

A Pre-Preamp for Moving Coil Cartridges

by R. N. MARSH

MOVING COIL (MC) CARTRIDGES have been popular for some time now. However, their low output voltage means they need additional amplification before being connected to the preamplifier. This article describes such a "pre pre-amplifier."

Due to the low signal levels, signal-to-noise-ratio is however a major design consideration; Fig. 1 shows a popular topology used in MC preamplifiers, a single stage, single-ended design. Some of the more versatile units allow for various input (R_{in}) terminating loads; usually 40-100 Ω is used. To go too low with R_{in} will reduce the voltage generated by the MC and therefore degrades S/N.

J.P. Moncrieff¹ has shown that moving coil cartridges working into low impedance (Z) loads (comparable to the cartridge Z) typically lower distortion by a factor of 10, and that electromotive damping applied at the cartridge generator coil progressively reduces distortion by ever lower values of terminating Z . This damping helps the stylus assembly cope with groove rattling problems. My circuit uses negative feedback to reduce the input impedance to a very low value (limited to a minimum value of $0.5R_1$). Measured input impedance is 0.68 Ω ; thus the input is a good circuit summing junction.

This low MC terminating impedance means we need higher gain. R_f , R_6 , and R_7 determine the gain, which is 225; I settled upon this for my MC, a Denon 103S. The circuit, with the values shown, is also suitable for most other MC cartridges.

For this pre-preamplifier I have adhered to several requirements established while I was developing my passive RIAA preamplifier? The design is symmetrical and balanced to give the lowest distortion potential and low inductance ground and supply distribution; it eli-

minates any requirement for large value capacitors, such as aluminum or tantalum, in the signal path. I planned the device from the outset so it would need no large value (polar) input or output coupling capacitors, which are high in dielectric absorption and other abnormalities.^{2,4} The input is directly coupled to the cartridge, and you can couple the output directly to the preamplifier input if that input has a coupling capacitor or use a 5 μ F polypropylene.

My circuit appears in Fig. 2. I used common, inexpensive devices so that selecting matched pairs would not become a financial burden; a dozen of each type should be enough to find four pairs. The circuit of Fig. 3 is useful for matching complementary devices and can be used for other projects as well. The input transistors (Q_1 , Q_2) are complementary common-base. The outputs (Q_3 , Q_4) act as load and current sources for Q_1 and Q_2 . The I_b of Q_3 and Q_4 sets the collector current for Q_1 and Q_2 . Consequently, the circuit depends on device parameters. Beta matches should be within five percent of one another, and Q_3 and Q_4 should have a beta of 130-150. Matched devices reduce distortion and minimize the dependency on negative feedback to reduce distortion.

If you like meaningless numbers: THD is less than .005% at 30mV output (20kHz). With lower output levels, THD becomes virtually unmeasurable and drops below the noise. Noise with an actual cartridge (a Denon 103S) attached to the pre-preamp input measured -69dB re 10mV. This is an unweighted figure measured over a 20kHz bandwidth; an "A" weighting would make the number much better. Quieter devices and power supply could lower the noise even further, although this would probably be of academic interest only. A 3-5dB improvement might be possible.

My power supply is ± 15 VDC at $\geq \pm 100$ mA. I used a non-switching commercial unit with a noise and ripple specification of 0.5mV RMS and a Z_o of 0.2 Ω at 10kHz. Many suitable power supply designs have been published in TAA. Michael P. Sulzer's design (TAA 2/80, p. 8) offers very low output impedance over a wide bandwidth, a necessary condition for audio equipment power supplies. Audio circuits should be kept under 50 milliohm to 100kHz. I located my supply about 18 inches from the circuit. Therefore, in order to preserve the supply's low output impedance at the circuit, I designed a low inductance, high capacitance cable. It is audibly superior to ordinary multiconductor cable or hook-up wire; you should use it in order to realize maximum performance with a remote power supply (see Fig. 4).

Some manufacturers, such as 3M or W.G. Gore & Assoc., Inc., of Newark, Del., make thin copper foil with a film insulation. It comes in rolls, like tape, and makes cable construction easy. I

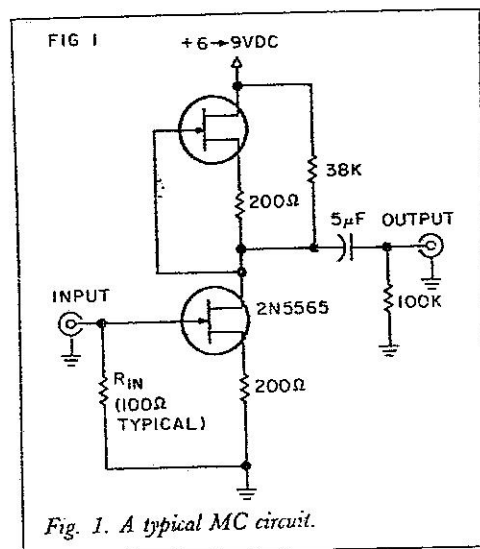


Fig. 1. A typical MC circuit.