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HAWTHORNE, CALIFORNIA 90250
TELEX NO. 66-4494

OWNER'S MANUAL
MODEL 150
PROFESSIONAL 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.

- 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 150 is one of the most advanced solid state, fully complementary, bridgeable, stereo power amplifiers available.

Features of the Model 150 include precision step attenuator level controls, LED metering, separate circuit and chassis grounds, XLR and ¼" input connectors with transformer sockets, and small size.

The front panel includes two vertical rows of four red LED's, one row for each channel. The lower LED in each row is the IDLE indicator or pilot lamp. They will be lit whenever the amplifier is turned on.

The top LED in each row is a clipping indicator and utilizes an exclusive BGW circuit. Whenever either channel of the 150 is driven into clipping, a corresponding indicator lights and remains lit for 0.20 seconds. These indicators, which actually indicate loss of feedback, tell the operator that the amplifier is being overdriven and can be invaluable to the engineer who must be sure that every component in his system is producing a clean, distortion-free signal. An inadvertant short-circuited output (with signal) will cause the LED to remain on until the short is removed.

The middle LED's are connected to a circuit employing integrated circuit to provide an audio level indication of 0.5% and 50% of maximum power output. They provide a valuable tool for total system evaluation in multiple amplifier installations.

Both the circuit and chassis grounds are connected to separate barrier strip terminals on the rear of the amplifier. They are connected together by a removeable link. By removing the link, the circuit grounds of all active units (amplifiers, preamplifiers, mixers, etc.) can be tied to earth ground at a common point. This aids in eliminating ground loops.

Either XLR-type of ¼ inch phone plugs may be used for input connections. If plug-in transformers are used, the XLR-type connectors are connected. If not, jumpers must be employed in the transformer sockets. See sections 03011, 03021, 03031, and 03041 for details.

The size of the Model 150 is convenient for a wide variety of applications. However, please note the following precaution:

- 1) Do not use the front panel as the sole support for the amplifier. Side rails or rack shelves should be employed (See section 02650).

The output stages of your amplifier use the most advanced type of transistors available. These large geometric, complementary, power devices have large safe operating areas and extended power bandwidth. Electrostatic and other highly reactive speaker systems present no difficulties for the Model 150. The aluminum heat sinks are located so the 150 power amplifiers can be stacked on top of each other and air can be forced through both sides to cool the products.

All of the semiconductors in the output area are in intimate contact with the heat sink. The bias circuit is also mounted on this isotherm to provide rock steady bias stability with temperature.

The voltage gain circuits are also mounted on the same circuit board. A true operational amplifier integrated circuit acts as the front end.

The op-amp is a special unit featuring very low noise, high speed (10MHz). The op-amp stage is followed by a discrete complementary pair acting as an active current source/sink and providing voltage gain. The current source is the ideal way to drive the output stage, which is basically a triple Darlington voltage follower.

This sophisticated circuit design makes for an extremely accurate amplifier. The accuracy of an amplifier is a function of the ratio of the open loop gain to the closed loop gain. In this case, the open loop gain is about 1,000,000. This extremely accurate signal processing enables the amplifier to drive speakers at very high levels while adding absolutely no coloration of its own. Even at milliwatt levels, the output waveform exhibits no sign of crossover distortion.

THE BGW 150
PROFESSIONAL POWER AMPLIFIER

Exact design standards and unique features establish the BGW amplifier as the industry leader in power amplifier technology. Features such as all steel chassis and covers, metal-case output transistors and totally modular construction, have set the industry standard in audio power amplifiers.

Delivering a full 50 watts per channel into 8 ohm loads and using the latest in full complementary circuitry techniques, the Model 150 offers reliability and performance unparalleled in the industry.

SPECIFICATIONS: BGW MODEL 150

OUTPUT POWER

50 watts minimum sine wave continuous average power output per channel with both channels driving 8 ohm loads over a power band from 20Hz to 20kHz. The maximum Total Harmonic Distortion at any power level from 250-milliwatts to 50 watts shall be no more than .05%.

75 watts minimum sine wave continuous average power output per channel with both channels driving 4 ohm loads over a power band from 20Hz to 20kHz. The maximum Total Harmonic Distortion at any level from 250-milliwatts to 75 watts shall be no more than .08%.

150 watts minimum sine wave continuous average power output monaural driving an 8 ohm load over a power band from 20Hz to 20kHz. The maximum Total Harmonic Distortion at any power level from 250 milliwatts to 150 watts shall be no more than .08%.

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

SPECIFICATIONS

Intermodulation Distortion:	Less than 0.02% from 250 milliwatts to rated power.
Small Signal Frequency Response:	+0, 3dB, 1Hz to 100kHz, +0, 0.25dB, 20Hz, to 20kHz.
Hum and Noise Level:	Better than 102dB below 50 watts (unweighted, 20Hz to 20kHz).
Input Sensitivity:	1.0 volts for maximum power output. Voltage gain 26dB (20 times).
Input Impedance:	15K ohms.
Damping Factor:	Greater than 400 to 1. Referenced at 8 ohms at 1kHz.
Output Impedance:	Designed for any load impedance equal to or greater than 4 ohms.
Power Requirements:	100, 120, 200, 220 or 240 volts 50-60Hz 350 watts.
Semiconductor Complement:	2 Ultra-low noise Op Amp IC's, 2 level detector IC's, 2 delay timer IC's, 26 transistors, 4 zener diodes, 12 diodes, 8 LED's.
Dimensions:	1 3/4" by 19" standard rack front panel. Depth behind front panel 1 1/2". (4.45cm X 48.26cm X 29.21cm).
Weight:	14 lbs. (6.37 kg) net, 18 lbs (8.18 kg) shipping.

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.

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 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 to the sides of the unit is not restricted. Inadequate ventilation may cause the protective heat sensors to shut the unit off. 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.

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.

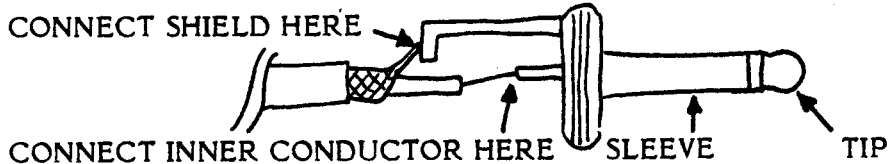
When racks are to be transported or used in a mobile installation, some means of securing the rear of the equipment is required. Angle brackets either attached to the bottom, side rails or rear panel are practical approaches.

STEREO INPUT CONNECTIONS

Three-pin XLR and 1/4 in. phone jacks are provided on the rear of the amplifier for input connections. Balanced or unbalanced lines may be used; however if input cables are longer than 8 feet, balanced lines may be necessary to maintain the signal-to-noise ratio and high frequency response.

1/4 INCH PHONE JACKS

The 1/4" phone jacks are for unbalanced lines only (single conductor, shielded) and may be used directly. 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.



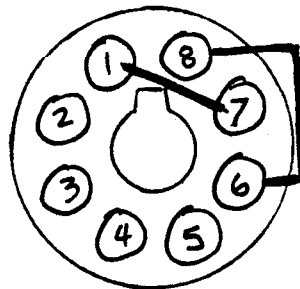
3-PIN XLR CONNECTORS

The 3-pin XLR connectors may be used with balanced (2-conductor, shielded) or unbalanced lines. They are connected to the amplifier's inputs by using the 8-pin transformer socket; they cannot be used directly.

Unbalanced Lines

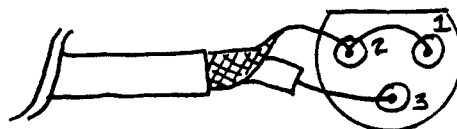
To use the 3-pin XLR connectors with unbalanced lines, a jumper plug (BGW P/N 1350-0108) must be inserted into each transformer socket. The jumper plug connects pin #1 to pin #7, and pin #6 to pin #8 as shown.

