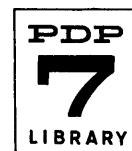


1. IDENTIFICATION
- 1.1 Maindec 710
- 1.2 PDP-7 Tape Reader (Type 444B) Test
- 1.3 August 27, 1965

(7-57-m)



NOTE

Change code for variable used: see listing

2. ABSTRACT

Maindec 710 incorporates two separate test programs. The first tests the performance of all the IOT instructions associated with the reader and its connections to the program interrupt. It reads a loop of tape containing alternate characters of 1's and 0's, first in alphanumeric, then in binary mode.

The second test reads a loop of tape containing the sequence 1-377 repeated three times. This program tests only the accuracy of reading; the interrupt is not used, and the flags are assumed to be working.

3. REQUIREMENTS

3.1 Storage

Maindec 710 occupies memory locations 0 - 7 and 20 - 1325. It requires that the RIM Loader be in memory.

3.2 Subprograms and/or Subroutines

Maindec 710 uses two library subroutines:

Teletype Output Package (Digital-7-10-0)

Octal Print Subroutine (Digital-7-14-0)

Both subroutines are included in the Maindec 710 Funny Format binary tape provided. The ASCII tapes of the two subroutines are not supplied.

3.3 Equipment

Standard PDP-7 with paper tape reader and punch.

3.4 Miscellaneous

Tapes supplied:

ASCII (Test program only)

Funny Format binary

*put in rim loader*

4. USAGE

4.1 Loading

4.1.1 Place the FF binary tape in the reader.

4.1.2 Set the ADDRESS switches to (1)7770.

4.1.3 Press START.

4.3 Switch Settings

4.3.1 Loading Address: (1)7770

4.3.2 Starting Addresses

Section 1:	100	(To punch test loop)
	140	(To test reader)
Section 2:	200	(To punch test loop)
	375	(To test reader)

*146 eliminates type outs.*

## 4.3.3 Other Switch Settings

The settings given apply to both sections of the test program.

Switch	Setting	Function
ACS <sub>0</sub>	Down Up	Halt on error No halt on error
ACS <sub>1</sub>	Down Up	Print error messages Do not print message
ACS <sub>2-17</sub>	---	The setting determines the speed at which the reader operates: the higher the number in the switches, the slower the rate used down to a minimum of 3 cps.

## 4.4 Start up and/or Entry

## 4.4.1 Section 1: Maximum Noise Test

Set the ADDRESS switches to 00100 and press START. The program title will be printed on the teleprinter:

SECTION 1 TEST.

POSITION TAPE IN READER.

ACS0 DOWN FOR HALTS, UP FOR NONE.

ACS1 DOWN FOR PRINTING, UP FOR NONE.

ACS2-17 FOR SPEED CONTROL.

CHARACTER

READ EXPECTED

The computer will stop with the AC and link cleared.

Remove the test tape from the punch bin, and make a loop by overlapping the blank ends of the tape.

Place the test loop in the reader so that the blank section falls under the read heads. Put the reader arm down.

Set the AC switches as desired (see Section 4.3.3) and press CONTINUE. The program will read the loop and continue until an error is encountered or until the operator stops the computer.

It is not necessary to punch a new loop every time the test is run. If a loop has already been made, place it in the reader, set the ADDRESS switches to 140, and press START. The title and instructions will be printed, and the computer will halt. Proceed as outlined above.

## 4.4.2 Section 2: Numeric Sequence Test

Set the ADDRESS switches to 00200 and press START. The title will be printed:

SECTION 2 PUNCH.

The test tape is punched, and the title and instructions for the test are printed. These are identical to the instructions for Section 1, except for the first line, which reads:

#### SECTION 2 TEST.

The computer halts with the AC and link clear. Make a loop of the test tape by overlapping blank ends as before, and place it in the reader with the blank section under the read heads. Put the reader arm down. Set the AC switches as desired, and press CONTINUE.

The test will run until an error is encountered, or until the operator stops the computer.

As in Section 1, the test tape can be used over again. If the loop has been prepared, place it in the reader as before. Set the ADDRESS switches to 00375, and press START. The title and instructions are printed, and the procedure is as described above.

