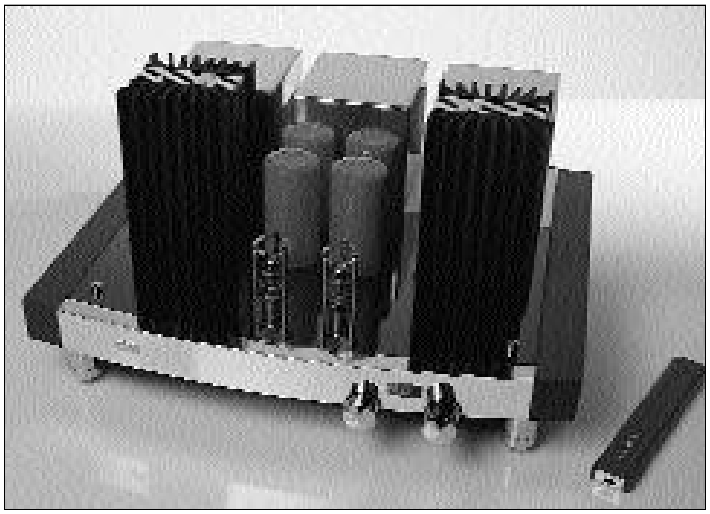
Pathos Twin Towers Integrated Amplifier: Inpol Inside



Pathos, a manufacturing and design concern based in Vicenza, Italy, and as yet little known in the Americas, is now attempting to replicate here the success it has enjoyed throughout much of the Old World. If there is any justice in the New, they will succeed.

Pathos, established in 1994, is more than a little reminiscent of the late great Threshold Corporation. Like that seminal High End firm, Pathos is a partnership consisting of an electrical engineer and an industrial designer, both singular talents. Even more to the point, the Pathos innovation, and it is a real innovation providing unique benefits, is a species of regulator circuit eccentrically applied to the output stage of a power amplifier.

The Twin Towers integrated, reviewed here, represents the first implementation of the new circuit, dubbed Inpol by its inventors, and it remains the mainstay of the Pathos product line though it has been joined by a preamp, phono stage, D/A converter, more affordable integrated amp, and straight power amps.

Ascending the Twin Towers

The Twin Towers integrated is a 35-watt-per-channel, pure class A hybrid design. Of immediately arresting physical appearance, the Twin Towers cries "tube" in its every lineament. Three massive, chrome-plated transformer cans stand sentinel along the back of the unit, preceded by a couple of huge, deeply finned black heat sinks with chrome accents. Between the heatsinks is a brace of four, bright red, high-capacity electrolytic capacitors, and two 12AX7 triodes, each captive in its own tiny chrome cage. Verticals cease at that point, and a flat, featureless expanse of matte chrome or satin-gold – your choice – extends in unrelieved splendor to the gently curved chrome front panel. Abbreviated side panels of Italian walnut, ash, or padouk, a sumptuous Central American hardwood, complete the composition.

The disposition of these forms in space is eminently successful, and the Twin Towers is, I think, among the most beautiful of all High End products. And its beauty, as I'll explain in a moment, is more than skin deep.

A second glance at the Twin Towers leads one to ask, "Where are the power tubes?" Indeed, there are none. The Twin Towers may borrow the open chassis construction and chrome bright work of classic tube gear, but the two 12AX7s are the only bottles in the rack. Lest you suppose that the amplifier trades somewhat illegitimately on the tube mystique, let me say that the Inpol output manages what has never been achieved before in a hybrid, and succeeds in leveraging the small signal tubes in such a manner that the sonic signature of the Twin Towers is pure tube in all desirable aspects, while retaining the frequency extension and bass control of solid state.

Of course that claim has been made for every hybrid on the market, but then the Pathos line contains the only hybrids to achieve long-term market success. It is the first hybrid I've encountered that truly fulfills the hitherto empty promise of hybrid technology. Pathos succeeds, I believe, because it utilizes a novel strategy for integrating a tube driver with a solid-state output.

