MDC G4829

DESIGN AND PERFORMANCE OF A LARGE VOCABULARY DISCRETE WORD RECOGNITION SYSTEM

VOLUME II
APPENDIXES

by

Pattern Recognition Research Section
and
Advanced Information Systems Engineering

McDonnell Douglas Astronautics Company
Huntington Beach, California 92647

November 1973

Prepared Under Contract No. NAS8-25701
Crew/Computer Communications Study
for the
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
George C. Marshall Space Flight Center
Alabama 35812

CONTENTS

PREFACE

The following report consists of two separate volumes for the reader's convenience. Volume I consists of the main body of this report while Volume II consists of a user manual and as such is considered an appendix to Volume I.

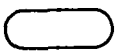
CONTENTS

APPENDIX A

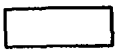
COMPLETE FLOW DIAGRAM
WORD RECOGNITION SYSTEM

The following flowcharts present a logical diagram of the WRS software including input/output routines. The flowcharts are arranged basically in the same order as the applicable assembly language WRS program listing in Appendix F.

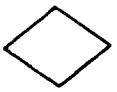
All labels in capital letters correspond to actual assembly language labels and all numbers are in base 10 unless designated as base 8 (octal) as in 17777_8. The flowchart symbols are as follows:



Entry or exit point for a routine, program, or subroutine

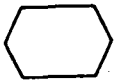


Operations executed within this block



Interrogation (decision)

Output to a peripheral



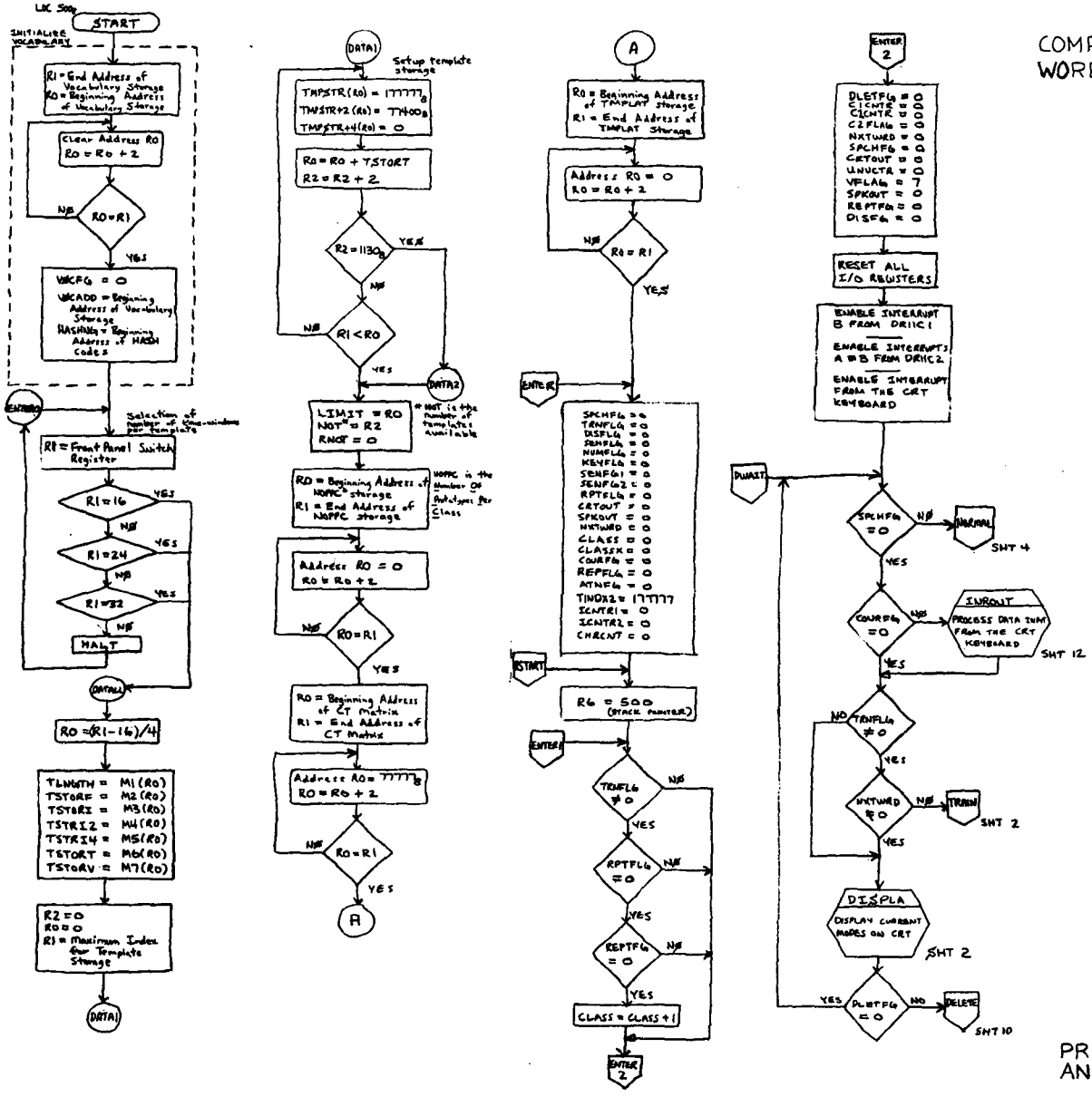
Subroutine

Flowchart label utilized only on this page*

Flowchart label utilized on another page as well*

Figure 1 shows the WRS in operation.

*Single capital letters do not correspond to actual assembly language program labels but merely indicate flow.

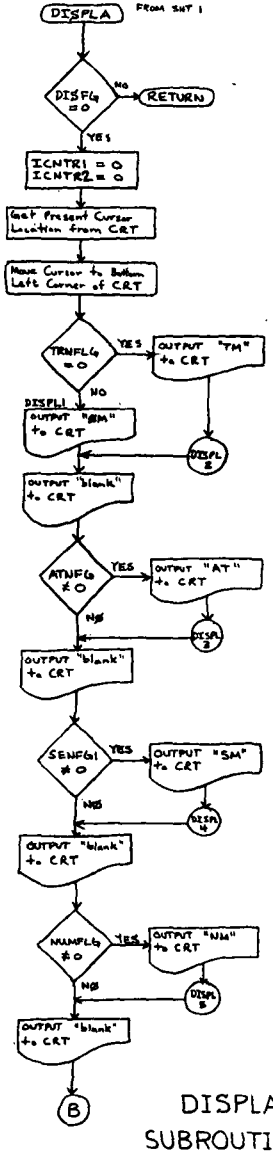


COMPLETE FLOW DIAGRAM WORD RECOGNITION SYSTEM

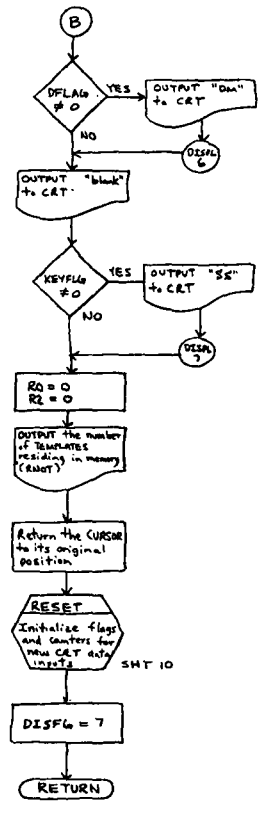
DATE : SEPTEMBER, 1973
BY : T. J. EDWARDS

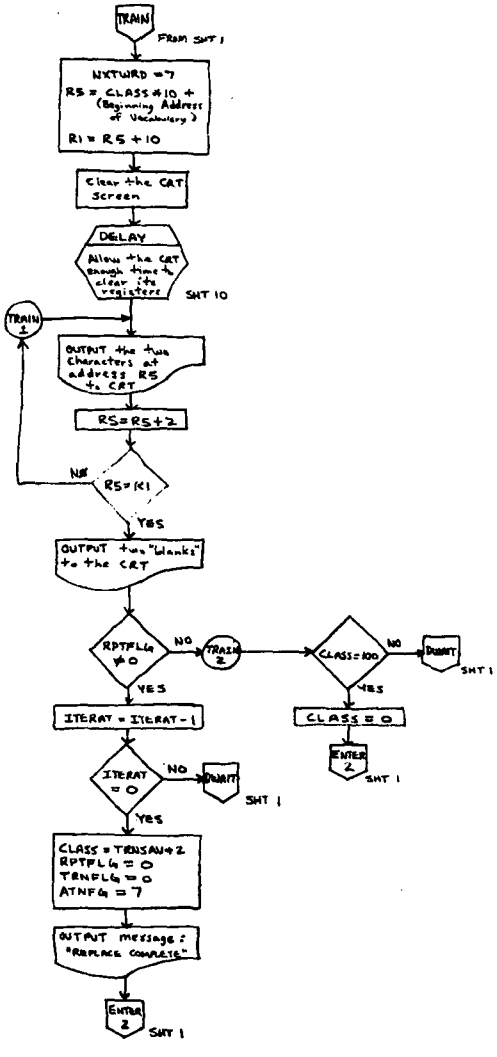
PROGRAM INITIALIZATION AND EXECUTIVE

SHT 1 of 14

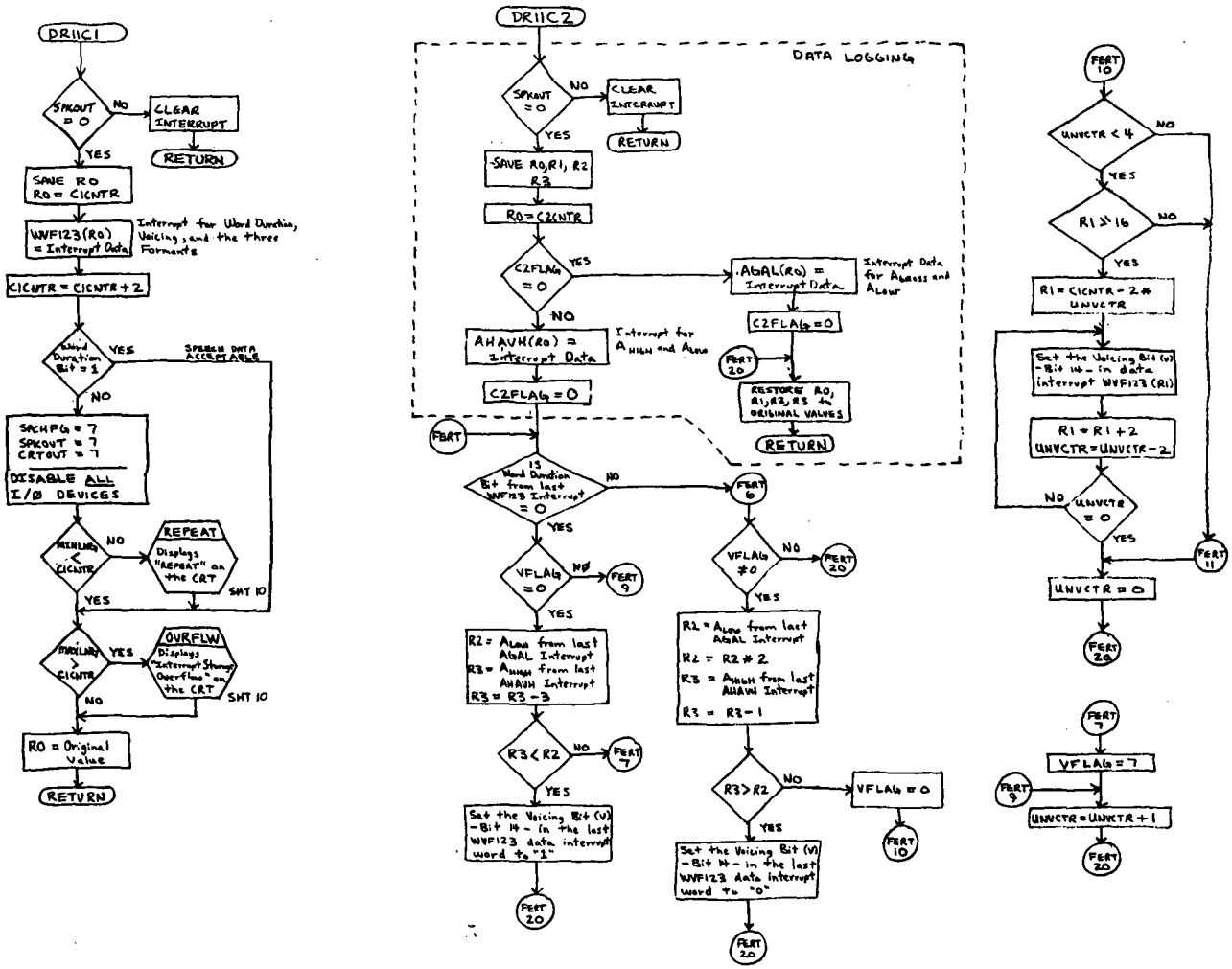


DISPLA SUBROUTINE

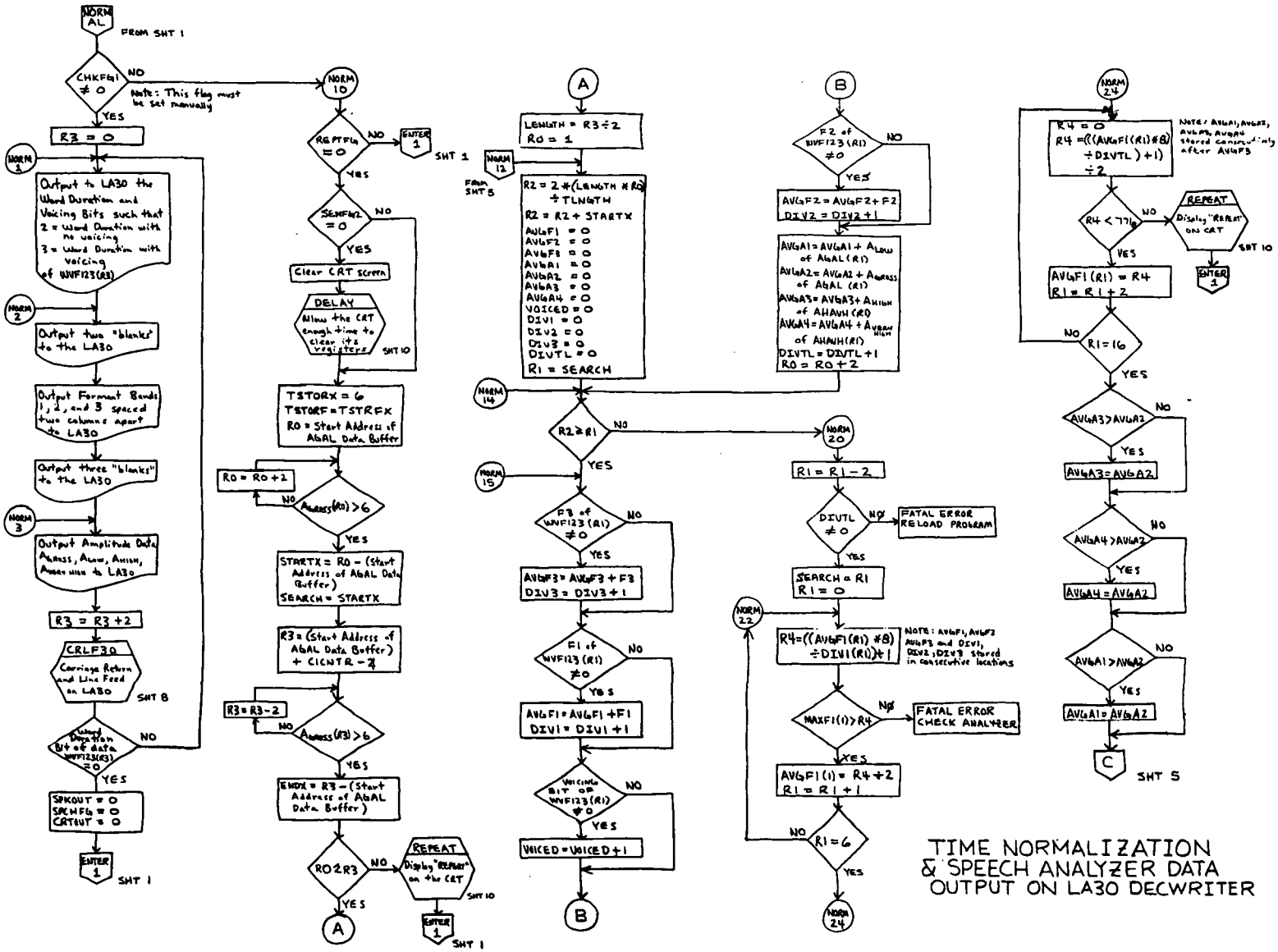




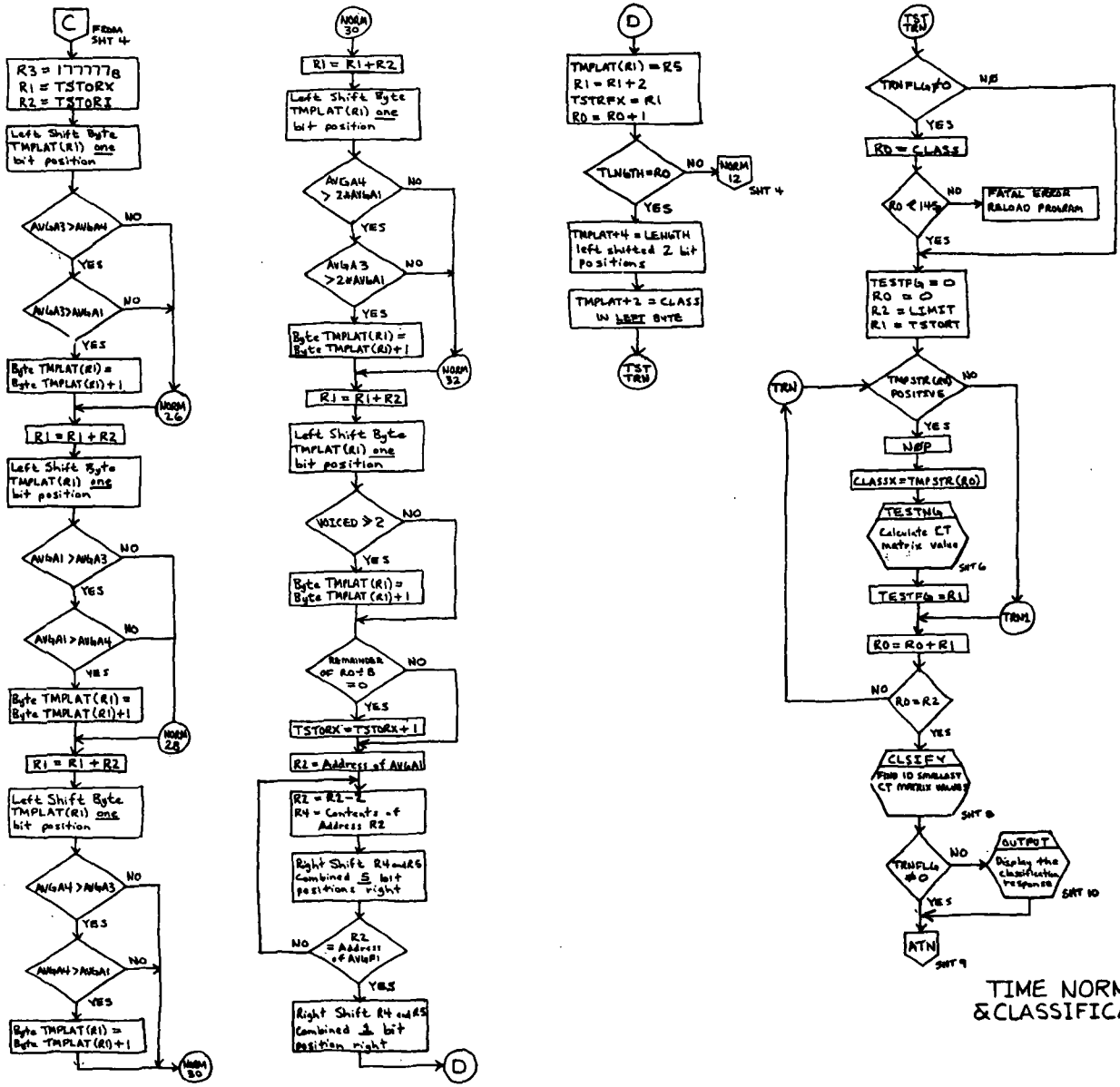
TRAIN ROUTINE



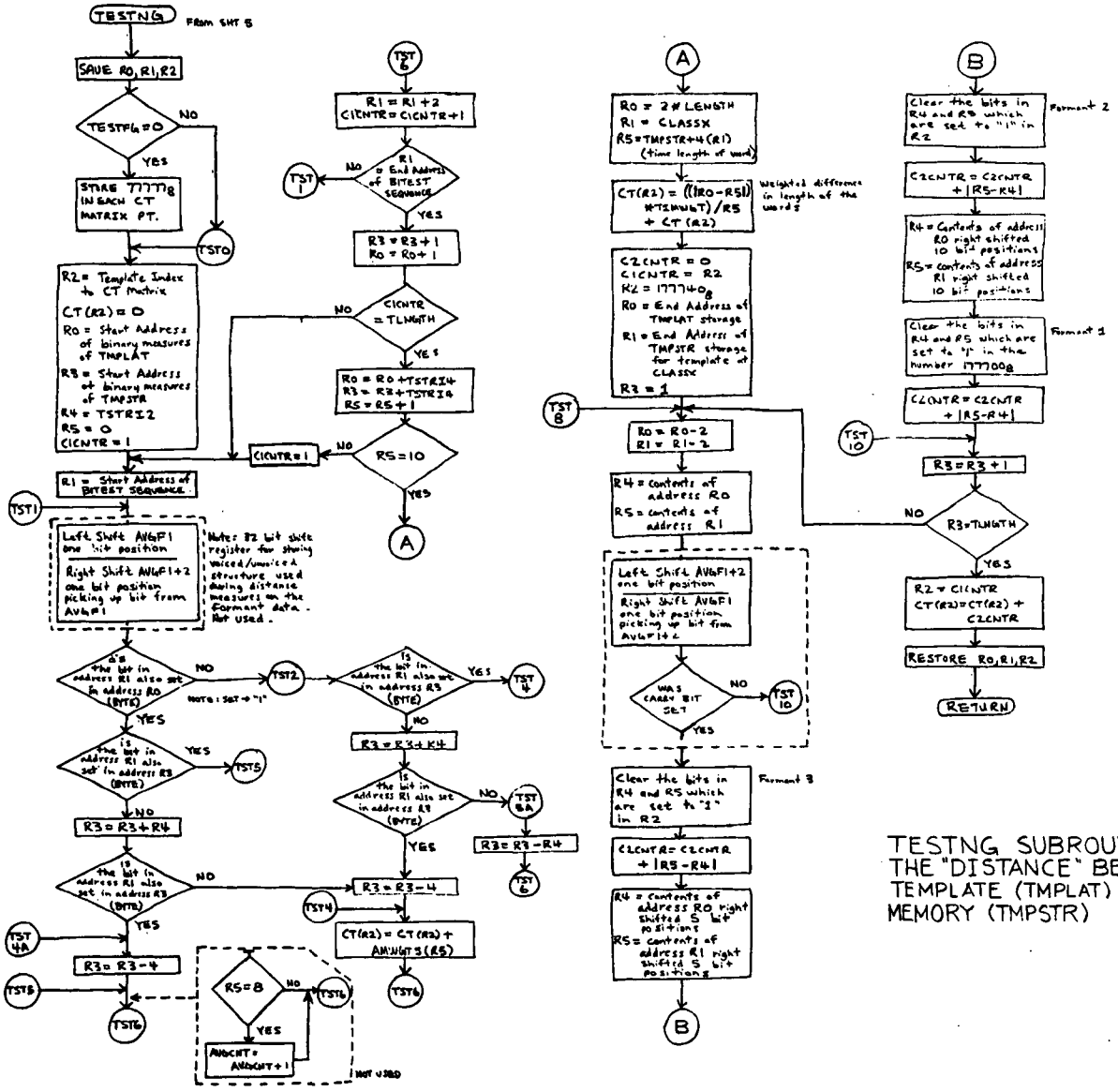
SUBROUTINES FOR LOGGING THE DATA FROM THE SPEECH ANALYZER INCLUDING SMOOTHING OF THE VOICING DATA (FERT)



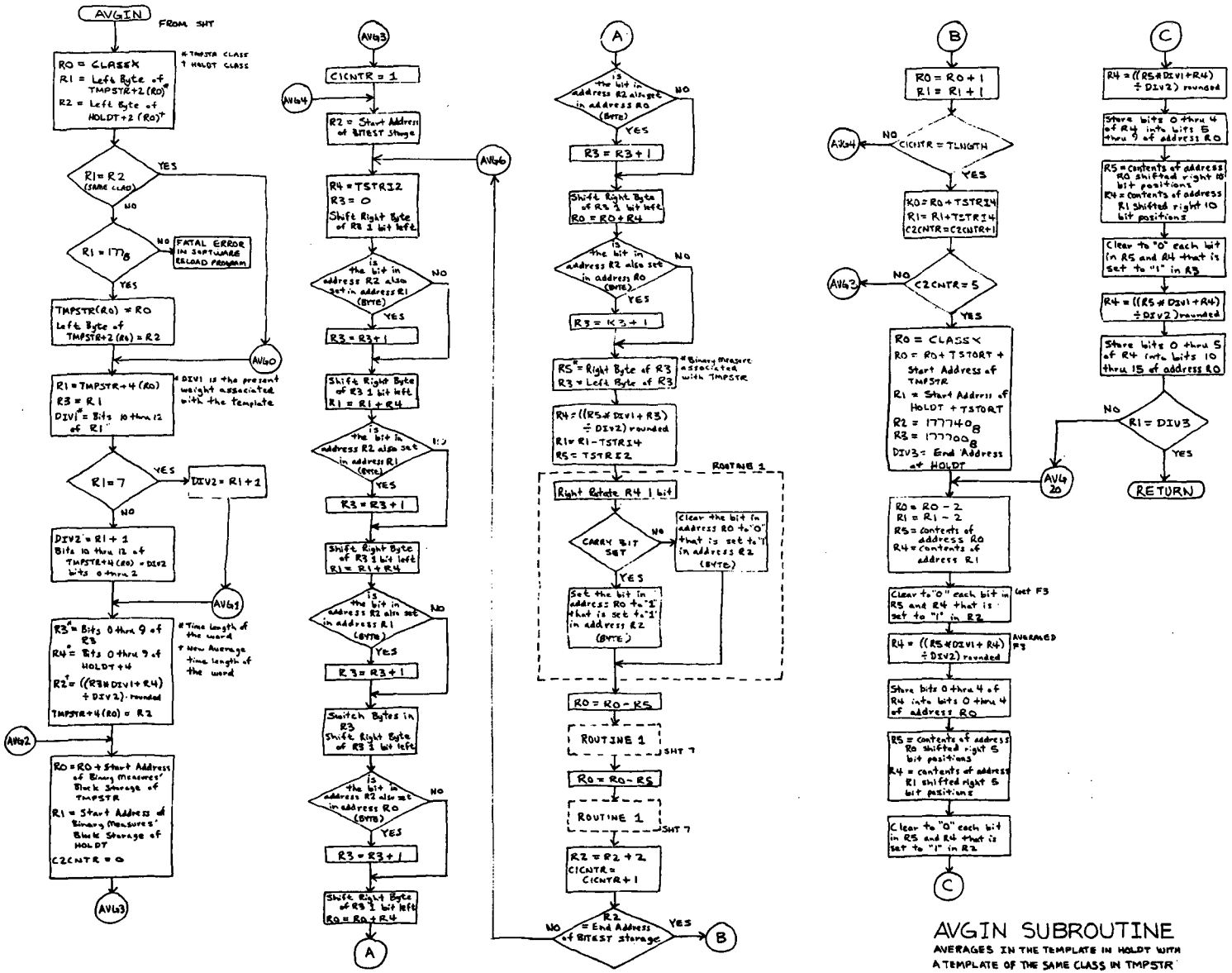
TIME NORMALIZATION & SPEECH ANALYZER DATA OUTPUT ON LA30 DECWRITER



TIME NORMALIZATION &CLASSIFICATION EXECUTIVE

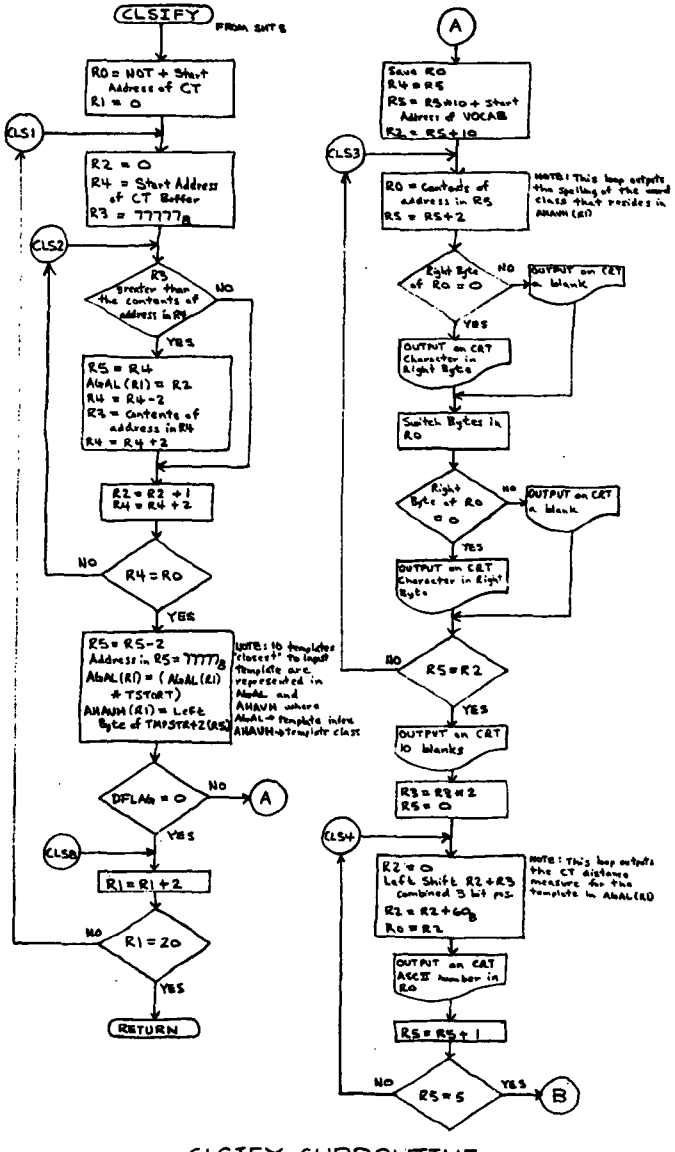


TESTNG SUBROUTINE : CALCULATES THE "DISTANCE" BETWEEN THE WORD INPUT TEMPLATE (TMPLAT) AND ANY TEMPLATE IN MEMORY (TMPSTR)



