



HI-FI+ GUIDE TO ANALOGUE AUDIO



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Here we offer a compendium of *Hi-Fi+* reviews of turntables, tonearms, phono cartridges, and phonostages, not to mention analogue-centred feature articles.

ENCYCLOPAEDIA ANALOGIA

Let's face it: Analogue audio terminology and concepts can seem complicated, esoteric, and scary at first, but we can help. This latest is our product-themed series of 'Encyclopaedia' articles will help bring you up to speed in no time.

Recognising that some of our readers may never have owned or used analogue audio gear, we tackle the subject of Analogue Audio on two levels:

- Just the (Analogue) Basics
- More Advance Analogue Terms & Concepts



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EDITOR, *HI-FI+* GUIDE TO ANALOGUE AUDIO
PUBLISHER, *HI-FI+*

Chris Martens

Tel: +1 (512) 419-1513 Office

Tel: +1 (512) 924-5728 Mobile

Email: cmartens@nextscreen.com

EDITOR, *HI-FI+* MAGAZINE

Alan Sircom

Email: editor@hifiplus.com

GUEST CONTRIBUTORS

Jonathan Valin, Executive Editor,

The Absolute Sound

Andre Jennings, Contributing Writer,

The Absolute Sound

GRAPHIC DESIGNER

Jenny Watson

Fonthill Creative, Salisbury

ADVERTISING

Tom Hackforth

Tel: +44 (0)1425 655255

Email: tom@hifiplus.com

ASSOCIATE PUBLISHER

Pete Trewin

Tel: +44 (0)1425 655699

Email: pete@hifiplus.com

THE EDITORIAL OFFICE CAN BE
CONTACTED AT:

Hi-Fi+ Editorial

Absolute Multimedia (UK) Ltd

Unit 3, Sandleheath Industrial Estate,

Sandleheath, Hampshire SP6 1PA

United Kingdom

Tel: +44 (0)1425 655255

Web: www.hifiplus.com

Absolute Multimedia (UK) Ltd is a
subsidiary of TMM Holdings LLC,
2601 McHale Court, Suite
Austin, Texas 78758, USA

CHAIRMAN AND CEO

Thomas B. Martin, Jr.

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FROM THE EDITOR

WELCOME to the first-ever *Hi-Fi+ Guide to Analogue Audio*.

With the advent of digital audio in the 1980s and the more recent arrival of high-resolution digital audio formats, some predicted the demise of vinyl records and the equipment made to play them. But happily, both predictions were dead wrong. Analogue audio shows real staying power and not just as a matter of nostalgia or fondness for all things retro. On the contrary, many music lovers think analogue audio simply sounds better than its digital competition, possessing a certain sonic *je ne sais quoi* that brings recorded music alive in almost magical ways. Against all odds, then, vinyl records sales are making a slow, steady comeback, while technical improvements in analogue equipment continue to show there's more musical treasure buried in those vinyl record grooves than we ever thought possible.

- **Analogue audio components continue to get better:** Thanks to new materials, new CNC-machining capabilities, and an ever-expanding body of design knowledge, today's top analogue components sound better than ever.
- **Access to high-quality vinyl releases is expanding:** LPs are gradually returning to retailer's shelves, while online sellers give us unprecedented access to new vinyl recordings and an immense back catalogue of LP reissues.
- **Vinyl playback represents a different kind of 'social media':** New generations of music lovers are discovering what older audiophiles have long known: vinyl playback makes an ideal centrepiece for social gatherings where the focus is not upon digital gossip, but upon music and the lasting friendships built around it. Anyone for Sunday afternoon listening parties?

The aim of this Guide is to:

- Introduce you to a wide range of upcoming or recently released analogue audio products,
- Treat you to interviews with several of the best, brightest, and most creative analogue audio equipment designers on the scene today,
- Provide a first-rate how-to article on phono cartridge set up,
- Give you Editor Alan Sircom's latest thoughts on the familiar analogue v. digital audio debate, and
- Deliver a glossary to explain analogue audio concepts, acronyms and terminology, with a special section geared to bring newcomers up to speed.

As always, we hope to help readers to derive deeper satisfaction from the music they love, while having great fun with carefully selected audio equipment and music systems. We wish you all the best analogue audio has to offer, and happy listening.

Chris Martens
Publisher, *Hi-Fi+*

WHAT'S NEXT IN ANALOGUE AUDIO?

TURNTABLES AND TONEARMS



PHONO CARTRIDGES



PHONOSTAGES



GREAT ANALOGUE PRODUCTS COMING SOON!

TURNTABLES, TONEARMS & ACCESSORIES

Together, turntables and tonearms represent the heart and soul of analogue audio, making it possible for us to 'spin vinyl', as the expression goes. Both these types of components can seem deceptively simple at first, but the more you know about the challenging design briefs both face the more you realise that 'the genius is in the details'.

Here, we explore recently released, new, or upcoming turntables, tonearms, and accessories from some of today's most promising analogue manufacturers.

Amazon Audio Grand Reference Turntable

The upcoming Grand Reference turntable from the German firm Amazon Audio will offer the following design highlights:

- Dual chassis separated by eight low-resilience polymers and made of a special ICI cast material to optimise resonance reduction.
- The 12kg composite platter uses aluminum, cast acrylic, and filler—again to minimise resonances.
- Inverted centre-type bearing made of special hardened steel with a ruby bearing.
- DC drive motor is separated from the chassis, featuring Amazon's proprietary Linear Speed Controller to provide 33/45 constant speed monitoring.
- Automatic rechargeable NiMH battery power supply controlled by microprocessors.
- Tonearm board accommodates 9 to 12-inch tonearms.
- Dimensions: Chassis, 470 × 450 × 150 mm; Motor unit, 120 × 450 × 115 mm
- Weight: 33kg.
- Price: £9,540.

www.amazon-audio.de



AMG 12JT Turbo tonearm

The deluxe 'Turbo' version of AMG's popular 12JT 12-inch tonearm features a new larger bearing housing with multi-ball horizontal bearing. All adjustments are accomplished with calibrated, locking thumb screws.

Price: USD\$8,500.

www.amg-turntables.com

UK distributor: www.selectaudio.co.uk



AnalogueWorks TFTOne turntable and The Wand tonearm

The Wand Tonearm has already shown itself to be a superb musical match to any AnalogueWorks turntable so we are really excited that Simon is planning an 'ultimate' variant of The Wand with even higher spec wiring and great features like on the fly VTA. AnalogueWorks have also been in the development lab testing new materials and power supplies for their forthcoming cut down turntable, the multi-armed TFTOne. Both will rock!

designbuildlisten.com

UK distributor: www.analogueworks.co.uk



The Booplinth Company, Booplinth

Booplinth is a plinth performance upgrade for the Linn LP12 turntable. Booplinth's advanced low mass, one-piece plinth design is the fundamental performance upgrade for the any LP12 regardless of age or specification.

The random structure of bamboo grass and air in every Booplinth diminishes signal pollution all the way to the stylus tip, revealing hidden recorded detail, greater clarity, and a more musical performance that traditional wooden plinth constructions simply cannot deliver. The Booplinth upgrade reveals even greater LP12 performance because you hear more of the recording and less of the plinth.

Available now, priced at £1,650.

www.booplinth.com



Brinkmann Bardo turntable

Inspired by the design of Brinkmann's top-of-the-line Balance and LaGrange models, the magnetic drive Bardo has been fully developed in-house by Helmut Brinkmann.

The tonearm base of the Brinkmann Bardo can be cleverly rotated and fixed without play to allow a simple and precise tonearm adjustment for all tonearms between 9-inch and 10.5-inch lengths.

The Bardo uses the same metal cased power supply as the Balance and LaGrange turntables, resulting in a more defined bass response and wider room imaging.

Brinkmann's take on the magnetic drive uses a proprietary motor system in order to maximize the performance and advantages of this technology, which the Bardo does to great effect.

www.brinkmann-audio.com

UK distributor: www.symmetry-systems.co.uk



Brinkmann Spyder turntable

The Spyder turntable is a radical new design that sets a benchmark for versatility in modern analogue equipment, while delivering extreme sonic performance and high-fidelity music reproduction.

This daring new belt-driven design accommodates up to four 9-inch to 12-inch tonearms and allows maximum flexibility of placement regardless of how many 'arms are installed. Sharing many tried-and true construction techniques with Brinkmann's direct-drive Bardo and flagship Balance turntables, the Spyder offers the precision, wide dynamics, and emotional involvement Brinkmann 'tables are renowned for in the most versatile design available today.

www.brinkmann-audio.com

UK distributor: www.symmetry-systems.co.uk



Clearaudio Innovation turntable

A beauty to look at and a classic of the Clearaudio range, the Innovation incorporates a wealth of innovative features and technologies. The three-pointed main chassis design comprises a complex sandwich of aluminium and bulletproof panzerholz wood, engineered to minimise resonance. A high-torque decoupled DC motor rotates the precision-machined 70mm-thick acrylic platter. The platter rotates in a virtually friction-free environment atop the 15mm-thick stainless steel sub-platter, thanks to Clearaudio's patented ceramic magnetic bearing technology. An infrared sensor combined with Clearaudio's optical speed control ensures an outstanding level of speed stability. The Innovation can accommodate up to two tonearms.

Available now in wood or piano black, priced at £6,400 (not including tonearm).

clearaudio.de/en

UK distributor: soundfoundations.co.uk



Continuum Audio Labs Obsidian turntable and Viper tonearm

Continuum Audio Labs is pleased to introduce the new Obsidian turntable and Viper tonearm. The Obsidian/Viper analogue playback system represents the successful integration of a highly sophisticated platter/suspension system, a custom-designed motor assembly, and the tonearm itself. The system's goal is to reduce noise and vibration using natural elements and good physics. The turntable features mechanically isolated tonearm and motor mounts in a plinth-less design, uses tungsten extensively in key areas, and incorporates a purpose-built zero-cogging DC motor controlled by a servo-amplifier. The Viper tonearm, developed with finite-element analysis software, builds upon previous Continuum designs for the optimum stiffness to mass ratio.

Price: Obsidian turntable: est. \$35,000
Viper tonearm: est. \$10,000
Available soon

www.continuumaudiolabs.com

UK distributor: www.absolutesounds.com



EAT C-Major

European Audio Team is intent on bringing its terrific turntables to lower price points without sacrificing the elegant design and performance for which they are famed. First came the C-Sharp, a slimline design with a suspended carbon fibre sub-chassis and weighty aluminium platter, and now the even more affordable C-Major is spinning into view.

Both turntables are cut from similar cloth. The C-Major is a little smaller, sports a new alloy platter and lacks the C-Sharp's separate PSU, but it uses the same ingenious mix of materials including the carbon fibre sub-chassis and thermoplastic elastomers to damp vibrations. Given the C-Major's projected price of £1,750, including the excellent C-Note unipivot tonearm, it's sure to turn both heads and records.

www.europeanaudioteam.com

UK distributor: www.absolutesounds.com



ELAC Miracord 90 Anniversary turntable

Many assume ELAC is primarily a loudspeaker company, but for many decades the firm's Miracord division was known for producing turntables of exceptional quality. To remind us of this fact ELAC proudly introduces the ELAC Miracord 90 Anniversary turntable and tonearm.

The turntable features a 5.5-kilogram MDF chassis with specially developed silicone isolation feet, and is offered in striking gloss finishes. The main bearing features a hardened steel shaft riding in bronze bushings and resting upon a ruby ball for minimum friction. The motor, in turn, is double-decoupled from the chassis and tonearm. The Miracord comes with a carbon-fibre tonearm fitted with a MicroLine stylus-equipped phono cartridge developed by AudioTechnica in collaboration with ELAC. The price will be approximately €2,000.

www.elac.com



Elipson Alpha and Omega turntables

Elipson's Alpha and Omega are the world's first premium turntables to offer the option of wireless technology while retaining audiophile specifications and sound quality. They are compatible with any line voltage/frequency in the world.

Advanced features include: a DSS speed control system, an MSD motor vibration-control device, and a precision-cut bronze bearing for accurate platter centering. Elipson's Orbital Torsion Tone-arm features torsion adjustments for anti-skating and is compatible with all MM/MC cartridges.

Top Alpha and Omega models feature RIAA phono stages and optional aptX Bluetooth wireless transceivers, allowing listeners to stream their vinyl to BT speaker systems.

UK SRPs range from £199 for the entry-level Alpha 50 up to £499 for the flagship Omega 100 RIAA BT USB model.

www.elipson.com



Grand Prix Audio Monaco 2.0 turntable

Grand Prix Audio's Monaco v2.0 turntable features an iconic carbon fibre plinth with new drive technology for average speed accuracy of 20 parts per billion, with < 0.0002% in peak deviation. Monaco v 2.0 features an infinite pole-design slotless motor and custom controller with a > 75,000 line encoder disc. A silent active feedback loop measures the speed of the magnesium platter nearly 76,000 times per revolution. Monaco v 2.0 provides a phosphor bronze bearing and flywheel flotation via pressurised oil and the DC motor's magnetic field. Monaco includes Apex Footers, multiple tonearm mounts, and a NEW True Pressure™ record clamping system with internal platter sensor and a spindle-tip LED to indicate correct clamping pressure.

Available now (including upgrades from v1.0-1.5), priced at USD\$37,500.

www.grandprixaudio.com/?q=products/monaco-turntable-2-0



Kronos Pro turntable

The Kronos Pro breaks the rules of conventional turntable design with an incredibly innovative solution to an age-old problem: suspended or solid construction? Each comes with pros and cons. The Pro employs two identical high mass platters, one above the other, rotating in opposite directions and moving at precisely the same speed. This patented engineering solution completely eliminates torsional forces, so the turntable is protected from mechanical and environmental vibrations. Judicious use of materials (plus a spot of aerospace metallurgy) minimises the transfer of any remaining mechanical vibrations emitted from the bearings or stylus friction. The result is a turntable platform of unparalleled stability delivering an incredible listening experience.

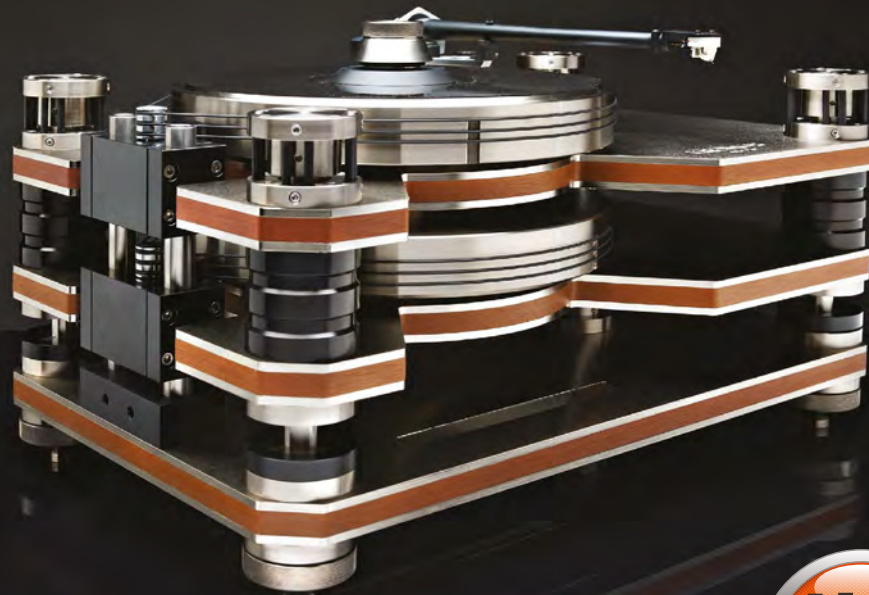
Available now, priced at £35,000.

www.kronosaudio.com

UK distributor: www.decentaudio.co.uk



KRONOS
TIME FOR MUSIC®



... one outstanding package.
This one's special.

Alan Sircom *Hi-Fi+*

The sound was, you'll pardon the expression,
fxxxing amazing.

Art Dudley, *Stereophile*

DECENT AUDIO
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T: 05602054669

E: info@decentaudio.co.uk

www.decentaudio.co.uk

Linn Kore

Kore follows the same design philosophy as Linn's flagship sub-chassis—Keel—and is an essential upgrade for anyone looking to achieve Akurate-level performance from his or her LP12.

Strengthened by a multi-layer, box construction of 1.5mm aluminium, the sub-chassis is designed for extra rigidity and removal of unwanted damping. Three layers are bonded together using a bespoke adhesive to form an incredibly stiff structure, while keeping the weight low.

The armboard is machined from solid aluminium and strengthened by underside ribs to provide the ultimate rigidity. This is then bonded to the sub-chassis so the assembly exhibits the valuable properties of a single piece—the arm collar is bolted directly to the sub-chassis so the arm has a direct connection to the bearing.

www.linn.co.uk/hifi-separates/turntables/sub-chassis#kore



Moerch DP-8 tonearm

The Moerch DP-8 is a radial tonearm available in multiple finishes with 9 or 12-inch armtubes. Moerch offers interchangeable armtubes with a choice of different weights—4g to 14g—facilitating cartridges compliance matching.

The DP-8 has a unique dual pivot bearing system with dual sapphires for the vertical axis and a well-damped precision ball for the horizontal axis. The pivot point is level with the record surface.

A special feature of the DP-8 is its excellent bass reproduction, achieved through the "Anisotropic" design—free vertical movement but restricted horizontal movement. VTA and bias are adjustable whilst playing and azimuth adjustment for correct channel separation. The arm is supplied with a 1.2m Moerch phono cable.

Price, £2,815 (chrome/black) or £3,580 (gold).

www.moerch.dk



Pear Audio Blue Cornet 1 tonearm

Pear Audio Blue's Cornet 2 tonearm, designed by Tom Fletcher, is the triumphant culmination of the Tom's continuing development of the Space Arm. Now, Pear Audio Blue introduces the Cornet 1 tonearm, an affordable tonearm with exceptional performance and dynamics.

The Cornet 1 uses a Pear Audio Blue proprietary unipivot design. Two parallel metal bars on either side of the roller bearing restrict horizontal movement, creating a more dynamic tonearm that is more stable than conventional unipivot designs. A hi-tech carbon fibre tube, with fibres orientated lengthwise and not wrapped around the arm, greatly increases the strength, resonance control, and rigidity of the arm.

Available later this year, priced at USD\$1,495. Can be combined with any Pear Audio Blue turntable for a discount.

www.pearaudio-analogue.com

US distributor: www.audioskies.com



Pear Audio Blue Capt. John Handy turntable

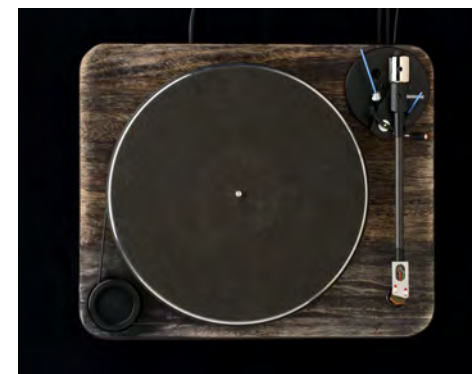
Pear Audio Blue handcrafted turntables and tonearms represent the late Tom Fletcher's (Nottingham Analogue) triumphant last designs in the pursuit of the ultimate turntable. The Capt. John Handy, is created to deliver the ultimate in analogue playback in a compact yet stunning visual package.

The turntable features a solid wood plinth, a massive platter, and an ultra low-torque AC synchronous motor that affords extreme speed stability while drastically reducing energy transfer to the platter. The result is an ultra-quiet turntable with superior tempo, flow, and timing—a turntable where every part is sonically in-phase and the whole worth more than the sum of its parts.

Price USD\$3,495, including the Cornet 1 tonearm.

www.pearaudio-analogue.com

US distributor: www.audioskies.com



TechDAS Air Force III turntable

When TechDAS unleashed the Air Force One turntable, it took the high-end world by storm—delivering unsurpassed sound quality for collectors of vinyl records who demand the very best. Of course, not everyone can stretch to this mighty deck's £70,000 asking price, which is why TechDAS created the Air Force II (£34,998) and now the Air Force III (£18,998).

Like its big brother, the Air Force III's high-mass platter floats on an air bearing for ultra-stable, friction-free rotation, while adjustable air suspension ensures complete freedom from interference from air- and floor-borne vibration. A silent vacuum pump clamps records perfectly flat against the platter, and there's the facility to mount two tonearms for ultimate flexibility—truly a turntable tour de force.

www.techdas.jp

UK distributor: www.absolutesounds.com



Thales TTT-Slim turntable and Easy tonearm

The Thales TTT-Slim turntable with our Easy tonearm offers a new dimension in precise analogue tracking. It is Thales statement to confirm a high-end turntable does not need to be big in size to have a great sound.

Packed into the turntable's chassis is a battery power-source, driving a brushless motor via an ultra-precise-belt-system. Meanwhile, the tonearm with variable offset angle reduced the tracking error down to 0,4∞. For the first time, the unique tonearm-geometry allows a pivoted tonearm with a zero-point for the offset angle, which reduces distortion and side forces tremendously.

The turntable and tonearm are both manufactured in Switzerland, and priced at £9,500.

www.tonarm.ch

UK distributor: www.fiaudio.co.uk



Vertere MG-1 record player system

Vertere's new MG-1 record player, with many of its design aspects based on the world-renowned Reference RG-1, makes possible a vinyl replay standard never before achieved in this class.

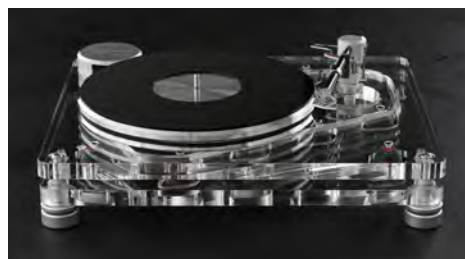
The MG-1 precision main bearing and platter assembly, belt-driven by the new MkII SG-1 motor drive, ensures smooth running and a stable platform for the tonearm and cartridge.

And, with matching Vertere SG-1 tonearm, this combination provides an unparalleled wide dynamic range with the 'dark' backgrounds associated with live music. Stylish and beautifully crafted, the MG-1 provides an unmatched musical experience and enjoyment of vinyl records.

Paul Tao of Audio Art commented in his review, "...this system is definitely your most valuable Hi Fi investment."

Available now, priced from £6500.

www.vertereacoustics.com



VPI Avenger turntable

Newly released, the VPI Avenger is a magnetic drive turntable with the ability to mount up to three tonearms of any make or size. The Avenger has a built-in upgrade path giving the user the ability to start with a standard aluminum platter (as found on the Prime) and then upgrade the arm, feet, and platter assembly over time. In addition the table uses the Nordost Reference-wired version of the JMW 3D Reference tonearm with VTA that is adjustable 'on the fly'. The Avenger chassis uses layers of acrylic/aluminum/acrylic material with damping between layers. Supporting the chassis a machined aluminum/Delrin/ball bearing isolation feet. Thanks to magnetic drive, noise levels are approaching -100dB!

Available now, priced from USD\$9,500 – USD\$30,000.

vpiindustries.com/avengerref.html

UK distributor: www.renaissanceaudio.co.uk



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Get close to a live performance at home with a Vertere Record Player.

A Vertere Record Player is uniquely designed and engineered to the highest standards, enabling you to enjoy the best possible musical experience.



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vertereacoustics.com

VPI JMW 3D tonearm

VPI Industries pioneered use of 3D printing technologies in audio applications with the JMW 3D tonearm. The original JMW tonearm was a metal unipivot design made as a memorial for Jonathon Mathew Weisfeld—the son of VPI founder Harry and Sheila Weisfeld, and the brother of present VPI owner Mathew Weisfeld.

Years later, Mathew furthered his father's original JMW Memorial tonearm design by recreating it using 3D printing technology. The resulting award-winning JMW 3D tonearm is fully dampened, rigid, heat resistant, UV light resistant, and lets the user listen in 3D! The JMW arm also has an easy to use 'on the fly' VTA adjustment tower, making it easier to dial in your cartridge.

Available now, priced at USD\$2,999.

vpiindustries.com/JMW.html

UK distributor: www.renaissanceaudio.co.uk



VYGER Indian Signature IV Generation turntable and tonearm

Vyger believes that work without compromise is the rule in crafting extreme products such as the Indian Signature IV. The design achieves complete reduction of contact between bearing and platter via exclusive integral air cushion technology, making for incredible dynamics, transparent sound, and realistic soundstages. Rumble values are so low that they cannot be quantified using traditional devices like the Thorens rumble measurement system. The turntable offers high rotational precision, with radial and axial spindle rotation errors less than 0.001mm.

Vyger has always supported the superiority of the tangential high pressure air tonearm. The Vision IV Tonearm has the best geometrical characteristics, dynamic stiffness, and damping superior to any system presently on the market.

Available now, priced at €48,700.

www.vyger.com



Well Tempered Lab Royale 400 turntable/tonearm

Pear Audio proudly announces the latest arrival in the Well Tempered Lab family: the Royale 400. The flagship turntable weighs an impressive 46kg and is over half a metre in width, featuring isolation feet capable of supporting the load and maintaining stability. The Royale 400 is enhanced by the "zero clearance" main bearing and refined platter assembly, a multi-layer plywood central layer sandwiched between anodised aluminium top and bottom layers, with a 0.004-inch polyester thread belt driven by the motor sited to the rear of the platter. The unique bearing-less LTD tonearm has an effective length of 16" from its silicone bath, with a fixed headshell and easy azimuth adjustment. A custom rack is optional.

Available now, priced at £10,000.

www.welltemperedlab.net

UK distributor: www.pearaudio.com



Wilson Benesch Circle 25 turntable & A.C.T. 25 tonearm

Hand built in Sheffield, England, the Circle 25 was launched to celebrate Wilson Benesch's 25th anniversary. Using a distinctive two-part design, the concentric circular plinths feature a sub-chassis suspended by unidirectional carbon fibre cantilevers. Carbon fibre exhibits high stiffness and energy damping properties, providing an unyielding platform while damping structural borne resonance.

The advanced material science employed in the Circle 25 and the A.C.T. 25 Carbon Fibre Tonearm define the Wilson Benesch sound; a sonic presentation characterised by incredible detail, wide-open soundstages, and perfect timing.

Machine finished, available in Black Edition and White Edition.

Pricing: Circle 25 Turntable, £1,995; A.C.T. 25 Tonearm, £1,995

www.wilson-benesch.com





**Behind Brinkmann (the brand),
stands Brinkmann (the man) -
Helmut Brinkmann.**

From Turntables to Tonearms, Phonostages to Amplifiers, Brinkmann set a benchmark for versatility in modern analog equipment.

Delivering wide dynamics and emotional involvement, Brinkmann are truly renowned for the most versatile turntable designs, with extreme sonic performance and high-fidelity music reproduction.

Distributed in the UK by



Phone 01727 865488 web site www.symmetry-systems.co.uk

PHONO CARTRIDGES

In a very real way, phono cartridges are where the analogue audio experience begins; they are the point where the undulating squiggles in vinyl record grooves are first converted back into audio signals that can be amplified, equalised, and played back through our favourite music systems.

Below, we'll explore recently released, new, or upcoming phono cartridges from some of today's most promising analogue manufacturers.

AMG Teatro moving coil phono cartridge

The Teatro features a two-piece titanium body for a superior strength-to-weight ratio and is dimensioned to minimize resonance and reflected energy. Its internal construction is radiused and includes a fixture for rigid mounting of the MC generator. The generator is an extremely efficient electro-mechanical design, using separate coils for each channel for superior channel separation. The coils are wound with Ohno cast (OCC) mono-crystal high-purity oxygen-free copper wire. Neodymium magnets are combined with a special soft magnetic alloy yoke consisting of cobalt and iron to produce an output of .4mV at 5cm/sec. Coil impedance is 12Ω allowing the use of many phono stages and step-up devices. The Teatro incorporates a solid boron cantilever fitted with a line-contact stylus.

