BEDDOES, M. P.
--Final report on french spellex.

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1976

THE UNIVERSITY OF BRITISH COLUMBIA
2075 WESBROOK PLACE
VANCOUVER, B.C., CANADA
V6T 1W5

DEPARTMENT OF ELECTRICAL ENGINEERING

October 21, 1976

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Dr. A. Ronald Elliott
Head, System Implementation Techniques
Directorate of Data Systems
Department of Communications
Government of Canada
Ottawa, Ontario

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Dear Dr. Elliott:

Re: Contract 02SU.36100-5-0613
Serial 0SU5-0129
-- the French Spellex.

It was a great pleasure to talk with you in Ottawa at the CMBES Conference and later meeting and talking to you and John Crysdale and Jack Hobbs mainly about French Spellex. I appreciated your offer to waive the deadline date on the contract.

There was much confusion in my laboratory on my return to UBC. Much havoc seemed repeatedly to appear in the shape of destroyed computer programs and mutilated programs traceable, in part, to the computer failures late 1975. The situation was not improved by my finding that the work with French was only partly completed. However, some order seems now to reign, and I am pleased to include a Final Report on French Spellex with many details, and a tape recording of the synthesized French alphabet sounds and other sounds. I have been informed through Dr. Spratley and Ms Kouri that the contract deadline has been extended until the 30th October. I assume that this was your work. Many thanks.

The Final Report enclosed gives some details firstly through a photograph of the hardware built for French Spellex. (Appendix 1). This can be made operable using the English ROM's. As I explained earlier, the award did not permit us to have ROM's made for French. The report contains circuits. The 8080 assembly language program is available. The report touches on many aspects of recording the French data and storing it in the PDP 12. The tape recording of the sounds was made directly from the PDP 12.

I hope when you listen to your tape recording you will make an assessment of the sounds you hear. The Report contains an informal assessment of quality and it might be of interest to compare your later assessment with the report's. (Appendix 4). The key to the recording is contained in Appendix 5. I would be very interested to

checked 10/83

correspond with you on your impressions of the quality. The tape recording was made with a Scully tape recorder on a full-size reel. It has been my rather sad experience that cassette tapes exhibit pronounced "printing" effects. We thought that a full size tape would present a better case for Spellex than a cassette.

My feeling is that the French sounds now recorded are intelligible and probably higher in quality than the English sounds recorded by Dr. Suen. They represent a set which I would be quite happy to place in ROM's, but I think we could do better. We have gained much experience in the techniques for this synthesis especially recently. I think that a completely fresh set of recordings might have interesting results. I plan, therefore, to make a completely new set of French recordings working from utterances made by a CBC announcer. Our previous work started with recording 40 words uttered by a student. We should be able to make the recordings and process them quite rapidly. I estimate that we should have a further set of French data sounds ready for Christmas. I would like to send them to you for evaluation.

I must await the results of this further work before I attempt to persuade you or John Crysdale or Dr. Hopps to support us in any way to encapsulate the phonemes for French spelled speech (and French Speech) in ROM units.

I look forward to hearing your reactions to the tape recordings and any other matters.

Many thanks for your kind handling of this affair,

Yours sincerely,

Michael P. Beddoes
Professor

sl

Encl.

FINAL REPORT ON FRENCH SPELLEX

Contract 02SU.36100-5-0613
Serial 0SU5-0129

M.P. Beddoes
October 21, 1976

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1. Introduction and Summary

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4. Comments on the Quality of French Spelled Speech

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Appendix 1 Photograph of the Hardware unit for French Spellex.

Appendix 2 Circuit diagrams.

Appendix 3 Set of phonemes and corresponding words from which the phonemes were extracted: Spelled-speech letters, numbers, and punctuation and corresponding phoneme composition.

Appendix 4 List of Spelled Speech sounds and subjective assessment of quality.

Appendix 5 Key to the French Spellex recording - announcements in English.

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1. Introduction and Summary

The conclusion of the project FRENCH SPELLEX was somewhat drawn out because of computer breakdown for 2 months in 1975 and other matters referred to in previous correspondence: see letters to Dr. Elliott April 2, June 8, 1976 and Dr. Elliott's reply of June 12, 1976.

This report gives details of what was accomplished to make a hardware version of SPELLEX for French-speaking blind. Circuits are included. Essentially new ground was turned over in the recording of French Spelled Speech in digital form. This report is accompanied by a tape recording of the French Spelled Speech which will give some idea of the quality obtainable. Preliminary evaluation by a phonetician and by the French speaking engineering research assistant, Mr. Chu, last working with the project, are included.

2. Hardware - called SPELLEX III

The terms of reference of the DOC contract as accepted in my letter of June 23, 1975 were to make a hardware unit for SPELLEX and to record the data for French Spelled Speech in the PDP 12 computer. Using the latter as a data store, it should be possible to operate the hardware unit to produce spoken Spelled Speech.

The SPELLEX III is shown in the photograph of Appendix 1. Three circuit boards in the foreground contain parts for a complete generator, power supply, etc. These circuit boards are normally housed in the box shown in the background. The circular hole on the side of the box is for the loudspeaker. The design is centered around an 8080 microprocessor and a complete speech generator is contained in the most right-hand board. The left hand board contains the power supply and the loudspeaker. ~~The centre board contains the power supply and the loudspeaker~~. The centre board contains the data acquisition and processor circuits for accepting, storing and replaying data from a typewriter. The provision of a typewriter was not included in the contract.

Full details of the circuits for the boards are given in Appendix 2. The program for the 8080 is available.

3. Recording Data for French Spelled Speech

Data for French speech can be analysed and recorded in the PDP 12 using programs developed in the first place for English speech. The first work was done in the summer of 1975 by Guy Paquin - a French-speaking Electrical Engineering student: subsequent work has been carried out by Mr. T.K. Chu, a French-speaking Research Assistant in Electrical Engineering.

Guy's task was to select and then record 29 words from which the French phonemes would be extracted (Appendix 3, page 1). The recordings were made using a Bruël & Kjœr condenser microphone and a high-quality Scully tape recorder. The tape recorder was later connected to the PDP 12, and the words were played into the 10b analog input port of the computer. The computer stored the words in digital memory. One word was then recalled, say "lit". The "it" part of the word was cut away using a "trimming" program, and the phoneme, initial place /l/, was isolated. Further compression of this phoneme took place and a small fraction of this data was finally stored using

techniques described by Suen and Beddoes. This data was sufficient to reconstitute the phoneme. The same processing techniques were carried out to obtain 29 basic phonemes, (Appendix 3, page 1). The last 3 entries were omitted but could be included in any set which would attempt to synthesize speech rather than just spelled speech.

The spelled speech letter-sounds, number-sounds, and abbreviations for the punctuation are listed on pages 2 and 3 of Appendix 3. These rules were suggested by Guy and slightly modified in later work by Mr. Chu.

There is an art to using a tape recorder and further art in trimming away parts of data. There were rules to be discovered. Due to deficiencies in these three areas, many of the spelled speech sounds made by August 1975 were distorted. Some of the words for punctuation, especially, were grossly mistimed. Mr. Chu was assigned the problem of improving the quality: he was also expected to assist with the hardware design.

