PARTS LIST * AR-324 * DUAL L.F.O., LAG, INVERTER

NUMBER	QUANTITY	DESCRIPTION	VALUE AND RATINGS
NOTE: QUANTITES FOR LFO PARTS ARE FOR 2			
C1,2	2	Capacitor,Disc	0.1 mfd,25v
C3,9,11	5	Capacitor,Tantalum	1 mfd,50v
C4,5,10,12,14	8	Capacitor,Disc	33 pf
C6	2	" "	0.001 mfd
C7,8	4	" "	0.005 mfd
C13	1	Capacitor,Disc	150 pf
D1 thru 6	12	Diode,Silicon	1N914,1N4148 or equivalent
P1	2	Potentiometer,1/4" shaft	100k, log
P2	1	" "	1 meg,log
P3	1	" "	100k, linear
Q1,4	4	Transistor,NPN	2N3393 or TE3393
Q2,5	4	Transistor, PNP	2N3638
Q6	2	Field Effect Transistor, N-Channel	E212 (Siliconix)
Q7,8	2	Transistor,Dual PNP	3347-1
R1,2,3,15,27,31	11	Resistor,Carbon	100k, 10%
R4,7	4	" "	10k, 10%
R5,16,19,21,29, 33,34	11	" "	1k, 10%
R6	2	Resistor,Carbon	470 ohm, 10%
R8,9,14	6	" "	47k, 10%
R10,	2	" "	10 ohm, 10%
R11	2	" "	100 ohm, 10%
R12	2	" "	680 ohm, 10%
R13,23	4	" "	2.2k, 10%
R17	2	" "	6.8k, 10%
R18,20,24	6	" "	15k, 10%
R22	2	" "	390 ohm, 10%
R25,26	4	" "	5.6k. 10%
R28	1	" "	1 meg, 10%
R30	1	" "	39 ohm, 10%
R32	1	" "	120k, 10%
T1	2	Trimpot	50k, linear
U1	2	Operational Transconductance Amplifier	CA3080 (RCA)
U2,3,4,5,6	8	Operational Amplifier	LM301A
Q3	2	Darlington Transistor	MPS-A65

PARTS LIST * AR-324 * (cont.)

QUANTITY	DESCRIPTION
12	Jack, Mini-Phone
1	Printed Circuit Board
1	Front Panel
4	Knob, 1/4" shaft
1	Frame
2	Bracket
6	Screw, 4-40 x 3/16"
6	Nut
2	P C Card Guides

ARIES System 300 Music Synthesizer
Module AR 324
Dual LFO, Lag, Inverter Assembly Instructions

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 Dual LFO, Lag, Inverter module. 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.

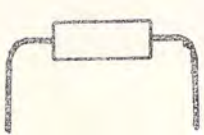
Unpack the parts carefully and place in a large box or tray so they won't get lost.

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 long nose pliers
Regular pliers
Flat blade screw driver

( ) 2. Jumpers
Find jumper J1 on 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 insualtion from each end being carefull 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, bend them at a 45 degree angle on the foil side of the board to hold the wire in place. Solder and cut off the excess. (Refer to the introduction on parts installation.) Install J2 through J5 in the same manner.

( ) 3. Resistors
(Remember that you will be assembling two LFOs and one Lag and one Inverter on the same board when you proceed with the following instructions.) Install all 62 resistors on the circuit board. First install R 101 through R 127, then install R 201 through R 227, then install R 28 through R 34. 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 24 capacitors on the board. First install C 101 through C 110, then install C201 through C 210, then install C 11 through C 14. Be careful to observe polarity where indicated.

( ) 5. Diodes
Install all 12 diodes on the board. First install D 101 through D 106, then install D 201 through D 206. Be careful to observe polarity where indicated.

( ) 6. Transistors
Install all 8 transistors on the board. Be careful to maintain proper orientation of the leads.

