



Rotating Heart

By: Justin Steichen,
University of Colorado @ Colorado Springs
And by Andy Frost and Marsh Faber,
Agilent Technologies

Purpose

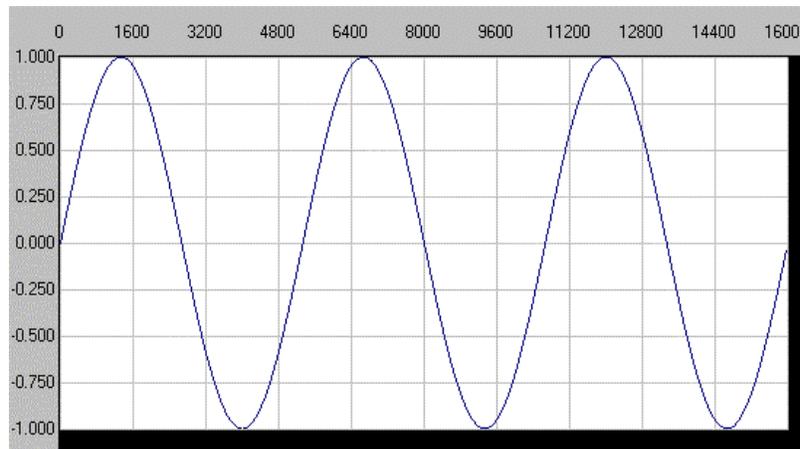
To demonstrate the versatility of Lissajous patterns (and to show that lab managers do have a heart).

Equipment:

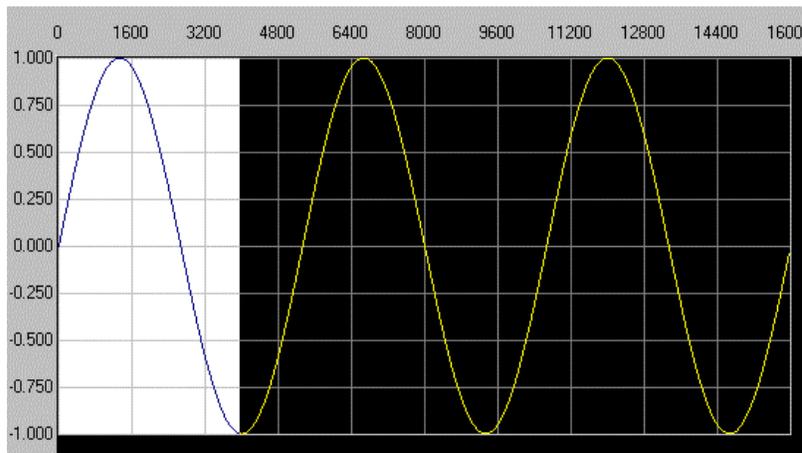
- Agilent BenchLink/Arb software or Agilent BenchLink/Suite software
- Agilent 33120A Function/Arb Generator
(Replacement model: Agilent 33220A Function / Arbitrary Waveform Generator)
- Agilent 54600B Oscilloscope
(Replacement model: Agilent DSO5012A 5000 Series Oscilloscope)
- Agilent 54654A User Training Board or low-frequency sine wave source
(Replacement model: N2918A Oscilloscope Evaluation Kit for 6000/7000 Series Oscilloscopes)
- PC with GPIB or RS-232 Interface Card
- I/O Module for Agilent 54600B (Any of Agilent 54650A/52A/55A/56A/57A or /59B) [Note: Only necessary if you want to “dump” the oscilloscope screen to the PC. The experiment can be run without it.]

