

Introducing the Third Era of Amplification:

# The Infinity DSP Switching Amplifier.



## **The Infinity DSP Switching Amplifier™ makes all previous amplifier technologies obsolete.**

First there was the vacuum tube amplifier.

Then the transistor amplifier and its evolutionary vertical field effect transistor (V-FET) amplifier.

Now there is the Switching Amplifier. It is the world's first consumer application of Class D switching—a major new audio technology based upon mathematic and electronic principles in use only in exotic aerospace applications.

The Infinity DSP Switching Amplifier has nothing in common with existing amplifiers. The sophistication of its computer technology and the unprecedented, life-like purity of its sound are totally new. Its power is startling: 250 watts per channel RMS (2,000 watt power supply) in a chassis only 19 by 4½ by 15 inches, weighing less than 40 pounds.

In performance, it eclipses anything ever heard in the audio world. Including vacuum tubes and vertical FETs, which have produced the finest sound available until now.

The DSP Switching Amplifier is one of the ideas upon which Infinity was founded. At the time, it was *only* an idea.

In fact, it was more of a question: Would it be possible to utilize the highly exotic Class D switching amplification which was in use in space-borne applications, for a consumer audio product?

## **It started with dissatisfaction.**

As audiophiles and musicians we had long been dissatisfied with the hard, edgy bite of transistor sound. It simply didn't reproduce the music as we knew it in the concert hall. And as physicists we were familiar with some of the amplification parameters in outer-space that might have bearing on the design of an ideal amplifier: heat dissipation where the air is thin and you can't get rid of heat; infinite reliability; the need for tremendous amounts of regulated power within infinitely small size and weight, etc.

In theory, a Class D Switching Amplifier would be as different from transistor and V-FET amplifiers as *they* were from tube amplifiers; it would incorporate the best features of vacuum tubes and transistors while eliminating their drawbacks, and it would be a tremendous advance in quality, reliability and power.

The theory became an obsession. Was it feasible with current technology?

It was obvious the creation of a switching amplifier would take massive amounts of time, talent, money and patience. We knew we had the talent, hoped we'd find the money, so we decided to invest the time.

Six years later we're manufacturing and marketing the Infinity Class D Digital Signal Processing (DSP) Switching Amplifier. The first consumer switching amplifier in the world.

## **It wasn't easy.**

We approached the Switching Amplifier as a project in team design, assigning portions of the problem to experts in such disciplines as circuit design, power supply design and thermal analysis.

Normally, an audio designer builds a prototype, then alters it after testing. Instead, we modeled the Switching Amplifier on the computer, mathematically. Only after the computer confirmed (after several years of modeling) that our formulae would give us the performance criteria we wanted, did we begin a working model.

This involved microminiaturization and engineering techniques used in computers. In fact, the Infinity Switching Amplifier has more in common with computers than with existing amplifiers.

## **Switching, not amplifying.**

All amplifiers to date, whether vacuum tube or transistor (including the evolutionary and excellent-sounding V-FET) have used their device for *amplification*.

The DSP Switching Amplifier however, employs a truly revolutionary mode of operation: it uses the transistor *not* for amplification, but as a switch. It simply switches the signal on and off 500,000 times per second, or at the rate of two millionths of a second. The output transistors act as valves that are either fully open or fully closed, providing a flow of bits of information. (They are never part-way open, as in traditional classes of amplification.) Their function is identical to the switching in a digital computer. With the signal thus processed, the device may be called a "digital signal processing switching amplifier."

(We know that the concept of Class D switching sounds offbeat and a little opaque, but you'll have to take our—and the computer's—word for it: mathematically, it calculates as an amplifier.)

## You may be wondering...

*Since the device is used as a switch and not as an amplifier, how does it amplify?*

*How does all this translate into superior sound?*

*How is 500 Watts RMS developed in so small a space?*

*If Class D switching was such a great idea, why haven't major companies done it before this?*

To answer the last first—at least one major company has been at work for several years on a switching amplifier which will undoubtedly be on the market soon—and which we expect to be a superb instrument. We are proud that Infinity has, in effect, provided the feasibility study for other explorations in Class D switching and for advancement of the art by all imaginative and capable companies.

