Errata

Title & Document Type: **6941B Multiprogrammer Extender Operating and Service Manual**

Manual Part Number: **06941-90003**

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MULTIPROGRAMMER EXTENDER
MODEL 6941B

OPERATING AND SERVICE MANUAL

FOR SERIALS 1506A-00106 AND ABOVE *

* For Serials Above 1506A-00106
a change page may be included.

HP Part No. 06941-90003
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SECTION I
GENERAL INFORMATION

1-1 SCOPE

1-2 This instruction manual provides complete operating and service instructions for the 6941B Multiprogrammer Extender. Accessory input/output cards and the 6940B Multiprogrammer, which is the Master unit in a Multiprogrammer System, are covered in separate instruction manuals. Overall system concepts, including system installation, troubleshooting, and operating considerations are covered in the instruction manual for the 6940B Master unit and will not be repeated in this manual.

1-3 DESCRIPTION

1-4 6941B Multiprogrammer Extender

1-5 This unit is intended for use only as an addition to the 6940B Master and must be controlled through this unit. Up to fifteen Extenders can be operated with one 6940B to extend the maximum capacity of a Multiprogrammer System to 240 input/output channels.

1-6 The 6941B mainframe is similar in construction to the 6940B, having the same basic card cage, rear panel, and dc power supply. The main differences between the two units are in the circuit cards which plug into the mainframe. The plug-in card complement for the 6941B is as follows:

SLOT	6941B PLUG-IN CARDS
100	A1 Input Card (Extender)
200	A2 I/O Transfer Card
300	A3 Logic and Timing Card (same as A3 card in 6940B)
400-414	A4 Input and/or Output Accessory Cards
500	Vacant (occupied by Unit Select Card in 6940B)
600	A6 Regulator Card (when used)

1-7 The programmed data and address bits, 15 unit selection lines, and control and timing signals from the 6940B Multiprogrammer are cabled to input jack J1 of the first 6941B extender unit in the system. Further, when the input mode is selected, extender unit input data is placed on the programmed data lines and on to connector J1 for return along with control signals, to the 6940B Multiprogrammer.

1-8 When the input mode is not selected, the data and address bits are routed through input adapter card A7 to input card A1. After being properly terminated by card A1, the bits are coupled through I/O transfer card A2 in slot 200 to logic and timing card A3. When the input mode is selected, input data bits 0-11 from the A3 card are buffered on the A2 card and selected for return to the 6940B. Since the outputs of the A2 card selection logic are connected to the same lines as the output mode programmed data, the input data is routed to connector J1 in place of programmed data for return to the 6940B.

1-9 The A3 logic and timing card in the 6941B extender unit is identical to the A3 card in the 6940B multiprogrammer. The A3 card selects either programmed data for application to the extender unit output card slots or it selects input card data for application to the A2 card and transmission back to the computer. The selection is based on the input mode control signal supplied to the 6941B from the 6940B. Like the 6940B A3 card, in addition, the 6941B A3 card generates a flag signal which is returned to the 6940B, through the J1 connector and chaining cable, to indicate the busy-ready status of the 6941B extender unit Ø1.

1-10 The unit Ø1 select line of the 15 input unit select lines is wired to all input/output card slots of unit Ø1, while the remaining 14 unit select lines are jumpered directly from input jack J1 to output jack J2 (after being buffered on the A8 output adapter card) and then through a chaining cable to the next extender unit in the system. This process is repeated until at the 15th extender unit all unit select lines have been terminated at their associated unit.

1-11 When unit Ø1 is selected, its 400 through 414 input/output card slots are partially enabled. The next data or address word will enable one input/output card of unit Ø1 to receive programmed data (output) or transmit (input) data. The input/output data, unit select, and control and timing signals at output jack J2 are chain-cabled to input jack J1 of the next 6941B extender unit in the system.

1-12 Input/Output Cards

1-13 The function of the output cards is to develop an output quantity proportional to programmed data, and to deliver this quantity to the user's system. The output cards are similar to one another in that each contains address gate, data storage, and output data conversion circuits. The nature

of the output conversion circuits determines the card type.

1-14 Output cards are programmed using a 16-bit data word. Twelve of the bits represent programmed data while the remaining four bits contain the output card slot address. The 12 bits are used in different ways on the various type output cards to develop an output to the user's systems. For digital-type output cards, the 12-output bits can be either identical to or the complement of the 12-programmed bits. For analog-type output cards (voltage, resistance, etc.) the data bits are used to adjust the value of binary-weighted precision resistance networks. The outputs of the networks are then either connected directly to external programmable power supplies (or other devices that can be programmed by a variable resistance) or used on the output card to adjust the gain of an operational amplifier. In the latter case, the operational amplifier will produce a voltage or current output proportional to the programmed data.

1-15 An output card programmed to a particular output value will hold that value until it is readdressed and the programmed data is changed.

1-16 The function of the input cards is to receive data from the user's system and make it available to the computer. The input cards each contain an address gate and input data interface circuits. Further, input cards can be supplied with storage capability so that the user's system need supply input data for a short period of time after which it is maintained on the input card until accepted by the computer. The nature of the user's input; i.e., digital input data versus relay contact closure data, determines the card type.

1-17 Input cards are programmed using a 16-bit address word. The same four bits used to specify an output card slot address are also used to address an input card slot. The remaining 12 bits are not relevant to the input cards. An input card's 12 data bit outputs are transmitted to the computer when an address word selects the associated input card slot and the multiprogrammer has been previously placed in the input mode.

1-18 When an input/output card is plugged into a particular slot of a particular unit, it assumes the address of that slot and unit, and will either receive and store data (output cards) or transmit data (input cards) only when that unit and slot are addressed. Unit selection is accomplished by decoding control words, as described previously, but slot address decoding is accomplished by directly wiring a unique combination of four slot address bits to each of the 15 input/output slots. If a card is moved to a new slot it assumes the address of that slot.

1-19 When one or more D/A voltage converter, D/A current converter or voltage monitor cards are used in a 6940B (or a 6941B), an A6 voltage regulator card must be installed in slot 600 to supply operating power. This card contains four isolated +15 and −15 volt regulated supplies. One of the supplies has a 750mA capability while the remaining three can provide up to 150mA.

1-20 All input/output cards are fabricated on a 4½" x 11" printed circuit card. The inner end of the card contains a dual 24 pin (48 pin total) printed circuit plug that can mate with any connector in slot 400 through 414. For analog-type output cards, the output quantity is taken from a terminal block located on the outer-end of the card; for digital-type input/output cards, the input/output bits are received/taken from a dual 15 pin printed circuit plug on the outer-end of the card. All external device wiring is routed through a false-bottom channel of the multiprogrammer unit to the user's system.

1-21 INTERFACING

1-22 Interfacing of the entire Multiprogrammer System with the digital programming device is accomplished by input card A1 in the 6940B Master. Input card A1 in the 6941B merely provides the proper termination for unit-to-unit cabling.

1-23 As supplied from the factory, the 6941B is configured for operation from a 120Vac (+5%, −10%), 48-440Hz power source. The 6941B can also be operated from a 100, 220, or 240Vac (+5%, −10%), 48-440Hz power source by changing the position of the PC board (voltage selection board) within the ac power module on the rear panel (see Paragraph 2-22). Ensure that the proper line fuse (4A for 100V/120V operation or 2A for 220V/240V operation) is installed.

1-24 SPECIFICATIONS

1-25 Specifications for the 6941B Multiprogrammer Extender are given in Table 1-1.

1-26 ACCESSORIES

1-27 Tables 1-2 and 1-3, respectively, list the accessories furnished with and available for use with the 6941B. The descriptions of the available accessories in Table 1-3 are general and in no way represent complete specifications. Complete specifications are covered in the Instruction Manual for each accessory.

Table 1-1. Specifications

INPUT POWER: 100Vac (+5%, −10%), 48-440Hz 120Vac (+5%, −10%), 48-440Hz 220Vac (+5%, −10%), 48-440Hz 240Vac (+5%, −10%), 48-440Hz } Selectable DATA WORD TRANSFER RATE: 20k word/sec. maximum, in the handshake mode. DATA RESOLUTION: 12 bits.	TEMPERATURE RANGE: Operating: 0° to +55°C. Storage: -40° to +75°C. OPERATING POSITION: 30 degrees off horizontal (maximum). DIMENSIONS: See Figure 2-1. COOLING: Natural convection.

Table 1-2. Accessories Furnished

ACCESSORY	DESCRIPTION
Data Input Plug P1, Part No. 06936-60009	Mates with data input connector on 6941B; allows user to fabricate his own chaining cable (up to 100 feet).
Rack Mounting Kit, Part No. 5060-8741	Allows 6941B to be rack mounted.
Plug-In Extender Card, Part No. 5060-7901	Extends plug-in cards out of the unit chassis for troubleshooting.

Table 1-3. Accessories Available

ACCESSORY	DESCRIPTION
PROGRAMMABLE OUTPUT CARDS:	
Programmable Resistance Cards: Model 69500A	A versatile programmable output card that can be configured by the user to provide one 12-bit or two 6-bit output channels. Output resistors are not loaded on this model. The choice of output component values is left to the user.
Models 69501A through 69506A	Provides a single 12-bit resistance programming channel; the programming coefficients of these models are compatible with HP Programmable Power Supplies.
Models 69510A through 69513A	Provides two 6-bit resistance programming channels; these models are designed for programming the current limit of HP Programmable Power Supplies
Bipolar Power Supply/Amplifier Control Cards, Models 69325A through 69328A	Provide resistance outputs to control the voltage programming (69325A), current limit programming (69326A or 69327A), and gain programming (69328A) of HP Bipolar Power Supply/Amplifiers.
Relay Output Card, Model 69330A	Provides 12 separate form A (SPST, normally open) mercury-wetted contact outputs that reflect the status of 12 programmed data bits.
Relay Output/Readback Card, Model 69433A	Provides same outputs as Model 69330A; also supplies 12 input data lines that can be read by the computer and which indicate the relay coil voltage status.

Table 1-3. Accessories Available (Continued)

ACCESSORY	DESCRIPTION
D/A Voltage Converter Card Model 69321B	Provides programmable voltage output from +10V to −10V at programming speeds of < 50μsec.
D/A Current Converter Card, Model 69370A	Provides programmable current output from 0 to 20mA at programming speeds of <100μsec.
Voltage Regulator Card, Model 69351A	Required for use with D/A Voltage Converter, D/A Current Converter, and A/D Voltage Monitor cards. Installed in multiprogrammer slot 600 to provide ±15Vdc operating voltage for these cards.
Digital Output Card, Model 69331A	Provides microcircuit logic level outputs on 12 separate output lines. Outputs reflect the status of 12 programmed data bits.
Open Collector Output Card, Model 69332A	Provides 12 solid state output switches to control lamps and relay coils using an external dc power source. Each output circuit is rated at up to 30Vdc and 40mA.
Stepping Motor Card, Model 69335A	Provides 1 to 2047 pulses from either of two output terminals on receipt of one computer word. These pulses, when applied to the stepping motor translator, are converted to CW and CCW drive pulses for a stepping motor.
Breadboard Output Card, Model 69380A	Allows customer to design and build a custom analog or digital output card. Card includes basic address, storage, and control signal buffer circuits.
PROGRAMMABLE INPUT CARDS: Digital Input Card, Model 69431A	Accepts 12 bits of TTL, DTL, or contact closure data from user's device. Card includes gate/flag circuits for exchange of control signals with user's device. Outputs to computer reflect the status of 12 input bits.
Isolated Digital Input Card, Model 69430A	Accepts 12-bits of input data from user's device. All input lines are isolated from one another and from the multiprogrammer power supply. Eight options of the card are available to accommodate either ground-true or positive-true logic sense inputs and a wide range of input levels.
Event Sense Card, Model 69434A	Compares the magnitude of an external 12-bit input word with a stored reference word and generates a computer interrupt for any of four conditions, depending on the placement of a jumper on the card. The four possible conditions are: In=Ref, In≠Ref, In>Ref, In<Ref. The reference word is loaded from the computer. Both the input and reference words can be read back to the computer.
Voltage Monitor Card, Model 69421A	Monitors dc voltages in the range of +10.235V to −10.240V and returns a 12-bit binary word to the computer that indicates the magnitude and sign of the measured voltage. An optional version of the card has an input voltage range of +102.35V to −102.40V.
Pulse Counter Card, Model 69435A	Counts pulses or contact closures, up or down, in the range of 0 to 4095. It can be preset by the computer to any value in this range and can have its contents read into the computer. When used in conjunction with a Programmable Timer Card or Frequency Reference Card, it can make frequency or time interval measurements.

Table 1-3. Accessories Available (Continued)

ACCESSORY	DESCRIPTION
Programmable Timer Card, Model 69600A	Generates a single crystal-controlled pulse each time it is commanded by the program. The duration of the pulse can be programmed in the range 1 to 4095 times a jumper-selectable interval that can have any of six decade values ranging from 1μsec to 0.1sec. When used to provide an enable to a Pulse Counter Card for frequency measurements, the 69600A may be armed to request a computer interrupt for the Pulse Counter Card at the end of the programmed time interval.
Frequency Reference Card, Model 69601A	Provides crystal-controlled square-wave outputs at fixed frequencies from 1Hz to 100kHz. The 69601A may be used in conjunction with the Pulse Counter Card for time interval measurements.
Breadboard Input Card, Model 69480A	Allows customer to design and build a custom input card. Card includes basic address and readback circuits.
Process Interrupt Card, Model 69436A	Generates an interrupt whenever any of 12 inputs changes state (1 to 0, 0 to 1, or both). Bit(s) that changed state are readback by the controller.
CHAINING CABLE ASSEMBLY, Model 14541A	Interconnects 6940B and 6941B's in expanded Multiprogrammer Systems.

1-28 INSTRUMENT IDENTIFICATION

1-29 Hewlett-Packard instruments are identified by a three-part serial number. The first part is the instrument model number. The second part is the serial number prefix, consisting of a number-letter combination denoting the date of a significant design change. The first two digits indicate the year (10 = 1970, 11 = 1971, etc.); the second two digits indicate the week; and the letter "A" designates the U.S.A. as the country of manufacture. The third part is the instrument serial number; a different 5-digit sequential number is assigned to each instrument, starting with 00101.

1-30 If the serial number on your instrument does not agree with those on the title page of this manual, Change Sheets supplied with the manual or Manual Backdating Changes define the differences between your instrument and the instrument described by this manual.

1-31 OPTION 001

1-32 Option 001 modifies the 6940B and 6941B so that they are compatible with 6940A/6941A multiprogrammer systems and software. Since 6940A's and 6941A's have been discontinued, Option 001 must be specified by customers ordering a replacement 6940B or additional 6941B's for use in a 6940A/6941A multiprogrammer system. Appendix A in the rear of this manual describes the 6941B Option 001 modifications. The 6940B Option 001 modifications are described in the 6940B instruction manual.

1-33 ORDERING ADDITIONAL MANUALS

1-34 One manual is shipped with each instrument. Additional manuals may be purchased from your local Hewlett-Packard field office (see list at rear of this manual for addresses). Specify the model number, serial number prefix, and HP Part number shown on the title page.

SECTION II
INSTALLATION

2-1 INITIAL INSPECTION

2-2 Before shipment, this instrument was inspected and found to be free of mechanical and electrical defects. As soon as the instrument is received, proceed as instructed in the following paragraphs.

2-3 Mechanical Check

2-4 If external damage to the shipping carton is evident, ask the carrier's agent to be present when the instrument is unpacked. Check the instrument for external damage such as broken controls or connectors, and dents or scratches on the panel surfaces. If the instrument is damaged, file a claim with the carrier's agent and notify your local Hewlett-Packard Sales and Service Office as soon as possible (see list at rear of this manual for addresses).

2-5 Electrical Check

2-6 Check the electrical performance of the instrument as soon as possible after receipt. Section V of this manual contains checkout procedures which will verify instrument operation. Refer to the inside front cover of the manual for the Certification and Warranty statements.

2-7 REPACKAGING FOR SHIPMENT

2-8 To insure safe shipment of the instrument, it is recommended that the package designed for the instrument be used. The original packaging material is reusable. If it is not available, contact your local Hewlett-Packard field office to obtain the materials. This office will also furnish the address of the nearest service office to which the instrument can be shipped. Be sure to attach a tag to the instrument specifying the owner, model number, full serial number, and service required, or a brief description of the trouble.

2-9 INSTALLATION DATA

2-10 The 6941B is shipped with all standard mainframe cards (A1, A2, and A3) installed. To prepare the 6941B for operation, it is necessary to rack-mount it, install accessory input or output cards, and connect signal and power cables. The 6941B can be controlled only through a 6940B Master unit. Refer to the 6940B manual for system installation, cabling and other data.

——CAUTION——

Always turn off power to the multiprogrammer before removing or installing printed circuit cards (standard mainframe cards or accessory cards). If power is not removed, it is possible to cause damage by shorting components.

2-11 Location

2-12 The 6941B is convection cooled. When mounted in a rack, a minimum of 0.25 inch (and preferably 1 inch) should be left between units so that a free flow of cooling air can reach internal components. The unit should be installed in an area where the ambient temperature remains between 0°C and +55°C.

2-13 Outline Diagram

2-14 Figure 2-1 illustrates the outline shape and dimensions of the 6941B.

2-15 Rack Mounting

2-16 An instruction card attached to the 6941B rack mounting kit (supplied with each unit) illustrates and describes the procedure for perparing the 6941B for rack mounting.

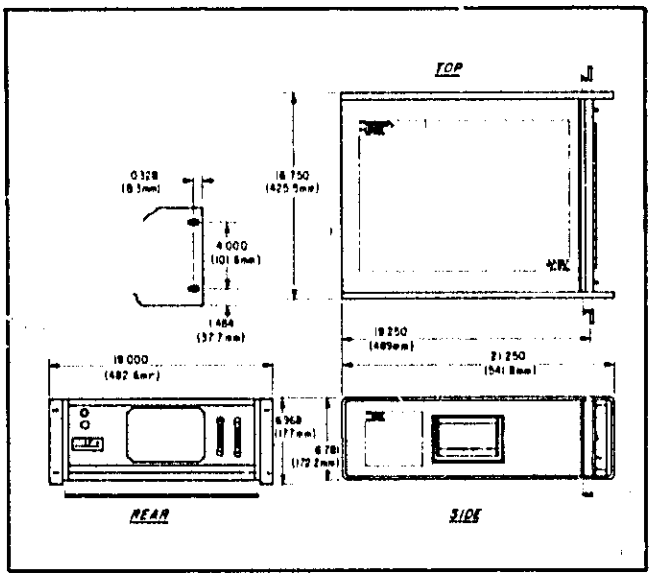


Figure 2-1. Outline Diagram

2-17 Accessory Card Installation

2-18 Before installing cards, be sure to first perform the 6941B checkout procedure given in Section V of this instruction manual. Accessory cards are installed in slots 400 through 414. To install the accessory cards, proceed as follows:

a. Open the hinged front panel of the unit by turning the recessed screw within the knurled handle counterclockwise.

b. With the accessory card components on the right, slide the card into the desired slot (400 through 414). Note that all accessory cards are slotted between pins 4 and 5 and all 400 series connectors on the mainframe are keyed between the same points. This makes it virtually impossible to plug an accessory card in upside down or into any other than a 400 series slot.

c. Route all wiring from the accessory cards through the false-bottom channel and out the back of the unit to the external system. Special wiring considerations are covered in the instruction manuals for the individual accessory cards.

d. As installation is completed for each accessory card, carefully note and record the following types of information:

(1) Accessory card type
(2) Application in external system
(3) Nature of output (voltage, resistance, contact closure, etc.)
(4) Ranges, scaling factors, polarity, logic sense, etc.

2-19 System Cabling

2-20 The 6940B/6941B Multiprogrammer System is designed to operate with distances of up to 100 feet between units. Because of this design, programmed delays are required in the 6940B/6941B system software (see Section III of 6940B Manual). Thus, 6940B/6941B units are not compatible with the discontinued 6940A/6941A units. Consequently, B units and A units may not be mixed in a multiprogrammer system. Option 001, however, is available (see paragraph 1-31) which converts the 6940B/6941B units to operate in 6940A/6941A systems. This option allows a customer to purchase replacement or additional units for an existing 6940A/6941A system. Refer to Section II of the 6940B Operating and Service Manual for system cabling information.

