DEVICE the newsletter for the electronic guitarist/musician VOL.1:6-79

DOUBLE COIL PICKUP MODIFICATIONS

mitchell colby

There are many ways to wire a double coil (humbucking) pickup. This article explains how to wire such a pickup to add sound possiblilties not available with most stock guitars. The typical guitar with double coil pickups comes with one or two pickups, a pickup selector, and various volume and tone controls. With a few simple modifications (wiring and the additon of some switches) more variety is possible. All of the following was done to my own guitar (a 1965 Gibson SG standard) with excellent results. I have tried other combinations of wirings but these seem to be the most useful.

When you finish, you will be able to get the following from your pickups:

1. Choice of double coil (normal humbucking) or single coil (thinner "Fender" type sound) options;
2. In phase (normal) or out of phase (thinner, hollow type sound) options when both pickups are used together.

Read the whole article over carefully before starting this modification to make sure you have all the necessary materials and tools on hand. If you have never done any work on a guitar you may wish to either consult with an experienced person, or let them do the work. If you want to avoid drilling any additional holes in your guitar, I'd recommend getting pots that have a push-pull switching option (Schecter, etc.) to implement the described switching circuitry. This is the most desirable way to go since you can re-convert your guitar back to stock later on if desired.

(cont. on page 11)

IN THIS ISSUE: pg.

REVIEW:

BLACET MUSIC RESEARCH "PHASEFILTER"

by Craig Anderton

The "Phasefilter" (PF for short) is an effects device designed to process guitars, keyboards, synthesizers, and other electrified instruments. It can also serve as general-purpose synthesizer module usable with the AMS-100, or any other exponentially responsive system, employing a 0 to +1CV control range.

Blacet's ads classify the PF as a "timbre modulator" or "waveform animator" type of device; in other words, it is specifically designed not to create very radical effects, but rather, to impart more character and texture to the normally static waveforms associated with electronic music. As a result, it doesn't shift phase as much as the typical phase shifter, nor does it filter as much as your average low-pass filter; it instead combines some of the characteristics of both filters and phasers to give a diffused, animated type of sound. The results are difficult to describe on paper, but perhaps going into the technical aspects of the circuit for a bit will enable you to mentally picture the types of timbres available from this unit.

Reviewing the the PF is further complicated by the fact that just about everything in this unit is done differently from the way things are usually done in the effects design biz. For example, instead of the usual triangle wave LFO for sweeping, there is a digital pattern generator that is considerably more flexible (and also more time-consuming to adjust) than a standard LFO.

(cont. on page 2)

PHASEFILTER continued You'll see what I mean about being different as the review continues...

AUDIO CIRCUITRY ANALYSIS. Figure 1 shows a basic block diagram of the PF, which on the surface appears deceptively normal: signal in, a 2040 filter chip, and an output mixer to choose between the 2040 output and the straight input. However, the 2040 is configured in an unusual way. As you may know, this filter chip contains four separate filtering blocks, each capable of giving a 6 dB/octave low pass response (as well as giving other responses). Tying all four blocks in series therefore yields a 24 dB/octave slope low pass filter. These four stages may also be set up to give a phase shifter effect (refer to this month's AMS-100 module for details) or create other filter modes such as high and low pass. The PF, however, hooks up two of the filter blocks as low pass filters and two as phase shifters. Furthermore, the timing capacitors for these sections are different (for example, the cap of one of the low pass sections is the 1000 pf, while the other is 2000 pF) which creates extra variety between the filtering structures.

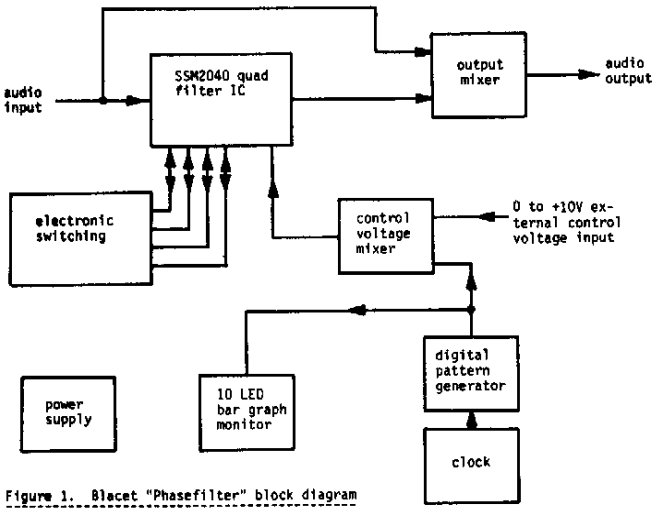


Figure 1. Blacet "Phasefilter" block diagram

What makes this "individual block" configuration really worthy of note, however, is the inclusion of electronic switching that allows you to put the blocks in various combinations of series and parallel. Two switches send a binary address to the electronic switching section, so as a result there are 4 total possible configurations of the 2040's four blocks. According to John Blacet, he tried several different combinations of these blocks and decided on the four that sounded most musically useful to him. These turned out to be all four sections in series, two paralleled strings of low pass/phase shifter series combination, and two low pass filter sections in series feeding two paralleled phase shift sections. Each combination does indeed sound distinctly different from the others.

The 2040 output (or outputs when using parallel configurations) feed a premixer that then dumps into the output mixer along with the straight signal. There is a panpot that allows you to vary the blend of straight and processed sound.

That pretty much sums up the audio section, but a few other comments are in order. The input impedance is relatively low (approximately 10K) so you will need buffering if you plan to use an instrument like a guitar. You will also need some preamplification with low level instruments in order to maximize the signal-to-noise ratio. Bi-fet op amps are used in the output mixing sections. The input to the 2040 and the output of the premixer are capacitively coupled, don't plan on trying to process control voltages with this module.

CONTROL VOLTAGE CIRCUITRY ANALYSIS. The 2040 control voltage terminal is fed from a standard control voltage summing amp; the output of the C.V. mixer is then attenuated to change the standard synthesizer 1V/octave response to the 18 mV/octave response required by the chip itself. This circuitry is temperature compensated by a +3600 ppm resistor at the input of the 2040 control terminal.

You can feed the PF with a control voltage from a footpedal, envelope generator, or similar control source; however, there is also a digital pattern generator (DPG) that's pretty clever. In the DPG a clock feeds a counter, then the 4 counter outputs go through 4 level controls. There are a total of 14 possible discrete voltage levels per counter cycle. The output from each control gets summed in one op amp, and is then integrated by another op amp stage. The time constant of the integrator is variable with a "glide" or "portamento" control. This control allows you to smooth out the control voltage coming out of the DPG so that it appears as a continuously changing waveshape, as opposed to a series of steps.

Naturally, there are instances where you wouldn't want to use the glide control in order to give effects that sound like a sample-and-hold. The counter also has an optional reset line when you wish to synchronize it to external events.

The number of control voltage waveshapes available from the DPG is just about unlimited. You can obtain simple waveforms like a standard triangle wave sweep effect, or if desired, much more bizarre control voltage waveforms. My only objection to the DPG is that when changing the period of the waveform, it is necessary to re-adjust the glide control for optimum effect. For example, suppose you're generating a relatively fast triangle-type waveform, and have the glide adjusted so that all the control voltage "steps" are smoothed into a true triangle wave; should you slow down that waveform, you will need to add more glide to maintain the same amount of smoothness. This is not a tremendous problem, but adjusting the DPG to a "perfect" setting can be somewhat time-consuming.

