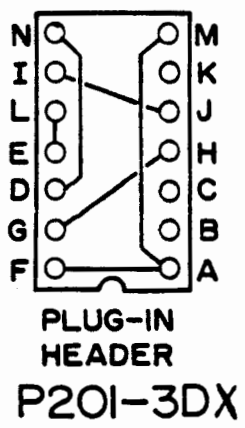
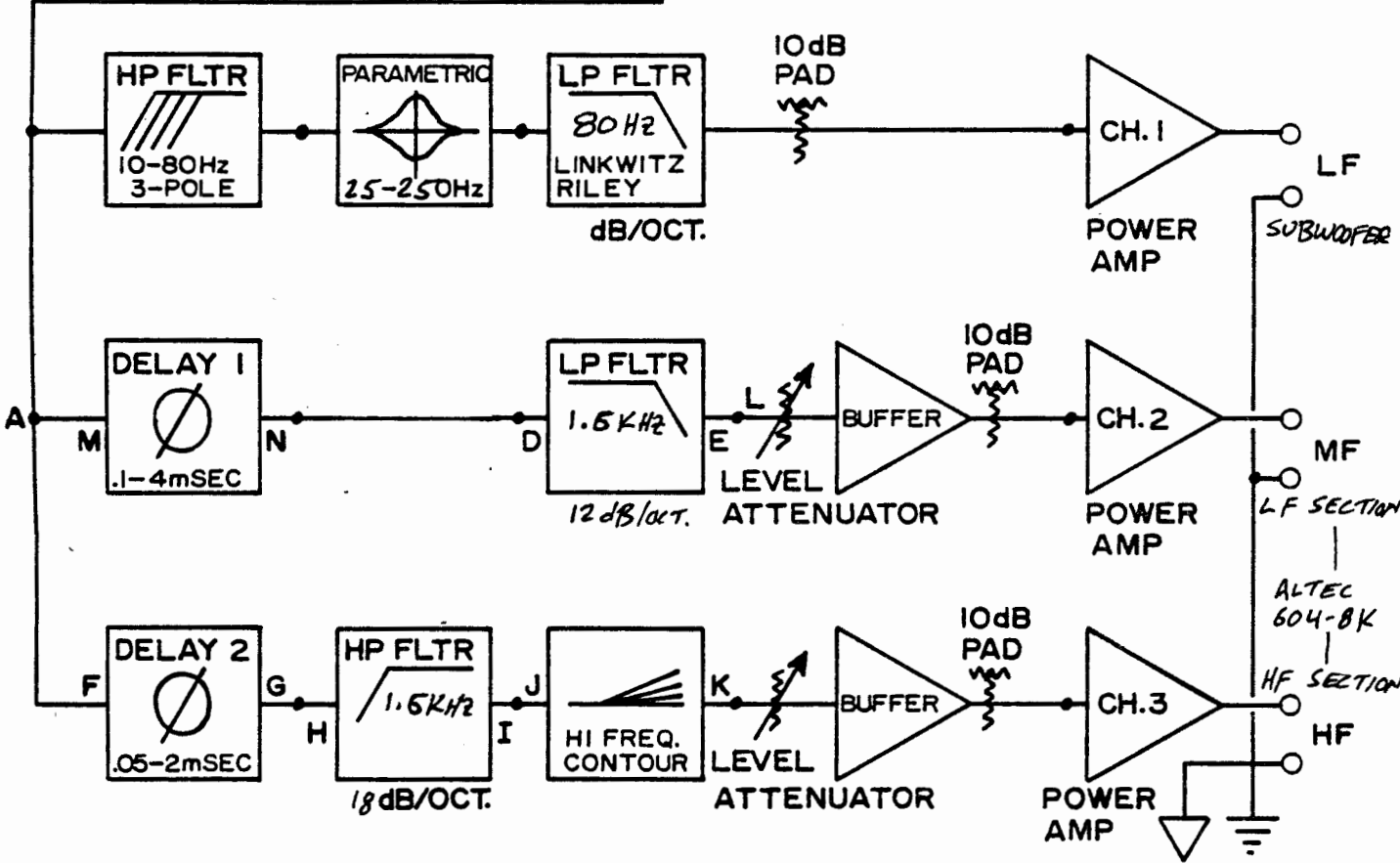
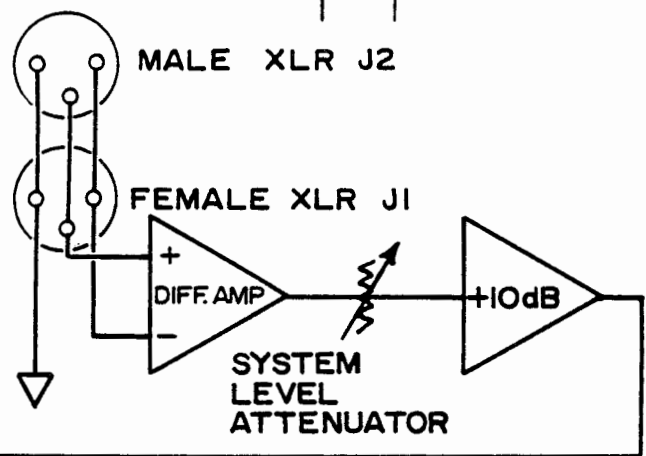




**SPA-3**  
SIGNAL PROCESSING AMP

CUSTOMER \_\_\_\_\_  
CONFIGURATION \_\_\_\_\_  
SERIAL NO. \_\_\_\_\_

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



CUSTOMER [REDACTED]				BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090	
DRAWN <i>S.W. Selberg</i>	8-26-87	TITLE SPA-3 CONFIGURATION 3DX			
CHECK		SYSTEM BLOCK DIAGRAM			
PROJECT ENGR <i>S.W. Selberg</i>	8-22-85				
SPEAKER SYSTEM [REDACTED]		SIZE A	DRAWING NUMBER 9512-7723		REV
[REDACTED]		SCALE			SHEET 2 OF 2

# THE BGW SPA-1 & SPA-3 SIGNAL PROCESSING AMPLIFIERS



## SPA-1 Signal Processing Subwoofer Amplifier • SPA-3 Signal Processing 3-Way Amplifier

Built-in electronic crossovers with up to 24 dB/octave filters • Parametric EQ • All-pass filter delays • Precision digitized attenuators  
High performance active balanced input • Socket for input transformer (SPA-3) • High frequency propagation loss compensation (SPA-3)  
System reconfiguration via plug-in jumper network (SPA-3) • Controls behind security panel • Turn-on delay & fast-off • A rack full in 5-1/4"

# The BGW SPA-1 or SPA-3 – A Rack Full of Power in 5.25 Inches

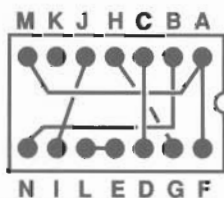
The BGW SPA-1 and SPA-3 are dubbed "signal processing amplifiers" because they are more than just power amps: they contain a number of signal processors that would otherwise have to be purchased in separate packages and interconnected in order to adequately drive the loudspeaker system. By combining the necessary functions in one package, BGW has made it possible to assemble a sound system in less space, for comparable or less money, and with better reliability and performance than was previously available. What's more, the system designer can use these products as basic "toolboxes" from which almost any sound system can be created.

The SPA-3 is the more flexible and more complex of the two models, since it includes three power amplifiers and numerous processors that can be set up in almost unlimited configurations optimized for the drivers in any system. The SPA-1 has the required signal processors and two power amplifiers of sufficient horsepower to drive the subwoofers for almost any sound system. These two products can be used together, or separately, as needs dictate.

## SPA-3A: Your Own System Design, Professionally Packaged

### Many Functions, Easily Reconfigured

This product utilizes a modular design wherein functional blocks can be reconfigured in seconds via plug-in "headers." These 14-pin jumper-networks are about the size of an IC, come in numerous factory preset configurations, and/or may be reconfigured in the field.



Header (Jumper Network) Configures SPA-3

Standard blocks include three power amplifier modules, two signal delays, a 3-way electronic crossover network, a Switchset™ subsonic filter, a low frequency

parametric EQ, a high frequency contour filter, three digitized attenuators, and several buffer amplifiers, pads, and a differential input circuit. An octal socket is provided for an optional input transformer. This same socket may be used for the various signal take-off points (to drive additional external power amps, for example). You can readily change the location of the attenuators, delays, etc., within the signal flow, the way signals mix (or don't mix), and so forth.

If you don't need all the processing capability, you can order the system without these options (i.e., less the parametric EQ or one of the delays).

### Precision and Repeatability

EQ characteristics, delay times, attenuator levels, and virtually all adjustments are accessible on the front panel behind a removable security cover. These settings are made via precision, calibrated rotary controls or miniature digi-switches so you can document the values from testing. Correct settings can be re-established quickly and accurately, and multiple systems will closely track each other.

The attenuators are a unique design; a digi-switch arranges 1% precision resistors providing approximately 0.1 dB accuracy down to at least -40 dB. In the standard configuration, one attenuator adjusts overall system level (0 to -89 dB), and two more attenuators scale amp channels 2 & 3 in 1 dB increments below system level. The attenuators can be ordered optionally at twice the resolution (1/2 dB scaling).

### Packaged for the Professional, Designed For Unskilled Use

Both the SPA-1 and SPA-3 are strong enough for touring, yet also equipped with the connections you want for permanent installations. Everything is contained in a compact 5-1/4" high rack-mount chassis. A modular design facilitates service, and flexicircuits reliably link individual modules while minimizing hand wiring. Each amplifier module is constructed around a heavy, extruded aluminum heat sink, and can be swapped out in minutes. (Precision controls make recalibration a snap.) Signal processing functions can be hard-wire bypassed. Of course, with fewer cables, there is less opportunity for installation errors, oxidized contacts, or cable faults — basically you eliminate many of the problems associated with large, complex sound systems.

Interface with the rest of your equipment is straightforward. Parallel-wired male and female balanced XLRs handle the inputs (although in some configurations, one of the XLRs can be used as a buffered output). Ground lift and phase reversal are there, too. The power amplifier outputs are brought to 5-way binding posts for use with tinned leads, banana plugs, or terminal lugs. In addition, the octal socket that accepts an optional input transformer also may be used to tap interstage signals for feed to additional external processors or amplifiers (one SPA-3 can serve as the master amp/processor, and other amps then serve as slaves). Five buffer amplifiers are built into the SPA-3, and some of these may be used as line drivers.

While it's loaded with functions and lots of custom-tunable processing, once the SPA is installed, it is very straightforward to use. Just turn it on. The magnetic circuit breaker/power switch even turns itself off so an untrained operator can immediately respond to any fault. Signal presence and clip LEDs on each channel make it easy to verify normal operation. The rest of the controls and adjustments are discreetly out of reach behind the front-panel security cover.

### Outstanding Performance

Often in electronics, multi-function boxes represent compromises in order to squeeze a lot of function into a little space. Not so with the SPA-1 and SPA-3. For example, the power amplifiers are top quality, using proven BGW technology, with very conservative ratings. The SPA-3 will deliver 200 watts into 8 ohms for each of its three amp modules, thus allowing plenty of headroom for compression drivers. The low frequency output will deliver 400 watts into 4 ohms — ample for very solid bass reproduction. This model is convection cooled, making it physically quiet enough for use in a control room. The use of a compact toroidal transformer further silences the chassis, while reducing stray magnetic fields to avoid inducing hum in adjacent rack-mounted components. Electronically, the system is also quiet, using low-noise TL074 and 5532 opamps. High common mode rejection is afforded by a differential input that includes HF & DC gain trim for optimization of CMRR. If you require the utmost in common mode range (as in very high noise environments), you can plug in an optional input transformer at any time.

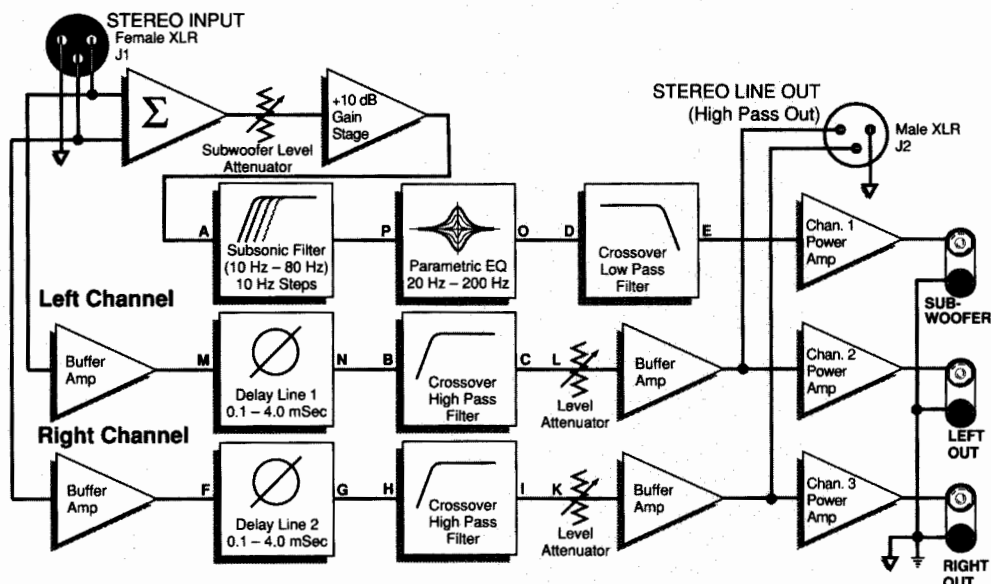
We have, in fact, put in extra touches to preserve signal quality. For example, the



# A Few of the Many Ways the SPA-3 Can Be Configured

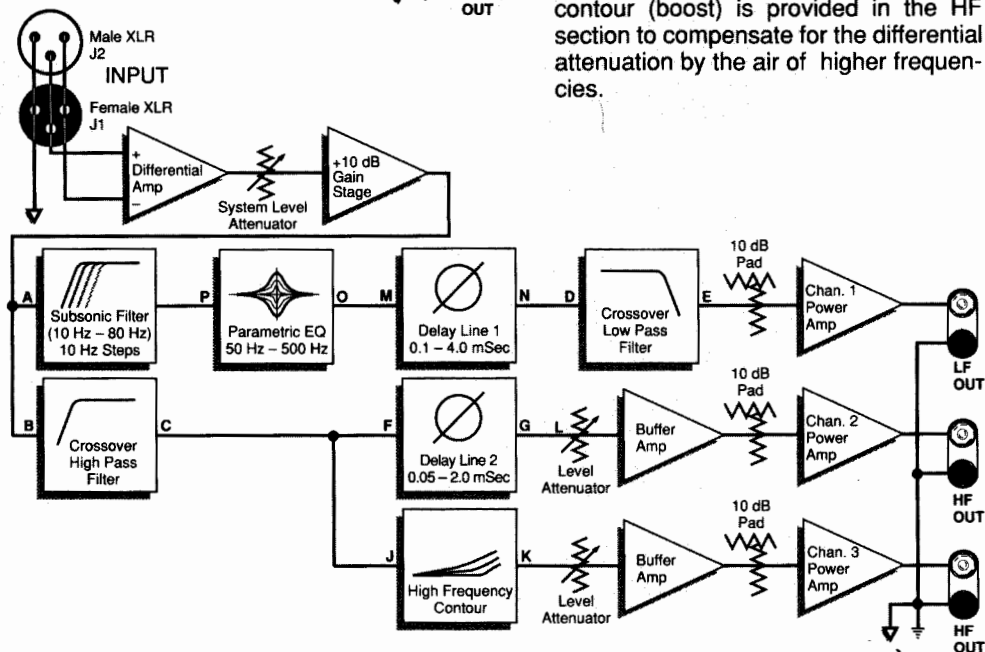
## Stereo Full-Range System With Mono Subwoofer

This system includes a 2-way crossover network. The low frequency (subwoofer) section includes parametric equalization and a precision subsonic filter. Separately adjustable signal delays are provided for the left and right high-pass outputs so that the wavefronts from these speakers can be aligned with the wavefront from the subwoofer. A separate high-pass stereo output is provided for additional stereo amplifiers and speakers.



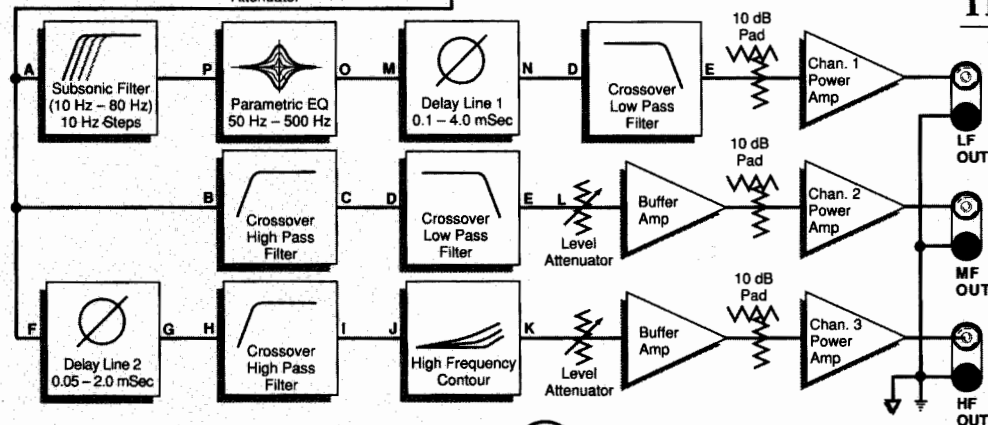
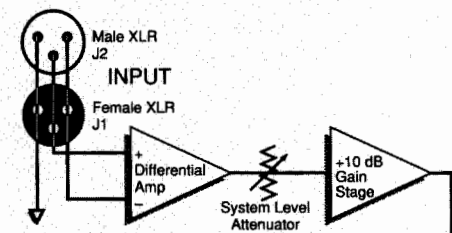
## Three-Way Full-Range System

This full-range system utilizes a three-way crossover. The low frequency section includes its own precision subsonic filter, parametric EQ, and signal delay for wavefront arrival compensation due to the nearer proximity of the low frequency cone in relation to the diaphragm on the midrange compression driver/horn assembly. The high frequency output has a signal delay for wavefront arrival compensation (the same reason as the LF delay, though scaled differently) due to the relatively closer location of the driver diaphragm on a shorter horn. High frequency contour (boost) is provided in the HF section to compensate for the differential attenuation by the air of higher frequencies.



## Two-Way Full-Range System with Near- and Long-Throw High Frequency Drivers

This full-range system utilizes a two-way crossover, yet has three outputs. The LF section includes its own precision subsonic filter, parametric EQ, and signal delay for wavefront arrival compensation due to the nearer proximity of the low frequency cone in relation to the diaphragm on the compression drivers in the long-throw, high-frequency horns. Both HF outputs cover the same band, but one is for a near-throw fill speaker cluster, and the other is for a long-throw cluster. The near-throw cluster has shorter horns, and hence a signal delay to compensate for wavefront arrival in the overlapping coverage zone. The long-throw output has a high frequency contour (boost) to compensate for HF attenuation in the air.



signal going into each delay section is 10 dB above nominal, with a 10 dB attenuator following the delay; this preserves best S/N performance through the circuit. Indeed, the overall performance of the SPA-1 and of the SPA-3 is top quality. These units are, however, easier to set up and more cost effective than the rack full of separate high-quality components they each replace.

### Unique Signal Delays

The SPA-1 has one delay section, and the SPA-3 has two delay sections. Your signals are not quantized (digitized), and consequently there is none of the potential degradation of A/D -D/A conversion, anti-aliasing filtration, etc. Instead, we use special all-pass delays that are very linear with regard to delay over frequency. Our unique "stagger tuning" design that assures maximally flat response was devised over several months of computer aided design.

The precision delay-controlled driver alignment made possible by these units means you'll need less corrective EQ because initial speaker system response is flatter, and dispersion is better controlled. Hence you enjoy better overall sound quality. Typically, you'll use the delay on the low

band because the voice coil of a direct radiator woofer will be physically mounted closer to the listener than that of a horn-mounted compression driver. Thus, the delay brings the two wavefronts into alignment in the crossover region, which reduces lobing and phase cancellation, and provides the intended directional characteristics. Delay N<sup>o</sup> 1 in the SPA-3 is permanently installed in channel 1 (the LF channel) and is adjustable in 100  $\mu$ S increments (1.35") to a maximum of 4 milliseconds (4-1/2"). Delay N<sup>o</sup> 2 can be inserted in the mid- or high-frequency path (channels 2 or 3), or both, and is adjustable in ten 50  $\mu$ S increments (0.68") to a maximum of 2 milliseconds (2-1/4").

### An Electronic Crossover with Subsonic Filter, HF Contour & LF Parametric EQ

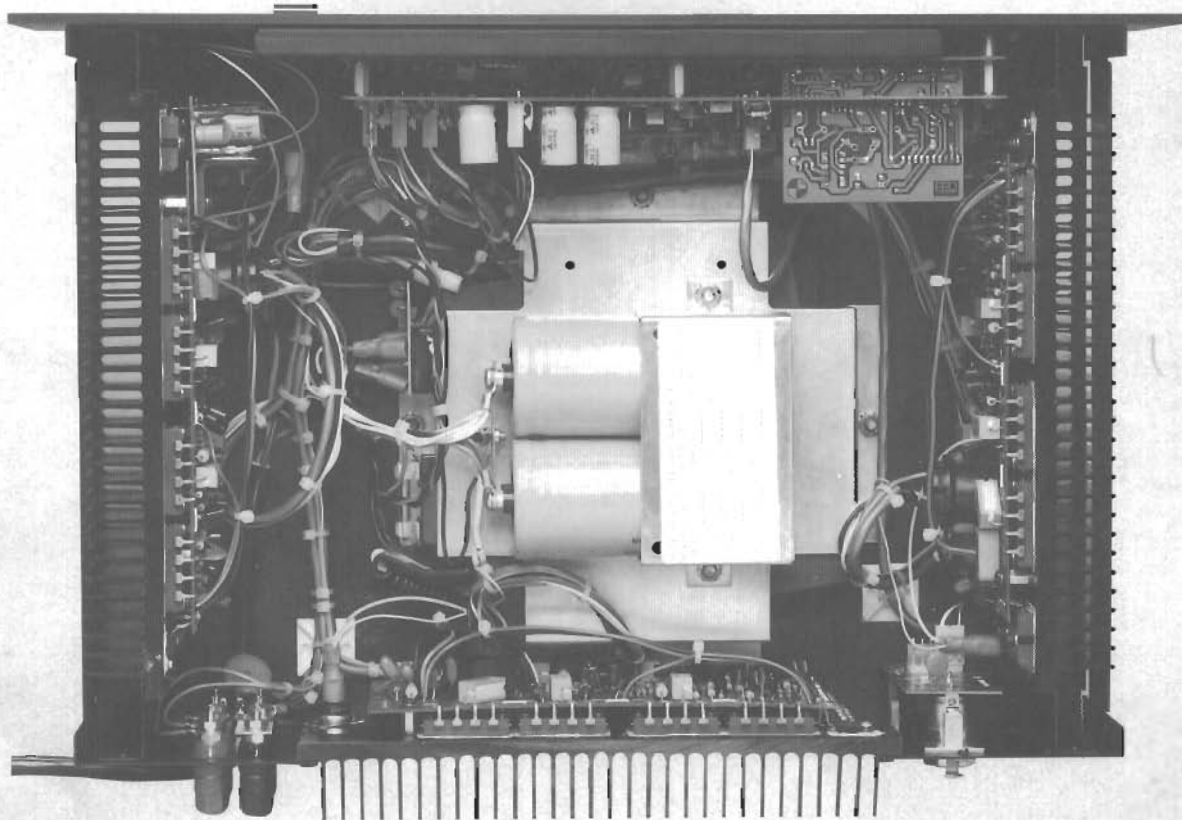
The SPA-3 has numerous filter functions. Two low-pass and two high-pass sections permit configuration of the system into a 3-way full-range triamplifier (or a biampifier). The standard filters are 24 dB/octave (4-pole) Linkwitz-Riley type, each consisting of dual 12 dB/octave filters. They are 6 dB down at the crossover point, and have a smoother sound. However, you can order the latter, or

you can order Butterworth filters in 1, 2, 3 or 4 pole configurations if you prefer. The unit also comes with a set of component value tables so you can configure your own custom-designed crossover in the field.

There is a precision subsonic high pass filter to eliminate unwanted noise and potentially damaging DC or infrasonic transients. Standard configuration is an 18 dB/octave (3-pole) Butterworth, adjustable from 10 Hz to 80 Hz in 10 Hz steps; optional ranging is available.

To correct for overall system response, a parametric equalizer is included in the low frequency channel. The center frequency is adjustable over the decade from 30 Hz to 300 Hz, Q from 0.5 to 2.0, and the gain range is  $\pm 6$  dB. Optional frequencies are available.

A filter is provided specifically for compensation of rolloff due to horn/driver response and air attenuation. The High Frequency Contour processor is a single-pole (6 dB/octave) filter providing 0 to 9 dB of boost in 1 dB increments, with a corner frequency selectable at 5 kHz or 10 kHz. Optional High-Resolution (0.5 dB) incremental boost is available.



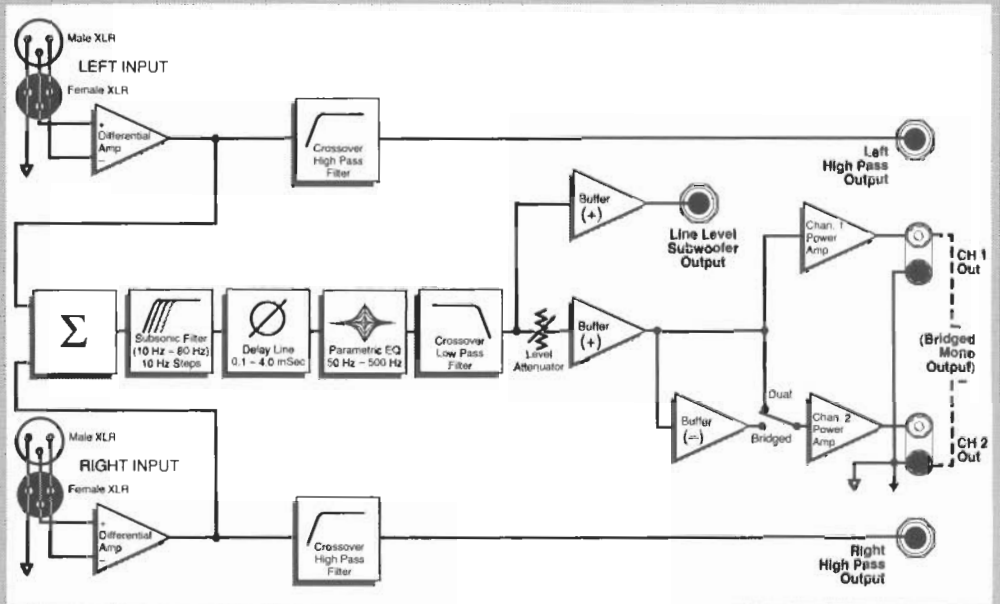
Inside The SPA-3: A Neat, Modular Layout

# The SPA-1 Subwoofer Amplifier System

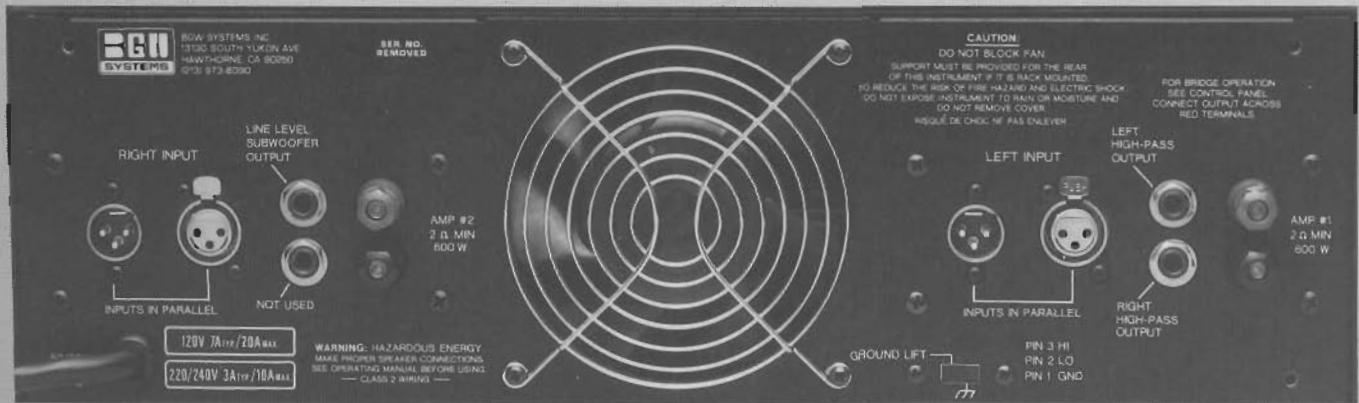
This unit is based on the same concept as the SPA-3, but is designed for use as either a dual channel full-range amplifier, or a bridged (mono) amp. It is ideal for driving subwoofers, though its performance is absolutely uncompromising in full-range applications as well.

The SPA-1 will deliver 250 watts per channel into 8 ohms or 600 watts per channel into 2 ohms in either the 2-channel discrete or summed input (dual mono) mode. When operated in bridged output mode, it will deliver a whopping 1200 watts into 4 ohms. To dissipate this kind of power, the SPA-1 is forced air cooled.

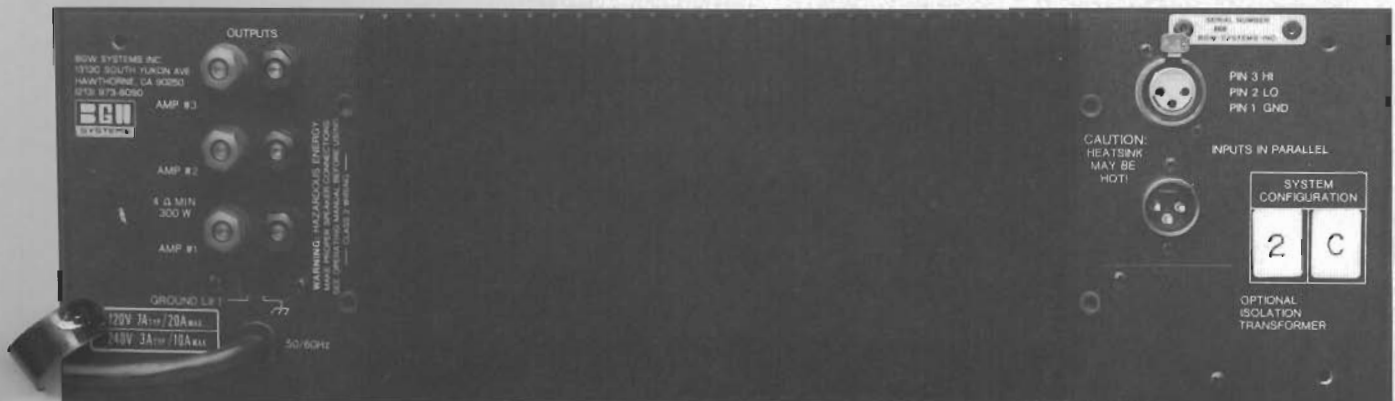
The basic functional blocks of the SPA-1 include a 2-way electronic crossover network, a summing amplifier to mix the left and right inputs to a mono signal (for driving a subwoofer) while providing discrete high-passed L & R line outputs to other amps, a subsonic filter, a signal delay, and a parametric equalizer.



Block Diagram: The SPA-1 with Dual Mono or Bridged Mono Output



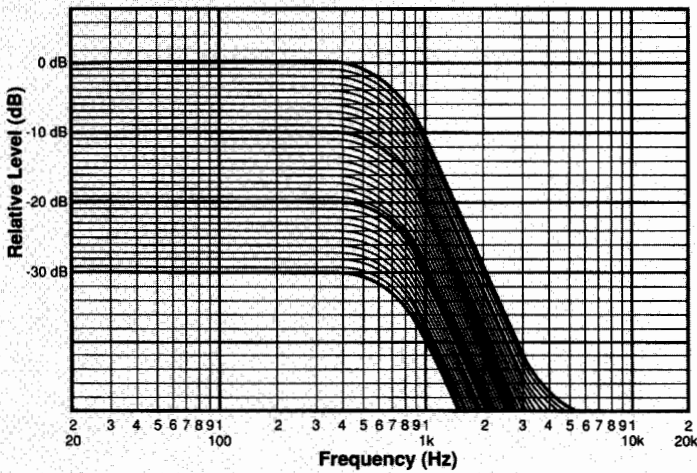
The SPA-1 Rear Panel



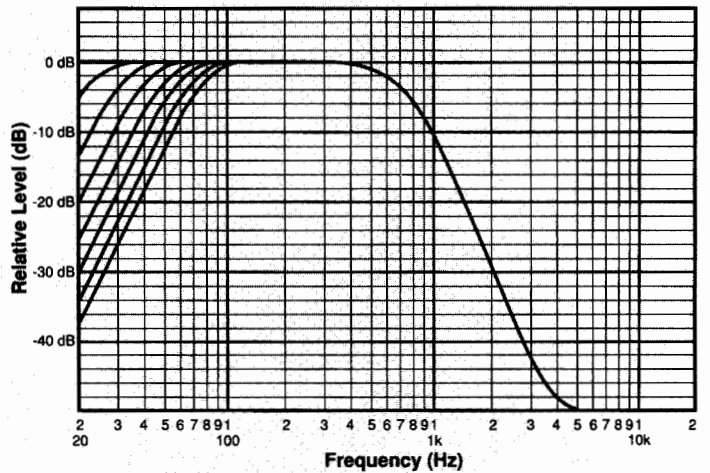
The SPA-3 Rear Panel



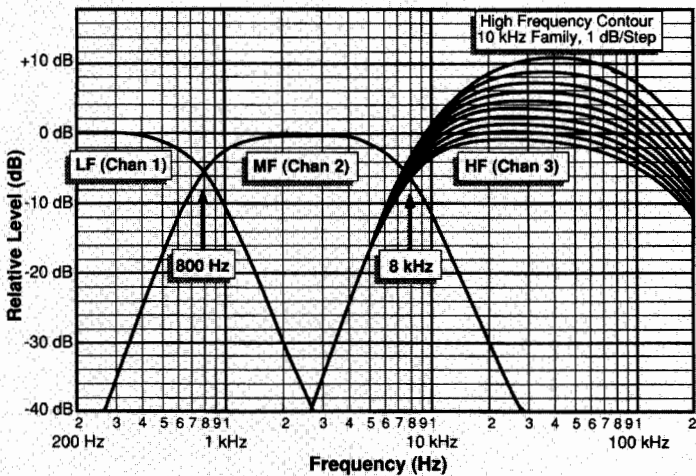
# SPA-3 Typical Performance Graphs



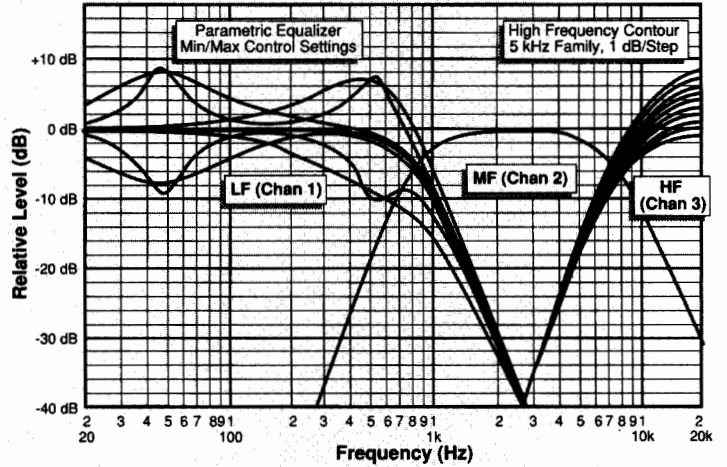
**System Attenuator Accuracy**  
(1 dB Steps, Low Frequency Channel)



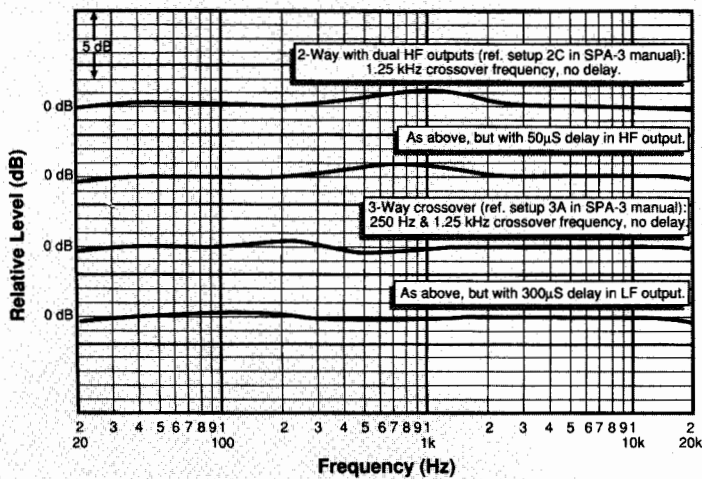
**High-Pass Filter Frequency Response**  
(Family of Curves, Low Frequency Channel)



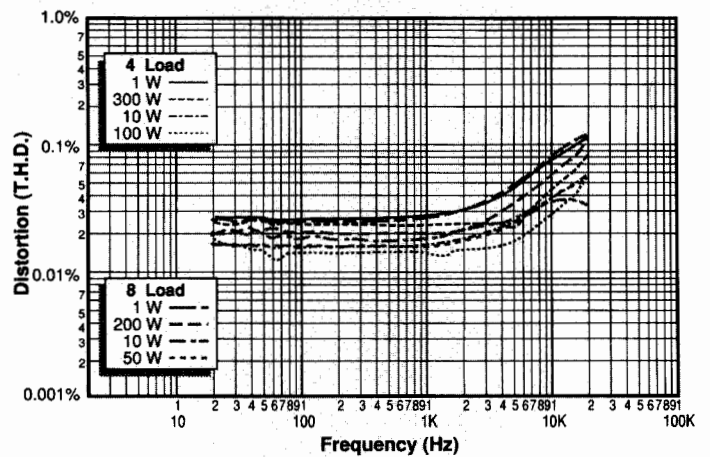
**System Frequency Response (Wideband)**  
(24 dB/Octave Linkwitz-Riley Crossover)