Procedure:

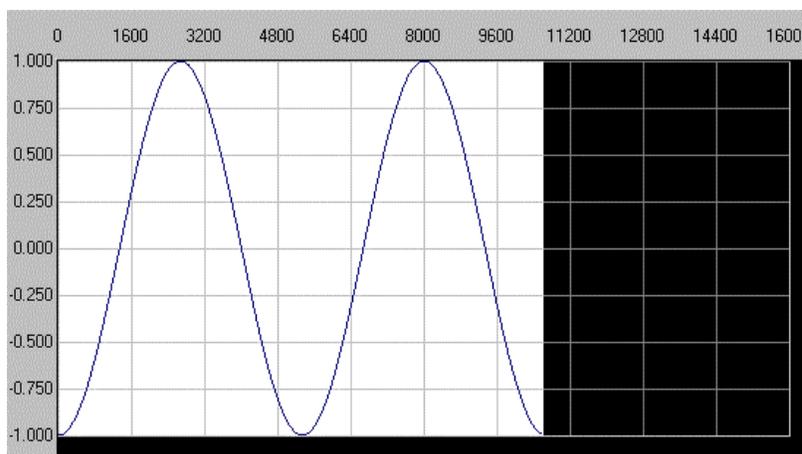
Start BenchLink/Arb. Go to **FILE, NEW** and set up a triple sine wave:



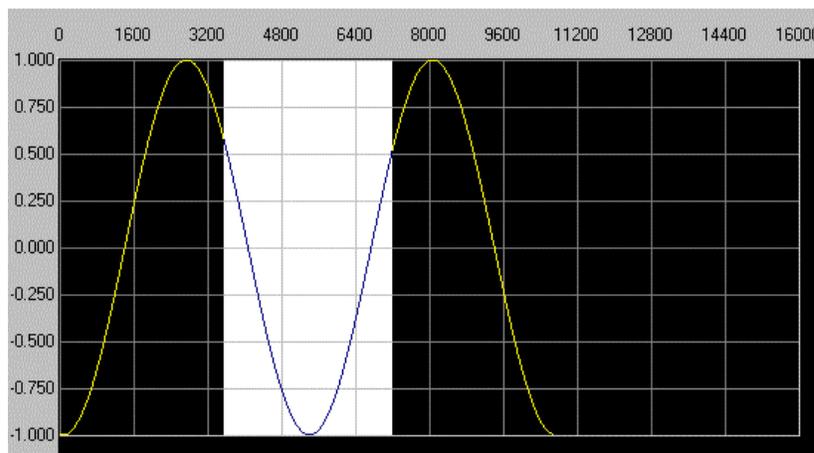
- Do this by clicking the **Sine Wave** ICON 3 times to get 3 consecutive sine waves. Use **EXPAND TO FIT** under the **MATH** menu to fill the screen for easier editing.
- 2) Drag the mouse to mark the waveform as shown below.



- 3) Now use the **DELETE** key to erase the highlighted portion of the waveform. Continue this procedure to get the waveform shown below.

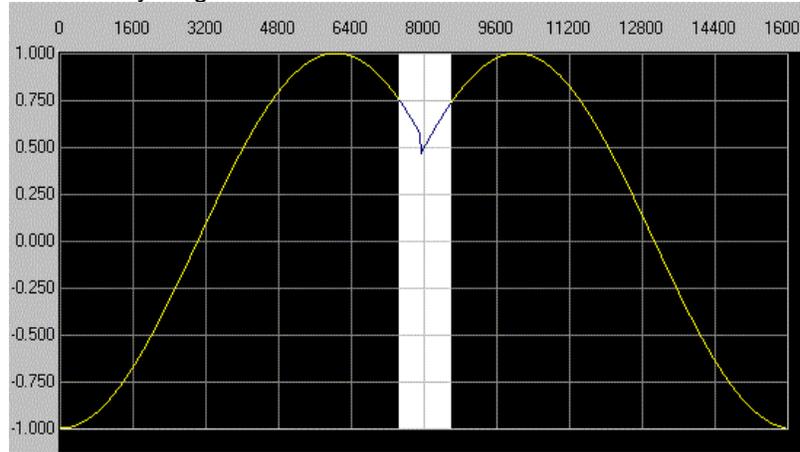


- 4) Next, let's eliminate the center part of the waveform:

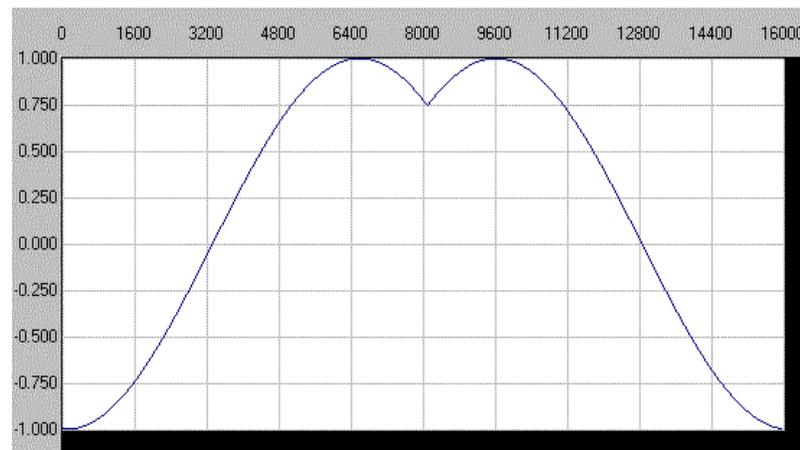




- 5) It's hard to be precise with the waveform compressed, so once again use the **EXPAND TO FIT** command to stretch the waveform so we can edit it more exactly. The idea is to erase everything in the center of the waveform that falls below 0.750:



- 6) When you hit **DELETE** again and expand it to fit, you should see something like this:



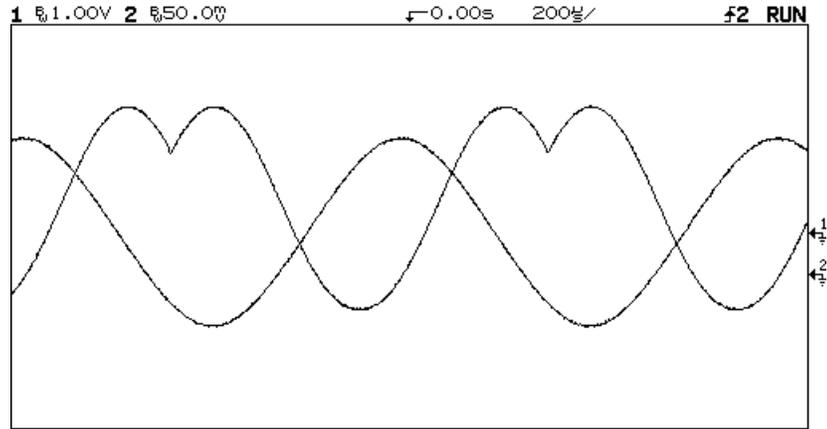
- 7) Unless the Agilent 33120A is already configured for I/O, go to the **OPTIONS/ Configure Interface** command. Hit **SEARCH** to find the Agilent 33120A. Then click **OK**.
- 8) Send the above waveform to the Agilent 33120A using the **I/O SEND WAVEFORM** command. Within a few seconds, the Agilent 33120A should indicate **Arb** and should be producing the waveform above.

The above waveform is one of TWO Waveforms that will drive the X and Y axes.

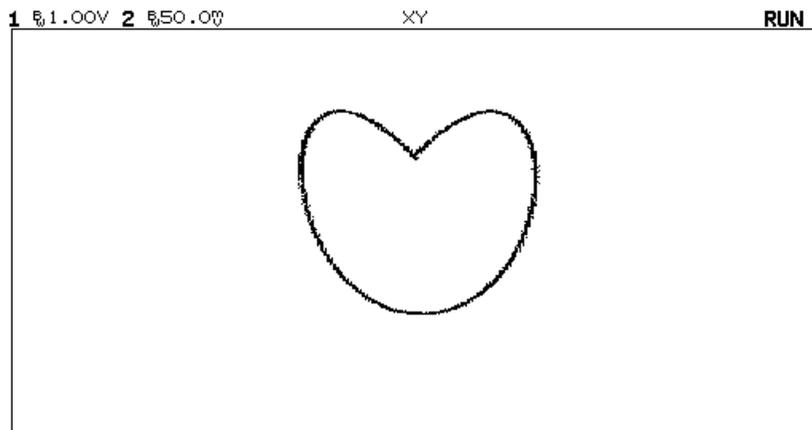
- 9) Connect the Arbitrary Waveform to the Y (Channel 2) input of the Agilent 54600B.
- 10) Set the Agilent 33120A to 1 kHz, Amplitude 100 mV p-p.
- 11) Connect the X (Ch 1) input of the oscilloscope to TP13 (1 kHz Sine Wave) of the Agilent 54654A User Training Board. Don't forget to connect the ground clip to the ground test point of the board, and turn on the push switch next to the battery.



