EMS VOCODER

2000

SERVICE MANUAL

Information from

EMS

E M S V O C O D E R

2 0 0 0

S E R V I C E M A N U A L

Written by Tim Orr - May 1977

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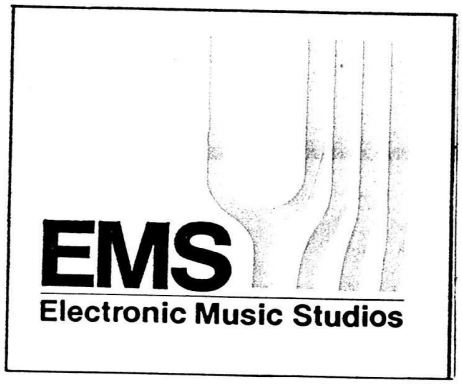


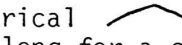
REV 3

INTRODUCTION

The Vocoder 2000 is a signal processing device, which takes two input signals and produces one output. These two signals are known as the 'speech' and the 'excitation'. The output from the Vocoder is a signal which contains a proportion of the harmonic structure of the excitation and the formant structure (the articulation) of the speech. Thus it is possible to make normally inarticulate sounds speak. For instance, if you were to take speech and an organ, it would be possible to make a 'talking organ'.

The heart of the Vocoder is the analysing and synthesizing filter bank. The speech is analysed into 16 frequency bands which cover the audio spectrum. The time varying energy levels in each channel is extracted by an envelope follower. This is in fact a real time spectrum analysis of the speech. Another signal, the excitation is introduced into the Vocoder.

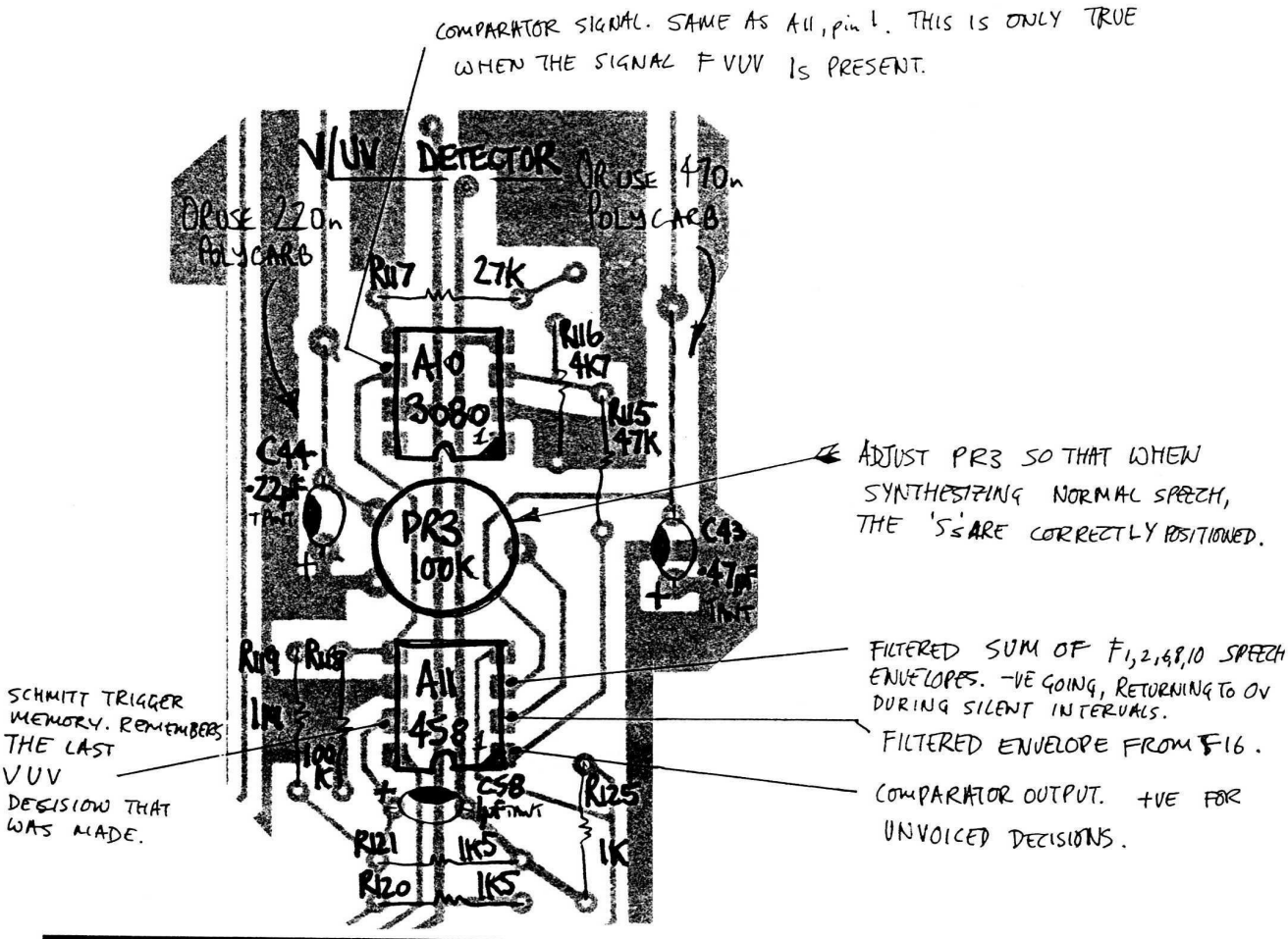
This is the signal that we will make talk. The excitation signal is also analysed into 16 frequency bands throughout the audio spectrum. However, the signal that is presented to each band is multiplied by a control voltage, which is the envelope from the speech channels. Thus the time varying spectrum of the speech is imposed upon the excitation signal; that is the excitation is filtered in a way entirely prescribed by the speech signal.

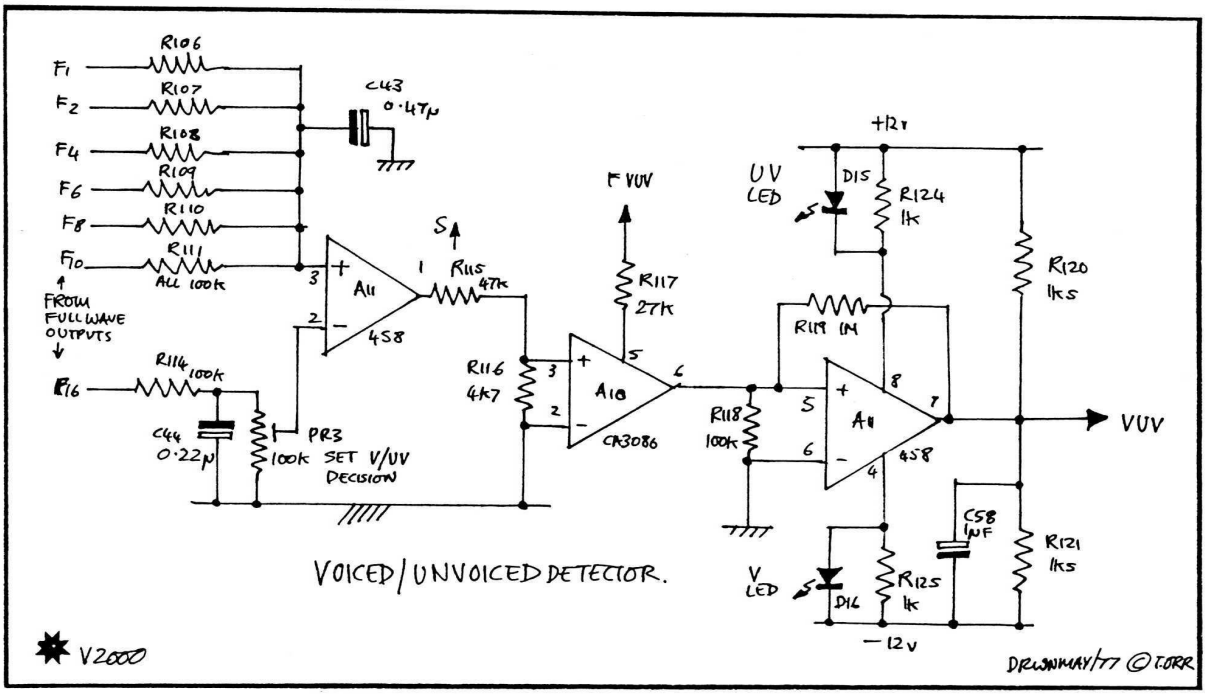
The speech and the excitation signals are connected via $\frac{1}{4}$" mono jack sockets to the input amplifiers. The signal level is adjusted and given a pre-emphasis, a top lift. A switch connects a VU meter to either the speech or the excitation signal. A device called a voiced/unvoiced detector looks at the speech signal and decides whether or not the speech is unvoiced ('s' sounds) or voiced (sounds derived from vocal chord vibrations). These voiced/unvoiced decisions can be used to turn on or off the machine's internal oscillator and noise source. Also, the unvoiced decision can be used to alter the external excitation signal so that it becomes more 'S' like. This is done by operating the 'S' generator switch. The Vocoder 2000 has two internal excitation sources, the noise source and the oscillator. The noise source is generated by zener diode and can be used continuously, or gated on by the unvoiced decisions or it can be switched off so that it has no effect. The oscillator produces a pulse waveform which can also be used continuously or gated ON by the voiced decision or it can be switched off. Also the pitch of the oscillator can be manually set as well as the option of being varied by a control voltage generated by the filter bank analysis. The slew freeze section controls the synthesis section of the filter bank. It is possible to freeze or to slew limit the control voltages inside the filter and this will of course have an effect on the Vocoder's output. When frozen, the formant structure remains fixed. When heavily slewed, the output sounds very reverberent. This is because information in the filter bank is time smeared. There are two possible types of time smearing that are available, symmetrical  and asymmetrical  . The symmetrical option takes as long for a sound to build up as it does to decay, but the asymmetrical gets loaded with a sound structure immediately and then it slowly decays.

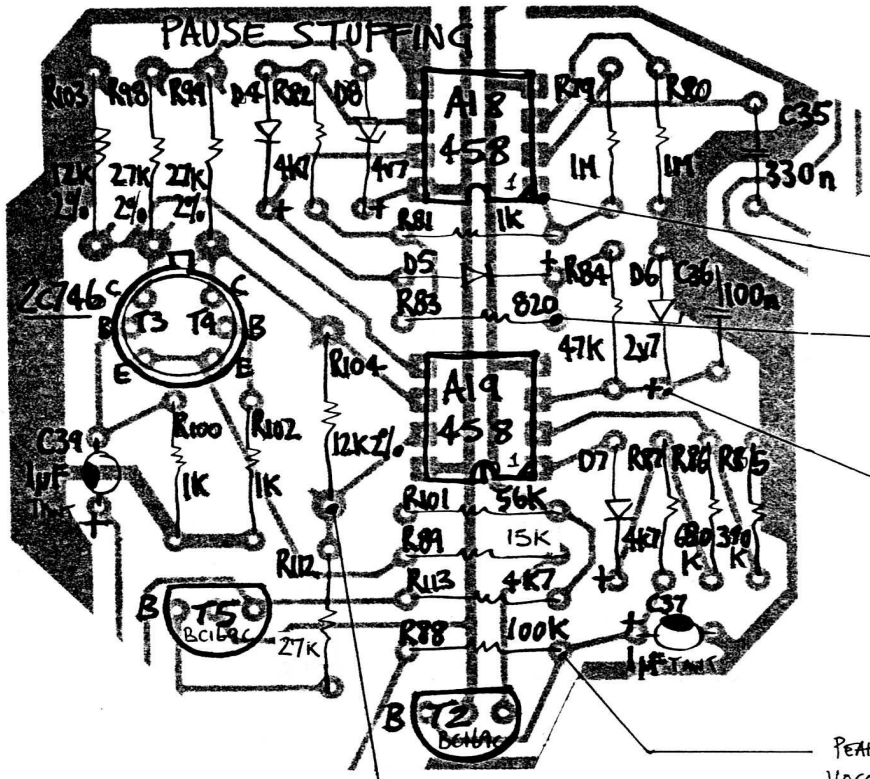
When you are making a piece of orchestral music talk, the amplitude dynamics of the speech will be imposed upon the output. Thus there will be lots of big gaps in the Vocoder output which might not be very desirable. To overcome

Continued/.....

this problem we use a device called a pause stuffer. This fills in the silences by fading up the music signal, immediately fading it down when the Vocoder output reappears. Speech or excitation can be used to 'stuff' the pauses and there is a choice of fade in times. The output mixer is used to select either the Vocoder output or the speech or external excitation signal. It is also possible to control any of these signals with an external swell pedal.


