



HP 2100A TAPE READER TEST

Order No. HP 24189



11000 Wolfe Road
Cupertino, California 95015

Manual of Diagnostics
HP 5951-1363

April 1971



HP Computer Museum
www.hpmuseum.net

For research and education purposes only.

HP 2100A TAPE READER TEST

The Tape Reader Test program confirms proper operation of a punched tape reader (HP 2748 or HP 2758) and interface kit (HP 12597A-002) with an HP 2100A computer. If any operational errors are found, the program may be used to isolate the problem.

HARDWARE REQUIREMENTS

This diagnostic program is used in the 2100A computer. A teleprinter must be used to report errors and messages to the user and to punch test tapes.

FUNCTIONAL AND OPERATIONAL CHARACTERISTICS

The SIO teleprinter driver is loaded and configured first. The diagnostic program is loaded, configured, then started. It first performs a Functional Test in which the basic functions of the tape reader are checked:

- Initialization of the interface board by the computer EXTERNAL PRESET button.
- Proper command responses by the interface board and the computer I/O control circuits.
- Operation of the interrupt control circuits.

After the Functional Test is complete, the program halts to allow switch register settings to select program options (see Table TRT-2) for the start of the Operational Test. First, a standard test data tape is punched on the teleprinter, then read to test the tape reader and the interface board for data transfer. If any errors are found, the Operational Test may be used to punch then read a special test data tape to isolate any transfer problem. If a trap cell halt occurs, the computer halts with 1020xx (xx = trap cell location) in MEMORY DATA Register. The cause is determined by the user; after the error is corrected, the diagnostic is restarted.

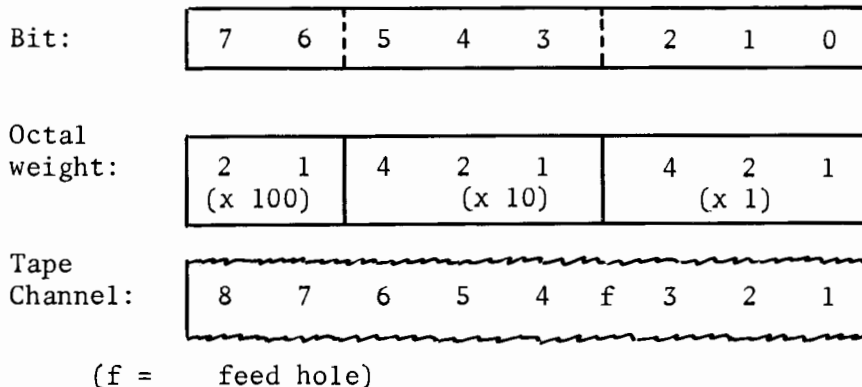
TEST DATA TAPES

The contents of the standard test data tape are defined in the diagnostic program. Those contents are three identical 55 character data records (separated by at least 15 blank feed-frames) that present the most difficult data patterns for both continuous and start-stop reading of tapes. The 55 character data records are described below and in Table TRT-1.

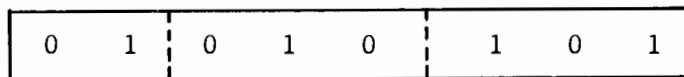
The contents of the special test data tape are determined by the user, according to errors reported when the diagnostic program reads the standard test data tape. This tape contains one character punched repetitively until a desired length of tape is reached. Several special test data tapes (each for a different character) may be punched then read to check reader operation.

Standard Test Data Records

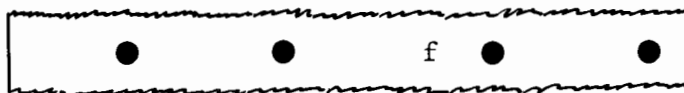
Each of the three 55 character data records in the standard test data tape contains bits 7 through 0 of 55 words punched into tape channels (punch levels) as follows:



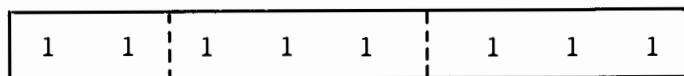
Thus, the octal value 125_8 is set into bits 7 through 0 as:



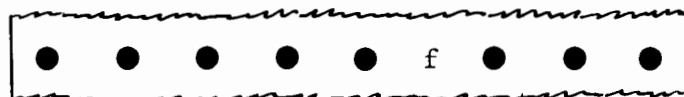
and punched as a tape character:



Or, the octal value 377_8 is set into bits 7 through 0 as:



and punched as a tape character:



Each of the 55 characters in the three standard test data records is identified either as a "single character" (SC) or a "character" (FC = first character, xx = character number, LC = last character) within one of four "test blocks" (TBx = test block number x). (See Table TRT-1.)

