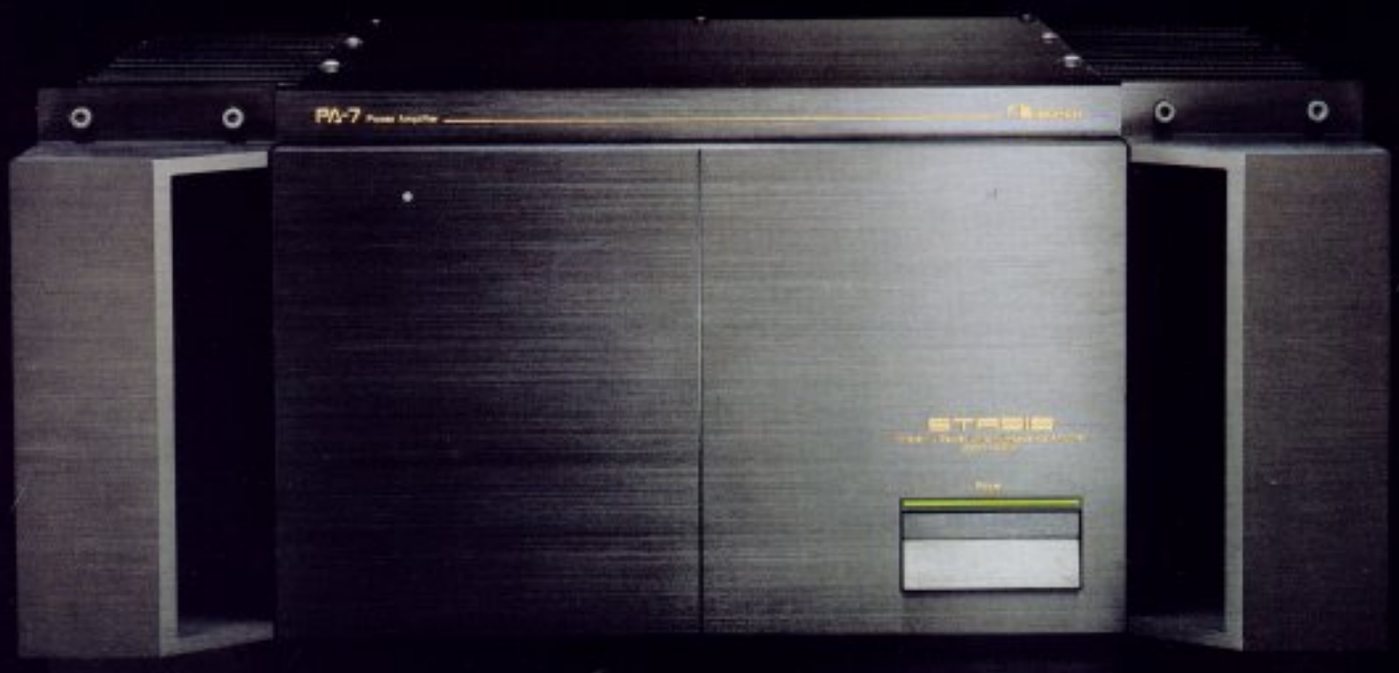
Nakamichi
PA-7/PA-5
Power Amplifiers



The PA-7 and PA-5... Better Sounding Inherently Stable/Uniform Impedance Powe

When you audition a power amp, listen carefully for musical clarity. Can you hear the subtle details of the music, its nuances, the light texture of a harpsichord, guitar or triangle within the musical framework? Or are the softer instruments muddled, confused and overwhelmed by the more powerful ones? Can you hear *each* instrument clearly and individually? Or is everything awash in a blurry sea of sound?

Listen for bass reproduction. Is it clean and tight as well as powerful, or merely boomy and resonant? And, listen to the texture of the high treble. Is it bright and clean as it should be, or sharp and frizzy?

Listen at higher-than-average levels and at softer-than-average levels. Is there a difference in clarity and detail? There shouldn't be!

