

POLYPHONY™

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1981

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ELECTRONIC MUSIC & HOME RECORDING

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PORTABLE MUSIC - TAKE IT ALONG

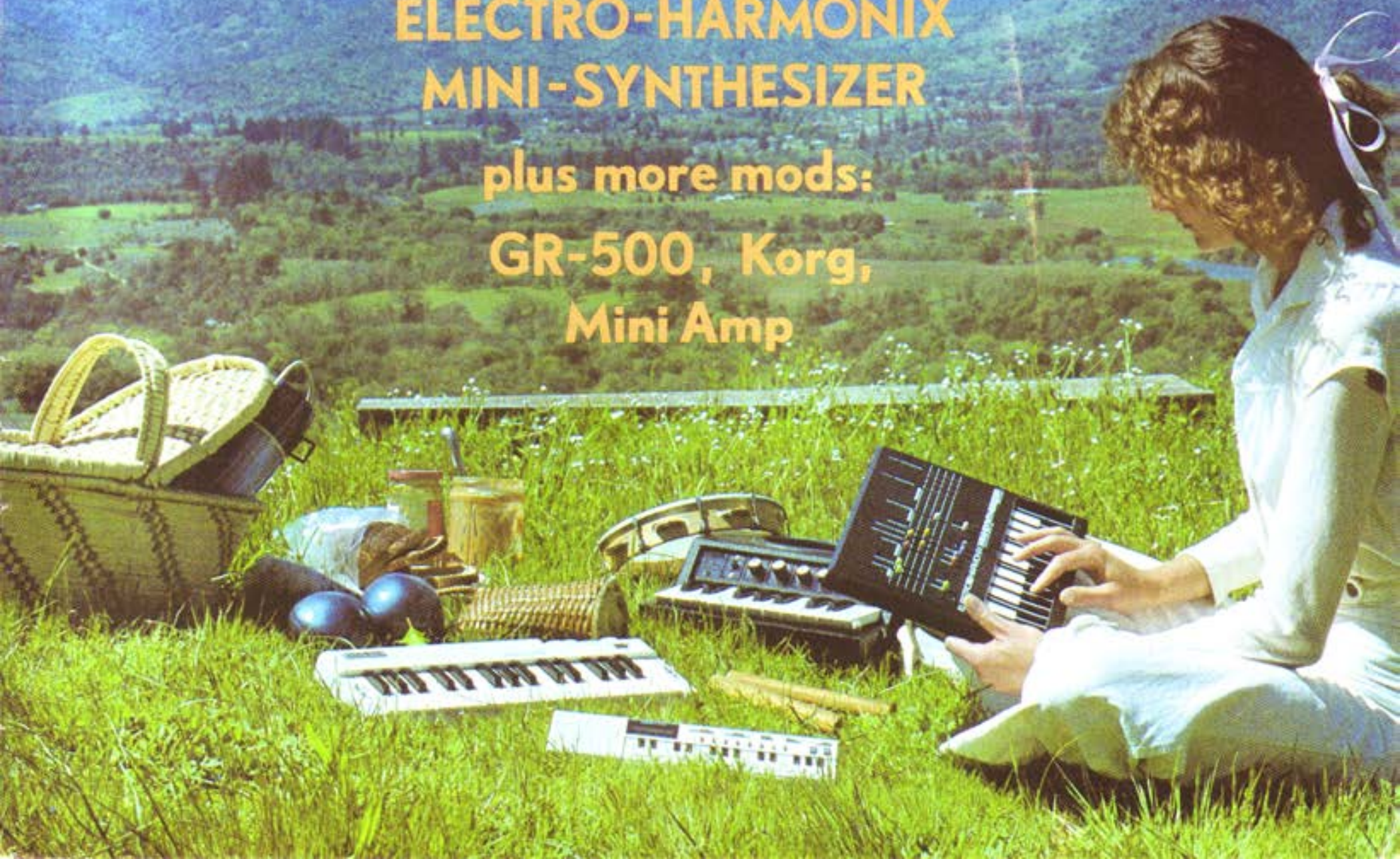
REMCO'S 'FX'

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MINI-SYNTHESIZER

plus more mods:

GR-500, Korg,
Mini Amp



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For portable synthesizers, like the CAT, Odyssey, or Minimoog, you can connect the CATSTICK outputs to the VCO, VCF or VCA inputs normally intended for footpedal controls. This lets you use the CATSTICK LFO's and control voltages to modulate the synthesizer as the joystick is moved. In patchable systems like the ARP 2600 or Modular Moogs, you can connect the CATSTICK VCA's in series with patch-cords to allow real-time control of synthesizer patches.

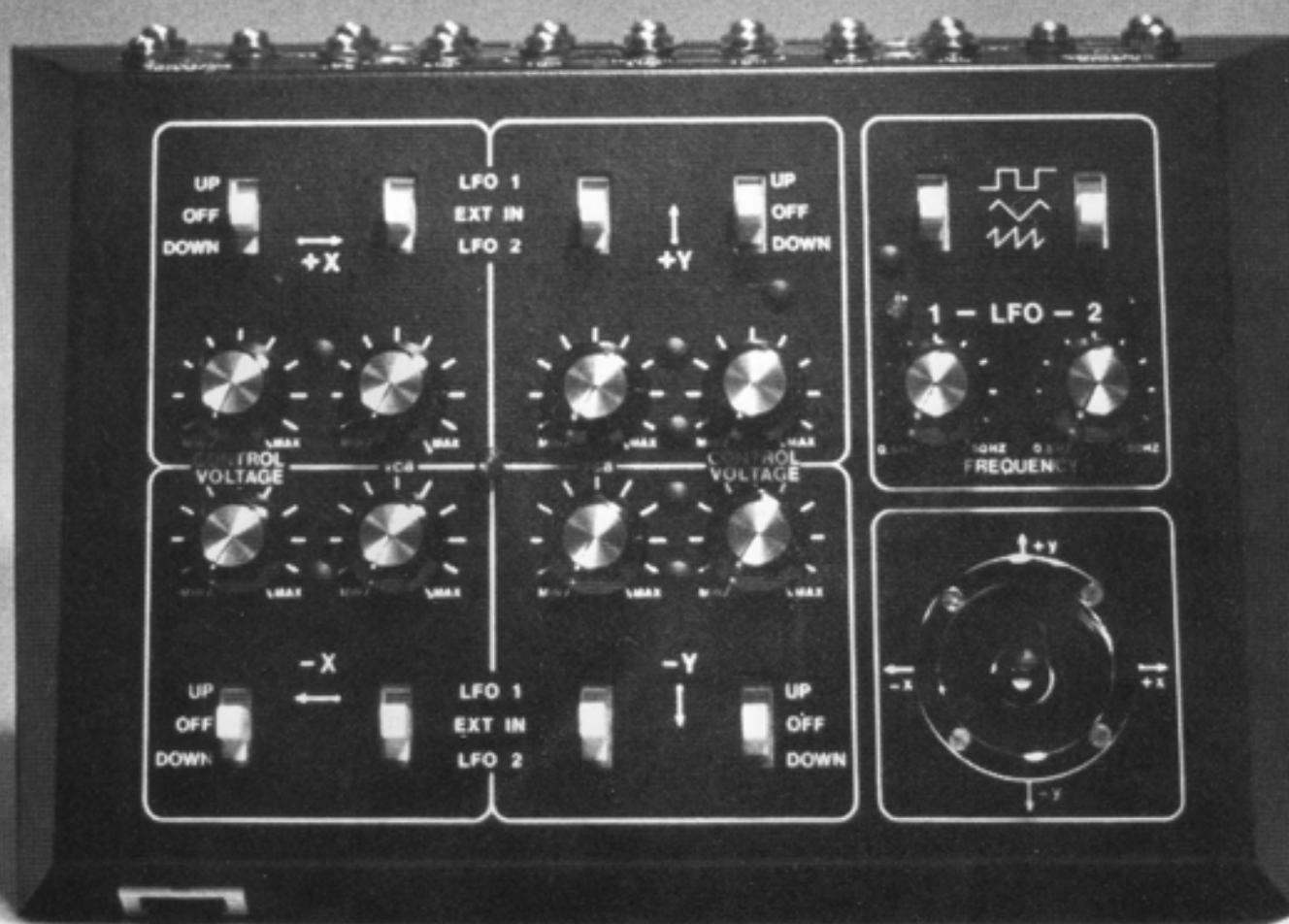
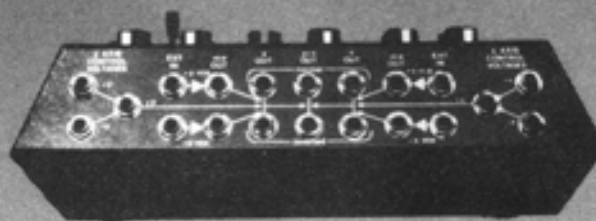
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NATIONAL
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March/April 1981

EDITOR'S note



Music has always been, to a certain degree, portable. The human voice goes anywhere humans go, as will a harmonica or flute. Carrying a guitar around is a little more difficult, perhaps, but it still qualifies as the outer fringes of "portable". However, the idea of portable electronic music synthesizers puts a different slant on the subject.

It's my feeling that synthesizers are the ultimate "people's instrument". Why? Cost, for one reason. Synthesizers are becoming lower in price all the time, and there is no reason to think this trend won't continue. Also, synthesizers are light and portable, don't need to have their strings changed, are relatively energy efficient, and can supply a wide range of timbres.

I also feel that a synthesizer is much easier to play for a beginning musician. A 7 year old can play cello sounds on a synth with relative ease - but imagine the amount of time it would take just to learn how to rosin and hold the bow if that same child were trying to learn the standard, acoustic cello. The synthesizer is not only for virtuosos; it also unlocks a whole new world of sound to those with fair to middling musical talent, or those who are only really familiar with one particular instrument. Throw in a multi-track tape recorder, and you can go a long, long way with relatively little technique.

Purists, of course, might complain that this type of thinking trivializes music. But, is music only for an elite? Is the ultimate aim of music simply to gain technical proficiency on one instrument? I think not. Music is truly the universal language, and therefore belongs to humanity. While a certain degree of technical proficiency is certainly laudable, I still feel the main reason for playing music is personal enjoyment or enjoyment shared with other musicians. To me, the true trivialization of music is judging a performer by how many notes that person can play in a second or how well he or she can reproduce someone else's compositions; isn't communication ultimately more important?

Many primitive cultures regard music as a group or social type of activity, either simply for its own sake or as the accompaniment to a ritual. In this instance all of the instruments are basically portable music, which inspires the concept of social interaction. Hey, pal, bring around your drum and let's jam...

Now the synthesizer has joined the world of portable music, and I think that means something.

Shortly after receiving my E-H Mini-Synthesizer, I took it on a trip to a lake with some friends. After making some jokes about how it could

make great duck noises, I set up some duck noises. After a few seconds of playing, ducks starting coming around. Did they think I was a duck? Or were they just interested in the sounds? I don't know, but I do know that we communicated: I provided the stimulation, and they responded. Another time I had the Mini-Synth along on a picnic, and was noodling around on a song at a very low level (I always play these instruments at extremely low volume whenever I'm in a public place, by the way) when I noticed a very young child listening to the music, as if entranced. With eyes closed, he homed in on the synthesizer and started pressing his ear and head up against the speaker holes. His father, noticing the son had drifted off, came to retrieve him. Only then did I find out that the boy was blind; we talked for a while about the fact that the synthesizer was, for whatever reason, really getting through to this fellow and creating reactions that other sound sources had never before elicited.

Clearly, portable music isn't just music; it's people, a social thing. On a plane trip, I took the portable synth along and met several people solely because I had that particular device. The interesting thing is that if you just sit off in a corner playing unobtrusively, most people will ignore you or not even notice what you're doing. But others will let their curiosity overcome their shyness, and ask what kind of instrument is that. For whatever reason, a synthesizer seems more accessible to non-musicians than traditional instruments.

The field of portable music is evolving; read the review of Casio's new VL-Tone in this issue and you'll see what I mean. What's more, it's still only 1981 - just think about the jump in synthesizer technology over the past 10 years, and it doesn't take much imagination to predict that the portable music generator of 1991 might have pretty much the same characteristics as something like a Synclavier has today.

But perhaps the most important aspect of portable music has nothing to do with the technology, but instead with the social implications mentioned above. It's about time that people stopped sublimating their musical impulses by getting bigger and better stereos, and instead picked up an instrument and started expressing themselves. Today's technology is finally making it possible for non-musicians to get involved with music, just as calculators have made it possible for non-mathematicians to have a suitable degree of proficiency with numbers.

There are a lot of people who would like to express themselves musically - all they need are the right tools and a little encouragement in order to develop their musical potential. Manufacturers are now providing the tools; it's up to people like us to provide the encouragement.

Want to bring over your synthesizer and jam?

LETTERS

Aries Owner

(We recently received a letter from Raphael Walrond, a disgruntled Aries Synthesizer owner - and Polyphony reader - in Trinidad. We asked Ron Rivera at RMS to help him out; below is an excerpt from Ron's letter:)

Thank you for referring Mr. Walrond's problem to us. We are indeed handling all inquiries for the Aries modular system; we have been concerned for the customers left flat when Aries went out of business, and want to help them as much as we can. Despite notifying everyone on the Aries mailing list, sending out press releases, and mentioning the takeover of the Aries product line in our ad, there are still some people whom we haven't reached. If you know of any others, please refer them to us.

Ron Rivera
Rivera Music Services
48 Brighton Avenue #11
Boston, MA 02134

Editor's note: I'm sure owners of Aries Synthesizers will appreciate Ron's conscientious attitude. However, it should be noted that Rivera Music Services is, and always has been, a different entity from Aries; it is therefore in no way liable for the financial liabilities that remained when Aries went out of business. As a result, their ability to aid owners of Aries system is limited to helping them complete systems and offering technical advice or servicing.

Patch...Update

People using the "Creating Spaces in Sequences" patch presented in the Nov/Dec 1980 issue may experience problems in some applications when trying to hard-patch the gate and voltage outputs as shown. Here are three improved versions:

1. Using a summer instead of hard-patching allows Sequencer 2 to step as Sequencer 1 leaves a stage that's set low. The gate output was attenuated about 80% before summing - set it just low

enough so that Sequencer 2 doesn't step on every stage of Sequencer 1.

2. Adding an inverter steps Sequencer 2 as Sequencer 1 enters a stage set low.

3. In the figure, the gate output of Sequencer 1 is inverted and left unattenuated. Sequencer 2 steps in time as Sequencer 1 leaves a stage set low, but steps with a delay set by the gate duration of Sequencer 1 as this sequencer leaves a stage set high.

All of the above patches work more reliably (with a wider range of equipment) than the original "Creating Spaces" patch, and therefore open up many new timing possibilities.

Chris Meyer
Terre Haute, IN

Digital VCO

Here's an idea concerning the Digital VCO in the July/August 1980 issue. By using switches (logic "hi" - logic "lo" toggles, for example) you could treat this module as a programmable waveform generator. While this application may not be glamorous, it does not require a microcomputer. Given the high cost of quality pots and the need for at least 10 - 16 stages to make an analog implementation, this could be very cost-effective alternative to analog techniques.

I look forward to continuing to receive your fine publication in the future.

David Vosh
Gaithersburg, MD 20760

strings

Editor's note: I recently heard a tape from Thomas Henry that had an excellent synthesized string sound. I asked how he got it, and received the following reply:

The strings were done like this. First, I chorded a full string section on my 5 octave custom Organtua, with a fairly long attack time. Now clearly, Organtua by itself isn't designed to give string sounds, so I then added one synthesized string line on top of that. The ears are fooled into hearing all of those notes (Organtua and the synthesized string) as having the same characteristics. And the sound isn't too shabby, if I do say so myself!

Thomas Henry
Coralville, Iowa

CRYSTALS

For a project in my electronics class I built the A 440 Tuner (project #16) from Craig Anderton's "Electronic Projects for Musicians" book (first edition). I had to buy enough crystals for a minimum order, which means I have 8 surplus crystals available. If anyone is looking for one of these, they are available for \$10.00 each.

Michael Lanza
4023 Maxwell Road
Colorado Springs, CO
80909

MXR Owners

For those guitar players that own MXR Distortion + fuzzes, to reduce the noise try replacing the 741 in that circuit with a TL081 single bifet (available at Radio Shack). It won't be quiet, but you will notice a difference. If you use an 8 pin DIP socket, you can try a handful of 741 compatible ICs and select for lowest noise.

And - how about a circuit for matching balanced lines to Hi-Z lines?