Sometimes it's very difficult to visualize the correlation between the settings on the DPG counter level controls and the final resulting waveshape, so I'm very glad the PF includes a 10 LED bar graph level indicator. This reacts just like any regular LED VU meter with the linear response, and is most helpful when setting the DPG controls -- it gives you instant feedback on the results of control adjustments. My first reaction when I saw the LED meter was that it was there for decoration, but I found over time that its raison d'etre is primarily utilitarian.

That pretty much describes the circuitry of the PF, with the exception of the power supply. The PF is AC powered, and includes its own power transformer and 4195 regulator.

THE KIT ITSELF. Like other Blacet modules, the PF does not include a case; it's a circuit-board plus parts type of affair. However, the circuit board, parts, and pots are of high quality, and the instructions are reasonably complete and certainly not cryptic. I didn't actually assemble the unit evaluated in this review, but it looks like a one or two evening project. Unless you're a complete novice, I would rate this kit as being quite easy to complete successfully.

USER EVALUATION. In some ways, waveform enhancers and animators are not the world's most glamorous devices; but

→(cont. on page 14)

IDEA

Are VU meters going to become extinct? Texas Instruments has announced a family of analog level detectors. The TL489 has linear response and drives 5 LEDs; the TL490 is also linear and drives 10 LEDs. The latter is cascadable to deliver 150 levels if desired. Perhaps of more importance to audio buffs, the TL487 is a 5 LED logarithmic response driver, while the TL480 is also logarithmic and drives 10 LEDs.

TELEFUNKEN offers two linear 5 step LED display drivers (parts U237B and U247B) and two logarithmic 5 step drivers (U257B and U267B). Tying the U257B and U267B together yields a 100mV to 1V display.

SIEMENS manufactures the UAA180, a 10 LED bar graph driver, and the UAA170 , a 10 point graph driver, both of which have a linear response.

NATIONAL SEMICONDUCTOR has announced the LM3941, a dot/bar display driver that can drive 10 LEDs without multiplexing. Power supply requirements are 3 to 20V; the LM3914 is currently available from RADIO SHACK. While this chip has a linear response, the companion LM3915 offers logarithmic response suitable for audio work with a 3 db per step response. Either chip can be cascaded with like chips to create displays containing up to 100 LEDs.

EXAR makes a 12 point level detector IC with a log response (XR2276). It can drive either fluorescent or LED bargraph displays, and has provisions for an externally adjustable 0 VU trim.

In a related development, LITRONIX is now offering a 10 LED bar display for display driver chips; all diodes in these DIP arrays are individually addressable. The development, of these various easy-to-use display drivers, coupled with inexpensive displays, will mean that we'll be seeing alot more electronic VU meters on equipment in the years ahead. For those anxious to start experimenting, pick up an LM3914 from RADIO SHACK, and hope that someone catering to hobbyists picks up on some of the logarithmic indicators that are more up our alley.

NEW ORGAN CHIPS. Tired of square wave output organ dividers? MATSUSHITA7s newest organ chip has sawtooth wave outputs and note decay times that vary from 25 milliseconds to 2 seconds.

(cont. on page 4)

INFO Only four of these chips are required to create a 61 note electronic organ keyboard.

SGS-ATES (the Italian semiconductor company is planning to use a 3870 microprocessor for keyboard control in conjunction with a sound chip that can handle 16 simultaneous voices over a 5 octave range. They are also introducing a chip containing the oscillator and frequency dividers needed to implement 3 octaves of notes along with a rhythm generator and some pedal controls.

TANGERINE DREAM BREAKING UP? Our crystal ball tells that TANGERINE DREAM won't be around much longer despite an attempt to get PATRICK GLEASON to join at the last minute. Best wishes to all in all future endeavors.

KORG is introducing quite a few new products of interest.

First in line is the MS-03, a pitch to voltage convertor specifically designed for the guitar. No special pickups or modifications are needed for operation but a double pick-up guitar is recommended. The MS-03 is said to be interfacable with any synthesizer with control voltage and trigger (or gate) inputs. Other major features include: Portamento, Envelope follower outputs, mode switch (changes triggering characteristics), CV and trigger hold and synthesizer cancel. With a $300 suggested list price this could be an easy way for you so inclined to design your own guitar/synthesizer systems without putting the big bucks up front. Watch for a review in the very near future.

Next on the list is an item for those who would rather have a complete self-contained guitar/synthesizer. The X911 Variable Preset Guitar Synthesizer offers preprogrammed preset control with separate variability for each preset in a monophonic format. The presets consist of 5 mixable synthesizer voices (e.g. a 4' sawtooth wave with a quick attack time) and 6 mixable instrument voices (e.g. flute, tuba, ect.) with a variable parameter above each voice select switch (e.g. attack/decay control on sawtooth setting; fc on tuba setting). Electronic solid state switching allows quick and quiet selection of the different voices for fast changes during preformance. Other features include: Portamento, infinite sustain, variable detune, and synthesizer cancel (all controllable from footswitches), 3 octave voicing range, built in fuzz (processable through the filters and envelope generators), and CV and trigger out so that it is interfacable with other synthesizers. The suggested retail price is estimated at under $600 with a release date sometime in the fall.

Finally from the KORG line is the SE-300 STAGE ECHO, a baby brother to the recently released SE-500. The SE-300 offers a tape echo system with three individually selectable (through pushbuttons) playback heads and a professional quality spring reverb. The SE-300 has two channels, each with it's own volume control and is equiped with a VU meter and peak level LED indicator. With it's "auto-pat" input system and output attenuator, the unit can be used with any type of input (guitar, synth, mike) and output systems (PA mixers, guitar amps). The motor is of the brushless direct drive servo type for a low maintenance operation with a minimum of wow and flutter. Suggested retail: $700.

For more information on these products write to UNICORD, INC., 89 Frost St., Westbury, NY 11590

More Guitar/Synthesizer News From ONCOR, INC. [471 W.5th St., Salt Lake City, Utah 84101 phone: (801)328-0847] comes THE TOUCH digital guitar and bass/synthesizer, a completely self-contained (within the body of the instrument) system that uses a touch sensitive fret board instead of vibrating strings in determining pitch. These units were showcased at the recent NAMM convention in Atlanta which we hope to review shortly.

Also new guit/synth products from ROLAND (part of the new ROLAND RACK series) ELECTRO-HARMONIX and MUSICO (RESYNATOR) more about these products next month.

A New Reverb Chip. MATSUSHITA's MN3011 is a 3,328 stage bucket brigade delay line with 6 output taps. These taps are placed at various intervals, rather than regularly, to simulate the random reflection characteristics of reverb. Creating feedback with multiple taps gives a more natural reverb sound than adding feedback to a standard delay line, as there are several different delayed signals being sent back. Since the specs are similar to the MN3005 (typical 0 VU operating level and quite low noise), We suspect the MN3011 might be a permutation of that part.

MATSUSHITA also has a driver chip

(cont. on page 13)

EDITORIAL

AN OPEN LETTER TO MANUFACTURERS

For over 10 years, I've been trying to promote greater understanding of musical electronics...not only how the devices work, but how to use them effectively. Many times, I've felt I've been doing this in a vacuum since manufacturers have little inclination to try and educate their customers in the same way hi-fi companies have. But perhaps we're in for a change of attitude; I'm referring to MXR's two page spread ["MXR on the use of multiple effects"] that appeared in the july issues of several music magazines. For those who haven't seen it, the ad is a discussion of how to use multiple effects written in a style similar to my **GP** column (i.e. informally informative) and hitting on most of the same points that I consider important.

