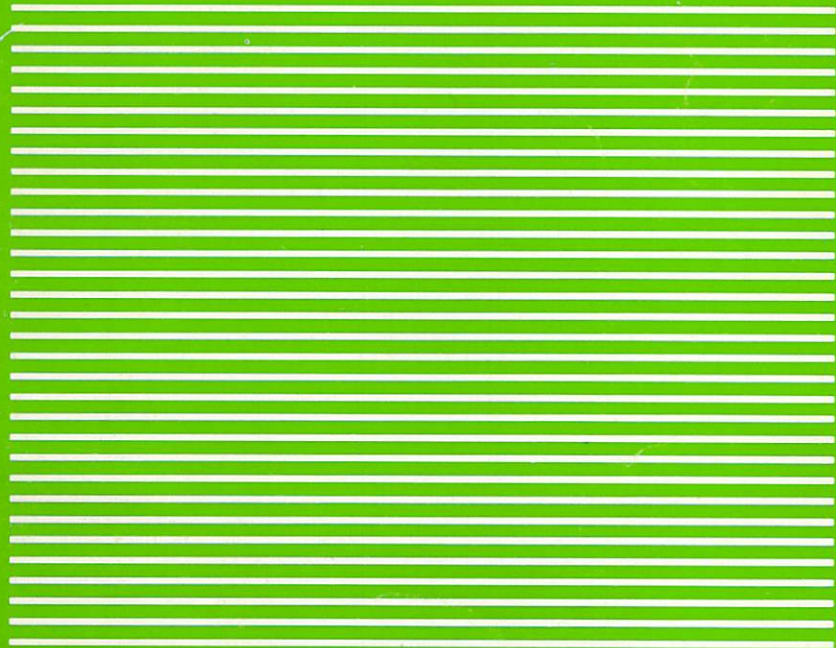


SYNTHESOUND 64

By Thomas Daschel

Instruction Manual



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This Manual was written by: Gregory Yob

This Manual was illustrated by: Tom Wahl

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SESSION 1

INTRODUCTION

Welcome to the world of computer synthesized music! SYNTHESOUND 64 and your Commodore-64™ lets you make music with many of the features found in modern music synthesizers. SYNTHESOUND 64 gives you access to all of the powerful features of the SID 6581 music chip in your Commodore-64. This includes the equivalent of three Voltage Controlled Oscillators (VCOs), Three Envelope Generators (ADSRs), one Voltage Controlled Filter (VCF) and one Voltage Controlled Amplifier (VCA). For special effects, the VCOs can be hard synchronized (Sync) and can modulate each other (Ring Modulation). The tuning of the oscillators is quartz crystal controlled, so your synthesizer setups will never drift or get out of tune.

By the magic of software, SYNTHESOUND 64 also provides eight Low Frequency Oscillators (LFOs), two keyboards, computer storage of 256 setups (known as Patches of Presets) and one channel of "tape" recording to disk. If you have a disk, nine different songs can be recorded and nine sets of 256 setups may be stored and recalled at will.

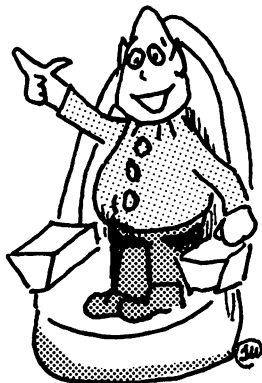
Your guides through this maze of wonders are Sid Clavier (A clavier is any keyboard instrument. If you have the VIC version of SYNTHESOUND 64, you have met Sid's brother, FRED.) and Glitch! the friendly Gremlin.

Sid says, "Don't worry about all those technical terms you just read. Relax and go through this Manual one Session at a time. We don't have room for examples of all the features of SYNTHESOUND 64, so as you read about a feature, take a moment and try each one out to see what it really does. Just as the Commodore-64 is your PERSONAL computer, SYNTHESOUND 64 is your PERSONAL SYNTHESIZER."

Glitch! sez: "Computers, you know, are a bit funky. It isn't that they don't work, but sometimes they don't do what you think they should. I'll try to warn you about some !Gotcha!s here and there. Remember to just keep trying

different things — the worst that can happen is you will learn more and more."

(Note: Commodore-64 is a trademark by Commodore Business Machines.)



SESSION 2

GETTING STARTED

Turn on the power to your monitor, Commodore 64, and disk drive. Insert the SYNTHESOUND 64 Master Disk into your 1541 Disk Drive with the label facing up. Then type:

LOAD "*",8

When "READY." appears, type:

RUN

SYNTHESOUND 64 will then load itself and a color display will appear on your TV. Adjust your TV monitor for the most legible picture. Now, BE SURE TO REMOVE YOUR SYNTHESOUND 64 DISK FROM THE DRIVE!!! Finally, press the **Q** key and a sound should be heard. Adjust the volume to a comfortable level.

Note: Most color TVs have trouble with some of the colors used here, especially red over black and purple over black. It takes practice, but the smudges can be interpreted. For real legibility, get a black and white monitor. The way to get the best sound quality is to hook the audio output to your stereo's Aux input. Set the stereo to Mono mode.

Glitch! sez: "Though it is hard to mess up SYNTHESOUND 64, sometimes SYNTHESOUND 64 might "hang" or become unresponsive to your key-presses. If this happens, remove any disk in the 1541 Disk Drive and reset your Commodore-64 by turning the power off and then on. Then repeat the SYNTHESOUND 64 startup sequence."

Now, press the = key and release it. This copies the initial setting of SYNTHESOUND 64 into Register # 0. Glitch sez: "The reason for this will be explained later.

Sid says, "Want to make some music? Well, just press the keys

Q W E R T Y U I O P

and listen to the rising scale. See the two keyboards in the middle of the screen — when you press a key, this is indicated on the screen's Keyboard. OK, are you ready for a tune? Well, let's try these keys:"

R	R	T	R	U	Y	(pause)
R	R	T	R	I	U	(pause)
R	R	@	O	U	Y	T (pause)
P	P	0	U	I	U	(pause)

"And a Happy Birthday jam to you too!"



SYNTHESOUND 64 STARTING SCREEN

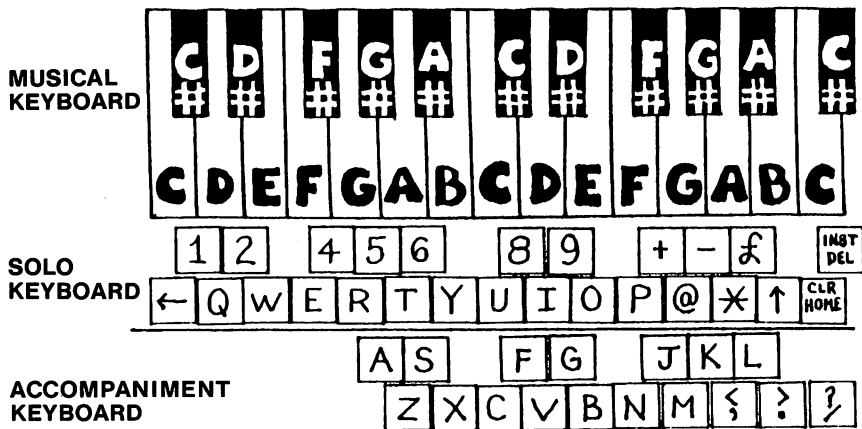
VC01 ^64	^PW 8030	VC02 ^64	^PW 0020	VC03 ^64	^PW 1025
LF01 ^08	LF02 ^09	LF03 ^97	LF04 ^80	LF05 ^45	LF06 ^07
A.D. 0107	S.R. 0703	A.D. 0509	S.R. 0609	A.D. 0212	S.R. 0123
VCF 0700	MA 57	SYNTHESOUND 64 AM 00:38:13.7		VCO 123X	VCA V45
LF07 ^08	SYNC:--- RING:---		DEPTH PITCH		LF08 ^59
REG3978 SOLO KEYB. 1 2 3	SET SID 6581 REGISTER				SYS8756 GLIDE: 1 2 3 428667
ACCOM KEYB. 1 2 3					TUNE: 1 2 3 398567

This is the SYNTHESOUND 64 screen when the program starts. The colors are used to indicate related areas, like the three VCOs. If you have a color TV, some parts may not be legible on your screen. Sid says, "Be patient. We will go through every part of the SYNTHESOUND 64 screen as you work through the Sessions."

Glitch! sez: "If you can't read your color TV, this picture tells you what's really there."

Now press either SHIFT key. On the two Keyboards, letters will appear. These show which keys on your Commodore-64 Keyboard are used for playing tunes. For the moment, only the upper Keyboard will play. Try pressing more than one key and listen to the results. Up to three keys can be down, with three notes playing at once. (Each independent note is called a "voice.") If you want the letters display to remain, press the SHIFT-LOCK key. (Don't make this a habit. In some cases, SYNTHESOUND 64 will respond more slowly when SHIFT is pressed.)

Sid says, "Now, let's make note of this. The letter keys correspond to the white keys on a piano, and the number keys correspond to the black keys. Here's a picture of what I mean."



If you press the **U** key, you will hear the "middle C" of SYNTHESOUND 64. Pressing **R** gets you the note G and so on.

On the SYNTHESOUND 64 display, the Clr/Home is shown by a reverse heart symbol (Clear Screen). The high C-Sharp will play but is not indicated on the SYNTHESOUND 64 display.


SYNTHESOUND 64 Notes Table

Note	Solo Keyboard	Accom Keyboard
C.....	'Left Arrow'	n/a
C #.....	'1'	n/a
D.....	'Q'	n/a
D #.....	'2'	n/a
E.....	'W'	n/a
F.....	'E'	n/a
F #.....	'4'	n/a
G.....	'R'	n/a
G #.....	'5'	'A'
A.....	'T'	'Z'
A #.....	'6'	'S'
B.....	'Y'	'X'
C.....	'U'	'C'
C #.....	'8'	'F'
D.....	'I'	'U'
D #.....	'9'	'G'
E.....	'O'	'B'
F.....	'P'	'N'
F #.....	'+'	'J'
G.....	'@'	'M'
G #.....	'_'	'K'
A.....	'*'	' '
A #.....	'Pound Sign'	'L'
B.....	'Up Arrow'	' '
C.....	'Clr/Home'	'/'
C #.....	'Inst/Del'	n/a

Sid says, "If you've tried the lower Keyboard, I bet you got a surprise — no sound! That's because no VCOs are assigned to this Keyboard yet."

