

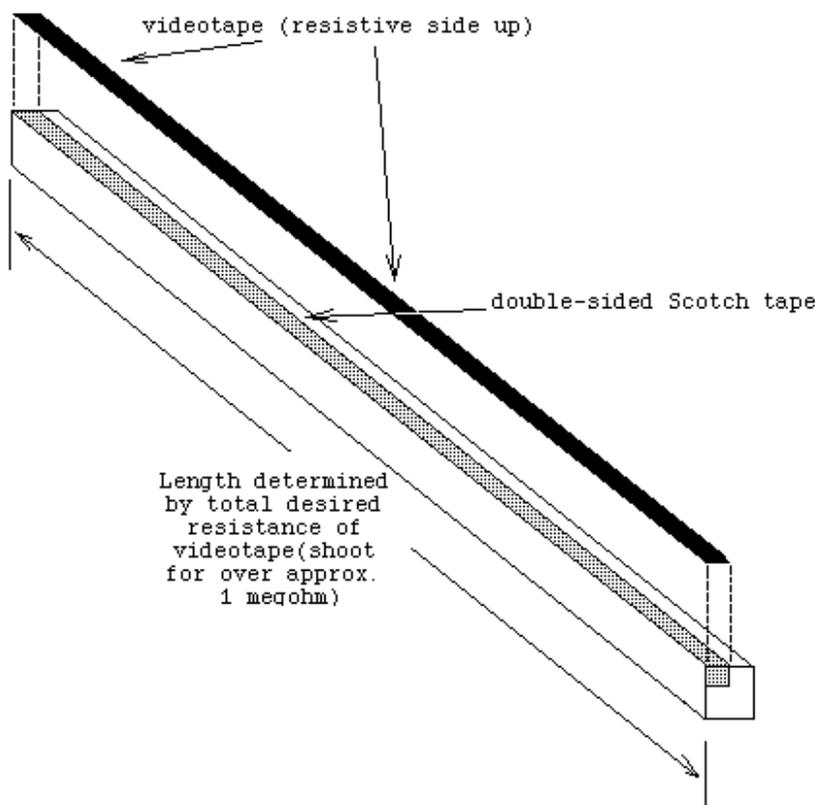
The Synthstick

Strangely enough, there are three sources of inspiration for this project:

- 1) That Tesla coil of the musical world, the odd and mysterious Theremin
- 2) The little known [Paul Tanner Electro-Theremin \(a.k.a. Tannerin\)](#).
- 3) And the humbly lo-tech, self-contained Stylophone.

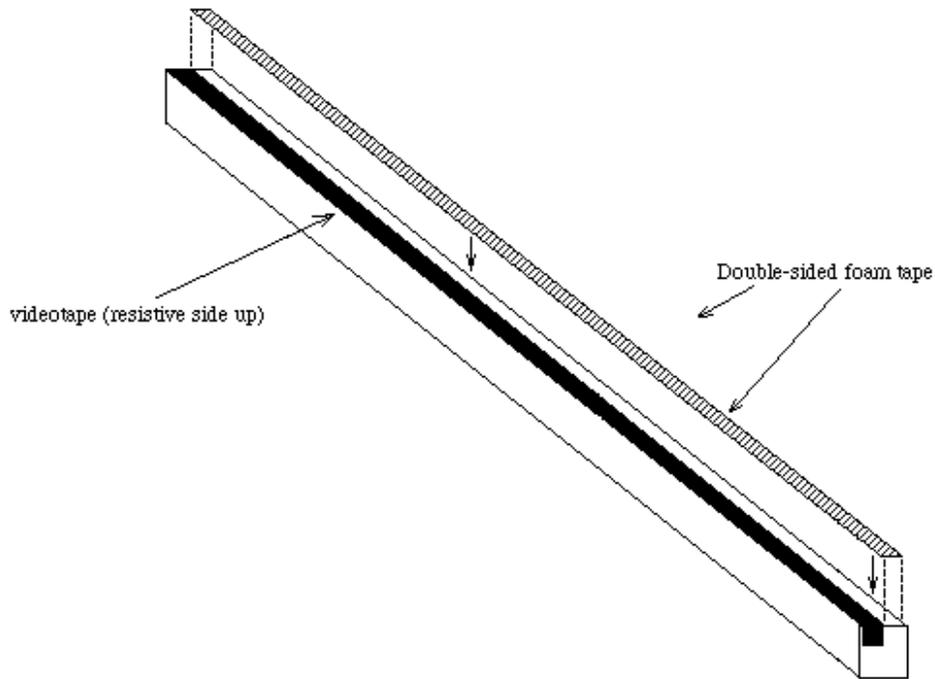
Now, the web is crawling with references, stories, and schematics pertaining to theremins and theremin inspired instruments. Something about the theremin sound, playing style and reputation seems to capture the imagination. Though not a theremin (or Tannerin) in any sense of the word, the Synthstick was designed with that unorthodox (and possibly unplayable) spirit in mind.

