VACUUM STATE RTP3D Differential Full Preamp

A Statement of the Art...

A little background...

It's not widely known that tube circuit R&D made huge advances in the late 40's/early 50's, but most of this new technology was classified 'secret' and never released to the world. By the time it became free in the late 60's, audio had moved on to solid state. But those breakthroughs from research places like *Bell Labs* had been made available to key test equipment companies *(Hewlett Packard, Tektronix etc)* and their products from the late 50's & early 60's were ultimate wide bandwidth, accurate, low distortion tube equipment designs.

In 1980, more than twenty five years later, Allen Wright (founder, CEO and circuit designer at *Vacuum State*) felt he had taken the advancement of the classic *Marantz 7* type of tube preamp about as far as it would go, and needed some fresh ideas. So he called his old boss at *Hewlett Packard*, and asked to hunt through their wall of service manuals— maybe the circuit ideas used in the last of their very high tech tube oscilloscopes could be used to create completely new concepts in tube audio amplification.

Some intense study identified a number of circuit concepts consistently used by the *HP* designers:

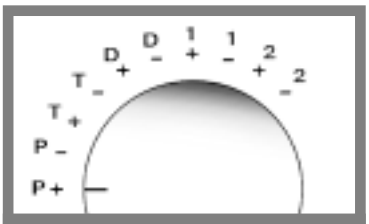
* Utilise differential operation (an optimised form of 'balanced') to ensure absolute internal stability and freedom from noise
* Achieve very low distortion from correct design of the circuits themselves, without the crutch of negative feedback
* Use no loop negative feedback—as this destroys transient purity and *paints over* any inherent circuit problems
* Allow extremely wide bandwidths— at least a decade higher & lower than that of the signal to be handled.
* Create the gain needed in as few a number of stages as possible—aka the KISS principle
* Use constant current operation to ensure that large, fast signal swings don't even momentarily unbalance the circuits
* Make the power supply and all support circuitry hugely capable—well beyond what's normal or expected
* Operate all the electronic components–especially the tubes–way inside their ratings to ensure reliability, stability and long life.

None of these eight points were employed in the *Marantz 7*, but were religiously implemented in the first *Vacuum State Realtime* preamp that reached the Australian market in 1982—and it stunned those who heard it! And once these technical basics were known, understood and proven in audio application, subsequent R&D was able to focus on optimising these circuit's sonic properties. Things rapidly progressed outside of easily explainable science: components of identical measured quality were found to sound different, power supplies became far more important than they are in test equipment, wires & cables took on importances unimagined by conventional engineers, etc etc etc..

That first *Realtime* preamp has been the subject of continuous development over the intervening 25 years—and still using instrumentation circuit topologies and employing all those eight key points above, has culminated in this *RTP3D*, with these features:

* Modular construction allowing: 1/ phono + line, 2/ line only, 3/ double line, 4/ double line with electronic crossovers *included* in the circuitry
* Fully differential, zero negative feedback, current sourced signal circuitry developed with extensive listening tests for extreme sonic results
* Ultra low noise, MC sensitive phono stage built in to eliminate all the extra connections & complexity needed with an external phono stage
* Only two gain stages to provide MC sensitivity phono input to line level output—in fact, all circuits made as KISS as possible
* All primary signal path wiring is hard wired/point to point with either solid core pure silver wire, or pure silver foil
* Extreme power supply regulation with *Vacuum State's* unique *SuperRegs*—current sourced shunt regulators. One per channel
* Absolute phase selection available on all inputs via the input selector switch—hence not requiring any extra components in the signal path
* 100% hand made in Switzerland by experienced technicians

The VACUUM STATE RTP3D preamp is built in dual mono format and the modular construction allows you to take advantage of several possibilities: 1/ Full function preamp (phono + line) 2/ Line stage only preamp 3/ Double linestage preamp 4/ Double linestage preamp with electronic crossovers built into each line stage



Right Channel input selector knob (absolute phase choice on all inputs)

This 4th option is intended for those who want to biamp their speaker system and maintain the absolute sonic quality of the RTP3D—without having to feed it's pristine signal through a lesser quality electronic crossover. The line amps are easily configured to low pass or high pass with minimal extra parts, so no further stages are needed to provide this—keeping things KISS to the max! The crossover points and gain can be set anywhere from subwoofer to midband, even up to super tweeter frequencies—and would normally be set at the factory according to client specifications—but can be dealer altered as needed. Available crossover slopes of 6, 12, 18 are readily available, and 24dB/octave is possible on request.