Price: USD\$2,750

www.amg-turntables.com

UK distributor: www.selectaudio.co.uk



Clearaudio da Vinci V2 moving coil phono cartridge

With a total weight of just 7g, a Micro-HD stylus, rigid boron cantilever and 90-decibel dynamic range, the da Vinci V2 sits two models below Clearaudio's flagship Goldfinger Statement, but shares many of the same features – at less than half the price. Its distinctive bright red, 12-fingered aluminium body is purposefully asymmetrical and coated with an extra-hard, 30-micron thick ceramic layer, designed for superior resonance control and rigidity. Inside, the patented generator construction is absolutely symmetrical: mechanically, magnetically, and electrically. Its 24-carat gold coils move in an intensely focused magnetic field provided by eight super neodymium magnets in a ring configuration. It's a superlative all-round performer that combines cutting-edge research with meticulous craftsmanship.

Available now, priced at £3,850.

clearaudio.de/en

UK distributor: soundfowndations.co.uk



DS Audio DS-W1 optical phono cartridge

The Japanese firm DS Audio is the pioneer behind the DS-W1, the world's only current optical phono cartridge. Incorporating state-of-the-art technologies developed by photo-optics specialists Digital Stream Corporation (co-inventors of the optical mouse), the design is a pure analogue contact system using a conventional stylus and cantilever: no lasers and nothing digital here. Unlike MM/MC cartridges, which work on principles of electromagnetic induction, the DS-W1 uses an optical system to convert stylus/cantilever movements into electrical signals, eliminating the electromagnetic frictional force found in all MM/MC designs that affects the cantilever and stylus movement. The DS-W1 can be installed on almost any tonearm and comes with a special phono equalizer/power supply (no phonostage required).

Available now, priced at £6,250.

www.ds-audio-w.biz

UK distributor: soundfowndations.co.uk



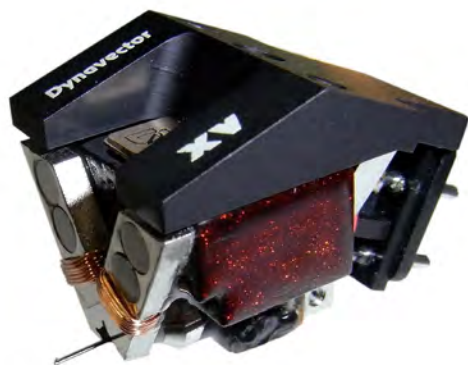
Dynavector Systems DRT XV1-t moving coil phono cartridge

Pear Audio proudly presents Dynavector Systems' flagship DRT-XV1-t cartridge. With a small cross-shaped armature made of purified iron and a miniscule 16-micron coil, this cartridge's motor system is inherently lean and allows for precise and agile tracking with near silent backgrounds. The magnetic circuit is stabilised by eight powerful Alnico column magnets, which also increase the linearity of the magnetic distribution within the air gap. The distinctive V-shaped front yoke with its magnetically stabilising coil wound on each 'arm', opens at the aperture in a rectangular cross, where the tough and steadfast Boron cantilever protrudes, securing the diamond PF line contact stylus with a titanium bond. The body is bamboo coated in protective Urushi lacquer.

Available now, priced at £5,695.

www.dynavector.com

UK distributor: www.pearaudio.com



Kiseki Blue N.S. moving coil phono cartridge

The Kiseki Blue N.S. is the first 'New Style' Kiseki cartridge. The typical, but shorter, Kiseki body is machined out of solid aluminium. The generator is built from the finest parts available. Two years of experimenting and testing all possible materials and techniques has resulted in the finest Kiseki Blue cartridge ever.

Specifications include:

- Cartridge body: Aluminium.
- Cantilever: Solid Boron Rod, 0.28 mm diameter.
- Stylus: Nude line contact diamond, mirror polished.
- Vertical tracking angle VTA: 20 degrees
- Weight: 8 grams
- Output voltage: 0.44mV

Kiseki cartridges are hand made in limited quantities to ensure the finest sound. Each Kiseki Blue N.S. is a work of art.

www.kiseki-eu.com

www.kiseki-usa.com

UK Distributor: www.symmetry-systems.co.uk



the
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consultants

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www.audioconsultants.co.uk

FINE TWO CHANNEL AUDIO SYSTEMS

For those seeking true excellence from their audio system



Clockwise from top left: SME, Audiodesksysteme, Clearaudio, Transfiguration

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Avalon Acoustics	ELAC	Jeff Rowland Design	Nottingham Analogue
Benz-Micro	Finite Element	Lawrence Audio	ProAc
Clearaudio	Furutech	Lyra	SME
	German Physiks		Transfiguration

Linn Kandid moving coil phono cartridge

Kandid is Linn's best moving coil cartridge yet, designed to extract as much musical detail from vinyl records as possible.

Linn has removed the front housing to eliminate potential sources of resonance and has also replaced the metal front yoke screw with a plastic version to eliminate magnetic interference to the coils.

The stylus and cantilever have been repositioned within the cartridge body to achieve the most accurate audio reproduction. Kandid uses the finest nude diamond, micro-ridge stylus and benefits from a ceramic boron cantilever for ultra-low mass and extremely high rigidity. It is constructed around a machined-from-solid, 7075 aluminium alloy body for complete rigidity and includes our unique triple-point mounting system to ensure a more rigid and accurate coupling.

www.linn.co.uk/hifi-separates/turntables/cartridges#kandid



Linn Krystal moving coil phono cartridge

Over two years in development, Krystal uses the design principles of Linn's leading moving coil cartridge Kandid to capture the minute changes in the record groove and let every musical detail be heard.

It also features a similar approach to minimising mass as Kandid, using a nude design to give the cartridge less inertia so it can react more quickly to the changes in the groove. It also uses the triple-point mounting system for a solid connection to the tonearm headshell, while the aircraft grade 7075 aluminium chassis provides a lightweight, stiff and stable platform for the generator. Even the adhesive used on Krystal was painstakingly selected to provide the most rigid bond possible to avoid any dampening effects.

www.linn.co.uk/hifi-separates/turntables/cartridges#krystal



LP Gear® The Vessel™ series phono cartridges

LP Gear®, a global analogue resource, introduces The Vessel™ Cartridge Series, a complete line of nine cartridges priced between \$99 and \$799. The first four available are the A3 Super Series models, featuring aluminum cantilevers. You can upgrade your Vessel™ cartridge as your system improves by replacing the stylus.

Also available is the value-priced LPG CF3600LE cartridge (USD\$34.95) designed for LP Gear® by Audio-Technica engineers with a carbon fibre cantilever and special elliptical stylus for improved clarity and harmonic richness over the standard AT3600.

The Vessel™ A3SE - Super elliptical - USD\$99
The Vessel™ A3SV- Super Vivid Line - USD\$260
The Vessel™ A3SS - Super Shibata - USD\$499
The Vessel™ A3SM - Super Microline - USD\$499

www.lpgear.com



Lyra Etna moving coil phono cartridge

Lyra again turns the analogue world on its ear with the introduction of the exciting Etna moving coil phono cartridge.

Etna was designed with a strong emphasis on engineering efficiency. Employing innovations such as a solid titanium core structure machined with non-parallel surfaces, yokeless dual magnet system, diamond-coated boron rod cantilever and Lyra-designed variable-radius line-contact stylus, and Lyra's New Angle technology, which mechanically pre-biases the signal coils so they are perfectly aligned to the front and rear magnets during LP playback.

One listen will demonstrate that this cartridge's performance easily defines the very top of any other cartridge line.

www.lyraanalog.com

UK distributor: www.symmetry-systems.co.uk



變容
Transfiguration



... What I was hearing put it up there with the best, most musically involving cartridges I've heard at any price

Michael Fremer, *Stereophile*

The Transfiguration Proteus is as good a conduit to the language of music as anyone needs, and is way better than most I have ever heard.

Jason Kennedy, *Hi-Fi+*

DECENT AUDIO
sound distribution

T: 05602054669

E: info@decentaudio.co.uk

www.decentaudio.co.uk

Miyajima Madake moving coil phono cartridge

The Madake is Japanese Miyajima's top-of-range stereo cartridge. The clue about what makes it special lies in the name: Madake is Japanese for a rare species of bamboo, Giant Timber Bamboo. Light in weight yet extremely rigid, it has excellent natural damping properties and is used in the Madake's cantilever. The generator system features a unique patented Miyajima cross-ring design in which the cantilever fulcrum and coils are exactly positioned in the centre of the magnetic field. The whole assembly is beautifully housed in a handsome body of African Blackwood, known for its exceptional tonal and acoustic properties. A small team of just six dedicated craftspeople handcrafts every Miyajima cartridge in-house.

Available now, priced at £3,750.

www.miyajima-lab.co.uk



Shelter Accord moving coil phono cartridge

The Shelter Accord MC phono cartridge is a magnificent composite of intricately layered, ultra-dense, dry-carbon fibre and titanium whose exquisite character is accomplished by precisely integrating the stylus into the tip of the cantilever. The combination of carbon fibre and titanium materials, the incorporated elliptical stylus (0.3 × 0.7 mil), and precisely wound coil assembly is a testimony to this handcrafted masterpiece of a cartridge.

The synthesis is a phono cartridge of remarkable character, warmth, quietness, and sonic integrity for its cost and performance.

Available now, priced at USD\$3,500.

www.axissaudio.com

UK distributor: www.soundhifi.com



Transfiguration Proteus low-impedance moving coil phono cartridge

The Proteus is Japan-based Transfiguration's top-of-range MC cartridge and is designed to lack any of its own character. By lowering the internal impedance to only 1 ohm, the Proteus aims to add nothing to a recording while extracting its every last detail. Its patented yokeless dual-ring-magnet generator design places the moving coil at the focal point of the magnetic flux field, reducing phase errors. The front and rear ring magnets are neodymium, while the square core's ultra high-purity μ -metal construction increases sensitivity, improving the signal/noise ratio and reducing distortion. Coil windings in newly-developed high purity silver wire increase transparency, and a special damping compound, insensitive to temperature change, provides perfect stylus/coil alignment and control.

Available now, priced at £3,750.

transfigurationcartridges.co.uk



van den Hul MC-ONE Special moving coil phono cartridge

Since van den Hul's 1970s inception, their every cartridge has been personally hand-built and fine-tuned by Dutch master designer A. J. van den Hul himself. The MC-ONE Special is no exception, despite being a relatively affordable model in the range. Modifications in the 'Special' edition over the earlier MC-ONE include a new, thicker front-pole borrowed from the higher-end Grasshopper model and an additional magnet, which together enhance the cartridge's resolution and output voltage. Selected and matched crystal silver-wire coils, a solid boron cantilever, and van den Hul's own VDH-type 1 stylus profile are also in the list of ingredients of this exceptionally good value entry point to the world of high-end cartridges.

Available now, priced at £1,250.

www.vandenhul.com

UK distributor: www.decentaudio.co.uk




“This is the Best Phono Stage
I have ever heard.”

Harry Weisfeld, founder/ownr of VPI.

JENS REFERENCE PHONO STAGE



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CanadianHiFi.com
HearEverything.nl
Merrill Audio Advanced
415.562.4434

Canadian Distributor
European Distributor
Merrill Audio Advanced Technology Labs, LLC
www.merrillaudio.net

PHONO STAGES

As many analogue enthusiasts recognise, **phono stages—operating in conjunction with our turntables, tone arms, and phono cartridges—are the components that give our analogue systems their ‘voice’.**

Below, we explore recently released, new, or upcoming phono stages from some of today’s most promising analogue manufacturers.

Aesthetix Rhea Eclipse all-valve MM/MC phono stage

Californian Aesthetix has been steadily advancing its already high-performance Saturn Series components with several impressive ‘Eclipse’ edition upgrades. The Rhea is an all-valve, zero feedback, MM/MC phono stage that offers high maximum gain at 75 dB—ideal for low output cartridges. It broke new ground as the first phono stage with three phono inputs, the first with gain and loading settings stored in memory for every input, and the first with full remote control adjustability (even of the built-in cartridge demagnetizer). The Eclipse edition adds advanced StealthCap coupling capacitors to dramatically reduce reflections, hand-adjusted tuning capacitors for superior frequency response, advanced mechanical chassis isolation, and a new refined power supply with improved trace routing.

Available now, priced at £10,000.

aesthetix.net



Amazon Audio B-lab Phonoamplifier phono stage

Highlights of Amazon Audio’s B-lab Phonoamplifier include:

- Complementary, symmetrical, single-ended Class A MC preamplifier with automatic load impedance settings for MC cartridges.
- RIAA circuitry equalizes the incoming signal in two stages, both single-ended.
- External gain adjustment via DIPswitches, providing 12 stages of volume setting for adjustment to other line level sources (CD, tuner, aux).
- Regulated power supply incorporates high capacity charging capacitors, symmetrical voltage regulators (using an extremely low-noise reference voltage source), plus Schottky rectifier diodes to minimise losses.
- Cases and periphery: massive aluminium block, with separate internal chambers so that the circuit board and transformer are insulated from micro-physics.
- RCA in/output sockets - pure copper, gold-plated.
- Measurements: 300W × 350D × 75H mm
- Weight: 12 kg
- Price, £4,400.

www.amazon-audio.de



Audio Research Foundation PH9 phono stage

A part of Audio Research’s new Foundation series products (the line also including DAC and line preamplifier, with a power amplifier expected next year), the PH9 phono stage replaces the popular PH6 and PH8 phono stages in the company’s line up. The new PH9 features a trio of 6H30 vacuum tubes in its extremely short signal path, and includes five different cartridge loadings that can be adjusted from the remote handset. Like all its siblings in the Foundation series, the new-look, hand assembled, American made phono stage shares a lot in common with the Reference series. All three Foundation models are priced at \$7,500, and the PH9 should be available from now!

www.audioresearch.com

UK distributor: www.absolutesounds.com



Brinkmann Edison phono stage

The remote controlled Edison phono stage from Brinkmann is the perfect choice for those wanting to extract maximum sound quality from their vinyl and for those wanting to use more than one tonearm.

Edison provides three inputs, two of which can be used as XLR inputs, and each input can be individually optimised in terms of gain (16 steps) and load (12 steps between 50 Ohms and 47kOhms) for the attached cartridge. All the settings for each input are conveniently saved in an EPROM for easy selection.

Incorporating sophisticated circuitry, bipolar transistors, and selected NOS Telefunken tubes, the Edison sounds pure, precise, and effortless. Recording after recording, you'll rediscover music that, up until now, you thought you knew intimately.

www.brinkmann-audio.com

UK distributor: www.symmetry-systems.co.uk



Clearaudio Absolute Phono Inside phono stage

While most phono stages rely on voltage amplification, the Absolute Phono Inside features an innovative current amplification circuit; this alleviates the need for cartridge loading at the input and eliminates many of the usually required capacitors and resistors at various points through the signal path. Those that still remain are exotic Vishay Dale resistors and Clearaudio Silver Glimmer capacitors. The result is an enhanced signal-to-noise ratio, enabling an extremely high level of resolution while maintaining a free, natural sound. The Absolute Phono Inside is built into two matching chassis, each constructed from precision-milled aluminium clamshells separated by a layer of resonance-damping panzerholz wood. Unbalanced RCA and balanced XLR inputs enable connection to any tonearm.

Available now, priced at £8,995.

clearaudio.de/en

UK distributor: soundfoundations.co.uk



Constellation Audio Perseus phono stage

Part of Constellation Audio's Performance Series, the Perseus phono stage combines performance and flexibility. Because of the amount of gain required to amplify phono signals, microphonic noise is a particular problem for phono stages. By isolating the circuit boards on a metal "raft" that floats on an elastomeric suspension, Perseus isolates the delicate circuits from outside vibrations. A separate power supply further helps eliminate unwanted noise. Functionally, Perseus has three separate inputs, each of which can accept either a balanced or single-ended input. Perseus allows the user to adjust cartridge settings on the front panel from moving magnet to the most elaborate moving-coil designs. It even lets users adjust the equalization curve for particular recordings.

Available now, priced at USD\$32,000.

www.constellationaudio.com

UK distributor: www.absolutesounds.com



Cyrus Audio Phono Signature phono stage

Designed to appeal to the most advanced vinyl enthusiasts who enjoy multiple cartridges, turntables, or arms, Phono Signature has four inputs, which can be accurately matched to the exact specification of the cartridge, and now, the acoustic preference of the user. Adjustment is provided for MC cartridges in gain, resistance, and capacitance facilitating a huge 160 possible combinations. In addition a switchable warp filter is provided to maximise amplifier performance. Cyrus has used shorter signal paths and mechanical relays enabling the company to design in lower noise and unique controllability for remote operation. Plenty of headroom ensures the dynamics of vinyl are never limited by clipping. Cyrus provides output level meters for simple visual adjustment.

Available now, priced from £1,200.

www.cyrusaudio.com/phono-signature



D'Agostino Master Audio Systems Momentum Phonostage preamplifier

First seen in 2015, Dan D'Agostino's \$33,000 Momentum Phonostage builds upon lessons learned in the Momentum integrated amplifier, by creating an incredibly clean AC power supply, that both sits on the floor and also forms the base plate for the phono stage itself. Couple this power feed with two separate moving coil and two moving magnet inputs, easily adjustable gain and loading settings, and five of the most popular EQ curves, and this all adds up as one of the most important phono stages that money can buy today, from a designer with an unparalleled reputation for making audio electronics.

www.dandagostino.com

UK distributor: www.absolutesounds.com



Dynavector Amplifiers P75 mkIII phono stage

Pear Audio announces that Dynavector's newly upgraded P75 mkIII phono stage features a new scratch resistant glass front fascia, a new painted finish on the chassis, and a new style earth terminal at the rear. More importantly, there's now more headroom from the unique 250mHz internal power supply and further noise reduction with the new multi-layered printed circuit board, plus a new output amplifier that offers extra drive current, more loading and gain adjustments (notably MM gain), and that includes support for 1mV MM/MC output cartridges. The patented Phono Enhancer circuit dramatically improves performance of low output cartridges. The P75 mkIII is compatible with most conventional MM, MI, and MC cartridges.

Available now, priced at £649.

www.dynavector.com.au

UK distributor: www.pearaudio.com



Exposure Electronics 3010S2 phono stage

Launched in 2013, the 3010S2 remains British brand Exposure's top high-performance phono stage. Its advanced dual-regulated power supply features a large custom-made toroidal transformer and smoothing capacitors; regulation is optimised for the different circuit sections, combining IC regulators on the main board and hybrid regulators on the phono board. The input stage is based around interchangeable circuit boards, each specifically tailored for either MM or MC cartridges to provide uncompromised performance with both. The input is fully configurable to ensure that cartridge loading and gain are optimally set. Discrete RIAA gain and equalization are derived from Exposure's flagship MCX series.

Available now, priced at £900 (MM or MC, in black or titanium). Optional plug-in MM/MC boards are priced at £220.

www.exposurehifi.com



FM Acoustics – FM 122MkII Phono Linearizer phono stage

Vertere proudly presents the FM 122MkII Phono Linearizer from FM Acoustics of Switzerland. The 122 MkII, with its unique continuously variable de-emphasis controls, allows correct replay curves of any record ever issued! This feature plus hand selected, precisely matched DIN, IEC & MIL standard components, guarantees utmost accuracy and absolutely transparent performance without equal.

The 122 MkII is entirely built of proprietary discrete Class A circuitry with unlimited combinations of cartridge loading that allows fine-tuning to any MC or MM cartridge.

With the 122 MkII, the music that comes out of the speakers sets a new standard in vinyl replay bringing your record collection to life. Priced from £9,500.

Partnered with a Vertere record player, the FM Acoustics phono stage gives you a world-class vinyl playback system.

www.fmacoustics.com

UK Distributor: www.vertereacoustics.com



Graham Slee Accession MM phono stage

The Graham Slee Accession MM Phono Preamp is now available in the US. Its special superpower is that it EQs the rising top end of the cartridge as well as EQing the recording. The record's EQ was applied when it was recorded, but your phono cartridge is applying its rising top-end response in real time as the record plays; that's two completely separate events in time. The Accession features adjustable and fixed-level outputs, volume control, RIAA, NAB and FFRR EQ. There's a mono/stereo switch and capacitive loading options of 47k ohms, 100pf, 220pf, 320pf, and open.

Available now, priced at USD\$1,450.

www.gspaudio.co.uk

US Distributor: www.LPGear.com



Icon Audio PS3 MkII all-valve phono stage

The PS3 MkII is Icon Audio's 'no expense spared' flagship model, an all-valve MM/MC phono stage built on two chassis. The second chassis houses the valve rectified and regulated power supply, engineered to deliver precise voltage of exceptional purity for great dynamic potential. The main phono stage chassis features four ECC88 valves arranged in a no-feedback double cascode circuit with passive RIAA equalization, combining high gain and low noise with exceptional resolution. A 6SN7 valve, widely considered as one of the best sounding hi-fi valves ever made, drives the PS3 MkII's output. The PS3 MkII includes a stereo-mono switch, while the volume control allows direct connection to a power amp.

Available now, priced at £1,899.95 (MM only) or £2,099.95 (MM/MC).

www.iconaudio.com



iFi iPHONO2 Class A, TubeState® MC/MM phono stage.

The original iPhono was a hit. The iPHONO2 is set to repeat this. First, with an ultra-wide 36-72dB Dynamic Range and an EQ circuit accuracy of +/- 0.2dB, iPHONO2 offer performance numbers few ultra high-end phono stages can match. Second, the exceptional A-weighted SNR of 85dB/88dB is class re-defining. Third, an all-new 15V iPOWER module with ANC® and 12-Element Output Array® ensure the quietest and most natural power supply. Fourth, iPHONO2 uses refined TubeState® circuitry with a special Burr-Brown Soundplus® J-FET design and the latest generation SMD components. The proof is in the listening; just lower the needle on the legendary (and often unplayable) Telarc 1812 and be captivated.

Available now, priced at USD\$499/€550.

ifi-audio.com/portfolio-view/micro-iphono2/

UK distributor: www.selectaudio.co.uk



Lounge LCRMKIII phono stage

The LCRMKIII is a dual-mono, pure analogue phonograph pre-amplifier. Smaller inductors were engineered for an ergonomic approach to LCR phonograph reproduction. The LCR topology brings out the detail of small instrument inflections keeping a musical cohesiveness in context of performance space. Advanced hi-speed op-amps allow for transformer-less direct drive of the LCR network. Current sources are employed to bias each amplifier stage into class A operation. Discrete power supply regulators are dedicated to each amplifier IC power supply pin. Also, for ease of current delivery, the pass element of the series regulator is vastly over-rated in current capacity. Critical components in the audio section are hand matched.

Available now, priced at £400.

www.loungeaudio.com

UK distributor: www.divineaudio.co.uk



Merrill Audio Jens phono stage for low-output moving coil cartridges

VPI Industries Owner/Founder, Harry Weisfeld testifies formally, "This is the best Phono stage I have ever heard". Merrill Audio is pleased to announce the LOMC Jens Phono Stage Pre-amplifier, the result of seven years of research and field development, 1.5 years of production design, and built specifically for Low Output Moving Coil Cartridges. The Jens phonostage features 70dB gain, ultra low noise, isolated mono channels, 0.1dB RIAA EQ, 0.1dB channel-matching, and a superb input stage that optimizes LOMC performance of high-end cartridges. An external power supply is standard. Jens is impervious to power cord interactions and offers sound staging and sonics that belie its solid stage origins, making it one of the best phono stages around, regardless of price.

Shipping now: USD\$15,449.

Europe: www.heareverything.nl

Canada: www.USAhifi.com

Singapore: www.horizonacoustics.com

www.merrillaudio.net/jens.html



MOON by Simaudio Neo 310LP phono stage

The MOON Neo 310LP Phono Preamplifier is exceptionally quiet thanks to a great deal of attention given to noise levels and dynamic range. It provides improved performance over its predecessor, the MOON 310LP. A major strength is that it is highly configurable for both MM and MC cartridges. There are numerous adjustments for resistance and capacitance loading, as well as gain level. You can even select from two different equalization curves—RIAA and IEC curves. Balanced outputs are a standard feature.

With clean, powerful, fast, and extended bass combined with an open midrange and airy extended high frequencies, the NEO 310LP is on a par with and even exceeds many models at significantly higher prices.

Available soon, priced at USD\$1,900.

www.simaudio.com

UK distributor: www.renaissanceaudio.co.uk




"This is the Best Phono Stage I have ever heard."

Harry Weisfeld, founder/owner of VPI.

JENS REFERENCE PHONO STAGE



MERRILL  AUDIO

Award Winning



CanadianHiFi.com
HearEverything.nl
Merrill Audio Advanced Technology Labs, LLC
415.562.4434

Canadian Distributor
European Distributor
Merrill Audio Advanced Technology Labs, LLC
www.merrillaudio.net

Musical Surroundings Nova II battery-powered phono stage

Designed by Michael Yee and built in California, the Nova II is a battery-powered MC/MM phono stage that resolves the problem of variable quality mains power. It features all-discrete, dual-mono circuitry and offers peerless flexibility in loading and gain options, easily adjustable via accessible DIPswitches on the rear panel. Two internal NiMH battery packs, one for each phase, supply the power in full-battery mode and a novel 'smart-sensing' circuit automatically prompts the unit to recharge when the batteries run low, without interrupting playback. A charge is good for about three hours of listening, and when full-battery operation is selected, a relay completely disconnects the unit from the AC power.

Available now in silver or black finishes, priced at £1,200.

www.musicalsurroundings.com

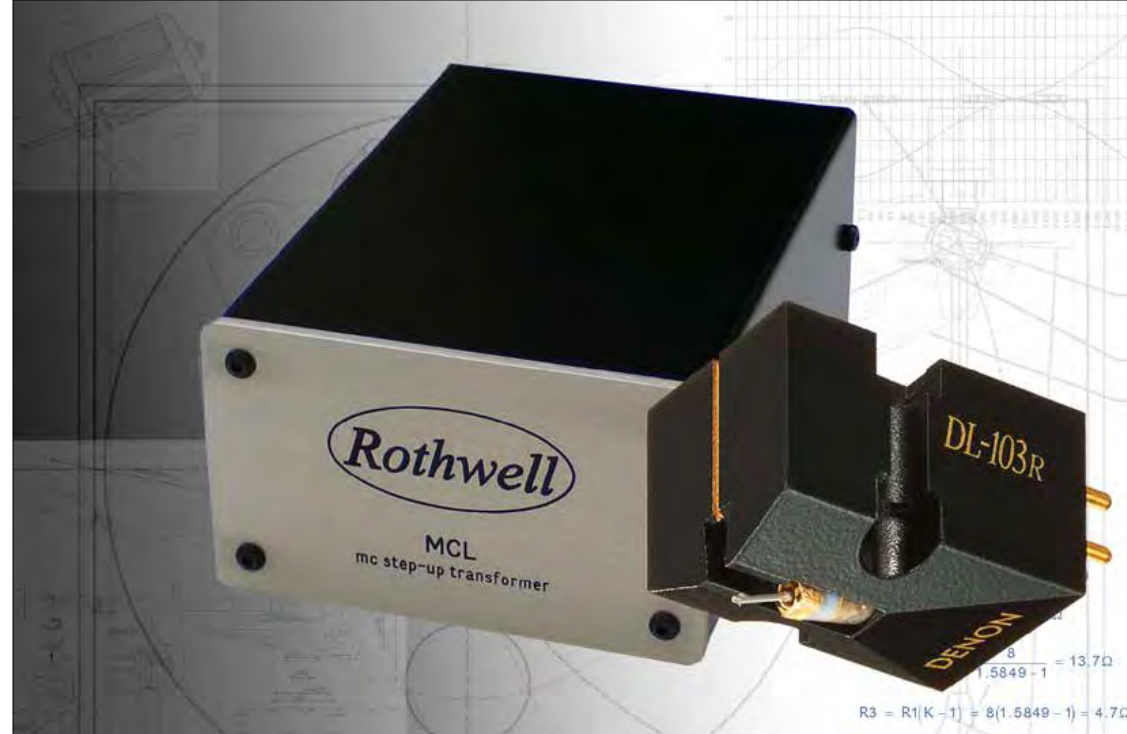


Musical Surroundings SuperNova III phono stage

Built on 15 years of "phenomenal" success with the original SuperNova and SuperNova II, the SuperNova III features a full-size chassis with Smartsensing™ battery power supply, discrete dual-mono circuitry, three selectable EQ curves, and unique subsonic filter. The SuperNova III also includes outboard linear charging power supply.

