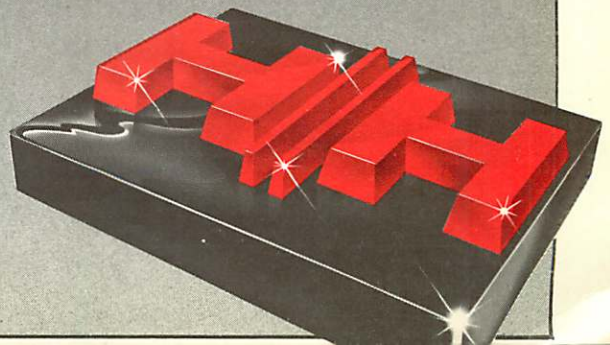
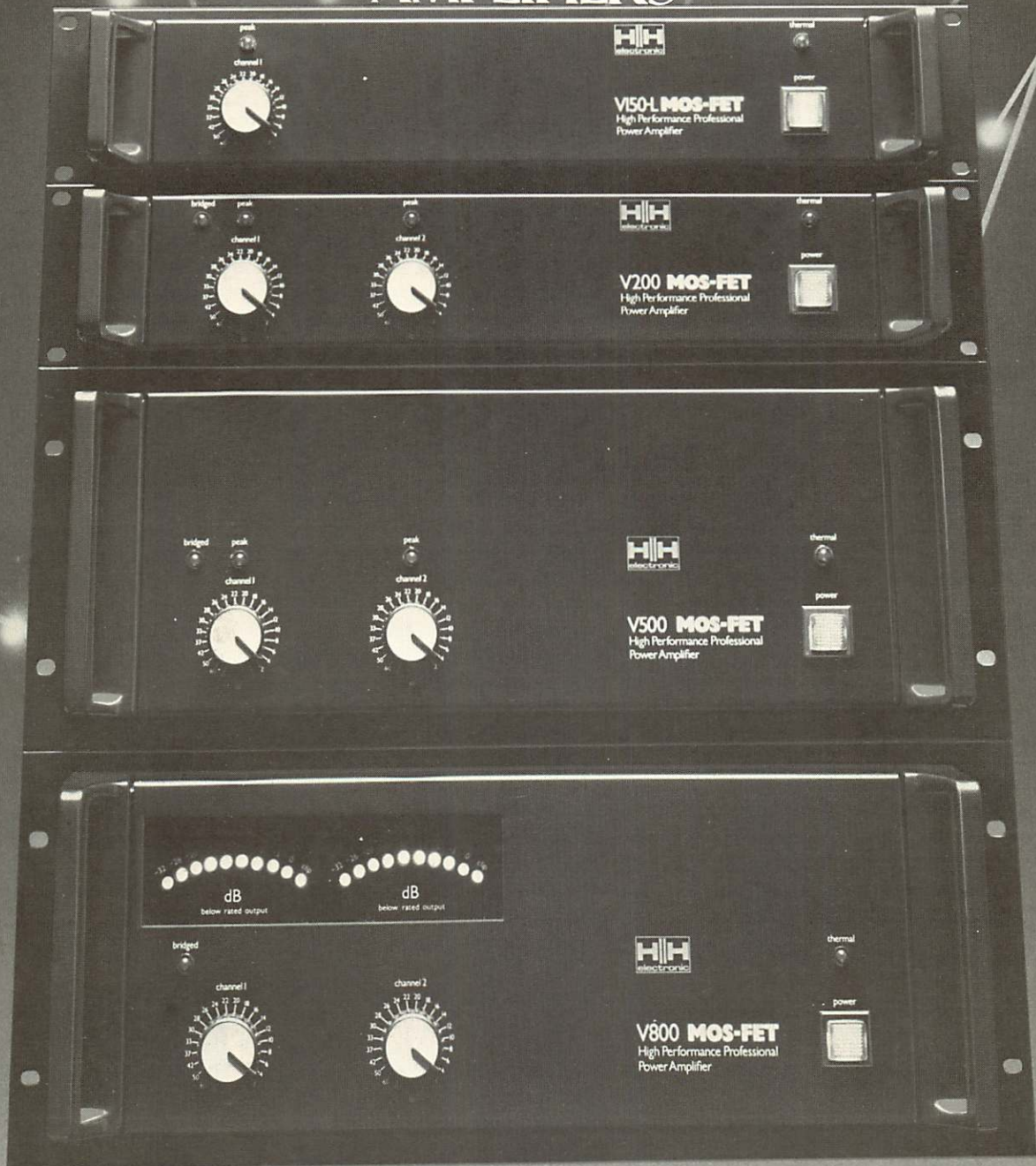


# MOS-FET POWER AMPLIFIERS

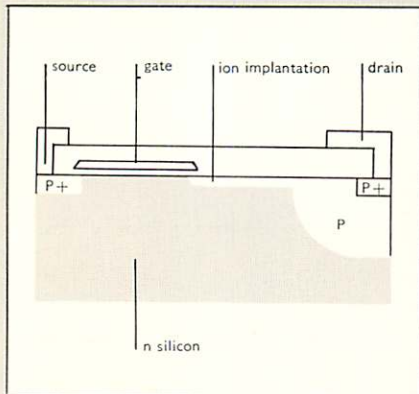
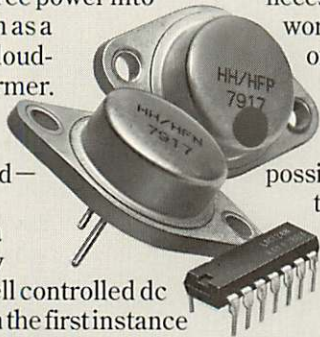




# INTRODUCING **MOS-FET** SUPERIOR PERFORMANCE POWER AMPLIFIERS

**HH** are recognised as the leader in the field of professional power amplifiers, continually setting new standards for the industry. These new generation HH amplifiers are superior by deliberate design and offer many advantages: A user optimised range of features, rugged mechanical design and a completely new solid-state technology...Power MOS-FET's, whose characteristics make them ideally suited for use in the output stages of linear amplifiers that must deliver distortion free power into a reactive load such as a high performance loud-speaker or transformer.