#### 4.5 Errors in Usage

On all error halts, the link is set to 1.

Error E01-E05 will halt only if ACS<sub>0</sub> is down.

Error: E01  
Message: CAF DID NOT CLEAR FLAG.  
C(MA): 00153  
C(AC): I/O status  
Cause: The CAF instruction failed to clear the reader flag. Since the flag is not set by the program up to this point, the error implies that the flag is permanently on; otherwise, it would have been cleared when the START button was pressed to start the program.  
Recovery: Press CONTINUE. The test will proceed from the point of error.

Error: E02  
Message: RSF SKIPPED ON CLEARED FLAG.  
C(MA): 00047  
C(AC): I/O status  
Cause: The reader flag was clear; nevertheless the RSF instruction skipped.  
Recovery: Press CONTINUE. The test will proceed from the point of error.

Error: E03  
Message: RSA DID NOT CLEAR FLAG.  
or  
RSB DID NOT CLEAR FLAG.  
C(MA): 00226  
C(AC): I/O status  
Cause: In both cases, the reader select instruction failed to clear the reader flag. This may imply the same thing as E01, above, unless it is clear that the tape has been read at least in part, in which case this is not likely to be a systematic failure.

Error: E04  
Message: RRB DID NOT CLEAR FLAG.  
C(MA): 00246  
C(AC): I/O status  
Cause: Again, the flag was unaffected by an associated IOT.  
Recovery: Press CONTINUE. The test will proceed from the point of error.

Error: E05  
Message: RSF DID NOT SKIP WHEN FLAG WAS SET.  
C(MA): 00032  
C(AC): I/O status  
Cause: This is the other possible skip error. In this case, the RSF failed to skip even though the flag was set.  
Recovery: Press CONTINUE. The test will proceed from the point of error.  
Errors E30-E33 will always halt, regardless of the setting of ACS<sub>0</sub>.

Error: E30  
Message: RRB DID NOT CLEAR AC.  
C(MA): 00337  
C(AC): 777777  
Cause: The AC was not cleared when the RRB instruction was executed.  
Recovery: Reposition the tape so that the blank section falls under the read heads, and put the arm down. Press CONTINUE. The program will try to put the tape in phase again.

Error: E31  
Message: LEADER SIGNAL IS INCORRECT.  
C(MA): 00332  
C(AC): Word read from tape.  
Cause: On both test tapes, the test sequence is preceded by a signal to indicate the end of the blank tape section. This signal consists of three binary characters forming the word 770000. The program tests to see if the signal read from tape is in fact 770000. If not, this error occurs.  
Recovery: Reposition the tape so that the blank section falls under the read heads, and put the arm down. Press CONTINUE. The program will try to put the tape in phase again.

Error: E32  
Message: NO INTERRUPT AFTER 10 MSEC. IS THE READER ARM DOWN?  
C(MA): 00236  
C(AC): I/O status  
Cause: The time ran out while waiting for a program interrupt from the reader. The question in the diagnostic implies that the tape did not move beyond the leader signal. If the error occurs after some of the test sequence has been read, it may be the result of a failure in the program interrupt control.  
Recovery: Press CONTINUE. The test will begin again, printing the title and instructions. When the computer halts, proceed as described in Section 4.4.1 or 4.4.2.

In each of the following errors, no message is printed. Instead, the erroneous and correct characters are printed in the columns labeled "READ" and "EXPECTED," respectively. Errors E10 and E11 refer to the alphanumeric sequence of the Section 1 test. Errors E12 and E13 refer to the binary sequence of the same test. Error E20 refers to Section 2. Each of these errors occurs when the character (or word) read from tape does not match that expected by the program. In each case, when the program halts, the AC displays as 1's those bits which do not match.

Error: E10  
C(MA): 00166  
Expected Character: 377

Error: E11  
C(MA): 00174  
Expected Character: 000

Error: E12  
C(MA): 00211  
Expected Word: 770077

Error: E13  
C(MA): 00217  
Expected Word: 007700

Error: E20  
C(MA): 00443  
Expected Character: 1-377 in sequence.