2-21 INPUT POWER REQUIREMENTS

2-22 The 6940B and 6941B may be operated continuously from a nominal 100V, 120V, 220V, or 240V (48-440Hz) power source. A printed circuit board located within the ac power module on the rear panel (figure 2-2) selects the power source. Voltage choices are available on both sides of the PC board. Before connecting the instrument to the power source, check that the PC board selection matches the nominal line voltage of the source. The operating voltage is shown in the window of the ac power module (Figure 2-3). If required, select the proper voltage as follows (refer to

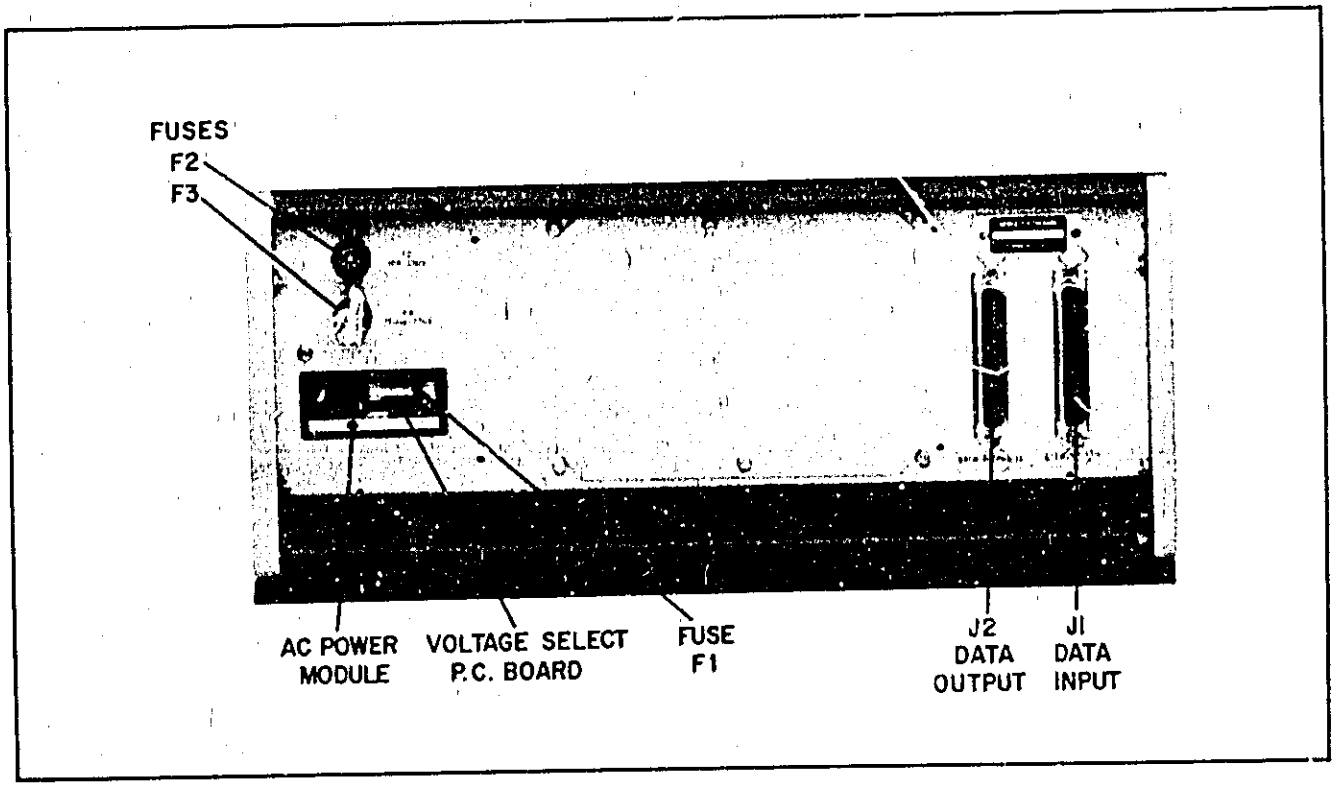


Figure 2-2. 6941B Multiprogrammer Extender, Rear View

Figure 2-3).

a. Remove power cable from instrument.
b. Move plastic door on power module aside.
c. Rotate FUSE PULL to the left and remove fuse F1.
d. Remove PC board from slot. Select operating voltage by orienting PC board to position the desired voltage on top-left side of PC board. Push board firmly into slot.
e. Rotate FUSE PULL back into normal position and re-insert fuse F1 in holder using caution to select the correct fuse value (4A for 100V or 120V and 2A for 220V or 240V).
f. Close plastic door and connect power cable.

2-23 When the instrument leaves the factory, the proper fuse is installed for 120V operation. An envelope containing a fuse (2A) for 220V/240V operation is attached to the instrument. Make sure that the correct fuse is installed if the position of the PC board is changed.

2-24 Also, before connecting the instrument to the power source, ensure that the proper fuse value is installed for F2 (10A) and F3 (.75A). Fuses F2 and F3 are located on the rear panel as shown in Figure 2-2. Fuse F2 is in the +5V (reg.)/+12V (unreg.) circuit and F3 is in the −12V (unreg.) circuit of the main power supply.

2-25 Power Cable

2-26 To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that the instrument panel and cabinet be grounded. This instrument is equipped with a three conductor power cable. The third conductor is the ground conductor and when the cable is plugged into an appropriate receptacle, the instrument is grounded. The offset pin on the power cable's three-prong connector is the ground connection.

2-27 To preserve the protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the green lead on the adapter to ground.

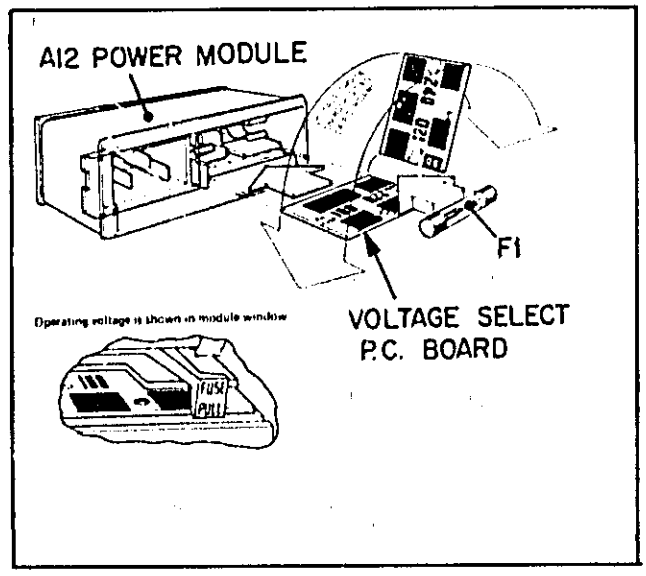


Figure 2-3. Line Voltage Selection

OPERATION AND THEORY

SECTION III
OPERATING INSTRUCTIONS

3-1 PRE-OPERATIONAL CONSIDERATIONS

3-2 Before applying power to the unit, ensure that the proper operating voltage (100V, 120V, 220V, or 240V) has been selected as described in Paragraph 2-21. All system cable connections (between the computer and the 6940B Multiprogrammer and between the 6940B and all 6941B Multiprogrammer Extenders) should be made as outlined in Section II of the 6940B manual.

3-3 Input/Output Cards

3-4 Input/Output cards should be inserted into the desired slots (400 through 414) of the 6941B card cage. All input/output cards are marked as to type on the card extractor handles. Notice that whenever an input/output card is inserted into a slot (400 through 414) it assumes the address of that particular slot position. Detailed information about each input/output card is contained in the instruction manual associated with each card.

3-5 Pre-Operation Checkout

3-6 Before connecting system loads to any of the input/output cards, perform the basic checkout procedures given in Section V of this instruction manual.

3-7 If the checkout procedure results are satisfactory, external device connections can be made to the cards (as described in the card manuals) and the unit operated normally.

3-8 Operating Controls

3-9 The 6941B contains only an ON-OFF LINE switch and associated pilot lamp on the front panel. To ready the unit for operation, simply set the LINE switch to ON.

3-10 Programming

3-11 The 6941B is a "slave-type" device which is remotely programmed by a computer (or other digital device) through the 6940B Master unit. Each 6941B can also be programmed manually using the front panel proximity switches on the 6940B. Complete system programming instructions are given in the Operating and Service Manual for the 6940B Multiprogrammer.

3-12 INPUT/OUTPUT DATA

3-13 Figures 3-1 and 3-2 show the 6941B input and output connectors and the data and control signal designations. Notice that all digital signals that are exchanged between the computer and a Multiprogrammer System are interfaced within the 6940B Master unit. The following paragraphs contain a brief description of each input/output line shown on Figures 3-1 and 3-2.

3-14 Input/Output Data Bits

3-15 Data bits $\overline{B15}$ through $\overline{B00}$ are exchanged between the 6940B and 6941B's in negative-true form (e. g., logic 1= $\overline{B15}$, LO; logic 0 = B15, HI). The four most significant bits ($\overline{B15}$ through $\overline{B12}$) represent input/output card slot addresses and are always transmitted from the 6940B to the 6941B's. Bits $\overline{B11}$ through $\overline{B00}$, however, represent either data word output data (in which case they are transmitted from the 6940B to the 6941B's) or input data from an addressed input card (in which case they are received by the 6940B from the 6941B's). Notice that only output-mode data words or input-mode address words are meaningful in the extender units. The control word code (slot address 111 1) serves no function in the extender units.

3-16 Gate Signal $\overline{GAT}$

3-17 Gate signal $\overline{GAT}$ is utilized by all extender units to initiate actions on the input/output cards. For output cards, $\overline{GAT}$ initiates (when the card is also addressed) the storage of programmed data bits $\overline{B11}$ through $\overline{B00}$. For input cards, $\overline{GAT}$ enables (when the card is addressed) the gate/flag circuits on the input card or initiates the resetting of control circuits on the card, depending upon the state of mode signal ISL. A HI to LO transition of $\overline{GAT}$ initiates these actions. Refer to Paragraphs 3-109 and 3-114 of the 6940B manual for additional details.

3-18 Flag Output and Flag Override Input

3-19 The meaning of the flag ($\overline{FLG}$) output of a 6941B depends on the programmed mode of operation (input/output; handshake/timing). An extender unit flag has the same meaning to the computer as a master unit flag. Section III of the 6940B manual covers the flag functions in detail.

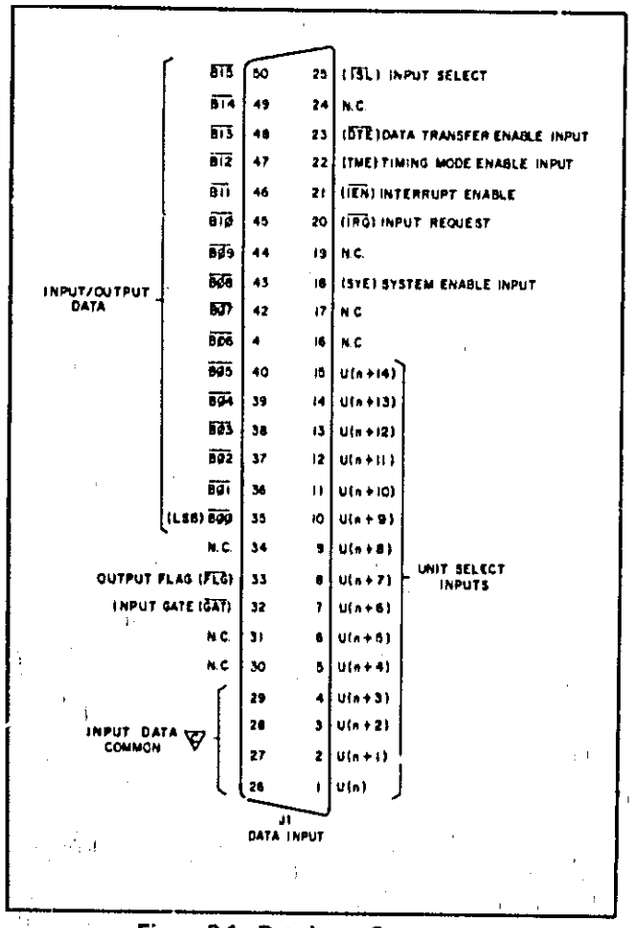


Figure 3-1. Data Input Connector

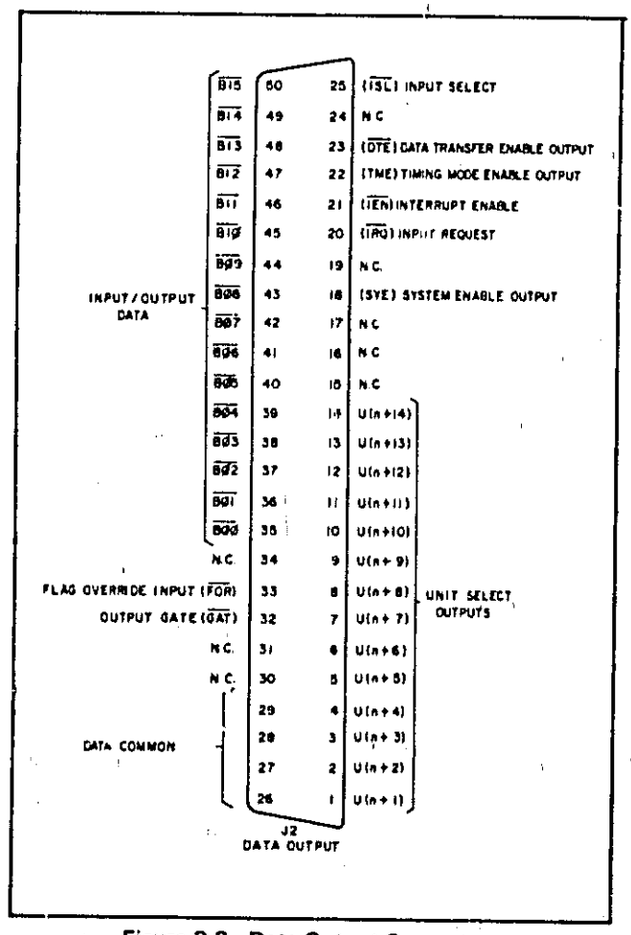


Figure 3-2. Data Output Connector

3-20 The $\overline{FLG}$ output signal of each 6941B is applied to the flag override ($\overline{FOR}$) input of the next upstream unit in the system, forming the system flag ORing configuration described in Paragraph 4-26 of this manual.

3-21 $\overline{ISL}$, $\overline{IEN}$, $\overline{DTE}$, TME, SYE, and $\overline{IRQ}$

3-22 $\overline{ISL}$ (input select), $\overline{IEN}$ (interrupt enable), $\overline{DTE}$ (data transfer enable), TME (timing mode enable), and SYE (system enable) are mode selection bits which are chain-cabled to each extender unit in the system from the 6940B master unit. The signals are derived from programmed control words and are stored on the unit select card of the 6940B. The signals are received through data input connector J1 of each 6941B, utilized on the unit, buffered, and coupled through data output connector J2 to the next downstream unit.

3-23 Input request signal $\overline{IRQ}$ is a common signal line from all input-type cards in the system. The signal is looped from unit-to-unit in the upstream direction. $\overline{IRQ}$ is buffered on each unit before being passed on to the next upstream unit.

3-24 The function of each control bit is described in detail in Section III of the 6940B manual.

3-25 Unit Select Bits

3-26 The unit select bits are received by the extender units in positive logic form (logic 1 = U(n) HI; logic 0 = U(n) LO). When a unit select line goes HI, all of the input/output cards associated with that unit are enabled. The U(n) line, at pin 1 of the INPUT connector, is the unit select line for any particular 6941B in the system chain. The U(n) line is connected to each accessory card in the applicable unit. The remaining unit select lines (Un + 1 through Un + 14) are connected directly to the rear OUTPUT connector, pins 1 through 14, respectively. These outputs are distributed to the downstream units as described in Note 1 of Figure 7-1, Sheet 3.

3-27 SAFETY FEATURES

3-28 In addition to the system safety features (SYE override and monitor data check) provided by the 6940B Master, each 6941B power supply contains a built-in crowbar and current latch circuit to protect its accessory cards. The crowbar and current latch circuits are identical to those used in the Master unit (refer to Paragraphs 3-164 and 3-166 in the 6940B manual).

SECTION IV
PRINCIPLES OF OPERATION

4-1 INTRODUCTION

4-2 This section contains principles of operation for the 6941B Multiprogrammer Extender. The discussion is divided into two main paragraphs: first, a basic block diagram discussion and second, a detailed circuit description using the schematic diagrams at the rear of the manual.

4-3 Circuits which are identical to those used in the 6940B are not discussed in detail in this Section, since the reader must be familiar with the operation of the 6940B Master unit in order to understand Multiprogrammer System concepts.

4-4 The 6941B mainframe is similar in construction to the 6940B, having the same basic card cage, rear panel, and dc power supply. The main differences between the two units are in the circuit cards which plug into the mainframe. The plug-in card complement for the 6941B is as follows:

SLOT	6941A PLUG-IN CARDS
100	A1 Input Card (Extender)
200	A2 I/O Transfer Card
300	A3 Logic and Timing Card (same as A3 card in 6940B)
400-414	A4 Input and/or Output Accessory Cards
500	Vacant (occupied by Unit Select Card in 6940B)
600	A6 Regulator Card (when used).

4-5 BASIC BLOCK DIAGRAM DISCUSSION

4-6 Figure 4-1 is an overall block diagram of the 6941A showing all of its major circuits and principal input/output signals. Each major circuit has an associated sheet number so that this diagram can be correlated with the schematic sheets (Figure 7-1) at the rear of the manual. It should be noted that the logic symbols and signal designations shown on Figure 4-1 represent simplified logical operations and do not reflect the actual logic circuits. Actual circuit implementation of these functions is covered in the detailed circuit analysis.

4-7 The 6941B is a slave type device which is controlled by data originating from a computer. The computer data is first processed by the 6940B Master unit and then looped to each 6941B in the system by means of changing cables.

4-8 Addressing

4-9 The two-step addressing procedure described for the 6940B Master unit also applies to the 6941B Extender units. In the first step, a control word containing the desired unit address is programmed. The 6940B detects the control word and stores and decodes the unit address. The unit select line (1 of 15) corresponding to the addressed unit is energized and partially enables all accessory card slots of that unit. The last unit selection will remain in effect until a new unit is selected by a later control word. In the second step, the four address bits (15-12) of a data word (for data output modes) or an address word (for data input modes) enable the selected accessory card in the energized unit.

4-10 Control Modes

4-11 All control mode data is received from the computer via control words. The 6940B Master unit stores the mode selections and cables them to the 6941B Extender units. The control mode signals are buffered by each extender unit before being passed on to the next unit downstream.

4-12 Input/Output Mode Selection

4-13 The programmed state of mode signal ISL (input select) determines the input/output status of the Multiprogrammer System. When ISL is programmed off, 12 output-logic gates in each 6941B in the system are enabled and pass the 12 programmed data bits (11 through Ø) to every downstream unit. When ISL is programmed on, the output gates are inhibited and a set of 12 input-gates are enabled. This effectively reverses the 12-bit data bus in the direction of the computer.

4-14 Output Modes

4-15 In the absence of an input mode selection (ISL, off) the 6941B will function as an output device, supplying programmed data to selected output cards. Two of the five programmable modes, SYE and DTE, relate exclusively to output functions; TME is used for both output and input modes. Each of these three functions is covered briefly in the following paragraphs.

