dbx

903

Instruction Manual

903

NOTE: 903's Serial number 2000 and lower do not have the "CV Input" feature mentioned on Page 8 and shown in Figures 2.4.2, 2.4.3, 2.4.5, 5.2 and 5.3.3. On these earlier p.c. cards, there is no "Y-3" jumper, and the CV Input (p.c. finger 9) is connected to ground.

1.0 INTRODUCTION

1.1 PRODUCT DESCRIPTION

The dbx Model 903 Compressor/Limiter is designed for use in a 900 Series mainframe or in custom installations. The 903's unique features make it possible to achieve even large amounts of compression without undesirable side effects. The 903's features include:

Over Easy® Threshold - Typically in a conventional compressor/limiter, normal program dynamics are heard until the input level rises above a pre-set threshold--at which point the gain suddenly begins to be reduced by a fixed ratio. Depending upon the nature of the program material, the listener will be aware of undesirable side effects; there will be a feeling of "holding back". In the Model 903, the Over Easy compression characteristic provides a gradual increase in the ratio of gain reduction as the input signal approaches and exceeds the pre-set threshold. There is no sudden alteration of dynamics. The compressed program sounds natural--even with relatively large amounts of gain reduction.

Infinity +™ (Negative) Compression - At a compression ratio of ∞:1, the 903 acts as an RMS-based absolute limiter and holds program material at or below a fixed output level. At settings beyond ∞:1, the 903 actually reduces the output signal whenever the input level exceeds the threshold setting. With Infinity + compression an apparent dynamic inversion can be achieved, making the 903 capable of producing unusual special effects with percussive signal envelopes.

RMS-Level Detection - A compressor's level-detection circuitry determines how the compressor will interpret input-signal level. dbx uses patented, true-RMS detection because it provides superior sonic performance to other detection schemes. Most compressor/limiters use some form of peak detection. Peak detection responds to complex audio waveforms in an unmusical manner, producing an inappropriate variation in output level from the compressor/limiter. This variation in output level is affected by the crest factor of the program material being processed and is especially objectionable when spurious transients are present in the signal. RMS detection, as used in the 903, interprets the level of a signal as the human ear does. This permits compression and limiting which is audibly superior.

External Detector Input - To trigger the compressor by signals other than the audio input, access to the detector is provided. Use of the detector input allows the 903 to perform a variety of frequency- and time-based special effects.

Other features of the 903 include:

Continuously Variable Compression Ratio
Continuously Variable Threshold Select
LED Metering
Hard-wire Bypassing

The 900 Series is a modular signal-processing system, which eliminates redundant packaging and saves rack space. Up to 8 modules plug into a 900 Series mainframe in seconds. For the recording studio, broadcast station or on the road, the right combination of processors can be set up or interchanged quickly and easily.

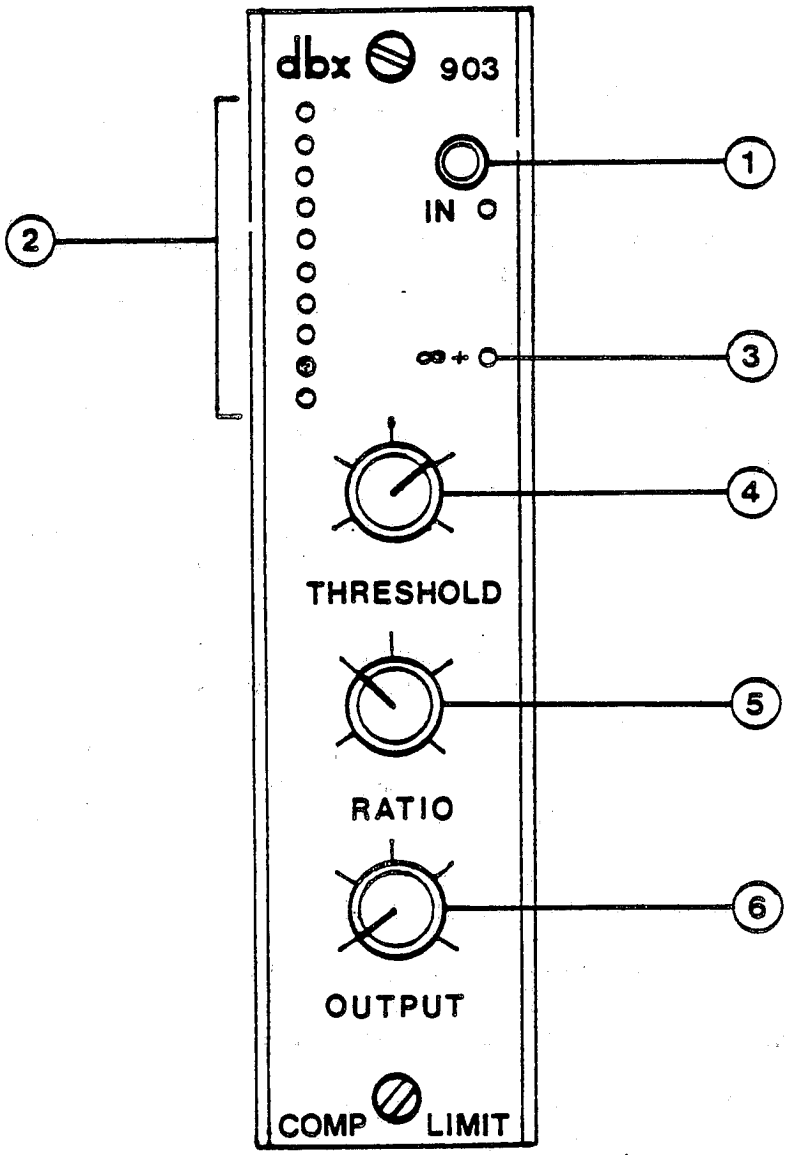


Figure 1.2

1.2 FRONT PANEL

1) IN/OUT - This button allows the user to hard-wire bypass the 903 for before/after comparisons. Controls and indicators continue to function in the bypass mode.

2) GAIN REDUCTION - The LEDs indicate the amount of compression in dB.

3) ∞+ - The ∞+ LED comes on when the RATIO control setting equals or exceeds ∞:1.

4) THRESHOLD - This control adjusts the sensitivity of the 903, allowing the user to place the compression knee at any signal level between -40 dBm (7.75mV) and +20 dBm (7.75V).

5) RATIO - This control varies the amount of compression from 1:1 (no compression) through increasing ratios until ∞:1 (infinite compression) is reached. On the 903, this control can be turned past ∞:1, going into negative-compression ratios which produce inverted dynamics and a sense of "punch" as the ratio approaches -1:1.

6) OUTPUT - The output gain is controllable from -20 dB to +20 dB, allowing the output level of the 903 to be increased or decreased as necessary.

1.3 SPECIFICATIONS

Input Impedance: Balanced=25K Ohms / Unbalanced=18.5K Ohms
Output Impedance: 22 Ohms, designed to drive 600 Ohms or greater
Maximum Input Level: +24 dBm
Maximum Output Level: +24 dBm into 600 Ohms or greater
Frequency Response: 20Hz-20kHz (+1, -1 dB)
Distortion: 2nd Harmonic .05%, 3rd Harmonic .2% typical at ∞ compression, 1kHz, 0 dBm
Equivalent Input Noise: -88 dBm
Attack Rate: Program-Dependent — 15ms for 10 dB above threshold, 5ms for 20 dB above threshold to achieve 63% gain reduction measured in ∞ compression region of Over Easy curve
Release Rate: 120 dB/sec
Threshold: Variable -40 dBm to +20 dBm (7.75 mV to 7.75V)
Compression Ratio: Variable (1:1)-(∞:1)-(-1:1)
Output Gain: Variable -20 dB to +20 dB
Detector Input Impedance: Balance=250K Ohms / Unbalanced=185K Ohms
Controls: Threshold, Ratio, Output
Switches: In/Out
Indicators: In/Out, ∞+
Metering: LED Column - 1, 2, 4, 6, 8, 10, 15, 20, 30, 40dB gain reduction
Power Requirements: ±15V (+0mV, -5mV) Regulated 60mA
±24V (±1.0V) Unregulated (1% ripple) 30mA

Manufactured under one or more of the following U.S. patents: 3,681,618; 3,714,462; 3,789,143; 4,101,849; 4,097,767. Other patents pending.

2.0 INSPECTION AND INSTALLATION

2.1 UNPACKING

The carton should contain:
1 - 903 Compressor/Limiter
1 - Warranty Card
1 - Operator's Manual

The Model 903 was carefully inspected, tested and burned in at the factory. Contact your dealer in the event of problems. We suggest saving the shipping carton and packing materials for safely transporting the unit in the future.