Steve Campana
El Cajon, CA

The Mean Little Kit



New compact 24-piece kit of electronic tools for engineers, scientists, technicians, students, executives. Includes 7 sizes screwdrivers, adjustable wrench, 2 pair pliers, wire stripper, knife, alignment tool, stainless rule, hex-key set, scissors, 2 flexible files, burnisher, miniature soldering iron, solder aid, coil of solder and desoldering braid. Highest quality padded zipper case, 6 x 9 x 1 3/4" inside. Satisfaction guaranteed. Send check, company purchase order or charge Visa or Mastercard. We pay the shipping charges.
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setting up and using a multitrack

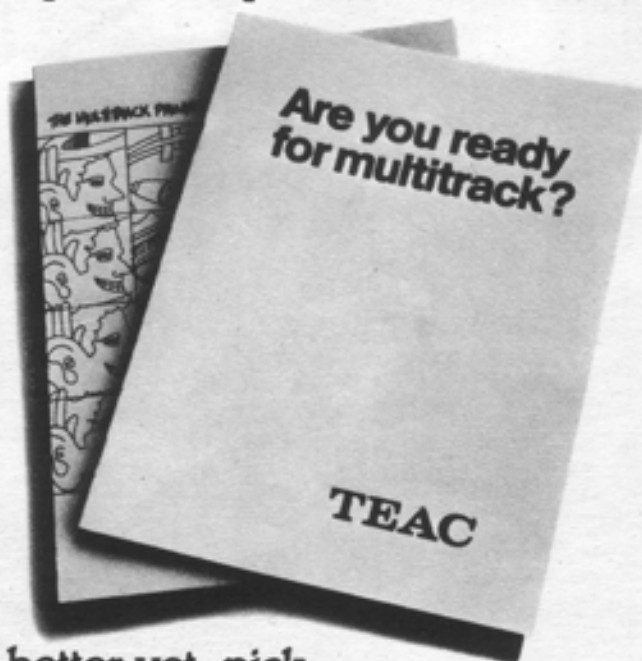
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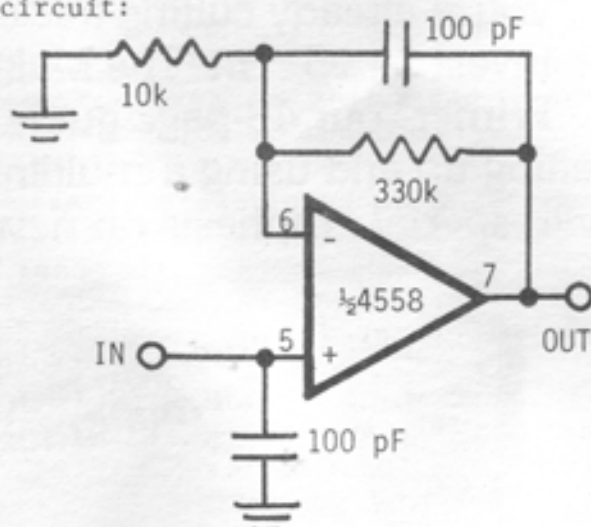
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MODIFYING the GR-500 Guitar Synthesizer

by Gary Cowtan

This article will describe how GR-500 owners can add a number of modifications to improve the straight guitar sound. The main problem seems to be the humbucking pickups, which being low impedance, don't have the characteristic resonance (2 - 3 KHz) of a higher impedance Gibson or DeMarzio pickup. Due to the low output level of this pickup, there is a preamp built into the guitar body under the rear cover. The schematic below shows the GR-500's standard circuit:



The IC is one half of a 4558 (dual 741) op amp. I replaced the standard humbucker with a DiMarzio P.A.F. which I modified with a coil tap. The high output from this pickup overloaded the preamp, so I changed the 330k resistor to 47k to prevent distortion. You can leave the 100 pF capacitor as is, since this rolls off the gain starting at about 30 KHz - way above the response of the pickup.

I next removed the so-called 3-way "EQ" switch and replaced it with a DPDT switch for the pickup coil tap. I then replaced the .047 uF capacitor connected to the tone control pot (which is 500k, so it can be left alone without having to worry about loading down the high impedance pickup) with a .022 uF type, which gave a more useful range with the P.A.F. pickup. With regards to the electronics, I removed the 4558 preamp IC located nearest the end of the instrument, soldered in an 8 pin socket, and plugged in a TL072, which is pin compatible (National's LF353 will also work - Ed.). I used a socket, because IC technology is changing so fast that next year there might be something better available and I would want to be able to try it out without doing any more soldering. I had considered changing all seven 4558s in the guitar to TL072s, but my local supplier ran out of them and won't get any more for six months!

It is also a good idea to add a separate output jack for the guitar pickup. When holding the guitar in a playing position, there is room for this jack just above the multipin connector. Use a closed

circuit type to switch the active circuitry out of the signal path when a plug is inserted. This facilitates using an electronic tuner backstage, without having to take the synthesizer console into the dressing room - roadies don't seem to dig that. It also, of course, allows you to plug the guitar into an amplifier in the conventional manner. This will, however, mean rewiring the volume control (for the guitar sound) unless you use a foot pedal volume control, as I do. Normally, the guitar volume control is wired after the preamp; for this application, it would need to be connected between the humbucker and tone pot.

Another tip involves the triggering response of the synthesizer section, since it can be adjusted more than Roland's instruction book would have you believe. You may find, as I did, that after setting the height of the hex synthesizer pickup and the threshold control on the console, different strings still trigger differently. Well, alongside each of the aforementioned 4558 ICs is a trimmer that sets the triggering threshold of each individual string. The IC closest to the neck is for the low E string, with the next one down for the A string, then the D string, and so on. One word of warning: if you don't stick to one brand and gauge of strings, you will be forever resetting these pots! Speaking of strings, many of the triggering problems associated with guitar synthesizers are due to dead strings: they must be changed VERY often. Otherwise, the hex pickup has a hard time trying to determine what note is actually being played; also, an adequate signal level leads to better sustain characteristics.

Two more tips, more of a mechanical nature, but which aid the triggering and the straight guitar tone: replace the bridge with an all brass, heavy-duty construction replacement such as the Might Mite Tunamatic, and replace the nut with a brass type as well. This gives the instrument itself more sustain, and makes life easier for the pitch to voltage converter and envelope generators. I have found that Gibson Equa strings (.009 - .038) give a good uniform response but you have to change them often.

Finally, a few words about the synthesizer sound. Basically, the GR-500 is a one-oscillator synthesizer, which can tend to sound rather sterile. You can, however, mix the "Solo Melody" with the "Polyensemble" (which is really a hex-fuzz) and detune the former slightly, to give a fatter sound. If you then run the whole thing through a stereo setup with a stereo chorus unit such as the Roland "Dimension D" or a stereo flanger such as the Dynacord TAM19 (pricey, but good); it livens up your sound no end!

I hope these tips help you get more enjoyment out of the GR-500.Σ



re-view

by Robert Carlberg

With increasing numbers of local record stores cutting back on the high-cost, low-profit import market, ordering records by mail is becoming more and more popular. Luckily, the quality and quantity of mail order record houses has grown to fill the need, some offering services no record store offers. The following is a partial list of the better-known record vendors.

Aeon Import Records (604 Princeton, Fort Collins, CO 80525 - tel 303-484-0963 or 303-221-1576). Specializes in obscure independent and private releases. Includes electronic, new jazz, avant garde classical, and unclassifiable. Prices range from \$6.25 to \$8.00 per disc, and service is reported excellent from all corners.

Ikon Records (PO Box 456, Salamanca, NY 14779 - tel 716-945-1661). A division of the International Electronic Music Association located at the same address, Ikon offers a wide variety of progressive rock, jazz, and electronic albums. Prices and selection are reported quite good, but stock is limited; this sometimes leads to delays of two weeks or more in shipment.

Moby Music (formerly Moby Disc; 14410 Ventura Blvd., Sherman Oaks, CA 91423 - tel 213-996-6754). Domestic and imported progressive rock and electronic music from one of the original mail order houses. Prices range from \$5.79 upwards; selection and delivery rated good.

New Music Distribution Service (500 Broadway, New York, NY 10012 - tel 212-925-2121). Non-profit distribution for private, independent, "new" and experimental discs. Selection is far-ranging, prices a reasonable \$6.00 for most discs, and service is prompt.

Out Music Co., Inc. (PO Box 7129, Baltimore, MD 21218 - tel 301-467-9140). Progressive rock, jazz, and electronics, specializing in independents. Prices are good; no reports yet on service.

Paradox Music Mailorder (2730 Monterey #104, Torrance, CA 90503 - tel 213-373-1262). One of the largest mail order operations, with extensive selection. Prices (\$8.00 most discs) aren't a bargain but are within reason. Service is prompt and friendly.

Passport Imports (formerly Intergalactic Trading Co.; 3146 E. Burnside, Portland, OR 97214 - tel 503-233-0916). Not a record vendor per se, but a service offering cassette copies of rare, out-of-print important electronic albums, mostly from Germany. Prices are a reasonable \$2.00 for dubbing, plus the tape. Quality of the dubs is excellent. Unfortunately, it's a one-man operation on a time-available basis, sometimes taking a few weeks to deliver. Worth the wait, nevertheless.

Rather Ripped Records (1878 Euclid Avenue, Berkeley, CA 94704 - tel 415-848-6495). Progressive rock and electronic from another long-standing mail order house. No report at presstime of either prices or service.

Recommended Records (583 Wandsworth Road, London SW8, England - tel 6228834). Progressive and politically-active rock, with several titles not usually found elsewhere. Shipping is airmail continued on page.....20

We want you to participate in this column by sending us your electronic music albums for review. As the world's largest and oldest electronic music journal, we are in a position to give maximum exposure to your releases. Whether your disc is on one of the larger corporate labels or privately released, you can make the most of your promotional budget - whether six figures or two - by including us on your promotional copy list.

Of course we can't guarantee a favorable review to anyone; an untruthful review is worse than none at all. What we can guarantee is that your album will be heard, considered, analyzed and, if we feel it merits the space, explained to the readership. Polyphony's long-standing "Do-It-Yourself" philosophy, coupled with our sincere interest in alternative music styles, means that we will never dismiss an album simply because of an unusual approach. Every effort is made to consider each album on its own terms, in recognition of the diverse vitality that makes electronic music great.

Records for review should be sent to:

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We'll be looking for you!

CURRENT EVENTS

'Tell Them You Saw It In Polyphony'

Literature

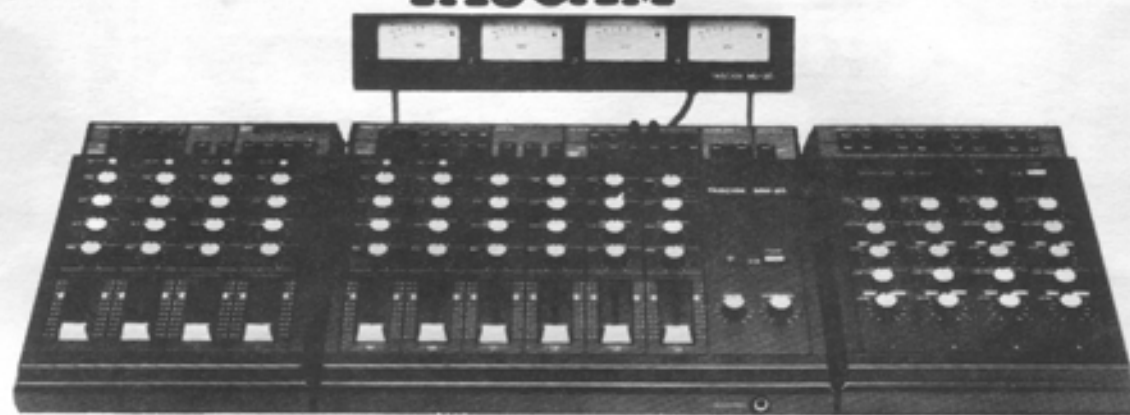
NEW BOOKS. Musical Applications of Micro-processors" (by Hal Chamberlin and published by Hayden Book Company, Inc., Rochelle Park, NJ) is a large (661 pages), well-written, comprehensive treatment of how microcomputers and synthesizers work together. Well worth the \$24.95 price, this book will excite old pros as well as newcomers to the field of computer controlled synthesis. Hardcover.

"The Musician's Guide" (6th edition) is published by Marquis Who's Who, Inc. (the same people who publish "Who's Who in America"). Its 960 pages include information such as music associations and societies, state arts agencies, music libraries, music periodicals, newspaper music editors and critics, opera companies, schools, certified music teachers, colleges and conservatories, workshops and music camps, festivals, entertainment lawyers, personal managers, booking agents, record companies...you get the idea. If your career is music, this sounds like a most helpful reference. Copies are available for \$59.50 plus \$2.50 postage and handling from Marquis Academic Media, 200 East Ohio Street, Chicago, IL 60611.

"How to Build a Small Budget Recording Studio from Scratch" (by F. Alton Everest and published by TAB Books, Blue Ridge Summit, PA 17214). Emphasis is on practical considerations involved in constructing a small recording or audio-visual studio, with twelve tested designs for specific types of studios (multitrack audio, commercials, TV, etc.). \$8.95 soft cover.

CURTIS CHIP NEWSLETTER. Curtis Electromusic Specialties (110 Highland Ave., Los Gatos, CA 95030) is now offering a quarterly newsletter, Synthesource, that covers developments in the Curtis line of electronic music ICs. The first issue is 16 pages long, and contains information on new products, an interview with Tom Oberheim, a detailed discussion of the 3340 VCO chip, an improved compensation scheme for their VCA, and unusual ways to apply the 3310 envelope generator. Subscriptions are \$12.50 per year.

TASCAM



TASCAM INTRODUCES MODULAR MIXING APPROACH. The System 20 modular mixing system operates much like an electronic patch bay, in that the operator has access to all signals at all relevant points along the signal path. The basic unit in the system is the MM-20 Master Module (\$395 list), with six inputs (two transformer isolated microphone inputs), six output busses (stereo line, monitor, and cue), and provisions

for four track monitoring. The PE-20 module (\$350 list) includes four channels of 3 stage parametric type equalization (low 60 Hz to 1.5 KHz; mid 1.5 KHz to 8 KHz; high fixed at 10 KHz; all ranges include ± 12 dB level control). The EX-20 module (\$350 list) includes additional transformer isolated inputs in groups of four, while the MU-20 meter module (\$150 list) completes the system.



TWO NEW TASCAM RECORDERS. Recognizing the need for more cost-effective multi-track equipment, TASCAM has introduced the 22-4, a compact 4 track 15 IPS multichannel recorder with sync functions and a high speed 7" transport. Features include function and output select,



headphone monitor select, pitch control, optional dbx interface, and remote pause controls. A companion deck, the 22-2, is a compact 15 IPS half-track recorder designed for mastering and mixdown. Both units are 3 motor, 3 head transports. The 22-4 lists for \$1,425; the 22-2 for \$750.

A/Delay



NEW WAY TO DELAY. A/DA (2316 Fourth Street, Berkeley, CA 94710) has just introduced the STD-1 Stereo Tapped Delay. This voltage controlled analog delay unit has 6 individual taps, each of which may be routed to one of two summing busses; extensive mixing and modulation options

allow for such effects as negative or positive flanging, chorusing, voice doubling, multi-voice chorusing, true stereo chorusing that will not cancel in mono, echo, "machine gun" reverb, and many other effects that nonetheless retain full audio bandwidth.

CURRENT EVENTS

TELL 'EM

GG-1

NEW BOOSTER. The GG-1 by Furman Sound (616 Canal Street, San Rafael, CA 94901) is a general-purpose signal booster & single stage parametric equalizer designed for installation in guitars, basses, and keyboards. The GG-1 measures 3.25 x 1.5 x 0.75 inches and includes controls for frequency (100 Hz to 5 KHz), boost/cut (± 17 dB), and volume; there are also screwdriver adjustable trimpots for customizing gain (0 to 20 dB) and bandwidth (0.2 to 2.5 octaves). The GG-1 features a buffered, low impedance output for driving long cable runs, comes complete with installation instructions, and lists for \$80.

speakers



SOMETHING NEW IN SPEAKERS.

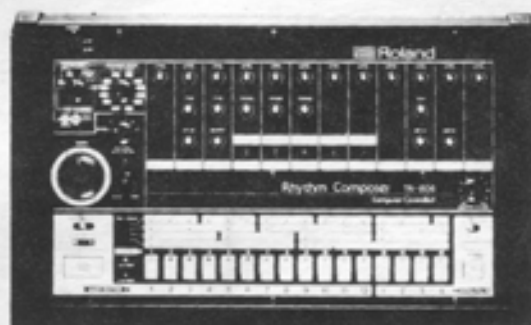
Audio Electronics Systems, Inc. (101 North Park Street, East Orange, NJ 07017) has introduced a line of three hi-fi loudspeaker systems featuring the first U.S. produced solid flat woofers and soft-dome tweeters. The new line is called the PC (for Phase Coherent) Series. The flat woofers use a solid, flat high-density cell structure with expanded polystyrene diaphragms. Suggested resale prices for the three loudspeaker systems range from \$150 each for two-way systems, to \$550 each for the top-of-the-line four-way system.

