

MAINDEC 11

READ ALPHANUMERIC TEST PROGRAM

Abstract: Read Alphanumeric Test is a utility program designed to test the performance of the PDP-1 photo-electric paper tape reader during alphanumeric operation. (MAINDEC 10 is used to test the reader during binary operation.) As the reader reads a closed loop of tape, containing alternate lines of eight 1's and eight 0's $(377\ 000\ 377\ \dots)_8$ each bit is checked against data stored in core memory. The MAINDEC 11 program detects two types of reader malfunction: picking up bits, and dropping bits.

CHAPTER 1

CONSOLE OPERATING PROCEDURE

The five tables below describe the console operating procedure to be used when running the Read Alphanumeric Test program.

TABLE 1-1 TAPES REQUIRED FOR TEST

- a) Read Alphanumeric Test program tape.
- b) A closed loop of tape in binary format containing alternate lines of 1's and 0's as follows:

$(377\ 000\ 377\ \dots)_8$

TABLE 1-2 SWITCHES

Switch	Setting	Function
SENSE SWITCH 2	0	Program loops around SS2 and is ready to begin operating as soon as the closed loop of tape is loaded.
	1	Releases program from wait loop during load sequence.
TEST WORD	0XX...XXX XXX ┌ └--- sign = 0	Program delay in microseconds equal to the number (XX...XXX XXX) times 10.
	1XX...XXX XXX ┌ └--- sign = 1	Program delay equal to 10 microseconds.
ADDRESS	$(0000)_8$	Starting address of program.

TABLE 1-3 LOAD SEQUENCE

- a) Set SENSE SWITCH 2 = 0.
- b) Load Read Alphanumeric Test tape into memory (refer to PDP-1 Maintenance Manual, Chapter 11, paragraph 11-6.) At this point computer loops between locations 0000 and 0001 to allow the operator to load the next tape.
- c) Load the closed loop of alphanumeric-format tape into reader.
- d) Turn reader on.
- e) Set TEST WORD switches to 011 000...000.
- f) Set ADDRESS switches to $(0000)_8$.
- g) Set SENSE SWITCH 2 = 1. Program should begin reader test routine.
- h) If halt occurs immediately after SENSE SWITCH 2 is set to one, then the closed loop of tape was out of phase--Push START. Any subsequent halt is a legitimate error stop.
- i) Refer to Chapter 2 below for suggested test procedure.

TABLE 1-4 ERROR HALTS

Location 0030 contains the number 00377 and location 0031 contains the number 000000. After any error halt, both the AC and IO contain the last number read.

Error No.	Contents of MA	Contents of AC and IO	Cause of Error Halt
Errhlt 1	0006	000000	Reader skipped a line of the tape loop.
Errhlt 2	0006	XXXXXX	Reader picked up (or dropped) all the bits of the number "XXXXXX" that differ from 377.
Errhlt 3	0014	000377	Reader skipped a line of the tape loop.
Errhlt 4	0014	XXXXXX	Reader picked up (or dropped) all bits of the number "XXXXXX" that differ from 000.
Errhlt 5	any other address		Not a programmed error halt.

TABLE 1-5 POST-ERROR RESTART PROCEDURES

The operator should record the type of error which occurred, noting the bit or bits that were misread.

Error No.	Procedure
Errhlt 1	Depress START - any subsequent halt is a legitimate error stop.
Errhlt 2	Depress START twice - any subsequent halt is a legitimate error stop.
Errhlt 3	Depress START twice - any subsequent halt is a legitimate error stop.
Errhlt 4	Depress START - any subsequent halt is a legitimate error stop.
Errhlt 5	This halt is not part of the test program. Depress START. If the program does not run properly (i.e. neither reads the tape loop nor halts at a programmed error stop), then try reloading the program.