Available soon, expected price: USD\$3,500.

www.musicalsurroundings.com



we specialise in ...
phonostages | step-up transformers | mc headamps



Pear Audio Blue – Classic phono stage

Pear Audio Blue introduces a complete line of tube audio gear, amps, and phono stages. Pear Audio Blue amplifiers feature excellent design, remarkable build quality and great components. Pear Audio Blue tube electronics are marvels of minimalist design, providing the purest possible sound without any unnecessary components or frills, and all share the following features:

- Shortest possible circuit paths
- High quality valves
- Point-to-point wiring
- Matched components
- Low noise floor
- High quality connectors
- Large Toroidal transformers
- Real wood face plates

We believe the Pear Audio Blue-series phono stages are the most revealing yet natural-sounding available.

Three Pear Audio Blue phono stage models are available as of Q1: Elemental, USD\$1,495; Classic, USD\$1,995; and the 2-box Reference Phono Stage, USD\$4,495.

www.pearaudio-analogue.com

US distributor: www.audioskies.com



RCM Audio SENSOR2 phono stage

The versatile RCM SENSOR2 is designed to fit a variety of systems. SENSOR2 lets you select between single-ended or balanced outputs, and features 6-way gain and 8-way load switches for unmatched flexibility.

Amplification is handled by selected integrated circuits. EQ correction is performed by a two-step passive system featuring hand picked low-noise resistors, polypropylene capacitors, and other components, resulting in EQ deviations lower than 0.3dB in the 20Hz-20kHz range. A separate power supply was designed to minimise distortion. The chassis of the amplifier and power supply are made of hollow rectangular cross-section tubes that drastically reduce flexing. This superior phono stage will easily find itself at home in your system.

Available now, starting at £2,190.

www.rcmaudio.pl

UK distributor: www.fiaudio.co.uk



Timestep T-01MC phono stage

The Devon-based firm Timestep offers its T-01MC phono stage as a deliberately minimalist moving coil-only design that is specifically engineered to eliminate noise. It avoids the use of integrated circuits, instead using 16 individually hand-selected FETs in a fully discrete, dual-mono, zero negative feedback design. Gain and loading are fixed, based on extensive testing with a wide range of cartridges from the Denon DL-103 to the ultra-high-end Clearaudio Goldfinger Statement. This saves considerable cost over user-switchable settings, not to mention shortening signal paths and eliminating another potential source of noise, thus enabling the T-01MC to deliver an exceptional performance-price ratio.

Available now, the T-10MC retails at an impressively wallet-friendly £995.

www.time-step.com



Trilogy 906 MM/MC phono stage

The 906 MM/MC phono stage from Trilogy brings as much of the acclaimed 907's technology as possible within the reach of a wider audience. Sharing a very close bond with its illustrious sister, the 906 brings genuine audiophile performance to a more affordable price point.

With its compact chassis, the 906 cleverly combines a Class A single-ended gain stage, a high bandwidth and low distortion circuit topology, a signal path free from cheap off-the-shelf op-amp integrated circuits, a generously specified custom transformer, and beautiful bespoke casework.

The 906 meets all of Trilogy's expectations and when you sit down and listen to the music you love, it will almost certainly exceed yours.

www.trilogyaudio.com

UK distributor: www.symmetry-systems.co.uk



van den Hul The Grail phono stage

A very high quality single-ended design, The Grail combines both novel and tried-and-tested elements of high-end audio engineering. Its circuit boards feature gold conductors while the circuit design avoids unnecessary capacitors—even down to the essential RIAA equalization, performed here by coils rather than the typical capacitor-based filters. Both MM and MC cartridges are catered for, the inputs selectable at the flick of a switch. Automatic MC input loading ensures accurate optimization, while the low-noise MC input stage eliminates noise even with low-output cartridges. The magnetically shielded power supply, housed in a separate chassis, features gyrators for each amplifier stage for very effective noise cancellation. There is also an optional battery power supply.

Available now, priced at £5,125.

www.vandenhul.com

UK distributor: www.decentaudio.co.uk



Vinnie Rossi LIO phono stage

Vinnie Rossi's LIO Phonostage is a breakthrough design whose power supply employs two ultracapacitor banks that provide 100% isolation from the AC mains power at all times. With its incredibly low noise floor and fully discrete, zero-feedback, Class-A JFET design with optional tube output stage, you will experience a deep and natural musical involvement when spinning your favorite LPs. LIO's three inputs (one MM, two MC) allow you to connect more than one turntable or arm/cartridge and toggle between them. MC inputs feature premium built-in step-up transformers. There is also an option for remote cartridge loading, so you can make loading adjustments from your listening chair! Made in the USA with 10-year warranty.

Available now, starting at only USD\$3,395.

www.vinnierossi.com



V.Y.G.E.R. Krimon I Phono Stage

V.Y.G.E.R., in collaboration with VYDA Laboratories, is pleased to announce the beginning of a range of audio electronics components designed for uncompromised performance.

The Krimon I is a battery-powered, solid-state phono stage. The power supply uses two banks of 10 batteries with 60 volts per channel. The phono stage itself uses special hyper-speed transistors, with low noise and high bandwidth to provide proper signal tracking. The Krimon I printed circuit board features very high thickness plating. In fact, with 120 microns of copper and 15 microns of gold plating, the components are all built to MIL standards.

The resulting sound is perfect, the dynamic of the sound seems limitless, and the tonal consistency, in our opinion, is startlingly accurate.

Available now, priced at €43,500.

www.vyger.com



COMING SOON!

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www.hifiplus.com



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MASTER DESIGNERS: ANALOGUE AUDIO



HI-FI+ INTERVIEWS TEN TITANS OF TURNTABLE & TONEARM TECHNOLOGY

Helmut Brinkmann of Brinkmann Audio

Hi-Fi+: What drew you to the field of analogue audio in the first place and what do you regard as your specialties within that field?

HB: I started repairing and improving hi-fi equipment, mainly tube amplifiers, disco systems, and stage equipment in my youth. I was fortunate to have a friend and mentor who sold and serviced disco equipment. I accompanied him on appointments and learned the business. Starting with this background I began designing my own amplifiers. Turntables came at a later stage of my career but the experience with amplifier design was critical in my ability to design good turntables because the electronics—motor, drive circuitry, and power supply—have an enormous influence on the sound of analog playback equipment.

I always paid close attention to detail in my designs and obviously every part on the turntable is important and has an influence upon the sound. Consequently, my designs have evolved and improved over time. Instead of launching a new product every year, I continue to refine the existing models until I'm certain that I've achieved the best possible result in every aspect.

Many in our industry say that analogue audio presently is enjoying a renaissance. Would you agree with this viewpoint and, if so, what do you think is driving that renaissance?

Yes, I would agree with this viewpoint. Obviously LP and turntable sales are growing and not only at the High End, but also among young people who buy inexpensive turntables and enjoy playing LPs. When the Compact Disc debuted in 1983, everybody was thrilled because it was so much more user-friendly, smaller, eliminated surface noise, offered cleaner sound, etc. It looked like a great advancement overall. Now, decades later, it's obvious that there were limits that digital music never managed to transcend. Analog playback is simply more engaging, emotional, and involving. There is something about the sound of an LP that gets you closer to the essence of music, an essence that digital playback just doesn't seem to capture.

How have engineering practices changed since you built your first turntable? Have the changes influenced subsequent designs?

Engineering has advanced of course. CNC driven machines have become ubiquitous and that makes production easier, but I wouldn't regard that as an important influence because a good machinist could always produce high quality parts. I think the more important change is in the perception



of turntables. When I started, turntables just had to turn at the right speed: they were a utensil to play LPs. With time, the concept that a turntable improved the sound became more and more prevalent. That, of course, improved with experience and a growing demand for good hi-fi equipment. I would say that advancements in amplifier technology and consumer demand for high quality home hi-fi are the main factors for me to improve our turntable designs.

What are the distinctive ‘hallmarks’ or signature elements of your analogue designs? What distinguishes your products from those of your competitors?

After much experimentation, I decided to champion unsuspended, high mass turntable designs. Because Brinkmann foregoes the use of sprung suspensions, the resonance discharge in our turntables and tonearms are more critical and led to our extensive use of aluminum, which is a very neutral material from a sonic standpoint. I have spent a lot of time experimenting with different materials in every part of the analog chain in order to understand both their sonic and resonant characteristics.

Brinkmann is renowned for inventing the Heated Platter Bearing, which enables the use of higher-precision tolerances and eliminates “Platter rocking.” Another unique feature is the glass platter mat and clamp design which provides optimal coupling between LP and platter. It also inhibits the accumulation of dust and dirt and thereby protects cherished LPs.



All our turntables feature Brinkmann-designed motors that are purpose-built in our factory. The development work on the direct drive motor for our Oasis and Bardo turntables led to the design of our bespoke belt drive motor, which offers massive performance benefits.

Finally, we’re probably the only High End manufacturer to offer a tube power supply—the RÖNt—for our turntables. My amplifier designs provided me with the necessary electronics background to lavish the same amount of attention upon the design of the motor and power supply that went into the

Above: Brinkmann uses a consistent set of design criteria in its turntables, irrespective of whether the turntable uses a direct or belt drive, and regardless of tonearm length.

mechanical aspects of a turntable. The tube topology of the RÖNT provides a richer, more musical sound.

Some prefer to treat turntables and tonearms as integrated systems whose elements should be developed in concert with one another. Others prefer to take more of a 'mix-and-match' approach. What is your recommendation and why?

Since Brinkmann offers complete analog playback systems, I obviously think it's a great advantage to design turntable, tonearm, and cartridge in concert because you can optimize the synergy between the components. Our products are designed to work together. Each turntable, tonearm, and cartridge combination we build offers a maximum of synergy because they all follow the same design philosophies. High quality music playback involves neutral sounding equipment. I have a strong focus on maximizing sonic neutrality in order to avoid colored sound, which means that all of our analog products are also a good fit with other brands. An essential part of our philosophy is to provide mounting bases for third-party tonearms because the analog source needs to complement the other components of the complete audio system and a customer might prefer a solution with another brand of tonearm or cartridge.

Being as candid as possible, how would you compare the relative merits of digital and analogue source components? What things do you think good analogue sources do singularly well?



Digital is cleaner sounding, easier to use, and offers great advantages for storing huge amounts of music, especially since hard disc and streaming files have become popular. Analog was always somewhat "fussy" and anybody with a large LP collection knows how much space they consume.

That there is a Vinyl Revival despite all of these inconveniences shows that there are qualities in analog playback that are missing in digital playback. Analog can take you on a trip right to the heart of the performance, to the source of the recorded music and engage emotionally, almost like time travelling. There

Above: Brinkmann's electronics are as highly prized as the company's turntables, and its phono stages, amplifiers, and most recently full-function DAC command a fine reputation for longevity and great sound.

is an authenticity to analog that, once heard, is addictive. Digital is the sound, analog is the music. The merits of digital music are on the practical side and the merits of analog music are on the emotional side.

Which elements in the analogue audio signal path—turntables, tonearms, phono cartridges, or phono stages—have the most overall impact on sound quality?

As a rule of thumb, the closer a component is to the beginning of the playback chain, the more impact it has on sound quality. The rest of the system can't make up for the flaws of the cartridge because that's the initial signal that gets passed on. The rest of the chain can color or diminish the quality of the initial signal, but can't improve upon it. The rest of the components should of course live up to the quality of the phono cartridge and the overall synergy and balance of the system is very important.

Which three of your favourite analogue demo discs might you recommend to our readers? (It's hard to choose just three, we know, but please do your best.)

First let me point out that "Demo" LPs are not necessarily ones that I would choose to play when I'm listening for pleasure or utilize in the design of a product. My personal choices are what I enjoy when I'm not working, whereas the LPs I use when I'm designing are all critical in various sonic aspects, as they help me identify and overcome weaknesses in our products. My favorite demo LPs are those that are recorded well and demonstrate the special qualities of our products. My three

first picks would be Ella Fitzgerald and Louis Armstrong, Ella and Louis (Verve MG V-4003), Elvis Presley, Elvis Is Back (Living Stereo LSP-2231), and New Symphony Orchestra of London, Alexander Gibson, Witches Brew (Living Stereo LSC-2225). All three are great recordings of outstanding artists performing wonderful music and all are excellent original recordings that are also available as high quality reissues.

What set-up or installation tips would you give the newcomer... and what guidance would you give to the expert?

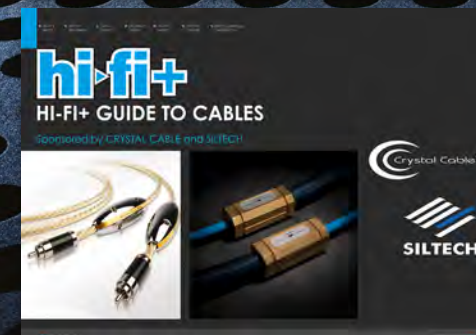
I would give exactly the same recommendations to newcomer and expert alike, though the expert should already know what I'm going to say! The most important factor in the set up of a high quality turntable is a resonance-free stand, the heavier the better, and properly leveled. This is equally important regardless of turntable design: high or low mass, suspended or unsuspended. High-quality set-up tools are also necessary; in particular, an accurate stylus force gauge and a precise, easy to use protractor for geometric alignment. With these basic tools and a trained ear it's not difficult to achieve excellent results. There is an excess of mystification and complexity surrounding analog set up and it can escalate into an unwieldy process, but my best advice is: "Keep it simple." That's why all Brinkmann turntables are designed for easy and stable set up. It's helpful to re-check the adjustments again after a break in period. Other than that, just keep your LPs and stylus clean!

In five years' time, how do you anticipate that the world of analogue audio will have changed?

The current "vinyl hype," as it has been called by some people, might slow down a bit, especially in the entry level segment; on the other hand, all those young music lovers buying inexpensive turntables today will be potential Brinkmann customers in the future! I expect analog to remain the prominent consumer format for ultimate quality music playback. I think there is a disappointment about digital music because it seems to offer great technical advancement but little musical advancement. I have a feeling that analog playback will continue to be the benchmark for high fidelity playback quality. +

hi-fi+

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Arthur Khoubesserian of The Funk Firm

Hi-Fi+: What drew you to the field of analogue audio in the first place and what do you regard as your specialties within that field?

AK: It turns out that at school, my maths master was an esteemed reviewer, recording engineer, and owner of Meridan Records: John Shuttleworth.

I was fortunate enough to go to live recording sessions where I learned both what good recorded sound was and more importantly what poor recordings were. He was fastidious to a fault and I was flummoxed to learn that despite owning Meridan Records, he was utterly scathing over what he described as “Groove Grinders”.

Comparing his records to his master tapes on what was, of its day, a fine piece of analogue reproducing machinery, one could understand why! They sounded so different. So, it was obvious. Records were crap! Or, were they?

I had experienced first hand the meticulous effort that went into record cutting and that was impressive. This therefore seemed an unlikely route for so great a divergence of sound. That then left the replay apparatus as the prime culprit, never mind that the mechanism of the failure was eluding me. Indeed, at the time, I gave it scant attention.

When I left school in the seventies, new, all-powerful (digital) record-playing “King” was on the throne. Not only was it taking no prisoners, in fact there were more than a few casualties.

“Aha,” I thought. “This is it.” Swept along with the tide of mass hysteria, I was confident in the knowledge that owning this piece of supreme engineering and illogical but obviously brilliant design would close the performance gap I had experienced, leaving me content and free to follow my chosen and quite alternate career. I had no choice. I had to have one.

Dutifully, I saved up and bought said hallowed artifact.

Only...imagine my utter, utter horror and dismay when it failed even more spectacularly than John’s setup to deliver! I felt I had been well and truly duped and by the ‘Experts’. Something needed doing.

So it was, in total innocence and naïveté and with nothing but my unyielding reliance on physics, maths (and my wits), that I joined the industry.

Thus, my exciting and it has to be said quite eventful journey of literally “Following the Groove” began.



Many in our industry say that analogue audio presently is enjoying a renaissance. Would you agree with this viewpoint and, if so, what do you think is driving that renaissance?

From 1979 – 1998 I was co-owner of Pink Triangle and amongst various developments I pioneered, I had released the acrylic platter and, I have to say, to much incredulity.

In 1998, utterly exhausted and burned out, I took a seven-year sabbatical. I isolated myself entirely from the industry.

The dark days: During this period, digital had landed. CD sales went through the roof. People literally ditched all their vinyl. Record sales crashed... well, except for those odd DJ guys. They were the stalwarts and guardians of vinyl and they kept it going.

I returned in 2005 to start Funk. I expected to find an industry where companies had developed even bigger ideas to the point that the likes of me would not stand a chance. Somewhat dumbfounded, about the only thing that was apparent was the almost universal adoption of the acrylic platter! Although one could probably say I felt vindicated, cold comfort was nearer the mark.

The other thing that started to happen was that turntable sales had started a new rise in acceptance and the answer was pretty obvious. Digital, for all of its fabulous technology had, sonically speaking, not evolved. The sound was still essentially the same digital sound they first heard. People



Above: The Funk Firm isn't content with making turntables. It also provides upgrades for a range of turntables. One of the simplest – yet most effective – is the Achromat vinyl replacement for the conventional felt slipmat.

had had their time with it and show after show that I attended I was presented with the same answer: “I take my iPod to work (remember them?) but when I get home, it is not what I want to listen to.”

This limitation I likened to the digital artefacts we get with fast moving images

on TV. Processing was getting in the way. Now don't get me wrong. Analogue is no saint in this regard. Ticks and pops, end of side distortion and more, analogue has it all, only it doesn't get in the way of the music as much as digital.

After all the years of improving and refining digital it was still regarded as somewhat sterile. By contrast, analogue retained an immediacy that we react to emotionally. It is the only way I could and can explain this phenomenon. People still love that and haven't been willing to lose it.

So, contrary to all expectations this bizarre format has clung on because fifty years on, it really does still offer something new.

How have engineering practices changed since you built your first turntable? Have the changes influenced subsequent designs?

Computers have been unleashed. The challenge is the increasing cost of good engineering.

In years gone by, one could ask one of any number of engineers for a few of this or that and get things done.

Today, computers and accountants dominate... and they want volume. The prevalence of computer controlled machines dictates quotas where the vast majority of companies will not even look at a job sheet that does not ask for hundreds of every single component.

Any idiot can produce a record deck satisfying all our sonic demands at tens of thousands of pounds.

Trying to get the absolute sonic best for a customer with a budget of eight hundred, or even fifteen hundred pounds to spend? Now we have the challenge.

Graciously it is said that I have a talent for turntable design and one day I will produce my 'ultimate statement' on record reproduction, but given the above restrictions, currently I've decided to focus on giving my customers the best possible sound within sensible budgets.

Today's world really has been a game changer.

What are the distinctive 'hallmarks' or signature elements of your analogue designs? What distinguishes your products from those of your competitors?

Throwing caution to the wind, defying convention, and following the free spirit.

Who in their right mind calls a product 'Little Pink Thing', LSD ('Little Super Deck')... or indeed calls a company "Pink Triangle"?!

Yet that very freedom of thought from the constraints and conventions and taboos is found throughout all my designs.

Take the original acrylic platter. Decried at the time, now everyone is using it.

(And with everyone copying it, it was time for the mouse-trap to get better: Achromat.)

Or consider DC motors. From day one I championed their use. At the time the whole industry tried to shout me down with sillinesses such as "they never run at the right speed".

I think it speaks volumes that my most vocal critics on the issue – a certain Scottish turntable manufacturer – now employ a DC motor themselves!

So, how good is a DC motor? Let's ask the Germans, you know, "Vorsprung durc.." and all that. Against all comers they have bestowed on LSD (a very modestly priced product) nothing less than "Ultimate Reference status for technical excellence" (let alone its sonic attributes).

Who was right in the first place?

Or, how about solving a problem that no one even knew was there? I am speaking of the question of bearing stability, where the bearing is pulled to one side by the belt (and thereby giving the slower turning motor of a direct drive an advantage?). By incorporating three pulleys, the forces are vectored and



now the belt drive has the advantage by virtue of a higher turning motor.

Or, let's turn to tonearm behaviour. Arm tubes ring like a bell. This is a fact. Just look at measurements, which have been telling this to us for decades and you can hear the problem, too. But because no one had an answer on how to deal with it, we accepted it.

This one simple example of the challenge of analogue is indeed quite formidable; thought experiments are one way to overcome it. I kept looking at the problem over and over again. There had to be a solution...and there was. As with the development of the acrylic platter, the solution came by freeing

Above: The core of The Funk Firm's line-up of high performance audio products – the Little Super Deck. A complete, just add cartridge, package, the LSD even comes with a lid. What a trip!

one's mind of conventional constraints and opening it up to a whole new way of seeing the problem and thereby formulating the solution.

The results were the genesis of the cross-braced tube technology now found in FX3. It added little mass yet was an order of magnitude stiffer than a conventional tube. Here's how it goes: A tube has great torsional (twisting) stiffness, but is wobbly along its length (think fishing rod)...and cartridges?

They produce longitudinal forces, which is how the tube is made to flex – recall the measurements.

Aha! Is the light being switched on?

By contrast, an I-beam (think RSJ) is longitudinally stiff. F.X technology combines the strengths of these two structures in a new and unique way and so solves the problems. Ever-lower levels of information become discernable, when previously they had not been.

The proof? We just compared two arms, one with and one without. Simple really.

By eliminating the obscuring colourations that held back previous deck, arm, and cartridge designs, we are getting ever closer to resolving all that microscopic detail.

In this way, going back to my days with John Shuttleworth, when the master tape as reference was king, this was how true progress was made. Slowly and sometimes painfully my efforts to attain my holy grail are beginning to bear fruit.

Unlike digital, which objectively has a defined limit to its resolving power, with analogue the limit really is at the atomic level of vinyl.

Some prefer to treat turntables and tonearms as integrated systems whose elements should be developed in concert with one another. Others prefer to take more of a ‘mix-and-match’ approach. What is your recommendation and why?

To save irrelevant repetition, I’m going to tie-up two questions in one in answering this and include Hi-Fi+’s next question, which is:

Which elements in the analogue audio signal path—turntables, tonearms, phono cartridges, or phono stages—have the most overall impact on sound quality?

Where to start?

The motor is that which drives the deck. That’s important.

The stability of the bearing is also crucial, which is why we need to apply a Vectoring drive to control that motion.

The huge 30dB spikes that a normal tonearm exhibits are also critical, which is why we need an ultra-rigid arm and with free bearings.

Then we get to the cartridge. If the magnetic circuit is not correctly structured, then we will have distortions just where the stylus begins its journey; so the cartridge is also critical.

But the cartridge’s signal is miniscule and needs to be amplified by special circuitry, which brings us to the phono stage. The best stages I have experienced (and we developed

at Pink Triangle) are transconductance stages, where the signal voltage is converted to a current and then amplified. They are complex and a pain to service but they make a noticeable improvement in maintaining transparency.

“So, once we’ve sorted out the motor, the support, the bearing, the arm beam, the bearings, the cartridge magnetic circuit, and fixed the stylus pivot, and amplified the signal as purely as possible, now can we finally listen to the music?”

Well, yes... only, another thought: Is your deck suspended or rigid? You see, if it’s rigid, then it is constantly feeding back all the junk from the outside world all the time. This truly affects the final result in ways your brain is only too happy to tell you about! That’s why suspended decks will out perform a rigid deck, everyday of the week. You need to isolate your deck.

“Got you, now. Your decks are rigid, aren’t they?”

That decision was market driven. Long story to do with something that someone at a show said. Yes. It was just one person! I won’t bore you with it here. All you need to know is that we have returned and released Bo!ng. Easily fitted, it is a universal isolation system.

Once again it is so easy to do a ‘before and after’ comparison for yourself to prove how significant and damaging an effect low-level feedback is.

So: Turntable? Arm? Cartridge? Phono stage? No one element outshines the other. They are all incremental, inter-dependent, and important.

We strive to find the best solution in each case.

Being as candid as possible, how would you compare the relative merits of digital and analogue source components? What things do you think good analogue sources do singularly well?

With digital, the signal is (simple) code and cannot be altered, meaning the results are pretty much fixed. 99.99% of the time, the technology translating the code is “off-the-shelf”.

(Pink Triangle developed a D-A converter that was not off the shelf and to this day people still say to me it has an ‘analogue’ quality that they have yet to better. That is quite some compliment and is testament to the free creative spirit that is this industry at its best.)

Similarly and at the same time in total opposition, analogue, for all its faults, has a seamless quality that is beguiling. I say that not because I make analogue equipment but because that is what I hear.

Ultimately and despite my physics training I have to describe analogue in emotive terms because that is its quality. It is not digital and thank goodness for that. What would be the point of producing something that is identical

to what you already have? Like fine wines or cars, for us human beings it is the differences that we appreciate.

Analogue is a total challenge. It is the artist who, despite delivering photo-realistic renditions of a subject, can add in a soupçon of extra pleasure that a mere photograph will never attain.

By definition digital is very precise. Of itself it can be nothing else and I find it interesting that some of the better digital sources turn to fuzziness or various analogue techniques to improve the final subjective appeal.

The human ear and brain is so fallible, yet at the same time, it knows what it likes!

Which three of your favourite analogue demo discs might you recommend to our readers? (It's hard to choose just three, we know, but please do your best.)

John Shuttleworth's recordings are obviously excellent and I'll choose Anthony Hedges' Scenes from the Humber.

If that's too esoteric, how about Ricky Lee Jones' self-titled (eponymous) album? It's a magnificent recording; I turn to that often.

Or, try Brian Eno's Apollo.

There are so many it's hard to pin down just three. But there you are, for what it's worth.

What set-up or installation tips would you give the newcomer... and what guidance would you give to the expert?

Goodness me I've heard some awful systems from 'experts'. I bought one! In this industry, you can never tell an expert anything... that's why they are the 'Expert'. Snake oil is wonderful stuff! I wish I knew where to buy it.

I believe everything should be validated and easily. Use your ears and don't be bogged down by the dogma from others.

Every rule can be broken and there is nothing wrong with that; if, when you close your eyes and listen and hear an improvement, then there is an improvement. Otherwise, there isn't!

Don't worry about every single dit and dot. It really is not important. Close your eyes. Enjoy the performance. That's what you bought your system for.

In five years' time, how do you anticipate that the world of analogue audio will have changed?

I will have retired!

Change means the unknown and so a crystal ball is needed. Why do we die to be replaced by our progeny? Our ability both to take on new ideas and to generate new ones falls away with age. Change is about leaping into the unknown and old people tend to be quite, quite inflexible.

Analogue audio, audio in general, and ultimately progress itself will only occur if there is new blood to help drive our quest, in this instance for musical nirvana, and sadly I see very few original thinkers and that is what we need and hence the need for progeny.

As for my part? I may be ageing, but I have yet more crazy ideas for people to shriek at – and they will. For me that is what I have grown to love the most. +

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Louis Desjardins of Kronos Audio

Hi-Fi+: What drew you to the field of analogue audio in the first place and what do you regard as your specialties within that field?

LJ: I have been blessed to be born in a musical family. My sister Elise is a conservatory-trained pianist, and I took violin lessons as a child. Thankfully I stopped these lessons after five years as I was horrible at it. What I retained from this experience is an ear for the true tone and texture of instruments. Analogue is the only means to record and playback music in all its complexity and vinyl is the perfect medium to store recorded music.

Many in our industry say that analogue audio presently is enjoying a renaissance. Would you agree with this viewpoint and, if so, what do you think is driving that renaissance?

As audio systems as a whole improve in resolution and fidelity, the advantages of analogue audio become ever more obvious. The more information we can access, the better we can appreciate the differences between analogue and digital. It appeared to me 10 years ago that we had been fooled to believe the digital promise of “perfect sound forever”. Even a modest turntable rig will communicate music with much more intimacy than any digital system, no matter how evolved it is. I think it is this connectedness that is attracting audiophiles

towards analogue, despite the loss of convenience analogue audio presents.

How have engineering practices changed since you built your first turntable? Have the changes influenced subsequent designs?

We introduced Kronos five years ago, so perhaps it is a little early to tell. What I can say is that we are constantly striving to push the envelope, manufacturing-wise and design-wise. We introduced a new power supply at the Munich High End 2016. It is a world first and it uses technology that was unavailable five years ago. We are also looking at further advances on the mechanical front and in modern materials... so stay tuned!

What are the distinctive ‘hallmarks’ or signature elements of your analogue designs? What distinguishes your products from those of your competitors?