COMPARATOR SIGNAL. SAME AS A11, pin 1. THIS IS ONLY TRUE WHEN THE SIGNAL F VUV IS PRESENT.
V/UV DETECTOR
ORDER 220n POLYCARB
ORDER 470n POLYCARB
R117 27K
A10 3080
R116 4K7
R115 47K
C44 .22µF TANT
PR3 100K
C43 .47µF TANT
ADJUST PR3 SO THAT WHEN SYNTHESIZING NORMAL SPEECH, THE 'S's ARE CORRECTLY POSITIONED.
R119 1M
R118 100K
A11 458
C58 1µF TANT
R125 1K
R121 1K5
R120 1K5
FILTERED SUM OF F1,2,4,8,10 SPEECH ENVELOPES. -VE GOING, RETURNING TO 0V DURING SILENT INTERVALS.
FILTERED ENVELOPE FROM F16.
COMPARATOR OUTPUT. +VE FOR UNVOICED DECISIONS.
SCHMITT TRIGGER MEMORY. REMEMBERS THE LAST V UV DECISION THAT WAS MADE.


F1
F2
F4
F6
F8
F10
R106
R107
R108
R109
R110
R111 ALL 100K
C43 0.47µ
FROM FULL WAVE OUTPUTS
F16
R114 100K
C44 0.22µ
PR3 100K SET V/UV DECISION
A11 458
R115 47K
S
F VUV
R117 27K
R116 4K7
A10 CA3086
R118 100K
R119 1M
+12v
UV LED
D15
R124 1K
R120 1K5
A11 458
VUV
C58 1µF
R121 1K5
V LED
D16
R125 1K
-12v
VOICED/UNVOICED DETECTOR.
V2000
DRJONWAY/77 ©TORR



VCA ▷ ANY DUAL TRANSISTOR (NPN) WILL DO.

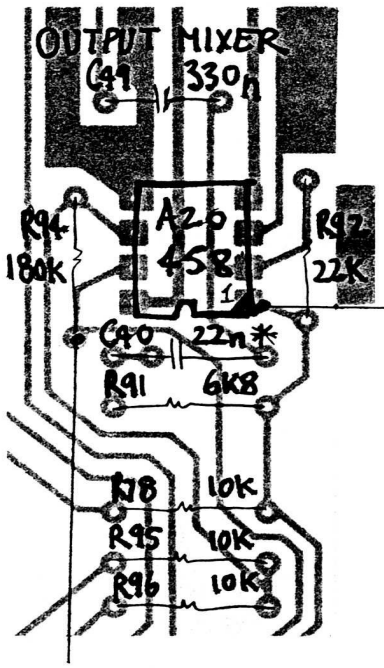
FILTER BANK OUTPUT X100 GAIN.

POSITIVE GOING, FULL WAVE RECTIFIED VERSION OF THE FILTERBANK OUTPUT SIGNAL.

LOW PASS FILTERED SIGNAL OF ABOVE. LIMITED TO +2·7V.

PEAK VOLTAGE FOLLOWER. FOLLOWS VOCODER SIGNAL WITH A CHOICE OF RELEASE TIMES, SELECTED BY SW13. SLOW FAST

VCA OUTPUT. THE SPEECH OR THE EXCITATION SIGNAL IS CONTROLLED IN LEVEL BY THE ENVELOPE OF THE VOCODER.



MIXED OUTPUT OF THE FILTER BANK, WITH A TREBLE CUT.

VOCODER OUTPUT. VARIOUS OUTPUTS INCLUDE, SPEECH, EXTERNAL EXCITATION, VOCODER, PAUSE STUFFED AND SWEEPED OUTPUTS.

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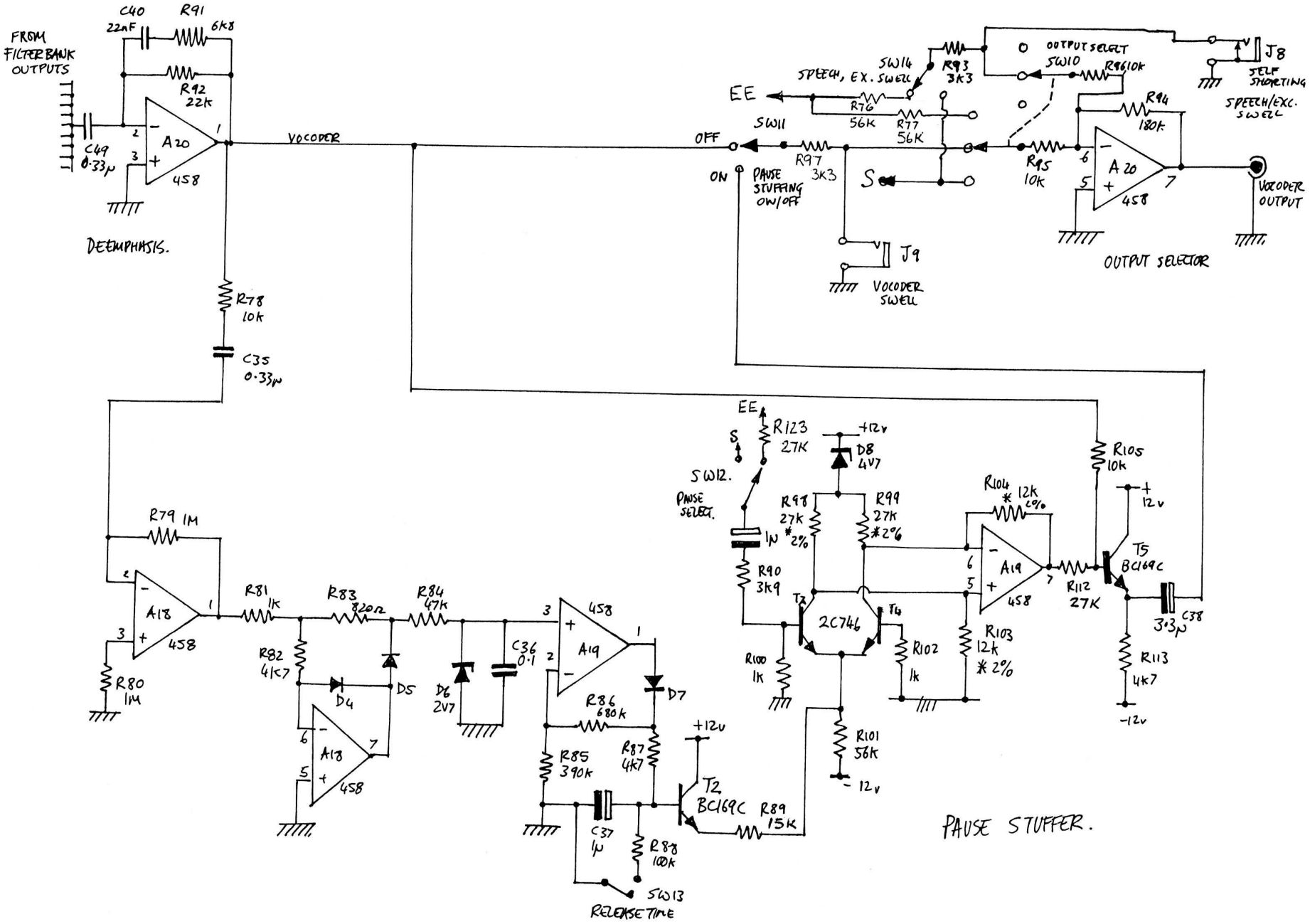
26.7.77 MDX.


FROM FILTER BANK OUTPUTS
C40 22nF
R91 6k8
R92 22k
C49 0·33µ
A20
458
DEEMPHASIS.
VOCODER
R78 10k
C35 0·33µ
OFF
ON
SW11
PAUSE STUFFING ON/OFF
R97 3k3
S
J9
VOCODER SWELL
EE
SW14
SPEECH, EX. SWELL
R93 3k3
R76 56k
R77 56k
OUTPUT SELECT SW10
R96 10k
R94 180k
R95 10k
A20
458
OUTPUT SELECTOR
J8
SELF SHORTING
SPEECH/EXC. SWELL
VOCODER OUTPUT
R79 1M
A18
458
R80 1M
R81 1k
R83 820Ω
R84 47k
R82 4k7
D4
D5
D6 2V7
C36 0·1
A18
458
A19
458
D7
R86 680k
R85 390k
R87 4k7
+12v
T2 BC169C
R89 15k
C37 1µ
R88 100k
SW13
RELEASE TIME
EE
S
SW12.
PAUSE SELECT.
R123 27k
+12v
D8 4V7
1µ
R90 3k9
R98 27k *2%
R99 27k *2%
T2 2C746
T4
R100 1k
R102 1k
R101 56k
-12v
R104 12k *2%
A19
458
R103 12k *2%
R105 10k
R112 27k
T5 BC169C
+12v
3·3µ C38
R113 4k7
-12v
PAUSE STUFFER.
V2000
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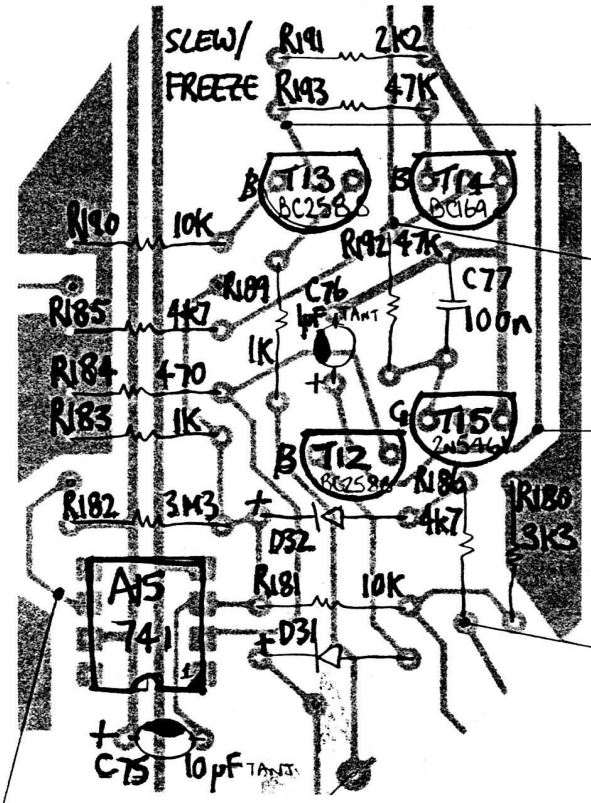
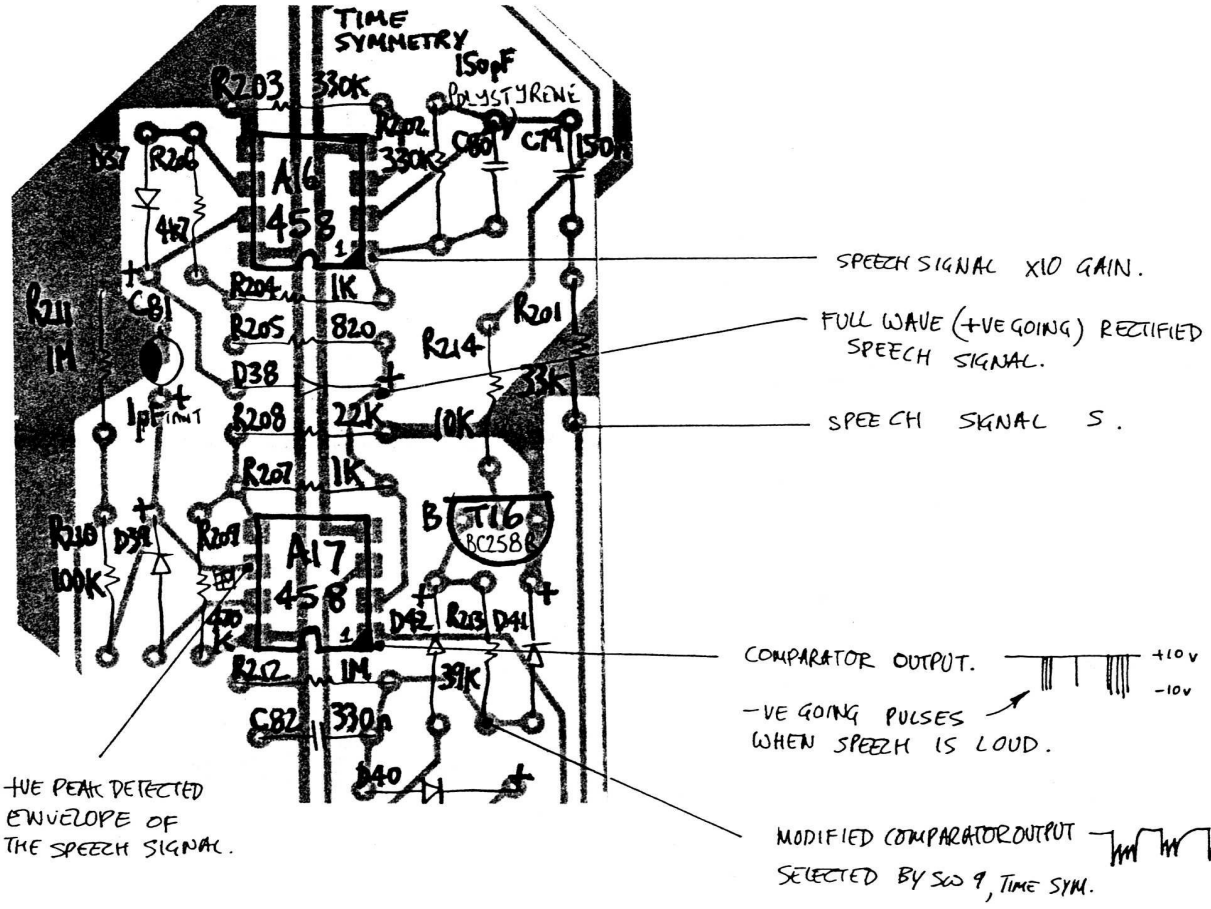
26.777 NDV


