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Precision Electro-Acoustic Research Laboratory ❦ Hand-Builders of Fine Music-Reproduction Equipment

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Getting the Shake & Rattle Out of Your Rock & Roll:

Suppressing Microphonic Output From Vacuum-Tube Equipment

THE PURPOSE of this monograph is to outline in general the mechanisms of microphonic-signal generation within electronic equipment; within vacuum tubes in particular and to explain how these can be suppressed to a worthwhile degree in tube equipment.

One can go to terrific extremes in the selection of top-quality components and masterfully execute a superb circuit topology yet still finish up some distance from ultimate circuit performance if the factors affecting the mechanical performance of susceptible components have not been carefully taken into consideration.

The extent to which high-fidelity music reproduction is adversely affected by microphonic contamination appears to have been largely overlooked in the great majority of present commercial offerings, although the reasons for this are, to this observer, not particularly clear.

Microphonic output results from the mechanical stimulation of components and is sometimes determined to originate from surprising sources. To name but a few, resistors, capacitors, transformers, cable, tubes, switches, connectors, and relays are capable of creating spurious microphonic signals.

Almost always, such spuriae are generated by some change in the relative position of the mechanical elements composing a device.

Vacuum tubes, which employ electrostatic fields to control electron flow, are by the nature of their physical construction, particularly capable producers of microphonic outputs. This can occur because the grids—the electrostatically operated "gates" that control electron flow through the tube—are physically very fine structures and quite responsive to subtle mechanical stimuli. For example, the grid in each triode section of the commonly used dual-triode, 6DJ8, is wound with wire that is nearly invisible to the naked eye.

A grid can be thought to resemble a miniature harp that has all of its strings tuned to approximately the same note. When a mechanical stimulus of the right frequency induces vibration in the tube structure, the turns of fine grid wire can be set into resonance. Like a harp, they will sing their own song for some time after the stimulus has passed.

Since the flow of electrons through the tube is a function of both the controlling voltage applied to the grid and the grid's physical position within the tube, a change in either of these parameters will cause a change in current flow and, consequently, the appearance of an output signal. Microphonic output will result if the grid suffers a physical displacment with respect to the cathode. Such movement will take place when the tube is subjected to vibrational stimuli or—somewhat surprisingly—as a result of the tube's normal operation in a vibrationally "silent" environment. See AN 28.0, *"Dynamic Compression and Self-Microphony in Triodes"* for more on this

The suppression of microphonic output requires that mechanical vibration be prevented from reaching the tube. So with this goal in mind, the PEARL Iso-Socket was designed.

While some equipment designers have tried to reduce microphonic effects by the (usually not very) compliant mounting of tube laden circuit boards, this is, at best, a partial solution. Acoustic energy can still act on the circuit board stimulating its self-resonant modes which are not likely to be well damped by the compliant board-mounting. Via their sockets, vibrational energy reaches and acts on the tubes through a sort of sounding-board effect.

A more effective solution is to mechanically isolate the tube socket from the surface to which it's mounted and this is exactly what an Iso-Socket does.

The sonic improvements that accrue from this are numerous and worth discussing in some detail.

Generally, it can be said that small changes in signal level are more clearly delineated. Some of the effects of this are heard as greater dynamic contrast, improved inter-transient silence and a heightening of contrast among the various musical colors. The sound assumes a more relaxed quality while musical climaxes are handled with less apparent effort.

Subtle changes in tempo, intonation and phrasing are effortlessly reproduced. One is struck by the feeling of having missed much of the emotional content of a given performance on previous listenings where microphonic effects have been at work.

In particular, the lower registers are presented more clearly, with greater impact yet with an engaging immediacy and warmth. The loose, much reviled tube-bass sound essentially vanishes. (Largely, it's presence appears to be an effect of cathode resonances. See Audio Note 8.1, *The Measurement of Microphonic Effects in Vacuum Tubes*.) The sonic character of the recording venue is more apparent while the performance as a whole is presented against a quieter, blacker background.

Your present tube gear may be of the highest caliber yet if you are still listening to the ringing resonances of the tubes modulating the music, you are missing much of the beautiful reproduction that, to date, only tubes can offer. Given that the appreciation of such musical beauty is the reason for owning tube gear in the first place, is there any reason to continue listening to microphonic effects?

The Iso-Socket is available in 7- and 9-pin types suitable for pc-board mounting only. Horizontal- or vertical-mounting types are produced in the following variations:

- 7-pin – horizontal and vertical types, low-profile, gold contacts only.
- 9-pin – horizontal and vertical types, low-profile, gold contacts only.
- 9-pin – vertical types, standard-profile, silver contacts only.

