

## PARTS LIST \* AR-316 \* VOLTAGE CONTROLLED AMPLIFIER

| NUMBER       | QUANTITY | DESCRIPTION                      | VALUE AND RATINGS |
|--------------|----------|----------------------------------|-------------------|
| C1,2         | 2        | Capacitor,Tantalum               | 1 mfd, 25v        |
| C3,4         | 2        | Capacitor,Disc                   | 33 pf             |
| Q1           | 1        | Transistor, NPN                  | 2N3393 or TE3393  |
| Q2           | 1        | Transistor, PNP                  | 2N3638            |
| R1,3         | 2        | Potentiometer, 1/4" shaft        | 100k Log          |
| R2,4,5,6     | 4        | Resistor,Carbon                  | 100k 10%          |
| R7,9         | 2        | " "                              | 220 ohm, 10%      |
| R8           | 1        | " "                              | 330 k ohm, 10%    |
| R11          | 1        | Resistor,Carbon                  | 1.5k, 10%         |
| R12          | 1        | " "                              | 33k, 10%          |
| R10,13,31    | 3        | Trimpot                          | 50k,linear        |
| R14          | 1        | Resistor,Carbon                  | 47k 10%           |
| R15,16       | 2        | " "                              | 1k, 10%           |
| R17,23       | 2        | Potentiometer, 1/4" shaft        | 100k, linear      |
| R18,19,20,21 | 4        | Resistor,Carbon                  | 100k, 5%          |
| R24          | 1        | " "                              | 2.7k 10%          |
| R25          | 1        | " "                              | 150k 5%           |
| R26          | 1        | " "                              | 56k 5%            |
| R27          | 1        | " "                              | 3.3k 5%           |
| R22          | 1        | Resistor,Carbon                  | 150k 5%           |
| R29          | 1        | " "                              | 1 meg, 5%         |
| R30,33       | 2        | " "                              | 10k 10%           |
| R32          | 1        | " "                              | 15k 10%           |
| S1           | 1        | Switch,Toggle                    | DPDT              |
| U1           | 1        | Operational Transconductance Amp | CA3080 (RCA)      |
| U2,3         | 2        | Operational Amplifier            | LM301A            |
|              | 2        | P C Card Guides                  |                   |
|              | 12       | Jack,Miniphones                  |                   |
|              | 1        | Printed Circuit Board            |                   |
|              | 1        | Front Panel                      |                   |
|              | 4        | Knob, 1/4" shaft                 |                   |
|              | 1        | Frame                            |                   |
|              | 2        | Bracket                          |                   |
|              | 6        | Screw, 4-40 x 3/8"               |                   |
|              | 6        | Nut, 4-40                        |                   |

ARIES System 300 Music Synthesizer  
Module AR 316  
Voltage Control Amplifier Assembly Instructions

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Assembly p. 1 of 5  
22 Sept 75

The previous pages were written as a general guide, to familiarize the builder with the components. Here, now, are the specific assembly instructions for building your  
It is recommended that you do the following before you proceed:

Find a place where you can work through completion, without disturbing your set-up.  
Use adequate lighting.  
Wash your hands before starting. This removes contaminating oils and perspiration and makes assembly more comfortable.  
As you proceed, check off each step with a pencil.

- ( ) 1. Preparation  
Lay the circuit board down on a sheet of white paper. PLACE METAL SIDE DOWN! Turn board so that connector strip is to the left.

Lay the assembly drawing down near the board.

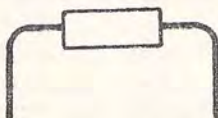
Unpack the parts carefully and place in a large box or tray so they won't get lost.