SLEW/ FREEZE
R191 2K2
R193 47K
'F'. NOT FROZEN ≡ -12V. FROZEN ≡ -4V → -1V
T13 BC258
T14 BC169
R190 10K
R192 47K
'F VUV' NOT FROZEN ≡ 0V FROZEN ≡ -12V
R189
C76 1µF TANT
C77 100n
R185 4K7
R184 470
R183 1K
T15 2N5461
SHORTED TO THE -VE RAIL WHEN FROZEN.
T12 BC258
R186 4K7
R182 3K3
R180 3K3
D32
A15 741
R181 10K
D31
TO FREEZE SWITCH SW8 . FREEZE ≡ +12V
C75 10µF TANT
USUALLY -VE. +VE WHEN FROZEN.


TIME SYMMETRY
R203 330K
150pF POLYSTYRENE
R202 330K
C80
C79 150n
D37
R206 4K7
A16 4538
SPEECH SIGNAL X10 GAIN.
R204 1K
C81
R211 1M
R205 820
R214
R201
FULL WAVE (+VE GOING) RECTIFIED SPEECH SIGNAL.
D38
33K
1µF TANT
R208 22K
10K
SPEECH SIGNAL S.
R207 1K
T16 BC258
R210 100K
D39
R209 470K
A17 4538
D42
R213
D41
COMPARATOR OUTPUT. +10V -10V
R212 1M
39K
C82 330n
-VE GOING PULSES WHEN SPEECH IS LOUD.
D40
+VE PEAK DETECTED ENVELOPE OF THE SPEECH SIGNAL.
MODIFIED COMPARATOR OUTPUT SELECTED BY SW 9, TIME SYM. 0V -VE

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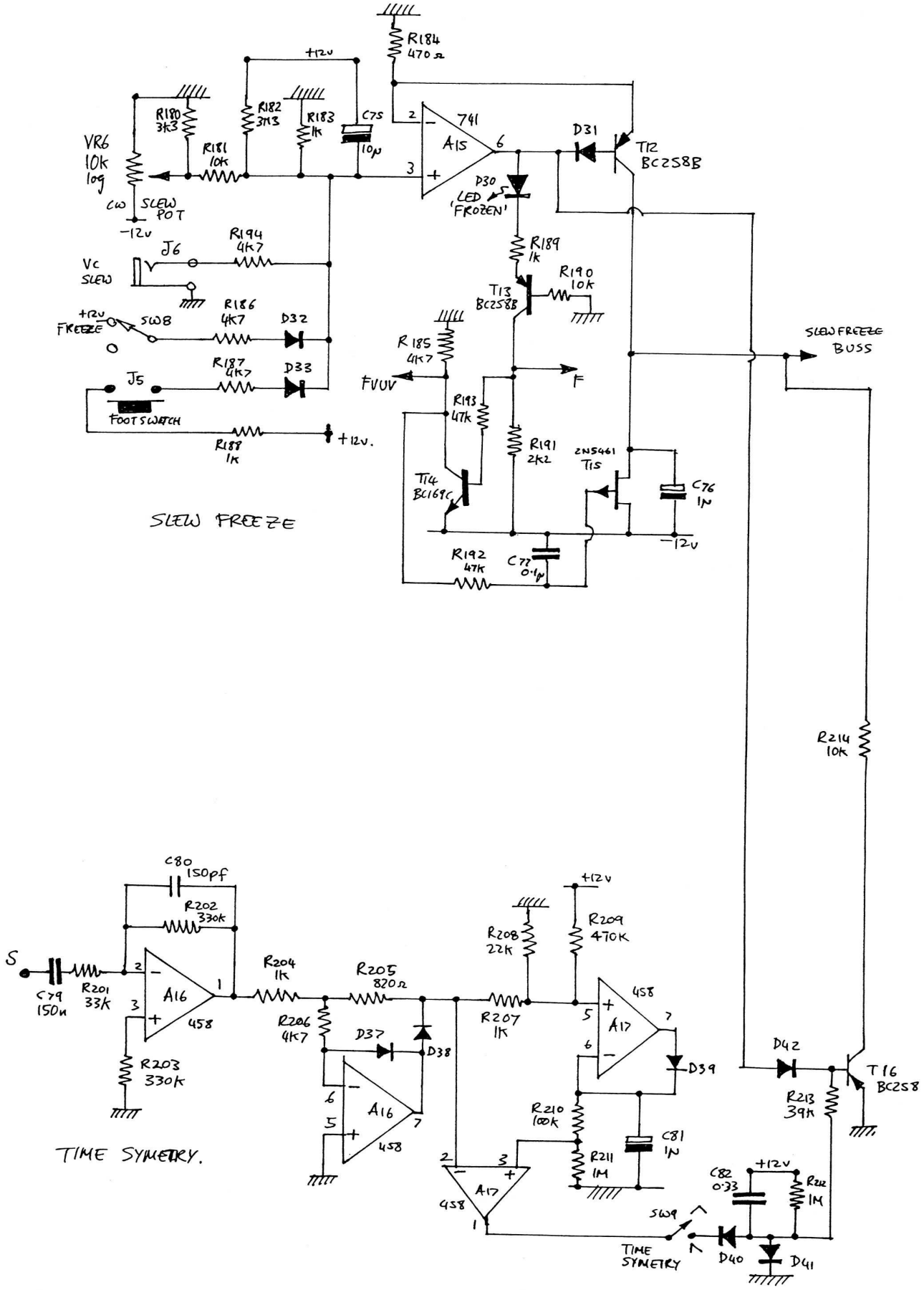

