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OWNER'S MANUAL
MODEL 320B
COMMERCIAL POWER AMPLIFIER

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- 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 $\frac{1}{4}$ 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.

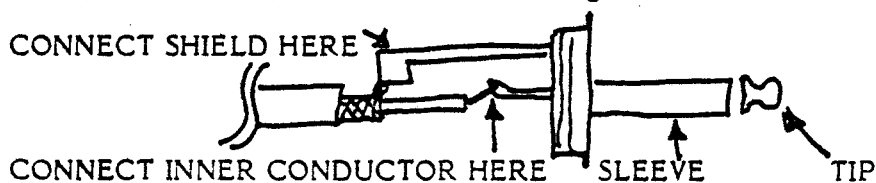
When racks are to be transported or used in a mobile installation, some means of securing the rear of the equipment are required. Angle brackets either attached to the bottom, side rails or rear panel are practical approaches.

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.



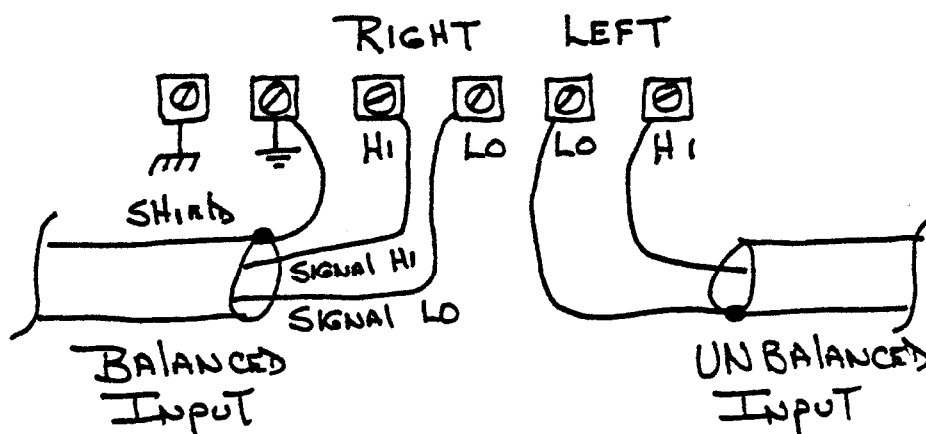
BARRIER INPUTS

The barrier strip inputs are for balanced or unbalanced line 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.

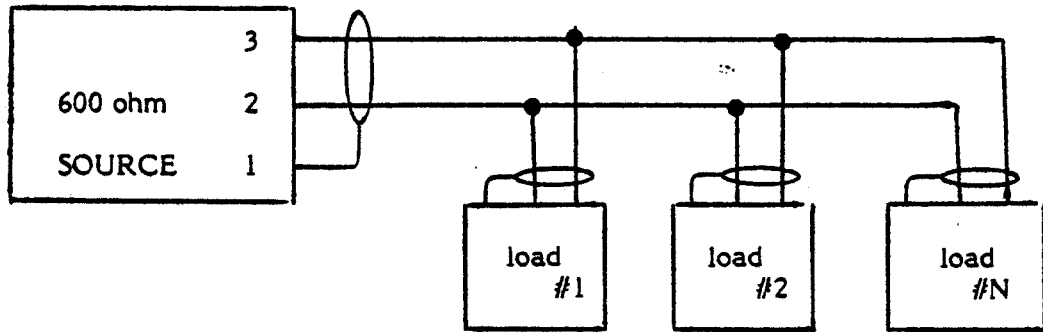
UNBALANCED LINE INPUT requires the use of the jumper plug assembly (supplied with the amplifier). Simply connect the shield to signal (LO) and the inner connector to signal (HI). See diagram below.

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

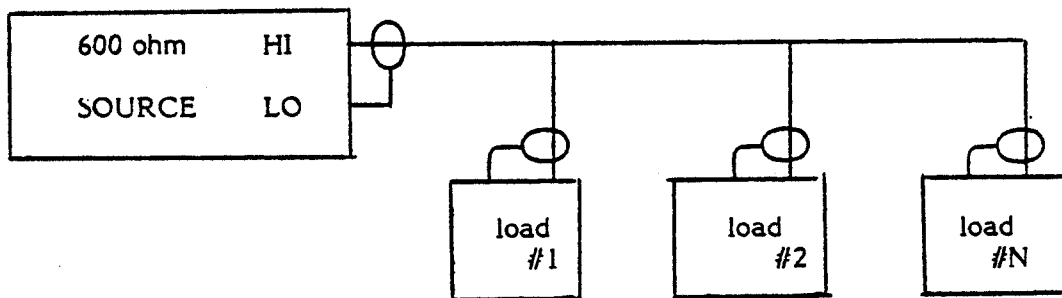
- C. 1:1 transformer 15K ohms to 15K ohms
- D. Nth load must have a terminating resistor added to the primary of the input transformer.

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.