E-mu



E-mu Systems has introduced the Emulator, a computer-based polyphonic instrument that allows the musician to digitally record any sound - either live from a microphone or a line level source - and then to play that sound at any pitch over the range of the Emulator's 8 octave keyboard. A split keyboard allows simultaneous control of two independent sounds; a built-in disk drive allows storage of sounds on diskettes (the instrument comes with a library of pre-recorded sounds and special function software). Self-contained and portable, the Emulator requires no special programming skill or knowledge of computers.

rhythm



ROLAND'S TR-808 RHYTHM COMPOSER MAKES DEBUT. Roland Corp US (1285 Mark Street, Bensenville, IL 60106) has introduced the TR-808, which allows the user to write and record 32 percussive rhythms incorporating up to 11 different sounds plus accents. Rhythm patterns can be written with up to 64 steps per measure, which also allows the generation of odd time signature rhythms (such as 5/4 or 7/8). Once the various rhythm patterns are written and stored in computer memory, they can be arranged to perform an entire composition's percussion track by means of a Compose function. The Composed track can last up to 768 measures in its entirety, or can be broken into twelve different segments of 64 measures each for playing twelve different songs.

Aries

Rivera Music Services (48 Brighton Ave., Allston, MA 02134) has taken over production of the Aries synthesizer line. Older modules will be supported, and several new modules are planned for introduction this year.

Effects

DAN ARMSTRONG MODIFIERS BACK IN PRODUCTION. Beigel Sound Lab (24 Main Street, Warwick, NY 10990) now manufactures the Dan Armstrong line of effects. These effects, formerly made by Musitronics, are compact little boxes that plug directly into guitar and other instruments. Units include the "Orange Squeezer" compressor, "Blue Clipper" fuzz, "Green Ringer" pseudo-ring modulator, "Purple Peaker" filter & booster for guitar, "Yellow Humer" filter & booster for bass, and "Red Ranger" preamp/equalizer. List price for each product is \$39.50.

SOFTWARE



PROTEUS I SOFTWARE PACKAGE.

PAIA Electronics (PO Box 14359, Oklahoma City, OK 73114) has announced an Apple II compatible software package for the Proteus I programmable preset lead synthesizer. This software allows over 800 presets to be named, annotated (including visual display of all control settings), and saved on a single Apple II disk. Price is \$34.95 plus \$3 postage and handling.

E-H

MINI-SYNTHESIZER REVIEW



a
hands-on
report

by Craig Anderton

The Electro-Harmonix Mini-Synthesizer is one of the few American-made pieces of portable music equipment (PAIA's Oz notwithstanding), and interestingly enough, it's selling pretty well in Japan. The difference between the Mini-Synth and something like the M-10 is the classic difference between organ and synthesizer: the M-10 produces a limited number of polyphonic, organ-like sounds, whereas the Mini-Synth creates many possible tonal variations on a basic monophonic sound. Which is best for you? Read on...

The general story. The Mini-Synth (M/S for short) is lightweight and small: 12-1/2" X 10-1/2" X 1" (not including switch caps). While E-H would lead you to believe that the two 9V batteries don't last very long, in practice they last for at least a couple of months if you don't play at too loud a volume. The M/S fits easily into a suitcase, knapsack, or back seat of your car. Its plastic case is relatively tolerant of abuse, although the cardboard bottom is not a model of sturdiness. The bottom isn't a problem if you treat the instrument with even a minimal amount of care.

The keyboard is closer to regulation size than the Casio M-10 keyboard, but more importantly, you're still closing a switch when you hit each note, and the motion required to close the switch is so small, and the required actuation pressure so light, that the feel is for all practical purposes touch-sensitive. This is one of the few keyboards I've ever played where you can "finger-paint" your notes if you so desire.

The internal speaker is of necessity pretty small, but E-H does include an output jack for feeding an external speaker as well as an AC adapter jack if you plan to play at loud volume for extended periods of time.

The slide pot controls and switches. The M/S is quite simple to operate. You turn on the power switch, turn up the master volume, and you're ready to go. Here are the major control categories:

Pitch related controls. The M/S includes a Pitch Bend control covering a one octave range (suitable for pitch bending or fine tuning), a Sub-Octave control that brings in an octave below sound, and an Octave switch that shifts the range of the keyboard down an octave for some fat bass sounds. There's also a Tune trimpot for adjusting the scale of the keyboard, but I haven't had any need to use this yet.

"Phaser" related controls. A Phase switch determines the mode of the Phase Rate control. With the Phase switch down, the Phase Rate adjusts the pulse width of the sound; with the switch up, Phase Rate adjusts the speed of an LFO that varies the pulse width. Turning up the Rate decreases the depth of the effect simultaneously. Since the sound of pulse width modulation resembles phasing, that explains the labelling for these controls.

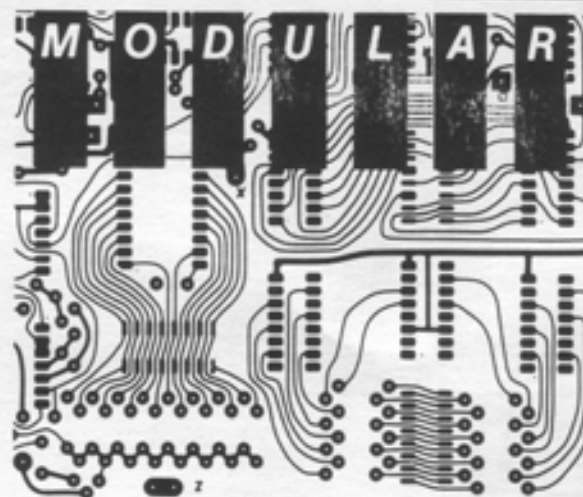
Filter related controls. There are three pots, Sweep Start Freq, Sweep Stop Freq, and Sweep Rate. This circuitry has been found before on other E-H equipment, and gives you many options considering the small number of controls. Sweep Start determines where the filter will start its sweep; Sweep Stop determines where the sweep will stop; and Sweep Rate determines how long it takes the filter to travel from the start point to the stop point. For example, if Start is set higher than Stop, the filter will sweep from high to low. If Start is set lower than Stop, the filter will sweep from low to high. In either case, Rate determines the time of this sweep action. If Start and Stop are set at the same level, the filter doesn't sweep but rather filters at a single frequency.

There are three switches associated with the filter: 2X Filter, Q, and a mysterious Sens switch. This is definitely not your normal 24 dB per octave low pass filter; it sounds more like some kind of complex-bandpass response, but does give some novel, voice like sounds. Engaging the 2X Filter seems to basically cut off highs for a mellower sound, while Q increases the Q by a fixed amount when switched upward.

The Sens control...well, I took the synthesizer apart (there was a dirty keyboard problem that had to be fixed when I first got the unit), and can report that E-H has stuck a miniature crystal mic underneath the middle key of the keyboard that senses dynamics. If you set the filter Start and Stop controls at a relatively low setting, hitting a note on the keyboard - and I do mean hit - will kick open the filter if the Sens control is on. How useful is this feature? Not very, in my opinion, although it is fun to occasionally bash the keyboard and listen to the filter respond to these bashings.

Overall Evaluation. The E-H has more of a toy element than something like the M-10, but interestingly enough, creates some sounds that are very useful from a musical standpoint. Considering continued on page32

SERGE



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Creating



(In the Nov/Dec issue of Polyphony, Richard Wolton described how to add more voices to Casio's M-10 portable keyboard. Now, Robin Whittle, an electronics technician in his mid-20s from Australia, passes along some extremely useful mods that will make your Casio do some truly amazing things.)

The Casio M-10 is a battery-operated, handheld, polyphonic keyboard whose unique features and low cost have made it very popular. The heart of the Casio is a large integrated circuit which contains a small computer that also includes the electronics necessary to make actual sounds. This chip is capable of many functions not included in a stock M-10, including the ability to select additional voices, a milder vibrato, sustain, a "hold" function whereby single notes or chords are held until a new key is depressed, and an octave drop that shifts the whole keyboard down exactly one octave. We will not only describe ways to include the above functions (except for the extra voices, which was previously covered in these pages), but also a hardware octave drop that adds an entirely different kind of octave lower sound.

However, before you turn on your soldering iron please beware of the following:

- The modifications, which require one CMOS IC and some miniature switches, have to be made with great care as there is very little space in which you can work. Also, you will void any warranties on the unit when you take it apart.

- If you don't possess a fine soldering iron and a good understanding of digital electronics, then pass the job onto someone who does or you risk hours of confusion and possible damage to your instrument.

- The modifications which worked on my M-10 (bought in December 1980 - serial number 1016489) may not work if Casio changed the internal programs prior to making yours.

- Be very patient and slow in your work. Take the time to dress wires correctly and double-check your work at every step of the modification process.
- There are many static sensitive parts in the M-10. Make sure that you, the M-10, and your soldering iron are all properly grounded to avoid any possibility of static blow-out.

If you follow the above precautions, several hours work and a few dollars worth of parts will transform your Casio M-10 into an instrument with powers and abilities beyond those of any other portable instrument, in short, a SUPER-CASIO (Look! Up in the sky! etc.). Put some of these sounds through a decent sound system and you won't believe it's your little M-10 doing all this magic.

DISMANTLING THE M-10. The following steps allow you to have complete access to the insides of the M-10.

1. Use a smooth rounded dinner knife to pry off the three slider knobs. Note that the vibrato knob has a slightly smaller hole than the others.

2. Remove the 5 Phillips head screws from the bottom of the case.

3. Take the knife used in step 1 and insert the side opposite the cutting edge in the encircling seam that goes around the instrument. A good place to start is the part of the seam located just below key #13 (counting from the bottom up). Wiggle the knife up and down, and separate the top and bottom case halves with a prying motion. (Caution: the plastic used is quite soft, so be careful not to mark or scratch it with the knife.) Eventually you will hear a snap, which means that the little clip holding the two halves together has released the top of the case. Do not try to separate the two halves just yet; the snap sound means you're on your way, so continue the process by moving the knife progressively further along the seam. Keep using the same type of prying motion, and you will eventually release all four clips located along the front of the case. Then, release the four clips along the back of the case in a similar manner. At this point, the top of the case should separate easily from the bottom of the case.

4. At the left end of the battery compartment is an exposed battery contact with 7.5 Volts on it. Put some insulation tape over it so it can't touch anything.

Five New Modifications by Robin Whittle

5. Undo the two small Phillips head screws that attach the switch panel (vibrato, voice, volume) to the bottom part of the case. Since this will create two unfastened lugs, undo the left screw that holds the vibrato switch on the plate and re-attach the lugs between the screw head and panel. Be careful that the lugs are secured in such a manner that they don't interfere with the motion of the vibrato switch.

6. Undo the four screws that hold the keyboard frame onto the case and undo the two screws holding the switch panel to the keyboard frame. Put all these screws in a second pile.

7. Lift up the keyboard and turn it over on to something soft so that you can remove the 6 screws holding the circuit board to the keyboard frame. Lift the circuit board towards you. Take out one of the little grey plastic cups from the keyboard and store the keyboard so that dust will not get on the conductive rubber contacts.

8. Observe the foil side of the board, as that is where we will start the modification process. Note that each keypad has a small, gold plated circle of interlaced conductors; be very careful not to get grease or fingerprints on these important contact points.

9. Put the circuit board down in the case again and verify that your Casio still works by pressing the contact cup you just souveniered from the keyboard on to one of the gold-plated keypads.

MODIFYING THE VIBRATO. The stock vibrato sound of the M-10 is pretty drastic, and there are many times where a milder vibrato would be far more musically useful. To change over to this milder vibrato, locate the keypads associated with keys 23 and 26 on the foil side of the board; we will be working on the part of the circuit board that lies between these two keypads. Referring to figure 1,



Figure 1

cut the traces at A and B and add jumpers between C and D as well as E and F. Use either wire wrap wire or very fine wire (Vector wiring pencil wire, etc.) as any other type will take up too much space. You should now be able to play your M-10 and try out the new vibrato.

OCTAVE DROP, HOLD, AND SUSTAIN. This modification involves adding three switches and three diodes. Ultra-miniature switches can be added in the space in the upper case half, to the immediate right of the M-10's highest key. However, be careful that the switch tabs don't come into contact with any metal parts of the keyboard bracket, and **MAKE SURE** that your switches will fit comfortably when the unit is re-assembled before you even think about drilling the holes for these switches.

Figure 2 shows the circuit we wish to construct; I mounted the diodes on the switches and made the wires running between the keyboard and switches about 8 inches long. The connections to the M-10 were made on the component side of the board in the following way:

S1: Solder to the anode lead of the diode which goes to the pad labelled D in figure 1. S2: Solder to the anode lead of the diode which goes to the pad labelled F in figure 1. If you have not modified the vibrato as detailed in the last step,

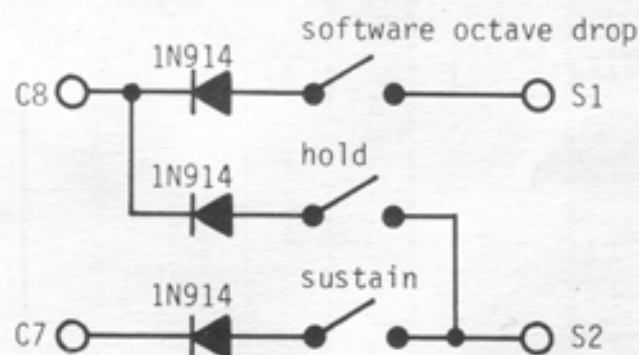


Figure 2

solder to the anode leads of the diodes which go to pads E and F instead of D and F.

C8: Solder to the jumper wire labelled J-1B between keypads 29 and 30.

C7: Solder to the jumper wire labelled J-G between keypads 22 and 23.

To protect against static damage to the main chip the metal parts of the switches must be grounded. A ground point is available at jumper J-A between keypads 30 and 31. You should now be able to use the octave drop, hold, and sustain functions.

HARDWARE OCTAVE DROP. This involves adding an extra IC to divide the clock frequency by two when a switch is flicked. The circuit is shown in figure 3; a 4013 D-type flip-flop and a switch insert (continued.....on next page)

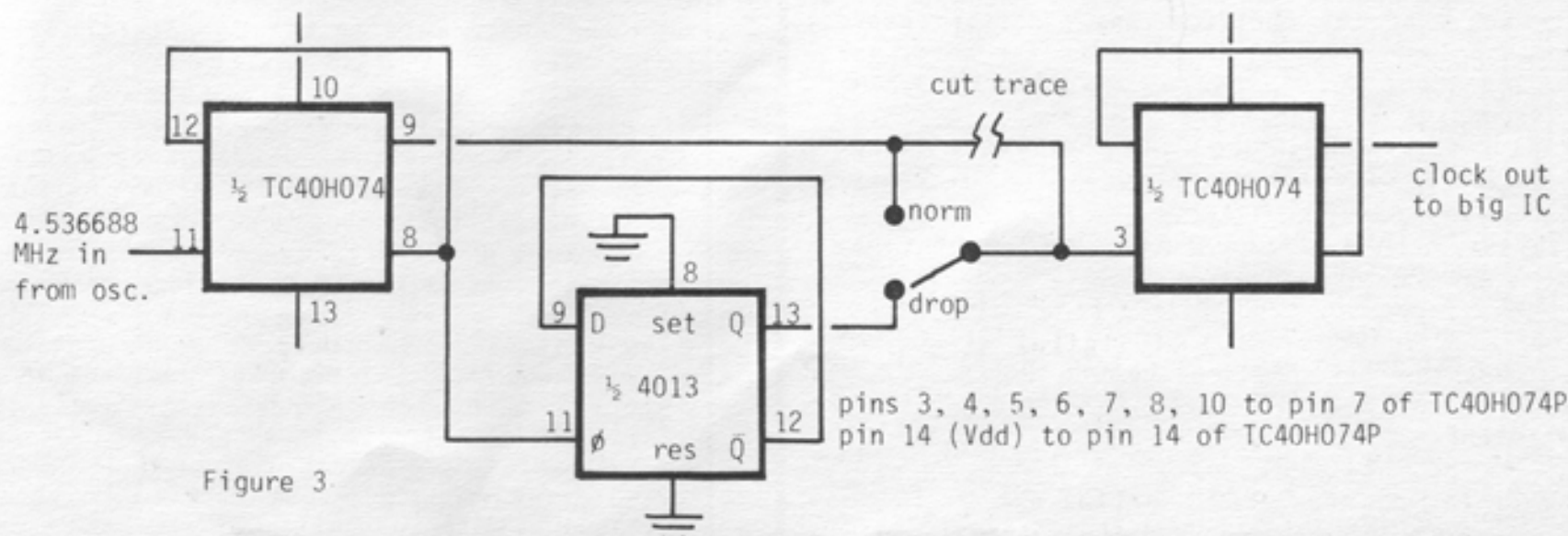


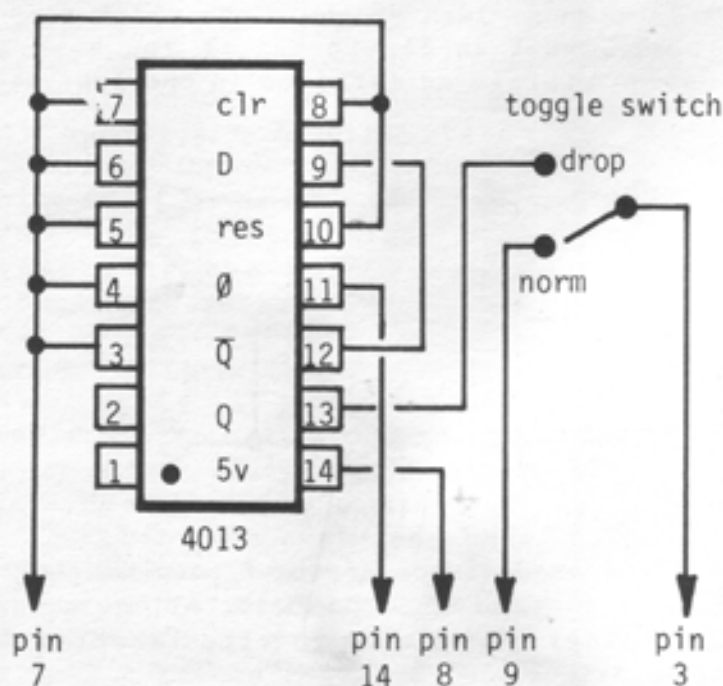
Figure 3

Creating the SUPER Casio M-10

between the two existing flip-flops that divide the 4.536688 MHz master clock oscillator down to 1.134172 MHz for the main chip.