**Low & High Frequency Equalizer Response**  
(24 dB/Octave Linkwitz-Riley Crossover)

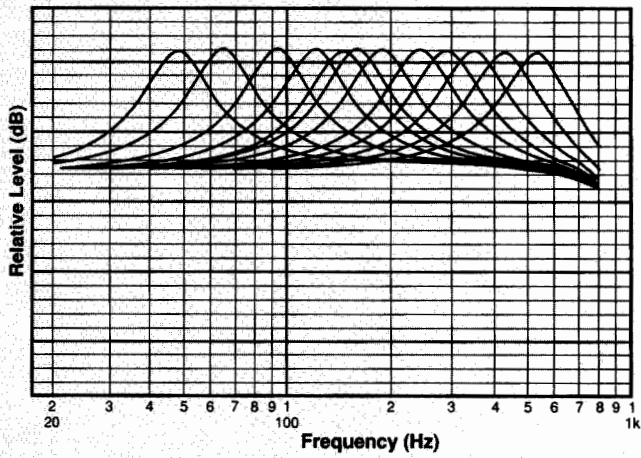


**Summed Crossover Outputs**  
(System configurations described in SPA-3 Operation Manual)

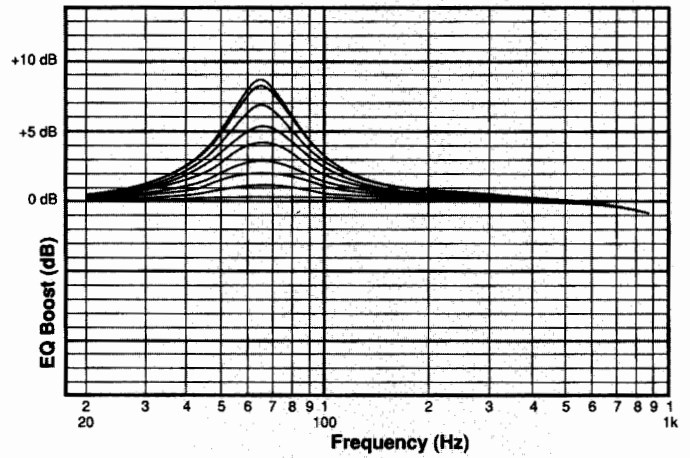


**Total Harmonic Distortion vs. Frequency vs. Power**  
(BGW 7510 Power Amplifier Module, 4Ω & 8Ω Loads)

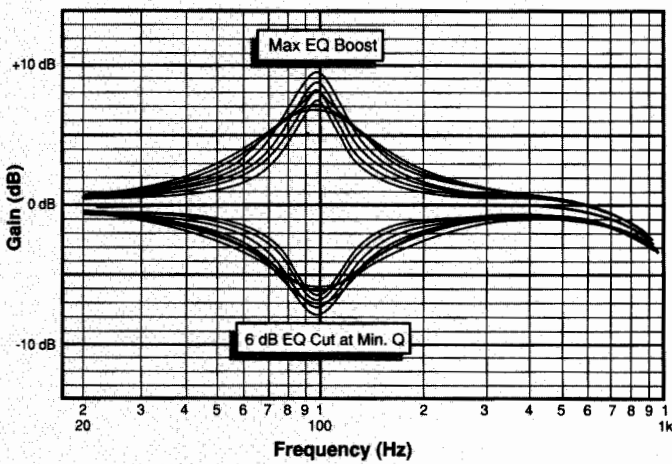




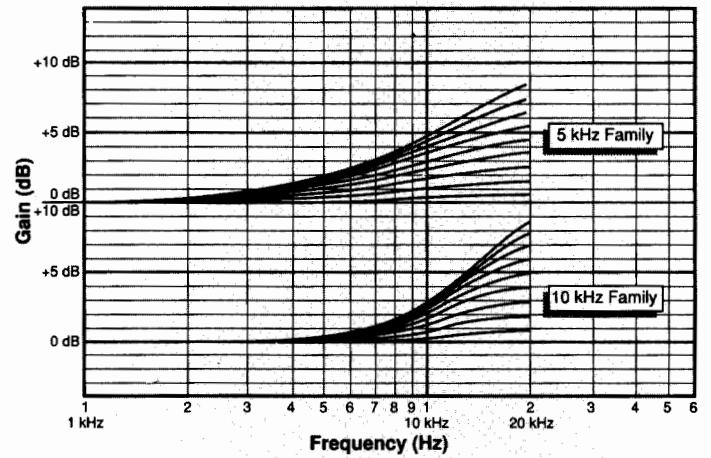
**Parametric EQ: Frequency Control Rotation**



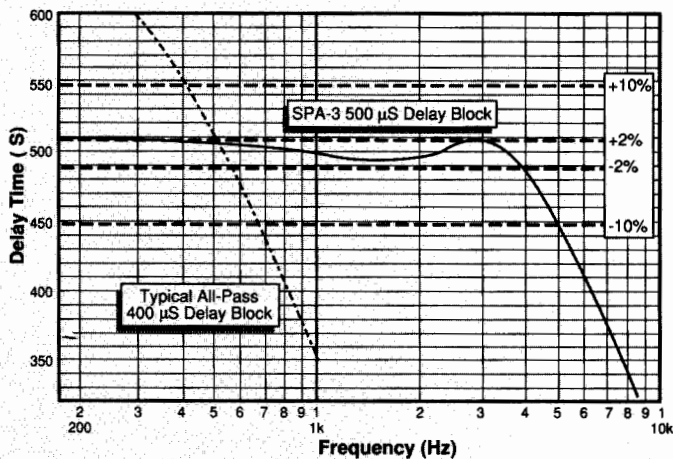
**Parametric EQ: Level Control Rotation (Boost)**



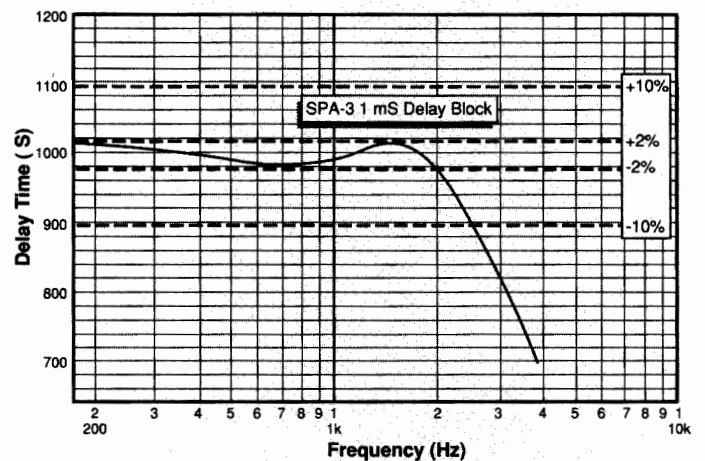
**Parametric EQ: Q Control Rotation**  
(Max Boost Curves, Cut Curves Set at -6 dB With Minimum Q)



**HF Contour: 5 kHz & 10 kHz Boost Curve Families**



**Delay vs. Frequency at 500 Microseconds Nominal**  
(Exceptionally Flat Delay Curve Compared to Other Units)



**Delay vs. Frequency at 1 Millisecond Nominal**  
(Consistently Flat Delay Curve at Increased Delay Time)

## SPA-1 & SPA-3 Specifications

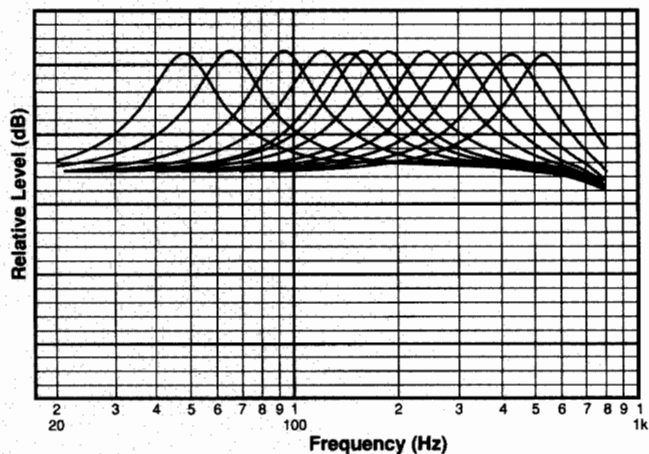
	SPA-1	SPA-3
<b>Power Output</b>	<i>Dual CH Mode    Bridge Mono</i>	<i>LF Section            MF &amp; HF Sections</i>
16 ohms	125 W/CH      400 W	125 W/CH      125 W/CH
8 ohms	250 W/CH      800 W	250 W/CH      250 W/CH
4 ohms	400 W/CH      1200 W	400 W/CH      300 W/CH
2 ohms	600 W/CH      N/A	N/A              N/A
<b>Maximum Gain</b>	30 dB Each Channel	30 dB Each Channel
<b>Attenuation</b>	Precision stepped rotary decimal switches adjustable in 1 dB steps; from 0 to 89 dB attenuation.	Precision stepped rotary decimal switches adjustable in 1 dB steps; from 0 to 89 dB attenuation. Three attenuators are provided: System Level, Mid and High Output.
<b>Attenuation Accuracy</b>	±0.10 dB from indicated value, down to -40 dB.	±0.10 dB from indicated value, down to -40 dB.
<b>Frequency Response</b>	Determined by filter settings.	Determined by filter settings.
<b>Input Impedance</b>	15 kohms with active balanced input or optional factory-provided transformer.	15 kohms with active balanced input or optional factory-provided transformer.
<b>CMRR</b>	Greater than 80 dB.	Greater than 80 dB.
<b>Crossover</b>		
<b>Frequency (ies)</b>	Customer specified ISO frequency.	Customer specified ISO frequency.
<b>Slope Rate</b>	24 dB/octave standard; customer to specify as single 24 dB slope or dual 12 dB + 12 dB slopes; 6, 12 or 18 dB/octave on special order.	24 dB/octave standard; customer to specify as single 24 dB slope or dual 12 dB + 12 dB slopes; 6, 12 or 18 dB/octave on special order.
<b>Filter Type</b>	Linkwitz-Riley standard; Butterworth optional.	Linkwitz-Riley standard; Butterworth optional.
<b>High-Pass (Subsonic) Filter</b>		
<b>Frequency</b>	10, 20, 30, 40, 50 60, 70 or 80 Hz, or bypass.	10, 20, 30, 40, 50 60, 70 or 80 Hz, or bypass.
<b>Slope Rate</b>	18 dB/octave (Butterworth).	18 dB/octave (Butterworth).
<b>Parametric Equalizer</b>		
<b>Frequency Range</b>	F <sub>c</sub> 25 Hz to 250 Hz.	F <sub>c</sub> 50 Hz to 500 Hz.
<b>Q Range</b>	0.5 to 2.0.	0.5 to 2.0.
<b>Gain Range</b>	±6 dB.	±6 dB.
<b>All-Pass Delay</b>		
<b>Delay 1 Time and Resolution</b>	100 μS to 4.0 mS (or bypass). 10 steps of 100 μS, 1 step of 1 mS, 1 step of 2 mS.	LF: 100 μS to 4.0 mS (or bypass). 10 steps of 100 μS, 3 steps of 1 mS; 2.5 kHz linear delay bandwidth.
<b>Delay 2 Time and Resolution</b>	N/A	MF/HF: 50 μS to 2.0 mS (or bypass). 10 steps of 50 μS, 3 steps of 0.5 mS; 5 kHz linear delay bandwidth.
<b>Linearity</b>	+2%, -10% up to 1200 Hz.	+2%, -10% up to 1200 Hz.
<b>System S/N Ratio</b>	Better than 100 dB (unweighted) with 1 step of 2 mS delay.	Better than 100 dB (unweighted) with 1 step of 2 mS delay.
<b>Dimensions</b>		
<b>Height</b>	5.25"	5.25"
<b>Width</b>	19"	19"
<b>Depth</b>	13.7"	13.7"
<b>Net Weight</b>	41 pounds	43 pounds

### NOTES

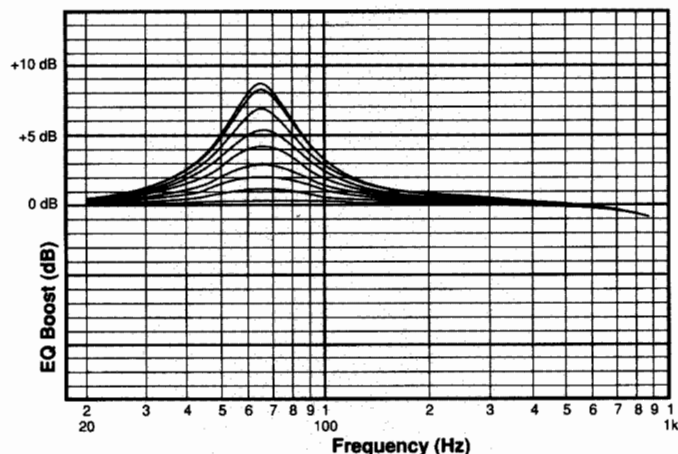
Power ratings are continuous average sine wave, all channels driven (where applicable); SPA-3 "Total Power" is FTC rating. THD at maximum power output varies depending on selected signal processing; amplifier modules alone typically produce under 0.05% THD at rated power. All measurements assume 120V AC power input.

All specifications and features are subject to change without notice.

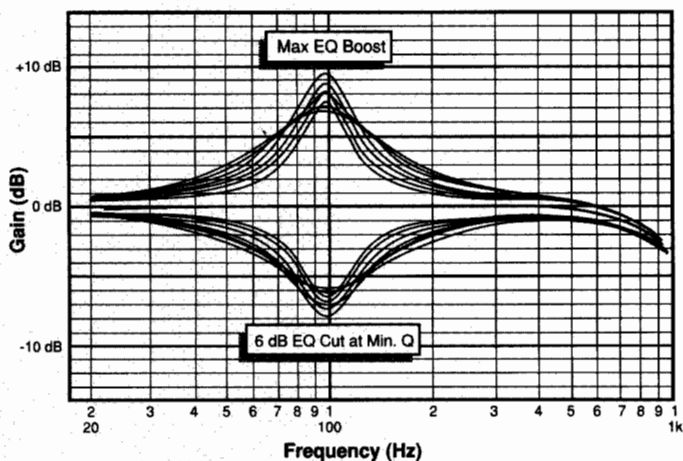




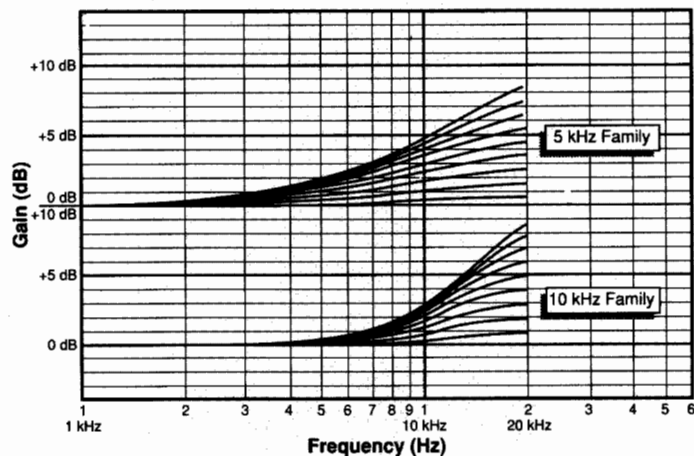
**Parametric EQ: Frequency Control Rotation**



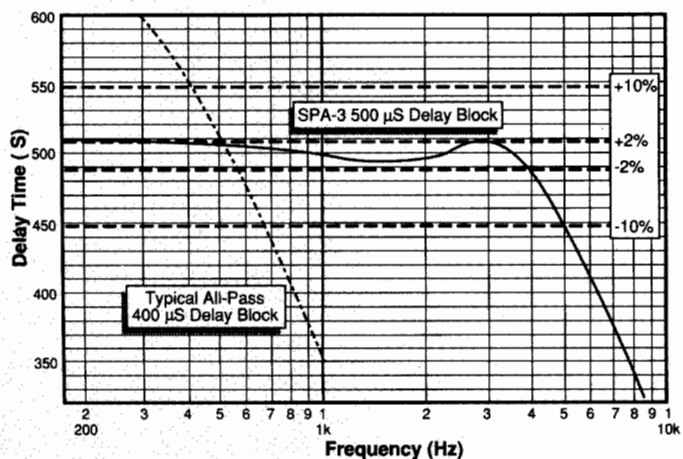
**Parametric EQ: Level Control Rotation (Boost)**



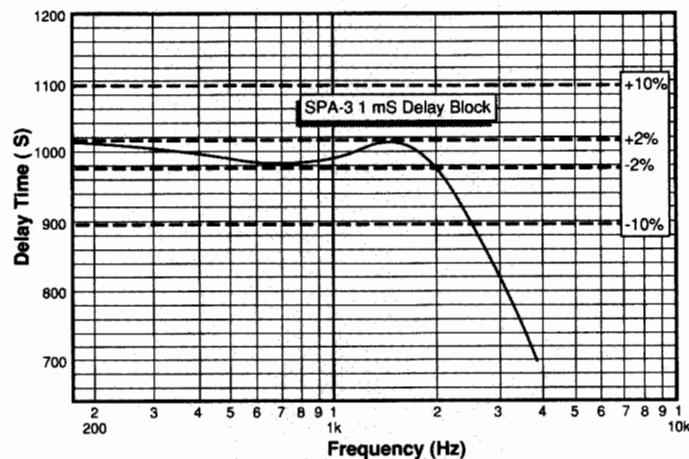
**Parametric EQ: Q Control Rotation**  
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(Consistently Flat Delay Curve at Increased Delay Time)

# LAB TEST REPORT

## The BGW SPA-3 Signal Processing Amplifier

by Jesse Klapholz and Richard Feld

BGW has been manufacturing time-proven, reliable power amplifiers for over 10 years. These have been more of a traditional type—two channels and volume controls. While BGW's only other entry into the signal processing sector has been an electronic crossover, this new amplifier has incorporated several new and unique features. The name SPA-3, which stands for Signal Processing 3-Way Amplifier, tells part of the story. It consists of a three-channel power amplifier, and a crossover/alignment-delay/eq section.

The three-rack-space unit has a removable security cover on its front panel, which provides access to the various level, eq, and delay settings. All of the functions are easy to set and are completely repeatable by the use of detent-type thumbwheel, slide, and DIP switches. Included on the front panel are a 20-amp magnetic circuit breaker (which acts as both an over-current protection device and power switch); power, and input signal presence LED's; and signal and clip

indicator LED's for each of the three channels. The rear-panel includes three sets of standard five-way binding post outputs, parallel male/female balanced XLR-type input connectors, an octal-socket for an optional input transformer, and a ground lift switch.

Opening the amplifier uncovers a well designed layout, with circuit cards easily removed for servicing, and headers easily reached for user changeable options. A closer inspection revealed high-quality low-noise op-amps were used throughout the signal processing circuits (TLO74's and 5532's). Also, the input circuit incorporated phase-reversal jumpers, and CMR (Common Mode Rejection) adjustment. A main reason for using a balanced input is to optimize CMR. Both the high-frequency and DC gain are adjustable and the second half of the input—a feature not even found on many recording consoles.

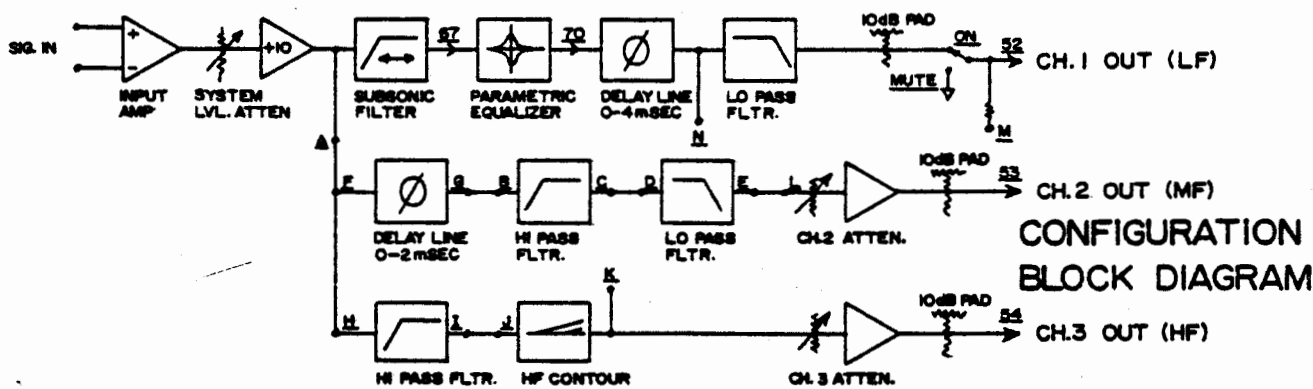
We just mentioned *headers* above. These are DIP sockets into which jumpers may be installed using a

14-pin block assembly the size of an IC-chip. These jumpers are used to configure the signal flow through the amplifier. The overall block diagram of the signal processing section is shown in Figure 1. Channel 1, or the low-frequency output, is hard-wired as follows: subsonic filter, parametric equalizer, 0-4 ms delay-line, and low-pass filter.

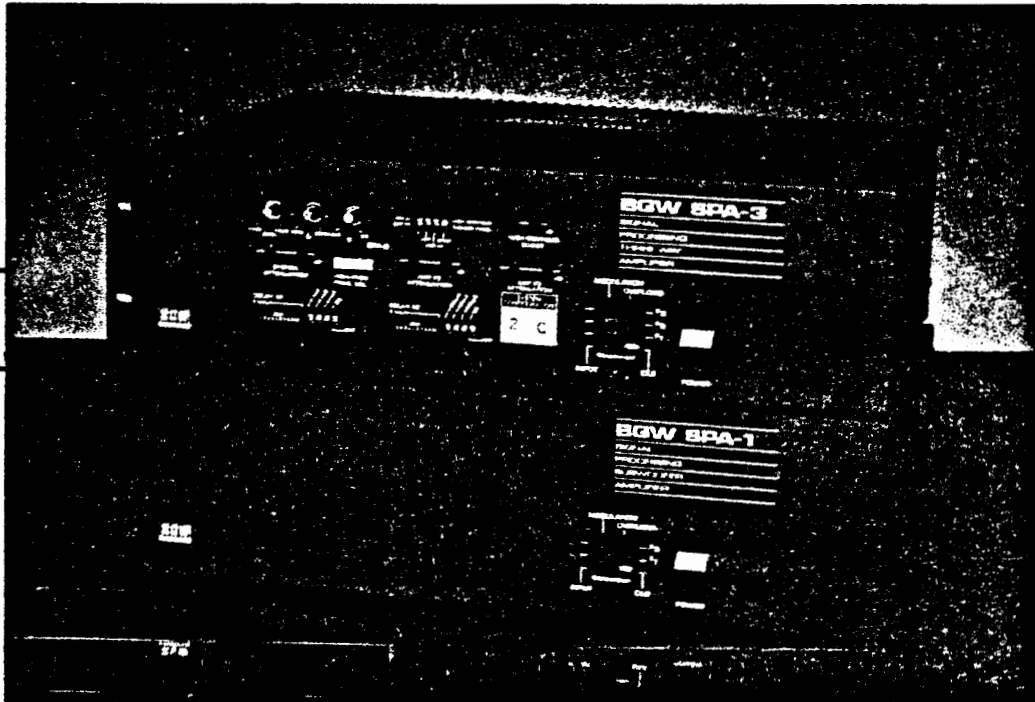
The delay will allow for up to 4.5 feet of alignment correction in the low-end with 100 us/step adjustments (100 us equals approximately 1.35 inches). The Mid/Hi Frequency delay will allow for up to 2.25 feet of correction with ten 50 us/step adjustments (50 us equals approximately .68 inches).

Channels two and three share five remaining blocks which are: two high-pass filters, a low-pass filter, a 0-2 ms delay-line, and a high-frequency contour equalizer. These channels are usually used for mid- and high-frequencies, and can derive their input signals from one of the three following stages: a) after the system in-

Figure 1







put level control; b) after the sub-sonic filter, parametric eq, and delay; and c) after a), c), and a low-pass filter. A flow-chart can be drawn, and implemented by simply wiring jumpers into a DIP header, providing for several variations in either two- or three-way setups.

A turn-on-delay/fast-off circuit is built into the amplifier to eliminate transients and *thumps* into the loudspeakers at power-up/power-down. The crossover network used is the currently accepted state-of-the-art Linkwitz/Riley type, with either 4th-order or *dual 2nd-order* slopes available. The dual-slope scheme, according to some, sounds better and still affords twice the power handling capability through the crossover region (more on this may be found in *Directing the Signal Flow*, October 1986 *Sound & Communications Magazine*). However, 12 dB/octave Butterworth filters are also available for those *die hards* who still use them.

### The Tests

We tested the SPA-3 with a Sound Technology 1710, and a Tektronix 502 oscilloscope. These instruments are commonly used and the test pro-

cedures are ones that any technician should be normally performing. Our tests used standard test bench resistive loads.

Upon power up, we ran the amplifier to clipping and verified smooth wave deformation which caused only minimal temperature increase of the heat sinks at these above normal output levels. The crossover frequencies were 800 Hz and 5 kHz. Since the amplifier was not set up as a full-range system, we were not able to test for IM distortion. These tests, however, would not be applicable because the individual amplifier channels are used over restricted bandwidths.

It should be noted that these tests are the same as testing a system from delay input, through eq/crossover, to amplifier output. There are from three to five stages of processing in any one amplifier channel with up to some 76 op-amps in the SPA-3 in all.

The manufacturer does not specify distortion figures for the amplifier, but we ran wide-band THD tests in all three channels, at both 8 and 4 ohm loads. We found the amplifier to have more than acceptable THD levels, and the power output exceeded that specified by the manufacturer. Also, the

signal-to-noise was not specified. These measurements were very good in all three channels as shown in our measurements. The amplifier performed well throughout our tests and never overheated or went into protection mode.

### Comments

We found the amplifier to be easily adaptable to a number of design/install situations. The precision level controls allow for exact gain structures to be established within a system and repeatability is simple. The parametric equalizer can be used for a step-down eq, or power response correction of low-frequency devices. The high-frequency eq is really utilitarian, in that it will compensate for the roll-off common to all constant-directivity type horns. This eliminates the need for external eq—reducing overall noise levels—a feature incorporated in some of the better crossover networks.

The optional input transformer socket can be used to bring out any signal processing block output. Thus, the crossover, delay, and eq can be used to drive other amplifiers. Furthermore, just about any frequency can be easily modified by changing a capacitor,

# REP NEWS

AKG Acoustics has announced the appointment of several new representative firms. ProMusica Sales in Keene, New Hampshire, will represent all AKG products to the professional audio and music dealers in New England. VF Sales in Natick, Massachusetts, continues to represent AKG products to the hi-fi market. Profit Line Marketing in San Rafael, California, will represent AKG products to the hi-fi market in northern California. J.N.D. in Fairfax, California, continues as pro products representative. Sound Marketing in Palos Heights, Illinois, will represent all AKG products to all dealers in Indiana and Kentucky. Central Electronics Sales Company in Royal Oaks, Michigan, will represent all AKG products to all dealers in Michigan.

Lowell Manufacturing Company has appointed Lichtenauer & Associates to represent the company in northern California and northern Nevada.

Martin America has appointed three new rep firms to handle Martin Audio Products of London. They are North Coast Marketing in Erie, Pennsylvania; Ludwig Marketing in Kenosha, Wisconsin; and Central Electronics Sales Co. in Royal Oak, Michigan. North Coast will serve Ohio, West Virginia, and western Pennsylvania; Ludwig will serve Illinois, Indiana, Kentucky and Wisconsin; and Central will serve Michigan.

the high-frequency contour eq for example. The *programmable* signal processing combined with three good-sized

power amplifiers in a compact package will find itself useful in many integrated or single cluster type systems.

## Specifications:

	MANUFACTURER'S	LAB TEST'S
Distortion THD	n/a	<.02%, 280W <.04%, 450W
Max Power Low Section	250W @ 8 ohms 400W @ 4 ohms	280W @ 8 ohms 450W @ 4 ohms
Max Power Mid/High Section	250W @ 8 ohms 300W @ 4 ohms	260W @ 8 ohms 450W @ 4 ohms
Signal to Noise Ratio	>100dB unweighted	>112 dB, low >106 dB, mid >102 dB, hi
Common Mode Rejection	n/a	>80 dB

## GENERAL SPECIFICATIONS

Attenuation	Precision stepped rotary decimal switches adjustable in 1 dB steps, provides from 0 to 89 dB attenuation. Three attenuators are provided, system level, mid, and high output.
Input Impedance	15K ohms, transformer or active balanced
High Pass Frequencies	10, 20, 30, 40, 50, 60, 70, 80 Hz or bypass
Crossover Fc	User specified ISO centers, specify slope as 24 dB/octave Linkwitz-Riley, 12 dB + 12 dB dual-point, or 12 dB/octave Butterworth.
Parametric Equalizer	Fc: 50 Hz - 500 Hz Q: 0.5 - 2.0 Boost/Cut: +/- 6 dB
Delay	Low-Frequency: 10 steps of 100 ms, 3 steps of 1 ms; delay range from 100 $\mu$ s to 4.0 ms Mid/Hi-Frequency: 10 steps of 50 $\mu$ s, 3 steps of 0.5 ms; delay range from 50 $\mu$ s to 2.0 ms
Dimensions	5.25"H x 19"W x 13.1"D
Net Weight	43 pounds
Price	\$2499 pro net

# 1

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## EQUIPMENT INSTALLATION

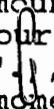
### RACK MOUNTING HINTS

Use care when mounting equipment in a rack enclosure. Place the heaviest units near the bottom of the rack. 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. This will restrict movement of the equipment in any direction in the rack enclosure. Likewise, equipment weighing more than 50 lbs require rear support to prevent distorting or breaking the Front Panel. BGW Power Amplifiers are fitted with Rear Panel Support provisions for this purpose. Please refer to the CHASSIS DIMENSIONS AND REAR SUPPORT DETAIL drawing in this manual. Angle brackets attached to the sides or bottom of the rack enclosure, and fitted to mate up with the mounting holes on the Rear Panel is one suggestion.

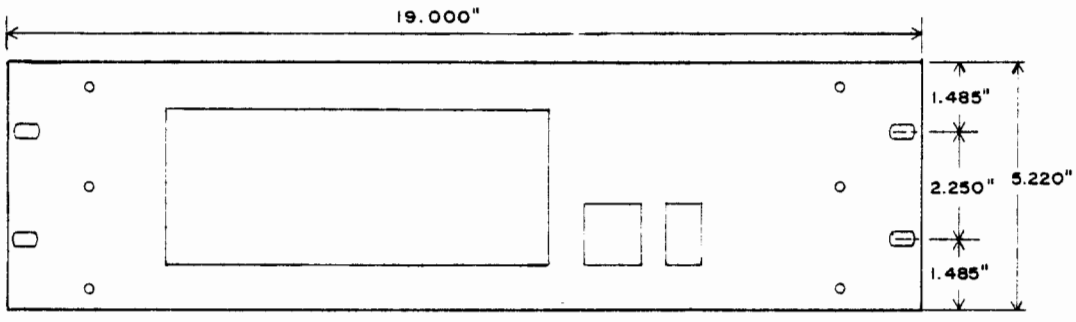
NOTE: DO NOT ALLOW MORE THAN 1/2" OF SCREW SHANK INSIDE CHASSIS. Select a screw length of about 1/4" greater than the bracket/washer thickness.

To protect the Front Panel finish from deep scratches occurring around the rack mount slotted holes, use NYLON Finishing Washers between the mounting screws and the Front Panel. #10-32 hardened machine screws are recommended, and is the size required for the rear support provisions. (Avoid "packaged" hardware found in consumer discount lumber/hardware stores, as most of it is too soft and can shear off easily. Hex-key style hardware, in general, has the proper hardness ratings).

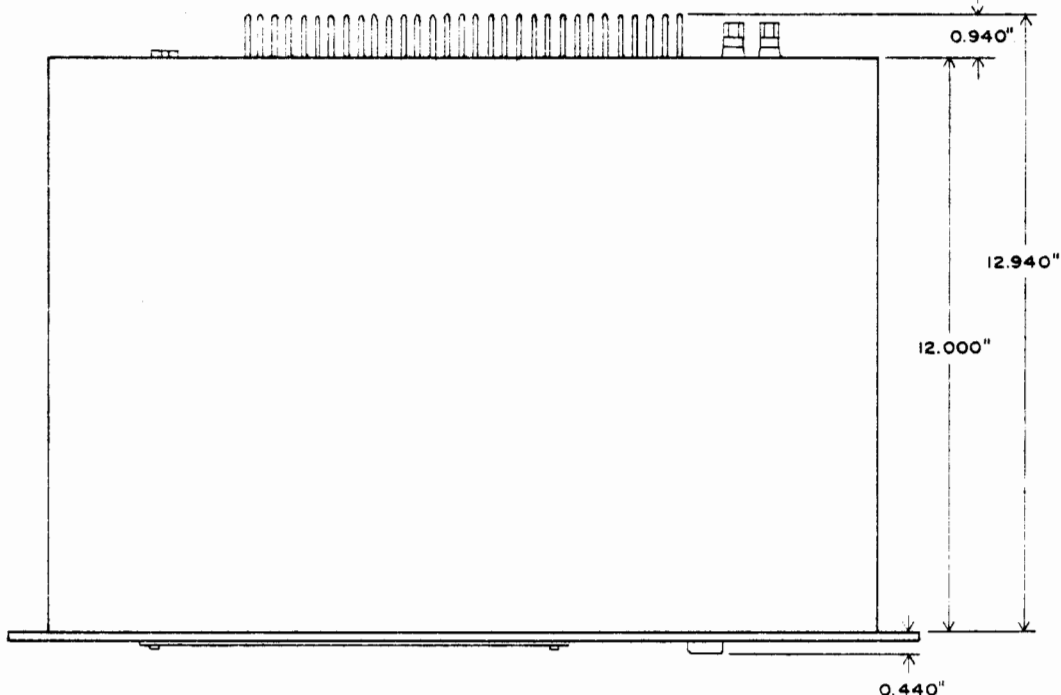
Unless the rack enclosure is small, and/or light enough in weight to lay down on its' back, allowing the amplifier(s) to be easily positioned and "bolted in" by yourself, LET SOMEONE ASSIST YOU! While lighter weight equipment can be installed by one person into vertical rack enclosures (by performing a "circus balancing act" sometimes), attempting the same with 50 lbs-PLUS amplifiers can lead to VERY PAINFUL PERSONAL INJURY or DAMAGE to the equipment (OR BOTH)! Again, LET SOMEONE ASSIST YOU ! Very little intelligence is involved in one person on each side of a 50 to 80 lb amplifier and, together, slipping it into position and start the mounting hardware threading into the proper rack rail holes ("Does your side line up? Mine neither. Let's slide it up one position" , and share the tool to tighten the mounting hardware. Within moments, the amplifier is in place.

The better quality (and more expensive) rack mount enclosures provide (or have provisions for) front-to-back, right angle steel

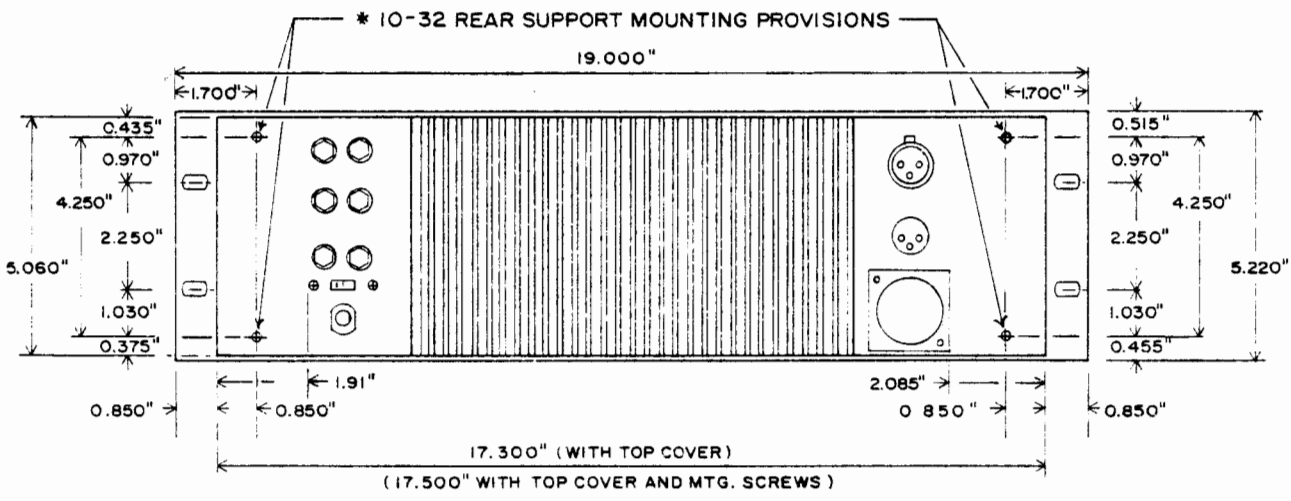
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FRONT VIEW



TOP VIEW



REAR VIEW

<b>BGW SYSTEMS</b> 13130 SOUTH YUKON AVE HAWTHORNE, CA 90250 (213) 919-7380		<b>TITLE</b> SPA-3 CHASSIS DIMENSION AND REAR SUPPORT DETAIL	
<b>DRAWN</b> <i>P. Pas</i>	<b>CHECK</b> <i>S.W. Scobey</i>	<b>DATE</b> 6-21-88	<b>REV</b> C
<b>PROJECT ENGR</b> <i>S.W. Scobey</i>		<b>DATE</b> 4-21-86	<b>DRAWING NUMBER</b> 9512-7723
<b>UNLESS OTHERWISE SPECIFIED          DIMENSIONING AND TOLERANCING          PER USAS1 Y14.5.</b>		<b>SCALE</b> 1:1	
<b>DIMENSIONS ARE IN INCHES          AND APPLY AFTER PLATING.</b>		<b>SIZE</b> C	
<b>TOLERANCE ON DECIMALS:</b> .XX = ± .03    .XXX = ± .010		<b>REV</b> /	
<b>TOLERANCE ON ANGLES = ± 0° 30'</b> <b>BREAK SHARP EDGES .010 MAX.</b> <b>SURFACE ROUGHNESS 125</b>		<b>SHEET</b> 1 OF 1	

DO NOT SCALE DRAWING

NOTES: UNLESS OTHERWISE SPECIFIED



support brackets, in addition to identical, aligned rack-mount rails at the rear of the enclosure. (At least, they are supposed to be aligned with the front rack rails). If the bottom support brackets are used, a blank rack panel will be required between the bottom of most BGW products and the top of the next unit, as the chassis bottom is very close to being flush with the bottom of the front panel.

A most clever arrangement we have seen for the rear support made use of #10-32 threaded, tapered guide pins bolted into the Rear Support Provision holes, and mating bushings installed into aligned right angle brackets attached to the enclosure side walls. Front panels were secured with (quality) standard hardware. This made installation and removal of the amplifiers easy, once the input, output and power cord connections were detached.