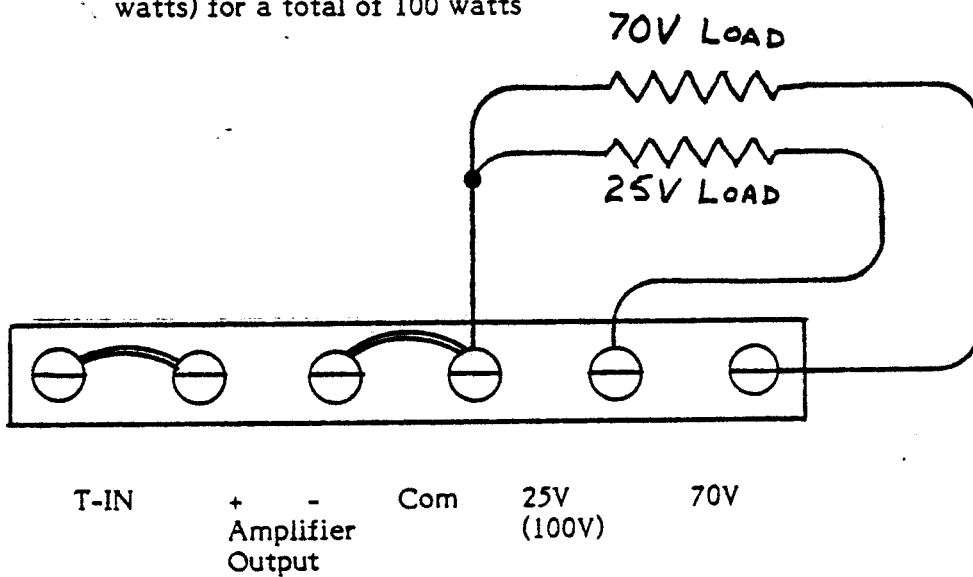
The load 25 or 70 volt line (100 or 70 volt on export Models) should be connected between common and/or any combinations that do not exceed the power rating of the amplifier output.

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

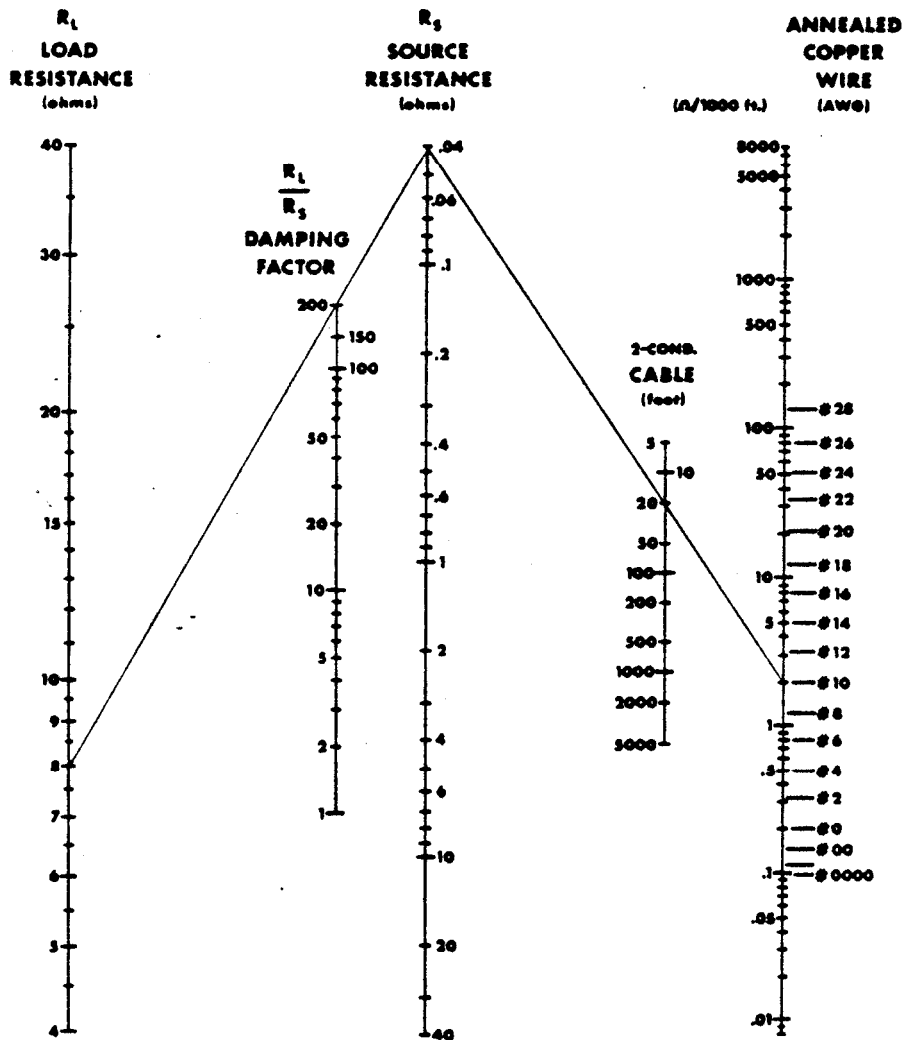
The high damping factor of BGW amplifiers results in a very clean bass response. Excessively long, and small diameter speaker wires can lower the damping factor and distort the lower frequencies. A damping factor of at least 50 should be maintained to insure good audio quality.

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.