Kronos are the first and only suspended turntables using counter rotation to eliminate torque induced vibrations. We were granted a patent for this technology. It has been stated that this is the most important advance in turntable designs in decades (Greg Weaver, The Absolute Sound). Additionally, we have innovated in our bearing design, drive system, and now in our power supply. The quality of every component in a turntable will impact the sound, but overall, the importance simplicity and efficiency cannot be overstated.



Some prefer to treat turntables and tonearms as integrated systems whose elements should be developed in concert with one another. Others prefer to take more of a ‘mix-and-match’ approach. What is your recommendation and why?

Kronos does not make tonearms and our turntables can be mated with most tonearms available today. This being said,

we distribute the Black Beauty and Helena tonearms because we feel they represent the state of the art and benefit from a design philosophy similar to that of our turntables. Their designs answer basic physics issues that were previously ignored and produce better sound as a result. You could say the proof is in the pudding.

The other side of this argument is that we are in strong disagreement with some other tonearm designs. I would rather not get into this here, but suffice it to say some of these simply do not perform properly and are horrible.

Being as candid as possible, how would you compare the relative merits of digital and analogue source components? What things do you think good analogue sources do singularly well?

Candidly, I think computers have little to do with true musical enjoyment. They have everything to do with convenience. I would rather listen less often, but hearing more. It is really about quality over quantity.

Which elements in the analogue audio signal path—turntables, tonearms, phono cartridges, or phono stages—have the most overall impact on sound quality?

As you could predict, I will say that the most important component is the turntable, followed by the tonearm, followed by the cartridge, followed by the phono stage all the way down to the speakers, which are a special case all to themselves. The music we hear comes from the source. The first source component is actually the microphone, but this being a given, the turntable will make

Right: The Kronos Pro was the first product from the company. The limited edition model features a pair of platters rotating in opposite directions at precisely the same speed.



the most difference reproducing music in our homes. The cartridge will retrieve what is in the groove if it is made to vibrate by the turntable. This is where we put all our efforts. Of course, every component has its own importance, and the chain will only be as strong as its weakest link...

Which three of your favourite analogue demo discs might you recommend to our readers? (It's hard to choose just three, we know, but please do your best.)

I love the soundtrack to the movie Bullitt, composed and conducted by Lalo Schifrin (Warner, Japanese pressing). It has that big band in a big hall sound...very powerful stuff. They do not record big bands like this anymore. I love Hendrix in the West, the track "Red House" (also a Japanese pressing) – maybe one of the best live recordings ever. It completely takes you there, on stage, in 1969! And I love Arie Antique on Decca recorded by Monserrat Caballe; it may be one of the great piano and voice recordings.

What set-up or installation tips would you give the newcomer... and what guidance would you give to the expert?

For newcomers, a good idea is to have the turntable on a wall mounted shelf. This avoids a lot of parasitic vibrations from the start. Avoid heavy record clamps or ring weights as these will tense up the vinyl. Avoid everything rubber or Plexiglas (Perspex) that will be in contact with the record as it will color the sound. Get your tonearm and cartridge properly aligned.

For the expert, train and trust your ears. If something doesn't sound real, then it cannot be good. Otherwise, just enjoy the music.

In five years' time, how do you anticipate that the world of analogue audio will have changed?

I wished I had a crystal ball. I hope younger people will join the ranks of audiophiles. Hopefully, there will be more vinyl production capacity. And, probably we will still find more gold within the grooves. +

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Franc Kuzma of Kuzma Ltd

Hi-Fi+: What drew you to the field of analogue audio in the first place and what do you regard as your specialties within that field?

FK: Back in the late sixties I became interested in music and then good sound reproduction, which—in those days of course—meant records. I was always more technically orientated and I am a mechanical engineer by education. My first job was in an electroacoustic research department working on the mechanical construction of acoustic transducers for telephones – the microphones and loudspeakers. So the move into audio design was a natural progression.

Many in our industry say that analogue audio presently is enjoying a renaissance. Would you agree with this viewpoint and, if so, what do you think is driving that renaissance?

I started our company in 1983, the same year as the CD was introduced and the beginning of the decline of the LP. Back in 1990 you might have seen two or three turntables at audio shows. After this time though people became disenchanted with the promise of perfect sound from the CD and started looking again at analogue reproduction and buying used records. Interest grew and some companies started reissuing LPS and later even cutting new records. The number of turntable manufacturers increased and now, nearly two decades later, there is a wide

choice of records and turntables available, more of the latter in fact, than ever before.

How have engineering practices changed since you built your first turntable? Have the changes influenced subsequent designs?

In the early 80s products were designed with a ruler and a pencil. Today a lot of designers use a variety of software, which can really help in construction. Still the most important thing is the feel for product construction and how to convert theoretical ideas to practical designs. CNC machines do help making more complex and better looking products, but to a lesser extent help in actual construction.

What are the distinctive ‘hallmarks’ or signature elements of your analogue designs? What distinguishes your products from those of your competitors?

Our approach to design is to follow the principle that only groove modulation should move the diamond tip and so, via cantilever coils in the cartridge, produce accurate electrical signals. In practice a lot of compromises have to be made to get close to this ideal. As the smallest information in the grooves is in the range of a few molecules so every detail in the chain of turntable, tonearm, and cartridge matters. Even seemingly insignificant parts affect performance so every part is manufactured with this in mind. I believe it is this attention to detail, whether it be in the damping of



platter, subchassis and arm tube, the zero play in bearings, or the rigid and robust construction of all parts, that help us solve some issues better than our competitors.

Some prefer to treat turntables and tonearms as integrated systems whose elements should be developed in concert with one another. Others prefer to take more of a 'mix-and-match' approach. What is your recommendation and why?

Good products should be as neutral sounding as possible and if this is achieved then mix and match is not a problem. It is a different case in matching cartridges to tonearms. Here certain rules have to be taken into account. For example if you use a low compliance (stiffer cantilever suspension) MC cartridge then you need to use a higher mass tonearm, which is also more rigid due to the use of more mass in its design. Higher compliance MM cartridges (softer cantilever suspension) require lower mass tonearms as they return less energy to the tonearm due to the action/reaction rule. This is more important than the tonality of the specific cartridge.

Being as candid as possible, how would you compare the relative merits of digital and analogue source components? What things do you think good analogue sources do singularly well?

Personally I do not have much long term listening experience with top digital playback. I have on occasions heard some really good sounds and I ask myself how would that sound from an LP. It is certainly

easier to go down the digital path for good sound, more practical, no noise, needing less space but when I compare a good LP to a master tape I am amazed by the LP sound...

Which elements in the analogue audio signal path—turntables, tonearms, phono cartridges, or phono stages—have the most overall impact on sound quality?

A system is only as good as its weakest link. If each component is good but not

outstanding this is preferable to having one bad component in an otherwise excellent system. If you put a very good tonearm and cartridge with a turntable that has poor speed control and a lot of motor noise, the

Below: Kuzma's Reference turntable might be the longest-running product in the company's line-up, but it's still more than good enough to show what the company's top Air-Line air bearing tonearm is capable of.



end result will be very poor. If you put a flimsy tonearm onto a very good turntable the result would be equally poor. But if you don't want to damage your records and money is limited it is best to buy a good tonearm and cartridge and mount it correctly onto a cheap turntable. After all a car can drive frequently on a muddy road without damaging it but a truck will destroy the same road in one journey.

Which three of your favourite analogue demo discs might you recommend to our readers? (It's hard to choose just three, we know, but please do your best.)

I have used many records over the years but the following are those I use constantly and am still discovering new information from these well worn grooves.

- Johann Strauss - Die Fledermause [Deutsche Gramophon, 2LP set 2707 088]
The recording superbly reproduces the orchestra , singers, stage...
- Igor Stravinsky - The Firebird [(Mercury) Classic Records reissue, SR90226]
The orchestra plays with great dynamics and impact.
- Stanley Clark - Stanley Clark [CBS, EPC 32042]
Acoustic and electrical bass, drums...

What set-up or installation tips would you give the newcomer... and what guidance would you give to the expert?

Newcomer: If you buy a turntable in the budget range then be sure that the dealer sets up your turntable. A lot of information is in the manual. Read it and learn some basics. Some parameters are more and some less important but it is unwise to experiment on your new turntable as probably you will not improve the performance. Learn a bit first.

Expert: Keep it simple and do not complicate things when there is no need. For example, setting up tracking force to a precision under 0.1 gram or pivot to spindle distance less than 0.5 mm is pointless. Bias force cannot be accurate due to various factors. Use the instruction manual. If you use test records with tracking modulation grooves, be sure to lower the chosen bias value for 20%. Steady tracks shows a higher bias force than musical peaks.

Tangential geometry: There are three slightly different theories for optimal set up but they are precise only up to 0.5 mm on the protractor.

VTA: Use a microscope for precise VTA set up, although not all cartridges will have the optimum 92 degree stylus angle.

Azimuth: Use available devices for precise azimuth set up. This is important when using stylus types like microridge. Do not be surprised if expensive cartridges require odd set ups for VTA and azimuth.



In five years' time, how do you anticipate that the world of analogue audio will have changed?

If there are no major economic changes in the world interest in analogue will continue to grow until the next major digital breakthrough. Long term analogue interest will remain with those music lovers who are not solely interested in pop music. We still have not managed to get everything from the grooves and until then we still have work to do. +

Above: The mighty XL turntable has recently undergone a transformation thanks to its excellent DC motor upgrade, and is a perfect counterpoint to the company's 4Point tonearm.

Gilad Tiefenbrun of Linn Products Ltd

Hi-Fi+: What drew you to the field of analogue audio in the first place and what do you regard as your specialties within that field?

GT: It was my father, Ivor's, creation of the LP12 (turntable) that led to Linn being founded – the product came before the company!

Before founding Linn Products, Ivor was driven by the fact that he couldn't find a turntable good enough to re-create the sound of his father's hi-fi system and set out to find out why. This set him on a journey of discovery towards the realisation that the source was the most important part of the hifi chain, not the speaker. This gave rise to Linn's philosophy of 'source-first' and led him to develop his own turntable, the LP12.

Following a much simpler design which removed components that introduce noise and interference, and using higher quality, precision-engineered components in a build process with much greater attention to detail, the resulting LP12 was capable of retrieving far more information from the groove of a record than any other on the market. And we still believe it's the pinnacle of turntable design.



Many in our industry say that analogue audio presently is enjoying a renaissance. Would you agree with this viewpoint and, if so, what do you think is driving that renaissance?

Music lovers are realising there's more to musical enjoyment than the convenience of carrying thousands of tracks around on an MP3 player; there's a definite move to quality whether that's vinyl or high resolution downloads like Studio Master.

Online streaming services such as TIDAL are offering new ways to discover music, which is driving people to purchase vinyl copies or re-discover their old collections. There's still great appeal for many to have a tangible product, there's the artwork, the weight, the collectability.

Vinyl is also appealing to a younger audience – it's fashionable, DJs use it, and many bands are putting their music out on limited release vinyl.

How have engineering practices changed since you built your first turntable? Have the changes influenced subsequent designs?

There's been a huge amount of change in the forty-plus years since the Sondek LP12 was first launched, the biggest of which have been to the tools used to design products and in our understanding of the materials involved.



The first LP12 design would have been hand-drawn and now we have CAD, which has enabled better visualisation, making the process much faster and easier to refine before we even begin to build.

Better analysis has allowed us to make use of materials we hadn't considered before and improved our knowledge of how different materials work together. And of course the changes have influenced subsequent designs – each new component Linn launches delivers significant performance improvements over those previously released.

What are the distinctive 'hallmarks' or signature elements of your analogue designs? What distinguishes your products from those of your competitors?

The Sondek LP12 was created with a modular, upgradeable, and expandable design so it could be built-upon and upgraded over time in order to continually meet the requirements of the person that owns it. What sets the Sondek LP12 apart is the ability to upgrade a product

Above: The audiophile classic. There have been more than 100,000 Linn Sondek LP12 turntables manufactured since 1972, many of which are still in circulation and are able to be upgraded to the very latest specification.

purchased over forty years ago to current day specification.

Other hallmarks of the LP12 are its premium Scottish engineering and that it's hand-built in the Linn factory by skilled craftsmen and women.

Some prefer to treat turntables and tonearms as integrated systems whose elements should be developed in concert with one another. Others prefer to take more of a 'mix-and-match' approach. What is your recommendation and why?

Linn takes an integrated solution approach in the sense that new components are always developed and tested within the LP12 ecosystem, but new components aren't created so as to be matched with only one other specific component. For example, our latest cartridge, Krystal, will sound incredible with any tonearm, and so on.

Being as candid as possible, how would you compare the relative merits of digital and analogue source components? What things do you think good analogue sources do singularly well?

If you have a vinyl record, the best way to enjoy it is on a quality turntable – for original analogue recordings there may be no better way.

Modern digital recordings have the potential to be better than anything that has come before and the best way to experience these is in Studio Master quality on a Linn network

music player. This is the only way to ensure a truly lossless performance between the recording studio and the listener's home.

Which elements in the analogue audio signal path—turntables, tonearms, phono cartridges, or phono stages—have the most overall impact on sound quality?

Following the source-first philosophy we recommend upgrading a turntable in this order to achieve the most significant impact on sound quality: bearing, power supply, motor, subchassis, tonearm, cartridge, and then phono stage.

Which three of your favourite analogue demo discs might you recommend to our readers? (It's hard to choose just three, we know, but please do your best.)

Well, of course these must be the highest quality recordings so only Linn Records will do!

At the moment I'm enjoying Robin Ticciati and the Scottish Chamber Orchestra's Haydn Symphony, Joe Stilgoe's New Song For Old Souls, and Dunedin Consort's Mozart Requiem.

What set-up or installation tips would you give the newcomer... and what guidance would you give to the expert?

It would be the same advice for all whether it's the newcomer deciding which turntable to buy, the Linn Specialist retailer setting up an LP12, or a Linn engineer developing new products: use the Linn Tune Dem method to evaluate whether it sounds better.



In five years' time, how do you anticipate that the world of analogue audio will have changed?

The future is digital!

In five years' time more people will be connecting their Sondek LP12 to a Linn Exakt DSM so that the music signal is digitised at the earliest possible stage in order to protect it all the way into the speaker, eliminating the loss contributed by analogue components. +

Above: Linn now provides complete systems in one of three grades: Klimax, Akurate, and Majik. This one features Akudorik loudspeakers from the Akurate range. The LP12's upgrade path allows movement between these ranges.

Peter Mezek of Pear Audio Analogue

Hi-Fi+: What drew you to the field of analogue audio in the first place and what do you regard as your specialties within that field?

PM: I have been a passionate music lover for as long as I can remember and I started to collect my own records when I was less than 10 years old. I had my first stereo turntable, when I was 15 (an East German Soleta), and that's how it all started.

I always listen very carefully when we are changing or developing (products). I have a very stable, high-quality, top notch reference system, which I have used for many years, with extraordinary E.S.P. and Shalinian loudspeakers at the end of the chain. Also I use several high-quality phono stages, like top models from Croft, Pure Audio, Accuphase, and Parasound, just to name a few, and of course adequate electronics.

In the end I have quite a good idea of what I prefer from the standpoint of music. I know my music.

My idea is to create a turntable where everything in the turntable is sonically in phase for a better musical experience, yet is still affordable to a normal music lover.



Many in our industry say that analogue audio presently is enjoying a renaissance. Would you agree with this viewpoint and, if so, what do you think is driving that renaissance?

This for sure is true. It is good to see how many younger people are also interested in vinyl. I think that a lot of people actually realised that although digital is very good, listening to the records is a different experience. Also, I believe, that top quality digital equipment is very expensive.

Many music lovers, who did not have a chance to listen to good turntables, are actually quite surprised when they hear a good turntable. It is quite a different experience and you can get really good, top-level results, for less money too.

30 years ago it was maybe digital against analogue, but today it is normal to use both.

How have engineering practices changed since you built your first turntable? Have the changes influenced subsequent designs?

Certainly you approach designing a turntable quite a bit differently today, than was common 30 years ago. Because we now understand better how an analogue turntable works, we can avoid potential trouble-making areas in the first place through effective, elegant design, so later you don't need to cure problems – problems that could have been avoided with better, proper designs. This is why the performance of today's turntables is getting better all the time. Also most parts are of course made

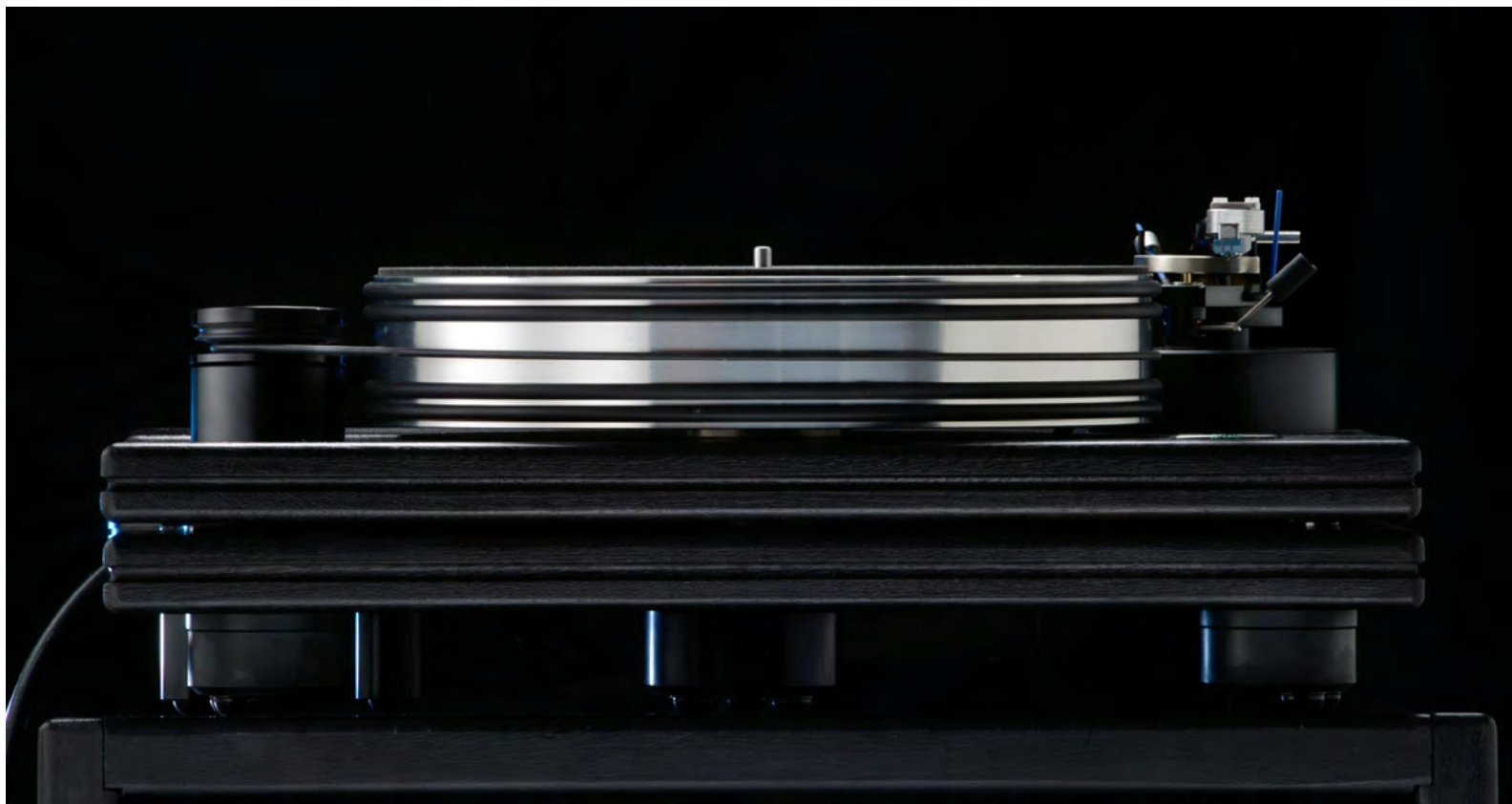
with CNC machines, so you have much better consistency and quality.

What are the distinctive 'hallmarks' or signature elements of your analogue designs? What distinguishes your products from those of your competitors?

In general, all of our designs use innovative constructions. Furthermore, a few of our

turntables are the last of the genuine designs from the late Tom Fletcher (of Nottingham Analogue Systems fame). They really are the culmination of Tom's in-depth understanding in designing analogue turntables.

The gramophones that I develop by myself are of course highly influenced by Tom and



Above: There is a strong design influence by late British turntable expert Tom Fletcher, of Nottingham Analogue fame. However, the Pear Audio ethos builds from there thanks to Peter Mezek's own design skills.

we are trying to develop further along these lines, and keep the flag up.

All our turntables have many innovative features, and all are based on the new marriage of materials and ideas defined by Tom Fletcher.

A typical would be our unique mechanical speed control, just to name one of our hallmarks. There are many others features, of course.

I believe, that the main difference – the thing that distinguishes us – is the approach and the fact that we want to make our products as good as possible, but at the same time to be as affordable as possible.

Some prefer to treat turntables and tonearms as integrated systems whose elements should be developed in concert with one another. Others prefer to take more of a ‘mix-and-match’ approach. What is your recommendation and why?

I definitely regard them as an integrated system. I don’t believe in the “mix and match approach”, because if the turntable/tonearm constructor did not have a clear idea and vision about what he is doing, you have more chance to only get a different sound, but not necessarily a better one. This is one of the reasons, why we support and train specialized analogue experts.

Customers usually are just not in a position to predict what the end result of the “mix” will be. If I were in their position, I would

for sure rely upon or at least seriously consider what dealers and manufacturers recommend. We have great and sincere interest, that our equipment would work at it’s best.

Being as candid as possible, how would you compare the relative merits of digital and analogue source components? What things do you think good analogue sources do singularly well?

This is a very good question. I also have top-quality digital sources in my system, of course, though I very rarely use them. I can say that 90% of the time, when I am seriously listening to the music, I play vinyl.

I asked myself many times, how can this be, and why? Recently, I was listening to my new turntable prototype, which we launched in May this year at the Munich High End show, and it just happened that I had my digital player also connected to the system. The digital player sounded very good, but when we switched to the gramophone, there was so much more flow, impact, and air between instruments, and the 3D stage was better as were dynamics. It was an experience that was just very, very pleasant.

So for me, it is the overall impact, music if you wish, where analogue is important. As digital for sure has other merits, like mobility (I like to use my Calyx M digital player very much), but mostly for outdoor sports, in the car, etc. You really use both formats today. There is no conflict there, but there is a difference.



Which elements in the analogue audio signal path—turntables, tonearms, phono cartridges, or phono stages—have the most overall impact on sound quality?

I will say that you can vary quite a bit with the cartridges; there are several really good ones being made. I think that it is a good approach if you start with the fundamental component: the turntable. Because it is very important, how it has been designed, and of course it should be as quiet as possible in the first place. You don’t want the quietest note, for instance, to be drowned-out by the motor. At the same time it is very important to understand, that every material has its

Above: The double-layer plinth on the Kid Punch turntable is identical to that of the top Kid Thomas design. Only the narrower platter gives the game away!

own sonic signature. We know, that our gramophones are all sonically in phase, and will play any record well; the turntable (you choose) does not need to be exclusively an “audiophile” one.

Also equally important is the tonearm. The design issues are the same as with turntables.

Choice of materials, lubrication, marriage of materials, etc., will all define the final result.

Phono stages are obviously very, very important too. Immensely important! Here also is where you can hear quite big differences, as with the turntables. I think very highly of the Glen Croft designs in that respect, for instance.

Which three of your favourite analogue demo discs might you recommend to our readers? (It's hard to choose just three, we know, but please do your best.)

Kid Thomas, Sonnets From Algiers; Rossini Overtures, London Symphony orchestra Gamba; and Duke Ellington, Uptown.

What set-up or installation tips would you give the newcomer... and what guidance would you give to the expert?

Make sure that you set up your turntable and other components accordingly to the manufacturer and dealer's instructions. The best approach is always to ask experts to do the set up for you, (and for this reason) we encourage our customers to visit specialized dealers.

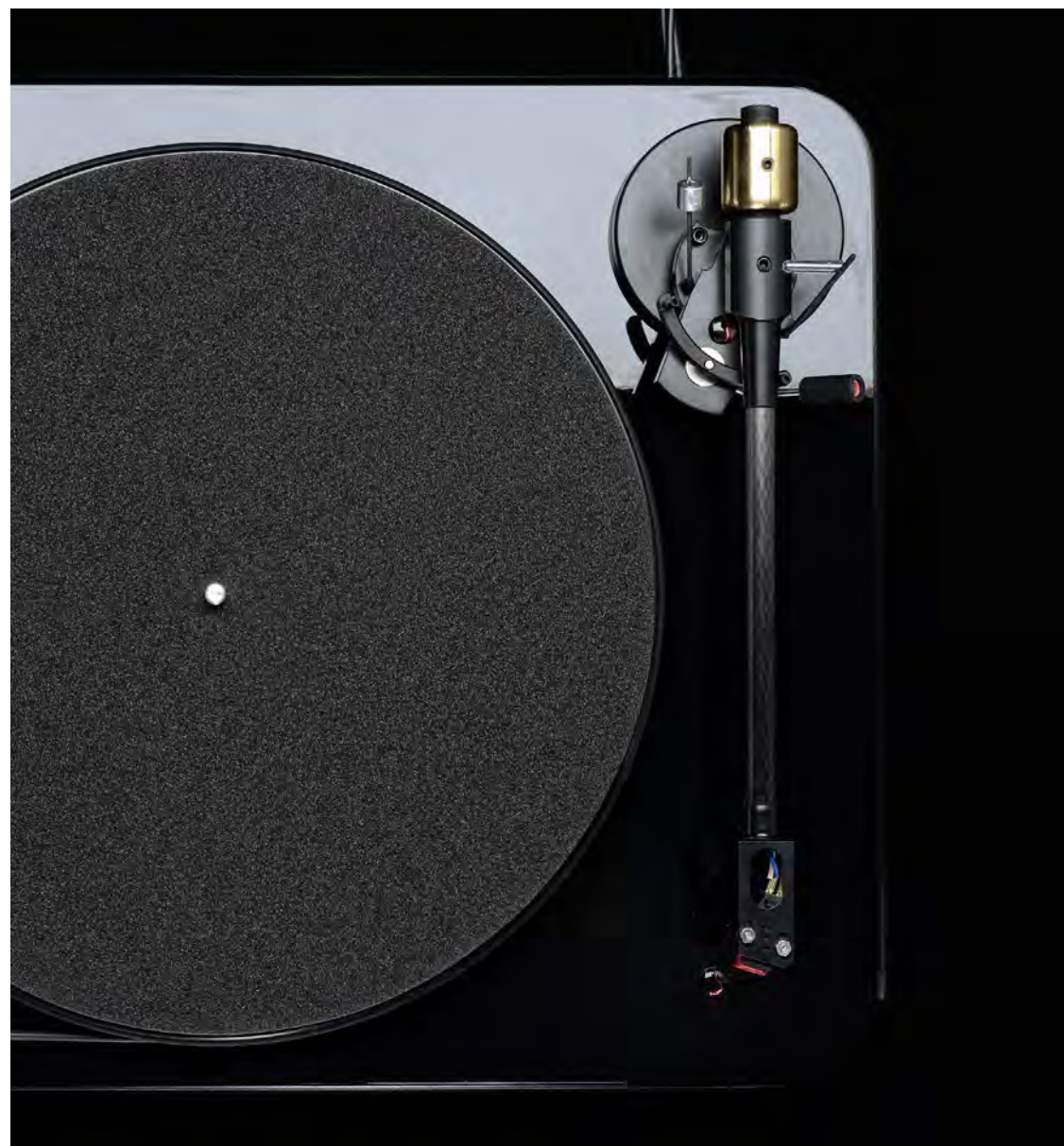
To give general advice, (I would encourage listeners) to further develop and improve understanding of the consequent system approach, to improve the sound of their hi-fi at home, to stay committed to high quality music reproduction, and to listen to a lot of good music.

In five years' time, how do you anticipate that the world of analogue audio will have changed?

Records are here to stay. I remember that very many years ago (it was in the early 80's when I was distributing Linn Products and Naim Audio), a well known electronic designer of a famous brand said, "Peter, it's over now with vinyl; better to give it up."