SYNTHESOUND 64 has two Keyboards, as you can see on the screen and the table on Page 6. The upper Keyboard is called the Solo Keyboard and the lower one is called the Accom (Accompaniment) Keyboard. The Accom Keyboard has fewer playable keys on it as the table shows, and only plays the upper 17 notes of the Solo Keyboard. When you have two different sounds (say a Tuba and a Choo-Choo), you can set up the Keyboards so one sound is on the Solo Keyboard and the other on the Accom Keyboard.

Glitch! sez: "If you wanna have some fun, press the <— and **W** keys at the same time. Watch the red bar grow to the right of "SYNC" on the screen. If

you press the RUN/STOP key you get the same effect. (Press the  Commodore key to get rid of the bar.) **2 & 4** do the same thing. Some other combinations like **4 & 6** will activate the **X** key and so on."

"So what's this all about? The Commodore-64 keyboard is a grid of switches and in some cases, pressing two keys at once will make 'phantom' keys appear pressed down in other places. Unfortunately, there's nothing SYNTHESOUND 64 can do about this short of getting a real piano type keyboard."

SESSION 3

DIAGRAM OF SYNTHESOUND 64 SCREEN

VCO #1 Control Area			VCO #2 Control Area			VCO #3 Control Area		
VCF Control			SYNTHESOUND 64 Clock			VCF Assign		
VCF LFO			Modulation Control Area			VCA LFO		
Patch #			Function Select Line			Sys		
VCO to Keyboard Assignment			Solo Keyboard Diagram			VCO Glide		
			Accom Keyboard Diagram			VCO Tune		

The colors on the screen indicate areas with similar functions. Note that the VCF area (purple) includes the "VCF Assgn" area to the right of the Clock.

TOUR OF THE SYNTHESOUND 64 SCREEN

The SYNTHESOUND 64 display tells you nearly everything about your current setup of SYNTHESOUND 64. The top area enclosed with red lines has all of the information about the generation of sounds. The lower area is all about the use of the Keyboards, the tuning of the VCOs and the current Function Selection.

The SID chip has three independent sources of sound, which are called VCOs. (Sid says, "The term VCO means Voltage Controlled Oscillator. This is a bit obsolete, for the Commodore-64 changes some internal registers instead of making voltages. DCO for Digitally Controlled Oscillator is a better term, but VCO is what synthesists recognize for this.") Each VCO has three boxes for its various options. Each VCO comes in a different color, red, light green, and blue respectively.

The VCF (Sid says, "DCF for Digitally Controlled Filter, etc.") area is coded in purple. Note that the "VCF Assgn" to the right of the clock is part of this area. The title, SYNTHESOUND 64, comes in yellow and the clock is cyan. To the right of the clock is the VCA. ("Ahem, DCA for Digitally Controlled Amplifier.")

Below the clock is the Modulation Control Area which is concerned with the twenty or so ways you can modulate the VCOs. This takes care of the top area. (Be patient – you'll learn the details in the upcoming sessions.)


The white message, "SET SID 6581 REGISTER," is the Function Select Line. The current one of the thirteen Function Selections is shown here. The cyan "REG" is the number of the current "patch" or SYNTHESOUND 64 setup in use. The "SYS" in cyan is a high speed clock to show you how rapidly SYNTHESOUND 64 is operating.

The two Keyboards, Solo and Accom are in grey in the lower part of the screen. To the left are three colored numerals for each Keyboard. These correspond to the VCOs assigned to the Keyboards. (Currently all three VCOs are assigned to the Solo Keyboard.) The Glide and Tune controls on the right have tri-colored numerals which again correspond to the VCOs.

PITCH BENDING (CuRL & CuUD KEYS)

Press the **Q** key and while keeping it down, press the Cursor Left/Right key. (Note: Cursor Left/Right will be called CuRL and Cursor Up/Down CuUD.) The pitch of the note will rise until you release the CuRL key. Now press the **Q** key and CuUD and the pitch falls. On the screen in the Modulation Control Area, a light green bar grows and shrinks along with the pitch next to the '+PITCH.' This is called Pitch Bending. Glitch sez: "Try pressing several keys on the Solo Keyboard while bending the pitch back and forth. Can you do an air raid siren?"

DEPTH CONTROL (CBM & RS KEYS)

Likewise, the Run/Stop key (RS for short) will grow a light red bar next to the message '+DEPTH' and the Commodore (CBM)  key will shrink it. When any of the LFOs associated with the VCOs are on, the Depth control will make their effect audible. Sid says, "At the moment, none of the LFOs are set to do anything, so you won't hear any changes. If you want to hear Depth in action, make sure the message 'SET SID 6581 REGISTER' appears in the Function Select Line. (If not, press F1 until it does appear.) Now, press F3 five times and then press F5 seven times. Hold down the **Q** key and press the RS key."

PAUSE CONTROL (CTRL KEY)

Press the **Q** key and while holding it down, press the CTRL key. Then release the **Q** key. The note will still play. Note the SYS number is not changing while CTRL is kept down. CTRL forces SYNTHESOUND 64 to pause and 'freezes' the action. None of the other keyboard keys will operate when CTRL is down.

ABOUT PATCHES AND PRESETS (REGISTERS)

The original synthesizers like the Moog and Buchla were made of many different modules (VCOs, VCAs, ADSRs and so on) which were connected together using patch cords. Setting up a sound on one of these machines involved hooking up the patch cords and adjusting the multitude of knobs on the modules. The name for a particular hookup and setting became 'patch.' Later machines, like the ARP used pre-wired connections with switches to replace the patch cords. On these machines the term is 'preset.' Sid says, "I'll use the word 'Patch' even though SYNTHESOUND 64 sees all of its setups as registers in the Commodore-64's memory."

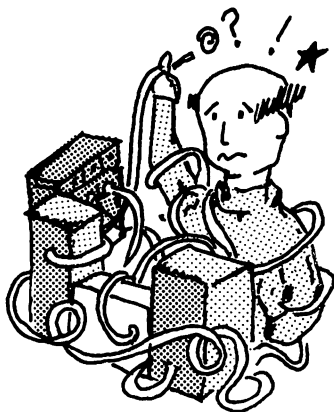
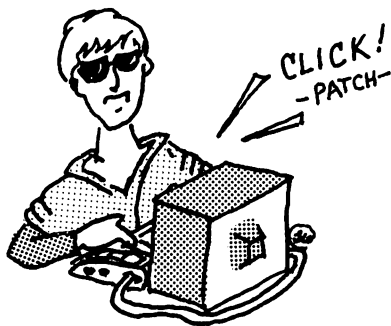
SELECTING AND SETTING PATCHES (: , ; & = KEYS)

SYNTHESOUND 64 can store up to 256 Patches in the Commodore-64's memory at one time (more than most professional synthesizers). You can instantly change from one setting to another by using the : and ; keys. Press the ; key. The number following the cyan REG to the left of the Function Select Line will now count upwards. When you release the ; key, this value is the Patch # that SYNTHESOUND 64 is now playing. Take a look at the screen — the various settings for the VCOs and so on have changed. Press the : key to count the Patch # downwards. The Patch # can be from 0000 to 0255.

So, : and ; selects a Patch to play. The current Patch will vanish when you do this! The = key lets you store and copy Patches from one Patch # to another. Read this carefully: When = is pressed down, the current playable Patch is 'grabbed.' You can now use : and ; to select the Patch # you want. When = is released, the Patch is stored in the current REG number (Patch #).

Glitch! sez: "When you pressed = so long ago, the current Patch was grabbed. When you released =, it was stored in Patch # 0000. If you didn't do this, NOTHING was in Patch # 0000. When you change the Patch # without using the = sign, the original Patch VANISHES."

Sid says, "It is a bit tricky to get the Patch # you really want. Here is an exercise for you: When you turn SYNTHE SOUND 64 on, press = to store the initial Patch into Patch # 0000. Now use : , ; , and = to copy this into Patch #s 0001 through 0010. Don't be afraid to reset your Commodore-64 if you somehow lose the sound. Scan through Patch #s 0000 to 0010 before you reset the Commodore-64 — it's awful easy to skip over working patches. Don't worry, it all comes with practice."



SESSION 4

FUNCTION SELECTION KEYS

- F1 — Browse through Functions
- F3 — Select a Function
- F7 — Leave a Function

SYNTHESOUND 64 has thirteen Functions which are used via the Commodore-64's Function keys F1 through F7. Take a moment and press the F1 key. The Function Select Line should now display: SET VCOS TO KEYBOARDS. Keep pressing F1 to see each of the thirteen SYNTHESOUND 64 Functions.

When the selection you want is on the Function Select Line, press F3 to actually select this option. When F3 is pressed, the meaning of F1, F3, F5 and sometimes RETURN will depend on which Function is 'on.' See the table on the next page.

Leaving a Function is performed by the F7 key. You can re-select the same Function with F3. Press F1 to move onwards.

Sid says, "Some of these Functions are really easy, like SET REAL-TIME CLOCK. The hardest one is SET SID 6581 REGISTER. We'll go through these starting with the easy ones, and SET SID 6581 REGISTER will be saved for last."

Glitch! sez: "You gotta be careful. Some options like ENGAGE DIRECT FROM DISK look just like others, like ENGAGE DIRECT TO DISK or LOAD vs SAVE REGISTERS. The order these come up via F1 isn't logical!"

SYNTHESOUND 64 FUNCTION TABLE

Function Name	F1	F3	F5	F7	RT	Page
SET SID 6581 REGISTER	SP	SN	V+	EX	V-	33
SET VCOS TO KEYBOARDS	-	SN	TS	EX	-	19
ACCOM: MELODY/CHORD	-	-	TS	EX	-	24
SET REAL-TIME CLOCK	-	SN	V+	EX	-	18
ENGAGE DIRECT FROM DISK	-	AL	-	-	-	28
ENGAGE DIRECT TO DISK	-	AL	-	-	-	27
EQUALIZE VCOS BY #?	-	AL	SN	EX	-	23
SOLO/MULTI PLAY MODE	-	-	TS	EX	-	23
SET GLIDE FOR VCO #?	-	V+	SN	EX	-	20
SET TUNE FOR VCO #?	-	V+	SN	EX	-	20
SET DISK FILE #?	-	SN	SN	EX	-	25
LOAD REGISTERS	-	AL	-	-	-	26
SAVE REGISTERS	-	AL	-	-	-	26

Codes:

AL Act & Leave	SN Select Next Item
EX Exit Function	SP Select Previous Item
- Not Applicable	TS Toggle Selection
RT RETURN Key	V+ Select Value, +
	V- Select Value, -

This table shows the uses of the Commodore-64's function keys once a Function is selected by pressing F3. The two letter codes in the first five columns indicate the use for the corresponding Function key.

