Performance Testing

The SCA-35 Phono Stage

SCA-35

by George Ronnenkamp

Pacific Audio Regenesis

In May of 1964 High Fidelity Magazine published its review of the new Dynaco SCA-35 integrated amplifier. With its numerous features, and measured performance above average for its class, it was deemed to be an excellent amplifier in view of its cost. Over the years, my own measurements, on several samples, had always correlated well with the results presented in that article, including the phono stage. Although it had its shortcomings it has managed to keep a low profile, evading the type of criticism heaped, often unjustly, upon Dynaco's flagship PAS preamplifier. Due in part, perhaps, to its perceived budget, entry level status. In any case, I was never particularly motivated to examine the phono stage any further. More recently, however, Dave Gillespie's impressive work in maximizing the potential of the SCA-35 inspired me to engage in a more detailed analysis. I proceeded in the belief that I already had a good understanding of what the major shortcomings were, but I was in for a surprise. The phono stage had been keeping some rather dark and elusive secrets.

The process was initiated with the intent of following the same procedures I had employed in my previous analysis of the PAS phono stage. Begin with some modelling, followed by extensive laboratory measurements on a properly functioning example, then compile the results and present a report. Simply a matter of completing a routine, albeit time consuming, process. It did not proceed as expected, with initial modelling efforts revealing issues that had evaded my earlier measurement efforts. One rabbit hole of discovery led to another uncovering several rather significant shortcomings and, at the end of the process, I was left wondering *"what were they thinking?"* For those less technical, or perhaps not inclined to wade through the following, rather lengthy, technical expose', a condensed summary is provided at the end of the article.

Circuit Analysis:

While primarily meant to be a performance evaluation, not a detailed circuit analysis, some basic knowledge will be helpful to better understand the rather unusual issues this phono stage presents. The complete circuit configuration, which is not immediately obvious as presented in the manual, is shown in Fig. 1. The component designations relate to the left channel.

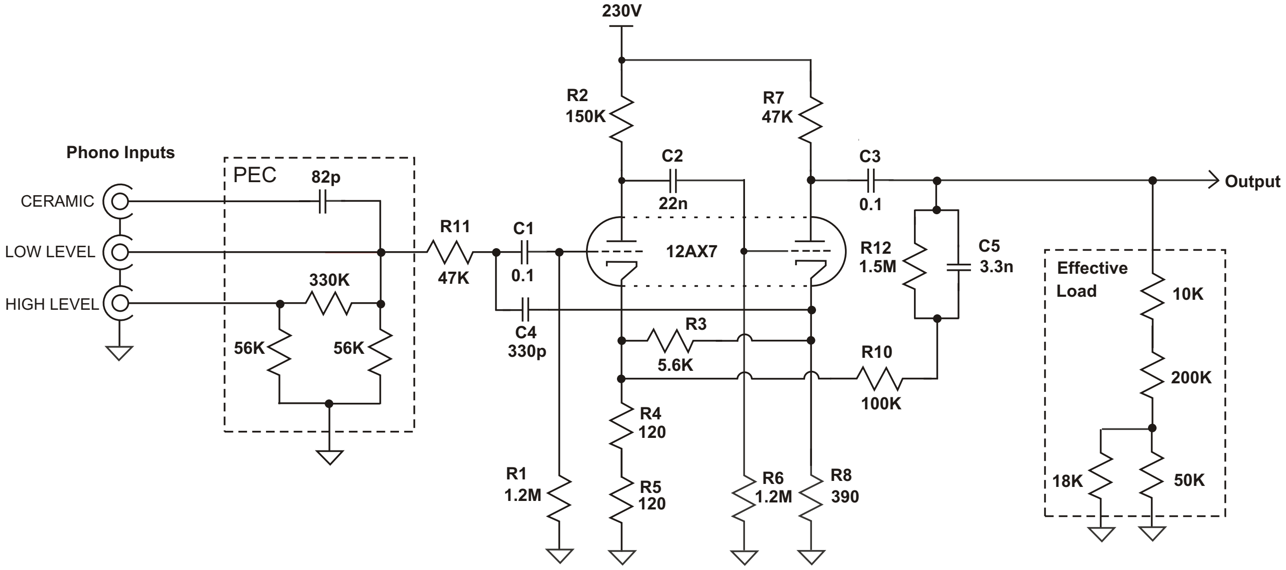

Fig. 1 SCA-35 Phono Stage

PEC

Three inputs are available by means of a PEC (packaged electronic circuit) located at the input jacks. These include ceramic, low level (for typical MM cartridges), and high level (for MM cartridges rated at more than 20mV). Little used, and not generally considered a high fidelity source, the ceramic input will not be included in the analysis. At the low level input, the PEC presents a resistor array consisting of 56K in parallel with a series combination of 330K and 56K, for an effective cartridge load of 48.9K. At least, that was the intent, and *seems* obvious, but is not actually achieved in practice. At the high level input, again 56K is seen in parallel with a series combination of 330K and 56K, resulting in the same 48.9K cartridge load. However, the input to the amplifier is now taken at the junction of the 330K and second 56K resistor resulting in a calculated attenuation of 16.7dB. Seemingly, just a simple resistor attenuator, which is stated in the manual as being *"not a detriment to performance"*. But this, again, is not actually the case in practice.

Each of the phono inputs is ultimately coupled to the input of the amplifier stage via R11 and C1. At first glance, it may appear that R11 is merely a grid stopper however, as will become apparent, that is not its primary purpose.

Amplifier

The basic amplifier circuit consists of a cascaded pair of common cathode, capacitively coupled 12AX7 stages, a common configuration in tube phono stages. In this case, however, 8.4dB of positive feedback has been applied, cathode to cathode, via R3, boosting the *midband* gain to over 71dB before RIAA equalization is applied. We'll consider this to be the effective open loop gain. The application of positive feedback does, however, significantly degrade the OL bandwidth and will be responsible for the phono stage not being able to maintain the required RIAA equalization slope below about 40Hz. The difference in response, with and without the positive feedback (no RIAA EQ applied), relative to 1KHz, is displayed in Fig. 2.

It should be noted that these are modelled results. Attempts to verify by actual measurement were thwarted by instability when the negative feedback components, related to RIAA EQ, were removed on the test sample.