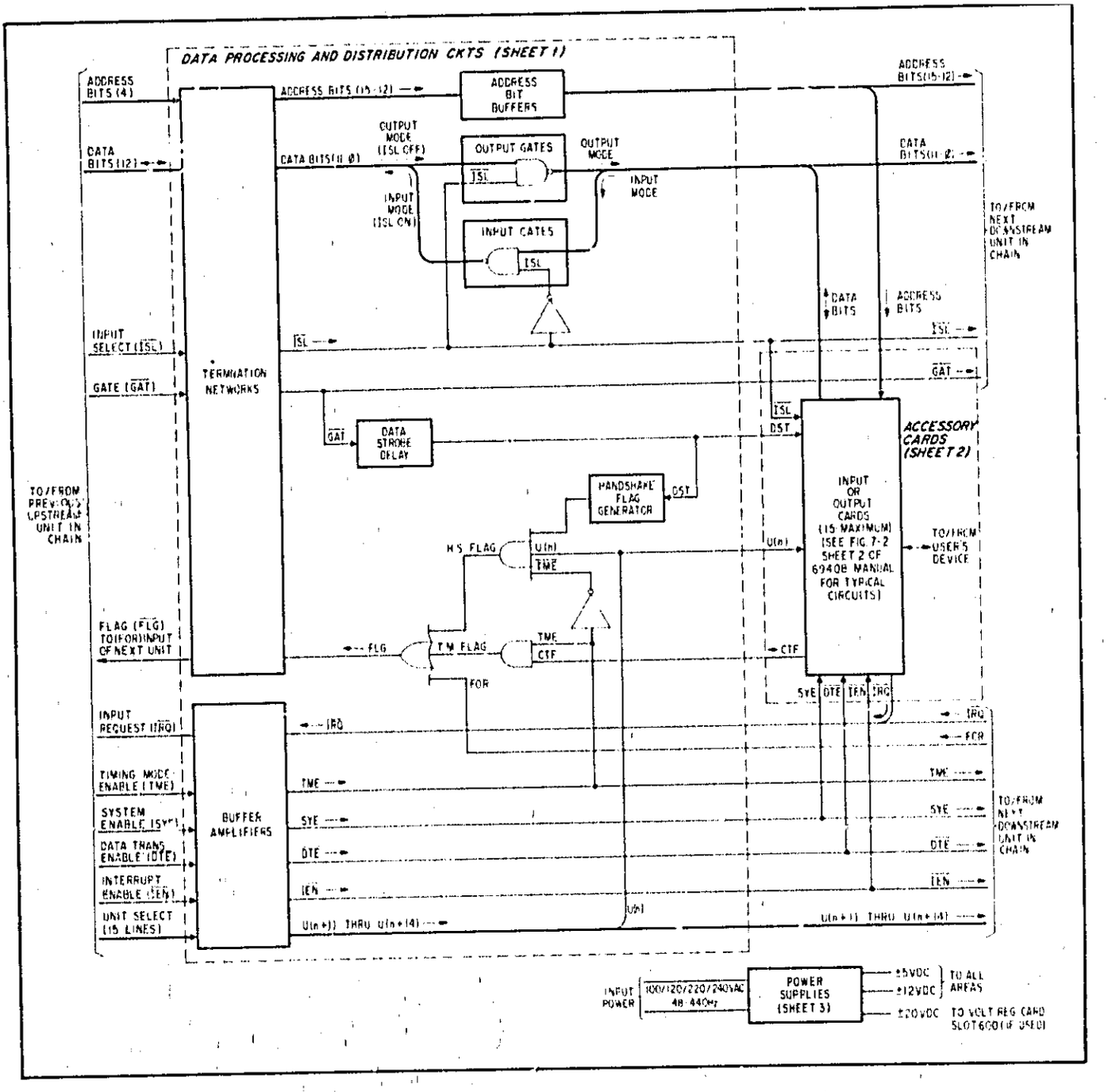


Figure 4-1. Basic Block Diagram

4-16 **System Enable Mode.** The system enable mode (SYE) is selected when bit 5 of a control word is programmed to the 1-state. SYE is routed from the programmed mode storage circuits of the 6940B to all accessory card slots in the system. Prior to SYE being programmed, the output circuits of all output cards are disabled; resistance outputs are short circuited, voltage outputs are held at 0 volts, current outputs are opened, relay contact outputs are held open, and TTL outputs are at logical Ø's. When SYE is programmed, the output cards are allowed to respond to programmed data. SYE is reset by programming bit 5 = 0. As an added safety feature, a jumper on input data plug P1 of the 6940B completes the SYE path to all card slots making it necessary to have input computer data connected to the system in order to enable the output cards.

4-17 **Timing Mode.** The timing mode (TME) is utilized for both output and input operations. It is selected by programming bit 4 of a control word to the 1-state. For output functions, TME causes the flag signal returned to the computer to be held in the busy state until the programmed output cards have completed processing their last data input. The busy state of the flag signals the computer not to input new data. TME is distributed to all timing mode flag circuits of all units in the system. The mode remains in effect until programmed off by bit 4 = 0.

4-18 **Data Transfer Enable Mode.** The data transfer enable mode (DTE) is selected by programming bit 6 = 1. DTE is wired to all accessory card slots of the system but is utilized only by output cards having dual-rank storage, by relay output cards and by TTL output cards. Output cards with dual-rank storage have two sets of storage registers. The first set of registers store the programmed data as it is strobed in by DST. The second set of registers receive the data from the first set of registers and apply it to the output conversion circuits only when DTE is programmed.

4-19 For output cards with dual-rank storage, the DTE mode is normally used in either of two ways:

(1) *DTE is selected first and latched.* The output cards are then addressed and programmed one at a time. Since DTE is present, the programmed data is transferred immediately from the first set of registers to the second set of registers to the conversion circuits. Each card thus produces an output proportional to the programmed data, as it receives the data.

(2) *DTE is not initially selected.* The output cards are addressed and store the programmed data in the first set of registers, but do not transfer the data to the second set of registers, since DTE has not been programmed. This method permits the first registers of all cards of this type to be loaded with data first; then by programming DTE, the outputs of all the cards are simultaneously transferred to the user's system. The output cards will continue to hold the most recently programmed value after DTE is removed in preparation for the next data loading cycle.

4-20 The relay output cards have only a single level of storage and the output relays respond to data as the card is programmed. However, a gate line (a contact closure available on each relay output card) is enabled only when DTE is programmed. These contacts can be used in the external system to initiate two operations:

(1) To simultaneously strobe the outputs of all relay output cards into the external system.

(2) To start a timing flag circuit in the external system that will hold the flag line returned to the multiprogrammer in the busy state until the circuit times out. The delay provided by this circuit should coincide with the maximum time required for the user's system to process the data relay outputs.

4-21 For TTL output cards, DTE is used in the same manner described for relay output cards.

4-22 **Data Input.** For output modes, the output cards are programmed by 16-bit data words derived from the computer and channeled through the 6940A to the extender units. A data word contains two types of information; slot addresses (bits 15, 14, 13, and 12 programmed to any number from 0000 to 1110) and data (bits 11 through 0). A unique combination of the four address bits is wired to each of the 15 card slots. Slot 400 receives address 0000; slot 401 receives 0001; ... slot 414 receives 1110. The same slot address wiring is carried through in all units so that when a given slot address is programmed, all slots in the system having that address are partially enabled. However, only one unit of the system can be selected at a time, so only the slot of the unit selected by a previous control word is fully enabled to accept the data contained in bits 11 through 0. (Input-type cards require ISL in addition to the appropriate slot and unit addresses to be enabled.) The 6940B Multiprogrammer is assigned unit number ØØ (UØØ), while the extender units are numbered consecutively from UØ1 up to U15.

4-23 **Handshake Mode.** Computer data is entered into the Multiprogrammer System in either of two modes; the handshake mode or the timing mode. The return path to the computer for the handshake flag is enabled when TME is programmed off, and blocked when it is programmed on.

4-24 In the handshake mode, a 6941B will accept data at rates up to 20k words/sec. A timing diagram of the data, gate, flag and data strobe signals for the handshake mode are given in Figure 4-2. The significant multiprogrammer and computer operations at each time interval are described as follows:

NOTE

Because the multiprogrammer system is designed to operate with up to 100 feet of cabling between each unit an 8μsec software delay is required between data output to the multiprogrammer and setting the gate signal (see Section III of the 6940B manual).

T_0 – Following the 8μsec software delay, the gate signal from computer goes LO indicating that a word is available on the 16 data input lines. The gate signal is applied to identical data strobe circuits in all extender units in the system.

T_1 – After a delay of approximately 8μsec from the start of the gate, the handshake flag generator sets the handshake (H.S.) flag LO which is applied to a flag stretcher circuit in the 6940B setting the flag line ($\overline{FLA}$) back to the computer LO (busy). This indicates to the computer that the data input operation has been completed. The computer must reset the gate at this time. Data may be removed after the gate is reset.

T_3 – The gate line is reset (goes HI) in preparation for the next data output operation.

T_4 – When the gate line is reset, the data strobe delay circuit resets DST and the handshake generator resets the H.S. flag ($\overline{FLG}$ goes HI) allowing the computer flag ($\overline{FLA}$) to go HI. Note that the 6940B's flag stretcher circuit (see paragraph 4-26) holds the $\overline{FLA}$ signal LO (busy) for 20μsec.

T_5 – The computer flag ($\overline{FLA}$) goes HI (ready). The computer may initiate a new data output cycle anytime after T_5.

4-25 **Timing Mode.** Whenever an output card is addressed and data is strobed in, a CTF pulse is produced by a timing circuit on the addressed card. This flag pulse (Figure 4-3) is initiated by DST but its duration depends on the timing circuit on the individual output cards. The timing flag duration for a particular output card is selected on the basis of the maximum time required for the card, or the external device connected to it, to complete processing data before it can accept new data. The timing flag output of the individual cards are ORed together to become the common timing flag (CTF). When the timing mode is not programmed, CTF is still generated by the output cards but has no effect on the flag line back to the computer. When TME is programmed, the CTF pulse becomes the flag to the computer. In the timing mode, the flag is held busy until the timing flag pulses from the individual output cards have timed out. The flag stretcher circuit in the 6940B holds the computer flag ($\overline{FLA}$) line busy for a minimum of 20μsec.

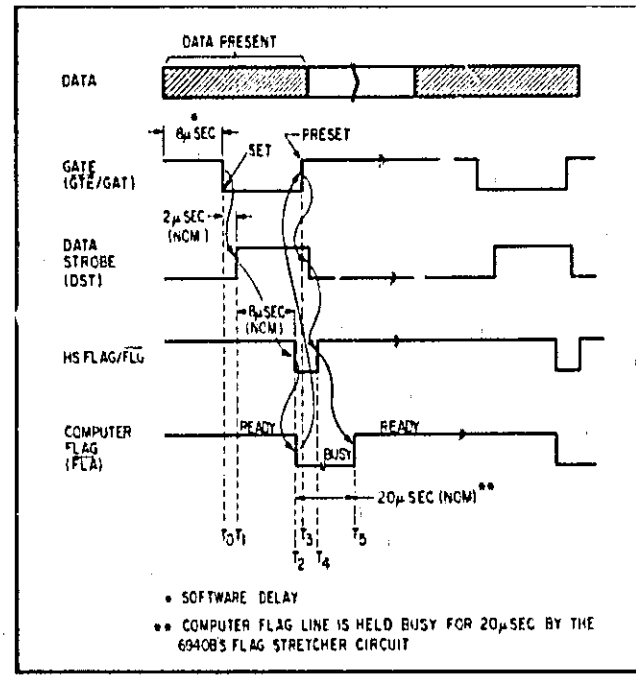


Figure 4-2. Handshake Mode, Timing Diagram

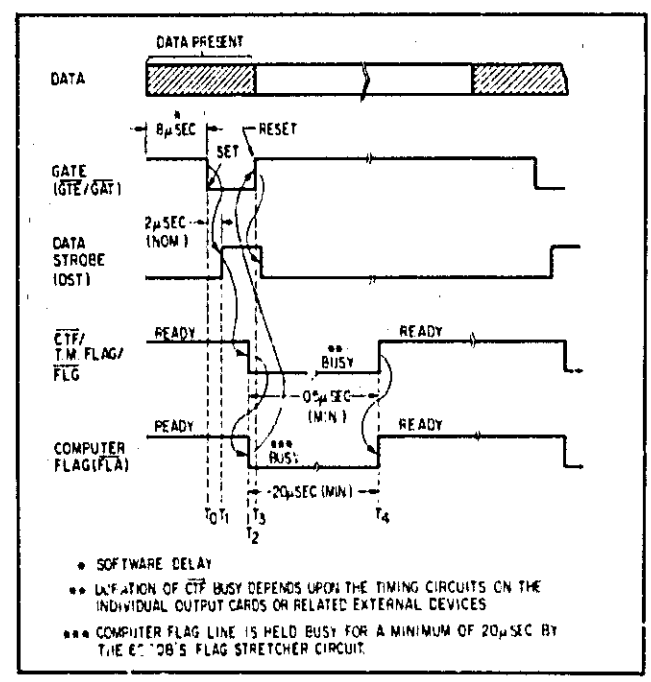


Figure 4-3. Timing Mode, Timing Diagram

4-26 **Extender Unit Flags.** Every extender unit in the system has an identical flag circuit. Figure 4-4 is a block diagram showing the interconnection between flag circuits. As can be seen from Figure 4-4, a handshake or timing flag generated by

an extender unit is ORed through each unit in the system to the 6940B master unit. The 6940B receives the flag line as FOR and returns it to the computer (via the 6940B flag stretcher circuit) as the system flag. The operation of the extender unit flag circuits is identical to the master unit flag circuits.

4-27 Input Modes

4-28 There are two primary input modes and a number of secondary variations of these modes involving both hardware and software options. The two primary modes are designated:

(1) The Dedicated Input Mode
(2) The Interrupt-Search Mode.

4-29 The basic theory of operation for input functions will be described in terms of the two primary input modes as related to a typical digital input card.

4-30 **Dedicated Input Mode.** In this mode, the computer reads data from input cards on an individual card basis. Until it completes its operation on the currently addressed card, the computer should not go on to another input card. The dedicated input mode is normally used in either of two ways; ungated, or in the timing mode.

4-31 *Ungated.* This is the most basic method of reading data from an input card. The procedure is accomplished in two programming steps: (1), programming a control word with ISL = 1, IEN = 0, and TME = 0; and (2), programming the desired card address and *not* issuing a computer gate signal.

NOTE

Because the multiprogrammer system is designed to operate with up to 100 feet of cabling between each unit, a software delay must be incorporated between addressing an input card and reading its data without a gate. Refer to Section III in 6940B manual.

4-32 In Step (1), ISL = 1 simply turns the 12-data bit lines of each unit in the Multiprogrammer System in the direction of the computer. Although ISL is also applied to the input cards it has no effect on their operation in the ungated mode.

4-33 In Step (2), the 12-data bits currently stored on the addressed input card are placed on the return data lines and will remain there for as long as the card address is present. Since a computer gate is not issued in this mode, the multiprogrammer does not produce a data strobe (DST) and the addressed card is not armed. (CTF and IRQ are neither generated nor required in the ungated mode.)

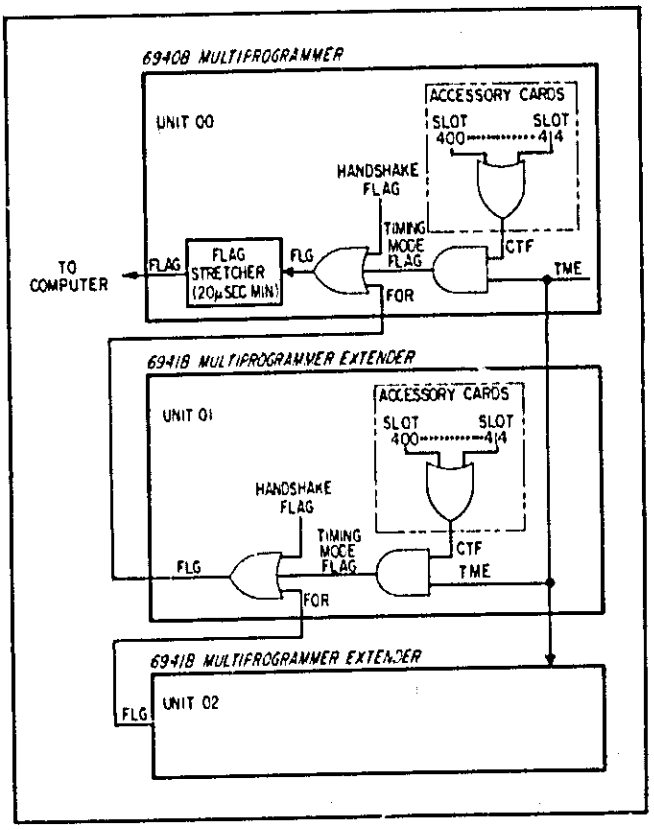


Figure 4-4. Flag ORing Circuits, Block Diagram

4-34 *Timing Mode.* This mode is also programmed in two steps: (1), a control word is programmed with ISL = 1, IEN = 0, and TME = 1; and (2), the desired card address is issued along with a computer gate signal.

4-35 Step (1) sets up three initial conditions for this mode. First, ISL reverses the direction of the 12 data-bit lines; second, ISL is applied to all input cards as a condition necessary to enable (arm) an input card when it is addressed and data strobed; and third, TME enables the common timing flag (CTF) return path from the input cards to the computer.

4-36 In Step (2), the address of the desired input card is programmed along with a computer gate. Upon receipt of its address bits, the selected input card will immediately place 12-bits of data on the return data bus to the computer. However, the computer should not accept this data until the multiprogrammer signals, via the trailing edge of CTF, that the input data from the addressed card has been updated and is now ready to be read.

4-37 Within the selected input card, the combination of ISL, DST, and the card address will send a gate signal to the external device and simultaneously reset the flag flip-flop on the input card. Resetting the flag flip-flop causes the CTF line back to the multiprogrammer to switch to the busy state. When the external device is ready with new data it will signal the input card via the trailing edge of its device flag. This edge

will set the input card flag flip-flop which will return the CTF line to the ready state. At the same time, new data will be strobed into the storage registers on the input card. The computer should interpret the trailing edge of CTF as permission to read the return data.

4-38 Before going on to an interrupt-search mode, previously armed cards whose flag flip-flops have been set should either be rearmed (by programming ADDR·DST·ISL) or disarmed (by programming ADDR·DST·$\overline{ISL}$), with either operation done in the handshake mode.

4-39 **Interrupt-Search Mode.** The interrupt-search mode offers an efficient means of retrieving data from groups of input cards. As covered in Section III of the 6940B manual, there is a hardware option available which adds versatility to this mode by allowing all digital input cards with jumper W6 installed to be armed as a group. However, in order to keep this explanation simple, the multiprogrammer operation in the interrupt-search mode will be described in terms of four basic programming steps, with W6 *not* installed. (Figure 3-12A of the 6940B instruction manual is a timing diagram of the interrupt-search mode.)

Step 1. Establish initial mode conditions by programming a control word with ISL = 1, IEN = 0, and TME = 0.

Step 2. Arm desired input cards by programming card addresses. (A computer gate must accompany each address as it is programmed.)

Step 3. Select the interrupt enable mode by programming a control word with IEN = 1, TME = 1, and ISL = X (X = doesn't care).

Step 4. Wait for the multiprogrammer CTF flag to indicate that one or more addressed input cards has valid data ready. Then, poll the input cards (by issuing their addresses) in a software determined order. Do not issue a computer gate while polling. A programmed delay (wait time) must be incorporated between addressing each input card and reading its data without a gate. The delay time depends upon the multiprogrammer unit number (0-15) of the addressed card (see Section III of 6940B manual). Examine bit 15 of each return data word in the computer and accept the data only when bit 15 = 1. (The state of bit 15 is determined by IRQ from the addressed input card; when the addressed input card has valid data available, IRQ makes bit 15 = 1.)

4-40 Step (1) establishes two initial conditions for this mode: First, ISL reverses the direction of the 12 data bit lines; and second, ISL is applied to all input cards as a condition necessary to enable (arm) an input card when it is addressed and data strobed. Since the timing mode has been programmed off in this step, subsequent data transfers between the computer and the multiprogrammer will be done in the handshake mode.

4-41 In Step (2), the address of the desired input card is programmed along with a computer gate. Upon receipt of its address bits, the selected input card will momentarily place 12-bits of data on the return data bus to the computer. The computer should ignore this data.

4-42 As in the dedicated input timing mode, the combination of ISL and DST and the card address arm the addressed card; a gate is sent to the external device and the flag flip-flop on the card is reset. When the device is ready with data it will signal the input card via the trailing edge of its device flag. This edge will set the flag flip-flop and strobe new data into the storage registers on the input card. When the interrupt mode is programmed in the next step, the "set" flag flip-flop on this, or any other input card with new data ready, will generate an interrupt. Also, when the input cards are polled in the search mode, any card whose flag flip-flop is set will cause IRQ, and thus bit 15 returned to the computer, to be true.

4-43 Step (3) establishes conditions for enabling interrupts from previously armed input cards which now have data available. Along with the control word containing IEN = 1 and TME = 1, the computer must also issue a gate signal. When the control word containing IEN = 1 is programmed the unit select card in the 6940B, which normally generates a handshake flag when a control word is programmed, is prevented from doing so. The computer will now wait for a transition of the CTF line from an input card to signal an interrupt. Within the input cards, IEN and DST (derived from the computer gate) are logically ANDed with the output of the flag flip-flop, which is true when the external device has data ready. When all three conditions are true on any input card, the CTF line will be set to the busy state. This transition of the CTF line to the busy state signals the computer to reset its gate, which in turn resets DST. With DST reset, the CTF AND-gate within the input cards is inhibited, causing CTF to return to the ready state. The computer interprets this transition an an interrupt request.

4-44 In Step (4), the address of each input card of the selected group is programmed in a software assigned order, without a computer gate. As each card is addressed, it places its 12-data bits on the return data bus. The card address is also ANDed with the output of the flag flip-flop on the input card, and when both are true (signifying that the addressed input card has new data) the IRQ signal is made true. IRQ directly controls the state of bit 15 returned to the computer; when bit 15 is true, the computer should accept the associated 12 data bits.

4-45 DETAILED CIRCUIT ANALYSIS (See Figure 7-1)

4-46 Logic Definitions

4-47 As in the 6940B, the internal logic circuits of the 6941B are designed within and conform to the definition of

positive logic. This simply means that a logical 1 is represented by a voltage level more positive than a logical 0 and that the logic circuits are utilized within this framework. The actual logic levels utilized within the 6941B are:

LOGIC 1 = +2.4V to +5.5V (HI)
LOGIC 0 = 0V to +0.4V (LO).