For the technically curious, the ingenious Inpol circuit is described in detail in a sidebar. In brief, it shelters the output stage in large measure from thermal fluctuations that beget telltale solid-state distortions. Like the "current dumper" in the old Quad solid-state amps, or the "current bootstrap" in the Threshold Stasis design, the Inpol circuit is essentially a current amplifier, a gigantic regulator, as it were. Thus the voltage characteristics of the output signal, including the spectrum of distortion components, are almost entirely controlled by the tube driver rather than the output stage.

Inpol is not without its limitations, though, or everyone would be rushing to infringe the patent. In its basic form, it is a single-ended solid-state circuit, and thus must be operated pure class A to avoid switchlike turnoff at the signal extremes. Such single-ended circuitry virtually enforces strict class A operation with the consequent requirement for continuous high-current draw and a massive power supply to permit that. Which in turn limits practical power output. At slightly over 30 watts of output, the Twin Towers weighs 88 pounds, and a correspondingly larger and heavier power supply would be required to increase that output. A higher powered mono version was recently introduced called the InPower; weight for the pair exceeds 200 pounds for an 80-watt-per-side output.

Apart from its obvious inefficiency, the Inpol circuit imposes yet another liability on the user to offset partially its manifest advantages. Inpol, to an unusual degree for a high-current solid-state output stage, is load sensitive. It wants to "see" a relatively constant fixed terminating impedance of 5 to 8 ohms, and the manufacturer advises that performance is sub-optimal with speakers rated at 4 ohms or below.

Technically, the manufacturer is correct. Like all practical class A output circuits, the Inpol derates to AB at low impedances, and distortion rises sharply on that account at higher outputs, since there's no push-pull operation to maintain linearity at transistor cut-

off. Also, the Inpol regulates current less well into low impedances. But in my listening experiments with 4-ohm speakers, I found that the Twin Towers maintained superb sound quality at sound pressure levels as loud as I cared to experience. The Twin Towers may not be the first choice for driving the most difficult speakers, but it won't express audible distress at the first impedance dip like some mass-market IC receiver.

A final word on the basic design: a glance at the Twin Towers might lead you to assume that the amplifier possesses a transformer-coupled output, something not seen in a solid-state output circuit for nearly 40 years. Actually, only one of the three transformer cans arrayed along the back of the amplifier conceals a transformer – a power transformer, as it happens, not an output type. The others cover two extremely large iron core chokes tied to the sources of paralleled high power MOSFETs – three per channel. A parallel circuit communicates with two of the electrolytic capacitors jutting out of the top of chassis. These in turn are in series with the load, making the amplifier, remarkably, capacitor coupled.

Capacitor-coupled outputs are in grave disfavor in audiophile circles, and are seldom used, save as crude expedients for blocking DC in OTL single-ended circuits. They serve the latter function in the Inpol circuit, as well, but they also form the heart of what is, in effect, a passive current regulator, and thus are essential to the achievement of the design goal. Considering the prejudice against capacitor coupling, it took considerable courage and vision for the designer to proceed along this path. But he was entirely justified by the results.

How It Sounds

Quite wonderful, up to the limits of its power rating.

The first time I heard the Twin Towers driving the French Triangle Electroacoustique dynamic loudspeakers at last year's CES, I thought it was a pure tube design. The sound on symphonic program material was expansive in both dynamics and spatiality, and extremely warm and involving, but with an unusual degree of high-frequency extension and bass solidity for a tube amp. Of course, upon closer inspection, it proved not to be pure tube design.

Ensconced in my living room, it proved even more endearing.

Fully warmed up, after about a half hour of idling, the Twin Towers soon reveals its singular virtue, an ability to replicate the precise timbre and attack and decay characteristics of individual instruments with arresting accuracy. I've had many amps in and out my door, and with one exception, a very unusual and sadly little known OTL design from Transcendent, I've never heard anything to equal it. The Twin Towers is so revelatory on so many excellent recordings that it's difficult to know where to begin with examples.