With RIAA EQ applied, the gain of a phono preamplifier is typically specified as that which occurs at 1KHz. In this case, information contained within the manual implies a gain of about 48dB, however both modelled and measured results showed a little over 50dB. This is about 10dB higher than a typical phono stage, but is required because the following line stage is passive.

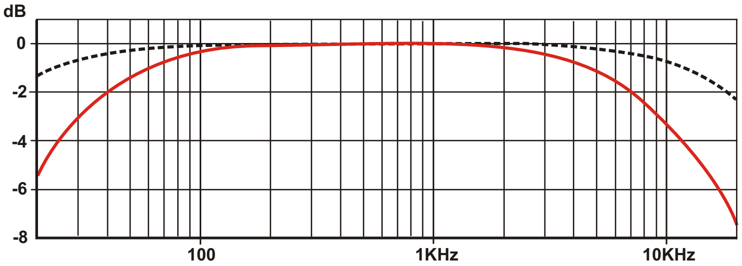

Fig. 2 PFB vs No PFB Relative Response dB 20Hz - 20KHz

No PFB --------- With PFB ———

RIAA Equalization

Basically, the equalization process involves reducing the gain of the amplifier by approximately 40dB over the frequency range of 20Hz - 20KHz, however this is not a totally linear end-to-end function. The *idealized* response is a linear 20dB reduction between 50Hz and 500Hz, followed by a flat response between 500Hz and 2.12KHz, then another 20dB linear decline from 2.12KHz to 20KHz. Practical implementation, however, will produce a somewhat curve shaped response rather than the sharply defined ideal. Three filter poles, or turnover frequencies, determined by RC time constants, define the response, these occurring at 50Hz, 500Hz, and 2.12KHz. Common configurations include passive filtering, negative feedback, or a combination of these. In this case, negative feedback was the chosen approach, although it is applied in a rather unusual fashion involving separate loops for low and high frequency EQ. This will prove to be problematic, especially in regard to the high frequency loop, so we'll examine these feedback loops separately.

Low Frequency FB Loop

The low frequency loop, which is global, is a rather classic configuration involving R12, C5 and R10 between the output of the second stage and cathode of the first stage. In this case, the first turnover frequency (50Hz) is determined by R12 and C5 while the second (500Hz) is determined by C5 and R10. Fully implemented, this configuration would have also included a capacitor across R10 to determine the final turnover frequency, but has been omitted in this case. The component values as chosen do, in fact, provide proper low frequency equalization within the limitations of available gain, as confirmed in both modelling and actual measurement. The main point being made here is not the values of the components, or how they were determined, rather, the fact that they can be easily identified as to the functions they perform.

High Frequency FB Loop

Being problematic, we'll examine the high frequency loop more closely. This loop effectively encompasses only the first stage via C4, spanning the cathode of the second stage to the input of the first. However, the associated resistance, which would determine the final time constant, is not readily apparent, with two possible pathways to investigate from the junction of C1 and R11. The path through C1 presents a rather large impedance of 1.2M ohms at the input grid, while the path from R11, through the PEC, presents a much lower impedance and is thus the logical one to pursue. It is tempting to assume that the series combination of R11 (47K) and the effective resistance presented by the PEC (48.9K) is the desired value, but that is not so. The impedance presented by the input source must also be taken into account with the low and high level inputs presenting different scenarios.

Fig. 3 depicts the case for the low level input, where the source impedance is effectively directly in series with R11. If the source is a low impedance signal generator, the resistors in the PEC are effectively negated, leaving R11 (47K) as the sole resistance to determine the time constant. As it happens, 47K actually does produce the correct time constant which, I suspect, was the case Dynaco designed for. The problem, which should have been obvious, is that the intended source, a phono cartridge, presents significant resistance and inductance which cannot be discounted. The cartridge becomes an undesired element in the feedback circuit, effectively lowering the turnover frequency and degrading high frequency response. The extent will be dependant upon the specifications of any particular cartridge, and thus, not easily predicted.

As if that were not enough, there is yet another problem, that being the input impedance. Phono cartridges are intended to operate with a specific load impedance, typically 47K. While the PEC, supposedly, presents 48.9K, this is actually only realized at the low end of the band. What happens in practice is that R11 and C4 provide a path to the low impedance cathode of the second amplifier stage. As frequency increases, R11 is effectively placed in parallel with the resistance presented by the PEC, resulting in about half of the intended load impedance at 20HKz. Thus, proper cartridge loading is not maintained over the required frequency range.

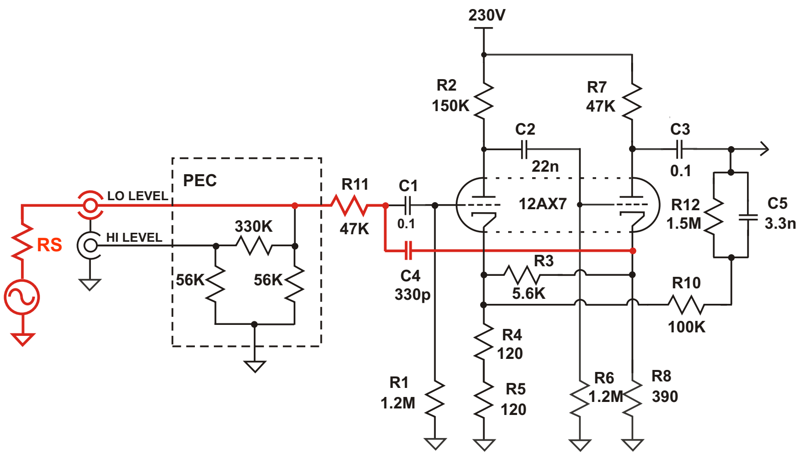

Fig. 3 HF Feedback Loop Low Level Input

Fig. 4 presents the case for the high level input. Here we see that the path from the input source to R11 is buffered by the 330K resistor in the PEC. In the relative sense, the source impedance will be much lower than first 56K resistor, which can be ignored. Thus, the effective resistance associated with the time constant becomes R11 in series with the parallel combination of the 330K and second 56K resistor in the PEC, or about 94K. Again, the turnover point will be moved downward with a significant loss of high frequency response, although will be at a more fixed point, minimally affected by cartridge specifications. Unlike the low level input, the input impedance is not significantly degraded since the 330K resistor provides buffering from the R11/ C4 path back to the cathode of the second stage. However, that path still presents a problem in that, being in parallel with the second 56K resistor, input attenuation becomes frequency dependant. As frequency increases, so does the attenuation, further contributing to high frequency degradation.