It simply doesn't make sense for many major companies—particularly those with mass-marketing-oriented philosophies—to become involved with such explorations. As we pointed out earlier, development of a switching amplifier takes a major commitment in time and money, as well as physicists with unique theoretical and engineering skills. Only a company committed to state-of-the-art as a company philosophy can afford such a commitment.

We were fortunate. As physicists, our professional training was in the environment of problems attendant to putting a man on the moon. At Infinity, state-of-the-art is our bread and butter.

The inevitable questions concerning amplification, lack of distortion and power generation in the DSP Switching Amplifier can best be answered by an understanding of what the Switching Amplifier is, and what happens to the signal.

## How it works.

Essentially, the DSP Switching amplifier performs as a digital computer. The amplifier is simply a device which switches very high voltages, turning a transistor on and off 500,000 times a second. A circuit called a "pulse-width modulator" modulates two square wave signals which turn the two switching transistors on and off. The output of the power switching stage is a high voltage square wave with the music contained in its modulation. The last step is to filter out the carrier signal and pass the demodulated audio signal to the speakers—thus creating a literal but highly amplified replica of the input signal at the output.

(By switching at a rate ten times higher than the highest frequency we want to reproduce, or at 500 kHz, there is no interference with the audio signal coming in. There is no amplification circuitry, no superious oscillation. There are none of the elements that make a conventional amplifier unstable; stability is inherent in the nature of the switching process.)

## To put it another way...

Physically, the Infinity Switching Amplifier is modular in concept; the Power Supply Section in the middle, and the right and left Switching Modules all plug into a mother board and slide out on rails.

Considerably understated, the circuitry works like this:

The Power Supply section delivers 1500 watts of regulated power by converting the 60 cycle AC line to DC, then to a higher regulated voltage level DC, and then square-wave modulating that voltage, by switching at 25kHz. (These are the first switching elements in our circuitry.) This high frequency output is converted to various voltages to drive the digital logic and power switch transistors in the Switching Amplifier modules.

The Switching Amplifier modules each contain three sections: 1) an analogue pulse-width converter, 2) the switching section (to switch high voltages and currents), and 3) a smoothing and averaging section (containing the inductor and filtering network). Thus, the amp section converts the audio analogue signal to a computer-coded pulse-width modulation and a filtering network then decodes the modulation from the switched audio signal. The entire function is controlled by an exotic 2½" by 2½" digital-chip "brain center"—the Ulrick-Henderson DSP Hybrid—a plug-in module containing the logic which processes the signal and controls performance functions; in effect, connecting the power supply directly to the speakers.



The Ulrick-Henderson DSP Hybrid (actual size). This is the digital chip brain center that controls the functions of the switching amplifier.

## The Infinity DSP Switching Amplifier.

### What it does.

It does what all previous types of amplification have tried to do and failed. It brings you the ambient, warm, life-quality of live music in a way that makes it virtually indistinguishable from the original sound.

It produces a transient-perfect signal that is literally incapable of overshooting or undershooting. It lifts the veils and bypasses the edgy colorations and transient intermodulation distortions that are inherent limitations in all conventional amplifiers.

It totally eliminates the thermal degradation that plagues all transistors, vacuum tubes and V-FETs; its designed-in thermal characteristics result in junction temperatures that are extremely low. In addition, all sections are extravagantly over-heatsinked.

It delivers a regulated, rock-steady 250 RMS watts continuous per channel, with power bandwidth from 20Hz to 20kHz, and harmonic distortion of less than 0.1%; under *any* line

conditions, either AC or DC, from 100 to 240 volts, anywhere in the world, and with no degradation in power, output quality or performance.

Our 250 watts per channel rating is conservative. The Switching Amplifier regularly puts out 300 watts per channel RMS into 8 ohms and we have tested it at 400 watts per channel RMS at 1kc into 4 ohms, both channels driven. That calculates as 1 horsepower.