Recovery: From each of these error halts, the recovery procedure is the same. Press CONTINUE. The test will proceed from the point of error.

Error: E33  
Message: INTERRUPT FROM SOMETHING OTHER THAN THE READER. CHECK THE OTHER DEVICES...I/O STATUS IS IN THE AC.

C(MA): 00026

C(AC): I/O status

Cause: A device other than the reader has caused an interrupt. By examining the I/O status, the offending device probably can be identified.

Recovery: Press CONTINUE. The test will begin again, printing the title and instructions. When the computer halts, proceed as described in Section 4.4.1 or 4.4.2.

#### 4.6 Recovery from Such Errors:

See Section 4.5, Errors.

### 5. RESTRICTIONS

If the automatic priority interrupt option is installed, it must be kept off. Since pressing the START key disables the API, there should be no interference from that system.

### 6. DESCRIPTION

#### 6.1 Section 1

The first section of Maindec 710 tests all of the IOTs associated with the tape reader, the performance of the program interrupt, and the accuracy of information transfer under conditions of maximum noise. This is obtained by causing the reader to scan a tape punched with alternating characters of 337 and 000.

(Reading in binary mode, the alternation is between words of 770077 and 007700.) The test tape is produced by an auxiliary punch program. The tape has the following format:

- blank leader (40 lines)
- leader signal
- alphanumeric sequence
- binary sequence
- blank trailer (40 lines)

The leader signal consists of the three binary characters 277, 200, 200. The alphanumeric sequence consists of 257<sub>10</sub> character pairs of 377 and 000. The binary sequence consists of 258<sub>10</sub> character pairs of 277 and 200. The test program keeps a count as it scans the tape. When the end is reached, an RSB is given which causes the blank section of the loop to be skipped. The next information read from tape is the leader signal, and the test begins again.

The reading speed is controlled by the setting of AC switches 2-17. If all switches are down, there is no delay, and the reader operates at maximum speed, 300 cps. The speed decreases linearly as the value of the switches increases. The slowest speed is obtained by a setting of 177777, corresponding to a reading rate of about 3 cps.

#### 6.1.2 Section 2

This test operates in exactly the same manner as Section 1, except that it assumes that all IOTs are working (except, possibly, RSA). It does not use the program interrupt. The tape has the same leader and trailer format and leader signal. The body of the tape consists of the sequence of character codes 1-377 repeated three times. This test is designed to check the accuracy of transmission of every possible combination of bits.

The speed control works exactly the same way as for Section 1.

#### 6.2 Examples and/or Applications

The use of each section of Maindec 710 is evident from the foregoing. It should be noted, however, that the speed control can be used to detect certain types of failures. There are certain reading rates at which the reader is more likely to fail than at others. Using the ACS, the operator can find these error points by making the following test.

Start the program with the loop positioned and ACS<sub>2-17</sub> down. After a short time, raise ACS<sub>17</sub>. Gradually decrease the reading speed by putting up each switch in turn from the lowest order to the highest, putting the previous switch down as you raise the next. At some point, the reader may fail. You can then test reader accuracy at speeds near that point.

#### 7. METHODS

See DESCRIPTION

#### 8. FORMAT (Not Applicable)

#### 9. EXECUTION TIME

The time for one pass over a test tape depends on the setting of the AC switches. Reading rates can be varied from 3 to 300 cps.