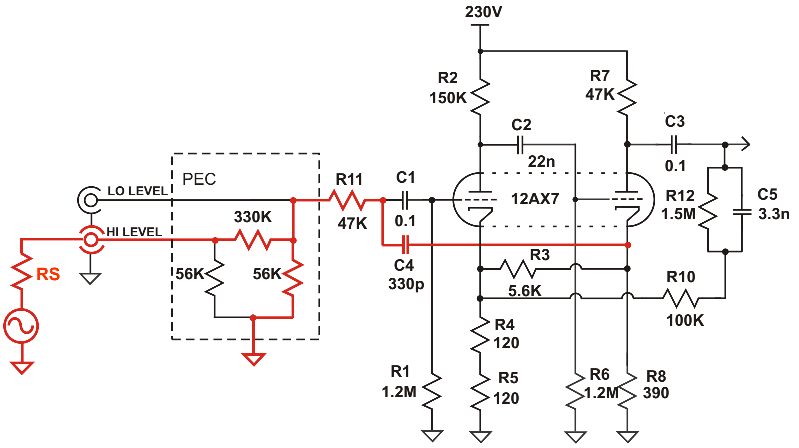

Fig. 4 HF Feedback Loop High Level Input

Circuit Analysis Summary

The main takeaway from this abbreviated circuit analysis is that the secondary feedback loop, which provides high frequency equalization, is flawed in that the time constant for the final turnover frequency is not properly defined. At the low level input, the phono cartridge interacts undesirably with the feedback circuit while, at the high level input, the resistance presented by the PEC results in an incorrect high frequency EQ time constant. As well, undesired interaction with the feedback circuit results in frequency variable input impedance at the low level input, and variable attenuation at the high level input. These conditions will result in significant degradation of high frequency response at both inputs. With an understanding of the significant issues the phono circuit presents, we'll move on to the modelled and measured results that support the circuit analysis.

Modeled Performance:

From the outset, this particular effort was an exercise in frustration, highlighting the shortcomings that may occur when modelling tube circuits. In the case of the SCA-35 phono stage, there is a particular issue due to variations in gain exhibited by the various 12AX7 subcircuit models in common use. One may assume these models would all be based upon datasheet specifications and provide very similar, if not identical results, but they do not. The use of positive feedback, pushing the gain to theoretical maximum, also magnified the gain errors in the 12AX7 models. What may have been a minor issue in another circuit simulation became significant in this case, particularly for low end response where negative feedback is minimal. I began with the Munro 12AX7 subcircuit since it had provided a rather close approximation of measured results in the case of the PAS phono evaluation I had performed previously. Other popular 12AX7 models I had tried at the time proved to be somewhat optimistic in terms of gain. However, in this case, even the Munro model proved to be far too optimistic compared to measured results. Thus began the search for other 12AX7models, finally settling on a more recent one by Adrian Immler which, although slightly pessimistic in regards to gain in this case, presented the closest approximation of measured results. In addition, there were other issues, related to implementation, that only showed up during actual measurement and could not be modelled. Taken together, these only served to reinforce my stance that modelled results, standing alone, can be misleading. However, the model did prove extremely useful in revealing some unusual faults as well as providing insight into aspects not easily measured.

The LTSpice model is shown in Fig. 5 as it applies to the low level input. The reverse RIAA filter driving the amplifier is attributed to Norman Koren. The high level input model is the same except the reverse RIAA filter drives the PEC high level input. Resistors R18-R21 at the output represent the load seen with the volume potentiometer set to minimum.

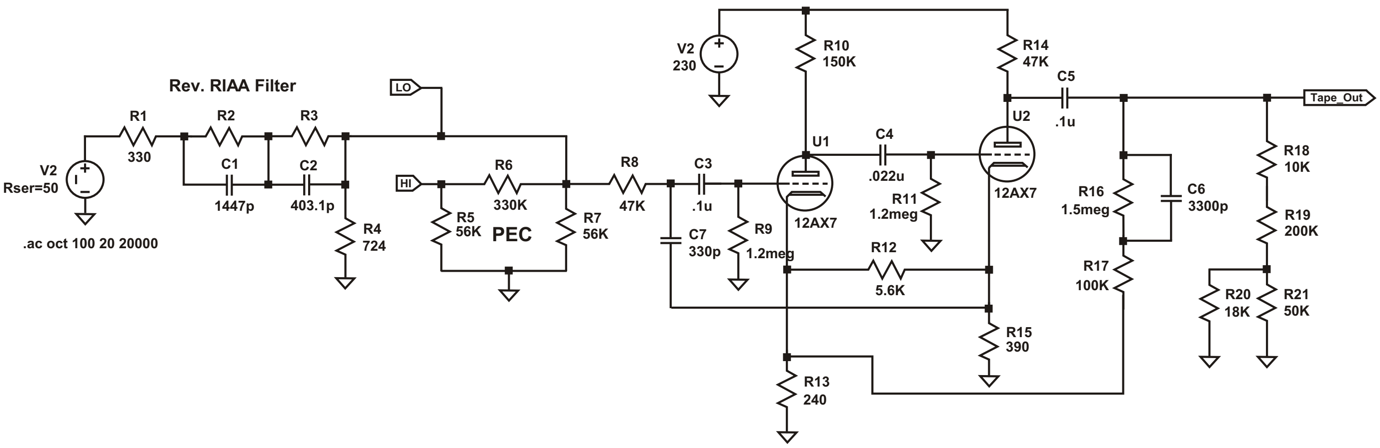

Fig. 5 SCA-35 Phono Stage LTSpice Model

Modelled Response 20Hz-20KHz

At the low level input, the response was consistent with my previous measured results and showed a gain of 50.2dB at 1KHz. At the high level input, the attenuation exhibited at 1KHz was almost 3dB greater than the PEC resistor divider would suggest. The frequency dependancy issue, described in the circuit analysis, was beginning to manifest. Truly dramatic, however, was the unexpected divergence in response from that at the low level input. The difference is displayed in Fig. 6 where the response is compared relative to 1KHz. The black plot indicates the low level input and the red plot the high level. Low level response was +0.51dB/-0.48dB from 60Hz to 20KHz, falling off quickly at frequencies below 40Hz. Ultimately -2.6dB at 20Hz, which was expected and consistent with past measurements. The high level input was significantly different showing +1.6db/-3.54dB from 60Hz to 20KHz. At this point I realized that I had never actually measured the response at the high level input, only the low level, which is the most commonly used. I had assumed, incorrectly, that the response would be the same, as had been stated in the manual. Although little used, the high level input was, perhaps, the most important as it became the gateway to discovery leading back to a closer analysis of the circuit itself. Significant issues are evaded, by either modelling or measurement, at the low level input.

