Modifying the Hafler DH-101: Circuitry

by JOHN ADELSBACH AND
HOWARD LEE

WE HAVE MODIFIED the most recent version of the Hafler DH-101 preamplifier in several ways for more accurate performance. This version has the Q_1 and Q_2 (see *Fig. 2*) transistors closely matched in current gains. Also, the current in the output of the phono stage has been increased by changing R_{10} and R_{11} to 47 ohms. If these changes are not present, we suggest that they be made in addition to the modifications recommended here. [A kit is available for this change from The David Hafler Co., 5910 Crescent Blvd., Pennsauken, NJ 08109 for $19.95 ppd.]

RIAA EQUALIZATION

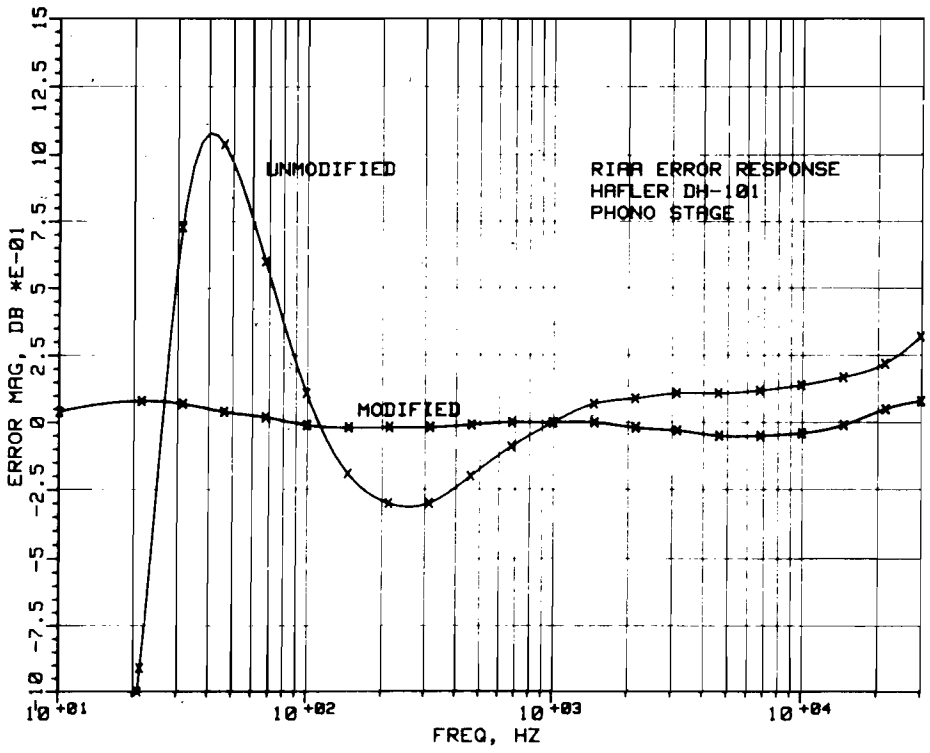
We think the RIAA equalization accuracy of the Hafler is rather poor compared to that of other high quality preamps. The Hafler has a falling frequency response in the lower bass region as a result of a 6dB/octave rolloff below 20Hz with the frequency response −3dB at that point. This design choice makes it necessary to adjust the 3180μsec RIAA time constant to compensate. This results in the low frequency error around 200-400Hz as shown in *Fig. 1* (note the expanded vertical scale).

To correct this, first the low frequency cutoff must be lowered by doubling the value of C_5 to 940μF and increasing R_9 to 90.9k (C_5 and R_9 set the frequency at which the phono stage has unity gain). This moves the −3dB point down to about 1Hz. Ideally, C_5 should have zero volts across it but, in practice, some voltage is present due to the imbalance of current gains of Q_1 and Q_2. Therefore the manufacturer has specified that a non-polarized electrolytic be used since the sign of the voltage is unpredictable in production units. We have found, however, that no greater than 0.1V is across C_5 even for large differences in current gains. Therefore we placed a 470μF solid tantalum electrolytic in parallel with C_5. (Tantalum capacitors can have a reverse voltage of up to 10% of their rated voltage).

Once C_5 and R_9 have been changed, the 3180μsec time constant can be correctly set by changing C_7 to .024μF. This capacitor should be as close to this value as possible (place trimming capacitors in parallel if necessary) and be a low dielectric absorption type (teflon, polypropylene, polystyrene, or polyester).

