AU-X1 ULTRA LOW TIM

Sansui Super Integrated Amplifier with Ultra-High Speed DD/DC Circuit.

Sansui Only hi-fi, everything hi-fi.

Research is Moving Us Closer to the Ideal Amp

The AU-X1 is the latest development in Sansui's ambitious pursuit of the ideal amp—the almost mythical "straight wire with gain," an amp that would provide amplification with absolutely no adverse sonic effect on the sound signal. By concentrating our efforts on eliminating all transient distortion, we have, with this supreme model, moved one step closer to the ideal.

In the beginning, we set about improving our amplifiers' transient characteristics. First, we examined the factors that cause transient distortion. Second, we developed methods to measure these factors. Finally, we began to design new circuitry based on the results of our research.

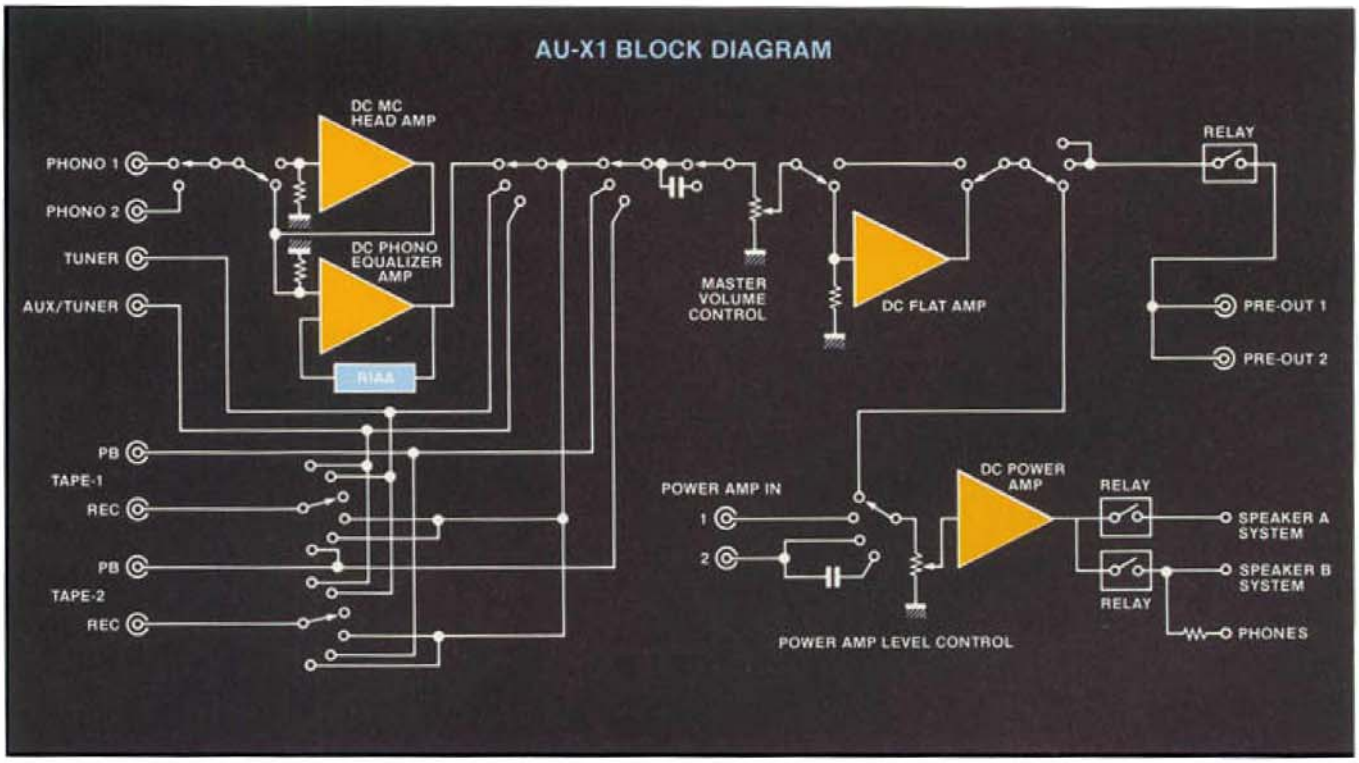
What is well known, of course, is the very close relationship between transient distortion and the sound quality of today's amps. We at Sansui analyzed transient intermodulation (TIM) distortion and envelope distortion, which we knew would lead to greatly improved transient characteristics of the AU-X1. In the process, we were able to arrive at the conclusion that the previously held belief, holding that transient response and steady-state response couldn't be simultaneously improved, was erroneous. You will discover in the AU-X1 that both steady-state and transient parameters are superb. By both realizing the nature of transient intermodulation, and by putting to use this knowledge in the AU-X1, we know that we've come very close to creating the perfect amplifier. The rest of this presentation tells you why.

Sansui "Straight DC" Circuit Configuration

All circuits inside the AU-X1 are DC. The entire circuit configuration is: DC pre-preamp for MC (Moving-Coil) cartridges, DC phono equalizer, DC flat amp, DC power amp in Sansui "Straight DC" configuration. Needless to say, brilliant reproduction results from the extensive use of DC.

There's another common denominator to all these circuits: the ICL (Input Capacitor-Less) design, with input formed of FETs and push-pull drive. The first has dramatically improved circuit stability; the latter contributes to record-high transient response.

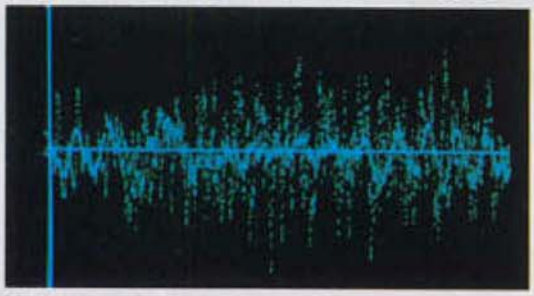
The AU-X1 is the quintessential integrated amp, with elaborate preamp and power amp built on a single chassis. This explains the absence of familiar tone controls on the front panel. State-of-the-art perfection attained in the AU-X1 precludes the use of tone controls with ordinary capability: an amp this sophisticated requires an independent equalizer of the versatile parametric type.