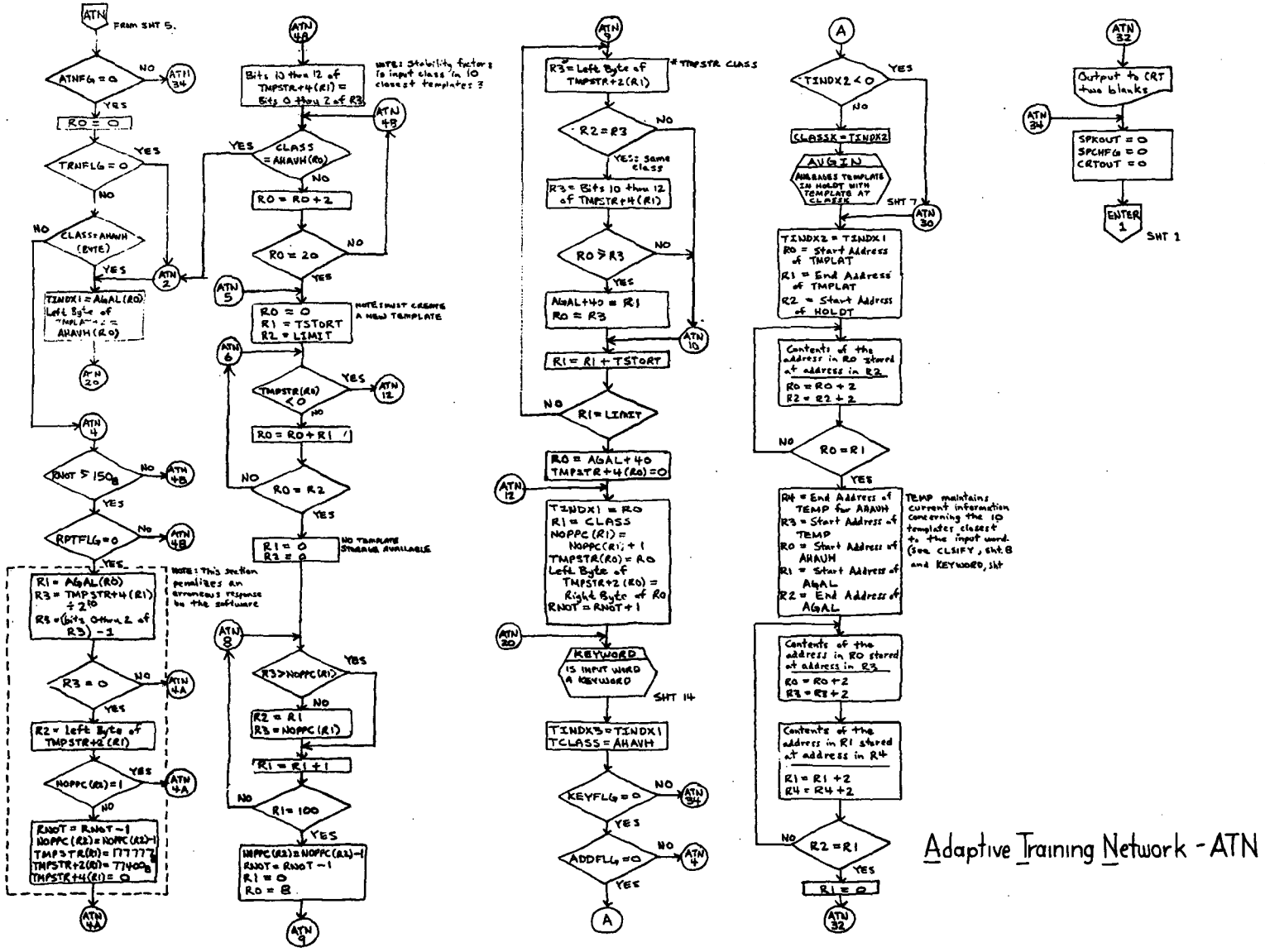
AVGIN SUBROUTINE

AVERAGES IN THE TEMPLATE IN HOLDT WITH A TEMPLATE OF THE SAME CLASS IN TMPSTR

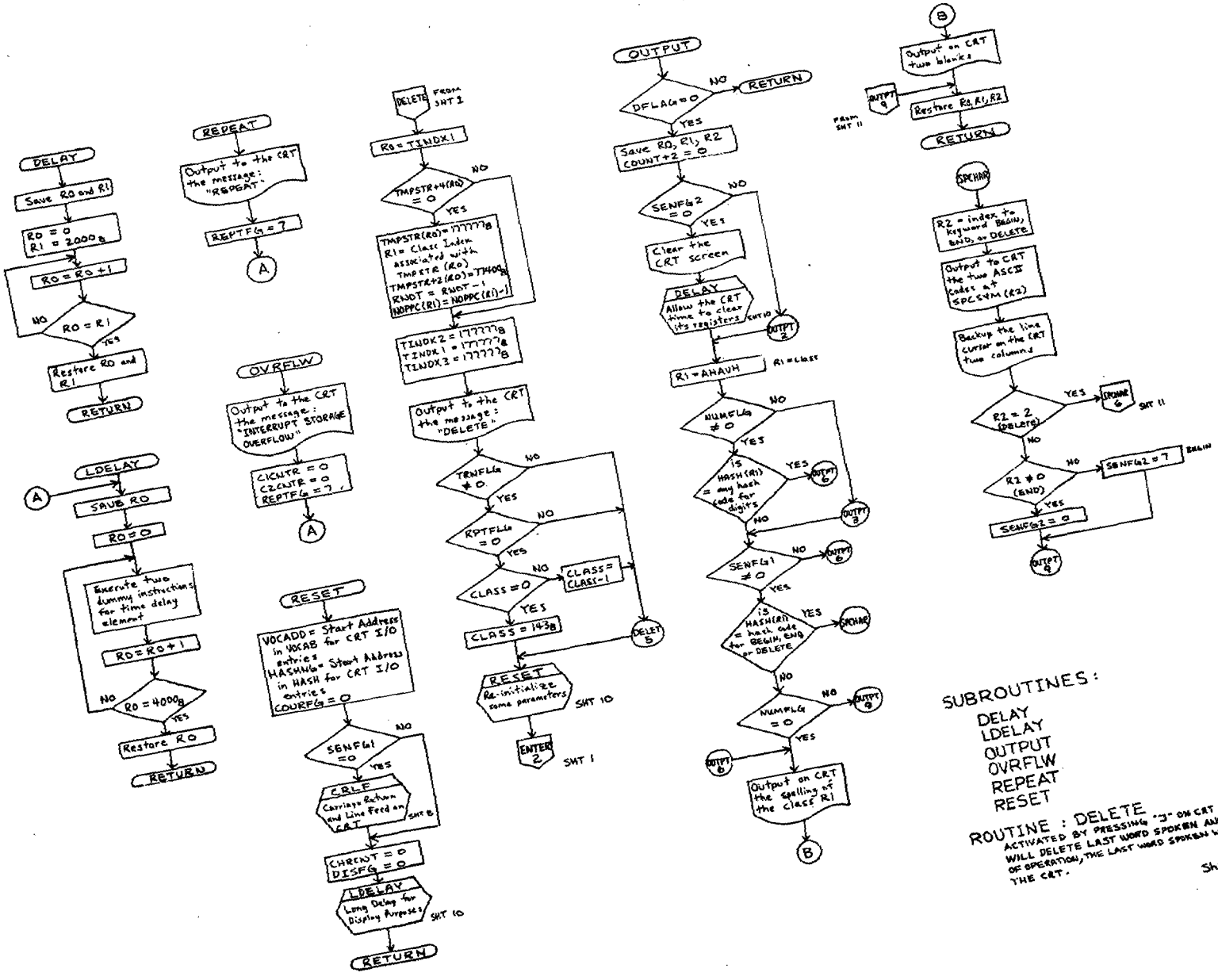


CLSIFY SUBROUTINE

OUTPUT SUBROUTINES TO PERIPHERAL DEVICES (CRT AND LA30)



Adaptive Training Network - ATN

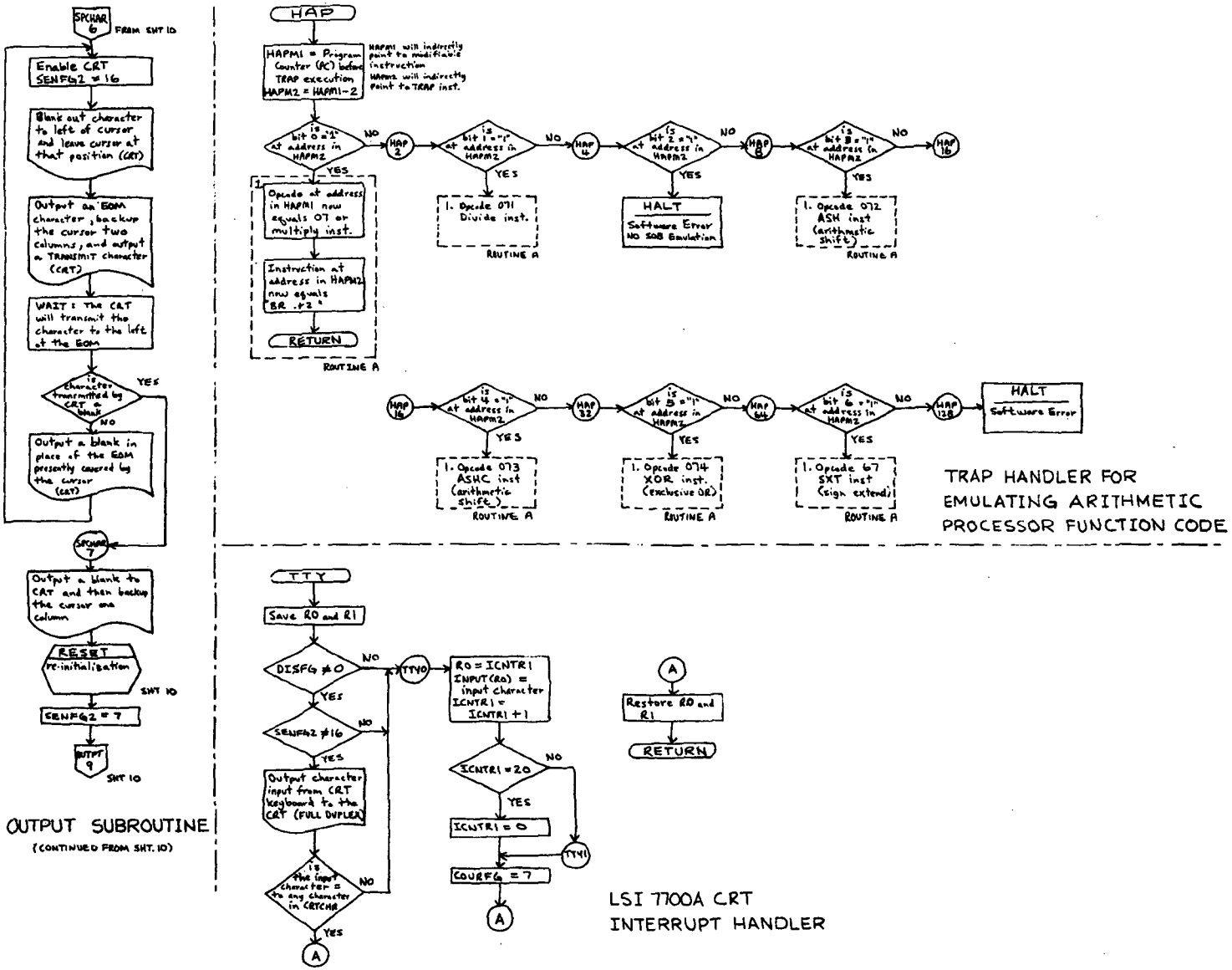


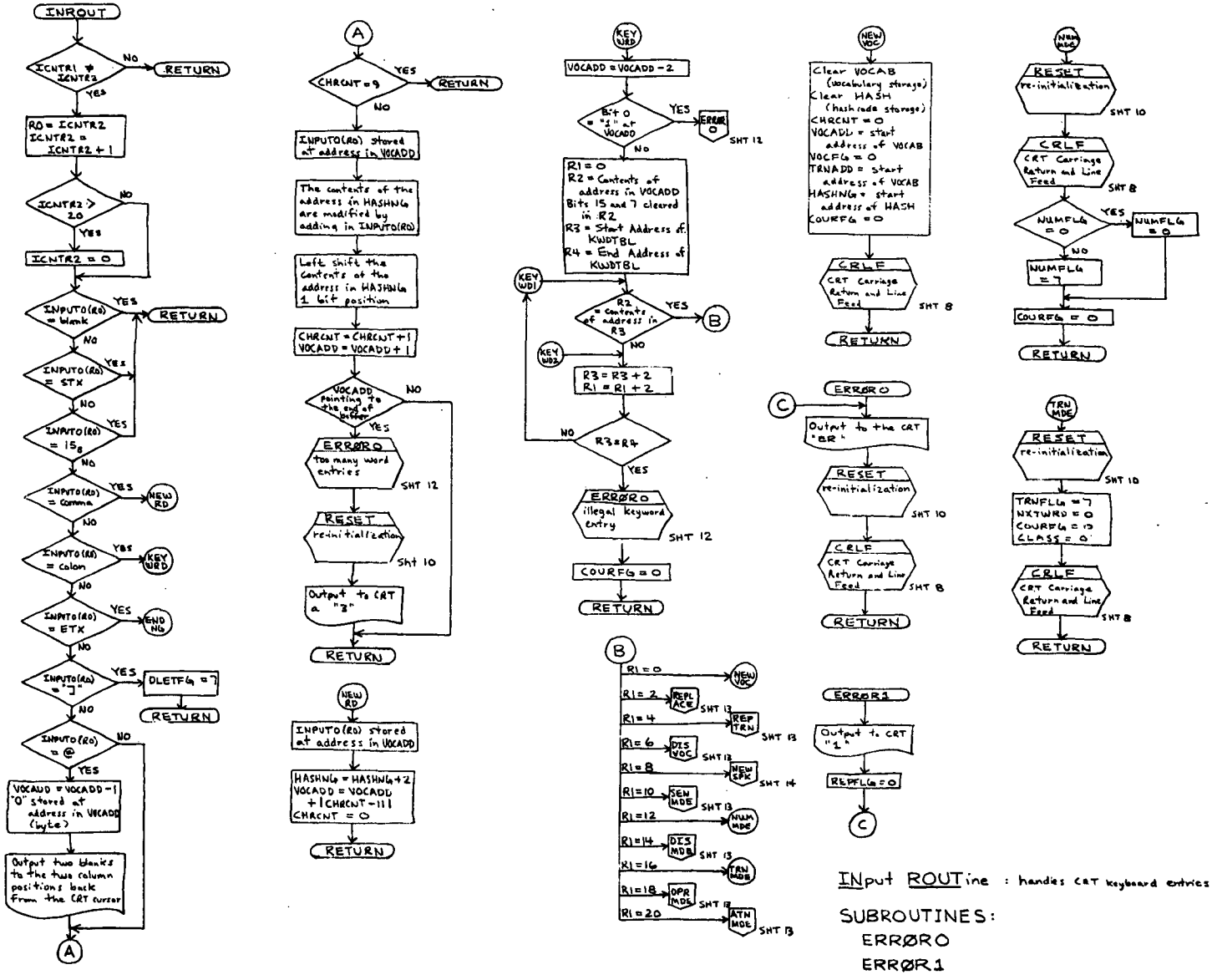
SUBROUTINES:

- DELAY
- LDELAY
- OUTPUT
- OVRFLW
- REPEAT
- RESET

ROUTINE : DELETE
ACTIVATED BY PRESSING "J" ON CRT KEYBOARD. IT WILL DELETE LAST WORD SPOKEN AND IF IN TM MODE OF OPERATION, THE LAST WORD SPOKEN WILL REAPPEAR ON THE CRT.

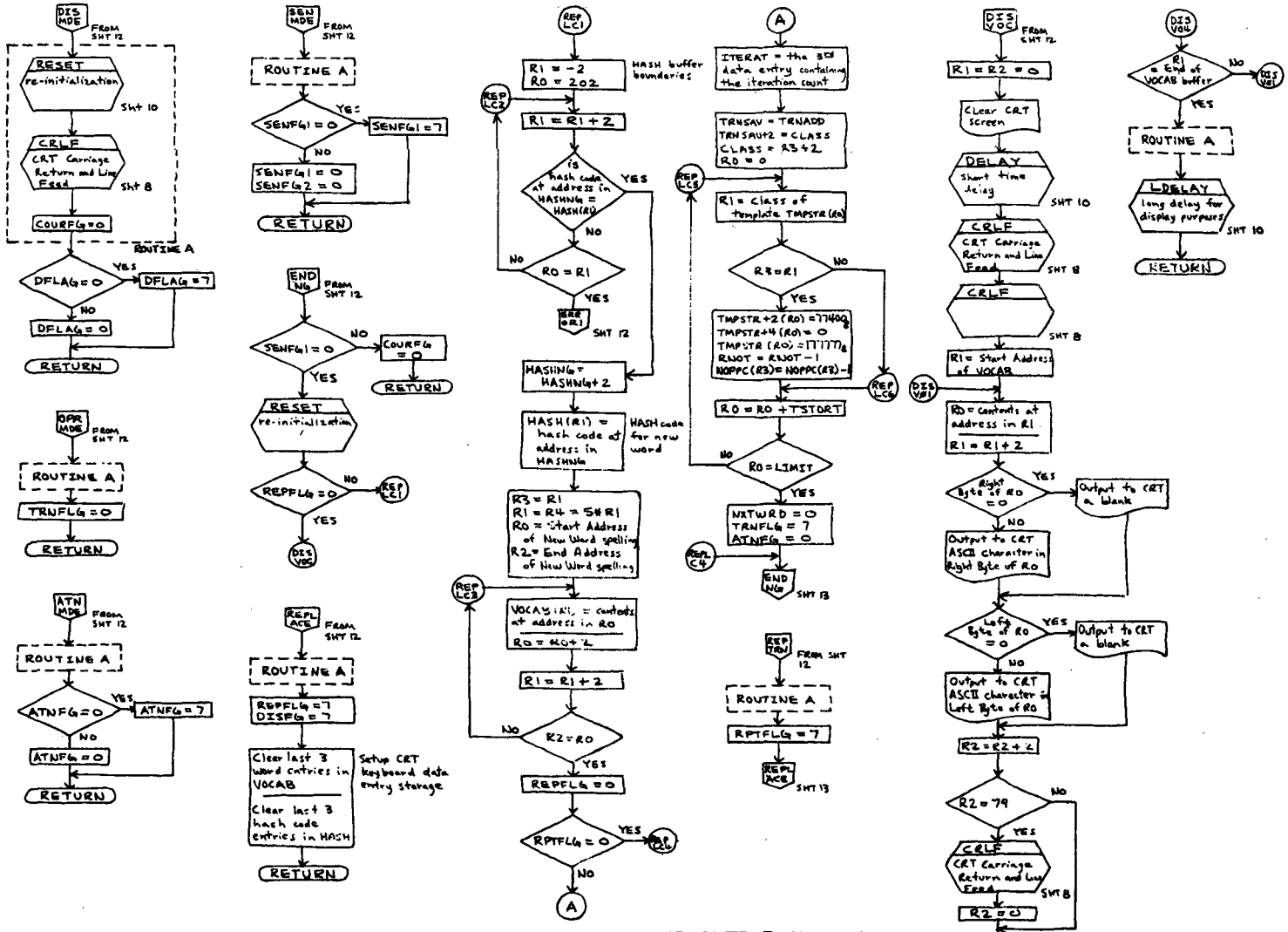
Sht 10 of 14

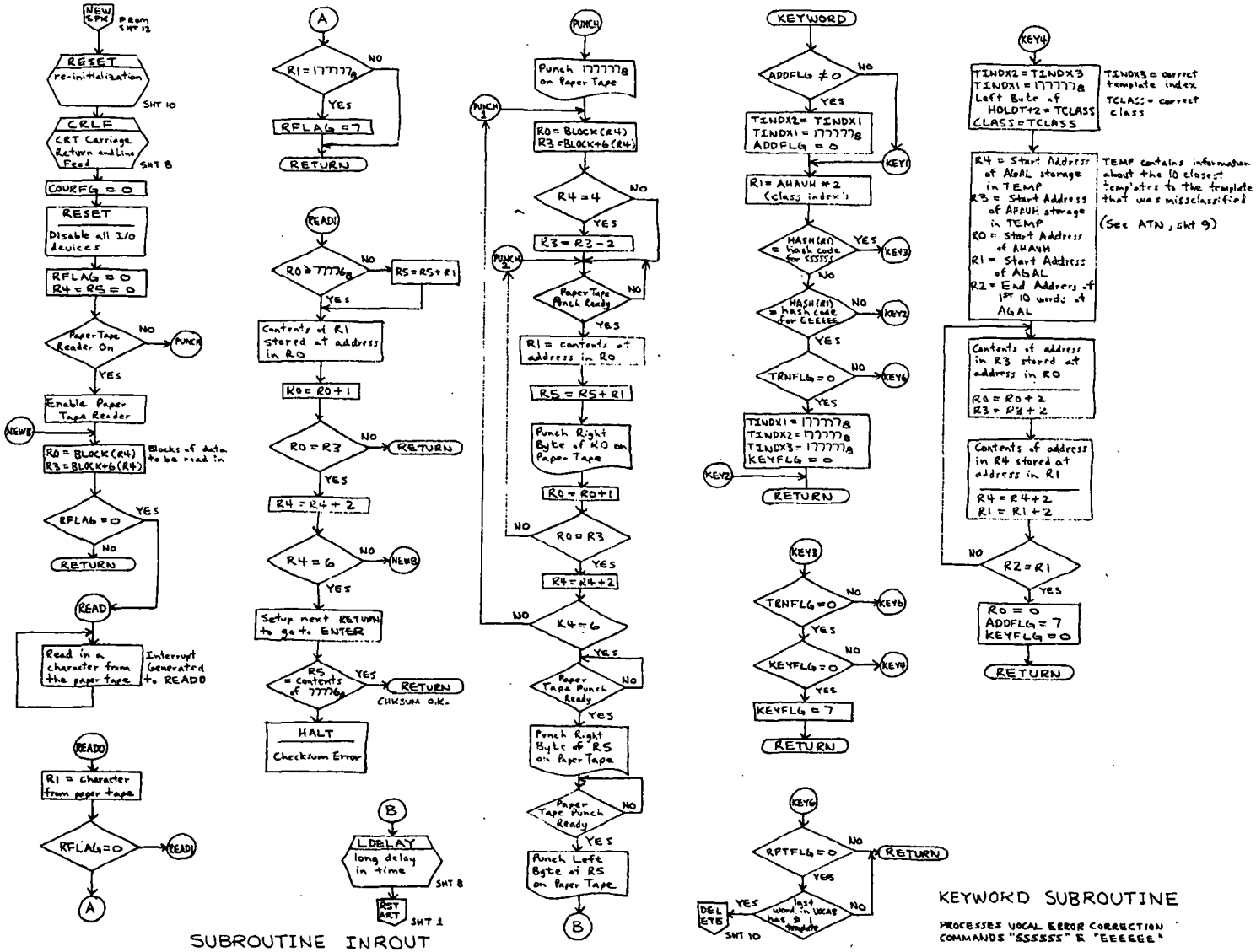

SPCHAR 6
FROM SHT 10
Enable CRT
SENFG2 = 16
Blank out character to left of cursor and leave cursor at that position (CRT)
Output an EOM character, backup the cursor two columns, and output a TRANSMIT character (CRT)
WAIT: The CRT will transmit the character to the left of the EOM
Is character transmitted by CRT ?
YES
NO
Output a blank in place of the EOM presently covered by the cursor (CRT)
SPCHAR 7
Output a blank to CRT and then backup the cursor one column
RESET
re-initialization
SHT 10
SENFG2 = 7
OUTPT 9
SHT 10
OUTPUT SUBROUTINE
(CONTINUED FROM SHT. 10)
HAP
HAPM1 = Program Counter (PC) before TRAP execution
HAPM2 = HAPM1 - 2
HAPM1 will indirectly point to modifiable instruction
HAPM2 will indirectly point to TRAP inst.
Is bit 0 = "1" at address in HAPM2
NO
YES
HAP 2
Is bit 1 = "1" at address in HAPM2
HAP 4
Is bit 2 = "1" at address in HAPM2
HAP 8
Is bit 3 = "1" at address in HAPM2
HAP 16
Opcode at address in HAPM1 now equals 07 or multiply inst.
Instruction at address in HAPM2 now equals "BR .+2"
RETURN
ROUTINE A
1. Opcode 071 Divide inst.
ROUTINE A
HALT
Software Error
NO SOB Emulation
1. Opcode 072 ASH inst (arithmetic shift)
ROUTINE A
HAP 16
Is bit 4 = "1" at address in HAPM2
HAP 32
Is bit 5 = "1" at address in HAPM2
HAP 64
Is bit 6 = "1" at address in HAPM2
HAP 128
HALT
Software Error
1. Opcode 073 ASHC inst (arithmetic shift)
ROUTINE A
1. Opcode 074 XOR inst. (exclusive OR)
ROUTINE A
1. Opcode 67 SXT inst (sign extend)
ROUTINE A
TRAP HANDLER FOR EMULATING ARITHMETIC PROCESSOR FUNCTION CODE
TTY
Save R0 and R1
DISFG ≠ 0
NO
YES
TTY0
SELFG2 ≠ 16
NO
YES
Output character input from CRT keyboard to the CRT (FULL DUPLEX)
Is the input character = to any character in CRTCHR
NO
YES
A
R0 = ICNTR1
INPUT(R0) = input character
ICNTR1 = ICNTR1 + 1
ICNTR1 = 20
NO
YES
ICNTR1 = 0
TTY1
COUFG = 7
A
A
Restore R0 and R1
RETURN
LSI 7700A CRT INTERRUPT HANDLER



