

HP 2100A ASYNCHRONOUS CHANNEL MULTIPLEXER TEST



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HP 2100A ASYNCHRONOUS CHANNEL MULTIPLEXER TEST

This diagnostic confirms the proper operation of the HP 12921A Multiplexer Data Interface board and the data send/receive lines through the 30062A Communications Multiplexer panel for the HP 2100A computer.

The program provides convenient modes of testing. The operator can repeat each function test within the diagnostic as often as desired; or he can run the entire program, stopping at the end of each function test to evaluate the results.

OPERATING ENVIRONMENT

This diagnostic requires an HP 2100A Computer running under the control of a HP 2000C, HP 2000E or HP 2000F Time-Shared BASIC System. The HP 2000E system uses only one 2100A computer. The HP 2000C and HP 2000F systems use two 2100A computers, one as the Central Processor and the other as the I/O Processor.

Before using the diagnostic, the HP 30062-60003 test cable(s) must be connected to the HP 30062A Communications Multiplexer panel.

On the HP 2000E system, a teleprinter can be used to report errors or diagnostic messages. On the HP 2000C and HP 2000F systems (and on the HP 2000E system if no teleprinter is available) errors and messages are reported by coded displays in the computer MEMORY DATA Register.

FUNCTIONAL AND OPERATIONAL CHARACTERISTICS

If a teleprinter is to be used (HP 2000E system only), the SIO teleprinter driver must be loaded and configured before the diagnostic is loaded. The operator then loads the program tape and configures the program for the I/O select code of the multiplexer interface board by setting the switch register according to Table MDI-1.

NOTE: To avoid reconfiguring the diagnostic program (and the teleprinter driver) for each use, run the SIO System Dump program to punch a copy of the configured teleprinter driver and the configured diagnostic program.

Run Modes

After the diagnostic program has been loaded and configured (or a configured diagnostic tape has been loaded), the user decides in which of two possible modes the diagnostic is to run.

Mode 1

Mode 1 tests two channels. The user attaches the HP 30062-60003 test cable to the two channels on the multiplexer panel (Figure MDI-1). He indicates which pair of channels the program is to test by setting the switch register according to Table MDI-2. The channels tested can be changed by returning to the CFGCH routine and setting new channel numbers into the switch register according to Table MDI-2.

Mode 2

Mode 2 tests all 16 send/receive channels (eight pairs) in sequence. The user must obtain seven additional HP 30062-60003 test cables and connect them according to Figure MDI-2. To indicate that the diagnostic is to test all 16 multiplexer channels, set on bit 15 of the switch register (Table MDI-2).

Before running the diagnostic, initiate run options (such as suppressing error messages and repeating function tests) by setting the switch register according to Table MDI-3.

Diagnostic Errors

If any errors are detected during execution, the program types a message (if error messages are not suppressed) and halts with an error halt displayed in the computer MEMORY DATA Register. Exceptions: trap cell and configuration halts do not include messages.

Trap cell halts are not recoverable. The cause of a trap cell halt (beyond the scope of this diagnostic) should be determined before restarting the diagnostic.

When a teleprinter is not available and the program halts, the halt code is displayed in the MEMORY DATA Register. Data displayed to the operator is contained in the computer A- and/or B-registers. Consult Table MDI-4 for the meaning of the A- or B-register contents.

PROGRAM ORGANIZATION

The diagnostic program consists of the following test routines.

TWP This bootstrap routine transfers the diagnostic program into the I/O Processor from the Central Processor computer. In the HP 2000C and HP 2000F systems, the TWP routine is read into the Central Processor through the photoreader. Then the rest of the diagnostic program tape is read and the program transferred to the I/O Processor. The bootstrap reads one character at a time and passes it to the I/O Processor Basic Binary Loader on one of the communications channels. The bootstrap routine is not used in the HP 2000E system; no separate I/O Processor exists.

CFGIO Reads the switch register settings and configures the diagnostic for the proper I/O select code, with or without teleprinter.