### KEEPING IT COOL

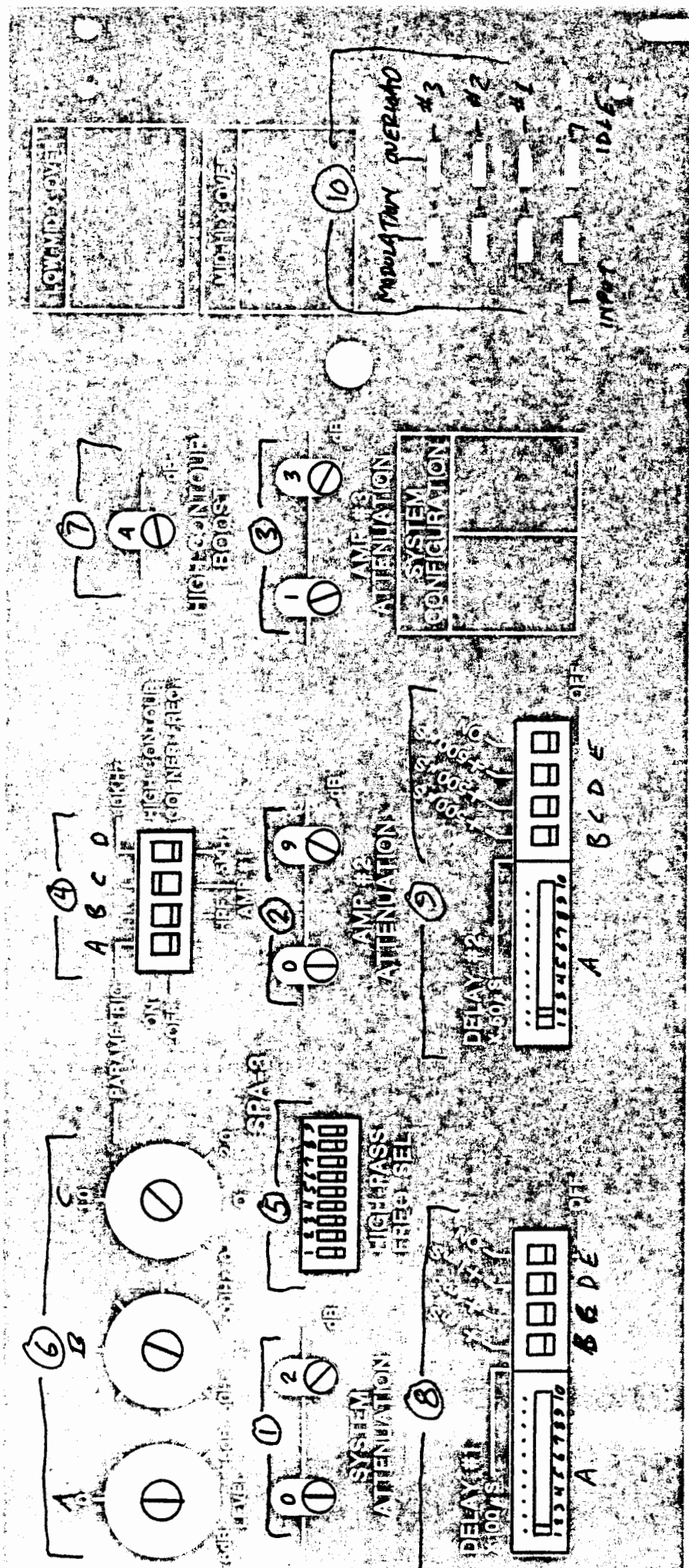
A power amplifier draws energy from a primary electrical service, usually a 120 Volt service, to drive loudspeaker systems with an audio signal. Typically, only half of the energy can be delivered to the loudspeakers; the remaining energy is converted into heat, and must be dissipated (ventilated) into 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 obstructed, 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 or small cases. Power amplifiers using convection cooling require spacing between each other to permit air flow between them. Power amplifiers using forced-air cooling, on the other hand, can usually be stacked close to each other and may not need any blank panel spacing between them.

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 cool 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. It is advisable to provide dust filters at both the air inlet and exhaust outlets of the rack. Likewise, periodic maintenance is required to clean the filters. If no filters are used, then similar maintenance should be performed on the amplifiers to prevent heat buildup or failure from conductive elements that may be in the dust.



SPA-3 CONTROL PANEL (FIG. 1)

## DESCRIPTION OF CONTROL FUNCTIONS & INDICATORS

Refer to Control Panel Fig. 1

**SIGNAL LEVEL ATTENUATORS:** Control groups (1), (2), and (3) provide the operator/system installer with an extremely accurate set of calibrated attenuators. These are oriented to read out directly in dB LOSS by using a X10dB and a X1dB control, hence the term DIGI-SWITCH. Accuracy is typically  $\pm 0.05$ dB over the first 40dB range. Meaning, dial up 13dB Attenuation, you get 13dB. Unit to unit, consistently!

'Normal' SPA-3 System Configurations designate Attenuator Group (1) as the System Master Level Control. Amplifier Channels 1, 2, and 3 output levels follow this control setting. (In 3-Way Configurations, CH. 1 is LF; CH. 2 is MF; CH. 3 is HF). For relocation of the System Master, or rescaling the Attenuators for 1/2 dB Steps/ 5 dB Steps, refer to the System Applications section (See Table of Contents).

**CHANNEL MUTE FUNCTIONS:** Channel 2 and Channel 3 Level Attenuators provide output level balance relative to Channel 1, which 'normally' has no Level Attenuator, but is equipped with a MUTE Switch (4C). The MUTE function for Ch. 2 and Ch. 3 is provided by the X90 position of the Level Attenuators. In addition to the controls having detents, they have no mechanical 'stop', allowing you to dial from '0dB' to '-90dB' in one clockwise step. System mute function is performed in the same way.

**HIGH PASS FILTER:** Controls (5) and (4B) provide an adjustable 18dB/OCT. Subsonic Filter and an ON/OFF switch. Cut-off Frequencies range from 10Hz to 80Hz in 10Hz steps. Control (5) is a 9-Position On/Off switch that requires the use of the SWITCHSET™ Code Chart silkscreened on the inside of the Security Cover Plate. It is restated here with, perhaps, greater clarity.

FREQ.	SWITCHSET™ SETTINGS
10Hz	Pos. 1-9 ALL OFF
20Hz	Pos. 1, 4, 7 ON
30Hz	Pos. 2, 5, 8 ON
40Hz	Pos. 1, 2, 4, 5, 7, 8 ON
50Hz	Pos. 3, 6, 9 ON
60Hz	Pos. 1, 3, 4, 6, 7, 9 ON
70Hz	Pos. 2, 3, 5, 6, 8, 9 ON
80Hz	Pos. 1-9 ALL ON

(Pos. Numbers Not Stated are OFF)

'Normal' placement of this Function Block is in the Low Frequency Channel (Ch. 1), preceding the Parametric Equalizer. Optional Freq. Range, Hz/Step, relocation, and other slopes are covered in the the Applications Section (See Table of Contents).

**PARAMETRIC EQUALIZER:** Control Group (6A-6C) and (4A) is the only set of controls that are continuously variable, a departure from the 'DIGI-SWITCH' precision characteristic of all other SPA-3 controls. The four controls provided are as follows:

- (4A). EQ IN/OUT Switch;
- (6A). Boost/Cut...nominally  $\pm$  6dB at minimum Q setting;
- (6B). Fc...this allows tuning of the Equalizer over a one decade frequency range, 'normally' 50-500Hz;
- (6C). Q...this control really should have been labeled 'Freq. Bandwidth', as the chosen 'Q' range spans from 1/3 OCT. to 1 OCT. in width, and is easier to relate to.

Refer to the SPA-3 Typical Performance Graphs for Frequency Response characteristics.

'Normal' placement of this Function Block is in the Low Frequency Channel (Ch. 1), between the adjustable High-Pass Filter and Delay Line #1. Alternate Frequency Tuning Ranges, relocation, or elimination of this Function is covered in the System Applications section (See Table of Contents).

**DELAY LINE #1:** Control Group (8A-8E) is formatted in two separate control actuator groups. (8E) is the Delay IN/OUT switch. Slide switch (8A) is a 10-Position linear control that provides 100 uSEC Delay/Step, configured as a 1000 uSEC Tapped-Delay Line. Switch controls (8B), (8C), and (8D) allow insertion of 1 mSEC Delay Line Sections in series with the Tapped-Delay Line. Minimum Delay is 100 uSEC, and maximum Delay is 4.0 mSEC.

'Normal' placement of this Function Block is in the Low Frequency Channel (Ch.1), between the Parametric Equalizer and the Low-Pass portion of the SPA-3's Crossover Filter section.

**DELAY LINE #2:** Control Group (9A-9E) is, like its' counterpart (Delay Line #1), similarly formatted in two separate control actuator groups. (9E) is the Delay IN/OUT switch. Slide switch (9A) is a 10-Position linear control that provides 50 uSEC Delay/Step, configured as a 500 uSEC Tapped-Delay Line. Switch controls (9B), (9C), and (9D) allow insertion of 500 uSEC Delay Line Sections in series with the Tapped-Delay Line. Minimum Delay is 50 uSEC, and maximum Delay is 2.0 mSEC.

Placement of this Function Block, if used, is normally in either Channel 2 or Channel 3, depending on that required of the Loudspeaker components used.



**HIGH FREQUENCY CONTOUR BOOST:** Controls (7) and (4D) are included to provide POWER RESPONSE CORRECTION EQUALIZATION to commonly-used Constant-Directivity Horns/Compression Drivers. Two separate 'Family of Equalization Curves' are provided by switch (4D), labeled '5kHz' and '10kHz', and adjusted in 1dB steps by DIGI-SWITCH control (7). Please refer to the SPA-3 Typical Performance Graphs for clarification.

The stock equalization provided approximate that required for either 1" Throat HF Drivers (10kHz setting), or 2" Throat HF Drivers (5kHz setting). 'Normal' placement of this Function Block is in Channel 3, following the High Pass Crossover Filter and immediately preceding the Level Attenuator. As the System Applications and Transducer Response Library for the SPA-3 is continually growing, this Function Block is, of course, not limited to the 'normal' production item. For alternate EQ response curves, or relocation of this Equalizer, refer to the System Applications section (See Table of Contents).

**POWER SWITCH:** In a normal installation, only one control is present to the System operator: the Power Switch. Locked behind the Security Cover Plate are all the System Installer/Tuner Controls. Once proper System 'Tuning' is achieved, the Cover Plate is locked in place, and 'Operator-Mentality' set in motion: "This is only a Power Amplifier. It has no controls-only a Power Switch." The switch is actually a Magnetic Circuit Breaker, and a main System Protection Device.

**LED DISPLAY INDICATORS:** Eight LED Indicators are provided. These are grouped into two Signal-Directed color bands, and a single, Non-Signal indicator, marked IDLE. This is the POWER ON INDICATOR, and is GREEN in color. With the Power Switch depressed, and the SPA-3 plugged into a 'live' power outlet, this GREEN LED should be illuminated.

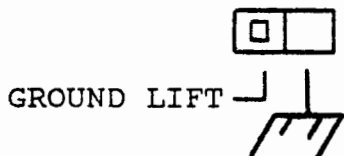
Adjacent to this 'IDLE' Indicator is the Signal Input Presence Indicator, marked INPUT. It, and all the LEDs in the 'MODULATION' column are ORANGE in color. This 'INPUT' Indicator will illuminate whenever an input signal exceeding approximately 60 mV peak (-22dBm re: 0.775 V) is present, REGARDLESS of any control settings. In 'Multi-channel' Sound Systems, this Indicator is invaluable in tracing down system faults or system checkout without the Speaker System in place.

The remainder of the 3-Channel Display provides indication of Power Amplifier signal output level. These are grouped in two columns: MODULATION (ORANGE LEDs, Left column); and OVERLOAD (RED LEDs, Right column). The MODULATION Indicators will illuminate whenever the output level exceeds approximately 0.9V peak. Similarly, the OVERLOAD Indicators will illuminate whenever the output level exceeds approximately 51V peak (36V RMS).

The nature of Signal Detection provided in the LED Indicator circuits is Positive-Peak Voltage, AC-Coupled. True Clip indication is not (presently) provided. RED-level indication,

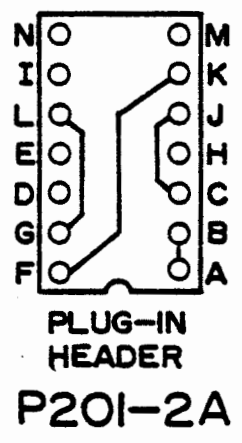
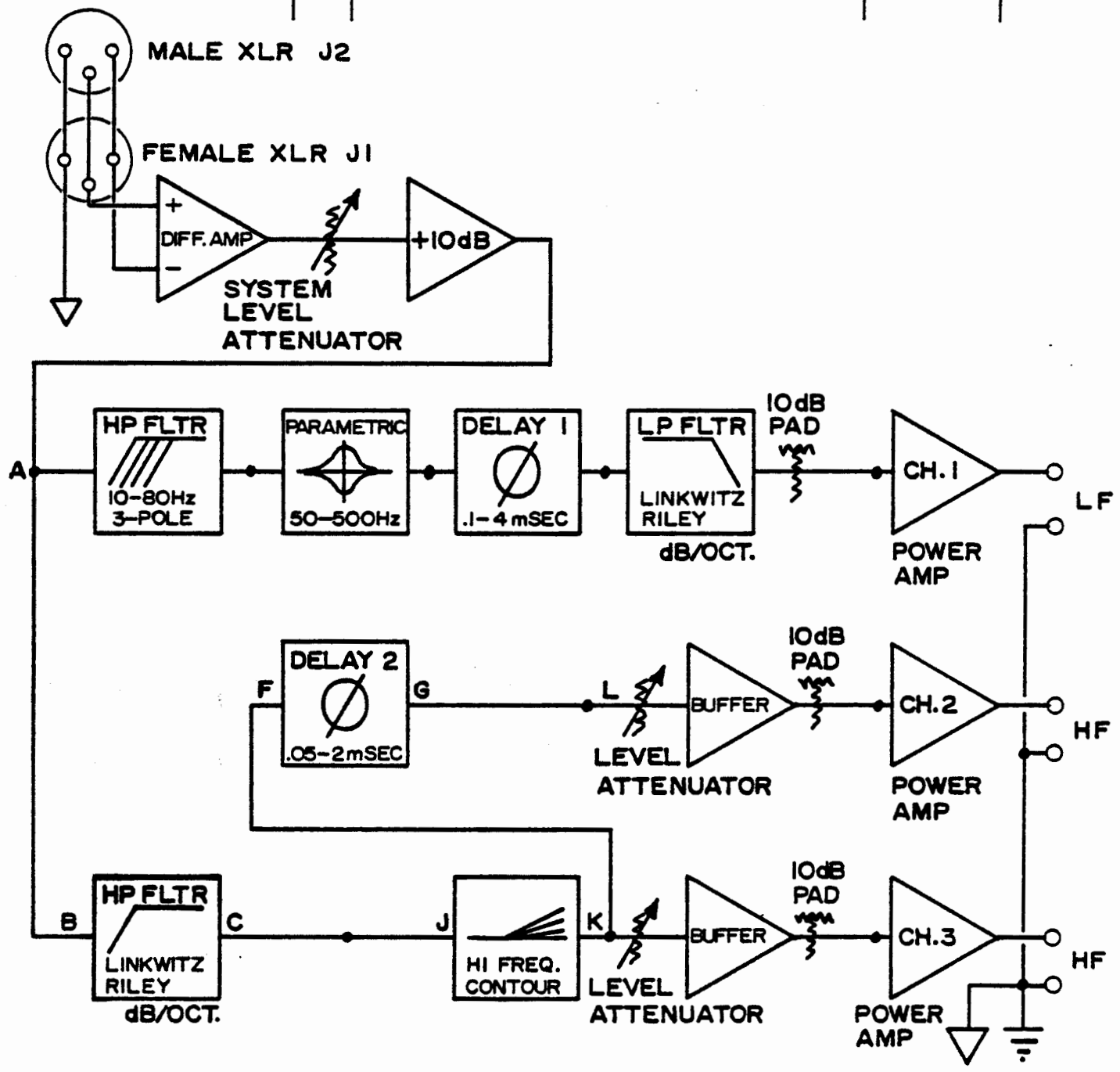
therefore, doesn't absolutely depict a distorted signal output condition. Nor will a shorted output condition, or True clipping into low impedance loads cause the RED LEDs to illuminate.

**REAR PANEL CONTROL FUNCTIONS:** There is only one System Installer-Oriented control on the Rear Panel: CHASSIS GROUND/SIGNAL GROUND ISOLATION SWITCH. It bears the markings about it:



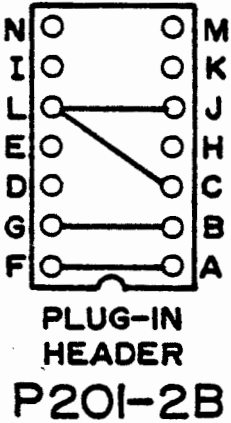
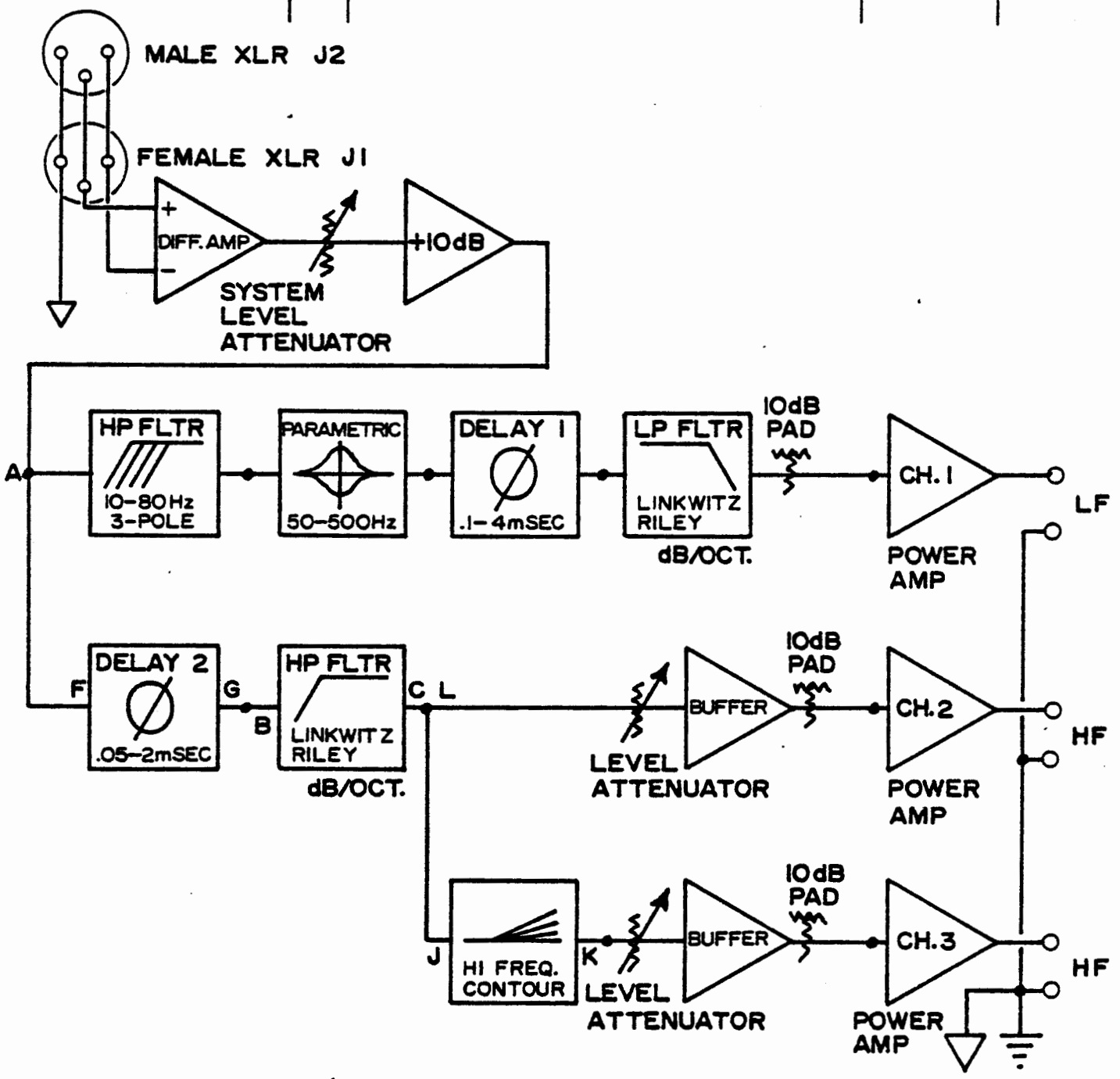
As this section is meant for Description of control functions, the proper use of this switch shall not mark the beginning of the volumes of text that could follow. Instead, let us say it allows the Installer to isolate Signal Ground from AC Power Ground and facilitate proper System Grounding Techniques. For further discussion, refer to the INSTALLATION INSTRUCTIONS; SYSTEM GROUNDING section (See Table of Contents).


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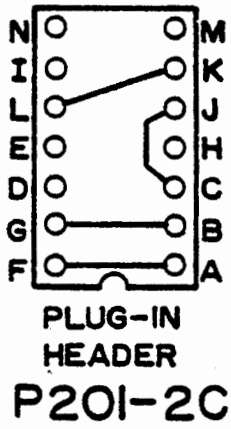
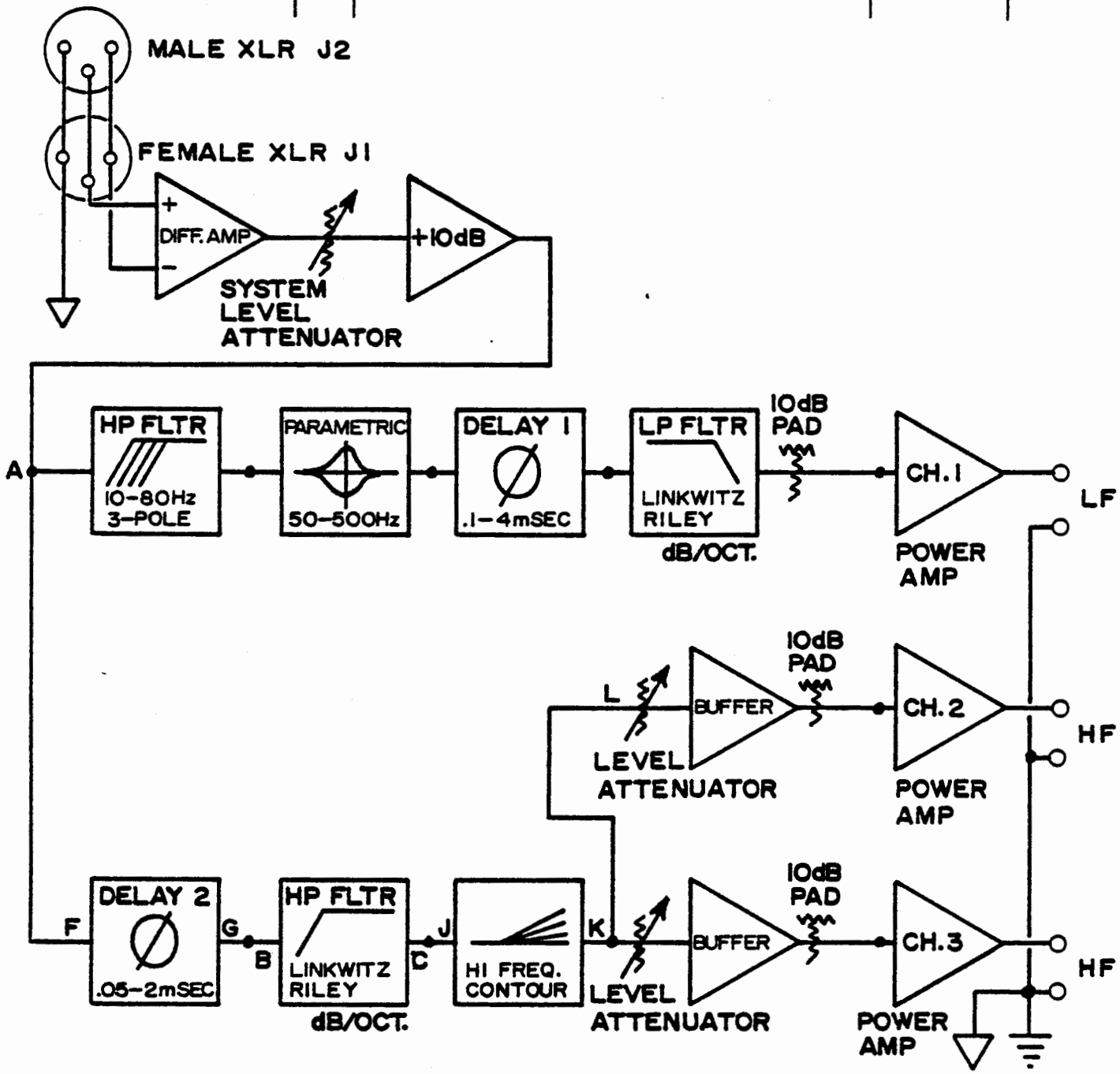
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CHECK				
PROJECT ENGR <i>S.W. Selberg</i>	8-22-85			
SPEAKER SYSTEM		SIZE	DRAWING NUMBER	REV
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DRAWN <i>S.W. Selberg</i>	8-29-87	TITLE	
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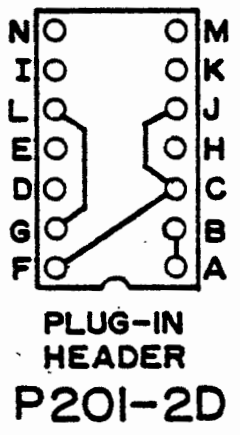
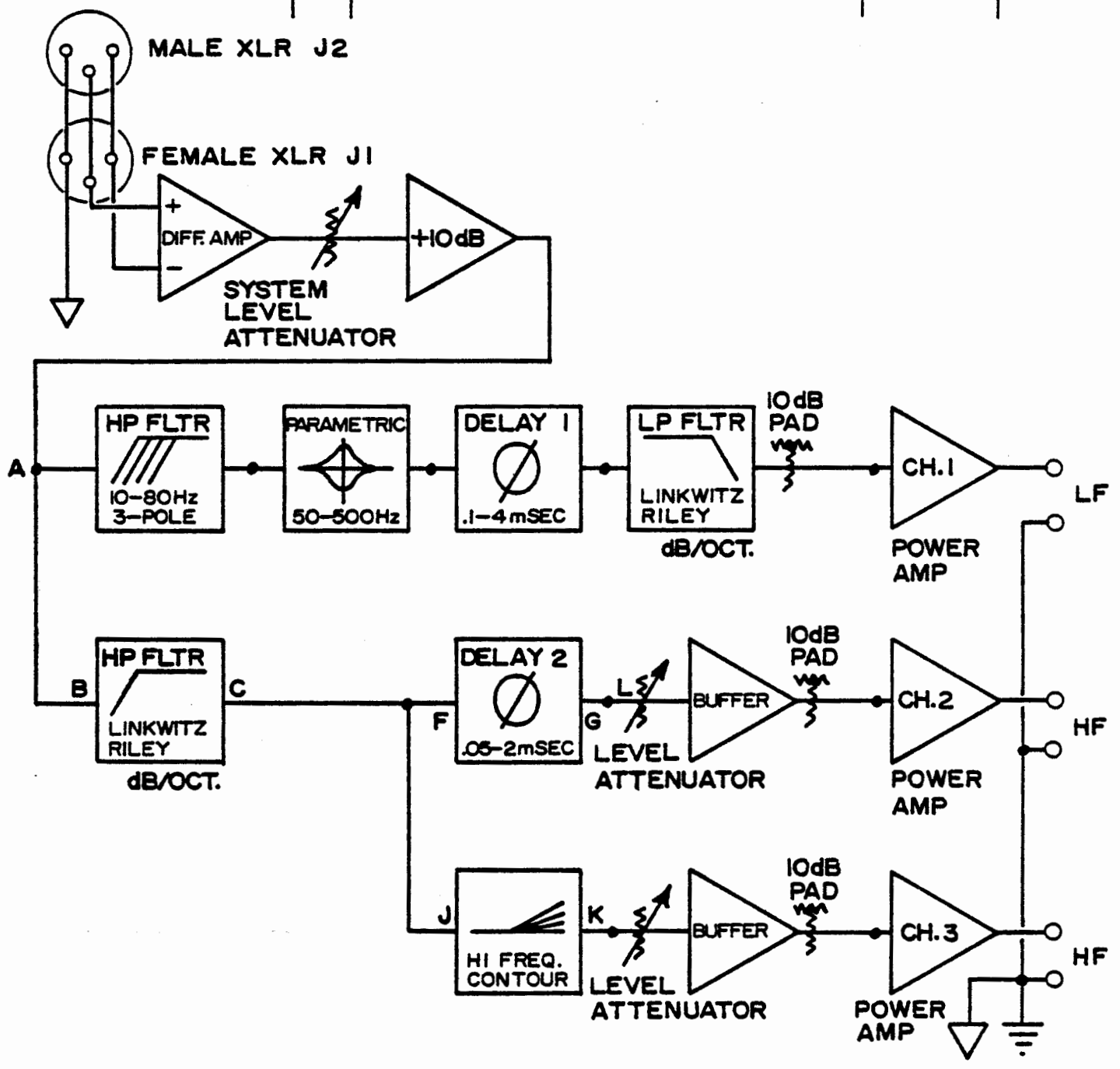
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		SCALE	SHEET	OF

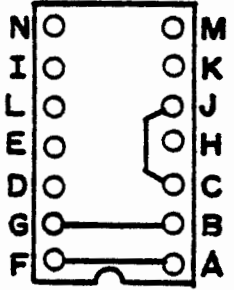
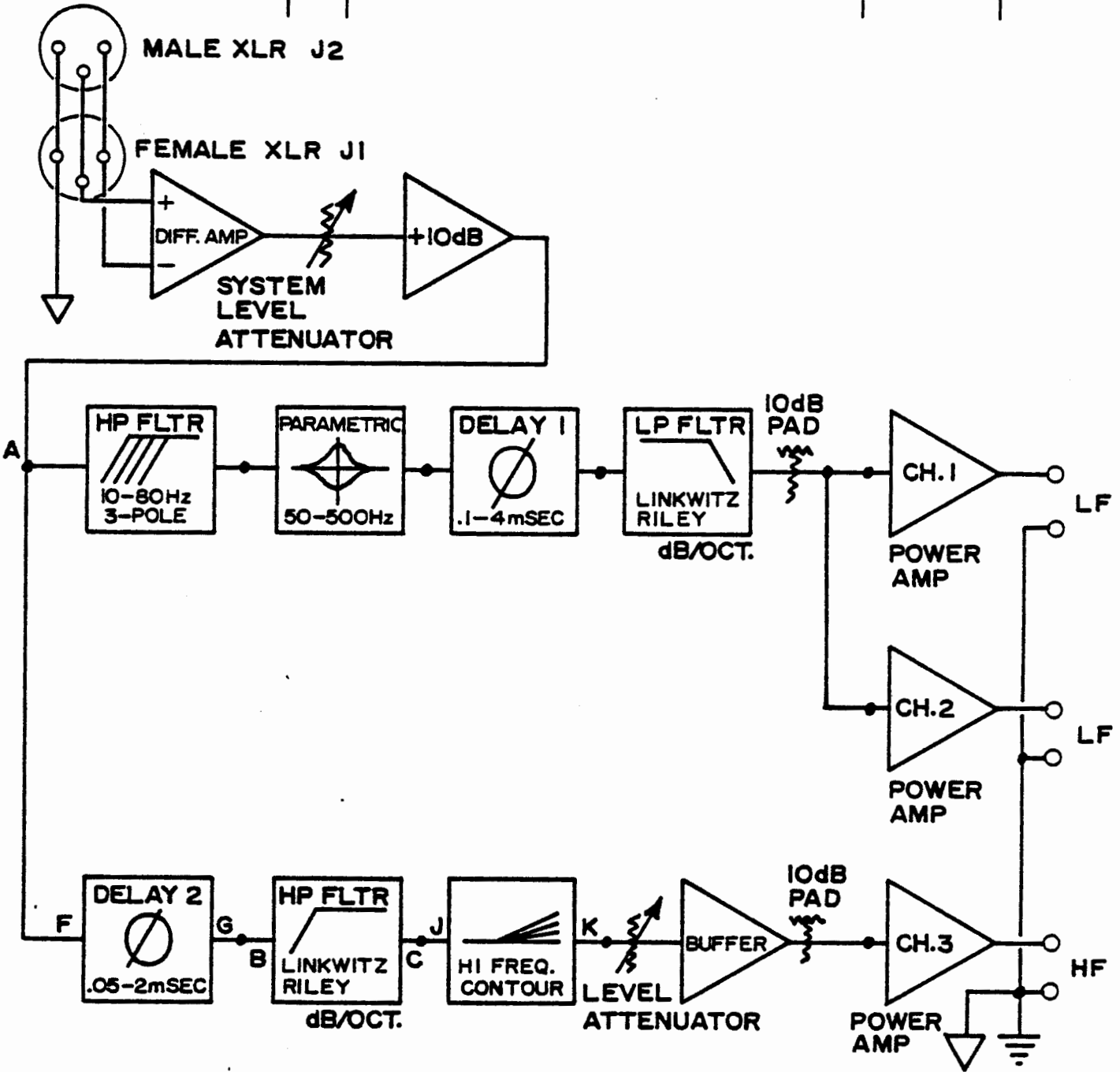


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PROJECT ENGR <i>S.W. Salberg</i> SPEAKER SYSTEM	8-22-85	SIZE <b>A</b>
DRAWING NUMBER <b>9512-7723</b>	REV	SCALE
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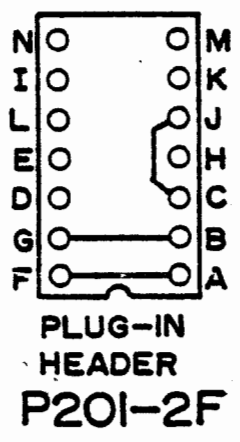
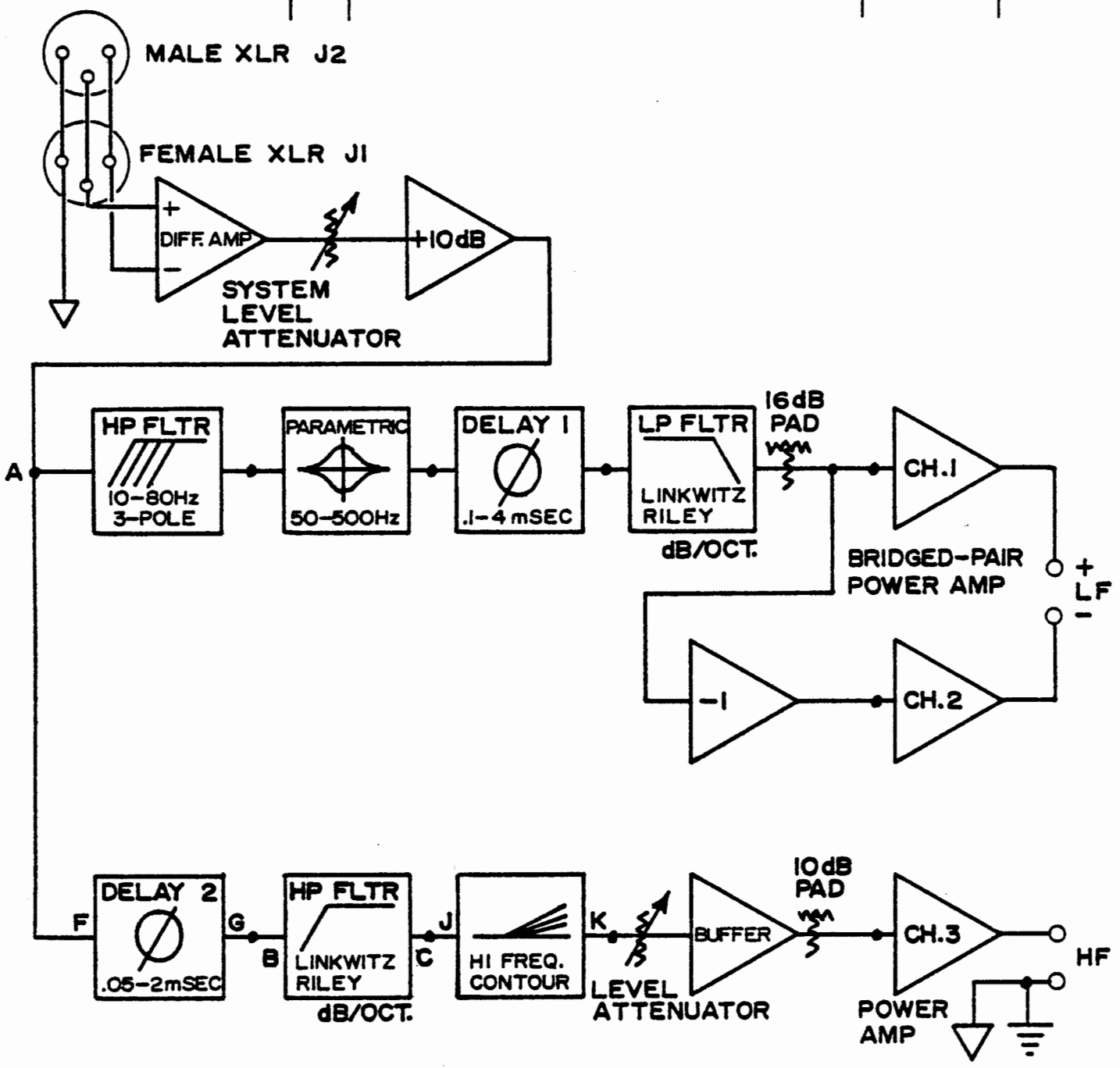
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PLUG-IN  
HEADER  
P201-2E