Left Channel input selector knob (absolute phase choice on all inputs)

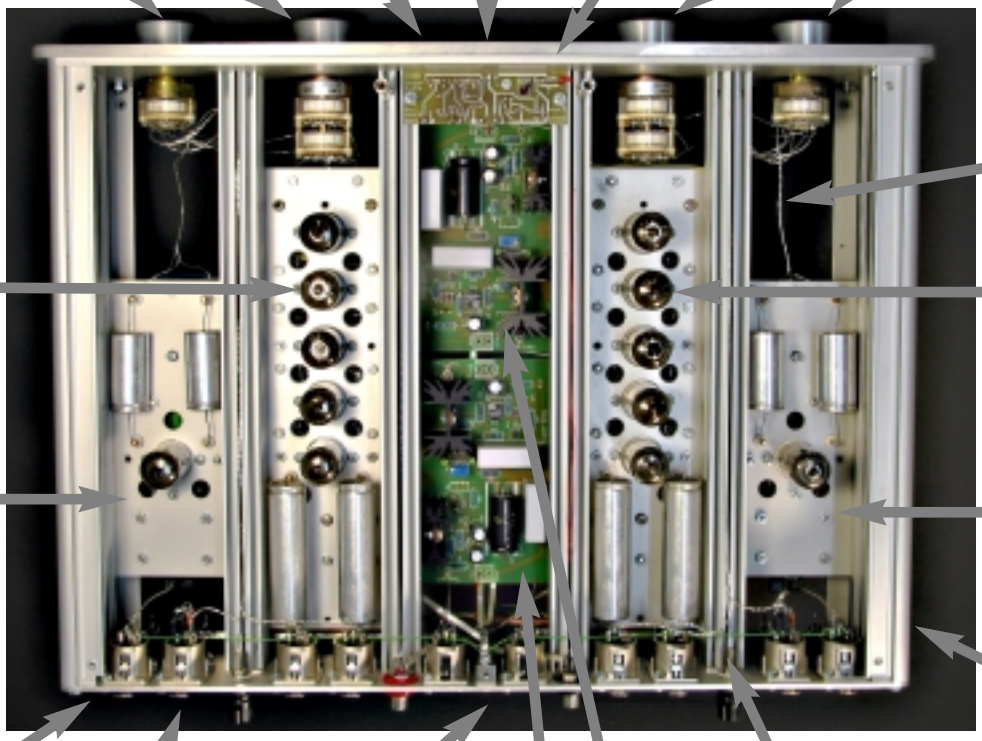
Right ch Gain Control:

6mm Al Front Panel

Mute Switch

4mm Sub Front Panel

Left ch Gain Control:



Pure silver signal wiring

Right ch Lineamp Module position

Left ch Lineamp Module position

Right ch Phono Module or second Lineamp module position

Left ch Phono Module or second Lineamp module position

Extruded Chassis Side

4mm Rear Panel

RCA, XLR and REDEL sockets

External Power Supply socket

Right Ch SuperReg position

Left Ch SuperReg position

Extruded Chassis Rails (x10)

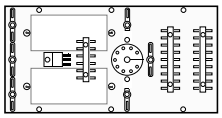
The REDEL connector is made by LEMO in Switzerland, and is the best sounding audio connector we know of. We offer it on all our balanced products

Concepts, explanations, and talk...

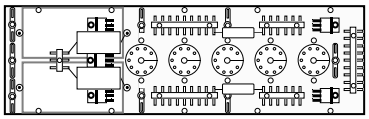
Circuit design

• The RTP3D is the result of 25 years of ongoing development based on unique circuit concepts borrowed from the instrumentation world. But as we would never consider it can't be improved in the future, it's been constructed to be easy to upgrade if revisions are found that improve the sonics.

• The circuits are discussed in Allen Wright's *Tube Preamp CookBook. (TPCB)*, which is essential reading if you have an interest in how these things work, and which gives the history of the RTP design concept from it's originations way back then!



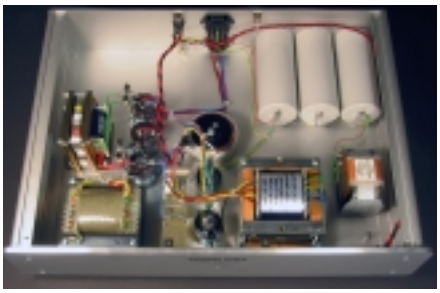
• The signal circuits are built up as individual modules, which carry one or five tubes. (The T0220 semiconductor packages in these drawings are only for the individual current sourced heater supplies for each tube)



• To maximise performance, this preamp is built in *dual mono* format, mirror imaged out from the dual centrally mounted *SuperReg*s. Separate *dual mono* selector and gain controls maintain this *extremo* layout concept.

• *The main chassis* is strongly engineered from aluminium extrusions & heavy plate.

