Accuphase

INTEGRATED STEREO AMPLIFIER

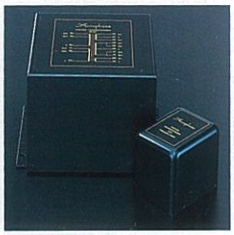
E-406

● Quadruple Parallel Push-Pull Output Stage Delivers 170 Watts/ch of Quality Power into 8 ohms ● Superb Low-Impedance Drive Capability ● High-Performance Phono Equalizer Amplifier for MM and MC Cartridges ● Logic-Controlled Relays Allow Shortest Signal Paths

Perfect Isolation of Power Amplifier and Preamplifier Assures Performance on Par with Separate-Type Con Drive Capability Provide More than Ample Quality F Real-World Conditions. Dedicated MM and MC Phor Switched by Logic-Controlled Relays. Remote Comm

Based on many years of experience in building superb separate-type amplifiers, Accuphase proudly presents the ultimate integrated amplifier, featuring totally separate power amplifier and preamplifier partitions.

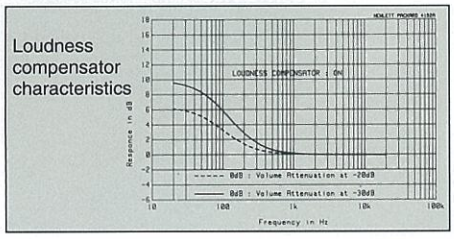
Integrated amplifiers offer various advantages, among them ease of setup and operation, high gain, and modest space requirements. However, since the total gain from the input to the output can be as high as 100 dB (amplification by a factor of 100,000), even the slightest interference or crosstalk at the input will greatly affect the sonic result. To preclude such problems, the E-406 actually contains two entirely separate amplifiers within a single housing. The preamplifier and power amplifier sections of the E-406 provide performance on par with the best separate-type amplifiers. Each section has its own dedicated power transformer and power supply circuitry, housed in shielded enclosures. This totally eliminates the possibility of interference. There is even a SEPARATE switch which makes it possible to split the power amplifier and the preamplifier electrically and to use each section by itself.



The power amplifier section features a quadruple parallel push-pull arrangement which delivers an ample 170 watts/ch into 8 ohms. Drive capability with low-impedance loads is excellent. The E-406 can drive even difficult high-end loudspeakers with ease and authority. Generous current reserves ensure that the musical signal will always be reproduced faithfully, even during dynamic passages with abrupt level fluctuations and fast transients. The power supply with two enormous 33,000 µF capacitors boasts filtering capacity previously unheard of in integrated amplifiers. This generous design helps the E-406 to provide almost unlimited amounts of quality power. Actual measurement ratings are 170 watts/ch into 8 ohms, 250 watts/ch into 4 ohms, and 300 watts/ch into 2 ohms.

The preamplifier section consists of two units: a line amplifier with 20 dB gain and a phono equalizer amplifier with switchable gain of 30 dB (MM) or 60 dB (MC). The units are powered by a dedicated power transformer with extremely low leakage flux. Interference from the power amplifier section is totally absent, assuring stable operation and impeccable sound quality at all times.

Thanks to a total of eleven inputs, the E-406 can easily cope with a wide range of program sources. Two of the inputs are balanced, to permit signal transmission with ideal characteristics. For tape enthusiasts, two sets of tape recorder jacks are provided, with monitoring capability and copy function. All switching operations are handled by hermetically sealed miniature relays filled with nitrogen gas. The contacts are gold-plated for minimum contact resistance and outstanding long-term reliability. Arranged at strategic points to allow shortest signal paths, these logic-controlled relays contribute greatly to the impeccable sound quality and reliability of the E-406.



The E-406 provides flexibility and convenience without sacrificing quality. A case in point are the tone controls and the loudness compensation circuit. The tone controls employ the summing active filter principle, and the loudness compensator provides just the right amount of compensation, depending on the volume level setting. All printed circuits which carry the audio signal are gold-plated, for superior sonic performance.