With respect to the phonemes, he made a thorough study of the PDP 12 programs and found some flaws which affected the quality. In particular, he was able to minimize distortion which was due to round-off error. He then, starting 2 months ago, retrimmed the words and derived a fresh set of phonemes. They now probably represent a performance which is limited only by the quality of the recordings made on the tape recorder.

4. Comments on the Quality of French Spelled Speech

The French data was used to produce 57 words corresponding to French Spelled Speech. These are directly accessible from the ASR 33 teletype machine. Accents such as ´, ` and ^ are stored in the program but were not made accessible. The sounds are listed in Appendix 4 and opposite each entry is an informal estimate of quality made by a phonetician and by Mr. Chu. The estimates are to a four point scale and range from Excellent down to "To be improved" or Poor. Generally, long words were more easily perceived than short ones. The alphabet symbols were generally monosyllable but the number of "excellent" entries was only 6 for monosyllable words. With 3 syllables, there were 3 "excellent" entries from a total of 7 tri-syllable words.

The quality of the French speech is demonstrated by the enclosed tape recording, and the key to the recording is given in Appendix 5.

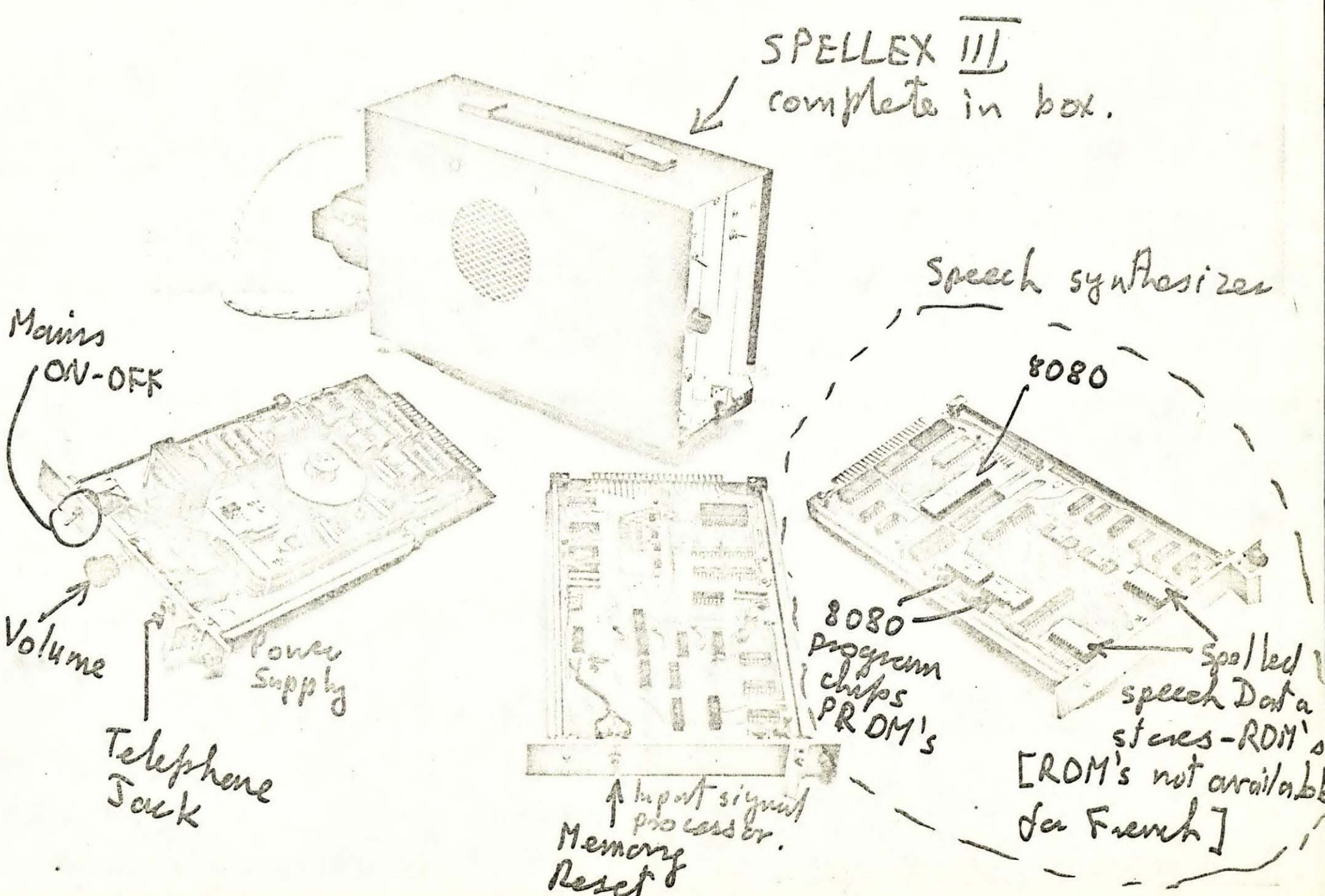
5. Conclusions

The quality of most of the alphabet sounds seems at the least adequate in terms of being intelligible: there are quite a number of sounds which are very good. A novice may perhaps hear "elan" for !, but he should be easily taught or persuaded that what he hears is really a dialect form of "exclam". We do not anticipate that the French blind would have difficulty adjusting to this brand of French. Thus, we think that the set of sounds on the tape would represent a serviceable group.

However, we are at a point where further improvements in quality could be made. We have the experience, and we have identified some of the problems and have solutions in the preparation of French sounds. One thing is obvious. The first set of sounds must be very good. They must not be

so faint as to be masked by the noise in the tape-recorder nor close to distortion: blowing on the microphone on the plosives is difficult to avoid. Thus we suggest that a further set of originals should be made by trained announcers from the CBC. Perhaps we should have done this at the start. From this new set of words, we would produce a set of phonemes. Depending on the results of this work, I should like to raise, possibly by January 1977, the question of further funding. An amount of about $10,000 would be needed to encapsulate the French data in ROM's which would then plug directly into the sockets provided - Appendix 1 shows these sockets presently occupied with ROM's for the English Spelled Speech. The main cost would be to make the masks for the ROM's: the actual ROM chips cost only $25 each in quantities of 10 or more.

Appendix I


SPELLEX III
complete in box.
Speech synthesizer
Mains
ON-OFF
8080
Volume
Power
Supply
Telephone
Jack
8080
program
chips
PROM's
Spelled
speech Data
stores - ROM's
[ROM's not available
for French]
Input signal
processor.
Memory
Reset

Appendix 3

PHONETIC SYMBOLS

i	lit	p	papa
e	été	t	tout
ɛ	lait	k	cas
a	patte	b	bébé
y	lui	d	dos
ə	le	g	gai
(ø	deux)	f	fin
(oe	heure)	s	son
u	loup	ʃ	chat
o	rose	v	va
ɔ	robe	z	zéro
ɑ	pâte	ʒ	juge
ɛ̃	fin	m	maman
ɑ̃	dans	n	nez
ɔ̃	mon	ɳ	gagné
œ̃	brun	l	lit
		r	rose
		w	oui
		ɥ	lui
		(j	bien)

