MODULE 1045 VOLTAGE CONTROLLED VOICE

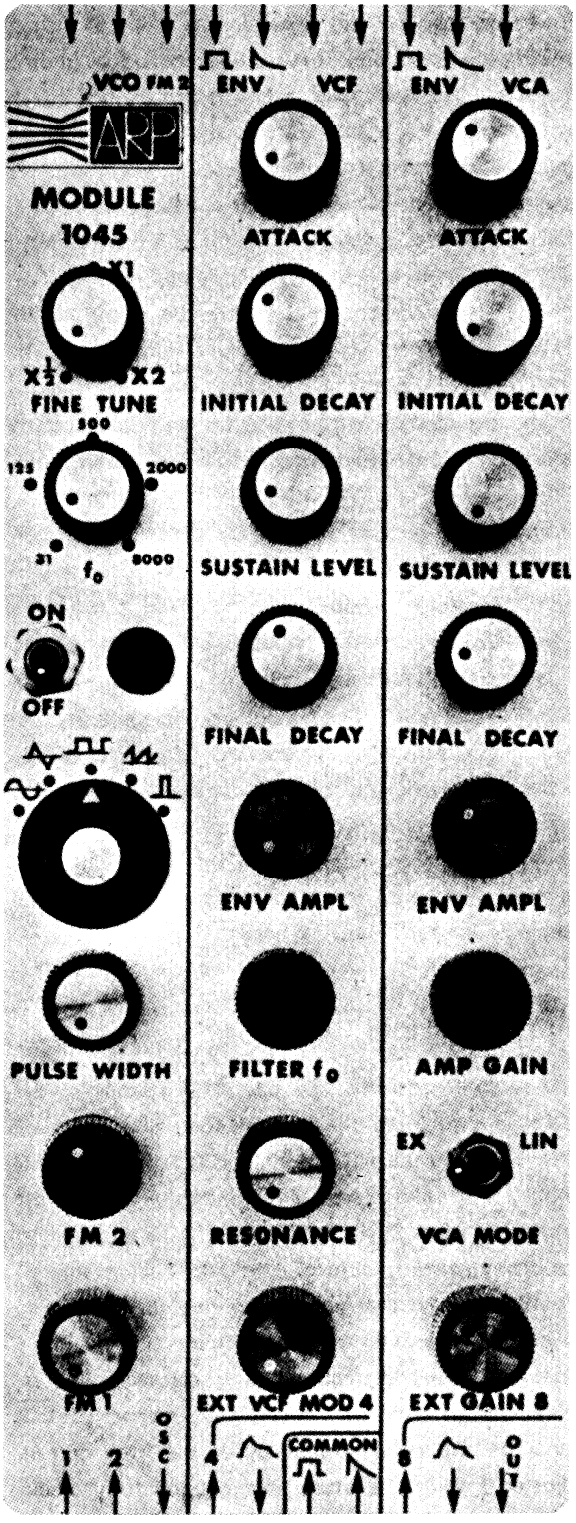
The ARP Module 1045 is a functional circuit package designed for use in the ARP Series 2000 Synthesizers. The module contains a voltage controlled oscillator, a voltage controlled low pass filter, a voltage controlled amplifier, and a dual exponential envelope generator.

Fig. A shows a block diagram of the module 1045. The output of the Voltage Controlled Oscillator is coupled through a switch permitting waveform selection to the input of the voltage controlled low pass filter. The output of the filter is in turn connected to the input of the voltage controlled amplifier. The final signal is obtained at the output of the voltage controlled amplifier. Exponential envelope generators are coupled through attenuators to the control inputs of both the filter and amplifier. The module 1045 is a small self-contained synthesizer, offering the user control over pitch, timbre, amplitude, and combinations of time-variant functions of pitch, timbre, and amplitude. Outputs and inputs are arranged so that the oscillator, filter-amplifier, or envelope generators may be used separately or in various combinations.

OSCILLATOR SECTION

The voltage controlled oscillator used in the module 1045 is electrically similar to the ARP 1004 Voltage controlled Oscillator. The oscillator output is connected to a rotary switch which permits the selection of sine, triangle, square, sawtooth or pulse output waveforms. The output frequency range of the oscillator is 16Hz to 16,000 Hz without external control voltages and the control voltage range is 10 octaves. Control signals may be either positive or negative, provided that the sum of the control voltages does not drive the oscillator frequency beyond the above limits.

A coarse panel adjustment knob permits setting the zero-control-voltage frequency to anywhere within the frequency range. A fine adjust knob with a ± 1 octave range is provided for accurate tuning.



ACTUAL SIZE

There are two control signal inputs along the lower matrix switches and three along the upper matrix switches. The two lower matrix switch control inputs are connected to attenuators so that the effect of an external control signal on the oscillator's frequency can be adjusted. When these attenuators are rotated fully clockwise, a change of 1 volt at a control input will result in a change of frequency of 1 octave. Two of the three control inputs from the upper matrix switches are fixed at 1 volt/octave sensitivity. The third control input is tied to the second control input from the lower matrix switches and is therefore affected by the attenuator associated with that input.

In addition, another panel-knob control (PW) permits manual adjustment of the duty cycle of the pulse waveform output.

The input impedances of the control inputs is 100-Kohms minimum. The output impedance is 1Kohm and this output may be shorted to ground or any other module output without damage to the oscillator. When several such outputs are shorted together, the resulting waveform will be the averaged instantaneous voltage of the outputs that are shorted together.

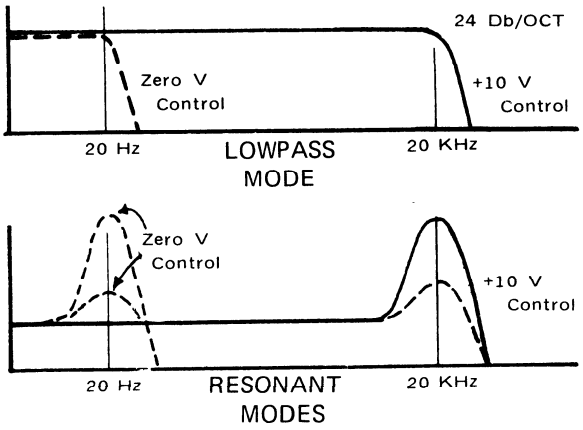
FILTER SECTION

The voltage controlled low-pass filter section of the 1045 is similar to the voltage controlled low-pass filter found in the ARP Module 1006. A front panel knob (f_c) is used to manually adjust the filter cutoff frequency from 20Hz to 20,000Hz. In addition to the front panel f_c control, the cutoff frequency of the filter can be changed by applying control signals to any of the external control inputs. The input from the lower matrix switch is connected to an attenuator so that the effect of an external control signal on the cutoff frequency of the filter can be adjusted. With the attenuator rotated fully clockwise, a change of 1 volt at the control input will result in a change of 1 octave in cutoff frequency. The sensitivity of the control input from the upper matrix switch is fixed at 1 volt/octave.

In addition to the external control signals and the front panel f_c control, the cutoff frequency of the filter may also be varied by the application of the 1045's internal envelope generator to the filter control. A front panel knob (Env. Ampl) directly above the F_c control permits the output of the envelope generator to be connected directly into the control input of the filter. By a clockwise rotation of this knob, the effect of the envelope generator output on the cutoff frequency of the filter is increased. When this knob is turned fully counterclockwise, the envelope generator output is fully attenuated and will not affect the filter. Since the output voltage of the envelope generator can reach +10 volts, it is possible to change the cutoff frequency of the filter by 10 octaves when the "Env Ampl" knob is rotated fully clockwise.

By adjusting the "resonance" control on the front panel, a "peaked" response at the cutoff frequency may be obtained if so desired. This type of response is useful for creating certain types of formants, such as "wa-wa" and "yeow" effects. The panel knob adjusts the height of the resonant peak with respect to the pass-band characteristics of the filter. Figure (B) demonstrates the effect of this control.

FIGURE B



MODULE 1045 VOLTAGE CONTROLLED VOICE

AMPLIFIER SECTION

The voltage controlled amplifier (VCA) accepts the output signal from the voltage controlled filter (VCF), and modifies the signal level according to the sum of a local control voltage (provided by the panel knob marked "gain"), a number of external control voltages and the output of the internal envelope generator.

The voltage controlled amplifier may be operated in one of two selectable modes. The exponential mode has a control transfer function of 10 dB per volt. In other words, a change of 1 volt in the sum of the control signals will result in a change of 10 dB in gain. When the sum of the control voltages is +10 volts (maximum usable control voltage), the gain of the amplifier is 0 dB. When the sum is 9 volts, for instance, the VCA would attenuate the audio signal by 10 dB. In the linear mode the gain (V_{out}/V_{in}) of the amplifier is directly proportional to the control voltage. Again, when the sum of the control signal is +10 volts, the gain of the amplifier is unity.

The range of the voltage controlled amplifier is over 100 dB, which permits the VCA to be used as a squelch gate device. By proper adjustment of controls, no discernible output should be obtained in the absence of control voltages, even when the audio input entering the amplifier is at very high levels.

The gain of the VCA may be controlled by the internal envelope generator by advancing the control marked "Env Ampl" directly over the "gain" control. When this control is rotated fully clockwise, the full 10 volt amplitude of the envelope generator output is applied to the control input of the VCA.

In addition, external control inputs are provided from both the upper and lower matrix switches. The input from the upper matrix switch is of fixed sensitivity (10 volts = 0dB gain) while the input from the lower matrix switch is connected to an attenuator so that the effect of the external control signal on the gain of the amplifier can be adjusted.

ENVELOPE GENERATOR SECTION

The envelope generators in the 1045 module produce exponential functions with four adjustable parameters: Attack time, Initial Decay Time, Sustain Level, and Final Decay Time. For each of the two envelope generators, there is a panel knob to adjust each of these parameters.

An envelope is initiated when signals are applied to both the Gate and Trigger inputs. The Gate input is symbolized by a rectangular pulse (⎍) and the Trigger input by an exponentially decaying impulse (⌐). When a gate pulse and a trigger pulse are applied at the same time (as they would be if derived from a keyboard) the output voltage of the envelope generator rises exponentially to 10 volts at a rate determined by the setting of the "Attack Time" control. When the output reaches 10 volts, the attack is ended and the output falls to the "Sustain Level" at an exponential rate determined by the "Initial Decay Time" Control. The sustain level is adjustable from 0 to 10 volts. The output will remain constant at the sustain level until the Gate signal is removed, at which time the output returns exponentially to 0 volts at a rate determined by the "Final Decay Time" control, (Fig. C).

If the Gate voltage is removed during any part of the cycle, the output will always return directly to zero at the exponential rate set by the "Final Decay Time" control, (Fig. D). If the Gate and trigger signals are reapplied before the output returns to zero, a new attack will begin immediately without the output voltage returning to zero, (Fig. E).

If at any time a Gate signal is applied in the absence of a trigger pulse, the output voltage will rise exponentially to the sustain level at a rate determined by the Initial Decay Time control. When the Gate is removed, the output will return to zero according to the Final Decay Time control setting.

MODULE 1045 VOLTAGE CONTROLLED VOICE

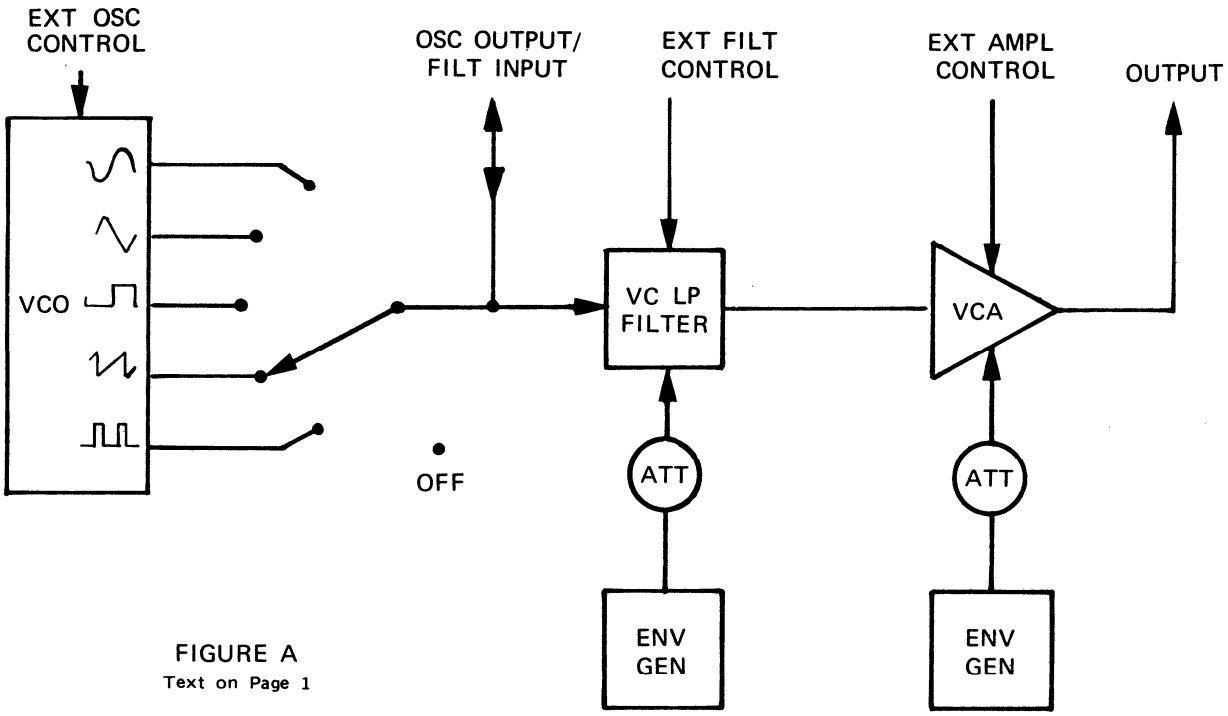
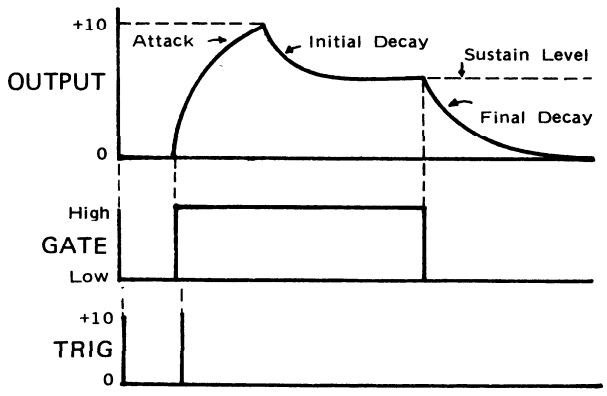


