

Audio . . .

CONSOLES OF INTEGRITY



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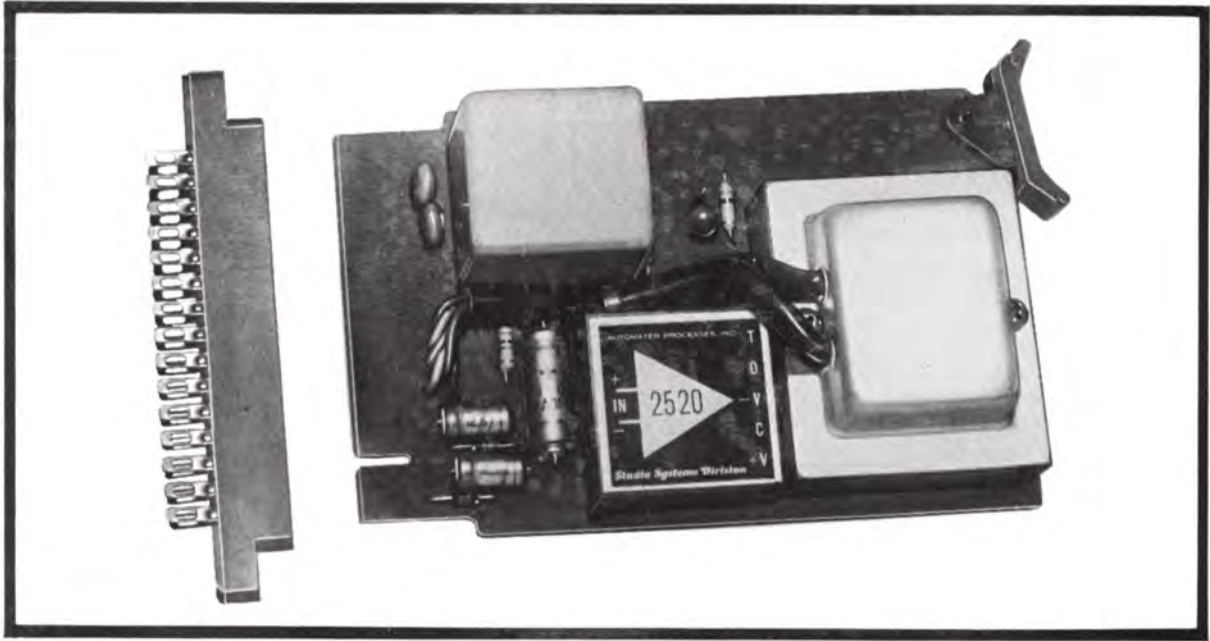
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. . . The Innovators

Preamplifier

MODEL 312



Features:

- Transformer coupled input—150 ohm and 600 ohm Bridging
- Two transformer coupled outputs
- Gain externally adjustable (15 to 65 dB)
- Low noise and distortion
- High output (+30 dBm)
- Reverse polarity and overload protected
- Small interchangeable plug-in card
- Utilizes the Model 2520 Audio Operational Amplifier

Description:

The Model 312 is a plug-in PC card preamplifier having extremely low noise and distortion characteristics. Its power handling capability insures freedom from overload with today's high output microphones. Because of the high input acceptance level, the unit is also ideal as a line or booster amplifier. The Model 312 makes use of Automated Processes' 2520 Operational Amplifier as its active element and therefore exhibits the reliability, long life and uniformity which are characteristic of this device.

Gain of the Model 312 may be accurately adjusted through a 40 dB range to a maximum of 65 dB by the use of an appropriate fixed resistor on the external connector, or made variable within this range by the use of a potentiometer. By means of transformer connections, gain

may be reduced to 15 dB. Optimum signal to noise ratio and low distortion characteristics are maintained independent of gain settings within the ratings of the amplifier. Since all input and output impedance connections as well as gain selection are accomplished on an external connector, all Model 312 amplifiers in a system are completely interchangeable.

The output transformer of the Model 312 is of unique design and contains two independent secondary windings. The first winding, which is centertapped, provides greater than +26 dBm into 600 ohms. An output in excess of +22 dBm is simultaneously available from the second winding. Continuous undistorted power output capability of +30 dBm into 600 ohms is provided by strapping both secondary windings in series at the connector. The unit is short circuit protected and cannot be damaged by input or output overloads.

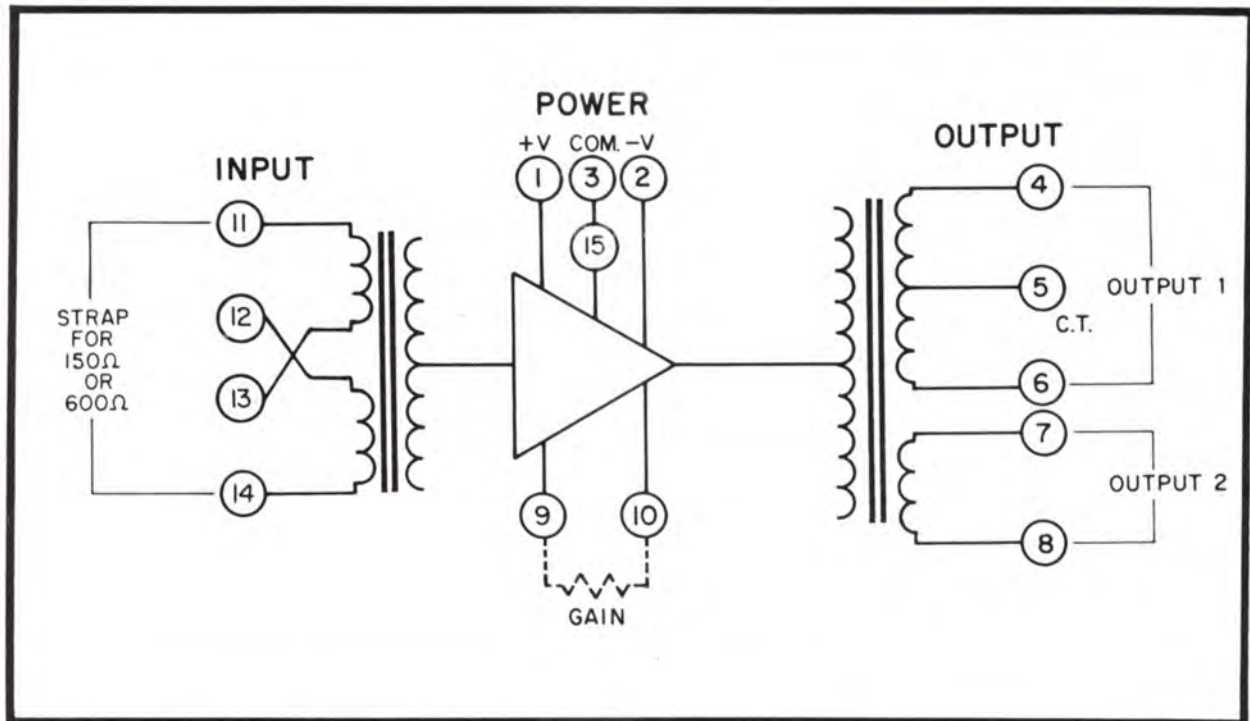
The Model 312 operates from a bipolar power supply of from ± 12 to ± 20 volts permitting great latitude in system design and assurance of stability under normal operating conditions. It is reverse polarity protected and will withstand transients as high as ± 30 volts preventing damage from power line surges and power supply malfunctions. Tightly regulated supplies are therefore not required. Power decoupling is also provided to prevent signal coupling in the power supply lines.

Up to eleven amplifiers can be mounted in Card Frame Model 411, which is 3½" high, 6" deep, and 19" wide. Five amplifiers can be mounted in Card Frame Model 405, which is 3½" high, 6" deep and 10" wide.

The Model 312 is supplied with mating connector and is equipped with a color coded card extractor handle.



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Specifications (600 ohm load unless otherwise specified)

Applications:	Microphone Preamplifier, Line Amplifier, Booster Amplifier	Output Impedance:	Less than 45 ohms (output 1) Less than 15 ohms (output 2) Less than 85 ohms (2 windings in series)
Gain:	Externally adjustable on mating connector from 15 dB to 65 dB.	Overload Protection:	Current limited; protected against overload or short circuit under any output or input condition.
Frequency Response:	± 0.5 dB, 30 Hz to 20 KHz at rated output	Overload Recovery:	Instantaneous
Noise:	Equivalent to an input of -129 dBm, 20 Hz to 20 KHz unweighted	Power Requirements:	± 12 V to ± 20 VDC, Bipolar 20 ma at $+4$ dBm output 65 ma at $+30$ dBm output Protected against overvoltage (150%) and polarity reversal.
Distortion	Less than 0.01% THD at $+4$ dBm output, 30 Hz to 20 kHz	Temperature of Environment:	Up to 150° F without derating
± 16V Operation:	Less than 0.05% THD at $+18$ dBm output, 20 Hz to 30 kHz	Connector:	Dual 15 pin connector supplied
Clipping Level (3% THD)		Dimensions:	$2\frac{3}{4}$ " high, $4\frac{1}{4}$ " deep, $1\frac{1}{8}$ " wide
± 16V Operation:	$+26$ dBm (output 1 into 600 ohms) $+30$ dBm (both outputs in series)		
Input:	Bridging transformer		
Source Impedance:	150 ohms or 600 ohms		
Input Level:	Signal amplitude as high as 0 dBm will produce no more than 0.5% THD, 30 Hz to 20 KHz, within the output ratings of the amplifier.		
Input Impedance:	Greater than 10 times source impedance		
Output:	2 secondary windings which may be used in series or as 2 separate outputs.		