CHAPTER 2

SUGGESTED APPLICATION OF THE READ ALPHANUMERIC TEST PROGRAM

The following procedure is frequently a useful method of reader checkout.

a READER-OPERATION CHECK

- 1) High-speed Test - Set all TEST WORD switches to zero, and start the program. This switch setting gives the maximum read speed allowed by the program.
- 2) Brake Test - Alternate the TEST WORD switch setting between 000 000 ... 000 and 011 000 ... 000. This alternates the reader between high-speed read and slow-speed read, thereby checking the action of the reader brake.
- 3) Clutch (and Brake) Test - Set the TEST WORD switches to 011 111 ... 111. This causes the reader to perform a "rpa - stop - rpa - stop - rpa ... "sequence.
- 4) Multispeed Test - Set the TEST WORD switches to 000 ... 000 001. Change the setting to 000 ... 000 010; then to 000 ... 000 100. Continue to move the "1" left, one place at a time, until the setting is 100 ... 000 000. Allow the program to run at each of the eighteen settings.

b MARGIN CHECKS - (For detailed procedures refer to PDP-1 Maintenance Manual, Chapter 11, paragraph 11-7.)

- 1) Check the ± 10 volt margins on the reader feedhole amplifiers while repeating the reader-operation tests (a above).
- 2) Check the ± 10 volt margins on the reader information hole amplifiers while repeating the reader-operation tests (a above).
- 3) Check the ± 10 volt margins on the input mixer, and on the in-out logic while repeating the reader-operation tests (a above). Margins to both the input mixer and the in-out logic can be checked simultaneously.

CHAPTER 3

PROGRAM DESCRIPTION

Read Alphanumeric Test is a utility program designed to test the performance of the PDP-1 reader during alphanumeric operation. The reader test requires two tapes: the Read Alphanumeric Test tape which is loaded into core memory, and a closed loop of tape which is left in the reader. This tape loop contains alternate lines of eight 1's and eight 0's (377 000 377 ...)₈.

The Read Alphanumeric Test tape must be loaded into the reader with SENSE SWITCH 2 set to 0. The READ IN button is then depressed. The computer stores the program in memory, turns off the RIM flip-flop, and begins executing the stored program. The program loops around SENSE SWITCH 2; it tests the sense switch and continues to test it so long as the switch is off, without going any further into the program. This gives the operator time to unload the Read Alphanumeric Test tape and load the closed tape loop into the reader. After the closed tape loop is properly loaded, the sense switch should be turned on; the stored program then executes the reader test routine.

This test routine assumes that the first number read is 377. When the tape loop is loaded so that 377 reads first, the tape is said to be in phase. Because the tape loop consists of alternate lines of 377, then 000, then 377, etc., it is equally probable that the first number read be 000 instead of 377. But when the first number read is 000 the next number read must be 377.

If the tape loop is loaded out of phase, the computer halts immediately when SENSE SWITCH 2 is turned on. (This is not an error halt.) After the halt the tape loop is in phase. The START button is then pushed, and any further halts are legitimate error stops.

The test routine begins by executing an "rpa" command. On an "rpa" command the reader reads eight bits, and transfers them, through the reader buffer to bits 10-17 of the IO; bits 0-9 of the IO are cleared. The contents of IO are transferred to AC, where the 8 bits read are checked against a number stored in a core register. If the contents of the accumulator do not equal the contents of the core register, then a reader error has occurred and the program halts the computer. On the other hand, if the contents of the accumulator and the memory

register are equal, then the reader has read correctly and the program enters a COUNT loop. The COUNT loop is set up after each "rpa" command. The program stores the complement of the TEST WORD switches in memory location COUNT and then uses this memory register as a binary counter. The time required to increment the counter to any positive number determines the tape loop speed. The counter is incremented by 1's and each increment takes 10 micro-seconds. Thus, the TEST WORD switches on the right have the least control over loop speed. After completing the COUNT loop the program executes another "rpa" command. The procedure after every "rpa" command is exactly as described above. The program therefore runs until a reader error is encountered or until the operator halts the machine.

The program actually has two "rpa" commands which are iterated as the program loops; the first "rpa" tests for the number 377, and the second tests for the number 000. The only two programmed halts are for reader errors. These cause the machine to halt at either location 0006 or location 0014. A machine halt at any other location is not part of the program.