Yet each channel has but two power output transistors.

By any measurement, the Infinity DSP Switching Amplifier is a stunning scientific achievement.

An analogy may be made to Pointillist art, which is painted with a series of points, or to the reproduction of a photograph in a magazine or newspaper. The actual image may be seen under a magnifying glass as a series of dots of varying size and value. Yet the eye perceives them as a continuous visual tone, and the brain accepts the total configuration in the Gestalt completion of the whole.

The same factors are at work in perception of the sound of music recreated by the Switching Amplifier. In a sense, the output signal is "painted" with a series of points of power. The ear hears 500,000 such power points per second, further smoothed by a

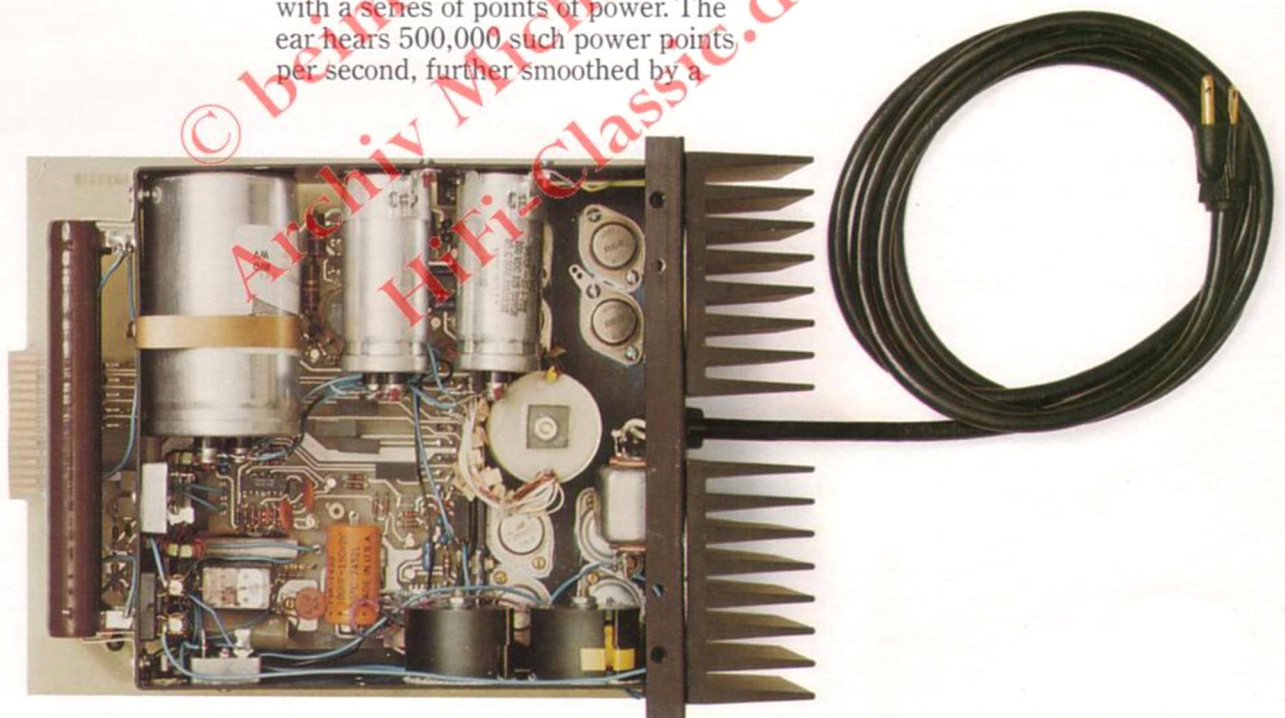
filter network, into a smooth flow of sound at the speaker. The listener hears (and the oscilloscope sees) a literal duplication of the input signal, except that it is several thousand times larger in power.