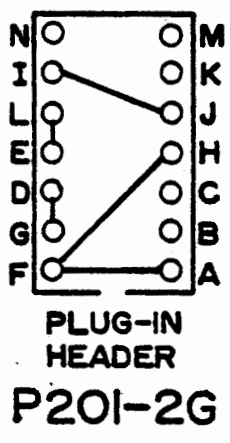
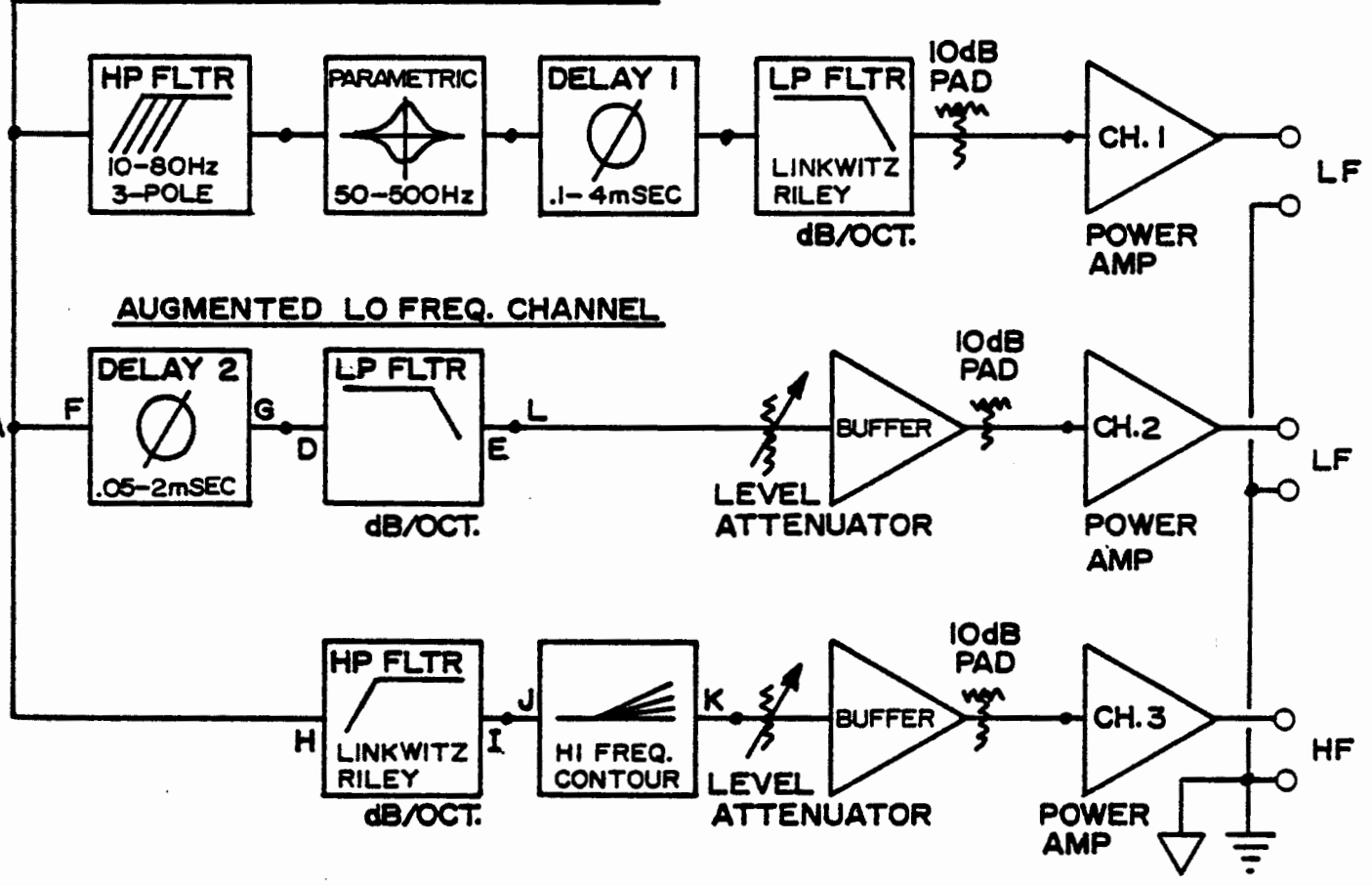
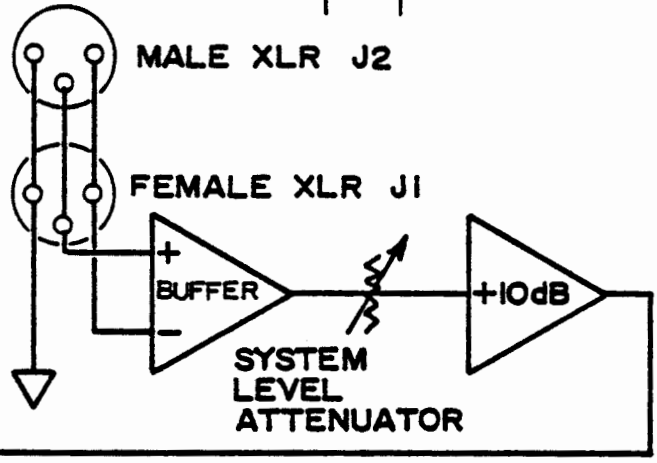
CUSTOMER		 BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090	
DRAWN <i>S.W. Selberg</i> CHECK	8-27-87		
PROJECT ENGR <i>S.W. Selberg</i> SPEAKER SYSTEM	8-22-85	SIZE <b>A</b>	DRAWING NUMBER <b>9512-7723</b>
SCALE		SHEET	OF

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



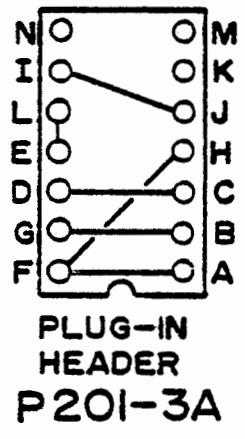
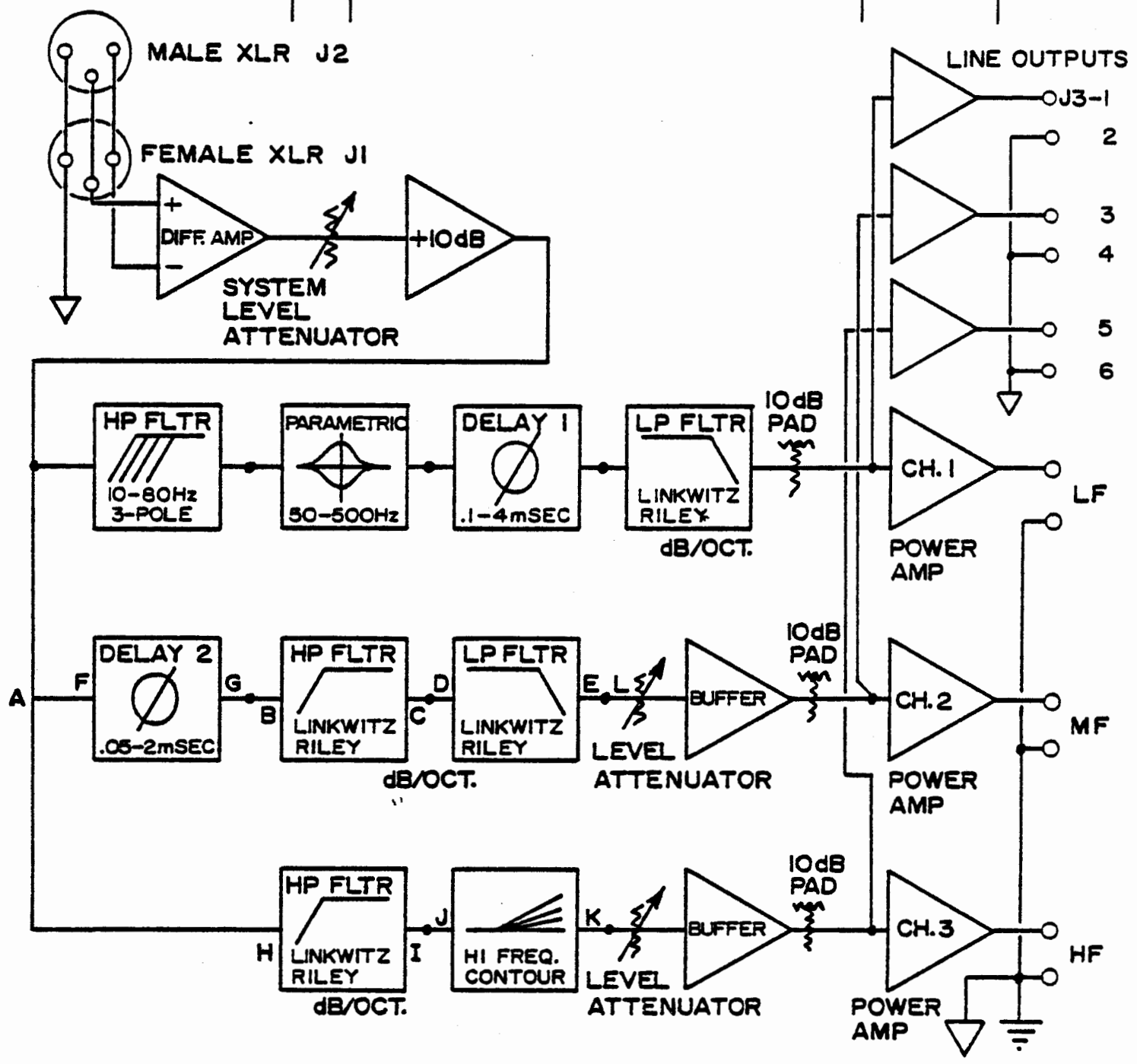
CUSTOMER			BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090	
DRAWN <i>S.W. Selberg</i>	8-27-87		TITLE <b>SPA-3 CONFIGURATION 2F</b> (HI-POWER 2-WAY) <b>SYSTEM BLOCK DIAGRAM</b>	
CHECK		PROJECT ENGR <i>S.W. Selberg</i>		8-22-85
SPEAKER SYSTEM		SIZE <b>A</b>	DRAWING NUMBER <b>9512-7723</b>	REV
		SCALE	SHEET	OF


REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



CUSTOMER				BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090	
DRAWN	<i>S.W. Selberg</i>	8-30-87	TITLE		
CHECK			SPA-3 CONFIGURATION 2G (2-WAY W/AUGMENTED LF CH. ADDED)		
PROJECT ENGR.	<i>S.W. Selberg</i>	8-12-85	SYSTEM BLOCK DIAGRAM		
SPEAKER SYSTEM		SIZE	DRAWING NUMBER		REV
		A	9512-7723		
		SCALE			SHEET OF

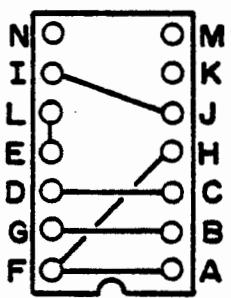
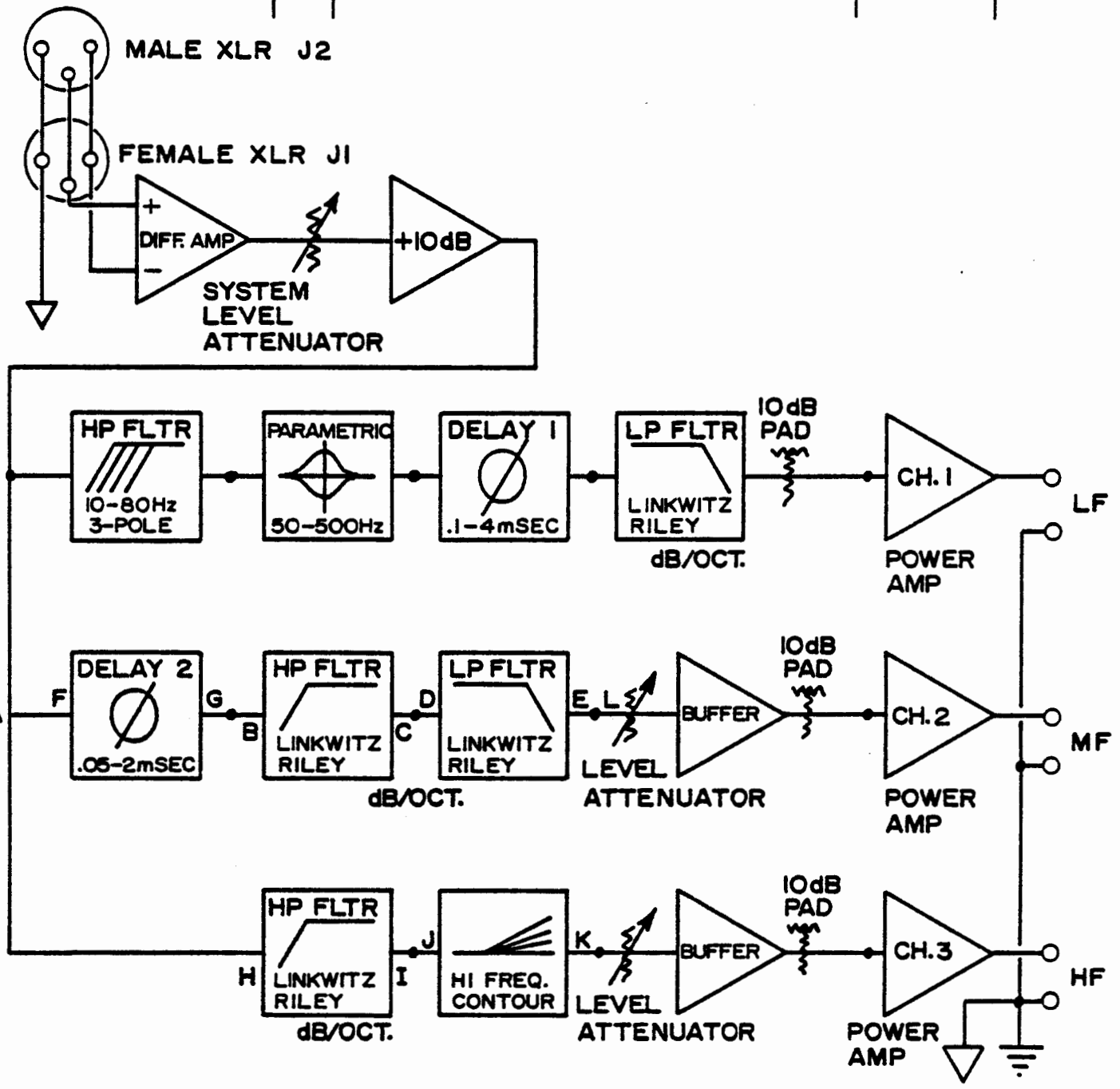
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED




CUSTOMER			BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090	
DRAWN <i>S.W. Selberg</i>	8-26-87		TITLE <b>SPA-3 CONFIGURATION 3A</b> (W/BUFFERED LINE OUTPUTS) <b>SYSTEM BLOCK DIAGRAM</b>	
CHECK				
PROJECT ENGR <i>S.W. Selberg</i>	8-22-85			
SPEAKER SYSTEM		SIZE <b>A</b>	DRAWING NUMBER <b>9512-7723</b>	REV
		SCALE	SHEET	OF



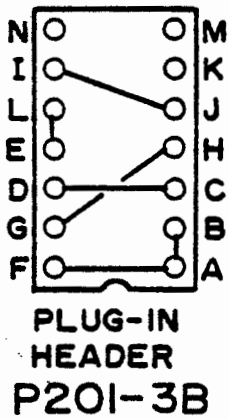
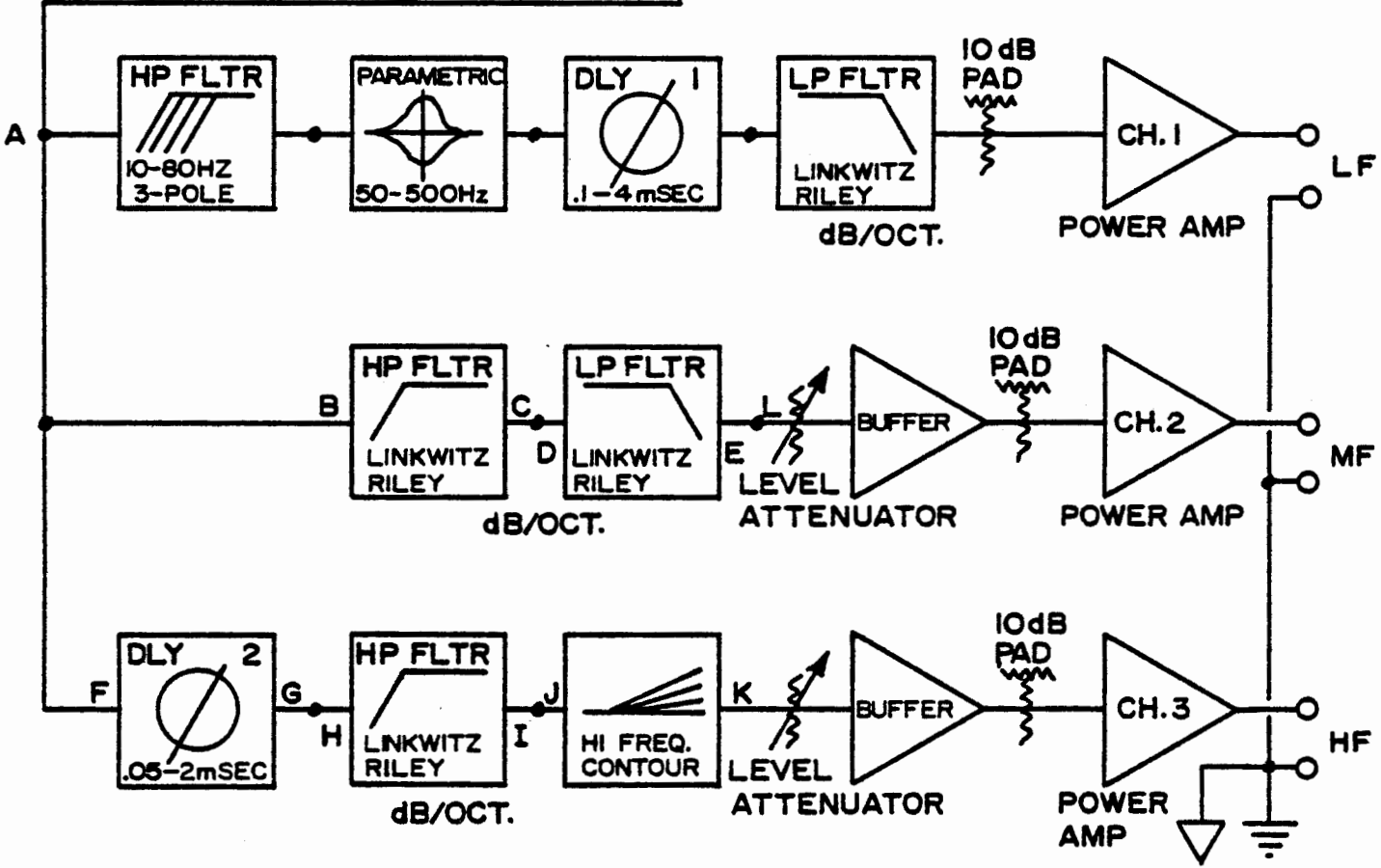
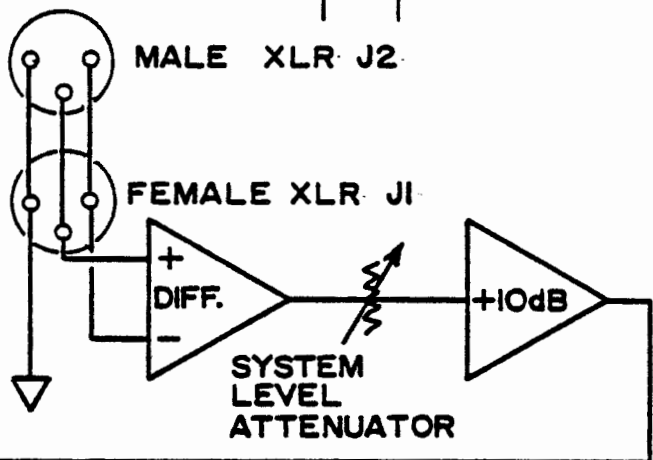
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



PLUG-IN  
HEADER  
P201-3A

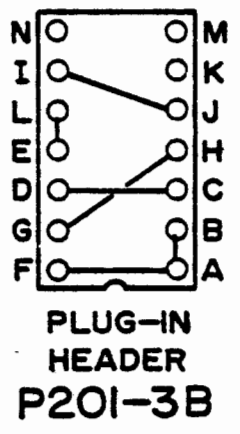
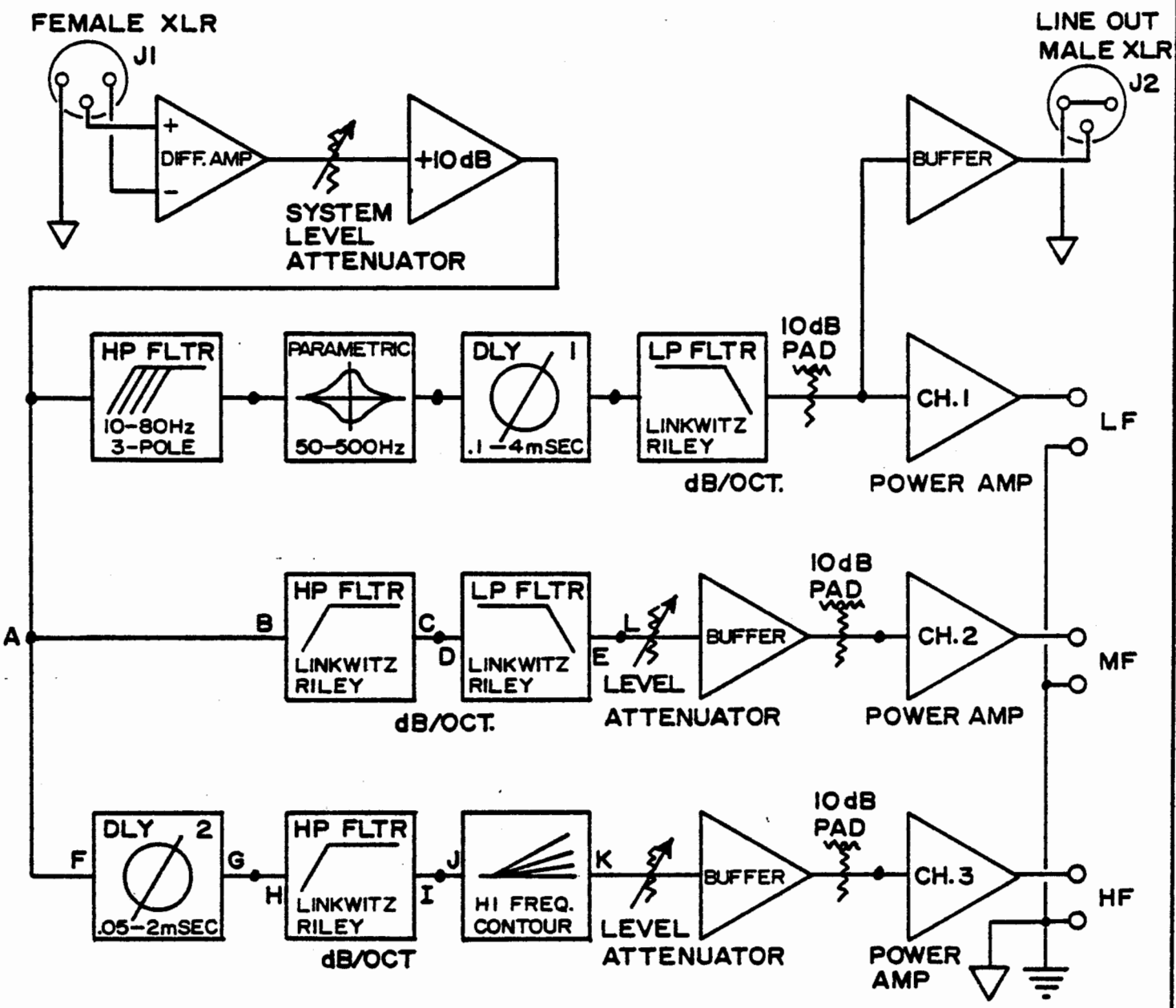
CUSTOMER		 BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090
DRAWN <i>S.W. Selberg</i> 8-26-87	TITLE	
CHECK	SPA-3 CONFIGURATION 3A	
PROJECT ENGR <i>S.W. Selberg</i> 8-22-85	SYSTEM BLOCK DIAGRAM	
SPEAKER SYSTEM	SIZE	DRAWING NUMBER
	A	9512-7723
	SCALE	SHEET OF

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



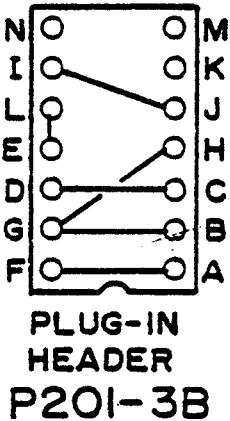
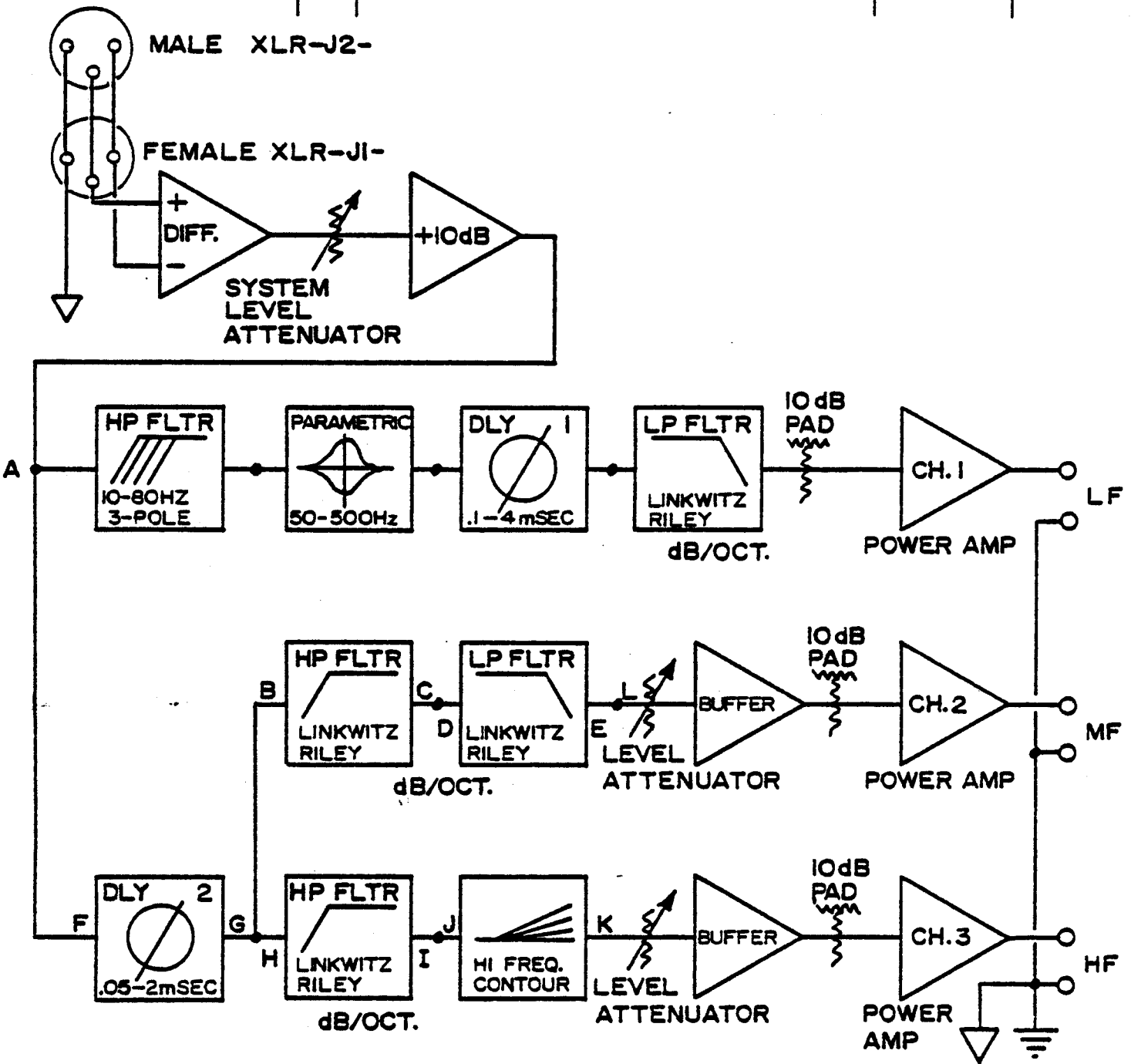
CUSTOMER			BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090	
DRAWN <i>S.W. Selberg</i>	8-26-87		TITLE <b>SPA-3 CONFIGURATION 3B</b> <b>SYSTEM BLOCK DIAGRAM</b>	
CHECK 		PROJECT ENGR <i>S.W. Selberg</i>		8-22-85
SPEAKER SYSTEM		SIZE <b>A</b>	DRAWING NUMBER <b>9512-7723</b>	REV
		SCALE	SHEET	OF

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



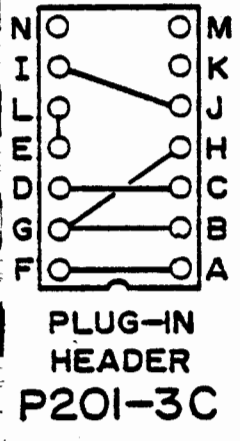
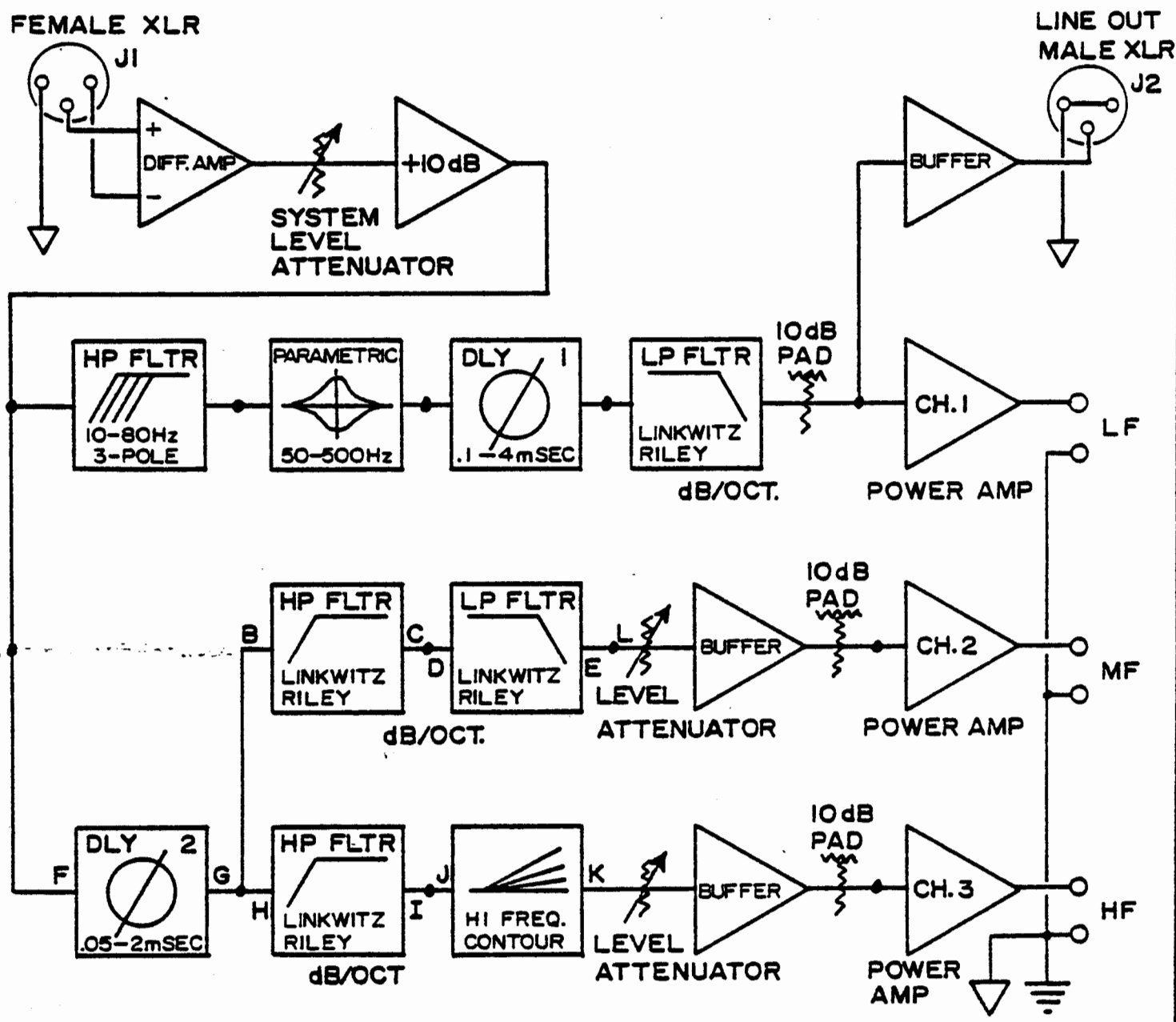
CUSTOMER			BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090	
DRAWN <i>S.W. Selberg</i> CHECK	8-26-87		TITLE <b>SPA-3 CONFIGURATION 3B</b> (W/LO FREQ. LINE OUTPUT ADDED) <b>SYSTEM BLOCK DIAGRAM</b>	
PROJECT ENGR <i>S.W. Selberg</i>	8-22-85	SIZE <b>A</b>	DRAWING NUMBER <b>9512-7723</b>	REV
SPEAKER SYSTEM		SCALE	SHEET	OF

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



CUSTOMER			BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090	
DRAWN <i>S.W. Selberg</i>	8-26-87		TITLE SPA-3 CONFIGURATION 3C SYSTEM BLOCK DIAGRAM	
CHECK		PROJECT ENGR <i>S.W. Selberg</i>		8-22-85
SPEAKER SYSTEM		SIZE A	DRAWING NUMBER 9512-7723	REV
		SCALE	SHEET	OF

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

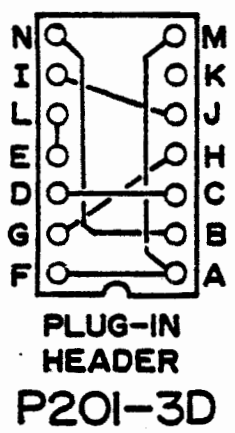
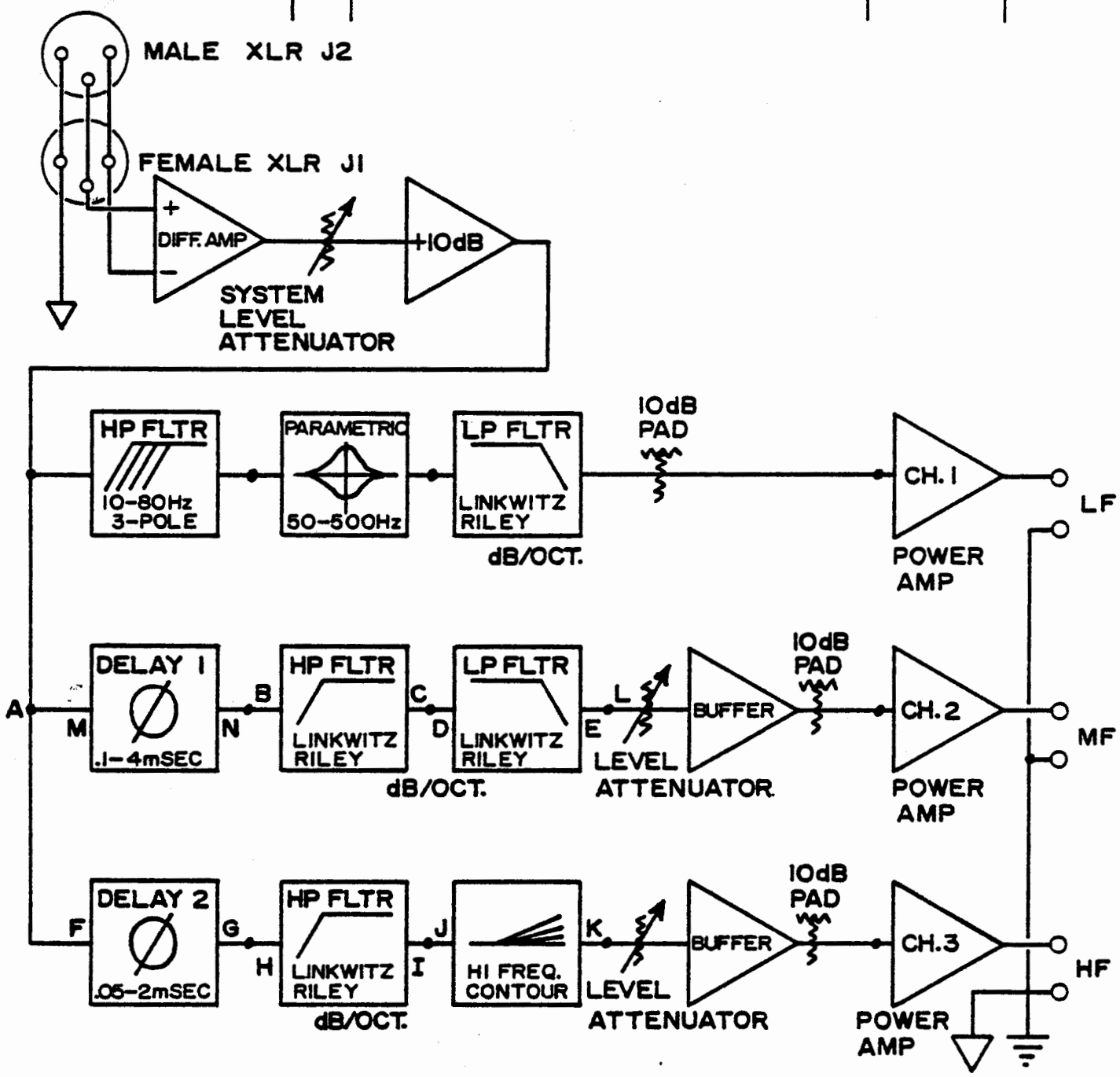



CUSTOMER			BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090	
DRAWN <i>S.W. Selberg</i> CHECK	8-26-87		TITLE <b>SPA-3 CONFIGURATION 3C</b> (W/LO FREQ. LINE OUTPUT ADDED) <b>SYSTEM BLOCK DIAGRAM</b>	
PROJECT ENGR <i>S.W. Selberg</i>	8-22-85	SPEAKER SYSTEM		
SIZE <b>A</b>		DRAWING NUMBER <b>9512-7723</b>		REV
SCALE		SHEET		OF



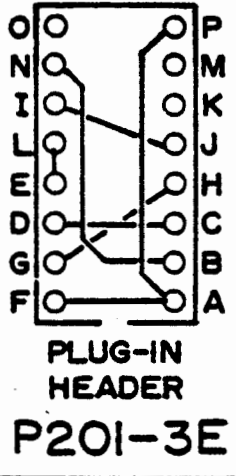
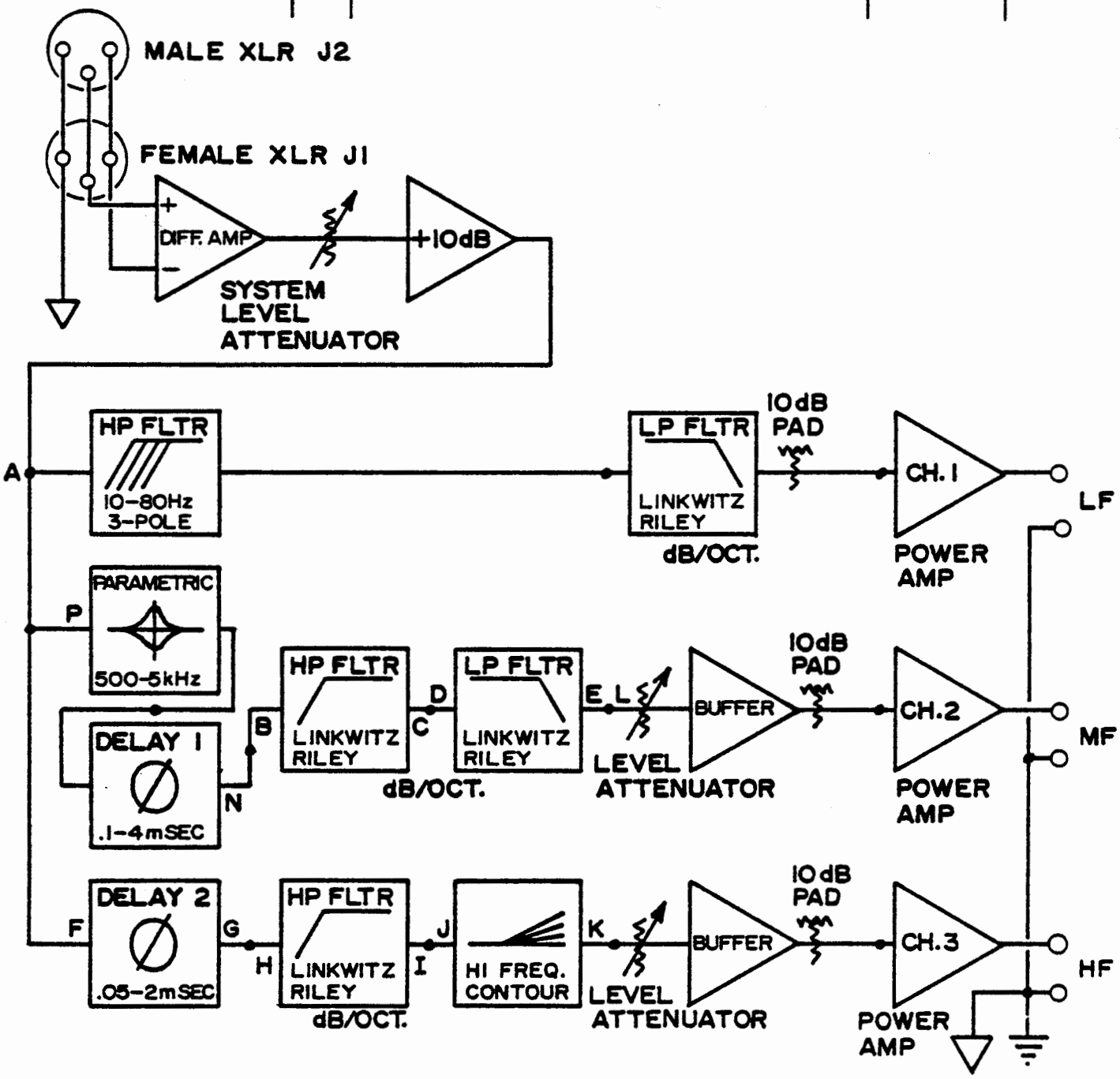
REVISIONS