INput ROUTine : handles CRT keyboard entries

SUBROUTINES:
- ERRØRO
- ERRØR1


DIS MDE
FROM SHT 12
RESET
re-initialization
SHT 10
CRLF
CRT Carriage Return and Line Feed
SHT 8
COURFG=0
ROUTINE A
DFLAG=0
YES
DFLAG=7
NO
DFLAG=0
RETURN
OPR MDE
FROM SHT 12
ROUTINE A
TRNFLG=0
RETURN
ATN MDE
FROM SHT 12
ROUTINE A
ATNFG=0
YES
ATNFG=7
NO
ATNFG=0
RETURN
SEN MDE
FROM SHT 12
ROUTINE A
SENFG1=0
YES
SENFG1=7
NO
SENFG1=0
SENFG2=0
RETURN
END MDE
FROM SHT 12
SENFG1=0
NO
COURFG=0
RETURN
YES
RESET
re-initialization
REPFLG=0
NO
REP LC1
YES
DIS VOC
REPLACE
FROM SHT 12
ROUTINE A
REPFLG=7
DISFG=7
Clear last 3 word entries in VOCAB
Clear last 3 hash code entries in HASH
Setup CRT keyboard data entry storage
RETURN
REP LC1
R1=-2
R0=202
HASH buffer boundaries
REP LC2
R1=R1+2
Is hash code at address in HASHNG = HASH(R1)
YES
NO
R0=R1
NO
YES
ERR 01
SHT 12
HASHNG=HASHNG+2
HASH(R1)=hash code at address in HASHNG
HASH code for new word
R3=R1
R1=R4=5*R1
R0=Start Address of New Word spelling
R2=End Address of New Word spelling
REP LC3
VOCAB(R1)=contents at address in R0
R0=R0+2
R1=R1+2
R2=R0
NO
YES
REPFLG=0
RPTFLG=0
YES
REP LC4
NO
A
ITERAT=the 3rd data entry containing the iteration count
TRNSAV=TRNADD
TRNSAV2=CLASS
CLASS=R3+2
R0=0
REP LC5
R1=class of template TMPSTR(R0)
R3=R1
NO
YES
TMPSTR+2(R0)=177400
TMPSTR+4(R0)=0
TMPSTR(R0)=177777
RWOT=RWOT-1
NOPPC(R3)=NOPPC(R3)-1
REP LC6
R0=R0+TSTORT
R0=LIMIT
NO
YES
NXTWRD=0
TRNFLG=7
ATNFG=0
REPL AC4
END NG
SHT 13
REP TRN
FROM SHT 12
ROUTINE A
RPTFLG=7
REPL ACE
SHT 13
SUBROUTINE INROUT
(CONTINUED FROM SHT. 12)
DIS VOC
FROM SHT 12
R1=R2=0
Clear CRT screen
DELAY
Short time delay
SHT 10
CRLF
CRT Carriage Return and Line Feed
SHT 8
CRLF
SHT 8
R1=Start Address of VOCAB
DIS VB1
R0=contents at address in R1
R1=R1+2
Right Byte of R0 =0
YES
Output to CRT a blank
NO
Output to CRT ASCII character in Right Byte of R0
Left Byte of R0 =0
YES
Output to CRT a blank
NO
Output to CRT ASCII character in Left Byte of R0
R2=R2+2
R2=79
NO
YES
CRLF
CRT Carriage Return and Line Feed
SHT 8
R2=0
DIS VOC
DIS VOC
R1=End of VOCAB buffer
No
DIS VB1
YES
ROUTINE A
LDELAY
long delay for display purposes
SHT 10
RETURN



SUBROUTINE INROUT

(CONTINUED FROM SHTS 13, 14)

KEYWORD SUBROUTINE

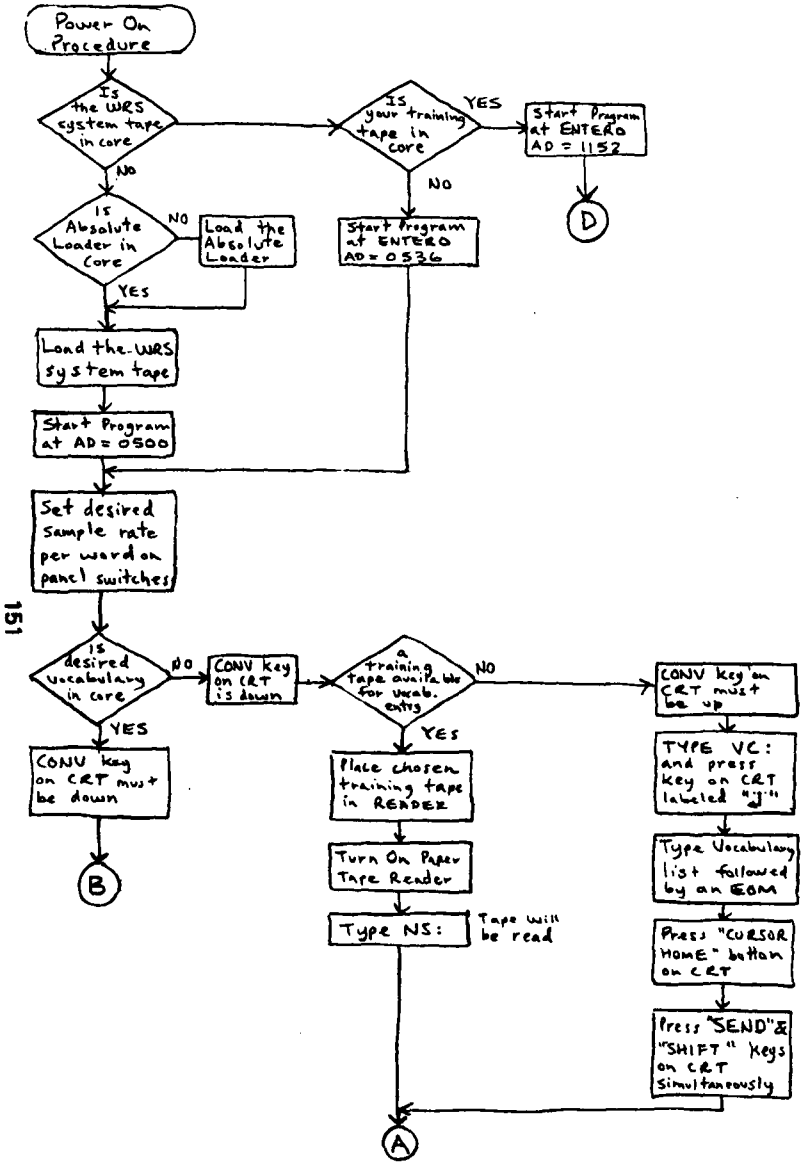
PROCESSES VOCAL ERROR CORRECTION COMMANDS "SSSSSS" & "EEEEEE"

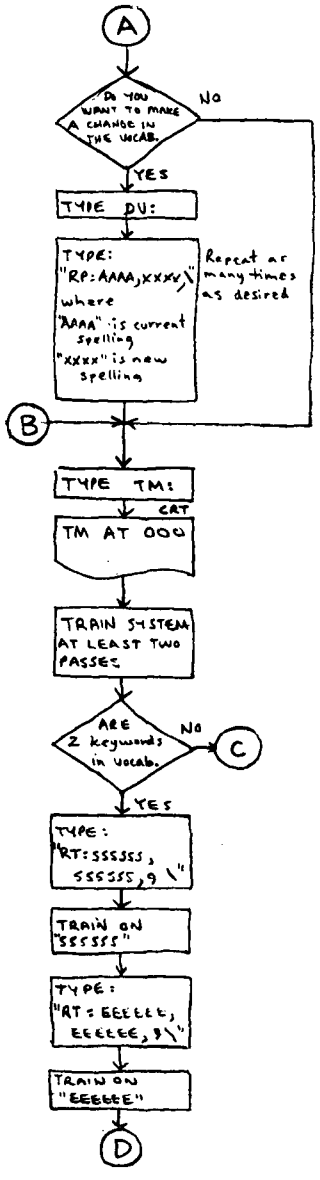
FIGURE 1. WORD RECOGNITION SYSTEM IN OPERATION

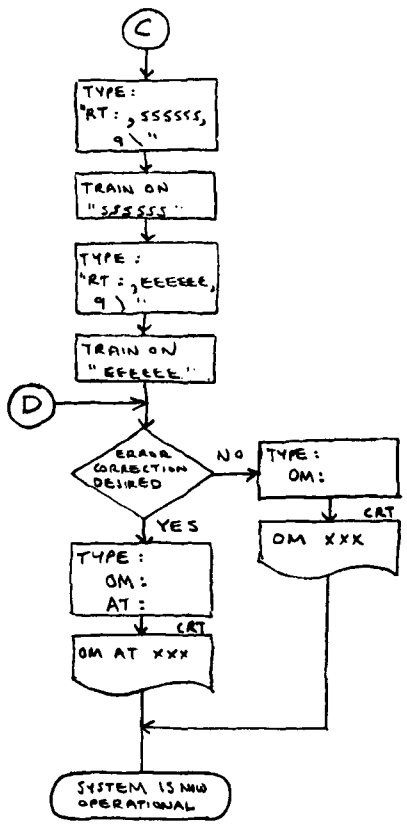
APPENDIX B

WRS OPERATING INSTRUCTIONS AND OPERATIONAL FLOWCHART

The following flow chart and operating instructions are intended for those people who must work intimately with the WRS. The attached flowchart is intended to provide a general description of the user input/output necessary to utilize the system, while the following text provides a very complete step-by-step procedure for the user who is new to the WRS operating concepts. It is strongly suggested that the flow chart and operating instructions be well understood by any person attempting to train and operate the WRS, especially when utilizing the Adaptive Training Mode.





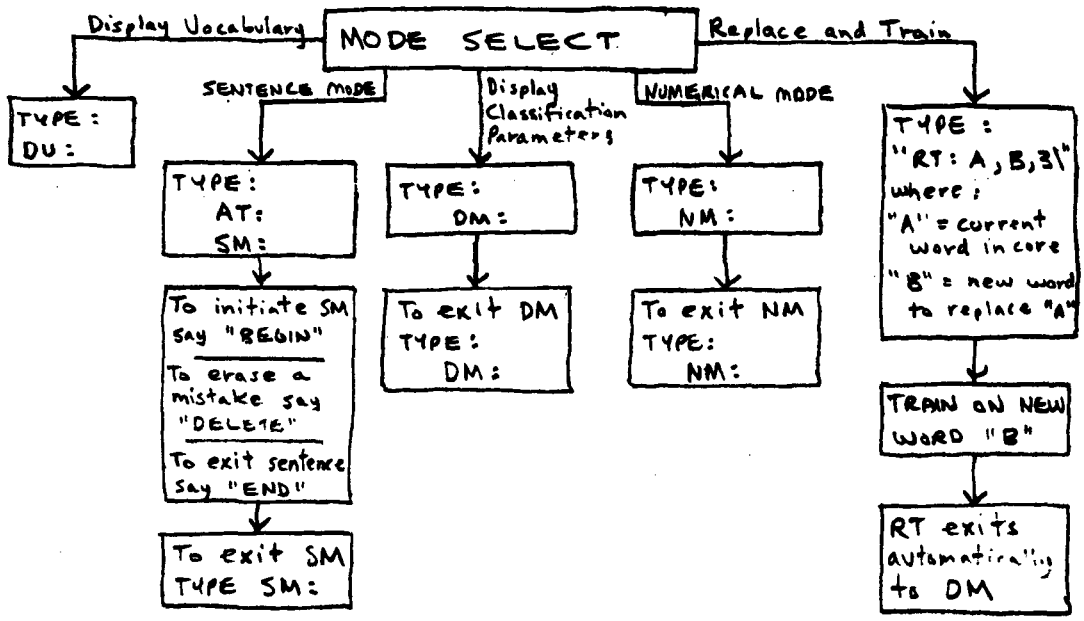


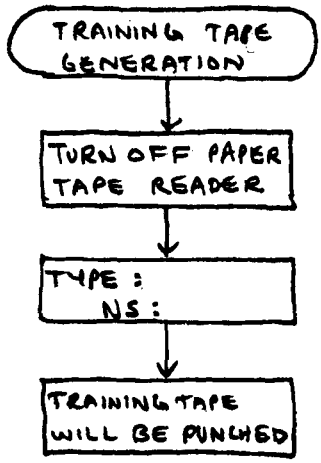
APPENDIX B

SYSTEM OPERATIONS FLOW DIAGRAM

SHT 1 of 2

63.5-





APPENDIX B

SHT 2 of 2

WORD RECOGNITION SYSTEM OPERATING INSTRUCTIONS

I. SYSTEM STARTING INSTRUCTIONS

A. Starting the WRS via a training set paper tape entry:

1. Turn on the power to the DEC' PDP 1140 computer.
2. Turn on the power to the LSI' 7700A CRT terminal.
3. Turn on the PDP 1140 paper tape READER.
4. If the system program is currently residing in memory, go to step 12, otherwise continue with step 5.
5. Load the perforated leader of the ABSOLUTE LOADER paper tape into the PDP 1140 paper tape READER.
6. Via the PDP 1140 panel switches (0 through 17), load the address "773000." This is accomplished by setting octal "773000" on the switches and temporarily pushing down the switch labeled "LOAD ADDRESS." "773000" should then appear in the ADDRESS register located on the front panel.
7. Place the PDP 1140 "HALT" switch down, press the "START" switch down and release it, place the "HALT" switch up, and then press the "CONT" switch down and release it.
8. If the address register does not read 077500 after the tape has been read in, repeat steps 1 through 7.
9. Load address "077500" via the panel switches.
10. Place the WRS SYSTEM TAPE to be read in the PDP 1140 paper tape READER with blank tape leading.
11. Perform step 7. The tape will be read in.
12. Load address "000500" via the PDP 1140's panel switches.
13. Perform step 7. The address register should read 566.

14. Load the desired system configuration via the panel switches as follows:

    16 sample system - "000020"

    24 sample system - "000030"

    32 sample system - "000040"

15. Press the "CONT" switch down and release it. If the address register still reads 566, then repeat steps 14 and 15. Otherwise continue with step 16.

16. Make certain the "CONV" key on the CRT keyboard is down.

17. Place the desired TRAINING TAPE to be read in the PDP 1140 paper tape reader with blank tape leading.

18. Type "NS:" on the CRT keyboard and the TRAINING TAPE will be read. As the tape may not fit into the tape bucket after some reading, one may temporarily place the PDP 1140 "HALT switch down, rearrange the tape in the tape bucket, place the "HALT" switch up, and press the "CONT" switch down and then release it. The tape will continue to be read.

19. If the tape reads in without failure, the program will be running ("RUN" light on). If a halt is encountered ("RUN" light off), consult the computer listing at the address displayed in the front panel ADDRESS register.

B. Starting the WRS without a training tape:

1. Perform steps I.A.1 through I.A.16.

2. Enter a vocabulary as described in Section II.

3. If someone else's TRAINING TAPE was utilized for vocabulary input perform the following steps; otherwise, proceed to step 8.

4. Press "HALT" switch down on the PDP 1140.

5. Load the address corresponding to "ENTERO" in the system software listing in Appendix F, on the PDP 1140 panel switches.

6. Perform step I.A.7.

7. Perform steps I.A.14 and I.A.15.

8. Type "TM:" on the CRT keyboard (the CRT keyboard "CONV" key must be down).

9. The first word in the vocabulary should now appear on the CRT. In the bottom left corner should appear "TM AT 000."

10. Put on the microphone headset so that the microphone is opposite the upper lip and about two fingers away. Place the microphone ON-OFF switch to "ON."

11. Pronounce the displayed word. The CRT will temporarily clear and the next word in the vocabulary will appear.

12. Repeat step 11 for every word in the vocabulary. One should cycle through the vocabulary at least twice.

13. If one should like to repeat a word he has just spoken, press the "]" key on the CRT keyboard. The last word spoken will appear on the CRT. This backup mode is most often utilized when the user feels he has mispronounced a word or background noise may have distorted the speech entry.

14. To enable the user to utilize the Adaptive Training Network (ATN) or "AT" mode, he must train on the two keywords necessary for its operation. For the completion of of this task, consult Section III.

15. The user may now enter Operational Mode (OM) by typing "OM:" and "AT:" on the CRT keyboard. The mode displayed on the CRT should only be "ØM." The user can now test his training set by pronouncing the words in the vocabulary which the CRT should then display.

16. One should now enter the "AT" mode as described in Section III. Remember that each error made by the WRS must either be corrected or acknowledged for the WRS to function accurately.

II. VOCABULARY AND TRAINING SET INPUT/OUTPUT

A. Entering a new vocabulary via the CRT keyboard:

1. Make certain the "CONV" key is up.

2. Press "CURSOR HOME."

3. Type in "VC:"

4. Press "↵" which will start you on the next line.

5. Type in each of the 100 words of the new vocabulary; each word being followed by a comma, and each word occupying no more than 9 characters. If more than 9 characters per word are typed, the word will be truncated to the first 9 characters.

6. After the last comma is typed, press "EOM."

7. Now press "CURSOR HOME."

8. Now press "SEND" while concurrently pressing "SHIFT." The cursor will trace through all of the words on the screen and return with a display of the vocabulary just entered consisting of 8 words per line on the CRT.

9. The vocabulary is now started.

B. Entering a new vocabulary via the Paper Tape Reader/Punch (DEC):

1. Make certain the CRT keyboard has the "CONV" key down.

2. Make certain the Reader on the PDP 1140 is "ON."

3. Take any person's training tape containing the desired vocabulary and load it into the paper tape reader. Make sure that the initial blank leader (only sprocket holes) is over the reading sensors.

5. Type "NS:" on the CRT keyboard. The tape will then be read. As the tape will NOT automatically fit into the tape bucket after some reading, one may temporarily place the PDP 1140 "HALT" switch down, rearrange the tape in the bucket, place the "HALT" switch up, and press the "CONT" switch down and then release it. The tape will continue to be read.

6. If the tape reads in without failure, the program will start running. If a halt is encountered however, consult the program listing. A checksum error is the probable cause.

7. The tape having been read in via paper tape, now type in "DV:" on the CRT keyboard and the vocabulary on the tape will be displayed.

8. To set up the software for your training set, see system starting instructions.

C. Modifying the spelling of a word via the CRT keyboard:

1. Make certain the "CONV" key is down.

2. Type in "RP:." The cursor will restart two lines down.

3. Type in "AAAA, XXXX," where "AAAA" is the current spelling and "XXXX" is the desired new spelling.

4. Press "EOM" and release. The screen will display the entire vocabulary and the program is ready for a voice input or another keyboard entry.

D. Replacing a word in the vocabulary with a new word and training on that new word up to 9 times:

1. Make certain the "CONV" key is down.

2. Type in "RT:." The cursor will restart four lines down.

3. Type in "AAAA, XXXX, Z" where "AAAA" is the current word's spelling, "XXXX" is the new word's spelling, and "Z" is a number from "1" to "9" which indicates the number of training iterations for the new word.

4. Press "EOM." The system software will now eliminate all templates for the word "AAAA" and display "Z" times the new word "XXXX." Each time "XXXX" is displayed, the user says the word until "REPLACE COMPLETE' appears on the CRT. At this time, say "XXXX" once more to make certain the recognition software does recognize the new word. If the word is classified correctly, the user may continue use of the system. If the word is repeatedly misclassified, then either the above procedure should be performed on "XXXX" or on the word it is misclassified as being.

E. Entering the keywords "EEEEEE" and "SSSSSS" used in the ATN:

1. Type "RT:X, SSSSSS, 9" on the CRT keyboard where X represents a blank if "SSSSSS" is not in the vocabulary and "SSSSSS" if it is in the vocabulary.

2. Press "EOM" on the same keyboard. "SSSSSS" should now appear on the CRT.

3. Pronounce "SSSSSS" as in "hissss" each time it reappears on the CRT until "REPLACE COMPLETE" appears on the CRT.

4. Pronounce "SSSSSS" once more.

5. If "SSSSSS" does not appear on the CRT (i.e., incorrectly classified), repeat steps 1 through 4 again.

6. Perform steps 1 through 5 for "EEEEEE" where "EEEEEE" is any word not contained in the vocabulary itself which is easily separable from the words in the vocabulary. "Eliminate, Erase, or Error" are acceptable for entries if they are easily classified by the user.

7. The user may now continue in the normal mode of operation. Notice that the system is not now in the "AT" mode and if desired, must be entered as described in Section III.

F. Output of vocabulary and training set:

1. Turn off the PDP 1140 Paper Tape Reader.

2. Type "NS:" on the CRT keyboard.

3. The vocabulary and training set presently in the system will be punched on tape. If you should run out of tape, load in a new box of tape, and start the program at RSTART.

III. ADAPTIVE TRAINING NETWORK (ATN)

NOTE: The ATN allows production or modification of word templates. During Training Mode, one must also be in Adaptive Training (AT) in order to create templates - only in Replace and Train (RT) is this taken care of automatically. If one is in Operational Mode (OM) then the system has no way of knowing whether it gave the correct response to a user's speech input, therefore the user must verbally correct an error or acknowledge it whenever he is in the Operational Mode and in Adaptive Training concurrently.

A. ATN entry or exit:

1. If one is not in ATN, then "AT" will not appear at the lower left corner of the screen. To enter ATN mode, type "AT:" via the CRT keyboard.

2. If one wishes to exit the ATN mode, one types "AT:" via the CRT keyboard and the "AT" at the lower left corner will disappear.

B. Verbal correction of misclassification when in OM and AT concurrently:

NOTE: You may only correct the last word spoken. If you should make an error and accidentally skip over it, the template corresponding to the incorrect response will be erroneously modified. The next word following the error must be one of the two control words "SSSSSS" or "EEEEEE."

1. *Correction of the misclassification:*

   a. Pronounce the sound "SSSSSS" as in "hisss."

   b. After "SSSSSS" appears on the CRT and "SS" in bottom left corner, repeat the word that was misclassified until that word appears on the CRT.

   c. Pronounce "SSSSSS" again. When "SSSSSS" appears on the CRT, the misclassification has been corrected and the "SS" in the bottom left corner of the CRT will disappear.

   d. If one should never be able to get the word that was misclassified, then say the word that corresponds to "EEEEEE." This will acknowledge the error but will not correct for it. It is suggested that the *Replace and Train mode be utilized on either the* misclassified word or the word that the system erroneously gave in response.

   e. The user may now continue in the normal manner of operation.

2. Acknowledgement of the misclassification without correction:

   a. Pronounce the word corresponding to "EEEEEE."

   b. When "EEEEEE" appears on the CRT, the user may continue in the normal manner of operation.

C. ATN keywords entry:

See Section II. E.

IV. DISPLAY MODES OF OPERATION VIA THE CRT KEYBOARD

A. Distance mode (DM):

NOTE: The distance mode allows the user to visually observe the "n" words* in the vocabulary which most closely resemble the input word giving three statistics as well in this order: 1) calculated distance from the input word to the displayed word, the number of templates representing the displayed word, and the weight associated with the template of the displayed word.

1. To enter the display mode, type in "DM:."
2. To exit the display mode, type in "DM:."
3. If "DM" appears in the lower left corner of the CRT, one is in the display mode, otherwise it is not active.

B. Sentence Mode (SM):

NOTE: The sentence mode enables the user to create sentences on the CRT with the aid of three keywords: BEGIN, DELETE, and END. BEGIN initiates a sentence and will appear as a "(." END terminates a sentence and is represented by a ")." DELETE will erase from the CRT the last word spoken.

1. To enter the sentence mode, type in "SM:."
2. To exit the sentence mode, type in "SM:."
3. If "SM" appears in the lower left corner of the CRT, one is in the sentence mode, otherwise it is not active.

C. Numerical Mode (NM):

NOTE: The numerical mode enables the user to display only the numerals 0 through 9 and special characters such as +, -, /, *, ., (,), ?, >. No other words will be displayed. The words must, of course, appear as the numerals and symbols.

1. To enter the numerical mode, type in "NM:."
2. To exit the numerical mode, type in "NM:."
3. If "NM" appears in the lower left corner of the CRT, one is in the numerical mode, otherwise it is not active.

---

*See Section 6.C of Volume I.

D. Display Vocabulary (DV):

To display the 102 word vocabulary (including the two keywords), type "DV:."

V. SYSTEM MESSAGES TO THE USER VIA THE CRT

A. Error messages from keyboard action:

NOTE: All error messages displayed on the CRT as "ER" are non-fatal.

1. "ER" - repeat the keyboard operation again.

2. "1ER" - word not in the vocabulary. Repeat the "RP" or "RT" operation again.

3. "3ER" - the user has attempted to store too many words in the vocabulary or attempted to type in too many arguments for one of the various modes.

B. Error messages from speech input action:

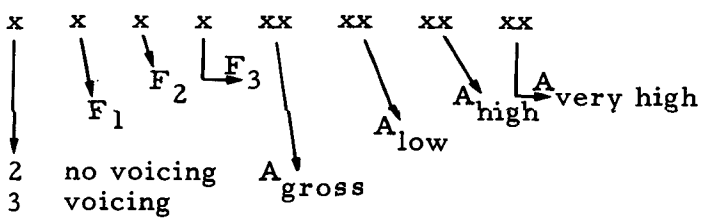
NOTE: These errors are non-fatal.

1. "Interrupt Storage Overflow" - this occurs when the speech input to the WRS exceeds 1.6 seconds. This word input will not be accepted and the system will set up for the next word input.

2. "REPEAT" - This is a reject message flashed on the CRT whenever a spurious injection of noise occurs or if a discrete word's total time length is less than 480 milliseconds. If noise caused "REPEAT" to occur, ignore the message. However, if pronouncing a word caused "REPEAT" to occur, then repeat the word again.

VI. OUTPUT OF THE ANALYZER DATA INPUT VIA THE LA30 DECWRITER

Set the core location labeled CHKFG1 in the program listing in Appendix F to a non-zero value. Each word uttered into the microphone will then be displayed on the LA30 Decwriter as 8 millisecond time samples per line as follows:



APPENDIX C
COMPUTER MEMORY MAP FOR WRS TEMPLATES

The memory map for WRS templates (Figure 2) provides the user with a means for accessing speech template data either for expansion of the system or for purposes of displaying the template data. Note that for the first template in memory, its "TEMPLATE INDEX" is located at "TMPSTR" in the WRS software program listing in Appendix F.

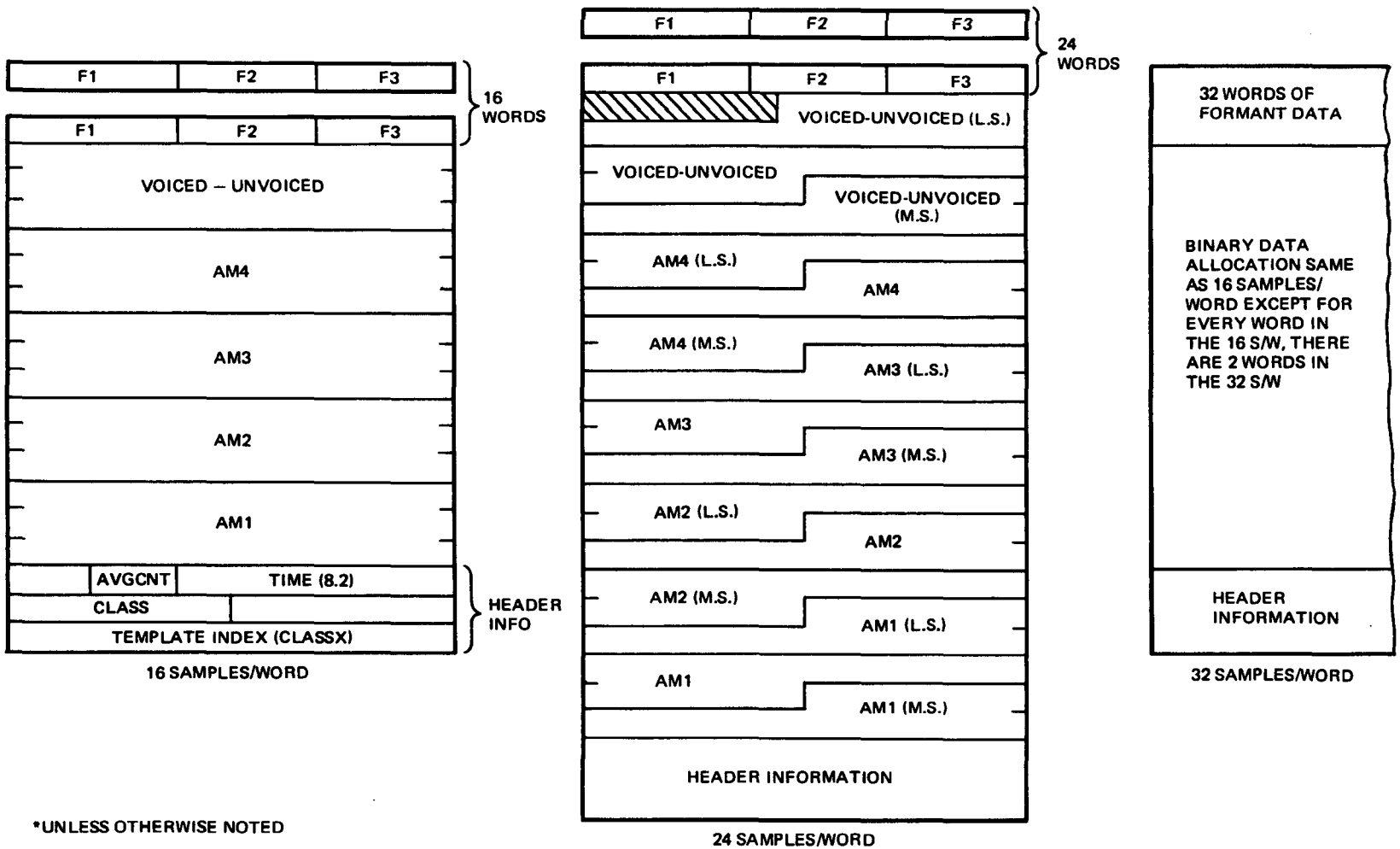


FIGURE 2. COMPUTER MEMORY MAP FOR WRS TEMPLATES (1 16-BIT-WORD/LINE*)

APPENDIX D
SPEECH ANALYZER CARD ARRANGEMENT

This appendix provides the user with a physical mapping of the cards within the speech analyzer chassis and briefly outlines the function performed by each circuit card. A front view of the chassis is shown in Figure 3.