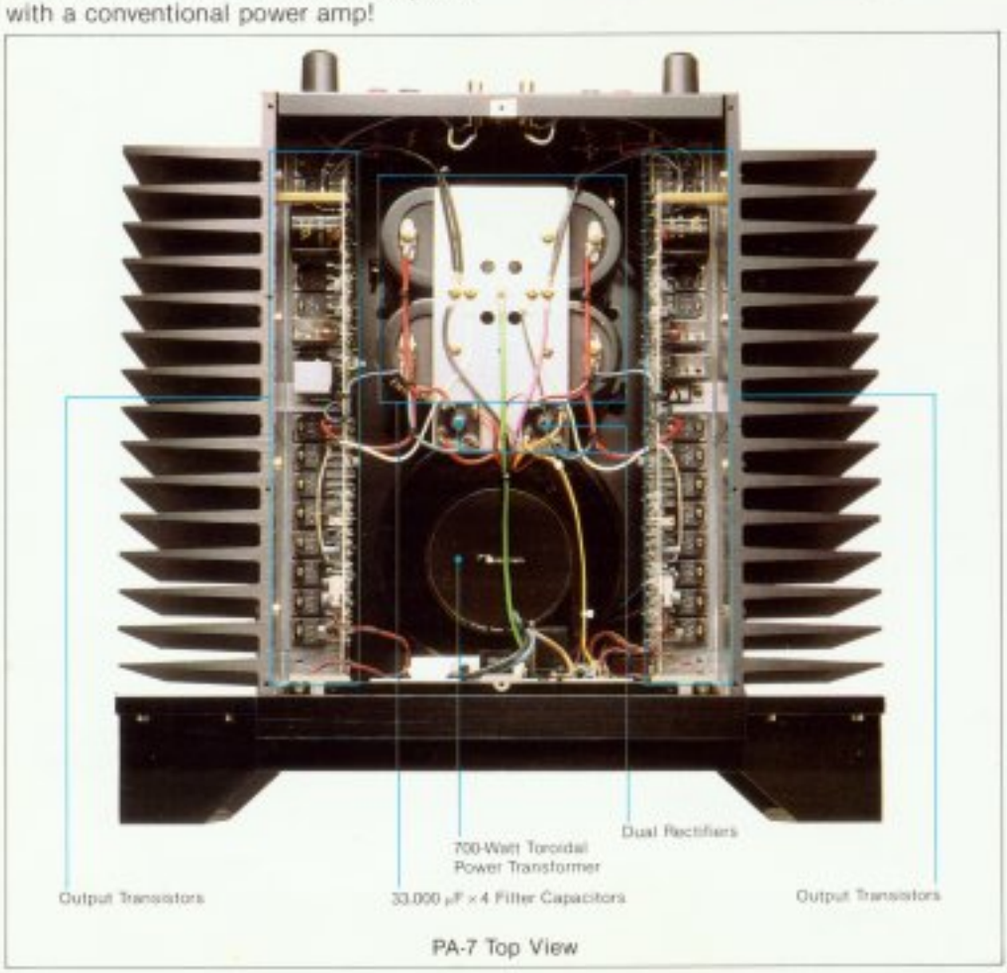
If you're listening to a good program source—through a good preamp and loudspeaker—the differences you hear are due to the power amplifier. And, if you wish to prove to yourself that such differences *do* exist, simply compare a Nakamichi PA-7 or PA-5 Power Amplifier with a conventional power amp!

Why Nakamichi Power Amplifiers Sound Better

Most power amplifiers sound the same because they're designed with the same circuit configuration or "topology." There may be differences in the brand and type of transistors that are used. And there may be differences in construction quality and in the quality of various other components. But, *once the signal enters the input jack of any conventional power amplifier, it follows pretty much the same path to the output.*

The STASIS circuit used in the Nakamichi PA-7 and PA-5 is the exception! It is radically different from—and vastly superior to—conventional topologies.