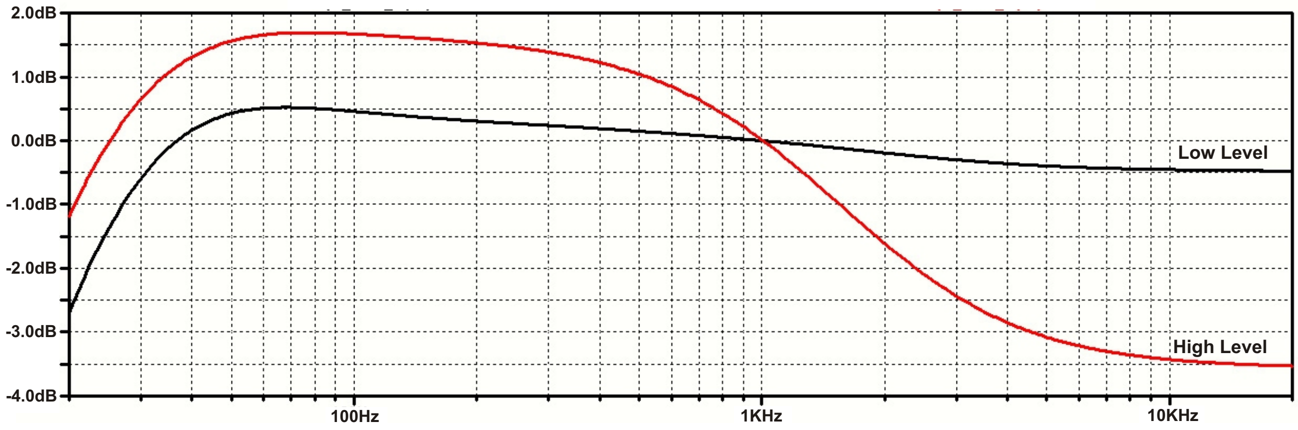

Fig. 6 SCA-35 Phono Stage Modeled Response 20Hz - 20KHz

Low Level ▬ High Level ▬

Modelled Input Impedance

The input impedance at both low and high level inputs was determined by plotting Vin/Iin over a 20Hz-20KHz range. The reverse RIAA filter is out of circuit. Fig. 7 displays the results with the black and red plots indicating the low and high level inputs respectively. The frequency dependant degradation at the low level input was anticipated, however the impedance at the very low end of the band was somewhat lower than expected.

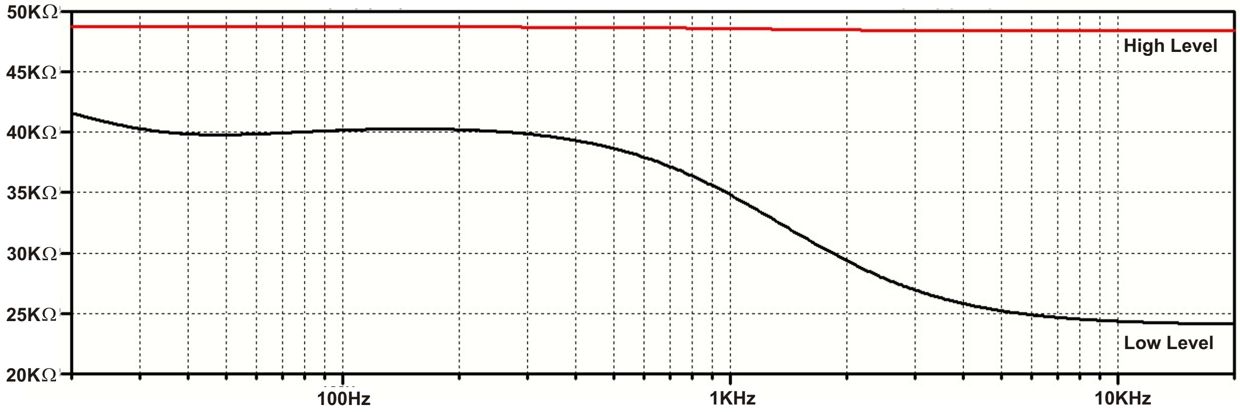

Fig. 7 Modelled Input Impedance 20Hz - 20KHz

Low Level Input ▬ **High Level Input** ▬

Modelled Output Impedance

As with the input impedance, the model calculates Vin/Iin, however, in this case, the generator drives the output of the amplifier with the input shorted. With similar results at both inputs, only a single plot is presented in Fig. 8.The more traditional implementation of negative feedback RIAA equalization presents an output impedance that is typically high at the low end of the band but drops significantly, and continuously, as frequency, and feedback, increase. Loading effects, at the tape out jacks, are thus predominant at the low end of the band. The unusual feedback scheme employed in the SCA-35, however, presents a different scenario. Global LF feedback levels off as the frequency approaches 1KHz, while first stage local HF feedback increases. Since the HF loop does not reside within the greater OL gain that the LF loop does, it is not effective in further reducing the output impedance, which then rises again. With higher HF output impedance, capacitive loading effects of interconnect cables at the tape output jacks can now become an issue as well, as was discovered during measurements.

