

Trumping the Ace

HAS AUDIO RESEARCH AGAIN RAISED THE PRE-AMPLIFIER STAKES WITH ITS REFERENCE 5 MODEL? MARTIN COLLOMS INVESTIGATES.

MARTIN COLLOMS

The *HIFICRITIC* team was very impressed by Audio Research's previous *Reference 3* line-level pre-amp, first introduced in late 2004 and covered in *Vol1 No2* (April 2007). *Reference 3* recently benefited from a running upgrade involving several improved passive components, a procedure which Audio Research has followed for some 25 years. Given that this model continues to set such a high standard of performance for balanced and single-ended operation, why on earth should it be replaced? Audio Research has introduced a considerable number of designs over the past 25 years, and sometimes seems rather driven, endlessly pursuing higher performance and hauling sometimes unwilling potential customers along with them.

Modest update improvements may often be applied retrospectively to customers' existing models, but (like the *Reference 2* phono stage) the new *Reference 5* line level pre-amp has undergone such radical surgery that new purchase will be required. One aspect addressed is the inherent noise floor, which for the *Reference 3* was 'very good' in full balanced mode, 'good plus' for single-ended in, balanced out, and just 'good' for full single-ended operation. However, with a high sensitivity speaker or high gain power amp it's a bit marginal: the *Reference 4/5* ought really to be quieter.

Jumping the '4' designation due to unhappy associations in Chinese translation, experience gained in designing the recent *Reference 2* phono stage led to a similarly full structural revamp for the *Reference 5*. Audio Research discusses new single-board construction, revised power supplies, and new selection of audio and power supply components.

Priced at £11,000 or so the *Reference 5* is a line level pre-amp with moderate amplification, matched to CD level and similar sources. You get 6dB gain for single-ended working and 12dB gain for full balanced and also single-ended-to-balanced operation. Full width and full height in dimensions yet very neatly presented, this versatile yet purist all-triode valve pre-amp also uses valves in the vital high tension supply.

The characteristic grab handles (a hangover from traditional rack mounting requirements) are now satin chrome with the silver alloy finish, or the whole lot may be ordered in a sombre black. A huge dimmable green fluorescent display dominates the fascia, so settings may be easily read from 20 feet away, and the display has an auto-off option after a longish 10 second wait. Flanking the display, two rotary controls provide volume in 104 steps, and the selector for six inputs, all available in single-ended or balanced mode. Three sets of outputs (including a unity gain processor



loop) also parallel single-ended (RCA phono) and balanced (XLR) socketry.

A row of black rectangular buttons cover power on/off, 'processor through' mode, balanced or single-ended input (either/or for each input), mono, absolute phase inversion, and muting. All the fascia controls are duplicated on the lightweight plastic remote handset, alongside additional features like channel balance and 'hours' (which reveals the elapsed time for the current set of valves).

The unit is built entirely of anodised aluminium, apart from a finely slotted cover in transparent polycarbonate polymer (conferring low mechanical resonance and no electric field interaction). (We have heard a similar cover material improve sound quality in other products.) Power comes in via a 16A IEC connector power cord (called 20A in the US), along with a mains fuse and provision for 12V trigger switching for system control integration. The polymer feet have a decoupling and damping function.

While the circuit technology is based on the *Reference 3*, that model's stack of vertical boards has been shoe-horned onto a single horizontal layout with short path, logical signal flow connections. There is just enough clearance for the tall 6550 regulator tube but nothing should be left on top of this pre-amp, as it will get cooked!

As before it uses Class A stages without loop negative feedback. These are fully differential balanced line amplifiers based on two stages and comprising four triodes per channel, augmented by FET current sources for optimum common mode performance. There are four (freely available and inexpensive) Russian 6H30 wideband double triodes, another is used in the power supply regulator, together with the readily available 6550 power tetrode serving both channels. All valves are Sovteks. The two power transformers include a very high quality R-core type for the audio gain stages, and a low noise toroidal to



Listening Ancillaries:

Amplification: XTC *Pre 1*, Audio Research *Reference 3*; Krell *Evo 402, 600*, Conrad Johnson *Premier 350SA*, Audio Research *Reference 110, 210*.

Sources: Naim *CDS3*, Marantz *CD-7*, Audio Research *CD-8*, Linn *LP12/Radikal/Keel*, Naim *ARO*, Koetsu *Urushi Sky Blue*, Naim *Superline/Supercap*.

Loudspeakers: Wilson Audio *MAXX3, Sasha, Sophia 2*, Avalon *Eidolon Diamond*, Quad 63.

Cables: Van den Hul *The First Ultimate*, Transparent *XL MM2*, Cardas *Golden Reference*.

supply the heater and auxiliaries, the relay array and the microprocessor.

