



# HP 6940A/B MULTIPROGRAMMER

## Verification Manual



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# LIST OF EFFECTIVE PAGES

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## 1. INTRODUCTION

This manual provides procedures for verifying the operation of an HP 6940A/B Multiprogrammer, its local or remote computer interface hardware, and its input/output (I/O) cards. The procedures can also be used for a functional check of the HP 6941A/B Extender and the chaining cable if included in the installation. The procedures cover two functionally identical verification programs (called T6940): one program operates on-line in all HP RTE software systems except RTE-B; the other program operates off-line for RTE-B or BCS systems. For event sense or interrupt tests, an additional program (SENSE) is used to process the interrupts for the on-line verification program; the off-line verification program includes interrupt processing.

The on-line verification program requires approximately 5000 words of background area; program SENSE requires 150 words. The off-line verification program requires approximately 12500 words of memory.

## 2. FUNCTIONAL TESTS

The verification program provides six functional tests; you may choose to perform any or all of them, as desired. The tests are described briefly in the following paragraphs.

### 3. INPUT TEST

T6940 reads data from a user-selected 6940 input card and outputs the data on the user terminal. The user checks that the data output on the terminal corresponds to the data applied to the input card. T6940 allows the selection of either a normal read with gate or a direct read without gate.

### 4. OUTPUT TEST

T6940 outputs either a single selected word or one continuously rotated bit to a selected 6940 output card. The user checks the output of the card to verify correct operation. Data Transfer Enable (DTE), System Enable (SYE), and Timing Mode Enable (TME) can be individually set or cleared.

### 5. EVENT SENSE TEST

T6940 outputs a selected reference word to a selected 6940 event sense card. If the external data and the reference word meet the hardware-determined requirements for an interrupt, the 6940 generates an interrupt that activates

program SENSE. SENSE outputs (on the system terminal) the slot number of the 6940 card being tested, the external data, and the computer select code of the 6940.

### 6. PULSE COUNTER TEST

T6940 programs the pulse counter card to output one carry pulse when the user inputs one pulse at the card's up-count input, and then programs the card to output a borrow pulse when the user inputs a pulse at the down-count input. The user checks that the carry and borrow pulses are output at the correct time. The pulse counter card can also be tested by using the Output Test to preset the card to zero, applying a predetermined number of pulses to a count input, and using the Input Test to read the count data from the card.

### 7. PROGRAMMABLE TIMER TEST

T6940 presets the timer to a user-selected time period; the user verifies that the timer's output pulse duration agrees with the selected time period.

### 8. STEPPING MOTOR CONTROL TEST

T6940 programs the stepping motor control card to output a selected number of pulses at both of the card's outputs. The user checks the number of output pulses to verify correct operation of the card.

## 9. VERIFICATION PROCEDURES

The I/O cards of the 6940 (and 6941) are verified by using the detailed verification procedures given in Appendixes A through K. Before the detailed procedures can be used, however, the verification program must be loaded and initialized; this initialization verifies the interface between the computer and the 6940. Table 1 lists the Appendix to be used for each card model.

## 10. ON-LINE PROGRAM LOADING

To load program T6940 on-line in a non-RTE-B (or BCS) system, proceed as follows:

- a. With the RTE system generated and operational, load the verification tape (HP Part No. 09611-16006) into the photoreader.
- b. On the terminal keyboard, enter the RTE operator command:  
ON, LOADR

Table 1. Verification Appendixes

HP 6940 I/O CARD	APPENDIX
69321B D/A Voltage Converter	A
69330A Relay Output	B
69331A Digital Output	C
69335A Stepping Motor Control	D
69370A D/A Current Converter	E
69430A Isolated Digital Input	F
69431A Digital Input	G
69434A Event Sense	H
69435A Pulse Counter	I
695xxA Resistance Output	J
69600A Programmable Timer	K

- c. The system loads the tape and outputs (on the terminal) the message:  
/LOADR: LOAD
- d. Load the verification subroutine tape (HP Part No. 09611-16015) into the photoreader and enter the command:  
GO, LOADR
- e. The system loads the tape and outputs the message:  
/LOADR:LOAD
- f. Enter the command:  
GO, LOADR, 1
- g. The system outputs the message:  
/LOADR: T6940 READY  
LOADR: \$END
- h. If the sense or interrupt mode is to be tested, load the SENSE tape (HP Part No. 09611-16007) into the photoreader and repeat steps b, c, and f.

## 11. ON-LINE PROGRAM INITIALIZATION

To initialize T6940 on-line, proceed as follows:

- a. Enter the RTE operator command:

ON, T6940, INPUT LU, OUTPUT LU

where: INPUT LU and OUTPUT LU are the logical unit numbers of the devices to be used as the input device and the list device for the remainder of this procedure. If your system is configured for multiple terminal operation, either (or both) command parameter defaults to the terminal you are using if omitted; otherwise, the default is to the system terminal. If you enter an invalid LU number, T6940

reports the error on the system terminal and terminates itself.

If the command is entered correctly, T6940 outputs the message:

ENTER THE LU OF THE 6940 UNIT.

- b. Enter the logical unit number of the multiprogrammer to be tested. T6940 checks that the LU entered corresponds to a multiprogrammer driver. If the LU does not correspond to the proper driver, T6940 repeats the request for a 6940 LU; if the LU does correspond, T6940 outputs the message:

SELECT CODE = n, DRIVER # m

where: n and m are the select code of the multiprogrammer and the driver number.

T6940 then outputs the message:  
ENTER THE # OF 6941'S

- c. Enter the number of 6941's to be tested; if none, enter 0. T6940 tries to initialize the multiprogrammer (and the extenders, if any); if a transmission error occurs or if a flag is not returned, T6940 identifies the failure by the message:

UNIT # n HAS STATUS = xxx

where: xxx = 200 means transmission error;  
= 004 means no flag returned;  
= 204 means transmission error plus no flag.

If communication with the multiprogrammer is OK, and if program SENSE is to be used, T6940 replaces the user's alarm program address with the address of SENSE and outputs the message:

THE ID SEGMENT ADDRESS OF ALARM IS xxxxx  
THE ADDRESS IS STORED AT xxxxx

This information allows you to manually restore the address of the alarm program if the system fails during the verification procedure. When you command T6940 to terminate, it first restores the alarm program's address in the driver's table and then terminates.

If communication failure occurs, the test "menu" shown in step d will still be listed although a hardware defect exists. Refer to paragraph 15.

- d. T6940 lists the test "menu" as follows:

\* \* \* TEST MENU \* \* \*

1. INPUT TEST - NORMAL READ.
2. INPUT TEST - READ DIRECT WITHOUT GATE.

3. SINGLE OUTPUT TEST.
  4. CONTINUOUSLY ROTATED OUTPUT TEST.
  5. EVENT SENSE TEST.
  6. PULSE COUNTER TEST.
  7. PROGRAMMABLE TIMER TEST.
  8. STEPPER MOTOR CONTROL TEST.
  0. REPEAT PREVIOUS TEST.
  - 1. TERMINATE PROGRAM.
- ENTER TEST NUMBER.



## 12. TEST SELECTIONS

After the verification program has been initialized, refer to the appendix applicable to the 6940 I/O card to be tested and follow the instructions given there (refer to table 1). If more than one card or card model is to be tested, exit the selected test (as instructed in the appendix) after testing the first card; T6940 will output the message:

ENTER TEST NUMBER

Enter the number from the test menu appropriate either to repeat the previous test or to select a different test for a different card model (refer to the appropriate appendix).

T6940 is terminated by entering a "-1" when it requests the entry of a test number. Upon termination, T6940 outputs:

T6940 : STOP 0000

The verification program can be restarted by:

- a. Pressing the terminal's space bar to obtain the RTE prompt character(\*);
- b. Using the RTE ON command as described in paragraph 11.

**Note:** If you are using the off-line T6940, do not specify the input and output LU's. Also, enter the number "3" when T6940 requests the entry of the 6940 LU.

If you have a disc-based RTE system, it would be practical to save the verification program by using the File Manager SP command. This would make it readily available and eliminate reloading the paper tape each time you performed the verification procedure.

## 13. OFF-LINE PROGRAM LOADING

In order to use verification program T6940 in an RTE-B or BCS system, it is necessary to:

- a. Shut down the system (halt the computer).
- b. Load the verification program tape.

- c. Perform the selected tests.
- d. Terminate T6940 and halt the computer.
- e. Reload your RTE-B or BC system.

