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tech tips

Understanding And Using The SC61's Vector And Z Functions

Two secondary functions of the SC61 Waveform Analyzer™ are the Vector (X - Y) function and the Z Axis Input. This Tech Tip explains how to use each of these functions and where you would use each of them.

What Is A Vector Pattern?

To eliminate the mystery of the vector pattern, let's see how it is derived. The vector pattern is composed of two signals: one is applied to the horizontal plates of a scope, and the other to the vertical plates. The CRT display becomes an electronic graph of two instantaneous voltages. The resultant display is called a LISSAJOUS (liss-a-jew) pattern.

A lissajous pattern represents the phase and frequency relationships of two waveforms. For example, if two sinewaves are applied and one is 90 degrees out of phase but at the same frequency, the results will be a circle as shown in figure 1. A vector pattern lets a service technician view such signals as the R-Y and B-Y signals of a color television to determine the phase angles, frequency relationships, tint ranges, color sync, etc.

The SC61's Vector (X-Y) Operation

The SC61 may be used as a vector (sometimes called "X-Y") scope by pressing the VECTOR display button. The signal applied to channel A causes vertical deflection, and the signal applied to channel B causes horizontal deflection. The resulting lissajous pattern compares the phase and frequency relationships of the two signals. The special design of the SC61 provides accurate phase comparisons to 4 MHz with less than 3 degrees of phase shift between channels.

The vertical gain is controlled by the channel A VOLTS/DIVISION switch. The channel A VERTICAL POSITION control adjusts the pattern's vertical position. The channel B VOLTS/DIVISION switch controls the amount of horizontal gain. The horizontal position is adjusted by the HORIZ POSITION control (the channel B VERTICAL POSITION control has no effect on the trace when the vector function is selected).

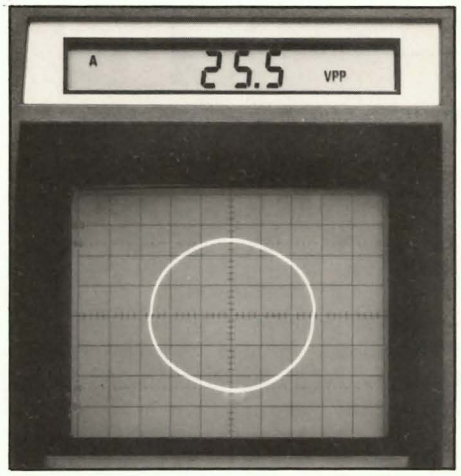


Fig. 1: Figure 1 shows a circular LISSAJOUS pattern on the SC61's CRT resulting from applying sinewaves of the same frequency, but 90 degrees out phase, to the channel A and channel B inputs.

Vector Graticule

A special graticule overlay (63K28) is included with the SC61 to use when analyzing color TV receiver circuits with the vector function. The graticule is made of a special plastic that will cling to the CRT face without the need of adhesive. Simply place the center circle of the special graticule over the center of the CRT so that the lettering is readable with the R-Y positioned at the top. Rub your hand over the overlay to make it stick. Save the backing paper to store the graticule overlay when not in use.

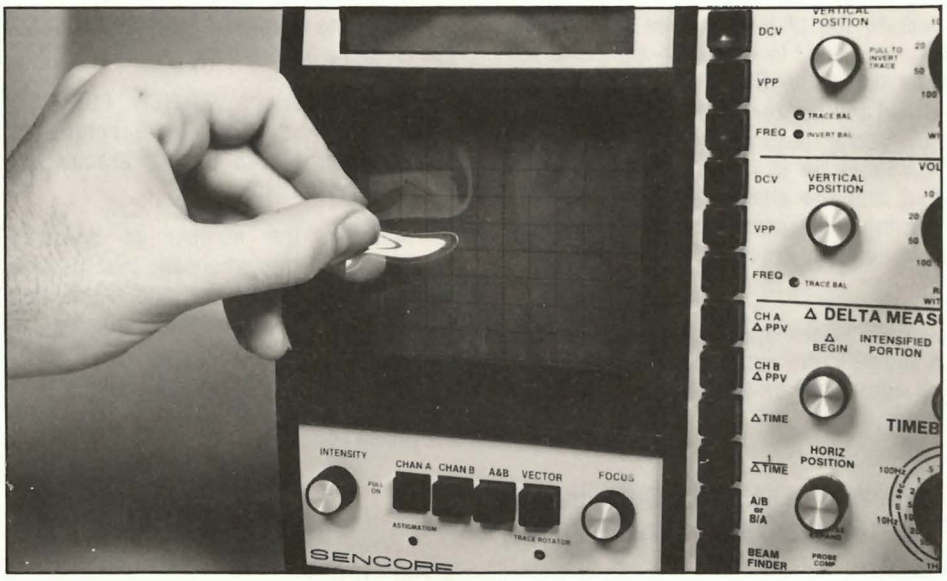


Fig. 2: A special graticule is included for TV vector service. The graticule is placed over the front of the CRT and rubbed gently to make it stick in place.