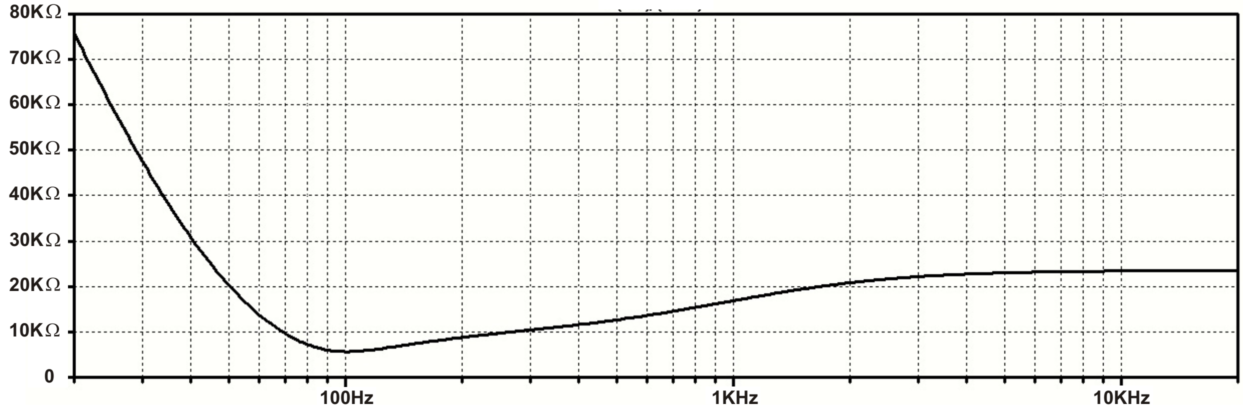

Fig. 8 Modelled Output Impedance at Tape Out Jack 20Hz - 20KHz

Simulated Phono Cartridge Response

It was predicted that a phono cartridge, connected at the low level input in particular, will interact with the high frequency EQ feedback loop, resulting in degraded response. Confirmation by means of traditional measurement techniques presents some difficulties, thus, we'll get a sense of what may happen by simulating a phono cartridge. Due to mechanical resonances, this is very difficult to accomplish precisely, thus, cartridge models tend to include only the electrical elements namely, inductance, resistance and recommended loading. Typically, the simplified models exhibit a response peak and roll off at the high end of the band not exhibited by the actual cartridge in practice. They can still be useful, however. In this case, it is the *relative* response of the cartridge alone compared to the response through the preamplifier that matters, not the absolute response, so the simple model should suffice. The complete model, shown in Fig. 9, displays a simulated Shure V15 III cartridge as applied to the low level input, as well as a stand-alone reference model of the cartridge to allow response comparison. The high level input model is the same, of course, with the cartridge connected to the high level input.

The reverse RIAA filter is buffered so that it does not impact the simulated cartridge that follows. The cartridge model involves a series inductance/resistance of 500mH and 1350 ohms, which drives the effective 48.9K load resistance presented by the PEC. The 100pF load capacitance is somewhat less than that recommended by Shure, but was chosen for flattest response, as exhibited by the cartridge model alone, eliminating the aforementioned high end peak, for a less confusing presentation..

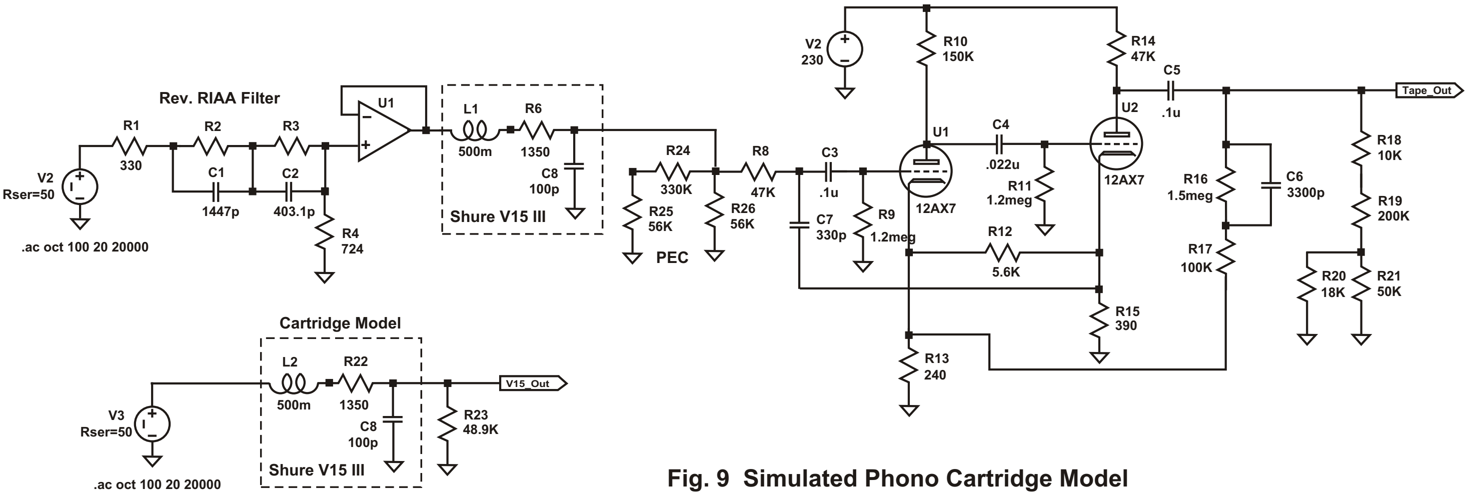

Fig. 9 Simulated Phono Cartridge Model

Fig. 10 compares the cartridge alone to the response through the preamp at both low and high level inputs, relative to 1KHz. The black plot represents the cartridge and red and blue plots the low and high level inputs respectively. Low level input response, below 1KHz, remained much it as was when driven by a low impedance generator, but this was not the case at higher frequencies where the response, at 20KHz, was down 6dB relative to the cartridge alone. At the high level input, the response is virtually the same the as signal generator response displayed in Fig. 6. As expected, cartridge impedance had little effect at the high level input. As a point of interest, I also ran the simulated cartridge in my previous PAS phono stage model and there was virtually no degradation at all. The response of the PAS matched the output of the cartridge model with near perfection.