LTR	DESCRIPTION	DATE	APPROVED



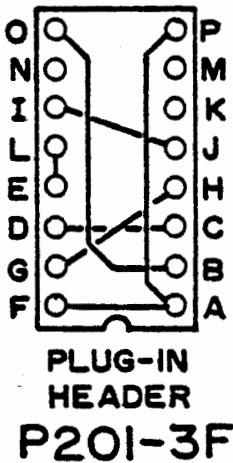
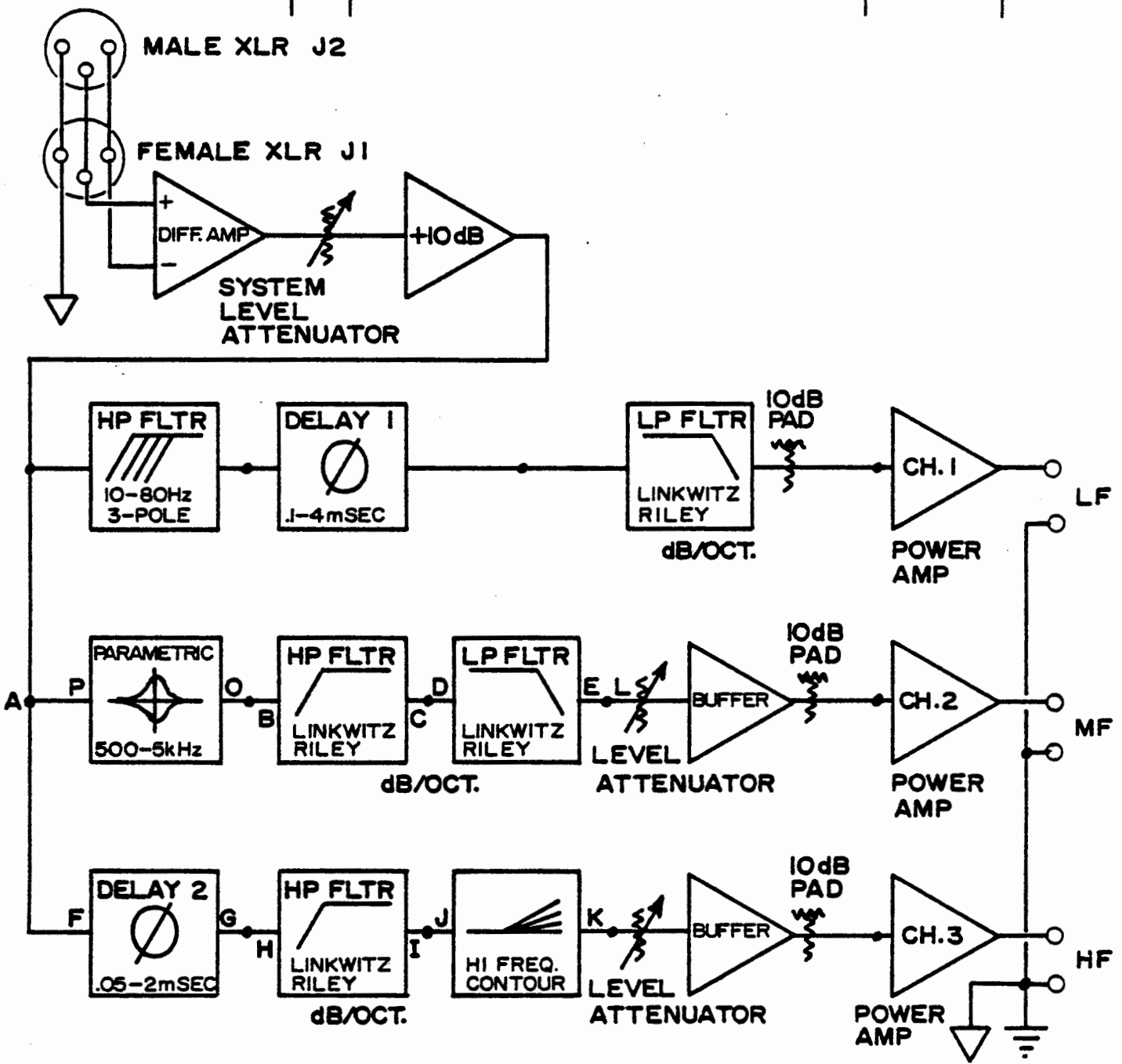
CUSTOMER		 BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090	
DRAWN <i>S.W. Selberg</i>	8-26-87		
CHECK		TITLE	
PROJECT ENGR <i>S.W. Selberg</i>	8-22-85	SPA-3 CONFIGURATION 3D SYSTEM BLOCK DIAGRAM	
SPEAKER SYSTEM	SIZE	DRAWING NUMBER	REV
	A	9512-7723	
	SCALE	SHEET	OF


REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



CUSTOMER			BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090	
DRAWN <i>S.W. Selberg</i> 8-30-87	CHECK		<b>TITLE</b> <b>SPA-3 CONFIGURATION 3E</b> <b>SYSTEM BLOCK DIAGRAM</b>	
PROJECT ENGR <i>S.W. Selberg</i> 8-22-85	<b>SPEAKER SYSTEM</b>	<b>SIZE</b> <b>A</b>	<b>DRAWING NUMBER</b> <b>9512-7723</b>	<b>REV</b>
<b>SCALE</b>		<b>SHEET</b>		<b>OF</b>

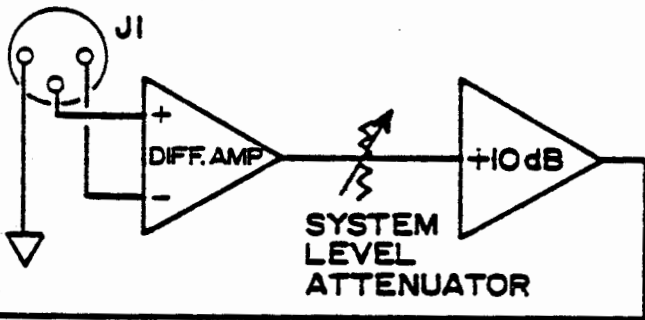
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



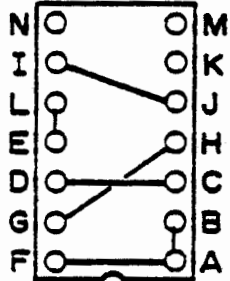
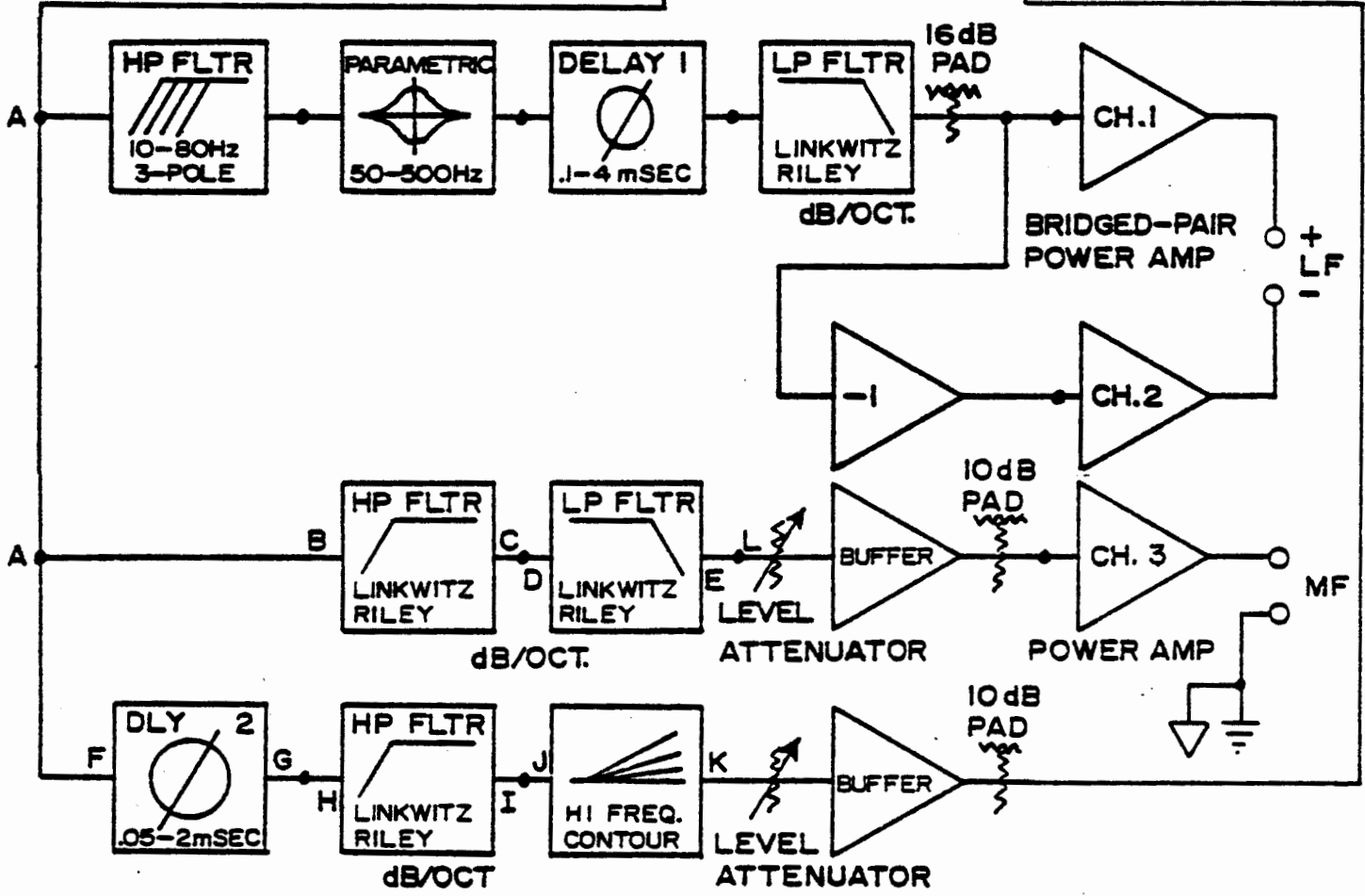
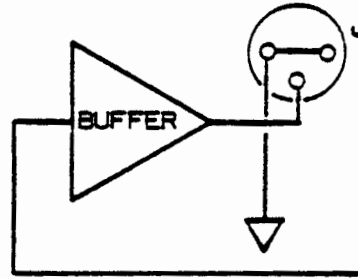
CUSTOMER		 BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090	
DRAWN	8-30-87		
CHECK		SPA-3 CONFIGURATION 3F	
PROJECT ENGR.	8-22-85	SYSTEM BLOCK DIAGRAM	
SPEAKER SYSTEM		SIZE	DRAWING NUMBER
		A	9512-7723
		SCALE	SHEET OF

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

FEMALE XLR  
J1



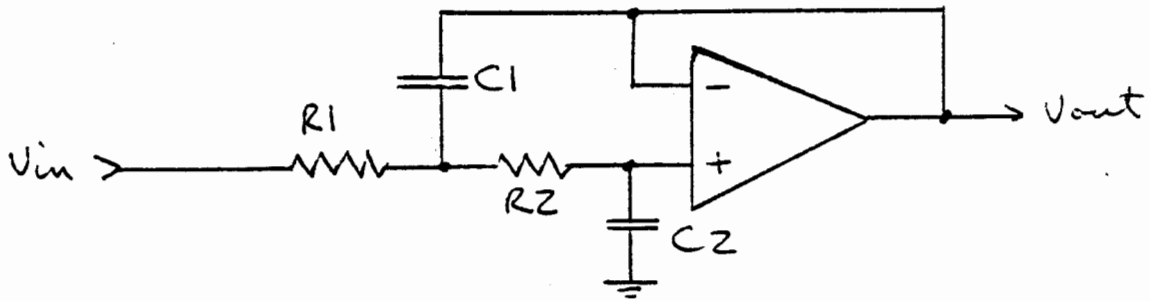
HI FREQ.  
LINE OUT  
MALE XLR  
J2



PLUG-IN  
HEADER  
P201-3G

CUSTOMER		 BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090	
DRAWN <i>S.W. Selberg</i>	9-9-87		
CHECK		TITLE <b>SPA-3 CONFIGURATION 3G</b> (HI POWER 3-WAY-EXT. HF AMP REQ'D) <b>SYSTEM BLOCK DIAGRAM</b>	
PROJECT ENGR <i>S.W. Selberg</i>	8-22-85		
SPEAKER SYSTEM		SIZE <b>A</b>	DRAWING NUMBER <b>9512-7723</b>
		SCALE	SHEET OF

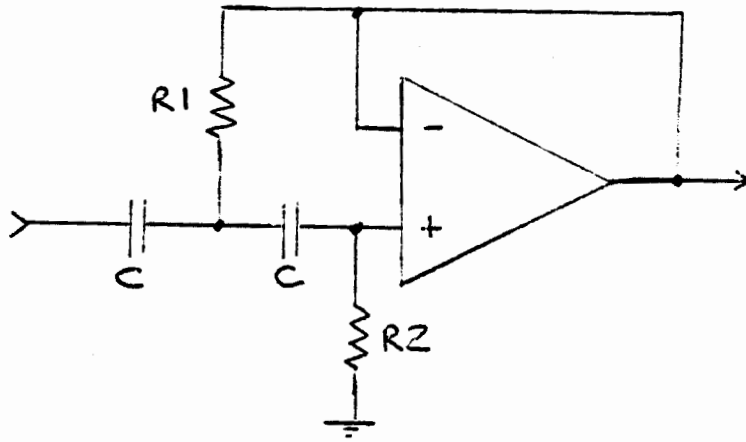
## Butterworth 2-pole Low Pass Filter Component Values



Frequency	R1	R2	C1	C2
40	45.3K	75K	.1 uf	.047 uf
50	35.7K	60.4K	↓	↓
63	28.7K	47.5K		
80	22.6K	37.4K		
100	18.2K	30.1K		
125	14.3K	23.7K		
160	11.3K	18.7K	↓	↓
200	9.09K	15.0K		
250	7.32K	11.8K		
315	12.1K	20.5K		
400	9.53K	16.2K		
500	7.68K	12.7K	↓	↓
630	6.04K	10.2K		
800	9.76K	18.2K		
1.00K	7.87K	14.7K		
1.25K	6.34K	11.8K		
1.60K	11.3K	18.7K	↓	↓
2.00K	9.09K	15.0K		
2.50K	7.32K	11.8K		
3.15K	12.1K	20.5K		
4.00K	9.53K	16.2K		
5.00K	7.68K	12.7K	↓	↓
6.30K	6.04K	10.2K		
8.00K	9.76K	18.2K		
10.0K	7.87K	14.7K		
12.5K	6.34K	11.8K		

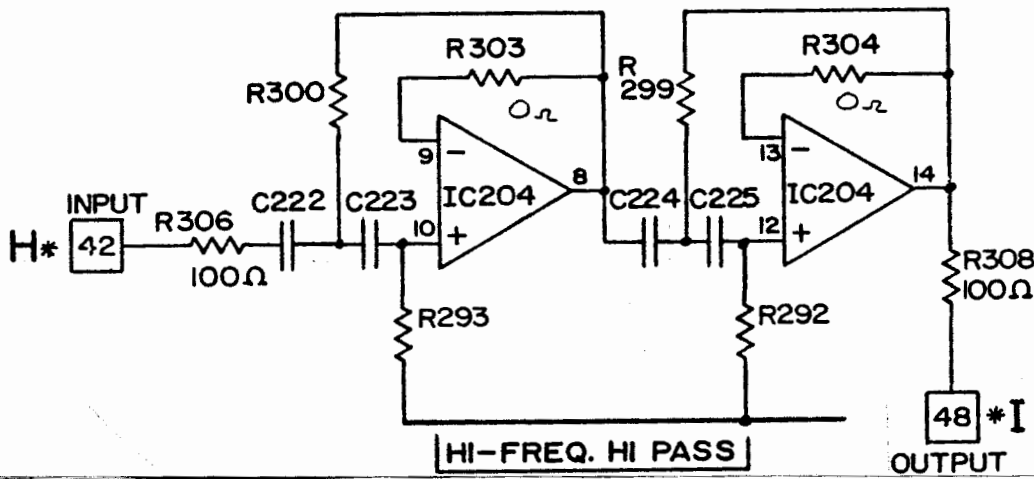
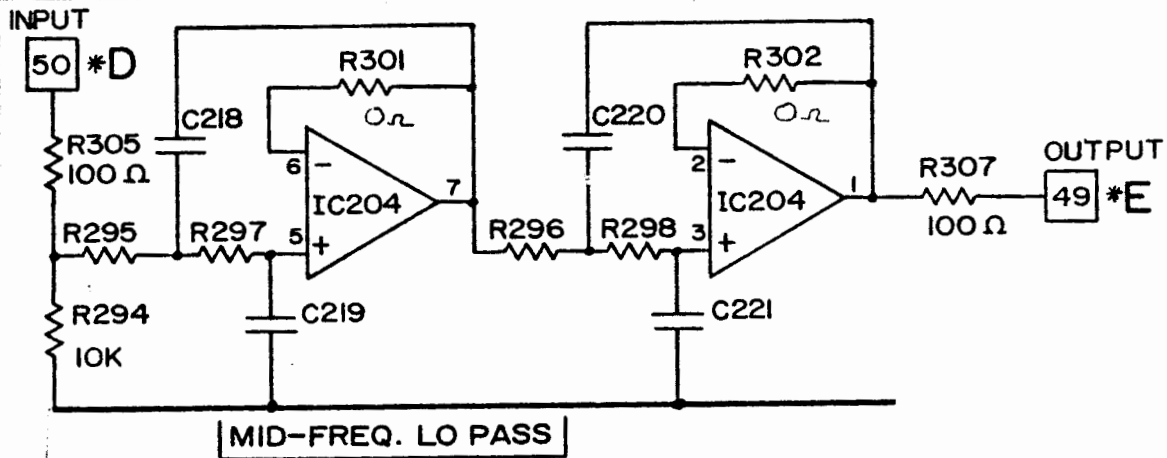
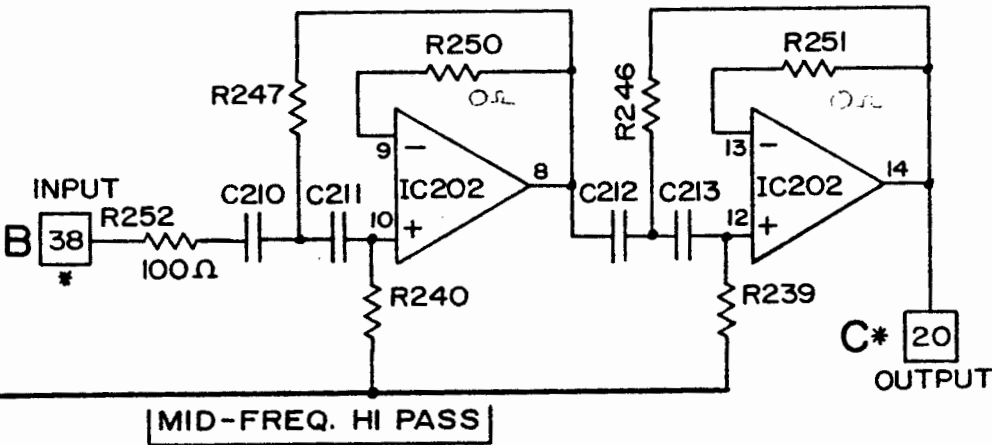
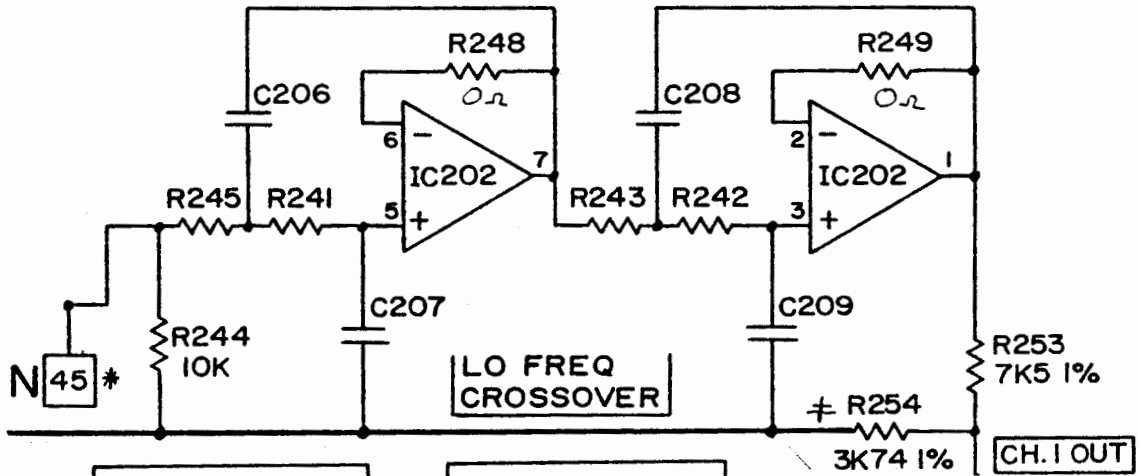


# BUTTERWORTH 2-POLE HIGH PASS FILTER COMPONENT VALUES



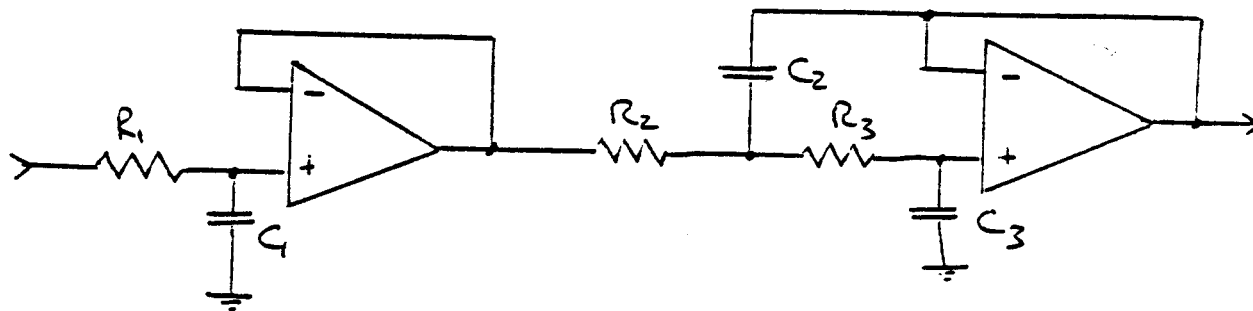
Frequency (hz)	R1	R2	C
40	12.7K	25.5K	.22uf
50	10.2K	20.5K	↓
63	8.06K	16.2K	
80	14.0K	28.0K	.10uf
100	11.3K	22.6K	↓
125	9.09K	18.2K	
160	6.98K	14.0K	↓
200	12.1K	24.3K	
250	9.53K	19.1K	↓
315	7.68K	15.0K	
400	12.7K	25.5K	.047uf
500	10.2K	20.5K	↓
630	8.06K	16.2K	
800	14.0K	28.0K	.022uf
1.00K	11.3K	22.6K	↓
1.25K	9.09K	18.2K	
1.60K	6.98K	14.0K	↓
2.00K	12.1K	24.3K	
2.50K	9.53K	19.1K	↓
3.15K	7.68K	15.0K	
4.00K	12.7K	25.5K	.010uf
5.00K	10.2K	20.5K	↓
6.30K	8.06K	16.2K	
8.00K	14.0K	28.0K	↓
10.0K	11.3K	22.6K	
12.5K	9.09K	18.2K	.0047uf
			↓
			.0022uf
			↓
			.0010uf
			↓

SPA-3 9008-7723  
CROSS-OVER SCHEMATICS



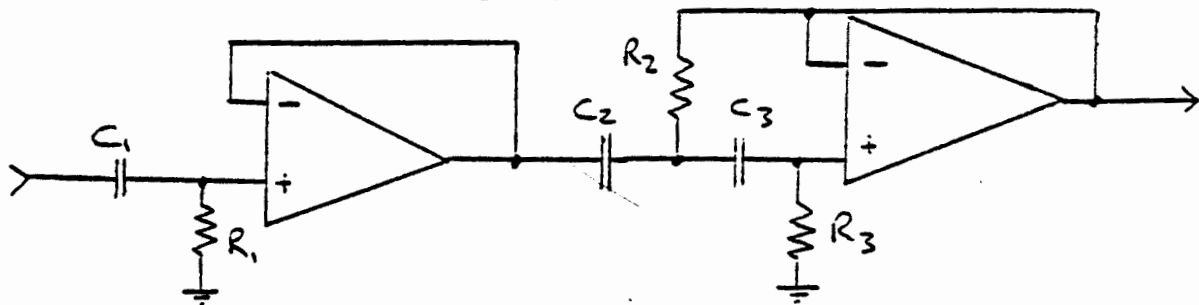


### 3-POLE BUTTERWORTH LOW PASS FILTER

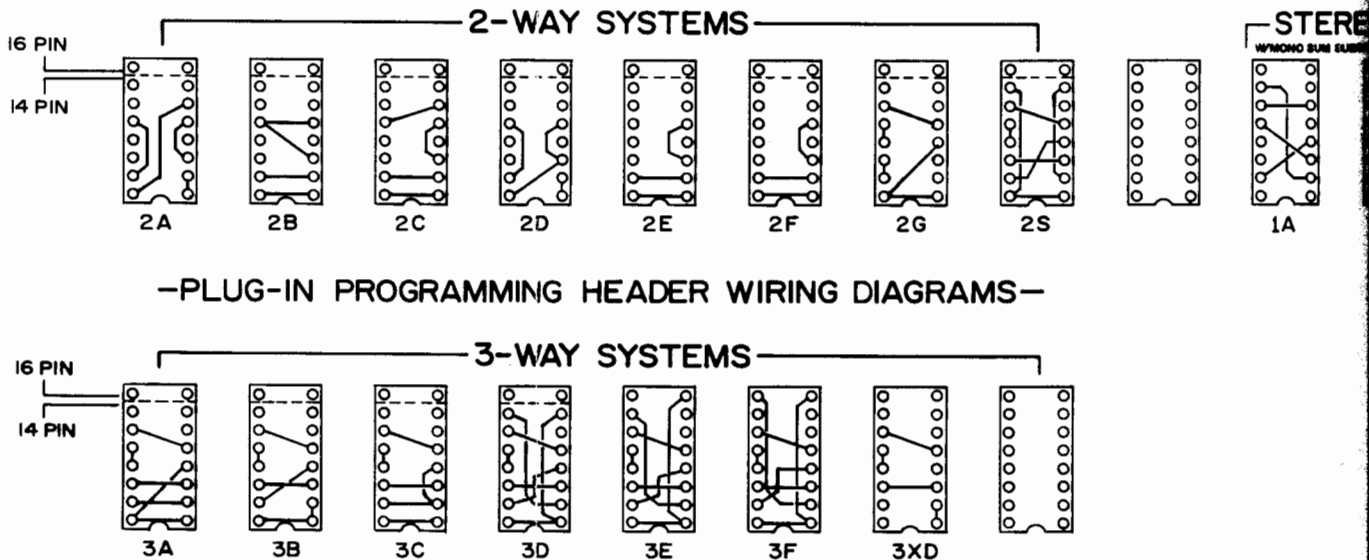
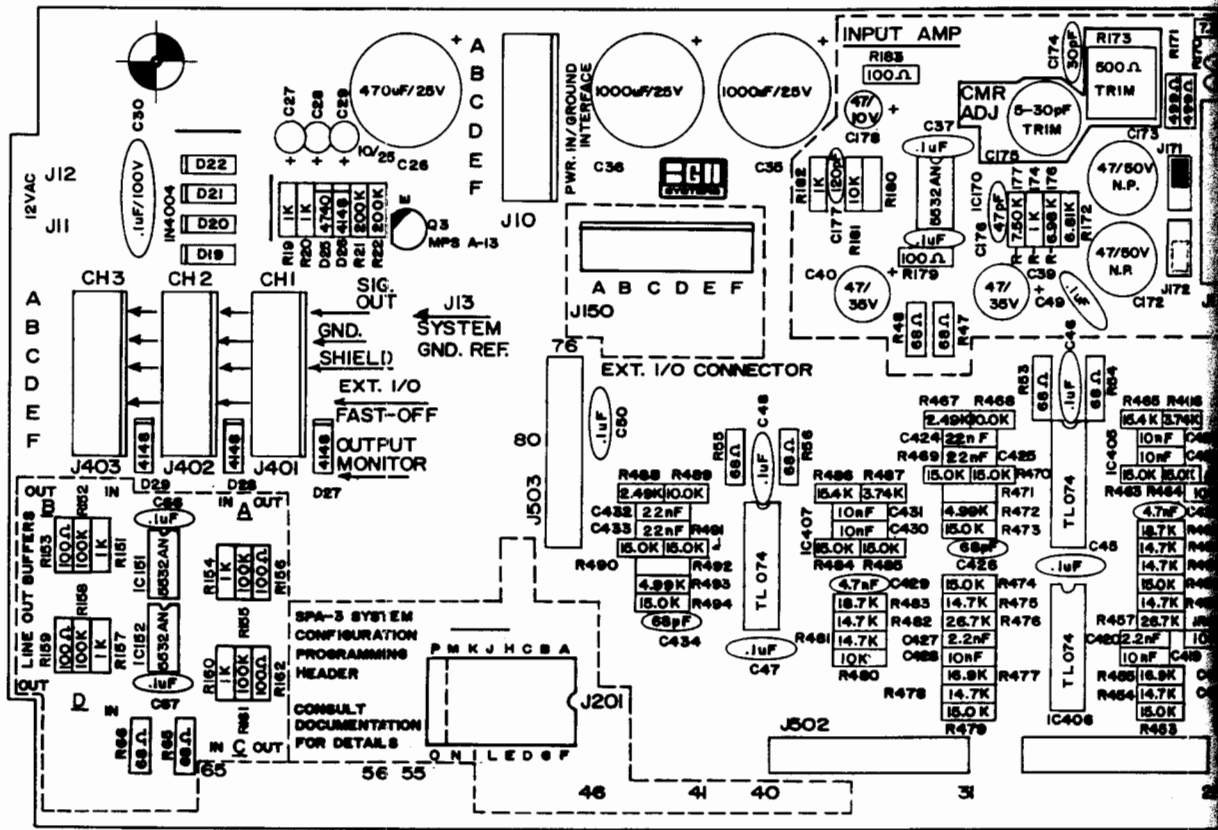


Frequency	$R_1$	$R_2$	$R_3$	$C_1$	$C_2$	$C_3$			
40	40.2K	121K	59.0K	.1uf	.1uf	22nf			
50	31.6K	97.6K	47.5K						
63	25.5K	76.8K	37.4K						
80	20.0K	60.4K	29.4K						
100	15.8K	48.7K	23.7K						
125	12.7K	39.2K	19.1K						
160	10.0K	30.9K	14.7K						
200	7.87K	24.3K	11.8K						
250	6.34K	19.6K	9.53K						
315	10.7K	15.4K	7.50K	47nf					
400	8.45K	27.4K	12.1K				47nf	10nf	
500	6.81K	22.1K	9.76K						
630	11.5K	17.4K	7.68K						22nf
800	9.09K	13.7K	6.04K			22nf			4.7nf
1.00K	7.15K	23.2K	10.5K						
1.25K	12.7K	18.7K	8.45K	10nf					
1.60K	10.0K	14.7K	6.49K				10nf	2.2nf	
2.00K	7.87K	24.3K	11.8K						
2.50K	6.34K	19.6K	9.53K			4.7nf			1.0nf
3.15K	10.7K	15.4K	7.50K						
4.00K	8.45K	27.4K	12.1K				2.2nf	470pf	
5.00K	6.81K	22.1K	9.76K						
6.30K	11.5K	17.4K	7.68K		2.2nf				
8.00K	9.09K	13.7K	6.04K			2.2nf			
10.0K	7.15K	23.2K	10.5K						

### 3-POLE BUTTERWORTH HIGH PASS FILTER



Frequency	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>
40	40.2K	20.0K	80.6K	.1uf	.1uf	.1uf
50	31.6K	15.8K	63.4K			
63	25.5K	12.7K	51.1K			
80	20.0K	10.0K	40.2K			
100	15.8K	7.87K	31.6K			
125	12.7K	6.34K	25.5K			
160	10.0K	10.5K	42.2K	.1uf	47nf	47nf
200	7.87K	8.45K	34.0K			
250	6.34K	6.81K	27.4K			
315	10.7K	11.5K	46.4K	47nf	22nf	22nf
400	8.45K	9.09K	36.5K			
500	6.81K	7.15K	28.7K			
630	11.5K	12.7K	51.1K	22nf	10nf	10nf
800	9.09K	10.0K	40.2K			
1.00K	7.15K	7.87K	31.6K			
1.25K	12.7K	6.34K	25.5K	10nf		
1.60K	10.0K	10.5K	42.2K		4.7nf	4.7nf
2.00K	7.87K	8.45K	34.0K			
2.50K	6.34K	6.81K	27.4K			
3.15K	10.7K	11.5K	46.4K	4.7nf	2.2nf	2.2nf
4.00K	8.45K	9.09K	36.5K			
5.00K	6.81K	7.15K	28.7K			
6.30K	11.5K	12.7K	51.1K	2.2nf	1.0nf	1.0nf
8.00K	9.09K	10.0K	40.2K			
10.00K	7.15K	7.87K	31.6K			

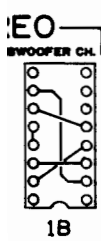
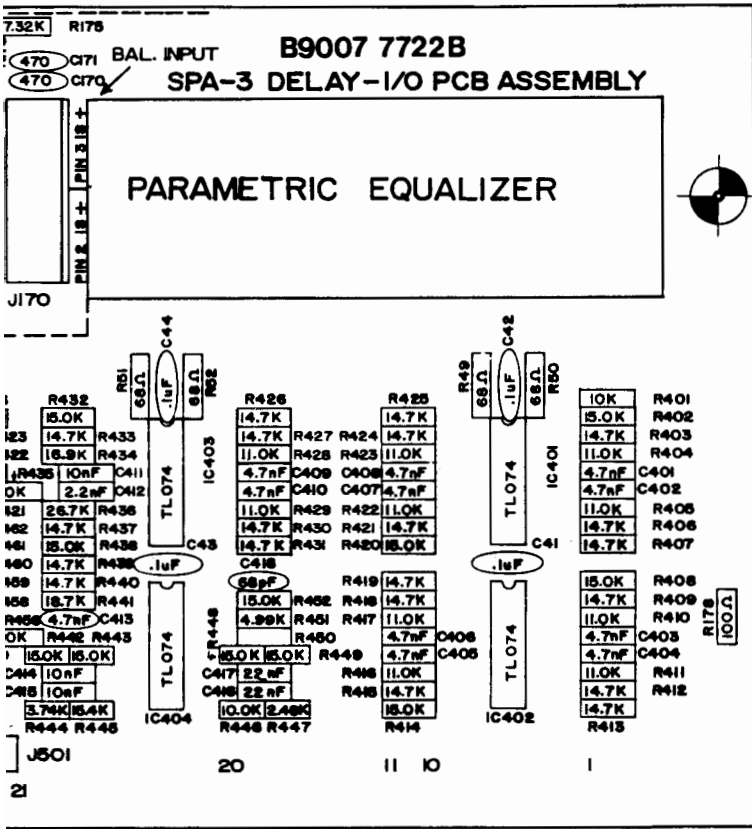


4. CAPACITORS REMAINING IN C400 SERIES ARE 5% WINDOW BATCH-SORTED FROM  $\pm 5\%$  PARTS.
3. CAPACITORS C414/B, 416/I7, 422/23, 424/25, 430/31, 432/33 ARE 1% MATCHED PAIRS.
2. ALL RESISTORS W/ TWO SIGNIFICANT DIGITS (XX.0) ARE 1/4W 5% CARBON FILM.
1. ALL RESISTORS W/ THREE SIGNIFICANT DIGITS (XX.X K) ARE 1% METAL FILM, 1/4W.

NOTES: UNLESS OTHERWISE SPECIFIED.