Our staff is fully equipped and stands ready to provide engineering services, from applications assistance to complete system design, and fabrication.

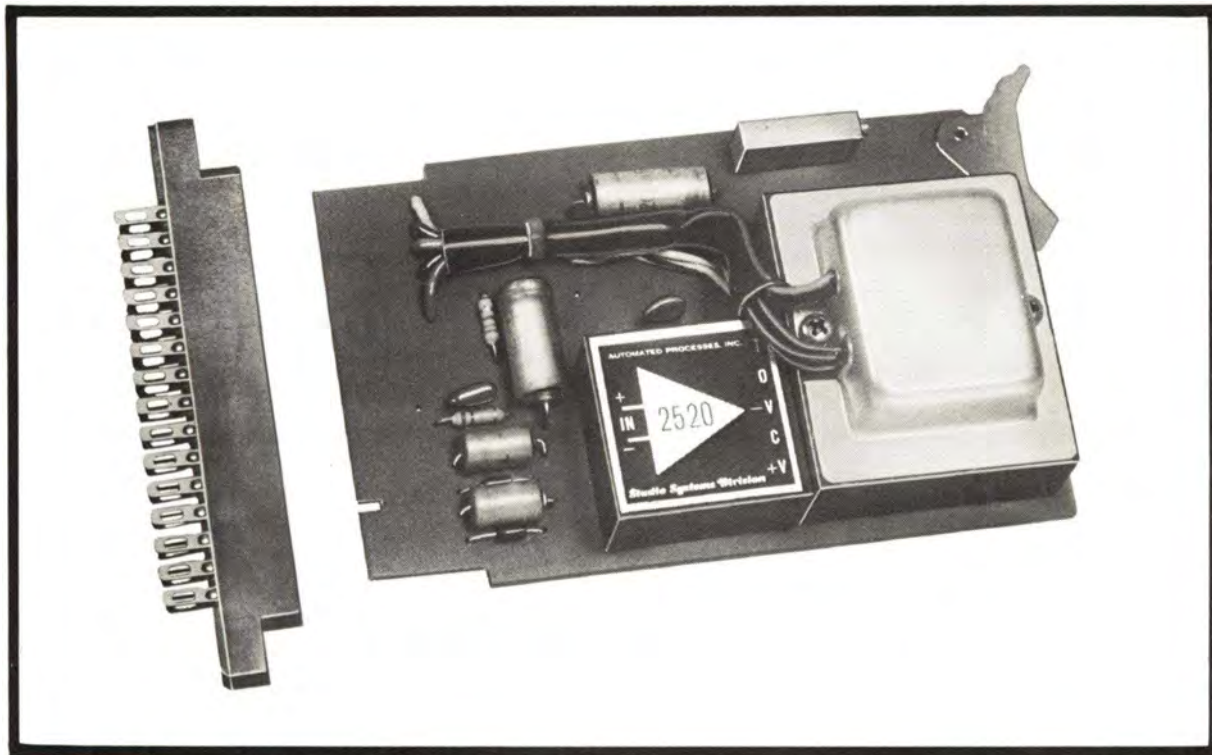
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Phono, Tape, Film Equalized Preamplifier MODEL 330



Features

- Low Noise—Low Distortion
- Transformer Coupled High Level Output
- High Frequency Equalization and Output Level Adjustments
- Small Interchangeable Plug-in Card
- Reverse Polarity and Overload Protected
- Utilizes Automated Processes Model 2520 Audio Operational Amplifier

Description

The Model 330 series of equalized preamplifiers is designed to provide proper playback response curves according to RIAA disc standards (330P), NARTB 7½, 15 ips tape standards (330T), and SMPTE 16, 35mm film standards (330F). All Model 330 preamplifiers are on identical size PC cards, all have centertapped output transformers and all have sufficient gain to provide a +6 dBm output level when fed with the standard reference levels through appropriate and conventional magnetic tape heads or phonograph cartridges.

Each unit provides an easily accessible trimmer ad-

justment of the high frequency end of the curve to compensate for differences between individual tape heads, head wear, or variations in phono cartridges.

In the Model 330F, both 16mm and 35mm equalizations are provided and are selectable by means of an external switch which may be wired to the connector. If only one equalization is required, a permanent jumper wire can be installed in place of the switch. In this model there are two high frequency trimmers so that each equalization curve may be separately adjusted.

Gain of the Model 330 may be conveniently and accurately adjusted to a maximum of 54 dB by the use of an appropriate fixed resistor on the external connector, or made variable within this range by the use of a potentiometer. Optimum signal to noise ratio and low distortion characteristics are maintained independent of gain settings within the ratings of the amplifier.

The centertapped output transformer of the Model 330 provides continuous undistorted power output of +26 dBm into 600Ω. The unit is short circuit protected and cannot be damaged by input overloads.

The Model 330 operates from a bipolar power supply of from ±12 to ±20 volts permitting great latitude in system design and assurance of stability under normal operating conditions. The amplifiers are reverse polarity protected and will withstand transients as high as ±30



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volts, preventing damage from power line surges and power supply malfunctions. Tightly regulated supplies are therefore not required. Power decoupling is also provided to prevent signal coupling in the power supply lines.

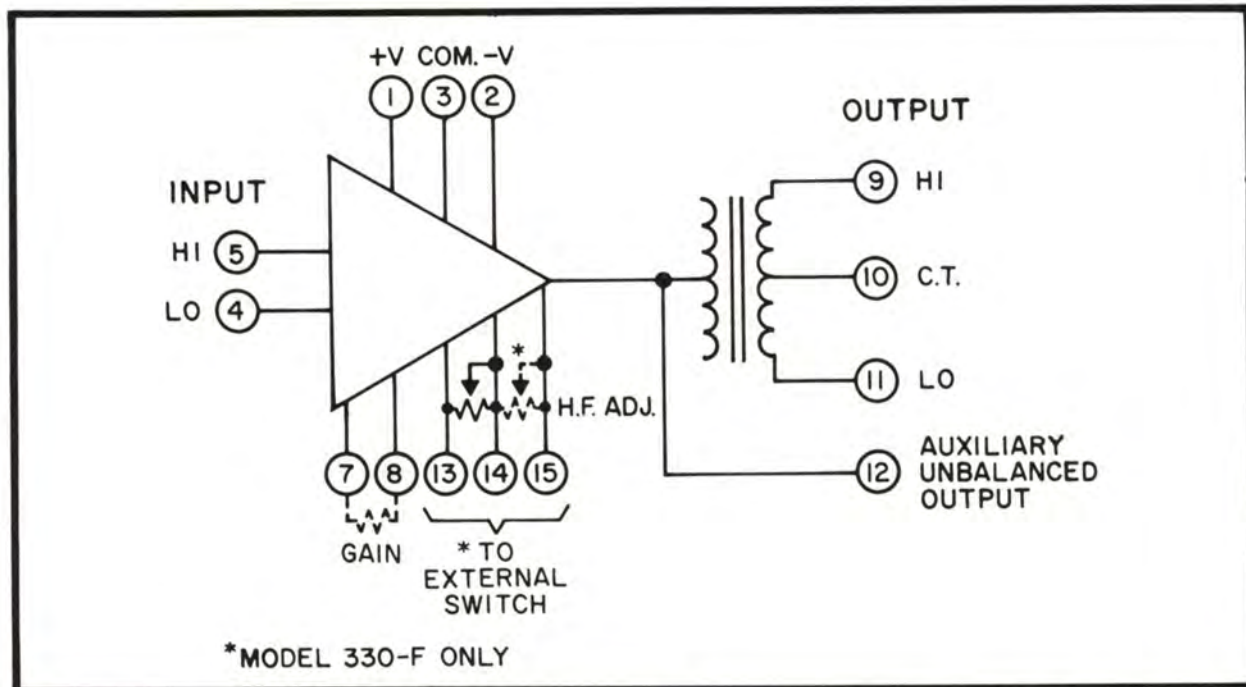
The Model 330 makes use of Automated Processes 2520 operational amplifier as its active element and therefore exhibits the reliability, long life and uniformity which are characteristic of this device.

Up to eleven amplifiers can be mounted in Model 411

Card Frame, which is 3½" high, 6" deep and 19" wide. Five amplifiers can be mounted in Model 405 Card Frame, which is 3½" high, 6" deep and 10" wide.

The Model 330 is supplied with mating connector and is equipped with a color coded card extractor handle.

The series of Model 330 Preamplifiers are ideal links between program sources and the main body of a professional audio system. The 330 series along with the Model 312 Microphone Preamplifier provides total, consistent, extremely high quality input capability.