Note that most of these keys act when you RELEASE them. The exceptions are some of the Function keys are used to select large values, say from 0000 to 4095. If you hold these keys down, the value will automatically keep changing, like : and ; do for the Patch #.

SET REAL-TIME CLOCK

SYNTHESOUND.64
AM 01:23:45.6

- F3 — Select Hours, Minutes, Seconds
- F5 — Set Time (repeating key)
- F7 — Exit

In the center of the SYNTHESOUND 64 display is a 24 hour clock ticking away in tenths of a second. This Function Selection lets you set the clock. (Remember to press F1 to get to this Function Selection and to press F3 to actually Select this Function.)

Pressing F3 will cycle you through Hours, Minutes, and Seconds. Then press F5. This will change the time numerals. For example, if you are in Hours, the numerals will go through 1-12 AM and then 1-12 PM. Release F5 when you have the time you want.

Repeat the F3, F5 sequence until you have the time set. F7 returns you to function Select mode.

Sid says, "See, that's an easy one. Practice a bit on this one — it's just a different way of doing musical scales."

SET VCOs TO KEYBOARDS

SOLO KEYB. >1 2 3

ACCOM KEYB. 1 2 3

- F3 — Select Next VCO
- F5 — Toggle Assignment Status
- F7 — Exit

Each VCO in the SID chip is an independent source of sound. This means that you can have a maximum of three sounds at once. (These are called Voices.) With two Keyboards to choose from (Solo and Accom) there's the problem of which VCOs are to play with which Keyboards. When SYNTHESOUND 64 turns on, all three VCOs are assigned to the Solo Keyboard — if you press a key on the Accom Keyboard there are no VCOs assigned, so no sounds result.

You can't assign the same VCO to both Keyboards, but you can use this Function Selection to share out the VCOs as you wish. When this Function is selected (Via F1 and F3, remember?) a cursor appears to the left of the '1' on the left side of the Solo Keyboard. Pressing F3 moves this cursor to the '2.' Keep pressing F3 and the cursor moves through all six positions. (three for Solo, three for Accom.)

When a numeral is in reverse field, the corresponding VCO is assigned to the Keyboard to the right. Pressing F5 toggles (switches back and forth) the VCO between assignment to the Keyboard or not. Unassigned VCOs are not in reverse field. If pressing F5 doesn't change the VCO's assignment, look at the other Keyboard's assignment line — the VCO is already in use!

Exercise: Assign all three VCOs to the Accom Keyboard.

A MATTER OF PRIORITY

Sid says, "Try playing a few tunes which have chords in them. Do this really slowly. When you have more keys down than there are oscillators for a Keyboard, listen carefully, SYNTHESOUND 64 will select the leftmost keys pressed for the VCOs to play."

"This is called the priority rule for a synthesizer. It takes some getting used to — most synthesizers select the highest notes to play."

Glitch! sez: "Yah, watch your step with chords, it can get rather funky! Also, if you have assigned a voice (VCO) to the Accom Keyboard try pressing two keys from the Solo Keyboard. If you selected **4** and **6**, note that **X** is also playing. The Phantom Key strikes again! See if you can find all of the 'bad guy' combinations. I know about 14 that play notes and two that make the Depth control turn on (RS Key)."

SET TUNE FOR VCO #?

TUNE: #1#2#3 000000

F3 — Increase Pitch by $\frac{1}{8}$ Semitone

F5 — Select Next VCO

F7 — Exit

This Function Selection adjusts the pitch of each VCO in steps of $\frac{1}{8}$ semitone. One Octave is equal to 96 such steps (12 Notes \times 8 steps/note = 96 steps). The total amount of pitch adjustment is from 00 to 99, or slightly more than one Octave. Sid says, "If you want to change the Octave of a VCO, see the SET SID 6581 REGISTER function which describes the VCO Octave Selection. The SET TUNE Function is for fine-tuning your 'instruments.'"

The colors in the #1#2#3 part are coded to the VCOs (red, light green, blue) along with the corresponding pairs of numerals in the 000000 part. Each numeral pair indicates the amount of pitch increase for the corresponding VCO.

Press F5 to select the VCO you want to fine-tune. The VCO's number will appear in reversed field on the Function Selection Line. Press F3 to increase the pitch. The colored digits for the selected VCO will indicate the increase.

Glitch! sez: "Be sure to listen to your VCO when you do this. It's easy to overshoot and it takes a lot of F3s to go around the 99 steps back to 00. It might help if you assign only the VCO you want to the Solo Keyboard first."

If you store your present patch before tuning the VCOs, you won't have any trouble with "overshooting" the values — you simply recall this patch.

SET GLIDE FOR VCO #?

GLIDE: #1#2#3 000000

F3 — Increase Glide by One SYS Tick

F5 — Select Next VCO

F7 — Exit

Sid says, "There's an effect called Glide or Portamento which works like this: When you press one key, the pitch is set. When you release the key and press another one, the pitch doesn't change instantly. Instead, it 'glides' to the new value. That's what this Function Selection is all about."

Again, the VCO#s are color coded and the 000000 part is also color coded. When you press F5, the number of the selected VCO will be in reversed field on the Function Selection Line.

Pressing F3 will increase the Glide value by one unit over a range of 00 to 99. If the Glide is set to 00, the Glide effect is turned off. Other values tell SYNTHESOUND 64 to wait for the SYS clock to 'tick' the same number of times, and then to change the pitch by $\frac{1}{2}$ semitone (see Set Tune for VCO#?). So, a small value, like 2, waits 2 ticks per tonal step, and a large value, like 90, waits for 90 SYS ticks per step.

Glitch! sez: "Try small values to get good effects. Also, try some Pitch Bending with the Cursor keys with Glide set — Glides slow down your Pitch Bendings, so beware!"

SESSION 5

EQUALIZE VCOs BY #?

F3 — Copy Selected VCO to Other Two & Exit

F5 — Select VCO to Copy From

F7 — Exit

SYNTHESOUND 64 has eleven parameters to set for each of the VCOs. (See SET SID 6581 REGISTER for details.) This Function Selection lets you copy the eleven values for one VCO into the other two. Sid says, "It takes time and patience to get just the sound you want out of one VCO. Now you have to copy this sound into the other two VCOs if you want to have chords in your music. This Function Selection does the job for you."

Press F5 to select the "master" VCO. The number of the "master" VCO will appear on the Function Select Line in reversed field.

Press F3 to actually do the copying. Once F3 is pressed, there's no point to the use of F5 (can you figure out why?), so this Function is exited. If you want to leave without doing anything, press the F7 key.

Sid says, "Only the VCO settings in the red boxes are copied. The TUNE and GLIDE settings are not copied. We are working with the Timbre, not the Pitch."

Glitch! sez: "I only got one comment here. All three VCOs will now have the SAME values. If you liked what one of the other VCOs was doing, stash everything in a Patch via the = key first."

SOLO/MULTI PLAY MODE

F5 — Toggle between Solo Play and Multi Play Modes

F7 — Exit

The Mode you are in is indicated in reverse field on the Function Select Line. Pressing F5 will 'flip' or toggle to the other mode. Press F5 again to get back.

Up to now, when you pressed one key, one VCO is assigned to play the note. This is the Solo Play Mode. In Multi Play Mode, all available VCOs are set to play the note. For example, if all three VCOs are set to one Keyboard and you press just one key, all three VCOs will sound the note. Pressing two keys at once will leave one VCO for the first key pressed and two for the other key.

If all the VCOs have the same setting, the note is merely louder. One way to get good effects is to use the SET TUNE FOR VCO #? function to slightly detune the VCOs.

Glitch! sez: "This works for both the Solo and Accom Keyboards. There's an exception — if the Accom Keyboard is in Chord Mode, it can play only one note at a time, and Chord Mode has precedence over Multi Play Mode."

ACCOM: MELODY/CHORD

F5 — Toggle Accom Keyboard between Melody and Chord Modes

F7 — Exit

The Mode you are in is indicated in reverse field on the Function Select Line. Press F3 to select this function. Pressing F5 will 'flip' or toggle to the other mode. Press F5 again to get back.

In normal play, when two or more keys are pressed on the Accom Keyboard, two or more VCOs will be assigned to play notes. This of course depends on having some VCOs assigned to the Accom Keyboard. This is Accom Melody Mode.

In Accom Chord Mode, pressing two or more keys creates an 'arpeggio' effect. Starting with the lowest note, the notes are played ONE at a time for each key pressed down until the highest note is played. This sequence then repeats. All available VCOs are assigned to the currently playing note.

Glitch! sez: "This is sort of opposite to what you think a Chord Mode does. On the other hand, you can have more than three keys down at once on the Accom Keyboard. Chord Mode has precedence over Solo or Multi Play modes, by the way."

SESSION 6

DISK OPERATIONS

Your SYNTHESOUND 64 Master Disk should not be used to store any information. Use this disk to Load SYNTHESOUND 64 only.

For all of your other work with SYNTHESOUND 64, you must use an already formatted diskette. To format a diskette, remove the SYNTHESOUND 64 Master Disk (if you followed instructions you've already done this) and then turn your Commodore-64 off. Then turn your Commodore-64 on again and insert a blank diskette into the drive. Now type:

```
OPEN 1,8,15  
PRINT#1,"N:SY64 DATA DISK,SD"
```

After about 3 minutes the disk will stop running. To check the formatting, type:

```
LOAD "$",8  
LIST
```

An empty directory should appear. Now, remove the diskette, and insert the SYNTHESOUND 64 Master Disk. Start up SYNTHESOUND 64 as usual. Now remove the SYNTHESOUND 64 disk and insert your newly formatted diskette into the drive.

If you are a serious user of SYNTHESOUND 64, you will need to back up your disks from time to time (say after recording a good 'cut' or Patch). Remove your data disk, turn off your Commodore-64, wait a few seconds and turn it on again. Now load and run your 1541 diskette backup program and follow its instructions. To obtain a 1541 backup program, see the Disc Misc section.