Elegant circuit design incorporating + and - balanced devices throughout, gives a superior symmetry which results in well controlled dc and ac balance from the first instance of turn-on. Additional benefits are a surge-free turn-on with a marked absence of output voltage excursion when compared to complicated bipolar transistor designs. Its nice to know that when you turn on your HH MOS-FET amplifier your speakers will not receive a mighty pulse. Indeed the



circuit is so well balanced that even in the unlikely event of a +Ve or -Ve supply rail going down, no more than a few harmless millivolts will appear at the output.

MOS-FET devices are virtually immune from thermal runaway. A temperature increase has the effect of reducing device current, thereby decreasing power dissipation and pushing the temperature back down. No thermal feedback is required and MOS-FET's easily operate at quiescent currents five times higher than those of bipolar transistors. This higher operating current lowers signal distortion, especially at high frequencies.

Because no thermal tracking is necessary, the new HH power amplifiers work at an optimum from the moment of switch-on and the performance remains constant regardless of the temperature at the output devices. Thus, it has been found possible to replace the normally troublesome protection circuits with a much simpler arrangement, for excellent performance when driving highly reactive loads.

Furthermore, the MOS-FET devices are paralleled for increased current handling and higher power rating. If one device tends to take a larger share of the load current, that device's "on" resistance will increase as the temperature rises, thus forcing part of its current to be shunted to the other devices in the circuit. Therefore current sharing is self-equalising.

MOS-FET devices have very high input impedance at audio frequencies, eliminating the need for high current gain driver stages. This circuit simplification permits ultra low distortion, without using a large amount of negative feedback. The reduced negative feedback results in improved amplifier stability at high frequencies. (Fig 2).

The new HH MOS-FET amplifiers provide superior high frequency performance for both open-loop and closed-loop operation. Their slew rate may be more than 60V/ $\mu$ sec, which is much faster than that of conventional bipolar transistor amplifiers. And the open-loop frequency response can be greater than 100 kHz (an improvement by a

factor of six). Far from being superfluous, this superior high-end performance means better sound quality when reproducing fast transients. (Fig 3).

The inherent thermal control of MOS-FET devices enables the output stage quiescent current to be set considerably higher than bipolar transistor designs. This results in a complete absence of crossover "notches" as shown by the oscilloscope photographs (Figs 4 and 5).

In recent years, the inadequacy of steady state harmonic distortion measurements in assessing an amplifier's performance has been recognised. More sophisticated and revealing methods are essential when judging the performance of a power amplifier designed for the accurate reproduction of complex musical wave forms.

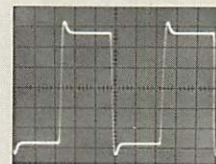


Fig 2  
10 kHz load 8 ohms + 1 $\mu$ F

Reactive load impulse response. Note single overshoot, well damped, no ringing.

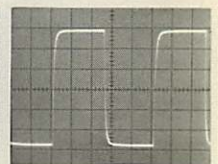


Fig 3  
10 kHz into 8 ohms

10 kHz square wave response. Note Fast rise time, clean response.

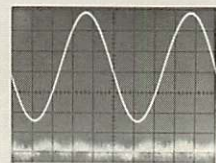


Fig 4  
1 kHz into 8 ohms

Scope gain x 2000. Note Distortion components lost in noise. Harmonic distortion less than 0.005%.



Fig 5  
10 kHz into 8 ohms

Scope gain x 1000. Note complete absence of crossover distortion. Harmonic distortion less than 0.01%.

For example, intermodulation distortion is audibly more annoying than harmonic distortion, and consists of the interaction between components in a complex audio signal, which produce frequency components not found in the original signal. When



# MOS-FET ADVANTAGES:

- Superior reliability, simpler circuitry.
- No protection circuits, superior power delivery.
- Superior load protection, no risk of DC output under component fault conditions.
- Superior high frequency performance; high speed MOS-FET's.
- Immunity from thermal runaway.
- No secondary breakdown mechanism.
- Superior audio performance, ultra-low distortion levels.
- Small levels of negative feedback, superior sound reproduction.

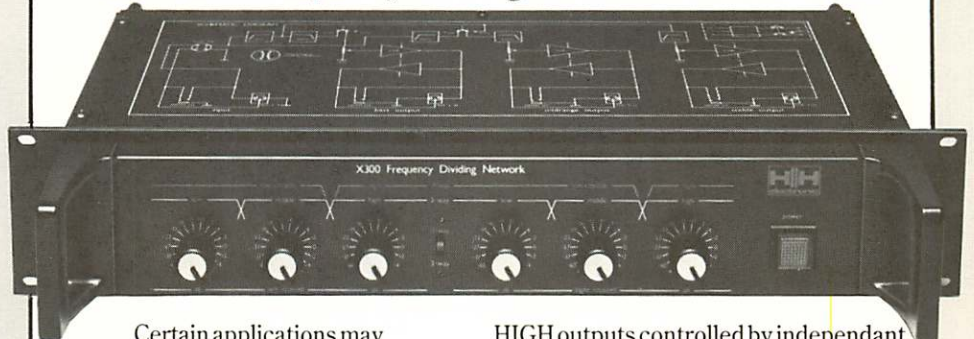
tested with a realistic two-tone test signal, HH MOS-FET amplifiers perform so brilliantly well, as to be on or below the limit of the measuring equipment. (Fig 6).