If the machine halts at location 0006, the number read should have been 377. On the other hand, if the machine halts at location 0014, the number read should have been 000. The number 377 is in memory location 0030, and the number 000 is in memory location 0031. After an error halt, both the AC and the IO contain the number actually read. The operator should record the type of error that occurred, noting the bit or bits which were read incorrectly.

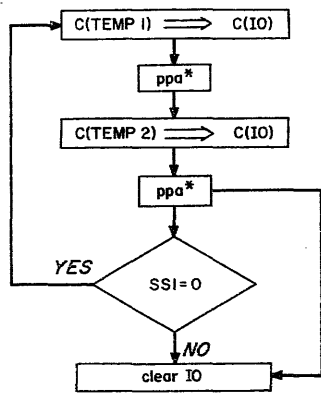
To restart the program after a reader error halt, the operator should push the START button. It may be necessary to push this button twice to restart the program (depending on the phasing of the tape loop).

If the error halt is at location 0006, the tape loop is positioned so that the next number read is 000. When START is pushed, the test routine checks for 377. The machine therefore halts immediately at location 0006, leaving the tape loop positioned to read 377. When START is again depressed, the program tests for this number. Any subsequent error halt is legitimate.

When the error halt is at location 0014, the tape loop is positioned to read the number 377. Depressing START causes the program to test for this number, and any subsequent halt is a legitimate error stop.

There is one exception to the restart sequence described above. This exception occurs when the reader skips a line of the tape loop. In that case, the number read is the complement of the number which should have been read. The restart procedure is then exactly reversed: START is pushed once on a location 0006 halt, and pushed twice on a halt at location 0014.

Complete listings are given below both for the Read Alphanumeric Test program, and for the auxiliary program which generates the tape loop. Detailed flow charts of these two programs are included in Figure 3-1.



