - which employs a K67 type Chinese mic capsule - we are using a 10 MHz oscillator, so the impedance is lower - at around 500Ω .

The addition of R3 in series with the winding restricts the oscillator current to prevent excessive current drain from the 48V phantom power supply powering the circuit.
With the value of R3 at 4k7, the oscillator current is restricted to around 2mA. This allows around 20% of the oscillator output voltage to be presented across the primary winding.

The loading presented to T1 secondary - by the combination of C4, the mic capsule, and T2 primary - is a complex load that is further affected by the tuning of both inductors.
(The actual maths involved here are way above my pay grade!) .

The quality of the overall performance of this circuit is largely dependent on the step up turns ratio, and the 'Q' of the tuned inductors.

T1 is tuned for optimum resonance with all the other components attached. This presents as the maximum 10MHz AC voltage available across T1 secondary.

The 'bridge' circuit - formed by the centre tapped secondary of T1, together with C4 and the microphone capsule – needs to be slightly 'unbalanced' for the circuit to function.
Peter Baxandall - the creator of the original concept in the 1960s - acknowledges this in his original notes, and more recently Group DIY contributor Abbey has described the same requirement.
Obviously with a fully 'balanced' bridge providing zero output to bias the J113 JFET there would – at best – only be a small highly distorted output.

But how much unbalance is 'slightly'? …. In practice it has - so far - not been possible to actually create a truly 'balanced' bridge using real world components.
Even replacing the microphone capsule with a second capacitor - carefully selected to match the exact value (within 1pF) of C4 - will still result in a 'usable' unbalanced bridge signal of something like 200mV p-p, which – as the JFET is always self biased at its Vp point - is more than adequate for the infinite impedance detector to function normally.

In theory, it must be possible to create a balanced bridge, but the simple addition of even a few picofarads to the value of C4 would at once restore a useful 'unbalanced' situation.

In practice, selecting a value of C4 to be close to the measured capacitive value of the mic capsule should work well, allowing the full resonant 'Q' of T2 to be utilised as a source of essentially 'noise free' gain.
Chinese 'K.67' type capsules will typically have a capacitive value of around 65pF – so selecting C4 as 68pF should be ideal.

Other capsules – like edge terminated 'C12' style capsules - often have a larger capacitive value, typically around 90pF, so C4 would need to be either 82pF or 100pF in that case.

It is important to note that the polarity of the microphone will be determined by whether the value of C4 is larger or smaller than the capsule value – not on the polarity of the capsule connections…. Just one slightly unusual aspect of an 'AM unbalanced bridge' RF microphone!

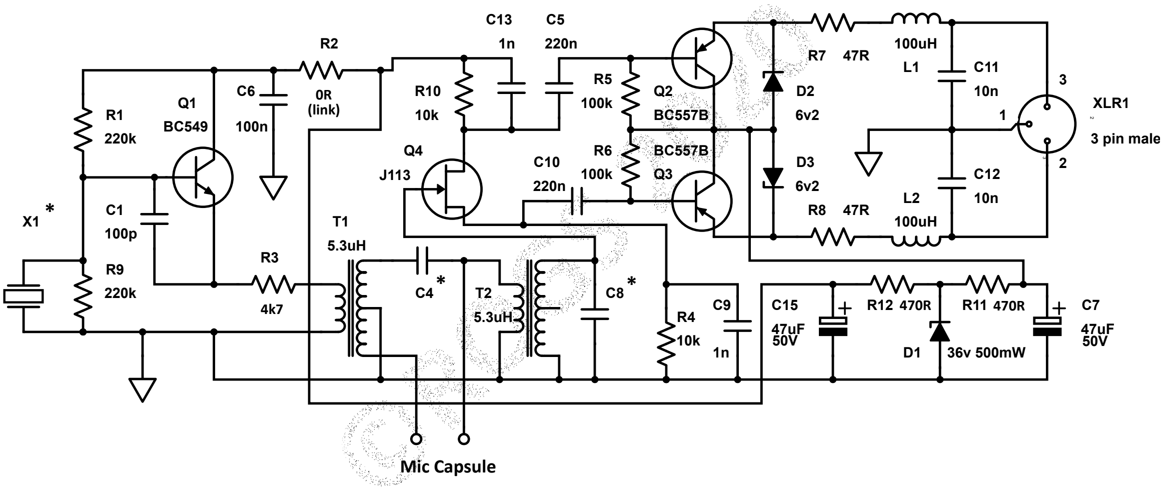
It has also been discovered that better results can be obtained by changing some component values to better suit different capsules. As mentioned above, the original version is designed to utilise a K.67 capsule. A higher capacitive value capsule - like the 90pF 'C12' style mentioned above - is better served using an 8MHz oscillator, for example.
At the other extreme, some capsules have smaller capacitive values. Those at less than 50pF are probably best served by a 12MHz oscillator … and some with values around 40pF or less may even benefit from using 2.6uH inductors - like the Toko KACSK3894 - with the internal capacitor removed!
(That 'removal' operation is quite simple – the internal capacitor is ceramic, so a quick 'poke' with a small screwdriver, and it's gone!)

The schematic below shows the current version of the circuit (v.3.0) which includes component options for different capsule capacitance values. The values of R3 , R11 and R12 are chosen to allow an overall current drain of c.3mA from a phantom power 48V supply. These values produce a circuit which has a self noise level of c.10dB(A).
With a typcial sensitivity of -17dB this version of the circuit seems to offer the best compromise beween current drain and system noise.

RF.AMX10 v.3.0

DIY RF Condenser Microphone – Schematic

• Sensitivity: -17dB • S/N: 84dB • Current: 3mA



Mic Capsule "Style"	Capacitive value (typical)	X1 *	C4 *	C8 *
"K67" (centre terminated)	65pF	10MHz	68pF	47pF
"C12" (edge terminated)	90pF	8MHz	100pF	68pF