2.2 MOUNTING

The 903 can be mounted in a 900 Series mainframe where it simply slides into a module bay. The thumb-screws on the 903's front panel secure the module to the mainframe. For custom installations, mount the 903 with these same screws (6/32 thread).

2.3 PRECAUTIONS

When locating any electronic equipment near a heat source (such as a power amplifier), provide adequate clearance for ventilation. Excessive heat shortens the life of electronic components. Avoid high humidity and water.

Mounting electronic equipment and connecting cables as far as possible from motors and large power transformers lessens the possibility of picking up the 50 or 60 Hz hum.

2.4 CONNECTION

2.4.1 AUDIO INPUT (A+, A-)

Terminating resistors are not needed for the 903's audio input to provide proper operation but may be required if the input is fed from devices (such as passive equalizers) designed for a specified load impedance. The 903 has an actual input impedance of 25k Ohms in balanced configuration or 18.5k Ohms if unbalanced. This makes the 903 audio input suitable for use with virtually any nominal source impedance, low or high.

Balanced lines — Connect the signal leads to the A+ and A- (p.c. fingers 12 and 13; see Figure 2.4.2) terminals of the 900 Series mainframe. If a hum develops, try attaching the shield to the ground (⏚) connection at the 903 input.

Unbalanced lines — Wire the hot lead to the A+ terminal and the shield to the A- terminal. If a hum develops, try connecting a jumper between the A- terminal and the 903's input ground.

Reversing the input wires to the A+ and A- terminals will result in the output signal from the 903 being 180° out of phase with the input signal.

2.4.1 AUDIO INPUT (A+, A-) (cont.)

For maximum hum rejection, avoid common grounding at the 903's input and output. The best starting point is to ground the shield of the input cable at the source device (leaving it unconnected to the 903) and to ground the shield of the output cable to the ground terminal of the 903 (leaving it unconnected at the receiving device).

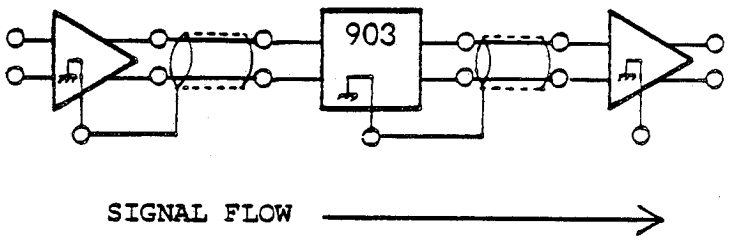
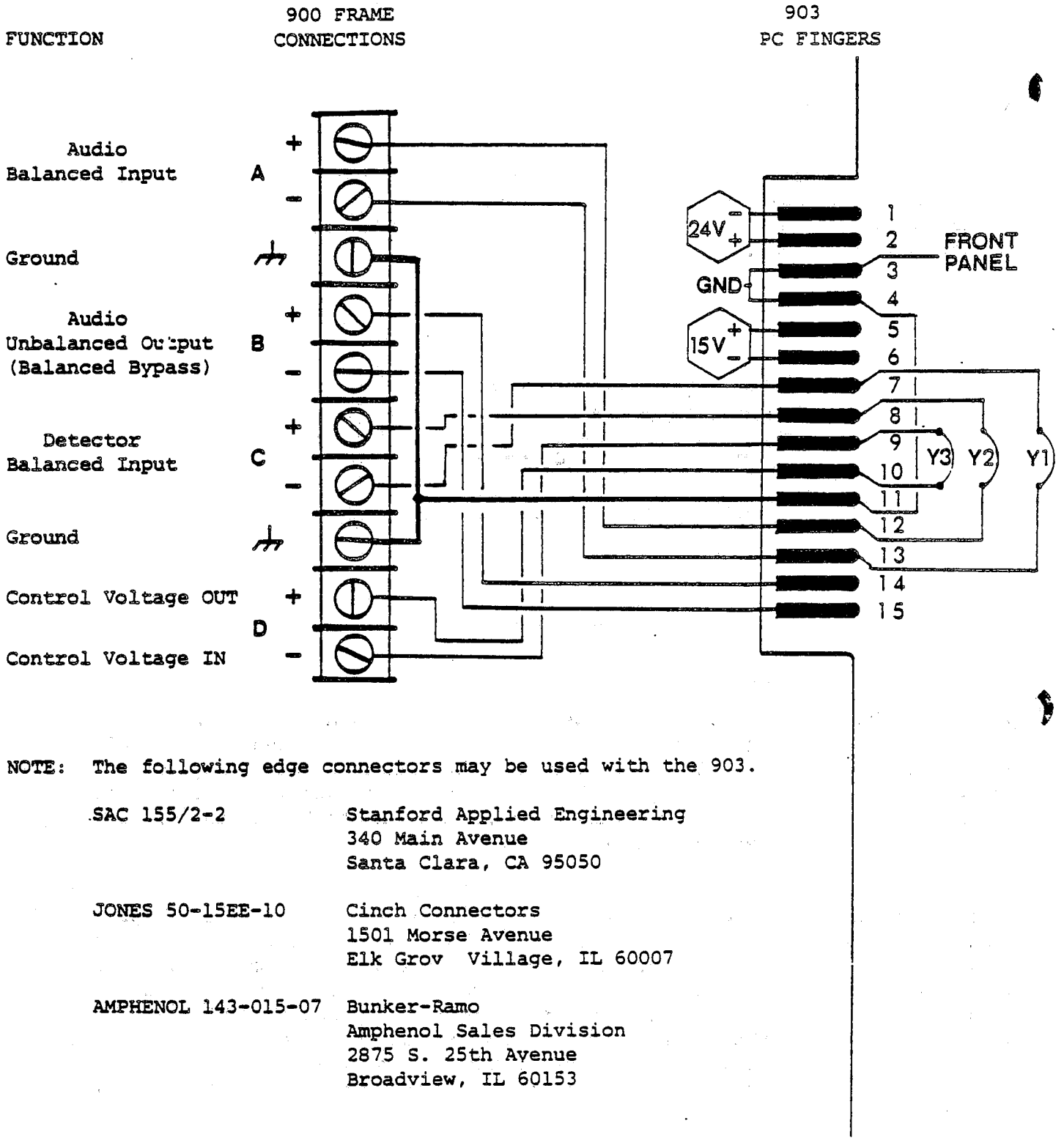


Figure 2.4.1

2.4.2 AUDIO OUTPUT (B+, B-)

The output of the 903 is designed to feed balanced or unbalanced loads of 600 Ohms or greater. The output stage is single-ended; in normal operation, the B- (p.c. finger 15) terminal is connected internally to (p.c. finger 11). When the system bypass switch is engaged, the signal inputs are directly connected to the signal outputs (i.e. A+ to B+, A- to B-) and the internal jumber between B- and ⏚ is removed.

NOTE: The IN/OUT switch on the 903 makes no noise in the signal path when it is switched. Switching back and forth between processed and unprocessed signal may reveal a level difference, depending upon the degree to which the program is being compressed and the setting of the OUTPUT control. If a pop or click is heard when the IN/OUT switch is activated, there is probably a grounding problem in the signal-processing system. Compare the grounding of the signal shields to and from the 903 with the suggestions in 2.4.1 above. If the problem persists, try connecting a jumper wire between B- and ⏚. This should cure the popping sound, but the signal will now be unbalanced in the OUT, or bypass, mode and hum may increase.



NOTE: The following edge connectors may be used with the 903.

SAC 155/2-2	Stanford Applied Engineering 340 Main Avenue Santa Clara, CA 95050
JONES 50-15EE-10	Cinch Connectors 1501 Morse Avenue Elk Grov Village, IL 60007
AMPHENOL 143-015-07	Bunker-Ramo Amphenol Sales Division 2875 S. 25th Avenue Broadview, IL 60153

Figure 2.4.2

2.4.3 DETECTOR INPUT (C+, C-)

The 903 detector input has an actual impedance of 250k Ohms in balanced or 185k Ohms if unbalanced. This very high impedance means the level detector will bridge virtually any nominal source impedance. It also means that the detector input has a negligible effect on the audio input impedance as seen by the source device when the inputs are tied together (the 903 leaves the factory with the detector and audio inputs jumpered together on the p.c. card). Due to the high input impedance, cables from an external source to the detector input should be kept as short as is practical so as to reduce susceptibility to EMI or RFI.