CFGCH Reads the switch register and configures the diagnostic to test the two multiplexer channels indicated (Mode 1) or, if switch register bit 15 is set on, configures the diagnostic to test all channels in sequence (Mode 2).

INIT Sets all trap cell halts in locations 2_8 through 77_8 . Types the starting message on the teleprinter (if program option bit 9 is set off).

BI/O Clears the multiplexer interface I/O logic, checks all flag instructions and the ability to enable and disable interrupts. BI/O then forces an interrupt, checks the interrupt return address and whether the interrupt was acknowledged. Then BI/O checks the control reset instructions and, if switch register bit 10 is set on, the PRESET switch tests (flag set, interrupt disable and control clear).

SEND/
RECEIVE Sends and receives a variable-length bit pattern of alternating ones and zeros on the two channels specified during the CFGCH routine or on all 16 channels in sequence (if Mode 2 was chosen). The send and receive channels operate at a maximum of 2400 baud and a maximum character size of nine data bits plus two stop bits. The test is then repeated using the complement of the data pattern. In each send and receive test, the flag is checked for operation complete and the unit number is checked for correct channel interrupt.

BREAK Sends and receives a non-zero test character on a channel and checks that the break bit (bit 2 of the status word) is set to zero after each send and receive. Then BREAK sends a break character (all zeros) on a channel and checks that the break bit of the status word is set to one.

PARITY Sends and receives odd ASCII parity and checks bit 15 of the receive word for one. PARITY then sends and receives even ASCII parity and checks bit 15 of the receive word for zero.

DIAGNOSE Tests the ability to route send data through auxiliary channels 16 through 20 when bit 11 (diagnose bit) of the send parameter word is set to one, and tests the ability to route received data to the auxiliary channels 16 through 20 when bit 11 (diagnose bit) of the receive parameter word is set to one.

ECHO Receives a test character on a channel with bit 12 (echo bit) of the receive parameter word set to one, and echos the character back through the corresponding send channel.

SYNC Sets bit 11 (sync bit) of the send parameter word to one, then sets all data bits to one. The all ones character is sent. SYNC checks to insure that the receive channel does not interrupt.

CHARACTER LOST Sends two characters to a receive channel without responding to the first interrupt. This condition is flagged by setting bit 1 (character lost) of the status word to one.

OPERATING INSTRUCTIONS: HP 2000E SYSTEM



- a. Halt the HP 2100A computer.
- b. If a configured version of the diagnostic tape is available, skip directly to step i below.
- c. Use the Basic Binary Disc Loader (BBDL) to load the SIO teleprinter driver (if the teleprinter is to be used) and configure that driver. Consult Software Operating Procedures, *HP 2100A FRONT PANEL PROCEDURES* (HP 5951-1371).
- d. Use the BBDL to load the HP 12921A Asynchronous Multiplexer Test tape.

NOTE: The first foot of the test tape contains the bootstrap routine for the HP 2000C and HP 2000F systems. This routine may be skipped by placing the tape in the photo-reader behind the bootstrap routine so it will not be loaded.

- e. Set a starting address of 2_8 .

- f. Set the switch register to the octal I/O select code used by the multiplexer interface board, according to Table MDI-1.
- g. Press RUN. The computer halts with 107076_8 displayed in the computer MEMORY DATA Register.
- h. If desired, use the SIO SYSTEM DUMP program to punch a copy of the configured diagnostic (and SIO teleprinter driver if it was loaded in step c). If a copy is not desired, skip this step and continue with step j.
- i. Use the BBDL to load the configured diagnostic tape.
- j. Set the switch register to the octal representations of the decimal send/receive channel numbers to be tested (for two-channel testing) or set on switch register bit 15 if all 16 send/receive channels are to be tested (see Table MDI-2).
- k. Install the test cable to the multiplexer channels chosen in step j. If all 16 channels are to be tested (bit 15 set on in step j) install eight test cables according to Figure MDI-2. If only two channels are to be tested, install one test cable according to Figure MDI-1.
- l. Press RUN. The computer halts with 107077_8 displayed in the MEMORY DATA Register.
- m. Set the switch register for the desired program run options, according to Table MDI-3.
- n. Press RUN.
 1. If program option bits 9 and 11 are set off, the diagnostic types a message (Table MDI-4, message H8) and starts the first test.
 2. To access a specific test, set program option bit 15 on. The program halts at the end of each test and prints out a message on the teleprinter, if one is available. Set program option bits 11 and 14 on to suppress both error messages and halts until the desired test is reached. When the desired test is reached, set bit 13 on to loop through the test. Set bit 13 off to advance the program to the next test after execution of the current test.