JUMPER PLUG
MUST BE USED
WITH
UNBALANCED
LINES

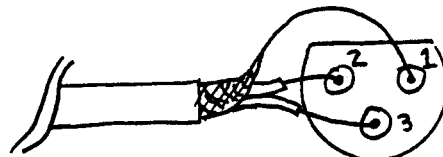


With the jumper plug in place, the 3-pin XLR connector has pin #2 connected to ground, and pin #3 to the input of the amplifier. Note: Rear of plug shown.

When using single conductor shielded cable for unbalanced lines, connect the inner conductor to pin #3 and the shield to pins #1 & #2.



When using 2-conductor shielded cable for unbalanced lines, connect the high level signal wire to pin #3, the low level signal wire to pin #2, and the shield to pin #1.



Note: Shield not connected to anything at signal source.

To achieve a true balanced input, it is necessary to use one transformer for each input. These should be plugged into the octal sockets provided. Depending on the specific application, one of several different transformers may be selected.

Forms are included in this manual to help guide you in your use and selection of transformers. Use the index below to find the appropriate form to match your needs.

CONNECTING ON SOURCE TO ONE AMPLIFIER

Using Balanced Lines: Refer to form #03031

Using Unbalanced Lines: Refer to form #03041

CONNECTING ONE SOURCE TO TWO OR MORE AMPLIFIERS OR DEVICES

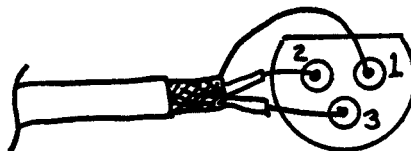
Using Balanced Lines: Refer to form #03011

Using Unbalanced Lines: Refer to form #03021

NOTE: Each amplifier input will be referred to as the "Load" in the above mentioned forms. Only one channel will be shown.

Two conductor shielded cable should be used in a balanced line system. Connect input cables as shown below.

Pin #1 Shield (Ground)
Pin #2 Signal (Minus)
Pin #3 Signal (Plus)

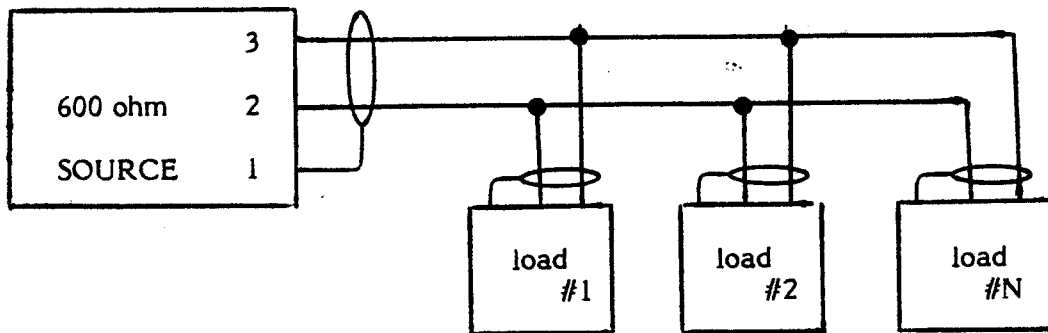


FOR MONO (BRIDGED) OPERATION

To operate the unit as a mono amplifier, use the left channel input only. DO NOT use the right channel input. Remember to place the stereo/mono switch in the mono position.

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

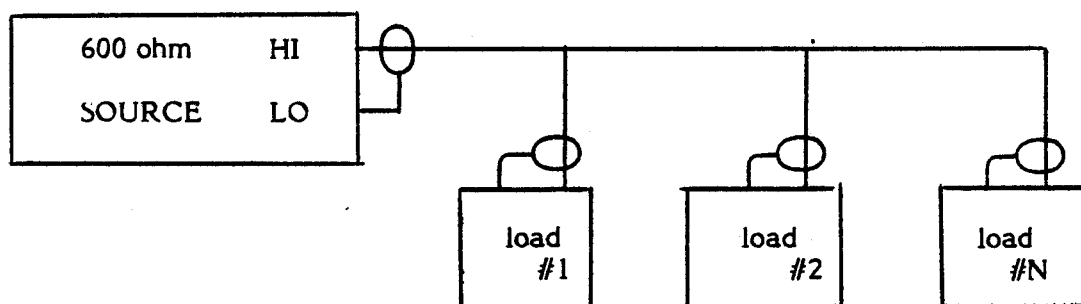
- C. 1:1 transformer 15K ohms to 15K ohms
- D. Nth load must have a terminating resistor added to the primary of the input transformer.

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.



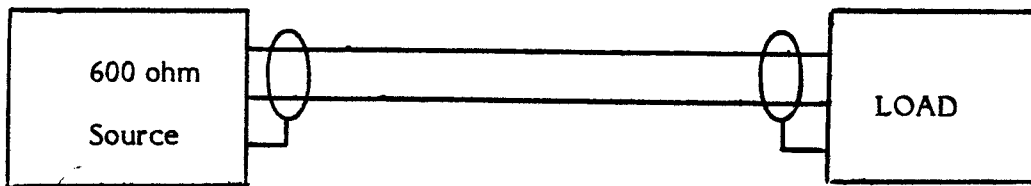
The Nth load should have a terminating resistor added to its octal plug between pin 1 and pin 6.

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.

BALANCED LINE INPUT:

Used only when one amplifier is driven from one source.



Input transformer for above

A. Use 1:5 transformer 600 ohms to 15K ohms

NOTE: No 600 ohm TERMINATION IS REQUIRED

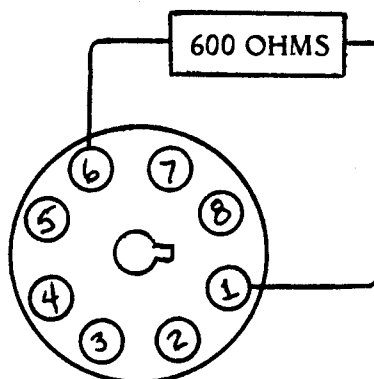
B. Alternate transformer

Use 1:1 transformer 600 ohms to 600 ohms

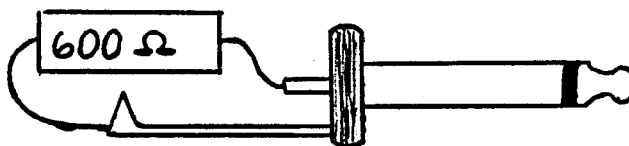
NOTE: 600 ohms termination is required on the secondary of the transformer

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

600 ohm termination, when required, can be accomplished by soldering the resistor across pins 1 and 6 of the transformer as shown below

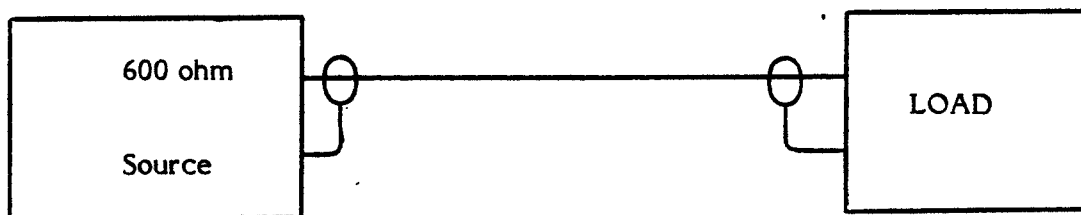


or by installing the resistor in a 1/4" phone plug and inserting it into the unused unbalanced input jack.



UNBALANCED LINE INPUT

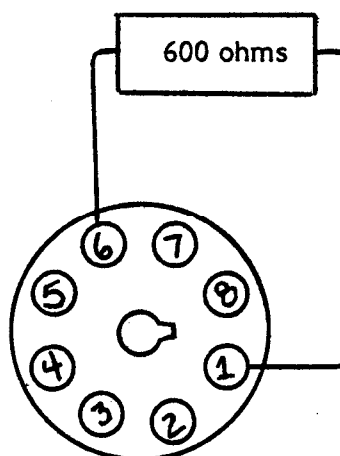
Used only when one amplifier is driven from one source



A 600 ohm terminating resistor must be added to its octal plug.

Between pin 1 and pin 6

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

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

STEREO OUTPUT CONNECTIONS

Two sets of five-way binding posts, on the rear panel, serve as output connectors, with one black and one red binding post for each channel. Left channel leads go to the binding posts marked LEFT; right channel, to those marked RIGHT.