To trigger the compressor by signals other than the audio input, remove (desolder or clip) jumpers Y1 and Y2 from the p.c. card. Once the jumpers have been removed, the detector inputs C+ and C- (p.c. fingers 8 and 7) must be used. If normal compressor operation is desired, the detector and audio inputs must be wired together externally or jumpers Y1 and Y2 must be replaced. By wiring Tip/Ring/Sleeve phone jacks as shown in Figure 2.4.3, quick connections can be made to the detector input when desired, while allowing normal operation of the 903 when no plug is inserted in the "Detector Input" phone jack.

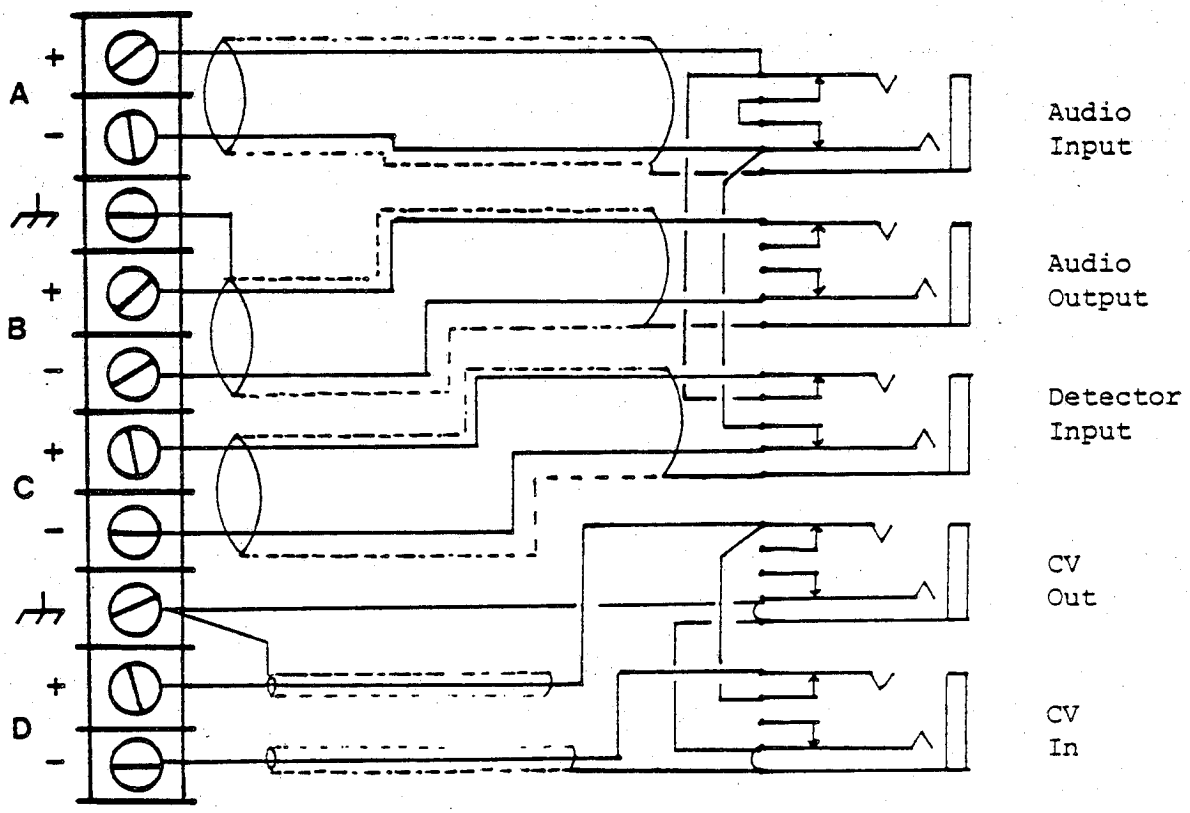


Figure 2.4.3

2.4.4 CONTROL-VOLTAGE INPUT (D-)

The CV input and output connections come from the factory jumpered together for normal compressor operation. To use the CV input, this jumper (Y3) must be removed. Figure 2.4.3 illustrates a way of setting up the external wiring to the 903 so that the CV input can be accessed when necessary without preventing easy normal use of the unit.

The CV input provides direct access to the control port of the Blackmer VCA used in the 903 for gain control. This provides the user with a variety of DC-control options, including using the 903 as an automatable level control or grouping two or more 903's in a Master/Slave configuration (Section 2.4.6).

The control characteristic of the VCA is a convenient -50mV/dB (-20dB/V). The Blackmer VCA provides linear-gain tracking in decibels over a range from -100 to +40 dB with 1% accuracy (max. 1dB deviation per 100 dB gain change). An input of 0V produces 0 dB gain through the VCA. The input impedance of the control port is 650 Ohms and should be driven by an opamp or other low-impedance source. A bypass capacitor may be required between the CV input (P.C. finger 9) and ground to prevent the audio signal from bleeding into this control port and causing modulation distortion.

2.4.5 CONTROL-VOLTAGE OUTPUT (D+)

The control-voltage output is a DC voltage which changes in proportion to the amount of gain change being produced by the 903. The relationship between this voltage and the amount of gain change can be expressed as CV = -50mV/dB gain change. The CV output (p.c. finger 10) is low-impedance and capable of driving bridging loads of more than 10k Ohms and less than .01 µf without affecting the operation of the 903.

2.4.6 MASTER/SLAVE GROUPING

By using the detector inputs and the CV inputs and outputs, two (or more) 903's can be grouped together in a Master/Slave configuration. The modification required is easily reversible and may be left in place without imparing easy access to normal 903 operation.

Parts Required: (2) 10k Ohm, 5%, ¼Watt Carbon Film resistors per 903. (If your 903 already has 10k Ohm resistors in place of Y1 and Y2, no parts are required).

Procedure:
1) Replace Y1 and Y2 on each 903 p.c. card with a 10k Ohm resistor (this will require soldering).
2) Remove the Y3 jumper from each 903 p.c. card (this will require soldering or cutting).

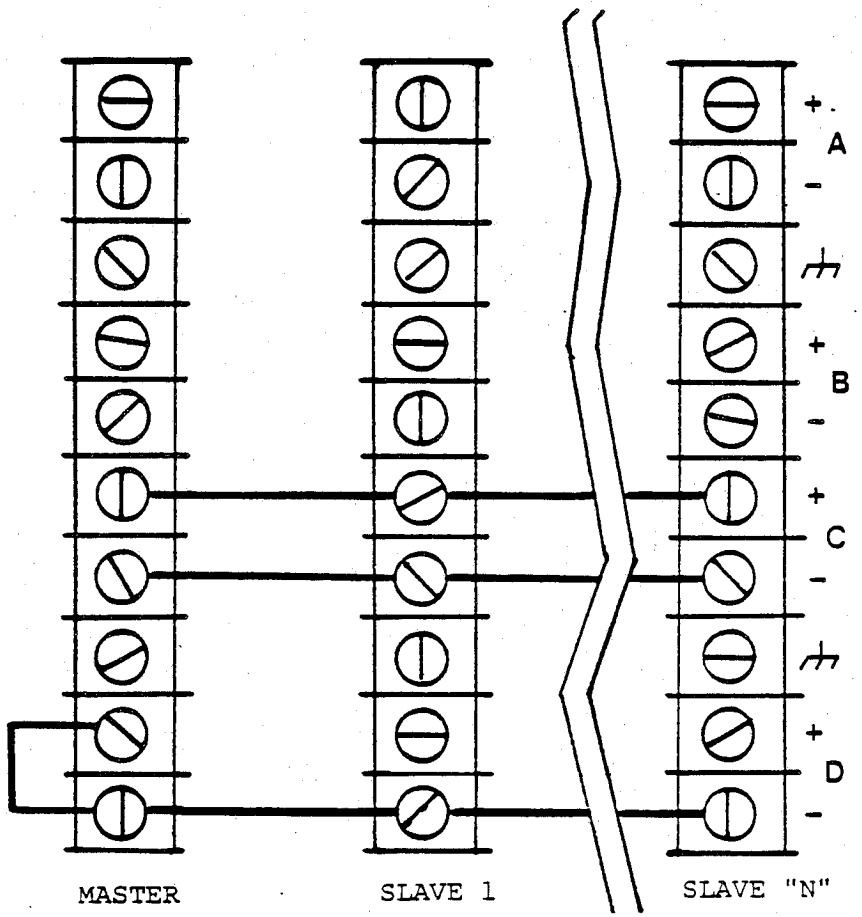
2.4.6 MASTER/SLAVE GROUPING (cont.)