The other major problem in the phono equalization is a rising high frequency response. This is due to the noninverting circuit which introduces another high frequency turnover point in the RIAA response. This can be compensated by adding a .068μF ±10% capacitor from the output of the phono stage to ground (node of R_{14}, C_7, C_8, and R_{12}). This

Fig. 1. Response of the unmodified and the modified DH-101 Hafler preamp.



capacitor flattens the response in the supersonic range and decreases the current required to drive the circuit, reducing distortion. A typical error response after making these modifications is shown in the *Fig. 1.*

COUPLING CAPACITORS

The input and output coupling capacitors in the Hafler are all electrolytics. To investigate the Jung/White findings about coupling capacitors (*TAA* 3/79), we bypassed C_2, C_8, C_{11}, and C_{20}. The improvement was small but immediately noticeable. These capacitors obscure musical information and add distortion that make the preamp seem overly bright and harsh in the upper midrange.

Eliminating these capacitors has liabilities, however, that should be understood before modifications are made. When the phono output coupling capacitor, C_8, is bypassed, any DC offset in the stage will appear at its output. This output drives the volume and balance controls. It is undesirable to permit current to flow through these controls since it deteriorates their wiper contacts, adding distortion. The increase in the value of R_9 described earlier will also increase DC offset due to the imbalance of current gains of Q_1 and Q_2. The solution is to null phono offset by adjusting the value of R_8 or R_6. Either resistor will shift DC balance. We temporarily substituted a 10 turn, 50k potentiometer for R_8. After allowing the circuit to thermally stabilize, the pot was adjusted until there was near zero DC voltage at the output of the phono stage. A fixed resistor of the resulting pot value was then re-installed at R_8.

Some drift occurs due to temperature changes but we have found that after phono offset is nulled, no greater than 20mV of DC voltage appears at the preamp's main output. Since many power amps are unity gain at DC (including both Pass and Leach amps), this would generate only 50 microwatts in an 8 ohm speaker, neglecting any power amp offset.

Nevertheless, if DC offset is a concern, then a capacitor at the phono output should be retained (the line stage has very little DC offset due to its balanced design). It has been found that a 10μF metallized polyester paralleled by a 0.5μF polypropylene detracts very little from the preamp's sound quality.

POWER SUPPLY

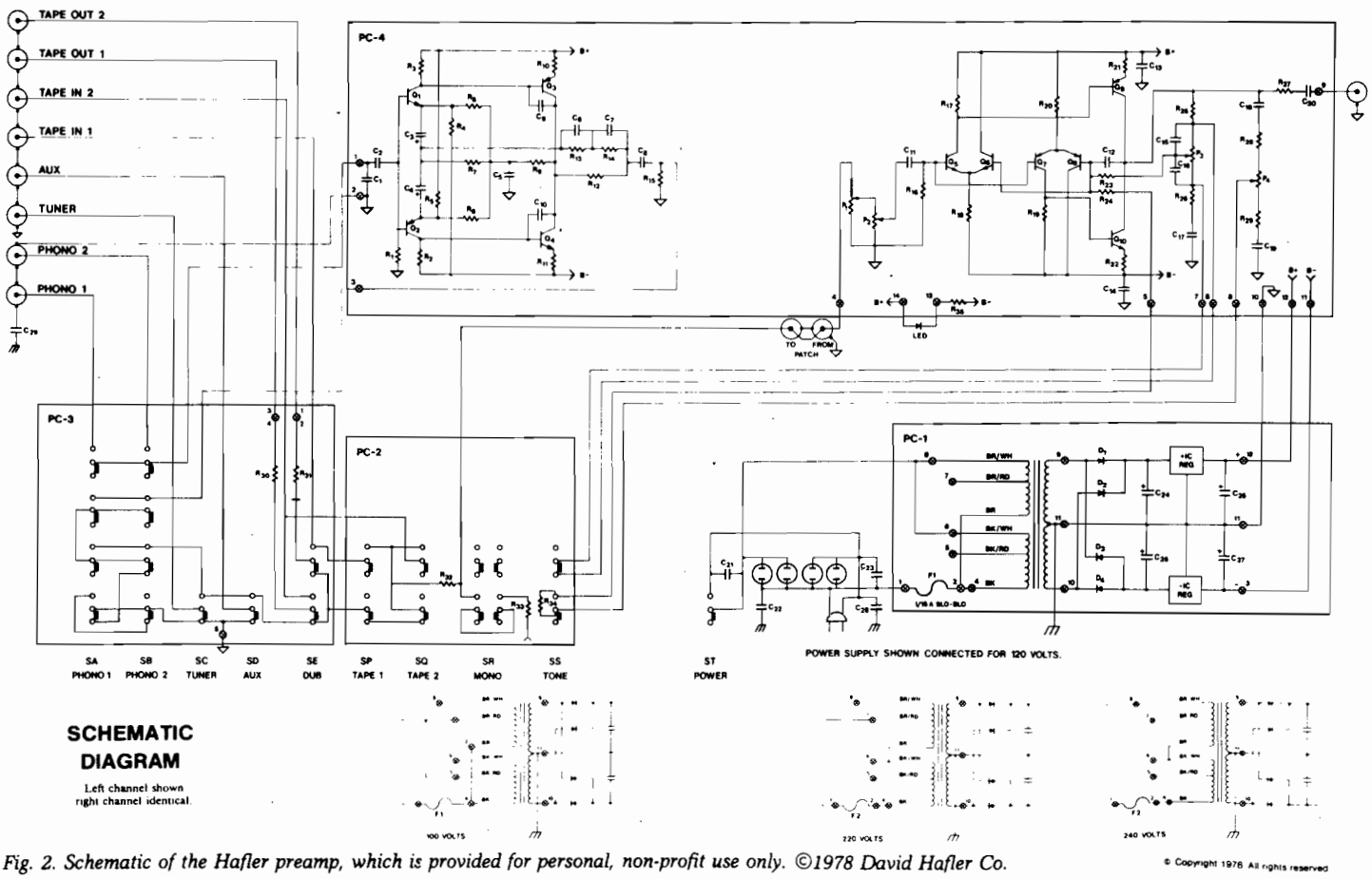
The final modifcation we made was to power the preamp with a low impedance supply similar to that described in the Jung/White article. The same benefits that those authors noted with their IC preamp were apparent with the modified Hafler. The entire bass range showed the most improvement, having great detail, control and balance. The effect of the power supply change alone made a greater improvement in sonic accuracy than some of our previous changes in power amplifiers, speaker systems, or subwoofers.