Nakamichi Power Amplifiers are designed to drive "real-world" speakers, not just the load resistors used on the test bench. Driving an 8-ohm power resistor is easy! Driving a *real* speaker whose impedance changes with frequency and whose reactance keeps current and voltage out of phase with each other is another matter entirely! That is what separates "the men from the boys" and the PA-7/PA-5 from the ordinary!



PA-7 Top View

Conventional Power Amps Rely On Global Feedback

Conventional power amps use "global feedback"—feedback from output to input—to correct basic design problems. A few amplifiers "feed forward" but the concept is the same: *problems that shouldn't be there in the first place are corrected by injecting compensating errors into the system.*

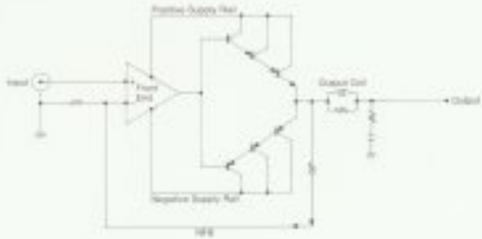


Figure 1 Conventional Power Amplifier

Figure 1 is a simplified block diagram of a conventional power amp. The signal is voltage amplified by the "Front End" and then current amplified by the output transistors. If the voltage and current amplifiers are perfectly "linear"—that is, if output is exactly proportional to input—everything is fine.

But this isn't the case! In the *real* world, voltage and current amplifiers are *not* perfectly linear—all signal levels are *not* amplified by the same amount. Put another way, *the amplifier introduces distortion!*

Adding a "global" negative feedback loop from output to input (marked "NFB" in the diagram) seems the perfect solution—at least, on paper! In theory, "global," or "overall" feedback reduces distortion and output impedance by the same factor that it reduces voltage gain. It's a tradeoff—you give up voltage gain to reduce distortion.

At first glance, the tradeoff seems good. It's easy to increase gain—especially if you needn't be concerned about distortion!—and then use feedback to reduce the gain and the distortion along with it. It's like getting something for nothing!

If you suspect that's too good to be true, you're right! The idea that global feedback is the ideal cure for amplifier disease is a simplistic misunderstandi of how feedback works and a gross underestimation of the problems involved. However, it *is* the view that has dominated amplifier design for years and it is the reason why most power amplifiers *sound* the same.

r Amplifiers...From Nakamichi!

What's Wrong With Feedback

Feedback is *most* effective when it's not needed and *least* effective when it is! It *assumes* there's gain to trade to reduce distortion. In the crossover region and at clipping, gain drops to zero. The theory goes out the window! Furthermore, feedback is always late. By the time the signal reaches the output, the input has changed and the feedback "fixes" the wrong problem.

Because the feedback is late, there's *one* frequency at which it's a *half cycle* late. Feedback changes from negative to positive and the amplifier oscillates! The amp must be "stabilized" by reducing high-frequency gain so that, when the feedback turns positive, there's no gain left. The more gain to begin with, the lower the frequency at which it—and the *benefits* of NFB—disappear!

In a *real* speaker, voltage and current are not in phase which can cause an amplifier with NFB to become unstable. So the speaker is "isolated" with a coil. The coil increases output impedance and may resonate with the speaker! The true frequency response may be *quite* different from that given in the specs.

Gain depends upon level. If global NFB is used, the amplifier may be stable at some levels and not at others. It may even oscillate over *portions* of the cycle with disastrous consequences.

STASIS Operation

STASIS is a radically different approach to power amplifier design that *eliminates the need for global feedback*. The amplifier is *inherently* stable with *any* load and has *uniform* output impedance.