The low-profile devices accommodate equipment where very little increase in the seated height of the tube is permissible. The mechanical stops provided in the vertical types prevent over-stressing of the decoupling elastomers when inserting or removing tubes, while those in the horizontal types act only to limit over-stress on tube removal. Dimension drawings of all of these types appear overleaf. Only the low-profile socket types use gold-plated beryllium-copper contact fingers within each pin receptacle. These are press-fitted into a precisely machined body of standard, unclad, G10 PC-board material

The standard-profile device uses heavily silver-plated, hard-brass contacts contained within a ceramic body. We think the silver-contact devices sound slightly better than the gold-plated units, although the difference is subtle and likely to be heard only on systems of exceptional resolving power.

Application Note

It should be noted that the silver-plated brass contacts are very stiff, and insertion or removal of the tubes requires considerable force. We recommend that you firmly grasp the socket body when changing tubes even though there are mechanical stops built into its suspension system. Further, care should always be taken to ensure that the pins on all tubes are straight and clean before attempting insertion into any sort of socket.

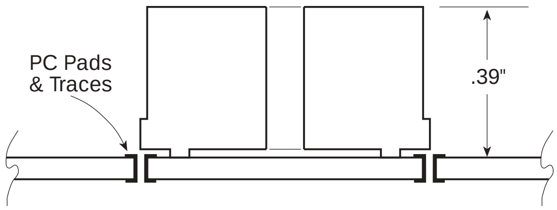


Fig. 1. The seated height of a standard, PC mounted 7/9-pin tube socket is shown above. Use this to gauge the increase in the seated height of tubes fitted into any of the ISO-SOCKETS shown on this page.

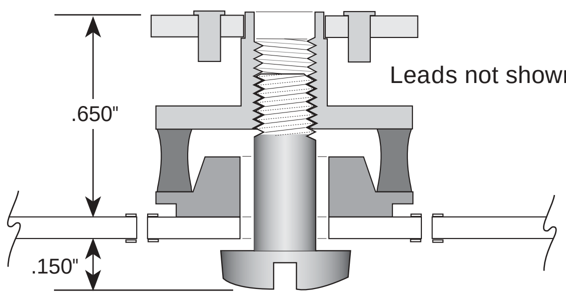


Fig. 2. The low profile, PC mounting, vertical ISO-SOCKET is shown above. The contacts are gold plated brass, the socket body is blue G10 fiberglass and Sorbothane is used is used for the decoupling elastomer.

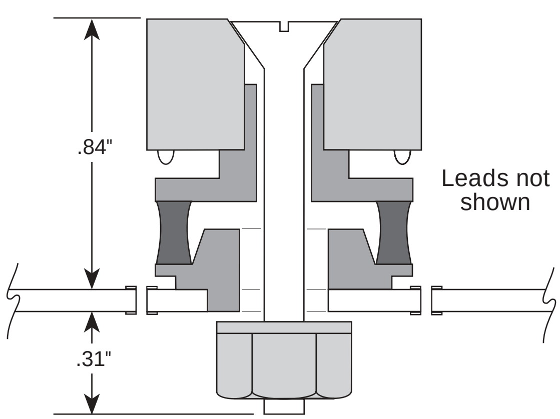


Fig. 3. The standard profile, PC mounting, vertical ISO-SOCKET is shown above. The contacts are silver plated brass, the socket body is white ceramic and Sorbothane is used is used for the decoupling elastomer

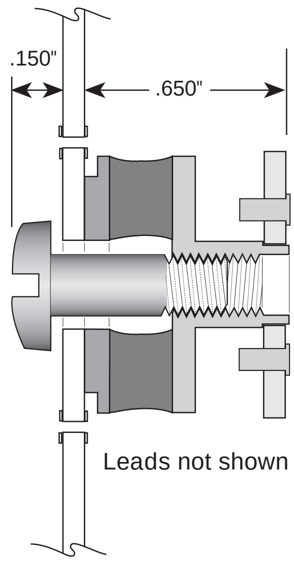


Fig. 4. The low profile, PC mounting, horizontal ISO-SOCKET is shown above. The contacts are gold plated brass, the socket body is blue G10 fiberglass and silicone foam is used is used for the decoupling elastomer