The following steps are most easily accomplished if the 903's are in adjacent module bays of a 900 Series frame (see Figure 2.4.5). If you are using some other packaging system, modify the instructions appropriately.

3) Connect the C+ terminals together
4) Connect the C- terminals together
5) Connect the D- terminals together
6) On the Master only, connect the D+ terminal to the D- terminal.

The master 903 will now respond to the combined inputs of the 903's. The master's controls will adjust the amount and nature of the compression and the slave(s) will track accurately. The threshold calibration will be accurate for the sum of the input voltages divided by the number of 903's being grouped (i.e., for two 903's, a setting of -20dBm will produce a threshold action when the sum of the input voltages is -14 dBm—the equivalent to having -20 dBm at both inputs). The LED display on the MASTER module will accurately indicate the amount of gain reduction taking place in each of the modules.

To return the 903's to normal operation, the connections between them must be removed, and the CV input-to-output jumpers (D+ and D-) must be replaced on the slave(s).



NOTE: In MASTER/SLAVE mode, the control settings of the slave modules will not have any effect on the gain reduction taking place. The LED displays of the slave modules should be ignored.

Figure 2.4.5

3.0 OPERATION

3.1 THRESHOLD

The THRESHOLD control sets the level at which the 903 begins to compress the signal it is processing. The control has a wide range (-40 dBm to +20 dBm) so the desired compressor operation can be obtained with any normally encountered input level. At low compression ratios, a very low threshold setting can be used to gently reduce the overall dynamic range of the program. Higher compression ratios coupled with low threshold settings will provide levelling for instruments and vocals. High threshold settings are generally used for limiting program levels. Compression of the whole program (caused by low threshold settings) tends to sound less natural at RATIO settings of 10:1 or greater.

The dbx Over Easy compression curve utilizes a "soft knee" at the threshold of compression (see Figure 3.2.1). The 903 gradually increases the compression ratio from 1:1 toward the selected RATIO as the input signal rises through the threshold region. Since Over Easy compression has no distinct point at which the gain changes, the threshold is defined differently from conventional compression systems. We define the threshold as the point approximately midway between fixed gain and the point at which the curve "levels off" to the selected compression ratio. At an ∞:1 setting, the maximum permissible output level is 5 dB above the threshold (with the OUTPUT gain set a "0").

3.2 RATIO

The compression ratio setting determines the number of dB by which the input level must exceed the THRESHOLD setting to raise the output signal by 1 dB. A setting of 2 indicates a ratio of 2:1 and means that a 2 dB increase in the input level above the THRESHOLD setting will produce a 1 dB increase in the output level. A setting of ∞ indicates that the input signal would have to increase to an infinitely high value to produce a 1 dB increase in the output level. The 903's RATIO control covers a range from 1:1 to ∞:1 and, in addition, goes to Infinity + (negative) compression ratios. It utilizes a specially designed potentiometer which stretches the control range to provide easy adjustment within the subtle lower ratios (Figure 3.2).

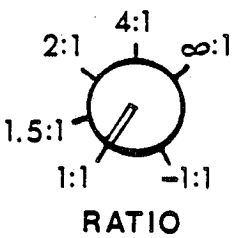


Figure 3.2

3.2 RATIO (cont.)

High compression ratios (6:1 and greater), coupled with low threshold settings, significantly reduce a program's dynamic range and prevent output signals from substantially exceeding the threshold setting. (This presumes the output gain control to be a "0". Regardless of the compression ratio or threshold setting, the output gain control can be used to increase or decrease the output level as necessary.) Low compression ratios (4:1 and lower) affect a program's dynamic range to a lesser degree. These settings are used, for example, to tighten up the sound of a bass guitar, snare drum or vocals. Moderate overall compression is typically used during stereo mixdowns and for levelling program audio in broadcast applications.

NOTE: Whenever threshold-level and compression-ratio settings are made, it is important to watch the LEDs for an indication of the amount of processing taking place. A compressor/limiter is a tool that can provide desirable effects when used properly. When used to excess, the results can sound unusual and may be of value only for special effects.

3.2.1 NEGATIVE COMPRESSION RATIOS

When the RATIO control is rotated clockwise past the ∞ position, the 903 begins to function in a negative-compression mode. At the extreme clockwise rotation of the RATIO control, a -1:1 OUTPUT:INPUT ratio is achieved. At this setting, the 903 reduces the output level by 1 dB for every 1 dB that the input signal increases above the THRESHOLD setting. The signal being processed will seem to "swallow" its attack transients. The output from the 903 will rise in level with the input until the input begins to approach the THRESHOLD setting, at which point the output level will begin to decrease with further increase in input level. By using a relatively low threshold setting, the dynamics of some instruments can be effectively inverted, producing a "tape played backward" effect.

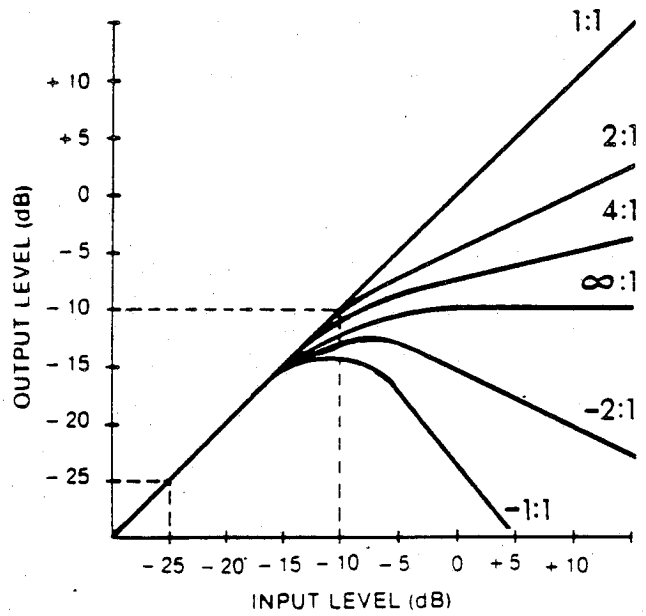


Figure 3.2.1

3.3 OUTPUT

This control adjusts the amount of gain in the 903's output-amplifier stage and does not affect the compression of the signal. The signal can be adjusted ±20 dB relative to the "0" center setting (unity gain) to make up for reductions in signal level caused by compression. At high gain settings, it is possible to cause clipping of the 903's output stage, even with the input level at less than +24 dBv.

4.0 TYPICAL APPLICATIONS

4.1 SMOOTHING OUT VARIATIONS IN MICROPHONE LEVEL

When the distance between a vocalist and a microphone changes, variations in signal level occur. Start with the 903 adjusted for low compression (around 2:1) to smooth out these variations.

4.2 SMOOTHING OUT VARIATIONS IN MUSICAL INSTRUMENT LEVEL

To achieve a smoother electric-bass sound, compress the instrument's output with a ratio of about 4:1. Compression lessens the loudness variations among the strings and increases the sustain. Other instruments, such as horns, vary in loudness depending on the note being played, and benefit similarly.

4.3 RAISING A SIGNAL OUT OF A MIX

Since reducing dynamic range increases the <u>average</u> signal level and meter readings by a small amount, a single track can be raised out of a mix by boosting its level slightly and applying compression. It is also possible to separate certain vocals or instruments from a mono program already mixed by following the procedure in Section 4.6.1.

4.4 PREVENTING TAPE SATURATION

With programs of widely varying levels, compression can prevent recording levels from saturating tape tracks (see also Section 4.6.1).

4.5 SPEAKER PROTECTION

Compressors are frequently used to prevent excessive program levels from damaging drivers in a sound-reinforcement system. Limiting also benefits intelligibility by allowing low-level input signals to be reproduced through the system at higher volume. In a musical performance, this provides additional intimacy as the vocalist's whispers are heard clearly at each seat in the house. The Over Easy curve utilized by the 903 permits a very high amount of compression (10:1 or greater) to be used in many situations. Vocalists and musicians don't get the sense of being choked back, but high average levels can be maintained without speaker damage due to excessive heat buildup. As a general rule, the compressors should be <u>as close to the amplifiers as possible</u> in the signal chain. If the 903 is placed before the EQ, for example, a potentially damaging boost in EQ won't be seen by the 903 and the speakers may be damaged. (See Section 4.6.2). For maximum sound-pressure levels, large sound-reinforcement systems frequently use a separate compressor on each output of the electronic crossover(s).