Specifications

Applications: 330P: Phono Preamplifier — RIAA curve
 330T: Tape Playback Preamplifier NARTB 7½ and 15 ips curve
 330F: 35 and 16mm Magnetic film playback preamplifier SMPTE curves

Gain: 330P: Max. 54 dB (externally adjustable on connector)
 330T: Max. 52 dB (externally adjustable on connector)
 330F: Max. 50 dB (externally adjustable on connector)

Sensitivity: 330P: 1.4 mv at 1 kHz produces 0 dBm output
 330T: 2.3 mv at 700 Hz produces 0 dBm output
 330F: 2.8 mv at 1 kHz produces 0 dBm output

Frequency Response: ±1 dB of specified curve at rated output

Distortion: Less than 0.01% THD, 30 Hz to 20 kHz @ 4 dBm output
 Less than .05% THD, 30 Hz to 20Hz @ 18 dBm output

Noise: -75 dBm, Maximum Gain

Clipping Level (3% THD)
 ±16V Operation: +26 dBm

Signal Source: 330P: Less than 500 mhy
 330J: Less than 800 mhy
 330F: Less than 800 mhy

Input Impedance: 330P: 51 kΩ
 330T: 330 kΩ
 330F: 330 kΩ

Output: Center-tapped Transformer

Output Impedance: 55 Ω

Power Requirements: ±15V to ±20V D.C. Bipolar, 20 mA

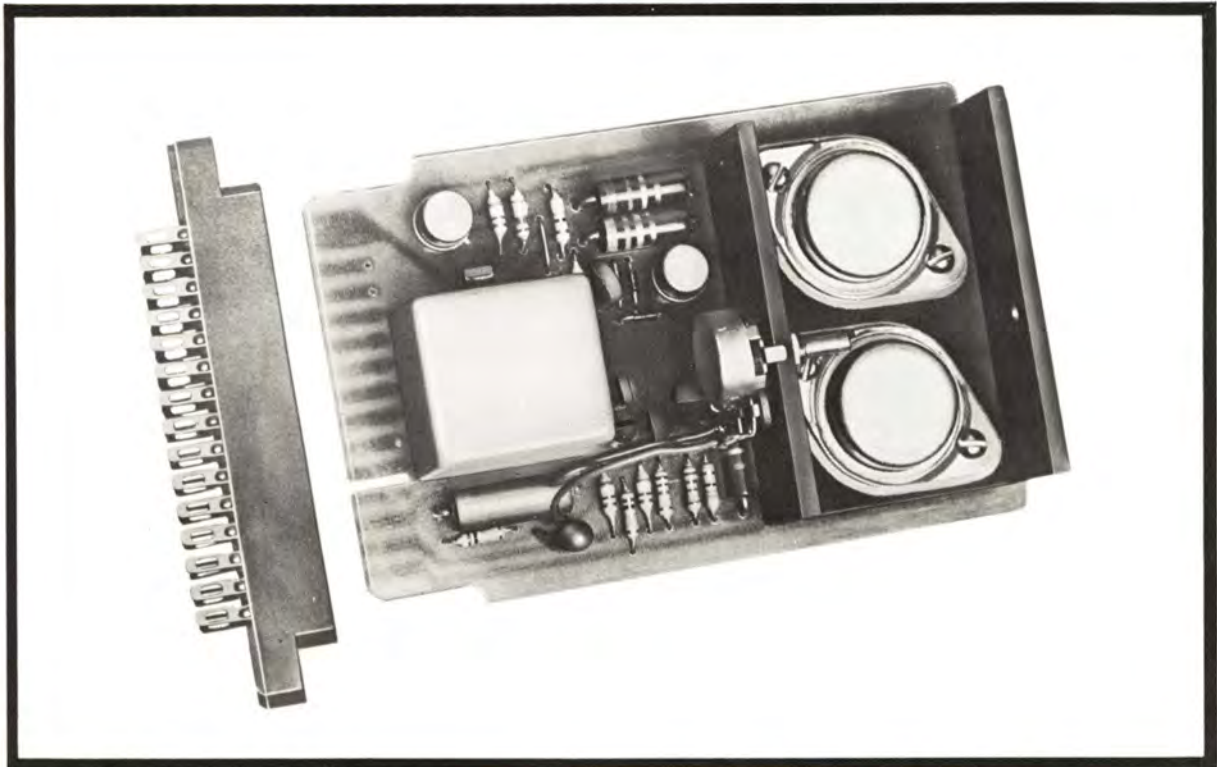
Dimensions: 2¾" high, 4¼" deep, 1¾" wide

Our staff is fully equipped and stands ready to provide engineering services, from applications assistance to complete system design, and fabrication.



10 Watt Power Amplifier

MODEL 701



Features

- Small Size
- Fail Safe Design
- Low Noise
- Transformer Isolated Input
- Instant Overload Recovery
- Integral Level Control

Description

The Model 701 is a virtually burn out proof, miniature, power amplifier for driving headphones, small speaker systems or other devices.

Conservative design permits the amplifier to operate continuously at 10 watts rms sinewave at any audio frequency. A dynamic power limiting circuit monitors the power being delivered and automatically and instantaneously controls both current and voltage, thus providing complete protection and instant recovery from overload. This instant

recovery permits much higher average power output by reducing the objectionable peak overload distortion usually found in transistor amplifiers.

The Model 701 operates from a bipolar power supply of ± 16 volts to deliver its full rated power. Up to eleven Model 701's can be mounted in the standard Automated Processes Model 411 Card Frame. Five Model 701 amplifiers can be mounted in the Model 405 Card Frame.

Specifications

Power Output: 10 watts 4Ω , 8 watts 8Ω at ± 16 VDC
12.5 watts 4Ω , 15 watts 8Ω at ± 24 VDC

Distortion: Less than 0.3% T.H.D. 20 Hz to 20kHz

Frequency Response: 30 to 20kHz ± 0.3 dB

Hum and Noise: 110dB below full output

Input Voltage: 0.75 Volts for full output

Input Impedance: $16k\Omega$ (Transformer Isolated)

Power Requirement: ± 16 Volts to ± 24 VDC 800mA Max.

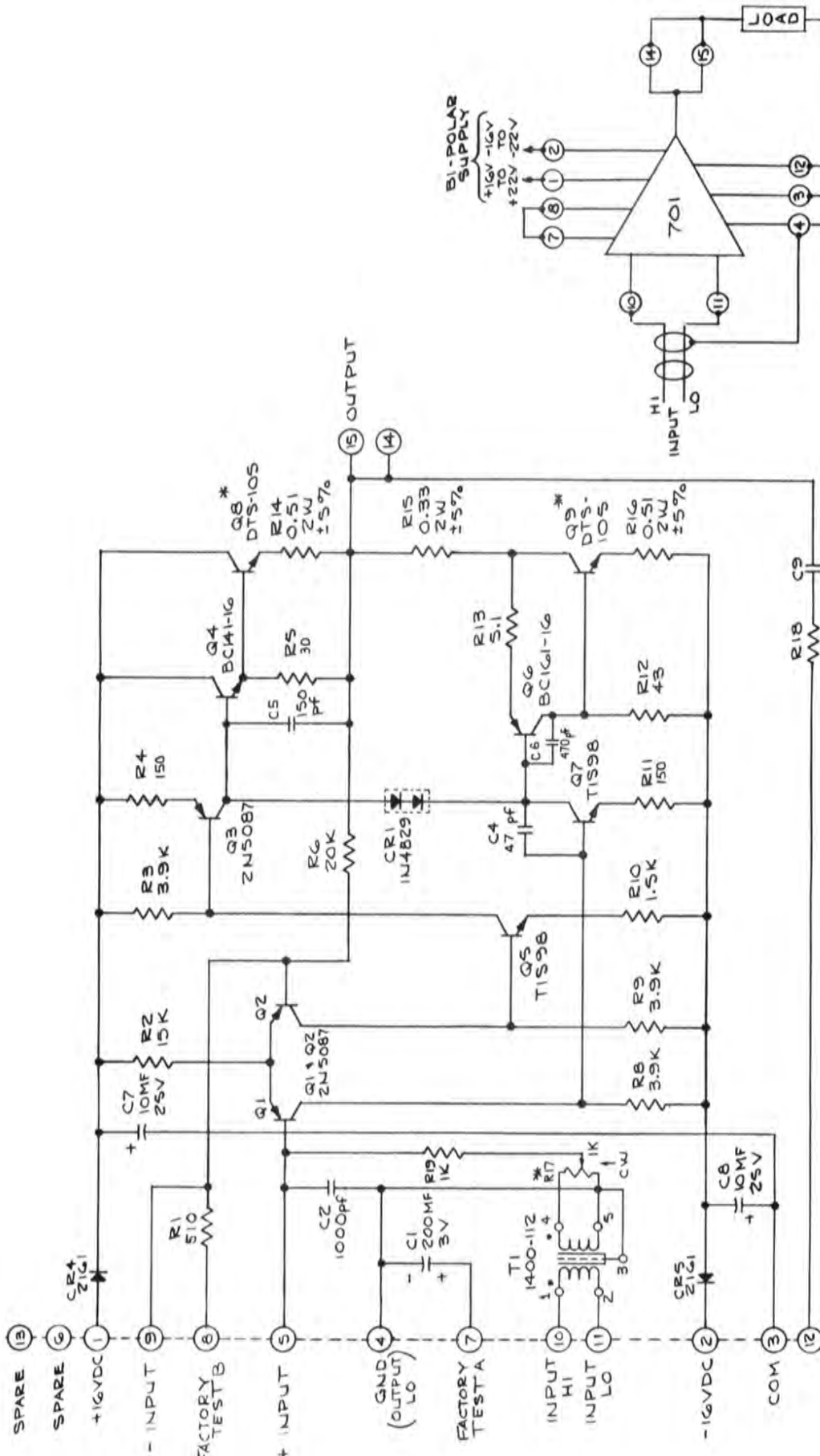
Dimensions: $2\frac{3}{4}$ " high, $4\frac{1}{4}$ " deep, $1\frac{1}{4}$ " wide