Visual Proofs

You may already have evidence in your own system of an unfortunate stereo fact: Even amps with spectacular steady-state specifications may lack in sound quality when heard in actual performance. Good specs alone don't make for a good amp, and vice versa. But why? Sansui thinks it's because steady-state measurements use a fixed, constant-amplitude test signal, unlike the wildly modulating signals sent to amps in actual musical performance. Transient measurements, on the other hand, use pulsive signals like those found in actual music. In the making of the AU-X1, and other advanced Sansui components, we have paid major attention to the steady-state parameters, but we haven't lost sight of what's really important: actual musical performance. That's why we've developed ways to test and measure transient characteristics like TIM (Transient Intermodulation) distortion and envelope distortion.

WAVEFORM REPRESENTING DRUM SOLO



Musical input first digitally computer-memorized and then displayed as digital dots at 50μSec. sampling frequency.

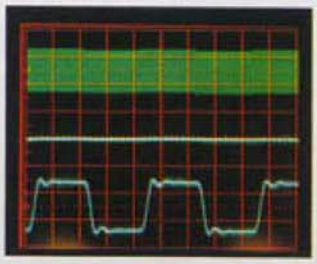
Recently, manufacturers have been able to greatly improve steady-state characteristics in amplifiers through the use of negative feedback. Negative feedback has proved invaluable in improving steady-state characteristics like constant gain margin, the wide frequency range, and matched input/output impedance. The more negative feedback added to the amp, the better steady-state characteristics become. On the other hand, the more negative feedback used in an amp, the higher the current demand which, when the increased current requirements become too much for the amp to handle, results in "clipping." And it is this combination of factors that produces TIM distortion.

TIM Distortion

TIM distortion or Transient Intermodulation distortion is one of the most important of all the transient characteristics, since it has so much to do with how music is heard. Not only does TIM damage tonal quality, it also makes correct amplification of a signal impossible, resulting in degradation of the signal's waveform integrity.

Until recently, manufacturers have acted to lessen TIM distortion by cutting down on the amount of negative feedback used, or by employing a filter at the input of an amp to keep pulsive signals reduced to a level below which the amp can handle without producing TIM. The flaw is that both methods (and others as well) sacrifice steady-state parameters to better transient characteristics. In dealing directly with the generation of TIM, Sansui has also developed extremely advanced methods of measuring it. We developed the patent-pending DD/DC circuit so that negative feedback could be used in such a way as not to detract from steady-state characteristics. This circuit completely suppresses TIM distortion simply because it has driving power so strong that current saturation cannot occur, leading to the development of an amplifier like the AU-X1 in which both steady-state and transient parameters are in the premier range.

TIM DISTORTION



Input Waveform

AU-X1: 0.014% at 80W

Conventional Amp: 2.7% at 80W

Diamond Differential DC Circuit for Low TIM

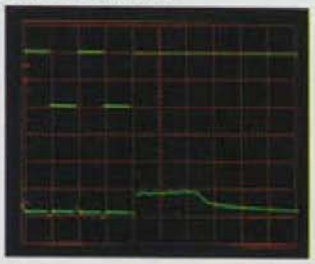
The secret behind the AU-X1's greatly improved transient response is its Diamond Differential DC circuit, so called because of the shape it forms in a schematic diagram. In essence, electrical current is always sufficient, no matter how demanding and pulsive the signal. Clipping is also eliminated; hence, there is drastically reduced TIM.

The circuit is basically a dual complementary differential circuit with push-pull output formed of two pairs of PNP and NPN transistors. As its schematic indicates, the input is voltage-amplified by the left and right pairs of transistors. These symmetrical differentials feature perfect CMRR (Common Mode Rejection Ratio). When an input demands a large power output, the upper and lower pairs of transistors work as current differential to achieve high drive current.

The combination of high current drive capability and stable application of negative feedback makes the AU-X1 virtually TIM distortion-free.

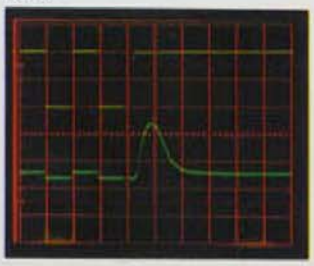
CURRENT WAVEFORMS

Conventional Amp



Conventional Amp: Input is so transient that drive current cannot be provided as quickly as demand requires. This current saturation leads to generation of TIM distortion.

AU-X1



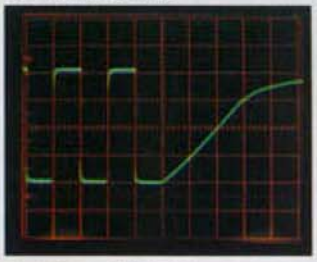
AU-X1: The driver circuit in the DD/DC Circuit always feeds sufficient drive current; no matter how pulsive or transient the input, current saturation cannot occur.

High Slew Rate and Fast Rise/Fall Time

Besides reducing TIM distortion to close to the vanishing point, the DD/DC circuit makes the AU-X1 a very fast amp, with a ±260V/μSec. slew rate and a 0.5μSec. rise/fall time. The high slew rate is particularly important because it measures the amount of voltage an amp can apply to a square wave signal in one microsecond. One rule holds here: The faster the better. Our theory that low TIM leads to a higher slew rate and a faster rise time has been proven decisively with the AU-X1.

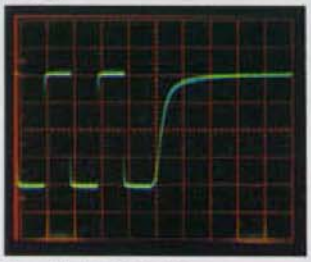
SLEW RATE & RISE TIME

Conventional Amp



Slew Rate: 20V/μSec.
Rise Time: 4μSec.