Output leads are best connected, to the amplifier, with standard banana plugs; however, the five-way action of the binding posts permits the use of tinned wires or spade lugs.

Make certain that the speakers are properly phased. Connect the black or minus (-) terminal on the speaker cabinet to the appropriate black binding post on the amplifier. Connect the red or plus (+) terminal to the red binding post. Check to see that the stereo-mono switch on the rear of the amplifier is in the stereo position.

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 red terminal on the rear of the amplifier.

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

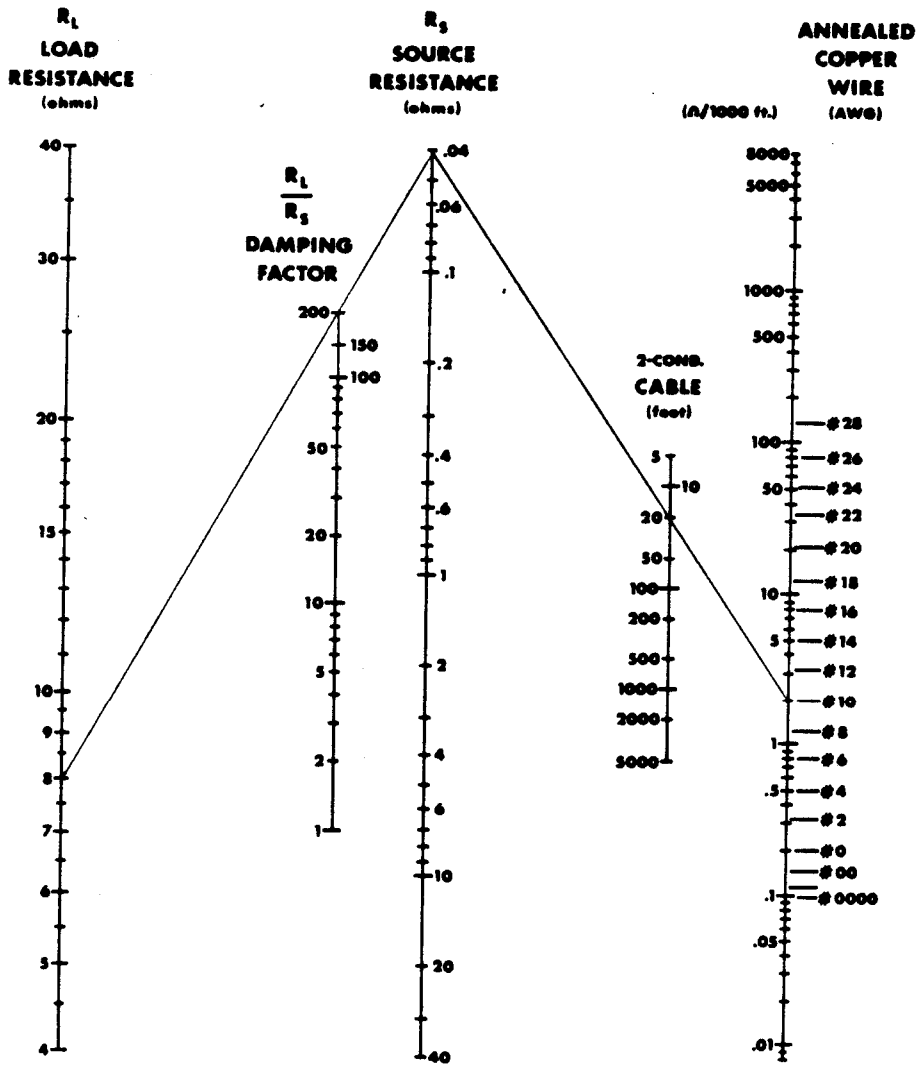
The high damping factor of BGW amplifiers results in a very clean bass response. Excessively long, and small diameter speaker wires can lower the damping factor and distort the lower frequencies. A damping factor of at least 50 should be maintained to insure good audio quality.

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.

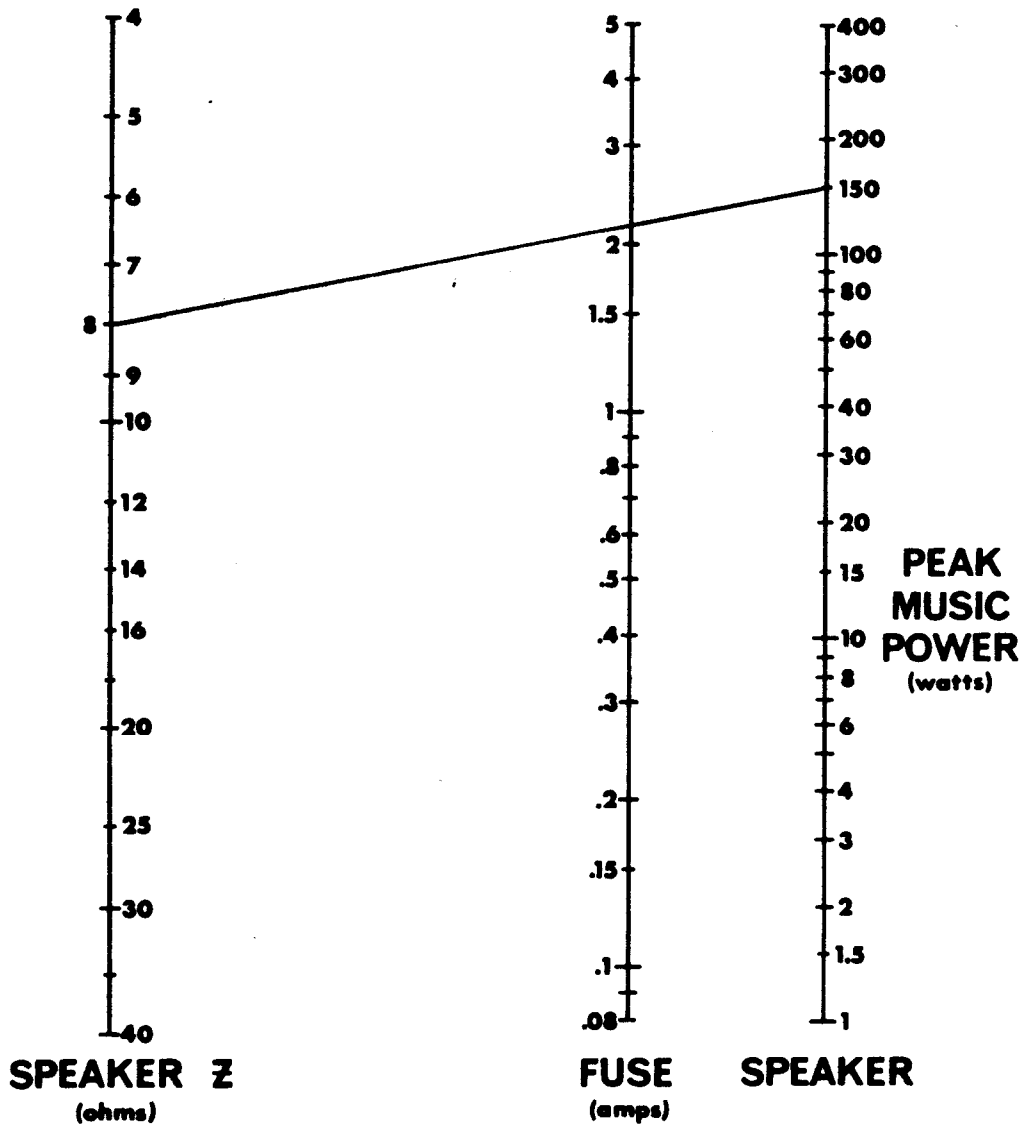
Note: This method cannot be used with electrostatic speakers.