• The *Power Supply* matches the preamp's chassis size, looks and style. Using choke input filters for B+ & heater supplies, polyprop filter caps, it is the biggest change & improvement over previous RTP models



Components

• The components chosen have been carefully selected from long term experience for their reliability, but most of all from listening experience for their sonic qualities. In this product, sonics are a far greater importance than price They are all from recognised suppliers, although we do have some special parts from sources we do not disclose!

—*Siemens MKV* 'atomic power station' quality primary signal path capacitors

—*VISHAY bulk foil* resistors for the lower power *crucial* primary signal path positions

—*Mills* wire wound resistors for the higher power *crucial* primary signal path positions

—*Dale non-magnetic* metal film resistors for the important but not quite *crucial* secondary signal path locations

—*Secret* ceramic sockets and terminal strips

—*Elma silver contact* selector switches

—*VACUUM STATE* stepped attenuators (*Elma* switches with non magnetic resistors)

—*Redel &* Silver *Neutrix* XLR sockets for the balanced connections. *Redel?* This is the sonically preferred balanced connector, but as they're exclusive to *Vacuum State* interconnects, the very best XLR's are also fitted.

• And of course *Vacuum State* silver foil and silver wire for all critical internal signal, ground and B+ wiring!

• We use tubes selected from currently manufactured *E88CC's*—which give stable long term results with a proven *5 year* usable lifetime—even when the RTP3D is on *24/365*.

• There are certainly more freaky components out there—paper in oil capacitors, silk covered wire, or old *NOS* tubes especially made for the *Titanic* mission—but from our experience their sonic improvement are doubtful—or even disastrous, and their reliability is far below what we want to offer you.

Sonic standards

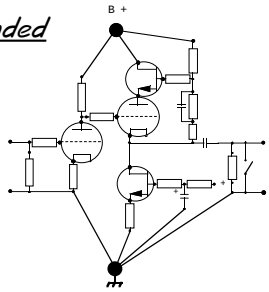
Live *acoustic* music is of course the only useful reference to accurately judge the quality of audio equipment. A design team must regularly attend live concerts of all types to maintain a realistic viewpoint of what they are doing and move towards increasing in their products the ability to create the same liveness in the owner's listing rooms.

The unique characteristic we work toward is *Downward Dynamic Range* (DDR)—fully explained in the TPCB—but briefly, it describes the ability of a product to present the *micro*dynamics/room space of a performance *in the presence* of *macro*-dynamics—something most equipment does not do well. They may do micro and macrodynamics independently very well—but not *simultaneously*. If anything describes the sound of *Vacuum State* equipment, it's their oustanding DDR, quite different to all other brands!

Differential?

Vacuum State are serious proponents of differential circuit topologies, as it's performance gain is major—even when used only from SE sources and into SE power amps!
This is a schematic of the FVP5 *single ended* line amp, as described in the *TPCB*.

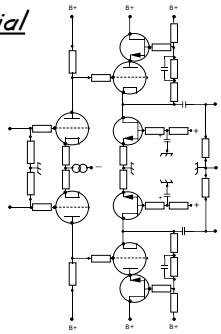
Single Ended



Single ended (SE) means the signal is *input* between the input and ground, is output *between* the output and ground, and internally all signals are directly *referenced* to ground, and indirectly referenced (but heavily affected) by the power supply.
SE operation allows the simplest signal path with minimal components—but the big disadvantage is that the ground and power supply wiring are *unavoidably* part of the signal path, carrying the signal as well as the high voltage supply, ground currents—and things *you'd never dream of...* And even with careful grounding, these nasties can (and do) interact to the disadvantage of your music!

Here's the map of an earlier RTP *differential* line amp, also fully explained in the *TPCB*.

Differential



A differential amp (an optimised form of *balanced*) accepts the *difference* between the inputs terminals, *floats* this signal (without reference to ground or B+) internally, and outputs the *difference* between the two output terminals. Any interference signals that appear at the inputs and/or in the internal ground or power supply wiring are simply ignored—and kept completely separate from the music signal.
This brings such a *major* increase in clarity, coherence and inter-transient silence, as well as a corresponding reduction in the sonic noise floor—that *in my experience* these advantages greatly outweigh the increase in complexity and cost over an SE design built with similar components and care.
Naturally, all inputs (except one) and the main outputs accept balanced cables for the lowest noise pickup, and best signal transfer.

Numbers...

Description

Double chassis (electronics and power supply) modular, full function, effectively dual mono, differential tube preamplifier, with client defined specifications.