AU-X1



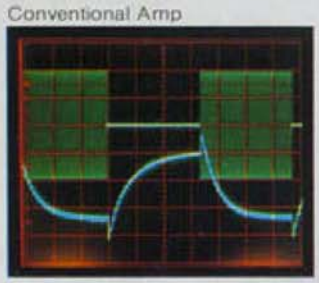
Slew Rate: 260V/μSec.
Rise Time: 0.5μSec.

Envelope Distortion

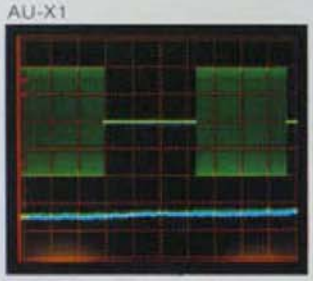
In the course of Sansui's war on TIM distortion, we discovered yet another kind of music-spoiling transient distortion—*envelope distortion*. Discovered by Sansui researchers in 1978, envelope distortion is a kind of amplitude-modulated transient distortion that is particularly noticeable in low frequencies. When pulsive signals (similar to actual music signals) are fed into an amplifier, a transient power voltage fluctuation develops at the input and causes a shift in circuit operation potentials. Since this type of distortion occurs when short-duration transient pulses form a long-duration enveloping wave, the name "envelope distortion" is appropriate. This is the audible kind of distortion that makes piano attacks less immediate and vocal texture less distinct. Envelope distortion is particularly annoying because its frequency components are out of harmonic relation with fundamentals.

ENVELOPE DISTORTION

Conventional Amp



AU-X1



In the measuring arrangement, a filter to eliminate tone burst components is set at the output; there should thus be no output. Photo shows, however, that there *is* an output: envelope distortion is generated. There's almost no signal at the output of the AU-X1; envelope distortion is insignificant.

We've greatly reduced envelope distortion in the AU-X1 by, one, utilizing elaborate circuits—symmetrical configuration, push-pull drive, differential circuits—which are independent of external environment and in/output impedance; and two, separating the power supplies for the power stage and those for the predriver stage.

Superb Steady-State Response

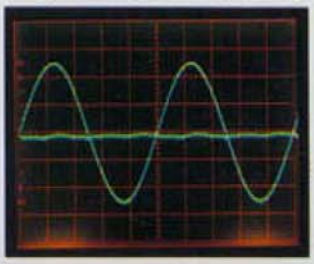
The AU-X1 delivers 160 watts per channel, min. RMS, both channels driven, into 8 ohms from 5 to 20,000Hz with no more than 0.007% total harmonic distortion and intermodulation distortion. Its power amp has a super-wide frequency response of DC (zero Hz) to 500kHz! The stable application of negative feedback made possible by the DD/DC circuit, plus superb open-loop response, are the reasons behind such low-distortion, high-power operation.

The pre-preamp for MC (Moving-Coil) cartridges employs a symmetrical circuit configuration, made of newly-developed P-channel and N-channel FETs, while the phono equalizer utilizes the Sansui DD/DC circuit. Both achieve low-noise amplification for wide dynamic range at low TIM and low envelope distortion.

The pre-preamp and the phono equalizer boast phono overloads of 40mV and 330mV, and signal-to-noise ratios of −156dB (input equivalent noise) and 91dB, respectively.

RIAA accuracy is another hallmark of the phono equalizer thanks to the use of select 1% metalized-film resistors and 2% polypropylene capacitors. The ±0.2dB tolerance is kept across a wide 20 to 20,000Hz range.