First, cut the trace that runs between pins 3 and 9 underneath the TC40H074P IC (this seems to be the same as a 74C74 but is probably faster). Use contact cement to hold the 4013 flip-flop upside down on the component side of the board between the crystal and the TC40H074P; scratching both surfaces beforehand will help them stick. Fold over or cut off the thin ends of the 4013's pins as they will hit the case bottom otherwise.

Figure 4 (view from above of upside down 4013 - mount the 4013 this way on board)



These all connect to the indicated pins on the existing TC40H074P.

Wire up the 4013 as shown in figure 4. Pins 3, 4, 5, 6, 7, 8, and 10 all go to ground which may be tapped off pin 7 of the TC40H074P. Re-assemble the unit carefully, making sure that all wires clear any critical parts of the circuit and that the case halves go together smoothly.

If you haven't heard a SUPER-CASIO yet I promise you that the modifications described above are worth doing. With an instrument like this, you can forget about multiplexers, power sockets, and bulky expensive keyboards and play music in places you wouldn't have thought of...at the bottom of the bed...whilst skydiving...or rollerskating...sitting around a campfire...and more.

Casio is in a strong position to make fine, flexible, and portable musical instruments. I think that if a lot of musicians write to them explaining what they would like, then there is a better chance that they will design really complete instruments in addition to the simpler ones. I will be writing soon, please consider doing likewise. Casio's address is: Casio Computer Company Ltd., Shinjuku Sumitomo Bldg., 6-1 Nishu-Shinjuku 2-chome, Shinjuku-ku, TOKYO, Japan.

Please keep me informed of any successes, difficulties, or new discoveries you have. My address is Robin Whittle, c/o 42 Yeneda St., North Balwyn 3104, AUSTRALIA (phone 03-459-2889).

(Editor's note: The above was excerpted from a lengthy paper that Robin will make available to Polyphony readers for US\$4.00. It includes some technical information on the chip, how the keyboard decoding scheme works, a way to change the clock from fixed to variable tuning, a method for retrieving even more voices out of the M-10 than the way described in the Nov/Dec issue of Polyphony, and more. Robin can also perform the above modifications for a nominal fee, as well as provide parts for some of his more esoteric modifications. Write him for details on current pricing for these services.)

POLYTEST: M-10 MODS

We took an M-10 into the lab, stock except for an extra voice selection pushbutton, and started work on Robin's mods. About 4 hours later, we had our SUPER-CASIO - and Robin isn't kidding when he says these modifications are worthwhile.

The stock vibrato switch gives a very deep vibrato with little subtlety; the milder vibrato mod produces a much more pleasing effect.

The sustain switch adds the "R" of ADSR to the waveforms, so that the sound continues for a bit after you lift your fingers off the keys. This turns some normally uninteresting voices (such as the flute) into more colorful sounds.

The octave drop switch does exactly what you think it would, and gives you access to some great bass effects. The hold switch is somewhat less useful, but still is fun and since Robin points out that all you need is a switch and a diode, it's worth adding.

The hardware octave drop switch is a most worthwhile addition, even though it does require adding another IC and doing some pretty tight construction. By slowing down the master clock, not only do the sounds come out an octave lower; everything slows down by one-half, including the vibrato rate, decay, attack characteristics, and the like. The end result is a rich palette of tonal possibilities.

There were a few tight moments during the modification; all mods were done extremely carefully, and everything was checked and double checked before proceeding with a particular mod. This care was worth it, however. When the M-10 was re-assembled, everything worked perfectly...and the capabilities of this tiny keyboard are really mind-boggling.

As Robin said in a letter accompanying his manuscript, "surely (the M-10) is what the 80's are all about". We couldn't agree with him more. Find yourself an M-10 and make these mods: you'll end up with a portable and powerful musical instrument at a very low price.

MINI AMP MOD

by Jack Orman

I have constructed several of Craig Anderton's Mini-Amps (project #5 in Electronic Projects for Musicians), and they have proven very useful not only to myself but also to the friends that I've made them for. However, it wasn't long before I found myself wishing the small amp had just a bit more power. In studying the circuit and National Semiconductor's Linear Data Handbook, I hit upon this useful modification to Craig's design. It should also work with the various commercially available mini-amps that use LM380 ICs to provide the power amp function.

The LM380 is a 2 Watt chip with a maximum power supply rating of 22 Volts DC; but National also manufactures the LM384, which is a specially selected LM380 that can take up to 28V and is rated at 5 Watts. By merely switching chips

and increasing the power supply, more than double the power is available.

If you intend to drive the amp at high levels for any period of time, then you will need a good heat sink. I epoxied a special DIP heat sink to the top of the chip, and with the copper PC board sinking pins 3, 4, 5, 10, 11, and 12, this combination worked very well. Alternately, the above-mentioned pins can be bent up and soldered to a small piece of copper as National's Databook suggests.

Note that merely substituting a 384 for the 380 won't bring you any increase in power; you must boost the supply voltage to take advantage of the potential for extra Watts.

According to National's data, the LM380 on 18V and driven to 10% distortion into an 8 Ohm load

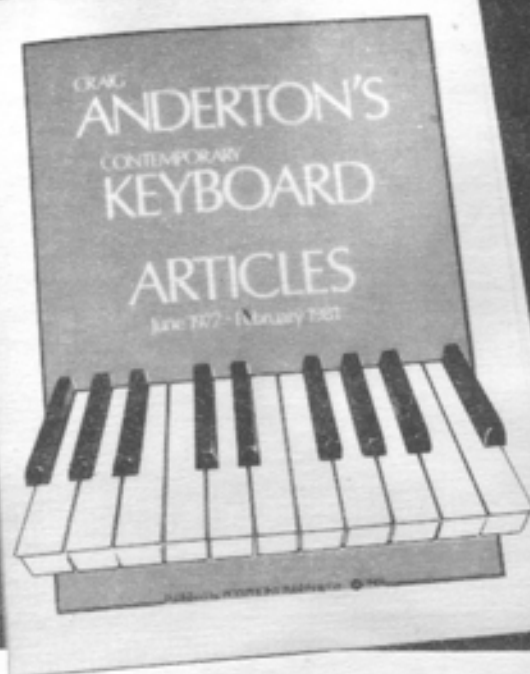
produces 4 Watts. The LM384 on a 28V supply with the same load and driven to the same distortion gives 9 Watts. Of course 10% distortion is quite excessive, but this does illustrate to what limits these chips can be pushed.

By the way, if you have trouble finding a high voltage calculator-style adapter, Electro-Harmonix makes an 18 Volt unit that they offer for powering their flanger. This is perfect for the miniamp, but if you're using the LM380 chip then check the voltage of the adapter carefully. Both of my E-H adapters exceed 18V even under a load. In any case, add some extra capacitance across the supply line to smooth out the DC voltage and improve the filtering.

I hope that the above tips will help out those who like the EPFM Mini-Amp, but would like a little more power.Σ

NEW

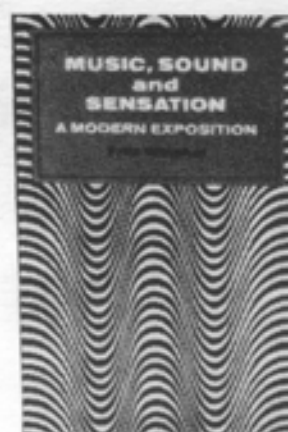
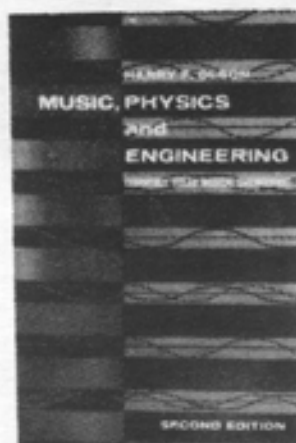
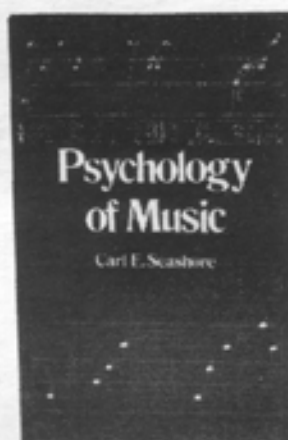
POLYPART



For those of you who have been asking for Craig Anderton's Contemporary Keyboard reprints (June 1977 - February 1981) here it is. Article topics include tips, technique, theory, maintenance and projects, such as, Design and Build: Keyboard Mixer, Keyboard Pre Amp, Multiple Identity Filter, Combo Organ, Tremolo, LED Control Voltage Meter, Expansion Oscillator, Noise Generator, and more.
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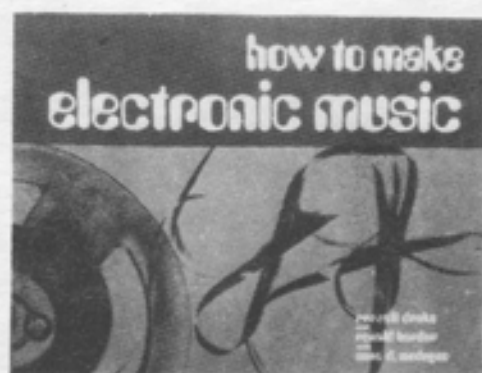
Without a logbook remix and overdubs often mean going back to re-familiarize yourself with the piece. Having all the important information on your tape library in one place as opposed to take sheets scattered among a lot of different reels is convenient but more importantly, a well-kept logbook becomes part of your records for tax, accounting and planning purposes.

This 4/8 Track Studio Logbook represents an improvement over standard track sheets in that you can not only indicate technical information such as timing and type of tape used; there is also a generous amount of space for recording patches and making notes, as well as an expanded track sheet page that provides space for listing sequential changes in various tape tracks and relating these to settings of the index counter.
Order # SLB\$4.95



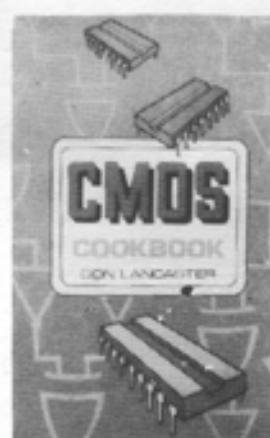
The physical and psychological aspects of Helmholtz's **Sensations of Tone** provide an in-depth look at physiological acoustics. **Test**, provides an in-depth look at instruments. **Music, Physics and Engineering**, is a thorough look at synthesizers (plus a chapter on instruments like the Helmholtz work).

#SENS On The Sensations of Tone
#MPE Music, Physics and Engineering



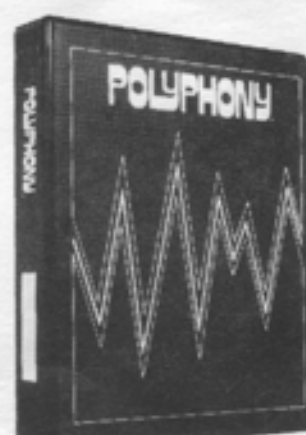
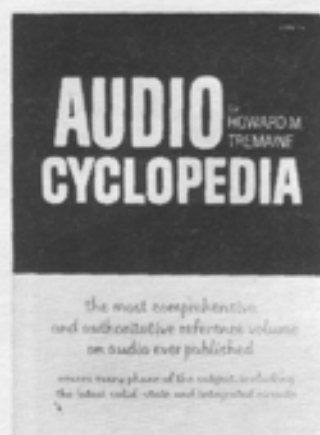
Synthesists must be well-versed in the use of books. These books are a great way to learn about the standard tape technique, composition, building, outfitting, and computer control of electronic music. **Home Recording For Musicians** provides maximum results, including:

#HMEM How to Make Electronic Music
#BYTE Byte Book of Computer Music



Electronic cookbooks are a great way to learn about the theory, definitions, and electronic construction techniques. They can easily replace stacks of reference. Walt Jung's **CMOS Cookbook** is required reading for synthesists. Lancaster's **Audio IC Op-Amp Applications** is a must for electronic construction techniques. **Electronic Projects for Musicians** is a must for recording of the effects.

#OACB Op-Amp Cookbook
#AFCB Active Filter Cookbook
#AUOA Audio Op-Amp Applications



Often used reference material. **The Source** is over 125 pages of information to answer any questions about electronic music. **Audio Cyclopedic** is a publication without parallel. **Synthesizers** devotes to the work of Paia, Oberheim, EML, and other experimenters.

#SOURCE The Source
#CYCLO Audio Cyclopedic
#EMS Music Synthesizers
#BIND Binders

SCIENCE

Acoustical background to music is an important part of musical synthesis. **Of Tone** is, a century after its publication, still the standard text for **Psychology of Music** by Carl Seashore, developer of the Seashore Music analysis of musical style and performance characteristics of many **Physics, and Engineering** by Harry Olson, who worked on the first RCA (discussion of the physical properties and design of traditional musical er on electronic music). **Music, Sound and Sensation** by Winckel is much with a bit less detail and more concentration on psycho-acoustics.

Of Tone	\$7.50	#PSYCH Psychology of Music	\$5.00
Engineering	\$5.00	#MSS Music, Sound and Sensation	\$3.50

RECORDINGS

#ERRO	Electronic Realizations - Synergy	\$7.95
#SEQU	Sequencer - Synergy	\$7.95
#CORDS	Cords - Synergy	\$7.95
#GAMES	Games - Synergy	\$7.95
#PICT	Moving Pictures - Michael Gilbert	\$7.95
#ELEM	Elements - Mychael Danna	\$6.95
#CAMT	Craig Anderton Music Tape	\$5.95
#MOEB	Moebius - Moebius	\$7.95
#ARPT	Music For Airports - Brian Eno	\$7.95
#DELTA	Rainbow Delta - Pat Gleeson	\$7.95

TECHNIQUE

versed in a number of techniques and principles. "How to" and project oriented ck up these skills easily. **How to Make Electronic Music** by Drake, Herder d introductory text for music synthesis classes, with chapters on equipment, n projects, and more. **Multitrack Primer** by Teac is a step-by-step guide to erating your home studio. The Byte book of **Computer Music** describes ro-mechanical instruments, Fourier analysis, circuits and loads of software. **Musicians** is the original guide to outfitting and operating a budget studio for g mixer and audio processing circuits and a demo recording.

Electronic Music	\$3.95	#TEAC Multi-Track Primer	\$4.95
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re-view

continued from page8

postpaid; no report on prices but you can expect them to be slightly higher because of shipping.