Of course, it's easy to be fashionably cynical and say that MXR is doing this just to increase their sales. Or that parallel effects combinations are ignored. Or that nothing is said that hasn't already been covered elsewhere. Or that the annual NAMM show brings out the best in people...but anyone that cynical is missing the point; I feel MXR should be commended for breaking the ice on educational advertising. What's more, in the ad they make a point of mentioning the principles discussed apply to effects **generally**, not just the ones manufactured by MXR. Naturally, they also get the point across that they'd be just as happy if you bought MXR stuff, but they keep their pitch at a very low key.

The DEVICE opinion poll results in issue 1:4 showed that musicians generally have a high regard for MXR products; it's nice that something is being given back to those musicians in the form of education. I hope that other companies will pick up on a good thing, and do their best to come up with ads that educate as well as sell.

Once again, we'd like to emphasize to MXR——and all other manufacturers---that DEVICE is a forum for <u>you</u> as well as the end user of devices. We'd be glad to run stories on how you overcame a design problem, how to retrofit older products, testing procedures you employ, and generally how the effects biz looks from your end of things. It's nice to take out two page spreads to promote your stuff, but you can also talk to a select and very dedicated group of musicians at no cost through this newsletter. Many companies have already shown their support, and we're very thankful to you all; now we want to get as many other manufacturers as possible involved in the two way communication process.

Craig

* * * * * * * * * * * * * * *

In issue 1:1, we ran a review of the ARP Avatar that some people interpreted as being highly critical of the unit...and we get the impression this has scared off some manufacturers who feel that we somehow get sadistic pleasure out of knocking a piece of equipment. Actually, we wanted to run two differing opinions of the Avatar because we felt that would give the readers a better perspective; so we contacted a prominent Avatar user who likes his machine very much. He promised to write us a piece, but after many calls, and further promises, no article ever came through. Eventually we were staring our deadline in the face and had to go with what we had. When the issue came out, we urged ARP to write a rebuttal of any criticisms they felt were unfair or overly subjective. Again, no response.

Many people who had promised us sutff for review mysteriously disappeared, presumably after reading the review; letters went unanswered and the like. On the other hand, other companies saw what we were trying to do and encouraged us in our attempts to get a dialogue going...but they were a distinct minority.

We're here to disseminate information <u>and</u> opinions. However, we're also not <u>afraid</u> of controversy. We try to get both sides of any story; but if a side just doesn't respond, what should we do? Or maybe, what more <u>can</u> we do?

Craig & Roger

7 MODS FOR THE EH MICRO SYNTH

craig anderton

After noting in a previous review (DEVICE 1:3) that the attack delay triggering of my Micro-Synth was not up to snuff, E-H was kind enough to forward schematics of the thing so I could figure out a suitable modification. Well, I got carried away, so here is that modification along with six others aimed at improving the performance of the Micro-Synth.

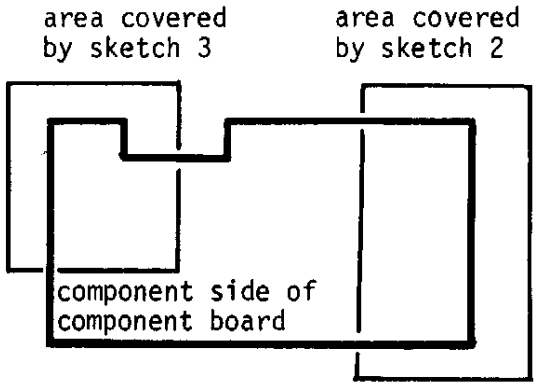
First, a note about modifications in general. Once you start messing around with a box, the warranty is void and you really can't expect the manufacturer to come to your rescue if you run into trouble...so, work very carefully, dress wires well to avoid shorting problems, and be patient. My pace of work gets a lot slower when doing modifications because I try to be really careful; remember, the object of a modification is to improve a unit, not destroy it.

To disassemble the unit, unscrew the six screws that hold the bottom plate in place. Next, looking at the front panel, unscrew the screws located on the extreme left and right hand sides, as well as the bottom screw. At this point, by pushing gently on the slider pot knobs, you should be able to push the circuit boards holding the circuitry and slide pots away from the case.

The next step is VERY important: looking at the foil side of the component PC board, make a diagram of where the various wires from the outboard parts (transformer, jacks, etc.) connect to the board. During the modification process these wires will be flexed several times, and one may easily become disconnected...so take this precaution and you'll know where to put it back if it breaks off.

MOD #1: PROTECTING PANEL GRAPHICS. Carefully remove the two screws that hold the transformer to the front panel, and also remove the footswitch. Next, get some clear contact paper and cut a piece 7.75 X 5.75" (19 X 14.5 cm). CAREFULLY lay it over the front panel--you only get one shot at this. If the contact paper goes on wrong, attempting to remove it may pull off some of the paint. You might want to enlist the aid of someone to grab two corners while you grab the other two. Center the contact just over the top of the panel, then lower one end only, press down lightly, then work your way down to the other end. After the piece is squarely on the front panel; burnish it down, then cut slots for the slide pots, screw holes, and footswitch hole with an X-Acto knife or scalpel. When re-attaching the transformer and footswitch, don't tighten the screws down too much or you'll distort the contact in the area around the screw heads.

MOD #2: ATTACK DELAY SENSITIVITY ADJUSTMENT. Remove the three screws and various spacers that hold the slide pot and component boards together; then unfold these two boards (I like the way E-H has made this unit so easy to service). Now, stare at the component side of the board and align it as shown in sketch #1. Referring to detail sketch #2, note that the little preamp gain adjust trimpot should now be in the upper right hand corner. For simplicity, sketches #2 & #3 show only the ICs and a few pertinent components; the numbers for the ICs refer to the E-H schematic, but unfortunately are not indicated on the board.



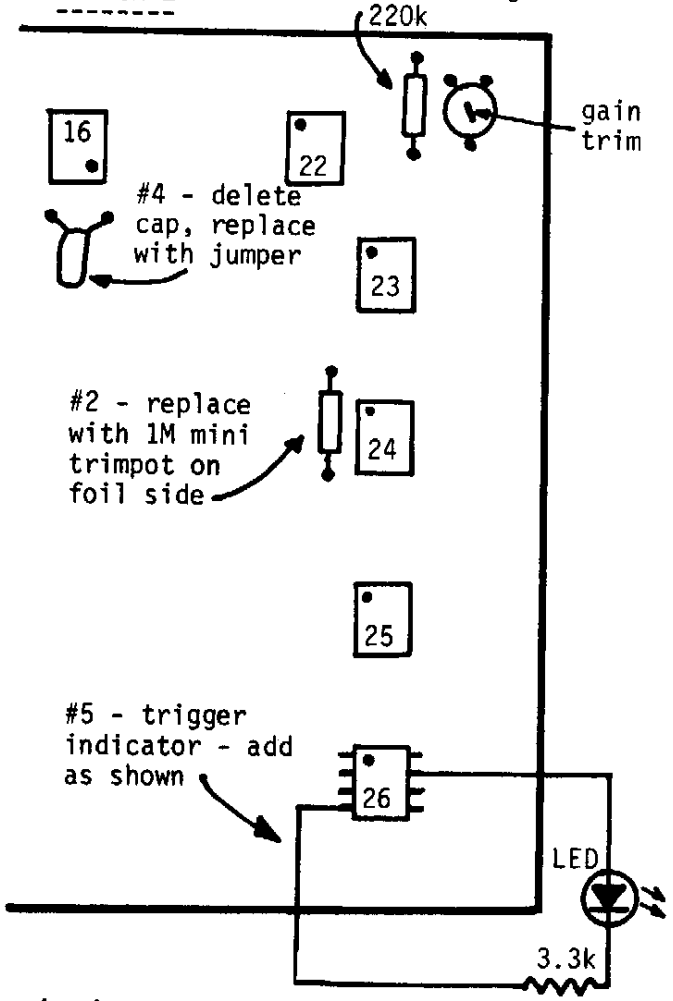
Begin this mod by carefully removing the 1 Meg resistor to the immediate left of IC24. On my unit, there was also a 1 Meg resistor tack soldered to the bottom of the board paralleling the original resistor; if this is present, remove it also. Now, wire in a minature 500K or 1M trimpot in place of the 1M resistor originally located next to IC24. If you mount this trimpot on the foilside of the board it will be easier to adjust when the case is back together again; just remember to insulate it from the foil if necessary. Maximum resistance equals maximum sensitivity. If you have problems with retriggering or a failure to reset between notes, decrease the trimpot resistance. For me, about 250K worked well.