Difference frequency distortion is measured by introducing two test tones of very close frequencies into the amplifier and quantifying the difference between the two original signals or multiples thereof. Measurement of the HH MOS-FET power amplifiers shows exceptionally good results on the bottom limits of the test equipment, even when driving a reactive load. (Figs 7, 8, 9).

Transient intermodulation distortion arises in amplifiers due to the time delay in the feedback loop and the resultant overload of the amplifier within the feedback loop, when a sudden change is applied to the input. Such distortion is not significantly present in HH MOS-FET amplifiers, due to their inherently wide bandwidth, super fast slew rate and minimal negative feedback.

Thus, HH MOS-FET power amplifiers can be justifiably regarded as the definitive standard for the 1980's.

## X300 Stereo Frequency Dividing Network & Sub-Bass Filter



Certain applications may demand power levels beyond the capability of a single amplifier. Even if an adequately large amplifier existed, it would have a limited dynamic range and chronic distortion due to the following law of physics:

Musical signals contain much more energy in the bass than in high frequency material. Thus, the low frequencies will absorb most of any available power, leaving inadequate reserves to accurately reproduce the high frequencies.

This problem is avoided by using a biamplified or triamplified system, in which the X300 routes chosen frequency bands to separate power amplifiers.

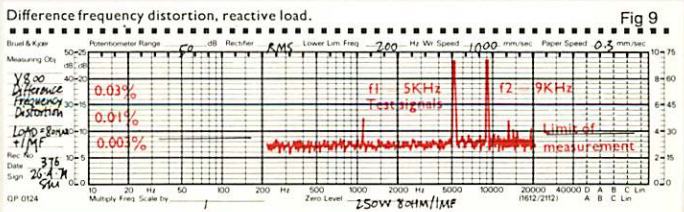
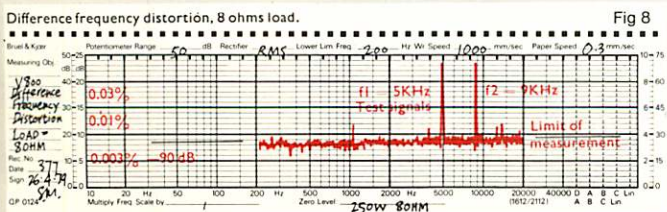
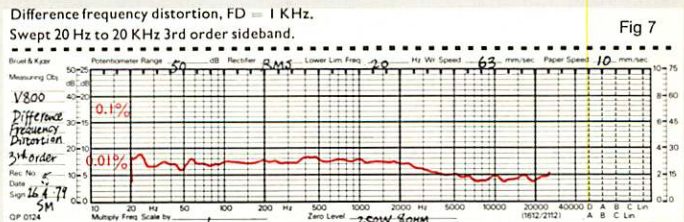
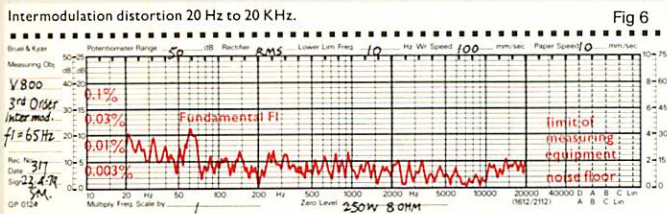
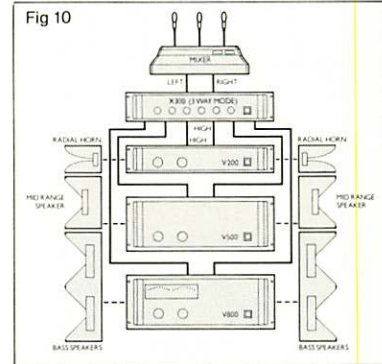
The X300 contains two complete electronic crossover networks and two subsonic bass filters in one very tough package (19" x 3 1/2" x 11") (483mm x 89mm x 279mm). Compared with traditional passive crossovers, the electronic X300 exhibits no absorption of amplifier power and will not degrade the damping factor.

Each left or right channel has four filters which divide the frequency spectrum into LOW, MIDDLE and

HIGH outputs controlled by independent attenuators with calibrated detents from -60dB to +6dB. Additionally, a fixed 35Hz filter cuts out subsonic rumble and protects bass speakers from dangerous signals (for example, caused by dropping a microphone).

Naturally, the X300 performs with no audible distortion, hum or noise and maintains a flat frequency response throughout the entire audio bandwidth.

For versatility, there are 1/4" jack sockets and XLR connectors for balanced or unbalanced lines at the input and output, plus optional transformer coupled inputs. (Fig 10).





# V150L

## SINGLE CHANNEL POWER AMPLIFIER

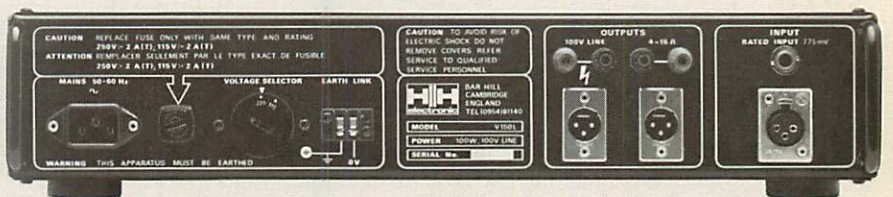
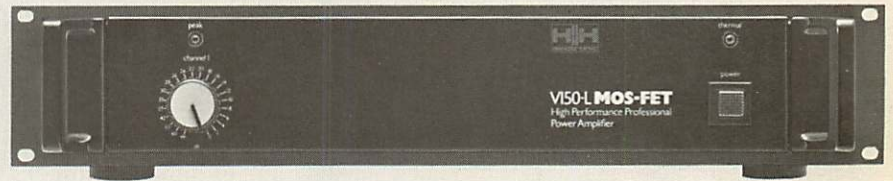
Designed for demanding professional applications that require a single channel power amplifier of exceptional performance and reliability. A choice of internal input/output balanced matching transformers permits adaption to a variety of applications:

- Broadcast or recording studio monitor amplifier.
- Sound distribution amplifier with balanced 100V line output.
- High performance professional PA amplifier.
- Servo motor drive amplifier.
- Vibrator drive amplifier for industrial use.