Sirenes Musique (4 Rue Bonnier d'Alco, 34000 Montpellier, France). Progressive and electronic rock, at a respectable \$7.50 most discs. The postage kills you though - \$6.00 for the first three discs. No word on service.

Systematic Record Distribution (729 Heinz Ave. #1, Berkeley, CA 94710 - tel 415-845-3352). Domestic and import new wave and electro-beat. No word yet on service or price.

Wayside Music (PO Box 6517, Wheaton, MD 20906 - tel 301-460-1402. A very interesting service offering progressive/experimental cutouts from \$1.99 to \$3.99, along with selected non-cutouts from \$5.99 to \$7.49. Service is very quick and stock is excellent.

Also, here are four entries taken verbatim from Thom Holmes' Recordings Magazine (4 South Haviland Avenue, Audubon, NJ 08106). I've never dealt with any myself, so can't comment on service or price.

Cross Country (PO Box 3584, Washington, DC 20007 - tel 703-243-4899). Domestic and import punk rock and new wave, blues, and rock.

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KORG X-911 RESONANCE MOD

by Craig Anderton

The Korg X-911 is a single note, "lead" synthesizer expressly designed for guitar. (For a complete review of this unit, see my July 1980 Notes column in Modern Recording magazine.) While it tracks quite well and offers many good synthesized voices, one complaint I have about the unit is that the filter resonance is set for fairly high resonance and cannot be adjusted. Although lots of resonance does give a sharp, cutting kind of sound, this effect has been so overused in commercials and top 40 seconds that it's beginning to turn into a "synthesizer cliché". As a result, I came up with the following modification to lower the resonance for a more subtle effect.

THE MODIFICATION. Begin by unplugging the line cord, then unscrew the five phillips head screws on the top panel (put them aside in some safe place - if one of those little plastic washers gets lost in the rug forget about finding it again!). Lift up the panel, then place it face down (behind the body of the unit) as shown in figure 1.

Locate the output control (the one with the AC power switch on the back), then work your way left across the circuit board. About 2" to the left of the pot's center is the foil pattern associated with an 8 pin DIP socket; about 3-1/4" to the left of the pot's center is the foil pattern associated with a 16 pin DIP socket. This is the one we want.

Figure 2 shows a close-up of this area of the circuit board. An LM13600 located on the component side of the board forms the basis of the filter. There is a 47.5k resistor, also on the component side of the board, connected between pins 1 and 5 of this IC. This resistor sets the feedback around one of the filter stages, thus determining the resonance. Lowering the value of this resistor lowers the resonance. Bridging a parallel resistor across pins 1 and 5 as shown effectively lowers the value of this resistor.

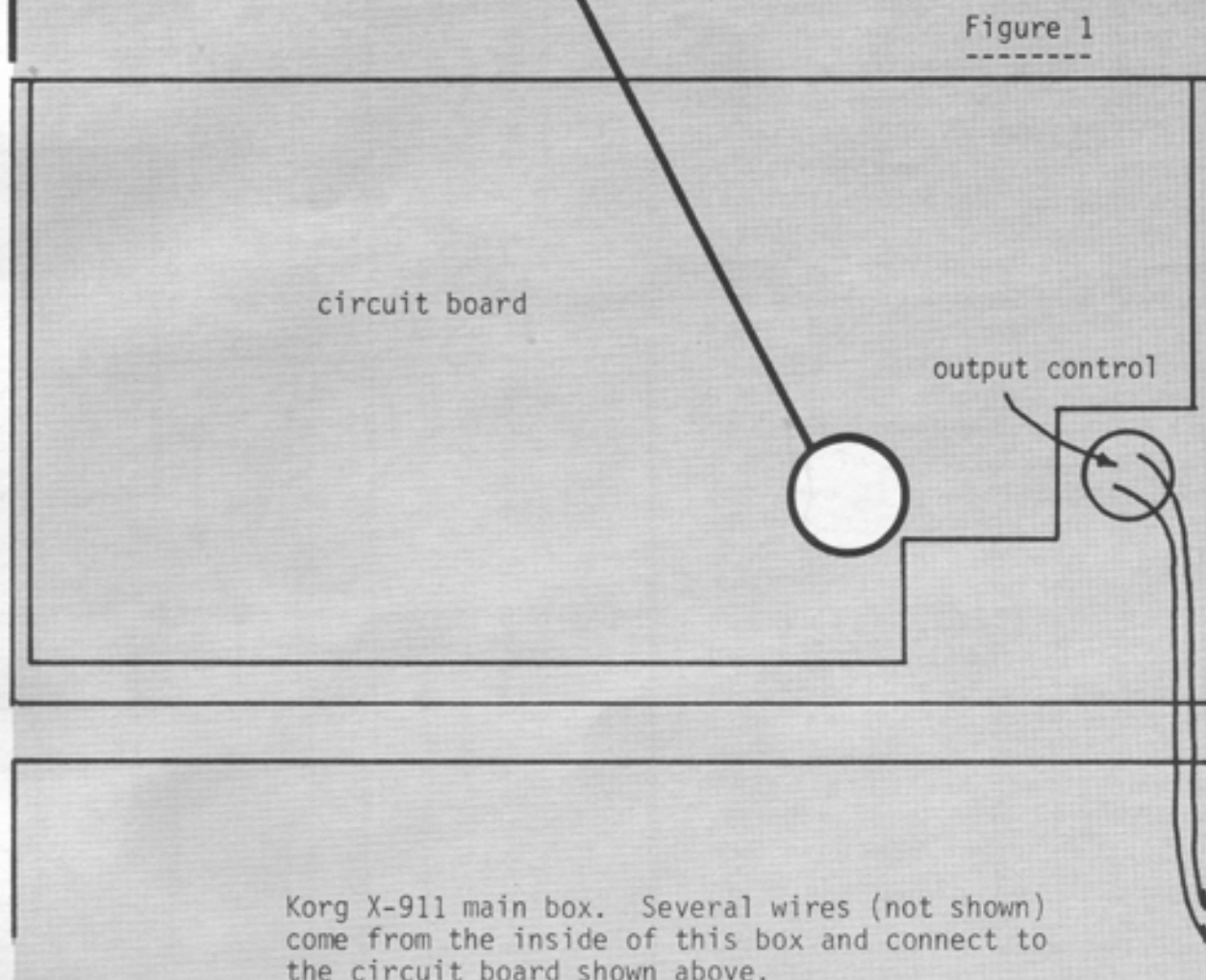
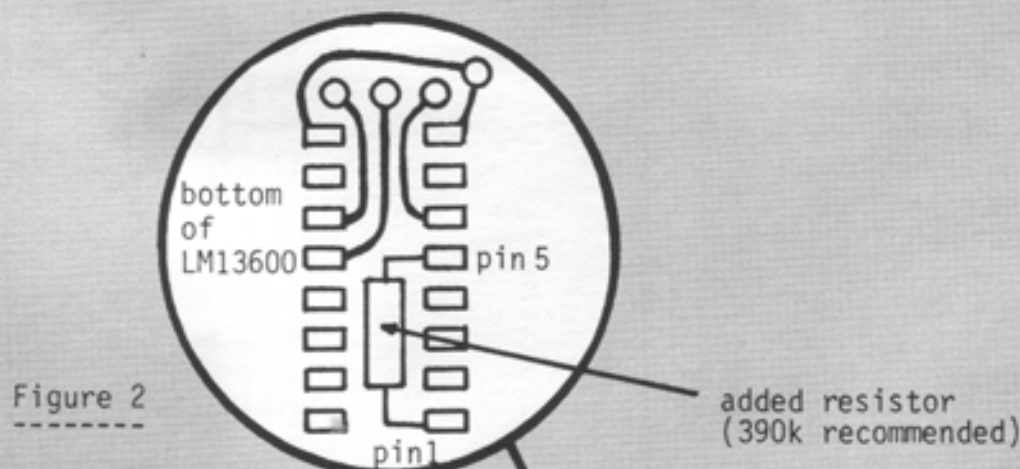
The value of this parallel resistor depends upon the degree of resonance you'd like to have. 1M will reduce the resonance slightly but still noticeably; I ended up choosing 390k, since this gave a subtler sound but did not kill the resonance entirely. I suppose this is mostly a matter of

personal preference. If you wanted, you could install a 1M pot in series with a 220k resistor and bridge this combination across pins 1 and 5 if you needed variable resonance. Another option would be to use a 1M trimpot bridged across the appropriate pins, and adjust it for the degree of resonance that you find most pleasing.

Although variable resonance appears to be the most attractive option, this involves drilling a hole in the case which could affect the resale of the unit. Also, you would need to route the leads going to this pot very carefully to prevent possible oscillation problems. So, unless

you're possessed with an adventuresome spirit and a desperate need for variable resonance, I would suggest just going with the resistor bridge. Besides, my complaint with the filter was not the lack of variability, but the opinion that the amount of resonance chosen by Korg was excessive. Adding one resistor solves this problem.

I'm much more pleased with the synthesizer section sounds now; they sound far less gimmicky and I feel that they are more musically useful. If you agree that less filter resonance would enhance the X-911's performance, take a minute or two to add this mod - I think you'll be pleasantly surprised. Σ



PRACTICAL CIRCUITRY

RHYTHM GENERATION:

ITS ABOUT TIME...

TOM HENRY

Hello and welcome! In "Practical Circuitry" we will discuss many things, but in one way or another they will all relate back to synthesizer design and construction. We'll start off with a detailed look at rhythm generation. One of my reasons for coming up with the unit was that I didn't like to play alone! By integrating the unit into my synthesizer system, I'll always have a nice pattern to play against. I think that you'll find this can be a great aid to composition as well. Often, just hearing a beat starts the creative juices flowing.

I think that every one has, at one time or another, played with automatic rhythm boxes - you know, those neat toys that when you push a button labelled "Rock 1" kicks out a repetitive "book-chik-a-boom" over and over. Such boxes are great to practice with in lieu of a metronome, but for performing are next to worthless due to the constant repetitive nature of the sound. Well, guess what? We're going to build one anyway! But by applying synthesizer techniques and generalizing the unit, we'll get a broad range of sound and rhythms that would be unheard of with a simple rhythm box...we'll even get into tape synching and other neat topics.

THE CIRCUIT. The basic rhythm generator is configured around a special ROM, the AMI S-2566 (see fig. 1). This chip contains eight standard drum patterns, and was originally designed to be used in drum boxes. As we'll see shortly, there are ways to make it do much more. This chip must be used in conjunction with a clock circuit, and the clock's main job is simply

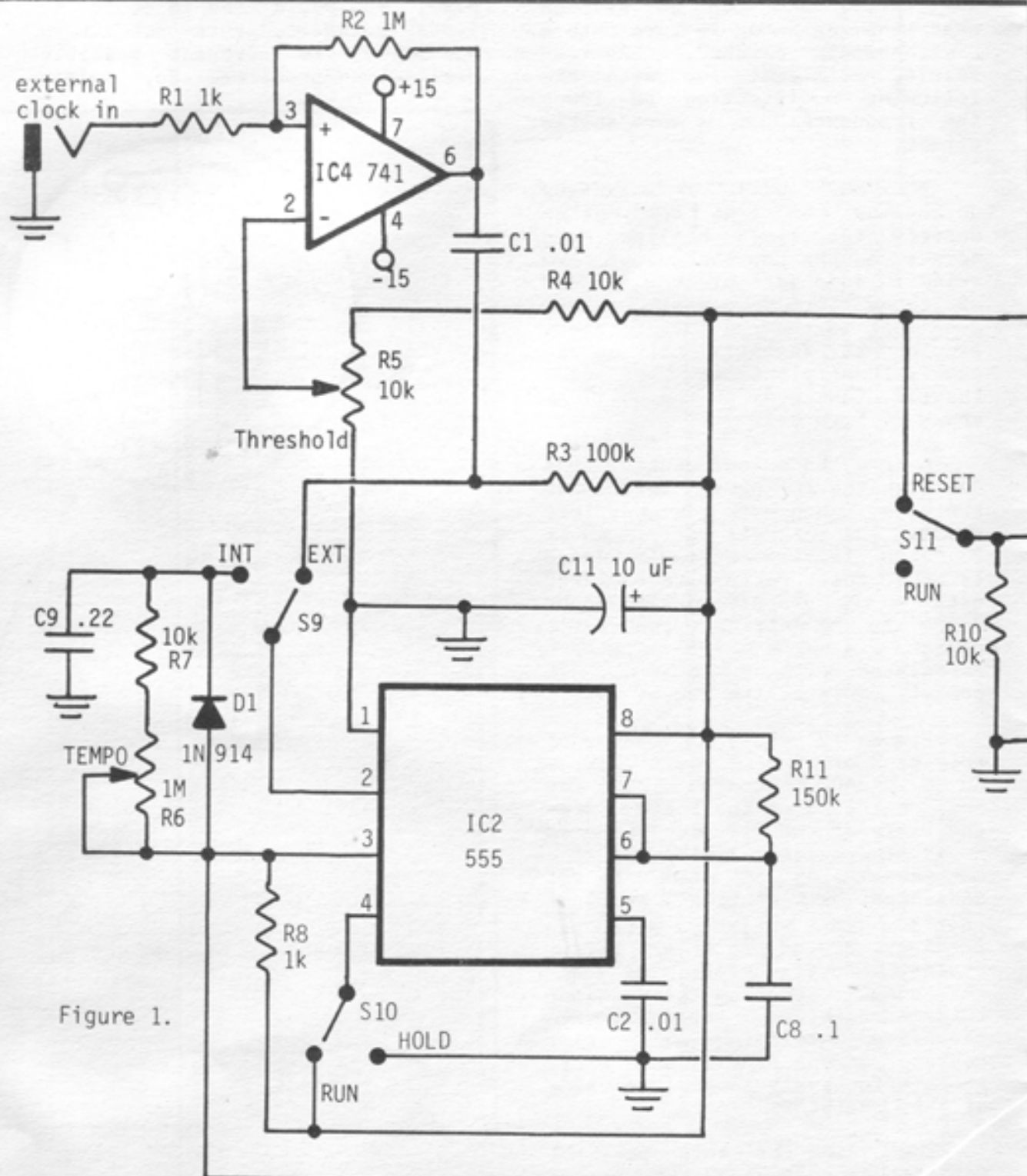


Figure 1.

to walk out the various patterns.

Switches S1 through S8 address the various rhythms, and in most drum boxes, a single pole/eight throw switch is used for selection. However, by using individual switches, one may combine patterns by throwing any number of switches. The results are quite interesting, and the new patterns quite complex (it is rare when I use one of the "standard" patterns for composition). If you are into combinatorial analysis, the total possibilities for switch combinations is now 2 to the 8th power, or 256. I haven't really tried all the possibilities, but I suspect that the real number is somewhat less than this, since

some combinations may be duplicates of others. And then of course "no switches on" is mathematically possible, but musically not very useful, since no sound is generated.

There are five outputs, which the manufacturer labels bass drum, snare, brush, congo, and bongo. Now on my unit, I labelled the outputs 1, 2, 3, 4, and 5 and the pattern selectors A through H since I didn't want to be constrained to think about the unit in its normal sense. More about this later.