A highly developed and fine tuned power reservoir technique uses a cascade of successively smaller (*ie* higher frequency) decoupling capacitors in conjunction with matched filter inductors to provide wideband decoupling. This minimises noise and maximises the uniformity of the supply source impedance with frequency.

The low noise microprocessor controlled 'solid state' volume control uses Maxim and Dallas ICs – passive low noise monolithic resistors rather than a DAC. This approach will never wear out and provides usefully high 65kohm single-ended and 130kohm balanced mode input impedances. After selection by high quality sealed, gold contact relays, the inputs go straight to the volume control and thence to the tube gain stage. Only the output is capacitor coupled, using large custom made film and foil capacitors, and paralleled components help achieve a wide frequency response. For 200kohm loading, Audio Research claims 0.2Hz at -3dB. The specifications also quote the output impedance at a low 300/600ohm (single-ended/balanced), helping to control termination impedance and cable differences (but as is usual with tube electronics it is advisable not to load them too heavily). (Audio Research suggests 20kohm or more with less than 2nF of capacitance. It will operate with a lower loading, though dynamics, clarity and distortion will gradually decline with severity.)

The pre-amp will deliver up to 30V at low distortion into 200kohm loading, indicating good headroom, while the input overload is also good at 10V RMS (20V balanced). For a 2V nominal output the midband distortion is claimed at better than 0.01% (-80dB) which all sounds good to me. In the event of 'brownout' or mains failure, a shut down mode uses a fail safe output muting relay to avoid system damage.

Sound Quality

I have said before and I am happy to repeat: "If its sounds great straight out of the box, then it is great". The *Reference 5* is one of those, delivering exceptional sounds almost from switch on. The usual more extended warming up, running in, placement and connection tweaks added valuable mileage but did not greatly alter that first impression.

By the time the review was completed the unit had 500 hours on the clock and was stable. Whereas the *Reference 3* had delivered a class leading 130 sound quality points, the *Reference 5* is fully 33% better at a mighty 175. This might seem improbable and surprising, but the way this product substantially advances rhythm and timing, delivers more expressive low level dynamics, subtle shadings of loudness near to

the aural threshold, and has more powerful and 'live' sounding transient and peak dynamics is certainly impressive.

The *Reference 5* sounds a little more open and less 'dark' than the '3 (itself only very mildly compromised), with a sparkingly clear, finely detailed treble, great vocal clarity, precisely enunciated articulation, and very good focus. Bass line extension, definition, detail and tune playing are significantly improved, sounding more naturally and excitingly percussive in this range.

The overall effect is one of greater power and control, of reduced compression, greater animation and communication, and an infectious enthusiasm for making music reproduction more like a performance. The sound has a natural flowing character, with very spacious, wide and deep stereo images. Near effortless subtle detail emerges in the far field, with an almost uncanny recovery of deep reverberation. Stereo images were correctly projected with a near holographic separation from the ambience field – this quality best heard with the lights off!

More than with any other preamplifier I've experienced, it clearly resolved the difference between phase correct and inverted recordings, showing clear preferences on many. By using inversion at the power amp outputs, I was able to confirm that it was equally transparent in both phase modes.

I found it really hard to find grounds for criticism here and this pre-amp's insertion in my system had less negative effect than that caused by many a fine audio cable. It seemed generally tolerant of ancillary equipment variations, but clearly showed the advantages of well chosen mains and interconnect cables. Backgrounds were silent in balanced, part single-ended and full single-ended modes with the 400W/ch Krell 402 power amp, so it is fully compatible.

Lab report

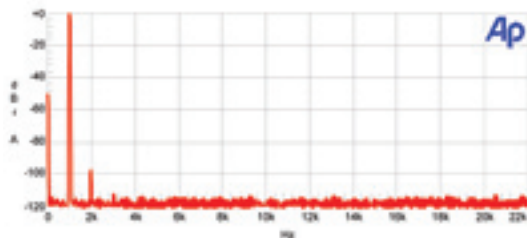
The redesigned topology has helped improve the measured performance as well, in noise, distortion and channel separation, the latter now 125 dB at lower frequencies. The frequency response remains wide and flat (-3dB at 195kHz, and 0.15dB down at 10Hz, into 100kohm load). (The response/distortion graph shown includes an 80kHz instrument filter.)

The 100 step volume control operates at close to 0.5dB steps from an indicated '103' right down to '20', with the usual occasional mild misalignment due to the available resolution of the combination ladder steps (sometimes 0.4dB, sometimes 0.7 dB, but always perfectly balanced between channels). Below '10' the steps are about 1dB increasing to 1.8, 2.5 and 3.5dB to the full -50dB at '1', while '0' provides full mute at -120dB: fine results all.