To load program T6940 in an RTE-B or BCS system, proceed as follows:

- a. Halt the computer.
- b. Load the verification tape (HP Part No. 09611-16013) into your computer using the paper tape loading procedure applicable for your computer.
- c. In the P register, set the starting address to 2.
- d. In the S register, set the select code of the time base generator card in switches 6 through 11 and set the select code of the terminal to be used to run program T6940 in switches 0 through 5.
- e. Press PRESET and then press RUN. T6940 outputs on the terminal the following:

SET TIME  
6940 SELECT CODE =

- f. Ignore the "SET TIME" and enter the select code of the 6940 to be tested. T6940 outputs:

LOCAL OR REMOTE?

- g. Enter an "L" if the 6940 is interfaced to the computer locally; enter an "R" if the interface is remote (i.e., via an HP 09610-60044 Interface Card). T6940 outputs:

FOR 6940 USE LU = 3  
ENTER THE LU OF THE 6940 UNIT.

- h. Enter the number "3". T6940 checks that a "3" was entered; if it was not, the LU entry request is repeated; if it was, T6940 outputs:

LU # 3: DRIVER 72, SELECT CODE n

where: n is the number entered in step f.

T6940 then outputs:

ENTER THE # OF 6941'S

- i. Perform step c of paragraph 11 to initialize the multi-programmer. The test "menu" will be listed as in paragraph 11d. Refer to paragraph 12 to select the desired test. Like the on-line verification program, the off-line program can be restarted by using the ON command as described in paragraph 11 but the input and output LU's must not be specified.

**Note:** When restarting the off-line verification program, the number "3" must be entered when the program requests the entry of the 6940 LU number. If your system has more than one 6940 which you wish to test, finish testing the first 6940 and then reload the program as above with a different 6940 select code entered at step f.

## 14. CTF AND TIME OUT VALUE

For some of the 6940 I/O cards, it is desirable to check the common timing flag (CTF) by setting the Timing Mode Enable (TME) control line. When TME is set, T6940 outputs an error message if the 6940 I/O card under test does not return a CTF before a preset time out value elapses. For the on-line verification program, the time out value is set by the user when the RTE system is generated. For the off-line verification program, the time out value is set at 10 seconds when the program is loaded and initialized.

In some cases, it may be necessary to change the time out value. For example, if the stepping motor control card is to be tested at its maximum number of pulses (2047), the time out value should be at least 30 seconds. A time out value change can be made as follows:

- a. Terminate program T6940 (if it is running) by entering a "-1" when it requests a test number.
- b. Press the terminal's space bar to obtain the RTE prompt (\*).
- c. Enter the RTE operator command:

TO, EQT, NUMB

where: EQT is the Equipment Table number of the 6940. (For the off-line verification program, use the number "3" for EQT.)

NUMB is the number of 10-ms intervals to be used as the time out value. For example, NUMB = 3000 sets a time out value of 30 seconds: 3000 times 10 ms equals 30 seconds.

**Note:** Whenever T6940 is terminated, the time out value can be listed on the terminal by using the RTE command:

TO, EQT

- d. Restart T6940 by using the RTE ON command as described in paragraph 11.

**Note:** If you are using the off-line T6940, do not specify the input and output LU's. Also, enter the number "3" when T6940 requests the entry of the 6940 LU.

## 15. STATUS WORD REPORTS

Whenever program T6940 tries to communicate with the 6940, it checks the status word (EQT5) and if any status bits are set it reports the word in the form xxx (octal). The status words that might be reported and their meanings are:

- a. 001. Sense mode required.
- b. 002. Alarm pending.
- c. 003. Weird thing happened.
- d. 004. No flag returned.
- e. 00x. Essentially the same as 004.
- f. 200. Transmission error.
- g. 204. Transmission error plus no flag.
- h. 20x. Essentially the same as 200 or 204.

If either status word a, b, or c is reported during program initialization, just ignore it and enter the test number of the desired test (refer to paragraphs 11d and 12). If either of these three status words is reported during a verification test, try to clear it by re-entering the test number and continuing through the verification procedure. If the status word is reported again, perform test number 3 (e.g., Appendix A), entering 0's for unit, slot, DTE, SYE, TME, and data; then exit the test and perform the desired test.

If any one of status words d through h is reported at any time, proceed as follows:

- a. Terminate T6940 by entering a "-1" as the test number.
- b. Check the hardware for incorrect cabling and other defects. (Note that a transmission error can occur only if the 6940 is interfaced to the computer via an HP 09610-60044 Interface Card; in which case, thoroughly check this card's installation.)
- c. After correcting the hardware defect, restart T6940 by performing the procedure given in paragraph 11.

**Note:** If you are using the off-line T6940, do not specify the input and output LU's. Also, enter the number "3" when T6940 requests the entry of the 6940 LU.



## APPENDIX A

## HP 69321B D/A VOLTAGE CONVERTER CARD VERIFICATION

## A-1. FUNCTION OF CARD.

The HP 69321B Card provides a high speed, bipolar output voltage that is the analog of the digital data sent to the card. (HP 69351A Voltage Regulator plug-in card also required.)

## A-2. PRIMARY SPECIFICATIONS.

For complete listing of specifications, refer to 69321B manual, 69321-90003.

1. Output: - 10.240 to +10.235V dc, 0 - 10 mA
2. Resolution: 5 mV
3. Accuracy:  $\pm 5.0$  mV at 25°C  $\pm 5\%$  when delivering 0 - 5 mA. Accuracy is also affected by load regulation, temperature coefficient and stability.

## A-3. EQUIPMENT.

A voltage measuring instrument with resolution and accuracy  $> 0.1$  mV and with input impedance  $> 1$  K ohms.

## A-4. STATUS WORD.

On all calls to the 6940 driver, T6940 checks the status word, EQT5. If any of the status bits are set, T6940 reports the status word as follows:

ERROR RETURN FROM DRIVER. STATUS = XXX

where:

XXX is the status word in octal;

Bit 0 = Sense Mode Required

Bit 1 = Alarm Pending

Bit 2 = Time Out

Bit 7 = Parity Error on Transmission

**A-5. PROCEDURE.**

The verification procedure is as follows:

1. The test program must have been initialized.
2. Connect the voltage measuring instrument across the output terminals of the card, TB1-A and TB1-B.
3. Note the voltage output of the card.
4. Enter the following information to the computer in response to printouts as shown below. (AR and NP are abbreviations for As Required and Next Printout, respectively.)

MESSAGE	RESPONSE	RESULTS/NEXT STEP
a. ENTER TEST NUMBER.	3	3. SINGLE OUTPUT TEST
b. UNIT #, SLOT #?	AR	NP
c. DTE, SYE, TME? (-1 TO EXIT)	0,1,0	NP
d. ENTER DATA (OCTAL).	AR (see table A-1)	No output change (DTE off). NP
e. DTE, SYE, TME? (-1 TO EXIT)	1,1,0	NP
f. ENTER DATA (OCTAL).	AR	Voltage out is analog of data word. NP
g. DTE, SYE, TME? (-1 TO EXIT)	1,0,0	NP
h. ENTER DATA (OCTAL).	AR	No output (SYE off).
i. Repeat steps e and f, above, with SYE and DTE "on" at selected voltages over the entire range (see Table A-1). To select a new unit or slot number, exit the test and go back to step a.		

5. Common Timing Flag (CTF) check:

Before checking the CTF make sure that the time out value for the 6940 is nonzero. If the time out value is zero, and the 6940 fails to receive the CTF from the 6940 card, the computer will hang indefinitely. Otherwise the computer will wait no longer than the time set by the time out value, and T6940 will print out:

ERROR RETURN FROM DRIVER. STATUS = 004

Thus, with a nonzero time out value proceed as follows:

MESSAGE	RESPONSE	RESULTS/NEXT STEP
a. ENTER TEST NUMBER.	3	3. SINGLE OUTPUT TEST
b. UNIT #, SLOT #?	AR	NP
c. DTE, SYE, TME? (-1 TO EXIT)	1,1,1	NP
d. ENTER DATA (OCTAL).	AR	NP

If the return flag is properly received, the next printout is:

DTE, SYE, TME?(-1 TO EXIT)

Table A-1. Output Voltages

Output Data Word	Decimal Value	69321B Standard Output Voltage <sup>1</sup>	69321B, Opt. J12 Output Voltage <sup>2</sup>
3777	2047	10.235	12.282
3720	2000	10.000	12.000
2000	1024	5.120	6.144
1777	1023	5.115	6.138
1750	1000	5.000	6.000
1000	0512	2.560	3.072
0777	0511	2.555	3.066
0400	0256	1.280	1.536
0200	0128	0.640	0.768
0100	0064	0.320	0.384
0040	0032	0.160	0.192
0020	0016	0.080	0.096
0010	0008	0.040	0.048
0004	0004	0.020	0.024
0002	0002	0.010	0.012
0001	0001	0.005	0.006
0	0	0	0
7777	-0001	-0.005	-0.006
7776	-0002	-0.010	-0.012
7774	-0004	-0.020	-0.024
7770	-0008	-0.040	-0.048
7760	-0016	-0.080	-0.096
7740	-0032	-0.160	-0.192
7700	-0064	-0.320	-0.384
7600	-0128	-0.640	-0.768
7400	-0256	-1.280	-1.536
7001	-0511	-2.555	-3.066
7000	-0512	-2.560	-3.072
6030	-1000	-5.000	-6.000
6001	-1023	-5.115	-6.138
6000	-1024	-5.120	-6.144
4060	-2000	-10.000	-12.000
4001	-2047	-10.235	-12.282
4000	-2048	-10.240	-12.288

<sup>1</sup> Output voltage for standard 69321B is 0.005 X Decimal Value.