Have the following tools nearby:  
Pencil tip soldering iron, hot and tinned (solder coated)  
Solder--Use only thin rosin core solder!  
Small diagonal wire cutters  
Small wire strippers  
Small long-nose pliers  
Regular pliers  
Flat blade screw driver

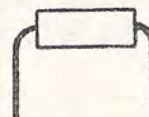
- ( ) 2. Jumpers  
Find jumper J1 on the drawing. Measure J1 on the PCboard. Cut a piece of insulated wire one inch longer than J1 measures on the PC board. Strip 1/2 inch of insulation from each end being careful not to damage the wire itself. Bend the bare ends to a right angle and insert into the holes on the board, according to the drawing. While holding the ends down against the board to hold the wire in place. Solder and cut off the excess. (Refer to the introduction on parts installation.) Install all 4 jumpers in the same manner.

- ( ) 3. Resistors  
Carefully install all 29 resistors on the circuit board. R 10,13, and 31 are trim pots. R 1,3,17, and 23 are potentiometers and will later be mounted on the panel.  
To avoid breaking the resistors leads, bend the leads at least 1/16 of an inch away from the body of the resistor.  
For example:

Correct



Incorrect



- ( ) 4. Capacitors  
Install all four capacitors on the board. (C1 through C4)
- ( ) 5. Transistors  
Install all transistors on the board. (Q1 and Q2)
- ( ) 6. Integrated Circuit Amplifiers  
Install all Integrated Circuit Amplifiers. U1 is a CA3080.  
U2 and 3 are LM 301.