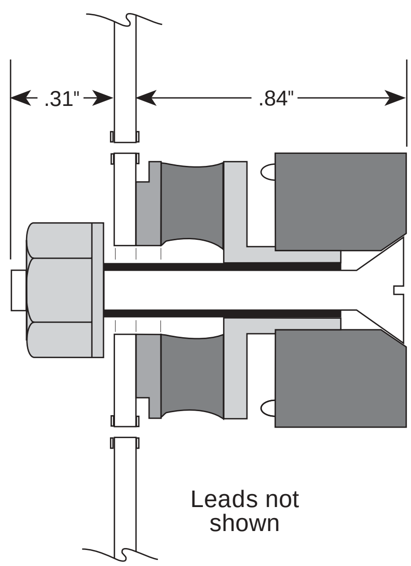
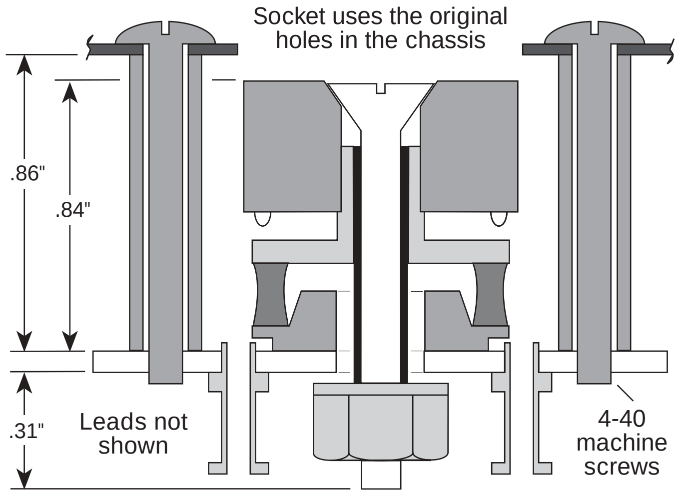
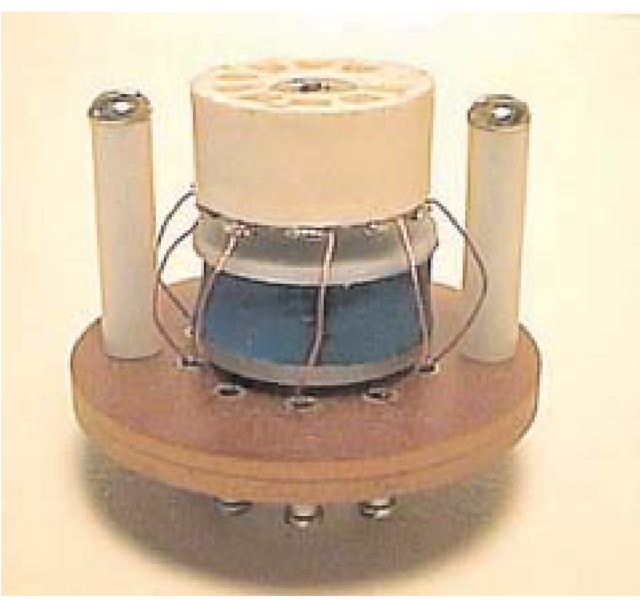


Fig. 5. The standard profile, PC mounting, horizontal ISO-SOCKET is shown above. The contacts are silver plated brass, the socket body is white ceramic and silicone foam is used is used for the decoupling elastomer



`Fig. 6 The standard profile, chassis mounting, vertical ISO-SOCKET is shown above. The contacts are silver plated brass, the socket body is white ceramic and Sorbothane is used is used for the decoupling elastomer. The socket is supplied fully assembled with the flex leads threaded though the holes in but not soldered onto the hollow, turret terminals. Note that the insulation on the leads is solder strippable.
See AN 7.1 *ISO-SOCKET Installation Instructions* for complete directions on the method to use to dress the leads.



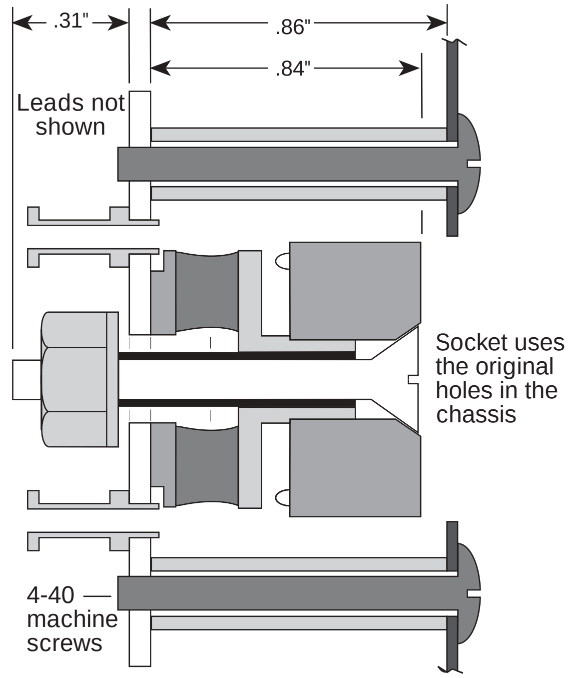


Fig. 7 The standard profile, chassis mounting, horizontal ISO-SOCKET is shown above. The contacts are silver plated brass, the socket body is white ceramic and silicone foam is used is used for the decoupling elastomer. The socket is supplied fully assembled with the flex leads threaded though the holes in but not soldered onto the hollow, turret terminals. Note that the insulation on the leads is solder strippable.
See AN 7.1 *ISO-SOCKET Installation Instructions* for complete directions on the method to use to dress the leads.