SPEECH ANALYZER CARD ARRANGEMENT

BOARD

1 Pre-Amp, Equalizer Scaling Amp, Word Duration Scaling Amp, Equalizer, 6757LP (F22A), Word Duration

2 ALC-1 (S&H, A/D, Shift Req., Shift Clock, Sample Control, Start Conv.)

3 ALC-2 (X2 Amp, Square, LP filter, Bias, Square Root, Divide, D/A Scaling Amps (input and output), 6757LP (F22B), Drivers

4 Spare

5 Filters-F_1, F_2, F_3, F_4

6 Filters-F_5, F_6, F_7, F_8

7 Filters-$F_9, F_{10}, F_{11}, F_{12}$

8 Filters-$F_{13}, F_{14}, F_{15}, F_{16}$

9 Filters-$F_{17}, F_{18}, F_{19}, F_{20}$

10 Filters-F_{21}

11 HP Filter and AL > θ

12 Rectifiers/Low Pass $R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, R_{12}$

13 Rectifiers/Low Pass $R_{13}, R_{14}, R_{15}, R_{16}, R_{17}, R_{18}, R_{19}, R_{20}, R_{21}, R_{22B}, R_{HP22}$

14 Spare

15 Diff. Amps-$D_2, D_3, D_4, D_5, D_6, D_7, D_8, D_9, D_{10}, D_{11}, D_{12}, D_{13}$

BOARD	
16	Diff. Amps-D_{14}, D_{15}, D_{16}, D_{17}, D_{18}, D_{19}, D_{20}, D_{21}, D10-F1, D10-F2, D16-F2, D14-F3
17	Diff. Amps-D(20-18)
18	Spare
19	Spare
20	Spare
21	Pitch Range Switching
22	Formant #1, Formant Frequency and Amplitude Network
23	Formant #2, Formant Frequency and Amplitude Network
24	Formant #3, Formant Frequency and Amplitude Network
25	Fill Logic and Request B-1
26	LED Drivers W_D, V/UV, F_1, F_2, F_3 and AG
27	Timing and Control
28	Amplitude Digitizer and Voice/Unvoiced Circuitry
29	LED Drivers AL, AH, AVH
30	Analyzer to 1140 Interface (IN-2)

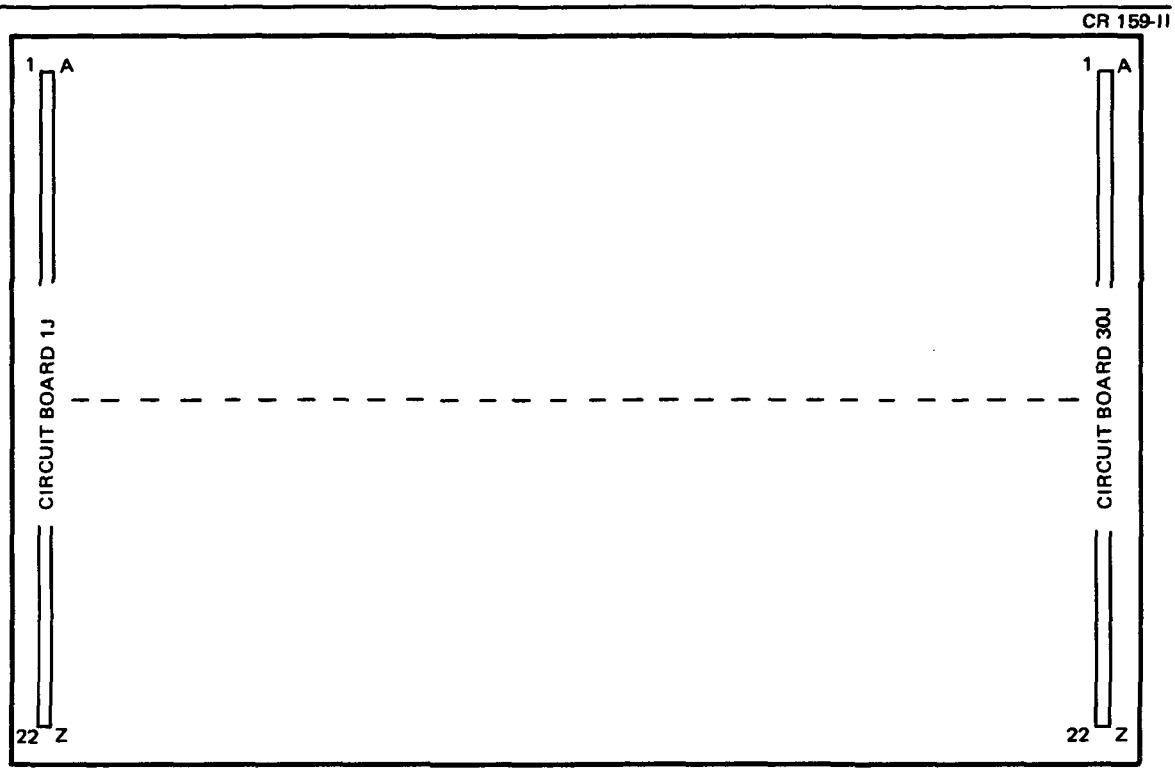


FIGURE 3. SPEECH ANALYZER CHASSIS — FRONT VIEW

APPENDIX E

WRS MINICOMPUTER INPUT/OUTPUT INTERFACE BOARDS

The WRS Minicomputer (DEC PDP 11/40) contains 3 DR11-C 16-bit parallel input-output boards, each containing 2 available interrupts for a total of 96 data bits of input and output. Currently, only interrupt A on DR11-C-1 and both interrupts A and B on DR11-C-2 are being utilized, allowing for a total of 48 bits of input by the user when preceded by digital multiplexing. No output lines are used and therefore 48 data bits of output are available to the user as well. The following pages describe the pin-listings for each DR11-C interface board.

DR11-C-1-IN

C1	Berg	1140 Term	Analyzer Term	Analyzer Pin
1	A	—		
2	C	DATA TRANS-1	DATA TRANS-1	25J-B
3	E	IN02-1	F3-4	25J-15
4	H	IN02-1	F3-4	
5	K	CSRO		
6	M	IN15-1	WD	25J-5
7	P	IN13-1	GND	
8	S	REQUEST B-1	REQUEST B-1	25J-D
9	U	IN12-1	GND	
10	W	IN10-1	F1-4	25J-7
11	Y	IN09-1	F1-2	25J-8
12	AA	GND		
13	CC	IN07-1	F2-8	25J-10
14	EE	IN06-1	F2-4	25J-11
15	HH	IN05-1	F2-2	25J-12
16	KK	IN04-1	F2-1	25J-13
17	MM	GND		
18	PP	GND		
19	SS	GND		
20	UU	GND		
21				
22				
23				
24				
25				
26	B	—		
27	D	—		
28	F	—		
29	J	GND		

DR11-C-1-IN (Continued)

C1	Berg	1140 Term	Analyzer Term	Analyzer Pin
30	L	GND		
31	N	IN14-1	V/UV	25J-4
32	R	GND		
33	T	GND		
34	V	IN11-1	F1-8	25J-6
35	X	GND		
36	Z	IN08-1	F1-1	25J-9
37	BB	IN03-1	F3-8	25J-14
38	DD	GND		
39	FF	—		
40	JJ	GND		
41	LL	IN01-1	F3-2	25J-16
42	NN	INITH		
43	RR	INITH		
44	TT	IN00-1	F3-1	25J-17
45	VV	—		
46		REQUEST A-1	(Jumper C4-41 to C1-46)	
47				
48				
49				
50				

DR11-C-2-IN

C1	Berg	1140 Term	Analyzer Term	Analyzer Pin
1	A	—		
2	C	DATA TRANS-2	DATA TRANS-2	30J-15
3	E	IN02-2	IN02-2	30J-11
4	H	IN02-2		30J-11
5	K	CSRO		
6	M	IN15-2	—	GND
7	R	IN13-2	IN13-2	30J-2
8	S	REQUEST B-2	REQUEST B-2	30J-17
9	U	IN12-2	IN12-2	30J-3
10	W	IN10-2	IN12-2	30J-5
11	X	IN09-2	IN09-2	30J-6
12	AA	GND		
13	CC	IN07-2	—	GND
14	EE	IN06-2	—	GND
15	HH	IN05-2	IN05-2	30J-8
16	KK	IN04-2	IN04-2	30J-9
17	MM	GND		
18	PP	GND		
19	SS	GND		
20	UU	GND		
21				
22				
23				
24				
25				
26	B	—		
27	D	—		
28	F	—		
29	J	GND		

DR11-C-2-IN (Continued)

C1	Berg	1140 Term	Analyzer Term	Analyzer Pin
30	L	GND		
31	N	IN14-2	—	GND
32	R	GND		
33	T	GND		
34	V	IN11-2	IN11-2	30J-4
35	X	GND		
36	Z	IN08-2	IN08-2	30J-7
37	BB	IN03-2	IN03-2	30J-10
38	DD	GND		
39	FF	—		
40	JJ	GND		
41	LL	IN01-2	IN01-2	30J-12
42	NN	INITH		
43	RR	INITH		
44	TT	IN00-2	IN00-2	30J-13
45	VV	—		
46		REQUEST A-2	REQUEST A-2	30J-16
47				(From C5-41 to C2-46)
48				
49				
50				

DR11-C-3-IN

C1	Berg	1140 Term	Analyzer Term	Analyzer Pin
1	A	–		
2	C	DATA TRANS		
3	E	IN02-3		
4	N	IN02-3		
5	K	CSRO		
6	M	IN15-3		
7	R	IN13-3		
8	S	REQUEST B		
9	U	IN12-3		
10	W	IN10-3		
11	X	IN09-3		
12	AA	GND		
13	CC	IN07-3		
14	EE	IN06-3		
15	HH	IN05-3		
16	KK	IN04-3		
17	MM	GND		
18	PP	GND		
19	SS	GND		
20	UU	GND		
21				
22				
23				
24				
25				
26	B	–		
27	D	–		
28	F	–		
29	J	GND		

DR11-C-3-IN (Continued)

C1	Berg	1140 Term	Analyzer Term	Analyzer Pin
30	L	GND		
31	N	IN14-3		
32	R	GND		
33	T	GND		
34	V	IN11-3		
35	X	GND		
36	Z	IN08-3		
37	BB	IN03-3		
38	DD	GND		
39	FF	—		
40	JJ	GND		
41	LL	IN01-3		
42	NN	INITH		
43	RR	INITH		
44	TT	IN00-3		
45	VV	—		
46				
47				
48				
49				
50				

DR11-C-1-OUT

C1	Berg	1140 Term	Analyzer Term	Analyzer Pin
1	A	–		
2	C	OUT00-1		
3	E	–		
4	H	–		
5	K	OUT01-1		
6	M	GND		
7	R	INITH		
8	S	GND		
9	U	OUT03-1		
10	W	OUT08-1		
11	X	GND		
12	AA	OUT11-1		
13	CC	GND		
14	EE	GND		
15	HH	OUT14-1		
16	KK	GND		
17	MM	GND		
18	PP	GND		
19	SS	GND		
20	UU	GND		
21				
22				
23				
24				
25				
26	B	–		
27	D	–		
28	F	–		
29	J	GND		

DR11-C-1-OUT (Continued)

C1	Berg	1140 Term	Analyzer Term	Analyzer Pin
30	L	OUT04-1		
31	N	OUT05-1		
32	R	OUT06-1		
33	T	OUT07-1		
34	V	GND		
35	X	OUT09-1		
36	Z	OUT10-1		
37	BB	OUT12-1		
38	DD	CSR1		
39	FF	OUT13-1		
40	JJ	OUT15-1		
41	LL	REQUEST A		
42	NN	OUT02-1		
43	RR	OUT02-1		
44	TT	OPEN		
45	VV	NEW DATA READY		
46				
47				
48				
49				
50				

DR11-C-2-OUT

C1	Berg	1140 Term	Analyzer Term	Analyzer Pin
1	A	—		
2	C	OUT00-2		
3	E	—		
4	H	—		
5	K	OUT01-2		
6	M	GND		
7	R	INITH		
8	S	GND		
9	U	OUT03-2		
10	W	OUT08-2		
11	X	GND		
12	AA	OUT11-2		
13	CC	GND		
14	EE	GND		
15	HH	OUT14-2		
16	KK	GND		
17	MM	GND		
18	PP	GND		
19	SS	GND		
20	UU	GND		
21				
22				
23				
24				
25				
26	B	—		
27	D	—		
28	F	—		
29	J	GND		

DR11-C-2-OUT (Continued)

C1	Berg	1140 Term	Analyzer Term	Analyzer Pin
30	L	OUT04-2		
31	N	OUT05-2		
32	R	OUT06-2		
33	T	OUT07-2		
34	V	GND		
35	X	OUT09-2		
36	Z	OUT10-2		
37	BB	OUT12-2		
38	DD	CSR1		
39	FF	OUT13-2		
40	JJ	OUT15-2		
41	LL	REQUEST A		
42	NN	OUT02-2		
43	RR	OUT02-2		
44	TT	OPEN		
45	VV	NEW DATA READY		
46				
47				
48				
49				
50				

DR11-C-3-OUT

C1	Berg	1140 Term	Analyzer Term	Analyzer Pin
1	A	–		
2	C	OUT00		
3	E	–		
4	H	–		
5	K	OUT01-3		
6	M	GND		
7	R	INITH		
8	S	GND		
9	U	OUT03-3		
10	W	OUT08-3		
11	X	GND		
12	AA	OUT11-3		
13	CC	GND		
14	EE	GND		
15	HH	OUT14-3		
16	KK	GND		
17	MM	GND		
18	PP	GND		
19	SS	GND		
20	UU	GND		
21				
22				
23				
24				
25				
26	B	–		
27	D	–		
28	F	–		
29	J	GND		

DR11-C-3-OUT (Continued)

C1	Berg	1140 Term	Analyzer Term	Analyzer Pin
30	L	OUT04-3		
31	N	OUT05-3		
32	R	OUT06-3		
33	T	OUT07-3		
34	V	GND		
35	X	OUT09-3		
36	Z	OUT10-3		
37	BB	OUT12-3		
38	DD	CSR1		
39	FF	OUT13-3		
40	JJ	OUT15-3		
41	LL	REQUEST A		
42	NN	OUT02-3		
43	RR	OUT02-3		
44	TT	OPEN		
45	VV	NEW DATA READY		
46				
47				
48				
49				
50				