Standard Test Data Additional Tests

When the standard test data tape is read, the tests listed below are made if program option bit 1 (in the switch register) is set off. The tests are bypassed by setting program option bit 1 on. (When the special test data tape is read, these tests should be bypassed; they are not useful then.)

1. Between the following characters (see Table TRT-1) the program stops then restarts the reader:

1 and 2	12 and 13	40 and 41
2 and 3	13 and 14	45 and 46
3 and 4	33 and 34	46 and 47
4 and 5	34 and 35	49 and 50
		52 and 53

These tests check the reader's control circuits.

2. Between the following characters the program inserts one of four delay times:

47 and 48	51 and 52
48 and 49	53 and 54
50 and 51	54 and 55

The four delay times are:

1. During the first, fifth, ninth, etc. reading of a 55 character record, 0.5 milliseconds.
2. During the second, sixth, tenth, etc. reading, 0.75 milliseconds.
3. During the third, seventh, eleventh, etc. reading 1.00 milliseconds.
4. During the fourth, eighth, twelfth, etc, reading, 1.25 milliseconds.

The delay is between the flag signal and the drive signal, to check the reader's response time.

Special Test Data

The special test data, determined by the user, consists only of continuous repetition of any character on the punched tape. The same assignments of octal digits to tape channels are used. The user specifies any character in switch register bits 15 through 8 when he selects the program options to punch then read the special data test tape. (See Table TRT-2.)

Error Reports

If an error is detected during the Functional Test, the program prints a message on the teleprinter then continues. After all functional checks have been made, the Functional Test prints its completion message. All Functional Test messages and their meanings are listed in Table TRT-3.

If an error is detected during the Operational Test while reading the standard test data tape, the program prints a two-line message:

```
G vvvvvvvv  
B vvvvvvvv ww xx yyyy zzzzzzzzzz
```

Where:

G vvvvvvvv = the correct character that should have been transmitted,

B vvvvvvvv = the incorrect character transmitted by the reader,

ww = the character number (see Table TRT-1) within the field of 55 characters,

xx = the identity of the character (see Table TRT-1);

FC = first character of a test block,

Ø3 = (for example) character #3 of a test block,

LC = last character of a test block,

SC = a single character (not part of a test block),

yyyy = the flag-to-drive delay time in milliseconds (see Standard Test Data Additional Tests),

NOTE: This field is not printed if there is no delay.

zzzzzzzzzz = the type of error:

BIT ERROR = one or more bits have been missed, but the sequence of reading is correct.

NOTE: After three "BIT ERROR" messages are printed followed by a "RESYNC" message, the program skips the tape through the next field of blank feed-frames to start reading a new record.

REREAD CH = the character transmitted is identical to the last one transmitted. This causes the program to print "RESYNC" then skip through the next field of blank feed-frames to start reading a new record.

MISSED CH = the character just read is out of proper sequence. This causes the program to print "RESYNC" then skip through the next field of blank feed-frames to start reading a new record.

If an error is detected while reading a special test data tape, the program prints a short two-line message:

G vvvvvvvv

B vvvvvvvv

Where:

G vvvvvvvv = the correct character that should have been transmitted,

B vvvvvvvv the incorrect character transmitted by the reader.

OPERATING INSTRUCTIONS

- a. If the tape reader to be tested is in good operating condition and this program is only to confirm that condition, skip to step c and use that reader to load the program. Otherwise, the teleprinter tape reader mechanism should be used to load the program, beginning with step b.
- b. Check the type of loader program by displaying the contents of location $0x7701_8$ ($x = 0$ for a 4K memory, 1 for an 8K memory, 3 for 16K, etc). If the contents are 063770_8 , the Basic Binary Loader (BBL) is in core; if the contents are 002401_8 , the Basic Binary Disc Loader (BBDL) is in core. Accordingly, in one of the following sets of locations change bits 5 - 0

(but no other bits) to the select code of the teleprinter rather than the punched tape reader):