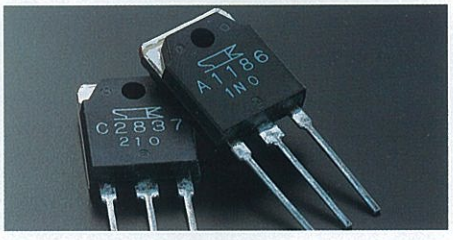
Another important convenience feature of this amplifier is the supplied remote commander for program source switching and volume adjustment. The volume control of the E-406 uses low-distortion resistor elements which are rotated while the contact brush remains stationary. This solution has proven to be optimal in terms of sound quality. To allow remote operation without any sound quality degradation, a motor and gear assembly have been added to drive the control.

The external design of the E-406 is refined and elegant, with a champagne gold brushed front panel and a simple and uncluttered appearance. Two large power meters in the center are flanked by the symmetrically arranged input selector section and the volume control. Less frequently used controls are arranged behind a hinged panel. Sensible human engineering is in evidence throughout, contributing to the unsurpassed musical enjoyment afforded by this amplifier.

Power Amplifier Section

Robust Power Amplifier Block Delivers 170 Watts/ch into 8 Ohms, 250 Watts/ch into 4 Ohms, and 300 Watts/ch into 2 Ohms

Fig. 1 shows the circuit principle of this amplifier's power amplifier section. The output stage consists of the transistors Q_{12} to Q_{19} which are arranged in a quadruple parallel push-pull configuration. The devices are mounted to large heat sinks, to assure stable operation even with very low-impedance loads. The E-406 delivers 170 watts of clean power per channel into 8 ohms, 250 watts into 4 ohms, and 300 watts into 2 ohms (actual measurements).



The output of the power amplifier section is supplied directly to the loudspeakers, without any coupling capacitors in the signal path. To prevent any possibility of sound degradation and instable operation due to

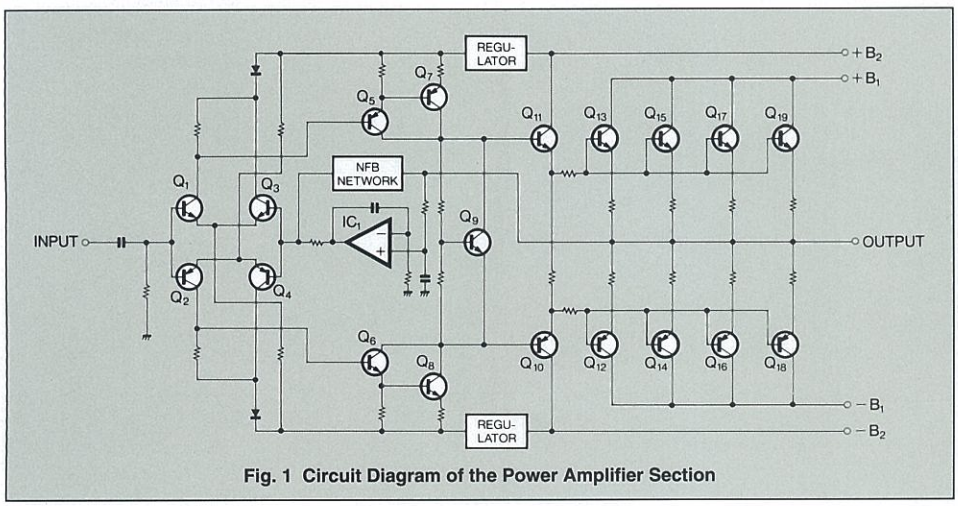


Fig. 1 Circuit Diagram of the Power Amplifier Section

ctions with Dedicated Power Transformers and Power Supplies nents. Quadruple Parallel Push-Pull Topology and Low-Impedance er: 170 Watts/ch of into 8 ohms and 300 Watts/ch into 2 ohms under Equalizer Amplifier and All Other Program Sources are ler Supplied as Standard.

offset voltage (DC drift) in the output, Accuphase uses an exclusive DC servo amplifier circuit for the NFB loop. Even extreme power line fluctuations or changes in temperature do not affect output stability.