APPENDIX F
WRS ASSEMBLY LANGUAGE PROGRAM LISTING

The next 69 pages contain the complete assembly language listing of the WRS software. The first two pages contain the symbol table. For a flowchart description of the software, see Appendix A.

```
ADDFLG  011640  AGAL    012502  AHAVH   013322  AMWGTS  015114
ASH   = 104410  ASHC  = 104420  ATN     007150  ATNEG   011631
ATNMDE  020542  ATN1    007172  ATN10   007550  ATN12   007572
ATN2    007232  ATN20   007626  ATN30   007706  ATN32   007776
ATN34   010014  ATN4    007230  ATN4A   007346  ATN4B   007366
ATN5    007410  ATN6    007422  ATN8    007442  ATN9    007504
AVGA1   014166  AVGA2   014170  AVGA3   014172  AVGA4   014174
AVGF1   014160  AVGF2   014162  AVGF3   014164  AVGIN   005512
AVG0    005572  AVG1    005662  AVG2    005726  AVG20   006320
AVG3    005752  AVG4    005760  AVG6    005764  BITEST  014220
BLOCK   024130  CHKFG1  011660  CHRCNT  023500  CLASS   011620
CLASSX  011622  CLSIFY  006534  CLS1    006546  CLS2    006560
CLS3    006674  CLS4    006762  CLS8    007134  COUNT   024146
COURSG  024034  CRLF    010126  CRLF30  010146  CRTCHR  021150
CRTKB = 176502  CRTKS = 176500  CRTOUT  011615  CRTPB = 176506
CRTPS = 176500  CT      015126  C1CNTR  011624  C1REGB = 167772
C1REGS = 167770 C1REGT = 167774 C2CNTR  011626  C2FLAG  011630
C2REGB = 167762 C2REGS = 167760 C2REGT = 167764 DATALL  000570
DATA1   000672  DATA2   000724  DEL     010560  DELAY   010166
DELETE  010372  DELET5  010550  DFLAG   024144  DIGITS  024044
DISFG   011641  DISFLG  011614  DISMDE  020422  DISPLA  001374
DISPL1  001524  DISPL2  001542  DISPL3  001576  DISPL4  001632
DISPL5  001666  DISPL6  001722  DISPL7  001756  DISVOC  017566
DISVO1  017622  DISVO4  017676  DIV   = 104402  DIVTL   014206
DIV1    014200  DIV2    014202  DIV3    014204  DLETFG  011621
DR    = 177570  DR11C1  002360  DR11C2  002512  DUMMY   014212
DWAIT   001312  EEEEEE  024154  ENDNG   020504  ENDX    014152
ENTER   001024  ENTER0  000536  ENTER1  001156  ENTER2  001204
ERROR0  017016  ERROR1  017050  ETX     024042  FERT    002612
FERT10  002754  FERT11  003026  FERT20  003032  FERT6   002670
FERT7   002740  FERT9   002746  FINDX   014154  HAP     011304
HAPM1   011302  HAPM2   011300  HAP128  011610  HAP16   011464
HAP2    011362  HAP32   011520  HAP4    011416  HAP64   011554
HAP8    011430  HASH    023510  HASHNG  024032  HOLDT   014470
ICNTR1  023474  ICNTR2  023476  INPUT0  023424  INROUT  016332
ITERAT  011656  KEYFLG  011635  KEYWD1  016764  KEYWD2  016774
KEYWOR  020602  KEYWRD  016722  KEY1    020630  KEY2    020710
KEY3    020712  KEY4    020736  KEY6    021050  KWDSUB  021122
KWDTBL  021074  LA30    010034  LDELAY  010252  LENGTH  014216
LIMIT   015040  MAXF1   014240  MAXLNG  011650  MINLNG  011646
MUL   = 104401  M1      016260  M2      016266  M3      016274
M4      016302  M5      016310  M6      016316  M7      016324
NEWB    017770  NEWRD   016656  NEWSPK  017726  NEWVOC  017066
NOPPC   014672  NORMAL  003044  NORM1   003060  NORM10  003362
NORM12  003550  NORM14  003614  NORM15  003620  NORM2   003112
NORM20  004012  NORM22  004034  NORM24  004110  NORM26  004310
NORM28  004342  NORM3   003220  NORM30  004374  NORM32  004432
NORM4   003342  NOT     015042  NUMFLG  024040  NUMMDE  020326
NXTWRD  011617  OPRMDE  020462  OUTPT2  010632  OUTPT3  010672
OUTPT6  010734  OUTPT9  011012  OUTPUT  010566  OVER    010336
OVRFLW  010314  PPB   = 177556  PPS   = 177554  PRB   = 177552
PRS   = 177550  PUNCH   020130  PUNCH1  020136  PUNCH2  020160
RD      002314  READ    020010  READ0   020020  READ1   020052
REPEAT  010214  REPEET  010306  REPFLG  024036  REPLAC  017166
```

```
REPLC1   017252   REPLC2   017262   REPLC3   017346   REPLC4   017534
REPLC5   017440   REPLC6   017504   REPTFG   011642   REPTRN   017540
RESET    021322   RFLAG    020126   RNOT     014264   RPTFLG   011636
RSTART   001152   SEARCH   014210   SENFG1   011633   SENFG2   011634
SENFLG   024041   SENMDE   020262   SOB    = 104404   SPCHAR   011022
SPCHFG   011612   SPCHR6   011110   SPCHR7   011246   SPCSYM   024122
SPCWRD   024114   SPKOUT   011616   SSSSSS   024152   STARTX   014142
SXT    . = 104500 TCLASS   011637   TEMP     015044   TESTFG   011632
TESTNG   004730   TIMWGT   016256   TINDX1   014144   TINDX2   014146
TINDX3   014150   TKB    = 177562   TKS    = 177560   TLNGTH   014156
TMPLAT   014266   TMPSTR   024156   TPB    = 177566   TPS    = 177564
TRAIN    002112   TRAIN1   002160   TRAIN2   002334   TRN      004652
TRNADD   023506   TRNFLG   011613   TRNMDE   020366   TRNSAV   011652
TRN1     004700   TSTORF   014256   TSTORI   014250   TSTORT   014260
TSTORV   014262   TSTORX   014246   TSTRFX   014214   TSTRI2   014252
TSTRI4   014254   TSTTRN   004612   TST0     004766   TST1     005042
TST10    005460   TST2     005074   TST4     005110   TST4A    005120
TST5     005122   TST5A    005140   TST6     005142   TST8     005336
TTY      021174   TTY0     021250   TTY1     021302   TYPO     010060
UNVCTR   011644   VFLAG    011643   VOCAB    021372   VOCADD   023502
VOCFG    023504   VOICED   014176   WVF123   011662   XOR    = 104440
       = 024160

END ?
          000004          . =4
000004    000006          . WORD    . +2, HALT
000006    000000
          000034          . =34
000034    011304          HAP
000036    000340          . WORD    340
          000060          . =60
000060    021174          TTY
          000070          . =70
000070    020020          READ0
000072    000340          . WORD    340
          000370          . =370
000370    021174          TTY
000372    000340          . WORD    340
          000300          . =300
000300    000302          . +2
000302    000000          HALT
          000304          . =304
000304    002360          DR11C1
000306    000340          . WORD    340
          000310          . =310
000310    002512          DR11C2
000312    000340          . WORD    340
000314    002512          DR11C2
000316    000340          . WORD    340
          167770          C1REGS=167770
          167772          C1REGB=167772
          167774          C1REGI=167774
          167760          C2REGS=167760
          167762          C2REGB=167762
```

```
        167764          C2REGT=167764
        176504          CRTPS=176504
        176506          CRTPB=176506
        177566          TPB=177566
        177564          TPS=177564
        104401          MUL=TRAP+1
        104402          DIV=TRAP+2
        104404          SOB=TRAP+4
        104410          ASH=TRAP+8.
        104420          ASHC=TRAP+16.
        104440          XOR=TRAP+32.
        104500          SXT=TRAP+64.
        177570          DR=177570
        000500          .=500
000500  012701          MOV     #VOCAB+1050.,%1         ;CLEAR VOCABULARY STORAG
        023424
000504  012700          MOV     #VOCAB,%0
        021372
000510  005020          CLR     (0)+
000512  020001          CMP     %0,%1
000514  001375          BNE     .-4
000516  012767          MOV     #VOCAB,VOCADD
        021372
        022756
000524  005067          CLR     VOCFG
        022754

                        PAGE    001

000530  012767          MOV     #HASH,HASHNG
        023510
        023274
000536  016701 ENTER0:  MOV     DR,%1           ;GET DISPLAY REGISTER
        177026
000542  020127          CMP     %1,#16.
        000020
000546  001410          BEQ     DATALL  ;16 BIT CONFIGURATION
000550  020127          CMP     %1,#24.
        000030
000554  001405          BEQ     DATALL          ;24 BIT CONFIGURATION
000556  020127          CMP     %1,#32.
        000040
000562  001402          BEQ     DATALL          ;32 BIT CONFIGURATION
000564  000000          HALT                    ;PLEASE SELECT CONFIGURATION WIT
000566  000763          BR      ENTER0          ;CLEAR HALT WHEN SWITCHES SET
000570  162701 DATALL:  SUB     #16.,%1
        000020
000574  005000          CLR     %0
000576  104402          DIV
000600  020027          CMP     %0,#4
        000004
000604  016067          MOV     M1(0),TLNGTH
        016260
        013344
```

```
000612 016067          MOV     M2(0),TSTORF
       016266
       013436
000620 016067          MOV     M3(0),TSTORI
       016274
       013422
000626 016067          MOV     M4(0),TSTRI2
       016302
       013416
000634 016067          MOV     M5(0),TSTRI4
       016310
       013412
000642 016067          MOV     M6(0),TSTORT
       016316
       013410
000650 016067          MOV     M7(0),TSTORV
       016324
       013404
000656 005002          CLR     %2
000660 005000          CLR     %0
000662 012701          MOV     #77676,%1
       077676
000666 162701          SUB     #TMPSTR,%1
       024156
000672 012760 DATA1:   MOV     #177777,TMPSTR(0)
       177777
       024156
000700 012760          MOV     #077400,TMPSTR+2(0)
       077400
       024160
000706 005060          CLR     TMPSTR+4(0)
       024162

                       PAGE    002

000712 066700          ADD     TSTORT,%0
       013342
000716 005202          INC     %2
000720 005202          INC     %2
000722 020227          CMP     %2,#1130        ;LIMIT TEMPLATES TO 300
       001130
000726 001402          BEQ     DATA2
000730 020001          CMP     %0,%1
000732 100757          BMI     DATA1
000734 010067 DATA2:   MOV     %0,LIMIT
       014100
000740 010267          MOV     %2,NOT          ;NO. OF TEMPLATES * 2 AVAILABLE
       014076
000744 005067          CLR     RNOT            ;RUNNING COUNT OF TEMPLATES USED
       013314
000750 012700          MOV     #NOPPC,%0
       014672
000754 012701          MOV     #NOPPC+102.,%1
       015040
```

```
000760 005020          CLR     (0)+
000762 020001          CMP     %0,%1
000764 001375          BNE     .-4
000766 012700          MOV     #CT,%0
       015126
000772 012701          MOV     #CT+600.,%1
       016256
000776 012720          MOV     #077777,(0)+
       077777
001002 020001          CMP     %0,%1
001004 001374          BNE     .-6
001006 012700          MOV     #TMPLAT,%0
       014266
001012 012701          MOV     #TMPLAT+130.,%1
       014470
001016 005020          CLR     (0)+
001020 020001          CMP     %0,%1
001022 001375          BNE     .-4
001024 105067 ENTER:   CLRB    SPCHFG  ;WHEN SET, START TIME NORMALIZATION
       010562
001030 105067          CLRB    TRNFLG  ;WHEN SET, IN TRAINING MODE
       010557
001034 105067          CLRB    DISFLG  ;WHEN SET, DISPLAY 100 WORDS W/ DISTANCE
       010554
001040 105067          CLRB    SENFLG
       022775
001044 105067          CLRB    NUMFLG
       022770
001050 105067          CLRB    KEYFLG
       010561
001054 105067          CLRB    SENFG1
       010553
001060 105067          CLRB    SENFG2
       010550
001064 105067          CLRB    RPTFLG
       010546
001070 105067          CLRB    CRTOUT  ;WHEN SET, LA7700A LOCKED OUT
       010521

                       PAGE    003

001074 105067          CLRB    SPKOUT  ;WHEN SET, SPEECH ANALYZER LOCKED OUT
       010516
001100 105067          CLRB    NXTWRD  ;WHEN SET, DO NOT REDISPLAY WORD FOR TRA
       010513
001104 105067          CLRB    CLASS   ;CLASS INDEX(0 TO 143 OCTAL)
       010510
001110 005067          CLR     CLASSX  ; TEMPLATE INDEX (0 TO +199)
       010506
001114 005067          CLR     COURFG
       022714
001120 005067          CLR     REPFLG
       022712
001124 105067          CLRB    ATNFG   ;WHEN SET, ATN NETWORK IS ACTIVE,OTHERWI
```

```
        010501
001130  012767          MOV     #177777,TINDX2
        177777
        013010
001136  005067          CLR     ICNTR1          ;INCREMENTED FOR EACH CHAR RECEI
        022332
001142  005067          CLR     ICNTR2          ;INCREMENTED FOR EACH CHARACTER
        022330
001146  005067          CLR     CHRCNT
        022326
001152  012706 RSTART:  MOV     #500,%6         ;STACK POINTER
        000500
                                                ;
001156  105767 ENTER1:  TSTB    TRNFLG
        010431
001162  001410          BEQ     ENTER2
001164  105767          TSTB    RPTFLG
        010446
001170  001005          BNE     ENTER2
001172  105767          TSTB    REPTFG
        010444
001176  001002          BNE     ENTER2
001200  105267          INCB    CLASS
        010414
001204  105067 ENTER2:  CLRB    DLETFG  ; WHEN SET, DELETE LAST TRAINING INPUT
        010411
001210  005067          CLR     C1CNTR  ;WYF123 INTERRUPT COUNTER
        010410
001214  005067          CLR     C2CNTR  ;AGAL AND AHAVH INTERRUPT COUNTER
        010406
001220  105067          CLRB    C2FLAG  ;DETERMINES WHETHER AGAL OR AVAVH DATA
        010404
001224  105067          CLRB    NXTWRD
        010367
001230  105067          CLRB    SPCHFG
        010356
001234  105067          CLRB    CRTOUT
        010355
001240  005067          CLR     UNVCTR          ;USED IN VOICED/UNVOICED SMOOTHI
        010400
001244  112767          MOVB    #7,VFLAG        ;USED IN VOICED/UNVOICED SMOOTHI
        000007
        010371

                        PAGE    004

001252  105067          CLRB    SPKOUT
        010340
001256  105067          CLRB    REPTFG
        010360
001262  105067          CLRB    DISFG
        010353
001266  000005          RESET           ;CLEAR ALL I/O DEVICE REGISTERS
001270  012767          MOV     #40,C1REGS      ;ENABLE REQ B FROM DR11C1
```

```
        000040
        166472
001276  012767          MOV     #140,C2REGS     ;ENABLE REQ A,B FROM DR11C2
        000140
        166454
001304  012767          MOV     #101,CRTKS      ;ENABLE CRT
        000101
        175166
001312  105767 DWAIT:   TSTB    SPCHFG
        010274
001316  001402          BEQ     .+6
001320  000167          JMP     NORMAL  ;BEGIN TIME NORMALIZATION
        001520
001324  005767          TST     COURFG          ;WHEN SET, PROCESS CRT DATA
        022504
001330  001402          BEQ     .+6
001332  004767          JSR     7,INROUT
        014774
001336  105767          TSTB    TRNFLG
        010251
001342  001405          BEQ     .+12.   ;NO
001344  105767          TSTB    NXTWRD
        010247
001350  001002          BNE     .+6
001352  000167          JMP     TRAIN
        000534
001356  004767          JSR     7,DISPLA
        000012
001362  105767          TSTB    DLETFG  ;DELETE LAST WORD IN TRAINING ?
        010233
001366  001751          BEQ     DWAIT   ;NO
001370  000167          JMP     DELETE  ;YES
        006776
001374  105767 DISPLA:  TSTB    DISFG
        010241
001400  001401          BEQ     .+4
001402  000207          RTS     7
001404  005067          CLR     ICNTR1
        022064
001410  005067          CLR     ICNTR2
        022062
001414  012700          MOV     #1,%0           ;FUNCTION CMD
        000001
001420  004767          JSR     7,TYPO
        006434
001424  012700          MOV     #12,%0          ;GET PRESENT CURSOR LOCATION
        000012
001430  004767          JSR     7,TYPO
        006424

                        PAGE    005

001434  000001          WAIT            ;PRESENT COLUMN POSITION
001436  000001          WAIT            ;PRESENT ROW POSITION
```

```
001440 012700           MOV     #1,%0           ;FUNCTION CMD
       000001
001444 004767           JSR     7,TYPO
       006410
001450 012700           MOV     #3,%0           ;MOV    CURSOR TO BOTTOM LEFT CO
       000003
001454 004767           JSR     7,TYPO
       006400
001460 005000           CLR     %0
001462 004767           JSR     7,TYPO
       006372
001466 012700           MOV     #24.,%0
       000030
001472 004767           JSR     7,TYPO
       006362
001476 105767           TSTB    TRNFLG          ;OUTPUT SYSTEM MODES OF OPERATIO
       010111
001502 001410           BEQ     DISPL1
001504 012700           MOV     #"TM,%0
       046524
001510 004767           JSR     7,TYPO
       006344
001514 000300           SWAB    %0
001516 004767           JSR     7,TYPO
       006336
001522 000407           BR      DISPL2
001524 012700 DISPL1:   MOV     #"OM,%0
       046517
001530 004767           JSR     7,TYPO
       006324
001534 000300           SWAB    %0
001536 004767           JSR     7,TYPO
       006316
001542 112700 DISPL2:   MOVB    #' ,%0
       000040
001546 004767           JSR     7,TYPO
       006306
001552 105767           TSTB    ATNFG
       010053
001556 001007           BNE     DISPL3
001560 012700           MOV     #"AT,%0
       052101
001564 004767           JSR     7,TYPO
       006270
001570 000300           SWAB    %0
001572 004767           JSR     7,TYPO
       006262
001576 112700 DISPL3:   MOVB    #' ,%0
       000040
001602 004767           JSR     7,TYPO
       006252
001606 105767           TSTB    SENFG1
       010021
001612 001407           BEQ     DISPL4
```

```
                                PAGE    006

001614 012700                   MOV     #"SM,%0
       046523
001620 004767                   JSR     7,TYPO
       006234
001624 000300                   SWAB    %0
001626 004767                   JSR     7,TYPO
       006226
001632 112700 DISPL4:           MOVB    #' ,%0
       000040
001636 004767                   JSR     7,TYPO
       006216
001642 105767                   TSTB    NUMFLG
       022172
001646 001407                   BEQ     DISPL5
001650 012700                   MOV     #"NM,%0
       046516
001654 004767                   JSR     7,TYPO
       006200
001660 000300                   SWAB    %0
001662 004767                   JSR     7,TYPO
       006172
001666 112700 DISPL5:           MOVB    #' ,%0
       000040
001672 004767                   JSR     7,TYPO
       006162
001676 105767                   TSTB    DFLAG
       022242
001702 001407                   BEQ     DISPL6
001704 012700                   MOV     #"DM,%0
       046504
001710 004767                   JSR     7,TYPO
       006144
001714 000300                   SWAB    %0
001716 004767                   JSR     7,TYPO
       006136
001722 112700 DISPL6:           MOVB    #' ,%0
       000040
001726 004767                   JSR     7,TYPO
       006126
001732 105767                   TSTB    KEYFLG
       007677
001736 001407                   BEQ     DISPL7
001740 012700                   MOV     #"SS,%0
       051523
001744 004767                   JSR     7,TYPO
       006110
001750 000300                   SWAB    %0
001752 004767                   JSR     7,TYPO
       006102
001756 112700 DISPL7:           MOVB    #' ,%0
       000040
```

```
001762 004767          JSR     7,TYPO
       006072
001766 005000          CLR     %0              ;OUTPUT THE NUMBER OF TEMPLATES
001770 005002          CLR     %2
001772 016701          MOV     RNOT,%1
       012266

                       PAGE    007

001776 104420          ASHC
002000 020027          CMP     %0,#10.
       000012
002004 062700          ADD     #60,%0
       000060
002010 004767          JSR     7,TYPO
       006044
002014 005000          CLR     %0
002016 104420          ASHC
002020 020027          CMP     %0,#3
       000003
002024 005202          INC     %2
002026 020227          CMP     %2,#3
       000003
002032 001364          BNE     -22.
002034 012700          MOV     #1401,%0
       001401
002040 004767          JSR     7,TYPO
       006014
002044 000300          SWAB    %0
002046 004767          JSR     7,TYPO
       006006
002052 016701          MOV     ICNTR1,%1
       021416
002056 116100          MOVB    INPUT0-2(1),%0
       023422
002062 004767          JSR     7,TYPO
       005772
002066 116100          MOVB    INPUT0-1(1),%0
       023423
002072 004767          JSR     7,TYPO
       005762
002076 004767          JSR     7,RESET
       017220
002102 112767          MOVB    #7,DISFG
       000007
       007531
002110 000207          RTS     7
                       ;
                       ;
002112 112767 TRAIN:   MOVB    #7,NXTWRD       ;WORD   DISPLAYED,CLEARED AFTER
       000007
       007477
002120 116705          MOVB    CLASS,%5
       007474
```

```
002124 104401          MUL
002126 020527          CMP     %5,#10.
       000012
002132 062705          ADD     #VOCAB,%5
       021372
002136 010501          MOV     %5,%1
002140 062701          ADD     #10.,%1
       000012
002144 012700          MOV     #31,%0
       000031
002150 004767          JSR     7,TYPO
       005704

                       PAGE    010

002154 004767          JSR     7,DELAY
       006006
002160 012500 TRAIN1:  MOV     (5)+,%0
002162 004767          JSR     7,TYPO
       005672
002166 000300          SWAB    %0
002170 004767          JSR     7,TYPO
       005664
002174 020501          CMP     %5,%1
002176 001370          BNE     TRAIN1
002200 012700          MOV     #40,%0
       000040
002204 004767          JSR     7,TYPO
       005650
002210 004767          JSR     7,TYPO
       005644
002214 105767          TSTB    RPTFLG          ;WHEN SET IN REPACE AND TRAIN MO
       007416
002220 001445          BEQ     TRAIN2
002222 005367          DEC     ITERAT
       007430
002226 001402          BEQ     .+6
002230 000167          JMP     DWAIT
       177056
002234 116767          MOVB    TRNSAV+2,CLASS
       007414
       007356
002242 105067          CLRB    RPTFLG
       007370
002246 105067          CLRB    TRNFLG
       007341
002252 112767          MOVB    #7,ATNFG                ;PRINT O.K.
       000007
       007351
002260 012702          MOV     #RD,%2
       002314
002264 012701          MOV     #RD+18.,%1
       002336
002270 012200          MOV     (2)+,%0
```

```
002272 004767          JSR     7,TYPO
       005562
002276 000300          SWAB    %0
002300 004767          JSR     7,TYPO
       005554
002304 020201          CMP     %2,%1
002306 001370          BNE     .-14.
002310 000167          JMP     ENTER2
       176670
002314    122 RD:      .ASCII  /REPLACE COMPLETE/
002315    105
002316    120
002317    114
002320    101
002321    103
002322    105
002323    040

                       PAGE    011

002324    103
002325    117
002326    115
002327    120
002330    114
002331    105
002332    124
002333    105
002334 126727 TRAIN2:  CMPB    CLASS,#100.
       007260
       000144
002342 001402          BEQ     .+6
002344 000167          JMP     DWAIT
       176742
002350 105067          CLRB    CLASS
       007244
002354 000167          JMP     ENTER2  ;RETURN TO DECISION WAIT LOOP
       176624
                       ;
002360 105767 DR11C1:  TSTB    SPKOUT
       007232
002364 001404          BEQ     .+10.
002366 016767          MOV     C1REGT,DUMMY
       165402
       011616
002374 000002          RTI
002376 010046          MOV     %0,-(6)
002400 016700          MOV     C1CNTR,%0
       007220
002404 016760          MOV     C1REGT,WVF123(0)        ;STORE INTERRUPT DATA
       165364
       011662
002412 005200          INC     %0
002414 005200          INC     %0
```

```
002416 010067          MOV     %0,C1CNTR       ;INCREMENT DR11C1 COUNTER
       007202
002422 005760          TST     WVF123-2(0)             ;TEST   FOR WORD ONSET B
       011660
002426 100001          BPL     .+4
002430 000420          BR      +34             ;DATA IS STILL COMING IN
002432 112767          MOVB    #7,SPKOUT       ;INHIBIT DATA FROM ANALYZER
       000007
       007156
002440 112767          MOVB    #7,SPCHFG
       000007
       007144
002446 000005          RESET           ;DISABLE ALL I/O DEVICES
002450 112767          MOVB    #7,CRTOUT
       000007
       007137
002456 026767          CMP     MINLNG,C1CNTR   ;IS SPEECH INPUT LONG ENOUGH?
       007164
       007140
002464 100402          BMI     .+6             ;YES
002466 004767          JSR     7,REPEAT        ;WORD LENGTH TOO SHORT
       005522

                       PAGE    012

002472 026767          CMP     MAXLNG,C1CNTR   ;IS SPEECH INPUT TOO LONG ?
       007152
       007124
002500 100002          BPL     .+6
002502 004767          JSR     7,OVRFLW        ;INTERRUPT STORAGE OVERFLOW!!
       005606
002506 012600          MOV     (6)+,%0
002510 000002          RTI                     ;RETURN

002512 105767 DR11C2:  TSTB    SPKOUT
       007100
002516 001404          BEQ     .+10.
002520 016767          MOV     C2REGT,DUMMY
       165240
       011464
002526 000002          RTI
002530 010046          MOV     %0,-(6)
002532 010146          MOV     %1,-(6)
002534 010246          MOV     %2,-(6)
002536 010346          MOV     %3,-(6)
002540 016700          MOV     C2CNTR,%0
       007062
002544 105767          TSTB    C2FLAG          ;SET FOR AH + AVH  REQ B
       007060
002550 001007          BNE     .+16.
002552 016760          MOV     C2REGT,AGAL(0)  ;REQ     A
       165206
       012502
002560 112767          MOVB    #7,C2FLAG
```

```
        000007
        007042
002566  000521          BR      FERT20
002570  016760          MOV     C2REGT,AHAVH(0) ;REQ B
        165170
        013322
002576  105067          CLRB    C2FLAG
        007026
002602  005200          INC     %0
002604  005200          INC     %0
002606  010067          MOV     %0,C2CNTR       ;INCREMENT DR11C2 COUNTER
        007014
                                                ;
                                                ;
002612  016701 FERT:     MOV     C1CNTR,%1       ;VOICED/UNVOICED SMOOTHING NETWO
        007006
002616  032761          BIT     #40000,WVF123-2(1)      ;CHECK VOICING BIT
        040000
        011660
002624  001021          BNE     FERT6
002626  105767          TSTB    VFLAG
        007011
002632  001045          BNE     FERT9
002634  116002          MOVB    AGAL-2(0),%2
        012500
002640  016003          MOV     AHAVH-2(0),%3
        013320

                        PAGE    013

002644  105003          CLRB    %3
002646  000303          SWAB    %3
002650  162703          SUB     #3,%3
        000003
002654  020302          CMP     %3,%2           ;(AH-2) - AL
002656  100030          BPL     FERT7   ;DO NOT ADD VOICING BIT
002660  052761          BIS     #40000,WVF123-2(1)
        040000
        011660
002666  000461          BR      FERT20
002670  105767 FERT6:   TSTB    VFLAG
        006747
002674  001456          BEQ     FERT20          ;CONTINUATION OF VOICED SEGMENT
002676  116002          MOVB    AGAL-2(0),%2
        012500
002702  006302          ASL     %2
002704  016003          MOV     AHAVH-2(0),%3
        013320
002710  105003          CLRB    %3
002712  000303          SWAB    %3
002714  005303          DEC     %3
002716  020302          CMP     %3,%2           ;AH - (2*AL + 1)
002720  100403          BMI     .+10            ;2*AL .LT. AH-1
002722  042761          BIC     #40000,WVF123-2(1)      ;DELETE VOICING
```

```
        040000
        011660
002730  000440          BR      FERT20
002732  105067          CLRB    VFLAG           ;BEGINNING OF VOICED SEGMENT
        006705
002736  000406          BR      FERT10
002740  112767 FERT7:   MOVB    #7,VFLAG        ;NON-VOICED     SEGMENT
        000007
        006675
002746  005267 FERT9:   INC     UNVCTR          ;NO. OF UNVOICED SAMPLES
        006672
002752  000427          BR      FERT20
002754  026727 FERT10:  CMP     UNVCTR,#4       ;UNVCTR - 4     (3 OR LESS  FILL
        006664
        000004
002762  100021          BPL     FERT11
002764  020127          CMP     %1,#16.
        000020
002770  100416          BMI     FERT11
002772  006367          ASL     UNVCTR
        006646
002776  166701          SUB     UNVCTR,%1
        006642
003002  052761          BIS     #40000,NVF123-2(1)
        040000
        011660
003010  005201          INC     %1
003012  005201          INC     %1
003014  005367          DEC     UNVCTR
        006624
003020  005367          DEC     UNVCTR
        006620

                        PAGE    014

003024  001366          BNE     .-18.
003026  005067 FERT11:  CLR     UNVCTR
        006612
003032  012603 FERT20:  MOV     (6)+,%3
003034  012602          MOV     (6)+,%2
003036  012601          MOV     (6)+,%1
003040  012600          MOV     (6)+,%0         ;CLEAR HALT AND CONTINUE
003042  000002          RTI                     ;RETURN
003044  105767 NORMAL:  TSTB    CHKFG1
        006610
                        .EOT

EOF ?
003050  001002          BNE     .+6
003052  000167          JMP     NORM10
        000304
003056  005003          CLR     %3              ;DISPLAY RAW DATA WHEN CHKFG1 MA
003060  016300 NORM1:   MOV     NVF123(3),%0
        011662
```

```
003064 104410           ASH
003066 020027           CMP     %0,#-14.        ;GET    V AND WORD ONSET
       177762
003072 042700           BIC     #177774,%0
       177774
003076 052700           BIS     #60.%0
       000060
003102 004767           JSR     7,LA30          ;WORD ONSET AND VOICING OUT
       004726
003106 012704           MOV     #-8.,%4
       177770
003112 012700 NORM2:    MOV     #40.%0          ;TWO SPACES
       000040
003116 004767           JSR     7,LA30
       004712
003122 004767           JSR     7,LA30
       004706
003126 016300           MOV     WVF123(3),%0
       011662
003132 104410           ASH
003134 020004           CMP     %0,%4
003136 042700           BIC     #177760,%0
       177760
003142 052700           BIS     #060,%0
       000060
003146 004767           JSR     7,LA30          ;OUTPUT F1,F2,F3
       004662
003152 062704           ADD     #4,%4
       000004
003156 020427           CMP     %4,#4
       000004
003162 001353           BNE     NORM2
003164 012700           MOV     #40,%0
       000040
003170 004767           JSR     7,LA30
       004640
003174 004767           JSR     7,LA30
       004634
003200 004767           JSR     7,LA30
       004630

                        PAGE    015

003204 005005           CLR     %5
003206 005004           CLR     %4
003210 016300           MOV     AGAL(3),%0
       012502
003214 016301           MOV     AHAVH(3),%1
       013322
003220 104420 NORM3:    ASHC
003222 020004           CMP     %0,%4           ;SHIFT LEFT 0,THEN 8 BITS IN %4
003224 000300           SWAB    %0
003226 010002           MOV     %0,%2
003230 006200           ASR     %0
```

```
003232 006200           ASR     %0
003234 006200           ASR     %0
003236 042700           BIC     #177770,%0
       177770