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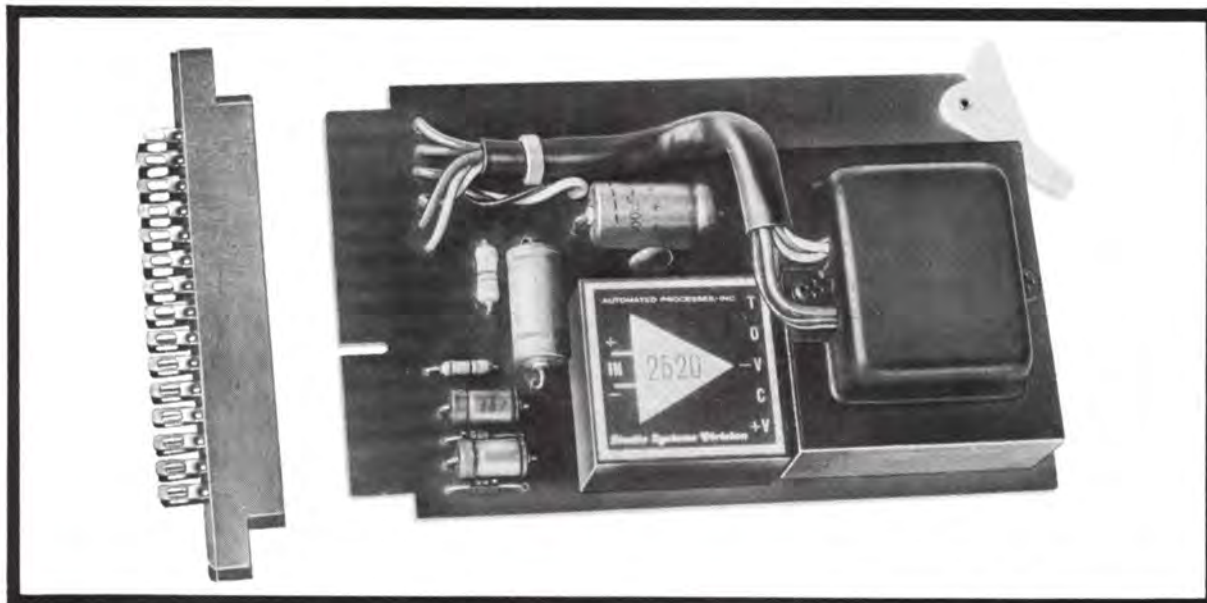
NOTE:
 1. UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS, 1/4 W, ±5%.
 * 2. TRANSISTORS Q8 & Q9 & POT R17 ARE LOCATED ON HEATSINK.

BI-POLAR SUPPLY
 +16V -16V TO TO
 +22V -22V

±16V TO ±22V
 D.C. COMMON
 ♣ CHASSIS GND.

CONNECTION DIAGRAM

Line, Booster, or Combining Amplifier MODEL 325



Features

- Bridging or combining function input.
- Three transformer coupled outputs.
- Gain externally adjustable.
- Low noise and distortion.
- High output (+30 dBm).
- Reverse polarity and overload protected.
- Small interchangeable plug-in card
- Utilizes the Model 2520 Audio Operational Amplifier.

Description

The Model 325 is unique in its design as a bridging amplifier and a differential active combining network with transformer coupled output.

All of the connections for the two modes of operation are accomplished at the external connecting socket. A companion terminal board containing a precision summing network is also available.

The Model 325 makes use of Automated Processes' 2520 operational amplifier as its active element and therefore exhibits the reliability, long life and uniformity which are characteristic of this device.

Gain of the Model 325 may be conveniently and accurately adjusted through a 40 dB range to a maximum of 49 dB by the use of an appropriate fixed resistor on the external connector, or made variable within this range by the use of a potentiometer. By means of transformer connections, gain may be reduced to unity. Optimum signal to noise ratio and low distortion characteristics

are maintained independent of gain settings within the ratings of the amplifier. Since mode of operation, choice of impedance, and gain selection are accomplished on an external connector, all Model 325 amplifiers in a system are completely interchangeable.

The output transformer of the Model 325 is of unique design and contains three independent secondary windings. Each winding is capable of simultaneous outputs in excess of +20 dBm into 600 ohms. Continuous undistorted power output of +30 dBm into 600 ohms is available by strapping all three secondary windings in series at the connector. The unit is short circuit protected and cannot be damaged by input overloads. The Model 425 companion Summing Network gives complete freedom of choice as to number of inputs to be summed up to 22, with gain set between unity and 20 dB.

The Model 325 operates from a bipolar power supply of from ± 12 to ± 20 volts permitting great latitude in system design and assurance of stability under normal operating conditions.

It is reverse polarity protected and will withstand transients as high as ± 30 volts preventing damage from power line surges and power supply malfunctions. Tightly regulated supplies are therefore not required. Power decoupling is also provided to prevent signal coupling in the power supply lines.

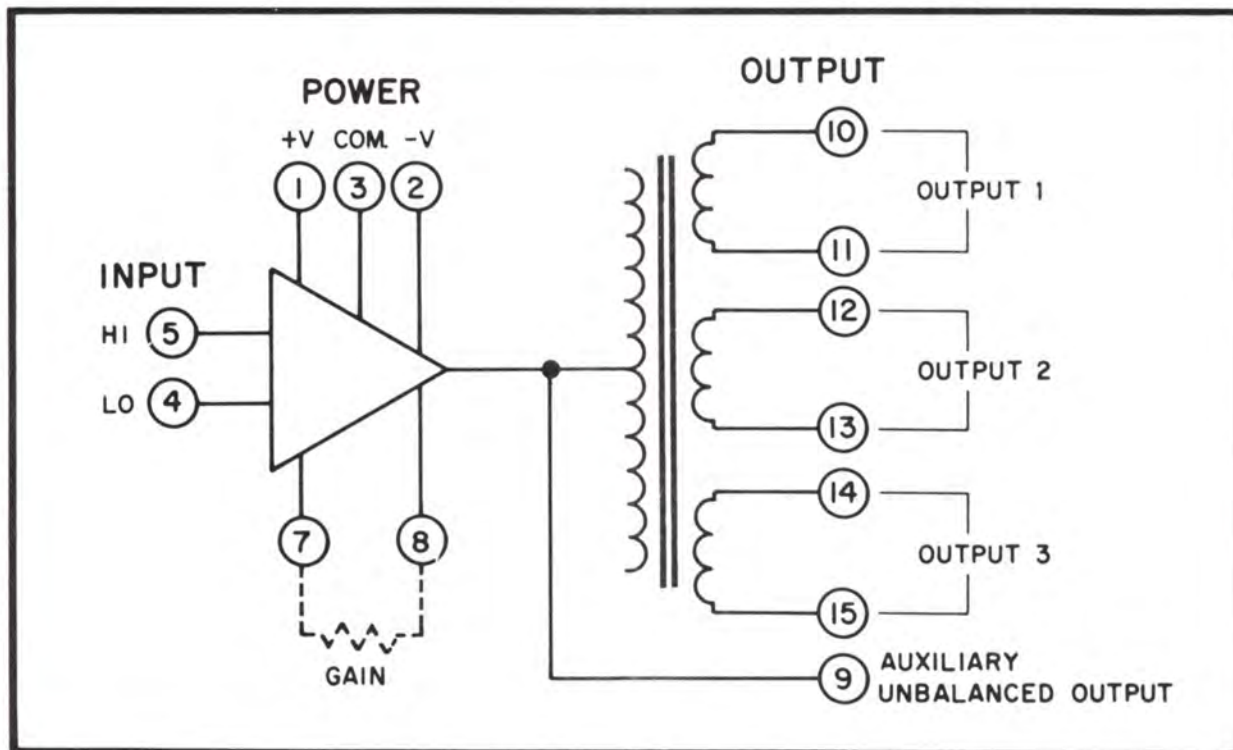
Up to eleven amplifiers can be mounted in Model 411 Card Frame, which is $3\frac{1}{2}$ " high, 6" deep, and 19" wide. Five amplifiers can be mounted in Model 405 Card Frame, which is $3\frac{1}{2}$ " high, 6" deep and 10" wide.

The Model 425 Summing Network mounts between adjacent amplifiers in either card frame and therefore does not require additional space.

The Model 325 is supplied with mating connector and is equipped with a color coded card extractor handle.



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Specifications (600 ohm load unless otherwise specified)

Applications: Line Amplifier, Booster Amplifier, Lossless Combining Network, Differential Amplifier, Headphone or Cue Amplifier.

Gain: Externally adjustable on mating connector from unity to 49 dB.

Frequency Response: ± 0.25 dB, 30 Hz to 20 KHz at rated output

Distortion Less than 0.01% THD at +4 dBm output, 30 Hz to 20 kHz
 $\pm 16V$ Operation: Less than 0.05% THD at +18 dBm output, 20 Hz to 30 kHz

Clipping Level (3% THD) +22 dBm (3 simultaneous outputs into 600 ohms)
 $\pm 16V$ Operation: +30 dBm (3 outputs in series)

Noise: Equivalent to an input of -125 dBm, 20 Hz to 20 KHz unweighted

Input Impedance: 12,000 ohms

Output: 3 identical secondary windings which may be used as 3 separate outputs, or in any series or any parallel combination.

Output Impedance: Less than 15 ohms (each output)
 Less than 85 ohms (3 windings in series)

Overload Protection: Current limited; protected against overload or short circuit under any output or input condition.

Overload Recovery: Instantaneous.

Power Requirements: $\pm 12V$ to $\pm 20V$ DC Bipolar
 20 ma at +4 dBm output
 65 ma at +30 dBm output
 Protected against overvoltage (150%) and polarity reversal.

Temperature of Environment: Up to 150°F without derating

Connector: Dual 15 pin connector supplied (15 spare terminals)

Dimensions: 2 $\frac{3}{4}$ " high, 4 $\frac{1}{4}$ " deep, 1 $\frac{1}{8}$ " wide.

Our staff is fully equipped and stands ready to provide engineering services, from applications assistance to complete system design, and fabrication.