SET DISK FILE #?

```
F3 — Select Next File Number  
F5 — Select Next File Number  
F7 — Exit
```

The current Disk File Number is in reverse field on the Function Select Line. The File Number can be from 1 to 9. Pressing F3 or F5 will select the next Disk File Number.

SYNTHESOUND 64 has two kinds of disk files, Direct and Register. The Direct File is a recording of the music you play. The Register File stores the 256 Patches set via the = key. All disk operations refer to these files.

Up to nine Direct and nine Register Files can be accessed by SYNTHESOUND 64. At any time, however, only one of each is available. The Disk File # is the number of the currently available Direct and Register Files.

Sid says, "You see, if you selected Disk File # 3, only Direct File 3 and Register File 3 are available to SYNTHESOUND 64's other Disk Functions. If you want to use Direct File 4 and Register File 4, you must change the Disk File # to 4."

Glitch! sez: "That isn't a typo up there. Both F3 and F5 do the same thing."

SAVE REGISTERS (PATCHES)

Note: When you select this Function via F3 this action is done automatically.

The 256 Patches in SYNTHESOUND 64's memory are written to the Disk Register File. If a Register File already exists for the current Disk File #, it is destroyed and the current values saved in its place. When the save is completed, a horizontal blinking line will glide down the Commodore-64's screen.

Sid says, "The following applies to ALL disk operations. First, if you don't have a disk in the 1541 drive, or the disk is not formatted, you will see the complaint INVALID FILE ERROR in red on the Function Select Line. Second, there's NO WAY to stop a file operation once started with the exception of ENGAGE DIRECT TO DISK. Third, BE SURE you have the Disk File # you want, or you might lose something you saved earlier. Fourth, there's no prompt to put the disk in the drive. You must have the disk inserted BEFORE you do a disk operation. Note this happens IMMEDIATELY on pressing F3 to select the Disk Function. Fifth, the gliding horizontal line is used as a cue that SYNTHESOUND 64 is able to await your next action."

"Finally, the SYS clock runs more slowly or even stops in some operations. Even the Real-Time Clock might stutter. The Commodore-64 is just busier than usual."

Glitch! sez: "In other words, look before you leap with disks."

LOAD REGISTERS (PATCHES)

Note: When you select this Function via F3 this action is done automatically.

The 256 Patches stored in the current Register File are read from the disk and put into SYNTHESOUND 64's memory. Any current Patches are destroyed and replaced with the ones from the disk. The blinking line tells you when the new Patches are loaded.

Glitch! sez: "Make it a habit to save your current Patches to some standard Disk File #, say File # 9. Then change the File # and do the LOAD REGISTERS."

Sid says, "See my speech in Save Registers."

ENGAGE DIRECT TO DISK

SPACE — Exit Direct to Disk

Note: When you select this Function via F3 this action is done automatically.

The Engage Direct to Disk Function opens a Direct File (using the current Disk File #) to the disk and then records your Keyboard actions as you play SYNTHESOUND 64. This includes both your musical play on the Solo and Accom Keyboards and any of SYNTHESOUND 64's non-disk Functions.

When you press F3 to select this Function, the 1541 disk drives will run. Then the blinking horizontal line will roll down the screen — this is your 'cue' signal to begin playing SYNTHESOUND 64. All of your actions now go into the disk Direct File.

When you press SPACE, Direct to Disk will disengage and the disk drives will run briefly. The horizontal line will reappear when SYNTHESOUND 64 is ready for action.

Sid says, "Engage Direct to Disk lets you 'tape' your performances for later playback. This includes both your musical play on the Solo and Accom Keyboards and the Patches you use during your recording session."

Glitch! sez: "SYNTHESOUND 64 lets you record anything you do, including any of the non-disk Functions, during a Direct To Disk session. If you do get exotic, there's no guarantee it will play back right. It's best to have your Patches ready to go before going Direct To Disk."

"Also, when SYNTHESOUND 64 is talking to the disk, it takes more time to respond to your keypresses. Keep an eye on the SYS clock and keep any non-musical keys down for at least four 'ticks' of this clock. In hot playing this might force you to think ahead a bit."



ENGAGE DIRECT FROM DISK

Note: When you select this Function via F3 this action is done automatically.

The 'jam sessions' you have recorded via Direct To Disk can be replayed via this Function Selection. The Disk File # currently in effect determines which Direct File is played back. Once you begin Direct From Disk, the entire 'jam session' is played back. When the playback is finished, the horizontal line will wander down the screen to give you a cue.

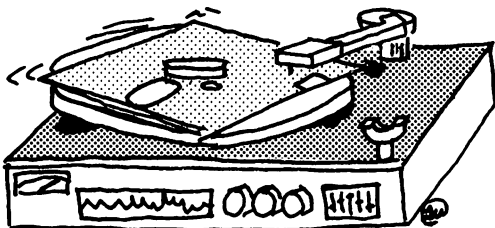
Sid says, "Once a playback is started, SYNTHESOUND 64 thinks the disk drive is the source of all the input. The real Commodore-64 keyboard is totally ignored! If you want to stop a playback, the ONLY thing you can do is to remove the diskette from the disk drive. Even so, SYNTHESOUND 64 will play out the notes remaining in the 1541 disk drive's buffer memory. DON'T TURN THE DISK DRIVE OFF! This will make SYNTHESOUND 64 'hang up.' If you do get 'hung up,' REMOVE ANY DISK IN YOUR 1541 DRIVE FIRST. Then reset your Commodore-64 and restart SYNTHESOUND 64 in the usual way."

The program can also be revived by switching the disk drive off and IMMEDIATELY on again. To stop a playback, you do the following steps:

1. Remove the disk from the disk drive.
2. Wait until the program stops playing (i.e. buffer is emptied).
3. Wait for the FIRST "rattle" sound of the disk drive.
4. At that instant, TURN THE DISK DRIVE OFF AND IMMEDIATELY ON again.

Glitch! sez: "Yah, this one is a bummer — but it will teach you to only record your best jam sessions! Don't let it get you down — if your play isn't satisfying, keep re-recording it until you have what you want."

"Also, if you have a musical setting you like on SYNTHESOUND 64, store it in a Patch via the = key before engaging Direct From Disk. Otherwise, you'll lose the setting during playback. (Direct From Disk uses the current setting area for playback use.)"



DISC MISC.

Errors

Disk operations are especially prone to human error. If you didn't put a disk in the drive, or if a Direct or Register File wasn't saved on the disk, you'll see INVALID FILE ERROR appear on the Function Select Line in reversed field red. An attempt to do Direct to Disk or Save Registers won't give you an error message. Instead, the blinking horizontal line will appear immediately which ends your attempt. Look at the 1541 Disk Drive — a blinking LED tells you that an error occurred.

Resources

Your SYNTHE SOUND 64 Master Disk has a number of demo files on it. The dealer's demos are the Direct and Register Files for Disk File # 1. The example Patches on Pg. 00 are in Register File # 9 as Patch #s 0002 to 0011.

Though the SYNTHE SOUND 64 Master Disk is copy protected, you can duplicate the Register files by: 1) Inserting the SYNTHE SOUND 64 Master Disk into the drive and using LOAD REGISTERS. 2) Insert your Data Disk into the drive and use SAVE REGISTERS.

Glitch! sez: "When doing this, be sure your Disk File Number is set appropriately for both disks — if you change the Disk File # before you do the SAVE REGISTERS you can move the Registers to a new Disk File #."

Sid says, "There are many Commodore-64 user's groups around. A list of these can often be found in Commodore Magazine. Two especially useful groups are: Public Domain at 5025 S. Rangeline Rd., West Milton, OH, 45383, phone: (513) 698-5638 and Toronto PET User's Group, P.O. Box 100, Station S, Toronto, Ontario, Canada M5M 4L6, phone: (416) 782-8900. Both groups will sell you disks with non-copyrighted Commodore-64 software. The Toronto group has an excellent 1541 Disk Backup program available.

SESSION 7

HOW SOUND SYNTHESIS WORKS

Before we tackle the last Function, SET SID 6581 REGISTER, you need to know how music synthesis works. Briefly:

Sound is the vibrations in the air. Your Commodore-64 doesn't actually make sound, just the electrical signal that corresponds to the moment to moment air pressure. It is the job of your amplifier and speaker to actually produce the sound.

Any repeating pattern of pressure change (we'll call it a wave) is a sound with pitch. Higher pitches correspond to faster rates of repetition. A VCO (Voltage Controlled Oscillator) makes waves whose pitch depends on a control voltage (That's what controls the VCO.). So, a Keyboard can select the pitch you want by making a voltage (Pitch Control) go into a VCO.

Now, a violin doesn't sound like a flute, though the note being played might have the same pitch. The timbre of a note depends a lot on the shape of the wave used for the pitch. A wave shaped like a triangle sounds smooth, and one shaped like the edge of a saw (Sawtooth) sounds more jagged. A VCO also offers you a selection of wave shapes to choose from.

Now, the difference between an organ and a piano is that the piano note will die away, but the organ note lasts until the key is released. The loudness of a sound can be seen as a slower kind of wave, one called an 'envelope.' Most envelopes can be described in four terms: Attack, which describes how the sound starts; Decay, which is how the sound falls from its loudest point; Sustain, which is the loudness the note remains at if the key remains down; and Release, which is how the note dies away when the key is released.

The circuit that makes the envelope is called the ADSR (Attack, Decay, Sustain, Release) and the voltage of the envelope is combined with the VCO to make a note whose loudness changes with time. So, the ingredients for a note are Pitch, Waveshape and Envelope.

Now, the notes coming from the VCO + ADSR may sound harsh, for some of the waveshapes are really rather jagged. A Filter can modify the sound by removing various frequencies from the signal. (Fourier's Theorem says that any wave can be made of simpler waves, each of which has a fixed frequency. The exact mix of frequencies is called the sound spectrum for a wave. A Filter modifies the mix by removing selected frequencies.) The exact way in which the Filter removes the frequencies can vary from only letting the low ones through (Low Pass), only letting the high ones (High Pass) or a range (Band Pass) through.

So, a VCO makes a sound with waveshape and pitch. The ADSR adds the envelope, or loudness with time. Then the sound is sent to the Filter for final modification. After all of this, SYNTHE SOUND 64 finally makes a note!