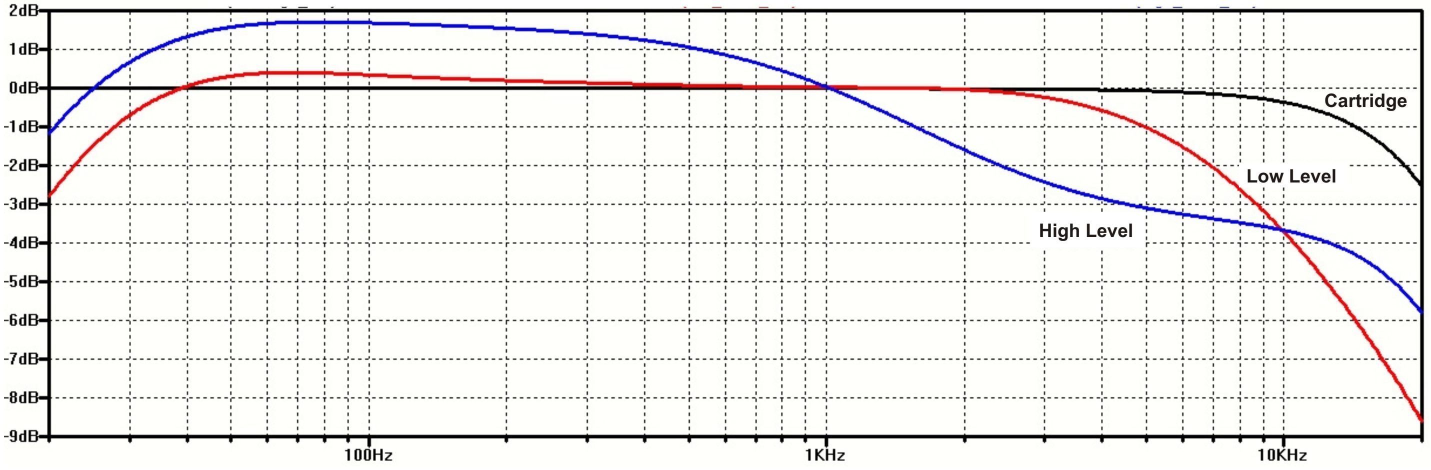

Fig. 10 Simulated Phono Cartridge Response 20Hz - 20KHz

Cartridge ▬ Low Level Input ▬ High Level Input ▬

Model Summary

Modelling efforts have essentially confirmed the issues predicted in the circuit analysis, including undesired interaction with the phono cartridge, improper high frequency EQ turnover frequency, and cartridge loading anomalies. Of note, is that it was the high level input that proved to be the gateway to discovery. Although traditional response measurements, if performed at the high level input, would have been just as revealing, it seems few, if any, have bothered. Measurements taken at the low level input will simply evade the issues.

Measured Performance:

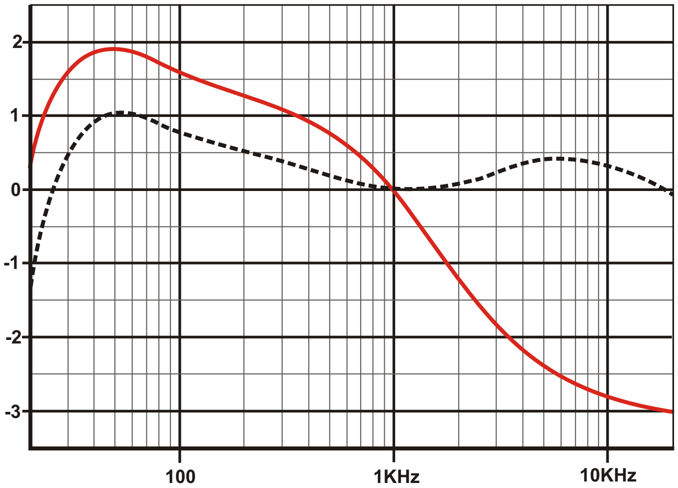

Fig. 11 Measured Response 20Hz - 20KHz dB Relative to 1KHz

Low Level Input ------ High Level Input ——

The test subject SCA-35 was a fully functional, all original, kit built example with no modifications or upgrades. The only work done was to replace a few out of spec. resistors in the phono stage and confirm proper operation. Tests were predominantly performed using a specific 12AX7, chosen from my stock, which measured as close as possible to published specifications using a custom test fixture. This, coincidentally, just happened to be a Telefunken.

Frequency Response

The response was measured at the tape out jacks. The left channel results are shown here, although the right channel was similar when using the same 12AX7. A high impedance op amp buffer was employed to avoid loading by the 100K input impedance presented by the HP8903 audio analyser used in the measurements. Even so, initially, a notable loss of high frequency response was evident and was quickly traced to the capacitance of the interconnect cable and high output impedance of the phono stage. The buffer was then modified to connect directly to tape out jack, eliminating the cable, which solved the problem. The response at both the low and level inputs, relative to 1KHz, is shown in Fig. 11. As with the model, the significant divergence in response is immediately evident. The drop in response below 40Hz was also expected due to the gain limitation discussed in the circuit analysis.

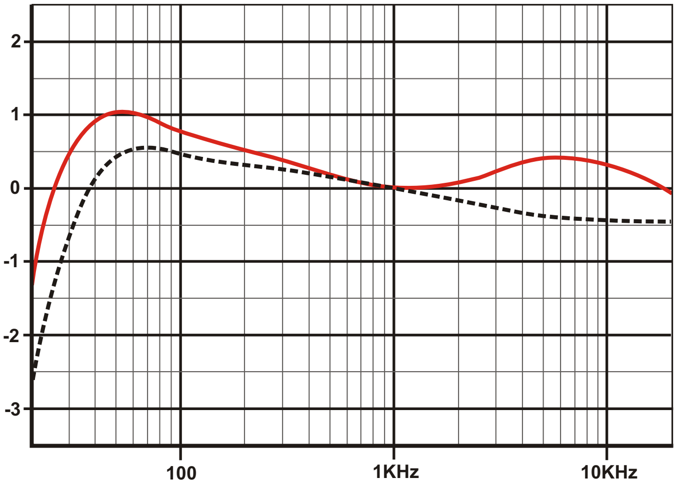

Fig. 12 Modelled vs Measured Response 20Hz - 20KHz

Modelled ------ Measured ——

Low Level Input

Of note, however, and most obvious at the low level input, is the curious rise (hump) in response above 1KHz not exhibited by the model. This is more clearly illustrated in Fig.12 which displays the modelled vs measured response. It took quite some time and effort to track down the reason for the discrepancy. There is an apparent feedback mechanism between the selector switch wiring and the close proximity of the very high gain phono stage. By removing the wires associated with switching the high frequency EQ feedback capacitor, and jumpering the related connections directly on the back of the PCB, the measured HF response then approached that exhibited by the model. This is an implementation condition that could not be foreseen by modelling, confirming the need to verify with actual measurements. In this case, however, the response anomaly is perhaps more of a curiosity than an actual concern, likely eclipsed by the degradation that will be exhibited when a phono cartridge is the source. Keep in mind that the measured results, as presented, relate to the response with a low impedance signal generator and simply verify the modelled results. The response with a phono cartridge, as we now know, is quite different and cartridge dependant.