4-48 A system of mnemonics is also used to identify functions implemented at specific points through out the system. Mnemonics are three character abbreviations of the signal function name. A signal function may be designated in either its true form (e.g., TME) or its complemented form ($\overline{\text{TME}}$). When a particular function is set to its assertive state, its true form = logical 1 (HI) and its complement = logical 0 (LO). The opposite states exist when the function is not asserted. A few examples will be given relative to this system to expand on the previous definitions:

(1) When a flag signal is generated by the logic and timing card, the $\overline{\text{FLG}}$ line makes a transition from a logical 1 (HI) to a logical 0 (LO) and returns to a logical 1 (HI) when the flag has been completed.

(2) When a specific bit is programmed to a logical 1 at the computer, the corresponding $\overline{\text{B}}$—— input line to each 6941B goes to the logical 0 (LO) state.

4-49 Input Card A1

4-50 The four address bits ($\overline{\text{B15}}$ through $\overline{\text{B12}}$), the twelve data bits ($\overline{\text{B11}}$ through $\overline{\text{B00}}$), and the gate ($\overline{\text{GAT}}$) signal from the previous upstream unit are applied to identical termination networks on input card A1. The networks minimize noise and ringing on the transmission lines by providing the ideal line termination impedance. The 1kΩ pull-up resistor in the $\overline{\text{FLG}}$ return circuit improves the 1-state driving capability of the output NAND gate (G14) on the logic and timing card.

4-51 Input select signal ISL is buffered by circuit A1Z1 before being transferred to the required circuits in this unit and on to the next down stream unit. Also located on the A1 Input Card is a +5 volt shunt regulator which provides isolated +5 volt power for the termination resistors. This circuit is described in detail in Paragraph 4-117 of the 6940B manual.

4-52 I/O Transfer Card A2

4-53 I/O Transfer Card A2 is comprised of 12 input NAND gates (G11 through G0) and associated inverter amplifiers; and buffer amplifiers for mode signals $\overline{\text{ISL}}$, $\overline{\text{IEN}}$, $\overline{\text{DTE}}$, and $\overline{\text{IRQ}}$. For all input modes (ISL, off), the 12-input NAND gates are inhibited and data bits $\overline{\text{B11}}$ through $\overline{\text{B00}}$ are passed in the downstream direction, through flat cable W1, to logic and timing card A3. When an input mode is programmed (ISL, on), gates G11 through G00 are allowed to pass the 12 data bits from an addressed input card in the direction of the the computer (upstream).

4-54 Logic and Timing Card A3

4-55 Logic and Timing Card A3 performs data and address bit buffering, I/O data bit selection, and data strobe and flag signal generation. This card is identical to the one used in the 6940B Master unit and, therefore, will not be described here. Refer to Paragraphs 4-51 and 4-121 in the 6940B Operating and Service Manual for complete circuit description of the A3 card.

4-56 Main Power Supply Board A10

4-57 The main power supply board contains a +5 volt regulator (with current latch and overvoltage circuits) and four ±20 volt rectifier-filters. The power supply board is identical to that used in the 6940B Master unit (refer to Paragraph 4-132 in the 6940B manual).

MAINTENANCE

SECTION V
MAINTENANCE

5-1 INTRODUCTION

5-2 This Section contains a basic checkout procedure for the 6941B, together with detailed troubleshooting procedures for all of its circuits. These procedures make use of the local programming capabilities of the associated 6940B and the test instruments listed in Table 5-1.

5-3 A faster and more comprehensive method of testing and troubleshooting Multiprogrammer Systems is available through use of the optional HP Computer Interface Kit, Model 14550A. This kit, and other useful service aids, are listed in Table 1-2 of the 6940B manual.

5-4 Detailed checkout and troubleshooting procedures for the 6940B and the accessory input/output cards are provided in their associated instruction manuals.

5-5 MAINTENANCE FEATURES

5-6 Several maintenance features have been incorporated into the design of multiprogrammer instruments for the purpose of minimizing down-time, and for convenience in troubleshooting and repairing malfunctions. These features are listed as follows:

a. *Local Programming.* This feature permits manual programming of the extender units through use of proximity switches on the 6940B front panel. Refer to Paragraph 3-143 of the 6940B manual for details.

b. *Logic Probe Connector.* Logic probe connectors are provided on both the 6940B and 6941B. The connectors are located on the card cage behind the hinged front panel, and provide operating voltage (+5 volts) for a logic probe.

c. *Power Supply Indicators.* The 6941B has lamps that indicate the status of the ac input power (LINE indicator) and the +5 volt power supply (lamp on card A3). Although there is no direct indication of +12 volts on the 6941B, its presence is implied by the +5 volt indicator.

d. *Slot 414.* Slot connector 414 on both the 6940B and the 6941B (in addition to being a normal slot for an accessory card) has special test capabilities. The wiring to slot 414 includes all eight card address lines, whereas the other slot connectors contain only the four address-lines peculiar to the particular slot.

e. *Test Points on Card A3.* Logic and timing card A3 contains stand-off test points which provide access to key signals on the A3 card.

f. *Plug-In Circuit Cards and IC's.* Most components of the 6940B and 6941B are located on plug-in printed circuit cards. All IC's are mounted on sockets.

5-7 All of the above capabilities are utilized in the testing and troubleshooting procedures of this section.

5-8 Handling Plug-In Components

5-9 While the plug-in cards and IC's are a great convenience, care must be exercised in their handling, especially while they are being installed or removed. For example, the printed circuit plug of each plug-in card is slotted between a particular pair of fingers, and the mating connector on the mainframe is keyed at the same point. This makes it virtually impossible to plug a card into the wrong slot. However, if the card is forced into the wrong slot, the key, the mainframe connector and the printed circuit card could be damaged. The IC's should also be handled carefully. When removing an IC, lift it straight out of the socket to avoid bending its pins. When installing an IC, be sure that the identification dot or notch is located at the same end as the bevel on the IC socket.

5-10 Recommended Test Equipment

5-11 Table 5-1 lists the test equipment recommended for use in testing and troubleshooting Multiprogrammer Extender units.

5-12 BASIC CHECKOUT PROCEDURE

5-13 The basic checkout procedures given in Table 5-2 represents complete static check of the 6941B using the 6940B local switch register as the programming source. The procedure is useful for incoming inspection and for verifying operation of each 6941B prior to its installation into a system. All signals into and out of a 6941B, including those supplied to accessory input/output cards, are checked by these procedures. Of course, operation of the 6940B Master should be verified first, before checking out a 6941B. Each 6941B that is used in the system should then be checked in sequence. As the operation of each 6941B is verified, that unit should be chained to the next unit to be checked-out so that actual system operation can be duplicated.

5-14 If an abnormal indication is noted during performance of the checkout procedure, Table 5-2 will recommend either of two solutions: (1) where the fault may be corrected by

replacing one or two plug-in IC's, the suspect IC's will be listed in the table; and (2), where more extensive troubleshooting is indicated, a separate table will be referenced for the appropriate procedure.

NOTE

Although the unit was completely checked prior to shipment, faults may be introduced as a result of rough handling in transit or during installation. If the troubleshooting procedures fail to uncover the fault, check for open or shorted connections in plugs, jacks, back-plane, extender card, etc.

5-15 Before proceeding to Table 5-2, perform the following preliminary procedures:

a. Open the hinged front panel of the 6941B and install the extender card in slot 414.

b. Connect the logic probe to the mating connector on the front of the 6941B card cage.

c. Connect one end of the chaining cable (14541A) into DATA INPUT connector J1 of the 6941B to be checked and the other end of the cable into the DATA OUTPUT connector J2 of the next upstream unit.

Table 5-1. Recommended Test Equipment

TYPE	REQUIRED CHARACTERISTICS	USE	RECOMMENDED MODEL
Extender Card	Supplied with 6941B.	Extends plug-in cards out of the extender chassis for testing and troubleshooting.	HP 5060-7901
Logic Probe	Impedance: 25k. Trigger Threshold: 2.0V and 0.8V nominal. Min. pulse width: 10nsec.	Logic circuit troubleshooting.	HP 10525T
Oscilloscope	Bandwidth: dc to 50MHz. Sensitivity: 20mV/div.	Monitor GATE, FLAG, and DST pulses.	HP Model 180A with 1804A and 1821A plug-ins.
Multimeter	10Ω to 1MΩ, ±5% 0.1V to 100V, ±2%.	General troubleshooting.	HP 427

Table 5-2. Basic Checkout Procedure

<table>
<tr><th>TEST</th><th>INSTRUCTIONS</th><th>NORMAL INDICATION</th><th>IF INDICATION IS ABNORMAL</th></tr>
<tr><td>1
POWER
TURN-ON</td><td>Connect ac power cord to primary power. Set LINE switches on all applicable units to ON.</td><td>On unit under test, LINE indicator lamp and lamp on card A3 should go on.</td><td>Refer to power supply troubleshooting, Table 5-4.</td></tr>
<tr><td>2
DATA/
ADDRESS
BITS</td><td>Set DATA SOURCE switch on 6940B to LOCAL. Touch CLEAR REGISTER. Starting with bit 15, alternately set bit switches on 6940B off (dark) and on (light). With logic probe, monitor logic levels at extender card pins (slot 414) for each proximity button setting. (Be sure that ISL mode is off.)

<table>
<tr><th></th><th>SW. REG. BUTTON</th><th>EX. CD. PIN</th></tr>
<tr><td rowspan="4">ADDR BITS</td><td>15</td><td>24, BB</td></tr>
<tr><td>14</td><td>23, AA</td></tr>
<tr><td>13</td><td>22, Z</td></tr>
<tr><td>12</td><td>21, Y</td></tr>
<tr><td rowspan="12">DATA BITS</td><td>11</td><td>20</td></tr>
<tr><td>10</td><td>19</td></tr>
<tr><td>9</td><td>18</td></tr>
<tr><td>8</td><td>17</td></tr>
<tr><td>7</td><td>16</td></tr>
<tr><td>6</td><td>15</td></tr>
<tr><td>5</td><td>14</td></tr>
<tr><td>4</td><td>13</td></tr>
<tr><td>3</td><td>12</td></tr>
<tr><td>2</td><td>11</td></tr>
<tr><td>1</td><td>10</td></tr>
<tr><td>0</td><td>9</td></tr>
</table></td><td>As switch register lamps go on and off, bit levels at the extender card pins switch HI and LO. (Where two extender card pins are specified for a switch setting, the bit levels will be complementary.)</td><td><u>MECHANICAL CHECKS</u>
(1) Check that DATA SOURCE switch on 6940B is in LOCAL position.
(2) Check that flat cable W1 is plugged into card A2.
(3) Check that cards A1, A2, and A3 are properly installed.

<u>ADDRESS BIT (12-15) FAILURE</u>
Check address bit amplifiers on card A3. Refer to Table 5-6.

<u>DATA BIT (Ø-11) FAILURE</u>
(1) Make sure ISL is off.
(2) Note the failure pattern and try to relate it to the applicable IC's on card A3 listed below:
<table>
<tr><th>Failed Bit</th><th>Replace IC</th></tr>
<tr><td>11</td><td>Z4 Z2</td></tr>
<tr><td>10</td><td>Z5 Z2</td></tr>
<tr><td>9</td><td>Z4 Z2</td></tr>
<tr><td>8</td><td>Z5 Z2</td></tr>
<tr><td>7</td><td>Z4 Z2</td></tr>
<tr><td>6</td><td>Z4 Z2</td></tr>
</table></td></tr>
</table>

Table 5-2. Basic Checkout Procedure (Continued)

TEST	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS ABNORMAL
2 (Continued)			Failed Bit — Replace IC 5 — Z6 Z1 4 — Z6 Z1 3 — Z6 Z1 2 — Z5 Z1 1 — Z5 Z1 0 — Z6 Z1 (3) Check flat cable W1. ALL BITS FAIL Check 5V shunt regulator on card A1. Refer to Table 5-5.
3 DST	Monitor pin D (DST) on extender card. Touch CLEAR REGISTER. Touch LOAD OUTPUT.	When LOAD OUTPUT is touched, DST bit level goes HI.	Replace A3Z3 and A3Z7, retest. If test fails again, refer to DST troubleshooting, Table 5-6.
4 CONTROL MODE AMPLIFIERS	At 6940B switch register, tough CLEAR REGISTER. Select control word (bits 15, 14, 13, and 12 on). Select control modes TME (bit 4 on), SYE (bit 5 on), DTE (bit 6 on) and IEN (bit 8 on). Check that ISL (bit 7) is off. Touch LOAD OUTPUT. Monitor bit levels at the following pins on the extender card and at DATA OUTPUT connector J2 of the extender unit under test. FUNCTION — EX. CD. PIN NO. — CONNECTOR J2 PIN NO. TME — N/A — 22 — HI-level SYE — 1 — 18 — HI-level $\overline{DTE}$ — 5 — 23 — LO-level $\overline{ISL}$ — 6 — 25 — HI-level $\overline{IEN}$ — J — 21 — LO-level		TME FAILURE Replace A8Z3 and retest. If TME fails again, check wiring. Refer to Figure 7-1. SYE FAILURE (1) If SYE fails at both test points, check wiring. (2) If failure occurs on extender card only, replace amplifier A3Z17 and check A3Q3. (3) If failure occurs only at connector J2, replace A8Z3; retest. If SYE fails again, check emitter follower A8Z3. $\overline{DTE}$ FAILURE Replace A2Z6, retest. If $\overline{DTE}$ fails again, check wiring. $\overline{IEN}$ FAILURE Replace A2Z6; retest. If $\overline{IEN}$ fails again, check wiring. $\overline{ISL}$ FAILURE Replace A1Z1; retest. If $\overline{ISL}$ (off) fails again, check A2Z6 and wiring.

Table 5-2. Basic Checkout Procedure (Continued)

TEST	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS ABNORMAL
5 ISL PROGRAMMING	With control word still selected, program ISL mode on (bit 7, on). Monitor bit level at pin 6 of extender card or pin 25 of DATA OUTPUT connector J2. Touch LOAD OUTPUT → Clear control word address →	$\overline{ISL}$ level remains HI. $\overline{ISL}$ level goes LO.	Replace A1Z1; retest. If test fails again, check A2Z6 and wiring.
6 INPUT MODE DATA	At switch register, touch switches 11-0 to make sure that ISL mode (programmed in previous step) is on. The switch indicators will not respond to being touched if ISL is on. While observing switch register lamps 11-0, ground the extender card pins listed below: OBSERVE SW. REG. LAMP / GROUND PIN–ON EX. CARD 11 – 20 10 – 19 9 – 18 8 – 17 7 – 16 6 – 15 5 – 14 4 – 13 3 – 12 2 – 11 1 – 10 0 – 9	Lamp on switch register goes on when corresponding bit is grounded at extender card.	ALL BITS FAIL Replace A2Z6; retest. If test fails again, check A2Q1. ($\overline{ISL}$ level can be checked at TP13 on card A2.) SOME BITS FAIL Note the failure pattern and try to relate it to the applicable IC's listed below: FAILED BIT / CHECK IC A2 / A3 11 – Z2-Z5 / Z9 10 – Z2-Z5 / Z9 9 – Z2-Z5 / Z9 8 – Z1-Z4 / Z9 7 – Z1-Z3 / Z9 6 – Z1-Z3 / Z9 5 – Z1-Z4 / Z8 4 – Z1-Z4 / Z8 3 – Z1-Z5 / Z8 2 – Z2-Z4 / Z8 1 – Z2-Z3 / Z8 0 – Z2-Z3 / Z8
7 HANDSHAKE FLAG	Program control word. Program the address of the unit under test; as part of the same control word, program ISL off. Touch LOAD OUTPUT. With logic probe, monitor the $\overline{FLG}$ test point on the outer edge of logic and timing card A3. Touch LOAD OUTPUT.	$\overline{FLG}$ goes LO while LOAD OUTPUT is touched.	Replace A3Z10; retest. If test fails again, check A3Z3 delay circuit.

Table 5-2. Basic Checkout Procedures (Continued)

TEST	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS ABNORMAL
8 TIMING MODE FLAG	Retain control word. Select TME (bit 4, on). Touch LOAD OUTPUT. Monitor $\overline{FLG}$ test point on A3 card. On extender card, connect a jumper from pin 7 ($\overline{CTF}$) to ⓒ.	$\overline{FLG}$ goes LO while $\overline{CTF}$ is grounded.	Replace A3Z7; retest. If test fails again, replace A3Z3.
9 $\overline{FOR}$ FLAG	Monitor $\overline{FLG}$ test point on logic and timing card in 6940B Master unit. Connect jumper from pin 33 ($\overline{FOR}$) of DATA OUTPUT connector J2 of unit under test to ⓒ.	$\overline{FLG}$ goes LO.	Check $\overline{FOR}$ wiring. Refer to Figure 7-1.
10 $\overline{IRQ}$ AMPLIFIER	Monitor $\overline{IRQ}$ test point on I/O transfer card A2. Connect pin F ($\overline{IRQ}$) of extender card to ⓒ.	$\overline{IRQ}$ goes LO.	Replace amplifier A2Z6.
11 UNIT SELECT WIRING	The unit select wiring through each extender unit can be checked by first programming the address of the unit currently under test (Un), at the switch register and monitoring the corresponding logic level at pin 4 of the extender card. Next, program the address of each unit further downstream and monitor the corresponding logic levels at DATA OUTPUT connector J2, as listed below. [For example, if unit Ø3 is currently under test, then the logic level for unit address Ø4 (or U3 + 1) is available at J2-1; unit address Ø5 (or U3 + 2) is available at J2-2, etc.]	Logic level goes HI for each address when LOAD OUTPUT is touched.	If failure detected at J2 pins 1-6, 7-12, or 13 and 14, replace A8Z1, A8Z2, or A8Z3 respectively; retest.

PROGRAM UNIT ADDR.	CHECK LOGIC LEVEL
U (n)	Extender Card, Pin 4
U (n + 1)	J2-1
U (n + 2)	J2-2
U (n + 3)	J2-3
U (n + 4)	J2-4
U (n + 5)	J2-5
U (n + 6)	J2-6
U (n + 7)	J2-7
U (n + 8)	J2-8

Table 5-2. Basic Checkout Procedure (Continued)

TEST	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS ABNORMAL
11 (Continued)	PROGRAM UNIT ADDR. / CHECK LOGIC LEVEL U (n + 9) J2-9 U (n + 10) J2-10 U (n + 11) J2-11 U (n + 12) J2-12 U (n + 13) J2-13 U (n + 14) J2-14		
12 BITS TO DOWNSTREAM UNITS	Monitor output bits to downstream units at data output connector J2 while toggling each bit on and off at switch register. BIT / J2, PIN NO. $\overline{B15}$ 50 $\overline{B14}$ 49 $\overline{B13}$ 48 $\overline{B12}$ 47 $\overline{B11}$ 46 $\overline{B10}$ 45 $\overline{B09}$ 44 $\overline{B08}$ 43 $\overline{B07}$ 42 $\overline{B06}$ 41 $\overline{B05}$ 40 $\overline{B04}$ 39 $\overline{B03}$ 38 $\overline{B02}$ 37 $\overline{B01}$ 36 $\overline{B00}$ 35	Bit level switches LO (when bit switch lights) and HI (when switch is off).	Check wiring. Refer to Figure 7-1.

5-16 TROUBLESHOOTING

5-17 If trouble is encountered in a previously normal system, follow the system troubleshooting procedures in Paragraph 5-18 of the 6940B manual. Briefly, these procedures recommend a "quick check" of the 6940B first to ensure that it is operational. When proper operation of the Master unit and the programming source is verified, proceed to the first 6941B that exhibits the malfunction and perform the quick check (Table 5-3) again.

5-18 When troubleshooting a 6941B, the following types of failures can be anticipated. Each failure-type is analyzed in succeeding paragraphs and troubleshooting procedures recommended.

a. Failures involving data and address bits.
b. Failures involving gate-flag functions.
c. Power supply failures.

5-19 Data or Address Bit Failure

5-20 This will probably be the most commonly encountered hardware trouble, since the 16 programmed bits are part of most system functions. The failure of one or more bits can produce many different types of failure symptoms including erroneous addressing, erroneous programming of output magnitude or direction, and erroneous mode selection. Depending on where the bit is lost, the trouble may show-up in one unit, in several units, or in all units. The quick-check procedure given in Table 5-3 exercises all bits. The bits are programmed at the local control panel of the 6940B, and the bit levels are monitored on an extender card plugged into accessory card slot 414 of the 6941B. Unless the location of the faulty bit is obvious, or if the failure is restricted to one accessory card, perform the quick-check on the 6940B first. If the 6940B checks out, go to the first 6941B exhibiting the malfunction and perform the quick-check again. If the failure is restricted to one accessory card, the card itself is probably at fault. However, check that the mainframe is providing the proper inputs (by performing the quick-check in slot 414 of the applicable unit) before troubleshooting the card.

5-21 Gate-Flag Failures

5-22 Tests 3, 7, 8, and 9 of the Basic Checkout Procedure, Table 5-2, are static tests of the gate-flag functions of the 6941B. However, it is possible to have a condition where a faulty circuit on the A3 card would not be detected by the Basic Checkout Procedure. Symptoms of this condition could be the inability to program at a 20k word/sec. rate, random loss of flag, or random failure to gate data into storage. The quickest method of dynamically checking a suspect logic and timing card of an extender unit is to install it in slot 300 of a working 6940B Master unit and perform the dynamic test described in Paragraph 5-26 of the 6940B manual.