Just to add to the fun, the sound made this way can be further modified. One way is to vary the pitch at a slow rate (say five times per second). This is called tremolo. Another way is to vary the loudness — this is called vibrato. A third is to vary the shape of the wave — this is modulation. Yet another way is to change the characteristics of the Filter. Each of these methods employ Low Frequency Oscillators (LFOs) and SYNTHESSOUND 64 has eight of them.

Sid says, "A really complete description of sound synthesis would fill several books. For the details on the SID chip, see the Commodore-64 Programmer's Reference Guide, Chapter 4 (pg 183) and Appendix O (pg 457)."

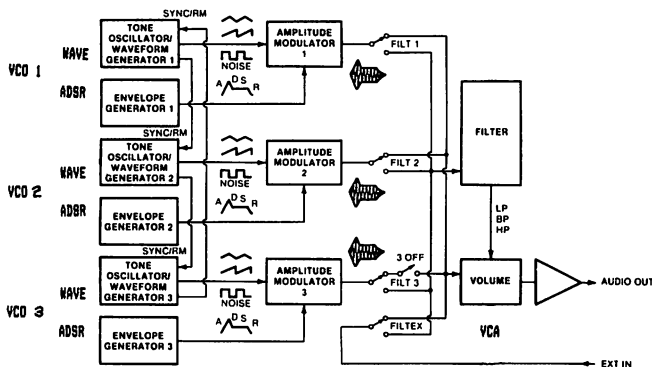
SID SIMPLIFIED

Now let's take a look at the SID block diagram. The SID has three VCOs, each of which has an ADSR attached to it. For a given VCO you select the pitch by the key you press and one of the waveforms to play. The ADSR is set for each of the envelope values (Attack Rate, Decay Rate, Sustain Level & Release Rate). The envelope and waveform are combined in the box marked 'Amplitude Modulator.'

The three VCOs' amplitude modulated sound can then either go directly 'outside,' or be routed through the Filter. After this the sound is ready to hear.

The SYNTHESSOUND 64 software simulates the LFOs by altering the settings of the SID chip like LFOs actually do for other synthesizers. For example, a tremolo LFO will slightly vary the Pitch setting for a VCO.

Sid, says, "Take some time and be sure you understand how SID makes sound. You'll find it easier to understand what happens as you adjust the settings for your Patches."



6581 BLOCK DIAGRAM

SET SID 6581 REGISTER (PATCH)

- F1 — Select Prior Option
- F3 — Select Next Option
- F5 — Increase Option's Value or Selection
- F7 — Exit

Note: Two Options, Pulse Width Select and Filter Freq Select, user RETURN to reduce the Value.

The Commodore-64's SID chip has a host of options to control the timbre of its sounds. SET SID 6581 REGISTER lets you adjust most of these by providing 44 Options to play with.

A white cursor appears to the left or right of your current Option. Pressing F1 moves the cursor to the previous Option. F3 will advance the cursor to the next Option.

Once you have the Option you want, F5 will set the Option to the next valid value. In two cases, Pulse Width Select for the VCOs and Filter Freq Select, F5 will repeat if held down. Also, in these two cases only, pressing RETURN will decrease the value instead.

Sid says, "Use F3 and F1 to move the cursor about the screen. Watch carefully where it goes. Move the cursor to the VCA: to the right of the Real Time Clock. Now press F5 and watch the numbers change. Here is a list of the 44 Options in SET SID 6581 REGISTER."

SET SID 6581 REGISTER OPTIONS LIST

Option Name		Value Range		Page
VCO1	Wave	0-7	(8 waves)	35
	Octave	0-7	(8 octaves)	36
	Pulse Width	0-4075		36
LFO1	Wave	0-7	(8 waves)	38
	Rate	0-15		38
LFO2	Wave	0-7	(8 waves)	38
	Rate	0-15		38
	Attack Rate	0-15		40
	Decay Rate	0-15		40
	Sustain Level	0-15		40
	Release Rate	0-15		40
VCO2 — Same as VCO1 using LFOs 3 & 4 respectively				
VCO3 — Same as VCO1 using LFOs 5 & 6 respectively				
VCF	Mode	0-7	(8 modes)	43
	Frequency	0-2047		44
	Q (Resonance)	0-15		44
	VCO Selection	0-15	(16 combinations)	43

VCA	Volume	0-15		45
LF07	Wave	0-7	(8 waves)	45
	Rate	0-15		45
Sync		0-7	(8 combinations)	47
Ring		0-7	(8 combinations)	48
LF08	Wave	0-7	(8 waves)	46
	Rate	0-15		46

Note: LFOs 1, 3 & 5 modulate the pitch of their respective VCOs.
 LFOs 2, 4 & 6 modulate pulse width. LFO 7 modulates the
 frequency of the Filter. LFO 8 modulates the volume of the VCA.

SESSION 8

THE VCO OPTIONS

The upper third of the SYNTHESOUND 64 display has nine boxes for the VCO Options. The VCOs are indicated by their colors, red, light green, and blue. Each VCO has three boxes in a column in the VCO's color. As you press F1, the cursor will move through the 11 Options for VCO1, then VCO2 and VCO3. The white cursor takes the shape of 'Greater Than' (shown by '>') when it is on the left of an Option and 'Backarrow' (shown by '<') when to the right of an Option. Try it and see.

The effect of the Options is exactly the same for each VCO. Due to this, we will describe the Options for VCO1 only. If you wish, use the EQUALIZE VCO BY #? Function to copy one VCO into the other two.

Sid says, "I can't spend the time to tell you the sonic effect of each and every Option. Try changing an Option's Selection or Value and listen to what happens. Trying Options and listening to the result is the easiest way to learn SYNTHESOUND 64."

Glitch! sez: "If you set up your VCOs to different sounds on the same Keyboard, remember that VCO1 will be assigned to the lowest key you are playing. VCO2 goes to the next highest, and VCO3 to the third key down."

VCO1 — WAVE

VCO1	PW
> 08	0000

The SID chip can make four basic waveforms (Sawtooth, Pulse, Noise & Triangle) and four 'combination waves.' Each of these makes a different kind of sound. A little symbol to the right of the '>' cursor indicates which waveform you have selected with this Option. Press F5 to see the eight symbols and hear what they do.

SYMBOL	WAVEFORM	ON THE SCOPE
	S Sawtooth	
	P Pulse	
	N Noise	
	TS Tri & Saw	
	TP Tri & Pulse	
	SP Saw & Pulse	
	STP Saw & Tri & Pulse	
	T Triangle	

ON THE SCOPE shows what you would see if you looked at the waveform on an oscilloscope. The 'combination waves' look strange for they are made by the logical AND operation inside the SID chip.

Sid says, "As you try these out, you'll notice that some waveforms are much louder than others. In general, the more jagged the wave the louder the sound. The Pulse wave is silent until you set the Pulse Width to some value. (We'll get to that one soon.) The three 'combination waves' that have Triangle in them are very quiet — you can see that ON THE SCOPE shows little going on."

Glitch! sez: "Want to be confused? A 'combination wave' is made by converting the height of each wave to a binary number. The numbers are then 'ANDed' together bit by bit to get a new binary number. The new number is the 'combination wave's' value."

VCO1 — OCTAVE

VCO1	PW
08<	0000

Here the 'Backarrow' (we are using the '<' symbol here) is pointing at the Octave Option. As you press F5 the Octave Option will go through the values 64, 32, 16, 8, 4, 2, 1. Each step is one octave higher in pitch. By combining this with the SET TUNE FOR VCO #? Function Selection you can tune your VCO over eight octaves. The low settings (64 & 32) are good for special effects.

VCO 1 — PULSE WIDTH

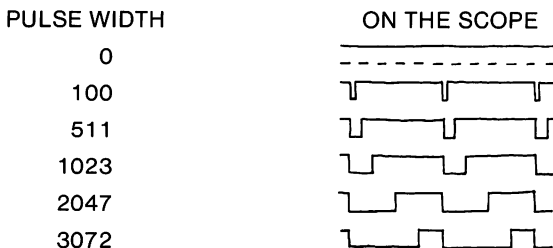
VCO1	PW
08	>0000

This Option is only effective when you have selected the Pulse waveform. The SID Pulse Generator lets you vary the width of the pulse through

4096 steps. Pressing F5 increases the PW number and pressing RETURN decreases it. Both keys repeat to speed things up.

To try it out, select the Pulse waveform and then hold the **Q** key down. While keeping **Q** down, press F5 and keep it down too. Listen to how the sound changes. The loudest Pulse sounds are in the middle range (1000–1500).

Here are some Pulse Width Examples:



The value 1023 sounds the same as 3072. In general, value N sounds the same as $4095 - N$.

ABOUT LFOs

Sid says, “Musical tones made by traditional instruments are very complex. The fairly simple synthesis methods used in the SID chip can produce sounds that remind you of a traditional instrument, but the ear gets tired of them after a while. One way to liven up the SID sounds is to vary some of the parameters (i.e. waveshape, frequency, etc.) at a slow rate, say from once every few seconds to seven or ten times per second. The Low Frequency Oscillator (LFO) is used to do this in SYNTHE SOUND 64. Since the SID chip doesn't have LFOs built into it, SYNTHE SOUND 64 does this via its software.”

“Take for example the Pitch of a note. You could smoothly increase the pitch to a maximum and then suddenly drop to the starting value. This corresponds to the Sawtooth waveform which also rises and suddenly drops. A smooth rise followed by a smooth fall is like the Triangle waveform.”

“In SYNTHE SOUND 64, each LFO has two Options. First is the Waveform Option which lets you select one of the eight waveforms for modulation. These are the same waveforms used in the VCOs. The other Option is how rapidly the LFO repeats the modulation. A small number (1) goes slowly and a large number (15) goes rapidly.”

Glitch! sez: “Each LFO has its own effect — you just have to try it out. Be sure to set the +DEPTH to some value (so you see the red bar) or the LFOs will have no effect. Some LFO settings don't have much of an effect.”

VCO1 — LFO 1 & LFO 2

LFO1	LFO2
> 00	00

LFO1 (& LFO3, LFO5) — TREMOLO

LFO1 shifts the frequency of VCO1 in a repeating way. This effect is called Tremolo. Two Options are available, the Waveform and Rate. For any effect to be heard, the Rate must not be 00 or 15 and the +DEPTH must be on (the red bar be visible).

The Waveform Option selects the same eight waves that the VCO has. Try setting the Rate to 10 and vary the Waveform. The different Waveforms have very different effects.

