



## RADIKAL and URIKA

### KEY TECHNOLOGY

DC Motor, Motor Control Unit and Internal Phono Stage



1

### BACKGROUND

The first LP12 SE Upgrades (Keel, Ekos SE and Trampolin) launched in March 2007 and won the EISA European High-End Audio 07/08 award. These upgrades were a huge leap forward in LP12 performance and revealed to us where further improvements could be made along the signal path. Our engineers tested every aspect of our best LP12 system to find any potential weaknesses or inefficiencies, in order to push the design on even further. We also learnt a couple of tricks from the development of the Klimax DS player that we could adapt into our latest analogue updates - Radikal and Urika.

Technological developments in DC motor technology have now produced stable and reliable DC motors with ultra low magnetic fields, allowing us to locate the phono stage inside the deck for the first time (AC motors produce more interference) to produce an even cleaner sound.

In addition, we had feedback from customers who preferred using separate Linto phono stages for left and right channels, using only one channel from each in order to reduce interference or crosstalk between the channels. Our tests proved that there was an improvement and the challenge became trying to design a board that could achieve this within the tight space restraints.

We faced numerous engineering challenges in our attempt to better Linn's flagship turntable, a fully specified Sondek LP12 with Keel, Trampolin and Ekos SE. Not only did the solution have to surpass the performance standard set by over 35 years' worth of upgrades, and do so by a huge margin, but it would have to be modular and retro-fittable, capable of being used with any any LP12 deck ever produced in the last 25 years.

As always, we're passionate about continuously improving a timeless design and we've incorporated a number of advances that simplify and reduce installation and maintenance tasks, as well as making the LP12 easier to use. After all, our objective is to make you forget about the hi-fi and concentrate on the music.



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## RADIKAL

### DC MOTOR

No matter how well it's engineered, a synchronous AC motor does produce some degree of electromagnetic noise, which can cause pickup effects on the cartridge. There are two interference modes: electric and magnetic fields. The magnetic disturbance created by the motor couples directly into the coils in the pickup cartridge. The electric field (the AC motor requires voltages at around 80 V AC to be wired into the turntable plinth) couples into the wiring from the cartridge. The electromagnetic disturbance associated with an AC motor is also the reason that we have not previously been able to fit a phono pre-amplifier inside the plinth.

Linn Radikal uses a customised precious metal brushed dc motor with a moving coil rotor, high performance Neodymium magnets and a machined aluminium pulley designed and engineered by Linn. The Radikal motor has high reliability and excellent efficiency, along with key characteristics of exceptionally low electromagnetic interference and virtually no magnetic cogging.

The motor has a very low magnetic field and extremely low levels of electromagnetic interference, which means that there is less acoustic and electrical noise than an AC motor and the result is cleaner, purer sound. The lack of magnetic cogging ensures a very smooth movement – 'magnetic cogging' (also known as 'reluctant torque') is the term used to describe the interaction between the permanent magnets of the rotor and the stator slots of the motor, an interaction that can cause jerkiness and noise – the motor can actually start on only 200mV and will maintain an accurate and constant speed.

The magnet disturbance of the current AC motor can be demonstrated by holding a Linn Akiva cartridge above the run-off groove of a record – if you turn the volume up you will hear the 50Hz (or 67.5Hz if you are running 45rpm) above the background noise. This is the magnetic noise from the motor. We have measured this at -64dB (relative to a 2Vrms). The Linn Radikal DC motor does not have this issue. The motor used in Linn Radikal is actually designed and supplied by the same company who provide motors to the NASA Mars Rover, which just celebrated 5 years' perfect running on Mars since 2004. Specified by Linn and engineered into Radikal, this motor produces an exceptional speed accuracy (or 'drift') of 0.05%.



### MOTOR MOUNTING

The motor is housed within a mounting enclosure specially designed and manufactured by Linn to minimise vibration and dampen acoustic noise. The enclosure de-couples and dampens any mechanical vibrations from the DC motor and prevents them transferring to the top plate. The motor mounting is a composite construction (see figure 3), making use of specially selected non-resonant materials to ensure the highest quality of audio reproduction.