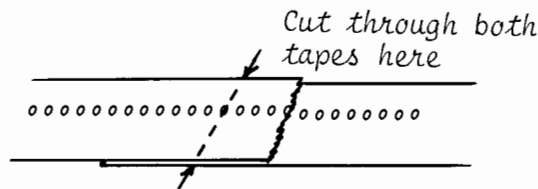
<u>BBL</u>		<u>BBDL</u>	
<u>Location</u>	<u>Content</u>	<u>Location</u>	<u>Content</u>
0x7763	1067cc	0x7744	1037cc
0x7764	1023cc	0x7745	1023cc
0x7766	1025cc	0x7747	1074cc



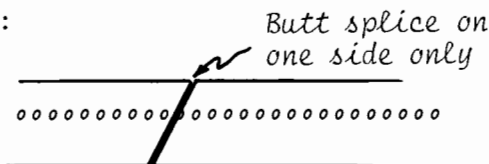
(cc = select code of teleprinter or punched tape reader.)

- c. Place the SIO teleprinter driver tape in the tape reader device to be used (see steps a and b) and ready that reader.
- d. Use the Basic Binary Loader or the Basic Binary Disc Loader to load the driver, then configure that driver.
- e. Place the HP 2100A Tape Reader Test tape in the tape reader device to be used (see steps a and b) and ready that reader.
- f. Load the tape using the Basic Binary Loader or Basic Binary Disc Loader.
- g. Set the starting address 2_8 .
- h. Set the tape reader select code (I/O address) in bits 5-0 of the switch register.
- i. Press RUN. The diagnostic halts with 102000_8 in MEMORY DATA when the configuration is complete. Use the SIO System Dump program to punch copies of the configured driver and test, if wanted.
- j. Load any binary punched tape in the reader, press EXTERNAL PRESET, then RUN to execute the functional test section. Upon completion, the program types out "FUNCTIONAL TEST COMPLETE" and halts with 102001_8 in MEMORY DATA. From this point on, the Operational Test executes according to program options selected by the user through switch register settings listed in Table TRT-2.

- k. If a standard test data tape has not yet been punched, set switch register (program option) bit 0 only on then perform steps l through p. Otherwise, skip to step q.
- l. Perform the following steps to punch a length of blank (feed-frames only) tape on the teleprinter:
 - 1. Turn off the tape punch unit (on an HP 2752, press the OFF button; on an HP 2754, set the MODE switch to K).
 - 2. Set the teleprinter to LOCAL.
 - 3. Turn on the tape punch unit (on an HP 2752, press the ON button; on an HP 2754, set the MODE switch to T).
 - 4. Punch at least three inches of blank tape. (On an HP 2752, press the HERE IS key as many times as needed; on an HP 2754, press and hold four keys in this order: SHIFT, CTRL, @, and REPT as long as needed.)
 - 5. Turn off the tape punch unit (as in step l-1).
 - 6. Set the teleprinter to LINE.
- m. Turn on the teleprinter tape punch unit (as in step l-3).
- n. Press RUN. The program punches the standard test data tape then halts.
- o. Perform step l again, to punch a length of trailer tape, then proceed to step p.
- p. Form the standard test data tape into a loop:
 - 1. Overlap the ends of the tape by at least five blank feed-frames, carefully to align the holes, then cut through the overlap diagonally:



- 2. Butt splice the diagonal cut ends with clear mending tape on one side only:



- q. Place the looped standard test data tape into the tape reader to be tested then ready that reader. Be sure the tape is properly positioned (the feed holes are nearest the reader panel and the printed arrow points from left-to-right).
- r. Set all switch register bits off.
- s. Press RUN. The program reads the standard test data tape continuously with stop-start and flag-to-drive delay tests.
- t. After allowing the tape loop to be read at least twice, set switch register bit 1 on to switch the program to the "No-stop Read" mode. Tape reading continues but without the stop-start and delay tests.
- u. When wanted, terminate the standard test data tape reading by setting switch register bit 4 on. The program prints "-TERMINATE-" on the teleprinter then halts.

If no errors were reported during steps t and u, the tape reader has been throughly tested and the program may be considered complete.

If errors were reported, one or more special test data tapes may now be prepared then read to test any particular character.

Proceed to step v.