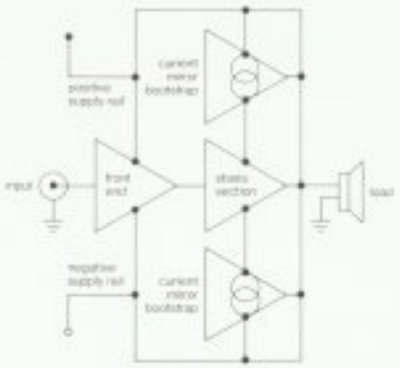


Figure 2 STASIS Configuration

Figure 2 shows the STASIS circuit. There is *no* negative feedback loop and *no* output coil. The load is driven directly by the "STASIS Section" and two "Current-Mirror Bootstraps." STASIS operation rests on the premise that it is possible to design a high-voltage low-current amplifier with negligible distortion, wide bandwidth, uniform output impedance, and inherent stability *without* conventional feedback.

How does one increase power without compromising performance? By an elegantly simple means! Current-Mirror Bootstraps provide muscle while a high-quality STASIS amplifier controls them and ensures accuracy!

STASIS operation is based upon an incontrovertible fact: *the current through a load is determined by the voltage across it.* If the *voltage* is free of distortion, the *current* (and *power*) will be distortion-free too. In the PA-7/PA-5, the STASIS section has a much lower output impedance than the Bootstraps so *STASIS* determines the output *voltage* while the Bootstraps supply the current. If the Bootstraps are imperfect, STASIS makes up the difference. But the correction current is negligible so the STASIS section operates virtually distortion free. Since *STASIS* determines the output voltage (and therefore the power), the output is as distortion free as the STASIS section itself!

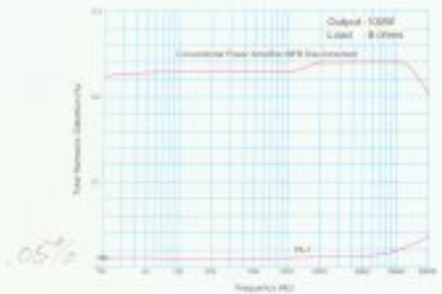


Figure 3 Total Harmonic Distortion vs. Frequency PA-7 vs. Conventional Power Amplifier (NFB Disconnected)

PA-7 Power Amplifier

Figure 3 compares PA-7 THD with that of a conventional amplifier without NFB, i.e. when it loses its "fix." The PA-7 operates in the same manner *regardless* of load and dynamic conditions; the distortion of the conventional amplifier skyrockets when it loses feedback!

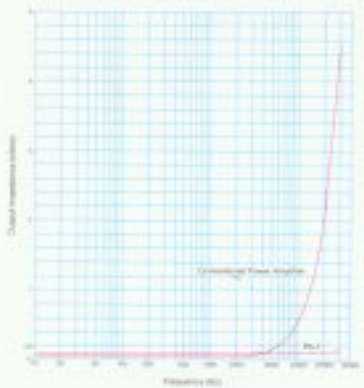


Figure 4 Output Impedance vs. Frequency PA-7 vs. Conventional Amplifier

The PA-7 output impedance is constant so response and damping are uniform with real-world speakers. That of a conventional amplifier rises sharply above 5 kHz because of the loss of feedback and the reactance of its output coil.

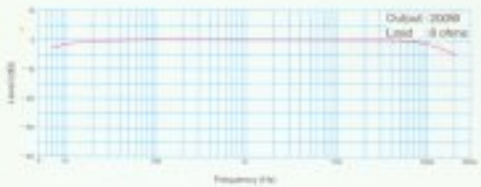


Figure 5 Frequency Response

The response of the PA-7 is flat from 20 Hz to 50 kHz *at full power*—performance that is rare among conventional amplifiers!

High-Current Power Supply, Multiple Output Transistors, And Massive Heat Sinks Ensure Safe Operation And Tremendous Peak-Current Capability

The PA-7 and PA-5 are designed for safe reliable operation into resistive or reactive loads. High-power toroidal transformers (700 watts in the PA-7, 450 watts in the PA-5), independent high-current rectifiers for each channel in the PA-7 and huge filter capacitors (132,000 μF total in the PA-7, 94,000 μF in the PA-5) provide tremendous current reserves.