MOD #3: INCREASED INPUT IMPEDENCE. Change the resistor to the immediate left of the white trimpot from 68K to 220K.

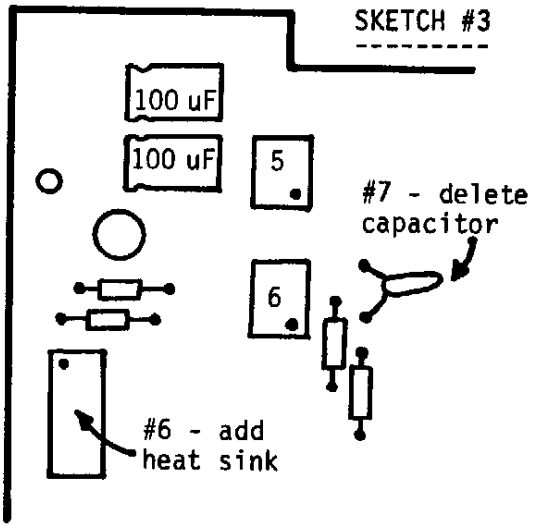
MOD #4: INCREASED LOW FREQUENCY RESPONSE OCTAVE SECTION. Right below IC16, you'll notice a .01 uF mylar capacitor. Removing it and putting a wire jumper in its place improves the bass response of the octave above circuit, which makes it less "tinny" sounding to my ears. This mod doesn't seem to lessen the intensity of the octave effect on higher notes, but does add more flavor to lower notes.

MOD #5: FILTER TRIGGER INDICATOR LIGHT. A box this tricky should have a blinky light, right? Add it by connecting the anode of an LED to pin 7 of IC26, the cathode of the LED to a 3.3K resistor, and the other end of the 3.3K resistor to pin 4 of IC26. The LED will flash once when the unit is turned on (if the LED stays on, unplug the unit then plug in again), and also whenever the filter is triggered. Where to put the LED is another matter. You could drill a hole in the panel, but I found a neat alternative. I routed the LED leads through the slot in the "trigger" slide pot, and then brought them out through the space in the top of the pot. Although this restricts the throw of the slider by a minute amount, there should be no problems as long as you use a relatively small LED (with my Micro-Synth, pushing the trigger slider all the way just kicked the filter on full anyway). By mounting the LED in this fashion, when the case is reassembled the LED sits just below the word "trigger", nestled snugly in the slide pot slot. Put some insulation ("spaghetti") around the LED wires, and hold them in place on the board with glue or tape.

SKETCH 2



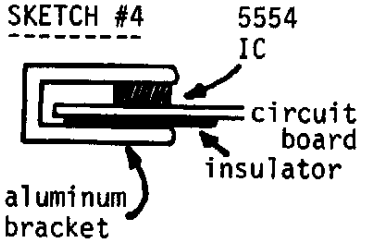
SKETCH #3



MOD #6: ADDING REGULATOR HEAT SINK. For this mod refer to sketch #3 (it shows the upper left-hand portion of the board). The 5554 regulator runs a little warm for my taste, and by adding the trigger indicator light I figured I was maybe pushing it a bit. So, I added an extra heat sink. There are commercially available IC heat sinks that fit over a standard DIP package; I improvised one by bending a small U shaped piece of aluminum that clamped pretty tightly over the IC top and foil side of the board (see sketch #4). Add some kind of insulator (like a strip of bakelite or plastic) between the heat sink and foil side of the board if you use this approach. I doubt if this modification is necessary, but it certainly cannot hurt.

(cont. on page 14)

SKETCH #4

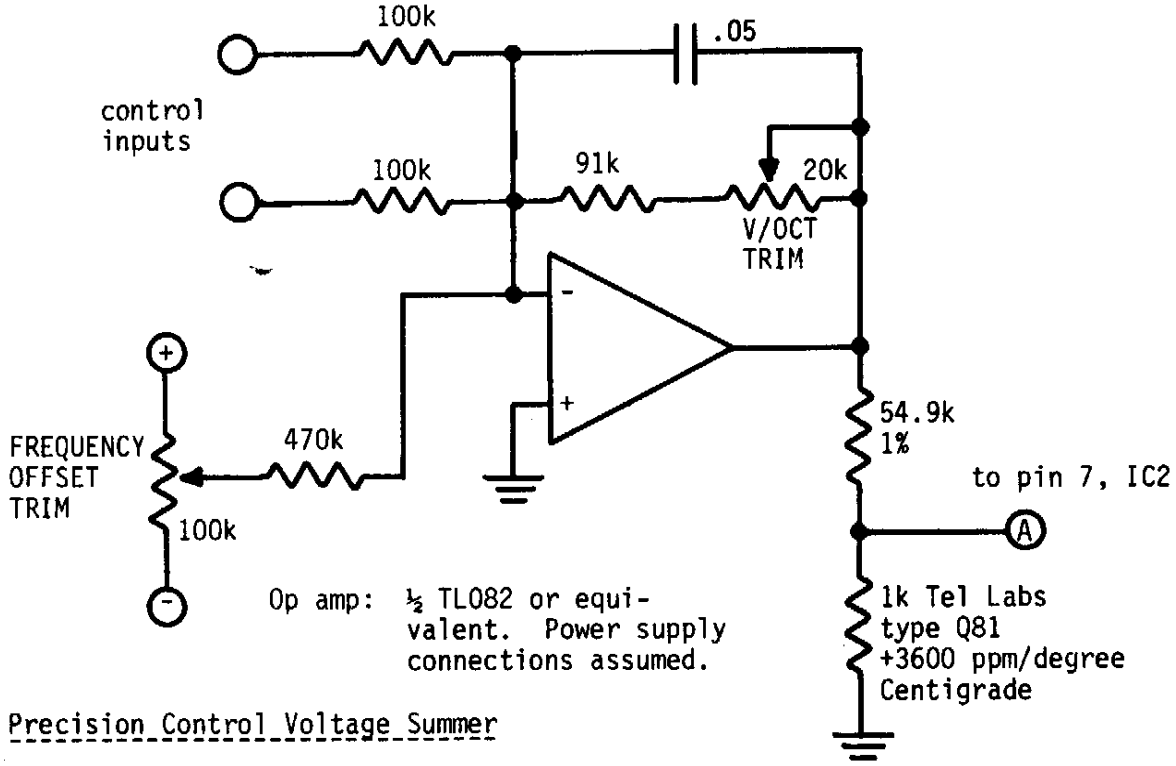


construction: BUILDING THE AMS-100

by craig anderton

This month's circuit is based on a schematic sent up by RON DOW, co-designer with DAVE ROSSUM of the SSM/Eu series of electronic music ICs. Ron has been most helpful with application ideas, information on the chips, and keeping me up on the latest design twists for these ICs... thanks, Ron.

