



For more Hi-Fi manuals and set-up information
please visit www.hifiengine.com



13130 SOUTH YUKON AVENUE
PHONE (213) 973-8090

HAWTHORNE, CALIFORNIA 90250
TELEX NO. 66-4494

OWNER'S MANUAL
MODEL 320B
COMMERCIAL POWER AMPLIFIER

TABLE OF CONTENTS

<u>DESCRIPTION</u>	<u>FORM NUMBER</u>
Important	00601
Description	01660
Option Page	01665
Specifications	02230
Unpacking and Set-Up	02510
Rack Mounting Hints	02650
Input Connections	03090
Bridging Balanced Line Inputs	03011
Bridging Unbalanced Line Inputs	03021
Balanced Line Inputs	03031
Unbalanced Line Inputs	03041
Terminating Resistance Chart	03051
Transformer Output Connections	03420
Direct Output Connections	03541

Damping Factor Chart	03510
Speaker Fuse Nomograph	03530
25/70v Line Applications	03241
25/70v Line vs. Impedance Chart	03250
Power Mains Connection	04000
Operating Precautions	05001
Circuit Description, 320B	06271
Schematic, Amplifier Module	12710/11
Schematic, Chassis	12720/21
Block Diagram	12730
Parts List	12740
Power Mains Voltage Conversion	04504
Warranty	17000
Service Authorization Form	17020
Warranty Registration Form	17030

- IMPORTANT -

**PLEASE READ THIS PAGE BEFORE OPERATING
YOUR
BGW POWER AMPLIFIER**

Your new BGW amplifier is designed to provide years of trouble free performance. Observing these few precautions will insure proper operation:

Read all Instructions before connecting any AC power to your power amplifier.

Retain this Manual for future reference.

Heed all warnings on the top or rear of the power amplifier.

The amplifier should not be used near water - for example, near a bathtub, washbowl, kitchen sink, laundry tub, in a wet basement, or near a swimming pool, etc.

The amplifier should be situated so that its location or position does not interfere with its proper ventilation. For example, it should not be situated on a bed, sofa, rug, or similar surface that may block the ventilation openings; or, placed in a built-in installation, such as a bookcase or cabinet that may impede the flow of air through the ventilation openings.

The amplifier should be situated away from heat sources such as radiators, heat registers, stoves, or other appliances that produce heat.

The amplifier should be connected to a power supply only of the type described in the operating instructions or as marked on the rear panel.

Precautions should be taken so that the grounding means of the amplifier is not defeated.

The power supply cord should be routed so that it is not likely to be walked on or pinched by items placed upon or against it, paying particular attention to cord at the plug, convenience receptacles, and the point where they exit from the amplifier.

Care should be taken so that objects do not fall into, and liquids are not spilled into the amplifier through openings.

The amplifier should be serviced by qualified service personnel when:

The power supply cord or the plug has been damaged; or objects have fallen into, or liquid has been spilled into the amplifier; or has been exposed to rain; or does not appear to operate normally or exhibits a marked change in performance; or has been dropped, or the enclosure has been damaged.

All connections should be made to the power amplifier with the power OFF.

Speaker fuses should be used to afford maximum speaker protection.

Never connect the output of one channel to that of another.

Connect the power cord to the proper voltage mains as indicated on the rear of the amplifier. Conversion to another voltage requires internal rewiring.

Do not remove the amplifier's cover. Amplifiers may not be covered under warranty if they are tampered with. There are NO adjustments within. Potentially lethal voltages exist within the amplifier. Refer all service work to an authorized BGW service station.

DESCRIPTION

The BGW Model 320B is a basic, high-power, stereo amplifier designed for background sound distribution systems and other professional use. Circuitry, connectors, and cosmetics have been kept to a minimum for simple operation and overall economy.

Gain controls, indicator lights and the on/off switch are located on the front panel. Input, output, and ground connectors are on the rear panel.

Input connections are made with either standard single-channel, 1/4-inch phone plugs, spade lugs, or bare wires. Output connections are made to the barrier strips with either spade lugs or bare wires. Amplifiers have built-in output transformers and will drive either 25-volt or 70-volt distribution systems. Export versions will drive 70 volt and 100 volt lines distribution systems. Signal ground can be separated from chassis ground, if desired, by removing the connecting link on the rear panel barrier strip.

The LED's located above the gain controls on the front panel serve as clipping indicators for each channel. They are activated when the amplifier output level (peak) equals the power supply voltage. Distortion rises significantly when this occurs, because there is not enough energy available to accurately reproduce the signal. As this condition can occur at a rate too fast for the eye to follow, the LED's remain on for 1/4 second once clipping is sensed. A third red LED is employed as a "power on" indicator.

Features include: a discrete low noise input stage, heat sink mounted bias circuit to provide precise temperature compensation, and a full complementary output stage featuring six 150-watt transistors in each channel (1800 watt total dissipation capability), temperature activated switches and magnetic circuit breaker protection safeguard the unit.

Mechanical features include: a 16-gauge steel chassis, massive heat sinks, and modular construction.

All active audio circuit components are contained in two modules, one for each channel. These modules consist of a glass epoxy circuit board mechanically coupled to a large aluminum heat sink. Vertical fin arrangement allows natural convection currents to flow upward and away from the amplifier. Removal of the modules for service is easily accomplished by removing the support screws and the plug-in electrical connectors.

The commercial audio power amplifier model 320B is available from the factory with custom options to fit your needs.

Some of these options may require a minimum quantity of products to be purchased at one time. Please contact the factory with your requirements.

Some of the options for the 320B are listed below:

320B-01	Without Autotransformers
320B-02	With Tweeter protection circuit
320B-03	With 70 Volt isolated output transformers
320B-04	With local and remote status indicators
320B-05	No input level controls
320B-06	AC switch and thermal circuit Breaker
320B-07	Rear panel controls with locking shafts
320B-08	Front panel controls with locking shafts
320B-09	Remote monitoring circuitry

SPECIFICATIONS MODEL 320BDIRECT OUTPUTOUTPUT POWER AND TOTAL HARMONIC DISTORTIONOUTPUT POWER

100 watts minimum sine wave continuous average power output per channel with both channels driving a constant voltage line over a power band from 20Hz to 20kHz. The maximum Total Harmonic Distortion at any power level from 250 milliwatts to 100 watts shall be no more than 0.2%.

1 kHz Power: 105 watts into 8-ohms per channel, both channels operating. 0.2% Total Harmonic Distortion.

Small Signal Response:	+0, -3dB, 10Hz to 50kHz Frequency +0, -1dB, 20Hz to 20kHz
Intermodulation Distortion:	Less than 0.05% from 250 milliwatts to rated output (60Hz & 7kHz, 4:1)
Hum and Noise Level:	Better than 100dB below rated output into 8 ohms (unweighted, 20 Hz to 20 kHz)
Damping Factor:	Greater than 150 to 1 at 8 ohms, 1 kHz
D.C. Offset Voltage:	Less than 10mV
Load Impedance:	Equal to or greater than 4 ohms

SPECIFICATIONS: MODEL 320BTRANSFORMER OUTPUTOUTPUT POWER

100 watts minimum sine wave continuous average power output per channel with both channels driving either a 25-volt or 70-volt distributed system* over a power band from 40 Hz to 15 kHz. The maximum Total Harmonic Distortion at any power level from 250 milliwatts to 100 watts shall be no more than 0.5%.

OUTPUT IMPEDANCE

Designed for load impedance of 6.25 ohms (25-volts) or 49 ohms (70-volts). Export models 49 ohms (70-volts) or 100 ohms (100-volts).

SPECIFICATIONS MODEL 320BGENERAL

Hum and Noise Level:	Better than 100dB below rated output (unweighted, 20 Hz to 20 kHz)
Input Sensitivity:	0.7 volts for maximum output voltage gain: 40.4 x (32.1dB) main amp; 25V line 35.7 x (31.06dB); 70V line 100 x (40dB).
Input Impedance:	Greater than 15,000 ohms
Load Impedance:	4 ohms minimum direct output 6.25 ohms min, @ 25V line 49 ohms min. @ 70V line 100 ohms min @ 100V line
Power Requirements:	Internal Jumper selects either 100, 120, 200, 220 or 240 volts: 50-60 Hz
Semiconductor Complement:	2 discrete low noise dual transistors, 42 transistors, 4 zener diodes, 8 diodes, 1 bridge rectifier and 3 LED's
Dimensions:	5 1/4 inch by 19-inch standard rack front panel by 11 3/4 inches deep (13.35cm x 48.26cm x 29.85cm)
Weight:	39 lbs., net; 44 lbs., shipping 17 Kg., net; 20 Kg., shipping

*MEASURED USING AN EQUIVALENT RESISTIVE LOAD

* All specifications and features are subject to change without notice.

UNPACKING AND SET-UP

Your BGW Power Amplifier is shipped in an advanced packing container.

SAVE THE CONTAINER AND ALL PACKING MATERIAL!

The container should be saved in the event the unit is moved or shipped at some future date. Replacement containers are available from BGW Systems.

Inspect the unit for damage in transit immediately upon receipt. If damage is found, notify the transportation company immediately. Only the consignee may institute a claim with the carrier for shipping damage. BGW will cooperate fully in such an event. Be sure to save the container as evidence of damage for the shipper to inspect.

The amplifier's mounting position must be chosen carefully, so that the air flow around the unit is not restricted. Inadequate ventilation may cause failure of the amplifier. For rack mounting, the four rubber feet on the bottom of the unit may be removed and no hardware will be loosened inside the unit.

The size of the amplifier is convenient for a wide variety of applications. However, please note the following precautions:

- 1.) Do not use the front panel as the sole support for the amplifier. Side rails or rack shelves should be employed.
- 2.) Do not stack amplifiers. A minimum of 1 3/4" above each amplifier should be provided for free air circulation.

DO NOT PLUG THE AMPLIFIER IN YET!

All connections should be made before power is applied.

RACK MOUNTING HINTS

KEEPING IT COOL

A power amplifier draws energy from a primary electrical service, usually a 120 VAC outlet, to drive loudspeaker systems with an audio signal. Typically, only half of the energy can be delivered to the loudspeakers; remaining energy is converted into heat, and must be dissipated (ventilated) into the air.

Air circulating past heat-producing components absorbs the heat and carries it away. To accomplish this, low and medium power amplifiers rely on natural convection currents, while most high power amplifiers use fans. If the air flow is impeded, the resulting rise in heat may cause an amplifier to stop working or fail.

Circulating air currents must not be cut off when installing power amplifiers in racks. Power amplifiers using convection cooling require spacing between amplifiers to permit air flow between them. Power amplifiers using forced-air cooling, on the other hand, can usually be stacked closer to each other and may not need any blank panel spacing between amplifiers.

To improve natural convection currents within a rack, a chimney can be created by closing the back of the rack and venting the rack at the bottom to let in fresh air, and at the top to exhaust hot air. Vents should be large rectangular slots approximately 19" wide by 4" high.

The rack cabinet will require some type of blower if a large air-flow is required. It is best to exhaust air from the top of the rack rather than to blow it in from the bottom. There will be less dust and dirt in the rack this way, if the bottom vent is sufficiently large.

INSTALLING THE UNITS

Use care when mounting equipment in a rack. Place the heaviest units near the bottom of the rack and fill in all unused rack spaces with blank panels. Equipment cannot always be supported by front panels alone. This is especially true of amplifiers whose depth is more than twice their height. Uniform support can be insured by installing bottom or side rails.

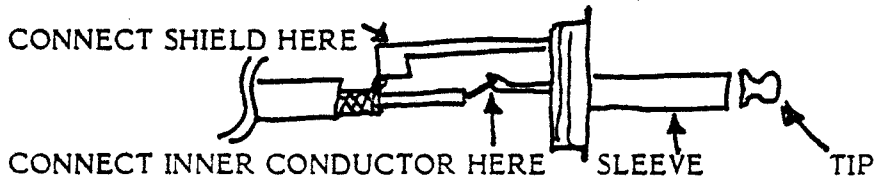
When racks are to be transported or used in a mobile installation, some means of securing the rear of the equipment are required. Angle brackets either attached to the bottom, side rails or rear panel are practical approaches.

INPUT CONNECTIONS

1/4 inch phone jacks and a barrier terminal strip are provided on the rear of the amplifier for input connections.

1/4 INCH PHONE JACKS

The 1/4" phone jacks are for unbalanced lines only (single conductor, shielded). Simply connect the shield to the outer sleeve of the plug and the inner conductor to the tip, or buy ready-made cables. See diagram below.