FIGURE A

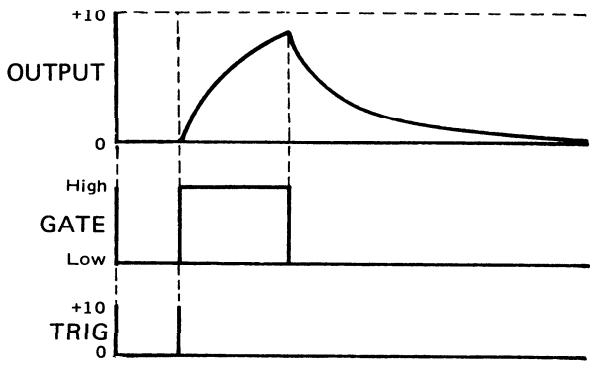
Text on Page 1

FIGURE C



If it is desirable to operate the envelope generator from a gate signal alone, the Trigger input is connected to the Gate Input by positioning the matrix switches for these two inputs to the same horizontal line.

FIGURE D



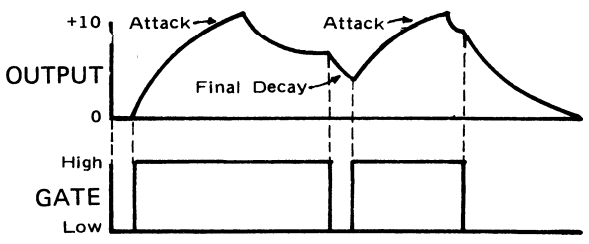


FIGURE E

MODULE 1045 VOLTAGE CONTROLLED VOICE

ELECTRICAL SPECIFICATIONS

OSCILLATOR SECTION

OUTPUTS:	Frequency range: 16Hz to 16,000Hz
	Sine, Triangle, Square, Sawtooth, and Pulse waveforms.
INPUTS:	Frequency modulation: fixed 1v/octave (2)
	Frequency modulation: Adjustable, 1v/octave maximum (3)
LONG TERM FREQUENCY DRIFT:	Ambient $50^{o}F$ to $90^{o}F$, $\pm 5^{o}F$, drift is typically less than 1/6 semitone per hour.

FILTER SECTION

ROLLOFF:	24dB/octave above cutoff frequency
FILTER RESONANCE:	0 to 20 dB peak.
MAX AUDIO SIGNAL LEVEL:	20 volts P–P Max
CONTROL INPUT SENSITIVITY:	1 volt/octave all inputs (attenuators fully clockwise); 0v = 20Hz

AMPLIFIER SECTION

RESPONSE:	$\pm$3dB, 2Hz to 30KHz.
MAX GAIN:	0dB
MAX ATTENUATION:	100dB
TRANSFER FUNCTION:	$V_{out} = (V_{in} \cdot V_{control})/10$, Linear mode
	$V_{out} = V_{in} \cdot 10(V_{control}-10)/2$, Exp'l mode

ENVELOPE GENERATOR SECTION

ATTACK TIME:	.001 secs to 2.0 secs
INITIAL DECAY TIME:	.001 secs to 2.0 secs
SUSTAIN LEVEL:	0 to +10 volts
FINAL DECAY TIME:	.001 secs to 2.0 secs
GATE SENSITIVITY:	8.0 volts, upper matrix switch
	1.8 volts lower matrix switch

GENERAL

INPUT IMPEDANCES:	100Kohms min.
OUTPUT IMPEDANCES:	1Kohm
MAXIMUM POWER REQUIREMENTS:	$\pm$15 volts @ 120 ma, regulated to $\pm$ 0.1%.
	+12 to +15 volts @ 20 ma unregulated, lamp supply

1045 TEST PROCEDURE (PRELIMINARY)

February 2, 1973

1. Test Equipment Required:
   1.1 Tektronix Oscilliscope
   1.2 2500 Wing Cabinet
   1.3 Function Generator (or a 1004 module)
   1.4 0V - 10V/out box 1.5 Frequency counter
   1.5 Digital Voltmeter

2. Applicable Documents
   2.1 C-1045-012 Rev. K (Bd. 1 P.C. Layout)
   2.2 C-1045-022 Rev. D (Bd. 1 Schematic)
   2.3 C-1045-013 Rev. F (Bd. 2 P.C. Layout)
   2.4 C-1045-021 Rev. C (Bd. 2 schematic)
   2.5 C-1045-014 Rev. E (Bd. 3 P.C. Layout)
   2.6 B-1045-020 Rev. C (Bd. 3 schematic)

3. Preliminary Set-up:
   3.1 Thoroughly inspect the module per the sample
   3.2 Measure the resistance between all five power supply inputs. It must be greater than 400
   3.3 Check alignment of the knobs
   3.4 Set all of the pots fully CCW
   3.5 Switch the module to ON
   3.6 Make sure Q1 and Q2 on the main board are installed
   3.7 Plug the module into the wing cabinet using an extender card
   3.8 Apply power

4. Pulse Width Trim and Test
   4.1 Set both freq. controls to midrange
   4.2 Connect the scope to the output(osc)
   4.3 Set the Function Switch to pulse
   4.4 Select R54 for 5% ± 1% pulse on the scope
   4.5 Set the PW pot fully CW
   4.6 Select R55 on Bd. 1 for a 95% ± 1% pulse on the scope
   4.7 Set the Pulse Width Pot to midrange

5. FM Inputs Test:
   5.1 Set both freq. controls fully CCW
   5.2 Connect a 10V P-P, 1HZ sawtooth to input "1"
   5.3 Connect the scope to the osc. output
   5.4 Set the Function Switch to pulse
   5.5 Verify that the pulse output remains constant
   5.6 Set the "FM1" pot fully CW
   5.7 Verify that the osc. output is now freq. modulated by the 1 HZ sawtooth
   5.8 Repeat steps 5.2 thru 5.7 for the input "2" and upper FM2 input
   5.9 Repeat steps 5.2, 5.3, 5.6 for the upper two VCO inputs

6. Output Test:
   6.1 Set all of the pots fully CCW
   6.2 Set both freq. controls to midrange
   6.3 Connect the scope to the osc. output

1045 TEST PROCEDURE (PRELIMINARY) continued

6.4 Switch to each of the five functions and verify that they are 10V P-P ± .25V and have the proper waveform

7. Trigger Modes Test:
   7.1 Connect a 25 HZ pulse at 65% duty cycle to the lower gate and trigger
   7.2 Set all of the pots fully CCW
   7.3 Set both Sustain pots MID-RANGE
   7.4 Set the left Env. Amp pot fully CW
   7.5 Connect the scope to the left envelope output
   7.6 Verify that the envelope is present and looks like fig. 4-1
   7.7 Remove the 25 HZ pulse from the trigger input
   7.8 Verify that the envelope now looks like fig. 4-2
   7.9 Repeat steps 7.1 thru 7.8 for the right envelope output
   7.10 Repeat steps 7.1 thru 7.9 using the upper gate and trig. inputs

8. ADSR Adjustment Test:
   8.1 Attack time adjustment range
      8.1.1. Set all of the pots fully CCW
      8.1.2. Connect a NO push button from +15V to the lower gate +TRIGGER input
      8.1.3. Set the left Env. Amp pot fully CW
      8.1.4. Connect the scope to the left envelope output
      8.1.5. Push the button repeatedly and verify that the attack time is 2 msec, or less
      8.1.6. Set the left attack pot fully CW
      8.1.7. Push the button and hold
      8.1.8. Verify that the envelope slowly rises to 10 volts in 2 to 3 seconds and that it falls to 0V when it reaches 10V
   8.2 Initial DECAY Time Adjustment range:
      8.2.1. Set all of the pots fully CCW
      8.2.2. Set the left Env. Amp. pot fully CW
      8.2.3. Set the left sustain pot to midrange
      8.2.4. Push the button repeatedly and verify that the time from the peak of the envelope to the plateau is 3 to 6 msec.
      8.2.5. Set the left sustain pot fully CCW
      8.2.6. Set the Initial Decay pot fully CW
      8.2.7. Push the button and hold
      8.2.8. Verify that the envelope rises quickly to 10V and then falls to 0V in 4 to 10 seconds
   8.3 Sustain Level Adjustment Range
      8.3.1. Set all of the pots fully CCW
      8.3.2. Set the left Env. Ampl. pot fully CW
      8.3.3. Push the left manual gate button repeatedly and verify that the level of the envelope, while the gate is depressed, is controlled by the sustain level pot
      8.3.4. Set the sustain level pot fully CW
      8.3.5. Connect a digital voltmeter to the left envelope output
      8.3.6. Push the button and hold

1045 TEST PROCEDURE (PRELIMINARY) continued

8.3.7. Trim R149 or R156 on Bd. 2 for +10.00V ± .05 VDC
8.4 Final DECAY Time Adjustment Range
8.4.1. Set all of the pots fully CCW
8.4.2. Set the left Env. Ampl. pot fully CW
8.4.3. Set the sustain level pot MID-RANGE
8.4.4. Push the button repeatedly and verify that the envelope fall time is 3 to 6 msec.
8.4.5. Set the Final DECAY pot fully CW + SUSTAIN POT FULLY CW
8.4.6. Push the button and release
8.4.7. Verify that the envelope falls to 0V in 4-10 sec.
8.5 Repeat steps 8.1 thru 8.4 for the right channel(in step 8.3.7. trim R149 and R156 on Bd. 2)

9. Sustain Pedal Jack Test:
9.1 Set all of the pots fully CCW
9.2 Set the sustain level pots fully CW
9.3 Set the left Env. Ampl. pot fully CW
9.4 Connect the scope to the left envelope output
9.5 Connect a normally open push button switch to the pedal jack
9.6 Connect a 10 HZ square wave at 10V P-P to the lower gate input
9.7 Verify that there is a square wave on the output
9.8 Push the external switch and hold
9.9 Verify that the output locks up at 10V
9.10 Release the external switch and verify that the square wave returns to the output
9.11 Repeat steps 9.2 thru 9.10 for the right channel

10. Control Input Adjustments:
10.1 VCF Control Input Adjustment
10.1.1. Install a 56K resistor for R85
10.1.2. Set all of the pots fully CCW
10.1.3. Switch the module OFF
10.1.4. Set the Filter fo knob fully CW
10.1.5. Connect the DVM to A1 pin 6 on Bd. 3
10.1.6. SELECT R58 on Bd. 3 for -10.00V ± .05VDC at A1 pin 6
10.2 VCA Control Input Adjustment
10.2.1. Set the Amp. Gain knob fully CW
10.2.2. Connect the DVM to A2 pin 6 on Bd. 3
10.2.3. SELECT R60 on Bd. 3 for - 10.00V ± .05VDC at A2 pin 6

11. Output Offset Adjustment:
11.1 Set all of the pots fully CCW
11.2 Set the Amp. gain pot fully CW
11.3 Connect the scope to the module output
11.4 Adjust trimpot R15 on Bd. 3 for 0VDC at the output
*-SEE STEP 13

12. LINEAR and EXP'L. Gain Adjustments:
12.1 Switch the module ON
12.2 Set all of the pots fully CCW
12.3 Set the Filter fo pot fully CW
12.4 Set both frequency pots to midrange
12.5 Set the oscillator function switch to square wave
12.6 Set the Amp. Gain pot fully CW
12.7 Set the VCA Mode Switch to Linear

1045 TEST PROCEDURE (PRELIMINARY) continued

12.8 Connect the scope to the module output
12.9 Trim R85 on Bd. 3 for a 10V P-P square wave at the output
12.10 Set the switch to EXP'L.
12.11 Trim R75 on Bd. 3 for a 10 V P-P square wave of the output

13. VCF Control Rejection Adjustment: Do Twice - Before Step 12 after Step 12
13.1 Set all of the pots fully CCW
13.2 Switch the module OFF
13.3 Connect the DVM to the junction of R41 + R43 on Bd. 3
13.4 Adjust trimpot R8 on Bd. 3 for a minimum voltage swing as the filter Fo pot is rotated from min. to max.