10. PROGRAM

Maindec 710  
Page 7

10.4 Program Listing

/MAINDEC 710: PDP-7 TAPE READER TEST

/IN TWO SECTIONS: SECTION 1---MAXIMUM NOISE, RSA, ^ RSB  
/SECTION 2--NUMERIC SEQUENCE, RSA ONLY

100/ /SECTION 1 PUNCH  
PUNT1, TIN /TITLE  
LAW PIT  
TSR  
LAM -50  
JMS FEED /LEADER  
JMS PULS /LEADER SIGNAL  
PALF, LAM -400 /ALPHA SEQUENCE  
DAC APTEM  
LAW 377  
PSA  
PSF  
JMP .-1  
SMAV CMA /COUNT?  
ISZ APTEM /YES  
JMP .-5  
PUBS, LAM-401 /BINARY SEQUENCE  
DAC APTEM  
LAW 77  
JMS BIP  
SMA CMA /COUNT?  
ISZ APTEM /YES  
JMP .-3  
PEND, LAM-50  
JMS FEED  
JMP RET1 /GO TEST  
PULS, 0 /PUNCH LEADER SIGNAL  
LAW 77  
JMS BIP  
CLA  
JMS BIP  
JMS BIP  
JMP I PULS  
ORB-700102 /OR READER BUFFER INTO AC.  
/MAINDEC 710, PAGE 2  
RET1, TIN /SECTION 1 TEST  
LAW R1T  
TSR  
LAW RIP  
TSR  
A, HLT VCLAVCLL  
LAC DCAF /INITIALIZE EM0



		DAC DIPT	
		CLOF	
		CAF	
		JMS REFT	/TEST FLAGS
E01,		HLTV STL	/CAF DIDN'T CLEAR
INRA,		JMS TAPH	/INITIALIZE TEST
		LAC DRSA	
		DAC DIPT	
		LAM -400	
		DAC APTEM	
RALPH,		JMS DELAY	/ALPHA TEST
		RSA	
	163	<del>LAM -4000</del> → CLA	/INTERRUPT TIME
		JMS TESC	
		377	/ARGUMENT
166 E10,		HLTV STL	/BAD BITS IN AC ON HALT
		JMS DELAY	
		RSA	
	171	<del>LAM -4000</del> → CLA	
		JMS TESC	
		000	
E11,		HLT STL	
		ISZ APTEM	
		JMP RALPH	
		SKP	/GET AROUND ENTRY
200/		JMP PUNT2	/ENTRY FOR SECTION 2
INREB,		ISZ DIPT	/CHANGES TO RSB
		LAM -125	
		DAC APTEM	
204 BIRD,		JMS DELAY	/BINARY TEST
		RSB	
	206	<del>LAM -14000</del> → CLA	/BINARY MODE TIMER
		JMS TESC	
		770077	
211 E12,		HLTV STL	
		JMS DELAY	
		RSB	
	214	<del>LAM -14000</del> → CLA	
		JMS TESC	
		007700	
E13,		HLTV STL	
/MAINDEC 710: PAGE 3			
		ISZ APTEM	/FINISHED?
		JMP BIRD	/NO
		JMP INRA	/YES. ROUND AGAIN
TESC,		0	/COMPARING SUBROUTINE
		DAC PICT	/SET TIMER

E03,	JMS REFT HLT V STL ION ISZ PICT JMP .-1	/FLAG STILL SET  /TIME TILL BREAK
ER32,	IORS JMS RACS LAW EM32 NOP	/NO BREAK  /ALWAYS HALTS
E32,	HLT V STL JMP RET1	
IRET,	IORS RAL SMA RAR JMP COMC JMS RACS LAW EM04	/RETURN HERE FROM BREAK  /IS THE FLAG CLEAR? /YES. /NO.
E04,	HLT V STL	
COMC,	LAC AP2 SAD I TESC JMP TOUT	/COMPARE CHARACTERS /OK.
ERI,	JMS RACS JMP ERP JMP E1H	/BAD.
TOUT,	ISZ TESC ISZ TESC JMP I TESC	/GO AWAY
E1H,	LAC I TESC XOR AP2 JMP TOUT+1	/ERROR STOP /EXTRACT BAD BITS
ERP,	TIN LAC AP2 JMS OPT TYT LAC I TESC JMS OPT JMP RAC2	/ERROR PRINT
STEM,	0	/STATUS HOLDER
PICT,	0	/INTERRUPT TIMER
RACS,	0	/SAVE THIS SPACE
/MAINDEC 710, PAGE 4		
/INTERRUPT SERVICES AND OTHERS		
0/	0 IORS RAL	