Input Stage with Differential Complementary Push-Pull Circuitry

The design of the input stage features another Accuphase development, the differential complementary push-pull circuit with high CMRR (common-mode rejection ratio). The circuit driving the output stage is a Darlington-connected emitter common circuit. This kind of push-pull arrangement with "vertical" symmetry results in utterly stable operation. When the power amplifier section is used individually, the input signal is fed directly to this stage, allowing it to develop its full potential.

Dedicated Power Transformers and Power Supply Circuitry for Power Amplifier and Preamplifier

The preamplifier deals with extremely delicate low-level signals, while the power amplifier has to handle large currents. In an integrated amplifier, both of these requirements must coexist. If only one power supply is used, mutual interference is all but inevitable. To reliably preclude this danger, the E-406 has entirely separate power supplies. The transformer for the power amplifier block is a massive type weighing in at a full 9 kg. Two giant 33,000 μF capacitors provide highly effective current filtering. This no-holds-barred approach allows the power amplifier to develop its full potential, on par with stand-alone components.

Large Speaker Terminals Accommodate Heavy-Gauge Cables or Banana Plugs

The oversize speaker terminals are made of extruded high-purity brass material. The connectors accept heavy-gauge speaker cable, and it is also possible to insert banana plugs into the terminals. Two sets of outputs with an A/B speaker selector are provided. The A+B position of the selector allows bi-wiring (supplying the same signal via dual leads to speakers with separate high-frequency and low-frequency inputs).

Large Power Meters with Direct Power Readings

The easy-to-read and highly accurate output power meters in the center of the front panel use logarithmic detection with a peak-hold circuit, which enables them to precisely follow the rapid changes in amplitude and frequency that are common with music signals.

Preamplifier Section

High-Quality Discrete-Type Line Amplifier

The output signals of CD players, tuners, and other high-level sources are handled by the line amplifier whose circuit diagram is shown in Fig. 2. The entire stage is built from discrete parts, to assure top-level performance. Circuit design is based on the differential pure complementary push-pull principle developed by Accuphase, while the output stage is a single-ended push-pull emitter follower. This comparatively simple circuit topology requires only minimal amounts of phase compensation in each stage. This in turn enhances signal purity and results in effortless, utterly natural sound. The use of local regulators with active ripple filters prevents crosstalk and interference via the master power supply.

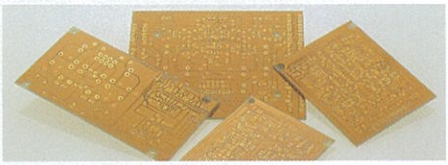
High-quality Phono Equalizer Stage Accommodates MM and MC Cartridges

Although digital program sources are becoming ever more popular, high-quality reproduction of analog records is still an important consideration for the true audiophile and music lover. The E-406 therefore incorporates a no-compromise phono stage designed to deliver top-notch performance. Fig. 3 shows the circuit configuration of this stage. Separate input circuits are provided for moving-coil (MC) and moving-magnet (MM) cartridges, to fully bring out the advantages of each cartridge type.

Since MM cartridges have high output voltage as well as high output impedance, the FET input stage (Q_1 and Q_2) is designed to maintain high input impedance over the entire frequency range. On the other hand, the MC section has to deal with very low-level signals at low impedances. Therefore, two low-noise devices (Q_5 and Q_6) are arranged in a differential configuration with a low-impedance NFB loop, to assure optimum signal-to-noise ratio and keep residual noise at a minimum.