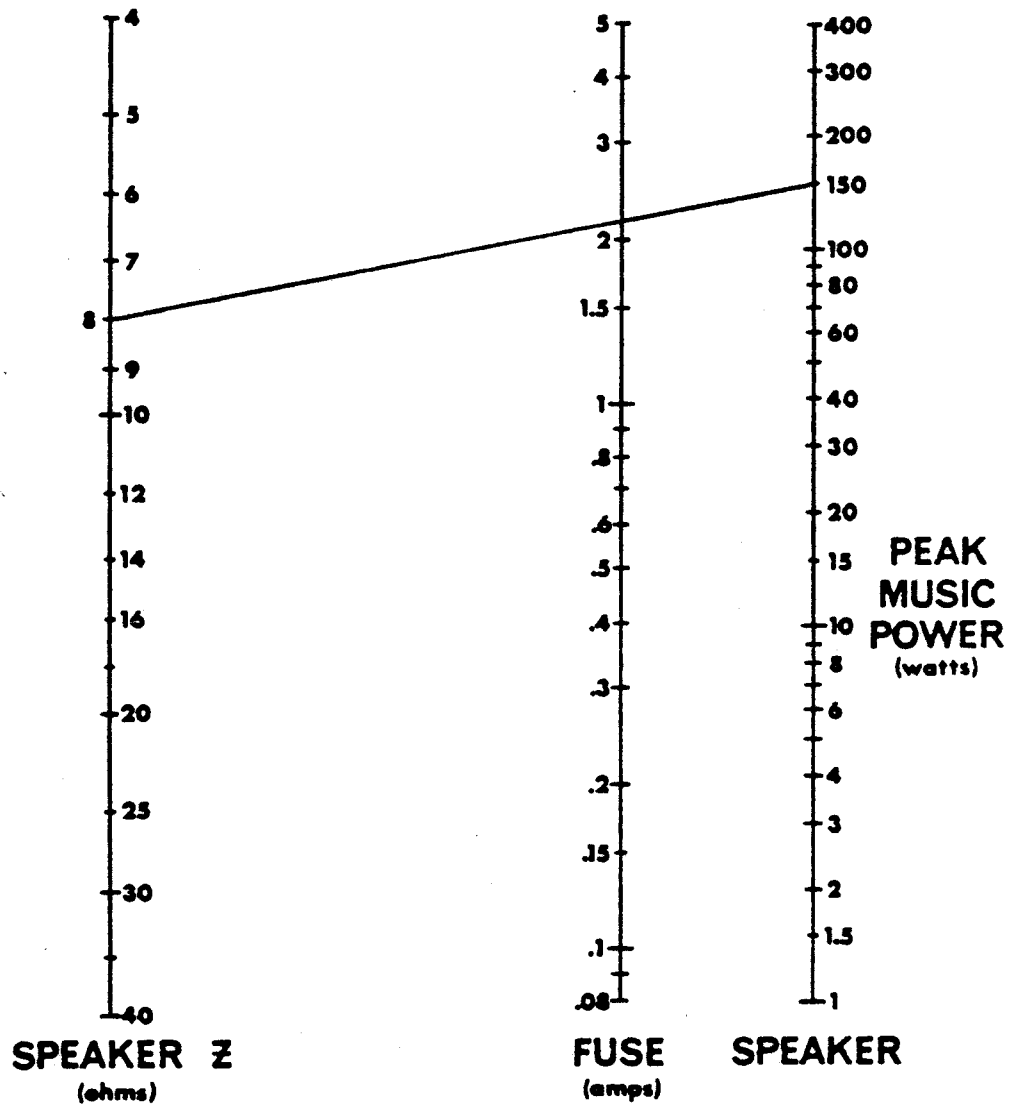
Note: This method cannot be used with electrostatic speakers.



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

MFRM-03510



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

FUSE SELECTOR NOMOGRAPH FOR LOUDSPEAKER PROTECTION

MFRM-03530

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 analogous 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.

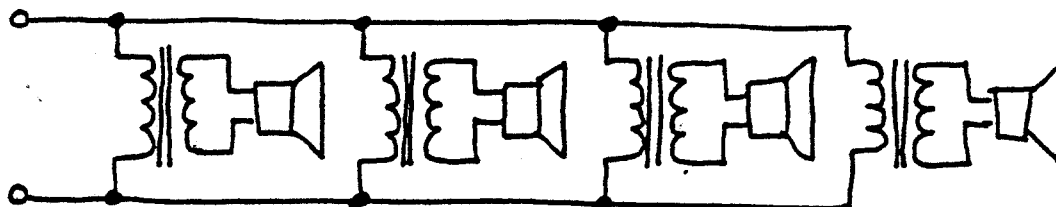
The most common voltage used in a constant voltage distribution system is 70.7 volts. In most areas of the USA, 70.7 volts is the maximum voltage that a pair of wires can carry without being enclosed in a metal conduit. Amplifiers used to power such a system must develop 70.7 volts across their output 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 :

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

where Z 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:

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

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

[119 W 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.