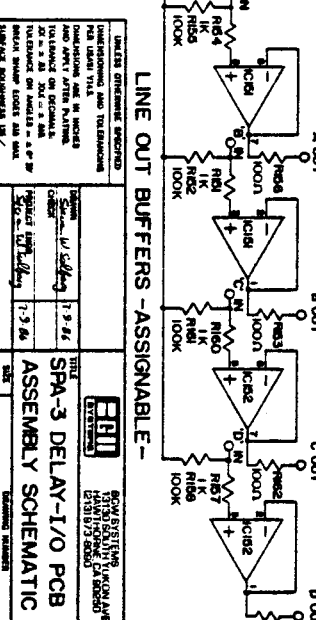
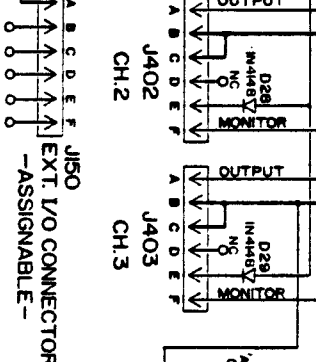
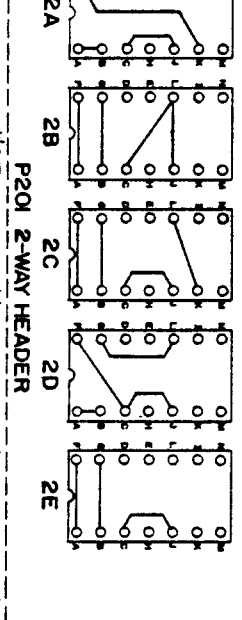
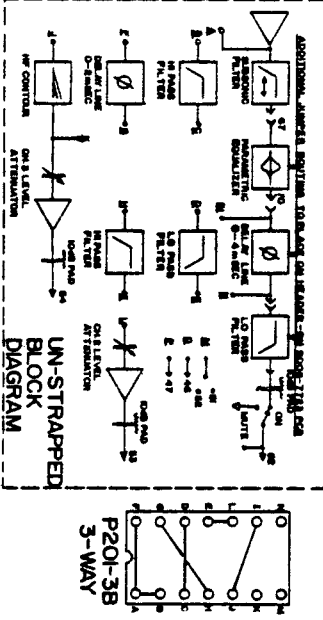
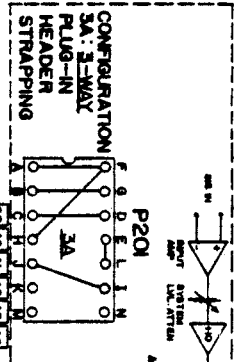
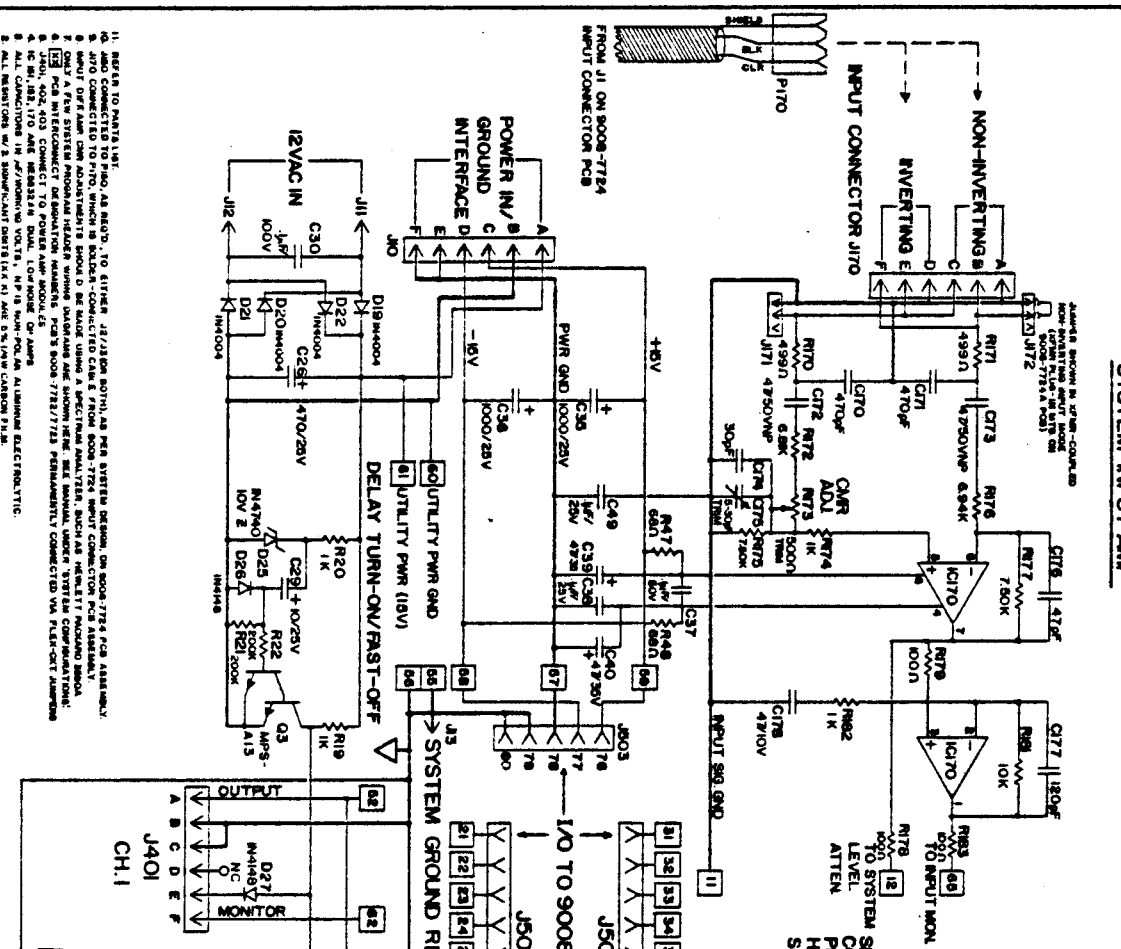


REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



LINE OUT BUFFERS	I/O CONNECTIONS	UNLESS OTHERWISE SPECIFIED	CUSTOMER	BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090	
A IN		DIMENSIONING AND TOLERANCING PER USAS1 Y14.5.	DRAWN <i>Stephen W. Sallberg</i> 7-31-87 CHECK	TITLE	
A OUT		DIMENSIONS ARE IN INCHES AND APPLY AFTER PLATING.		SPA-3 I/O PCB COMPONENT	
B IN		TOLERANCE ON DECIMALS: XX = ± .03 XXX = ± .010.	PROJECT ENGR <i>Stephen W. Sallberg</i> 4-21-86 SYSTEM	PLACEMENT GUIDE	
B OUT		TOLERANCE ON ANGLES = ± 0° 30'		SIZE	DRAWING NUMBER
C IN		BREAK SHARP EDGES .010 MAX.	D	9008-7722	B
C OUT		SURFACE ROUGHNESS 125 ✓	SCALE 2:1		SHEET 3 OF 3
D IN			DO NOT SCALE DRAWING		
D OUT					

# SYSTEM INPUT AMP

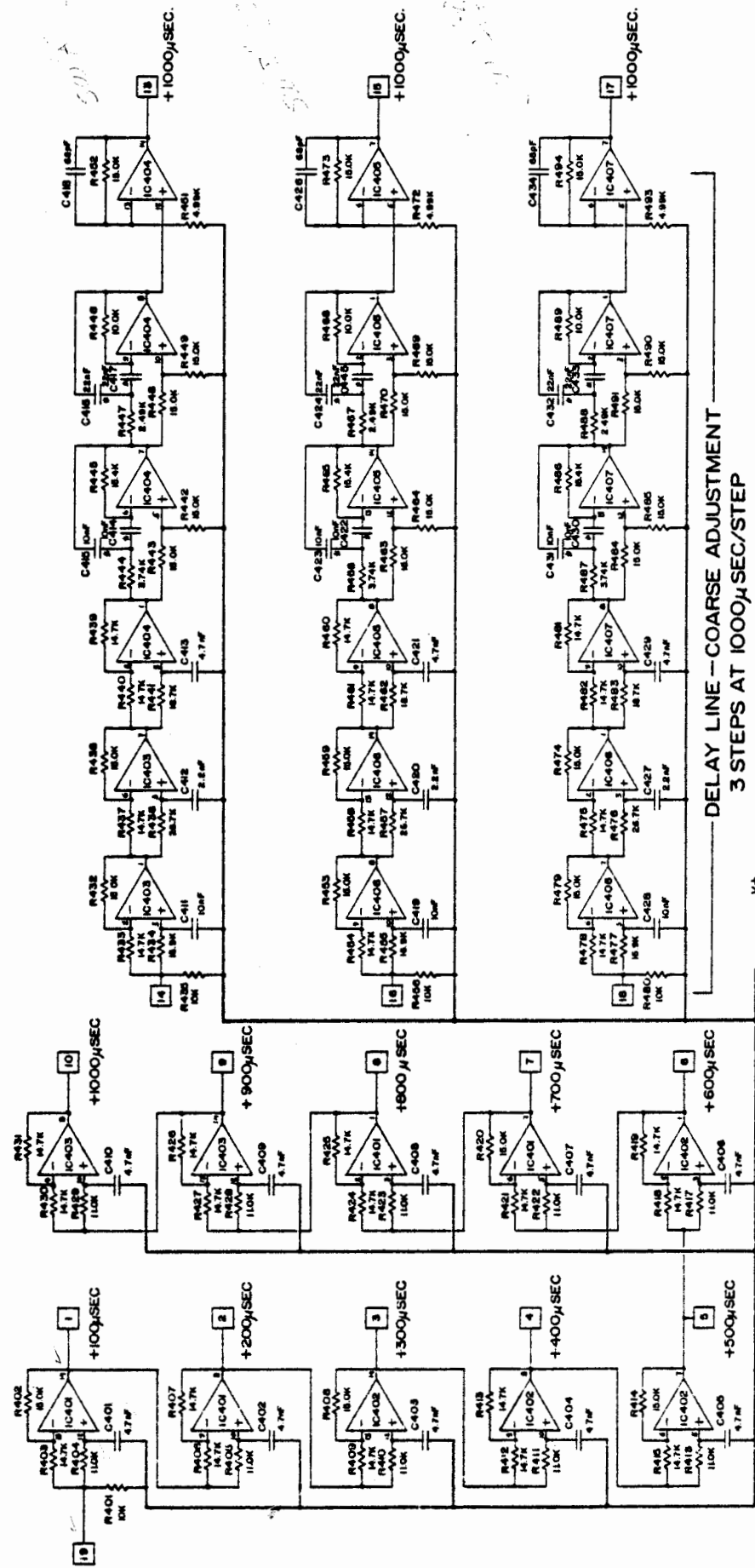


NOTES: 1. ALL RESISTORS W/ 3 SIGNIFICANT DIGITS ARE IN OHM METAL FILM.  
2. ALL RESISTORS W/ 2 SIGNIFICANT DIGITS ARE IN OHM METAL FILM.  
3. ALL RESISTORS W/ 1 SIGNIFICANT DIGIT ARE IN OHM METAL FILM.  
4. ALL RESISTORS W/ 0 SIGNIFICANT DIGITS ARE IN OHM METAL FILM.  
5. ALL RESISTORS W/ 1 SIGNIFICANT DIGIT ARE IN OHM METAL FILM.  
6. ALL RESISTORS W/ 2 SIGNIFICANT DIGITS ARE IN OHM METAL FILM.  
7. ALL RESISTORS W/ 3 SIGNIFICANT DIGITS ARE IN OHM METAL FILM.  
8. ALL RESISTORS W/ 4 SIGNIFICANT DIGITS ARE IN OHM METAL FILM.  
9. ALL RESISTORS W/ 5 SIGNIFICANT DIGITS ARE IN OHM METAL FILM.  
10. ALL RESISTORS W/ 6 SIGNIFICANT DIGITS ARE IN OHM METAL FILM.  
11. REFER TO PARTS LIST.  
12. J10 CONNECTED TO P100, AS NOTED, TO GIVE A 1/2 SECOND DELAY, ON 9008-7724 PCB ASSEMBLY.  
13. J10 CONNECTED TO P100, WHICH IS SOLDER-CONNECTED CABLE FROM 9008-7724 INPUT CONNECTOR PCB ASSEMBLY.  
14. ONLY A FEW SYSTEM PROGRAMMABLE MEMORY ADDRESS DATA BITS ARE SHOWN HERE. THE REMAINING SYSTEM PROGRAMMABLE MEMORY ADDRESS DATA BITS ARE NOT SHOWN.  
15. J401, J402, J403 CONNECT TO POWER AND GROUND.  
16. J401, J402, J403 CONNECT TO POWER AND GROUND.  
17. J401, J402, J403 CONNECT TO POWER AND GROUND.  
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98. J401, J402, J403 CONNECT TO POWER AND GROUND.  
99. J401, J402, J403 CONNECT TO POWER AND GROUND.  
100. J401, J402, J403 CONNECT TO POWER AND GROUND.

DO NOT SCALE DRAWING

REV	DATE	DESCRIPTION
B	8-1-78	3-1/2
D	9-1-78	3-1/2

9008 SYSTEMS  
9008-7722  
9008-7724  
9008-7726  
9008-7728  
9008-7730  
9008-7732  
9008-7734  
9008-7736  
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9008-7790  
9008-7792  
9008-7794  
9008-7796  
9008-7798  
9008-7800



**DELAY LINE - FINE ADJUSTMENT**  
 10 STEPS AT 100µSEC/STEP

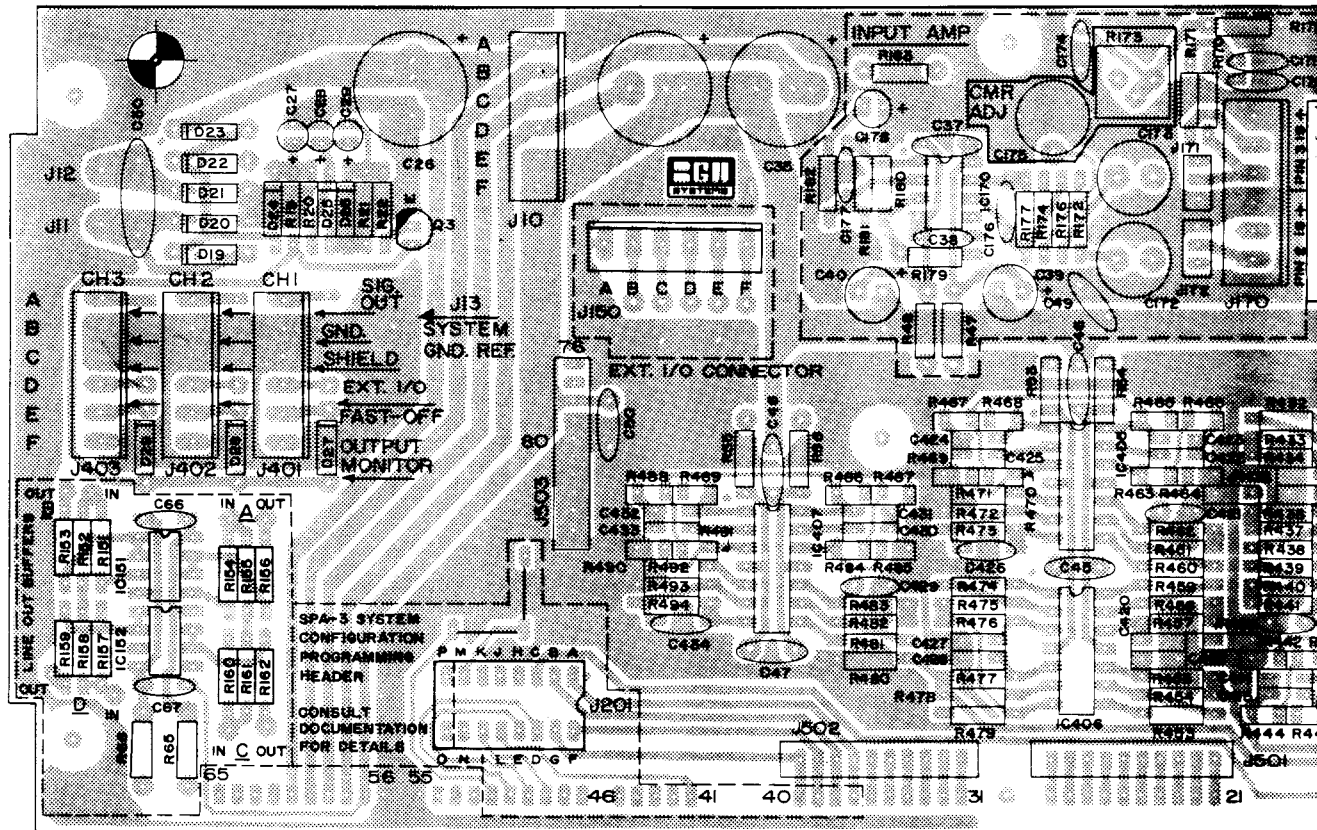
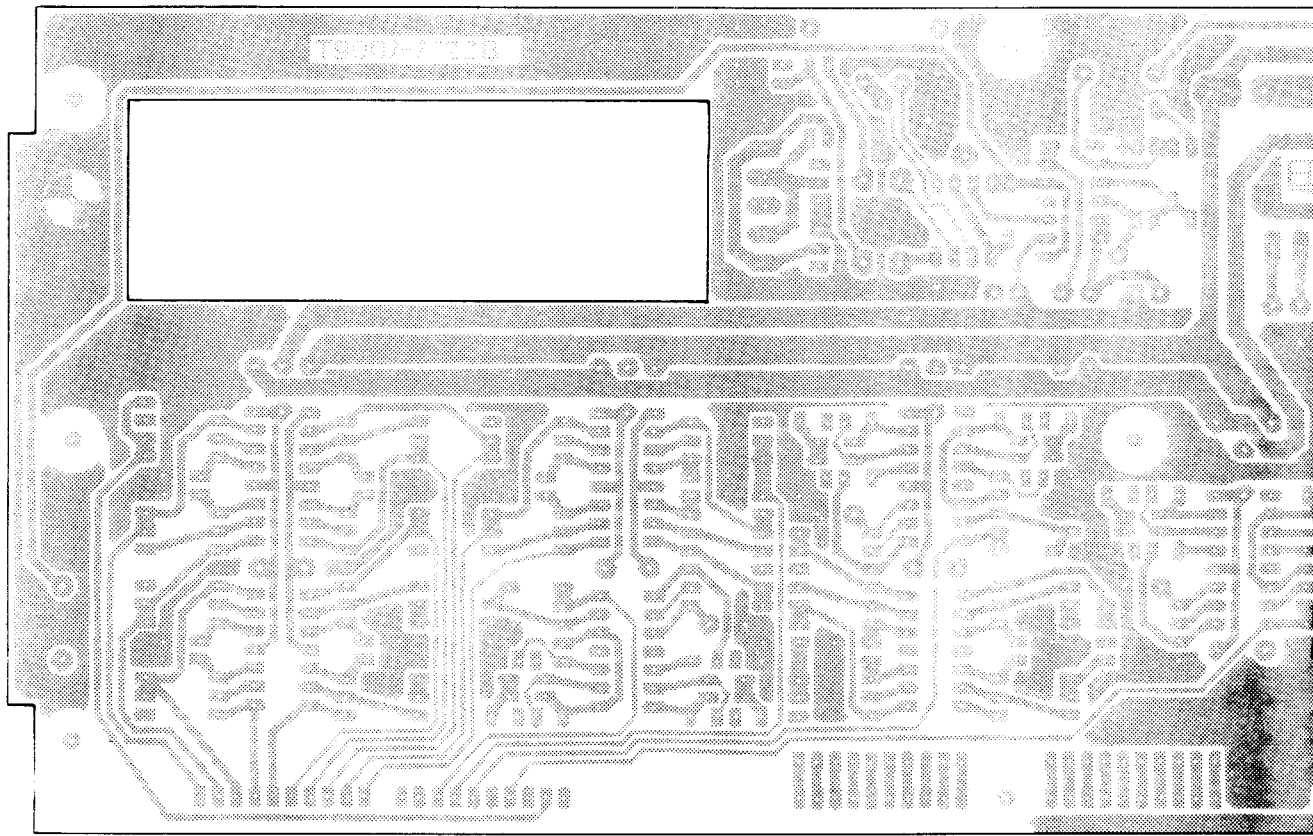
**DELAY LINE - COARSE ADJUSTMENT**  
 3 STEPS AT 1000µSEC/STEP

**3 STEPS AT 1000µSEC/STEP**

**NOTES:** UNLESS OTHERWISE SPECIFIED  
 1. ALL RESISTORS ARE 1% 1/4 W METAL FILM (EXCEPT R401, R35, R56, R480, R489, R498, R499, R505, R506 AND 66, WHICH ARE 1/4 W 5% CARBON FILM).  
 2. CAPACITORS MARKED WITH AN ASTERISK (\*) ARE MATCHED TO 1%.  
 3. ALL QUAD BIT-FET OF AMP IC'S ARE SELECTED FOR LOW NOISE (IC-401-407 T1074).  
 4. PCB INTERCONNECT DESIGNATION NUMBERS.  
 5. REFER TO PARTS LIST, 9008-7722 PLUS COMPONENT PLACEMENT GUIDE, AND 9008-7723 P.U.I. SCHEMATIC.  
 6. UNLESS OTHERWISE SPECIFIED, DIMENSIONS AND TOLERANCES PER UNLESS THIS DRAWING IS AMENDED BY A REVISION AND ANY OTHER PLATING TOLERANCE OR DIMENSION IS TO BE AS SHOWN ON THE SURFACE UNLESS INDICATED OTHERWISE.

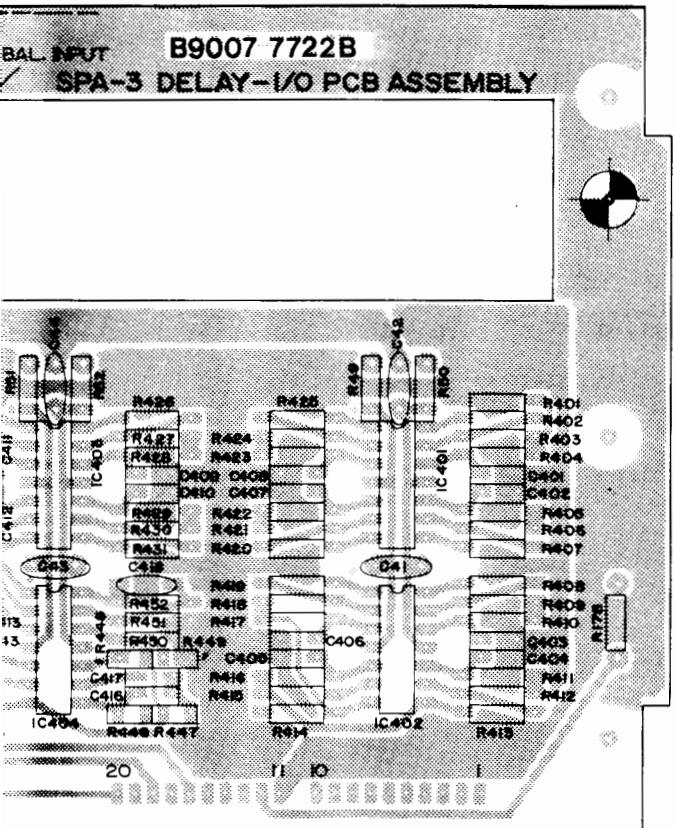
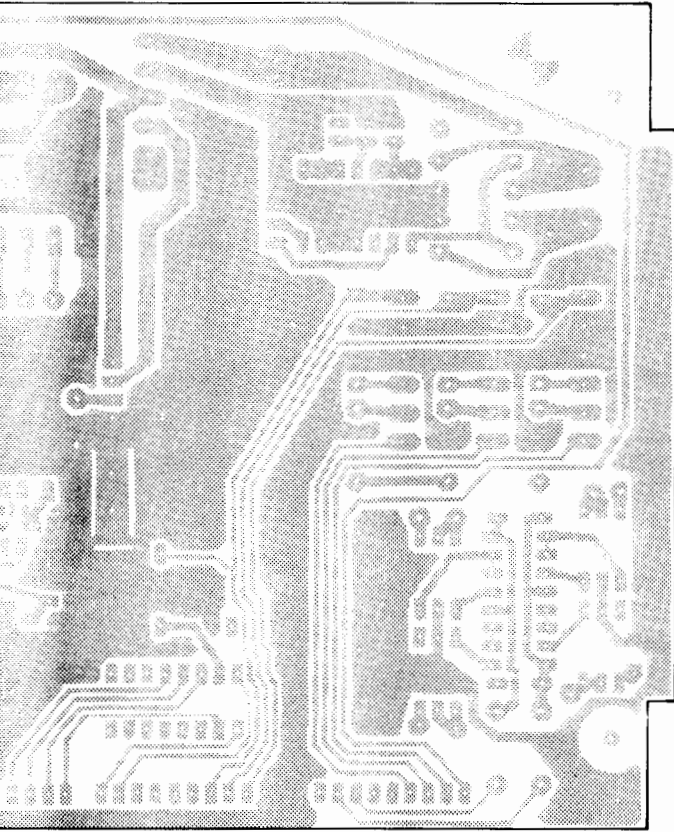
REV	B
DATE	11/16/66
DESIGNED BY	W. J. B. / J. B. B.
CHECKED BY	W. J. B. / J. B. B.
DATE	11/16/66
SCALE	D
TITLE	SPA-3 ANALOG DELAY LINE SCHEMATIC
PROJECT	9008-7722
DRAWING NUMBER	9008-7722
DATE	11/16/66
SCALE	D
SHEET	2 OF 3

**BOB SYSTEMS**  
 13155 SULLY BLVD  
 DALLAS, TEXAS 75244



NOTES: UNLESS OTHERWISE SPECIFIED.

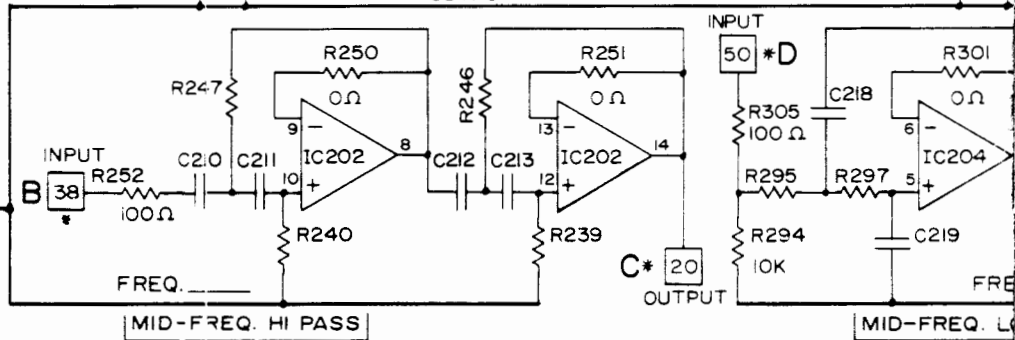
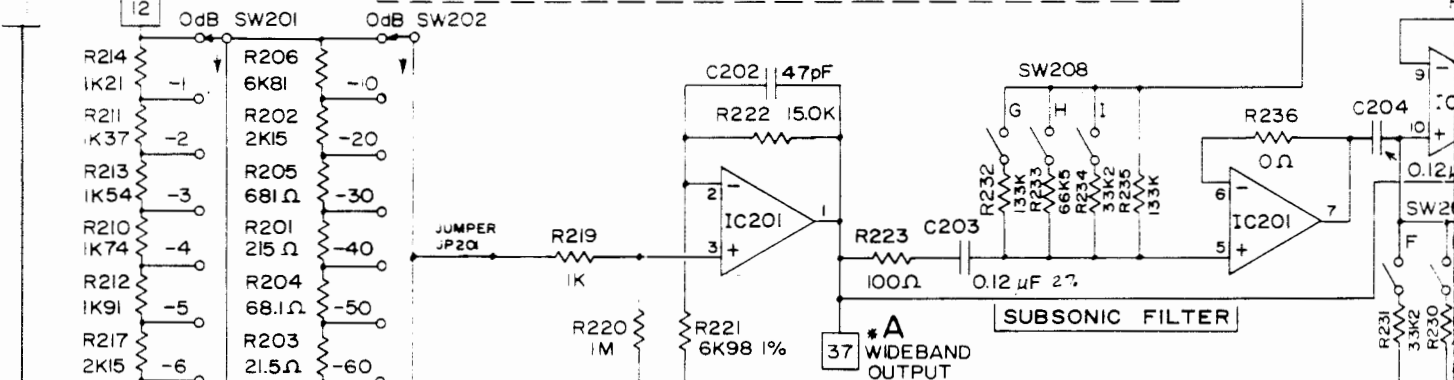
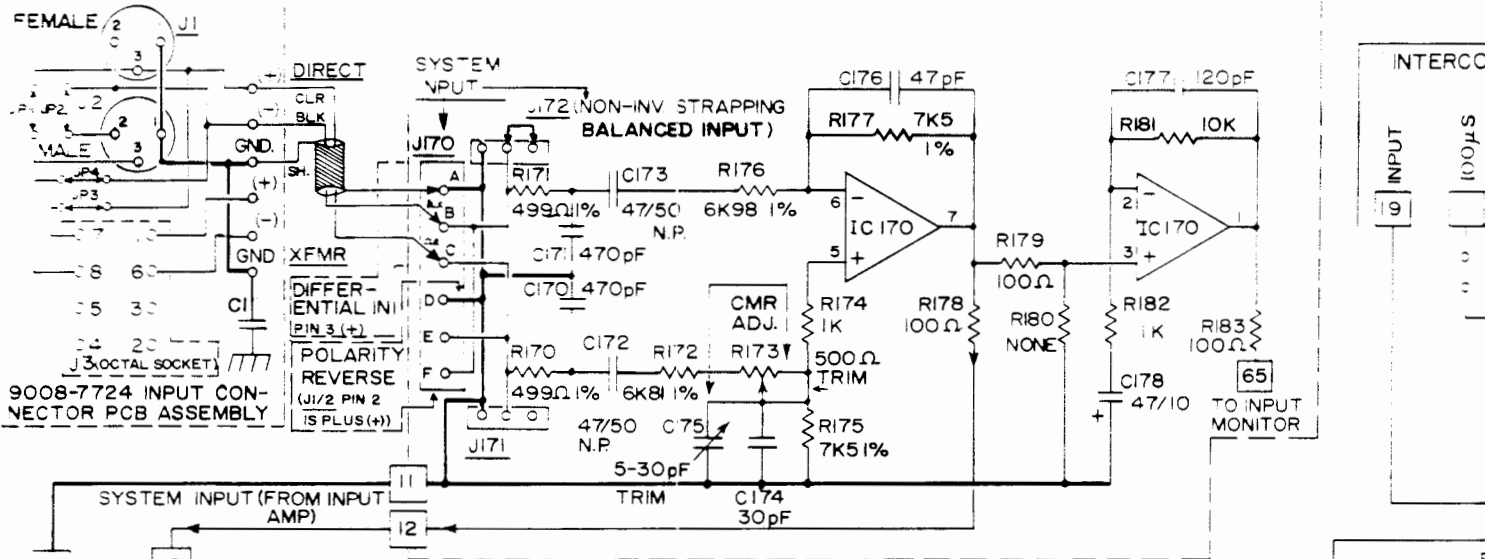
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



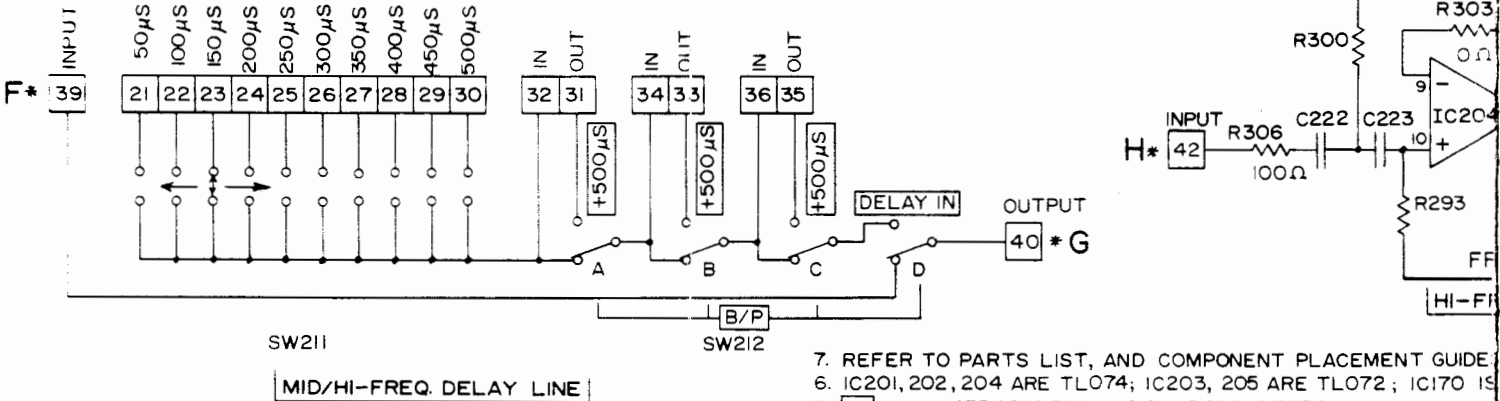
		<b>BGI</b> SYSTEMS		BGI SYSTEMS 13130 SOUTH YUKON AVE HAWTHORNE, CA 90250 (213) 973-8090	
DRAWN <i>S. V. Selberg</i>	9-24-87	TITLE <b>SPA-3 PC BOARD LAYOUT-TOP/BOTTOM.</b>			
CHECKED		PROJECT ENGR <i>S. V. Selberg</i> 4-21-86			
		SIZE <b>D</b>	DRAWING NUMBER <b>9007-7722</b>	REV <b>B</b>	
		SCALE 1:1			SHEET <b>7</b> OF <b>7</b>

DO NOT SCALE DRAWING

INPUT AMP - PART OF 9008-7722 PCB ASSEMBLY



INTERCONNECT TO DELAY LINE ON 9008-7727 PCB ASSEMBLY VIA 9008-7722



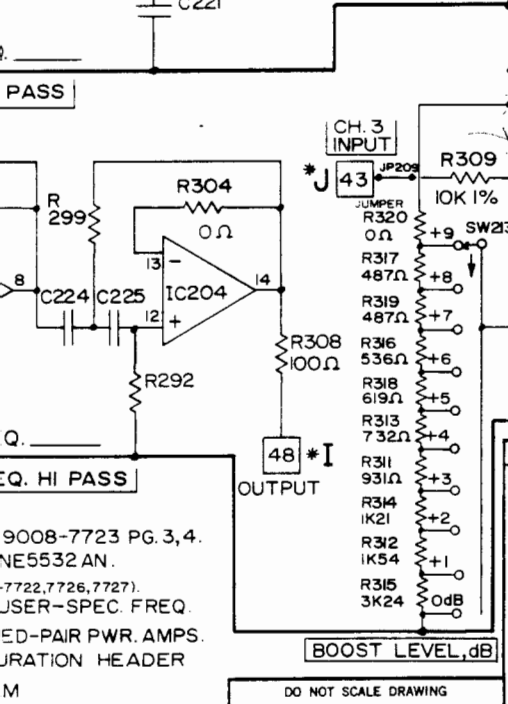
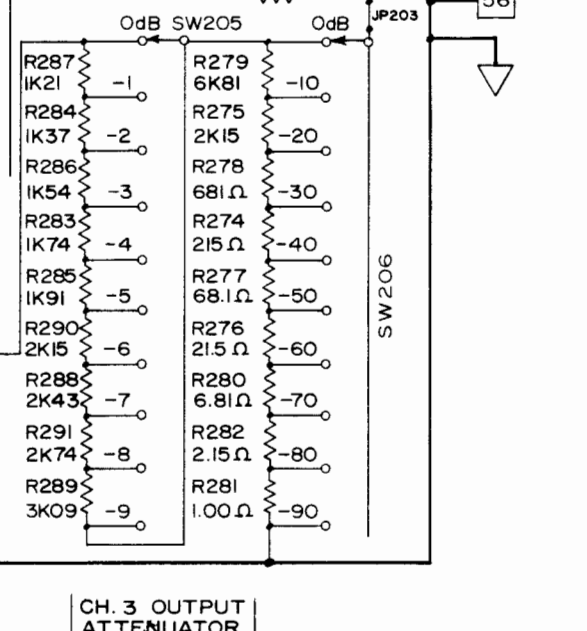
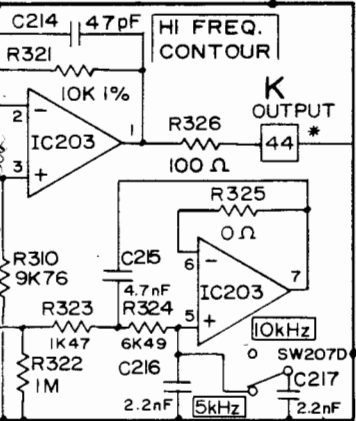
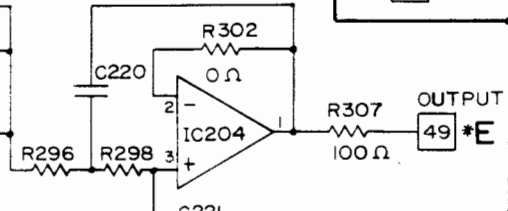
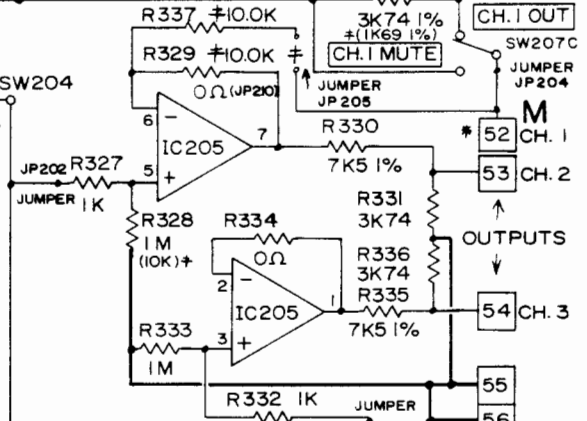
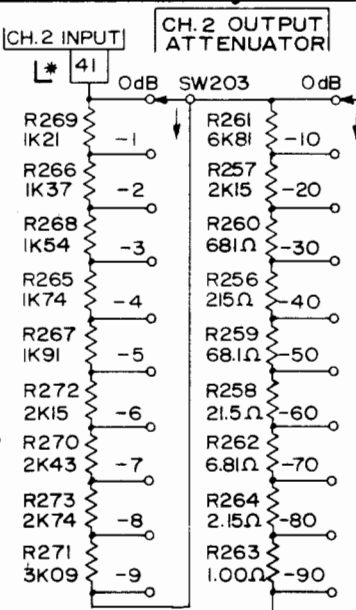
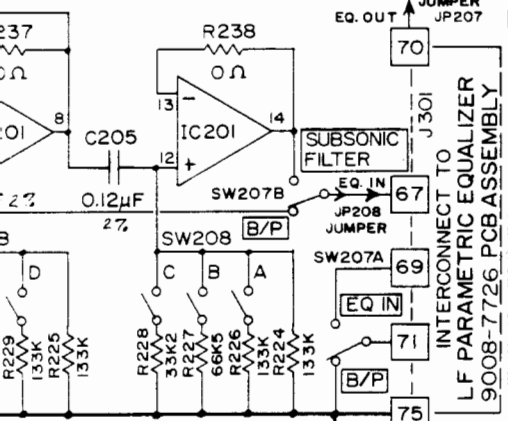
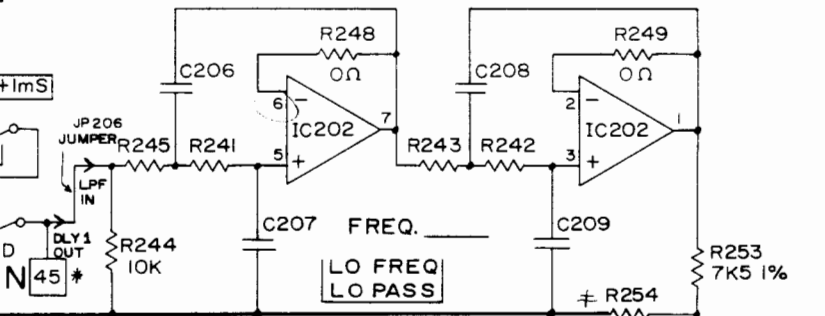
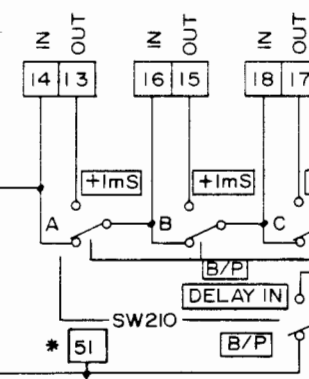
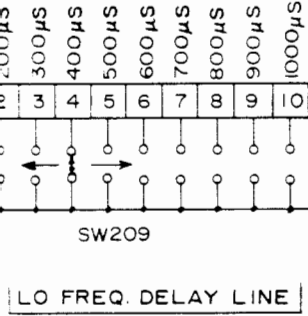
NOTES: UNLESS OTHERWISE SPECIFIED.

