Audio Circuit Oscillation Sniffer

Here is a simple way to detect if your circuit is oscillating. Its particularly useful if you don't have a scope handy - they are not cheap and a decent second hand unit with 100MHz bandwidth will set you back a few hundred $ at least. This sniffer can be build for less that a $2.00 into a used marker pen case and will reliably detect gross oscillation from about 100 kHz upwards starting at levels of about 150 mV if you can get hold of a small signal germanium diode like an OA81. If not, a 1N4148 will be good for detect levels at about 500 mV and up. So, this solution will not help in those cases where you have some subtle low level oscillation, but it will catch big oscillation problems.

This technique was quite popular amongst radio communications repairman in years gone by where it was called an 'RF detector'. Typically you would use an arrangement like this (but with different circuit values of course because the operating frequencies were higher) when tuning up radio transceivers, and especially for the receiver IF stages. More advanced versions first amplified the signal through a tube or JFET. I have avoided that temptation here – but it is certainly something that could be added at a later date. That will require some sort of supply as well, adding to the complexity of course.

The total input impedance is around 16 k at HF, and dominated by the parallel connection of R1, R3 and R6 plus series connection of R4. In conjunction with C1 and C3, these components form a high pass filter with a —3dB point of about 40 kHz and attenuation below that of 40 dB per decade. R4 is a 1 k resistor which isolates any capacitive load from the sniffer's circuit and wiring. This is quite important because we do not want the device to actually trigger any oscillation in the circuit under test.

If you are feeling up to creating something really well engineered, you can always build the circuit into a small metal case and fit it with a BNC connector to which you can plug a scope probe (these can be picked up for around $20) and a pair of banana sockets into which you can connect your DVM.

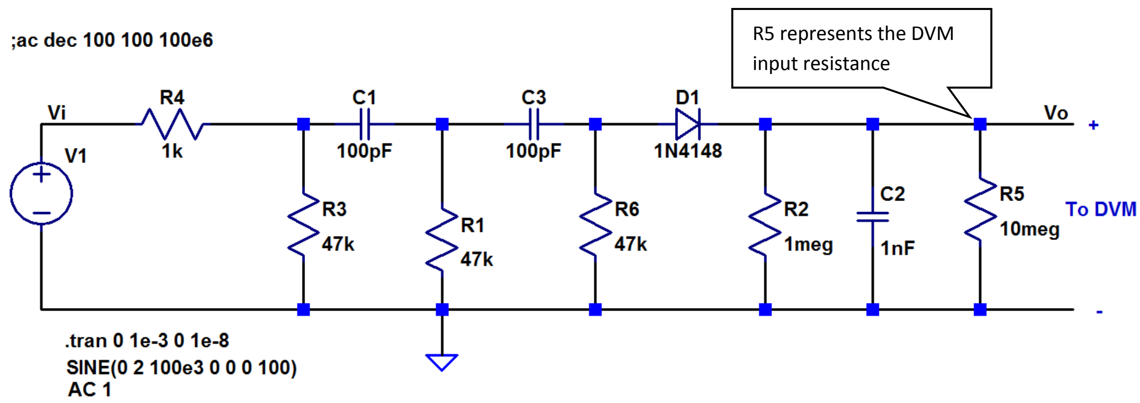

Figure 1 - Oscillation Sniffer Circuit

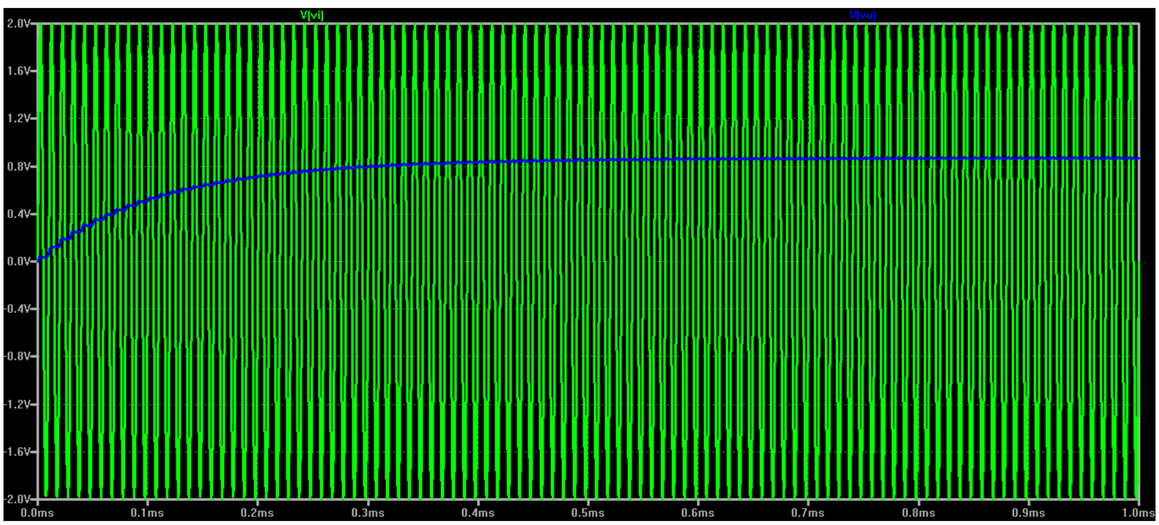

Figure 2 - Blue line is DC Output with 2V 100KHz Input Signal

Fig. 2 shows the DC output (BLUE Trace) to a 2 Vpk input signal at 100 kHz – this using a standard 1N4148 silicon diode. Figure 3 shows the response of the circuit to a 25 kHz 2V input signal whilst Fig. 4 plots the overall response.