For maximum strength and rigidity, the amplifier chassis is made from heavy gauge steel. Massive cast transport handles are conveniently mounted on the 5 mm thick aluminium front panel.

The elegant satin black front panel carries a professional attenuator, dB calibrated in 22 steps for accurate and repeatable level control.

A red LED indicates output waveform clipping, by a circuit which responds when the output voltage swing equals the power supply voltage



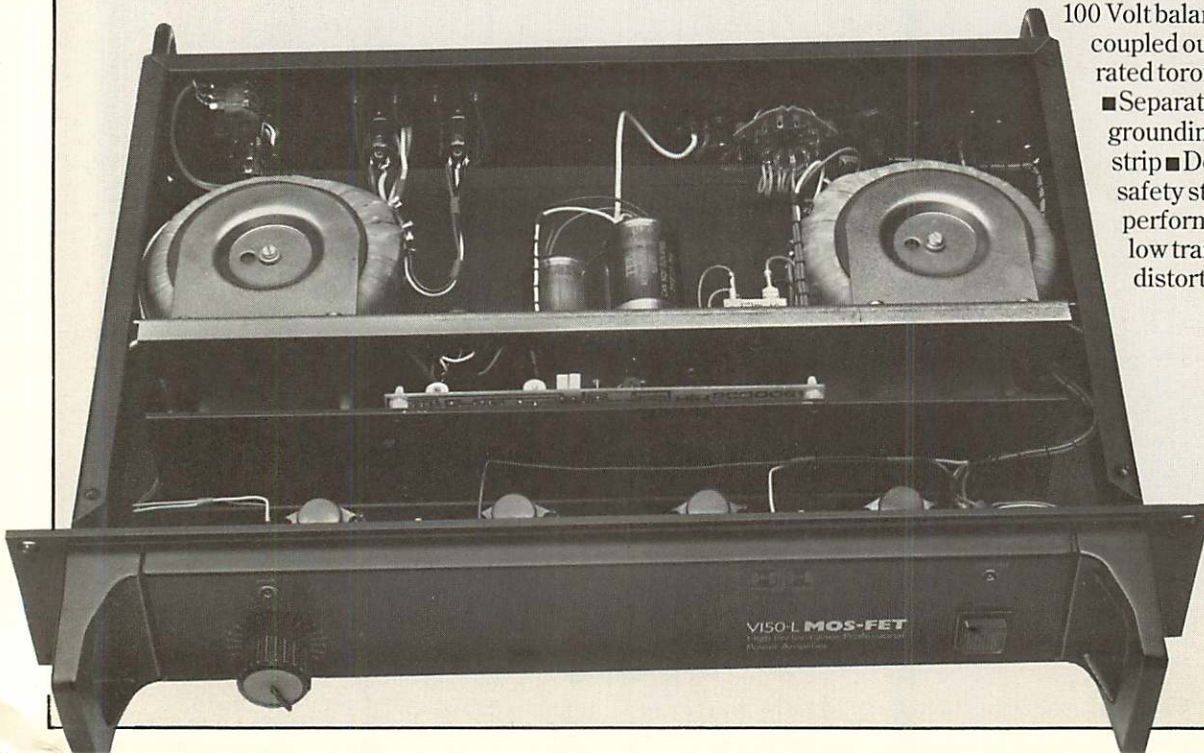
available to the output devices. This arrangement automatically takes full account of different load conditions. Even the shortest occurrence of clipping will cause the LED to glow for 200 milliseconds.

The output MOS-FET's operate within very conservative safety margins with inherent temperature control and full short-circuit protection. Also, the output is free from conventional V.I. limiting circuitry (which eliminates the possibility of audible signal degradations) and will deliver clean power into highly reactive loads.

Two separate outputs are provided, —100 Volt centre tapped balanced line for sound distribution systems, plus a normal low impedance 4 to 16 ohms output. Other output matching transformer options are available and XLR or binding post connectors are provided for both outputs.