5-23 Power Supply Failures

5-24 Power supply failures can easily be verified by observing the states of the LINE and +5V indicator lamps on the 6941B. If either indicator is off when the LINE switch is ON, refer to the power supply troubleshooting procedures in Table 5-4.

—— CAUTION ——

If fuse F2 requires replacement, use HP Part No. 2110-0051, only.

5-25 POWER SUPPLY TROUBLESHOOTING

5-26 Procedures for troubleshooting the power supply circuits of the 6941B are given in Table 5-4. If a faulty heat-sink mounted component is found during troubleshooting, refer to Paragraph 5-35 for replacement procedures.

5-27 Power Supply Adjustment

5-28 Following replacement of any component of the +5 volt power supply, check the +5 volt output and adjust +5V ADJ potentiometer A10R18, before returning the unit to service. Remove all loads (unplug all mainframe cards) before making the adjustment. The voltage measured from the +5 volt line to ⓒ, following a 5 minute warm-up period, should be set to precisely 5.10 volts.

5-29 EXTENDER INPUT CARD A1, TROUBLESHOOTING

5-30 Extender Input Card A1 consists of input termination resistors and a 5 volt shunt regulator. Failure of an individual termination network will result in loss of an individual bit. Failure of the shunt regulator could cause loss of all bits. Table 5-5 covers troubleshooting procedures for both types of circuits.

5-31 I/O TRANSFER CARD A2, TROUBLESHOOTING

5-32 I/O Transfer Card A2 consists of a set of 12 input-selection gates and associated amplifiers; and buffer amplifiers for control signals $\overline{\text{ISL}}$, $\overline{\text{IEN}}$, $\overline{\text{DTE}}$, and $\overline{\text{IRQ}}$. Checkout and troubleshooting instructions for these functions are provided in Steps 4, 6, and 10 of Table 5-2.

5-33 LOGIC AND TIMING CARD A3, TROUBLESHOOTING

5-34 Logic and Timing Card A3 consists of data bit I/O selection gates, data-bit buffers, address-bit buffers, and DST-flag circuits. Checkout and troubleshooting instructions for the I/O selection and data bit buffer circuits are provided in Table 5-2, Step 2. The DST and flag circuits, as well as the address-bit buffers, are covered in Table 5-6.

5-35 REMOVAL AND REPLACEMENT

5-36 Heat Sink Mounted Components

5-37 Series regulator transistors Q1 and Q2 are installed on heat sink assembly HP Part No. 5000-3119; diodes CR1 and CR2 are installed on heat sink assembly HP Part No. 5000-3120. The heat sink assemblies are located in the rear of the mainframe. The components are electrically insulated from the heat sink by mica washers and nylon bushings. If a component replacement becomes necessary, coat both sides of the mica washers with silicon grease (Dow Corning DC-5, or equivalent) to insure maximum thermal transfer between the component and the heat sink.

Table 5-3. Quick-Check Procedure

TEST	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1	Set LINE switches to ON and DATA SOURCE switch on 6940B to LOCAL.	LINE indicator lamp and lamp on card A3 of 6941B under test go on.	Refer to power supply troubleshooting, Table 5-4.
2	Touch CLEAR REGISTER. Select control word (15, 14, 13, 12, on). Select SYE and TME (5 and 4, on). Using buttons 0 through 3, address the 6941A under test. Touch LOAD OUTPUT. (Selects proper unit, SYE, and TME). Touch 12, 5, 4, and return 0, 1, 2, and 3 to the unlit state. Check the logic level or voltage at the following extender-card pins (slot 414) and observe the normal indications shown for Test No. 2:		

PIN NO.	NORMAL IND. FOR TEST NO. 2	NORMAL IND. FOR TEST NO. 3
1 (SYE)	HI	LO
2	+12V	+12V
3	+5V	+5V
4 (Un)	HI	LO
5 ($\overline{DTE}$)	HI	LO
7 ($\overline{CTF}$)	HI	HI
9 ($\overline{B00}$)	HI	LO
10 ($\overline{B01}$)	HI	LO
11 ($\overline{B02}$)	HI	LO
12 ($\overline{B03}$)	HI	LO
13 ($\overline{B04}$)	HI	LO
14 ($\overline{B05}$)	HI	LO
15 ($\overline{B06}$)	HI	LO
16 ($\overline{B07}$)	HI	LO
17 ($\overline{B08}$)	HI	LO
18 ($\overline{B09}$)	HI	LO
19 ($\overline{B10}$)	HI	LO
20 ($\overline{B11}$)	HI	LO
21 ($\overline{B12}$)	HI	LO
22 (B13)	HI	LO
23 (B14)	HI	LO
24 (B15)	HI	LO

CHECK CIRCUIT	REFER TO TABLE
SYE (A3Q3, A3Z17)	--
Power Supply	5-4
Power Supply	5-4
Unit Select (6940A)	--
DTE (A2Z6)	--

Pull out I/O cards one at a time and note which card is holding $\overline{CTF}$ LO.

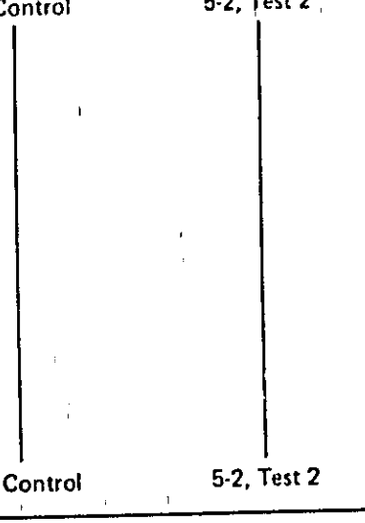


Table 5-3. Quick-Check Procedure (Continued)

TEST	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS ABNORMAL
(2)	Check only when A6 Voltage Regulator Card is used.	PIN NO. / NORMAL IND. FOR TEST NO. 2 / NORMAL IND. FOR TEST NO. 3	CHECK CIRCUIT / REFER TO TABLE
		B: +12V / +12V	Power Supply / 5-4
		C: +5V / +5V	Power Supply / 5-4
		D (DST): LO* / LO*	DST / 5-2, Test 3
		E: -12V / -12V	Power Supply / 5-4
		F ($\overline{IRQ}$): HI / HI	Pull out accessory input cards one at a time and note which card is holding $\overline{IRQ}$ LO.
		J ($\overline{IEN}$): HI / LO	$\overline{IEN}$ (A2Z6) / --
		K: +15V / +15V	A6 Voltage Regulator Card / Refer to Instruction Manual for A6 Voltage Regulator Card.
		L: -15V / -15V	
		M: (4) / (4)	
		N: +15V / +15V	
		P: -15V / -15V	
		R: (3) / (3)	
		S: +15V / +15V	
		T: -15V / -15V	
		U: (2) / (2)	
		V: +15V / +15V	
		W: -15V / -15V	
		X: (1) / (1)	
		Y (B12): LO / HI	Buffer Amplifier / 5-5
		Z ($\overline{B13}$): LO / HI	Buffer Amplifier / 5-5
		AA ($\overline{B14}$): LO / HI	Buffer Amplifier / 5-5
		BB ($\overline{B15}$): LO / HI	Buffer Amplifier / 5-5
		*DST goes HI when LOAD OUTPUT on 6940B is touched.	
3	Touch CLEAR REGISTER. Select control word (15, 14, 13, 12, on). Select DTE and IEN (6 and 8, on). Select unit 15 (3, 2, 1, 0, on). Touch LOAD OUTPUT. Touch CLEAR REGISTER. Touch switches 12 through 0. Check the logic level or voltage at the extender card pins specified in Test No. 2 and observe the normal indications shown for Test No. 3.	See Test No. 2.	See Test No. 2.

Table 5-3. Quick-Check Procedure (Continued)

TEST	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS ABNORMAL
4	Touch CLEAR REGISTER. Select control word Select ISL (bit 7, on). Touch LOAD OUTPUT. Monitor pin 6 on extender card. Clear control word (touch switch 15).	$\overline{\text{ISL}}$ remains HI until after control word is cleared, and then goes LO.	Check A2Z6, A1Z1, and A2Q1.

Table 5-4. Power Supply Troubleshooting

STEP NO.	TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1	LINE indicator and lamp on card A3 both fail to light when LINE switch is on.	a. Primary ac power not connected.	a. Check that power cord is connected to primary ac source and that fuse F1 is installed.	– –	– –
		b. Fuse F1 open.	b. Set LINE switch to OFF, replace fuse F1 and set LINE switch ON again.	b. Lamps go on.	b. Check if F1 has blown. If it has, set LINE switch to OFF and check that proper fuse was installed (4A for 100/120Vac or 2A for 220/240 Vac). If proper selection was made, check for a short circuit in the primary of T1.
2	LINE indicator ON, but +5V lamp on card A3 is OFF.(Both the +5V regulated and +12V unregulated outputs are at 0V).	a. Fuse F2 open due to short circuit between +12V line and C	a. Set LINE switch to OFF. Measure resistance from +12V line to C. If a short circuit exists, start removing plug-in cards one at a time while observing the ohmmeter.	a. Above 4 ohms (the exact resistance reading will be subject to the ohmmeter range and lead connections).	a. Troubleshoot the plug-in card causing the short circuit.
		b. Fuse F2 open due to short circuit between +12V line and +5V line.	b. Measure resistance from +12V line to +5V line. If a short circuit exists, first check if series regulators Q1, Q2, or diode A10CR2 are shorted. If none are shorted, follow the procedure in Step (a) above.	b. Above 4 ohms for both readings	b. Replace the shorted Q1, Q2, A10CR21, or troubleshoot the plug-in card causing the short circuit, as applicable.
		c. +12V rectifier-filter defective.	c. Set LINE switch to ON. Measure voltage across filter capacitor C2.	c. +12V (±10%)	c. Check transformer T1 and rectifier diodes CR1 and CR2.

Table 5-4. Fower Supply Troubleshooting (Continued)

STEP NO.	TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
3	+5V output line at 0V (A3 lamp is off), +12V line is at +12V ±10%.	a. +5 volt regulator in current-latch due to overvoltage or overcurrent condition.	a. Attempt to clear the latch condition by setting LINE switch OFF and ON. If this procedure is unsuccessful, remove all plug-in cards and try clearing the condition again. If the condition is now cleared, reinstall the cards one at a time until the fault reoccurs.	a. Lamp on card A3 lights when LINE switch is set to ON.	a. Troubleshoot the plug-in card causing the fault.
		b. Shorted crowbar SCR or shorted component in output circuit.	b. Set LINE switch to OFF. Measure the resistance across SCR A10CR26.	b. Above 4 ohms (the exact resistance reading will be subject to the ohmmeter range and lead connections).	b. Open connection at cathode of A10CR26, and measure resistance from +5V line to ▽C. If short circuit is cleared, replace A10CR26. If short circuit still exists, check A10C4, CR25, and wiring.
		c. +5 V regulator in current-latch because overvoltage detectors (crowbar), current latch, or basic regulator circuit defective.	c. Set LINE switch to OFF. Disconnect crowbar by opening the gate connection to SCR A10CR26. Set LINE switch to ON and measure voltage from +5V line to ▽C.	c. +5 volts.	c. If voltage reading is now normal, check crowbar circuit components: A10Q7, CR23, VR2. If not normal, proceed to test no. 4 or 5 as applicable.
4	+5V line near 0V with crowbar disconnected.	a. Current latch detector circuit defective.	a. Set LINE switch to OFF. Disconnect current latch by opening connection to collector of A10Q6. Measure voltage from +5V line to ▽C.	a. +5 volts.	a. If voltage reading is now normal, check A10Q3, Q4, Q6, CR22, VR1. If voltage reading is still 0V, see probable cause 4b. If voltage reading is full unregulated (10 to 12V), proceed to test no. 5
		b. Driver stage defective	b. Connect a jumper from the collector to the emitter of A10Q5 and measure voltage from +5V line to ▽C.	b. Full unregulated output voltage (+10V to +12V).	b. If voltage reading is the full unregulated output, check A10Q5 and Q6. If not, check series regulators Q1 and Q2.

Table 5-4. Power Supply Troubleshooting (Continued)

STEP NO.	TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
5	+5V line at full unregulated output (+10V to +12V) with crowbar disconnected.	a. Comparison amplifier defective.	a. Connect jumper across resistor R15 and measure voltage from +5V line to ▽C.	a. 0V (approx).	a. If voltage reading is 0V, replace A10U1. If not, see probable cause 5b.
		b. Series regulators or driver stage defective.	b. Connect jumper across resistor R36 and measure voltage from +5V line to ▽C.	b. 0V (approx).	b. If voltage reading is 0V, replace A10Q5. If not, check Q1, Q2, and A10CR21.
6	Poor regulation	a. Incorrect constant voltage reference	a. Measure voltage at A10U1 pin 6 to ▽C.	a. 7.15V ±5%.	a. Replace A10U1.
7	−12V line at 0V	a. Fuse F3 open due to short circuit between −12V line and ▽C.	a. Set LINE switch to OFF. Measure resistance from −12V line to ▽C. If short circuit exists, remove the plug-in cards (Isolated Digital Input and Event Sense Cards) which utilize −12V.	a. Above 4 ohms (the exact resistance reading will be subject to the ohmmeter range and lead connections).	a. Troubleshoot the plug-in card or the main power supply board, causing the short circuit.
		b. −12V rectifier-filter defective	b. Set LINE switch to ON. Measure voltage across A10C1.	b. −12V (±10%)	b. Check rectifiers A10CR3 and CR4.

Table 5-5. Extender Card A1, Troubleshooting

STEP NO.	TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1	Some programmed bits missing at slot 414 connector.	Faulty termination network on A1 input card.	Set LINE switch to OFF. Remove A2 card and install extender card in its place. Reapply power. At the 6940A switch register, toggle the faulty bits while observing the bit levels (on the extender card) associated with the faulty bits. (Check that ISL is off at the switch register).	Bit levels switch HI and LO.	Check associated termination network on card A1.
2	All programmed bits missing at slot 414 connector.	Faulty shunt regulator on card A1.	Set LINE switch to OFF. Install A1 card on extender. Set LINE switch to ON. Monitor the voltage at the emitter of A1Q1 (+ side of A1C1).	+5 volts.	Check A1Q1 and associated components.

Table 5-6. Logic and Timing Card A3, DST, FLAG, and Address Bit Amplifier Troubleshooting

STEP NO.	TROUBLE	PROBABLE CAUSE	ISOLATION PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1	DST not generated.	a. Faulty 2μsec delay circuit.	a. With 6940B switch register in LOCAL mode, monitor test point A3 (1) while tapping LOAD OUTPUT button.	a. HI signal starting 2μsec after start of $\overline{GAT}$.	a. Check A3Z3, Z7, C5, CR1, R22.
		b. Faulty DST amplifier	b. Monitor DST signal at A3 TP3 while tapping LOAD OUTPUT button.	b. HI level when LOAD OUTPUT is touched.	b. Check A3Q9 and associated components.
2	DST generated but $\overline{FLG}$ not generated.	Faulty 8μsec delay circuit.	Monitor signal at test point A3 (14) (A3Z3 pin 2) while tapping LOAD OUTPUT button.	Positive signal starting 6μsec after start of $\overline{GAT}$.	Check A3Z3, C6, CR2, and R23.
3	Address-bit erroneous at extender card.	Faulty address-bit amplifier.	Monitor address bit levels at test points A3 (2) through (13) while selecting bits 15, 14, 13, and 12 at switch register.	Bit levels $\overline{B15}$, $\overline{B14}$, $\overline{B13}$, and $\overline{B12}$ all LO. Bit levels B15, B14, B13, and B12 all HI.	Replace any amplifier having a normal input but an abnormal output.

PARTS LIST

SECTION VI
REPLACEABLE PARTS

6-1 INTRODUCTION

6-2 This section contains information for ordering replacement parts. Table 6-4 lists parts in alphanumeric order by reference designators and provides the following information:

a. Reference Designators. Refer to Table 6-1.

b. Description. Refer to Table 6-2 for abreviations.

c. Total Quantity (TQ). Given only the first time the part number is listed except in instruments containing many sub-modular assemblies, in which case the TQ appears the first time the part number is listed in each assembly.

d. Manufacturer's Part Number or Type.

e. Manufacturer's Federal Supply Code Number. Refer to Table 6-3 for manufacturer's name and address.

f. Hewlett-Packard Part Number.

g. Recommended Spare Parts Quantity (RS) for complete maintenance of one instrument during one year of isolated service.

h. Parts not identified by a reference designator are listed at the end of Table 6-4 under Mechanical and/or Miscellaneous. The former consists of parts belonging to and grouped by individual assemblies; the latter consists of all parts not immediately associated with an assembly.

6-3 ORDERING INFORMATION

6-4 To order a replacement part, address order or inquiry to your local Hewlett-Packard sales office (see lists at rear of this manual for addresses). Specify the following information for each part: Model, complete serial number, and any Option or special modification (J) numbers of the instrument; Hewlett-Packard part number; circuit reference designator; and description. To order a part not listed in Table 6-4, give a complete description of the part, its function, and its location.

Table 6-1. Reference Designators

A	= assembly	E	= miscellaneous electronic part
B	= blower (fan)	F	= fuse
C	= capacitor	J	= jack, jumper
CB	= circuit breaker	K	= relay
CR	= diode	L	= inductor
DS	= device, signaling (lamp)	M	= meter

Table 6-1. Reference Designators (Continued)

P	= plug	V	= vacuum tube, neon bulb, photocell, etc.
Q	= transistor	VR	= zener diode
R	= resistor	X	= socket
S	= switch	Z	= integrated circuit or network
T	= transformer		
TB	= terminal block		
TS	= thermal switch		

Table 6-2. Description Abbreviations

A	= ampere	mod.	= modular or modified
ac	= alternating current	mtg	= mounting
assy.	= assembly	n	= nano = 10^{-9}
bd	= board	NC	= normally closed
bkt	= bracket	NO	= normally open
°C	= degree Centigrade	NP	= nickel-plated
cd	= card	Ω	= ohm
coef	= coefficient	obd	= order by description
comp	= composition	OD	= outside diameter
CRT	= cathode-ray tube	p	= pico = 10^{-12}
CT	= center-tapped	P.C.	= printed circuit
dc	= direct current	pot.	= potentiometer
DPDT	= double pole, double throw	p-p	= peak-to-peak
DPST	= double pole, single throw	ppm	= parts per million
elect	= electrolytic	pvr	= peak reverse voltage
encap	= encapsulated	rect	= rectifier
F	= farad	rms	= root mean square
°F	= degree Farenheit	Si	= silicon
fxd	= fixed	SPDT	= single pole, double throw
Ge	= germanium	SPST	= single pole, single throw
H	= Henry	SS	= small signal
Hz	= Hertz	T	= slow-blow
IC	= integrated circuit	tan.	= tantulum
ID	= inside diameter	Ti	= titanium
incnd	= incandescent	V	= volt
k	= kilo = 10^{3}	var	= variable
m	= milli = 10^{-3}	ww	= wirewound
M	= mega = 10^{6}	W	= Watt
μ	= micro = 10^{-6}		
met.	= metal		
mfr	= manufacturer		

Table 6-3. Code List of Manufacturers

CODE	MANUFACTURER	ADDRESS
00629	EBY Sales Co., Inc.	Jamaica, N.Y.
00656	Aerovox Corp.	New Bedford, Mass.
00853	Sangamo Electric Co. S. Carolina Div.	Pickens, S.C.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Ind.	Beverly Hills, Calif.
01281	TRW Semiconductors, Inc.	Lawndale, Calif.
01295	Texas Instruments, Inc.	Dallas, Texas
01686	RCL Electronics, Inc.	Manchester, N.H.
01930	Amerock Corp.	Rockford, Ill.
02107	Sparta Mfg. Co.	Dover, Ohio
02114	Ferroxcube Corp.	Saugerties, N.Y.
02606	Fenwal Laboratories	Morton Grove, Ill.
02660	Amphenol Corp.	Broadview, Ill.
02735	Radio Corp. of America, Solid State and Receiving Tube Div.	Somerville, N.J.
03508	G.E. Semiconductor Products Dept.	Syracuse, N.Y.
03797	Eldema Corp.	Compton, Calif.
03877	Transitron Electronic Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N.J.
04009	Arrow, Hart and Hegeman Electric Co.	Hartford, Conn.
04072	ADC Electronics, Inc.	Harbor City, Calif.
04213	Caddell & Burns Mfg. Co. Inc.	Mineola, N.Y.
04404	*Hewlett-Packard Co. Palo Alto Div.	Palo Alto, Calif.
04713	Motorola Semiconductor Prod. Inc.	Phoenix, Arizona
05277	Westinghouse Electric Corp. Semiconductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	Grand Junction, Colo.
05820	Wakefield Engr. Inc.	Wakefield, Mass.
06001	General Elect. Co. Electronic Capacitor & Battery Dept.	Irmo, S.C.
06004	Bassik Div. Stewart-Warner Corp.	Bridgeport, Conn.
06486	IRC Div. of TRW Inc. Semiconductor Plant	Lynn, Mass.
06540	Amatom Electronic Hardware Co. Inc.	New Rochelle, N.Y.
06555	Beede Electrical Instrument Co.	Penacook, N.H.
06666	General Devices Co.	Indianapolis, Ind.
06751	Semcor Div. Components, Inc.	Phoenix, Arizona
06773	Robinson Nugent, Inc.	New Albany, N.Y.
06812	Torrington Mfg. Co.	Van Nuys, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp.	Elmira, N.Y.
07263	Fairchild Camera and Instrument	Mountain View, Calif.
07387	Birtcher Corp., The	Los Angeles, Calif.
07397	Sylvania Electric Prod. Inc.	Mountainview, Calif.
07716	IRC Div. of TRW Inc.	Burlington, Iowa
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Raytheon Co. Components Div.	Mountain View, Calif.
08484	Breeze Corporations, Inc.	Union, N.J.
08530	Reliance Mica Corp.	Brooklyn, N.Y.
08717	Sloan Company, The	Sun Valley, Calif.
08730	Vemaline Products Co. Inc.	Wyckoff, N.J.
08806	General Elect. Co. Minature Lamp Dept.	Cleveland, Ohio
08863	Nylomatic Corp.	Norrisville, Pa.
08919	RCH Supply Co.	Vernon, Calif.
09021	Airco Speer Electronic Components	Bradford, Pa.
09182	*Hewlett-Packard Co. New Jersey Div.	Rockaway, N.J.
09213	General Elect. Co. Semiconductor Prod. Dept.	Buffalo, N.Y.
09214	General Elect. Co. Semiconductor Prod. Dept.	Auburn, N.Y.
09353	C & K Components Inc.	Newton, Mass.
09922	Burndy Corp.	Norwalk, Conn.
11115	Wagner Electric Corp. Tung-Sol Div.	Bloomfield, N.J.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of Cal. Inc.	So. Pasadena, Calif.
11502	IRC Div. of TRW Inc.	Boone, N.C.
11711	General Instrument Corp.	Newark, N.J.
12136	Philadelphia Handle Co.	Camden, N.J.
12615	U.S. Terminals, Inc.	Cincinnati, Ohio
12617	Hamlin Inc.	Lake Mills, Wisconsin
12697	Clarostat Mfg. Co. Inc.	Dover, N.H.
13103	Thermalloy Co.	Dallas, Texas
14493	*Hewlett-Packard Co.	Loveland, Colo.
14655	Cornell Dubilier Electronics Div. Federal Pacific Electric Co.	Newark, N.J.
14936	General Instrument Corp. Semiconductor Prod. Group	Hicksville, N.Y.
15801	Fenwal Elect.	Framingham, Mass.
16299	Corning Glass Works	Raleigh, N.C.