<sup>2</sup> Output voltage for 69321B Opt. J12 is 0.006 X Decimal Value.

**APPENDIX B****HP 69330A RELAY OUTPUT CARD VERIFICATION****B-1. FUNCTION OF CARD.**

The HP 69330A Card provides 12 Form A (SPST - N.O.) mercury-wetted reed relay contacts which are controlled by the 12-bit output data word. A 13th contact is provided for an output gate signal and is controlled by DTE. Additionally, a return flag signal input is available for use by an external device.

**B-2. PRIMARY SPECIFICATIONS.**

For complete listing of specifications, refer to 69330A manual, 69330-90001.

1. Relay Contact State: Each of the 12 switching contacts (A1K1 through A12K1) are controlled by a corresponding bit (bit 0 through bit 11) in the output data word. Standard relationship is that a logic "1" closes a contact, logic "0" opens a contact.
2. Gate/Flag Operation: Output gate signal is set either simultaneously at time of 12 bit output by having DTE ON prior to data transfer or at a later time by setting DTE ON. This output gate signal is cleared by either receiving a return flag or by setting DTE OFF.

**B-3. EQUIPMENT.**

Any device or combination of devices which will show continuity or/no continuity. A dual 15-pin connector, HP part number 1251-0159 or equivalent, provides convenient connection points.

**B-4. STATUS WORD.**

On all calls to the 6940 driver, T6940 checks the status word, EQT5. If any of the status bits are set, T6940 reports the status word as follows:

ERROR RETURN FROM DRIVER. STATUS = XXX

where:

- XXX is the status word in octal;
- Bit 0 = Sense Mode Required
- Bit 1 = Alarm Pending
- Bit 2 = Time Out
- Bit 7 = Parity Error on Transmission

**B-5. PROCEDURE.**

The procedure is as follows:

1. The test program must have been initialized.
2. Enter the following information to the computer in response to printouts as shown below. (AR and NP are abbreviations for As Required and Next Printout, respectively.)

MESSAGE	RESPONSE	RESULTS/NEXT STEP
a. ENTER TEST NUMBER.	3	3. SINGLE OUTPUT TEST
b. UNIT #, SLOT #?	AR	NP
c. DTE, SYE, TME? (-1 TO EXIT)	0,1,0	NP
d. ENTER DATA (OCTAL).	AR (see table B-1)	
Determine whether the switching contacts of A1K1 through A12K1 are open or closed in accordance with the data word output. The output gate contacts should be open because DTE is OFF.		
e. DTE, SYE, TME? (-1 TO EXIT)	1,1,0	NP
f. ENTER DATA (OCTAL).	AR	

The gate contacts are closed (DTE on). Simulate a return flag signal by shorting pins 14 and 15 together. The output gate contacts should open.

MESSAGE	RESPONSE	RESULTS/NEXT STEP
g. TME, DTE, SYE? (-1 TO EXIT)	1,0,0	NP
h. ENTER DATA (OCTAL).	AR	No output (SYE off).
i. Repeat steps e and f with SYE and DTE "on" until all relays have been verified to be working (see table B-1). To select a new unit or slot number, exit the test and go back to step a.		

3. Common Timing Flag (CTF) check:

Before checking the CTF make sure that the time out value for the 6940 is nonzero. If the time out value is zero, and the 6940 fails to receive the CTF from the 6940 card, the computer will hang indefinitely. Otherwise the computer will wait no longer than the time set by the time out value, and T6940 will print out:

ERROR RETURN FROM DRIVER. STATUS = 004

Thus, with a nonzero time out value proceed as follows:

MESSAGE	RESPONSE	RESULTS/NEXT STEP
a. ENTER TEST NUMBER.	3	3. SINGLE OUTPUT TEXT
b. UNIT #, SLOT #?	AR	NP
c. DTE, SYE, TME? (-1 TO EXIT)	1,1,1	NP
d. ENTER DATA (OCTAL).	AR	NP

If the return flag is properly received, the next printout is:

DTE, SYE, TME?(-1 TO EXIT)

Table B-1. HP 69330A Input/Output Pin Signals

Output Data Word*	Bit/Signal Output to Card	Relay Affected	I/O Pins
0001	Bit 0	A1K1	1, A
0002	Bit 1	A2K1	2, B
0004	Bit 2	A3K1	3, C
0010	Bit 3	A4K1	4, D
0020	Bit 4	A5K1	5, E
0040	Bit 5	A6K1	6, F
0100	Bit 6	A7K1	7, H
0200	Bit 7	A8K1	8, J
0400	Bit 8	A9K1	9, K
1000	Bit 9	A10K1	10, L
2000	Bit 10	A11K1	11, M
4000	Bit 11	A12K1	12, N
(DTE)	GATE	—	13, P
—	FLAG (input)	—	14, R

\*This assumes only one set or contacts is checked at a time. Combinations of bits can be output simultaneously. For instance, output data word 5252 closes the contacts of K2, 4, 6, 8, 10 and 12.



## APPENDIX C

### HP 69331A TTL OUTPUT CARD VERIFICATION

#### C-1. FUNCTION OF CARD.

The HP 69331A Card provides 12 output transistor drivers which are controlled by the 12-bit output data word. A 13th transistor driver is provided for an output gate signal and is controlled by DTE. Additionally, a return flag signal input is available for use by an external device.

#### C-2. PRIMARY SPECIFICATIONS.

For complete listing of specifications, refer to 69331A manual, 69331-90001.

1. **OUTPUT:** Each of the 12 output transistors (A1Q1 through A12Q1) are controlled by a corresponding bit (bit 0 through bit 11) in the output data word. When turned ON (in LO state), standard output level = 0 to +0.3V (32 mA max sink current). When turned OFF (in HI state) standard output level = +4.5V to 5.0V (1 kilohm source impedance).

User-connected options: 0 to +12V (nominal) logic levels or open collector driver. Refer to table C-1 for further details.

2. **Gate/Flag Operation:** Output gate signal is set either simultaneously at time of 12 bit output by having DTE ON prior to data transfer or at a later time by setting DTE ON. This output gate signal is cleared by either receiving a return flag or by setting DTE OFF.

#### C-3. EQUIPMENT.

Any device or combination of devices which will show whether an output transistor is turned ON (in LO state) or is turned OFF (in HI state), where HI state is defined in table C-1. A dual 15-pin connector, HP part number 1251-0159 or equivalent, provides convenient connection points.

**C-4. STATUS WORD.**

On all calls to the 6940 driver, T6940 checks the status word, EQT5. If any of the status bits are set, T6940 reports the status word as follows:

ERROR RETURN FROM DRIVER. STATUS = XXX

where:

- XXX is the status word in octal;
- Bit 0 = Sense Mode Required
- Bit 1 = Alarm Pending
- Bit 2 = Time Out
- Bit 7 = Parity Error on Transmission

Table C-1. Output Voltage Levels

LOGIC SENSE OF OUTPUT BIT TO CARD	STANDARD		OPT 073	
	STATE	VOLTAGE	STATE	VOLTAGE
0 (False)	HI	+4.5 to +5.0V*	LO	0 to +0.3V
1 (True)	LO	0 to +0.3V	HI	+4.5 to +5.0V*

\*5V can be changed to +12V by changing a card jumper or can be changed to an open collector by removing collector resistor.

**C-5. PROCEDURE.**

The procedure is as follows:

1. The test program must have been initialized.
2. Enter the following information to the computer in response to printouts as shown below. (AR and NP are abbreviations for As Required and Next Printout, respectively.)