3. Set program option bit 12 on to halt program execution after one complete cycle of the program. Press RUN. If bit 8 is set on, the program loops back to the CFGCH routine and halts with 107073_8 displayed in the MEMORY DATA Register. If bit 8 is set off, the program loops back to the BI/O routine.
4. To reconfigure the diagnostic for a new I/O select code for the multiplexer interface board, set a starting address of 111_8 and perform steps f through n.
5. To restart the diagnostic without reconfiguring, set a starting address of 110_8 and perform steps m through n.

OPERATING INSTRUCTIONS: HP 2000C AND HP 2000F SYSTEMS

- a. Halt both the Central Processor and the I/O Processor.
- b. Using the Basic Binary Disc Loader (BBDL) and the photoreader for the HP 2100A Central Processor, load the HP 12921A Asynchronous Multiplexer Test tape. The computer halts with 102077_8 displayed in the MEMORY DATA Register after one foot of the tape (containing the TWP bootstrap routine) has been read. Consult Software Operating Procedures, *HP 2100A FRONT PANEL PROCEDURES* (HP 5951-1371).
- c. Set a starting address of 2_8 in the HP 2100A Central Processor.
- d. Press INTERNAL PRESET, EXTERNAL PRESET then press RUN on the Central Processor. The bootstrap program runs in a loop waiting for step e.
- e. Start execution of the Basic Binary Loader in the I/O Processor. The Central Processor resumes reading the HP 12921A diagnostic tape. When the entire tape has been loaded, the I/O Processor halts with 102077_8 in the MEMORY DATA Register. The Central Processor bootstrap program continues to loop. The Central Processor is no longer used, and may be ignored.

PERFORM THE REMAINING STEPS USING THE I/O PROCESSOR

- f. Set a starting address of 2_8 .

- g. Configure the diagnostic program by setting the switch register to the desired I/O select code as shown in Table MDI-1. Bit 9 must be set on to indicate that no teleprinter is available.
- h. Press RUN. The computer halts with 107076_8 displayed in the MEMORY DATA Register.
- i. Set the switch register to the octal representation of the decimal send/receive channel numbers to be tested (for two-channel testing) or set on switch register bit 15 if all 16 send/receive channels are to be tested (see Table MDI-2).
- j. Install the test cable to the multiplexer channels chosen in step i. If all 16 channels are to be tested (bit 15 on in step i) install eight test cables according to Figure MDI-2. If only two channels are to be tested, install one test cable according to Figure MDI-1.
- k. Press RUN. The computer halts with 107077_8 displayed in the MEMORY DATA Register.
- l. Set the switch register for the desired run options according to Table MDI-3.
- m. Press RUN.
 1. To access a specific test, set program option bit 15 on. The program halts at the end of each test. Set program option bit 14 on to suppress error halts until the desired test is reached. When the desired test is reached, set bit 13 on to loop through the test. Set bit 13 off to advance the program to the next test after execution of the current test.
 2. Set program option bit 12 on to halt the program after one complete cycle of execution. Press RUN. If bit 8 is set on, the program loops back to the CFGCH routine and halts with 107073_8 displayed in the MEMORY DATA Register. If bit 8 is set off, the program loops back to the BI/O routine.
 3. To reconfigure the diagnostic for a new I/O select code for the multiplexer interface board, set a starting address of 111_8 and perform steps g through m.