Technically, I guess you could call the Synthstick a ribbon controlled oscillator (sound generator). In this case, the "ribbon" consists of a strip of VHS videotape and a conductive strip of plastic film floating above it, acting together as a variable resistor. When the conductive strip of plastic film is pressed, it makes contact with the strip of VHS videotape, forming a resistor whose value is determined by where the plastic film and videotape make contact. In the interest of keeping it simple, there is only pitch control via the ribbon and a master output volume control.

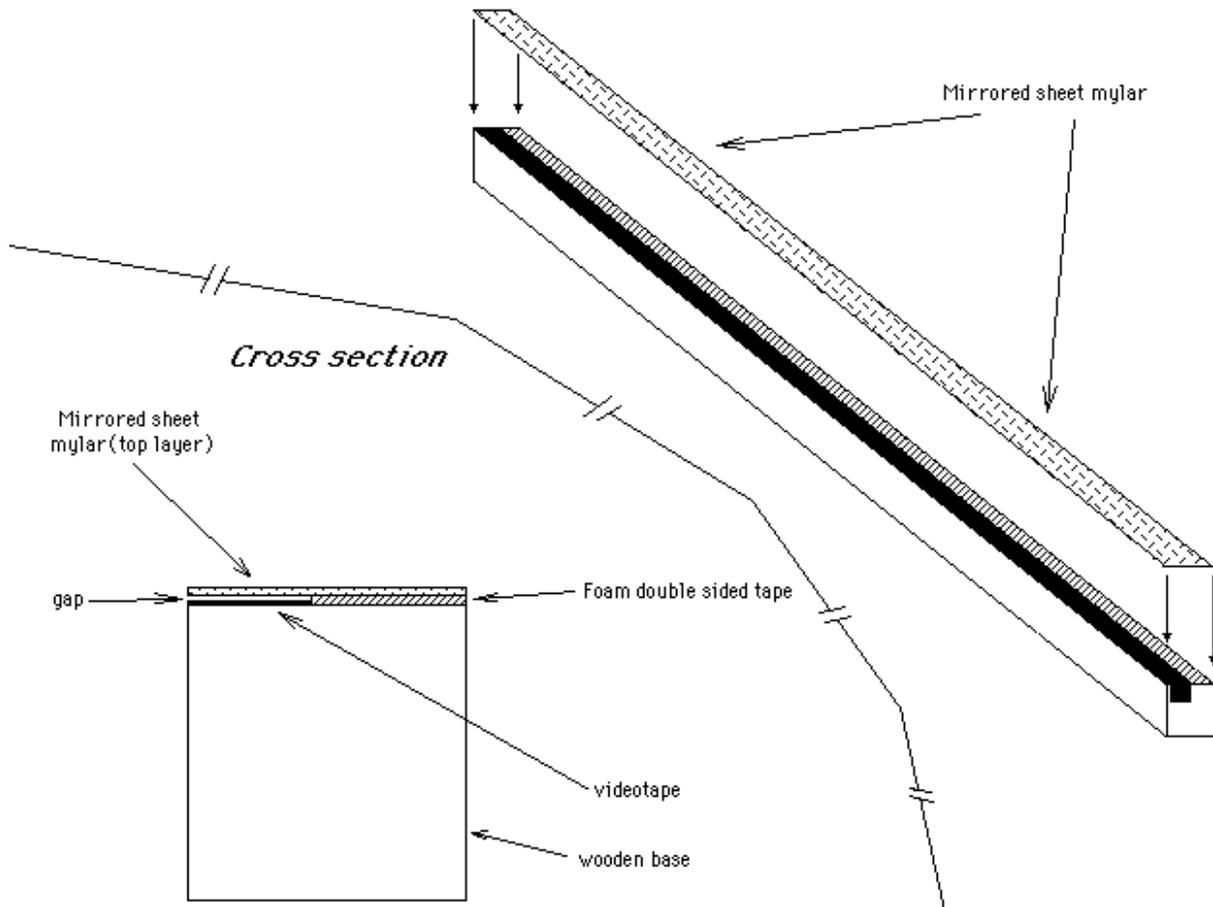


The "ribbon" itself is ridiculously simple. I used a scrap wooden stick, a length of VHS videotape, double stick tape (both the thin kind that resembles regular "Scotch" tape, and the thicker foam stuff), and some *mirrored* sheet mylar. That last part, the mirrored sheet mylar (similar to what's used for those shiny mirror-like drum heads or reflective windowshades), may be the most difficult part to find. I found some in a specialty plastics store, which sells it by the yard. The mirror surface is conductive. If you're hunting down