The Rate Option varies from no effect (00 and 15) to slowly (1–5) to rapidly (10–14). Play a bit and see what you like. The higher rates work best in normal play.

LFO2 (& LFO4, LFO6) — P.W.M.

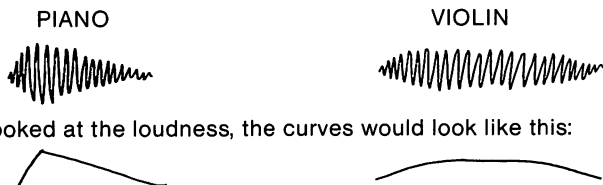
LFO1 varies the width of the Pulse waveform. This is called Pulse Width Modulation (P.W.M.). Again, the Rate must not be 00 and the +DEPTH must be on. Also, the VCO must have the Pulse waveform selected.

The Waveform Option and the Rate Option are similar to LFO1. The Rate value of 15 is audible in LFO2. However, some waveforms have no audible effect. Play a bit and see what you like.

ABOUT ADSR

Think about the difference between a piano note and a violin note. Both notes are made by strings, so that part is about the same. But what about the note's loudness? A piano note immediately becomes loud and then dies away. A violin note takes some time to get loud, and can remain loud for some time, depending on how the musician is playing.

If we looked at these notes on an oscilloscope, we'd see something like this:



If we only looked at the loudness, the curves would look like this:

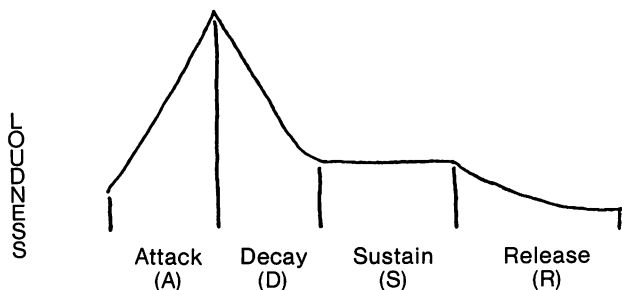
Since these curves 'envelop' the sound, they are called envelopes. Much of an instrument's quality comes from the envelope's exact shape. The envelope can be broken into several parts. For example, the piano has a rising part and a falling part. The violin rises, stays steady and then dies away.

A 'general purpose' note has four distinct parts:

1. **Attack** — This is the rate at which the note rises to its peak value. A piano has a rapid Attack and a violin has a slow Attack.
2. **Decay** — This is the rate at which a sound falls from its maximum loudness. A piano with the pedal down will rise rapidly (Attack), fall rapidly for a while (Decay) and then the other strings will vibrate for a while.
3. **Sustain** — This is the level the sound is at after the Attack and Decay. A violin note will be at the sustain level as long as the player wants the note to last.
4. **Release** — This is the speed of fall when the note is finally going away. A piano with the pedal up will release fairly rapidly. A violin's release rate is manually controlled.

Here is the 'general purpose' envelope:

THE ADSR ENVELOPE



VCO1 — ADSR (ENVELOPE GENERATOR)

A D	S R
>0107	0707

In SYNTHE SOUND 64, each of the four envelope parts can be assigned a value from 0 to 15. Press F3 and F1 to move the cursor to the Option you want and press F5 to set the exact value.

In the SID chip, the values for Attack (A), Decay (D) and Release (R) correspond to the list of times shown on the next page. That is, an Attack value of 12 means it takes one second for the note to reach its maximum loudness. The Sustain value indicates one of the 16 volumes available in the SID chip. (Note: 00 is no sound at all.)

Here are a few sample ADSR settings to try. Be sure to use EQUALIZE VCO BY #? to copy these to VCO2 and VCO3.

A	D	S	R	Remarks
01	07	07	07	Starting value
01	09	00	00	'Piano' like
03	10	03	10	A, D, S & R audible
01	01	07	01	'Reversed' envelope
15	01	10	13	Slow riser

Slow Attacks like the Slow Riser give you some control over a note's volume by varying the time you keep the key down.

Table of Attack, Decay & Release Times

Value	Attack	Decay	Release
0	2 ms	6 ms	6 ms
1	8 ms	24 ms	24 ms
2	16 ms	48 ms	48 ms
3	24 ms	72 ms	72 ms
4	38 ms	114 ms	114 ms
5	56 ms	168 ms	168 ms
6	68 ms	204 ms	204 ms
7	80 ms	240 ms	240 ms
8	100 ms	300 ms	300 ms
9	250 ms	750 ms	750 ms
10	500 ms	1.5 s	1.5 s
11	800 ms	2.4 s	2.4 s
12	1.0 s	3.0 s	3.0 s
13	3.0 s	9.0 s	9.0 s
14	5.0 s	15.0 s	15.0 s
15	8.0 s	24.0 s	24.0 s

The Attack times are shorter than the Decay and Release times for each of the values. Most musical instruments have rapid attacks and slower decays.

The term 'ms' means milliseconds (thousandths of a second) and 's' stands for seconds.

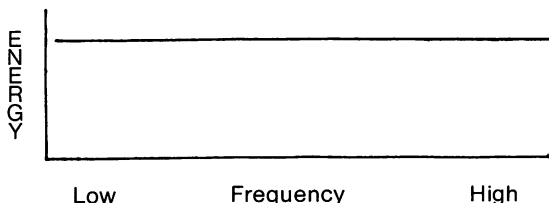
SESSION 9

ABOUT THE VCF

The Tone control on your stereo is a filter. When the tone is set to low or Bass, the sound is strong on the low frequencies (Bass notes are loud) and weak in the high frequencies (Treble notes are quiet). The opposite happens if the Tone control is set to the high or Treble setting. Some stereos have separate Bass and Treble filters. An Equalizer has many filters, each of which controls an octave or so of frequency.

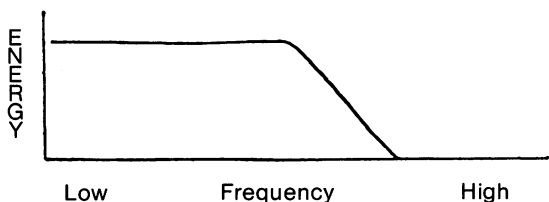
All of the waveforms made in the SID chip have energy at many frequencies. (The only sounds which are pure are sine waves. Sine waves are very dull for musical use, so the SID doesn't have them.) The VCF selectively removes some frequencies and thereby changes the sound's tonal quality.

One waveform, Noise, has equal amounts of energy in all frequencies. In the following sections, set your VCOs to the Noise waveform and Octave Option 8. Here is the Noise waveform plotted as a spectrum (energy vs frequency):



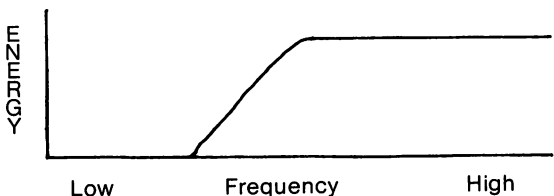
Noise has a horizontal line for its spectrum.

A filter which removes the higher frequencies and passes the low frequencies is called a Low Pass Filter. Notice that the line slopes down to the right. A perfect filter would fall off vertically — real filters fall off at different slopes. (The SID VCF has a slope of 12 db/octave.)



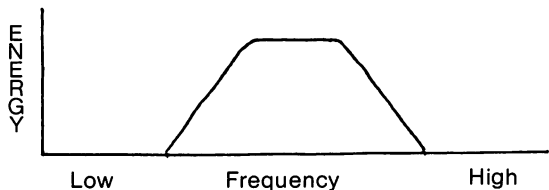
Low Pass Filter

Low Passed sounds are mellow and bassy, depending on where the cutoff is set. In a similar manner the low frequencies can be removed and the high ones passed. This is a High Pass Filter whose spectrum looks like this:



High Pass Filter

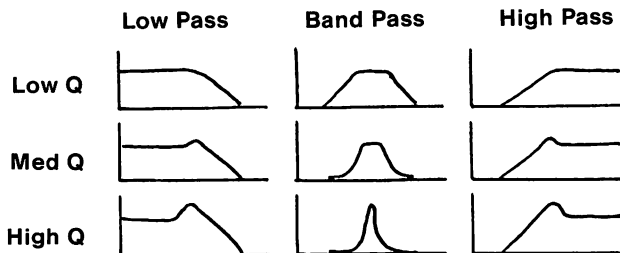
High Passed sounds are thin and tinny, depending on the frequency of the cutoff. The cutoff frequency can be varied in the VCF over a wide range.



Band Pass Filter

The third major filter mode is to remove low and high frequencies and let a band in the middle pass. (Sid says, "Band Pass Filter, of course!") The diagram above shows the Band Pass Filter's spectrum. Band Pass Filters are used in the equalizers in fancy stereo systems. The frequency in this case indicates the point of maximum sound passage.

A filter is a vibrating circuit, and in some cases it can have a higher output than input. This is called Resonance or **Q**. The VCF has an adjustable **Q** to let you enhance some frequencies. A large **Q** makes the area of enhancement narrower and the amount of enhancement high. Here are the three filter types with low, medium and high resonance.



VCF — VCO SELECT OPTION

VCO:	VCA:
123X<	V15

This box on the SYNTHESOUND 64 display has a purple part on the left (VCO) and a gray part on the right (VCA). The VCO part indicates which VCOs are connected to the SID chip's VCF and which are not. Connected VCOs are shown by number in reversed field.

Pressing F5 will count through the sixteen combinations of 1, 2, 3 and X. The VCF is connected to the numbers in reverse field. The X refers to the External Input for the SID chip.

Glitch! sez: "You have to assign your VCOs to the VCF or you won't hear the filter's effects. Be sure to assign all three VCOs to the VCF before going on, or you'll be disappointed."

"If you select the X for the VCF, the Audio In signal (Pin 5 on the DIN connector for audio & video) will be filtered and added to the VCO signals. This is for hardware nuts only!"

VCF — MODE SELECT OPTION

VCF:	>NA
0000	00

The VCF has three bits for the basic filtering modes (Low Pass, High Pass & Band Pass). Eight possible combinations exist for three bits, from all off to all on.