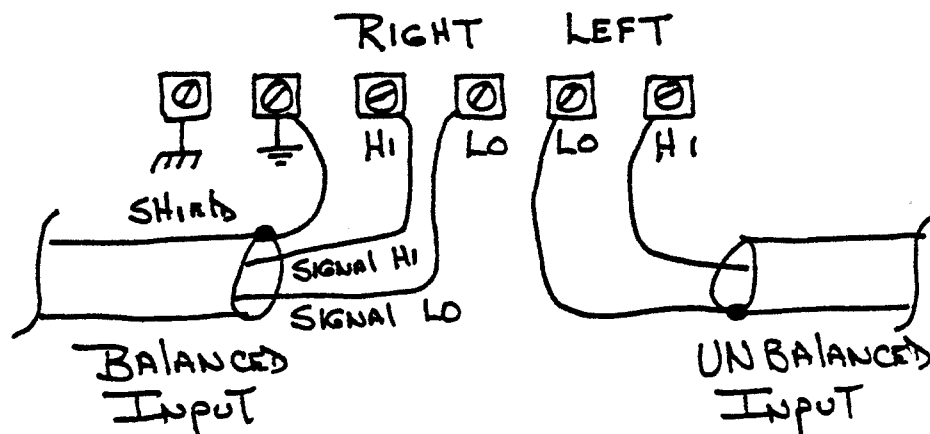
BARRIER INPUTS

The barrier strip inputs are for balanced or unbalanced line line inputs.

BALANCE LINE INPUT requires the use of a plug in, input transformer (0900-9250) simply connect the shield to signal ground, plus (+) signal to Hi and minus (-) signal to Lo.

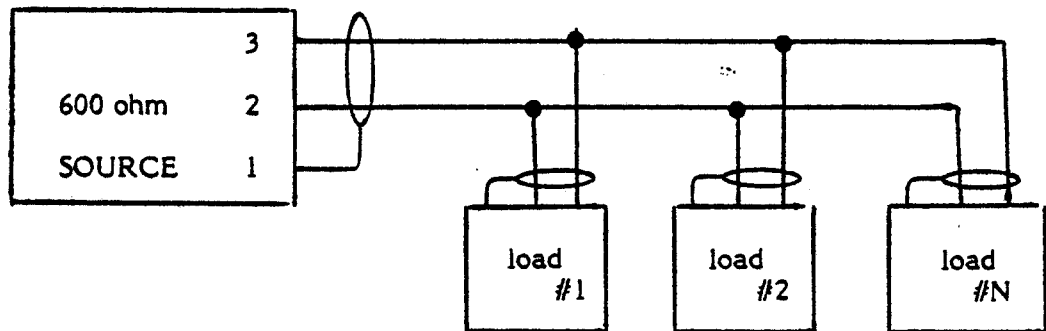
UNBALANCED LINE INPUT requires the use of the jumper plug assembly (supplied with the amplifier). Simply connect the shield to signal (LO) and the inner connector to signal (HI). See diagram below.

GROUNDS Both chassis and signal ground are independent of each other. They appear at the input barrier strip, and can be separated by removing the jumper. This can aid in removing external ground loops.



BRIDGING BALANCED LINE INPUTS

Used only when two or more devices are driven from the same input line.



MAXIMUM NUMBER OF AMPLIFIER 25ea

Input transformers for above

- A. Use 1:1 transformer 600 ohms to 600 ohms
- B. Nth load must have a terminating resistor added to the secondary of the Input transformer.

One alternative configuration is

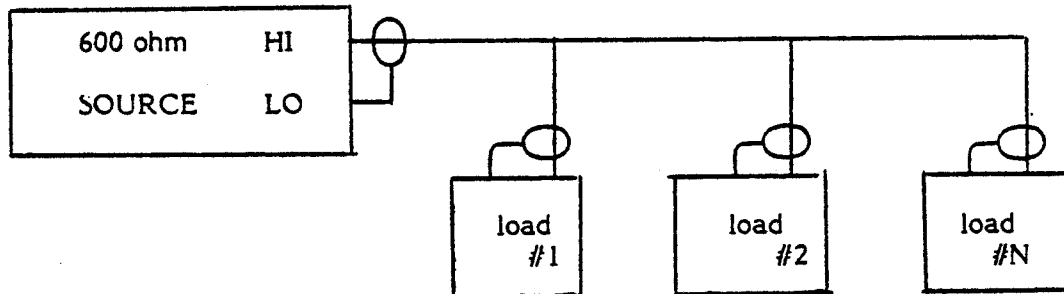
- C. 1:1 transformer 15K ohms to 15K ohms
- D. Nth load must have a terminating resistor added to the primary of the input transformer.

To find this resistance value see sheet TERMINATING RESISTANCE CHART, MFRM 03051.

NOTE: Terminating resistance is required when source is a transformer. Sources other than a transformer may not need a termination.

BRIDGING UNBALANCED LINE INPUTS

Used only when two or more devices are driven from the same Input line.



The Nth load should have a terminating resistor added to its octal plug between pin 1 and pin 6.

To find this resistor value see sheet "TERMINATING RESISTANCE CHART", MFRM 03051.

NOTE: Terminating resistance is required when source is a transformer. Sources other than a transformer may not need a termination.

TERMINATING RESISTANCE CHART

How to find terminating resistance for balanced or unbalanced 600 ohm lines, driving more than one amplifier.

STEP A $\frac{\text{*Input Impedance of Amplifiers}}{\text{Number of Amplifiers}} = \text{Total Load Impedance of Amplifiers}$

STEP B $\frac{\text{Total Impedance of Amplifiers} - 600}{600} = K \text{ (Impedance Factor)}$

STEP C $(\frac{1}{K} + 1) \times 600 \text{ ohms} = \text{Load Resistor Required}$

EXAMPLE:

Input Impedance of Amplifiers = 15,000 ohms

Number of Amplifiers = 4

A $\frac{15,000}{4} = 3750 \text{ ohms}$

B $\frac{3750 - 600}{600} = 5.25$

C $\frac{1}{5.25} + 1 \times 600 = 1.19 \times 600 = 714.29 \text{ ohms}$

Closest value is 715 ohms 1% metal film resistor.

* Note all amplifiers must have the same input impedance. If not, use formula below:

$$\frac{1}{\frac{1}{Z_1} + \frac{1}{Z_2} + \frac{1}{Z_3} + \frac{1}{Z_n}} = \text{Total Load Impedance}$$

EXAMPLE:

Four (4) Amplifiers with input impedance of 15k, 30k, 30k and 7.5k

$$\frac{1}{\frac{1}{15K} + \frac{1}{30K} + \frac{1}{30K} + \frac{1}{7.5K}} = 3750 \text{ ohms}$$

TRANSFORMER OUTPUT CONNECTIONS

The amplifier is shipped from the factory with the jumpers installed that strap the amplifier output to the autotransformer.

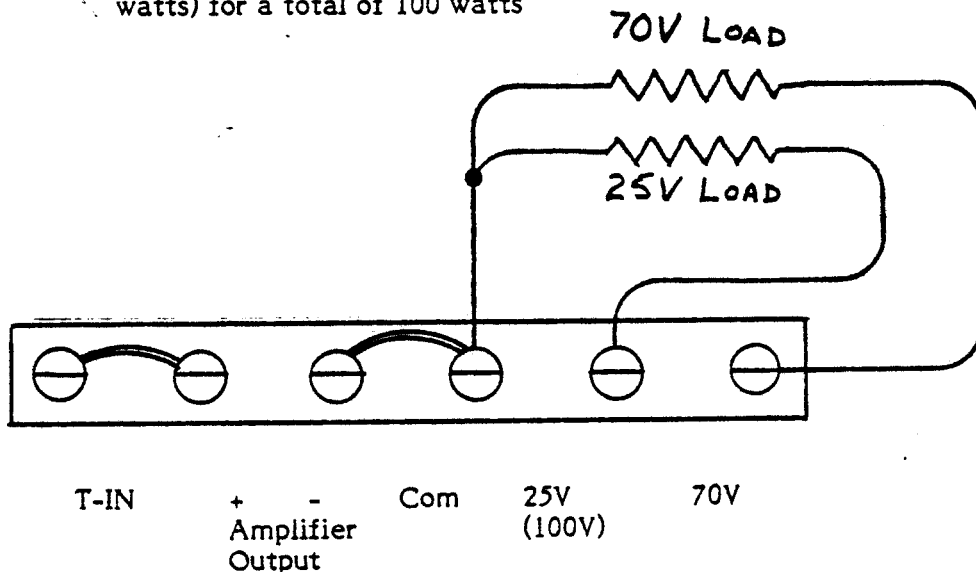
The load 25 or 70 volt line (100 or 70 volt on export Models) should be connected between common and/or any combinations that do not exceed the power rating of the amplifier output.

EXAMPLE: A 100 watt amplifier can drive the following loads

6.25 ohms @25 volt line (100 watts)

or 49 ohms @70 volt line (100 watts)

or 25 ohms @25 volt line (25 watts) and 65 ohms @70 volt line (75 watts) for a total of 100 watts



DIRECT OUTPUT CONNECTIONS

Make certain that the speakers are properly phased. Connect the black or minus (-) terminal on the speaker cabinet to the appropriate barrier strip screw (amp out -) on the amplifier. Connect the red or plus (+) terminal to the barrier strip screw (amp out +).

SPEAKER PROTECTION

All speakers can be damaged by having too much power applied to them. Fuse protection is an effective and inexpensive way of preventing this from occurring. If your speaker system does not contain a fuse or a circuit breaker, a fuse should be placed in series with each speaker and the wire going to the amplifier output (red or +) terminal on the rear of the unit.

Maximum protection can be obtained with fast-acting fuses. Use the value recommended by the manufacturer. If no value is specified, use the chart provided to select the correct value. (MFRM 03530)

To use the chart, take a straightedge, such as a ruler, and line up the speaker's impedance with its peak music power rating. The proper fuse value can then be read from the center column. Choose a fuse that is closest to, and below, the value indicated.

WIRE SIZE AND DAMPING FACTOR

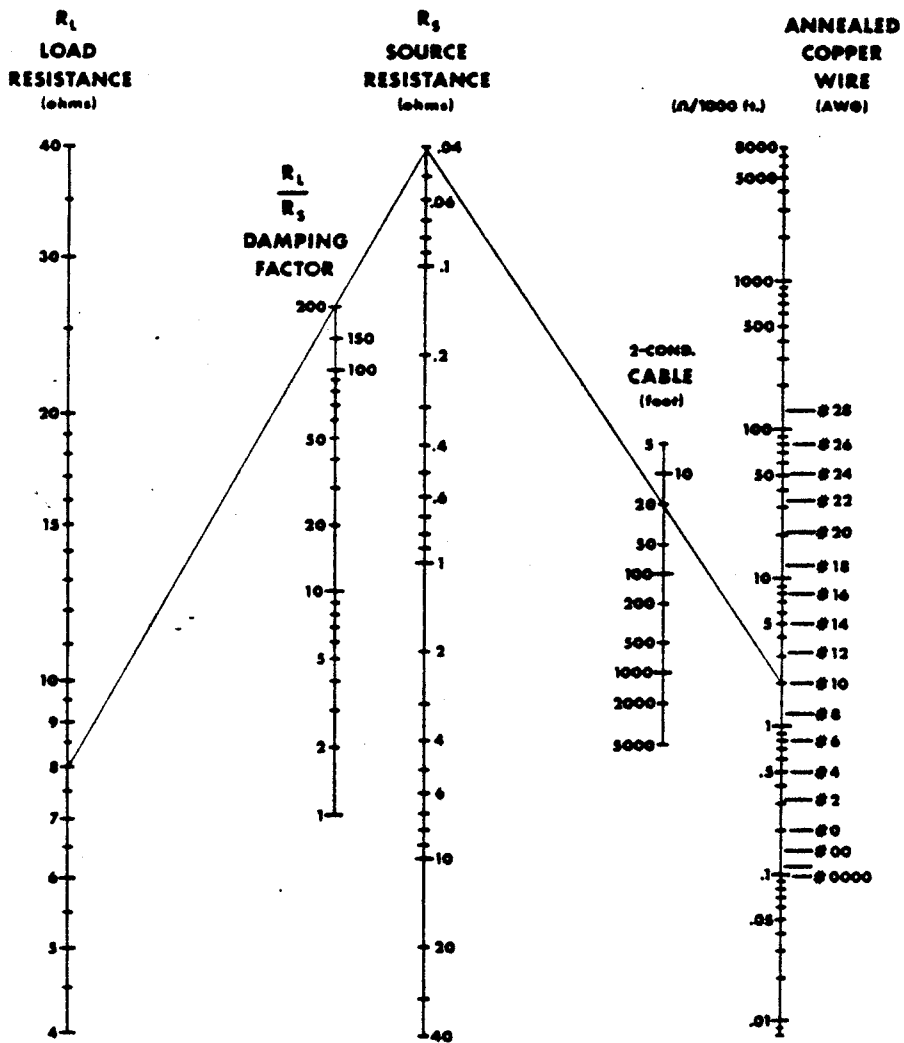
The high damping factor of BGW amplifiers results in a very clean bass response. Excessively long, and small diameter speaker wires can lower the damping factor and distort the lower frequencies. A damping factor of at least 50 should be maintained to insure good audio quality.