We believe these modifications to the Hafler DH-101 will eliminate many of its qualities that reviewers have complained about. We hope others will try the modifications and look forward to hearing their reactions.

A FINAL NOTE

The power supply should provide ±18 volts. If you use the Jung/White low impedance supply, (*TAA* 3/79, p. 25) the voltage should be set by a 16V zener diode (such as IN4745). Excellent transformers for low noise power supplies are the torodial types

Continued on page 10



SCHEMATIC DIAGRAM

Left channel shown
right channel identical.

Fig. 2. Schematic of the Hafler preamp, which is provided for personal, non-profit use only. ©1978 David Hafler Co.

Modifying the Hafler DH-101: Parts Placement

by JOE NEELY

THE HAFLER DH-101 is one of the biggest bargains in the audio marketplace today. Its low price (especially the kit version) and high quality has won it many admirers. Even though its circuit designs are excellent, the preamp does not come close enough to revealing its true potential. Its big weakness is its point-to-point wiring. These modifications correct many of the wiring problems.

1. First of all, perform John Philpot's grounding modification (*TAA* 2/79 page 39). This eliminates a nasty ground loop whose effects are very audible. With this change the background buzzes and noises drop to almost nothing, even at full volume. Detail and clarity are much improved and listener fatigue is greatly reduced.

Next reroute the ground wire that runs from the PC 3 switch circuit board to the power supply away from the wiring that carries audio signals from the rear jacks to the front switches. It may be run along the right side of the preamp to the power supply partition, under it, and then on to eyelet 11. This particular ground carries non-selected input signals away from the switches. This change eliminates the possibility of crosstalk between the ground wire and the active audio input in use. The only time this might become significant is when a tuner is inadvertently left on while another input (phono or aux) is being played.

2. DH-101 owners who use both phono inputs may be reluctant to perform this change since it limits the preamp to one phono input. Because the effects of this change are so remarkably good I recommend that everyone at least try it on a temporary basis. Start by removing all wiring between the phono input jacks, the phono selector switches (lugs 1, 2, 13, 14), and the phono stage input (eyelets 1L, 1R, 2L, 2R). Obtain a piece of low capacitance shielded phono cable (I used an old Dual cable that had a bad plug) and physically separate its left and right channels by splitting it down the middle. You end up with two single conductor shielded cables. Connect the Phono 1 jacks to the phono stage input using these cables. They should be physically arranged as shown in *Fig. 1*.