History proved that he was wrong. Very wrong... +

Right: If there needed to be any proof of Tom Fletcher and the legacy of Nottingham, it's in the name of this turntable –the Robin Hood!



Heinz Leichtenegger of Pro-Ject Audio Systems

Hi-Fi+: What drew you to the field of analogue audio in the first place and what do you regard as your specialties within that field?

HL: “Puhh...” That’s actually one of the longest answer I may have to give because actually my whole life and business carrier is about analogue turntables.

I am 55 and I come from that generation where the CD was born. So went through the whole big story as the CD tried to kill vinyl.

I come from a poor area north of Vienna. I wanted to have a hi-fi system that delivered high-end sound, but cost very little. That was the start of my career. I advised friends and later many more people more how to get a good sounding hi-fi stereo system for modest sums of money. Instead of a big hi-fi tower-type system with 1000 watts (or more?), a double cassette machine, an equaliser, VU Instruments, and four-way speakers, they instead got for the same price a turntable, a good but budget-priced amp, and a nice pair of two-way speakers with proper speaker stands and good cabling (and most of them still have these systems).

A CD player was not in discussion because it was super expensive, sounded cold and unnatural (especially at that time), and CDs would have been out of reach in terms of price.

For a fraction of the price you got a great deck with much better sound and the LP records were cheap: if you were lucky they were free, because some people threw them away in those days (oh, what a glorious time!).

My problem was that after some time, in the end of the 80’s, good turntables were getting expensive or rare because most of the serious makers had troubles with their sales volumes and prices went up. And plastic turntables from the Far East were things I did not want to sell. Every system had to be perfect for the customer, but also had to satisfy my standards of quality.

So, I had no turntable to sell anymore!

However it just happened that, one month after the ‘Iron Curtain’ fell, I learned that a Tesla factory that specialised in turntable manufacturing in the Czech Republic was closing its production.

I rushed there and found a heaven of electro-mechanical devices and supplies. Soon, the Pro-ject 1 turntable was born, and the rest is an unreal story of success.

In the next years, we fought for the analogue sound. Despite the big push of the CD industry, we were able to establish our brand more and more on the world market



and we convinced people about the magic experience of analogue music reproduction.

Our real specialty is that we try to produce products that sound high-end, but are very accessibly priced so that everybody can afford them. It's easy to design a cost-no-object deck, but very very difficult if you have some price in mind and don't want to use cheap materials and also want to keep the production in Europe.

Many in our industry say that analogue audio presently is enjoying a renaissance. Would you agree with this viewpoint and, if so, what do you think is driving that renaissance?

Sorry, that costs me a smile.

The analog renaissance has been going on for quite a long time, though it's only now in the a broader public mind set and recognized worldwide recognized, especially since it has been three to five years since the US began jumping on this trend. But it started way before, actually in the UK (praise their taste), at the end of the 90's. We realized this and therefore our idea was to make a really low cost table, still very good sounding, but in a nice fancy look also to attract the younger audience. That was the brightly coloured Debut (now 18 years on the market). That was the real start of the analogue hardware renaissance. We sold 10,000 per 10,000nds, later all over Europe, but also in Australia and Japan, and from 2010 in big volumes in the US, too. Also the never ending, increasing amount of used analog record shops caused

a slowly but steadily growing market, which exploded in the last several years.

I also have to admit that the hi-fi press and many music lovers and real listeners never gave up analog and supported it much more than the sheer market numbers (would suggest).

One of the catalysts for this revival was also that analog today is part of the intellectual lifestyle of the people. People now demand a certain 'deceleration' in their otherwise fast-paced lives, in a sense making their fast lives slower. More relaxation makes like more enjoyable. (Analogue audio is) the counterpoint to the MP 3 music, like in food – as in 'slow food' versus 'fast food.'

Additionally, a record is a "super sense" medium – one you can listen to, see, touch, read, and even smell (to enjoy the aroma of the cover jacket when the record is first unwrapped). Mmm, it's wonderful.

There are many more reasons, but the main is, it's a great experience!

How have engineering practices changed since you built your first turntable? Have the changes influenced subsequent designs?
In turntable design more or less everything was already invented. I have about 60 great



turntables at home, some designed from the 1960's, and they are fantastic. The main advantage what we have today, is that we have access to high-tech materials, like Acryl, carbon fibre, thermoplastoelastomers (rubber-like materials used for damping), neodymium magnets, better alloys, etc., etc. Also the machinery with ultra-precision CNC machines allows us to work with much lower tolerances, especially in lower price ranges

Above: The Pro-Ject Essential II retains all the core features that made Pro-Ject the most successful turntable maker of the modern age: robust construction, no unnecessary extra features, and a damn good tonearm!

Pro-ject is using a lot of known good technologies and simple-to-execute designs with better materials and higher precision.

What are the distinctive 'hallmarks' or signature elements of your analogue designs? What distinguishes your products from those of your competitors?

We studied many designs and realised that there are many ways to create a good sounding record table. You can't say there is only one right way; that's too easy. Therefore, Pro-ject is producing an array of different solutions.

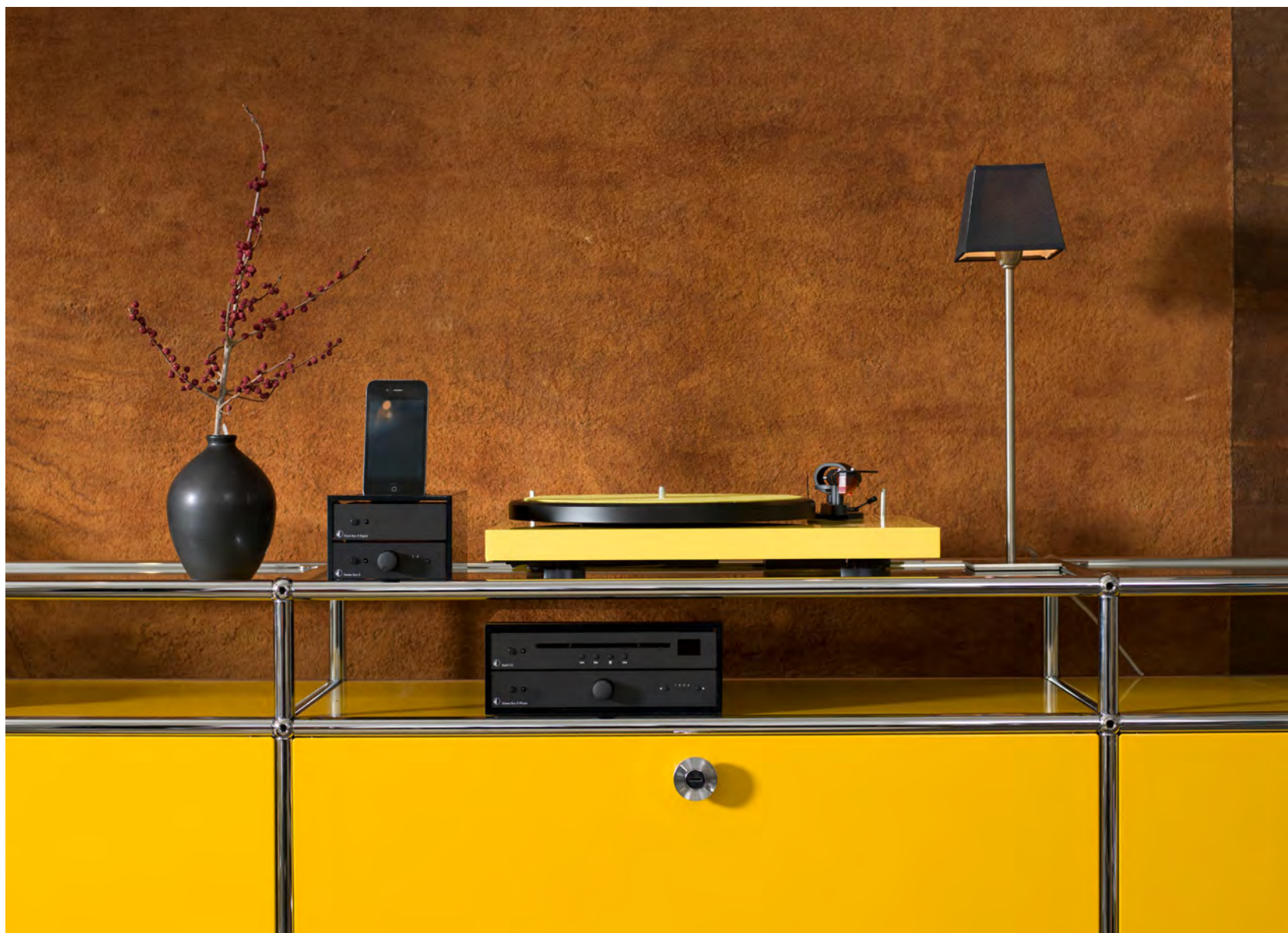
Energy-to-mass transporting designs, sub-chassis designs, mass-loaded designs, or some combination of all of these approaches are possible. Unipivot arms, kardan bearings, radial-bearing types are again all possible approaches.

All have advantages, and all have drawbacks.

The more we try to understand how to reach a better, more neutral sound the more we realise that some materials leave a certain 'footprint' in the sound.

Therefore we usually try to use sandwich construction with different materials to balance the acoustics.

Right: In recent years, Pro-Ject has branched out to include a range of high-value electronics, and it's made turntables in a wide range of finishes, including bright yellow!



The big difference between Pro-Ject as compared to anybody else is that a customer can choose from our programme the deck which, for him, sounds correct and best, and which best fits his environment and system, and which has the best subjective appearance, in any price range for any wallet.

Some prefer to treat turntables and tonearms as integrated systems whose elements should be developed in concert with one another. Others prefer to take more of a 'mix-and-match' approach. What is your recommendation and why?

Tonearms and turntables are a less critical problem. So, you can use different arms as long you respect the geometrical facts.

Unfortunately we see a lot of very good turntable designs, which are downgraded by relative "weak" tonearms in order to reach a certain price point.

Throughout our product line you will see that the higher the quality of the turntable, the better more precious the tonearm that comes with it!

What is outside of the question of taste is the correct mechanical fit of the cartridges to their tonearms. There is no way around the fact that the arm and cartridge have to have the correct resonance frequency. They must be compatible; otherwise you even risk to danger your speakers.

Being as candid as possible, how would you compare the relative merits of digital and analogue source components? What things do you think good analogue sources do singularly well?

This is an endless discussion what sound betters. For my ears analog sounds better, much more fluid, easier to listen, more relaxed. However the difference have got much smaller in the past. Modern digital recordings and equipment can sound pretty good too.

Which elements in the analogue audio signal path—turntables, tonearms, phono cartridges, or phono stages—have the most overall impact on sound quality?

All must match. You always hear the weakest link.

The cartridge has the most impact in the colour of the sound, because like speakers they are electro-mechanical transducers.

So, cartridge choices will be influenced most highly by listeners' tastes. (I have 50 different cartridges, ten of which I use regularly for listening to different styles of music.)

The arm and the turntable are much more objective. They are quiet and stable, or not!!

Which three of your favourite analogue demo discs might you recommend to our readers? (It's hard to choose just three, we know, but please do your best.)

Yes, you are right.

Today, I would choose: Keith Jarrett's Koln Concerts, Chuck Magione's Children of Sanchez, and Stravinsky's Firebird Suite (the Reference Recordings version).

Tomorrow my answer might well be different.

What set-up or installation tips would you give the newcomer... and what guidance would you give to the expert?

Buy a turntable with good pre-installed cartridge.

We see very often that the wrong cartridges are chosen for our tables, or they are badly installed. This is true even, or perhaps especially, with our more costly sets

Therefore, we offer pre-installed sets – so called 'Superpacks' – in all price ranges with perfectly aligned cartridges that are fitting to the level of the table. So high-end tables come with high-end MC cartridges pre-mounted, and so forth.

The rest is quite easy: set the level, care about a solid support, check the correct VTF, and here we go. We don't sell audiophile puzzles.

We recommend that experts make an effort to understand the physics of a turntable and cartridge. Try different geometries and null points, use higher quality phono stages with different EQ setting options and you will be surprised. Also, experiment with using different cartridges in order to get the best from all your records.

In five years' time, how do you anticipate that the world of analogue audio will have changed?

I don't think there will be a big change in the audiophile analog world, but I think more and more music lovers who where used to MP3s or CDs will come to the fascinating world of analog and consequently to the magic experience of stereo!

Analog music reproduction is the incarnation of hi-fi stereo,

Pro-Ject's goal is to bring as many people as possible to this fantastic hobby and to the enjoyment of their music. +

Roy Gandy of Rega Research

Hi-Fi+: What drew you to the field of analogue audio in the first place and what do you regard as your specialties within that field?

RG: Music drew me to the field. As a student I could not afford equipment to listen to music and so I had to make it. My specialties would be turntable, arm, and cartridge design along with an understanding of the turntables function and 40+ years of research and development into the subject.

Many in our industry say that analogue audio presently is enjoying a renaissance. Would you agree with this viewpoint and, if so, what do you think is driving that renaissance?

Yes: The renaissance is a very large growth in a very small niche market. I hope the growth is due to the possibilities of better sound quality but there are many other factors such as the difficulties with downloading, streaming, and the poor sound quality of any current digital format, particularly MP3, phones, and tablets.

How have engineering practices changed since you built your first turntable? Have the changes influenced subsequent designs?

At Rega we have seen huge R & D investment and changes to almost everything we make. However, elsewhere little has changed except that the increase in interest has seen a growth in massive, heavy acrylic sculptures.

The market success of our unique and controversial designs, which are based purely on demonstrable sound quality, has influenced all our turntable designs and we currently produce five models instead of the two which we produced for most of the company's life.

Most of our changes have come from new lighter and stiffer materials along with the increased accuracy available from CNC machines at a lower cost. We are also very proud of the hundreds of new design ideas that our research has allowed us to produce. Most of these are insignificant in marketing terms but hundreds of small improvements in shapes and materials have increased the ability of our turntables to accurately measure the micron levels of the record groove.

What are the distinctive 'hallmarks' or signature elements of your analogue designs? What distinguishes your products from those of your competitors?

The "hallmark" of a Rega turntable is that it is designed to attempt to measure the minute, microscopic vibrations contained in a record groove. We look at the real world of precision engineering and question the anecdotal mythology that has forever surrounded the idea of a turntable.

Some prefer to treat turntables and tonearms as integrated systems whose



elements should be developed in concert with one another. Others prefer to take more of a 'mix-and-match' approach. What is your recommendation and why?

Of course there are many people who wish to try new things. Hi-Fi in general has a large subjective element, which is ideal for those interested in experimentation and satisfying the neurotic urges that exist in many of us. Because the turntable has an almost impossible task of measuring vibration at the micron level, any change will alter the cartridge signal. However, in the engineering world, the turntable has only an objective function and that is a machine, tool, or instrument to measure the vibration contained in a rotating record, along with inputting the energy to rotate the record in a microscopically constant manner. The turntable, arm, and cartridge are all part of this machine and all need to be considered as a necessary part of the whole, while accepting that they require some different scientific and engineering functions.

Being as candid as possible, how would you compare the relative merits of digital and analogue source components? What things do you think good analogue sources do singularly well?

I don't understand why the answer to this question requires "being candid". The answer will depend on areas of musical interest and ability to discriminate.

Personally, I know many people for whom musical replay via YouTube on their phone or tablet is adequate for their needs and they

have no interest in an increase in quality. Most people eat readymade supermarket meals and are happy with the taste of frozen food, synthetic cheese, and factory-produced drinks. I am one of the few percent who are cursed or charmed with the ability to obtain intense pleasure from all my senses and actively seek to create that pleasure. Tasteless food makes me feel bad, so I don't own a freezer. I don't like background music or performers whose aim is stardom, but any special performer, professional or amateur, who cares and communicates, can make me cry, but I have never cried listening to recorded music of any sort. So my aim in the world of recorded music is to try and re-create the emotional elements that can make people cry. I own about three thousand LP's and about two hundred CD's. I still sometimes actively listen to music on LP but rarely on CD except maybe to transcribe song words or analyze an arrangement.

The simple answer is that neither digital nor analogue musical replay is good or bad. The artistic musical production possibilities using digital recording and mastering techniques far exceed anything possible on tape. But, if one wants to capture the specific performance characteristics of a special musician or an amazing voice, then this is only possible on tape and vinyl replay.

Above: The Rega turntable design is virtually a constant, improved by better materials, tighter tolerances, and less resonant structures in the plinth, such as in the RP10.



There are hundreds of thousands of badly recorded vinyl albums but maybe one or two thousand good ones. For me, most CD recordings emasculate the music and I have only about five that, for me, are listenable.

Both digital and analogue recording and replay are massively flawed sciences and it is difficult to understand how either can work at all. However, at its best the analogue approach far exceeds the digital both audibly and technically. Those that claim better measurements for the digital domain are simply measuring the wrong things.

Which elements in the analogue audio signal path—turntables, tonearms, phono cartridges, or phono stages—have the most overall impact on sound quality?

The signal from the record cannot be improved on (“you can’t polish a turd”) and missing information cannot be replaced so one assumes that the turntable/arm/cartridge, are important. However, the signal or music can be corrupted or destroyed at any stage so every part of the replay chain including amplifier and loudspeaker become equally important.

Which three of your favourite analogue demo discs might you recommend to our readers? (It’s hard to choose just three, we know, but please do your best.)

I don’t agree with the concept of “demo discs” or using discs to demonstrate the replay. I much prefer the concept that the function of the replay system is to demonstrate the disc.



What set-up or installation tips would you give the newcomer... and what guidance would you give to the expert?

Listen to the music. Don’t read reviews or magazines. Be confident in your own beliefs and what you hear. Find a good retailer who will let you listen and borrow equipment. Don’t spend large sums on equipment furniture or cables; most of it is a “con”. There is more available pleasure from listening to music than playing with hi-fi.

For the “expert”; I know many competent loudspeaker and electronics experts. I have never met a turntable expert. Almost all turntable accepted beliefs are anecdotal, mythological, or completely wrong.

In five years’ time, how do you anticipate that the world of analogue audio will have changed?

No change! +

Above: The Apheta 2 moving coil cartridge is designed to work in Rega’s best turntables, including the RP8 with its matching RB808 tonearm. The Aphelion and RP10 push the Rega envelope still further.

Touraj Moghaddam of Vertere Acoustics

Hi-Fi+: What drew you to the field of analogue audio in the first place and what do you regard as your specialties within that field?

TM: I found the timing of musicians, both individually and collectively, plus the emotions in the music when listening to my turntable were nowhere near a live FM broadcast or a well recorded tape. I actually recorded a TV programme of Thelonious Monk on VHS to compare to my turntable playing the same tracks on vinyl. His delicate touch and ingenious short stops that make his music come alive were present on the VHS recording and yet were virtually missing on the turntable! Of course the turntable sounded clearer and more 'HiFi' but not as emotional.

Surprised? Of course! I had sold my car to buy the hi-fi system! This comparison proved the turntable to be the culprit as the rest of the system was quite capable when listening to the VHS!

And so my journey to the world of analogue began in early 80's.

At that time I was completing my post-graduate project at Imperial College. Being outside the audio industry definitely had its advantages. This allowed me to look at the problem from a totally fresh perspective. It took a while to understand and spell

out the 'real' function of a record player – so important and yet surprisingly, never done before!

Without understanding the function of a record player, attempting to design one would at best result in a working piece of equipment and not necessarily one that could convey emotions – I mean high quality sound, but not really music.

Many in our industry say that analogue audio presently is enjoying a renaissance. Would you agree with this viewpoint and, if so, what do you think is driving that renaissance?

By 'Analogue' I assume we mean vinyl LP, which currently is by far the best media to store and play back music on.

When executed correctly and properly, vinyl would outperform even tape! Direct to disc cutting captures more of the music and the atmosphere than any other medium.

And how a microscopic groove on a piece of plastic yields such breath-taking music is almost a mystery!

The sheer quality, longevity and tactile nature of vinyl are the reasons for its renaissance. Most musicians, recording, mastering, and cutting engineers would endorse these too.



We should also not forget how ‘cool’ vinyl and turntables really are! The young generation love the idea of turntables and vinyl records. They may not enjoy the full quality of their records when using cheap and cheerful turntables but that could come at a later date.

I would encourage them to invest in a good vinyl collection. It will last the test of time, unlike tapes, CDs, and hard drives! And in time, a proper record playing system will bring them to life, as we do buying second-hand records every day!

I myself buy new and used records on a weekly basis.

How have engineering practices changed since you built your first turntable? Have the changes influenced subsequent designs?

The engineering world is constantly evolving and every time there are new components, material choices, and manufacturing techniques, we investigate the possibility of improving our products. Since the mid-eighties, introduction of improved electronic components plus great advances in precision engineering and manufacturing have all provided a platform to make our products better.

We do spend lots of time, however, testing and verifying to ensure that these lead to real improvements not just differences. This process is far more complicated than it sounds, by the way!



Often we witness changes that at first seem to be quite impressive and yet fail to deliver that which matters most – the music. Every step we take we compare against studio recordings where we know how the recording, mastering, and cutting

were carried out. This is something of a reality check. Without a proper and correct reference we could easily get lost in a maze of mere changes and not real improvements. Change for the sake of change.

Above: The Vertere RG-1 Reference turntable with the matching Reference tonearm is one of the best vinyl replay systems released this decade, and has created a significant following.

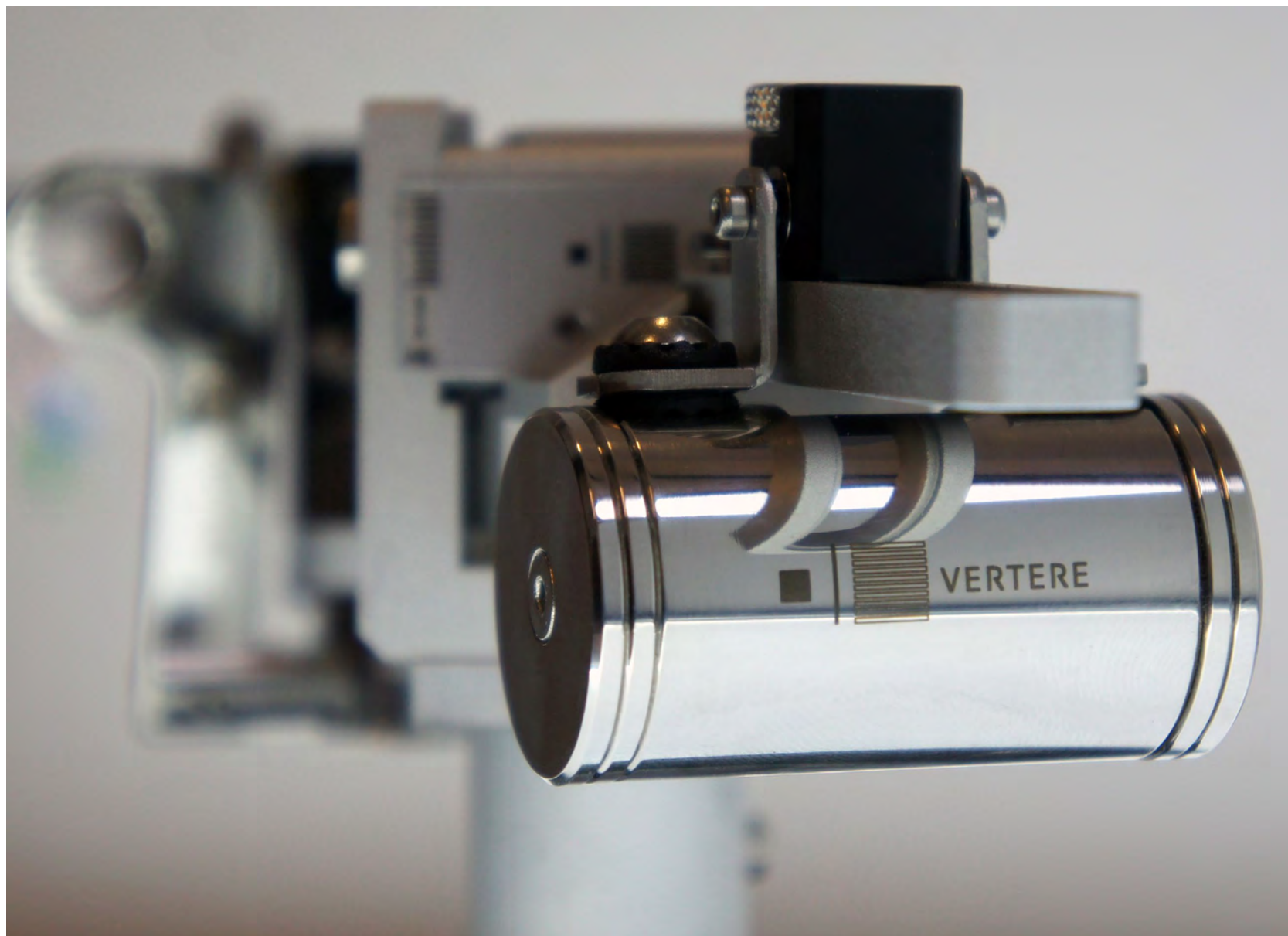
Taking our time and being diligent in this process also helps to combine a number of improvements and provide a real 'step forward' model. As an example, we now manufacture far superior main bearings for our record players. These utilise advanced materials and much tighter manufacturing tolerances. Also improved components with new circuit designs are used to make motor drives deliver far quieter and smoother running conditions. These plus many more examples, all provide a much more life-like vinyl replay than we could have achieved before.

What are the distinctive 'hallmarks' or signature elements of your analogue designs? What distinguishes your products from those of your competitors?

A number of unique features were first introduced in my original record player design, which have evolved and are now blue printed in my new reference record player.

These include: noise and stiction free tonearm bearings, an articulated and regulating tracking force counter weight system, split tonearm geometry to allow maximum information retrieval, linear control of the platter resonance utilising friction damping, constant belt tension mechanism via articulated motor system, and a self-centring, self-aligning, single-point main bearing system, and more...

Right: The counterweight on the Reference tonearm is fully articulated.



All these design features ensure the function of the record player is always kept in sight and not impeded.

As a result the absolute clarity, detail, natural timbre, and 'darkest' of backgrounds maximise dynamics and provide a life like performance. And with almost perfect timing of the musicians, individually and collectively, these performances then come 'alive' – the hallmark of a Vertere record player.

Some prefer to treat turntables and tonearms as integrated systems whose elements should be developed in concert with one another. Others prefer to take more of a 'mix-and-match' approach. What is your recommendation and why?

Turntable, tonearm, cartridge and the supporting structure provide the complete play back system. A record player's function is to measure the groove with respect to time. Thus a record player is in fact a super precision measuring device. The measurement of the groove provides the amplitude while 'with respect to time' gives us the frequency of the audio signal.

The stylus has to track groove modulations of fractions of a micron! And at 20 kHz it moves from side to side every 1/100th of a millimetre! So it does make sense to design the tonearm and the turntable together to fulfil these requirements. Of course they can also be designed independently as long as a 'working-zone' criterion is outlined for compatibility.

By this I mean a given turntable would be best partnered with a tonearm that is designed to be within that working-zone.

To achieve this we must first break down the function of a record player to (several basic requirements).

The turntable should index the base of the tonearm relative to the platter – both in distance and in movement.

And, the tonearm should keep the cartridge in one position relative to the mean-line of the groove while accommodating the record – note no record is flat or centred, even with the best vacuums and clamps.

Now as long as both the tonearm and the turntable do their job perfectly in relation to each other then there is no problem in mixing and matching. However, 'perfect' is rather a grand concept and quite unattainable!

Being as candid as possible, how would you compare the relative merits of digital and analogue source components? What things do you think good analogue sources do singularly well?

We all know that music is in nature analogue and consequently a 'pure' analogue recording should best serve to represent the original music.

Digital master recording however, has improved immensely over the last few years. Almost all leading studios now have some of



the best A to D equipment and the personnel to create amazing digital recordings.

Transferring these to analogue, however, can prove to be quite tricky. Indeed, many vinyl records that are cut from high-resolution files vary from being brilliant to being absolutely rubbish!

Although 'pure' analogue tape recording does have an edge over even the best digital recordings, it does however suffer from time degradation. After decades even the best well stored master tapes show signs of damage. So many are destroyed or have become unusable!

