AN-412
APPLICATION NOTE

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Video-Standard Selection Circuit for the AD722 Using Low Cost Crystals

The AD722 has various options for receiving a subcarrier reference frequency. This signal is input to FIN, Pin 3. The choices are: a logic-level (TTL) clock signal at either 1 × FSC (Subcarrier Frequency = 3.579545 MHz for NTSC; 4.433619 MHz for PAL) or 4 × FSC; or just using a parallel resonant crystal at 1 × FSC, whereby the on-chip oscillator circuit will drive the crystal. All three options are available for either NTSC or PAL operation.

If the lower cost, stand-alone crystal operation is desired, there is only a single pin available to connect a crystal. This does not directly avail itself to selecting between the two different crystals required for either NTSC or PAL operation in systems that offer both video standards.

A low cost crystal selection circuit can be made that, in addition to the two crystals, requires two low cost diodes, two resistors and a logic inverter gate. The circuit selection can be driven by the STND signal that already drives Pin 1 to select between NTSC and PAL operation for the AD722.

A schematic for such a circuit is shown in Figure 1. Each crystal ties directly to FIN (Pin 3) with one terminal and has the other terminal connected via a series diode to ground. Each diode serves as a switch depending on whether it is forward biased or has no bias.

Pin 1 (STND) of the AD722 is used to program the internal operation for either NTSC (HIGH) or PAL (LOW). For NTSC operation in this application the HIGH signal is also used to drive R1 and the input of inverter U1. This creates a LOW signal at the output of U1.

The HIGH (+5 V) signal applied to R1 forward biases CR1 with approximately 450 µA of current. This turns the diode "on" (low impedance with a forward voltage of approximately 0.6 V) and selects Y1 as the crystal to run the oscillator on the AD722. The bias across the diode does not affect the operation of the oscillator.

The LOW (0 V) output of the inverter U1 is applied to R2. This creates a 0 V bias condition across CR2 because its cathode is also at ground potential. This diode is now in

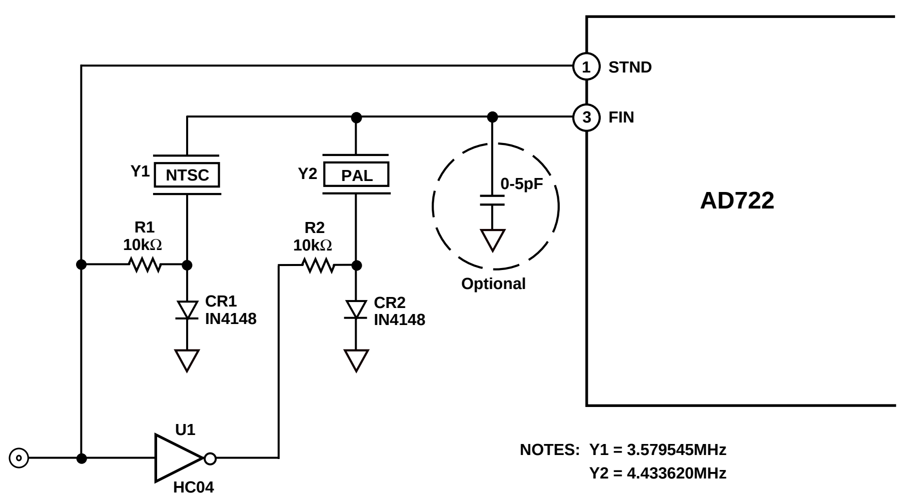

Figure 1. Crystal Selection Circuit

the "off" (high impedance) state, because it takes approximately 600 mV of forward bias to turn a diode "on" to any significant degree. The "off" condition of the diode does, however, look like a capacitor of a few pF.

For PAL operation, the STND signal that drives Pin 1 is set LOW (0 V). This programs the AD722 for PAL operation, deselects the NTSC crystal (Y1), because CR1 has no bias voltage across it and selects the PAL crystal (Y2) by forward biasing CR2.

In order to ensure that the circuits described above operate under the same conditions with either crystal selected, it is important to use a logic signal from a CMOS type logic family whose output swings fully from ground to +5 V when operating on a +5 V supply. Other TTL type logic families don't swing this far and might cause problems as a result of variations in the diode bias voltages between the two different crystal selection modes.

FREQUENCY TUNING

A parallel resonant crystal, which is the type required for the AD722 oscillator, will work at its operating frequency when it has a specified capacitance in parallel with its terminals. For the AD722 evaluation board, it was found that approximately 10 pF was required across either the PAL or NTSC crystal for proper tuning. The parallel capacitance specified for these crystals is 17 pF for the NTSC crystal and 20 pF for the PAL crystal.