If this circuit bears a resemblance to the voltage controlled phase shifter presented in DEVICE 1:4, it's for a reason: Both are built around the SSM2040 voltage controlled filter chip. However, there are some interesting design wrinkles in this application which, on the whole, make it a more useful module than the VC phase shifter. I wouldn't say it exactly obsoletes the 1:4 design; it is handy to have a module specifically dedicated to phase shifting... but this month's circuit is certainly versatile.

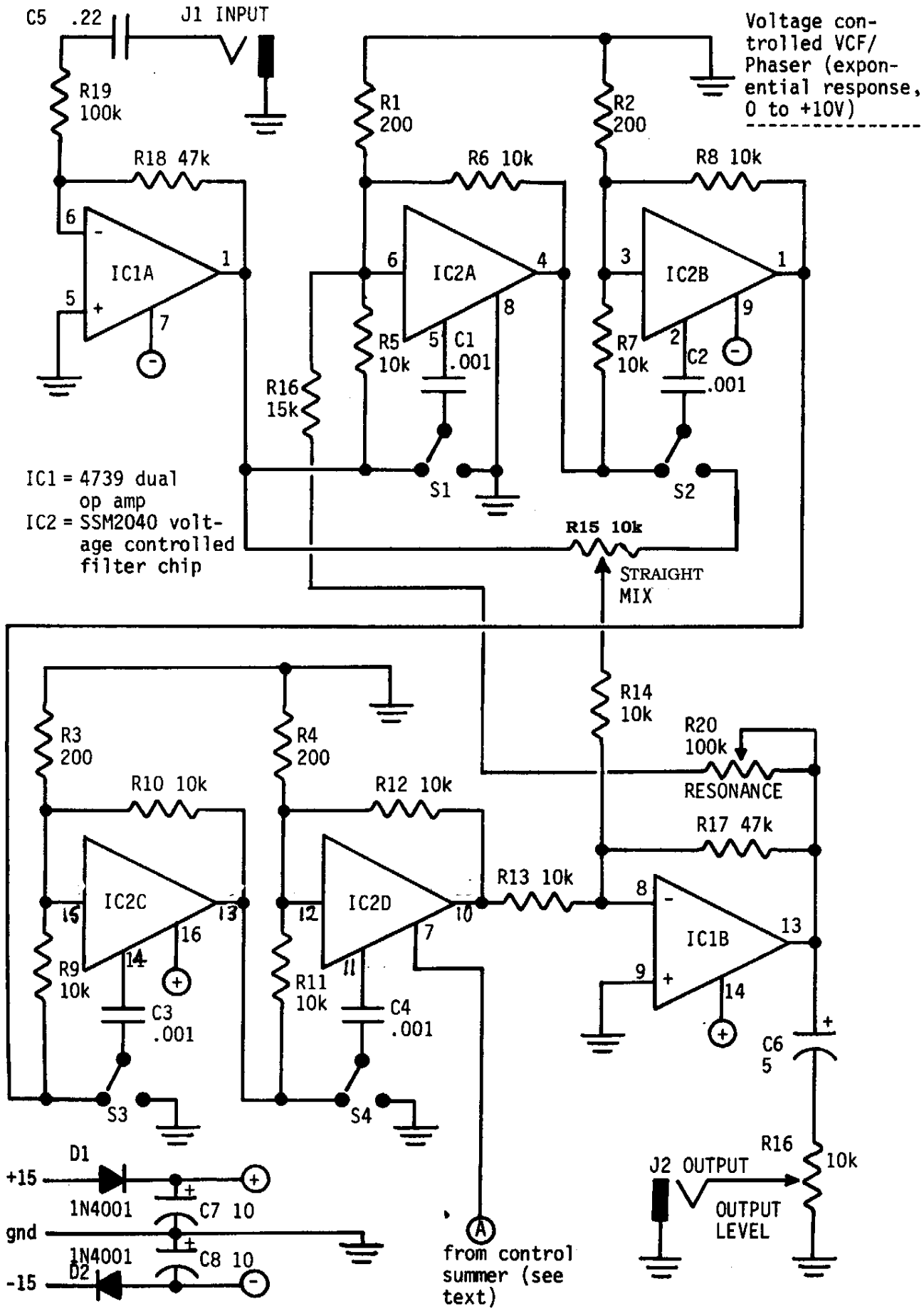


Precision Control Voltage Summer

HOW IT WORKS. Ron points out that by switching the filter capacitors for each stage (C1 - C4) between ground and the signal input, the response of each filter stage can be changed from low-pass (standard VCF sound) to all-pass (phase shifter sound). In his original schematic, Ron suggested using a 4 pole, 2 throw toggle switch to simultaneously switch all stages between VCF mode and phase shifter mode. However, John Blacet (BLACET MUSIC RESEARCH) turned me on to the trick of making different stages selectable between low pass and all pass; there are some really nice effects you can obtain by setting some stages to one response and some stages to the other. If you're into experimentation, I'd definitely suggest going for an "individual switch for each stage" approach.

The input signal goes through an inverter/buffer/attenuator (ICIA) that attenuates our nominal 2V pk-pk line level signal to a 1V pk-pk level suitable for driving the SSM2040 without overloading. ICIA's output feeds the filter/phaser stages (IC2A - IC2D), and also an output mixer via R15, the STRAIGHT MIX control (since phases shifters need to have some direct signal mixed in with the phase shifted sound in order to give the fullest possible effect, R15 provides this mixing function). Making this control variable allows for very subtle phase effects if desired, and is of great use when some filter sections are all-pass and some are low-pass.

(cont. on page 10)



part 8 VOLTAGE CONTROLLED VCF/PHASE SHIFTER

AMS 100 continued

The output of the filter/phaser stages (IC2A - IC2D) also feeds into the input of the output mixer. Since all AMS-100 modules are designed to be non-inverting, the combination of an input inverter and output mixer (which inverts the signal again) insures having a non-inverted signal at the output. This is vital when putting filters in paralled for thicker filter sounds.

Another AMS-100 design requirement is that any module be capable of providing greater than unity gain. R17 gives the output mixer some gain, and the overall module level can be adjusted with R16. If desired, R16 can be replaced with an on-board trimpot set for unity gain if you need to conserve panel space.

R20 sets the resonance of the module. In some modes of operation, the resonance control can be advanced to the point of oscillation, but this in not the case for all operating conditions.

VOLTAGE CONTROLLING THE MODULE. Pin 7 of IC2 accepts a negative-going control voltage to sweep the module over its full range. For applications where precision tuning of the filter is not necessary (for example, audio processing) I'd suggest you use the control voltage summing section described in DEVICE 1:4. In the schematic on page 9, this section comprises R6, R25, R27, R29-R35, C5, J3, J4, and IC1A, and feeds into pin 7 of IC2. You can build this summer around something like a 741 or similar available op amp. Feed the control voltage summer into pin 7 of this month's schematic in the exact same manner as the way it feeds into pin 7 of 1:4's schematic.

However, there are applications where you might want the filter to have a temperature compensated, precision 1V/octave response curve.

For example, one precision application might be a low pass filter for synthesizers, where you want the filter frequency to track an oscillator frequency exactly. Since the 2040 transconductance amplifiers are not internally compensated for temperature, Ron recommends the control voltage summer circuit shown for precision applications. It is identical to a circuit given in the SSM data sheet for the 2040 (I took a few liberties with the VCF/phaser to make it AMS-100 compatible, and also to give it a few more features). While the op amp shown is a TL082 op amp section, other op amps will also work. The V/Octave trim allows you to set the responses of the control summer for a precise 1V/octave response; the freq offset trim performs the same function as R33 in the 1:4 control voltage summer. The .047 uF capacitor compensates for a relative lack of control voltage rejection in the 2040 (typically, CV rejection is around -37 dB), by preventing excessively fast response that could cause "popping".