7. REFER TO PARTS LIST, AND COMPONENT PLACEMENT GUIDE
6. IC201, 202, 204 ARE TLO74; IC203, 205 ARE TLO72; IC170 IS
5. [XX] PCB INTERCONNECT DESIGNATION NUMBERS (CONNECTIONS TO 9008-7727)
4. COMPONENT VALUES FOR COVER FILTERS SELECTED AS PER (R239-243, 245-247, 292, 293, 295-300 AND C206-213, 218-225)
3. COMPONENTS AND CONNECTIONS MARKED WITH (+) ARE FOR BRID
2. ALL CONNECTIONS W/ASTERISK (\*) APPEAR ON SPA-3 CONF
1. ALL RESISTORS W/ 3 SIGNIFICANT DIGITS ARE 1% METAL F



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
B	ADD JUMPER CONNECTIONS TO INPUTS/OUTPUTS TO DLY <sup>2</sup> 'S, PARAMETRIC EQ, LPF FOR ADDITIONAL SIB. ROUTING	8-1-87	SWJ

CONNECT TO DELAY LINE ON 9008-7722 PCB ASSEMBLY  
 TAPPED DELAY LINE

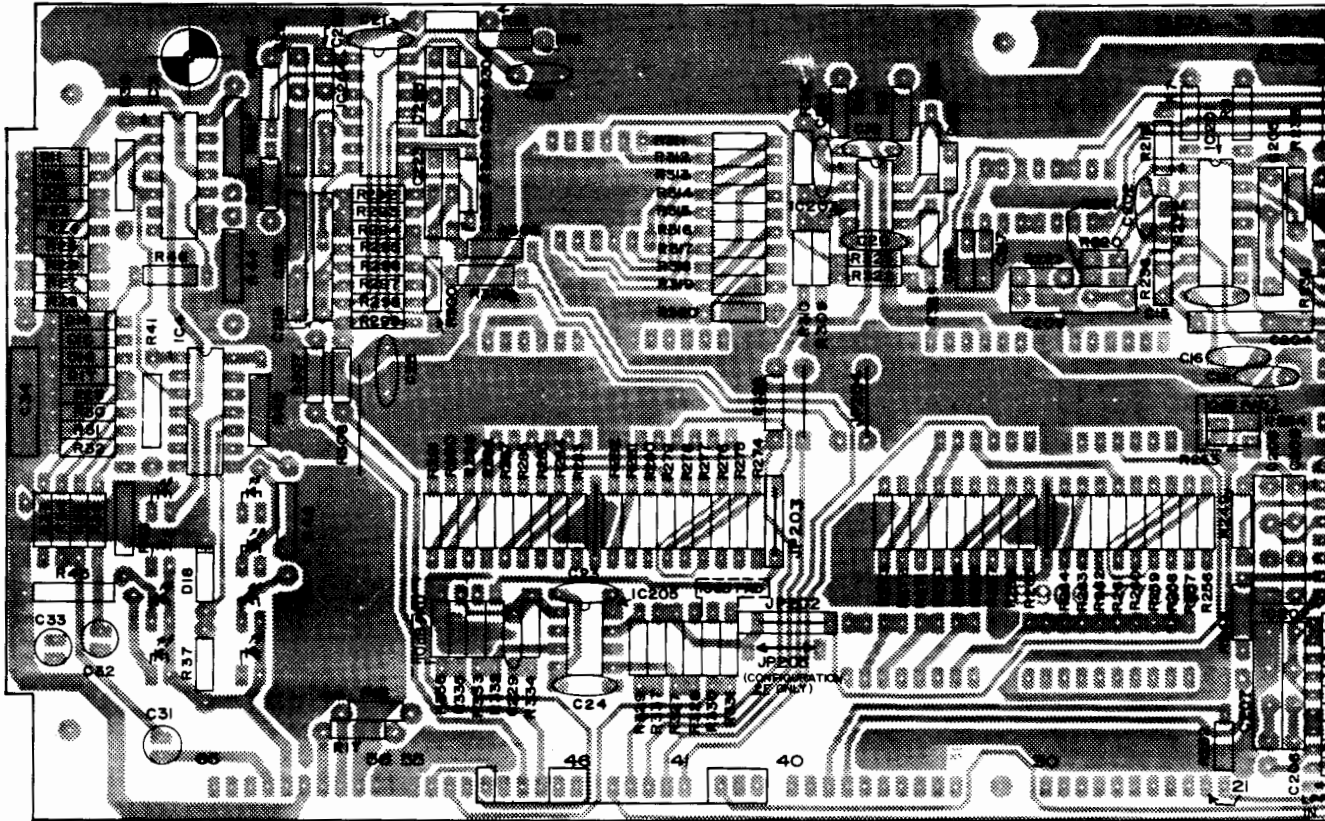
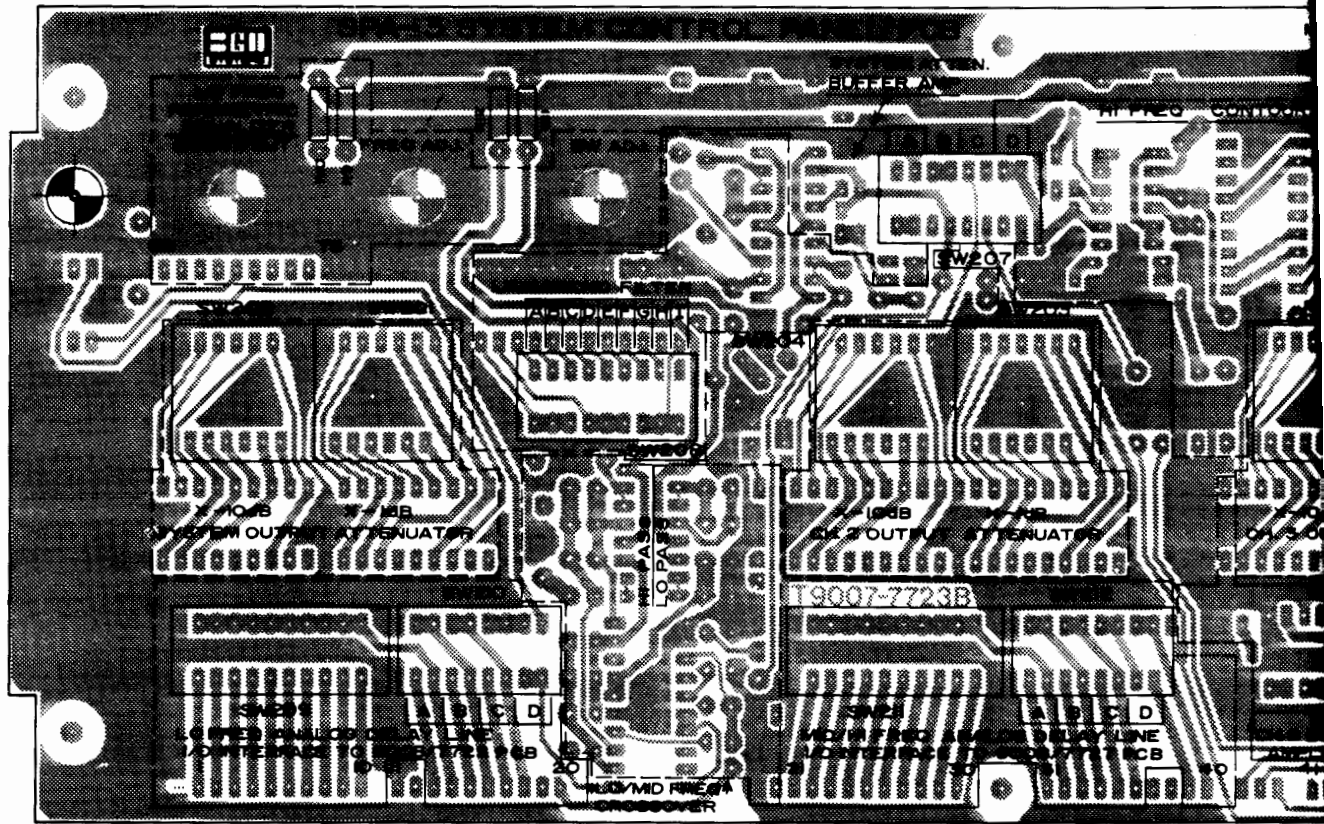


UNLESS OTHERWISE SPECIFIED  
 DIMENSIONING AND TOLERANCING PER ANSI Y14.5.  
 DIMENSIONS ARE IN INCHES AND APPLY AFTER PLATING.  
 TOLERANCE ON DECIMALS: XX = ±.03 XXX = ±.010.  
 TOLERANCE ON ANGLES = ± 0° 30'  
 BREAK SHARP EDGES .010 MAX.  
 SURFACE ROUGHNESS 125 ✓

		BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090	
DRAWN <i>Sw. Selberg</i> 4-27-86	CHECK	TITLE <b>SPA-3 SYSTEM CONTROL SCHEMATIC</b>	
PROJECT ENGR <i>Sw. Selberg</i> 4-27-86	ALL CIRCUITRY ON 9008-7723 PCB UNLESS OTHERWISE NOTED.	SIZE <b>D</b>	DRAWING NUMBER <b>9008-7723</b>
SCALE	SHEET 1 OF 4	REV <b>B</b>	

9008-7723 PG. 3, 4.  
 NE5532 AN.  
 -7722, 7726, 7727).  
 USER-SPEC. FREQ.  
 ED-PAIR PWR. AMPS.  
 URATION HEADER  
 M

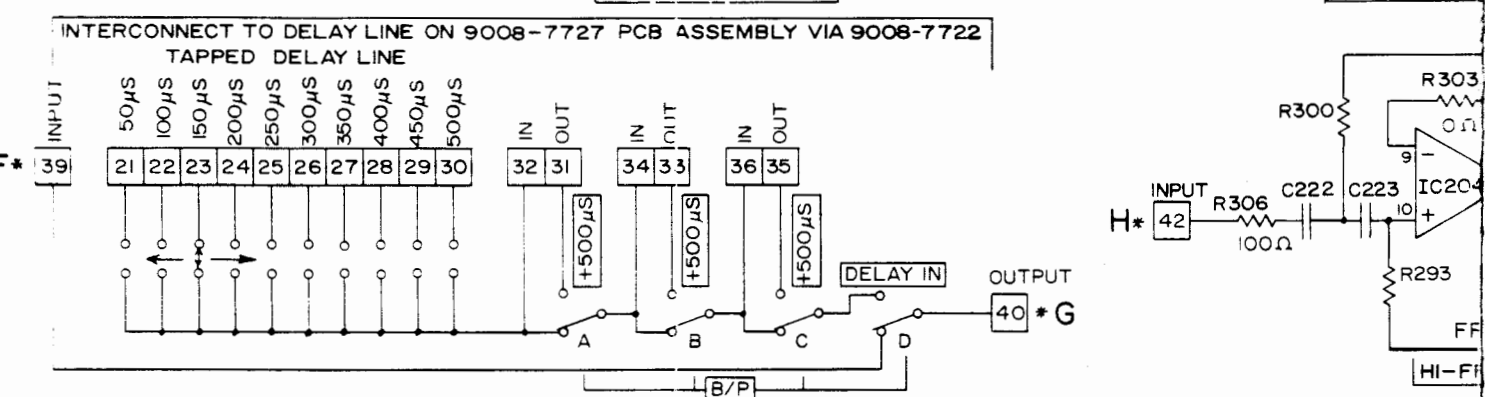
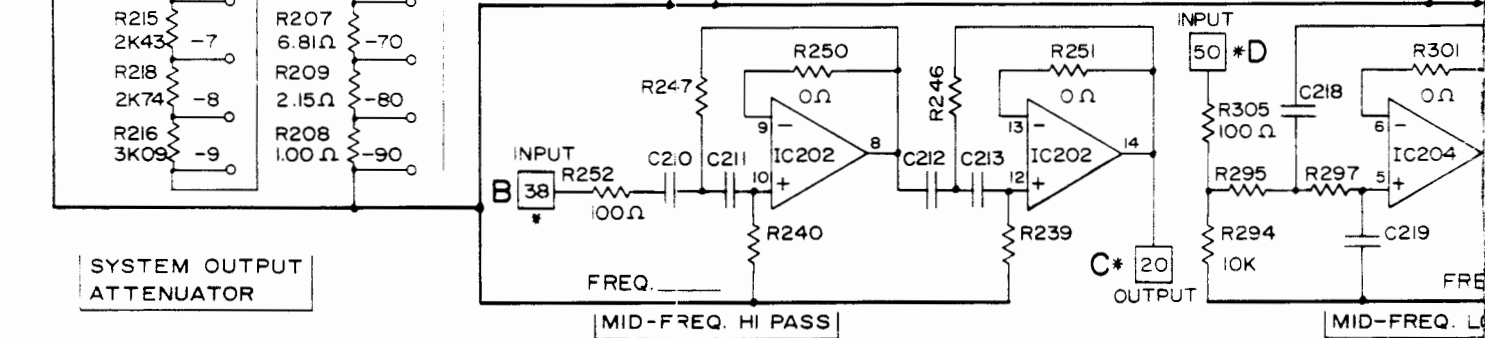
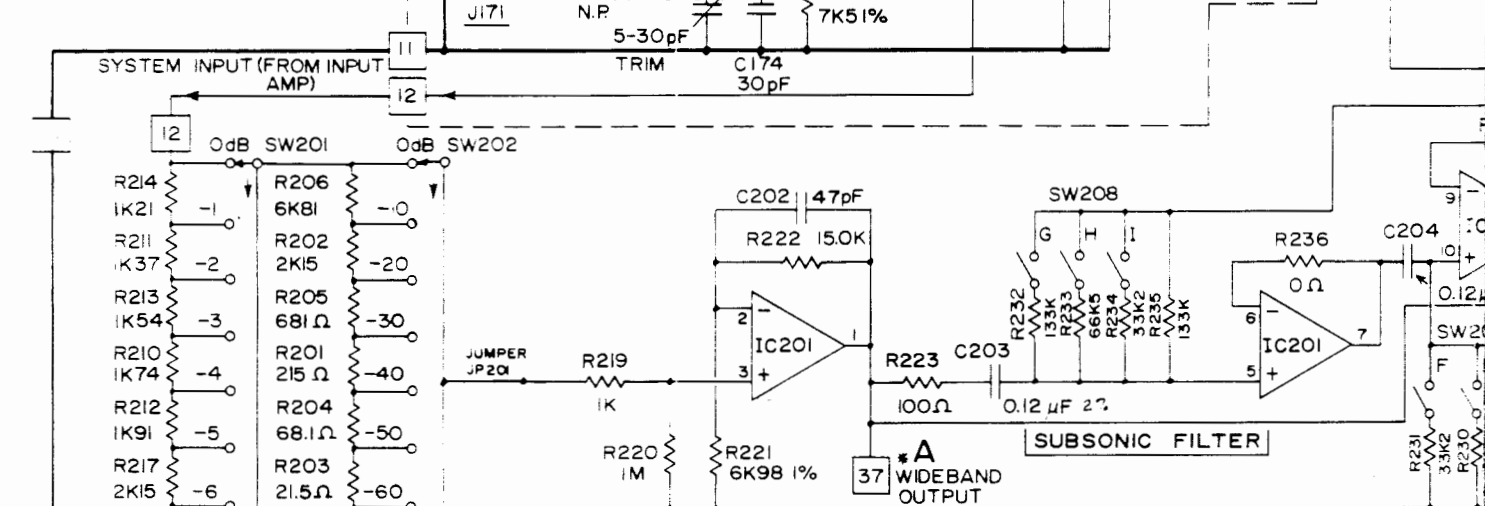
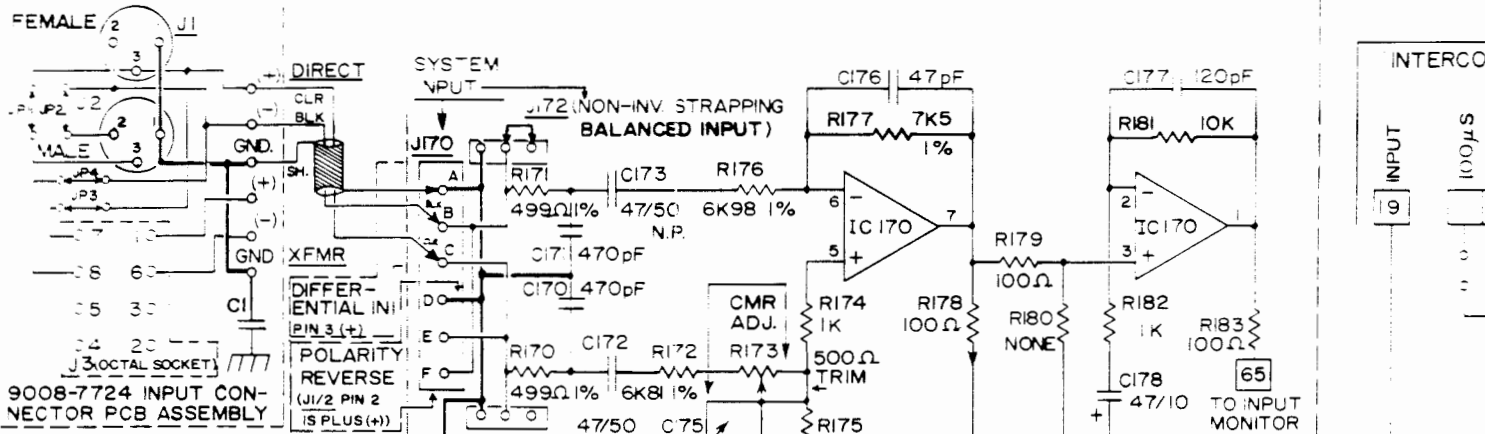
DO NOT SCALE DRAWING



NOTES: UNLESS OTHERWISE SPECIFIED.



INPUT AMP - PART OF 9008-7722 PCB ASSEMBLY

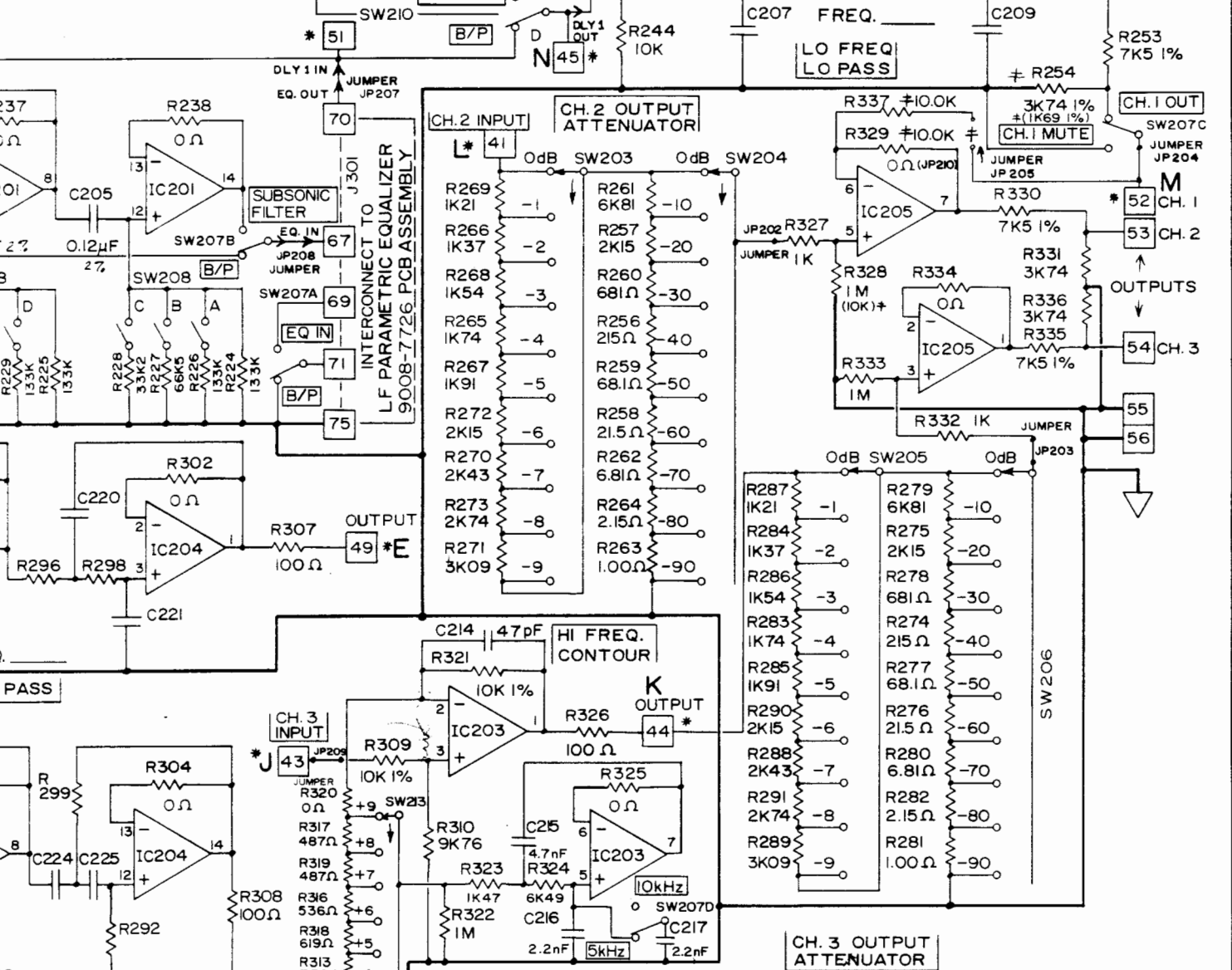
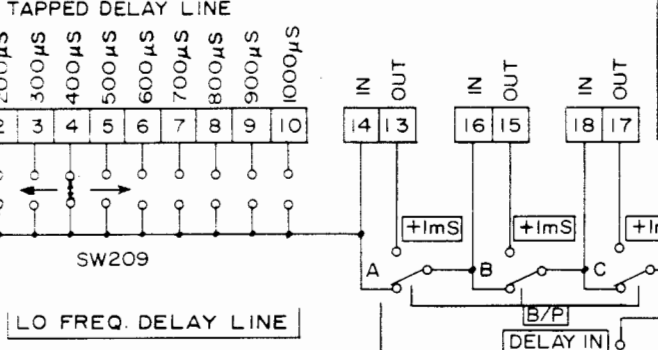


- NOTES: UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTORS W/ 3 SIGNIFICANT DIGITS ARE 1% METAL FILM
  2. ALL CONNECTIONS W/ASTERISK (\*) APPEAR ON SPA-3 CONF
  3. COMPONENTS AND CONNECTIONS MARKED WITH (+) ARE FOR BRID
  4. COMPONENT VALUES FOR XOVER FILTERS SELECTED AS PER (R239-243, 245-247, 292, 293, 295-300 AND C206-213, 218-225)
  5. [X] PCB INTERCONNECT DESIGNATION NUMBERS (CONNECTIONS TO 9008-7727)
  6. IC201, 202, 204 ARE TLO74; IC203, 205 ARE TLO72; IC170 IS
  7. REFER TO PARTS LIST, AND COMPONENT PLACEMENT GUIDE



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
B	ADD JUMPER CONNECTIONS TO INPUTS/OUTPUTS TO DLY#S, PARAMETRIC EQ, LPF FOR ADDITIONAL S16 ROUTING	8-1-87	SWS

CONNECT TO DELAY LINE ON 9008-7722 PCB ASSEMBLY

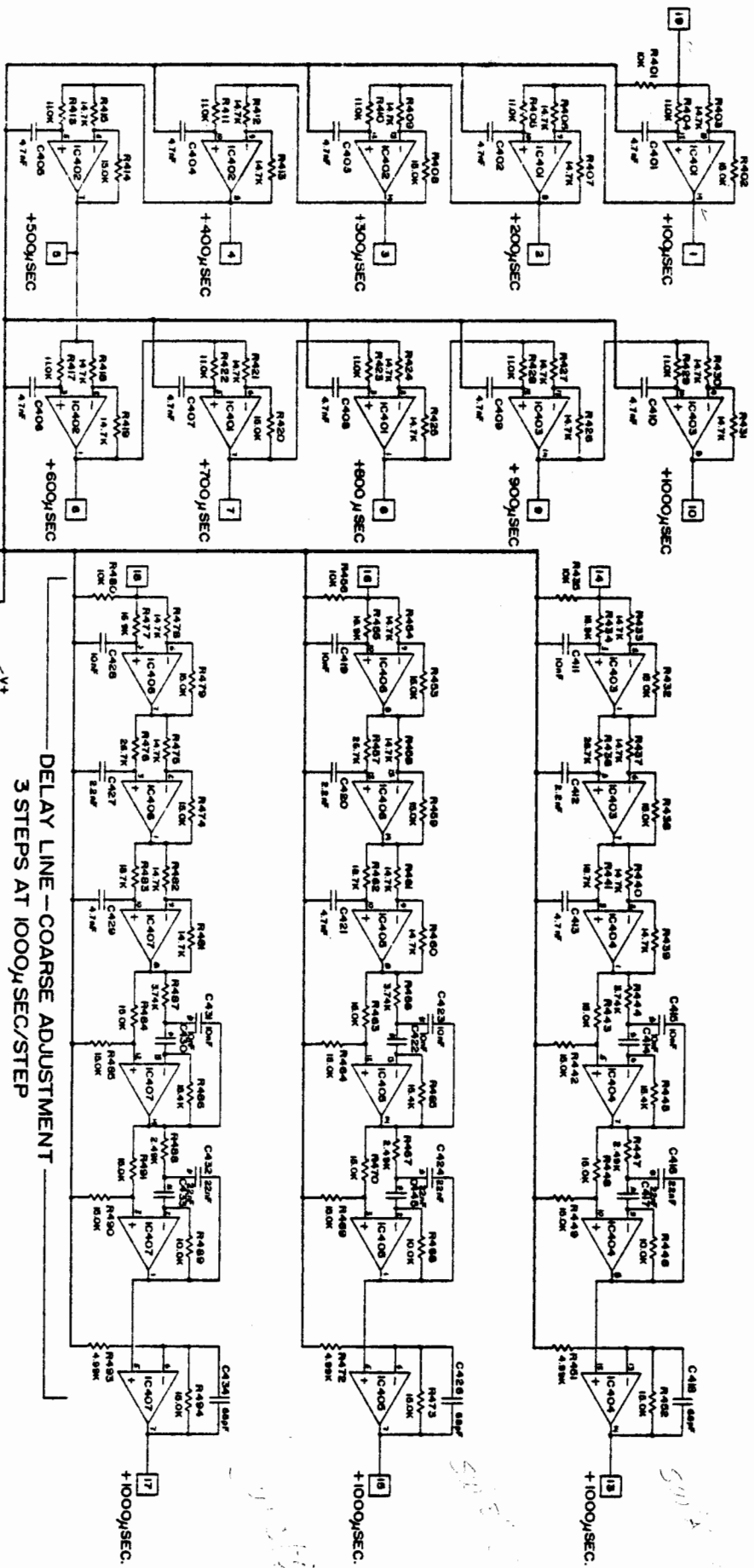


9008-7723 PG. 3, 4.  
NE5532 AN.  
7722, 7725, 7727).  
USER-SPEC. FREQ.  
ED-PAIR PWR. AMPS.  
URATION HEADER

UNLESS OTHERWISE SPECIFIED  
DIMENSIONING AND TOLERANCING PER USAS1 Y14.5.  
DIMENSIONS ARE IN INCHES AND APPLY AFTER PLATING.  
TOLERANCE ON DECIMALS:  
XX = ± .03 XXX = ± .010  
TOLERANCE ON ANGLES = ± 0° 30'  
BREAK SHARP EDGES .010 MAX.  
SURFACE ROUGHNESS 125 ✓

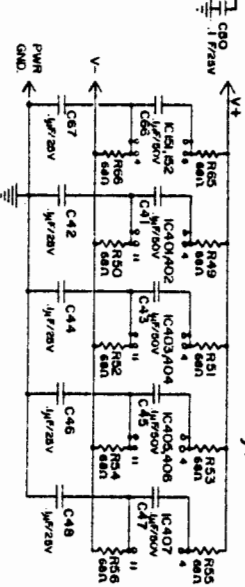
DO NOT SCALE DRAWING

		BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090	
DRAWN <i>S.W. Selberg</i> 4-27-86	CHECK	TITLE <b>SPA-3 SYSTEM CONTROL SCHEMATIC</b>	
PROJECT ENGR <i>S.W. Selberg</i> 4-27-86	SIZE <b>D</b>	DRAWING NUMBER <b>9008-7723</b>	REV <b>B</b>
ALL CIRCUITRY ON 9008-7723 PCB UNLESS OTHERWISE NOTED.	SCALE	SHEET 1 OF 4	



DELAY LINE - FINE ADJUSTMENT  
10 STEPS AT 100µs/STEP

DELAY LINE - COARSE ADJUSTMENT  
3 STEPS AT 1000µs/STEP



1. ALL RESISTORS ARE 1% 1/4 W METAL FILM EXCEPT R404, 490, 491, 492, 493 AND 494 WHICH ARE 1W 5% CARBON FILM.
2. CAPACITORS MARKED WITH AN ASTERISK (\*) ARE MATCHED TO 10%.
3. ALL QUAD BI-DIRECT AMP. IC'S ARE SELECTED FOR LOW NOISE (IC-401-407 TL 074).
4. PCB INTERCONNECT DESIGNATION NUMBERS.
5. 8008-7722 P-1 SCHEMATIC.
6. REFER TO PARTS LIST, 8008-7722 P-1 COMPONENT PLACEMENT GUIDE, AND 8008-7723 P-1 SCHEMATIC.

REVISIONS		DATE		APPROVAL	

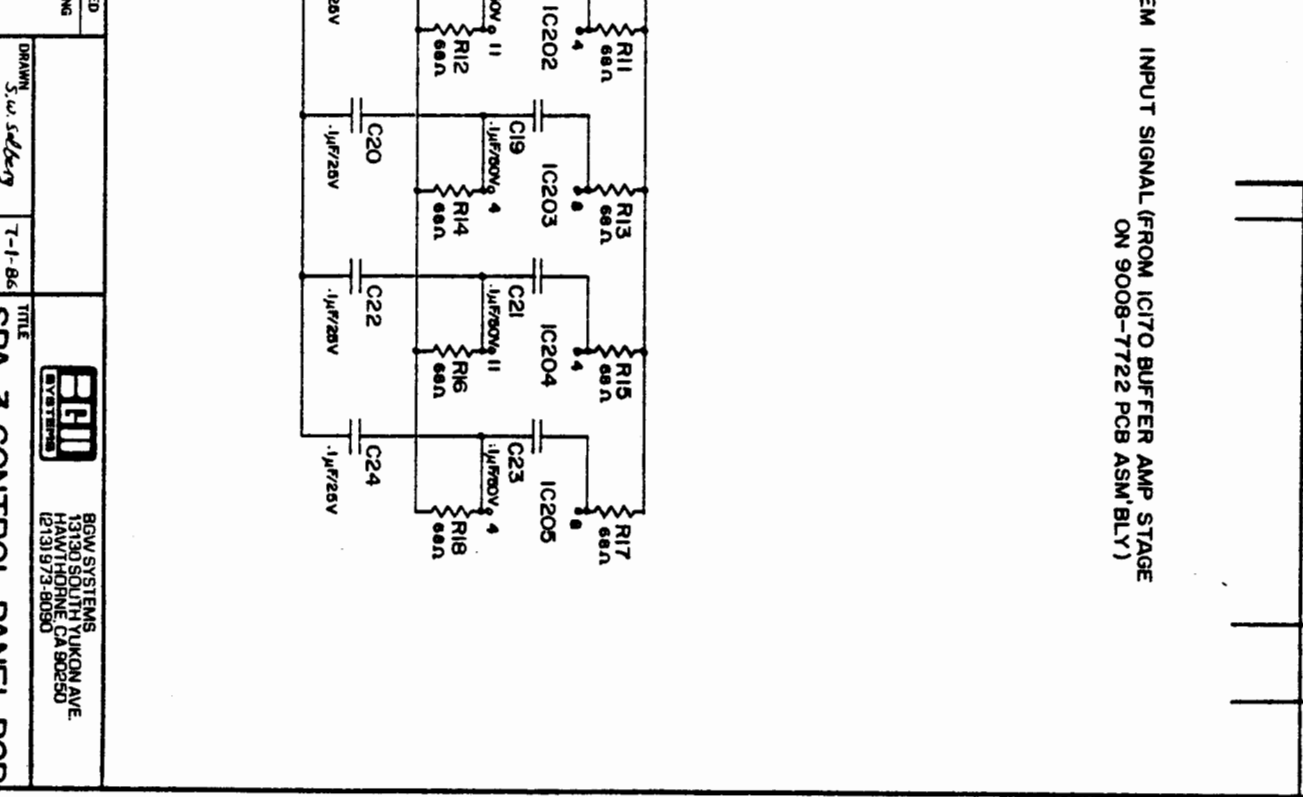
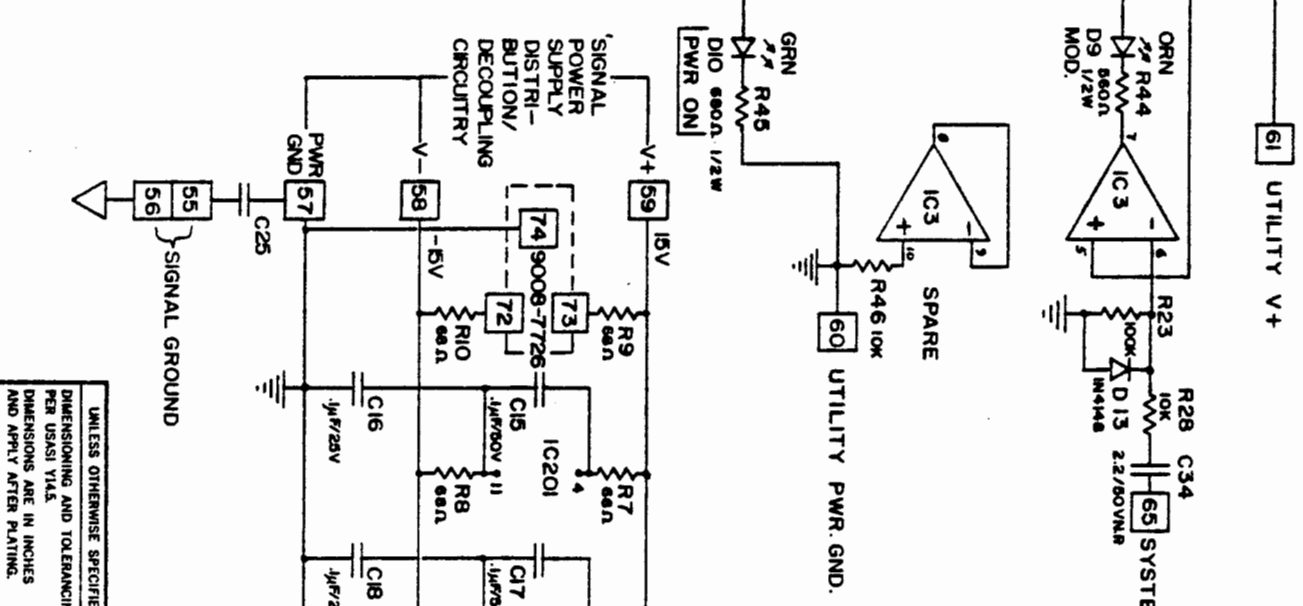
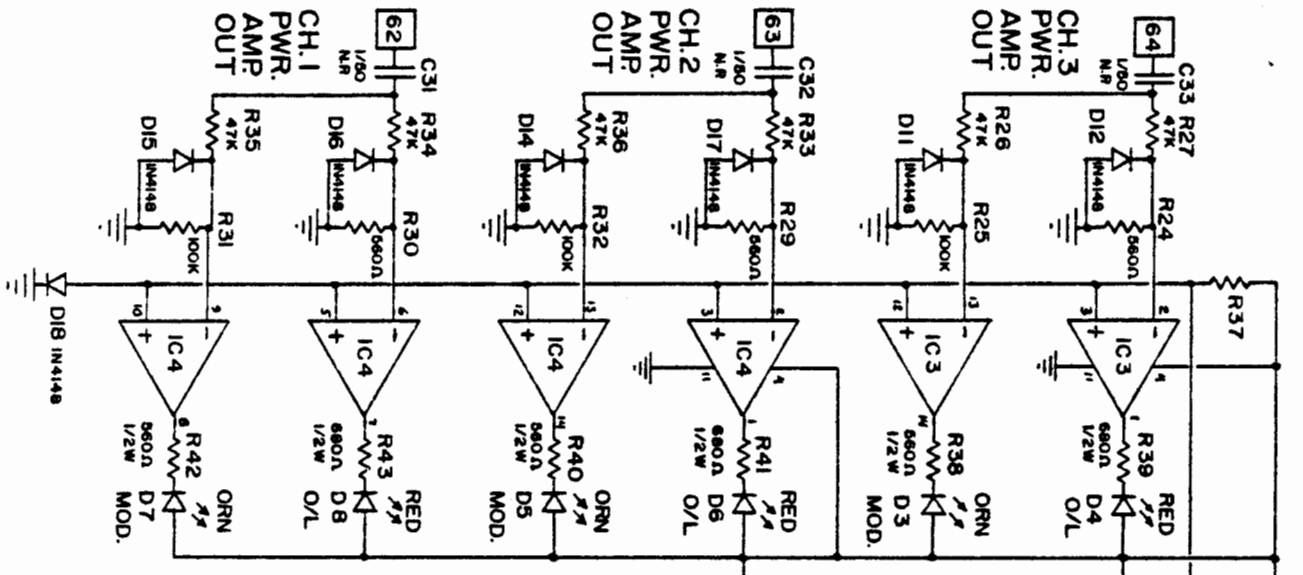
TITLE <b>SPA-3 ANALOG DELAY LINE SCHEMATIC</b>	DRAWING NUMBER <b>9008-7722</b>	REV. <b>B</b>
DATE <b> </b>	DESIGNED BY <b> </b>	CHECKED BY <b> </b>
DRAWN BY <b> </b>	APPROVED BY <b> </b>	PROJECT ENGINEER <b> </b>
DATE <b> </b>	PROJECT ENGINEER <b> </b>	PROJECT ENGINEER <b> </b>

PARTS LIST 8008-7722 P-1 8008-7723 P-1	DIMENSIONS AND TOLERANCES DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE TO CENTER UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE TO CENTER UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE TO CENTER UNLESS OTHERWISE SPECIFIED
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REV	DESCRIPTION	DATE	APPROVED



8. REFER TO PARTS LIST.
4. [X] DESIGNATION NUMBERS FOR PCB FLEX CABLE INTERCONNECT: 9007-7723/7722 CONNECTEDLY
3. IC 3, 4 ARE LM324, IC201, 202, 204 ARE TL074, IC 203, 208 ARE TL072.
2. CAPACITORS MARKED N/R IS NON-POLARIZED ALUMINUM ELECTROLYTIC,  $\mu F/V$
1. ALL RESISTORS 1/4W (OR 1/2W) 5% CARBON FILM, IN OHMS (Ω).