The relationship between wire length and diameter, and damping factor can be calculated using the chart (MFRM 03510) on the following page. Proceed as follows:

1. Using a straight-edge, line up the gauge of the speaker wire with its length. Mark off the resulting source resistance where this line crosses the center column.
2. Line up the source resistance, determined in step #1, with the manufacturer's impedance* of the speaker system. The damping factor can now be read.

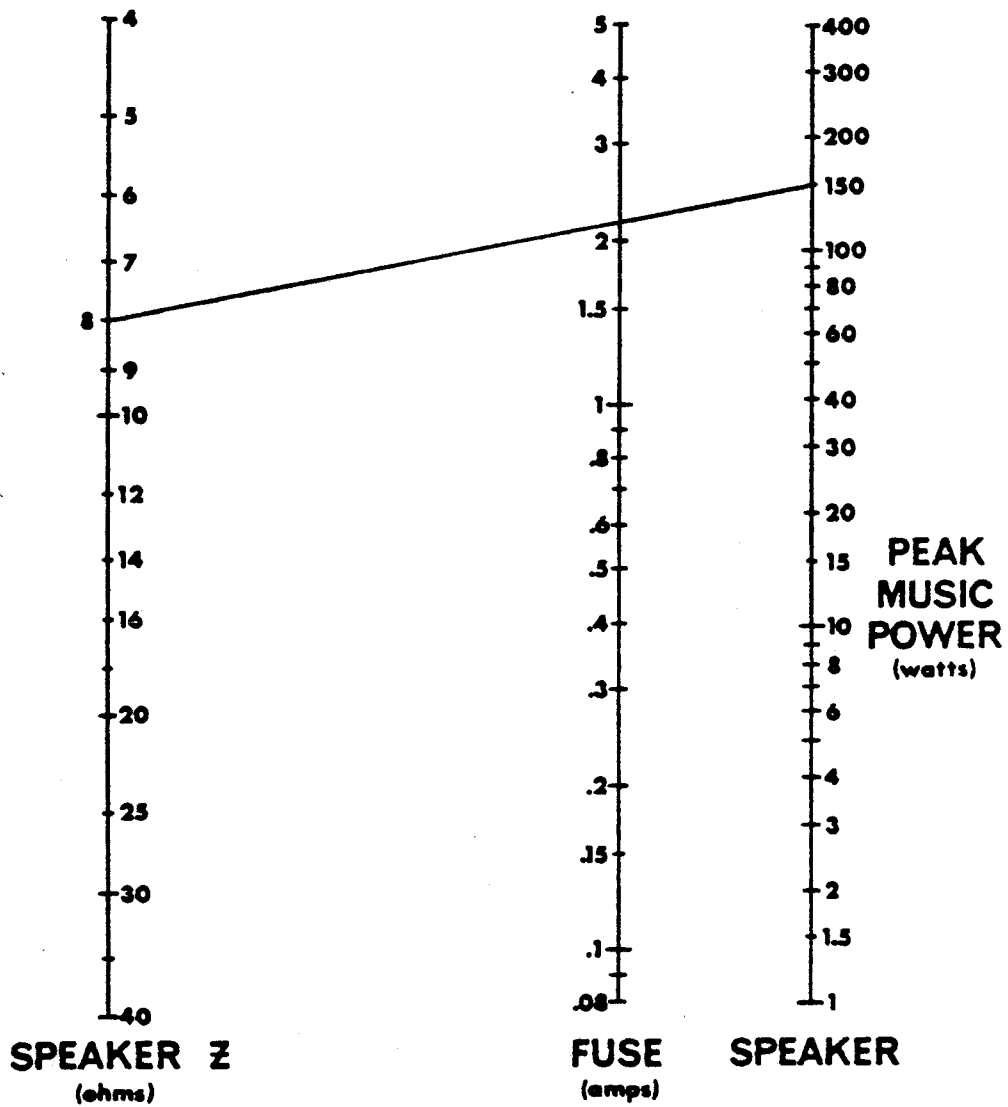
*The impedance of a speaker system can be approximated by measuring the resistance across the speaker terminals, with the amplifier disconnected. Multiplying this result by 1.33, gives you the approximate impedance.

Note: This method cannot be used with electrostatic speakers.



EXAMPLE: $R_L = 8\Omega$, $R_S = .04\Omega$ OR D.F. = 200
 CABLE LENGTH OF 20 FT. ANSWER: #10 WIRE

SOURCE RESISTANCE AND DAMPING FACTOR VS. LENGTH AND SIZE OF OUTPUT LEADS



EXAMPLE: $Z = 8\Omega$, PEAK POWER = 150W. ANSWER: FUSE = 2 AMPS

FUSE SELECTOR NOMOGRAPH FOR LOUDSPEAKER PROTECTION

25/70 VOLT DISTRIBUTION SYSTEMS

A constant voltage distribution system is a method of connecting loudspeakers to an amplifier wherein the output voltage of the amplifier and the amount of power delivered to any particular loudspeaker remains constant once the system is properly installed. The amplifier will produce 70 volts at rated power while a five-watt speaker will receive five watts regardless of how many loudspeakers are added to, or subtracted from, the distribution system.

The output voltage of an amplifier, properly set up in a constant voltage distribution system, is not dependent upon the load connected to the amplifier. It is determined by the input signal applied to the amplifier, and is limited only by the amplifier's output power capability.

An analagous constant voltage system is the power generating station that delivers electrical power to your home. Just as appliances can be turned on and off without affecting the operation of other appliances connected to the electrical system as a whole, speakers can be added to, or subtracted from, the distribution system without affecting its overall operation.

This occurs because both the amplifier and the generating station have extremely low output impedances with respect to their loads. The ratio between source (amplifier) and load (speaker) in a constant voltage distribution system is generally between 1:100 and 1:1000. A change in the load impedance would have to be very great to have any effect on the amplifier's output voltage.

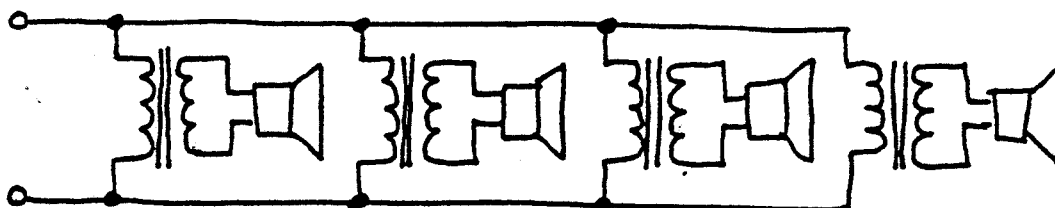
The most common voltage used in a constant voltage distribution system is 70.7 volts. In most areas of the USA, 70.7 volts is the maximum voltage* that a pair of wires can carry without being enclosed in a metal conduit. Amplifiers used to power such a system must develop 70.7 volts across their output terminals when driven to their full rated power. The 70.7-volt figure is the maximum voltage value. The output of the amplifier, in actuality, swings from 0 to 70.7 volts in response to changes in its input signals. One other value used in constant voltage systems is 25 volts.

*Note: Some local electrical codes may have power and/or other limitations.

Transformers are used to connect loudspeakers to the amplifier. They are usually designed for a specific constant voltage level (i.e. 70.7 volts) and have primary winding taps rated in watts and secondary winding taps rated in ohms. A transformer may have several primary and secondary winding taps, each with different ratings.

Primary windings are connected in parallel across the output terminals of the amplifier, while secondary windings are connected across a loudspeaker or loudspeaker system. Secondary winding taps are selected to match the impedance of the loudspeaker(s) to the impedance of the transformer. For example, an eight-ohm speaker system would be connected to an eight ohm tap on a transformer secondary winding. A speaker will receive the power (watts) determined by its primary winding tap only when the amplifier is at its full rated power. Power delivered to a speaker varies in proportion to the amplifier's output voltage.

Transformers are connected in parallel across the output terminals of the amplifier



Primary windings of certain transformers are rated in ohms instead of watts. To select a transformer for a specific power level, the following formula can be used :

$$Z = \frac{E^2}{P} \text{ where } Z \text{ is the impedance of the primary winding of the transformer (ohms).}$$

E is the constant voltage level of the system.

P is the desired power (watts).

For a 70.7 volt system, where 5 watts are desired at a particular speaker, the primary winding of the transformer must have an impedance of:

$$Z = \frac{5000}{5} = 1000 \text{ ohms.}$$

Note: $(70.7)^2$ is approximately 5000

Two factors must be considered when setting up a constant voltage distribution system. The amplifier must have sufficient power and the speaker system must have sufficient impedance.

The amplifier must have enough power at the system voltage level to drive all of the loudspeakers in the system. For example, in a 70.7-volt system where there are (ten) 2 watt and (twenty) five watt loudspeakers, an amplifier that can produce more than 120 watts is required. Use a more powerful amplifier than calculated if the system is to be expanded.

The total impedance of the speaker system must be maintained above a certain minimum value to insure constant voltage operation. This impedance can be determined by the following formula:

$$Z = \frac{E^2}{P} \text{ where } Z \text{ is the total impedance of the speaker system (ohms)}$$

E is the output voltage of the amp at full power

P is the full rated power of the amplifier (watts)

For a 50-watt amplifier to power a 70.7 volt system, the minimum impedance is:

$$Z = \frac{(70.7)^2}{50} = \frac{5000}{50} = 100 \text{ ohms} \quad (70.7)^2 \text{ is approximately } 5000$$

$$42 = \frac{70.7^2}{P}$$

(19W RMS)

CONSTANT VOLTAGE LINES
WATTS vs OHMS vs VOLTS

WATTS	OHMS			VOLTS		
	25V	70V	100V	4 Ω	8 Ω	16 Ω
25	25.0	196.0	400.0	10.0	14.1	20.0
50	12.5	98.0	200.0	14.1	20.0	28.3
75	8.33	65.3	133.3	17.3	24.5	34.6
<u>100</u>	6.25	<u>49.0</u>	100.0	20.0	28.3	40.0
125	5.00	39.2	80.0	22.4	31.6	44.0
150	4.17	32.7	66.7	24.5	34.6	49.0
175	3.57	28.0	57.1	26.5	37.4	52.9
200	3.13	24.5	50.0	28.3	40.0	56.6
<u>225</u>	2.78	21.8	44.4	30.0	42.4	<u>60.0</u>
250	2.50	19.6	40.0	31.6	44.7	63.3
300	2.08	16.3	33.3	34.6	49.0	69.3
400	1.56	12.3	25.0	40.0	56.6	80.0
500	1.25	9.8	20.0	44.7	63.3	89.5
600	1.04	8.2	16.7	49.0	69.3	98.0
700	0.89	7.0	14.3	53.0	74.8	105.8
750	0.83	6.5	13.3	54.8	77.5	109.5
800	0.78	6.1	12.5	56.6	80.0	113.1

$$E = \sqrt{PR}$$

$$P = \frac{E^2}{R}$$

$$R = \frac{E^2}{P}$$

E = volts

P = watts

R = resistance

To use chart you will have two of the known values; ohm, volts or watts. On the first horizontal line select one known value watts, constant volts or resistance. Then move down the column until you find the second known value. Then move horizontally to the unknown value.

Example 1 70V constant line and 49 ohms = 100 watts

Example 2 16 ohms and 60 volts = 225 watts

POWER MAINS CONNECTIONS

The unit should be plugged in only when it has been established that it is wired for the correct power mains voltage and after all other connections have been made.

The mains (AC line) voltage is indicated on the serial number label on the rear of the unit. Products supplied for use in the United States and Canada are factory wired for 120 volts. Only the indicated mains voltage should be used. If the mains voltage must be changed, see POWER MAINS VOLTAGE CONVERSION.

A molded, parallel blade, U-ground plug is supplied. This connector is standard in the United States and Canada. For use elsewhere, the plug must be replaced with the correct connector. The color-code of the cord is as follows:

HI (switched Leg) - Brown (or Black)

LO (neutral Leg) - Blue (or White)

EARTH (Chassis ground) - Green with Yellow tracer (or Green)

OPERATION

PRECAUTIONS

1. Speaker destruction is often due to improper equipment operation. This often occurs when someone, without the proper appreciation for the components of a high power, high quality music system, has the opportunity to change records or adjust levels. The best protection here is caution. Keep the equipment out of the reach of untrained adults and children.

Make sure the speaker is properly protected with fuses (Output Connections Section).