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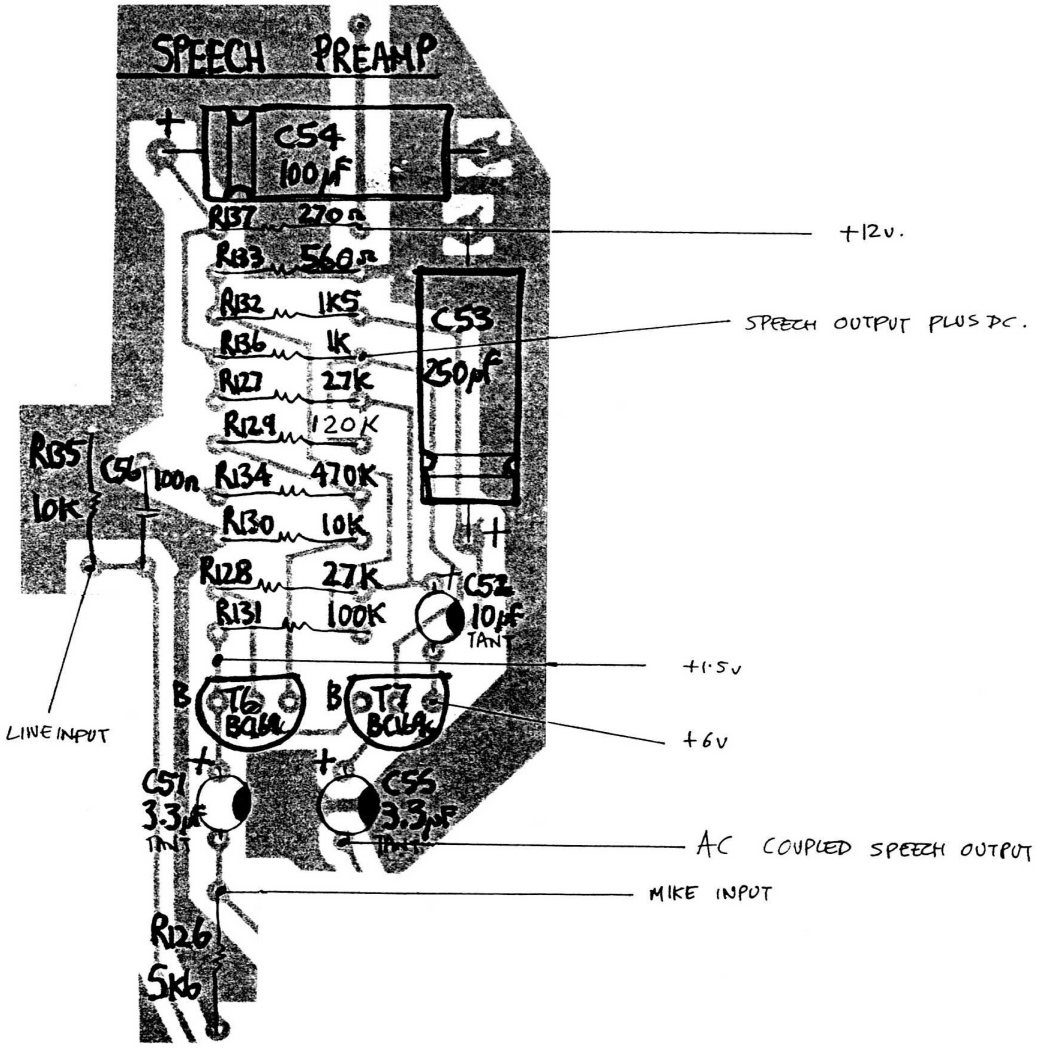
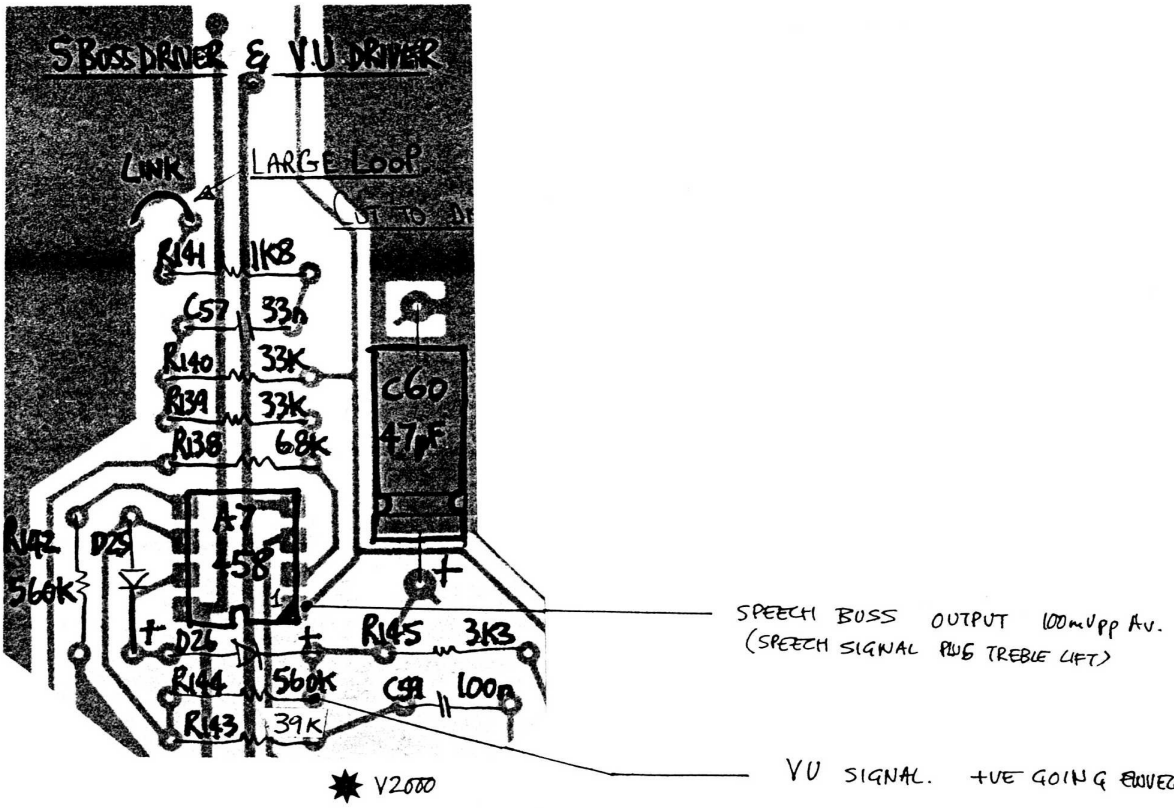
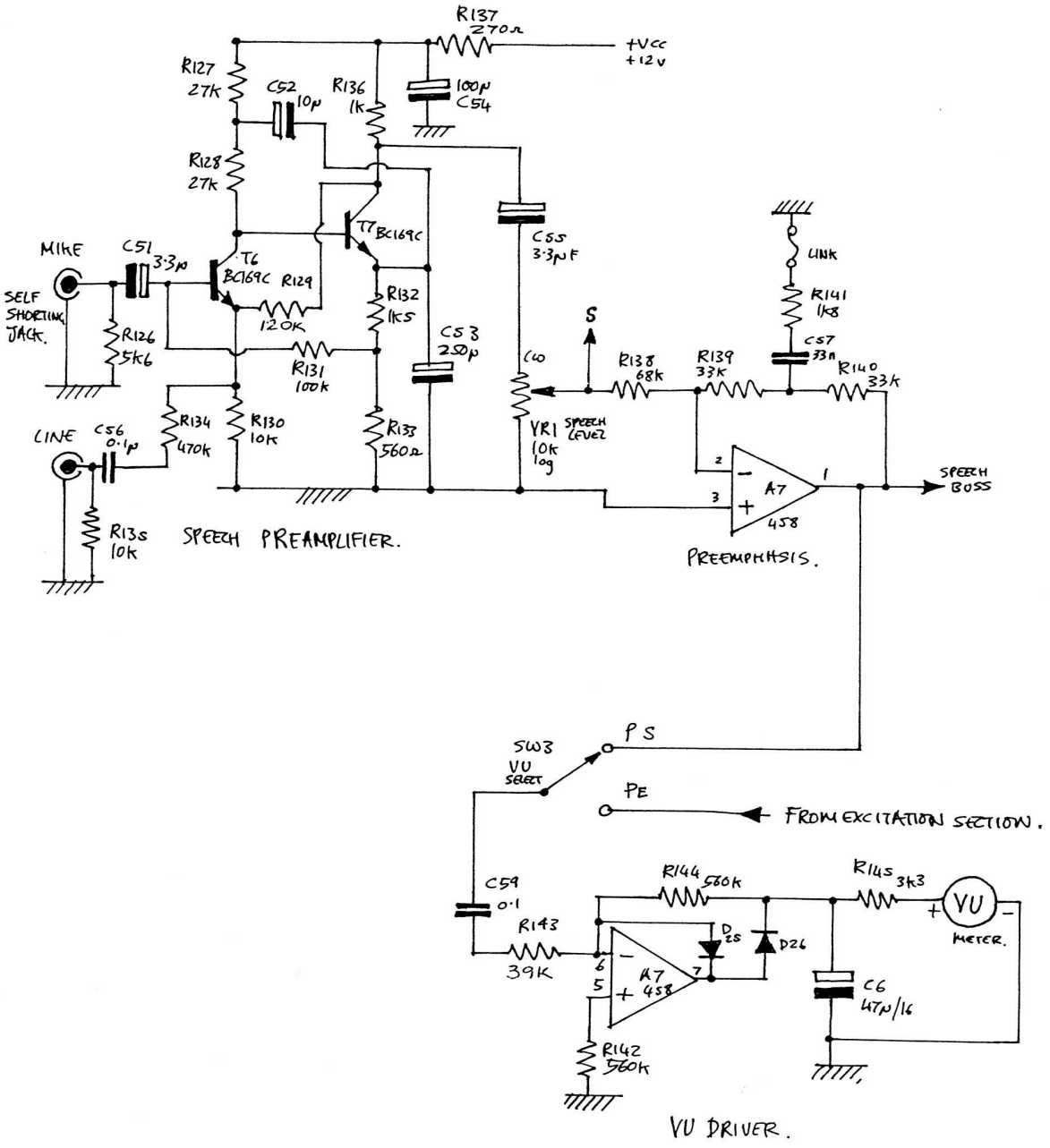

SPEECH PREAMP
C54 100µF
R137 270Ω
R133 560Ω
R132 1K5
R136 1K
R127 27K
R129 120K
R135 10K
C56 100n
R134 470K
R130 10K
R128 27K
R131 100K
C53 250µF
C52 10µF TANT
T6 BC184
T7 BC184
C57 3.3µF TANT
C55 3.3µF TANT
R126 5K6
+12v.
SPEECH OUTPUT PLUS DC.
+1.5v
+6v
LINE INPUT
AC COUPLED SPEECH OUTPUT
MIKE INPUT


S BOSS DRIVER & VU DRIVER
LINK
LARGE LOOP
R141 11K8
C57 33n
R140 33K
R139 33K
R138 68K
C60 47µF
R142 560K
D25
A7 458
D26
R145 3K3
R144 560K
C59 100n
R143 39K
SPEECH BOSS OUTPUT 100mVpp Av.
(SPEECH SIGNAL PLUS TREBLE LIFT)
VU SIGNAL. +VE GOING ENVELOPE
V2000

26.7.77 NAV



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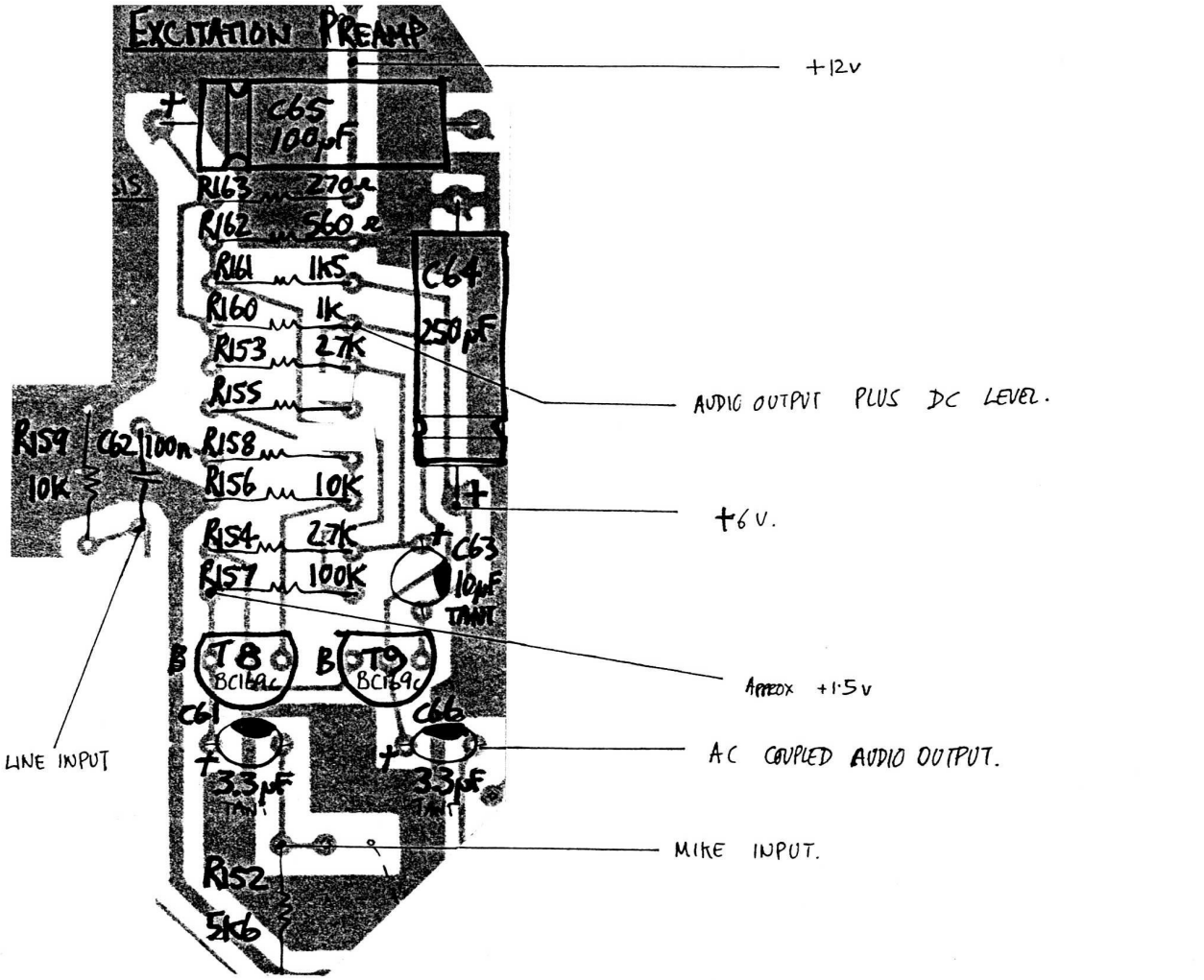
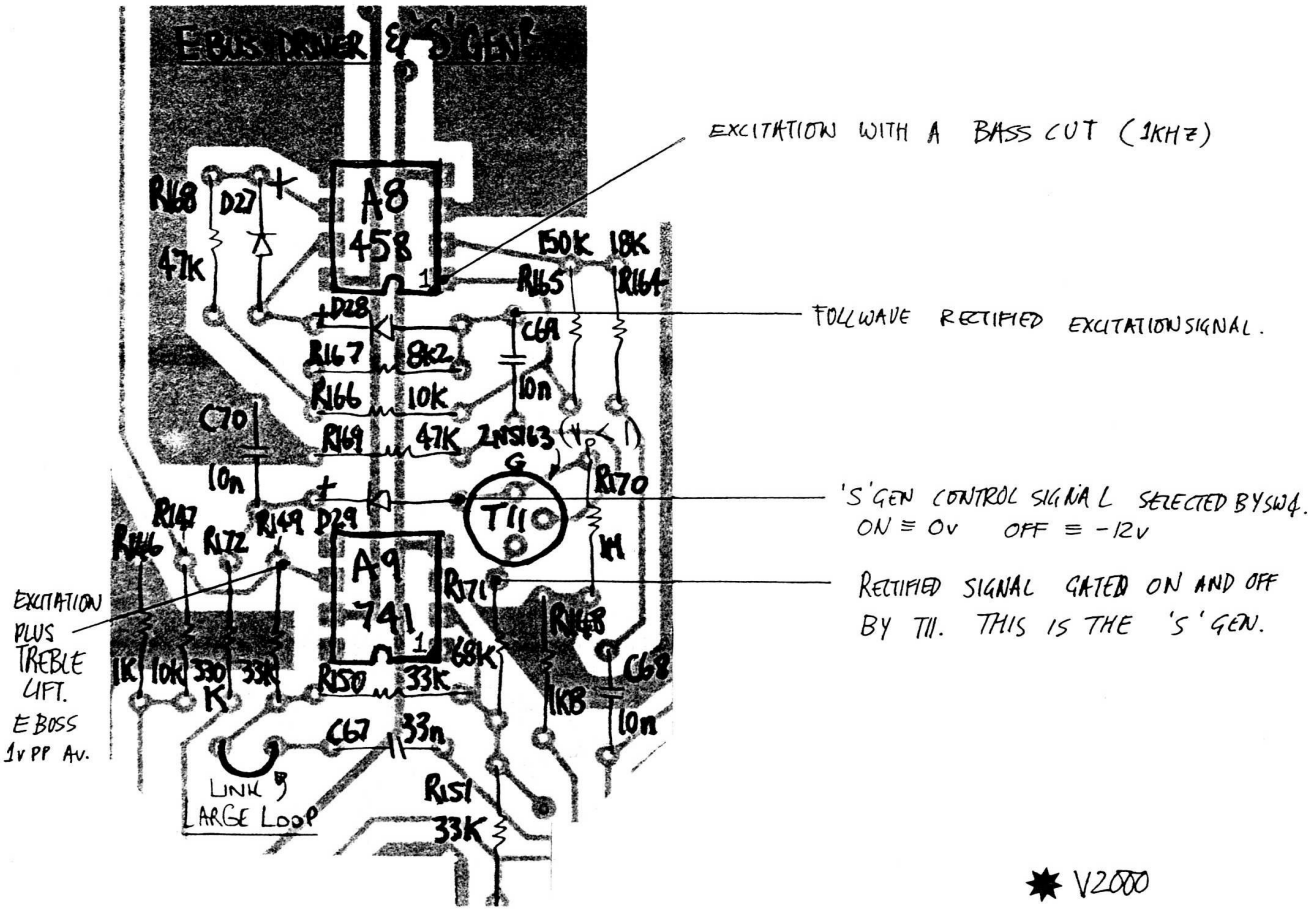
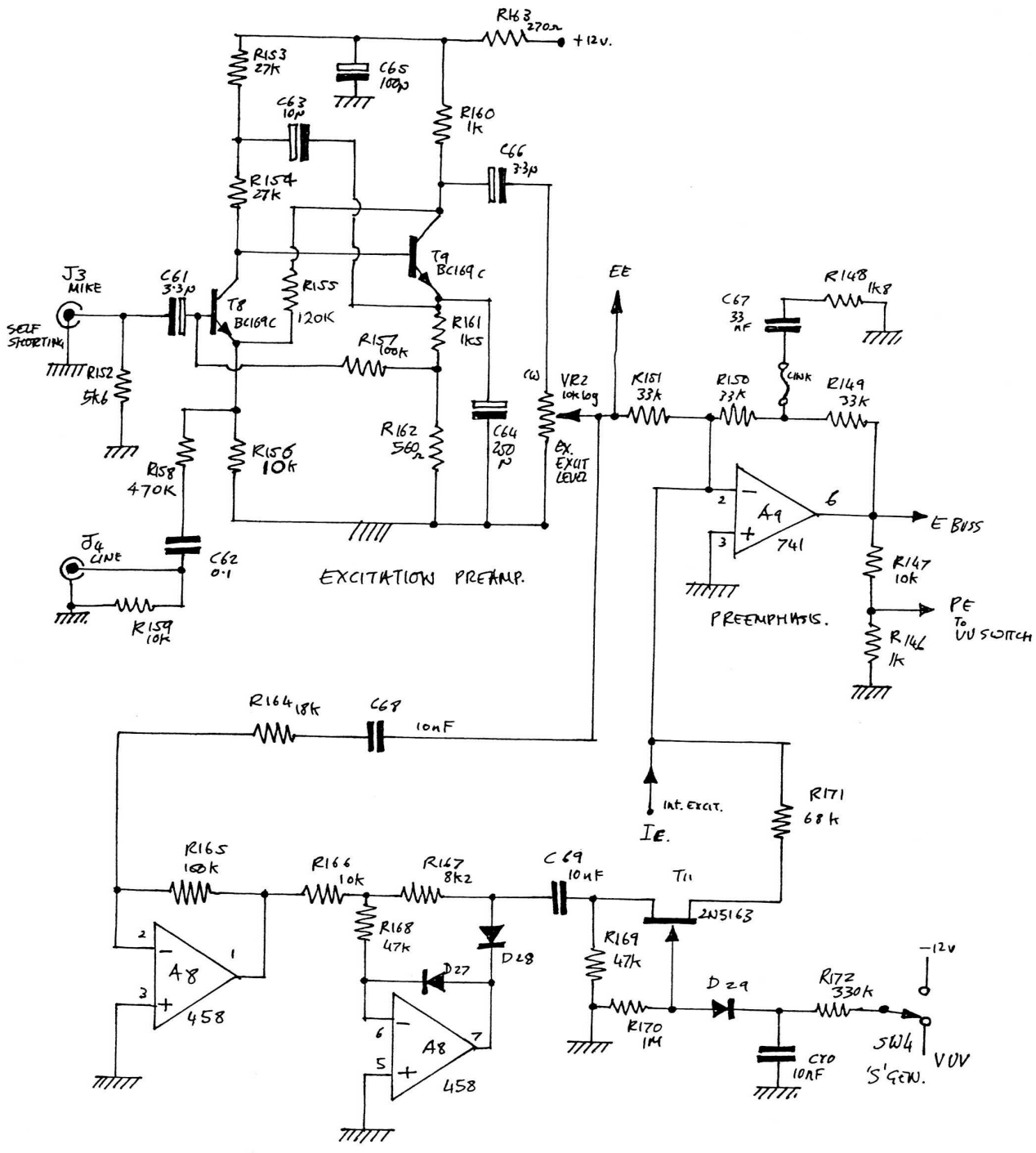