14. VCF Offset Adjustments:
14.1 Set all of the pots fully CCW
14.2 Set the Filter fo control fully CW
14.3 Connect the DVM to the junction of R41 + R43 on Bd. 3
14.4 Select R42 for 0V ± 1.0VDC at the junction of R41 + R43
14.5 Connect the DVM to the junction of R39 + R38 on Bd. 3
14.6 Select R40 for 0V ± 1.0VDC at the junction of R39 + R38
14.7 Recheck steps 13 and 14

15. Resonance Adjustment:
15.1 Set all of the pots fully CCW
15.2 Set the RESONANCE pot fully CW
15.3 Set the Amp. Gain pot fully CW
15.4 Trim R24 so that the module breaks into resonance with the Filter F_o pot at 80% - 100% CW

16. Control Rejection
16.1 Set all of the pots fully CCW
16.2 Set the Amp. Gain pot fully CW
16.3 Set the Filter fo pot to midrange
16.4 Switch the VCA Mode to Linear
16.5 Set the Ext. VCF Mod[illegible] pot fully CW
16.6 Connect a 1KHz sinewave at 10V P-P to the Ext. VCF Mode input
16.7 Connect the scope to the module output
16.8 Adjust trimpot R8 on Bd. 3 for a null on the output
16.9 Set the Ext. VCF Mod[illegible] pot fully CCW
16.10 Disconnect the 1KHz sinewave from the Ext. VCF Mode input and connect it to the Ext. Gain input
16.11 Set the Ext. Gain pot fully CW
16.12 Set the Amp. Gain pot to midrange
16.13 Adjust trimpot R15 on Bd. 3 for a null on the output

17. High Frequency Rejection: (Delete Step 17)
17.1 Set all of the pots fully CCW
17.2 Connect a 16KHz, 10V P-P sinewave to the junction of C2 and R43 on Bd. 3

1045 TEST PROCEDURE (PRELIMINARY) continued'

17.3 Connect the scope to the module output
17.4 Adjust trimpot R13 on Bd. 3 for a null on the output

18. Input-Output Test:
18.1 Filter Control Inputs Test:
18.1.1. Set all of the pots fully CCW + Both Freq. Pots Midrange
18.1.2. Set the Amp. Gain pot fully CW
18.1.3. Switch the module ON
18.1.4. Set the function switch to square wave
18.1.5. Connect a 1HZ 10V P-P sawtooth to the Ext. VCF Mod input
18.1.6. Connect the scope to the module output
18.1.7. Set the Ext. VCF Mod pot fully CW
18.1.8. Verify that the output is amplitude modulated by the 1HZ sawtooth and that the square wave rounds off as the output amplitude gets smaller
18.1.9. Verify that the Ext. VCF Mod pot controls the 1HZ control signal
18.1.10 Repeat steps 18.1.1. thru 18.1.6 and 18.1.8 for the upper two VCF control inputs
18.2 Amplifier Control Inputs Test:
18.2.1. Set all of the pots fully CCW
18.2.2. Set the Filter fo pot fully CW
18.2.3. Connect the scope to the module output
18.2.4. Set the function switch to square wave
18.2.5. Switch the module ON
18.2.6. Connect a 1HZ 10V P-P sawtooth to the Ext. Gain input
18.2.7. Set the Ext. Gain pot fully CW
18.2.8. Verify that the output is amplitude modulated by the 1HZ sawtooth
18.2.9. Verify that the Ext. Gain pot controls the amplitude of the 1HZ sawtooth
18.2.10 Repeat steps 18.2.1. thru 18.2.6 and 18.2.8 for the upper VCA control input

19. Module Interconnection Test:
19.1 Switch the module to ON
19.2 Set all of the pots fully CCW
19.3 Set both frequency pots to midrange
19.4 Set both sustain pots to midrange
19.5 Set both Initial Decay pots to 25% CW
19.6 Set both Final Decay pots to 25% CW
19.7 Set the left Env. Ampl. pot fully CW
19.8 Switch the VCA Mode to LIN
19.9 Switch the function switch to square wave
19.10 Connect the scope to the module output
19.11 Connect a 4HZ 10V P-P square wave to the lower gate and trig. inputs
19.12 Set the Amp. gain pot fully CW
19.13 Verify that the output is amplitude modulated by the envelope
19.14 Verify that the left Env. Ampl. pot controls the output amplitude

1045 TEST PROCEDURE (PRELIMINARY) continued

19.15 Set the Amp. Gain pot fully CCW
19.16 Set the Filter fo pot fully CW
19.17 Set the left Env. Ampl. pot fully CCW
19.18 Set the right Env. Ampl. pot fully CW
19.19 Verify that the output is amplitude modulated by the envelope
19.20 Verify that the right Env. Ampl. pot controls the output amplitude

20. Frequency Calibration and test:
20.1 Set all of the pots fully CCW
20.2 Switch the module to ON
20.3 Switch the function switch to sawtooth
20.4 Set the fine freq. control to X1
20.5 Set the coarse freq. control fully CW
20.6 Connect the freq. counter to the osc. output
20.7 Adjust trimpot R1 on Bd. 1 for 8050 HZ ± 50 HZ on the counter
20.8 Set the coarse freq. control fully CCW
20.9 Verify that the freq. on the counter is 31 HZ or less
20.10 Verify that the fine freq. control varies the frequency

21. V/oct. and HFT Adjustments:
21.1 Set all of the pots fully CCW
21.2 Connect the V/oct box to one the upper left FM input
21.3 Connect the freq. counter to the osc. output
21.4 Calibrate the 15V power supply in the wing cabinet
21.5 Set the V/oct box to 0V
21.6 Adjust the coarse and fine freq. controls for a 8.000 ± .002 msec. period on the counter
21.7 Set the V/oct box to 3V
21.8 Adjust trimpot R6 on Bd.1 for 1000HZ ± .5 HZ
21.9 Repeat steps 21.6 thru 21.9 until no further adjustment are necessary
21.10 Set the V/oct box to 5V
21.11 Adjust trimpot R59 on Bd.1 for 4000HZ ± 2HZ
21.12 Set the V/oct box to 4V
21.13 Select C5 on Bd.1 for 2000HZ ± 1HZ
21.14 Repeat steps 21.5 thru 21.13 until no adjustment is necessary
21.15 Switch the module to OFF and verify that the lamp goes off. Verify that the output goes to zero.

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APP'D BY D. [illegible] DATE SHEET 1 OF 5

REV BY DATE

B UPDATE 3-3-71 BA

C ECO-0094 RB 2/4/72

D ECO-0[illegible] 11-1-72 RB RAP

PARTS LIST

TITLE P.C. ASSEMBLY PL MOD 1045 OSCILLATOR BD 1

ITEM	REF.	DESCRIPTION OF PART	VENDOR	VENDOR PART NO.	TONUS PART NO.	QTY REQ	STANDARD COST	EXTENSION
1								
2								
3								
4	A3, A4, A1, A2, A5	I.C., OPERATIONAL AMP	NSC	LM301AH		5		
5	4001	EXPONENTIAL MODULE	ARP		APL4001-003B	1		
6	4002	EXPONENTIAL MODULE	ARP		APL4002-003B	1		
7	R37, R38	47Ω, 1/4W ±10%, RESISTOR, CARBON	AB	CB4701		2		
8	R31, R30, R48	100Ω		CB1011		3		
9	R39	220Ω		CB2211		1		
10								
11	R47	560Ω		CB5611		1		
12	R49, R56, R22	1K, 1/4W ±10%, RESISTOR, CARBON	AB	CB1021		3		

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PARTS LIST

TITLE P.C. ASSEMBLY PL MOD 1045
OSCILLATOR BD 1

REV	#	DATE
E	ECO-0321	CBK 9/22/74
F	ECO 0496	TJN/SW 11/25/74
G	ECO 0503	TJN/CDW 12/11/74

ITEM	REF	DESCRIPTION OF PART	VENDOR	VENDOR PART NO.	TONUS PART NO.	QTY REQ	STANDARD COST	EXTENSION
13	R32, R33 R82, R95	1.5K, 1/4W ±10%, RESISTOR, CARBON	AB	CB1521		4		
14	R50	1.8K		CB1821		1		
15	R51, R52, R57, R58, R69, R70, R79, R91, R93.	2.2K		CB2221		9		
16	R80, R83, R96	3.3K		CB3321		3		
17	R46, R53, R87, R88	4.7K		CB4721		4		
18	R61	5.6K		CB5621		1		
19	R72, 74, 77	10K		CB1031		3		
20	R89, R90, R92	15K		CB1531		3		
21	R75	33K		CB3331		1		
22	R40, R45	47K		CB4731		2		
23	R60	68K		CB6831		1		
24	R71, R76	100K, 1/4W ±10%, RESISTOR, CARBON	AB	CB1041		2		

NOV 7 1975

tonus inc.

DRAWN C. WORDEN DATE 8-19-70 DRAWING NO APL-1045-015 REV H

SHEET 3 OF 5

PARTS LIST

TITLE P.C. ASSEMBLY PL MOD 1045 REV H ECO 0583 DATE TN 10-7-75

OSCILLATOR BD 1

ITEM	REF.	DESCRIPTION OF PART	VENDOR	VENDOR PART NO	TONUS PART NO.	QTY REQ	STANDARD COST	EXTENSION
25	R78	120K, 1/4W ± 10%, RESISTOR, CARBON	AB	CB1241		1		
26	R65	150K		CB1541		1		
27	R73	1.5 MEG		CB1551		1		
28	R42, R44	8.2 MEG		CBB251		2		
29	R11, R13, R54, R55, R66, R81, R86, R94	SELECT				8		
30	R35, R36, R37, R38	SELECT, 1/4W ± 10%, RESISTOR, CARBON	AB			0 MIN 4 MAX		
31	R34	100Ω, 3% @ 25C, W.W. FENICOLOY, +3500 PPM/°C	TEL LABS	EL2H (AXIAL LEADS)		1		
32	R26, R27	5.36K, 1% METAL FILM (RN55)	HEPCO	RN55C5361F		2		
33	R22, R23	10K		RN55C1002F		2		
34	R28, R29	15K		RN55C1502F		2		
35	R63, R64 R100	40.2K		RN55C4022F		3		
36	R84	68.1K, 1% METAL FILM (RN55)	HEPCO	RN55C6812F		1		

NOV 7 1975

tonus, inc. 45 KENNETH STREET NEWTON HIGHLANDS MASSACHUSETTS 02161

DRAWN C.V. JORDEN DATE 8-19-70 DRAWING NO. APL-1045-015 REV H

APP'D BY DATE SHEET 4 OF 5

REV DATE

PARTS LIST

TITLE P.C. ASSEMBLY PL MOD 1045
OSCILLATOR BD 1

ITEM	REF	DESCRIPTION OF PART	VENDOR	VENDOR PART NO	TONUS PART NO.	QTY REQ	STANDARD COST	EXTENSION
37	R19	97.6K, 1% METAL FILM (RN55)	MEPCO	RN55C9762F		1		
38	R14, R15, R16, R17, R99	100K, 1% METAL FILM (RN55)		RN55C1003F		5		
39	R85	121K, 1% METAL FILM (RN65)		RN65C1213F		1		
40	R10	196K		RN65C1963F		1		
41	R9, R12	787K, 1% METAL FILM (RN65)	MEPCO	RN65C7873F		2		
42	R6	5K, POTENTIOMETER, (TRIMMER)	CTS	X201R502B		1		
43	R1, R41, R43	50K, POTENTIOMETER, (TRIMMER)	CTS	X201R503B		3		
43A	R59	1M " "		X201R105B		1		
44	C10, C19	10PF, CAPACITOR, CERAMIC DISC 20% 50V	ACI	AC-1		2		
45	C2	20PF,		AC-1		1		
46	C7	100 PF,		AC-1		1		
47	C1, 4, 16	220PF,		AC-1		3		
48	C15	680 PF, CAPACITOR, CERAMIC DISC 20% 50V	ACI	AC-1		1		