I tried several different wiring arrangements including unshielded wire, twisted unshielded wire, and twisted shielded wire (Belden 8762). The unshielded arrangements were not resistant to noise and hum and the twisted arrangements reduced the separation and spoiled the imagery. The wires from the phono stage output (3L and 3R) that lead to phono switch 2, lugs 4 and 16, should be shifted to phono switch 1 lugs 8 and 20. This causes the audio signal to go through one less set of switch contacts. These wires plus the ones that run between the selector switch area (more precisely the external patch input jack) and the input of the high level stage (4L and 4R) should be replaced with shielded cable to prevent crosstalk.

The changes keep the phono input as far from the transformer as possible to avoid hum and noise. The hum disappears and the noise is cut dramatically even with the volume control at maximum. This did not really surprise me. What did surprise me was the radical improvement in the unit's detail and clarity as a by-product of the noise reduction. What surprised me even more was the change in the unit's spatial characteristics. Signals through the phono input stage absolutely blossom in all directions. (Note: This modification is not compatable with units that use the built-in DH-102 pre-preamp and its associated changes.)

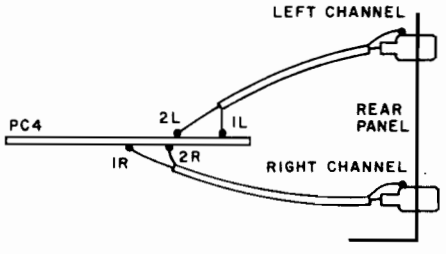


Fig. 1. New location for shielded phono input leads.

3. I switched in my DH-101's tone controls when I first got it merely to see how well they worked. Since I had never used them since then, I decided to remove them permanently, hoping to gain some sonic improvement. While the sound change is more than subtle, it certainly is not spectacular. The preamp's high level stage becomes more natural sounding to my ears than it was, regardless of whether the tone controls were previously switched in or out.

To disable the treble circuit, remove R_{24} and C_1X. Defeating the bass circuit is a little harder since the DC feedback loop that it is coupled to must remain active. Remove C_{15} and C_{16}. Disconnect the center lug of the bass pot (P_3) from the circuit board. Run a wire jumper from your right (the preamp is positioned with its bottom down and face forward) lug of the bass pot to each of the holes formerly occupied by the leads of C_{15}. The steps are identical for the other channel.

Why the preamp would sound better without tone controls than with them is fairly easy to explain: there are less components to affect the audio signal. The only explanation I can think of for the better sound without tone controls than with them switched out, is the long length of twisted wires running between the circuit board and the tone control switch. Perhaps they were either picking up a small amount of noise, the twist was causing them to act like inductors, or both.

4. After doing the first three modifications I began to realize that crosstalk and inductance caused by audio signal wires being twisted or otherwise too close together has affect on the sound of a preamp, more than most people realize or like to admit. With this in mind I replaced all the wiring

between the mono switch and the external patch "TO" jacks, the external patch "FROM" jacks and the high level input, and the high level output and the preamp out jacks using single conductor shielded cable. Physically, the wires were run from point-to-point in the most direct way possible, as in *Fig. 2*.

The channels were separated in a manner similar to the one I used in modification two. The wiring going to and from the external jacks were previously routed with the tape, tuner, and aux wiring. The wires going to the preamp out jacks were previously twisted. The high level stage separation and imagery, which was not bad when compared to that of the phono section before modification two, was improved quite a bit.

An upper midrange frequency response discontinuity was completely smoothed out, which was a pleasant surprise. The discontinuity is not a major problem on a stock DH-101, but becomes very bothersome after the first three modifications are done since they remove noise and spatial problems that otherwise "semi-mask" the discontinuity.

5. Many ideas could be pursued to extract more performance out of this preamp that I have not tried. Most of them would depend on how the preamp is being used and the owner's listening habits.

a. Eliminate crosstalk between tape in, tape out, aux, and tuner by using shielded cable.
b. Eliminate dub switch and reroute tape out wiring.
c. Remove external patch jack.
d. Eliminate balance control.
e. "Straight-line" type connection between phono 1, and phono 2 section, high level section, and preamp out by bypassing all switches.
f. A bypass for the high level section.
g. Phono bass response improvement (see *TAA* 3/78 p. 40).
h. The DH-106 parts upgrade kit. Use high grade 1% metal film resistors and polypropylene capacitors, especially in the RIAA network.
i. An ultra low impedance power supply (such as the Sulzer, *TAA* 2/80) with a low impedance power supply ground.