- v. To punch a special test data tape, set all switch register bits off then set bits 0 and 2 on and set bits 15 through 8 for the desired character (see Table TRT-2).
- w. Perform step l, then proceed to step x.
- x. Press RUN. The program types "TAPE LENGTH?". Type in the desired loop length number (between 10 and 99 inches) followed by pressing the return and linefeed buttons. The program types "TURN ON TTY PUNCH. PRESS RUN" and halts with 102002_8 in MEMORY DATA.

- y. Press RUN. The computer punches the desired length of the tape plus leader and trailer and then halts. Turn off tape punch (HP 2752) or set MODE switch to K (HP 2754).
- z. Form the special test data tape into a loop:
 - 1. The special test data tape must not have any blank feed-frames, so overlap the ends of the tape by at least five data frames. Carefully align the punched holes, then cut through the overlap diagonally, as shown in step p-1.
 - 2. Butt splice the diagonal cut ends with clear mending tape on one side only, as shown in step p-2.
- aa. Place the looped special test data tape into the tape reader to be tested then ready that reader. Be sure the tape is properly positioned (the feed holes are nearest the reader panel and the printed arrow points from left-to-right).
- bb. Set switch register bits 1 and 2 on. (Switch 0 off.)
- cc. Press RUN. The program reads the special test data tape continuously until terminated by setting switch register bit 4 on.

NOTE: Errors may be reported when the area of tape where the splice is located is read. This cannot be avoided, either because the splicing tape picks up dust or the splice may not quite exactly align the holes. Ignore such error reports. If many error messages are being printed, avoid all error messages by setting program bit 6 on. This will enable an oscilloscope to be used to monitor the tape reader and interface board circuits.

- dd. When wanted, terminate the special test data tape reading by setting switch register bit 4 on. The program prints "-TERMINATE-" on the teleprinter then halts.

Now the program may be directed to read the standard test data tape again or to punch then read another special test data tape.

- ee. To read the standard test data tape again, perform steps q through u.
- ff. To punch then read another special test data tape, perform steps v through dd.

Additional Operating Instructions

- a. During reading of the standard test data tape, if errors are being reported, switch register bit 5 may be set on. The program pauses in a waiting loop after the next RESYNC message is printed. This pause allows any changes to be made (such as placing another standard test data tape into the reader), after which the program may be resumed by setting that bit 5 off.
- b. If a pause is needed when reading a special test data tape, switch register bit 3 may be set on. The program enters a waiting loop; the program can be resumed by setting that bit off.
- c. The program can be set to perform an additional test of interrupt control during reading of either the standard or special test data tape. Set switch register bit 7 on, then start the reading.

If the interface board fails this interrupt control test, the program loops with 177777_8 in the B-Register.

Table TRT-1

Standard Test Data Records Contents

Character Number	Identity	Octal value	Character Number	Identity	Octal value
1	SC	377	29	16 (TB2)	102
2	SC	201	30	17 "	044
3	SC	125	31	18 "	030
4	SC	252	32	LC "	231
5	FC (TB1)	333	33	SC	044
6	Ø2 "	155	34	SC	102
7	Ø3 "	066	35	FC (TB3)	201
8	Ø4 "	033	36	Ø2 "	377
9	Ø5 "	204	37	Ø3 "	252
10	Ø6 "	037	38	Ø4 "	125
11	Ø7 "	340	39	Ø5 "	250
12	LC "	377	40	LC "	377
13	SC	127	41	FC (TB4)	000
14	FC (TB2)	201	42	Ø2 "	347
15	Ø2 "	102	43	Ø3 "	122
16	Ø3 "	145	44	Ø4 "	255
17	Ø4 "	132	45	LC "	211
18	Ø5 "	347	46	SC	152
19	Ø6 "	030	47	SC	235
20	Ø7 "	377	48	SC	052
21	Ø8 "	132	49	SC	367
22	Ø9 "	245	50	SC	010
23	10 "	030	51	SC	167
24	11 "	102	52	SC	030
25	12 "	044	53	SC	245
26	13 "	030	54	SC	044
27	14 "	201	55	SC	333
28	15 "	245			

NOTE: Each 55 character record is separated from another by at least 15 blank feed-frames.