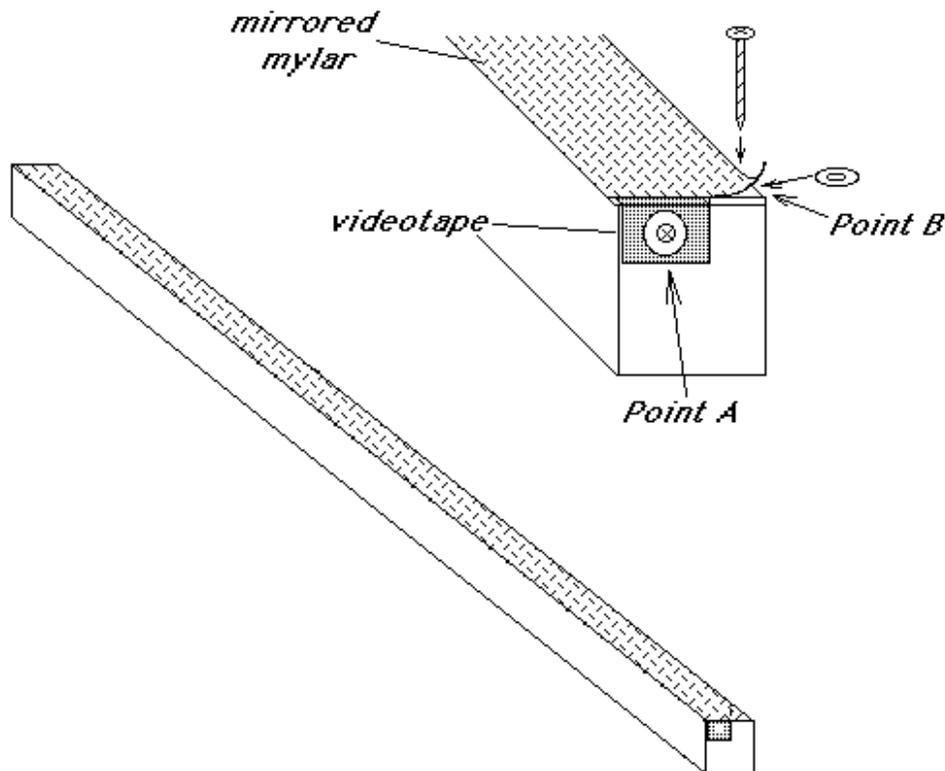
this stuff, it may be a good idea to take along a multimeter to make sure the surface is, in fact, conductive.



The strip of videotape is stuck to the stick with the resistive side up, using the thin double sided "Scotch" tape. Then one strip of the thicker foam double sided tape is affixed along side of the videotape, parallel the whole length, but not covering the videotape. The foam double sided tape is used to hold a strip of mirrored sheet mylar suspended about 1/16" above the videotape, but not making contact with it at all (Your fingers pressing the mylar will make the contact at various points along the videotape resistor).



The trickiest part is making two good electrical contacts...one with the conductive videotape and one with the mirrored mylar sheet. I used small brass screws and washers, functioning as terminals. Careful to keep the videotape terminal(Point A) isolated from the mylar terminal(Point B).

