Electronics World

Oscilloscope LISSAJOUS Patterns

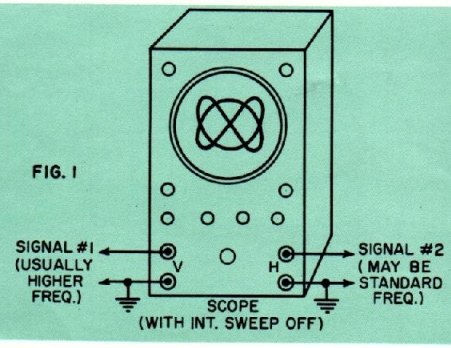
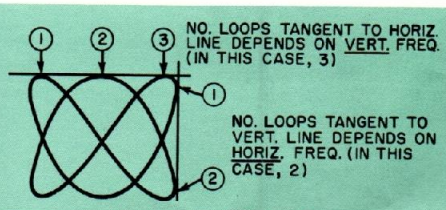


FIG. 1



FREQUENCY RATIO = VERT. FREQ. : HORIZ. FREQ. :: 3:2
(FOR EXAMPLE, IF HORIZ. FREQ. IS 60CPS
THEN VERT. FREQ. IS 90CPS)

FIG. 2

One of the most useful techniques of measuring frequency and phase is by means of Lissajous figures on a cathode-ray oscilloscope. To obtain these patterns, the scope's internal saw-tooth sweep is turned off and a known standard signal is applied directly to the horizontal input. The unknown signal is then applied to the vertical input (Fig. 1). The scope gain controls are adjusted for equal horizontal and vertical deflection. When either of the signals is adjusted so that there is an integral relation between the two frequencies, a stationary pattern will be seen on the scope screen. By examining the pattern it is possible to determine the ratio between the two frequencies as well as their phase relation.

For example, assume that the pattern shown in Fig. 2 is produced. To "read" this pattern, visualize a square surrounding the figure or position the pattern so that the ruled lines on the scope's graticule form a square around the figure. Then count the number of loops in the pattern that touch one of the horizontal sides of the square. This number depends on the signal applied to the scope's vertical channel. Next, count the number of loops that touch one of the vertical sides of the square. This number depends on the signal applied to the scope's horizontal channel. The ratio between the two numbers is the frequency ratio. In the example shown, this frequency ratio is 3:2, so that if the horizontal frequency is exactly 60 cps, then the vertical frequency is exactly 90 cps.

All the Lissajous patterns shown here were produced with two sine-wave signal generators. The same principle of pattern formation applies when other waveshapes are used, but the points of tangency may be a little more difficult to count. Beneath each pattern is shown the frequency ratio (the first number applies to the vertical signal) and the phase relation in degrees in the simpler patterns. If the frequencies are interchanged, for example, 2:3 rather than 3:2, then the pattern is simply rotated by 90 degrees. In some cases, scope gain controls have been re-adjusted in order to make it somewhat simpler to count the number of loops in the pattern.

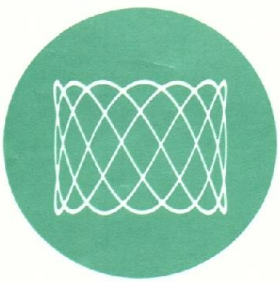

1:1 0°, 360

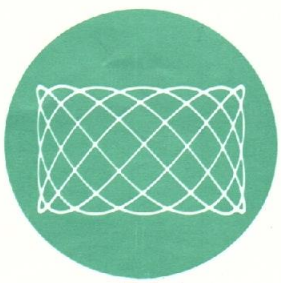

2:1 0°, 18

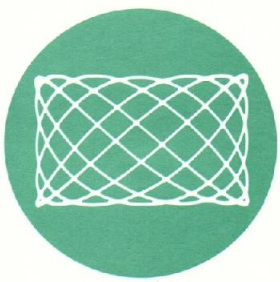

3:1 0

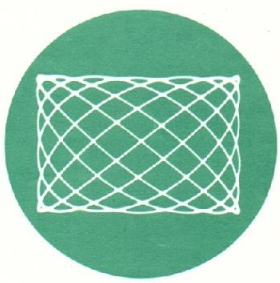

4:1


5:4

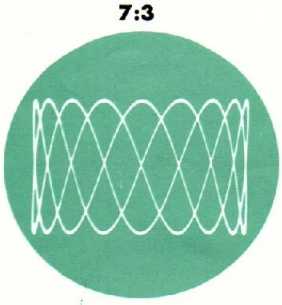

7:3

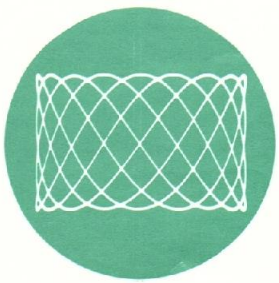

7:4


7:5


7:6


8:


9:2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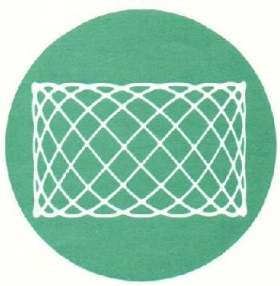
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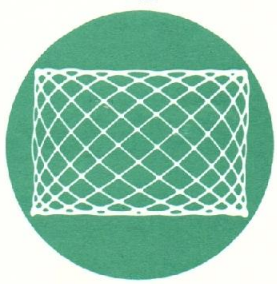
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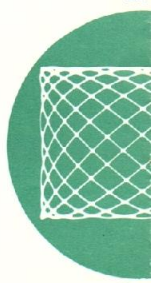
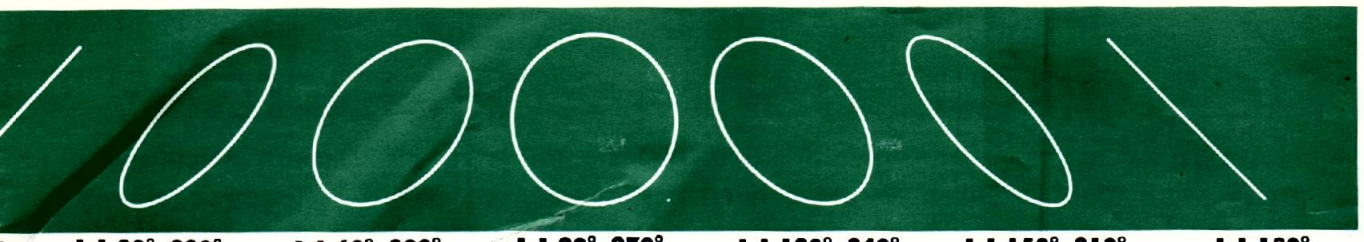
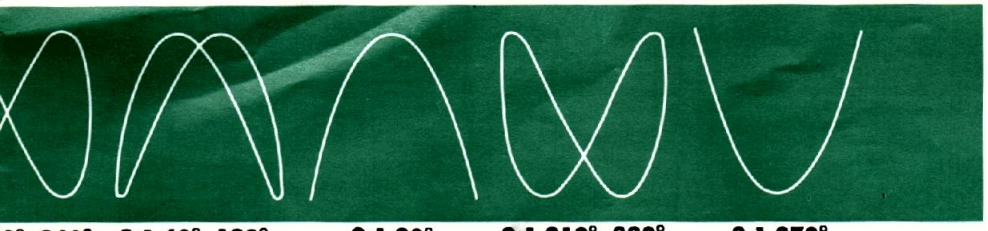

9:8

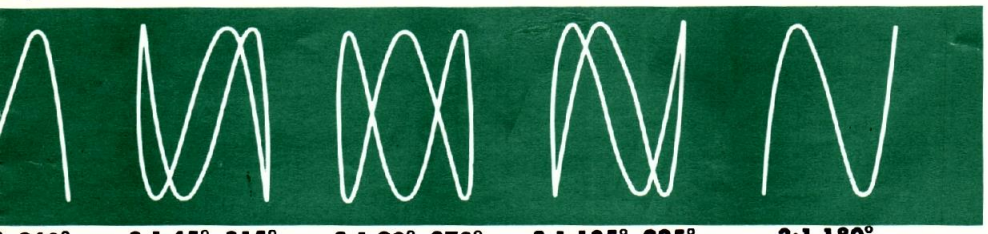
Waveforms from "Encyclopedia on Cathode-Ray Oscilloscopes and Their Uses" by Rider & Uslan (Published by John F. Rider Publisher, Inc.)



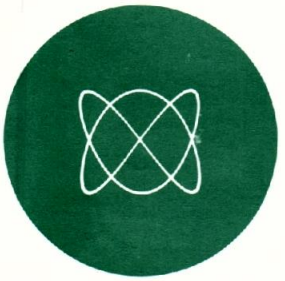
° 1:1 30°, 330° 1:1 60°, 300° 1:1 90°, 270° 1:1 120°, 240° 1:1 150°, 210° 1:1 180°



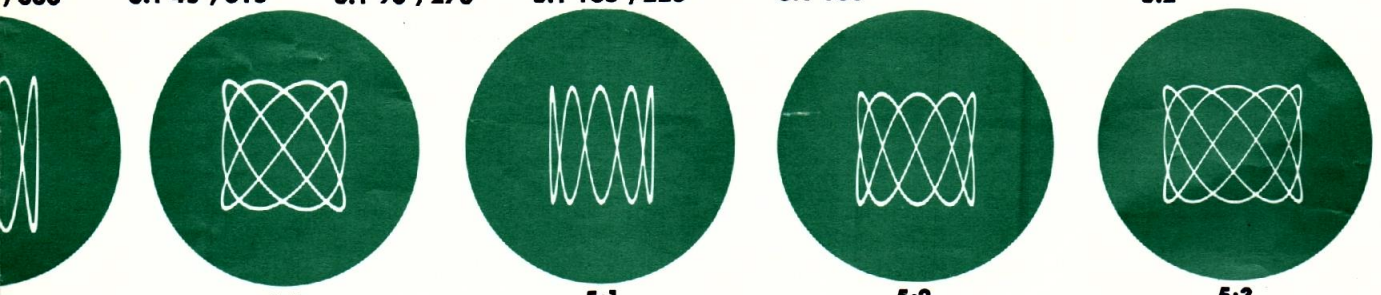
0°, 360° 2:1 60°, 120° 2:1 90° 2:1 210°, 330° 2:1 270°