Thus, the classic definition of amplification is achieved: the same signal, only bigger. What it provides is absolute fidelity of sound. Granted, there may be some limitations of the input sensor (phono cartridge, tuner or tape head) and the output device (the average speaker or headphone). *But for the first time, the amplifier limitations are eliminated.* The Infinity Switching Amplifier circuitry adds no sound of its own.

Consequently, one can hear a separation of instruments, a retention of individual colors and timbres in their original spacial depth, that is unapproached by any other amplification device in existence.

The warmth, the presence and the visceral quality of the Infinity DSP Switching Amplifier is unequalled — except by the live musicians themselves.

We would be pleased to have you hear it.



The Power Supply Section of the Infinity DSP Switching Amplifier. (A 2000 watt regulated power supply that can be held in one hand!)



INFINITY  $\infty$

LEFT GAIN

DISPLA

© beim Hersteller  
Archiv Michael Otto  
HiFi-Classic.de



Y RATE

RIGHT GAIN

DIGITAL AMPLIFIER

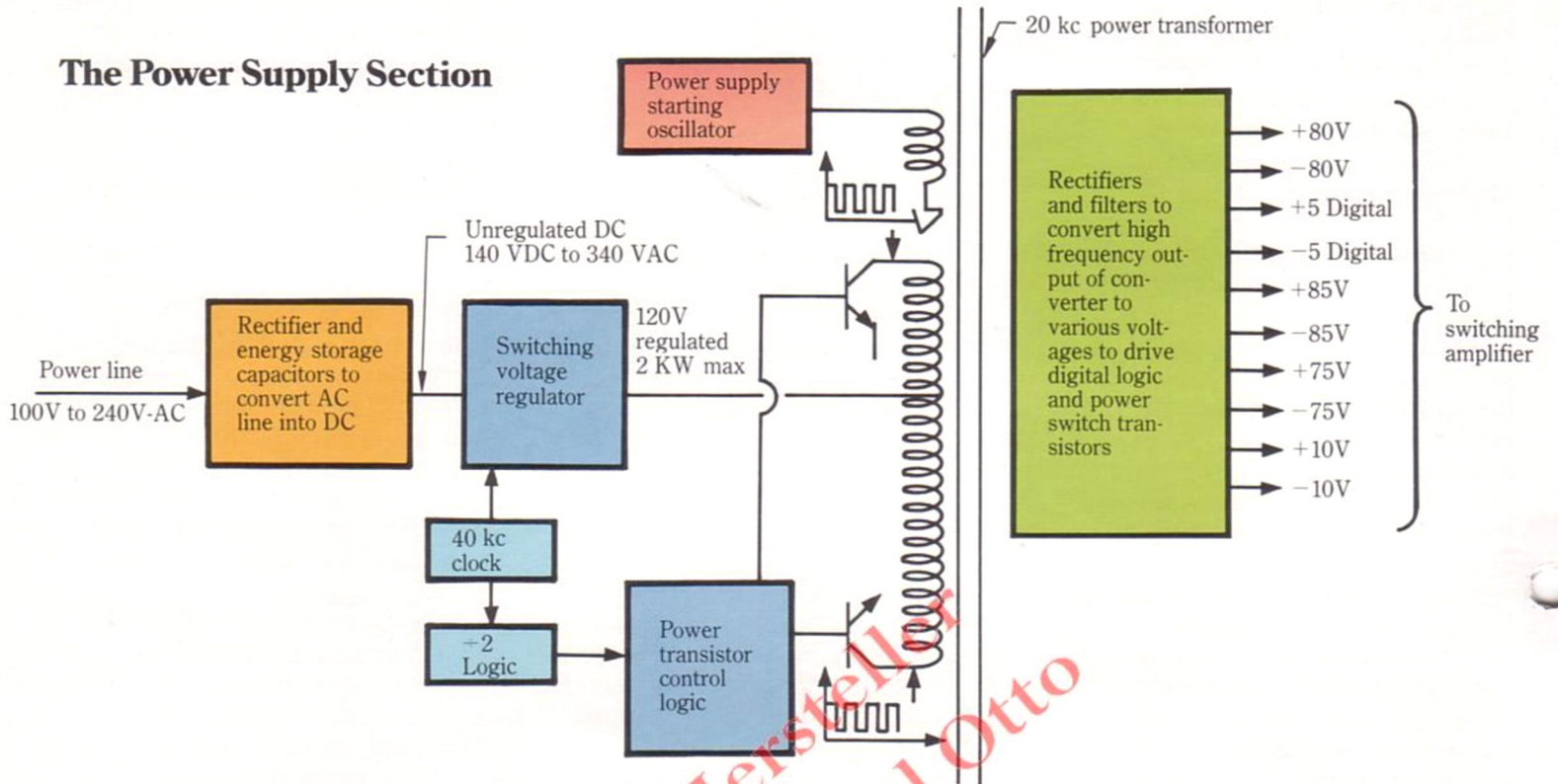
© beim Hersteller  
Archiv Michael Otto  
HiFi-Classic.de