Pressing F5 will step through the eight combinations. A two letter symbol indicates the VCF's mode. When two or more bits are set, the pass-band of the filter is inclusive, i.e., HB (High Pass + Band Pass) allows both the middle and high frequencies to pass through the VCF. Here are the symbols:

SYMBOL	VCF PASSES
NA	Nothing
LP	Low Pass
BP	Band Pass
LB	Low Band (LP + BP)
HP	High Pass
LH	Low High (LP + HP)
HB	High Band (BP + HP)
BR	Band Reject (LP + BP + HP)

Glitch! sez: "Band Reject is a misnomer, for the VCF will pass all three frequency bands. The standard term is All Pass."

"You won't hear much until the VCF Frequency is set, so be patient."

VCF — FREQUENCY SELECT OPTION

VCF:	NA
>0000	00

The Frequency Select Option determines where the VCF pass bands are. For example, a low Frequency will Band Pass only low tones, and a high Frequency will Band Pass only high tones.

Pressing F5 increases the Frequency and pressing RETURN will decrease the Frequency. Both keys repeat to help you set the Frequency rapidly. The Frequency may be from 0000 to 2047.

Sid says, "Now you can play with the VCF. Set the Mode to BP (Band Pass) and while holding the Q key down to play a note, press F3 and then hold F5 down. The note will start very quietly and gradually grow in volume, to a maximum around 890. Then it dies down again."

"Set the Frequency to 1300 and play some other notes. Press F1 to back up to the Mode selection and try different modes. Have fun."

Glitch! sez: "The SID's filter usually makes your sounds more 'mellow.' If you don't like its performance, remember the SID is the first sound generation chip that has a filter at all!"

VCF — Q (RESONANCE) SELECT OPTION

VCF:	NA
0000	>00

The Resonance of the VCF is set in this Option. The frequencies near the Frequency setting will be enhanced in volume. Pressing F5 steps through the Q settings of 00 to 15.

Sid says, "Try Q with a Frequency of 900, the **Q** key for a tone and the BP Mode. You will notice an increase in volume of about two, which abruptly falls when you go from 15 to 00. The Resonance setting is a subtle effect which can 'fine tune' your note's timbre."

"O.K., that's the VCF Options for you. They all interact with each other, so try lots of combinations. The VCF is best heard with the jagged waveforms, i.e., Noise, Sawtooth and Pulse."

VCF — LFO 7

LFO7 > 00

LFO7 changes the frequency of the VCF in a pattern determined by the selected waveform. You can alter either the Waveform or the Rate. To hear any effect, the VCF must be active (Mode not NA and a VCO assigned to the VCF), the Rate cannot be 00 and the +DEPTH be turned on and showing the red bar. (Glitch! sez: "That's a lotta conditions, man.")

The same eight waveforms used in the VCOs are available via the Waveform Option. Press F5 to step through them. The Rate varies from 00 to 15, with 01 being the slowest and 15 the most rapid. F5 performs this selection also. (Use F1 and F3 to move between Options.)

Sid says, "To hear the effect of LFO7, set VCO1 to the Noise waveform and the ADSR to 01 07 07 07. Use EQUALIZE VCO BY #1 to copy VCO1 into VCO2 and VCO3. Now assign all three VCOs to the VCF. Set the VCF to a Frequency of 900 and Band Pass (BP) Mode. Turn on the +DEPTH all the way up with the RS key. Now set LFO7 to the Triangle waveform and a Rate of 15."

"If you can do all of that, you've mastered a lot of SYNTHESOUND 64. Now play some notes on the Solo Keyboard. I call the effect 'Super Train.' For variety, change the VCF's mode. I like to think that BP = Outside the Train, HP = At the Station and LH = Aboard the Train."

THE VCA

VCA — Volume

VCO: VCA: 123X V15<

We've seen this box before (VCF — VCO Select Option). Now we are interested in the gray VCA part on the right.

Pressing F5 steps the volume setting of the VCA through 00 to 15. This is the overall volume setting for all of the voices (i.e., all the VCOs and the External Input).

Sid says, "You know by now that the volume varies a lot depending on the VCO waveform and the setup of the VCF. Set the VCA to a low value for loud sounds and higher for the quiet ones. Some care with this lets you leave the TV or stereo volume control alone. If you are performing through several Patches, this will keep your volumes similar for each Patch."

VCA — LFO 8

LFO8 > 00

LFO8 modulates the volume of the VCA with a Waveform and a Rate Option. The waveform selection is the same as for the other LFOs and so is the Rate selection.

Press F5 to step through the Waveforms or Rates. Use F1 and F3 to select either Option. To hear the effect of LFO8, you must have +DEPTH turned on.

Sid says, "Try the original Patch that SYNTHESOUND 64 turns on with and set +DEPTH to some value. Then choose a Rate of 15. By the way, when you select SET SID 6581 REGISTER, use F1 to get to LFO8 — it's faster!"

"This effect of changing volume is called vibrato."



MODULATION OF VCOs

VCO SYNC (Hard Synchronization)

SYNC: --- <	+DEPTH
RING: ---	+PITCH

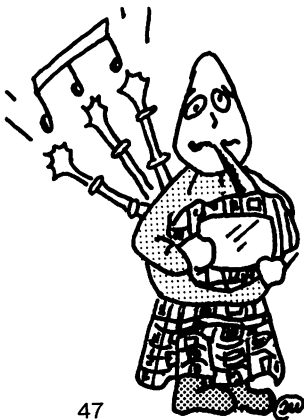
The SYNC Option forces one or more VCO to 'follow' other VCOs. For example, suppose VCO2 is SYNCed by VCO1. Every time VCO1 completes a cycle (one complete wave) it forces VCO2 to restart its wave at the beginning.

Here VCO2's Frequency is higher than VCO1 so the Triangle wave goes through about 1.25 cycles and then has to start over. These irregular and jagged waveforms will change with the keys in play and make the sound interesting. Pressing the F5 key sets SYNC to one of the eight possible combinations:

---	No effect
1<3	VCO1 follows VCO3
2<1	VCO2 follows VCO1
1&2	VCO1 mutual to VCO2
3<2	VCO3 follows VCO2
1&3	VCO1 mutual to VCO3
2&3	VCO2 mutual to VCO3
ALL	All 3 mutual

Note that < means the Backarrow symbol. To hear a nice SYNC effect set all of the VCOs to the Saw & Pulse waveform (SP). Set each VCO to Octave 02. Set the SYNC to the ALL Selection. The result is a 'Bagpiper' Patch

Try other waveforms for the VCOs and different SYNC combinations. Use the VCF to make the sounds less strident.



VCO RING Modulation

SYNC: ---	+DEPTH
RING: --- <	+PITCH

If SYNC is hard to understand, RING is even harder. If VCO2 is Ring Modulated by VCO1, the moment to moment value of the wave made by VCO1 is multiplied by the value VCO2. You might consider VCO2 to control the volume of a fast VCA whose input is the wave from VCO1. In fact, LFO8 serves as a very slow Ring Modulator for the VCA. When the frequencies are close together (within a few octaves of one another), the resulting waveform is very complicated. Many Ring Modulations sound metallic or bell-like.

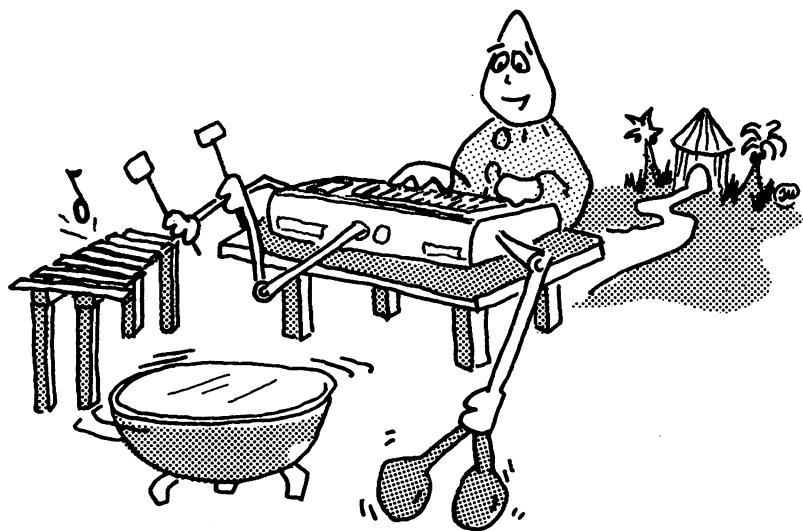
Pressing F5 selects the RING modulation combinations:

---	No effect
1<3	VCO1 modulated by VCO3
2<1	VCO2 modulated by VCO1
1&2	VCO1 mutual to VCO2
3<2	VCO3 modulated by VCO2
1&3	VCO1 mutual to VCO3
2&3	VCO2 mutual to VCO3
ALL	All 3 mutual

There's one requirement of RING modulation: The VCO being modulated **MUST BE SET TO THE TRIANGLE WAVEFORM**. If not, there's no effect.

RING modulation is good for 'spacey' sound effects. Here is an example which sounds like a Javanese Gamelan:

Set the VCO1 to Triangle Wave and the Octave to 02. Now copy this setting into the other two VCOs. Then set RING to the 'ALL' combination and play the Solo Keyboard.



SESSION 10

THE LAST SESSION

Sid says, "Here we'll tidy up a few things and then you'll be free to create new sounds with SYNTHESOUND 64. It takes a lot of work to make a good Patch and even with 256 Patches to choose from, you'll get confused about what's what. You'll also discover that it isn't easy to move a single Patch from one Disk File Number to another. (See if you can figure out how to do this. . .)

"So, it's important to keep some record of your Patches. This will let you find them in a hurry (Now which Disk File Number had that Train Patch?) and if your diskette gets mashed, it's possible to re-enter what got lost. The last page of this Manual is a sample sheet you can copy to keep your Patches recorded. Make it a habit to write down the really good ones."

"Just before the Sample SYNTHESOUND 64 Patch Chart are eleven Patches you can enter and try out."

Glitch! sez: "SYNTHESOUND 64 names the Direct Files by the Disk File Number. These names are: SD#1, SD#2 . . . SD#9. The Register Files go SR#1, SR#2 . . . SR#9. Unless your 'jam sessions' are really long, these files won't use all of the room on the disk. To make more room, rename the files to something else. Your 1541 Disk Manual explains how to do this on page 16. It is a nice exercise to write a small BASIC program to change the names automatically. There's lots of options to think about like 1) changing the names back 2) switching file names and 3) only changing some of the names."