2. Never parallel the two amplifier outputs together.
3. When driving any load with an impedance of less than 4 ohms, the load should be isolated from the amplifier with a series capacitor in order to avoid both damage to the load, and wasting of output power.
4. If the amplifier continuously shuts off, something is wrong - refer to Warranty and Service Station.
5. Do not connect an input ground lead to an output ground lead; to do so may cause a ground loop and oscillations.
6. Do not operate the amplifier from power mains which exceed the indicated mains voltage by more the 10%.
7. Never connect the output of the amplifier to another power source such as a battery or power main.
8. Do not expose the amplifier to corrosive chemicals such as lye, soft drinks, salt water, etc. Also, never immerse the amplifier in any liquid.
9. Do not remove the amplifier's cover.
10. The amplifier is designed for full power operation over the 20-20kHz audio band. High power operation above 20kHz should be avoided.
11. Neither the amplifier, nor any of its leads, should be exposed to areas likely to be struck by lightning.

320B-01 CIRCUIT DESCRIPTION

POWER SUPPLY

The AC input power goes through the power switch magnetic circuit breaker CB301, to the power transformer T301 via TB301 input AC voltage selection terminal strip.

The low voltage secondary (Sec 2) 12 volts AC, is rectified and current limited through D302 and R301 to light the power on LED D305.

The high voltage center tapped secondary (Sec 1), 76 volts AC, is connected to a full wave bridge rectifier, D301 and a capacitor input filter, C302 and C303, to give a +55 volts DC output.

Capacitor C301 and C306 across the Bridge Rectifier suppresses any high frequency noise that might be coupled through the transformer or generated by the Bridge Rectifier. The primary windings of the power transformer have a built-in Thermo Switch to protect from overloading of the high voltage secondary (Drawing too much power out of the transformer) and a fusible link to protect the low voltage 12V secondary.

INPUT CIRCUIT

Input from the Barrier Strip TB303 goes through J308 optional input transformer socket to the input jack J301, this input can be balanced using a transformer or unbalanced with jumper plug installed. Input Jack J301 (unbalanced only) is fed to Input Step Attenuator Control R302. The Output from the controls goes to the amplifier circuit through the connector P301.

AMPLIFIER

The input signal from pin 4 of J101 is applied to the base of Q101 through the coupling network C101, C102, R101, R102 and R103. This network provides a high input impedance to the amplifier and filters out DC and radio frequency interference.

Q101 is a low noise matched dual transistor connected as a differential input stage. The output of Q101 is Push Pull. This signal drives the emitters of Q102 and Q103. Q102 and Q103 are connected as a common base amplifiers. This stage acts as a voltage translator and removes Vce distortion from Q101. The output of Q102 and Q103 drives Q108 and Q109. Q108 and Q109 are connected as common emitter voltage amplifier stages. The output from Q109 (positive phase) drives the two driver stages Q111 and Q112, Vbe multiplier Q110 and the current mirror Q106/Q104.

The network consisting of R143, R144, R145, C118, D107 and D108 provides a small amount of DC bias to trim the amplifier output to zero volts.

The network consisting of R107, R146 and C104 form a delayed (slow on, slow off) current source to feed Q101. This means no turn on or turn off thumps.

Q110 is a V_{be} multiplier stage to provide bias voltage for the output stage to keep idle bias current at a constant level as the temperature changes.

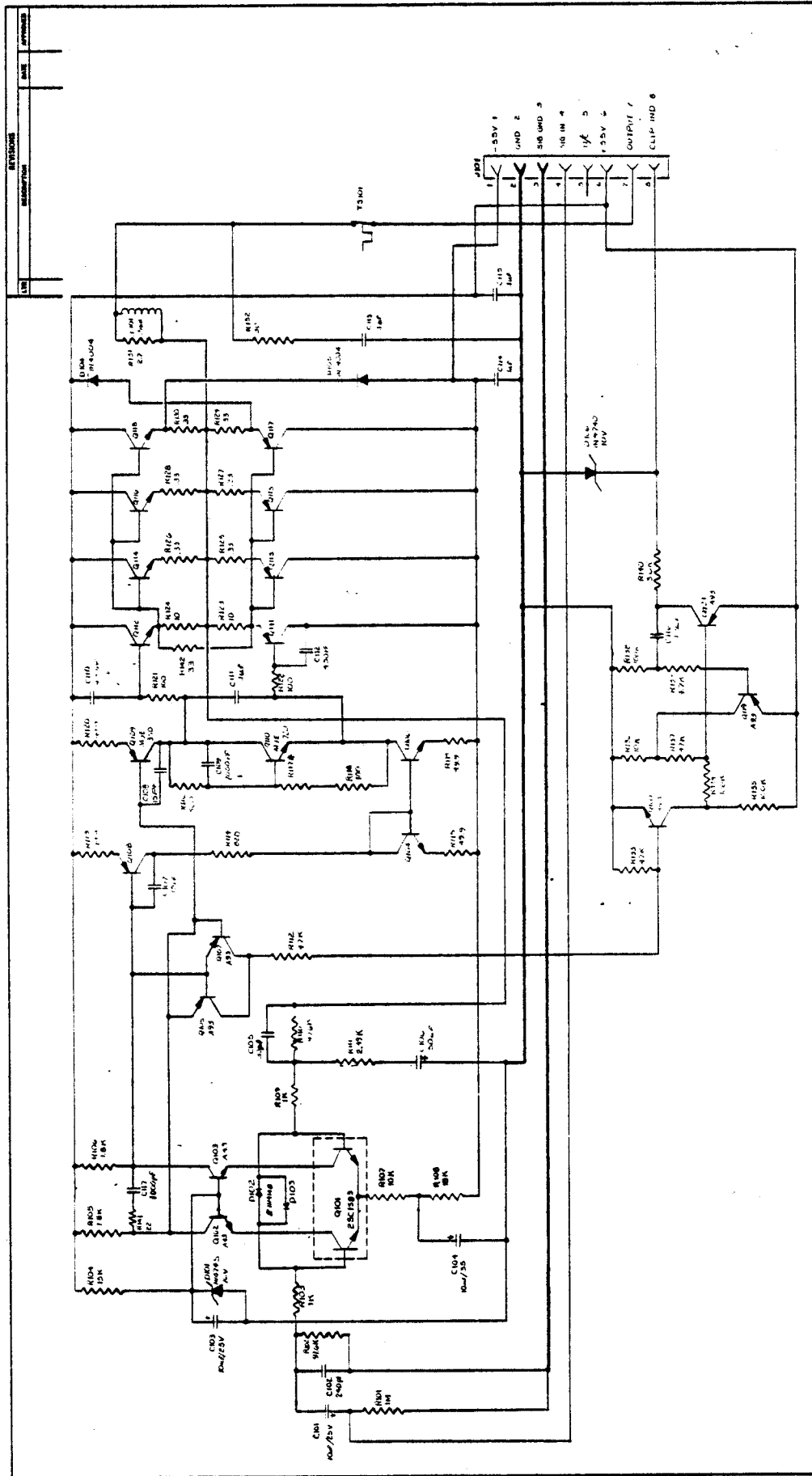
Q104 and Q106 form a current mirror stage that acts as load for Q108 and Q109. The current mirror stage uses base emitter diode only of Q104 to match base emitter diode of Q106. As more collector current is pulled from the collector of Q106, (Q109 is turning on harder) an equal and opposite amount of current is removed from Q104. Hence, the current of Q104 plus the current of Q106 is a constant level of current.

Q111 and Q112 are connected common collector to provide the current gain necessary to drive the output transistors Q112 through Q118. Q113 through Q118 are connected as common collector stages.

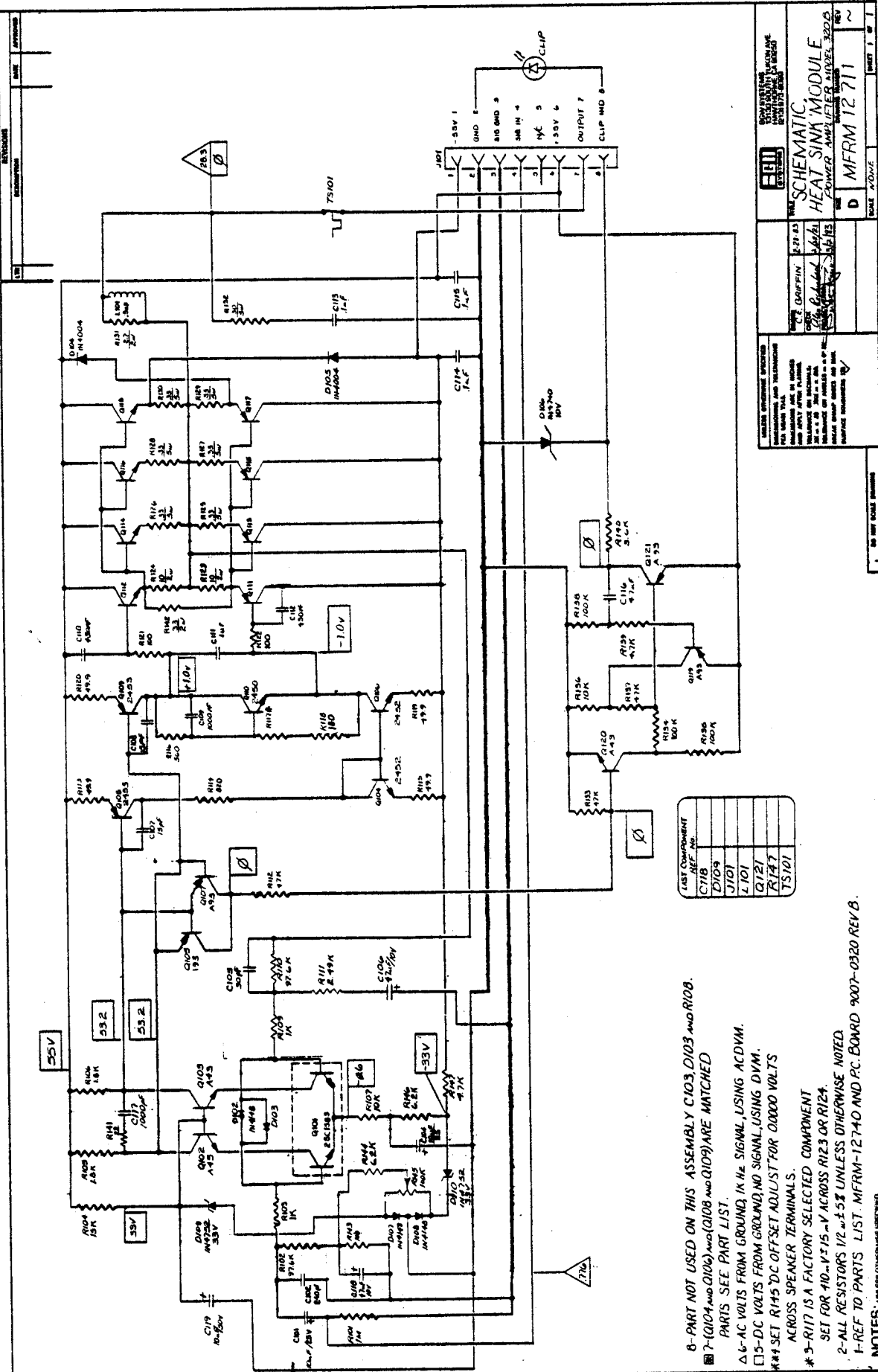
The output appears across flyback clipping diodes D104 and D105, then passes through compensation networks L101/R131 and R132/C113 through the thermal switch S101, then to pin 7 of P101. If the temperature of the output transistors reaches 90 degrees C, S101 opens and disconnects the load.

To maintain overall amplifier stability, linearity, and low distortion, degenerative feedback is used throughout the amplifier. Voltage divider R111/C106 and R110 applies the correct amount of feedback to the inverting input of Q101. Except for the input, and feedback loop, the amplifier uses direct coupling throughout.

Q105, Q107 & Q119-Q121 comprise the clipping indicator circuit. When the amplifier is driven into clipping, a voltage of sufficient magnitude to turn on Q105 or Q107 is generated at the output of Q102 and Q103. The current through R112 turns on Q120. This voltage appears because the amplifier is trying to compensate for the fact that the clipped feedback signal does not match the unclipped input signal. When Q120 turns on, the base of Q121 is driven negative through R134, so Q121 turns on. This turns on the LED clipping indicator, and pulls the base of Q119 positive, through R139 and C116, which shuts off Q119. As long as Q119 is off, the base of Q121 is not held negative through R136 and R137, so Q121 stays on. As C116 charges through R138, the base of Q119 becomes negative until Q119 turns on, which shuts off Q121 and the LED. Thus the length of time that the LED is held on is determined by R138 and C116. The zener diode D106 limits the open circuit voltage to the clip indicator LED to prevent a shock hazard.