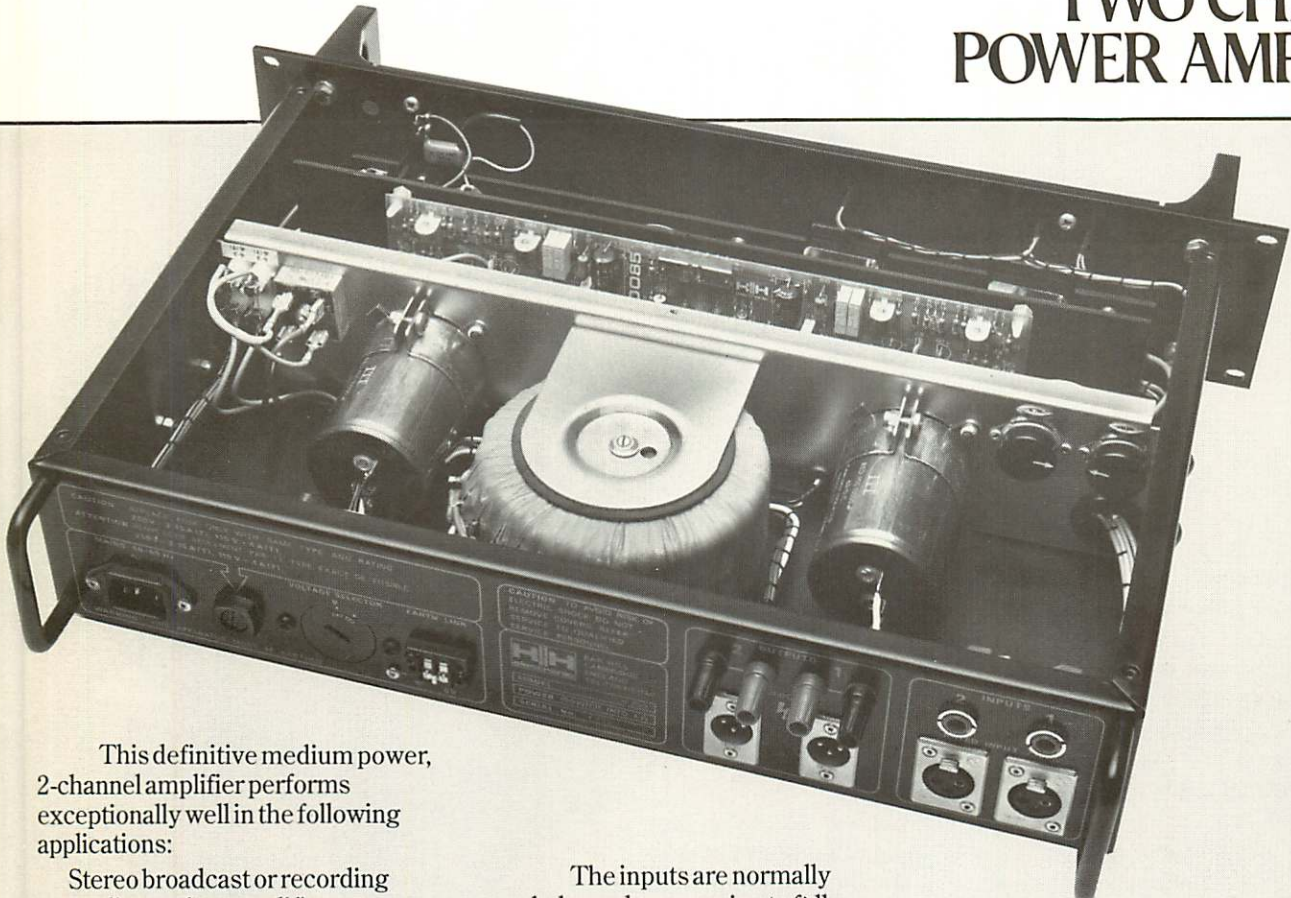
### Features

- 19" x 3 1/2" rack mount panel size
- Dual professional input connectors (both XLR and 1/4" jack)
- Optional plug-in balanced input transformer provision
- Direct low impedance output and/or 100 Volt balanced line transformer coupled output option
- Continuously rated toroidal mains power supply
- Separate circuit and chassis grounding on rear panel barrier strip
- Designed to international safety standards
- Superb audio performance, guaranteed ultra low transient intermodulation distortion.





# V200 TWO CHANNEL POWER AMPLIFIER



This definitive medium power, 2-channel amplifier performs exceptionally well in the following applications:

- Stereo broadcast or recording studio monitor amplifier.
- Superior stereo Hi-Fi amplifier.
- Professional sound reinforcement/PA amplifier.
- High frequency horn driver amplifier.

In use, this amplifier is remarkably clean; there is no tendency to shut down or "take-off" into spurious oscillation, even when connected to highly reactive multi-speaker loads.

The V200 power supply is rated for continuous operation and equipped with 2 large value electrolytic capacitors, plus a toroidal mains transformer.

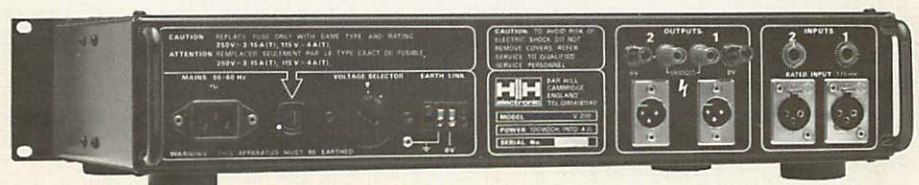
In the reputable HH tradition, this new generation of power amplifiers continues to set the highest design standards. The thick aluminium front panel with massive carrying handles fits any standard 19" rack system. A heavy gauge steel chassis, with strong but easily detached covers, completes a mechanical package designed to withstand the high "G" forces encountered under severe conditions.

Each channel features a red LED waveform clipping indicator which helps an operator to avoid over-driving a system into peak distortion.

The inputs are normally unbalanced; conversion to fully balanced input is achieved by simply plugging the optional transformers into pre-wired sockets located inside the amplifier. The V200 may be converted to a monaural amplifier with an internal STEREO/BRIDGED switch (refer to a qualified HH dealer). In this mode the output is "bridged" across the "hot" terminals of both channels, creating a balanced transformerless output of 200 Watts mono into an 8 ohm load. An LED on the front panel illuminates when the amplifier is switched to mono operation.