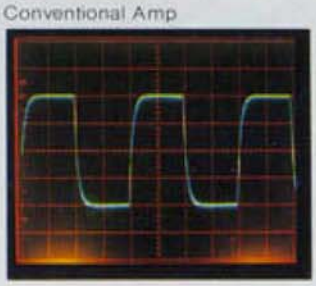
AU-X1'S OUTPUT AND DISTORTION WAVEFORMS



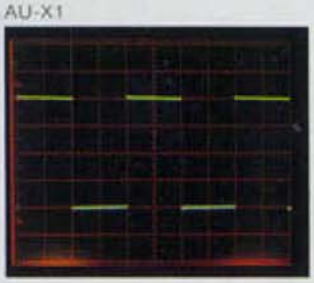
Power at 160W with 0.007% THD

PHONO EQUALIZER 1kHz Square-Wave Response

Conventional Amp



AU-X1



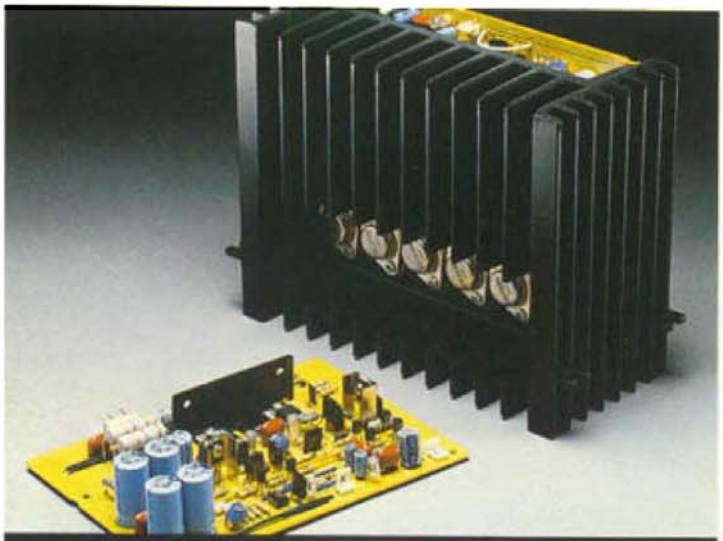
Circuit Description

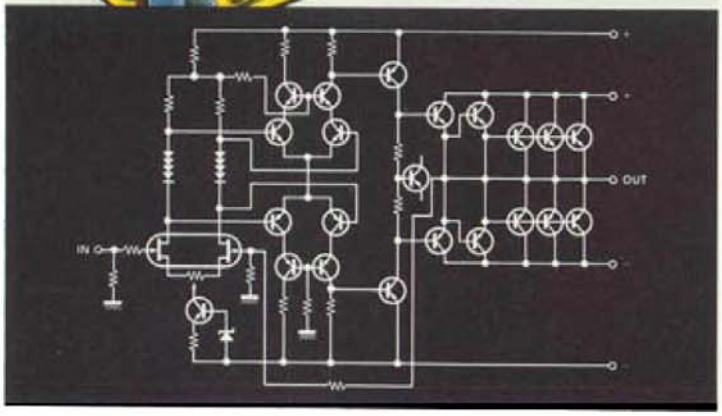
DC Power Amp

The power amp is in the DC design with Dual-FET differential input with current source, the Sansui Pat. Pending DD/DC circuit with a cascode bootstrapping circuit, current-differential push-pull drive stage, and 3-stage Darlington-connected true complementary, triple push-pull OCL output.

The input is formed by a Dual-FET with two thermally-matched FETs packaged together. The current source stabilizes differential amplification of the input. And the DD/DC circuit features amazingly high current supply capability, which contributes to improved slew rate and rise time, and reduces TIM and envelope distortion to near non-existence. Even high current, required when pulsive peaks are fed to the amp, is easily accommodated with no trace of saturation.

This circuit is made of a total of four PNP and NPN transistors. The upper and lower pairs form one differential, the left and right pairs form another, with the first pairs serving as a high current differential and the second pairs as a high voltage differential amp. The advantage of this simple circuit is that dynamic range is wider than ever yet achieved. We've selected the newly-developed LAPT (Linear Amplitude Power Transistors) for the power output.

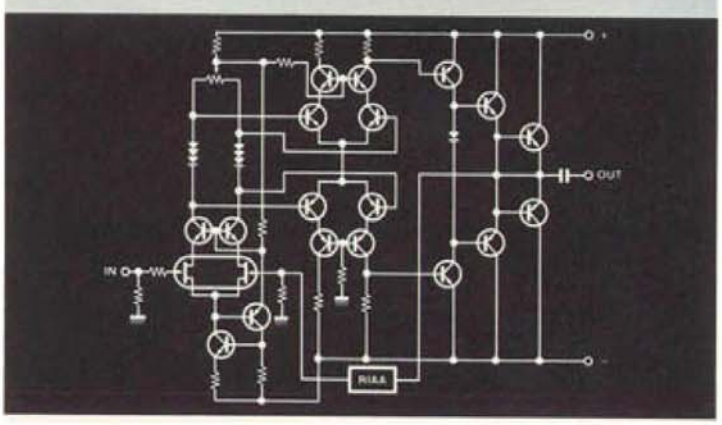




DC Phono Equalizer

This circuit is formed of: a Dual-FET differential input with a cascode bootstrapping circuit and current source, a Sansui Pat. Pend. DD/DC second stage, and an output made of true complementary current differential push-pull drive, two-stage Darlington-connected SEPP and true complementary power output. It is in a very advanced ICL/DC configuration using 20 semiconductors per channel. The key design features are, again, high signal-to-noise and wide dynamic range.

The input is formed of low noise, high-gm Dual-FETs, differentially arranged for high input impedance. The current source uses PNP and NPN transistors, direct coupled in its two stages. Featuring high CMRR and stabilizing current flowing through the transitors, it assures accurate operation at the input. The cascode bootstrapping circuit makes the input independent from variation in source impedance, to assure constant operation of the input. The second stage is DD/DC, about which you have read earlier. Finally, the Darlington configuration output stage features high current supply capability, high output stability and low output impedance.

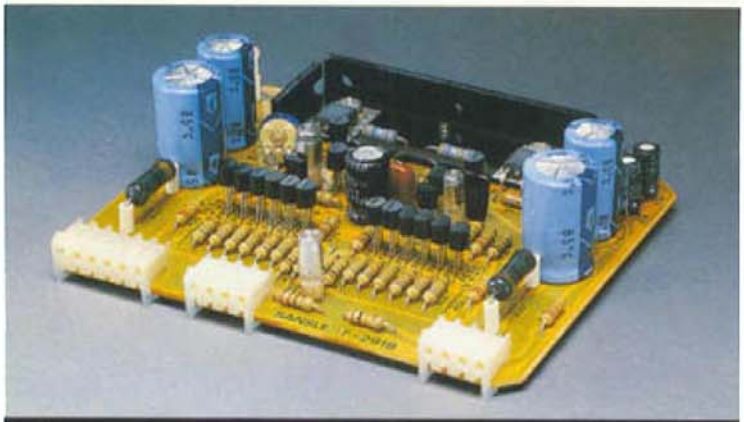


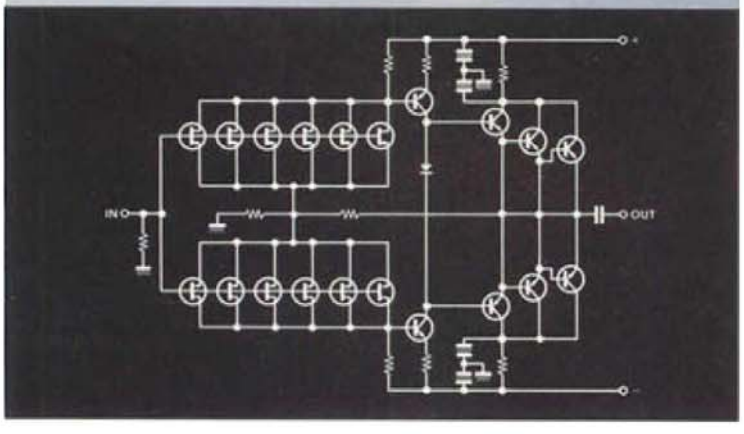
DC Pre-Preamp for Moving-Coil Cartridges

A total of 12 FETs and 8 transistors (per channel) forms the pre-preamp of the AU-X1. Input is formed of six low-noise FETs with high *gm*, parallel connected, in true complementary push-pull configuration, followed by a transistor two-stage push-pull true complementary amp, and then a 3-stage Darlington-connected SEPP (Single-Ended Push-Pull) true complementary output.