*Use Code 28480 assigned to Hewlett-Packard Co., Palo Alto, California

Table 6-3. Code List of Manufacturers

CODE	MANUFACTURER	ADDRESS
16758	Delco Radio Div. of General Motors Corp.	Kokomo, Ind.
17545	Atlantic Semiconductors, Inc.	Asbury Park, N.J.
17803	Fairchild Camera and Instrument Corp.	Mountain View, Calif.
17870	Daven Div. Thomas A. Edison Industries McGraw-Edison Co.	Orange, N.J.
18324	Signetics Corp.	Sunnyvale, Calif.
19315	Bendix Corp. The Navigation and Control Div.	Teterboro, N.J.
19701	Electra/Midland Corp.	Mineral Wells, Texas
21520	Fansteel Metallurgical Corp.	No. Chicago, Ill.
22229	Union Carbide Corp. Electronics Div.	Mountain View, Calif.
22753	UID Electronics Corp.	Hollywood, Fla.
23936	Pamotor, Inc.	Pampa, Texas
24446	General Electric Co.	Schenectady, N.Y.
24455	General Electric Co.	Nela Park, Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
24681	LTV Electrosystems Inc. Memcor/Components Operations	Huntington, Ind.
26982	Dynacool Mfg. Co. Inc.	Saugerties, N.Y.
27014	National Semiconductor Corp.	Santa Clara, Calif.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
28520	Heyman Mfg. Co.	Kenilworth, N.J.
28875	IMC Magnetics Corp.	Rochester, N.H.
31514	SAE Advance Packaging, Inc.	Santa Ana, Calif.
31827	Budwig Mfg. Co.	Ramona, Calif.
33173	G.E. Co. Tube Dept.	Owensboro, Ky.
35434	Lectrohm, Inc.	Chicago, Ill.
37942	P.R. Mallory & Co.	Indianapolis, Ind.
42190	Muter Co.	Chicago, Ill.
43334	New Departure-Hyatt Bearings Div. General Motors Corp.	Sandusky, Ohio
44655	Ohmite Manufacturing Co.	Skokie, Ill.
46384	Penn Engr. and Mfg. Corp.	Doylestown, Pa.
47904	Polaroid Corp.	Cambridge, Mass.
49956	Raytheon Co.	Lexington, Mass.
55026	Simpson Electric Co. Div. of American Gage and Machine Co.	Chicago, Ill.
56289	Sprague Electric Co.	North Adams, Mass.
58474	Superior Electric Co.	Bristol, Conn.
58849	Syntron Div. of FMC Corp.	Homer City, Pa.
59730	Thomas and Betts Co.	Philadelphia, Pa.
61637	Union Carbide Corp.	New York, N.Y.
63743	Ward Leonard Electric Co.	Mt. Vernon, N.Y.
70563	Amperite Co. Inc.	Union City, N.J.
70901	Beemer Engrg Co.	Fort Washington, Pa.
70903	Belden Corp.	Chicago, Ill.
71218	Bud Radio, Inc.	Willoughby, Ohio
71279	Cambridge Thermionic Corp.	Cambridge, Mass.
71400	Bussmann Mfg. Div.of McGraw & Edison Co.	St. Louis, Mo.
71450	CTS Corp.	Elkhart, Ind.
71468	I.T.T. Cannon Electric Inc.	Los Angeles, Calif.
71590	Globe-Union Inc.	Milwaukee, Wis.
71700	General Cable Corp. Cornish Wire Co. Div.	Williamstown, Mass.
71707	Coto Coil Co. Inc.	Providence, R.I.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71785	Cinch Mfg. Co. and Howard B. Jones Div.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co. Inc.	Willimantic, Conn.
72619	Dialight Corp.	Brooklyn, N.Y.
72699	General Instrument Corp.	Newark, N.J.
72765	Drake Mfg. Co.	Harwood Heights, Ill.
72962	Elastic Stop Nut Div. of Amerace Esna Corp.	Union, N.J.
72982	Erie Technological Products	Erie, Pa.
73096	Hart Mfg. Co.	Hartford, Conn.
73138	Beckman Instruments	Fullerton, Calif.
73168	Fenwal, Inc.	Ashland, Mass.
73293	Hughes Aircraft Co. Electron Dynamics Div.	Torrance, Calif.
73445	Amperex Electronic	Hicksville, N.Y.
73506	Bradley Semiconductor Corp.	New Haven, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73734	Federal Screw Products, Inc.	Chicago, Ill.
74193	Heinemann Electric Co.	Trenton, N.J.
74545	Hubbell Harvey Inc.	Bridgeport, Conn.
74868	Amphenol Corp. Amphenol RF Div.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.

Table 6-3. Code List of Manufacturers

CODE	MANUFACTURER	ADDRESS
75042	IRC Div. of TRW, Inc.	Philadelphia, Pa.
75183	*Howard B. Jones Div. of Cinch Mfg. Corp.	New York, N.Y.
75376	Kurz and Kasch, Inc.	Dayton, Ohio
75382	Kilka Electric Corp.	Mt. Vernon, N.Y.
75915	Littlefuse, Inc.	Des Plaines, Ill.
76381	Minnesota Mining and Mfg. Co.	St. Paul, Minn.
76385	Minor Rubber Co. Inc.	Bloomfield, N.J.
76487	James Millen Mfg. Co. Inc.	Malden, Mass.
76493	J.W. Miller Co.	Compton, Calif.
76530	Cinch	City of Industry, Calif.
76854	Oak Mfg. Co. Div. of Oak Electro/ Netics Corp.	Crystal Lake, Ill.
77068	Bendix Corp., Electrodynamics Div.	No. Hollywood, Calif.
77122	Palnut Co.	Mountainside, N.J.
77147	Patton-MacGuyer Co.	Providence, R.I.
77221	Phaostron Instrument and Electronic Co.	South Pasadena, Calif.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, P[illegible].
77342	American Machine and Foundry Co.	Princeton, Ind.
77630	TRW Electronic Components Div.	Camden, N.J.
77764	Resistance Products Co.	Harrisburg, Pa.
78189	Illinois Tool Works Inc.	Elgin, Ill.
78452	Everlook Chicago, Inc.	Chicago, Ill.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78526	Stanwyck Winding Div. San Fernando Electric Mfg. Co. Inc.	Newburgh, N.Y.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78584	Stewart Stamping Corp.	Yonkers, N.Y.
79136	Waldes Kohinoor, Inc.	L.I.C., N.Y.
79307	Whitehead Metals Inc.	New York, N.Y.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Co.	Mt. Kisco, N.Y.
80031	Mepco	Morristown, N.J.
80294	Bourns, Inc.	Riverside, Calif.
81042	Howard Industries	Racine, Wisc.
81073	Grayhill, Inc.	La Grange, Ill.
81483	International Rectifier	El Segundo, Calif.
81751	Columbus Electronics	Yonkers, N.Y.
82099	Goodyear Sundries & Mechanical Co. Inc.	New York, N.Y.
82142	Airco Speer Electronic Components	Du Bois, Pa.
82219	Sylvania Electric Products Inc.	Emporium, Pa.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals and Controls Inc.	Attleboro, Mass.
82866	Research Products Corp.	Madison, Wisc.
82877	Rotron Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83058	Carr Fastener Co.	Cambridge, Mass.
83186	Victory Engineering	Springfield, N.J.
83298	Bendix Corp.	Eatontown, N.J.
83330	Herman H. Smith, Inc.	Brooklyn, N.Y.
83385	Central Screw Co.	Chicago, Ill.
83501	Gavitt Wire and Cable	Brookfield, Mass.
83508	Grant Pulley and Hardware Co.	West Nyack, N.Y.
83594	Burroughs Corp.	Plainfield, N.J.
83835	U.S. Radium Corp.	Morristown, N.J.
83877	Yardeny Laboratories	New York, N.Y.
84171	Arco Electronics, Inc.	Great Neck, N.Y.
84411	TRW Capacitor Div.	Ogallala, Neb.
86684	RCA Corp.	Harrison, N.J.
86838	Rummel Fibre Co.	Newark, N.J.
87034	Marco & Oak Industries	Anaheim, Calif.
87216	Philco Corp.	Lansdale, Pa.
87585	Stockwell Rubber Co.	Philadelphia, Pa.
87929	Tower-Olschan Corp.	Bridgeport, Conn.
88140	Cutler-Hammer Inc.	Lincoln, Ill.
88245	Litton Precision Products Inc, USECO	Van Nuys, Calif.
90634	Gulton Industries Inc.	Metuchen, N.J.
90763	United-Car Inc.	Chicago, Ill.
91345	Miller Dial and Nameplate Co.	El Monte, Calif.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat, Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Neb.
91662	Elco Corp.	Willow Grove, Pa.
91929	Honeywell Inc.	Freeport, Ill.
92825	Whitso, Inc.	Schiller Pk., Ill.
93332	Sylvania Electric Prod.	Woburn, Mass.
93410	Essex Wire Corp.	Mansfield, Ohio
94144	Raytheon Co.	Quincy, Mass.
94154	Wagner Electric Corp.	Livingston, N.J.
94222	Southco Inc.	Lester, Pa.
95263	Leecraft Mfg. Co. Inc.	L.I.C., N.Y.
95354	Methode Mfg. Co.	Rolling Meadows, Ill.
95712	Bendix Corp.	Franklin, Ind.
95987	Weckesser Co. Inc.	Chicago, Ill.
96791	Amphenol Corp.	Janesville, Wis.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97702	IMC Magnetics Corp.	Westbury, N.Y.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98410	ETC Inc.	Cleveland, Ohio
98978	International Electronic Research Corp.	Burbank, Calif.
99934	Renbrandt, Inc.	Boston, Mass.

*Use Code 71785 assigned to Cinch Mfg. Co., Chicago, Ill.

Table 6-4. Replaceable Parts

REF. DESIG.	DESCRIPTION	TQ	MFR. PART NO.	MFR. CODE	HP PART NO.	RS
A1	Extender Input Card, Plug-In	1		28480	06941-60026	
C1, 2	fxd, elect. 1μF 35Vdc	2	150D105X9035A2	56289	0180-0291	1
CR1, 2	Rect. Si. 80V 200mA	2		28480	1901-0050	2
Q1	Power PNP Si.	1	2N3740	04713	1853-0037	1
R1	fxd, comp 300 5% 1/2W	1	EB-3015	01121	0686-3015	1
R2	fxd, ww 35 5% 10W	1	247E3505	56289	0811-1900	1
R3-6	fxd, comp 5.1k 5% 1/2W	4	EB-5125	01121	0686-5125	1
Z1	Quad, 2-Input NAND gate, IC	1	SN7400N	01295	1820-0054	1
Z2, 3	Resistor, Network 1k, 9 pin	2	200C-1855-CRR	56289	1810-0121	2
A2	I/O Transfer Card, Plug-In	1		28480	06941-60025	
C1-C7	fxd, elect. 1μF 35Vdc	7	150D105X9035A2	56289	0180-0291	2
CR1-CR4	Diode, Si. 180V 200mA	4		28480	1901-0033	4
Q1	SS NPN Si.	1		28480	1854-0071	1
R1-4	fxd, comp 430 5% 1/2W	4	EB-4315	01121	0686-4315	
R5-9	fxd, comp 1k 5% 1/2W	9	EB-1025	01121	0686-1025	2
R10	fxd, comp 2k 5% 1/2W	1	EB-2025	01121	0686-2025	1
Z1, 2	Hex Inverter, IC	2	SN7404N	01295	1820-0174	2
Z3-5	Quad. 2-Input NAND gate, IC	3	SN7438N	01295	1820-0621	3
Z6	Hex Buffer Amplifier, IC	1	SN7417N	01295	1820-0618	1
A3	Logic and Timing Card, Plug-In	1		28480	5060-2655	
C1-4	fxd, elect. 1μF 35Vdc	4	150D105X9035A2	56289	0180-0291	1
C5	fxd, mylar 6800pF 200V	1	292P68292-PTS	56289	0160-0159	1
C6	fxd, mylar .022μF 200V	1	292P22392-PTS	56289	0160-0162	1
C7, 8	fxd, mylar 1000pF 200V	2	292P10292-PTS	56289	0160-0153	1
CR1, 2	Diode, Si. 180V 200mA	2		28480	1901-0033	2
DS1	Lamp, Incandescent 6.0V	1	2305RA	94154	2140-0324	1
Q1, 2	Not assigned					
Q3	SS NPN Si.	1		28480	1854-0071	1
Q4-8	Not assigned					
Q9	SS NPN Si.	1		28480	1854-0448	1
R1-12	Not assigned					
R13	fxd, comp 5.1k 5% 1/2W	2	EB-5125	01121	0686-5125	1
R14, 15	Not assigned					
R16	fxd, comp 220 5% 1/4W	2	EB-2215	01121	0686-2215	1
R17	Not assigned					
R18	fxd, comp 200 5% 1/2W	3	EB-201F	01121	0686-2015	1
R19, 20	fxd, comp 1k 5% 1/2W	6	EB-1025	01121	0686-1025	1
R21	Not assigned					
R22, 23	fxd, comp 200 5% 1/2W		EB-2015	01121	0686-2015	
R24 25	fxd, comp 1k 5% 1/2W		EB-1025	01121	0686-1025	
R26	fxd, comp 1.5k 5% 1/2W	1	EB-1525	01121	0686-1525	1
R27	Not assigned					
R28	fxd, comp 1k 5% 1/2W		EB-1025	01121	0686-1025	
R29-31	fxd, comp 10k 5% 1/2W	3	EB-1035	01121	0686-1035	1
R32-35	Not assigned					
R36	fxd, comp 100k 5% 1/2W	1	EB-1045	01121	0686-1045	1
R37-40	Not assigned					
R41	fxd, comp 1k 5% 1/2W		EB-1025	01121	0686-1025	

Table 6-4. Replaceable Parts (Continued)

REF. DESIG.	DESCRIPTION	TQ	MFR. PART NO.	MFR. CODE	HP PART NO.	RS
A3R42	fxd, comp 5.1k 5% 1/2W		EB-5125	01121	0686-5125	
R43	fxd, comp 220 5% 1/4W		EB-2215	01121	0686-2215	
W2	Cable Assembly	1		28480	5060-9611	
Z1, 2	Hex, inverter, IC	3	SN7404N	01295	1820-0174	
Z3	Hex Schmitt Trigger	1	SN7414N	01295	1820-1053	
Z4-6	Open Collector Quad. 2-Input NAND	3		01295	1820-0621	3
Z7	Quadruple 2-Input NAND gate, IC	1		01295	1820-0054	1
Z8, 9	Buffer Amplifier, IC	2		01295	1820-0618	2
Z10	Triple 3-Input NAND gate, IC	1		01295	1820-0068	1
Z11, 12	Resistor Network, 1k, 9-pin	2	200C-1855-CRR	56289	1810-0121	2
Z13, 14	Resistor Network, 500 9-pin	2	200C-1826-CRR	56289	1810-0132	2
Z15	Hex inverter, IC		SN7404N	01295	1820-0174	
Z16	Resistor Network		200C-1855-CRR	56289	1810-0121	
Z17	Quad 2-Input NAND buffer	1	SN7437N	01295	1820-0539	
A7	Adapter Card, Includes Data Input Connector (J1)	1		28480	5060-6200	
J1	Connector, Data Input (50 pin)	1	57-40500(418)	90949	1251-0087	
A8	Adapter Card, Includes Data Output Connector (J2)	1		28480	5060-2645	
J2	Connector, Data Output (50 pin)	1	57-40500(418)	90949	1251-0087	1
Q1	SS NPN Si	1		28480	1854-0071	1
Z1-3	Hex Buffer Amp, IC	3	SN7417N	01295	1820-0618	3
Z4-7	Resistor Network, 500 9-pin	4	200C-1826-CRR	56289	1810-0132	4
A9	Interconnect Board (Backplane Ass'y)	1		28480	06941-60022	
J1-22	PC Card Edge Connectors	22		28480	1251-2025	5
A10	Main Power Supply Board				5060-2670	
C1	fxd, elect. 2000μF 28Vdc	9		28480	0180-1916	2
C2, 3	Not assigned					
C4	fxd, elect. 220μF 10Vdc	2	150D227X0010S2	56289	0180-0159	1
C5-12	fxd, elect. 2000μF 28Vdc			28480	0180-1916	
C13	fxd, elect. 1.0μF 50Vdc	1	30D105G050BA2	56289	0180-0108	1
C14	fxd, elect. 4.7μF 35Vdc	1	150D475X9035B2	56289	0180-0100	1
C15	fxd, mylar 0.01μF 200Vdc	1	292P10392-PTS	56289	0160-0161	1
C16	fxd, mica 100pF 300Vdc	1	RDM15F101J3S	72136	0160-3070	1
C17	fxd, elect. 220μF 10Vdc		150D227X0010S2	56289	0180-0159	
C18	fxd, tant. 0.22μF 35Vdc	1	150D224X9035A2	56289	0180-1735	1
CR1, 2	Not assigned					
CR3, 4	Diode, Si. 3A 200prv	4		28480	1901-0416	4
CR5-20	Rect. Si. 200V 1A	16		28480	1901-0327	8
CR21	Diode, Si. 3A 200prv			28480	1901-0416	
CR22-24	Diode, Si. 180V 200mA	3		28480	1901-0033	3
CR25	Diode, Si. 3A 200prv			28480	1901-0416	
CR26	SCR 25A, 50V	1		28480	1884-0046	1
Q1, 2	Not assigned					
Q3	SS PNP Si	1		28480	1853-0099	1
Q4	SS NPN Si	2		28480	1854-0071	2

Table 6-4. Replaceable Parts (Continued)