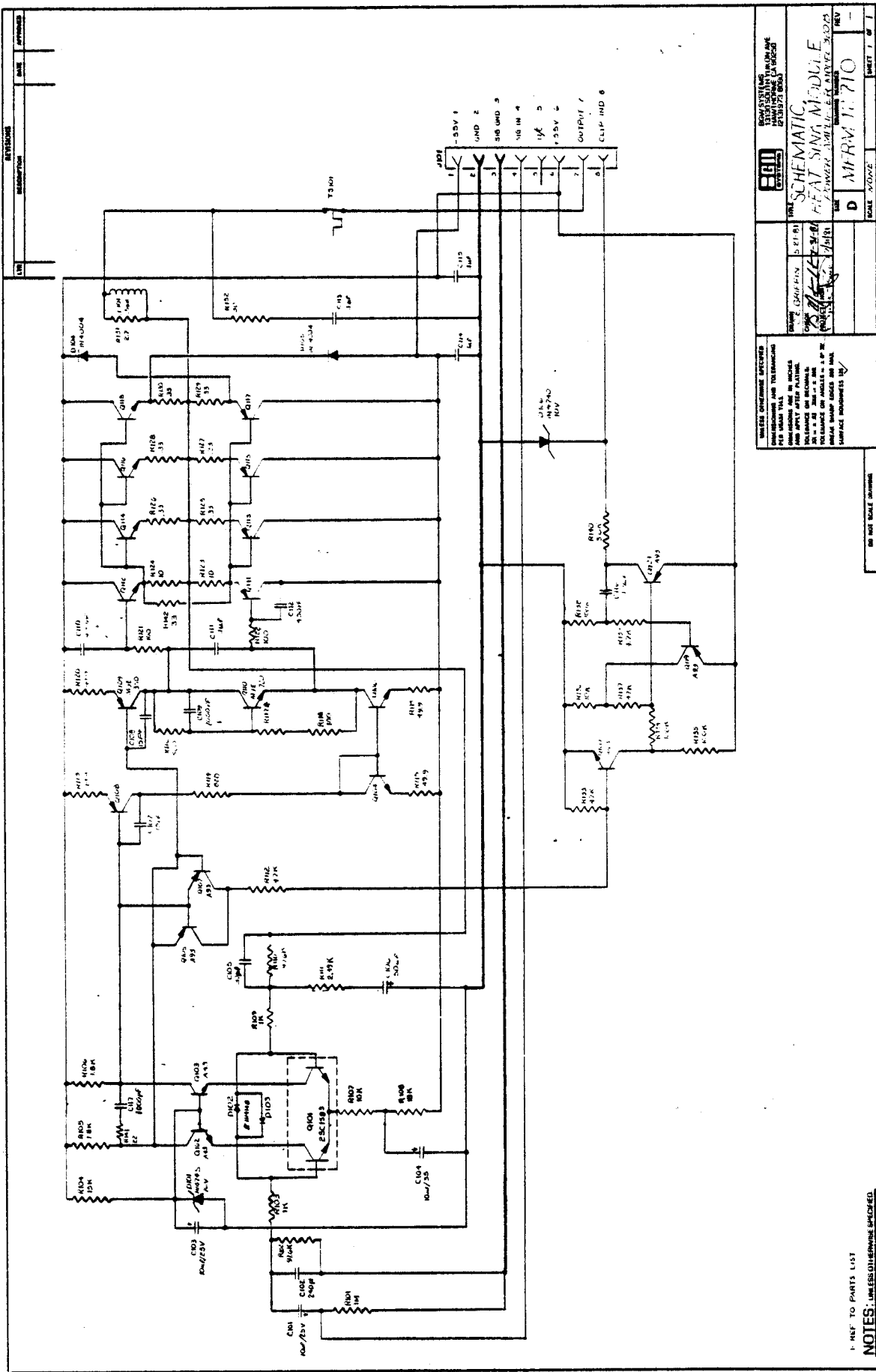
Q104 and Q106 form a current mirror stage that acts as load for Q108 and Q109. The current mirror stage uses base emitter diode only of Q104 to match base emitter diode of Q106. As more collector current is pulled from the collector of Q106, (Q109 is turning on harder) an equal and opposite amount of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