MESSAGE	RESPONSE	RESULTS/NEXT STEP
a. ENTER TEST NUMBER.	3	3. SINGLE OUTPUT TEST
b. UNIT #, SLOT #?	AR	NP
c. DTE, SYE, TME? (-1 TO EXIT)	0,1,0	NP
d. ENTER DATA (OCTAL).	AR (see table C-2)	

Determine whether the output transistors A1Q1 are ON (in LO state) or OFF (in HI state) in accordance with the data word output. The output gate transistor should be OFF (in HI state) with card jumper J3 in "B" position, which is "standard". If J3 is in "A" position, the output gate transistor should be ON (in LO state). The output gate transistor is inactive because DTE is OFF.

e. DTE, SYE, TME? (-1 TO EXIT)	1,1,0	NP
f. ENTER DATA (OCTAL).	AR	

The gate output transistor is activated (DTE "on"). Simulate a return flag signal by shorting pin R or 14 to pin S or 15. The gate output transistor should return to its inactive state.

g. DTE, SYE, TME? (-1 TO EXIT)	1,0,0	NP
h. ENTER DATA (OCTAL).	AR	No output (SYE off).
i. Repeat steps e and f with SYE and DTE "on" until all output transistors have been verified to be working (see table C-2). To select a new unit or slot number, exit the test and go back to step a.		

### 3. Common Timing Flag (CTF) check:

Before checking the CTF make sure that the time out value for the 6940 is nonzero. If the time and value is zero, and the 6940 fails to receive the CTF from the 6940 card, the computer will hang indefinitely. Otherwise the computer will wait no longer than the time set by the time out value, and T6940 will print out:

ERROR RETURN FROM DRIVER. STATUS = 004



Thus, with a nonzero time out value proceed as follows:

MESSAGE	RESPONSE	RESULTS/NEXT STEP
a. ENTER TEST NUMBER.	3	3. SINGLE OUTPUT TEST
b. UNIT #, SLOT #?	AR	NP
c. DTE, SYE, TME? (-1 TO EXIT)	1,1,1	NP
d. ENTER DATA (OCTAL).	AR	NP

If the return flag is properly received, the next printout is:

DTE, SYE, TME? (-1 TO EXIT)

Table C-2. I/O Pin Signals

Output Data Word*	Bit/Signal Output of Cd	I/O Pin
0001	Bit 0	1
0002	Bit 1	2
0004	Bit 2	3
0010	Bit 3	4
0020	Bit 4	5
0040	Bit 5	6
0100	Bit 6	7
0200	Bit 7	8
0400	Bit 8	9
1000	Bit 9	10
2000	Bit 10	11
4000	Bit 11	12
(DTE)	GATE	13, P
-	FLAG (input)	14, R

\*This assumes only one output pin is checked at a time. Combinations of bits can be output simultaneously. For instance output data word 5252 causes the voltage level at pins 2, 4, 6, 8, 10 and 12 to go LO for the standard TTL output card.

## APPENDIX D

## HP 69335A STEPPING MOTOR CARD VERIFICATION

**D-1. FUNCTION OF CARD.** The HP 69335A provides 1 to 2047 square wave pulses at either of two output terminals on the card. When applied to a stepping motor translator, these pulses are converted to clockwise and counterclockwise drive pulses for an associated stepping motor. The square wave outputs of the 69335A can also be used for pulse-train update of supervisory control stations.

**D-2. PRIMARY SPECIFICATIONS.** For complete listing of specifications, refer to 69335A manual, 69335-90001.

1. Output: A train of positive symmetrical square-wave pulses appears at the output selected by the directional bit (bit 11 of the data word).
2. Drive Pulse Levels: 12V (as supplied), jumper selectable to 5V or adjustable.
3. Drive Pulse Frequency: Nominally 100 Hz.

**D-3. EQUIPMENT.** A pulse counter capable of totalizing positive square wave pulses. (A HP 5326 or equivalent.)

**D-4. STATUS WORD.** On all calls to the 6940 driver, T6940 checks the status word, EQT5. If any of the status bits are set, T6940 reports the status word as follows:

ERROR RETURN FROM DRIVER. STATUS = XXX

where:

- XXX is the status word in octal;
- Bit 0 = Sense Mode Required
- Bit 1 = Alarm Pending
- Bit 2 = Time Out
- Bit 7 = Parity Error on Transmission

**D-5. PROCEDURE.** The procedure is as follows:

**Note:** For the stepping motor control test, Common Timing Flag (CTF) is checked automatically; T6940 waits until the card finishes transmitting the selected number of pulses. Consequently, the time out value should be set to a period greater than the time required to output the pulse train; otherwise, a time out error will be reported.

1. The test program must have been initialized.
2. Clear the pulse counter.

3. Enter the following information to the computer in response to printouts as shown below. (AR and NP are abbreviations for As Required and Next Printout, respectively.)

MESSAGE	RESPONSE	RESULTS/NEXT STEP
a. ENTER TEST NUMBER.	8	NP
b. STEPPER MOTOR CONTROL TEST. SET THE # OF PULSES (LESS THAN 4000B). WATCH OUT PUT #1.		NP
c. UNIT #, SLOT #?(-1 TO EXIT)	AR	NP
d. Connect the pulse counter between output #1 (pin 1) and common (pin 15).		
e. ENTER DATA (OCTAL). Check that the pulses counted at output #1 correspond to the data entered. Clear the counter and connect it between output #2 (pin 2) and common (pin 15).	AR (See Table D-1)	
f. KEY IN A 1 WHEN READY TO WATCH OUTPUT #2. Check that the pulses counted at output #2 correspond to the data entered in step e. Clear the counter and connect it to output #1.	1	NP
g. REPEAT?(0=NO, 1=YES)	1	NP
h. SET THE # OF PULSES (LESS THAT 4000B). WATCH OUTPUT #1. ENTER DATA (OCTAL). Repeat steps d through h, entering different data at step e, until card operation throughout its frequency range is verified.		Go to step d.
i. REPEAT?(0=NO, 1=YES)	0	NP
j. ENTER TEST NUMBER.	3	3. SINGLE OUTPUT TEST
k. UNIT #, SLOT #? (-1 TO EXIT)	AR	NP
l. DTE, SYE, TME? (-1 TO EXIT)	0, 0, 0	NP
m. ENTER DATA (OCTAL).	AR	No output (SYE off).
n. DTE, SYE, TME? (-1 TO EXIT)	0, 1, 0	NP
o. ENTER DATA (OCTAL).	50	Outputs forty pulses.
p. DTE, SYE, TME? (-1 TO EXIT)	0, 1, 1	NP
q. ENTER DATA (OCTAL) T6940 waits until the stepping motor control card has finished outputting pulses before going to the next step.	764	Outputs 500 pulses.
r. DTE, SYE, TME? (-1 to EXIT)		End of test.

Table D-1. HP 69335A Output Pulses

DATA	PULSES (OUTPUT #1)	DATA	PULSES (OUTPUT #2)
0000	0	4000	0
0001	1	4001	1
0002	2	4002	2
0004	4	4004	4
0010	8	4010	8
0020	16	4020	16
0040	32	4040	32
0100	64	4100	64
0200	128	4200	128
0400	256	4400	256
1000	512	5000	512
2000	1024	6000	1024
3777	2047	7777	2047





## APPENDIX E

## HP 69370A D/A CURRENT CONVERTER CARD VERIFICATION

**E-1. FUNCTION OF CARD.** The HP 69370A provides a high speed, output current that is the analog of the digital data sent to the card. (69351A Voltage Regulator plug-in card also required.)

**E-2. PRIMARY SPECIFICATIONS.** For complete listing of specifications, refer to 69370A manual, 69370-90001.

1. Output: 0 to 20.475 mA up to 10.5 Volts
2. Resolution: 5  $\mu$ A
3. Accuracy:  $\pm 2.5$  uA at 25 degrees C  $\pm 5\%$  when delivering up to 10.5V. Accuracy is also affected by load regulation, temperature coefficient and stability.

**E-3. EQUIPMENT.** A current measuring instrument with resolution and accuracy and with shunt impedance  $< 500$  Ohms. (Suggested an HP 428 Current Probe or a 512 Ohm precision resistor and a voltmeter).

**E-4. STATUS WORD.** On all calls to the 6940 driver, T6940 checks the status word, EQT5. If any of the status bits are set, T6940 reports the status word as follows:

ERROR RETURN FROM DRIVER. STATUS = XXX

where:

XXX is the status word in octal;

Bit 0 = Sense Mode Required

Bit 1 = Alarm Pending

Bit 2 = Time Out

Bit 7 = Parity Error on Transmission

**E-5. PROCEDURE.** The procedure is as follows:

1. The test program must have been initialized.
2. Connect the current measuring instrument across the output terminals of the card, TB1-A and TB1-B.
3. Note the current output of the card.
4. Enter the following information to the computer in response to printouts as shown below. (AR and NP are abbreviations for As Required and Next Printout, respectively.)