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

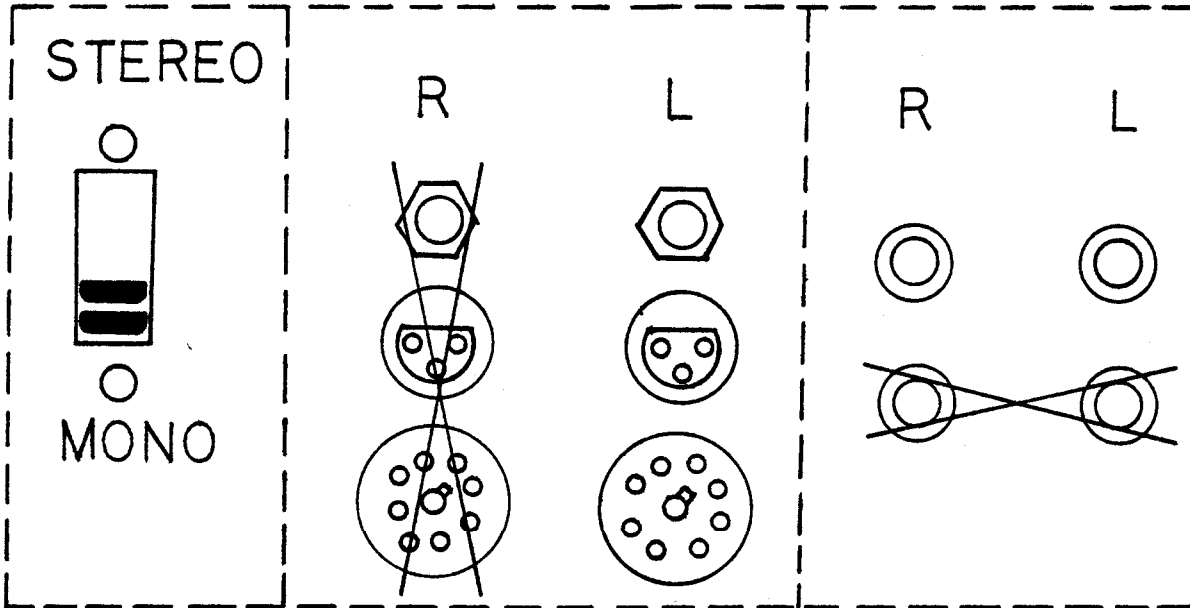
FUSE SELECTOR NOMOGRAPH FOR LOUDSPEAKER PROTECTION

MFRM - 03530

MONO OPERATION

The output power of the amplifier can be increased by operating it in the mono (bridged) mode. The correct procedure for mono operation is as follows:

1. Set Stereo/mono switch to mono position.
2. Use left channel input only. DO NOT use the right channel input.
3. Connect the output across the two red binding posts. DO NOT use the black binding posts. DO NOT reference the load (speaker) to ground. Designate the left channel red binding post (+) and the right channel red binding post minus (-). Fuses, when necessary, should be placed in series with one red binding post.



NOTE: Minimum load impedance for mono operation should be 8 ohms.

CIRCUIT DESCRIPTION

In the mono mode, the output of the left channel is fed into the inverting input of the right channel. The two channels work opposite each other; when one goes positive, the other goes negative, thus doubling the output voltage swing. The single output is referenced between the two red binding posts.

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 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 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. If the amplifier continuously blows fuses, something is wrong - do not increase fuse size.
4. Do not connect an input ground lead to an output ground lead; to do so may cause a ground loop and oscillations.
5. Do not operate the amplifier from power mains which exceed the indicated mains voltage by more than 10%.
6. Never connect the output of the amplifier to another power source such as a battery or power main.
7. Do not expose the amplifier to corrosive chemicals such as lye, soft drinks, salt water, etc. Also, never immerse the amplifier in any liquid.
8. Do not remove the amplifier's cover during operations.
9. The amplifier is not intended for high frequency-high power use and should not be used for high power at above 20 kHz.
10. Neither the amplifier nor any of its leads should be exposed to areas likely to be struck by lightning.

PROCEDURES

After all connections have been made to the power amplifier, turn the gain controls fully counter-clockwise. Turn on the preamplifier, then turn on the power amplifier. The LED over the circuit breaker or marked IDLE should light. If it does not, check to see that the amplifier is plugged in to a live power outlet.

With the preamplifier gain controls fully off, advance the left and right power amplifier gain controls about half way clock-wise (slit in knob facing upwards). There should be no audible hum; if a hum is heard, check the connections between the power amplifier and preamplifier. Now advance the preamplifier gain controls until the desired maximum volume is achieved. Should the preamplifier gain control be in excess of the $3/4$ setting, decrease it to half volume and increase the gain controls of the power amplifier to the desired level.

Often, turn-on transients originate in the pre-amp or tuner. This is especially true of tube-type units. If this situation arises, turn the amplifier on after the other units have had adequate time to stabilize.

150 CIRCUIT DESCRIPTION

Both channels of the amplifier operate in the same manner, and only the left channel will be explained.

POWER SUPPLY

The AC input power from P501 passes through the Circuit breaker CB 301. From CB 301, the AC goes to the power transformer T301.

The output of T301 goes to a full wave bridge rectifier, capacitor input filter circuit consisting of D301, C302 and C303 to give a positive and negative power supply voltages.

AMPLIFIER

The input signal from J301 is applied to the R301 input level control. The output from R301 is applied to the inverting input (pin 2) of op amp IC103 through the coupling network C101, R101, C102 and R104. This network provides a high impedance to the amplifier and filters out DC and radio frequency interference.

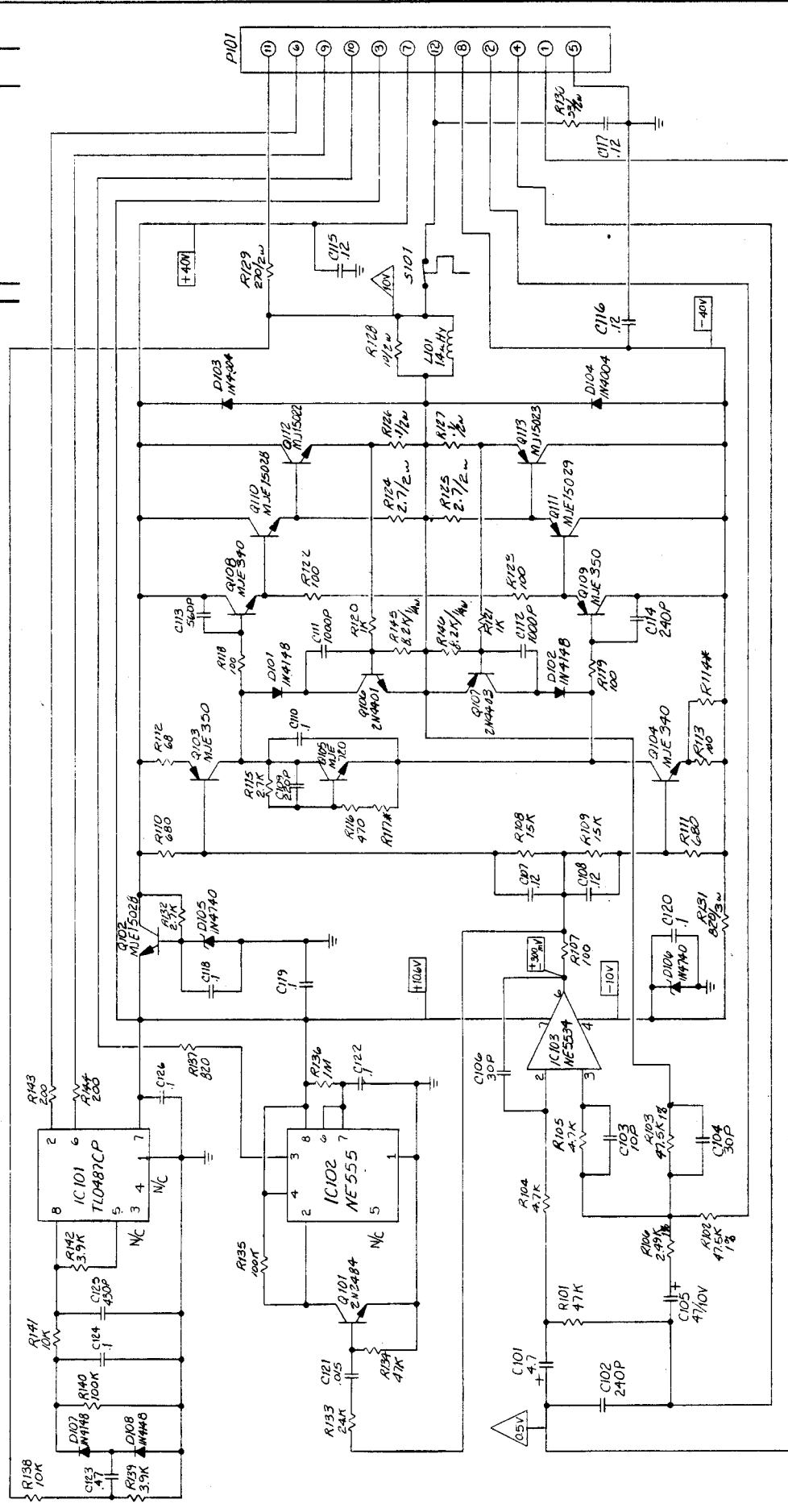
Q103 and Q104 divide the signal into positive and negative components respectively. They are connected common emitter and provide voltage gain. Q110 and Q111 are connected common collector to provide the current gain necessary to drive the output stages, Q112 and Q113. The output appears across flyback clipping diodes D103 and D104, then passes through compensation networks L101/R128 and R130/C117 and thermo switch S101, to appear at output jacks J308. Switch S101 opens if the output transistors reach 100 degrees C.