Gold-plated Circuit Boards

All printed circuits which carry the audio signal use highly pure copper and are gold-



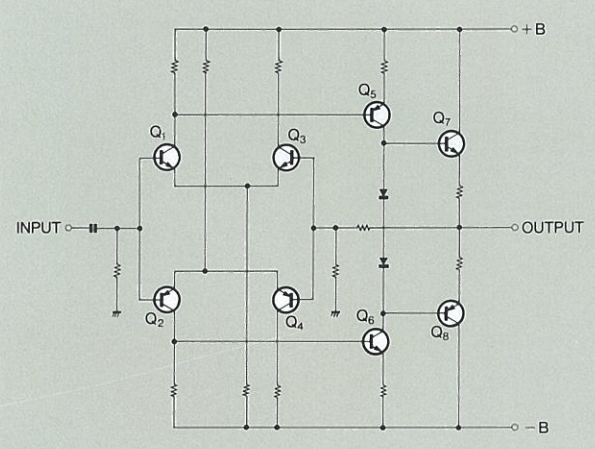


Fig. 2 Circuit Diagram of the Line Amplifier

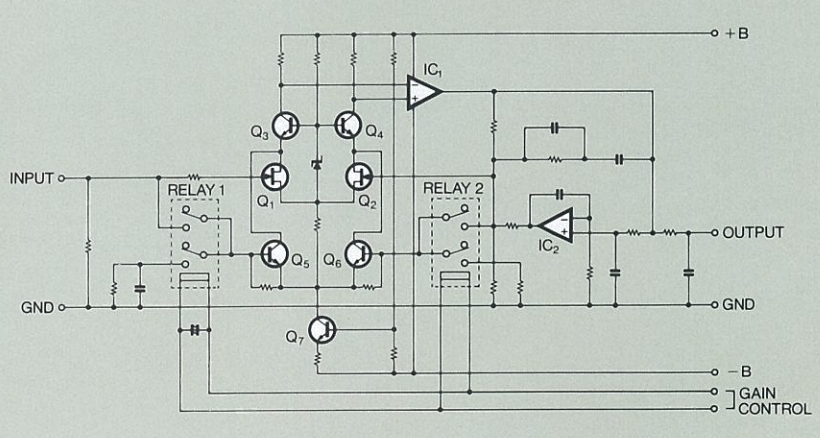
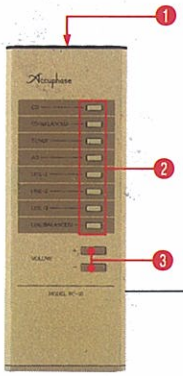


Fig. 3 Circuit Diagram of the Equalizer Amplifier

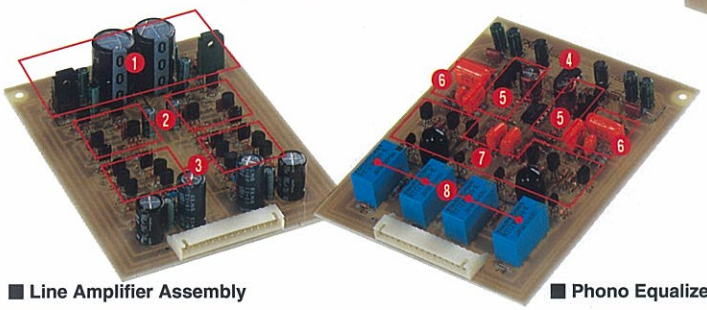


■ Remote Commander RC-10

1. LED transmiting section
2. Input selector keys
3. Volume control keys

■ Power Amplifier Unit (one channel)

1. Class A predrive PNP transistor
2. NPN drive transistor
3. NPN output transistors
4. Input differential complementary push-pull circuitry
5. Output stabilizer DC servo IC
6. Power supply circuitry for input amplifier stage and drive stage
7. Class A predrive NPN transistor
8. PNP drive transistor
9. PNP output transistors



■ Line Amplifier Assembly

1. Low-noise power supply circuitry
2. Single-ended push-pull circuit
3. Input differential complementary push-pull circuitry

■ Phono Equalizer Amplifier Assembly

4. DC servo IC
5. Single-ended push-pull output circuit
6. Equalizing components
7. MM/MC input differential amplifier
8. MM/MC switching relay

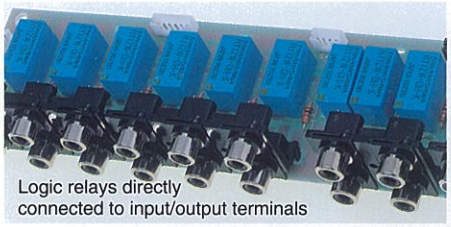
■ Internal layout

1. Left-channel power amplifier unit
2. Power transformer for power amplifier section
3. Large filtering capacitors
4. Right-channel power amplifier unit
5. Power transformer for preamplifier section
6. Preamplifier unit

plated, to minimize the skin effect and assure optimum conductivity. The result is perfectly pure signal transmission, which is essential for impeccable sound.