MESSAGE	RESPONSE	RESULTS/NEXT STEP
a. ENTER TEST NUMBER.	3	3. SINGLE OUTPUT TEST
b. UNIT #, SLOT #?	AR	NP
c. DTE, SYE, TME? (-1 TO EXIT)	0,1,0	NP
d. ENTER DATA (OCTAL).	AR (see Table E-1)	No output change (DTE off). NP
e. DTE, SYE, TME? (-1 TO EXIT)	1,1,0	NP
f. ENTER DATA (OCTAL).	AR	Current out is analog of data word. NP
g. DTE, SYE, TME? (-1 TO EXIT)	1,0,0	NP
h. ENTER DATA (OCTAL).	AR	No output (SYE off). NP
i. Repeat steps e and f, above, with SYE and DTE "on" at selected currents over the entire range (see Table E-1). To select a new unit or slot number, exit the test and go back to step a.		

5. Common Timing Flag (CTF) check:

Before checking the CTF make sure that the time out value for the 6940 is nonzero. If the time out value is zero, and the 6940 fails to receive the CTF from the 6940 card, the computer will hang indefinitely. Otherwise the computer will wait no longer than the time set by the time out value, and T6940 will print out:

ERROR RETURN FROM DRIVER. STATUS = 004

Thus, with a nonzero time out value proceed as follows:

MESSAGE	RESPONSE	RESULTS/NEXT STEP
a. ENTER TEST NUMBER.	3	3. SINGLE OUTPUT TEST
b. UNIT #, SLOT #?	AR	NP
c. DTE, SYE, TME? (-1 TO EXIT)	1,1,1	NP
d. ENTER DATA (OCTAL).	AR	NP
If the return flag is properly received, the next printout is:		
DTE, SYE, TME?(-1 TO EXIT)		
e. End of test.		

Table E-1. HP 69370A Output Currents

OUTPUT DATA WORD	DECIMAL VALUE	69370A OUTPUT CURRENT <sup>1</sup>
0000	0	0 mA
0001	1	.005
0002	2	.010
0004	4	.020
0010	8	.040
0020	16	.080
0040	32	.160
0100	64	.320
0200	128	.640
0400	256	1.280
1000	512	2.560
2000	1024	5.120
4000	2048	10.240
7777	4095	20.475

<sup>1</sup> Output current for 69370A is .005 mA x decimal value.



## APPENDIX F

## HP 69430A ISOLATED DIGITAL INPUT CARD VERIFICATION

**F-1. FUNCTION OF CARD.** The HP 69430A accepts 12 isolated digital inputs and passes them on to computer as "live" data. The 12-pairs of input lines are isolated from one another and from the multiprogrammer power supply through the use of photo-isolators.

**F-2. PRIMARY SPECIFICATIONS.** For complete listing, of specifications, refer to 69430A manual, 69430-90001.

1. Data Input: 12-bit binary
2. Voltage Levels.

## Ground-True Options:

Option	Logic 1	Logic 0*
069	0 to 0.4V	3.5 to 6V
084	0 to 0.4V	6 to 12V
085	0 to 0.4V	12 to 25V
086	0 to 0.4V	25 to 50V

## Positive-True Options:

Option	Logic 1*	Logic 0
073	3.5 to 6V	0 to 0.4V
087	6 to 12V	0 to 0.4V
088	12 to 25V	0 to 0.4V
089	25 to 50V	0 to 0.4V

(\*Voltage source must be capable of sourcing 3 mA, minimum, at low end of voltage span.)

**F-3. EQUIPMENT.** A voltage source capable of supplying the voltage levels that apply to the option of the card to be tested. These voltage levels are specified above in PRIMARY SPECIFICATION 2. A dual 15-pin connector HP part number 1251-0159 or equivalent, provides convenient connection points.

**F-4. STATUS WORD.** On all calls to the 6940 driver, T6940 checks the status word, EQT5. If any of the status bits are set, T6940 reports the status word as follows:

ERROR RETURN FROM DRIVER. STATUS = XXX

where:

XXX is the status word in octal;

- Bit 0 = Sense Mode Required
- Bit 1 = Alarm Pending
- Bit 2 = Time Out
- Bit 7 = Parity Error on Transmission

**F-5. PROCEDURE.** The procedure is as follows:

1. The test program must have been initialized.
2. Connect the voltage source to any pair (or pairs) of input pins using Table F-1 as a guide. Note that the more positive (high) line of the voltage source must be connected to the *number* pin, with the low connected to the *letter* pin.
3. Enter the following information to the computer in response to printouts as shown below. (AR and NP are abbreviations for As Required and Next Printout, respectively.)

MESSAGE	RESPONSE	RESULTS/NEXT STEP
a. ENTER TEST NUMBER.	1	1. INPUT TEST - NORMAL READ.
b. UNIT #, SLOT # ? (-1 TO EXIT)	AR	NP
c. TME? (0=OFF, 1=ON, -1 TO EXIT)	0	SLOT # ss HAS DATA ddddd

4. Verify that the input data word is in accordance with the test connection(s) that were made in step 2 above.
5. Repeat steps 2, 3c, and 4 until all input line pairs have been verified to be working, again using Table F-1 as a guide.

Table F-1. HP 69430A Input/Output Pin Signals

Input Data Word*		Bit Input From Card	I/O Pins**
(Ground True) Opts 069, 084, 085, 086	(Positive True) Opts 073, 087, 088, 089		
7776	0001	Bit 0	1, A
7775	0002	Bit 1	2, B
7773	0004	Bit 2	3, C
7767	0010	Bit 3	4, D
7757	0020	Bit 4	5, E
7737	0040	Bit 5	6, F
7677	0100	Bit 6	7, H
7577	0200	Bit 7	8, J
7377	0400	Bit 8	9, K
6777	1000	Bit 9	10, L
5777	2000	Bit 10	11, M
3777	4000	Bit 11	12, N

\*This assumes only one pair of pins are energized at a time. Combinations of bits can be input simultaneously. For instance, voltage signals could be applied to pins 1 and A, 5 and E, and 9 and K. The resulting input data word would be 7356 for ground true cards and 0421 for positive true cards.

\*\*The more positive (high) line of the voltage source must be connected to the *number* pin, with the low connected to the *letter* pin.





## APPENDIX G

## HP 69431A DIGITAL INPUT CARD VERIFICATION

**G-1. FUNCTION OF CARD.** The HP 69431A accepts 12 (single-ended) digital inputs and stores their state when an external device flag signal is received. Additionally, it provides an output gate signal. This card can be used in either input or interrupt mode of operation.

**G-2. PRIMARY SPECIFICATIONS.** For complete listing of specifications, refer to 69431A manual, 69431-90001.

1. Data Input: 12-bit binary

2. Voltage Levels

Options 069 and 073: LO = 0 to 0.8V (6 mA max. sink current)  
HI = 2.0V to 5.0V (1 k $\Omega$  source impedance)

Option 070: (open collector drivers)  
LO = 0V to 1.0V (15 mA max. sink current)  
HI = +6V to +14V

3. Input Data Storage:

Standard (Options 069, 070, 073):

12-bit storage register receives input data at end-of-Flag transition of external device Flag input.

User-Selected Option:

User can disable data storage by removing option jumper. Data available at card as received on input data lines.

4. Device Command (Gate) Output:

Standard (Options 069, 070, 073):

One normally HI logic level line. HI-to-LO change in level indicates data is requested by input card.

5. Device Signal (Flag) Input:

Standard (Options 069, 070, 073):

One normally HI input line. HI-to-LO change in level indicates external device is busy processing data in response to device command (gate) output. End-of-Flag (LO-to-HI transition) indicates device data available to input card.

**G-3. EQUIPMENT.** Jumper wires. Any device or combination of devices which will show whether an output gate transistor is turned ON (in LO state) or is turned OFF (in HI state). A dual 15-pin connector, HP part number 1251-0159 or equivalent, provides convenient connection points.

**G-4. STATUS WORD.** On all calls to the 6940 driver, T6940 checks the status word, EQT5. If any of the status bits are set, T6940 reports the status word as follows:

ERROR RETURN FROM DRIVER. STATUS = XXX

where:

XXX is the status word in octal;

Bit 0 = Sense Mode Required

Bit 1 = Alarm Pending

Bit 2 = Time Out

Bit 7 = Parity Error on Transmission

**G-5. PROCEDURE.** The procedure is as follows:

1. The test program must have been initialized.
2. Short any input pin(s) to ground using Table G-1 as a guide.
3. To test the digital input card for correct operation in a "fast" input mode (timing mode disabled), enter the following information to the computer in response to printouts as shown below. (AR and NP are abbreviations for As Required and Next Printout, respectively.)