( ) 7. Integrated Circuit Amplifiers
Install all 10 Integrated Circuit Amplifiers on the board. First install U 101 and U201 labelled CA 3080. Observe proper orientation of the leads. Now install all other Integrated Circuit Amplifiers as indicated . (U 102 through U104, U 202 through U 206)

( ) 8. Install all two trim pots on the board, as shown.

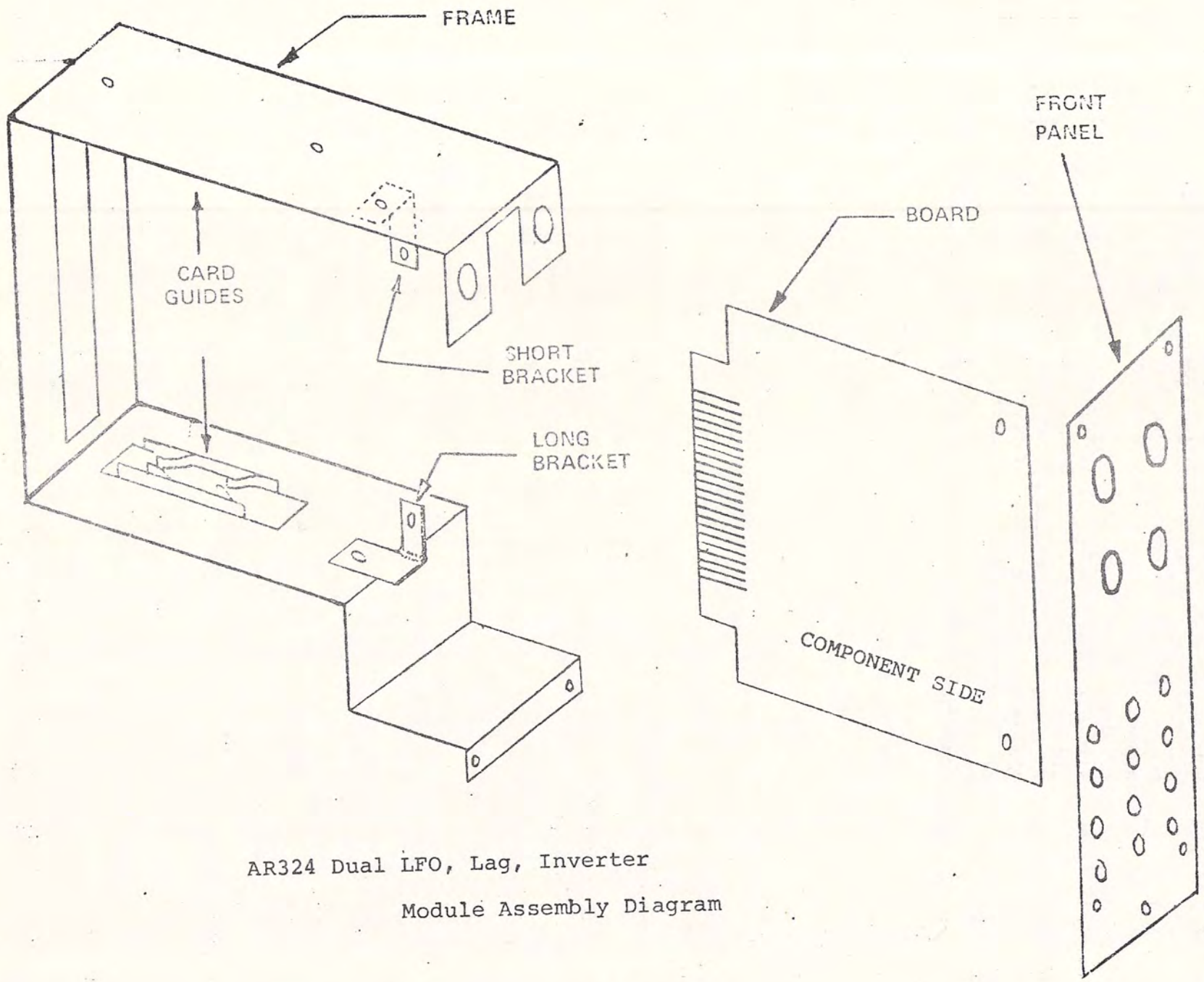
MODULE ASSEMBLY-- Please refer to Module Assembly Drawing

( ) 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.