Highly Reliable Logic-Controlled Relays

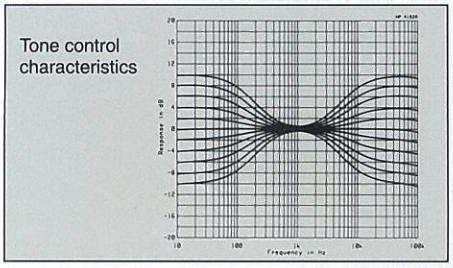
Long signal paths for functions such as input switching and tape monitoring tend to degrade high-frequency response and impair imaging. In the E-406, all switching is performed by relays which are arranged so as to permit the shortest possible signal paths. These relays are controlled electronically by a logic circuit to assure accurate and precise operation. The quality of the relays themselves is of course very important. The units in the E-406 are high-quality types developed specifically for demanding communication applications. They are filled with nitrogen gas and hermetically sealed. The contacts are twin crossbar types plated with gold for minimum contact resistance and outstanding long-term reliability.



Logic relays directly connected to input/output terminals

Summing Active Filter Tone Controls Combine Flexibility with Sonic Purity

Various program sources can differ considerably in their energy distribution over the frequency spectrum. Loudspeaker type and placement are other factors that affect frequency response. Often, a certain amount of compensation provided by tone controls will be highly desirable. However, conventional tone controls tend to degrade sound quality considerably and are therefore often shunned in high-end equipment. The E-406



Tone control characteristics

offers the ideal solution to this dilemma. Accuphase has developed a high-quality tone control circuit using summing active filters of the type found in high-grade graphic equalizers. Fig. 4 shows the operation principle of this circuit. While the flat signal passes without any alteration, F_1 and F_2 provide the required frequency compensation components which are added to or subtracted from the main signal. This creates the desired frequency characteristics without sound quality degradation.

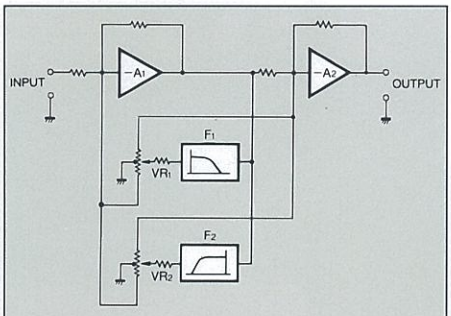
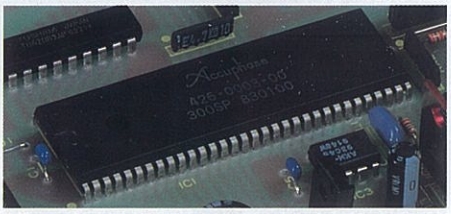


Fig. 4 Principle of the Tone Control Circuit (summing active filter type)

Supplied Remote Commander for Input Source Switching and Volume Adjustment

With equipment such as CD players and video recorders, remote control is now almost taken for granted. The E-406 provides similar convenience, but with special regard to sound quality, because for Accuphase it would not do to sacrifice sonic purity for convenience. As the inputs of the preamplifier are switched using electronically controlled relays, operation of the logic circuits via the remote commander has no influence at all on sound quality. The volume control of the E-406 is a high-quality type with low-distortion resistor elements and a stationary contact brush. A motor and gear assembly have been added to drive the control. The motor is magnetically shielded with silicon steel, to prevent any possibility of interference.

The switch timing for input source selection is controlled with millisecond-precision by a microprocessor. Switching noise is therefore totally absent. The remote commander is made of extruded aluminum with a gold finish that complements the refined styling of the amplifier itself.