NOTES: UNLESS OTHERWISE SPECIFIED.

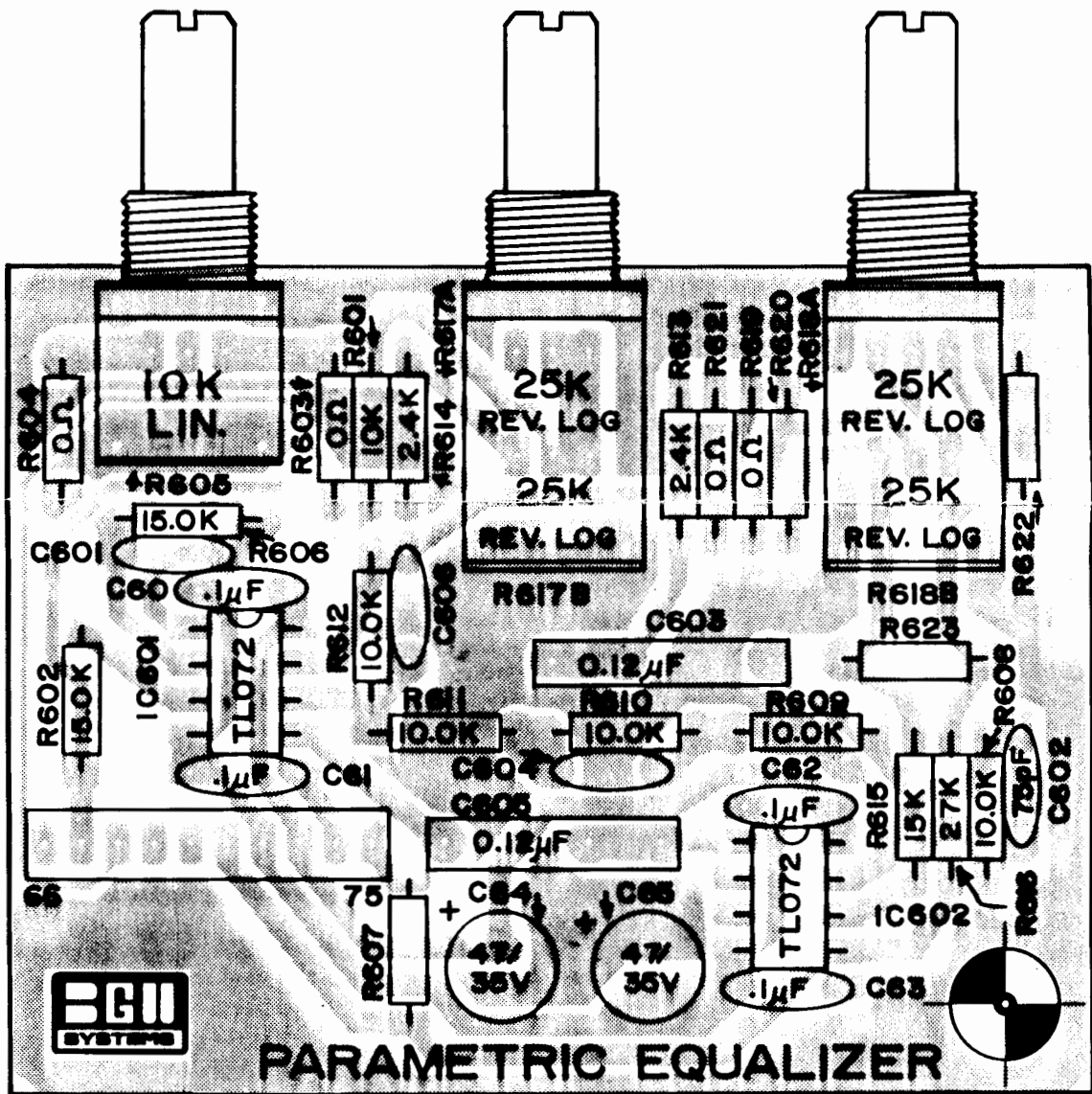
DO NOT SCALE DRAWING


UNLESS OTHERWISE SPECIFIED  
DIMENSIONING AND TOLERANCING  
PER UNAS1 Y14.5

DIMENSIONS ARE IN INCHES  
AND APPLY AFTER PLATING.  
TOLERANCE ON DECIMALS:  
XX = ± .03    .00X = ± .010  
TOLERANCE ON ANGLES = ± 0° 30'  
BREAK SHARP EDGES .010 MAX.  
SURFACE ROUGHNESS 125

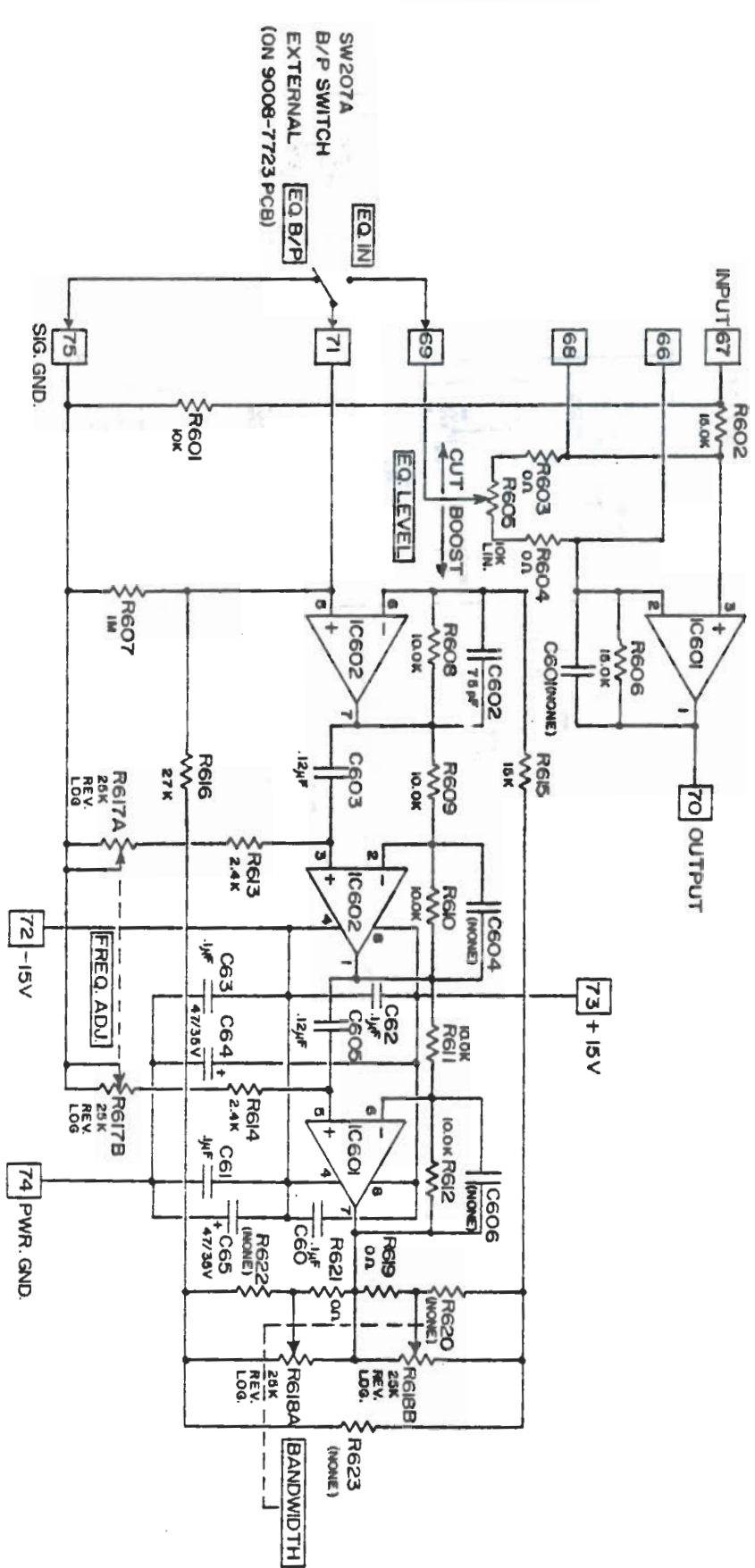
DRAWN	5.00 Sdk/ky	T-1-86	TITLE	SPA-3 CONTROL PANEL PCB SCHEMATIC: UTILITY CKTS.
CHECK	5.00 Sdk/ky	4-20-86	PROJECT ENGR	5.00 Sdk/ky
SCALE	C	9008-7723	DRAWING NUMBER	9008-7723
SHEET	2	OF	4	REV
BGW SYSTEMS 13130 SOUTH YUKON AVE HAWTHORNE, CA 90250 (213) 973-8050		REV B		





<b>TOP SIDE</b>			BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090
DRAWN	<i>S.W. Selberg</i>	8-22-87	<b>TITLE</b> <b>COMPONENT PLACEMENT</b> <b>PARAMETRIC EQ. PCB</b>
CHECK			
PROJECT ENGR	<i>S.W. Selberg</i>	1-8-86	

LT#	DESCRIPTION	DATE	APPROVED



- REFER TO PARTS LIST.
- INPUT/OUTPUT/SUPPLY CONNECTIONS VIA IO-COMD. FLEX CABLE TO 9008-7723 PCB ASSEMBLY, J301
- STANDARD FREQ. RANGE IS 60-800Hz; C603, C605, R613-616 WILL CHANGE FREQ. RANGE.
- CAPACITORS IN uF/WORKING VOLTS
- IC 601, 602 ARE TLO72 BI-FET OP AMPS.
- ALL RESISTORS W/ TWO SIGNIFICANT DIGITS (XX K) ARE 5% UAW CARBON FILM.
- ALL RESISTORS W/ THREE SIGNIFICANT DIGITS (XXX K) ARE 1% UAW METAL FILM.

UNLESS OTHERWISE SPECIFIED  
DIMENSIONING AND TOLERANCING  
PER USASI Y14.5

DRAWN Sw Selby 4/12/85  
CHECK  
PROJECT ENG  
4/16/85

TITLE  
SPA-1, 3 PARAMETRIC  
EQUALIZER SCHEMATIC

SIZE  
C

DRAWING NUMBER  
9008-7726

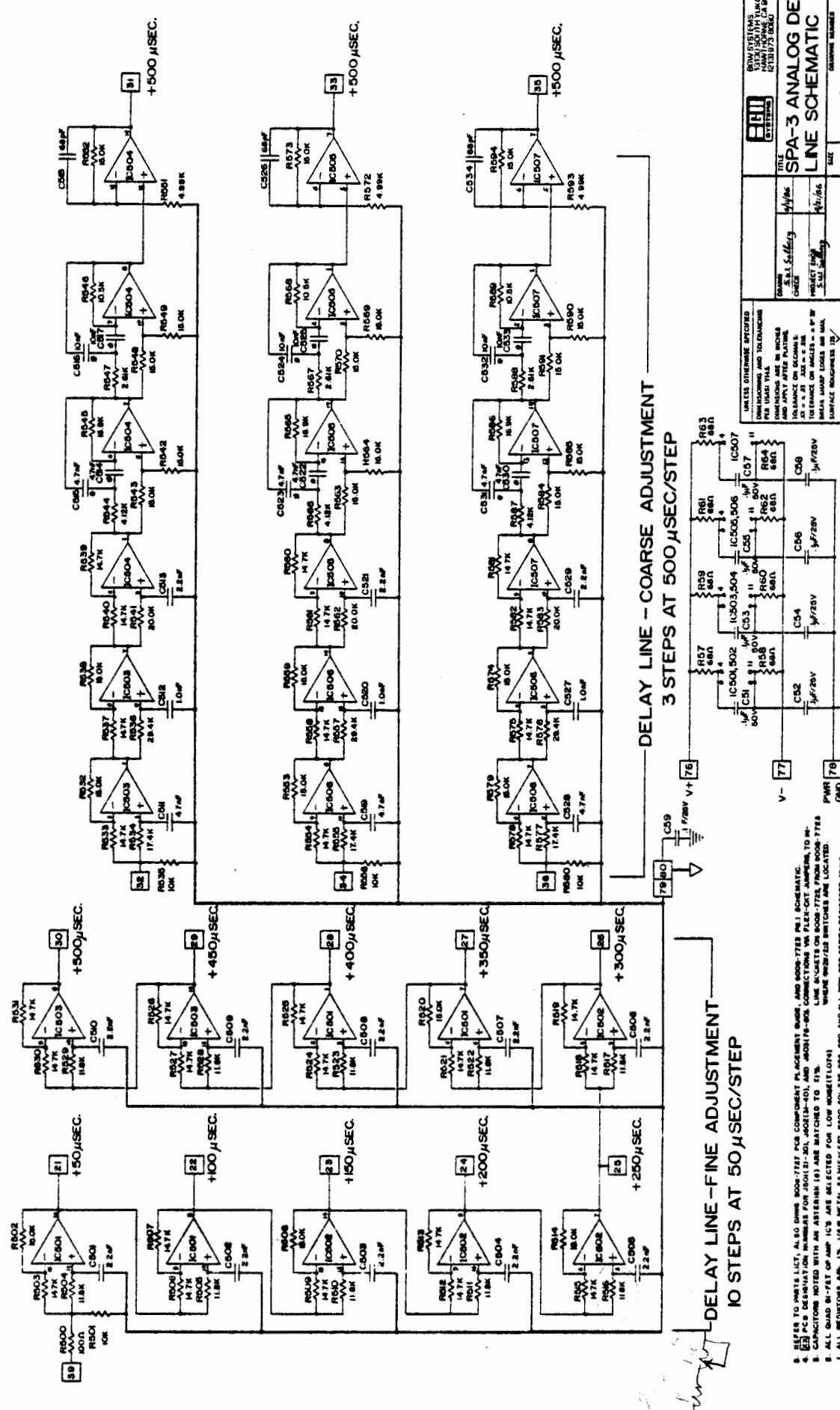
REV  
A

SCALE  
SHEET 1 OF 2

BGM SYSTEMS  
13130 SOUTH YUKON AVE.  
HAWTHORNE CA 90250  
(213) 973-8090

DO NOT SCALE DRAWING

REV	DESCRIPTION	DATE	APPROVED

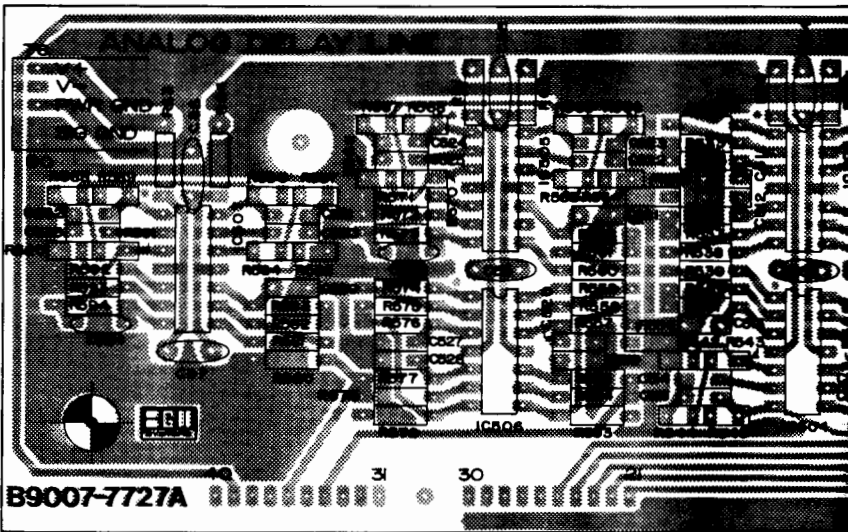
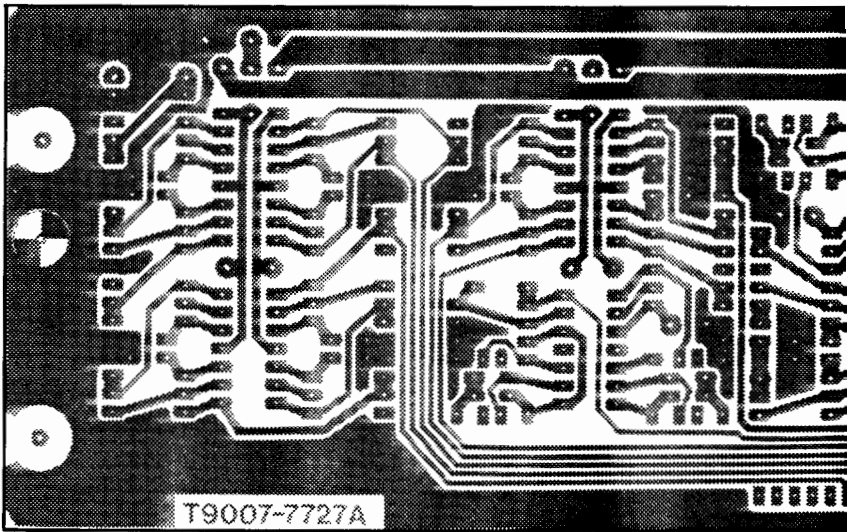


DELAY LINE - FINE ADJUSTMENT  
10 STEPS AT 50 μSEC/STEP

DELAY LINE - COARSE ADJUSTMENT  
3 STEPS AT 500 μSEC/STEP

		TITLE <b>SPA-3 ANALOG DELAY LINE SCHEMATIC</b>	DRAWN S. J. S. / 6/63	CHECKED J. S. / 6/63	PROJECT NO. 9008-7727	REV A
UNLESS OTHERWISE SPECIFIED DIMENSIONS AND TOLERANCES ARE IN INCHES AND APPLY AFTER PLATING TO FINISH OR ANGLE - 45° ± 0.015 ALL SURFACES UNLESS OTHERWISE SPECIFIED SHALL BE MAX. SURFACE FINISH 125		PARTS LIST SEE DRAWING	DATE 6/63	SCALE D	SHEET NUMBER 9008-7727	SHEET 1 OF 1

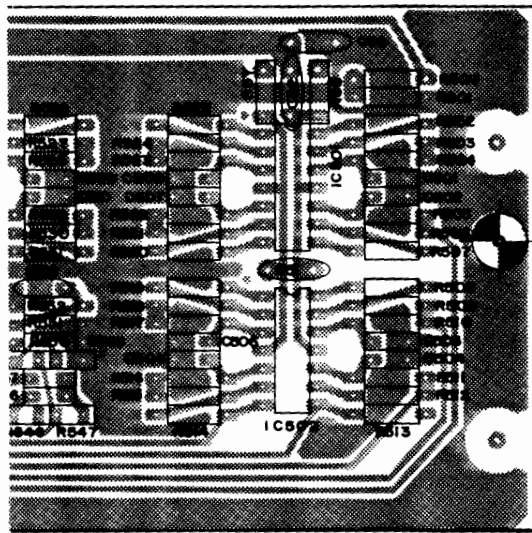
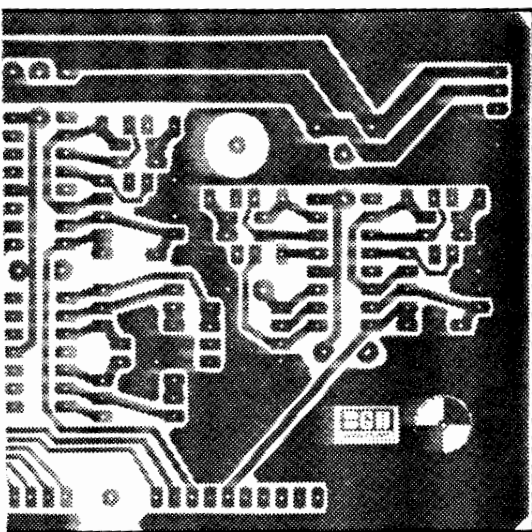
NOTES: UNLESS OTHERWISE SPECIFIED,  
 1. ALL DIMENSIONS ARE IN INCHES.  
 2. ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE SPECIFIED.  
 3. CAPACITORS NOTED WITH AN asterisk (\*) ARE MATCHED TO 1%.  
 4. ALL QUAD IN-PACK IC'S ARE SELECTED FOR LOW COST (1.00).  
 5. ALL RECTIFIERS ARE 1N 14 IN METAL PACKAGE (100, 50, 50A, 50B, 50C, 50D, 50E, 50F, 50G, 50H, 50I, 50J, 50K, 50L, 50M, 50N, 50O, 50P, 50Q, 50R, 50S, 50T, 50U, 50V, 50W, 50X, 50Y, 50Z).  
 6. ALL RESISTORS ARE 1/4 W METAL FILM (1/2 W METAL FILM, 1/4 W CARBON FILM, 1/4 W 5% CARBON FILM).



NOTES: UNLESS OTHERWISE SPECIFIED.




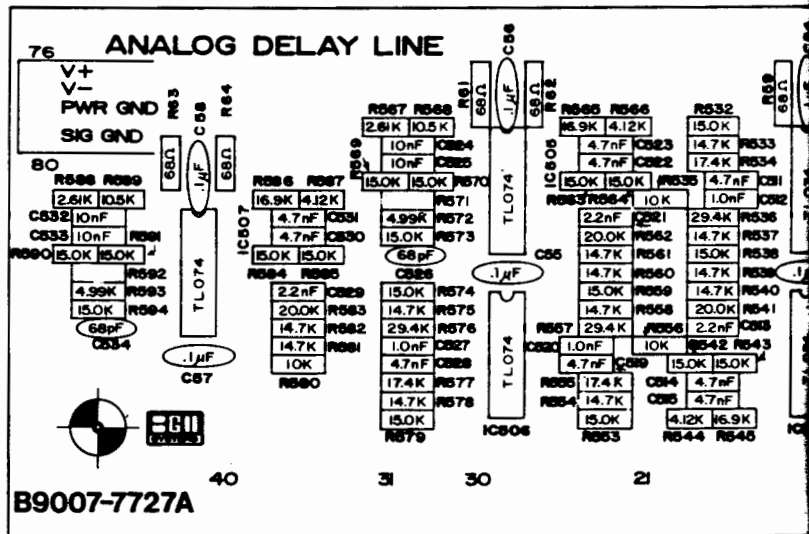
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



UNLESS OTHERWISE SPECIFIED  
 DIMENSIONING AND TOLERANCING PER USAS1 Y14.5.  
 DIMENSIONS ARE IN INCHES AND APPLY AFTER PLATING.  
 TOLERANCE ON DECIMALS:  
 .XX = ± .03    .XXX = ± .010.  
 TOLERANCE ON ANGLES = ± 0° 30'  
 BREAK SHARP EDGES .010 MAX.  
 SURFACE ROUGHNESS 125 ✓

DO NOT SCALE DRAWING

DRAWN <i>S.W. Salberg</i>		9-24-87	 BGW SYSTEMS 13130 SOUTH YUKON AVE HAWTHORNE, CA 90250 (213) 973-8090
CHECK			
PROJECT ENGR <i>S.W. Salberg</i>		4-21-86	TITLE <b>SPA-3 PC BOARD LAYOUT-TOP/BOTTOM</b>
SIZE <b>D</b>	DRAWING NUMBER <b>9007-7727</b>		REV <b>A</b>
SCALE 1:1	SHEET 7 OF 7		

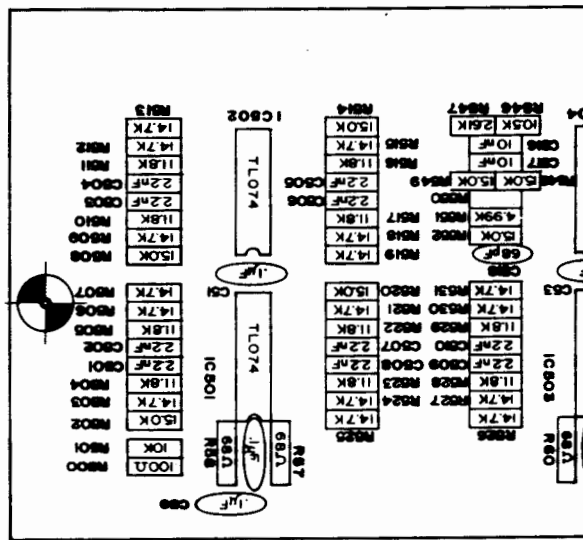


4. CAPACITORS REMAINING IN C500 SERIES ARE 5% WINDOW BATCH-SORTED FROM ± 5% PARTS
3. CAPACITORS C514/15, 516/17, 522/23, 524/25, 530/31, 532/33 ARE 1% MATCHED PAIRS
2. ALL RESISTORS W/TWO SIGNIFICANT DIGITS (XX.Ω) ARE 1/4 W 5% CARBON FILM
1. ALL RESISTORS W/THREE SIGNIFICANT DIGITS (XX.X K) ARE 1% METAL FILM, 1/4W

**NOTES:** UNLESS OTHERWISE SPECIFIED.

DO NOT SCALE DRAWING		SCALE N.T.S.		SHEET 2 OF 2	
UNLESS OTHERWISE SPECIFIED		DIMENSIONS AND TOLERANCING PER USAS Y14.5		DIMENSIONS ARE IN INCHES AND APPLY AFTER PLATING.	
TOLERANCE ON DECIMALS: XX = ± .03 XXX = ± .010		TOLERANCE ON ANGLES = ± 0.3°		BREAK SHARP EDGES .005 MAX	
SURFACE ROUGHNESS 125		DRAWN S.M. Collins		CHECK S.M. Collins	
PROJECT ENG 14-21-86		DATE 14-21-86		TITLE SPA-3 DELAY LINE PCB	
DRAWING NUMBER 9008-7727		SIZE D		DRAWING NUMBER 9008-7727	
REV A		SCALE N.T.S.		SHEET 2 OF 2	

BGW SYSTEMS  
13130 SOUTH YUKON AVE.  
HAWTHORNE, CA 90250  
(213) 973-8090



DATE	REVISION	APPROVED



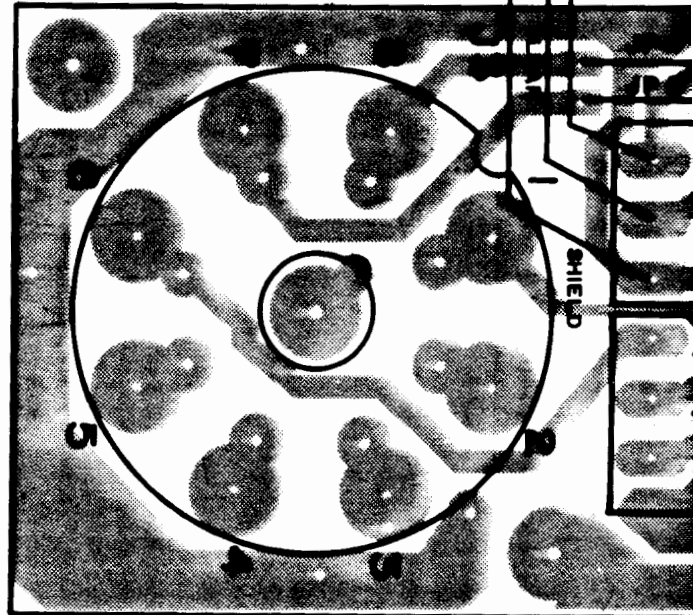
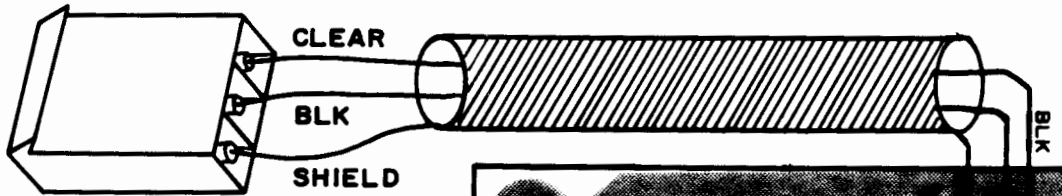
TO J170-A-B-C  
(J1-PIN 3 HOT)

-OR-

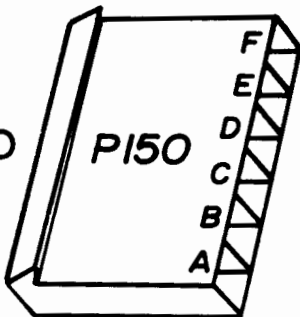
FOR PHASE REVERSE  
TO J170-D-E-F  
(J1-PIN 2 HOT)

PI70

ON 9008-7722B  
I/O PCB ASSEMBLY



↑  
TO J150



EXT. I/O CONNECTOR (WHEN REQ'D.)

	CONNECTIONS	UNLESS OTHERWISE SPECIFIED
JP 1		DIMENSIONING AND TOLERANCING PER USASI Y14.5. DIMENSIONS ARE IN INCHES AND APPLY AFTER PLATING. TOLERANCE ON DECIMALS: .XX = ± .03 .XXX = ± .010. TOLERANCE ON ANGLES = ± 0° 30' BREAK SHARP EDGES .010 MAX. SURFACE ROUGHNESS 125 ✓
JP 2		
JP 3		
JP 4		
PI50-A		
PI50-B		
PI50-C		
PI50-D		
PI50-E		
PI50-F		



DO NOT SCALE DRAWING

(9612-7723)

- 1. REFER TO CHASSIS WIRING SCHEMATIC
- 2. REFER TO PARTS LIST.

UNLESS OTHERWISE SPECIFIED  
 DIMENSIONING AND TOLERANCING  
 PER USAS1 Y14.5.  
 DIMENSIONS ARE IN INCHES  
 AND APPLY AFTER PLATING.  
 TOLERANCE ON DECIMALS:  
 .XX = ± .03 .XXX = ± .010.  
 TOLERANCE ON ANGLES = ± 0° 30'  
 BREAK SHARP EDGES .010 MAX.  
 SURFACE ROUGHNESS 125



TOP

DRAWN

S.W. Se

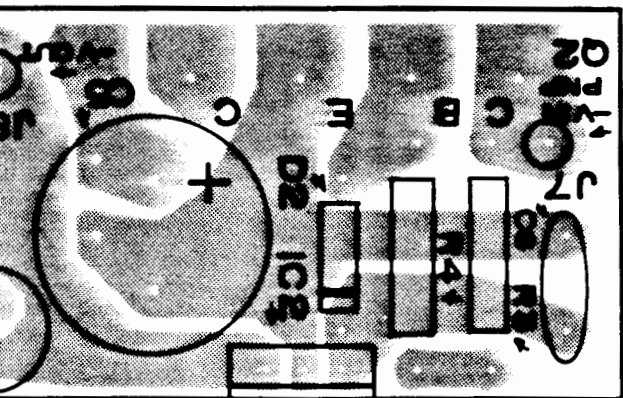
CHECK

PROJECT ENGR

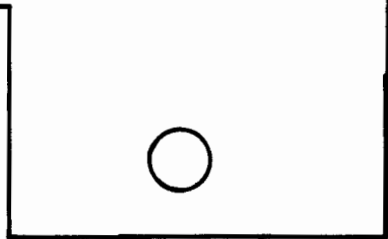
S.W. Se

PART OF I

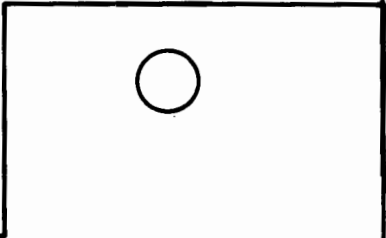
HEATSINK



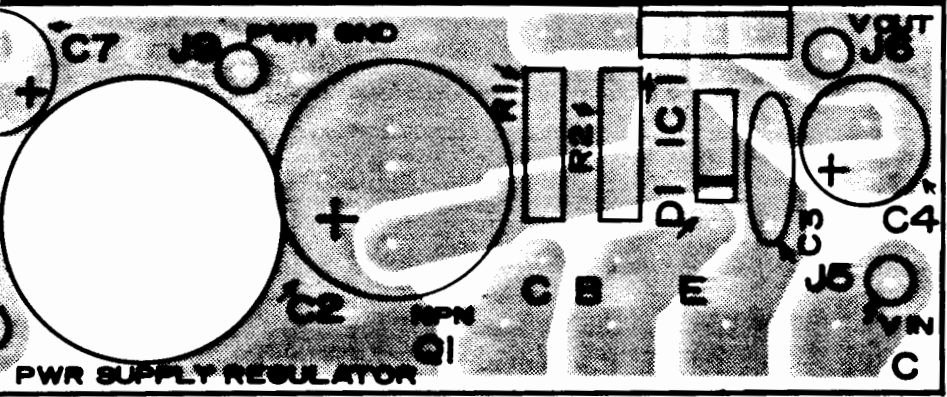
REGULA








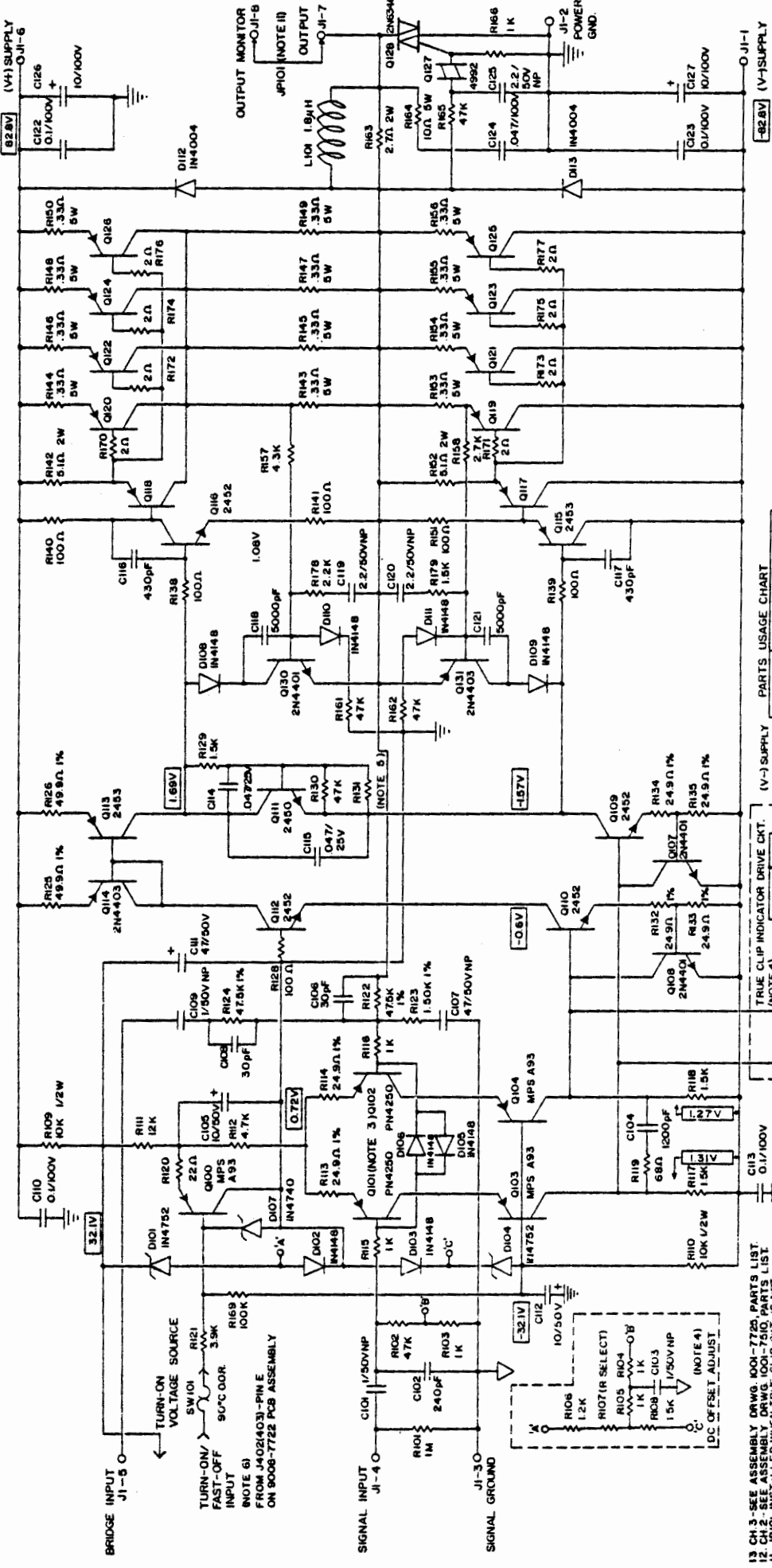
OR HEATSINK



<b>SIDE</b>				BGW SYSTEMS 13130 SOUTH YUKON AVE. HAWTHORNE, CA 90250 (213) 973-8090	
<i>Uberg</i>	8-22-87	TITLE <b>COMPONENT PLACEMENT          SPA-1,3 REGULATOR PCB</b>			
<i>19</i>	1/7/86				
001-7725		SIZE	DRAWING NUMBER		REV
			<b>9008-7725</b>		<b>A</b>
<b>ASSEMBLY</b>		SCALE 2:1	SHEET / OF /		







**PARTS USAGE CHART**

LAST USED	UNUSED
R 1179	R104, 105, 106, 107, 108, 127, 136, 137, 149, 150, 156, 159, 160, 167, 168, 176, 177
C 1127	C103
D 1113	D105, 106, 125, 126, 129
Q 1131	

**CHANEL 2(3)**

UNLESS OTHERWISE SPECIFIED DIMENSIONS AND TOLERANCES PER LOCAL TYPICAL PRACTICES APPLY AFTER PLATING. TOLERANCE ON DECIMAL INCHES ON ANGLES ± 0.0075. SURFACE FINISH AS PER SURFACE FINISH SPECIFICATION.

**POWER AMPLIFIER**

**SCHEMATIC MODEL SPA-3**

DATE: 9008-7510

SCALE: D

REV: A

BY: \_\_\_\_\_

CHKD: \_\_\_\_\_

APP'D: \_\_\_\_\_

DATE: \_\_\_\_\_

13 CH 3-SEE ASSEMBLY DRWG. 1001-7725 PARTS LIST  
 12 CH 2-SEE ASSEMBLY DRWG. 1001-7410 PARTS LIST  
 11 JPI01 INSTALLED WHEN TRUE CLIP CKT. IS NOT.  
 10 SIG GND AND PWR. GND. CONNECT AT OUTPUT GND. TERMINAL.  
 9 Q109-113, 115-126, 128 AND SWICHS ARE MOUNTED ON HEAT SINK.  
 8 X.XX VDC VOLTS TO GND. NO SIG. USING 3-1/2 DIGIT DMM (READINGS TYPICAL).  
 7 PWR XSTR'S Q117-126 ARE 258706 (Q125, 126 NOT USED IN MODEL 7500).  
 6 MODEL 7500 USES ON-BOARD VOLTAGE SOURCE FOR TURN-ON/FAST-OFF.  
 5 R131 IS FACTORY SELECTED TO YIELD 400mV ACROSS RA2, RI52 (1.10mV) NO LOAD.  
 4 DC OFFSET CKT. AND TRUE CLIP CKT. NOT STUFFED FOR MODEL 7500.  
 3 Q104/Q2 ARE BETA-MATCHED TO WITHIN ± 2.5%. WITH RESULTANT DC OFFSET = ± 15mV OUT.  
 2 Q106 IS A CARBON FILM, 1/4W, 5% NON-POLAR.  
 1 ALL RESISTORS 1/4W, 5% CARBON FILM, IN CHINA.  
 NOTES: UNLESS OTHERWISE SPECIFIED.