PANEL WIRING--Refer to panel wiring diagram and board assembly drawing.

( ) 1. Run a wire connecting the grounds of all 12 jacks ,as shown.
( ) 2. Run an insulated wire from pin 3 of P 101 to pin 3 of P 201 and from there to the appropriate point on the board.
( ) 3. Run a wire connecting pins 2 and 3 of P2 and from there to the appropriate point on the board as indicated on the assembly drawing.
( ) 4. Wire all four pots to the appropriate points on the board as indicated on the assembly drawing. Wire one at a time.
( ) 5. Wire all 12 jacks to the appropriate point s on the board near the edge connector which correspond with the letters indicated on the wiring diagram. Wire one at a time.

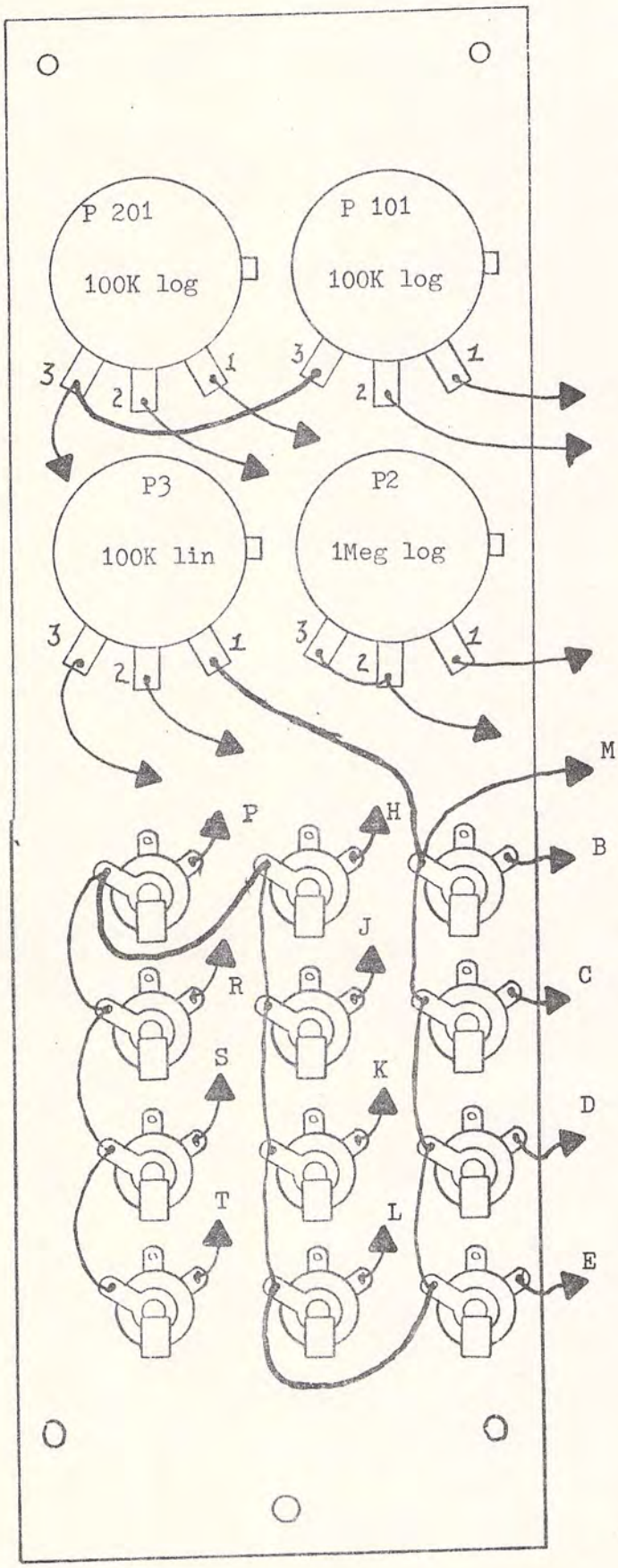
THIS COMPLETES ASSEMBLY OF YOUR AR 324 DUAL LFO, LAG,AND INVERTER,



AR324 Dual LFO, Lag, Inverter

Module Assembly Diagram

AR 324 Dual LFO, Lag, Inverter Panel Wiring - Rear View



Arrows indicate a wire to the P C board. All wires with arrows and ground bus with thick lines must be insulated.

NOTE:

Jacks with arrows are wired to holes in the board on the connector strip.

AR324 Dual LFO, lag, inverter trim procedure

Your AR324 requires only one trim on each LFO, and this is best done with an oscilliscope with DC vertical amplifier. However, with a slow frequency setting, a good approximation can be achieved with a fast voltmeter, or by ear using the LFO to control something on the synthesizer.

1. monitor the LFO sawtooth output with the scope
2. Set the frequency pot at 3
3. Adjust the trim for a 10 volt sawtooth waveform
   (this should be approx. 0v to 10 v)
4. Do the same for the other LFO.

THEORY OF OPERATION AR-324

DUAL LFO, LAG, INVERTER

I. Low Frequency Oscillator (LFO)
