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HP 2615 video terminal diagnostic

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HP 2615 Video Terminal Diagnostic

The HP 2615 Video Terminal Diagnostic confirms proper operation of the 2615 Video Terminal and the 12880 or 12531D Interface PCA used within a 2100 series computer system. This diagnostic is one of the 2100 series computer diagnostics executed in conjunction with the HP 2100 Series Diagnostic Configurator. Test sequence and test failure communication is provided to the operator through a teleprinter (if available), through the 2615 Video Terminal, through the computer Memory Data Register (sometimes referred to as the MDR or T-register), and the A- and B-registers.

Operator input is required via the switch register for test options and via the A-register for individual test selection. PRESET is entered by the operator to test the preset function. Throughout most of the test, the operator is required to visually verify test output to the video terminal.

The diagnostic program consists of a sequence of tests which exercise and check video terminal functions. First the I/O channel functions of the Interface PCA are tested. Then all on-line program controllable characteristics of the 2615 Video Terminal are tested, including operation with DMA, if available.

GENERAL ENVIRONMENT

The general hardware/software environments and system configuration procedures are described in the *HP 2100 Series Diagnostic Configurator* manual (02100-90157).

Hardware Requirement

1. The diagnostic is run on a 2100 series computer with a minimum of 4K of memory.

2. A paper tape reader is required to load the program only; the teleprinter paper tape reader can be used.

3. A system console teleprinter is optional, but recommended.

4. An HP 12880 or HP 12531 Interface Kit is required. If the 12531 is used, jumper connections must be made.

   Connect: W1 to A
   W7 to A

   Set the BAUD rate by connecting one of the following two-pole jumpers:

   W2 for 150 BAUD
   W3 for 300 BAUD
   W4 for 600 BAUD
   W5 for 1200 BAUD
   W6 for 2400 BAUD

5. An HP 2615 Video Terminal is required.

Software Requirement

The required software consists of the following binary object tapes:

1. HP 2100 Series Diagnostic Configurator (HP 24296).
2. This diagnostic.

Loading is performed using the Binary Loader, which is usually memory resident. See the appropriate *Front Panel Procedures* for the 2100 series computer being used for use of the Binary Loader. The loader is described in the HP manual *Basic Binary Loader-Basic Binary Disc Loader-Basic Moving-head Disc Loader* (HP 5951-1376).

LIMITATIONS

1. The BREAK key is not recognized by the Interface PCA. Consequently it cannot be tested by the diagnostic.

2. DMA tests, 2 and 9, are only executed if the diagnostic is configured for an HP 2114, 2115, or 2116 computer. Timing differences in other 2100 series computers preclude the use of DMA with the HP 12880 or HP 12531 Interface PCA. To test DMA thoroughly, use the *Direct Memory Access (DMA) Diagnostic*; the manual number is 2100-90179; diagnostic paper tape is HP Product Number 24322.

3. The HP 12531 Interface PCA is restricted to operation of 2400 BAUD or less. The Oscillator Test (Test 10) will not function properly, because the BAUD rate cannot be altered as required for the test.

4. If the HP 2615 is configured during program Start Up as the operator communication device (teleprinter), the diagnostic can hang-up, when outputting the header message, without giving any error messages. This is due to the fact that output is being sent to the Video Terminal before any tests have been performed.

Operating Procedures

Operating procedures are divided into three parts: Preparation for Diagnostic Run, Running the Diagnostic, and Diagnostic Messages and Halts.

PREPARATION FOR DIAGNOSTIC RUN

Before the tests can be initiated, the user performs the following actions:

- Load the Diagnostic Configurator
- Configure to available system hardware
- Load the diagnostic
- Dump the configuration for later use (optional)
- Make the 2615 Video Terminal ready for test.

Loading

Using the Binary Loader, load the HP 2100 Series Diagnostic Configurator. Perform the configuration procedure (see "Configuring" below) before loading the diagnostic. Then load the HP 2615 Video Terminal Diagnostic, using the Binary Loader. The user may insure that the proper diagnostic is loaded by checking memory location 126_8 for the Diagnostic Serial Number = 104007_8.

Configuring

Procedures for inputting the system hardware configuration parameters are found in the *HP 2100 Series Diagnostic Configurator* manual under "CONFIGURING." At the back of this same manual is a PRODUCT APPLICABILITY sheet, which describes which computers are compatible with this diagnostic.

The configuration procedure accepts six groups of parameters. This diagnostic requires only three groups to be defined. They are

- Computer type and options
- Teleprinter or 2615 Video Terminal configured as system slow output device
- Memory size and type

Enter zero for the other parameters.

Computer Type and Options and *Memory Size and Type* vary from one 2100 series installation to the other. The user must determine the parameters of his installation and configure accordingly.

A teleprinter is recommended for configuration as the *Slow System Output Device.* If a teleprinter is not available, then the HP 2615 under test may be configured as the Slow System Output Device. In the latter case the user must take care to sort out operator communication to the operator from test data displayed on the video terminal. No permanent record of test performance will be made in this latter case either.

Dumping

Using procedures described in the Diagnostic Configurator manual, the user may dump memory onto paper tape so that the above configuration procedures need not be repeated. The dumped paper tape holding the configured diagnostic can thereafter be loaded via the Binary Loader.

Making the 2615 Ready for Test

1. Insure that I/O cables are in place.

2. Place the 2615 ON-LINE.

3. Select a BAUD rate. If the 12880 Interface PCA is used, any BAUD rate may be used (except as specified in Test 10). If the BAUD rate is to be changed during the test, the CPU must be in a HALT state to avoid erroneous output on the Video Terminal. If the 12531 is used, the BAUD rate is restricted to the jumper-specified BAUD rate (see "Hardware Requirements").

4. Place the "HDX/FDX" switch to "FDX" (Full Duplex).

5. If the 12531 Interface PCA is used, insure that jumpers are in place (see "Hardware Requirements").

RUNNING THE DIAGNOSTIC

Parameter Entry And Program Options

The switch register is first used to specify the select code of the 2615 being tested. This is set up before execution is initiated. At the first HALT (MDR = 102074_8) after execution is initiated, the switch register is set up to hold program options. If the test selection option, *switch register bit 9*, is set, another HALT (MDR = 102075_8) occurs to allow the user to enter into the A-register his selection of tests to be executed. Bit 9 must be cleared when making the new test selection to avoid repeated HALTs.