NOV 7195

tonus, inc. 32 KENNEDY STREET NEWTON HIGHLANDS MASSACHUSETTS 02161

DRAWN BY C. WOLDEN DATE 8-19-70 DRAWING NO. APL-1045-0[illegible] REV H

APPD BY DATE SHEET 5 OF 5

REV DATE

PARTS LIST

TITLE P.C. ASSEMBLY PL MOD 1045
OSCILLATOR BD 1

ITEM	REF	DESCRIPTION OF PART	VENDOR	VENDOR PART NO.	TONUS PART NO.	QTY REQ	STANDARD COST	EXTENSION
49	C25	30 PF CAPACITOR, CERAMIC DISC 20% 50V	ACI	AC-1		1		
50	C5, C12	SELECT, CAPACITOR, CERAMIC, DISC	ERIE			0 MIN 2 MAX		
51	C11	330 PF, ±5% CAPACITOR, SILVER MICA 500V	ELMENCO	DM-15-331J		1		
52	C20	1300 PF, ±5% CAPACITOR, SILVER MICA, 500V	ELMENCO	DM-19-132J		1		
53	C21 C22 C30	1.0UF, CAPACITOR, TANTALUM, 35V, 20%	ITT	TAG-DO-$\frac{1}{35}$-$\frac{20}{20}$		4		
54	C8, C9, C10, C11	DIODE	FSC	1N4148		11		
55	Q1, Q2	TRANSISTOR, FIELD EFFECT P CHANNEL	MOT	2N5460		2		
56	Q3/Q4	, ASSY, NPN/PNP	ARP		APL4027-008	1		
57	Q5/Q6, Q7/Q8 Q9/Q10, Q12/Q13 Q16/Q17	, MATCHED PAIR	ARP		A4012-009-	5		
58	Q14/Q15	, MATCHED PAIR, PNP	ARP		A4027-007-	1		
59	Q11	TRANSISTOR, PNP	SPRAGUE	TE-581		1		
60		P.C. ASSEMBLY	ARP		C1045-012K	REF		
61		P.C. MACHINING (IN HOUSE)	ARP		C1045-002A	1		
62		P.C. BOARD (MAT'L FOR ITEM 61)	ARP		C1004-004CREF			
63		SCHEMATIC - 1045 BD 1	ARP		C1045-022D	REF		

NOV 1975

tonus, inc.
45 KENNETH STREET
NEWTON HIGHLANDS
MASSACHUSETTS 02161

DRAWN	DATE	DRAWING NO.	REV
BA	3.3.71	APL-1045-016	G
APP'D BY J. Freund	DATE	SHEET 1 OF 3	

PARTS LIST

TITLE PC ASSY BD # 2
(ENV. GEN.) MODULE 1045

REV	BY	DATE
C	UPDATE BA 3.3.71	
D	ECO-0216 RB	10-17-72
E	ECO-0321	KBR 4/22/74

ITEM	REF.	DESCRIPTION OF PART	VENDOR	VENDOR PART NO.	TONUS PART NO.	QTY REQ	STANDARD COST	EXTENSION
1		PC BOARD, IN HOUSE MACH.	ARP		C1045-003B	1		
1A		PC BOARD (MAT'L FOR ITEM 1)	ARP		C1033-003D	REF		
2	R101, 107, 108, 119, 120 121, 201, 207, 208, 219 220, 221	RESISTOR, 100K 1/4W 10% CARBON COMP	AB	CB1041		12		
3	R102, 134, 202, 234	15K		CB1531		4		
4	R103, 105 203, 205	22K		CB2231		4		
5	R104, 110, 113, 115, 116 122, 133, 135, 137, 149 204, 210, 213, 215, 216, 222, 233, 235, 237, 249	10K		CB1031		20		
6	R106, 132, 206, 232	2.2K		CB2221		4		
7	R108, 209	220K		CB2241		2		
8	R111, 211	82K		CB8231		2		
9	R112, 212	1K		CB1021		2		
10	R114, 145 214, 245	4.7K		CB4721		4		
11	R123, 223	330Ω		CB3311		2		
12	R138, 238	47K		CB4731		2		

NOV 7 1975

tonus, inc. 45 KENNETH STREET NEWTON HIGHLANDS MASSACHUSETTS 02161

DRAWN BA | DATE 3.3.71 | DRAWING NO. APL-1045-016 | REV G
APP'D BY | DATE | SHEET 2 OF 3

PARTS LIST

TITLE PC ASSY BD 2 (ENV GEN) MODULE 1045

REV	BY	DATE
F	ECO 0496	TNN/GW 11/25/74
G	ECO 0526	TNN/GW 1/31/75

ITEM	REF.	DESCRIPTION OF PART	VENDOR	VENDOR PART NO.	TONUS PART NO.	QTY REQ	STANDARD COST	EXTENSION
13	R139, 239	RESISTOR, 68K ¼W 10% CARBON COMP	AB	CB6831		2		
13A	R146, 246	39K		CB3931		2		
14	R156, 256	33K		CB3331		2		
14A	R117, 217	3.3 MEG		CB3351		2		
15	R157, 257	22 MEG		CB2261		2		
16	C103, 203	CAPACITOR, 330 pf CERAMIC DISC 10%, 1KV	ACI	AC-1		2		
17	C110, 112 210, 212	.001 µf 20%, 50V		AC-1		4		
18	C113, 213	220 pf 20%, 50V		AC-2		2		
19	2, 14, 107A, 107B, 207A, 207B	1 µf @ 35V TANT 20%	ITT	TAG-DO-$\frac{1}{35}$-$\frac{20}{20}$		6		
20	C109, 209	8 µf @ 25V ALUM 10%	SPRAGUE	TE1203.5		2		
21	CR101→109, 111, 112, 115, 201→209, 211, 212, 215	DIODE	FSC	IN4148		24		
22	Q101, 104, 105, 106, 116, 201, 204, 205, 206, 216	TRANSISTOR	GE	2N5172		10		
23	Q102, 108, 115, 117, 202, 208, 215, 217		GE	2N6076		8		
24	Q107, 207		GE	2N5308		2		

7975

tonus, inc. 45 KENNETH STREET NEWTON HIGHLANDS MASSACHUSETTS 02161

DRAWN	DATE	DRAWING NO.	REV
BA	5·3·71	APL-1045-01	G
APP'D BY	DATE	SHEET 3 OF 3	

PARTS LIST

TITLE PC ASSY BD 2 (ENV. GEN) MODULE 1045

REV	BY	DATE

ITEM	REF.	DESCRIPTION OF PART	VENDOR	VENDOR PART NO.	TONUS PART NO.	QTY REQ	STANDARD COST	EXTENSION
25	Q110, 119, 210, 219	TRANSISTOR, FET	INTERSIL MOTOROLA	2N5460		4		
26	A101, 102, 201, 202	OP AMP	NSC	LM301AH		4		
27		ASSY DWG	ARP		C-1045-013F	REF		
28		SCHEMATIC	ARP		C-1045-021C	REF		

NOV 1975

tonus, inc. 65 KENNETH STREET NEWTON HIGHLANDS MASSACHUSETTS 02161

DRAWN BY	DATE	DRAWING NO.	REV.
C. WORDEN	8-28-70	APL-1045-017	6
APP'D BY	DATE	SHEET 1 OF 4	

PARTS LIST

TITLE R.C. ASSEMBLY PL MOD 1045
FILTAMP BO 3

REV	BY	DATE
	UPDATE GA 3.4.71	
B	ECO-0094	2/9/72 KB
C	ECO-0118	4/5/72 KB

ITEM	REF.	DESCRIPTION OF PART	VENDOR	VENDOR PART NO.	TONUS PART NO.	QTY REQ	STANDARD COST	EXTENSION
1		P.C. BOARD, IN HOUSE MACHINING	ARP		C1045-004A	1		
1A		P.C. BOARD (MAT'L FOR ITEM 1)	ARP		C1006-003B	REF		
2		P.C. ASSY DWG	ARP		C-1045-014E	REF		
2A		SCHEMATIC	ARP		B1045-020C	REF		
3	A3	1339 I.C., OPERATIONAL AMP	TELEDYNE	1339		1		
3a	A1, A2,	LM301AH OP AMP	NSC	LM301AH		2		
4	EXP-N	EXPONENTIAL MODULE	ARP		APL4001-003B	1		
5	R89	2.2K, 1/4W ±10%, RESISTOR, CARBON	AB	CB2221		1		
6	R56	100Ω,		CB1011		1		
7	R80, R81	330Ω,		CB3311		2		
8	R86	390Ω		CB3911		1		
9	R30, R31, R32	470Ω,		CB4711		3	NOV 71975	
10	R34	820Ω,		CB8211		1		
11	R88	1K,		CB1021		1		
12	R33	1.8K, 1/4W ±10%, RESISTOR, CARBON	AB	CB1821		1		

tonus, inc. 45 KENNETH STREET NEWTON HIGHLANDS MASSACHUSETTS 02161

DRAWN	DATE	DRAWING NO.	REV
C.W. :OEN	8-28-70	APL-1045-07	G
APP'D BY	DATE	SHEET 2 OF 4	

PARTS LIST

TITLE P.C. ASSEMBLY P.L. MOD 1045
FILTAMP BO 3

REV	BY	DATE
D	ECO 0129	KB 4-2-72
E	ECO-0321	KBK 9/22/72
F	ECO 0496	TJN/SW 1/25/74

ITEM	REF.	DESCRIPTION OF PART	VENDOR	VENDOR PART NO.	TONUS PART NO.	QTY REQ	STANDARD COST	EXTENSION
13	R26, R27	3.3K, 1/4W ±10%, RESISTOR, CARBON	AB	CB3321		2		
14								
15	R76, E83 E90	4.7K,		CB4721		3		
16	E20, R23, R87, E91	10K,		CB1031		4		
18	R39, R4.	15K,		CB1531		2		
19	R57, R59	18K,		CB1831		2		
20	R50, R67	22K,		CB2231		2		
21	R22, R23	33K,		CB3331		2		
22	E24	39K,		CB3931		1		
23	R21, R43	56K,		CB5631		2		
24	R44 THRU 49 R51, R61 THRU R66, R68	100K, 1/4W ±10%, RESISTOR, CARBON	AB	CB1041		14		

NOV 7 1975

tonus, inc. 45 KENNETH STREET NEWTON HIGHLANDS MASSACHUSETTS 02161

DRAWN BY: C. WORDEN | DATE: 8-28-70 | DRAWING NO. APL-1045-011 | REV 6

APP'D BY | DATE | SHEET 3 of 4

PARTS LIST

TITLE P.C. ASSEMBLY PL M00 1045
FILTAMP BD 3

REV	BY	DATE
6	ECO 0583	TN. 10-1-75

ITEM	REF.	DESCRIPTION OF PART	VENDOR	VENDOR PART NO.	TONUS PART NO.	QTY REQ	STANDARD COST	EXTENSION
25	R35, R36	220K, 1/4W ±10%, RESISTOR, CARBON	AB	CB2241		2		
26	R6 THRU R13 R79	470K,		CB4741		5		
27	R75	680K,		CB6841		1		
28	R40, R42, R58 R60, R84, R85	SELECT, 1/4W ±10%, RESISTOR, CARBON	AB			3 MIN 6 MAX		
29	R74	100Ω, 3% @ 25°C, W.W. FENICOLOY, 3500ppm/°C	TEL LABS	EL2H Y		1		
30	R72	3.32K, 1%, RN55, METAL FILM	MERCO	RN55C3321F		1		
31	R54	5.36K,		RN55C5361F		1		
32	R73	6.98K,		RN55C6981F		1		
33	R55	15K, 1%, RN55, METAL FILM	MERCO	RN55C1502F		1		