FRENCH SPELLEX

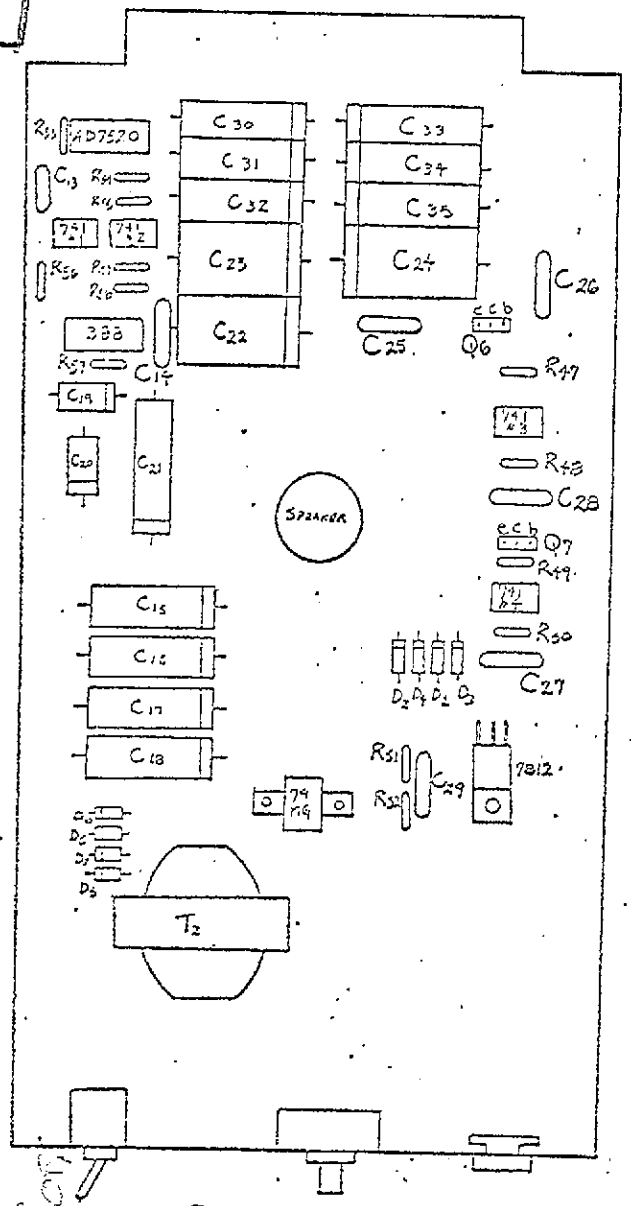
ALPHABET	
A	a
B	be
C	se
D	de
E	ə
F	ɛf
G	ʒe
H	aʃ
I	i
J	ʒi
K	Ka
L	ɛl
M	ɛm
N	ɛn
O	o
P	pe
Q	Ky
R	ɛR
S	ɛS
T	te
U	y
V	ve
W	dublə̀ve
X	iks
Y	igrɛk
Z	zɛd

NUMBER	
1	œ̂
2	də (dø)
3	trwa
4	Katr
5	sɛ̃K
6	sis
7	sɛt
8	yit
9	nœf
0	zero

PUNCTUATION & SYMBOLS

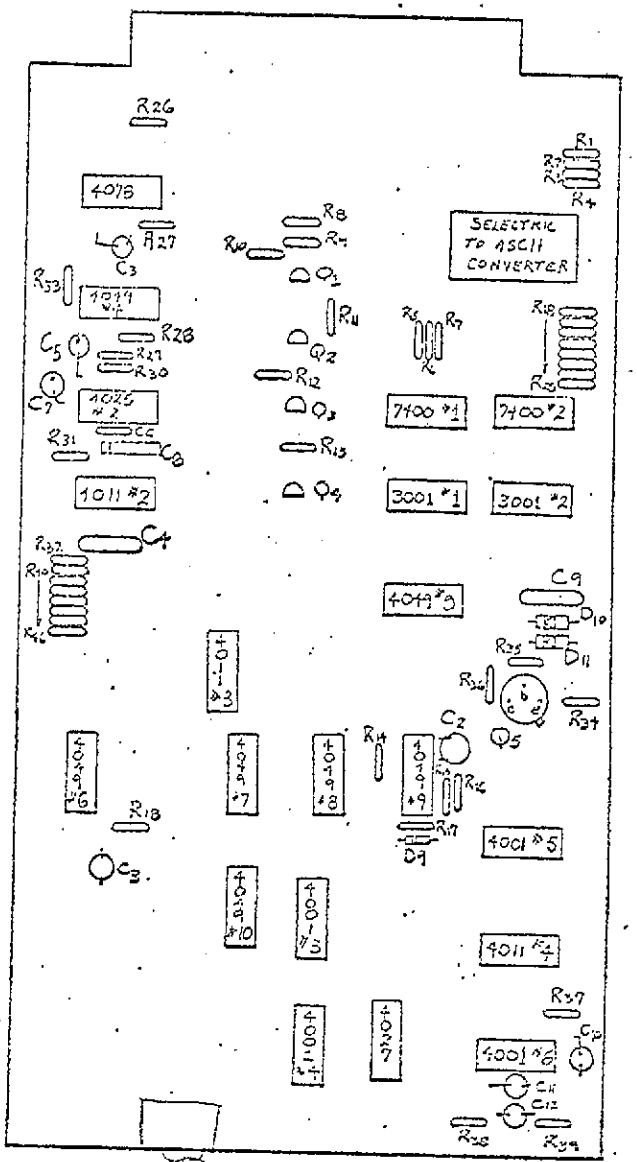
.	point	pwẽ
,	virgule	virgyl
;	point-virgule	pwẽ virgyl
:	deux-points	də pwẽ
-	tiret	tire
?	interrogation	ẽterogasiɔ̃
!	exclamation	ɛkslam
"	guillemet	giəme (gijmɛ)
#	numéro	nymero
$	dollar	dolar
%	pourcent	pursã
&	et	e
'	apostrophe	apɔstrɔf
(	parenthèsẽ gauche	parã guoʃ
)	parenthèsẽ droit	parã drwat
*	astérisque	asterisk
=	égale	egal
+	plus	plys
<	plus petit	plys pəti
>	plus grand	plys grã