To maintain overall stability, linearity, and low distortion, degenerative feedback is used throughout the amplifier. Voltage divider R103/C106 and R106 applies the correct amount of feedback to the non-inverting input (pin 3) of op amp IC103. Except for the input, the amplifier uses direct coupling throughout. Q106 and Q107 provide the current limiting necessary to protect the output stage.

BRIDGED MODE

When the mono/stereo switch S301 is set to mono, it converts the right channel amplifier to a unity gain inverting power amplifier.

S301 Mono/Stereo switch grounds the normal input to the right channel and connects the output of the left channel amplifier to drive the right channel summing point R102.



UNLESS OTHERWISE SPECIFIED
DIMENSIONS AND TOLERANCES
PER MIL-STD-203
DIMENSIONS ARE IN INCHES
AND APPLY UNLESS OTHERWISE
SPECIFIED
TOLERANCE ON DIMENSIONS IS ± 0.005
UNLESS OTHERWISE SPECIFIED

DATE: 10-9-81
DRAWN BY: G. GRIFFIN
CHECKED BY: J. G. S. J.
PROJECT NO.: 12380
REV: 1

REV: 1
DATE: 10-9-81
DRAWN BY: G. GRIFFIN
CHECKED BY: J. G. S. J.
PROJECT NO.: 12380
REV: 1

UNLESS OTHERWISE SPECIFIED
DIMENSIONS AND TOLERANCES
PER MIL-STD-203
DIMENSIONS ARE IN INCHES
AND APPLY UNLESS OTHERWISE
SPECIFIED
TOLERANCE ON DIMENSIONS IS ± 0.005
UNLESS OTHERWISE SPECIFIED

DATE: 10-9-81
DRAWN BY: G. GRIFFIN
CHECKED BY: J. G. S. J.
PROJECT NO.: 12380
REV: 1

UNLESS OTHERWISE SPECIFIED
DIMENSIONS AND TOLERANCES
PER MIL-STD-203
DIMENSIONS ARE IN INCHES
AND APPLY UNLESS OTHERWISE
SPECIFIED
TOLERANCE ON DIMENSIONS IS ± 0.005
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AND APPLY UNLESS OTHERWISE
SPECIFIED
TOLERANCE ON DIMENSIONS IS ± 0.005
UNLESS OTHERWISE SPECIFIED

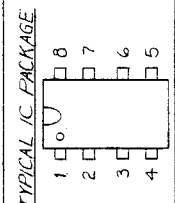
DATE: 10-9-81
DRAWN BY: G. GRIFFIN
CHECKED BY: J. G. S. J.
PROJECT NO.: 12380
REV: 1

UNLESS OTHERWISE SPECIFIED
DIMENSIONS AND TOLERANCES
PER MIL-STD-203
DIMENSIONS ARE IN INCHES
AND APPLY UNLESS OTHERWISE
SPECIFIED
TOLERANCE ON DIMENSIONS IS ± 0.005
UNLESS OTHERWISE SPECIFIED

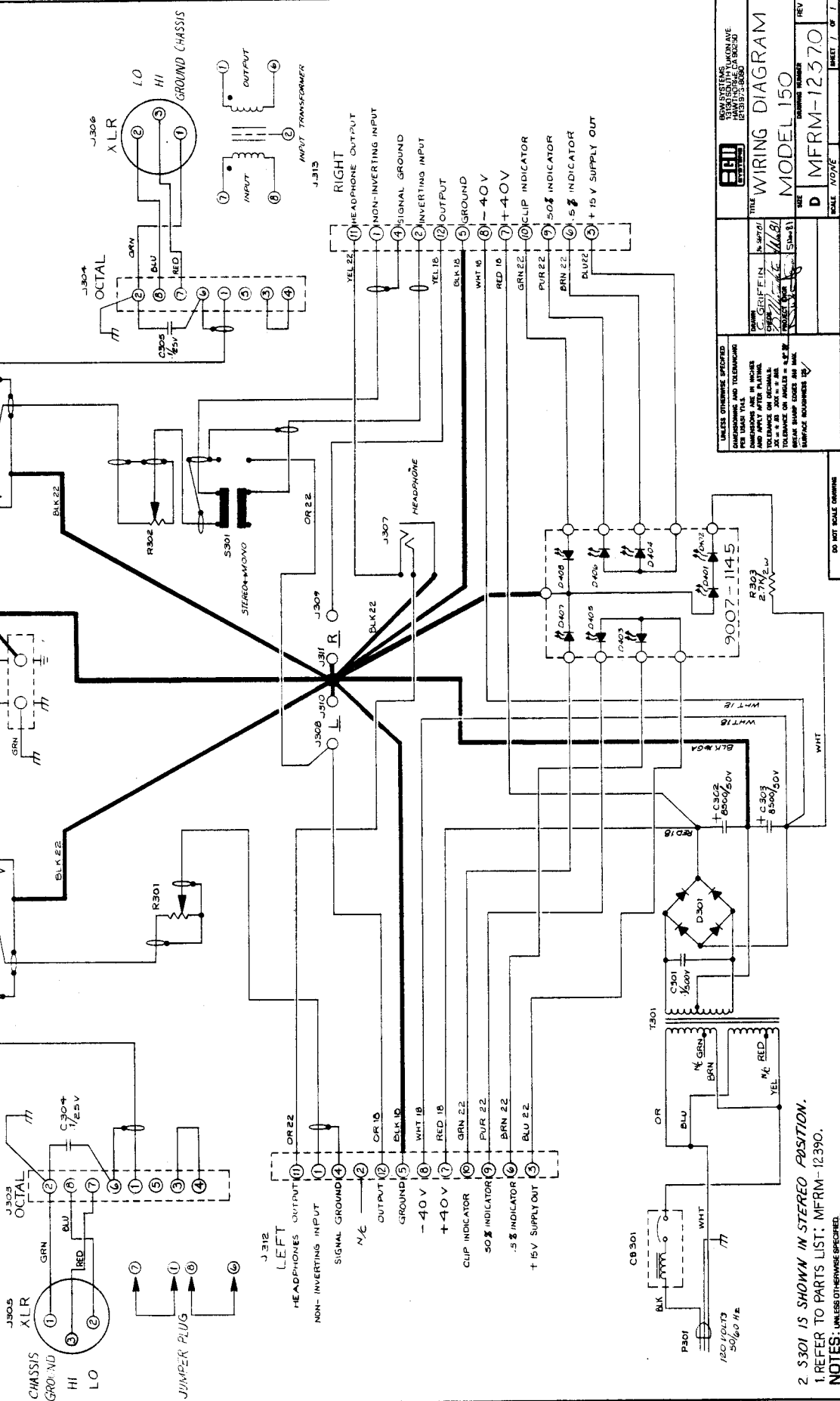
DATE: 10-9-81
DRAWN BY: G. GRIFFIN
CHECKED BY: J. G. S. J.
PROJECT NO.: 12380
REV: 1

5 □ DC VOLTS FROM GROUND USING DVM NO SIGNAL
4 △ AC VOLTS FROM GROUND USING AC DVM.
VOLTAGE ACROSS R124 OR R125 IS 390 mV ± 20 mV.
3 OFFSET ADJUSTMENT; NO SIGNAL HEAT SINK COLD.
ADJ R14 SO OUTPUT OF IC103 IS ZERO VOLTS ± 300 mV.
* 2 FACTORY SELECTED COMPONENT.