4. To restart the diagnostic without reconfiguring, set a starting address of 110_8 and perform steps 1 through m.



ERROR ANALYSIS

Messages to the operator typed on the teleprinter (if available) are prefixed by an alphanumeric code. The H prefix indicates an operating instruction while the E prefix indicates an error message.

All halts display a value in the computer MEMORY DATA Register. If no teleprinter is available for messages, the meaning of the halt is found in Table MDI-4 opposite the halt code. Any data to be read is found in the A- and/or B-register. Press RUN to continue program execution after an error halt (except trap cell halts).

Table MDI-1

Multiplexer Select Code Configuration--Switch Register Settings

<u>Bits</u>	<u>Description</u>
0-5	Select code for the I/O channel containing the multiplexer interface.
6-8	Not used.
9	If set on, a teleprinter is not available. If set off, a teleprinter is available.
10-15	Not used.

Table MDI-2

Multiplexer Send/Receive Channel Numbers--Switch Register Settings

<u>Bits</u>	<u>Description</u>
0-3	Send/Receive channel number.
4-5	Not used.
6-9	Send/Receive channel number.
10-14	Not used.
15	Set on to test all 16 channels in sequence (mode 2 operation). This switch overrides the setting of all other switches.

Table MDI-3

Program Options--Switch Register Settings

<u>Bits</u>	<u>Description</u>
0-7	Unused.
8	<p>If set on, return the program to the CFGCH routine at the end of the program and halt with 107073₈ displayed in the MEMORY DATA Register. The operator starts at step i of the operating instructions for HP 2000C and HP 2000F or step j of the operations instructions for HP 2000E.</p> <p>If set off, return program to the BI/O test at the end of the cycle.</p>
9	<p>If set on, omit start and stop messages on the teleprinter.</p> <p>If set off, print start and stop messages.</p>
10	<p>If set on, execute the PRESET test.</p> <p>If set off, omit the PRESET test.</p>
11	<p>If set on, suppress all printouts.</p> <p>If set off, type messages on the teleprinter.</p>
12	<p>If set on, halt the program at the end after one complete cycle.</p> <p>If set off, return to the CFGCH or BI/O routine at the end of the program, depending upon the setting of bit 8.</p>
13	<p>If set on, recycle the current test instead of advancing to the next test within the diagnostic.</p> <p>If set off, advance to the next test.</p>
14	<p>If set on, suppress error halts.</p> <p>If set off, halt on error.</p>
15	<p>If set on, each separate test within the diagnostic runs and halts (with the appropriate message typed on the teleprinter if available). Go on to the test by pressing RUN. Repeat the current test by setting bit 13 on and pressing RUN.</p> <p>If set off, execute each test without halting between tests.</p>