REVISIONS	DATE	APPROVED					
			SCHEMATIC HEAT SINK MODULE FOR POWER SUPPLY SYSTEM				
			DRAWN: G.P.H. (5/7/61) CHECKED: J.P.H. (5/7/61) DESIGNED: J.P.H. (5/7/61) PROJECT: 100-100-100				
			D MFRM 11-710 SCALE 2:000 SHEET 1 OF 1				
<p>UNLESS OTHERWISE SPECIFIED DIMENSIONS AND TOLERANCES PER MIL-STD-200 SHALL APPLY AFTER PLATING TOLERANCES ON DIMENSIONS SHALL BE AS SHOWN ON DRAWING UNLESS OTHERWISE SPECIFIED SURFACE FINISHES TO SURFACE FINISHES IN</p>							
DO NOT SCALE DRAWING							
<p>1- REF TO PARTS LIST NOTES: UNLESS OTHERWISE SPECIFIED</p>							

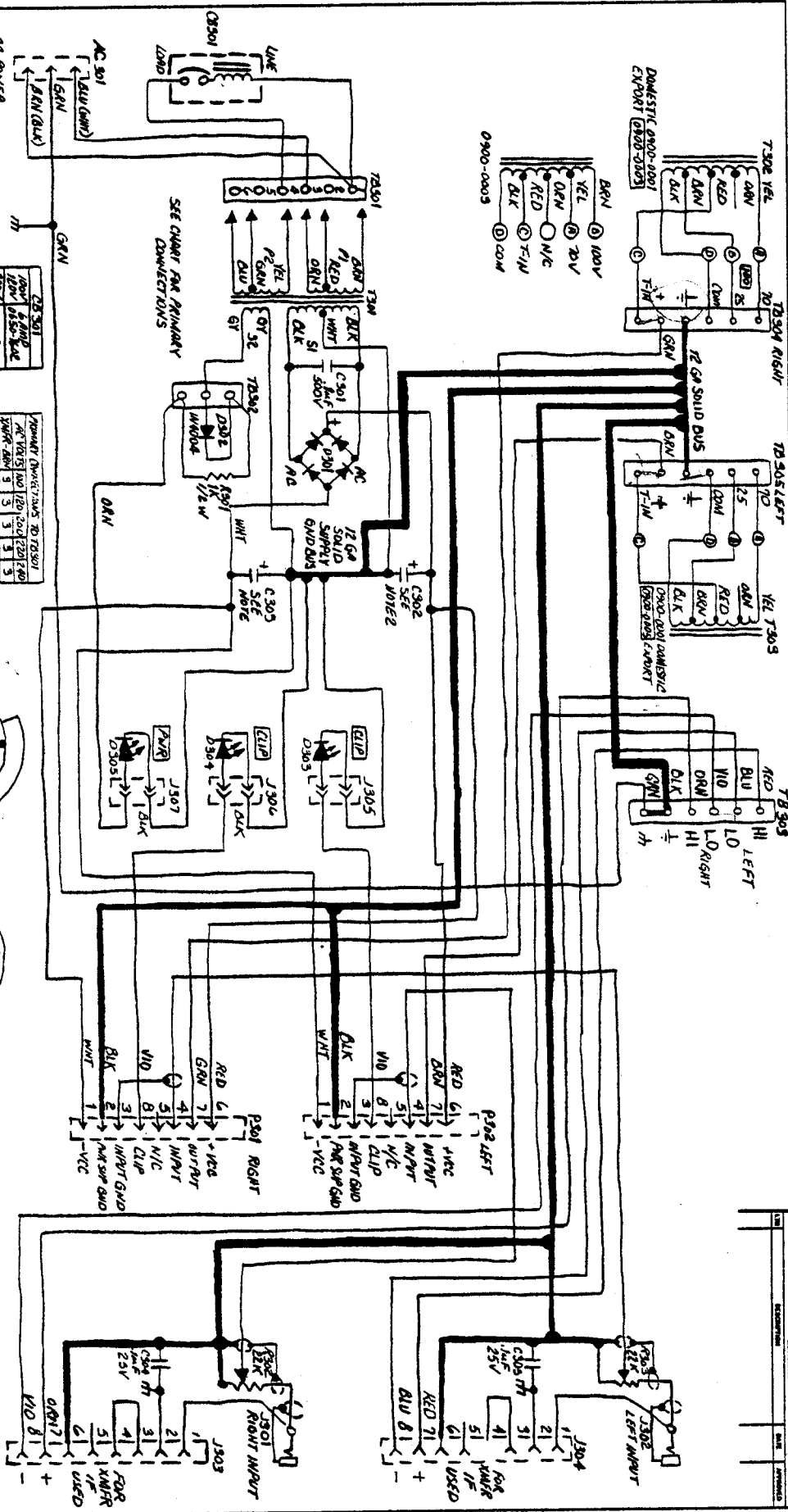


LIST COMPONENT	REF. DES.	VAL.
C103	1000P	1000P
C104	1000P	1000P
C105	1000P	1000P
C106	1000P	1000P
C107	1000P	1000P
C108	1000P	1000P
C109	1000P	1000P
C110	1000P	1000P
C111	1000P	1000P
C112	1000P	1000P
C113	1000P	1000P
C114	1000P	1000P
C115	1000P	1000P
C116	1000P	1000P
C117	1000P	1000P
C118	1000P	1000P
C119	1000P	1000P
C120	1000P	1000P
C121	1000P	1000P
C122	1000P	1000P
C123	1000P	1000P
C124	1000P	1000P
C125	1000P	1000P
C126	1000P	1000P
C127	1000P	1000P
C128	1000P	1000P
C129	1000P	1000P
C130	1000P	1000P
C131	1000P	1000P
C132	1000P	1000P
C133	1000P	1000P
C134	1000P	1000P
C135	1000P	1000P
C136	1000P	1000P
C137	1000P	1000P
C138	1000P	1000P
C139	1000P	1000P
C140	1000P	1000P
C141	1000P	1000P
C142	1000P	1000P
C143	1000P	1000P
C144	1000P	1000P
C145	1000P	1000P
C146	1000P	1000P
C147	1000P	1000P
C148	1000P	1000P
C149	1000P	1000P
C150	1000P	1000P
C151	1000P	1000P
C152	1000P	1000P
C153	1000P	1000P
C154	1000P	1000P
C155	1000P	1000P
C156	1000P	1000P
C157	1000P	1000P
C158	1000P	1000P
C159	1000P	1000P
C160	1000P	1000P
C161	1000P	1000P
C162	1000P	1000P
C163	1000P	1000P
C164	1000P	1000P
C165	1000P	1000P
C166	1000P	1000P
C167	1000P	1000P
C168	1000P	1000P
C169	1000P	1000P
C170	1000P	1000P
C171	1000P	1000P
C172	1000P	1000P
C173	1000P	1000P
C174	1000P	1000P
C175	1000P	1000P
C176	1000P	1000P
C177	1000P	1000P
C178	1000P	1000P
C179	1000P	1000P
C180	1000P	1000P
C181	1000P	1000P
C182	1000P	1000P
C183	1000P	1000P
C184	1000P	1000P
C185	1000P	1000P
C186	1000P	1000P
C187	1000P	1000P
C188	1000P	1000P
C189	1000P	1000P
C190	1000P	1000P
C191	1000P	1000P
C192	1000P	1000P
C193	1000P	1000P
C194	1000P	1000P
C195	1000P	1000P
C196	1000P	1000P
C197	1000P	1000P
C198	1000P	1000P
C199	1000P	1000P
C200	1000P	1000P

6- PART NOT USED ON THIS ASSEMBLY C103, D103 AND R108.
 7-(Q104 AND Q106) AND (Q108 AND Q109) ARE MATCHED
 PARTS SEE PART LIST.
 Δ 6-AC VOLTS FROM GROUND, 1K Hz SIGNAL, USING AC DVM.
 □ 5-DC VOLTS FROM GROUND, NO SIGNAL, USING DVM.
 *#1 SET R145 DC OFFSET ADJUST FOR 0.000 VOLTS
 ACROSS SPEAKER TERMINALS.
 * 3-R117 IS A FACTORY SELECTED COMPONENT
 SET FOR 410-V²/15-V ACROSS R123 OR R124.
 2-ALL RESISTORS 1/2 ± 5% UNLESS OTHERWISE NOTED.
 1-REF TO PARTS LIST MFRM-12740 AND P.C. BOARD 9007-0320 REV B.

SCHEMATIC
 HEAT SINA MODULE
 POWER AMPLIFIER MODEL 3008
 DATE: 12-21-63
 BY: [Signature]
 CHECKED: [Signature]
 APPROVED: [Signature]
 PARTS LIST: MFRM 12711
 SCALE: 2:00VE
 SHEET 1 OF 1

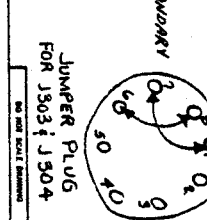
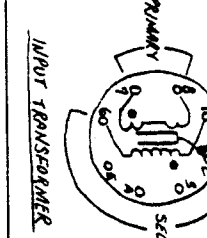
REVISED: _____
 DATE: _____
 APPROVED: _____



BASE PARTS LIST MFRM 12040
 1-REF-MODEL 300B
 NOTES: 1. WIRE SIZE DESIGNATED OTHERWISE

WIRE SIZE	WIRE COLOR	WIRE SIZE	WIRE COLOR
18	RED	18	RED
18	GRN	18	GRN
18	BLK	18	BLK
18	WHT	18	WHT
18	BLU	18	BLU
18	OR	18	OR
18	YEL	18	YEL
18	PUR	18	PUR
18	BRO	18	BRO
18	SLV	18	SLV
18	GRY	18	GRY
18	BRN	18	BRN
18	TRG	18	TRG
18	PKI	18	PKI
18	MAU	18	MAU
18	LSI	18	LSI
18	LSB	18	LSB
18	LSG	18	LSG
18	LSH	18	LSH
18	LSM	18	LSM
18	LSN	18 </tr	

WIRE SIZE	WIRE COLOR	WIRE SIZE	WIRE COLOR
18	RED	18	RED
18	GRN	18	GRN
18	BLK	18	BLK
18	WHT	18	WHT
18	BLU	18	BLU
18	OR	18	OR
18	YEL	18	YEL
18	PUR	18	PUR
18	BRO	18	BRO
18	SLV	18	SLV
18	GRY	18	GRY
18	BRN	18	BRN
18	TRG	18	TRG
18	PKI	18	PKI
18	MAU	18	MAU
18	LSI	18	LSI
18	LSB	18	LSB
18	LSG	18	LSG
18	LSH	18	LSH
18	LSM	18	LSM
18	LSN	18	LSN



WIRE COLOR CHART
 RED 61
 GRN 71
 WHT 41
 WHT 51
 WHT 61
 WHT 71
 WHT 81
 WHT 91
 WHT 101
 WHT 111
 WHT 121
 WHT 131
 WHT 141
 WHT 151
 WHT 161
 WHT 171
 WHT 181
 WHT 191
 WHT 201
 WHT 211
 WHT 221
 WHT 231
 WHT 241
 WHT 251
 WHT 261
 WHT 271
 WHT 281
 WHT 291
 WHT 301
 WHT 311
 WHT 321
 WHT 331
 WHT 341
 WHT 351
 WHT 361
 WHT 371
 WHT 381
 WHT 391
 WHT 401
 WHT 411
 WHT 421
 WHT 431
 WHT 441
 WHT 451
 WHT 461
 WHT 471
 WHT 481
 WHT 491
 WHT 501
 WHT 511
 WHT 521
 WHT 531
 WHT 541
 WHT 551
 WHT 561
 WHT 571
 WHT 581
 WHT 591
 WHT 601
 WHT 611
 WHT 621
 WHT 631
 WHT 641
 WHT 651
 WHT 661
 WHT 671
 WHT 681
 WHT 691
 WHT 701
 WHT 711
 WHT 721
 WHT 731
 WHT 741
 WHT 751
 WHT 761
 WHT 771
 WHT 781
 WHT 791
 WHT 801
 WHT 811
 WHT 821
 WHT 831
 WHT 841
 WHT 851
 WHT 861
 WHT 871
 WHT 881
 WHT 891
 WHT 901
 WHT 911
 WHT 921
 WHT 931
 WHT 941
 WHT 951
 WHT 961
 WHT 971
 WHT 981
 WHT 991
 WHT 1001