Microcomputers for controlling the timing of switching

Versatile Input Configuration Including Balanced Inputs

The input selector provides eight positions, plus facilities for connection of two tape

Balanced input with XLR connectors

recorders. Two balanced inputs (CD and LINE) are included. The principle of balanced signal transmission is shown in Fig. 5. At the source component, the signal is converted into a positive and negative signal with identical voltage potential but phase-inverted by 180 degrees. The receiving equipment feeds the two signals to a [+] amplifier and a [–] amplifier and mixes their output. As any noise which was picked up by the connecting cable etc. has the same phase in both lines, it is cancelled by the mixing process, ensuring noise-free signal transmission with optimum sonic purity.

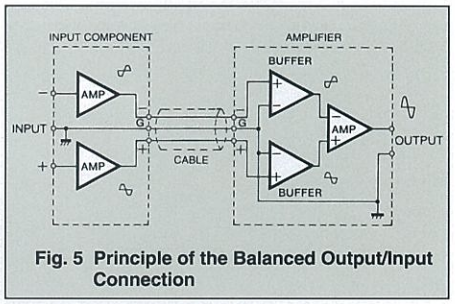


Fig. 5 Principle of the Balanced Output/Input Connection

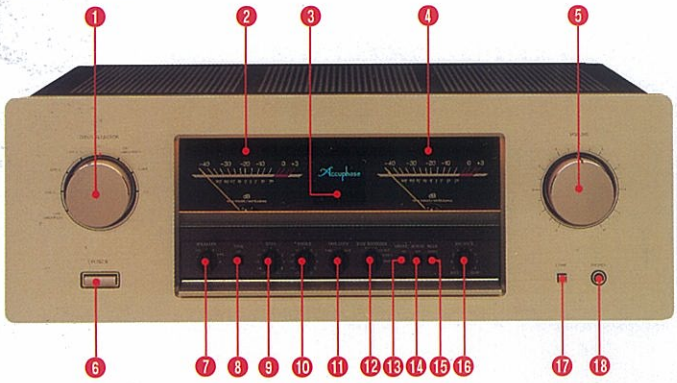
Dedicated Headphone Amplifier for Great Sound

Headphone listening is another aspect of integrated amplifier performance that is all too often overlooked. Not so in the case of the E-406. Its headphone output is driven by a dedicated amplifier designed with optimum sonic performance in mind. Simply turn the loudspeakers off with the speaker selector and adjust the headphone listening level with the main volume control.

Provisions for Independent Use of Preamplifier and Power Amplifier

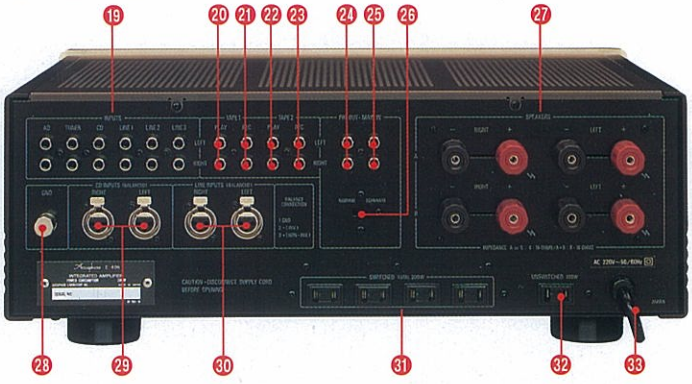
Separate outputs and inputs controlled by a selector switch allow use of the preamplifier section and the power amplifier section as separate components. The jacks can also serve to introduce components such as a graphic equalizer or a sound processor into the signal path. Since the gain of the power amplifier section is the same as that of stand-alone Accuphase power amplifiers (28 dB), integration with other system components is easy and straightforward.