## Features

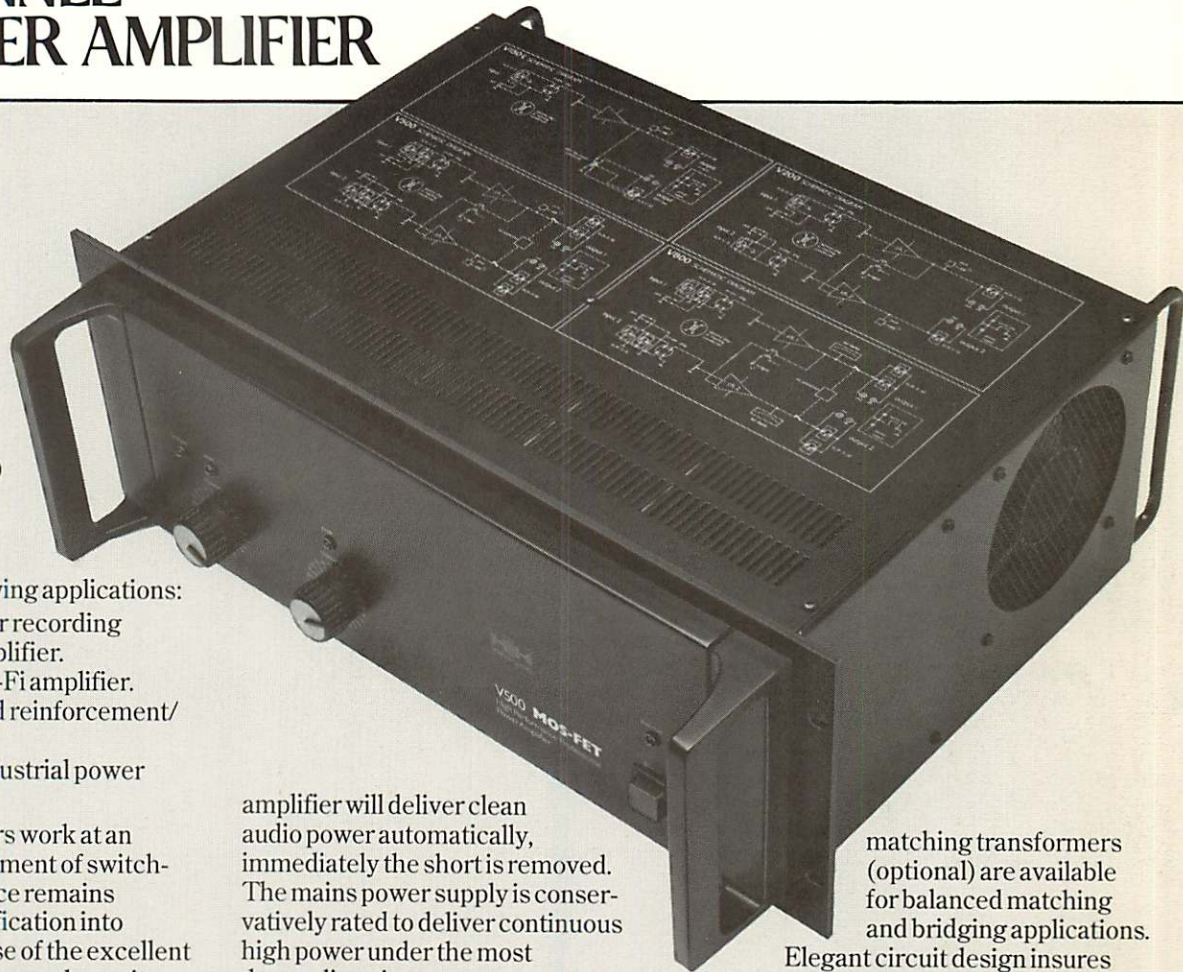
- LED clipping indicators
- Stepped calibrated input attenuators
- Optional plug-in balanced input transformer provision
- Dual professional input connectors (both XLR and 1/4" jacks)
- XLR and binding post output connectors
- Switchable to bridged mono output
- Continuously rated toroidal mains power supply
- Separate circuit and chassis grounding on rear panel barrier strip
- 19" x 3 1/2" rack mount panel size
- Designed to international safety standards.





# V500

## TWO CHANNEL HIGH POWER AMPLIFIER



Beautifully constructed, the V500 offers high accuracy performance at more than 250 Watts per channel, for the following applications:

- Stereo broadcast or recording studio monitor amplifier.
- Superior stereo Hi-Fi amplifier.
- Professional sound reinforcement/PA amplifier.
- Commercial or industrial power requirements.

These amplifiers work at an optimum from the moment of switch-on and the performance remains constant within specification into reactive loads. Because of the excellent thermal stability and ruggedness, it has been possible to replace the normally troublesome protection circuits with a much simpler arrangement. This results in clean performance when driving loads such as electrostatic loudspeakers, or transformers. Only under really tough operating conditions (i.e. continuous drive into

amplifier will deliver clean audio power automatically, immediately the short is removed. The mains power supply is conservatively rated to deliver continuous high power under the most demanding circumstances.

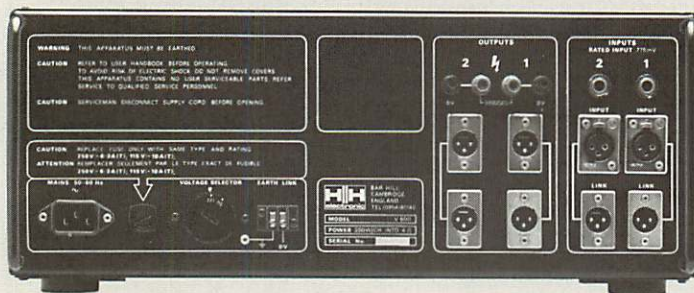
The User Handbook included with every amplifier provides system data for loudspeaker connection. The V500 may be converted to a monaural amplifier with an internal STEREO/BRIDGED switch (refer to a qualified HH dealer), creating a balanced transformerless output of 500 Watts

matching transformers (optional) are available for balanced matching and bridging applications.