4.6 SIDE-CHAIN APPLICATIONS

4.6.1 FREQUENCY-WEIGHTED COMPRESSION

It is possible to separate certain vocals and instruments from a mix by frequency-weighted compression. With an equalizer inserted ahead of the detector input (but not in the audio path), the equalization settings do not shift the timbre or frequency response of the audio signal. They merely alter the threshold response of the compressor on a "frequency-weighted" basis (see Figure 4.6.1). With this arrangement, raising certain frequencies on the equalizer causes them to be suppressed in the audio signal. A relatively high threshold setting can allow normal sounds to be unaffected while solo and very loud sounds are held back. (Of course, when compression does occur, the level of the entire program is affected.) Depending on the threshold setting, lower-level fundamentals or harmonics will not cause compression, and the program is not subject to the phase shift normally caused by program equalization.

During the recording of cymbals and tom-toms, a compressor with an equalizer in the detector path can help prevent tape saturation. The equalizer can be adjusted for boost with a peak of about 5 kHz, causing the cymbal to be compressed on a very loud crash, stopping tape saturation at high frequencies, where there is less headroom. However, gentle tapping of a drumstick or brushing of the cymbal will not be held back. Assuming the tom-tom is a lower-frequency instrument and can be better-tolerated by the tape, it has less need for compression. The equalization in the detector circuit means that the compressor is not triggered as readily by a loud tom-tom beat as by an equally loud cymbal crash.

The converse of the above EQ technique may be used: dipping the equalizer bands causes any sound with dominant energy in the affected register to pull the level up because the 903 will detect a need for less compression.

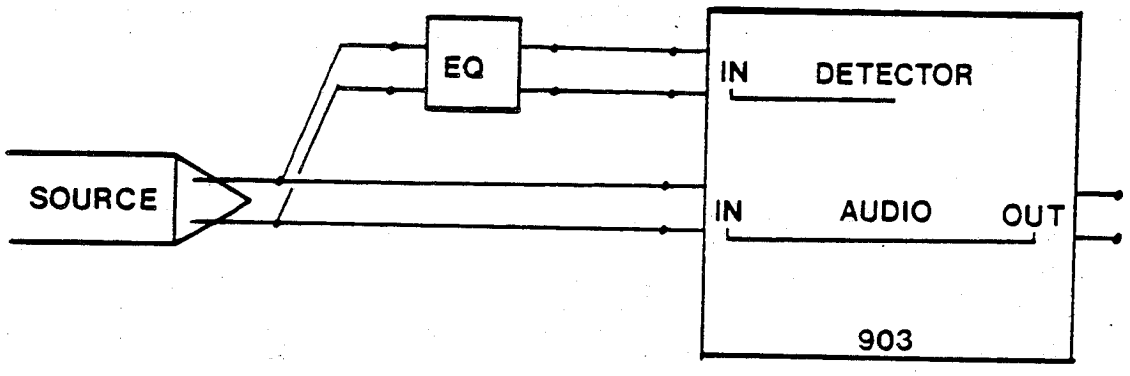


Figure 4.6.1

4.6.2 MULTI-WAY SPEAKER SYSTEMS

If a single compressor is to be used with a multi-way speaker system (i.e., before the crossover, after EQ), the system operator is faced with the problem of keeping levels down below the point of destruction of the most sensitive part of the system. If, for example, mid-range drivers are frequently damaged, the whole system must be operated at a lower sound-pressure level, or additional mid-range drivers must be added. By inserting an equalizer in the detector path of the 903, it can be made more sensitive to frequencies in the range handled by the sensitive drivers. The system can then be run at higher levels and will only be dropped back when damaging signals are present.

4.6.3 PRE-EMPHASIS FOR BROADCAST APPLICATIONS

By inserting a pre-emphasis filter network in the detector path of a 903 processing pre-emphasized audio, higher signal levels can be run within the headroom limitations of the broadcast chain.

4.6.4 ANTICIPATED COMPRESSION

By feeding the program directly to the 903's detector input and sending the audio signal through a delay line before the audio input, the unit can "anticipate" the need for a gain change. See Figure 4.6.4. With some experimentation, the effect can be that of "zero" attack time at a given frequency. Additional signal delays beyond this "zero" time will then cause the compressor to finish reducing the gain before the leading edge of the loud passage even enters the signal input. This will suppress the program material preceding this loud passage. The 903 will then begin to recover from compression (release) before the loud passage has dropped back down toward the set threshold. This will cause the output level to surge higher as the note or passage should be decaying. This special effect obtained with time delay sounds similar to the inversion of dynamic envelopes produced during reverse playback of a tape recording.

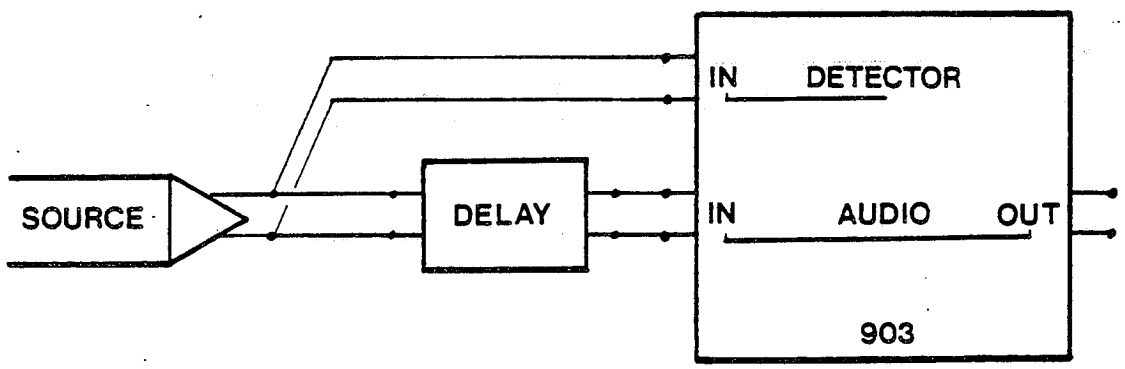
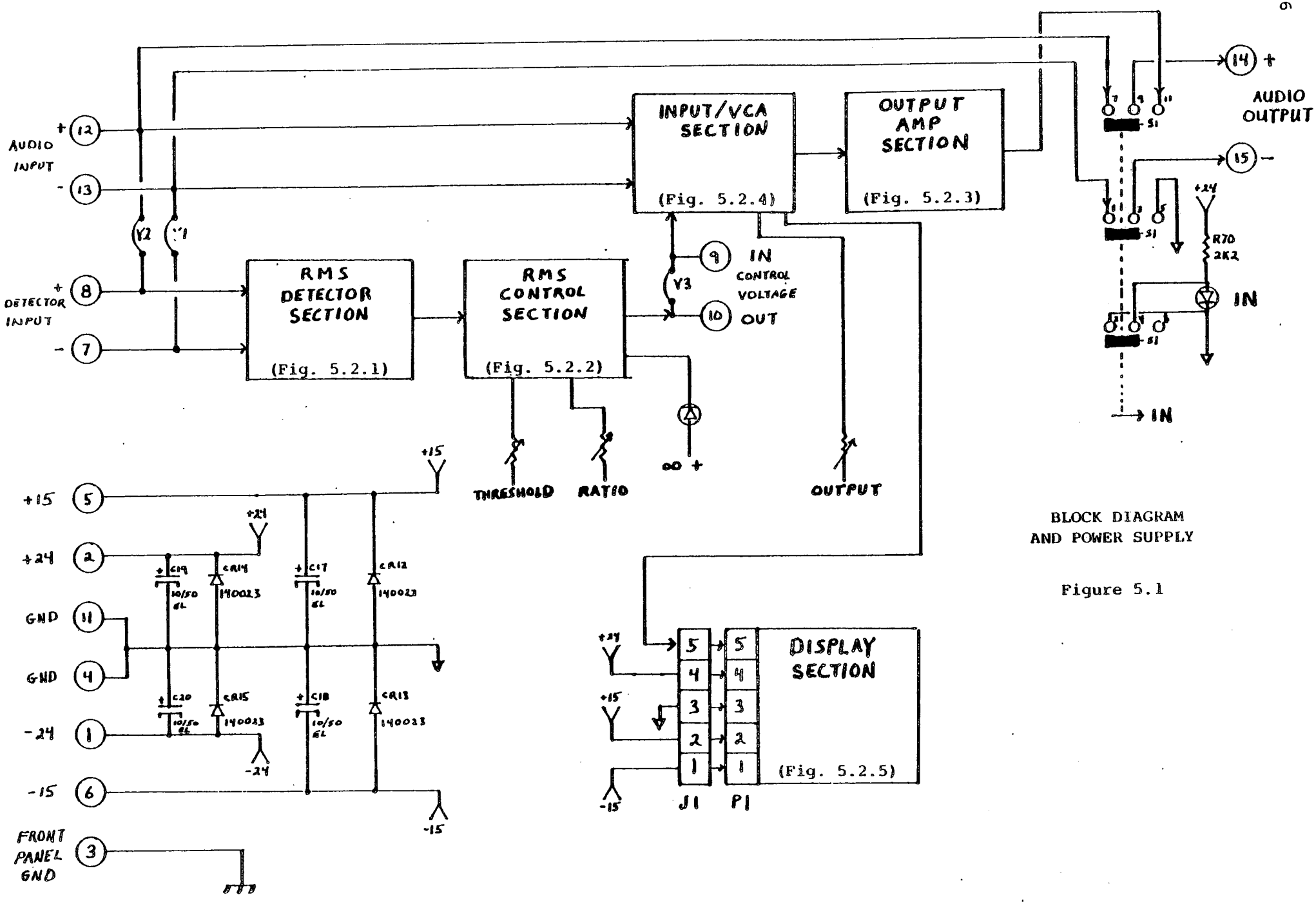