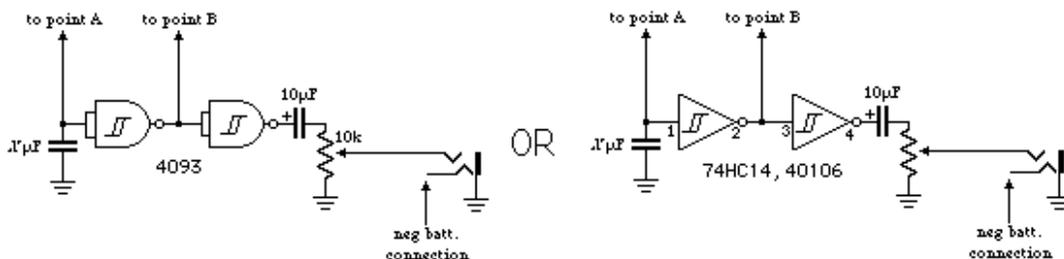


Here's how it works. The IC chip used here is either a quad or hex Schmitt trigger. That's engineer talk for "really simple oscillator". The CD4093, CD40106, or 74HC14 will work equally well (use whichever is easiest to find). These CMOS chips have four or six identical sections, making it possible to make multiple independent oscillators. In this circuit, we'll only use two of those sections, one as an oscillator, and one as a buffer, to isolate the oscillator from the output. All other inputs should be connected to ground, as shown in the schematic.

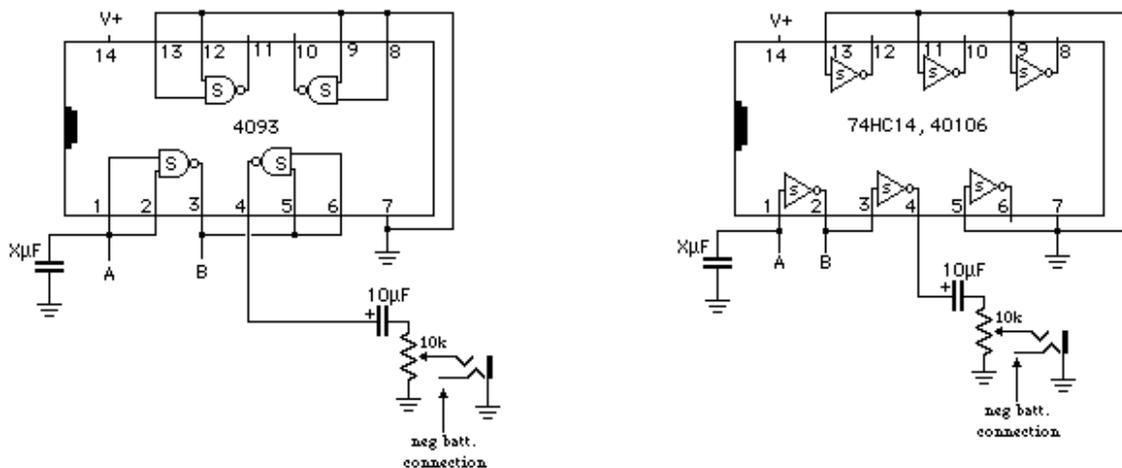
The oscillator only needs two parts...a capacitor and a resistor. The capacitor and a resistor interact to determine the frequency, or notes you can play. But instead of buying a variable resistor to change pitch, we'll improvise one. The key is videotape. The backside of VHS videotape is a conductor, but not a perfect one. That is, resistance of this conductor increases as the length of videotape increases. I used a 28" length of videotape, measuring a bit more than 1 Megaohm from end to end. So, videotape acts as a variable resistor by making electrical contact at various lengths of the tape. Where you press the mylar sheet against the videotape determines the value of the resistor, and thus, frequency of the oscillator.

Not all videotape is created equal! I've found some videos in my collection that won't work as resistive material. Be sure to use a multimeter to make sure it'll work before you start cutting!

Synthstick oscillator



Capacitor X determined by personal preference, smaller values are higher range, larger values are lower range. In general, .001µF to .05µF work OK.



Construction tips:

If you've never made an electronic gizmo before, go to [Common Questions](#), from Aron's Nelson's Stompbox Page, [GEO - the Guitar Effects Oriented Web Page](#), and check out the links [Electronics - enough to make you dangerous!](#) and [FX skills and How-To's](#) to get some good info for beginners (in addition to lots of other neat information).

If you use the 74HC14, make absolutely sure your power supply doesn't exceed 6 volts, or the chip will be fried. But it will work as low as 2 volts. Two AA or AAA batteries are perfect with this chip. The 4093 and 40106 will work well with anywhere from 3 to 15 volts. The typical 9V battery is perfect with these chips.

Use an IC socket for the chip. They're cheap and can save a lot of hassle if you accidentally zap the chip, which brings us to...

...CMOS chips are sensitive to static electricity. They usually come in a static resistant tube or foam. Be especially careful handling these chips. The static charge you get from walking across the carpet on a dry day is enough to zap 'em.

Make sure that electrolytic capacitors are oriented correctly, negative going to ground.