There are two identical LFO circuits. The basic waveform is a triangle. Voltage from the logarithmic pot P1 is applied to the emitter resistor, R18, of Q8. D5 balances the base-emitter voltage of Q8. The current from emitter to collector is then an exponential function of the rotation of P1. Now, U3 is a comparator with positive feedback, which will latch on to either +13 volts or -15. Assume it is positive. Then U1 has a positive voltage at pin 2, its negative input. Then, a current will be drawn into pin 6, approximately equal in magnitude to the current from Q8 into pin 5 . This causes C9 to charge negatively. The resulting negative-going voltage is buffered by voltage follower U4, and applied to pin 3 of U3 through R26. When the voltage across R26 is negative enough to compensate for the positive voltage across R24, pin 3 becomes negative. This is the positive input of an op amp, so the input then jumps negative. This, through R24, makes the input even more negative. However, the change in input makes U1 supply current out of pin 6, which reverses the direction of charge of C9. Its voltage rises now, until it becomes positive enough to reverse U3 again. This cycle repeats, and generates a triangle wave, whose frequency rises as more current is put into U1 by turning up P1. Incidentally, the output of U3 is a square wave, which is shifted to a level of 0 to +10 volts by D2, R22, and R23.

Meanwhile, Q7 is adjusted to have the same current range as Q8, by trimpot T1. The current out of the collector of Q7 charges up C3 linearly; that is, its voltage rises uniformly. (Initially, when discharged, the + side of C3 is at -15 volts.)When the output of U3 jumps positive, C8 differentiates the wave to give a pulse. This turns on Q4, which turns on Q5. The two transistors hold one another on, discharging C3 rapidly, until it is so discharged that it can't supply enough current to keep Q4 and Q5 on. Then, they become non-conducting again, and C3 starts to charge again. The current in Q7 is adjusted so that C3 charges by about 7 volts (+side of C3 at -8 volts) by the time the pulse discharges it. The resulting sawtooth wave is buffered by emitter follower Q3, andamplified by U2, to give a sawtooth output level of 0 to 10 volts.