Table 1 holds a summary of test options which are entered after the initial HALT.

If *switch register bits 8* or *12* are set, operator intervention tests, 7 through 10 are suppressed, even if selected by user. These switches also suppress the PRESET test in Test 0.

Table 1. Switch Register Options

Bit	Function If Set
0	Reserved
1	Pause at the end of test section for as long as this switch is set; used by test sections 1 through 6 and 11.
2	Terminate operator keyboard input, used by test sections 7 through 9.
3	Cut normal 15 second pause after each test section to a 1/2 second pause; used by test sections 1 through 6 and 11.
4	Loop on currently executing subtest (see "Test Sections" for description of subtests).
5	Reserved
6	Reserved
7	Reserved
8	Suppress tests requiring operator intervention; i.e. the "PRESET" part of Test 0, and Tests 7 through 10.
9	Abort current diagnostic run after the currently executing test section and perform a HALT with MDR = 102075_8; user sets bits of A-register to corresponding tests to be run; that is, set bit 0 of A-register, if Test 0 is to be run, set bit 1 of A-register if Test 1 is to be run, etc. A-register set to zero causes all tests to be run. Clear Switch 9 before restarting diagnostic.
10	Suppress Information (non-error) messages. (Coded *H* in Table 2.)
11	Suppress error messages. (Coded *E* in Table 2.)
12	Repeat all selected test sections of diagnostic after diagnostic is complete without HALT, printing "PASS *nnnnnn*" after each loop; operator intervention tests, 7 through 10, and "PRESET" part of Test 0, are suppressed.
13	Repeat current test section.
14	Suppress error HALTs (normally executed when 2615 fails a test).
15	Perform a HALT with MDR = 102076_8 after each test section is completed.

Starting Up

1. Set P-register to 100_8.

2. Load switch register, bits 0 to 5, with the select code of the 2615 Video Terminal to be tested.

3. Press PRESET (INTERNAL and EXTERNAL, if applicable).

4. Press RUN.

   Result: HALT with MDR = 102074_8 occurs.

5. Load switch register with options (Table 1).

6. Press RUN.

   Result: Normal diagnostic execution of all selected tests begins unless switch register bit 9 is set. In that event a HALT with MDR = 102075_8 occurs and user specifies tests to be run in the A-register. A-register bit 0 specifies test 0 to be run; A-register bit 1 specifies test 1 to be run; A-register bit 11 specifies test 11 to be run, etc. A-register set to all zeros causes all tests to be run (unless bits 8 or 12 of switch register are set).

Diagnostic Execution

Tests are divided into two groups: Basic I/O, test 0, and Peripheral, tests 1 to 11. Appropriate error messages are printed for software detected video terminal test failures.

a. *Execution of Basic I/O*

ACTION	EXPLANATORY INFORMATION
Initiate diagnostic execution via Starting Up procedures, above.	

Result: If test 0 is selected, and bit 8 and 12 of the switch register are not selected, the message

H024 PRESS PRESET (EXT AND INT), PRESS RUN

is printed, followed by a HALT with MDR = 102024_8.

ACTION	EXPLANATORY INFORMATION
Press PRESET (EXTERNAL and INTERNAL, if applicable).	
Press RUN.	**Restart execution.**

Result: Basic I/O test is completed. The message

H025 BI-O COMP

is printed. Execution of Peripheral tests, if selected, begins immediately.

b. *Execution of Peripheral Tests*

These tests should not be run until the 2615 Video Terminal passes all Basic I/O tests. Some of these tests require visual verification and some require manual intervention by the user. In Appendix A is given the printout of the various tests in the form of figures.

Result: If test 1, The Character Set, is selected, the character set is written on the video terminal, as shown in Figure 1.

ACTION	EXPLANATORY INFORMATION
Visually verify that printout appears as shown in Figure 1.	**Ripple print of 95 displayable characters is written on screen.**

Result: If test 2, The DMA Output, is selected, *and*, if DMA option was configured via Diagnostic Configurator, *and*, if DMA feature is installed on computer, *and*, if computer is 2114, 2115 or 2116, the pattern shown in Figure 2 is written on the video screen. Pattern is written for each DMA channel available, followed by channel number written on screen.

ACTION	EXPLANATORY INFORMATION
Visually verify that printout appears as shown in Figure 2.	**If only one DMA channel is installed the pattern is written once via this channel. If two channels are installed pattern is written twice.**

Result: If test 3, Memory, is selected, a checkerboard pattern alternating characters "?" and "@" is written on the screen. The pattern is written 78 characters long and 28 lines wide. A subset of the pattern appears like this:

```
?@?@?@?@
@?@?@?@?
?@?@?@?@
```

ACTION	EXPLANATORY INFORMATION
Verify checkerboard pattern.	Program cannot verify pattern written into video terminal memory; a half second pause between each line written allows operator to visually verify the display.

Result: If test 4, Dot Matrix, is selected, a pattern is displayed exercising all dot matrix positions. The pattern consists of repeated sequences of the characters "N#Z+". The pattern fills the screen with successive lines rotated one character. Each line consists of 76 characters. A subset of the pattern appears like this:

```
N#Z+N#Z+
#Z+N#Z+N
Z+N#Z+N#
```

ACTION	EXPLANATORY INFORMATION
Verify Dot matrix pattern. If test 5, Cursor Control, is to be run next, select a low BAUD rate at the 2615 so that the cursor movements may be easily observed.	Figure 3 holds exploded view of dot matrix for each character used in this test. Suggested "low" BAUD rate is 300 BAUD or less.

Result: If test 5, Cursor Control, is selected, pattern is written on screen which exercises all cursor movements. Figure 4 shows resulting pattern.