Acetal is used to avoid a metal-on-metal connection that can produce a rattle. Poron is used inside the mounting between the motor and Acetal housing for its superb dampening properties and non-degradation characteristics. Poron features excellent compression set resistance which ensures the motor is sealed and held securely for exceptional isolation from the deck. A metal cap machined from aircraft-grade aluminium is added for extra rigidity and dampening, and finished with the Linn logo machined into the base of the cap (see figure 2).

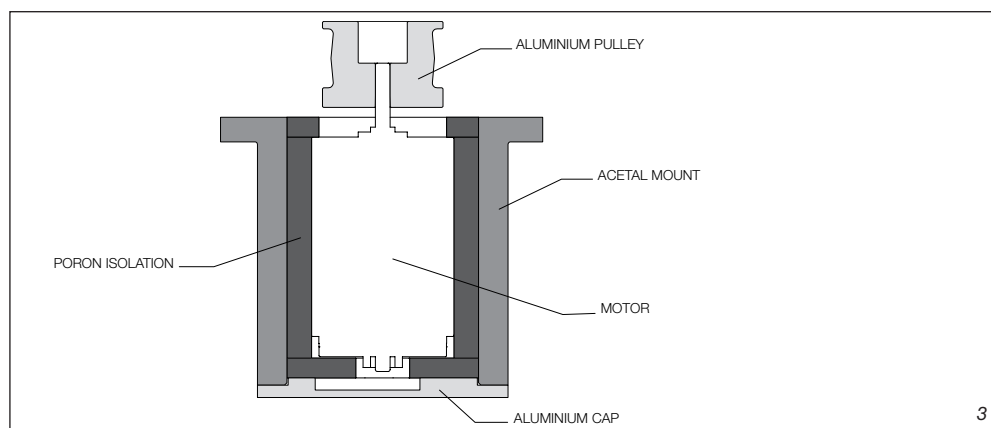


Figure 2 Motor Cap

Figure 3 Motor Elevation, cross-section

Figure 4 Motor Elevation



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### SPEED CONTROL

Linn Radikal features auto speed management to ensure the turntable speed is calibrated every time the Sondek LP12 is turned on. The optical feedback system ensures that speed drift, a problem inherent in other DC motor solutions, cannot occur in the LP12. The automatic adjustment also makes setting up an LP12 easier and quicker. In fact, the speed management system is so effective that even the very gradual wear of motor and bearings over time is automatically corrected for by Linn Radikal, and a constant, exact speed is always maintained, which ensures pitch-accurate musical reproduction.

In the days before Linn Radikal, highly skilled Linn turntable specialists had to manually adjust the screws around the LP12 motor housing to calibrate the turntable speed using a Speedchecker strobe and disc. This manual fine-tuning stage could be quite time-consuming and would have to be carried out regularly to ensure the turntable was running at its very best.

Now you simply turn on your LP12 and Radikal will set and maintain the correct speed. Radikal will auto-calibrate within 10 seconds of being powered on, though it may take up to 10 minutes to set the correct speed the very first time. Radikal uses a small optical tachometer mounted on the top-plate of the LP12 and a felt marker attached to the outer platter to measure the speed of the platter. The timing is controlled by the same ultra low jitter clock used in the Klimax DS. Radikal adjusts the drive voltage to ensure the platter is always accurate and requires no manual adjustment, ensuring pitch-perfect reproduction at all times.

With the accuracy of the new DC motor system there is no longer any benefit in leaving the motor running continuously (as many considered beneficial with the AC motor). We recommend that the turntable is switched off when not in use, as this will enhance the product lifetime and also consume less power.