The antique cornet, a type of horn with a trumpet mouthpiece and a cow-horn body, was one of the most beautifully expressive instruments of the Renaissance and Baroque eras, and it is almost perfectly captured on the Edition Open Window recording *Il Cornetto* [OW 004]. On an excellent solid-state amp using Deane Jensen op amps for voltage gain and the JBL T output circuit, the cornet was slightly glary and rather reedy sounding. The Pathos gave it back the expressive penumbra of overtones I've heard at live concerts.

Alistair MacLachlan's baroque violin on the Harmonia Mundi recording of *The Beggar's Opera* [HM 1071] was completely realized, down to the scraping of fingernails on the strings and the signature throbbing of the sound box so that the sound emerged with

THE GUTS OF INPOL

The Inpol output circuit consists of a trio of source follower power MOSFETs current sourced by a large inductor and loaded with a capacitor. Essentially, that's all there is to it.

So what's so special about it? An examination of the manner in which it operates reveals some particularly appropriate behaviors.

A choke, by its very nature, impedes alternating current, while passing DC, and the bigger the choke the lower the frequency where the impedance manifests itself. A capacitor does just the opposite, opposing DC and passing AC. Since Inpol contains both in parallel, one or other condition will obtain, depending upon the presence or absence of an AC signal voltage at the gate.

Under no-signal conditions, the choke allows direct current to flow unimpeded from the positive supply to ground and provides an infinitely lower impedance path than the parallel capacitor – which is desirable since you don't want DC going into a loudspeaker. Since the output is class A, the current going to ground is considerable. The capacitor, incidentally, is the same size as that in the power supply, and, in addition to blocking DC, provides additional energy storage while equalizing current draw for either half of the wave cycle, i.e. when the MOSFET is sinking or sourcing current.

Now let's apply an alternating audio signal to the circuit and see what happens. The signal modulates the gate current of the MOSFET, increasing electron flow from ground up to the positive rail. Now the choke opposes current flow while the capacitor presents a relatively low-impedance path and begins to charge as current is diverted from ground into the capacitor. Impedances are set so that the total series impedance of the capacitor plus the loudspeaker circuit is somewhat higher than the impedance to ground; therefore current through the output transistor never varies appreciably even though the internal impedance of the MOSFET drops with increasing signal voltage.

Let's expand upon this last point since it is the key to the Inpol advantage.

As the MOSFET conducts more heavily with increasing signal level, the load impedance rises as current is diverted from the low DC impedance path to ground to the speaker circuit. Thus, even though the voltage and power are increasing with the signal level, output current remains more or less constant because the load impedance "seen" by the output is rising simultaneously (Ohm's Law dictates that current will remain at the same value if load impedance and signal voltage rise by the same amount). As a result, the MOSFET itself is stabilized and sees no change in its own internal resistance due to thermal variations, which in turn are the consequence of current fluctuations – so long, that is, that the speaker itself represents an appreciable load, namely, 5 ohms or above.

Variations in internal resistance associated with instantaneous thermal changes constitute one of the principal distortion mechanisms of solid-state devices. Such internal impedance variance is reduced with class A operation and further reduced with Inpol.

Interestingly, Inpol precludes the use of negative feedback around the output which would tend to attenuate the input and reduce current output further, thereby destabilizing the circuit. But then Inpol, by removing a primary distortion mechanism, obviates the need for feedback.

The Inpol circuit, matched with the appropriate speaker load, is in fact nearly distortionless below clipping simply because it lacks any mechanism for producing distortion. It magnifies the driver and replicates the driver's signature spectrum of residual distortions. And that's why it's so transparent to the tube preceding it.

An added benefit is that it is more efficient than a conventional class A output since, under signal conditions, no current returns to ground without first passing through the speaker circuit. Thus the entire current flow is performing useful work, not just heating up the output device.