Elegant circuit design insures that in the unlikely event of a +Ve or -Ve supply rail going down, no more than a few harmless millivolts will appear at the output. As an extra safety measure a dc energised relay disconnects the load in the unlikely event of component failure, affording complete load protection.

### Features.

- LED clipping indicators
- Stepped calibrated input attenuators
- Dual professional input connectors (both male female XLR and 1/4" jacks) with linking provision
- Option plug-in balanced input transformer provision
- Switchable to bridged mono output
- XLR and binding post output connectors
- New loudspeaker protection circuitry prevents dc damage
- Automatic thermal control for MOS-FET output devices
- Silent running forced air cooling for dependable continuous duty under heavy load
- 19" x 7" rack mount panel size
- Separate circuit and chassis grounding on rear panel barrier strip
- Designed to international safety standards.



low load impedances) a silent cooling fan automatically cuts in. This well thought out arrangement allows the amplifier to be fitted in a rack with other (possibly hot running) equipment, without concern. Under intermittent short-circuit conditions, this HH

into an 8 ohm load. An LED on the front panel illuminates when the amplifier is switched to BRIDGED operation.

Pre-wired sockets and a retaining clamp for input transformers are located inside the amplifier. Input



# V800

## TWO CHANNEL SUPER POWER AMPLIFIER

powerful bass amplifier in a biamplified or triamplified system designed for working hard all night long.

Each of the output meters features 10 LED's arranged in an arc, calibrated in decibels below rated

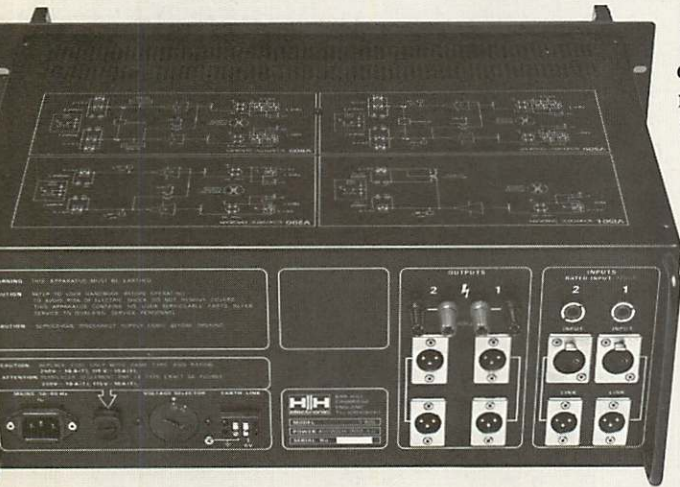
power. The "0" dB LED indicates rated output voltage, the remainder ranging downwards to -33 dB.

The LED's function by comparing the amplifier output voltage to a reference voltage derived from the main power supply. This arrangement ensures that the output meters when indicating 0 dB, are automatically

corrected for different load impedances and maintain an accurate reading. The red LED indicates waveform clipping.

Features:

- Superb audio performance, wide bandwidth and ultra low transient intermodulation distortion
- Load sensing output level dB meters
- Stepped calibrated input attenuators
- Dual professional input connectors (both male and female XLR and 1/4" jacks) with linking provision
- Optional plug-in balanced input provision
- XLR and binding post output connectors
- Switchable to bridged mono output of 800 Watts into 8 ohms
- Automatic thermal control for MOS-FET output devices
- Silent running forced-air cooling for dependable heavy duty operation in rack systems
- 19" x 7" rack mount panel size
- Separate circuit and chassis grounding on rear panel barrier strip
- Designed to international safety standards.



This superlative amplifier obsolesces conventional transistor high power amplifiers in every important respect: Performance, facilities, and dependability.

The V800 excels in the following applications:

- High power stereo studio monitor amplifier
- Esoteric Hi-Fi stereo amplifier
- Driver amplifier for professional PA systems
- Industrial power amplifier
- Environmental testing power source.

A sustained high quality output of no less than 400 Watts from each channel will deliver the transient peaks present in today's dynamic music and will avoid much of the clipping distortion present in a lesser amplifier.

Sound quality is absolutely neutral right up to the limit of the amplifier's wide rated bandwidth and beyond.

The ability to operate continuously under heavy load makes this HH amplifier ideal for live rock or disco sound systems, as a