**ALL BOARD COMPONENTS ARE NOW MOUNTED**

**MODULE ASSEMBLY--Please refer to Module Assembly Drawing**

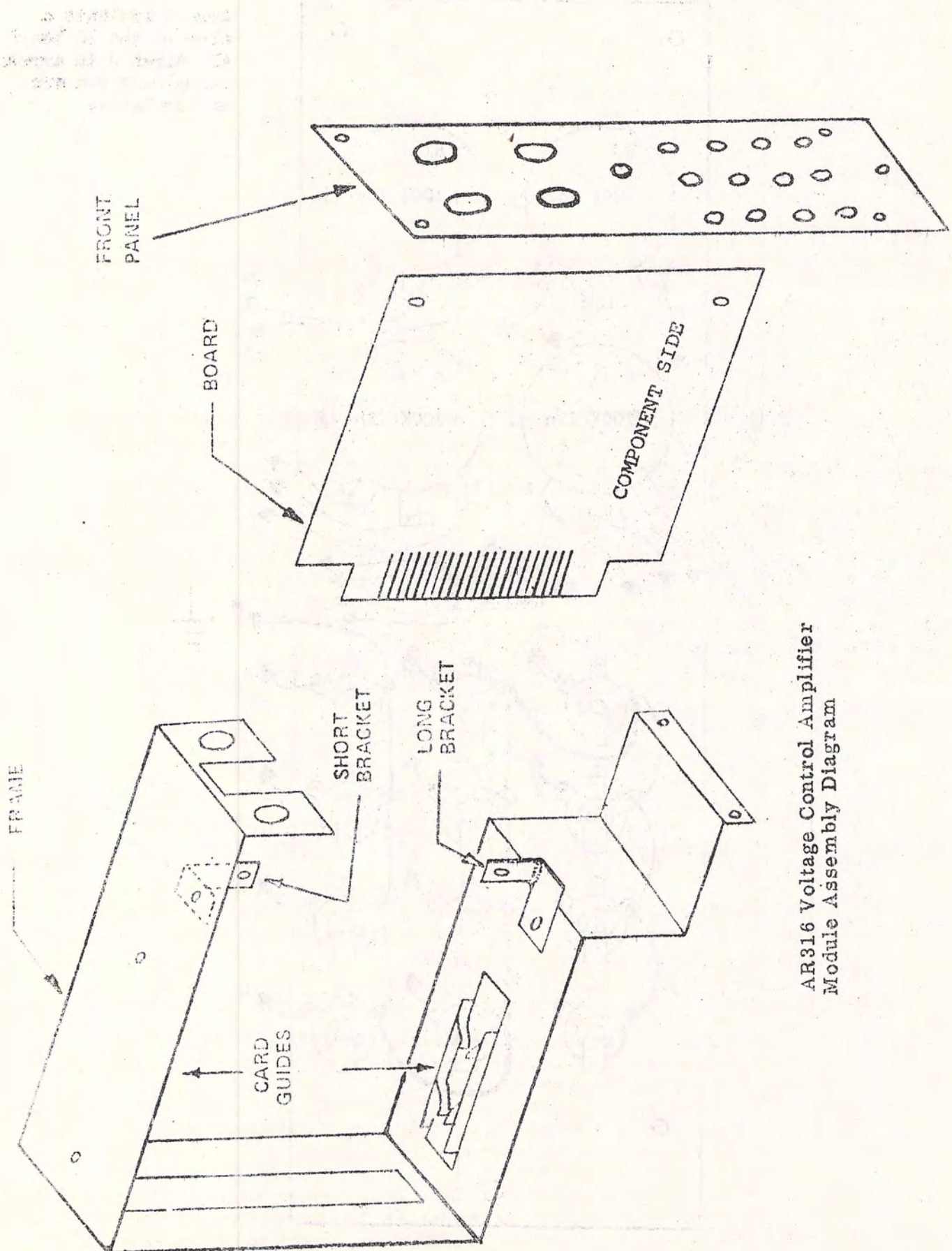
- ( ) 1. Unpack the frame, bag of hardware, and front panel.
- ( ) 2. Snap the two plastic card guides into the holes in the frame.  
Be sure that the pairs of tabs in the guides which hold the board point toward the rear of the frame. (The bottom one is shown installed in the drawing.)
- ( ) 3. Slide the circuit board into the frame, holding the top and bottom of the frame together against the board so that the board fits snugly in the card guides. Be sure that the pairs of plastic tabs pinch the edge of the circuit board properly.
- ( ) 4. Using 4-40X3/8" screws and nuts, mount the two angle brackets to the frame as shown in the drawing. The brackets should be entirely on the component side of the board.
- ( ) 5. Now screw the board to the brackets. Insert the 4-40 X 3/8" screw from the foil side of the board. **DOUBLE CHECK THAT THE HEAD OF THE SCREW DOES NOT TOUCH ANY FOIL!!!**
- ( ) 6. Unpack the front panel carefully. Avoid scratching its surface.  
**AT THIS POINT** you may if you wish skip steps 7-8 and proceed through the first few steps in the panel wiring (those in which wiring is done between components on the panel, but not to the board) before finishing the module assembly.
- ( ) 7. Mount the top of the panel to the top of the module frame using the top two potentiometers as follows: If there are tabs sticking up parallel to the shaft on the pots, bend 90 degrees inward out of the way. Put the locking washer on the pots. Insert the pot shafts through the matching 3/8" holes in the frame and the top of the panel. Put on the nuts and tighten them very snugly, but avoid scratching the panel.
- ( ) 8. Attach the bottom of the panel to the frame using the remaining 4-40 screws and nuts.
- ( ) 9. Install the other pots onto the panel.
- ( ) 10. Install all 12 mini-phone jacks as shown in the panel drawing.
- ( ) 11. Turn all pot shafts fully counterclockwise and mount the knobs pointing to the leftmost number. Tighten knob screws.