■ FRONT PANEL



1. Input selector: LINE (BALANCED), LINE-3, LINE-2, LINE-1, CD, CD (BALANCED), TUNER, AD
2. Left channel output meter (dB div., wattage direct reading)
3. Remote sensor
4. Right channel output meter
5. Volume control
6. Power switch
7. Speaker selector: OFF, A, B, A+B
8. Tone control ON/OFF switch
9. Bass control
10. Treble control
11. Tape copy switch: 1→2, OFF, 2→1
12. Record output/tape monitor switch: REC OFF, SOURCE, TAPE-1, TAPE-2
13. MM/MC equalizer gain selector switch
14. Subsonic filter
15. Stereo/monophonic selector switch
16. Volume balance control
17. Compensator switch
18. Headphone jack

■ REAR PANEL



19. Input jacks: AD, CD, TUNER, LINE-1, LINE-2, LINE-3
20. TAPE-1 tape input jacks
21. TAPE-1 recording output jacks
22. TAPE-2 tape input jacks
23. TAPE-2 recording output jacks
24. Preamplifier output jacks
25. Power amplifier input jacks
26. Preamplifier/power amplifier separation switch
27. Left and right channel output terminals for speaker systems A and B
28. Ground terminal
29. CD (balanced) input connectors: (1) Ground, (2) Inverted (–), (3) Non-inverted (+)
30. Line (balanced) input connectors
31. Switched AC outlets*
32. Unswitched AC outlet*
33. AC power cable

** These switched and unswitchted AC outlets may not be supplied depending on the safety standards or regulations applicable in the particular country or where the unit is desired.*

GUARANTY SPECIFICATIONS (Guaranty specifications are measured according to EIA standard RS-490.)

enrich life through technology

Performance Guaranty:
All Accuphase product specifications are guaranteed as stated.

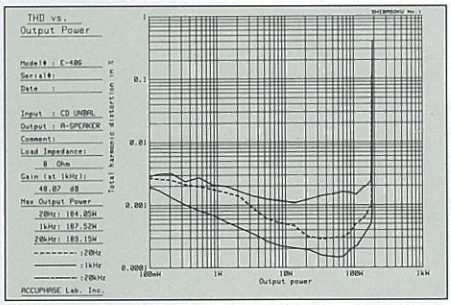
- **Continuous Average Output Power**
  250 watts per channel into 4 ohms
  170 watts per channel into 8 ohms
  (Both channels driven, 20 to 20,000 Hz, THD 0.02%)
- **Total Harmonic Distortion**
  0.02% with 4 to 16 ohms load
  (both channels driven, from 0.25 watts to rated continuous average output, 20 to 20,000 Hz)
- **Intermodulation Distortion**
  0.01%
- **Frequency Response**
  MAIN AMP INPUT: 20 to 20,000 Hz, +0, –0.2 dB (for rated output)
  2 to 150,000 Hz, +0, –3.0 dB (for 1 watt output)
  HIGH LEVEL INPUT: 20 to 20,000 Hz, +0, –0.2 dB (for rated output)
  LOW LEVEL INPUT: 20 to 20,000 Hz, +0.2, –0.5 dB (for rated output)
- **Damping Factor**
  120 (8-ohm load, 50 Hz)
- **Maximum AD Input Level (1kHz, THD 0.005% (REC OUT))**
  MM INPUT: 300 mV rms
  MC INPUT: 8.0 mV rms
- **Input Sensitivity and Impedance**

Input terminal	Sensitivity		Input Impedance
	Rated output	EIA (1W output)	
AD INPUT (MC)	0.15mV	0.011mV	100 ohms
AD INPUT (MM)	4.65mV	0.35mV	47 kohms
HIGH LEVEL INPUT	147mV	11.2mV	20 kohms
BALANCED INPUT	147mV	11.2mV	40 kohms
MAIN AMP INPUT	1.47V	112mV	20 kohms