After making these changes, I sought out every DH-101 review I could find (there were plenty!) to see how many problems pointed out by reviewers had been solved. The serious ones include: noise and spatial and upper midrange discontinuity. The two remaining ones are frazzled edges on extreme musical climaxes, which is probably solved by the DH-106 upgrade kit, and "weak" phono low bass response, which can be solved by some capacitor changes. I believe this modified DH-101 can hold its own with the top SOTA preamps: AR SP6A, ML-1, various PAS-3s, and SP-3s.

The equipment used in testing includes: a Micro Seiki turntable, Grace 714 arm, a Grado G2 cartridge, the amplifier section of a Marantz 4400 receiver, Hafler DH-200 amplifier and Koss ESP 9B electrostatic headphones. I was also lucky enough to have access to a stock DH-101 for direct comparison tests.

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MODIFYING THE HAFLER DH-101 PREAMP by Adelsbach and Lee

Continued from page 8

made by Avel-Lindberg. These have outstandingly low radiated magnetic field and acoustic hum. We used a model 40/3004 obtained from: Sager Electrical Supply Co., 60 Research Road, Hingham, MA 02043, (617) 749-6700, or from Old Colony Sound Lab.

PARTS LIST

C_5'	470μF, 35V solid tantalum
C_7	.024 ±1% polypropylene (parallel capacitors to achieve accuracy)
C	.068μF ±10% polypropylene
R_9	90.9k ±1% Metal Film
R_t	50k 10 turn pot
T	Avel Lindberg model 40/3004 20 + 20VAC, flying leads
D	Zener diode, IN4745 ½W, ±5% (16V)

Phono Output Capacitor—use either: 10μF ±20% metallized polyester paralleled with 0.5μF ±20% polypropylene or 5μF ±20% polypropylene.

MODIFIER CAVEAT

We remind you that these changes will void your warranty from the DH-101's manufacturer. Further, the Hafler Co. will *not* answer questions about the merits of these alterations nor will they supply any parts for any modification other than the standard update mentioned in the first paragraph.

—The Editor

AN ANALOG PHASE METER

Continued from page 16

trol until the meter indicates a null.
6. Read phase shift.

So far I have used my prototype for checking capacitors, speaker cables and my Leach designed 6dB/octave electronic crossover. The 20Hz to 20kHz limits have proven more than adequate and the accuracy is very good, less than 20 degrees error at 20kHz. One last thing, if you choose a battery supply for the instrument it must be regulated since the circuit is very sensitive to supply voltage fluctuations. □

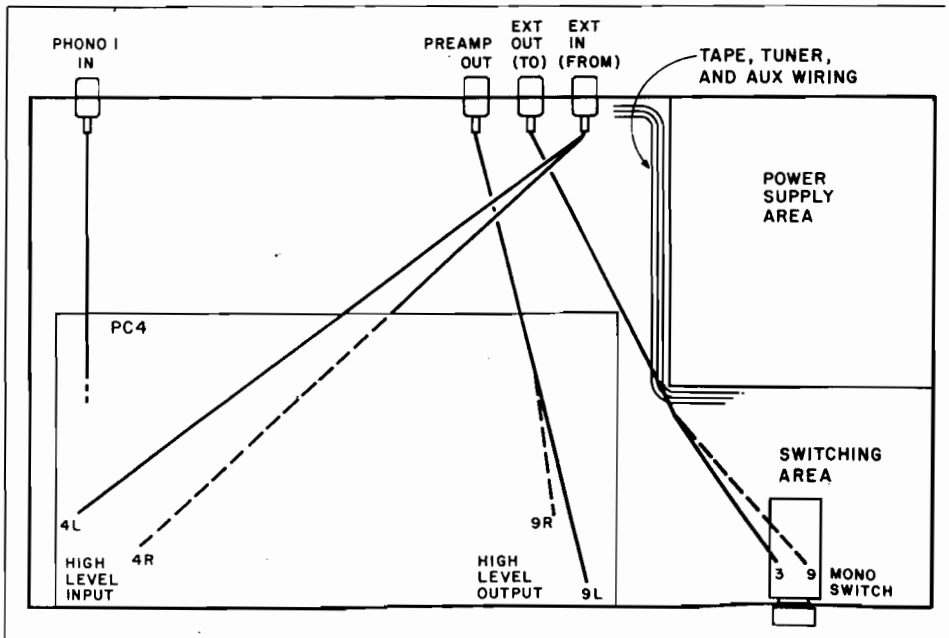

Fig. 2. Wiring location guide for the Hafler preamp.