**THIS COMPLETES MODULE ASSEMBLY**

**PANEL WIRING-- Please refer to panel wiring diagram and layout diagram.**

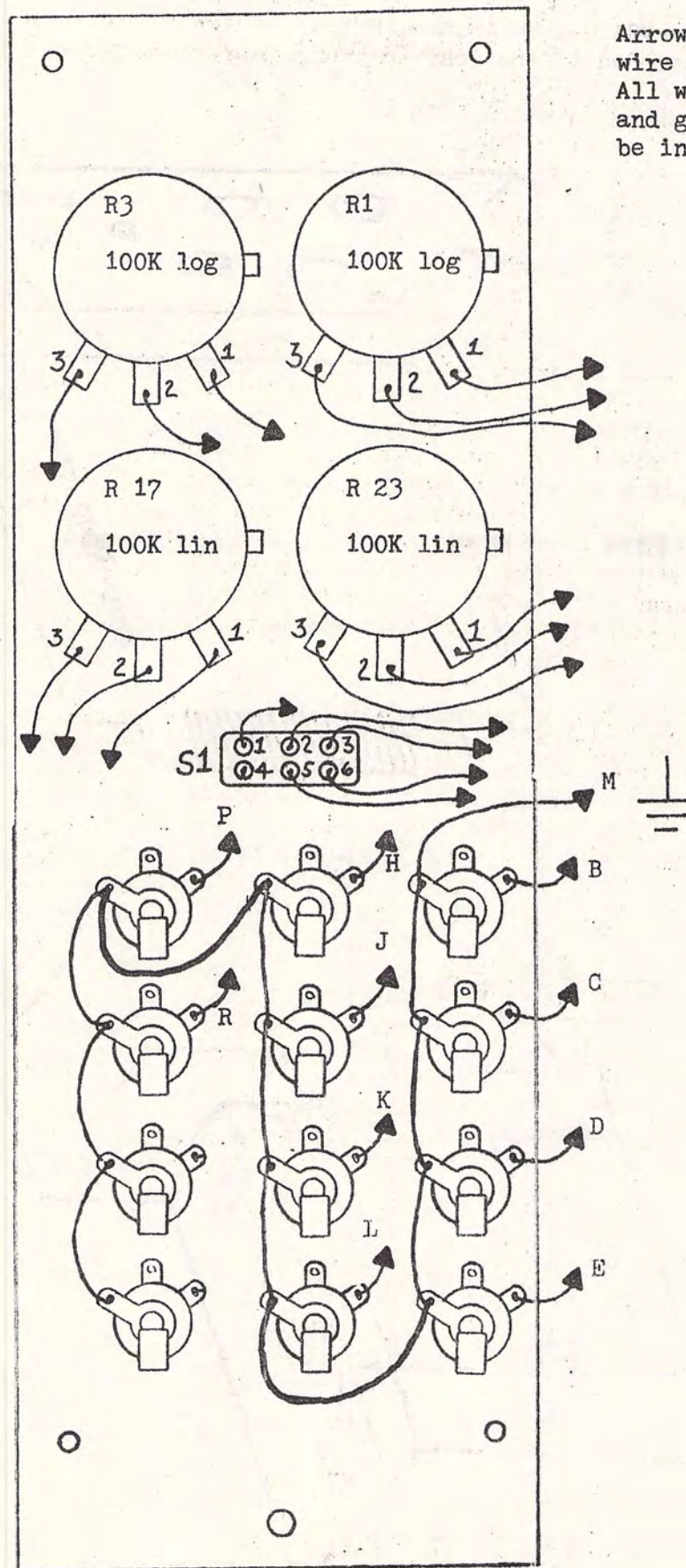
- ( ) 1. Run a wire connecting the grounds of all 12 mini-jacks, as shown, and from there to the ground point on the circuit board near point "M" of the edge connector.
- ( ) 2. Wire the 3 pins of each pot as shown in the panel diagram. Wires indicated with arrow heads connect to the appropriate points on the circuit board, as shown on the layout diagram. Wire one pot at a time to avoid confusion.
- ( ) 3. Wire all jacks with arrows and a letter designation to the appropriate points at the rear edge of the board, as shown in the layout diagram.
- ( ) 4. Wire S1 to the appropriate points on the board as labelled on the assembly drawing.

**THIS COMPLETES ASSEMBLY OF YOUR AR 316 VOLTAGE CONTROL AMPLIFIER**



AR316 Voltage Control Amplifier  
Module Assembly Diagram

AR316 VCA Assembly p.4 of 5  
AR 316 VOLTAGE CONTROL AMPLIFIER PANEL WIRING DIAGRAM--rear view



Arrows indicate a wire to the PC board. All wires with arrows and ground bus must be insulated.