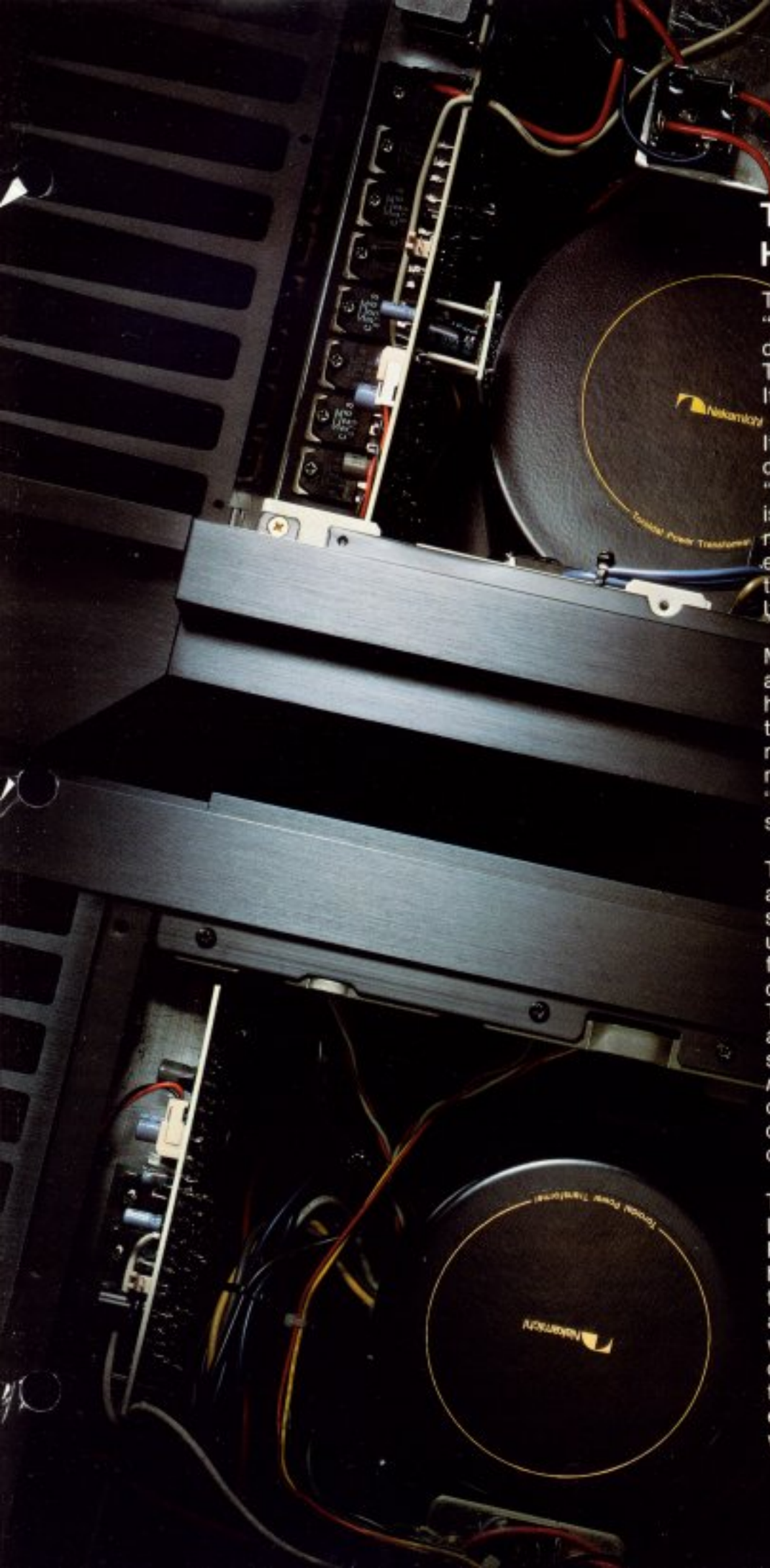
To deliver this current to the speakers, a total of 32 high-power output transistors are employed in the PA-7—16 for the left channel, 16 for the right. The PA-5 uses 20 output devices—10 per channel. In both amplifiers, 2 transistors per channel are used for the STASIS section and the others are parallel connected in two groups to form the positive and negative Current-Mirror Bootstraps.