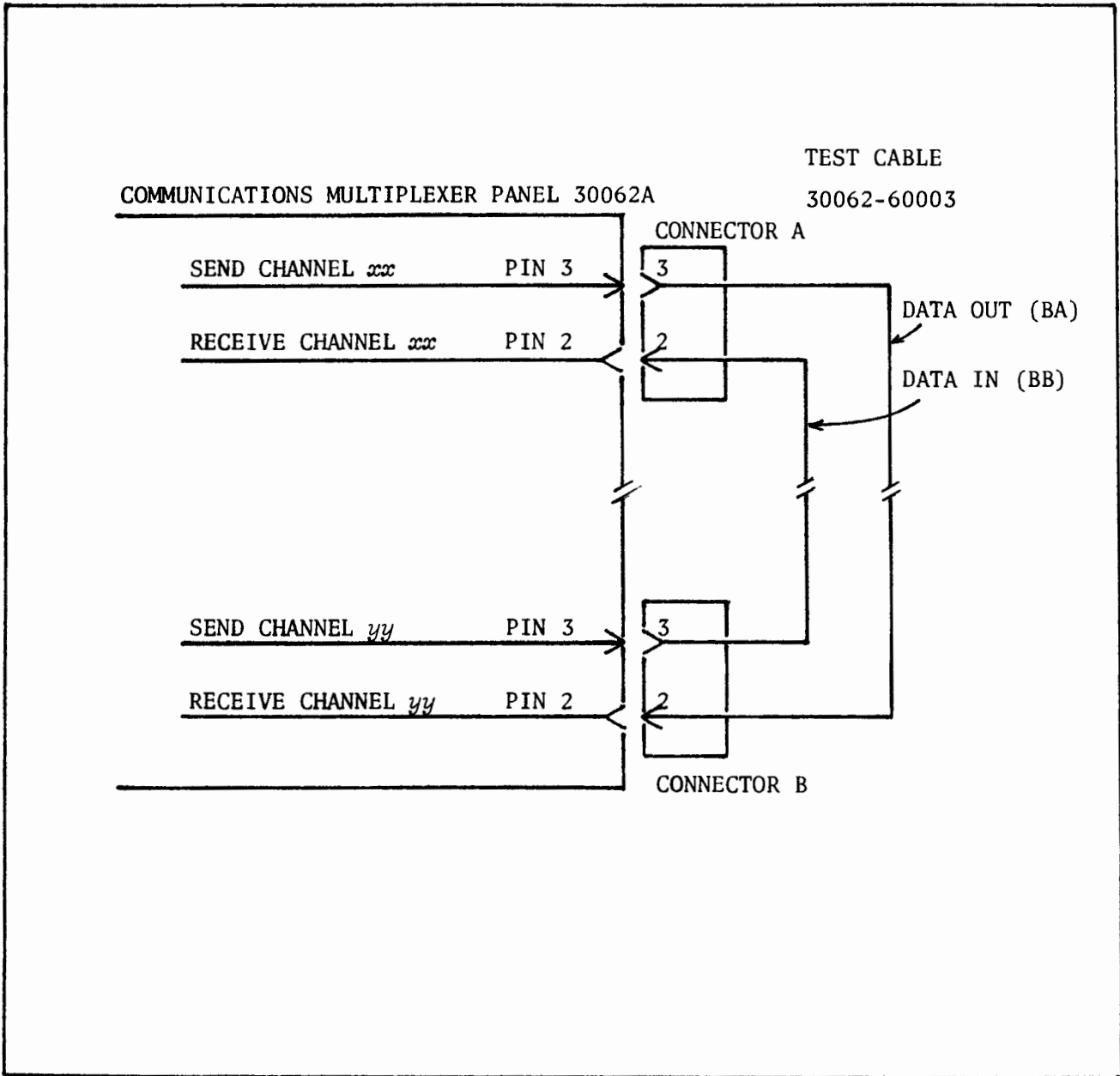


Figure MDI-1

Test Connector Scheme for Routing Data Output and Input Signal Lines.