	SMAV RAR	/IS READER FLAG SET?
	JMP ER33	/NO
	RSF	/TEST SKIP
	JMP ER05	/FAILED
	JMP IAWAY	
20/	0	/CALCATCHER
	HLT	
	JMP .-1	
ER33,	JMS RACS	/SPURIOUS INTERRUPT
	LAW EM33	
	NOP	/ALWAYS HALTS
E33,	HLTV STL	
	JMP RET1	
ER05,	JMS RACS	/RSF FAILED
	LAW EM05	
E05,	HLTV STL	
IAWAY,	RRB	/OK, READ BUFFER
	DAC AP2	
	JMP IRET	/GO COMPARE
REFT,	0	/FLAG TEST SUBROUTINE
	IORS	
	RAL	
	SPAV RAR	/IS FLAG STILL SET?
	JMP ERO	/YES
	RSF	/NO. TEST SKIP
	JMP REO	/OK. GO AWAY
ER02,	JMS RACS	/SKIPPED ON CLEAR FLAG
	LAW EM02	
E02,	HLTV STL	
	JMP REO	
ERO,	JMS RACS	/FLAG NOT CLEARED
	JMP EOP	
	JMP I REFT	/IF STOPPING
REO,	ISZ REFT	/IF NOT
	JMP I REFT	
EOP,	LAC DIPT	/PRINT DIAGNOSTIC
	TY3	
	LAW EM0	
	JMP RAC2-1	
/MAINDEC 710, PAGE 5		
/VARIOUS KINDS OF SUBROUTINES		
RACS/	0	/DIAGNOSTIC HANDLER
	DAC STEM	/SAVE STATUS
	IOF	
	LAS	

	RAL	
	SPAVRAR	/PRINT MESSAGE?
	JMP RAC2+1	/NO
	TIN	
	XCT I RACS	/LAW OR JMP
	TSR	/IF LAW
RAC2,	LAS	
	SPA	/STOP FOR ERROR?
	ISZ RACS	/NO
	ISZ RACS	
	CAF	/CLEARS HANGING TTY FLAGS
	LAC STEM	
	JMP I RACS	
TAPH,	0	/TAPE PHASER
	RSB	/SKIP BLANK TAPE, PICK UP LEAD SIGNAL
	RSF	
	JMP .-1	
	CLC	/TO TEST RRB
	RRB	
	SAD (-0	/DID AC CLEAR?
	JMP ER30	/NO
	SAD (770000	/IS SIGNAL OK?
	JMP I TAPH	/YES, PROCEED
ER31,	JMS RACS	/NO
	LAW EM31	
	NOP	/ALWAYS HALTS
E31,	HLT V STL	
	JMP TAPH+1	/TRY AGAIN
ER30,	JMS RACS	/RRB FAILED
	LAW EM30	
	NOP	/THIS ONE ALWAYS STOPS, TOO
E30,	HLT V STL	
	JMP TAPH+1	/TRY AGAIN
FEED,	0	/TAPE BLANKER
	DAC APTEM	
	PSA+10	
	PSF	
	JMP .-1	
	ISZ APTEM	
	JMP .-4	
	JMP I FEED	

/MAINDED 710: PAGE 6

/SECTION 2---NUMERIC SEQUENCE TEST

PUNT2,	TIN	/SECT. 2 PUNCH
	LAW P2T	
	TSR	
	LAM -50	

	JMS FEED JMS PULS	
PUSE,	LAM -2 DAC APTEM LAM -376 DAC PIX	/THREE CYCLES OF 1-377
PIX,	LAM PSA PSF JMP .-1 ISZ PIX JMP PIX ISZ APTEM JMP PIX-2 LAM -50 JMS FEED	/INDEX AND LOAD AC     /END OF CYCLE /NO /YES - END OF SEQUENCE? /NO /YES
RET2,	TIN LAW R2T TSR LAW RIP TSR IOF	/SECTION 2 TEST
B,	HLTVCLAV CLL	
	JMS TAPH LAM -2 DAC AP2	/TRY PHASING TAPE /SET UP COUNTERS
NESQ,	LAM -376 DAC APTEM JMS DELAY	
RECH,	RSA RSF JMP .-1 LAM -377 ORB SAD APTEM JMP REX	/777400 IN AC /ORS READER BUFFER INTO AC /COMPARE RESULT /OK
ER20,	JMS RACS JMP E20P JMP E20H	/NO GOOD
/MAINDEC 710: PAGE 7		
REX,	ISZ APTEM JMP RECH-1 ISZ AP2 JMP NESQ JMP B+1	/END OF CYCLE? /NO /YES. END OF TAPE? /NO /YES. GO ROUND AGAIN
E20P,	TIN LAC STEM	