Table TRT-2

Program Options -- SWITCH REGISTER Settings

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
----	----	----	----	----	----	---	---	---	---	---	---	---	---	---	---

<u>Bit</u>	<u>Function</u>
0	PUNCH OR READ. Set on to punch, set off to read.
1	READ MODE. Set off to read with stop-start and delay tests, set on to read in the No-stop mode. Can be changed during the run.
2	TEST DATA. Set off to use standard data, set on to use special data as set into bits 15 through 8.
3	PAUSE.* Set off when the Operational Test is started. Can be set on while reading to pause the program momentarily. Set off to resume the program.
4	TERMINATE*. Set off when the Operational Test is started. To terminate the test, set this bit on. See "Operating Instructions" for full details.
5	PAUSE AFTER NEXT RESYNC. Set off when the Operational Test is started. Can be set on while reading the standard test data tape, to pause the program after the next "RESYNC" message is printed.
6	BYPASS ERROR MESSAGES. Set off when the Operational Test is started. Can be set on at any time to bypass all error messages. See "Operating Instructions" for full details.
7	TEST INTERRUPT CONTROL. Set on to include the additional test of interrupt control, as described in "Additional Operating Instructions;" set off to bypass the additional test.
8 - 15	SPECIAL DATA CHARACTER. Set before starting to punch or read a special test data tape, to specify the character to be used. Each bit set on is punched, bits 15 through 8 correspond to punch levels 8 through 1, respectively.

**PAUSE and TERMINATE take effect immediately when performing special tape functions, but only after every fourth data record when reading the standard test data tape.*

Table TRT-3
DIAGNOSTIC MESSAGES - FUNCTIONAL TEST

<u>Message</u>	<u>Comments</u>
BIT ERROR	A character read is in error (one or more bits dropped, for example), but the sequence of reading is correct. Three consecutive BIT ERROR messages are typed out if two or more characters are skipped.
FUNCTIONAL TEST COMPLETE	The functional test of the interface card is completed.
INTERRUPT ON PRESET (CONTROL)	An interrupt occurred in the preliminary steps of the functional test on the interface card. If there were no error type-outs prior to this, the control FF on the interface card was not reset when the EXTERNAL PRESET switch was pressed at the beginning of the test.
INVALID INPUT	An integer between 10 and 99 was not typed in after the tape length request. The tape length message is repeated.
MISSED CH	The character just read is out of place so it is assumed that at least one character was skipped. This is generally caused by feedhole phototransistor sensitivity or improper setting of pinch roller tension. Following this type-out, a RESYNC message is typed, the program automatically positions the test tape to the next group of leader characters, and the testing is restarted.

Table TRT-3 (cont.)

<u>Message</u>	<u>Comments</u>
NO NORMAL INTERRUPT	An interrupt signal was not received from the interface card within 30 milliseconds after the drive signal was sent to the tape reader. If there were no error type-outs prior to this, the circuits in the tape reader which supply the flag signal to the interface card or the interrupt logic on the interface card are suspected.
READER CLF ERROR (CLF OR SFC)	The flag FF on the interface card did not respond to a clear flag (CLF) instruction, or the skip on flag clear (SFC) instruction used in testing the flag FF did not function properly on the interface card.
READER FLAG OFF - PRESET	The flag FF (reader flag) on the interface card did not set when the EXTERNAL PRESET switch was pressed.
READER STF ERROR (STF OR SFS)	The flag FF on the interface card did not respond to a set flag (STF) instruction, or the skip on flag set (SFS) instruction used in testing the flag FF did not function properly on the interface card.
REREAD CH	The character read is identical to the last character read, so it is assumed to be a reread of that character. This is generally caused by tape reader noise. Following this type-out, a RESYNC message is typed, the program automatically positions the test tape to the next group of leader characters, and the testing is restarted.

Table TRT-3 (cont.)

<u>Message</u>	<u>Comments</u>
RESYNC	Character sequence errors or three consecutive bit errors have been detected. The program automatically positions the test tape to the next group of leader characters, and the testing is restarted.
TAPE LENGTH?	When punching the special test tape, the program requests the length desired. The length must be in integer inches between 10 and 99.
-TERMINATE-	Switch 4 of the computer switch register is placed in the on position and the test is terminated. The test can be continued if the computer RUN switch is pressed.
TURN ON TTY PUNCH. PRESS RUN.	Occurs before the punching of the special test tape on the Teleprinter Punch. The computer halts with 102002 in MEMORY DATA.