Re: Help understanding circuits

Source: http://sci.tech−archive.net/Archive/sci.electronics.basics/2008−03/msg00168.html

- *From*: et472@xxxxxxxxxxxxxxxxxxx (Michael Black)

- *Date*: 6 Mar 2008 15:29:11 GMT

"AJ" (itwasme33@xxxxxxxxxxx) writes:

> Hi,
>
> I was wondering if someone might be able to answer some questions on the following video transmitter circuits...
> http://www.ajpotts.fsnet.co.uk/Circuits.html
>
> 1. In the top circuit, what is the idea of the diode on the video input and why isn't it on the bottom circuit?

If you mean by the "top circuit", the one at
http://www.ajpotts.fsnet.co.uk/videotx.gif
then that 1N4148 after the 4.7uF capacitor is a clamping diode. Look it up in a dictionary. The video signal is AC coupled in order to take out any DC voltage, but the transmitter actually needs that video signal to be not a negative and positive going signal that you get after the coupling capacitor, but a voltage that varies from about ground potential to a more positive level. The diode "clamps" the voltage at just below ground level (because the diode has a voltage drop, the signal can go somewhat below zero volts), so the video signal fluctuates from there to a positive voltage.

One decided they'd use the diode, the other decided not to.

> 2. I have never really understood how this configuration of oscillator works, mainly the purpose of the 10pF cap from the collector to emitter. I assume it is a variation of the colpitts and by applying a voltage on the base of the transistor varies the CE capacitance which in turn varies the frequency for modulation but im not sure? What I am mainly confused about is how this capacitor turns the transistor on and off and how its value was derived. I must have looked at 100 circuits and descriptions but nothing explains it in a way I understand, I feel like a bit of a fool.

An oscillator by definition is an amplifier with feedback, you need to

take the output signal from somewhere and feed it back to the input of the amplifier. In both circuits, the base of the oscillator transistor is at ground for radio frequencies, the 470pF capacitors on the top one the 1nF capacitor on the bottom one, which means there can't be feedback to the base. So instead, the output from the collector is fed back to the emitter, the transistor acting as a common base transistor. If you don't have that feedback capacitor there, the circuit may not oscillate. I say "may not" because if you are high enough up in frequency and other factors are right, there is enough inherent capacitance there to do the feedback without an explicit capacitor.

The value of the capacitor is enough so that there is enough feedback to get the amplifier oscillating and keep oscillating. The lower the frequency, the larger that capacitor will ahve to be, though some of the rest of the circuit comes into play in determing the exact value (though "exact" is relative, since it will oscillatoe with the capacitor varying over a reasonable range.)

Take note that neither of these transmitters are FM. They are both amplitude modulated, the modulating video signal going to the emitter to control the voltage there which varies the amplitude of the signal. (In the top one, the video signal is applied to the emitter of the actual oscillator, so there is likely to be incidental frequency modulation, but that is just because it's a really simple circuit.

Your question about FM may be because a common "FM wireless mic" circuit is to use such an oscillator, and then feed the audio into the base of the transistor, which does cause the frequency to vary. But that works because the audio signal is far below the frequency of the actual oscillator, so the bypass capacitor that puts the base at ground won't be large enough to "short" the audio signal to ground. But, a video signal is larger, and by the time you get a low enough bypass capacitor there, if you were frequency modulating the oscillator, you might find it's too low and will affect operation of the oscillator.

> 3. What are the capacitors on the emitters of the transistors on the bottom circuit for? I am guessing they are to bypass the emitter resistors to provide higher gain at the oscillator frequency but if that's the case then why is there one on the frequency doubler circuit made up from Q2? Also, why does the oscillator on the bottom circuit have the bypass cap while the top one doesn't?

The top one is just a modulated oscillator, nothing else. If you bypass the emitter of that one, it will limit the frequency response, and like I said, a video signal requires a wider frequency response and any bypass capacitor there would start affecting the input video frequency.

Plus, if you bypass that emitter in the oscillator, you will kill the oscillation since there will be no place for the feedback signal from

the collector to go but ground.

I see, there is a small value capacitor on the bottom one. That's just
a way of adjusting the feedback, the small value doesn't act as a "short"
at that frequency, but it will reduce the signal at that point, which is
often what you want (since too much feedback causes problems). Think of
those two capacitors, the one from the collector to the emitter and the
one from the emitter to ground, as a voltage divider, similar to two
resistors acting as a voltage divider.

I said above that in some circuits at some frequencies you don't need
the capacitor from collector to emitter, there's enough inherent capacitance
do do the job. Likwise, there is inherent capacitance from the emitter
to ground anyway, so you can see such oscillators without a capacitor
from emitter to ground.

Any amplifier needs to be biased at DC, but what's good for that may not
be good for the AC response of the stage. You could just short the
emitter to ground, which would give the most AC gain, but might not
be the best way to bias the circuit. Put a resistor in the emitter,
and you may not get the best AC gain. But, if you bypass the emitter,
it in effect puts the emitter at "ground" for AC signals, allowing full
AC gain despite the resistor.

> 4. How does this frequency doubler work? Hints on what to search form in
> google would be a great help as I have been unable to find much.

It in effect distorts the input signal to generate harmonics (ie multiples
of the input frequency) and then has a frequency selective element to
pick off the desired frequency. So let's say the oscilator puts out
a sinewave. There will be relatively little harmonic content (how little
dependong on how pure the sinewave is), but drive a stage hard enough (ie
overload it) and it will generate harmonics of that input frequency. Then
you put a tuned circuit in the collector, to pick off the desired harmonic,
ie multiple of the input frequency.

So in that circuit, the second stage has the output tuned to twice
the input, generating the desired signal in the UHF tv band.

Michael

.