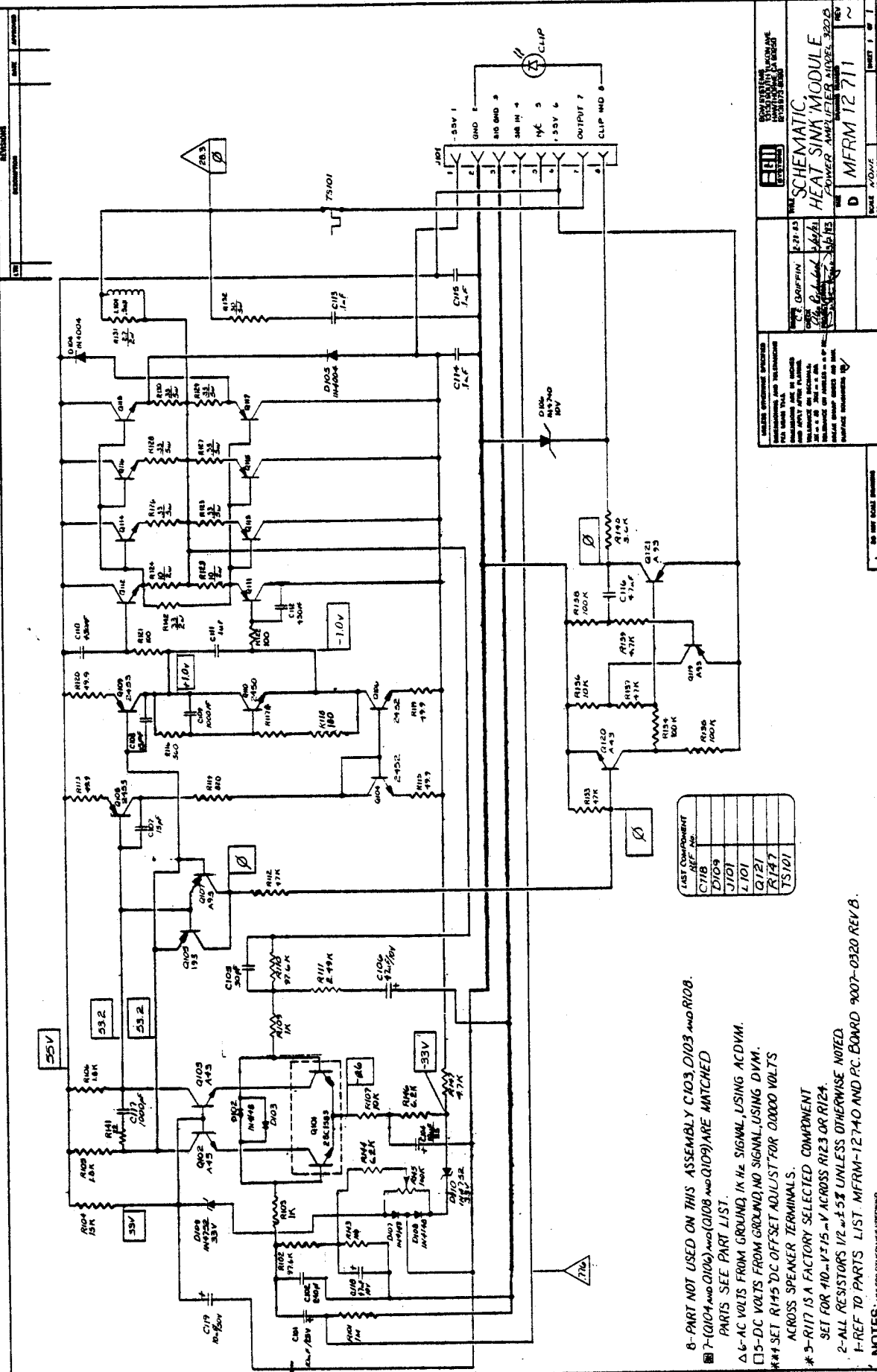
Q105, Q107 & Q119-Q121 comprise the clipping indicator circuit. When the amplifier is driven into clipping, a voltage of sufficient magnitude to turn on Q105 or Q107 is generated at the output of Q102 and Q103. The current through R112 turns on Q120. This voltage appears because the amplifier is trying 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.



UNLESS OTHERWISE SPECIFIED:
 COMPONENTS AND TOLERANCES
 ARE IN ACCORDANCE WITH MIL-STD-203
 AND APPLY AFTER PLATING.
 DIMENSIONS ARE IN INCHES
 UNLESS OTHERWISE SPECIFIED.
 TOLERANCE ON ANGLES = ± 1° UNLESS
 OTHERWISE SPECIFIED AND UNLESS
 OTHERWISE INDICATED BY

REV	1	DATE	11/17/70
BY	MMRM	CHKD	MMRM
SCHEMATIC FEAT SING M/D/L/E			
FORM 1-710			
SCALE 2X/2X			
SHEET 1 OF 1			

1- REF TO PARTS LIST
 NOTES: UNLESS OTHERWISE SPECIFIED



PART COMPONENT	
REF.	NO.
C118	
D109	
J101	
Q121	
R147	
TS101	

- 8-PART NOT USED ON THIS ASSEMBLY C103, D103 AND R108.
- 7-(Q104 AND Q106) AND (Q108 AND Q109) ARE MISMATCHED.
- PARTS SEE PART LIST.
- Δ-AC VOLTS FROM GROUND, IN THE SIGNAL, USING AC DVM.
- 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 110-V[±]15-V ACROSS R123 OR R124.
- 2-ALL RESISTORS 1/2[±]1.5% UNLESS OTHERWISE NOTED.
- F-REF TO PARTS LIST MFRM-12740 AND P.C. BOARD 9007-0320 REV B.

