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 black furnishes 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-
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.

JBL T output circuit, the cornet was slightly grainy 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
Herron Audio’s Phono and Line Stages: All They Lack Is Inexperience

Both components are all-tube, except for an optional FET (solid-state) moving-coil stage in the VTPH-1. Priced for serious music-listening audiophiles (whom David Manley calls “audio-musicophiles”) in the mid-three-thousands each, these units boast heavy-gauge circuit boards and enclosures, both sturdy enough to dance on. Your money purchases not glitz ‘n’ gizmos but robust construction plus circuits and features that designer Keith Herron believes deliver better musical sound. Deluxe parts include non-resonant ceramic tube sockets, which really ought to be as common in audio as are gold-plated connectors.

Speaking of connectors, Herron does not believe that balanced wiring delivers better musical sound, and so all the connectors on his units are TIFF RCA. The inputs to the line stage are switched via relays instead of corrosion-prone contacts. These relays are fastened in neat little boxes directly to the input jacks. Yes, we’ve come a long way from the days when the preamp-kit builder’s dreariest task was to stretch and solder sagging spaghettinis of noise-prone hookup wire from the input jacks on the back panel to the