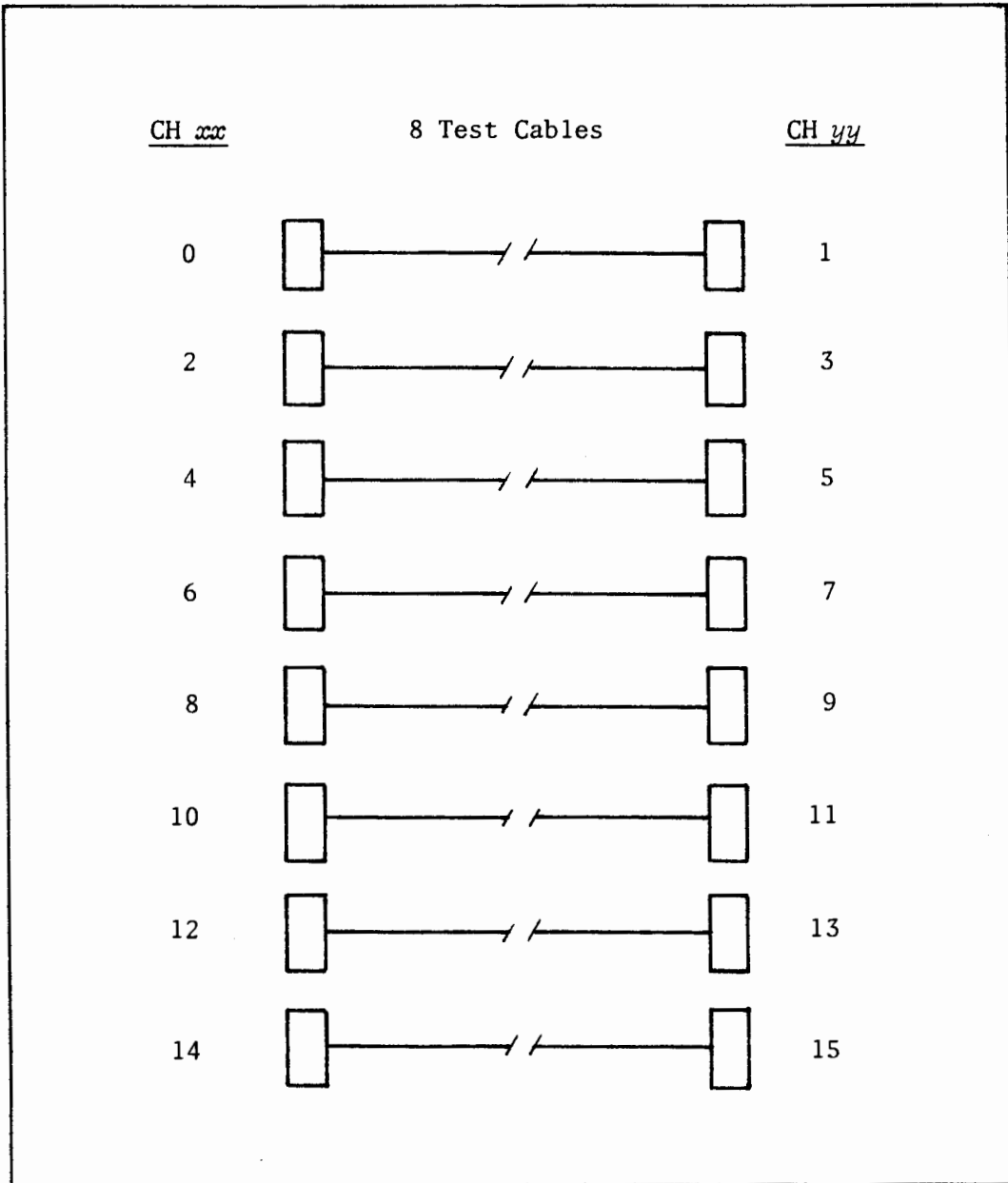


Figure MDI-2
 Test Cable Scheme For Automatic Mode

NOTE: Only one test cable is furnished with the diagnostic.