003242 052700           BIS     #60,%0
       000060
003246 004767           JSR     7,LA30          ;1ST 3 BITS OUT OF AMP
       004562
003252 010200           MOV     %2,%0
003254 042700           BIC     #177770,%0
       177770
003260 052700           BIS     #60,%0
       000060
003264 004767           JSR     7,LA30          ;2ND 3 BITS OUT OF AMP
       004544
003270 012700           MOV     #40,%0
       000040
003274 004767           JSR     7,LA30
       004534
003300 004767           JSR     7,LA30
       004530
003304 010200           MOV     %2,%0
003306 000300           SWAB    %0
003310 005205           INC     %5
003312 012704           MOV     #8.,%4
       000010
003316 020527           CMP     %5,#4.
       000004
003322 001336           BNE     NORM3
003324 005203           INC     %3
003326 005203           INC     %3
003330 004767           JSR     7,CRLF30
       004612
003334 005763           TST     WVF123(3)
       011662
003340 100647           BMI     NORM1
003342 105067 NORM4:    CLRB    SPKOUT
       006250
003346 105067           CLRB    SPCHFG
       006240
003352 105067           CLRB    CRTOUT
       006237
003356 000167           JMP     ENTER1
       175574
003362 105767 NORM10:   TSTB    REPTFG
       006254

                        PAGE    016

003366 001402           BEQ     .+6
003370 000167           JMP     ENTER1
       175562
003374 105767           TSTB    SENFG2
       006234
```

```
003400 001006          BNE     .+14.
003402 012700          MOV     #31,%0
       000031
003406 004767          JSR     7,TYPQ
       004446
003412 004767          JSR     7,DELAY
       004550
003416 012767          MOV     #6.,TSTORX      ;T I M E  N O R M A L I Z A T I
       000006
       010622
003424 016767          MOV     TSTORF,TSTRFX   ;BEGINNING OF FORMANT BUFFER
       010626
       010562
003432 012700          MOV     #AGAL,%0        ;FIND WHEN DATA BEGINS AND ENDS
       012502
003436 012001          MOV     (0)+,%1
003440 000301          SWAB    %1
003442 122701          CMPB    #6,%1           ;COMPARE AG TO A THRESHOLD
       000006
003446 100373          BPL     .-8.
003450 162700          SUB     #AGAL,%0
       012502
003454 010067          MOV     %0,STARTX       ;BEGINNING OF NORMALIZATION
       010462
003460 010067          MOV     %0,SEARCH
       010524
003464 012703          MOV     #AGAL,%3
       012502
003470 066703          ADD     C1CNTR,%3
       006130
003474 005303          DEC     %3
003476 005303          DEC     %3
003500 014301          MOV     -(3),%1
003502 000301          SWAB    %1              ;COMPARE AG TO A THRESHOLD
003504 122701          CMPB    #6,%1
       000006
003510 100373          BPL     .-8.
003512 162703          SUB     #AGAL,%3
       012502
003516 010367          MOV     %3,ENDX ;END OF NORMALIZATION
       010430
                       ;
003522 160003          SUB     %0,%3
003524 100004          BPL     .+10.
003526 004767          JSR     7,REPEAT
       004462
003532 000167          JMP     ENTER1                  ;ERROR: WORD LENGTH NOT
       175420
003536 006203          ASR     %3
                       ;
003540 010367          MOV     %3,LENGTH       ;LENGTH OF DISCRETE WORD
       010452
```

```
003544 012700           MOV     #1,%0
       000001
003550 016702 NORM12:   MOV     LENGTH,%2       ;TEMPLATE LENGTH # 16,24, OR 32
       010442
003554 104401           MUL                     ;TLTH = 17,25,33 FOR WINDOWS
003556 020200           CMP     %2,%0           ;RESULT IN R2 AND R3
003560 104402           DIV
003562 020267           CMP     %2,TLNGTH       ;(R0 * LENGTH)/TLNGTH
       010370
003566 006302           ASL     %2
003570 066702           ADD     STARTX,%2       ;LOOKING FOR END OF WINDOW IN R2
       010346
003574 012701           MOV     #AVGF1,%1
       014160
003600 005021           CLR     (1)+            ;CLEAR STORAGE FOR AVG WINDOW C
003602 020127           CMP     %1,#SEARCH
       014210
003606 001374           BNE     .-6
003610 016701           MOV     SEARCH,%1       ;START OF SEARCH
       010374
003614 020201 NORM14:   CMP     %2,%1           ;R2 = END OF WINDOW, R1 = BEGINN
003616 100475           BMI     NORM20          ;WINDOW AVERAGED
003620 016103 NORM15:   MOV     WVF123(1),%3    ;GET AVERAGE F1,F2,F3, AND VOICI
       011662
003624 010304           MOV     %3,%4
003626 042704           BIC     #177760,%4
       177760
003632 005704           TST     %4
003634 001404           BEQ     .+10.
003636 060467           ADD     %4,AVGF3
       010322
003642 005267           INC     DIV3
       010336
003646 000303           SWAB    %3
003650 010304           MOV     %3,%4
003652 042704           BIC     #177760,%4
       177760
003656 005704           TST     %4
003660 001404           BEQ     .+10.
003662 060467           ADD     %4,AVGF1
       010272
003666 005267           INC     DIV1
       010306
003672 000303           SWAB    %3
003674 032703           BIT     #040000,%3      ;CHECK FOR VOICING
       040000
003700 001402           BEQ     .+6
003702 005267           INC     VOICED
       010270
003706 104410           ASH
003710 020327           CMP     %3,#-4          ;RSH 4 BITS
       177774
003714 042703           BIC     #177760,%3
```

```
        177760
003720 005703           TST     %3
003722 001404           BEQ     .+10.

                        PAGE    020

003724 060367           ADD     %3,AVGF2
        010232
003730 005267           INC     DIV2
        010246
                                                ;GET AVERAGE AMPLITUDES
003734 016103           MOV     AGAL(1),%3
        012502
003740 110304           MOVB    %3,%4
003742 060467           ADD     %4,AVGA1        ;AVGA1 = AL
        010220
003746 000303           SWAB    %3
003750 110304           MOVB    %3,%4
003752 060467           ADD     %4,AVGA2        ;AVGA2 = AG
        010212
003756 016103           MOV     AHAVH(1),%3
        013322
003762 110304           MOVB    %3,%4
003764 060467           ADD     %4,AVGA3        ;AVGA3 = AVH
        010202
003770 000303           SWAB    %3
003772 110304           MOVB    %3,%4
003774 060467           ADD     %4,AVGA4        ;AVGA4 = AH
        010174
004000 005267           INC     DIVTL           ;TOTAL NO. POINTS IN THE WINDOW
        010202
004004 005201           INC     %1
004006 005201           INC     %1
004010 000701           BR      NORM14          ;RETURN TO EXAMINE NEXT DATA PO1
004012 005301 NORM20:   DEC     %1
004014 005301           DEC     %1
004016 005767           TST     DIVTL           ;NO. SAMPLE POINTS .GT. ZERO
        010164
004022 001001           BNE     .+4
004024 000000           HALT                    ;ERROR - MINIMUM NO. SAMPLES PER
004026 010167           MOV     %1,SEARCH       ;BEGIN  NEXT    WINDOW AT THIS B
        010156
004032 005001           CLR     %1
004034 005004 NORM22:   CLR     %4
004036 016105           MOV     AVGF1(1),%5
        014160
004042 104410           ASH
004044 020527           CMP     %5,#3           ;GET 3 BITS PRECISION INFORMAT
        000003
004050 104402           DIV
004052 020461           CMP     %4,DIV1(1)      ;AVGF1(X)/(NO. NONZERO SAMPLES)
        014200
004056 005204           INC     %4              ;ROUND AT B3 TO GET B2
004060 026104           CMP     MAXF1(1),%4
```

```
        014240
004064  100001          BPL     .+4
004066  000000          HALT                    ;ERROR: ANALYZER: ERRONEOUS BCD
004070  006204          ASR     %4
004072  010461          MOV     %4,AVGF1(1)     ;CHECK DATA BUFFER - DATA AT B2
        014160
004076  005201          INC     %1
004100  005201          INC     %1

                        PAGE    021

004102  020127          CMP     %1,#6
        000006
004106  001352          BNE     NORM22
004110  005004 NORM24:  CLR     %4
004112  016105          MOV     AVGF1(1),%5
        014160
004116  104410          ASH     -
004120  020527          CMP     %5,#3
        000003
004124  104402          DIV
004126  020467          CMP     %4,DIVTL        ;AVGA(X)/(NO. SAMPLES IN A WINDO
        010054
004132  005204          INC     %4
004134  006204          ASR     %4
004136  020427          CMP     %4,#771
        000771
004142  100404          BMI     .+10.
004144  004767          JSR     7,REPEAT
        004044
004150  000167          JMP     ENTER1  ;ERROR - AMPLITUDES OUT OF RANGE
        175002
004154  010461          MOV     %4,AVGF1(1)
        014160
004160  005201          INC     %1
004162  005201          INC     %1
004164  020127          CMP     %1,#16.
        000020
004170  001347          BNE     NORM24
004172  026767          CMP     AVGA2,AVGA3     ;AVH  MUST  BE  LE  AG
        007772
        007772
004200  100003          BPL     .+8.
004202  016767          MOV     AVGA2,AVGA3
        007762
        007762
004210  026767          CMP     AVGA2,AVGA4     ;AH MUST BE .LE. AG
        007754
        007756
004216  100003          BPL     .+8.
004220  016767          MOV     AVGA2,AVGA4
        007744
        007746
004226  026767          CMP     AVGA2,AVGA1     ;AL MUST BE  LT  AG
```

```
          007736
          007732
004234 100003          BPL     .+8.
004236 016767          MOV     AVGA2,AVGA1
          007726
          007722
004244 012703          MOV     #177777,%3      ;WINDOW MEAN VALUES NOE READY FO
       177777
004250 016701          MOV     TSTORX,%1
          007772
004254 016702          MOV     TSTORI,%2
          007770
004260 106361          ASLB    TMPLAT(1)       ;DO BINARY MEASURES FIRST
          014266

                       PAGE    022

004264 026767          CMP     AVGA3,AVGA4
          007702
          007702
004272 100406          BMI     NORM26          ;FAIL
004274 026767          CMP     AVGA3,AVGA1
          007672
          007664
004302 100402          BMI     NORM26          ;FAIL
004304 105261          INCB    TMPLAT(1)       ;AM1 = AVH .GE. AH AND AH .GE. A
          014266
004310 060201 NORM26:  ADD     %2,%1    ;INCREMENT %1 BY 6,9,12, FOR
004312 106361          ASLB    TMPLAT(1)       ;16, 24, AND 32 BIT CONFIGURATIO
          014266
004316 026767          CMP     AVGA1,AVGA3
          007644
          007646
004324 100406          BMI     NORM28
004326 026767          CMP     AVGA1,AVGA4
          007634
          007640
004334 100402          BMI     NORM28          ;FAIL
004336 105261          INCB    TMPLAT(1)       ;AM2 = AL .GE. AVH AND AL .GE. A
          014266
004342 060201 NORM28:  ADD     %2,%1
004344 106361          ASLB    TMPLAT(1)
          014266
004350 026767          CMP     AVGA4,AVGA3
          007620
          007614
004356 100406          BMI     NORM30          ;FAIL
004360 026767          CMP     AVGA4,AVGA1
          007610
          007600
004366 100402          BMI     NORM30          ;FAIL
004370 105261          INCB    TMPLAT(1)       ;AM3 = AH .GT. AVH AND AH .GT. A
          014266
004374 060201 NORM30:  ADD     %2,%1
```

```
004376 106361           ASLB    TMPLAT(1)       ;
       014266
004402 006367           ASL     AVGA1           ;2 * AL
       007560
004406 026767           CMP     AVGA4,AVGA1
       007562
       007552
004414 100406           BMI     NORM32          ;FAIL
004416 026767           CMP     AVGA3,AVGA1
       007550
       007542
004424 100402           BMI     NORM32          ;FAIL
004426 105261           INCB    TMPLAT(1)       ;AM4 = AVH .GT. 2*AL AND AH .GT.
       014266
004432 060201 NORM32:   ADD     %2,%1
004434 106361           ASLB    TMPLAT(1)
       014266
004440 026727           CMP     VOICED,#2       ;0.5 AT B2
       007532
       000002

                        PAGE    023

004446 100402           BMI     .+6
004450 105261           INCB    TMPLAT(1)       ;
       014266
004454 010003           MOV     %0,%3
004456 005002           CLR     %2
004460 104402           DIV
004462 020227           CMP     %2,#8.
       000010
004466 005703           TST     %3.
004470 001002           BNE     .+6
004472 005267           INC     TSTORX          ;INCREMENT BYTE
       007550
                                                ;STORE FORMANT DATA
004476 016701           MOV     TSTRFX,%1
       007512
004502 012702           MOV     #AVGA1,%2
       014166
004506 014204           MOV     -(2),%4
004510 104420           ASHC
004512 020427           CMP     %4,#-5
       177773
004516 020227           CMP     %2,#AVGF1
       014160
004522 001371           BNE     .-12.
004524 104420           ASHC
004526 020427           CMP     %4,#-1
       177777
004532 010561           MOV     %5,TMPLAT(1)    ;F1=4.2,F2=3.2,  F3=3.2
       014266
004536 005201           INC     %1
004540 005201           INC     %1
```

```
004542 010167          MOV     %1,TSTRFX
       007446
                                                ;CHECK FOR TEMPLATE STORAGE FULL
004546 005200          INC     %0
004550 020067          CMP     %0,TLNGTH
       007402
004554 001402          BEQ     .+6             ;CONTINUE TIME NORM.
004556 000167          JMP     NORM12
       176766

004562 016767          MOV     LENGTH,TMPLAT+4 ;STORE LENGTH OF THE WORD
       007430
       007502
004570 006367          ASL     TMPLAT+4
       007476
004574 006367          ASL     TMPLAT+4
       007472
004600 116767          MOVB    CLASS,TMPLAT+2
       005014
       007462
004606 000367          SWAB    TMPLAT+2
       007456

                       ;STORE FERT VALUES HERE WHEN ROUTINE READY
                       ;EXTRACT VOICED UNVOICED SEGMENT STRUCTURE IN FERT

                       PAGE    024

                       ;
004612 105767 TSTTRN:  TSTB    TRNFLG
       004775
004616 001406          BEQ     .+14            ;IN OPRMDE
004620 116700          MOVB    CLASS,%0
       004774
004624 022700          CMP     #145,%0
       000145
004630 100001          BPL     .+4
004632 000000          HALT                    ;ERROR: SOFTWARE: CLASS NOT IN R
004634 105067          CLRB    TESTFG  ;WHEN SET, CLASSIFICATION STORAGE NOT CL
       004772
004640 005000          CLR     %0
004642 016702          MOV     LIMIT,%2
       010172
004646 016701          MOV     TSTORT,%1
       007406
004652 005760 TRN:     TST     TMPSTR(0)       ;R0,R1,R2 USED
       024156
004656 100410          BMI     TRN1
004660 000400          BR      .+2             ;PRUNING NETWORK . . .JSR  7,PRUNE
004662 016067          MOV     TMPSTR(0),CLASSX        ;START ADDRESS IN CLASSX
       024156
       004732
004670 004767          JSR     7,TESTNG        ;FIND DISTANCE FROM INPUT TO STO
       000034
```

```
004674 110167          MOVB    %1,TESTFG
       004732
004700 060100 TRN1:    ADD     %1,%0           ;INCREMENT TO NEXT TEMPLATE
004702 020002          CMP     %0,%2           ;WHEN REACH LIMIT OF STOR. RESPO
004704 001362          BNE     TRN
004706 004767          JSR     7,CLSIFY        ;FIND  NEAREST TEMPLATE IN CT M
       001622
004712 105767          TSTB    TRNFLG
       004675
004716 001002          BNE     .+6
004720 004767          JSR     7,OUTPUT        ;DISPLAY SYSTEM RESPONSE
       003642

004724 000167          JMP     ATN             ;ADAPTIVE TRAINING NETWORK
       002220

004730 010046 TESTNG:  MOV     %0,-(6)         ;CLASSX MUST CONTAIN START OFFSE
004732 010146          MOV     %1,-(6)         ;THE STORED TEMPLATE AS A WORD
004734 010246          MOV     %2,-(6)         ;RELATIVE TO TMPSTR
004736 105767          TSTB    TESTFG
       004670
004742 001011          BNE     TST0
004744 012703          MOV     #CT,%3          ;SET CLASSIFICATION DISTANCE MAT
       015126
004750 012704          MOV     #CT+600.,%4
       016256
004754 012705          MOV     #77777,%5
       077777
004760 010523          MOV     %5,(3)+
004762 020304          CMP     %3,%4

                       PAGE    025

004764 001375          BNE     -4
004766 010005 TST0:    MOV     %0,%5
004770 005004          CLR     %4
004772 104402          DIV
004774 020401          CMP     %4,%1
004776 010402          MOV     %4,%2           ;INDEX TO CT MATRIX
005000 006302          ASL     %2      ;GET WORD ADDRESS
005002 005062          CLR     CT(2)
       015126

005006 012700          MOV     #TMPLAT+6,%0
       014274
005012 016703          MOV     CLASSX,%3
       004604
005016 062703          ADD     #TMPSTR+6,%3
       024164
005022 016704          MOV     TSTRI2,%4
       007224
005026 005005          CLR     %5
005030 012767          MOV     #1,C1CNTR       ;TST 1 THRU 8
       000001
```

```
                004566
005036 012701           MOV     #BITEST,%1      ;SEQUENCE OF 200,100,40,20,10,4,
       014220
005042 000404 TST1:     BR      .+10.           ;ELIMINATE LOOKING AT F'S ONLY W
005044 006367           ASL     AVGF1           ;PUSH MERGED VOICING BITS ONTOA
       007110
005050 006067           ROR     AVGF1+2
       007106
005054 131110           BITB    (1),(0)
005056 001406           BEQ     TST2
005060 131113           BITB    (1),(3)
005062 001017           BNE     TST5            ;OK VOICING BIT SET - PAS 5
005064 060403           ADD     %4,%3
005066 131113           BITB    (1),(3)
005070 001406           BEQ     TST4-2          ;FAIL
005072 000412           BR      TST4A           ;OK VOICING BIT SET - PASS 5
005074 131113 TST2:     BITB    (1),(3)
005076 001004           BNE     TST4
005100 060403           ADD     %4,%3
005102 131113           BITB    (1),(3)
005104 001415           BEQ     TST5A           ;OK
005106 160403           SUB     %4,%3
005110 066562 TST4:     ADD     AMWGTS(5),CT(2) ;FAIL
       015114
       015126
005116 000411           BR      TST6
005120 160403 TST4A:    SUB     %4,%3
005122 000407 TST5:     BR      TST6            ;ELIMINATE LOOKING AT F'S ONLY W
005124 020527           CMP     %5,#8.
       000010
005130 001004           BNE     TST6
005132 005267           INC     AVGF1
       007022
005136 000401           BR      TST6
005140 160403 TST5A:    SUB     %4,%3

                        PAGE    026

005142 005201 TST6:     INC     %1
005144 005201           INC     %1
005146 005267           INC     C1CNTR
       004452
005152 020127           CMP     %1,#BITEST+16.
       014240
005156 001331           BNE     TST1.
005160 005203           INC     %3
005162 005200           INC     %0
005164 026767           CMP     C1CNTR,TLNGTH
       004434
       006764
005172 001321           BNE     TST1-4
005174 066700           ADD     TSTR14,%0
       007054
005200 066703           ADD     TSTR14,%3
```

```
        007050
005204  005205          INC     %5
005206  005205          INC     %5
005210  020527          CMP     %5,#10          ;FIND DISTANCE FOR BINARY MEASUR
        000012
005214  001305          BNE     TST1-10
005216  016700          MOV     LENGTH,%0       ;R2 CONTAINS INDEX TO CT MATRIX
        006774
005222  006300          ASL     %0
005224  006300          ASL     %0
005226  016701          MOV     CLASSX,%1
        004370
005232  016105          MOV     TMPSTR+4(1),%5
        024162
                        .EOT
EOF ?
005236  042705          BIC     #176000,%5      ;STORED TEMPLATE TIME LENGTH (8.
        176000
005242  160005          SUB     %0,%5
005244  005705          TST     %5
005246  100001          BPL     .+4
005250  005405          NEG     %5
005252  104401          MUL
005254  020567          CMP     %5,TIMWGT       ;(T - T AVG) * WEIGHT FACTOR
        010776
005260  005004          CLR     %4
005262  104402          DIV
005264  020004          CMP     %0,%4           ;(T - T AVG) * (WEIGHT FACTOR/ T
005266  060462          ADD     %4,CT(2)        ;STORED IN CT MATRIX AS A B2 VAL
        015126
005272  005067          CLR     C2CNTR
        004330
005276  010267          MOV     %2,C1CNTR       ;NOW CALCULATE FORMANT DISTANCES
        004322
005302  012702          MOV     #177740,%2
        177740
005306  012700          MOV     #TMPLAT,%0
        014266
005312  066700          ADD     TSTORT,%0       ;END+2 OF TMPLAT FORMANTS
        006742
005316  012701          MOV     #TMPSTR,%1
        024156

                        PAGE    027

005322  066701          ADD     CLASSX,%1
        004274
005326  066701          ADD     TSTORT,%1       ;END+2 OF STORED TEMPLATE FORMAN
        006726
005332  012703          MOV     #1,%3
        000001
005336  014004  TST8:    MOV     -(0),%4
?005340 014105          MOV     -(1),%5
```

```
005342 000405          BR      .+12.    ;ELIMINATE LOOKING AT F'S ONLY DURING VO
005344 006367          ASL     AVGF1+2          ;IF CARRY SET, THEN VOICING SET
       006612
005350 006067          ROR     AVGF1            ;CODE FOR SPEED - POP 32 BIT VOI
       006604
005354 103041          BCC     TST10            ;VOICING BIT NOT SET, GO TO TST1
005356 040204          BIC     %2,%4
005360 040205          BIC     %2,%5            ;GET FORMANT 3
005362 160405          SUB     %4,%5
005364 100001          BPL     .+4
005366 005405          NEG     %5
005370 060567          ADD     %5,C2CNTR        ;SUMMATION
       004232
005374 011004          MOV     (0),%4
005376 011105          MOV     (1),%5
005400 104420          ASHC
005402 020427          CMP     %4,#-5           ;GET FORMANT 2
       177773
005406 040205          BIC     %2,%5
005410 040204          BIC     %2,%4
005412 160405          SUB     %4,%5
005414 100001          BPL     .+4
005416 005405          NEG     %5
005420 060567          ADD     %5,C2CNTR        ;SUMMATION
       004202
005424 011004          MOV     (0),%4
005426 011105          MOV     (1),%5
005430 104420          ASHC
005432 020427          CMP     %4,#-10.         ;GET FORMANT 1
       177766
005436 042704          BIC     #177700,%4
       177700
005442 042705          BIC     #177700,%5
       177700
005446 160405          SUB     %4,%5
005450 100001          BPL     .+4
005452 005405          NEG     %5               ;ABSOLUTE        VALUE
005454 060567          ADD     %5,C2CNTR        ;SUMMATION OF FORMANTS AT B2
       004146
005460 005203 TST10:   INC     %3
005462 020367          CMP     %3,TLNGTH
       006470
005466 001323          BNE     TST8
005470 016202          MOV     C1CNTR,%2
       004130
005474 066762          ADD     C2CNTR,CT(2)
       004126
       015126

                       PAGE    030

                                        ;CT MATRIX DIST. DONE FOR THIS S
005502 012602          MOV     (6)+,%2
*005504 012601         MOV     (6)+,%1
```

```
005506 012600           MOV     (6)+,%0
005510 000207           RTS     7

                                                ;MODIFICATION OF EXISTING OR NEW
                                                ;TEMPLATES - FROM ATN NETWORK

005512 016700 AVGIN:    MOV     CLASSX,%0
       004104
005516 016001           MOV     TMPSTR+2(0),%1  ;CLASS,VOUNVP
       024160
005522 105001           CLRB    %1
005524 000301           SWAB    %1
005526 016702           MOV     HOLDT+2,%2
       006740
005532 105002           CLRB    %2
005534 000302           SWAB    %2
005536 020102           CMP     %1,%2
005540 001414           BEQ     AVG0
005542 020127           CMP     %1,#177
       000177
005546 001401           BEQ      +4
005550 000000           HALT                    ;ERROR: SOFTWARE: WRONG TEMPLATE
005552 010060           MOV     %0,TMPSTR(0)
       024156
005556 000302           SWAB    %2
005560 042760           BIC     #177400,TMPSTR+2(0)
       177400
       024160
005566 060260           ADD     %2,TMPSTR+2(0)
       024150

005572 016001 AVG0      MOV     TMPSTR+4(0),%1  ;GET AVGCNT (0 TO 7)
       024162
005576 010103           MOV     %1,%3
005600 104410           ASH
005602 020127           CMP     %1,#-10
       177766
005606 042701           BIC     #177770,%1
       177770
005612 010167           MOV     %1,DIV1
       006362
005616 020127           CMP     %1,#7
       000007
005622 001004           BNE      +10
005624 005201           INC     %1
005626 010167           MOV     %1,DIV2
       006350
005632 000413           BR      AVG1
005634 005201           INC     %1
005636 010167           MOV     %1,DIV2
       006340
005642 104410           ASH
005644 020127           CMP     %1,#10
       000012
```

```
                        PAGE    031

005650 042760           BIC     #016000,TMPSTR+4(0)
       016000
       024162
005656 060160           ADD     %1,TMPSTR+4(0)  ;NEW AVGCNT (0 TO 7)
       024162
005662 042703 AVG1:     BIC     #176000,%3
       176000
005666 016704           MOV     HOLDT+4,%4
       006602
005672 042704           BIC     #176000,%4
       176000
005676 104401           MUL
005700 020367           CMP     %3,DIV1
       006274
005704 060403           ADD     %4,%3
005706 006303           ASL     %3
005710 005002           CLR     %2
005712 104402           DIV
005714 020267           CMP     %2,DIV2
       006262
005720 005202           INC     %2
005722 006202           ASR     %2
005724 042760           BIC     #001777,TMPSTR+4(0)     ;CLEAR TIME STORAGE
       001777
       024162
005732 060260           ADD     %2,TMPSTR+4(0)          ;NEW AVERAGE TIME LENGTH
       024162

005736 062700 AVG2:     ADD     #TMPSTR+6,%0
       024164
005742 012701           MOV     #HOLDT+6,%1             ;BEGINNINGS OF BINARY BC
       014476
005746 005067           CLR     C2CNTR                  ;SUCCESSIVE BIT LOC OF T
       001654
005752 012767 AVG3:     MOV     #1,C1CNTR
       000001
       003644
005760 012702 AVG4:     MOV     #BITEST,%2
       014220
005764 016704 AVG6:     MOV     TSTR12,%4
       006262
005770 005003           CLR     %3
005772 106303           ASLB    %3
005774 131211           BITB    (2),(1)
005776 001401           BEQ     .+4
006000 105203           INCB    %3
006002 106303           ASLB    %3
006004 060401           ADD     %4,%1
006006 131211           BITB    (2),(1)
006010 001401           BEQ     .+4
006012 105203           INCB    %2
```

```
006014 106303          ASLB    %3
006016 060401          ADD     %4,%1
006020 131211          BITB    (2),(1)
006022 001401          BEQ      +4
006024 105203          INCB    %3

                       PAGE    032

006026 000303          SWAB    %3
006030 106303          ASLB    %3                      ;USE OTHER BYTE FOR STOR
006032 131210          BITB    (2),(0)
006034 001401          BEQ      +4
006036 105203          INCB    %3
006040 106303          ASLB    %3
006042 060400          ADD     %4,%0
006044 131210          BITB    (2),(0)
006046 001401          BEQ      +4
006050 105203          INCB    %3
006052 106303          ASLB    %3
006054 060400          ADD     %4,%0
006056 131210          BITB    (2),(0)
006060 001401          BEQ      +4
006062 105203          INCB    %3
006064 110305          MOVB    %3,%5
006066 105003          CLRB    %3
006070 000303          SWAB    %3
006072 164401          MUL
006074 020567          CMP     %5,DIV1
       006100
006100 060305          ADD     %3,%5
006102 005004          CLR     %4
006104 006305          ASL     %5                      ;1 BIT PRECISION
006106 104402          DIV
006110 020467          CMP     %4,DIV2                 ;(Y # AVG + INPUT)/ (N+1
       006066
006114 005204          INC     %4
006116 006204          ASR     %4                      ;AT B2 IN REG 4
006120 166701          SUB     TSTR14,%1               ;BACK AT FIRST BINARY BI
       006130
006124 016705          MOV     TSTR12,%5
       006122
006130 006004          ROR     %4
006132 103002          BCC      .+6.
006134 151210          BISB    (2),(0)
006136 000401          BR       .+4
006140 141210          BICB    (2),(0)
006142 160500          SUB     %5,%0
006144 006004          ROR     %4
006146 103002          BCC      .+6.
006150 151210          BISB    (2),(0)
006152 000401          BR       .+4
006154 141210          BICB    (2),(0)
006156 160500          SUB     %5,%0                   ;BACK AT FIRST BINARY BI
006160 006004          ROR     %4
```

```
006324 040204           BIC     %2,%4           ;F3 SET UP - INPUT
006326 040205           BIC     %2,%5           ;F3 SET UP - STORED
006330 104401           MUL
006332 020567           CMP     %5,DIV1
       005642
006336 060405           ADD     %4,%5
006340 005004           CLR     %4
006342 006305           ASL     %5
006344 104402           DIV
006346 020467           CMP     %4,DIV2
       005630
006352 005204           INC     %4
006354 006204           ASR     %4              ;ROUNDED AVERAGE
006356 042710           BIC     #037,(0)
       000037
006362 060410           ADD     %4,(0)          ;F3 AVERAGED

                        PAGE    034

006364 011005           MOV     (0),%5
006366 011104           MOV     (1),%4
006370 104420           ASHC
006372 020427           CMP     %4,#-5          ;R4 AND R5 W/ F2 RIGHT JUSTIFIED
       177773
006376 040204           BIC     %2,%4
006400 040205           BIC     %2,%5
006402 104401           MUL
006404 020567           CMP     %5,DIV1
       005570
006410 060405           ADD     %4,%5
006412 005004           CLR     %4
006414 006305           ASL     %5
006416 104402           DIV
006420 020467           CMP     %4,DIV2
       005556
006424 005204           INC     %4
006426 006204           ASR     %4              ;ROUNDED AVERAGE
006430 104410           ASH
006432 020427           CMP     %4,#5
       000005
006436 042710           BIC     #01740,(0)
       001740
006442 060410           ADD     %4,(0)
006444 011005           MOV     (0),%5
006446 011104           MOV     (1),%4
006450 104420           ASHC
006452 020427           CMP     %4,#-10.        ;R4 AND R5 W/ F1 SHIFTED RIGHT
       177766
006456 040304           BIC     %3,%4
006460 040305           BIC     %3,%5
006462 104401           MUL
006464 020567           CMP     %5,DIV1
       005510
006470 060405           ADD     %4,%5
```

```
006634 000305          SWAB    %5
006636 010561          MOV     %5,AHAVH(1)      ;CLASS NO
       013322
                       ;
006642 105767          TSTB    DFLAG            ;DISTANCE MODE WHEN DFLAG SET
       015276
006646 001532          BEQ     CLS8
006650 010046          MOV     %0,-(6)