In sum, Inpol represents some highly unconventional thinking, and it's a topology no textbook engineer would ever conceive. But by eliminating complex DC servo circuits and using reactive components to advantage, it achieves a remarkable synergy. It is damned clever and extremely elegant.

DISTRIBUTOR INFORMATION
Hi-Fi Forum
Phone: 800-771-8279
or 514-932-7786
Fax: 514-931-8891
Email: info@hi-fi-forum.com
Serial Number: 980327
Price: Base - $4,950 (manual or with remote); Reference remote - $5,700

ASSOCIATED EQUIPMENT
Hewlett Packard signal generator and distortion analyzer; Win Labs SEC-10 turntable; Mission Mechanic tonearm; Win Labs MC-10 moving coil cartridge; Win Labs moving-coil step-up transformer; Boulder L3AE preamp; Wolcott Audio Presence P220 Mk II power amps; Win SM-8 monitors with Elac 4Pi Plus ribbon tweeters; Speaker Art Odyssey loudspeakers; MIT cabling throughout; ASC room treatment.

proper sheen and body.

The snares, xylophones, and traps figuring in the classical percussion pieces on *Super Percussion* [Super Analogue Disc, 2219, King Records] became a truly motley crew, fully differentiated in timbre and apparent location in space. Each stroke registered as a distinct event, with skin sounds particularly well realized.

Tim Wheaton's flute on the old Meridian recording of *Spun Gold* [E45 003] capered through an astonishing range of tonalities, sounding alternately hard and liquid, piercing and dulcet, and evincing variances I've simply never heard previously.

Finally, on a superbly recorded traditional jazz recording, Dick Sudhalter and Connie Jones on *Stomp Off* [SOS 1207], featuring an extended trumpet/cornet duet between Sudhalter and Jones, the Pathos most aptly recreates the high-energy partials of the brasses, outperforming in this regard any amplifier I've had in my system.

On orchestral and choral music, the Pathos is equally adept. On the Decca Set of *Porgy & Bess* [609-11], massed and individual voices emerge with startling palpability from a fully realized depiction of the orchestra, with individual sections reported with equal justice throughout.

In terms of overall frequency response, the Pathos is extremely extended on the top end and taut and solid in the depths, though lacking low-frequency heft. The overall character of the sound is limpid and somewhat warm – like clear turtle soup, as my wife put it.

Imaging, since it is so dependent upon room acoustics, loudspeaker design, and signal source, is difficult to ascribe to an amplifier, but the Pathos did appear to enlarge the soundstage in terms of both width and depth.

How It Measures

As indicated in its literature, the Twin Towers puts out a bit over 30 watts per side into 8 ohms. Distortion on my unit was quite a bit higher than the published spec of 0.5% at half power. I got 1.7% THD at 15 watts at 1kHz and 20Hz, and 3% at 30 watts at the same frequencies. 20kHz measurements at 15 watts yielded 5% THD. Distortion was nearly all second harmonic, with a gently rising characteristic found in some single-ended pure tube designs, but nothing else I've seen.

I reported the measurement discrepancy to the distributor who supplied me with independently generated test results supporting the factory specs. The designer believes that the tubes are defective. I know that my unit had been dropped, hitting with such force that the remote was shattered and the volume-control solder joint was broken. I'm inclined to trust the factory on this one since no other reviewer has reported similar figures. All I know is that the thing sounds lovely, and that it represents a formidable challenge to all tube single-ended triode designs.

I shall be receiving another Twin Towers soon, which I shall retest for distortion. In the meantime I shall experiment with different brands of 12AX7 to determine if distortion readings change. My analysis of the circuit and conversations with engineers familiar with the design convinces me that the residual distortion of the tubes themselves probably determines the overall sonic character of the circuit in large measure. Incidentally, a 2 percent value for the second harmonic, absent other distortion components, would probably be audible but would be deemed euphonic by most listeners. Certainly the Pathos sounded ravishingly sweet, while lacking the congestion I've heard with many single-ended all-tube designs. I intend to purchase a unit.

DAN SWEENEY