Table MDI-4
Diagnostic Messages

<u>Memory Data</u>	<u>Routine</u>	<u>Message</u>	<u>Comments</u>
1060xx	Any	None.	Trap cell interrupt. P=memory address when interrupted, xx= the trap cell location.
102001	BI/O	E1. CLF DID NOT CLEAR FLAG OR SFS CAUSED SKIP WITH FLAG CLEAR.	Test the ability to clear the interface flag and test the SFS instruction.
102002	BI/O	E2. SFC DID NOT SKIP WITH FLAG CLEAR.	Test the ability of the SFC instruction.
102003	BI/O	E3. STF DID NOT SET FLAG, OR SFC CAUSED SKIP WITH FLAG SET.	Test the ability to set the interface flag and test the SFC instruction.
102004	BI/O	E4. SFS DID NOT SKIP WITH FLAG SET.	Test the SFS instruction.
102005	BI/O	E5. DID NOT INTERRUPT.	Test the interface interrupt capability.
102006	BI/O	E6. THE RETURN ADDRESS IS NOT CORRECT.	The return address that resulted from the interrupt is incorrect.
102007	BI/O	H7. PRESS PRESET, THEN PRESS RUN.	Press INTERNAL and EXTERNAL PRESET.
No Halt	INIT	H8. START ASYNC MULTIPLEXER DIAGNOSTIC.	Start message (omitted if bit 9 set).
102010	BI/O	E10. PRESET DID NOT SET THE FLAG.	EXTERNAL PRESET logic failed.
102011	BI/O	H11. END BI/O.	Select options and press RUN.
102012	BI/O	E12. INTERRUPTED AFTER CLF Ø.	CLF 0 should prevent interrupts. Teleprinter may not type this message if there is a failure in the CLF 0 logic.
102013	BI/O	E13. PRESET DID NOT SET FLAG AND DID NOT DISABLE INTERRUPTS.	INTERNAL and EXTERNAL PRESET failed.

Table MDI-4 (cont.) Diagnostic Messages

<u>Memory Data</u>	<u>Routine</u>	<u>Message</u>	<u>Comments</u>
102014	BI/O	E14. INTERRUPT ACKNOWLEDGE DID NOT WORK. TEST ABORTED.	Remaining tests of BI/O are terminated.
102015	BI/O	E15. CLC Ø DID NOT CLEAR CONTROL F/F.	Control F/F did not reset with CLC 0 instruction.
102016	BI/O	E16. PRESET DID NOT CLEAR CONTROL F/F.	EXTERNAL PRESET logic failed.
102017	BI/O	E17. CLF Ø OR SFS Ø DID NOT WORK.	CLF 0 did not disable interrupts or SFS 0 caused a bad skip.
102020	BI/O	E20. CLF Ø OR SFC Ø DID NOT WORK.	CLF 0 did not disable interrupts or SFC 0 caused a bad skip.
102021	BI/O	E21. STF Ø OR SFC Ø DID NOT WORK.	STF 0 did not enable interrupts or SFC 0 caused a bad skip.
102022	BI/O	E22. STF Ø OR SFS Ø DID NOT WORK.	STF 0 did not enable interrupts or SFS 0 caused a bad skip.
102023	BI/O	E23. PRESET DID NOT DISABLE INTERRUPTS.	INTERNAL PRESET logic failed.
102024	BI/O	E24. CLC CH,C DID NOT CLEAR FLAG OR SFC DID NOT SKIP WITH FLAG CLEAR.	This tests the ",C" part of the instruction to clear flag.
102025	BI/O	E25. CLC ON CHANNEL DID NOT CLEAR CONTROL FLIP-FLOP.	Control F/F did not reset with CLC SC instruction (SC=channel of interface).
102026	SEND/REC	E26. SEND CHANNEL xx DID NOT INTERRUPT.	Send channel xx did not cause an external interrupt within timeout period of 300 milliseconds. A-Register contains the value of xx.
102027	SEND/REC	E27. RECEIVE CHANNEL xx DID NOT INTERRUPT.	Receive channel xx did not cause an external interrupt within timeout period of 300 milliseconds. A-Register contains the value of xx.