006652 010504          MOV     %5,%4
006654 104401          MUL
006656 020527          CMP     %5,#10.
       000012
006662 062705          ADD     #VOCAB,%5
       021372
006666 010502          MOV     %5,%2
006670 062702          ADD     #10.,%2
       000012
006674 012500 CLS3:    MOV     (5)+,%0
006676 105700          TSTB    %0
006700 001002          BNE     .+6
006702 112700          MOVB    #40,%0
       000040
006706 004767          JSR     7,TYPO
       001146
006712 000300          SWAB    %0

                       PAGE    036

006714 105700          TSTB    %0
006716 001002          BNE     .+6
006720 112700          MOVB    #40,%0
       000040
006724 004767          JSR     7,TYPO
       001130
006730 020502          CMP     %5,%2
006732 001360          BNE     CLS3             ;CLASS
006734 012700          MOV     #40,%0
       000040
006740 005002          CLR     %2
006742 004767          JSR     7,TYPO
       001112
006746 005202          INC     %2
006750 020227          CMP     %2,#10.
       000012
006754 001372          BNE     .-10             ;10 BLANKS
006756 006303          ASL     %3
006760 005005          CLR     %5
006762 005002 CLS4:    CLR     %2
006764 104420          ASHC
006766 020227          CMP     %2,#3
       000003
006772 062702          ADD     #60,%2
       000060
```

```
006472 005004          CLR     %4
006474 006305          ASL     %5
006476 104402          DIV
006500 020467          CMP     %4,DIV2
       005476
006504 005204          INC     %4
006506 006204          ASR     %4                ;ROUNDED AVERAGE
006510 104410          ASH
006512 020427          CMP     %4,#10.
       000012
006516 042710          BIC     #176000,(0)
       176000
006522 060410          ADD     %4,(0)            ;F1 AVERAGED
006524 026701          CMP     DIV3,%1
       005454
006530 001273          BNE     AVG20
                                                 ;THE AVERAGE PROCESS IS DONE IN
006532 000207          RTS     7                 ;TO RETURN AT LAST!
                                                 ;
006534 016700 CLSIFY:  MOV     NOT,%0  ;END OF CT BUFFER
       006302

                       PAGE    035

006540 062700          ADD     #CT,%0
       015126
006544 005001          CLR     %1                ;COUNTER FROM 0 TO 10.
006546 005002 CLS1:    CLR     %2        ;COUNTER FROM 0 TO 199 TEMPLATES
006550 012704          MOV     #CT,%4
       015126
006554 012703          MOV     #077777,%3
       077777
006560 020324 CLS2:    CMP     %3,(4)+           ;WHEN DONE TOP 10. TEMPLATE INDE
006562 100405          BMI     .+12.             ;AND TOP 10. CLASSES IN AHAVH
006564 010405          MOV     %4,%5             ;WINNER ADDRESS = AGAL
006566 010261          MOV     %2,AGAL(1)        ;WINNER CLASS = AHAVH
       012502
006572 014403          MOV     -(4),%3
006574 005724          TST     (4)+
006576 005202          INC     %2
006600 020400          CMP     %4,%0
006602 001366          BNE     CLS2
006604 012745          MOV     #077777,-(5)
       077777
006610 016105          MOV     AGAL(1),%5
       012502
006614 104401          MUL
006616 020567          CMP     %5,TSTART
       005436
006622 010561          MOV     %5,AGAL(1)        ;INDEX TO TEMPLATE
       012502
006626 016505          MOV     TMPSTR+2(5),%5    ;CLASS
       024160
006632 105005          CLRB    %5
```

```
006776 010200          MOV     %2,%0
007000 004767          JSR     7,TYPO
       001054
007004 005205          INC     %5
007006 020527          CMP     %5,#5
       000005
007012 001363          BNE     CLS4            ;DISTANCE
007014 012700          MOV     #40,%0
       000040
007020 005002          CLR     %2
007022 004767          JSR     7,TYPO
       001032
007026 005202          INC     %2
007030 020227          CMP     %2,#10.
       000012
007034 001372          BNE     .-10.           ;10 BLANKS
007036 116400          MOVB    NOPPC(4),%0
       014672
007042 062700          ADD     #60,%0
       000060
007046 004767          JSR     7,TYPO          ;NUMBER OF TEMPLATES IN THAT CLA
       001006
007052 012700          MOV     #40,%0
       000040
007056 005002          CLR     %2
007060 004767          JSR     7,TYPO
       000774
007064 005202          INC     %2
007066 020227          CMP     %2,#10.
       000012
007072 001372          BNE     .-10.           ;10 BLANKS

                       PAGE    037

007074 016105          MOV     AGAL(1),%5
       012502
007100 016500          MOV     TMPSTR+4(5),%0
       024162
007104 104410          ASH
007106 020027          CMP     %0,#-10.
       177766
007112 042700          BIC     #177770,%0
       177770
007116 062700          ADD     #60,%0
       000060
007122 004767          JSR     7,TYPO
       000732
007126 004767          JSR     7,CRLF
       000774
007132 012600          MOV     (6)+,%0
007134 005201 CLS8:    INC     %1
007136 005201          INC     %1
007140 020127          CMP     %1,#20.
       000024
```

```
007144 001200           BNE     CLS1
007146 000207           RTS     7               ;RETURN WITH TOP 10 WINNERS IN C
                                                ;
007150 105767 ATN:      TSTB    ATNFG           ;ADAPTIVE TRAINING NETWORK
       002455
007154 001402           BEQ     .+6             ;IF ATNFG SET, THEN ATN ENABLED
007156 000167           JMP     ATN34
       000632
007162 005000           CLR     %0
007164 105767           TSTB    TRNFLG
       002423
007170 001404           BEQ     ATN2            ;NOT TRAINING, ASSUME CORRECT RE
007172 126767 ATN1:     CMPB    CLASS,AHAVH
       002422
       004122
007200 001013           BNE     ATN4            ;CORRECT CLASS NOT CHOSEN
007202 016067 ATN2:     MOV     AGAL(0),TINDX1  ;INDEX TO STORED TEMPLATE
       012502
       004734
007210 000367           SWAB    TMPLAT+2
       005054
007214 116067           MOVB    AHAVH(0),TMPLAT+2
       013322
       005046
007222 000367           SWAB    TMPLAT+2                ;CORRECT CLASS I.D.
       005042
007226 000577           BR      ATN20
007230 026727 ATN4:     CMP     RNOT,#150       ;PENALIZE TEMPLATES WHICH CREATE
       005030
       000150
007236 100453           BMI     ATN4B
007240 105767           TSTB    RPTFLG  ;DO NOT PENALIZE ANY TEMPLATE IN THIS MO
       002372
007244 001050           BNE     ATN4B
007246 016001           MOV     AGAL(0),%1
       012502

                        PAGE    040

007252 016103           MOV     TMPSTR+4(1),%3
       024162
007256 104410           ASH
007260 020327           CMP     %3,#-10.
       177766
007264 042703           BIC     #177770,%3
       177770
007270 005303           DEC     %3
007272 005703           TST     %3
007274 001024           BNE     ATN4A
007276 016102           MOV     TMPSTR+2(1),%2  ;GET CLASS
       024160
007302 105002           CLRB    %2
007304 000302           SWAB    %2
```

```
006162 103002          BCC     .+6.
006164 151210          BISB    (2),(0)
006166 000401          BR      .+4
006170 141210          BICB    (2),(0)
                                                ;ONE BINARY DECISION IS
006172 005202          INC     %2
006174 005202          INC     %2
006176 005267          INC     C1CNTR
       003422
006202 022702          CMP     #BITEST+16.,%2
       014240

                       PAGE    033

006206 001366          BNE     AVG6
006210 005200          INC     %0
006212 005201          INC     %1
006214 026767          CMP     C1CNTR,TLNGTH
       003404
       005724
006222 001256          BNE     AVG4
006224 066700          ADD     TSTRI4,%0
       006024
006230 066701          ADD     TSTRI4,%1               ;PICK UP NEXT MEASURE
       006020
006234 005267          INC     C2CNTR
       003366
006240 026727          CMP     C2CNTR,#5
       003362
       000005
006246 001241          BNE     AVG3
                                                ;ALL BINARY DATA NOW AVE
006250 016700          MOV     CLASSX,%0
       003346
006254 062700          ADD     #TMPSTR,%0
       024156
006260 066700          ADD     TSTORT,%0       ;END+2 OF FORMANT DATA - STORED
       005774
006264 012701          MOV     #HOLDT,%1
       014470
006270 066701          ADD     TSTORT,%1       ;END+2 OF FORMANT DATA - INPUT T
       005764
006274 012702          MOV     #177740,%2
       177740
006300 012703          MOV     #177700,%3
       177700
006304 012767          MOV     #HOLDT,DIV3
       014470
       005672
006312 066767          ADD     TSTORF,DIV3
       005740
       005664
006320 014005 AVG20:   MOV     -(0),%5         ;CODE FOR SPEED
006322 014104          MOV     -(1),%4
```

```
007306 126227          CMPB    NOPPC(2),#1      ;ONLY   ONE TEMPLATE COVERING TH
       014672
       000001
007314 001414          BEQ     ATN4A            ;YES
007316 005367          DEC     RNOT
       004742
007322 105362          DECB    NOPPC(2)
       014672
007326 012761          MOV     #177777,TMPSTR(1)        ;BAD TEMPLATE ELIMINATED
       177777
       024156
007334 012761          MOV     #77400,TMPSTR+2(1)
       077400
       024160
007342 005061          CLR     TMPSTR+4(1)
       024162
007346 104410 ATN4A:   ASH
007350 020327          CMP     %3,#10.
       000012
007354 042761          BIC     #16000,TMPSTR+4(1)
       016000
       024162
007362 060361          ADD     %3,TMPSTR+4(1)
       024162
007366 126760 ATN4B:   CMPB    CLASS,AHAVH(0)
       002226
       013322
007374 001702          BEQ     ATN2             ;CHOSEN CLASS IN TOP 10 OF CT MA
007376 005200          INC     %0
007400 005200          INC     %0
007402 020027          CMP     %0,#20.
       000024
007406 001367          BNE     ATN4B
007410 005000 ATN5:    CLR     %0               ;INPUT CLASS NOT IN TOP 10 OF CT
007412 016701          MOV     TSTORT,%1
       004642
007416 016702          MOV     LIMIT,%2
       005416
007422 005760 ATN6:    TST     TMPSTR(0)        ;CHECK FOR 177777= EMPTY BLOCK
       024156
007426 100461          BMI     ATN12            ;FOUND EMPTY BLOCK OF TEMPLATE S
007430 060100          ADD     %1,%0

                       PAGE    041

007432 020002          CMP     %0,%2
007434 001372          BNE     ATN6
007436 005001          CLR     %1               ;NO EMPTY STORAGE AVAILABLE
007440 005003          CLR     %3               ;ELIMINATE LEAST USED TEMPLATE F
007442 126103 ATN8:    CMPB    NOPPC(1),%3      ;THE CLASS W/ THE GREATEST COVER
       014672
007446 100403          BMI     .+8.
007450 010102          MOV     %1,%2
007452 116103          MOVB    NOPPC(1),%3
```

```
        014672
007456  005201          INC     %1
007460  020127          CMP     %1,#144
        000144
007464  001366          BNE     ATN8            ;FINDCLASS W/ GREATEST NO. OF TE
007466  105362          DECB    NOPPC(2)        ;ELIMINATE A TEMPLATE FROM THAT
        014672
007472  005367          DEC     RNOT
        004566
007476  005001          CLR     %1
007500  012700          MOV     #8.,%0
        000010
007504  016103 ATN9:    MOV     TMPSTR+2(1),%3  ;TEMPLATE CLASS
        024160
007510  105003          CLRB    %3
007512  000303          SWAB    %3
007514  020203          CMP     %2,%3           ;CLASS MATCH ?
007516  001014          BNE     ATN10           ;NO
007520  016103          MOV     TMPSTR+4(1),%3
        024162
007524  104410          ASH
007526  020327          CMP     %3,#-10.
        177766
007532  042703          BIC     #177770,%3
        177770
007536  020300          CMP     %3,%0           ;FIND GREATEST AVGCNT
007540  100003          BPL     .+8.
007542  010167          MOV     %1,AGAL+40.     ;TEMPLATE INDEX
        003004
007546  010300          MOV     %3,%0
007550  066701 ATN10:   ADD     TSTORT,%1
        004504
007554  020167          CMP     %1,LIMIT
        005260
007560  001351          BNE     ATN9
007562  016700          MOV     AGAL+40.,%0     ;TEMPLATE RENEWAL
        002764
007566  005060          CLR     TMPSTR+4(0)
        024162
007572  010067 ATN12:   MOV     %0,TINDX1       ;SET INDEX TO EMPTY BLOCK
        004346
007576  116701          MOVB    CLASS,%1
        002016
007602  105261          INCB    NOPPC(1)        ;NUMBER OF TEMPLATES PER CLASS
        014672
007606  010060          MOV     %0,TMPSTR(0)
        024156

                        PAGE    042

007612  010160          MOV     %1,TMPSTR+2(0)
        024160
007616  000360          SWAB    TMPSTR+2(0)     ;SET CLASS FOR CORRESPONDENCE
        024160
```

```
010304 000207            RTS     7
010306    122 REPEET:    .ASCII  /REPEAT/
010307    105
010310    120
010311    105
010312    101
010313    124
010314 012702 OVRFLW:    MOV     #OVER,%2
       010336
010320 012701            MOV     #OVER+28.,%1
       010372

                         PAGE    045

010324 005067            CLR     C1CNTR
       001274
010330 005067            CLR     C2CNTR
       001272
010334 000733            BR      REPEAT+8.
010336    111 OVER:      .ASCII  /INTERRUPT STORAGE OVERFLOW  /
010337    116
010340    124
010341    105
010342    122
010343    122
010344    125
010345    120
010346    124
010347    040
010350    123
010351    124
010352    117
010353    122
010354    101
010355    107
010356    105
010357    040
010360    117
010361    126
010362    105
010363    122
010364    106
010365    114
010366    117
010367    127
010370    040
010371    040
010372 016700 DELETE:    MOV     TINDX1,%0
       003546
010376 005760            TST     TMPSTR+4(0)
       024162
010402 001016            BNE     .+30.           ;AVGCNT .GT. 0
010404 012760            MOV     #177777,TMPSTR(0)       ;DESTROY TEMPLATE SETUP
       177777
```

```
        024156
010412  016001          MOV     TMPSTR+2(0),%1
        024160
010416  105001          CLRB    %1
010420  000301          SWAB    %1
010422  012760          MOV     #77400,TMPSTR+2(0)
        077400
        024160
010430  005367          DEC     RNOT
        003630
010434  105361          DECB    NOPPC(1)
        014672
010440  012767          MOV     #177777,TINDX2          ;DO NOT AVERASGE IN
        177777
        003500
010446  012767          MOV     #177777,TINDX1
        177777
        003470

                        PAGE    046

010454  012767          MOV     #177777,TINDX3
        177777
        003466
010462  012702          MOV     #DEL,%2
        010560
010466  012701          MOV     #DEL+6.,%1
        010566
010472  012200          MOV     (2)+,%0
010474  004767          JSR     7,TYPO
        177360
010500  000300          SWAB    %0
010502  004767          JSR     7,TYPO
        177352
010506  020201          CMP     %2,%1
010510  001370          BNE     -14
010512  105767          TSTB    TRNFLG
        001075
010516  001414          BEQ     DELET5
010520  105767          TSTB    RPTFLG
        001112
010524  001011          BNE     DELET5
010526  105767          TSTB    CLASS
        001066
010532  001004          BNE     .+10.
010534  112767          MOVB    #143,CLASS
        000143
        001056
010542  000402          BR      DELET5
010544  105367          DECB    CLASS
        001050
010550  004767  DELET5: JSR     7,RESET
        010546
010554  000167          JMP     ENTER2
```

```
        170424
010560      104 DEL:    .ASCII  /DELETE/
010561      105
010562      114
010563      105
010564      124
010565      105
010566 105767 OUTPUT: TSTB     DFLAG
        013352
010572 001401         BEQ      .+4
010574 000207         RTS      7
010576 010046         MOV      %0,-(6)
010600 010146         MOV      %1,-(6)
010602 010246         MOV      %2,-(6)
010604 005067         CLR      COUNT+2
        013340
010610 105767         TSTB     SENFG2
        001020
010614 001006         BNE      OUTPT2
010616 012700         MOV      #31,%0
        000031
010622 004767         JSR      7,TYPO
        177232

                      PAGE     047

010626 004767         JSR      7,DELAY
        177334
010632 016701 OUTPT2: MOV      AHAVH,%1
        002464
010636 105767         TSTB     NUMFLG
        013176
010642 001413         BEQ      OUTPT3
010644 012700         MOV      #DIGITS,%0
        024044
010650 012702         MOV      #DIGITS+40.,%2
        024114
010654 006301         ASL      %1
010656 026120         CMP      HASH(1),(0)+
        023510
010662 001423         BEQ      OUTPT6-2
010664 020002         CMP      %0,%2
010666 001373         BNE      .-8.
010670 006201         ASR      %1
010672 105767 OUTPT3: TSTB     SENFG1
        000735
010676 001416         BEQ      OUTPT6
010700 012702         MOV      #SPCWRD,%2
        024114
010704 012703         MOV      #SPCWRD+6,%3
        024122
010710 006301         ASL      %1
010712 026122         CMP      HASH(1),(2)+
        023510
```

```
010144 000207          RTS     7
010146 012700 CRLF30:  MOV     #105215,%0
       105215

                       PAGE    044

010152 004767          JSR     7,LA30
       177656
010156 000300          SWAB    %0
010160 004767          JSR     7,LA30
       177650
010164 000207          RTS     7
010166 010046 DELAY:   MOV     %0,-(6)
010170 010146          MOV     %1,-(6)
010172 005000          CLR     %0
                       .EOT

EOF ?
010174 012701          MOV     #02000,%1
       002000
010200 005200          INC     %0
010202 020001          CMP     %0,%1
010204 001375          BNE     .-4
010206 012601          MOV     (6)+,%1
010210 012600          MOV     (6)+,%0
010212 000207          RTS     7
010214 012702 REPEAT:  MOV     #REPEET,%2
       010306
010220 012701          MOV     #REPEET+6.,%1
       010314
010224 012200          MOV     (2)+,%0
010226 004767          JSR     7,TYPO
       177626
010232 000300          SWAB    %0
010234 004767          JSR     7,TYPO
       177620
010240 020201          CMP     %2,%1
010242 001370          BNE     .-14.
010244 112767          MOVB    #7,REPTFG
       000007
       001370
010252 010046 LDELAY:  MOV     %0,-(6)
010254 005000          CLR     %0
010256 017777          MOV     @HASHNG,@HASHNG
       013550
       013546
010264 017777          MOV     @HASHNG,@HASHNG
       013542
       013540
010272 005200          INC     %0
010274 020027          CMP     %0,#40000
       040000
010300 001366          BNE     .-18.
010302 012600          MOV     (6)+,%0
```

```
011400 052777          BIS     #071000,@HAPM1  ;DIVIDE INST NOW SET UP
       071000
       177674
011406 012777          MOV     #0400,@HAPM2    ;REPLACE TRAP W/ BR .+2
       000400
       177664
011414 000002          RTI
011416 032777 HAP4:    BIT     #4,@HAPM2
       000004
       177654
011424 001401          BEQ     HAP8
011426 000000          HALT                    ;SOFTWARE ERROR - NO SOB EMULATION
011430 032777 HAP8:    BIT     #8.,@HAPM2
       000010
       177642
011436 001412          BEQ     HAP16
011440 042777          BIC     #170000,@HAPM1
       170000
       177634
011446 052777          BIS     #072000,@HAPM1  ;ASH INST NOW SET UP
       072000
       177626
011454 012777          MOV     #0400,@HAPM2    ;REPLACE TRAP W/ BR .+2
       000400
       177616
011462 000002          RTI
011464 032777 HAP16:   BIT     #16.,@HAPM2
       000020
       177606
011472 001412          BEQ     HAP32
011474 042777          BIC     #170000,@HAPM1
       170000
       177600
011502 052777          BIS     #073000,@HAPM1  ;ASHC INST NOE SET UP
       073000
       177572
011510 012777          MOV     #0400,@HAPM2    ;REPLACE TRAP W/ BR .+2
       000400
       177562
011516 000002          RTI
011520 032777 HAP32:   BIT     #32.,@HAPM2
       000040
       177552
011526 001412          BEQ     HAP64
011530 042777          BIC     #170000,@HAPM1
       170000
       177544

                       PAGE    053

011536 052777          BIS     #074000,@HAPM1
       074000
       177536
011544 012777          MOV     #0400,@HAPM2
```

```
010716 001441           BEQ     SPCHAR
010720 020203           CMP     %2,%3
010722 001373           BNE     .-8.
010724 105767           TSTB    NUMFLG
       013110
010730 001030           BNE     OUTPT9
010732 006201           ASR     %1
010734 104401 OUTPT6:   MUL
010736 020127           CMP     %1,#10.
       000012
010742 010102           MOV     %1,%2
010744 062702           ADD     #10.,%2
       000012
010750 016100           MOV     VOCAB(1),%0
       021372
010754 004767           JSR     7,TYPO
       177100.
010760 000300           SWAB    %0
010762 004767           JSR     7,TYPO
       177072
010766 005201           INC     %1
010770 005201           INC     %1
010772 020102           CMP     %1,%2
010774 001365           BNE     .-20.
010776 012700           MOV     #40,%0
       000040
011002 004767           JSR     7,TYPO
       177052

                        PAGE    050

011006 004767           JSR     7,TYPO
       177046
011012 012602 OUTPT9:   MOV     (6)+,%2
011014 012601           MOV     (6)+,%1
011016 012600           MOV     (6)+,%0
011020 000207           RTS     7
011022 162702 SPCHAR:   SUB     #SPCWRD+2,%2
       024116
011026 016200           MOV     SPCSYM(2),%0
       024122
011032 004767           JSR     7,TYPO
       177022
011036 000300           SWAB    %0
011040 004767           JSR     7,TYPO
       177014
011044 012700           MOV     #11.%0
       000011
011050 004767           JSR     7,TYPO
       177004
011054 004767           JSR     7,TYPO
       177000
011060 020227           CMP     %2,#2
       000002
```

```
007622 005267          INC     RNOT
       004436
007626 004767 ATN20:   JSR     7,KEYWORD       ;SEE IF INPUT IS A KEYWORD
       010750
007632 016767          MOV     TINDX1,TINDX3
       004306
       004310
007640 116767          MOVB    AHAVH,TCLASS    ;USE FOR VOICED ERROR CORRECTION
       003456
       001771
007646 105767          TSTB    KEYFLG
       001763
007652 001060          BNE     ATN34
007654 105767          TSTB    ADDFLG
       001760
007660 001402          BEQ     .+6
007662 000167          JMP     ATN4
       177342
007666 005767          TST     TINDX2
       004254
007672 100405          BMI     ATN30           ;DO NOT AVERAGE HOLDT TEMPLATE I
007674 016767          MOV     TINDX2,CLASSX   ;SETUP FOR AVGIN ROUTINE
       004246
       001720
007702 004767          JSR     7,AVGIN         ;AVG TEMPLATE IN
       175604
007706 016767 ATN30:   MOV     TINDX1,TINDX2   ;PUSH NEW WORD ONTO HOLDT STACK
       004232
       004232
007714 012700          MOV     #TMPLAT,%0
       014266
007720 010001          MOV     %0,%1
007722 066701          ADD     TSTORT,%1
       004332
007726 012702          MOV     #HOLDT,%2
       014470
007732 012022          MOV     (0)+,(2)+
007734 020001          CMP     %0,%1
007736 001375          BNE     .-4
007740 012704          MOV     #TEMP+20.,%4
       015070
007744 012703          MOV     #TEMP,%3
       015044
007750 012700          MOV     #AHAVH,%0
       013322
007754 012701          MOV     #AGAL,%1
       012502
007760 012702          MOV     #AGAL+20.,%2
       012526
007764 012023          MOV     (0)+,(3)+
007766 012124          MOV     (1)+,(4)+
007770 020201          CMP     %2,%1

                       PAGE    043
```

```
011064 001411          BEQ     SPCHR6
011066 005702          TST     %2
011070 001403          BEQ     .+8.
011072 105067          CLRB    SENFG2
       000536
011076 000403          BR      .+8.
011100 112767          MOVB    #7,SENFG2
       000007
       000526
011106 000741          BR      OUTPT9
011110 012767 SPCHR6:  MOV     #101,CRTKS
       000101
       165362
011116 112767          MOVB    #16,SENFG2
       000016
       000510
011124 012700          MOV     #020010,%0
       020010
011130 004767          JSR     7,TYPO
       176724
011134 000300          SWAB    %0
011136 004767          JSR     7,TYPO
       176716
011142 000300          SWAB    %0
011144 004767          JSR     7,TYPO
       176710
011150 012700          MOV     #134,%0
       000134
011154 004767          JSR     7,TYPO
       176700
011160 012700          MOV     #10,%0
       000010
011164 004767          JSR     7,TYPO
       176670

                       PAGE    051

011170 004767          JSR     7,TYPO
       176664
011174 012700          MOV     #02,%0
       000002
011200 004767          JSR     7,TYPO          ;EOM,BACKUP ONE,TRANSMIT
       176654
011204 000001          WAIT
011206 016700          MOV     ICNTR1,%0
       012262
011212 005300          DEC     %0
011214 062700          ADD     #INPUT0,%0
       023424
011220 122710          CMPB    #40,(0) ;FIND LAST BLANK
       000040
011224 001410          BEQ     SPCHR7          ;FOUND IT
011226 012700          MOV     #4040,%0        ;NOT YET
       004040
```

```
011232 004767          JSR     7,TYPO
       176622
011236 000300          SWAB    %0
011240 004767          JSR     7,TYPO          ;PUT BLANK IN PLACE OF EOM
       176614
011244 000721          BR      SPCHR6          ;LEFT ARROW AND BLANK
011246 012700 SPCHR7:  MOV     #4040,%0
       004040
011252 004767          JSR     7,TYPO
       176602
011256 000300          SWAB    %0
011260 004767          JSR     7,TYPO
       176574
011264 004767          JSR     7,RESET
       010032
011270 112767          MOVB    #7,SENFG2
       000007
       000336
011276 000645          BR      OUTPT9
011300 000000 HAPM2:   0
011302 000000 HAPM1:   0
011304 011667 HAP:     MOV     (6),HAPM1       ;GET PC
       177772
011310 016767          MOV     HAPM1,HAPM2
       177766
       177762
011316 005367          DEC     HAPM2
       177756
011322 005367          DEC     HAPM2
       177752
011326 032777          BIT     #1,@HAPM2
       000001
       177744
011334 001412          BEQ     HAP2
011336 042777          BIC     #170000,@HAPM1
       170000
       177736
011344 052777          BIS     #070000,@HAPM1  ;MUL INST NOW SET UP
       070000
       177730

                       PAGE    052

011352 012777          MOV     #0400,@HAPM2    ;REPLACE TRAP W/ BR +2
       000400
       177720
011360 000002          RTI
011362 032777 HAP2:    BIT     #2,@HAPM2
       000002
       177710
011370 001412          BEQ     HAP4
011372 042777          BIC     #170000,@HAPM1
       170000
       177702
```

```
007772 001374          BNE     .-6
007774 005001          CLR     %1
007776 012700 ATN32:   MOV     #040,%0
       000040
010002 004767          JSR     7,TYPO
       000052
010006 000300          SWAB    %0
010010 004767          JSR     7,TYPO
       000044
010014 105067 ATN34:   CLRB    SPKOUT
       001576
010020 105067          CLRB    SPCHFG
       001566
010024 105067          CLRB    CRTOUT
       001565
010030 000167          JMP     ENTER1          ;ATN TASK IS COMPLETE
       171122
010034 105767 LA30:    TSTB    TPS     ;*******BEGINNING OF INPUT OUTPUT COMMON
       167524
010040 100375          BPL     LA30
010042 105700          TSTB    %0
010044 001002          BNE     .+6
010046 112700          MOVB    #40,%0
       000040
010052 110067          MOVB    %0,TPB
       167510
010056 000207          RTS     7
010060 105767 TYPO:    TSTB    CRTPS
       166420
010064 100375          BPL     TYPO
010066 005267          INC     COUNT+2
       014056
010072 105767          TSTB    DISFG
       001543
010076 001410          BEQ     .+18.
010100 122700          CMPB    #54,%0  ;COMMA
       000054
010104 001005          BNE     .+12.
010106 016767          MOV     COUNT+2,COUNT
       014036
       014032
010114 112700          MOVB    #40,%0  ;BLANK
       000040
010120 110067          MOVB    %0,CRTPB
       166362
010124 000207          RTS     7
010126 012700 CRLF:    MOV     #105215,%0
       105215
010132 004767          JSR     7,TYPO
       177722
010136 000300          SWAB    %0
010140 004767          JSR     7,TYPO
       177714
```

```
        000400
        177526
011552  000002          RTI
011554  032777  HAP64:  BIT     #64.,@HAPM2
        000100
        177516
011562  001412          BEQ     HAP128
011564  042777          BIC     #177700,@HAPM1
        177700
        177510
011572  052777          BIS     #06700,@HAPM1
        006700
        177502
011600  012777          MOV     #0400,@HAPM2
        000400
        177472
011606  000002          RTI
011610  000000  HAP128: HALT            ;SOFTWARE ERROR - NO SUCH TRAP AVAILABLE
                        ;
                        ;
011612      000 SPCHFG: .BYTE   0
011613      000 TRNFLG: .BYTE   0
011614      000 DISFLG: .BYTE   0
011615      000 CRTOUT: .BYTE   0
011616      000 SPKOUT: .BYTE   0
011617      000 NXTWRD: .BYTE   0
011620      000 CLASS:  .BYTE   0
011621      000 DLETFG: .BYTE   0
011622  000000 CLASSX: .WORD    0
011624  000000 C1CNTR: .WORD    0       ;*****BEGINNING OF STORAGE FOR ANALYZER
011626  000000 C2CNTR: .WORD    0
011630      000 C2FLAG: .BYTE   0
011631      000 ATNFG:  .BYTE   0
011632      000 TESTFG: .BYTE   0
011633      000 SENFG1: .BYTE   0
011634      000 SENFG2: .BYTE   0
011635      000 KEYFLG: .BYTE   0
011636      000 RPTFLG: .BYTE   0
011637      000 TCLASS: .BYTE   0
011640      000 ADDFLG: .BYTE   0
011641      000 DISFG:  .BYTE   0       ;UTILIZED FOR DISPLAY OF SYSTEM MODES
011642      000 REPTFG: .BYTE   0       ;WHEN SET, INPUT WOTD TOO SHORT OR TOO L
011643      000 VFLAG:  .BYTE   0       ;USED IN DR11C2 FERT SECTION
        011644          .EVEN
011644  000000 UNVCTR: 0        ;USED IN DR11C2 FERT SECTION    - NO. OF UNVOICE
011646  000170 MINLNG: .WORD    120.
011650  000620 MAXLNG: .WORD    400.
011652  000000 TRNSAV: .WORD    0,0
011654  000000
011656  000000 ITERAT: 0
011660      000 CHKFG1: .BYTE   0
        011662          .EVEN

                        PAGE    054
```

```
011662 000000 WVF123: 0                       ;200 WORDS OF INTERRUPT STORAGE
       012502         .=.+398.
012502 000000 AGAL:   0                       ;200 WORDS OF INTERRUPT STORAGE
       013322         .=.+398.
013322 000000 AHAVH:  0                       ;200 WORDS OF INTERRUPT STORAGE
       014142         .=.+398.
014142 000000 STARTX: 0
014144 000000 TINDX1: 0
014146 000000 TINDX2: 0
014150 000000 TINDX3: 0