The parallel-connected FETs improve the signal-to-noise ratio; the symmetrical design and true complementary arrangement assure absolutely stable voltage potential to help eliminate TIM, envelope and other kinds of transient distortion; ICL leads to still better transient response; and the input, formed of newly-developed, paired low-noise, high-*gm* FETs with matched thermal characteristics, has higher impedance and achieves much higher current driving than a transistor-built input. The 3-stage direct-coupled intermediate amp, formed of NPN and PNP transistors, features high current efficiency, high gain, high linearily; and the three-stage Darlington-connected output makes high current drive and high linearity possible, providing a wide dynamic range.

All of this adds up to a high signal-to-noise ratio and wide dynamic range, the least you should expect of any high-quality pre-preamp, where an infinitesimal microvolt signal – about 1/20th of the level handled in phono equalizers – must be handled and amplified.

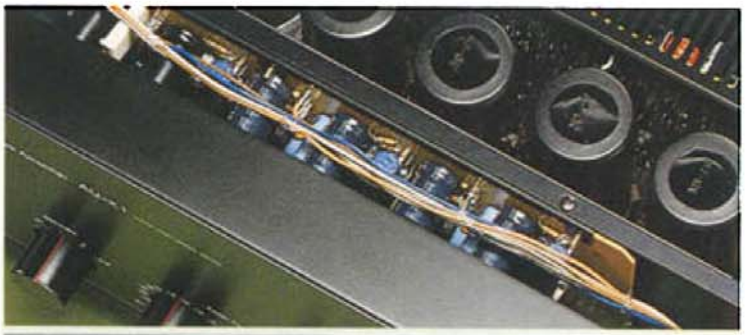


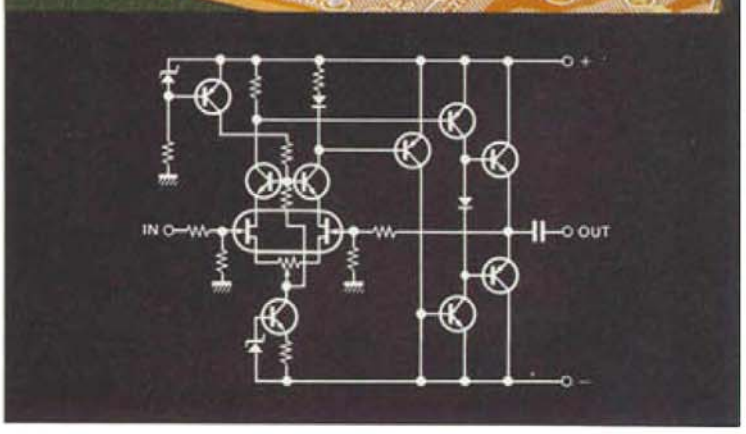


DC Flat Amp

Circuit configuration is: a differential input formed of Dual-FET, and a current source and cascode bootstrapping circuit; a second stage of current differential push-pull drive; and an SEPP true complementary output. A total of 11 FETs and transistors forms this ICL/DC flat amp with 14dB gain. It may be switched out if necessary.

The Dual-FET used in the input is actually made of two FETs, mounted on a chip. Their newly-developed thermally-matched characteristics make them an ideal device for the input that also features high input impedance, low noise and high gain. Voltage potentials are never changed by ambient temperature. The second stage push-pull drive forms a circuit of high current supply capability, low TIM distortion and high slew rate.

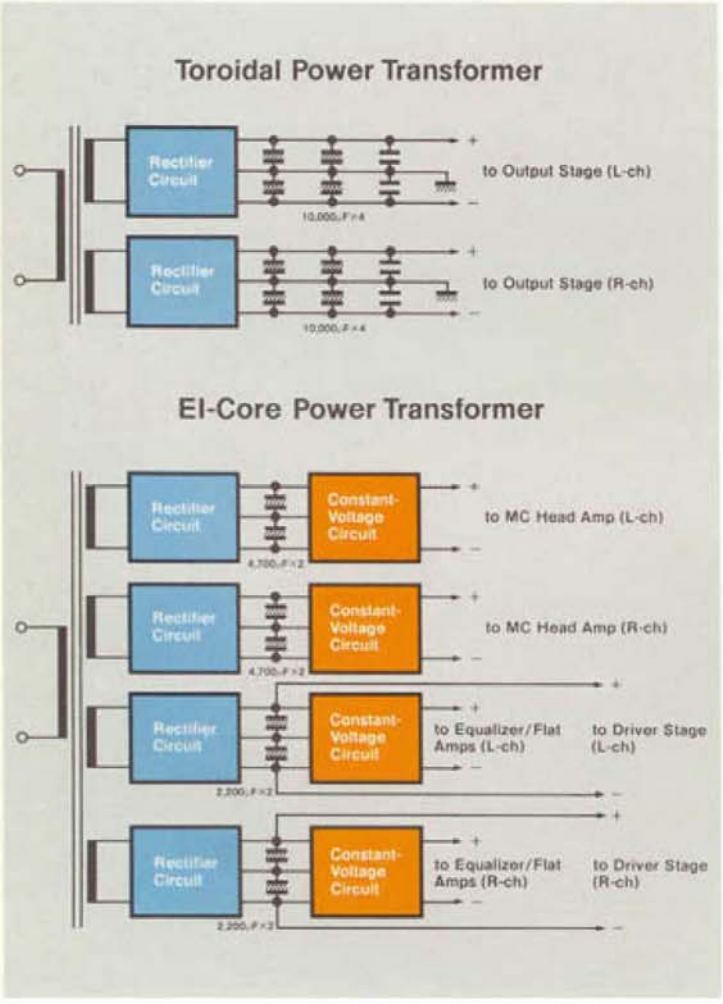




Power Supplies

Two transformers—one toroidal and one EI-core-type—were selected for use in the power supplies of the AU-X1. The toroidal transformer contains separate coil windings to feed electric power to the left and right power output sections, independent from each other. There are also separate windings on the EI-core transformer, each feeding power to the left or right channel of the pre-preamp for moving-coil cartridges. More windings are on this transformer, one that sends current to the left channel, another to the right, of the phono equalizer, flat amp and driver stage in the power amp. A total of eight power supplies are contained in the AU-X1, so that the optimum amount of current is distributed to each amp block when needed. Transient crosstalk distortion and envelope distortion are dramatically reduced thanks to this elaborate power supply system that separates the left power supply completely from the right.