NOTES:
1 REFER TO PARTS LIST: MFRM-12380.
UNLESS OTHERWISE SPECIFIED.



REV	DESCRIPTION	DATE	APPROVED



UNLESS OTHERWISE SPECIFIED
 DIMENSIONS AND TOLERANCES
 PER THIS FILE
 DIMENSIONS IN PARENTHESES
 AND APPLY AFTER PLATING
 TOLERANCE ON DECIMALS
 TO PLACE ON DIMENSIONS
 BREAK SHARP EDGES AND RADIUS
 SURFACE FINISHES TO

BRW SYSTEMS
 60W SYSTEMS
 HAWAIIAN DIVISION
 HAWAIIAN DIVISION
 HAWAIIAN DIVISION

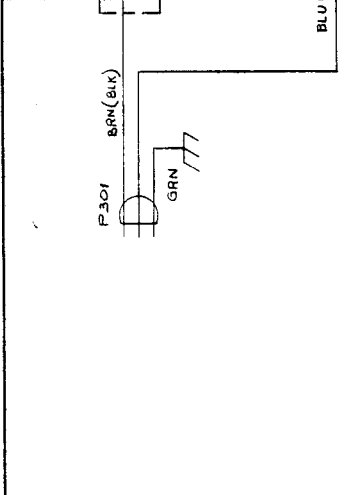
WIRING DIAGRAM
MODEL 150

DATE: 1/1/62
 DRAWN BY: [Signature]
 CHECKED BY: [Signature]

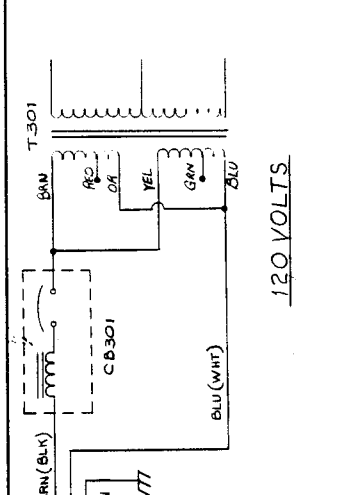
SCALE: 10/16
 SHEET 1 OF 1

2. S301 IS SHOWN IN STEREO POSITION.
 1. REFER TO PARTS LIST: MFRM-12390.
NOTES: UNLESS OTHERWISE SPECIFIED.

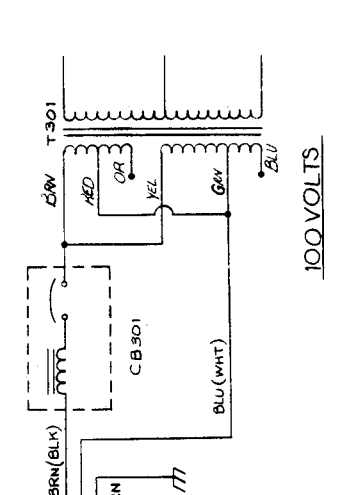
REV. NO.	DESCRIPTION	DATE	APPROVED



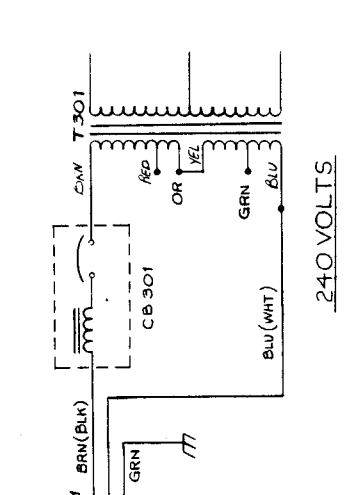
200 VOLTS



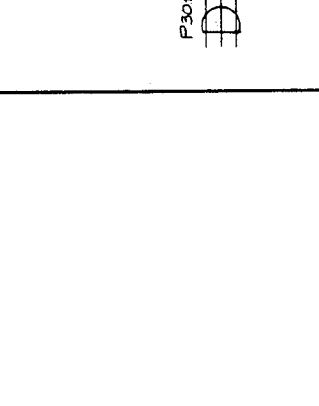
120 VOLTS



100 VOLTS



240 VOLTS



220 VOLTS

V	CB
100	4-A
120	4-A
200	2-A
220	2-A
240	2-A

BOM SYSTEMS
13130 SOUTH YUKON AVE.
PO BOX 1000
HAYWARD, CA 94520
(415) 975-8080

BOM SYSTEMS
EVALUATED

TITLE
150 WIRING FOR DOMESTIC
FRAC TION VOLTAGES

DRAWN
J.C. GRIFFIN

DATE
2-2-81

PROJECT
150 WIRING FOR DOMESTIC
FRAC TION VOLTAGES

SCALE
N.T.S.

SIZE
C

DRAWING NUMBER
MFRM-12390

REV
1

SHEET 1 OF 1

UNLESS OTHERWISE SPECIFIED
DIMENSIONS AND TOLERANCING
PER USASI Y14.5

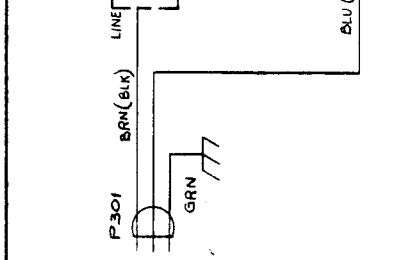
DIMENSIONS ARE IN INCHES
AND APPLY AFTER PLATING.

TOLERANCES UNLESS OTHERWISE SPECIFIED:
FRACTIONS: ± 0.005
DECIMALS: ± 0.010
HOLE POSITION: ± 0.010
TOLERANCE ON ANGLES = ± 0.5°
BREAK SHARP EDGES AND MAX.
SURFACE ROUGHNESS 12.5

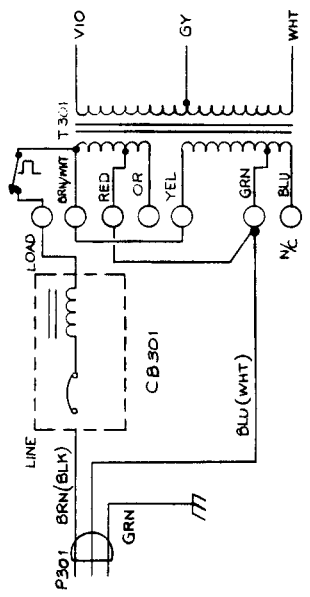
DO NOT SCALE DRAWING

1. REFER TO PARTS LIST: MFRM-12390.
NOTES: UNLESS OTHERWISE SPECIFIED.

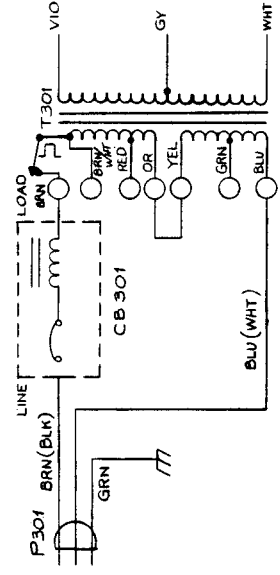
REV	DESCRIPTION	DATE	APPROVED
1	CORRECTED LEADS ON 200V CONNECTIONS	9-7-82	BA



120 VOLTS

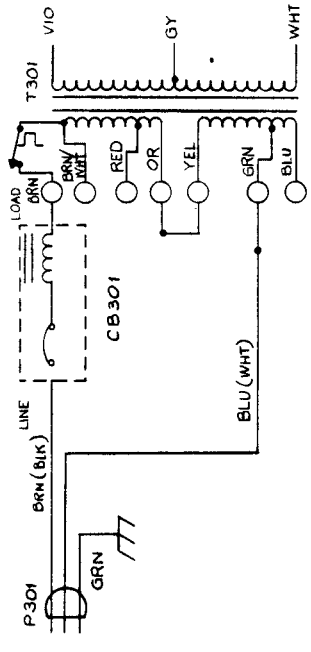


100 VOLTS



240 VOLTS

200 VOLTS



220 VOLTS

V	CB
100	4A
120	4A
200	2A
220	2A
240	2A

UNLESS OTHERWISE SPECIFIED
DIMENSIONING AND TOLERANCING
PER USAS1 Y11L1
DIMENSIONS ARE IN INCHES
AND APPLY AFTER PLATING.
TOLERANCE ON DECIMALS:
XX = ± .05
XXX = ± .01
TOLERANCE ON ANGLES = ± 1°
BREAK SHARP EDGES AND MAX
SURFACE ROUGHNESS IS