Above: Vertere's top tonearm leaves nothing to chance, even down to custom manufacturing the lift-lower arm!

And this is not unique to analogue tapes either. Even greater percentage of digital master tapes is now totally unplayable! In fact ironically the best medium for storing recorded music seems to be the vinyl LP – the one medium that everyone regards as the most fragile! The LP can last longer than either type of tape and even hard and solid-state disc drives!

We shouldn't be so concerned with 'is it analogue or digital'. Both done properly will

provide breath-taking results. Proper design of the recording and playback equipment will ultimately establish the quality of the recorded music we listen to and we should never abandon vinyl.

Which elements in the analogue audio signal path—turntables, tonearms, phono cartridges, or phono stages—have the most overall impact on sound quality?

Every component in this playback system is just as important as any other and the weakest link would always dictate the maximum performance level. It would be sensible to keep a reasonable performance balance common between these components.

Of course if future proofing is a criterion, it would make sense to have the turntable/tonearm to as high a standard as possible and partner them with a competent cartridge and phono stage. This combination will then allow the cartridge to perform at its best without the phono stage becoming the limiting factor.

Any future improvement then should be on phono stage and cartridge side.

It is, however, reckless to ignore the importance of the record player's supporting structure and the cables that connect the source components – we should always keep in mind that system's weakest link would be its limiting factor.

Which three of your favourite analogue demo discs might you recommend to our readers? (It's hard to choose just three, we know, but please do your best.)

Three albums!

When we do just an evening event with one of our retailers I alone take more than 150 albums! Of course we do not get the chance to play them all but there would be sufficient material to listen to for the evening.

However, it would be great to narrow them down to just three!

For me it has to be: Mozart's The Magic Flute – EMI 1964, The Philharmonia Orchestra & Otto Klemperer; Keith Jarrett Trio, Changes – ECM 1276, LC-2516 (1984 German Pressing); and Thelma Houston & Pressure Cooker, I've Got The Music In Me – Sheffield Lab (1975 German Pressing).

These three are amongst those timeless albums that embody the best in music, performance, and recording quality. And what's more, you can listen to them over and over again.

What set-up or installation tips would you give the newcomer... and what guidance would you give to the expert?

To the newcomer I'd say be very careful when cleaning your record player. Just kidding!

But seriously so many including us so-called experts have managed to knock off a cantilever at some point in time - so not a bad advice anyway.

In general any newcomer should expand their knowledge of their audio system if they want to optimise its performance. And they should not feel intimidated at all when asking questions especially enquiring from the original manufacturer. Systems only perform at their best when installed and setup correctly and each and every component has its own set of requirements to achieve this.

So I'd say go for it and be unafraid. But make sure you have sufficient insurance covering accidental damage!

For the expert there is only one rule: no matter how much we think we know, there is always so much more to be learnt. Knowledge and stupidity are probably the only two notions that truly give us an insight to the extent of infinity!

In five years' time, how do you anticipate that the world of analogue audio will have changed?

There are two issues we need to understand and keep in mind when we talk about 'Analogue': one is the recording side and the other playback.

To record in absolutely 'pure' analogue is and will get even more difficult as time goes on. The reason for this is lack of supply of highest quality tape and tape machines. We can resort, in extremely rare occasions, to Direct to Disc cutting. However, as you can imagine, it is very difficult to get musicians to sit in one continuous take and play a whole side of an album without any mistakes. There is also no room for errors in direct to disc 'live' mastering and cutting – any problem and it is a retake!

So it is more than likely that the source recordings will eventually be all from high resolution digital.

However, is high quality digital actually bad or inferior to an unacceptable level? There are many vinyl records cut today from master high definition digital files at ½ speed and sound absolutely amazing. In fact what little is lost with the original digitisation at the studio is to a great extent compensated by the higher resolution cutting at higher frequencies – thanks to ½ speed cutting.

Improving studio digital recording and our ability to cut records better during the next five years should be the direction to take. In fact we are currently working with one of the best cutting engineers investigating how to improve his cutting lathe to get even better results. +

Mat Weisfeld of VPI Industries

Hi-Fi+: What drew you to the field of analogue audio in the first place and what do you regard as your specialties within that field?

MW: Originally I had not planned to join the audio industry. Growing up I did essentially everything I could to move away from the industry. I had become a high school technology teacher in Web Design, Animation, Info Tech, and 3D modeling as well as teaching the same as a college professor.

My Mom and Dad, Sheila and Harry Wesifeld, owned and ran VPI and when my mom died from pancreatic cancer, I felt obligated to step in and help. In the process I found a true love I never appreciated or knew I had for the analogue industry and VPI. Before I knew it I was designing and working on turntables alongside my Dad and immersed myself into this world. I can't imagine doing anything else now!

Many in our industry say that analogue audio presently is enjoying a renaissance. Would you agree with this viewpoint and, if so, what do you think is driving that renaissance?

I have to agree. The main driving point is the community and "cool" factor to analog. People like to gather round and listen to records together. They will compare systems, share music, and share the experiences they have with one another. You don't get that

from digital! When someone buys a record they have something in hand that they can look at, touch, and share with others. There is a pride in ownership both in the records and the turntables the person has that they don't get from digital.

How have engineering practices changed since you built your first turntable? Have the changes influenced subsequent designs?

Technology has moved forward with 3D modeling, CAD, and the materials used. That being said, engineering practices have gotten lazy! The "engineers" of today are missing the hands on education of a wood shop in the classroom! VPI has explored and benefitted from 3D technology in our tonearm, but the practical process of engineering is turning into a lost art.

Harry designed the first VPI turntable, the HW 19, on a napkin. The Aries was drawn on a piece of cardboard. Following best VPI practices, I designed the Prime on a piece of cardboard and it has been our greatest success.

What are the distinctive 'hallmarks' or signature elements of your analogue designs? What distinguishes your products from those of your competitors?

In the past VPI has always been known for the latest upgrade or tweak by Harry Weisfeld. In recent years the most distinct



“hallmark” is our 3D printed tonearm. When I began working full time at VPI, my dad Harry was working on a new arm that was taking a bit longer to finish. While I was still a high school CAD teacher I used to have my students re-create my dad’s designs so they had a real life exposure in the classroom. On this day my students were working on the JMW arm, which made me throw out to dad, “Why don’t we 3D print the darn thing?!”

That set off a spark that led to the research and development that created the JMW 3D arm. The other hallmark is the Prime turntable. The Prime is my first solo project and was made to be an affordable super table offering the best high-end bang for the buck and having distinct curves and aesthetic features that can be identified as a true VPI!

Some prefer to treat turntables and tonearms as integrated systems whose elements should be developed in concert with one another. Others prefer to take more of a ‘mix-and-match’ approach. What is your recommendation and why?

Designs are subjective and I understand the mix-and-match mentality. However, I don’t drive a Ford and have a Honda steering wheel. When you have two components coming from the same company you know the math, the design, the synergy is all made to work! Mixing and matching can be a lot of fun and give different sound signatures, but consistency in pairing reigns supreme; that way, you know that your table and arm are working as the manufacturer originally intended.

Right: The Prime turntable, complete with the world's first 3D-printed tonearm, marked a significant change for VPI.



Being as candid as possible, how would you compare the relative merits of digital and analogue source components? What things do you think good analogue sources do singularly well?

Good analogue sources put the instruments into the room. When you walk down a

street in New York City and you can hear someone practicing their violin from a cracked-open window, your mind knows it is a real instrument! A good analogue source can bring the violin into your home with the realism and space of the actual violin. On the other hand, digital is great when you are cooking dinner or cleaning your home and want music playing without really listening to the music. Digital is great background music,

great in the car, but for me, doesn’t do much for the focused sit-down listening experience.

Which elements in the analogue audio signal path—turntables, tonearms, phono cartridges, or phono stages—have the most overall impact on sound quality?

The cartridge 100%! It starts at the source and everything else in the chain can only mess up the initial analog signal. From there it is the dampening and rigidity of the tonearm. Everything in the chain is important but if it isn’t right from the start then it is fighting an uphill battle.

Which three of your favourite analogue demo discs might you recommend to our readers? (It's hard to choose just three, we know, but please do your best.)

That is a tough one, but overall I like to mix it up with Sonny Rollins' Way Out West, Daft Punk's Random Access Memory, and Sonny Stitt's Blows the Blues.

What set-up or installation tips would you give the newcomer... and what guidance would you give to the expert?

The first advice I would give is to not psych yourself out! Yes, there is skill involved in setting up a cartridge, but it isn't rocket science and a lot of people go in with the mentality of, "I'm not worthy", when setting up their table. Read the manual, watch a setup video, and find out the recommendations of the cartridge manufacturer. That last part is key because every cartridge is different and younger/newer turntable users aren't aware of how drastically different each cartridge can be. You can get a cartridge 95% there in 15 minutes. The extra 5% might take someone another three hours. Do you want to spend three hours with a microscope, or three hours listening to your records?

In five years' time, how do you anticipate that the world of analogue audio will have changed?

Analogue will become more mainstream and less tweaky. Gone are the days where the customers were excited to take a screwdriver, open up their tables, and tweak them out. That being said, there will



always be the audience that appreciates and loves the DIY aspect of our industry. Also, in five years, all of the fad turntable companies will disappear since there are a lot of fly-by-night companies trying to get in on the action, but that aren't driven by the love of music and vinyl that analogue audio was built on. +

Above: The VPI unipivot arm design can use both traditional and 3D printed arm-tubes, and has one of the most easy to operate on-the-fly VTA adjustments.

Setting Up a Phono Cartridge

The Andre Jennings Way

Jonathan Valin

This in-depth feature article on cartridge set-up first appeared in issue 244 of our sister magazine, *The Absolute Sound* (TAS).

Significantly, the article was written (and photo-illustrated) by the veteran writer/photographer Jonathan Valin, Executive Editor of TAS. The piece documents in step-by-step detail the time-proven cartridge set-up procedures used by master analogue technician and frequent TAS contributing writer, Andre Jennings.

Enjoy.

Because it is a thing of beauty to witness and because the results make such a huge difference in sonics, I'd like to take you through the process of mounting, aligning, and optimizing a moving-coil phono cartridge the way an expert does it. That expert is my friend and TAS colleague Andre Jennings.

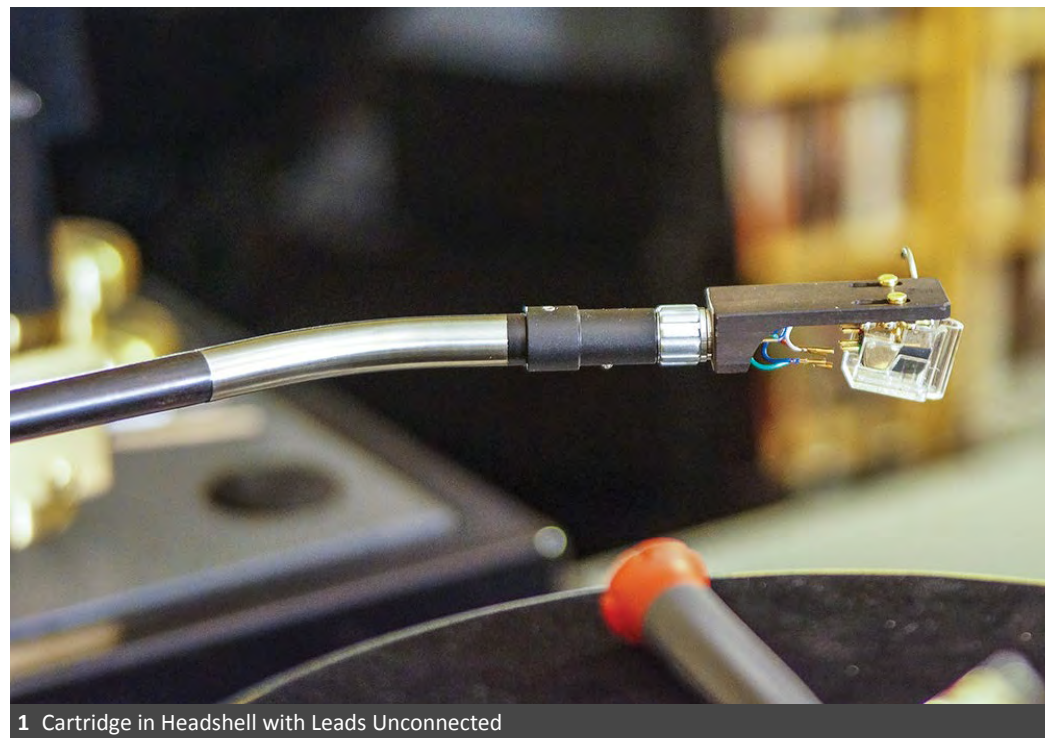
Although I am capable of handling several of these set-up chores on my own, I generally leave the fine-tuning to Andre. He's had experience with just about every cartridge and tonearm currently on the market (as well as many that are no longer marketed), and has set up cartridges and tonearms for friends and colleagues throughout the Midwest and for manufacturers at trade shows. His expertise is, IMO, unrivaled.

The photos I've taken of Andre's work actually involve the setup of two different cartridges in two different tonearms—the Goldfinger Statement in the DaVinci Master Reference Virtu tonearm and the Ortofon MC Anna in the Kuzma 4Point tonearm.

Like old age, cartridge setup—done right—is not for sissies. It is an arduous, painstaking process that requires nerves of steel and infinite patience. If, like me, you tend

towards clumsiness or near-panicky fits of pique when handling very small, very delicate items, you would be well-advised to leave cartridge setup to an expert like Andre—or to an analog maven of your acquaintance or a retailer with a good deal of experience in the field. The cartridges being installed here are anything but cheap—\$8,500 (Anna) to \$15,000 (Statement)—and getting fed up and doing something careless or stupid while handling them can end up costing you a lot of money.

1 Andre begins, of course, by mounting the cartridge in the tonearm's headshell—here the Goldfinger Statement in the DaVinci Audio Lab Master Reference Virtu. Unlike the headshell of DaVinci's previous flagship *Grandezza* tonearm, the Virtu's is removable, which makes attaching a cartridge to it a bit easier (although it also adds a potentially resonant "joint" to the structure of the 'arm). Obviously the width of the mounting screws has to be compatible with both the slots



1 Cartridge in Headshell with Leads Unconnected



2 Cartridge with Tonearm Leads Connected

in the headshell and the screwholes in the cartridge, and the length of the screws has to be sufficient to clear the added height of the headshell, while still fastening firmly into the cartridge body. (Nowadays, most cartridges have screwholes tapped into their bodies—a big improvement over the so-called Golden Age of Vinyl, when cartridges only came with molded plastic loops on either side of their plastic chassis and had to be attached to the headshell with screws, washers, and nuts, adding difficulty to the mounting process and resonant mass to the entire setup.)

Before alignment Andre snugs the screws down but doesn't fully tighten them, as the cartridge will need to be moved forward and back in the headshell and twisted slightly side-to-side to achieve proper alignment.

2 Step two is attaching the tonearm leads to the output pins at the back of the cartridge. Although I'm not showing you the process—just the result—this is (or, at least, can be) a tricky little step, depending on how handy you are. You have to use the right tool for this job, and

fingers aren't it. You'll need tweezers or small needle-nose pliers to do it right—and you'll still have to be careful! The stylus of a cartridge, like the Goldfinger Statement here illustrated, is completely unprotected by the cartridge body—sticking out in front of it like a tiny invitation to disaster. If you seek to gain leverage while attaching the clamps of the color-coded tonearm leads to the (usually) color-coded cartridge pins by putting a finger on the front or side of the cartridge, you may very well bump that stylus with some force if your finger slips, and, folks, take it from someone who knows: You do not want to hit the stylus of a Goldfinger Statement (or any cartridge, for that matter) with your finger. Keeping the stylus guard on the cartridge when attaching the leads is the safest procedure, and what Andre has done here.

If you're attaching a cartridge to a tonearm for the first time or switching cartridges, you may find that the clamps at the ends of the tonearm leads are too tight or too loose to fit snugly on the cartridge pins. Don't force anything! The clamps may need to be slightly enlarged or slightly narrowed prior to attachment. You can do the former by inserting a toothpick into the clamp, opening the gap up a wee bit; to close it down some, use your needle-nose pliers, but use those pliers gently and sparingly! The clamps at the end of tonearm leads can only stand a little bit of strain. If you pull them or twist them or abuse them repeatedly, chances are they will break off, making it necessary to solder them to the tonearm leads again (a job you don't want to do).

3 Step three is setting VTF (vertical tracking force). You need to do this before alignment, but you don't have to get VTF exactly right at this point—just in the ballpark of the manufacturer's recommendation. You will need to check VTF again in any event after alignment and other adjustments have been made—and later by ear.

There are several digital stylus-force gauges on the market; if you're heavily into analog I would recommend purchasing one of them. They are more precise than Shure's mechanical gauge, although be aware that some of them are affected by a cartridge's magnetic field. You can tell if you've got one of



3 VTF Gauge

these if the VTF reading changes to any value other than 0.000 as you prepare to lower (or actually lower) the cartridge onto the gauge. If your meter does fluctuate as you position the cartridge above the gauge's measuring platform, stop and press the TARE button. This should zero-out the meter, after which you can continue lowering the cartridge.

4 Step four is attaching an alignment jig to your turntable/tonearm. Once again, there are many of these on the market from freebies on the Internet, to protractor-style jigs like the custom-made one from Dr. Feickert that comes with the DaVinci Virtu tonearm, to engraved-mirror ones from Wally Tractor, to the dedicated paper or plastic graphs and other devices invariably supplied with tonearms.

I'm not going to go into the science behind alignment. Suffice it to say, that a cartridge in a pivoted arm is only exactly in the right position (in perfect tangency with the groovewalls) at two points in its arc of travel. Everywhere else it is slightly out of perfect tangency. A straight-line-tracking tonearm, OTOH, is always in perfect tangency vis-à-vis the groovewalls. However, neither a pivoted nor a linear-tracking tonearm will be "right" if it is not properly aligned to begin with.

Basically, alignment is a two-part process: 1) setting overhang, and 2) aligning the stylus. The first is accomplished by moving the cartridge back and forth in the headshell (toward and away from the tonearm pivot point) so that the stylus fits precisely in the

pinprick or crosshairs engraved on your protractor at one or two specified points in its arc of travel (or, with a straight-line tonearm, remains in the groove of your protractor through its entire radius of travel). Alignment is accomplished by twisting the cartridge body so that the stylus/cantilever assembly is perfectly "squared up" within the engraved rectangular grid surrounding the pinprick/crosshairs on your protractor (while the stylus tip is sitting in that pinprick), so that the stylus is not just sitting in precisely the right point(s) for proper overhang but is aligned so that it is squarely in that point and not at an angle to it. You can see Andre adjusting alignment in the photograph; he is using a flashlight in his cellphone to illuminate the cartridge and the jig.

Most modern cartridge bodies are not squared off. Because of this, Andre always aligns the stylus/cantilever assembly instead of the body of the cartridge. The most precise approach is to try to align the cantilever to the sightline running along the pinprick or crosshairs of the alignment jig. Basically this involves setting the stylus in the pinprick or crosshairs of the alignment grid and, from the front of the cartridge, following the sightline of the alignment grid running alongside or below the cantilever. Adjust (twist) the cartridge body in order to get the cantilever to lineup with this sightline. (This is easier to do, and can be more precise, with mirrored protractors that allow the reflection of both the cantilever and sightline to both be seen from the proper viewing angle.)

"Alignment is accomplished by twisting the cartridge body so that the stylus/cantilever assembly is perfectly 'squared up'."



4 Alignment tool



4 Cartridge Sitting in Alignment Tool



4 Alignment Process



4 Andre Checking Alignment

Precision cartridge alignment can be a tedious, time-consuming task, and it takes someone with a steady hand, a keen eye, a good deal of previous experience, and the patience of Job to do it accurately, safely, and thoroughly.

5 Step five is setting stylus rake angle (SRA)—a variant of what we used to call setting VTA (vertical tracking angle) back in the day. 'Course back in the day we adjusted VTA solely by ear. Received wisdom was that it should generally be set so that the tonearm was parallel to or slightly below parallel to the LP's surface. In practice, this always seemed to give you a richer, fuller sound with less treble bite, and in those days reducing treble bite was a good thing given the state of tonearms, moving-coil cartridges, and LPs (particularly Mercury LPs).



5 USB Microscopic Camera

However, it turns out this formula, for all its salubrious effects in listening, was technically incorrect. In March 1981, Jon M. Risch and Bruce R. Maier published an article in Audio magazine titled "More Than One Vertical Tracking Angle," in which they pointed out that, in order to play back an LP properly, in theory the playback angle of the stylus ought to be the same as the angle of the stylus in the cutting head, and their research determined that the cutting angle on most of the LPs listened to was typically 92° (not the 90° or less that we had always assumed was right).

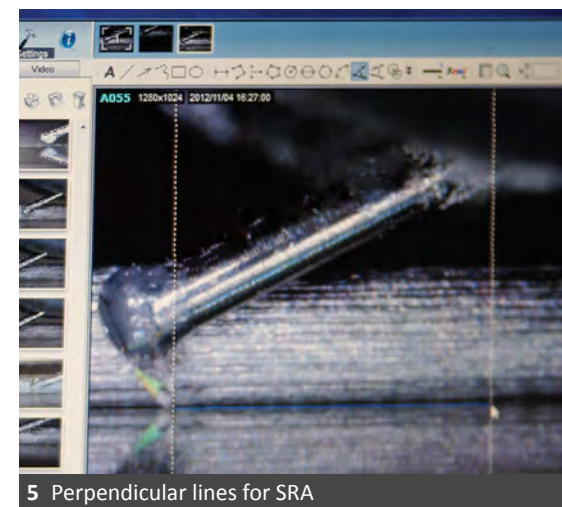
The article didn't have much effect until Michael Fremer of Stereophile, bless his analog heart, rediscovered it. Since then there has been a bit of a mini-revolution in cartridge setup, in which measuring SRA and

adjusting VTA to get SRA theoretically right—or close to right—have come to the fore.

The process of measuring SRA is not for the weak of spirit. To do it you must have a digital microscopic camera, a stand to put it on, a computer with a good deal of processing power, and, as is the case with every aspect of cartridge setup, a dedicated tweeker's spirit, nerve, and patience.

Pictured on the previous page is one of Andre's digital microscopic cameras, sitting beside an Acoustic Signature Ascona turntable with a Kuzma 4Point tonearm in which an Ortofon MC Anna has been mounted. The microscopic camera is a USB device that plugs into a laptop computer, whose screen you will see shortly. What it does—once you get the stylus in precise focus (a process so demanding that I literally couldn't stand to do it on my own)—is take a close-up picture, like the one below this paragraph, of the stylus sitting on a perfectly flat surface with, in this case, a cylinder of pencil lead, which also must be focused, sitting behind it to provide a flat horizon line.

Software, which comes with the camera, allows you to adjust two perpendicular lines so that one of them runs straight through the shank of the stylus to the contact patch at its tip (In case you're wondering why the perpendicular line in the photo above is not running straight through the stylus' shank to the contact patch, this is because, unlike typical moving-coil styli, the tip of the Ortofon Replicant 100 stylus of the MC



5 Perpendicular lines for SRA

Anna is not centered below the vertical shank of the diamond. The geometry of this Giger-type stylus is asymmetrical; thus, measurements are not taken down the center of the stylus, as would normally be the case. Instead the rear edge of the stylus provides the reference, for which see the photo below.)

Once the perpendicular lines of the measuring software are properly adjusted, they are then rotated from a position perpendicular to the record surface to a position parallel to the record surface. The computer then calculates the stylus rake angle (symbolized by the little white curve running from the black line at the back edge of the stylus to the flat surface the stylus is sitting on). In this case the measured SRA was 89.725° .



5 Measuring SRA

To adjust SRA for theoretical correctness, you then raise (or lower, depending on your reading) VTA until the SRA (which must be measured again—often repeatedly) is somewhere between 91° and 92° . (The slop built into this setting allows you to season by ear and by typical record thickness.) In the screenshot above, you see that SRA has been adjusted, by raising the back of the tonearm, to a closer-to-theoretically-correct 91.477° (which is where I liked it best).

The upshot of this SRA business is that the received wisdom of the past was wrong, or at least incomplete. To get theoretically correct SRA, a tonearm could (surprisingly) be raised above parallel to the record surface (sometimes a good deal above parallel), depending on the native SRA of the stylus (which, in Andre's considerable experience, can range from as low as 86° to as high as

97° —and can also differ substantially from sample to sample of the same cartridge). Of course, your ears must be the final judges in this matter (as in all things audio). My own experience has been that a setting of precisely 92° doesn't always "sound" best. (Andre agrees and typically aims for an SRA of 91.3° to 92° , the exact setting being adjusted by ear.) Whatever SRA you ultimately decide on, be assured that getting rake angle right (or right for you) has profound effects on every aspect of the presentation—from overall balance to resolution, dynamics, staging, and imaging.

6 Step six of Andre's setup is adjusting azimuth. There has been a lot of nonsense written about azimuth—some of it, alas, in the pages of TAS. Trust me: Azimuth matters, and getting it right doesn't just confer a theoretical advantage; you can readily hear the difference (as you can with SRA).

Unfortunately, getting it right isn't easy. Once again, you're going to need a computer and, to do it properly, Dr. Feickert's wonderful software program, Adjust+.

Adjust+ is actually a suite of programs that permits the precise measurement of all sorts of things, from turntable speed to (as you will see) harmonic distortion. But its foremost function is setting azimuth with high precision.

To use it you have to have a test LP (one comes with the software, although Andre



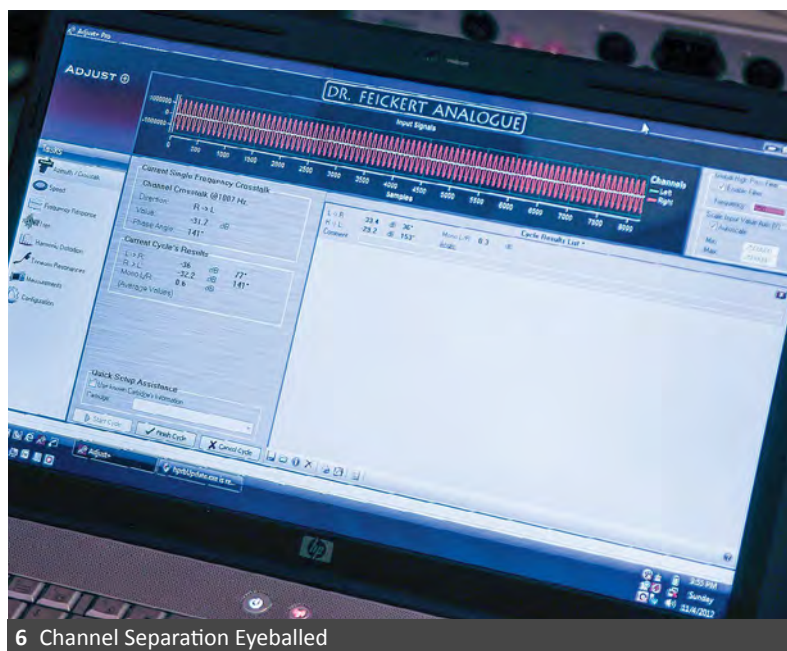
6 Ultimate Analog Test LP for Adjusting Azimuth

prefers to use The Ultimate Analog Test LP from Analogue Productions). Here's the drill: Before playing back 1kHz (mono) reference tones for the left and right channel (tracks one, two, and three of TUATLP), you route the signal from the outputs of your phonostage via a (supplied) RCA-to-3.5mm-jack cable to your computer's mike input. (Andre actually uses a sophisticated outboard 3.5mm-to-USB converter.) Adjust+ then measures (in real time) the mono output of both channels, then the left and right channels of your cartridge, calculating average left-to-right and right-to-left crosstalk in dBs.

Without azimuth adjustment, neither Andre nor I have ever seen a cartridge that measures the same (or even close to the same) crosstalk in both the left and right channels. At the top of the next column, you can see the initial test we ran of the Goldfinger Statement cartridge, adjusted by eye and mirror so that it "looked" as if azimuth were correct.