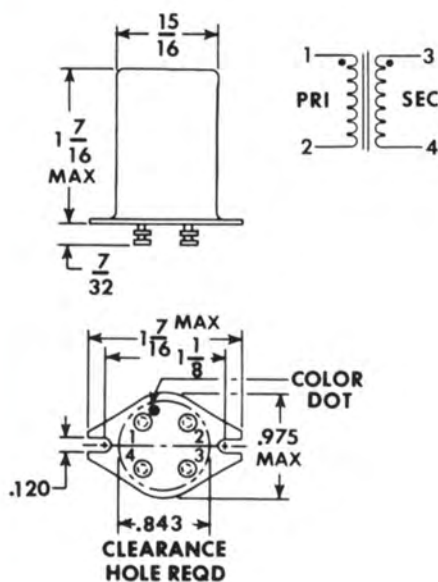


AUDIO TRANSFORMERS

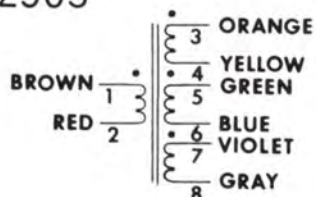
MODEL NO.	APPLICATION	PRIMARY IMPEDANCE	SECONDARY IMPEDANCE	FREQUENCY RESPONSE	MAXIMUM LEVEL	NOTES
AP2164	Input (Bridging)	10,000 Ω	600 Ω	20 to 30kHz ± 0.3 dB	+20dBm	
AP2503-1 AP2503-2	Output (Amplifier to Line)	75 Ω	75 Ω (1:1)* 300 Ω (1:2)* 600 Ω (1:3)*	30 to 20kHz ± 0.5 dB	+30dBm	Electrically identical, transformers differ only in mechanical details
AP2622	Input (Mic Preamp)	150/600 Ω	10,000 Ω	30 to 20kHz ± 0.5 dB	0dBm	
AP2623-1 AP2623-2 AP2623-3 AP2623-4	Output (Amplifier to Line)	75 Ω	75 Ω (1:1)* 300 Ω (1:2)*	30 to 20kHz ± 0.5 dB	+30dBm	Electrically identical, transformers differ only in mechanical details

*Minimum Load Impedances

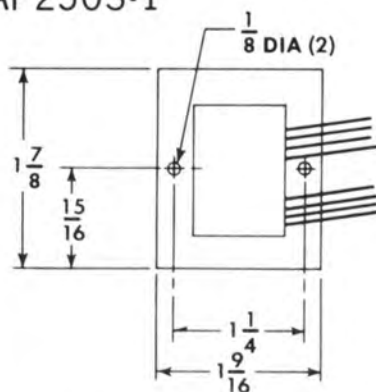
AP2164



AP2503

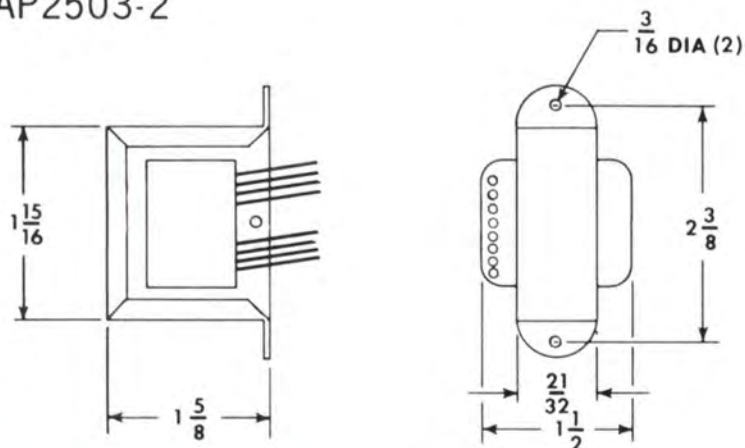


AP2503-1



(SHIELD NOT SHOWN)

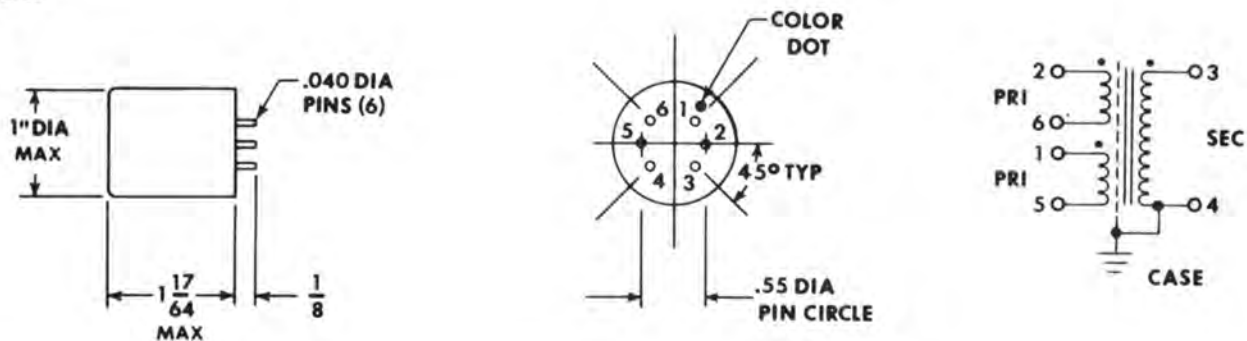
AP2503-2



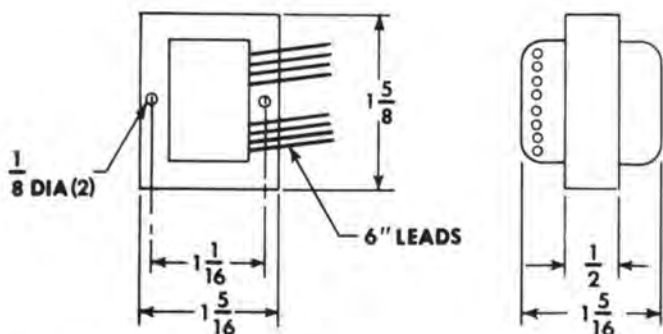
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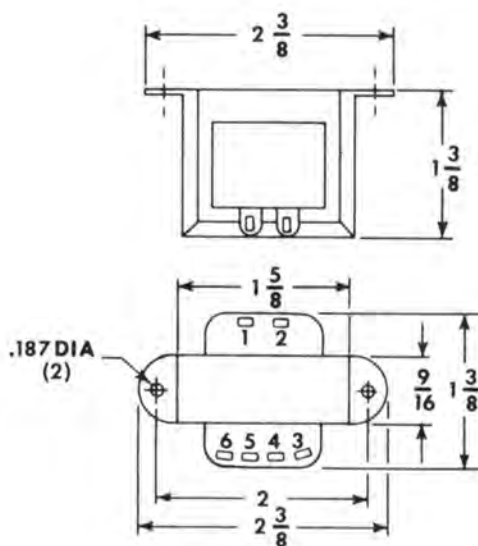
AP2622



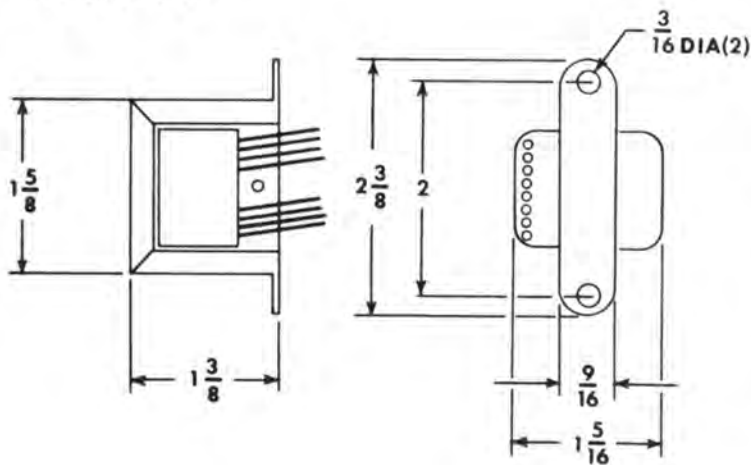
AP2623-1



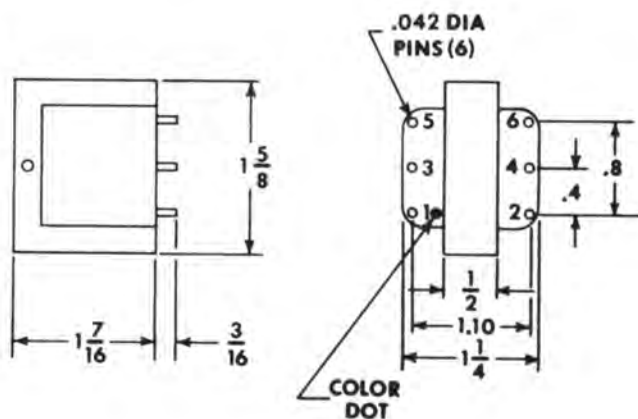
AP2623-3



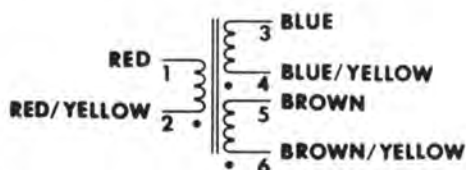
AP2623-2



AP2623-4

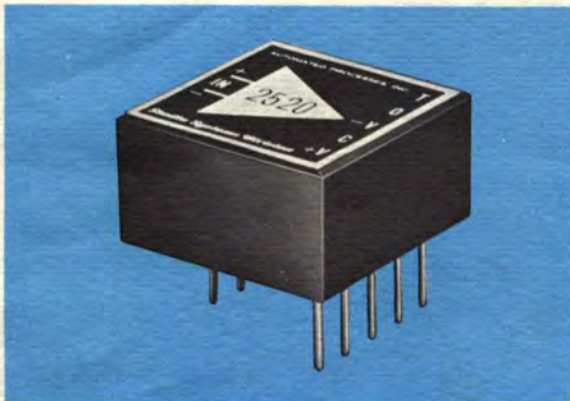


AP2623



Audio Operational Amplifier

MODEL 2520



Features

- Extremely low noise
- High output power
- Operation under a wide range of supply voltages
- Low quiescent current
- Low distortion
- Wide power bandwidth
- Standard OP-AMP connections (Plug-in or P.C. mount)
- Stable operating characteristics
- Electrostatically shielded
- Short-Circuit and overload protected

Applications

- Microphone Preamplifiers
- Line or Booster Amplifiers
- Lossless Combining Amplifiers
- Balanced Transformerless Amplifiers
- Equalizers and Equalized Preamplifiers
- Earphone or Small Speaker Drivers

The Model 2520 is a high gain, wide band, direct coupled amplifier with differential input, designed specifically for audio amplifier applications. Several Operational Amplifier circuits typical of those most often used in the audio field are shown on the following page, along with their characteristics. These circuits have been tested and the data shown has been validated in Automated Processes laboratories.