Figure 4.6.4

5.0 MAINTENANCE

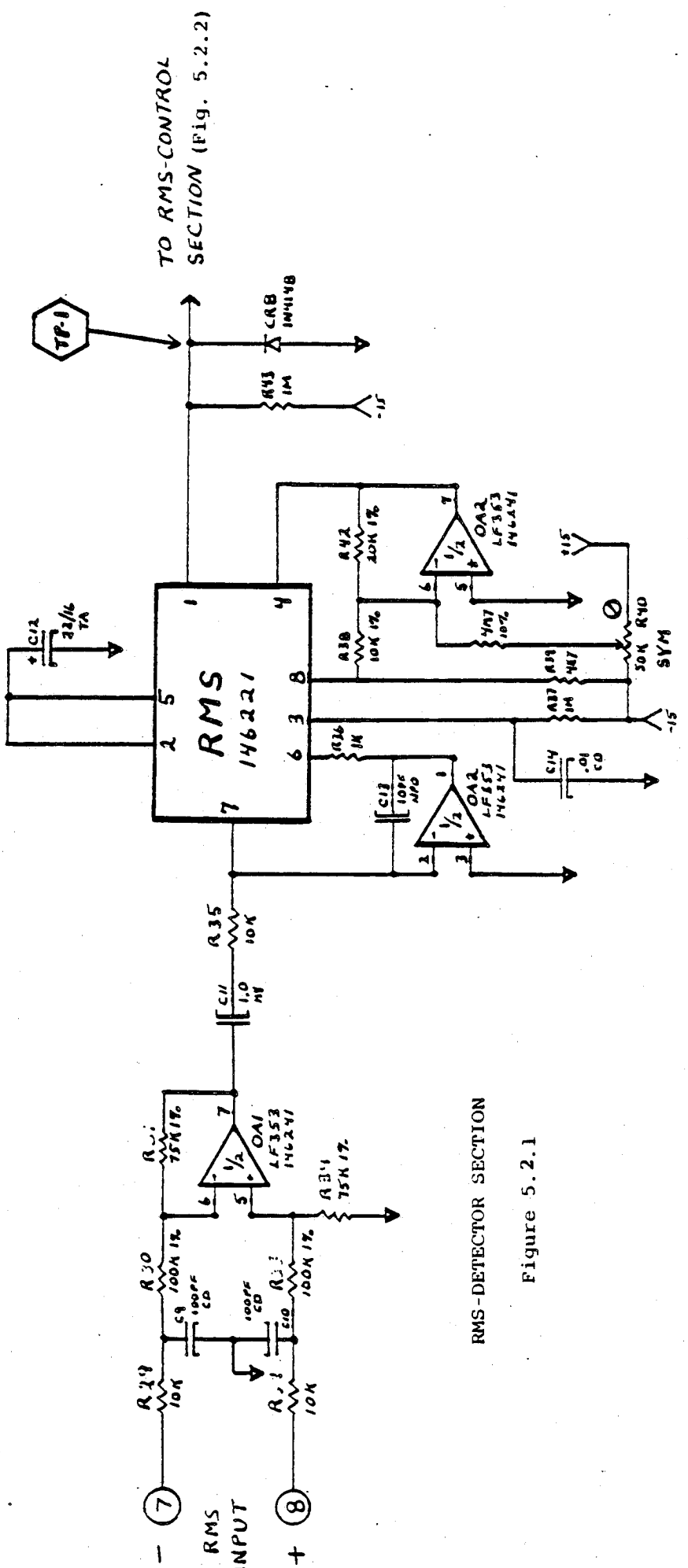
The 903 is an all-solid-state product with components chosen for high performance and excellent reliability. Each 903 is tested, burned in and calibrated at the factory and should require no adjustment of any type throughout the life of the unit. We recommend that your 903 be returned to the factory should circumstances arise which necessitate repair or recalibration (see Section 6.0).

The 903 requires no special preventive maintenance.