ACTION	EXPLANATORY INFORMATION
Verify cursor control movements and listen for bell to sound after printing each line of the characters "B", "C", "D", and "E."	A more detailed explanation of test may be found under heading "Test Sections" in this manual.

Result: If test 6, ERASE, is selected, an initial pattern, headed by "ERASE LINE," is printed on the screen. Figure 5 shows the initial pattern. The ERASE LINE function is used to erase every other line where the first line erased is the line of B's and the last is the line of X's.

ACTION	EXPLANATORY INFORMATION
Verify that every other line is erased.	Refer to this test under "Test Sections" for details of ERASE LINE execution.

Result: After the ERASE LINE test, the initial pattern is rewritten on the screen (Figure 5) headed with "ERASE TO END OF SCREEN." The function is tested in three stages: first the screen is erased below the line of K's; then the line of X's is rewritten; finally the screen is erased below the line of C's.

ACTION	EXPLANATORY INFORMATION
Verify the following sequence: the screen is erased below the line of K's; the X's are rewritten; the screen is erased below the line of C's, including the X's.	See this test under "Test Sections" for details of the test sequence.

Result: If test 7, Keyboard, is selected, the operator is prompted to make entries at the keyboard. Lines of characters are printed out. The video terminal enters input mode following each line of output. Figure 6 shows keyboard test printout. Figure 7 shows all characters and ASCII equivalent.

ACTION	EXPLANATORY INFORMATION
When a line of output is completed, enter at the keyboard the characters displayed.	If the input received by the diagnostic program does not agree with the requested character, the octal ASCII equivalent is output.

Result: When all prompted character input has been completed, the message

INPUT ANY KEYS EXCEPT THE BREAK KEY

is printed. The 2615 enters input mode.

ACTION	EXPLANATORY INFORMATION
Enter any sequence of keys, excluding the BREAK key. Terminate entry by setting, then clearing switch register bit 2.	The operator can check any keys that showed an error in the previous prompted keyboard entry sequence.

Result: Input keys are displayed. Non-displayable input results in the output of the octal equivalent. When switch 2 is set, then cleared, the next selected test section is entered.

If test section 8, Echo, is selected, any keys hit on the keyboard will be echoed back to the terminal.

ACTION	EXPLANATORY INFORMATION
Enter any keys and observe character written onto screen. Terminate entry by setting, then clearing switch register bit 2.	This checks only the echo operation on input. Non-printing characters are not given special treatment.

Result: If test 9, DMA Input, is selected and the DMA option is both installed and configured, and the CPU is an HP 2114, 2115, or 2116 the message

DMA CHANNEL 1 — INPUT ANY 10 KEYS PER INPUT
(EXCEPT THE BREAK KEY)

is printed.

ACTION	EXPLANATORY INFORMATION
Key in any ten characters at the keyboard. Set, then clear switch register bit 2 to terminate the input sequence.	**Input is accepted in ten character blocks. Operator may input as many of these blocks as needed.**

Result: If DMA channel 2 is installed and configured, the message

DMA CHANNEL 2 — INPUT ANY 10 KEYS PER INPUT (EXCEPT THE BREAK KEY)

is printed.

ACTION	EXPLANATORY INFORMATION
Key in any ten characters at the keyboard. Set, then clear switch register bit 2 to terminate the input sequence.	**The test repeats exactly the channel 1 input sequence.**

Result: If test 10, Oscillator, is selected, the message

H046 PUT TERMINAL IN 110 BAUD AND PRESS RUN

is printed, followed by a HALT with MDR = 102046_8.

Note: This test cannot function properly if the 12531 Interface PCA is installed. Press RUN to skip through the error halts.

ACTION	EXPLANATORY INFORMATION
Select the 110 BAUD setting at the back of the video terminal. Press RUN.	**I/O takes place automatically.**

Result: The message

H047 PUT TERMINAL IN 150 BAUD

is printed, followed by another HALT with MDR = 102047_8.

ACTION	EXPLANATORY INFORMATION
Select the 150 BAUD setting at the back of the video terminal. Press RUN.	**I/O takes place automatically.**

Result: If test 11, Calibration, is selected, the screen is filled with the character "E."

ACTION	EXPLANATORY INFORMATION
Verify character alignment.	80 characters by 25 lines orthogonally related. Width of display must be between 20.32 cm (8") and 22.23 cm (8.75"). Height of display must be between 17.78 cm (7") and 19.69 cm (7.75").

Result: After the last selected test is executed, the message

PASS *nnnnnn*

is printed, where *nnnnnn* is a six digit pass number with leading zeros suppressed. A HALT follows, unless suppressed, with MDR = 102077_8. The A-register holds the current selection of tests.

ACTION	EXPLANATORY INFORMATION
To run the same group of tests again, press RUN. To run a new group of tests, set bit 9 of the switch register and press RUN. Then follow the procedure given in Table 1 for switch register bit 9.	If switch register bit 12 is set, diagnostic will repeat without HALT or the execution of any operator intervention parts of the diagnostic.

DIAGNOSTIC MESSAGES AND HALTS

The diagnostic communicates to the operator by message text, HALT codes, or both, based on configuration and switch register settings.

HALT Code Summary

Table 2 lists octal HALT codes and their significance. Error HALTs are suppressed, if switch register bit 14 is set. The "end of test" HALT is executed, if switch register bit 15 is set; that is the diagnostic executes a HALT instead of proceeding to the next test. HALT at "end of pass," that is HALT at end of execution of all selected sections of the diagnostic, is suppressed, if switch register bit 12 is set. HALT to allow user to make a new test group selection is executed, if switch register bit 9 is set.

Table 2. HALT Codes and Significance

Octal MDR Code	Significance
1020*nn*	2615 test failure HALT; *nn* is octal HALT number and corresponds to message number, where applicable; *nn* ≠ 24, 46, 47, 50, or 73 through 77.
102024	Test 0 HALT to allow operator to perform PRESET entry test.
102046	Test 10 HALT to allow operator to select 110 BAUD; press RUN to continue after selection.
102047	Test 10 HALT to allow operator to select 150 BAUD; press RUN to continue after selection
1020*mm*	Configuration HALT; *mm* between 73_8 and 76_8; see "Starting Up" procedure in Operating Procedures.
102077	A diagnostic run has completed; A-register holds octal number of passes completed.
106077	Unexpected trap cell HALT; Memory Address register holds the I/O slot which interrupted. Diagnostic may be partially destroyed, if this HALT occurs. The program should be reloaded and the error corrected before proceeding.