# TECHNICAL SPECIFICATION

MODEL	V150-L	V200	V500	V800
<b>Power Output at Clipping</b>	105 watts RMS into 8 ohms at 1 kHz 150 watts RMS into 4 ohms.	65 watts RMS into 8 ohms both channels driven at 1 kHz. 100 watts RMS into 4 ohms, both channels driven.	250 watts RMS into 4 ohms, 1 kHz, both channels driven. 150 watts RMS into 8 ohms.	400 watts RMS into 4 ohms, 1 kHz, both channels driven. 260 watts RMS into 8 ohms.
<b>Balanced Line Output</b>	100 watts RMS at 1 kHz into 100 ohms at less than 0.1% THD. (100 volt line output) transformer coupled.	N/A	60 volt balanced line (bridged mono)	80 volt balanced line (bridged mono)
<b>Rated Power Output per Channel</b>	100 watts RMS into 8 ohms with less than 0.03% THD over a bandwidth of 40 Hz to 20 kHz. 100 watts RMS into 8 ohms at 1 kHz at less than 0.02% THD.	60 watts RMS into 8 ohms at <0.03% THD over a bandwidth of 20 Hz to 20 kHz 60 watts RMS into 8 ohms at 1 kHz at 0.02% THD both channels driven.	150 watts RMS into 8 ohms at <0.03% THD over a bandwidth of 20 Hz to 20 kHz, 245 watts RMS into 4 ohms at 1 kHz at <0.02% THD both channels driven.	250 watts RMS into 8 ohms at <0.03% THD over a bandwidth of 20 Hz to 20 kHz, 390 watts RMS into 4 ohms 1 kHz at <0.02% THD, both channels driven.
<b>Frequency Response</b>	100V-line output -3dB 30 Hz to 10 kHz 4-16 ohms output +0, -1.0 dB 30 Hz to 50 kHz	+0, -1.0 dB 10 Hz to 50 kHz	+0, -1.0 dB 10 Hz to 50 kHz	+0, -1.0 dB 10 Hz to 50 kHz
<b>Total Harmonic Distortion</b>	Less than 0.02% at 100 watts 8 ohms, 1 kHz. Less than 0.03% at 100 watts 8 ohms 40 Hz to 20 kHz.	Less than 0.02% at 60 watts into 8 ohms, 1 kHz. Less than 0.03% at 60 watts 8 ohms 20 Hz to 20 kHz	Less than 0.02% at 245 watts into 8 ohms, 1 kHz. Less than 0.03% at 150 watts 8 ohms 20 Hz to 20 kHz	Less than 0.02% at 390 watts into 8 ohms, 1 kHz. Less than 0.03% at 250 watts 8 ohms 20 Hz to 20 kHz
<b>Intermodulation Distortion</b>	Less than 0.03% using frequencies of 50 Hz and 7 kHz in 4:1 ratio at 100 watts into 8 ohms	Less than 0.03% using frequencies of 50 Hz and 7 kHz in 4:1 ratio at 60 watts per channel into 8 ohms	Less than 0.03% using frequencies of 50 Hz and 7 kHz in 4:1 ratio at 245 watts per channel into 4 ohms	Less than 0.03% using frequencies of 50 Hz and 7 kHz in 4:1 ratio at 400 watts per channel into 4 ohms
<b>Input Sensitivity</b>	0.775V for full output into 4 ohms attenuator set maximum.			
<b>Input Impedance</b>	15k ohms minimum, unbalanced, optional 600 ohms or 10k matching transformers.			
<b>Damping Factor (8 ohms)</b>	Greater than 300 at 100 Hz.			
<b>Hum and Noise</b>	Greater than 100 dB down ref full output, 20 Hz to 20 kHz.			
<b>Rise Time</b>	3μs or less (10%-90%) of IV, 1 kHz.			
<b>Slew Rate</b>	45V/μS	45V/μS	45V/μS	45V/μS
<b>Channel Separation</b>	Greater than 70 dB at 1 kHz			
<b>Power Requirements</b>	110/120/220/240V 50/60 Hz. Rear panel mounted voltage selector	110/120/220/240V A/C 50/60 Hz. Rear panel mounted voltage selector	110/120/220/240V A/C 50/60 Hz. Rear panel mounted voltage selector	110/120/220/240V A/C 50/60 Hz. Rear panel mounted voltage selector
<b>Input Connectors</b>	1 x 1¼" 3-pole jack and 1 XLR 3-31 female socket per channel.		1 x 1¼" 3-pole jack socket, 1 XLR 3-31 per channel. Jack input:	
<b>Output Connectors</b>	One male XLR 3-32 and one pair binding posts per output.	One male XLR 3-32 and one pair binding posts per channel	Two male XLR 3-32 and one pair binding posts per channel.	
<b>Bridged Mono Output</b>	N/A	200 watts RMS into 8 ohms at less than 0.02% THD at 1 kHz. Internal switch for bridged operation. Input 1 operative.	500 watts RMS into 8 ohms at less than 0.03% THD at 1 kHz. Internal switch for bridged operation. Input 1 operative.	800 watts RMS into 8 ohms at less than 0.03% THD at 1 kHz. Internal switch for bridged operation. Input 1 operative.
<b>Indicators</b>	One 'Peak' LED illuminates 1 dB before amplifier clip point. 'Thermal' shutdown indicator.	One 'Peak' indicating Led per channel. 'Peak' LED's illuminate 1 dB before clip point. 'Thermal' shutdown indicator.	LED output display, calibrated CLIP 0, -3, -6, -9, -12, -15, -21, -27, -33 dB. 'Thermal' shutdown indicator. Red LED 'bridged' indicator indicates bridged mono operation.	
<b>Protection</b>	Short circuit, open circuit and mismatch proof. Thermal guard protects in case of inadequate ventilation. Mains fuse 2A A/S secondary fuses 6.3A (2 off).	Short circuit, open circuit and mismatch proof. Thermal guard protects in case of inadequate ventilation. Mains fuse 3.15A A/S secondary fuses 6.3A (2 off).	Short circuit, open circuit and mismatch proof. Thermal guard protects in case of inadequate ventilation. Mains fuse 4A A/S	Short circuit, open circuit and mismatch proof. Thermal guard protects in case of inadequate ventilation. Mains fuse 10A A/S
<b>Load Protection</b>	N/A	N/A	Protection relay energised by presence of a DC fault condition at the amplifier output.	
<b>Dimensions (WxHxD)</b>	19" x 3¼" x 15¼" 483 x 89 x 384mm.	19" x 3¼" x 15¼" 483 x 89 x 384mm.	19" x 7" x 15¼" 483 x 178 x 384mm.	19" x 7" x 15¼" 483 x 178 x 384mm.
<b>Weight</b>	10.5 kg.	10.5 kg.	19.5 kg.	21.5 kg.
<b>Cooling</b>	Convection	Convection	Thermostatically controlled, quiet running fan.	

In pursuing a policy of continual improvement, HH reserve the right to alter specifications without prior notice.