NOTES: UNLESS OTHERWISE SPECIFIED

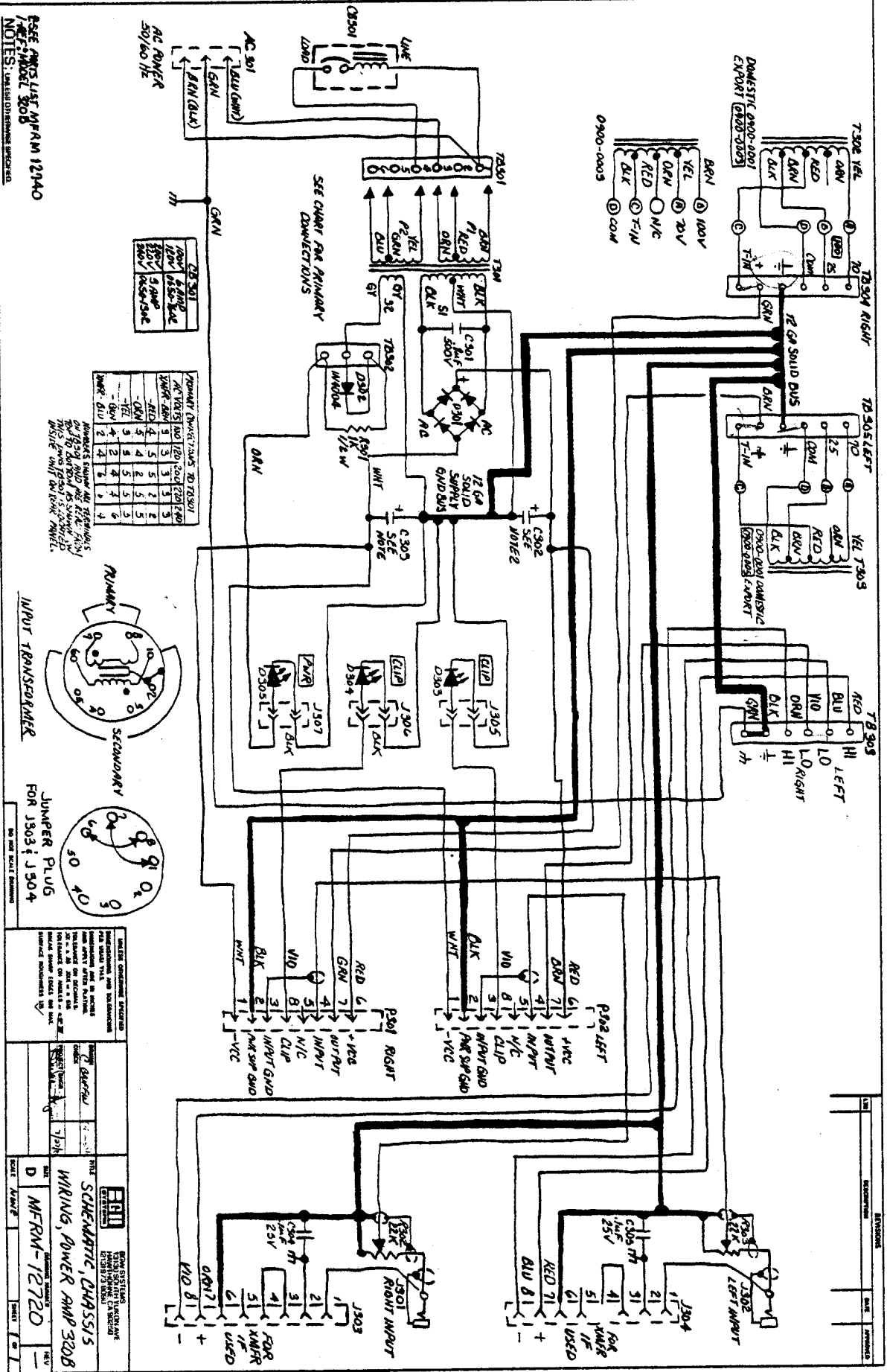
SCHEMATIC

 HEAT SINK MODULE

 POWER AMPLIFIER MODEL 3200

 D MFRM 12711

 SHEET 1 OF 1



BASE PARTS LIST MFRM 12140
 1-REF-MODEL 3208
 NOTES: 1. USE SHIELDING BRACKET.