Toroidal transformers are coupled with eight (!) custom-made electrolytic capacitors (80,000μF in total capacitance), connected in parallel. They help make internal impedance still lower and power regulation still better.

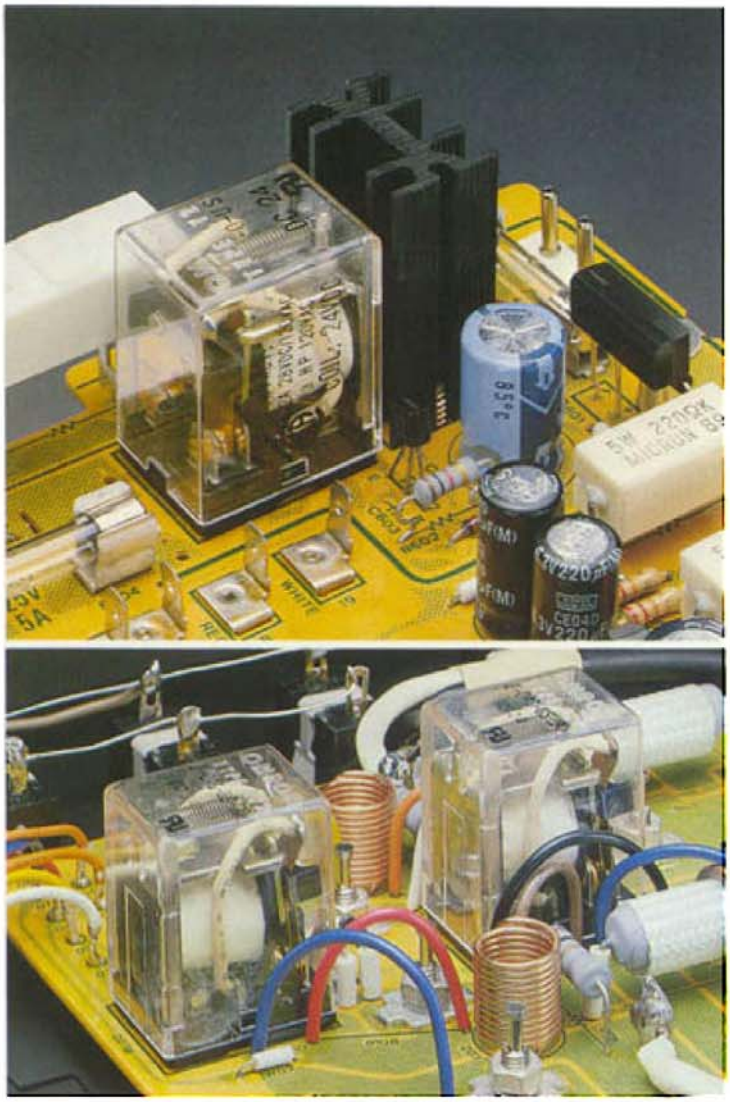


Power Protection Circuit

Two fail-safe circuits prevent DC components from appearing at the speaker terminals of the AU-X1 should the DC balance of the power amplifier section be disturbed:

- VOLTAGE DETECTION CIRCUIT—Opens a relay to electrically separate connected speakers from the output terminals if the voltage ever drifts from balanced zero values. No DC voltage, no matter how small, can ever reach valuable speaker systems.
- OVERLOAD CURRENT DETECTION CIRCUIT—If a dangerously excessive current is drawn in the output power transistors due to output shorts or other accidents, the speaker output is instantly powered off to protect the transistors from breakdown.

When and if either of these protection circuits is triggered, an LED Power Indicator on the front panel will flicker until the cause is detected and eliminated. This indicator also flickers for a few moments when the power switch is turned on, indicating that the circuits are being stabilized electrically.



Controls

Wide Versatility
The AU-X1 has more in/outputs than ordinary amplifiers. It accepts two turntables, two tuners, or up to four tape decks simultaneously. Since there are two PRE-OUT and two POWER-IN terminals, a wide range of equipment—including independent control amp, another power amp, tone equalizer, channel divider for bi-amping, etc.—may be connected and operated. Ease of use is further enhanced by the inclusion of a separate PRE-MAIN switch and power amp level controls on the front panel. The AU-X1 is easily converted into a separate power amp and preamp.

Input Selectors
A bank of input selectors, each selected by a short-stroke push switch and coupled with a relay, is contained in the AU-X1. Each has an indicator lamp that lights when the input is selected. By the combination of two selectors for phono and twin buttons for MM or MC selection, each of the phono inputs accepts either an MM or MC cartridge.

Tape Play Buttons & Copy Knob
Tape play/copy/dubbing procedures are made by operating the TAPE PLAY buttons and COPY knob. Since the AU-X1 accepts two tape decks, dubbing in both directions is possible. A third deck (and even a fourth) may be connected to the POWER AMP IN terminals for enhanced reproduction.
Radio programs may be recorded while you're listening to yet another program (records, tapes, etc.) by switching the TAPE COPY to AUX/TUNER or TUNER position. Use of the OFF position on this switch disconnects connected tape decks to the rear-panel tape terminals.

JUMP Switch
With this switch in, the equalizer amp is direct-connected to the power amp for purer reproduction.

Subsonic Muting
Cuts off low frequency noise below 16Hz (−3dB, 6dB/oct. curve) caused by record warp, etc.

Power Amp Operation
The preamp/power amp separation switch has been moved to the front panel of the AU-X1.