AUXILIARY PROGRAM TO GENERATE TEST TAPE

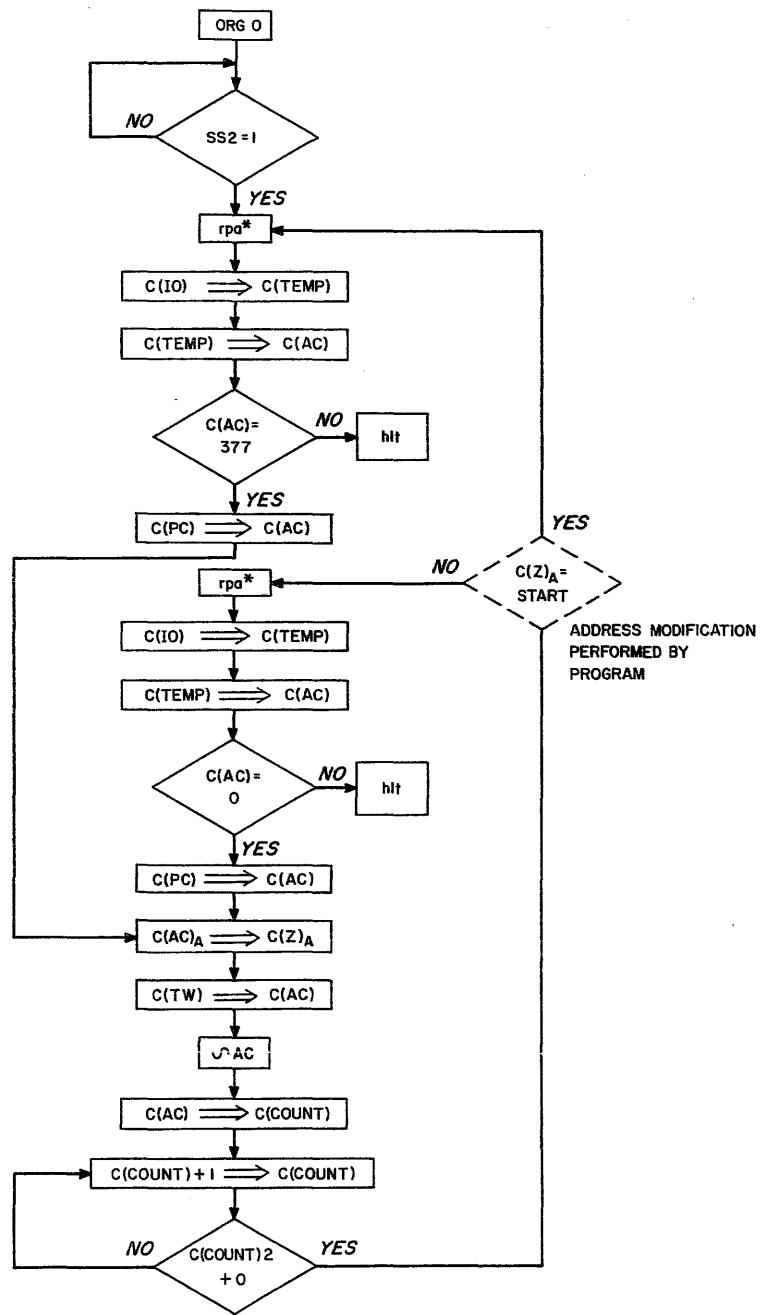


Figure 3-1 MAINDEC 11 - Read Alphanumeric Test

PROGRAM LISTING

MAINDEC 11 READ ALPHANUMERIC TEST PROGRAM

Location	Contents	Mnemonic Code	Remarks
0000	650020	szs * 20	Starting address 0000
0001	600000	jmp 0000	Program loops here until SS2 is turned on. Used only for loading program.
0002	730001	rpa *	Reads 1 line of tape, in alphanumeric mode, and waits for completion pulse.
0003	320027	dio 0027	Number is read into IO ₁₀₋₁₇ and IO ₀₋₉ are cleared. The IO is transferred to AC.
0004	200027	lac 0027	
0005	520030	sas 0030	Checks number read by skipping next instruction if contents of AC equal 377 (the contents of location 0030).
0006	760400	hlt	Reader error. Number read incorrectly is in both AC and IO. Check number is in location 0030.
0007	620020	jsp 0020	Jumps to location 0020 (subroutine which controls time delay).
0010	730001	rpa *	Reads number into IO and AC.
0011	320027	dio 0027	
0012	200027	lac 0027	
0013	520031	sas 0031	Checks number read against location 0031.
0014	760400	hlt	Reader error. Check number is in location 0031.

PROGRAM LISTING

MAINDEC 11 READ ALPHANUMERIC TEST PROGRAM (continued)

Location	Contents	Mnemonic Code	Remarks
0015	620020	jsp 0020	
0016	600002	jmp 0002	Loops back to start of test routine at location 0002.
0017	000000		Used as binary counter to control time between "rpa" commands. Initial contents are not used.
0020	260026	dap 0026	Sets address for "jmp" command located in 0026.
0021	762200	lat	Initializes the binary counter (location 0017) using the complement of the TEST WORD switches.
0022	761000	cma	
0023	240017	dac 0017	
0024	460017	isp 0017	Increments location 0017 by 1. If, after incrementing, the contents of this location are positive, then the next instruction is skipped.
0025	600024	jmp 0024	Loops back until counter is incremented to a positive number.
0026	600000	jmp - - - -	Jumps to "rpa" command in location 0002 if last "rpa" was from 0010 and vice-versa.
0027	000000		Used as temporary storage. Initial contents not used.
0030	000377		Number used to check "rpa" in location 0002.
0031	000000		Number used to check "rpa" in location 0010.

PROGRAM LISTING

MAINDEC 11 AUXILIARY PROGRAM TO GENERATE TEST TAPE

Location	Contents	Mnemonic Code	Remarks
0000	220007	lio 0007	Loads IO ₁₀₋₁₇ with number 377 and punches
0001	730005	ppa *	the number in alphanumeric mode.
0002	764000	cli	Clears IO and punches the number 000
0003	730005	ppa *	in alphanumeric mode.
0004	650010	szs * 10	To punch leader or trailer for tape, turn on SS1.
0005	600000	jmp 0000	Loops back to start of punch routine.
0006	600003	jmp 0003	Loops for leader and trailer punching.
0007	000377		Numbers which are punched on tape.