014152 000000 ENDX:   0
014154 000000 FINDX:  0
014156 000000 TLNGTH: 0          ;THE FOLLOWING 12 WORDS MUST REMAIN IN ORDER
014160 000000 AVGF1:  0          ;        1
014162 000000 AVGF2:  0          ;        2
014164 000000 AVGF3:  0          ;        3
014166 000000 AVGA1:  0          ;        4
014170 000000 AVGA2:  0          ;        5
014172 000000 AVGA3:  0          ;        6
014174 000000 AVGA4:  0          ;        7
014176 000000 VOICED: 0          ;        8
014200 000000 DIV1:   0          ;        9
014202 000000 DIV2:   0          ;        10
014204 000000 DIV3:   0          ;        11
014206 000000 DIVTL:  0          ;        12
014210 000000 SEARCH: 0
014212 000000 DUMMY:  0
014214 000000 TSTRFX: 0
014216 000000 LENGTH: 0
014220 000200 BITEST: .WORD   200,100,40,20,10,4,2,1
014222 000100
014224 000040
014226 000020
014230 000010
014232 000004
014234 000002
014236 000001
014240 000111 MAXF1:  .WORD   111,71,51
014242 000071
014244 000051
014246 000000 TSTORX: 0
014250 000000 TSTOR1: 0
014252 000000 TSTR12: 0
014254 000000 TSTR14: 0
014256 000000 TSTORF: 0
014260 000000 TSTORT: 0
014262 000000 TSTORV: 0          ;THIS AND THECPRECEDING 6 WORDS DEFINE THE SAMPL
014264 000000 RNOT:   0          ;RUNNING COUNT OF NUMBER OF TEMPLATES UTILIZED
014266 000000 TMPLAT: 0
       014470         .=.+128.         ;65 WORDS
014470 000000 HOLDT:  0
       014672         .=.+128.         ;65 WORDS
014672 000000 NOPPC:  0                 ;NUMBERV OF TEMPLATES IN EACH CLASS
```

```
        015040          .=.+100.                    ;100 BYTES
015040  000000  LIMIT:  0           ;SET BY PROGRAM - INDICATES END OF TEMPLATECSTOR
015042  000000  NOT:    0           ;NUMBER OF TEMPLATES AVAILABLE

                        PAGE    055

015044  000000  TEMP:   0           ;USED TO STORE TOP 10 WINNERS-SEE ATN AND KEYWOR
        015114          .=.+38.
015114  000010  AMWGTS: .WORD   8.,8.,8.,16.,10.          ;BINARY WEIGHTS - AM 1 2
015116  000010
015120  000010
015122  000020
015124  000012
015126  000000  CT:     0
        016256          .=.+598.            ;200 WORDS - CT MATRIX
016256  001000  TIMWGT: .WORD   1000        ;WEIGHT FOR LENGTH OF WORD
016260  000021  M1:     .WORD   17.,25.,33.
016262  000031
016264  000041
016266  000044  M2:     .WORD   36.,52.,66.
016270  000064
016272  000102
016274  000006  M3:     .WORD   6.,9.,12.
016276  000011
016300  000014
016302  000002  M4:     .WORD   2.,3.,4.
016304  000003
016306  000004
016310  000004  M5:     .WORD   4.,6.,8.
016312  000006
016314  000010
016316  000104  M6:     68.,100.,130.
016320  000144
016322  000202
016324  000036  M7:     30.,42.,54.
016326  000052
016330  000066
                        .EOT

EOF ?
        176506          CRTPB=176506
        176502          CRTKB=176502
        176500          CRTKS=176500
        176504          CRTPS=176504
        177562          TKB=177562
        177566          TPB=177566
        177560          TKS=177560
        177564          TPS=177564
                        ;
                        ;
016332  026767  INROUT: CMP     ICNTR1,ICNTR2
        005136
        005136
016340  001001          BNE     .+4
```

```
016342 000207          RTS     7
016344 016700          MOV     ICNTR2,%0
       005126
016350 005267          INC     ICNTR2
       005122
016354 022767          CMP     #20.,ICNTR2
       000024
       005114
016362 100002          BPL     .+6
016364 005067          CLR     ICNTR2
       005106

                       PAGE    056

016370 122760          CMPB    #40,INPUT0(0)    ;BLANK
       000040
       023424
016376 001001          BNE     .+4
016400 000207          RTS     7
016402 122760          CMPB    #12,INPUT0(0)
       000012
       023424
016410 001001          BNE     .+4
016412 000207          RTS     7
016414 122760          CMPB    #15,INPUT0(0)
       000015
       023424
016422 001001          BNE     .+4
016424 000207          RTS     7
016426 122760          CMPB    #54,INPUT0(0)
       000054
       023424
016434 001510          BEQ     NEWRD            ;COMMA - INITIATE NEW WORD
016436 122760          CMPB    #72,INPUT0(0)
       000072
       023424
016444 001526          BEQ     KEYWRD           ;COLON - KEYWORD PRECEDES
016446 126760          CMPB    ETX,INPUT0(0)
       005370
       023424
016454 001002          BNE     .+6
016456 000167          JMP     ENDNG            ;END OF TEXT INDICATOR .
       002022
016462 122760          CMPB    #135,INPUT0(0)          ;] IS DELETE MANUALLY
       000135
       023424
016470 001004          BNE     .+10.
016472 112767          MOVB    #7,DLETFG
       000007
       173121
016500 000207          RTS     7

016502 122760          CMPB    #100,INPUT0(0)  ;@ IS NOW THE LA7700A RUBOUT KEY
       000100
```

```
        023424
016510 001024           BNE     .+42
016512 005367           DEC     VOCADD
        004764
016516 105077           CLRB    @VOCADD
        004760
016522 012700           MOV     #20010,%0       ;BACKSPACE
        020010
016526 004767           JSR     7,TYPO
        171326
016532 004767           JSR     7,TYPO
        171322
016536 000300           SWAB    %0
016540 004767           JSR     7,TYPO
        171314
016544 004767           JSR     7,TYPO
        171310

                        PAGE    057

016550 000300           SWAB    %0
016552 004767           JSR     7,TYPO
        171302
016556 004767           JSR     7,TYPO
        171276

016562 026727           CMP     CHRCNT,#9.      ;9CHARS PER WORD MAXIMUN\M
        004712
        000011
016570 001001           BNE     .+4
016572 000207           RTS     7
016574 116077           MOVB    INPUT0(0),@VOCADD       ;STORE ASCII CODE AS(2ND
        023424
        004700
016602 116001           MOVB    INPUT0(0),%1
        023424
016606 060177           ADD     %1,@HASHNG              ;HASH CODE CREATION
        005220
016612 006377           ASL     @HASHNG
        005214
016616 005267           INC     CHRCNT          ;NO. CHARACTERS PER WORD
        004656
016622 005267           INC     VOCADD          ;SETUP FOR NEXT CHAR
        004654
016626 026727           CMP     VOCADD,#VOCAB+1051.     ;LIMIT CHECK
        004650
        023425
016634 001007           BNE     .+16.
016636 004767           JSR     7,ERROR0        ;TOO MANY WORDS BEING ENTERED
        000154
016642 004767           JSR     7,RESET
        002454
016646 112767           MOVB    #'3,CRTPB       ;********** ERROR 3 **********
        000063
```

```
        157632
016654  000207          RTS     7
016656  116077  NEWRD:  MOVB    INPUT0(0),@VOCADD
        023424
        004616
016664  005267          INC     HASHNG
        005142
016670  005267          INC     HASHNG
        005136
016674  162767          SUB     #11.,CHRCNT     ;CHRCNT - 9
        000013
        004576
016702  005167          COM     CHRCNT          ;ABS(CHRCNT- 9)
        004572
016706  066767          ADD     CHRCNT,VOCADD
        004566
        004566
016714  005067          CLR     CHRCNT
        004560
016720  000207          RTS     7
016722  005367  KEYWRD: DEC     VOCADD
        004554

                        PAGE    060

016726  005367          DEC     VOCADD
        004550
016732  032767          BIT     #1,VOCADD
        000001
        004542
016740  001026          BNE     ERROR0
016742  005001          CLR     %1
016744  017702          MOV     @VOCADD,%2
        004532
016750  042702          BIC     #100200,%2
        100200
016754  012703          MOV     #KWDTBL,%3
        021074
016760  012704          MOV     #KWDTBL+22.,%4
        021122
016764  020223  KEYWD1: CMP     %2,(3)+
016766  001002          BNE     KEYWD2
016770  000171          JMP     @KWDSUB(1)      ;ADDRESS VECTORS FOR SUBROUTINES
        021122
016774  005201  KEYWD2: INC     %1
016776  005201          INC     %1
017000  020304          CMP     %3,%4
017002  001370          BNE     KEYWD1
017004  004767          JSR     7,ERROR0
        000006
017010  005067          CLR     COURFG
        005020
017014  000207          RTS     7
017016  112700  ERROR0: MOVB    #'E,%0
```

```
                000105
017022 004767           JSR     7,TYPO
                171032
017026 112700           MOVB    #'R,%0
                000122
017032 004767           JSR     7,TYPO
                171022
017036 004767           JSR     7,RESET
                002260
017042 004767           JSR     7,CRLF
                171060
017046 000207           RTS     7
017050 112700 ERROR1:   MOVB    #'1,%0
                000061
017054 004767           JSR     7,TYPO
                171000
017060 005067           CLR     REPFLG
                004752
017064 000754           BR      ERROR0
                                        ;SUBROUTINES AND ETCETRA\\ERR
017066 012701 NEWVOC:   MOV     #VOCAB+1050.,%1
                023424
017072 012700           MOV     #VOCAB,%0
                021372
017076 005020           CLR     (0)+
017100 020001           CMP     %0,%1
017102 001375           BNE     .-4             ;CLEAR VOCABULARY STORAGE

                        PAGE    061

017104 012701           MOV     #HASH+210.,%1
                024032
017110 012700           MOV     #HASH,%0
                023510
017114 005020           CLR     (0)+
017116 020001           CMP     %0,%1
017120 001375           BNE     .-4
017122 005067           CLR     CHRCNT
                004352
017126 012767           MOV     #VOCAB,VOCADD
                021372
                004346
017134 005067           CLR     VOCFG
                004344
017140 012767           MOV     #VOCAB,TRNADD
                021372
                004340
017146 012767           MOV     #HASH,HASHNG
                023510
                004656
017154 005067           CLR     COURFG
                004654
017160 004767           JSR     7,CRLF
                170742
```

```
017164 000207          RTS     7
017166 012767 REPLACE: MOV     #7,REPFLG
       000007
       004642
017174 004767          JSR     7,CRLF
       170726
017200 004767          JSR     7,RESET
       002116
017204 112767          MOVB    #7,DISFG
       000007
       172427
017212 005067          CLR     COUREG
       004616
017216 012701          MOV     #VOCAB+1050.,%1
       023424
017222 012700          MOV     #VOCAB+1020.,%0
       023366
017226 005020          CLR     (0)+
017230 020001          CMP     %0,%1
017232 001375          BNE     .-4
017234 005067          CLR     HASH+208.
       004570
017240 005067          CLR     HASH+204.
       004560
017244 005067          CLR     HASH+206.
       004556
017250 000207          RTS     7
017252 012701 REPLC1:  MOV     #-2,%1   ;START OF BUFFER
       177776
017256 012700          MOV     #202.,%0
       000312
017262 005201 REPLC2:  INC     %1

                       PAGE    062

017264 005201          INC     %1
017266 027761          CMP     @HASHNG,HASH(1)
       004540
       023510
017274 001404          BEQ     .+10.
017276 020001          CMP     %0,%1
017300 001370          BNE     REPLC2
017302 000167          JMP     ERROR1
       177542
017306 005267          INC     HASHNG
       004520
017312 005267          INC     HASHNG
       004514
017316 017761          MOV     @HASHNG,HASH(1)
       004510
       023510
017324 010103          MOV     %1,%3
017326 104401          MUL                      ;PERFORM MULTIPLY INST,OPERANDS
017330 020127          CMP     %1,#5.           ;RESULT LEFT IN R1 ONLY.. LOW OR
```

```
                000005
017334 010104           MOV     %1,%4
017336 012700           MOV     #VOCAB+1030.,%0
       023400
017342 012702           MOV     #VOCAB+1040.,%2
       023412
017346 012061 REPLC3:   MOV     (0)+,VOCAB(1)
       024372
017352 005201           INC     %1
017354 005201           INC     %1
017356 020200           CMP     %2,%0
017360 001372           BNE     REPLC3
017362 005067           CLR     REPFLG
       004450
017366 105767           TSTB    RPTFLG
       172244
017372 001460           BEQ     REPLC4
017374 016767           MOV     VOCAB+1040.,ITERAT
       004012
       172254
017402 042767           BIC     #177760,ITERAT
       177760
       172246
017410 005267           INC     ITERAT
       172242
017414 016767           MOV     TRNADD,TRNSAV
       004066
       172230
017422 116767           MOVB    CLASS,TRNSAV+2
       172172
       172224
017430 006203           ASR     %3
017432 110367           MOVB    %3,CLASS
       172162
017436 005000           CLR     %0
017440 016001 REPLC5:   MOV     TMPSTR+2(0),%1
       024160

                        PAGE    063

017444 105001           CLRB    %1
017446 000301           SWAB    %1
017450 020301           CMP     %3,%1
017452 001014           BNE     REPLC6
017454 012760           MOV     #077400,TMPSTR+2(0)
       077400
       024160
017462 005060           CLR     TMPSTR+4(0)
       024162
017466 012760           MOV     #177777,TMPSTR(0)
       177777
       024156
017474 005367           DEC     RNOT
       174564
```

```
017500 105363           DECB    NOPPC(3)
       014672
017504 066700 REPLC6:   ADD     TSTORT,%0
       174550
017510 020067           CMP     %0,LIMIT
       175324
017514 001351           BNE     REPLC5
017516 105067           CLRB    NXTWRD
       172075
017522 112767           MOVB    #7,TRNFLG
       000007
       172063
017530 105067           CLRB    ATNFG           ;ENABLE ATN
       172075
017534 000167 REPLC4:   JMP     ENDNG
       000744
017540 004767 REPTRN:   JSR     7,RESET
       001556
017544 112767           MOVB    #7,RPTFLG
       000007
       172064
017552 004767           JSR     7,CRLF
       170350
017556 005067           CLR     COUREG
       004252
Q 017562 000167         JMP     REPLACE
       177400
017566 005001 DISVOC:   CLR     %1
017570 005002           CLR     %2
017572 012700           MOV     #31,%0  ;CLEAR LA 7700A SCREEN
       000031
017576 004767           JSR     7,TYPO
       170256
017602 004767           JSR     7,DELAY
       170360
017606 004767           JSR     7,CRLF
       170314
017612 004767           JSR     7,CRLF
       170310
017616 012701           MOV     #VOCAB,%1
       021372
017622 012100 DISVO1:   MOV     (1)+,%0

                        PAGE    064

017624 105700           TSTB    %0
017626 001002           BNE     .+6
017630 112700           MOVB    #40,%0  ;PRINT NULLS AS BLANKS
       000040
017634 004767           JSR     7,TYPO
       170220
017640 000300           SWAB    %0
017642 105700           TSTB    %0
017644 001002           BNE     .+6
```

```
Q 017646 012700          MOV     #40,%0  ;PRINT NULLS AS BLANKS
         000040
  017652 004767          JSR     7,TYPO
         170202
  017656 005202          INC     %2
  017660 005202          INC     %2
  017662 020227          CMP     %2,#79.
         000117
  017666 001003          BNE     DISV04
  017670 004767          JSR     7,CRLF
         170232
  017674 005002          CLR     %2
  017676 022701 DISV04:  CMP     #VOCAB+1020.,%1
         023366
  017702 001347          BNE     DISV01
  017704 004767          JSR     7,RESET
         001412
  017710 004767          JSR     7,CRLF
         170212
  017714 005067          CLR     COURFG
         004114
  017720 004767          JSR     7,LDELAY
         170326
  017724 000207          RTS     7
  017726 004767 NEWSPK:  JSR     7,RESET
         001370
  017732 004767          JSR     7,CRLF
         170170
  017736 005067          CLR     COURFG
         004072
         177552          PRB=177552
         177550          PRS=177550
         177554          PPS=177554
         177556          PPB=177556
  017742 000005          RESET           ;DISABLE ALL I/O
  017744 105067          CLRB    RFLAG
         000156
  017750 005004          CLR     %4
  017752 005005          CLR     %5
  017754 005767          TST     PRS
         157570
  017760 100463          BMI     PUNCH   ;IF READER ON, READ TAPE
  017762 052767          BIS     #100,PRS
         000100
         157560
  017770 016400 NEWB:    MOV     BLOCK(4),%0     ;BLOCK STARTING ADDRESS
         024130

                         PAGE    065

  017774 016403          MOV     BLOCK+6(4),%3   ;BLOCK ENDING ADDRESS
         024136
  020000 105767          TSTB    RFLAG
         000122
```

```
020004 001401          BEQ     .+4
020006 000002          RTI
020010 005267 READ:    INC     PRS
       157534
020014 000001          WAIT
020016 000774          BR      -6
020020 116701 READ0:   MOVB    PRB,%1
       157526
020024 105767          TSTB    RFLAG           ;DON'T STORE BLANK LEADER
       000076
020030 001010          BNE     READ1
020032 022701          CMP     #177777,%1
       177777
020036 001401          BEQ     .+4
020040 000002          RTI
020042 112767          MOVB    #7,RFLAG
       000007
       000056
020050 000002          RTI
020052 020027 READ1:   CMP     %0,#77776
       077776
020056 100001          BPL     .+4
020060 060105          ADD     %1,%5
020062 110110          MOVB    %1,(0)
020064 005200          INC     %0
020066 020003          CMP     %0,%3
020070 001401          BEQ     .+4
020072 000002          RTI
020074 005204          INC     %4
020076 005204          INC     %4
020100 020427          CMP     %4,#6
       000006
020104 001331          BNE     NEWB            ;START NEXT BLOCK
020106 012716          MOV     #ENTER,(6)
       001024
020112 020567          CMP     %5,77776        ;COMPARE CHECKSUMS
       057660
020116 001001          BNE     .+4
020120 000002          RTI
020122 000000          HALT                    ;CHECKSUM FAILURE - RE-READ TAPE
020124 000002          RTI
020126     000 RFLAG:  .BYTE   0
       020130          .EVEN
020130 112767 PUNCH:   MOVB    #177777,PPB     ;START TAPE
       177777
       157420
020136 016400 PUNCH1:  MOV     BLOCK(4),%0     ;START BLOCK ADDRESS
       024130
020142 016403          MOV     BLOCK+6(4),%3   ;END BLOCK ADDRESS
       024136
020146 020427          CMP     %4,#4
       000004

                       PAGE    066
```

```
020152 001002          BNE     .+6
020154 005303          DEC     %3
020156 005303          DEC     %3
020160 032767 PUNCH2:  BIT     #100200,PPS
       100200
       157366
020166 001774          BEQ     .-6
020170 111001          MOVB    (0),%1
020172 060105          ADD     %1,%5
020174 111067          MOVB    (0),PPB         ;PUNCH CHARACTER
       157356
020200 005200          INC     %0
020202 020003          CMP     %0,%3
020204 001365          BNE     PUNCH2
020206 005204          INC     %4
020210 005204          INC     %4
020212 020427          CMP     %4,#6
       000006
020216 001347          BNE     PUNCH1
020220 032767          BIT     #100200,PPS
       100200
       157326
020226 001774          BEQ     .-6
020230 110567          MOVB    %5,PPB          ;STORE CHECKSUM IN 77776
       157322
020234 000305          SWAB    %5
020236 032767          BIT     #100200,PPS
       100200
       157310
020244 001774          BEQ     .-6
020246 110567          MOVB    %5,PPB
       157304
020252 004767          JSR     7,LDELAY
       167774
020256 000167          JMP     RSTART  ;DONE
       160670
020262 004767 SENMDE:  JSR     7,RESET
       001034
020266 004767          JSR     7,CRLF
       167634
020272 105767          TSTB    SENFG1
       171335
020276 001405          BEQ     .+12.
020300 105067          CLRB    SENFG1
       171327
020304 105067          CLRB    SENFG2
       171324
020310 000403          BR      .+8.
020312 112767          MOVB    #7,SENFG1
       000007
       171313
020320 005067          CLR     COURFG
       003510
```

```
020324 000207          RTS     7
020326 004767 NUMMDE:  JSR     7,RESET
       000770

                       PAGE    067

020332 004767          JSR     7,CRLF
       167570
020336 105767          TSTB    NUMFLG
       003476
020342 001403          BEQ     .+8.
020344 105067          CLRB    NUMFLG
       003470
020350 000403          BR      .+8.
020352 112767          MOVB    #7,NUMFLG
       000007
       003460
020360 005067          CLR     COUREG
       003450
020364 000207          RTS     7
020366 004767 TRNMDE:  JSR     7,RESET
       000730
020372 112767          MOVB    #7,TRNFLG
       000007
       171213
020400 105067          CLRB    NXTWRD
       171213
020404 004767          JSR     7,CRLF
       167516
020410 005067          CLR     COURFG
       003420
020414 105067          CLRB    CLASS
       171200
020420 000207          RTS     7
020422 004767 DISMDE:  JSR     7,RESET
       000674
020426 004767          JSR     7,CRLF
       167474
020432 005067          CLR     COURFG
       003376
020436 105767          TSTB    DFLAG
       003502
020442 001403          BEQ     .+8.
020444 105067          CLRB    DFLAG
       003474
020450 000403          BR      .+8.
020452 112767          MOVB    #7,DFLAG
       000007
       003464
020460 000207          RTS     7
020462 004767 OPRMDE:  JSR     7,RESET
       000634
020466 105067          CLRB    TRNFLG
       171121
```

```
020472 004767          JSR     7,CRLF
       167430
020476 005067          CLR     COURFG
       003332
020502 000207          RTS     7
020504 105767 ENDNG:   TSTB    SENFG1
       171123
020510 001403          BEQ     .+8.

                       PAGE    070

020512 005067          CLR     COURFG
       003316
020516 000207          RTS     7
020520 004767          JSR     7,RESET
       000576
020524 005767          TST     REPFLG
       003306
020530 001402          BEQ     .+6
020532 000167          JMP     REPLC1
       176514
020536 000167          JMP     DISYOC
       177024
020542 004767 ATNMDE:  JSR     7,RESET
       000554
020546 004767          JSR     7,CRLF
       167354
020552 005067          CLR     COURFG
       003256
020556 105767          TSTB    ATNFG
       171047
020562 001403          BEQ     .+8.
020564 105067          CLRB    ATNFG
       171041
020570 000403          BR      .+8.
020572 112767          MOVB    #7,ATNFG
       000007
       171031
020600 000207          RTS     7
020602 105767 KEYWORD: TSTB    ADDFLG
       171032
020606 001410          BEQ     KEY1
020610 016767          MOV     TINDX1,TINDX2
       173330
       173330
020616 012767          MOV     #177777,TINDX1
       177777
       173320
020624 105067          CLRB    ADDFLG
       171010
020630 016701 KEY1:    MOV     AHAYH,%1        ;MUST DO A RT ON SSSSSS FIRST
       172466
020634 006301          ASL     %1
020636 026167          CMP     HASH(1),SSSSSS
```

```
          023510
          003306
   020644 001422          BEQ     KEY3
   020646 026167          CMP     HASH(1),EEEEEE
          023510
          003300
   020654 001015          BNE     KEY2
   020656 105767          TSTB    TRNFLG
          170731
   020662 001072          BNE     KEY6
   020664 012701          MOV     #177777,%1
          177777
   020670 010167          MOV     %1,TINDX1
          173250

                         PAGE    071

   020674 010167          MOV     %1,TINDX2
          173246
   020700 010167          MOV     %1,TINDX3
          173244
   020704 105067          CLRB    KEYFLG
          170725
Q  020710 000207 KEY2:    RTS     7       ;NOT SSSSSS OR EEEEEE KEYWORDS BY VOCAL
   020712 105767 KEY3:    TSTB    TRNFLG
          170675
   020716 001054          BNE     KEY6
   020720 105767          TSTB    KEYFLG
          170711
   020724 001004          BNE     KEY4
   020726 112767          MOVB    #7,KEYFLG
          000007
          170701
   020734 000207          RTS     7
   020736 016767 KEY4:    MOV     TINDX3,TINDX2           ;OK HAVE CORRECT ID
          173206
          173202
   020744 012767          MOV     #177777,TINDX1
          177777
          173172
   020752 000367          SWAB    HOLDT+2
          173514
   020756 116767          MOVB    TCLASS,HOLDT+2  ;CORRECTED CLASS
          170655
          173506
   020764 000367          SWAB    HOLDT+2
          173502
   020770 116767          MOVB    TCLASS,CLASS
          170643
          170622
   020776 012704          MOV     #TEMP+20.,%4
          015070
   021002 012703          MOV     #TEMP,%3
          015044
```

```
021006 012700          MOV     #AHAVH,%0
       013322
021012 012701          MOV     #AGAL,%1
       012502
021016 012702          MOV     #AGAL+20.,%2
       012526
021022 012320          MOV     (3)+,(0)+
021024 012421          MOV     (4)+,(1)+
021026 020201          CMP     %2,%1
021030 001374          BNE     .-6
021032 005000          CLR     %0              ;TOP TEN WINNERS RESTORED
021034 112767          MOVB    #7,ADDFLG
       000007
       170576
021042 105067          CLRB    KEYFLG
       170567
021046 000207          RTS     7
021050 105767 KEY6:    TSTB    RPTFLG
       170562

                       PAGE    072

021054 001401          BEQ     .+4
021056 000207          RTS     7
021060 105767          TSTB    NOPPC+50.
       173670
021064 001001          BNE     .+4
021066 000207          RTS     7
021070 000167          JMP     DELETE
       167276

                                ;CONSTANTS AND OTHER PASRAMETERS AND STORAGE
021074     126 KWDTBL: .ASCII  /VCRPRTDVNSSMNMDMTMOMAT/        ;KEYWORDS
021075     103
021076     122
021077     120
021100     122
021101     124
021102     104
021103     126
021104     116
021105     123
021106     123
021107     115
021110     116
021111     115
021112     104
021113     115
021114     124
021115     115
021116     117
021117     115
021120     101
021121     124
021122 017066 KWDSUB:  .WORD   NEWVOC
```

```
021124 017166          .WORD   REPLACE
021126 017540          .WORD   REPTRN
021130 017566          .WORD   DISVOC
021132 017726          .WORD   NEWSPK
021134 020262          .WORD   SENMDE
021136 020326          .WORD   NUMMDE
021140 020422          .WORD   DISMDE
021142 020366          .WORD   TRNMDE
021144 020462          .WORD   OPRMDE
021146 020542          .WORD   ATNMDE
021150 000011 CRTCHR:  .WORD   11,12,13,14,15,16,31,32,35,
021152 000012
021154 000013
021156 000014
021160 000015
021162 000016
021164 000031
021166 000032
021170 000035
021172 000000
021174 010046 TTY:     MOV     %0,-(6)
021176 010146          MOV     %1,-(6)
021200 105767          TSTB    DISFG
       170435

                       PAGE    073

021204 001421          BEQ     TTY0
021206 122767          CMPB    #16,SENFG2
       000016
       170420
021214 001415          BEQ     TTY0
021216 116767          MOVB    CRTKB,CRTPB      ;PRINT  CHARACTER
       155260
       155262
021224 012700          MOV     #CRTCHR+20.,%0
       021174
021230 012701          MOV     #CRTCHR,%1
       021150
021234 026721          CMP     CRTKB,(1)+
       155242
021240 001001          BNE     .+4
021242 000422          BR      .+38.
021244 020001          CMP     %0,%1
021246 001372          BNE     .-10.
021250 016700 TTY0:    MOV     ICNTR1,%0
       002220
021254 116760          MOVB    CRTKB,INPUT0(0)
       155222
       023424
021262 005267          INC     ICNTR1
       002206
021266 022767          CMP     #20.,ICNTR1      ;ICNTR1 .LT.  20
       000024
```

```
        002200
021274  100002          BPL     TTY1
021276  005067          CLR     ICNTR1
        002172
021302  012767  TTY1:   MOV     #7,COURFG       ;WHEN SET , DATA FROM TTY READY
        000007
        002524
021310  012601          MOV     (6)+,%1
021312  012600          MOV     (6)+,%0
021314  005267          INC     CRTKS   ;ENABLE TTY FOR ANOTHER CHARACTER
        155160
021320  000002          RTI
021322  012767  RESET:  MOV     #VOCAB+1020.,VOCADD
        023366
        002152
021330  012767          MOV     #HASH+204.,HASHNG
        024024
        002474
021336  005067          CLR     COURFG
        002472
021342  105767          TSTB    SENFG1
        170265
021346  001002          BNE     .+6
021350  004767          JSR     7,CRLF
        166552
021354  005067          CLR     CHRCNT
        002120
021360  004767          JSR     7,LDELAY
        166666

                        PAGE    074

021364  105067          CLRB    DISFG
        170251
021370  000207          RTS     7
        104401          MUL     =TRAP+1
        104402          DIV     =TRAP+2
        104404          SOB     =TRAP+4
        104410          ASH     =TRAP+8.
        104420          ASHC    =TRAP+16.
        104440          XOR     =TRAP+32.
        104500          SXT     =TRAP+64.
021372  000000  VOCAB:  0
        023424          .=.+1048.       ;1050. BYTES
023424  000000  INPUT0: 0
        023474          .=.+38.         ;40. BYTES
023474  000000  ICNTR1: 0
023476  000000  ICNTR2: 0
023500  000000  CHRCNT: 0
023502  000000  VOCADD: 0
023504  000000  VOCFG:  0
023506  000000  TRNADD: 0
023510  000000  HASH:   0
        024032          .=.+208.        ;210. BYTES
```

```
024032 000000 HASHNG: 0
024034 000000 COUREG: 0
024036 000000 REPFLG: 0
024040    000 NUMFLG: .BYTE   0
024041    000 SENFLG: .BYTE   0
024042 000134 ETX:    .WORD   0134
024044 000140 DIGITS: .WORD   140,142,144,146,150,152,154,156,160,162
024046 000142
024050 000144
024052 000146
024054 000150
024056 000152
024060 000154
024062 000156
024064 000160
024066 000162
024070 000134         .WORD   134,132,122,120,126,110,172,136,124,170
024072 000132
024074 000122
024076 000120
024100 000126
024102 000110
024104 000172
024106 000136
024110 000124
024112 000170
024114 010210 SPCWRD: .WORD   10210,21142,1750
024116 021142
024120 001750
024122    050 SPCSYM: .BYTE   50,40,10,10,51,40
024123    040
024124    010
024125    010
024126    051

                      PAGE    075

024127    040
024130 000000 BLOCK:  .WORD   0,SPCHFG,VOCAB,30,LIMIT,100000
024132 011612
024134 021372
024136 000030
024140 015040
024142 100000
Q 024144    000 DFLAG:  .BYTE   0       ;USED TO DISPLAY TOP 10 WINNERS- SEE CLS
       024146         .EVEN
024146 000000 COUNT:  .WORD   0,0
024150 000000
024152 024332 SSSSSS: .WORD   24332
024154 020766 EEEEEE: .WORD   20766
024156 000000 TMPSTR: 0       ;BEGINNING OF TEMPLATE STORAGE
       000001         .END

                      PAGE    076
```