The 54.9K resistor is stock 1% value, and can sometimes be located surplus. The Tek Labs Q81 resistor is a special kind of resistor that is temperature compensated so that as temperature variations change the responses of the IC2 control input, the resistor changes in an equal and opposite manner to compensate. The Q81 is available from Eu SYSTEMS for $3.50; the SSM2040 costs $10.00 from the same source.

Before getting off the subject of where to get parts, C1 through C4 should be high quality, polystyrene caps for best stability. These are available from Eu for 45 cents each, and also from BILL GODBOUT ELECTRONICS. By doubling the 54.9k resistor to 109.8Km, you can use the 2k temperature compensated resistor available from the ELECTRONOTES newsletter. Addresses for all these companies are printed at the end of the article.

PRECAUTIONS. Should you decide to breadboard this circuit on a solderless breadboard, the 2040 data sheet includes the following cautions:

--Outputs are not short circuit protected. Shorting any input, output, or capacitor pin of IC2 to either supply will generally blow up the part.

--Shorting any input, output, or capacitor pin to ground may be tolerated for a few seconds but is not recommended.

In addition, for precision work the Q81 resistor should be mounted in contact with IC2. Use heat sinking compound between the resistor and IC to incease the thermal uniformity of the two parts.

When testing, watch those probes and alligator clips...these chips are expensive to replace.

USING THE VCF/PHASER. Check out the VCF mode first. Start off with resonance at a minimum (R20 = 100k), S1-S4 connecting C1 - C4 to ground, R15 at minimum, and R16 up about halfway. Plug the AMS-100 input module PREAMP OUT into the input of the VCF/phaser (or use any other line level signal -- tape recorder, synthesizer output, etc.). If you're using the precision control summer presented in this issue, after grounding the control inputs

adjust the frequency offset trim so that the VCF cutoff frequency sits just below the lowest frequency of interest. Now, apply a variable 0 to + 10V control voltage to either control input; the VCF should sweep from its lowest cutoff frequency to highest cutoff frequency. If you're using the simple control voltage summer from issue 1:4, then with R34 and R35 turned all the way down, sweep through the R33's range. Again, the VCF should sweep from low to high.

Next, try the same sweeping action but this time turn up the resonance control. Careful; some settings may produce oscillation. Return the resonance control to minimum after these experimentations.

To check out the performance of the module as a phase shifter, change the positions of switches S1-S4 so that the caps connect to the inputs of the filter sections, thereby changing the filter response to all pass. Sweep through the range of the module again, but this time, adjust R15 until you get the fullest possible phase shifted sound. Experiment with different resonance settings; again, you may get oscillations with the control turned all the way up.

Now try different settings of S1-S4 -- some on all pass, some on low pass. You'll note that the setting of R15 is crucial to getting a wide variety of sounds in this "mixed mode" operation, and that it's possible to get some very pretty, very delicate kinds of timbre changes. This module seems especially good at taking fuzzed instruments sounds and making them very brass-like in nature, but is of course not limited to this type of effect.

When you're using the module strictly as a VCF, R15 may seem unnecessary since it detracts from the effect of the filter. However, with high resonance VCF settings, adding in some straight signal can give a less gimmicky sound when you're using this module for equalization as opposed to using it as an effect. Extreme VCF resonance produces a bandpass type of effect, so including some straight signal puts some lows and highs back into the signal.

FINAL COMMENTS. This is a very functional module, no doubt about it; you can get a lot of sound without putting out a lot of cash or effort. For anything but the most critical applications a precision control summer is not necessary, so you can use the 1:4 control summer to save a few more bucks.

Shortly, after playing with this project, I started to experiment with state-variable filter configurations of the 2040. Then today I just received ELECTRONOTES #99, which has a schematic for a 4th order state variable filter using the 2040. If you're looking for a more versatile structure than your basic 24 dB/octave lowpass, I'd suggest checking into this circuit. --Craig Anderton

Addresses:
ELECTRONOTES 1 Pheasant Lane, Ithaca, NY 14850
EU SYSTEMS 417 Broadway, Santa Cruz, CA 95060 ($2 handling/shipping per order)
GODBOUT ELECTRONICS Building 727, Oakland Airport, CA 94614

PICKUPS continued

Parts required for the modification include covered (insulated) stereo shielded cable (enough for both pickups), two single pole single throw (SPST) switches, and one double pole double throw (DPDT) switch. The switches can either be mounted on the back of the pots as mentioned previously, or can be mini toggle switches. Pots with push-pull SPST switches are usually available in local electronic parts houses, but pots with DPDT push-pull switches are only available from some guitar accessory manufacturers. Make sure you replace the original pots with pots of the same value (usually 500k, audio taper). The mini-toggle switches are commonly available.

Begin by unsoldering the pickups from the volume controls, unscrew the frames from the body, and remove from the guitar. One of the steps where you have to be very careful is when you remove the pickup covers (if you have them). Heat the solder quickly and use a desoldering tool to remove the solder from the case. If overheated, problems can arise - - so be careful. Once the cover is off, carefully remove any electrical tape covering the coil; you will see where the shielded wire connects to the pickup wires. Using low heat from your iron, remove the shielded lead which goes to the pickup screws (if needed) so you can slip the cable out of the pickup.

Take the stereo shielded cable and cut it to a length long enough to reach from the pickup to its associated volume control. Remove enough of the insulation, leaving the shield intact, so that the cable will fit through

PICKUPS cont. the cable hole in the pickup chassis. Now, carefully keep track of which wire connects to what part of the pickup in the following steps -- this information will be necessary later on, and you won't be able to get inside the pickup to look. I'd recommend writing it all down.

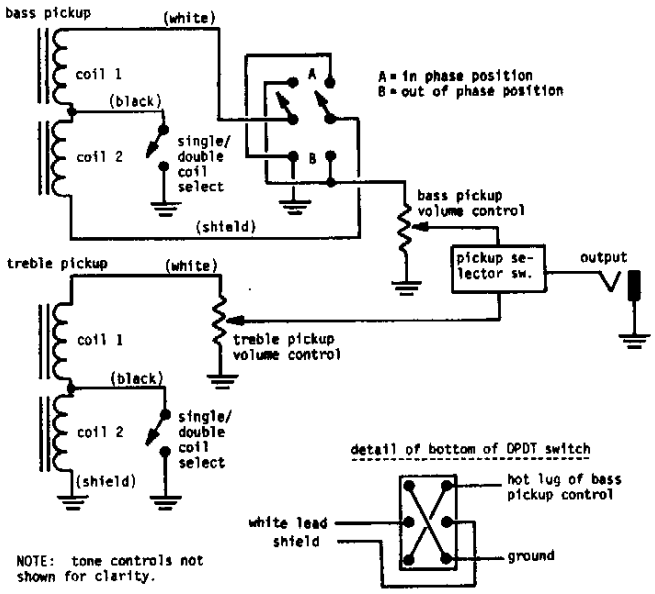
Solder on inner lead of the new shielded cable (say, the white lead) to the coil lead where the original hot lead was soldered. Retape this connection using good quality electrical tape. Solder the stereo cable shield to ground (the pickup case).