REF. DESIG.	DESCRIPTION	TQ	MFR. PART NO.	MFR. CODE	HP PART NO.	RS
A10Q5	SS NPN Si	1		28480	1854-0448	1
Q6	SS NPN Si	1		28480	1854-0071	1
Q7	SS PNP Si	1	2N2904A	04713	1853-0012	1
R1	Not assigned					
R2	fxd, metal ox. 510 5% 2W	1	EP42-2-T00-510R-J	24546	0698-0030	1
R3, 4	fxd, ww, 0.33 5% 10W	2	RG-42-1-B-2002-G	11502	0811-3177	1
R5	fxd, film 139 1% 1/8W	1	CEA-993	07716	0698-4099	1
R6	fxd, film 471 1% 1/8W	1	CCA-993	07716	0698-5514	1
R7	fxd, comp 1.5k 5% 1/2W	2	EB-1525	01121	0686-1525	1
R8	fxd, comp 10k 5% 1/2W	3	EB-1035	01121	0686-1035	1
R9	fxd, comp 5.1k 5% 1/2W	1	EB-5125	01121	0686-5125	1
R10	fxd, comp 3.9k 5% 1/2W	1	EB-3925	01121	0686-3925	1
R11	fxd, comp 1.5k 5% 1/2W		EB-1525	01121	0686-1525	
R12	fxd, comp 100 5% 1/2W	1	EB-1015	01121	0686-1015	1
R13	fxd, comp 10k 5% 1/2W		EB-1035	01121	0686-1035	
R14	fxd, 4.7 5% 2W	1	BWH2-4R7-J	75042	0811-1674	1
R15	fxd, comp 300 5% 1/2W	1	EB-3015	01121	0686-3015	1
R16	fxd, comp 390 5% 1/2W	1	EB-3915	01121	0686-3915	1
R17	fxd, film 1.5k 1% 1/8W	2	C4-1/8-T0-1501-F	24546	0757-0427	1
R18	var, ww, 1k	1	CT 106-4	84048	2100-1758	1
R19	fxd, film 4.64k 1% 1/8W	1	C4-1/8-T0-4641-F	24546	0698-3155	1
R20	fxd, comp 4.7k 5% 1/2W	1	EB-4725	01121	0686-4725	1
R21	fxd, film 1.5k 1% 1/8W		C4-1/8-T0-1501-F	24546	0757-0427	
R22	fxd, comp 33 5% 1/2W	1	EB-3305	01121	0686-3305	1
R23	fxd, comp 510 5% 1/2W	1	EB-5115	01121	0686-5115	1
R24	fxd, comp 10k 5% 1/2W		EB-1035	01121	0686-1035	
R25	fxd, comp 150 5% 1/2W	1	EB-1515	01121	0686-1515	1
R26	fxd, ww 25 5% 5W	1	243E25R5	56289	0811-1853	1
R27-34	fxd, comp 2k 5% 1/2W	8	EB-2025	01121	0686-2025	2
R35	fxd, ww 150 5% 5W	2	243E1515	56289	0811-1217	1
R36	fxd, comp 30 5% 1/2W	1	EB-3005	01121	0686-3005	1
R37	fxd, ww 150 5% 5W		243E1515	56289	0811-1217	
R38	fxd, comp 10 5% 1/2W	1	EB-1005	01121	0686-1005	1
U1	IC, Linear Voltage Reg.	1	723DC	07263	1826-0049	1
VR1, 2	Diode, zener 5.6V 400mW	2		28480	1902-3104	2
A11	NOT USED					
A12	Power Module (includes fuse, voltage select card, and filter)	1		28480	5060-9421	
F1	Fuse, 4A @ 250V Slo-Blo, 100/120Vac Input	1		28480	2110-0365	5
	FRONT PANEL – Electrical					
DS1	Line Indicator Lamp	1		28480	2140-0015	1
R1	fxd, comp 33k 5% 1/2W	1	EB-3335	01121	0686-3335	1
S1	LINE switch, SPST	1		28480	3101-1055	1

Table 6-4. Replaceable Parts (Continued)

REF. DESIG.	DESCRIPTION	TQ	MFR. PART NO.	MFR. CODE	HP PART NO.	RS
	REAR DECK ASSEMBLY – Electrical					
C1	Not assigned					
C2, 3	fxd, elect. 20,000μF 20V	2	602D203G020BC2A	56289	0180-2524	1
CR1, 2	Diode, Si. (Heat Sink) 12A 100prv	2	1N1200A	02735	1901-0002	2
F2	Fuse, ceramic 10A @ 250V	1	314.010	75915	2110-0051	5
F3	Fuse, 750mA @ 250V	1	312.750	75915	2110-0063	5
J1, 2	Data Input/Output Connectors– Part of A7, A8					
Q1, 2	Power PNP Si	2	2N3791	04713	1853-0059	2
T1	Transformer, Power	1		28480	06936-80091	1
	MECHANICAL					
	Front Door Assembly, Complete	1		28480	06941-60004	
	Base, Indicator DS1	1		28480	5040-0305	
	Base, Clear, DS1	1		28480	5040-0234	
	Shield, Outer, Aluminum	1		28480	5000-9309	
	Latch, Door	1		28480	0510-0271	
	Door, Blank, Lettered	1		28480	06941-60003	
	Card Cage Assembly, Complete	1		28480	5060-7926	
	Guide, Plug-In Cards	40		28480	5040-0765	
	Snap Tabs (for card guides)	120		28480	5040-0771	
	Stand-off, Metal, Side Plate	12		28480	0380-0950	
	Support Bar, Alum. (top, front)	1		28480	5020-2277	
	Support Bar, Alum. (with slot no.s)	1		28480	5060-7925	
	Support Bar, (center and rear)	4		28480	5020-8027	
	Side Plate, Right	1		28480	5000-9307	
	Side Plate, Left	1		28480	5000-9308	
	Rear Deck Assembly	1		28480	5060-7961	
	Heat Sink, Transistor	1		28480	5000-3119	
	Heat Sink, Diode	1		28480	5000-3120	
	Insulator, Mica, (Q1, Q2)	2	734	08530	0340-0174	1
	Insulator, Transistor (Q1, Q2)	2		28480	0340-0503	1
	Bushing, Nylon, CR1, 2	2		28480	0340-0170	2
	Washer, Mica, CR1, 2	4		28480	2190-0708	4
	Grommet, Nylon, H.S.Wiring(Trans)	1	SB-562-6	28520	0400-0108	
	Grommet, Nylon, H.S.Wiring(Diode)	1		28480	0400-0064	
	Clamp, C2, 3	2	4586-2B	56289	0180-0078	1
	Fuseholder	2	342.014	75915	1400-0084	1
	Washer, Neoprene, Fuseholder	2	901-129	75915	1400-0090	1
	Lockwasher, Fuseholder	2			2190-0054	1
	Hex Nut, Fuseholder	2	903-12	75915	2950-0038	1
	Rear Panel	1		28480	5000-9468	
	Top Trim Assembly, Front	1		28480	5060-7962	
	Trim, Aluminum, Bar	1		28480	5020-8056	
	Insert, Black Plastic	1		28480	5020-8030	

Table 6-4. Replaceable Parts (Continued)

REF. DESIG.	DESCRIPTION	TQ	MFR. PART NO.	MFR. CODE	HP PART NO.	RS
	MECHANICAL (Continued)					
	Bottom Trim Assembly, Front	1		28480	5060-7963	
	Trim, Bottom	1		28480	5020-8053	
	Insert, Black Plastic	1		28480	5020-8034	
	Connector, 5V (J8)	1		28480	1250-0118	
	Bracket, Connector, Logic Probe	1		28480	5000-9318	
	Shoulder Washer	2		28480	5040-0425	
	Striker Panel, Front Door	1		28480	5000-9312	
	Stop Panel, Front Door	1		28480	5000-9317	
	Cover, Top	1		28480	5000-9455	
	Cover, Bottom	1		28480	5000-9401	
	Cover, Side	2		28480	5000-9456	
	Side, Frame	2		28480	08660-20076	
	Handle Assembly, Side	2		28480	5060-0222	
	Retainer, Handle Assembly	2		28480	5060-8735	
	Side Trim, Fluted, Adhesive Back	2		28480	5000-0052	
	Cover, Plate, Rear Panel	1		28480	5000-9492	
	Foot Assembly	5		28480	5060-0767	
	Extractor Handle, A1 Card	1		28480	5081-4907	
	Heat Dissipator	1		28480	1205-0206	1
	Socket, IC, A1Z1	1	ICN-143-S3W	06776	1200-0508	1
	Extractor Handle, A2 Card	1		28480	5081-4939	
	Socket, IC, A2Z1-Z6	6	ICN-143-S3W	06776	1200-0508	6
	Socket, IC, A2XZ1 (Cable W1 Conn.)	1	ICN-163-S3W	06776	1200-0507	1
	Extractor Handle, A3 Card	1		28480	5081-4909	
	Socket, IC, A3Z1-Z10, Z15, Z17	12	ICN-143-S3W	06776	1200-0508	7
	Support Bars, A9 Board	2		28480	5020-8026	
	Cable Assembly, W1 (interconnects A2 and A3)	1		28480	5060-7964	
	Heat Dissipator, A10Q5	1		28480	1205-0033	1
	MISCELLANEOUS					
	Stand, Tilt	1		28480	1490-0030	
	Input Connector, P1	1		28480	06936-60009	
	Extender Board, Plug-In	1		28480	5060-7901	
	Connector, Extender Board	1	251-24-30-380	71785	1251-0497	
	Fuse, 2A Slo-Blo 220/240Vac Input	1		28480	2110-0303	5
	Bracket, Trim	2		28480	5020-8031	
	Bracket, Trim	2		28480	5020-8032	
	Rack Mounting Kit	1		28480	5060-8741	
	Power Cord	1		28480	8120-1348	
	Screw, Nylon (A9 Support Bars)	24	N-440-5/8	95987	2200-0768	
	Key,Connectors	20		28480	1251-1115	
	Packing Carton	1		28480	9211-1187	
	Floater Pad, Packing Carton	2		28480	9220-1400	

SCHEMATIC DIAGRAMS

SECTION VII
CIRCUIT DIAGRAMS

7-1 INTRODUCTION

7-2 This section contains circuit diagrams necessary for the operation and maintenance of the Model 6941B Multiprogrammer Extender.

7-3 COMPONENT LOCATION DIAGRAMS

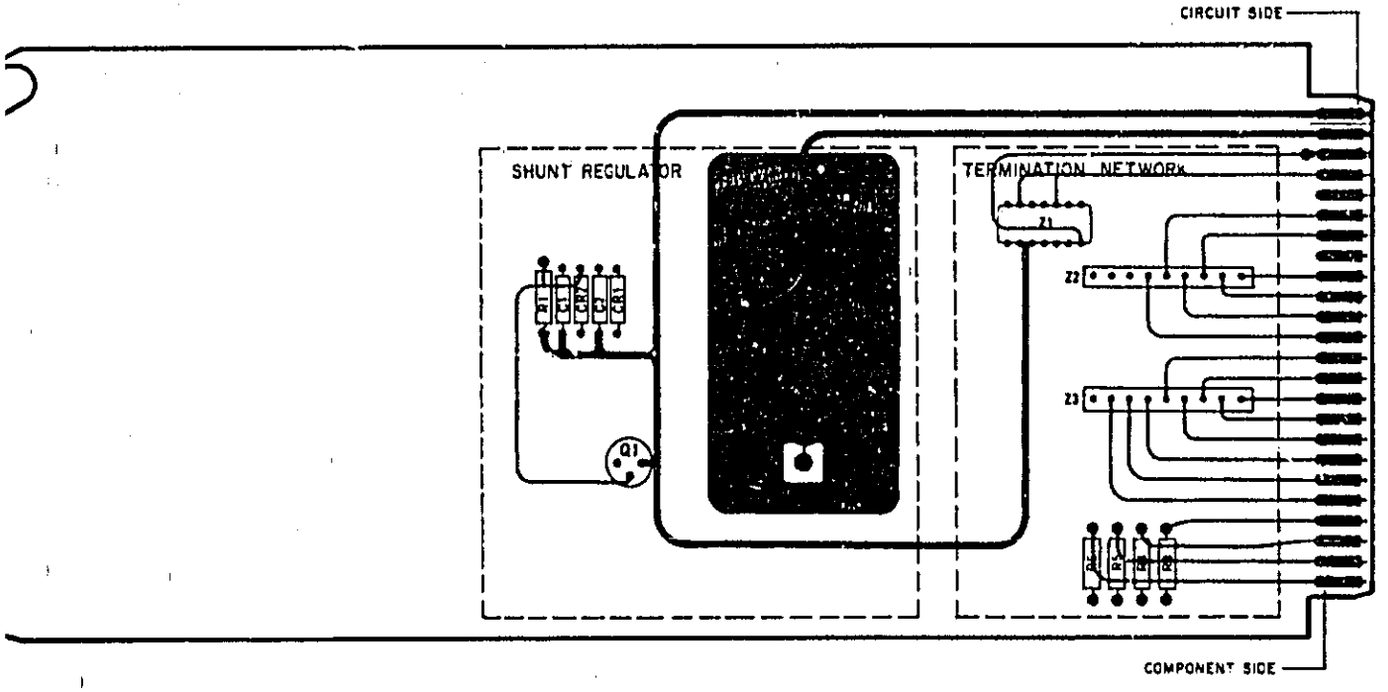
7-4 The component location diagrams show the physical location of parts mounted on each assembly. They are included on the schematic diagrams where they apply or on the rear of the previous schematic. Thus, the schematic diagram is unfolded to the right and the component location diagram is unfolded to the left.

7-5 SCHEMATIC DIAGRAMS

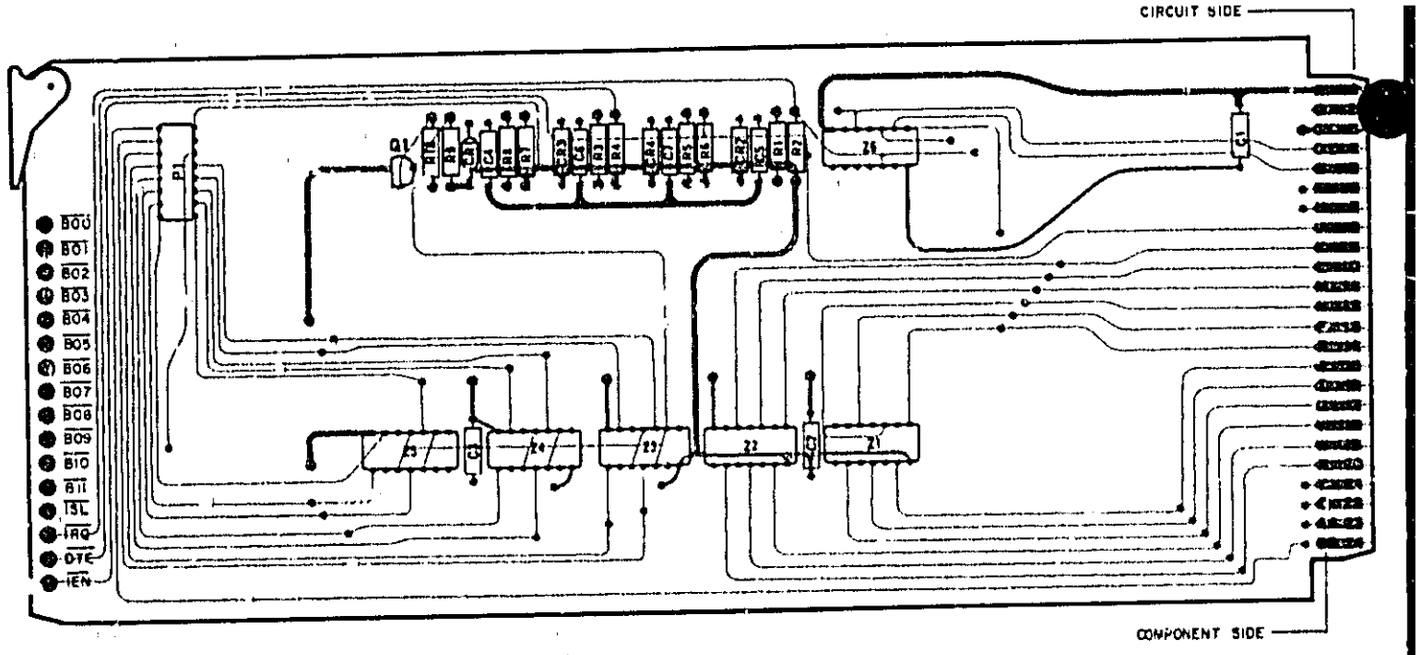
7-6 The circuits are functionally separated and included on three sheets of Figure 7-1. The three sheets cover the following functional areas:

Sheet 1: Data Processing and Distribution Circuits
Sheet 2: Accessory Cards
Sheet 3: Power Distribution.

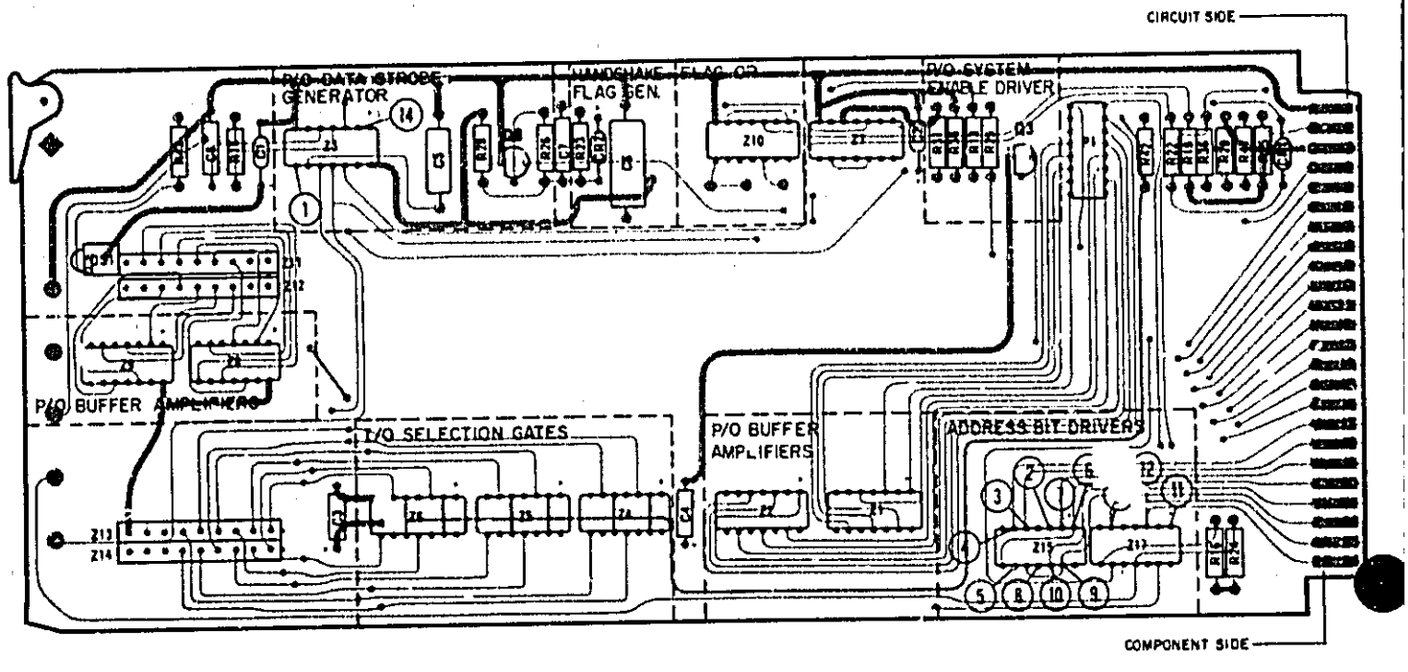
7-7 Test points (encircled numbers) appear on the schematics. These points coincide with the test points on the component location diagrams and are referred to throughout the maintenance instructions.