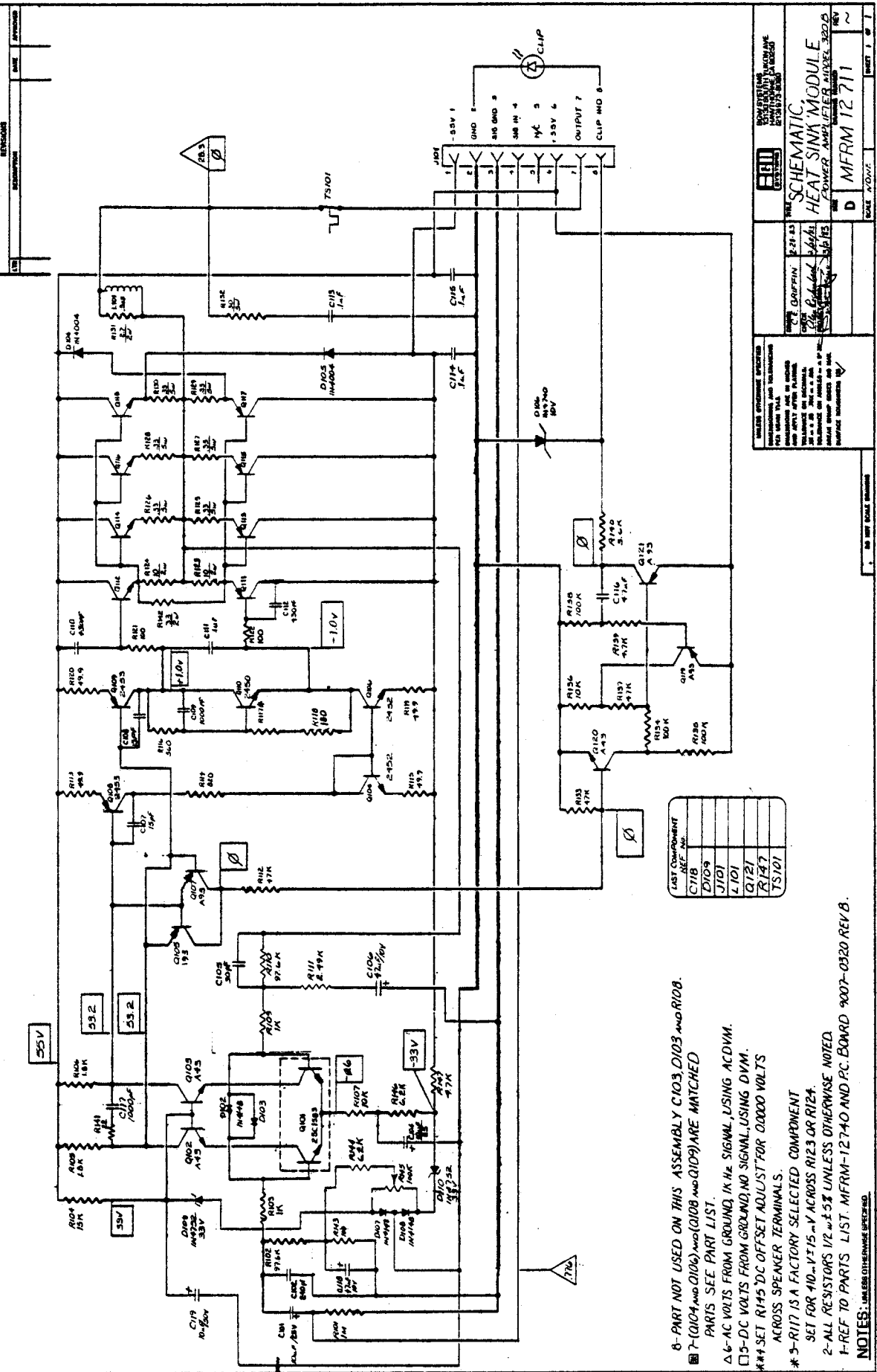
WIRING, POWER AMP 300B
 MFRM-12720

DATE: _____

BY: _____

REVISION: _____

APPROVED: _____



LAST COMPONENT SET NO.	
C116	
D105	
J101	
L101	
G121	
R147	
TS101	

- 8- PART NOT USED ON THIS ASSEMBLY C103, D103 AND R108.
- 7- (C104, AND C106), (D108 AND D109) ARE MATCHED PARTS SEE PART LIST.
- 6- AC VOLTS FROM GROUND, IN THE SIGNAL, USING ACVDM.
- 5- DC VOLTS FROM GROUND, NO SIGNAL, USING DVM.
- 4- SET R145 DC OFFSET ADJUST FOR 0.0000 VOLTS ACROSS SPEAKER TERMINALS.
- * 5- R117 IS A FACTORY SELECTED COMPONENT SET FOR 410-4715-VY ACROSS R123 OR R124.
- 2- ALL RESISTORS 1/2 W ± 5% UNLESS OTHERWISE NOTED.
- 1- REF TO PARTS LIST, MFRM-12740 AND PC BOARD 9007-0320 REV B.

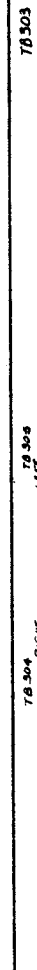
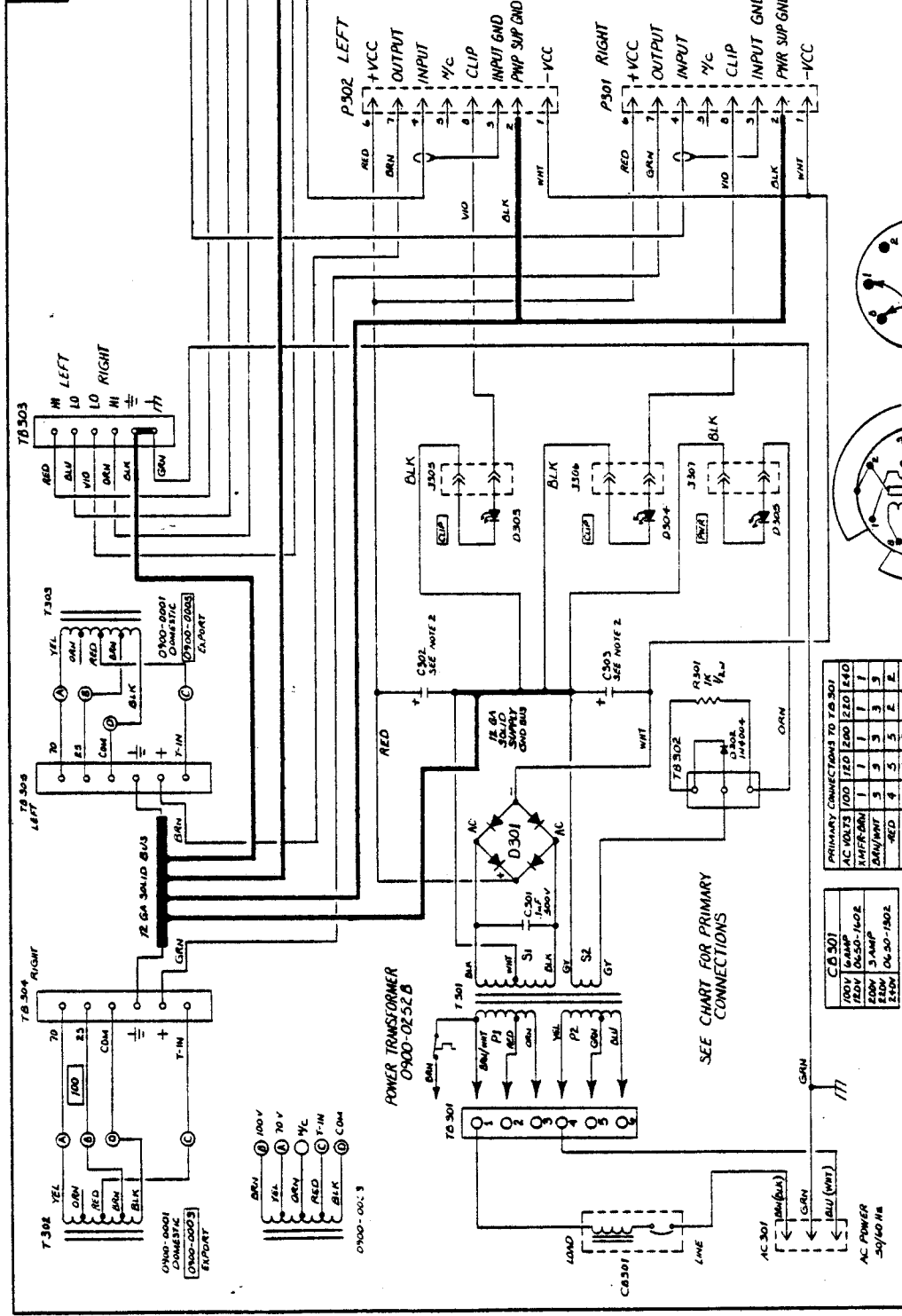
ELLIOTT
 COMMUNICATIONS DIVISION
 2700 UNIVERSITY AVENUE
 BOSTON, MASSACHUSETTS 02116

SCHEMATIC
 HEAT SINK MODULE
 POWER AMPLIFIER MODEL 302A

DATE: 12-15-64
 DRAWN BY: J. G. GRIFIN
 CHECKED BY: J. G. GRIFIN
 APPROVED BY: J. G. GRIFIN
 SCALE: 1:1

SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED
 ALL DIMENSIONS ARE IN INCHES
 DIMENSIONS IN PARENTHESES
 INDICATE FRACTIONS
 DIMENSIONS ON ANGLES ARE IN DEGREES
 UNLESS OTHERWISE SPECIFIED



POWER TRANSFORMER
 0900-0252 B

SEE CHART FOR PRIMARY CONNECTIONS

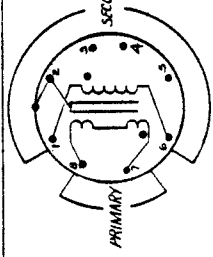
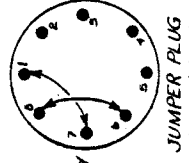
PRIMARY CONNECTIONS TO T301

AC VOLTS	100	120	220	240	E40
AMPERES	1	1	1	1	1
WAVEFORM	5	5	5	5	5
RED	5	5	5	5	5
GRN	5	5	5	5	5
YEL	5	5	5	5	5
BLK	5	5	5	5	5
WHT	5	5	5	5	5
BLU	5	5	5	5	5
BRN	5	5	5	5	5
PKT	5	5	5	5	5

NUMBERS SHOWN ARE TERMINALS ON T301 AND ARE READ FROM TOP TO BOTTOM AS INDICATED INSIDE UNIT ON REAR PANEL.

C8301

100V	6AMP
REV	0.5-1/2E
200V	3 AMP
REV	0L-30-150Z
250V	



RAY

SCHEMATIC CHASSIS WIRING POWER AMP MODEL 320 B

FORM 12721 A

DATE 7-7-53

WORKSHEET NO. 1 OF 1

REVISIONS:

1. REVISED SCHEMATIC

2. REVISED SCHEMATIC

3. REVISED SCHEMATIC

4. REVISED SCHEMATIC

5. REVISED SCHEMATIC

6. REVISED SCHEMATIC

7. REVISED SCHEMATIC

8. REVISED SCHEMATIC

9. REVISED SCHEMATIC

10. REVISED SCHEMATIC

11. REVISED SCHEMATIC

12. REVISED SCHEMATIC

13. REVISED SCHEMATIC

14. REVISED SCHEMATIC

15. REVISED SCHEMATIC

16. REVISED SCHEMATIC

17. REVISED SCHEMATIC

18. REVISED SCHEMATIC

19. REVISED SCHEMATIC

20. REVISED SCHEMATIC

21. REVISED SCHEMATIC

22. REVISED SCHEMATIC

23. REVISED SCHEMATIC

24. REVISED SCHEMATIC

25. REVISED SCHEMATIC

26. REVISED SCHEMATIC

27. REVISED SCHEMATIC

28. REVISED SCHEMATIC

29. REVISED SCHEMATIC

30. REVISED SCHEMATIC

31. REVISED SCHEMATIC

32. REVISED SCHEMATIC

33. REVISED SCHEMATIC

34. REVISED SCHEMATIC

35. REVISED SCHEMATIC

36. REVISED SCHEMATIC

37. REVISED SCHEMATIC

38. REVISED SCHEMATIC

39. REVISED SCHEMATIC

40. REVISED SCHEMATIC

41. REVISED SCHEMATIC

42. REVISED SCHEMATIC

43. REVISED SCHEMATIC

44. REVISED SCHEMATIC

45. REVISED SCHEMATIC

46. REVISED SCHEMATIC

47. REVISED SCHEMATIC

48. REVISED SCHEMATIC

49. REVISED SCHEMATIC

50. REVISED SCHEMATIC

51. REVISED SCHEMATIC

52. REVISED SCHEMATIC

53. REVISED SCHEMATIC

54. REVISED SCHEMATIC

55. REVISED SCHEMATIC

56. REVISED SCHEMATIC

57. REVISED SCHEMATIC

58. REVISED SCHEMATIC

59. REVISED SCHEMATIC

60. REVISED SCHEMATIC

61. REVISED SCHEMATIC

62. REVISED SCHEMATIC

63. REVISED SCHEMATIC

64. REVISED SCHEMATIC

65. REVISED SCHEMATIC

66. REVISED SCHEMATIC

67. REVISED SCHEMATIC

68. REVISED SCHEMATIC

69. REVISED SCHEMATIC

70. REVISED SCHEMATIC

71. REVISED SCHEMATIC

72. REVISED SCHEMATIC

73. REVISED SCHEMATIC

74. REVISED SCHEMATIC

75. REVISED SCHEMATIC

76. REVISED SCHEMATIC

77. REVISED SCHEMATIC

78. REVISED SCHEMATIC

79. REVISED SCHEMATIC

80. REVISED SCHEMATIC

81. REVISED SCHEMATIC

82. REVISED SCHEMATIC

83. REVISED SCHEMATIC

84. REVISED SCHEMATIC

85. REVISED SCHEMATIC

86. REVISED SCHEMATIC

87. REVISED SCHEMATIC

88. REVISED SCHEMATIC

89. REVISED SCHEMATIC

90. REVISED SCHEMATIC

91. REVISED SCHEMATIC

92. REVISED SCHEMATIC

93. REVISED SCHEMATIC

94. REVISED SCHEMATIC

95. REVISED SCHEMATIC

96. REVISED SCHEMATIC

97. REVISED SCHEMATIC

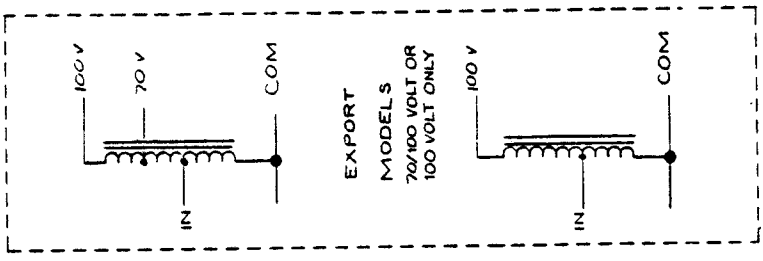
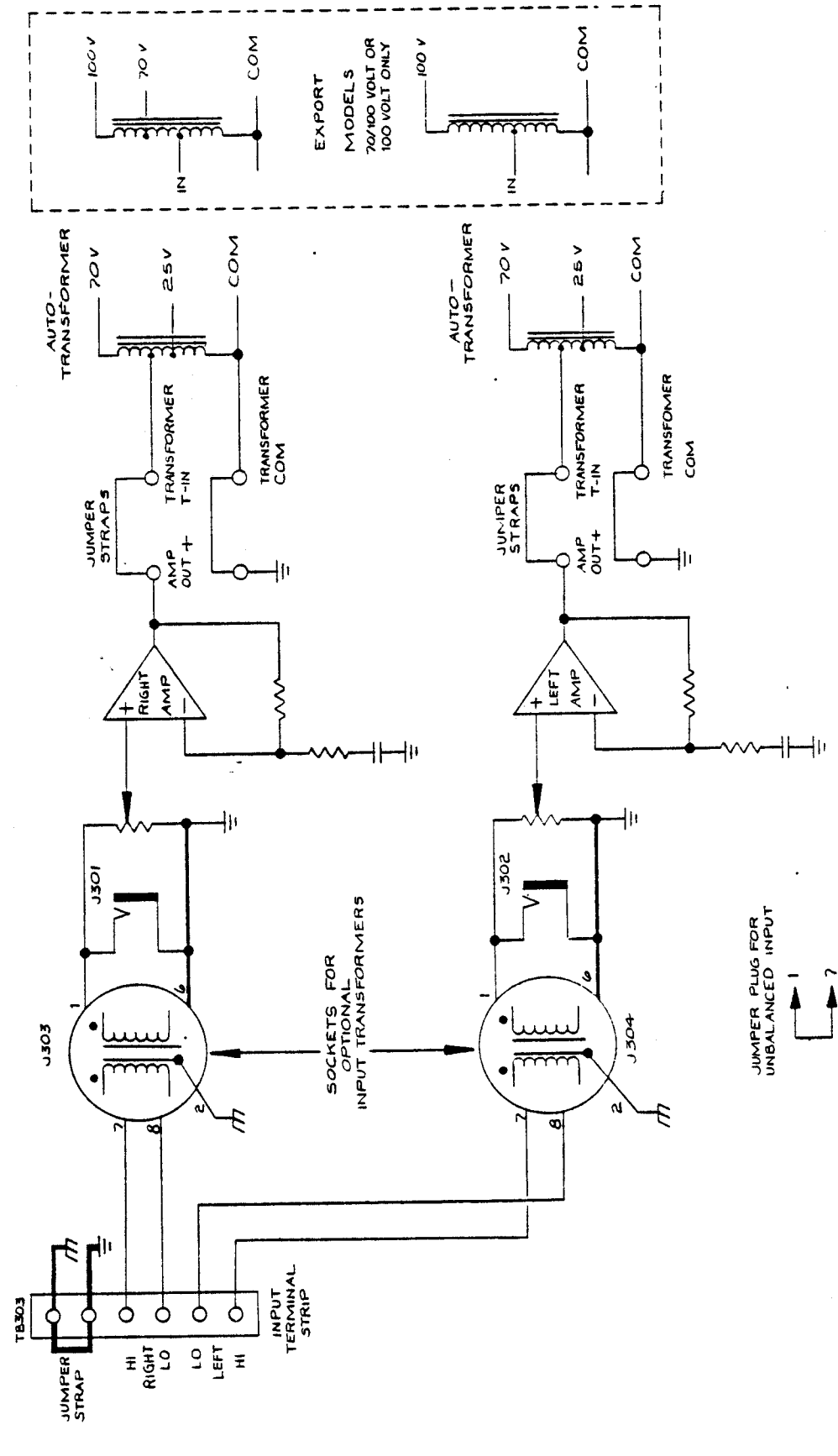
98. REVISED SCHEMATIC

99. REVISED SCHEMATIC

100. REVISED SCHEMATIC

R-SEE PARTS LIST MFRM-12740.
 P-REF-MODEL 320 B.
 NOTES: 1. USE 100V 6AMP 0.5-1/2E 250V 3 AMP 0L-30-150Z

REVISIONS	DATE	APPROVED
LTR		



		BGM SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8060	
TITLE BLOCK DIAGRAM MODEL 320B		DRAWING NUMBER MFRM-12730	
DRAWN <i>[Signature]</i>		SIZE C	
CHECKED <i>[Signature]</i>		SCALE <i>None</i>	
PROJECT ENGINEER <i>[Signature]</i>		REV 1	
PROJECT NUMBER 9A/81		SHEET 1 OF 1	

UNLESS OTHERWISE SPECIFIED
DIMENSIONING AND TOLERANCING
PER USAS Y14.5.

DIMENSIONS ARE IN INCHES
AND APPLY AFTER PLATING.

TOLERANCE ON DECIMALS:
XX = ±.05
XXX = ±.010

TOLERANCE ON ANGLES = ±.0°

BREAK SHARP EDGES .010 MAX.
SURFACE ROUGHNESS 12.5

DO NOT SCALE DRAWING

⊥ CIRCUIT GROUND.
⏏ CHASSIS GROUND.

NOTES: UNLESS OTHERWISE SPECIFIED.

© BGM SYSTEMS, INC. 1978

BGW SYSTEMS, INC.

ENG NO	DESCRIPTION	PART NO
***** PARTS LIST MODEL 3208 *****BG 12740		
	SCHEMATIC HEATSINK	MFRM-12710
	SCHEMATIC HEATSINK DC OFFSET ADJ	MFRM-12711
	SCHEMATIC POWER SUPPLY	MFRM-12720
	BLOCK DIAGRAM	MFRM-12730
NOTE**	ALL COMPONENTS WITH DESIGNATIONS IN THE 100 SERIES ARE LEFT CHANNEL COMPONENTS. ALL COMPONENTS WITH DESIGNATIONS IN THE 200 SERIES ARE RIGHT CHANNEL COMPONENTS ---REFER TO 100 SERIES NUMBERS ---EXAMPLE C201 IS THE SAME AS C101.	
***** AC CORD *****		
AC301	3-COND 16-GA PARALLEL-BLADE U-GROUND AMERICAN	8709-0163
***** CAPACITORS *****		
C101	10UF 50V ELECTROLYTIC	0456-0010
C102	240PF 500V MICA	0090-0240
C103	10UF 50V ELECTROLYTIC	0456-0010
C104	10UF 50V ELECTROLYTIC	0456-0010
C105	30PF 100V MICA	0060-0030
C106	50UF 12V ELECTROLYTIC	0456-0050
C107	15PF 300V CERAMIC DISC	0060-0015
C108	15PF 300V CERAMIC DISC	0060-0015
C109	1000PF 1KV CERAMIC DISC	0100-1000
C110	430PF 100V MICA	0060-0430
C111	.1UF 25V CERAMIC DISC	0129-0100
C112	430PF 100V MICA	0060-0430
C113	.1UF 100V MYLAR	0369-0100
C114	.1UF 100V MYLAR	0369-0100
C115	.1UF 100V MYLAR	0369-0100
C116	.47UF 100V MYLAR	0363-8000
C117	1000PF 1KV CERAMIC DISC	0100-1000
C118	47UF 10V ELECTROLYTIC	0456-0047
C119	10UF 50V ELECTROLYTIC	0456-0010
C301	.1UF 500V CERAMIC DISC	0199-0100
C302	10000UF 75V COMP GRADE ELECTROLYTIC	0543-0010
C303	10000UF 75V COMP GRADE ELECTROLYTIC	0543-0010
C304	.1UF 25V CERAMIC DISC	0129-0100
C305	.1UF 25V CERAMIC DISC	0129-0100
***** CIRCUIT BREAKER *****		
CB301	CIRCUIT BREAKER	100/120 VAC 6 AMP 0650-1602 200/220/240 VAC 3 AMP 0650-1302

BGW SYSTEMS, INC.

ENG NO	DESCRIPTION	PART NO
***** DIODES *****		
D101	1N4745 16V ZENER DIODE	1900-4745
D102	1N4148 DIODE	1900-4148
D103	1N4148 SI DIODE	1900-4148
D103	1N4148 DIODE	1900-4148
D104	1N4004 DIODE	5005-4004
D105	1N4004 DIODE	1900-4004
D106	1N4740 10V ZENER DIODE	1900-4740
D107	1N4148 SI DIODE	1900-4148
D108	1N4148 SI DIODE	1900-4148
D109	1N4752 33V ZENER DIODE	1900-4752
D110	1N4752 33V ZENER DIODE	1900-4752
D301	BRIDGE RECTIFIER	1886-2502
D302	1N4004 DIODE	1900-4004
D303	LED RED	1990-5053
D304	LED RED	1990-5053
D305	LED RED	1990-5053
***** JACKS *****		
J101	8 PIN PC MOUNT OCTAL SOCKET	1202-0008
J301	2 COND 1/4 INCH INSULATED PHONE JACK	9999-0111
J302	2 COND 1/4 INCH INSULATED PHONE JACK	9999-0111
J303	8 PIN OCTAL SOCKET w/ MTG RING	1203-0008
J304	8 PIN OCTAL SOCKET w/ MTG RING	1203-0008
J305	2 PIN MOLEX SOCKET	1200-2021
J306	2 PIN MOLEX SOCKET	1200-2021
J307	2 PIN MOLEX SOCKET	1200-2021
***** INDUCTOR *****		
L101	.5UH INDUCTOR	9999-2405
***** PLUGS *****		
P301	8 PIN OCTAL PLUG	1350-0008
P302	8 PIN OCTAL PLUG	1350-0008
	8 PIN JUMPER PLUG ASSEMBLY	1350-0109
***** TRANSISTORS *****		
Q101	2SC1583 DUAL NPN LO-NOISE	1854-1583
Q102	MPS A43 NPN SI LOW SIGNAL TO-92	1854-0043
Q103	MPS A43 NPN SI LOW SIGNAL TO-92	1854-0043

BGW SYSTEMS. INC.