The virtually perfect performance of the Model 2520 in audio operational amplifier applications makes possible the design of complete systems utilizing this low cost device as the only active element.

Since Operational Amplifier circuits derive their characteristics almost entirely from the performance of the passive elements connected into the feedback loop, accurate, predictable, and stable performance is assured. The use of this single active plug-in element reduces maintenance and service costs to a minimum.

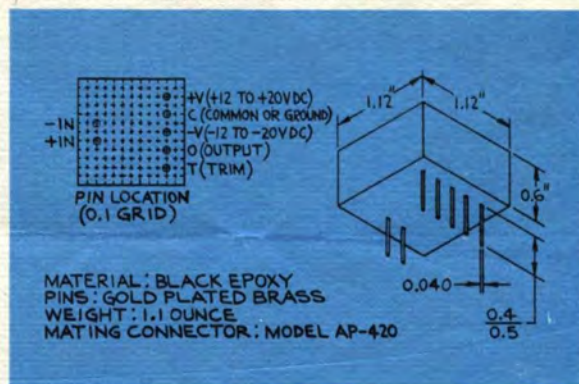
The specially formulated, thermally conductive epoxy in which this nine transistor amplifier is encapsulated, protects the internal circuitry against thermal shocks, vibration and humidity. Conservative design based upon "worst case analysis" plus thorough in-process inspection and performance test after "burn-in" assure long life and reliable performance.

Specifications

Gain:	Greater than 110 dB, DC
Frequency Response:	Small signal Gain Bandwidth Product—50 mHz Full Output Frequency—40 kHz
Equivalent Input Noise:	Less than 0.5 microvolts
Input Impedance:	Greater than 10 megohms, DC
Input Current Offset:	25 nA Typ.; 75 nA Max.
Input Voltage Offset:*	4 mV Typ.; 10 mV Max.
Common Mode Input:	±12 Volts with ±15 VDC supply ±15 Volts with ±20 VDC supply
Distortion:	0.2% THD, 20 to 20,000 Hz at rated output
Output Voltage:	Greater than 7.75 Volts RMS, ±15 VDC supply Greater than 11 Volts RMS, ±20 VDC supply
Minimum Load Impedance:	75Ω for full output voltage
Continuous Power Output: (Minimum Load Impedance)	0.8 Watts RMS @ ±15 VDC supply 1.5 Watts RMS @ ±20 VDC supply
Quiescent Current:	15 Milliamperes @ ±15 VDC supply 26 Milliamperes @ ±20 VDC supply
Current at Rated Output 600Ω Load:	18 Milliamperes @ ±15 VDC supply 32 Milliamperes @ ±20 VDC supply
75Ω Load:	60 Milliamperes @ ±15 VDC supply 85 Milliamperes @ ±20 VDC supply
Power Supply Voltage:	Bi-polar, ±12 VDC to ±20 VDC

*Output offset may be nulled to zero by means of a 100 kΩ trim pot between the +V and T terminals. This is normally not necessary in Audio applications.

Our staff is fully equipped and stands ready to provide engineering services, from applications assistance to complete system design, and fabrication.

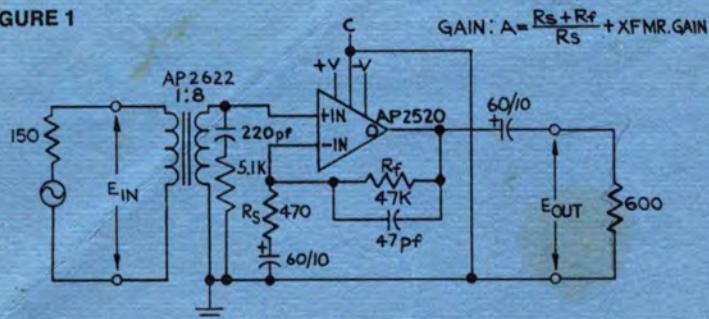


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2520 5M 973

Circuit Specifications

FIGURE 1



MICROPHONE PREAMPLIFIER (GAIN: 58dB)

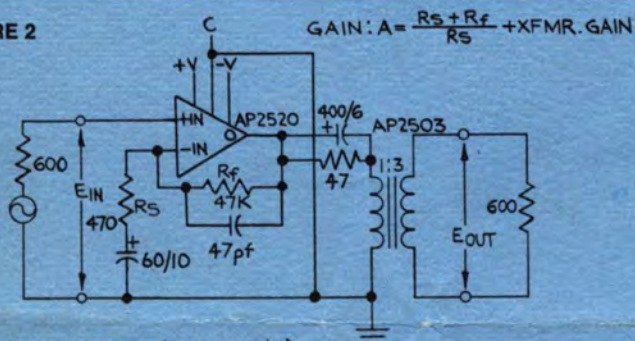
GENERAL (Figures 1-5)

- Load Impedance:** 600Ω
- Frequency Response:** ±0.25 dB, 20 to 20 kHz at rated output power
- Distortion:** Less than 0.2% THD, 20 to 20 kHz at rated output power

MICROPHONE PREAMPLIFIER (Figure 1)

- Gain:** 58 dB
- Equivalent Input Noise:** -129 dBm, 20 to 20 kHz, unweighted
- Input Impedance:** Greater than 1500Ω
- Output Impedance:** Less than 5Ω
- Power Output:** +21 dBm, ±15 VDC supply
+24 dBm, ±20 VDC supply

FIGURE 2

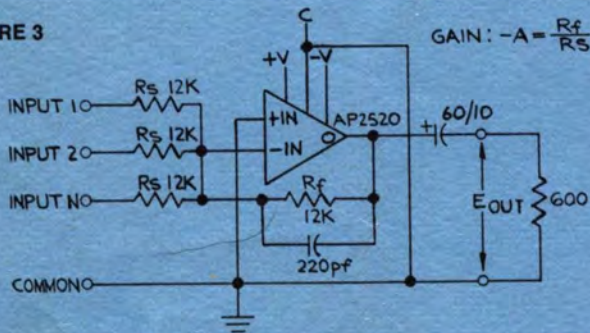


LINE AMPLIFIER (GAIN: 49dB)

LINE AMPLIFIER (Figure 2)

- Gain:** 49 dB
- Equivalent Input Noise:** -125 dBm, 20 to 20 kHz, unweighted
- Input Impedance:** Greater than 2 megohms
- Output Impedance:** Less than 100Ω
- Power Output:** +28 dBm, ±15 VDC supply
+30 dBm, ±20 VDC supply

FIGURE 3



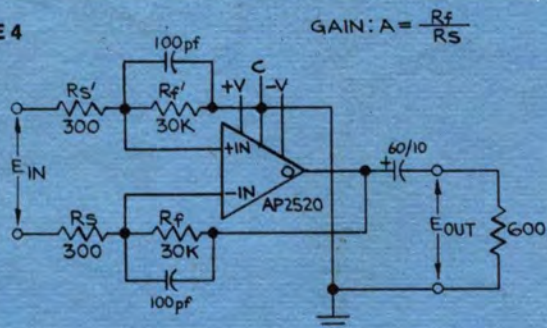
LOSSLESS COMBINING AMPLIFIER (GAIN: 0dB)

LOSSLESS COMBINING AMPLIFIER (Figure 3)

- Gain:** 0 dB
- Maximum Crosstalk:** -100 dB
- Maximum Gain:** 20 dB for 10 inputs
10 dB for 32 inputs
- Equivalent Input Noise:** -105 dBm for 10 inputs
-95 dBm for 32 inputs
- Input Impedance:** 12kΩ
- Output Impedance:** Less than 5Ω
- Power Output:** +21 dBm, ±15 VDC supply
+24 dBm, ±20 VDC supply

Note: This circuit produces a 180° phase reversal. An output transformer of such as that shown in Figure 2 may be used to correct the phase, and can also provide additional gain.