Finally, any fast rising waveform, such as a square wave, applied to the SYNC input, is differentiated by C6, R2, and R3 to give a pulse, which momentarily turns on Q1 and Q2. C7 holds the pulse appearing at R6 on for about 20 microseconds, which is long enough to reset the oscillator by doing 3 things.

THEORY OF OPERATION AR-324 (cont)

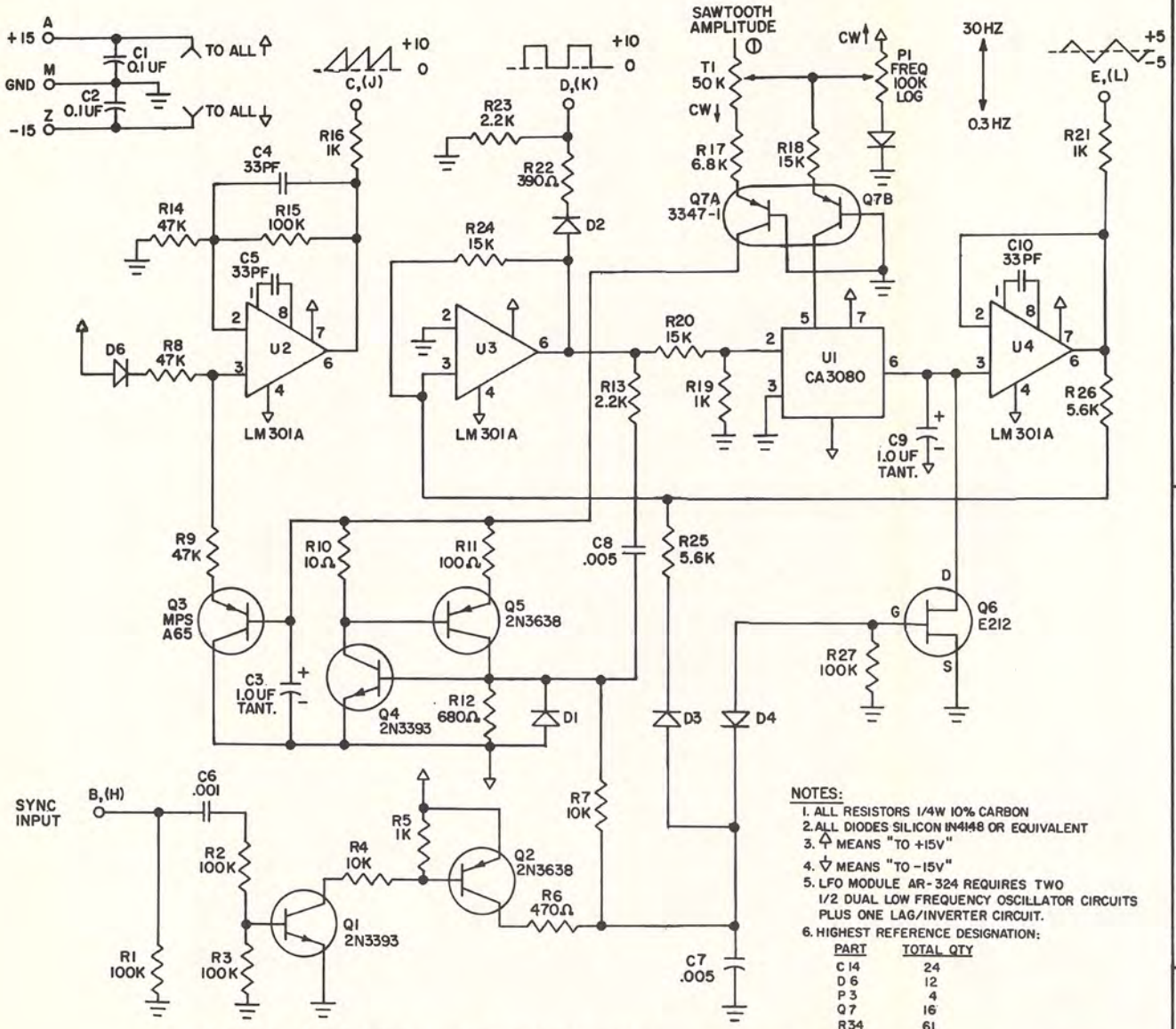
1. It makes U3 switch to a positive output (if it is not already positive) .
2. It allows R27 to turn on FET switch Q6, which discharges C9.
3. It turns on Q4 and Q5, discharging C3.