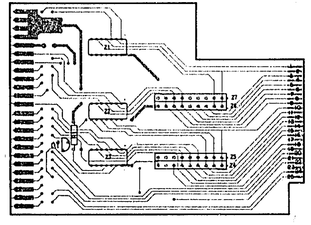
A1 Extender Input Card, Component Locations



A2 I/O Transfer Card, Component Locations



A3 Logic and Timing Card, Component Locations



A8 Output Adapter Card, Component Locations

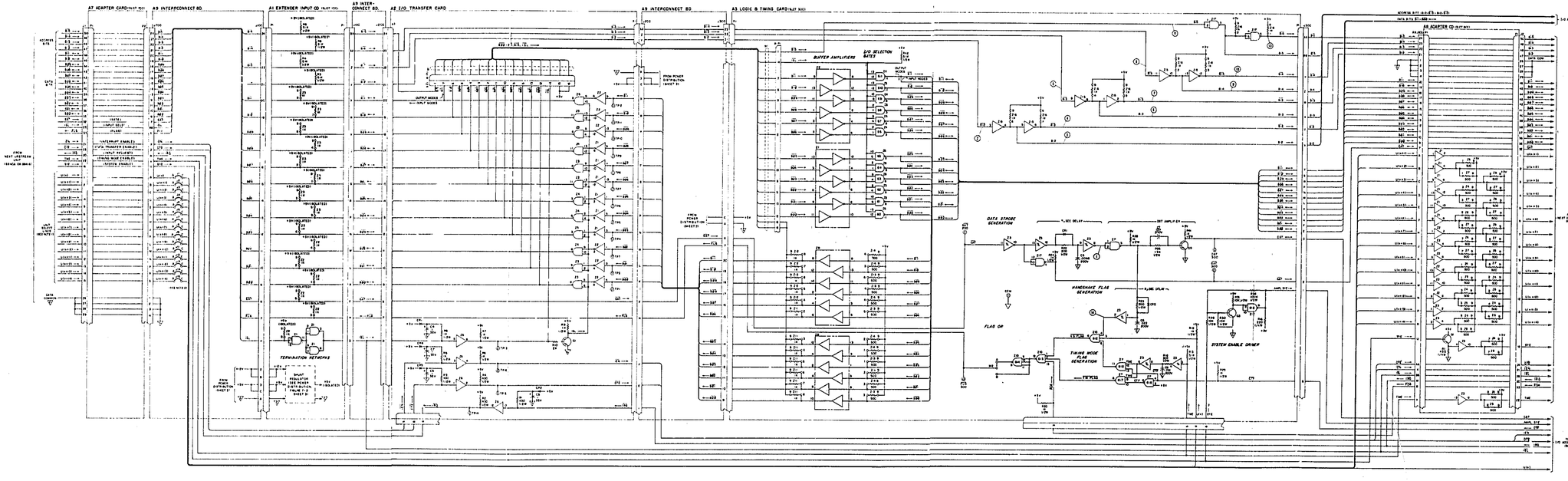
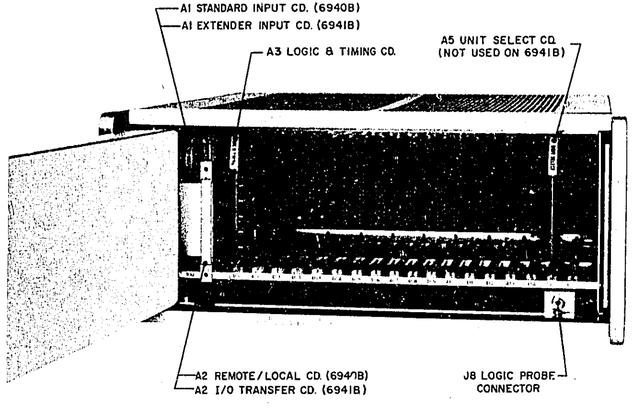


Figure 7-1 (Sheet 1). Data Processing and Distribution Circuits



6941B Multiprogrammer Extender Slot Locations

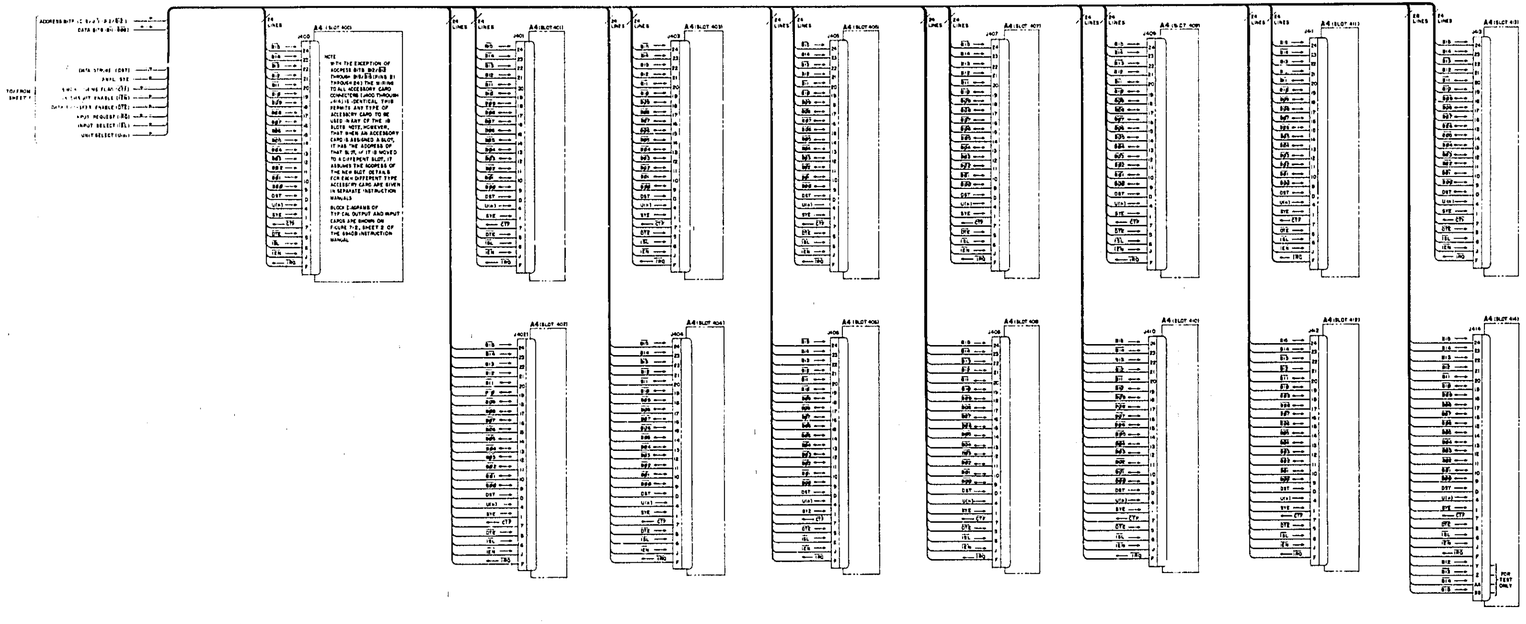
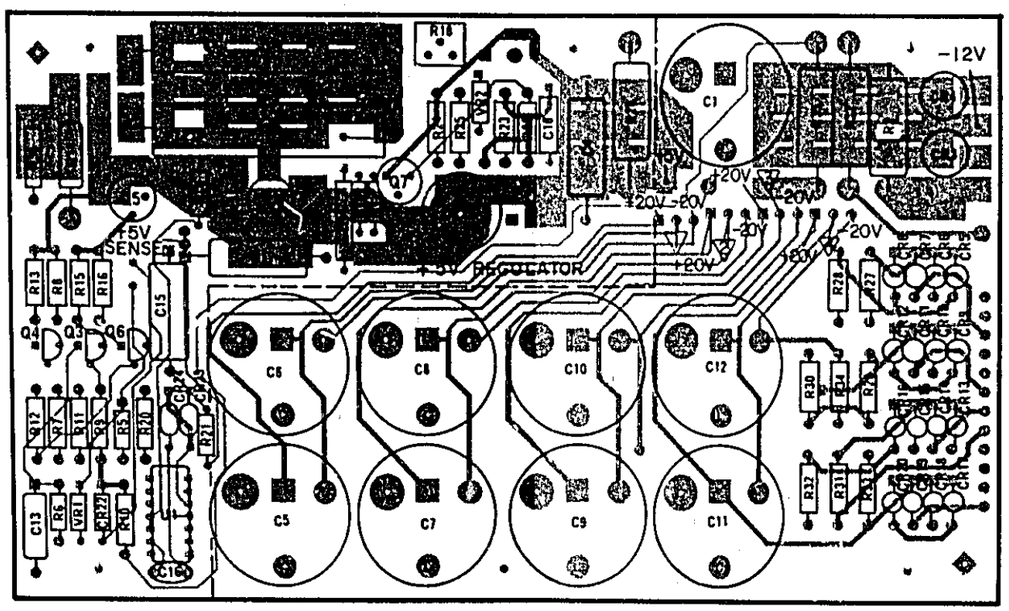
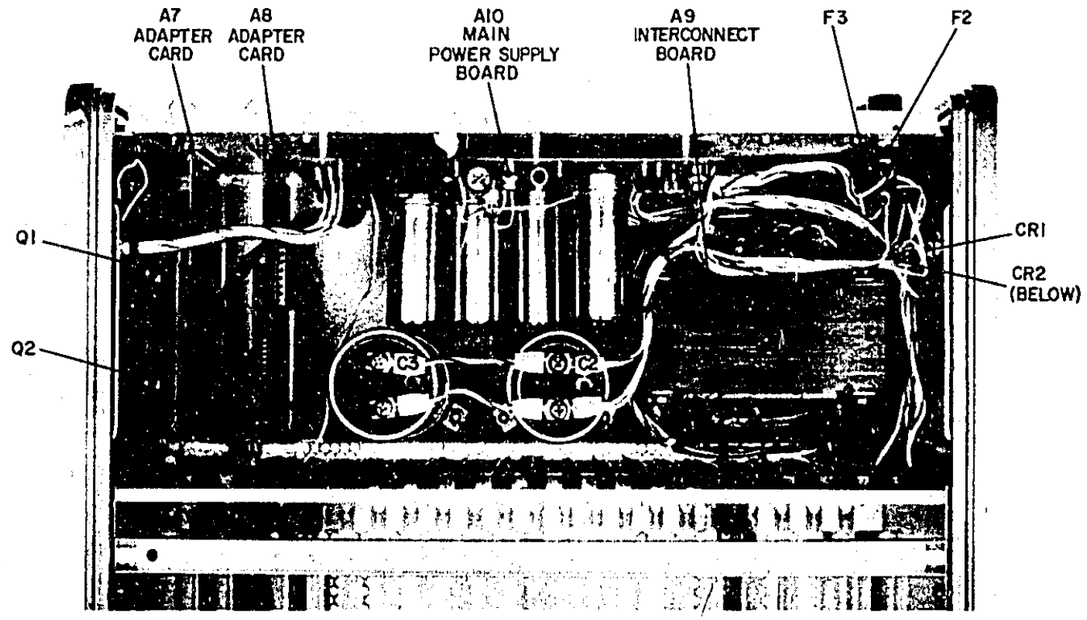


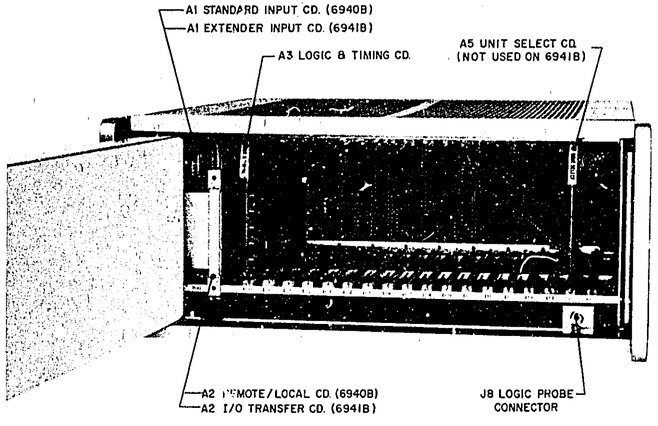
Figure 7-1 (Sheet 2). Accessory Cards



A10 Main Power Supply Board, Component Locations



Rear Chassis, Component Locations



6941B Multiprogrammer Extender Slot Locations

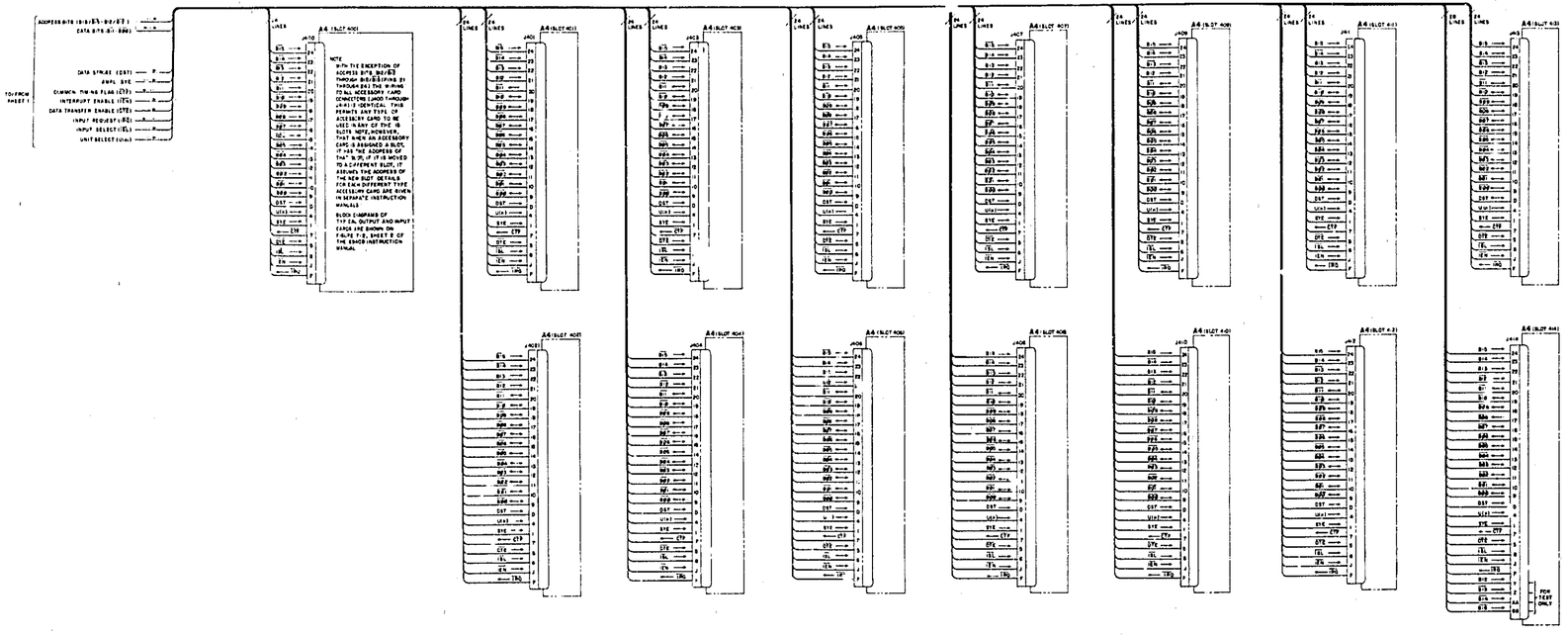


Figure 7-1 (Sheet 2). Accessory Cards

APPENDIX

APPENDIX A

OPTION 001 – CONVERTS 6941B TO OPERATE IN A 6940A/6941A MULTIPROGRAMMER SYSTEM

A-1 INTRODUCTION

A-2 This Appendix describes the Option 001 modifications which allow a 6941B Multiprogrammer Extender to operate in a 6940B/6941B Multiprogrammer System. The modifications consist of timing circuit changes on the A3 Logic and Timing Card. The timing circuit changes make the 6941B compatible with a 6940A/6941A system and associated software.

A-3 A3 LOGIC AND TIMING CARD MODIFICATION

A-4 The data strobe delay and handshake flag delay circuits (Figure 7-1, Sheet 1) are modified as follows.

A-5 The data strobe delay is changed from 2μsec (nominal) to 4μsec (nominal) by changing A3C5 from "fxd, mylar 6800pf 200V, HP Part No. 0160-0159" to "fxd mylar .015μf 200V, HP Part No. 0160-0194".

A-6 The handshake flag delay is changed from 8μsec (nominal) to 2μsec (nominal) by changing A3C6 from "fxd mylar .022μf 200V, HP Part No. 0160-0162" to "fxd, mylar ,01μf 200V, HP Part No. 0160-0207".

A-7 The HP Part No. of an A3 card equipped with Option 001 is 5060-2669.

MANUAL CHANGES

MANUAL CHANGES
Model 6941B Multiprogrammer Extender
Manual HP P/N 06941-90003

Make all corrections in the manual according to errata below, then check the following table for your multiprogrammer serial number and enter any listed changes(s) in the manual.

SERIAL		MAKE
Prefix	Number	CHANGES
All	---	Errata
1522A	00146-00305	1
1522A	00306-00325	1,2
1615A	00326-00345	1-3
1629A	00346-00525	1-4
1728A	00526-00680	1-5
1750A	00681-00714	1-6
	00716-00719	
	00721-00726	
	00729,00730	
1750A	00715-00720	1-7
	00727-00728	
1808A	00731-01115	1-7
1907A	01116-01140	1-8
1914A	01141-01180	1-9
1918A	01181-01420	1-10
2006A	01421-01500	1-11
2019A	01501-01720	1-12
2046A	01721-02065	1-13
2220A	02066-up	1-14

ERRATA:

On Figure 7-1 (Sheet 1), under A3 Logic and Timing Card, delete the +5V and associated 1k pull-up resistors (Z16 resistor network) connected to Z15 pins 2,4,6,8,10,12 and to Z17 pins 3 and 6.

Make the following changes in Table 6-4:
On page 6-6, delete A3Z16, HP P/N 1810-0121.
On page 6-8, change C2,3 to HP P/N 0180-2570. Also, change Insulator, Mica (Q1,Q2) to HP P/N 0340-0181.
On page 6-9, change Side, Frame to HP P/N 5060-9437.

Add the following notice to paragraph 1-27: "Effective Dec. 1, 1975, Rack Mounting Kit 5060-8741 is no longer a furnished accessory but is available as a standard option. The rack mounting kit is obtained by specifying Option 908 when ordering the instrument".

Add the following notice to paragraph 1-34: "Effective Dec. 1, 1975, extra manuals may be obtained by specifying Option 910 when ordering your instrument. The number of extra manuals depends upon the number of Option 910's ordered.

In Figures 3-1 and 3-2, interchange the pin designations for pins 23 and 24; pin 23 is not connected, and pin 24 is $\overline{\text{DTE}}$.

Make the following changes on Figure 7-1 (Sheet 1):
Change the number of the $\overline{\text{DTE}}$ pin at the extreme left edge of the schematic from "23" to "24".
Change pin "Z" at the inter-connection of the A7 and A9 boards to pin "AA".

On page 5-4, test 4, under the column headed "Connector J2 Pin No", change the pin number for the $\overline{\text{DTE}}$ function from "23" to "24".

In Appendix A, page A-1, paragraph A-2, the first sentence should read: "This appendix describes...a 6940A/6941A Multiprogrammer System". Also, delete paragraph A-5.

CHANGE 1:

In Table 6-4, on page 6-5, change A3 Plug-in card to HP P/N 5060-2689. Also, delete A3CR1, HP P/N 1901-0033.
In paragraph A-7 of Appendix A, change the P/N for any Option 001 A3 card to 5060-2690.
The component location diagram for the A3 board (opposite Figure 7-1, Sheet 1) has been affected as follows: R26 and C7 have been moved to a position between R29 and Q3, and Q9 has been moved to a position near R20. CR1 has been deleted.

CHANGE 2:

In Table 6-4, on page 6-9, delete Socket, IC (A1Z1), HP P/N 1200-0508. A1Z1 is now hardwired.

CHANGE 3:

In Table 6-4, on page 6-7, change A12 Power Module to HP P/N 0960-0443. The old and new modules are interchangeable.

CHANGE 4:

In Table 6-4, on page 6-9, delete Socket, IC (A2Z1-Z6), HP P/N 1200-0508. These IC's are now hardwired.

CHANGE 5:

Delete the Fuseholder and Hex Nut listed in Table 6-4, on page 6-8, and replace with two each: Fuseholder, HP P/N 2110-0564; Fuse Carrier, HP P/N 2110-0565; and Hex Nut, HP P/N 2110-0569.

CHANGE 6:

In Table 6-4, on page 6-9 under Miscellaneous, change HP P/N 5020-8031 to 5000-3145 and HP P/N 5020-8032 to 5000-3144.

CHANGE 7:

In Table 6-4, on page 6-5, change A3C7 to 0.01uF, 10%, HP P/N 0160-0161.

CHANGE 8:

In Table 6-4, on page 6-5, change A3C7 to 0.01uF, +80, -10%, HP P/N 0160-4761.

CHANGE 9:

In Table 6-4, on page 6-7, change S1 LINE switch to DPST, HP P/N 3101-0439. Also, make the following changes on page 6-8:

Change Front Door Assembly, Complete to HP P/N 06941-60006.

Change Shield, Outer, Aluminum to HP P/N 06941-00003.

Change Door, Blank, Lettered to HP P/N 06941-60005.

CHANGE 10:

In Table 6-4, on page 6-9 under Miscellaneous, add Label, HP P/N 7120-8236. Label cautions user to turn power off when removing or inserting cards.

CHANGE 11:

In Table 6-4, on page 6-9 under Miscellaneous, add C.S.A. (Canadian Standards Association) identification label, HP P/N 7120-8572. The 6941B is now C.S.A. certified for laboratory equipment.

CHANGE 12:

In Table 6-4, on page 6-7, change A1OR24 to 1k, 5%, 1/2 W, HP P/N 0686-1025.

CHANGE 13:

In Table 6-4, on page 6-8, change Heat Sink, Diode, to HP P/N 5000-3180 and add Power Transformer Bracket HP P/N 5000-3179.

CHANGE 14:

In Table 6-4, on page 6-5, change DS1 to LED, Yellow, HP P/N 1990-0831.

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