FIGURE 4

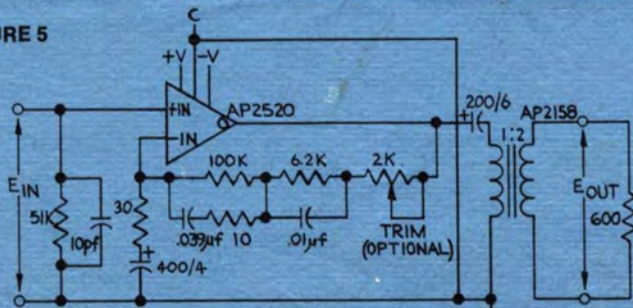


BALANCED TRANSFORMERLESS AMPLIFIER (GAIN: 40dB)

BALANCED TRANSFORMERLESS AMPLIFIER (Figure 4)

- Gain:** 40 dB
- Equivalent Input Noise:** -124 dBm, 20 to 20 kHz, unweighted
- Input Impedance:** 600Ω
- Common Mode Rejection:** Greater than 90 dB (with matched resistors)
- Maximum Common Mode Voltage:** ±8 Volts peak
- Output Impedance:** Less than 2Ω
- Power Output:** +21 dBm ±15 VDC supply
+24 dBm ±20 VDC supply

FIGURE 5



PHONO PREAMPLIFIER (GAIN: 54dB)

PHONO PREAMPLIFIER (Figure 5)

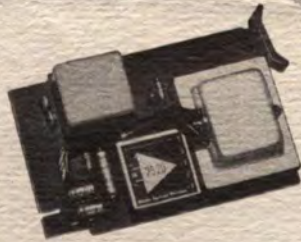
- Equalization:** RIAA
- Gain:** 54 dB (2.5 mV at 1 kHz produces +4 dBm output)
- Input Impedance:** 50kΩ
- Output Impedance:** Less than 100Ω
- Power Output:** +25 dBm ±15 VDC supply
+28 dBm ±20 VDC supply

System Engineered Audio Components



COMPRESSOR-LIMITER Model 525

Push-button selection of Compression, Limiting, De-essing and release time. Single knob 20dB Ceiling Control. Lighted meter. Transformer isolated. Size: 1½" x 5¼" x 6¼" deep.



MICROPHONE PRE-AMPLIFIER—Model 312

Transformer coupled input and output with exceptionally low noise (-129 dBm) and high output power capability with low distortion. Adjustable gain. Utilizes Model 2520 operational amplifier.



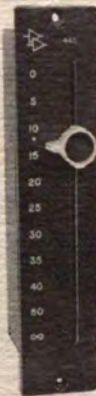
LINE AMPLIFIER—Model 325

Bridging input, low noise. Output power capability greater than +30 dBm. Adjustable gain, transformer coupled output. Can function as line amp, booster amp or "no-loss" combining network. Utilizes Model 2520 operational amplifier.

In both components, the output transformers are unique, permitting simultaneous multiple outputs. Both are PC cards (2¾" x 4½" x 1½") permitting standard modular use. Power supply decoupling and reverse voltage protection are provided.

LINEAR FADER—Model 440

Illuminated scale; infinite resolution; low-noise and long life; multi-gang and cue switch units available. Size: 7" x 1½" x 2¼" deep.



EQUALIZER — Model 550

Concentric High, Mid and Low frequency range switches allow a choice of 11 center frequencies with up to 12 dB boost or cut in each range. Additional switches provide independently selectable low and high frequency bell or shelf curves, band pass filter, and in-out function with indicator light. Output +28 dBm, transformer isolated.

Model 2520 Operational Amplifier sockets, card mounting frames, power supplies and other accessories available.

Our staff is fully equipped and stands ready to provide engineering services, from applications assistance to complete system design and fabrication.



EQUALIZED PREAMPLIFIER Model 330

Models available for RIAA Phono, NAB Tape, and Magnetic Film. Low noise, adjustable gain, high output capability. Equalization adjustable. Film model provides both 16 and 35 mm. curves, externally selectable. Utilizes Model 2520 operational amplifier.

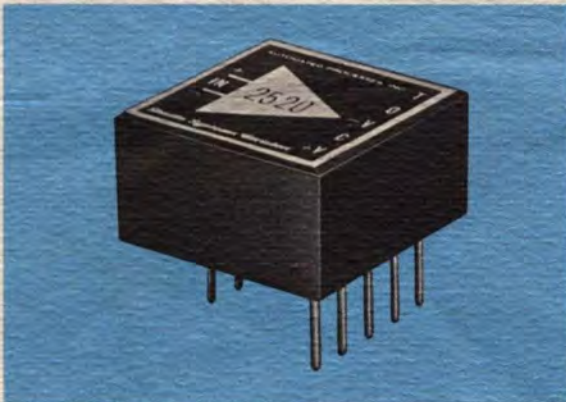
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Audio Operational Amplifier

MODEL 2520



Features

- Extremely low noise
- High output power
- Operation under a wide range of supply voltages
- Low quiescent current
- Low distortion
- Wide power bandwidth
- Standard OP-AMP connections (Plug-in or P.C. mount)
- Stable operating characteristics
- Electrostatically shielded
- Short-Circuit and overload protected

Applications

- Microphone Preamplifiers
- Line or Booster Amplifiers
- Lossless Combining Amplifiers
- Balanced Transformerless Amplifiers
- Equalizers and Equalized Preamplifiers
- Earphone or Small Speaker Drivers

The Model 2520 is a high gain, wide band, direct coupled amplifier with differential input, designed specifically for audio amplifier applications. Several Operational Amplifier circuits typical of those most often used in the audio field are shown on the following page, along with their characteristics. These circuits have been tested and the data shown has been validated in Automated Processes laboratories.

The virtually perfect performance of the Model 2520 in audio operational amplifier applications makes possible the design of complete systems utilizing this low cost device as the only active element.

Since Operational Amplifier circuits derive their characteristics almost entirely from the performance of the passive elements connected into the feedback loop, accurate, predictable, and stable performance is assured. The use of this single active plug-in element reduces maintenance and service costs to a minimum.

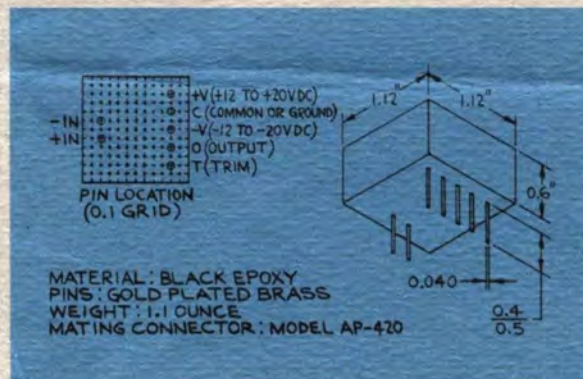
The specially formulated, thermally conductive epoxy in which this nine transistor amplifier is encapsulated, protects the internal circuitry against thermal shocks, vibration and humidity. Conservative design based upon "worst case analysis" plus thorough in-process inspection and performance test after "burn-in" assure long life and reliable performance.

Specifications

Gain:	Greater than 110 dB, DC
Frequency Response:	Small signal Gain Bandwidth Product—50 mHz Full Output Frequency—40 kHz
Equivalent Input Noise:	Less than 0.5 microvolts
Input Impedance:	Greater than 10 megohms, DC
Input Current Offset:	25 nA Typ.; 75 nA Max.
Input Voltage Offset:*	4 mV Typ.; 10 mV Max.
Common Mode Input:	±6 Volts with ±15 VDC supply ±8 Volts with ±20 VDC supply
Distortion:	0.2% THD, 20 to 20,000 Hz at rated output
Output Voltage:	Greater than 7.75 Volts RMS, ±15 VDC supply Greater than 11 Volts RMS, ±20 VDC supply
Minimum Load Impedance:	75Ω for full output voltage
Continuous Power Output:	0.8 Watts RMS @ ±15 VDC supply 1.5 Watts RMS @ ±20 VDC supply
Quiescent Current:	15 Milliamperes @ ±15 VDC supply 26 Milliamperes @ ±20 VDC supply
Current at Rated Output 600Ω Load:	18 Milliamperes @ ±15 VDC supply 32 Milliamperes @ ±20 VDC supply
75Ω Load:	60 Milliamperes @ ±15 VDC supply 85 Milliamperes @ ±20 VDC supply
Power Supply Voltage:	Bi-polar, ±12 VDC to ±20 VDC

*Output offset may be nulled to zero by means of a 100 kΩ trim pot between the +V and T terminals. This is normally not necessary in Audio applications.

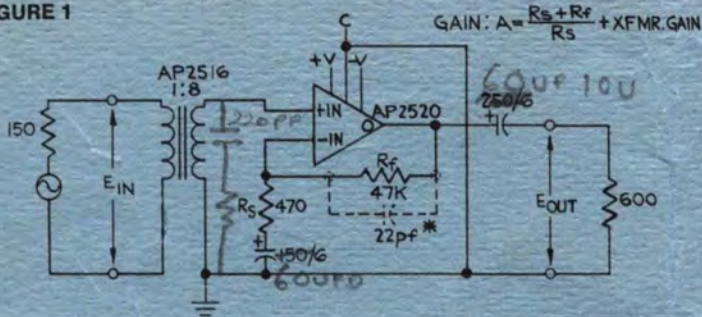
Our staff is fully equipped and stands ready to provide engineering services, from applications assistance to complete system design, and fabrication.