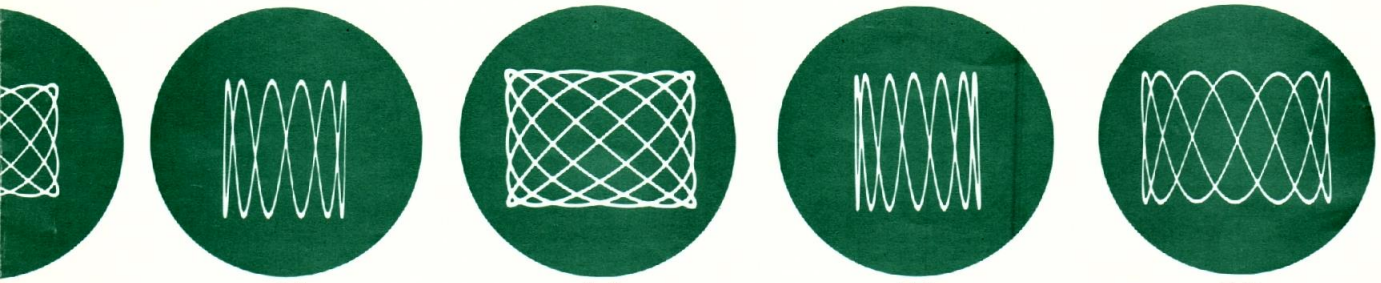
°, 360° 3:1 45°, 315° 3:1 90°, 270° 3:1 135°, 225° 3:1 180°



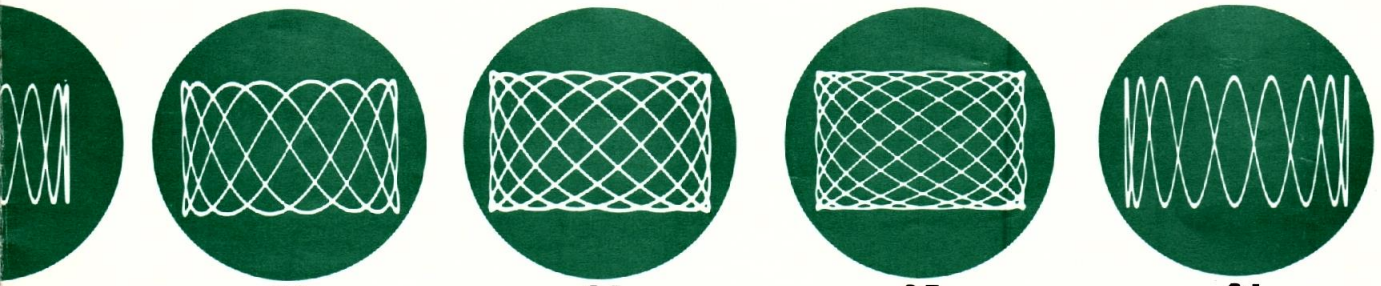
3:2



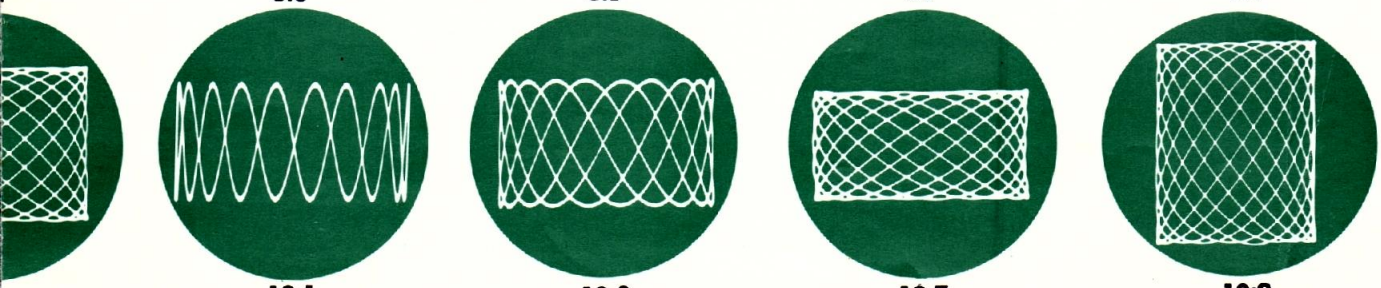
4:3 5:1 5:2 5:3



6:1 6:5 7:1 7:2



8:3 8:5 8:7 9:1



10:1 10:3 10:7 10:9