NOV 7 1975

tonus, inc. 45 KENNETH STREET NEWTON HIGHLANDS MASSACHUSETTS 02161

DRAWN BY	DATE	DRAWING NO.	REV
C.WOLDEN	8-28-70	APL1045-01	G
APP'D BY	DATE	SHEET 4 OF 4	

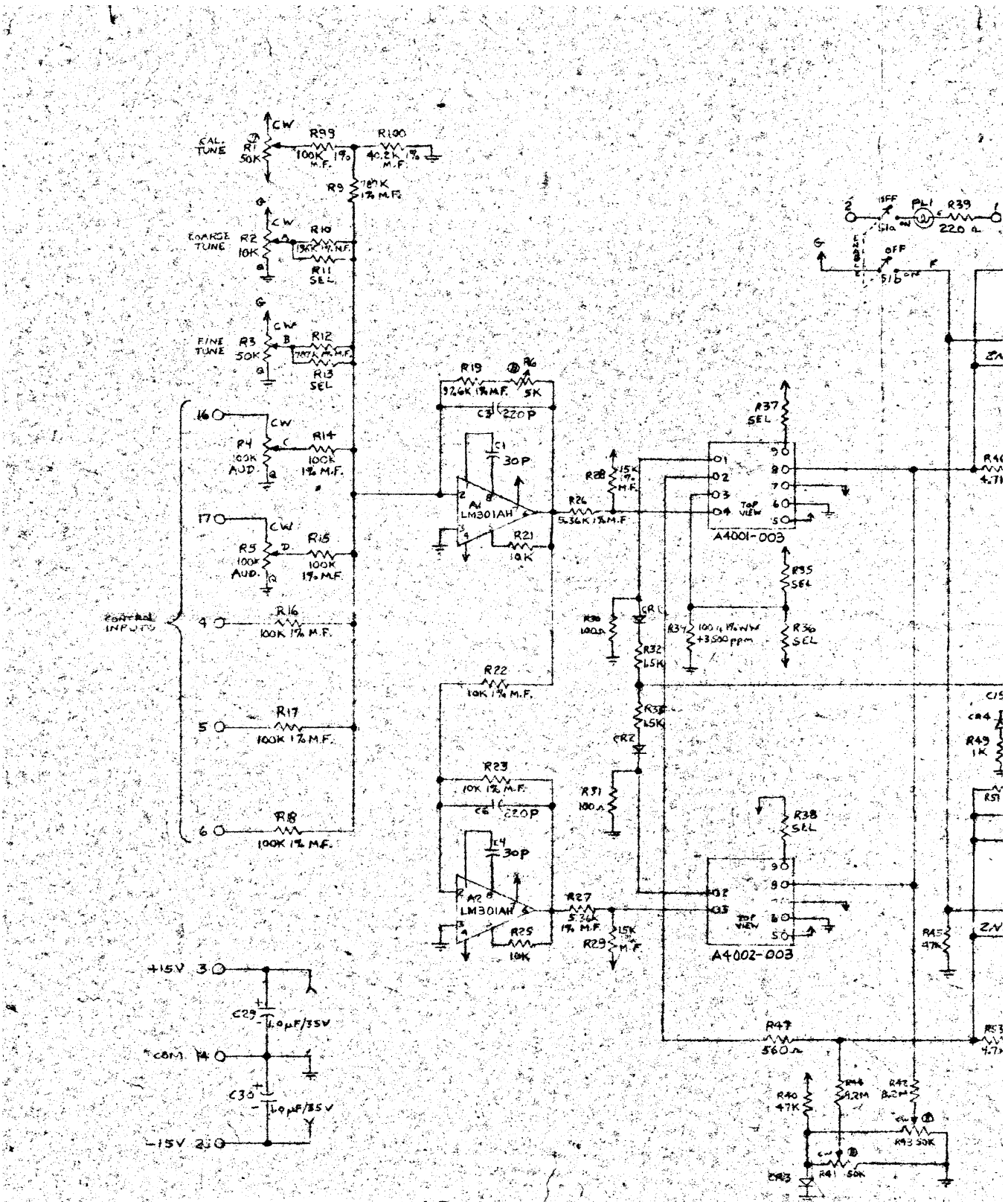
PARTS LIST

TITLE P.C. ASSEMBLY PL MOD 1045
FILTAMP BC 3

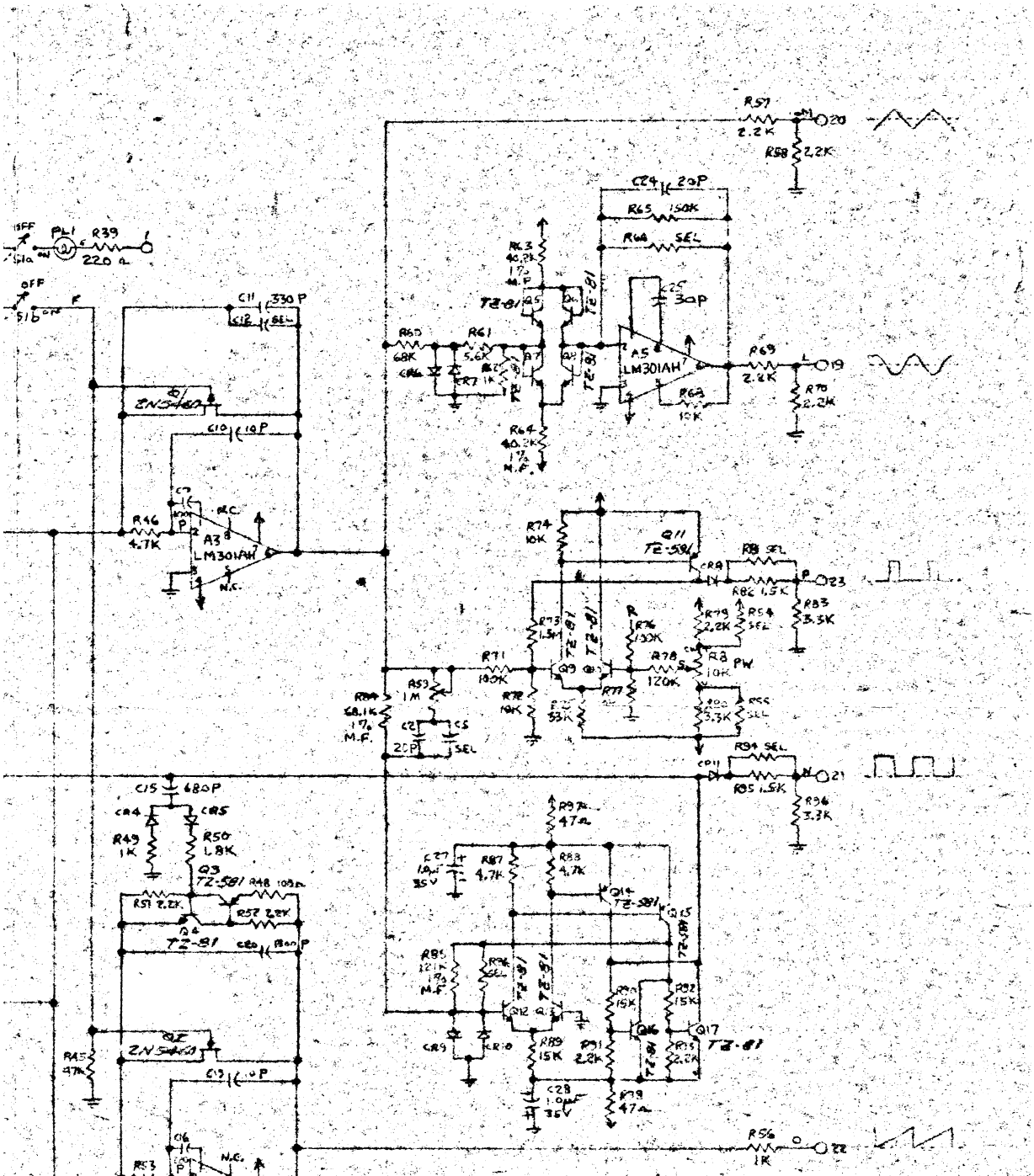
REV	BY	DATE

ITEM	REF.	DESCRIPTION OF PART	VENDOR	VENDOR PART NO.	TONUS PART NO.	QTY REQ	STANDARD COST	EXTENSION
37	CR6	DIODE, ZENER 1N5236				1		
38	C7, C9, C11	20PF, CAPACITOR, CERAMIC DISC 20% 50V	ACI	AC-1		3		
38a	C3, C4	30PF 20% 50V	ACI	AC-1		2		
39	C8, C10	50PF, 20% 50V	ACI	AC-2		2		
41	C6	2200PF,	ERIE	811-000X5F0222K		1		
42	C14 THRU C17	.01UF,	ERIE	811-0002SU0103M		4		
43	C1	0.1UF, CAPACITOR, CERAMIC DISC	ERIE	8045-000X5V0104Z		1		
44	C2	0.68UF, CAPACITOR, FILM, 50V	GE	75F6R5A684		1		
45	C12, C13	1.0UF, CAPACITOR, TANTALUM, 35V	SPRAGUE	150D105X9035A		2		
46	CR1 THRU CR5	DIODE, IN914				5		
46A	Q20	TRANSISTOR, NPN, PLANAR	SPRAGUE	TZ-81		1		
47	Q1-14, 21-24	TRANSISTOR, NPN, PLANAR, MATCHED PAIR	ARP		A4012-009-	9PR		
47A	Q17, 27	TRANSISTOR, PNP, PLANAR	SPRAGUE	TZ-581		2		
47B	Q18, 19	TRANSISTOR ASSY., NPN/PNP	ARP		APL4027-008	1PR		
48	Q15, 16, 25, 26	TRANSISTOR, PNP, PLANAR, MATCHED PR	ARP		A4027-007-	2PR		