There basically two types of oscillation that this sniffer can be used to detect. The first is low level gross oscillation at around 500mV and above (standard silicon diode for D1). This type of problem happens when the circuit oscillates without any external stimulus, a situation that could arise for example if you plugged an uncompensated op amp into a circuit that was designed for a unity gain stable opamp. Another scenario might be where you plug your new op amp in, and the comp pins are across pins 1 and 5, not 1 and 8. To test for gross oscillation, you simply power up your opamp circuit with no input signal - probably best here that you actually short the input in fact. You should get no reading on your DVM (set it to the 2 V range). The second type of oscillation involves applying some stimulus to the circuit under test. This could be done with a signal generator and a say 1 kHz input signal. Ideally there should still be no reading on the DVM. If there is, the input signal is exciting the opamp or regulator into oscillation. However, another great test is to just play a CD (not SACD or DVD) through the circuit under test. CDs should have no significant content above 22 kHz, although there will be distortion artifacts from the D-A process – but these will typically be many orders of magnitude down on the output signal. The advantage here is that you are using a wide band stimulus and this really does excite your circuit more thoroughly than just a single tone. Note, this is not the same as saying a single tone is not a valid way to test amplifier distortion performance – that is a separate issue! Here we are looking at stability criteria, opamp/psu interaction and so forth.

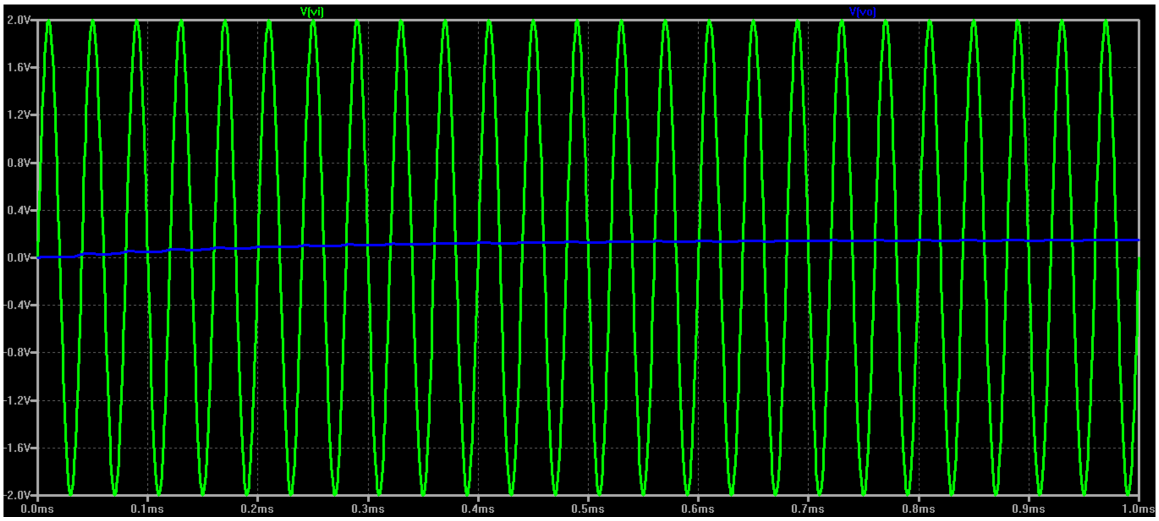

Figure 3 - Output (Blue trace) with 2V pk input at 25KHz

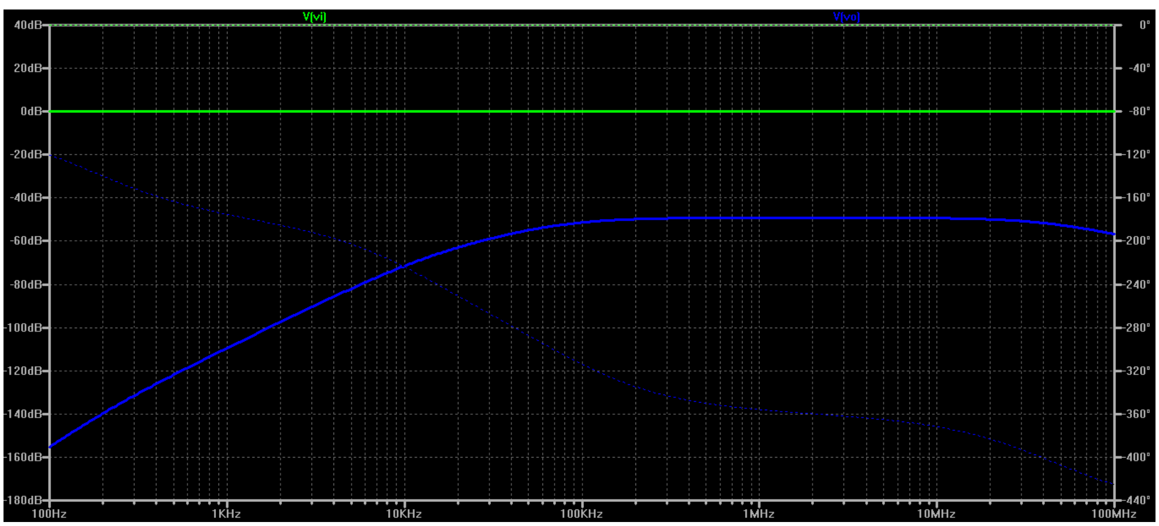

Figure 4 - Response of the Sniffer 100Hz to 100MHz

The sniffer will not replace a scope. It however is designed to help you identify quickly (and cheaply) if you have any gross instability and oscillation problems when experimenting with opamps. Happy opamp swapping!