AND (377                    /EXTRACT CHARACTER  
JMS OPT  
TYT  
LAC APTEM  
AND (377  
JMS OPT  
JMP RAC2

E20H,            XOR APTEM  
E20,            HLTV STL            /AC SHOWS WRONG BITS  
                  JMP REX

DELAY,            0                    /SPEED CONTROL  
                  LAS  
                  AND (177777  
                  CMA  
                  DAC AP3  
                  ISZ AP3  
                  JMP .-1  
DLOUT,            JMP I DELAY

EOP+4/  
OTY,            0                    /PRINT A CHARACTER  
                  TLS  
                  TSF  
                  JMP .-1  
                  JMP I OTY

APTEM,            0                    /ALL PURPOSE TEMPORARY STORAGE  
AP2,            0  
AP3,            0

BIP,            0                    /PUNCH BINARY CHARACTER  
                  PSB  
                  PSF  
                  JMP .-1  
                  JMP I BIP

/MAINDEC 710: PAGE 8

/ORACLES, WARNINGS, AND ANSWERS

DLOUT+1/

P1T,            TEXT -SECTION 1 PUNCH.  
-

R1T,            TEXT -SECTION 1 TEST.  
-

P2T,            TEXT -SECTION 2 PUNCH.  
-

R2T,            TEXT -SECTION 2 TEST.  
-

RIP,            TEXT                    /POSITION TAPE IN READER.  
ACS0 DOWN FOR HALTS, UP FOR NONE.

ACSI DOWN FOR PRINTING, UP FOR NONE  
ACS2-17 FOR SPEED CONTROL.

CHARACTER	
READ	EXPECTED
DCAF,	FLEX CAF /DIPT SETUPS
DRSA,	FLEX RSA
DIPT,	0
EM0,	TEXT -DID NOT CLEAR FLAG.
-	
EM02,	TEXT -RSF SKIPPED ON CLEARED FLAG.
-	
EM04,	TEXT -RRB DID NOT CLEAR FLAG.
-	
EM05,	TEXT -RSF DID NOT SKIP WHEN FLAG WAS SET.
-	
EM30,	TEXT -RRB DID NOT CLEAR AC.
-	
EM31,	TEXT -LEADER SIGNAL IS INCORRECT.
-	
EM32,	TEXT -NO INTERRUPT AFTER 10 MSEC. IS THE READER ARM DOWN?
-	
EM33,	TEXT -INTERRUPT FROM SOMETHING OTHER THAN THE READER. CHECK THE OTHER DEVICES...I/O STATUS IS IN THE AC.
-	

START

/TELETYPE OUTPUT PACKAGE 8-13-63

XIT=LAC-JMS TTAB=10

/TYPE 1 CHARACTER FROM AC BITS 12-17

TY1=JMS .

0  
DAC TY→SVAC  
RAR  
JMS TY1A  
XIT TY1  
TYEXIT

/TYPE 1 CHARACTER (5 BIT), LINK INDICATES CASE

TY1A, 0  
DAC T→EMY  
AND (37  
SNA  
JMP TY2  
703301  
SKP  
JMP TY1B

LAC OCL  
SZL  
LAC OCU  
SAD OCS  
JMP . 3  
JMS OTY  
DAC OCS  
LAC TEMY  
JMS OTY  
ISZ T BC  
TY2, LAC TEMY  
JMP I TY1A

/TYPE 3 CHARACTERS FROM AC 0-5, 6-11, 12-17 RESPECTIVELY

TY3=JMS .

0  
DAC TYSVAC  
JMS RL6  
JMS TY1A  
JMS RL6  
JMS TY1A  
JMS RL6  
JMS TY1A  
XIT TY3  
TYEXIT

/TELETYPE OUTPACKAGE PAGE 2

/TYPE A CARRIAGE RETURN, AND LINE FEED

TCR=JMS .