ENG NO	DESCRIPTION	PART NO
Q104*	NPN SI MED POWER PLASTIC TO-126	1854-2452
Q105	MPS A93 PNP SI LOW SIGNAL TO-92	1853-0093
Q106*	NPN SI MED POWER PLASTIC TO-126	1854-2452
Q107	MPS A93 PNP SI LOW SIGNAL TO-92	1853-0093
Q108*	PNP SI MED POWER PLASTIC TO-126	1853-2453
Q109*	PNP SI MED POWER PLASTIC TO-126	1853-2453
Q110	NPN SI MED POWER PLASTIC TO-126	1854-2450
Q111	2N6469/67571 PNP SI MED POWER TO-66	1853-6468
Q112	2N3583/67570 NPN SI MED POWER TO-66	1854-3583
Q113	SJ9216 PNP SI POWER TO-3	1853-9216
Q114	SJ9215 NPN SI POWER TO-3	1854-9216
Q115	SJ9216 PNP SI POWER TO-3	1853-9216
Q116	SJ9215 NPN SI POWER TO-3	1854-9215
Q117	SJ9216 PNP SI POWER TO-3	1853-9216
Q118	SJ9215 NPN SI POWER TO-3	1854-9215
Q119	MPS A93 PNP SI LOW SIGNAL TO-92	1853-0093
Q120	MPS A43 NPN SI LOW SIGNAL TO-92	1854-0043
Q121	MPS A93 PNP SI LOW SIGNAL TO-92	1853-0093
*	Q104 & Q106 ARE MATCHED PAIRS	
*	Q108 & Q109 ARE MATCHED PAIRS	

***** RESISTORS *****

R101	1MEG 1/2W 5% DEPOSITED CARBON	5005-1006
R102	97.6K 1/4W 1% METAL FILM	5001-9762
R103	1K 1/2W 5% DEPOSITED CARBON	5005-1003
R104	15K 1/2W 5% DEPOSITED CARBON	5005-1503
R105	1.8K 1/2W 5% DEPOSITED CARBON	5005-1802
R106	1.8K 1/2W 5% DEPOSITED CARBON	5005-1802
R107	10K 1/2W 5% DEPOSITED CARBON	5005-1004
R147	4.7K 1/2W 5% DEPOSITED CARBON	5005-4702
R108	18K 1/2W 5% DEPOSITED CARBON	5005-6202
R109	1K 1/2W 5% DEPOSITED CARBON	5005-1003
R110	97.6K 1/4W 1% METAL FILM	5001-9762
R111	2.49K 1/4W 1% METAL FILM	5001-2491
R112	47K 1/2W 5% DEPOSITED CARBON	5005-4703
R113	49.9R 1/4W 1% METAL FILM	5001-4990
R114	820R 1/2W 5% DEPOSITED CARBON	5005-8201
R115	49.9R 1/4W 1% METAL FILM	5001-4990
R116	560R 1/2W 1% DEPOSITED CARBON	5005-5601
R117	FACTORY SELECTED COMPONENT	
R118	180R 1/2W 5% DEPOSITED CARBON	5005-1801
R119	49.9R 1/4W 1% METAL FILM	5001-4990
R120	49.9R 1/4W 1% METAL FILM	5001-4990
R121	100R 1/2W 5% DEPOSITED CARBON	5005-1002
R122	100R 1/2W 5% DEPOSITED CARBON	5005-1002
R123	10R 2W 5% WIREWOUND BWH	4025-1001
R124	10R 2W 5% WIREWOUND BWH	4025-1001
R125	.33R 5W WIREWOUND	4050-0330
R126	.33R 5W WIREWOUND	4050-0330

BGW SYSTEMS, INC.

ENG NO	DESCRIPTION	PART NO
R127	.33R 5W WIREWOUND	4050-0330
R128	.33R 5W WIREWOUND	4050-0330
R129	.33R 5W WIREWOUND	4050-0330
R130	.33R 5W WIREWOUND	4050-0330
R131	2.7R 2W 5% WIREWOUND BWH	4025-2070
R132	30R 5W WIREWOUND	4050-3001
R133	47K 1/2W 5% DEPOSITED CARBON	5005-4703
R134	100K 1/2W 5% DEPOSITED CARBON	5005-1005
R135	100K 1/2W 5% DEPOSITED CARBON	5005-1005
R136	10K 1/2W 5% DEPOSITED CARBON	5005-1004
R137	47K 1/2W 5% DEPOSITED CARBON	5005-4703
R138	100K 1/2W 5% DEPOSITED CARBON	5005-1005
R139	4.7K 1/2W 5% DEPOSITED CARBON	5005-4702
R140	3.6K 1/2W 5% DEPOSITED CARBON	5005-3602
R141	22R 1/2W 5% DEPOSITED CARBON	5005-2200
R142	33R 2W 10% WIREWOUND BWH	4020-3300
R143	1000HM 1/2W 5% DEPOSITED CARBON	5005-1002
R144	6.2K 1/2W 5% DEPOSITED CARBON	5005-6202
R145	100K PC MOUNT TRIMMER POT	7100-1005
R146	6.2K 1/2W 5% DEPOSITED CARBON	5005-6202
R147	4.7K 1/2W 5% DEPOSITED CARBON	5005-4702
R301	1K 1/2W 5% DEPOSITED CARBON	5005-1003
***** TRANSFORMERS *****		
T301	POWER TRANSFORMER	0900-0252
T302	AUTO TRANSFORMER	25/70 VOLT 0900-0001
	AUTO TRANSFORMER	100 VOLT 0900-0002
	AUTO TRANSFORMER	70/100 VOLT 0900-0003
T303	SEE T302	
***** TERMINAL STRIPS *****		
T8301	6 LUG SLIP-ON BARRIER STRIP	0720-9126
T8302	3 LUG SOLDER TYPE TERMINAL STRIP	1231-3003
T8303	6 LUG SCREW TYPE BARRIER STRIP	0720-1697
T8304	6 LUG SCREW TYPE BARRIER STRIP	0720-1697
T8305	6 LUG SCREW TYPE BARRIER STRIP	0720-1697
***** THERMAL SWITCH *****		
TS101	THERMAL SWITCH 90°C OOR	0630-0001
***** MISCELLANEOUS *****		
2	.88 DIA KNOB METRIC SHAFT	0700-1113
10	4-40X3/8 PANHEAD MACHINE SCREW PHILLIPS CAD	2115-2375
10	COMPRESSION WASHER FOR CASE 77	8130-0000

BGW SYSTEMS, INC.

ENG NO	DESCRIPTION	PART NO
10	MICA INSULATOR TAB INSULCOTE	0723-5677
32	SHOULDER INSULATOR LONG SHANK	0723-3448
12	MICA INSULATOR TO-3 INSULCOTE	0723-5603
4	MICA INSULATOR TO-66 INSULCOTE	0723-5666
4	RUBBER BOOT FOR FEMALE SLIP-ON LUG	0723-6125
5	TERMINAL STRIP JUMPER STRAP	1231-0601
2	CAPACITOR CLAMPS	1235-0001
1	STRAIN RELIEF CLAMP	1235-6034
7	CRIMP ON ROUND LUG	1313-4123
14	INSULATED FEMALE SLIP-ON LUG	1321-5305
4	FEMALE SLIP-ON LUG	1322-9700
2	#6 SOLDER LUGS	1331-1416
6	MOLEX PIN FOR 2 PIN MOLEX SOCKET	1349-0114
12	10-32X1/2 PANHEAD MACHINE SCREW PHILLIPS BLK	2111-5500
4	4-40X1/4 PANHEAD MACHINE SCREW PHILLIPS CAD	2115-2250
32	6-32X5/8 PANHEAD MACHINE SCREW PHILLIPS CAD	2115-3625
2	6-32X3/8 FLATHEAD MACHINE SCREW PHILLIPS BLK	2311-3375
6	10-32X3/8 FLAT HEAD MACHINE SCREW ALLEN BLK	2331-5375
8	10-32X3/8 ALLEN SOC CAP SCREW	2431-5375
2	8-32X1/4 SOC SETSCREW CUP PT	2731-4250
8	6X3/8 PANHEAD SHEET METAL SCREW PHILLIPS BLK	3111-3312
4	8X1/2 PANHEAD SHEET METAL SCREW PHILIPS CAD	3115-4500
4	#4 ITL WASHER	8122-0000
37	#5 ITL WASHER	8132-0000
3	FIBER WASHER 1/8 ID 1/2 OD	8135-0001
3	FLAT FIBER WASHER 3/8X.195	8155-0000
3	#8 FLAT WASHER	8141-0000
6	#8 ITL WASHER	8142-0000
1	#8 ETL WASHER	8143-0000
10	#10 FLAT WASHER	8151-0000
16	#10 SPLIT LOCK WASHER	8154-0000
38	6-32X1/4 HEX NUTS	8530-0250
8	8-32X5/16 HEX KEP NUTS	8543-0312
6	10-32X3/8 HEX NUT W/ NYLON INSERT	8555-0375
.83 FT	HEAT SHRINK TUBING BLK	8901-0187
1	FRONT PANEL	9000-1321
1	TOP COVER	9005-1270
1	CARTON 23X17 7/8X8 7/8 PRINTED	9851-1250
.004	TAPE 3 EGGSHELL WHITE	9860-0002
1	BAG 10X6X.004 MIL	9899-0004
1	BAG 20X30X.004 MIL	9899-2030
.2 FT	GREY FOAM TAPE	9999-0010
42	TIE WRAP 5 1/2 IN	9999-0550
4	RUBBER FEET	9999-2085

POWER MAINS VOLTAGE CONVERSION
 POWER TRANSFORMERS MARKED 0900-0252B AND 0900-0411B
 FOR ALL MODELS EXCEPT MODEL 600's AND 600SP's

CAUTION: These servicing instructions are for use by qualified personnel only. To avoid electric shock do not perform any servicing other than that contained in the Operating Instructions, unless you are qualified to do so. Refer all servicing to qualified service personnel.

Voltage conversion should be done by a BGW Authorized Service Station only.

Terminal Strip Connections

The terminal strip (TB1) is located on the inside back wall of the chassis. To gain access, remove the eight screws holding the top cover. The chart below indicates the proper transformer connections for each voltage.

PRIMARY CONNECTIONS TO TB1					
AC VOLTS	100	120	200	220	240
XMFR - BRN	1	1	1	1	1
XMFR - BRN/WHT	3	3	3	3	3
XMFR - RED	4	5	5	2	2
XMFR - ORN	5	4	2	5	5
XMFR - YEL	3	3	5	5	5
XMFR - GRN	4	2	4	4	6
XMFR - BLU	2	4	6	6	4

NOTE: Numbers shown are terminals on TB1 and are read from top to bottom as shown.

LIMITED ONE YEAR WARRANTY

BGW SYSTEMS, INC., (BGW), 13130 South Yukon Avenue, Hawthorne, California, 90250, warrants to the original owner all parts, except front panels, knobs, cases and cabinets, of every new BGW product to be free from defects in materials or workmanship, as hereinafter provided, for one (1) year from the original date of purchase.

BGW will at its option, repair or replace any equipment covered by this warranty which becomes defective, malfunctions or otherwise fails to conform with this warranty under normal use and service during the term of this warranty, at no charge for parts or labor.

In order to obtain warranty service, the equipment, together with the original or a machine reproduction of the Bill of Sale or other dates, proof-of-purchase document describing the equipment, must be delivered to an Authorized BGW Dealer/Service Center in the continental United States, or to BGW at the above address, at the owners expense. Any evidence of alteration, erasing or forgery of proof-of-purchase documents will be cause to void the warranty. Collect shipments to BGW will be refused unless previously authorized. The names and addresses of Authorized BGW Service Stations may be obtained by writing to BGW Warranty Department at the above address.

This warranty does not cover defects, malfunctions or failures resulting from shipping or transit accidents, abuse, misuse, operation contrary to furnished instructions, operation on incorrect power supplies, operation with faulty associated equipment, modification, alteration, improper servicing, tampering or normal wear and tear. Equipment on which the serial number has been defaced or removed shall not be eligible for warranty service. Should any equipment submitted for warranty service be found ineligible therefore, an estimate of repair cost will be furnished and the repair will be accomplished if requested by the owner upon receipt of payment or acceptable arrangements for payment.

ANY IMPLIED WARRANTIES INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, SHALL BE LIMITED IN DURATION TO THE PERIOD OF TIME SET FORTH ABOVE. BGW SHALL NOT BE RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES. SOME STATES DO NOT ALLOW LIMITATION ON HOW LONG AN IMPLIED WARRANTY LASTS OR THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATIONS OR EXCLUSION MAY NOT APPLY TO YOU. This warranty gives you specific legal rights and you may also have other rights which vary from state to state. This is the only expressed warranty applicable to BGW products. BGW neither assumes nor authorizes anyone to assume for it any other expressed warranty.

Completion and return of the owner registration card enclosed with the equipment is requested, but is not a condition for obtaining warranty service.

BGW reserves the right to make changes or improvements in design or manufacturing without incurring any obligation to change or improve products manufactured prior thereto.