Diagnostic Messages

There are two general categories of messages output to the operator: program/operator communication messages and test failure (error) messages. Table 3 lists diagnostic messages ordered by message number. Some communication messages have no message number. Those that do are coded with the letter "H" to identify them as communication messages. All error messages are coded with the letter "E." Communication messages are printed if switch register bit 10 is clear. Error messages are printed if switch register bit 11 is clear.

The test outputting each message is indicated in the table. The tests are described in this manual under the heading "Test Sections." "TC" refers to the Test Control program. "CFG" refers to the configuration portion of the diagnostic. Otherwise, the numbers refer to the test number.

Table 3. Messages to Operator

Message	Test	Meaning
2615 VIDEO TERMINAL DIAGNOSTIC	TC	Diagnostic header message.
TEST *nn*	TC	Indicates to which test a list of error messages, which follow, belongs.
PASS *nnnnnn*	TC	All selected tests of the diagnostic have completed; *nnnnnn* is the decimal number of passes completed; A-register holds the octal number of passes completed, if HALT is invoked.
E000 CLF 0-SFC 0 ERROR	0	CLF/SFC 0 combination failed; CLF did not clear flags *or* SFC caused no skip with flags clear.
E001 CLF 0-SFS 0 ERROR	0	CLF/SFS 0 combination failed; CLF did not clear flags *or* SFS caused skip with flags clear.
E002 STF 0-SFC 0 ERROR	0	STF/SFC 0 combination failed; STF did not set flags *or* SFC caused skip with flags set.
E003 STF 0-SFS 0 ERROR	0	STF/SFS 0 combination failed; STF did not set flags *or* SFS caused no skip with flags set.
E004 CLF 0 DID NOT INHIBIT INT	0	With card FLAG and CONTROL set, CLF 0 did not turn off interrupt system.
E005 CLF CH-SFC CH ERROR	0	CLF/SFC combination to the 2615 select code (CH) failed; CLF did not clear FLAG *or* SFC caused no skip with FLAG clear.
E006 CLF CH-SFS CH ERROR	0	CLF/SFS combination to the 2615 select code (CH) failed; CLF did not clear FLAG *or* SFS caused skip with FLAG clear.
E007 STF CH-SFC CH ERROR	0	STF/SFC combination to the 2615 select code (CH) failed; STF did not set FLAG *or* SFC caused skip with FLAG set.
E010 STF CH-SFS CH ERROR	0	STF/SFS combination to the 2615 select code (CH) failed; STF did not set FLAG *or* SFS caused no skip with FLAG set.
E011 STF *nn* SET CARD FLAG	0	Select code screen test failed; *nn* = select code that caused the Interface FLAG to set.
E012 INT DURING HOLD OFF INSTR	0	Interrupt occurred during an I/O instruction, a JMP indirect, or a JSB indirect instruction.

Table 3. Messages to Operator (cont.)

Message		Test	Meaning
E013	SECOND INT OCCURRED	0	Card interrupted a second time after initial interrupt was processed.
E014	NO INT	0	No interrupt occurred with card FLAG and CONTROL set and the interrupt system on.
E015	INT RTN ADDR ERROR	0	Interrupt did not occur at the correct location in memory.
E016	CLC CH ERROR	0	CLC to 2615 select code (CH) did not clear card CONTROL with the interrupt system on.
E017	CLC 0 ERROR	0	CLC 0 did not clear CONTROL with the interrupt system on.
E020	PRESET (EXT) DID NOT SET FLAG	0	PRESET (External, if applicable) did not set the card FLAG.
E021	PRESET (INT) DID NOT DISABLE INTS	0	PRESET (internal, if applicable) did not disable the interrupt system.
E022	PRESET (EXT) DID NOT CLEAR CONTROL	0	PRESET (External, if applicable) did not clear CONTROL.
E023	PRESET (EXT) DID NOT CLEAR I/O LINES	0	PRESET (External, if applicable) did not clear I/O data lines.
H024	PRESS PRESET (EXT & INT), RUN	0	Press PRESET (External and Internal, if applicable), then press RUN.
H025	BI-O COMP	0	Test 0, Basic I/O tests, are complete.
E026	INT EXECUTION ERROR	0	Instructions being executed prior to and/or just after interrupt did not execute correctly.
E040	NO INT ON DMA	2	No interrupt occurred after output was initiated on DMA channel 1.
E041	NO INT ON DMA	2	No interrupt occurred after output was initiated on DMA channel 2.
E042	DMA I-O INCOMPLETE	2,9	The I/O FLAG bit on the Interface did not turn on after DMA channel 1 signalled I/O complete.
E043	DMA I-O INCOMPLETE	2,9	The I/O FLAG bit on the Interface did not turn on after DMA channel 2 signalled I/O complete.

Table 3. Messages to Operator (cont.)

Message		Test	Meaning
H044	NO DMA	2,9	DMA test was bypassed; DMA or a 2114, 2115, or 2116 CPU was not specified in the configuration via the Diagnostic Configurator.
H045	NO DMA 2	2,9	Testing of DMA channel 2 has been bypassed; only one DMA channel was specified during configuration via the Diagnostic Configurator.
H046	SET TERMINAL TO 110 BAUD AND PRESS RUN	10	Instruction message for test 10.
H047	SET TERMINAL TO 150 BAUD AND PRESS RUN	10	Instruction message for test 10.
H050	CLOCK OK	10	Terminal oscillator is within tolerance.
E051	CLOCK FAST	10	Terminal oscillator rate is too high.
E052	CLOCK SLOW	10	Terminal oscillator rate is too low.
E053	NO INT	10	No interrupt occurred after I/O was initiated for oscillator test.
E054	I-O FLAG NOT SET AFTER DATA OUTPUT	Any	The I/O FLAG bit did not turn on after output on the 2615 was initiated.