POWER SUPPLY +
AUDIO OUTPUT



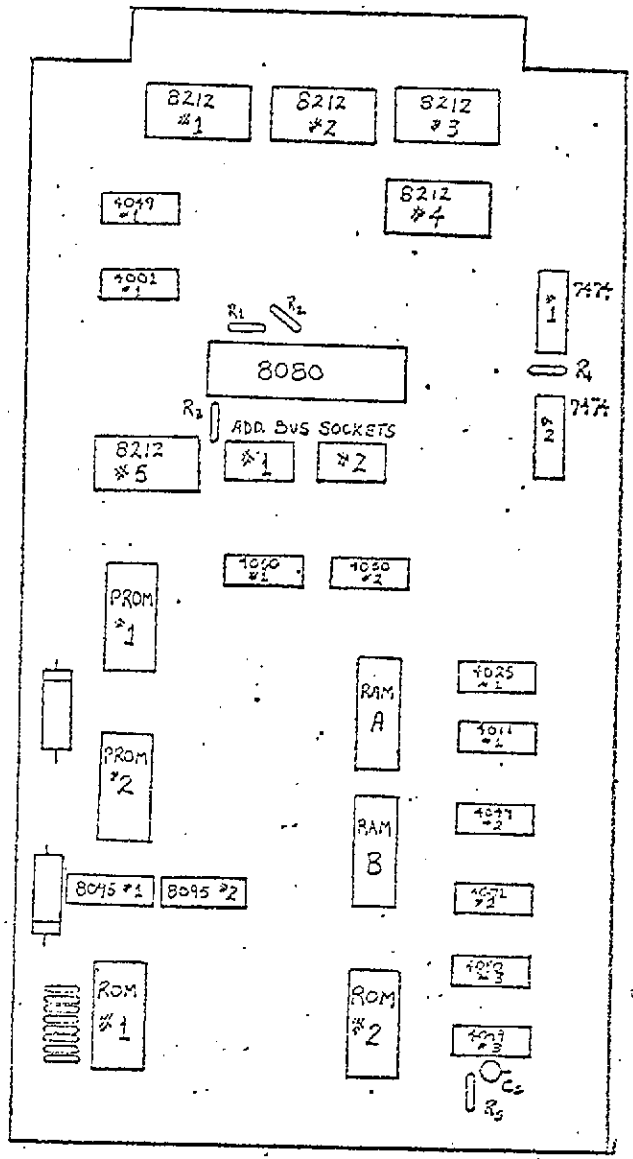
BOARD 1

TTY

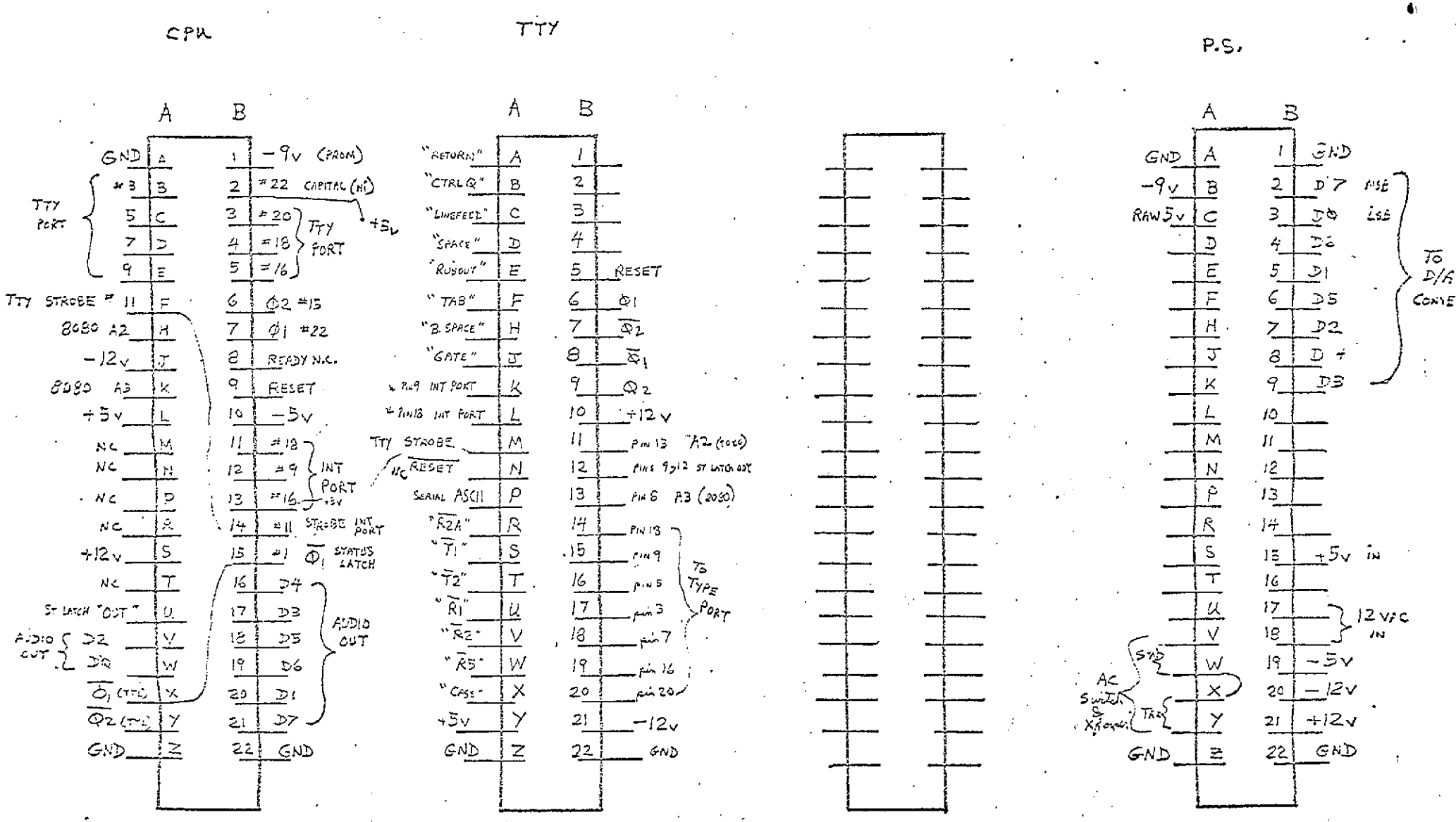


BOARD 2

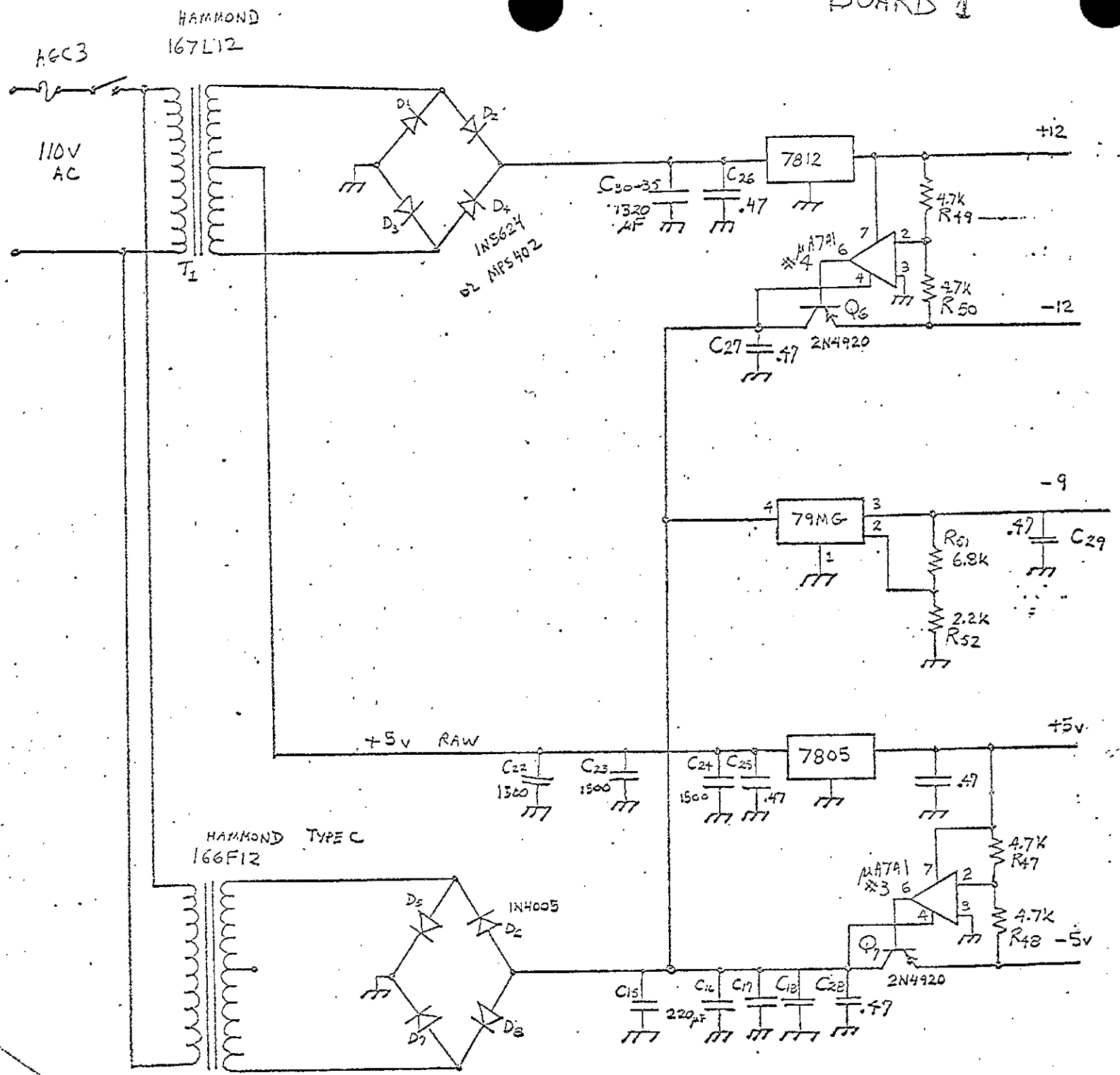
CPU



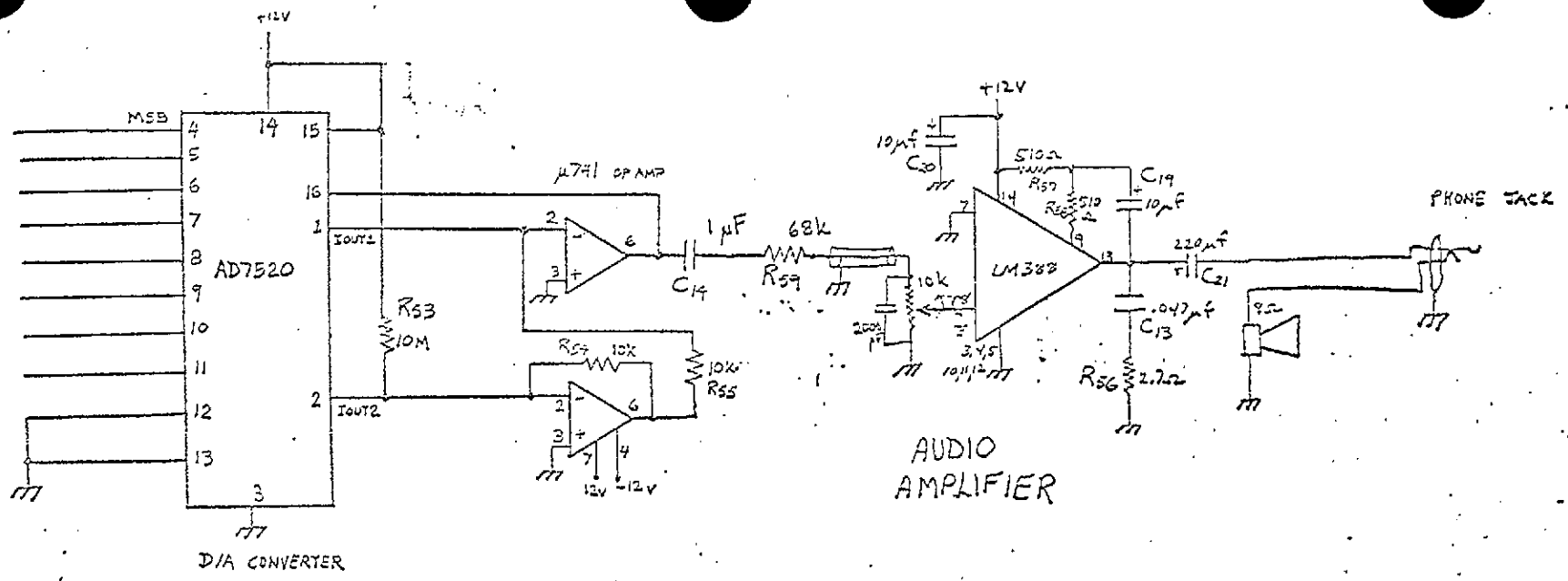
BOARD 3


CPU
TTY
P.S.
A
B
GND
-9v (PROM)
#3
#22 CAPITAL (HI)
TTY PORT
+5v
#20
#18
#16
TTY STROBE #11
Φ2 #15
8080 A2
Φ1 #22
-12v
READY N.C.
8080 A3
RESET
+5v
-5v
NC
#18
#9
INT PORT
#16
+5v
STROBE INT PORT
+12v
#1
Φ1 STATUS LATCH
ST LATCH "OUT"
D4
AUDIO OUT
D2
D3
D5
D6
D1
D7
Φ1 (TTL)
Φ2 (TTL)
GND
"RETURN"
"CTRL Q"
"LINEFEED"
"SPACE"
"RUBOUT"
"TAB"
"B. SPACE"
"GATE"
* PIN 9 INT PORT
* PIN 18 INT PORT
TTY STROBE
RESET
SERIAL ASCII
"R2A"
"T1"
"T2"
"R1"
"R2"
"R5"
"CASE"
PIN 13 A2 (TOLO)
PINS 9,12 ST LATCH OUT
PIN 8 A3 (8080)
PIN 18
PIN 9
PIN 5
PIN 3
PIN 7
PIN 16
PIN 20
TO TYPE PORT
-12v
GND
GND
-9v
RAW 5v
D7 MSB
D0 LSB
D6
D1
D5
D2
D4
D3
TO D/A CONVE
+5v IN
12 VAC IN
STAB
AC Switch & Xfrmr
TRX
-5v
-12v
+12v
GND