0  
DAC TYSVAC  
703301  
SKP  
JMP TCRA  
LAW 2  
JMS OTY  
LAW 10  
JMS OTY  
DZM TBC  
XIT TCR  
TYEXIT

/TYPE A SPACE

TSP=JMS .

0  
DAC TYSVAC  
LAW 4  
703301  
SKP



LAW 240  
JMS OTY  
ISZ TBC  
XIT TSP  
TYEXIT

/TYPE A TABULATION

TYT=JMS .

0  
DAC TYSVAC  
LAC TBC  
ADD (1  
TAD (-TTAB  
SMA  
JMP .-2  
TAD (-1  
DAC TEMY1  
LAC TYSVAC  
TSP  
ISZ TEMY1  
JMP .-2  
XIT TYT  
TYEXIT

/TELETYPE OUTPUT PACKAGE - PAGE 3

/TYPEWRITER INITIALIZE

TIN=JMS .

0  
DAC TYSVAC  
LAC OCL  
DAC OCS  
703301  
SKP  
JMP . 3  
TLS  
JMS OTY  
LAC TYSVAC  
TCR  
JMP I TIN-JMS

/TYPE THE DIGIT IN THE AC

TDIGIT=JMS .

0  
DAC TEMY1  
AND (17  
ADD (LAC NCT  
DAC . 1  
XX  
TYI

LAC TEMY1  
JMP I TDIGIT-JMS

/TYPE A STRING OF CHARACTERS

TSR=JMS .

0  
DAC T+EMY1  
LAC I TEMY1  
TY3  
AND (76  
ISZ TEMY1  
SZA  
JMP TSR+2-JMS  
LAC TEMY1  
JMP I TSR-JMS

/EXIT AFTER RESTORING AC AND LINK

TYEXIT=JMP .  
DAC TEMY  
RAL  
LAC TYSVAC  
JMP I TEMY

/TELETYPE OUTPUT PACKAGE - PAGE 4

/ROTATE LEFT 6

RL6, 0  
RTL  
RTL  
RTL  
JMP I RL6

/TABLE OF DIGITS

NCT,	33	73	63	41	25
	3	53	71	31	7

/CASE STORAGE

OCU, 33  
OCL, 37  
OCS, 0

/END OF TELETYPE OUTPUT PACKAGE

/PDP-4/7 ADDENDUM

TY1B, ADD (LAC BTATAB-1  
DAC . 1  
XX  
SZL  
JMP TY1C  
TY1D, JMS OTY  
JMP TY2-1

```
TY1C,      JMS RL6
           RTL
           RTL
           JMP TY1D
TCRA,      LAW 215
           JMS OTY
           LAW 212
           JMP TCR-JMS 10
BTATAB,    265324      /5,T
           215215      /CARRIAGE RETURN
           271317      /9,O
           240240      /SPACE
           243310      /x,H
           254316      /,,N
           256315      /.,M
           212212      /LINE FEED
           251314      /),L
           264322      /4,R
           246307      /+,G
           270311      /8,I
           260320      /0,P
           272303      /:,C
           273326      /;,V
           263305      /3,E
           242332      /$,Z
           244304      />D
           277302      /?,B
           211323      /BELL,S
           266331      /6,Y
           241306      /+,F
           257330      //,X
           255301      /-,A
           262327      /2,W
           247312      / ,J
           377377      /FIGURES
           267325      /7,U
           261321      /1,Q
           250313      /(.K
           377377      /LETTERS
```

START

OCTAL PRINT SUBROUTINE 9-26-62

/ENTER HERE TO SUPPRESS INITIAL ZEROS

```
OPT,      0
           DAC O → CN
           LAC OP3 1
           JMS OPI
           JMP I OPT
```

/ENTER HERE TO SUPPRESS INITIAL ZEROS WITH SPACES

```
OPS,      0
          DAC OCN
          LAC (JMP OP3
          JMS OPI
          JMP I OPS
```