Test Sections

The 2615 Video Terminal diagnostic provides twelve tests to verify proper operation of the 2615 Video Terminal and the 12880 or 12531D Interface PCA. The string of tests are normally executed in sequence, although any one or subset of tests may be run. Basic I/O, test 0, should run without error before the rest of the tests are attempted. The test sections are titled by function.

Test Number	Title
0	Basic I/O Channel Functions
1	Character Set
2	DMA Output
3	Memory
4	Dot Matrix
5	Cursor Functions
6	Erase Functions
7	Keyboard Entry
8	Echo
9	DMA Input
10	Oscillator
11	Calibration

In addition to the test sections, a Test Control Section and a Configuration section are provided; neither is selectable.

TEST CONTROL

This section prints messages and controls execution of diagnostic test sections according to configuration parameters and switch register options.

CONFIGURATION

This section accepts I/O select code and configures diagnostic I/O commands accordingly.

BASIC I/O CHANNEL FUNCTIONS–TEST 0

This test section verifies video terminal I/O channel functions. It consists of seven subsections. No loopable subtests (as mentioned in Table 1, switch register bit 4) exist in test 0.

Section 1

The ability to clear, set, and test the interrupt system is tested.

Section 2

The absence of an interrupt is verified when the video terminal select code FLAG is set, when the select code CONTROL flip-flop is set, and when the interrupt system is OFF.

Section 3

The ability to clear, set, and test the video terminal select code FLAG is tested.

Section 4

The FLAG of every select code (from 10_8 to 77_8), except the video terminal select code, is set. A test is then made to insure that the I/O system does not set the video terminal FLAG as well.

Section 5

The ability of the video terminal select code channel to interrupt is tested. With the FLAG and CONTROL flip-flop set and the interrupt system on, an interrupt should occur on the video terminal channel. It is then verified that the interrupt occurred where expected and that another interrupt does not occur, when the interrupt system is turned back on.

Section 6

It is verified that no interrupt occurs following a "CLC SC" instruction (clear I/O CONTROL bit on video terminal select code) when the interrupt system is on and the video terminal select code FLAG and CONTROL flip-flop are set. The "CLC SC" instruction should clear the select code CONTROL flip-flop. A test is also made to insure that a "CLC 0" instruction indirectly clears the video terminal select code CONTROL flip-flop.

The PRESET switch (EXTERNAL and INTERNAL PRESET switches, if applicable, to the particular computer used) is tested with the aid of manual switch entry by the operator. It is verified that the video terminal select code flag is set and the interrupt system is cleared.

CHARACTER SET—TEST 1

Ninety-five characters are displayed including the SPACE, alphabet, numbers and special characters. Twenty-five lines of 79 characters each are printed in a ripple pattern. The second alphabet in the character sequence is transmitted as lower case letters and should be displayed as their equivalent upper case letters. CARRIAGE RETURN and LINE FEED are suppressed on the last line to avoid automatic roll-up. Test 1 has no loopable subtests.

DMA OUTPUT—TEST 2

Output functions of both DMA channels, if installed and configured, are tested. Twenty-four identical lines of characters are transmitted just through DMA channel one, then through channel two. This test is executed only if the configured CPU is an HP 2114, 2115, or 2116.

Subtest 1 consists of DMA channel 1 transmission.

Subtest 2 consists of DMA channel 2 transmission.

MEMORY—TEST 3

A checkerboard pattern is generated consisting of the character "?", which has an ASCII octal code of 077 and "@", which has an ASCII octal code of 100. The display is prepared by positioning the cursor in column 1, line 25 with a CLEAR and 24 LINE FEEDs. Twenty-eight lines of printing follow to produce the checkerboard pattern. Each line contains 78 characters.

There are no loopable subtests.

DOT MATRIX—TEST 4

Four characters are displayed over all of the screen to exercise all dot positions within the character dot matrix. Each line contains repeated sequences of the characters "N", "#", "Z", and "+" with successive lines rotated one character. Each line contains 76 characters.

There are no loopable subtests.

CURSOR FUNCTIONS—TEST 5

Cursor control functions and the display are exercised. The operator verifies cursor movements visually.

The test sequence is as follows:

1. Initialize screen (CLEAR).
2. Output 6 letter A's followed by three CR LF.
3. Output the letter "B" followed by CURSOR RIGHT commands.
4. Output the vertical column of letter "C" using CURSOR DOWN and CURSOR LEFT commands.
5. Output the horizontal line of letter "D" using CURSOR LEFT commands.
6. Output the vertical column of letter "E" with CURSOR UP and CURSOR LEFT commands.
7. Position the cursor at line 25 column 75. This is done by a HOME UP, CURSOR UP, six BACK-SPACE commands, and a CURSOR DOWN. This exercises the wraparound through the top and right of screen.
8. Display twelve letters "F". This exercises the automatic CR LF at the end of the display causing the six A's at the top of the screen to be overlayed by six F's.
9. Position the cursor at column 75 line 1 and display twelve letters "G" to exercise the automatic CR LF to the next line.
10. Set the cursor at line 25, column 1 by HOME UP and 25 LINE FEEDS. Display six letters "H" and a CR LF. This exercises the automatic ROLL UP feature.
11. Output six letters "I" and a CURSOR DOWN. The cursor should now be to the right of the sequence of G's at the top of the screen. This tests the wraparound through the bottom of the display.

The bell is sounded after steps 3, 4, 5, and 6, i.e. at each corner of the box created by those steps.

There are no loopable subtests.

ERASE FUNCTIONS—TEST 6

This test checks the erase functions of the terminal. The test is divided into two sections:

1. Erase Line; subtest 1

   First, a pattern is put on the screen. The first line of the pattern identifies the function being tested—ERASE LINE. Line two consists of 80 A's, line three, 80 B's; line four, 80 C's; and so on to line 25 which consists of 80 X's. After drawing the initial pattern, the cursor should be at the home position.

Now the program proceeds to erase every other line starting with line 3 (line of B's). At the end of test, the cursor should be in column 78, row 25.