MESSAGE	RESPONSE	RESULTS/NEXT STEP
a. ENTER TEST NUMBER.	1	1. INPUT TEST - NORMAL READ. (NP)
b. UNIT #, SLOT #? (-1 TO EXIT) Before reading in data word (next step), simulate an input flag signal by connecting pin 14 to 15.	AR	
c. TME? (0=OFF, 1=ON, -1 TO EXIT)	0	NP
d. SLOT # ss HAS DATA ddddd		
e. Verify that the data printed in step d corresponds to the input conditions set in step 2, above.		
f. Repeat steps 2, 3c, 3d, and 3e until all input lines have been verified to be working, (use Table G-1 as a guide.)		
g. TME? (0=OFF, 1=ON, -1 TO EXIT) T6940 waits until either an input flag signal is simulated (pin 14 connected to 15), in which case it prints out data as in step 3d above, or until the time out value elapses, in which case it prints out the following:	1	Output gate transistor activated.

ERROR RETURN FROM DRIVER. STATUS = 004

ENTER TEST NUMBER.

If data is printed out, exit the test by entering -1 in response to "TME? (etc.)". Remove the jumper between pins 14 and 15.

4. If the 69431A Card is in unit 00, its interrupt capability can be tested by performing the event sense verification (Appendix H); an interrupt can be generated by simulating an input flag signal. The output gate transistor will return to its deactivated state.

Table G-1. HP 69431A Input/Output Pin Signals

INPUT DATA WORD*		BIT/SIGNAL INPUT FROM CARD	I/O PIN
(POSITIVE TRUE) OPTION 073	(GROUND TRUE) OPTIONS 069, 070		
7776	0001	Bit 0	1
7775	0002	Bit 1	2
7773	0004	Bit 2	3
7767	0010	Bit 3	4
7757	0020	Bit 4	5
7737	0040	Bit 5	6
7677	0100	Bit 6	7
7577	0200	Bit 7	8
7377	0400	Bit 8	9
6777	1000	Bit 9	10
5777	2000	Bit 10	11
3777	4000	Bit 11	12
-	(STC)	GATE (output)	13
-	-	FLAG	14

\*This assumes only one pin is shorted at a time. Combinations of bits can be input simultaneously. For instance, grounding of pins 1, 3, 5, 7, 9, and 11 would result in an input data word of 2525 from an option 069 card.

Table G-2. Input Voltage Levels

Logic Sense of Input Bit From Card	Voltage Levels					
	Option 069		Option 070		Option 073	
	State	Voltage	State	Voltage	State	Voltage
0 (False)	HI	+2.0 to +5.0V	HI	+6V to +14V	LO	0 to 0.8V
1 (True)	LO	0 to +0.8V	LO	0 to +1.0V	HI	+2.0 to +5.0V



## APPENDIX H

## HP 69434A EVENT SENSE CARD VERIFICATION

**H-1. FUNCTION OF CARD.** The HP 69434A monitors 12 (single-ended) external digital input lines, compares them with a stored 12-bit reference word and, if the multiprogrammer is in the interrupt enable state, signals the computer when an event occurs. An event is a change in the external data that causes it to be different from (or not equal to) the internal reference word.

**H-2. PRIMARY SPECIFICATIONS.** For complete listing of specifications, refer to 69434A manual, 69434-90001.

1. Data Input: 12-bit binary
2. Voltage Levels

Standard 69434A and option 082: Relay contact states

Binary 1 = Contact open (resistance  $>1M\Omega$  to computer common)

Binary 0 = Contact closed (resistance  $<100\Omega$  to computer common)

Option 083: Digital (TTL/DTL, open-collector, etc.) input

Binary 1 = LO: 0V to 1V (2.3 mA max. sink current)

Binary 0 = HI: 2.9V to 5.0V

$E_{OC}$  = 3.3V (max.)

**H-3. EQUIPMENT.** Jumper wires. A dual 15-pin connector, HP part number 1251-0159 or equivalent, provides convenient connection points.

**H-4. STATUS WORD.** On all calls to the 6940 driver, T6940 checks the status word, EQT5. If any of the status bits are set, T6940 reports the status word as follows:

ERROR RETURN FROM DRIVER. STATUS = XXX

where:

XXX is the status word in octal;

Bit 0 = Sense Mode Required

Bit 1 = Alarm Pending

Bit 2 = Time Out

Bit 7 = Parity Error on Transmission

**H-5. PROCEDURE.** The procedure is as follows:

1. The test program must have been initialized.

2. Before *any* event sense card can be tested, *all* event sense cards installed in the multiprogrammer must have their stored reference word set to the proper state. For the standard 69434A or option 082, all 12-bits must be set to "1" by outputting a data word of 7777. For option 083, all 12-bits must be set to "0" by outputting a data word of 0.
3. After determining what types of event sense cards (standard or otherwise) are in what slots, output the correct reference word to each card by entering the following information to the computer in response to print outs as shown below. (AR and NP are abbreviations for As Required and Next Printout, respectively.)

MESSAGE	RESPONSE	RESULTS/NEXT STEP
a. ENTER TEST NUMBER.	5	5. EVENT SENSE TEST. SET REFERENCE WORDS.
b. UNIT #, SLOT # ? (-1 TO EXIT)	AR	NP
c. ENTER DATA (OCTAL).	AR	

4. Repeat steps 3b and 3c until the proper reference word has been output to all event sense cards.
5. To test the event sense card for correct operation in the interrupt mode, enter the following information to the computer in response to printouts.

a. UNIT #, SLOT # ? (-1 TO EXIT)	-1	NP
b. CAUSE EVENTS? T6940 waits for 10 seconds for an event to occur. Cause an event by shorting any input signal line (pins 1 through 12) to ground (pin 15). Program SENSE handles the interrupt and prints: THE INTERRUPTING SLOT IS ssssss THE DATA IS ddddddd THE 6940 SELECT CODE IS cccccc REPEAT INTERRUPT MODE? (0=NO, 1=YES)		

- c. Verify that the printed interrupt data corresponds to the test short that was made by using Table H-1. Short a different input line and enter a "1" to repeat the test. T6940 prints out interrupt data as in step b.
- d. Repeat step c until all input lines on the card have been verified.
- e. To test another event sense card, enter "0" in response to "REPEAT (etc.)" and return to step 3a. Note that at the conclusion of testing a card, its Input Request signal must be re-initialized by outputting its correct reference word; use steps 3a, 3b, and 3c.
6. In order to check the reported external data word, enter the following information in response to the following printouts.

a. ENTER TEST NUMBER	2	2. INPUT TEST — READ DIRECT WITHOUT GATE.
b. UNIT #, SLOT # ? (-1 TO EXIT)	AR	SLOT # ss HAS DATA ddddddd ENTER TEST NUMBER.

- c. Repeat steps a and b for each event sense card. The event sense mode of operation is working correctly if the data from step b (with bit 15 set) is otherwise the same as the data reported in step 5b for a particular event sense card.

Table H-1. HP 69434A Input/Output Pin Signals

Input Data Word*		Bit Input From Card	I/O Pin
(Positive True) Standard, Opt. 082	(Ground True) Opt. 083		
7776	0001	Bit 0	1
7775	0002	Bit 1	2
7773	0004	Bit 2	3
7767	0010	Bit 3	4
7757	0020	Bit 4	5
7737	0040	Bit 5	6
7677	0100	Bit 6	7
7577	0200	Bit 7	8
7377	0400	Bit 8	9
6777	1000	Bit 9	10
5777	2000	Bit 10	11
3777	4000	Bit 11	12

\*This assumes that only one pin is shorted at a time. Combinations of bits can be input simultaneously. For instance, grounding of pins 1, 3, 5, 7, 9, and 11 would result in an input data word of 5252 from the standard event sense card.



7. The user may program a reference word by using Test Number 3 and verify the reference word by using Test Number 1. To do this, enter the following information in response to the following printouts.
- |                                 |       |                              |
|---------------------------------|-------|------------------------------|
| a. ENTER TEST NUMBER.           | 3     | 3. SINGLE OUTPUT TEST        |
| b. UNIT #,SLOT #?(-1 TO EXIT)   | AR    | NP                           |
| c. DTE,SYE,TME?(-1 TO EXIT)     | 0,1,0 | NP                           |
| d. ENTER DATA (OCTAL).          | AR    | NP                           |
| e. DTE,SYE,TME?(-1 TO EXIT)     | -1    | NP                           |
| f. ENTER TEST NUMBER.           | 1     | 1. INPUT TEST - NORMAL READ. |
| g. UNIT # , SLOT #?(-1 TO EXIT) | AR    | NP                           |
| h. TME?(0=OFF,1=ON,-1 TO EXIT)  | 0     | SLOT # ss HAS dddddd         |

Verify that data dddddd equals the programmed reference word entered in step d.