NOV 7 1975

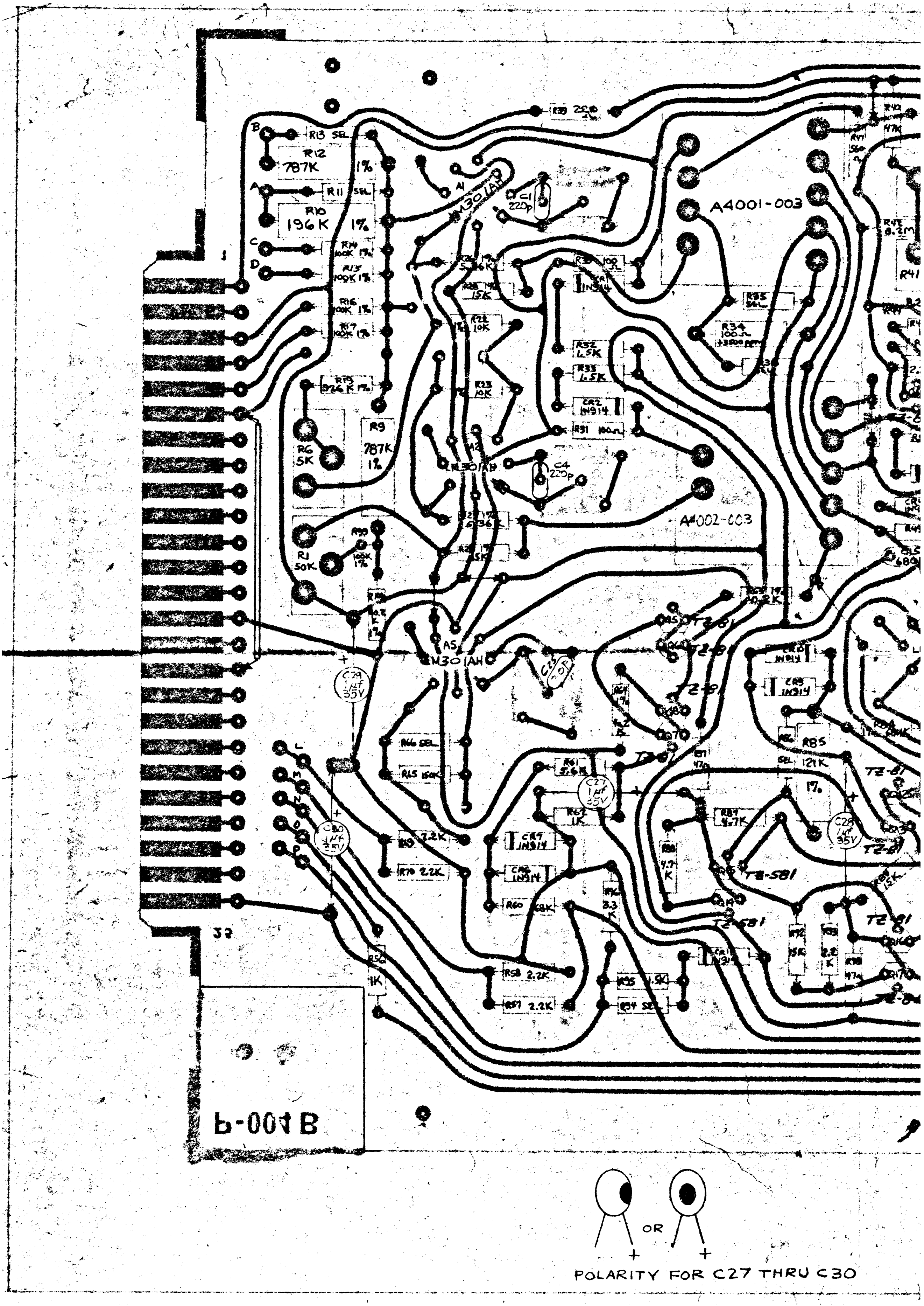


2. ALL DIODES ARE IN4148
1. UNLESS OTHERWISE SPECIFIED CAP. VALUES ARE IN μf (P=PICOFARADS)



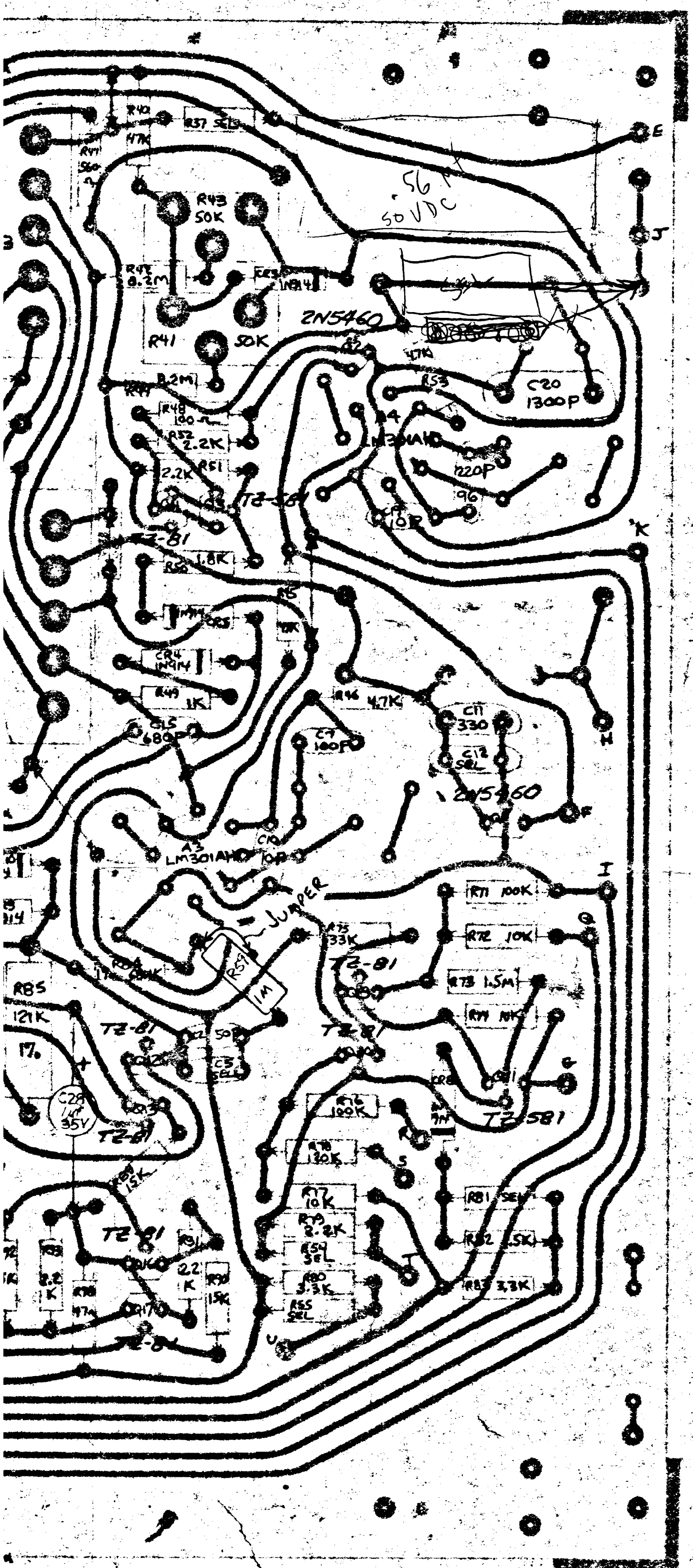
FEB 22 1974

REVISIONS			
NO.		BY	tonus, inc.
A	ECO-0094 2-4-72		SCHEMATIC BD#1
B	ECO-0222 11-1-72	RAP	OSCILLATOR MODULE 1045
C	ECO 0321		
D			
E			
F			C-1045-022 C

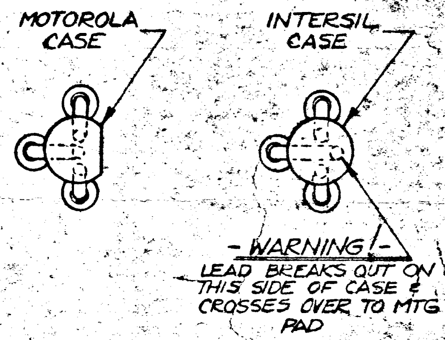

A4001-003
A4002-003
R12 787K
R10 196K
R9 787K 1%
R6 5K
R1 50K
P-004B
LM301AH
POLARITY FOR C27 THRU C30

NOTES:

.56
.15
41



1. Q1 & Q2 ARE SELECTED FET'S ($V_P < 4V$)
2. FOR PARTS LIST SEE APL ~~1045~~-115
3. UNLESS OTHERWISE SPECIFIED CAP. VALUES ARE IN µf (P=PICOFARADS)



TYPICAL MTG. OF 2N5460 FET (Q1, Q2) USING DIFFERENT CASE CONFIGURATIONS.

(MOTOROLA CASE IS SHOWN ON ASS'Y)

DEC 17 1975

			REVISIONS		
H	ECO-0321	KBR	F	ECO-0222 11-1-72 RE	RAP
J	ECO 0496		B	2-18-70	RES
K	ECO 0503		C	6-17-70	RES
L	ECO 0627	TN 12-17-75	D	[illegible]	
			E	UPDATE	
			F	ECO-1094 2-4-72	

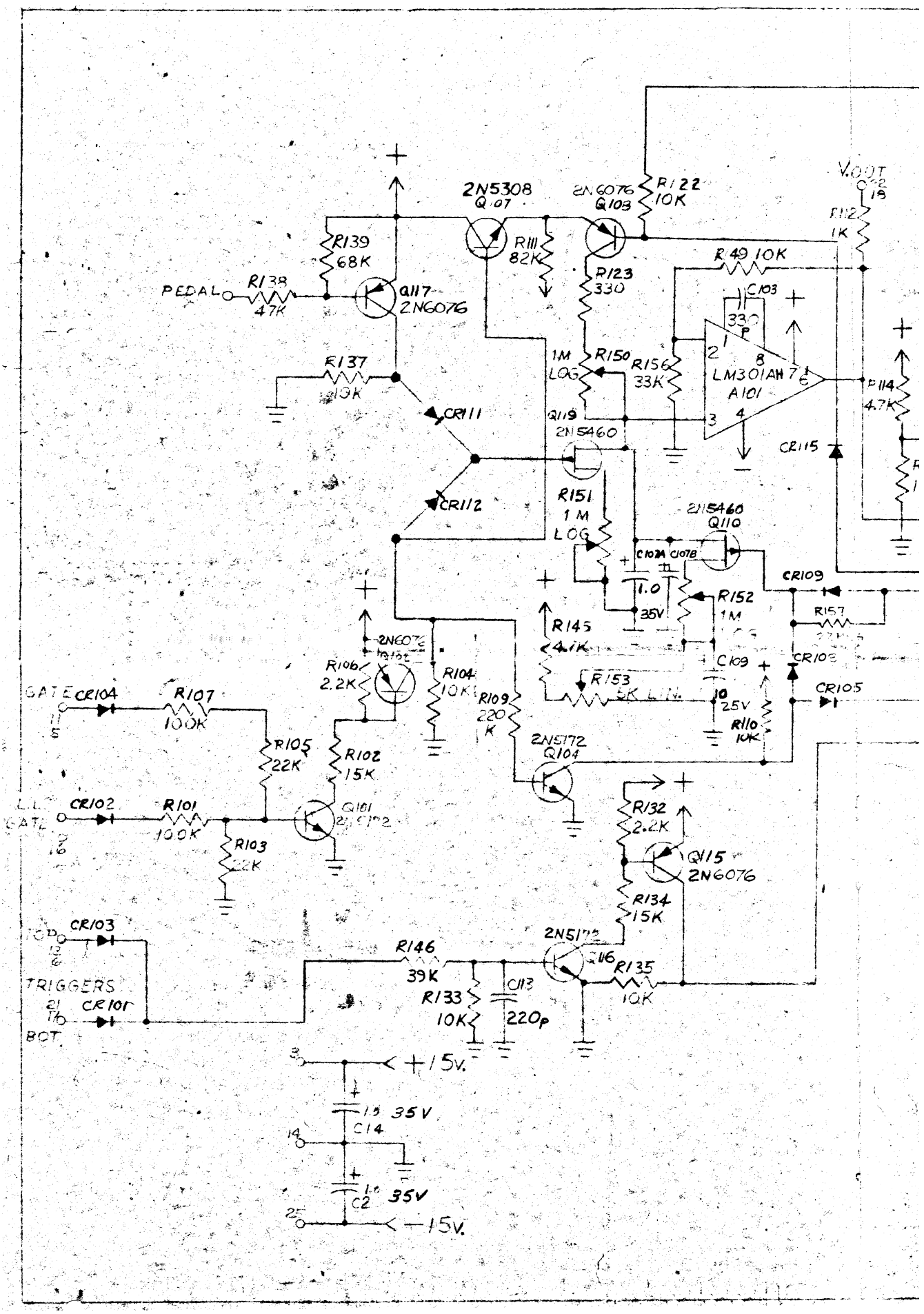
tonus inc

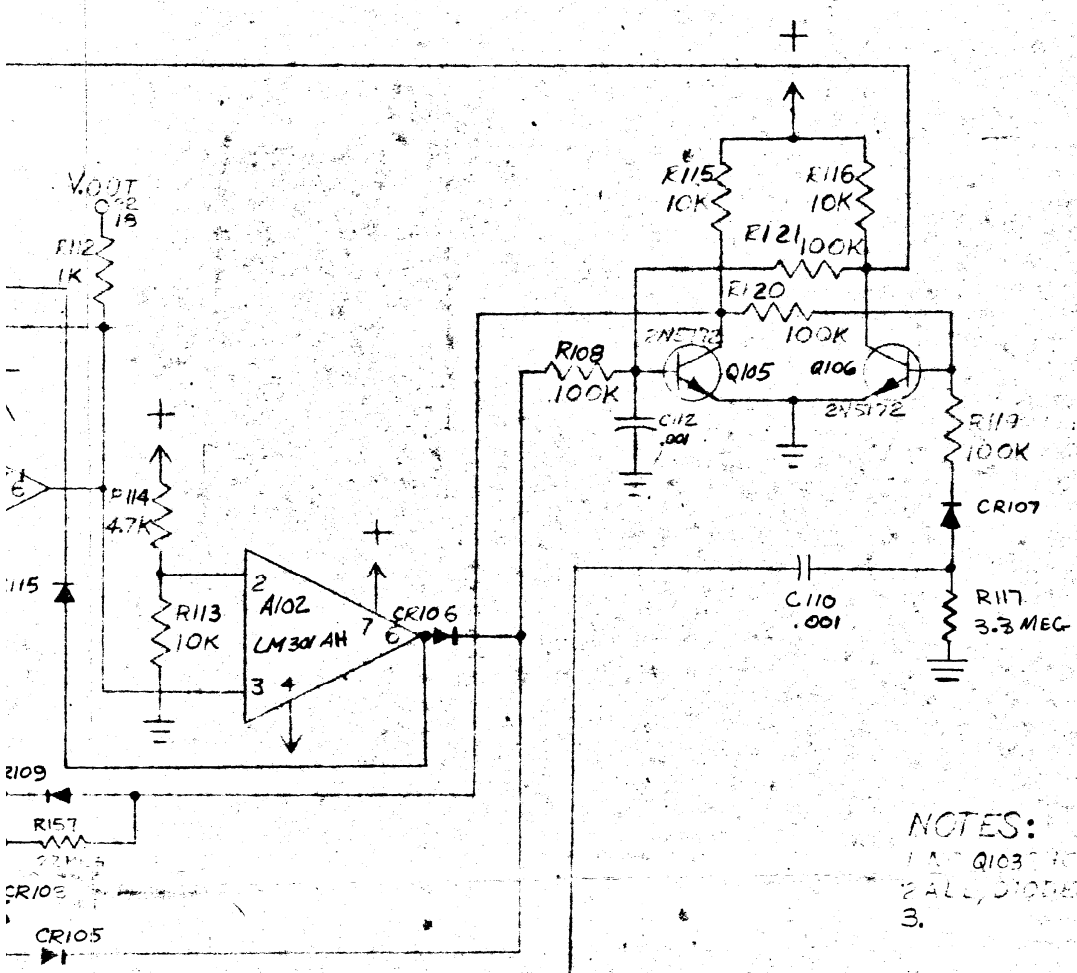
P.C. ASSEMBLY BD#1 OSCILLATOR [illegible] 1045

R.E.S. 6-17-70

C 1045-C12 L

U C30


2N5308
Q107
2N6076
Q103
R122
10K
R139
68K
R111
82K
R123
330
R49 10K
PEDAL
R138
47K
Q117
2N6076
C103
330P
1M
LOG
R150
R156
33K
LM301AH
A101
R137
10K
CR111
Q119
2N5460
CR115
CR112
R151
1 M
LOG
2N5460
Q110
C102A
C107B
1.0
35V
R152
1M
CR109
R157
R145
4.7K
2N6076
Q102
R106
2.2K
R104
10K
C109
R153
5K LIN.
10
25V
CR108
CR105
R110
10K
GATE
CR104
R107
100K
R109
220
1K
R105
22K
R102
15K
2N5172
Q104
CR102
R101
100K
Q101
2N5172
R103
22K
R132
2.2K
Q115
2N6076
R134
15K
CR103
R146
39K
2N5172
Q116
R135
10K
TRIGGERS
CR101
R133
10K
C113
220P
BOT.
+15V.
15 35V
C14
15
35V
C2
-15V.



