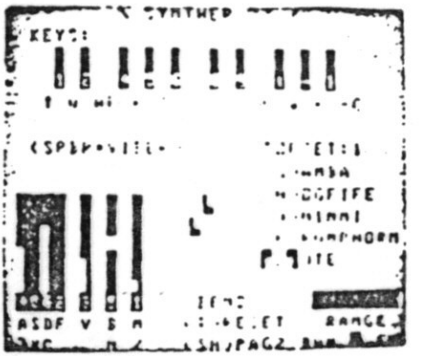
Synther 77™ is a digital synthesizer for your TRS-80 Color Computer that is completely contained in the software. No expensive, additional hardware is needed. The user has control of almost every aspect of the music that is created. The envelope and waveform may be preset in as many as 50 different steps. Special features such as the bender and the boinger can be used to add special effects.

The sound produced by Synther 77™ is available from the speaker of the TV or monitor and from the AUX plug that connects to the tape recorder. You can record your creations by disconnecting the ON/OFF cable (the smallest plug into the recorder), inserting a blank tape and pressing RECORD.

As the above introduction (and alot of this manual) implies, some aspects of Synther 77™ can be rather complicated. However, using Synther 77™ can be very easy and a lot of fun. The tools are there to create virtually any sound possible, and plenty of experimentation will yield rewarding results. The casual user will enjoy just playing Synther 77™, while the serious 'student' of music can perfect not only the pitch, but the various other aspects of a musical instrument. We recommend that you take the 'Tour' which this manual provides. Then enter a simple melody; put Synther 77™ in autoplay and experiment with the 50 different voices along with all the other variable modifiers. When you find a combination you like, save it for future playback.

GETTING STARTED

Synther 77™ is written entirely in machine language. It is loaded from tape by typing CLOADM and pressing the ENTER key. To load from disk, type LOADM"SYNTHER and press the ENTER key. Once the program has loaded, it will automatically EXECute and you will see a flashy title screen. When you get bored of the opening screen, press any key and you will see the play page. This should look something like:



The PLAY page

You will notice that the first and second row of the keyboard are used as the piano keyboard. The QWERTY row corresponds to the white keys and the number keys to the black ones. You should also notice that some of the number keys are NOT used. The ones that work are 1, 2, 4, 5, 6, 8, 9, :, - and the BREAK key. The CLEAR key is used as high C. You may want to put a little piece of tape on the keys that work. If you press the SHIFT key, you will see Page Two. This page is where you will make most of the changes to your musical notes. There is a picture of Page Two in a later section of this manual.

A GUIDED TOUR

The following section is a guided tour of the functions of Synther 77™. You should have Synther 77™ running before you continue. At the end of the tour, you should be familiar with each area of the program.

Once the program is running, press the 'U' key several times while adjusting the volume on your TV. You should hear a note that lasts about a half second and sounds like a ukelele. This is the LUTE stop. You may need to adjust the tuning on your TV for the clearest sound. The pitch is middle C.

Press the 'UP-ARROW' key. This is the same note, C, but an octave lower. The pitch of this note is half of that of middle C and contains only half as many cycles per second. Now press the 'CLEAR' key. This note is the C one octave higher than middle C. It's pitch is twice that of middle C and has twice as many cycles per second.

In the lower right corner of the screen is the RANGE indicator. Its upper colored block shows the two octave range of the computer keyboard. The lower colored bar shows the tuned musical range of the particular stop you have selected. Press the 'ENTER' key and watch what happens to the blocks. Where is middle C on the keyboard now?

Now press the 'DOWN-ARROW' key. Voila! We are back home again. Now press it a few more times until range indicator is as low as it will go. Congratulations!!! you now own the world's first 256 foot long Lute! (You may need to turn the volume up to be able to hear the 4 cycle per second note...)

Press the 'K' key. (And turn the volume down) What happened to middle C? You have just shifted stops from the Lute to the KRUMPHORN. Notice that the stop range color bar has shifted to the right and has gotten smaller. This is because the musical range of the Krumphorn is less than that of the Lute. The keyboard range indicator has moved to within this boundary.