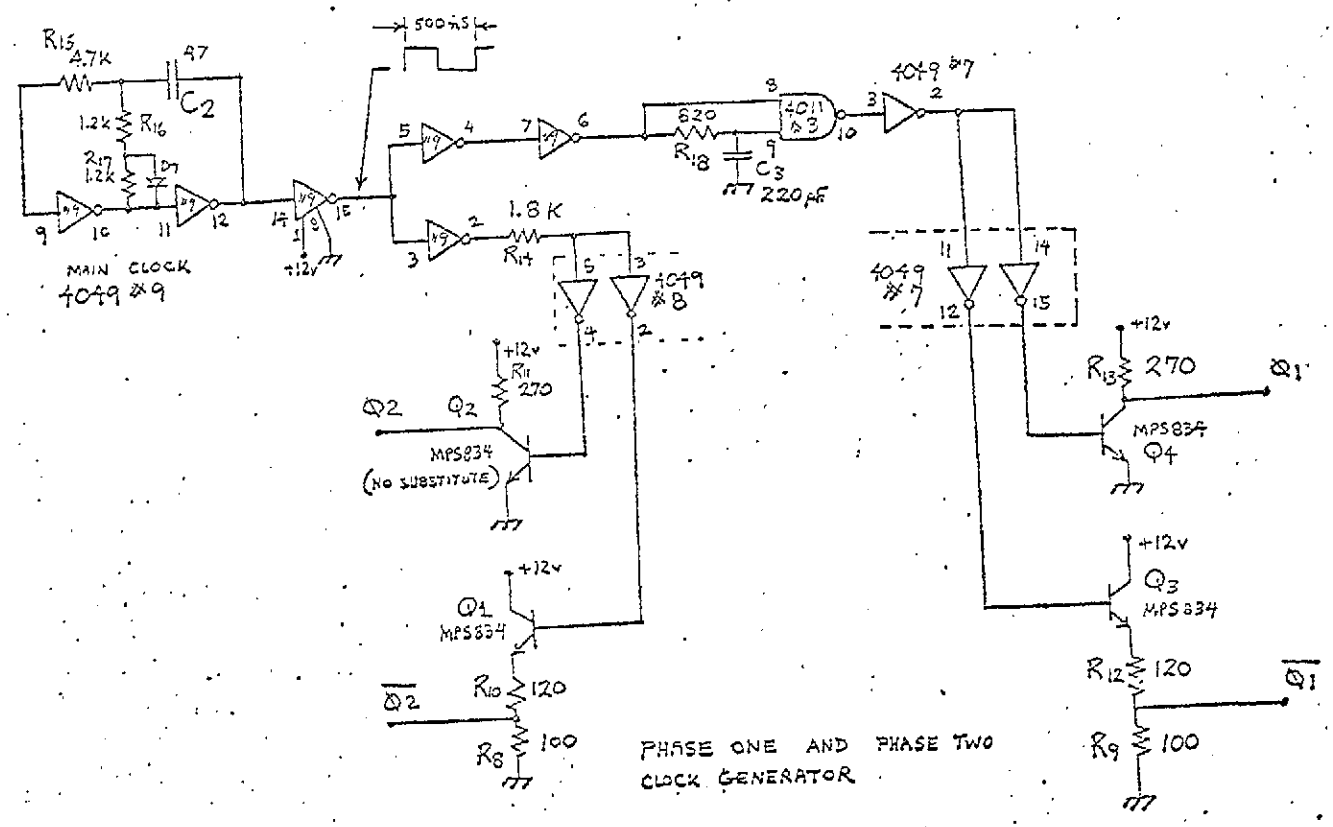
BOARD 1

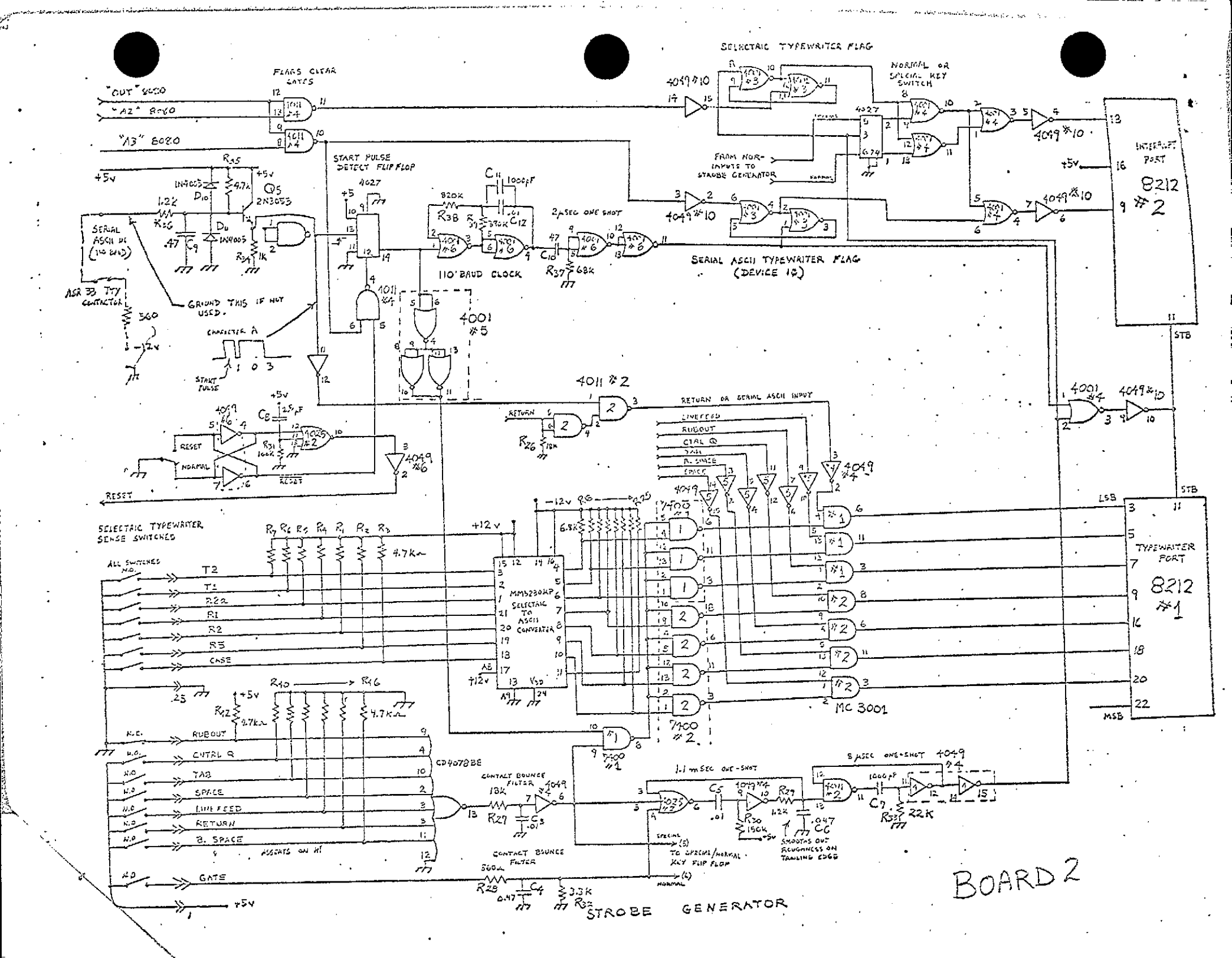

HAMMOND
167L12
AGC3
110V
AC
T1
D1
D2
D3
D4
IN5624
OR MR5402
C30-35
1320
μF
C26
.47
7812
+12
4.7k
R49
μA741
#4
7
2
6
3
4
4.7k
R50
Q6
2N4920
-12
C27
.47
-9
79MG
4
3
2
1
R51
6.8k
.47
C29
2.2k
R52
+5v RAW
C22
1500
C23
1500
C24
1500
C25
.47
7805
+5v
.47
HAMMOND TYPE C
166F12
D5
D6
D7
D8
IN4005
μA741
#3
4.7k
R47
4.7k
R48
-5v
Q7
2N4920
C15
220μF
C16
C17
C18
C28
.47