## APPENDIX I

## HP 69435A PULSE COUNTER CARD VERIFICATION

**I-1. FUNCTION OF CARD.** The HP 69435A provides for counting pulses, up or down, in the range of 0 to 4095. A carry or borrow pulse is generated as the counter goes above 4095 or below 0. These pulses allow multiple counter cards to be cascaded for greater counting capability or they can serve as alarm signals. The card can also be used as a pre-set counter.

**I-2. PRIMARY SPECIFICATIONS.** For complete listing of specifications, refer to 69435A manual, 69435-90001.

1. **Input Count Frequency:** Up to 200 kHz square wave. Other wave shapes can be counted providing the rise time is  $< 5 \mu\text{sec}$ . (Slower rise times can be accommodated by making minor component changes on the card.)
2. **Minimum Pulse Width:**  $2.5 \mu\text{sec}$ .
3. **Maximum Rise Time:**  $5 \mu\text{sec}$ .
4. **Breakdown Voltage:** Potential difference between isolated input terminals B through L and chassis ground must not exceed 100 Vdc or 100 Vrms.
5. **Temperature Range:** 0 degrees C to 70 degrees C operating in mainframe (allow +15 degrees internal rise when operating in mainframe at up to +55 degrees C ambient); -40 degrees C to +80 degrees C storage.

**I-3. EQUIPMENT.** Any device to test the logical state of a TTL standard output, and any device capable of generating a single, TTL compatible, pulse. (An HP logic probe and an HP 8004 Pulse Generator in manual mode, or equivalent instruments are suggested.)

**I-4. STATUS WORD.** On all calls to the 6940 driver, T6940 checks the status word, EQT5. If any of the status bits are set, T6940 reports the status word as follows:

ERROR RETURN FROM DRIVER. STATUS = XXX

where:

- XXX is the status word in octal;
- Bit 0 = Sense Mode Required
- Bit 1 = Alarm Pending
- Bit 2 = Time Out
- Bit 7 = Parity Error on Transmission

**I-5. PROCEDURE.** The procedure is as follows:

1. The test program must have been initialized.
2. Enter the following information to the computer in response to printouts as shown below. (AR and NP are abbreviations for As Required and Next Printout, respectively.)

MESSAGE	RESPONSE	RESULTS/NEXT STEP
a. ENTER TEST NUMBER.	3	3. SINGLE OUTPUT TEST
b. UNIT #, SLOT # ? (-1 TO EXIT)	AR	NP
c. DTE, SYE, TME? (-1 TO EXIT)	0,0,0	NP
d. ENTER DATA (OCTAL).	AR (see Table I-1)	NP
e. DTE, SYE, TME? (-1 TO EXIT)	-1	NP
f. ENTER TEST NUMBER.	1	1. INPUT TEST — NORMAL READ.
g. UNIT #, SLOT # ? (-1 TO EXIT)	AR	NP
h. TME? (0=OFF, 1=ON, -1 TO EXIT)	0	SLOT # ss HAS DATA ddddd
The data printed in this step should be the same as the data entered in step d.		
i. TME? (0=OFF, 1=ON, -1 TO EXIT)	-1	ENTER TEST NUMBER.
j. Repeat steps a through i entering different data at step d until all storage bits have been verified.		
k. ENTER TEST NUMBER.	6	6. PULSE COUNTER TEST. KEY IN A 1 WHEN READY TO CONTINUE.
l. UNIT #, SLOT # ? (-1 TO EXIT)	AR	CARRY LINE CHECK: PULSE COUNT UP INPUT ONCE WHILE WATCHING CARRY LINE. (NP)

Check for a pulse from the Carry Line (pin 13) while shorting the Count Up input (pin E) to the input common (pin F).

- m. Enter a "1" when ready to continue; T6940 prints out the following:

SLOT # ss HAS DATA 000000

Verify that the printed data is 000000.

BORROW LINE CHECK: PULSE COUNT DOWN INPUT ONCE WHILE WATCHING BORROW LINE. KEY IN A 1 WHEN READY TO CONTINUE.

Check for a pulse from the Borrow Line (pin 14) while shorting the Count Down input (pin H) to pin F.

- n. Enter a "1" when ready to continue; T6940 prints out:

SLOT # ss HAS DATA 007777

ENTER TEST NUMBER.

- o. Verify that the printed data is 007777.

Table I-1. HP 69435A Data Versus Storage Bit

DATA	COMPUTER OUTPUT EQUAL LOGICAL ONE.	
	BIT	PIN #
0001	0 (LSB)	1
0002	1	2
0004	2	3
0010	3	4
0020	4	5
0040	5	6
0100	6	7
0200	7	8
0400	8	9
1000	9	10
2000	10	11
4000	11	12



## APPENDIX J

## HP 695XXA PROGRAMMABLE RESISTANCE CARDS VERIFICATION

**J-1. FUNCTION OF CARDS.** The HP 695XXA provides variable resistance outputs that are the analog of the digital data sent to the card. The resistance outputs can be used to control programmable power supplies or other devices requiring a variable resistance for control.

**J-2. PRIMARY SPECIFICATIONS.** For complete listing of specifications, refer to Programmable Resistance Cards manual, 5950-5983.

**1. Variable Resistance Output Accuracy:**

0.1%  $\pm$ 1 ohm of resistance value programmed (Models 69501A through 69506A are supplied with a 10 ohm zero calibration resistor installed in series with the output terminals).

**2. Output Channels:**

Cards 69500A-69506A, one 12-bit resolution channel; cards 69510A-69513A, two independent, six-bit resolution channels.

**3. Resistance Output and Resolution:**

Card	Max. Resistance (ohms)	Resolution (ohms)
69500A*	—	—
69501A	8,190	2
69502A	30,712.5	7.5
69503A	61,425	15
69504A	40,950	10
69505A	81,900	20
69506A	204,750	50
69510A	252	4
69511A	945	15
69512A	1,260	20
69513A	1,890	30

\*69500A supplied without programming resistors

**J-3. EQUIPMENT.** A resistance measuring instrument with accuracy and resolution sufficient to measure the output of the type of card being tested.

**J-4. STATUS WORD.** On all calls to the 6940 driver, T6940 checks the status word, EQT5. If any of the status bits are set, T6940 reports the status word as follows:

ERROR RETURN FROM DRIVER. STATUS = XXX

where:

- XXX is the status word in octal;
- Bit 0 = Sense Mode Required
- Bit 1 = Alarm Pending
- Bit 2 = Time Out
- Bit 7 = Parity Error on Transmission

**J-5. PROCEDURE.** The procedure is as follows:

1. The test program must have been initialized.
2. Connect the resistance measuring instrument across the output terminals of the channel to be tested. For cards 69500A-69506A, these terminals are TB1-C and TB1-D. For cards 69510A-69513A, these terminals are TB1-A and TB1-B (programmed by bits B11 thru B06) or TB1-C and TB1-D (programmed by bits B05 thru B00). See Tables J-1 and J-2.
3. Enter the following information to the computer in response to printouts as shown below. (AR and NP are abbreviations for As Required and Next Printout, respectively.)

MESSAGE	RESPONSE	RESULTS/NEXT STEP
a. ENTER TEST NUMBER.	3	3. SINGLE OUTPUT TEST
b. UNIT #, SLOT # ? (-1 TO EXIT)	AR	NP
c. DTE, SYE, TME? (-1 TO EXIT)	0,1,0	NP
d. ENTER DATA (OCTAL).	AR (see Tables J1 and J2)	

Verify that the output resistance corresponds to the entered data.

e. DTE, SYE, TME? (-1 TO EXIT)	0,0,0	NP
f. ENTER DATA (OCTAL).	AR	

Verify that the output is 10 ohms for cards 69501 through 69506, or that the output remains the same as in step d for cards 69510 through 69513.

- g. Repeat steps c and d until all output resistances have been verified; use Tables J-1 and J-2 as a guide.