2. Erase To End of Screen; subtest 2

First, the initial pattern of the Erase Line test is written on the screen. The first line is changed to identify that the ERASE TO END OF SCREEN function is being tested.

From the home position, twelve (12) LINE FEEDS are issued, then an ERASE TO END OF SCREEN command is given. This should erase the screen from (and including) the line of L's to the end of the screen.

A HOME UP and a CURSOR UP are issued to place the cursor on line 25, column 1. The row of X's is rewritten which returns the cursor to the home position. Then, four LINE FEEDS and a CURSOR LEFT are issued to position the cursor at column 80, line 4 (line of C's). An ERASE TO END OF SCREEN command is given leaving only the top three lines on the screen. The cursor should remain in column 80 of line 4.

KEYBOARD ENTRY—TEST 7

This routine checks the proper operation of the terminal keyboard input. The test is divided into two sections:

1. Every key check; subtest 1

The program will display a given sequence of keys that the operator must enter. If the input does not agree with the requested key, then the octal equivalent of the input is displayed under the requested key. The program then moves on to the next key. This is repeated until all requested keys have been entered. A check is also made for the approaching end of line signal. The cursor is placed in column 69 and the program requests that any displayable character be input. The bell should sound off immediately after the key is pressed. The program now pauses for 15 seconds (1/2 second if bit 3 of the switch register is set on, longer if bit 1 is set on), then proceeds to the free input section.

2. Free input; subtest 2

The program now prints message "INPUT ANY KEYS EXCEPT THE BREAK KEY." The operator can check any keys that showed an error in section 1 and input any combination of keys without using the BREAK key. If the character that is input is not in the displayable range, the octal equivalent is displayed.

Either section may be terminated by setting and clearing bit 2 of the switch register.

ECHO—TEST 8

This test checks the echo mode. The program prints the message "ECHO TEST—INPUT ANY KEY EXCEPT THE BREAK KEY." Any keys hit on the keyboard will be echoed back to the terminal, including non-printing characters, with no special treatment. This test is terminated by setting, then clearing, switch register bit 2.

There are no loopable subtests.

DMA INPUT—TEST 9

This test checks input through both DMA channels. The program requests 10 characters per input block via the prompting message: "DMA CHANNEL *n*—INPUT ANY 10 KEYS PER INPUT (EXCEPT THE BREAK KEY)." The value *n* is 1 or 2, depending on the channel tested. After reading 10 characters, the characters received by the CPU are displayed on the terminal. This continues until bit 2 of the switch register is set and cleared. DMA channel 1 is checked first, then DMA channel 2 is checked, if two DMA channels were specified in the configuration of the Diagnostic Configurator. The whole test is skipped if no DMA was specified in the configuration or if the CPU is not an HP 2114, 2115, or 2116. No checking of the input is made by the program.

Testing of each DMA channel is a subtest.

OSCILLATOR—TEST 10

This routine provides a check of the two oscillators settings in the terminal by operating the terminal at the two lower BAUD rates (110 and 150). The test will first request the lower BAUD rate, then the higher. The program will halt if either trial shows an out of tolerance condition.

Testing of each BAUD rate is a subtest.

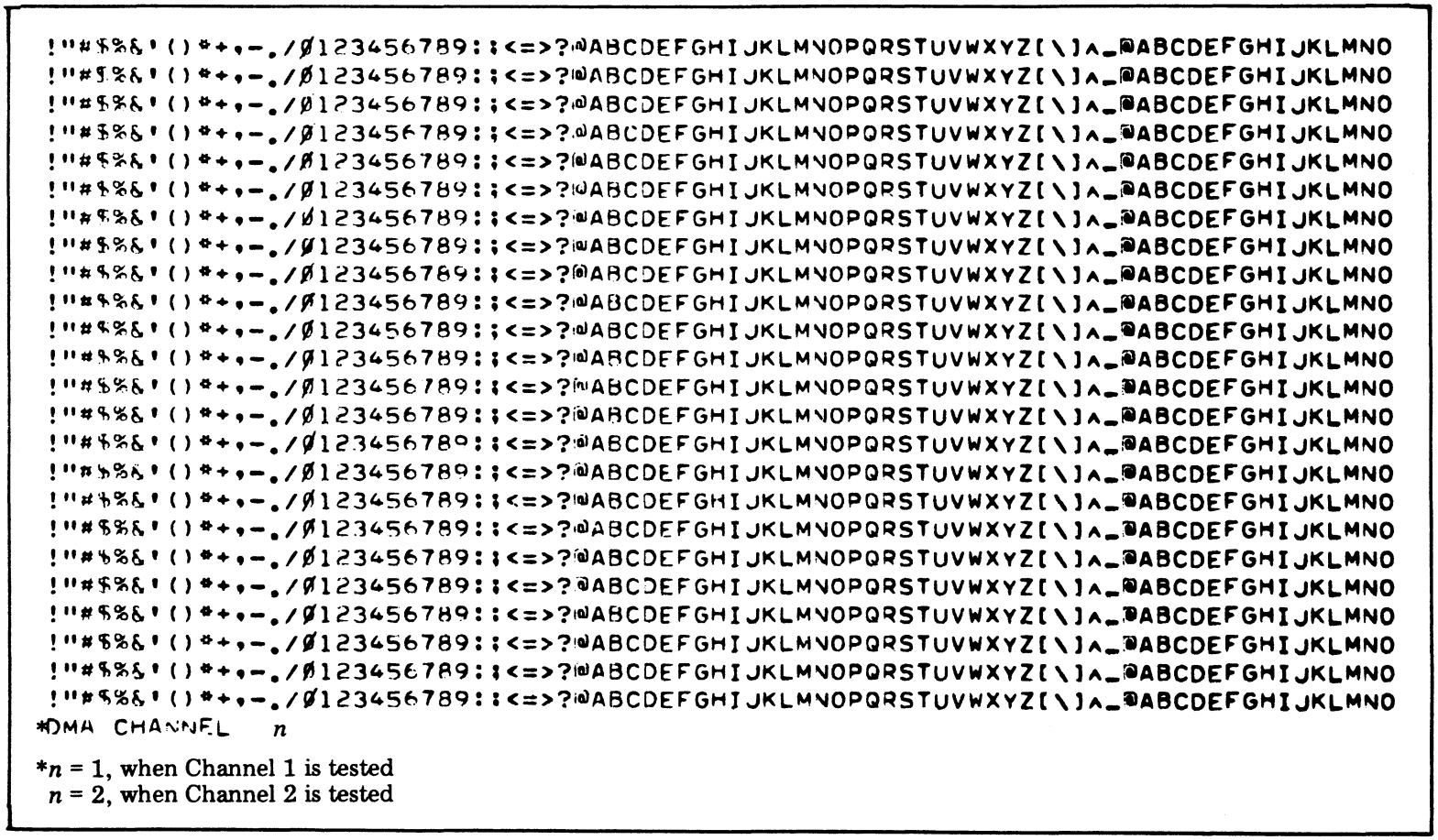
Note: If the HP 12531 Interface PCA is used, the BAUD rate is fixed and this test will indicate BAUD rate errors.