The parasitic capacitance of the PC board, packaging and the internal circuitry of the AD722 appear to be contributing 7 pF–10 pF in shunt with the crystal. A direct measurement of this was not made, but the value is inferred from the measured results.

With the crystal selection circuit described above, the unselected crystal and diode provide additional shunt capacitance across the selected crystal. The evaluation board tested actually required no additional capacitance in order to run at the proper frequency for each video standard. However, depending on the layout, some circuits might require a small capacitor from FIN (Pin 3) to ground to operate with the chrominance at the proper frequency.

SUBCARRIER FREQUENCY MEASUREMENT

It has been found to be extremely difficult to measure the oscillation frequency of the AD722 when operating with a crystal. The only place where a CW oscillation is present is at the FIN pin. However, probing with any type of probe (even a low capacitance FET probe) at this node will either kill the oscillation or change the frequency of oscillation, so the unprobed oscillating frequency cannot be discerned. Neither the composite video nor chroma signals have the subcarrier represented in a CW fashion (the LUMA signal does not contain any of the subcarrier). This makes it virtually impossible to accurately measure the subcarrier frequency of these signals with any oscilloscope technique.

Two methods have been found that can be used to measure the subcarrier oscillating frequency accurately. The first method uses a spectrum analyzer like the HP3585A that has an accurate frequency counter built in. By looking at either the COMP or CHROMA output of the AD722 a spectrum can be observed that displays the tone of the subcarrier frequency as the largest lobe.

The CHROMA or COMP output of the AD722 should be input into the spectrum analyzer either by means of a scope probe into the 1 MΩ input port or a 75 Ω cable that can be directly terminated by the 75 Ω input termination selection of the HP3585A. Each of these signals has present at least the color burst signal on almost every line which will be the dominant tone in the frequency band near its nominal frequency. Sidelobes will be observed on either side of the central lobe spaced at 50 Hz (PAL) or 60 Hz (NTSC) intervals due to the vertical scanning rate of the video signals. There will also be sidelobes on either side at about 15.75 kHz intervals, but these will not be observable with the span set to only a few kHz.

The center frequency of the spectrum analyzer should be set to the subcarrier frequency of the standard that is to be observed. The span should be set to 1 kHz–3 kHz and the resolution bandwidth (RBW) set to between 10 Hz to 100 Hz. A combination of wider frequency span and narrower RBW will require a long time for sweeping the entire range. Increasing the RBW will speed up the sweep at the expense of widening the "humps" in the subcarrier tone and the sideband tones.

Once the subcarrier is located, it can be moved to the center of the display and the span can be narrowed to cover only that range that is necessary to see it. The RBW can then be narrowed to produce an acceptably fast sweep with good resolution.

The marker can now be placed at the location of the subcarrier tone and the frequency counter turned on. The next scan across the location of the marker will measure and display the subcarrier frequency to better than 1 Hz resolution.

A second means for measuring the subcarrier frequency of an AD722 operating from a crystal involves equipment even more specialized than a spectrum analyzer. The technique requires a Tektronix VM700A video system measurement instrument.

The VM700A has a special measurement mode that enables it to directly measure the frequency of one subcarrier in a video waveform with respect to an internally stored reference or a simultaneously supplied reference. The instrument gives a reading of the relative frequencies of the reference and test signals in units of 0.1 Hz. This is not a direct reading of the subcarrier frequency in MHz but a relative reading in Hz of the difference in frequency between the two signals.

If the reference video source is supplied by a video generator that has a CW subcarrier output, its CW subcarrier can be measured with a frequency counter to accurately determine its frequency. The AD722 circuit under test can then be measured relative to this reference by using the built in colorburst measuring function of the VM700A, and the offset frequency measured can be added to or subtracted from the measured frequency of the CW subcarrier to determine the operating frequency of the DUT.

It should be noted that the VM700A is a highly specialized video measurement instrument. In order for it to synchronize on a video signal, the synchronization pattern of the signal must adhere very closely to the appropriate video standard. In particular, a video signal that is missing equalization and serration pulses from the vertical blanking interval will cause the "Loss of sync" message to be displayed by the VM700A. Many such signals might make a perfectly acceptable picture on a monitor, but will not be recognized by the VM700A.

CONCLUSIONS

A low cost crystal selection circuit for the AD722 can be made with a few simple parts in addition to the PAL and NTSC crystals. The signal that performs the selection is one that is already needed to program the selection for the AD722. Two means are detailed for measuring the subcarrier frequency out of an AD722 when it is running with a crystal.

E2115–9–2/96

PRINTED IN U.S.A.