This unusually generous output complement ensures a wide "Safe Operating Area" which is very important for reliable operation into the reactive loads that "real-world" loudspeakers present. The PA-7 has a Continuous Output Current Rating of 18 amperes per channel and will deliver peak currents of 50 amperes per channel so it will drive low-impedance speakers easily. Although the PA-5 carries a continuous power rating half that of PA-7, it supplies 2/3 the current of its larger brother.

The output transistors are mounted to high-dissipation heat sinks that are capable of cooling the devices without a noisy fan. Heavy-duty gold-plated universal output connectors ensure a low-resistance connection to virtually any speaker cable.

PA-7 Major Components

PA-5 Power Amplifier



The Essence Of High Fidelity

The dictionary defines *high fidelity* as "the reproduction of sound with a high degree of faithfulness to the original." That may be fine for the dictionary. It is not for Nakamichi!

If you think about it, the dictionary definition means nothing. What is "a high degree of faithfulness?" What is "good enough?" To Nakamichi, nothing short of perfection is "good enough." That's why we developed the PA-7 and PA-5 Inherently Stable/ Uniform Impedance Power Amplifiers.

Many listeners think that all power amplifiers sound the same. Even some high-fidelity reviewers think that if two power amplifiers have similar ratings and perform in a similar manner when subjected to the "standard" battery of tests, they will sound the same.

That simply isn't true! Standard tests and specifications do *not* tell the whole story because the tests are performed under artificial conditions which often fail to show up the difference between one power amplifier and the next. To the extent that *most* power amplifiers with similar specifications sound the same—and we agree that *most* do!—it is because they are cast from the same mold. They're designed with virtually identical circuitry.

The Nakamichi PA-7 and PA-5 Inherently Stable/Uniform Impedance Power Amplifiers are different. They have a radically different circuit topology than run-of-the-mill power amplifiers so they perform as well with "real-world" speakers as they do with the artificial loads used on the test bench. This brochure will explain the differences—your ears will confirm them!

PA-7 1595 PA-5 995

PA-7/PA-5 Specifications

	PA-7	PA-5
Continuous Average Output Power (New IHF)	200 watts per channel into 8 ohms, both channels driven, 20—20,000 Hz at no greater than 0.1% THD. 330 watts per channel into 4 ohms, both channels driven, 20—20,000 Hz at no greater than 0.1% THD.	100 watts per channel into 8 ohms, both channels driven, 20—20,000 Hz at no greater than 0.1% THD. 160 watts per channel into 4 ohms, both channels driven, 20—20,000 Hz at no greater than 0.1% THD.
Dynamic Output Power	300 watts per channel into 8 ohms 550 watts per channel into 4 ohms	150 watts per channel into 8 ohms 270 watts per channel into 4 ohms
Dynamic Headroom (New IHF)	1.7 dB (8 ohms) 2.2 dB (4 ohms)	1.7 dB (8 ohms) 2.2 dB (4 ohms)
Power Bandwidth (8 ohms, −3 dB re Rated Power, 0.1% THD)	5 Hz—50 kHz	5 Hz—50 kHz
Damping Factor (8 ohms, New IHF)	Greater than 60 (20 Hz to 20 kHz)	Greater than 60 (20 Hz to 20 kHz)
Input Sensitivity/Impedance (New IHF)	2.0 V/75k ohms (for rated output) 140 mV (for 1 watt output)	1.4 V/75k ohms (for rated output) 140 mV (for 1 watt output)
Frequency Response (1 watt, New IHF)	20—20,000 Hz, +0, −0.5 dB 7—150,000 Hz, +0, −3 dB	20—20,000 Hz, +0, −0.5 dB 7—150,000 Hz, +0, −3 dB
Signal-to-Noise Ratio (Input Shorted, A-Wtd re Rated Power)	Better than 120 dB	Better than 120 dB
Residual Noise Level (A-Wtd)	Less than 25 μV	Less than 25 μV
Total Harmonic Distortion (8 ohms, Rated Power, 20—20,000 Hz)	Less than 0.1%	Less than 0.1%
Intermodulation Distortion (8 ohms, Rated Power, 60 Hz: 7 kHz, 4:1)	Less than 0.1%	Less than 0.1%
Stereo Separation (Input Shorted)	100 Hz/1 kHz/10 kHz—110/100/80 dB	100 Hz/1 kHz/10 kHz—100/90/70 dB
Output Complement	16 transistors per channel	10 transistors per channel
Output Current Capability	18 A continuous, 50 A peak (per channel)	12 A continuous, 35 A peak (per channel)
Power Supply	700 W toroidal transformer 132,000 μF total filter capacitance	450 W toroidal transformer 94,000 μF total filter capacitance
Power Source	120, 220, 240, or 110-120/220-240 V AC, 50/60 Hz (according to country of sale)	120, 220, 240 or 110-120/220-240 V AC, 50/60 Hz (according to country of sale)
Power Consumption	700 W max.	450 W max.
Dimensions	435 (W) × 200 (H) × 421 (D) millimeters 17-1/8 (W) × 7-7/8 (H) × 16-9/16 (D) inches	435 (W) × 135 (H) × 368 (D) millimeters 17-1/8 (W) × 5-5/16 (H) × 14-1/2 (D) inches
Approximate Weight	27 kg; 59 lbs 8 oz	16 kg; 35 lbs 4 oz