BOARD 1



BOARD 2



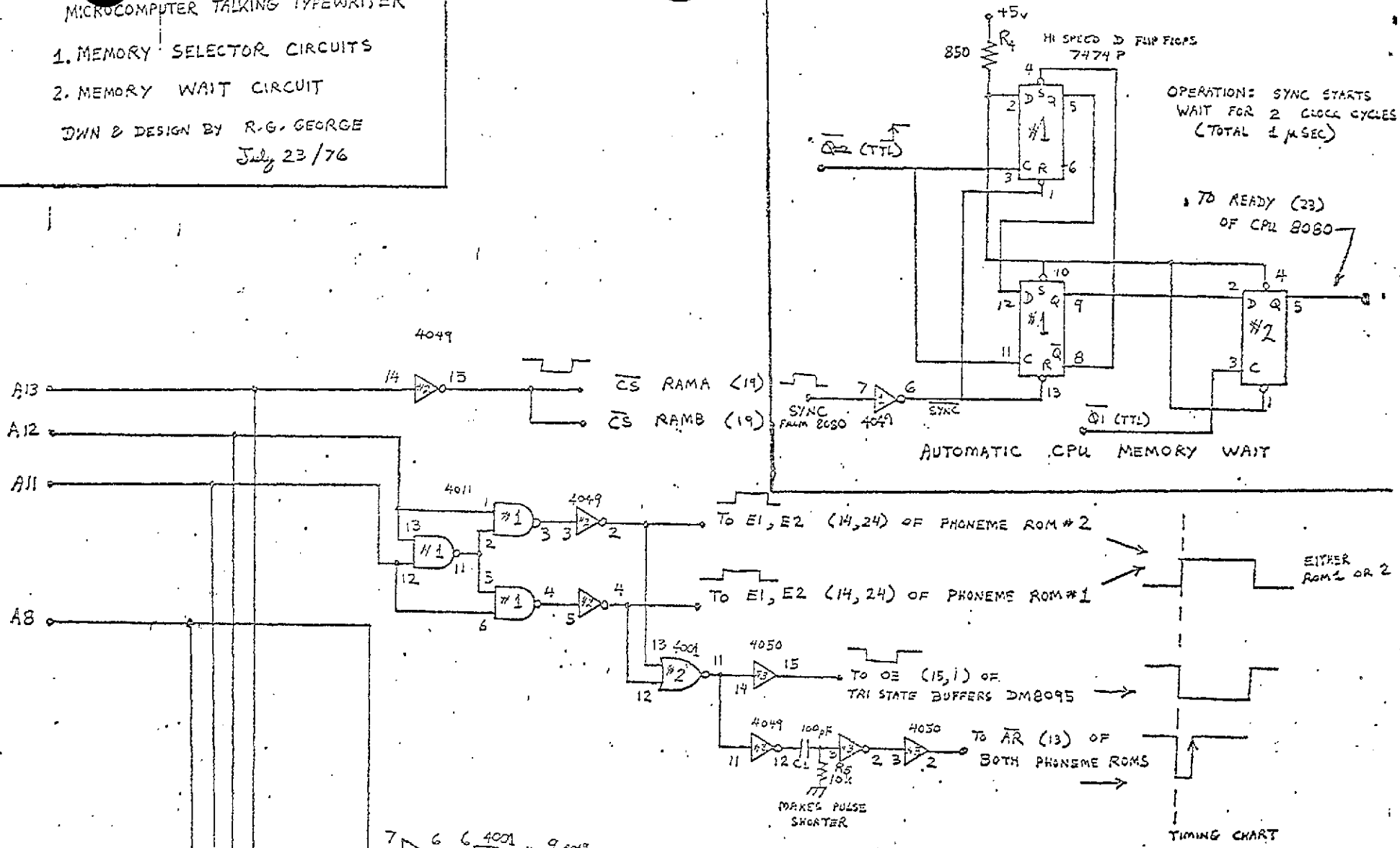


SELECTRIC TYPEWRITER FLAG
FLAGS CLEAR GATES
"OUT" 8080
"A2" 8080
"A3" 8080
NORMAL OR SPECIAL KEY SWITCH
FROM NOR-INPUTS TO STROBE GENERATOR
INTERRUPT PORT
8212 #2
START PULSE DETECT FLIP FLOP
2μSEC ONE SHOT
110' BAUD CLOCK
SERIAL ASCII TYPEWRITER FLAG (DEVICE 10)
SERIAL ASCII IN (110 BAUD)
ASR 33 TTY CONTACTOR
GROUND THIS IF NOT USED.
CHARACTER A
START PULSE
RETURN OR SERIAL ASCII INPUT
LINEFEED
RUBOUT
CTRL Q
TAB
B. SPACE
SPACE
RESET
NORMAL
SELECTRIC TYPEWRITER SENSE SWITCHES
ALL SWITCHES N.O.
T2
T1
R2a
R1
R2
R3
CASE
MM5230KP SELECTRIC TO ASCII CONVERTER
TYPEWRITER PORT
8212 #1
LSB
MSB
STB
MC 3001
RUBOUT
CNTRL Q
TAB
SPACE
LINEFEED
RETURN
B. SPACE
ASSERTS ON HI
GATE
CD4078BE
CONTACT BOUNCE FILTER
1.1 mSEC ONE-SHOT
8μSEC ONE-SHOT
SMOOTHS OUT ROUGHNESS ON TRAILING EDGE
TO SPECIAL/NORMAL KEY FLIP FLOP
STROBE GENERATOR
BOARD 2