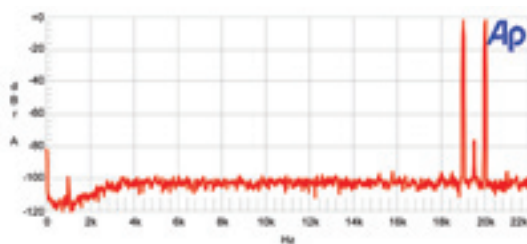
Noise levels were very good with almost undetectable hum intrusion even at -120dB on 0.5V, which is excellent for a valve design. The invert switch had almost no effect on the performance, for example an 0.011dB gain change and none for noise or distortion. Likewise the preferred XLR shorting plug for single-ended input working had no significant effect – just 0.011dB in level and a slight noise improvement, so the improvement I heard was not due to some stray artefact.

High frequency intermodulation distortion is -83dB and -94dB at IHF signal levels, and also remained very good at higher levels up to 8V. Harmonic distortion was very low and almost constant with frequency, as the graph shows, while the distortion spectrum for a midband 1kHz tone is very good with just a trace of (probably beneficial) second harmonic at -100dB. Small distortion differences were present between channels, the result of small natural variations in valve characteristics and unlikely to affect the sound quality significantly.

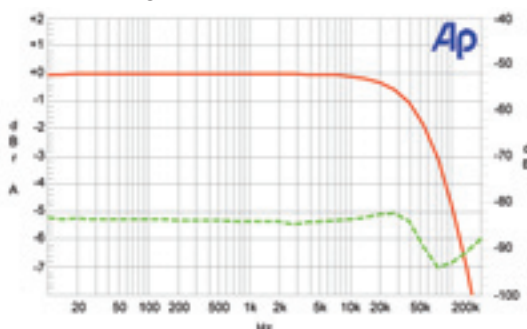
ARC REF 5 Distortion Spectrum, IHF, balanced



ARC REF 5 High Frequency I/M, IHF, balanced



ARC REF 5 Frequency Response 2V IN/OUT 100kohm load and distortion [green]



Finally it shows improved consistency for balanced and single-ended input working making it more universal in application. (Note that the input impedance specs are wrong at 150/300kohm balanced/single-ended; it measures 65kohm single-ended, still a usefully high value, and 130kohm in balanced mode.)

Conclusions

This is a remarkable performer. Minor technical issues have been closely addressed in this version leading to an excellent lab test results with very low noise and distortion and very versatile balanced, single-ended and combination single-ended/balanced operation. Headroom and overload margins are class leading.

This all triode line pre-amp is a top class performer with a well balanced overall sound quality that combines very high resolution with great musical integrity. I came to rely upon its performance and consistency and cannot recommend it too highly. The valves are standard items, so maintenance will neither be problematic nor expensive. While no giveaway, in my opinion this genuine reference grade design compares well with models costing more than twice its price.



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PREAMPLIFIER TEST RESULTS

Make Audio Research	Date: 5/2/2010		
Model REF 5	Ser. No. 49904918		
Distortion, THD inc noise	20Hz	1kHz	20kHz
At IHF 0.5V out, 0.5V line in L/R	-90/84 dB	-90/85 dB	-85/83 dB
At IHF 2.0V out, 2.0V line in	95 dB	-83.5 dB	83.1 dB
At IHF 0.5V out, 0.5V line in bal	-89.9 dB	-90.2 dB	-84 dB
Channel separation			
IHF, 0.5V (SE) Aux Bal	125/(120) dB	93/(81) dB	75/(63) dB
Frequency response			
IHF, 0.5V Aux SE	-0.01 dB	0 dB	-0.25 dB
IHF, 0.5V Aux Bal	-0.02 dB	0 dB	-0.014 dB
Intermodulation Distortion	19.5kHz/20.5kHz 1:1	0.5V output 1kHz difference tone	
Aux SE	-83 dB		
Aux Bal	-94 dB		
Signal to noise ratio	CCIR Weighted	20Hz-22kHz	A Weighted
IHF, 0.5V Aux SE	-75.3 dB	-89 dB	-83.6 dB
Aux Bal	-93.1 dB	-94 dB	-93.2 dB
Channel Balance over volume range			
Rch is reference at 0dB	+0.13 dB		
at -20dB	+0.17 dB		
at -40dB	+0.14 dB		
at -60dB	+0.02 dB		
Maximum output level (1% clip)			
100k Ohm load	15 V SE	33 V Bal	
600 Ohm load	2.2 V SE	4.4 V Bal	
Output impedance			
SE	330 Ohms		
Balanced	660 Ohms		
Input Data	Socket	Sensitivity	Loading
Aux input balanced	XLR	mV	130kohms .05 nF
Aux input single ended	Phono mV	65 kohms	0.1 nF
DC offset	Left 0 mV	Right 0 mV	
Size cm	Width 48	Height 17.7	Depth 44
Price	£ 11,000		