Crosstalk in this "eye-balled" setup measured -33.4dB L-to-R and -29.2dB R-to-L. Now, folks, that is better than a 4dB difference in crosstalk—from what "looked" like a fairly correct alignment! It should go without saying that imaging and soundstaging would be audibly affected by this setup, and so would timbre.

After considerable trial-and-error (unlike the marvy Kuzma 4Point, the DaVinci Virtu tonearm does not have a geared mechanism



6 Channel Separation Eyeballed

to adjust azimuth—you just loosen a set-screw and twist), Andre grew closer and closer to getting optimum crosstalk (equal channel separation and phase angle) from both channels.

Like everything else I've written about in this article, azimuth adjustment can be a tedious process, but the results are certainly worth the effort. In the end this is the reading Andre got by means of Adjust+ (and his own inexhaustible patience):

You may not be able to see this on the page, but the final crosstalk measurements show -35.5dB L-to-R and -35.4dB R-to-L. Now,

these aren't just sterling numbers (although they are that); the results are instantly and dramatically audible in playback.

(Just as a side note, after mounting, connection, VTF, alignment, SRA, and azimuth, Andre also measured THD via Adjust+ with the Goldfinger Statement in the Da Vinci Virtu tonearm and came up with the best results he's ever seen from any cartridge and tonearm: 0.21% in the left channel and 0.29% in the right.)

Throughout all of these procedures, each parameter is rechecked as necessary to ensure that subsequent adjustments haven't



6 Channel Separation Max'd Out with Adjust+

affected the others. And once again and above all other considerations, your ears should be the final arbiters when fine-tuning the setup.

Although it takes considerable expertise, getting everything just right in cartridge setup—as Andre does—has a tremendous effect on the overall sound. Those who dismiss analog as a form of nostalgia simply haven't ever heard a great turntable, tonearm, and cartridge set up by a genuine expert. Thanks to Andre I have (on many occasions), and I'm here to tell you that, IMO, hi-fi playback doesn't get better than this. +

Is Analogue Audio Competitive with High-Res Digital Audio?

Alan Sircom

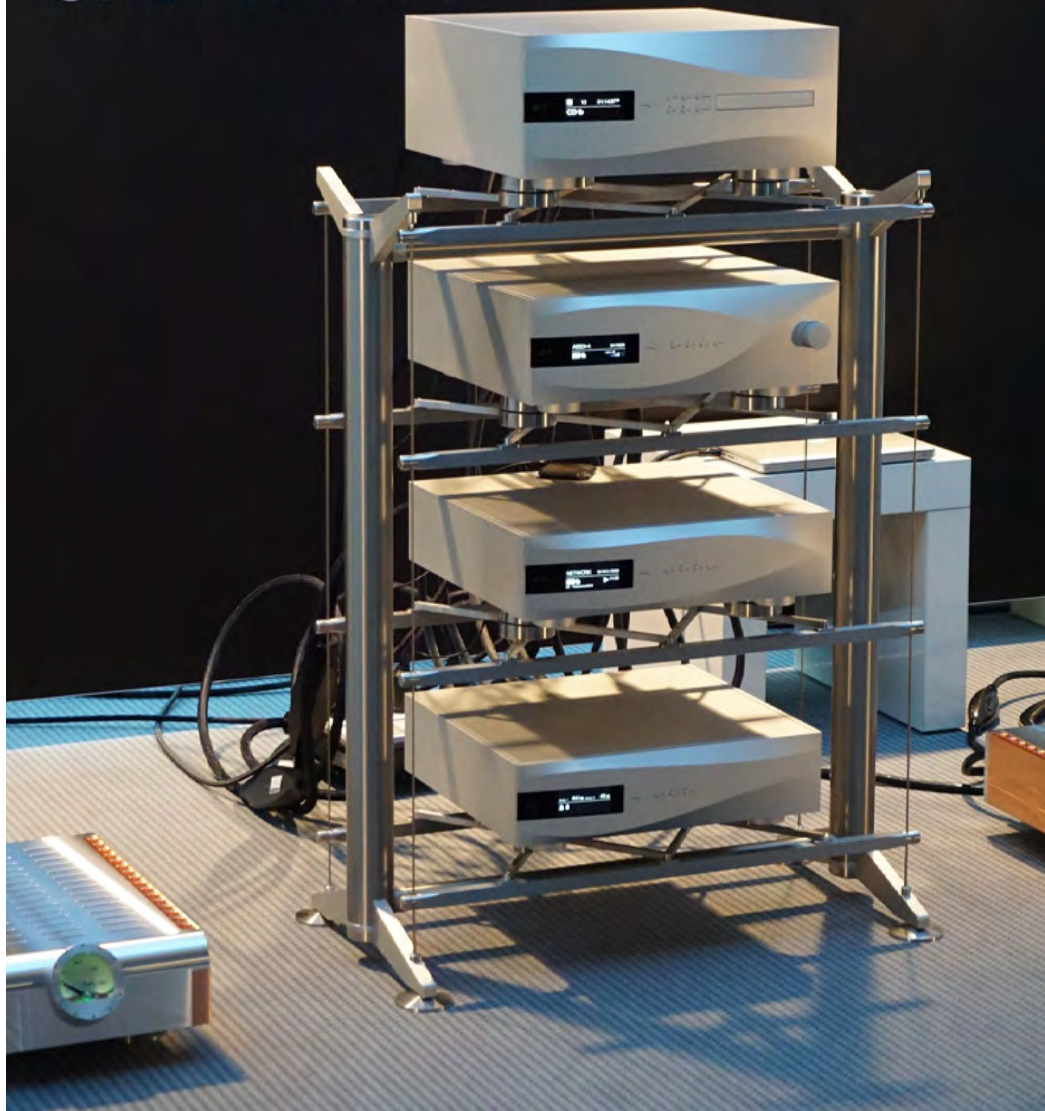
To some of the more hardcore audiophiles out there, analogue is the original high-res audio, and nothing about digital audio can compete. Paradoxically, there are even people who believe the sound of CD audio files when transferred to vinyl – or open reel tape – to be better than the original CD master. It must be said however, that this is a relatively extreme, and extremely hard to defend, position.

A more pragmatic assessment of the high-resolution and analogue audio battleground is in order. Notionally at least, the digital files hold all the aces: any digital format will have better signal-to-noise ratio, lower inherent harmonic distortion, the absence of distortion inherent to a cartridge tracking an arc across the side of an LP, better pitch stability, no wow or flutter, no cogging effects, no rumbles, no damaged groove walls or stretched tapes, no surface noise, clicks, or pops... the list goes on. It would be logical to assume that such marks against analogue would make even the most low-fi digital infinitely better than analogue, and to some who side strongly with the digital audio world, that's exactly how the world is. To them, digital is better. End of story.

Right: Analogue and digital sources can complement one another beautifully as in this Burmester/Thorens system



ONLY THE MUSIC



However, that's not a universally held view. Many still prefer the sound of analogue, and even suggest the format is more intrinsically high-resolution than any digital format. The discussion here centres around the way music is recorded in the digital domain, as this creates finite musical samples that are inherently limited in terms of frequency response: Nyquist sampling theorem dictates that the maximum frequency response is $\frac{1}{2}$ the sampling rate, so a 44.1kHz sampling rate will not record anything higher than 22.05kHz, where LP has no such 'brick wall' filter. Also, the word length of CD-resolution digital audio files does not provide enough resolution compared to analogue.

Of course, for this 'infinite resolution' argument to truly hold water, it notionally requires an absence of digital conversion throughout the whole signal chain. If the argument for vinyl's high-performance status is that it doesn't have CD's 'brick wall' filter cutting off frequencies beyond 22.05kHz, then having a recording made at 96kHz or 192kHz is simply making that same brick wall a little more distant. And, if we are relying on a complete analogue signal chain, although there isn't a rigid 'brick wall' point, the functional limits of tape and tape heads means any ultrasonic component of an analogue recording is swamped by

Left: Many audiophiles regard the DCS 'stack' as the 'gold standard' against which all other high resolution digital audio sources should be judged

instrument self-noise and the mechanical limits of the system. The roll-off of higher frequencies might be more 'organic' in an all-analogue signal chain than its digital counterparts, but what is actually recorded, what can be cut on a lathe, and what can be reproduced on a turntable in reality doesn't provide much beyond 20kHz anyway.

However, at the leading edge of recording technology, there are 'difficult' questions being asked about the very nature of digital sampling. The Master Quality Authenticated movement suggests conventional digital audio's frequency-domain sampling fails to take subtle timing issues into account, something that analogue systems address automatically. MQA's promotional material points to analogue recording and replay systems as a high-water-mark of sound quality in the home, which is a significant statement from companies with coders and engineers who have spent their entire lives in the digital domain.

The common dismissal of analogue audio by high-resolution digital supporters comes down to noise, whether tape hiss in the recording chain, or surface noise on an LP. However, to quote the late, great, and profoundly influential British DJ, John Peel, "Somebody was trying to tell me that CDs are better than vinyl because they don't have any surface noise. I said, 'Listen, mate, life has surface noise!'" While any noise in a system undermines that system's signal-to-noise ratio by definition, many listeners do not find the sound of tape hiss musically



Above: Contrary to some expectations, the number of top-tier, cost-no-object analogue sources—such as this Acoustic Signature Invictus system—seems to be increasing

compromising. And those used to listening on vinyl are often able to ‘listen through’ surface noise because it has no inherent connection to the music – just as you can listen to music in a room with a fan whirring because you quickly compensate for the fan noise, but if the fan was making noise in time with the music, it would become annoying... fast.

Ultimately, I think the arguments on both sides are missing the point. High resolution audio is great. The sound from good vinyl replay is great. The two can co-exist without causing the world to implode. From personal listening experience, I have many recordings that sound best on LP, many that sound best on CD, and many that sound best on high-resolution files. I also have some recordings that sound great on almost anything, and

Right: Which are better: analogue or digital sources? The answer is both! And remember, ‘analogue’ could mean both tape and vinyl playback

some that sound lousy even when played as the most manicured media through an exceptional audio system.

The comparison, should the need arise, takes place at a case-by-case level; whether a particular recording sounds better on one format or another. I wish there were a standard answer here – and one could definitively say that you should always choose LP, or CD, or SACD, or MQA, or DSD, or 24/192 PCM... but the reality seems to be the care and attention applied at source to the engineering and mastering process defines which version of a recording sounds best. While there are some automatic recommendations (a modern Mobile Fidelity Sound Lab master of a recording will, in all likelihood, sound closer to the in-studio master tape sound than the equivalent commercial mix, for example), often the results of good audio mastering are more important. I have heard many recordings that sound better on CD than on LP despite an all-analogue recording chain, and I’ve heard all-digital recordings that work best on LP than any download or polycarbonate disc. This case-by-case approach doesn’t play well with the militants who insist the world must only be viewed one way, however. And, unfortunately, it sometimes means you have to go through a lot of different versions of a recording (both analogue and digital) to find the best possible one.



There is one caveat to this scatter-gun approach to buying music: recordings that have ‘loudness war’ style mixes of heavy signal compression coupled with high average volume levels often sound slightly better (make that ‘slightly less dreadful’) when cut on vinyl than when played out digitally. The reason for this is recordings that approach 0dBFS (peak loudness) can be played through a digital system time and time again; they don’t sound any good, but they consistently don’t sound any good no matter how many times you play them. On the other hand, the same recording made on a piece of vinyl will have potential for mistracking and track damage after the first

few plays, so the mastering engineer will pull back from the same peak loudness just to preserve the track integrity for more plays. This often means a better sounding LP; not much better, but not as pre-ruined as the digital file or disc.

Ultimately, as with many things, the arguments surrounding analogue vs. high-resolution have become politicised over time, with well-rotted, deeply entrenched opinion able to effectively side-step fact. They both sound good in their own ways, and we should enjoy both side-by-side instead of drawing faux battle-lines. Which one’s better? Both of them! +

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ENCYCLOPAEDIA ANALOGIA

VINYL REPLAY TERMINOLOGY EXPLAINED, *Hi-Fi+ Staff*

As in other disciplines within high-end audio, the world of analogue audio has spawned terminologies that at times can seem obscure or mysterious, even to the best of us, whether newbie or veteran. This article is an attempt to define and demystify some of the acronyms, words, and phrases you may be apt to encounter as you investigate the art and science of vinyl playback.

Just the (Analogue) Basics

This brief section is intended for those who have little or no experience with analogue audio and are eager to learn the basics. Treat this information as a set of foundational building blocks you can build upon later on.

LPs/Records/'Vinyl'/'Vinyls':

The whole idea behind analogue audio is to achieve musically satisfying playback of vinyl phonograph records. Records are sometimes also called LPs (for 'long play records') or called 'vinyl' by the older generation or 'vinyls' by the younger buyers (as in, "I picked up some great new vinyls at the record shop today.").

Vinyl LP records are relatively thin, flat vinyl discs, almost exactly 12-inches in diameter, with music—captured in the form of undulating grooves—pressed into their front and back sides. Traditionally, LPs rotated at 33 ⅓ RPM, although an increasing number of audiophile pressings now include multiple 45 RPM records, treating the LP as if it were a collection of 12" singles.



Right: As the exotic and costly Tone Tools Sprocket turntable and Derenneville DTT-02 radial-tracking tonearm demonstrate, analogue lovers sometimes go to extreme lengths to maximize the performance of their vinyl playback systems

In contrast, the single has commonly spun at 45 RPM and was often sold as either a 7" or 12" record. A small number of 10" extended play ('EP') records have also been produced, but – like the single – are rarely pressed today.

By convention, the spiraling grooves in the record surface start at the outer rim of the record and move inward toward the record's centre. When the last piece of music on the record side is complete, the groove—no longer containing music—spirals inwards a bit further to a so-called 'run-out groove' where the stylus of the phonograph cartridge quietly rests, waiting to be lifted from the groove when the listener is ready either to turn the record over or to shut off the playback system.

Critically Important LP/Record Factoids

Staying within the (Straight) Lines: Masters lacquers for vinyl records are made on record cutting lathes where the lathe's cutting head travels in a straight line from the outer rim toward the centre of the master disc. In an ideal world, we would want the styli of our phono cartridges to follow this exact same straight line during playback, so that the phono cartridge/stylus would remain perfectly tangent to the record grooves at all times. In practice, though, it is rarely possible to achieve true straight-line motion

or perfect stylus-to-record-groove tangency at all times, so that engineers must create compromise solutions that position the phono cartridge stylus so that it remains nearly tangent to the record groove, most of the time.

Spacing Out: The spacing between record grooves is not constant, as some suppose. If you think about it, quieter musical passages require only very low amplitude modulations in the record groove, whereas loud and dynamic passages require groove modulations so high in amplitude that they are sometimes visible to the naked eye! Given this, record-cutting lathes can vary groove-to-groove spacing to allow for the dynamic swings that inevitably occur in music. This means that as the tonearm, phono cartridge, and stylus play the record from the outer edge to the innermost groove, their lateral motion is not absolutely constant, but rather varies in response to groove spacing variations.

Record Players:

Some listeners (especially newcomers) sometimes use the informal term **Record Player** to describe a complete record playback system, including a turntable, tonearm, and phono cartridge. However, audiophiles almost always discuss these playback components individually, as each has a separate role to play.

Turntables:

Turntables are the devices we use to play or “spin” vinyl records. The turntable’s job is to both support and rotate the record at a precise speed (typically either 33 ⅓ RPM or 45 RPM) during playback, while contributing as little noise and as few speed fluctuations as possible. (The human ear is extremely sensitive to speed fluctuations, because they translate directly into musical pitch fluctuations.)

Some people use the word “turntable” to mean the whole record player assembly, but most serious audiophiles use the term to refer only to that part of the record player that is responsible for spinning the record.

Phono Cartridges:

Phono Cartridges are the devices tasked with ‘reading’ or tracking the grooves in the spinning record and then converting the physical movements involved in tracking the grooves into electrical signals that can be amplified for playback in our hi-fi systems. Phono cartridges have three basic elements: a stylus, a cantilever, and a motor (or signal generator mechanism) of some type.

The stylus is the part of the cartridge that makes physical contact with the record groove and tracks the undulations in the grooves. Styli (the plural of stylus) are almost invariably made of extremely small, precisely shaped, and finely polished diamonds.

The cantilever is a miniature rod or tube that forms a connection between the stylus and whatever type of electrical signal generator



Ortofon’s MC Anna is a quintessential top-tier moving coil phono cartridge

or motor the cartridge happens to use. The cantilever is typically supported by a flexible suspension system that serves double duty as both a ‘spring’ that supports the cartridge and as a damper to help control the motion of the stylus/cantilever mechanism.

The motor of the phone cartridge translates the movements of the stylus in the record groove into an electrical signal that is analogous and proportional to the music encoded in the record grooves.

Tonearms:

The tonearm’s job is to position the cartridge over the surface of the record and to hold the cartridge in place while the stylus is

tracking the record grooves. This description sounds straightforward enough until you consider that the tonearm’s design brief can at times seem like a contradiction in terms.

For example, we want the tonearm to hold the cartridge’s body (or outer shell) almost perfectly still as the stylus, cantilever, and signal generating mechanism rapidly move in response to the groove modulations in the record. But at the same time, the tonearm cannot and must not hold the cartridge body in a rigidly fixed position; on the contrary, the tonearm must allow the cartridge freedom of movement in both the vertical (up and down) and horizontal (left and right) axes. These degrees of freedom of movement are necessary for three reasons.

First, tonearms must allow the phono cartridge to move so as to stay centred directly above the inwardly spiraling record grooves. Second, tonearms must allow cartridges to deal with the fact that many records are at least slightly eccentric, meaning the inward spiral of the groove is not necessarily smooth and continuous. Sometimes, listeners encounter records that require the tonearm to swivel back and forth (from left to right) as the record rotates, even if only very slightly. Third, many records are at least slightly warped, meaning the tonearm must allow the cartridge to move up and down to maintain a stable position relative to the surface of the record—a surface that, when viewed from the side, may at times appear to be ‘bobbing’ up and down as the record rotates.



Tonearms are offered in a variety sizes, shapes, and lengths, as this collection from Acoustic Signature illustrates

Stated simply, the mission of the tonearm is to hold the cartridge in a stable position relative to record groove, while at the same time allowing the cartridge freedom of movement where necessary. +

More Advanced Analogue Terminology

Anti-Skating Systems/ Skating Forces

The majority of tonearms on the market today are pivoted, non-tangential designs and the geometry of such arms makes for a condition where the cartridge stylus tends to be pulled inward toward the centre of the record. This inward pull is called skating and its result is that there is more stylus pressure on one side of the record groove than the other.

Ideally, we would want equal pressure on both sides of the record groove and to achieve this result many tonearms feature so-called anti-skating mechanisms that apply a compensatory force that is intended to offset skating forces.

Note that skating forces can and do vary with the amount of tracking force applied to the stylus, and also vary from one stylus shape to another (because styli of different shapes may have more or less 'drag' within the record groove). For these and other reasons, setting anti-skating forces is not an exact science and in fact some manufacturers advise against applying any anti-skating forces at all. In any event, adjustments to anti-skating force should—as with everything else in high-end audio—be verified by ear.

Arm Lengths/Stylus-to-Pivot Lengths

Phono cartridges mounted in pivoted tonearms move in an arc over the record and by following an arc the cartridge/stylus can achieve true tangency to the record groove at two points per record side. But at all other points the cartridge/stylus assembly will experience some degree of tracing error, meaning the stylus will be just slightly askew to the ideal tangent-to-the-groove position.

This is where tradeoffs come into play and tonearm length looms large as a design variable. Generally speaking, the greater the length of a pivoted tonearm the lower its geometric tracing error will be—provided other length-induced design tradeoffs can be properly managed. However, increasing tone arm length is not a panacea, because longer tonearms may have potential problems with structural rigidity, unwanted resonance, cumbersome size, and excess mass.

These days the most common tonearm length is in the range of 9-inches from the pivot point to the stylus—a length that offers a good set of compromises in terms of structural rigidity, relative freedom from resonance, manageable mass, ease of handling, and reasonable physical size. At the same time, designers and listeners recognise that longer tonearms can and do reduce tracing error (because their arc-shaped travel paths more closely approximate the



Well Tempered's Royale 400 turntable sports a 14-inch tonearm

theoretically ideal straight lines). For this reason, the analogue world has in the past several years seen a resurgence of interest in 10-inch and 12-inch tonearms, with at least one manufacturer offering a turntable fitted with a 14-inch tone arm!

Azimuth

Azimuth refers to the degree of left/right tilt of the phono cartridge stylus as it rests in the record groove, where the ideal is for the stylus to be positioned exactly vertically in the record groove as viewed from the front.

One tricky factor, however, is that there is no guarantee that the stylus is perfectly aligned relative to the phono cartridge body, meaning that technically correct azimuth

alignment might in fact require the cartridge body to be tilted just slightly to the left or right.

Not all tonearms (and especially not many inexpensive tonearms) offer provisions for making azimuth adjustments, but many mid- and upper-tier tonearms do. Many enthusiasts have discovered that a very useful and simple tool for setting azimuth is a device called the Fozgometer (named for the veteran audio designer Jim Fosgate), which can be used in conjunction with a set of recommended test records to check, revise, and adjust azimuth settings. It is also possible to use a test record and an oscilloscope for precision adjustment of azimuth, although this requires a considerably higher degree of user expertise... and the purchase of a test record and an oscilloscope!

Are the benefits of proper azimuth alignment audible? In high-resolution systems they most certainly are, making for a heightened sense of focus, clarity, and freedom from mistracking on complicated musical passages.

Cartridge Overhang & Alignment/ Cartridge Adjustment Protractors

As stated above, the theoretical ideal would be for the phono cartridge stylus to move across the record surface following the same straight-line path followed by the record

cutting head when the original master lacquer for the record was made.

The majority of turntables are fitted with pivoted tonearms that cause the phono cartridge/stylus to swing in an arc across the record, rather than following a true straight-line path. Since an arc can only intersect a straight line at two points, the stylus can only achieve perfect stylus-to-groove tangency at two points on the record, meaning it will be slightly out of tangency at all other points on the record. To achieve best results with pivoted arms, two adjustments are critical: cartridge overhang (the exact distance from the arm pivot to the stylus) and cartridge alignment (the left-to-right angle of the cartridge relative to the tonearm and the record).



The Arche tonearm headshell from Acoustical Systems offers special provisions for adjusting azimuth, stylus rake, cartridge overhang and alignment

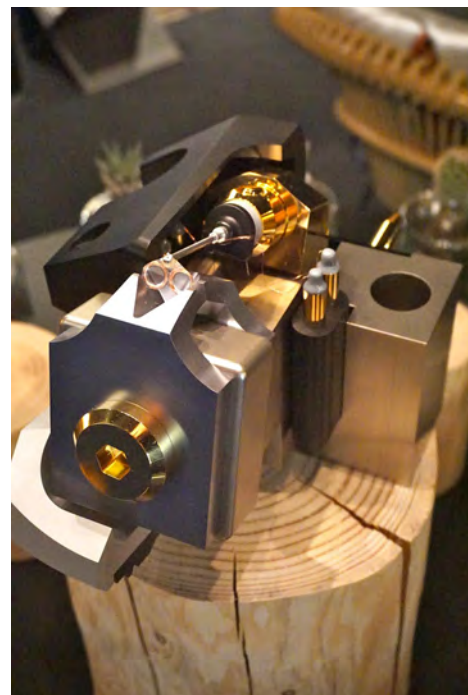
To help users adjust these two variables, many manufacturers offer cartridge alignment protractors, which are designed to slip over the turntable spindle and to rest temporarily on the turntable platter. Protractors provide markings that show where the stylus should be positioned in terms of overhang (X marks the spot) and that show how the cartridge/stylus should be aligned.

To use such protractors, listeners first loosen the fixing screws for their cartridges, then gently and carefully move the cartridges fore and aft and from left to right, following a gradual trial-and-error process until the desired overhang and alignment positions are achieved. Once the cartridge is correctly positioned, the fixing screws can be tightened to lock the cartridge in its properly aligned position.

Note that so-called straight-line or tangential-tracking tonearms also require overhang and alignment adjustments, but with the important difference that, once properly adjusted, they maintain perfect stylus-to-groove tangency across the entire record surface.

Cartridge Suspension/Dampening Systems

As noted above, the stylus/cantilever/motor assemblies used in all phono cartridges require some sort of suspension system, which in most cases will also double as a dampening system or 'shock absorber' of sorts. Many designs use either an



This oversize, cutaway model of Audio-Technica's new AT-ART1000 moving-coil cartridge makes it easy to see the black elastomeric support system that serves as the suspension for the cartridge's stylus/cantilever assembly

elastomer ring or suspension block for this purpose, and as you may surmise the exact dimensions and compositions of these suspension/dampening elements are critical to performance.

If the suspension of the cartridge is too stiff or over damped, compliance will be reduced

and resonance problems may be introduced. On the other hand, if the suspension is too soft or under damped, compliance will be too high, and other types of resonance problems may arise (not to mention the potential problems of increased fragility and possible cartridge collapse). For obvious reasons, then, the idea is to achieve a carefully judged blend of appropriate compliance levels and damping characteristics that best suit the intended playback application.

It is worth noting that, in some moving coil cartridges, designers sometimes add a supplementary suspension/dampening 'tie-wire' at the rear of the cantilever assembly to provide additional support and resonance control.

Cartridge Types

Phono cartridges tend to be classified by the types of signal-generation systems or 'motor' mechanisms they employ.

Moving iron & moving magnet: Moving iron and moving magnet cartridges are conceptually similar. In both cases, either a small magnet (moving magnet) or small ferrous metal tip with adjacent stationary magnets (moving iron) is fitted to the cartridge cantilever and positioned near a set of stationary coils of wire. As the stylus tracks the groove, the magnet or ferrous metal tip (acting as an induced magnet) is set in motion and generates a voltage in the cartridge's signal coils. In most but not all cases, moving magnet and moving iron cartridges are considered high output

designs and therefore should be used with phono stages that have a standard gain, moving magnet (“MM”) phono input.

As a general rule, moving iron cartridges are thought to offer better transient response than moving magnet designs, because their ferrous metal tips are lower in mass than equivalently sized magnets.

Moving coil: As their name suggests, moving coil cartridges feature cantilevers typically fitted with tiny cruciform frames around which are wound coils of wire positioned near sets of stationary magnets. As the stylus tracks the groove, the cruciform frame and coils are set in motion (within a fixed magnetic field), thus generating an audio signal. In the majority of cases, moving coil cartridges are considered low or mid-level output designs and therefore should be used with phono stages that have a high(er) gain moving coil “MC” input.

As a general rule, moving coil cartridges are thought to offer superior transient speeds and higher levels of detail than moving iron/magnet cartridges, because their moving coils of signal wire are considerably lower in mass than moving magnet or moving iron signal generators. However, this theoretically superior performance comes at a price.

Generally speaking, moving coil models are more complicated to build and more costly to make and to buy than moving magnet/iron equivalents. Some moving coil models are prone to high-frequency resonances,



Kuzma’s CAR 30 is representative of an entire class of highly accomplished moving coil cartridges

which means designers must pay extra attention to damping schemes to mitigate potential problems. Finally, moving coil models typically require more costly high-gain/low-noise phono stages. With all this said, however, the majority of today’s top-tier phono cartridges are moving coil designs.

Optical: Optical phono cartridges use an opto-electronic mechanism to modulate a voltage supplied from an external power supply/equalization box. In typical optical designs, which at this point are comparatively rare, the cartridge cantilever is fitted with a tiny light-permeable screen. When the stylus moves in the record grooves, the screen moves in response. An LED illuminates the screen, while an opto-electronic photodiode sensor located behind the screen ‘reads’ the light (as modulated by the moving screen) to produce an output signal.



DS Audio offers an optical phono cartridge that is drawing considerable attention of late

Two theoretical advantages of optical cartridges is that their moving mechanisms are very low in mass, making for excellent clarity and transient speed, and they can in principle be very low in noise. One potentially significant drawback, however, is that they must be used with their own companion power supply/equalisation boxes, which also serve in lieu of traditional wphono stages.