Power Amp Level Controls
High-precision carbon volume controls permit separate input gain control for both left and right channels.

Construction and Parts

Special care has been taken in parts selection and construction of the AU-X1 to complement its advanced design and precision circuitry. The AU-X1 has been constructed from input to output with left and right fully separated. All possibility of electrical interference between left and right channels has been prevented.

Linear Amplitude Power Transistors (LAPT)

The LAPT transistors employed in the power output section are fast, linear over a wide range and highly resistant to breakdown. Linearity is much better than conventional "high-speed" transistors.

Linear Amplitude Power Transistors

Toroidal and EI-Core Transformers

The high-performance toroidal transformer used in the power section uses separate coil windings to supply left and right power outputs separately. The power stage and the driver stage have separated power supplies to improve transient characteristics. An EI-core transformer has been used in the preamp and driver stages.

Custom-Made Electrolytic Capacitors

These have a huge capacitance of 80,000μF (for power stage) and are parallel-connected to deliver low impedance and distortion into the highest frequencies. The length of wire running between capacitors and output transistors has been minimized to deliver pure reproduction.

Power Transformers

Electrolytic Capacitors

Heat Sinks

These are newly-developed to prevent thermal degradation of the power transistors in actual performance. They are mounted to provide maximum surface area so that heat can be efficiently dissipated as quickly as it is generated.

High-Efficiency Cables to Speaker Terminals

High-efficiency cables are used from the output transistors to the speaker terminals to ensure low DC resistance, high efficiency and a high slew rate right up to the speaker terminals.

Heat Sink

High-Efficiency Cable

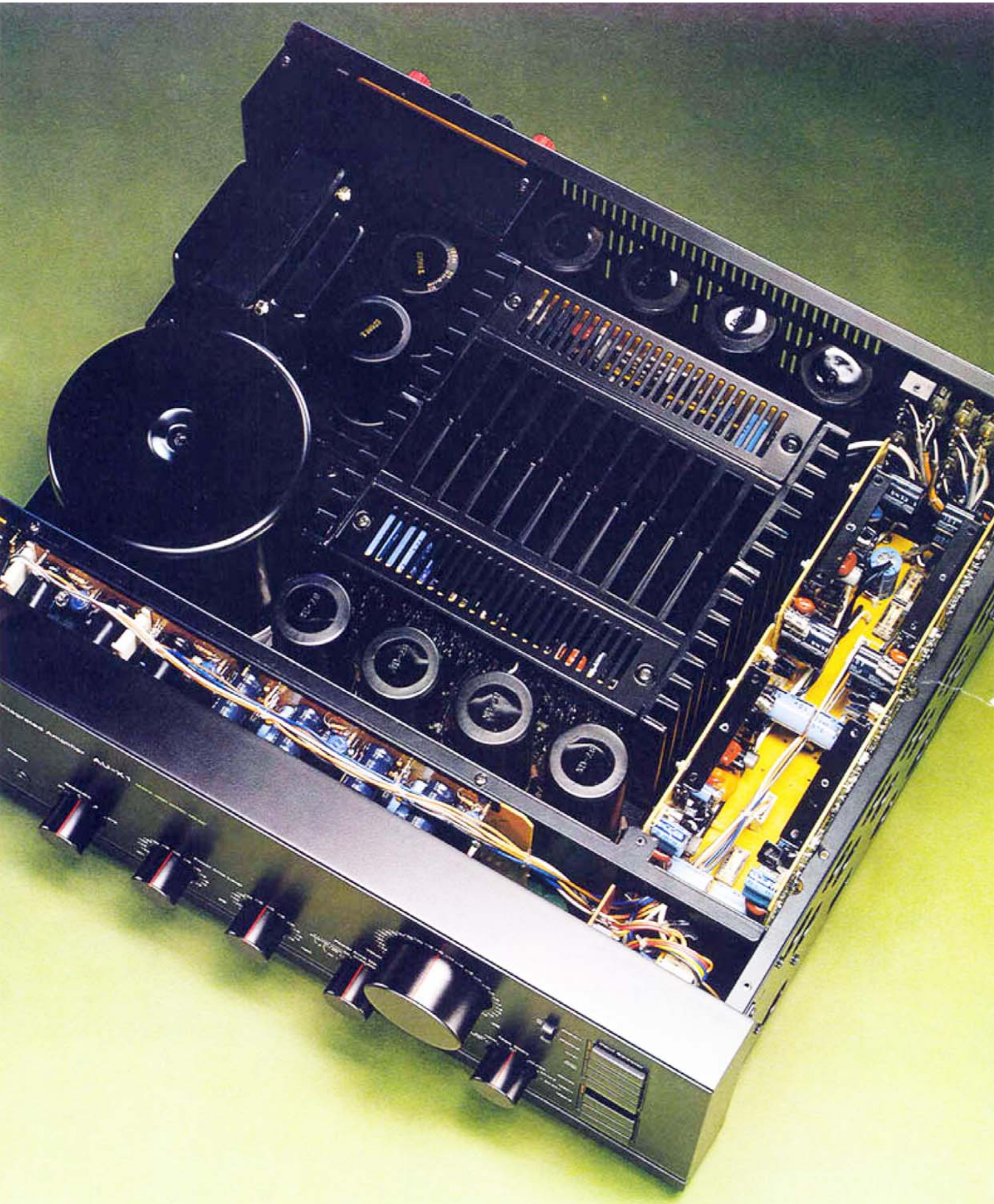
Other Features

Thick pure-copper grounding sheets have been used as bus line to reduce internal impedance. High-current power relays are employed at the output to eliminate mechanical speaker connector switching and the tonal degradation it can cause. Gold-plated jacks in the phono inputs reduce contact resistance and corrosion. Large screw-type speaker terminals assure firm grip on connected speaker wires. And there's much more, too, from Sansui, where it's *all* hi-fi.