Table MDI-4 (cont.) Diagnostic Messages

<u>Memory Data</u>	<u>Routine</u>	<u>Message</u>	<u>Comments</u>
102030	SEND/REC	E30. SEND UNIT NUMBER IS xx SHOULD BE yy.	Data was sent out on a channel different from the one intended. A-Register contains value xx and B-Register contains value yy.
102031	SEND/REC	E31. RECEIVE UNIT NUMBER IS xx SHOULD BE yy.	Data was received on a channel different from the one intended. A-Register contains value xx and B-Register contains value yy.
102032	SEND/REC	E32. DATA RECEIVED ON CHANNEL xx IS xxxx SHOULD BE yyyy.	Data sent did not compare with data received. A-Register contains value xxxx and B-Register contains value yyyy.
102033	SEND/REC	H33. END SEND/RECEIVE TEST.	Select options and press RUN.
102034	BREAK	E34. BREAK BIT SHOULD NOT BE SET.	A non-zero test character was sent but bit 2 of status word was not set to a zero.
102035	BREAK	E35. BREAK BIT SHOULD BE SET.	A zero test character was sent but bit 2 of status word was not set to a one.
102036	BREAK	H36. END OF BREAK TEST.	Select options and press RUN.
102037	PARITY	E37. PARITY BIT SHOULD BE SET.	Odd ASCII parity sent but bit 15 of received word was not set to a one.
102040	PARITY	E40. PARITY BIT SET.	Even ASCII parity sent but bit 15 of received word was not set to a zero.
102041	PARITY	H41. END OF PARITY TEST.	Select options and press RUN.
102042	DIAGNOSE	E42. SEND DATA NOT ON AUXILIARY CHANNEL xx.	Bit 11 (diagnose) of send parameters was set but data was not routed to auxiliary channel xx. A-Register contains value xx.

Table MDI-4 (cont.) Diagnostic Messages

<u>Memory Data</u>	<u>Routine</u>	<u>Message</u>	<u>Comments</u>
102043	DIAGNOSE	E43. RECEIVED DATA NOT ON AUXILIARY CHANNEL xx.	Bit 11 (diagnose) of received parameters was set but data received was not routed to auxiliary channel xx. A-Register contains value xx.
102044	DIAGNOSE	H44. END OF DIAGNOSE TEST.	Select options press RUN.
102045	ECHO	E45. NO ECHO ON CHANNEL xx.	Bit 12 (echo) of receive parameters was set but data was not echoed back on channel xx. A-Register contains value xx.
102046	ECHO	H46. END OF ECHO TEST.	Select options and press RUN.
102047	SYNC	E47. SYNC TEST FAILED.	Failed to send an all mark (all ones) character when sync bit was set to a one and all data bits were ones.
102050	SYNC	H50. END OF SYNC TEST.	Select options and press RUN.
102051	CHAR-LOST	E51. CHARACTER LOST FAILED.	Bit 1 (character lost) of status word should be set to a one to indicate character-lost condition.
102052	CHAR-LOST	H52. END OF CHARACTER LOST TEST.	Select options and press RUN.
102053	Any	E53. SEEK BIT IS A ONE SHOULD BE A ZERO.	During a seek operation the seek bit (bit 15) failed to reset within timeout period of 300 milliseconds.
102054	SEND/REC	E54. S/R BIT SHOULD BE SET.	When send data was transmitted the status bit for send/receive indicated received data.
102055	SEND/REC	E55. S/R BIT SHOULD BE RESET.	When received data was received the status bit for send/receive bit indicated send data.

Table MDI-4 (cont.) Diagnostic Messages

<u>Memory Data</u>	<u>Routine</u>	<u>Message</u>	<u>Comments</u>
102077	END	H77. DIAGNOSTIC HAS BEEN COMPLETED.	End of test. If bit 12 of switch register is set, program will halt (102077).
107073	CFGCH	None.	Configure the SEND/RECEIVE channel numbers according to Table MDI-2. (Step i of Operating Instructions for HP 2000C, HP 2000F, step j of Operating Instructions for HP 2000E).
107074	CFGCH	None.	The channel numbers entered during the data channel configuration are invalid. Set the correct values in the switch register and press RUN.
107075	CFGIO	None.	The select code (switch register bits 5-0) is invalid. (Valid codes are 10_8-77_8 .) Set the correct select code then press RUN.
107076	CFGIO	None.	The I/O select code configuration is now complete. Follow the HP 2000E Operating Instructions at step j or the HP 2000C and HP 2000F Operating Instructions at step i.
107077	CFGCH	None.	The data channel configuration is now complete. Follow the HP 2000C and HP 2000F Operating Instructions at step l or the HP 2000E Operating Instructions at step m.