BGM SYSTEMS
13130 SOUTH LUKON AVE.
HAWTHORNE, CA 90250
(213) 973-8080

DRW	5-7-82	TITLE	150 WIRING FOR DOMESTIC & FOREIGN VOLTAGES
CHK		SIZE	C
REV		DRAWING NUMBER	MFRM-12361
		SCALE	N.T.S.
		SHEET	1 OF 1

2.T301P/N0900-0124A
1. REFER TO PARTS LIST: MFRM-12390.

NOTES: UNLESS OTHERWISE SPECIFIED.

DO NOT SCALE DRAWING

BGW SYSTEMS, INC.

ENG NO	DESCRIPTION	PART NO
**	PARTS LIST 150	** 12390

BLOCK DIAGRAM MFRM 12350
 SCHEMATIC AC WIRING MFRM 12360
 SCHEMATIC CHASSIS MFRM 12370
 SCHEMATIC HEATSINK MFRM 12380

NOTE# ALL COMPONENTS WITH DESIGNATIONS IN THE
 100 SERIES ARE LEFT CHANNEL HEATSINK
 NUMBERS.

ALL COMPONENTS WITH DESIGNATIONS IN THE
 200 SERIES ARE RIGHT CHANNEL HEATSINK
 NUMBERS-- REFER TO 100 SERIES NUMBERS.

EXAMPLE C201 IS THE SAME AS C101.

ALL COMPONENTS WITH DESIGNATIONS IN THE
 300 SERIES ARE CHASSIS NUMBERS

ALL COMPONENTS WITH DESIGNATIONS IN THE
 400 SERIES ARE LED DISPLAY NUMBERS.

CAPACITORS

C101	4.7 UF 25V TANTALUM	0226-0005
C102	240PF 500V MICA	0090-0240
C103	10PF 100V MICA	0060-0010
C104	30PF 500V MICA	0060-0030
C105	47UF 10V ELECTROLYTIC	0456-0047
C106	30PF 500V MICA	0060-0030
C107	.12UF 100V METALIZED MYLAR	0363-8003
C108	.12UF 100V METALIZED MYLAR	0363-8003
C109	220PF 500V DISC	0100-0220
C110	.1UF 25V DISC	0129-0100
C111	1000PF 500V DISC	0100-1000
C112	1000PF 500V DISC	0100-1000
C113	560PF 500V MICA	0080-0560
C114	240PF 500V MICA	0090-0240
C115	.12UF 100V METALIZED MYLAR	0363-8003
C116	.12UF 100V METALIZED MYLAR	0363-8003
C117	.12UF 100V METALIZED MYLAR	0363-8003
C118	.1UF 25V DISC	0129-0100
C119	.1UF 25V DISC	0129-0100
C120	.1UF 25V DISC	0129-0100
C121	.015UF 100V MYLAR	0369-0015
C122	.1UF 25V DISC	0129-0100
C123	.47UF 100V METALIZED MYLAR	0363-8000
C124	.1UF 25V DISC	0129-0100
C125	430PF 100V MICA	0060-0430
C126	.1UF 25V DISC	0129-0100
C301	0.1UF 500V DISC	0199-0100
C302	8500UF 50V ELECTROLYTIC	0533-0008

BGW SYSTEMS, INC.

ENG NO	DESCRIPTION	PART NO
C303	8500UF 50V ELECTROLYTIC	0533-0008
C304	0.1UF 25V DISC	0129-0100
C305	0.1UF 25V DISC	0129-0100

CIRCUIT BREAKERS

CB301	CIRCUIT BREAKER BAT HANDLE			
		120VAC	4 AMP	0651-0400
		100VAC	4 AMP	0651-0400
		200VAC	2 AMP	0651-0200
		220VAC	2 AMP	0651-0200
		240VAC	2 AMP	0651-0200

DIODES

D101	1N4148/1N914 DIODE	1900-4148
D102	1N4148/1N914 DIODE	1900-4148
D103	1N4004 DIODE 1A 400V	1900-4004
D104	1N4004 DIODE 1A 400V	1900-4004
D105	1N4740A 10V ZENER DIODE	1900-4740
D106	1N4740A 10V ZENER DIODE	1900-4740
D107	1N4148/1N914 DIODE	1900-4148
D108	1N4148/1N914 DIODE	1900-4148
D301	BRIDGE RECTIFIER KBH2502	1886-2502
D401	LED GREEN	1990-4950
D402	LED GREEN	1990-4950
D403	LED GREEN	1990-4950
D404	LED GREEN	1990-4950
D405	LED YELLOW	1990-4550
D406	LED YELLOW	1990-4550
D407	LED RED	1990-4650
D408	LED RED	1990-4650

INTEGRATED CIRCUITS

IC101	LEVEL DETECTOR TL0487CP	1885-0487
IC102	TIMER NE555	1885-0555
IC103	OP AMP NE5534	1885-5534

JACKS

J301	INPUT JACK N111	9999-0111
J302	INPUT JACK N111	9999-0111
J303	8 PIN SOCKET	1203-0008
J304	8 PIN SOCKET	1203-0008
J305	3 PIN XLR PC MOUNT	1205-0002
J306	3 PIN XLR PC MOUNT	1205-0002
J307	STEREO PHONE JACK 3/8 BUSHING	1205-0005
J308	CONNECTOR BINDING POST RED	1231-0008
J309	CONNECTOR BINDING POST RED	1231-0008
J310	CONNECTOR BINDING POST BLACK	1231-0009

BGW SYSTEMS. INC.

ENG NO	DESCRIPTION	PART NO
J311	CONNECTOR BINDING POST BLACK	1231-0009
J312	MOLEX 12 PIN CONNECTOR 03-09-1126	1231-1126
J313	MOLEX 12 PIN CONNECTOR 03-09-1126 PINS FOR MOLEX CONNECTOR 1126	1231-1126 1200-1139

INDUCTORS

L101	1.4UH INDUCTOR 22GA WIRE 8022-0400 SEE R128	1700-0001
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PLUGS

P101	MOLEX 12 PIN CONNECTOR 03-09-2121 PINS FOR MOLEX CONNECTOR 2121	1231-2121 1349-2137
P301	AC CABLE 3-COND 18GA PARALLEL-BLADE U-GROUND	8708-0883

TRANSISTORS

Q101	2N2484 NPN SILICON LOW SIGNAL T092	1854-2484
Q102	MJE 15028 NPN TRANSISTOR T0220	1854-5028
Q103	MJE 350 PNP TRANSISTOR	1853-0350
Q104	MJE 340 NPN TRANSISTOR	1854-0340
Q105	MJE 720 NPN TRANSISTOR	1854-0720
Q106	2N4401 NPN SILICON LOW SIGNAL T092	1854-4401
Q107	2N4403 PNP SILICON LOW SIGNAL T092	1853-4403
Q108	MJE 340 NPN TRANSISTOR	1854-0340
Q109	MJE 350 PNP TRANSISTOR	1853-0350
Q110	MJE 15028 NPN TRANSISTOR T0220	1854-5028
Q111	MJE 15029 PNP TRANSISTOR T0220	1853-5029
Q112	MJ 15022 NPN TRANSISTOR T03	1854-1522
Q113	MJ 15023 PNP TRANSISTOR T03	1853-1523