It may be a good idea to cover Point A and Point B with electrical tape so that they don't accidentally short out together.

Parts list for the Synthstick

One CD4093, CD40106, or 74HC14 CMOS IC.
One 10µF electrolytic capacitor, rated 15 Volts or more.
One 10k Ohm potentiometer for the volume control. Audio taper is nice, but not necessary.
One capacitor for Capacitor X. Actually, I'd be a good idea to get several capacitors in the ranges from .001µF to .1µF. Try different ones out that'll give your Synthstick a range you like.
A stereo 1/4" phone jack. Wiring it like the diagram shows eliminates the need for a power switch (unplugging the 1/4" guitar cable turns off the power).
A battery holder, knob for the volume potentiometer and a box to hold it all together.
Some mirrored and conductive sheet mylar.
An old VHS videotape.
Something flat and non-conductive to hold the mylar and videotape strip, such as a flat sided stick.

For the sake of simplicity, this instrument has been kept to a bare minimum. All the circuitry, including the battery, circuitboard, and output jack, fit in an empty Altoids Mints tin. As is, the Synthstick is a stand alone (well, minus amplifier) electronic musical instrument. It outputs a pretty solid square wave that can sound as good as any analog synth. No filtering is provided. Electronic sound generation can get ridiculously complex without even trying. If your electronic chops are up to it, it can be enhanced to the point of rivaling just about any commercially available instrument. But the most useful Synthstick enhancement may likely be a modification to output a CONTROL VOLTAGE rather than audio. This really comes in handy if you've got other gear with CV inputs, and can be utilized to control any number of things besides audio frequency. Remember, it's basically a oddly configured home-made potentiometer.

[Click here to hear what the Synthstick sounds like.](#)

[Click here to hear what the Synthstick sounds like with a Boss Dynamic Filter stompbox following it.](#)

[Simple, low cost or no cost modifications](#)

Coming soon: actual photos

RELATED LINKS

Thanks to André C. STORDEUR and his web page, [Ribbon Controller](#)

The Electronic Peasant with his [Percussion Ribbon Controller](#)

[15 Minutes to a Ribbon Controller](#) SVHS Videotape resistive material! Good alternative to the scarce resistive generic videotape.

[PAIA's How 2 Build a Ribbon Controller](#) The late, brilliant John Simonton shares his brilliantly simple idea for conductor-a guitar string! Why didn't I think of this!?! HIGHLY RECOMMENDED!

Back to [FolkUrban Music](#)

Any questions? tpe123@yahoo.com

Synthstick Tips and Mods

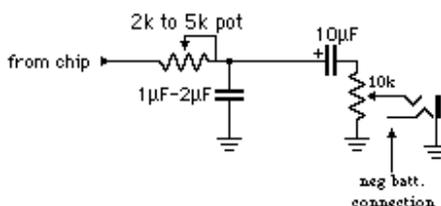
Perhaps most useful

After it's finished and plays in a range you like, I found it's nice to pull out a tuner and mark out where the notes are. Being familiar with the guitar, I made marks resembling a fretboard on the side of the stick next to the mylar, the fretmark placement dictated by the tuner. Doing this makes it a bit easier to see where the notes are. Interestingly, due to the nature of the oscillator design, the fretmarks will get progressively closer as the notes go higher, very much like a real fretboard.

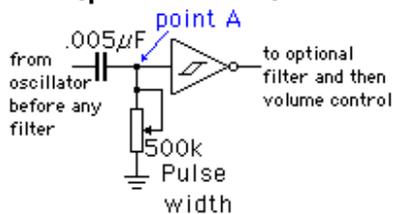
Taming the square

The output of this instrument is a raw square wave. If you want it less harsh, you can put a simple fixed lowpass filter on the output, just before the 10uF capacitor. The filter consists of two parts...one capacitor and one resistor. The resistor can be a value between 2k Ohm and 5k Ohms. The capacitor should be 1 or 2 uF. Or instead of a fixed resistor, use a potentiometer between 2k and 5k Ohms. Using the pot allows the filtering to be variable.

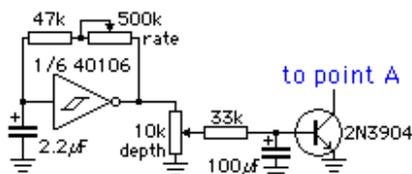
Low Pass Filter



PW (pulse width) Control



EZ LFO for PWM



[Back to The Synthstick](#)