Now carefully examine the pickup. Two thin wires, one from each coil, connect together and are taped together; unwrap the tape and carefully solder the remaining inner lead from you stereo cable (usually colored black) to this connection -- you should end up with three wires connected together at this point, two thin ones and the black inner lead. When making this solder connection don't use too much heat or you'll melt the insulation on the coil wires; this could cause shorts when the pickup is re-assembled. Carefully re-tape all wires, and wrap a turn of tape around the coil assembly after you're sure that all is in order.

Using a vice, fit the cover tightly over the pickup and resolder the two together quickly, making sure the solder adheres to both the pickup and cover securely. Reinstall the pickups in the body of the guitar.

Following the wiring diagram and switch detail, here's how to reconnect the bass pickup. Connect the white lead (the one that was soldered where the original hot lead was) and the shield to the middle lugs of the DPDT switch. Next, wire the two sets of opposite lugs to each other as shown. Connect the terminal that connects to the white wire in one position of the switch to the hot lug of the volume control, and connect the terminal that connects to the shield wire in the other position of the switch to ground. The "hot lug" of the volume pot is usually the one that is on the opposite side of the pot from the lug that connects to ground. This DPDT switch is now wired to throw the bass pickup out of phase if desired. Although the chassis of the pickup is not grounded in the out-of-phase position, you should encounter no hum problems.

Connect the third (black) lead from the stereo cable to one lug of the SPST



switch. Connect the other switch lug to ground.

To reconnect the treble pickup, locate the stereo cable coming from the pickup. Connect the shield to ground, the hot lead to the hot lug of the second volume pot, and the third lead to one lug of the remaining SPST switch. The other lug of the SPST switch again goes to ground.

CHECKING OUT THE MODIFICATION. When you turn the SPST switches on (wire from pickup connected to ground), the sound of your guitar should be much thinner. With both pickups on at the same volume the guitar should sound very "Fenderish", almost like a Strat in one of the middle switch positions.

With the DPDT switch on (out of phase), the guitar should acquire a hollow type of sound. Again, the effect is most pronounced when the volume and tone controls for both pickups are adjusted to the same settings. Note that you'll only get the out of phase sound when both pickups are being selected.

Many manufacturers are installing similar switching options in their stock guitars as these other-than-traditional guitar sounds become more popular. I hope they prove useful to you. If you have any questions or suggestions on guitar modifications, please feel free to write. (Mitch Colby is product specialist with Unicord Inc. His address is 1130 Stadium Avenue, Bronx, NY 10465.)

Note: DEVICE has a new address -

12304 SCRIBE DRIVE, AUSTIN, TX 78759

specifically designed to drive BBD's called the MN3101. It contains an oscillator, flip flop, waveform shaper, and clock driver. This sounds like a much easier way to drive a BBD than using a 4047 and pumping that through a batch of 4049s!

GENTLE ELECTRIC Announces Model 101 Pitch/Envelope Follower Circuit Board Sets. KEVIN MONAHAN at GENTLE ELECTRIC just sent us a letter heralding the availability of their popular Model 101 PEF in an OEM (Original Equipment Manufacturer) Version. Board sets, include 2 boards per set: an amplitude circuitry board and a pitch circuitry board (pitch board contains two potted modules; one for exponential current sink and one for fundamental extraction) documentation and manual. OEM price is $275 and there are quantity discounts. They are also offering a lead string selector (LSF) which should open the door for some of you to tackle building a custom guitar synthesizer system. Or use it as a module on the AMS-100. For more information contact GENTLE ELECTRIC, 130 Oxford Way, Santa Cruz, CA 95060 or phone: (408)423-1561.

Iron Curtain Not Soundproof. ELECTRO-HARMONIX will be exhibiting their line of effects, and demonstrating them with live music, at the Consumer Goods and Fashions exhibition in Moscow, June 28th to July 8th. The exhibition is organized by the USSR Chamber of Commerce and Industry, and is being opened to international participants for the first time. Last year's show drew 300,000 people.

According to ELECTRO-HARMONIX's press release, in addition to seeking new sales for E-H president, MIKE MATTHEWS will begin negotiations for the purchase of an assortment of unusual Soviet products not yet available in the U.S. When reached by phone, an E-H spokesperson would flat out not comment on the nature of these products; but our crystal ball says to look for something involving Russian research into ESP and other psychic phenomena.

Interestingly enough, Mr. Matthews claims to have received substantial assistance from Soviet officials, and that "they've been more than cooperative in working with us to help us reach the general public".

More Filter ICs Surface. RETICON's filter family includes 2 lowpass units and 3 bandpass units. They utilize switched capacitor techniques, so the frequency is determined by a clock, not by precision resistors and capacitors. The R5604 contains three 1/3 octave bandpass filters, the R5605 two 1/2 octave bandpass filters, and the R5606 is a full octave bandpass filter. They are claimed to have 0 dB insertion loss and a signal to noise ratio greater than 80 dB. They are not cheap (around $16 to $24 in hundred lots), but then again, neither were calculator chips when they first came out.

New Multiplier/Dividers. NATIONAL SEMICONDUCTOR has announced the LH0094 multifunction generator; it produces an output voltage based on the relationship of 3 input voltages. Packaged in 16 pin DIP, the LH0094 is designed for precision applications and carries a price tag to match...on the low-cost front, RAYTHEON is now selling the 4200 analog multiplier for only $3.75 in large quantities. This chip has 3 on-board op amp circuits designed specifically for use in multiplier logging circuits, and multiplies 2 input currents (divided by a third input current) to yield an output current. Non-linearity is held to .1%, which is very good. Typical uses include low distortion gain control, voltage controlled filters, and precision oscillators.

(NOTE: information on electronics parts for this section is generally gleaned from ads that manufacturers take out in the trade publications. Many of these items are not available to the hobbyist at this moment, since when trying to create a market for new parts, companies are looking more for large purchases from manufacturers than single quantity sales to hobbyists.)

CORRECTIONS (OOOPS)

They have a lot of bugs in Texas in the spring, and some of them made it into issue 1:5 -- out first issue produced entirely in Austin.

For starters, there are 5 illustrations given for Thomas Henry's article on modifying the Electric Mistress. Unfortunately, 4 of them were intended to go with this month's Micro-Synth modification article...so ignore all of them except for the two

(cont. on page 15)

PHASEFILTER cont.

while you don't want them to drastically color an instrument's sound, you should also be able to notice a distinct difference in sound quality when the device is being used. Fortunately, the PF can make some relatively heavy alterations as well as being at home with subtle effects. Upon using the thing for the first time, I wouldn't be surprised if your initial reaction was confusion -- it takes some time to experiment with getting the best possible sound from the various configurations. However, any time spent on learning how the PF works is time well spent. I've tried it with guitar and keyboards; in both cases it added some very pleasing effects, and created a "warmer" and more interesting sound with all-electronic keyboards. I don't like to make sweeping generalizations, but I would say that waveform animators seem most effective with electronic instruments. An acoustic waveform already has a lot of animation, and adding additional artificial animation can give a muddy, overly diffused type of sound. Nonetheless, if you want a guitar to sound like a background wash the PF will do the job -- perhaps better than any other non-time delay based module.

Drawbacks? Like any product, there are bound to be some flaws...some conceptual, some practical. But really, my major objection would have to be the price: $99. Compared to commercially available products, that's not too bad; besides, this is certainly not an item that sells in the zillions, allowing the manufacturer to do a lot of cost reduction. And although the kit is of high quality, it is still a kit so you must take assembly time, and cost of packaging, into account when figuring out the total price you're paying for the module. On the other hand, you are also getting a unique module for which there is no commercial equivalent, which seems to add something to the intrinsic value right there. If the PF cost $49, I'd recommend it without hesitation to anybody; but at $99, I'm sure some people will feel the PF just isn't cost-effective enough.