Let's look at a typical output, as shown on the schematic. The outputs give a simple "voltage on" or "voltage off", and must

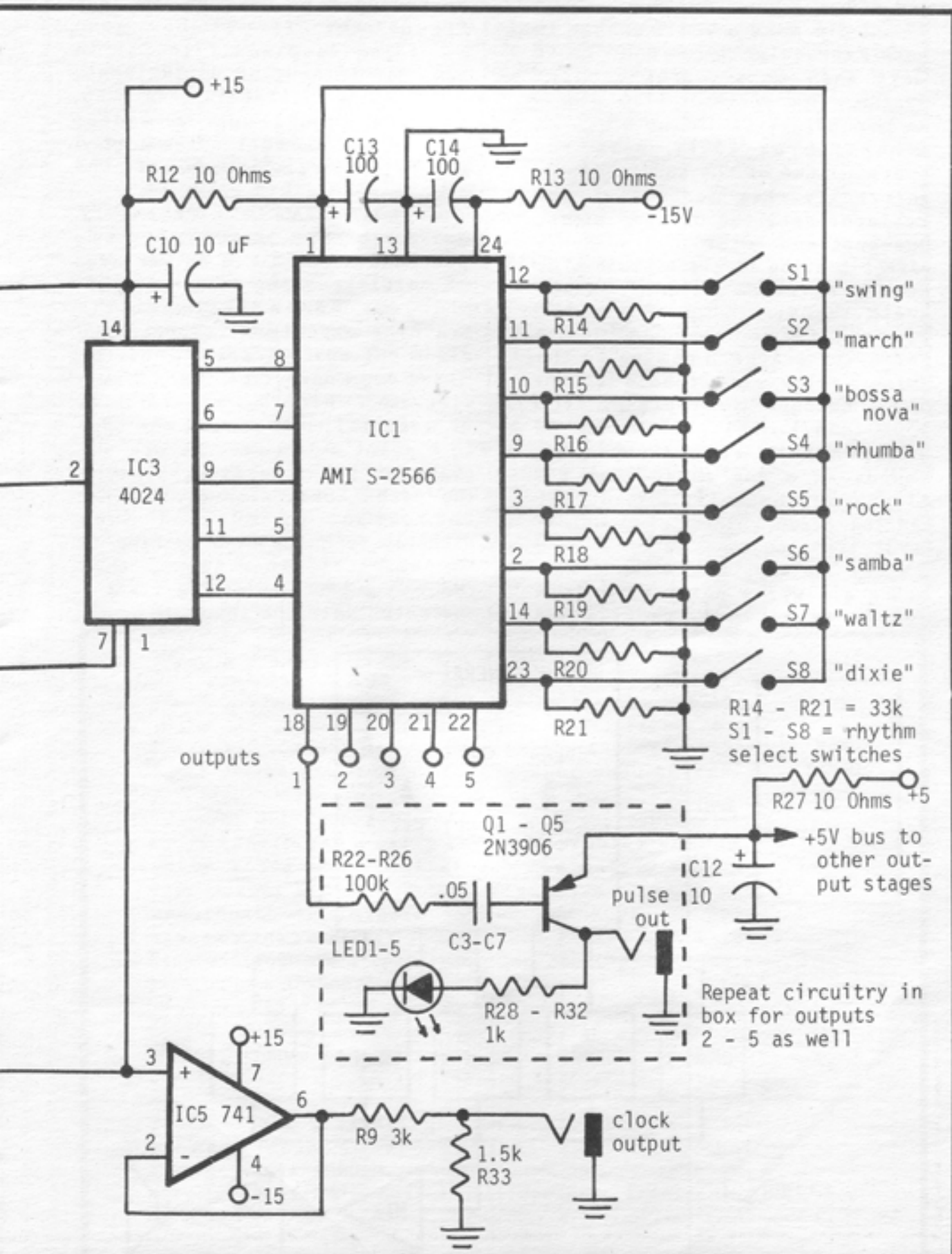
therefore be differentiated by R22 and C3 to give a synthesizer compatible trigger pulse. Q1 performs the level conversion necessary to generate a 5V trigger. LED 1 gives a visual indication of what's going on. The five LEDs are most important, since not every rhythm uses all of the outputs, and with the LED you can see which output to use for what purpose (as well as get a multi-media feel for the patterns). The outputs terminate in standard 1/4" phone jacks.

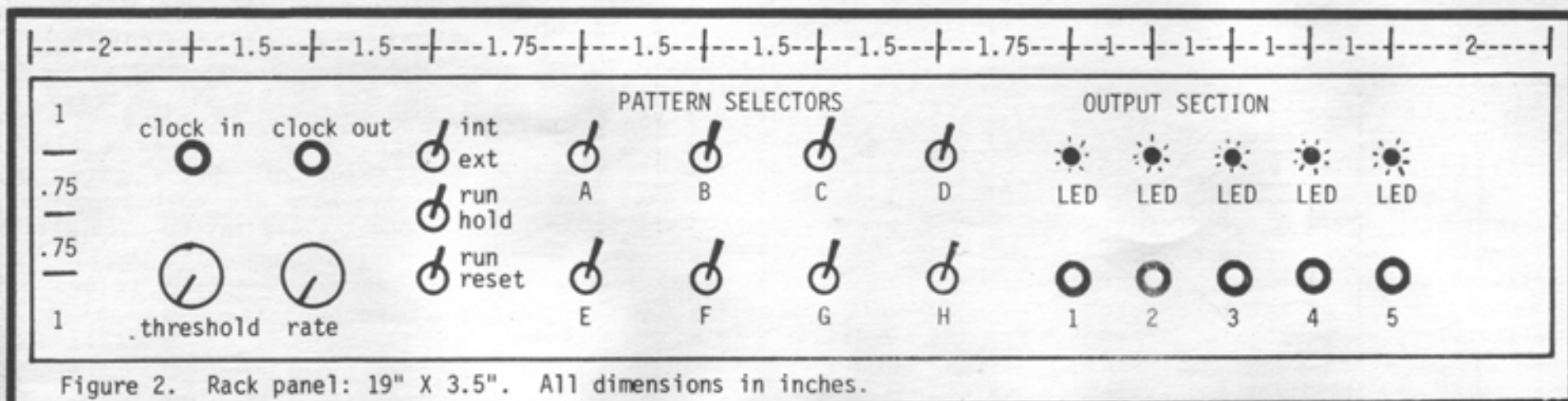
Now let's look at the clock circuitry. The basic clock is a 555 timer, but note the unusual configuration. With S9 in the INTERNAL mode, the 555 acts as an astable oscillator. With S9 in the EXTERNAL mode, it becomes a monostable (one shot) and must be fired from an external clock. I'll say more about that in a moment; for now, let's leave S9 on INTERNAL. C9, and R7 are the basic frequency determining components, and establish the tempo of the selected pattern. R11 and C8 determine the pulse width of the clock output pulse, and remain fixed. This is the reason for the unusual configuration of the 555; regardless of whether one is using the INTERNAL or EXTERNAL mode, the 4024 will always receive the same width clock pulse - even in the EXTERNAL mode, R11 and C8 still determine the pulse width. This standardization of clock pulses is important for multi-track recording, when we want to pick up clock pulses off of a click track.

S10 disables the 555. This switch is important, since it allows you to start a pattern right on the beat.

The external clock input accepts a possibly nonstandard clock pulse and conditions it via the 741 and differentiator R1, R2, and C1. R2 adds a bit of hysteresis, giving the input clock pulse a little more snap. This sub-circuit is really nothing more than a simple comparator, and R5 sets the threshold at which the comparator trips. The threshold control is useful when recovering pulses from a click track (you generally want to record the click track at a low level to avoid bleed-through on to adjacent tracks, and use a sensitive comparator for recovery).

Another 741 buffers the clock output, and presents it to a 1/4" phone jack, through R9 and R33. This resistor network does two things; first, it divides the output voltage to a standard +5V





range, and second, adjusts the output impedance to a standard 1k. This is the output one would use for synching other rhythm units to one clock, driving a sequencer, and the like. In addition, one would use this output to record sync pulses.

The clock also feeds pin 1 of the 4024, whose outputs drive the S-2566. S11 allows for resetting the 4024, and the musical effect of this is to cause the pattern to return to the start of the measure. When it comes time to do some synching effects with the unit, you will appreciate this control.

A few words about the power supply...the 741s and S-2566 require $\pm 15V$ DC, the 555 and 4024 need $\pm 15VDC$, and transistors Q1 through Q5 require a $\pm 5V$ supply (this can be dropped from the positive bipolar supply with a 5V regulator).

CONSTRUCTION. I used a standard 3.5" X 19" rack panel for packaging, with the layout shown in figure 2. All jacks are standard 1/4" phone jacks; I used clip-lites for mounting the LEDs, and the results were nice looking.

FINDING THE AMI S-2566. The AMI S-2566 is currently available on the surplus market from Diamondback Electronics (PO Box 12095, Sarasota, FL 33578) for under \$2 with data (quite a contrast to what these parts cost when they first came out). While you're at it, you might want to order a couple, since I have plans to do some series/parallel applications in the future.

HOW TO USE IT. Before you can really play with the unit you must have some drum voices that accept 5V triggers. In my system, I use two of the Percussive Noise Sources described by John Blacet in *Polyphony* Nov/Dec '79, pages 12 and 13 (corrections in Jan/Feb 80 issue, page 5), and two typical twin-tee sinusoidal "bongo" generators set for bass drum and tom-tom frequencies. Circuits for

this type of circuit abound; see *Polyphony* 3/76, pp 37-42. I use my synthesizer proper for the fifth voice. Typically, this voice employs a noise source, VCA, and VCF.

I did make a small change in both Percussive Noise Sources to make them more useful with my system. The resistor from pin 24 to ground, given in the original schematic as 150k, sets the sustain time of the audio output. Internally this means that the resistor sets the ON time of the one-shot generator, and so has a direct bearing on the sustain time of the envelope imposed on the audio signal. This initial ON time was far too long, in fact, a series of triggers coming to the Noise Source simply held it on. So, I changed the resistor from 150k to 47k...this allows me to now generate such interesting sounds as a dog scratching for fleas, rhythmically! And, all kidding aside, other short-noise-burst type sounds.

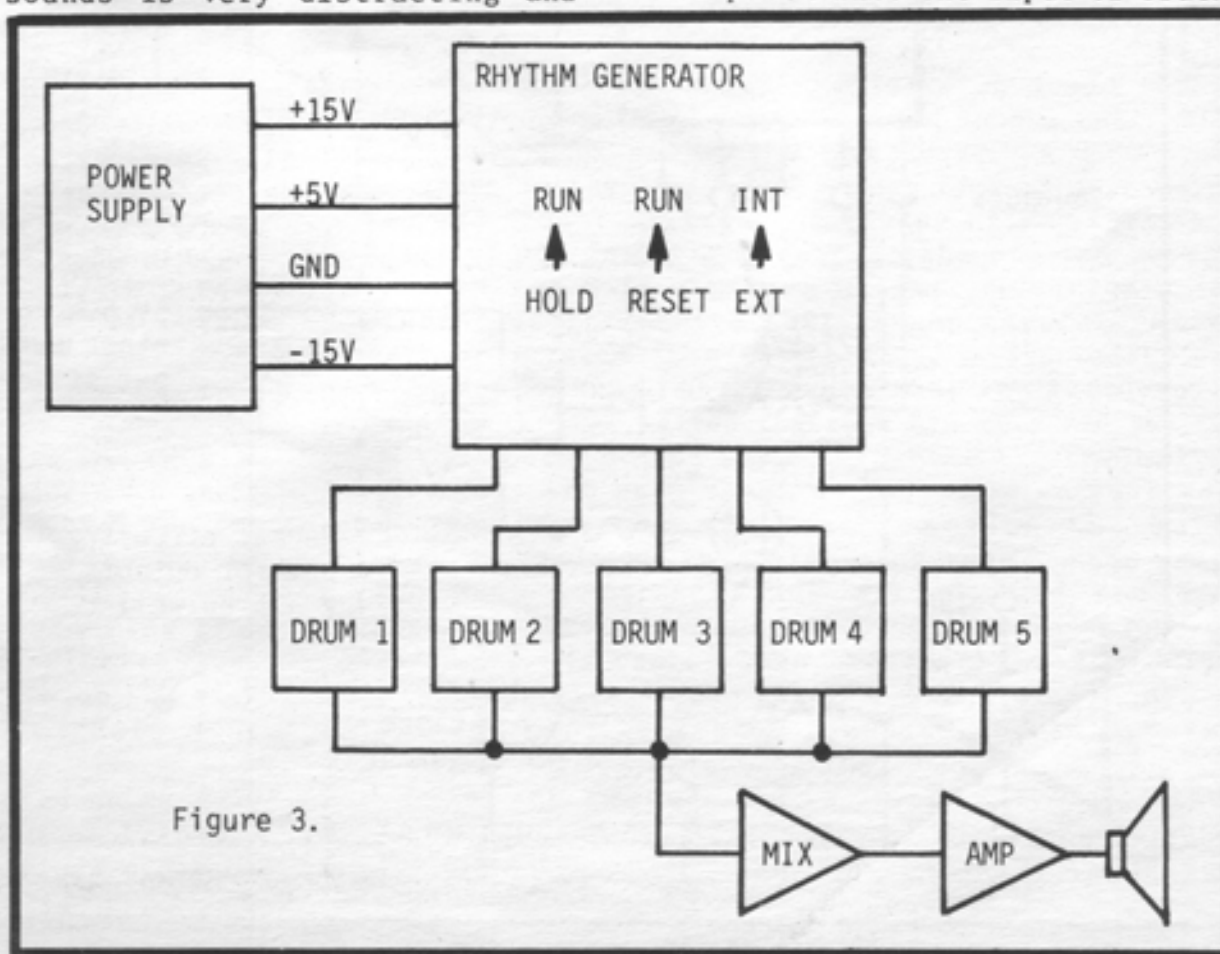
By the way, I have found that using all white noise type drum sounds is very distracting and

using all bongo type circuits is very boring. It is a combination of the two types that really produce a pleasing sound.

Well, let's suppose you've hooked up some drum voices (see figure 3). If all has gone according to plan, flip S11 to RUN, S10 to RUN, S9 to INTERNAL, select some pattern via S1 - S8, and you should hear a madcap electronic drummer wailing away! R6 adjusts the tempo of the pattern.

MULTI-TRACKING EXPERIMENTS.

As much fun as real time percussion is, it is in the area of multi-tracking that this unit shines. For a basic multi-tracking experiment, record the clock out on to track 1, and the mixed drum output to track 3 (see figure 4). Record a minute or so of material; now rewind the tape to a point a few feet before the start of the recording. Switch the patch cords around, so that the output of track 1 goes directly from the tape machine to the external clock input, then remove the patch cord from track 3 and patch into the input of track



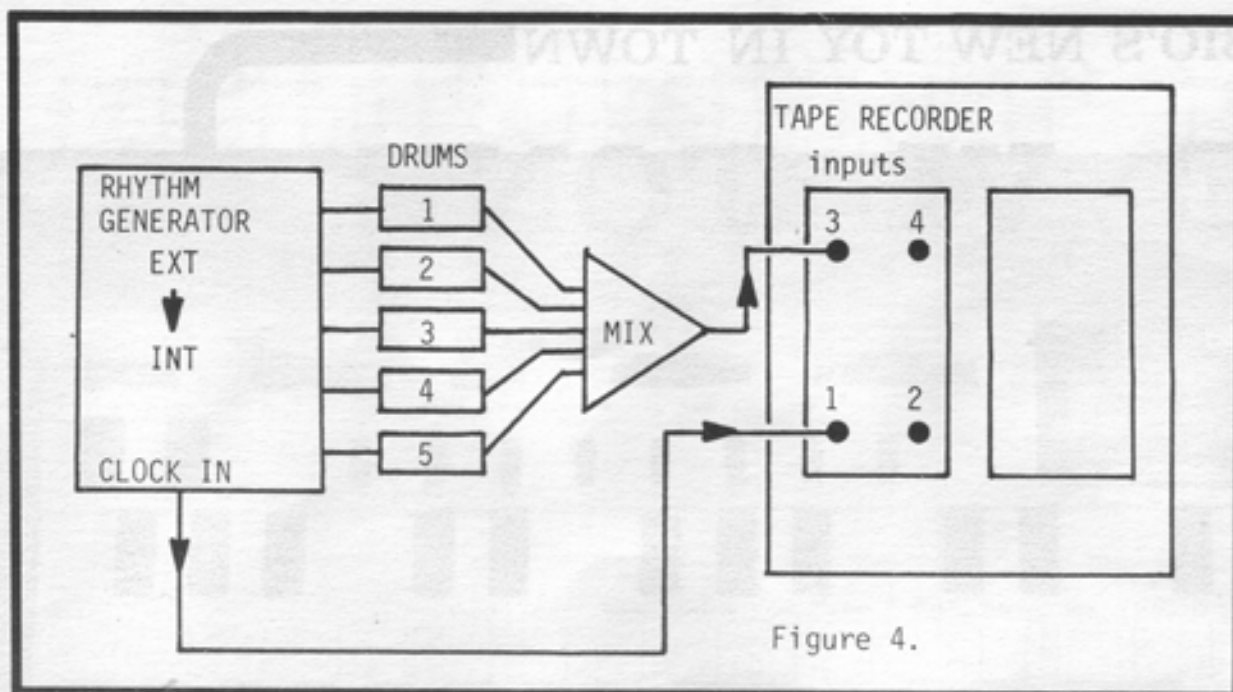


Figure 4.

Try to visualize six of these chips wired so that one chip was the master chip, and each output would drive the clock inputs of the remaining five chips (see figure 6). The master clock would have to run much faster now, since there would be quite a few divisions taking place. Anyway, the result would be 25 drum outputs (five from each chip), resulting in a very complex pattern. Practical? I don't know. Like I said, this came to be during a bout of insomnia...

Here's another wild and crazy idea. Notice how the 4024's divide by 2, 4, 8, 16, and 32 pins are used for clocking the S-2566; continued on page32

4. This time we are going to record on track 4, so be sure to leave track 3 alone (see figure 5). Flip S9 to EXTERNAL mode, put S10 in the HOLD mode, and toggle S11 from RUN to RESET back to RUN again.