NOTES:

1. Q103 [illegible]
2. ALL DIODES IN4148
3.

4. THIS CIRCUIT IS DUPLICATED FOR THE 2ND SECTION. REF. DES. BEGIN WITH 101 IN THIS HALF, AND BEGIN WITH 201 IN THE SECOND SECTION.
EXAMPLE: A102 [illegible]
A203 IN 2nd [illegible]

5 UNLESS OTHERWISE SPECIFIED CAPS ARE IN uf (p = PICOFARADS)

JAN 29 1975

REVISIONS			
NO	DATE	BY	
A	ECO-0216 10-17-72	RB	
B	ECO 0321 2-6-74	KBR	
C	ECO 0526 1-29-75	TJN/EW	
D			
E			
F			

tonus, inc. 45 KENNETH STREET NEWTON HIGHLANDS MASSACHUSETTS 02161

M [illegible] 1045 SCHEMATIC 1/2 (BD#2)

[illegible] ENVELOPE [illegible]

DRAWN BY [illegible] SCALE —

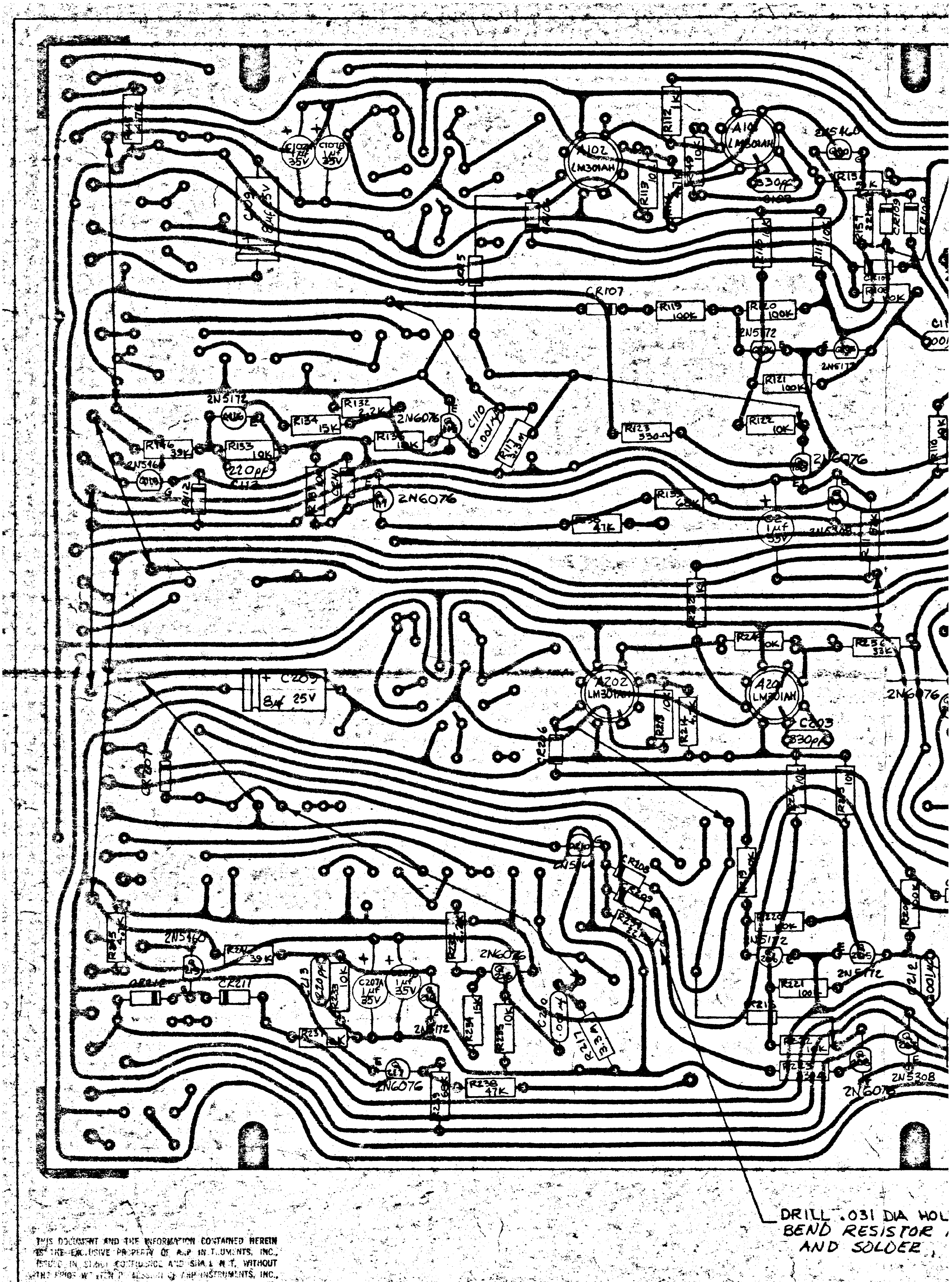
CHK'D [illegible] DATE [illegible]

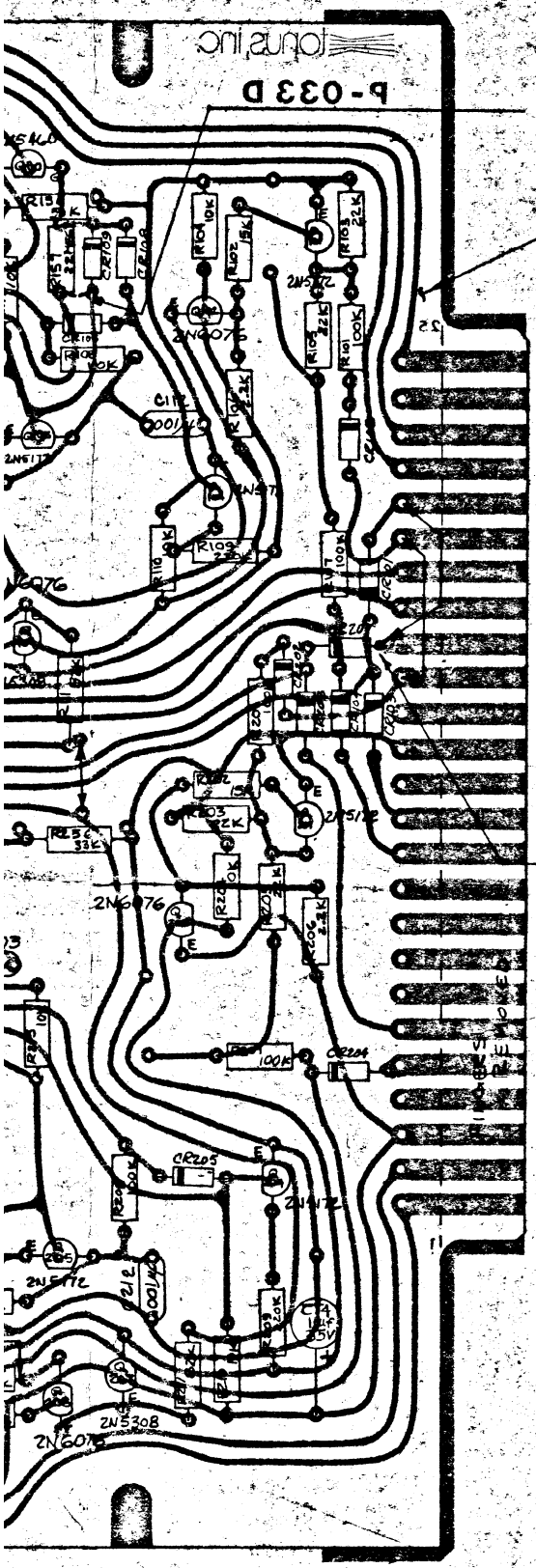
APP'D FOR PROTOTYPE [illegible]

APP'D FOR MFG [illegible]

MATERIAL

DRAWING C-1045-A21





BEND ACROSS & SOLDER LEAD? TO DIODE (CR109) LEAD, ETCH SIDE

OR

POLARITY FOR C2, 14, 107A, 107B, 207A, 207B

NOTES

1. INSTALL #2 (TWELVE) JUMPERS AS SHOWN (→——←) USING AWG # 24 SOLID WIRE & BURNBACK # T-500-22 SLEEVING
2. ARROW CONNECTIONS WITH DOTS (——●) INDICATE A CONNECTION MADE ON COMPONENT SIDE TO COMPONENT LEAD (5 PLACES)
3. ALL DIODES TO BE IN4148
4. FOR PARTS LIST SEE PL-7207501.

SEE NOTE 2

MOTOROLA CASE

INTERSIL CASE

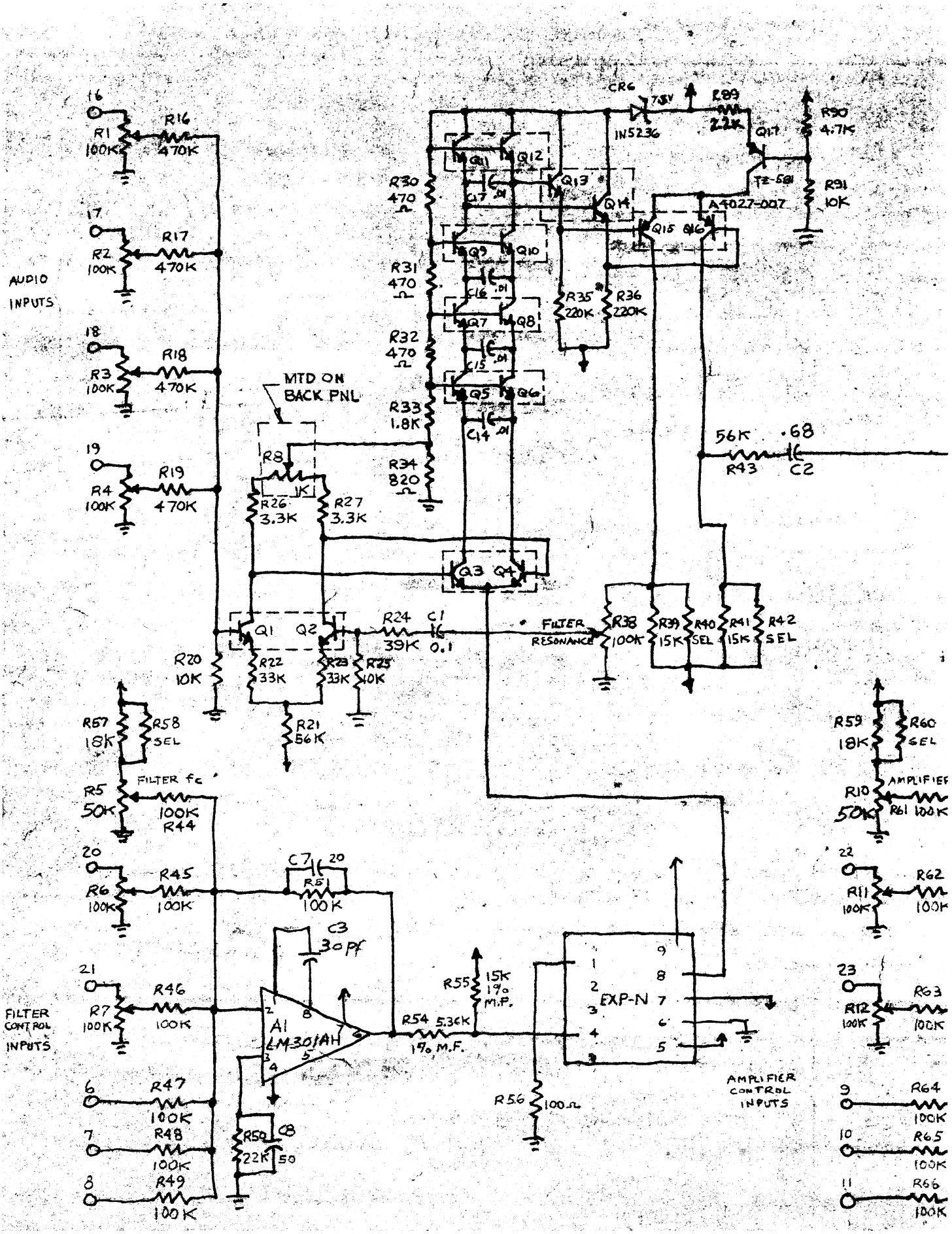
-WARNING!-
LEAD BREAKS OUT ON THIS SIDE OF CASE & CROSSES OVER TO MTG PAD.