RESISTORS

R101	47K 5% 1/2W DEPOSITED CARBON	5005-4703
R102	47.5K 1% METAL FILM	5001-4752
R103	47.5K 1% METAL FILM	5001-4752
R104	4.7K 5% 1/2W DEPOSITED CARBON	5005-4702
R105	4.7K 5% 1/2W DEPOSITED CARBON	5005-4702
R106	2.49K 1% METAL FILM	5001-2491
R107	100R 5% 1/2W DEPOSITED CARBON	5005-1002
R108	15K 5% 1/2W DEPOSITED CARBON	5005-1503
R109	15K 5% 1/2W DEPOSITED CARBON	5005-1503
R110	680R 5% 1/2W DEPOSITED CARBON	5005-6801
R111	680R 5% 1/2W DEPOSITED CARBON	5005-6801
R112	68R 5% 1/2W DEPOSITED CARBON	5005-6800
R113	100R 5% 1/2W DEPOSITED CARBON	5005-1002
R114	FACTORY SELECTED OFFSET ADJUSTMENT	
R115	2.7K 5% 1/2W DEPOSITED CARBON	5005-2702
R116	470R 5% 1/2W DEPOSITED CARBON	5005-4701
R117	FACTORY SELECTED BIAS ADJUSTMENT	
R118	100R 5% 1/2W DEPOSITED CARBON	5005-1002

ENG NO	DESCRIPTION	PART NO
R119	100R 5% 1/2W DEPOSITED CARBON	5005-1002
R120	1K 5% 1/2W DEPOSITED CARBON	5005-1003
R121	1K 5% 1/2W DEPOSITED CARBON	5005-1003
R122	100R 5% 1/2W DEPOSITED CARBON	5005-1002
R123	100R 5% 1/2W DEPOSITED CARBON	5005-1002
R124	2.7R 5% 2W WIRE WOUND BWH	4025-2070
R125	2.7R 5% 2W WIRE WOUND BWH	4025-2070
R126	0.1R 5% 2W WIRE WOUND BWH	4025-1009
R127	0.1R 5% 2W WIRE WOUND BWH	4025-1009
R128	10R 10% 2W CARBON COMP SEE L101	6020-1001
R129	270R 10% 2W WIRE WOUND BWH	4020-2701
R130	33R 10% 2W WIRE WOUND BWH	4020-3300
R131	820R 3W WIRE WOUND	4030-8201
R132	2.7K 5% 1/2W DEPOSITED CARBON	5005-2702
R133	24K 5% 1/2W DEPOSITED CARBON	5005-2403
R134	47K 5% 1/2W DEPOSITED CARBON	5005-4703
R135	100K 5% 1/2W DEPOSITED CARBON	5005-1005
R136	1M 5% 1/2W DEPOSITED CARBON	5005-1006
R137	820R 5% 1/2W DEPOSITED CARBON	5005-8201
R138	10K 5% 1/2W DEPOSITED CARBON	5005-1004
R139	3.9K 5% 1/2W DEPOSITED CARBON	5005-3902
R140	100K 5% 1/2W DEPOSITED CARBON	5005-1005
R141	10K 5% 1/2W DEPOSITED CARBON	5005-1004
R142	3.9K 5% 1/2W DEPOSITED CARBON	5005-3902
R143	200R 5% 1/2W DEPOSITED CARBON	5005-2002
R144	200R 5% 1/2W DEPOSITED CARBON	5005-2002
R145	8.2K 5% 1/4W DEPOSITED CARBON	5065-8202
R146	8.2K 5% 1/4W DEPOSITED CARBON	5065-8202
R301	22K STEP ATTENUATOR NOBLE	7006-2015
R302	22K STEP ATTENUATOR NOBLE	7006-2015
R303	2.7K 5% 2W CARBON COMP	6025-2702

SWITCHES

S101	THERMAL SWITCH DOR 90C	0630-3441
S301	SLIDE SWITCH, RECESSED HANDLE	0620-6206

TRANSFORMERS

T301	TRANSFORMER, TOROID	0900-0124
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TERMINAL STRIPS

TB301	GROUND BARRIER STRIP W/STRAP	0720-1696
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MISCELLANEOUS

	KNOB MODEL 150	0700-1140
	BARRIER STRIP W/ JUMPER STRAP	0720-1696
	ADHESIVE BARRIER PAPER	0721-0125
	MICA INSULATOR TO-3	0723-5603

BGW SYSTEMS, INC.

ENG NO	DESCRIPTION	PART NO
	MICA INSULATOR TAB	0723-5677
	INSULATOR BOOT FOR SLIP-ON LUG	0723-6125
	CLOSED END SPLICE 12-10 GA	1231-1210
	CLOSED END SPLICE 22-18 GA	1231-2218
	CAPACITOR CLAMP	1231-0140
	3 LUG TERMINAL STRIP	1231-3003
	#10 CRIMP LUG 12-10 GA	1313-3457
	#10 CRIMP LUG 16-14 GA	1313-4123
	SLIP-ON LUG BLUE INSULATED	1321-5305
	SLIP-ON LUG 22-18 GA	1322-9600
	SLIP-ON LUG 16-14 GA	1322-9700
	OCTAL JUMPER PLUG ASSEMBLY	1350-0108
	RUBBER BUSHING TRANSFORMER	1610-0103
	6-32X3/8 PANHEAD MACHINE SCREW PHILLIPS BLK	2111-3375
	5-40X1/4 PANHEAD MACHINE SCREW PHILLIPS BLK	2111-7250
	4-40X3/8 PANHEAD MACHINE SCREW PHILLIPS CAD	2115-2375
	6-32X3/16 PANHEAD MACHINE SCREW PHILLIPS CAD	2115-3187
	10-32X3/8 PANHEAD MACHINE SCREW SLOT CAD	2125-5375
	10-32X3/8 FLATHEAD MACHINE SCREW ALLEN BLK	2331-5375
	8-32X3/8 ALLEN SOCKET CAP SCREW	2431-4375
	6-32X5/16 FLATHEAD MACHINE SCREW PHILLIPS BLK	2511-3312
	6X3/8 PANHEAD SHEETMETAL SCREWS PHILLIPS BLK	3111-3312
	6X5/8 PANHEAD SHEETMETAL SCREWS PHILLIPS BLK	3111-3625
	COMPRESSION WASHER FOR FLAT PACKAGES	8130-0000
	INSULATOR BUSHING TO-220	8130-0001
	#6 INTERNAL TOOTH LOCK WASHER	8132-0000
	#8 FLAT WASHER	8141-0000
	#8 EXTERNAL TOOTH LOCK WASHER	8143-0000
	WASHER TRANSFORMER CLAMP	8150-0001
	#10 SPLIT LOCK WASHER	8154-0000
	3/8 INTERNAL TOOTH LOCK WASHER	8172-0001
	6-32X5X16 HEX KEP NUT	8533-0312
	8-32X5/16 HEX KEP NUT	8543-0312
	1/4-20 HEX NUT LOCKING	8565-0437
	3/8-32 HEX NUT NICKEL	8574-0500
	PDP RIVET	8699-0001
	HEATSHRINK TUBING BLK	8901-0125
	HEATSHRINK TUBING BLK	8901-0187
	TEFLON TUBING #22 WHITE	8902-0022
	L-BRACKET PC BOARD TO HEATSINK	9004-0176
	CARTON WHITE 23X17-7/8X5-3/8 PRINTED	9851-1140
	TAPE EGGSHELL WHITE	9860-0002
	PLASTIC BAG 10X6X.004 MIL	9899-0004
	PLASTIC BAG 20X30X.004 MIL	9899-2030
	TIE WRAP	9999-0550
	RUBBER FEET ADHESIVE	9999-5003

THREE YEAR LIMITED 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 three (3) years 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 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 are listed in your owner's manual or 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.