AC POWER

120V/60HZ	250V/60HZ
100V/50HZ	250V/50HZ
100V/60HZ	250V/50HZ
100V/60HZ	250V/50HZ

PRIMARY CONNECTIONS TO T3501

AC VOLTAGE	NO. 120V	NO. 250V	NO. 250V	NO. 250V
RED	4	5	3	5
ORN	5	4	2	5
GRN	3	4	5	3
YEL	4	5	3	5
BLK	3	4	5	3
DLU	2	4	3	4



WARNING CONCERNING ELECTRIFIED EQUIPMENT

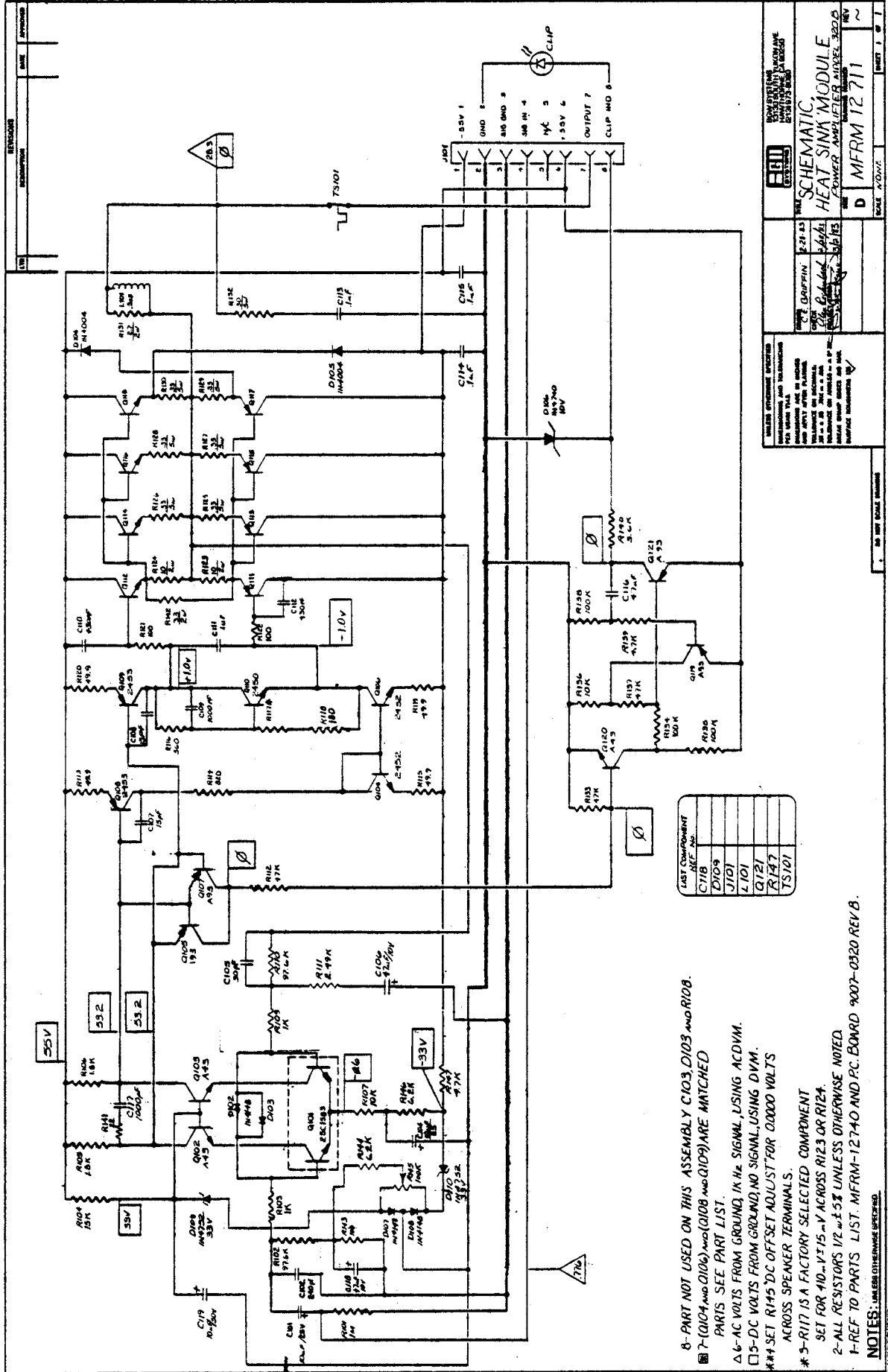
CAUTION: THE CHASSIS AND COMPONENTS ARE IN CONTACT WITH THE AC POWER SUPPLY. TO PREVENT ELECTRICAL SHOCK, DO NOT TOUCH THE CHASSIS OR COMPONENTS UNTIL THE POWER IS DISCONNECTED. ALWAYS USE PROPER SAFETY PROCEDURES.