Efforts to emulate a phono cartridge with physical components were largely thwarted by the hum and noise pickup of the rather large inductor. At the time, I did not wish to expend the time and effort to construct a fully shielded enclosure which would have been required to achieve precise results. I was, however, still able to observe the same general trend exhibited by the model.

Input Impedance

The input impedance was measured by applying a variable series resistance (trim pot) to the generator and adjusting until the -6dB point was reached at the input jack. Again, buffering was employed to eliminate instrument loading. The series resistance, plus generator output impedance, represented the input impedance at numerous frequencies from 20Hz-20KHz. The plotted result (smoothed) is displayed in Fig. 13. The degradation is very evident at the low level input, and the impedance at the low end of the band is closer to the expected results than the model.

Output Impedance

The output impedance was determined by connecting a variable resistance (trim pot) directly at the tape out jack and adjusting to achieve -6dB at the output of the buffer over numerous frequencies from 20Hz-20KHz. The resistance at each -6dB point essentially being equal to the output impedance of the preamp. The impedance plot (smoothed) is displayed in Fig.14. For comparison, the output impedance of the PAS phono stage is also displayed.

It was noted that the measured impedance, at the lowest frequencies, was somewhat lower than that indicated by the model, with the results converging with increasing frequency. While the model does employ a rather different method to determine the impedance, the overall trend is similar.

Sensitivity to Output Loading

With a very high, and variable, output impedance, it might be expected that the phono stage will have issues driving almost any type of load presented at the tape out jacks. Being sensitive to capacitive loading as well makes it more difficult to quantify the effects since the interconnect cable itself may be the dominant factor in some cases. However, the significance of purely resistive loads is easy to determine and some example are presented in Fig. 15 comparing the response for values of 50K, 100K and 250K relative to 1KHz. Interestingly, values of 250K (or higher) which might be typical in the tube era, would present little difficulty despite the peculiar output impedance curve.

Sensitivity to Tube Gain

Because there is insufficient headroom at the low end of the band, it should be expected that low frequency response will be sensitive to tube gain. To verify, tubes with somewhat higher, and lower, Gm were compared to the reference test tube. Tested in a custom test fixture, the related tubes measured 1320/1340, 1260/1250 (reference) and 1130/1120 under conditions of 100V plate voltage and 0.5mA current where the spec. sheet rating is 1250. The comparative higher and lower gain tubes were chosen so as to be not greatly different from the test reference. The results, shown in Fig. 16, display the response variations rather dramatically. This is not a circuit in which sub par tubes should be employed, and even those with above rated Gm will essentially end up in the same place at the

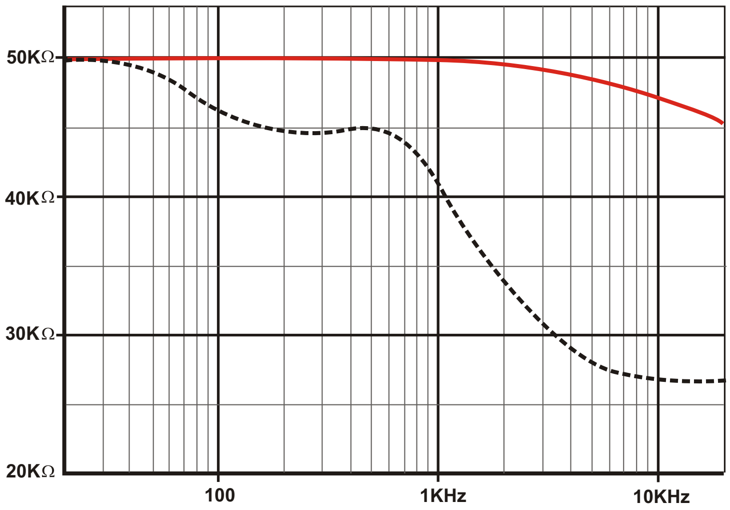

Fig. 13 Phono Input Impedance vs Frequency

Low Level Input - - - - - - - **High Level Input** ——

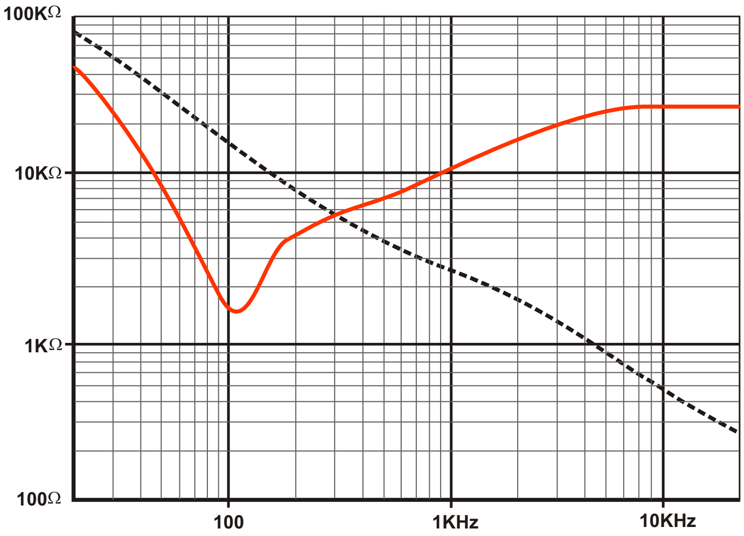

Fig. 14 Phono Output Impedance vs Frequency

SCA-35 —— **PAS** - - - - - - -

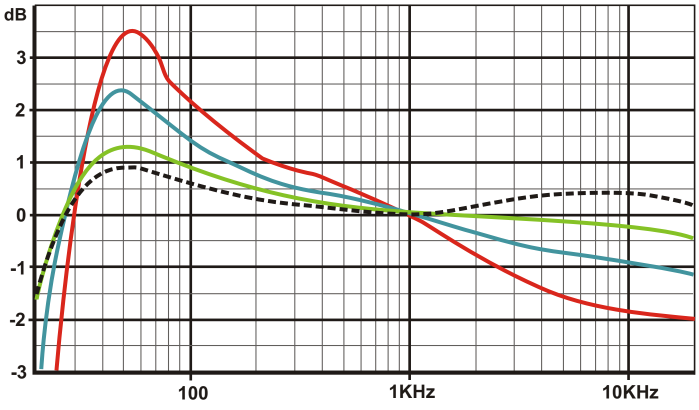

Fig. 15 Resistive Loading at Tape Out Jacks

50K —— **100K** —— **250K** —— **Unloaded** - - - -

very low end of the band. As a point of interest, the lower gain tube, though a bit short of the specifications, still performed reasonably well in the PAS phono stage, but was quite unacceptable in the SCA-35.

