

## *The LOCI Tonearm*

The Psionic Corporation has developed a new tonearm: the **LOCI**. The creation of the **LOCI** was based on three things: knowledge of the realities concerning records, knowledge of the laws of nature, and knowledge of the sound of live music.

This booklet briefly describes the result of our experiments, which is a tonearm very different from those currently available. The **LOCI** has an articulated vertical motion to allow cartridges to play low bass frequencies and still cope with warps, a parallelogram linkage to eliminate warp-wow, an adjustable vertical tracking angle with a scale to enable the listener to hear each record in his collection at its optimum setting, and fine craftsmanship to preserve the integrity of the sonic signal.

## *Articulated Motion*

The relation between the effective mass of a tonearm and the resulting sound is more complicated than most audiophiles realize. The perfect tonearm will hold the cartridge body rock steady while the stylus is tracking musical information in a record groove but will move the cartridge in perfect unison with the stylus while it is tracking warps or other low frequency noise. In order to design a conventional single-pivot tonearm, compromises must be made between accuracy of low bass response and reducing the effect of the small warps that are present on almost all records. The articulated vertical motion of the LOCI alleviates the need for this compromise.

At lower frequencies, the signal from a good cartridge is supposed to be proportional to the stylus deflection from its rest position. This signal can be predicted from knowledge of the motion of the stylus in the groove and the physical parameters of the tonearm-cartridge combination. These parameters include the compliance (or springiness) of the stylus cantilever in the cartridge, the effective mass of the cartridge-tonearm combination, and the damping of the tonearm motion.

The laws of physics tell us that motion of the stylus at relatively high frequencies will leave the tonearm and cartridge body virtually motionless so that the signal will match the stylus motion. Motion of the stylus at very low frequencies will allow the tonearm and cartridge to follow the stylus so no signal at all will be transmitted. Motion at frequencies in a certain range will cause the cartridge and tonearm to resonate, so the signal is actually much greater than the stylus motion itself. The frequency at which this is most severe is called the *resonance* frequency.

Musical information can be heard at frequencies as low as 21 Hertz (low "F" on a Bosendorfer piano) and little warps can excite great nastiness at frequencies as high as six Hertz unless the tonearm and cartridge move along with the stylus as it follows the warp. Since the amplifying effect of resonance on both music and warps is harmful, the tonearm mass and cartridge compliance are usually chosen so that the resonant frequency is about 12 Hertz to compromise between bass problems and warp problems.

There is another way to discriminate between the lowest frequency musical vibrations and the highest frequency warp vibrations which results from the way records are made. The left and right channels of a stereo record are cut at 45

degree angles to the surface of the record and at right angles with each other. This means that the horizontal motion of the stylus represents the sum of the two channels while the vertical motion of the stylus represents the difference between them.

Since the lowest frequency that a listener can locate in space is about 80 Hertz, there is no reason to separate left and right channels below that frequency so there is no reason to record vertical vibration at very low frequencies. Records have very little musical vibration in the vertical direction below 80 Hertz. So the frequency band of resonant activity of the tonearm system in the vertical direction must fit between six Hertz and 80 Hertz, which is a wide enough range to contain the entire problem. Since warps are almost always vertical rather than horizontal, the highest frequency that the tonearm has to follow in the horizontal direction is about two Hertz, so the frequency band of resonant activity in the horizontal direction must fit between two Hertz and 21 Hertz, which is also a wide enough range to contain the entire problem.

The articulated vertical motion of the LOCI reduces the vertical mass which raises the vertical resonance frequency and the horizontal mass of the LOCI is higher than most other tonearms which lowers the horizontal resonance frequency so no compromise need be made in sound quality.

## *WarpWow*

The idea of articulated vertical motion has been tried before, but the results have not been accepted by audiophiles. When a moderately warped record was played on these tonearms, the sound changed in speed because the motion of the cartridge as a warp was played was not straight up and down, but was at an angle to the vertical, so the stylus moved forward and backward in the direction of the groove's motion. The music was heard to slow down as the stylus rose and speed up as the stylus fell. This effect is called *warp-wow*. People who have just spent a lot of money on a turntable with no wow or flutter do not want their music to waver as if it were being played on a cheap cassette player!

The parallelogram linkage in the LOCI constrains the cartridge motion so there is negligible forward-backward motion as the cartridge moves up and down over a warp. This way the speed and pitch of the music stay constant as the record is played.

## *Vertical Tracking Angle*

On most good cartridges, a small error in vertical tracking angle (VTA) causes significant sonic deterioration. Therefore, it is imperative that the VTA of the cartridge not change as a record is played. Other tonearms have the cartridge mounted so that it rotates as it moves up and down. The effect of this is a slight angle change, but a slight angle change can bring about major sonic consequences. The parallelogram linkage of the LOCI keeps the cartridge angle constant as a record is played.

The different record companies have not, alas, agreed on a standard VTA. (And even if they do set a standard now, what about all those treasured older disks?) Therefore, it is also imperative that the VTA be adjustable. Some tonearms have VTA adjustable during play under the assumption that the listener will carefully adjust each record *by ear* before he plays it. But do they expect any listener to have the patience to fine-tune his sound system by ear each and every time he settles down to listen to a record?

The VTA adjustment should be calibrated with a scale so that the listener can set the VTA to the optimum setting for a record based on earlier listening. The LOCI comes with a list of record labels and their optimum VTA settings so that the listener can set the VTA based on *our* listening. (The record labels tend to have been very consistent over the years.)

The dealer can adjust VTA on one record to calibrate the LOCI for almost every label rather than just pointing to a VTA knob and telling the owner what it does!

## *Quality of Manufacture*

The ultimate purpose of any tonearm is to hold the cartridge body firmly in place. Any vibration in the cartridge body will color the electronic signal that leaves the cartridge.

The mechanical integrity of the LOCI is insured by having each arm hand machined, hand assembled, and hand tested before it is shipped to the dealer. Materials were chosen based on listening tests, not just handbook data. Parts are machined to 10 microns (.0005 inch) throughout the tonearm.

The electrical integrity of the LOCI is also a prime concern. The electrical connection between the tonearm body and the pillar is made through a Swiss-made LEMO connector. Mel Schilling RY-MS-1 co-axial cable is used for minimum energy storage and maximum signal transmission.

*The Psionic Corporation*

We are proud of the LOCI. We choose our dealers on the basis of their ability to treat their customers and our product with the respect they deserve. We will repair or replace any LOCI that fails to perform as it should. Of course there will be no charge if this is due to our negligence. If cats or children find the tonearm irresistible, we can almost certainly fix it for less than the cost of a new tonearm. We are not trying to make our living in the tonearm repair business!

We value our product and dealers and our customers. If anyone has questions, problems, or suggestions, then we are anxious to hear them.