FRD


SCHEMATIC, CHASSIS WRING, POWER AMP 3208

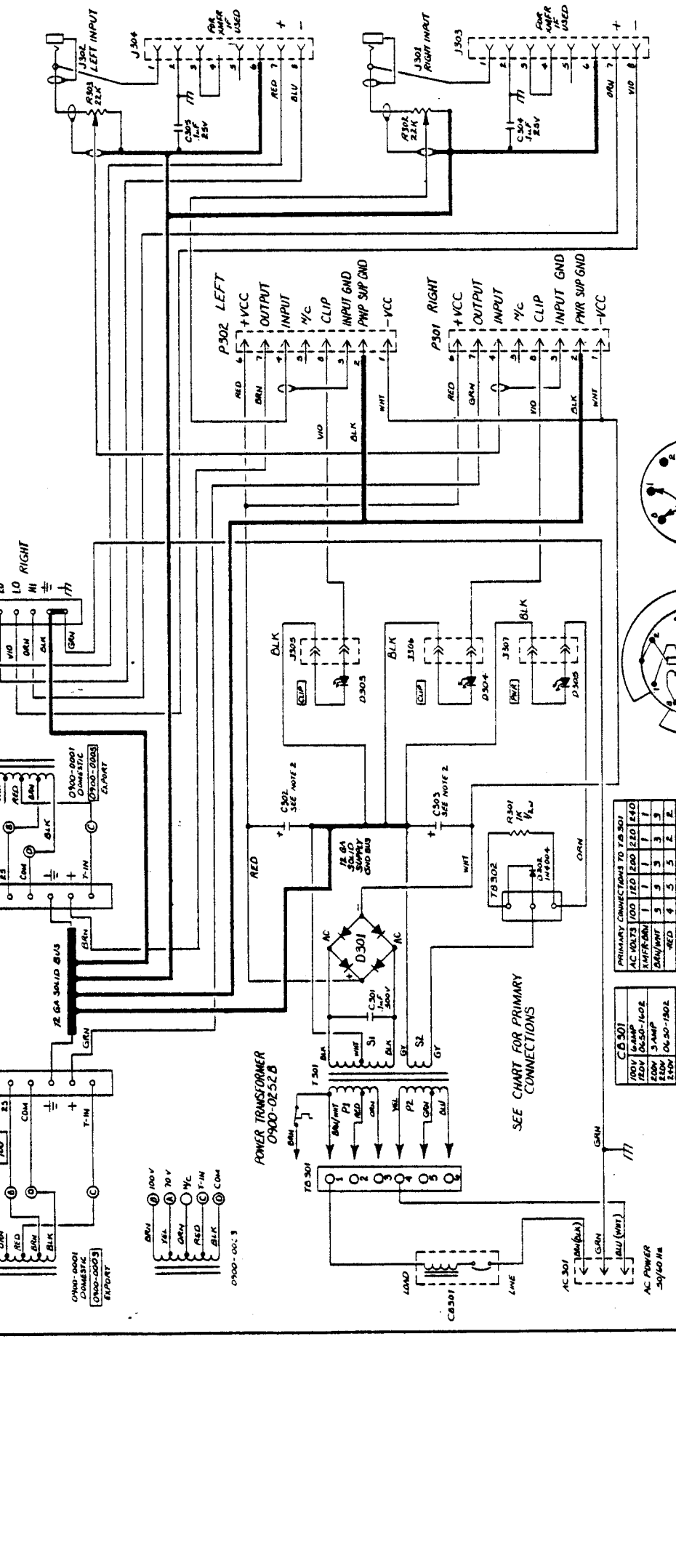
MFRM-12720

REV. 1



8-PART NOT USED ON THIS ASSEMBLY C103, D103 AND R108.
 7-(C104 AND C106) AND (D108 AND D109) ARE MATCHED PARTS SEE PART LIST.
 5-DC VOLTS FROM GROUND, NO SIGNAL, USING AC DVM.
 6-AC VOLTS FROM GROUND, NO SIGNAL, USING DVM.
 4-SET R115 DC OFFSET ADJUST FOR 0.000 VOLTS ACROSS SPEAKER TERMINALS.
 5-R117 IS A FACTORY SELECTED COMPONENT SET FOR 410-11715-V ACROSS R123 OR R124.
 2-ALL RESISTORS 1/2-WATT UNLESS OTHERWISE NOTED.
 1-REF TO PARTS LIST MFRM-12740 AND P.C. BOARD 9007-0320 REV B.
 NOTES: UNLESS OTHERWISE SPECIFIED.

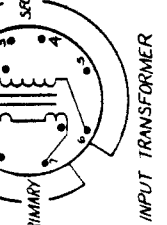
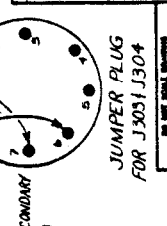

SCHEMATIC
 HEAT SINK MODULE
 POWER AMPLIFIER
 MFRM 12711
 SCALE: 1:1
 SHEET 1 OF 1



PRIMARY CONNECTIONS TO T-301

AC VOLTS	100	120	150	220	240
1MFR-GRN	1	1	1	1	1
1MFR-WHT	5	3	3	3	3
-RED	4	5	5	2	2
-GRN	5	4	2	5	5
-YEL	5	3	5	5	5
-GRN	4	2	4	4	4
1MFR-BLU	2	4	4	4	4

NUMBERS SHOWN ARE TERMINALS
 FOR T-301 (T-302) AS SHOWN ON
 THIS DRAWING T-301 IS LOCATED
 INSIDE UNIT ON REAR PANEL.



SEE CHART FOR PRIMARY CONNECTIONS

100V	120V	150V	220V	240V
6AMP	6AMP	6AMP	6AMP	6AMP
3AMP	3AMP	3AMP	3AMP	3AMP
2AMP	2AMP	2AMP	2AMP	2AMP
1AMP	1AMP	1AMP	1AMP	1AMP

AC POWER
 50/60 Hz

AC POWER
 50/60 Hz

AC POWER
 50/60 Hz

AC POWER
 50/60 Hz

REORDERING INFORMATION
 MODEL 12721 A
 DATE 11-12-53

REORDERING INFORMATION
 MODEL 12721 A
 DATE 11-12-53

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REORDERING INFORMATION
 MODEL 12721 A
 DATE 11-12-53

2-SEE PARTS LIST MFRM-12740.
 1-REF. MODEL 320 B.
 NOTES: SEE PARTS LIST MFRM-12740.
 1-REF. MODEL 320 B.

NOTES: SEE PARTS LIST MFRM-12740.
 1-REF. MODEL 320 B.

REORDERING INFORMATION
 MODEL 12721 A
 DATE 11-12-53

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	1350-0108
***** 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	2N6468/67571 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 *****

TB301	6 LUG SLIP-ON BARRIER STRIP	0720-9126
TB302	3 LUG SOLDER TYPE TERMINAL STRIP	1231-3003
TB303	6 LUG SCREW TYPE BARRIER STRIP	0720-1697
TB304	6 LUG SCREW TYPE BARRIER STRIP	0720-1697
TB305	6 LUG SCREW TYPE BARRIER STRIP	0720-1697

***** THERMAL SWITCH *****

TS101	THERMAL SWITCH 90°C OOR	0630-0001
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***** 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.