/PRINT SUBROUTINE

```
OPI,      0
          DAC OPM 3
          LAM -5
          DAC O+PC
          LAC (SZA
          DAC OPM
```

```
OP0,     LAC OCN
          RCL
          RTL
          DAC OCN
          RAL
          AND (7
```

```
OPM,     XX
          JMP OP2
          ISZ OPC
          XX
          TDIGIT
          JMP I OPI
```

```
OP2,     TDIGIT
          LAC OPM 1
          ISZ OPC
          JMP OP0-1
          JMP I OPI
```

```
OP3,     TSP
          JMP OP0
```

/END OCTAL PRINT SUBROUTINE

START

A	145	DELAY	445
APTEM	67	DIPT	601
AP2	70	DLOUT	454
AP3	71	DRSA	600
B	403	EM0	602
BIP	72	EM02	612
BIRD	204	EM04	625
BTATAB	1177	EM05	636
COMC	247	EM30	653
DCAF	577	EM31	663

EM32	675	OTY	62
EM33	720	PALF	106
ERP	263	PEND	126
ER0	51	PICT	273
ER02	45	PIX	363
ER05	30	PUBS	117
ER1	252	PULS	131
ER20	421	PUNT1	100
ER30	334	PUNT2	351
ER31	327	PUSE	357
ER32	232	P1T	455
ER33	23	P2T	472
EOP	56	RACS	274
E01	153	RAC2	306
E02	47	RALPH	161
E03	226	RECH	412
E04	246	REFT	36
E05	32	REO	54
E1H	260	RET1	140
E10	166	RET2	375
E11	174	REX	424
E12	211	RIP	507
E13	217	RL6	1136
E20	443	R1T	464
E20H	442	R2T	501
E20P	431	STEM	272
E30	337	TAPH	315
E31	332	TBC	1304
E32	236	TCR	101026
E33	26	TCRA	1173
FEED	341	TDIGIT	101107
IAWAY	33	TEMY	1305
INRA	154	TEMY1	1303
INREB	201	TESC	223
IRET	240	TIN	101073
NCT	1143	TOUT	255
NESQ	407	TSP	101042
OCL	1156	TSR	101120
OCN	1302	TTAB	10
OCS	1157	TYEXIT	601132
OCU	1155	TYSVAC	1306
OPC	1301	TYT	101054
OPM	1264	TY1	100762
OPS	1243	TY1A	770
OPT	1236	TY1B	1160
OP0	1256	TY1C	1167
OP1	1250	TY1D	1165
OP2	1272	TY2	1012
OP3	1277	TY3	101014
ORB	700102	XIT	100000

TTAB	10
ER33	23
E33	26
ER05	30
E05	32
IAWAY	33
REFT	36
ER02	45
E02	47
ER0	51
REO	54
EOP	56
OTY	62
APTEM	67
AP2	70
AP3	71
BIP	72
PUNT1	100
PALF	106
PUBS	117
PEND	126
PULS	131
RET1	140
A	145
E01	153
INRA	154
RALPH	161
E10	166
E11	174
INREB	201
BIRD	204
E12	211
E13	217
TESC	223
E03	226
ER32	232
E32	236
IRET	240
E04	246
COMC	247
ER1	252
TOUT	255
E1H	260
ERP	263
STEM	272
PICT	273
RACS	274
RAC2	306
TAPH	315
ER31	327

E31	332
ER30	334
E30	337
FEED	341
PUNT2	351
PUSE	357
PIX	363
RET2	375
B	403
NESQ	407
RECH	412
ER20	421
REX	424
E20P	431
E20H	442
E20	443
DELAY	445
DLOUT	454
P1T	455
R1T	464
P2T	472
R2T	501
RIP	507
DCAF	377
DRSA	600
DIPT	601
EM0	602
EM02	612
EM04	625
EM05	636
EM30	653
EM31	663
EM32	675
EM33	720
TY1A	770
TY2	1012
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TY1D	1165
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OPT	1236
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OP2	1272	TY3	101014
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TYSVAC	1306	TYEXIT	601132
XIT	100000	ORB	700102

11. DIAGRAMS (Not Applicable)

12. REFERENCES (Not Applicable)