4. Common Timing Flag (CTF) check:

Before checking the CTF make sure that the time out value for the 6940 is nonzero. If the time and value is zero, and the 6940 fails to receive the CTF from the 6940 card, the computer will hang up indefinitely. Otherwise the computer will wait no longer than the time set by the time out value, and T6940 will print out:

ERROR RETURN FROM DRIVER. STATUS = 004

Thus, with a nonzero time out value proceed as follows:

MESSAGE	RESPONSE	RESULTS/NEXT STEP
a. ENTER TEST NUMBER.	3	3. SINGLE OUTPUT TEST
b. UNIT #, SLOT # ?	AR	NP
c. DTE, SYE, TME? (-1 TO EXIT)	1,1,1	NP
d. ENTER DATA (OCTAL).	AR	NP

If the flag is properly received, the next printout is:

DTE, SYE, TME? (-1 TO EXIT)

Table J-1. HP 69501A-69506A Resistance Output

Output Data Word	Bit Output to Card	Prog. Res.	Card Numbers					
			69501A	69502A	69503A	69504A	69505A	69506A
0001	Bit 0	R1	2, 0.25%	7.5, 0.25%	15, 0.10%	10, 0.10%	20, 0.05%	50, 1%
0002	Bit 1	R2	4, 0.25%	15, 0.10%	30, 0.05%	20, 0.05%	40, 0.05%	100, 1%
0004	Bit 2	R3	8, 0.10%	30, 0.05%	60, 0.05%	40, 0.05%	80, 0.05%	200, 1%
0010	Bit 3	R4	16, 0.10%	60, 0.05%	120, 0.05%	80, 0.05%	160, 0.05%	400, 0.5%
0020	Bit 4	R5	32, 0.05%	120, 0.05%	240, 0.05%	160, 0.05%	320, 0.05%	800, 0.1%
0040	Bit 5	R6	64, 0.05%	240, 0.05%	480, 0.05%	320, 0.05%	640, 0.05%	1.6K, 0.05%
0100	Bit 6	R7	128, 0.05%	480, 0.05%	960, 0.05%	640, 0.05%	1.28K, 0.05%	3.2K, 0.05%
0200	Bit 7	R8	256, 0.05%	960, 0.05%	1.92K, 0.05%	1.28K, 0.05%	2.56K, 0.025%	6.4K, 0.025%
0400	Bit 8	R9	512, 0.05%	1.92K, 0.05%	3.84K, 0.05%	2.56K, 0.05%	5.12K, 0.025%	12.8K, 0.025%
1000	Bit 9	R10	1.024K, 0.05%	3.84K, 0.05%	7.68K, 0.05%	5.12K, 0.05%	10.24K, 0.01%	25.6K, 0.01%
2000	Bit 10	R11	2.048K, 0.05%	7.68K, 0.05%	15.36K, 0.05%	10.24K, 0.05%	20.48K, 0.01%	51.2K, 0.01%
4000	Bit 11	R12	4.096K, 0.05%	15.36K, 0.05%	30.72K, 0.05%	20.48K, 0.05%	40.96K, 0.01%	102.4K, 0.01%
JUMPER CONNECTIONS:			J1-A TO B CLOSED					
			J2-CLOSED					
			J3-OPEN					
OUTPUT TERMINALS:			TB1-C AND D					



Table J-2. HP 69510A-69513A Resistance Output

Output Data Word	Bit Output to Card	Prog. Res.	Card Numbers			
			69510A	69511A	69512A	69513A
0001	Bit 0	R1	4, 0.25%	15, 0.10%	20, 0.05%	30, 0.05%
0002	Bit 1	R2	8, 0.10%	30, 0.05%	40, 0.05%	60, 0.05%
0004	Bit 2	R3	16, 0.05%	60, 0.05%	80, 0.05%	120, 0.05%
0010	Bit 3	R4	32, 0.05%	120, 0.05%	160, 0.05%	240, 0.05%
0020	Bit 4	R5	64, 0.05%	240, 0.05%	320, 0.05%	480, 0.05%
0040	Bit 5	R6	128, 0.05%	480, 0.05%	640, 0.05%	960, 0.05%
0100	Bit 6	R7	4, 0.25%	15, 0.10%	20, 0.05%	30, 0.05%
0200	Bit 7	R8	8, 0.10%	30, 0.05%	40, 0.05%	60, 0.05%
0400	Bit 8	R9	16, 0.05%	60, 0.05%	80, 0.05%	120, 0.05%
1000	Bit 9	R10	32, 0.05%	120, 0.05%	160, 0.05%	240, 0.05%
2000	Bit 10	R11	64, 0.05%	240, 0.05%	320, 0.05%	480, 0.05%
4000	Bit 11	R12	128, 0.05%	480, 0.05%	640, 0.05%	960, 0.05%
<p><b>JUMPER CONNECTIONS:</b> J1-A TO C AND B TO D CLOSED  J2-OPEN  J3-CLOSED</p> <p><b>OUTPUT TERMINALS:</b> TB1-A AND B (CHANNEL 2 – PROGRAMMED BY B11 THRU B06)  TB1-C AND D (CHANNEL 1 – PROGRAMMED BY B05 THRU B00)</p>						



## APPENDIX K

## HP 69600A PROGRAMMABLE TIMER CARD VERIFICATION

**K-1. FUNCTION OF CARD.** The HP 69600A provides a crystal-controlled one-shot pulse whose duration is defined as the product of the time interval (controlled by the 12 data bits) and the time increment (controlled by a jumper placement).

**K-2. PRIMARY SPECIFICATIONS.** For complete listing of specifications, refer to 69600 manual, 69600-90001.

1. Output Pulse Duration: 1 to 4095 programmable increments. The period of each increment is jumper selectable in six decades from  $X1 \mu\text{sec}$  to  $X10^5 \mu\text{sec}$  (or 1 to 4095  $\mu\text{sec}$  to 0.1 to 409.5 sec). Longer periods are available on special order.
2. Output Pulse Drivers: Outputs available in positive-true and ground-true form. Each output can drive 10 TTL standard loads, or 10 count enable inputs of 69435A pulse counter cards.
3. Accuracy: 0.01% of programmed time interval  $\pm 100$  nsec.

**K-3. EQUIPMENT.** Any instrument capable of measuring time intervals from 1  $\mu\text{s}$  to 409.5 seconds with accuracy  $>0.01\%$  (an HP 5326 or equivalent.)

**K-4. STATUS WORD.** On all calls to the 6940 driver, T6940 checks the status word, EQT5. If any of the status bits are set, T6940 reports the status word as follows:

ERROR RETURN FROM DRIVER. STATUS = XXX

where:

- XXX is the status word in octal;
- Bit 0 = Sense Mode Required
- Bit 1 = Alarm Pending
- Bit 2 = Time Out
- Bit 7 = Parity Error on Transmission



**K-5. PROCEDURE.** The procedure is as follows:

1. The test program must have been initialized.
2. Connect the time interval measuring device to the positive-true time interval output (pin 13).
3. Clear the time interval measuring device.
4. Enter the following information to the computer in response to printouts as shown below. (AR and NP are abbreviations for As Required and Next Printout, respectively.)

MESSAGE	RESPONSE	RESULTS/NEXT STEP
a. ENTER TEST NUMBER.	7	7. PROGRAMMABLE TIMER TEST. PRESET TIMER COUNT, AND WATCH TIMER OUTPUT.
b. UNIT #, SLOT # ? (-1 TO EXIT)	AR	NP
c. ENTER DATA (OCTAL).	AR (see Table K-1)	
Verify that the output pulse length corresponds to the entered data and the placement of jumper W2 (see Table K-1).		
d. REPEAT? (0=NO, 1=YES)	1	NP
e. ENTER DATA (OCTAL).	AR	
Repeat the test using different data; verify the results by using Table K-1. Repeat steps d and e as desired.		
f. REPEAT? (0=NO, 1=YES)	0	NP
g. ENTER TEST NUMBER.	3	3. SINGLE OUTPUT TEST.
h. UNIT #, SLOT # ? (-1 TO EXIT)	AR	NP
i. DTE, SYE, TME? (-1 TO EXIT)	0, 0, 0	NP
j. ENTER DATA (OCTAL).	AR	No output (SYE off). NP
k. DTE, SYE, TME? (-1 TO EXIT)	-1	NP
l. ENTER TEST NUMBER.	7	7. PROGRAMMABLE TIMER TEST, PRESET TIMER COUNT, AND WATCH TIMER OUTPUT.
m. Connect the time interval measuring device to the negative true output (pin 12) and repeat steps b through f. Pulse should go "off" for the time specified in step c (see Table K-1).		

Table K-1. HP 69600A Pulse Length

DATA	DECIMAL
0001	1
0002	2
0004	4
0010	8
0020	16
0040	32
0100	64
0200	128
0400	256
1000	512
2000	1024
4000	2048
7777	4095

Note: Pulse length is equal to the time interval (decimal value) multiplied by the time increment (W2 jumper placement). For example, if the data word is 0100 (decimal 64) and W2 is connected to 10 ms then the pulse length is 640 ms.