Start the tape machine rolling, then flip S10 to RUN. The reason for starting the tape machine first is that engaging the tape machine in the record mode may enter a mechanical or electrical click through the system, thus causing the 555 to trigger once and offsetting the tempo from the original. Now, if all has gone well, the rhythm unit will pick up the clock pulses from track 1 and convert them into the drum pattern being recorded on track 4. Rewind the tape and play back tracks 3 and 4; they should sound the same. While this isn't too musically useful, it does demonstrate that one set of synch pulses has perfectly synchronized the two drum parts. The fun starts when you record two different patterns synched to the same pulses, on to different tracks. The resulting sounds are wonderfully complex.

I should probably say a few things about the use of sel-sync, simul-sync, or whatever your tape machine calls this function. When recording on track 4, monitor tracks 1 and 3 through the record heads, using the above mentioned sync function. Failure to do this would mean that during the recording process tracks 3 and 4 would sound synched, but during playback, the two tracks would be horribly mixed up due to the distance between the record and playback heads. If you're not sure what I'm talking about, refer to Craig Anderton's book, Home Recording for Musicians, pp 24-25 for more information.

RANDOM COMMENTS. You'll note that we didn't use track 2 in the previous example; this serves as a guard track between the click track and the other audio tracks. These clicks represent a fair amount of energy, and you don't want to have any leakage getting over to the other tracks. Of course, after recording all the drums you don't need the clicks anymore, at which point they can be erased, leaving room for additional overdubs.

Here's one idea I came up with on a sleepless night. Recall that the S-2566 has five outputs.

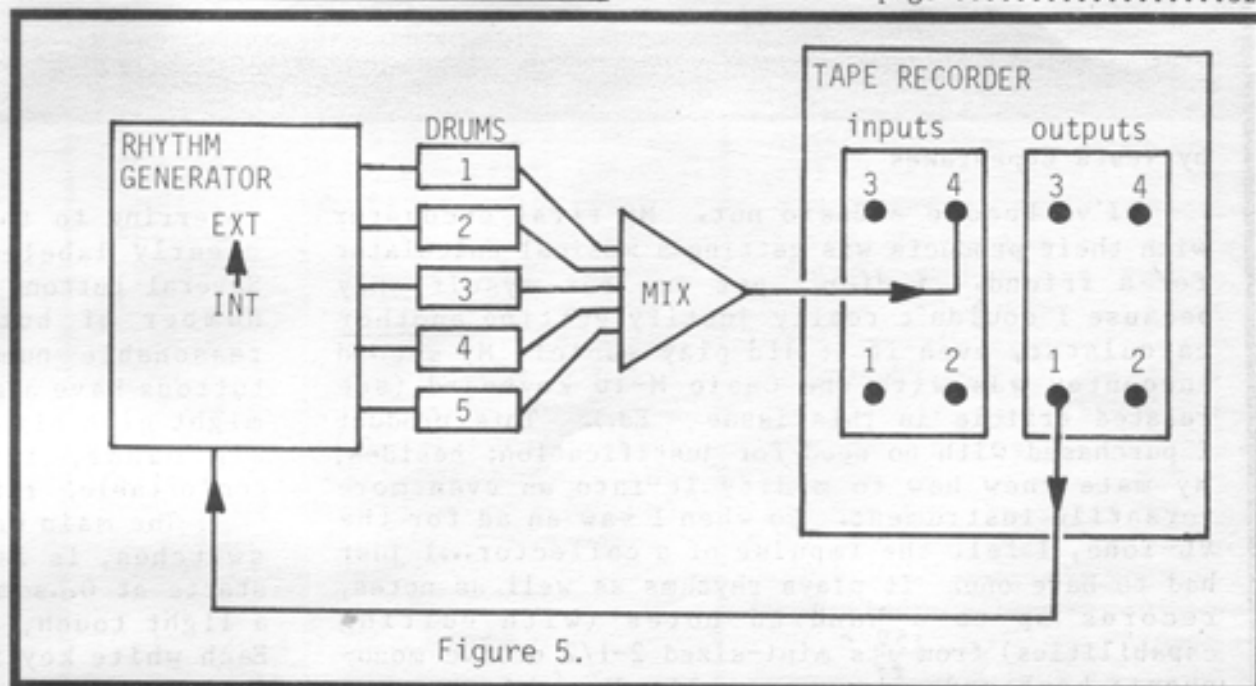


Figure 5.

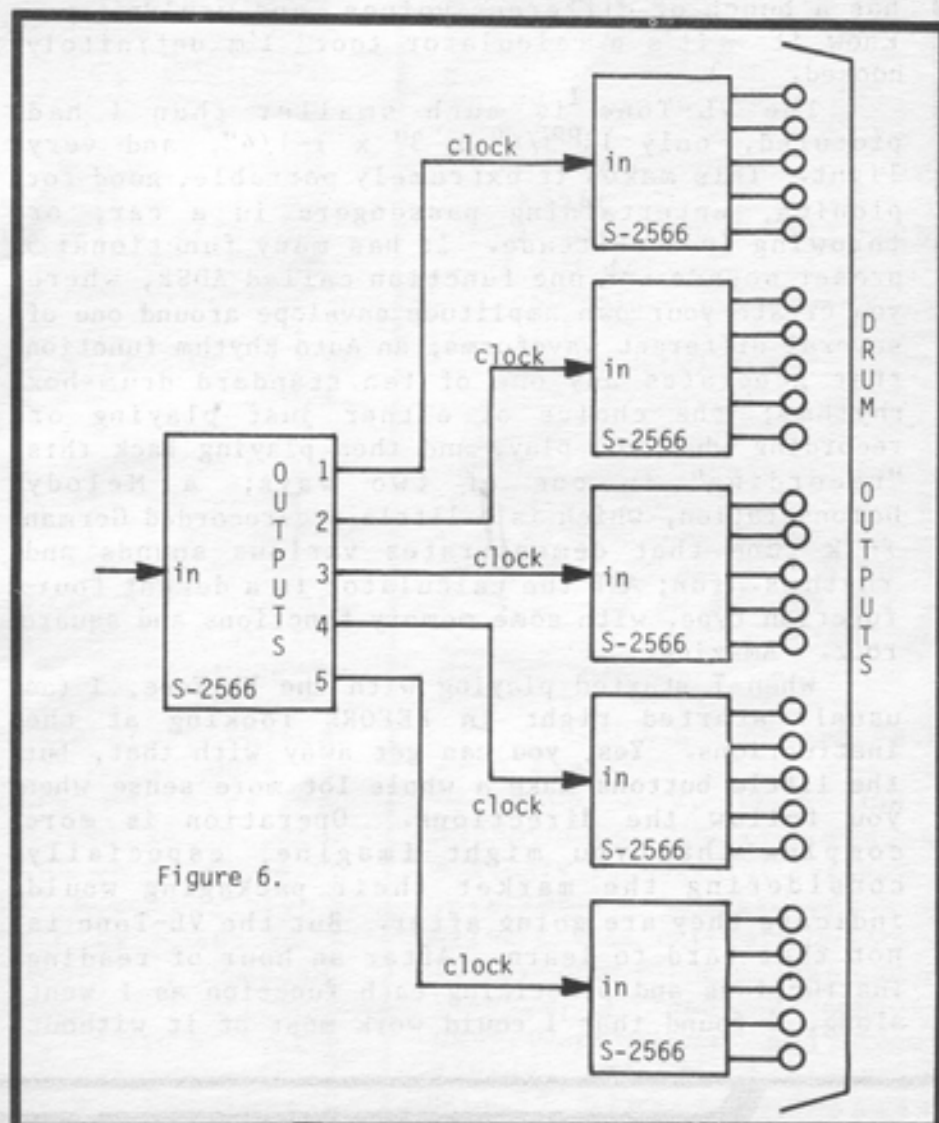
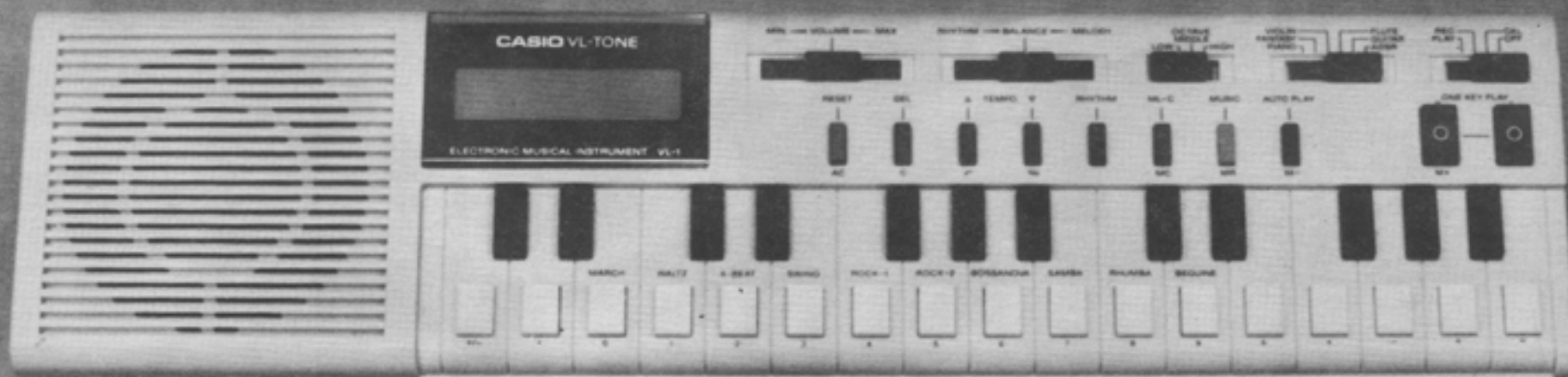


Figure 6.

THE VL-TONE



by Vesta Copestakes

I've become a Casio nut. My first encounter with their products was getting a musical calculator for a friend. I didn't get one for myself only because I couldn't really justify getting another calculator, even if it did play music! My second encounter was with the Casio M-10 keyboard (see related article in this issue - Ed.). This product I purchased with no need for justification; besides, my mate knew how to modify it into an even more versatile instrument. So when I saw an ad for the VL-Tone, I felt the impulse of a collector...I just had to have one. It plays rhythms as well as notes, records up to a hundred notes (with editing capabilities) from its mini-sized 2-1/2 octave monophonic keyboard, plays you a little musical demo, has a bunch of different voices, and wouldn't you know it - it's a calculator too. I'm definitely hooked.

The VL-Tone is much smaller than I had pictured, only 11-3/4" x 3" x 1-1/4", and very light. This makes it extremely portable, good for picnics, entertaining passengers in a car, or throwing in a suitcase. It has many functions: 5 preset sounds and one function called ADSR, where you create your own amplitude envelope around one of several different waveforms; an Auto Rhythm function that generates any one of ten standard drum-box rhythms; the choice of either just playing or recording what you play, and then playing back this "recording" in one of two ways; a Melody Demonstration, which is a little pre-recorded German folk tune that demonstrates various sounds and rhythms...fun; AND the calculator is a decent four-function type, with some memory functions and square root. Amazing!

When I started playing with the VL-Tone, I (as usual) started right in BEFORE looking at the instructions. Yes, you can get away with that, but the little buttons make a whole lot more sense when you follow the directions. Operation is more complex than you might imagine, especially considering the market their packaging would indicate they are going after. But the VL-Tone is not that hard to learn. After an hour of reading instructions and practicing each function as I went along, I found that I could work most of it without

referring to the instructions again. Everything is clearly labeled with tiny, but clear, legending. Several buttons are multi-function, which keeps the number of buttons to choose from down to a reasonable number. However, while the little buttons have a good feel, they are quite small and might give big hands some trouble. So if you have big hands, try one out first to see if it's comfortable, rather than buying by mail as I did.

The main keyboard, made up of white and black switches, is laid out like a piano except that it starts at G...somewhat unusual. These switches have a light touch, and it's easy to hit them squarely. Each white key is also labelled with a calculator function, so the keyboard becomes your calculator keyboard when in the CAL (calculator) mode. As you play the keys, the number associated with each key (C=1, D=2, E=3, etc.) shows up on the LCD display that also displays calculator results. If you hit a sharp note, then a little sharp sign comes on next to the number. The readout shows the note you are playing as well as the two previous ones. This comes in handy when you are recording a tune, because when you make a mistake, you can go back, erase the wrong note, and replace it with the right note/number. Ten of the white keys are also labelled with the choice of rhythms, so when choosing a rhythm, you press the corresponding white keyboard switch.

Above the keyboard, going from left to right we find the LCD display on the left, then the volume slide potentiometer, a rhythm/melody mix slide pot to get your preferred balance between the two, a three-position octave select switch (low, middle and high), the voice select switch (chooses between Piano, Fantasy [sustain], Violin, Flute, Guitar and ADSR - although the voices don't sound all that much like the labels) and on the far right, the record/play/CAL/off switch.

Below these slide switches is a row of eight tiny buttons and two bigger ones. These switches are what make this machine the remarkable instrument that it is. The eight tiny switches provide access to the computer and the clock/rhythm circuitry. Their functions are labelled with the musical uses
continued on page28

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CASIO'S NEW TOY IN TOWN

THE VL-TONE

continued from page26

above the switch, and the calculator functions below the switch. I'm just going to talk about the musical uses, since that's where the fun is. Left to right again, the first is a reset button. It takes you back to ground zero, but without disturbing what you have in memory. The next switch over is the Delete switch, which you use while recording to get rid of a mistake. You simply step the music note-by-note using the One Key Play switch until you reach the bad note, press the Delete button to get rid of the bad note, and replace it with a good one (how considerate). The next two keys select the tempo of the rhythm. Pushing one button increases the speed incrementally, while pressing the other decreases the speed in a similar way. You have eighteen choices from very slow to very fast, your choice showing up on the LCD display as anywhere from -9 (slow) to +9 (fast). The next button to the right is the Rhythm switch, which you press before choosing your rhythm on the keyboard. Further to the right is the Melody Clear key, which does just that and allows you to enter new melodies; then comes the Music key. This is the button you push to hear the little German folk song, with drums, that demonstrates what the VL-Tone can do.

The Auto Play button is the next button over to the right. This plays back what you have put in memory, just as you played it, timing errors and all - truly a solid-state tape recorder. You can play your melody along with the rhythm track by starting the rhythm, then pressing Auto Play exactly on the beat to start the melody. The rhythm does not record. Then over on the far right are the two One Key Play buttons. One of these does double duty as the memory enter button for the calculator and for the ADSR sound. Either button will play a note out of memory when pushed, which allows you to play your sequence note-by-note. This comes in handy for correction, as mentioned above, and gives you another way to access the notes you've put in memory other than Auto Play. The two buttons make it possible to alternate hitting them with your index and third fingers, which is easier than just banging away with one finger.

Now, about that ADSR sound switch. It's a little complicated, but this is what gives you a massive variety of sounds. It's an envelope generator that you program yourself; an 8 digit number specifies the desired envelope for your notes. But it is also a sound maker, and this is where the complicated comes in. I just haven't had the VL-Tone long enough to understand this function completely, but there are ten different basic sound waveforms to choose from, each with a number; this number becomes the first digit of the "master" 8 digit number. The next 5 digits specify the attack, decay, sustain level, sustain time, and release parameters of the ADSR. The last two digits specify the level of vibrato and tremolo. You enter this eight digit number into the memory, and voila - a new sound. Incidentally, a number 9 at the end gives you an echo-like effect that's pretty neat. The ADSR function is fun, and greatly expands the number of possible sounds...how many possible combinations are there of an eight digit number, using ten digits?

I really like the VL-TONE; the physical characteristics of it alone are appealing. This is really something BIG in a small package. I like the feel of the plastic, and the smooth easy feel of the switches. It looks very well made, sturdy, comes with a little carrying case and has got to be the most portable electronic instrument currently available. Oh yes, and you can plug it into a big amplifier for big sound, or even plug it directly into your tape recorder for clean recording. This and a Portastudio could be all you need! And, you can tune it up and down a half tone to get in line with other instruments when jamming. I have yet to find anything about it that I DON'T like.