EXCITATION PREAMP
+12v
C65 100µF
R163 270Ω
R162 560Ω
R161 1K5
R160 1K
R153 2.7K
R155
C64 250pF
AUDIO OUTPUT PLUS DC LEVEL.
R159 10K
C62 100n
R158
R156 10K
+6v.
R154 2.7K
R157 100K
C63 10µF TANT
T8 BC184C
T9 BC184C
Approx +1.5v
C61 3.3µF TANT
C66 33µF TANT
LINE INPUT
AC COUPLED AUDIO OUTPUT.
MIKE INPUT.
R152 5K6


EXCITATION WITH A BASS CUT (1KHz)
A8 458
R68 47K
D27
150K
18K
R165
R164
FOLLWAVE RECTIFIED EXCITATION SIGNAL.
D28
C69 10n
R167 8K2
R166 10K
C70 10n
R169 47K
2N5163
R170
'S' GEN CONTROL SIGNAL SELECTED BY SW4.
ON ≡ 0v OFF ≡ -12v
T11
R147
R146
R172
R149
D29
A9 741
RECTIFIED SIGNAL GATED ON AND OFF BY T11. THIS IS THE 'S' GEN.
EXCITATION PLUS TREBLE LIFT.
EBOSS 1v PP Av.
1K
10K
330
K
33K
R150 33K
68K
R148
C68 10n
1K8
C67 33n
LINK LARGE LOOP
R151 33K
V2000



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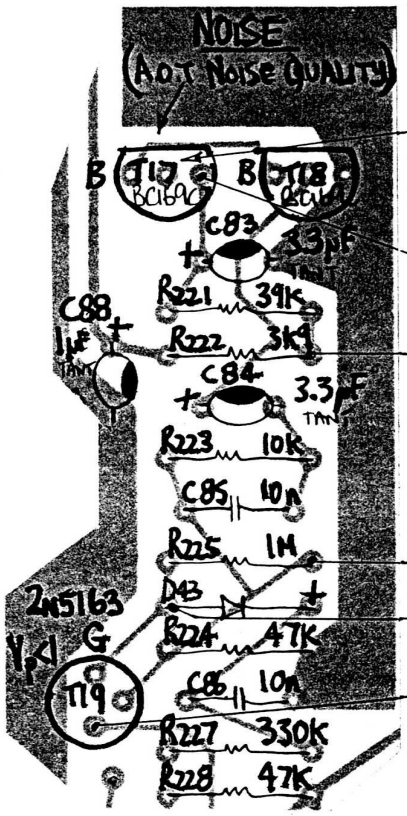
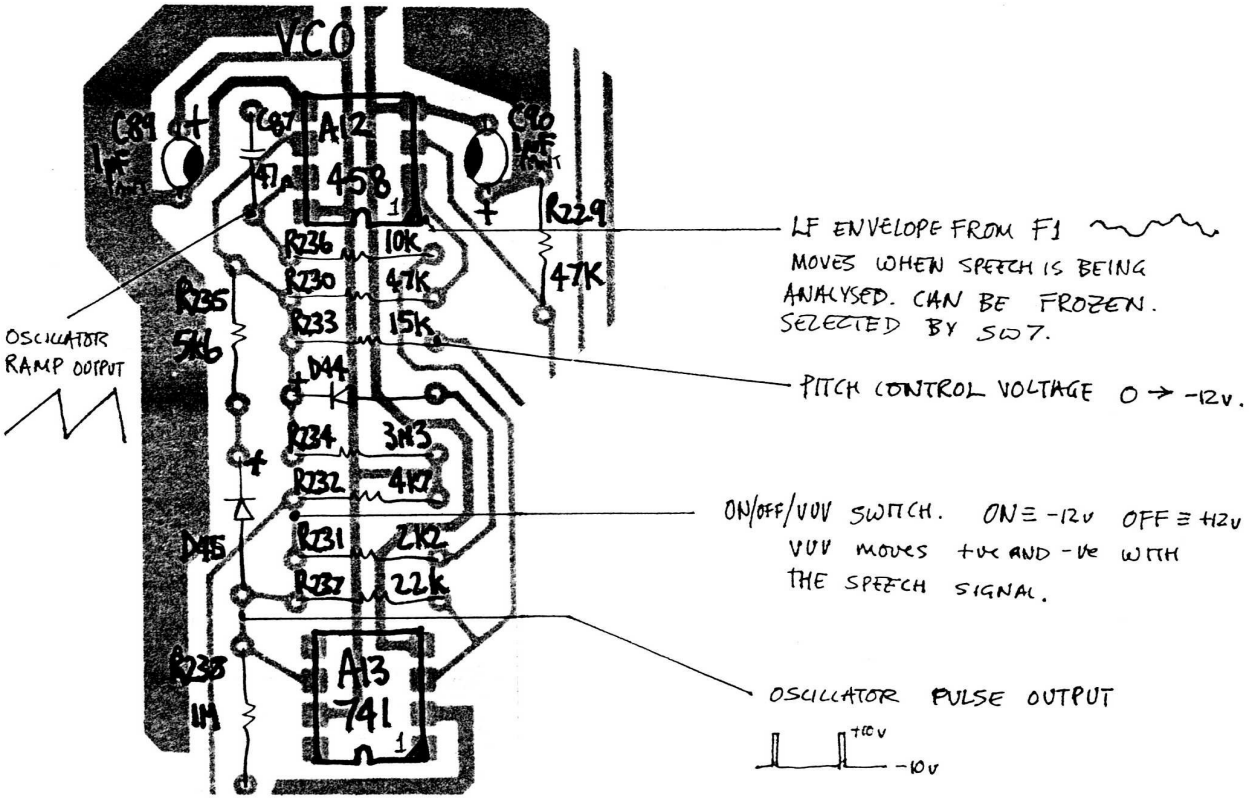
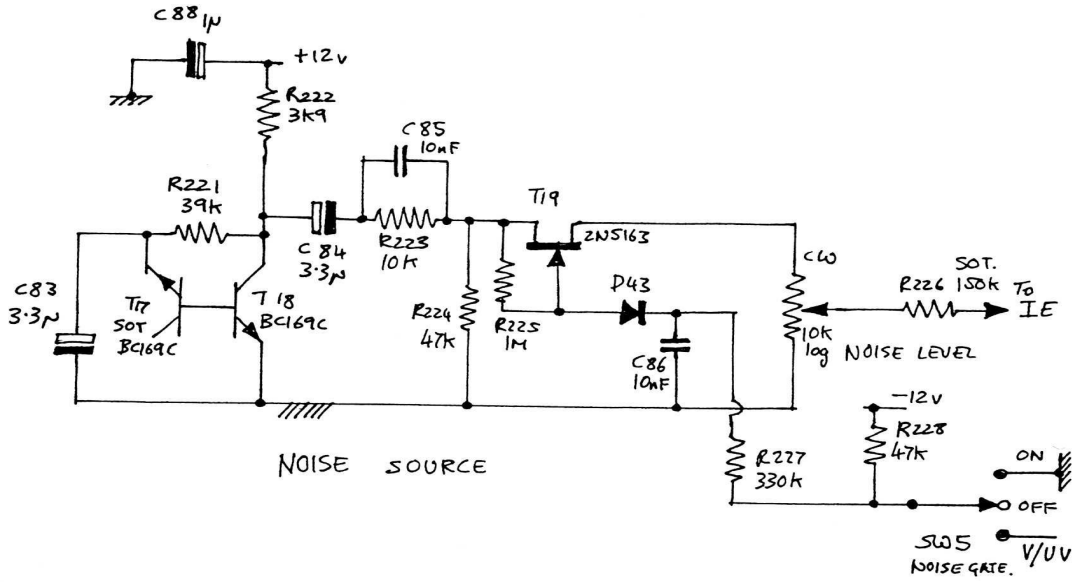
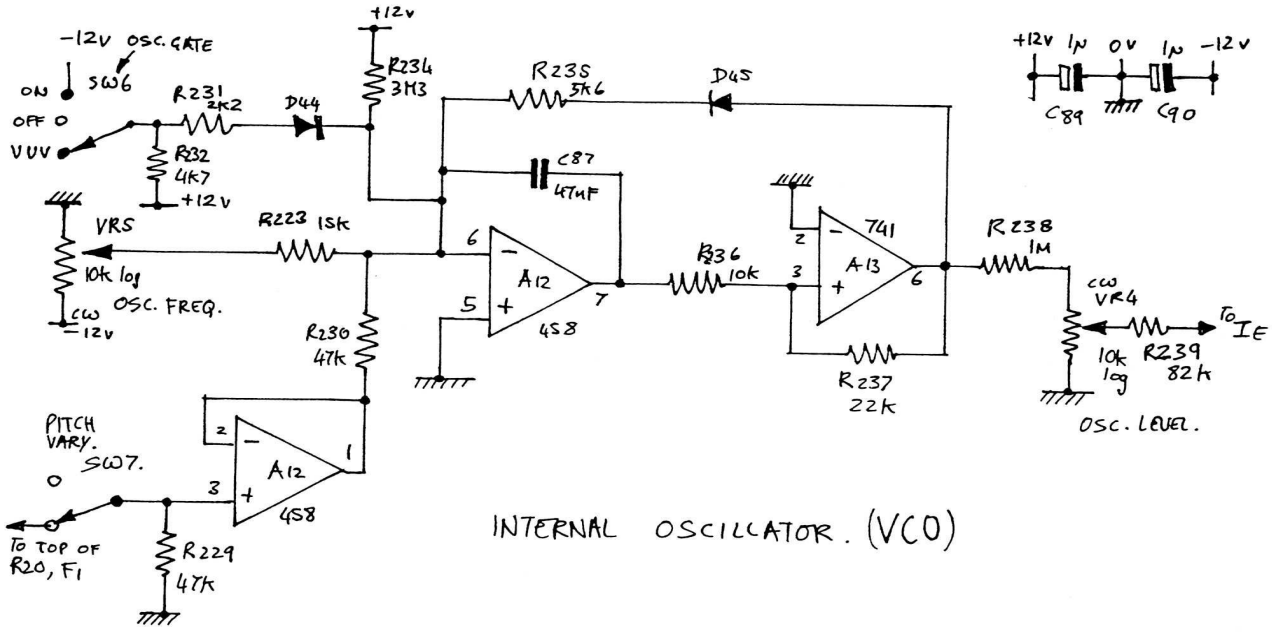