CALIBRATION—TEST 11

A pattern consisting of all letters "E" fills the screen for the purpose of alignment.

APPENDIX A
Test Figures

Figure 1. Character Set Printout; Test 1



*n = 1, when Channel 1 is tested
n = 2, when Channel 2 is tested

Figure 2. DMA Channel Output Printout; Test 2

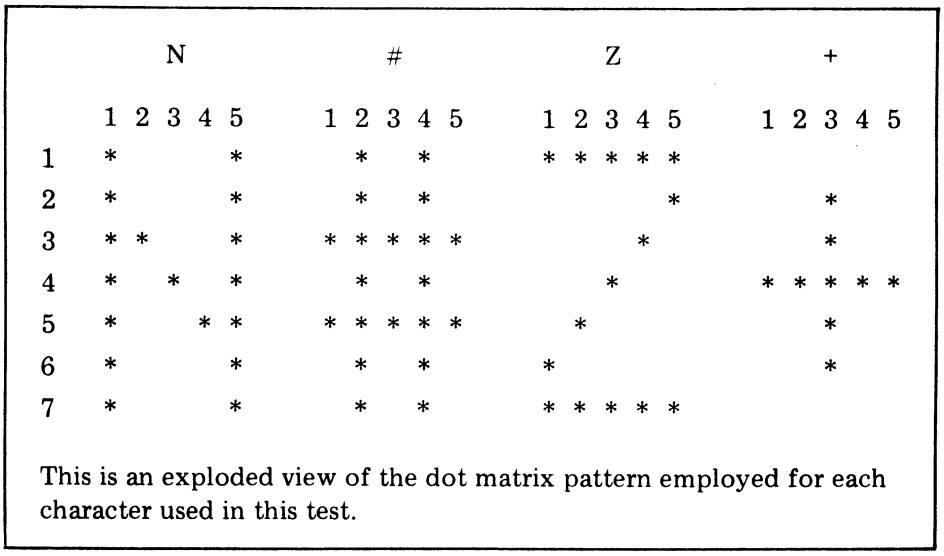
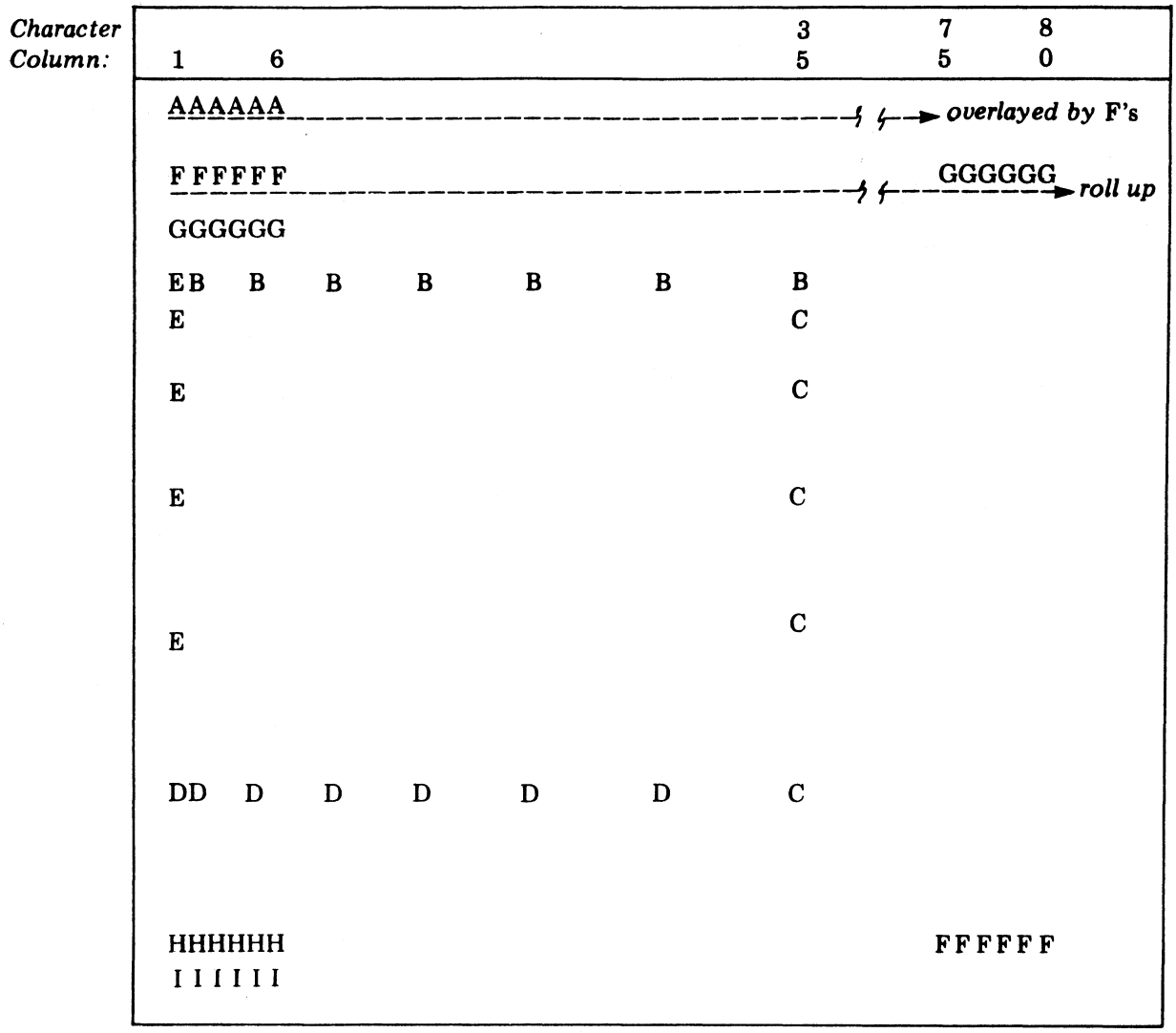