MODULE AR316  
VCA TRIM PROCEDURE

NOTE: The VCA may be trimmed by ear, however, the following test procedure is recommended if the test instruments are available.

1. A regulated + and - 15 volt power supply
2. Oscilloscope with DC coupled vertical input.
3. Envelope Generator or LFO.
4. LFO or VCO.

Trim as follows:

1. Monitor the output with the oscilloscope.
2. With no audio inputs to the VCA and audio level pots at 0, apply a 10 volt square wave to the control input.
3. Adjust R10 for minimum signal at the output. (Increase the gain on the oscilloscope for more precise trimming.)
4. Apply a 10 volt sawtooth to audio input 1 and set the pot to 10.
5. Apply a 10 volt square wave to control input 1 and set the pot to 10. The envelope generator can be used to produce the square wave.
6. Turn the initial gain to 0 and the control mode switch to LIN.
7. Adjust R 13 for a 10 volt sawtooth at the output.
8. Change the control mode switch to EXP.
9. Adjust R 31 for a 10 volt sawtooth at the output.

Your AR 316 is now ready to use.

THEORY OF OPERATION- AR-316  
VOLTAGE CONTROLLED AMPLIFIER

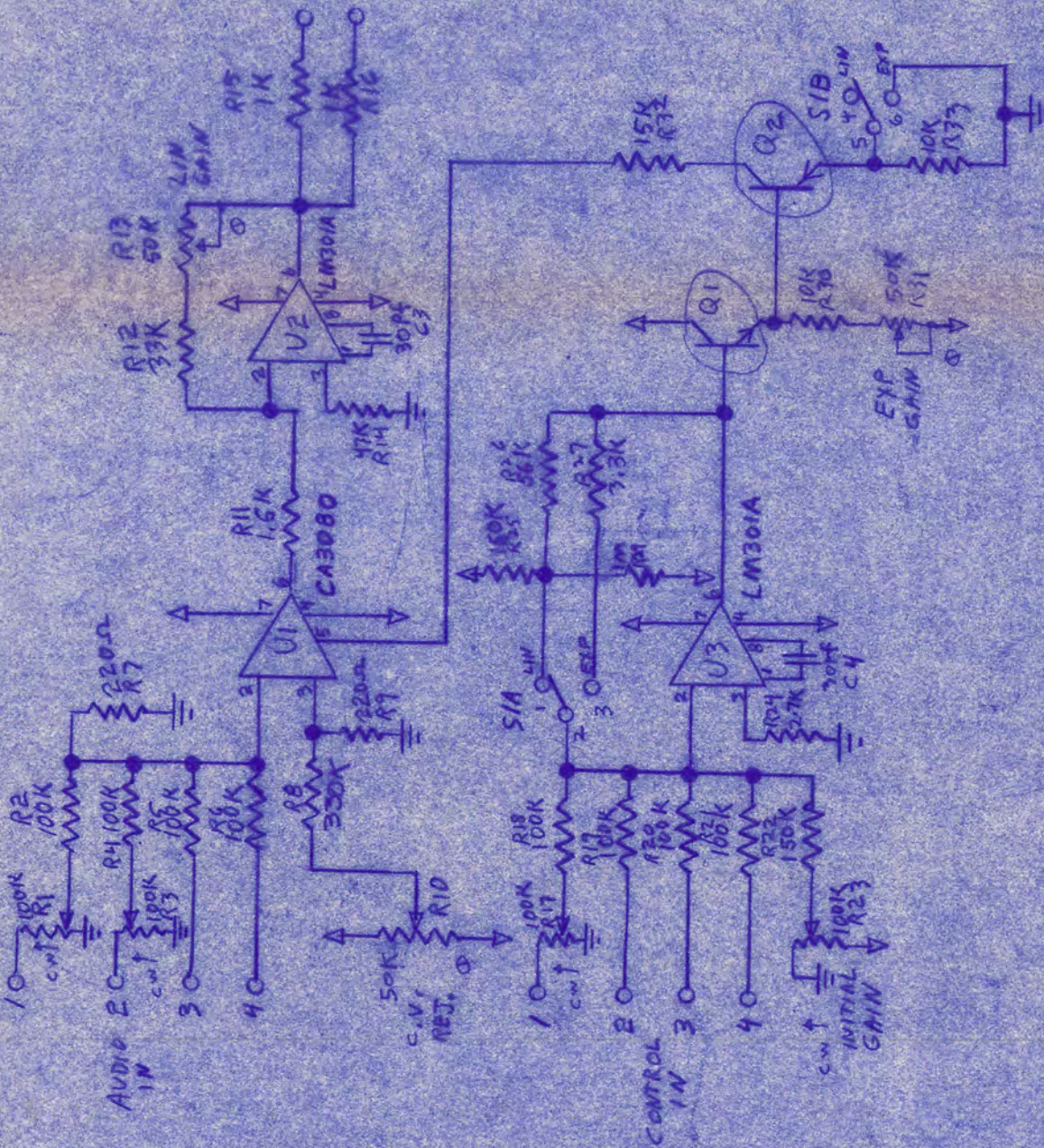
Audio inputs are summed in by R2, 4, 5, and into the inverting input of U1, which is a current-controlled gain circuit. The inputs, after mixing at the input, appear as an output current. This is converted to a voltage by U2, a conventional inverting op amp. The output is of the same polarity as the input, because the two inversions cancel.