The Krumphorn not only has a different timbre (pronounced like "CAMBER") - or tone - than does the Lute, but also has a different envelope. The colored bars at the lower left of the screen indicate the envelope of the notes you are playing.

Press the 'B' key, then a new note. Can you hear the difference it makes? What happens when you do this several times? The 'B' controls the pitch BOING at the beginning of each note. At higher levels of 'S' (Sustain), you will hear more Boing. The number below the 'B' color stripe displays the value to which it is set. At a value between 6 and 9, the note decends into pitch. At a value between 1 and 4, it rises into pitch. At a value of 5, there is no Boing. At either extreme there is a little extra twist. The 'N' key lowers the Boing value and the 'B' key raises it. At low values of 'S', almost imperceptible amount of onset Boing can be found which mimic the flattening of a plucked string. This is useful to remember for those times when you may tire of Loch Ness Monster sounds...

Now set the Boing indicator level and let's proceed with the tour. The composer Ussachevsky once specified for a composition some electronic notes which included attack, sustain, decay, and release parameters. These parameters defined the varying loudness of a note from start to finish. Since then, this set of names has become a fairly standard way of describing the envelope or shape of a sound. Since the release process has become confused with decay, and particularly since the keyboard of the Color Computer is ready made for it, Synther 77™ uses a FELT rather than a Release generator. This will be explained in detail later.

The 'A' and 'Z' keys set the intensity of the ATTACK - 'A' increases it while 'Z' decreases it. Set the Attack to its lowest value and compare the sound as you increase it to its highest value. The attack controls the volume rise at the beginning of each note. Set the Attack to some reasonable value and let's move on to the Sustain.

The 'S' and 'X' keys set the length of the SUSTAIN. Sustain is a pause between the attack and the decay during which the tone does not change in loudness. Usually, Sustain is set to be longer than it needs to be. In Synther 77™ this function also affects the Boing rate, the Vibrato rate, and the Bend rate, which we shall discuss shortly. In a way, the 'S' key may be said to set the slowness of things.

Press the 'L' key to set the Lute stop again. This resets the 'S' to a low value. How does the sound change as you increase the 'S' to its maximum? Now return 'S' to zero and put a bit of Boing on the note. See what happens now as you increase the 'S' to a maximum. The Boing effect should become longer and deeper.

The next part of the envelope to be explored is the decay function. The 'D' and 'C' keys set the decay rate. A high value lets the note fade away slowly while a lower value makes it fade away faster. Reset the Lute and see what happens at various Decay rates. At the lowest value it should sound like a plucked rubber band. At the highest value - where there is no decay at all - it becomes like an organ.

Leave the decay at the high value - in the organ position - and let's explore the final element of the envelope process, the release. When you lift your finger from the key of a piano, the internal mechanism drops a block of felt on the vibrating wire, damping the sound. Depending on the size of the felt, the sound may die away quickly or last a while longer after the key has been released. The 'F' key sets the amount of FELT - the greater the Felt value, the more rapidly the damping occurs. Notice that this damping occurs only AFTER the note key has been released. The Felt adjustment has six levels. By pressing 'F' when the Felt value is six, you can return it to one.

You will also notice that when the 'F' value is set to one, the Decay is set to the organ mode, and the sustain set to zero that the tone lasts forever. This allows the use of the low frequency oscillations as vibrato source voltages. This continuous signal may then be set by the keys to various rates and wave shapes. To escape this configuration, simply press the ';' key. This restores you to the CONTROL mode. It is labeled on the screen as the BREAK key.

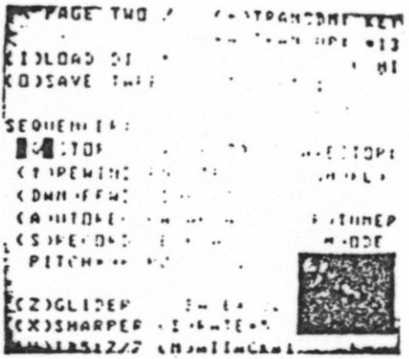
Each stop key (G,H,J,K,L) may be seen as a "RESET" key which returns you to a stable, known sound. There is also a general reset key, the '/', which provides you with a uniform envelope from stop to stop. It adjusts the range variable to provide a more complex timbre with some stops.