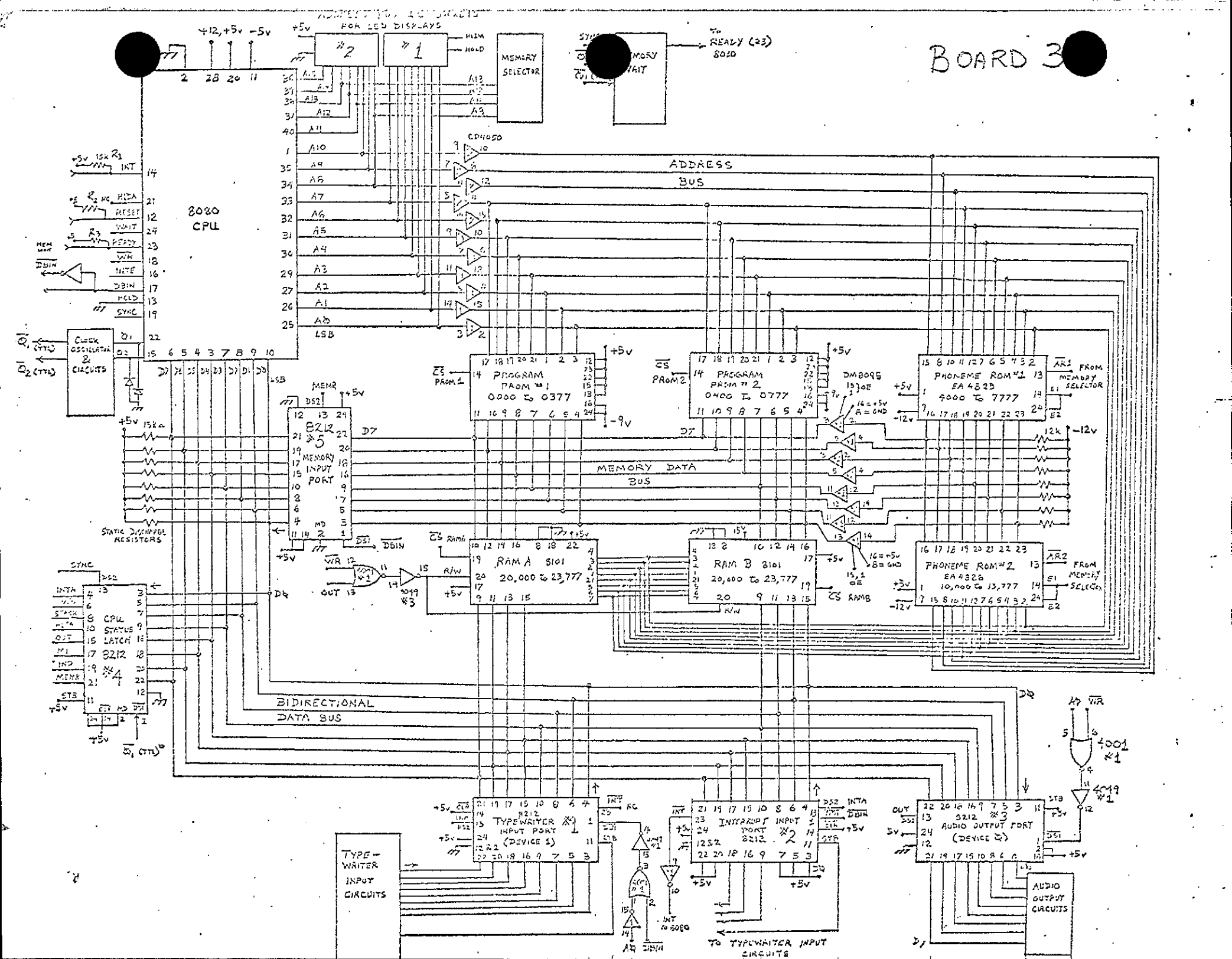
MICROCOMPUTER TALKING TYPEWRITER

1. MEMORY SELECTOR CIRCUITS
2. MEMORY WAIT CIRCUIT

DWN & DESIGN BY R.G. GEORGE
July 23/76



BOARD 3


BOARD 3
FOR LED DISPLAYS
MEMORY SELECTOR
MEMORY WAIT
TO READY (23) 8080
8080 CPU
CLOCK OSCILLATOR & CIRCUITS
ADDRESS BUS
MEMORY DATA BUS
BIDIRECTIONAL DATA BUS
PROGRAM PROM #1 0000 to 0377
PROGRAM PROM #2 0400 to 0777
PHONEME ROM #1 EA 4823 4000 to 7777
PHONEME ROM #2 EA 4826 10,000 to 13,777
RAM A 8101 20,000 to 23,777
RAM B 8101 20,000 to 23,777
8212 #5 MEMORY INPUT PORT
CPU STATUS LATCH 8212 #4
TYPEWRITER INPUT PORT (DEVICE 1) 8212 #1
INTERRUPT INPUT PORT 8212 #2
8212 #3 AUDIO OUTPUT PORT (DEVICE 0)
TYPE-WRITER INPUT CIRCUITS
AUDIO OUTPUT CIRCUITS
TO TYPEWRITER INPUT CIRCUITS
STATIC DISCHARGE RESISTORS
FROM MEMORY SELECTOR
DM8095
4001 #1
4049 #1

COMMENT

Appendix 4

ALPHABET	Excellent	Good	Acceptable	To be improved	
A		✓			
B			✓		
C		✓			
D			✓		
E		✓			
F			✓		
G		✓			
H	✓				excellent combination
I		✓			
J		✓			
K		✓			
L			✓		
M			✓		
N			✓		
O		✓			
P		✓			
Q	✓				due to good U
R			✓		
S		✓			
T			✓		
U	✓				good phoneme
V			✓		
W			✓		
X			✓		
Y			✓		
Z			✓		

COMMENT

PUNCTUATION & SPECIAL SYMBOL	Excellent	Good	Acceptable	To be improved	
. point		✓			
, virguille		✓			
; point-virguille		✓			
: deux points		✓			
' trait			✓		
- tiret			✓		
! Exclam	✓				good combination
" guillemet				✓	
# numero	✓				good phoneme & combination
$ dollar			✓		
% pourcent			✓		
[redacted]	✓				good phoneme
' apostrophe			✓		
(parent-gauch		✓			
) parent-droit			✓		
* asterisque	✓				good combination
= égale			✓		
+ plus	✓				good combination
? interroga-tion			✓		
< plus petit	✓				good combination
> plus grand	✓				good combination

The excellent sounds from FRENCH SPELLEX due to the credits from:

[redacted]a) good phonemes,
[redacted])) the beginning and the end of the concatenated phonemes are matched,
[redacted]c) the word itself is easy to be recognized.

With continued effort, ALL sounds could be improved to be very close to the originals.

COMMENT

NUMBER	Excellent	Good	Acceptable	To be improved	
1	√				sound from single phoneme
2			√		
3			√		
4			√		
5			√		
6	√				good combination
7			√		
8			√		
9			√		
0	√				good combination

THE UNIVERSITY OF BRITISH COLUMBIA

VANCOUVER 8, CANADA

Appendix 5

DEPARTMENT OF ELECTRICAL ENGINEERING

Oct.18/1976

FRENCH SPELLEX RECORDING

****

The recording is divided into 4 parts: alphabet,number,special symbol & punctuation, and spelling examples.

Part one : alphabet

each letter is repeated 3 times

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Part two : number

each number is repeated 3 times.

1 2 3 4 5 6 7 8 9 0

Part three : special symbol & punctuation

each character is repeated 3 times.

(.): point ; (,): virgule ; (;) : point-virgule ; (:) :deux-points ;

(-): tiret ; (?): interrogation ; (!) : exclam ;(") : guillemet ;

(#): numéro ; ($): dollar ; (%) : pourcent ; (&) : et ;
('): apostrophe ; (( ) : paren-gauche ; ( )) : paren-droit ;

(*) : astérisque ; (=) : égale ; (+) : plus ;(<):plus petit ;

(>) : plus grand .

part four : spelling examples

the SPELLEX ITSELF will first say the word , then spell it out, then say the word again . This is repeated twice .

\+ PLUS
< PLUS PETIT
> PLUS GRAND
! EXCLAM
* ASTERISQUE
% POURCENT
# NUMERO

This is the end of the recording .

****

CACC / CCAC
86986

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1976

BEDDOES, M. P.
--Final report on french
spellex.

NAME OF BORROWER

P
91
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1976

DATE DUE
DATE DE RETOUR

LOWE-MARTIN No. 1137

P
91
C655
B44
1976

BEDDOES, M. P.
--Final report on french spellex.

DATE	NAME OF BORROWER NOM DE L'EMPRUNTEUR

Gouvernement du Canada
Ministère des Communications

Government of Canada
Department of Communications

CIRCULATION RECORD

FICHE DE CIRCULATION

06-96
279

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DATE	NAME OF BORROWER NOM DE L'EMPRUNTEUR

Gouvernement du Canada
Ministère des Communications

Government of Canada
Department of Communications

CIRCULATION RECORD

FICHE DE CIRCULATION

06-96
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SEDDON, M. P.
--Final report on franch spellex.

DATE	NAME OF BORROWER NOM DE L'EMPRUNTEUR

Gouvernement du Canada
Ministère des Communications

Government of Canada
Department of Communications

CIRCULATION RECORD

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