Control signals are summed through R18, 19 20, 21, and 22, and U3. In the LINEAR mode, the output of U3 varies from 0 to +5 volts. This is coupled through emitter follower Q1 into Q2. The two base-emitter drops cancel, since opposite polarity transistors are used. So, the emitter voltage of Q2 varies between 0 and -5 volts. This voltage across R33, determines the current from emitter to collector of Q2, and into the control terminal of U1, the variable gain circuit. When R23, the INITIAL GAIN CONTROL, is to the left, its output of -15 volts is balanced by the +15 volts across R25, so U3 output is 0, as is the current into U1. Then, the gain is 0. (Off). Turning up R23, or applying a positive control input voltage, causes U3 output to become negative, which turns on Q2 and U1. R13, across U2, trims the maximum gain to be unity at full control input of +10 volts.

In the EXPONENTIAL mode, action is similar except (1) R33 is shorted, which makes the current through Q2 change much more rapidly (exponentially) as its base voltage changes, and (2) the resistors across U3 are changed to provide a smaller drive voltage. U3 output now varies between 0 and -0.33 volts. R31 varies the emitter current through Q1, then changing its base-emitter drop by a total of 0.05 volts. This is not significant in the LINEAR mode, but is in the EXPONENTIAL mode, where it is used to trim the maximum gain, also to unity.

Thus, in both modes, the gain varies from essentially 0 to 1 as the INITIAL GAIN control is varied over its full range. However, in the LINEAR mode, the gain is .5 (-6db) at the mid-position, or with a +5 volt control signal. In the EXPONENTIAL mode, the gain at this point is only 0.003 (-50 db).

Finally, R10 introduces a variable D C offset into U1, which balances out its own internal offset. This prevents varying control signals from carrying a changing D C offset at the final output.