TYPICAL AMPLIFIER CIRCUITS

Circuit Specifications

FIGURE 1



MICROPHONE PREAMPLIFIER (GAIN: 58dB)

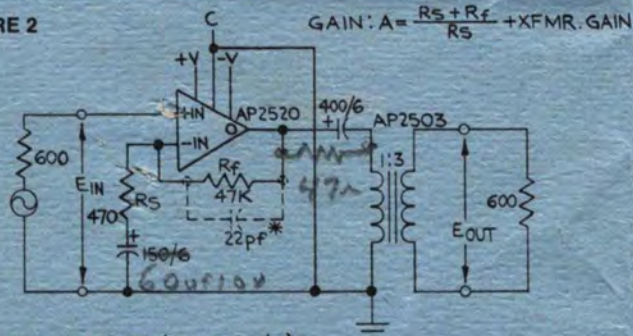
GENERAL (Figures 1-5)

- Load Impedance:** 600Ω
- Frequency Response:** ±0.25 dB, 20 to 20 kHz at rated output power
- Distortion:** Less than 0.2% THD, 20 to 20 kHz at rated output power

MICROPHONE PREAMPLIFIER (Figure 1)

- Gain:** 58 dB
- Equivalent Input Noise:** -129 dB, 20 to 20 kHz, unweighted
- Input Impedance:** Greater than 1500Ω
- Output Impedance:** Less than 2Ω
- Power Output:** +21 dBm, ±15 VDC supply
+24 dBm, ±20 VDC supply

FIGURE 2

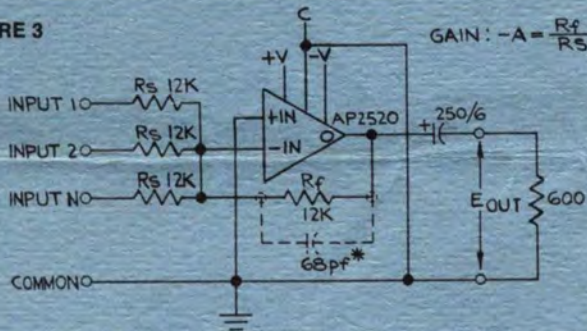


LINE AMPLIFIER (GAIN: 49dB)

LINE AMPLIFIER (Figure 2)

- Gain:** 49 dB
- Equivalent Input Noise:** -125 dB, 20 to 20 kHz, unweighted
- Input Impedance:** Greater than 2 megohms
- Output Impedance:** Less than 2Ω plus transformer reflected impedance
- Power Output:** +28 dBm, ±15 VDC supply
+30 dBm, ±20 VDC supply

FIGURE 3



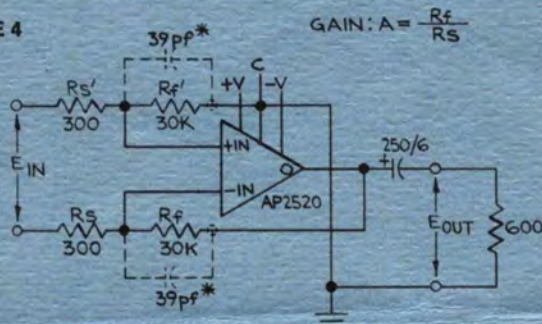
LOSSLESS COMBINING AMPLIFIER (GAIN: 0dB)

LOSSLESS COMBINING AMPLIFIER (Figure 3)

- Gain:** 0 dB
- Maximum Crosstalk:** -100 dB
- Maximum Gain:** 20 dB for 10 inputs
10 dB for 32 inputs
- Equivalent Input Noise:** -115 dBm for 10 inputs
-110 dBm for 32 inputs
- Input Impedance:** 12kΩ
- Output Impedance:** Less than 2Ω
- Power Output:** +21 dBm, ±15 VDC supply
+24 dBm, ±20 VDC supply

Note: This circuit produces a 180° phase reversal. An output transformer such as that shown in Figure 2 may be used to correct the phase, and can also provide additional gain.

FIGURE 4

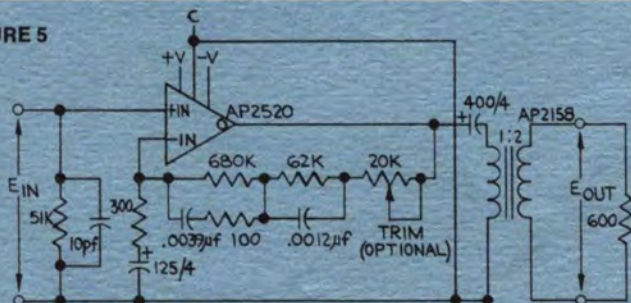


BALANCED TRANSFORMERLESS AMPLIFIER (GAIN: 40dB)

BALANCED TRANSFORMERLESS AMPLIFIER (Figure 4)

- Gain:** 40 dB
- Equivalent Input Noise:** -120 dB, 20 to 20 kHz, unweighted
- Input Impedance:** 600Ω
- Common Mode Rejection:** Greater than 90 dB (with matched resistors)
- Maximum Common Mode Voltage:** ±8 Volts peak
- Output Impedance:** Less than 2Ω
- Power Output:** +21 dBm ±15 VDC supply
+24 dBm ±20 VDC supply

FIGURE 5



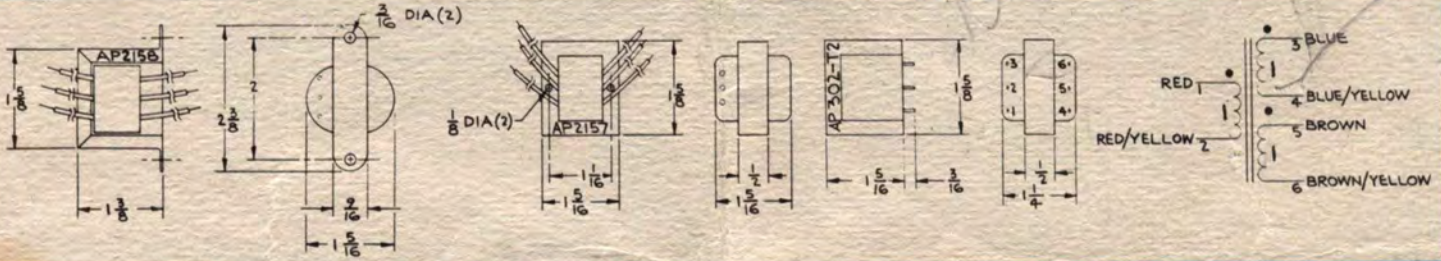
PHONO PREAMPLIFIER (GAIN: 54dB)

PHONO PREAMPLIFIER (Figure 5)

- Equalization:** RIAA
- Gain:** 54 dB (2.5 mV at 1 kHz produces +4 dBm output)
- Equivalent Input Noise:** -125 dBm
- Input Impedance:** 50kΩ
- Output Impedance:** Less than 2Ω plus transformer reflected impedance
- Power Output:** +25 dBm ±15 VDC supply
+28 dBm ±20 VDC supply

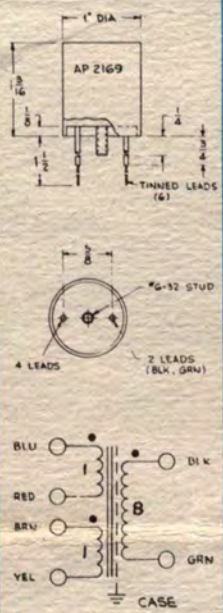
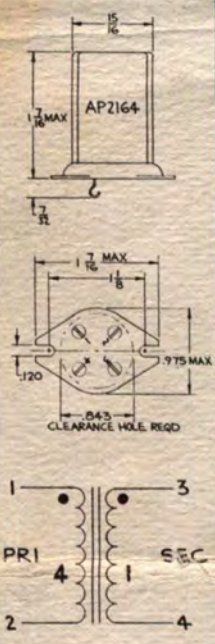
*OPTIONAL ROLL-OFF CAPACITOR

SYSTEM ENGINEERED AUDIO COMPONENTS

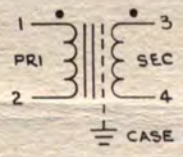
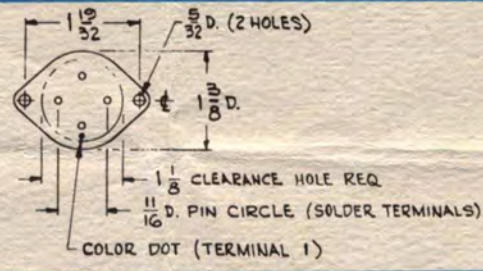
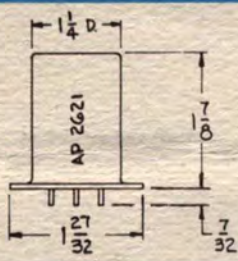
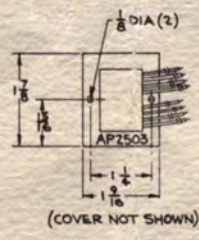
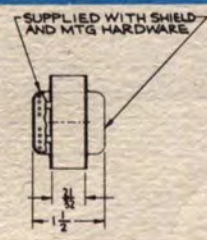


AUDIO TRANSFORMERS

	AP 2169	AP 2164	AP 2157* AP 2158* AP 302T2*	AP 2503	2621 AP 2164
Application	Input (Mic Preamp)	Input (Bridging)	Output (Amplifier to line)	Output (Amplifier to line)	Isolation (Line to Line)
Primary Impedance	150/600 Ω	10,000 Ω	75 Ω	75 Ω	600 Ω**
Secondary Impedance	10,000 Ω	600 Ω	75 Ω(1:1)† 300 Ω(1:2)†	75 Ω(1:1)† 300 Ω(1:2)† 600 Ω(1:3)†	600 Ω**
Frequency Response	30 to 20 kHz ±0.5 dB	20 to 30 kHz ±0.3 dB	30 to 20 kHz ±0.5 dB	30 to 20 kHz ±0.5 dB	30 to 30 kHz ± 0.25 dB
Maximum Level	0 dBm	+20 dBm	+30 dBm	+30 dBm	+20 dBm



*These transformers are electrically identical and differ only in mechanical details.
 †Minimum load impedances.
 **May be used unterminated to isolate a bridging load.



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CONSOLES

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