Hum and Noise

Unlike most other Dynaco equipment I have tested, in my experience, the SCA-35 has never even come close to meeting its published hum and noise specifications, especially the phono stage. Unsurprisingly, it is also the most common complaint with the SCA-35. While the manual states 70dB, I typically measure something in the mid 50's and, in this case, 56dB. In the 1964 High Fidelity Magazine review of the SCA-35, phono stage hum and noise was similarly measured at 54dB.

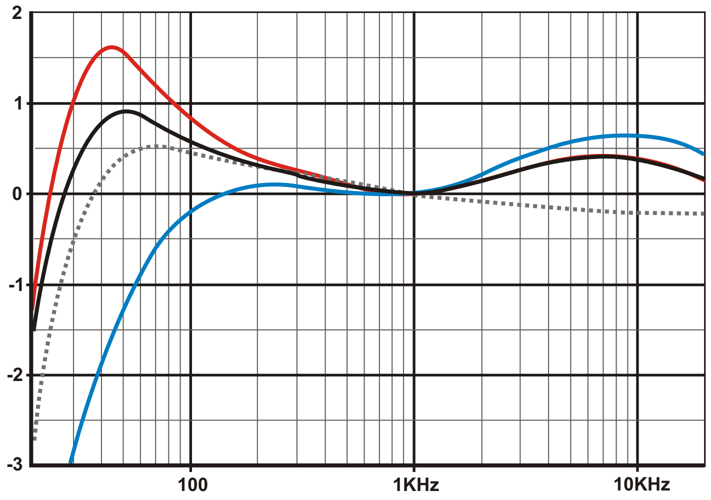

Fig. 16 Phono Response dB Relative to Tube Gm

Measurement Summary

The measured results are in general agreement with the model with a few minor disparities that can be expected when comparing a model to a real world device, and this is especially true with vacuum tube equipment. The predictions made in the circuit analysis were well supported in both modelled and measured scenarios.

SCA-35 Phono Stage Summary and Comments

This performance evaluation uncovered a number of significant and unexpected issues, primarily related to the unusual dual feedback loop employed for RIAA equalization, and can be summarized as follows:

- At the low level input, the impedance presented by the phono cartridge becomes an unintentional part of the RIAA feedback circuit resulting in degradation of high frequency response. The severity will be dependant upon the characteristics of the particular cartridge being used.

- Input impedance at the low level input decreases dramatically over the audio band due to interaction with the RIAA feedback circuitry

- Significant degradation of response on the high level input, regardless of source impedance, due to the PEC attenuator interacting with the RIAA feedback circuit.

- Unusual output impedance characteristics may present loading issues including significant sensitivity to capacitive loading effects of interconnect cables at the tape output jacks.

- Extreme gain, required due to the passive line stage, and which cannot be maintained at lower frequencies, results in degraded low frequency response which is very tube sensitive.

- Apparent feedback between the selector switch wiring and high gain phono stage may result in high frequency response anomalies, the magnitude of which is related to wire routing.

- Performance issues are easily evaded by common measurement techniques when applied to the low level input.

In keeping with my original goal, the results presented in this report include only those most pertinent to the performance review of the stock phono stage, however, my efforts actually extended much further as I investigated possible solutions. Throughout the process, I consulted regularly with Dave Gillespie keeping him informed of my progress and welcoming his wealth of knowledge and insightful input. When the model revealed even more issues, and stymied by results that, seemingly, defied all sense and logic, Dave pointed out the possibility that, given the low values of the cathode resistors, the tubes may be attempting to establish contact bias. Something I likely would have never considered, but perfectly explained the confusing results. Moving forward then, the troublesome secondary EQ loop was eliminated and numerous feedback iterations, based upon the common single loop scheme were modelled, implemented and measured. Each, however, involved some degree of both success and new issues. While they all solved the previous interaction and impedance issues, loading and/or distortion became new concerns while attempting to maintain the high gain. Time and again, my modifications inevitably morphed into something that resembled the PAS phono stage, along with the lower gain, and similar performance. In the end, not having succeeded in developing a solution I was fully comfortable with, and not willing to allocate more time at the present, I discontinued the effort. While I may revisit this some time in the future, currently I am more inclined to suggest the well proven PAS configuration as an option.

In my communications with Dave, possible reasons for the adoption of the dual loop feedback scheme were discussed, with none clearly determined, however, the results of my modification efforts did tend to support his thoughts. Essentially, the conventional network presents a low impedance load to the second stage at high frequencies and, while heavy feedback compensates, it can only do so much. If the load becomes too great, distortion will rise regardless of the feedback. Given the operating parameters, and high gain of the SCA-35 phono stage, it is possible that said loading was an issue. By removing the HF EQ turnover capacitor from the conventional network, and placing it within the local first stage network, the output FB load burden is greatly reduced, never being less than 100K. Just speculation, of course, and we'll likely never know for sure. Whatever other issues Dynaco likely knew were inherent in the implementation, they may have been considered acceptable given the overall concept of the amplifier, where simplicity, budget concerns and compromise are evident throughout. The SCA-35 may well be the King of compromise, yet clearly, it all worked "well enough" as an entry level integrated amplifier.

Despite the revelations in this review, if you are an SCA-35 owner who has enjoyed the phono stage as it is, many have said they do, it may be best if you simply continue to do so and try not to fret over the issues. Essentially, the overall effect will be the same as if you engaged a scratch filter, with the cutoff frequency being dependant on the impedance presented by your particular phono cartridge. With that in mind, and the age of your ears, the issues may not be all that audible to you. If concerns remain, then you may want to consider changing the circuit configuration to that used the PAS preamp. While it does have lower gain, working around this is possible. The process is included in Dave Gillespie's definitive work "Hidden Treasure: Bringing Out The Very Best of Dynaco's SCA-35" as presented in the tube forum at Audiokarma.org.