You should now have two distinct waveforms going into the 'scope. They should look something like this:



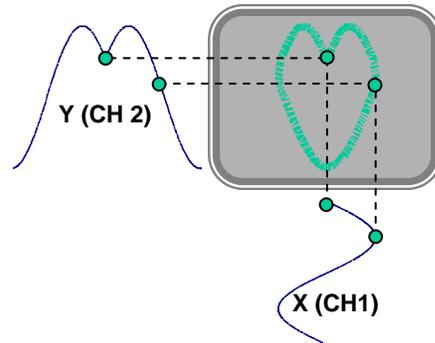
- 12) Play with these waveforms until they are about the same frequency and amplitude.
- 13) Touch the **MAIN/DELAYED** button on the Agilent 54600B oscilloscope to get the Horizontal Mode softkeys on the screen.
- 14) Touch softkey XY. Now whatever you put into CH1 will effectively deflect the screen in the X direction, while the signal on CH2 deflects the screen in the Y direction.
- 15) Adjust the frequency of the Agilent 33120A until you see a single rotating "heart". You should be able to adjust the phase between the two signals to see the figure below:



- 16) Notice that by changing the FREQUENCY of the arbitrary waveform, you can get the heart to rotate.

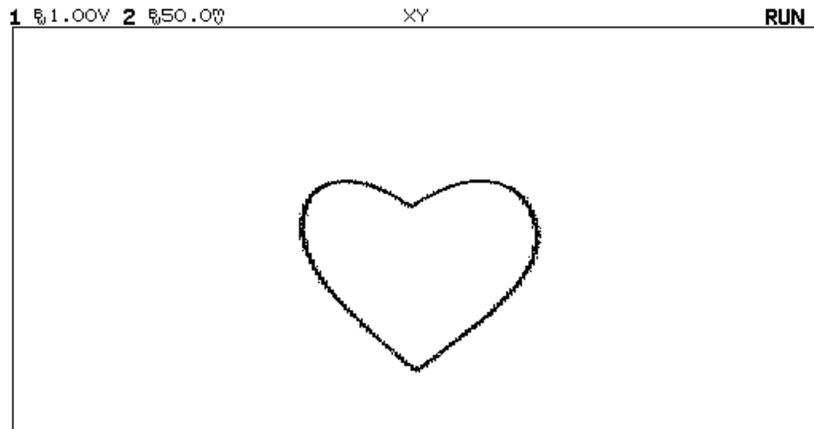


17) What's happening? Think about it this way:



The CH 1 input signal (the sine wave) is deflecting the scope in the X direction, while at the same time the Ch 2 input signal (the arbitrary waveform) is driving the screen in the Y direction.

18) Instead of making the heart rounded on the bottom, think about what you would do to the arbitrary waveform to make the heart look like this:



Try it!

19) Now see if you can make the heart rotation rate change by blowing on the circuit board (AGILENT 54654A Training Module). Can you explain what happens? Is this effect due to heat or humidity?

These experiments have been submitted by third parties and Agilent has not tested any of the experiments. You will undertake any of the experiments solely at your own risk. Agilent is providing these experiments solely as an informational facility and without review.

AGILENT MAKES NO WARRANTY OF ANY KIND WITH REGARD TO ANY EXPERIMENT. AGILENT SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, GENERAL, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE USE OF ANY OF THE EXPERIMENTS.