NOISE
(A.O.T. Noise Quality)
B
T17
BC184
B
T18
BC184
C83
33nF
+
R221
39K
C88
1μF
TANT
+
R222
3K3
C84
3.3μF
TANT
+
R223
10K
C85
10n
R225
1M
D43
2N5163
G
T19
R224
47K
C86
10n
R227
330K
R228
47K
SELECTED NOISE TRANSISTOR.
+6v to +8v
NOISE SIGNAL PLUS DC.
AC COUPLED NOISE SIGNAL.
CONTROL SIGNAL FOR GATE. ON ≡ 0V OFF ≡ -12V
GATED NOISE OUTPUT. CONTROLLED BY SW5.


VCO
C89
1μF
TANT
C87
47p
A12
4558
1
C90
1μF
TANT
+
R229
47K
R236
10K
R230
47K
R235
5K6
R233
15K
D44
R234
3K3
R232
4K7
D45
R231
2K2
R237
22K
R238
1M
A13
741
1
OSCILLATOR
RAMP OUTPUT
LF ENVELOPE FROM F1
MOVES WHEN SPEECH IS BEING
ANALYSED. CAN BE FROZEN.
SELECTED BY SW7.
PITCH CONTROL VOLTAGE 0 → -12V.
ON/OFF/VUV SWITCH. ON ≡ -12V OFF ≡ +12V
VUV MOVES +VE AND -VE WITH
THE SPEECH SIGNAL.
OSCILLATOR PULSE OUTPUT
+10V
-10V

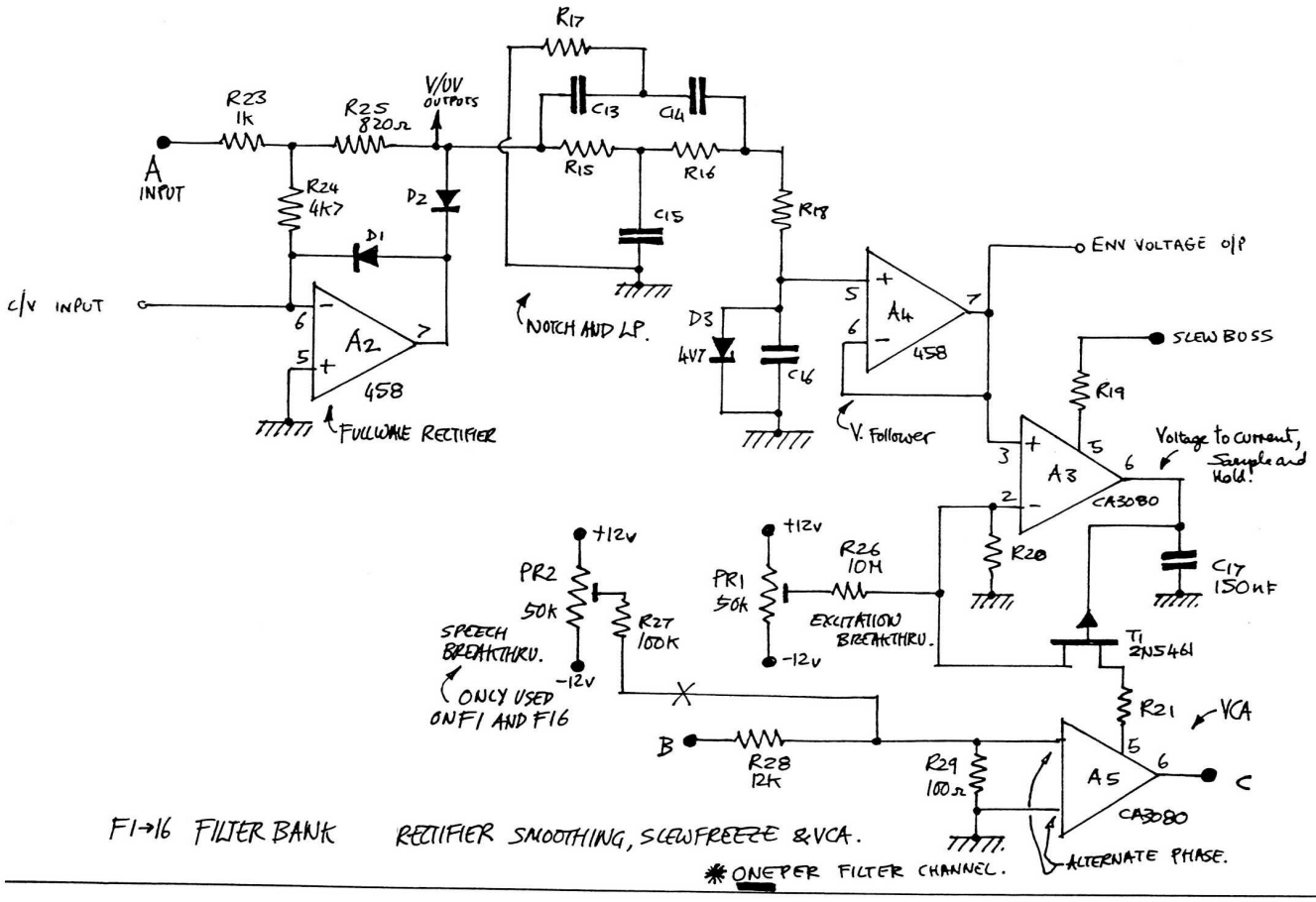


NOISE SOURCE



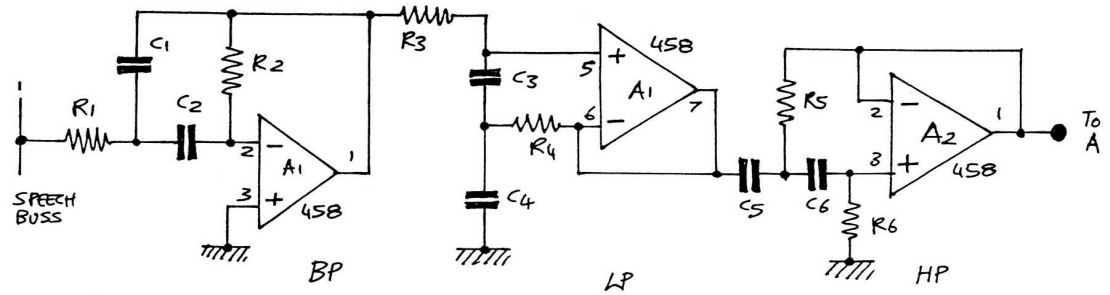
INTERNAL OSCILLATOR. (VCO)

V2000 DRWN MAY 77

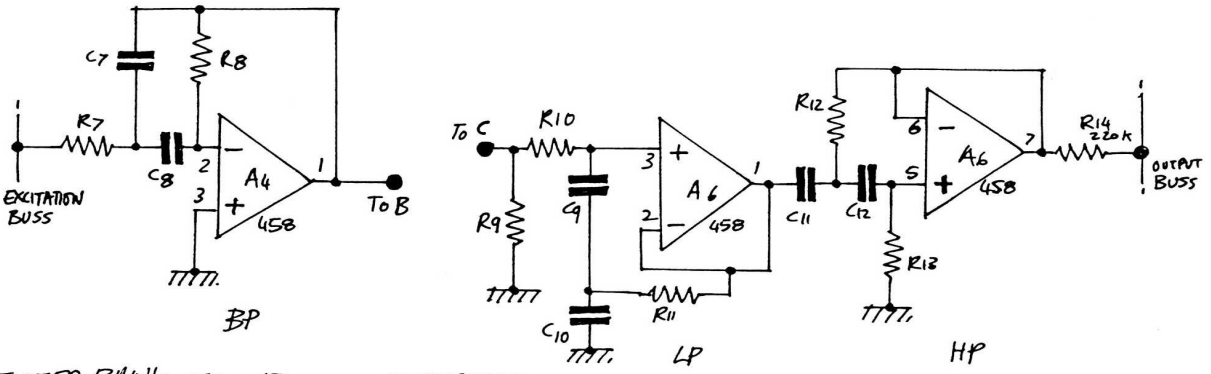


F1→16 FILTER BANK RECTIFIER SMOOTHING, SLEWFREEZE & VCA.

✱ ONE PER FILTER CHANNEL.