Figure 3. Character Dot Matrix; Test 4



Characters used in this display pattern exercise the following test functions:

A – Initially written, to be overlayed by F's after an automatic CR LF

B – Associated with CURSOR RIGHT

C – Associated with CURSOR DOWN

D – Associated with CURSOR LEFT

E – Associated with CURSOR UP

F – Associated with BACKSPACE and wraparound on an automatic CR LF, to be removed by ROLL UP

G – Associated with automatic CR LF

H – Displayed after HOME UP and 24 LINE FEEDS

I – Displayed after CR LF to cause a ROLL UP

Figure 4. Cursor Control; Test 5

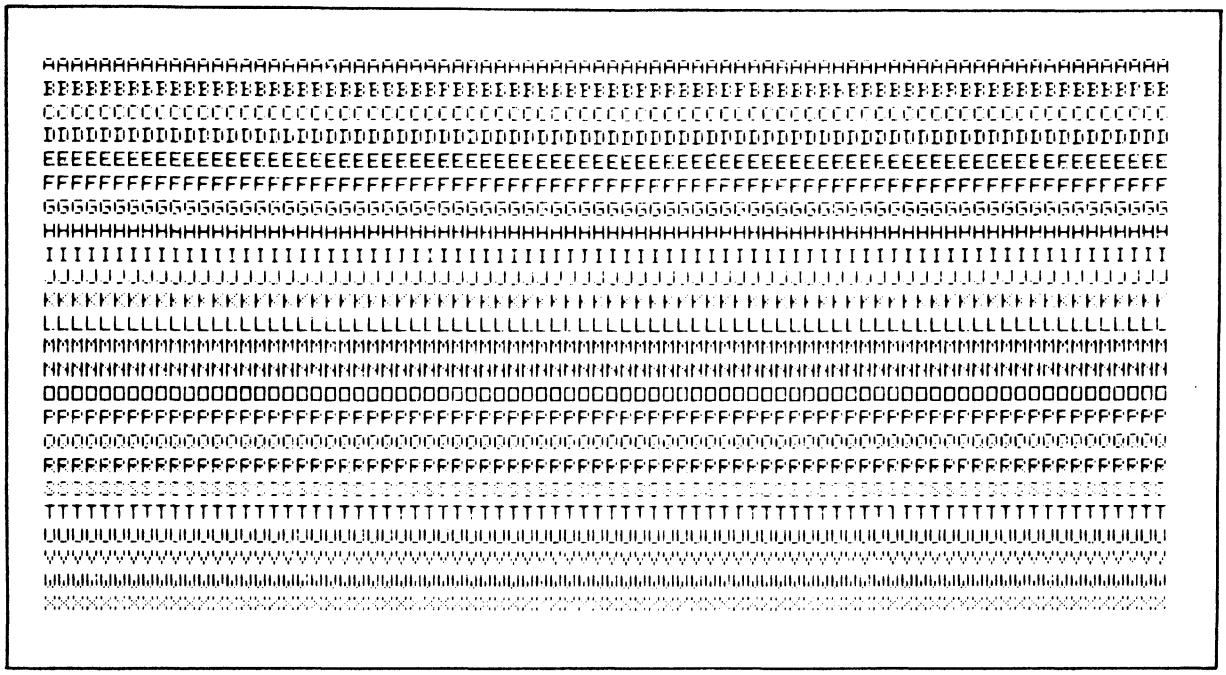


Figure 5. ERASE Test Starting Pattern; Test 6

```
INPUT THE FOLLOWING:
1     2     3     4     5     6     7     8     9     0     :     -

Q     W     E     R     T     Y     U     I     O     P

A     S     D     F     G     H     J     K     L     ;

Z     X     C     V     B     N     M     ,     .     /

SHIFT+
!     "     #     $     %     &     '     (     )     0     #     =

_     @     [     \     +     ^     ]     <     >     ?

CNTRL+
G     H     J     M     X

BHOT LF    CR    ESC   SPACE

BELL TEST - INPUT ANY DISPLAYABLE CHARACTER
THE BELL SHOULD SOUND OFF IMMEDIATELY AFTER THE KEY IS PRESSED
```

Figure 6. Prompted Keyboard Entry; Test 7

ASCII CHARACTER	OCTAL EQUIVALENT	ASCII CHARACTER	OCTAL EQUIVALENT
BELL	007	>	076
BACKSPACE	010	?	077
LF	012	@	100
CR	015	A	101
ESC	033	B	102
SPACE	040	C	103
!	041	D	104
"	042	E	105
#	043	F	106
$	044	G	107
%	045	H	110
&	046	I	111
'	047	J	112
(	050	K	113
)	051	L	114
*	052	M	115
+	053	N	116
,	054	O	117
-	055	P	120
.	056	Q	121
/	057	R	122
0	060	S	123
1	061	T	124
2	062	U	125
3	063	V	126
4	064	W	127
5	065	X	130
6	066	Y	131
7	067	Z	132
8	070	[	133
9	071	\	134
:	072	]	135
;	073	^	136
<	074	_	137
=	075	RUBOUT	177

Figure 7. 2615 Character Set and ASCII Equivalent