Y RATE

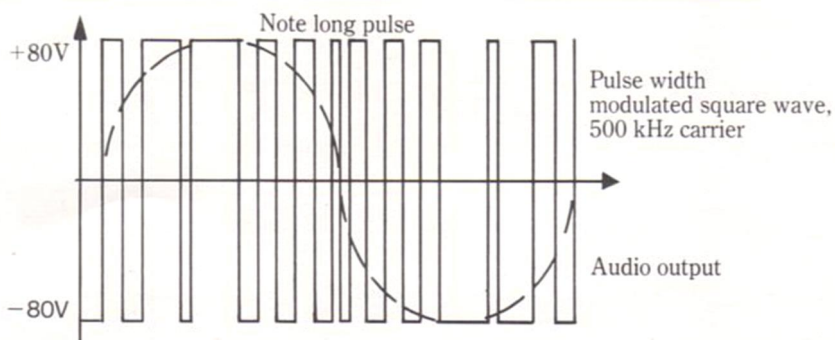
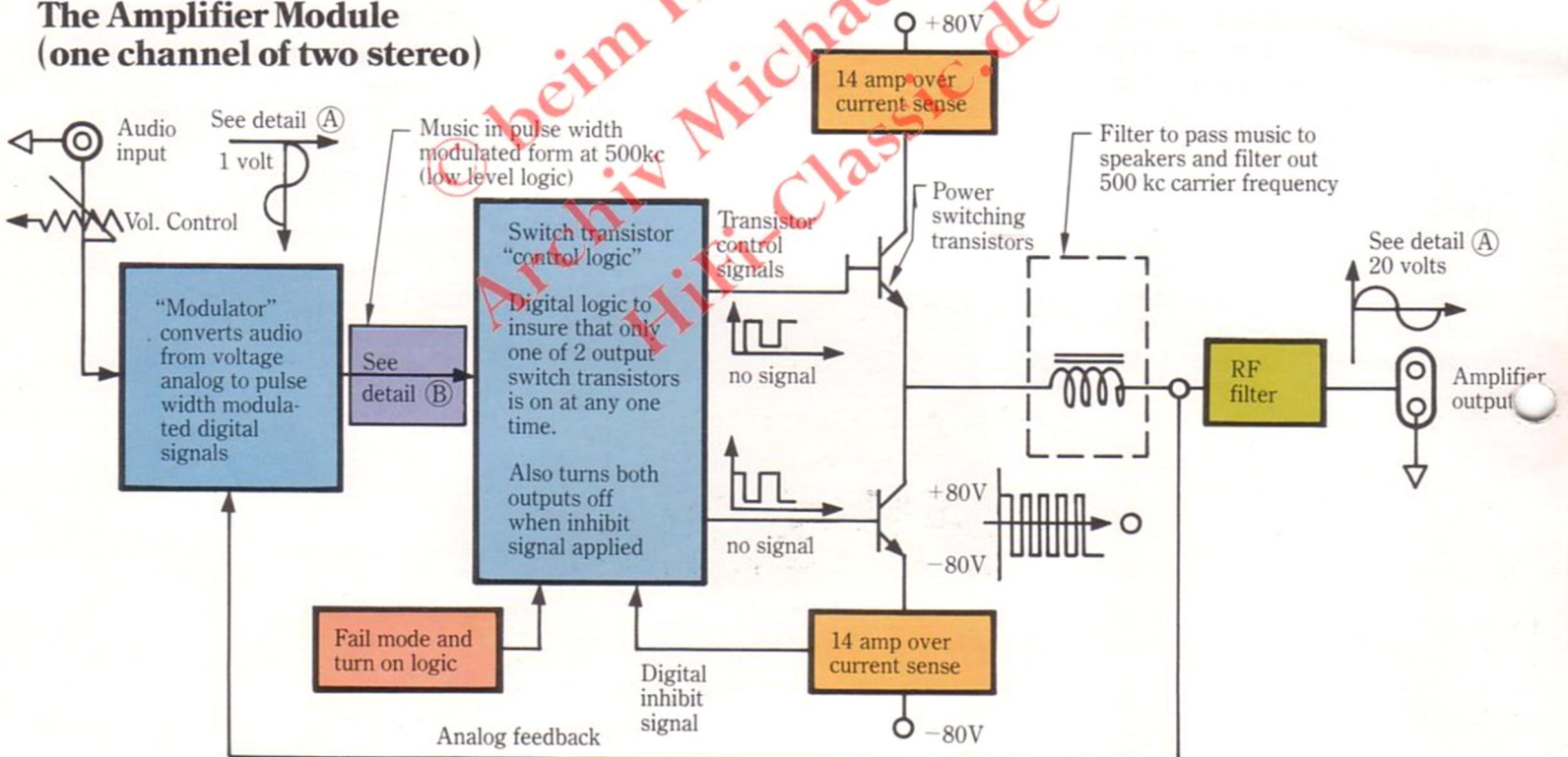
RIGHT GAIN