VCA  
AR-316

C4  
Q2  
R33  
S1  
6-13-70  
03

+15V

AUDIO IN 1

AUDIO IN 2

AUDIO IN 3

AUDIO IN 4

CONTROL IN 1

CONTROL IN 2

CONTROL IN 3

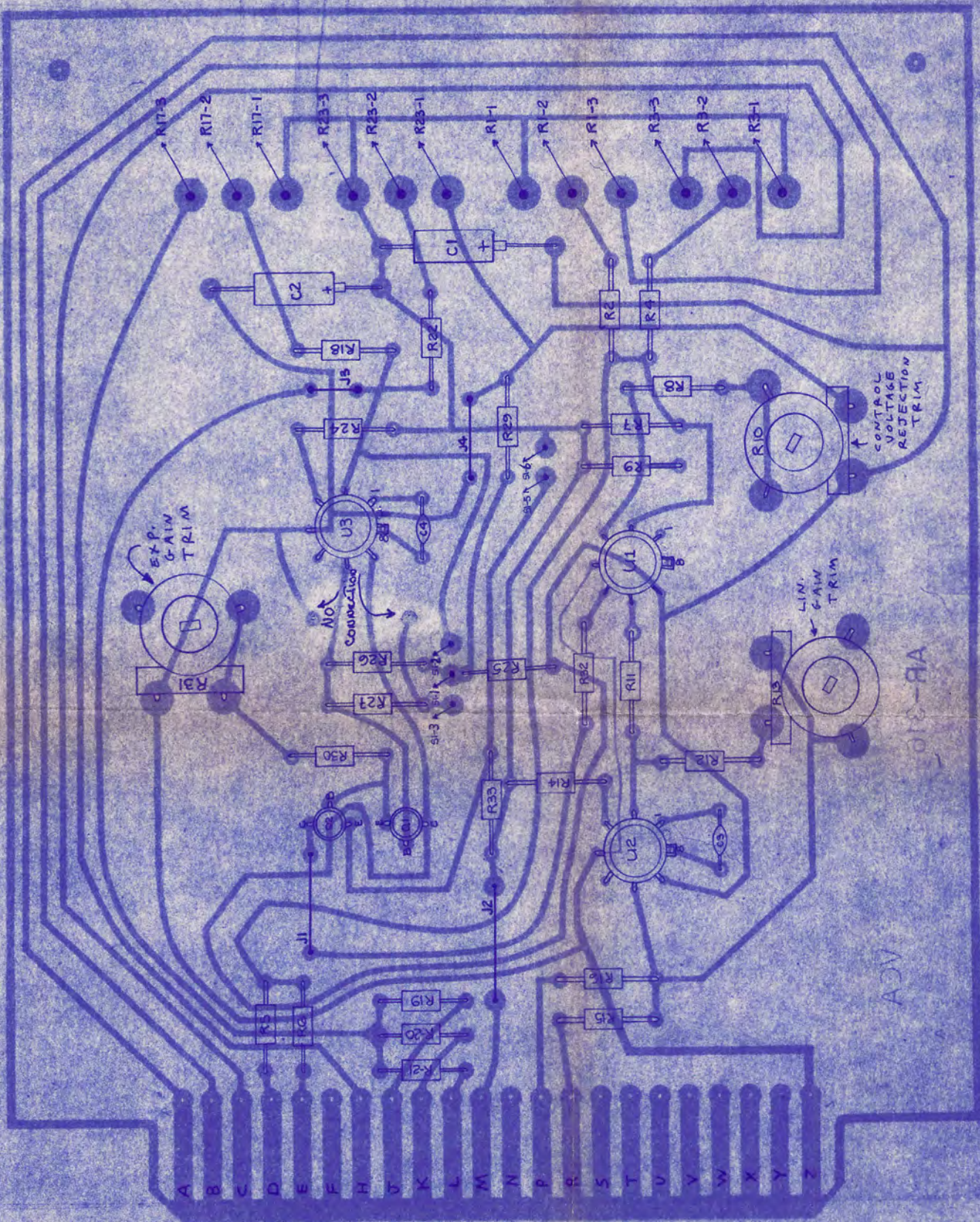
CONTROL IN 4

GROUND

OUTPUT 1

OUTPUT 2

-15V



4 JUMPERS

VCA AR-316 LAYOUT

6-18-75  
5-30-75