To the right of the envelope stripes is an individual stripe labelled 'V'. The 'V' key sets the vibrato depth. Remember that the 'S' key sets the vibrato rate, which is the number of cycles per second. Press the Lute stop, set the decay to organ mode, and try different vibrato depths while varying the sustain. you will find that vibrato appears at the start of a note and dwindles away. There are four rates available from the sustain, spread over its nine segment range. The more usual middle rate covers most of the middle to allow more useful combinations of Boing and Bend. The extremes are at the ends. To force a note to have more vibrato, just press the space bar while playing the note.

Also with the vibrato you get the BENDER. Try pressing the '<' or '>' keys during a note. Phasing lasers! It's Pinball Alley!!! Play several notes while holding one of the bend keys down. Now while holding the other down. You can see the destructive potential.

To the right of the vibrato indicator is another indicator labeled 'M'. This is the control for MORE VOLUME. It steals from the volume available to the vibrato and with some stops produces vibrato with peaky tops, but is does produce interesting effects. It is very easy to lock the program into continuous play with this control set too high but remember that the ';' key will stop the note at any time.

Just when you thought you knew everything there was to know about Synther 77™, we're going to introduce Page Two. When you press the SHIFT key, Page Two will be displayed. It should look something like this:



Page Two

The upper left corner should say PAGE TWO so you know where you are. The upper right corner of Page Two contains information on the TRANSPOSER. The left arrow moves the pitch of the keyboard down and the right arrow moves it up. Suppose you want to play a duet with a friend and he plays the B-flat clarinet. Just press the left arrow key twice. The lowest note on the keyboard now sounds a B-flat, just like the clarinet. You can now play in any key.

Just below the transposition block is the word STOPSET=1. There are 10 sets of stops available. To select another one, press SHIFT and a number key from 1 to 0. The last five are labeled SPARE and can be used when copying stops around.

Below the stopset block is the word SAVESTOP. If you have just changed things around and particularly like the sound you have created, you can save your stop into any of the 50 available. To do this, select the stopset that contains the stop you want to change and then press SHIFT and a letter from G to L. After saving the new stop, you will be given the opportunity to change the stops name. See the section on loading and saving for information on how to save your custom stops.

Below the savestop is the word (P)TUNER. Press SHIFT-P
go back and play some notes. You will find that the notes do
die away (the decay has been set to maximum). Select one of
higher notes and press the < key about 20 times. You shou
notice that the note is getting gradually flatter (lower). N
press the > key the same number of times. The note should
back to it's original pitch. Each individual note is tunabl
That is, changing one note does not affect the rest of the sca
Now you can tune Synther 77" to match your piano or to sc
special tuning for a band. Each of the five different stops
a different pitch set and each pitch set contains 37 notes.
order to completely tune a stop, you will need to move
transposer to its lowest position. Any special tunings will
saved along with the stops (see below).

To quit tuning and return to normal play, press the / ke
This returns the program to the state it was in before y
selected the tuning mode.

In the lower right corner of Page Two is a little diagr
that describes the WAVEFORM of your music. There are actual
255 points in the waveform but due to screen resolution
drawings are not that detailed. More accurate drawings of
waveforms can be found towards the end of this manual in
Technical Notes section.

By pressing M (while viewing Page Two), you can select a
of the nine waveforms available. Each gives a distinctive soun
Try them and decide which ones you like best.

To the left of the waveform picture is the word <>BASE=03
The waveform table is actually just 255 bytes of memory. T
base is the number of steps the program advances through
table each time it gets a sample. If the base is 1, then ever
value in the table goes out the speaker. If the value is 5
then every fifth value is used. Press the < or > keys to chan
the base. This can create hundreds of different sounds from a
waveform.

Just below the base is the word (B)RATE=5. Pressing the
key changes the bend rate. If this value is high, the < and
keys will cause a rapid change in the pitch of any note bei
played. If the value is low, the change will be more gradua
The bend rate also affects the attack and boing rates. At l
values, almost imperceptible amounts of boing can be found whi
mimic the flattening of a plucked string.