- Specifications and design subject to change for further improvement without notice.
- STASIS manufactured under license from Threshold Corporation.
- STASIS is a trademark of Threshold Corporation.

Other Nakamichi Audio Components...

CR-7 Discrete Head Cassette Deck
The most technically sophisticated easy-to-use cassette deck ever created! Automatic adjustment of play-head azimuth, bias and level. Manual adjustment of playback azimuth as well. And, wireless remote control!

CR-7 1350

CR-5 Discrete Head Cassette Deck
The perfect deck for a Series-5 system. Easy to use and top performance thanks to Discrete-Head Technology and an extraordinary Asymmetrical Dual-Capstan Direct-Drive Transport. "Bias Tune" matches your tape for best performance.

CR-5 830

OMS-7 Compact Disc Player
The top-of-the-line CD Player from Nakamichi—the company that created the world's first Optical Memory Recording System. Top performance, wireless remote control, direct track and index search and a 24-command program memory.

OMS-7 1,295

OMS-5 Compact Disc Player
Quadruple oversampling, digital filtering, dual D/A converters, and Nakamichi's exclusive Direct-Coupled Linear-Phase Analog Signal Processor ensure the same sound quality as the OMS-7. Fewer features but true Nakamichi Sound!

OMS-5 995

ST-7 AM/FM Stereo Tuner
The ST-7 AM/FM Stereo Tuner features SCHOTZ* NR which increases the effective stereo reception area 8 times! With 16 presets, and seek and manual tuning, broadcast listening has never been as convenient...or as good!

* SCHOTZ Noise Reduction manufactured under license from L.S. Research, Inc., U.S. and foreign patents pending.

ST-7 595

CA-5 Control Amplifier
The Nakamichi CA-5 Control Amplifier is designed for the audiophile "purist." By employing a minimum number of controls and components of the highest quality, the CA-5 assures you the ultimate in fidelity.

CA-5 650

Nakamichi Corporation
Tokyo Office
Shinjuku Daiichi Seimei Bldg., 2-7-1 Nishishinjuku, Shinjuku-ku, Tokyo
Phone: (03) 342-4461 Telex: 2324721 (NAKAMJ)

Nakamichi U.S.A. Corporation
19701 South Vermont Avenue, Torrance, California 90502 Phone: (213) 538-8150

Nakamichi GmbH
Stephanienstrasse 6, 4000 Düsseldorf 1 Phone: (0211) 359036

Printed in Japan S-8512500A