Aside from cost, I did find that the DPG is more time-consuming and complex to adjust than a standard LFO, which might be a problem under live performance conditions. Nonetheless, considering the ability of the DPG to generate a wide variety of different and interesting waveforms, this is a drawback that can be tolerated.

OVERALL EVALUATION. For "aptness of thought", I'd give the PF very good marks. There are some clever circuit tricks, as well as conceptual innovations that are a welcome change from the "me-too" effects design mentality. As a timbre modulator or waveform animator, the PF fulfills its intended function just about perfectly. About the only improvement I could think of would be something to randomize the DPG if desired.

However, if you only had $150 to spend on effects, you'd probably be better off spending it on something like an analog delay line or other "workhorse" type of effect. The PF is a specialized device, and is therefore not usable on all instruments in all instances. But if you're tired of the same old effects and can swing the bucks, you'll probably find the PF to be a welcome and novel additon to your collection of signal processors.

[Address: Blacet Music Research, 18405 Old Monte Rio Road, Guerneville, CA 95446]

7 MODS continued

MOD #7: IMPROVING SUBOCTAVE HIGH FREQUENCY RESPONSE. When using the Micro-synthesizer in the studio, I found the suboctave sound was a bit too heavily filtered for my tastes. This prevented the bass sound from "cutting through" on tape; instead, the bass line would turn out as mushy and somewhat ill-defined. Referring to sketch #3, delete the capacitor as indicated. The result will be a raspier, juicer bass sound that sounds just great playing along with keyboard synthesizers.

Well, that's it for the mechanics of the modification. Calibrate the attack delay sensitivity to your taste, then close up the box. When you rescrew the six bottom plate screws, do so CAREFULLY or you may strip the threads. Also, make sure that the regulator heat sink doesn't short out against the chassis.

I'm far happier now with the Micro-Synth than I was at the time of writing the review; the attack delay is an integral part of getting interesting sounds with this box, and having it trigger predictably really helps. I also like the new tonal qualities of the octave and suboctave voices, so I use them often...all in all, I find myself reaching for the Micro-Synthesizer a whole lot more since these mods have been made, and enjoying myself much more when I do use it.

ON LOCATION:

There is a place for the American guitar hero here in Hong Kong. While he might not be aware of it, his every record is being played over and over again and his style is being studied and copied; as a result, we are always only a few steps behind what is current. Being a people of another culture and less overtly expressive of ourselves, it is amazing all this has happened at all.

Some of our top guitarists can really play like Americans. They use the best equipment available and are actively engaged in the recording industry. Interestingly, some of them can blend their music superbly well with Chinese hit songs. One can almost feel no discomfort when listening to such a union. Some even rewrite Chinese lyrics for "Saturday Night Fever" or the like and create instant hits. The combination may sound unlikely, but it works well.

Basically our "veterans" are from the early 60's. Some have a strong Phillipine influence because they were taught by Phillipinos, but the younger ones are purely American oriented. They are very involved and have high standards for their sounds. It is a pity that their creativities are limited by the audiences, who are not very sophisticated; so, our guitar only retains a backup role as it traditionally has.

On live performance, unlike on records, I do not see many of them using a lot of effects. Since PA systems are often provided by patronizing big stores, they should be able to get the pedals they like.However, it seems using a lot of pedals while playing is too distracting for them. Curiously, rotating speakers are still being used.

In the shops,one can see MXR, Ibanez, and other products. Some lowpriced Australian products are also available. But I do not think the sales of these are all that encouraging. People flock to learn Yamaha organs and every small band tries to have keyboard among their instruments; the only guitar synthesizer that I ever saw was the one from Hagstrom, and it was quite possibly for display or studio use only. Once I asked the price of a beautiful Gretsch and was sorry to learn it was for display only. Fender and Gibson products get along quite peacefully and enjoy equal reputations. Music Man and Ibanez made their debut only recently. But, it is Ibanez that is taking over from below.

I doubt if there are many people here who make their own effects, though we are by no means unexposed to the latest technology. LM, NE, CA types of ICs and even microprocessors are available. With the exchange rate being HK$5 to US$1, we have to pay a lot to get some really good stuff; so many would be content to simply build something like a fuzz. People are much more enthusiastic about their hi-fi systems, and we have 5 magazines dealing with electronics. We can get some primitive effect circuits from there. Information can also be obtained from books translated from German or Japanese, but the translators seem to be unable to make themselves clearly understood.

As for myself, I want to go beyond devices like fuzzes because the sound of fuzz is not right for me. I would prefer a sawtooth instead of pulse or square wave. Since sound is such a subjective thing and sound depends on its own harmonic structure, it is natural that the guitar's future lies in synthesizers. The main thing that scares the ordinary player is the price of the synthesizer, but some professionals also complain about its response or delay or this and that. Yet the situation is not that pessimistic at all, because as has happened many times before when the cost is reduced the rest will handle itself fairly rosily.

In Hong Kong, nearly all school children play or love the guitar. The numbers are increasing. But none of this benefits the American manufacturer, because they are steadily losing their market to the Japanese here--especially in the acoustic area. I often see people at the shop window looking fondly at some Martin or Guild, but his pocket reminds him that he has to settle for less.

-Lee Wai Hung-

INFO cont. drawings in column 2 of page 2. Pretend it was a sneak preview or something.

Next, Craig forgot to mention in the text for the AMS-100 that IC2 in module #7 should be a bifet or similar high input impedance op amp, and that power supply connections are assumed for the various op amps shown on page 9.

Finally, what can we say about all those typos...except that time was short, and we were just getting used to doing the whole thing on a word processor, which wasn't always perfect either. Nonetheless, we really do know how to spel gud!

WHAT IS DEVICE?

DEVICE is a subscriber supported monthly newsletter dedicated to those interested in the latest developments in signal processing and guitar-related electronics. **DEVICE** offers maximum editorial freedom and indepth views of the current status of our field. **DEVICE** plugs you into a network of information and communication that puts you closely in touch with the rapidly changing electronic music industry. Every month **DEVICE** brings you a variety of features including news, accurate reviews, construction projects, modifications, interviews and much more. **DEVICE** needs your support to make it work. Subscriptions are one way, the others are your submitting ideas, articles and opinions. Then **DEVICE** becomes the forum we all desire. What is **DEVICE**? **DEVICE** is your publication!

YES! DEVICE SOUNDS SOUND. I'LL BITE.
(your subscription will start with 1:6)

Subscriptions: $15/yr.
$16/yr. Canada/Mexico
$18/yr. Int'l. surface
$24/yr. Int'l. air

Back Issues: _1:1 _1:2 _1:3 _1:4 _1:5

NAME _____

ADDRESS _____

CITY _____ STATE/REGION _____

ZIP/COUNTRY _____

back issues

YES! THERE ARE BACK ISSUES. DEVICE 1:1,1:2,1:3,1:4,1:5 are available for $1.50 each. We pay postage on all U.S./Canadian requests. Foreign requests please include $1.00 extra for postage.

DEVICE is published by Craig Anderton and Roger Clay. Subscriptions: DeAnna Holohan. Photo credits: Vesta Copestakes. Effects modifications editor: Thomas Henry. **DEVICE** is assembled during the first 2 weeks of the month, printed during the 3rd, and mailed out during the 4th. If you do not receive consecutive issues within at the most 45 days of each other then contact us. Send correspondence, products for evaluation, press releases, manuscripts, etc. to 12304 Scribe Drive, Austin, Texas 78759.

DEVICE
the newsletter for the electronic guitarist/musician
12304 Scribe Drive, Austin, Tx. 78759

send to:

FIRST CLASS