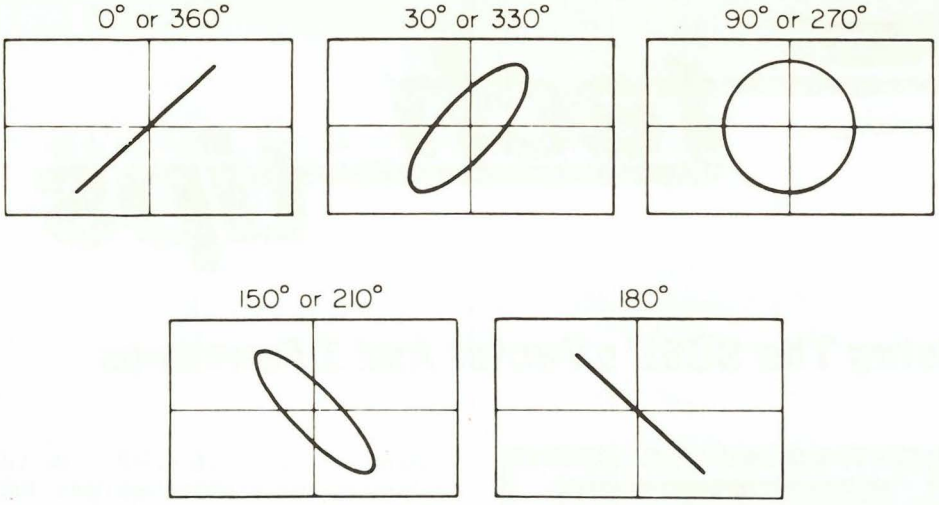


Fig. 3: Phase relations are represented in the vector mode with different shapes and orientations.

When making vector tests in a TV receiver, the channel A probe should be connected to the R-Y output and the channel B probe to the B-Y output. Both vertical attenuators should be set for the same gain and turn the vernier controls clockwise to the CAL position for proper vector shaping.

Using The Vector Mode To Measure Phase Differences

Many circuits use timing pulses referenced to another signal for proper operation. If the signals are not properly phased and timed, the circuit may not work as designed.

A dual trace oscilloscope is the best way to measure the phase between two signals since you need to view both signals at the same time. The SC61's closely matched vertical and horizontal deflection amplifiers allow Vector measurements for their phase differences up to 4 MHz. The channel A input and the channel B input form the resulting Lissajous pattern from which measurements are made.

Figure 3 shows typical phase relationships as shown in the vector mode. The following procedure may be used to calculate phase angles.

To Measure The Phase Difference Of Two Signals Using The VECTOR Mode:

1. Apply the two signals to the two SC61 inputs.

2. Depress the VECTOR display pushbutton.

3. Set the channel B INPUT COUPLING switch to the ''ground'' position and the channel A INPUT COUPLING switch to the AC position.

4. Adjust the channel A VOLTS/DIVISION and VERNIER control for 4 divisions of display along the vertical axis.

5. Set the channel A INPUT COUPLING switch to the ''ground'' and the channel B INPUT COUPLING switch to AC.

6. Adjust the channel B VOLTS/DIVISION switch and VERNIER control for exactly 4 divisions of display along the horizontal axis.

7. Return the channel A INPUT COUPLING switch to the AC position.

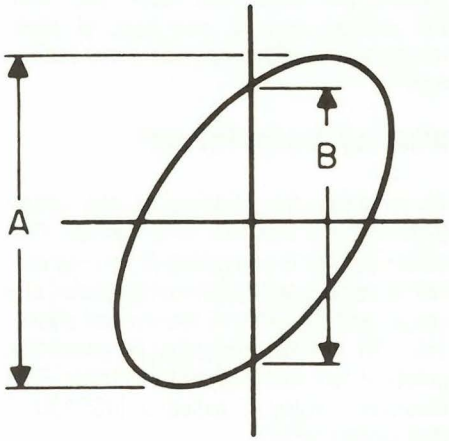
8. Use the channel A VERTICAL POSITION control and the HORIZ POS control to center the displayed pattern around the center of the graticule.

9. Measure the number of divisions between the points where the oval touches the vertical graticule line and divide this figure by ''4'' (the total number of divisions of the outside oval) as shown. The result is the sine of the phase angle. Use a calculator or trig table to determine the phase angle.

Z Axis Input

A signal applied to the Z AXIS INPUT connector on the rear panel of the SC61 intensifies or blanks the trace. A positive signal of 5 volts will cause the trace to blank and a 5 volt negative signal will intensify the trace at normal viewing levels of the INTENSITY control. The direct-coupled Z axis input is usable from DC to 5 MHz with a maximum input voltage of 35 volts (DC + Peak AC).

Intensity modulation of the oscilloscope trace can be used in applications such as measuring rise time, frequency, and pulse width. An audio oscillator or a squarewave generator are two examples of signals that can be used as Z-Axis inputs.



$$\text{Sine } \emptyset = \frac{B}{A}$$

Where Ø = Phase Angle

If the Lissajous pattern falls in quadrants 1 and 3, add or subtract the calculated angle from 0°.

If the Lissajous pattern falls in quadrants 2 and 4, add or subtract the calculated angle from180°.

Fig. 4: Calculation of phase angle using a Lissajous pattern (VECTOR).

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