Inputs: 1 x MC/MM *Phono*—balanced via paralleled XLR, Redel or RCA sockets
1 x *Digital* with -10dB attenuation for digital players—balanced via XLR & Redel, or unbalanced via RCA sockets
3 x *Line* level balanced via XLR & Redel—or unbalanced via RCA sockets.
1 x *Line* level unbalanced via RCA sockets

Outputs: 1 x balanced out via paralleled XLR & Redel—or unbalanced via RCA sockets
1 x unbalanced recording level output (before the gain controls) via RCA sockets

Phasing: XLR's wired to the international professional standard: Pin 1 ground, Pin 2 '+' phase (hot), Pin 3 '–" (cold).

Controls: 2 x separate left & right ch 10 position input selector switches—providing '+' and '–' absolute phase selection
2 x separate left & right ch 23 position stepped attenuators, hand built using silver ELMA switches & 1% SMD resistors
1 x central mute control, 1 x AC power on/off switch on the power supply chassis

Tube: 12 x E88CC/PCC88 from current production. Special/NOS tubes are owner changeable with no adjustments needed.

Size: Preamp: 445 (17.5") W x 110 H (4.3") including feet x 345 (13.6") D
Power supply: 445 (17.5") W x 110 H (4.3") including feet x 320 (12.6") D

An additional 80mm (3.2") space is needed at the rear for the power supply umbilical cable, and to access the signal connectors

Weight: Electronics + power supply chassis: 19kg (42 lb.), shipping container: 3kg (6.6 lb.) Total shipping weight: 22kg (48.6 lb.)

Electronic Specifications

Phono stage gain: Overall 70dB MC/50dB MM, owner/dealer selectable for MC or MM cartridges with an internal wiring link.

Line stage gain: 20dB, owner/dealer adjustable from 10dB to 30dB with a resistor change, to exactly match system requirements

Max output: 28V RMS/+33dBm @ 1kHz

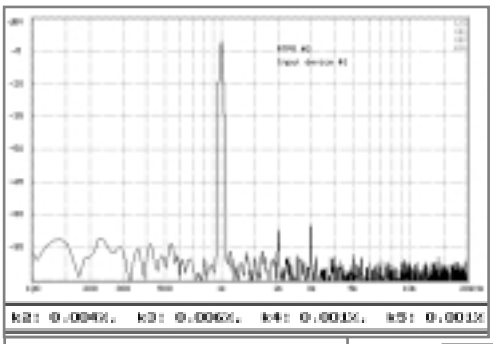
Input overload: Line: 2.8V RMS with the attenuator at maximum gain—increasing linearly with decreasing gain settings
Phono, MC: 100mV RMS MM: 1V RMS

RIAA accuracy: +/– 0.1dB 10Hz—50kHz Channels matched to 0.02dB

Input impedances: Phono 47k balanced, adjustable by inserting chosen loading resistor plugs into an unused phono input socket
Line: 47k unbalanced, 93k5 balanced

Output impedance: Main: 200 ohms balanced, 100 ohms unbalanced Recording: 100 ohms unbalanced (buffered)

Measurements

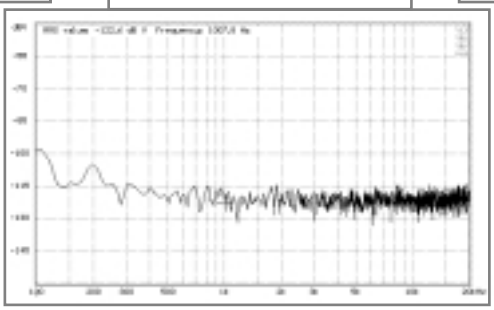


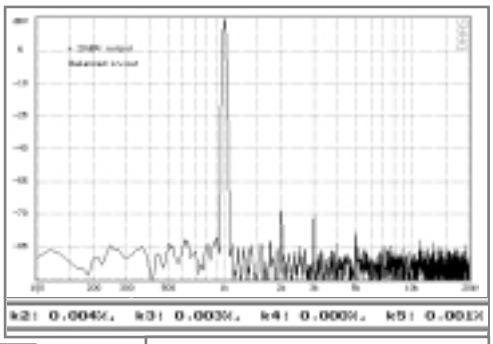
Distortion

Phono + Line @ 1V RMS out:
2nd harmonic: 0.004%
3nd harmonic: 0.006%
4th harmonic: 0.001%
5th harmonic: 0.001%

Any top solid state designer would be very proud of these distortion & noise figures—but for a negative feedback free tube preamp, they are quite remarkable and are a proof of the effectiveness of the 8 key points of *Hewlett Packard*/audio design. But we ask you to listen to really judge our sonic quality!

Noise Line stage: –122dBV





Distortion

Line stage @ 10V RMS out:
2nd harmonic: 0.004%
3nd harmonic: 0.003%
4th harmonic: 0.000%
5th harmonic: 0.001%

Available from:

Completely handmade in Switzerland by skilled technicians

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