Below the bend rate is the word (N)ATTACK01. There are
different attack modes. These are drawn in diagram 1 in t
technical notes. Attacks 1 and 2 simulate a stringed instrume
with a plucking sound at the beginnig of each note. With t
attack set to 1 or 2 and the attack rate (Page One!) set at t
top of its range, you will hear quite a loud chirp. Attacks
and 15 are the opposite of 1 and 2. The attack builds UP to t
sustain level instead of DOWN. (Take a look at the diagram
With the attack set to 14 or 15 and the attack rate (Page O
again) set high, the note will take a few moments to get to fu

volume. In fact, if the sustain and decay values are not long enough, you may not even hear the note.

In the lower left corner are three aditional things for you to play with. The first is the GLIDER. By pressing 'Z' while viewing Page Two, you turn on the glider. The familiar blocks will appear on each side of the Z to let you know that the glider is available. Now, if you hold the Z key down while you play music, the notes will glide (hence the name) into each other. If the sustain and decay values are set high enough, you can glide over the whole two octaves for an interesting sound. You may want to change the BEND RATE to get a quicker glide effect.

Below the glider is the SHARPER. By pressing the X, you can turn on the sharper feature. Now, while playing music, if you press the X key, your notes will become a litter sharper (higher). This is helpful if you are playing in a band and you want to stand out during a solo. The effect of the sharper is most obvious on notes at the high end of the scale.

NOTE: When the glider and sharper are enabled, the Z and X keys will NOT lower the attack and sustain like the normally do. Their whole purpose is now to turn these features on and off. (If only there were more keys on the CoCo...)

On the left side of the screen, towards the top are the words (I)LOAD and (O)SAVE. These are the commands you will use to save your custom stops and music and to re-load them later on. Upon pressing I or O, you will be asked if you want to use cassette or disk. If you press C for cassette, you will simply be asked for a filename. You should then set up the recorder, and press ENTER. The file you specified will be loaded (if you pressed I originally) or saved (if you pressed O).

If you select disk, you will see a menu like the one shown below:

```
DISKSYS:
 (D)IR        (N)DRIVE#0
 (S)AVE       (K)ILL
 (L)OAD       (E)XIT
```

You can Load or Save from either the I or O menus (they are both exactly the same). You now have the option of getting a directory listing by pressing D, changing the drive number by pressing N, killing (deleting) a file by pressing K and supplying the filename, or exiting back to the play page by pressing E. If you press S or L to save or load, you will be asked for a filename. On save, you will be further asked whether to save the stopset, the melody, or both at the same time. Enter this information and make sure the disk is ready before pressing ENTER.

The SEQUENCER

The sequencer is like a tape recorder except that no tape is needed. It allows you to save more than 2000 notes into memory and play your songs back at different speeds, using different envelopes, stops, etc. The controls for the sequencer are in the middle left part of Page Two.

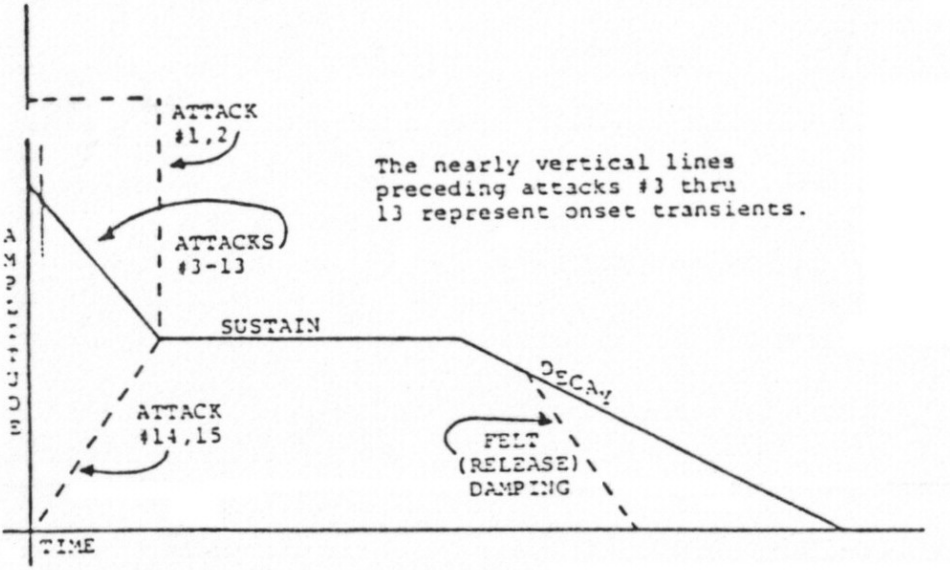
There are two record and two playback modes. In standard record or play (options S or E), the music is recorded or played until the end of memory is reached. In auto record or play (options A or W), when the end of the recording buffer is reached, the program zips back to the beginning and starts over. This way, you can play your song over and over (and over and over...). To stop auto record or play, press SHIFT Q - you will be returned to the normal state. You may want to use auto record so you can play continuously and quit after playing a good song and be assured that it is in the buffer. (Somewhere... Use the (D)elete command to get rid of the extra stuff.)

