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A Sweep Tuner for the VCO

There have been many VCO's described in VHF Communications, the latest ten appear in the last years volumes, (1) to (10). Obviously some of them are intended for use in conjunction with phase detectors in PLL's and are not to be tuned manually.This does not prevent them from use in some other, manually tuned applications.

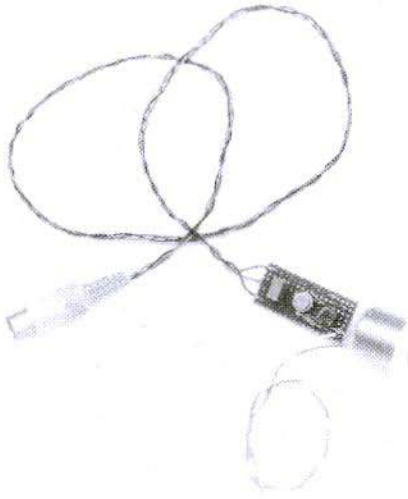
1. DESCRIPTION

The component count for this project is low: One integrator and one DC motor!

Select an OP amp with very low bias current such as the AD 549 electrometer amplifier from Analog Devices, or something from the new LMC 6XXX-family from National Semiconductor.

Note the LMC6482/4 and LMC6572/4 amplifiers that have rail-to-rail input common-mode range and outputs range, operating down to 3V! Bias currents around 20pA.

I used the slightly older AD549J. The J-grade has a typical input bias current



of 150pA, whereas the LMC 6XXX family has plenty of members with less than 10pA of bias current. The AD 549 has an offset trim option (10k pot to -Vs) which is useful here.

The amplifier is connected as an integrator with the lowest leakage capacitor you can find. Do not even dream of putting the virtual ground point on the circuit board! Bend the IC pin up in the air and connect the capacitor to it with air as an insulator!

The permanent magnet motor generates a voltage when the shaft is rotated. The faster rotation, the higher voltage. Polarity depends on direction of rotation.. Any motor can be used., even the cheapest piece of junk from some of the kids broken toys will give a nice smooth output from the integrator!

The preferred choice is a quality motor though, since, when it is fitted with a knob, one can spin it and it keep rotating for a while. The Swiss Portescap and the American Micromotor are to my knowledge the best.

Broken, non-working, Japanese home video cameras can sometimes be found on flea-markets. The zoom and distance servos on the lens are usually equipped with fairly nice motors as well. Tape recorders and turn tables can be worth looking into.

I have a Plexiglas disk, 6mm thick and 60mm diameter on my motor, giving it a good spin with a finger keeps it rotating for half a minute and a results in a shift of 3.5V. With the components indicated, the Escap SR 601 B1 motor gives a shift of 15mV per rotation. It is possible to set a voltage within some 10μV. Considering the output range of ± 12 V this leads to the dial length of ± 1.2 million parts. Since the extremes thereof can be reached in less than a minute using a trick described later, it is a very versatile "potentiometer" for setting the frequencies of VCO's, levels of voltage for speed control, light, temperature, pressure, etc.

We live in an age when everything "is going digital" at a mindless pace. "You see, it can be controlled better that

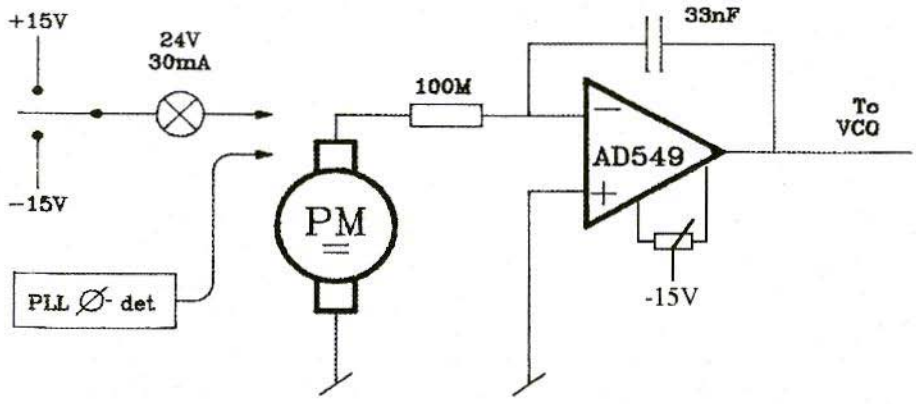


Fig.1: Circuit Diagram of the VCO Sweeper

way!" May it be said that the device described here corresponds to a 21-bit resolution D/A, is continuous, linear and has the right "finger feel" in operation. The resolution can be extended to 24-bits (a few μV settability) simply with a larger capacitor.

2. CONSTRUCTION

The construction barely requires any description as it is very simple. If the voltage goes "the wrong way" switch the wires on the motor. If the voltage vary too fast, increase the resistor from the motor to the integrator or the capacitor value therein.

If the range desired is, say 5 to 25V for a VCO, feed the amplifier with +30/0V instead of +15/-15V. Note that at halfway, or thereabouts, ground must then be created for the other end of the motor. The most convenient method is to put this at the centre, or most used, voltage level in the application. The capacitor will then hold no charge (= no leakage) and only the offset trim of the amplifier becomes an issue.

3. THE QUICK SPIN

To move fast over a longer distance, a voltage can momentarily be applied direct to the motor. The voltage is higher than would be the case if the motor was spinning at the speed it is going, so it hastens the move. The applied voltage will make the motor spin faster than can be achieved by hand. As the voltage is getting closer to the desired, one can just use a finger as a break and slow down the flywheel/knob with a finger for the final adjustment.

± 15V can be a bit much for some small, fine motors. Use a 24V/30-50 mA light bulb in series to limit the current. (A sudden reverse at high speed may blow a 12V lamp.) Use an ON-OFF-ON biased switch with spring return to middle OFF for a control.

Circuit AFC can be arranged by nudging the motor voltage very lightly via a resistor from the detector circuit. More juice here may provide the ultimate happiness, watching the knob rotate back and forth as the frequency is kept on target!

4. LITERATURE

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(10) 2/89 p. 109. Dr. Eng. J. Jirman, DB1NV: A Spectrum Analyser for the Radio Amateur. Part 3.