### POWER SUPPLY

Linn Radikal uses a Switch Mode Power Supply which provides power for both the motor drive and the Urika phono stage. It is very important that noise from the motor drive cannot get into the phono stage. Radikal employs techniques similar to those used in a Class-A amplifier to ensure full isolation of the two functions. All parts of the Radikal circuit are powered through constant current sources and shunt regulators, which means that changes in the Radikal load conditions will not affect the low level cartridge signals.

For further isolation, there are separate power supply filters, rails and ground returns for the phono stage to ensure that there are no inter-stage modulation effects between the phono stage power supply and the motor controller power supply.

The power supply enclosure, whether housed in a standard 'wide' or 'AV' Linn chassis or a 'machined-from-solid' aluminium chassis, is superbly isolated to ensure the highest quality audio reproduction.

#### Long-term speed accuracy - how important is it?

The long-term speed accuracy of a turntable is very easy to measure and readily understood by most. Some of our competitors have used this parameter to differentiate their products. However, this is far from being the most significant element in audio quality.

To illustrate this, consider the playback of movies on TV and DVD. Films are traditionally shot at 24 frames per second, in countries where TV scan rate is 50 Hz these films are shown 4% fast. This would appear to be a gross error, and yet it is barely noticeable.

The aspect of speed accuracy that is most significant for audio quality is short-term variation (wow and flutter), and this is where the Radikal wins. The 13 segment DC motor has a very smooth rotational characteristic compared to the 'cogged' rotation of AC synchronous motors.



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## URIKA

### INTERNAL PHONO STAGE

The use of a DC motor with a specially Linn-engineered housing has allowed us to locate the Linn Urika phono stage within the plinth for the very first time, minimising signal loss and noise. This key change, along with important improvements to the circuit design and implementation, ensure the shortest signal path and the cleanest audio reproduction yet.

The internal phono stage allows a shorter and simpler signal routing layout, ensuring that the low level cartridge output stays within the deck at all times, reducing the potential for interference from power, signal or loudspeaker cables.

A key part of Urika's design is how it is fixed within the plinth. The optimum mounting solution was to fix it to its own unique suspended base board. Based on the current Trampolin design, this new base board incorporates extra Accusteel, which provides additional deadening and dampening benefits through the added mass and increased rigidity of the base plate.

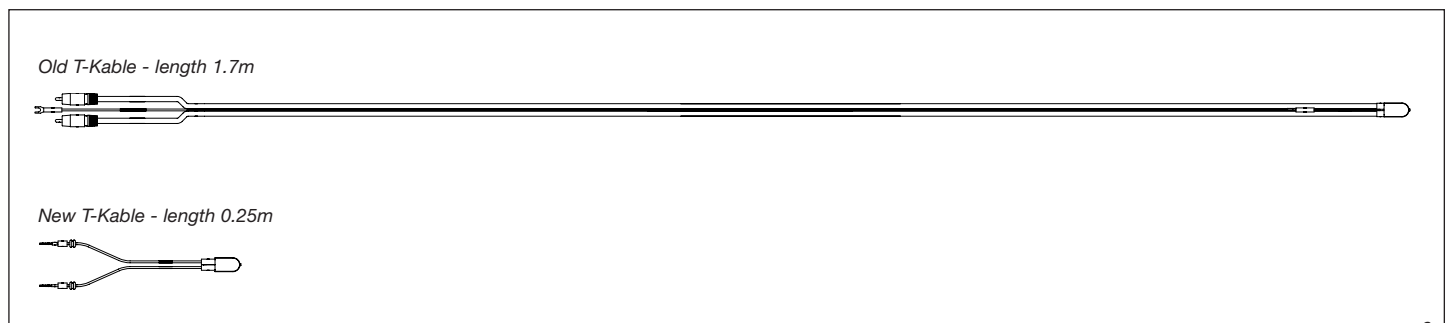
In addition, the phono stage is contained within a lightweight enclosure, which allows the suspension to work effectively. This suspension not only isolates the deck itself, but also minimises microphonic effects that could adversely affect the phono stage signal.