You may want to record a song slowly to make sure you don't make any mistakes. You can then play it back faster (or slower). Press SHIFT-; to slow the playback down or SHIFT-/ to speed it up. Speed 3 is normal, and each step up or down doubles or halves the playback speed.

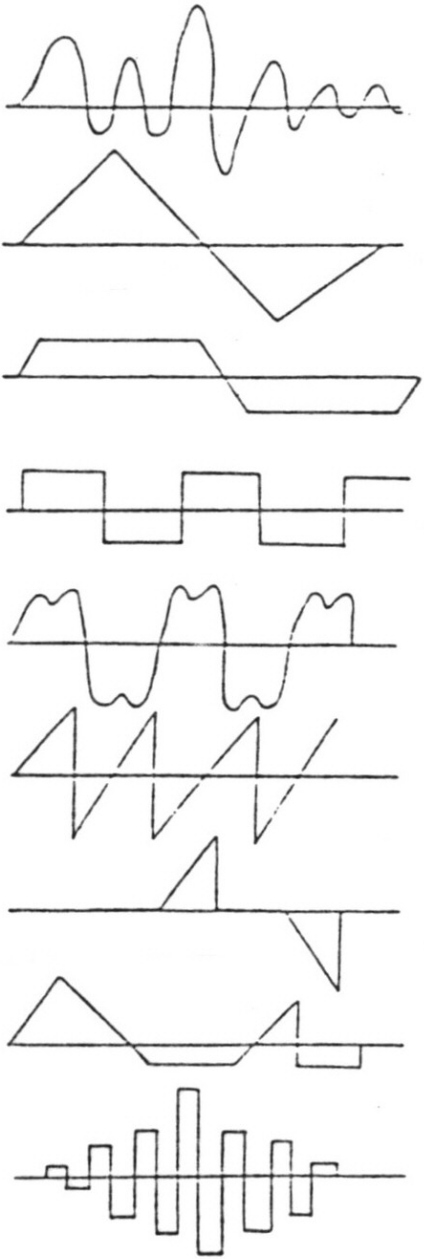
Even if you played your song slowly, you may still have played a few notes that are wrong or just didn't belong where they are. To step through the music one note at a time, press ENTER to go backwards or CLEAR to go foreward. When you get to a bad note, you can either press D to delete it (the notes after it will be moved up to fill the hole) or you can change it. To change a note, press ; until the speed is 1 and press E to start the play mode. When the note to be changed sounds, play the correct note right on top of it. The note you play will be put into the song in place of the old one. NOTE: If the new note is very different from the old one, the timing may be a little off.

Well, now that you've had the 'tour', do some experimenting, knowing that with Synther 77™ you can save that once in a lifetime masterpiece to replay another day. We hope you have fun with your synthesizer.

For those users who are interested in the more technical pect of a software synthesizer, the following section is ovided. In it, you will find drawings of the envelopes and veshapes possible using Synther 77".



the ENVELOPE



OLD SYNTHER 7:
TRIANGLE + 4 OVERTONES

TRIANGLE WAVE

TRUNCATED TRIANGLE

SQUARE WAVE

MOLAR WAVE
$\sin x + \frac{\sin 3x}{3}$

SAWTOOTH

HALF-SAWTOOTH

TRIANGLE FUNDAMENTAL
+ SAW 3RD OVERTONE

SQUARE MODULATED WITH SINE

WAVEFORM Diagrams