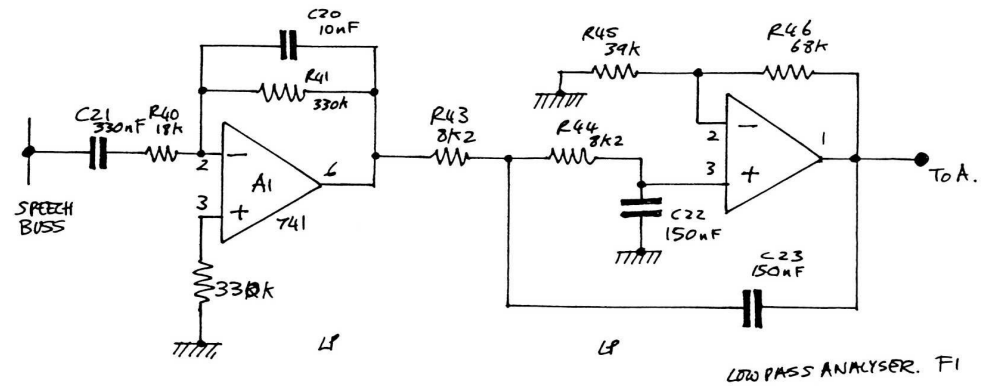


ANALYSER.

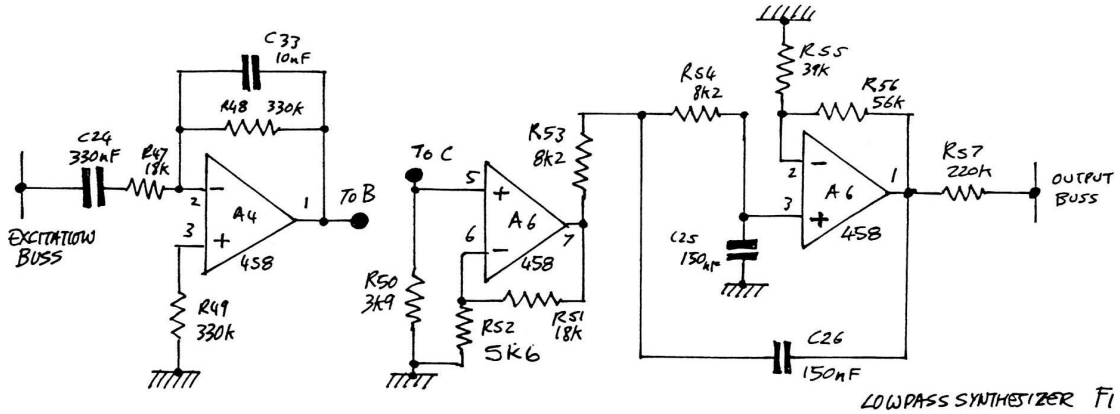


FILTER BANK. F2→15 SYNTHESIZER.

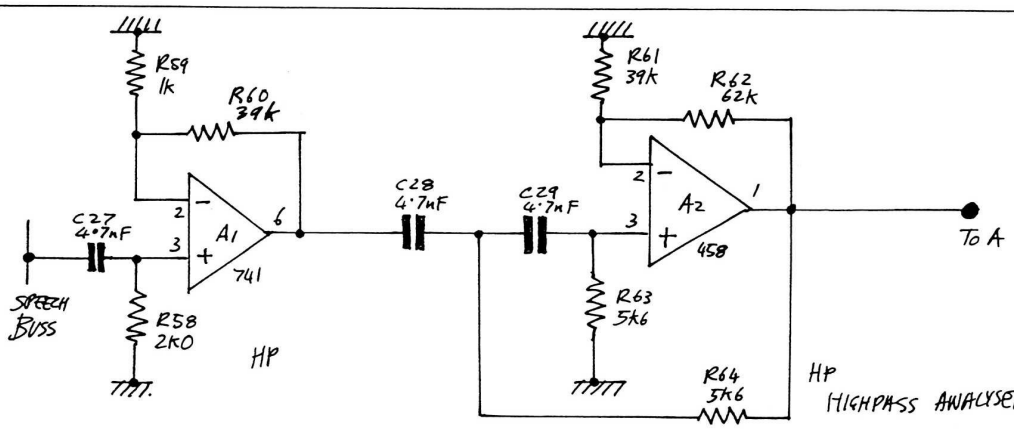
✱ V2000 DRAWN. MAY 1977 ©T.OTLEY



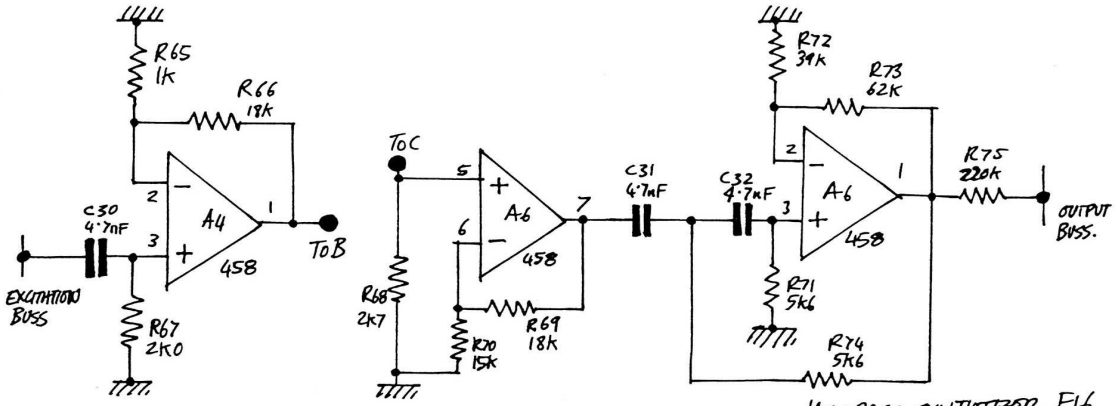
LOW PASS ANALYSER. F1



LOW PASS SYNTHESIZER F1

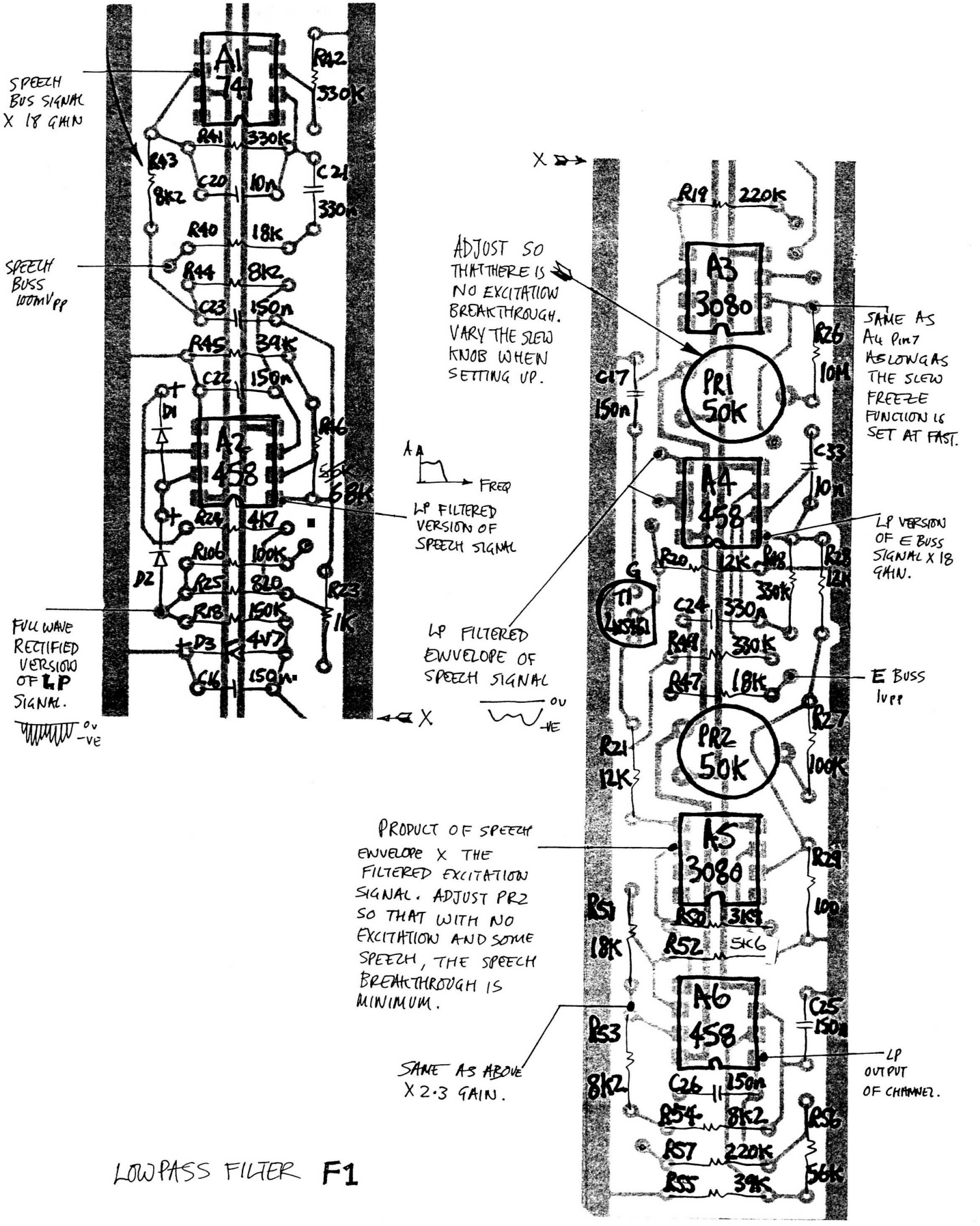


HIGH PASS ANALYSER F16.