Thus, the oscillator will be synchronized with the external synd input signal.

II Lag Circuit
This is a circuit which provides a variable amount of slowing down, or low pass filtering.

A signal at the input goes through R29 and the variable resistance of P2, and must charge or discharge C11. The higher its resistance, the less current can flow from the signal, and so C11 will take longer to change its voltage. The output is buffered by U5, connected as a high impedance voltage follower.R28 provides a path to ground for C11 and pin 3 of U5 when the input is not connected to anything.

III Inverter Circuit
This is a standard op amp inverter, coupled to the input through a variable attenuator, or level control (P3). Maximum gain is -1.



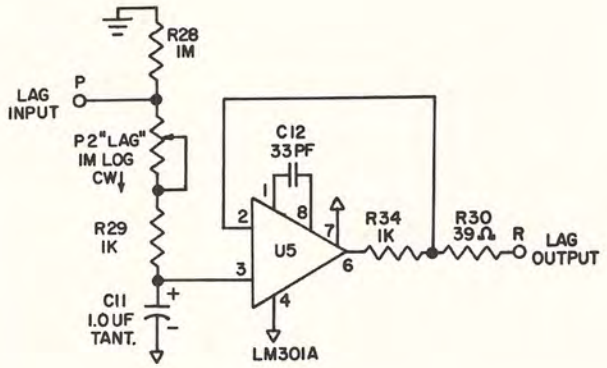
I/2 DUAL LOW FREQUENCY OSCILLATOR

NOTES:

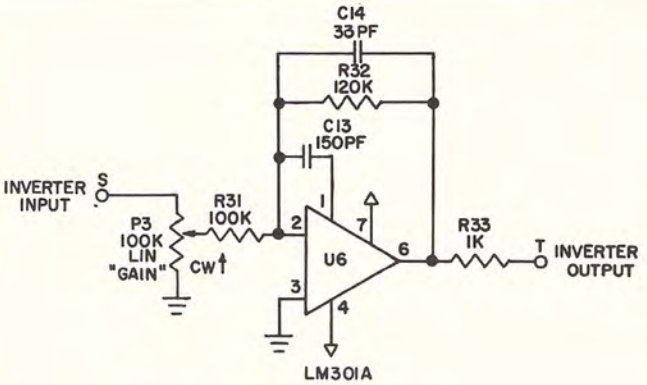
1. ALL RESISTORS 1/4W 10% CARBON
2. ALL DIODES SILICON IN4148 OR EQUIVALENT
3. ⏃ MEANS "TO +15V"
4. ⏃ MEANS "TO -15V"
5. LFO MODULE AR-324 REQUIRES TWO 1/2 DUAL LOW FREQUENCY OSCILLATOR CIRCUITS PLUS ONE LAG/INVERTER CIRCUIT.
6. HIGHEST REFERENCE DESIGNATION:

PART	TOTAL QTY
C 14	24
D 6	12
P 3	4
Q 7	16
R 34	61
T 1	2
U 6	10

7. PIN DESIGNATIONS IN PARENTHESES ( ) REFER TO LFO #2.

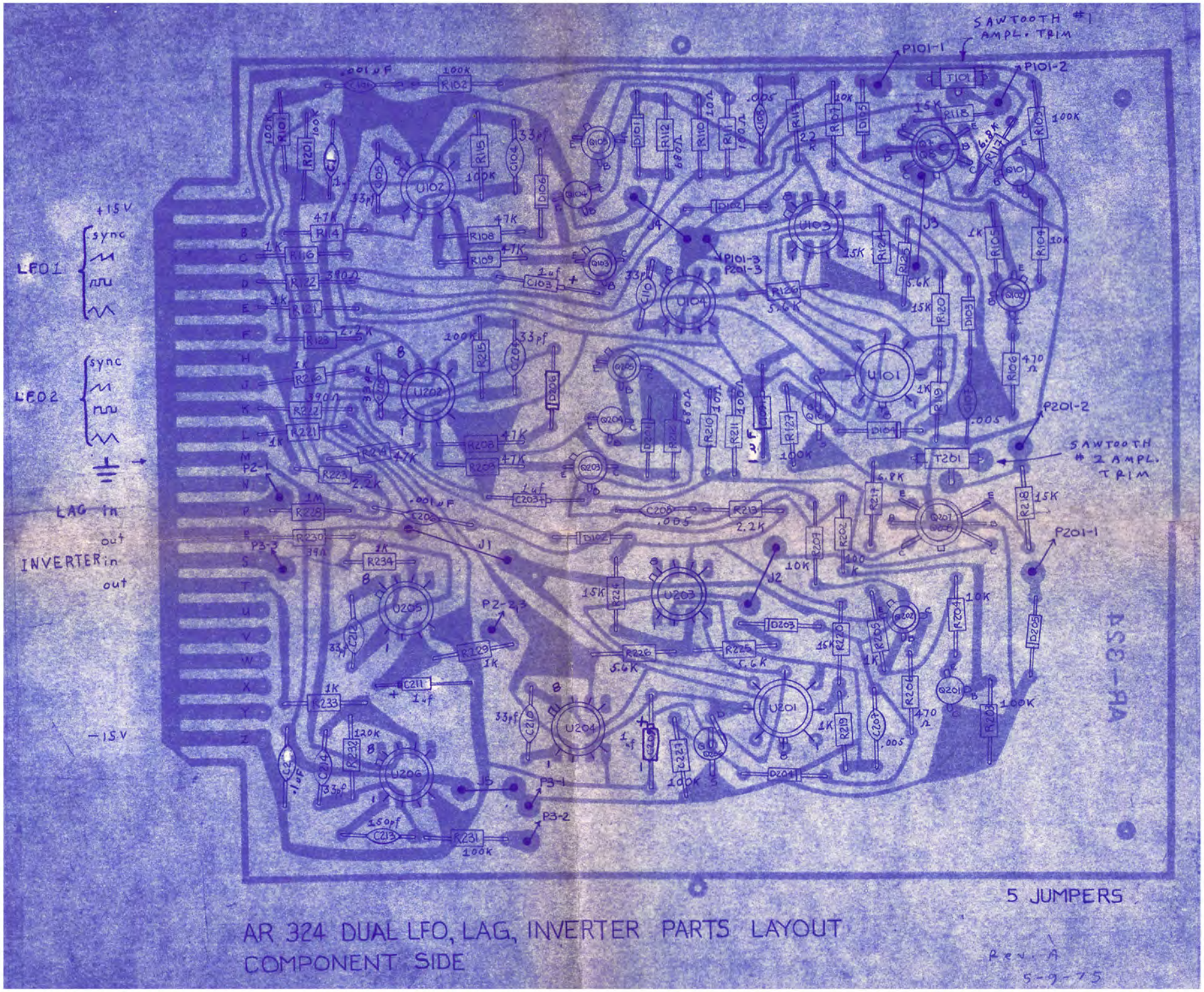


LAG CIRCUIT



INVERTER CIRCUIT

AR-324
LAG, INVERTER
AND
1/2 DUAL LOW FREQUENCY OSCILLATOR



AR 324 DUAL LFO, LAG, INVERTER PARTS LAYOUT
COMPONENT SIDE

Rev. A
5-9-75