Pure-Copper Grounding Sheet

Gold-Plated Terminals

Power Relays



Specifications

POWER AMP SECTION

POWER OUTPUT*

Min. RMS, both channels driven, from 5Hz to 20,000Hz with no more than 0.007% total harmonic distortion
160 watts per channel into 8 ohms

Min. RMS, both channels driven, at 1,000Hz, with no more than 0.007% total harmonic distortion
240 watts per channel into 4 ohms
180 watts per channel into 8 ohms

TOTAL HARMONIC DISTORTION*
less than 0.007% at or below rated min. RMS power output

INTERMODULATION DISTORTION
(70Hz : 7,000Hz=4 : 1 SMPTE method)
less than 0.007% at or below rated min. RMS power output

DAMPING FACTOR 100 into 8 ohms
LOAD IMPEDANCE* 8 ohms
SLEW RATE ±260V/μsec.
RISE TIME 0.5μsec.
FREQUENCY RESPONSE (at 1 watt)
DC to 500,000Hz +0dB, −3dB
HUM AND NOISE (IHF) 125dB
CHANNEL SEPARATION (at 1,000Hz)
95dB
INPUT SENSITIVITY AND IMPEDANCE (at 1,000Hz)
1V, 47k ohms

PREAMP SECTION

RIAA CURVE DEVIATION (20 to 20kHz)
+0.2dB, −0.2dB

INPUT SENSITIVITY AND IMPEDANCE (at 1,000Hz)

PHONO 1, 2 (MM)	2.5mV/47k ohms
PHONO 1, 2 (MC)	0.1mV/200 ohms
AUX, TUNER, TAPE PLAY	200mV/47k ohms

MAXIMUM INPUT CAPABILITY (at 1,000Hz 0.01% T.H.D.)

PHONO 1, 2 (MM)	330mV RMS
PHONO 1, 2 (MC)	40mV RMS

OUTPUT VOLTAGE AND IMPEDANCE (at 1,000Hz)

TAPE REC (PIN)	200mV/600 ohms into 47k ohm load
PREAMPLIFIER OUTPUT	1V/600 ohms into 47k ohm load
MAXIMUM PREAMPLIFIER OUTPUT (0.05% T.H.D.)	20V/1k ohms into 47k ohm load

FREQUENCY RESPONSE (at 1 watt)
OVERALL (from AUX) 5 to 500,000Hz +0dB, −3dB

HUM AND NOISE

PHONO 1, 2 (MM)	91dB
PHONO 1, 2 (MC)	−156dBV
AUX, TUNER, TAPE PLAY	100dB

CHANNEL SEPARATION (at 1,000Hz)

PHONO 1, 2 (MM)	75dB
PHONO 1, 2 (MC)	70dB
AUX, TUNER, TAPE PLAY	80dB

MAJOR FUNCTIONS

SUBSONIC FILTER	−3dB at 16Hz (6dB/oct.)
JUMP	−14dB
PREAMPLIFIER OUTPUT	1, 2
POWER AMP OPERATION	external input 1 (DC Integrated) external input 2 (AC or DC)
POWER AMP LEVEL	0 to −60dB

GENERAL

AC OUTLETS switched max. 100 watts
unswitched total 300 watts

POWER REQUIREMENTS

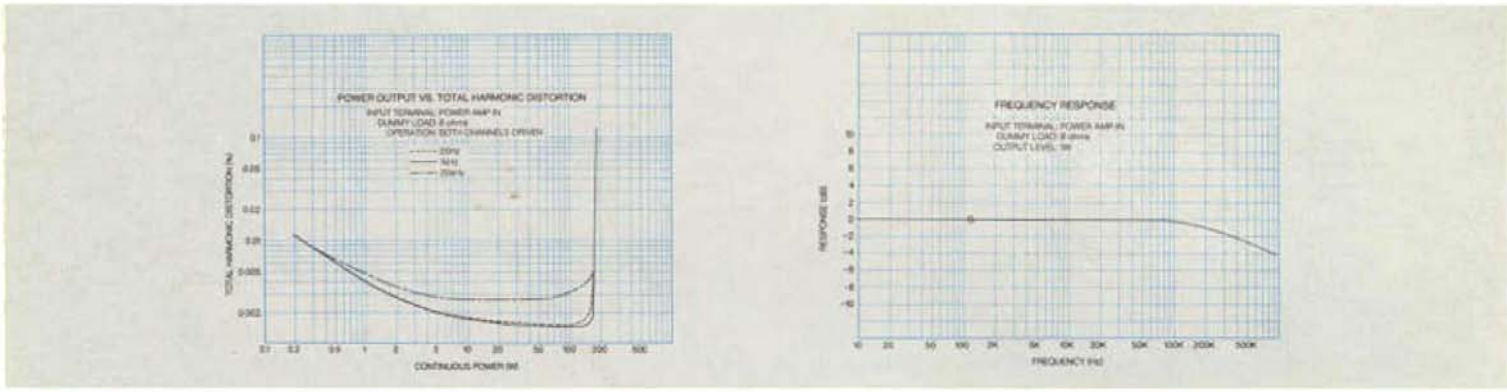
POWER VOLTAGE	100, 120, 220, 240V 50/60Hz
POWER CONSUMPTION	500 watts

SEMICONDUCTORS 129 Transistors; 69 Diodes; 16 Zener Diodes; 1 SCR; 1 LED; 18 FETs

DIMENSIONS 480mm (18 9/16")W
197mm (7 3/8")H
450mm (17 3/4")D

WEIGHT 27.7kg (61.1lbs.) Net
30.4kg (67lbs.) Packed

*Power specifications measured pursuant to U.S. Federal Trade Commission trade regulation on power output claims for amplifiers
●For European models, some specifications might change to comply with local safety regulations and standards.
●Design and specifications subject to change without notice for improvements.



PS-107C/112C Wide-range Triaxial Speaker Cables

PS-1P/2P Extension Plug Adaptors
PS-4C/5C Hi-Fi Pin Cords
PS-6C/7C Stereo/Mono Phone Plug Cords

SS-80/60/40/30 Dynamic Stereo Headphones

Sansui

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