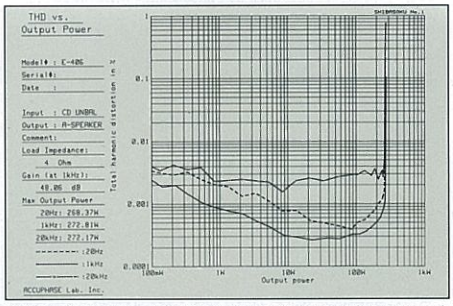
- **Rated Output Level and Impedance**
  PRE OUTPUT 1.47 V at 50 ohms
  TAPE REC OUTPUT 125 mV at 200 ohms
  (from AD input)
- **Gain**
  MAIN INPUT → OUTPUT: 28 dB
  HIGH LEVEL INPUT → PRE OUT: 20 dB
  AD INPUT (MM) → TAPE REC OUTPUT: 30 dB
  AD INPUT (MC) → TAPE REC OUTPUT: 60 dB
- **Tone Controls**
  Turnover frequency and adjustment range
  BASS: 300 Hz ±10 dB (50 Hz)
  TREBLE: 3 kHz ±10 dB (20 kHz)
- **Loudness Compensator Characteristics**
  +6 dB (100 Hz) (Volume control setting –30 dB)
- **Signal-to-Noise Ratio**

Input terminal	Input short circuit A-weighted		EIA S/N
	S/N ratio with rated input	Input-converted noise	
MAIN INPUT	130 dB	–127dBV	108 dB
HIGH LEVEL INPUT	113 dB	–130dBV	84 dB
BALANCED INPUT	90 dB	–108dBV	84 dB
AD INPUT (MM)	90 dB	–137dBV	80 dB
AD INPUT (MC)	75 dB	–151dBV	80 dB

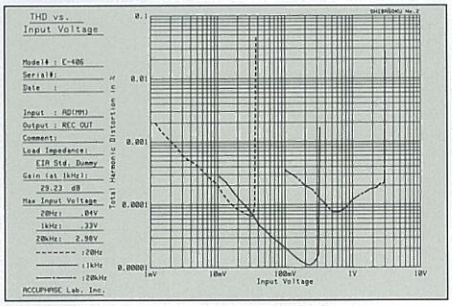
- **Subsonic Filter Characteristics**
  Cutoff frequency: 17 Hz, –12 dB/octave.
- **Power Level Meters**
  Logarithmic compression, peak reading meters, dB and direct watt-reading (8-ohm load) scale
- **Output Load Impedance** 4 to 16 ohms
- **Stereo Headphones**
  Suitable impedance: 4 to 100 ohms



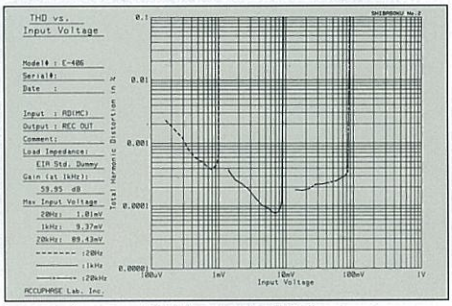
Output power vs. total harmonic distortion (at 8 ohms)



Output power vs. total harmonic distortion (at 4 ohms)



Input voltage vs. total harmonic distorion (input: MM; output: tape output terminal)



Input voltage vs. total harmonic distorion (input: MC; output: tape output terminal)

- **Power Requirements**
  100V, 120V, 220V, 230V, 240V (Voltage as indicated on rear panel) AC, 50/60 Hz
- **Power Consumption**
  65 watts at zero signal input
  390 watts in accordance with IEC-65
- **Maximum Dimensions**
  475 mm (18-23/32 inches) width, 180 mm (7-1/12 inches) height, 423 mm (16-21/32 inches) depth
- **Weight** 28.0 kg (61.7 lbs.) net
  33.0 kg (72.7 lbs.) in shipping carton

- **Supplied Remote Commander RC-10**
  Remote control principle: infrared pulse
  Power supply: 3V DC (IEC R03 batteries (size AAA) x 2)
  Dimensions: 66 mm (2-19/32 inches) width, 175 mm (6-7/8 inches) height, 20 mm (25/32 inches) depth
  Weight: 190g (0.42 lbs.) (including batteries)

※Specifications and design subject to change without notice for improvements.

Accuphase
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