So in essence, I did get the Casio calculator that makes music, only this is a year and a half later, and the "calculator" looks more like a musical instrument that also calculates! I think it's a GREAT toy that's well worth the list price of \$70. As far as I'm concerned, the VL-Tone has just got to be the ultimate portable instrument. ☺

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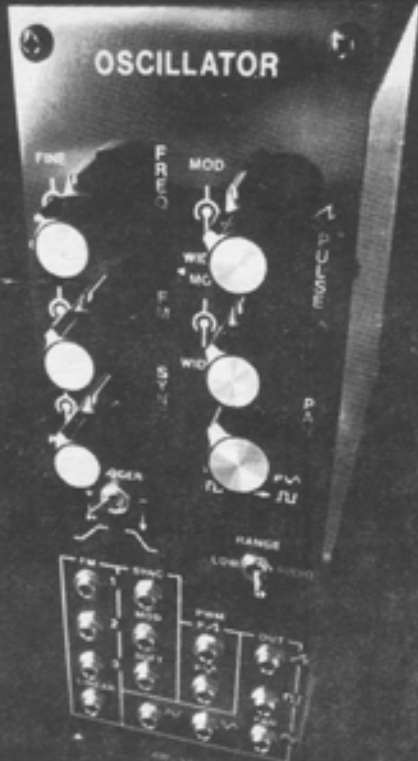
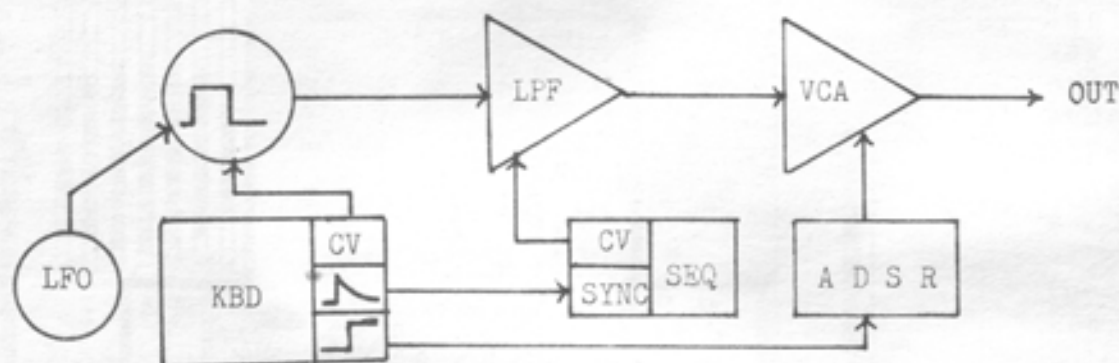
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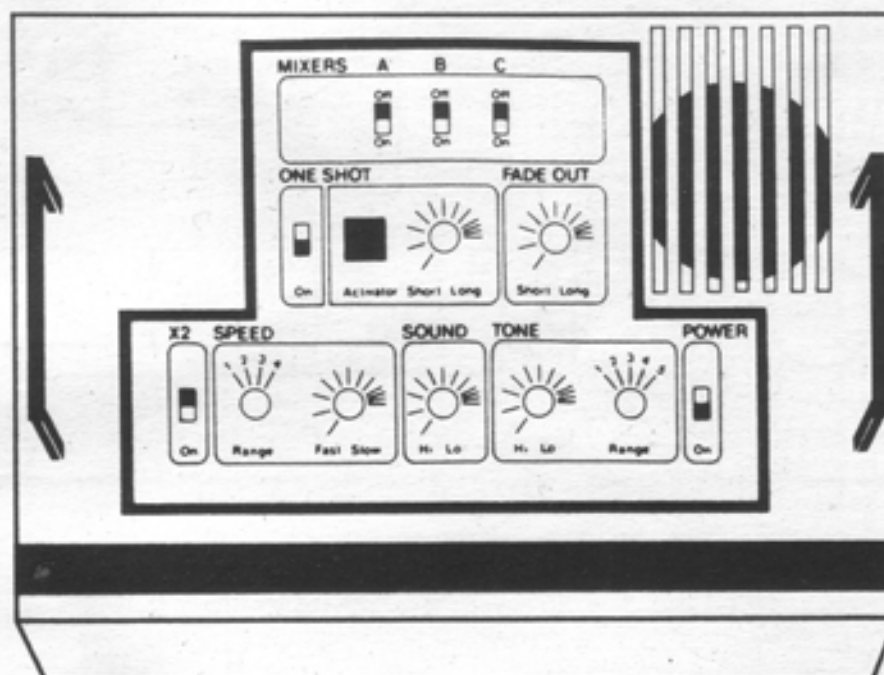
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World's Most Inexpensive Synthesizer: Remco's 'FX'

by Dr. Andrew Gelt

The "Sound FX Machine" (trademark of Remco) sells for under \$30, and is one of the growing number of toys and games utilizing microprocessor-based technology. Even if this synthesizer is thought of as merely a toy, it at least shows the promise of LSI (large-scale integration) and how digital circuitry can inexpensively achieve "analog behavior". Although the machine has serious shortcomings, probably due to its low cost, it will make many of the sounds produced by larger synthesizers. It is essential, however, to first "translate" the words on the Remco device to a more standard electronic music vocabulary:



Remco's term	Standard terminology
Tone	Primary oscillator
Speed	Modulator (an oscillator is used for this purpose)
Sound	Noise generator
One Shot	Envelope generator controlling a VCA; an accompanying potentiometer determines the sustain time
Fade Out	Decay time of the envelope generator
Activator	Manual trigger for the above envelope generator
X2	Envelope follower-type module (not a true envelope follower)
Mixers	Internal patch switches
Power	Power

The primary oscillator, which has audio, sub-audio, and supra-audio capabilities, sounds as if it is a sine wave in the upper frequencies, triangle wave in the midrange, and a square wave with slightly modified pulse width in the lower frequencies. This multiple waveform effect is probably not intentional and may be due to the inability of the amplifier and 2.25" speaker to accurately reproduce sounds. The primary oscillator is constantly frequency modulated by the modulator.

The modulator, with both audio and subaudio capabilities, can also be heard by using one of the internal patch switches to route this sound to the output.

The potentiometer of the noise generator allows for some filtering and attenuates the white noise spectrum towards pink or "violet" noise.

When the envelope generator (which controls the voltage controlled amplifier) switch is on, you will hear no sound until the manual trigger button is depressed. This trigger activates not only the envelope generator but also the envelope follower module (when on). With the envelope generator off, the chosen sound remains on constantly.

The "X2" envelope follower type module creates two separate sound-generating phases (with a few exceptions) in which two completely different sounds are heard. The choice of sounds in either phase is determined by the positions of the internal patch

switches. Duration of the first sound is controlled by the potentiometer of the envelope generator, and the second by the decay time potentiometer. The following chart shows the fourteen permutations of the internal patch switches (switches A, B, and C) when used alone and then when used in conjunction with the "X2" function:

Switches on	Result
none	Primary oscillator modulated by modulator (sine wave).
A	Modulator sound only (square wave), audio and subaudio capability.
B	Noise generator only.
C	Modulator (square wave) controls VCA which amplifies noise generator.
A+B	Noise generator added to the sound produced when all switches are off.
A+C	Same as A+B with modulator (square wave) controlling VCA (modulator continues to modulate primary oscillator with sine wave).
B+C	Same as all switches off with modulator (square wave) controlling VCA (modulator continues to modulate primary oscillator with sine wave).
A+B+C	Silence.
X2	Phase 1: Primary oscillator modulated by modulator (sine wave). Phase 2: Noise generator.
X2+A	Phase 1: Modulator sound only (square wave). Phase 2: Same sound as A+B.
X2+B	Same as B (only one phase).
X2+C	Phase 1: Same sound as C. Phase 2: Same sound as B+C.
X2+A+B	Same as A+B (only one phase).
X2+A+C	Phase 1: Same sound as A+C. Phase 2: Silence.
X2+A+B+C	Both phases: Silence.

Despite the synthesizer's amazing performance in light of the \$30 cost, the shortcomings are disappointing. Both the escutcheon and back panel of the plastic chassis are thin cardboard. I also question the reliability of the inexpensive variety of slide switches as well as the need for the two plastic carrying handles. There is no keyboard (although this is admittedly not essential for electronic composition), but more surprising, no VCF - the module which produces some of the most striking synthesized sound effects. Also, despite being powered only by a nine Volt battery and utilizing a 2.25" speaker, the unit is almost too loud. For this reason, I modified the unit to include a volume control. To further improve the sound, especially of the primary oscillator, I added an external jack which allows for the use of larger speakers and signal processing (reverberation and the like). For long term use, a 110 VAC to 9 Volt DC adapter would also be useful.

The accompanying manual, which shows the settings for 39 different sounds, would be improved if explanations of some basic theoretical concepts were included. The young operator could then create his or her own sounds rather than merely adjust the knobs according to the instructions. (It is gratifying, however, that blank diagrams are provided for notating different patches from those provided in the manual.) Furthermore, the cost and quality control causes each machine, and therefore the indicated settings, to vary from unit to unit. Thus, the manual itself becomes inaccurate.

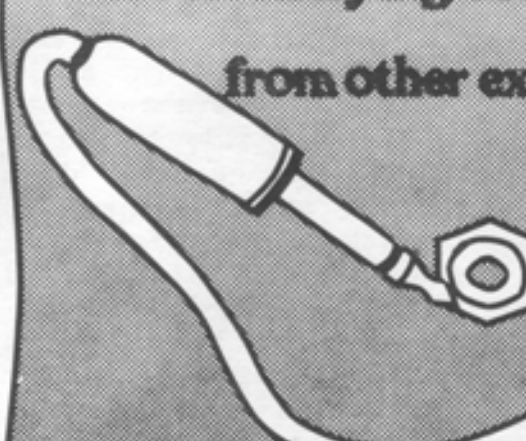
There are even less expensive sound toys on the market, such as the "Sound Gizmo"™ by Fundimensions (under \$20 list). However, although the sounds of this unit can be manipulated to a certain degree, the operator is generally at the mercy of presets such as "jet plane", "phaser", "explosion", "gunshot", etc. The Remco has the advantage of being both adjustable and inexpensive; nonetheless, I would rather pay perhaps an additional \$10 for a more feasible and longer lasting version. Still, even with the present form of this unit, the FX could help a student gain the advantage of early development of an electronic music aptitude. Perhaps a test might be designed using the device to determine if an individual already has such aptitude (for other examples of similar testing see my article "Electronic Toys - Testing Devices for Musical Aptitude?", *The School Musician*, April 1980, pp 22-23).

Devices such as the Remco FX and similar items provide the expectation that microprocessor circuit technology will shortly overcome the problem of expense in electronic music synthesis. As Professor Jon Appleton said in a recent article ("Computers that Make Waves: Digital Synthesizers Take to the Road" by Jim Farber, *Rolling Stone*, 7 February 1980, page 64): "We are literally on the edge of a significant technological change in music."Σ

(Dr. Gelt is an electronic music composer whose primary expertise is eclecticism in music composition. The author of several articles on the applications of small microprocessor devices, he was a consultant for an agency representing Parker Brothers, subsequently developing a music aptitude test utilizing their "Merlin"™.)

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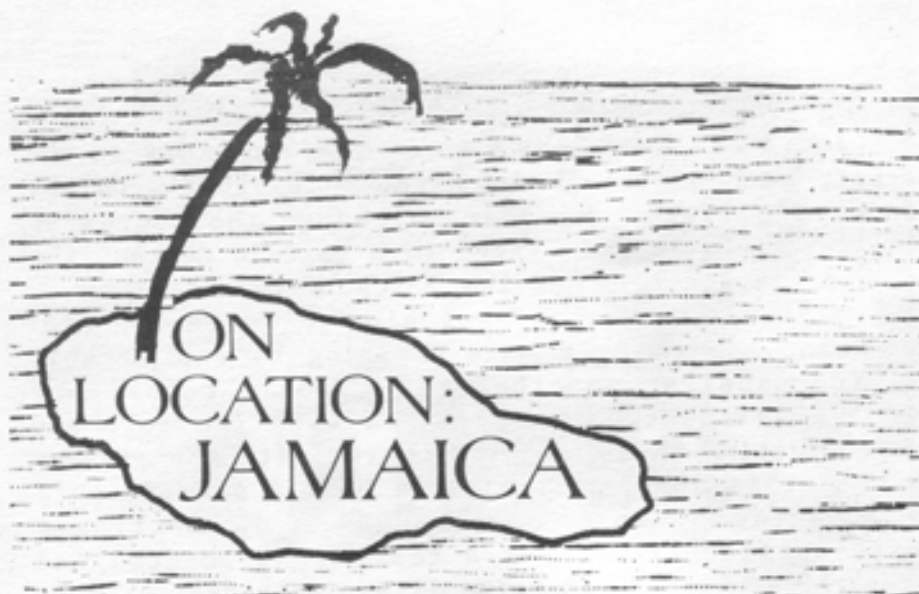
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by Andy Bassford

(This is the start of what we hope will become a semi-regular feature. We encourage readers from other countries to contribute similar articles that describe the musical electronics scene in their country. Tell us about do-it-yourself activity, how well musical electronics is accepted, and the like...just as Andy has done below.)

I moved from Hartford, Connecticut to Kingston, Jamaica about eight months ago. I am a guitarist with WE THE PEOPLE band, one of the island's most popular groups, and do many sessions as well.

The electronic music scene in Jamaica, like everything else in Jamaica, is dramatically affected by the problem of foreign exchange. Without going into a dissertation on international finance, the Jamaican dollar is largely valueless in the outside world, and this, coupled with the fact that there are extensive government restrictions on buying foreign currency and importing in general, means that a 741 op amp costing maybe a dollar at Radio Shack sells for \$10.50 Jamaican, if you can find one to buy. A Fender Vibro Champ amp sells for \$750 Jamaican - you get the picture.

Because of this problem, there are no do-it-yourselfers among the Jamaican musicians I know. However, they have a tremendous interest in effects, and guitarists especially own at least one or two commercially produced devices (usually bought while on tour out of the country). If you're a musician in Kingston you play reggae, especially if you do sessions. And, as anyone who has heard a "dub" album (remixed rhythm tracks with psychedelic effects) can tell you, echo and reverb effects are vital components of reggae. Phase shifters and Mutron-type devices are common on sessions, but the real electronic star in the Jamaican firmament is the Syndrum sound. It is common to have two or three tracks of Syndrum dubbed on to a record in addition to regular drums and percussion. Keyboard synthesizers are also popular, and Robbie Shakespeare (one of reggae's top bass players - Ed.) has a Gizmo. I am the only musician that I know of with a pedalboard. Session fees are \$50 a song, and reggae musicians work very quickly. One day I was on a session where we laid down 14 rhythm tracks in six and a half hours!

Unlike the states, live performances of music in Jamaica are relatively rare, due to the difficulty of obtaining instruments. A few clubs have resident bands, and the large hotels have lounge-style groups, but most dances and parties are serviced by portable discos rather than bands. Stage shows, when they do occur, last for anywhere from three to five hours straight as a variety of singers, vocal groups, and DJ-rappers come on one after another, do their four or five songs, and

leave. After my experiences in the backup band at these shows, I'll never complain about four sets a night again! Effects use in these situations is generally confined to the PA system, although our keyboard player often plays Syndrum parts on his synthesizer, and the musicians simulate echo effects manually on their instruments in order to approximate the "dub" style.

In conclusion, I would say that despite the many obstacles facing them, Jamaican musicians have developed an original and sophisticated style of using effects to enhance their music which other musicians can learn from - a style in which effects are used more as an organic part of the music rather than as a gimmick, and are integrated into the rhythm track rather than being piled on top of it. Anyone seriously interested in electronic music owes it to him or herself to check out reggae.Σ

RHYTHM GENERATION: IT'S ABOUT TIME...

continued from page25

how about scrambling these in some other order? Or what about using the divide by 64 or 128 pins in some combination with the others? Crazy!

As you can imagine, there are infinite variations on the basic rhythm generator circuit. I would be interested to hear your ideas on the subject, no matter how strange or wild they may be; I'm sure that what we've done here is to just scratch the surface.Σ

E-H MINI SYNTH REVIEW

continued from page13

there's no VCA and that the filter pops when you remove your finger from the key, this is not something that most synthesists would use on stage; however, the M/S does make some truly grandiose bass sounds. If I played bass regularly and could only spend \$200 to improve my setup, the M/S would be my first choice. The keyboard is easy to play, and you can get a wealth of great alternative bass sounds. Drop the octave, turn on the "phaser", and wail - the results are most impressive. I've even used the M/S for some recorded bass parts because frankly, no other synthesizer gets quite the same sound. If you want to get trumpets and strings, you had better move on to something more costly. But for bass lines and an occasional screaming solo, the M/S is pretty impressive when heard through a decent sound system.

However, evaluating the M/S solely from a technical standpoint overlooks some of its most attractive features - namely, the social implications of playing something like the M/S (see "Editor's Note"). Non-synthesists seem far more fascinated by the M/S than the M-10 simply because...well, it's a synthesizer, and the M-10 is still basically an organ (of course, if you add the M-10 mods we've covered in Polyphony, then you've got one heck of an organ). But, in the world of portable music both units fulfill a unique place. Give the rhythm player an M-10, and the lead player an M/S; that should make for a pretty good jam!Σ

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