HIGH PASS SYNTHESIZER. F16

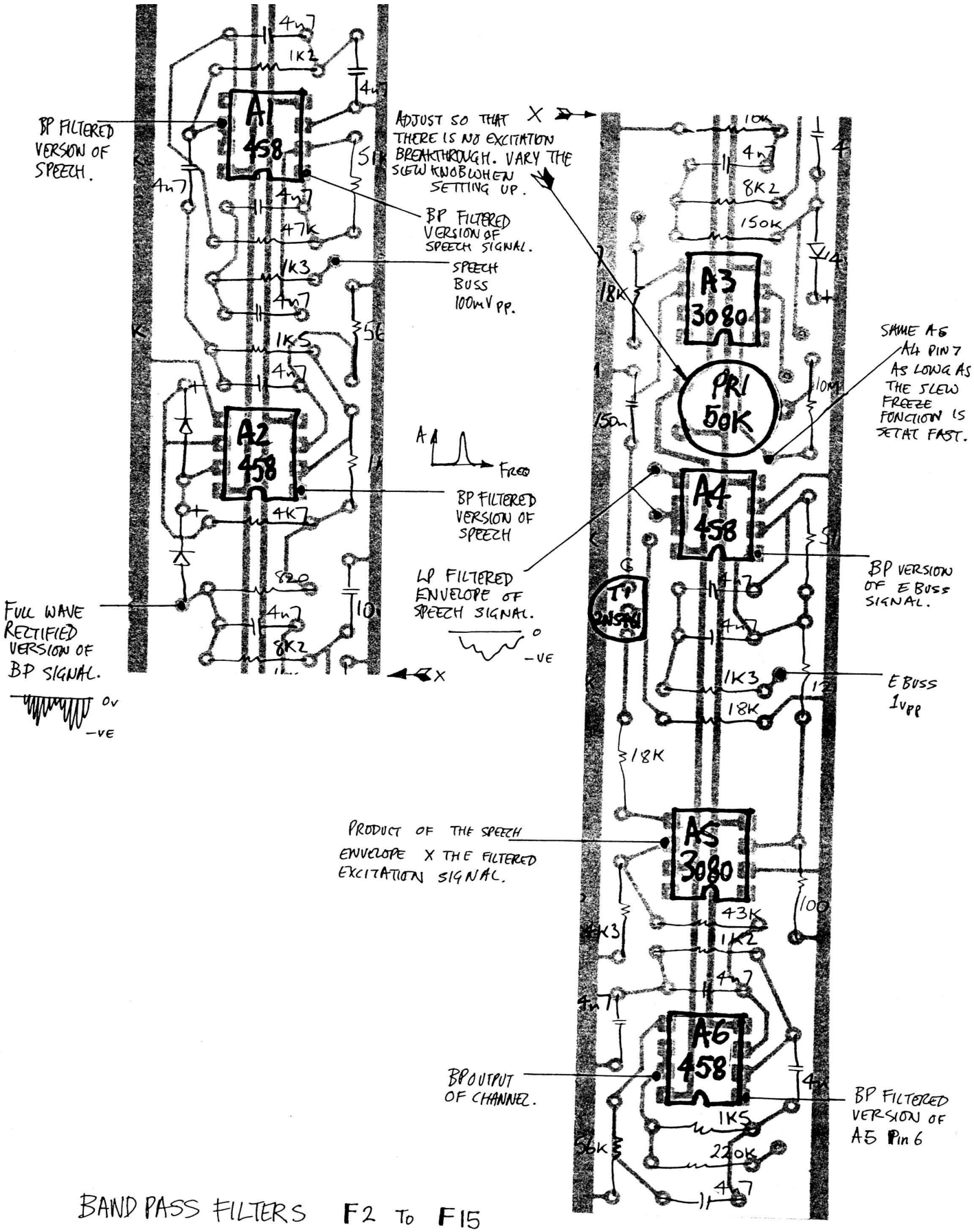
✸ V2000 DAMON MAY 1977 © T.OTTER



LOWPASS FILTER **F1**

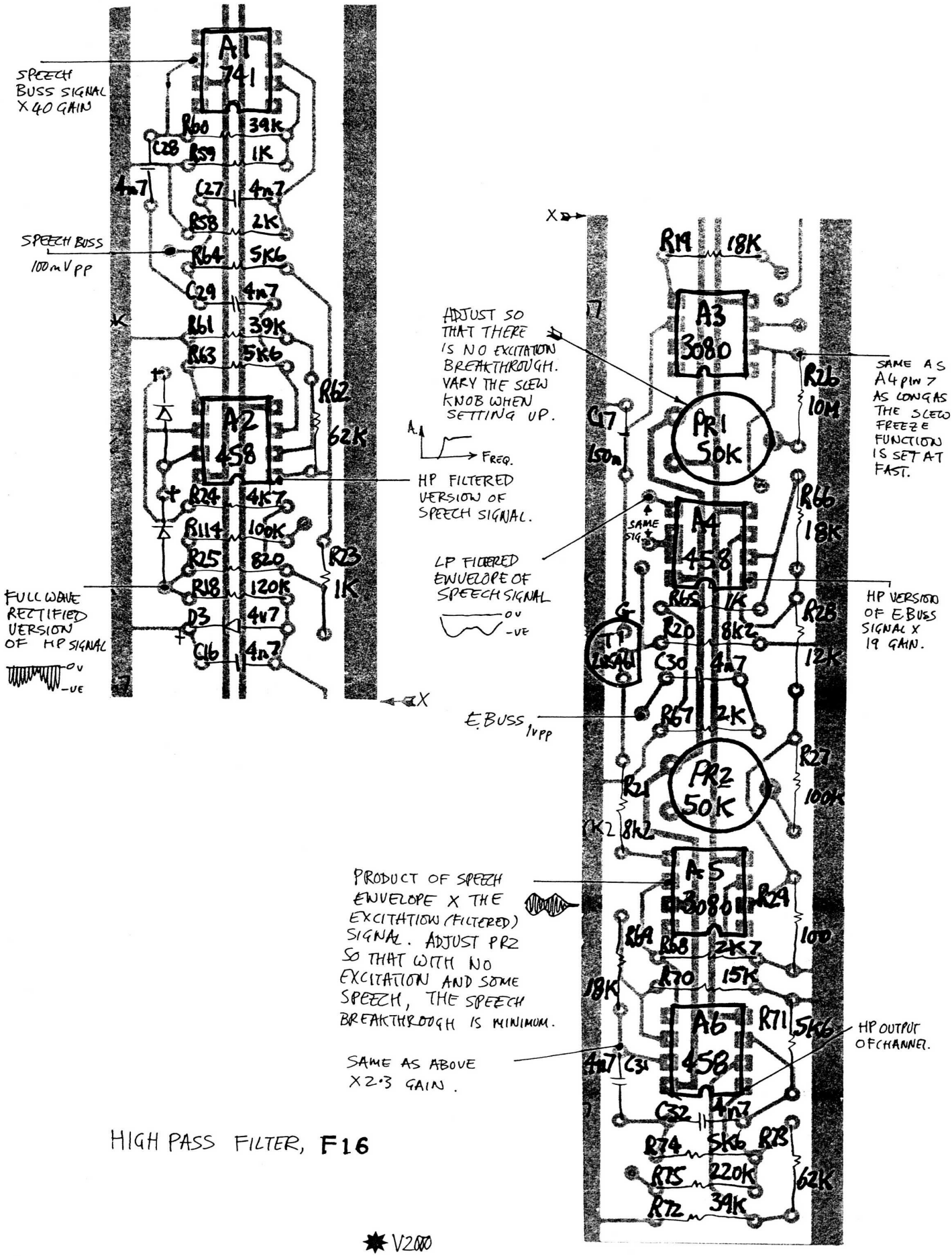
✸ V2000

19.9.77 WDN

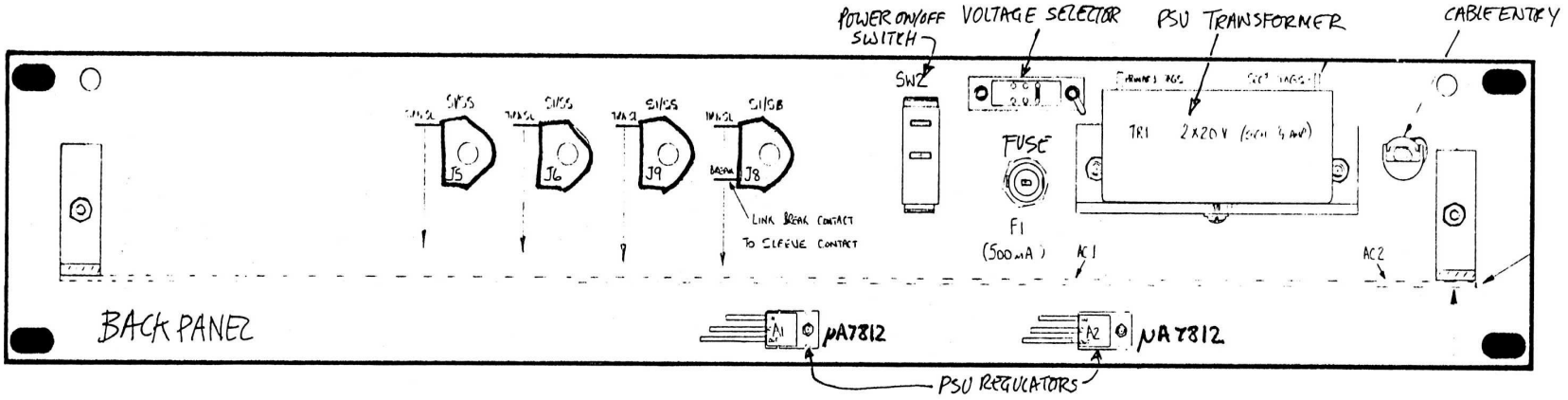


BAND PASS FILTERS F2 TO F15

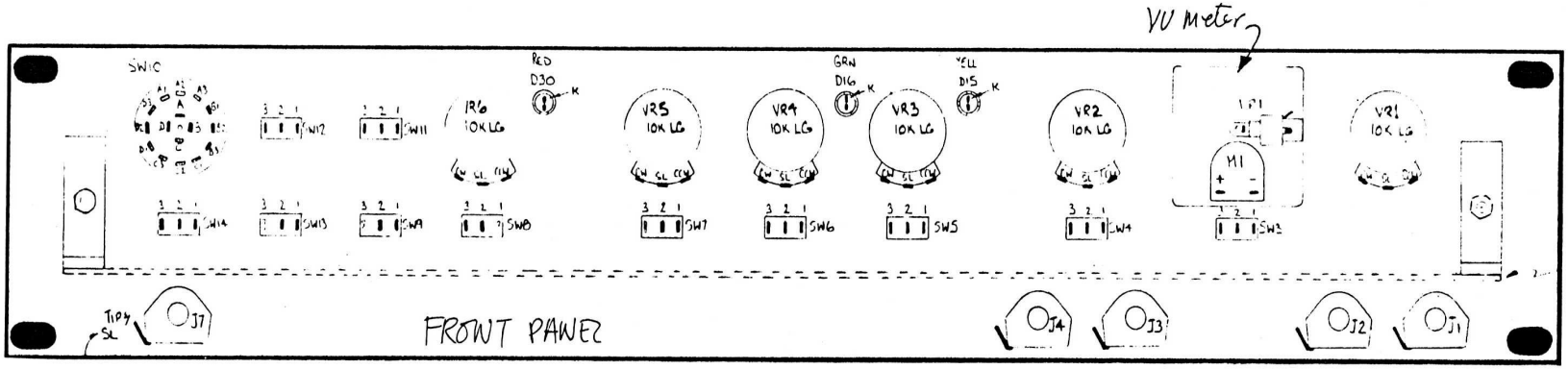
✸ V2000



HIGH PASS FILTER, **F16**

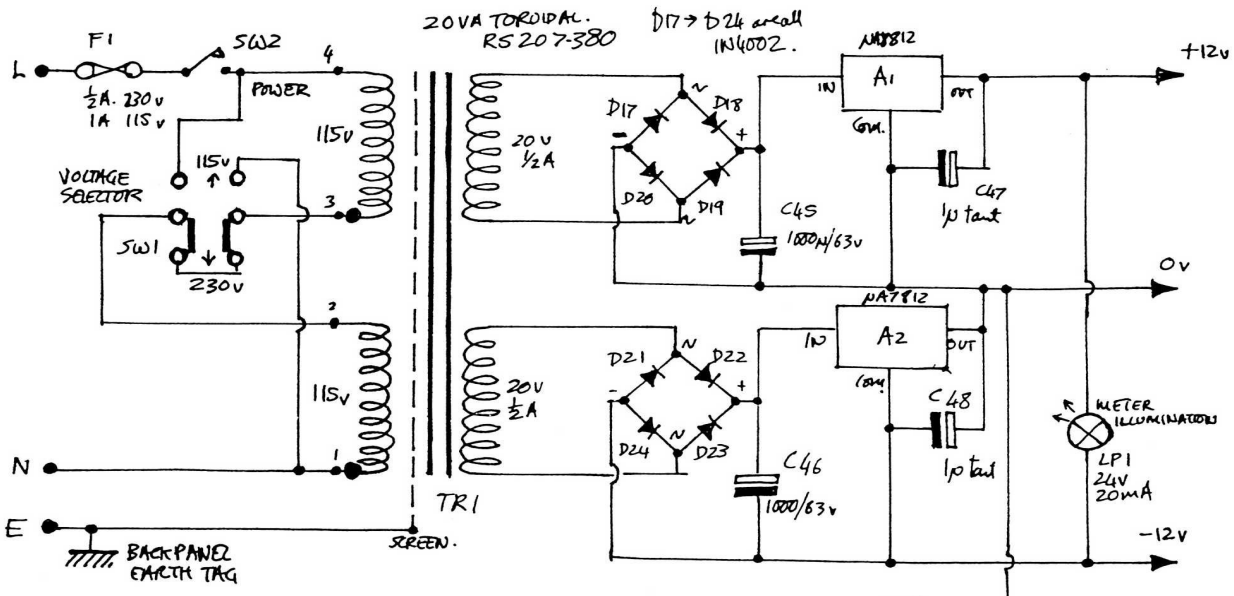


PSU ELECTRONICS MOUNTED NEAR TO BACKPANEL.



FRONT AND BACK PANEL COMPONENTS

✸ Y2000



POWER SUPPLY

DRAWN MAY 1977 © T. ORR.

PARTS. GENERAL NOTES

ALL UNMARKED DIODES ARE IN4148 OR IN914 OR EQUIVILANTS

CA3080. MADE BY RCA. NO EQUIVILANTS.

741. OP AMP MADE BY VIRTUALLY EVERY ONE.

458 DUAL 741. MADE BY MANY PRODUCERS *

* CA1458 RCA
U9T7558393 FAIRCHILD
MC1458 MOTOROLA
LM1458 NATIONAL SEMICONDUCTOR
RC1458 RAYTHEON
SG 1458 SILICON GENERAL
N 5558 SIGNETICS
SN 72558 TEXAS INSTRUMENTS.

2N5163 GENERAL PURPOSE N FET.
2N5461 GENERAL PURPOSE P FET.
BC169C LOW NOISE NPN TRANSISTOR
BC258B LOW NOISE PNP TRANSISTOR
NA7812. ½A PLASTIC POSITIVE 12v REGULATOR.
MOST PC CAPACITORS — MADE BY SIEMENS. ✸V2000