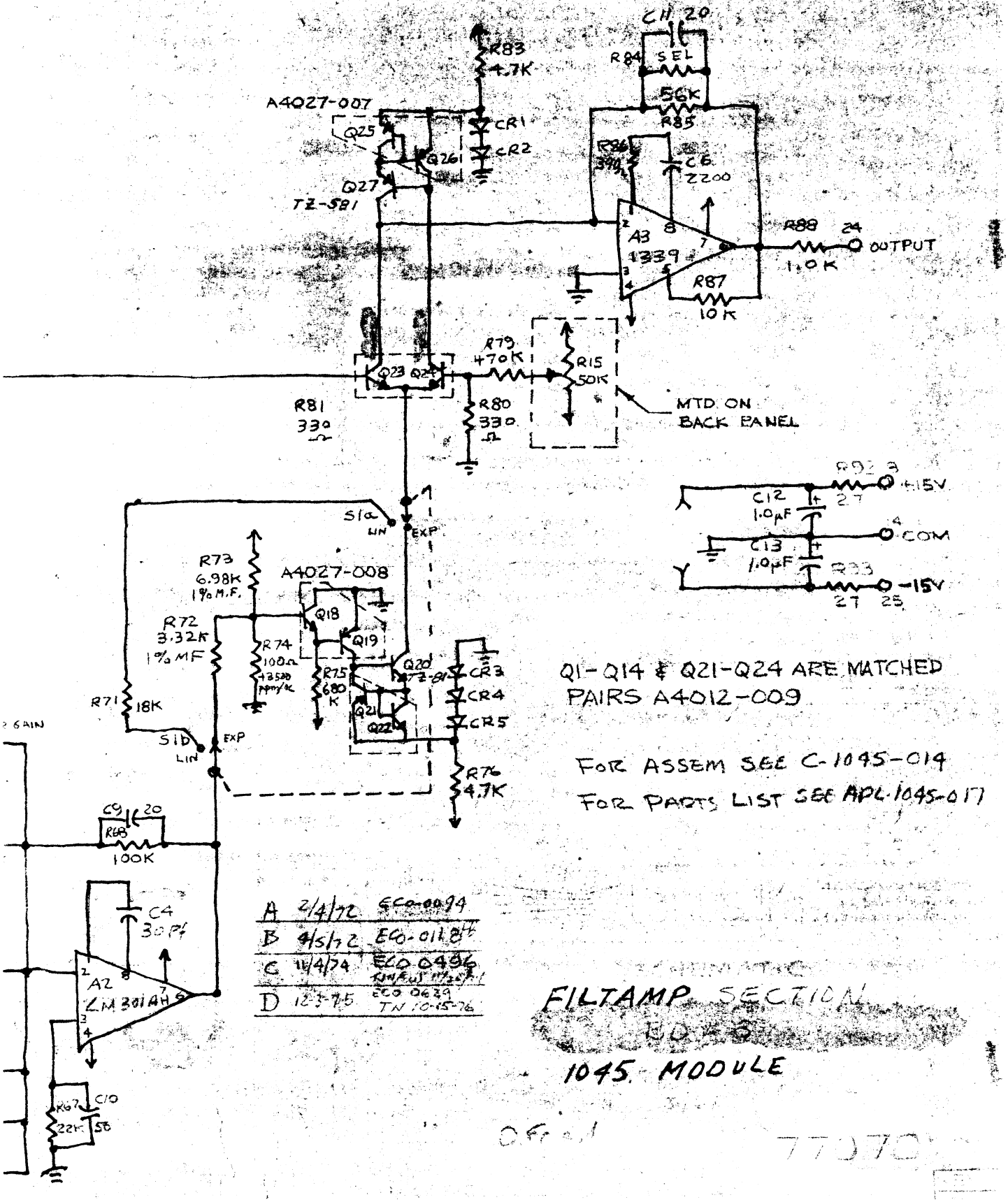
TYPICAL MTG. OF 2N5460 FET (Q110, 119, 210, 219) USING DIFFERENT CASE CONFIGURATIONS

(MOTOROLA CASE IS SHOWN ON ASS'Y)

L .031 DIA HOLE (#68 DRILL) AS SHOWN
D RESISTOR R257 LEAD TO DIODE CR209
ID SOLDER, ETCH SIDE

REVISIONS				
NO.	DESC	BY	tonus, Inc.	
H	ECO 0778	GAS 1-19-71	P.C. ASSY ENVELOPE GEN. BD 1045 BD 2	
B				
C	REDRAW	BA 1-18-71	DRAWN BY BA 1-18-71	SCALE 2:1
D	ECO 0822	DJC	CHK'D	DO NOT SCALE PRINT
E	ECO 0216	RB	APP'D FOR PRODUCTION	
F	ECO 0321	CAR 2-22-71	APP'D FOR ENG.	DRAWING NO. 72075 REV H


AUDIO INPUTS
16
R1 100K
R16 470K
17
R2 100K
R17 470K
18
R3 100K
R18 470K
19
R4 100K
R19 470K
MTD ON BACK PNL
R8 1K
R26 3.3K
R27 3.3K
R20 10K
R22 33K
R23 33K
R25 10K
R21 56K
R24 39K
C1 0.1
Q1 Q2
Q3 Q4
Q5 Q6
Q7 Q8
Q9 Q10
Q11 Q12
Q13
Q14
Q15 Q16
Q17
R30 470
R31 470
R32 470
R33 1.8K
R34 820
C14 .01
C15 .01
C16 .01
C17 .01
R35 220K
R36 220K
CR6 7.5V IN5236
R89 2.2K
R90 4.7K
R91 10K
TZ-581
A4027-007
56K
.68
R43
C2
FILTER RESONANCE
R38 100K
R39 15K
R40 SEL
R41 15K
R42 SEL
R57 18K
R58 SEL
FILTER fc
R5 50K
100K R44
20
R6 100K
R45 100K
C7 20
R51 100K
C3 30pf
21
R7 100K
R46 100K
FILTER CONTROL INPUTS
A1 LM301AH
R55 15K 1% M.F.
R54 5.36K 1% M.F.
R56 100Ω
EXP-N
AMPLIFIER CONTROL INPUTS
6 R47 100K
7 R48 100K
8 R49 100K
R50 22K
C8 50
R59 18K
R60 SEL
AMPLIFIER
R10 50K
R61 100K
22
R11 100K
R62 100K
23
R12 100K
R63 100K
9 R64 100K
10 R65 100K
11 R66 100K



Q1-Q14 & Q21-Q24 ARE MATCHED PAIRS A4012-009

FOR ASSEM SEE C-1045-014

FOR PARTS LIST SEE APL-1045-017

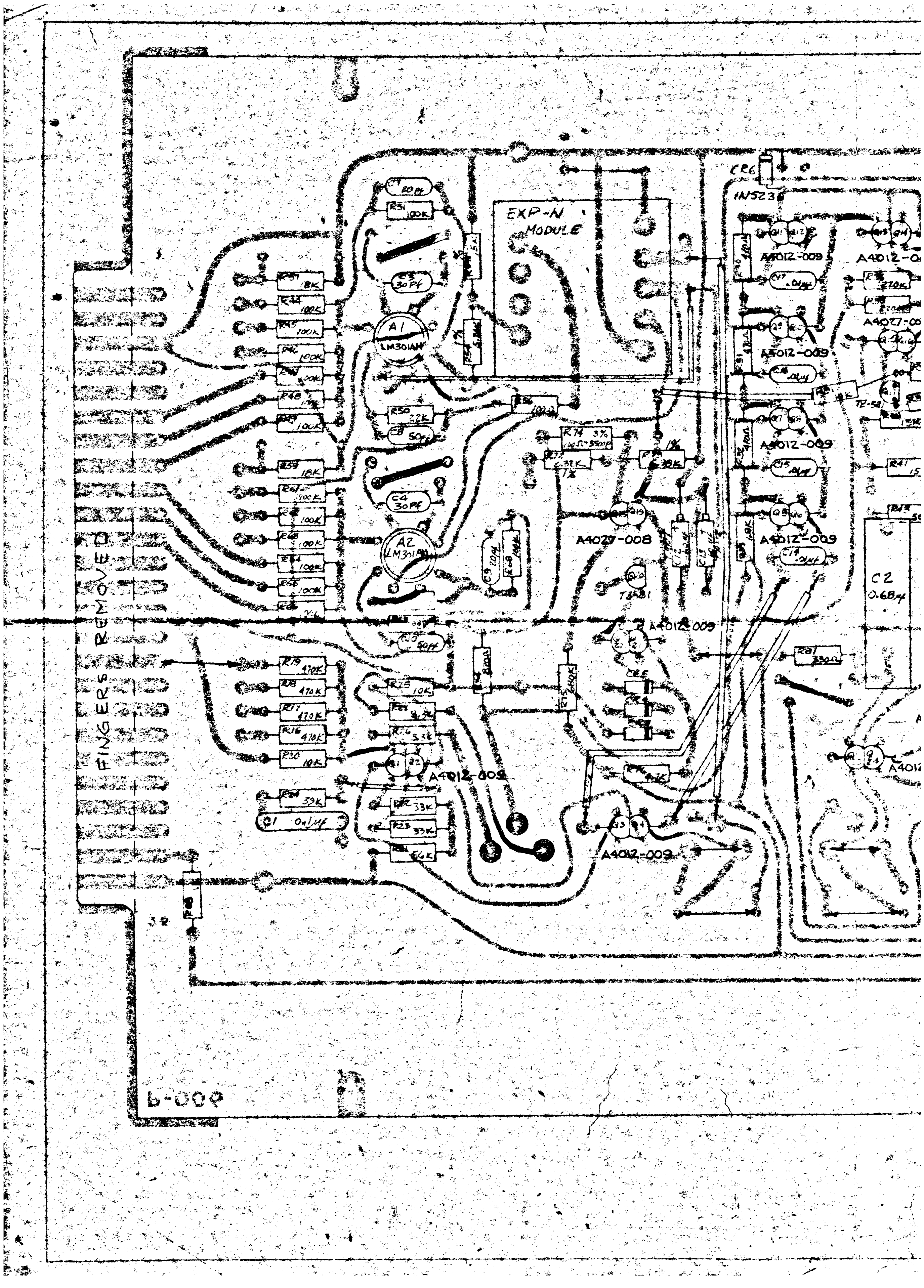
A	2/4/72	ECO-0094
B	4/5/72	ECO-0118
C	11/4/74	ECO 0496
D	12-3-75	ECO 0629 TN 10-15-76

SCHEMATIC

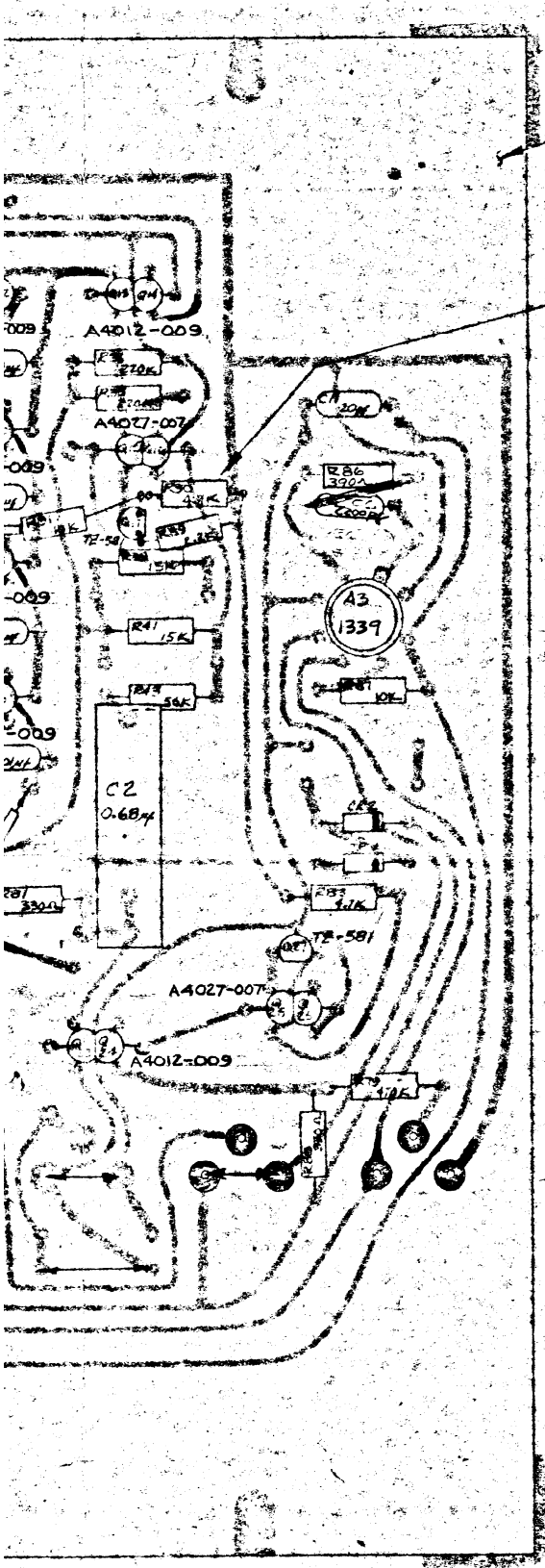
FILTAMP SECTION

1045 MODULE

Orig.



EXP-N
MODULE
FINGERS REMOVED
A1
LM301AH
A2
CR6
A4012-009
A4027-008
C2
0.68µf
R81 330Ω
C1 0.1µf



(1)

DRILL 7 (SEVEN) HOLES (#68 DRILL) AS SHOWN

NOTES:

1. INSERT FIRST - TEN (10) BARE WIRE JUMPERS USING AWG # 24 SOLID WIRE. INSTALL AS SHOWN (⟷)
2. OBSERVE POLARITY OF OP AMPS A1, A2, A3, CAPACITORS C12, C13, AND DIODES CR1, CR2, CR3, CR4, CR5, CR6
3. DIODES CR1-CR5 ARE IN914 OR IN4148 DIODE CR6 IS IN5236 ZENER
4. INSERT LAST - FIVE (5) SLEEVED JUMPERS AS SHOWN (⟷) USING AWG #24 SOLID WIRE & BIRNBACH T 300-EQ SLEEVING
5. FOR PARTS LIST SEE APL-1045-017
   FOR SCHEMATIC SEE B-1045-020

INDICATES CONNECTION WRAPPED & SOLDERED ON COMPONENT SIDE OF BOARD

NOV 25 1974

REVISIONS			tonus inc
—	—	—	
A			FAC ASSY, Bd # 3
B	UPDATE 3-3-71	DF	EXTENDED RANGE 1045
C	ECO 0074 2-4-72	LB	DRAWN 1-29-71
D	ECO-0178 4-5-72	EB	
E	ECO 0936 4-8-74	TON/EW	
F			1045014 E