# How the signal is digitally processed and switched in the Infinity DSP Switching Amplifier

## The Power Supply Section



## The Amplifier Module (one channel of two stereo)



Detail (A) and (B)

This detail shows the Switching Amplifier wave form in both modulated (the rectangular shapes) and demodulated forms (the dash line).

## Specifications of the Infinity DSP Switching Amplifier

<i>Power:</i>	500 watts; 250 watts per channel RMS
<i>Frequency Response:</i>	10 Hz to 100 kHz at 1 volt
<i>Power Bandwidth:</i>	20 Hz to 20 kHz
<i>Distortion:</i>	Harmonic: Less than .1% at 250 watts
<i>Delay Time:</i>	300 nS (nanoseconds)
<i>Damping Ratio:</i>	Greater than 100
<i>Power Requirements:</i>	Stand by: 25 watts Maximum: 2000 watts Any voltage from 100 to 240 volts AC, 50 to 400 Hz Minimum voltage DC: 160 volts Maximum voltage DC: 240 volts
<i>Dimensions:</i>	19" wide, 15" deep, 4½ high Weight: 36 pounds
<i>Controls:</i>	Left and Right Volume
<i>Sensitivity:</i>	2.2 Volts input for 250 watts out
<i>Hum and Noise:</i>	100 dB below 250 watts
<i>Input Impedance:</i>	100K ohms
<i>Power Supply:</i>	Regulated ±80v DC at 1500 watts switching pre-regulator followed by DC:DC converter operated at 20 kHz.
<i>Warranty:</i>	3 years parts and labor limited warranty. (See complete warranty statement).

### Companion to the Switching Amplifier: the Infinity FET Preamplifier.

Infinity has designed a High Resolution Preamplifier that is, in the Infinity tradition, advanced in every way; in field-effect transistor gain-stage design, in circuitry, in styling, in features and in flexibility.

It will upgrade *any* system by revealing a warmth of tone, musicality and accuracy of transient response that was not previously apparent.

Patch the Infinity preamp into your system and then listen to your favorite records. We guarantee you'll be hearing them for the first time.



We get you back to what it's all about. Music.