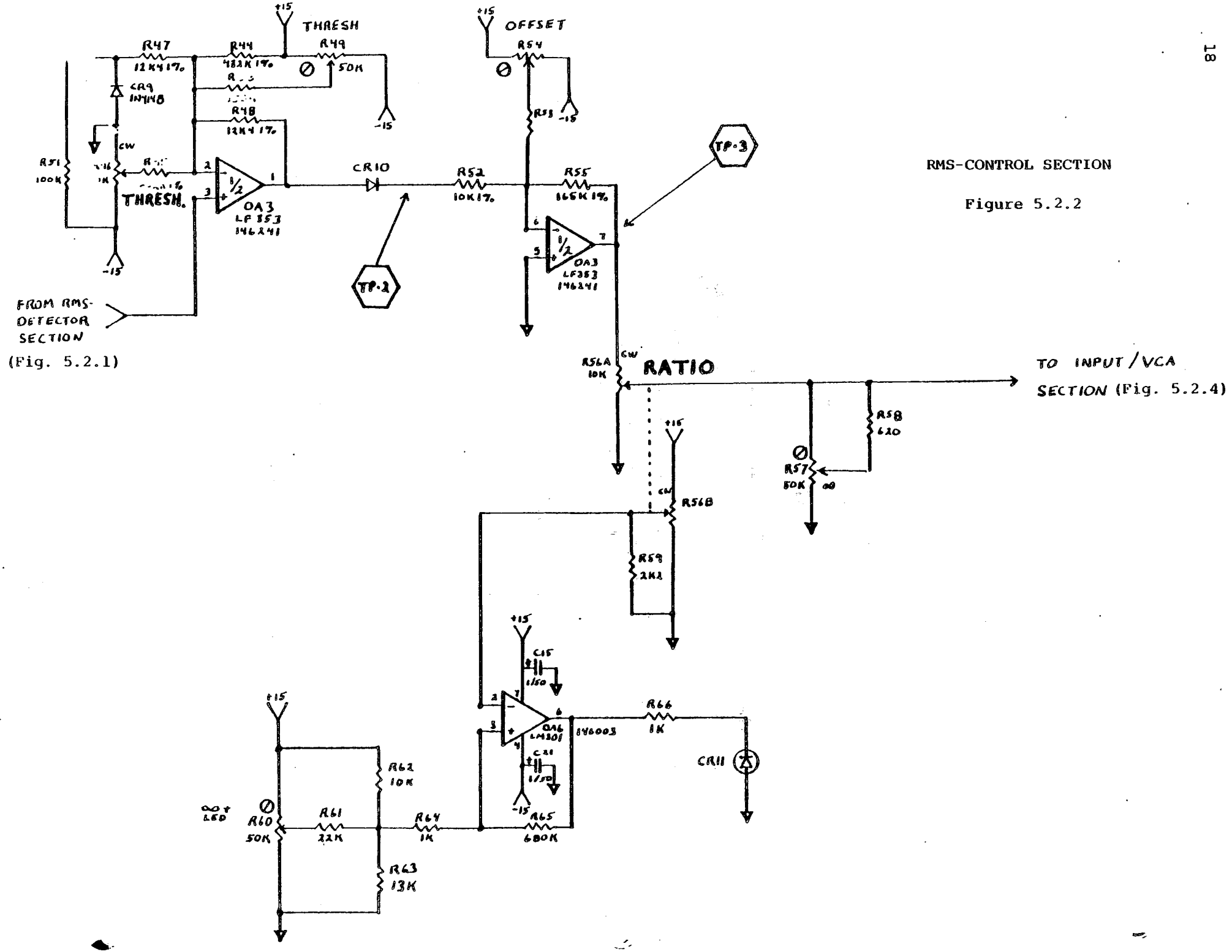
BLOCK DIAGRAM
AND POWER SUPPLY

Figure 5.1



RMS-DETECTOR SECTION

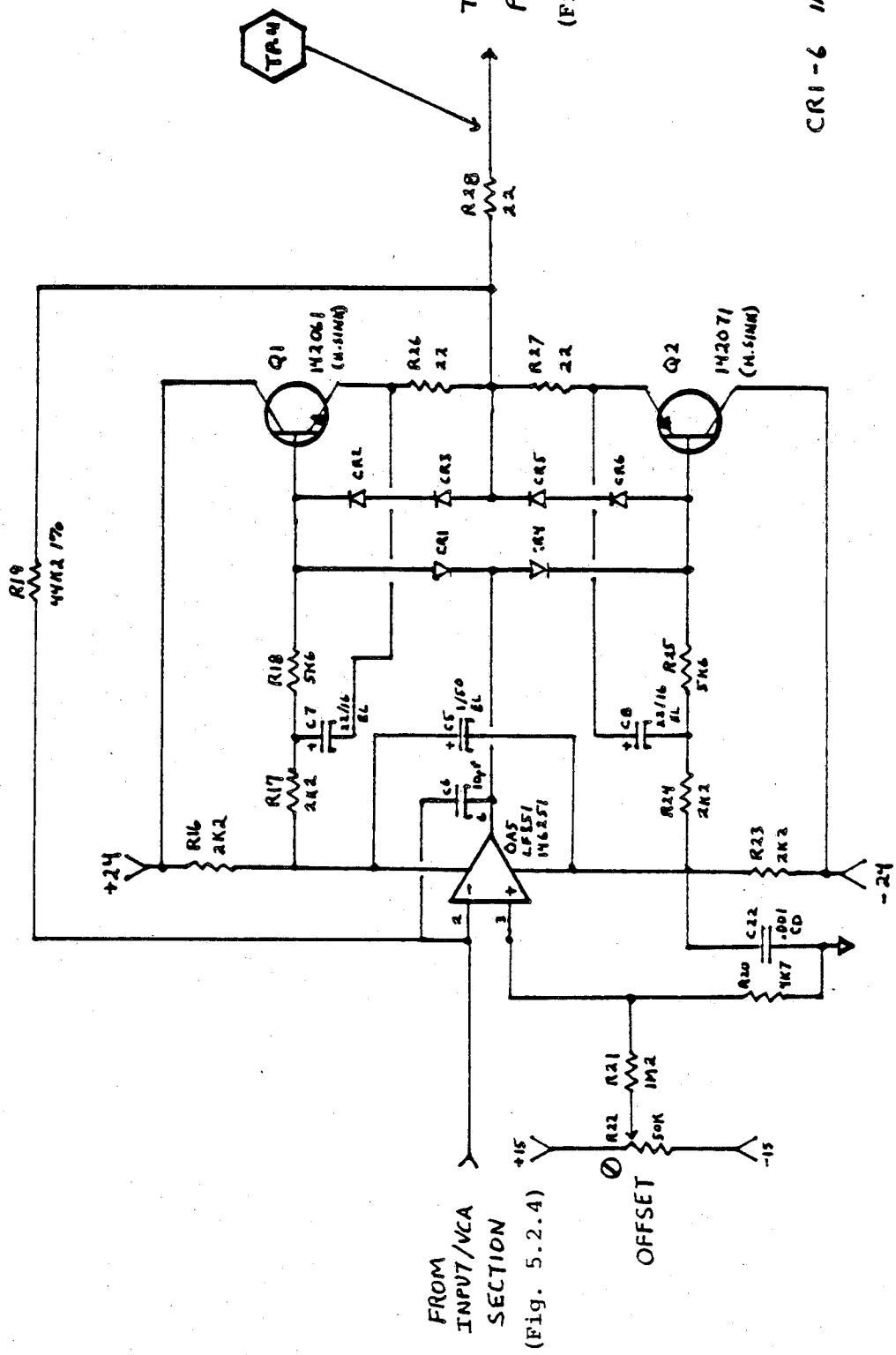
Figure 5.2.1



(Fig. 5.2.1)