Strain Gauge: Strain gauge-type cartridges are based—you guessed it—on strain gauges, which are flexible materials whose resistance to current flow changes as the

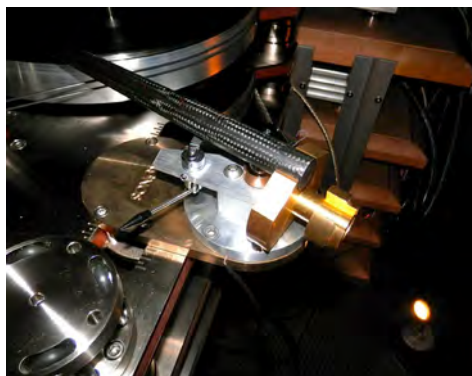
materials expand and contract. In a stereo strain gauge cartridge, then, the cantilever is connected to two such strain gauges, with the strain gauges typically serving as both the suspension for the cantilever/stylus assembly and as the signal modulation mechanism.

Like optical cartridges, strain gauges require an external power supply box, but interestingly they do not require traditional RIAA equalisation; this is because—unlike moving magnet, iron, or coil designs—strain gauges are not velocity-sensitive transducers (where the signal depends upon how fast the stylus is moving), but rather are displacement-sensitive transducers (where the signal depends upon how far the stylus moves).

Advantages of strain gauges include the fact that their moving mechanisms are very low in mass and that their stylus/cantilever assemblies are directly and mechanically connected to the strain gauges that modulate their output signals. Three possible drawbacks are that strain gauge cartridges are costly to manufacture and to buy, are thought to be comparatively fragile, and they require use of a dedicated external power supply box.

Counterweights

Moveable counterweights are used at the back ends of tonearms, primarily to balance the arms once phono cartridges are installed, but also—in some but not all designs—to apply tracking force on the stylus. Also, for some unipivot tonearms, counterweights



Shown here is the massive and beautifully made counterweight system of a Therault unipivot tonearm as mounted on a Kronos turntable

are deliberately eccentric in shape, so that the weights not only can move fore and aft, but also can rotate side to side for purposes of making azimuth adjustments. Typically, counterweights are made of relatively dense materials such as brass or, in some instances, even tungsten.

Headshells

The headshell is that element of the tonearm to which the phono cartridge is affixed and which traditionally would provide a finger lift, if one happens to be used on the tonearm in question. Headshells may range from ultra-minimalist on through to quite elaborate designs that, in some instances, provide within-the-headshell adjustments for azimuth and for stylus rake angle.

Headshell designs can either be fixed (that is, permanently attached to the tonearm wand or perhaps even fashioned as an



KL Audio offers precision-made phono cartridge headshells to fit various applications

integral part of the wand) or detachable—usually via a locking collar of some kind. Proponents of fixed headshells cite their potentially superior strength, rigidity, structural integrity, and freedom from resonance, where proponents of detachable headshells emphasise the fact that detachable headshells facilitate cartridge swapping (because users are free to mount spare cartridges in separate headshells, thus making it possible to switch cartridges with a minimum of set-up hassles).

Motors

A wide variety of motors can be found in turntables, but some of the more common types are AC synchronous motors (motors that are in essence locked to the frequency of the mains), low-noise DC motors, and so-called ‘Hall Effect’ direct-drive motors (where in essence, the platter serves double-duty as the ‘armature’ of the motor).

Each type of motor has its ardent proponents and each can, if well executed, give sonically superb results. The main points to grasp are that motors need to drive their associated platters at precise, unvarying speeds with as little noise as possible and with virtually no tendency to show speed fluctuations (not even extremely minor ones) in the presence of large or small-scale dynamic variations in the music.

Platters/Sub-Platters/Main Bearings/Spindles

Platters: Platters are the relatively heavy, disc-like elements upon which records rest and rotate while in play. Ideally, we would want platters to be perfectly flat, perfectly round, and to be fitted with spindles that are perfectly centred in the platter’s top surface (the spindle is a round vertical post used to centre the record upon the platter). Further, we would want platters to offer sufficient mass that, once in rotation, they would have



This Klimo Audio Stern turntable features a glass platter, which enables viewers to see the aluminium sub-platter below

enough inertia to be able to resist speed fluctuations—even when playing records where timing accuracy is hyper-critical (e.g., certain piano passages) or where there are wild dynamic variances over time (think of Tchaikovsky’s classic 1812 Overture). Finally, we would want platters made of materials that offer good internal damping and provide a solid, neutral sounding support surface for the record. It is common to see platters made of machined aluminium, glass, brass, copper, composite materials or combinations of the above.

Sub-Platters: Depending on the design brief being followed, some turntable designs feature platters that rest upon smaller sub-platters to which the turntable drive mechanism is connected and to which the main bearing of the turntable is attached.

Main Bearings: Main bearings must support the weight of the platter while allowing it to rotate as smoothly and quietly as possible. It is important to bear in mind that any noise—even seemingly very low-level noise—from the main bearing can be passed upward through the platter and the record, to be picked up by the phono cartridge. For this reason, precision-made main bearings are an absolute must for optimal sonic results to be achieved. It takes a great deal of expertise to design and to manufacture top-class main bearings, but the effort pays huge dividends in terms of sound quality. Indeed, one of the biggest differences between good vs. great turntables lies in the quality of the main bearings used.

Some common main bearing types include shaft and bushing designs (with or without continuous recirculating oil baths and with or without inverted bearing shafts), shaft and ball designs, air bearings (where the weight of the platter is borne upon a cushion of pressurised air), and opposed magnet supported bearings, where sets of opposing magnets are used to partially ‘levitate’ the platter thus relieving physical pressure on the bearing assembly. Bearings can be made of hardened tool steel with or without jeweled contact surfaces or balls, sintered bronze, other exotic metal alloys, ceramics, composites, specialised plastics/polymers, and other man-made materials.

Spindles: Spindles are precision-made circular posts, typically made of metal, that protrude from the top centre surface of the platter. Spindles are made to an industry standard diameter and their primary purpose is to act as a centering-pin for records, when records are placed on the platter for playback (and yes, there is a corresponding, industry standard, spindle-sized hole in the centre of all LP records). But one other purpose for the spindle is to provide a gripping surface to which optional record clamps, if any, may attach.

Plinths

Plinths are the externally visible housings or structural frames for turntables. In some design, the plinth is essentially an outer shell to which various sub-frames or assemblies (for example, motor mounts) are attached—or from which they are suspended.

In other designs, however, the plinth basically is the frame of the turntable, to which the turntable’s tonearm, main bearing/platter assembly, and in some cases even the drive mechanism or motor is attached.

Can plinths affect sound? Recent *Hi-Fi+* reviews of aftermarket plinths for popular turntables such as the Linn LP12 suggest that plinths can have a surprising high level of impact on the turntable’s overall sonic presentation.

For this reason, it is important to respect plinths as significant elements of turntable design and not as an afterthought.

Record Clamps and Vacuum Hold-Down Systems

Many analogue audio experts think that it is desirable to clamp records firmly to the platters upon which they rest during playback and for this reason a number of turntable makers and aftermarket accessory manufacturers offer specialised record clamps, which typically are attached via the platter’s spindle.

Others go even further, suggesting that, since many records are very slightly warped, it is desirable not only to clamp records at their centres, but also around their outer perimeters (so that the records will lie perfectly flat upon the platter’s top surface). Accordingly, a handful of manufacturers offer ring-shaped clamps, typically made of metal, that slip over the outer edges of the record and turntable platter, thus coupling the



This Dr Feickert Analogue perimeter ring clamp is designed to hold records flat against the platter surface, while also adding a desirable degree of inertial mass to the platter

record firmly to the platter, flattening out any warps in the record surface as a result.

Finally, it is worth noting that not all analogue experts are devotees of record clamps, mostly out of concern that clamps might put undue pressure on the platter main bearing while potentially creating unwanted stresses in the record surface.

One way of achieving the benefits of clamping systems, but without actually using clamps, is to build turntables that incorporate vacuum-powered record hold-down systems. Turntable manufacturers such as SOTA and TechDAS have done just this, with very good results. The only drawbacks to the vacuum hold-down approach involve complexity, costs, and the need to manage the noise produced by the requisite vacuum pumps.



Many Airforce-series turntables from TechDAS, including the Airforce 1 model shown here, employ both air bearings and vacuum-powered record hold-down systems

RIAA (and other phono EQ curves)

A fact little known among laymen is that records as pressed do not have flat frequency response. On the contrary, during the record mastering process specific equalisation curves are applied—curves that reduce the amplitude of bass frequencies and boost high frequencies. The typical EQ curve used is called the RIAA curve, where the acronym stands for Recording Industry Association of America. There are also other phono EQ curves that provide similar functions, although they are far less common than the RIAA curve. Alternate phono EQ curves include those from CCIR/Teldec, Columbia, DMM, and Decca/EMI. Arguments continue to rage today as to whether record companies switched wholesale to the RIAA curve when stereo arrived in 1958, or whether recordings cut in the 1960s or later used the alternate EQs derived in the monophonic era.

Why is phono equalisation necessary? The answer is that bass content, if cut into the record with flat frequency response, would require record groove modulations so extreme that it is doubtful that even the finest phono cartridges could properly track them. What is more, the modulations would be so large in amplitude that they would force unfeasibly wide spacing between record grooves, which would severely limit the amount of content that could be included on each record side. At the other end of the audio spectrum, high frequency material, if cut into the record with flat frequency response, would potentially be so low in amplitude that it might get masked by naturally occurring groove noise.

Thus phono equalisation, complete with boosted highs and trimmed-back low frequencies, is always applied during the record mastering process. However, in order to restore flat frequency response when playing vinyl records, inverse phono equalisation is applied during the playback process via a specific type of preamplifier called a phono stage. All phono stages provide inverse RIAA equalization, but some of today's more elaborate, upper-tier phono stages may also provide six or more specialised phono EQ curves, as mentioned above.

Rumble

Rumble is a measure of the detectable noise generated by turntables as they rotate, so that you could think of rumble as being the turntable world's equivalent of the signal-to-

noise-ratio in conventional audio electronics. Rumble is typically quoted as a negative dB figure (for example, -64dB) where—as with signal-to-noise ratios—the higher the negative number of dB, the quieter the turntable will be.

As with audio electronics, lower rumble in turntables may not necessarily be perceived as 'lower noise' (although it is just that), but rather as 'enhanced low-level detail' in the music.

Speed Controls

It is impossible to overstate the importance of proper speed control in turntables since even very minor speed fluctuations can, under the right circumstance, be painfully audible (long, sustained piano chords are extremely revealing in this respect). For this reason, many designers have developed



[Speed control boxes such as this unit from Pear Audio Analogue help tighten up speed regulation for their associated turntables, significantly improving sonic performance in term of PRaT \(Pace, Rhythm, and Timing\)](#)

precision outboard power supply/speed control regulation boxes that serve to tighten up the speed accuracy of their associated turntables.

Is this just an example of 'gilding the lily'? No. Proper speed control can make all the difference between a good turntable and a great one.

Stylus Profiles

The exact shape and dimensions of the phono cartridge stylus have much to do with how well the phono cartridge will track the record grooves. Some common stylus shapes you will encounter are the following.

Conical/Spherical: As the name suggests, conical styli are cone-shaped, but with rounded, hemispherical tips. Conical/spherical styli are the easiest to make and are the least finicky about set-up, but they have performance limitations in that they are comparatively high in mass, have relatively large tips with respect to the dimensions of the record grooves, and also provide relatively small 'contact surfaces' (analogous to the 'contact patches' of automotive tyres) between the stylus and the groove.

Elliptical: An elliptical stylus represents an improvement over the conical/spherical because, rather than having a large round tip, the elliptical stylus offers a tip with an elliptical profile whose narrower edges face to the sides and directly contact the record groove. Two benefits accrue. First, the elliptical stylus is lower in mass than

an equivalent conical stylus would be, and second, the elliptical stylus' narrower but more elongated contact surface offers a better fit for purposes of tracking the undulating contours of the record groove (those narrow-radius contact points can much more readily track high-frequency details, for example). Elliptical styli require somewhat more attention to set-up, but are still relatively forgiving.

Shibata: The Shibata stylus, named after its inventor, represents an even more radical step forward from the elliptical stylus in that it has an even narrower tip shape that, under a microscope, looks somewhat like the blade of a garden trowel turned so that the flatter side of the blade is facing the viewer. The side-radius of the Shibata tip is even smaller than that of an elliptical stylus so that the contact surface is not merely a somewhat elongated ellipse (as with typical elliptical styli), but rather is a much taller and narrower ellipse that almost resembles a vertical line. Relative to elliptical styli, Shibata styli offer three compelling advantages: significantly lower tip-mass, even narrower side-radius dimensions for superior tracking of high frequencies, and—somewhat unexpectedly—an increase in contact area with the record groove (meaning that even if higher tracking forces are used there is still less stylus pressure per square centimetre than with an elliptical design). Because the side-profile of the Shibata stylus is narrower and more blade-like than with elliptical designs, greater care must be taken to make sure that the stylus rake angle is properly adjusted.

Line Contact/Fine Line: Line contact/fine line styli, often attributed to the designers A.J. van den Hul and Fritz Geiger, represent an even further advancement along the same lines that inspired the Shibata stylus. The general idea is to pare away yet more stylus tip mass while narrowing the side-radius of the stylus tip, so that the stylus contact area becomes an extremely narrow and elongated ‘fine line’. But don’t let the shape and dimensions of that fine line mislead you; the fine line/line contact shape still offers plenty of stylus-to-groove contact area, so that stylus pressure per square centimetre still remains reasonable. Once again, improvements are noted in high-frequency tracking and in overall ability to trace fine, small details in the record grooves. More so than other stylus types, line contact/fine line styli are sensitive to set-up and to stylus rake angle adjustments.

Stylus Rake Angle

Stylus rake angle (SRA) refers to the front-to-back tilt angle of the phono cartridge stylus vis-à-vis the record grooves (whereas azimuth is the side-to-side tilt angle of the stylus in the groove). Unlike azimuth, however, the optimal stylus rake angle is not dead vertical (90 degrees), but rather is thought to be in the range of 91.5 – 92 degrees (depending upon which experts you consult), with the stylus tipped back just a bit, as if ‘scooping’ into the oncoming groove by 1.5 – 2 degrees.

Why is this very slight tilt back desirable? The answer is that the cutting head used to produce the lacquer master for the record

also had a similar degree of tilt back. As always, for best sonic results the ideal is for the phono cartridge stylus to come as close as possible to following both the horizontal path and the vertical ‘angle of attack’ of the original cutting head.

It is possible to adjust SRA by ear, but an even more foolproof method is to use a USB microscope to observe and adjust the stylus rake angle as the stylus is resting upon the record.

Note that not all tonearms make provisions for SRA adjustments and note too that many audiophiles and even some experts tend to use the terms ‘stylus rake angle’ and ‘vertical tracking angle’ (VTA) interchangeably—even though they aren’t precisely the same thing. Sonically speaking, though, SRA is the adjustment you want to get right.

Turntables with Suspensions vs. Mass-loaded Turntables

Almost all turntable manufacturers seek to isolate key elements of their playback systems from both mechanical and airborne vibration, but there is much divergence of opinion as to how best to achieve that result.

Some designers believe in using mass loading to prevent (or at least suppress) transmission of unwanted vibrations and their designs typically use fixed, solid plinths to which the turntable platter and tonearm assemblies are firmly affixed (though turntable motors/drive units may, in such designs, be mounted in separate housings or ‘pods’ that stand apart



The VPI Prime is a mass-loaded turntable with isolation feet and a standalone motor ‘pod’ as shown

from the main plinth). In such mass-loaded designs, there usually is no suspension at all, apart from feet that may, in some instance, provide built-in elastomeric or spring-loaded suspension elements.

Other designers, however, strongly believe that it is best to have the turntable platter and tonearm mounted on sturdy sub-chassis that is suspended and—to a degree—isolated from its surrounding plinth. For even greater noise isolation, such designs very often attach the motor to the turntable plinth and then use an elastic belt-drive system to transfer power from the motor to the platter.

As a general rule, mass-loaded turntables are sometimes more prone to mechanically-induced noise and vibration transferred via audio furniture or the floor, while suspended turntables tend to offer somewhat better vibration isolation, but at the expense of considerably more elaborate initial set-up procedures and a certain tendency to drift out of adjustment over time.



The classic Linn Sondek LP-12 turntable is a suspended chassis design that has continued to evolve from the 1970s to the present day (the sample shown is from the mid-1980s and is still in use today)

Tonearm Types

In broad strokes, there are three main types of tonearms you might encounter, although pivoted tonearms are by far the most common types. The other two types of arms are radial-tracking/straight-line tonearms and tangential-tracking tonearms.

Pivoted Tonearms: Pivoted tonearms may feature straight or curved tonearm wands with either fixed or detachable cartridge headshells at the front end, a bearing assembly toward the rear, and a counterweight at the back end. In a pivoted arm, the cartridge/stylus always moves in an arc across the record surface, though tracing errors can be mitigated by careful adjustment of cartridge overhang and alignment angles.



Clearaudio's TT-3 is considered a classic radial-tracking tonearm design. Note how the arm's bearing carrier allows the arm assembly to move straight sideways over the record

Radial-tracking or 'Straight-line' Tonearms:

Radial-tracking or straight-line tone arms almost invariably feature comparatively short, straight tonearm wands with either fixed or detachable cartridge headshells at the front end, a bearing/arm carrier assembly toward the rear, and a counterweight at the back end. What sets straight-line tonearms apart, though, are their distinctive bearing/arm-carrier assemblies, which significantly allow the tonearms to move straight sideways—not swinging in an arc as pivoted arms do. In this way, the arms realise the ideal goal of having the stylus move in a perfectly straight line across the record, always maintaining perfect tangency to the record grooves. The downside of straight-line tonearms however, is that they are complicated to design and

build, costly, and can in some instances prove difficult to set-up and to keep in proper adjustment.

Tangential-tracking Tonearms: Tangential-tracking tonearms are conceptually a cross between pivoted tonearms and radial-tracking tonearms. On one hand, tangential-tracking tonearms are pivoting designs, but with one crucial difference: their cartridge headshells are not locked in a fixed position on the tonearm wand, but rather are position on an articulated mount that—get this—allows the cartridge alignment angle to be continuously adjusted during playback to maintain stylus-to-groove tangency all the way across the record. To achieve this desirable result, most tangential-tracking tonearm are built with a main tone arm wand and a secondary control arm that rides beside the main wand and that is responsible for making continuous



The Swiss-made Thales Simplicity is a fine example of a tangential-tracking tone arm. Note how a control arm allows continuous, on-the-fly adjustment of cartridge alignment via the tonearm's articulated, pivoting headshell

alignment adjustments as needed. When viewed from above, tangential-tracking tonearms and their associated, articulated headshells look something like slender, elongated trapeziums. For obvious reasons, tangential-tracking tonearms must be crafted with extremely tight-tolerance bearings for the arms' several articulated joints.

Tonearm Bearing Systems

As mentioned above, it is very important for tonearms to offer nearly friction-free movement, while preserving tonearm/cartridge/stylus geometry with great precision. To this end, designers have devoted a lot of attention to the types of bearings used. Some type commonly encountered are as shown below.

Air bearings: Air bearings are typically shaft-and-sleeve bearings where the sleeve is fed pressurised air from an external source so that the shaft never makes metal-to-metal contact with the sleeve, but rather rides on a virtually friction-free cushion of air. This type of bearing is used in a number of straight-line tone arm designs. Examples would include the Bergmann Magne, Kuzma Air Line, or Walker Proscenium Back Diamond V tonearms.

Ball/Gimbal bearings: Precision-made ball bearings are popular for use in tonearms, often via gimbal-type mounts where one pair of bearings handles horizontal axis motion and the other pair handles vertical axis motion. Ball bearings are often graded using ABEC (Annular Bearing Engineering Committee) ratings where the higher the



Bergmann's Magne is a classic, air-bearing equipped radial-tracking tonearm

ABEC number the tighter the bearing tolerances are.

Knife-edge bearings: Some tonearm designs have used so-called knife-edge bearings for vertical axis applications. A knife-edge bearing consists of a knife-like blade that rides within a corresponding, precision machined V-shaped trough.

Multi-point/Kinematic bearings: Multi-point or kinematic-type bearings, as used by a handful of manufacturers, combine the precision of ball/gimbal-type bearings but offer the promise of even lower friction and



The Kuzma 4 Point tonearm shown here uses a multi-point bearing system

essentially zero ‘free-play’ in the bearings. The general idea is to precisely locate the centre of motion typically using just three or four contact points. Examples would include the Kuzma 4 Point and Wilson-Benesch ACT-series tonearms.

Thread-type bearings: Some tone arms forego traditional, metal rotational bearings and use threads not only to suspend the tonearm but also to afford it both horizontal and vertical motion. Examples would include the Well Tempered tonearms or the Funk Firm F6 tonearm.



Well Tempered's Symmetrix LTD tonearm uses a thread-type bearing, as this close-up reveals

Unipivot bearings: As their name suggests, unipivot bearing feature just a single point of contact—an idea appealing in its simplicity. Such bearings typically feature a spike (with or without jeweled tip) that rests in a cup (again, with or without jeweled contact surfaces). One point to note, though, is that arms fitted with unipivot bearings must be balanced from side-to-side in order to achieve proper azimuth alignment.



The Wand from Design Build Listen is an elegantly simple, minimalist unipivot tone arm sporting a carbon fibre tonearm tube

Tonearm wands/tubes, etc.

As mentioned above, tonearm must position phono cartridges precisely without introducing resonance problems. For this reason, arm wands/tubes must be strong, rigid, well damped, and as resonance-free as possible.

Most tonearm wands are constructed as tubes that can be made of metal, plastics, composites, or hybrid combinations of materials. Many manufacturers enhance tubular tonearm designs either by adding internal stiffeners or by adding dampening materials, or both.



VPI's innovative JMW Memorial 3D tonearm was the first to use a 3D-printed tonearm wand

Lately, several manufacturers have begun to experiment with 3D-printing techniques for arm wands, some using plastic-type materials and other using metal materials. 3D printing allows complex shapes/designs that could not be made via traditional machining techniques.

Tracking Force

Tracking force is the amount of downward pressure applied to the phono cartridge stylus and that is necessary in order for the stylus cleanly to track demanding material encoded in the record grooves. Above all, the intent behind using the proper amount of tracking force is to make sure the stylus remains in contact with the walls of the record grooves at all times, yet without applying so much pressure that the groove walls are damaged or subject to undue wear.

When a stylus does break contact with the record groove, even if only to a slight

degree, that condition is called mistracking, which is audible, unpleasant-sounding, and hard on the record grooves. Typical tracking forces for most modern phono cartridges will range from the mid-one gram range to the mid-two gram range, in accordance with published specifications for the cartridge. The general idea is to use sufficient force to eliminate mistracking, but not more force than is necessary.

Contrary to popular assumptions it is preferable to use slightly too much tracking force than not enough. While heightened tracking force does increase record wear to a degree it also tends to help prevent mistracking, which can be even more damaging to one's record grooves.

Turntable Drive Systems

Turntables are often classified by the drive mechanisms they use. Some common drive mechanism types are described below.

Belt drive: In belt drive turntables the motor stands separate from the platter assembly, while a precision-made belt (typically, but not always made of elastomeric materials) transfers power from the motor drive pulley to the turntable platter (or to a sub-platter beneath the main platter). Some designs use thread or magnetic tape in lieu of an elastomeric belt. The belt is thought to decouple the platter from the motor, keeping motor noise from being transferred into the platter where it could be detected by the phono cartridge.



VPI's new belt-driven Avenger turntable uses multiple drive belts to share the platter-spinning workload

Direct drive: In a true direct drive turntable the 'armature' of a Hall-effect motor is embedded within the platter, while other parts of the motor are contained in the turntable plinth. In other words, the platter is essentially its own motor. If properly designed, direct drive turntables can be extremely quiet as their motors, by definition, rotate at platter speed and thus do not introduce higher-frequency vibrations. Also, direct drive tables—again, if properly designed—also allow extremely tight speed control.



Technics' new SL-1200GAE represents both a reissue of and a substantial technical update to one of the most iconic (and best loved) direct drive turntables in the analogue world

Early generation direct drive turntables sometimes got unfavourable reviews because their designs allowed some degree of audible motor 'cogging' and because their speed control mechanisms sometimes introduced noise and micro-variations in speed. More contemporary designs typically address and solve both problems.

Idler-wheel drive: Idler wheel drive, sometime confusingly called 'direct drive', involves a motor with a drive wheel and an idler wheel that transfers motor power to the platter. Almost the opposite of belt drive designs, idler wheel designs forge a direct coupling between the motor and the platter, so that it is imperative to base such designs on extremely low-noise motors (typically very high quality DC motors). Proponents of idler-wheel drive praise their dynamic



The Italian-made Audio Silente Blackstone SE turntable uses an idler-wheel drive mechanism inspired, in part, by much earlier generation idler-wheel-driven turntables from Thorens



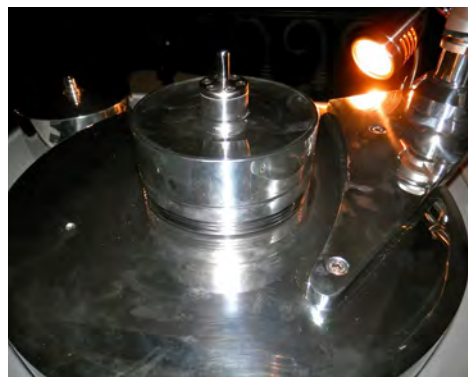
The JR Transrotor Fat Bob Reference 80 TMD turntable uses a belt-driven Transrotor Magnetic Drive bearing assembly to spin its massive, 80 mm thick, solid aluminium platter

immediacy and solidity as well as their freedom from such micro-variations in speed as can be introduced by elastic drive belts.

Magnetic drive: Magnetic drive offers another method for transmitting power to the platter while at the same time physically decoupling the motor, per se, from the platter. In this system, the motor typically drives a substantial sub-platter, which is magnetically coupled to a physically isolated platter positioned directly above the magnetic coupler. When the sub-platter rotates, its magnets attract those in the platter above, causing the platter to rotate.

Vertical Tracking Angle (VTA)

Many audiophiles and experts use the term vertical tracking angle to describe what should properly be called stylus rake angle (SRA). See above.



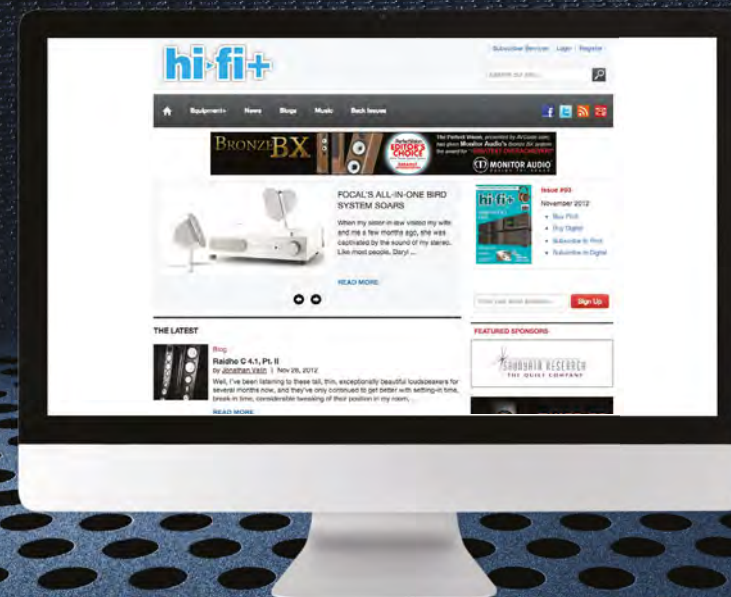
JR Transrotor's magnetic drive turntables feature a belt-driven, magnetic-drive subsection (the lower cylinder seen here) with an adjacent, magnetically sensitive sub-platter/bearing assembly above (the upper cylinder/spindle assembly seen in this photo)

Wow and Flutter

The terms 'Wow' and 'Flutter' refer to two undesirable types of speed variation in turntables. Wow is a slow, gradual fluctuation that might yield a slow "Wow" sound as speed gradually increases and then decreases. Flutter is a more rapid speed fluctuation with would produce vibrato or tremolo-like sounds as speed rapidly increases or decreases. For obvious reasons, it is desirable to have turntables that produce as little wow or flutter as possible, though of the two types of speed variation flutter is arguably the more noticeable. +

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