Sid says, "This is just a dream, but a possible one. If you are a dedicated 'hacker' you can write BASIC programs that look at the Direct and Register Files made by SYNTHESOUND 64. With some care you can decipher how these files are built. I do know that: 1) The Register File is 65 Blocks long, therefore each Patch uses 64 bytes. 2) The Direct File saves the current Patch (first 64 bytes) and then records your play, possibly in the ASCII values of the keypresses or the keyboard matrix values thereof."

"Now, this raises some interesting ideas. First, you can write a BASIC program that builds Patches and moves them from file to file — sort of a super Patch Editor. Second, music can be composed from sheet music and the appropriate Direct Files built for performances in SYNTHESOUND 64. Third, your performances could be edited and cleaned up — a super Performance Editor."

"If you send any of your BASIC programs to Public Domain (pg 33) they might become available to other SYNTHESOUND 64 users."

"Happy Hacking, and especially,
Happy Music Making with
SYNTHESOUND 64."

SOME INTERESTING PATCHES

Note: In all Patches, only VCO1 is shown. VCO2 and VCO3 are identical. If the VCF is not in NA mode, all VCOs are assigned to the VCF. All 3 VCOs are assigned to the Solo Keyboard. Waveforms are: S = Sawtooth, P = Pulse, N = Noise, T = Triangle, SP = Sawtooth & Pulse, etc. More than one Rat: value after LFO1 and LFO2 are for LFO3/LFO5 & LFO4/LFO6.

Name: Super Train				Patch #: 0002
VCO1	Wav: N	Oct: 08	Pul: 0000	
	Att: 01	Dec: 07	Sus: 07	Rel: 07
LFO1	Wav: T	Rat: 00		SYNC: ---
LFO2	Wav: T	Rat: 00		RING: ---
VCF	Mode: BP	Frq: 0900	Q: 00	DEPTH: 50 %
VCA	Vol: 15			PITCH: 00 %
LFO7	Wav: T	Rat: 15		TUNE: 00 00 00
LFO8	Wav: T	Rat: 00		GLIDE: 00 00 00

Name: Mephisto's Organ				Patch #: 0003
VCO1	Wav: T	Oct: 01	Pul: 0000	
	Att: 01	Dec: 07	Sus: 07	Rel: 07
LFO1	Wav: T	Rat: 14 12 10		SYNC: ---
LFO2	Wav: T	Rat: 00		RING: ALL
VCF	Mode: NA	Frq: 0000	Q: 00	DEPTH: 50 %
VCA	Vol: 15			PITCH: 00 %
LFO7	Wav: T	Rat: 00		TUNE: 00 05 11
LFO8	Wav: T	Rat: 00		GLIDE: 00 00 00

Name: Champagne				Patch #: 0004
VCO1	Wav: T	Oct: 02	Pul: 0000	
	Att: 01	Dec: 07	Sus: 07	Rel: 07
LFO1	Wav: T	Rat: 14 12 10		SYNC: ---
LFO2	Wav: T	Rat: 00		RING: ALL
VCF	Mode: NA	Frq: 0000	Q: 00	DEPTH: 50 %
VCA	Vol: 15			PITCH: 00 %
LFO7	Wav: T	Rat: 00		TUNE: 00 05 11
LFO8	Wav: T	Rat: 00		GLIDE: 02 03 04

Name: Bronx Voices				Patch #: 0005
VCO1	Wav: SP	Oct: 32	Pul: 0000	
	Att: 10	Dec: 06	Sus: 05	Rel: 10
LFO1	Wav: S	Rat: 13		SYNC: ---
LFO2	Wav: T	Rat: 00		RING: ---
VCF	Mode: NA	Frq: 0000	Q: 00	DEPTH: 50 %
VCA	Vol: 15			PITCH: 00 %
LFO7	Wav: T	Rat: 00		TUNE: 00 00 00
LFO8	Wav: T	Rat: 00		GLIDE: 00 00 00

Name: Poltergeist			Patch #: 0006	
VCO1	Wav: SP	Oct: 32	Pul: 0000	
	Att: 10	Dec: 06	Sus: 05	Rel: 10
LFO1	Wav: S	Rat: 13		SYNC: ALL
LFO2	Wav: T	Rat: 00		RING: ALL
VCF	Mode: NA	Frq: 0000	Q: 00	DEPTH: 50 %
VCA	Vol: 15			PITCH: 50 %
LFO7	Wav: T	Rat: 00		TUNE: 00 00 00
LFO8	Wav: T	Rat: 00		GLIDE: 00 00 00

Name: Mutagen			Patch #: 0007	
VCO1	Wav: T	Oct: 08	Pul: 0000	
	Att: 01	Dec: 05	Sus: 05	Rel: 10
LFO1	Wav: SP	Rat: 14		SYNC: ---
LFO2	Wav: T	Rat: 00		RING: ---
VCF	Mode: LB	Frq: 1300	Q: 14	DEPTH: 00 %
VCA	Vol: 15			TUNE: 00 %
LFO7	Wav: T	Rat: 00		PITCH: 00%
LFO8	Wav: T	Rat: 00		GLIDE: 00 00 00

Name: Brilliant			Patch #: 0008	
VCO1	Wav: P	Oct: 08	Pul: 0200	
	Att: 00	Dec: 05	Sus: 08	Rel: 12
LFO1	Wav: T	Rat: 00		SYNC: ---
LFO2	Wav: T	Rat: 00		RING: ---
VCF	Mode: NA	Frq: 0000	Q: 00	DEPTH: 00 %
VCA	Vol: 15			PITCH: 00 %
LFO7	Wav: T	Rat: 00		TUNE: 04 05 06
LFO8	Wav: T	Rat: 00		GLIDE: 00 00 00

Name: Bar Flies			Patch #: 0009	
VCO1	Wav: P	Oct: 08	Pul: 0200	
	Att: 00	Dec: 05	Sus: 08	Rel: 12
LFO1	Wav: T	Rat: 13		SYNC: ---
LFO2	Wav: T	Rat: 14		RING: ---
VCF	Mode: NA	Frq: 0000	Q: 00	DEPTH: 50 %
VCA	Vol: 15			PITCH: 00 %
LFO7	Wav: T	Rat: 00		TUNE: 04 05 06
LFO8	Wav: T	Rat: 00		GLIDE: 00 00 00

Name: Yeech!			Patch #: 0010	
VCO1	Wav: P	Oct: 08	Pul: 0200	
	Att: 00	Dec: 05	Sus: 08	Rel: 12
LFO1	Wav: T	Rat: 13		SYNC: ALL
LFO2	Wav: T	Rat: 14		RING: ---
VCF	Mode: NA	Frq: 0000	Q: 00	DEPTH: 50 %
VCA	Vol: 15			PITCH: 00 %
LFO7	Wav: T	Rat: 00		TUNE: 04 05 06
LFO8	Wav: T	Rat: 00		GLIDE: 00 00 00

Name: **Seasick**

Patch #: 0011

VCO1 Wav: P Oct: 08
 Att: 00 Dec: 05
 LFO1 Wav: T Rat: 00
 LFO2 Wav: T Rat: 00
 VCF Mode: LB Frq: 1000
 VCA Vol: 15
 LFO7 Wav: T Rat: 14
 LFO8 Wav: T Rat: 00

Pul: 0200
 Sus: 08

Rel: 12
 SYNC: ---
 RING: ---
 Q: 14 DEPTH: 50 %
 PITCH: 00 %
 TUNE: 04 05 06
 GLIDE: 00 00 00

Name: **Summer Bugs**

Patch #: 0012

VCO1 Wav: SP Oct: 16
 Att: 12 Dec: 11
 LFO1 Wav: P Rat: 05
 LFO2 Wav: T Rat: 00
 VCF Mode: NA Frq: 0000
 VCA Vol: 15
 LFO7 Wav: T Rat: 00
 LFO8 Wav: N Rat: 15

Pul: 0000
 Sus: 04

Rel: 00
 SYNC: ---
 RING: ALL
 Q: 00 DEPTH: 50 %
 PITCH: 50 %
 TUNE: 00 00 00
 GLIDE: 01 01 01


```

+=====+
!  SYNTHESOUND 64 PATCH CHART      By:                               !
+-----+-----+-----+-----+-----+-----+-----+-----+
!Patch                                     ! File #! Reg # !
!Name:                                   !      !      !
+-----+-----+-----+-----+-----+-----+-----+
!VCO! Wave !Octave!Attack !Decay  !Sustain!Release!
! 1 !      !      !      !      !      !      !
+-----+-----+-----+-----+-----+-----+-----+
! Pulse !LFO ! Wave  ! Rate  !LFO ! Wave  ! Rate  !
!      ! 1 !      !      ! 2 !      !      !
+-----+-----+-----+-----+-----+-----+-----+
!VCO! Wave !Octave!Attack !Decay  !Sustain!Release!
! 2 !      !      !      !      !      !      !
+-----+-----+-----+-----+-----+-----+-----+
! Pulse !LFO ! Wave  ! Rate  !LFO ! Wave  ! Rate  !
!      ! 3 !      !      ! 4 !      !      !
+-----+-----+-----+-----+-----+-----+-----+
!VCO! Wave !Octave!Attack !Decay  !Sustain!Release!
! 3 !      !      !      !      !      !      !
+-----+-----+-----+-----+-----+-----+-----+
! Pulse !LFO ! Wave  ! Rate  !LFO ! Wave  ! Rate  !
!      ! 5 !      !      ! 6 !      !      !
+-----+-----+-----+-----+-----+-----+-----+
! VCF Mode ! Freq ! Q ! VCO Assignmt ! VCA Ampl !
!      !      !  !      ! 1 2 3 x !      !
+-----+-----+-----+-----+-----+-----+-----+
!LFO! Wave ! Rate !LFO! Wave ! Rate ! Solo/Accom !
! 7 !      ! 8 !      !      !      !
+-----+-----+-----+-----+-----+-----+-----+
! Sync ! Ring !Depth % !Pitch % ! Melody/Chord!
!      !      !      !      !      !
+-----+-----+-----+-----+-----+-----+-----+
!VCO Assignment! Solo 1 2 3 ! Accom 1 2 3 !
+-----+-----+-----+-----+-----+-----+-----+
!Glide ! 1 ! 2 ! 3 ! Tune ! 1 ! 2 ! 3 !
! VCOs !      !      !      ! VCOs !      !
+=====+

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HesWare
Human Engineered Software
150 North Hill Drive
Brisbane, CA 94005
(415) 468-4111
For customer service:
(800) 624-2442