RMS-CONTROL SECTION

Figure 5.2.2

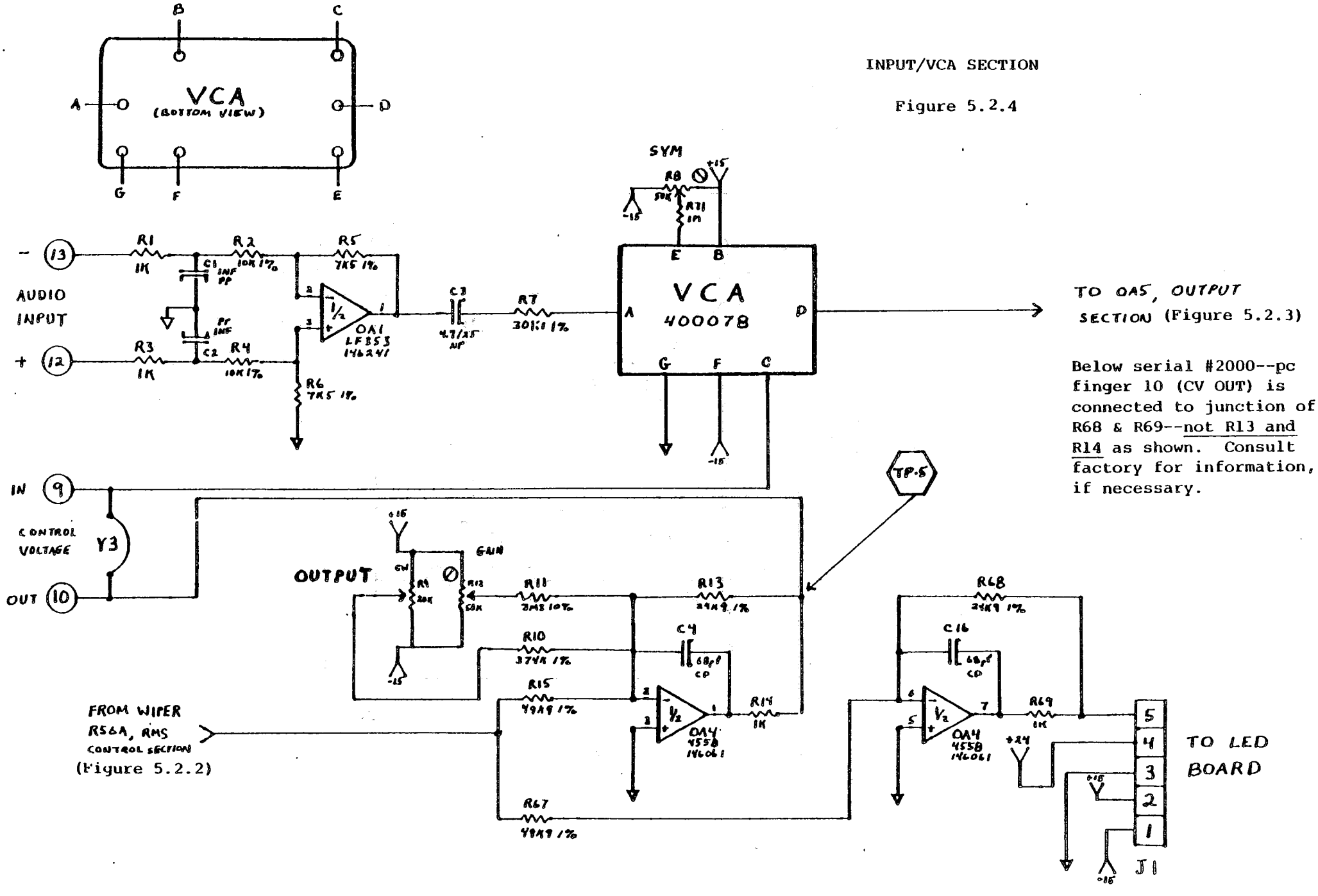


OUTPUT-AMPLIFIER SECTION

Figure 5.2.3

INPUT/VCA SECTION

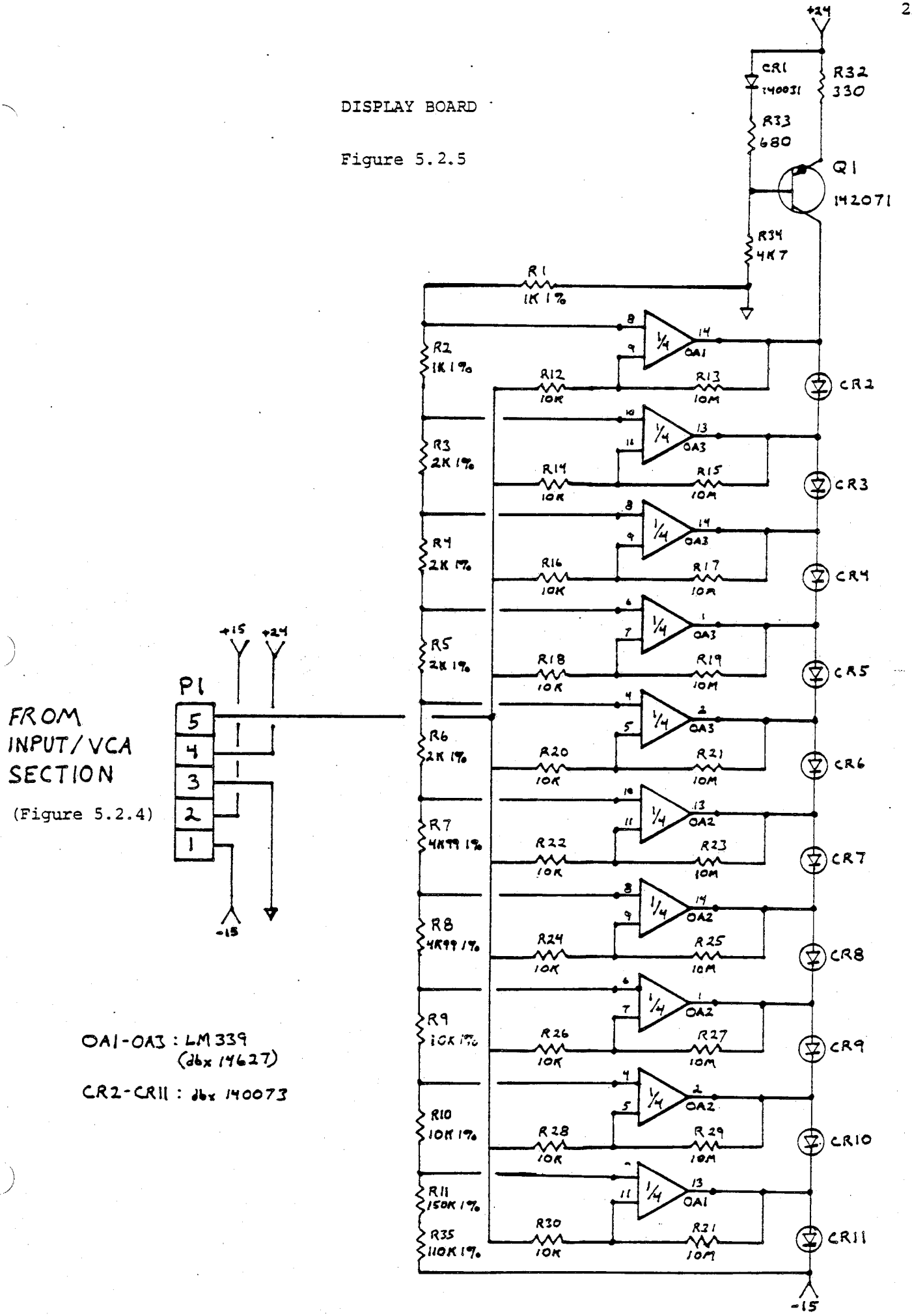
Figure 5.2.4



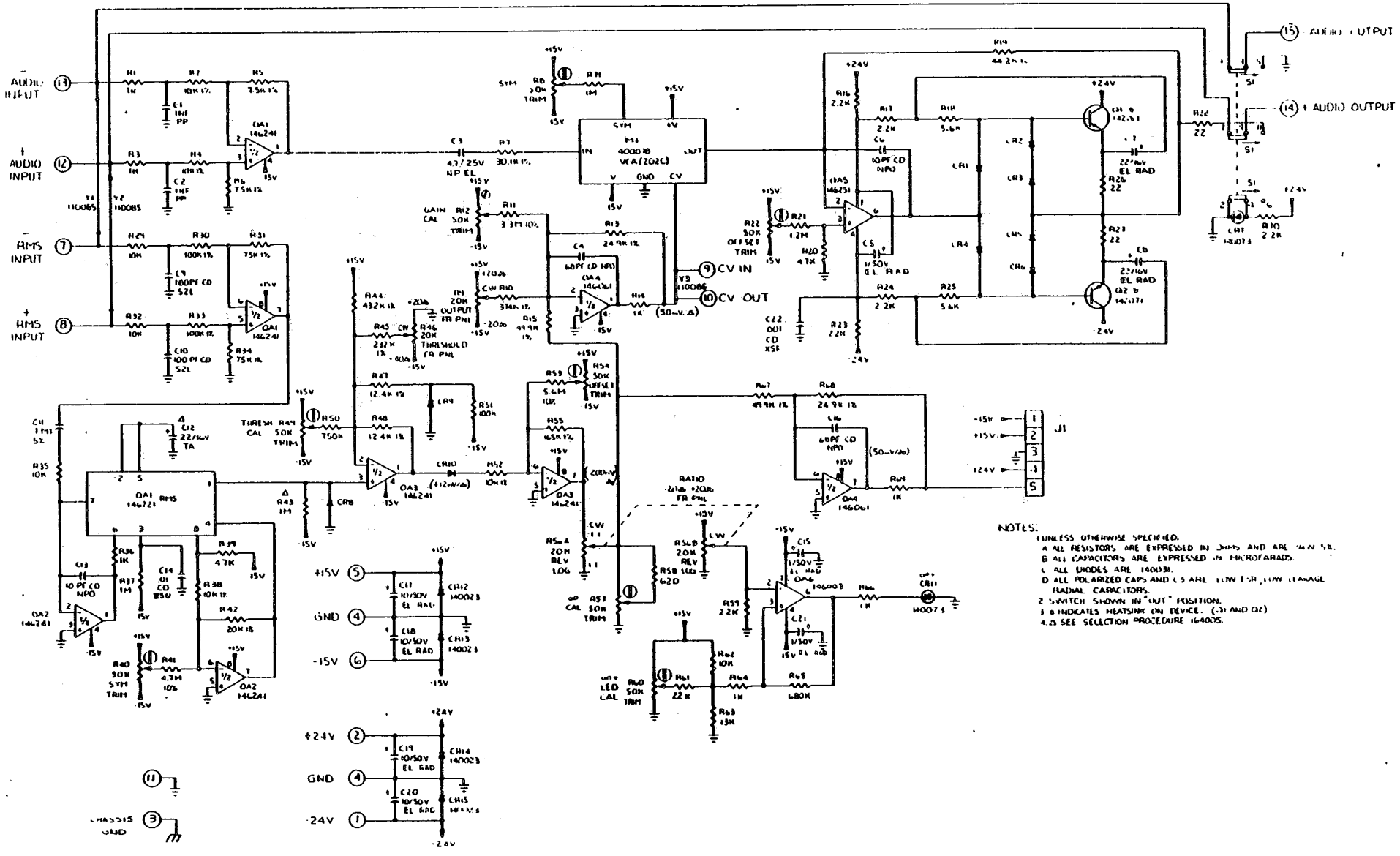
Below serial #2000--pc finger 10 (CV OUT) is connected to junction of R68 & R69--not R13 and R14 as shown. Consult factory for information, if necessary.

DISPLAY BOARD

Figure 5.2.5



dbx MODEL 903 SCHEMATIC



Manufactured under one or more of the following U.S. patents: 3,681,618; 3,714,462, 3,789,143; 4,101,849; 4,097,767. Other patents pending.

WARRANTY and FACTORY SERVICE

All dbx products are covered by a limited warranty (warranties for products purchased outside the USA are valid only in the country of purchase and the USA). For details, consult your warranty/registration card or your dealer/distributor.

The dbx Customer Service Dept. will help you use your new product. For answers to questions and information beyond what's in this manual, write to:

dbx
71 Chapel St.
Newton, Mass. 02195 USA
Attn: Customer Service

You also may call (617) 964-3210 during business hours (USA Eastern time). The Telex is 92-2522.

Should problems arise, consult your dealer or distributor. If it becomes necessary to have your equipment serviced at the factory, repack the unit, including a note with a description of the problem and the date of purchase, and send the unit freight prepaid to the above address, marking it Attn: Repairs.