### T-KABLE

No matter how good an arm cable is, it always has an electrical resistance and electrical capacitance. There is, therefore, always some degree of signal loss. In this revised layout, the T-Kable is very short (see figure 6) and this makes a significant difference to reducing losses. In addition, the new T-Kable is now differential (or 'balanced'), which improves the signal-to-noise ratio of the cartridge output, and fully screened, which reduces interference from other cables.

The T-Kable is now hard soldered to the input stage of each channel to minimise the number of connections between the cartridge and the phono stage.



Finally, the T-Kable has always been an important factor in fine-tuning the deck suspension; the new T-Kable is very flexible and short, which minimises any interaction or interference with the suspension.

Figure 5 Linn Urika  
Figure 6 Old T-Kable vs. New T-Kable (to scale)

### DUAL MONO

A dual mono design has been implemented to ensure the very highest quality reproduction. Each channel has its own dedicated phono stage and power supply filtering and regulation, with separate circuit boards, power and ground returns for left and right channels. This was developed based on feedback from customers who reported a noticeable improvement using two separate Lintos for each channel.

The dual mono design is created on two mirror image circuit boards which are joined together and travel through the production process as a pair, from the point of PCB manufacture right through the surface mount process and through-hole board population stage, until finally, at the assembly stages, the pair of boards is placed inside the Urika enclosure. This matching maximises the channel to channel consistency.

The RIAA (Recording Industry Association of America) equalisation is DC-coupled with no capacitors in the direct signal path – normally, such capacitors would ‘colour’ the audio reproduction by imposing their characteristic sound, dependent upon their material and/or construction. The omission of these capacitors makes the characteristic of the Urika very neutral, which results in more accurate reproduction of the source material. The new circuit design produces less than 0.2dB variation from the RIAA equalisation curve, significantly flatter than the Linto.

### CONNECTIONS



Urika features high quality gold-plated RCA and XLR connectors, allowing you to choose the ideal connector type for your particular system. Direct coupled RCA outputs sound best for connection to the pre-amplifier when standard length interconnects are used. Transformer coupled XLR outputs sound best for area where poor earth is present or when long cable runs are needed. Urika features the same transformers used in the award-winning Klimax DS player, ensuring that the XLR connections produce the very best audio possible.

### OPERATION

In addition to improving the acoustic performance of the Sondek LP12, we have also made the LP12 easier than ever to use. There are now two modes of operation that allow you to change speeds without stopping the turntable, one of which also allows you to mute the phono stage while you change record, preventing the loud ‘thump’ that occurs when the stylus locates in the groove. This additional functionality is added without abandoning the traditional LP12 power switch, squeezing a little bit more from a classic design. A switch at the back of the Radikal allows you to select between the two modes.

### CONCLUSION

Linn Radikal and Urika represent a new way of powering and amplifying the Sondek LP12 transcription turntable. The combination of an ultra-smooth, low-noise DC motor with speed management, and an internal phono stage with dual mono channels, produces an exceptionally pure and musical listening experience.

The above information is subject to change without prior notice.

**Linn Products Limited**

Glasgow Road, Waterfoot, Eaglesham, Glasgow G76 0EQ, Scotland, UK.

Telephone: +44 (0) 141 307 7777, Facsimile: +44 (0) 141 644 4262, Helpline: 0500 888909, E-mail: [helpline@linn.co.uk](mailto:helpline@linn.co.uk), Website: [www.linn.co.uk](http://www.linn.co.uk)

**Linn Records Limited**

Glasgow Road, Waterfoot, Eaglesham, Glasgow G76 0EQ, Scotland, UK.

Telephone: +44 (0) 141 303 5435, Facsimile: +44 (0) 141 303 5007, Helpline/Mail order: +44 (0) 141 303 5027, E-mail: [records@linn.co.uk](mailto:records@linn.co.uk),  
Website: [www.linnrecords.com](http://www.linnrecords.com)

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